ALFA ROMEO 145 / 146

MASTER WORKSHOP MANUAL

Technical data, service, diagnosis, repair and overhaul

MODEL FAMILY	Tipo 930 - Alfa Romeo 145 and 146
COVERAGE	All factory-documented powertrains and systems

Consolidated workshop edition - 2,837 pages

USING THIS MANUAL

APPLICABILITY FIRST

Identify model, production phase, engine code, gearbox code and equipment version before applying a procedure or specification.

DO NOT COMBINE VARIANTS

Where the manual provides different values or procedures, keep them separate. A later update or 146 supplement overrides a general instruction only within its stated applicability.

NAVIGATION

Use the PDF bookmark panel to move by system and factory document. The Technical Database provides additional filtering by model, engine, gearbox and system.

SAFETY

Use suitable lifting equipment, personal protective equipment and isolation procedures. Airbag, fuel, refrigerant and high-current electrical work requires trained personnel and the specified equipment.

FASTENER CONTROL

Replace single-use fasteners, locking devices, seals and stretch bolts where directed. Apply torque-plus-angle stages exactly and use calibrated tools.

IDENTIFICATION

Engine and gearbox codes take precedence over commercial engine names. Market names and production dates can overlap.

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GENERAL TECHNICAL DATA AND MAINTENANCE

10 documents - 176 factory pages

PROTECTIVE PRODUCTS

SUPPLIER	NAME	USE
AREXONS	1090	Electrically-weldable protective products
BOSTON	- -	
GELSON	2inc coat 2014	
TEROSON	2inc spray 11719N	
3 M	Wed thrdugh seller 8625	
AREXONS	- -	High thickness electrically-weldable products
BOSTON	- -	
GELSON	G 600	
TEROSON	Teromix 6700	
3 M	8625	
AREXONS	Ferox 4144/5/6/7	Oxide converters for boxed sections
BOSTON	- -	
GELSON	- -	
TEROSON	- -	
3 M	888 1E Protectiv	
AREXONS	Oto-boxed 1032 - 1033	Protective waxes for inside boxed sections
BOSTON	Scudo car 700 CR	
GELSON	from 20351 to 20364	
TEROSON	Terotex HV200 - HV400	
3 M	Protectiv 888 1 E	

SEALANTS

SUPPLIER	NAME	USE
AREXONS	- -	Preformed sealant to be applied for cracks of above 2 mm
BOSTON	SOPL	
GELSON	G 600 - Gummigel	
TEROSON	Terostat II - 18123	
3 M	Preformed sealant from 8572 to 8574	
AREXONS	Polyurethan 006 (1070)	Sealant for seams on bonnets and doors
BOSTON	Nex VS - B880 - 770	
GELSON	Gelflex 336 - 339	
TEROSON	Terostat 9120 (1K PUR)	
3 M	Polyurethan Sealant from 8680	

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(Continued)

SUPPLIER	NAME	USE
AREXONS	- -	Preformed sealant to be applied for cracks of over 2 mm
BOSTON	SOPL	
GELSON	G 600 - Gummigel	
TEROSON	Terostat II - 18123	
3 M	Preformed sealant from 8572 to 8574	
AREXONS	Polyurethan 006 (1070)	Sealant for seams on doors and bonnets
BOSTON	Nex VS - B880 - 770	
GELSON	Gelflex 336 - 339	
TEROSON	Terostat 9120 (1K PUR)	
3 M	Polyurethan Sealant from 8680	

PRODUCTS FOR UNDERBODY PROTECTION

SUPPLIER	NAME	USE
AREXONS	Oto body 1037 - 1075 1080 - 1085	P.V.C. sound and gravel proofing spray-on product (hidden areas)
BOSTON	Scudo car A1000 A3000	
GELSON	Side scudex underbody da 20729 a 20764	
TEROSON	Terotrend - 9320	
3 M	Polyurethan with two components 8660	
AREXONS	Oto body 1031 - 1037 - 1075	P.V.C. sound and gravel proofing spray-on product (visible areas)
BOSTON	Scudo car CR 700	
GELSON	Side scudex 20721 a 20764	
TEROSON	Terotex super 9320 - 3000	
3 M	Body seal 8860	
AREXONS	Sound deadener 1033	Bituminous protective wax for underbody
BOSTON	- -	
GELSON	Gel protex da 20300 a 20352	
TEROSON	Terotex wax	
3 M	Body seal 8860	

SOUNDPROOFING PRODUCTS

SUPPLIER	NAME	USE
AREXONS	–	Heat bonded soundproofing materials for car interior
BOSTON	–	
GELSON	Vibragel 20650	
TEROSON	Terodem SP 100 - 300	
3 M	–	
AREXONS	–	Glued soundproofing materials for car interior
BOSTON	8821	
GELSON	Vibragel 20635	
TEROSON	Terodem SP 200	
3 M	–	
AREXONS	–	Preformed soundproofing carpeting materials for car interior
BOSTON	–	
GELSON	Vibrafelt 20640	
TEROSON	–	
3 M	–	
AREXONS	–	Soundproofing product for foam treatment of boxed sections
BOSTON	Schiuma fix	
GELSON	Gel - foam 30750	
TEROSON	Terostat schiuma pu spray	
3 M	Polyschiuma 300	

ONE-LEVEL PRESSURE SWITCH SETTING

Contact opening pressure	1.8 ± 0.07 bar
Contact closing pressure	3 ÷ 3.5 bar

3-LEVEL PRESSURE SWITCH SETTING (TRINARY)

	All models except T. Spark 16V and 1910 JTD		T. Spark 16V (with M2.10.3 injection - ignition system)	
1. Level	Contact opening	2.2 ÷ 2.7 bar	Contact opening	2.45 ± 0.25 bar
	Contact closing	2.26 ÷ 2.94 bar	Contact closing	2.85 ± 0.50 bar
2. Level	Contact closing	14.2 ÷ 16.18 bar	Contact closing	15.2 ± 0.98 bar
	Differential	3.92 ± 0.98 bar	Contact opening	11.28 ± 1.99 bar
3. Level	Contact opening	25 ÷ 30 bar	Contact opening	25 ÷ 30 bar
	Differential	6 ± 2 bar	Contact closing	17 ÷ 26 bar

4-LEVEL PRESSURE SWITCH SETTING

	T. Spark 16V (with M2.10.4 and M1.5.5 injection - ignition system) 1910 JTD	
1. Level	Contact opening	2.45 ± 0.35 bar
	Contact closing	max 3.5 bar
2. Level	Contact opening	15 ± 1 bar
	Contact closing	11 ± 2 bar
3. Level	Contact opening	20 ± 1.2 bar
	Contact closing	16 ± 2.2 bar
4. Level	Contact opening	28 ± 2 bar
	Contact closing	22 ± 4 bar

COMPRESSOR

	1929 TD	1910 JTD	1598 1747 1970 T. SPARK 16V	1370 T. SPARK 16V
Make and type	HARRISON V5	SANDEN SD7V16	NIPPONDENSO TV 14SC	NIPPONDENSO TV 12SC
Cylinders number	5	(*)	-	-
Cylinders diameter	36.8 mm	(*)	-	-
Stroke	28.4 mm	(*)	-	-
Theoretic capacity	151 cm^3 at rev (max)	(*)	-	-
Max revolutions number	7000 rpm	(*)	-	-
Deflector vanes number	-	(*)	2	2
Deflector vanes lenght/depth	-	(*)	72.5 mm / 38.5 mm	72.5 mm / 38.5 mm
Theoretic capacity	-	(*)	127 cm^3/rev	127 cm^3/rev
Working voltage electromagnetic coupling	12 V	(*)	12 V	12 V
Absorbed power from electromagnetic coupling	-	(*)	40 W (min)	40 W
Working current electromagnetic coupling	4.2 A	(*)	2.2 A (min)	2.2 A (max)

(*): Not available when this publication was sent to print.

FUEL SYSTEM

FUEL (Specific for petrol engines)

Unleaded fuel	minimum R.O.N. = 95

FUEL TANK

Total capacity	51/61 litres (*)
Reserve	5 ÷ 8 litres

(*): For Versions/Markets.

SAFETY VALVE SETTING CHECK (on fuel tank) (Specific for petrol engines)

Opening vacuum for tank ventilation	≤ 0.020 bar
Opening pressure for releasing fuel vapours	0.065 ÷ 0.085

CHECKING FUEL SUPPLY PRESSURE (Specific for petrl engines)

	1351	1596 1712 16V	T. SPARK 16V
Opening vacuum for tank ventilation	2.3 ÷ 2.7 bar	2.8 ÷ 3.2 bar	2.8 ÷ 3.2 bar (*)
Opening pressure for relasing fuel vapours	4 bar (*)		

(*) For versions with M1.5.5 injection - ignition system: 3.5 ± 0.2 bar.

MULTI-PURPOSE VALVE SETTING CHECK (on fuel tank)

	Petrol engines	Turbodiesel engines
Opening pressure for releasing fuel vapours	0.038 ÷ 0.053 bar	0.055 ÷ 0.075 bar
Opening vacuum for tank ventilation	- 0.020 bar	- 0.020 bar

CHECKING THE FUEL WARMING DEVICE THERMAL SWITCH SETTING (Specific for 1929 Turbodiesel engine)

Contact closing temperature	6°C
Contact opening temperature	15°C

INJECTOR SETTING CHECK (Specific for 1929 Turbodiesel engine)

Injector seal control pressure	130 ÷ 138 bar
Injector setting pressure	150 ÷ 158 bar

CHECKING INJECTION PUMP TIMING (Specific for 1929 Turbodiesel engine)

Injection pump distribution stroke	0.8 mm

CHECKING AUTOMATIC FAST IDLE DEVICE THERMOSTATIC SENSOR SETTING (Specific for 1929 Turbodiesel engine) (*)

Start of stroke	60° ± 2 °C
Stroke at 75 °C	7 mm
MAX stroke at 100 °C	11 mm

(*): On the version with catalyst, though the injection pump has a fast idle device, use of it is not made (there is no connection with the thermostatic sensor).

CHECKING AUTOMATIC FAST IDLE AND IDLE SPEED (Specific for Turbodiesel engines)

	1929 TD	1910 JTD
Idle speed	880 ÷ 920 rpm with control lever in contact with adjustment screw	770 ÷ 830 rpm
Automatic fas idle speed (*)	1180 ÷ 1220 rpm with gap between control lever & adjustment screw of 5 mm	–

(*): - On the version with catalyst, though the injection pump has a fast idle device, use of it is not made (there is no connection with the thermostatic sensor).
- 1910 JTD versions are not equipped with an automatic fast idling device.

CHECKING KSB DEVICE THERMAL SWITCH SETTING (Specific for 1929 Turbodiesel engine)

Contact closing temperature	60° ± 2°C
Contact opening temperature	50° ± 2°C

AIR SUPPLY

FLUXING TEST Specific for Boxer 1596 - MP3.1 engine

Throttle on contact (closed)	80 MAX Scale D - SOLEX flow meter
Throttle adjusted	295 ± 10 Scale N - SOLEX flow meter

Specific for Boxer 1712 16V engine

Air leakage with by-pass screws completely tightened	120 ÷ 130 Scale K - SOLEX flow meter
Air leakage with throttles adjusted and by-passes open	185 Scale N - SOLEX flow meter

EXHAUST EMISSIONS CONTROL
Specific for Boxer engines (1)

CO while exhausting	% vol.	≤ 0.2
HC while exhausting	p.p.m.	≤ 50

(1): Measured at the end of the exhaust pipe with nominal slow running, warmed up engine, neutral gear and accessories not operating.

Specific for T. Spark 16V engines

CO while exhausting	≤ 2.2 g x km
HC + NOx while exhausting	0.5 g x km

CALIBRATION CHECKING OF THE OVERPRESSURE VALVE "WASTE-GATE" (Specific for Turbodiesel engines)

Check pressure	Corresponding actuator's stroke
1929 TD	
0.96 ÷ 1.04 bar	2 mm
1.10 ÷ 1.19 bar	4 mm
1910 JTD	
0.86 ÷ 0.91 bar	1 mm

SMOKE GRADE CHECKING DURING EXHAUSTION (Specific for Turbodiesel engines)

Limit value of smoke grade while exhausting	< 70%

SENSORS

ENTREFER SENSOR OF REVOLUTIONS AND TDC (Specific for Boxer engines)

0.7 ± 0.1 mm

ENTREFER PHASE SENSOR (Specific for Boxer 1712 16V engines)

1.5 mm

ENTREFER SENSOR OF REVOLUTIONS (Specific for 1929 Turbodiesel engines)

0.25 ÷ 1.3 mm

ENTREFER SENSOR OF REVOLUTIONS AND PHASE (Specific for T. Spark 16V and 1910 JTD engines)

0.8 ÷ 1.5 mm

COOLING SYSTEM

Check pressure of hydraulic system	1.08 bar (1.1 kg/cm^2)
Calibration pressure of the pressurized cap	0.98 ± 0.1 bar (1 ± 0.1 kg/cm^2)

WATER PUMP

	Boxer engines	Turbodiesel engines
Play between impeller and pump body	0.5 ÷ 0.8 mm	0.53 ÷ 1.37 mm

THERMOSTAT

	Boxer engines	Turbodiesel engines		T. Spark 16V engines
		1929 TD	1910 JTD	
Temperature of start opening	86° ± 2°C	83° ± 2°C	80° ± 2°C	83° ± 2°C
Valve stroke	(a 100°C) > 7 mm	(a 90°C) ≥ 7.5 mm	-	(a 103° ± 2°C) 9.5 mm

THERMAL CONTACT OF THE ELECTRIC COOLING FAN

		Petrol engines (**)	1929 TD
1^ speed	ON (contacts closing)	92° ± 2°C	88° ± 2°C
	OFF (contacts opening)	87° ± 2°C	83° ± 2°C
2^ speed (*)	ON (contacts closing)	97° ± 2°C	92° ± 2°C
	OFF (contacts opening)	92° ± 2°C	87° ± 2°C

(*): For cars with Boxer engines, the second ... is present only on air conditioned versions.
(**): Not for T. SPARK 16V with injection- ig... system M2.10.4 e M1.5.5.

TRANSMITTER GAUGE FOR TEMPERATURE OF COOLING/CONTACT FLUID PILOT LIGHT OF MAXIMUM TEMPERATURE

Contact temperature pilot light of max. temperature	Boxer engines	Turbodiesel engines		1970 T. SPARK 16V	1370 1598 1747 T. SPARK 16V
		1929 TD	1910 JTD		
Intervention temperature	117° ± 3°C	115° ± 3°C	(*)	122° ± 2°C	120° ± 2°C
Release temperature	100° ± 3°C	85°C	(*)	112° ± 3°C	108° ± 3°C

N.B. To check the calibration data of the transmitter, please refer to "ELECTRIC-ELECTRONIC DIAGNOSTICS".
(*): Data which are not available while printing

IGNITION

IGNITION COIL (Specific for petrol engines)

	1351	1596 ▲ 1712 16V	T. SPARK 16V
Resistance of primary winding	550 mΩ ± 10% (*)	0.5 Ω (*)	0.3 Ω ± 12%
Resistance of secondary winding	7.4 kΩ ± 10% (*)	13.3 kΩ (*)	7 kΩ ± 12%

(*): At a temperature of 23°C ± 5°C
(▲): Only for MP3.1

SPARKING PLUGS (Specific for petrol engines)

	1351 1596	1712 16V	T. SPARK 16V
Type	GOLDEN LODGE 25HL	NGH PFR 6B	NGK PFR6B + NGK PMR7A (*) [NGK BKR6EKPA + NGK PMR7A (*)]

(*): On each cylinder there are two different plugs, one per type
[ ]: Alternative solution

PREHEATING GLOW PLUGS (Specific for Turbodiesel engines)

	1929 TD	1910 JTD
Nominal voltage	11 V	-
Bulb's temperature within 7 secs.	≥ 850°C	-
Absorption within 7 secs.	14 ± 1.5 A	-
Bulb's temperature after 30 secs.	≤ 1140°C	-
Internal resistance at 20°C	-	0.6 Ω

STARTING

STARTING MOTOR (Specific for Boxer engines)

		1351 1596			1712 16V
		BOSCH	MAGNETI MARELLI	DEM	BOSCH
Nominal voltage (V)		12	12	12	12
Nominal power (kW)		0.8	0.9	0.5	1.1
Full load test	Voltage(V)	9	9.8	10	9
	Absorption (A)	300	215	200	290
	Revs.(revs/min)	1450	1800	≥ 1450	1700
	Torque (Nm)	5.5	5	5	6
Loadless test	Voltage (V)	12	-	-	12
	Absorption (A)	30	-	-	70
	Revs.(revs/min)	5000	-	-	3000
Test in short circuit	Voltage(V)	5	8	8	-
	Absorption (A)	400	400	380	-
	Torque (Nm)	5.5	12	≥ 11.3	-

STARTING MOTOR (Specific for T. Spark 16V engines)

		1970 T. SPARK 16V	1370 T. SPARK 16V	1598 T. SPARK 16V	1747 T. SPARK 16V
		MAGNETI MARELLI	MAGNETI MARELLI		
Nominal voltage (V)		12	12		
Nominal power (kW)		1.4 (*)	1.4 (*)		
Full load test	Voltage (V)	8.2	7 ± 0.1		
	Absorption (A)	400	325		
	Revs. (revs/min)	1330	1020		
	Torque(Nm)	11	> 10.7		
Loadless test	Volatge (V)	11.3	12 ± 0.1		
	Absorption (A)	95	< 90		
	Revs.(revs/min)	6000	> 4500		
Test in short circuit	Voltage (V)	4.4	4 ± 0.1		
	Absorption (A)	800	< 750		
	Torque(Nm)	25.5	> 21.5		

(*): 1.1 kW for BOSCH M70 R.

STARTING MOTOR (Specific for Turbodiesel engines)

		MARELLI	BOSCH
Nominal voltage		12 V	
Nominal power		2.2 kW	
Full load test	Voltage	7.9 V	-
	Absorption	600 A	-
	Revolutions	1400 revs/min	-
	Torque	16 Nm	-
Loadless test	Voltage	-	-
	Absorption	-	-
	Revolutions	-	-
Test in short circuit	Volatge	4.4 ÷ 4.6 V	4 V
	Absorption	1110 ÷ 1150 A	1200 A
	Torque	≥ 39 Nm	≥ 40 Nm

RECHARGE

BATTERY

	Boxer Engines		Turbodiesel Engines	T. Spark 16V Engines	
	Non-conditioned cars	Conditioned cars		Non-conditioned cars	Conditioned cars
Nominal voltage	12 V	12 V	12 V	12 V	12 V
Capacity (20 ore)	45 A/h	60 A/h	60 A/h	45 A/h	50 A/h 60 A/h (*)

(*): For Versions/Markets if envisaged

ALTERNATOR

	Boxer Engines	Turbodiesel Engines		T. Spark 16V Engines	
		Non-conditioned cars	Conditioned cars	Non-conditioned cars	Conditioned cars
Nominal voltage	14 V	14 V	14 V	14 V	14 V
Nominal current	80 A	70 A 85 A (*)	90A 100 A (*)	75 A	85 A
Maximum continous speed	-	15000 revs/min	15000 revs/min	18000 revs/min	18000 revs/min
Resistance to inductive Winding (measured Between the manifold's rings at a temperature of 25°C)	-	2.83 ± 0.28 Ω	2.6 ± 0.15 Ω	2.6 ± 5% Ω	2.6 ± 5% Ω

(*): Specific for 1910 JTD version

WHITE

ENGINE SPECIFICATIONS

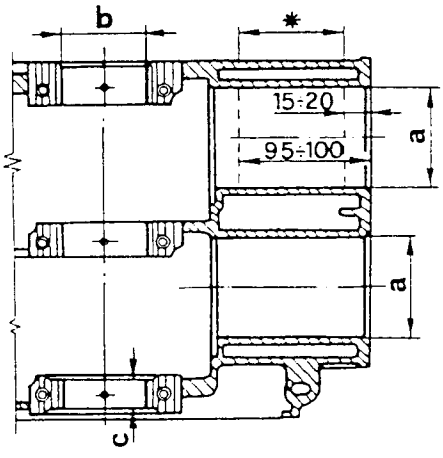
TECHNICAL DATA

Engine type		AR 33501	AR 33201
Cycle		Otto 4-stroke	Otto 4-stroke
Fuel system/ignition		Multi-Point IAW	Multi-Point Motronic MP3.1 (Δ)
Firing order		1 - 3 - 2 - 4	
Displacement	cm^3	1351	1596
Number of cylinders		4 horizontal opposed	4 horizontal opposed
Bore	mm	80	84
Stroke	mm	67.2	72
Maximum power	HP CEE (kW CEE) rpm	90 (66) 6000	103 (76) 6000
Maximum torque	kgm CEE (Nm CEE) rpm	11.7 (115) 4400	13.7 (134) 4500
Compression ratio		9.5 : 1	9.5 : 1
Engine oil pressure (with engine oil at 100°C) - At idle speed - At 4000 rpm	bar	 > 0.8 > 4	 > 0.8 > 4
Idle r.p.m.	rpm	850 ± 50	850 ± 50

(Δ) Multi-Point Rochester for after change version.

COMPLETE CRANKCASE

Crankcase

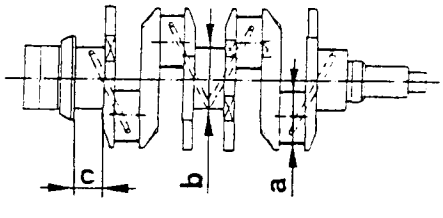


(*) Area for dimensional control

Unit: mm

		AR 33501	AR 33201
Diameter of cylinders "a"	Class A - Blue	80.000 ÷ 80.010	84.000 ÷ 84.010
	Class B - Pink	80.010 ÷ 80.020	84.010 ÷ 84.020
	Class C - Green	80.020 ÷ 80.030	84.020 ÷ 84.030
	Class D - Yellow	80.030 ÷ 80.040	84.030 ÷ 84.040
	Class E - White	80.040 ÷ 80.050	84.040 ÷ 84.050
	Oversize 0.2	80.200 ÷ 80.210	84.200 ÷ 84.210
	Oversize 0.4	80.400 ÷ 80.410	84.400 ÷ 84.410
	Oversize 0.6	80.600 ÷ 80.610	84.600 ÷ 84.610
Diameter of main journals "b"		63.663 ÷ 63.673	63.663 ÷ 63.673
Width of rear main journal shoulder "c"		23.68 ÷ 23.73	23.68 ÷ 23.73

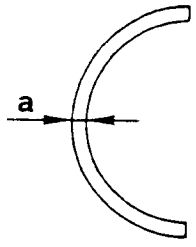
Crankshaft



Unit: mm

		AR 33501	AR 33201
Diameter of connecting rod pins "a"	Class A - Red	49.992 ÷ 50.000	49.992 ÷ 50.000
	Class B - Blue	49.984 ÷ 49.992	49.984 ÷ 49.992
Diameter of main bearing journals "b"	Class A - Red	59.944 ÷ 59.957	59.954 ÷ 59.964
	Class B - Blue		59.944 ÷ 59.954
Length of rear main bearing journal shoulder "c"		28.51 ÷ 28.55	28.51 ÷ 28.55

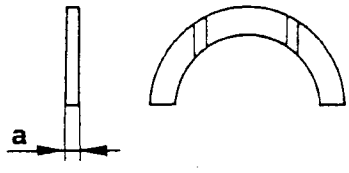
Main half bearings



Unit: mm

		AR 33501	AR 33201
Thickness of main half bearings "a"	Class A - Red	1.833 ÷ 1.839	1.832 ÷ 1.838
	Class B - Blue		1.836 ÷ 1.842
Operating clearance between main journals and half bearings		0.028 ÷ 0.063	0.023 ÷ 0.057

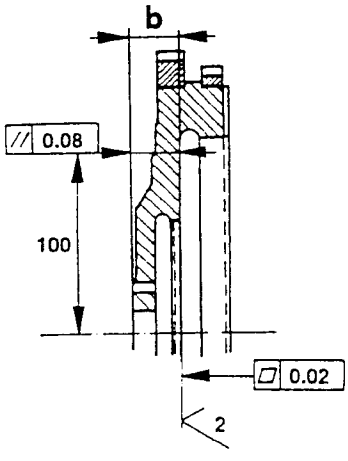
Half thrust rings



Unit: mm

Thickness of half thrust rings "a"	2.310 ÷ 2.360
Crankshaft end float	0.060 ÷ 0.250

Engine flywheel

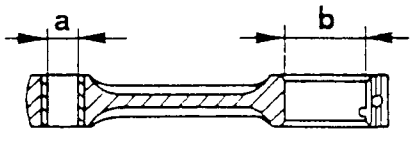


Flywheel grinding dimension "b" (1)	≥ 21.15 mm
Maximum error of parallelism between driven plate rest surface and flywheel rest surface at crankshaft (measured on a radius of 100 mm)	0.08 mm
Maximum error of flatness of driven plate resting surface	0.02 mm
Roughness of driven plate rest surface	2 µm
Heating temperature of ring gears for assembly on engine flywheel	120° ÷ 140°C

(1) The removal of material must be the same on both the driven plate rest surface and on the clutch cover rest surface.

CONNECTING ROD PISTON ASSEMBLY

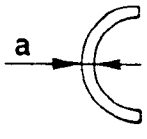
Connecting rod



Unit: mm

Small end bushing bore "a"	21.007 ÷ 21.015
Inside diameter of rod big end "b"	53.696 ÷ 53.708
Clearance between small end bushing and pin	0.007 ÷ 0.019

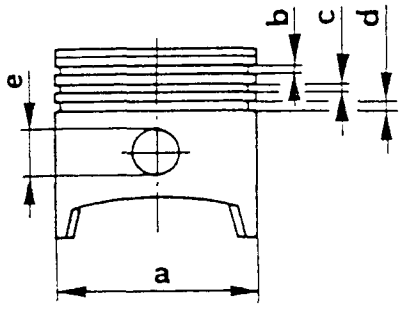
Connecting rod half bearings



Unit: mm

Thickness of rod half bearings "a"	Class A - Red	1.826 ÷ 1.832
	Class B - Blue	1.830 ÷ 1.836
Operating clearance between rod pins and their half bearings		0.032 ÷ 0.064

Piston

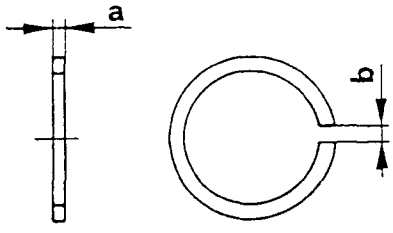


Unit: mm

		AR 33501	AR 33201
Diameter of pistons "a" (1)	Class A - Blue	79.960 ÷ 79.970	83.950 ÷ 83.960
	Class B - Pink	79.970 ÷ 79.980	83.960 ÷ 83.970
	Class C - Green	79.980 ÷ 79.990	83.970 ÷ 83.980
	Class D - Yellow	79.990 ÷ 80.000	83.980 ÷ 83.990
	Class E - White	80.000 ÷ 80.010	83.990 ÷ 84.000
	Oversize 0.2	80.154 ÷ 80.170	- - -
	Oversize 0.4	80.354 ÷ 80.370	84.346 ÷ 84.364
	Oversize 0.6	80554 ÷ 80.570	- - -
Height of first seal ring seat "b"		1.525 ÷ 1.545	1.525 ÷ 1.545
Height of second seal ring seat "c"		1.775 ÷ 1.795	1.510 ÷ 1.530
Height of oil scraper ring seat "d"		4.015 ÷ 4.035	3.510 ÷ 3.530
Diameter of gudgeon pin hole in pistons "e"		21.004 ÷ 21.008	
Clearance between cylinder and piston (not oversized)		0.03 ÷ 0.05	

(1) To be measured perpendicular to the gudgeon pin hole at a distance of 14mm from the lower edge of skirt for "Borgo" pistons and 11.5 mm from the pin axis for "Mondial" pistons.

Piston rings

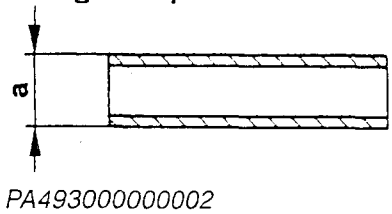


Unit: mm

		AR 33501	AR 33201
Thickness of rings "a"	First ring	1.478 ÷ 1.490	1.478 ÷ 1.490
	Second ring	1.728 ÷ 1.740	1.478 ÷ 1.490
	Oil scraper ring	3.978 ÷ 3.990	3.478 ÷ 3.490
Ring gap "b" (1)	First ring	0.30 ÷ 0.45	0.3 ÷ 0.5
	Second ring	0.30 ÷ 0.45	0.3 ÷ 0.5
	Oil scraper ring	0.25 ÷ 0.40	0.25 ÷ 0.40
Axial play between piston rings and seatings	First ring	0.035 ÷ 0.067	0.035 ÷ 0.067
	Second ring	0.035 ÷ 0.067	0.020 ÷ 0.052
	Oil scraper ring	0.025 ÷ 0.057	0.020 ÷ 0.052

(1) To be measured in the checking ring nut or in the cylinder.

Gudgeon pins

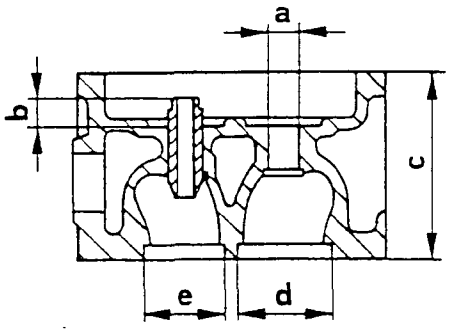


Unit: mm

Outside diameter of gudgeon pins "a"	20.996 ÷ 21.000
Clearance between gudegeon pin and seating on piston	0.004 ÷ 0.012

CYLINDER HEADS

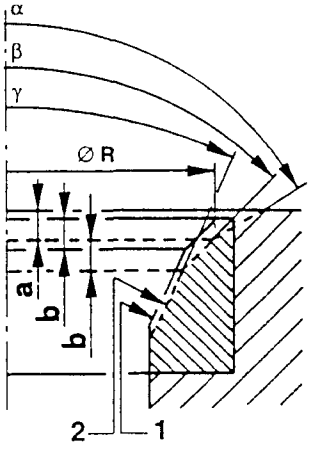
Heads



Unit: mm

Diameter of valve guide seat "a"		13.000 ÷ 13.018
Valve guide protrusion "b"		9.3 ÷ 9.5
Minimum permissible height of head after refacing "c"		77.676 ÷ 77.750
Maximum error of flatness of head lower surface		0.03
Valve seat diameter	Intake "d"	40.000 ÷40.025
	Exhaust "e"	33.000 ÷ 33.025
Cylinder head heating temperature for fitting valve seats		100° ÷ 120°C

Valve seats

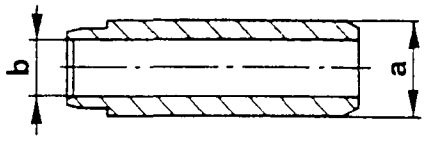


(1) Origin profile
(2) Profile after maximum reconditioning

Unit: mm

Outside diameter of valve seats	Intake	40.075 ÷ 40.100
	Exhaust	33.075 ÷ 33.100
Reference diameter $\varnothing_R$	Intake	39.0
	Exhaust	31.9
Limit for refacing valve seat upper section "a"		2.9
Limit for refacing valve seat contact area "b"	Intake	1.07 ÷ 1.37
	Exhaust	1.26 ÷ 1.56
Upper valve seat taper "α"		120°
Valve seat contact area taper "β"		90° ÷ 90°30'
Valve seat lower section taper "γ"	Intake	70°
	Exhaust	30°

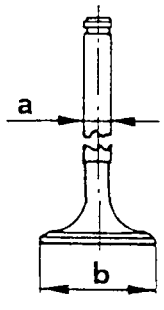
Valve guides



Unit: mm

Outside diameter of valve guides "a"	13.050 ÷ 13.068
Inside diameter of valve guides "b" (bore)	8.013 ÷ 8.031
Interference between valve guides and seats	0.032 ÷ 0.068

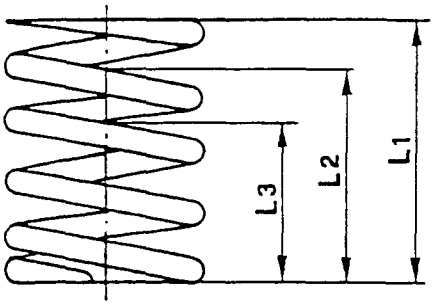
Valves



Unit: mm

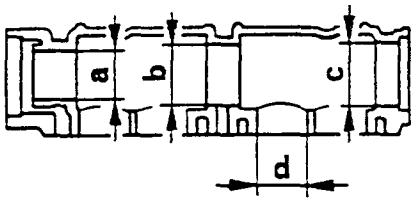
Diameter of valve stem "a"	Intake	7.985 ÷ 8.000
	Exhaust	7.968 ÷ 7.983
Diameter of valve mushrooms "b"	Intake	39.700 ÷ 39.990
	Exhaust	33.000 ÷ 33.200
Radial clearance between valve stem and guide	Intake	0.013 ÷ 0.046
	Exhaust	0.030 ÷ 0.063

Valve springs



	Inner spring	Outer spring
Free length "L1"	~ 45 mm	~ 44 mm
Length with valves closed "L2"	32.25 mm	30.25 mm
Corresponding load at "L2"	23 ÷ 24.4 kg	11.6 ÷ 12.5 kg
Length with valves open at "L3"	23.25 mm	21.25 mm
Load corresponding to length with valves open	43.3 ÷ 46.1 kg	20.4 ÷ 21.8 kg

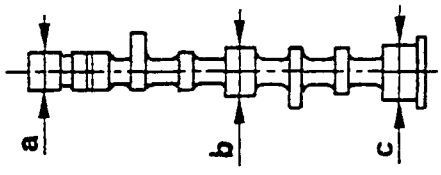
Camshaft bearings



Unit: mm

Diameter of camshaft bearings	Front "a"	35.015 ÷ 35.040
	Centre "b"	48.000 ÷ 48.025
	Rear "c"	49.200 ÷ 49.225
Diameter of valve cup seats "d"		35.000 ÷ 35.025

Camshafts

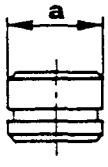


Unit: mm

Diameter of camshaft journals	Front "a"	34.940 ÷ 34.961
	Centre "b"	47.940 ÷ 47.956
	Rear "c"	49.140 ÷ 49.156
Maximum cam lift	Intake	9.80 (*)
	Exhaust	9.00
Clearance between camshaft journals and their housings	Front	0.054 ÷ 0.100
	Centre - rear	0.044 ÷ 0.085

(*) 9.00 for 1351 c.c. engine after change and 1596 c.c. Rochester.

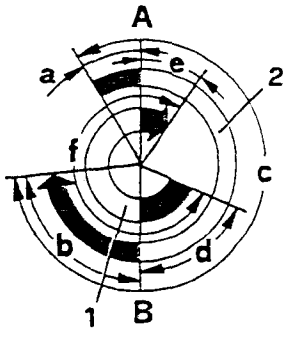
Hydraulic tappets



Unit: mm

Outside diameter of hydraulic tappet "a"	34.959 ÷ 34.975
Clearance between hydraulic tappets & their housings	0.025 ÷ 0.066

ANGLES OF ACTUAL TIMING DIAGRAM



(1) Intake (2) Exhaust
(A) T.D.C. (B) B.D.C.

Intake	Opens (before T.D.C.)	(a)	30°
	Closes (after B.D.C.)	(b)	84° (Δ)
	Intake angle	(c)	294° (❑)
Exhaust	Opens (before B.D.C.)	(d)	68°
	Closes (after T.D.C.)	(e)	34°
	Exhaust angle	(f)	282°

(Δ) 76° (❑) 286°: for 1351 c.c. engines after change and 1596 c.c. Rochester

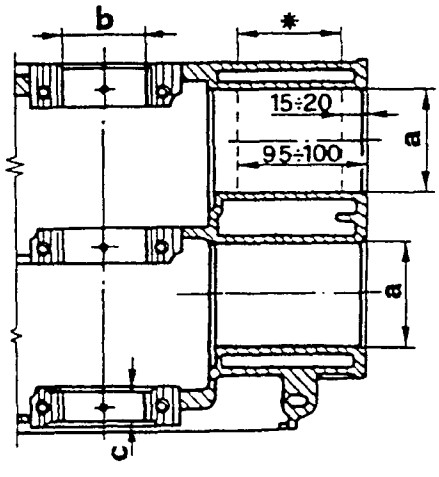
ENGINE SPECIFICATIONS

TECHNICAL DATA

Engine type		AR 33401
Cycle		Otto 4-stroke
Fuel/ignition system		Multi - Point Motronic M 2.10.3
Firing order		1 - 3 - 2 - 4
Displacement	cm^3	1712
Number of cylinders		4 horizontal opposed
Bore	mm	87
Stroke	mm	72
Maximum power	HP CEE (kW CEE) rpm	129 (95) 6500
Maximum torque	kgm CEE (Nm CEE) rpm	15.1 (148) 4300
Compression ratio		10 : 1
Engine oil pressure (with engine oil at 100°C) - At idle speed - At 4000 rpm	bar	 > 0.8 > 4
Idle r.p.m.	rpm	900 ± 50

COMPLETE CRANKCASE

Crankcase

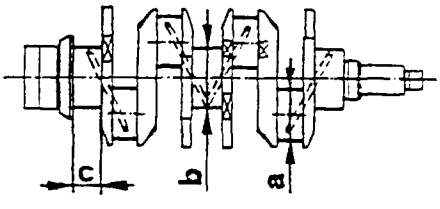


(*) Area for dimensional control

Unit: mm

Cylinder diameter "a"	Class A - Blue	87.000 ÷ 87.010
	Class B - Pink	87.010 ÷ 87.020
	Class C - Green	87.020 ÷ 87.030
	Class D - Yellow	87.030 ÷ 87.040
	Class E - White	87.040 ÷ 87.050
	Oversize 0.2	87.200 ÷ 87.210
	Oversize 0.4	87.400 ÷ 87.410
	Oversize 0.6	87.600 ÷ 87.610
Diameter of main bearings "b"		63.663 ÷ 63.673
Width of rear main bearing shoulder "c"		23.68 ÷ 23.73

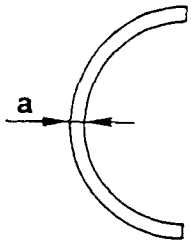
Crankshaft



Unit: mm

Diameter of connecting rod pins "a"	Class A - Red	49.992 ÷ 50.000
	Class B - Blue	49.984 ÷ 49.992
Diameter of main bearing journals "b"	Class A - Red	59.954 ÷ 59.964
	Class B - Blue	59.944 ÷ 59.954
Width of rear main bearing shoulder "c"		28.51 ÷ 28.55

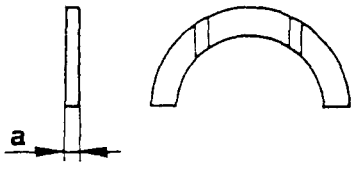
Main half bearings



Unit: mm

Thickness of main half bearings "a"	Class A - Red	1.832 ÷ 1.838
	Class B - Blue	1.836 ÷ 1.842
Operating clearance between main journals and half bearings		0.023 ÷ 0.055

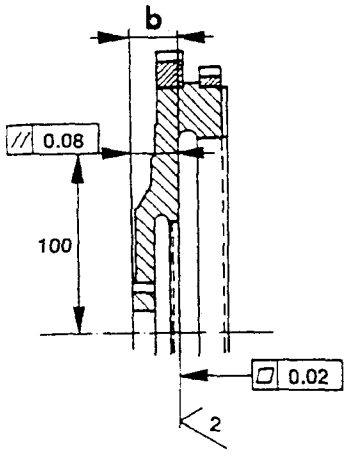
Half thrust rings



Unit: mm

Thickness of half thrust rings "a"	2.310 ÷ 2.360
Crankshaft end float	0.06 ÷ 0.25

Engine flywheel

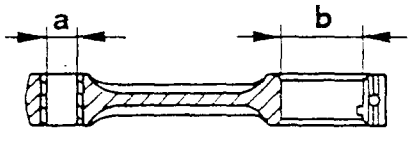


Flywheel grinding dimension "b" (1)	≥ 21.15 mm
Maximum error of parallelism between driven plate rest surface and flywheel rest surface at crankshaft (measured on a radius of 100 mm)	0.08 mm
Maximum error of flatness of driven plate rest surface	0.02 mm
Roughness of driven plate rest surface	2 µm
Heating temperature of ring gears for fitting on flywheel	120° ÷ 140°C

(1) The removal of material must be the same on both the driven plate rest surface and on the clutch cover rest surface.

CONNECTING ROD - PISTON ASSEMBLY

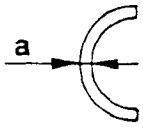
Connecting rods



Unit: mm

Inside diameter of small end bushing "a"	21.007 ÷ 21.015
Inside diameter rod big end "b"	53.696 ÷ 53.708
Clearance between small end bushing and pin	0.007 ÷ 0.019

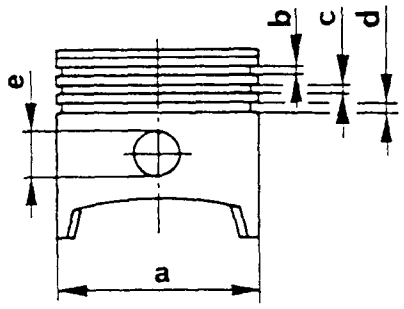
Connecting rod half bearings



Unit: mm

Thickness of connecting rod half bearings "a"	Class A - Red	1.826 ÷ 1.832
	Class B - Blue	1.830 ÷ 1.836
Operating clearance between rod pins and their half bearings		0.032 ÷ 0.064

Piston

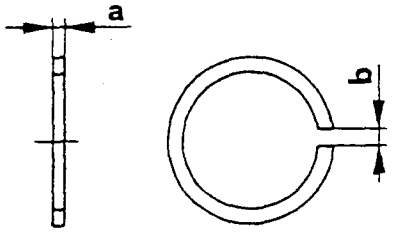


Unit: mm

Diameter of piston "a" (1)	Class A - Blue	86.950 ÷ 86.960
	Class B - Pink	86.960 ÷ 86.970
	Class C - Green	86.970 ÷ 86.980
	Class D - Yellow	86.980 ÷ 86.990
	Class E - White	86.990 ÷ 87.000
	Oversize 0.2	87.144 ÷ 87.160
	Oversize 0.4	87.344 ÷ 87.360
	Oversize 0.6	87.544 ÷ 87.560
Height of first seal ring seats "b"		1.535 ÷ 1.555
Height of second seal ring seats "c"		1.775 ÷ 1.795
Height of oil scraper ring seat "d"		3.015 ÷ 3.035
Diameter of gudgeon pin holes in pistons "e"		21.004 ÷ 21.008
Clearance between cylinders and pistons (not oversized)		004 ÷ 006

(1) To be measured perpendicular to the gudgeon pin hole at a distance of 13.9 mm from the gudgeon pin axis.

Piston rings

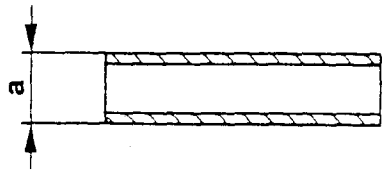


Unit: mm

Thickness of rings "a"	First ring	1.478 ÷ 1.490
	Second ring	1.728 ÷ 1.740
	Oil scraper ring	2.978 ÷ 2.990
Ring gap "b" (1)	First ring	0.30 ÷ 0.50
	Second ring	0.30 ÷ 0.50
	Oil scraper ring	0.25 ÷ 0.50
Axial play between piston rings and housings	First ring	0.045 ÷ 0.077
	Second ring	0.035 ÷ 0.067
	Oil scraper ring	0.025 ÷ 0.057

(1) To be measured in the checking ring nut or in the cylinder.

Gudgeon pins

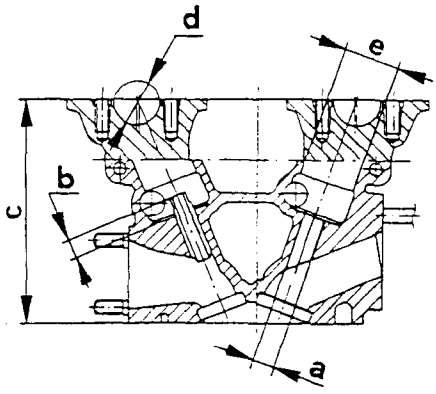


Unit: mm

Outside diameter of gudgeon pins "a"	20.996 ÷ 21.000
Clearance between gudgeon pin and seats on piston	0.004 ÷ 0.012

CYLINDER HEADS

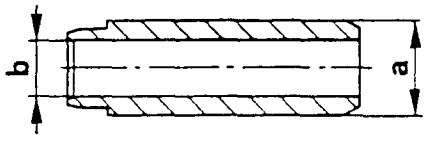
Heads



Unit: mm

Diameter of valve guide seats "a"	12.000 ÷ 12.018
Valve guide protrusion "b"	10.35 ÷ 10.65
Minimum permissible height after refacing "c"	≥ 127.8
Maximum error of flatness of head lower surface	0.03
Diameter of camshaft journals "d"	27.000 ÷ 27.033
Diameter of valve cup seats "e"	33.000 ÷ 33.025
Cylinder head heating temperature for fitting valve seats	100° ÷ 120°C

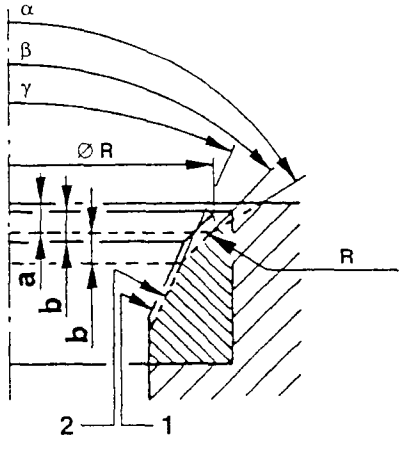
Valve guides



Unit: mm

Outside diameter of valve guides "a"	Intake	12.040 ÷ 12.051
	Oversize 0.2	12.240 ÷ 12.251
	Exhaust	12.050 ÷ 12.068
	Oversize 0.2	12.250 ÷ 12.268
Inside diameter of valve guides "b"		7.000 ÷ 7.015
Interference between valve guides and their seats	Intake	0.022 ÷ 0.051
	Exhaust	0.032 ÷ 0.068

Valve seats

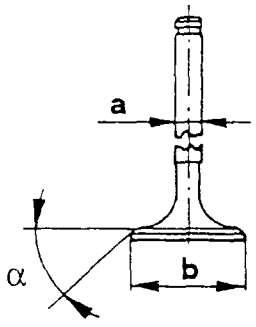


(1) Origin profile
(2) Profile after maximum reconditioning

Unit: mm

Outside diameter of valve seats	Intake	34.100 ÷ 34.116
	Oversize 0.2	34.300 ÷ 34.316
	Exhaust	28.096 ÷ 28.116
	Oversize 0.2	28.296 ÷ 28.316
Reference diameter $\varnothing_R$	Intake	31.0
	Exhaust	24.5
Limit for refacing valve seat upper section "a"	Intake	0.4
	Exhaust	1.1
Limit for refacing valve seat contact area	Intake "R"	0.9
	Exhaust "b"	1.1
Upper valve seat taper limit "α"	Intake	150°
	Exhaust	120°
Valve seat contact area taper "β"		90° ± 20'
Inner valve seat taper limit "γ"	Intake	75°
	Exhaust	60°

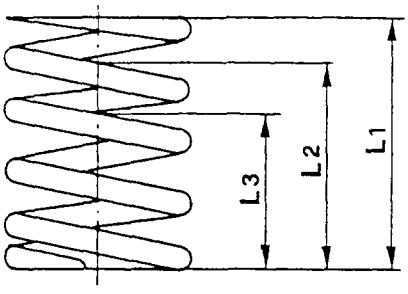
Valves



Unit: mm

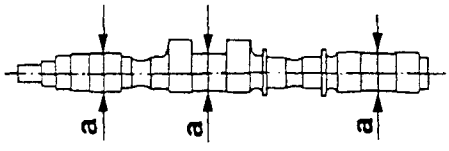
Diameter of valve stems "a"	Intake	6.965 ÷ 6.980
	Exhaust	
Diameter of valve mushrooms "b"	Intake	31.8 ÷ 32.0
	Exhaust	25.8 ÷ 26.0
Valve mushroom angle "α"	Intake	44°25' ÷ 44°35'
	Exhaust	
Radial play between valve stems and valve guides	Intake	0.02 ÷ 0.05
	Exhaust	

Valve springs



	Outer spring	Inner spring
Free length "L_1"	~ 51.8 mm	~ 38 mm
Length with valves closed "L_2"	32.5 mm	30.5 mm
Load corresponding to "L_2"	21.4 ÷ 22.6 kg	13.6 ÷ 14.4 kg
Length with valves open "L_3"	22.9 mm	20.9 mm
Corresponding load at "L_3"	35.52 ÷ 35.72 kg	31.89 ÷ 33.69 kg

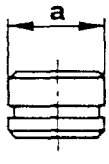
Camshafts



Unit: mm

Diameter of camshaft journals "a"		26.959 ÷ 26.980
Maximum cam lift	Intake	9.50
	Exhaust	9.40
Clearance between camshaft journals and their housings		0.020 ÷ 0.074

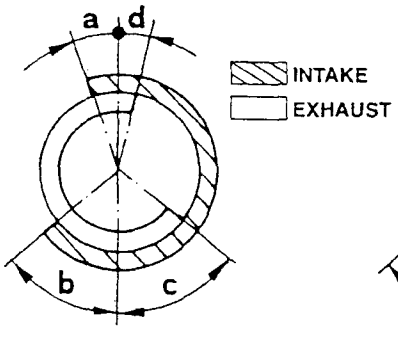
Hydraulic tappets



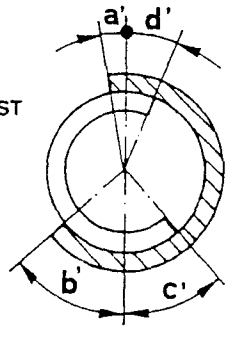
Unit: mm

Outside diameter of hydraulic tappets "a"	32.959 ÷ 32.975
Clearance between cup and housing	0.025 ÷ 30.066

ANGLES OF ACTUAL TIMING DIAGRAM



TIMING OF FIRST PAIR OF VALVES



TIMING OF SECOND PAIR OF VALVES

Intake	Opens (before T.D.C.)	a	20°
		a'	10°
	Closes (after B.D.C.)	b	49°
		b'	49°
Exhaust	Opens (before B.D.C.)	c	52°
		c'	42°
	Closes (after T.D.C.)	d	12°
		d'	22°

TECHNICAL FEATURES OF THE ENGINE

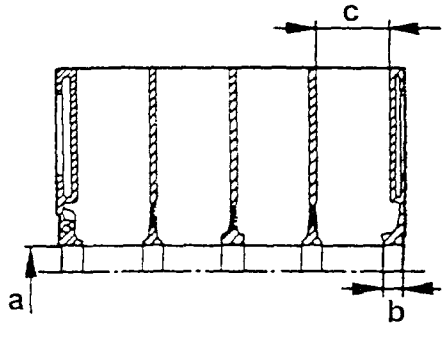
SPECIFIC DATA

Engine		AR 67501 - AR 33601 (▲)
Cycle		four-stroke Diesel engine
Feed		Direct injection with supercharging
Piston displacement	cm^3	1929
Cylinders' number		4 in line
Boring	mm	82.6
Stroke	mm	90
Maximum Power	CV CEE (kW CEE) revs/min	90 (66) 4100 4200 (•)
Pull-in Torque	kgm CEE (Nm CEE) revs/min	19.0 (186) 2400 2500 (•)
Compression ratio		19.2 : 1
Firing order		1 - 3 - 4 - 2
Slow running	revs/min	900 ± 20 900 ± 40 (•)

(▲): Version with catalyst (•): For versions/markets envisaged.

COMPLETE CYLINDER BLOCK

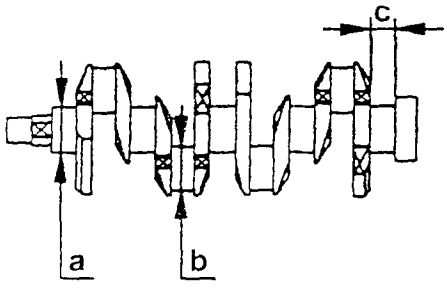
Cylinder block



Unit: mm

Diameter of main bearing "a"		56.717 ÷ 56.735
Shoulder length of rear main bearing "b"		23.12 ÷ 23.20
Diameter of cylinder barrels "c"	Class A	82.600 ÷ 82.610
	Class B	82.610 ÷ 82.620
	Class C	82.620 ÷ 82.630
	Class D	82.630 ÷ 82.640
	Class E	82.640 ÷ 82.650
	Oversize by 0.1	

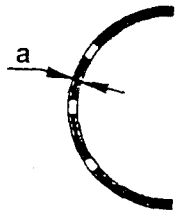
Driving shaft



Unit: mm

Diameter of main journals "a"	Class 1	52.995 ÷ 53.004
	Class 2	52.986 ÷ 52.995
	Undersize by 0.127	
Diameter of rod pins"b"	Class 1	50.796 ÷ 50.805
	Class 2	50.787 ÷ 50.796
	Undersize by 0.127	
Length of rear main journal "c"		27.975 ÷ 28.025

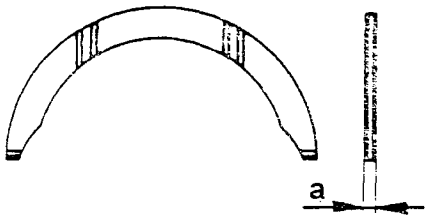
Half bearings



Unit: mm

Thickness of half bearings "a"	Class A (Red)	1.837 ÷ 1.843
	Class B (Blue)	1.843 ÷ 1.849
	Undersize by 0.127	
Radial clearance between pins and main bearings	Class A (Red)	0.027 ÷ 0.066
	Class B (Blue)	0.024 ÷ 0.063

Thrust half rings



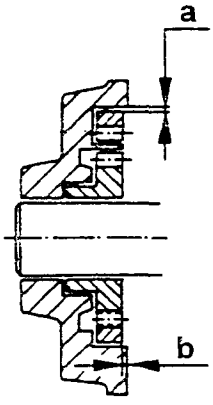
Unit: mm

Thickness of thrust half rings "a"	2.347 ÷ 2.363
	Oversize by 0.127
End play of the driving shaft	0.049 ÷ 0.211

Flywheel

Heating temperature of crown gear for the fitting of engine flywheel	80°C

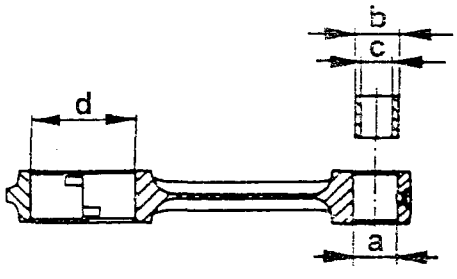
Oil pump



Clearance between pump seat and driven gear "a"		0.080 ÷ 0.186 mm
Clearnce between face of pump cover and gears "b"		0.025 ÷ 0.056 mm
Spring of pressure relief valve	Length	36 mm
	Check load	74 ÷ 82.9 N
Engine oil pressure (with engine oil at 100°C)	bar	3.43 ÷ 4.0

CONNECTING ROD - PISTON GROUP

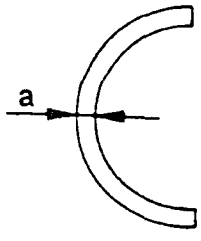
Connecting rods



Unit: mm

Diameter of small end "a"			27.939 ÷ 27.972
External diameter of small end bushings "b"			28.020 ÷ 28.060
Internal diameter of small end bushings (line-boring) "c"	Version before mod.	Class 1	26.004 ÷ 26.007
		Class 2	26.007 ÷ 26.010
	Version after mod.		26.004 ÷ 26.009
Diameter of connecting rod heads "d"			53.897 ÷ 53.913
Weight difference between connecting rods			± 2.5 g
Play among bushings, small ends and piston pins	Version before mod.		0.014 ÷ 0.020
	Version after mod.		0.013 ÷ 0.022
Interference among bushings, small ends and bushings' seats			0.048 ÷ 0.121

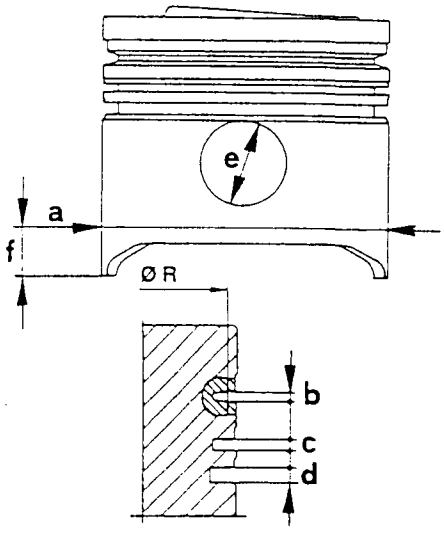
Half bearings



Unit: mm

Thickness of half bearings "a"	Class A (Red)	1.527 ÷ 1.533
	Class B (Blue)	1.533 ÷ 1.539
	Undersize by 0.127	
Radial play between pins and bearings	Class A (Red)	0.026 ÷ 0.063
	Class B (Blue)	0.023 ÷ 0.060

Pistons

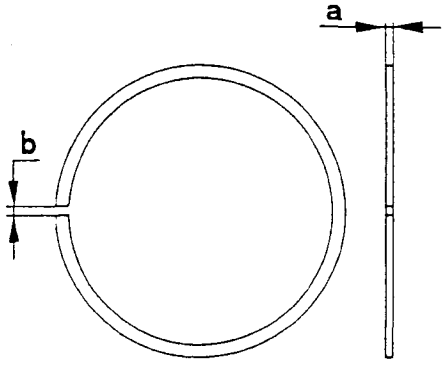


Unit: mm

Diameter of pistons "a" (1)		Class A	82.530 ÷ 82.540
		Class B	82.540 ÷ 82.550
		Class C	82.550 ÷ 82.560
		Class D	82.560 ÷ 82.570
		Class E	82.570 ÷ 82.580
		Oversized by 0.1	
Height of first piston ring seats "b" (at reference diameter Ø R 79.6 mm)			2.675 ÷ 2.705
Height of second piston ring seats "c"			2.010 ÷ 2.030
Height of oil scraper ring seats "d"			3.020 ÷ 3.040
Diameter of gudgeon pin hole in pistons "e"	Version before change	Class 1	25.993 ÷ 25.996
		Class 2	25.996 ÷ 25.999
	Version after change		25.994 ÷ 25.999
Clearance between liners and pistons			0.060 ÷ 0.080
Difference in weight between pistons			± 5 g

(1): To be measured perpendicular to the gudgeon pin hole at a distance of f = 15 mm from lower edge of skirt.

Seal rings

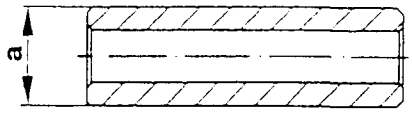


Unit: mm

Thickness of rings "a"	First ring	2.575 ÷ 2.595
	Oversized by 0.1	
	Second ring	1.978 ÷ 1.990
	Oversized by 0.1	
	Oil scraper ring	2.975 ÷ 2.990
	Oversized by 0.1	
Ring gap "b" (1)	First ring	0.20 ÷ 0.35
	Second ring	0.30 ÷ 0.50
	Oil scraper ring	0.25 ÷ 0.50
Axial clearance between seats and seal rings	First ring	0.080 ÷ 0.130
	Second ring	0.020 ÷ 0.052
	Oil scraper ring	0.030 ÷ 0.065

(1) To be measured in the check ring nut or in the cylinder liner.

Gudgeon pins

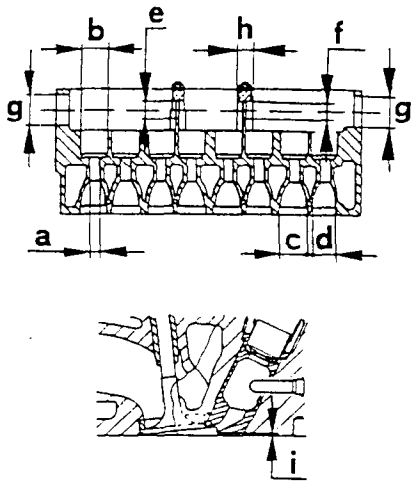


Unit: mm

Outside diameter of gudgeon pins "a"	Version before change	Class 1	25.987 ÷ 25.990
		Class 2	25.990 ÷ 25.993
	Version after change		25.987 ÷ 25.991
	Oversized by 0.2		
Clearance between piston holes and gudgeon pins	Version before change		0.003 ÷ 0.009
	Version after change		0.003 ÷ 0.012

CYLINDER HEAD

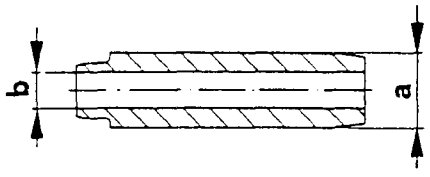
Head



Unit: mm

Diameter of valve guide seats "a"		13.950 ÷ 13.977
Diameter of valve cup seats "b"		37.000 ÷ 37.025
Diameter of valve seat housings	Intake "c"	38.989 ÷ 39.014
	Exhaust "d"	34.989 ÷ 35.014
Diameter of camshaft centre bearings	Second "e"	25.545 ÷ 25.570
	Third "f"	24.045 ÷ 24.070
Diameter of camshaft side bearings "g"		43.020 ÷ 43.040
Width of third camshaft bearing shoulder "h"		18.950 ÷ 19.030
Precombustion chamber protrusion or undercut in relation to the cylinder head surface "i"		- 0.765 ÷ + 0.055

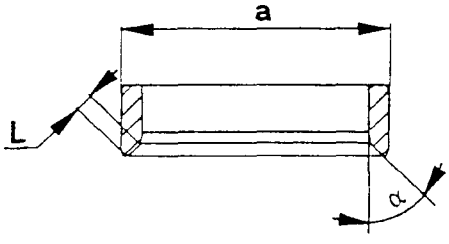
Valve guides



Unit: mm

Outside diameter of valve guides "a"	14.040 ÷ 14.058	
	Oversized by 0.20	
Inside diameter of valve guides (bore) "b"		8.022 ÷ 8.040
Interference between valve guides and seats		0.063 ÷ 0.108

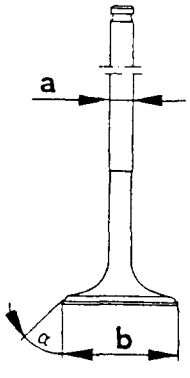
Valve seats



Unit: mm

Outside diameter of valve seats "a"	Intake	39.095 ÷ 39.110
	Exhaust	35.085 ÷ 35.100
Valve seat taper "α"		45° ± 5'
Length "L" of valve seat section with taper at 45°		~ 2.7
Interference between valve seats and housings	Intake	0.081 ÷ 0.121
	Exhaust	0.071 ÷ 0.111
Cylinder head heating temperature for fitting valve seats		80° ÷ 100°C

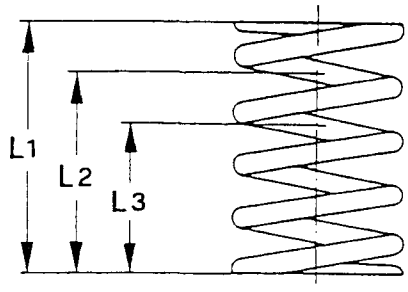
Valves



Unit: mm

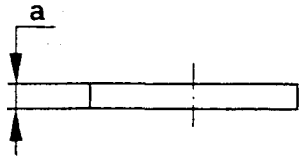
Diameter of valve stems "a"	Intake	7.974 ÷ 7.992
	Exhaust	
Diameter of valve mushrooms "b"	Intake	37.300 ÷ 37.600
	Exhaust	33.300 ÷ 33.600
Valve mushroom angle "α"	Intake	45°30' ± 7'
	Exhaust	
Radial clearance between valve stens and guides	Intake	0.030 ÷ 0.066
	Exhaust	

Valve springs



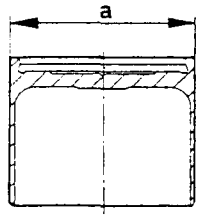
Free length "L_1"	53.9 mm
Spring length with valves closed "L_2"	36 mm
Load corresponding to spring length with valves closed	36.7 ÷ 39.6 daN (37.4 ÷ 40.4 kg)
Length of springs with valves open "L_3"	26.5 mm
Load corresponding to spring length with valves open	55.9 ÷ 60.8 daN (57 ÷ 62 kg)

Plates



Thickness of plates "a"	3.25 ÷ 4.40 mm

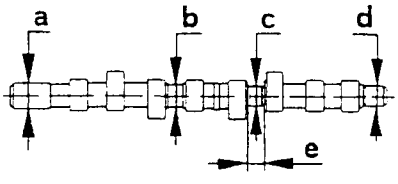
Valve cups



Unit: mm

Diameter of valve cups "a"	36.975 ÷ 36.995
Radial clearance between valve cups and housings	0.005 ÷ 0.050

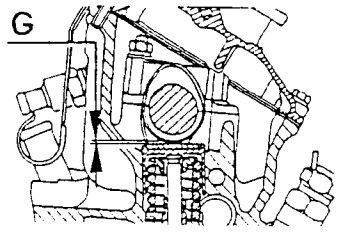
Camshaft



Unit: mm

Diameter of camshaft journals	First "a"	29.945 ÷ 29.960
	Second "b"	25.500 ÷ 25.515
	Third "c"	24.000 ÷ 24.015
	Fourth "d"	23.945 ÷ 23.960
Width of shaft shoulder "e"		19.100 ÷ 19.200
Cam lift (on valve spindle without play)	Intake	8.5
	Exhaust	8.5
Radial clearance between camshaft journals and seats		0.03 ÷ 0.07
Camshaft end float		0.1

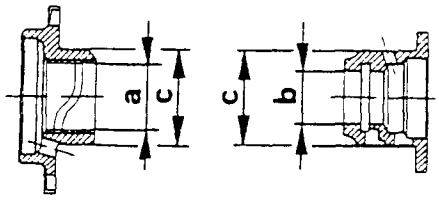
Valve clearance



Unit: mm

Valve clearance for checking timing	Intake	0.50
	Exhaust	0.50
Operating valve clearance (with cold engine) "G"	Intake	0.30 ± 0.05
	Exhaust	0.35 ± 0.05

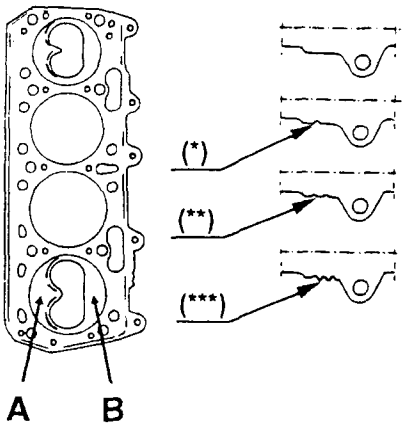
Side camshaft bearings



Unit: mm

Inside diameter of camshaft bearings	front "a"	29.990 ÷ 30.015
	rear "b"	23.990 ÷ 24.015
Outside diameter of camshaft bearings "c"		42.995 ÷ 43.015

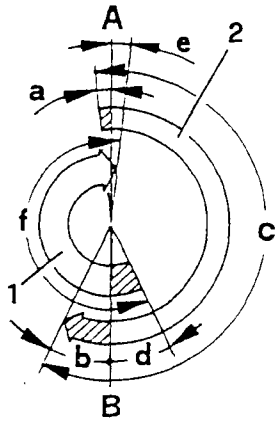
Cylinder head seal



Mean piston protrusion (1)		Thickness of cylinder head seal to be used
from engine no. 1762797	up to engine no. 1762798	
< 0.7 mm	< 1.05 mm	1.67 mm
0.7 ÷ 0.8 mm	1.05 ÷ 1.15 mm	1.75 mm (*)
0.8 ÷ 0.9 mm	1.15 ÷ 1.25 mm	1.85 mm (**)
> 0.9 mm	> 1.25 mm	1.93 mm (***)

(1): To be found by measuring it for each cylinder in points A and B of the piston; calculate the mean between the two values and consider the highest mean between the pistons to define the seal to be used.

ANGULAR VALUES OF ACTUAL TIMING DIAGRAM



Intake	Opens (before T.D.C.)	"a"	6°
	Closes (after B.D.C.)	"b"	26°
	Intake angle	"c"	212°
Exhaust	Opens (before B.D.C.)	"d"	26°
	Closes (after T.D.C.)	"e"	6°
	Exhaust angle	"f"	212°

(1) Exhaust (2) Intake
(A) T.D.C. (B) B.D.C.

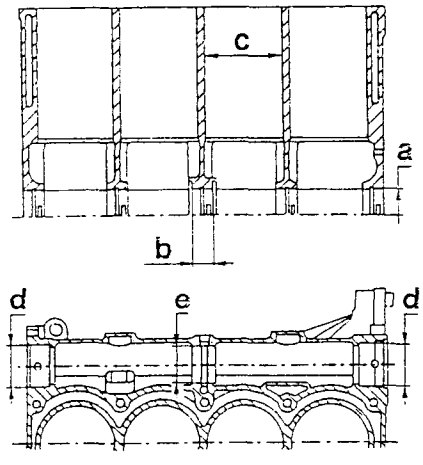
TECHNICAL FEATURES OF THE ENGINE

SPECIFIC DATA

Engine		AR 67204		AR 32301
Cycle		four-stroke Otto		
Feed / Ignition		Multi-Point Motronic M 2.10.3	Multi-Point Motronic M 2.10.4	Multi-Point Motronic M 1.5.5
Firing order		1 - 3 - 4 - 2		
Piston displacement	cm^3	1970		
Cylinders' number		4 in line		
Boring	mm	83		
Stroke	mm	91		
Maximum power	CV CEE (kW CEE) revs/min	150 (110) 6200		155 (114) 6400
Pull-in Torque	kgm CEE (Nm CEE) revs/min	19 (187) 4000		19.1 (187) 3500
Compression ratio		10 : 1		
Pressure of the engine oil - At slow running - At 4000 revs/min	bar	 ≥ 1.5 ≥ 4.5		
Slow running	revs/min	800 ± 50	840 ± 50	840 ± 50

COMPLETE CYLINDER BLOCK

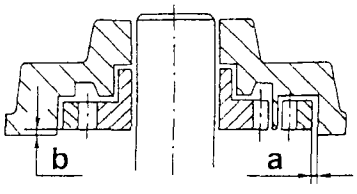
Cylinder block



Unit: mm

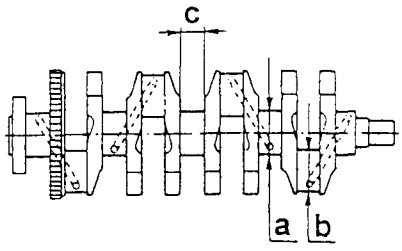
Diameter of main bearings "a"		56.705 ÷ 56.718
Length of shoulders for central main bearing "b"		21.720 ÷ 21.800
Cylinders' diameter "c"	Class A - Blue	83.000 ÷ 83.010
	Class B - Pink	83.010 ÷ 83.020
	Class C - Green	83.020 ÷ 83.030
	Oversize by 0.1	
Diameter of shoulder for counter-rotating shafts	Front and rear "d"	46.975 ÷ 47.000
	Central "e"	39.979 ÷ 40.009

Oil pump



Clearance between pump seat and driven gear "a"		0.080 ÷ 0.186 mm
Clearance between face of the pump cover and upper side of gears "b"		0.025 ÷ 0.070 mm
Spring of pressure relief valve	Check load	6.4 ÷ 7.2 kg
	Spring length	36 mm

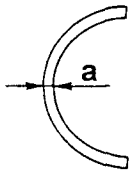
Driving shaft



Unit: mm

Diameter of main journals "a"	Class A - Red	52.994 ÷ 53.000
	Class B - Blue	52.988 ÷ 52.994
	Class C - Yellow	52.982 ÷ 52.988
	Undersize by 0.127	
Diameter of connecting rod pins "b"	Class A - Red	50.799 ÷ 50.805
	Class B - Blue	50.793 ÷ 50.799
	Class C - Yellow	50.787 ÷ 50.793
	Undersize by 0.127	
Length of central main journal "c"		26.575 ÷ 26.625
Maximum taper of main journals and rod pins		0.0045
Maximum concentricity error between main journals and rod pins		0.003

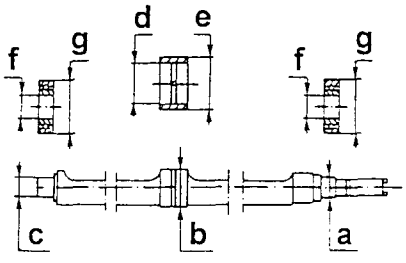
Half bearings



Unit: mm

Thickness of half bearings "a"	Class A - Red	1.836 ÷ 1.840
	Class B - Blue	1.839 ÷ 1.843
	Class C - Yellow	1.842 ÷ 1.846
	Undersize by 0.127	
Functioning play between pins and half bearings		0.025 ÷ 0.052

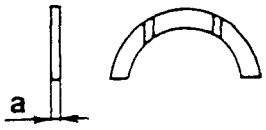
Counter-rotating shafts



Unit: mm

Pins' diameter of counter-rotating shafts	Front "a"	19.980 ÷ 19.993
	Central "b"	36.945 ÷ 36.960
	Rear "c"	19.990 ÷ 20.010
Diameter of central bushings	Internal "d"	37.020 ÷ 37.040
	External "e"	40.065 ÷ 40.090
Diameter of ball bearings	Internal "f"	19.990 ÷ 20.000
	External "g"	46.989 ÷ 47.000
Interference between central bushings and corresponding seats		0.056 ÷ 0.111
Radial play between bushings and central pins		0.060 ÷ 0.095
Play / Interference between ball bearings and corresponding seats on the block		+0.011 ÷ -0.025
Play / Interference between ball bearings and pins of counter-rotating shafts	Front	+0.020 ÷ -0.003
	Rear	+0.010 ÷ -0.020

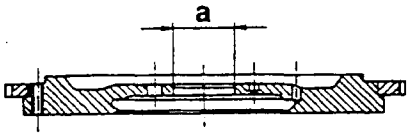
Half thrust rings



Unit: mm

Thickness of half thrust rings "a"	2.342 ÷ 2.358
	Oversize 0.127
Crankshaft end float	0.059 ÷ 0.221

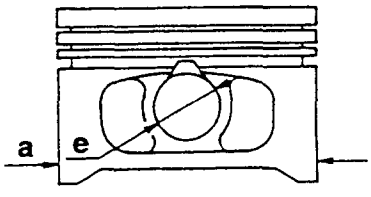
Engine flywheel

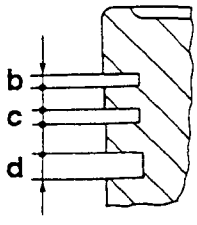


Inside diameter of centre bush (bore) "a"	47.010 ÷ 47.035 mm
Heating temperature of ring gear for assembly on flywheel	80° ÷ 100°C

CONNECTING ROD - PISTON ASSEMBLY

Piston



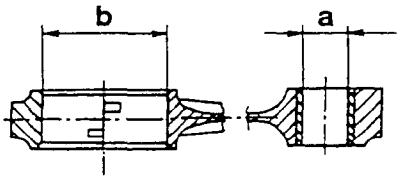


Unit: mm

Diameter of pistons "a" (1)	Class A - Blue	82.952 ÷ 82.962
	Class B - Pink	82.959 ÷ 82.971
	Class C - Green	82.968 ÷ 82.978
Height of first seal ring seats "b"		1.220 ÷ 1.240
Height of second seal ring seats "c"		1.510 ÷ 1.530
Height of oil scraper ring seats "d"		3.010 ÷ 3.030
Diameter of gudgeon pin holes in pistons "e"		20.002 ÷ 20.007
Clearance between cylinders and pistons		0.038 ÷ 0.062
Difference in weight between pistons		± 5 g

(1) To be measured perpendicular to the gudgeon pin hole at a distance of 12.5 mm from lower edge of skirt.

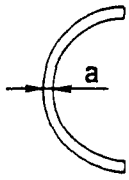
Connecting rods



Unit: mm

Diameter of small end bushing bore "a"	20.006 ÷ 20.012
Inside diameter of rod big ends "b"	53.897 ÷ 53.909
Difference in weight between rods	≤ 5 g
Clearance between small end bushings and pins	0.006 ÷ 0.016
Small end end float	0.25 ÷ 0.6

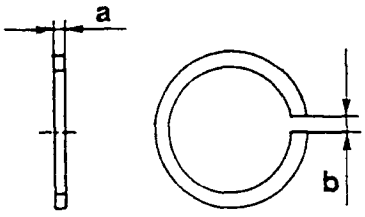
Connecting rod half bearings



Unit: mm

Thickness of connecting rod half bearings "a"	Class A - Red	1.527 ÷ 1.531
	Class B - Blue	1.530 ÷ 1.534
	Class C - Yellow	1.533 ÷ 1.537
	Undersize 0.127	
Operating clearance connecting rod pins and their half bearings	Class A - Red	0.03 ÷ 0.056
	Class B - Blue	
	Class C - Yellow	

Seal rings

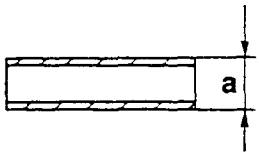


Unit: mm

Thickness of rings "a"	First ring	1.170 ÷ 1.190
		Oversize 0.1
	Second ring	1.475 ÷ 1.490
		Oversize 0.1
	Oil scraper ring	2.975 ÷ 2.990
		Oversize 0.1
Ring gap "b" (1)	First ring	0.25 ÷ 0.50
	Second ring	0.30 ÷ 0.50
	Oil scraper ring	0.25 ÷ 0.45
Axial play between seal rings and seats	First ring	0.030 ÷ 0.070
	Second ring	0.020 ÷ 0.055
	Oil scraper ring	0.020 ÷ 0.055

(1) To be measured in the checking ring nut or in the cylinder

Gudgeon pins

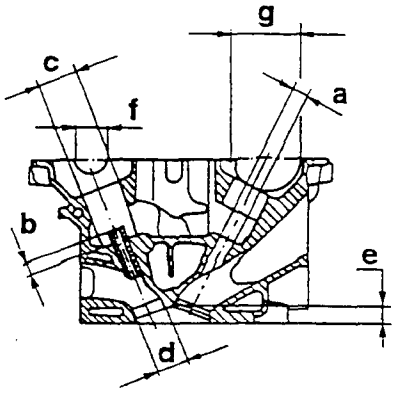


Unit: mm

Outside diameter of gudgeon pins "a"	19.996 ÷ 20.000
Clearance between gudgeon pins and their seats on pistons	0.002 ÷ 0.011

CYLINDER HEAD

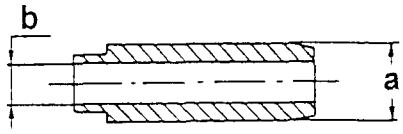
Head



Unit: mm

Diameter of sedi valve guide seats "a"		12.950 ÷ 12.977
Valve guide protrusion "b"		11.25 ÷ 11.75
Diameter of valve cup seats "c"		33.000 ÷ 33.025
Diameter of valve seat housing "d"	Intake	34.989 ÷ 35.014
	Exhaust	28.991 ÷ 29.012
Minimum depth of combustion chamber "e"		13 ± 0.2
Maximum error of flatness of head lower surface		0.1
Diameter of camshaft supports "f"		26.045 ÷ 26.070
Diameter of timing variator support "g"		55.990 ÷ 56.015

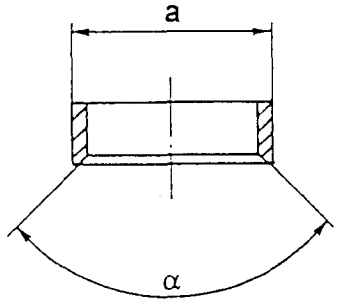
Valve guides



Unit: mm

External diameter of valve guides "a"	13.010 ÷ 13.030
	Oversize by 0.20
Internal diameter of valve guides(line-boring) "b"	7.022 ÷ 7.040
Interference between valve guides and corresponding seats	0.033 ÷ 0.080

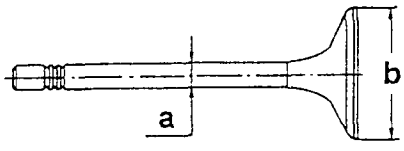
Valve seats



Unit: mm

External diameter of valve seats "a"	Intake	35.135 ÷ 35.150
	Exhaust	29.142 ÷ 29.157
Contact taper with valves "α"		90° ± 10'
Interference between valve seats and respective seats	Intake	0.121 ÷ 0.146
	Exhaust	0.130 ÷ 0.166
Heating temperature of cylinders' head for valve seats fitting		80°C

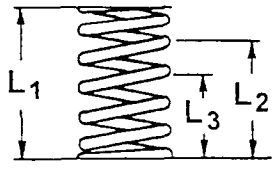
Valves



Unit: mm

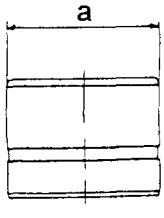
Diameter of valve stems "a"	Intake	6.975 ÷ 6.990
	Exhaust	6.960 ÷ 6.975
Diameter of valve heads "b"	Intake	33.4 ÷ 33.7
	Exhaust	27.9 ÷ 28.2
Radial play between valve stems and valve guides	Intake	0.032 ÷ 0.065
	Exhaust	0.047 ÷ 0.080

Valve springs



	External Spring	Internal Spring
Free length "L_1"	46 mm	39 mm
Length with closed valves "L_2"	34 mm	29.5 mm
Load corresponding to "L_2"	271 ÷ 294 N (27.6 ÷ 30 kg)	96 ÷ 106 N (9.8 ÷ 10.8 kg)
Length with open valves "L_3"	24.5 mm	20 mm
Load corresponding to "L_3"	485 ÷ 524 N (49.4 ÷ 53.4 kg)	201 ÷ 221 N (20.5 ÷ 22.5 kg)

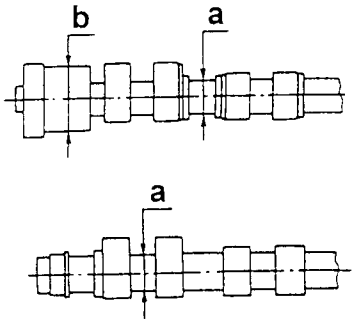
Hydraulic tappets



Unit: mm

External diameter of hydraulic tappets "a"	32.959 ÷ 32.975
Radial play between hydraulic tappets and corresponding seats	0.025 ÷ 0.066

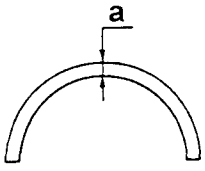
Camshafts



Unit: mm

Diameter of camshafts' pins "a"		26.000 ÷ 26.015
Diameter of phase transformer pin "b"		49.985 ÷ 50.000
Nominal cam lift	Intake	9.50
	Exhaust	9.50
Play between camshafts' pins and corresponding seats		0.03 ÷ 0.07
Camshafts' end play		0.10 ÷ 0.23

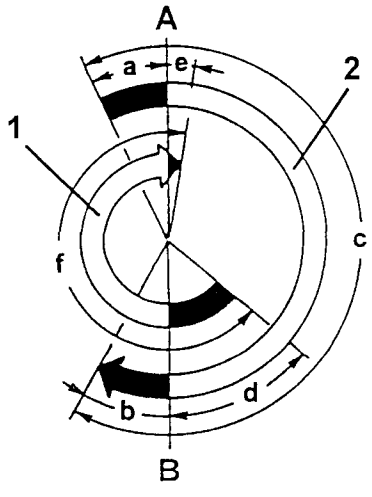
Phase transformer's half bearings



Unit: mm

Thickness of phase transformer half bearings "a"	2.992 ÷ 2.998
Play between phase transformers and corresponding bearings	0.034 ÷ 0.086

ANGULAR VALUES OF THE TRUE DIAGRAM OF THE TIMING SYSTEM (applying a check play of 0.45 mm)



			Engines AR 67204	Engines AR 32301
Intake	Opening (before TDC)	"a"	0° 25°(*)	-3° 22°(*)
	Closing (after BDC)	"b"	55° 30°(*)	51° 26°(*)
	Angular intake value	"c"	235°	228°
Exhaust	Opening (before BDC)	"d"	50°	47°
	Closing (after TDC)	"e"	8°	4°
	Angular exhaust value	"f"	238°	231°

(*): Values obtained with operating phase transformer

(1) Scarico (2) Intake
(A) P.M.S. (B) BDC

TECHNICAL FEATURES OF THE ENGINE

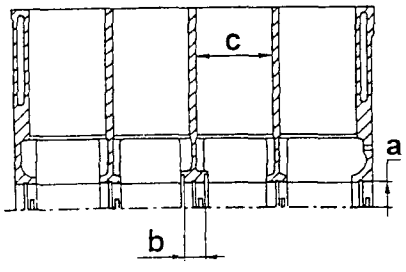
SPECIFIC DATA

Engine		AR 33503	AR 67601	AR 67106	AR 32201
Cycle		Four-stroke Otto			
Feed / Ignition		Motronic M2.10.4 Motronic M1.5.5	Motronic M2.10.4 Motronic M1.5.5	Motronic M2.10.4	Motronic M1.5.5
Firing order		1 - 3 - 4 - 2			
Piston displacement	cm^3	1370	1598	1747	
Cylinders' number		4 in line			
Boring	mm	82	82	82	82
Stroke	mm	64.87	75.65	82.7	
Maximum power	CV CEE (kW CEE) revs/min	103 (76) 6300	120 (88) 6300	140 (103) 6300	144 (106) 6500
Pull-in torque	kgm CEE (Nm CEE) revs/min	12.7 (124) 4600	14.7 (144) 4500	16.8 (165) 4000	17.2 (169) 3500
Compression ratio		10.5 : 1	10.3 : 1	10.3 : 1	10.3 : 1
Pressure of the engine oil - At slow running - At 4000 revs/min	bar	≥ 1.5 ≥ 4.5 (*)	≥ 1.5 ≥ 4.5	≥ 1.5 ≥ 4.5	≥ 1.5 ≥ 4.5
Slow running	revs/min	880 ± 50	840 ± 50	840 ± 50	840 ± 50

(*): For engines of the type AR33503 with injection system - Motronic ignition M1.5.5: > 4.0

COMPLETE CYLINDER BLOCK

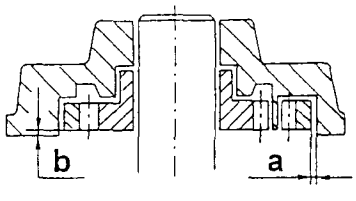
Cylinder block



Unit: mm

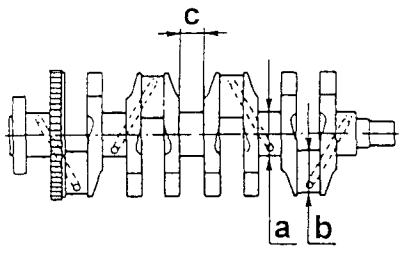
Diameter of main bearing "a"		56.705 ÷ 56.718
Length of shoulder for rear main bearing "b"		21.720 ÷ 21.800
Cylinders' diameter "c"	Class A	82.000 ÷ 82.010
	Class B	82.010 ÷ 82.020
	Class C	82.020 ÷ 82.030
	Oversize by 0.1	

Oil pump



Clearance between pump seat and driven gear "a"		0.080 ÷ 0.186 mm
Clearance between face of pump cover and upper side of gears "b"		0.025 ÷ 0.070 mm
Spring of pressure relief valve	Check load	6.4 ÷ 7.2 kg
	Spring length	36 mm

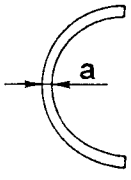
Driving shaft



Unit: mm

		1370	1598	1747
Diameter of main journal "a"	Class A - Red	52.994 ÷ 53.000		
	Class B - Blue	52.988 ÷ 52.994		
	Class C - Yellow	52.982 ÷ 52.988		
	Undersize by 0.127			
Diameter of rod pins "b"	Class A - Red	40.884 ÷ 40.890	48.238 ÷ 48.244	50.799 ÷ 50.805
	Class B - Blue	40.878 ÷ 40.884	48.232 ÷ 48.238	50.793 ÷ 50.799
	Class C - Yellow	40.872 ÷ 40.878	48.226 ÷ 48.232	50.787 ÷ 50.793
	Undersize by 0.127			
Length of middle main journal "c"		26.575 ÷ 26.625		
		Oversize by 0.254		
Maximum taper of main journals and rod pins		0.0045		
Maximum concentricity error between main journals and rod pins		0.03		

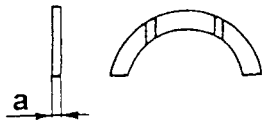
Half bearings



Unit: mm

		1598	1370 1747
Thic of later half b ings "a"	Class A - Red	1.836 ÷ 1.840	1.831 ÷ 1.837
	Class B - Blue	1.839 ÷ 1.843	1.836 ÷ 1.844
	Class C - Yellow	1.842 ÷ 1.846	1.843 ÷ 1.849
	Undersize by 0.127		
Thickness of central half bearings "a"	Class A - Red	1.831 ÷ 1.835	1.826 ÷ 1.832
	Class B - Blue	1.834 ÷ 1.838	1.831 ÷ 1.839
	Class C - Yellow	1.837 ÷ 1.841	1.838 ÷ 1.844
	Undersize by 0.127		
Clearance between pins and half bearings	Lateral	0.025 ÷ 0.052	0.019 ÷ 0.062
	Central	0.035 ÷ 0.062	0.029 ÷ 0.072

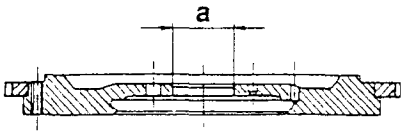
Thrust half rings



Unit: mm

Thickness of thrust half rings "a"	2.342 ÷ 2.358
	Oversize by 0.127
End play of the driving shaft	0.059 ÷ 0.221

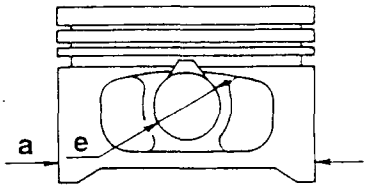
Flywheel

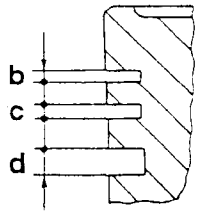


Inside diameter of centre bush (bore) "a"	47.010 ÷ 47.035 mm
Crown wheel heating temperature for assembly on flywheel	80° ÷ 100°C

CONNECTING ROD - PISTON ASSEMBLY

Piston



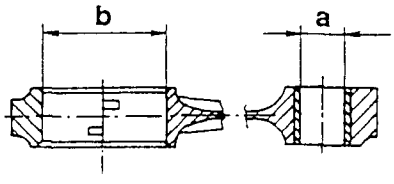


Unit: mm

Piston diameter "a" (1)	Class A - Blue	81.952 ÷ 81.962
	Class B - Pink	81.960 ÷ 81.970
	Class C - Green	81.968 ÷ 81.978
	Oversize 0.1	
Height of seats of first seal ring "b"		1.520 ÷ 1.540
Height of seats of second seal ring "c"		1.510 ÷ 1.530
Height of seats of scraper ring "d"		3.010 ÷ 3.030
Pin hole diameter in pistons "e"		20.002 ÷ 20.007
Clearance between pistons and cylinders		0.038 ÷ 0.062 (*)
Difference in weight between pistons		± 5 g

(1): To be measured at right angles to the pin hole at a distance of 12.5 mm from the lower edge of the skirt. (*): 0.040 ÷ 0.060 for engine AR33503.

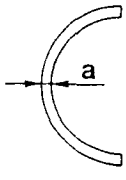
Connecting rods



Unit: mm

	(1370)	(1598)	(1747)
Small end bush hole diameter "a"	20.006 ÷ 20.012		
Inside diameter of big ends "b"	44.000 ÷ 44.012	51.354 ÷ 51.366	53.897 ÷ 53.909
Difference in weight between connecting rods	≤ 5 g		
Clearance between pins and small end bushes	0.006 ÷ 0.016		
Small end end float	0.25 ÷ 0.6		

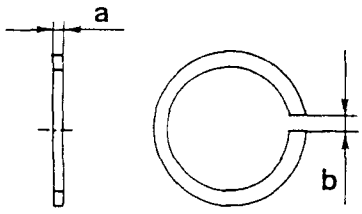
Connecting rod half bearings



Unit: mm

		(1370) (1598)	(1747)
Thickness of connecting rod half bearings "a"	Class A - Red	1.536 ÷ 1.540	1.527 ÷ 1.531
	Class B - Blue	1.539 ÷ 1.543	1.531 ÷ 1.535
	Class C - Yellow	1.542 ÷ 1.546	1.535 ÷ 1.539
	Undersize 0.127		
Clearance between connecting rod pins and corresponding half bearings	Class A - Red	0.030 ÷ 0.056	0.026 ÷ 0.056
	Class B - Blue		
	Class C - Yellow		

Seal rings

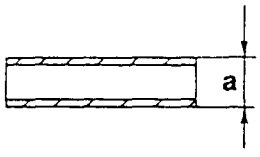


Unit: mm

Ring thickness "a"	First ring	1.470 ÷ 1.490
		Oversize 0.1
	Second ring	1.475 ÷ 1.490
		Oversize 0.1
	Scraper ring	2.975 ÷ 2.990
		Oversize 0.1
Ring gap "b" (1)	First ring	0.25 ÷ 0.50
	Second ring	0.30 ÷ 0.50
	Scraper ring	0.25 ÷ 0.50
End float between rings and their seats	First ring	0.030 ÷ 0.070
	Second ring	0.020 ÷ 0.055
	Scraper ring	0.020 ÷ 0.055

(1) To be measured in the checking nut or in the cylinder

Gudgeon pins

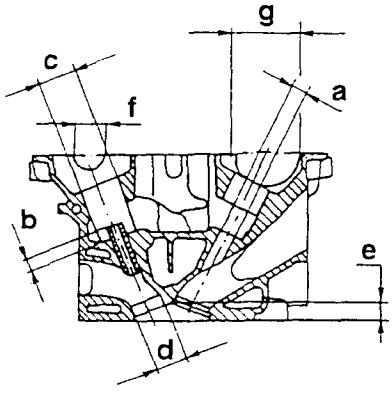


Unit: mm

Outside diameter of gudgeon pins "a"	19.996 ÷ 20.000
Clearance between gudgeon pins and their housings on pistons	0.002 ÷ 0.011

CYLINDER HEADS

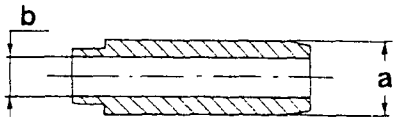
Head



Unit: mm

		(1370)	(1598) (1747)
Valve guide seat diameter "a"		12.950 ÷ 12.977	
Valve guide protrusion "b"		11.25 ÷ 11.75	
Valve cup seat diameter "c"		33.000 ÷ 33.025	
Valve seat housing diameter "d"	Intake	31.519 ÷ 31.544	35.019 ÷ 35.044
	Exhaust	27.021 ÷ 27.042	29.021 ÷ 29.042
Combustion chamber minimum depth "e"		13 ± 0.2	
Maximum flatness error of lower head surface		0.1	
Diameter of camshaft bearings "f"		26.045 ÷ 26.070	
Diameter of timing variator support "g"		55.990 ÷ 56.015	

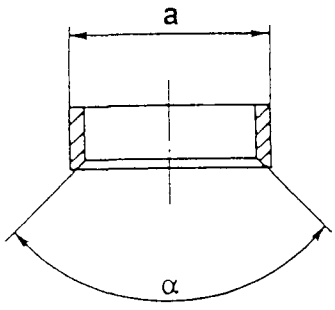
Valve guides



Unit: mm

Outside diameter of valve guides "a"	13.010 ÷ 13.030
	Oversize 0.20
Inside diameter of guide valves (bore) "b"	7.022 ÷ 7.040
Interference between valve guides and their housings	0.033 ÷ 0.080

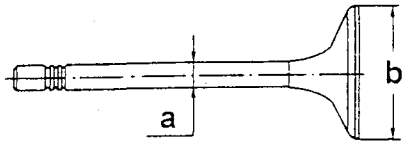
Valve seats



Unit: mm

		1370	1598 1747
External diameter of valve seats "a"	Intake	31.635 ÷ 31.650	35.135 ÷ 35.150
	Exhaust	27.142 ÷ 27.157	29.142 ÷ 29.157
Contact taper with valves "α"		90° ± 10'	
Interference between valve seats and respective seats	Intake	0.124 ÷ 0.131	0.091 ÷ 0.131
	Exhaust	0.100 ÷ 0.136	0.100 ÷ 0.136
Heating temperature of cylinders' head for valve seats fitting		80°C	

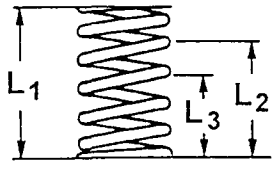
Valves



Unit: mm

		1370	1598 1747
Diameter of valve stems "a"	Intake	6.975 ÷ 6.990	
	Exhaust	6.960 ÷ 6.975	
Diameter of valve heads "b"	Intake	29.9 ÷ 30.2	33.4 ÷ 33.7
	Exhaust	25.9 ÷ 26.2	27.9 ÷ 28.2
Radial clearance between valve stems and valve guides	Intake	0.032 ÷ 0.065	
	Exhaust	0.047 ÷ 0.080	

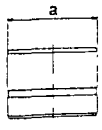
Valve springs



Unit: mm

	External spring	Internal spring
Free length "L_1"	46 mm	39 mm
Length with closed valves "L_2"	34 mm	29.5 mm
Load corresponding to "L_2"	271 ÷ 294 N (27.6 ÷ 30 kg)	96 ÷ 106 N (9.8 ÷ 10.8 kg)
Length with open valves "L_3"	24.5 mm	20 mm
Load corresponding to "L_3"	485 ÷ 524 N (49.4 ÷ 53.4 kg)	201 ÷ 221 N (20.5 ÷ 22.5 kg)

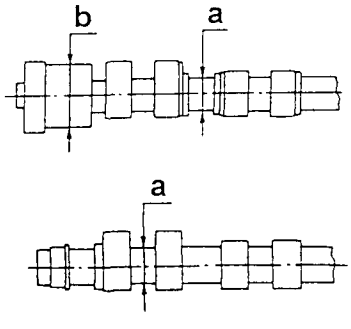
Hydraulic tappets



Unit: mm

External diameter of hydraulic tappets "a"	32.959 ÷ 32.975
Radial clearance between hydraulic tappets and corresponding seats	0.025 ÷ 0.066

Camshaft

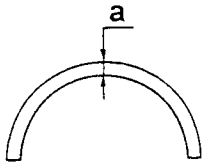


Unit: mm

		1370 1598	1747
Diameter of camshafts pins "a"		26.000 ÷ 26.015	
Diameter of phase transformer pin "b"		49.985 ÷ 50.000	
Nominal cam lift	Intake	8.3 9.0 (*)	9.5
	Exhaust	7.5	9.5
Clearance between camshafts' pins and corresponding seats		0.03 ÷ 0.07	
Camshafts' end play		0.10 ÷ 0.23	

(*): For 98's models with M1.5.5. injection

Phase transformer's half bearings



Unit : mm

Thickness of phase transformer half bearings "a"	2.992 ÷ 2.998
True functioning clearance between phase transformer and corresponding bearings	0.034 ÷ 0.086

ANGULAR VALUES OF THE TRUE DIAGRAM OF THE TIMING SYSTEM (Applying a checking play of 0.45 mm)

1370

Intake	Opening (before TDC)	"a"	-8° 17° (*)
	Closing (after BDC)	"b"	40° 15° (*)
	Angular intake value	"c"	212°
Exhaust	Opening (before BDC)	"d"	26°
	Closing (after TDC)	"e"	1°
	Angular exhaust value	"f"	207°

(*): Values obtained with operating phase transformer

1598

Intake	Opening (before TDC)	"a"	-8° 17° (*)
	Closing (after BDC)	"b"	40° 15° (*) 46° (**) 21° (**)
	Angular intake value	"c"	212°
Exhaust	Opening (before BDC)	"d"	26°
	Closing (after TDC)	"e"	1°
	Angular exhaust value	"f"	207°

(*):Values obtained with operating phase transformer
(**):For 98's models with M1.5.5. injection

1747

Intake	Opening (before TDC)	"a"	-3° 22° (*)
	Closing (after BDC)	"b"	51° 26° (*)
	Angular intake value	"c"	228°
Exhaust	Opening (before BDC)	"d"	47°
	Closing (after TDC)	"e"	4°
	Angular exhaust value	"f"	231°

(*):Values obtained with operating phase transformer

TECHNICAL FEATURES OF THE ENGINE

SPECIFIC DATA

Engine		AR 32302
Cycle		Diesel
Feed		Direct injection BOSCH COMMON RAIL EDC-15C
Cylinder displacement	cm^3	1910
Cylinder number		4 in line
Boring	mm	82
Stroke	mm	90.4
Max Power	CV CEE (kW CEE) revs/min	105 (77) 4000
Max torque	kgm CEE (Nm CEE) revs/min	26 (255) 2000
Compression Ratio		18.45 : 1
Injection order		1 - 3 - 4 - 2
Regime minimo	revs/min	800 ± 30

COMPLETE CYLINDER BLOCK

Cylinder block

Diameter of the main journal seats		63.691 ÷ 63.732 mm
Diameter of the cylinder barrels	Class A	82.000 ÷ 82.010 mm
	Class B	82.010 ÷ 82.020 mm
	Class C	82.020 ÷ 82.030 mm
	Oversize by 0.1 mm	
Cylinder's head face's flatness		< 0.1 mm

Driving shaft

Diameter of main journals	Class A	59.994 ÷ 60.000 mm
	Class B	59.988 ÷ 59.994 mm
	Class C	59.982 ÷ 59.988 mm
	Undersize by 0.127mm	
Diameter of rods' pins	Class A	50.799 ÷ 50.805 mm
	Class B	50.793 ÷ 50.799 mm
	Class C	50.787 ÷ 50.793 mm
	Undersize by 0.127 mm	
End play		0.049 ÷ 0.211 mm

Main bearings

Thickness of the main bearings	Class A	1.836 ÷ 1.840 mm
	Class B	1.839 ÷ 1.843 mm
	Class C	1.842 ÷ 1.846 mm
	Undersize by 0.127 mm	

Oil Pump

Play between pump bay and driven gear		0.080 ÷ 0.186 mm
Play between pump cover face and gears		0.025 ÷ 0.070 mm
Spring of oil pressure relief valve	Height	35 mm
	Check load	11.73 ÷ 12.51 daN
Engine oil pressure	At slow running	0.6 ÷ 0.7 bar
	At 4000 revs/1'	2.5 ÷ 3.0 bar

CONNECTING ROD - PISTON GROUP

Connecting rods

Inner diameter of the connecting rods bushings (line-boring)	26.006 ÷ 26.012 mm
Diameter of the connecting rods heads	53.883 ÷ 53.923 mm
Weight difference between the connecting rods	± 2.5 g

Connecting rods' bearings

Thickness of the connecting rods' bearings	Class A	1.527 ÷ 1.531 mm
	Class B	1.530 ÷ 1.534 mm
	Class C	1.533 ÷ 1.537 mm

Pistons

External diameter of pistons	Class A	81.783 ÷ 81.797 mm
	Class B	81.793 ÷ 81.807 mm
	Class C	81.803 ÷ 81.817 mm
Internal diameter of the bushings in the pistons		25.999 ÷ 26.004 mm
Weight difference among pistons		± 5 g

Gas rings

Rings'port	First ring	0.25 ÷ 0.40 mm
	Second ring	0.25 ÷ 0.50 mm
	Oil scraper ring	0.25 ÷ 0.50 mm
End play between seats and gas rings	First ring	-
	Second ring	0.020 ÷ 0.060 mm
	Oil scraper ring	0.030 ÷ 0.065 mm

Piston pins

External diameter of piston pins	25.982 ÷ 25.988 mm

Cylinders' head

Head

Diameter of transmission tappets seats	37.000 ÷ 37.025 mm
Diameter of transmission shaft supports	26.045 ÷ 26.070 mm
Lower plan's flatness	0.1 mm
Minimum height allowed after flattening	141.00 ± 0.15 mm

Valves' guides

External diameter of valves' guides	Intake	14.010 ÷ 14.030 mm
	Exhaust	
	Oversize by 0.05 - 0.10 - 0.25 mm	
Internal diameter of valves'guides		8.022 ÷ 8.040 mm

Valves' seats

External diameter of valve seat	Intake	36.135 ÷ 36.150 mm
	Exhaust	35.142 ÷ 35.157 mm
Taper of valves'seats		90° ± 20'

Valves

Diameter of the valve stem	Intake	7.974 ÷ 7.992 mm
	Exhaust	
Angle of the valve head		90° ± 20'
Embedding of the valve head		0.1 ÷ 0.5 mm

Valve springs

Loose height	53.9 mm
Height with check load 36.7 ÷ 39.6 N	36 mm
Height with check load 56.0 ÷ 61.0 N	26.5 mm

Transmission tappets

External diameter		36.975 ÷ 36.995 mm
Play with closed valves	Intake	0.25 ÷ 0.35 mm
	Exhaust	0.30 ÷ 0.40 mm

Propeller shaft

Diameter of pins of the propeller shaft		26.000 ÷ 26.015 mm
Nominal cam's lift	Intake	8.5 mm
	Exhaust	8.5 mm
End play of the propeller shaft		0.100 ÷ 0.230 mm

Valves play

Play to check the timing		0.50 mm
Play with closed valves	Intake	0.25 ÷ 0.35 mm
	Exhaust	0.30 ÷ 0.40 mm

Cylinder's head gasket

Average max protrusion of the pistor	Thickness of the cylinder head gasket to be used
0.795 ÷ 0.881 mm	1.55 ÷ 1.65 mm (no notch)
0.881 ÷ 0.967 mm	1.65 ÷ 1.75 mm (one notch)
0.967 ÷ 1.055 mm	1.75 ÷ 1.85 mm (two notches)

ANGULAR VALUES OF THE TRANSMISSION DIAGRAM (Obtained with a test play of 0.50 mm)

Intake	Opening (before TDC)	0°
	Closing (after BDC)	32°
	Angular intake value	212°
Exhaust	Opening (before BDC)	32°
	Closing (after TDC)	0°
	Angular exhaust value	212°

WARNINGS

To keep the car in good operating conditions, the following recommendations should be adhered to carefully:

Every 500 kms (or when refuelling) check:
- the engine oil level;
- the level of the fluid in the coolant circuit;
- the level of the brake/clutch fluid;
- the presence of water in the fuel filter (turbodiesel versions only);
- the level of the fluid in the windscreen wiper/washer system.

Engine oil and filter

To be changed at the specified intervals.
At all events, they must be changed once a year.

Air cleaner

If the car is habitually used on dusty roads, the air cleaner should be changed more often than specified.

Fuel filter (TD versions only)

The different degree of purity of the fuel may make it necessary to change the filter at shorter intervals than those foreseen.
Irregular functioning of the engine or reduced performance levels may indicate the need to change the fuel filter.

Brake pads

Wear of the front brake pads is indicated by the turning on of a warning light on the instrument cluster. When changing the front pads, also check the rear ones.
However, depending on the use of the car, the rear pads might not need to be changed immediately, in which case, you are recommended to check them at a later stage.

Brake and clutch fluid

The brake fluid is hygroscopic, i.e. it absorbs moisture.

To avoid braking faults, the brake fluid must be changed every two years, regardless of the milage.

Battery

During hot weather, check the electrolyte level frequently.

Dust and/or pollen filter (if fitted)

Once a year, preferably at the beginning of warm weather, check the conditions of the pollen filter. If the vehicle is used mainly in town, on motorways or dusty roads it is advisable to check the filter more frequently. Failure to change the filter can considerably reduce the performance of the air conditioner system.

Anti-freeze

It is advisable to top up with Alfa Romeo Climafluid Super Permanent -40°C Alfa Romeo to conserve the protective properties of the mixture.

Checking exhaust smoke

For the turbodiesel versions, this check must be carried out every 10,000 km.

Notes

Under special driving conditions (e.g. on roads sprinkled with antifreeze salt and/or corrosive substances, rough road surfaces, etc.) often check the boots of the axle shafts and steering box, and clean and lubricate joints, hinges, door catches, bonnet catch, etc.)
When forced to use fuel, lubricants and/or fluids in general with characteristics other than those specified by the manufacturer (in emergencies), replace the fluids and corresponding filters at the earliest opportunity.

WARNING:

THE FOLLOWING MAINTENANCE TABLE IS VALID FROM JULY 1996.

Operations to have carried out at the km shown	km x 1.000								
	20	40	60	80	100	120	140	160	180
Check tyre conditions and wear	●	●	●	●	●	●	●	●	●
Check operation of front disk brake pad wear indicator	●	●	●	●	●	●	●	●	●
Check conditions of rear disk brake pad wear		●		●		●		●	
Check conditions and wear of rear drum brake linings			●			●			●
Check intactness of boots for axle shafts, power steering, joint caps and check tightness of brake and fuel pipes	●	●	●	●	●	●	●	●	●
Check the tension and if necessary adjust accessories drive belt (except engines with automatic tensioners)		●		●		●		●	
Visually check conditions of trapezoidal and/or Poly-V accessory drive belts		●		●		●		●	
Check handbrake lever stroke		●		●		●		●	
Check/adjust valve clearance (Specific for turbodiesel engine)	●	●		●		●		●	
Check exhaust emissions (petrol engines)		●		●		●		●	
Check smoke opacity (Turbodiesel engines)		●		●		●		●	
Check operation of evaporative system				●				●	
Change the fuel filter (petrol engines)				●				●	
Change the fuel filter (Turbodiesel engines)		●		●		●		●	
Change the air cleaner cartridge (petrol engines)		●		●		●		●	
Change the air cleaner cartridge (Turbodiesel engines)	●	●	●	●	●	●	●	●	●
Check and if necessary top up fluid levels (brake, hydraulic clutch, power steering, windscreen wiper, battery, engine coolant, etc.)	●	●	●	●	●	●	●	●	●
Change the timing gear drive belt (at 80,000 km for Boxer engines)						●			
Change the spark plugs (T. Spark 16V and Boxer 16V engines)					●				
Change the spark plugs (Boxer 8V engines)		●		●		●		●	
Check operation of engine control system (through diagnosis socket)		●		●		●		●	
Check the gearbox and differential oil level				●				●	
Change the engine oil (*) (every 10,000 km for turbodiesel engines)	●	●	●	●	●	●	●	●	●
Changing the engine oil filter (every 10,000 km for turbodiesel engines)	●	●	●	●	●	●	●	●	●
Change the brake fluid (or every 24 months)			●			●			●
Change the pollen filter (or every 12 months)	●	●	●	●	●	●	●	●	●
Check conditions of timing gear belt (chloroprene rubber belts only)				●					

(*): In any case every 18 months in the event of lower mileage.

WARNING

Perfect performance and the life of every car are strictly linked to the use made of it and above all to the care with which normal maintenance operations are carried out, for which, as a result of product evolution, new programming criteria have been adopted.
The interval between scheduled maintenance coupons is 20.000 km; 10.000 km for Turbodiesel versions.
It is however wise to remember that the car needs routine care such as for instance systematically checking and if necessary topping up the level of fluids, checking the tyre pressure, etc.
You are reminded that correct vehicle maintenance is certainly the best way to keep the car's performance levels and safety features unchanged over the years while respecting the environment and at low running costs.

Engine oil

If the car is used in one of the following particularly exacting conditions:
- trailer towing
- dusty roads
- short (less than 7-8 km) repeated journeys with an outside temperature below zero
- enging frequently run at idle speed or long distance driving at low speed (or in the case of prolonged inactivity); it is advisable to change the engine oil more frequently than specified.

Battery

It is advisable to have the battery charge checked preferably at the onset of winter to avoid the possibility of freezing of the electrolyte.
This check should be carried out if the car is prevailingly used for short journeys, or if it is fitted with services that absorb current permanenlt when the ignition key is engaged, especially if fitted in the after market.

Fuel oil filter (only Turbodiesel versions)

The differing degree of purity of fuel oil in commerce may make it necessary to change the fuel oil filter more frequently than specified.

Dust and/or pollen filter (if fitted)

If the vehicle is used frequently in dusty or heavily polluted environments it is advisable to change the filtering element more frequently.
The failure to change the filter may considerably reduce the effectiveness of the climate control system.

Antifreeze

Topping up is recommended with Climafluid Super Permanent -40°C Alfa Romeo in order to preserve the protective characteristics of the mixture.

WARNING:
THE FOLLOWING SERVICE PLAN IS VALID FROM APRIL 1997
FOR T. SPARK 16V AND 1929 TD VERSIONS.

Operations to be performed at the km shown	km x 1.000								
	20	40	60	80	100	120	140	160	180
Check tyre wear and conditions	●	●	●	●	●	●	●	●	●
Check front disc brake pad wear sensor operation	●	●	●	●	●	●	●	●	●
Check rear disc brake pad coditions		●		●		●		●	
Check rear drum brake seal conditions are wear			●			●			●
Check intactness of drive shaft protective bellows, power steering and steering joint caps ande check tightness of brake and fuel feed system pipes	●	●	●	●	●	●	●	●	●
Check and, if required, adjust accessory belt tension (excluding engines with automatic take-up devices)		●		●		●		●	
Check counter-rotating shaft belt conditions (where relevant)		●		●				●	
Inspect accessory belt conditions		●		●		●		●	
Check handbrake stroke		●		●		●		●	
Check/adjust tappet clearance (specific for turbodiesel engine)		●		●		●		●	
Check exhaust emissions (petrol engines)		●		●		●		●	
Check smokiness (tubodiesel engine)		●		●		●		●	
Check evaporation system operation				●				●	
Replace fuel filter (petrol engines)				●				●	
Replace fuel filter (turbodiesel engine)		●		●		●		●	
Replace air cleaner cartridge (petrol engines)		●		●		●		●	
Replace air cleaner cartridge (turbodiesel engine)	●	●	●	●	●	●	●	●	●
Check and, if required, top up fluid levels (brakes, hydraulic clutch, power steering, windscreen washer, battery, engine coolant, etc.)	●	●	●	●	●	●	●	●	●
Check timing belt conditions				●					
Replace timing belt						●			
Replace counter-rotating shaft belt (where relevant)						●			
Replace spark plugs					●				
Check engine control system operation (by means of diagnostic socket)		●		●		●		●	
Check gearbox and differential oil level				●				●	
Change engine oil (*) (every 10.000 km for turbodiesel version)	●	●	●	●	●	●	●	●	●
Change engine oil filter (every 10.000 km for turbodiesel version)	●	●	●	●	●	●	●	●	●
Change brake fluid (or every 24 months)			●			●			●
Replace pollen filter (or every 12 months)	●	●	●	●	●	●	●	●	●

(*): Or every 18 months in the event of lower mileage.

WARNINGS

Attain to the following instructions integrating the Service Schedule to ensure correct vehicle operation:

Every 500 km (or when refuelling) check:
- engine oil level;
- coolant level;
- brake/clutch fluid level;
- powered steering fluid level;
- battery electrolyte level;
- tyre pressure;
- windscreen washer, rear window washer and headlight washer (where relevant) liquid level;
- the presence of water in the fuel filter (TD versions only); if required, bleed the filter.

Engine oil

If the vehicle is manly used in any of the following especially demanding circumstances:
- towing a trailer
- dusty roads
- short repeated trips (less than 7-8 km) with outside temperature below zero
- frequent engine idling or driving long distances at low speed (or long vehicle storage)

we recommend you change the oil more frequently than shown in the Service Schedule.

Air cleaner

If the vehicle is used mainly on dusty roads, the air cleaner will need to be replaced more frequently than prescribed.

Brake pads

Worn brake pads are signalled by means of a warning light on the instrument panel.
In vehicles equipped with a front brake pad wear sensors only, check the rear brake pads when the front pads are replaced. According to the vehicle use, however, the rear brake pads may not require immediate replacement. In this case, we recommend checking the rear brake pads later in time.

Brake/clutch fluid

The brake fluid is hydroscopic, i.e. it absorbs moisture. To avoid braking problems, change the brake fluid every 24 months, regardless of the mileage.

Battery

Check battery charge at the beginning of winter to avoid electrolyte freezing. Check the level more frequently if the vehicle is mainly used for short trips or if it is equipped with units which run off the battery when the ignition key is removed, especially if these unit were installed after-market.

Climate control system (where relevant)

Climate control system efficiency

To keep the system ship-shape, just turn it on once a fortnight, even in winter, for a few minutes.
For vehicles equipped with ECON function automatic climate control systems, turn the system off occasionally, as this system works without starting the compressor. In this way, operation will be ensured in summer or in hot weather with normal vehicle use. In intermediate seasons, check the ECON function is not on and press the TEMP button until the message LO appears on the display indicating the temperature required in the passenger compartment.
In the summer and before correct climate control system, check system efficiency.

Have the climate control system serviced and the coolant gas circuit recharged at an Alfa Romeo Dealership exclusively. The use of different types of gasses, in fact, can damage the system components beyond repair and is an environmental hazard.

Pollen and/or dust filters (where fitted)

If the vehicle is used mainly in built-up areas or on dusty roads, the filter may need to be replaced more often than shown in the Service Schedule.

The climate control system efficiency can be compromised if the filter is not replaced adequately.

Diesel fuel filter (turbo diesel versions only)

The various degrees of purity of diesel fuel on the market may led to replacing the diesel oil filter more frequently than shown in the Service Schedule.

Anti-freeze

We recommend you top up with Climafluid Super Permanent -40°C Alfa Romeo to preserve the protective features of the mixture.

Notes

In certain conditions of use (e.g. roads sprinkled with ice melting salt and/or corrosive substances, badly surfaced roads, etc.), check the drive shaft and steering unit bellows often. Also check lubrication of joints, hinges, door and lid locks, etc.
If, in the event of an emergency, lubricant and/or fluids not responding to the manufacturer's specifications are used, we recommend changing the fluid and filters in the specific circuit as soon as possible.

ATTENTION:
THE FOLLOWING MAINTENANCE GRID IS TO BE APPLIED STARTING FROM 98 MODELS FOR THE FOLLOWING VERSIONS : T. SPARK 16V AND 1910 JTD

Operations to be performed at the kms shown	Km X 1.000								
	20	40	60	80	100	120	140	160	180
Check tyres' conditions and wear	●	●	●	●	●	●	●	●	●
Check functioning of wear sensor for front brake pads	●	●	●	●	●	●	●	●	●
Check conditions of rear brake pads		●		●		●		●	
Check conditions and wear of rear drum brake shoes			●			●			●
Check integrity of half shafts'bellows,power steering, joint's caps and pipes' seal of braking and fuel system	●	●	●	●	●	●	●	●	●
Visual check of belts' conditions and accessories' controls			●						●
Check of the handbrake lever stroke		●		●		●		●	
Check/Adjustment of valvesì play (Specific for turbodiesel engines)		●		●		●		●	
Check of exhaust emissions (petrol engines)		●		●		●		●	
Check of smoke grade (turbodiesel engines)		●		●		●		●	
Check functioning of the antievaporative system				●				●	
Replacement of fuel filter (turbodiesel engines)		●		●		●		●	
Replacement of the air filter cartridge(petrol engines)		●		●		●		●	
Replacement of the air filter cartridge(turbodiesel engines)	●	●	●	●	●	●	●	●	●
Check and refill the fluids' level (brakes, hydraulic cluth, power stering, wipers, battery, engine cooling, etc.)	●	●	●	●	●	●	●	●	●
Replacement of the driving belt						●			
Replacement of the control belt of the counterrotating shafts (if foreseen)						●			
Replacement of spark plugs					●				
Check of functiong of engine control systems		●		●		●		●	
Check gearbox/differential oil level				●				●	
Replacement of engine oil (*) (every 10,000 km for turbodiesel engines)	●	●	●	●	●	●	●	●	●
Replacement of engine oil filter (every 10,000 km for turbodiesel engines)	●	●	●	●	●	●	●	●	●
Replacement of brakes' fluid (or every 24 months)			●			●			●
Replacement of anti-pollen filter (or every 12 months)	●	●	●	●	●	●	●	●	●

(*): However every 18 months in case of lower km covered.

WARNING

To achieve the best performance of the car it is necessary to comply with the maintenance agenda shown in the Scheduled Maintenance Plan and, besides, to stick to the following recommendations:

Every 1,000 km or before long travels it is advisable to check and eventually to refill:
- the engine oil level;
- the cooling fluid level;
- the brakes/clutch fluid level;
- the power steering fluid level;
- the battery fluid level;
- the tyres' pressure;
- the fluid level of the wipers, rear window,etc.;
- the possible presence of water in the fuel filter (only for TD versions); if necessary, the filter should be drained.

Engine oil

In case the car is mainly used under just one of the following severe conditions:
- trailer towing
- dusty roads
- short (less than 7-8 km) but repeated tracts at an outside temperature below 0°
- frequently running slow engine or long-distance driving at low speed (or in case of long lasting inactivity)

it is advisable to replace the engine oil more frequently than shown in the Scheduled Maintenance Plan.

Air filter

If usually driving onto dusty roads, the replace)f the air filter should be performed more frequ :n shown.

Brake pads

Brake pads are subjected to a different grade of utilisation and wear according to using conditions and driving approach.
In case the pilot lamp of the front brake pads is on, check immediately the thickness of the pads.
As the car is equipped with a wear sensor scanning only the front lefthand brake pad, it is important to check also the front righthand brake pad and the rear brake pads as well.
Maybe the latter do not require immediate replacement; so it is advisable to check them again after a short range of time.

Brakes/Clutch fluid

The brakes ' fluid is hygroscopic, i.e. it does absorb humidity.
In order to avoid braking failures it is important to replace it every 24 months apart from the km covered.

Battery

It is advisable to check the charging status of the battery especially at the beginning of the cold season so to avoid the freezing of the electrolyte.
This check is to be performed more frequently if the car is mainly used for short-range driving or if equipped with continous absorption users with the key out, especially if applied in after market.

Air-Conditioner (if foreseen)
Efficiency of the air-conditioning system

In order to keep the air-conditioning system at its best, it is sufficient to let it work every 15 days, even during winter time, by starting the compressor for a few minutes.
Before summertime, it is advisable to have the system checked for its efficiency.

For the maintenance of the air-conditioning system and for the possible refilling of the cooling gas circuit, please refer exclusively to the Authorized Alfa Romeo Assistance Centers, as the use of a different gas could cause unrepairable damage to the system's parts and hurts the environment.

Anti-dust/Anti-pollen filter
(onlly for cars equipped with air-conditioning system)

Check the filter's conditions at least once a year, better at the beginning of the summer, at your Authorized Alfa Romeo Assistance Center.
In case of frequent use of the car in dusty / polluted environment, it is advisable to check the systemmore frequntly than prescribed by the Scheduled Maintenance Plan; more precisely, the filtering part must be replaced if there is a decreased air quantity flowing into the passenger compartment.
In case of non-replacement, the efficiency of the air-conditioning system could be remarkably diminished.

Diesel fuel filter (only for turbodiesel versions)

The variety of the purity of the marketed Diesel fuel could require the replacement of the Diesel fuel filter at more frequent intervals than prescribed by the Scheduled Maintenance Plan.

Antifreeze

It is advisable to perform the refilling with Climafluid Super Permanent -40°C Alfa Romeo so to preserve the protecting features of the mixture.

Rubber hoses

The flexible rubber hoses of the braking system, the power steering, the fuel system, the feeding system, etc. must be carefully checked.

Wheels

Check the tyres' pressure (including the spare wheel's) periodically and before long travels.
The pressure check shoul be performed before starting the car.
Check periodically that the tread's depth complies with the minimum value envisaged by the law.

WARNING: Some tyres are equipped with wear indicators; thier replacement must be performed as soon as the indicators are perceivable on the tread.

Check periodically that the tyres do not have or show cuts, blowings or uneven wear of the tread.
In case of accidental puncture, stop the car imediately and replace the tyre so to avoid damage to the tyre itself, its rim, the suspensions and the steering.
The wheels (rims and tyres) supplied by the manufacturer are the most appropriate for the car's features and do guarantee the highest safety and comfort standard under normal driving conditions.
Before replacing the rims or the tyres, refer to the table showing the types allowed.
In any case, stick to the rim-tyre matching of the original supply.
In case of replacement, use only new tyres and avoid uncontrolled ones.

Remarks

Under particular using conditions (e.g. on roads with anti-ice salt on, in case of ravelled roads,etc.) check the bellows of the half shafts and the steering box frequently; besides, perform the cleaning and the lubrication of joints, hinges, locking hooks,etc.
In case of use of lubricants and/or fluids without the required properties specified by the manufacturer, it is advisable to replace the filter and the fluids concerned as soon as possible.

BOXER ENGINES' MAINTENANCE

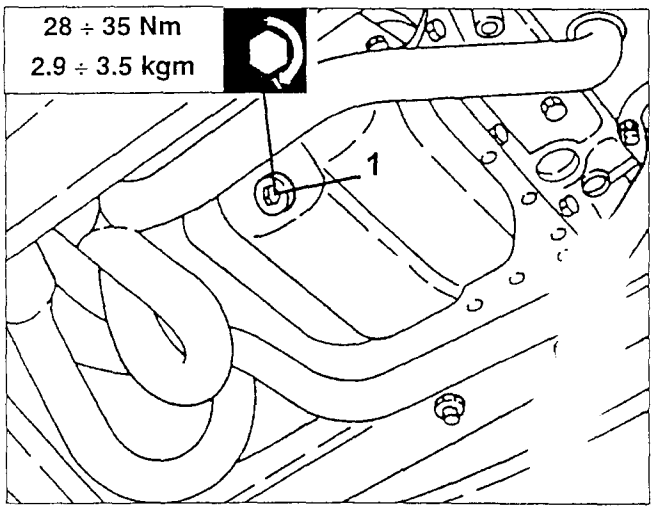
REPLACEMENT OF ENGINE OIL AND FILTER

ATTENTION:
Engine oil can hurt the skin : avoid direct contact as much as possible. Shoul contact occur, wash thoroughfully with soap and water.

- With warm engine, remove the refilling cap.
- Pull out the control indicator of oil level.
- Lift the car.

1. Unscrew the discharge cap and let the oil drain out completely into a proper container.

ATTENTION:
During the cap removal, be cautious: the oil could be hot.



ATTENTION:
Do not waste the oil into the environment: it cause pollution.

- Operating from underneath the car with the proper wrench, unblock the oil filter and remove it.
- Clean the discharge cap and screw it with its own gasket according to the prescribed torque.
- Damp with oil the gasket of the new filter and screw it by hand.
- Lower the car.
- Supply the engine with the oil as prescribed.
- Check with the oil indicator thecorrect oil level.

ATTENTION:
The check of the oil level is to be performed with the car in flat position. An oil level surpassing the MAX notch can cause excessive evaporation of the oil itself and hence a pressure loss.

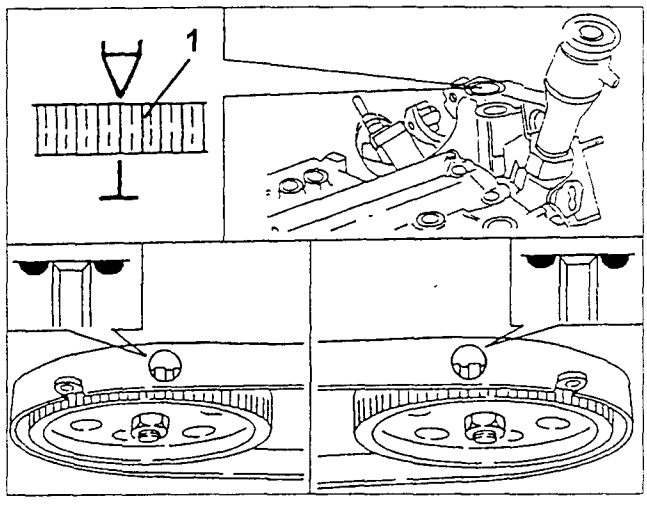
- Mount the refilling cap again and let the engine run for about 2 minutes; stop the engine and wait for a few minutes.
- Check the oil level and be sure there are no leakages.

ATTENTION: During refilling operations be careful to avoid accidental oil leaking in the alternator's louvers; this may cause severe damage and fire danger.

REPLACEMENT OF THE TRANSMISSION CONTROL BELTS
Specific for Boxer 8V engine

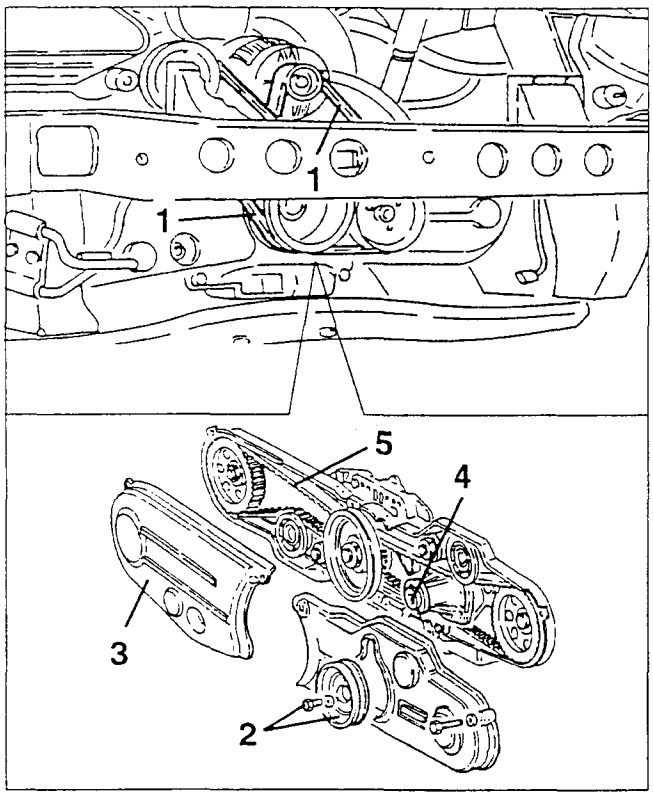
- Disconnect the battery terminal (-).
- Remove the electrofan for the engine cooling (see GROUP 10).
- Remove the sleeve for filter 's air intake.
- Disconnect the wires from the spark plugs and remove the plugs.

1. Check the engine timing.

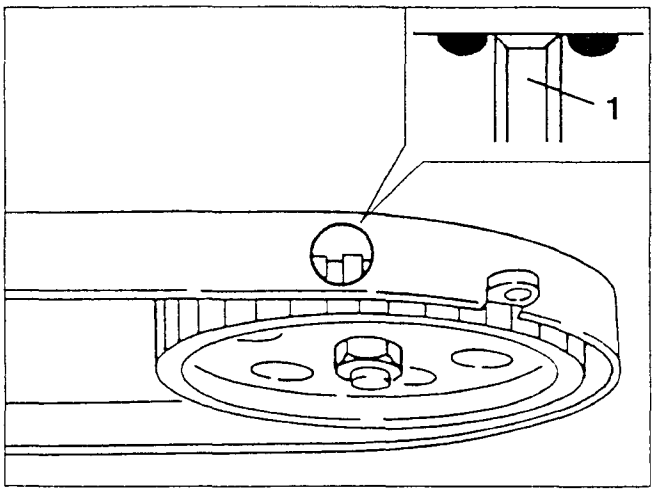


1. Loosen the clamping screws and bolts concerned, hence remove the control belt of the hydrodrive pump and the control belt of the alternator-water pump group.
2. Unscrew the clamping screws and remove the pulley of the water pump.
3. Unscrew the clamping screws and remove the covers of the transmission belts.
4. Loosen the clamping nut of the righthand belt-tightener, hence press onto the guide pulley so to win against the spring's load and block the clamping nut.

5. Remove the right timing belt firstly from the camshaft pulley and then from the crankshaft pulley. - Repeat the above procedure to remove the left-hand belt.



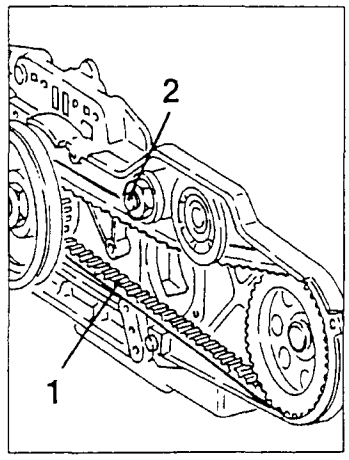
1. Turn the camshaft so that the tooth and the two adjacent milling marks on the timing pulley can be seen through the special hole on the rear cover.



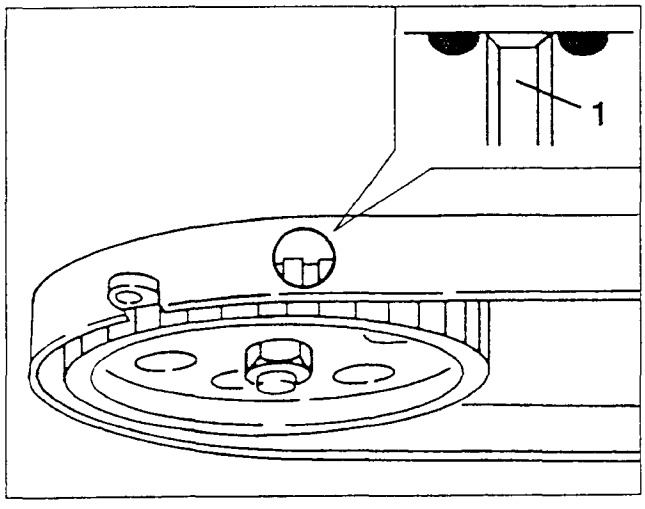
- Turn the crankshaft until the notch "T" on the flywheel is aligned with the fixed reference.
1. Fit the left-hand timing belt.

WARNING:
The belt should be keyed with the belt drive section opposed to the tensioned tensioners.

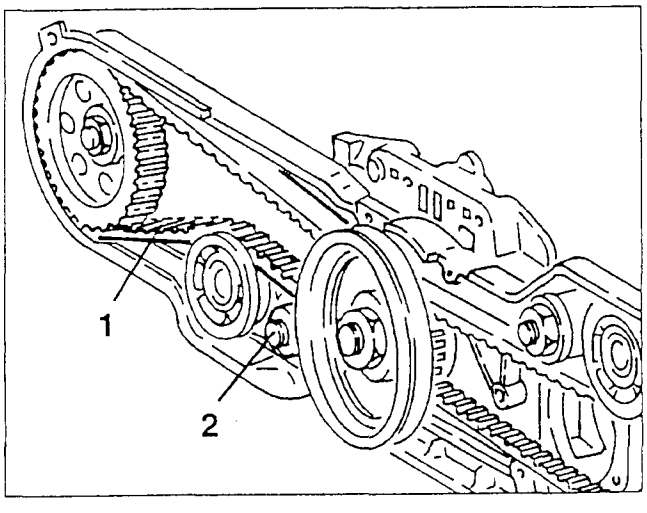
2. Slacken the nut fastening the belt tensioner so that it can exert the pressure impressed by the spring on the belt, then tighten the nut.



1. Turn the right camshaft until the tooth and the two adjacent marks milled on the timing pulley can be seen through the special hole on the rear cover.
- Turn the crankshaft to take the piston in cylinder no.

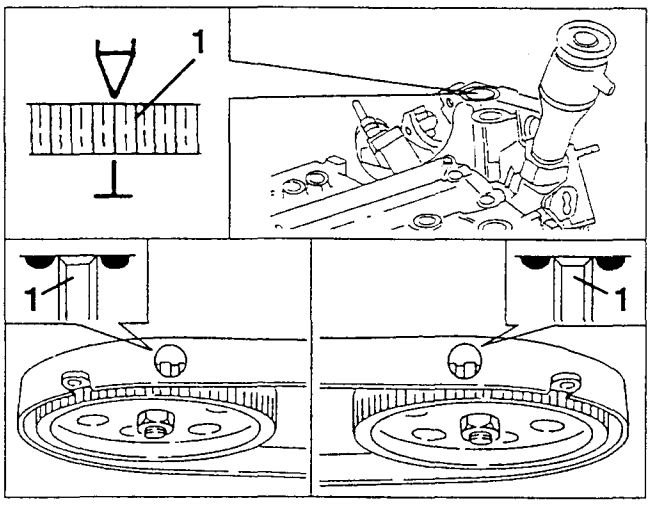


1 to the T.D.C. in the bursting stroke.
1. Fit the right-hand timing belt.
2. Slacken the nut fastening the belt tensioner so that it can exert the pressure impressed by the spring on the belt, then tighten the nut.

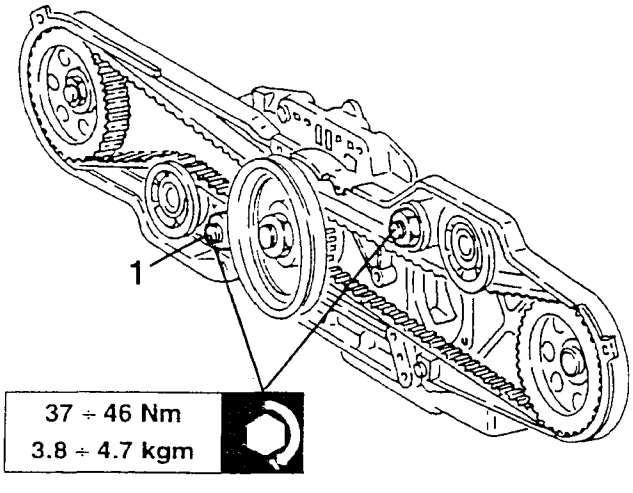


WARNING:
The pulley tends to turn away from the correct position as the camshaft interacts with the inlet valve of cylinder no. 3.
For this reason, use the special ratchet wrench N° 1.822.008.000 (A.5.0195) to keep the pulley in the correct position for fitting the belt.

- Turn the crankshaft a few times in its direction of rotation to allow the belts to take their final position.
1. Check the engine timing.



- Turn the crankshaft by 90° in its direction of rotation, until the notch "●" on the flywheel is aligned with the fixed reference.
1. Slacken the right-hand belt tensioner nut, then tighten it to the specified torque.



- Turn the crankshaft by 360° in its direction of rotation until the notch "•" on the flywheel is aligned with the fixed reference.
- Proceed as described for tightening the left-hand belt tensioner.

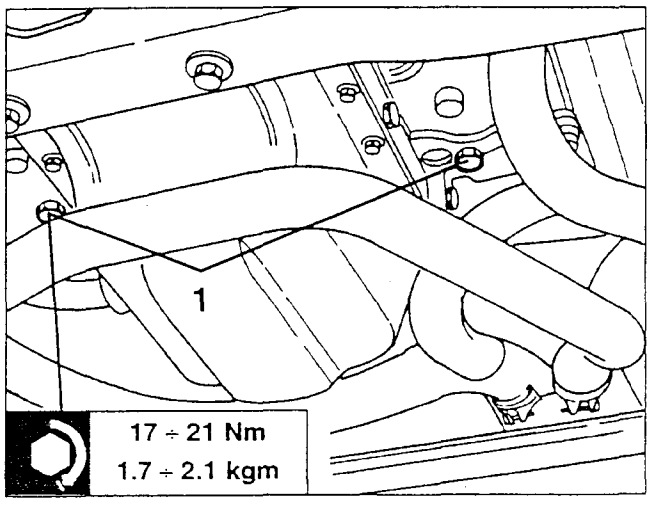
WARNING:
During this operation do not exert pressure on the belt tensioner to avoid changing the load foreseen for it.

- Upon completion of the operations described, check that the timing reference marks coincide.
- Complete refitting operations reversing the sequence described for removal.

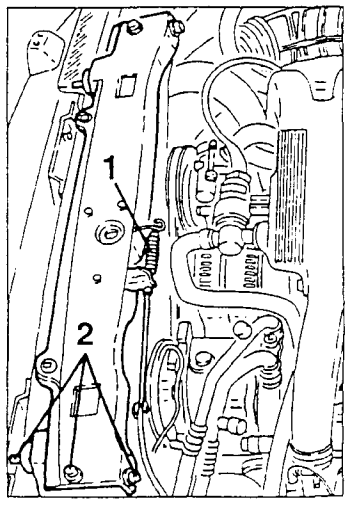
CHANGING THE TIMING GEAR DRIVE BELTS
Specific for 16V

- Disconnect the battery (-) terminal.
- Drain the fluid from the air conditioning system (see GROUP 50).
1. Unscrew the two plugs under the crankcase and drain the coolant fluid into a suitable recipient.

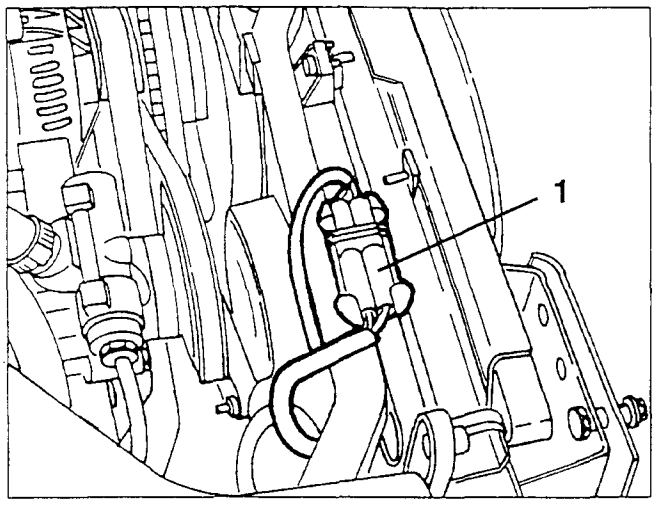
The anti-freeze mixture used as coolant fluid can damage the paintwork: therefore avoid touching painted components.



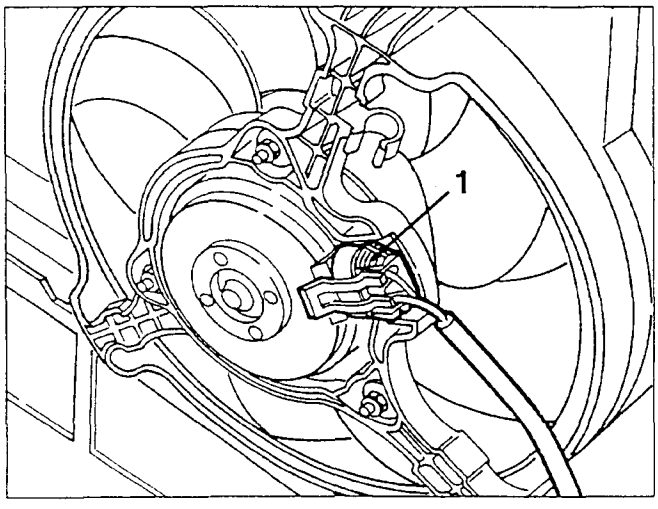
- Remove the radiator grille and the front bumper (see GROUP 70).
1. Disconnect the bonnet opening cable from the lock.
2. Slacken the fastening screws and remove the radiator upper crossmember.



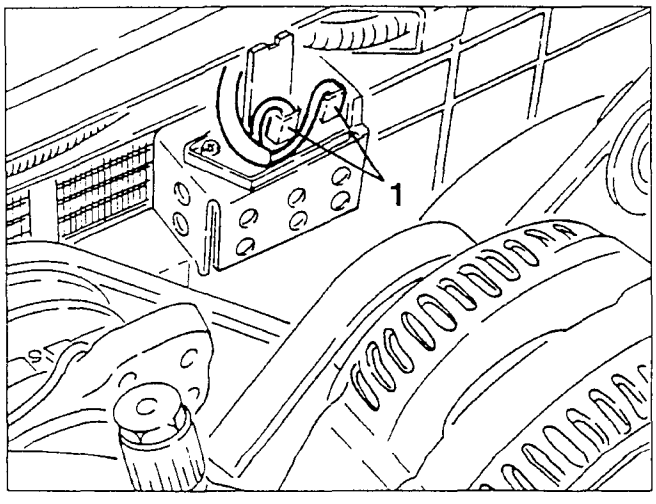
1. Remove the electrical connection withdrawing it from the support above the cooling radiator.



1. Disconnect the electrical connections supplying the cooling fans.

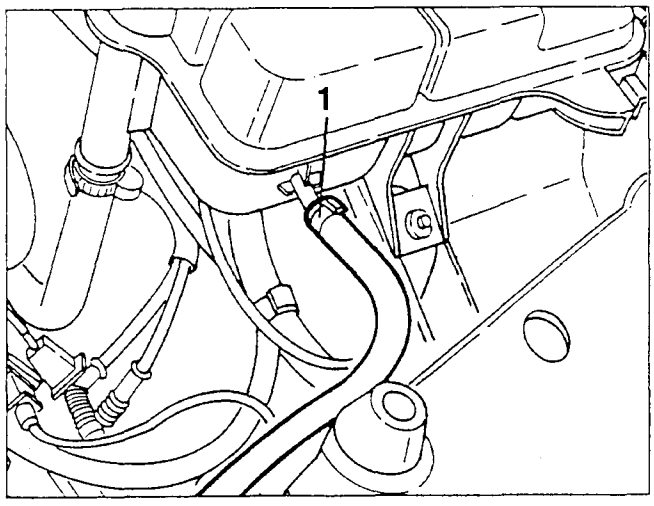


1. Disconnect the electrical connections from the cooling fan speed coil.

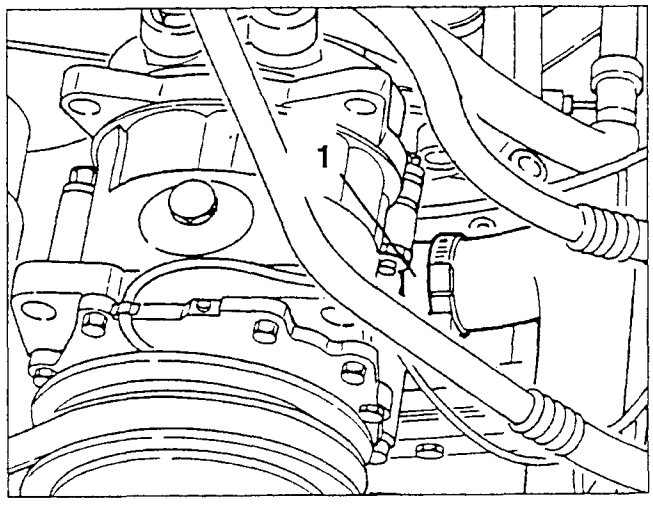


- Free the electrical cables from the radiator.

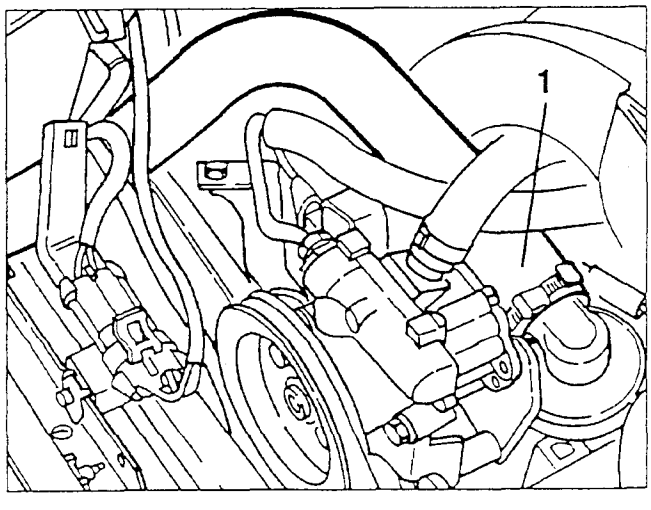
1. Disconnect the radiator connection pipe from the header tank.



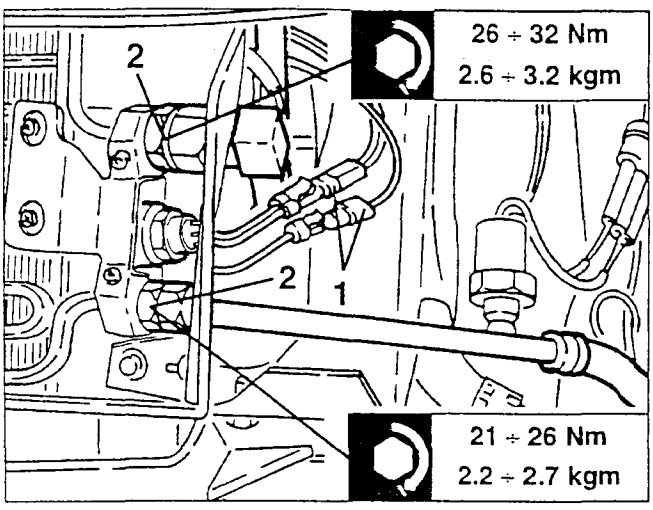
1. Disconnect the radiator coolant outlet sleeve from the connection on the crankcase.



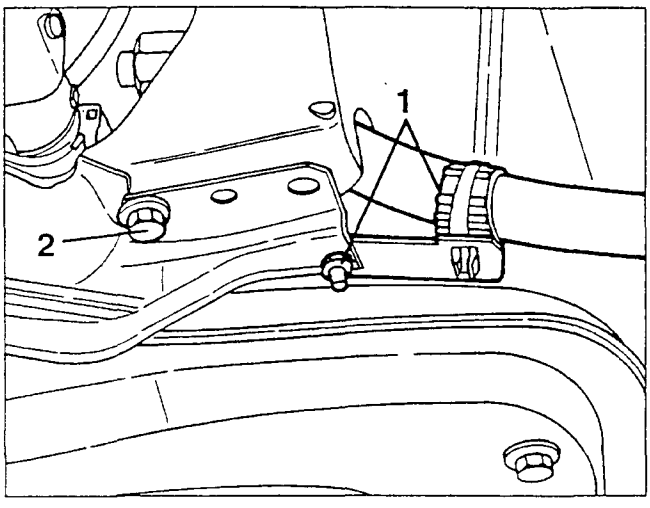
1. Disconnect the radiator coolant delivery pipe from the thermostatic cup.



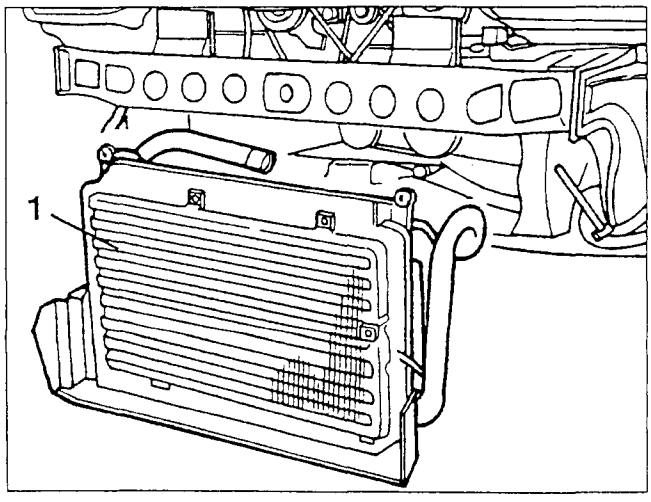
1. Disconnect the two electrical connections of the fan control thermal contact.
2. Disconnect the fluid inlet and outlet hoses from the conditioner condenser.



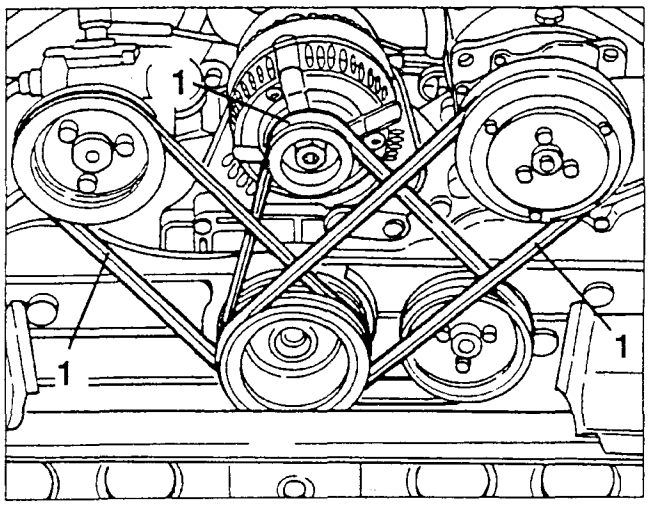
1. Free the R134A hose from the lower crossmember.
2. Slacken the screws fastening the lower crossmember.



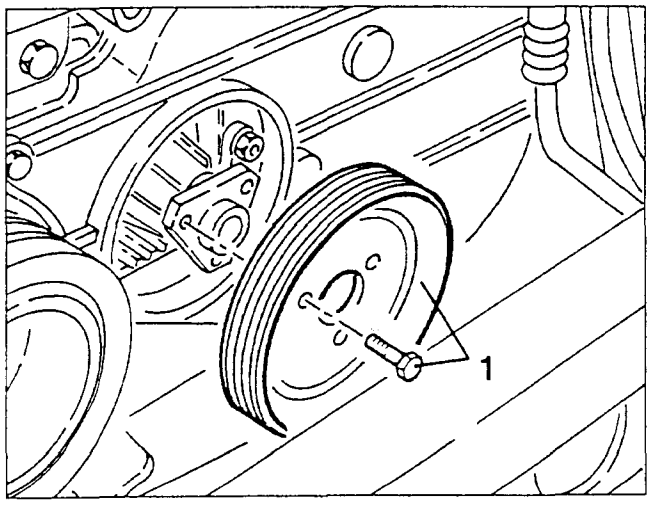
1. Remove the crossmember complete with radiator, condenser and electric fans.



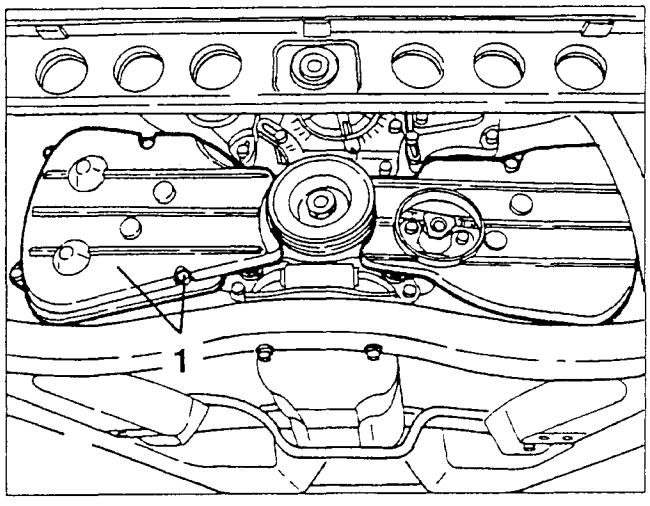
1. Slacken the fastening screws and bolts concerned, then remove the conditioner compressor drive belt, the power steering pump drive belt and the alternator - water pump drive belt.



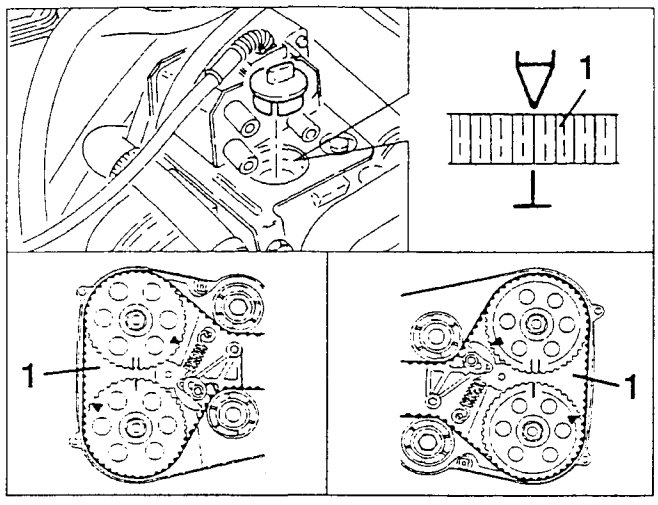
1. Slacken the three fastening screws and remove the water pump pulley.



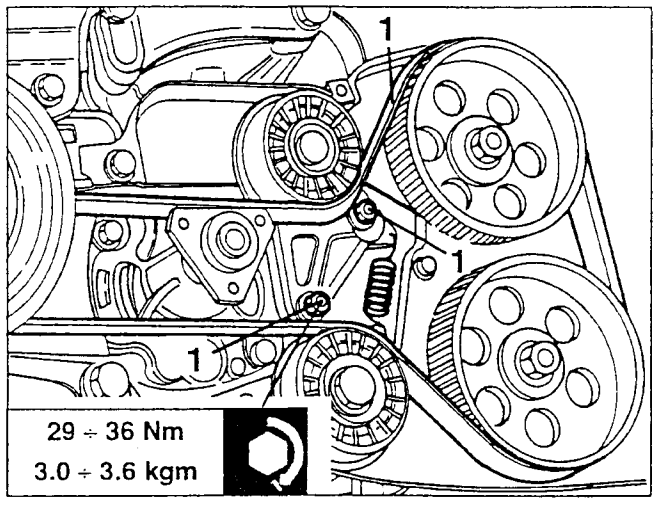
1. Slacken the fastening screws and remove the timing belt covers.



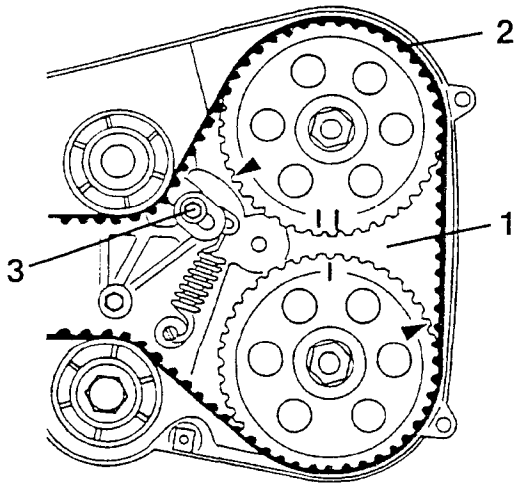
- Remove the spark plugs.
1. Check the valve gear timing.



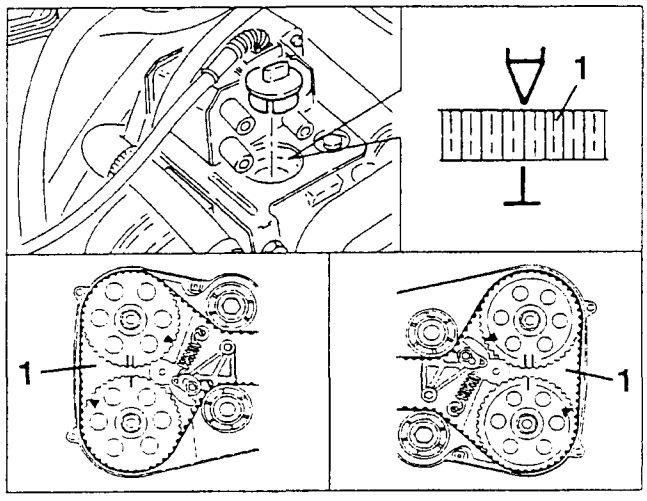
1. Slacken the nuts fastening the belt tensioner and remove the timing belts.



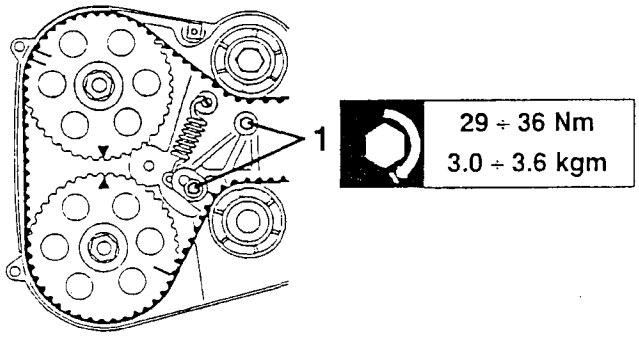
1. Turn the left head camshafts until the notches coincide.
- Turn the crankshaft until the notch "T" on the flywheel is aligned with the fixed reference.
2. Fit the left-hand timing belt.
3. Slacken the belt tensioner fastening nut so that it exerts the the load impressed by the spring on the belt.



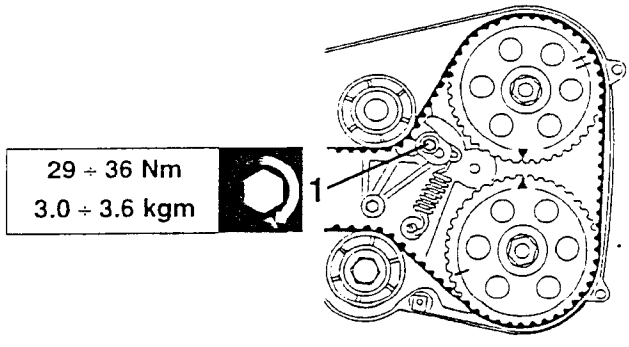
- Repeat the previous operations for assembling and timing the right-hand belt.
- Turn the crankshaft a few times in its direction of rotation, to all the belt to take its final position.
1. Check the valve gear timing.



- Turn the crankshaft by 90° until the notch "●" on the flywheel is aligned with the fixed reference and the notches "▲" on the right head timimg pulley are aligned.
1. Slacken the nuts fastening the right belt tensioner to settle it, then tighten them to the specified torque.

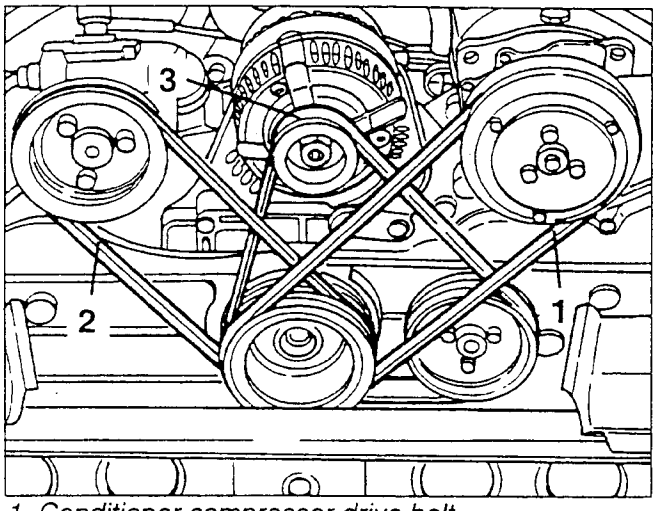


- Turn the crankshaft by 360° until the notch "●" on the flywheel is alighed with the fixed reference and the notches "▲" on the left head timing pulleys are aligned.
1. Slacken the nuts fastening the left belt tensioner to settle it, then tighten them to the specified torque.



- Turn the crankshaft a few times then check again that the timing references coincide.

AUXILIARY COMPONENT BELTS



1. Conditioner compressor drive belt
2. Power steering drive belt
3. Alternator - water pump drive belt

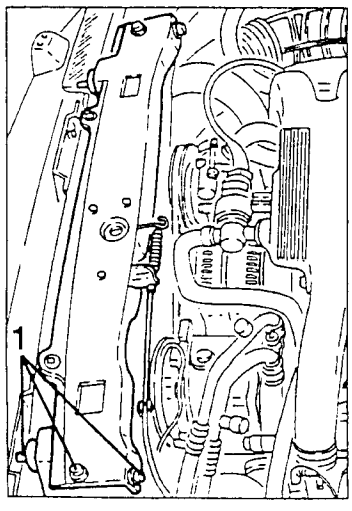
NOTE: When checking the belt tension, check that the belts are intact, and that they are free of:
- cuts
- cracks
- material surface wear (smooth and shiny)
- dry or stiff parts (lack of adherence).
In the event of one of the above defects, change the belt.

The contact of the belts with oil or solvents can damage the elasticity of the actual belt rubber and reduce its adherence.

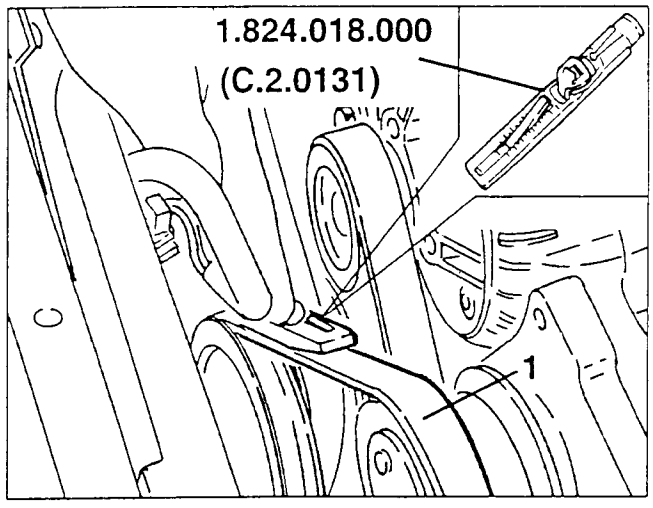
Conditioner compressor drive belt

Checking and tensioning

- Remove the radiator grille (see GROUP 70).
1. Slacken the screws fastening the upper radiator crossmember, then move it to one side without disconnecting the lock control cable.



1. Working as illustrated, measure the belt tension using tool N° 1.824.018.000 (C.2.0131).

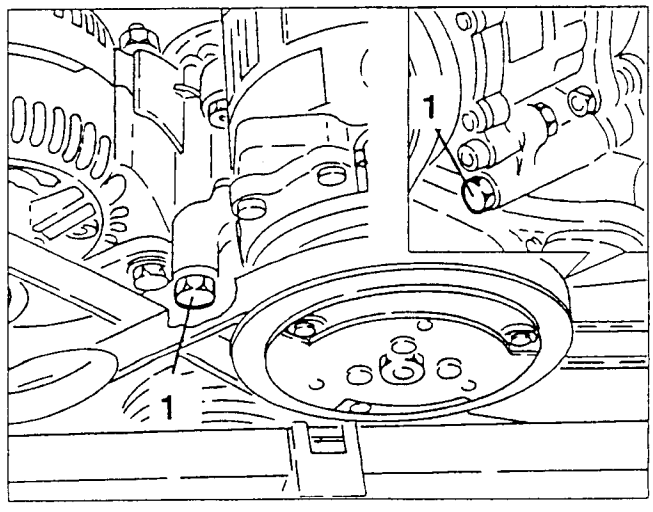


- Check that the tensioning values measured with the tool are within the specified limits.

Tensioning of trapezoidal drive belt "AV13" for conditioner compressor	
At assembly	500 ÷ 650 N
Retensioning	350 ÷ 450 N

NOTE: The belt may be retensioned after a brief running- in period, proceeding as follows:
- bring the engine to the normal operating temperature
- turn the engine off and allow it to cool down
- retension the belt to the specified limit.

- If the belt tensioning is incorrect, proceed as follows:
1. Slacken the two bolts fastening the conditioner compressor.

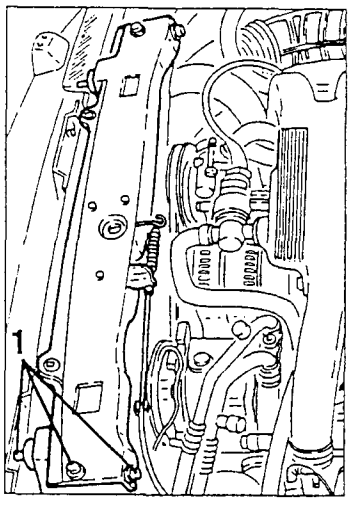


- Move the compressor to one side and tighten the fastening bolt from the slotted side and check the belt tension.
- If the tension is correct also tighten the remaining fastening bolt.
- Adapt the procedure suitably when changing the conditioner compressor belt.

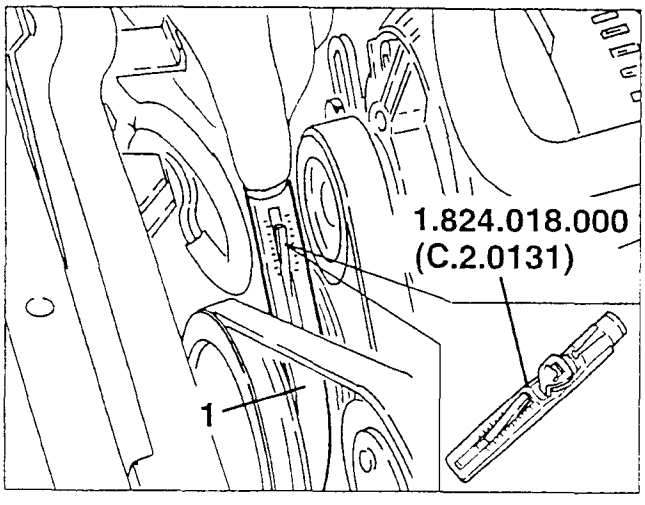
Power steering pump drive belt

Checking and tensioning

- Remove the radiator grille (see GROUP 70).
1. Slacken the screws fastening the upper radiator crossmember, then move it to one side without disconnecting the lock control cable.



1. Working as illustrated, measure the tension of the belt using tool N° 1.824.018.000 (C.2.0131).

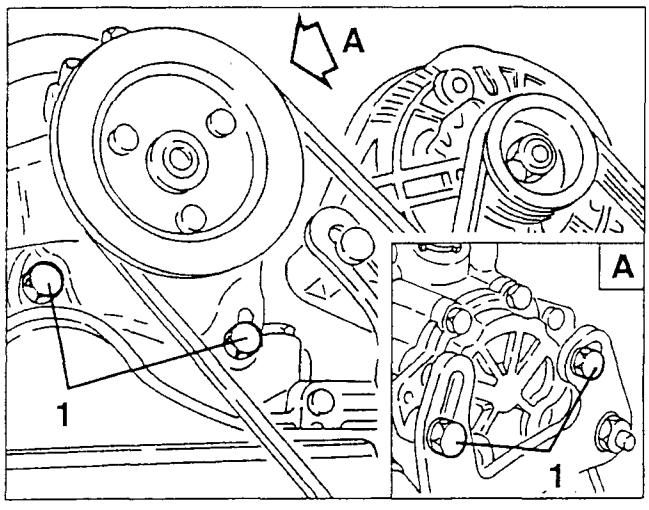


- Check that the tensions measured using the tool are within the specified limits.

Tensioning of trapezoidal drive belt "AV10" for power steering pump	
At assembly	400 ÷ 550 N
Retensioning	280 ÷ 370 N

The belt may be retensioned after a brief running-in period, proceeding as follows:
- **bring the engine to the normal operating temperature**
- **turn the engine off and allow it to cool down**
- **retension the belt to the specified limit.**

- If the tension found is incorrect, proceed as follows:
1. Slacken the four screws fastening the power steering pump.

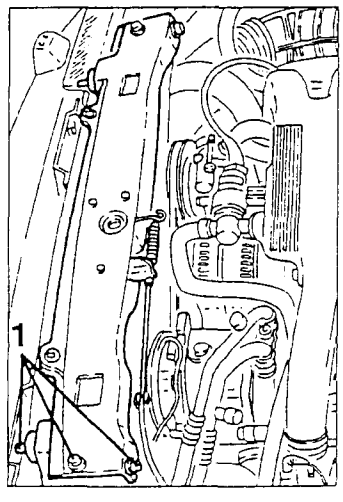


- Move the compressor to one side and temporarily tighten the fastening screws on the slots and check the belt tension.
- If the tension is correct, definitively tighten all the power steering pump fastening screws.
- Suitably adapt the above procedure to change the *power steering pump drive belt*.

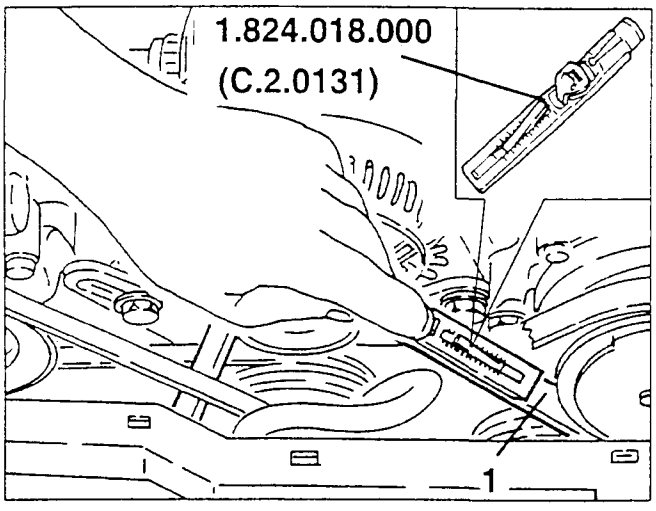
Alternator - water pump drive belt

Checking and tensioning

- Remove the radiator grille (see GROUP 70).
1. Slacken the screws fastening the upper radiator crossmember, then move it to one side without disconnecting the lock control cable.



1. Working as illustrated, measure the tension of the belt using tool N° 1.824.018.000 (C.2.0131).

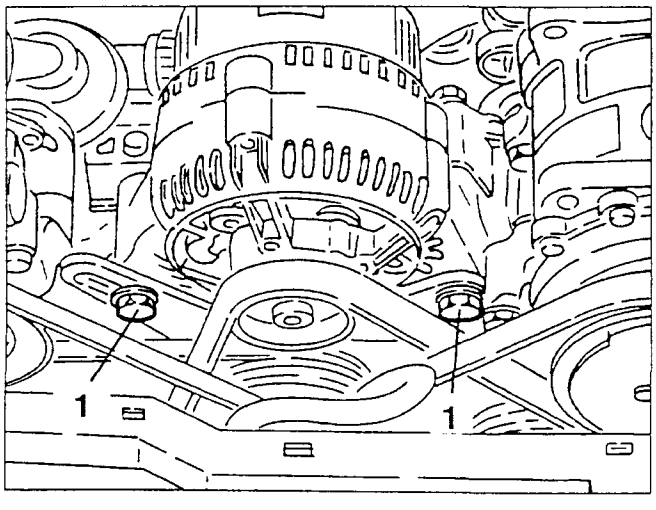


- Check that the tensions measured using the tool are within the specified limits.

Tensioning the drive belt "Poly V" for alternator & water pump	
At assembly	520 ÷ 670 N
Retensioning	300 ÷ 450 N

The belt may be retensioned after a brief running-in period, proceeding as follows:
- bring the engine to the normal operating temperature
- turn the engine off and allow it to cool down
- retension the belt to the specified limit.

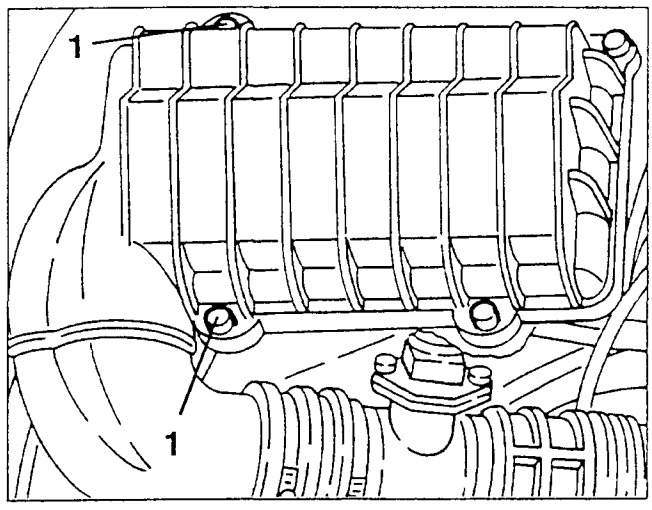
- If the tension found is incorrect, proceed as follows:
1. Slacken the two alternator fastening bolts.



- Move the alternator to one side and tighten the fastening bolt from the slotted side and check the belt tension.
- If the tension is correct also tighten the remaining fastening bolt.
- Suitably adapt the above procedure to change the alternator - water pump drive belt.

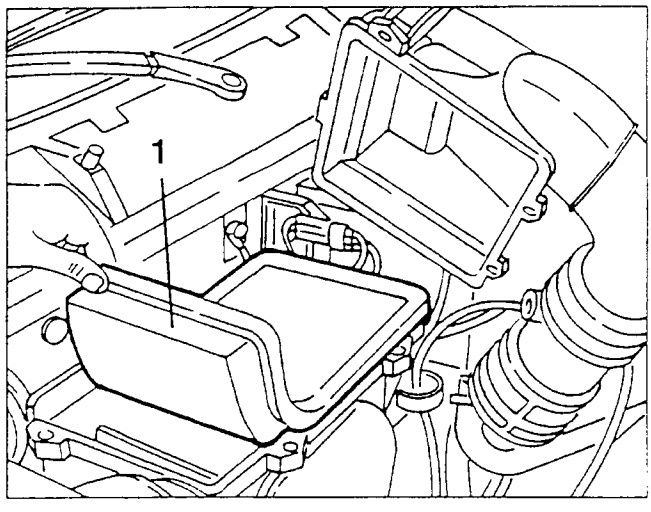
CHANGING THE AIR CLEANER CARTRIDGE

1. Slacken the four screws fastening the air cleaner cover.



1. Raise the air cleaner cover just enough to remove the filtering element.

Any filter cleaning operation might damage it, thereby jeopardising the correct operation of the engine supply system.

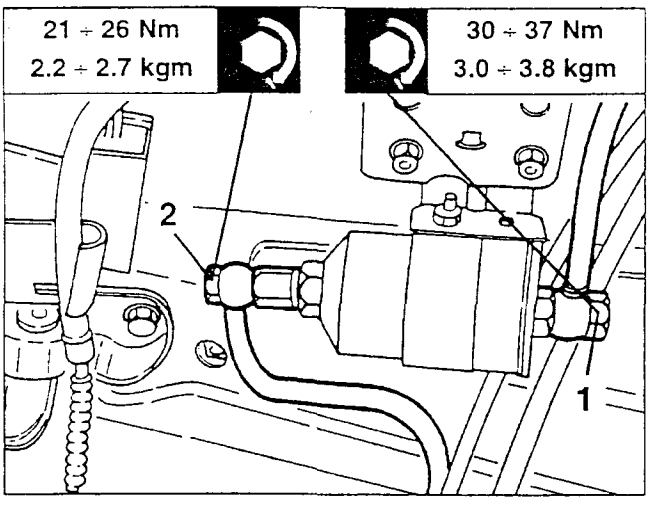


- Carefully clean the air cleaner cartridge container.
- Install a new air cleaner cartridge.
- Refit the cover and fasten with the corresponding screws.

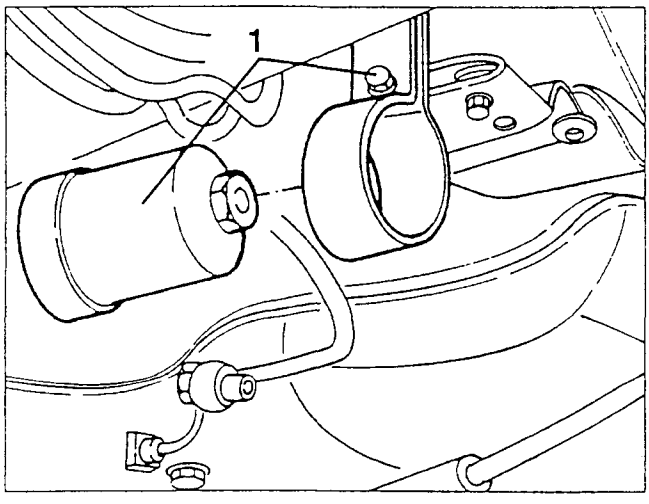
NOTE: **If the cleaner shows traces of oil, check for possible leaks in the entire air circuit.**

CHANGING THE FUEL FILTER

- Set the car on a lift and raise it.
1. Disconnect the fuel inlet pipe connection from the filter.
2. Disconnect the fuel outlet pipe connection from the filter.



1. Slacken the fastening clamp and remove the fuel filter.

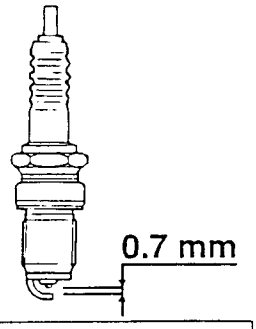


- Install the new filter reversing the sequence described for removal and taking care to:
- change the copper gaskets of the connections;
- assemble the filter with the arrow stamped on it pointing in the direction of the flow of the fuel.

CHECKING AND CHANGING SPARK PLUGS

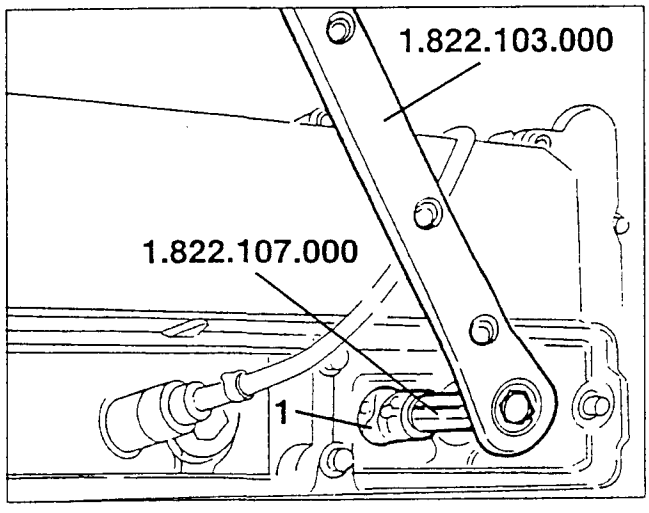
The standard spark plugs fitted to the engine are of the surface discharge type with four points and a centre electrode, for the 8 Valve engines and with one point and centre electrode, for the 16 Valve engine.

The former requires no routine gap adjustment, while the gap to be adhered to for the latter is shown in the table.



Spark plugs	
8 valves	LODGE 25 HL
16 valves	NGK PFR 6B

- With the engine cold disconnect the spark plug cables.
- Blow inside the spark plug openings to remove any impurities.
1. Slacken and remove the spark plugs.
For the 1712 16 Valve engine use tools N° 1.822.103.000 and N° 1.822.107.000.



- Check the spark plugs for dirt and the ceramic insulation for cracks. In this case, replace the spark plugs.

WARNING:
The use of spark plugs with different characteristics or sizes than those specified can cause serious damage to the engine and change the level of harmful emission at the exhaust.

WARNING:
A dirty or worn out spark plug is often the sign of a failure in the engine supply system.
For example:
- Traces of carbon dust: incorrect mixture, air cleaner very dirty.
- Spots of oil: oil leaking frm the piston rings.
- Formation of ash: presence of aluminium materials, contained in the oil.

- Burnt electrodes: overheating due to unsuitable fuel, defects in the valves;
- High electrode wear: harmful additives in the fuel or in the oil, pinging in the cylinder head, overheating.

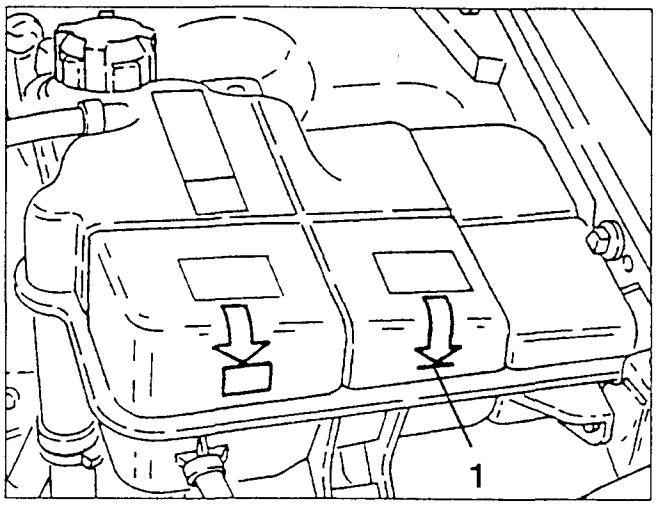
- When installing, lubricate the thread with engine oil and tighten the spark plugs to the following torque:

25 ÷ 30 Nm 2.5 ÷ 3.1 kgm

CHECKING THE LEVEL AND CHANGING THE COOLANT

Checking

1. With the engine cold, check that the level of the coolant in the header tank is between the MIN and MAX marks.



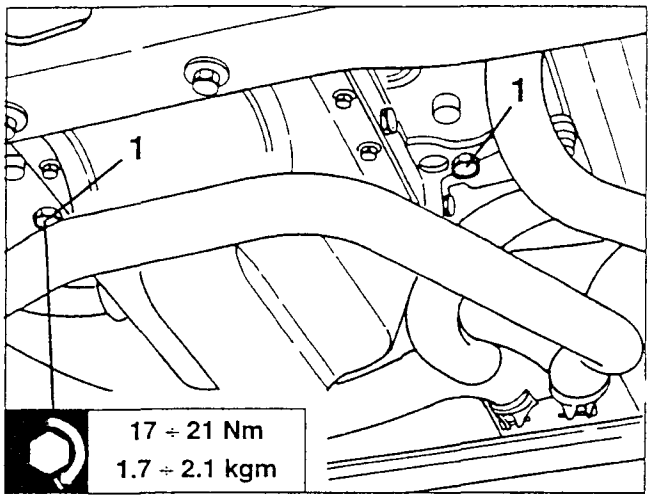
Draining and replenishing

- Set the car on a lift.
- Slacken and remove the header tank plug.

WARNING:
Absolutely never remove the header tank plug when the engine is warm!

- Raise the car.
1. Slacken the two plugs under the crankcase and drain the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can harm the paintwork: therefore avoid any contact with painted components.



- Refit the drain plugs and check that all the fastening clamps of the engine cooling system hoses are firmly tightened.
- Fill the header tank up to the MAX mark.
The type and indicative quantity of the coolant are given in the table below:

Alfa Romeo Climafluid Permanent -40°C	6.7 litres

- Start the engine and bring it to normal operating temperature so that the thermostat opens to release the amount of residual air in the circuit.
- With the engine cold, top up to the level indicated on the header tank.
- Retighten the pressurised cap on the header tank.

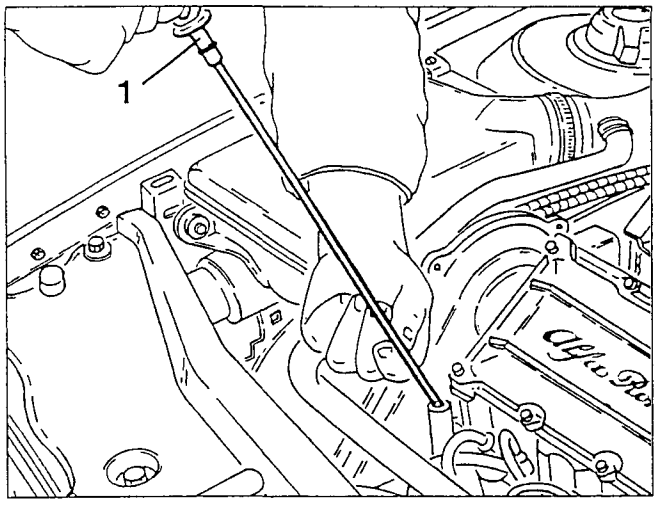
WARNING:
It is unwise to mix anti-freeze fluids of different types or brands!
Never use antirust additives: this might not be compatible with the anti-freeze in use!.

TURBODIESEL 1929 ENGINE SERVICING

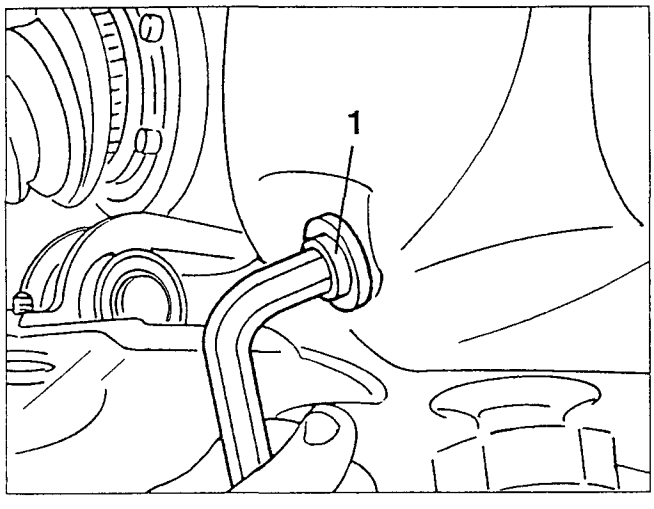
CHANGING ENGINE OIL AND FILTER

IMPORTANT:
Engine oil is harmful: avoid all contacts with your skin. In the event of contact, wash the effected part with soap and water.

- When the engine is hot, remove the filler cap.
1. Remove the dipstick.

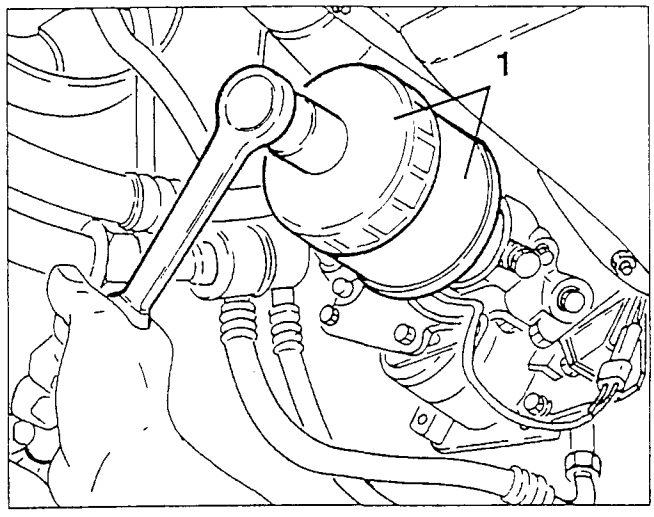


1. Remove the drain cap and drain completely collecting the oil in a suitable container.



IMPORTANT:
Dispose of oil appropriately. Waste oil is an environmental hazard.

1. Remove the oil filter with a suitable tool.

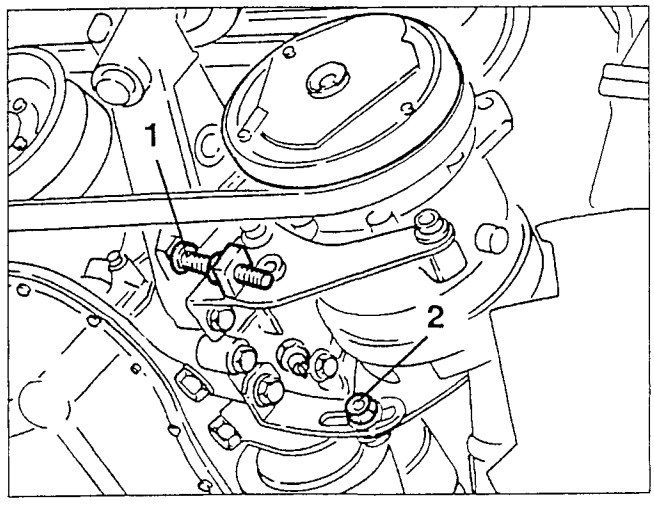


- Clean the drain cap and screw it back with its seal.
- Dampen the new filter seal with oil and screw it back by hand.
- Fill the engine with oil of the prescribed type and in the prescribed quantity.
Check the oil level with the vehicle standing on level ground.
Oil level over the MAX notch can cause excessive oil evaporation and drops in oil pressure.
- Refit the filler cap and idle the engine for approximately 2 minutes. Wait for a few minutes.
- Check the oil level. Check there are no leaks.

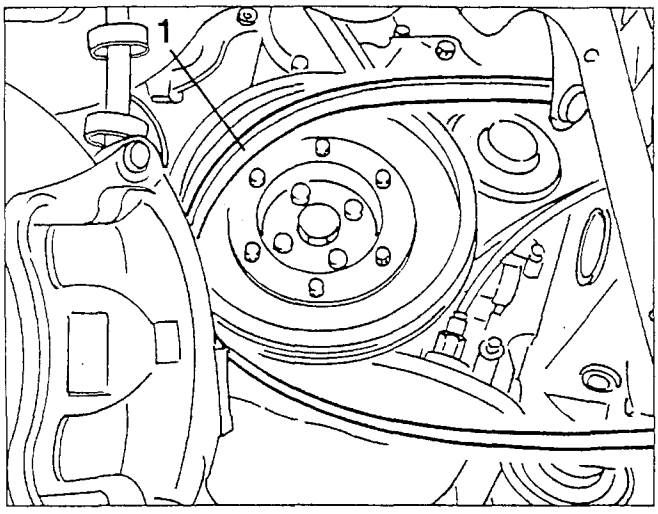
IMPORTANT: When topping up, be careful not to drip oil on the alternator ventilation slots. This could seriously damage the alternator and be a fire risk.

REPLACING TIMING BELT (To engine no. 1762797)

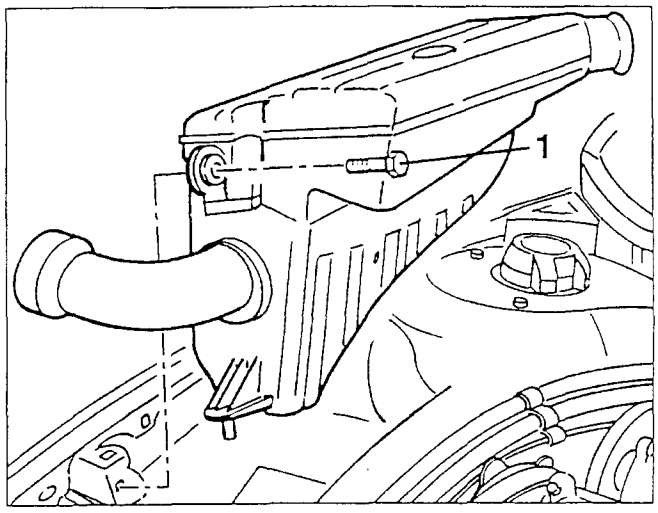
- Remove the front right-hand wheel and spray guard.
1. Turn the micro-metric tension device to release belt tension.
2. Remove the compressor fastening screws.



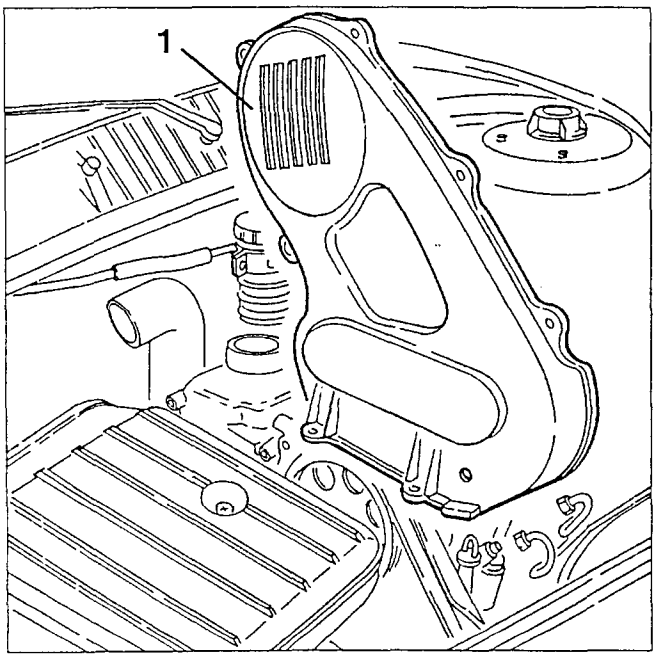
1. Remove the compressor drive belt from the auxiliary components driving pulley.



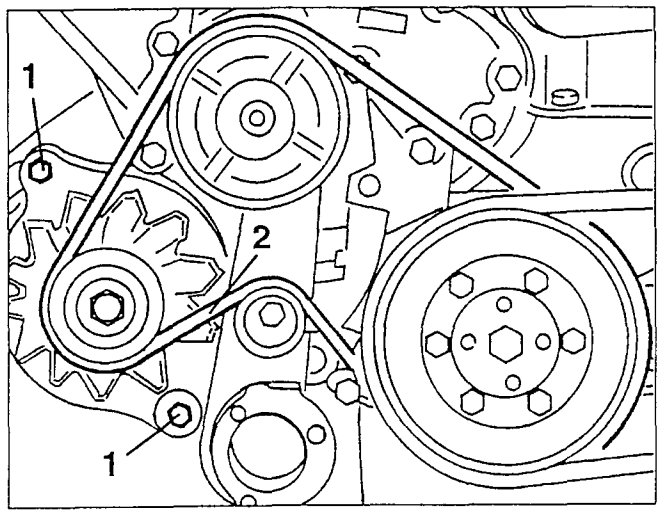
1. Slacken the fastening screws and remove the complete air cleaner.



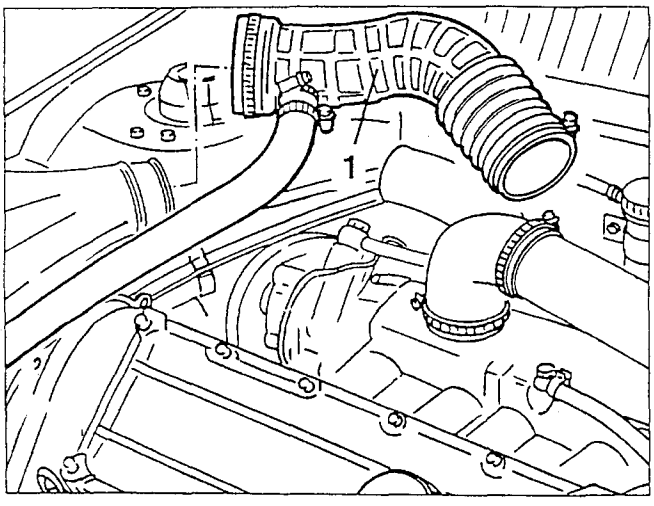
1. Remove the timing belt front cover.



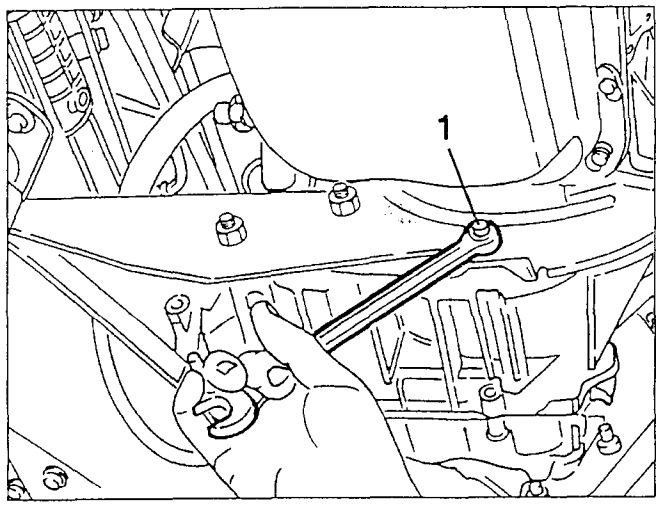
1. Slacken the two alternator fastening bolts.
2. Remove the alternator - water pump drive belt.



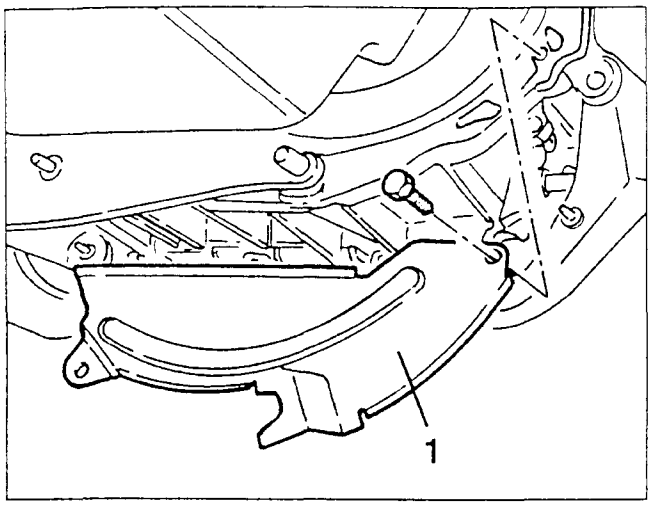
1. Remove the air intake corrugated sleeve and move it to one side without disconnecting the oil vapour recirculation hose.



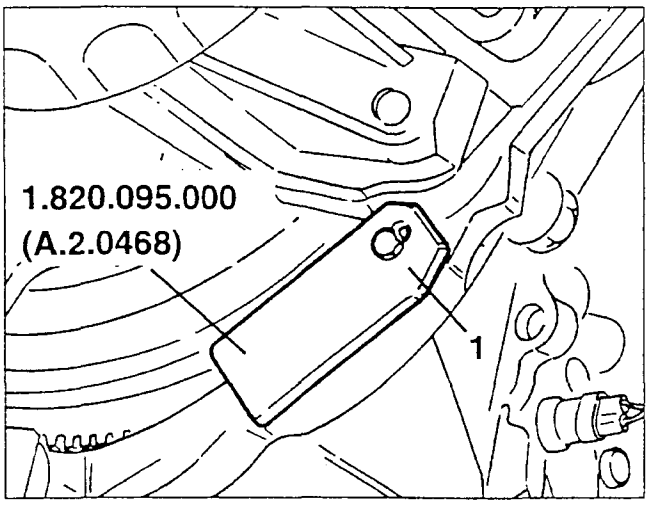
- Raise the car.
1. Slacken the front nut fastening the gearbox to its support bracket.



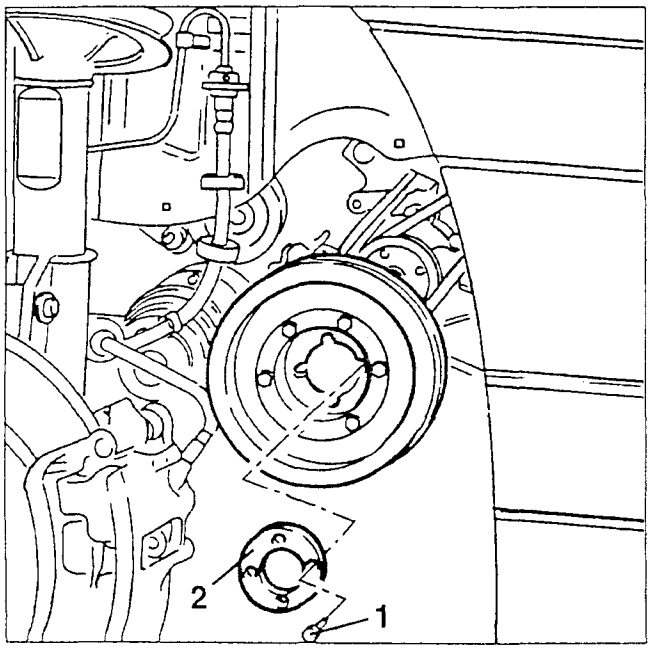
1. Slacken the fastening screws and remove the flywheel cover.



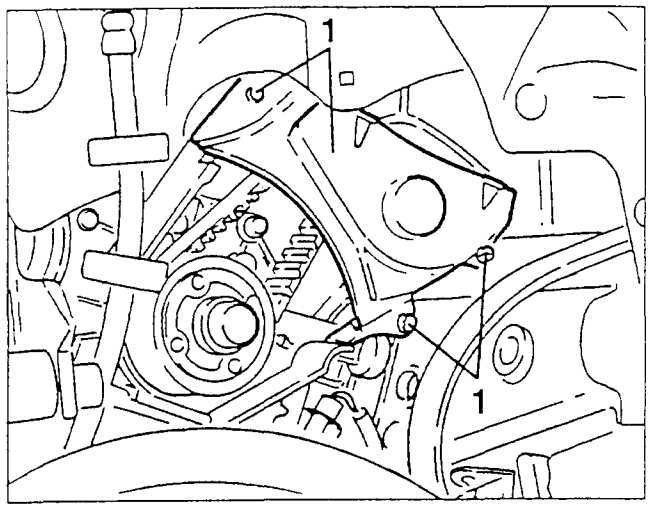
1. Install the tool for holding the flywheel N° 1.820.095.000 (A.2.0468).



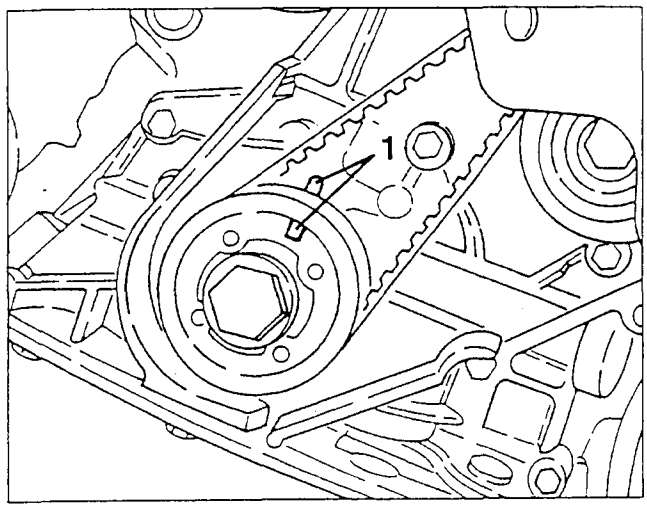
1. Slacken the fastening screws and remove the auxiliary components belt driving pulley.
2. Retrieve the spacer.



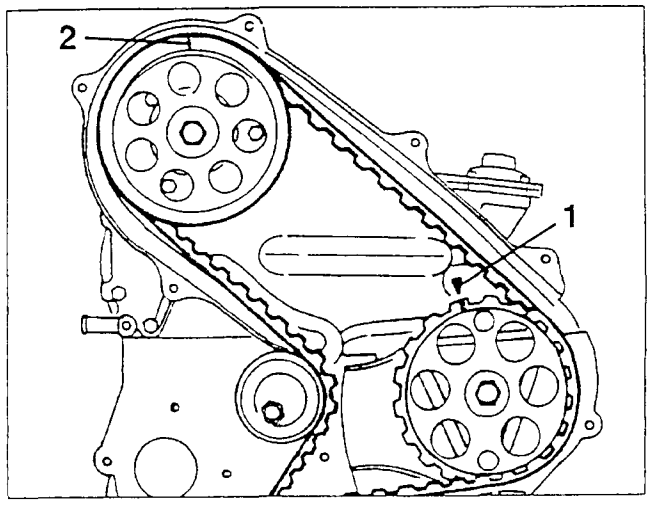
1. Slacken the fastening screws and remove the timing belt lower cover.



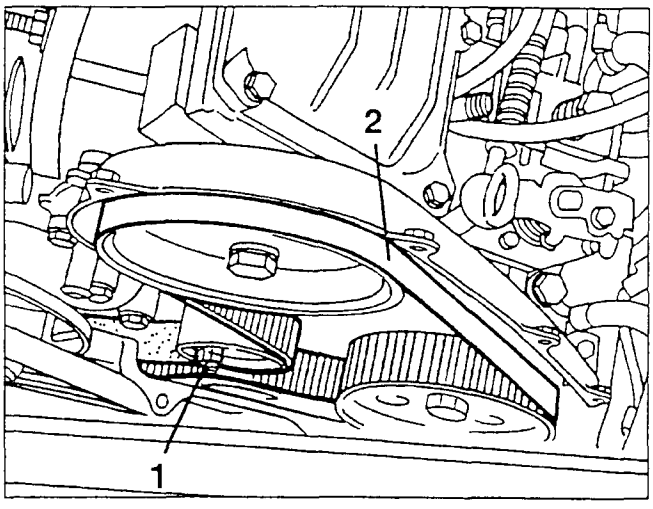
- Remove the tool for holding the flywheel installed previously.
1. Check that the notch on the pulley is aligned with the relief on the front cover.



1. Check that the notch etched on the pulley is aligned with the relief on the rear cover.
2. Check that the notch etched on the pulley is aligned with the hole on the rear cover.



1. Slacken the screw fastening the timing belt guide pulley.
2. Remove the timing belt.

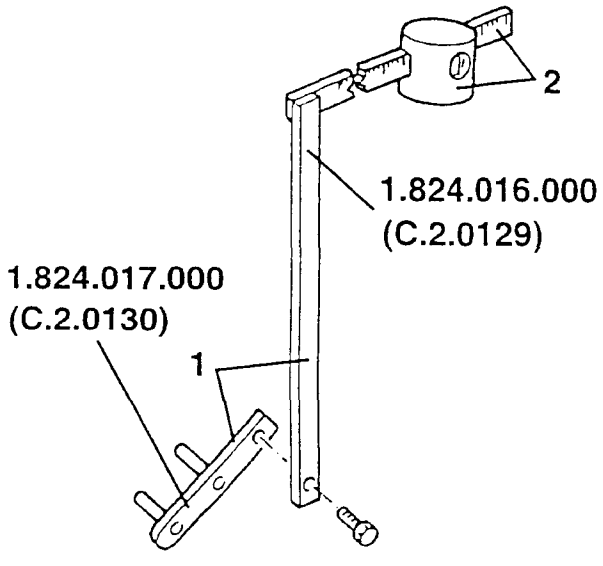


Refit reversing the sequence described for removal and observing the following instructions:

- Make sure that the first cylinder is in the bursting stroke, checking the alignment of the notches on the timing belt pulleys with the corresponding references.
- Install the timing belt making sure that the teeth are correctly coupled on all the pulleys.

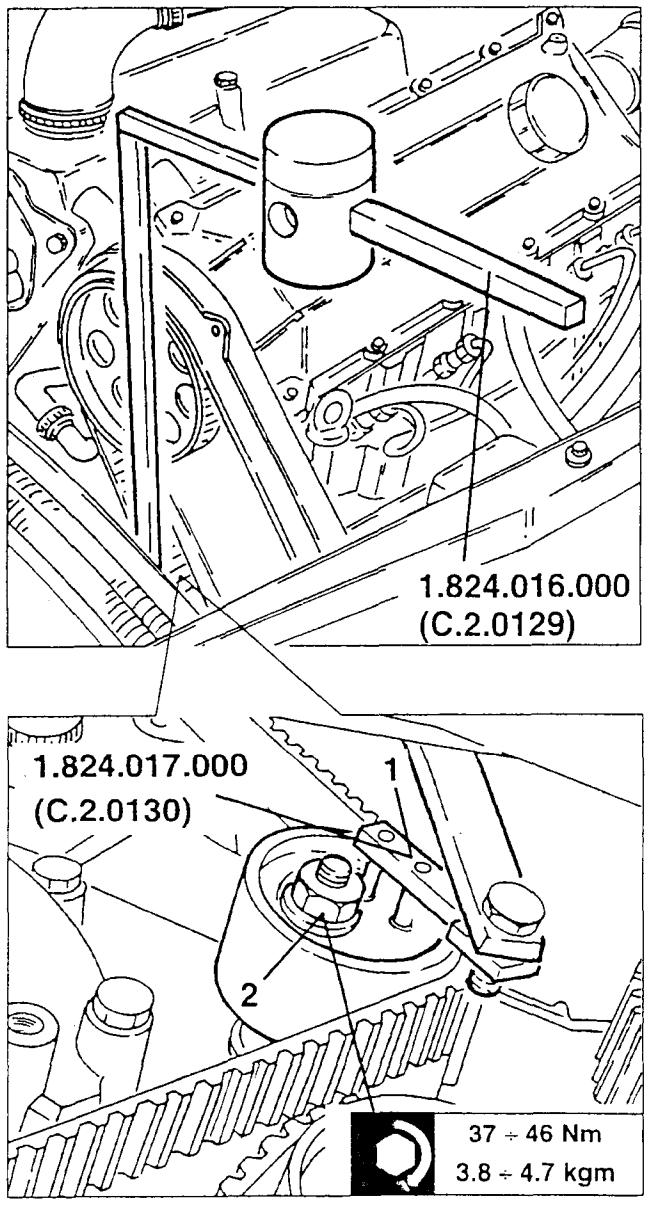
WARNING:
To avoid harming the structure of the fibres forming the belt, never bend it sharply when assembling.

1. On tool N° 1.824.016.000 (C.2.0129) install support N° 1.824.017.000 (C.2.0130).
2. Position the weight with the knurled part, at a distance of 120 mm on the millimetred rod and lock it.



1. Install the resulting tool on the belt tensioner, as illustrated, and adjusting the joint, set the millimetred rod to horizontal.
- Settle the toothed belt turning the crankshaft twice in its direction of rotation.
2. Tighten the belt tensioner fastening nut to the specified torque.

WARNING:
During the last phase, the millimetred rod might move from its horizontal position; in this case, working on the belt tensioner, it is necessary to restore the original position of the millimetred rod and repeat the operation.

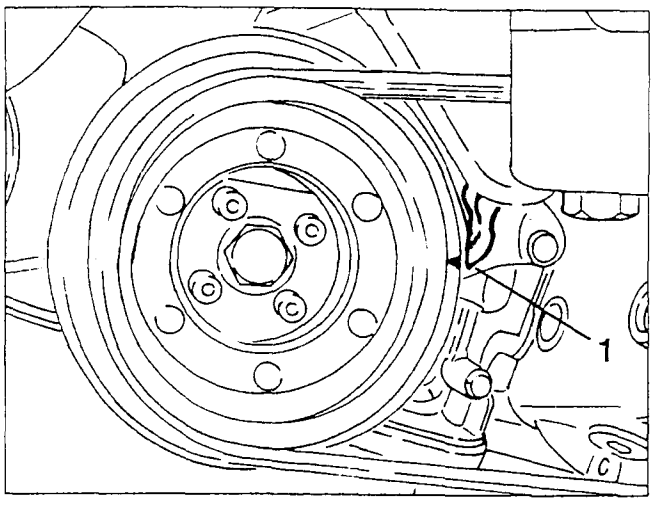


- Remove the belt tensioning tools.
- Tension the auxiliary component drive belts (see specific paragraphs).

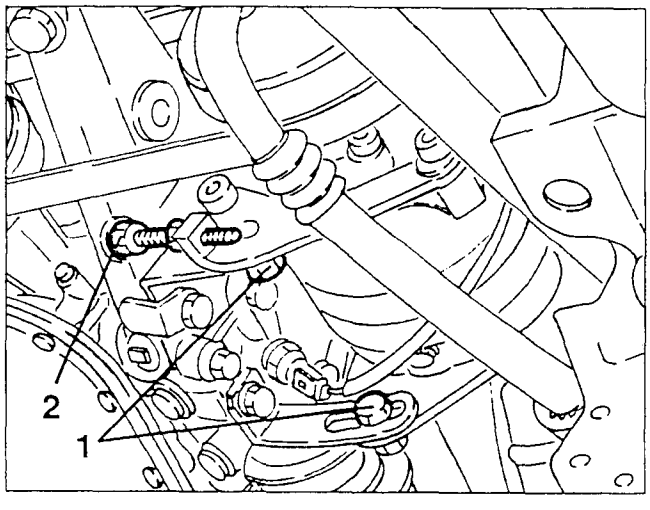
CHANGING THE TIMING GEAR DRIVE BELT (From engine no.1762798)

- Remove the right front wheel and mud flap.

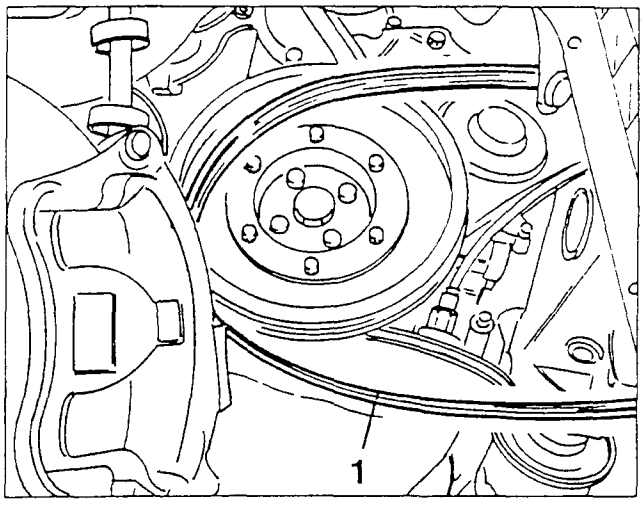
1. Turn the engine in its direction of rotation until the notch on the auxiliary components drive pulley coincides with the relief on the timing gear belt lower cover (engine timed).



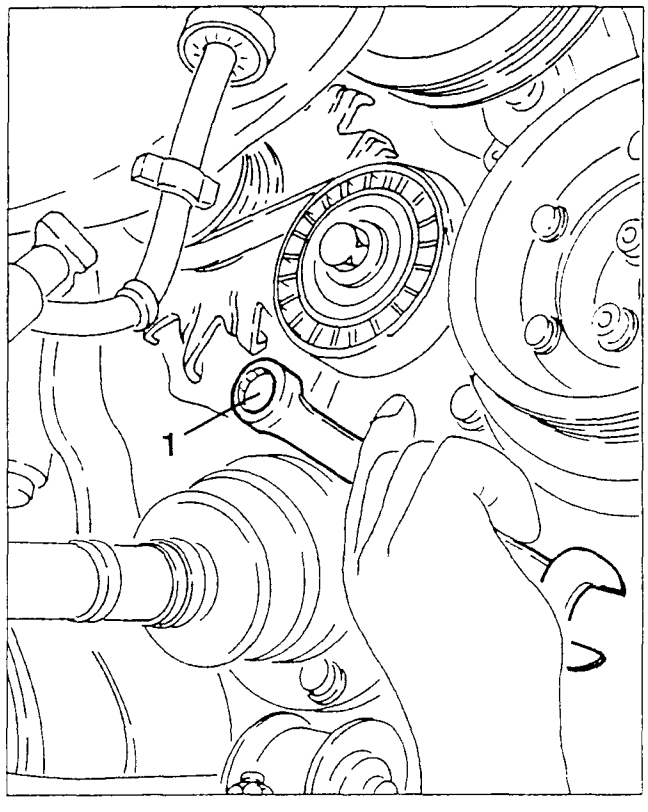
1. Loosen the two conditioner compressor fastening screws.
2. Working on the micrometric tensioner, slacken the tension of the conditioner compresssor drive belt.



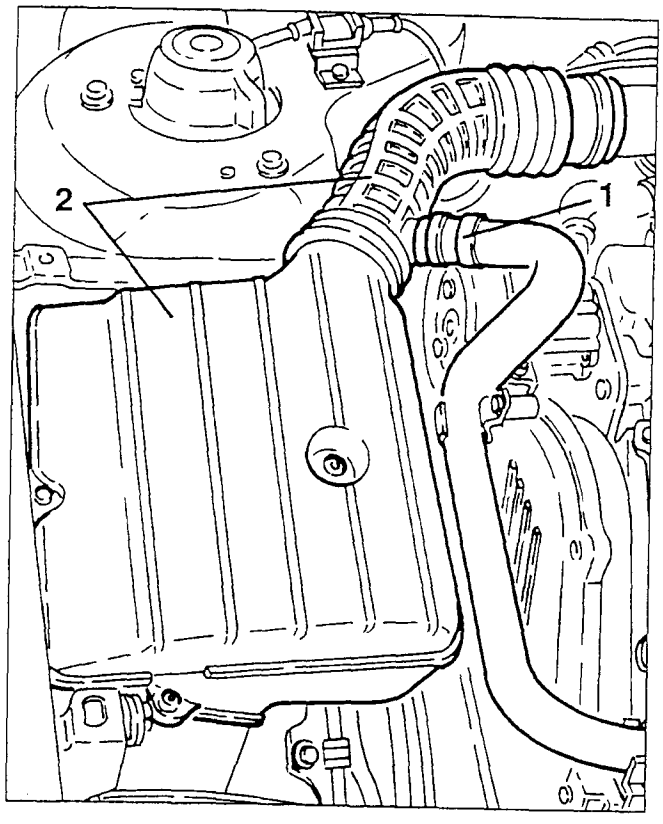
1. Prise conditioner compressor drive belt off the auxiliary components drive pulley.



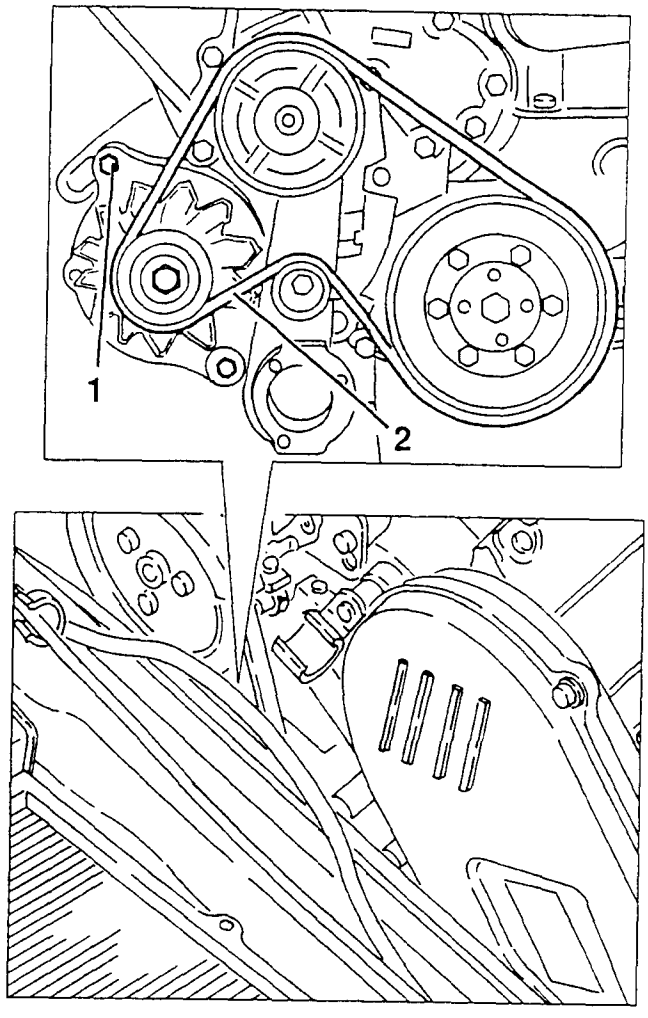
1. Loosen the alternator lower fastening bolt.



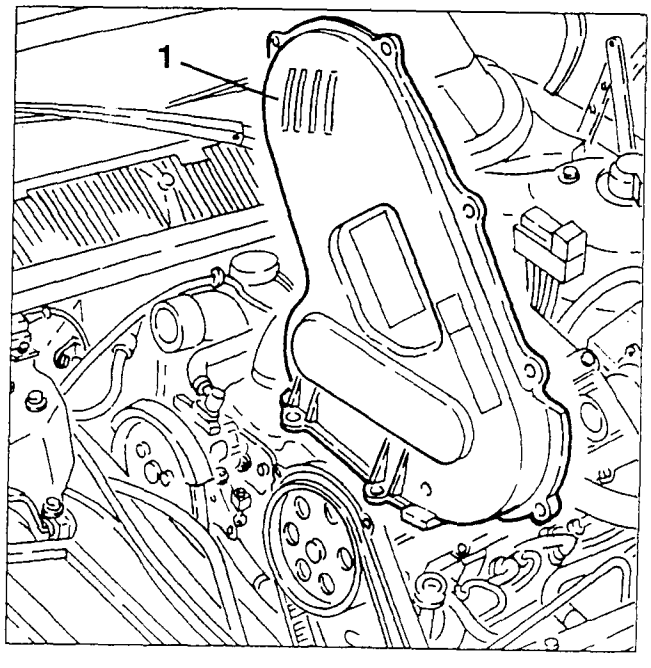
1. Lower the car, then disconnect the oil vapour recirculation pipe from the air intake corrugated sleeve.
2. Slacken the fastening screws, loosen the clamp, then remove the air cleaner cover complete with corrugated sleeve.



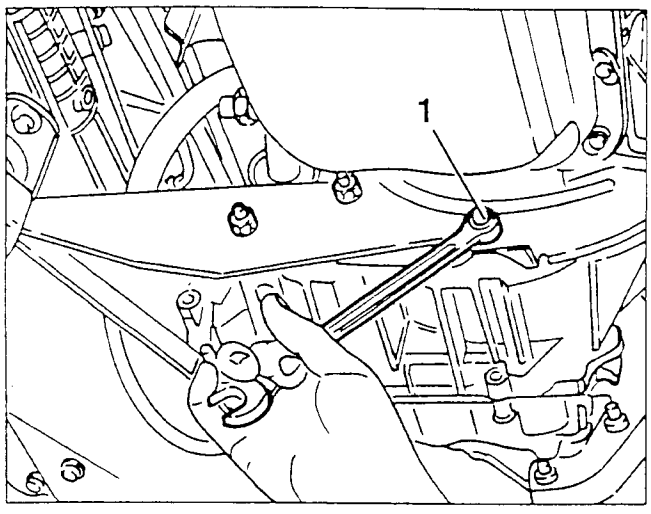
1. Loosen the upper alternator fastening screw.
2. Prise and remove the alternator - water pump drive belt.



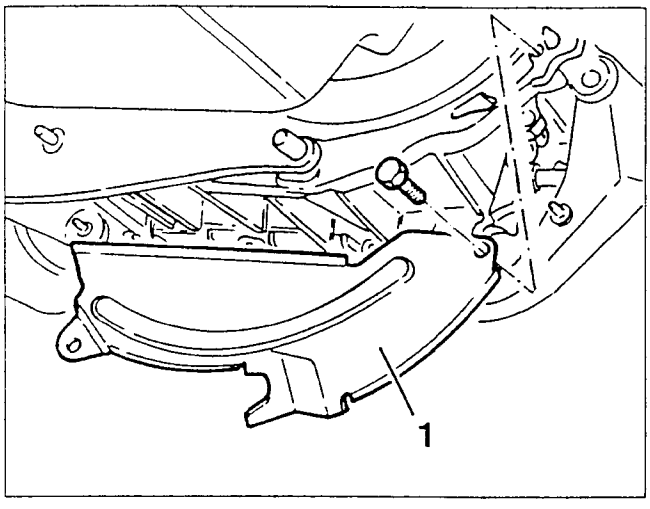
1. Slacken the fastening screws and remove the timing gear belt cover.



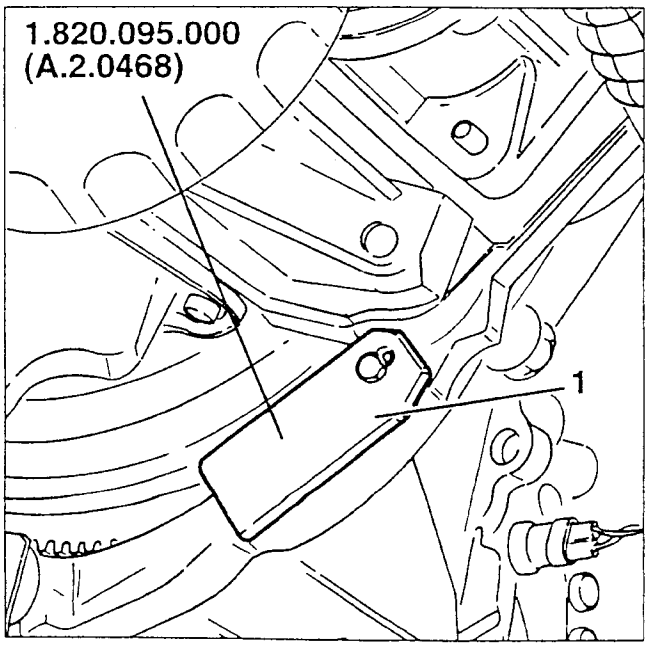
1. Raise the car and slacken the front nut fastening the gearbox to its support bracket.



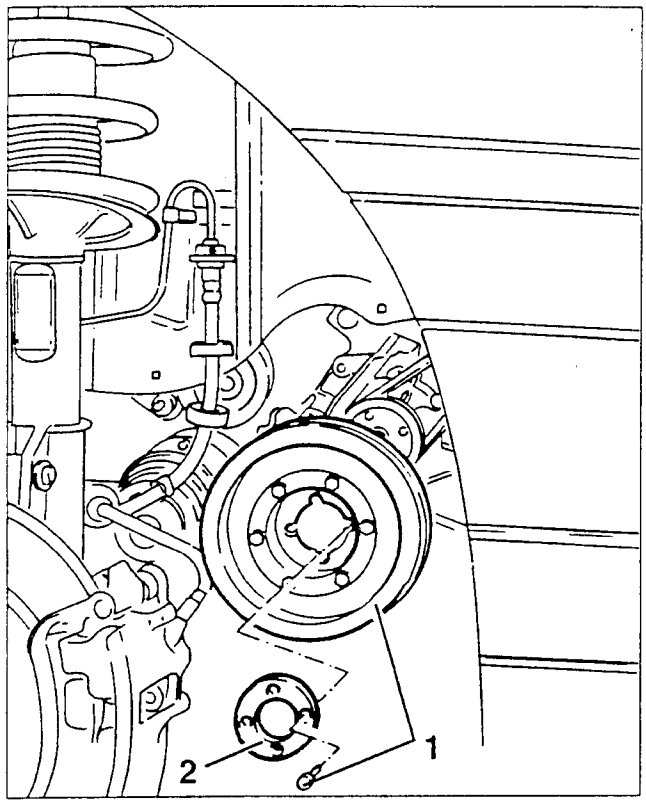
1. Slacken the fastening screws and remove the flywheel guard.



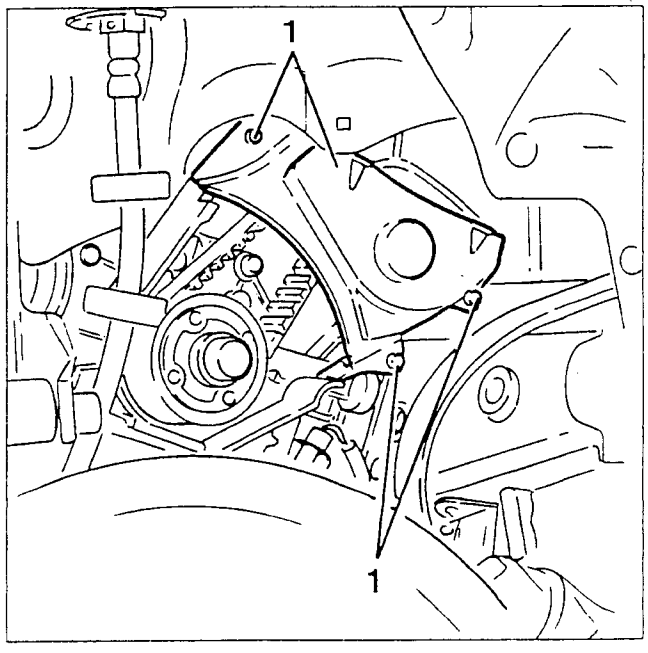
1. Install flywheel stopper tool no. 1.820.095.000 (A.2.0468).



1. Slacken the fastening screws and remove the auxiliary components belt drive pulley.
2. Retrieve the spacer.

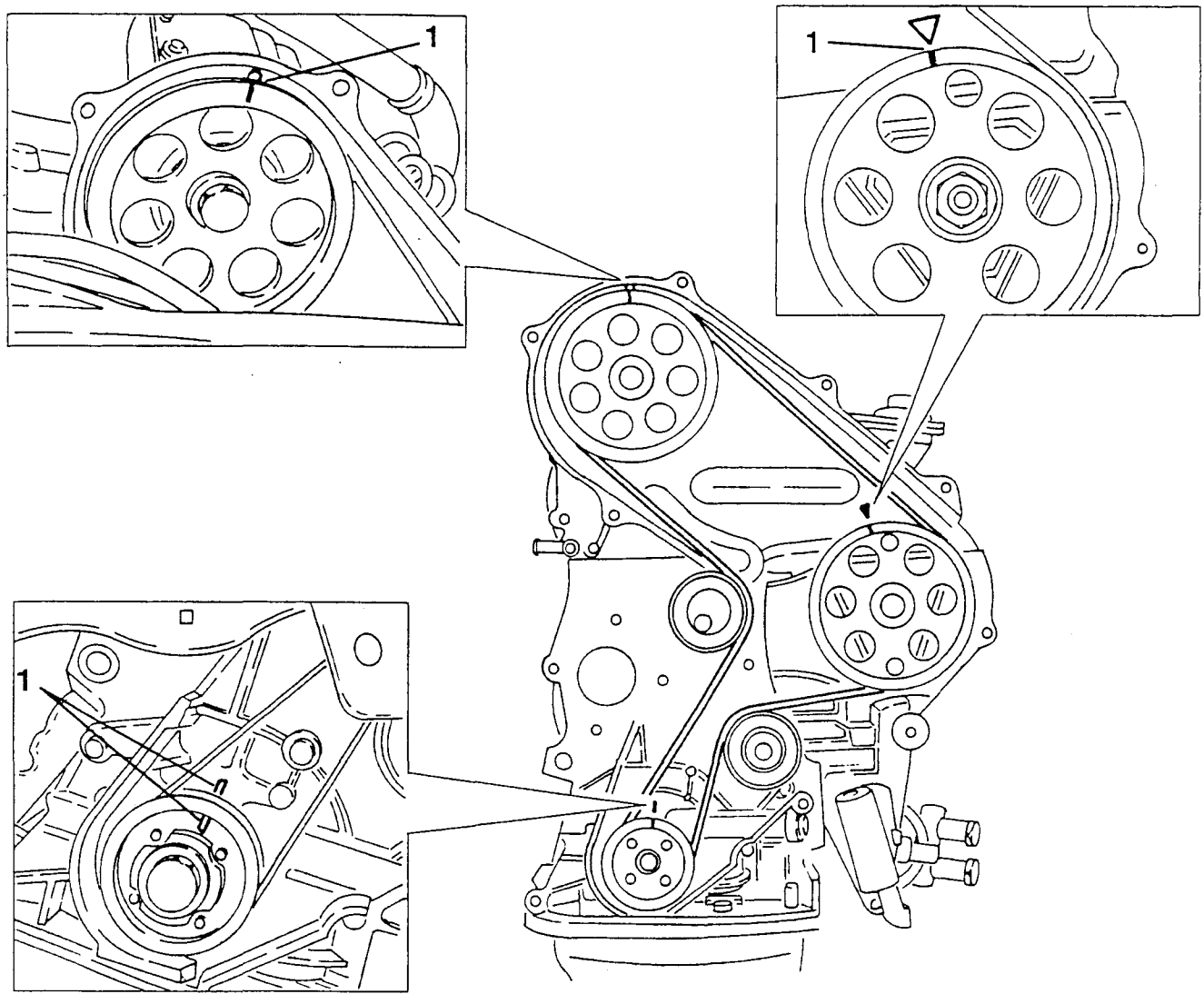


- Remove the flywheel stopper tool no. 1.820.095.000 (A.2.0468) installed previously.
1. Slacken the fastening screws and remove the timing gear belt lower cover.

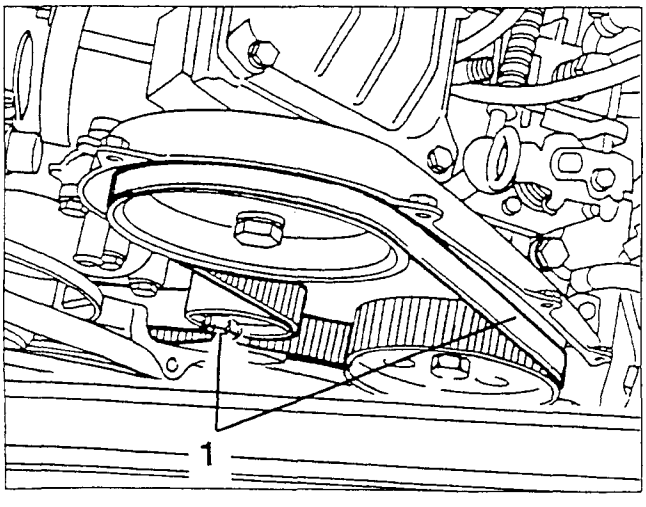


1. Check that the notches on the three pulleys coincide with the three fixed notches on the engine as illustrated.
This way the engine is in the T.D.C. position on the 1st cylinder and the camshaft is in the bursting stroke also on the 1st cylinder.

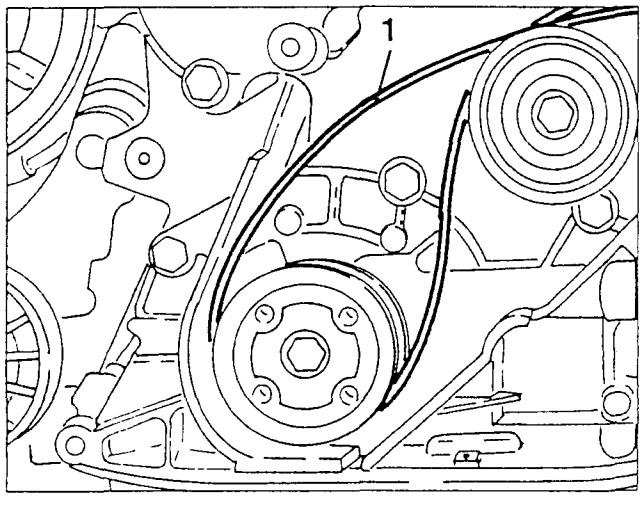
NOTE: - The camshaft pulley is slotted, therefore in this condition, the notch on it does not necessarily coincide with the fixed one.
- There are two notches stamped on the injection pump drive pulley, for timing check alignment with the yellow notch.



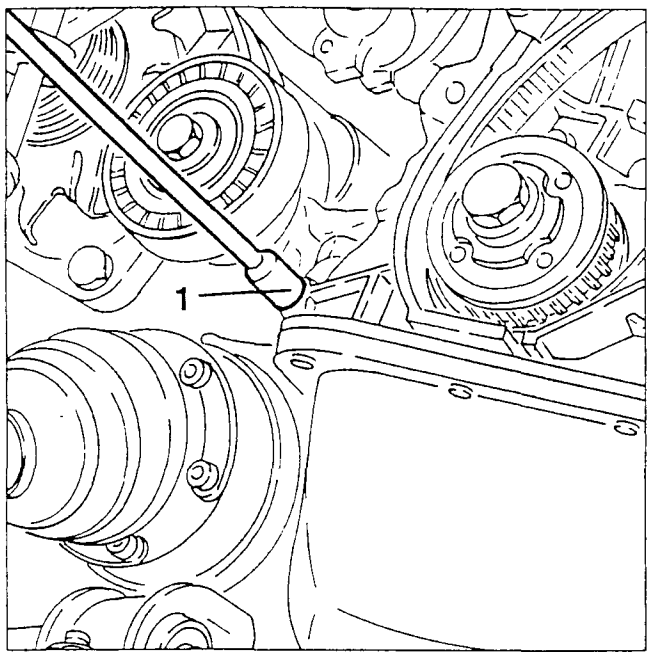
1. Loosen the belt tensioner nut, then prise and remove the timing gear drive belt.



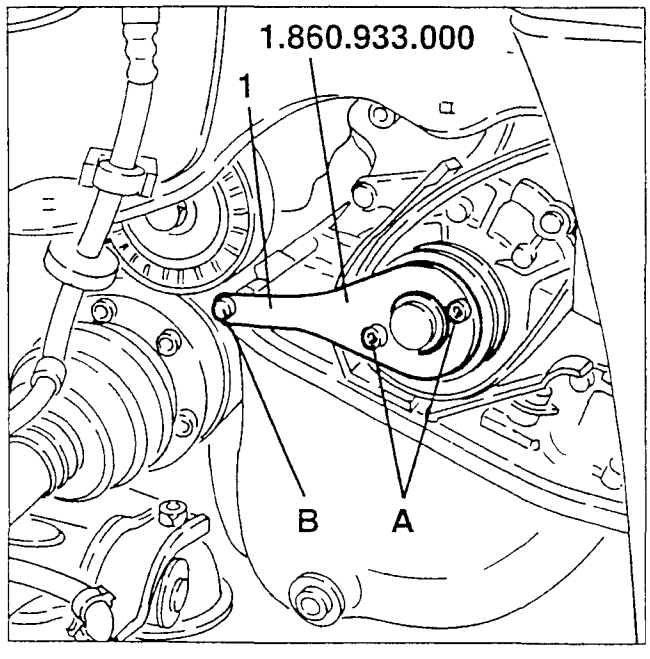
1. Install a new timing gear drive belt on the corresponding drive pulley.



1. Slacken and remove the screw fastening the front cover to the crankcase.

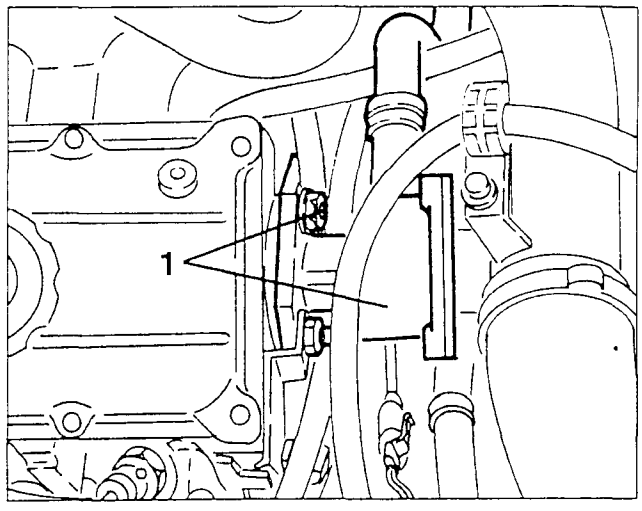


1. Position tool no. 1.860.933.000 for positioning the 1st cylinder at T.D.C.
The tool must be coupled to the timing gear belt drive pulley and fastened to it using screws (A). Using screw (B) it should also be positioned at the front crankcase cover (this way the angular position of the tool guarantees positioning of the 1st cylinder at T.D.C. in the bursting stroke).

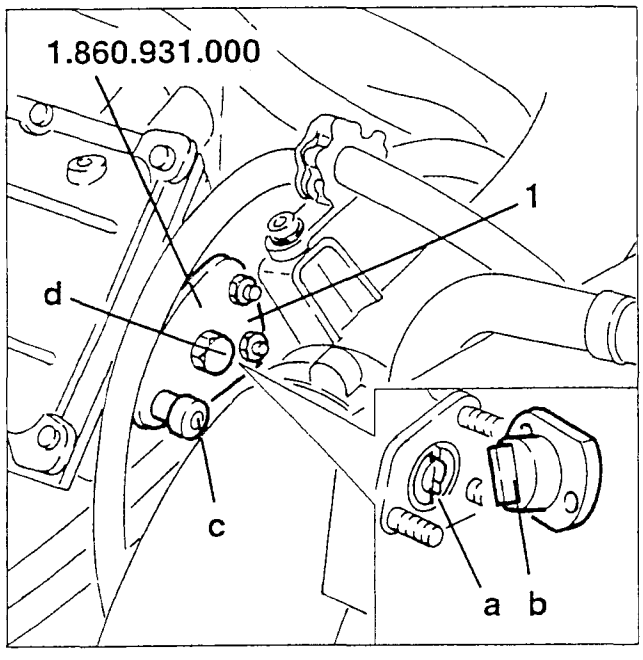


- Re-check that the timing notches are still aligned as described previously.

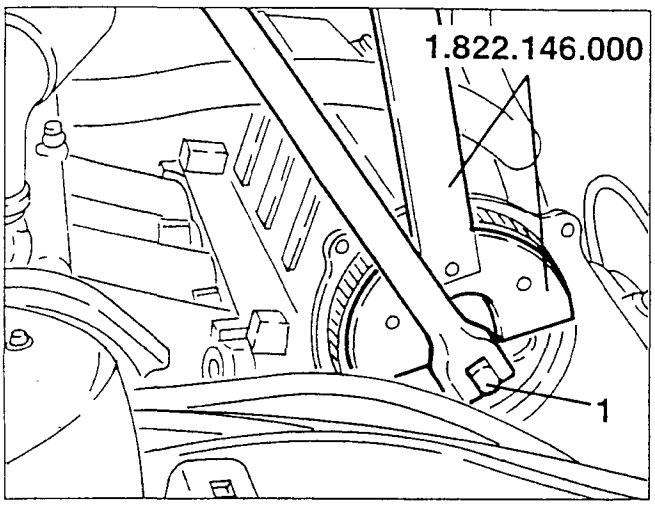
1. Lower the car, slacken the fastening nuts and remove the servobrake vacuum pump from the cylinder head.



1. Position tool no. 1.860.931.000 for timing the camshaft, coupling groove (a) of the camshaft with relief (b) of the tool.
- Fasten the tool to the cylinder head positioning dowel (c) as illustrated.
NOTE: The dowel must be centred on the tool, if not, use a wrench on the hexagon (d) and centre the dowel on the tool with tiny movements.



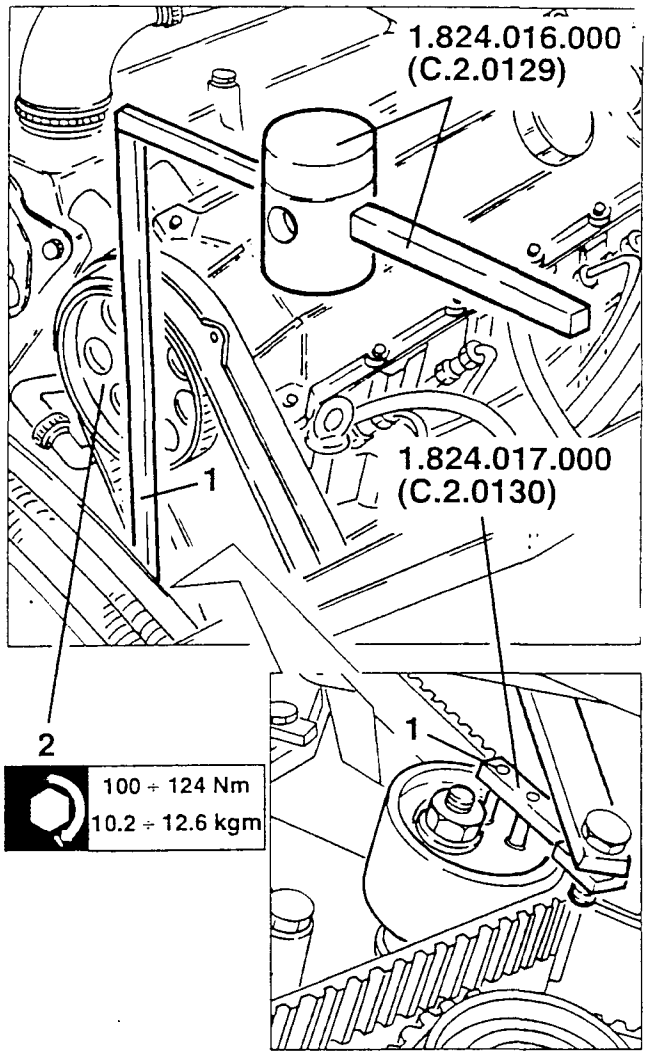
1. Using tool no. 1.822.146.000 slacken the screw fastening the camshaft drive pulley.



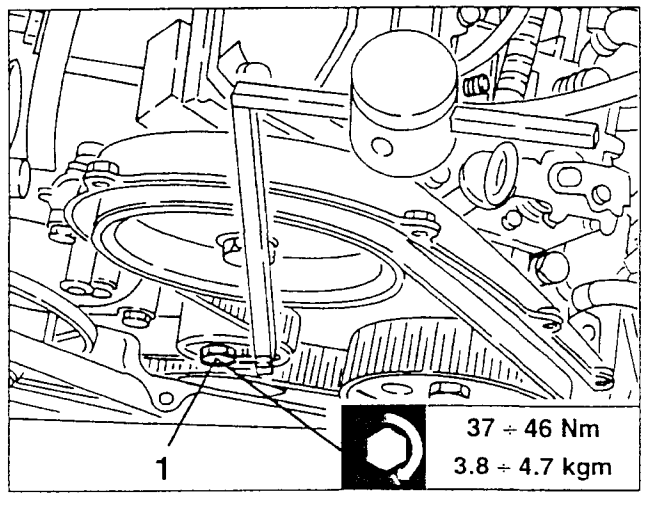
- Complete assembly of the camshaft drive pulley starting from camshaft drive pulley and continuing counter-clockwise.

NOTE: Check that the injection pump notch coincides with the fixed one on the rear cover.

1. Install tools no. 1.824.017.000 (C.2.0130) and no. 1.824.016.000 (C.2.0129) on the belt tensioner for tensioning timing gear belt as illustrated positioning the weight, complete with knurled piece, at a distance of 120 mm on the graduated rod.
2. Tighten the camshaft drive pulley fastening screw to the specified torque using the same tools as previously.

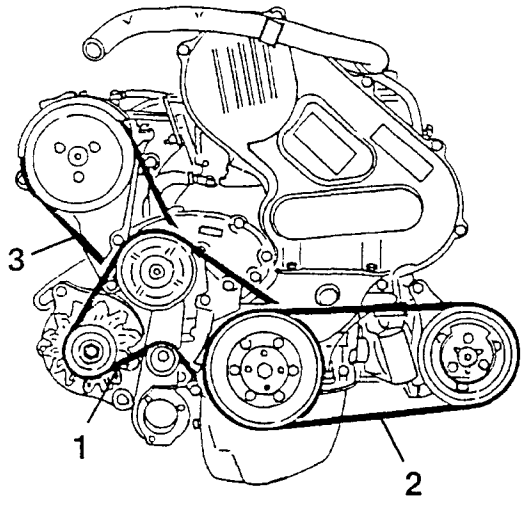


- Remove the tools installed previously for timing and locating the T.D.C.
- Settle the toothed belt turning the crankshaft twice in its direction of rotation.
1. Tighten the belt tensioner fastening nut to the specified torque.



- Remove the tools used for tensioning the belt.
- Complete refitting reversing the sequence followed for removal.

AUXILIARY COMPONENT BELTS



1. Alternator - water pump drive belt
2. Conditioner compressor drive belt
3. Power steering pump drive belt

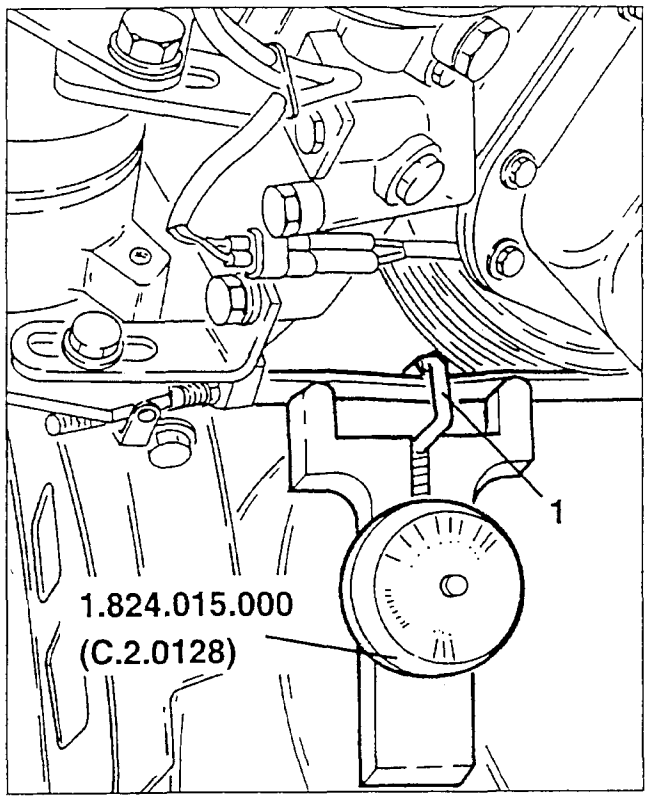
NOTE:
When checking the belt tension, also check that the belt is intact and free of:
- cuts
- cracks
- material surface wear (smooth and shiny).
- dry or stiff parts.
In the event of one of the above defects, change the belt.

WARNING:
The contact of the belts with oil or solvents can damage the elasticity ot the actual belt and reduce its adherence.

Conditioner compressor drive belt

Checking and tensioning

- Set the car on a lift and raise it.
1. Working as illustrated, measure the belt tension using tool N° 1.824.015.000 (C.2.0128).



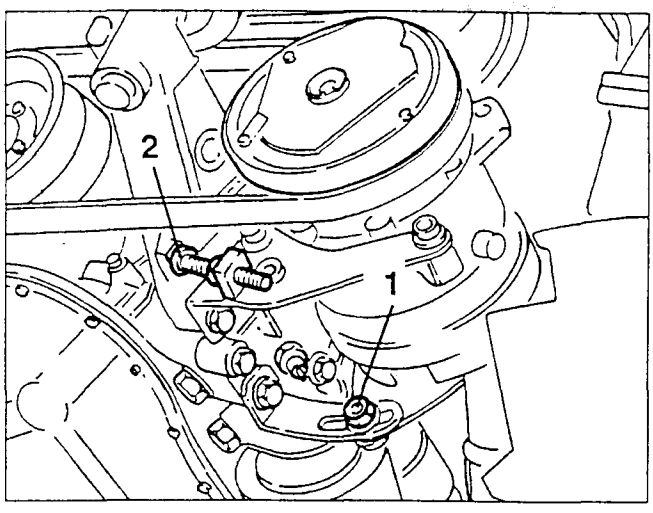
- Check that the tensioning values measured with the tool are within the specified limits.

Tension of trapezoidal belt "AV10" for conditioner compressor drive	
At assembly	400 ÷ 550 N
Retensioning	280 ÷ 370 N

NOTE: **The belt may be retensioned after a brief running-in period, proceeding as follows:**
- bring the engine to normal operating temperature
- turn off the engine and wait for it to cool down
- retension the belt to the specified value.

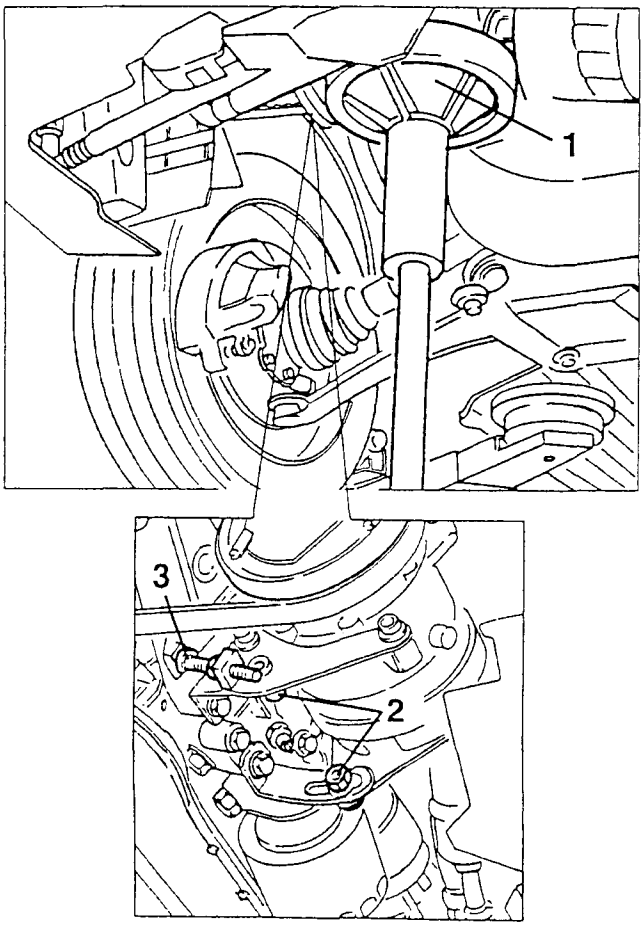
- If the belt tensioning is incorrect, proceed as follows.

1. Slacken the conditioner compressor fastening screws.
2. Tension the belt correctly using the micrometric tensioner.
- Tighten the conditioner compressor fastening screws.

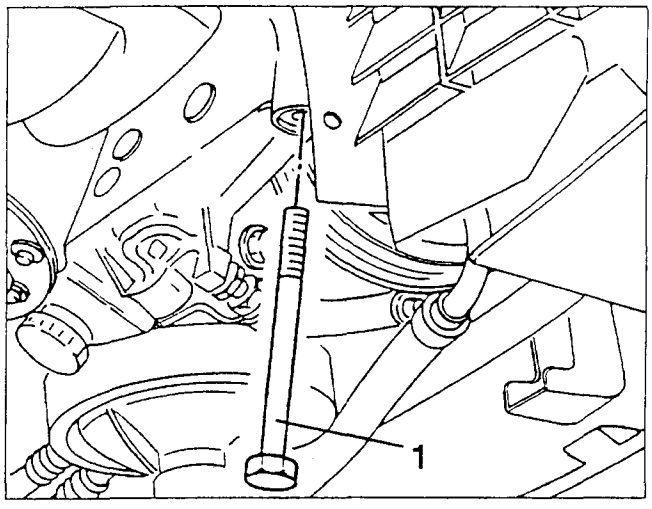


Changing the belt

1. Set a hydraulic jack underneath the engine as illustrated.
2. Slacken the conditioner compressor fastening screws.
3. Slacken the belt tension using the micrometric tensioner.



1. Slacken the screw fastening the oil filter support and injection pump to the engine flexible mount on the timing gear side.

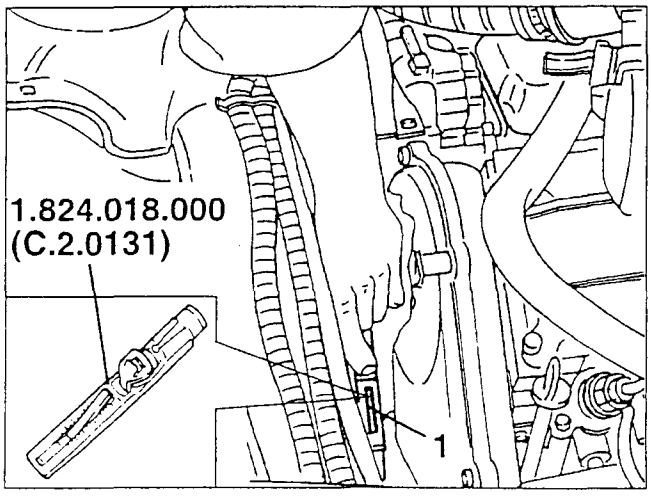


- Lower the hydraulic jack just enough to bring the compressor belt out from the engine mount and remove it.
- Install a new belt reversing the procedure described for removal and tension it following the procedure given in the previous paragraph.

Alternator - water pump drive belt

Checking and tensioning

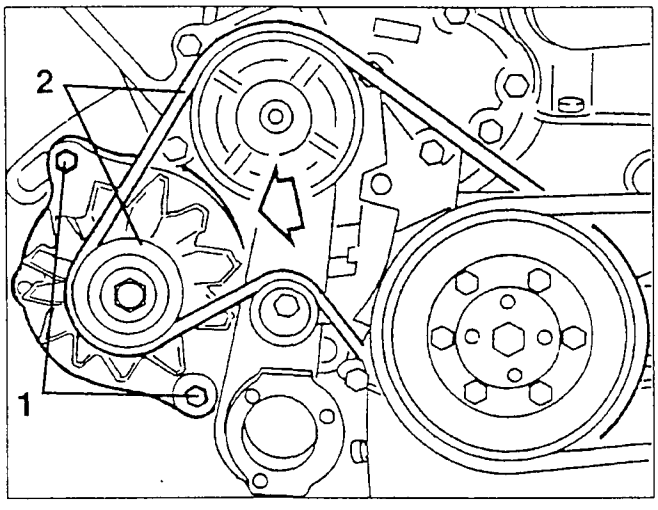
- Slacken the screws fastening the air cleaner and turn it over without disconnecting the sleeves.
1. Working as illustrated, measure the tension of the belt using tool N° 1.824.018.000 (C.2.0131).



Tension of belt "POLY-VK5" for alternator - water pump drive	
At assembly	400 ÷ 450 N
Retensioning	300 ÷ 350 N

NOTE:
The belt may be retensioned after a brief running-in period, proceeding as follows:
- bring the engine to normal operating temperature
- run the engine for about 10 minutes
- turn off the engine and wait for it to cool down
- retension the belt to the specified value.

- If the tension found is incorrect, proceed as follows:
1. Slacken the two alternator fastening bolts.
2. Move the alternator to one side to increase the belt tension.
- Tighten the upper alternator fastening bolt and check the belt tension.
- If the belt tension is correct also tighten the lower bolt fastening the alternator to the support bracket.
- Refit the air cleaner.

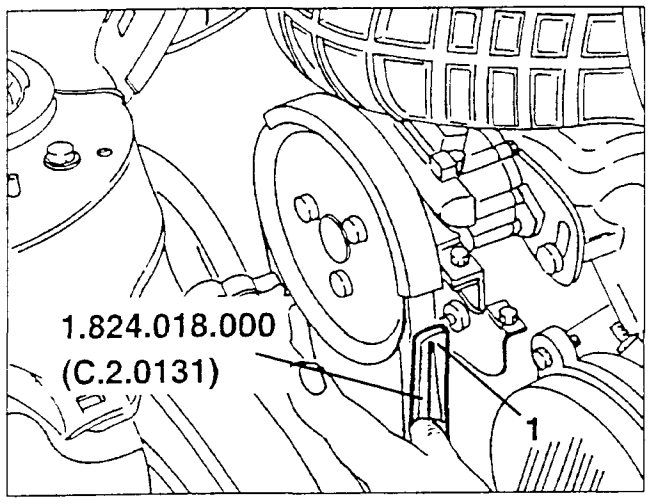


Replacement

- Set the car on a lift and raise it.
- Slacken the fastening screws and remove the lower engine guard.
- Remove the conditioner compressor drive belt from the pulley.
- Lower the car.
- Slacken the screws fastening the air cleaner and turn it over without removing the sleeves.
- Slacken the two alternator fastening bolts (See "Checking and tensioning") and remove the belt.
- Install a new belt reversing the procedure described for removal and tension it following the procedure given in the previous paragraph.
- Complete re-assembly taking care to tension the conditioner compressor belt (see specific paragraph).

Power steering pump drive belt

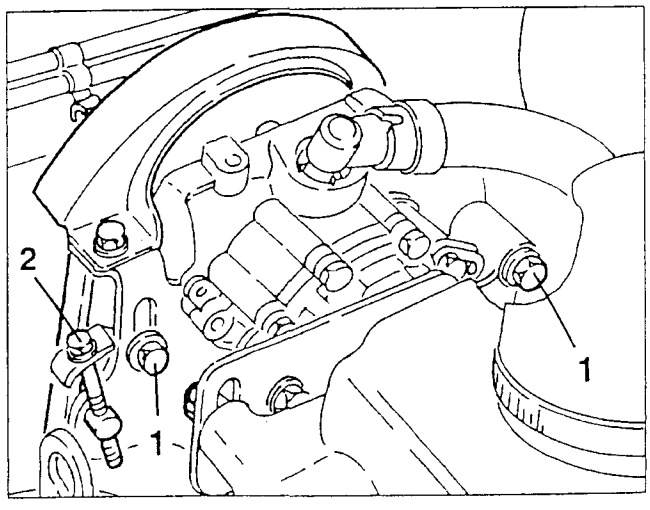
- Slacken the air cleaner fastening screws and turn it over without disconnecting the sleeves.
1. Working as illustrated, measure the belt tension using tool N° 1.824.018.000 (C.2.0131).



Tension of belt "POLY-VK5" for power steering drive	
At assembly	400 ÷ 450 N
Retensioning	300 ÷ 350 N

NOTE:
The belt may be retensioned after a brief running-in period, proceeding as follows:
- bring the engine to normal operating temperature;
- run the engine for about 10 minutes;
- turn off the engine and wait for it to cool down;
- retension the belt to the specified value.

- If the tension found is incorrect, proceed as follows:
1. Slacken the power steering pump fastening screws.
2. Tension the belt correctly using the micrometric tensioner.

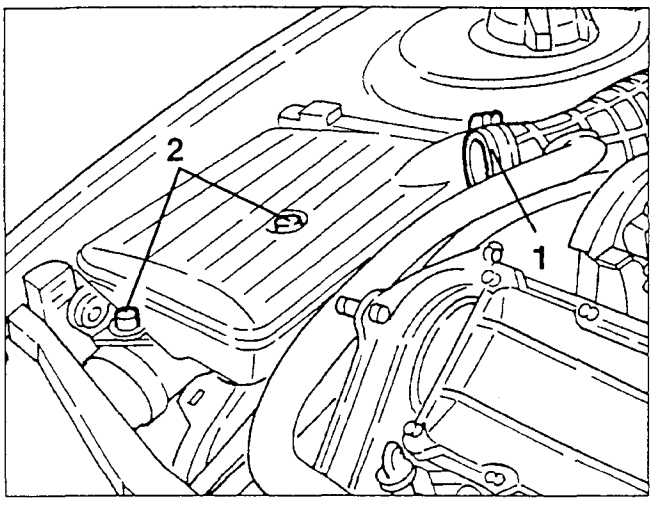


Replacement

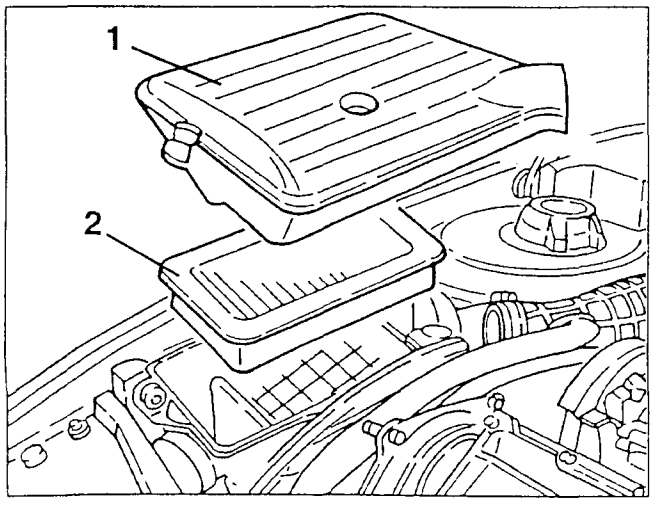
- Remove the alternator - water pump drive belt (see specific paragraph).
- Remove the power steering pump cover.
- Slacken the power steering pump fastening screws (see "Checking and tensioning").
- Lessen the tension of the power steering pump drive belt using the micrometric tensioner screw, then remove it.
- Install a new belt reversing the procedure described for removal and tension it following the procedure given in the previous paragraph.
- Complete refitting operations and tension the alternator - water pump drive belt and the conditioner compressor drive belt (see specific paragraphs).

CHECKING/CHANGING THE AIR CLEANER CARTRIDGE

1. Disconnect the corrugated sleeve from the air cleaner cover.
2. Slacken the air cleaner cover fastening screws.



1. Remove the air cleaner cover.
2. Remove the air cleaner cartridge.



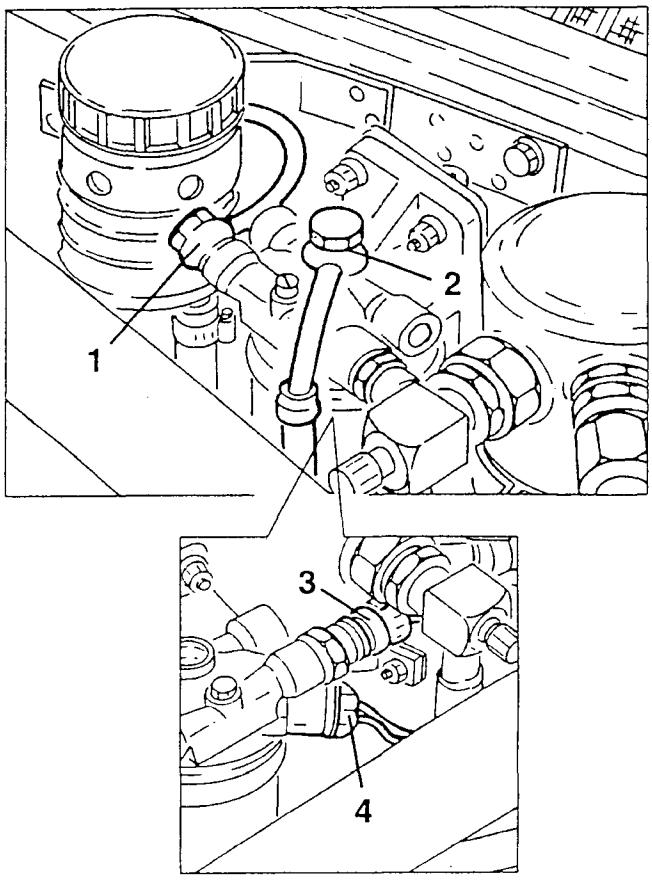
WARNING:
Any filter cleaning operation might damage it, thereby jeopardising the correct operation of the engine supply system.

- Carefully clean the air cleaner cartridge container.
- Check the conditions of the cartridge and if necessary install a new one.
- Refit the cover and fasten with the corresponding screws.
- Connect the corrugated sleeve to the air cleaner cover.

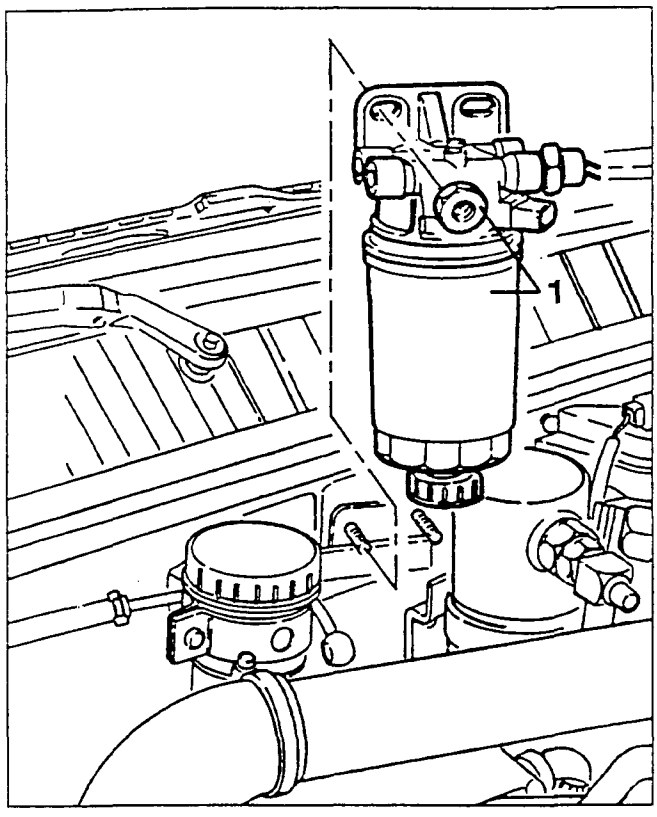
NOTE:
If the cleaner shows traces of oil, check for possible leaks in the entire air circuit.

CHANGING THE FUEL FILTER CARTRIDGE

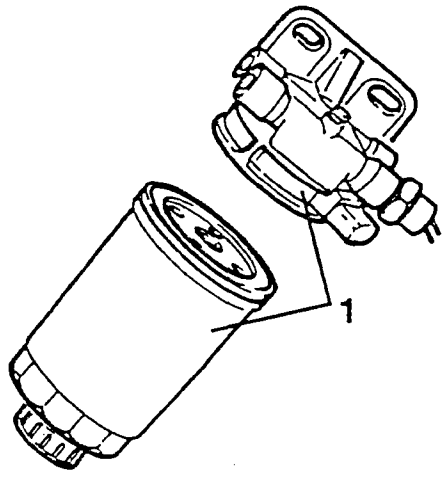
- Disconnect the battery (-) terminal.
1. Disconnect the connection of the tank fuel delivery hose from the filter.
2. Disconnect the connection of the fuel delivery hose to the injection pump from the filter.
3. Disconnect the electrical connection from the fuel warming device control sensor.
4. Disconnect the electrical connection for supplying the fuel warming device.



1. Slacken the two fastening nuts and remove the complete fuel filter.



1. On the bench slacken the fuel cartridge together with its support seal.

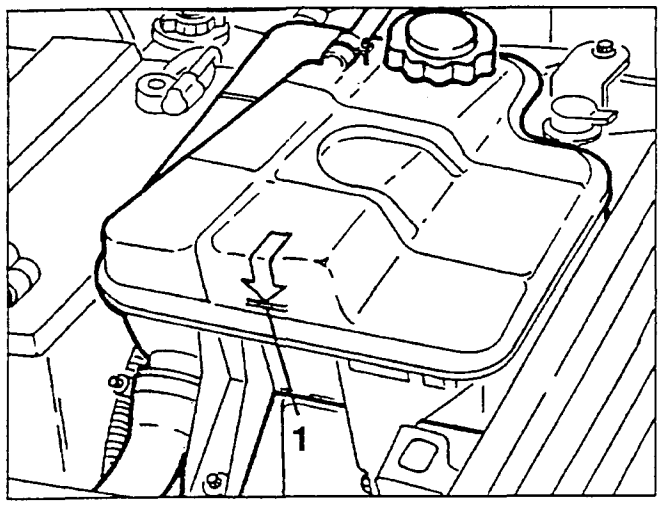


- Install a new cartridge with seal on the fuel filter support.
- Refit by reversing the procedure followed for removal.
- Purge air from the fuel supply system (see GROUP 10).

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

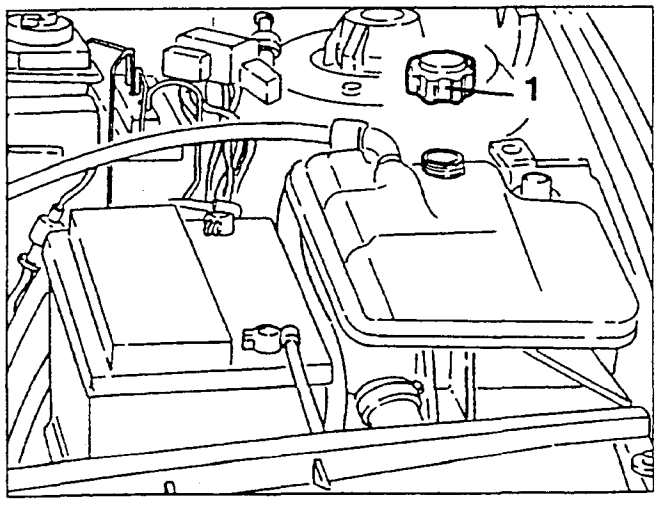
1. With the engine cold check that the level of the coolant in the header tank reaches the notch marked by the arrow and if necessary, top up with the specified fluid.



Draining and replenishing

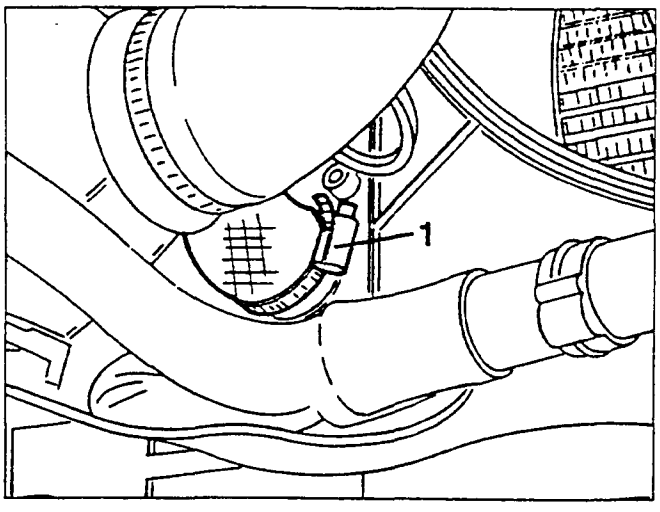
1. Slacken and remove the header tank plug.

Absolutely never remove the header tank plug when the engine is warm!



- Raise the car.
1. Drain the engine coolant fluid into a suitable recipient disconnecting the fluid outlet sleeve from the radiator.

WARNING:
The anti-freeze mixture used as coolant can harm the paintwork: therefore avoid any contact with painted components.



- Reconnect the sleeve to the radiator and any pipes that have been disconnected, checking that all the hose clamps are firmly tightened.
- Fill the header tank up to the mark.
- The type and indicative quantity of the coolant are given in the table below:

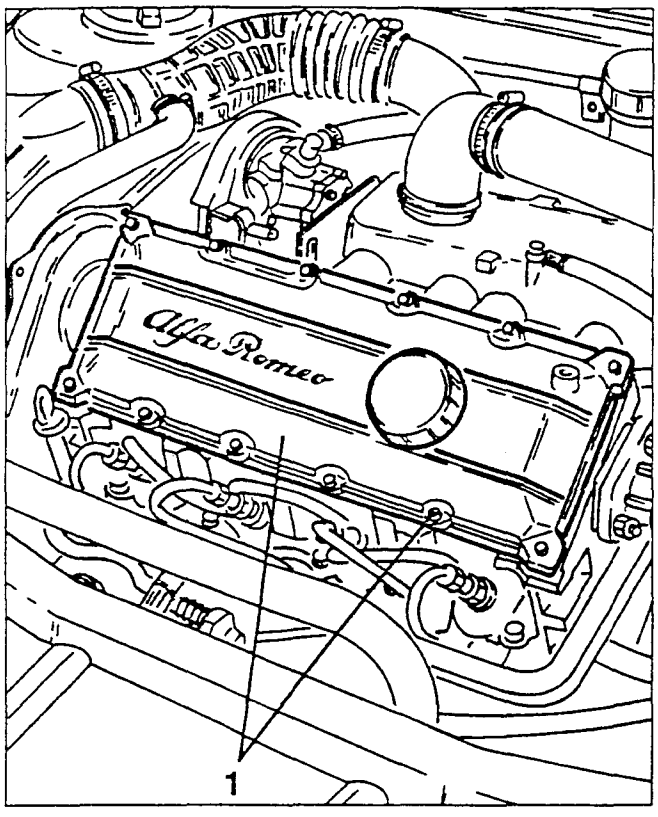
Alfa Romeo Climafluid Permanent -40°C	8.9 litres

- Start the engine and bring it to normal operating temperature so that the thermostat opens to release the amount of residual air in the circuit.
- With the engine cold, top up to the level indicated on the header tank.
- Retighten the pressurized cap on the header tank.

WARNING:
It is unwise to mix anti-freeze fluids of diferent types or brands!
Never use antirust additives: this might not be compatible with the anti-freeze in use!

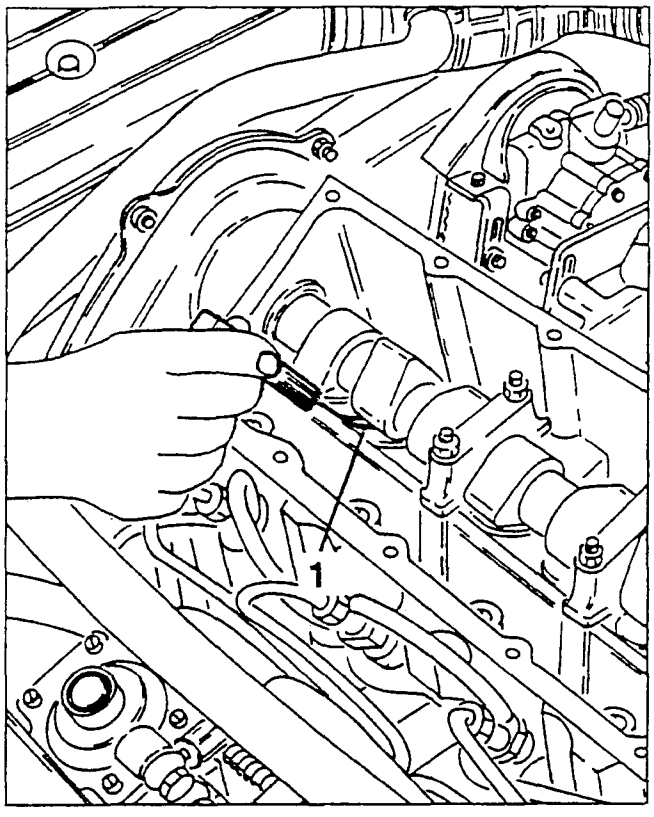
CHECKING AND ADJUSTING VALVE CLEARANCE

1. Unscrew the screws and remove the timing cover.
- Remove the gakset.

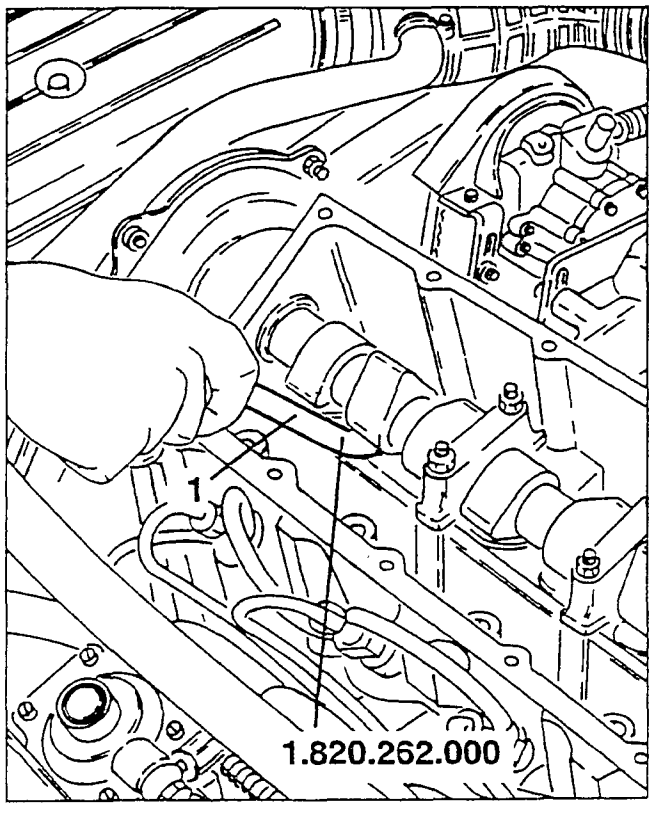


- Rotate the camshaft so that the intake and exhaust valves are in the closed position.
1. When the engine is cold, check that the clearance between the cam heel radius and the tappet falls within the prescribed limits.

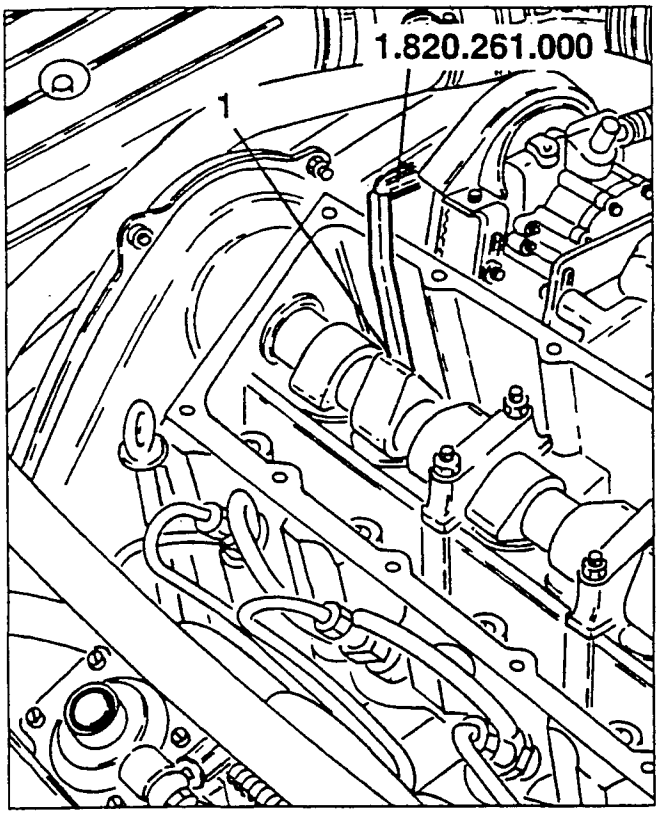
Operating valve clearance (when engine is cold)	
Intake	0.30 ± 0.05 mm
Exhaust	0.35 ± 0.05 mm



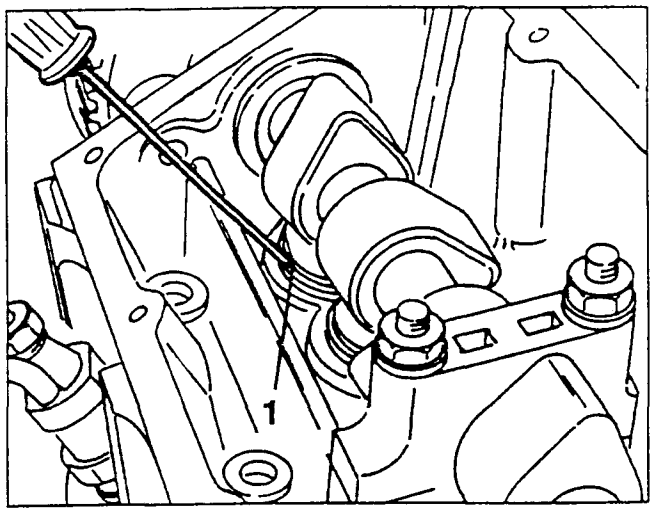
- If the valve clearance does not fall within the prescribed limits, proceed as follows:
1. Using the pressure lever N° 1.820.262.000 lower the tappets.



1. Position tappet support tool N° 1.820.261.000 and turn the notches on the edge of the tappet to facilitate the subsequent extraction of the regulating plate to be replaced.



1. Extract and remove the tappet regulating plate.



- Replace the plate removed beforehand with another which has the correct thickness to reset the correct valve clearance, then repeat the above mentioned operations for the remaining valves.

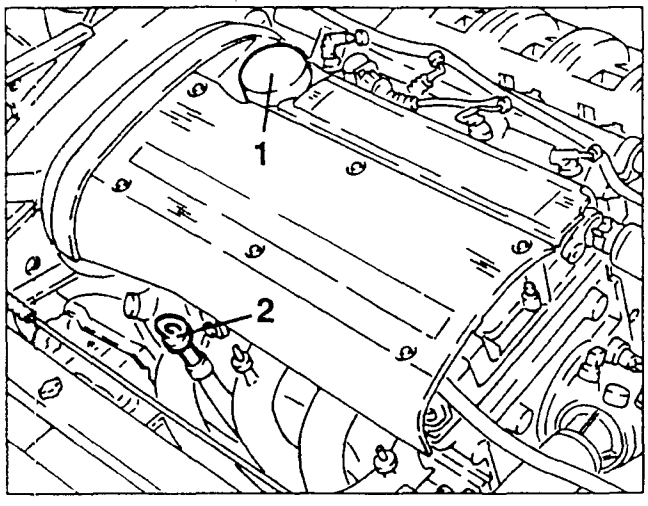
MAINTENANCE

1970 T. SPARK 16V ENGINE

CHANGING THE ENGINE OIL AND FILTER

WARNING:
Engine oil is harmful to the skin: minimise contact of the oil with the skin; if this does occur wash with soap and water.

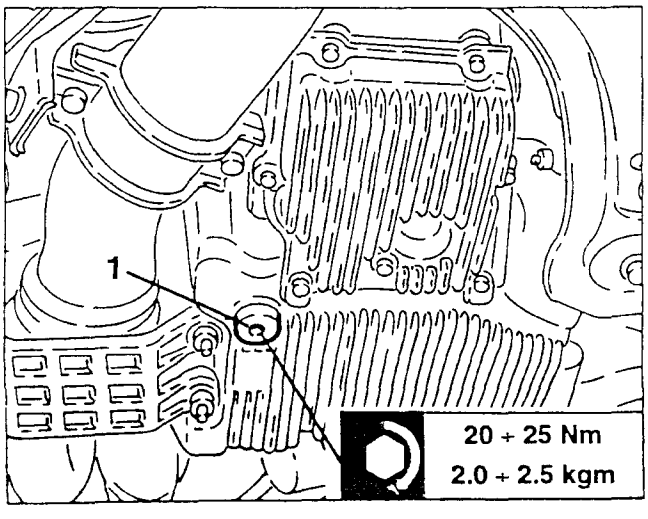
1. With the engine warm, remove the filler cap.
2. Withdraw the dipstick.



- Raise the car.

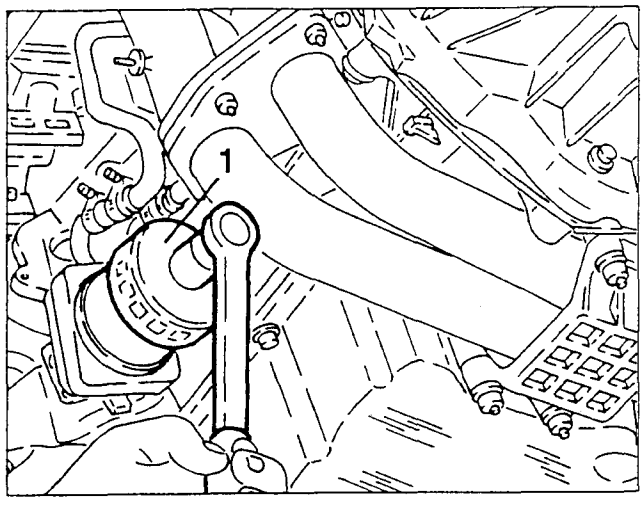
1. Remove the drain plug and drain off all the oil into a suitable recipient.

WARNING:
Be very careful when removing the drain plug; the oil might be very hot.



WARNING:
Never discard the oil in the environment as indiscriminate dumping causes pollution.

1. Working from underneath the car with the appropriate wrench, release the oil filter and remove it.



- Clean the drain plug and tighten it with the seal to the specified torque.
- Moisten the seal of the new filter and screw it on tightening fully by hand.
- Lower the car.
- Replenish the engine with oil of the type and in the quantity specified.
- Check that the oil level is correct with the dipstick.

WARNING:
The oil level should be checked with the car on level ground.
The oil level above the MAX mark can cause the oil to evaporate and loss of pressure.

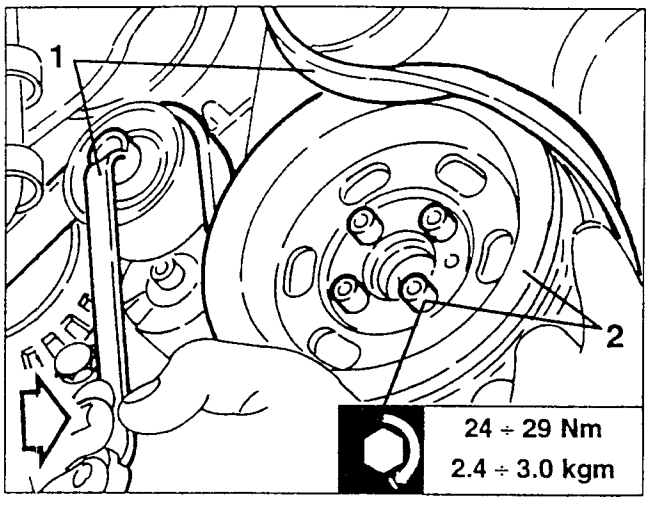
- Refit the filler cap, run the engine for appr. 2 minutes at idle speed, turn off the engine and wait for a few minutes.
- Check the oil level and make sure there are no leaks.

WARNING:
When refilling with oil, great care should be taken to prevent engine oil dripping into the alternator ventilation holes, as this could seriously damage the alternator and may cause fire.

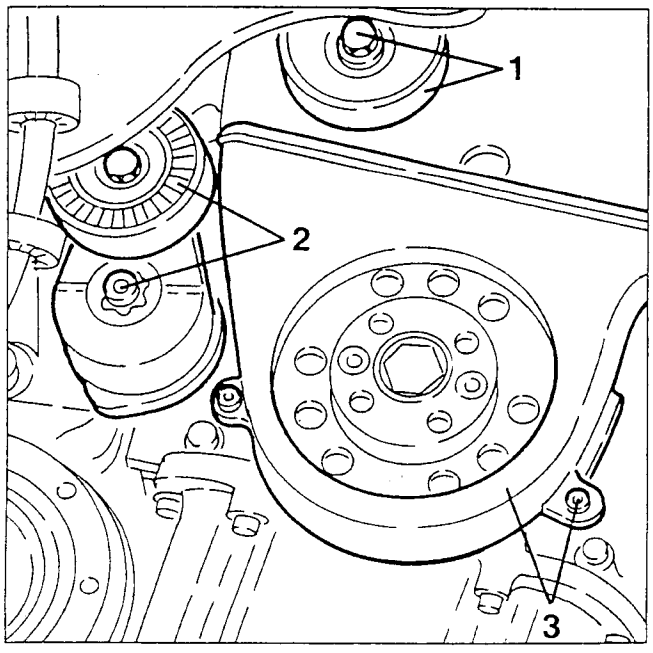
CHANGING THE TIMING GEAR BELT (For engines with counter-rotating shafts)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

1. Working as illustrated on the guide pulley, slacken the tension of the auxiliary components control belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components control belt.

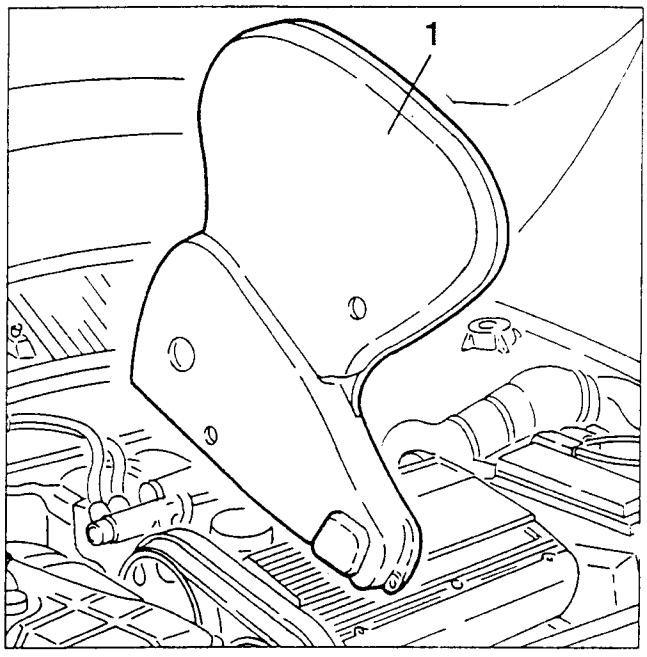


1. Slacken the fastening screw and remove the auxiliary components control belt guide pulley.
2. Slacken the fastening screw and remove the auxiliary components belt tensioner.
3. Slacken the fastening screws and remove the timing belts and counter-rotating shafts lower guard.

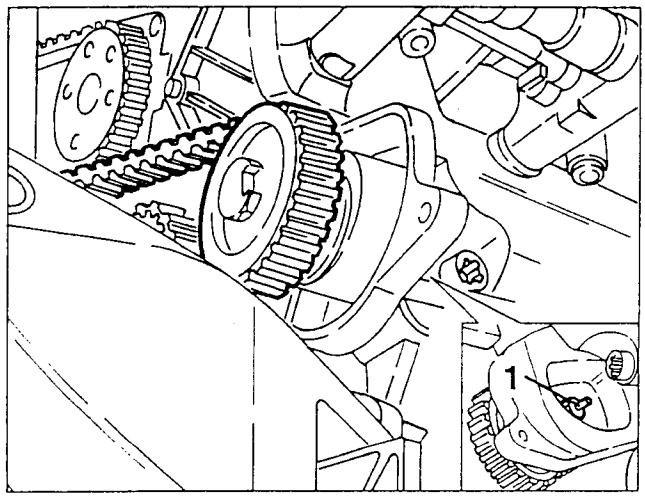


- Slacken the lower screws of the timing belts and counter- rotating shafts upper guard.

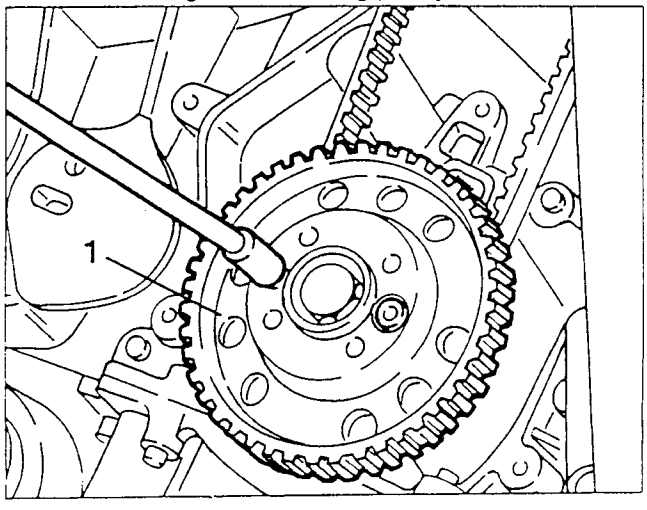
1. Lower the car, slackening the remaining fastening screws and remove the upper guard.



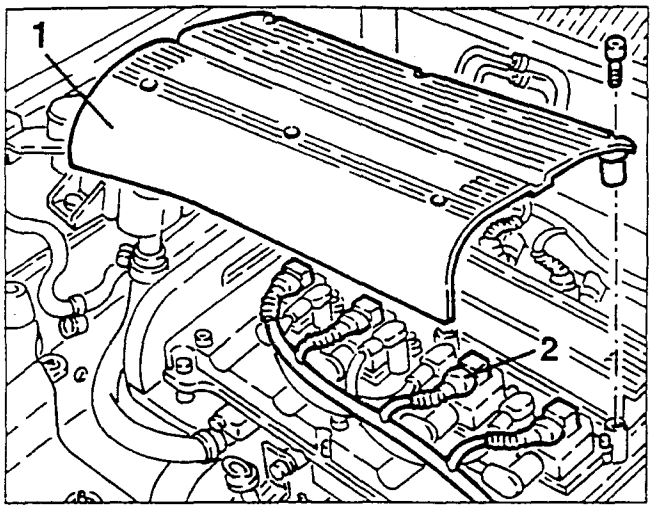
1. Slacken the tension of the counter-rotating shafts belt loosening the nut fastening the corresponding belt tensioner, then remove the belt.



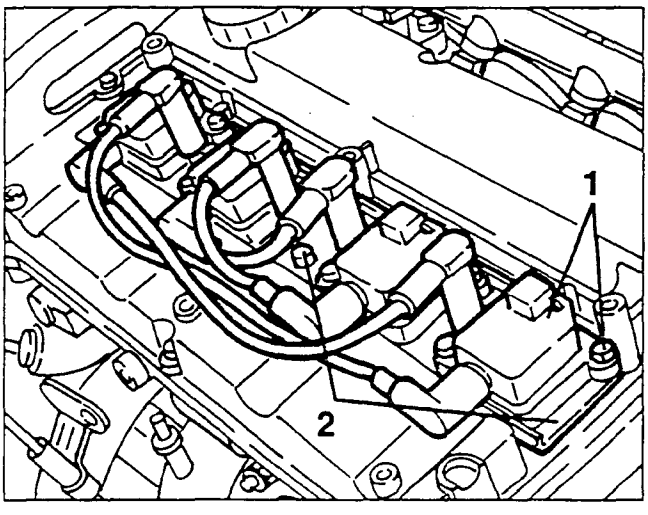
1. Slacken the two fastening screws and remove the counter-rotating shafts driving pulley.



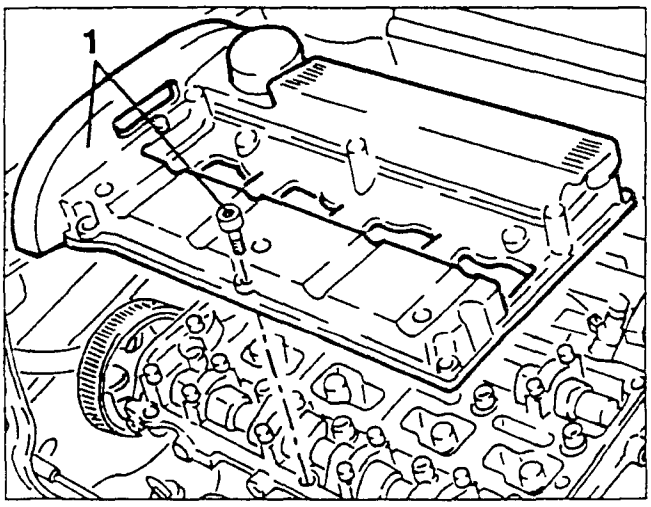
1. Slacken the fastening screws and remove the cover of the ignition coils.
2. Disconnect the electrical connections from the ignition coils.



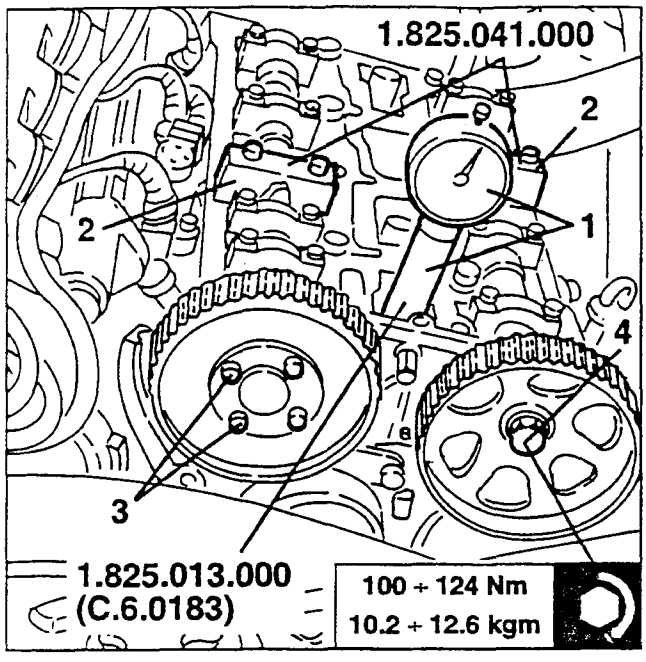
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



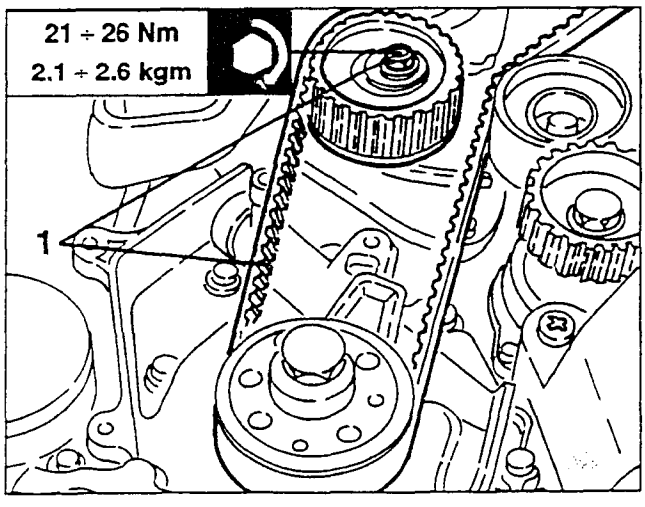
1. Slacken the fastening screws and remove the cylinder head cover complete with seal.



1. Install tool no. 1.825.013.000 (C.6.0183) fitted with dial gauge in the seat of the first cylinder spark plug.
- Turn the crankshaft in its direction of rotation, until the piston of the 1st cylinder reaches the T.D.C. in the bursting stroke.
2. Remove the camshaft caps illustrated and in their place install templates no. 1.825.041.000 tightening the fastening screws to a maximum torque of 10 Nm (1 kgm) and ensuring correct coupling with the cams.
3. Slacken the four screws fastening the camshaft pulley on the intake side.
4. Slacken the screw fastening the timing pulley on the exhaust side.



1. Working on the timing belt tensioner slacken the tension of the belt, then remove it.

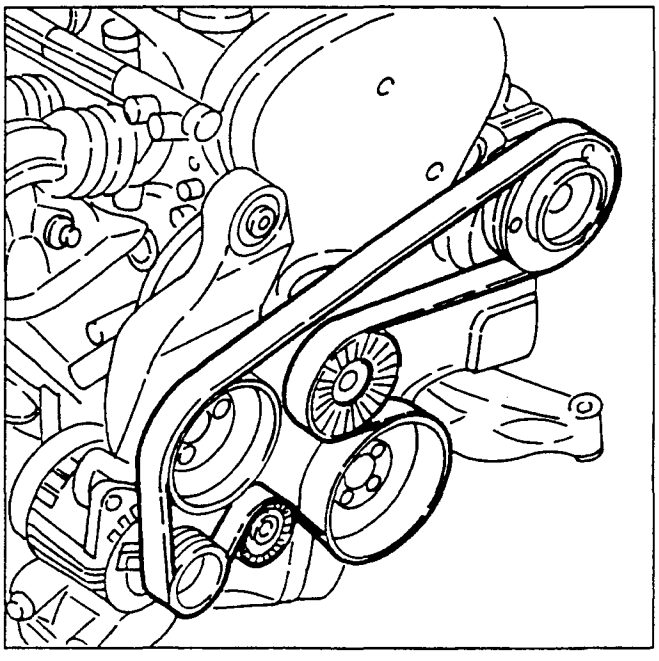


- Install a new timing belt proceeding as described in GROUP 10 - ENGINE OVERHAULING paragraph "Assembly of timing belt and checking timing".

- Install the counter-rotating shafts control belt proceeding as described in GROUP 10 - ENGINE OVERHAULING paragraph "Assembly of counter-rotating shafts control belt and timing".
- Complete re-assembly reversing the sequence followed for removal.

AUXILIARY COMPONENT BELT

The auxiliary components of the engine are driven by a single Poly V belt.
This belt is tensioned by an automatic tensioner: therefore checking the tension is unnecessary.



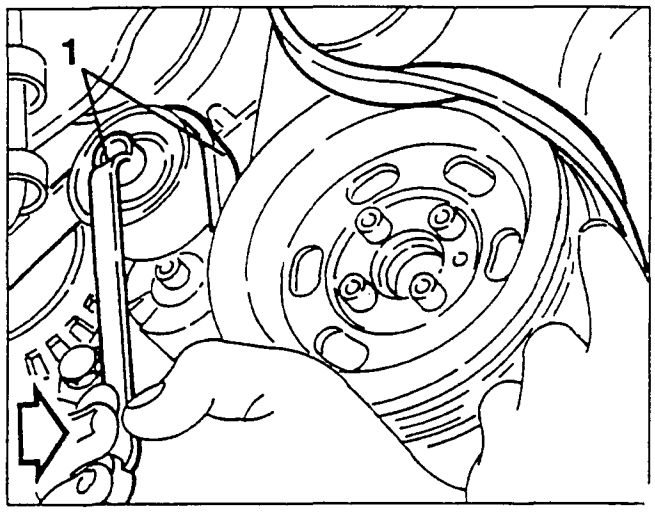
Replacement

- Set the car on a lift.
- Remove the right front wheel and mud flap.
- Check visually that the belt is intact and that it is free of:
• cuts
• cracks
• material surface wear (smooth and shiny)
• dry or stiff parts (lack of adherence).

In the event of one of the above defects, change the belt.

WARNING:
The contact of the belt with oil or solvents can damage the elasticity of the actual belt rubber and reduce its adherence.

1. Proceeding as illustrated on the guide pulley, slacken the tension of the auxiliary components drive belt and remove it.

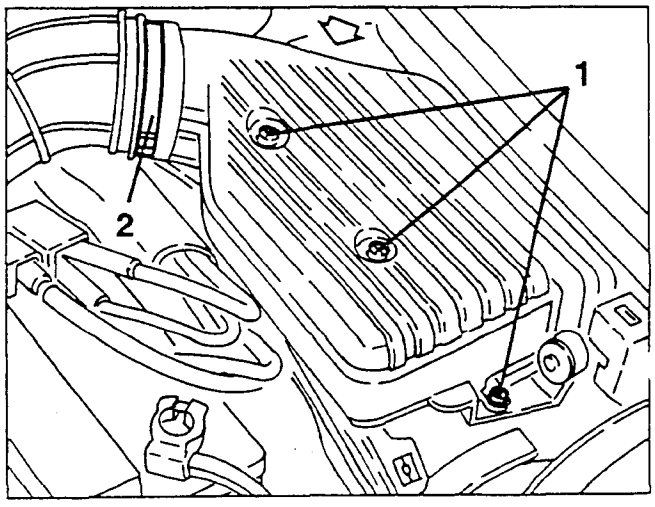


- Install a new belt reversing the sequence followed for removal.

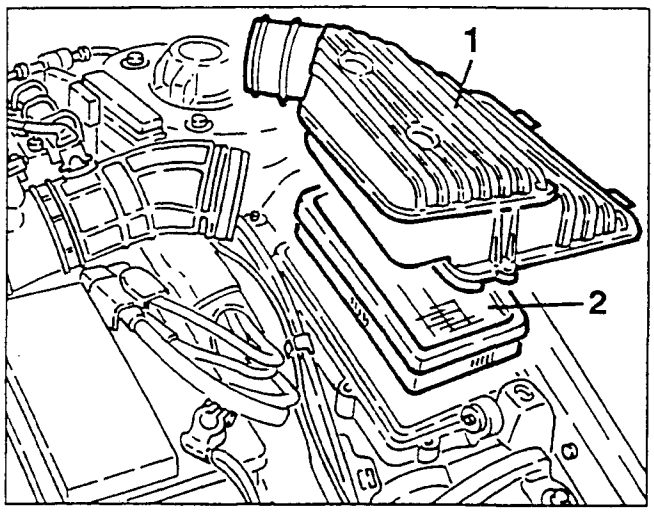
CHANGING THE AIR CLEANER CARTRIDGE

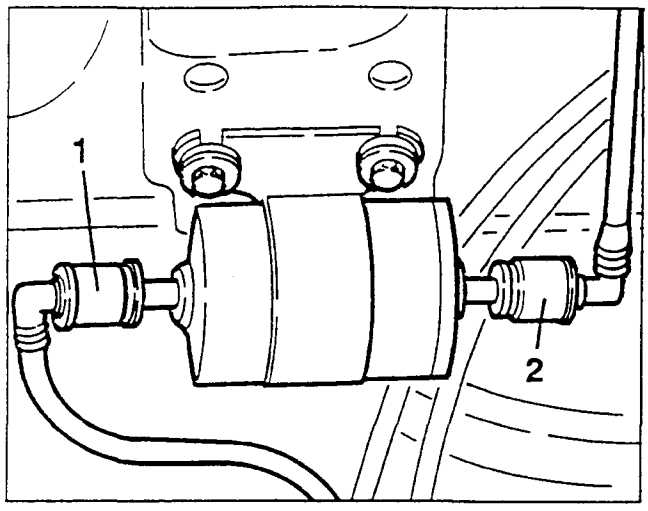
WARNING:
Any filter cleaning operation might damage it, thereby adversely affecting the correct operation of the engine.

1. Slacken the four air cleaner cover fastening screws.
2. Slacken the clamp fastening the air claner cover to the corrugated sleeve.



1. Remove the air cleaner cover.
2. Remove the air cleaner cartridge.

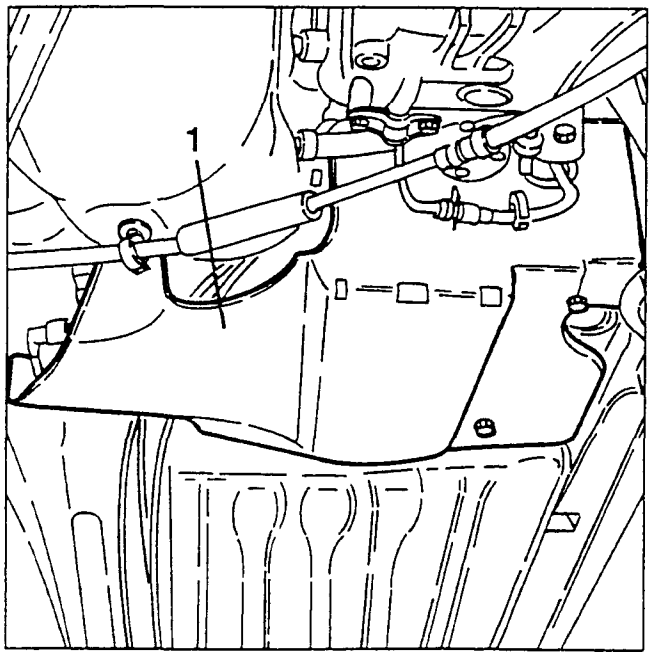




- Install the new filter so that the arrow stamped on it points in the direction of the flow of fuel.

REPLACEMENT THE FUEL FILTER

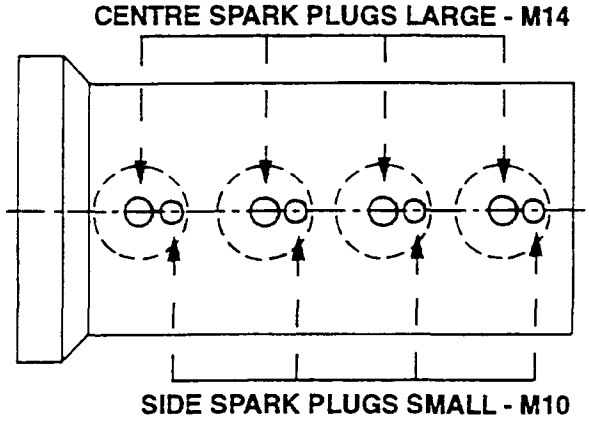
- Set the car on a lift and raise it.
1. Slacken the fastening screws and remove the plastic cover to gain access to the fuel filter.



1. Disconnect the connections of the fuel inlet and outlet pipes from the filter (for disconnecting operations see specific paragraph).
2. Slacken the two screws fastening the support bracket, then remove it complete with fuel filter.
- Separate the fuel filter from the support bracket on the bench.

CHECKING AND CHANGING SPARK PLUGS

The standard spark plugs are of the surface discharge type with one point and a centre electrode.
In order to operate correctly, the gap between the electrodes must be correct.
The spark plugs are positioned in the bursting chamber asymmetrically and they differ in size as illustrated below.



Spark plugs	
Centre spark plugs (large - M14)	NGK PFR6B
Side spark plugs (small - M10)	NGK PMR7A

- With the engine cold, remove the spark plugs, firstly blowing inside the spark plug openings to remove any impurities and traces of dirt.

- Check the spark plugs for dirt and the ceramic insulation for breaks. In this case replace the spark plugs.

WARNING:
The use of spark plugs with different characteristics or sizes than those specified can cause serious damage to the engine and change the level of harmful emission at the exhaust.

WARNING:
A dirty or worn out spark plug is often the sign of a failure in the engine supply system.
For example:
- **Traces of carbon dust: incorrect mixture, air cleaner very dirty.**
- **Spots of oil: oil leaking from the piston rings.**
- **Formation of ash: presence of aluminium materials, contained in the oil.**
- **Burnt electrodes: overheating due to unsuitable fuel, defects in the valves.**
- **High electrode wear: harmful additives in the fuel or in the oil, pinging in the cylinder head.**
- **Etc.**

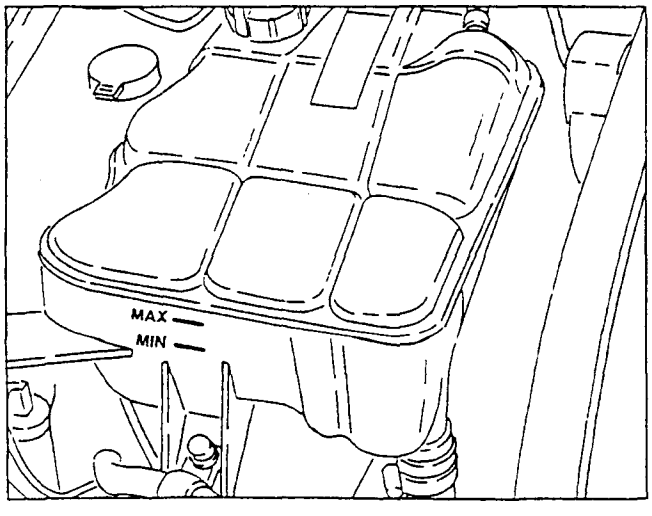
- When installing, tighten the spark plugs to the following torque:

Centre spark plugs (large)	25 ÷ 35 Nm 2.5 ÷ 3.6 kgm
Side spark plugs (small)	10 ÷ 12 Nm 1 ÷ 1.2 kgm

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

- With the engine cold, check that the level in the coolant in the header tank is between the MIN and MAX marks.



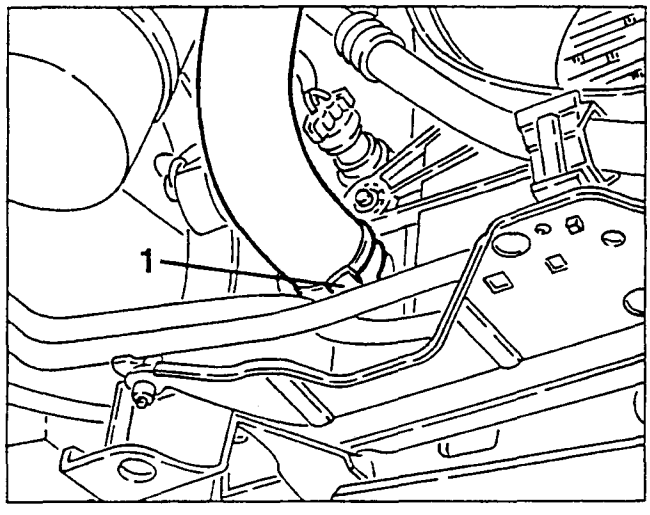
Draining and replenishing

- Set the car on a lift.
- Slacken and remove the header tank plug.

WARNING:
Absolutely never remove the header tank plug when the engine is hot!

- Raise the car.
1. Slacken the radiator outlet hose and drain the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can harm the paintwork: therefore avoid any contact with painted components.



- Reconnect the sleeve to the radiator and any disconnected pipes, checking that all the clamps are firmly tightened.
- Fill the header tank to the MAX mark with fluid of the specified type and quantity.
- Start the engine and bring it to normal operating temperature so that the thermostat opens to release the amount of residual air in the circuit.
- With the engine cold, top up to the MAX mark on the header tank.
- Retighten the pressurised cap on the header tank.

WARNING:
It is unwise to mix anti-freeze fluids of different types or brands!
Never use antirust additives: they might not be compatible with the anti-freeze in use!

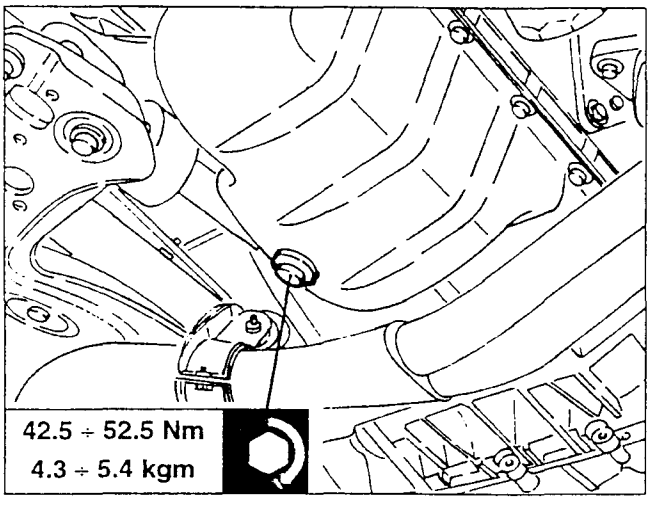
ENGINES MAINTENANCE

1370 1598 1747 T. SPARK 16V

Below the differences compared with the **1970 T.Spark 16V** are given.
Reference should be made to the above engine for items not mentioned here.

CHANGING THE ENGINE OIL AND FILTER

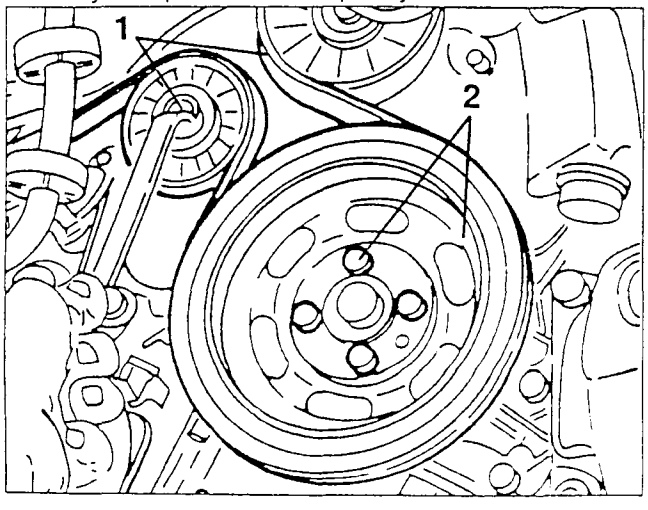
Proceed as described for the **1970 T.Spark 16V** engine bearing in mind that for the **1370 T.Spark 16V** engine a sheet metal oil sump has been used instead of the aluminium one, as illustrated.



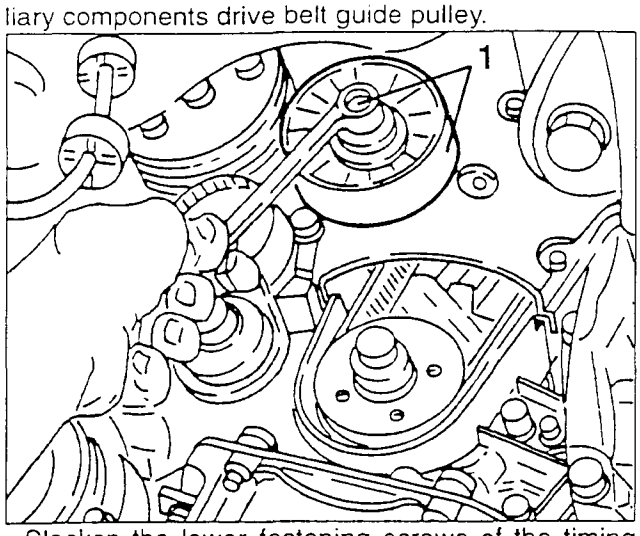
CHANGING THE TIMING GEAR DRIVE BELT (For engines without counter-rotating shafts)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

1. Working as illustrated on the guide pulley, slacken the tension of the auxiliary components drive belt and prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.

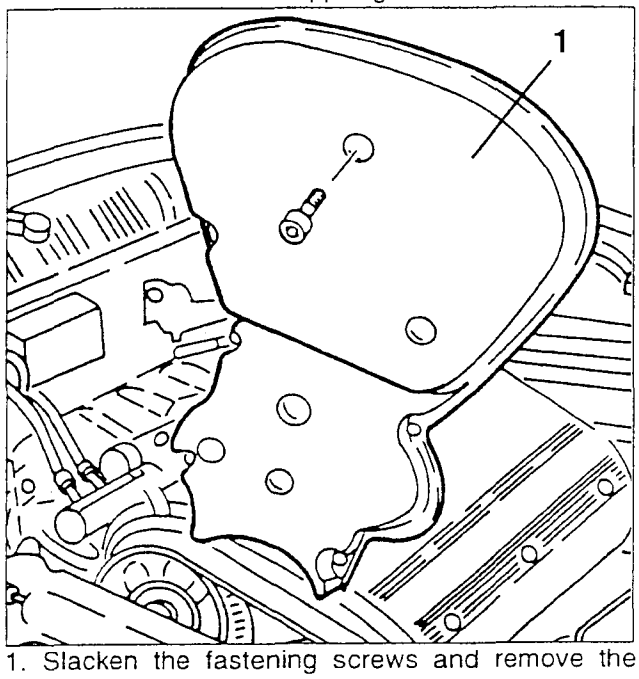


1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.

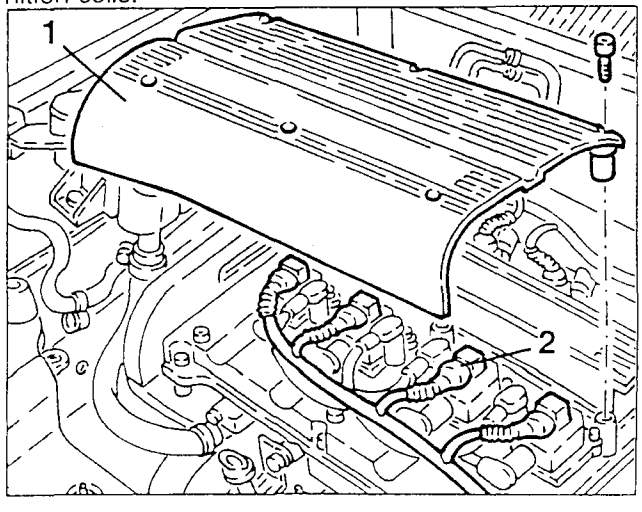


- Slacken the lower fastening screws of the timing gear drive belt guard.

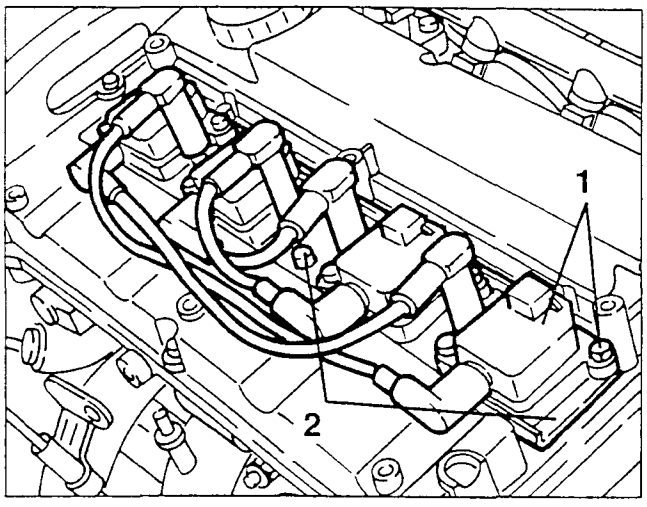
1. Lower the car, slacken the remaining fastening screws and remove the upper guard.



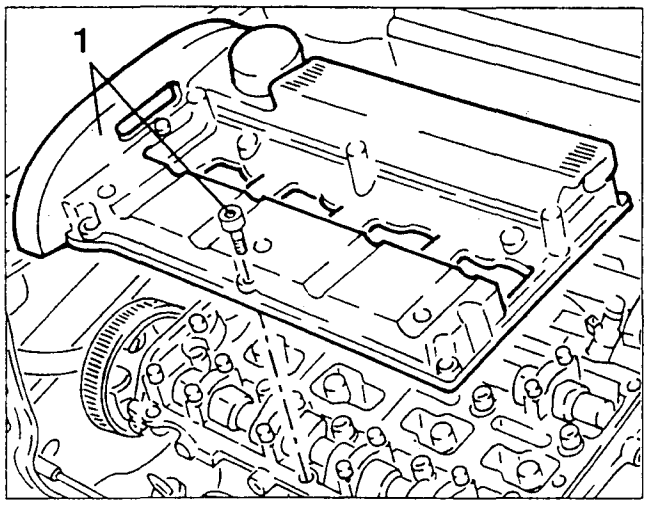
1. Slacken the fastening screws and remove the ignition coil cover.
2. Disconnect the electrical connections from the ignition coils.



1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coil support bracket.

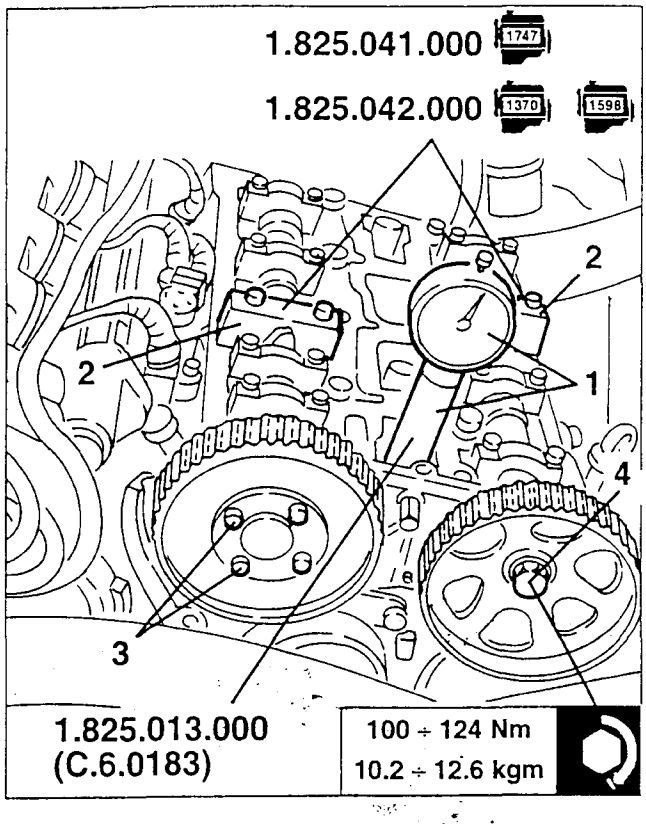


1. Slacken the fastening screws and remove the cylinder head cover complete with seals.

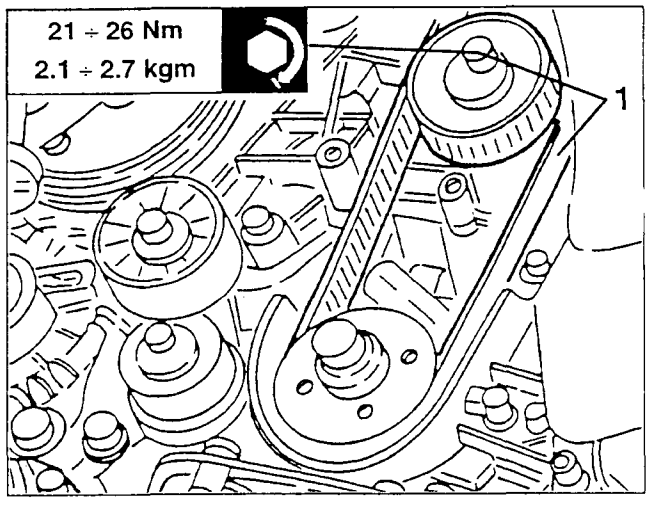


1. Install tool no. 1.825.013.000 (C.6.0183) fitted with dial gauge in the spark plug adaptor of the first cylinder.
- Turn the crankshaft in its normal direction of rotation, until the piston of the 1st cylinder reaches T.D.C. in the bursting stroke.
2. Remove the camshaft caps illustrated and in place of them install the templates, tightening the fastening screws to a maximum torque of 10 Nm (1 kgm) and making sure they mate correctly with the cams.

3. Slacken the four screws fastening the intake side timing gear pulley.
4. Slacken the screw fastening the exhaust side timing gear pulley.



1. Working on the timing gear belt tensioner, slacken the tension of the belt, then remove it.



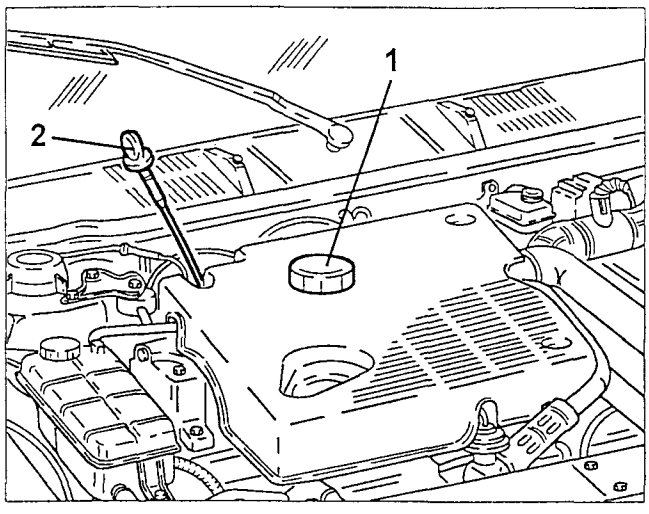
- Install a timing gear drive belt as described in the volume "ENGINE OVERHAULING" in paragraph "Assembling the timing gear drive belt and checking valve gear timing".
- Complete reassembly reversing the seuqence followed for removal.

ENGINE MAINTENANCE
1910 JTD

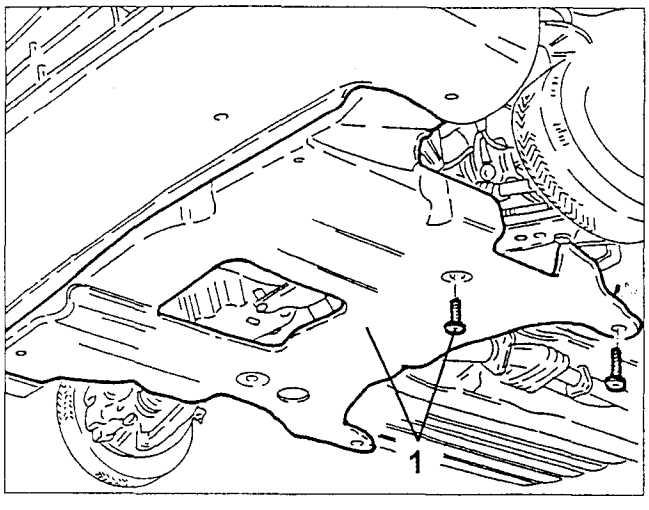
REPLACEMENT OF ENGINE OIL AND FILTER

ATTENTION: The engine oil hurts the skin. Avoid contact as much as possible. Should contact occur, wash thoroughly with soap and water.

- Place the car onto the carlift.
1. At warm engine, remove the refilling cap.
2. Pull out the level indicator of the engine oil.



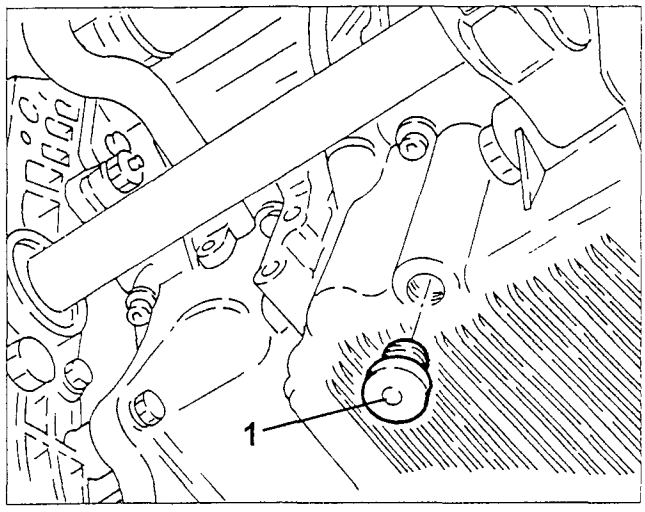
- Lift the car.
1. Unscrew the clamps and remove the under-engine protection.



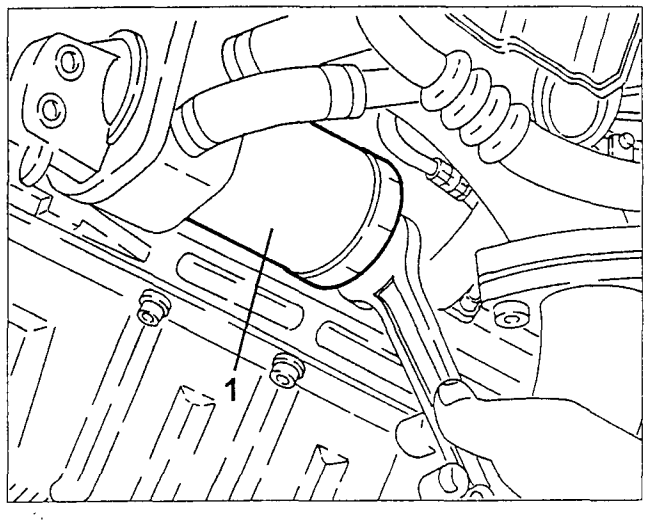
1. Unscrew the discharge cap and let the oil drain out completely into a proper container.

ATTENTION: During the removal of the discharge cap be cautious: the oil could be hot.

ATTENTION: Do not waste the oil into the environment: it causes pollution.



1. Operating from underneath the car and with the appropriate wrench, unblock the oil filter and remove it.



- Clean the discharge cap and screw it with its gasket according to the prescribed torque.
- Damp with the engine oil the gasket of the new filter and screw it by hand.
- Lower the car.
- Supply the engine with oil of the prescribed type and quantity.

ATTENTION: During refilling operations, be careful to avoid accidental oil leaking into the alternator's louvers; this may cause severe damage and fire danger.

- Check the correct oil level with the oil indicator.

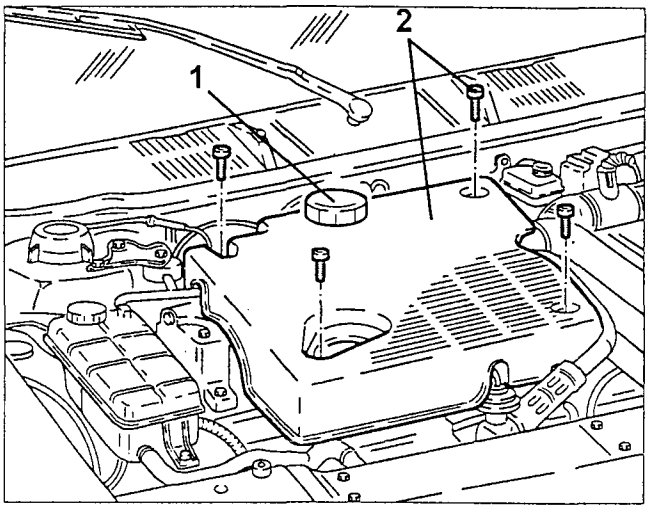
NOTICE: The check of the oil level is to be performed with the car in flat position.

The oil level surpassing the MAX notch may cause excessive evaporation of the oil itself and hence a pressure loss.

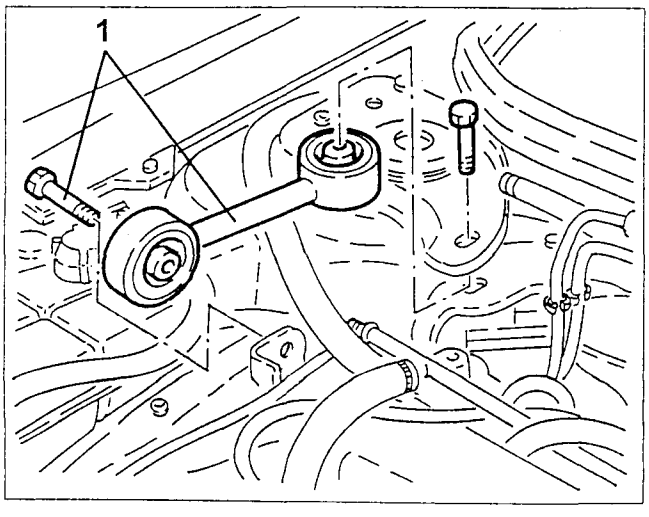
- Mount the refiling cap back, let the engine run for about 2 minutes, stop the engine and wait for a few minutes.
- Check the oil level and be sure there are no oil leakages.
- Mount the under-engine protection and clamp it.
- Move the car from the carlift.

REPLACEMENT OF THE TRANSMISSION CONTROL BELT

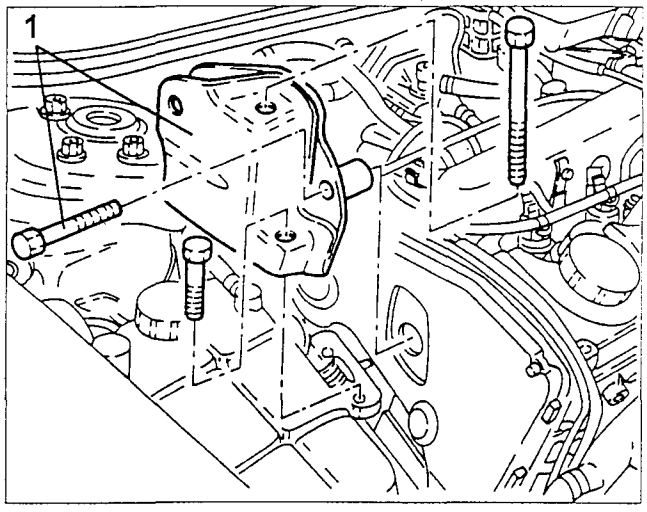
- Place the car onto the carlift.
1. Remove the supply cap of the engine oil.
2. Unscrew the clamping screws and remove the engine cover.
- Mount the supply cap of the engine oil back.



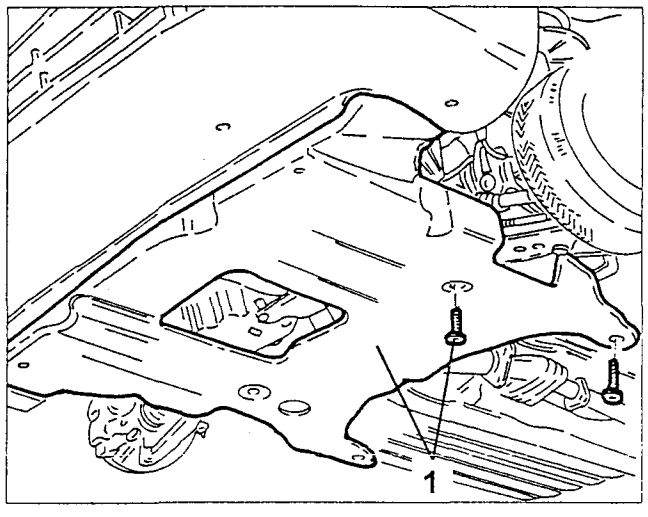
1. Unscrew the clamping screws and remove the reaction tightener of the motor propeller group.



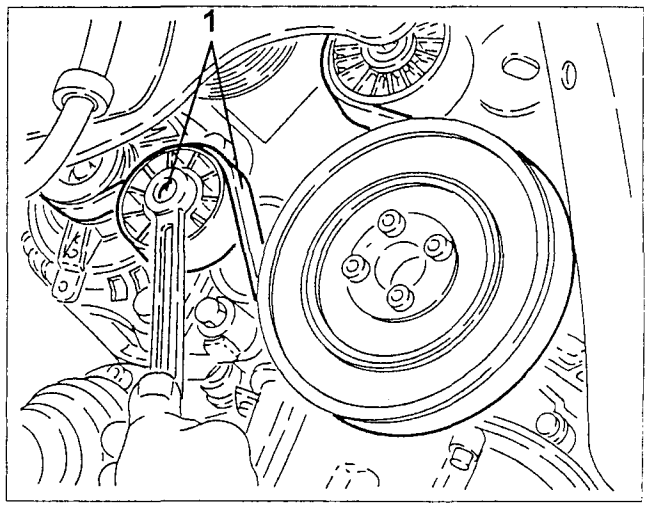
1. Unscrew the clamping screws and remove the bracket onto the engine's side which supports the reaction tightener.



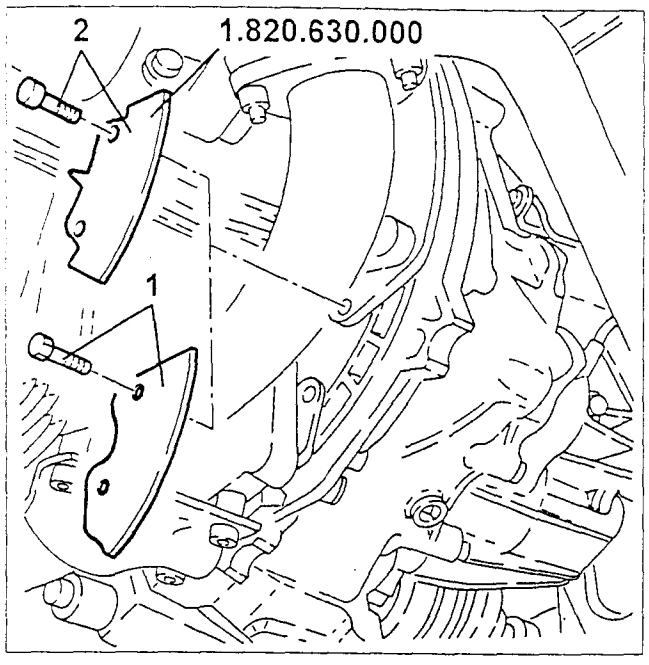
- Remove the front righthand wheel and the corresponding fender.
1. Unscrew the clamps and remove the under-engine protection.



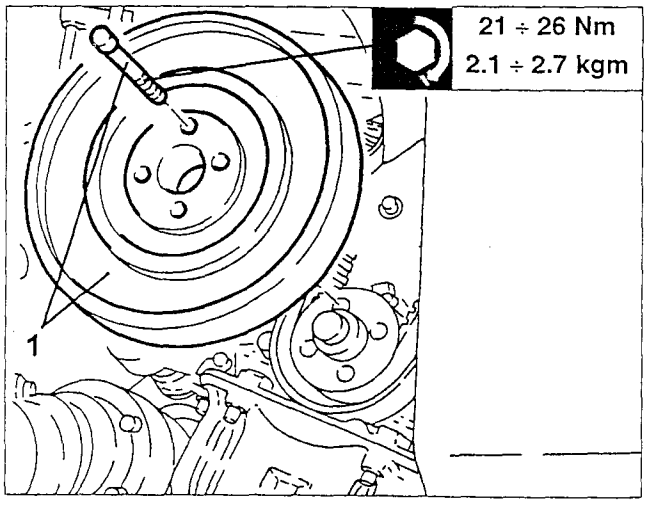
1. By acting on the tightener as shown in the figure, loosen the tension of the engine belt and remove it.



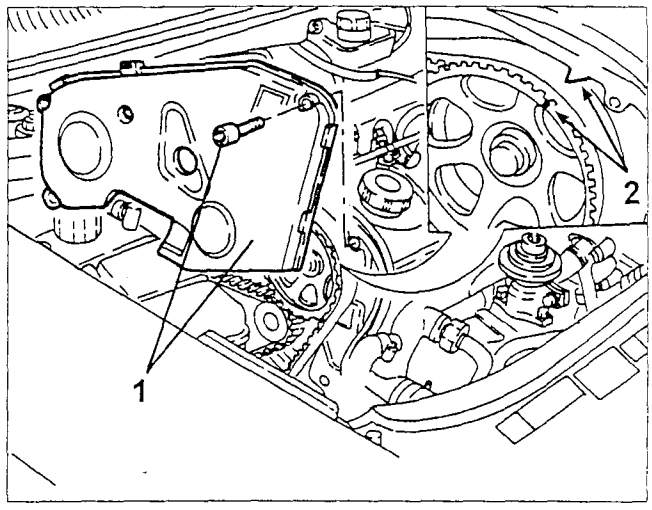
1. Unscrew the screws and remove the lower protection of the engine flywheel.
2. Mount the tool to stop the flywheel N° 1.820.630.000.



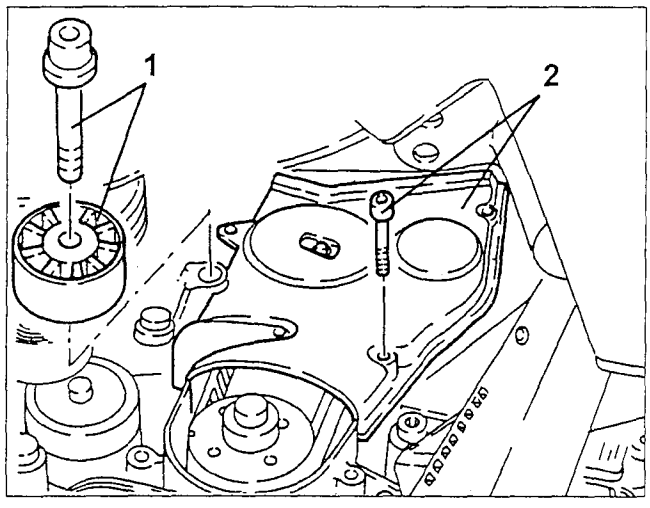
1. Unscrew the clamping screws and remove the driving shaft pulley.



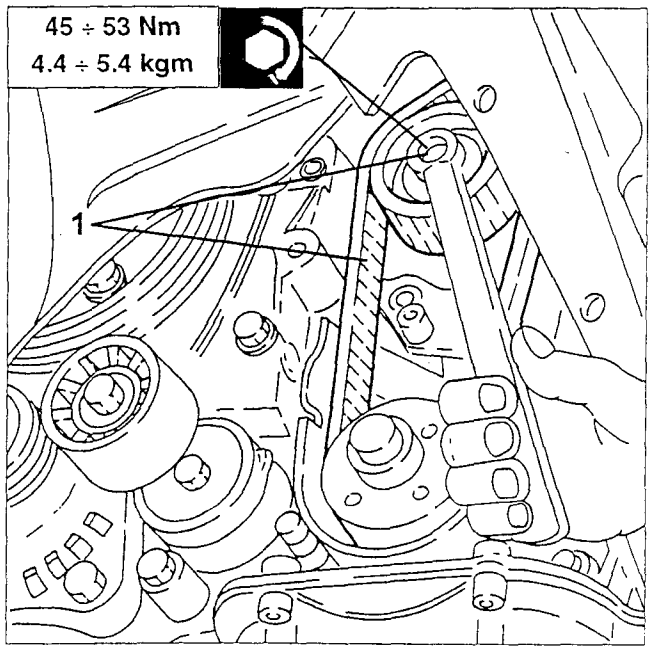
1. Unscrew the clamping screws and remove the upper protection of the transmission belt.
2. By acting onto the screw of the transmission pulley, make the driving shaft rotate till the timing references are aligned (1° cylinder at the TDC).



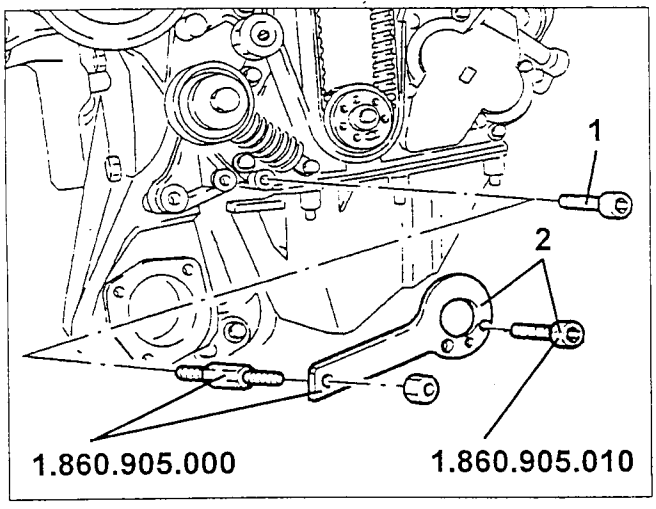
1. Unscrew the clamping screw and remove the fixed tightener of the engine belt.
2. Unscrew the clamping screws and remove the lower protection of the transmission belt.



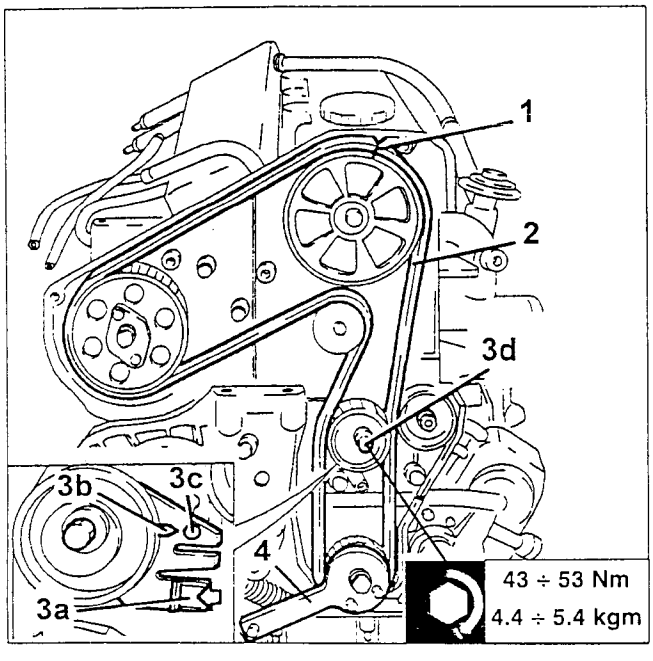
1. Loosen the clamping nut of the tightener of the transmission belt and hence remove the transmission belt itself.



1. Remove the clamping screw of the front cover of the cylinder block as shown in the figure.
- Mount provisionally a new transmission belt onto the pulley.
2. Mount the tool N° 1.860.905.000 and clamp it with the calibrated screw N° 1.860.905.010.



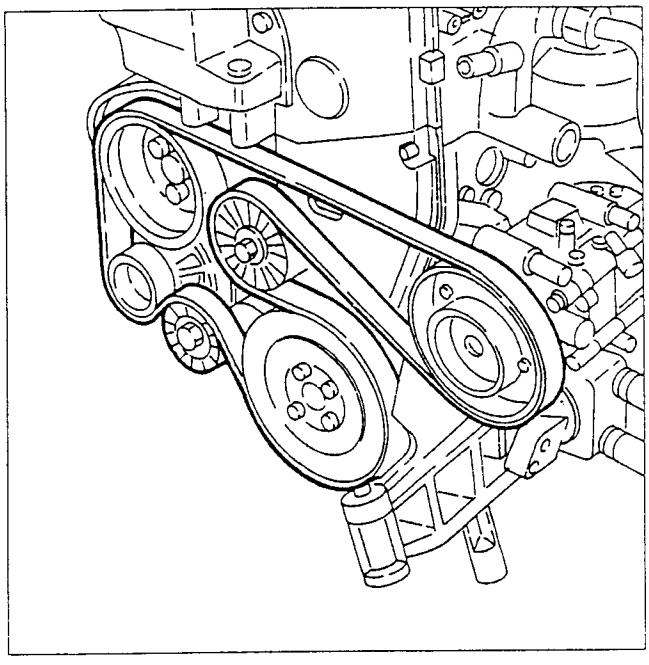
1. Check the collimation of the timing references.
2. Insert the transmission belt completely.
3. With a screwdriver in the hole (3a) move the pointer of the tightener (3b) till to the reference hole (3c) and in this position block the nut (3d) of the tightener according to the prescribed torque.
4. Remove the tools for the engine timing.
- Tighten the screw of the cylinder block front cover which had been previously removed.



- Make the driving shaft perform two revs.
- Check again the collimation of the timing references and the tightening references onto the transmission tightener.
- Complete the reattachment by performing the reverse procedure applied for the detachment.

AUXILIARY MEMBERS' BELT

The command to the auxiliary members of the engine is transmitted through a single belt of the Poly V type.
The tightening of the above-mentioned belt occurs through an automatic tightener: therefore the tightening check is not required.

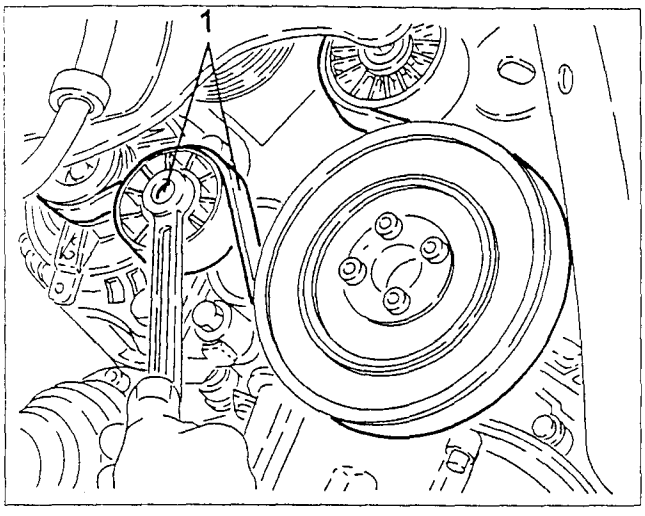


Replacement

- Place the car onto the carlift.
- Remove the front righthand wheel and corresponding fender.
- Visually check the integrity of the belt and in particular the absence of cuts, cracks, surface wear and tear of the material and of dried and stiffened parts. In case just one of the above-mentioned defects may occur, replace the belt.

ATTENTION: The contact of the belt with oil or solvents can damage the elasticity of the belt rubber and reduce its adhesion.

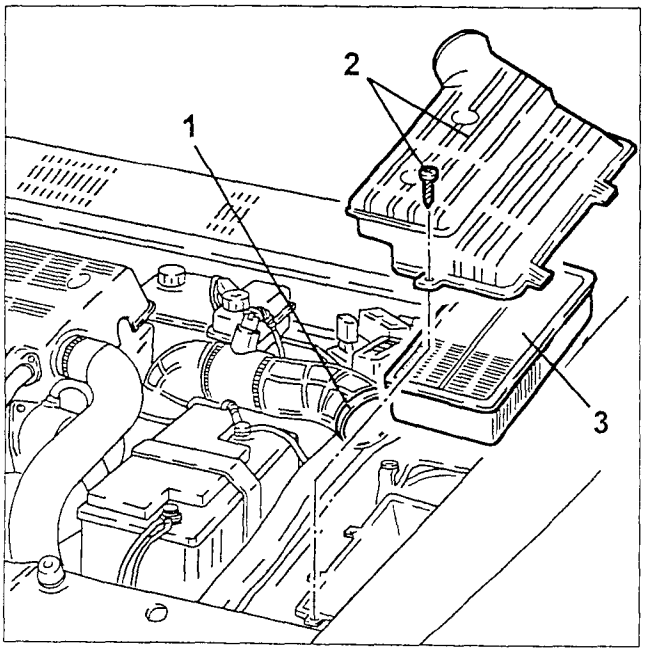
1. By acting onto the tightener as shown in the figure, loosen the tightening of the belt of the engine members and remove it.



- Mount a new belt following the reverse procedure.

REPLACEMENT OF THE AIR FILTER CARTRIDGE

1. Loosen the hose clamp of the corrugated sleeve to theair filter cover.
2. Unscrew the clamping screws and remove the air filter cover.
3. Remove the air filter cartridge.

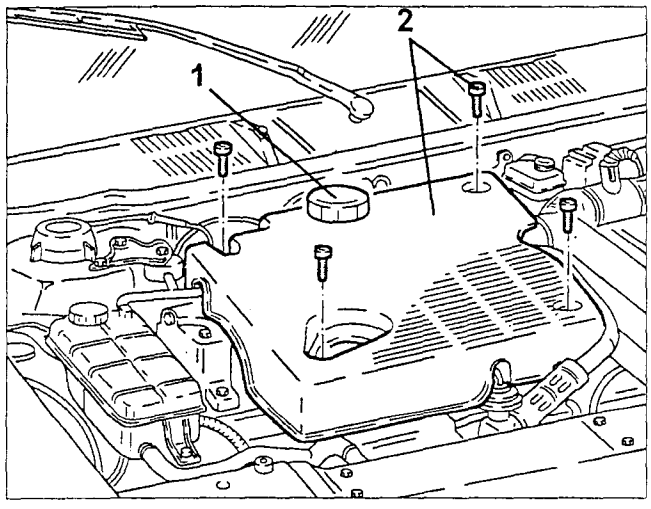


WARNING: Any cleansing operation of the filter can damage it and hurt the correct functioning of the engine feeding system.

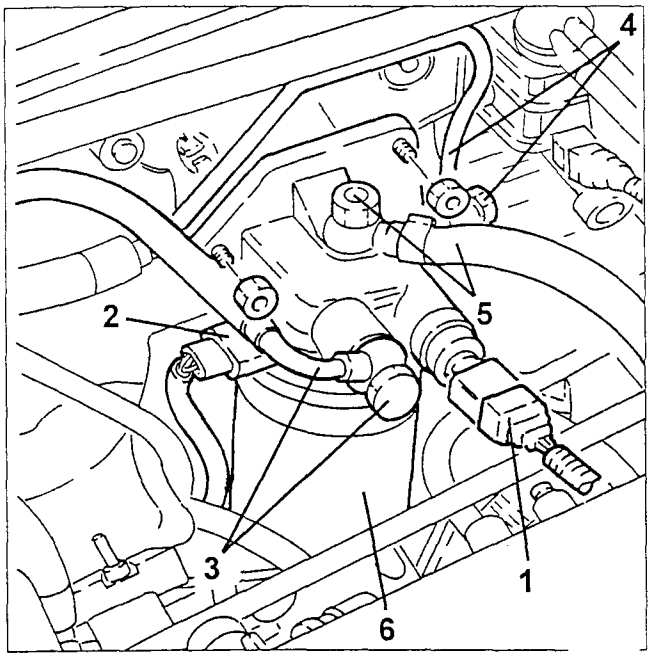
- Clean thoroughly the container of the air filter cartridge.
- Check the conditions of the cartridge and, if necessary, replace it.
- Mount the cover of the air filter and fix it with the corresponding screws.
- Tighten the hose clamp of the corrugated sleeve to the cover of the air filter.

REPLACEMENT OF THE FUEL FILTER CARTRIDGE

- Be sure the key is onto the "STOP" position, hence disconnect the battery terminal (-).
1. Remove the supply cap of the engine oil.
2. Unscrew the clamping screws and remove the engine cover.

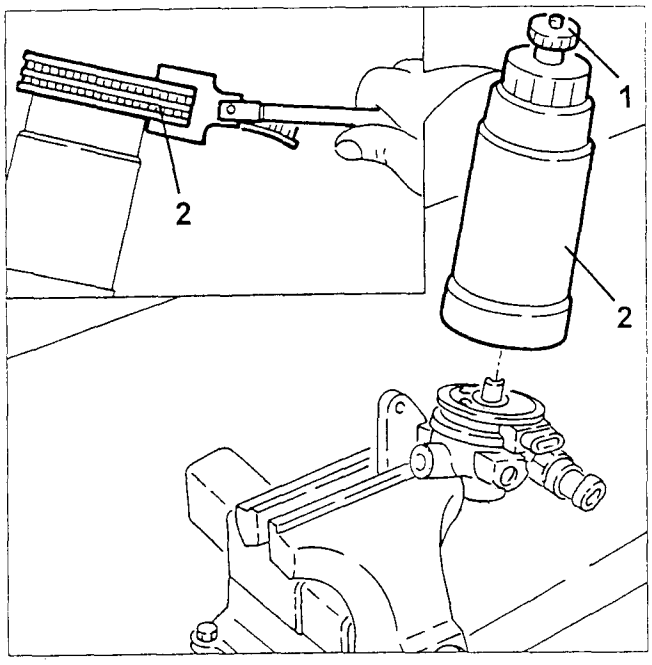


1. Disconnect the electrical connection from the thermal switch for the fuel heater.
2. Diconnect the electrical connection from the fuel pre-heating device.
3. Unscrew the pipe and disconnect the fuel pipe from the fuel filter.
4. Unscrew the pipe and disconnect the pipe to the pressure pump from the fuel filter.
5. Unscrew the pipe and dsconnect the pipe to the return manifold from the fuel filter.
6. Unscrew the clamping nuts and remove the complete fuel filter.



- Place the complete fuel filter with the co pon-ding protection jaws.
1. Remove the water discharge cap from the fuel filter.
2. Unscrew and remove the filtering element of the fuel filter by means of the correct tool.

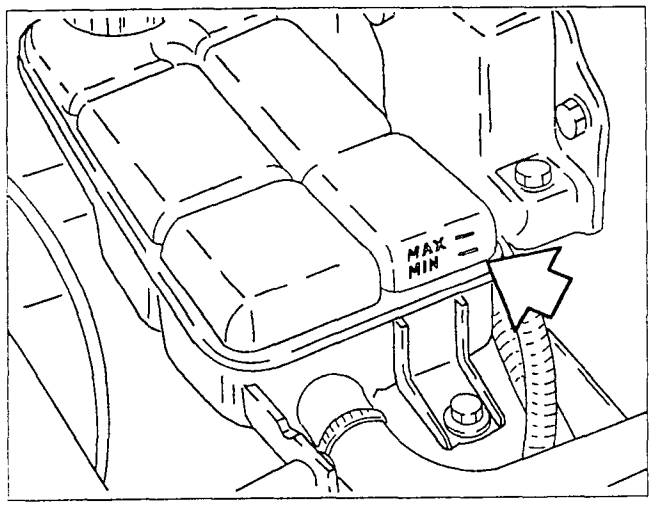
WARNING: While re-mounting, tighten the filtering element completely by hand.



LEVEL CHECKING AND REPLACEMENT OF THE ENGINE COOLING FLUID

Check

- Visually check that the level of the cooling fluid is included between the MIN and MAX values.

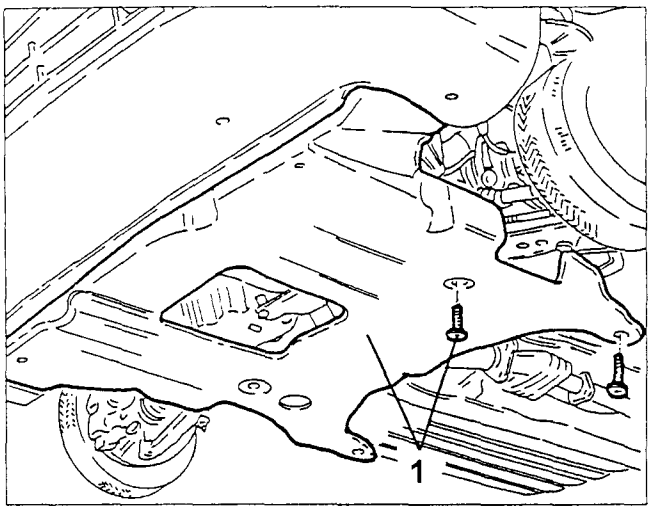


Replacement

- Place tha car onto the carlift.
- Unscrew and remove the cap of the expanding tank.

ATTENTION: Do not remove the cap of the expanding tank if the engine is still warm.

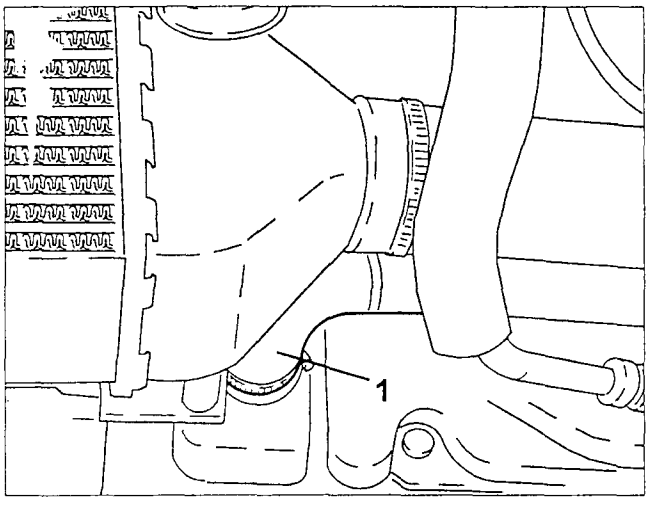
1. Unscrew the clamps and remove the under-engine protection.



1. Drain the engine cooling fluid by disconnecting the fluid outlet manifold from the radiator.

NOTICE: Collect the engine cooling fluid into a container.

WARNING: the anti-freezing mixture used as engine cooling fluid damages the paint: avoid contact with painted parts.

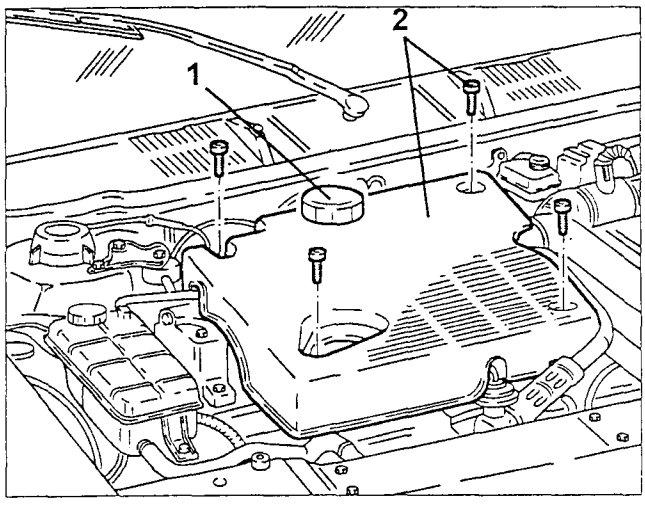


- Connect the manifold to the radiator back as well as all pipes disconnected; check the tightening of all hose clamps.
- Supply with the fluid prescribed and according to the type and quantity shown up to the MAX notch of the expanding tank.
- Start the engine and bring it to the running temperature so that the thermostat's opening may release the residual air quantity left in the circuit.
- At cold engine, refill up to the MAX notch of the expanding tank.
- Screw the cap of the pressurized expanding tank.

WARNING: Do not mix anti-freezing fluids of different kind or brand.
Do not use anti-rust additives: they may be incompatible with the anti-freeze used.

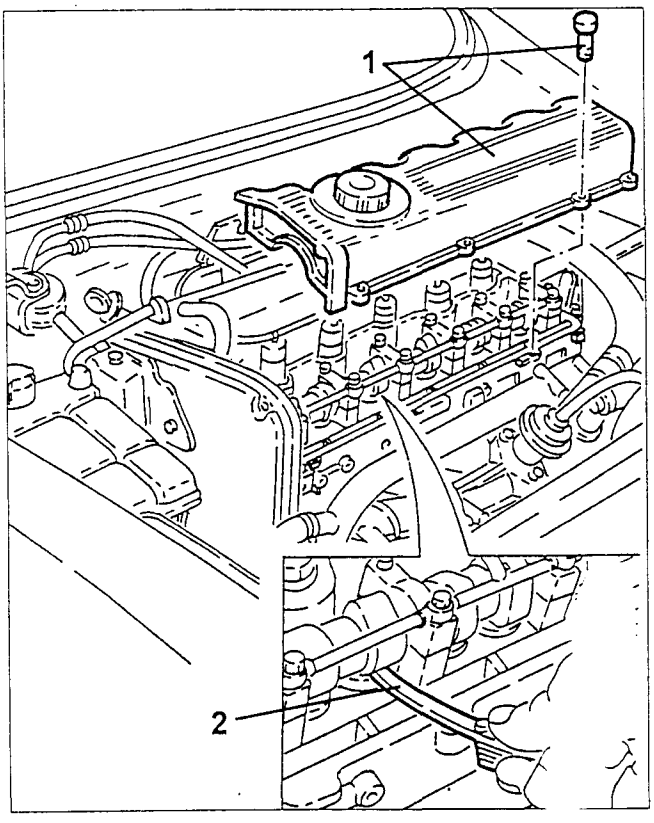
CHECK AND ADJUSTMENT OF THE VALVES' PLAY

- Place the car onto the carlift.
- Remove the front righthand wheel and the corresponding fender.
1. Remove the supply cap of the engine oil.
2. Unscrew the clamping screws and remove the engine cover.
- Mount the supply cap of the engine oil back.



1. Unscrew the clamping screws and remove the tappets' cover.
- Act onto the clamping screw of the transmission pulley with the right wrench so to close the valves.
2. At cool engine, check with a thickness gauge that the valves' play is included among the prescribed values (valves are in the closed position).

Valves' play (at cool engine)	
Intake	0.25 ÷ 0.35 mm
Exhaust	0.30 ÷ 0.40 mm

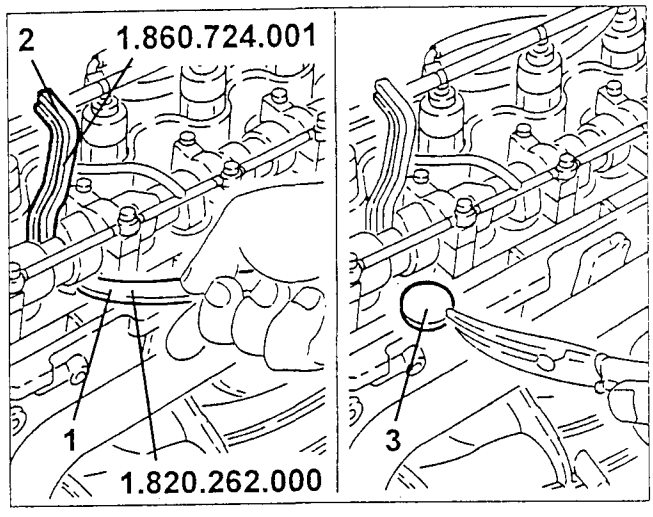


- If the valves'play is not included, act as follows :
1. Lower the tappet concerned with the lever N° 1.820.262.000.
2. Mount the tool N° 1.860.724.001 to hold the tappet lowered, hence remove the lever.

NOTICE: Move the notches on the tappet's edge so to ease further adjustment of the plug nut to be replaced.

3. Remove the plug nut for the adjustment of the valves' play and replace it with a new one of the correct thickness.

- Remove the tool to hold the tappet lowered.
- Repeat the same procedure as to the remaining valves.

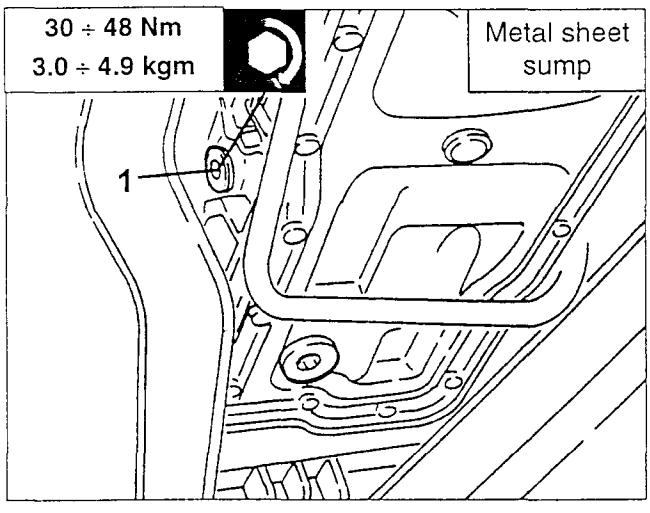


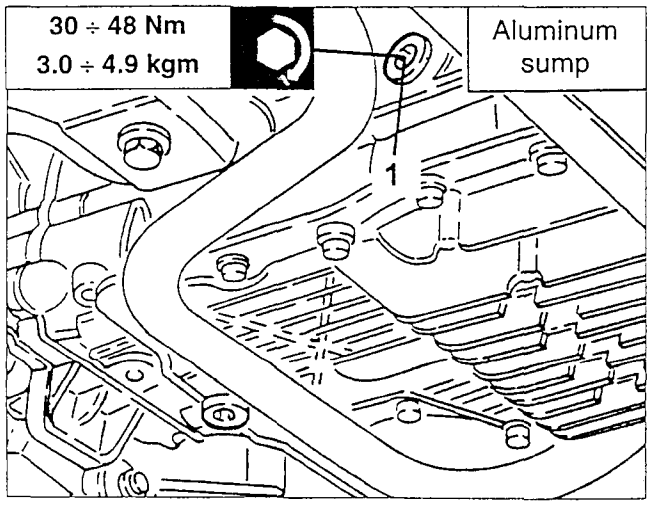
MAINTENANCE OF MECHANICAL GROUPS

OIL LEVEL CHECKING AND OIL REPLACEMENT OF THE GEARBOX-DIFFERENTIAL

Oil level checking (Specific for Boxer engines)

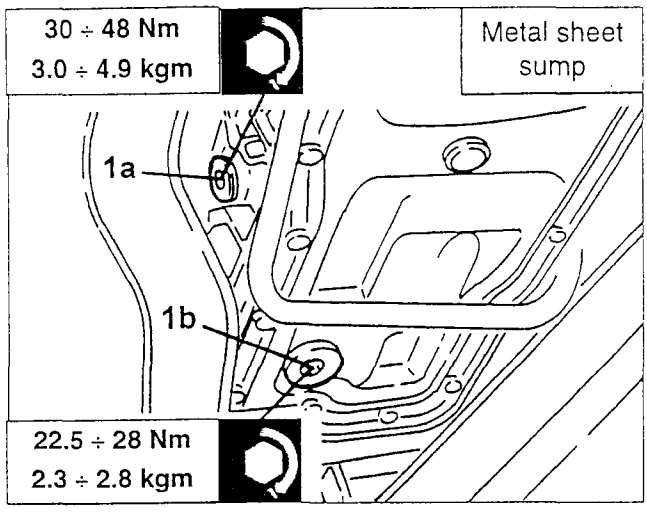
- Place the car onto the carlift.
1. Unscrew the supply cap and check that the oil level touches the lower edge of the hole.
- If necessary, refill up to the prescribed level.
- Screw the supply cap tightening it according to the prescibed torque.

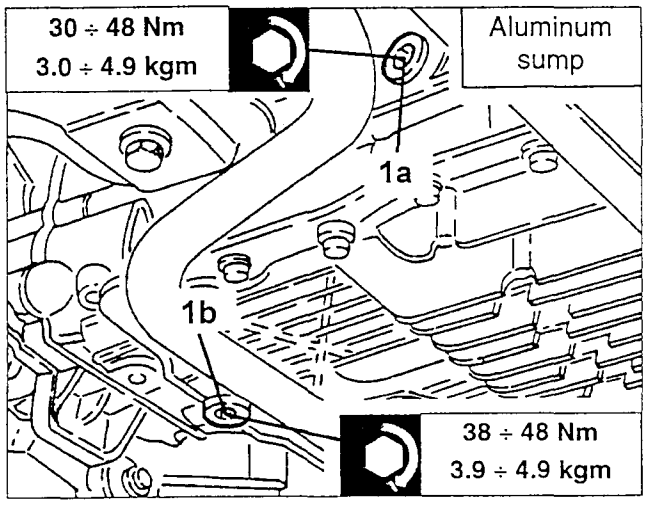




Oil replacement (Specific for Boxer engines)

- Place the car onto the carlift.
1. Unscrew the supply cap (1a) and the discharge cap (1b), hence let the oil drain out completely.





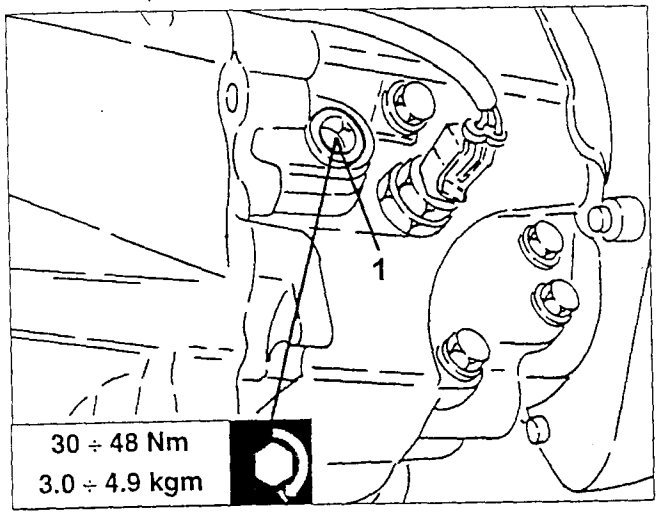
- Clean the discharge cap and screw it back according to the prescribed torque.
- Introduce oil of the type and in the quantity prescribed through the filling hole.
- Check that the level touches the lower edge of the hole, hence clean the supply cap and screw it back according to the prescibed torque.

Oil level checking (Specific for 1929 Turbodiesel and T.Spark 16V engines)

- Place the car onto the carlift.

1. Unscrew the supply cap and check that the oil level touches the lower edge of the hole.

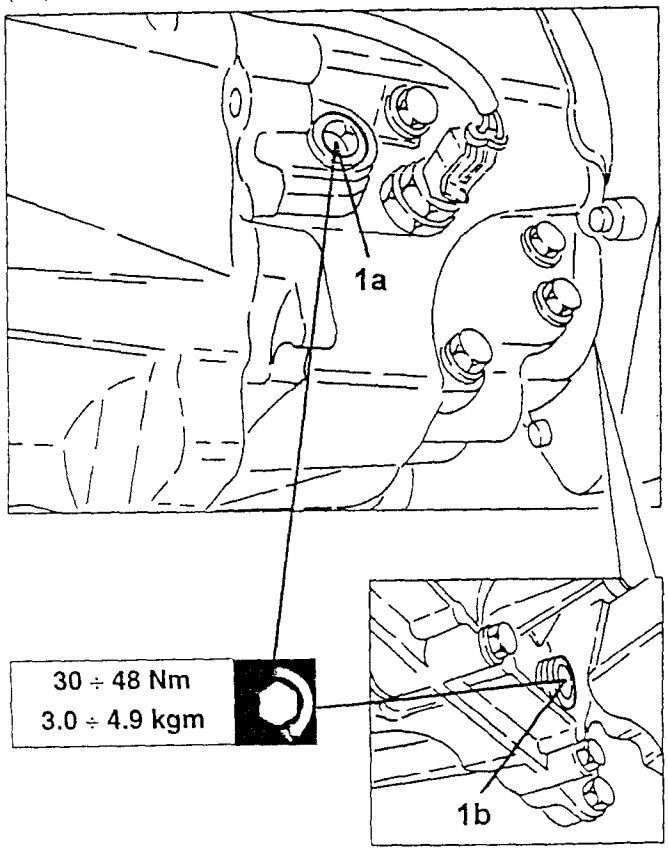
- If necessary, refill up to the prescribed level.
- Screw the supply cap back according to the prescribed torque.



Oil replacement (Specific for 1929 Turbodiesel and T. Spark 16V engines)

- Place the car onto the carlift.

1. Unscrew the supply cap (1a) and the discharge cap (1b), hence let the oil drain out completely.

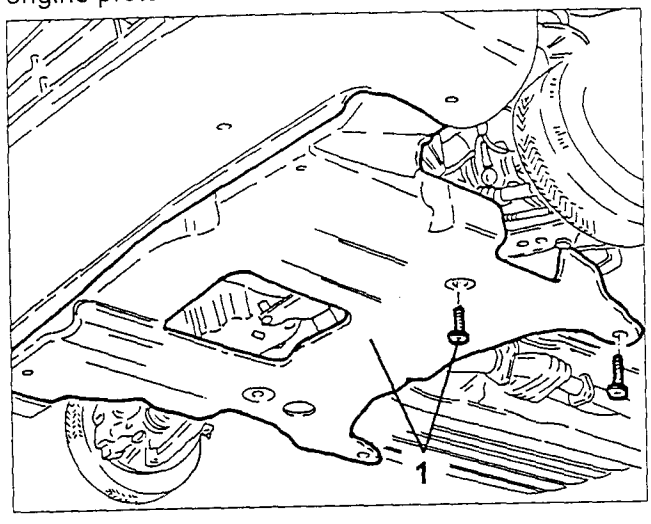


- Clean the discharge cap and screw it back according to the prescribed torque.
- Introduce oil of the type and the quantity prescribed through the filling hole.
- Check that the level touches the lower edge of the hole, hence clean the supply cap and screw it back according to the prescribed torque.

Oil level checking (Specific for 1910 JTD engine)

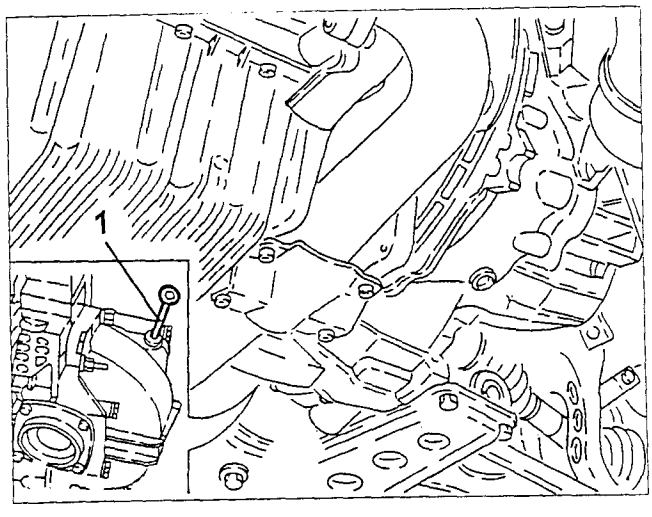
- Place the car onto the carlift.

1. Unscrew the clamps and remove the under-engine protection.



1. With the appropriate stem, check that the oil level of the mechanical gearbox with differential matches with the reference value on the stem itself.

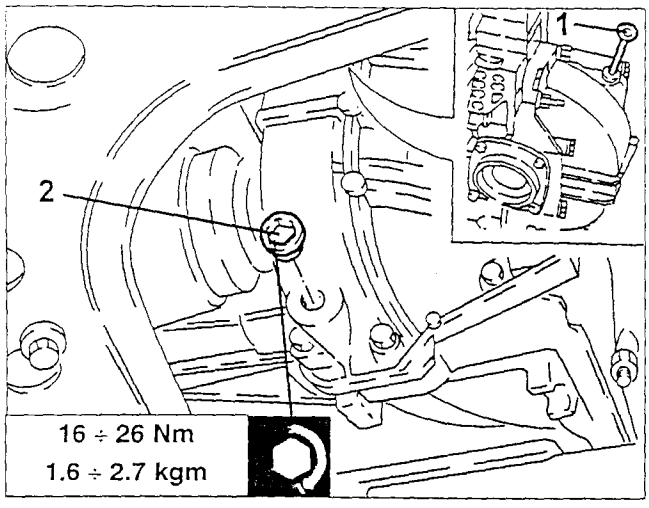
- If necessary, refill the oil level by introducing the prescribed oil.



- Check the oil level again, hence insert the checking stem.
- Mount the under-engine protection and clamp it. Remove the oil from the carlift.

Oil replacement
(Specific for 1910 JTD engines)

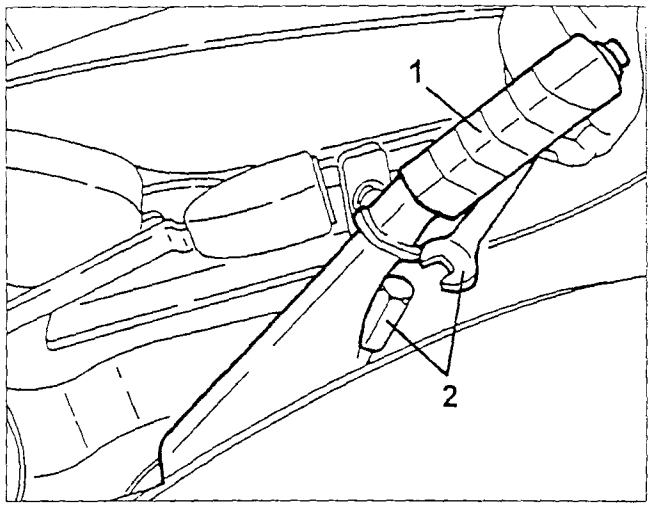
- Place the car onto the carlift.
- Unscrew the clamps and remove the under-engine protection.
1. Remove the oil checking stem.
2. Unscrew the discharge cap, hence let the oil drain out completely.



- Clean the discharge cap and crew it back according to the prescribed torque.
- Supply with oil of the type and in the quantity prescribed.
- Check with the stem that the oil level of the mechanical gearbox with differntial matches with the reference values shown on the stem.
- Insert the checking stem back.
- Mount the under-engine protection and clamp it.
- Remove the car from the carlift.

CHECKING OF THE PARKING BRAKE STROKE

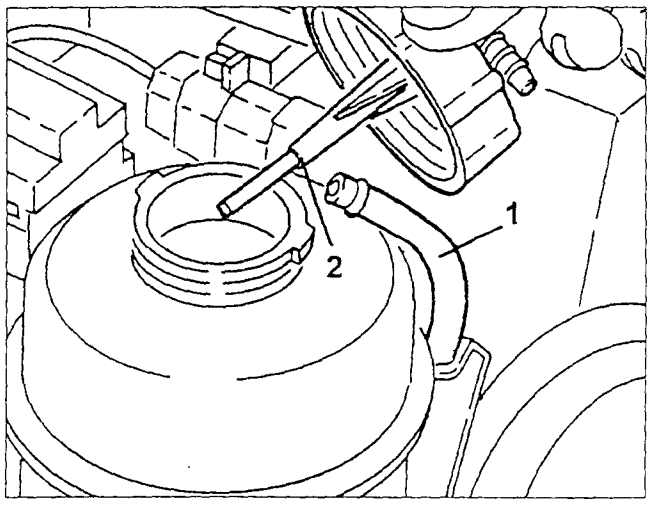
1. Shift the control lever onto the third/fourth release of the the toothed sector and holding the lever in this position, check if the wheels are blocked.
2. In case they are not, screw the adjustment nut till the rear wheels are blocked.
- By acting onto the control lever with a force of about 27 Kg, check that the number of releases onto the toothed sector is equal to 3.
- Check that the wheels are loosened if the lever is not inserted.



CHECKING OF THE OIL LEVEL OF THEHYDRAULIC TORQUE CONVERTER (Specific for Boxer engines)

ATTENTION: The oil level checking is to be performed with the car in flat position.

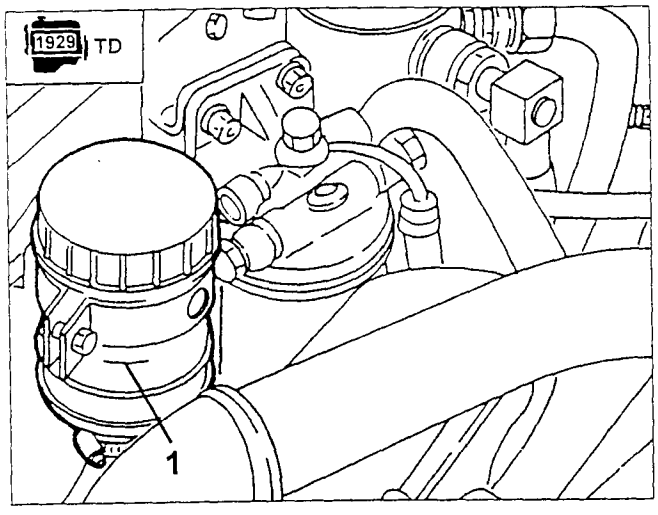
- With the engine off, clean the cover of the hydro-drive tank and the surrounding area.
1. Disconnect the breather pipe from the tank cover.
2. Remove the cover and check that the level matches the upper notch on the checking stem.

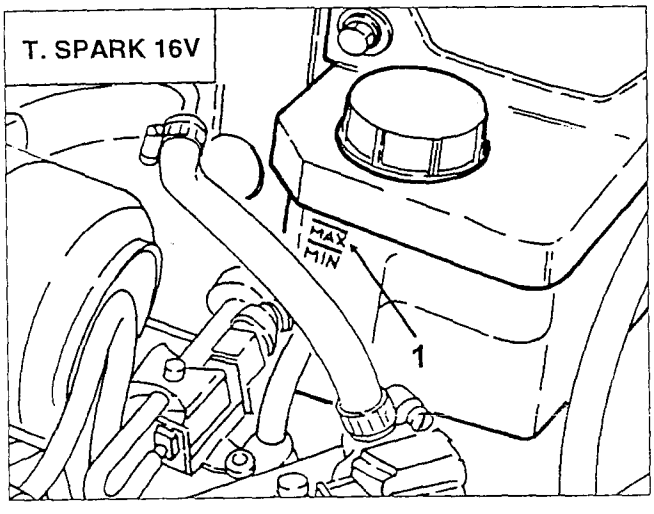


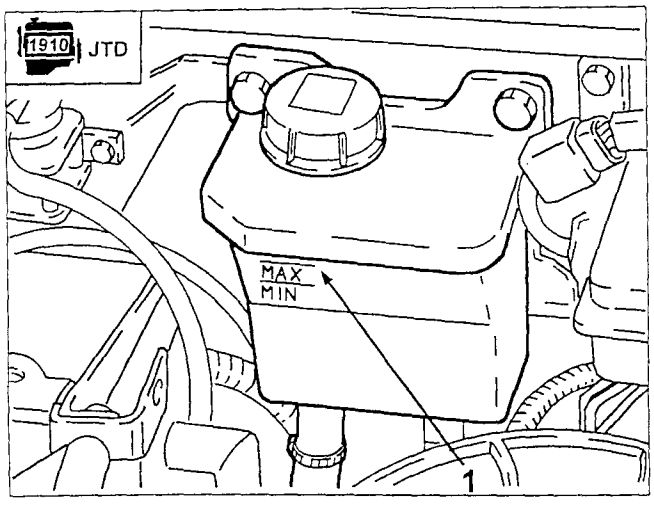
- If necessary, refill with the prescribed oil and as follows:
• Start the engine and wait for the oil level to stabilise.
• With running engine, rotate the steering wheel more times and completely.
• Refill till the level corresponds to the MAX level, hence screw the cover back and insert the breather pipe.

CHECKING OF THE OIL LEVEL OF THEHYDRAULIC TORQUE CONVERTER (Specific for Turbodiesel and T. Spark 16V engines)

1. With the engine off, check that the oil level corresponds to the MAX notch shown onto the tank.







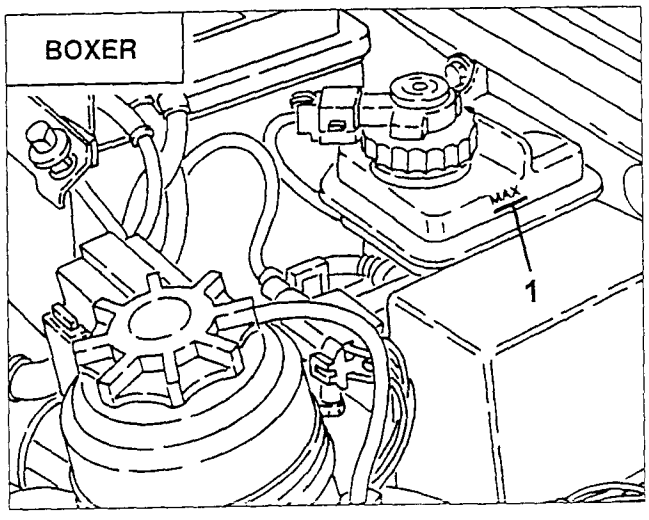
- If necessary, refill with the prescribed oil and as follows:
- Start the engine and wait for the oil level to stabilise.
- With running engine, rotate the steering wheel more times and completely.
- Refill till the level corresponds to the MAX level, hence screw the cover back.

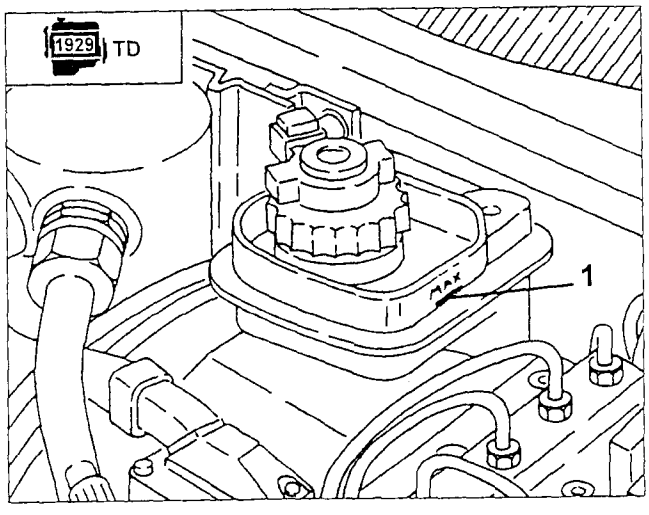
CHECKING OF THE LEVEL AND REPLACEMENT OF THE BRAKES-CLUTCH FLUID

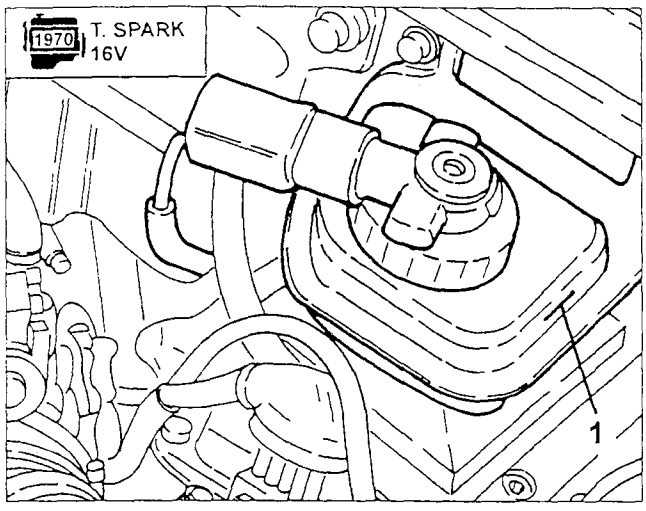
Oil level checking

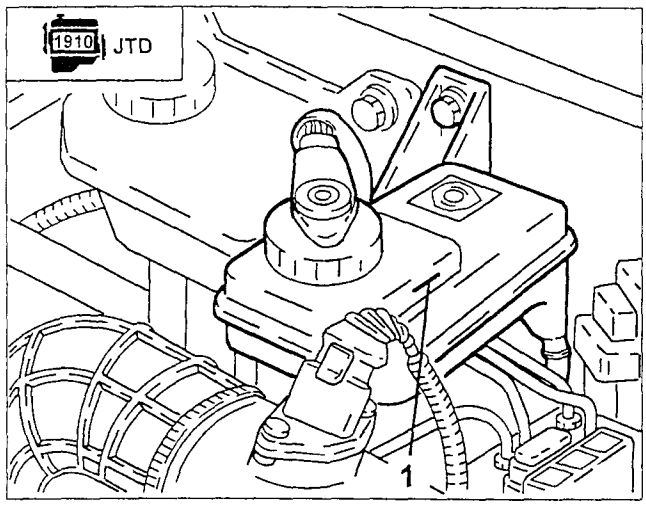
ATTENTION: The checking is to be performed with the car in flat position.

1. Check that the oil level in the tank corresponds to the MAX reference notch shown on the tank.





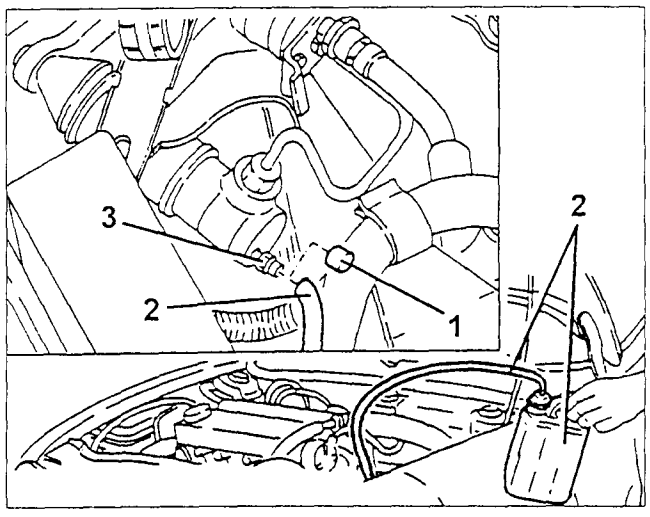




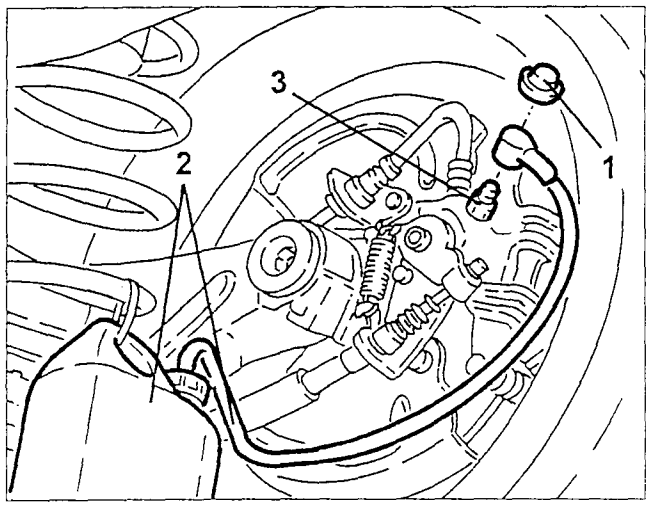
Oil replacement

- Place the car onto the carlift.
- Remove the battery (see GROUP 55).
- Remove the battery basket (see GROUP 55).
- Suck the brakes-clutch fluid from the tank by means of a syringe.

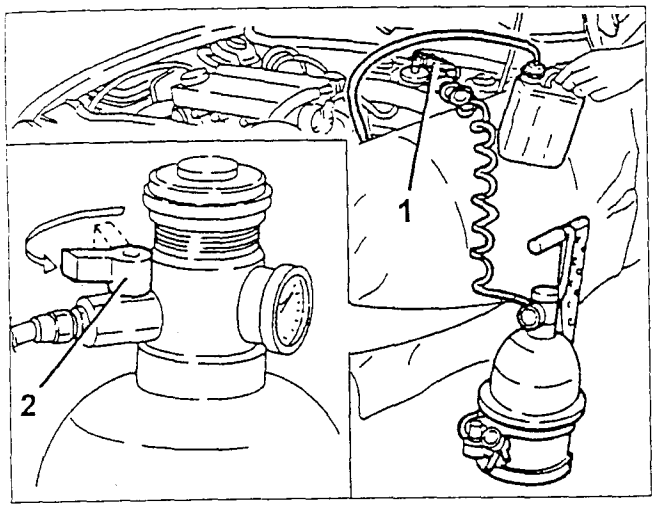
1. Remove the protection cap from the drain valve on the cylinder.
2. Connect the recovery device (pipe and tank) to the drain valve onto the cylinder.
3. Open the drain valve onto the cylinder.
- Press the clutch pedal till to empty the cicuit completely.



1. Remove the protection cover from the drain valve on the caliper.
2. Connect the recovery device (pipe and tank), to the drain valve on the caliper.
3. Open the drain valve onto the caliper
- Press the brake pedal till to discharge the whole fluid.
- Repeat the procedure for the remaining calipers.



1. Connect the equipment to the tank of the brakes-clutch fluid.
2. Slowly open the tank tap and supply the brakes-clutch with the fluid prescribed.



- Wait till the air contained in the hydraulic systems of brakes-clutch goes out completely.
- Close the drain valves and mount the corresponding protection caps.
- Remove the devices for fluid recovery.
- Remove the equipment.
- Mount the battery basket (see GROUP 55).
- Mount the battery (see GROUP 55).
- Remove the car from the carlift.

IDENTIFICATION OF CAR VERSIONS

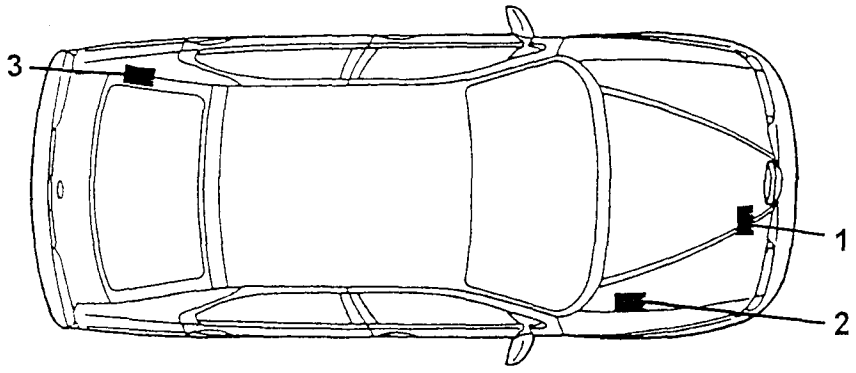
Commercial name	146 1.3/1.4	146 1.6	146 1.7 16V	146 TD	146 JTD
Equipment	5-door saloon				
Version (on identification plate)	930 B3	930 B2 930 B2A □	930 B1	930 B4 930 B4A ▲	930 B4B
Chassis (in the engine compartment, aside the upper connection of right shock absorber)	930000	930000	930000	930000	930000
Chassis ' number	2.001.001 4.001.001	2.001.001 4.001.001	2.001.001 4.001.001	2.001.001 4.001.001	-
Engine (code)	AR 33501	AR 33201	AR 33401	AR 67501 AR 33601 ▲	AR 32302
Engine's symbol	1351	1596	1712 16V	1929 TD	1910 JTD
Gearbox (code)	C.802.5.16.00	C.802.5.16.02 C.802.5.16.03□	C.802.5.18.00	C.510.5.17.63	C.530.5

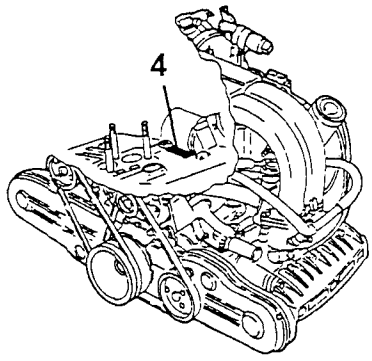
(□): Only for certain markets
(▲): Version with catalyst, only for certain markets.

Commercial Name	146 2.0 *ti*	146 1.4 T. Spark	146 1.6 T. Spark	146 1.8 T. Spark
Equipment	5-door saloon			
Version (on identification plate)	930 B5	930 B3A	930 B2B 930 B2C□	930 B1A
Chassis (in the engine compartment, aside the upper attachment of the right shock absorber)	930000	930000	930000	930000
Chassis Number	2.001.001 4.001.001	-	-	-
Engine (code)	AR 67204 AR 32301	AR 33503	AR 67601	AR 67106 AR 32201
Engine symbol	1970 T. SPARK 16V	1370 T. SPARK 16V	1598 T. SPARK 16V	1747 T. SPARK 16V
Gearbox (code)	C.510.5.21.13 C.510.5	C.510.5.18.03 C.513.5.14.02 (1)	C.510.5.18 C.510.5.17.96 □	C.510.5.17.93

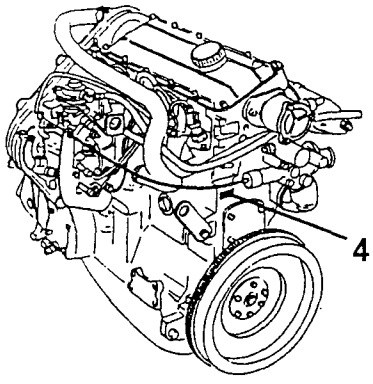
(□): Only for certain markets
(1): Starting from the chassis n° .....

POSITIONING OF THE ID PLATES

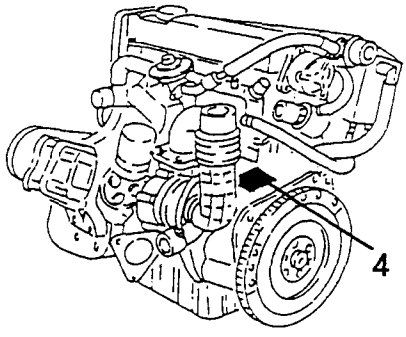




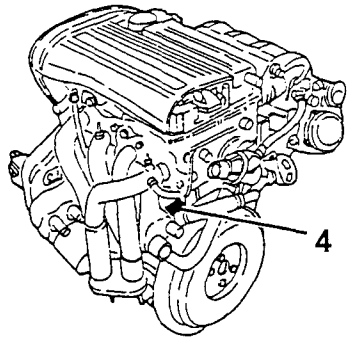
Boxer engines



1929 TD engine



1910 JTD engine

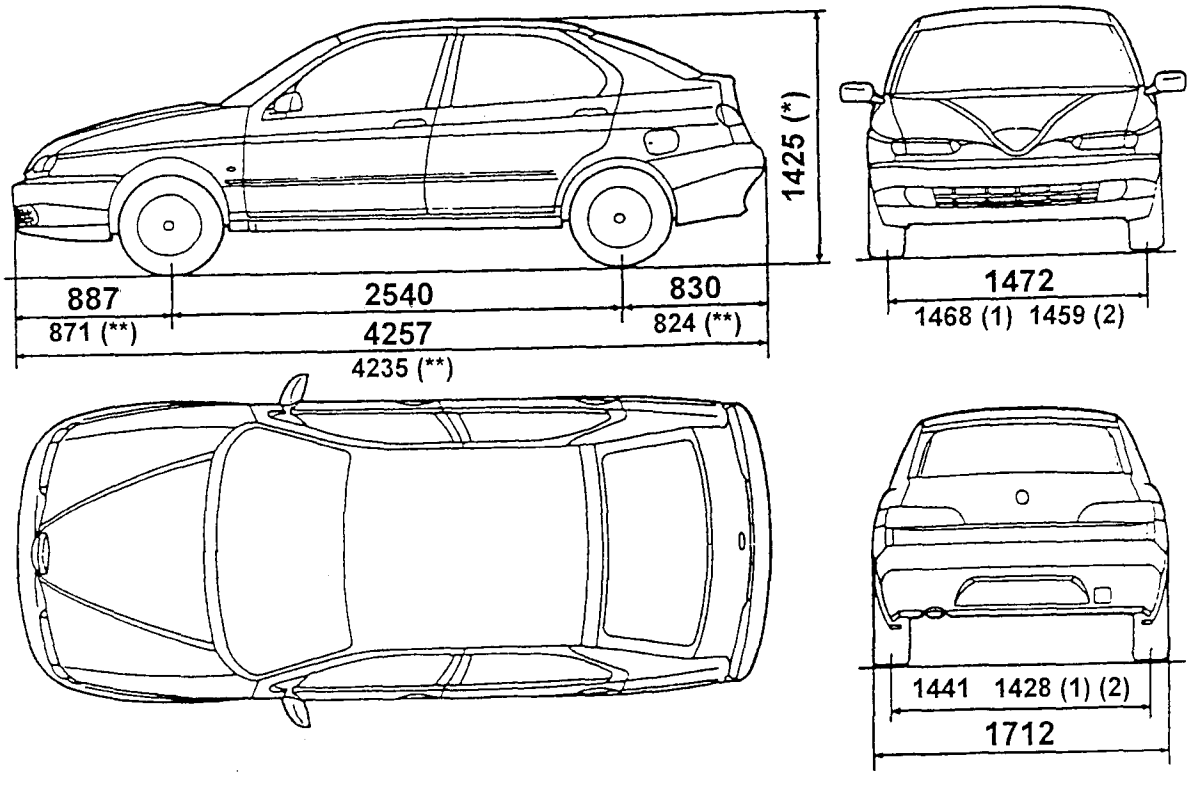


T. Spark 16V engines

1. ID plate
2. Bodywork punching

3. ID Plate of bodywork paint
4. Engine punching

DIMENSIONS



(*): Unloaded car (**): For 99s models (1): For 1.8 T. Spark and 20 *ti* versions (2): For sporting equipment

WEIGHTS AND LOADS

Unit: kg

Features \ Versions		930 B3	930 B2 930 B2A	930 B1	930 B4 930 B4A	930 B4B
Weight in running order (without driver)		1175	1175	1225	1245	1245
Maximum weight allowed		1705	1705	1745	1765	1765
Payload		530	530	520	520	520
Maximum weight allowe per axle	front	930	930	930	930	930
	rear	870	870	870	870	870
Towable weight	with braked trailer	1100	1100	1200	1300	1300 1300 (*)
	With non-braked trailer	350	350	350	350	350
Maximum load onto the ball		50	50	50	50	50

(*): Homologated for Switzerland only.

Features \ Versions		930 B5	930 B3A	930 B2B 930 B2C	930 B1A
weight in running order (without driver)		1275	1160	1190	1215
Maximum weight allowed		1800	1680	1710	1735
Payload		525	520	520	520
Maximum weight allowed per axle	front	950	950	950	950
	rear	900	900	900	900
Towable weight	with braked trailer	1200 1200 (*)	1100 800 (*)	1200 900 (*)	1200 900 (*)
	with non-braked trailer	350	350	350	350
Maximum load onto the ball		50	50	50	50

(*): Homologated for Switzerland only.

WHEELS AND TYRES

CAR	DIMENSIONS Rims Tyres		PRESSURES (bar)			
			REDUCED LOAD (2 people)		FULL LOAD	
			FRONT	REAR	FRONT	REAR
930 B3	Standard equipment	5.5J x 14" 175/65 R14" 82T	2.2	2	2.5	2.5
	Optional equipment	5.5J x 14" 185/60 R14" 82H				
930 B2	Standard equipment	5.5J x 14" 175/65 R14" 82T	2.2	2	2.5	2.5
	Optional equipment	5.5J x 14" 185/60 R14" 82H (*)				
930 B2A	Standard equipment	5.5J x 14" 185/65 R14" 86T	2.2	2	2.5	2.5
930 B1	Standard equipment	5.5J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 B4 930 B4A	Standard equipment	5.5J x 14" 175/65 R14" 82T	2.2	2.1	2.5	2.5
	Optional equipment	5.5J x 14" 185/60 R14" 82H				
930 B4B	Standard equipment	5.5J x 14" 185/60 R14" 82H 6J x 15" (▲) 195/55 R15" 84V (▲)	2.2	2.0	2.5	2.5
930 B5	Standard equipment	6J x 15" 195/55 R15" 84V	2.3	2.1	2.5	2.5
930 B3A	Standard equipment	5.5J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
		6J x 15" 195/50 R15" 82V 195/55 R15" 84V (▲)				
930 B2B	Standard equipment	5.5J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 B2C		6J x 15" 195/55 R15" 84V (▲)				
930 B1A	Standard equipment	6J x 15" 195/55 R15" 84V	2.2	2	2.5	2.5
ALL	SPARE SMALL WHEEL 4J x 15" (in steel) 4.00B x 15" (in alloy) - 115/70 R15" 90M		4.2			

(*): Standard equipment for certain markets
(▲): For sporting equipment (for versions/markets if envisaged)

WARNING: In case of continous running at high speed, pressures are to be increased by 0.3 bar.

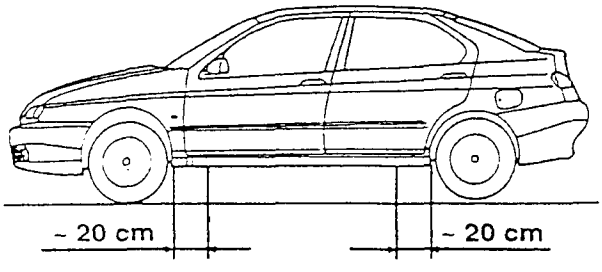
SUPPLY QUANTITIES

Supply Quantity \ Versions		930 B3	930 B2 930 B2A	930 B1	930 B4 930 B4A	930 B4B	930 B5	930 B3A 930 B2B 930 B2C 930 B1A
Fuel tank		51 liters			51/61 liters (*)			
Fuel stock		5 ÷ 8 liters						
Engine oil	Total capacity: pan + filter + sumps + radiator	4.7 liters		5.2 liters	6 liters	(**)	5.0 liters	
	Pan + filter (for periodic replacement)	4 liters		4.5 liters	5 liters	4.2 liters	4.4 liters	
Gearbox-differential oil		2.4 liters			2 liters		2 liters	
Hydraulic torque converter oil		1.1 liters				900 gr	1.3 liters	
Brakes/clutch oil		0.4 kg			0.5 kg	0.4 kg (▲)	0.5 kg	
Engine cooling fluid		7.8 liters			8.9 liters	6.1 liters	8.3 liters	8.4 liters
Conditioning compressor oil		240 ± 15 cm^3			236 ± 15 cm^3	130 g	150 ± 20 cm^3	
Conditioning system fluid		0.700 kg				(**)	0.700 kg	

(*): For versions /Markets
(▲): With A.B.S. = 0.54 kg
(**): Data which are not available while printing

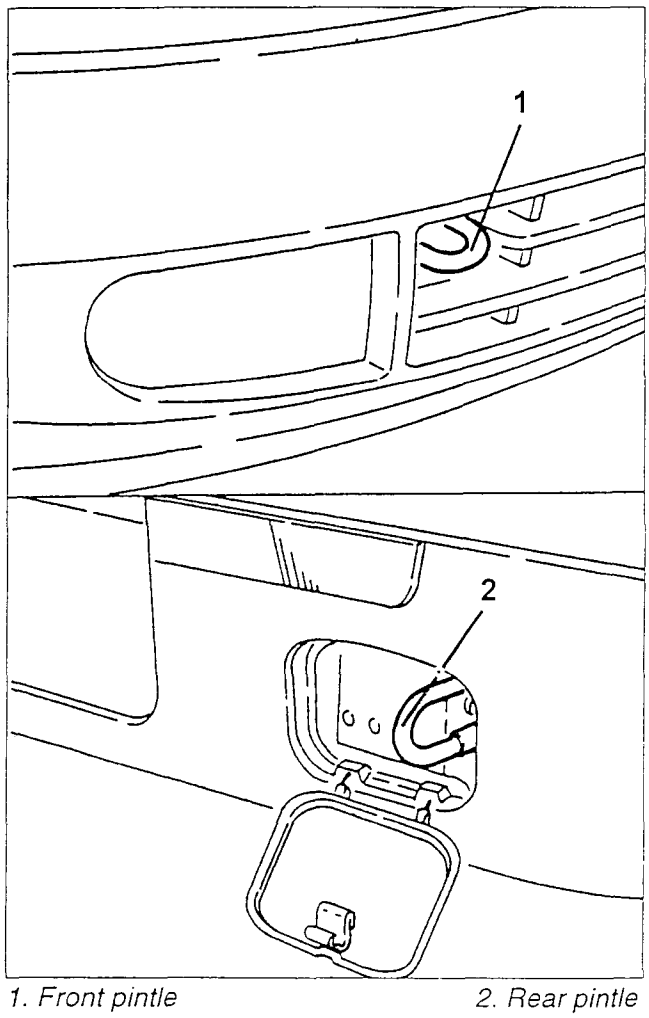
CAR'S LIFTING POINTS

Either with a bridge or with a carlift.
- The car is to be lifted as shown.



CAR'S TOWING POINTS

The car is equipped with two rings, one on the front and one on the back, located on the righthand side of the bumper.
the rear ring is covered by a door that can be opened by pressing on its edge.
Comply with the law provisions disciplining towing operations.
Before towing, the key is to be turned onto MAR position and hence turned back onto STOP position without taking it out; in this way the steering blocking is avoided.
It is necessary to remember that, in case of towing, there is no depression in the servo brake and it is therefore necessary to press the brake pedal more strongly.



1. Front pintle *2. Rear pintle*

GEARBOX

RATIOS (Specific for Boxer and Turbodiesel engines)

	Gearbox	Ratio	Inserted gearshift	Gearbox ratio	Total ratio
930 B3 (before mod.) **930 B2** (before mod.) **930 B1** (before mod.)	C.802.5	9/37 1 : 4.111	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 14.576 1 : 8.428 1 : 5.437 1 : 4.222 1 : 3.509 1 : 12.707
930 B3 (after mod.)	C.802.5	10/43 1 : 4.3	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 15.246 1 : 8.815 1 : 5.687 1 : 4.416 1 : 3.671 1 : 13.291
930 B2 (after mod.) **930 B1** (after mod.)	C.802.5	11/45 1 : 4.091	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 14.503 1 : 8.387 1 : 5.412 1 : 4.201 1 : 3.494 1 : 12.645
930 B2A	C.802.5	9/35 1 : 3.888	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 13.782 1 : 7.970 1 : 5.143 1 : 3.992 1 : 3.320 1 : 12.017
930 B4 **930 B4A**	C.510.5	18/57 1 : 3.166	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.440 1 : 1.029 1 : 0.794 1 : 3.909	1 : 12.376 1 : 7.085 1 : 4.559 1 : 3.258 1 : 2.514 1 : 12.376

RATIOS (Specific for T. Spark engines)

	Gearbox	Ratio	Inserted Gearshift	Gearbox ratio	Total ratio
930 B5	C.510.5	17/57 1 : 3.353	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.946 1 : 3.909	1 : 11.886 1 : 7.504 1 : 5.096 1 : 3.876 1 : 3.172 1 : 13.107
930 B3A	C.510.5	15/58 1 : 3.866	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.919 1 : 3.909	1 : 15.112 1 : 8.652 1 : 5.876 1 : 4.469 1 : 3.553 1 : 15.112
930 B3A	C.513.5	15/59 1 : 3.933	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.919 1 : 3.909	1 : 15.374 1 : 8.802 1 : 5.978 1 : 4.546 1 : 3.614 1 : 15.374
930 B2B	C.510.5	16/57 1 : 3.562	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.971 1 : 3.909	1 : 13.924 1 : 7.972 1 : 5.414 1 : 4.118 1 : 3.459 1 : 13.924
930 B2C	C.510.5	17/57 3 : 3.353	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.971 1 : 3.909	1 : 13.107 1 : 7.504 1 : 5.096 1 : 3.876 1 : 3.256 1 : 13.107
930 B1A	C.510.5	16/57 1 : 3.562	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.971 1 : 3.909	1 : 13.924 1 : 7.972 1 : 5.414 1 : 4.118 1 : 3.459 1 : 13.924

RATIOS (Specific for 99s models)

TO BE PUBLISHED SOON

TORQUE WRENCH SETTINGS

Group 70 - Bodywork

Part	Nm	kgm
Clamping nut for front safety belts	34 ÷ 42	3.5 ÷ 4.3
Clamping screws for rear bumper	16 ÷ 20	1.6 ÷ 2.0

SPECIFIC EQUIPMENT

Group 70 - Bodywork

1.822.152.000	Wrench to align the rear bumper
1.823.008.001	Tool for the gasket guide of the rear window

CLUTCH

		Boxer engines	Turbodiesel engines		T. Spark 16V engines
			1929 TD	1910 JTD	
Thickness of the plate	New	7.1 ÷ 7.7 mm	7.1 ÷ 7.7 mm	-	7.1 ÷ 7.7 mm 6.7 ÷ 7.3 mm (*)
	Almost worn out	6.1 mm	6.1 mm	-	6.3 mm 5.9 mm (*)
Cylinder cap stroke of clutch control		16.15 ÷ 18.2 mm	13.5 mm	13.5 mm	-

(*): Specific for engine 1370 T. SPARK 16V with gearbox C.513.5

GEARBOX

RATIOS (Specific for Boxer and Turbodiesel engines)

	Gear	Ratio	Inserted gearshift	Gear ratio	Total ratio
930 A3 (before mod.) **930 A2** (before mod.) **930 A1** (before mod.)	C.802.5	9/37 1 : 4.111	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 14.576 1 : 8.428 1 : 5.437 1 : 4.222 1 : 3.509 1 : 12.707
930 A3 (after mod.)	C.802.5	10/43 1 : 4.3	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 15.246 1 : 8.815 1 : 5.687 1 : 4.416 1 : 3.671 1 : 13.291
930 A2 (after mod.) **930 A1** (after mod.)	C.802.5	11/45 1 : 4.091	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 14.503 1 : 8.387 1 : 5.412 1 : 4.201 1 : 3.494 1 : 12.645
930 A2A	C.802.5	9/35 1 : 3.888	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.050 1 : 1.323 1 : 1.027 1 : 0.854 1 : 3.091	1 : 13.782 1 : 7.970 1 : 5.143 1 : 3.992 1 : 3.320 1 : 12.017
930 A4 **930 A4A**	C.510.5	18/57 1 : 3.166	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.440 1 : 1.029 1 : 0.794 1 : 3.909	1 : 12.376 1 : 7.085 1 : 4.559 1 : 3.258 1 : 2.514 1 : 12.376

ROLLING TORQUES (Specific for Boxer engines)

False pinion:	for reused bearings for new bearings	0.29 ÷ 0.59 Nm 1.17 ÷ 1.47 Nm
Pinion with gears:	for reused bearings for new bearings	0.39 ÷ 0.69 Nm 1.27 ÷ 1.57 Nm

RATIOS (Specific for T. Spark engines)

	Gearbox	Ratios	Inserted gearshift	Gear ratio	Total ratio
930 A5	C.510.5	16/57 1 : 3.562	1^ 2^ 3^ 4^ 5^ RM	1 : 3.545 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.946 1 : 3.909	1 : 12.631 1 : 7.973 1 : 5.415 1 : 4.119 1 : 3.370 1 : 13.926
930 A3A	C.510.5	15/58 1 : 3.866	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.919 1 : 3.909	1 : 15.112 1 : 8.652 1 : 5.876 1 : 4.469 1 : 3.553 1 : 15.112
930 A3A	C.513.5	15/59 1 : 3.933	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.919 1 : 3.909	1 : 15.374 1 : 8.802 1 : 5.978 1 : 4.546 1 : 3.614 1 : 15.374
930 A2B	C.510.5	16/57 1 : 3.562	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.971 1 : 3.909	1 : 13.924 1 : 7.972 1 : 5.414 1 : 4.118 1 : 3.459 1 : 13.924
930 A2C	C.510.5	17/57 1 : 3.353	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.971 1 : 3.909	1 : 13.107 1 : 7.504 1 : 5.096 1 : 3.876 1 : 3.256 1 : 13.107
930 A1A	C.510.5	15/56 1 : 3.733	1^ 2^ 3^ 4^ 5^ RM	1 : 3.909 1 : 2.238 1 : 1.520 1 : 1.156 1 : 0.946 1 : 3.909	1 : 14.592 1 : 8.354 1 : 5.674 1 : 4.315 1 : 3.531 1 : 14.592

DIFFERENTIAL (Specific for 1929 Turbodiesel and T. Spark 16V engines)

Bearings preloading (unloaded) = 0.12 mm
Play between crown wheels and side pinions ≤ 0.10 mm

RATIOS (Specific for 99s models)

TO BE PUBLISHED SOON

WHITE

BRAKES

BRAKE DISC

		FRONT			REAR
		Suction brake (*)	Suction brake	Non-suction brake	
Diameter	(mm)	284	257	257	240
Limit utilisation thickness	(mm)	20.2	18.2	10.2	9.2
Minimum thickness after grinding	(mm)	21.1	19.1	11.1	10.1
Nominal thickness	(mm)	21.8 ÷ 22.1	19.8 ÷ 20.1	11.8 ÷ 12.1	10.8 ÷ 11.1

(*): Specific for engines 1747 T. SPARK 16V 1970 T. SPARK 16V

BRAKE PADS

	FRONT	REAR
Limit utilisation thickness of friction brake shoe	1.5 mm (Shown by a sensor for brake pads wear)	1.5 mm

REAR BRAKE DRUMS

	BOXER ENGINES 1747 T.S. 16V 1970 T.S. 16V	1370 T.S. 16V 1598 T.S. 16V 1929 TD 1910 JTD
Nominal diameter	228.7 mm	203 mm
Max diameter after grinding	229.1 mm	-
Limit utilisation thickness	230 mm	-

REAR DRUM BRAKE SHOES

Limit utilisation thickness of friction gaskets	1.5 mm

ENTRFER OF INDUCTIVE SENSORS - A.B.S. PHONIC WHEELS

Front wheels	0.3 ÷ 1.05 mm
Rear wheels	0.2 ÷ 1.15 mm

FRONT SUSPENSIONS

HELICAL SPRINGS (Specific for Boxer and T. Spark 16V engines)

Engines / Features	Boxer 8V	Boxer 16V	1970 T. SPARK 16V		1370 T. SPARK 16V	1598 1747 T. SPARK 16V
			Before mod.	After mod.		
Wire's diameter	13.8 mm	13.8 mm	13.8 mm	13.7 mm	13.7 mm	13.8 mm
Internal diameter	150 mm	150 mm	150 mm	150 mm	150 mm	150 mm
Loose length	366 mm	369 mm	384 mm	370 mm	384 mm	386.5 mm

NOTICE: Helical springs are divided according to hardness classification and marked with different paint colours so to be easily detected. In case of replacement of one or both springs, check that the new springs are marked with the same colour of the replaced ones.

SHOCK ABSORBERS (Specific for Boxer and T. Spark 16V engines)

	Boxer	T. Spark 16V
Stem diameter	22 mm	22 mm
Stroke	145 mm	167 mm

STABILIZER BAR (Specific for Boxer and T. Spark 16V engines)

Bar diameter	22 mm	23 mm (*)

(*): Specific for engines 1370 T. SPARK 16V 1598 T. SPARK 16V

HELICAL SPRINGS (Specific for Turbodiesel engines)

Versions / Features	Conditioned	Non-conditioned
Wire's diameter	14 mm	13.8 mm
Internal diameter	150 mm	150 mm
Loose length	416 mm	386 mm

NOTICE: Helical springs are divided according to hardness classification and marked with different paint colours so to be easily detected. In case of replacement of one or both springs, check that the new springs are marked with the same colour of the replaced ones.

SHOCK ABSORBERS (Specific for Turbodiesel engines)

Stem diameter	22 mm
Stroke	155 mm

STABILIZER BAR (Specific for Turbodiesel engines)

Bar diameter	23 mm

REAR SUSPENSIONS

HELICAL SPRINGS

	BOXER TURBODIESEL	1970 T. SPARK 16V	1370 T. SPARK 16V	1598 1747 T. SPARK 16V
Wire's diameter	12.3 mm	12.1 mm	12.6 mm	12.1 mm
Internal diameter	100 mm	100 mm	100 mm	100 mm
Loose length	305 mm	305 mm	299 mm	295 mm

NOTICE: Helical springs are divided according to hardness classification and marked with different paint colours so to be easily detected. In case of replacement of one or both springs, check that the new springs are marked with the same colour of the replaced ones.

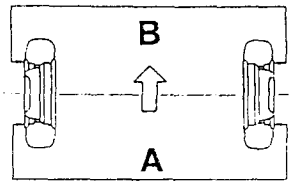
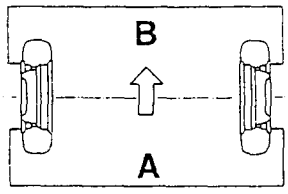
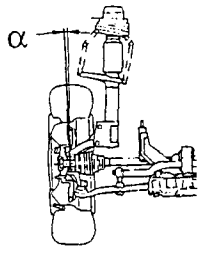
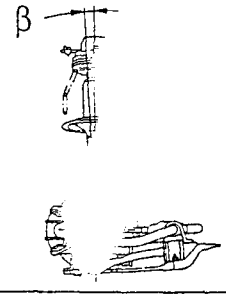
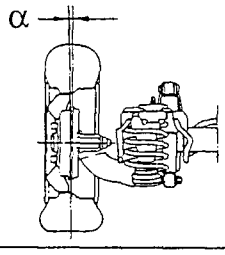
SHOCK ABSORBERS

Stem diameter	11.5 mm
Stroke	96.5 mm

STABILIZER BAR

Bar diameter	16 mm

WHEELS' POSITIONS AND CHARACTERISTIC ANGLES (*)

Features \ Versions		Boxer	Turbodiesel 1.4 T.Spark 16V 1.6 T.Spark 16V	1.8 T.Spark 16V 2.0 T.Spark 16V
Front position (B - A)	See GROUP 44	40 ± 5 mm	- 13 ± 5 mm	- 26 ± 5 mm
Rear position (C - D)	See GROUP 44	7 ± 5 mm	- 2 ± 5 mm	- 2 ± 5 mm
Toe-in/Toe-out front wheels (A - B)		3.5 ± 1 mm	- 1 ± 1 mm 0 ± 1 mm (•)	0 ± 1 mm
Toe-in rear wheels (A - B)		- 0.5 ± 2 mm 2.0 ± 2 (▲)		
Camber of front wheels "α"		- 1° ± 20'	- 1°10' ± 20'	- 1°30' ± 20'
Caster "β"		2°40' ± 30'		
Camber of rear wheels "α"		- 1° ± 20' - 45' ± 30' (▲)		

(*): Values measured in running gear (with prescribed supplies) and with tyres with prescribed pressure.
(•): *Specific for JUNIOR versions*
(▲): From chassis number 4.058.043 - 2.076.237.

General

Special tools play an important part in the maintenance of cars, since it is essential to ensure accurate, realiable and quick service.
It should be noted that the times scheduled for the various operations have been calculated assuming the use of these tools.
This manual lists and illustrates the special tools made expressly by the Manufacturer of overhauling, maintenance and repair operations on the car.

The tool identification code is formed of a new number with 10 figures and an old number with 1 letter and 5 figures:

Ex: 1.820.088.000
(A.2.0461)

Tools made recently only have the new number.
The service network will be able to supply particular special tools, following the procedure already used c/o sigle Alfa Romeo Dealers.
Below we are listing the special tools used.

Group 00 - Boxer engines maintenance

1.822.103.000	Ratchet wrench for removing/refitting spark plugs
1.822.107.000	Box wrench for removing/refitting spark plugs
1.824.018.000 (C.2.0131)	Tool for checking belt tension

Group 00 - 1929 Turbodiesel engine maintenance

1.820.095.000 (A.2.0468)	Flywheel stopper (to be used in the car)
1.820.261.000	Tappet cup retainer tool
1.820.262.000	Lever for changing tappet plates
1.824.015.000 (C.2.0128)	Tool for checking belt tension
1.824.016.000 (C.2.0129)	Rod for tightening timing gear belts
1.824.017.000 (C.2.0130)	End piece for tensioning timing gear belt
1.824.018.000 (C.2.0131)	Tool for checking belt tension
1.860.931.000	Tool for timing camshaft (from engine no. 1762798)
1.860.933.000	Tool for positioning 1st cylinder at T.D.C. (from engine n° 1762798)

Group 00 - T. Spark 16V engines maintenance

1.825.013.000 (C.6.0183)	Tool for checking T.D.C.
1.825.041.000	Templates for timing camshafts (for 1970 - 1747 engines)
1.825.042.000	Templates for timing camshafts (for 1370 - 1598 engines)

Group 10 - 8 Valve Boxer engines

1.820.012.000 (A.2.0195)	Support for overhauling cylinder heads
1.820.016.000 (A.2.0226)	Support fork for overhauling cylinder heads
1.820.059.000 (A.2.0378)	Flywheel stopper
1.820.609.000 (R.4.0145)	Engine supports for overhauling on stand
1.820.611.000 (R.4.0156)	Tool for removing/refitting power unit

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1.821.001.000 (A.3.0103)	Support for disassembling/reassembling valves
1.821.053.000 (A.3.0311)	Puller tool for valve guide
1.821.054.000 (A.3.0312)	Installing tool for valve guide
1.821.055.000 (A.3.0314)	Installing tool for camshaft oil seal
1.821.056.000 (A.3.0321)	Support for disassembling/reassembling valves
1.821.058.000 (A.3.0324)	Lever for disassembling/reassembling valves
1.821.063.000 (A.3.0337)	Installing tool for rear crankshaft oil seal
1.821.064.000 (A.3.0338)	Installing tool for front crankshaft oil seal
1.821.087.000 (A.3.0402)	Puller tool for crankshaft bush
1.821.110.000 (A.3.0469)	Installing tool for valve guide oil seal
1.822.008.000 (A.5.0195)	Counter-torque for camshaft pulleys
1.822.010.000 (A.5.0198)	Wrench for cylinder head fastening screws

Group 10 - 16 Valve Boxer engine

1.820.012.000 (A.2.0195)	Support for overhauling cylinder heads
1.820.016.000 (A.2.0226)	Support fork for overhauling cylinder heads
1.820.059.000 (A.2.0378)	Flywheel stopper
1.820.206.000	Counter-torque for removing/refitting camshaft pulleys
1.820.207.000	Reaction plate for disassembling cylinder head valves
1.820.609.000 (R.4.0145)	Engine supports for overhauling on stand
1.820.611.000 (R.4.0156)	Tool for removing/refitting power unit
1.821.001.000 (A.3.0103)	Support for disassembling/reassembling valves
1.821.058.000 (A.3.0324)	Lever for disassembling/reassembling valves
1.821.063.000 (A.3.0337)	Installing tool for rear crankshaft oil seal
1.821.064.000 (A.3.0338)	Installing tool for front crankshaft oil seal
1.821.104.000 (A.3.0450)	Installing tool for crankshaft bush

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1.821.176.000 (A.3.0641)	Puller tool for valve guide
1.821.204.000	Installing tool for front camshaft oil seals
1.821.205.000	Cage for disassembling/reassembling valves
1.821.206.000	Installing tool for valve guide oil seal
1.821.207.000	Installing tool for valve guide
1.821.208.000	Puller tool for valve guide oil seal
1.822.101.000	Extension wrench for slackening/screwing cylinder head fastening screws

Group 10 - 1929 Turbodiesel engine

1.820.012.000 (A.2.0195)	Base for cylinder head support tool
1.820.145.000 (R.4.0178)	Engine support brackets
1.820.225.000	Support for removing/refitting power unit
1.820.228.000	Flywheel stopper (to be used on the bench)
1.820.229.000	Flange for removing timing gear drive pulley
1.820.233.000	Bracket for removing/refitting power unit
1.820.253.000	Suppor base for dial gauge for measureing precombustion chamber protrusions/recesses
1.820.257.000	Support for disassembling/reassembling valves
1.820.258.000	Cylinder head support tool
1.820.261.000	Retainer tool for tappet cups
1.820.262.000	Levers for changing tappet plates
1.820.267.000	Tool for disassembling valves
1.820.277.000	Graduated disk for angle torque tightening
1.820.283.000	Support (camshaft side) for removing/refitting power unit
1.820.284.000	Support for disassembling/reassembling valves
1.820.286.000	Retainer tool for injection pump pulley for slackening or tightening fastening nut
1.820.287.000	Retainer tool for camshaft during disassembly or reassembly of side supports
1.821.058.000 (A.3.0324)	Lever for disassembling/reassembling valves
1.821.122.000 (A.3.0520)	Cage for disassembling/reassembling valves
1.821.161.000 (A.3.0617)	Mallet for removing timing gear drive pulley
1.821.169.000 (A.3.0633)	Puller tool for track rod pins
1.821.171.000 (A.3.0635)	Oil seal tool support grip
1.821.176.000 (A.3.0641)	Puller tool for valve guide
1.821.177.000 (A.3.0642)	Installing tool for valve guide

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1.821.203.000	Installing tool for front crankshaft oil seal
1.821.206.000	Installing tool for valve guide seal cap
1.821.208.000	Puller tool for valve guide seal cap
1.821.227.000	Installing tool for rear crankshaft oil seal
1.821.232.000	Puller tool for injection pump drive pulley
1.822.127.000	Wrench for disassembling/reassembling injectors
1.822.128.000	Wrench for disassembling/reassembling precombustion chamber fastening bushes
1.824.016.000 (C.2.0129)	Rod for tensioning timing gear belt
1.824.017.000 (C.2.0130)	End piece for tensioning timing gear belt
1.825.022.000 (C.6.0201)	Support tool for dial gauge for checking injection pump timing
1.828.004.000	Valve guide alesator

Group 10 - T. Spark 16V engines

1.820.011.000 (A.2.0192)	Valve supporting tool
1.820.012.000 (A.2.0195)	Cylinder head supporting tool
1.820.049.000 (A.2.0359)	Valve supporting tool nut
1.820.145.000 (R.4.0178)	Engine bench brackets
1.820.225.000	Engine removal/refitting support
1.820.258.000	Cylinder head support
1.820.267.000	Valve removal/refitting shim
1.820.277.000	Scaled disc for angle tightening torque
1.820.286.000	Counter-torque pulleys for counter-rotating shafts
1.820.617.000	Crankshaft counter-torque pulley (for pre-modification engines)
1.820.618.000	Crankshaft rotating adapter
1.820.619.000	Crankshaft rear oil seal centring disc
1.820.623.000	Engine removal/refitting supports
1.820.624.000	Flywheel lock (for use on bench)
1.820.626.000	Ram fitting
1.820.630.000	Flywheel lock (for post-modification engine)
1.821.058.000 (A.3.0324)	Valve removal/refitting lever
1.821.124.000 (A.3.0522)	Valve removal/refitting support
1.821.175.000 (A.3.0640)	Engine silent-block damper connecting rod extractor/taker-in

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1.821.176.000 (A.3.0641)	Valve guide extractor
1.821.205.000	Valve removal/refitting rack
1.821.206.000	Valve guide oil seal taker-in
1.821.208.000	Valve guide oil seal extractor
1.821.228.000	Camshaft oil seal taker-in on exhaust side
1.821.247.000	Crankshaft front oil seal and counter-rotating shaft oil seals taker-in
1.821.251.000	Counter-rotating shaft oil seal taker-in
1.821.252.000	Camshaft oil seal taker-in on intake side
1.821.254.000	Valve guide taker-in
1.822.144.000	Six-groove tool for oil sump removal/refitting
1.822.145.000	Six-groove tool for oil sump removal/refitting
1.822.146.000	Pulley support tool
1.822.147.000	Timing variator tool
1.822.149.000	Timing belt tension tool
1.822.154.000	Counter-rotating shaft belt tension tool
1.822.155.000	Timing pulley tool on intake side
1.822.156.000	Timing pulley tool on exhaust side
1.825.013.000 (C.6.0183)	TDC check tool
1.825.041.000	Camshaft timing template (for 1970 - 1747 engines)
1.825.042.000	Camshaft timing template (for 1370 - 1598 engines)
1.840.206.000	Ram

Group 10 - 1910 JTD engine

1.820.012.000	Cylinder head overhaul support
1.820.253.000	Comparator support
1.820.257.000	Valve removal/refitting support
1.820.258.000	Cylinder hear overhaul support
1.820.262.000	Tappet lowering lever
1.820.267.000	Valve removal/refitting shim
1.820.503.000	Comparator support
1.820.618.000	Crankshaft rotation flange
1.820.619.000	Crackshaft rear oil seal centring taker-in
1.821.053.000	Valve guide taker-in
1.821.058.000	Valve removal/refitting lever
1.821.178.000	Valve guide oil seal taker-in
1.821.205.000	Valve removal/refitting rack
1.821.208.000	Valve guide oil seal taker-in
1.821.228.000	Camshaft front oil seal taker-in
1.821.247.000	Crankshaft front oil seal taker-in

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1.821.254.000	Valve guide taker-in
1.822.144.000	Crankcase sump front and rear screw driver
1.822.145.000	Crankcase sump side screw driver
1.822.146.000	Driven toothed pulley anti-torque
1.822.156.000	Driven toothed pulley anti-torque
1.860.846.000	Flywheel lock tool
1.860.905.000	Engine timing template
1.860.942.000	Angle tightening goniometer
1.860.724.001	Lever to keep tappets down
1.860.814.001	Valve guide oil seal fastener
1.860.821.001	Connecting rod small end extractor/taker-in
1.861.001.139	Overhaul bench engine brackets
1.870.671.000	Diesel fuel feed pipe wrench
1.870.672.000	Diesel injector fitting wrench

Group 10 - Engine supply (Boxer 8 Valve engines)

1.822.135.000	Tool for slackening fuel pump cover lockring
1.824.110.000 (C.2.0056)	Plug for fluxing test

Group 10 - Engine supply (Boxer 16V engine)

1.822.135.000	Tool for slackening fuel pump cover lockring
1.824.002.000 (C.2.0014)	Four column vacuum meter for aligning and synchronising intake bodies
1.824.110.000 (C.2.0056)	Plug for fluxing test

Group 10 - Engine supply (1929 Turbodiesel engine)

1.820.098.000 (A.2.0471)	Tool for checking "WASTE-GATE" overpressure valve
1.820.286.000	Retainer tool for injection pump pulley for slackening or tightening fastening nut
1.821.167.000 (A.3.0631)	Wrench for slackening/tightening fuel suction device fastening lockring on tank
1.821.232.000	Puller tool for injection pump pulley
1.822.127.000	Wrench for disassembling/reassembling injectors
1.824.016.000 (C.2.0129)	Rod for tensioning timing gear belt
1.824.017.000 (C.2.0130)	End piece for tensioning timing gear belt
1.825.022.000 (C.6.0201)	Support tool for dial gauge for checking injection pump timing

Group 10 - Feed engine (T. Spark 16V engines)

1.820.079.000	Tool for entrefer
1.821.167.000	Tool to unscrew the locking ring of the fuel pump cover (Specific for engines with injection - ignition system M1.5.5)
1.822.135.000	Tool to unscrew the locking ring of the fuel pump cover (Specific for engines with injection - ignition system M2.10.4)
1.822.146.000	Support for pulleys' wrenches
1.822.156.000	Pulley wrench for distribution
1.822.161.000	Wrench to remove tachimetric sensor
1.860.955.000	Gauge
1.860.955.001	Kit to check fuel pressure
1.860.955.003	Kit to check fuel pressure
1.870.684.000	Connector to release fuel system pressure

Group 18 - Clutch (Boxer versions)

1.820.059.000	Flywheel stop
1.820.108.000	Centering tool of clutch disc

Group 18 - Clutch (1929 Turbodiesel version)

1.820.126.000	Centering tool of clutch disc
1.820.228.000	Flywheel stop

Group 18 - Clutch (T. Spark 16V versions)

1.820.124.000	Centering tool of clutch disc (Specific for 1370 T. SPARK 16V with gearbox C.513.5 from the chassis nu° .....)
1.820.126.000	Centering tool of clutch disc
1.820.624.000	Flywheel stop

Group 21 - Gearbox - Differential (Boxer version)

1.820.017.000	Half rings to extract the internal guide of the pinion's rear bearing
1.820.020.000	Checking support of preload of the pinion's bearing
1.820.021.000	Tool to block the pinion
1.820.024.000	Extracting plate of spacer and internal guide of the pinion's bearing
1.820.030.000	Spacer to check preload of the pinion's bearings
1.820.037.000	Countertorque to join/disjoin the clamping screw of the primary shaft
1.820.106.000	Support to compare and determine the pinion's position
1.820.107.000	Pinion to determine the generator

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1.820.146.000 (R.4.0189)	Support of gearbox - differential group for overhauling
1.820.152.000 (C.5.0125)	Disc to check the bearings' preload
1.820.208.000	Support to join/disjoin gearbox-differential from the car
1.820.226.000	Support to join/disjoin gearbox-differential
1.820.239.000	Crosspiece supports to join/disjoin gearbox-differential
1.820.581.000	Crosspiece supports for the engine to join/disjoin gearbox-differential
1.820.607.000	Brackets couple to join/disjoin the gearbox
1.821.034.000 (A.3.0290)	Mobile extractor of internal guides of the bearings in the differential box
1.821.035.000 (A.3.0291)	Extractor of bushing and splash oil guard of the primary shaft
1.821.036.000 (A.3.0292)	Introducing tool of the bearings' external guides
1.821.037.000 (A.3.0293)	Extracting/introducing tool of the bearing's locking ring and ring odometer onto the differential shaft
1.821.038.000 (A.3.0294)	Introducing tool of splash oil guard onto gearshifts control lever
1.821.039.000 (A.3.0295)	Extracting plate of the differential shaft from its support
1.821.040.000 (A.3.0296)	Extracting/introducing tool of external guide of the pinion's rear bearing and extractor of pinion/primary shaft
1.821.041.000 (A.3.0297)	Extracting/introducing tool of the external guide of the pinion's front bearing
1.821.042.000 (A.3.0298)	Extractor of the bearing locking ring of the differential shaft and odometer
1.821.043.000 (A.3.0299)	Extractor of the bearing external guide of the differential support
1.821.044.000 (A.3.0300)	Introducing tool of the primary shaft and gear of the 5^ speed
1.821.045.000 (A.3.0302)	Extracting/introducing of the bearing from the half axle hub
1.821.046.000 (A.3.0303)	Guide to mount control lever pawls of 3^ - 4^ and R.M. shifts
1.821.047.000 (A.3.0304)	Guide to mount control lever pawls of 1^ - 2^ and R.M. shifts
1.821.048.000 (A.3.0305)	Introducing tool of internal guides of bearings onto the hubs of the differential box
1.821.050.000 (A.3.0307)	Introducing tool of the bearing onto the primary shaft and the phonic wheel onto the primary shaft
1.821.051.000 (A.3.0308)	Introducing tool of the shaft bushing
1.821.052.000 (A.3.0309)	Introducing tool of the gearshift control lever pawls
1.821.057.000 (A.3.0322)	Extracting/introducing tool of the flexible pins of the gearshift control lever

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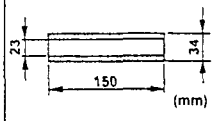
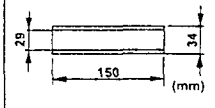
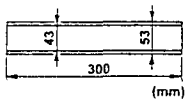
1.821.098.000 (A.3.0429)	Puller tool for gearshift control and selection rod oil seal
1.821.099.000 (A.3.0430)	Installing tool for differential axle shaft cover oil seal
1.821.107.000 (A.3.0452)	Puller tool for PTO shaft oil seal
1.821.108.000 (A.3.0453)	Installing tool for PTO shaft oil seal
1.821.114.000 (A.3.0490)	Puller tool for removing 4th speed gear from main shaft
1.821.115.000 (A.3.0491)	Puller/installing tool for main shaft rear bearing
1.821.116.000 (A.3.0492)	Puller tool for removing 4th speed gear from main shaft
1.821.117.000 (A.3.0495)	Puller tool for 5th speed driving gear
1.821.118.000 (A.3.0500)	Puller tool for main shaft rear bearing
1.824.006.001 ÷ 006 (C.2.0037)	Weight for checking bearing preload (100gr - 150 gr - 200 gr - 300 gr - 1000 gr - 2000 gr)
1.825.005.000 (C.6.0161)	Reference for defining pinion position dimension
1.825.006.000 (C.6.0162)	Tool for checking pinion position

Group 21 - Gearbox - Differential (1929 Turbodiesel and T. Spark 16V versions)

1.820.017.000	Half rings for: - removing main shaft 4th speed driven gear - main shaft disassembly
1.820.019.000	Plate for removing transmission shaft 2nd and 3rd speed driven gears
1.820.022.000	Half plates for inserting main shaft front bearing inner race
1.820.024.000	Plate for supporting half rings and removing transmission shaft 1st speed driven gear
1.820.085.000	Tool for defining differential bearing shims
1.820.146.000	Gearbox support plate on rotary stand
1.820.208.000	Support for removing/refitting gearbox (Specific for Turbodiesel version)
1.820.226.000	Engine support
1.820.227.000	Brackets for removing/refitting gearbox
1.820.229.000	Flange for removing differential flange
1.820.239.000	Support for engine gearbox
1.820.581.000	Engine support crossrail
1.820.623.001	Support for removing/refitting gearbox (Specific for T. Spark 16V engines)
1.821.003.000	Drift for removing differential support bearing outer race
1.821.028.000	Installing tool for differential support bearing outer race

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1.821.034.000	Puller tool for differential bearings
1.821.047.000	Installing tool for 1st - 3rd - 5th speed control rod safety pawls
1.821.049.000	Half plates for installing main shaft rear bearing
1.821.050.000	Installing tool for 4th speed driven gear
1.821.062.000	Installing tool for differential bearings
1.821.092.000	Installing tool for 1st speed driven gear
1.821.117.000	Puller tool for removing main and transmission shaft front bearing inner race
1.821.161.000	Mallet for removing differential flange
1.821.170.000	Installing tool for differential carrier oil seal gearbox side
1.821.171.000	Grip for installing tools
1.821.225.000	Installing tool for differential carrier oil seal engine side
	Installing tool for: main shaft front bearing inner race
	Installing tool for: transmission and main shaft rear bearing
	Installing tool for: synchroniser hub and transmission shaft 2nd and 3rd speed gears

Group 21 - Gearbox - Differential (1370 T. Spark 16V version with gearbox C.513.5 from chassis no. .....)

1.820.019.000 (A.2.0240)	Half plates for disassembling main and transmission shafts
1.820.022.000 (A.2.0247)	Half plates for reassembling main shaft
1.820.047.000 (A.2.0349)	Plate for disassembling main and transmission shafts
1.820.085.000 (A.2.0458)	Tool for defining differential bearing shims
1.820.146.000 (R.4.0189)	Gearbox support tool for disassembly on overhauling stand
1.820.226.000	Power unit support
1.820.239.000	Support for power unit
1.820.581.000	Power unit support crossrail
1.820.605.000	Half rings for disassembling main and transmission shafts
1.820.623.000	Support bracket for removing/refitting gearbox

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1.821.034.000 (A.3.0287)	Puller tool for differential support roller bearing outer race - gearbox cover side
1.821.037.000 (A.3.0293)	Installing tool for components on transmission shaft
1.821.049.000 (A.3.0306)	Half plates for disassembling main and transmission shafts
1.821.092.000 (A.3.0412)	Installing tool for components on main shaft
1.821.117.000 (A.3.0495)	Puller tool for transmission shaft front bearing inner race
1.837.432.100	Installing tool for components on transmission shaft
1.860.917.000	Puller/installing tool for differential support bearings
1.860.978.000	Support for removing/refitting front suspension crossmember
1.870.007.000	Grip for installing/puller tools
1.875.017.000	Tool for disassembling differential bearings
1.875.018.000	Tool for assembling differential bearings

Group 27 - Axle shafts

1.820.082.000	Pliers for installing joint boot fastening clamps
1.820.084.000	Pliers for installing joint boot fastening clamps
1.821.161.000	Mallet
1.821.165.000	Puller tool for CV joint
1.860.996.000	Installing tool for bearing on axle shaft (Specific for 1370 T. SPARK 16V with gearbox C.513.5 from chassis no. .....)
(*)	Half plates for removing axle shaft bearing (Specific for 1370 T. SPARK 16V with gearbox C.513.5 from chassis no. .....)

(*): Not available at time of going to press.

Group 33 - Brakes

1.820.610.000	Tool for retaining rear drum brake cylinder piston
1.821.034.000	Tool for adjusting position of front brake caliper piston
1.822.108.000	Tool for moving back rear brake caliper piston

Group 41 - Steering system

1.821.169.000 (A.3.0633)	Puller tool for steering side rod pin

Group 44 - Front suspension (Boxer versions)

1.820.047.002	Plate for removing bearing inner race from wheel hub
1.820.089.000	Tool for front suspension spring compression

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1.820.223.000	Half rings for removing bearing inner race from wheel hub
1.820.226.000	Engine support
1.820.238.000	Plate for front suspension spring compression
1.820.239.000	Supports for engine support crossrail
1.820.247.000	Tool for retaining front shock absorber stem
1.820.581.000	Engine support crossrail
1.820.608.000	Blocks for front suspension spring compression
1.820.622.000	Tool for angle torque tightenings
1.821.045.000	Tool for removing bearing outer race from wheel upright
1.821.051.000	Tool for: - removing wheel hub from upright - removing bearing inner race from wheel hub
1.821.149.000	Support for removing bearing outer race from wheel upright
1.821.169.000 (A.3.0633)	Tool for disconnecting steering rod ball joint from wheel upright
1.821.209.000	Tool for: - inserting bearing in wheel upright - inserting hub in wheel upright
1.822.134.000	Wrench for slackening and tightening front shock absorber fastening nut

Group 44 - Front suspension (1929 Turbodiesel and T. Spark 16V versions)

1.820.047.002	Plate for removing bearing inner race from wheel hub
1.820.089.000	Tool for front suspension spring compression
1.820.223.000	Half rings for removing bearing inner race from wheel hub
1.820.238.000	Plate for front suspension spring compression
1.820.247.000	Retainer ring for front shock absorber stem
1.820.608.000	Blocks for front suspension spring compression
1.821.045.000	Tool for removing bearing outer race on wheel upright
1.821.051.000	Tool for: - removing wheel hub from upright - removing bearing inner race from wheel hub
1.821.149.000	Support for removing bearing outer race from wheel upright
1.821.169.000 (A.3.0633)	Tool for disconnecting steering rod ball joint from wheel upright
1.821.209.000	Tool for: - inserting bearing in wheel upright - inserting hub in wheel upright
1.822.134.000	Wrench for slackening and tightening front shock absorber fastening nut

Group 44 - Rear suspension

1.822.003.000	Tool for removing/refitting rear stiff axle

Group 50 - Air-conditioning

1.822.111.000	Socket wrench for pipe joints of cooling fluid
1.822.112.000	Box wrench for pipe joints of cooling fluid
1.822.113.000	Wrench for pipe joints of cooling fluid
1.822.115.000	Pin wrench for pipe joints of cooling fluid
1.822.132.000	Ratchet wrench to join/disjoin control motor of outer air door/ blow-by
1.822.136.000	Inserts to join/disjoin control motor of outer air door/blow-by

Group 55 - Electrical system

1.822.103.000	Ratchet wrench to join/disjoin spark plugs (Specific for Boxer 16V engine)
1.822.107.000	Socket wrench to join/disjoin spark plugs (Specific for Boxer 16V engine)
1.822.138.000	Wrench for locking nut of pulley alternator

Group 70 - Bodywork

1.822.120.000	Wrench for hinges' locking screws
1.822.137.000	Wrench to adjust side mobile glass
1.832.010.000	Blade to seal-cut glasses
1.823.014.000	Shaving knife for plastic elements
1.823.015.000	Shaving knife for plastic buttons
1.823.019.000	Blade to seal-cut glasses
1.823.020.001	6-mm diameter pin for roof mounting
1.823.020.002	8-mm pins for roof-mounting
1.823.021.000	Blade to seal-cut glasses
1.823.022.000	Blade to seal-cut glasses
1.823.023.000	Blade to seal-cut glasses
1.823.025.000	Inserts to remove plastic buttons
1.823.027.000	Bodywork protection plate from sealing cut of glasses

THE FOLLOWING TOOLS REFER TO JOINING/DISJOINING OPERATIONS OF THE 1910 JTD VERSION, AS TO THE TOOLS FOR "ENGINE OVERHAULING" REFER TO PAGE 57

Group 00 - Engine maintenance

1.820.262.000	Lever to lower the tappets
1.820.630.000	Flywheel stop
1.860.724.001	Lever to hold the tappets lowered
1.860.905.000	Template for engine timing
1.860.905.010	Calibrated screw for engine timing

Group 10 - Engine

1.820.225.000	Base to join/disjoin boost engine
1.820.630.000	Flywheel stop
1.822.144.000	Spanner to unscrew/crew front and rear screws of the block sump
1.822.145.000	Spanner to unscrew/screw side screws of the block sump
1.822.156.000	Countertorque of the toothed pulley of the pipe
1.825.215.000	Thrust bearing extractor
1.860.910.002	Support to join/disjoin the boost engine
1.860.942.000	Goniometer for angle tightening of the cylinder head screws
1.870.671.000	Hexagon ring wrench for Diesel fuel feeding joints
1.870.644.000	Support to join/disjoin the boost engine
1.870.644.001	Support to join/disjoin the boost engine

Group 10 - Feed engine

1.820.630.000	Flywheel stop
1.822.135.000	Tool to remove the locking ring of the pump with level indicator control
1.822.138.000	Wrench to tighten the nut of the control pulley of the pressure pump
1.860.954.002	Extractor of the control pulley of the pressure pump
1.870.671.000	Hexagon ring wrench for Diesel fuel feeding joints

Group 21 - Gearbox - Differential

1.820.124.000	Centering to mount the clutch disc
1.820.226.000	Support of the boost engine group
1.820.229.000	Flange to extract differential flange
1.820.239.000	Small blocks to support the boost engine group
1.820.581.000	Crosspiece to support the boost engine group
1.820.624.000	Flywheel stop
1.821.161.000	Beater to extract the differential flange
1.821.170.000	Tool to introduce oil splash guard on the differential flange
1.821.171.000	Handgrip to introduce oil splash guard on the differntial flange
1.860.978.000	Support to join/disjoin the crosspiece of front suspensions
1.870.644.000	Support to join/disjoin the gearbox
1.870.644.001	Support to join/disjoin the gearbox
1.870.651.000	Support brackets of the boost engine group
1.870.668.000	Extractor of the handgrip of the gearbox control lever
1.870.974.000	Spacer for bowden adjustment of the gearbox control

MAINTENANCE OPERATIONS

Maintenance operations consist of checking and maintaining the efficiency of some parts of the vehicle which are believed to undergo wear and tear following their normal utilisation.
Here follows the table showing the maintenance operations to be performed at given km intervals.

WARNINGS:
Precautions to be respected before the operations. The engine bay contains many moving parts, high temperature elements and high voltage wires which could be dangerous.
Carefully stick to the following indications:
- Switch the engine off and let it cool down.
Do not smoke or use unprotected flames. The presence of fuel may cause fire.
- Check the presence of fire extinguishers.

ATTENTION:

THE FOLLOWING MAINTENANCE GRID IS VALID TILL JUNE 1996.

Operations to be performed at the km shown		Km x 1.000									
		20	40	60	80	100	120	140	160	180	200
Replace engine oil and Filter (each year) check the lubricating circuit	Petrol versions	●	●	●	●	●	●	●	●	●	●
	Turbodiesel versions	EVERY 10.000 km									
Check the valves' play (not for engines with hydraulic tappets)			●		●		●		●		●
Replace control transmission belts							●				
Check conditions of trapezoidal belts			●		●		●		●		●
Check conditions of Poly V belts					●				●		
Replace air filter cartridge			●		●		●		●		●
Replace fuel filter cartridge (turbodiesel versions)			●		●		●		●		●
Replace fuel filter cartridge (petrol version)					●				●		
Check functioning of oxygen sensor of exhaust Gases (lambda probe)					●				●		
Replace spark plugs (petrol version)	Boxer 8V		●		●		●		●		●
	Boxer 16V					●					●
	T. Spark 16V					●					●
Replace antifreezing mixture					●				●		
Check oil level of gearbox/differential					●				●		
Check integrity of protecting bellows of half shafts, power steering and steering joints' caps			●		●		●		●		●
Check fuel and braking system's seal			●		●		●		●		●
Check parking brake stroke			●		●		●		●		●
Check oil level of the hydraulic torque converter			●		●		●		●		●

Group 00 - Boxer engines maintenance

Part	Nm	kgm
Oil sump drain plug	28 ÷ 35	2.9 ÷ 3.5
Nuts fastening timing gear belt tensioner (8 valves)	37 ÷ 46	3.8 ÷ 4.7
Coolant fluid drain plugs (16 valves)	17 ÷ 21	1.7 ÷ 2.1
Union fastening compressor/condenser pipe on condenser	26 ÷ 32	2.6 ÷ 3.2
Union fastening condenser/evaporator pipe on evaporator	21 ÷ 26	2.2 ÷ 2.7
Nuts fastening timing gear belt tensioner (16 valves)	29 ÷ 36	3.0 ÷ 3.6
Fuel outlet union from filter	21 ÷ 26	2.2 ÷ 2.7
Fuel filter inlet union	30 ÷ 37	3.0 ÷ 3.8
Spark plugs	25 ÷ 30	2.5 ÷ 3.1

Group 00 - 1929 Turbodiesel engine maintenance

Part	Nm	kgm
Nut fastening timing gear belt tensioner	37 ÷ 46	3.8 ÷ 4.7
Screw fastening camshaft drive pulley	100 ÷ 124	10.2 ÷ 12.6

Group 00 - T. Spark 16V engine maintenance

Part		Nm	kgm
Oil sump drain plug (for aluminium sump)		20 ÷ 25	2.0 ÷ 2.5
Oil sump drain plug (for sheet metal sump)		42.5 ÷ 52.5	4.3 ÷ 5.4
Screws fastening auxiliary components drive belt pulley		24 ÷ 29	2.4 ÷ 3.0
Screw fastening exhaust side camshaft pulley		100 ÷ 124	10.2 ÷ 12.6
Nut fastening timing gear belt tensioner		21 ÷ 26	2.1 ÷ 2.6
Spark plugs	Central (large - M14)	25 ÷ 35	2.5 ÷ 3.6
	Side (small - M10)	10 ÷ 12	1.0 ÷ 1.2

Group 00 - Mechanical unit maintenance

Part	Nm	kgm
Gearbox oil filler plug (Boxer versions)	30 ÷ 48	3.0 ÷ 4.9
Gearbox oil drain cap for sheet metal sumps (Boxer versions)	22.5 ÷ 28	2.3 ÷ 2.8
Gearbox oil drain cap for aluminium sumps (Boxer versions)	38 ÷ 48	3.9 ÷ 4.9
Gearbox oil filler/drain cap (1929 Turbodiesel and T. Spark 16V versions)	30 ÷ 48	3.0 ÷ 4.9
Relief screws on brake calipers	6 ÷ 7	0.6 ÷ 0.8

Group 10 - Boxer 8 Valve engines

Part	Nm	kgm
Screw fastening rpm and T.D.C. sensor	8 ÷ 10	0.8 ÷ 1.0
Screws fastening pressure plate to flywheel	19 ÷ 23	1.9 ÷ 2.4
Screws fastening water pump inlet union on crankcase	20 ÷ 24	2.0 ÷ 2.5
Nuts fastening intake manifolds to heads	20 ÷ 24	2.0 ÷ 2.5
Screws fastening camshaft drive pulleys	67 ÷ 71	6.5 ÷ 7.2
Screws fastening water pump	20 ÷ 24	2.0 ÷ 2.5

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Part	Nm	kgm
Nut fastening crankshaft pulley	119 ÷ 147	12.1 ÷ 15.0
Screws fastening oil sump	8 ÷ 10	0.8 ÷ 1.0
Sump oil drain plug	28 ÷ 35	2.9 ÷ 3.5
Screws fastening oil pump to rear cover	20 ÷ 24	2.0 ÷ 2.5
Screws fastening front cover to crankcase	20 ÷ 24	2.0 ÷ 2.5
Screws fastening engine flywheel (in oil)	97 ÷ 107	9.9 ÷ 10.9
Screws fastening rear cover to crankcase	20 ÷ 24	2.0 ÷ 2.5
Screws fastening connecting rod caps	53 ÷ 58	5.4 ÷ 5.9
Upper screws fastening main bearing caps (in oil)	67 ÷ 74	6.8 ÷ 7.5
Side screws fastening main bearing caps (in oil)	41 ÷ 50	4.2 ÷ 5.1
Screws fastening cylinder heads to crankcase (in oil)	91 ÷ 101	9.3 ÷ 10.3
Screws fastening camshaft supports	20 ÷ 24	2.0 ÷ 2.5
Nuts fastening timing gear belt tensioner	37 ÷ 46	3.8 ÷ 4.7
Minimum engine oil pressure warning light sensor	34 ÷ 42	3.5 ÷ 4.3
Screws joining oil pump casing to support	8 ÷ 10	0.8 ÷ 1.0
Screws fastening front flexible mount to engine	38 ÷ 47	3.9 ÷ 4.8

Group 10 - 16 Valve Boxer engine

Part	Nm	kgm
Screws fastening pressure plate to engine flywheel	19 ÷ 23	1.9 ÷ 2.4
Screw fastening rpm sensor	9 ÷ 10	0.8 ÷ 1.0
Screws fastening water pump inlet union on crankcase	20 ÷ 24	2.0 ÷ 2.5
Nuts fastening drive shaft supports	6 ÷ 8	0.6 ÷ 0.8
Nuts fastening camshaft drive pulleys	76 ÷ 84	7.7 ÷ 8.6
Screws fastening water pump	20 ÷ 24	2.0 ÷ 2.5
Nut fastening crankshaft pulley	219 ÷ 242	22.3 ÷ 24.6
Screws fastening oil pump to rear cover	20 ÷ 24	2.0 ÷ 2.5
Nuts fastening intake bodies	20 ÷ 24	2.0 ÷ 2.5
Screws fastening front cover to crankcase	20 ÷ 24	2.0 ÷ 2.5
Screws fastening engine flywheel (in oil)	97 ÷ 107	9.9 ÷ 10.9
Screws fastening rear cover to crankcase	20 ÷ 24	2.0 ÷ 2.5
Screws fastening camshaft caps	20 ÷ 24	2.0 ÷ 2.5
Screws fastening connecting rod caps	53 ÷ 58	5.4 ÷ 5.9
Upper screws fastening main bearing caps (in oil)	67 ÷ 74	6.8 ÷ 7.5
Side screws fastening main bearing caps (in oil)	41 ÷ 50	4.2 ÷ 5.1
Screws fastening cylinder heads to crankcase (in oil)	91 ÷ 101	9.3 ÷ 10.3
Nuts fastening belt tensioner to head	29 ÷ 36	3.0 ÷ 3.6

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Part	Nm	kgm
Nuts fastening timing gear belt fixed guides tu supports	47 ÷ 58	4.8 ÷ 5.9
Screws fastening timing gear belt fixed guide supports to cylinder heads	20 ÷ 24	2.0 ÷ 2.5
Engine oil minimum pressure warning light sensor	34 ÷ 42	3.5 ÷ 4.3
Screws joining oil pump casing to support	8 ÷ 10	0.8 ÷ 1.0
Oil sump drain plug	28 ÷ 35	2.9 ÷ 3.5
Screws fastening front engine flexible mount	38 ÷ 47	3.9 ÷ 4.8
Screws fastening cylinder head covers	8 ÷ 10	0.8 ÷ 1.0

Group 10 - 1929 Turbodiesel engine

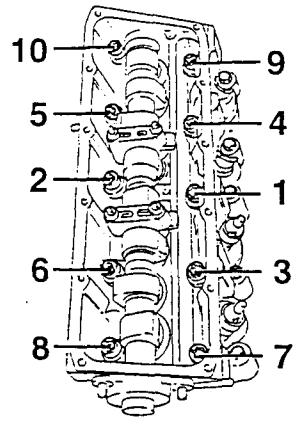
Part		Nm	kgm
Screws fastening main bearing caps to crankcase (in oil)		96 ÷ 119	9.8 ÷ 12
Screws fastening flywheel to crankshaft (with fixer)		121 ÷ 149	12.3 ÷ 15.2
Screws fastening connecting rod caps (in oil)		25 + 50°	2.6 + 50°
Nut fastening timing gear belt tensioner to crankcase		37 ÷ 46	3.8 ÷ 4.7
Screw fastening timing gear belt guide to crankcase		37 ÷ 46	3.8 ÷ 4.7
Screw and nuts fastening injection pump to its support		21 ÷ 26	2.1 ÷ 2.6
Nut fastening injection pump drive pulley		43 ÷ 53	4.3 ÷ 5.3
Upper screw fastening oil filter support and injection pump to crankcase		83 ÷ 103	8.5 ÷ 10.5
Lower screws fastening oil filter support and injection pump to crankcase		60 ÷ 75	6.2 ÷ 7.6
Screw fastening camshaft drive pulley to crankshaft (lefthand thread)		181 ÷ 200	18.4 ÷ 20.3
Engine oil minimum pressure sensor to oil filter support and injection pump		27 ÷ 34	2.8 ÷ 3.4
Screw fastening water pump to crankcase		21 ÷ 26	2.2 ÷ 2.7
Nuts fastening turbocharger to exhaust manifold		34 ÷ 42	3.5 ÷ 4.3
Air boost maximum pressure warning light switch to intake box		26 ÷ 32	2.6 ÷ 3.2
Fuel delivery unions from injection pump to injectors		26 ÷ 32	2.6 ÷ 3.2
Screw fastening oil vapour separator to crankcase		17 ÷ 21	1.7 ÷ 2.1
Nuts fastening alternator support bracket and layshaft to crankcase	M8	21 ÷ 26	2.2 ÷ 2.7
	M10	43 ÷ 53	4.3 ÷ 5.3
Screw fastening alternator support bracket and layshaft to crankcase		43 ÷ 53	4.3 ÷ 5.3
Union fastening overpressure pipe for flow limiter to injection pump and to intake box		13 ÷ 16	1.3 ÷ 1.6
Nuts fastening exhaust manifold and intake box to cylinder head		21 ÷ 26	2.2 ÷ 2.7
Screw fastening camshaft drive pulley		100 ÷ 124	10.2 ÷ 12.6

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Part	Nm	kgm
Bushes fastening precombustion chambers to cylinder head	100 ÷ 124	10.2 ÷ 12.6
Nuts fastening camshaft caps to cylinder head	16 ÷ 20	1.7 ÷ 2.0
Nuts fastening front and rear camshaft bearings and servobrake vacuum pump to cylinder head	16 ÷ 20	1.7 ÷ 2.0
KSB enable thermal switch to thermostatic cup	9 ÷ 11	0.9 ÷ 1.1
Thermostatic sensor for automatic fast idle device to thermostatic cup	26 ÷ 32	2.6 ÷ 3.2
Injector to cylinder head	47 ÷ 58	4.8 ÷ 5.9
Glow plugs to cylinder head	13 ÷ 16	1.3 ÷ 1.6

Cylinder head tightening

Inner screws Tighten the screws to a torque of:		100 Nm (10.2 kgm)
Turn all screws by an angle of:		90°
Complete tightening with a further angle of:		90°
Outer screws Tighten the screws to a torque of (1):		26 ÷ 32 Nm (2.6 ÷ 3.2 kgm)

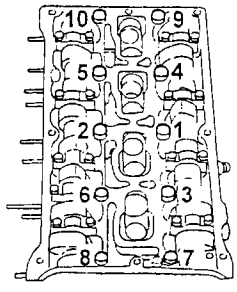
(1): No particular tightening sequence is necessary.

Group 10 - T. Spark 16V engines

Part		Nm	kgm
Screws fastening main bearing caps (in oil)		96 ÷ 119	9.8 ÷ 12.1
Screws fastening engine flywheel		121 ÷ 149	12.3 ÷ 15.2
Screws fastening connecting rod caps (in oil) (1370 T. Spark 16V)		25 + 50°	2.5 + 50°
Screws fastening connecting rod caps (in oil) (1598 - 1747 - 1970 T. Spark 16V)		25 + 60°	2.5 + 60°
Screws fastening auxiliary components belt drive pulley		24 ÷ 29	2.4 ÷ 3.0
Screw fastening timing gear drive belt pulley (lefthand)		340 ÷ 378	34.7 ÷ 38.5
Screws fastening water pump		17 ÷ 21	1.7 ÷ 2.1
Engine oil minimum pressure warning light sensor		25 ÷ 31	2.5 ÷ 3.2
Screws fastening counter-rotating shaft front coverts		6 ÷ 7	0.6 ÷ 0.7
Screws fastening oil sump	M6	7 ÷ 9	0.7 ÷ 0.9
	M8	21 ÷ 26	2.1 ÷ 2.7
Oil sump drain plug		17 ÷ 21	1.7 ÷ 2.1
Screws fastening oil pump		6 ÷ 8	0.6 ÷ 0.8
Screws fastening E.G.R. valve		17 ÷ 21	1.7 ÷ 2.1
Nuts fastening intake box to cylinder head		17 ÷ 21	1.7 ÷ 2.1
Screw fastening exhaust side camshaft pulley		100 ÷ 124	10.2 ÷ 12.6

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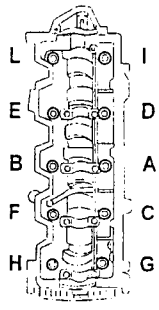
Part		Nm	kgm
Nut fastening timing gear gelt tensioner		21 ÷ 26	2.1 ÷ 2.6
Nuts fastening exhaust manifolds to cylinder heads		17 ÷ 21	1.7 ÷ 2.1
Screws fastening thermostatic cup to cylinder head		17 ÷ 21	1.7 ÷ 2.1
Screws fastening camshaft caps (in oil)		13 ÷ 16	1.3 ÷ 1.6
Spark plugs	Central (large - M14)	25 ÷ 35	2.5 ÷ 3.6
	Side (small - M10)	10 ÷ 12	1.0 ÷ 1.2
Engine coolant fluid temperature gauge transmitter and maximum temperature warning light contact		25 ÷ 31	2.5 ÷ 3.2
Cylinder head tightening			
Approach all the screws to a torque of:		20	2.0
Tighten the screws to a preliminary torque of:		40	4.1
Turn all the screws by an angle of:		90° + 90° + 90°	

Group 10 - 1910 JTD engine

Part	Nm	kgm
Fittings fastening pressure pump pipes to fuel manifold	26 ÷ 32	2.7 ÷ 3.3
Exhaust manifold fastening nuts	21 ÷ 26	2.1 ÷ 2.7
Tappet cover fastening screws	8 ÷ 10	0.8 ÷ 1.0
Front and rear crankcase sump fastening screws	7 ÷ 9	0.7 ÷ 0.9
Side crankcase sump fastening screws	21 ÷ 26	2.1 ÷ 2.7
Drive toothed pulley fastening screws (left-handed)	306 ÷ 378	31.2 ÷ 38.5
Engine flywheel fastening screws	136 ÷ 168	13.9 ÷ 17.1
Front crankcase cover fastening screws	8 ÷ 10	0.8 ÷ 1.0
Engine oil pressure minimum pressure warning light sensor	19 ÷ 23	1.9 ÷ 2.3
Rear crankcase sump fastening screws	8 ÷ 10	0.8 ÷ 1.0
Fittings fastening fuel manifold to injectors on injector side	19 ÷ 23	1.9 ÷ 2.3
Fittings fastening fuel manifold to injectors manifold side	26 ÷ 32	2.7 ÷ 3.3
Vacuum fastening screws	21 ÷ 26	2.1 ÷ 2.7
Thermostat fastening screws	21 ÷ 26	2.1 ÷ 2.7
Driven toothed pulley fastening screws	102 ÷ 126	10.4 ÷ 12.8
Coolant pump fastening screw	21 ÷ 26	2.1 ÷ 2.7
Injector fastening nuts	26 ÷ 32	2.7 ÷ 3.3
Glow plugs	13 ÷ 16	1.3 ÷ 1.6

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Part	Nm	kgm
Camshaft bearing fastening screws	13 ÷ 16	1.3 ÷ 1.6
Main bearing fastening screws	24 ÷ 26 + 100°	2.5 ÷ 2.7 + 100°
Connecting rod bearing fastening screws	24 ÷ 26 + 60°	2.5 ÷ 2.7 + 60°
Timing belt take-up fastening nut	45 ÷ 52	4.3 ÷ 5.3
Cylinder head tightening		
Tighten screws to the preliminary torque of:		65 / 6.6
Turn all screws by:		90° + 90° + 90°

Group 10 - Engine supply (Boxer engines)

Part	Nm	kgm
Fuel filter inlet union	30 ÷ 37	3.0 ÷ 3.8
Fuel filter outlet union	21 ÷ 26	2.2 ÷ 2.7
Union connecting fuel distributor manifold to pressure regulator	24 ÷ 29	2.4 ÷ 3.0
Nut fastening fuel pressure regulator	48 ÷ 60	4.9 ÷ 6.1
Nut fastening dash pot	9 ÷ 12	1.0 ÷ 1.2
Lambda sensor	43 ÷ 53	4.3 ÷ 5.4
Screw fastening rpm sensor	8 ÷ 10	0.8 ÷ 1.0
Screws/nuts fastening intake bodies (Specific for 16V)	20 ÷ 24	2.0 ÷ 2.5

Group 10 - Engine supply (1929 Turbodiesel engine)

Part	Nm	kgm
Nut fastening timing gear belt tensioner guide	37 ÷ 46	3.8 ÷ 4.7
Nuts fastening intake box to cylinder head	21 ÷ 26	2.2 ÷ 2.7
Nuts fastening exhaust manifold to cylinder head	21 ÷ 26	2.2 ÷ 2.7
Nuts fastening turbocharger to exhaust manifold	34 ÷ 42	3.5 ÷ 4.3

Group 10 - Engine supply (T. Spark 16V engines)

Part	Nm	kgm
Screws fastening auxiliary components belt drive pulley	24 ÷ 29	2.4 ÷ 3.0
Nut fastening timing gear belt tensioner	21 ÷ 26	2.1 ÷ 2.7
Screw fastening exhaust side camshaft pulley	100 ÷ 124	10.2 ÷ 12.6

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Part	Nm	kgm
Screws fastening E.G.R. valve	17 ÷ 21	1.7 ÷ 2.1
Engine coolant fluid temperature sensor (NTC)	12 ÷ 15	1.2 ÷ 1.5
Screws fastening intake box to cylinder head	17 ÷ 21	1.7 ÷ 2.1
Nuts fastening exhaust manifold to cylinder head	17 ÷ 21	1.7 ÷ 2.1

Group 10 - Engine cooling (Boxer engines)

Part	Nm	kgm
Fan control thermal contact	23 ÷ 37	2.3 ÷ 3.8
Screws fastening water pump to crankcase	20 ÷ 24	2.0 ÷ 2.5
Screws fastening water pump pulley	8 ÷ 10	0.8 ÷ 1.0
Screw fastening thermostating unit	20 ÷ 24	2.0 ÷ 2.5
Screws fastening water pump inlet union to crankcase	20 ÷ 24	2.0 ÷ 2.5

Group 10 - Engine cooling (1929 Turbodiesel engine)

Part	Nm	kgm
Automatic fast idle device thermostatic sensor	26 ÷ 32	2.6 ÷ 3.2
Cold injection advance automatic device thermal switch (KSB)	9 ÷ 11	0.9 ÷ 1.1

Group 10 - Engine cooling (T. Spark 16V engines)

Part	Nm	kgm
Screws fastening auxiliary components drive belt pulley	24 ÷ 29	2.4 ÷ 3.0
Nut fastening timing gear belt tensioner	21 ÷ 26	2.1 ÷ 2.7
Screw fastening exhaust side camshaft pulley	100 ÷ 124	10.2 ÷ 12.6

Group 18 - Clutch (Boxer versions)

Part	Nm	kgm
Screws fastening pressure plate to engine flywheel	19 ÷ 23	1.9 ÷ 2.4
Clutch circuit pipe unions on control cylinder and on pump	17 ÷ 19	1.7 ÷ 1.9
Nuts fastening clutch pump to pedal unit	13 ÷ 21	1.3 ÷ 2.1
Intermediate union for pipe connecting clutch pump-cylinder	17 ÷ 19	1.7 ÷ 1.9

Group 18 - Clutch (1929 Turbodiesel version)

Part	Nm	kgm
Screws fastening pressure plate to engine flywheel	20 ÷ 25	2.1 ÷ 2.6
Screws fastening clutch control cylinder to gearbox cover	13 ÷ 16	1.3 ÷ 1.6
Nuts fastening clutch pump to pedal unit	13 ÷ 21	1.3 ÷ 2.1
Clutch circuit pipe union on pump	17 ÷ 19	1.7 ÷ 1.9
Clutch circuit pipe union on control cylinder	17 ÷ 19	1.7 ÷ 1.9
Screws fastening thrust bearing sleeve	7 ÷ 9	0.7 ÷ 0.9

Group 18 - Clutch (T. Spark 16V versions)

Part	Nm	kgm
Screws fastening pressure plate to engine flywheel	20 ÷ 25	2.1 ÷ 2.6
Screws fastening thrust bearing sleeve	7 ÷ 9	0.7 ÷ 0.9
Screws fastening clutch control cylinder to gearbox cover	13 ÷ 16	1.3 ÷ 1.6
Clutch circuit pipe union on control cylinder	17 ÷ 19	1.7 ÷ 1.9

Group 21 - Gearbox - Differential (Boxer versions)

Part	Nm	kgm
Screws fastening gearbox - differential rear cover	20 ÷ 25	2.1 ÷ 2.6
Gearbox oil filler cap	30 ÷ 48	3.1 ÷ 4.9
Gearbox oil drain plug (sheet metal sump)	22.5 ÷ 28	2.3 ÷ 2.8
Gearbox oil drain plug (aluminium sump)	31 ÷ 38	3.1 ÷ 3.9
Screw fastening reversing shaft to gearbox	19 ÷ 23	1.9 ÷ 2.4
Nut locking gears pack on bevel pinion	224 ÷ 248	22.9 ÷ 25.3
Screw fastening oil cup on main shaft	81 ÷ 89	8.3 ÷ 9.1
Reversing light switch	40 ÷ 49	4.1 ÷ 5.0
Screw fastening 1st and 2nd gear engagement lever	25 ÷ 27	2.5 ÷ 2.8
Screw fastening 1st, 2nd, 3rd and 4th gear fork on gearshift control rods	21 ÷ 23	2.1 ÷ 2.4
Screws fastening differential supports to gearbox differential	38 ÷ 47	3.9 ÷ 4.8
Screws fastening crown wheel to differential carrier	100 ÷ 110	10.2 ÷ 11.2
Nut fastening gearshift control bar to upper U-bolt on gearbox cover	34 ÷ 42	3.5 ÷ 4.3
Nut fastening gearshift control bar to lower U-bolt on gearbox cover	19 ÷ 23	1.9 ÷ 2.4
Screw fastening rear support plug for gearshift control bar	19 ÷ 23	1.9 ÷ 2.4
Nut fastening gearshift control bar to gearshift lever	8 ÷ 10	0.8 ÷ 1.0
Nut fastening gearshift control lever to support	3.4 ÷ 4.2	0.34 ÷ 0.42
Nuts fastening gearbox - differential to rear engine cover	39 ÷ 48	4.0 ÷ 4.9
Screws fastening differential side axle shaft to flange	38 ÷ 42	3.9 ÷ 4.3

Group 21 - Gearbox - Differential (1929 Turbodiesel version)

Part	Nm	kgm
Nut fastening spring for clicking gearshift control rods into position	19.5 ÷ 31.5	1.98 ÷ 3.21
Screw fastening rear cover bearing retainer plate to gearbox	21 ÷ 26	2.2 ÷ 2.7
Screw fastening cover on gearbox support connection to engine	9 ÷ 11	0.9 ÷ 11
Screw fastening gearbox to connection to engine support	21 ÷ 26	2.2 ÷ 2.7
Screw fastening reversing shaft	29 ÷ 36	2.9 ÷ 3.6

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Part	Nm	kgm
Locknut for main and transmission shaft for fastening 5th gear	100 ÷ 124	10 ÷ 13
Screw fastening gearshift control forks	15 ÷ 19	1.6 ÷ 1.9
Screw fastening lever on gear engagement and shift control shaft	21 ÷ 26	2.2 ÷ 2.7
Screw fastening support for reverse control lever	9 ÷ 11	0.9 ÷ 1.1
Screw fastening bush for gear control shaft	9 ÷ 11	0.9 ÷ 1.1
Screw fastening differential crown wheel	75 ÷ 92	7.6 ÷ 9.4
Screw fastening flange retaining differential carrier to gearbox	21 ÷ 26	2.2 ÷ 2.7
Screw fastening tachometric support	8 ÷ 13	0.8 ÷ 1.3
Magnetic threaded taper plug for draining gearbox oil	30 ÷ 48	3.0 ÷ 4.9
Magnetic threaded taper plug for filling gearbox oil	30 ÷ 48	3.0 ÷ 4.9
Screw fastening right differential shaft support	7 ÷ 11	0.7 ÷ 1.1
Threaded taper plug for 1st and 2nd rod seat on gearbox	13 ÷ 21	1.3 ÷ 2.1
Screw fastening support for gearshift lever	10 ÷ 16	1 ÷ 1.6
Screw fastening differential side joint to flange	40 ÷ 52	4.1 ÷ 5
Screw fastening intermediate axle shaft	8 ÷ 10	0.8 ÷ 1.0
Reversing light switch screw	20 ÷ 32	2.0 ÷ 3.2
Nut for stud on gearbox support for connection to engine	68 ÷ 84	6.9 ÷ 8.6
Screw with spring washer for fastening flywheel cover to gearbox connection support	7 ÷ 8	0.7 ÷ 0.9
Screw fastening starter motor to gearbox support	19 ÷ 23	1.9 ÷ 2.4
Nut fastening supply cable to starter motor	9 ÷ 11	0.9 ÷ 1.1
Screw fastening upper gearbox to engine connection support	68 ÷ 84	6.9 ÷ 8.6
Screw fastening upper gearbox to engine connection support and power unit lifting hook	47 ÷ 58	4.8 ÷ 5.9
Screw fastening lower gearbox to engine connection support	47 ÷ 58	4.8 ÷ 5.9
Screw fastening gearshift control lever support to floor	5 ÷ 8	0.5 ÷ 0.8
Screw for fastening lower selection and engagement rod to gearshift control lever	19 ÷ 23	1.9 ÷ 2.4
Self-locking nut for pin fastening intermediate transmission	10 ÷ 16	1 ÷ 1.6
Self-locking nut fastening engagement tie-rod head to intermediate lever	10 ÷ 16	1 ÷ 1.6
Self-locking nut for screw fastening selection transmission on gearbox	13 ÷ 16	1.3 ÷ 1.6

Group 21 - Gearbox - Differential (T. Spark 16V versions with gearbox C.510.5)

Part	Nm	kgm
Screws and nuts fastening gearbox - engine	75 ÷ 92	7.6 ÷ 9.4
Gearbox-differential oil drain plug	30 ÷ 48	3.1 ÷ 4.9
Bolts fastening wishbones to wheel uprights	67 ÷ 74	6.8 ÷ 7.5
Screws fastening power steering to front crossmember	43 ÷ 47	4.4 ÷ 4.8
Front nuts fastening gearbox controls support	16 ÷ 25	1.6 ÷ 2.5

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Part	Nm	kgm
Rear centre screws fastening the suspension crossmember to the body	77 ÷ 95	7.8 ÷ 9.7
Rear side screws fastening the suspension crossmember to the body	92 ÷ 113	9.4 ÷ 11.5
Front screws fastening the suspension crossmember to the body	92 ÷ 113	9.4 ÷ 11.5
Bolts fastening transmission axle shaft to gearbox	40 ÷ 52	4.1 ÷ 5.3
Screws fastening starter motor	20 ÷ 25	2.0 ÷ 2.6
Bolts fastening transmission axle shaft to intermediate shaft	67 ÷ 76	6.8 ÷ 7.7
Bolts fastening uprights to wheel hubs	36 ÷ 44	3.7 ÷ 4.5
Screws fastening intermediate shaft to its support	8 ÷ 10	0.8 ÷ 1.0
Lockring for main and transmission shafts for fastening 5th gear	100 ÷ 124	10 ÷ 13
Screws fastening gearshift control forks	15 ÷ 19	1.6 ÷ 1.9
Bolt fastening rear bearing retainer plate to gearbox	21 ÷ 26	2.2 ÷ 2.7
Screw fastening reversing shaft	29 ÷ 36	2.9 ÷ 3.6
Screws fastening differential carrier retainer flange to gearbox	21 ÷ 26	2.2 ÷ 2.7
Screws fastening reverse gear fork support bracket	9 ÷ 11	0.9 ÷ 1.1
Screws fastening control lever to gearbox	21 ÷ 26	2.2 ÷ 2.7
Screws fastening gearbox rear cover	21 ÷ 26	2.2 ÷ 2.7
Screws fastening gear engagement device support bracket	10 ÷ 16	1.0 ÷ 1.6
Screws fastening crown wheel to differential carrier	75 ÷ 92	7.6 ÷ 9.4
Screws fastening gearbox side differential carrier seal cover	21 ÷ 26	2.2 ÷ 2.7

Group 21 - Gearbox - Differential (T. Spark 16V version with gearbox C.513.5)

Part	Nm	kgm
Screws fastening rear cover	24 ÷ 26	2.4 ÷ 2.6
Lockrings fastening main and transmission shafts	112 ÷ 124	11.4 ÷ 12.6
Screw fastening rear bearing retainer plate	24 ÷ 26	2.4 ÷ 2.6
Devices for positioning gearshift control rods	28.5 ÷ 31.5	2.9 ÷ 3.2
Screw fastening reversing shaft	32 ÷ 36	3.3 ÷ 3.6
Screws fastening differential carrier seal cover	46 ÷ 51	4.7 ÷ 5.2
Screws fastening gearbox cover	24 ÷ 26	2.4 ÷ 2.6
Screws fastening reverse intermediate gear control fork	10 ÷ 11	1.0 ÷ 1.1
Screws fastening gearshift control forks	24 ÷ 26	2.4 ÷ 2.6
Screws fastening crown wheel to differential carrier	65 ÷ 72	6.7 ÷ 7.4

Group 27 - Axle shafts (Boxer versions)

Part	Nm	kgm
Screws fastening axle shaft CV joint gearbox side	38 ÷ 42	3.9 ÷ 4.3
Nut fastening axle shaft to wheel hub	266 ÷ 294	27.1 ÷ 30.0

Group 27 - Axle shafts (1929 Turbodiesel and T. Spark 16V versions)

Part	Nm	kgm
Screws fastening axle shaft CV joint differential side to flange	36 ÷ 44	3.6 ÷ 4.5
Screws fastening intermediate axle shaft flange	8 ÷ 10	0.8 ÷ 1.0
Screws fastening damping mass halves to left axle shaft (Specific for T. Spark 16V version)	5 ÷ 8	0.5 ÷ 0.8

Group 33 - Brakes

Part			Nm	kgm
Stiff brake pipe unions on brake pump			13 ÷ 15	1.4 ÷ 1.5
Nuts fastening servobrake to pedal unit			10 ÷ 16	1 ÷ 1.6
Screws fastening brake caliper support plate			45 ÷ 46	4.6 ÷ 5.7
Screws fastening brake caliper support plate	with piece in "Driloc" (*)	M6	57	5.8
		M8	10.5	10.7
Screws fastening brake calipers (*)			31 ÷ 38	3.1 ÷ 3.9
Screws with centering pins for brake disks			5 ÷ 13	0.6 ÷ 1.3
Unions between brake system stiff pipes and hoses			13 ÷ 15	1.4 ÷ 1.5
Hose unions to brake calipers			15 ÷ 19	1.6 ÷ 1.9
Relief screw on brake calipers			4 ÷ 6	0.4 ÷ 0.6
Screws with centering pins for rear brake drums			5 ÷ 13	0.6 ÷ 1.3
Screws fastening handbrake lever to support			24 ÷ 29	2.4 ÷ 3.0
Screws fastening support for running handbrake cable			8 ÷ 9	0.8 ÷ 1
Screws fastening braking load proportioning valve to bracket			6 ÷ 7	0.6 ÷ 0.8
Brake stiff pipe unions on braking load proportioning valve			13 ÷ 15	1.4 ÷ 1.5
Screw for braking load proportioning valve adjustment bracket			20 ÷ 25	2.1 ÷ 2.6
Brake stiff pipe unions on A.B.S.			13 ÷ 15	1.4 ÷ 1.5

(*): To be replaced at each tightening.

Group 41 - Steering system (Boxer versions)

Part	Nm	kgm
Nut fastening steering wheel to steering column	43 ÷ 53	4.3 ÷ 5.3
Screws fastening power steering box to battery sidemember	21 ÷ 26	2.2 ÷ 2.7
Screws fastening track rods to power steering box	105 ÷ 116	10.6 ÷ 11.8
Screws fastening lower steering column to power steering box pinion	19 ÷ 23	1.9 ÷ 2.4
Union fastening oil inlet pipe to power steering box	38 ÷ 42	3.9 ÷ 4.3
Union fastening oil outlet pipe from power steering box	29 ÷ 32	2.9 ÷ 3.2
Nut fastening track rod ball pin to shock absorber coupling	34 ÷ 42	3.5 ÷ 4.3
Screws fastening track rod adjustment union	15 ÷ 19	1.6 ÷ 1.9
Union fastening oil outlet pipe from power steering pump	48 ÷ 53	4.8 ÷ 5.4

(Continued)

(Continued)

Part	Nm	kgm
Adjustable guide locking device nut (to be tightened with lever in locked position)	30 ÷ 37	3 ÷ 3.8
Screws fastening upper steering column to body	21 ÷ 26	2.2 ÷ 2.7

Group 41 - Steering system (1929 Turbodiesel and T. Spark 16V versions)

Part	Nm	kgm
Nut fastening steering wheel to steering column	43 ÷ 53	4.3 ÷ 5.3
Screws fastening power steering box to sidemember	43 ÷ 47	4.4 ÷ 4.8
Screws fastening upper steering column to body	5 ÷ 8	0.5 ÷ 0.8
Screw fastening lower steering column to power steering box pinion	15 ÷ 19	1.6 ÷ 1.9
Union fastening oil inlet pipe to power steering box	38 ÷ 42	3.9 ÷ 4.3
Union fastening oil outlet pipe from power steering box	29 ÷ 32	2.9 ÷ 3.2
Nut fastening track rod ball pin to wheel upright	30 ÷ 37	3 ÷ 3.8
Nuts fastening track rods	30 ÷ 37	3 ÷ 3.8
Union fastening oil outlet pipe from power steering pump	48 ÷ 53	4.8 ÷ 5.4
Adjustable guide locking device nut (to be tightened with lever in locked position)	30 ÷ 37	3 ÷ 3.8

Group 44 - Front suspension (Boxer versions)

Part		Nm	kgm
Nut fastening track rod to coupling on shock absorber		34 ÷ 42	3.5 ÷ 4.3
Bolts fastening shock absorber to wheel upright		67 ÷ 74	6.8 ÷ 7.5
Centre nut retaining helical spring to shock absorber		95 ÷ 105	9.7 ÷ 10.7
Screws fastening shock absorber to body		34 ÷ 42	3.5 ÷ 4.3
Nut fastening axle shaft to wheel hub	before change (1 caulk)	266 ÷ 294	27.1 ÷ 30.0
	after change (2 caulks)	67 ÷ 74 + 62°	6.8 ÷ 7.5 + 62°
Screws fastening brake calipers		45 ÷ 56	4.6 ÷ 5.7
Bolt fastening wishbone to wheel upright		67 ÷ 74	6.8 ÷ 7.5
Nut fastening stabiliser bar connecting rod to wishbone		26 ÷ 33	2.7 ÷ 3.3
Screws fastening wishbone to chassis		67 ÷ 74	6.8 ÷ 7.5
Screws fastening engine support frame crossmember		67 ÷ 74	6.8 ÷ 7.5
Lambda sensor		43 ÷ 53	4.3 ÷ 5.3
U-bolt nuts fastening stabiliser bar to chassis		26 ÷ 32	2.6 ÷ 3.2
Screws fastening power unit support frame to flexible mounts		26 ÷ 32	2.6 ÷ 3.2
Front screws fastening power unit support frame to body		68 ÷ 84	6.9 ÷ 8.6
Rear screws fastening power unit support frame to body		114 ÷ 126	11.6 ÷ 12.8

Group 44 - Front suspension (1929 Turbodiesel and T. Spark 16V versions)

Part		Nm	kgm
Bolts fastening shock absorber to wheel upright		67 ÷ 74	6.8 ÷ 7.5
Centre nut retaining helical spring to shock absorber		95 ÷ 105	9.7 ÷ 10.7
Screws fastening shock absorber to body		34 ÷ 42	3.5 ÷ 4.3
Nut fastening track rod to wheel upright		30 ÷ 37	3.0 ÷ 3.8
Bolt fastening wishbone to wheel upright		67 ÷ 74	6.8 ÷ 7.5
Nut fastening connecting rod to stabiliser bar		43 ÷ 53	4.3 ÷ 5.4
Nut fastening stabiliser bar connecting rod to wishbone		26 ÷ 33	2.7 ÷ 3.3
Screws fastening U-bolts joining wishbone to sidemember		68 ÷ 73	6.9 ÷ 7.4
Front screws fastening sidemember to body		92 ÷ 113	9.4 ÷ 11.6
Rear screws fastening sidemember to body	N° 4 central	77 ÷ 95	7.8 ÷ 9.6
	N° 2 side	102 ÷ 126	10.4 ÷ 12.9
Screws fastening steering box to sidemember		43 ÷ 47	4.4 ÷ 4.8
Nuts fastening U-bolts joining stabiliser bar to sidemember		34 ÷ 42	3.5 ÷ 4.3
Nut fastening axle shaft to wheel hub	before change (1 caulk)	266 ÷ 294	27.1 ÷ 30.0
	after change (2 caulks)	67 ÷ 74 + 62°	6.8 ÷ 7.5 + 62°

Group 44 - Rear suspension

Part	Nm	kgm
Nut fastening rear hub pin	266 ÷ 294	27.1 ÷ 30.0
Lower bolt fastening shock absorber	75 ÷ 92	7.6 ÷ 9.4
Upper bolt fastening shock absorber	48 ÷ 59	4.9 ÷ 6.0
Screw fastening stabiliser bar support U-bolts to longitudinal arm	24 ÷ 29	2.4 ÷ 3.0
Screw fastening stabiliser bar to longitudinal arm	48 ÷ 59	4.9 ÷ 6.0
Bolt fastening longitudinal arm to stiff axle	143 ÷ 158	14.5 ÷ 16.1
Screws fastening stiff axle support pads to body	92 ÷ 113	9.4 ÷ 11.6

Group 44 - Wheel

Part	Nm	kgm
Screws fastening wheels (with sheet metal rims)	83 ÷ 103	8.5 ÷ 10.5
Screws fastening wheel (with alloy rims)	83 ÷ 103	8.5 ÷ 10.5

Group 50 - Climate control (Specific for Boxer and 1929 Turbodiesel versions)

Part	Nm	kgm
Female connector fastening evaporator/drier filter pipe on evaporator	34 ÷ 42	3.5 ÷ 4.3

(Continued)

(Continued)

Part	Nm	kgm
Male connector fastening evaporator/drier filter pipe on drier filter	34 ÷ 42	3.5 ÷ 4.3
Female connector fastening drier filter/compressor pipe on drier filter	34 ÷ 42	3.5 ÷ 4.3
Screws fastening inlet and outlet pipe flange on compressor	21 ÷ 26	2.2 ÷ 2.7
End nut fastening compressor/condenser pipe on coupling flange on compressor (only for Boxer engines)	21 ÷ 26	2.2 ÷ 2.7
Female connector fastening compressor/condenser pipe on condenser	26 ÷ 32	2.6 ÷ 3.2
Female connector fastening condenser/evaporator pipe on condenser	21 ÷ 26	2.2 ÷ 2.7
Female connector fastening condenser/evaporator pipe on evaporator	21 ÷ 26	2.2 ÷ 2.7
Intermediate connector on which expansion valve is inserted	21 ÷ 26	2.2 ÷ 2.7

Group 50 - Climate control (Specific for T. Spark 16V versions)

Part	Nm	kgm
Female connector fastening condenser/evaporator pipe on evaporator	17 ÷ 19	1.7 ÷ 1.9
Female connector fastening evaporator/drier filter pipe on evaporator	40 ÷ 44	4.1 ÷ 4.5
Male connector fastening evaporator/drier filter pipe on drier filter	40 ÷ 44	4.1 ÷ 4.5
Female connector fastening drier/filter compressor pipe on drier filter	40 ÷ 44	4.1 ÷ 4.5
Intermediate pipe connector on which expansion valve is inserted	17 ÷ 19	1.7 ÷ 1.9
Three-level pressure switch	7.5 ÷ 8.5	0.8 ÷ 0.9
Screw fastening compressor electromagnetic joint hub	11 ÷ 16	1.1 ÷ 1.6
Minimum pressure switch	7.5 ÷ 8.5	0.8 ÷ 0.9

Group 50 - Climate control (Specific for '97 versions)

Part	Nm	kgm
Screws fastening coolant fluid inlet and outlet pipes from drier filter, evaporator, compressor and condenser	5 ÷ 6	0.5 ÷ 0.6
Four-level pressure switch	7 ÷ 8	0.7 ÷ 0.8

Group 55 - Electric system (Boxer versions)

Part	Nm	kgm
Spark plugs	25 ÷ 30	2.5 ÷ 3.1
Bolts fastening starter motor	39 ÷ 48	4 ÷ 4.9

Group 55 - Electric system (1929 Turbodiesel version)

Part	Nm	kgm
Glow plugs	13 ÷ 16	1.3 ÷ 1.6
Screws fastening starter motor	19 ÷ 23	1.9 ÷ 2.4

Group 55 - Electric system (T. Spark 16V versions)

Part		Nm	kgm
Spark plugs	Central (large - M14)	25 ÷ 35	2.6 ÷ 3.6
	Side (small - M10)	10 ÷ 12	1.0 ÷ 1.2
Screws fasening starter motor		20 ÷ 25	2.0 ÷ 2.6

Group 70 - Body

Part	Nm	kgm
Screw fastening bonnet hinges to body	16 ÷ 20	1.7 ÷ 2.0
Screw fastening bonnet hinges to bonnet	6 ÷ 7	0.6 ÷ 0.8
Bonnet lock pin	20 ÷ 25	2.1 ÷ 2.6
Screw fastening bonnet lock safety device	7 ÷ 8	0.7 ÷ 0.9
Nut fastening bonnet pad to body	30 ÷ 37	3.0 ÷ 3.8
Screw fastening door hinges to body	38 ÷ 47	3.9 ÷ 4.8
Screw fastening door lock striker	15 ÷ 19	1.6 ÷ 1.9
Screw fastening door lock device	6 ÷ 8	0.7 ÷ 0.8
Nut fastening boot hinges to body	4 ÷ 5	0.4 ÷ 0.5
Screw fastening boot lid to body	6 ÷ 8	0.7 ÷ 0.8
Screw fastening hinges to boot lid	6 ÷ 7	0.6 ÷ 0.8
Screw fastening boot lid lock striker to body and lock to boot lid	4 ÷ 5	0.4 ÷ 0.5
Screw fastening dashboard crossrail	31 ÷ 38	3.1 ÷ 3.9
Screw fastening front wheel arch	6 ÷ 8	0.7 ÷ 0.8
Screw fastening lower front wheel arch	4 ÷ 5	0.4 ÷ 0.5
Screw fastening door check rods	3 ÷ 4	0.3 ÷ 0.4
Screw fastening headlamp holder crossrail	20 ÷ 25	2.1 ÷ 2.6
Screw fastening front/rear tow hook	20 ÷ 25	2.1 ÷ 2.6
Ski rack screw	6 ÷ 8	0.7 ÷ 0.8
Screw fastening headlamp container to sidemember	6 ÷ 7	0.6 ÷ 0.8
Nut fastening complete wheel arch to side panel	4 ÷ 5	0.4 ÷ 0.5
Screw fastening headlamp crossrail to lower wheel arch piece	20 ÷ 25	2.1 ÷ 2.6
Screw fastening mobile crossrail complete	26 ÷ 32	2.6 ÷ 3.2
Screw fastening power steering and battery crossrail connection bracket	20 ÷ 25	2.1 ÷ 2.6
Screw fastening power steering and battery crossrail	20 ÷ 25	2.1 ÷ 2.6

(Continued)

(Continued)

Part	Nm	kgm
Screw fastening front seat belt runner	34 ÷ 42	3.5 ÷ 4.3
Screw fastening front seat belt reel	34 ÷ 42	3.5 ÷ 4.3
Screw fastening front seat belt connection	34 ÷ 42	3.5 ÷ 4.3
Screws fastening seat belt connection to front seats	34 ÷ 42	3.5 ÷ 4.3
Screw fastening front seat belt height adjustment device	17 ÷ 21	1.7 ÷ 2.1
Screw fastening rear seat belt reel	34 ÷ 42	3.5 ÷ 4.3
Screw fastening rear seat belt runner	34 ÷ 42	3.5 ÷ 4.3
Screw fastening rear seat belt lower connections	34 ÷ 42	3.5 ÷ 4.3
Screws fastening outer pretensioner arming bracket for front seat belt	3.5	0.35

THE FOLLOWING TORQUE WRENCH SETTINGS REFER TO JOIN/DISJOIN OPERATIONS OF 1910 JTD MOTORIZATION, FOR THOSE OF "ENGINE OVERHAULING" REFER TO PAGE 41

Group 00 - Engine maintenance

Part	Nm	kgm
Clamping screws of driving shaft pulley	21 ÷ 26	2.1 ÷ 2.7
Clamping nut of driving belt tightener	43 ÷ 53	4.4 ÷ 5.4

Group 10 - Engine

Part		Nm	kgm
Clamping nuts of half shafts		36 ÷ 44	3.6 ÷ 4.5
Clamping nuts of the righthand shock absorber to the wheel post		67 ÷ 74	6.8 ÷ 7.5
Clamping screws of the middle half shaft		8 ÷ 10	0.8 ÷ 1.0
Oil discharge cover of gearbox/differential		16 ÷ 26	1.6 ÷ 2.7
Clamping screws of the gearbox/differential group to the engine	M10	37 ÷ 45	3.8 ÷ 4.6
	M12	68 ÷ 84	6.9 ÷ 8.5
Clamping screws of clutch group		19 ÷ 23	1.9 ÷ 2.3
Clamping screws of the driving shaft pulley		21 ÷ 26	2.1 ÷ 2.7
Temperature sensor of the engine cooling fluid		17 ÷ 21	1.7 ÷ 2.1
Joints of pressure pump pipes to the fuel manifold - manifold's side/pressure pump's side		26 ÷ 32	2.7 ÷ 3.3

Group 10 - Feed engine

Part	Nm	kgm
Clamping screws of the driving shaft pulley	21 ÷ 26	2.1 ÷ 2.7
Clamping nut of the tightener of the driving belt	43 ÷ 53	4.4 ÷ 5.4
Joints of pressure pump pipes to the fuel's manifold - manifold's side/pressure pump side	26 ÷ 32	2.7 ÷ 3.3
Clamping nuts of the pressure pump	26 ÷ 32	2.7 ÷ 3.3
Clamping nut of the control pulley and pressure pump	43 ÷ 53	4.4 ÷ 5.4
Pipes joints of the fuel manifold to electroinjectors - electroinjector's side/manifold's side	19 ÷ 23	1.9 ÷ 2.3
Electroijectors' clamping nuts	26 ÷ 32	2.7 ÷ 3.3
Fuel temperature sensor	13 ÷ 16	1.3 ÷ 1.6
Clamping nuts of the multistage centrifugal blower (turbosupercharger)	21 ÷ 26	2.1 ÷ 2.7

THE FOLLOWING TORQUE WRENCH SETTINGS REFER TO JOIN/DISJOIN OPERATIONS OF 1910 JTD MOTORIZATION, FOR THOSE OF "ENGINE OVERHAULING" REFER TO PAGE 41

Group 00 - Engine maintenance

Part	Nm	kgm
Clamping screws of driving shaft pulley	21 ÷ 26	2.1 ÷ 2.7
Clamping nut of driving belt tightener	43 ÷ 53	4.4 ÷ 5.4

Group 10 - Engine

Part		Nm	kgm
Clamping nuts of half shafts		36 ÷ 44	3.6 ÷ 4.5
Clamping nuts of the righthand shock absorber to the wheel post		67 ÷ 74	6.8 ÷ 7.5
Clamping screws of the middle half shaft		8 ÷ 10	0.8 ÷ 1.0
Oil discharge cover of gearbox/differential		16 ÷ 26	1.6 ÷ 2.7
Clamping screws of the gearbox/differential group to the engine	M10	37 ÷ 45	3.8 ÷ 4.6
	M12	68 ÷ 84	6.9 ÷ 8.5
Clamping screws of clutch group		19 ÷ 23	1.9 ÷ 2.3
Clamping screws of the driving shaft pulley		21 ÷ 26	2.1 ÷ 2.7
Temperature sensor of the engine cooling fluid		17 ÷ 21	1.7 ÷ 2.1
Joints of pressure pump pipes to the fuel manifold - manifold's side/pressure pump's side		26 ÷ 32	2.7 ÷ 3.3

Group 10 - Feed engine

Part	Nm	kgm
Clamping screws of the driving shaft pulley	21 ÷ 26	2.1 ÷ 2.7
Clamping nut of the tightener of the driving belt	43 ÷ 53	4.4 ÷ 5.4
Joints of pressure pump pipes to the fuel's manifold - manifold's side/pressure pump side	26 ÷ 32	2.7 ÷ 3.3
Clamping nuts of the pressure pump	26 ÷ 32	2.7 ÷ 3.3
Clamping nut of the control pulley and pressure pump	43 ÷ 53	4.4 ÷ 5.4
Pipes joints of the fuel manifold to electroinjectors - electroinjector's side/manifold's side	19 ÷ 23	1.9 ÷ 2.3
Electroijectors' clamping nuts	26 ÷ 32	2.7 ÷ 3.3
Fuel temperature sensor	13 ÷ 16	1.3 ÷ 1.6
Clamping nuts of the multistage centrifugal blower (turbosupercharger)	21 ÷ 26	2.1 ÷ 2.7

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00

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TECHNICAL DATA

00

THE FOLLOWING GROUP CONTAINS ONLY THE SPECIFIC REFERENCES TO THE 146 MODELS; REFER TO THE GROUP 00 REGARDING THE 145 MODELS IN CASE OF MISSING REFERENCES.

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IDENTIFICATION OF CAR VERSION

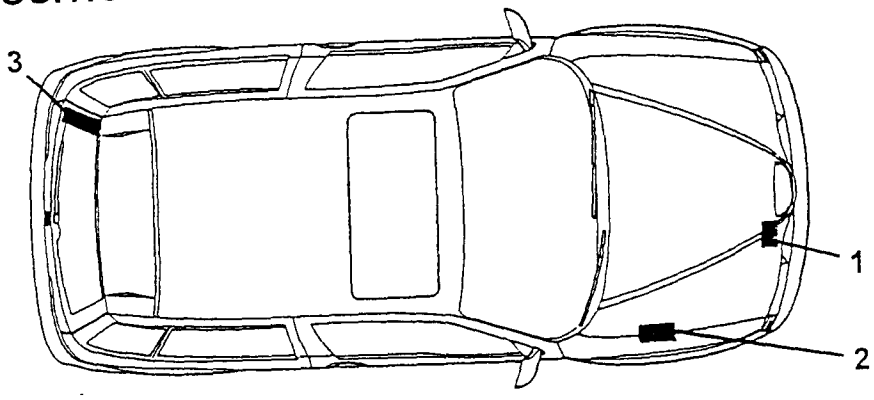
Commercial name	145 1.3/1.4	145 1.6	145 1.7 16V	145 TD	145 JTD
Equipment	3-door saloon				
Version (on identification plate)	930 A3	930 A2 930 A2A □	930 A1	930 A4 930 A4A ▲	930 A4B
Chassis (in the engine compartment, aside the upper connection of right shock absorber)	930000	930000	930000	930000	930000
Chassis ' number	2.001.001 4.001.001	2.001.001 4.001.001	2.001.001 4.001.001	2.001.001 4.001.001	-
Engine (code)	AR 33501	AR 33201	AR 33401	AR 67501 AR 33601 ▲	AR 32302
Engine's symbol	1351	1596	1712 16V	1929 TD	1910 JTD
Gearbox (code)	C.802.5.16.00	C.802.5.16.02 C.802.5.16.03□	C.802.5.18.00	C.510.5.17.63	C.530.5

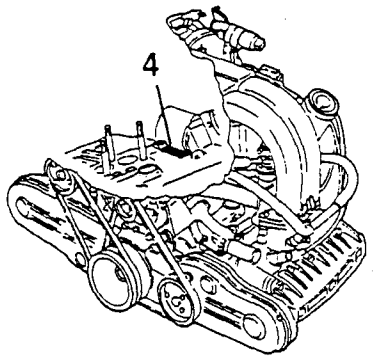
(□): Only for certain markets
(▲): Version with catalyst, only for certain markets.

Commercial name	145	145 1.4 T. Spark	145 1.6 T. Spark	145 1.8 T. Spark
Equipment	3-door saloon			
Version (on identification plate)	930 A5	930 A3A	930 A2B 930 A2C □	930 A1A
Chassis (in the engine compartment, aside the upper connection of right shock absorber)	930000	930000	930000	930000
Chassis ' number	2.001.001 4.001.001	-	-	-
Engine (code)	AR 67204 AR 32301	AR 33503	AR 67601	AR 67106 AR 32201
Engine's symbol	1970 T. SPARK 16V	1370 T. SPARK 16V	1598 T. SPARK 16V	1747 T. SPARK 16V
Gearbox (code)	C.510.5.21.13 C.510.5	C.510.5.18.03 C.513.5.14.02 (1)	C.510.5.18 C.510.5.17.96 □	C.510.5.17.93

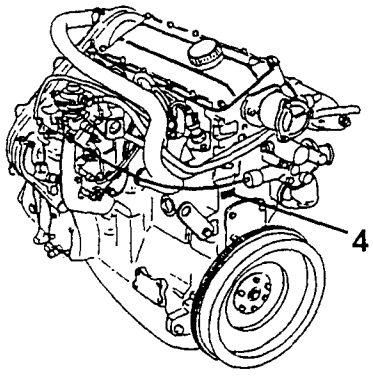
(□): Only for certain markets
(1): From chassis n° .....

POSITIONING OF IDENTIFICATION PLATES

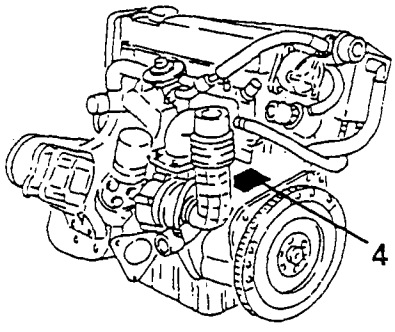




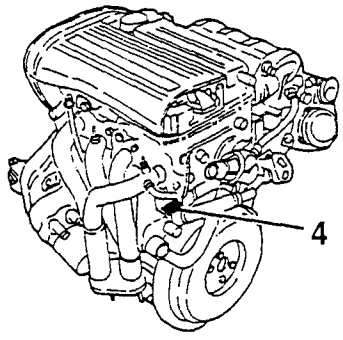
Boxer engines



1929 TD engine



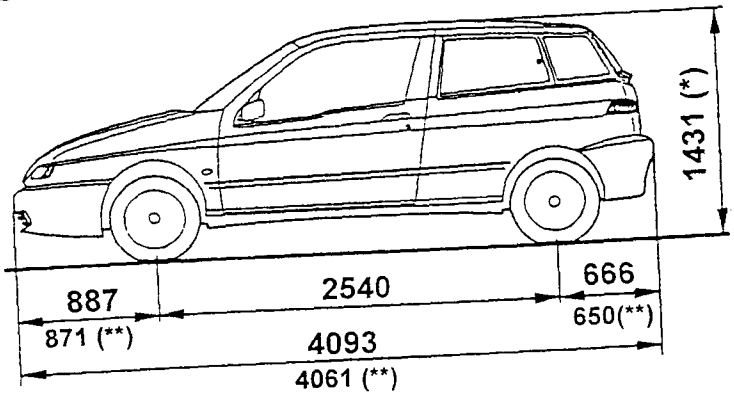
1910 JTD engine

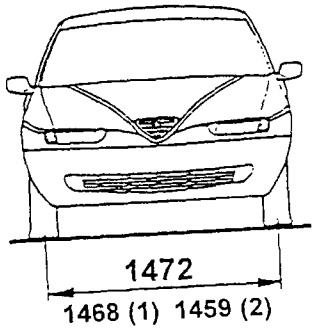


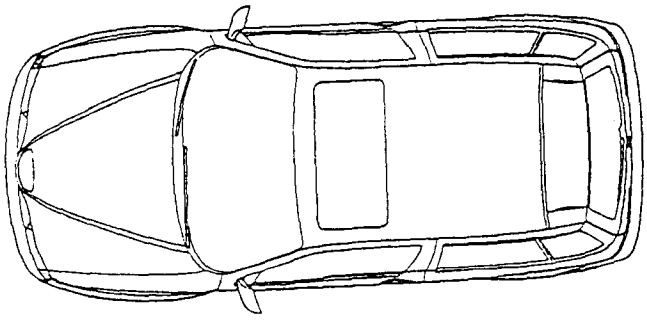
T. Spark 16V engines

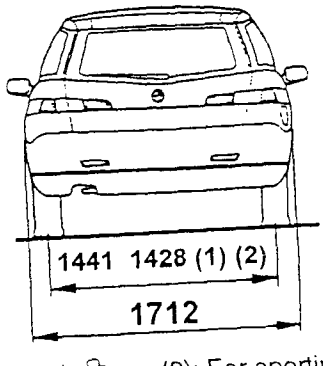
1. Plate of summarized identification data
2. Body marking
3. ID plate of body paint
4. Engine marking

DIMENSIONS





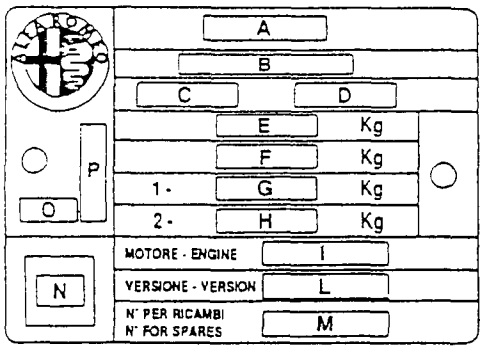




(*): With exhausted car (**): For 99s versions (1): For 1.8 T. Spark version and ✿ (2): For sporting version

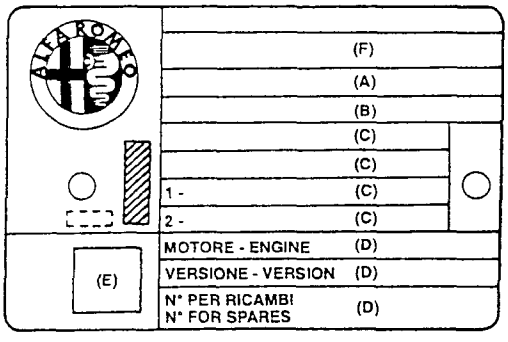
SUMMARIZING PLATE OF IDENTIFICATION DATA

It is applied on the cross member of the engine bay. It includes the ID data as listed hereafter:
A. Manufacturer's name



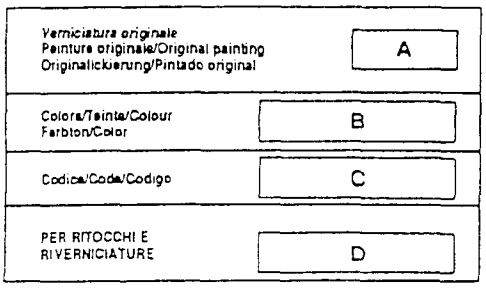
B. Registration number or code
C. ID code of vehicle type
D. Number of vehicle manufacture (no. of the chassis)
E. Maximum authorized weight of the full-load vehicle
F. Maximum authorized weight at full load plus trailer
G. Maximum authorized weight on the front axle
H. Maximum authorized weight on the rear axle
I. Engine's type
L. Code of vehicle version
M. Number of spare parts
N. Correct value of grade of smoke (for Diesel engine only)
O. Supplier's code
P. Foreign producing country

Starting fron the vehicle, chassis No. _____ the new ID plate is applied as follows:



A. Lines for national registration data
B. Lines where to punch the chassis number
C. Lines to indicate the max. weight authorized by different national norms
D. Lines where to indicate the version (e.g. 930A1) and possible additional data
E. Lines where to report the grade of smoke
F. Lines where to punch the manufacturer's name

ID PLATE OF BODYWORK PAINT



It is applied in the internal part of the rear bonnet and shows the following data:

A. Paint's manufacturer
B. Colour's name
C. Colour's code
D. Colour's code for touch-ups or repainting

WEIGHTS AND LOADS

Unit: kg

Features \ Versions		930 A3	930 A2 930 A2A	930 A1	930 A4 930 A4A	930 A4B
Weight in running order (without driver)		1140	1140	1190	1245	1200
Maximum weight allowed		1670	1670	1715	1765	1730
Payload		530	530	525	520	520
Maximum weight allowed per axle	front	950	950	950	950	950
	rear	850	850	850	850	900
Towable weight	with braked trailer	1100	1100	1200	1300 1300 (*)	1300 1300 (*)
	with unbraked trailer	350	350	350	350	350
Maximum load on the ball		50	50	50	50	50

(*): Homologated for Switzerland only.

Features \ Versions		930 A5	930 A3A	930 A2B 930 A2C	930 A1A
Weight in running order (without driver)		1240	1135	1165	1195
Maximum weight allowed		1765	1655	1685	1715
Payload		525	520	520	520
Maximum weight allowed per axle	front	950	950	950	950
	rear	900	900	900	900
Towable weight	with braked trailer	1200 1200 (*)	1100 800 (*)	1200 900 (*)	1200 900 (*)
	with unbraked trailer	350	350	350	350
Maximum load on the ball		50	50	50	50

(*): Homologated for Switzerland only.

WHEELS AND TYRES

CAR	DIMENSIONS Rims Tyres		Pressures (bar)			
			REDUCED LOAD (2 people)		FULL LOAD	
			FRONT	REAR	FRONT	REAR
930 A3	Standard equipment	5.5J x 14" 175/65 R14" 82T	2.2	2	2.5	2.5
	Optional equipment	5.5J x 14" 185/60 R14" 82H				
930 A2	Standard equipment	5.5J x 14" 175/65 R14" 82T	2.2	2	2.5	2.5
	Optional equipment	5.5J x 14" 185/60 R14" 82H (*)				
930 A2A	Standard equipment	5.5J x 14" 185/65 R14" 86T	2.2	2	2.5	2.5
930 A1	Standard equipment	5.5J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 A4 930 A4A	Standard equipment	5.5J x 14" 175/65 R14" 82T	2.2	2.1	2.5	2.5
	Optional equipment	5.5J x 14" 185/60 R14" 82H				
930 A4B	Standard equipment	5.5J x 14" 185/60 R14" 82H	2.2	2.0	2.5	2.5
	Optional equipment	6J x 15" 195/55 R15" 84V				
930 A5	Standard equipment	6J x 15" 195/55 R15" 84V	2.3	2.1	2.5	2
930 A3A	Standard equipment	5.5J x 14" 185/60 R14" 82H 6J x 15" (▲) 195/55 R15" 84V (▲)	2.2	2	2.5	2.5
930 A2B	Standard equipment	5.5J x 14" 185/60 R14" 82H 6J x 15" (▲) 195/55 R15" 84V (▲)	2.2	2	2.5	2.5
930 A2C	Standard equipment	5.5J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 A1A	Standard equipment	6J x 15" 195/55 R15" 84V	2.2	2	2.5	2.5
ALL	SPARE SMALL WHEEL 4J x 15" (in steel) 4.00B x 15" (in alloy) - 115/70 R15" 90M		4.2			

(*): Standard for certain markets
(▲): For sport equipment (for versions/markets if envisaged)

WARNING: In case of continous running in max. gears, pressures to be increased by 0.3 bar.

FLUIDS AND LUBRICANTS

Type	Reference Group	Application		Classification	Name
OIL	10 - Engine	Engine (Supply)	- BOXER - T.SPARK 16V	API SJ SAE 10W/40 ACEA A3-96	SELENIA 20K (1)
			1929 TD 1910 JTD	API CD SAE 10W/40 ACEA B3-96	SELENIA TURBODIESEL SAE 10W/40
	21 - Gearbox	Gearbox-Differential (Supply)	BOXER	API GL5 SAE 80W/90	TUTELA W 90/M - DA
			- 1929 TD - 1910 JTD - T. SPARK 16V	SAE 75W/90 API GL - 5	TUTELA ZC 75 SYNTH
	50 - Subsidiary elements	Compres (Supp	BOXER	-	SANDEM SP 10 "PAG"
			1929 TD	-	UCON RL - 488
			1919 JTD	-	PAG SP 20
			T. SPARK 16V	-	NIPPONDENSO ND-9
FLUID	10 - Engine	Cooling circuit (Supply)		-	ALFA ROMEO CLIMAFLUID SUPER PERMANENT -40°C
	18 - Clutch	Hydraulic Circuit Brakes - Clutch (Supply)		DOT 4 SAE J 1703 F	ALFA ROMEO BRAKE FLUID SUPER DOT 4
	33 - Brakes				
	41 - Steering	Hydraulic Driving System (Supply)		G.M. DEXRON II	TUTELA GI/A
	50 - Subsidiary elements	Contioning circuit system (Supply)		-	RIVOIRA: SUVA R134a HOECHST-TAZZETTI: FRIGEN R134a ICI-TAZZETTI: KLEA R134a

(1): - In case of highly sporting use of the vehicle, it is advisable to use the engine oil **SELENIA Racing 10W/60,** which is wholly synthetical.
- In case of severe and very cold weather conditions, it is advisable to use the engine oil **SELENIA Performer 5W30, ACEA1, API SJ.**

FLUIDS AND LUBRICANTS (Continued)

Type	Reference Group	Application		Classification	Name
GREASE	10 - Engine	Seat for intake manifold on water pump	1929 TD	-	SIL 133 MOLDGUARD
	18 - Clutch	Work seat for step bearing	BOXER	-	TUTELA MR 3
		Seat for step bearing and shaft of clutch control	- 1929 TD - T. SPARK 16V		
		Cylinder cap clutch control			
	21 - Gearbox	External rings taper bearings pinion and differential box	BOXER	-	TUTELA MR 3
		External surface: - spacer to fix rod and gear control lever; - spacer to fix lever and fork; - guide for gear control lever		-	TUTELA ZETA 2 ISECO MOLYKOTE LONGTERM N. 2
		Rod bushings gearshift control and spheric of gear lever	- 1929 TD - T. SPARK 16V		
	27 - Front axle	Homokinetic couplings half shafts		-	OPTIMOL OLISTAMOLY 2LN 584 MOLYKOTE VN 2461/C TUTELA MRM 2
	33 - Brakes	Knuckles and bushings Pedals		-	TUTELA ZETA 2
		Seats of inductive sensors A.B.S.			
	41 - Steering	Seat of rolled bush on the support of the steering column		-	SPCA SPAGRAPH ISECO ERGON RUBBER GREASE REINACH SFERUL B2 AR
	44 - Suspensions and wheels	Flexible supports and swinging arms		-	GREASE MOLYKOTE 7544 PG54 TUTELA MR3
		Side track rods of the steering		-	MOLYGUARD SYL 113

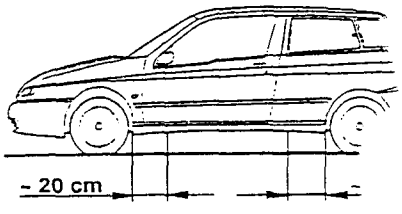
RELEVANT SUPPLY QUANTITIES

Supply capacities \ Versions		930 A3	930 A2 930 A2A	930 A1	930 A4 930 A4A	930 A4B	930 A5	930 A3A 930 A2B 930 A2C 930 A1A
Fuel tank		51 liters			51/61 liters (*)			
Fuel stock		5 ÷ 8 liters						
Engine oil	Total capacity: pan + filter + sumps + radiator	4.7 liters		5.2 liters	6 liters	(**)	5.0 liters	
	Pan + filter (for recurrent replacement)	4 liters		4.5 liters	5 liters	4.2 liters	4.4 liters	
Oil for gearbox - differential		2.4 liters			2 liters		2 liters	
Oil for hydraulic driving system		1.1 liters				900 gr	1.3 liters	
Oil for brakes and clutch		0.4 kg			0.5 kg	0.4 kg (▲)	0.5 kg	
Fluid for engine coooling system		7.8 liters			8.9 liters	6.1 liters	8.3 liters	8.4 liters
Oil for conditioning compressor		240 ± 15 cm^3			236 ± 15 cm^3	130 g	150 ± 20 cm^3	
Fluid for conditioning system		0.700 kg				(**)	0.700 kg	

(*): For Versions/Markets
(▲): With A.B.S. = 0.54 kg
(**): Data which are not available while printing.

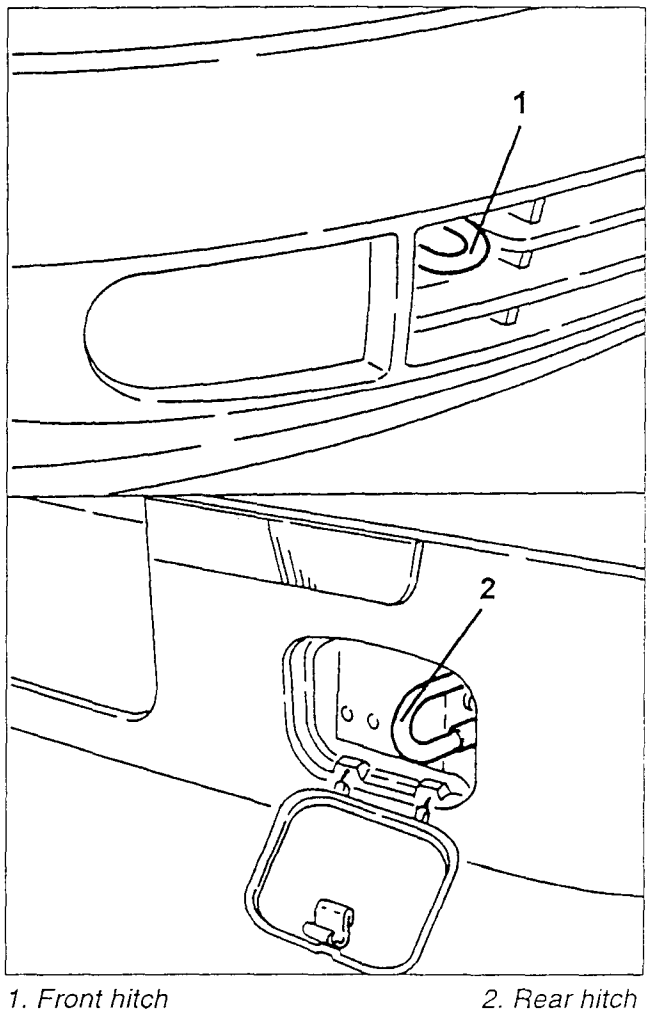
CAR LIFTING POINTS

With bridge or workshop autolift.
- The car is to be lifted by placing the arms' ends or the autolift as shown.



CAR TOWING POINTS

The car is equipped with two rings, a front and a rear one, located on the right side of the bumper.
The rear ring is covered by a door that can be opened by pressing on its edge.
Please comply with the existing norms in matter of tow operations.
Before the towing operation, the key must be turned onto MAR position and hence is to be turned back onto STOP position without removing it; in this way the steering block will be avoided.
It is important to know that, in case of towing, there is no depression in the servo brake, it is therefore necessary to press the brake pedal with increased strength.



1. Front hitch *2. Rear hitch*

WEIGHTS AND LOADS

Unit: kg

Characteristics \ Versions		930 B2B	930 B1A	930 B5
Kerb weight (without driver)		1190	1215	1275
Maximum allowed weight		1710	1735	1800
Useful load		520	520	525
Max. permissible weight per axle	front	950	950	950
	rear	900	900	900
Towable weight	with braked trailer	1200	1200	1200
	with trailer without brakes	350	350	350
Maximum load on tow hook		50	50	50

WHEELS AND TYRES

MODEL	Rim - Tyre SIZES	PRESSURE (bar)			
		MEDIUM LOAD (2 persons)		FULL LOAD	
		FRONT	REAR	FRONT	REAR
930 B2B	5.5J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
	6J x 15" (*) 195/55 R15" 84V (*)	2.2	2	2.5	2.5
930 B1A	6J x 15" 195/55 R15" 84V	2.2	2	2.5	2.5
930 B5	6J x 15" 195/55 R15" 84V	2.3	2.1	2.5	2.5

(*): For Junior version (only for some versions/markets).

MODEL IDENTIFICATION

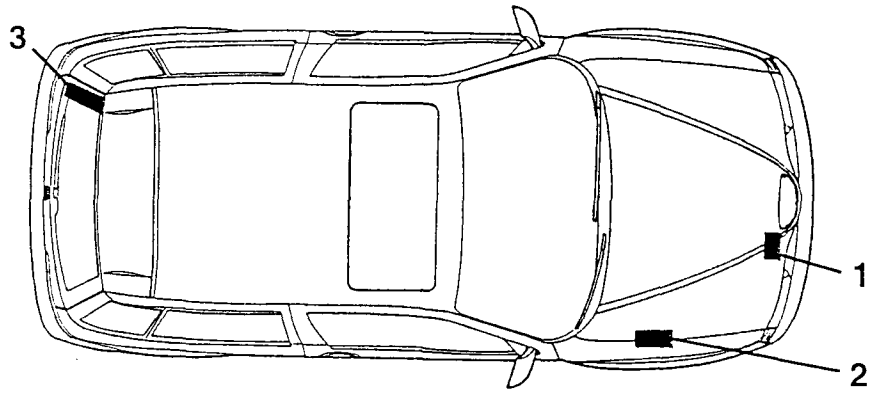
Trade name	145 1.3/1.4	145 1.6	145 1.7 16V	145 TD	145 JTD
Trim level	3-door saloon				
Version (on identification label)	930 A3	930 A2 930 A2A ❑	930 A1	930 A4 930 A4A ▲	930 A4B
Chassis (in the engine compartment to one side of the right-hand upper shock absorber attachment)	930000	930000	930000	930000	930000
Progressive chassis number	2.001.001 4.001.001	2.001.001 4.001.001	2.001.001 4.001.001	2.001.001 4.001.001	–
Engine (code)	AR 33501	AR 33201	AR 33401	AR 67501 AR 33601 ▲	AR 32302
Engine symbol	1351	1596	1712 16V	1929 TD	1910 JTD
Gearbox (code)	C.802.5.16.00	C.802.5.16.02 C.802.5.16.03❑	C.802.5.18.00	C.510.5.17.63	C.530.5.XX.YY (*)

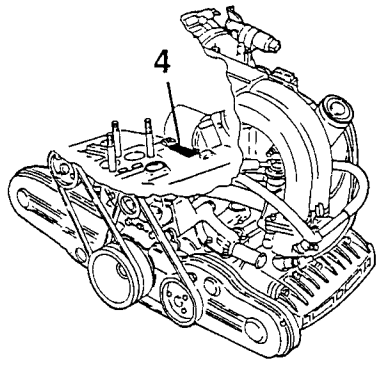
(❑): Only for some Markets
(▲): Version with catalyst only for certain Markets
(*): For future publication.

Trade name	145 ✿	145 1.4 T. Spark	145 1.6 T. Spark	145 1.8 T. Spark
Trim level	3-door saloon			
Version (on identification label)	930 A5	930 A3A	930 A2B 930 A2C ❑	930 A1A
Chassis (in the engine compartment to one side of the right-hand upper shock absorber attachment)	930000	930000	930000	930000
Progressive chassis number	2.001.001 4.001.001	–	–	–
Engine (code)	AR 67204 AR 32301	AR 33503	AR 67601	AR 67106 AR 32201
Engine symbol	1970 T. SPARK 16V	1370 T. SPARK 16V	1598 T. SPARK 16V	1747 T. SPARK 16V
Gearbox (code)	C.510.5.21.13 C.510.5.XX.YY (*)	C.510.5.18.03 C.513.5.14.02 (1)	C.510.5.18 C.510.5.17.96 ❑	C.510.5.17.93

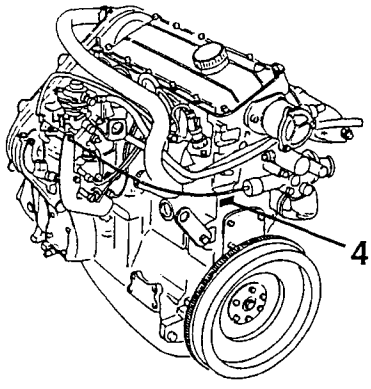
(❑): Only for some Markets
(1): From chassis no. .....
(*): For future publication.

LOCATION OF IDENTIFICATION LABELS

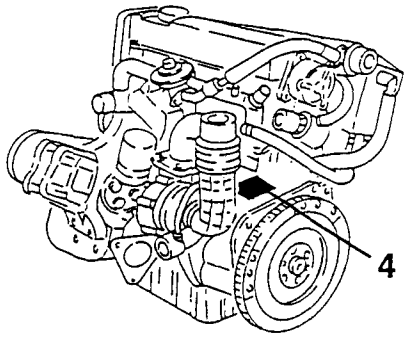




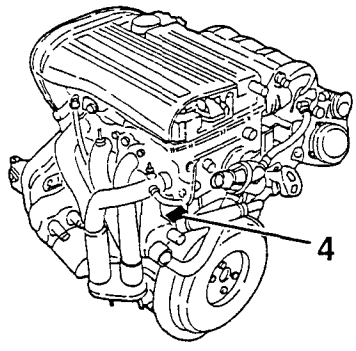
Boxer engines



1929 TD engine



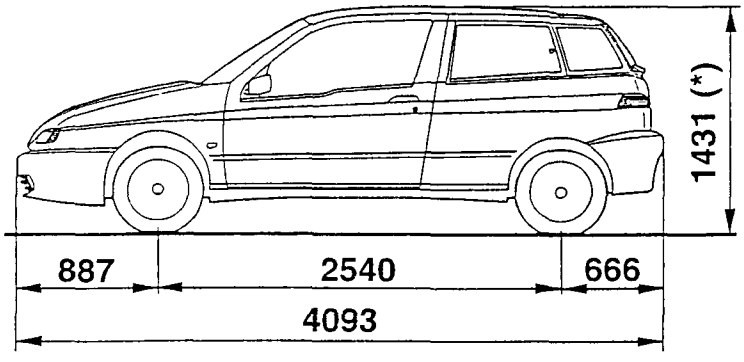
1910 JTD engine

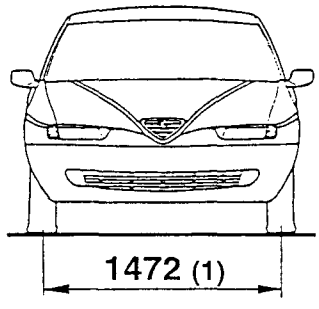


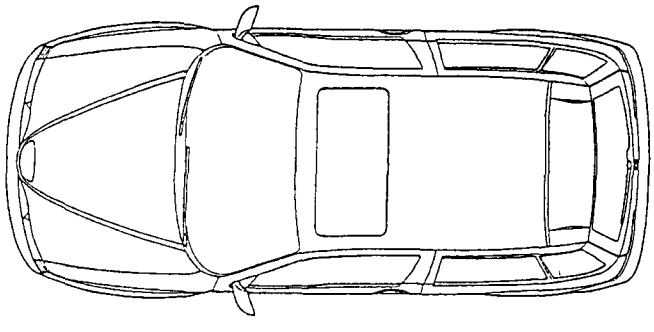
T. Spark 16V engines

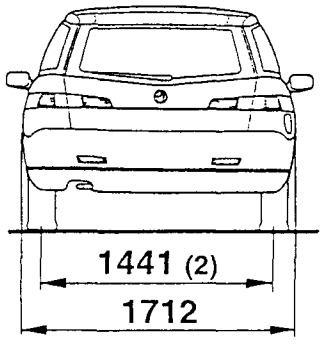
1. *Data plate*
2. *Body code*
3. *Paint identification label*
4. *Engine code*

DIMENSIONS









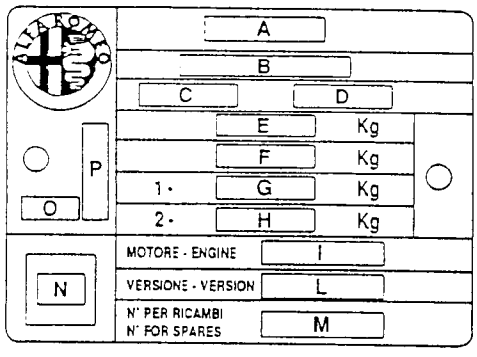
(*): Empty vehicle

(1): 1480 for Turbodiesel versions

(2): 1428 for T. Spark 16V versions

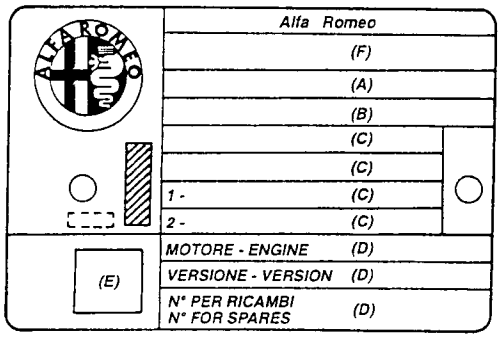
IDENTIFICATION LABEL

This is located on the engine compartment crossmember. It contains the data listed below:



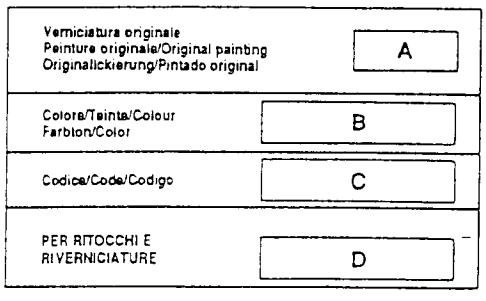
A. Manufacturer
B. Homologation number
C. Vehicle identification code
D. Chassis serial number
E. Maximum authorized weight of fully loaded vehicle
F. Maximum authorized weight of fully loaded vehicle plus trailer
G. Maximum authorized weight on front axle
H. maximum authorized weight on rear axle
I. Engine code
L. Vehicle version code
M. Number for spare parts
N. Correct smoke opacity index (for Diesel engine)
O. Supplier code
P. Foreign manufacturer

As from the car with chassis no. _____ the new data plate will be used:



A. Space for details of national homologation
B. Space for punching the consecutive chassis number
C. Space available for maximum weights authorised by various national laws
D. Space for versions (for example 930A1) and any supplementary indications to those specified
E. Space for smoke index
F. Space for punching manufacturer's name

PAINT IDENTIFICATION LABEL



This is located on the inner part of the luggage compartment and carries the data given below:

A. Paint manufacturer
B. Colour name
C. Colour code
D. Colour code for touch-up and respray

WEIGHTS AND LOADS

Unit: kg

Weights and loads \ Versions		930 A3	930 A2 930 A2A	930 A1	930 A4 930 A4A	930 A4B
Kerb weight (without driver)		1140	1140	1190	1210	1200
Maximum allowed weight		1670	1670	1715	1730	1720
Useful load		530	530	525	520	520
Max. permissible weight for axle	front	950	950	950	950	950
	rear	850	850	850	850	900
Towable weight	with braked trailer	1100	1100	1200	1300	1300
	with trailer without brakes	350	350	350	350	350
Carico massimo sulla sfera		50	50	50	50	50

Unit: kg

Weights and loads \ Versions		930 A5	930 A3A	930 A2B 930 A2C	930 A1A
Kerb weight (without driver)		1240	1135	1165	1195
Maximum allowed weight		1765	1655	1685	1715
Useful load		525	520	520	520
Max. permissible weight for axle	front	950	950	950	950
	rear	900	900	900	900
Towable weight	with braked trailer	1200	1100	1200	1200
	with trailer without brakes	350	350	350	350
Maximum load on tow hook		50	50	50	50

WHEELS AND TYRES

MODEL	SIZES Rim Tyre		PRESSURE (bar)			
			MEDIUM LOAD (2 persons)		FULL LOAD	
			FRONT	REAR	FRONT	REAR
930 A3	Standard item	5 1/2J x 14" 175/65 R14" 82T	2.2	2	2.5	2.5
	Optional item	5 1/2J x 14" 185/60 R14" 82H				
930 A2	Standard item	5 1/2J x 14" 175/65 R14" 82T	2.2	2	2.5	2.5
	Optional item	5 1/2J x 14" 185/60 R14" 82H (*)				
930 A2A	Standard item	5 1/2J x 14" 185/65 R14" 86T	2.2	2	2.5	2.5
930 A1	Standard item	5 1/2J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 A4 930 A4A	Standard item	5 1/2J x 14" 175/65 R14" 82T	2.2	2.1	2.5	2.5
	Optional item	5 1/2J x 14" 185/60 R14" 82H				
930 A4B	Not available at time of going to press					
930 A5	Standard item	6J x 15" 195/55 R15" 84V	2.3	2.1	2.5	2
930 A3A	Standard item	5 1/2J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 A2B	Standard item	5 1/2J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 A2C	Standard item	5 1/2J x 14" 185/60 R14" 82H	2.2	2	2.5	2.5
930 A1A	Standard item	6J x 15" 195/55 R15" 84V	2.2	2	2.5	2.5
ALL	COMPACT SPARE WHEEL 4J x 15" (in steel) 4.00B x 15" (in alloy) - 115/70 R15" 90M		4.2			

(*): Standard item for some Markets.

WARNING: In the event of continuous driving at top speed, the pressures should be increased by 0.3 bar.

FLUIDS AND LUBRICANTS

Type	Group ref.	Application		Classification	Name
OIL	10 - Engine	Engine (Refilling)	- BOXER - T. SPARK 16V	API SJ SAE 10W/40 ACEA A3-96	SELENIA 20K
			1929 TD 1910 JTD	API CD SAE 10W/40 ACEA B3-96	SELENIA TURBODIESEL SAE 10W/40
	21 - Gearbox	Gearbox - differential (Refilling)	BOXER	API GL5 SAE 80W/90	TUTELA W 90/M - DA
			- 1929 TD - 1910 JTD - T. SPARK 16V	SAE 75W/90 API GL - 5	TUTELA ZC 75 SINT
	50 - Auxiliary organs	Compressor (Refilling)	BOXER	–	SANDEM SP 10 "PAG"
			1929 TD	–	UCON RL - 488
			1910 JTD	–	PAG SP 20
			T. SPARK 16V	–	NIPPONDENSO ND-9
FLUID	10 - Engine	Cooling circuit (Refilling)		–	ALFA ROMEO CLIMAFLUID SUPER PERMANENT - 40°C
	18 - Clutch 33 - Brakes	Brake - clutch hydraulic circuit (Refilling)		DOT 4 SAE J 1703 F	ALFA ROMEO BRAKE FLUID SUPER DOT 4
	41 - Steering	Power steering system (Refilling)		G.M. DEXRON II	TUTELA GI/A
	50 - Auxiliary organs	Air conditioning system circuit (Refilling)		–	RIVOIRA: SUVA R134a HOECHST-TAZZETTI: FRIGEN R134a ICI-TAZZETTI: KLEA R134a

(1): For decidedly sportive use of the car fully synthetic **SELENIA Racing 10W/60** engine oil is recommended-

FLUIDS AND LUBRICANTS (Cont.d)

Type	Group ref.	Application		Classification	Name
GREASE	10 - Engine	Housing for intake manifold on water pump	1929 TD	–	SIL 133 MOLDGUARD
	18 - Clutch	Thrust bearing seat	BOXER	–	TUTELA MR 3
		Thrust bearing seat and clutch control lever shaft	- 1929 TD - T. SPARK 16V		
		Clutch control cylinder prod			
	21 - Gearbox	Pinion taper bearing outer rings and differential carrier	BOXER	–	TUTELA MR 3
		Outer surface: - spacer fastening rod to gearshift control lever; - spacer for fastening lever to fork; - guide for gearshift control lever		–	TUTELA ZETA 2 ISECO MOLYKOTE LONGTERM N. 2
		Gear engagement rod bushes and gearshift lever ball	- 1929 TD - T. SPARK 16V		
	27 - Front axle	Axle shaft constant velocity joints		–	OPTIMOL - OLISTAMOLY 2LN 584 MOLYKOTE VN 2461/C TUTELA MRM 2
	33 - Brakes	Pedal unit joints and bushes		–	TUTELA ZETA 2
		A.B.S. inductive sensor housing			
	41 - Steering	Roller bush housing on steering column support		–	SPCA SPAGRAPH ISECO ERGON RUBBER GREASE REINACH SFERUL B2 AR
	44 - Suspensions and wheels	Wishbone flexible mounts		–	GREASE MOLYKOTE 7544 PG54 TUTELA MR3
		Steering track rods		–	MOLYGUARD SYL 113

APPROXIMATE SERVICING CAPACITIES

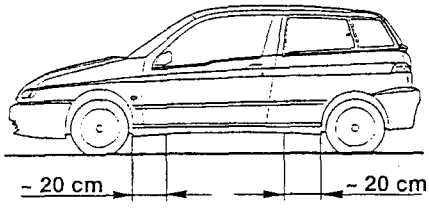
Capacity \ Version		930 A3	930 A2 930 A2A	930 A1	930 A4 930 A4A	930 A4B	930 A5	930 A3A 930 A2B 930 A2C 930 A1A
Fuel tank		51 litres			51/61 litres (*)			
Fuel reserve		5 ÷ 8 litres						
Engine oil	Total capacity: sump + filter + wells + radiator	4.7 litres		5.2 litres	6 litres	(**)	5.0 litres	
	Sump + filter (for periodical replacement)	4 litres		4.5 litres	5 litres	4.2 litres	4.4 litres	
Gearbox - differential oil		2.4 litres			2 litres		2 litres	
Power steering system oil		1.1 litres				(**)	1.3 litres	
Brake and clutch circuit oil		0.4 kg			0.5 kg	(**)	0.5 kg	
Engine cooling system fluid		7.8 litres			8.9 litres	(**)	8.3 litres	8.4 litres
Conditioner compressor oil		240 ± 15 cm^3			236 ± 15 cm^3	130 g	150 ± 20 cm^3	
Air conditioner system fluid		0.700 kg				(**)	0.700 kg	

(*): For Versions/Markets (**): Not available at time of going to press.

CAR LIFTING POINTS

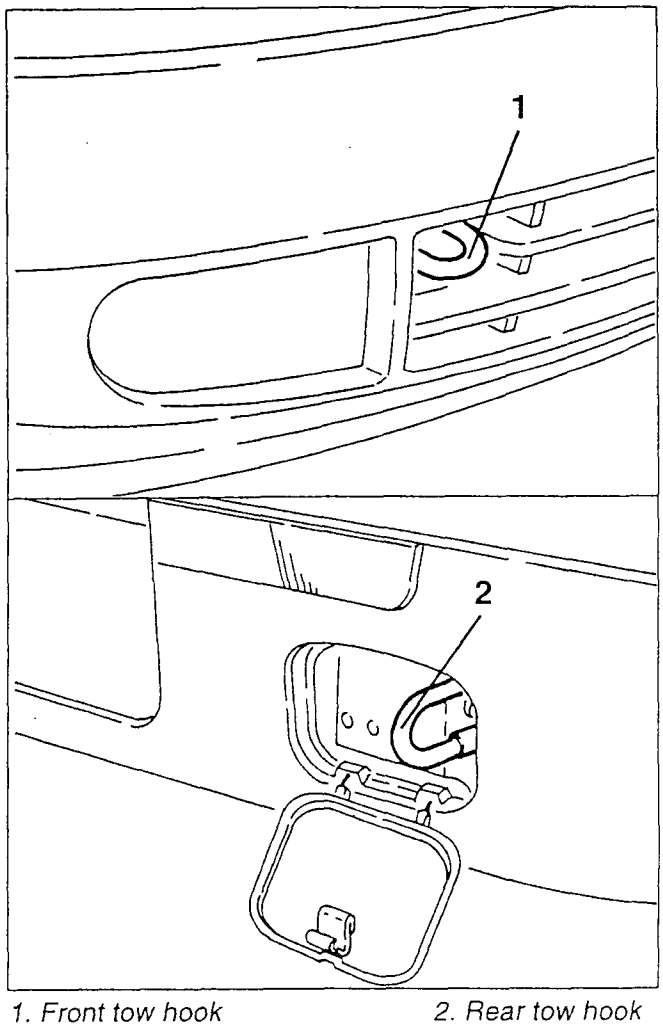
Using an arm lift or workshop jack.

- The car should be raised setting the ends of the arms or the jack in the areas illustrated.



CAR TOW POINTS

The car has two rings, one at the front and one at the rear, on the right-hand side of the bumpers.
The rear ring is covered by a lid that is opened by pushing on the edge.
Always strictly adhere to local regulations on the subject of towing.
Before towing, the ignition switch of the towed car should be turned to MAR and then to STOP without removing it; this will prevent the steering from locking.
Remember that when the car is towed, the vacuum is not created in the servobrake system, therefore, considerably greater pressure on the brake pedal is required.



1. Front tow hook *2. Rear tow hook*

10

ENGINE SERVICE

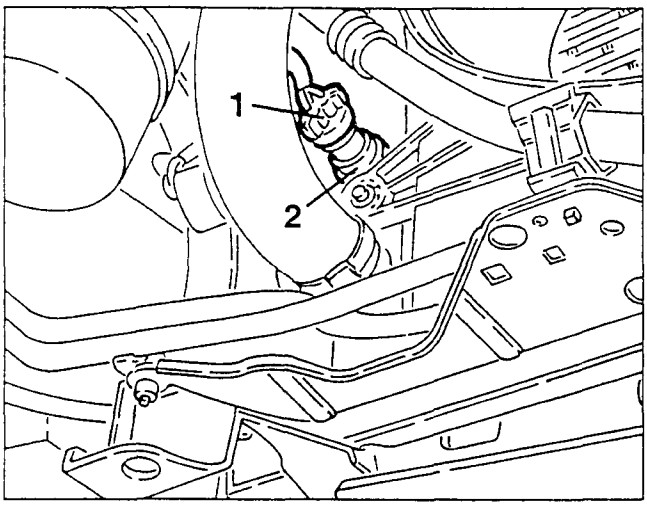
5 documents - 342 factory pages

FAN CONTROL THERMAL CONTACT (Specific for versions with M2.10.3 injection - ignition system)

REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Raise the car and disconnect the electrical connection from the fan control thermal contact.
2. Slacken and remove the fan control thermal contact and recover the coolant that comes out.



CHECKS AND INSPECTIONS

Check the setting of the thermal contact referring to the wiring diagram of the specific manual.

Cooling fan cut-in/cut-out temperature		
1st speed	Cut in (contacts close)	92 ± 2°C
	Cut out (contacts open)	87 ± 2°C
2nd speed	Cut in (contacts close)	97 ± 2°C
	Cut out (contacts open)	92 ± 2°C

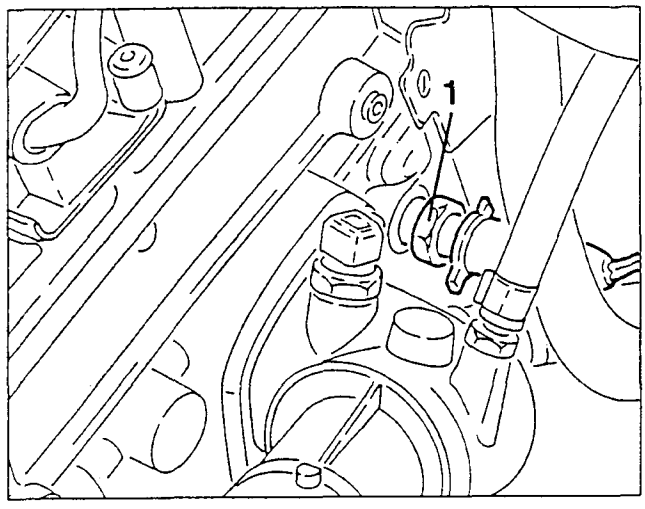
- If the values are not as specified, change the thermal contact.

COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Disconnect the electrical connection from the coolant temperature sensor (NTC).

1. Disconnect the electrical connection from the coolant temperature gauge transmitter and maximum temperature warning light contact, then remove it recovering the coolant that comes out.



CHECKS AND INSPECTIONS

Check the setting of the transmitter referring to the wiring diagram of the specific manual.

Temperature (°C)	Resistance (Ω)
60 (Water test liquid)	525 ÷ 605
90 (Water test liquid)	195 ÷ 245
120 (Glycerine test liquid)	82 ÷ 94

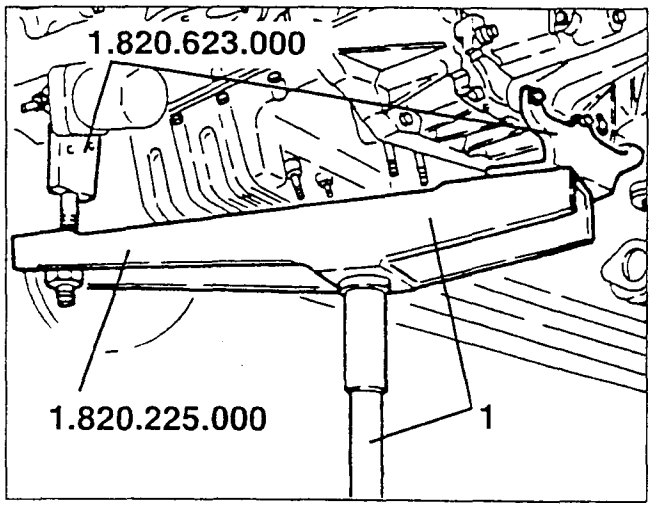
Contact closing temperature	122 ± 2°C
Contact opening temperature	112 ± 3°C

THE FOLLOWING PROCEDURE IS VALID FOR ALL ENGINES 1598 T. SPARK 16V AND 1747 T. SPAR 16V WHILE FOR ENGINE 1370 T. SPARK 16V IT IS VALID ONLY FOR VERSIONS WITH GEARBOX C.510.5 (UP TO CHASSIS NO. .....)

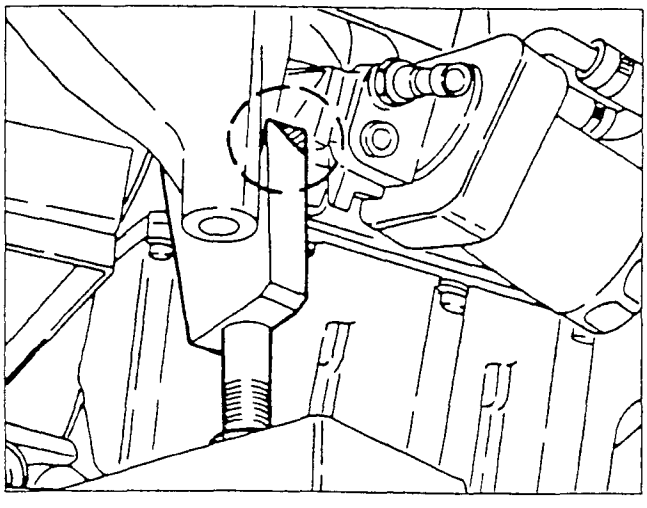
REMOVAL

Proceed as described for 1970 T. SPARK 16V engine removal with the exception of the following steps.

1. Set a hydraulic jack complete with tools no. 1.820.225.000 and no. 1.820.623.000 as illustrated.



NOTE: The camshaft side engine support part of tool no. 1.820.623.000, is to be relieved in the area illustrated to avoid interference with the oil filter support.

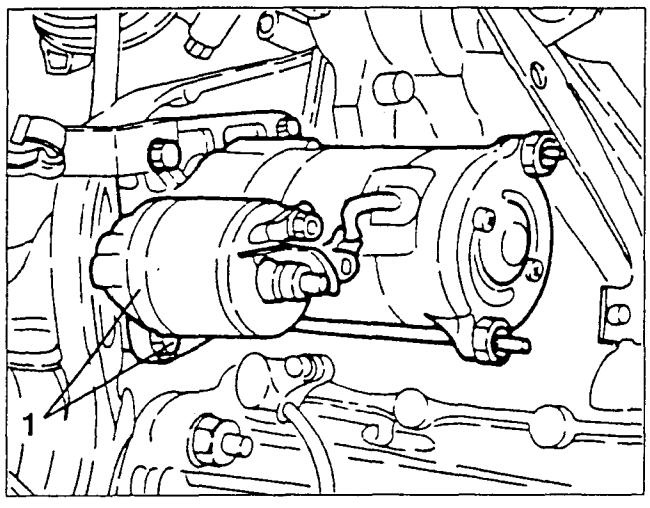


Complete removal of the engine from the car working as described for 1970 T. SPARK 16V engine.

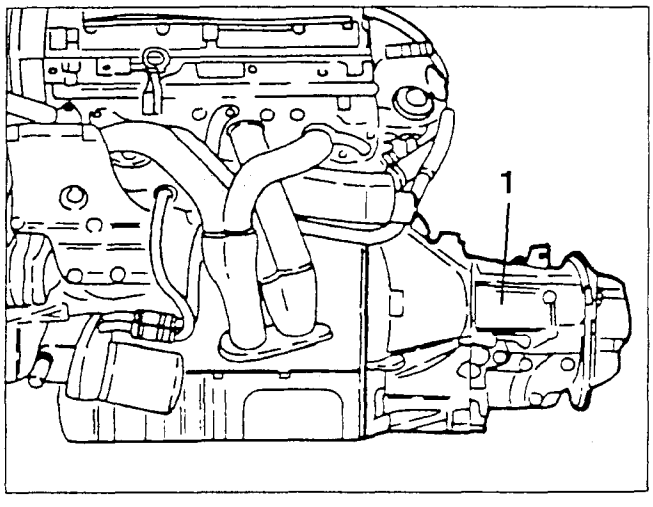
Once on the bench, remove the components as described below to make it possible to set the engine on the overhauling stand.

- Free the power unit from the support tools, then position it on a special work bench.

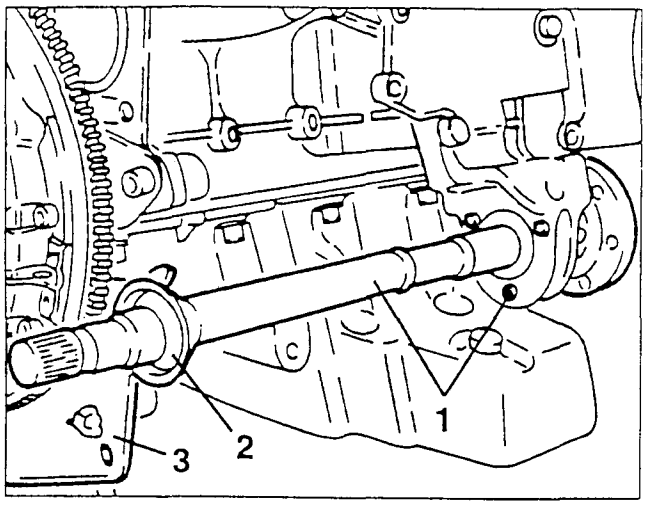
1. Slacken the fastening screws and remove the starter motor.



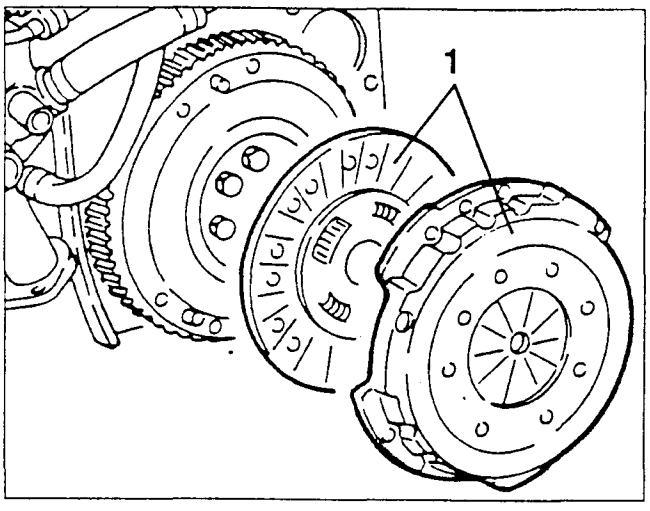
1. Slacken the fastening nuts and remove the gearbox and differential unit.



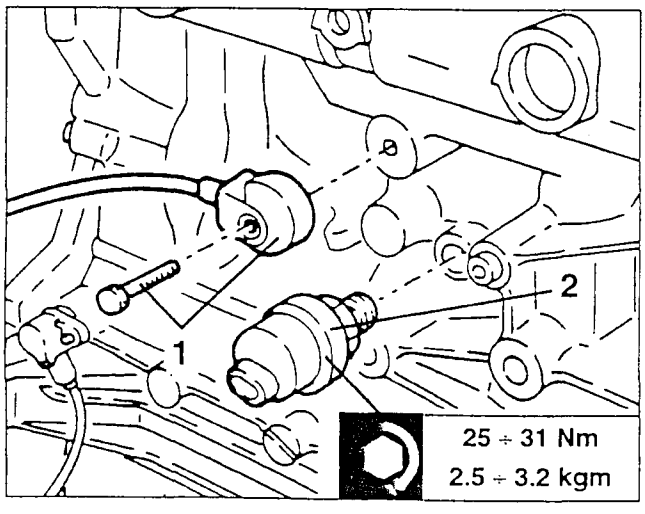
1. Slacken the three fastening screws and remove the intermediate shaft.
2. Remove the dust guard ring.
3. Retrieve the lower flywheel guard.



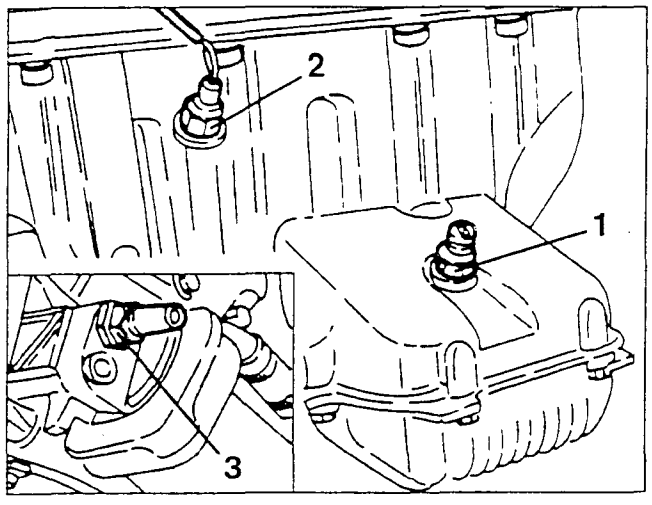
1. Slacken the fastening screws and remove the pressure plate body and clutch plate.



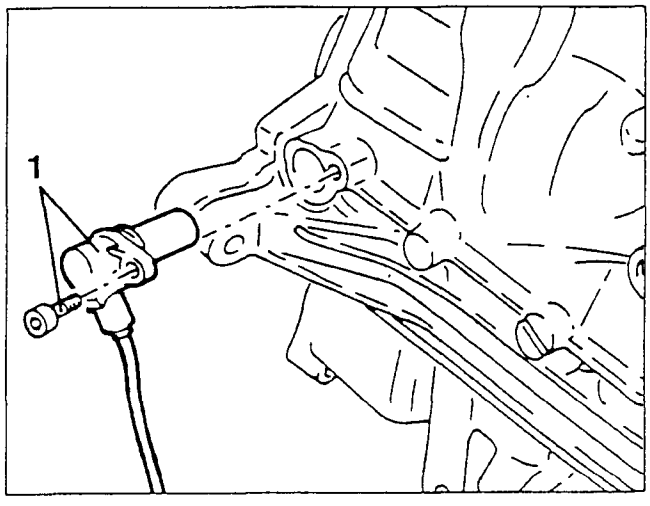
1. Slacken the fastening screw and remove the pinging sensor from the crankcase.
2. Remove the engine oil pressure meter.



1. Slacken and remove the engine oil temperature sensor.
2. Slacken and remove the engine oil minimum level sensor.
3. Slacken and remove the engine oil minimum pressure sensor.



1. Slacken the fastening screw and remove the rpm sensor.

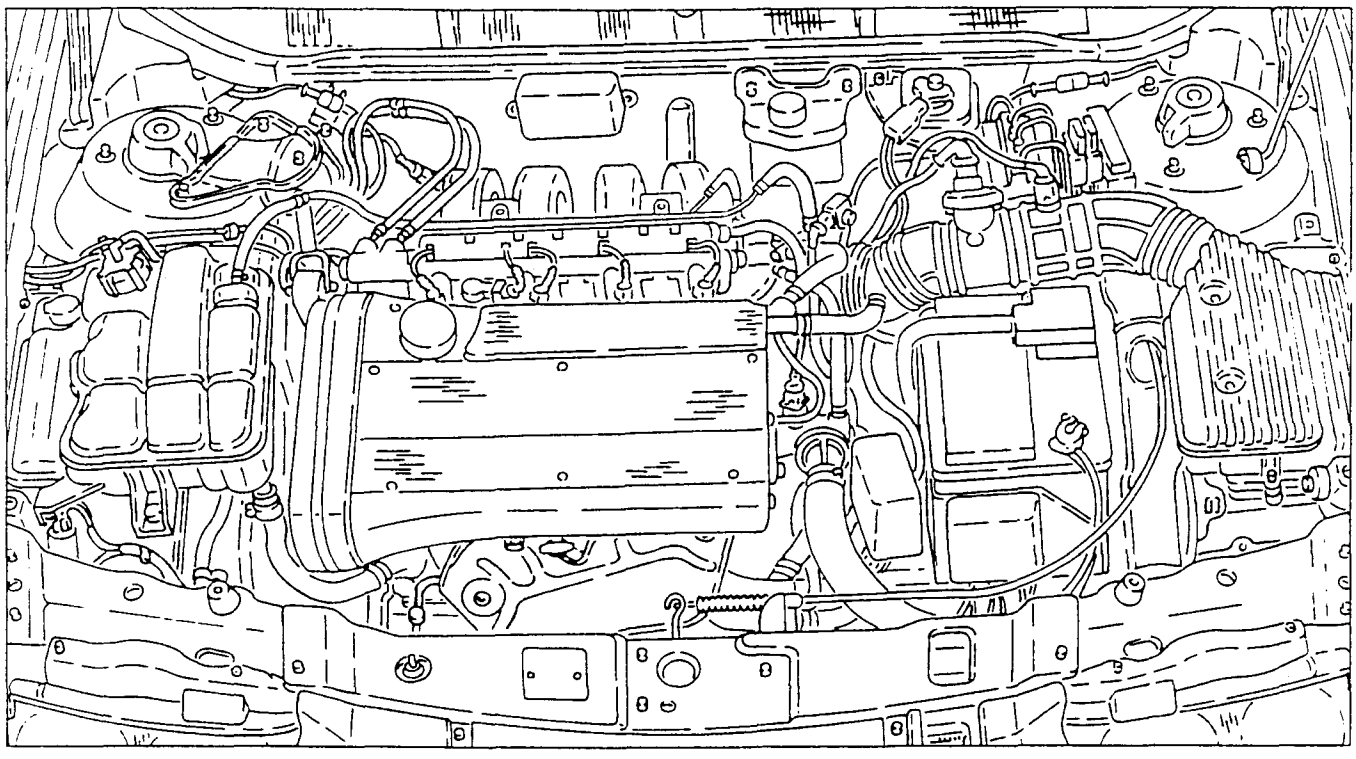


THE FOLLOWING PROCEDURE IS VALID ONLY FOR VERSIONS WITH GEARBOX C.513.5 (FROM CHASSIS NO.....)

GENERAL

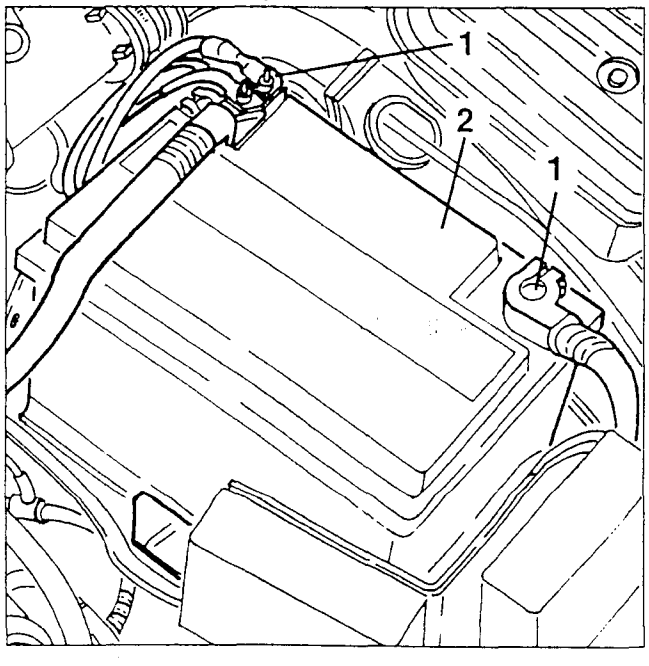
The information and illustrations givene below make it possible to quickly remove the power plant from its housing and subsequent refitting.
Disassembly of the single components on the bench is described in volume "ENGINE OVERHAULING".

The following procedure may be used only in part according to necessity.
For further information and details, see the chapters concerning specific components or units.

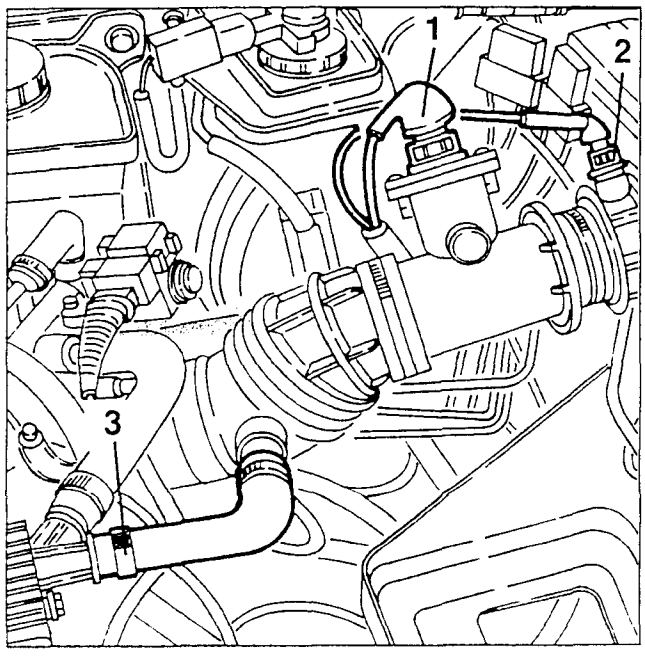


REMOVAL

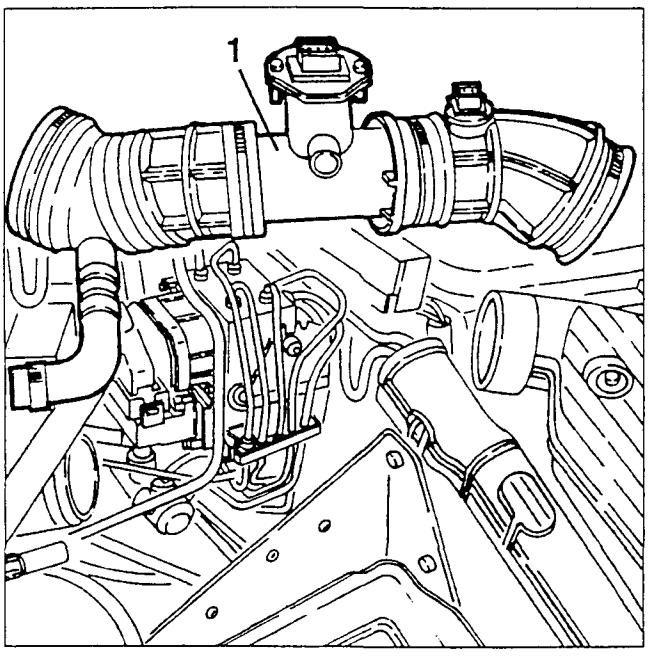
- Set the car on a two column lift.
1. Disconnect the battery terminals, also disconnecting the two starter motor supply cables from the positive terminal.
2. Remove the battery.



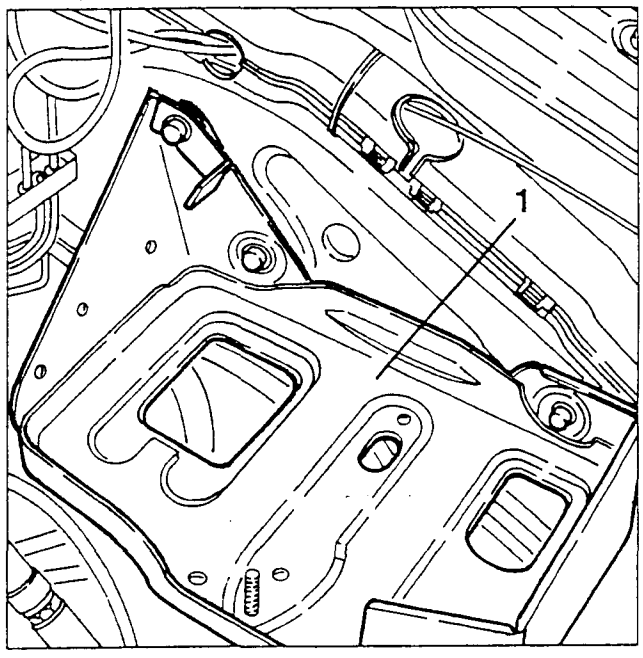
- Remove the front wheels and mud flaps.
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor.
3. Loosen the fastening clamp and disconnect the oil vapour recirculation pipe from the cylinder head cover.



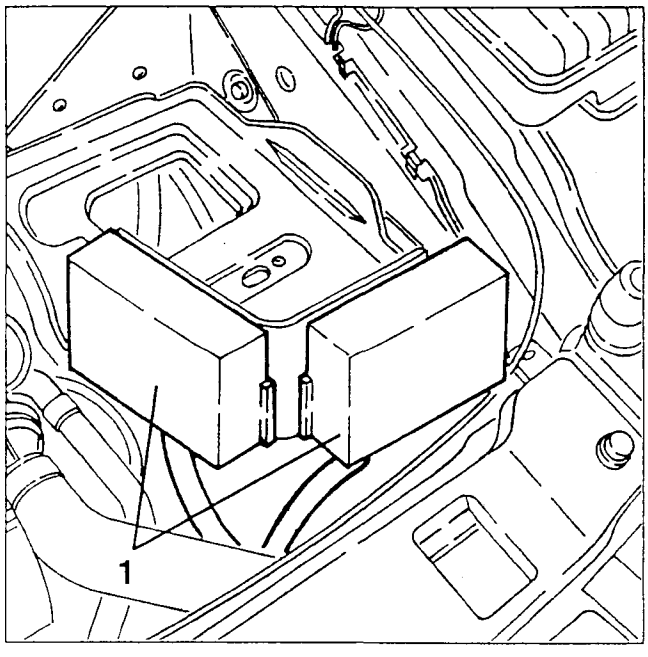
1. Loosen the two fastening clamps, then remove the corrugated sleeve complete.



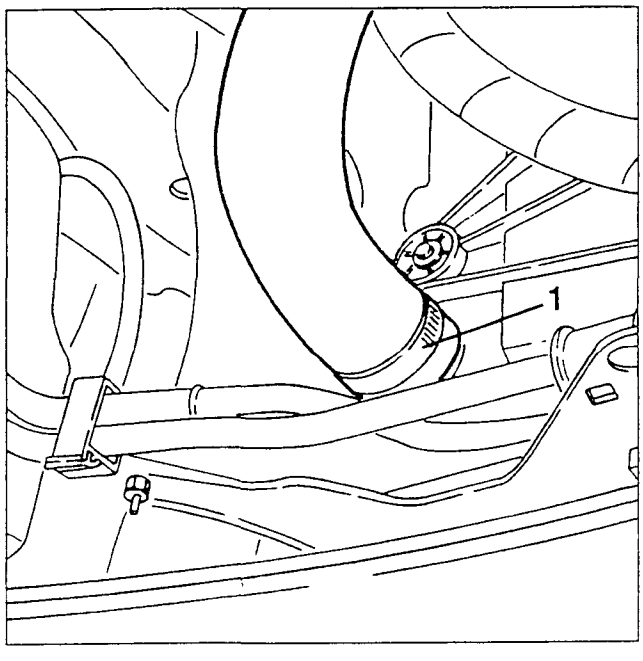
1. Slacken the fastening screws and remove the battery support complete with drainage tube after freeing this from the wheel house.



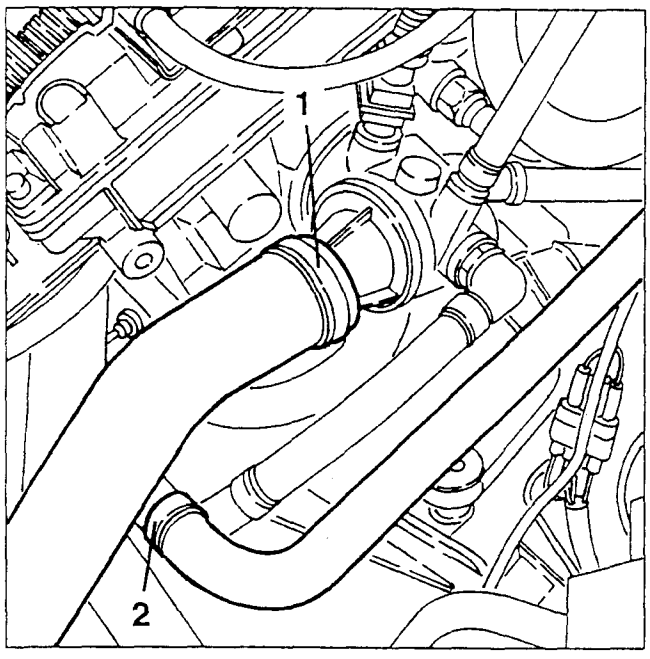
1. From the battery support release the two relay boxes and set them aside.



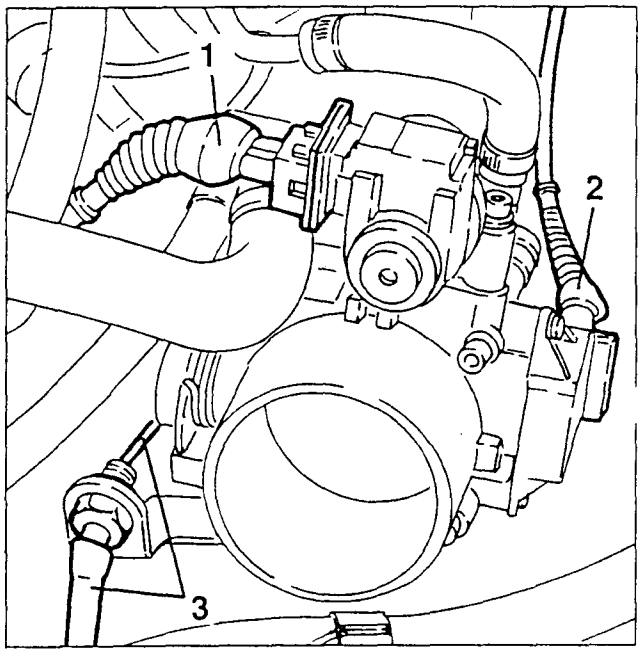
1. Raise the car and drain the engine coolant fluid disconnecting the outlet sleeve from the radiator.



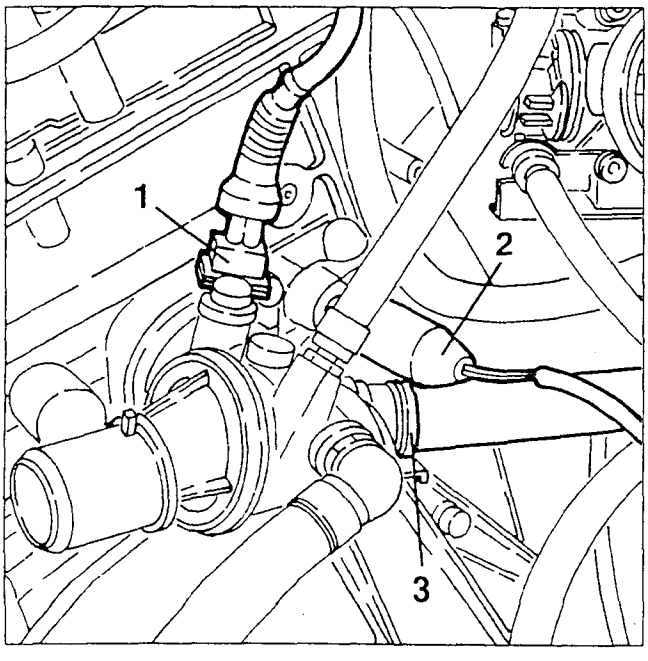
1. Lower the car then disconnect the radiator coolant delivery sleeve from the thermostatic cup.
2. Disconnect the coolant fluid return pipe from the climate control system heater from the longitudinal manifold.



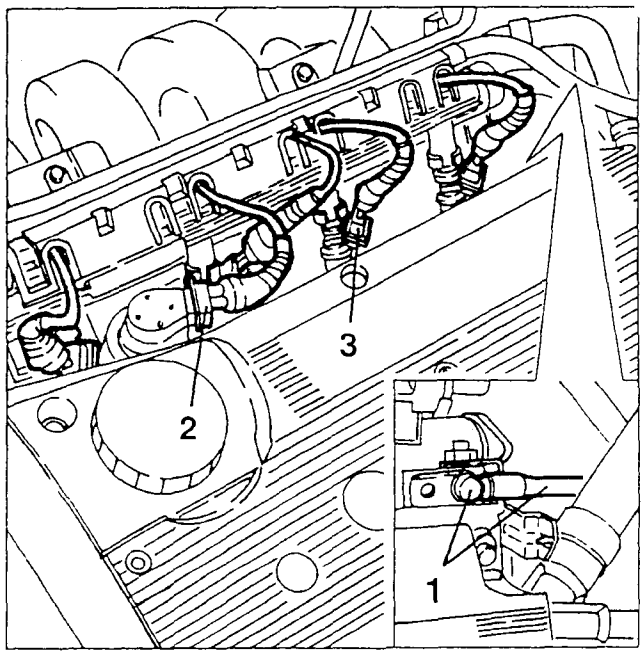
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection from the throttle potentiometer.
3. Disconnect the accelerator cable from the throttle body.



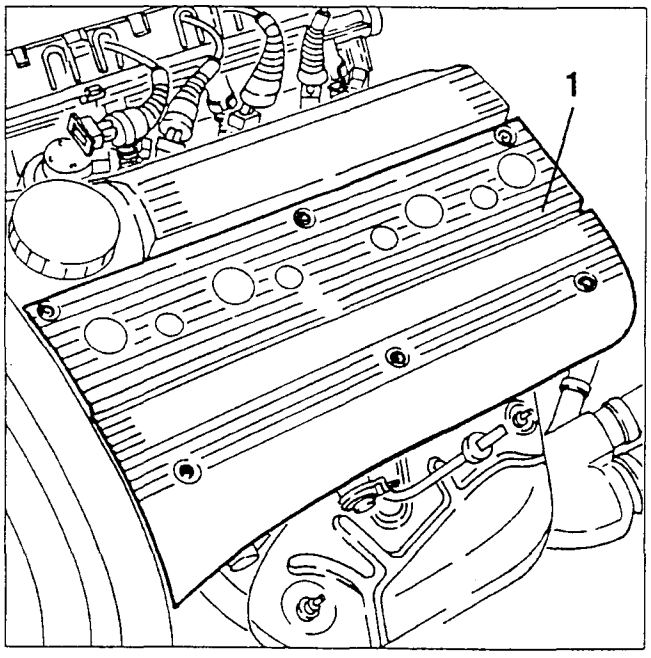
1. Disconnect the electrical connection from the coolant fluid temperature sensor NTC).
2. Disconnect the electrical connection from the engine coolant temperature gauge transmitter and maximum temperature warning light contact.
3. Disconnect the coolant delivery pipe to the climate control heater from the thermstatic cup.



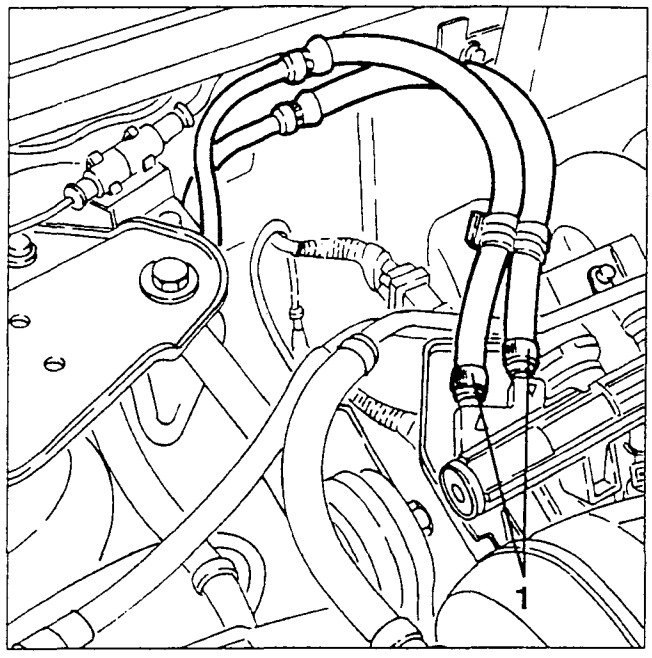
1. Disconnect the earth cable from the air intake manifold.
2. Disconnect the electrical connection from the timing variator electromagnet.
3. Disconnect the electrical connections from the injectors.



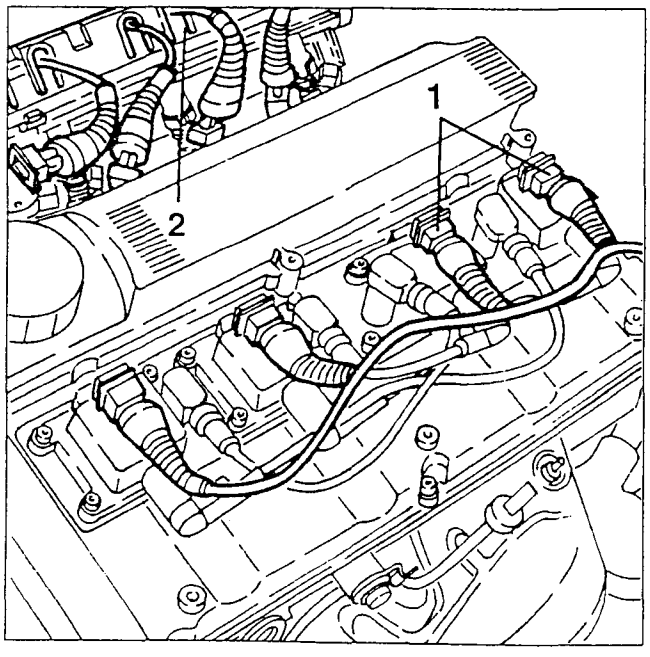
1. Slacken the fastening screws and remove the ignition coils cover.



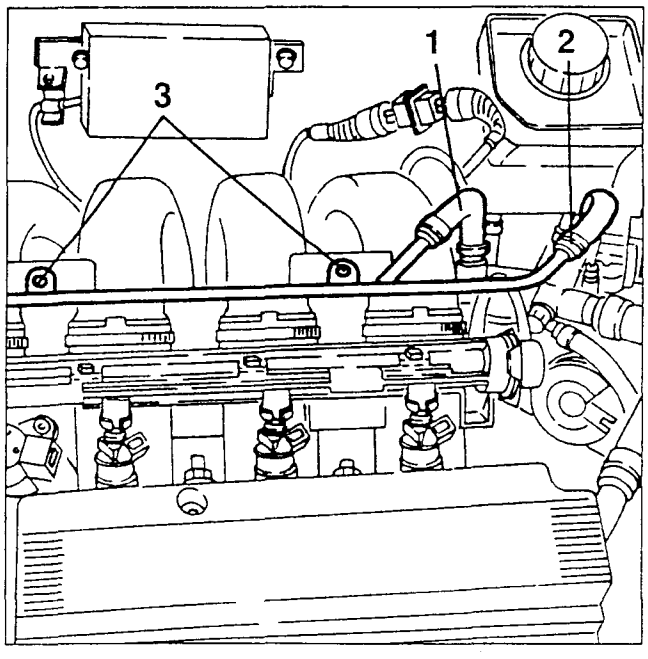
1. Disconnect the fuel inlet and outlet pipes from the distributor manifold.



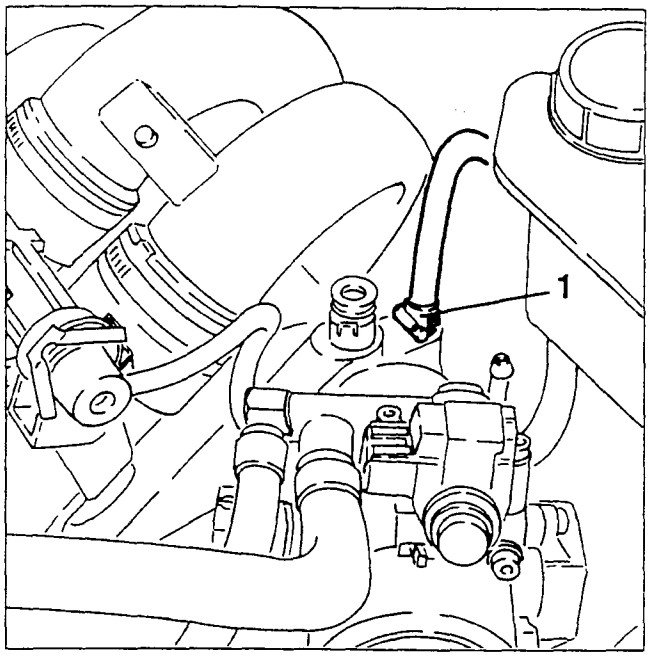
1. Disconnect the electrical connections from the ignition coils.
2. Release the cable race from the fuel distributor manifold, then withdraw the electric wiring and move it aside to prevent it from hindering the following operations.



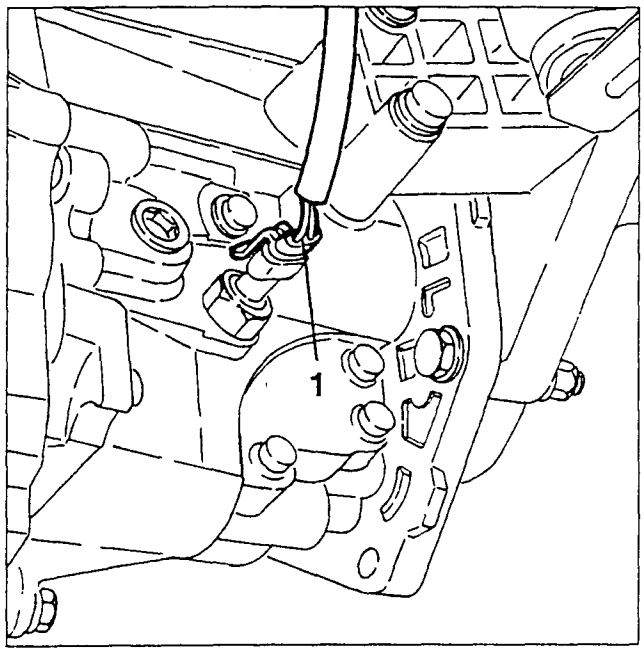
1. Disconnect the fuel vapour inlet pipe from the intake box.
2. Disconnect the the coolant return pipe to the header tank from the throttle body.
3. Slacken the two screws fastening to the intake box then turn aside the two stiff pipes.



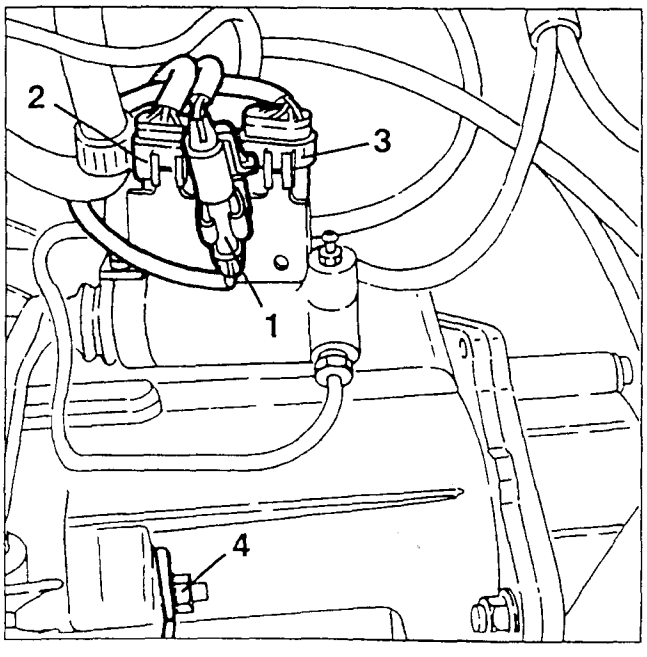
1. Disconnect the servobrake vacuum takeoff pipe from the intake box.



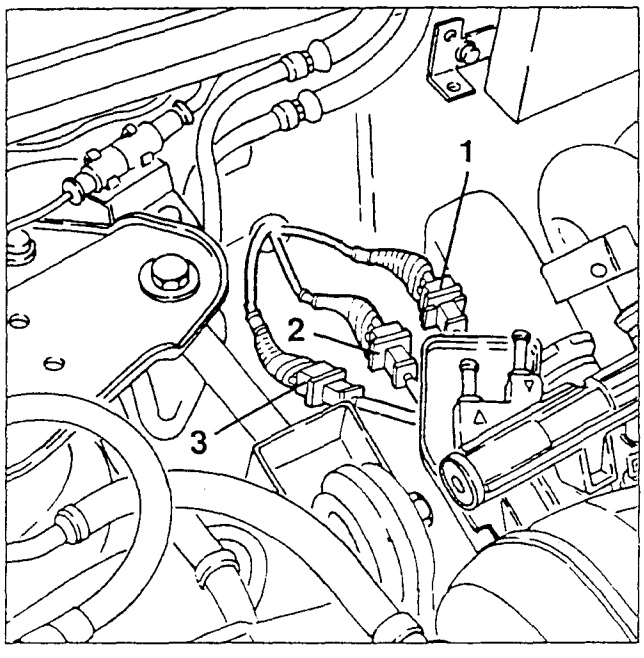
1. Disconnect the electrical connection from the reversing switch.



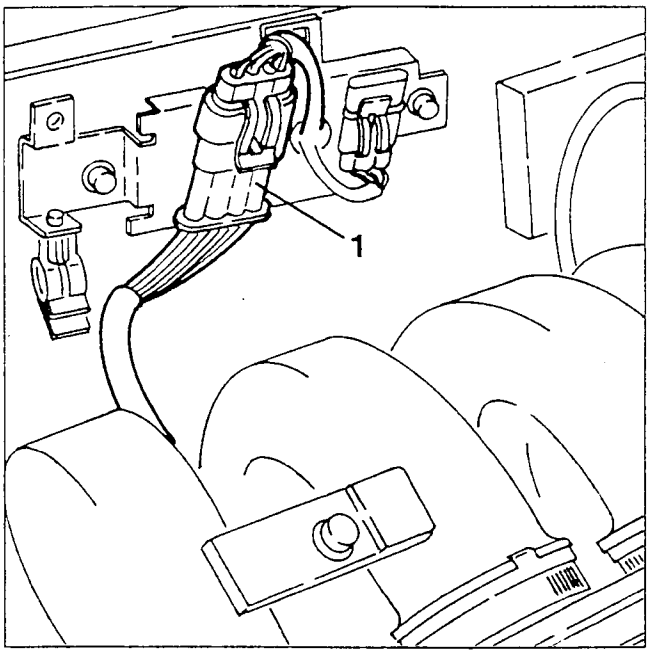
1. Disconnect the electrical connection of the starter motor.
2. Disconnect the electrical connection of the tachometric sensor.
3. Disconnect the electrical connection of the injection system.
4. Disconnect the earth cable from the gearbox cover.



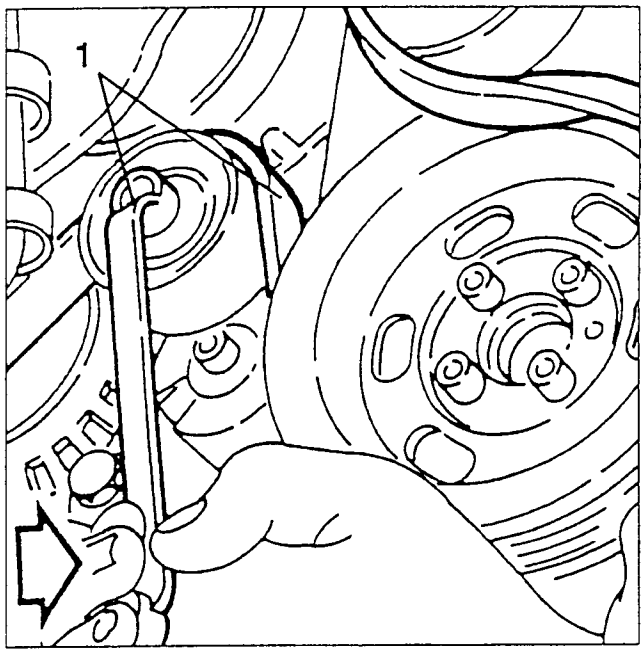
1. Disconnect the electrical connection of the timing sensor (blue).
2. Disconnect the electrical connection of the pinging sensor (white).
3. Disconnect the electrical connection of the rpm and timing sensor (brown).



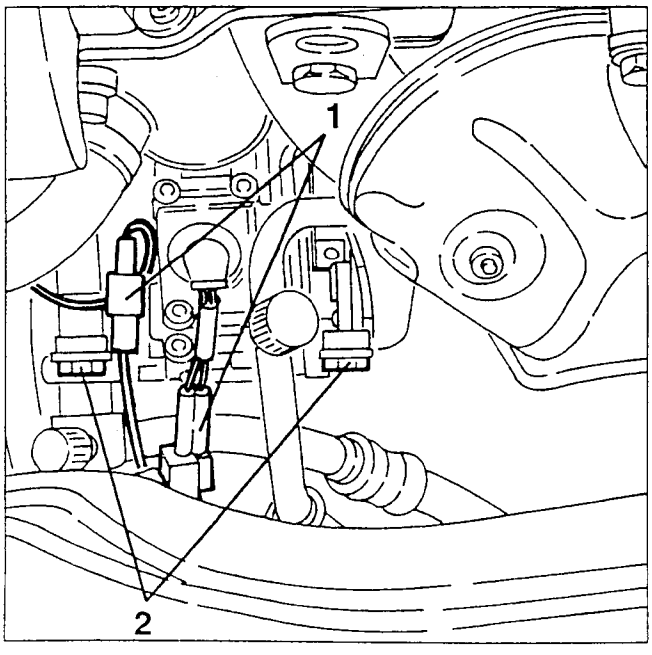
1. Remove the plastic protection, then disconnect the electrical connection of the lambda sensor.



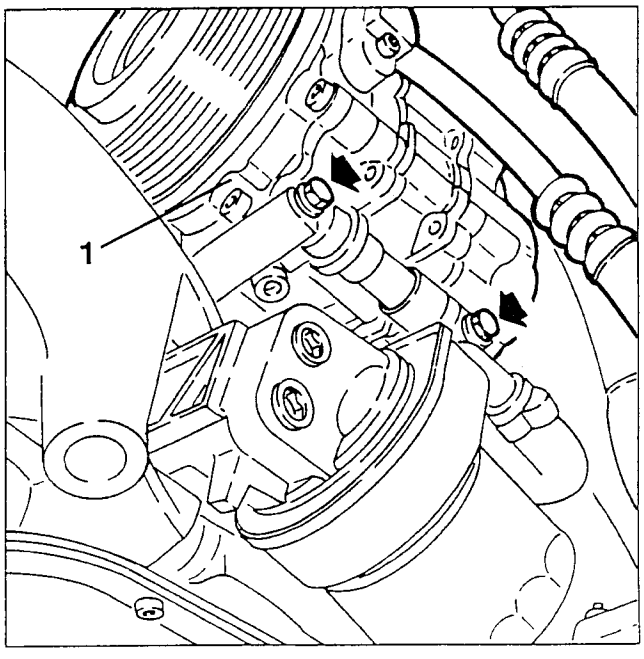
1. Working as illustrated on the pulley guide, loosen the tension of the auxiliary components drive belt and remove it.



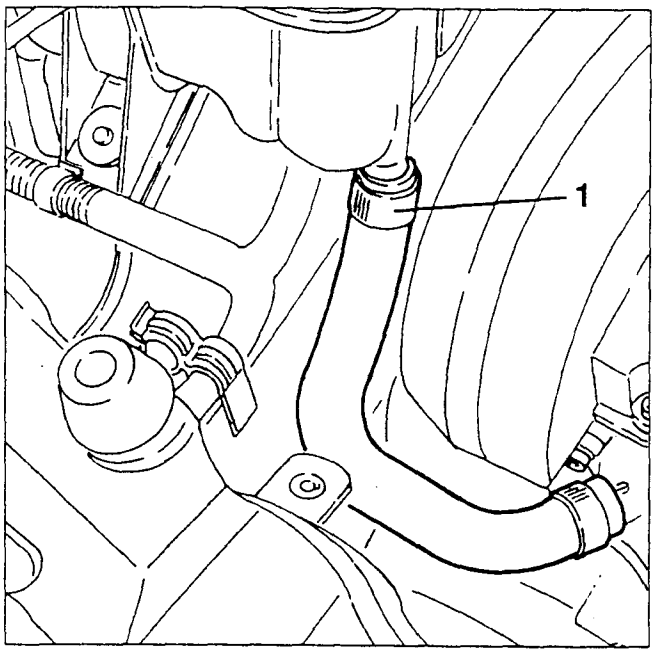
1. Disconnect the two electrical connections from the climate control system compressor.
2. Slacken the two upper compressor fastening screws.



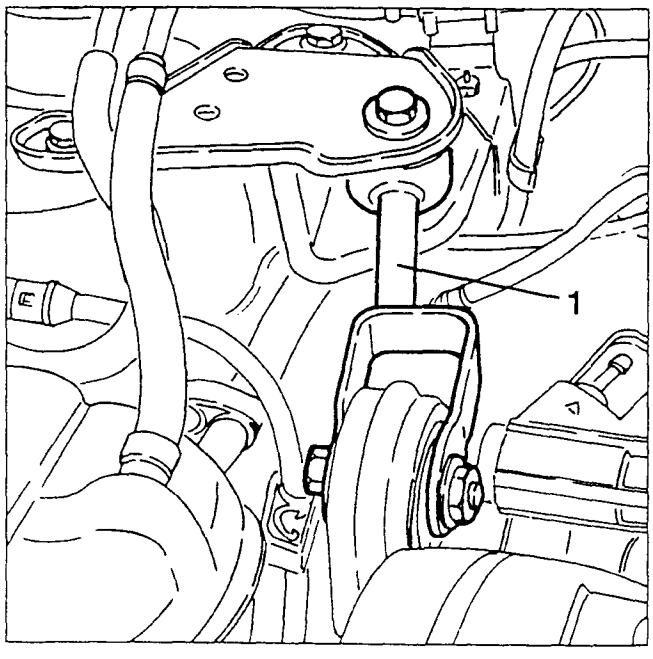
1. Slacken the two lower screws fastening the climate control system compressor, then without disconnecting the pipes, remove it and fasten it to one side so that it does not hinder the following operations.



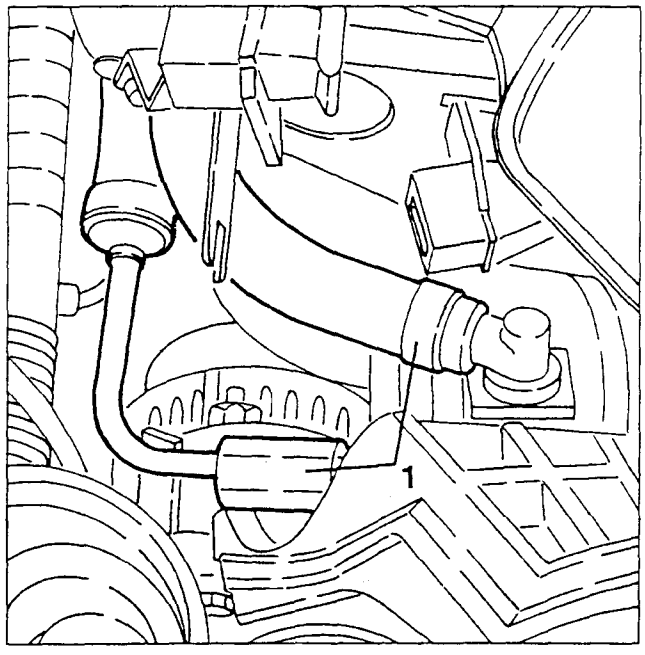
1. Lower the car and disconnect the system supply pipe from the header tank.



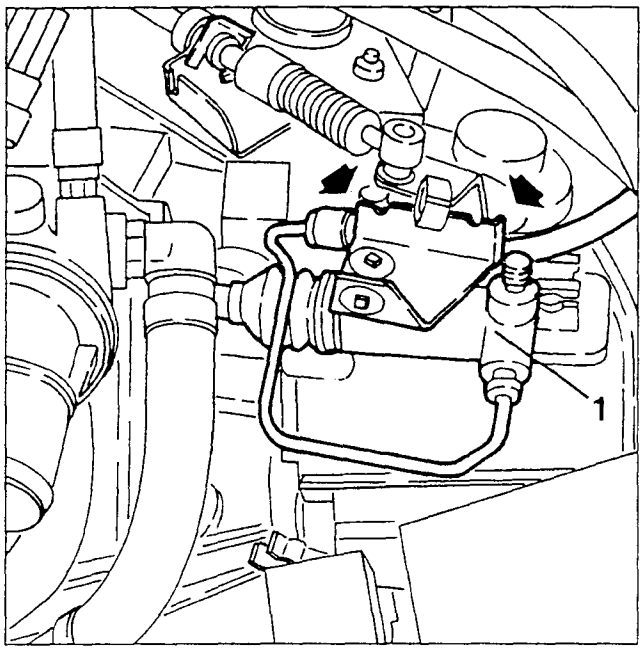
1. Slacken the fasteners and remove the engine stay rod.



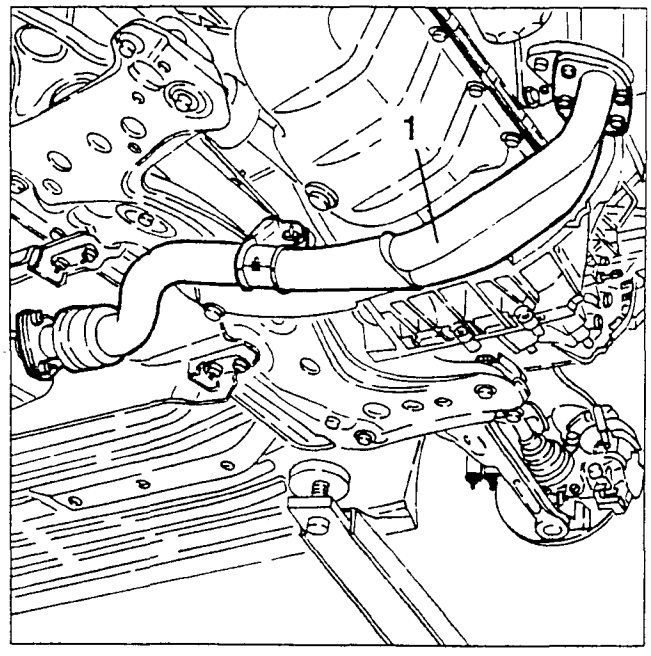
- Using a suitable syringe, withdraw the oil from the power steering tank.
1. Disconnect the two oil intake and delivery pipes from the power steering pump.



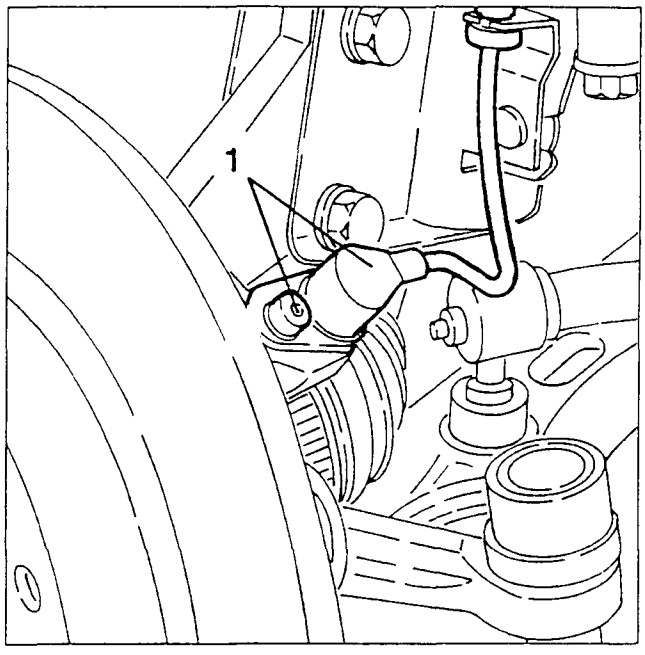
1. Slacken the fastening screws, then move the clutch control cylinder without disconnecting the associated pipes.



1. Slacken the fasteners and remove the front section of the exhaust pipe complete with lambda sensor.

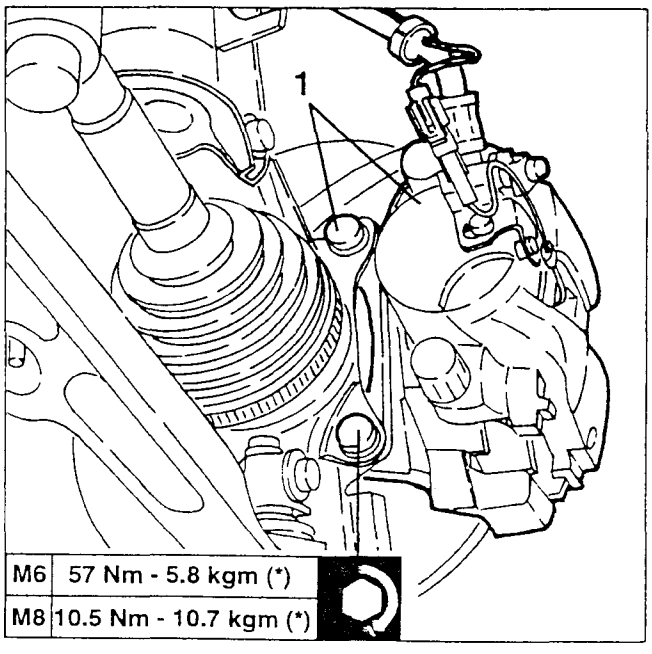


1. Slacken the fastening screw and remove the A.B.S. inductive sensor from the wheel upright.



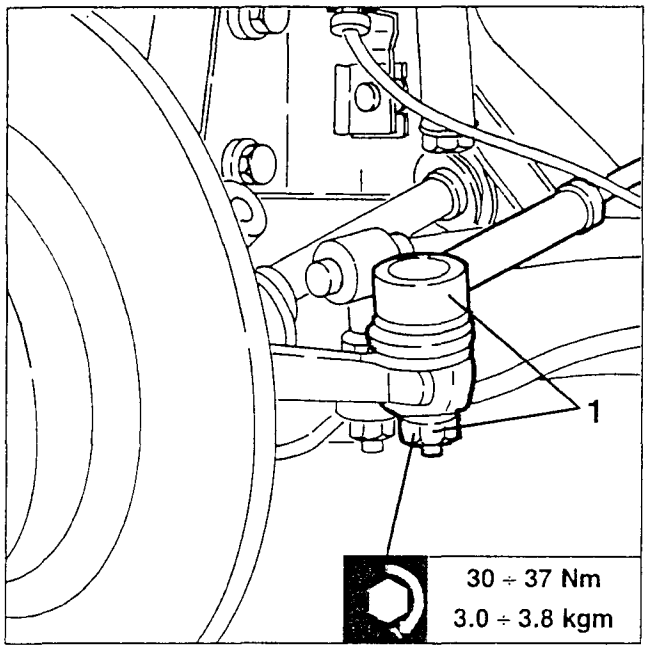
The following operations concerning removal of the complete axle shaft, wheel upright and brake disk are shown for the left hand side of the car, proceed in the same way for the right hand side.

1. Slacken the two fastening screws and remove the brake caliper complete without disconnecting the associated pipes and fasten it to one side so that it does not hinder the following operations.

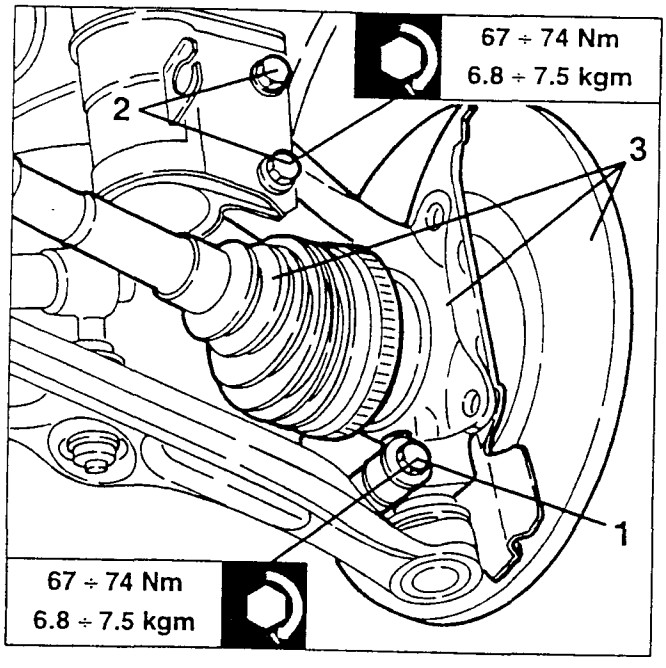


(*): Screws with "Driloc"; must be changed each time they are tightened or loosened.

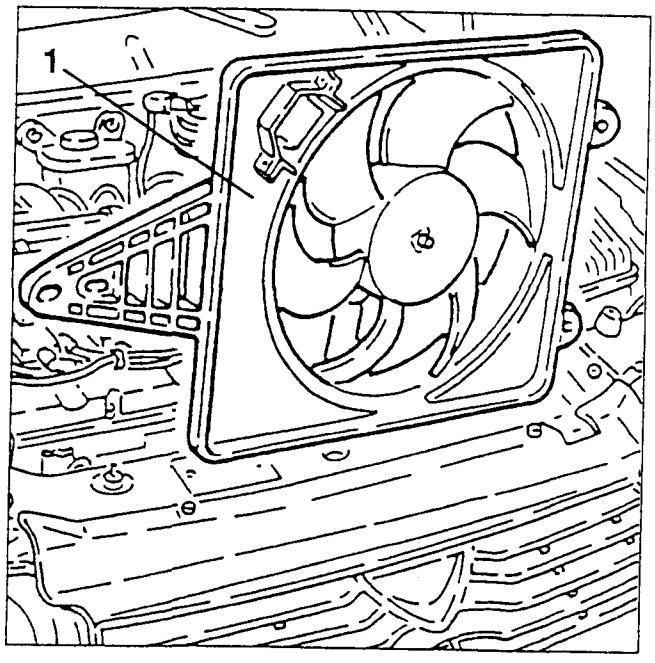
1. Slacken the fastening nut and disconnect the track rod from the wheel upright.



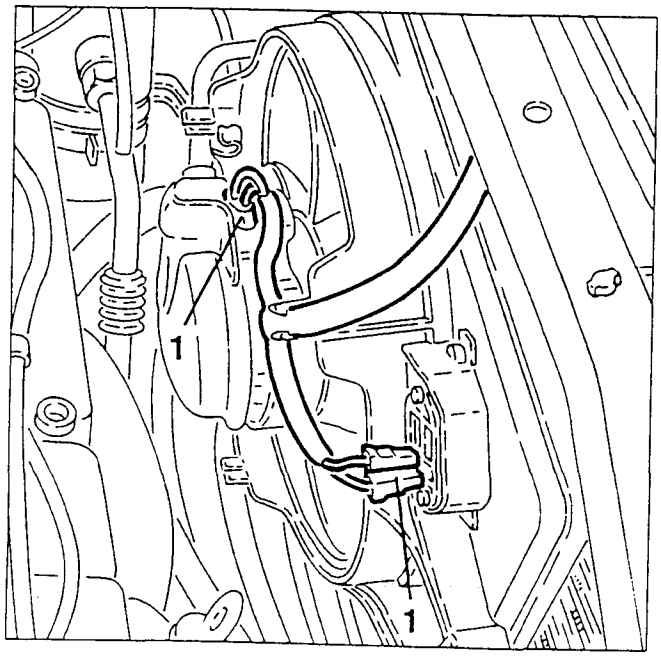
1. Slacken the bolt fastening the wishbone to the wheel upright.
2. Slacken the two bolts fastening the upright to the shock absorber.
3. Withdraw the axle shaft complete with wheel upright and brake disk after releasing the axle shaft boot from the differential.



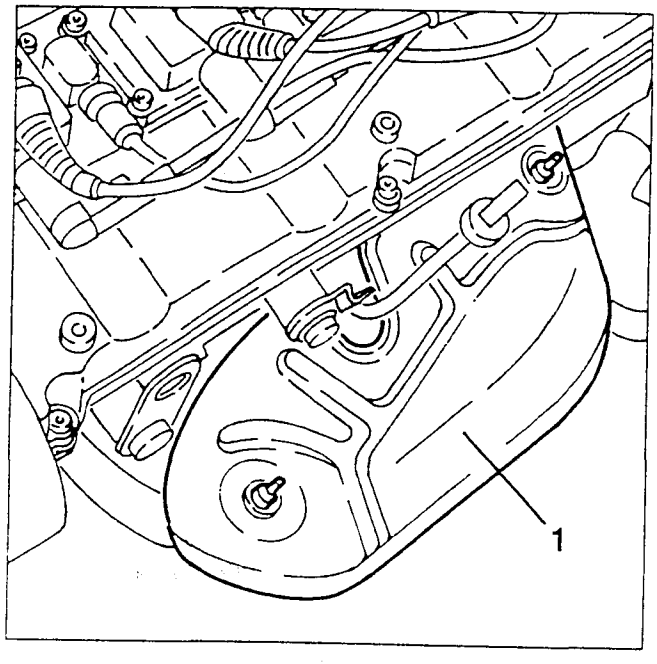
1. Slacken the fastening screws and remove the cooling fan.



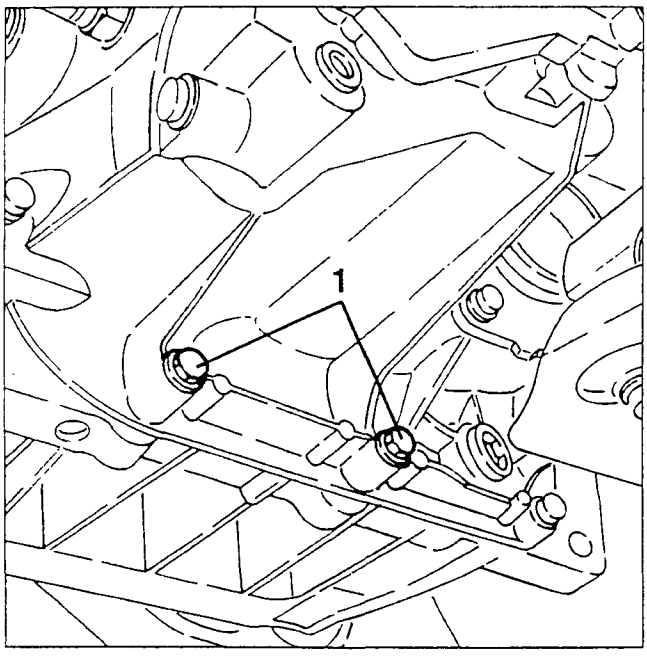
1. Disconnect the electrical connections from the cooling fan.



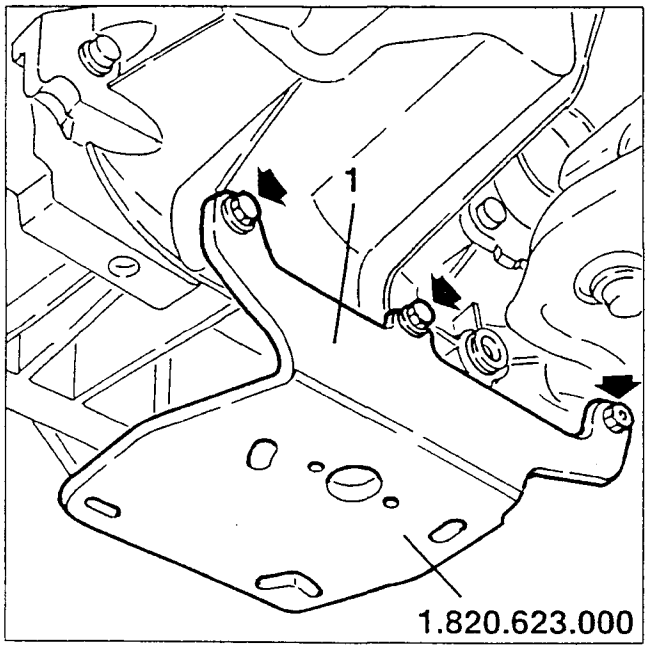
1. Remove the heat guard from the exhaust manifold.



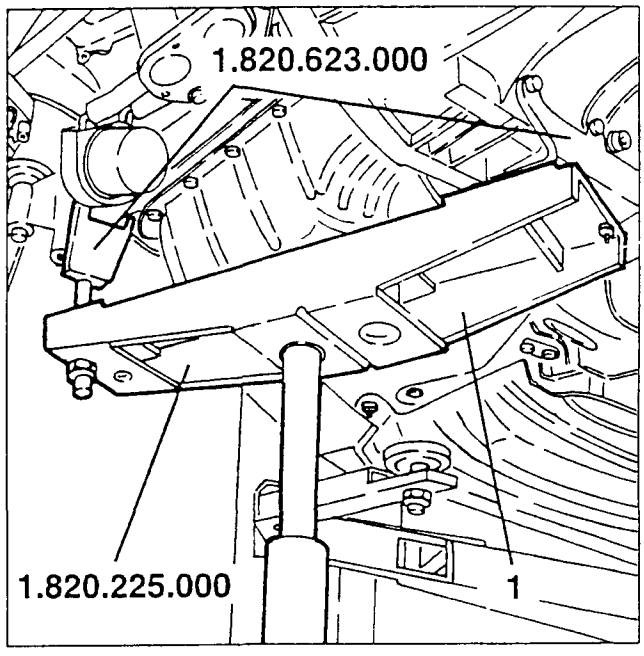
1. Slacken the two screws illustrated fastening the gearbox.



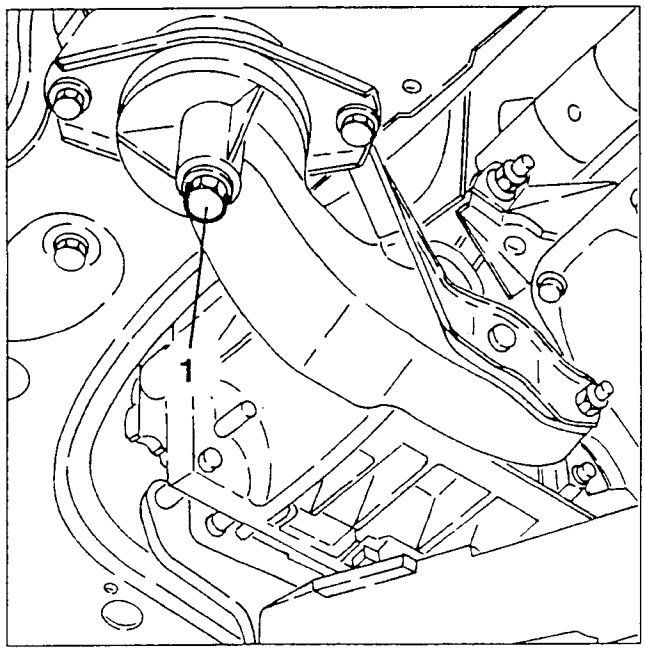
1. Position the bracket of tool no. 1.820.623.000 fastening it to the gearbox using the two screws removed previously and with a bolt in the hole already existing on the gearbox as illustrated.



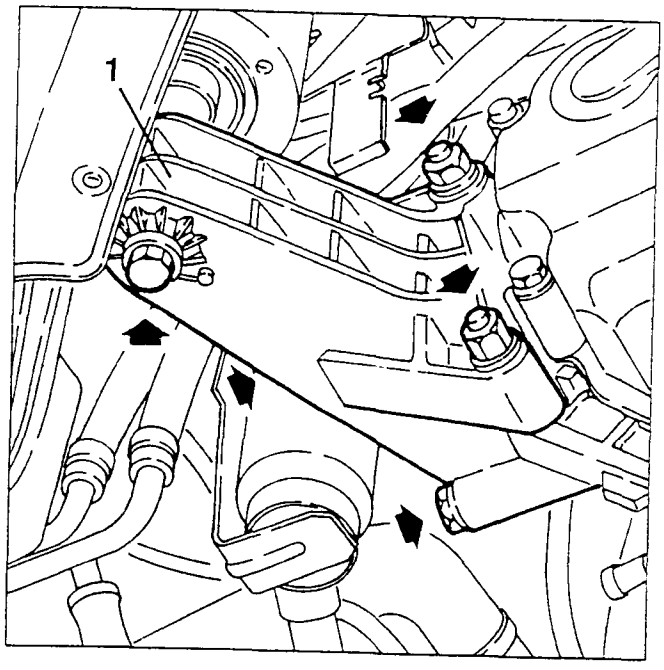
1. On hydraulic jack install support no. 1.820.225.000 complete with fork no. 1.820.623.000 and set it under the power unit as illustrated fastening the support to the bracket previously fitted on the gearbox.



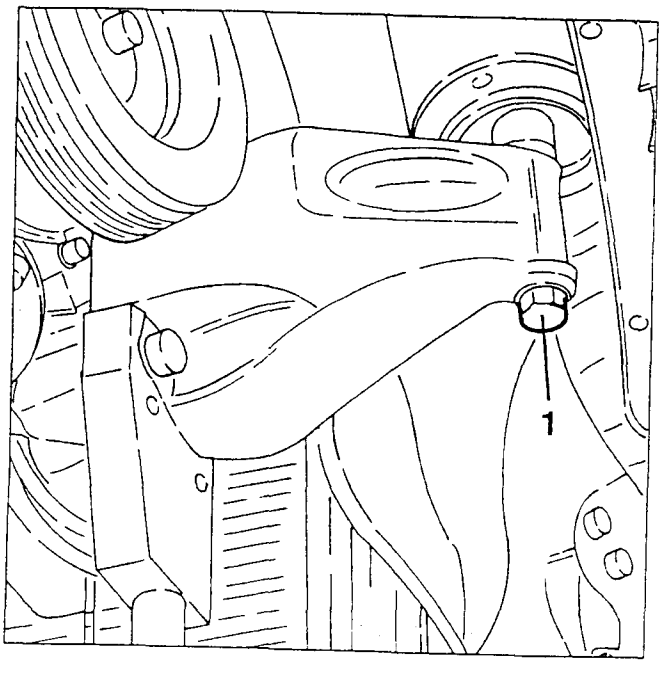
1. Slacken the fastening screw of the rear power unit support.



1. Slacken the fasteners and remove the power unit support on the gearbox side.

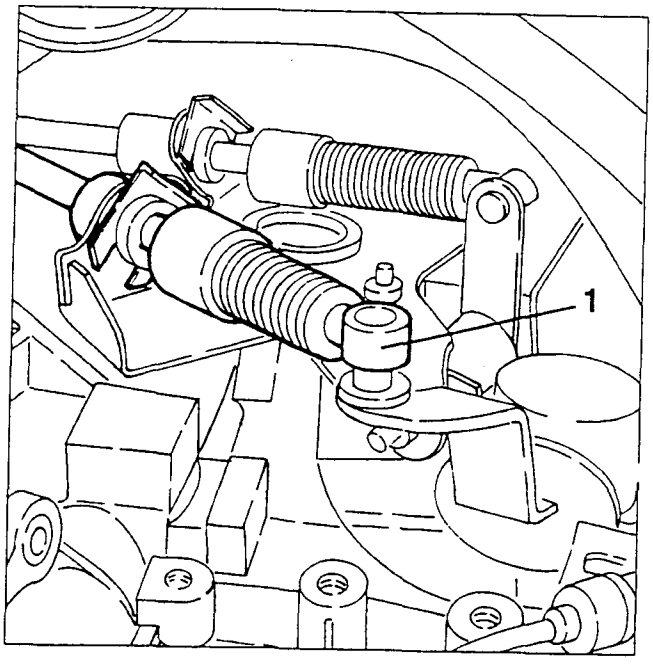


1. Slacken the screw fastening the camshaft side power unit support to the body.

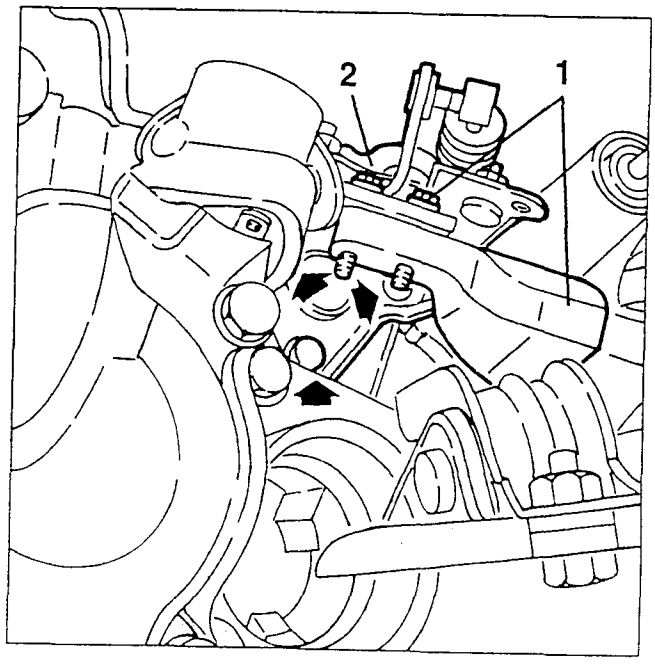


Specific for versions with bpwden gearbox control

1. Lower the power unit as far as necessary and disconnect the gearshift control bowden illustrated.

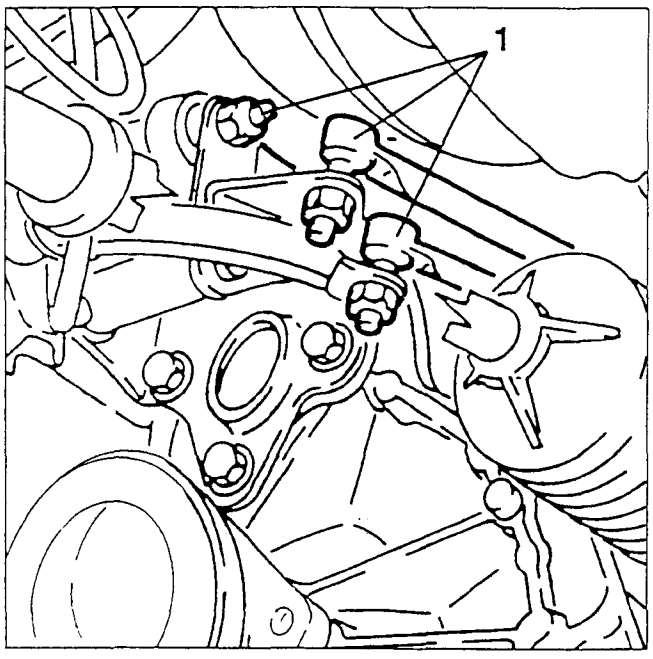


1. Slacken the two fastening screws and remove the damping mass.
2. Slacken the fastening screws and remove the gearshift control bowden connection bracket from the gearbox.



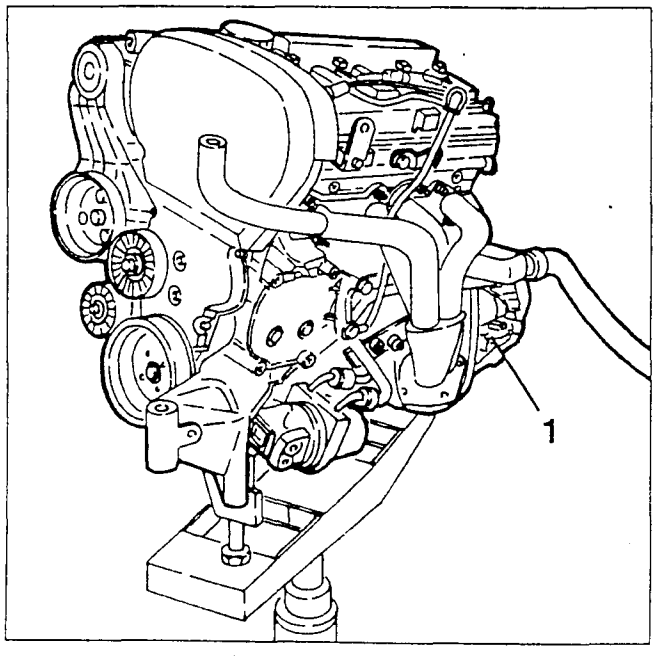
Specific for versions with rod gearbox control

1. Slacken the fastening nuts and disconnect the gearshift control rods.



1. Lower the hydraulic jack completely and remove the power unit from the engine compartment.

WARNING:
The hydraulic jack must have a capacity of at least 1000 kg.

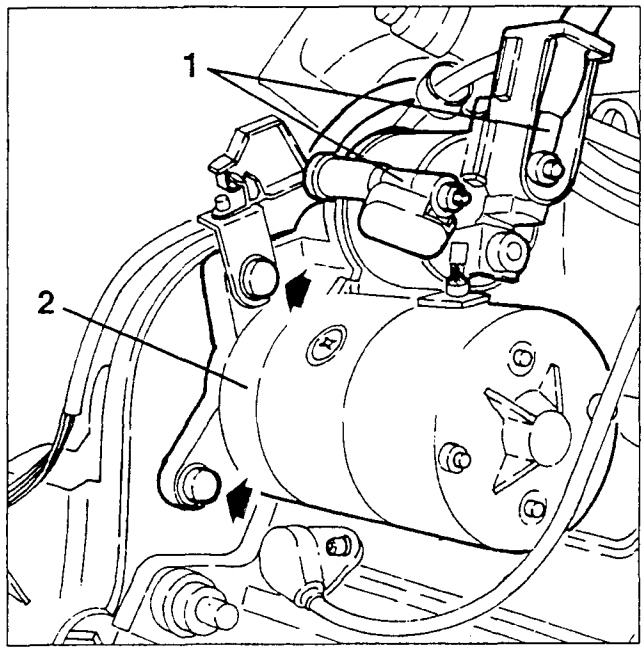


- Support the power unit with a hydraulic hoist in addition to the hydraulic jack used for removal.

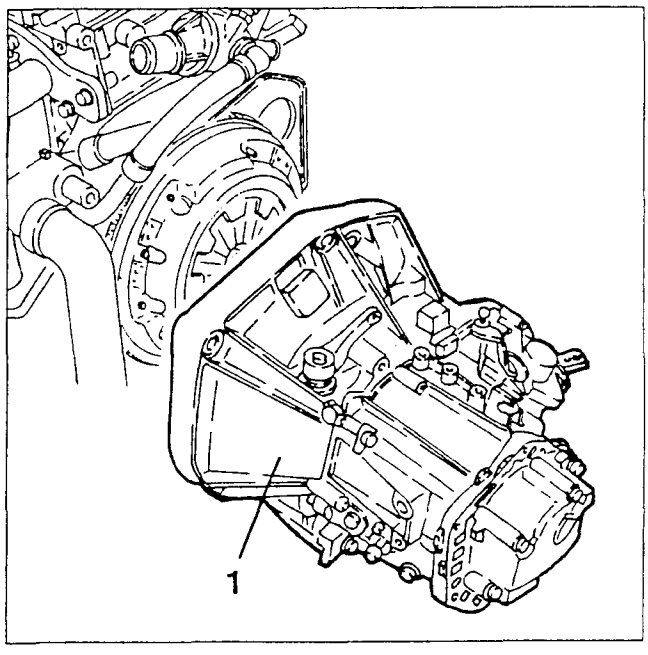
WARNING:
For handling the power unit use a hydraulic hoist after firstly releasing it from the hydraulic jack.

- Release the power unit from the support tools, then set it on a special work bench.

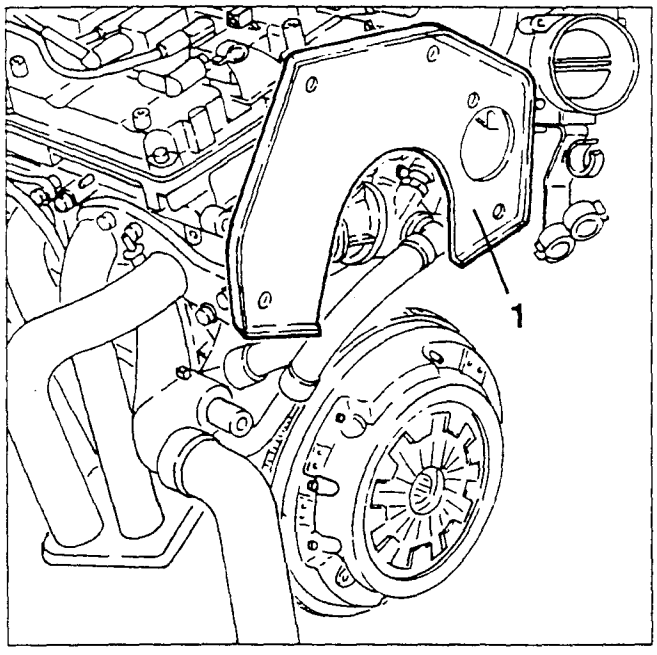
1. Disconnect the electrical connections from the starter motor.
2. Slacken the fastening screws and remove the starter motor.



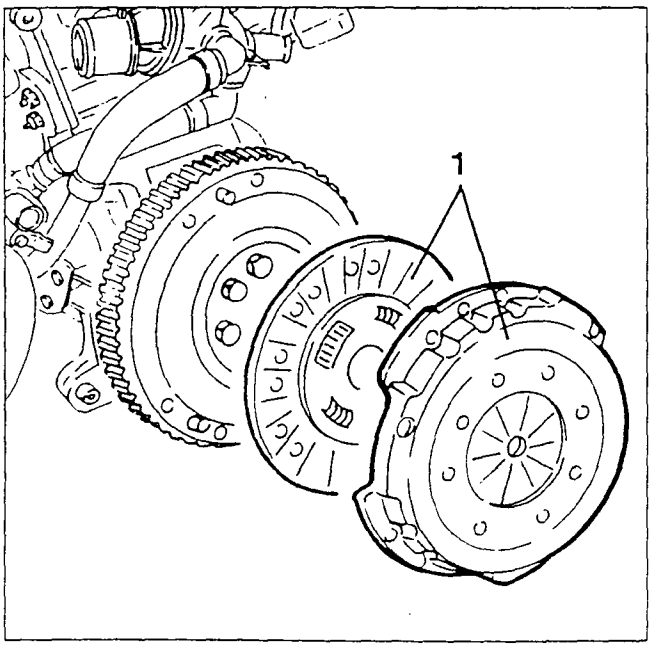
1. Slacken the fasteners and remove the gearbox-differential unit.



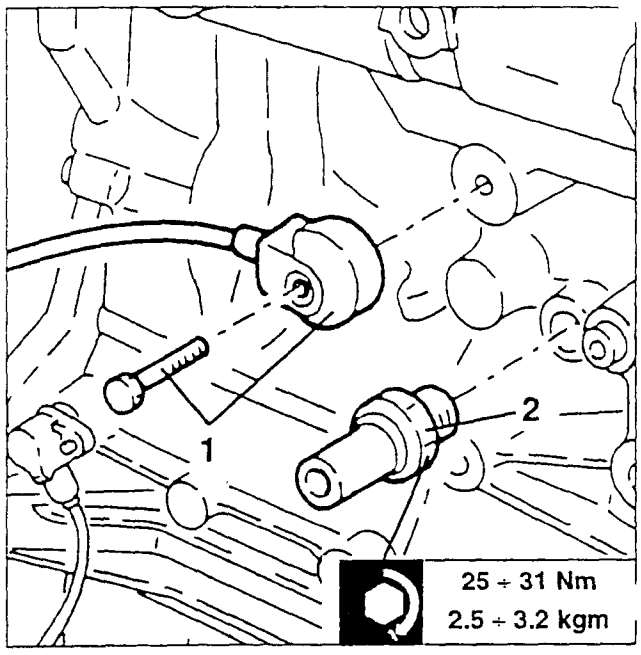
1. Retrieve the rear flywheel guard.



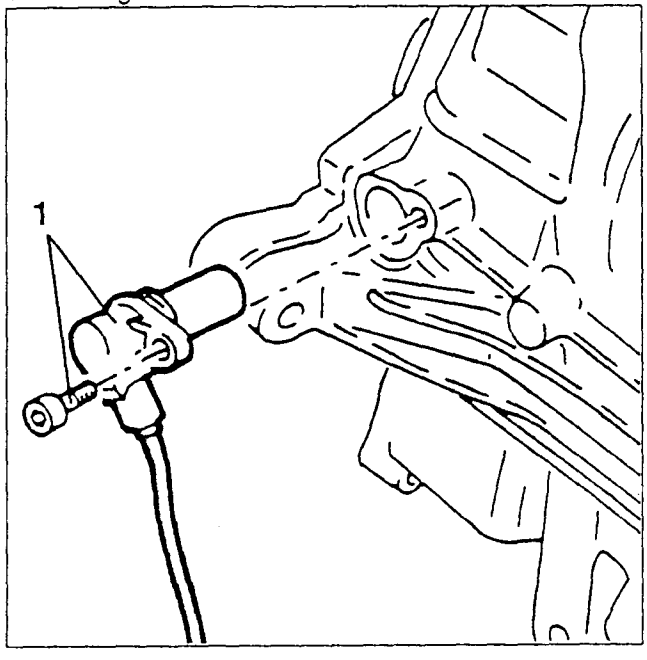
- Release the engine wiring from the cable clamps, disconnect the electrical connections still connected, then remove the wiring.
1. Slacken the fastening screws and remove the thrust plate and clutch plate.



1. Slacken the fastening screw and remove the pinging sensor from the crankcase.
2. Remove the engine oil minimum pressure sensor.



1. Slacken the fastening screw and remove the rpm and timing sensor.



REFITTING

Repeate the operations of the removal procedure reversing their sequence and following the instructions given below:
- Prepare the engine compartment for refitting the power unit, placing all the electrical cables, pipes, etc. so that they do not interfere.

WARNING: Make sure that the power unit support points have been fastened correctly.

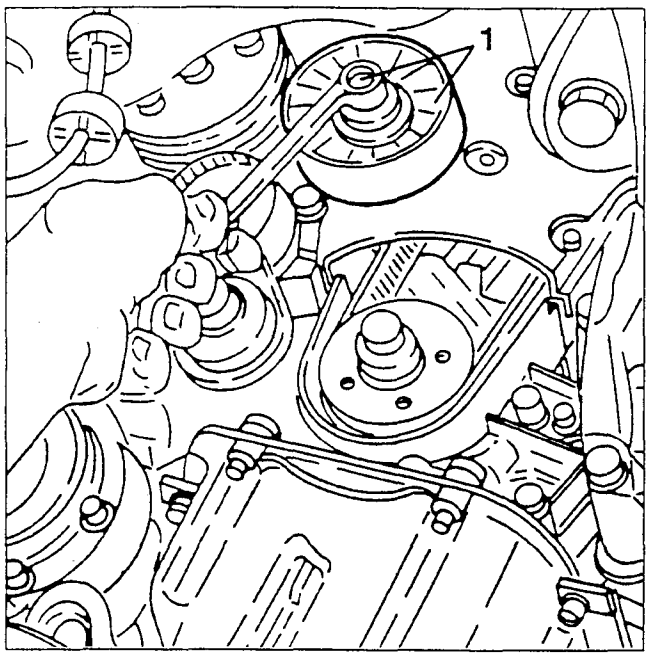
- After assembly, fill the systems as specified (see GROUP 00).
- Carry out all the checks and operations necessary (see GROUP 00).

CYLINDER HEAD

REMOVING/REFITTING

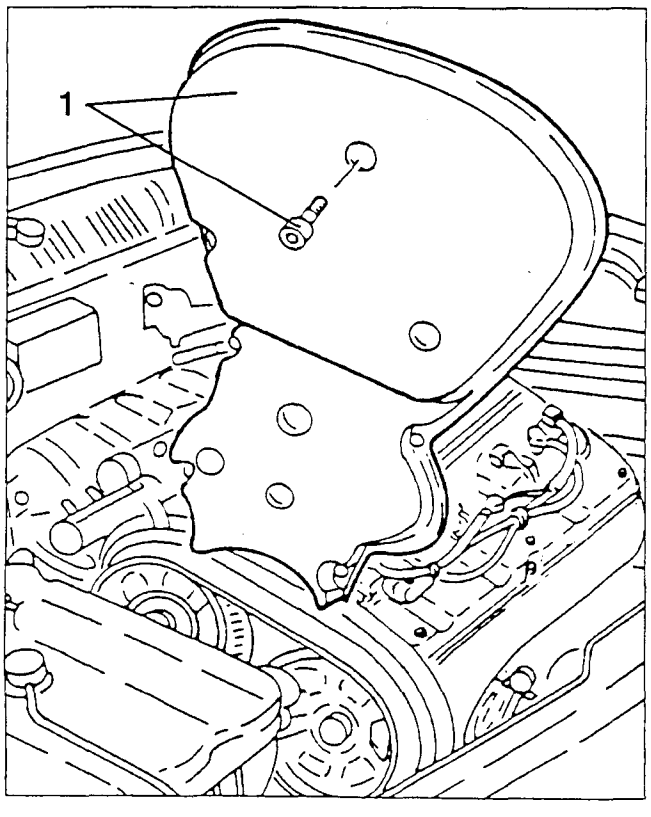
Proceed as described for 1970 T. SPARK 16V engine up to removing the auxiliary components drive pulley included.

1. Slacken the fastening screw and remove the auxiliary components drive pulley guide.

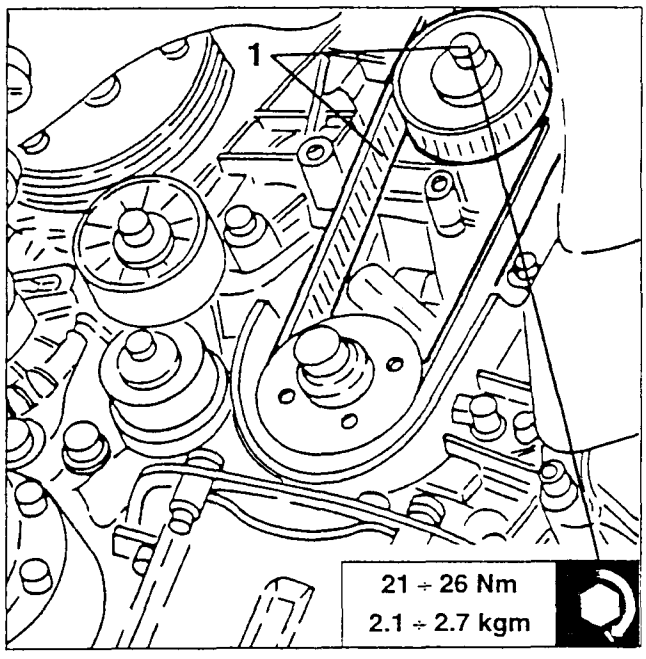


- Slacken the lower screws fastening the timing gear belt guard.

1. Lower the car, slacken the remaining fastening screws and remove the timing gear drive belt guard.



1. Working on the timing gear belt tensioner, loosen the tension of the belt, then remove it from the camshaft drive pulleys.



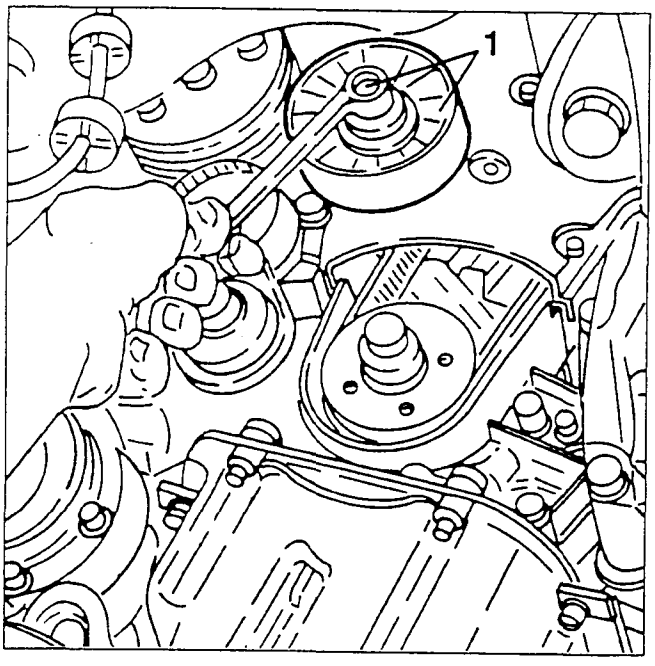
Complete the cylinder head removing/refitting procedure proceeding as described for 1970 T. SPARK 16V engine.

OIL SUMP 1598 T. SPARK 16V 1747 T. SPARK 16V

REMOVING/REFITTING

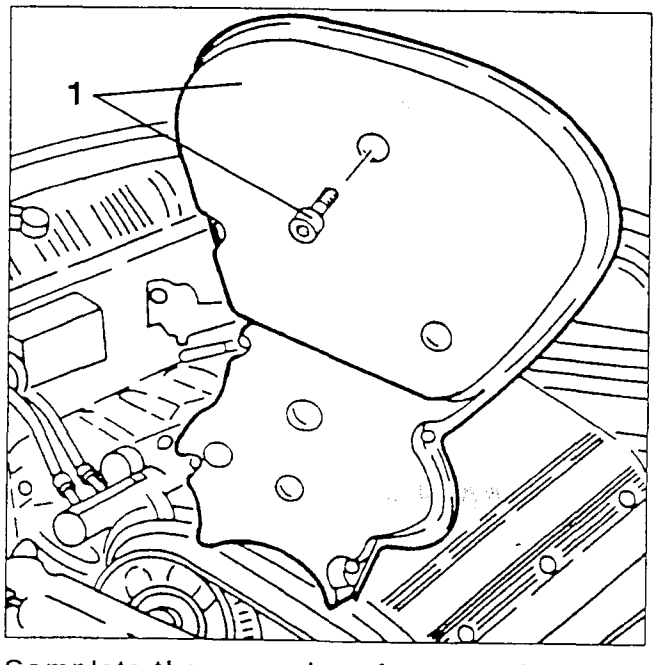
Proceed as described for 1970 T. SPARK 16V engine up to removing the auxilisry components drive pulley included.

1. Slacken the fastening screw and remove the auxiliary components drive belt pulley guide.



- Slacken the lower screws fastening the timing gear guard.

1. Lower the car, slacken the remaining fastening screws and remove the timing gear drive belt guard.

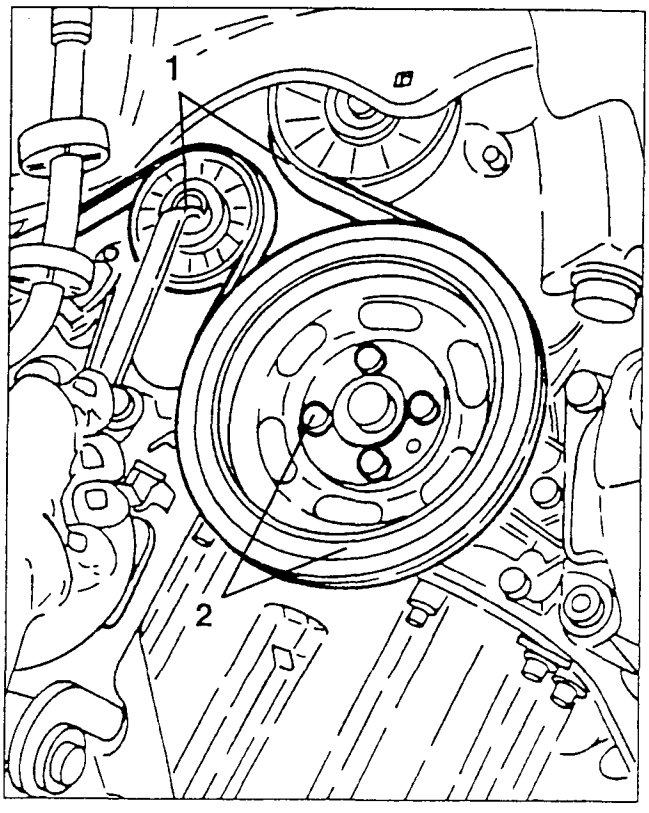


Complete the procedure for removing/refitting the head oil sump proceeding as described for 1970 T. SPARK 16V engine.

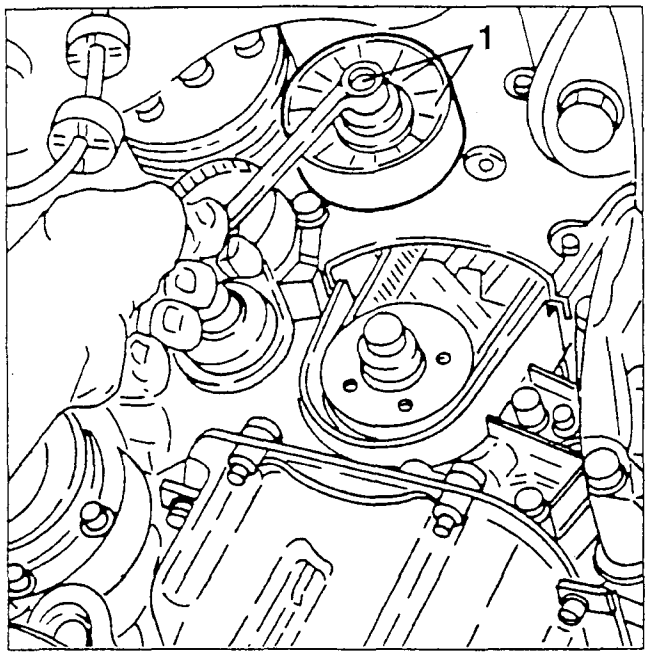
CHANGING THE FRONT CRANKSHAFT OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flaps.

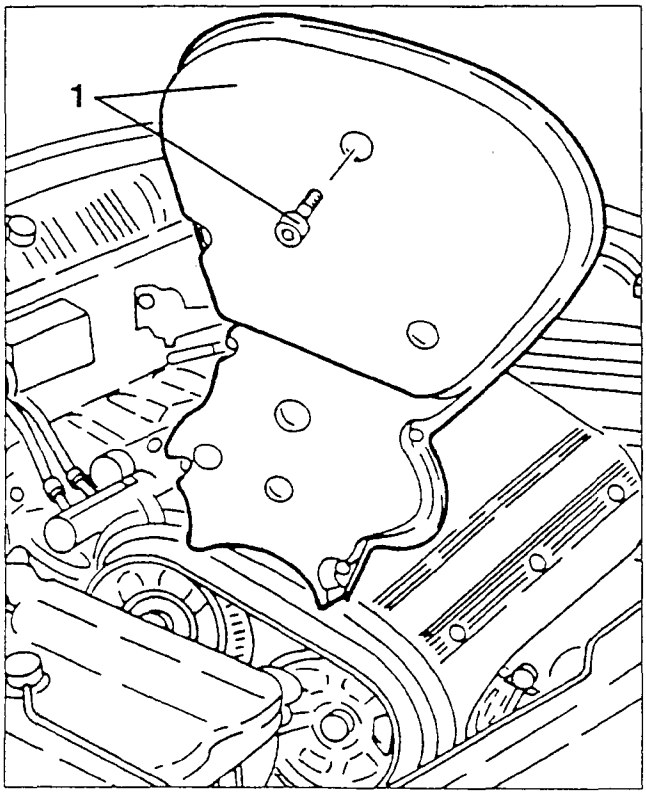
1. Raise the car and working on the belt tensioner as illustrated, slacken the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.



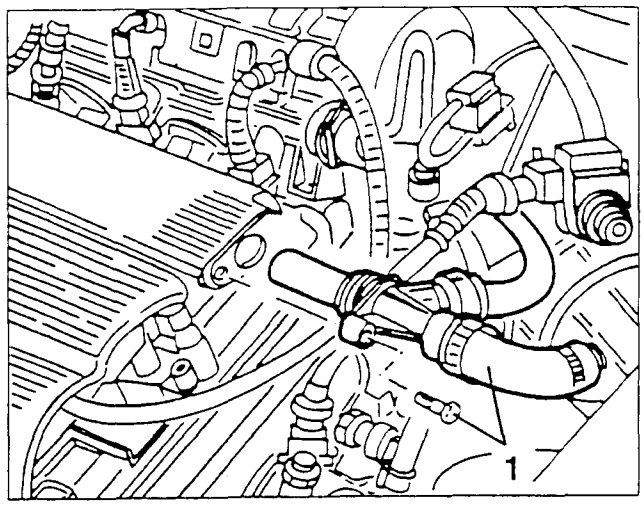
1. Slacken the fastening screw and remove the auxiliary components drive belt pulley guide.



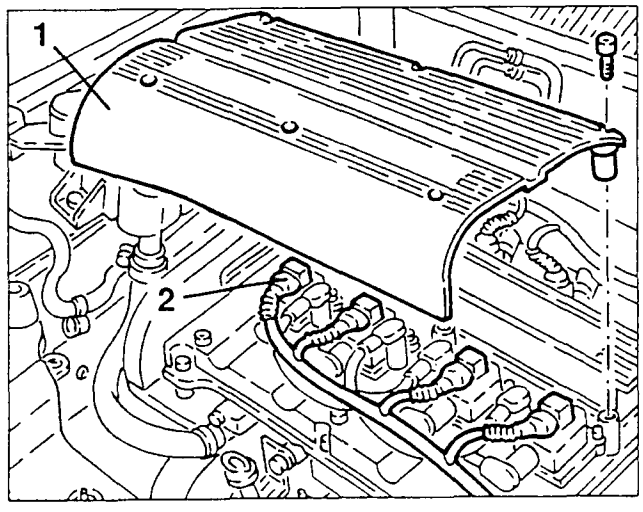
- Slacken the lower screws fastening the timing gear drive belt guard.
1. Lower the car, slacken the remaining fastening screws and remove the timing gear drive belt guard.



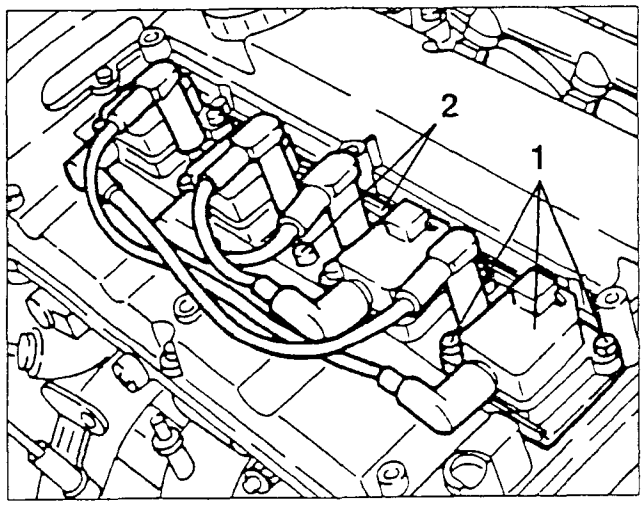
1. Slacken the fastening screw and withdraw the oil vapour recovery pipe socket.



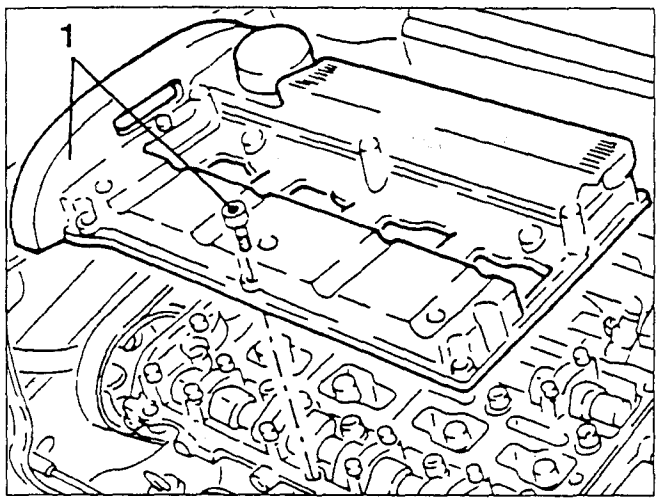
1. Slacken the fastening screws and remove ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



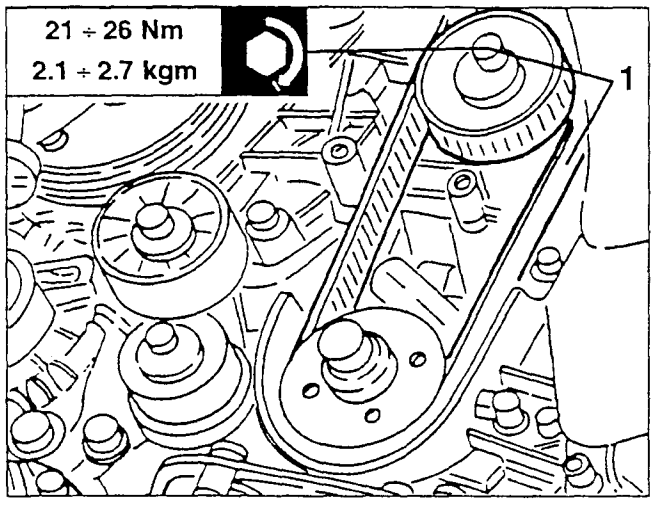
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



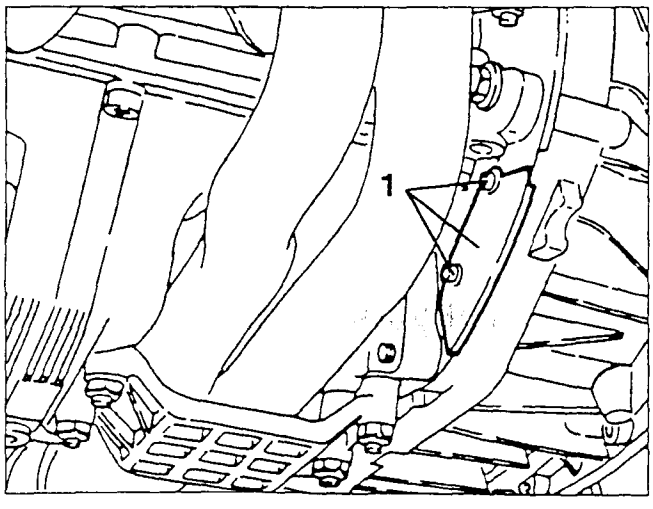
1. Slacken the fastening screws and remove the cylinder head cover complete with seal.



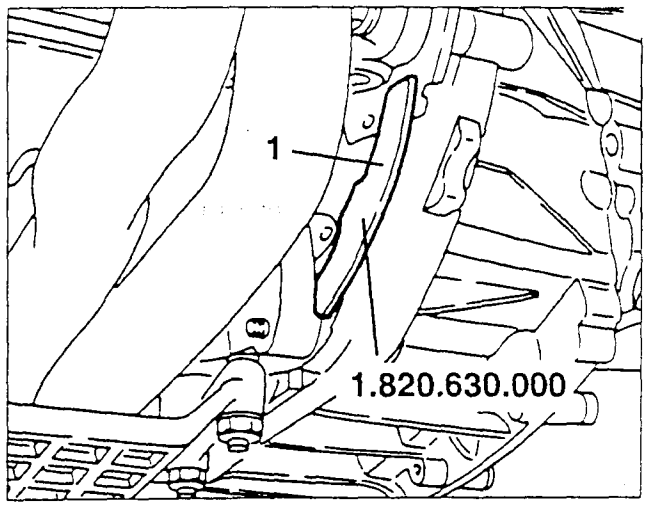
1. Working on the timing gear belt tensioner, slacken the tension of the belt, then remove it.



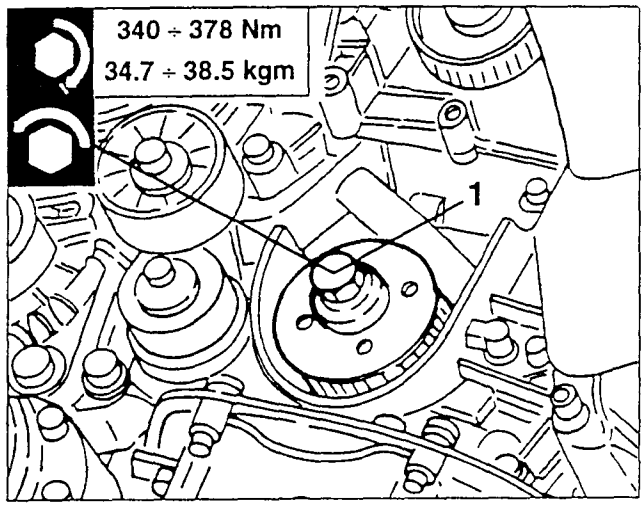
1. Slacken the two fastening screws and remove the flywheel guard plate.



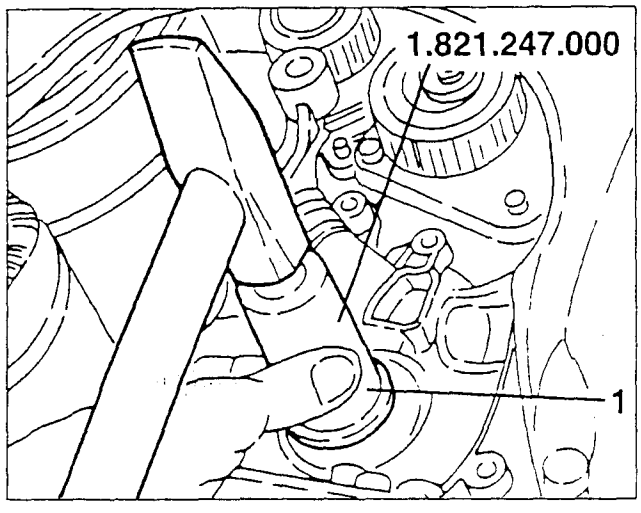
1. Install flywheel stopper tool no. 1.820.630.000, as illustrated.



1. Slacken the fastening screw (lefthand) of the timing gear drive belt pulley, then remove it.



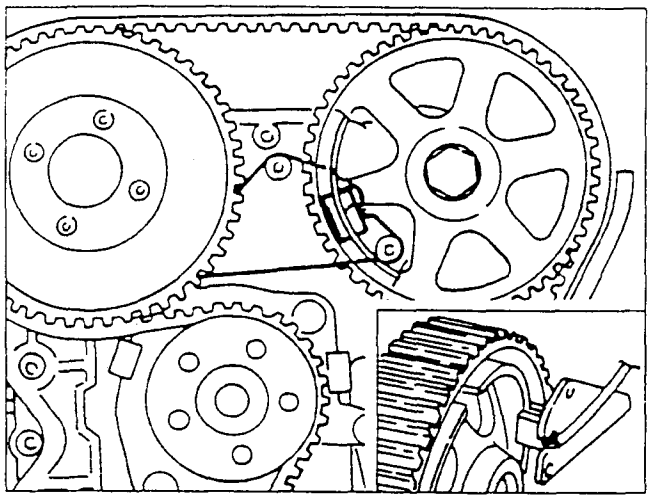
1. Remove the oil seal and install a new one using tool no. 1.821.247.000.



- Refit reversing the sequence described for removal.
Refer to GROUP 00 for refitting the timing gear drive belt and timing operations.

TIMING SENSOR

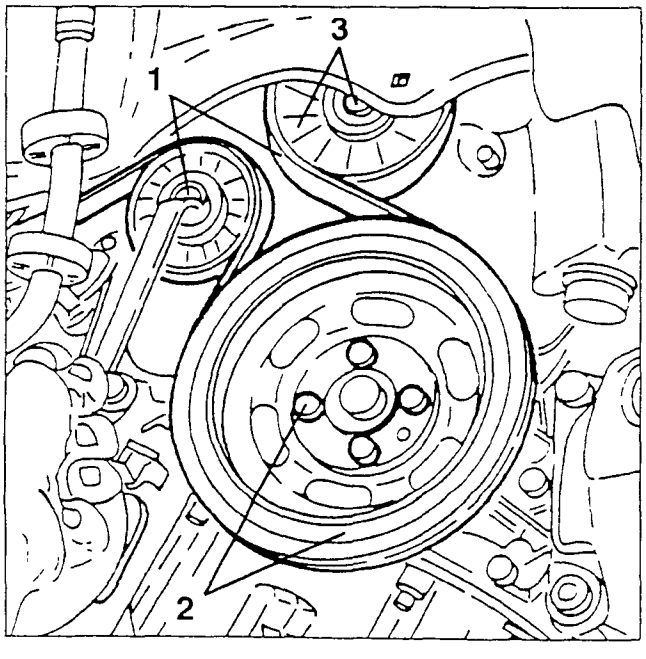
The timing sensor (cam angle sensor) is formed of a Hall effect device.
The voltage signal lowers abruptly when the tooth on the camshaft drive pulley facing the sensor passes in front of the sensor itself.



REMOVING/REFITTING (For engines without counter-rotating shafts)

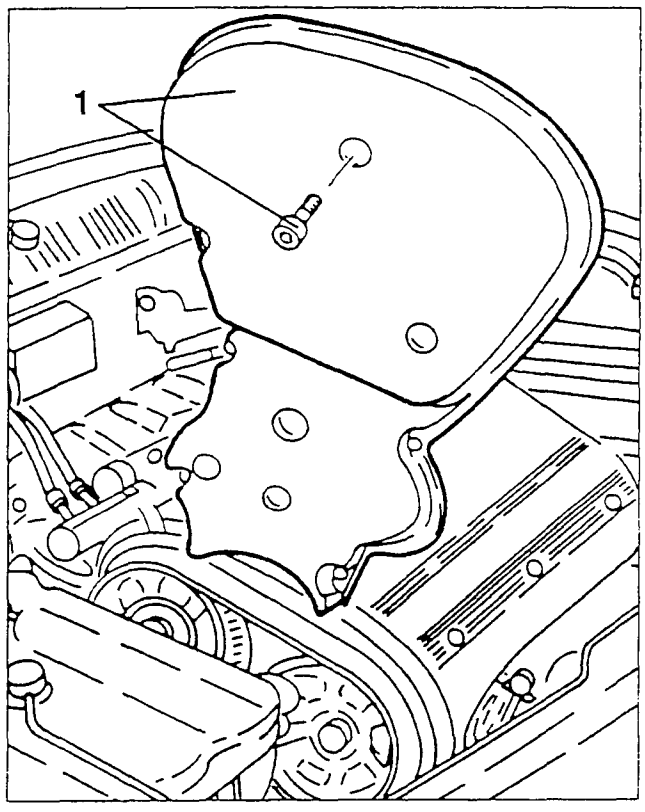
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

1. Raise the car and proceeding as illustrated on the belt tensioner, slacken the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.
3. Slacken the fastening screw and remove the auxiliary components drive belt pulley guide.

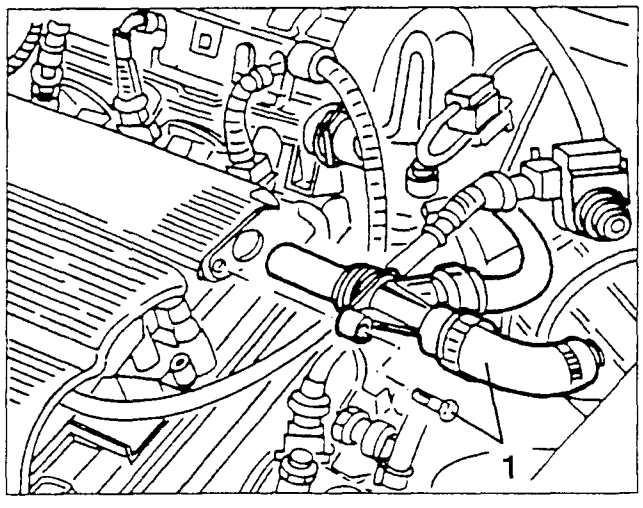


- Slacken the lower screws fastening the timing gear drive belt guard.

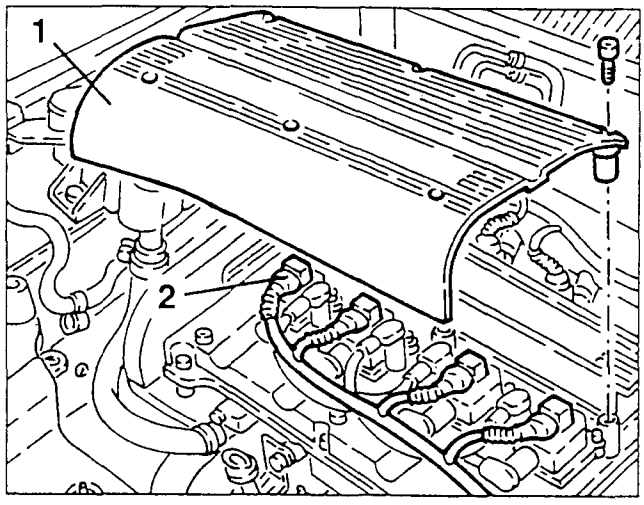
1. Lower the car, slacken the remaining screws and remove the timing gear drive belt guard.



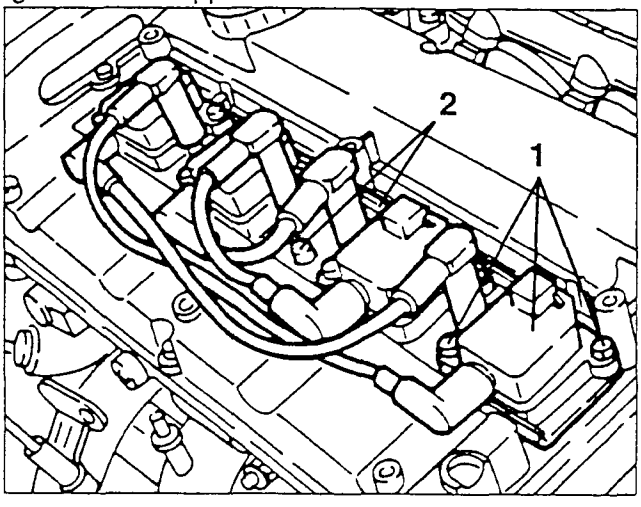
1. Slacken the fastening screw and clamp and remove the oil vapour recovery pipes.



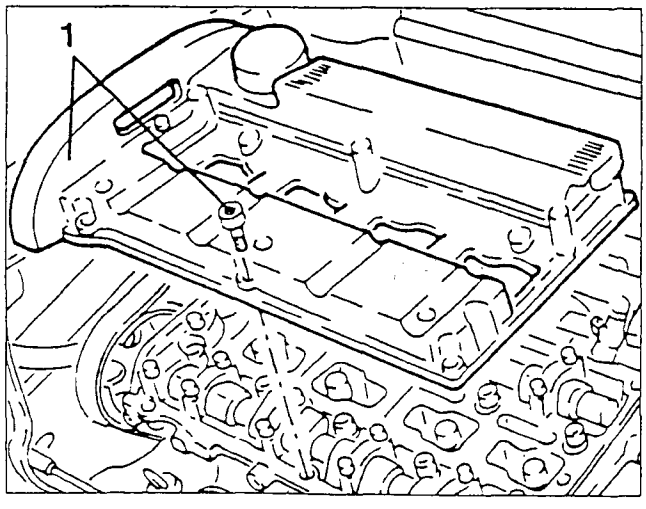
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



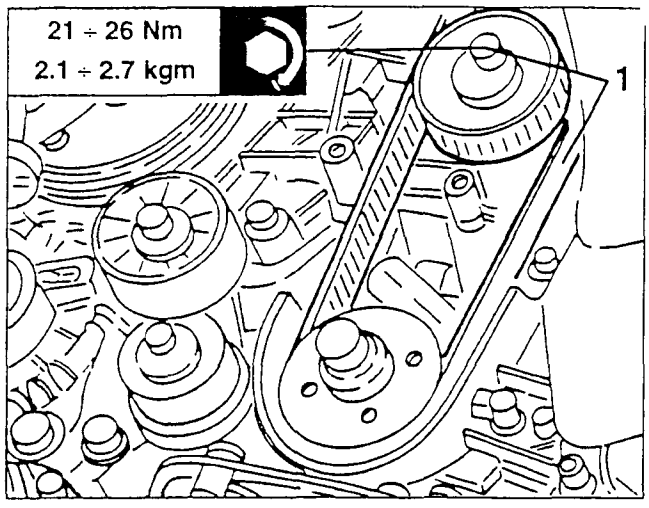
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



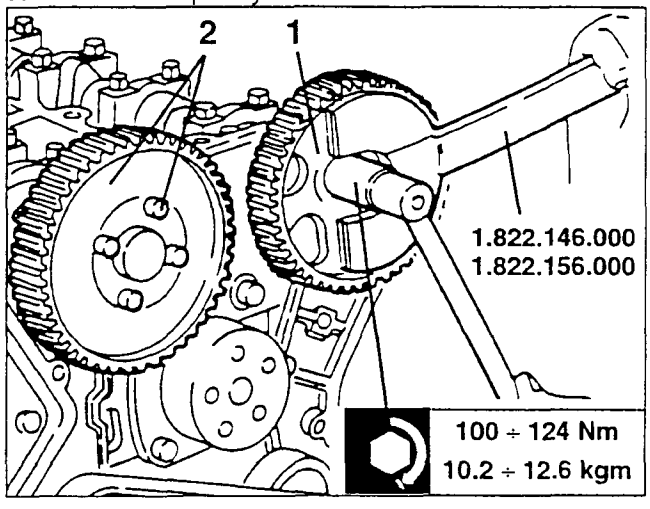
1. Slacken the fastening screws and remove the cylinder head cover complete with seal.



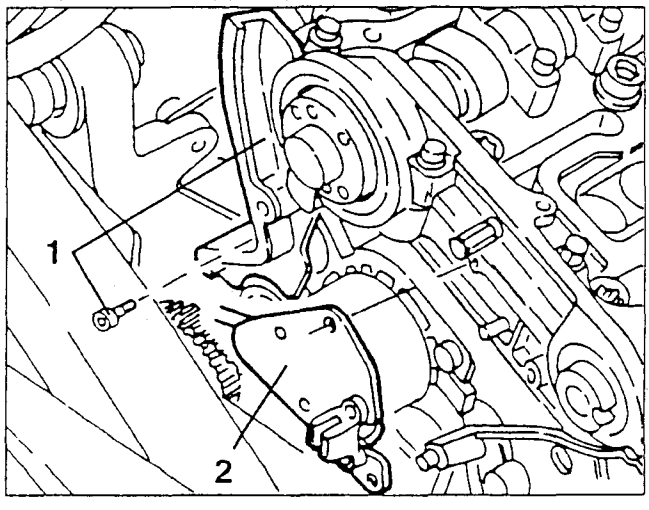
1. Working on the belt tensioner, slacken the tension of the belt, then remove it from the timing gear pulleys.



1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear drive pulley on the exhaust side and remove it.
2. Slacken the four fastening screws and remove the camshaft drive pulley intake side end remove it.

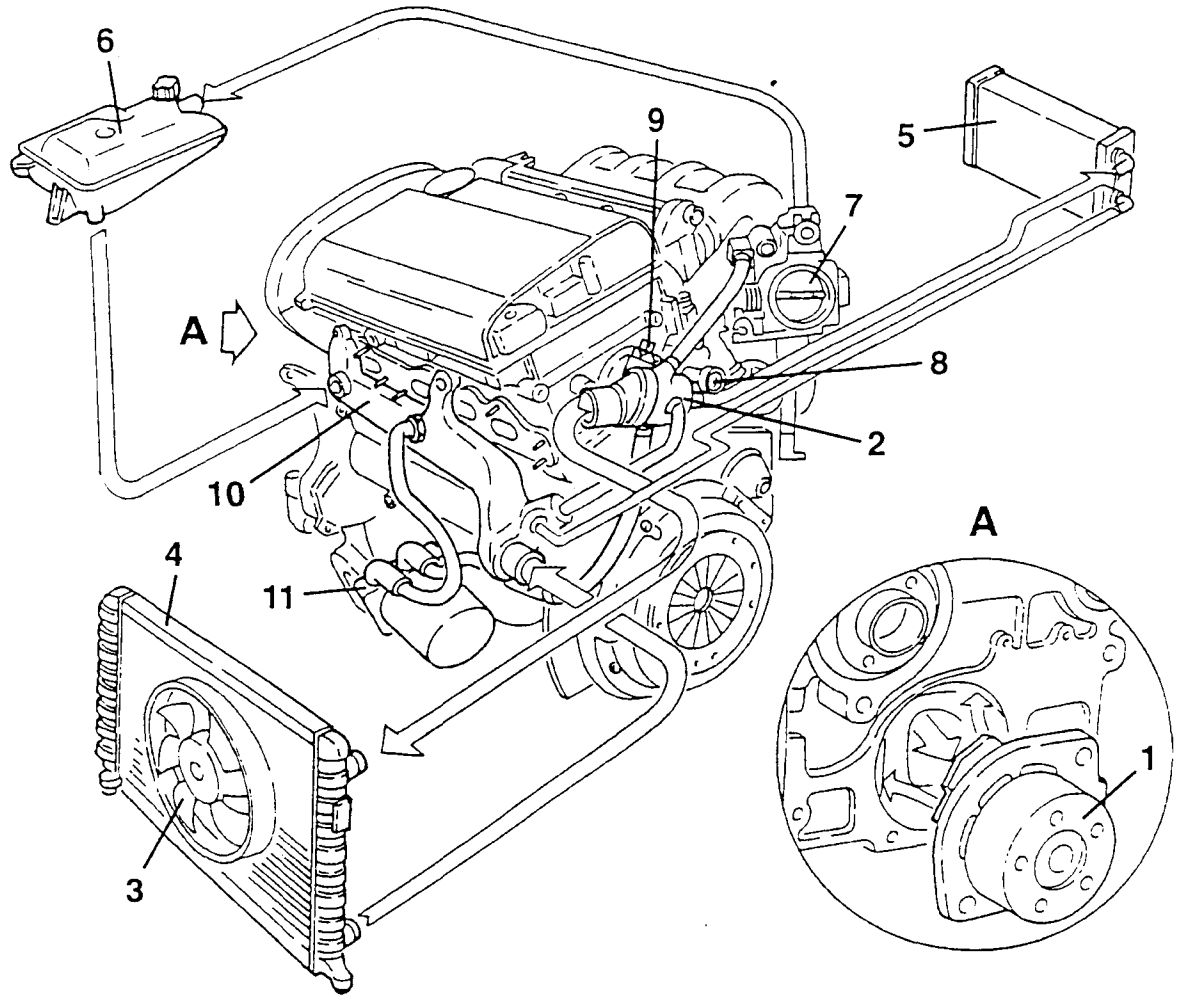


1. Slacken the fastening screws and remove the side guard on the intake side.
2. Disconnect the electrical connection, slacken the two fastening screws and remove the timing sensor complete with support plate.



Refer to GROUP 00 for refitting the timing gear drive belt and timing operations.

DESCRIPTION OF ENGINE COOLING SYSTEM



1. *Water pump*
2. *Thermostatic cup*
3. *Cooling fan*
4. *Radiator*
5. *Climate control heater*
6. *Header tank*
7. *Throttle body*
8. *Coolant fluid temperature gauge transmitter and maximum temperature warning light contact*
9. *Coolant fluid temperature sensor*
10. *Longitudinal manifold*
11. *Coolant fluid - engine oil heat exchanger*

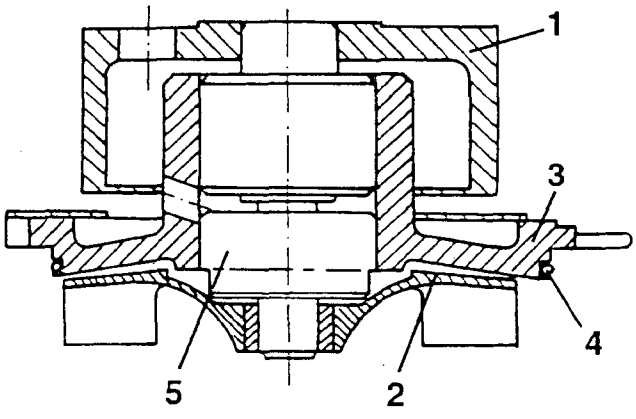
The cooling system is of the sealed type with forced circulation by centrifugal pump (1) located on the cylinder head and controlled by the timing gear belt.
A thermostatic valve (2), on the rear of the cylinder head, keeps the engine at optimum temperatures; it opens when the coolant fluid reaches a temperature of 83 °C.
In addition to the flow of dynamiic air the radiator (4) cools the engine fluid also through a two-speed fan (3) controlled directly by the MOTRONIC control unit, depending on the signal received from the engine coolant temperature sensor (NTC).
(For further details on how the fan works see ELECTRIC- ELECTRONIC DIAGNOSIS - Sect. 26 for versions with air conditioner and Sect. 27 for versions with heater).
The header tank (7) supplies the circuit if the level falls and acts as a lung absorbing the changes in volume of the fluid as the temperature changes; it also vents air from the circuit.
The circuit is fitted with a coolant fluid temperature transmitter for the gauge and a maximum temperature thermal contact (9) for the warning light.

OPERATION OF THE CIRCUIT

After cooling the engine, the fluid passes through the cylinder head to the thermostatising unit.
From here, if its temperature is below 83 °C, it is withdrawn by the pump (1) via a longitudinal coolant fluid return manifold (11) on the lefthand side of the cylinder head.
Converselym if the temperature exceeds this value, it is ducted by the opening of the thermostat towards the radiator (4).
After cooling in the radiator, the fluid returns, again through the longitudinal manifold, to the pump which channels it into the engine.
From the thermostatic cup the coolant fluid is also sent:
- to warm the throttle body (8) from which it flows to the header tank (7) also relieving air from the system;
- to the heater (6) of the climate control system and then return to the longitudinal manifold;
- to the heat exchanger (12) for cooling the engine oil from which it is ducted directly into the longitudinal manifold for coolant fluid return to the pump.
The header tank supplies the engine cooling system via a special connection hose to the longitudinal manifold.

WATER PUMP

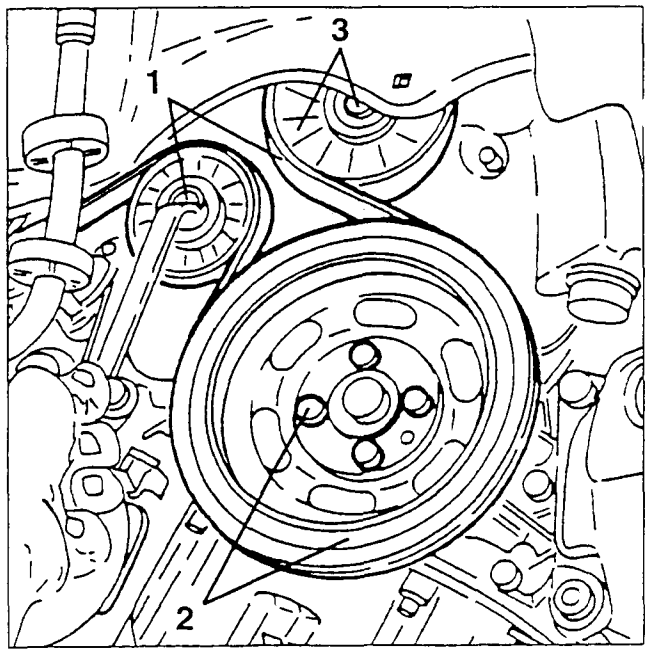
The water pump is of the centrifugal type with blades. It is fastened to the cylinder head and operated through the timing gear belt, by the crankshaft.
An O-Ring ensures tightness between the cylinder head and pump. The water pump operates constantly thereby ensuring the continuous circulation of the coolant fluid.



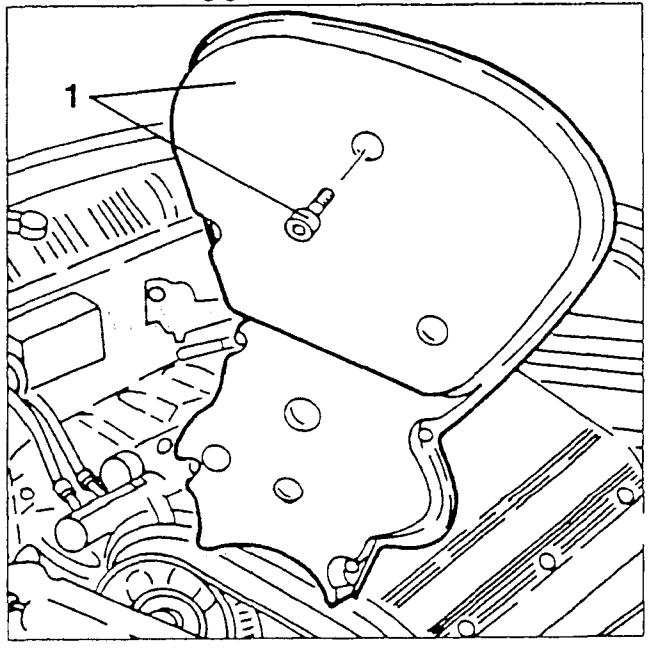
1. Pulley
2. Impeller
3. Pump casing
4. O-Ring
5. Bearing

REMOVING/REFITTING
(For engines without counter-rotating shafts)

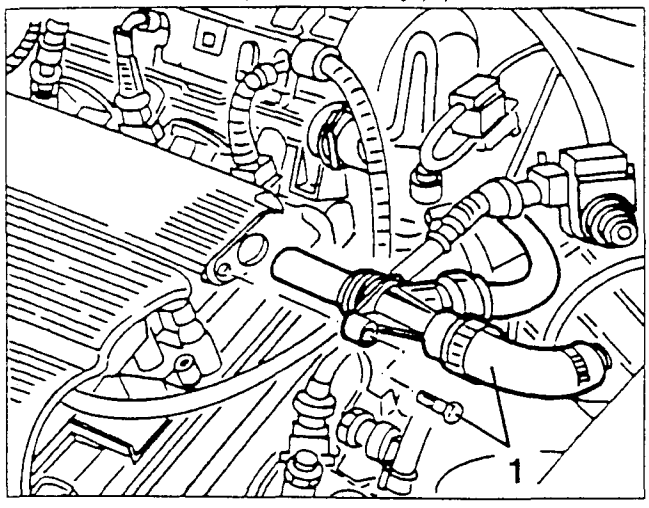
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the engine coolant fluid (see specific paragraph).
- Slacken the screws and move aside the header tank without disconnecting the hoses.
1. Raise the car and working as illustrated on the belt tensioner, loosen the tensione of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.
3. Slacken the fastening screw and remove the auxiliary components drive belt guide.



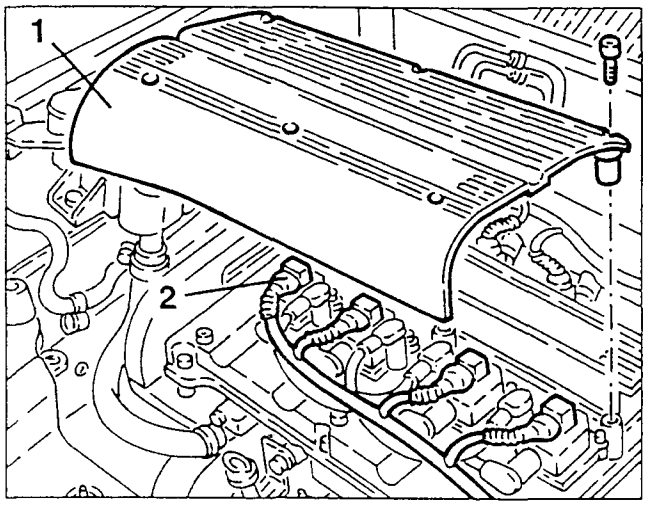
- Slacken the lower screws fastening the timing gear drive belt guard.
1. Lower the car, slacken the remaining screws and remove the timing gear drive belt guard.



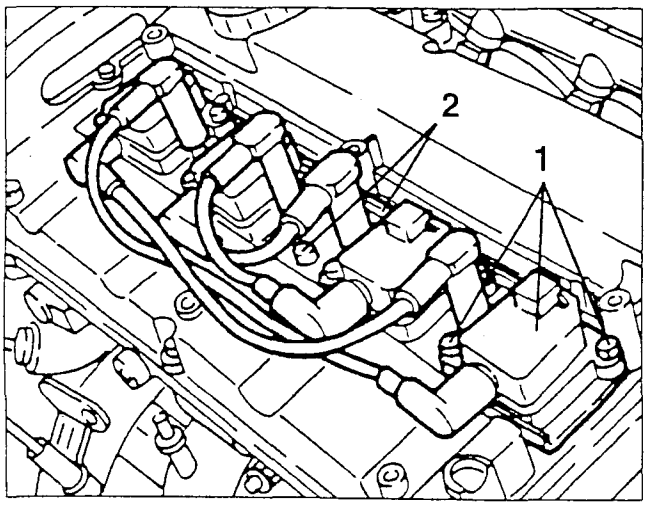
1. Slacken the fastening screw and withdraw the socket for the oil vapour recovery pipes.



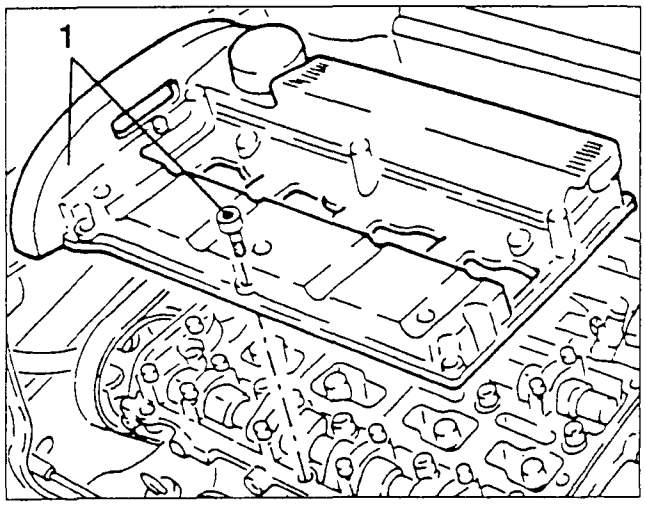
1. Slacken the fastening screws and remove the ignition coil cover.
2. Disconnect the electrical connections from the ignition coils.



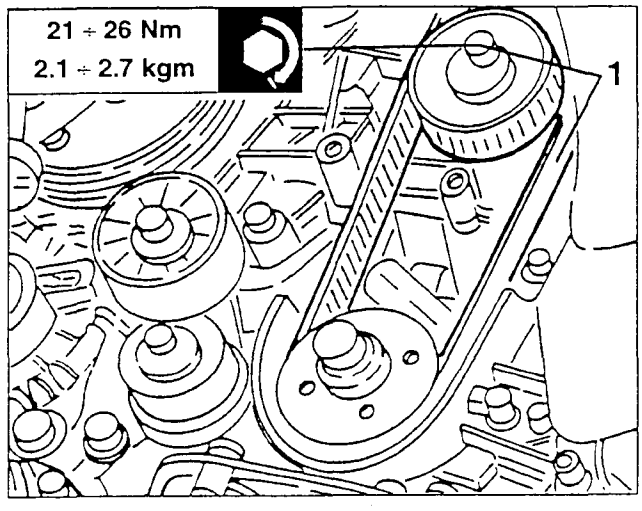
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coil support bracket.



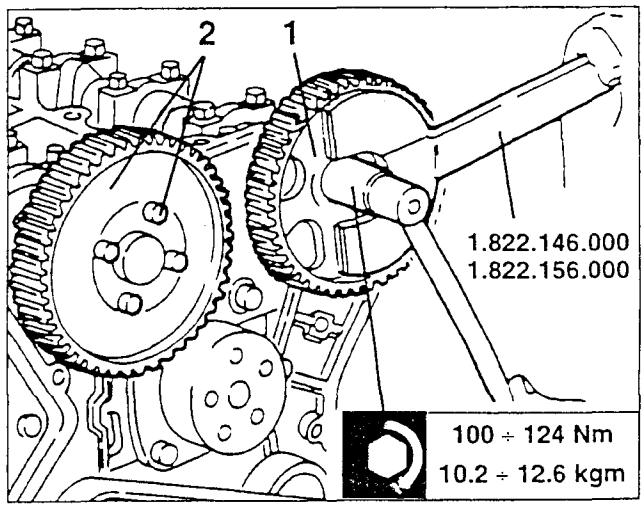
1. Slacken the fastening screws and remove the cylinder head cover complete with seal.



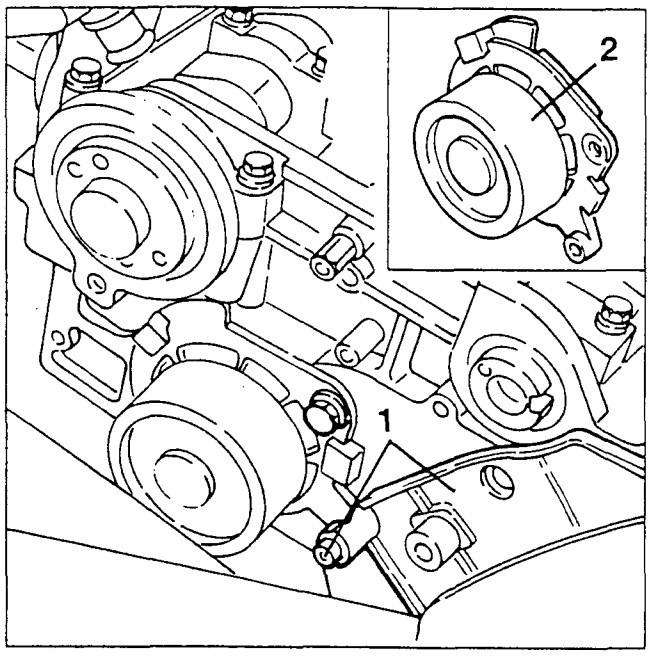
1. Working on the timing gear belt tensioner, loosen the tension of the belt, then remove it from the timing gear drive pulleys.



1. Using tools no. 1.822.146.000 and no. 1.822.156.000, slacken the screw fastening the camshaft drive pulley on the exhaust side and remove it.
2. Slacken the four screws and remove the intake side camshaft drive pulley.



1. Slacken the fastening screws and remove the exhaust side protection.
2. Slacken the two fastening screws and remove the water pump complete with O-Ring.



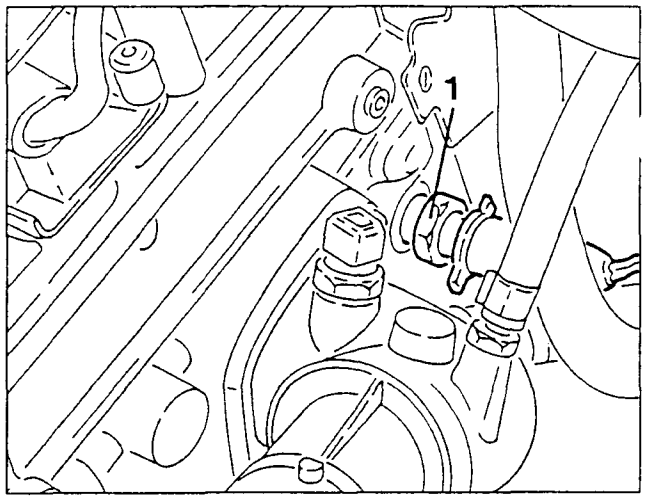
- Refit reversing the sequence followed for removal.

For reassembly of the camshaft drive belt and timing see GROUP 00.

COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Disconnect the electrical connection from the coolant fluid temperature sensor (NTC).
1. Disconnect the electrical connection from the coolant fluid temperature gauge transmitter and maximum temperature warning light contact, then remove it and collect the coolant fluid that comes out.



CHECKS AND INSPECTIONS

Check the transmitter setting referring to the wiring diagram (see "Electric System Diagnosis").

Temperature (°C)	Resistance (Ω)
60 (test fluid water)	470 ÷ 600
90 (test fluid water)	160 ÷ 230
120 (test fluid glycerine)	73 ÷ 93

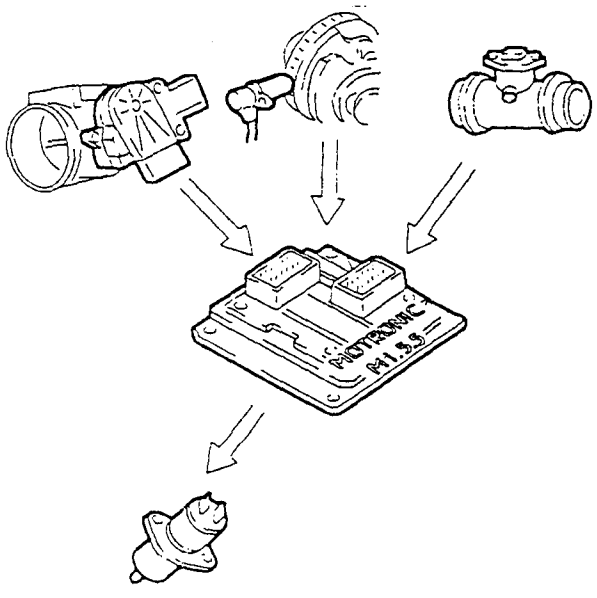
Contacts closing temperature	120 ± 2 °C
Contacts opening temperature	108 ± 2 °C

GENERAL DESCRIPTION

Refer to the instructions given for the **1747 T.S. 16V** and **1970 T.S. 16V** engines but bearing in mind that the system is not fitted with the variable geometry intake box and the associated components.
Therefore, the operating logic for "Timing variator and modular intake manifold control" is as described below.

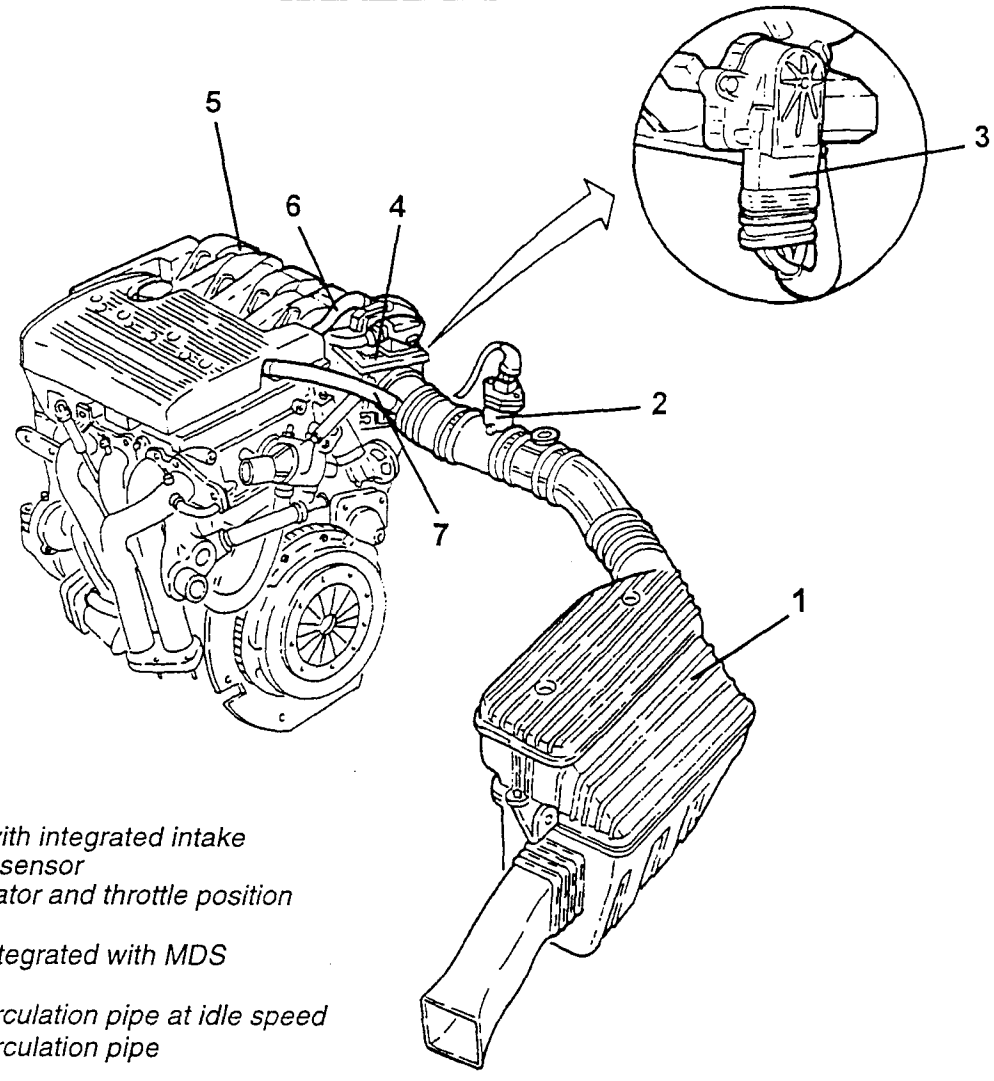
Timing variator control

In order to optimise the amount of air taken in by the engine the control unit controls intake timing on two angular positions.
At maximum torque the control units sets the "open" phase with the cam advance by 25° of the engine.
At full power and at idle speed, the control unit sets the "closed" phase with the cam in the normal position.
In the other engine operating conditions, the control unit chooses the most suitable configuration to optimise performance, consumption and emission rates.



For all the other operating logics, refer to the instructions for the **1747 T.S. 16V** and **1970 T.S. 16V** engines.

DESCRIPTION OF AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM



1. Air cleaner
2. Air flow meter with integrated intake air temperature sensor
3. Idle speed actuator and throttle position sensor (MDS)
4. Throttle body integrated with MDS
5. Intake manifold
6. Oil vapour re-circulation pipe at idle speed
7. Oil vapour re-circulation pipe

The air, taken in through a dynamic inlet and filtered by a cartridge element (1), through the corrugated sleeve on which the hot film air flow meter (2) with integrated intake air temperature sensor is fitted, reaches the throttle body integrated with MDS.
The latter, controlled by the accelerator cable, adjusts the amount of air in the intake manifold.
The throttle body integrates the idle speed actuator and throttle position sensor which are controlled directly by the injection control unit.
The fuel vapours (see specific paragraph) and oil vapours flow to the air supply system.
The oil vapours are developed when the engine is running and gather in the cylinder head from where the condensed oil falls back into the crankcase, while the remaining vapours are sent to the intake through two pipes.
When the engine is running at idle speed, the oil vapours are ducted to the throttle body through the special pipe (8). At higher loads, the vapours are sent upstream of the throttle valve through a connection pipe (9) to the corrugated sleeve and are then burnt in the engine.

INTAKE MANIFOLD

The intake manifold is made of plastic and differs from the one fitted on the **1747 T.S. 16V** and **1970 T.S. 16V** engines only in the fact that it does not have the control of the manifolds with variable geometry.

REMOVAL/REFITTING

Refer to the instructions given for the **1747 T.S. 16V** and **1970 T.S. 16V** engines, with the following differences:
- do not disconnect the electrical connection of the modular intake manifold control actuator (not present)
- do not remove the front section of the exhaust pipe and manifold support bracket (not present)
- free the cables from the clamp under the intake manifold during removal.

GENERAL DESCRIPTION

Bosch Motronic M1.5.5 is an electronic system with the following integrated functions:
- induced discharge digital electronic ignition
- static distribution
- timed sequenced electronic injection (1 - 3 - 4 - 2).

When the engine is idling, the unit controls:
- the instant of ignition
- the air intake

thus ensuring the engine is running regularly regardless of the environment conditions or applied loads.
The control unit handles injection ensuring that the stoichiometric ratio (i.e. air/fuel ratio) is constantly optimal.
The system functions are, essentially, the following:
- injection timing
- spark advance control
- cold start control
- acceleration enrichment control
- release phase fuel cut-off
- idling control and handling
- maximum rev limitation
- exhaust control - lambda sensor
- cylinder position acknowledgement
- fuel fume re-circulation
- air conditioner connection (where fitted)
- Alfa Romeo CODE (Immobilizer) ECU connection
- system self-adjustment
- self-test
- cooler fan control.

INJECTION SYSTEM

The essential air-fuel mixing conditions for the correct operation of controlled ignition engines are:
- the air/fuel ratio must be appropriately "dosed" and kept as close as possible to the stoichiometric value to ensure fast combustion and avoid unnecessary fuel consumption
- the mix must be "homogenous" i.e. must consist of petrol fumes spread as finely and evenly as possible in the air.

For optimal dosing, the ECU processes electric signals transmitted from:
- the intake air flow meter with integrated temperature sensor, signalling the exact amount of intake air
- the rev sensor, which generates an alternating single phase signal indicating the engine revolution frequency
- the throttle position potentiometer (integrated in the constant idle actuator), indicating minimum, partial and full loads
- the lambda sensor, defining the amount of oxygen contained in the exhaust gas.

IGNITION SYSTEM

This is a static inductive discharge ignition system (i.e. without high voltage distributor) with power modules located inside the injection ECU.
The system consists of a signal coil for each for each spark plug (MONO-COIL). The advantages of this solution are:
- lower electric overload;
- constant discharge on each spark plug.

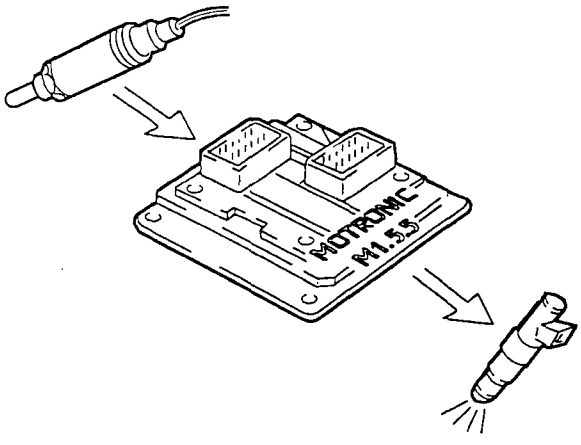
A map, containing the sequence of optimal spark advance values (for cylinder in explosion stroke) that the engine can adopt according to the required ratio or load, is stored in the ECU memory.
The ECU corrects the spark advance mainly on the basis of the following information:
- engine coolant temperature
- inlet air temperature
- knock
- throttle position.

The ECU processes the electric signals from the following devices and pilots the mono-coil:
- the intake air flow meter with integrated temperature sensor, signalling the exact amount of intake air
- the rev sensor, which generates an alternating single phase signal indicating the engine revolution frequency
- knock sensor (on the rear part of the crankcase between cylinders 2° and 3°) to acknowledge which cylinder is exploding and consequently correct spark advance
- the throttle position potentiometer (integrated in the constant idle actuator), indicating minimum, partial and full loads.

INJECTION SYSTEM OPERATING LOGIC

System self-adjustment

The ECU is equipped with a self-adjusting function with the purpose of acknowledging changes due to time and ageing in the engine and in its components. These changes are saved in the ECU memory as modifications to the basic map.
The purpose is to adjust the system operation to the progressive alterations of the engine and the engine components with respect to new units.
The self-adjustment function also compensates for the inevitable diversity between spare parts (due to manufacturing tolerance rates) which may be changed in time.
The exhaust gas analysis ECU changes the basic map with respect to new engines.
The self-adapting parameters are not deleted when the battery is disconnected.

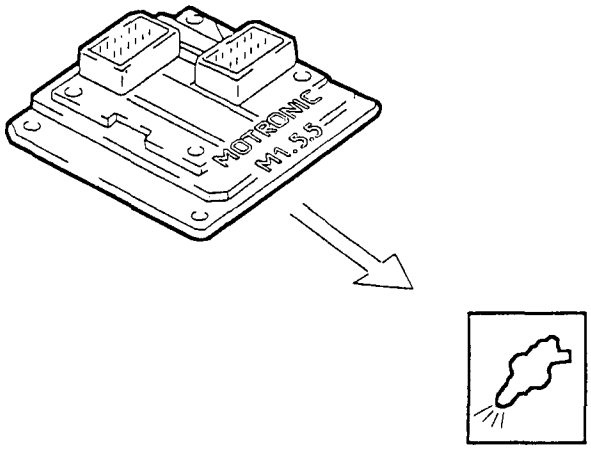


Self-test

The ECU self-test function checks the signals from each sensor and compares them to the thresholds:
- faults signalled during ignition
  - warning light on for 4 seconds indicates the test is being run
  - warning light off after 4 seconds indicates there are no faulty components which could alter pollution parameters
  - warning light on after 4 seconds indicates there is a fault.

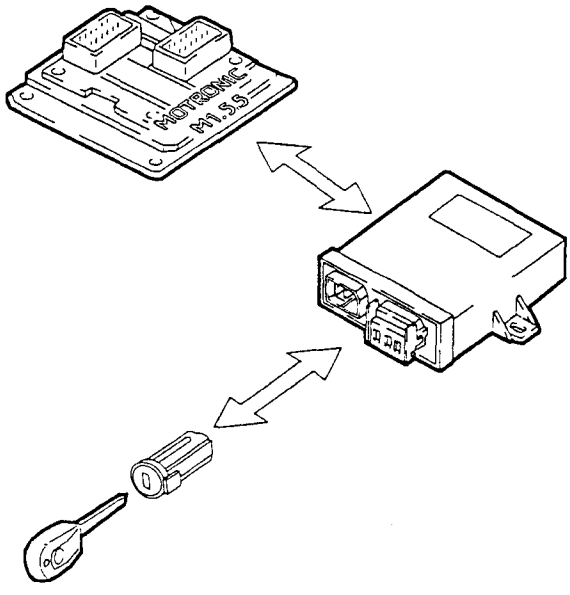
- faults signalled during operation
  - warning light on indicates a fault
  - warning light off indicates there are no faulty components which could alter pollution parameters.

- recovery
  - the ECU defines the type of recovery according to the faulty component
  - recovery parameters are not handled by faulty components.



Alfa Romeo CODE acknowledgement

When the ECU receives a signal indicating the ignition key is turned to "MAR", it dialogues with the Alfa Romeo CODE ECU and enables engine ignition.
The communication is performed along a two-way dedicated diagnostic serial line connecting the two ECU's.

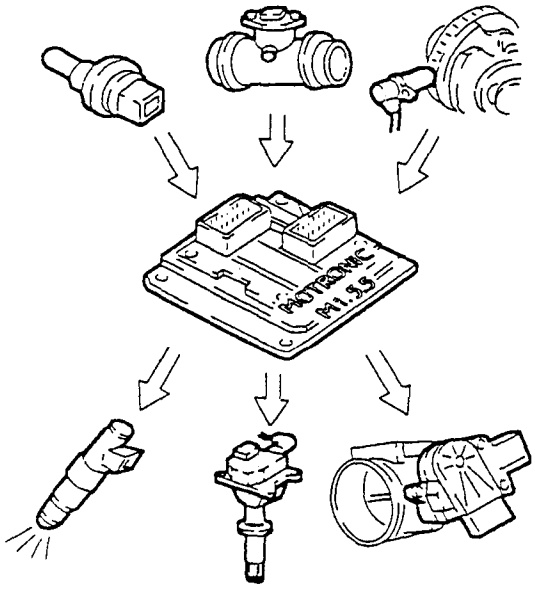


Cold starting control

Under cold starting conditions the following occur:
- natural impoverishment of the mixture (due to poor swirl of the fuel particles at low temperature)
- low fuel evaporation
- condensation of the fuel on the inner walls of the intake manifold
- higher viscosity of the lubricating oil.

The control unit detects this condition and corrects the injection time on the basis of the:
- coolant fluid temperature
- intake air temperature
- battery voltage
- engine rpm.

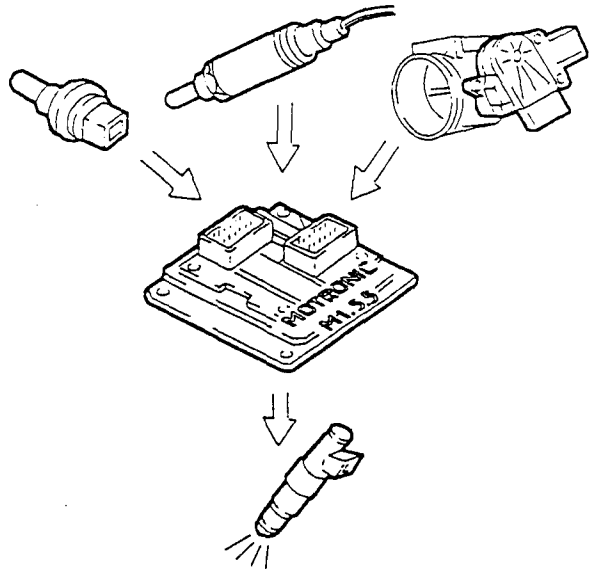
The spark advance depends only on the rpm and on the engine coolant fluid temperature.
During starting the control unit commands a first, simultaneous injection for all the injectors (full-group injection) and, after detecting the stroke of the cylinders, it starts normal, timed, sequential operation.
During the engine warming phase, the control unit governs the idle speed actuator to adjust the amount of air needed to ensure the engine self-supporting speed.
The rotation speed is decreased proportionately with the increasing engine temperature until obtaining the nominal rating when the engine reaches normal operating temperature.



Combustion control - lambda sensor

With the engine in the following conditions:
- idle speed
- medium load
- temperature > 30°C

with a special integrator, the control unit processes the lambda sensor signal and determines the injector opening time.



Timing variator control and modular intake manifold

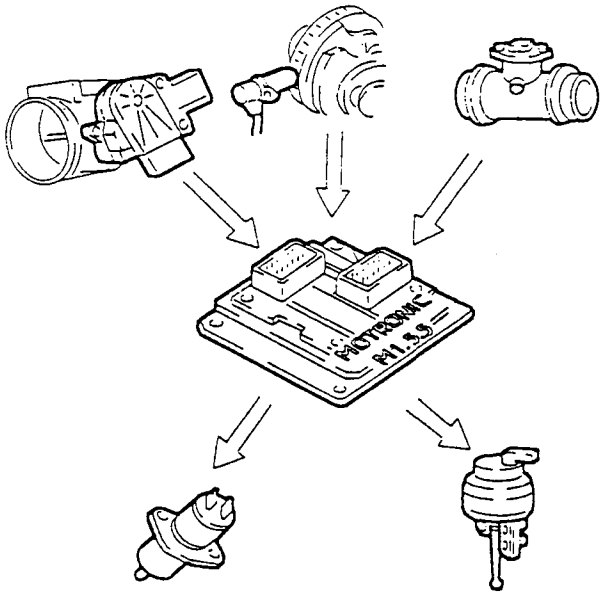
To optimise the amount of air taken in by the engine, the control unit controls:
- intake timing on two angular positions
- the geometry of the intake manifolds on two lengths.

At maximum torque the control unit sets the "open" phase:
- cam advanced by 25° of the engine
- intake box long manifolds.

At full power the control unit sets the "closed" phase:
- cam in normal position
- intake box short manifolds.

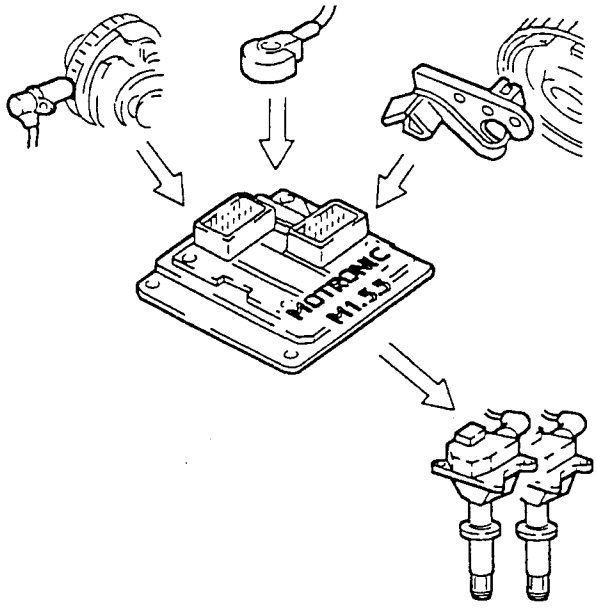
At idle speed the control unit sets the "closed" phase:
- cam in normal position
- intake box short manifolds.

In the other engine operating conditions, the control unit chooses the most suitable configuration to optimise performance - consumption - emissions.
During deceleration the box intake ducts are alwasy "short".



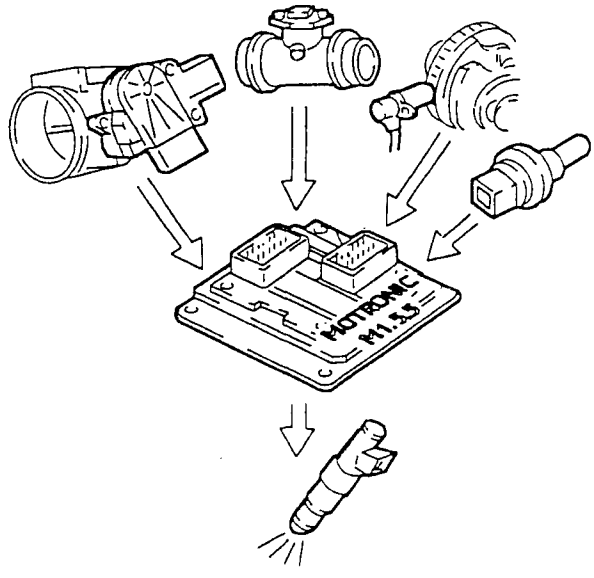
Pinging control

The control unit detects the presence of pinging by processing the signal leading from the corresponding sensor. The control unit continuously compares he signals from the sensor with a threshold value, which is in turn continuously updated, to take account of the engine background noise and engine ageing.
This way the control unit is able to detect the presence of pinging, (or incipient pinging) and reduces the spark advance (in steps of 3° up to a maximum of 6°) until pinging ceases.
The advance is then gradually restored to the base value (in 0.8° steps).
During acceleration, a higher threshold is used to take account of the higher engine noise in this condition.
The pinging control logic also has a self-adapting function which any continuously repeated advance reductions in order to adapt the map to the different engine conditions.



Enrichment control during acceleration

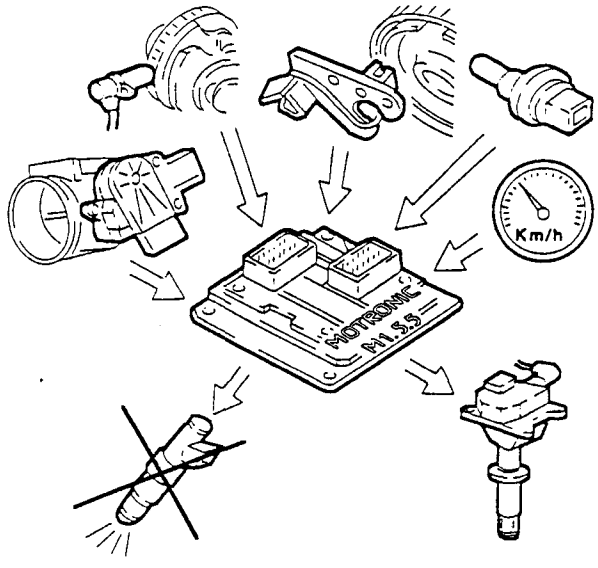
If during the request for acceleration the change in the air flow meter signal exceeds a pre-defined threshold, the control unit increases injection (injection time) to rapidly reach the required engine speed.
Recovery:
- the control unit replaces the signal leading from the faulty air flow meter with the throttle potentiometer signal.



Fuel cut-off during release

When the accelerator pedal is released and the engine rating exceeds a specific pre-set value, the ECU:
- cuts off injector power
- returns power to the injectors at 1300 ÷ 1500 rpm.

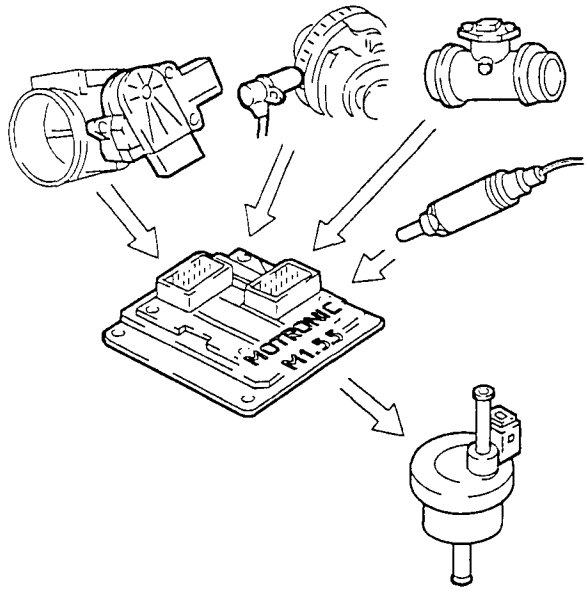
When the throttle is closed and the engine rating is 1700 rpm, the ECU inhibits injector opening.
Without fuel supply, the rating decreases more or less rapidly according to the vehicle running conditions.
Before idle rating is reached, the revolution decrease is checked.
If rating is higher than a pre-set value, fuel supply is partially reactivated to take the engine to idle rating "smoothly".
The fuel supply and fuel cut-off thresholds vary according to the following:
- engine coolant temperature
- vehicle speed
- rpm.



Fuel fume re-circulation

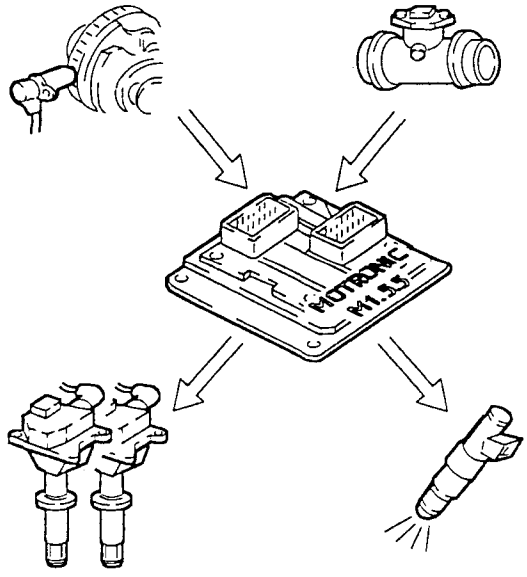
Fuel fumes (pollutants) are collected in an active carbon filter (canister) and sent through the intake manifolds to be burnt.
This is controlled by means of a solenoid valve controlled by the ECU only when engine running conditions allow.

The ECU, in fact, compensates the amount of supplementary fuel by reducing feed to the injectors.



Maximum revolution limiter

According to the following engine ratings:
- over 6800 rpm the ECU reduces injection time
- over 7000 rpm the ECU cuts injector feeding
- under 6800 rpm the ECU pilots the injectors again.

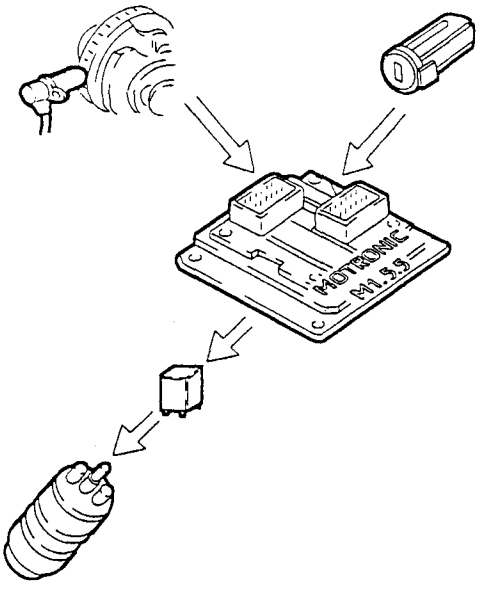


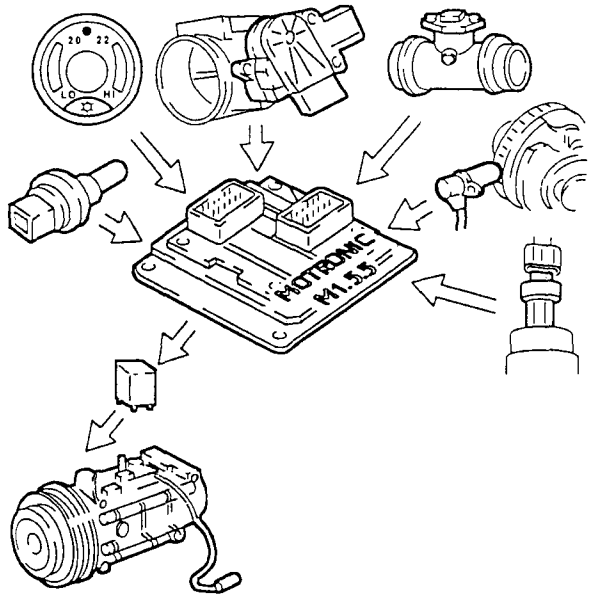
Fuel pump supply control

The ECU operates the fuel pump:
- for 0.8 seconds when the key turned to MAR
- when the key turned to AVV and engine rating is > 22.8 rpm.

The ECU cuts power to the pump:
- when the key turned to STOP
- when the engine rating is < 22.8 rpm.

The "no return" fuel supply system has a constant petrol pressure of 3.5 bars.

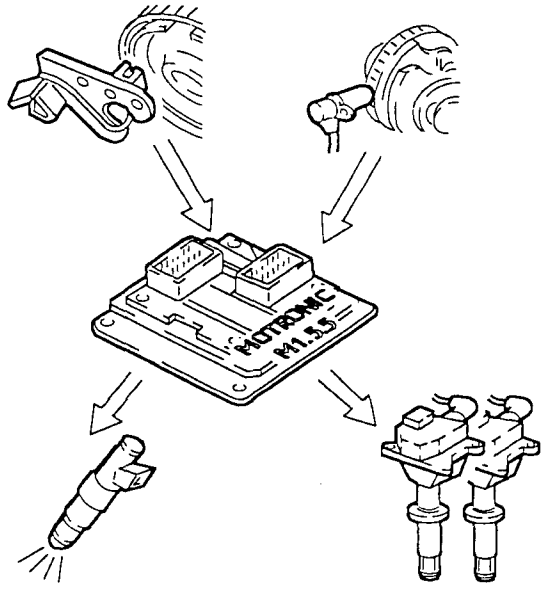




Cylinder position acknowledgement

During each engine cycle, the ECU acknowledges the cylinder in explosion stoke:
- it controls the injection and ignition sequence to the correct cylinder.

With no timing sensor signal, the ECU:
- deactivates the knock sensor
- if the vehicle is moving, it keeps timed injection
- if the vehicle is standing, it controls a simultaneous operation of cylinders 1-4 and 2-3.



Climate control system connection

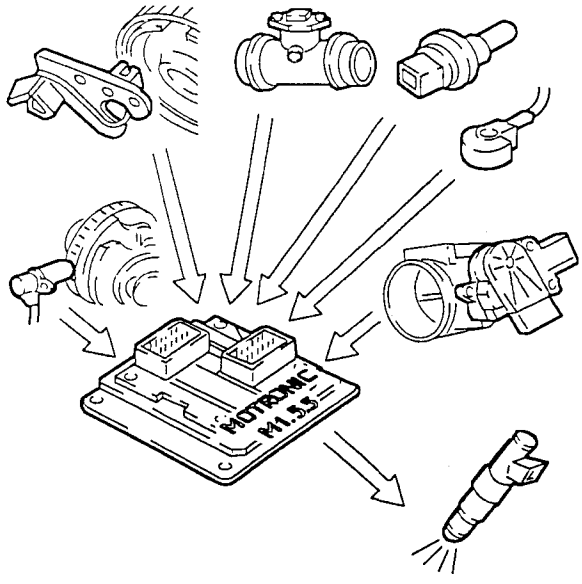
When the compressor is started and power demand is increased, the ECU pilots the idling actuator to increase air intake.

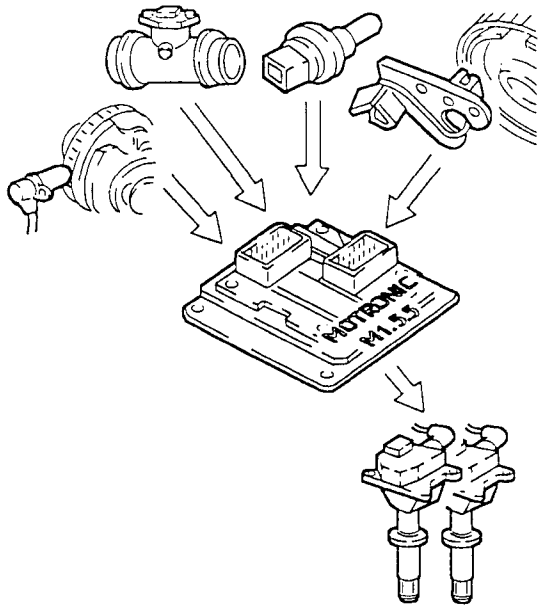
When the demand for power is high, the ECU temporarily cuts off power supply to the compressor as follows:
- over 6500 rpm, power to the compressor is cut off
- engine temperature > 112°C power to the compressor is cut off.

Injection time control

The ECU controls the injection opening time with extreme speed and accuracy according to the following:
- engine load (rpm and air intake)
- battery voltage
- engine coolant temperature.

Injection is sequential and timed for each cylinder.
"Injection start" is optimised.
"Injection end" is constant.





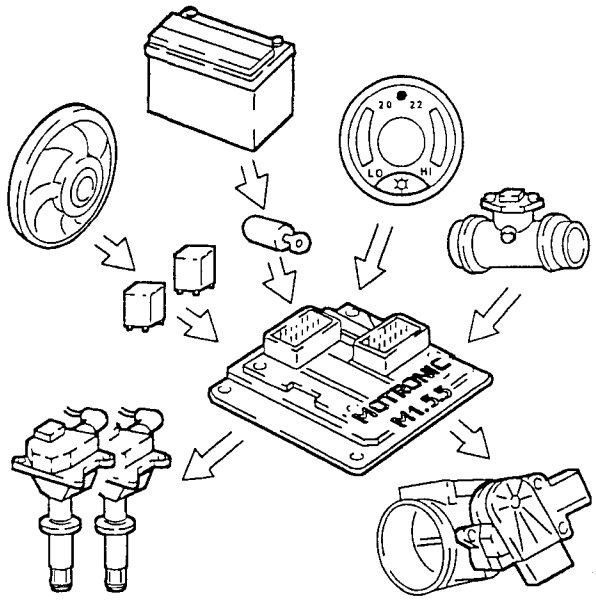
Spark advance

The ECU can compute, thanks to a map saved in its memory, spark advance on the basis of the following:
- engine load (minimum, partial, full, according to rpm and air intake)
- inlet air temperature
-engine coolant temperature.

Spark can be postponed only on the cylinder requiring it which is recognised be means of the values registered by the rev and timing sensors.

Idle control/handling

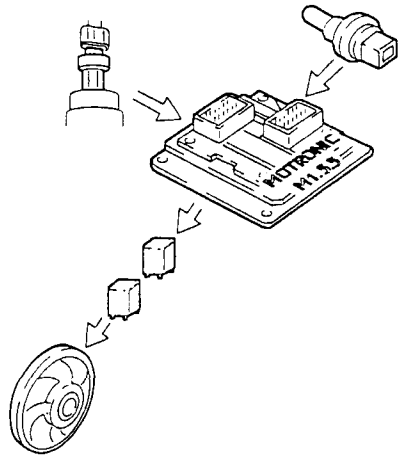
Idle status is acknowledged by the ECU via the potentiometer integrated in the idle actuator located on the throttle (valve axis).
The ECU controls idling ratio (850 ± 30 rpm) according to the devices in use by:
- changing spark advance
- piloting the throttle position (0° ÷ 15°), by means of the idling actuator, to control air intake.



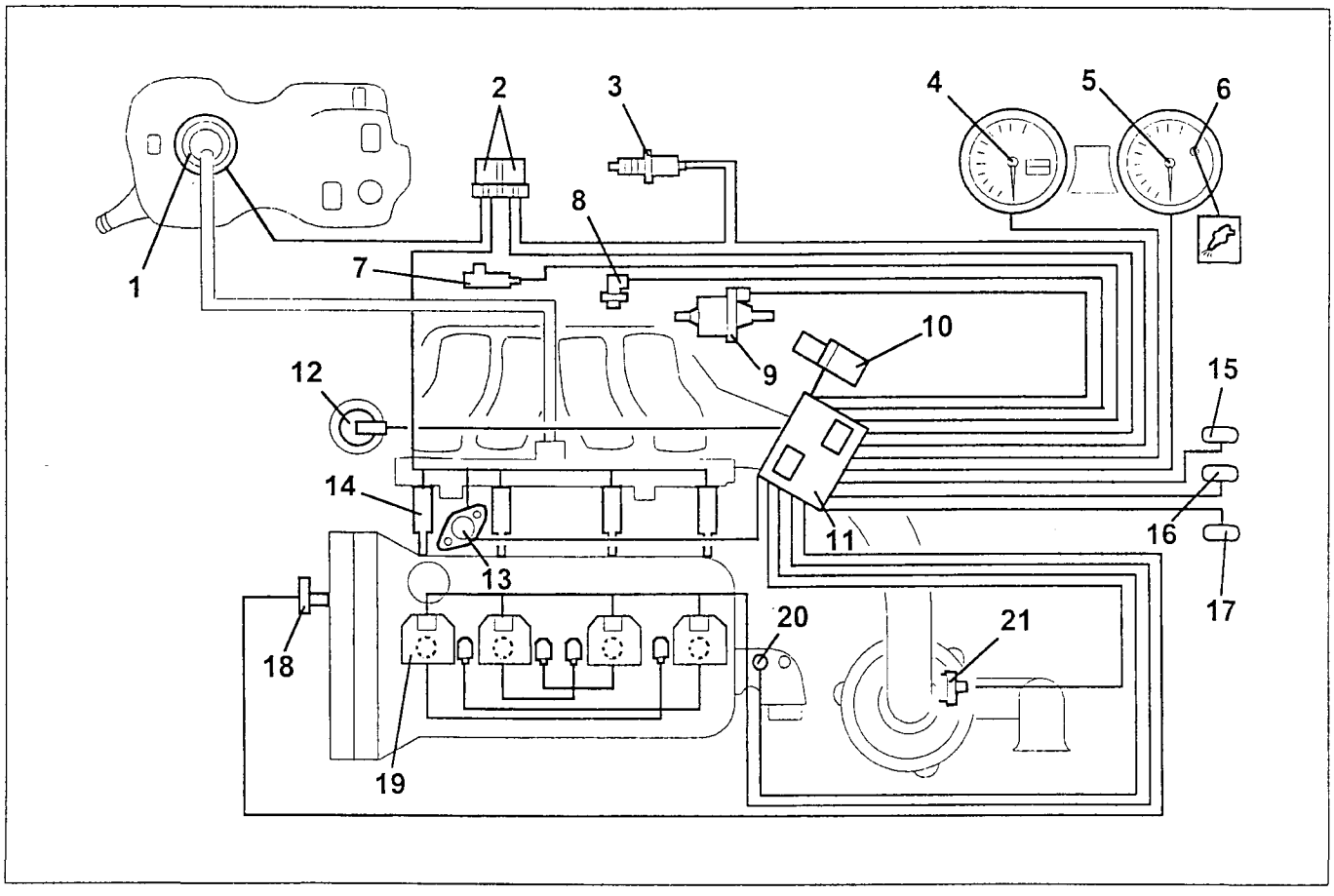
Radiator cooling fan

According the coolant temperature, the ECU controls the fan:
- 1st speed at 98°C
- 2nd speed at 101°C

An additional check (quadrinary signal), starts the fan at the 1st or 2nd speed according to the cooling gas pressure when the climate control system is on.
If no coolant temperature signal is received, the ECU runs a recovery function and operates the fan at 2nd speed until the error is solved.

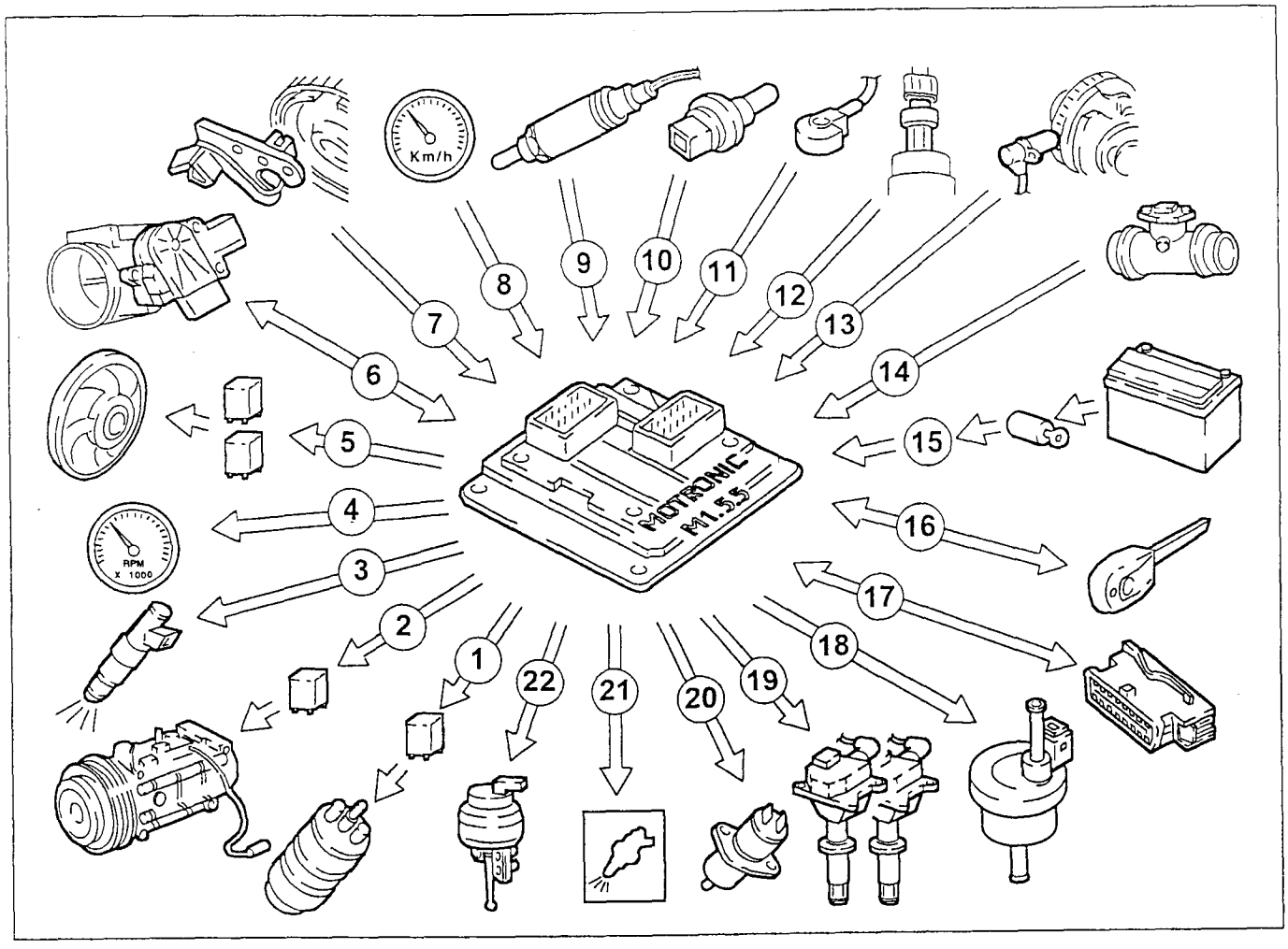


M1.5.5 IGNITION - INJECTION SYSTEM COMPONENTS



1. *Fuel pump*
2. *Relays*
3. *Lambda sensor*
4. *Speedometer*
5. *Rev counter*
6. *Check Engine warning light*
7. *Knock sensor*
8. *Rev sensor*
9. *Fuel fume re-circulation solenoid valve*
10. *Throttle position sensor (MDS) and idling actuator*
11. *Injection-ignition ECU*
12. *Modular intake manifold solenoid valve*
13. *Timing variator*
14. *Injectors*
15. *Climate control connector*
16. *Diagnostic connector*
17. *Alfa Romeo CODE connector*
18. *Timing sensor*
19. *Ignition coils*
20. *Engine coolant temperature sensor*
21. *Air flow meter with integrated air temperature sensor*

M1.5.5 IGNITION - INJECTION SYSTEM COMPONENTS

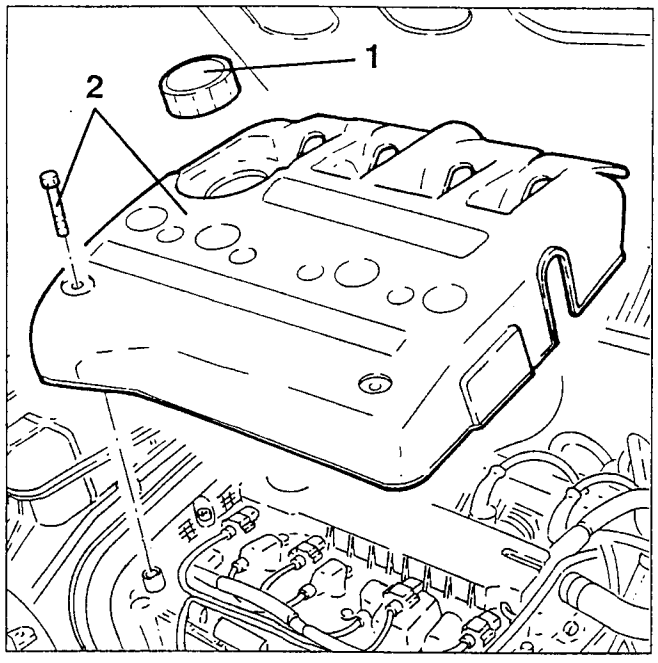


1. *Fuel pump*
2. *Air conditioner compressor*
3. *Injectors*
4. *Rev counter*
5. *Fan*
6. *Throttle position sensor (MDS) and idling actuator*
7. *Timing sensor*
8. *Speedometer*
9. *Lambda sensor*
10. *Engine coolant temperature sensor*
11. *Knock sensor*
12. *Quadrinary*
13. *Rev sensor*
14. *Air flow meter with integrated air temperature sensor*
15. *Battery*
16. *Alfa Romeo CODE*
17. *Diagnostic socket*
18. *Fuel fume re-circulation solenoid valve*
19. *Ignition coils*
20. *Timing variator*
21. *Check Engine warning light*
22. *Modular intake manifold solenoid valve*

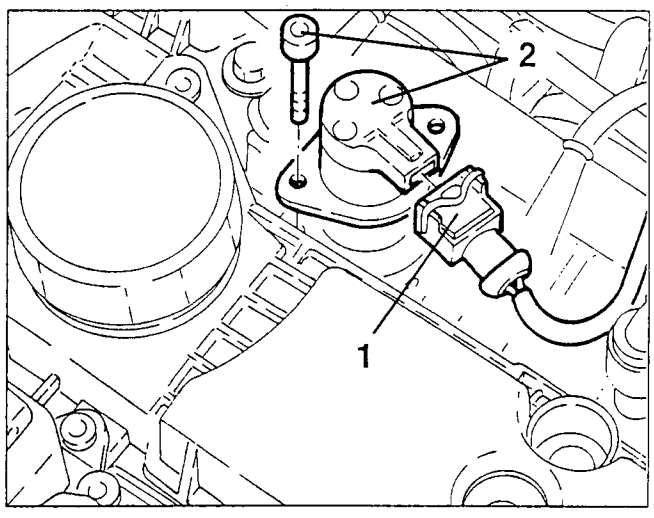
TIMING VARIATOR ELECTROMAGNET

REMOVAL/REFITTING

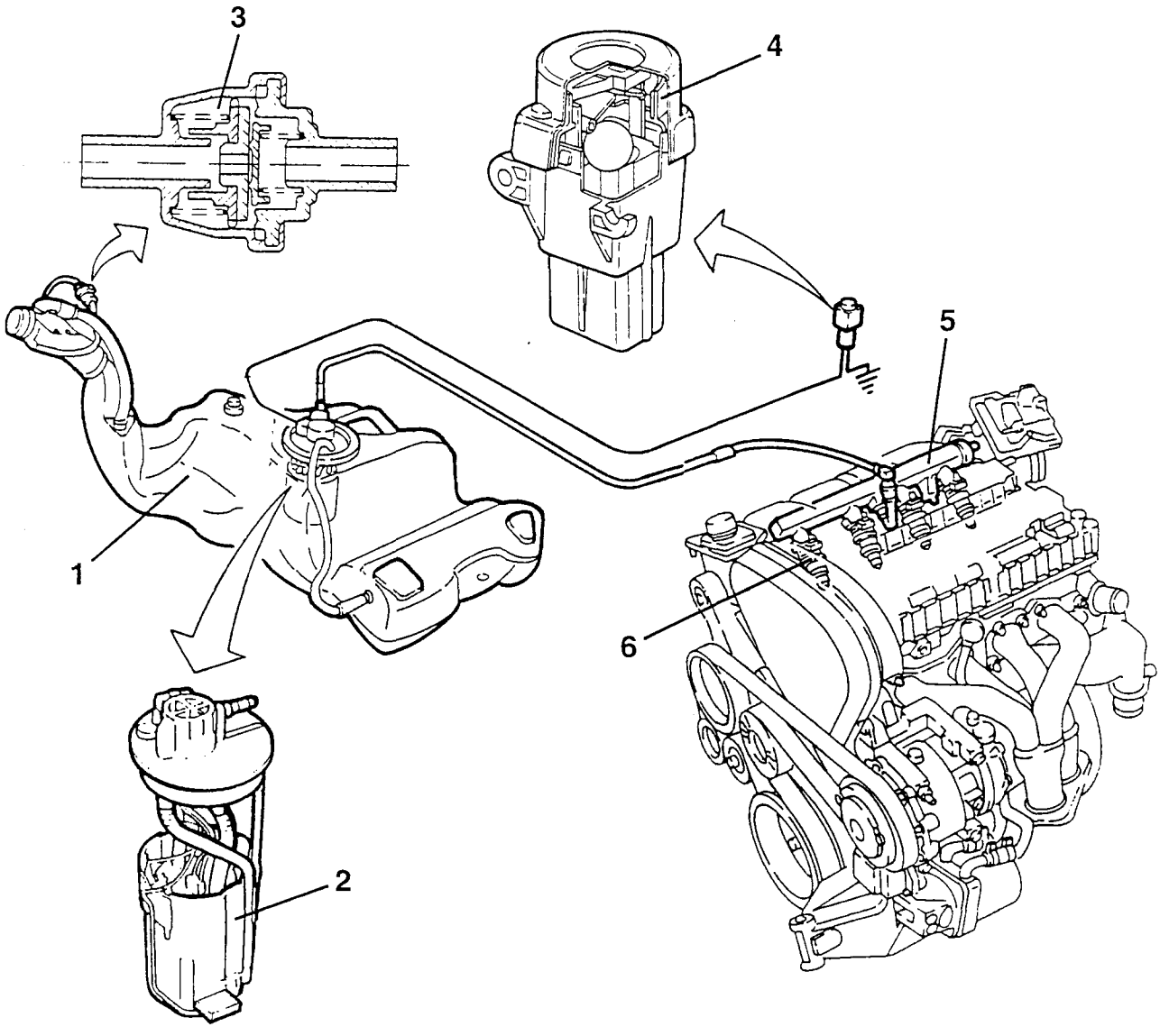
- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.



- Refit the engine oil filler cap.
1. Reconnect the electric connection from the timing variator electromagnet.
2. Remove the electromagnet fastening screws and remove the electromagnet.



FUEL FEEDING SYSTEM DESCRIPTION



1. *Fuel tank*
2. *Submerged pump unit and level gauge*
3. *Safety valve*
4. *Inertial switch*
5. *Distribution manifold*
6. *Injectors*

This is a return-less fuel feeding system, i.e. with a single pipe connecting the fuel pump and the engine. This allows:
- to reduce the risk of fire in the event of an accident
- to reduce fuel fume emission in the atmosphere.

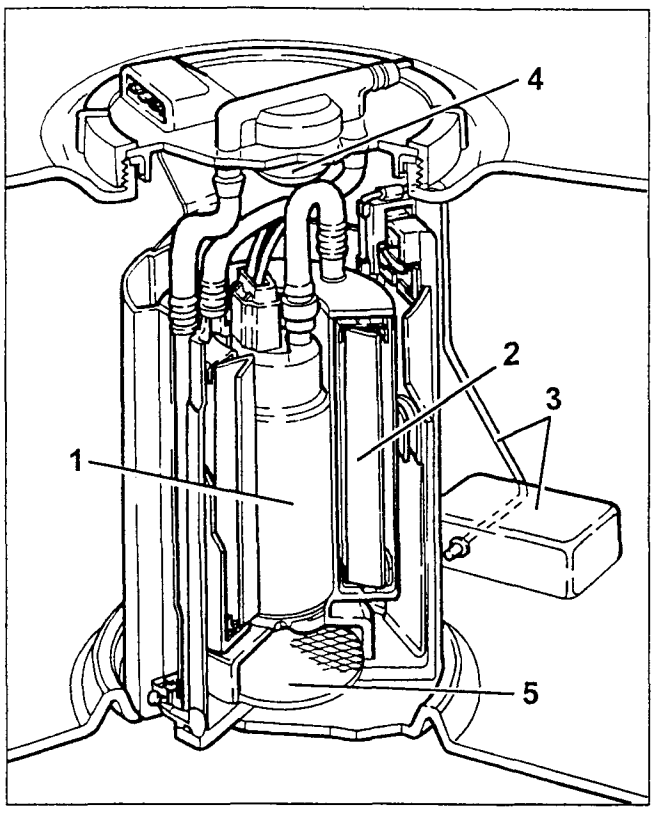
The fuel tank located under the body (boot) is made of high mechanical resistance plastic.

The pump is included in a rack which also contains:
- the fuel pressure regulator
- the fuel level gauge
- the fuel filter.

The system is equipped with an inertia switch which cuts off the fuel pump in the event of an accident.

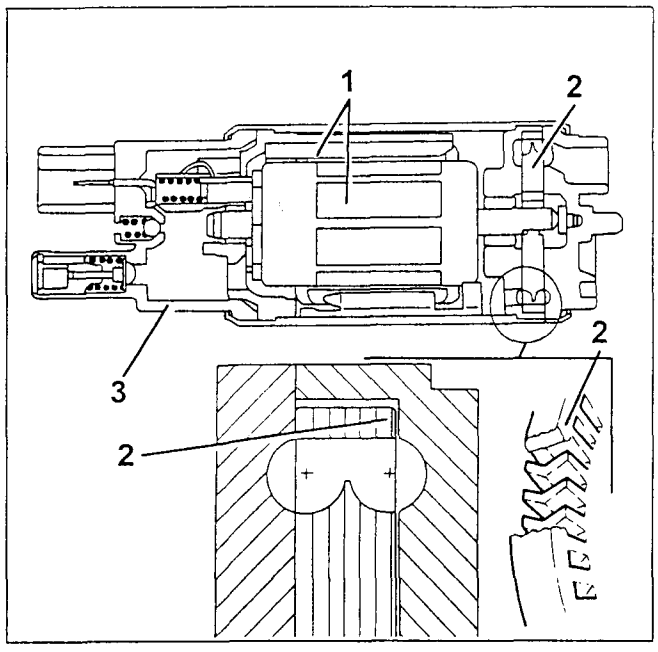
SUBMERGED PUMP UNIT AND LEVEL GAUGE

This unit essentially consists of:
- a fuel pump (1)
- a fuel filter (2)
- a floating level gauge (3)
- a membrane pressure regulator (4)
- a net pre-filter (5).



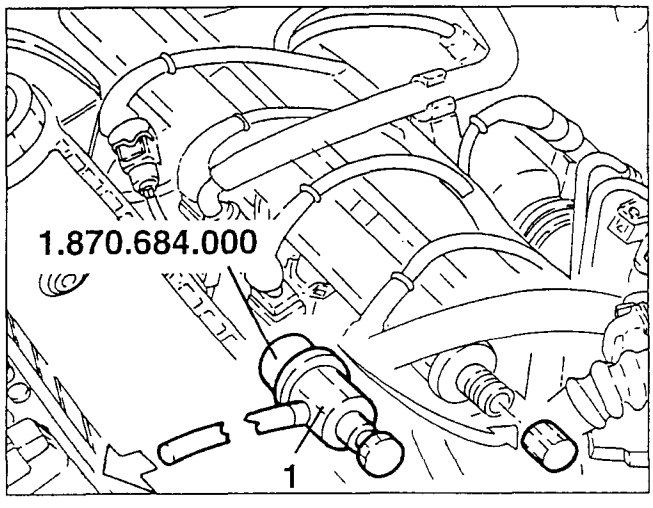
Fuel pump EKP 13.5

The fuel pump is equipped with a permanent magnet electric motor (1) which controls the pump impeller (2) and a terminal support cover (3) containing the electric and hydraulic connections.
This is a single stage, peripheral flow pump suited to operate in conditions of low voltage and temperature.
The advantages of this type of pump with respect to volumetric pumps are:
- reduced weight
- reduced size.



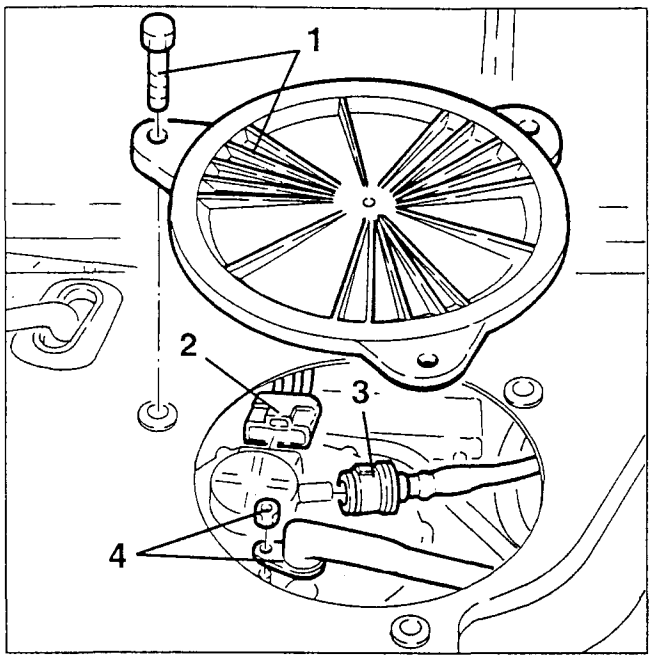
REMOVAL/REFITTING

- Disconnect the (-) battery terminal.
1. Connect tool No. 1.870.684.000 to the distribution manifold bleeder valve and discharge the fuel pressure.

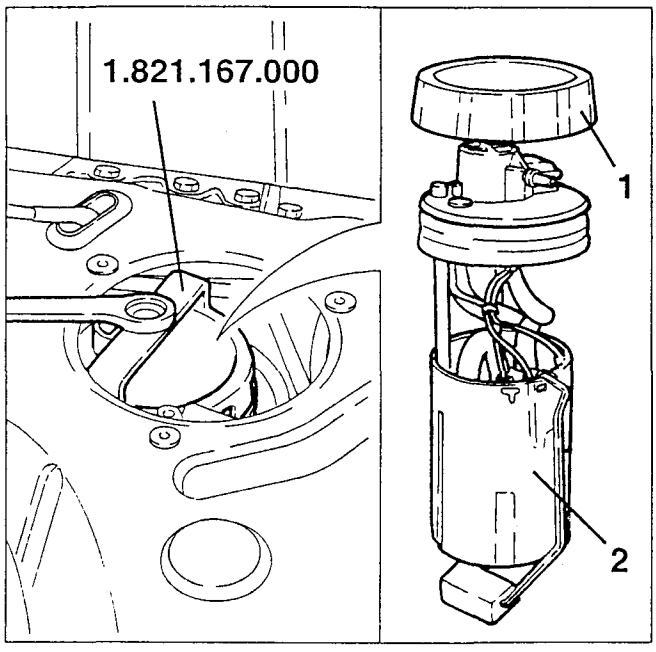


- Tilt the rear seat back forward.
- Lift the boot carpeting.
1. Remove the fastening screws and remove the pump cover.
2. Disconnect the pump electric connections.

3. Disconnect the fuel delivery manifold to the pump.
4. Remove the fastening nut and disconnect the breather pipe between the upper and lower part of the tank from the pump.

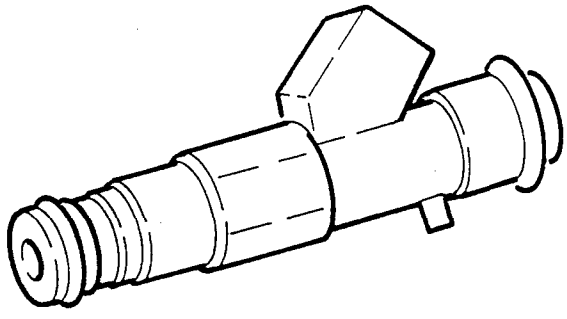


1. Remove the fuel pump nut screw with tool No. 1.821.167.000.
2. Remove the submerged pump – gauge unit and seal.



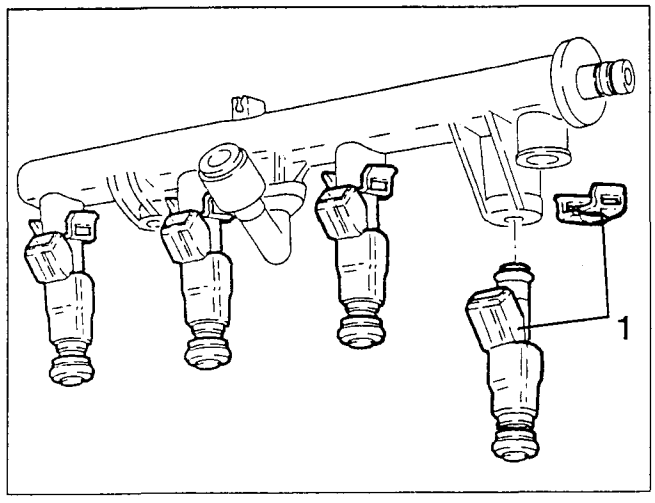
INJECTORS

These double jet injectors are installed on the distribution manifold.
They are secured to the distribution manifold by means of safety clips and sealed with O-rings.
The injectors output the appropriate quantity of fuel to the engine.
They are "all or nothing" type devices, i.e. they present two stable stages, either completely open or completely closed.
They let fuel flow through when they are open and stop the fuel flow when they are closed.



REMOVAL/REFITTING

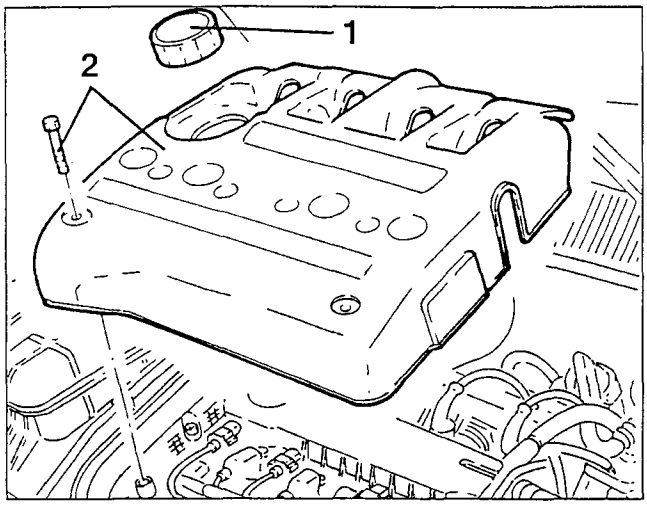
- Remove the fuel distribution manifold (see specific paragraph).
1. On a work bench, remove the safety clips. Remove the injectors from the distribution manifold.



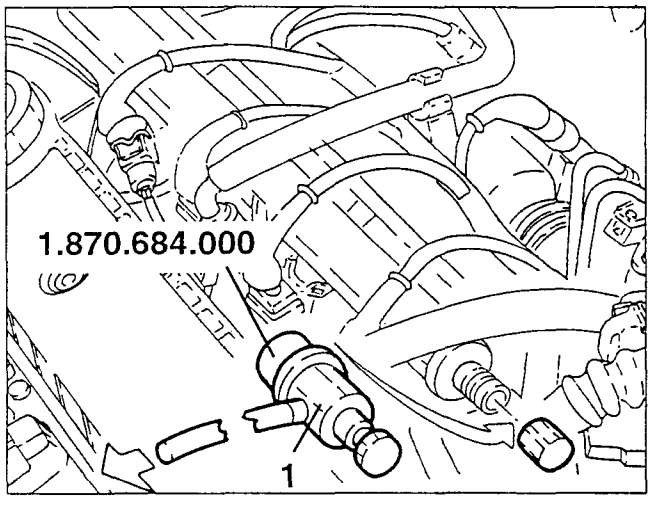
FUEL DISTRIBUTION MANIFOLD

REMOVAL/REFITTING

- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the ignition coil screws and cover.
- Refit the engine oil filler cap.



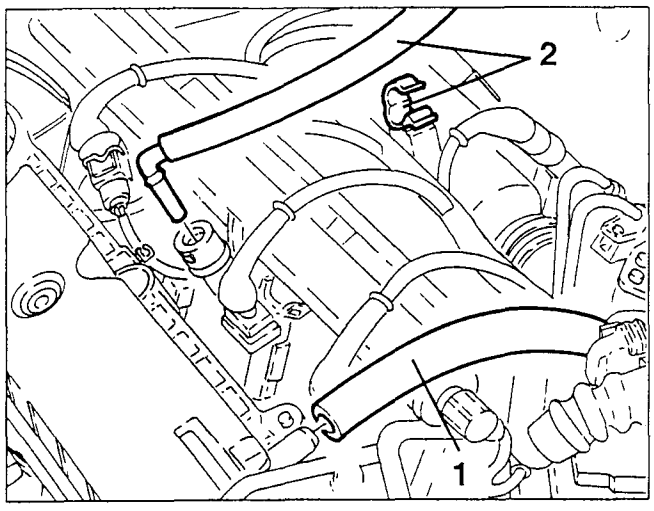
1. Connect tool No. 1.870.684.000 to the distribution manifold bleeder valve and discharge the fuel pressure.



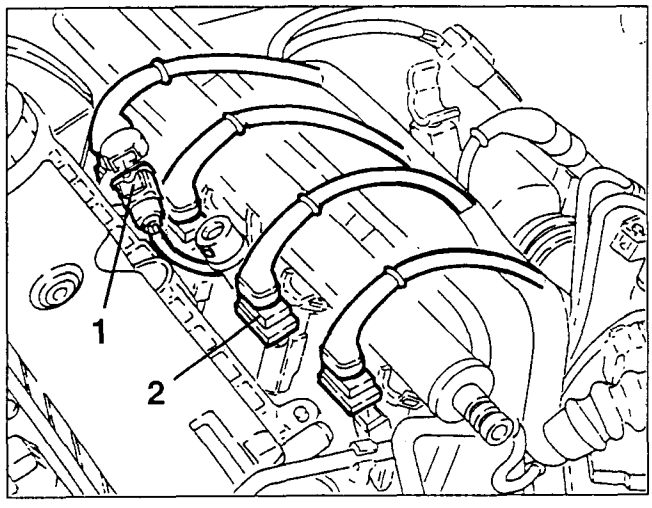
1. Disconnect the oil fume re-circulation pipe from the tappet cover.

NOTE: Collect the fuel in a suitable container.

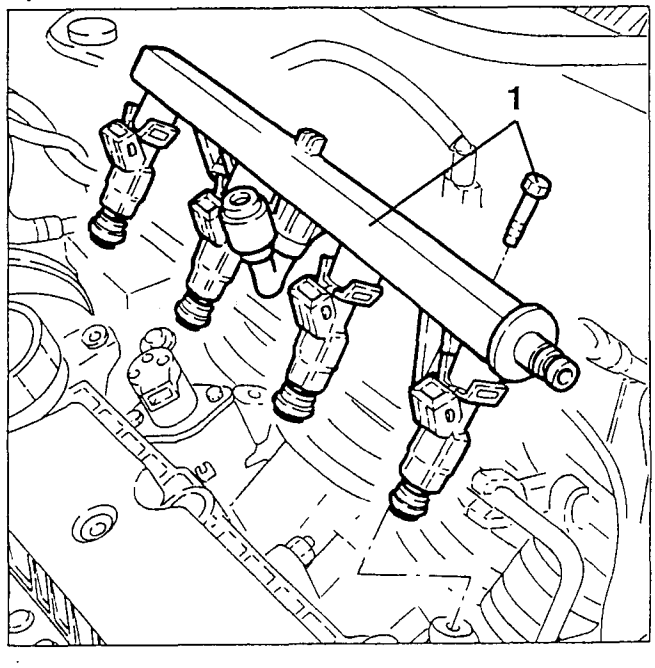
2. Disconnect the delivery pipe from the fuel distribution manifold. Release it from the clip on the modular intake manifold. Shift it to a side.



1. Disconnect the electric connection from the timing variator electromagnet.
2. Disconnect the electric connections from the injectors.



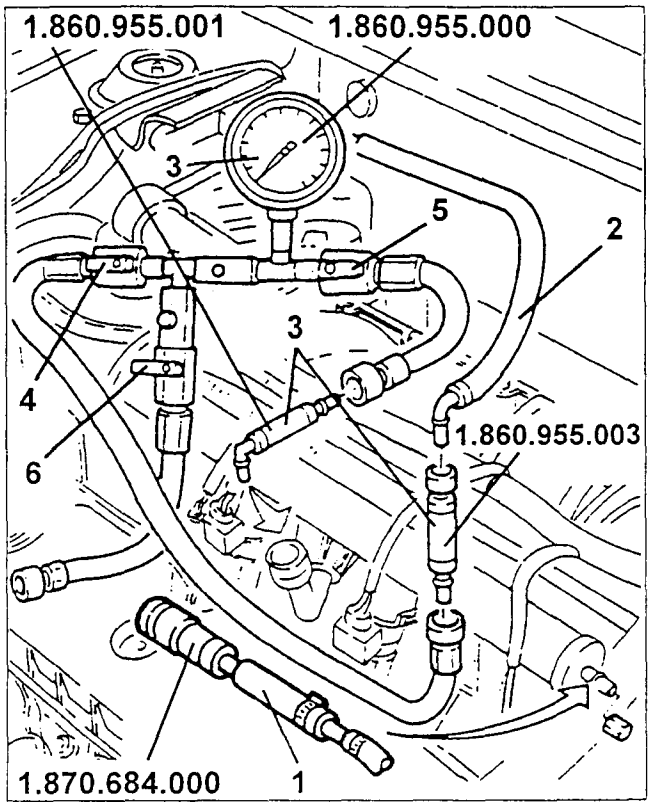
1. Remove the fastening screws and remove the distribution manifold and the injectors.
- If required, remove the safety clips and remove the injectors from the manifold.



CHECKING THE PRESSURE AND TIGHTNESS OF THE FUEL CIRCUIT

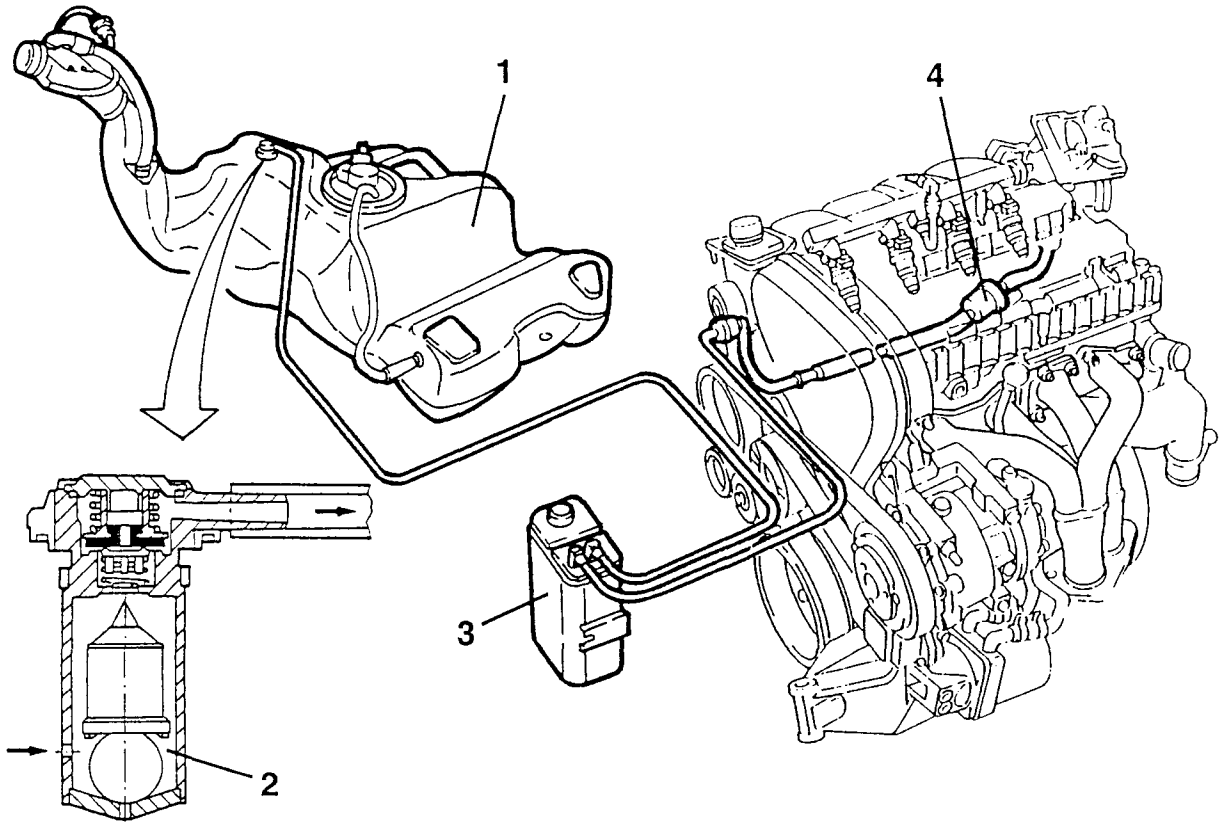
1. Connect tool no. 1.870.684.000 to the distributor manifold relief valve and relieve the fuel pressure.
2. Disconnect the fuel delivery pipe from the distributor manifold.
3. Assemble couplings no. 1.860.955.003 and no. 1.860.955.001 on pressure gauge no. 1.860.955.000.
- Connect the tool made in this way to the fuel delivery pipe and to the distributor manifold.
4. Open the ball valve.
5. Open the ball valve.
6. Close the engine and at idle speed, check that the fuel pressure is within the specified limits.

Fuel pressure at idle speed
3.3 ÷ 3.7 bar



BLANK

FUEL FUME RE-CIRCULATION SYSTEM DESCRIPTION



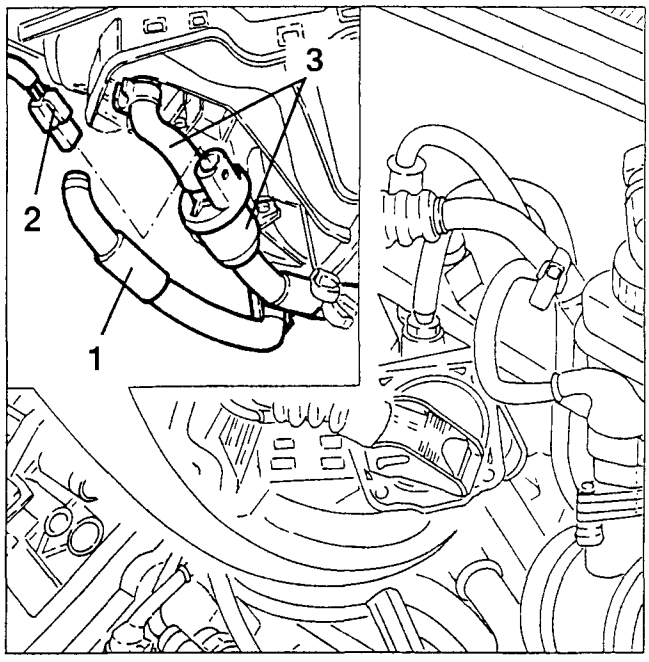
1. Tank
2. Multifunction valve
3. Fuel fume filter (canister)
4. Solenoid valve

The fuel in the tank (1) contains a considerable amount of fumes which would pollute the atmosphere if released. The re-circulation system collects these fumes and conveys them to the engine to be burnt.
When the fume pressure in the reservoir reaches 0.038 ÷ 0.053 bar, the multifunctional valve opens (2) and the fumes are conveyed to the fuel fume "canister" (3) via a specific pipe.
The canister absorbs and stores the fumes in an active carbon filter.
A solenoid valve (4) is located between the fuel fume filter and the intake unit. When the valve is not energised, the connection with the intake unit is closed and the fuel fumes are stored in the canister.
In certain load conditions, the Motronic ECU controls the opening of the solenoid valve allowing the intake of the fumes from the canister.
This condition persists also when the lambda sensor detects the decrease of oxygen in exhaust due to excessive presence of fuel in combustion chamber. This fact is signalled to the ECU which reduces the fuel feed to the injectors so that the engine is always fuelled appropriately.
If there are no fuel fumes in the canister and consequently only air is taken in, the lambda sensor detects the condition and signals in increase in oxygen to the ECU.
The ECU closes the solenoid thus closing the connection to the canister and eliminating the air in excess.

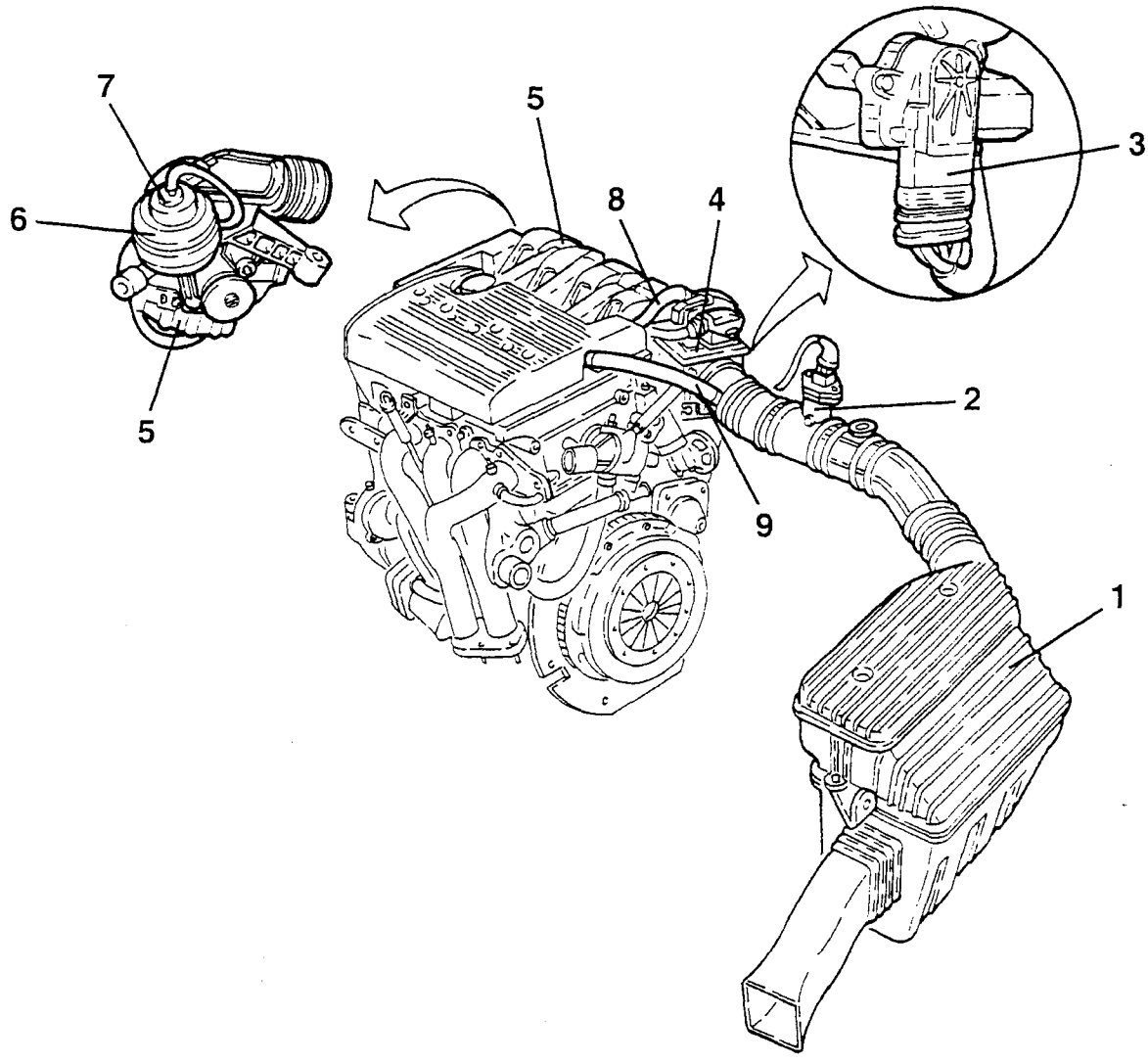
FUEL FUME INTERCEPTOR VALVE

REMOVAL/REFITTING

- Remove the throttle (see specific paragraph).
1. Disconnect the pipe from the distribution manifold, as shown in the illustration, to access the fuel fume interceptor valve.
2. Disconnect the electric connections of the fuel fume interceptor valve.
3. Disconnect the pipes and remove the fuel fume interceptor valve removing it from the support rod.



AIR INTAKE SYSTEM AND OIL FUME RE-CIRCULATION SYSTEM DESCRIPTION



1. *Air filter*
2. *Intake air flow meter with integrated air temperature sensor*
3. *Idling actuator and throttle position sensor (MDS)*
4. *Throttle*
5. *Modular intake manifold*
6. *Modular intake manifold pneumatic control actuator*
7. *Modular intake manifold control solenoid valve*
8. *Idling oil fume re-circulation pipe*
9. *Oil fume re-circulation pipe*

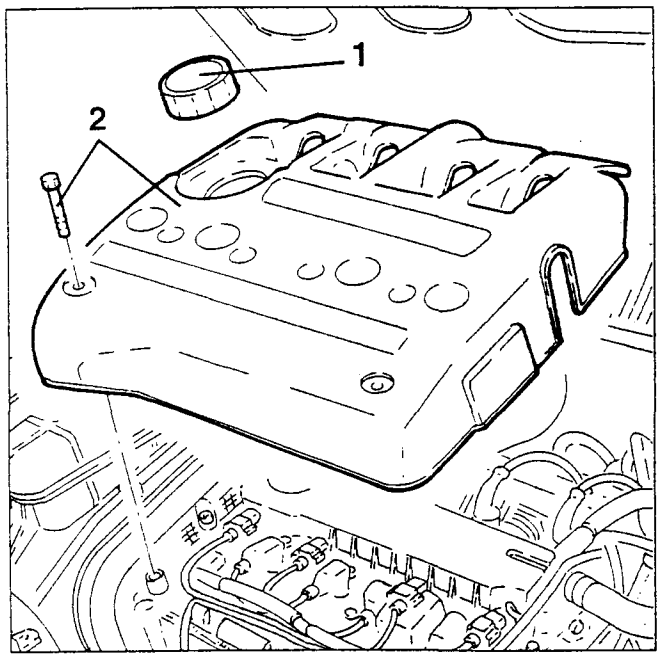
The intake air crosses a dynamic inlet and is filtered by a cartridge (1). It reaches the throttle (4) via a corrugated sleeve on which a hot film flow meter with integrated air intake temperature sensor is located.
The throttle is controlled by the accelerator wire and adjusts the amount of intake air in the unit.
The idling actuator is located on a side of the throttle.
The throttle position sensor (MDS) (3) controlled by the injector ECU and is also located on the throttle.
The fuel fumes (see specific paragraph) and the oil fumes are conveyed to the fuel feed system.

Oil fumes develop during engine operation.
They are collected in the cylinder head.
The condensed oil drips back to the crankcase while the fumes are conveyed to the intake unit via two pipes.
When idling, the oil fumes are conveyed to the throttle via the specific pipe (8).
At higher loads, the fumes are conveyed upstream with respect to the throttle via a connection pipe (9) to the corrugated sleeve to be burnt in the engine.

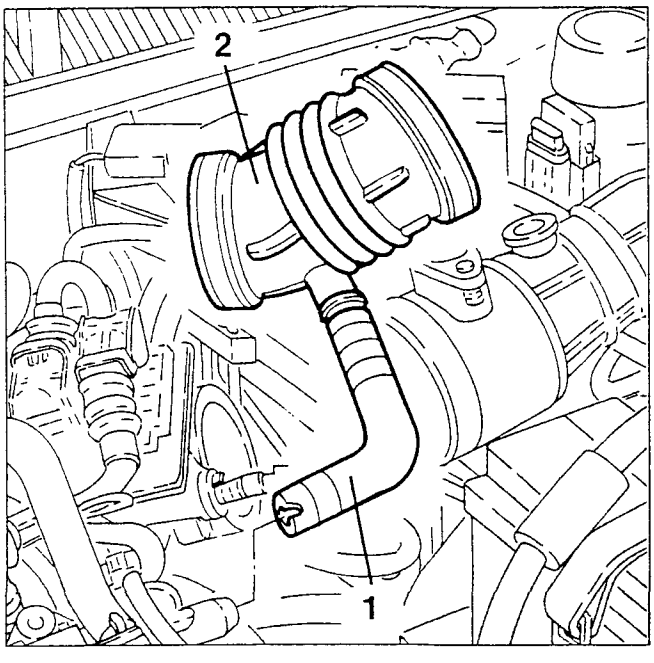
THROTTLE

REMOVAL/REFITTING

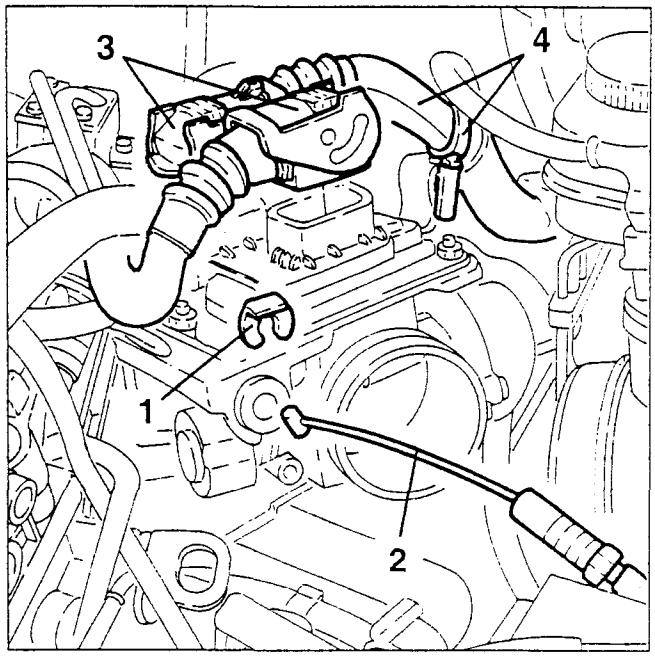
- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.



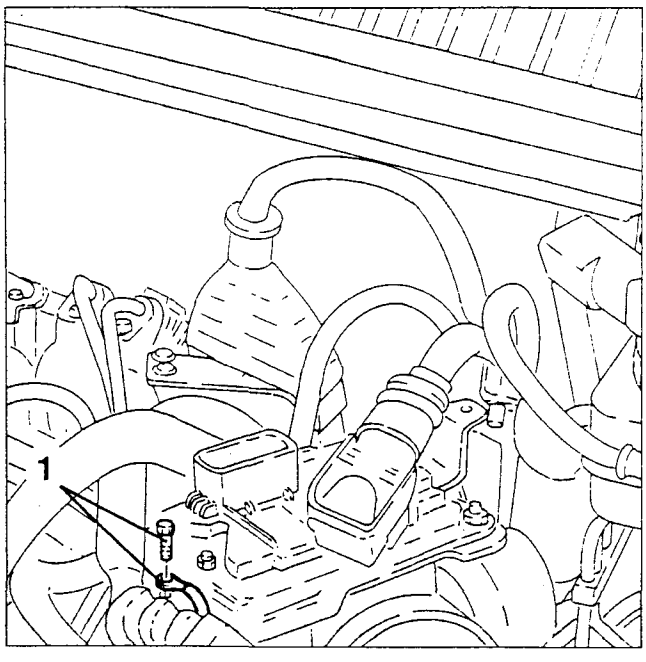
- Refit the engine oil filler cap.
1. Disconnect the oil fume re-circulation pipe from the tappet cover.
2. Disconnect the air flow meter sleeve from the throttle and remove it.



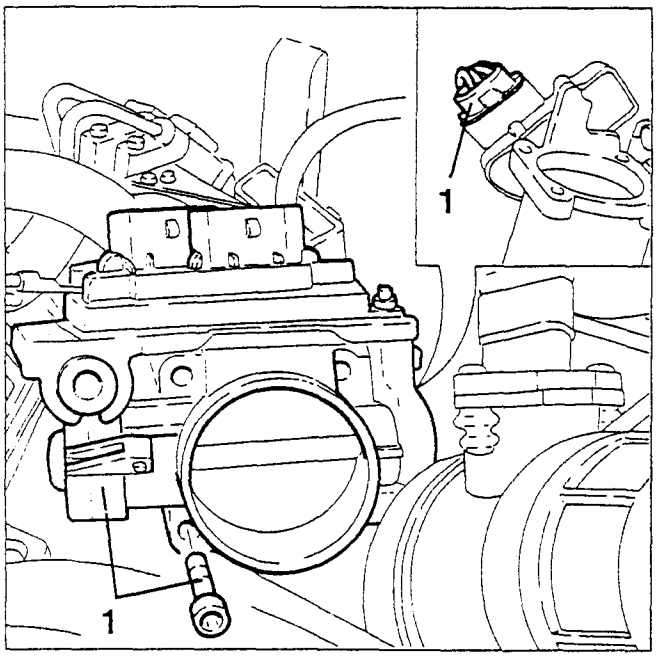
1. Remove the fastener from the accelerator wire from the rod.
2. Release the accelerator wire from the cam on the throttle and shift it.
3. Disconnect the engine ECU electric connections.
4. Release the wiring from the clip on the ECU.



1. Disconnect the earth from the engine ECU support.

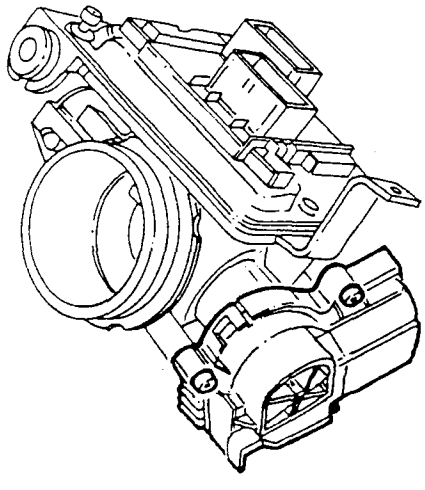


1. Remove the fastening screws and remove the throttle, disconnecting the idling actuator electric connection.



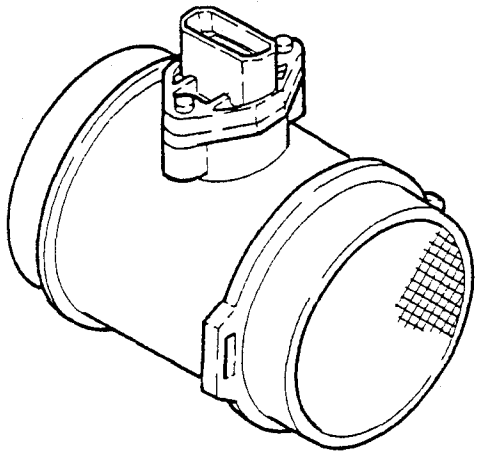
IDLING ACTUATOR AND THROTTLE POSITION SENSOR (MDS)

The actuator is located on the throttle and is controlled by the injection ECU.
It consists of a DC motor which adjusts the throttle opening from 0° to 15°.
Two potentiometers integrated in the actuator transmit the angle to the ECU, respectively:
- 0° ÷ 15° for idling
- 0° ÷ 83° for other engine ratios.

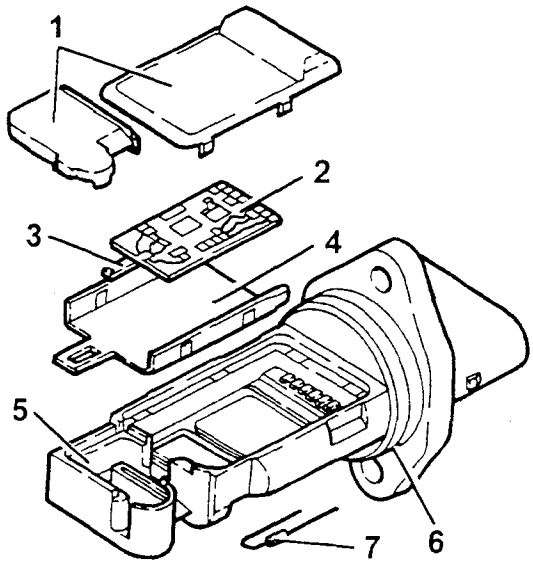


INTAKE AIR FLOW METER WITH INTEGRATED AIR TEMPERATURE SENSOR

This "heated film" flow meter is located on the intake manifold.



An intake air temperature sensor is integrated in the sensor.



1. *Covers*
2. *Electronic board*
3. *Sensors*
4. *Support plate*
5. *Support*
6. *O-ring*
7. *Temperature sensor*

The operation principle is based on a heated film interposed in the measuring channel the intake air directed to the engine flows through.

The membrane film is kept at constant temperature (approximately 120°C higher than the intake air temperature) by a resistance.
The intake air crossing the channel tends to take heat from the membrane.
To keep temperature constant, therefore, a certain current must cross the element.
This current is measured by means of a specific Wheatstone bridge and is proportional to the air flow.
A flow meter directly measures the amount of air (not the volume) thus eliminating problems due to temperature, altitude, pressure, etc.

MODULAR INTAKE MANIFOLD

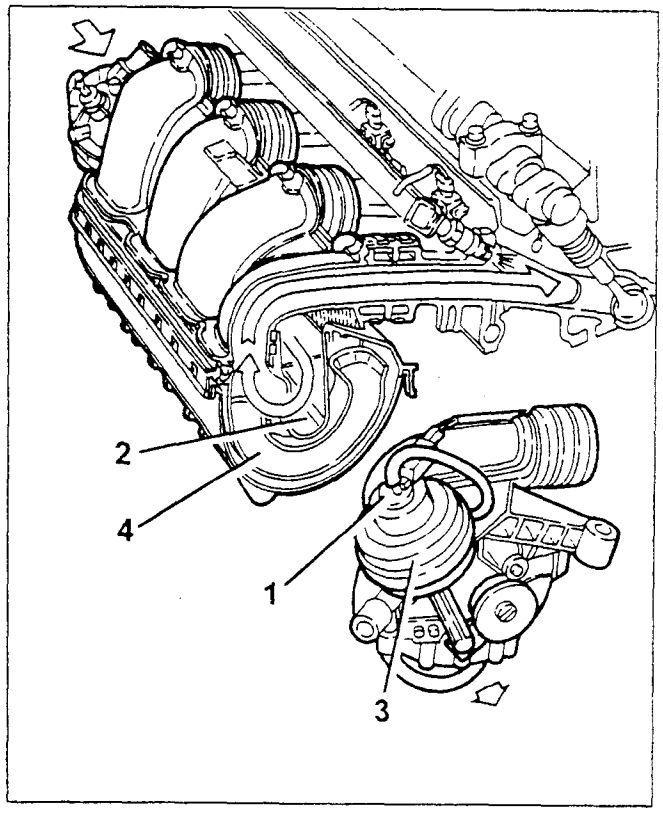
This modular length intake manifold is controlled by the injection ECU.
It increases volumetric performance and consequently:
- optimises torque output at low/medium ratios
- increases power at high ratios.

The manifold consists of:
- two half cases made in nylon
- an internal rocking manifold
- a vacuum accumulator inside the manifold
- a modular intake manifold actuator with an integrated three-way control solenoid valve.

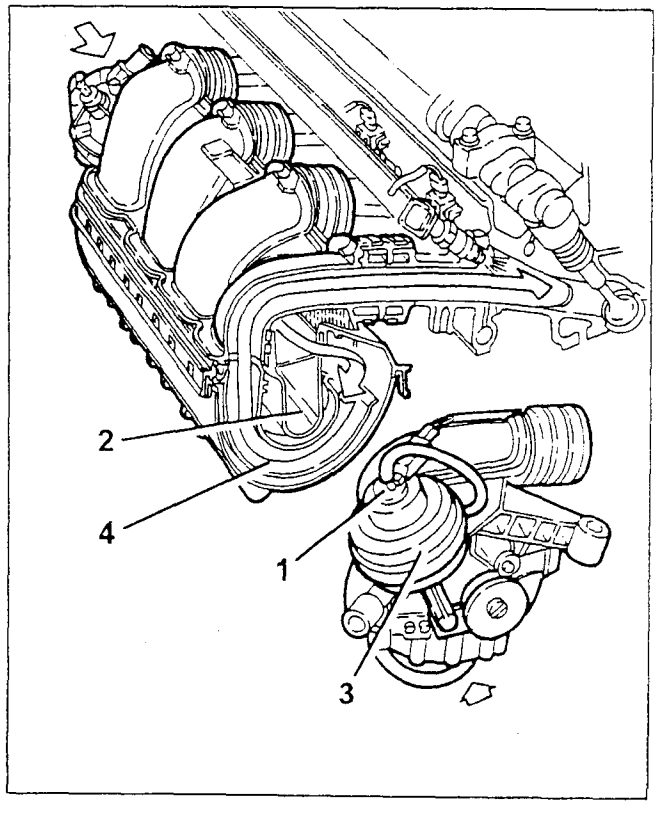
OPERATION

The injection ECU controls the three-way solenoid valve (1) thus connecting the vacuum accumulator (2) and the pneumatic actuator (3) which, by means of specific linkages, controls the movement of the rocking manifold (4).
The rocking manifold rotation configures the manifolds as follows:

- short power manifolds for engine ratio over 4900 rpm.



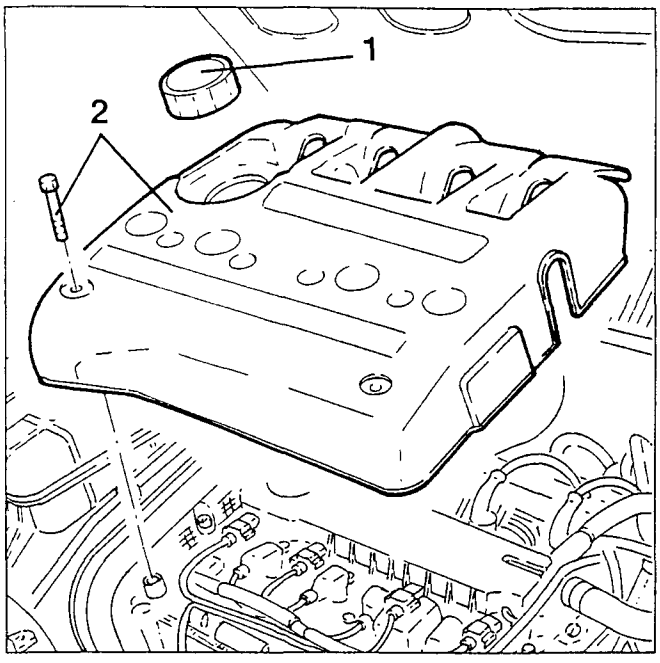
- long torque manifolds for engine ratio from 800 to 4900 rpm.



REMOVAL/REFITTING

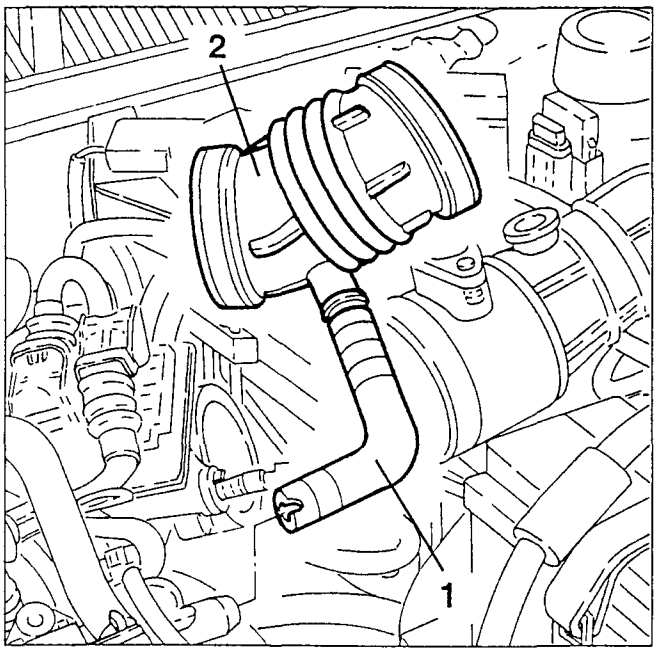
- Position the vehicle on a shop jack.
- Disconnect the (-) battery terminal.

1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.



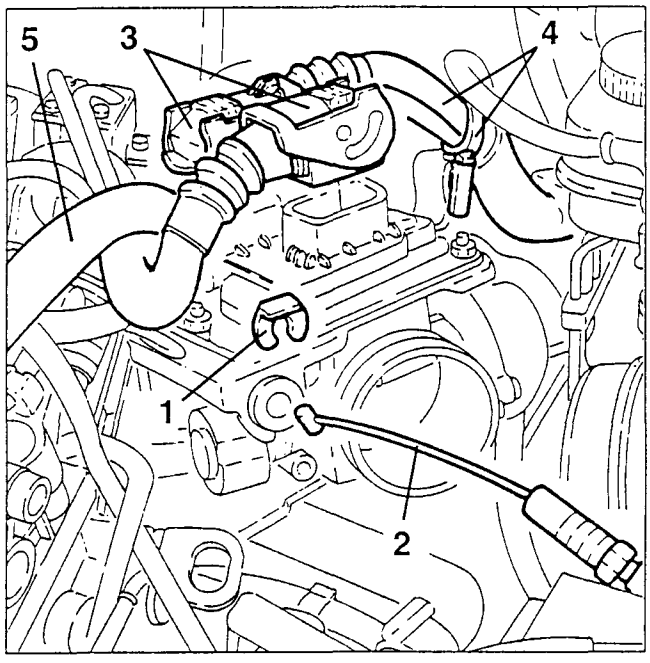
- Refit the engine oil filler cap.

1. Disconnect the oil fume re-circulation pipe from the tappet cover.
2. Disconnect the air flow meter sleeve from the throttle and remove it.

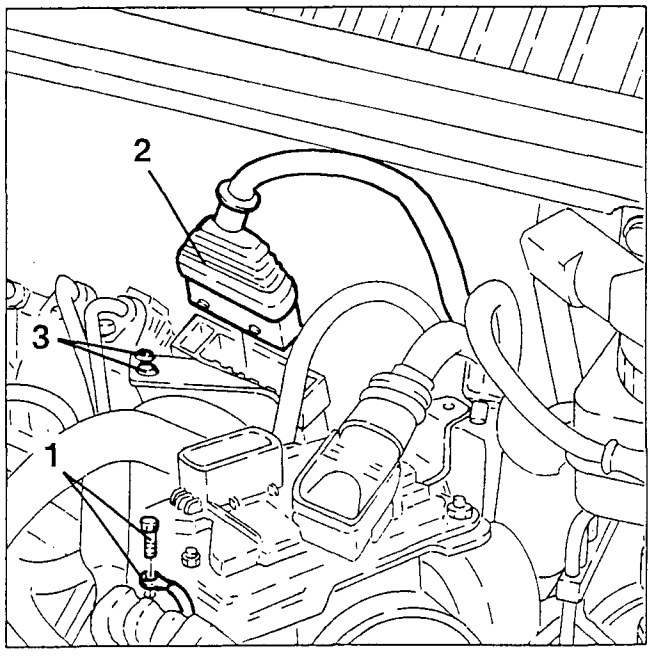


1. Remove the accelerator wire fastener from the rod.
2. Release the accelerator wire from the cam on the throttle and shift it.

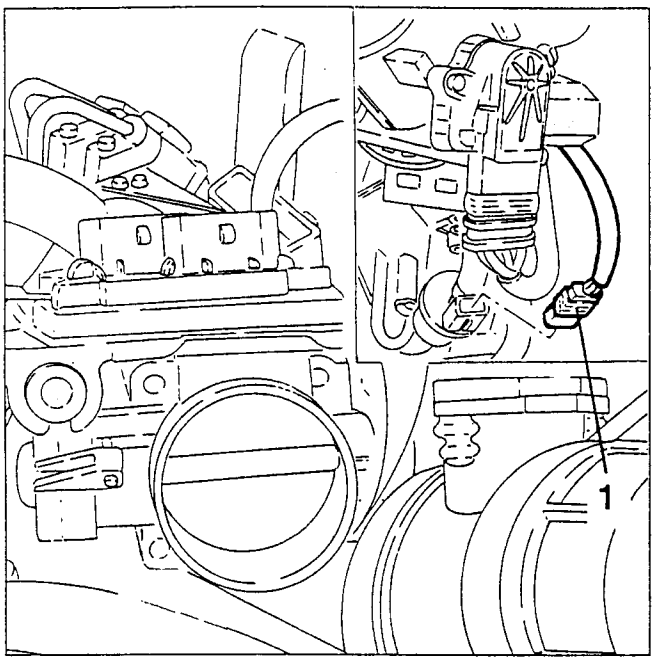
3. Disconnect the engine ECU electric connections.
4. Release the wiring from the clip on the ECU.
5. Disconnect the oil fume intake pipe from the throttle.



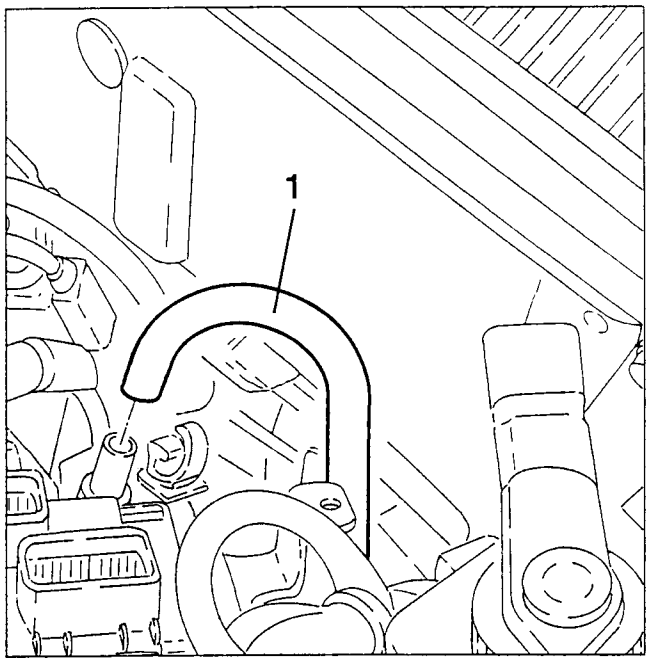
1. Disconnect the earth from the engine ECU support.
2. Disconnect the electric connection from the front/engine connection wiring.
3. Remove the screws fastening the front/engine connection wiring to the modular intake manifold.



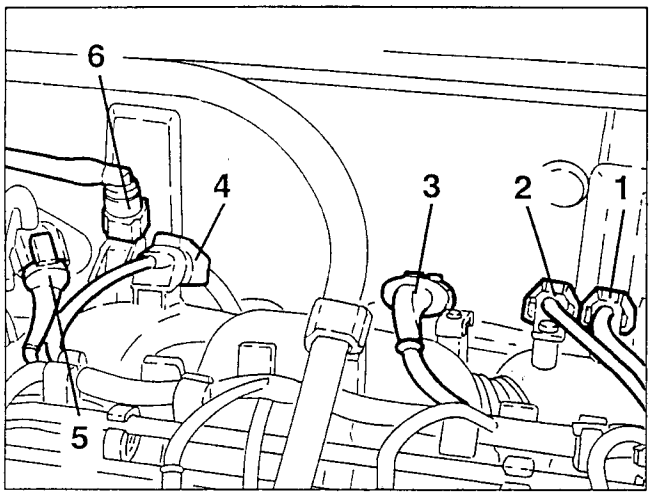
1. Disconnect the fuel fume interceptor valve electric connection.



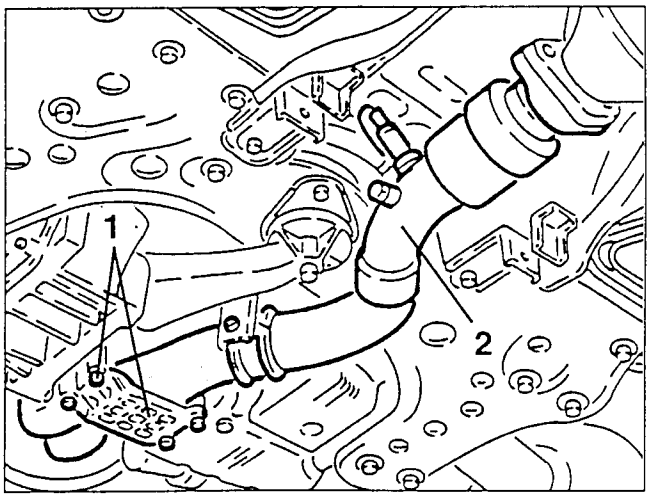
1. Disconnect the brake booster vacuum pipe.



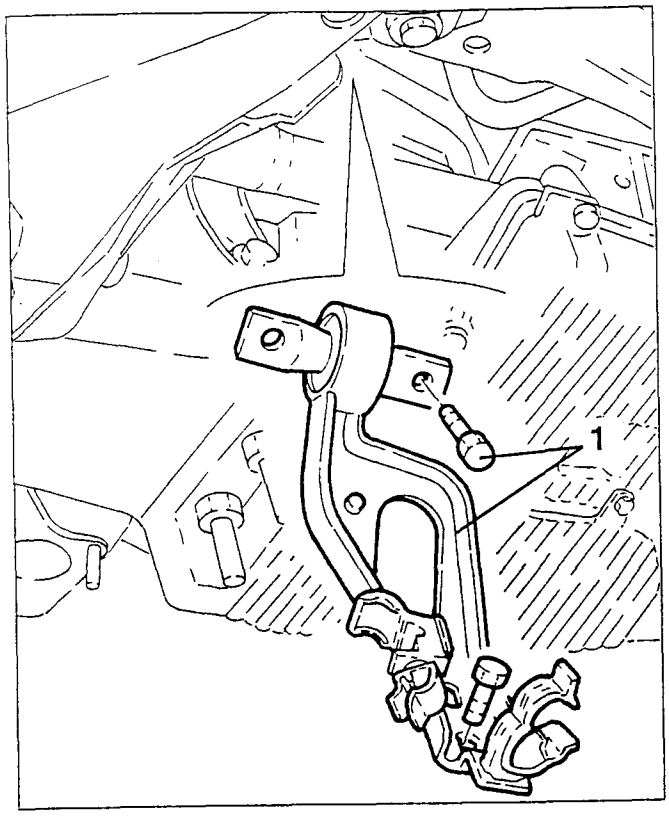
1. Disconnect the rev and timing sensor electric connection.
2. Disconnect the knock sensor electric connection.
3. Disconnect the lambda sensor electric connection.
4. Disconnect the timing sensor electric connection.
5. Disconnect the electric connection from the modular intake manifold actuator.
6. Disconnect the fuel fume hose.
- Release the electric wiring and pipes from the clips on the modular intake manifold.



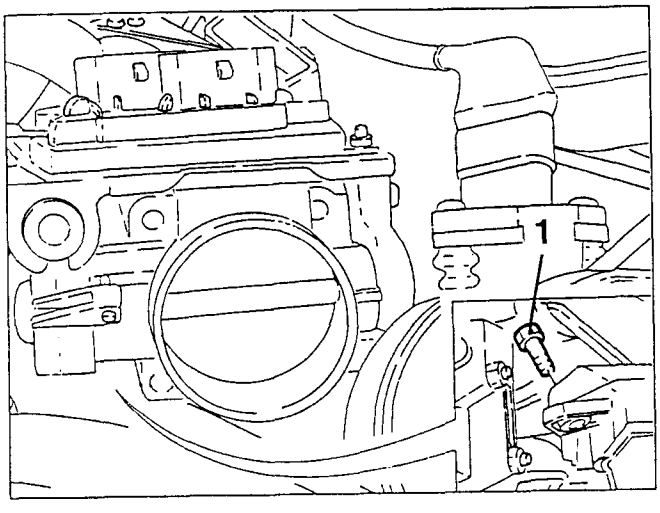
- Release the injector wiring from the fastening clips on the modular intake manifold.
- Release the coolant return pipe to reservoir from the clips on the modular intake manifold.
- Lift the vehicle.
- Remove the guard under the motor.
1. Remove the fastening nuts and the front exhaust pipe reinforcement.
2. Remove the fasteners and the front section of the exhaust pipe with lambda sensor and seals.



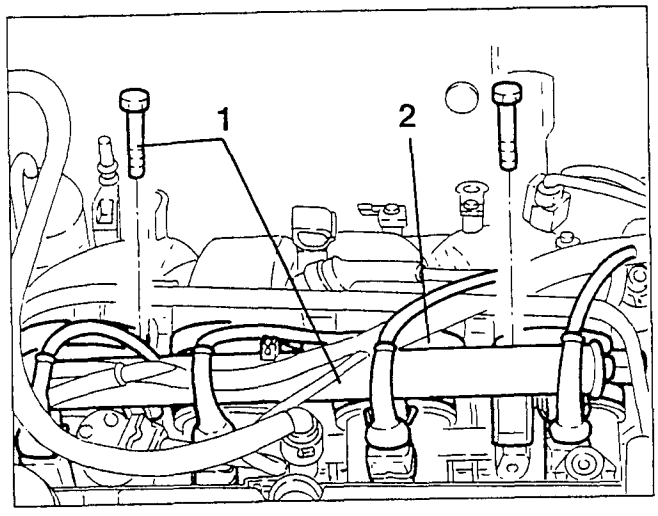
1. Remove the fastening screws and the modular intake manifold support rod.
- Remove the screw fastening the right-hand side of the modular intake manifold.



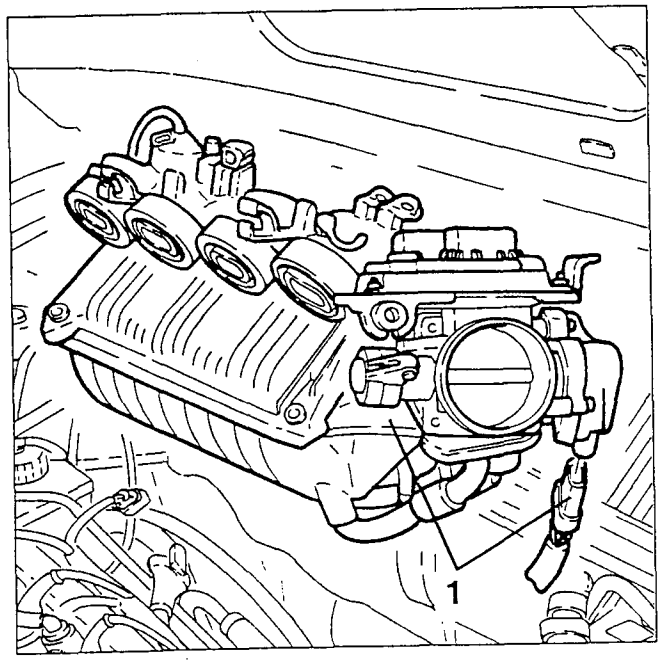
- Lower the vehicle.
1. Remove the screw fastening the left-hand side of the modular intake manifold.



1. Remove the fuel distribution manifold fastening screw and shift it to access the rubber sleeves.
2. Disconnect the rubber sleeve fastening clips. Shift the modular intake manifold and remove the sleeves.

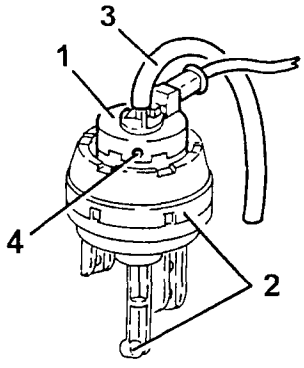


1. Remove the modular intake manifold, after disconnecting the constant idling actuator.



INTAKE MANIFOLD SOLENOID VALVE

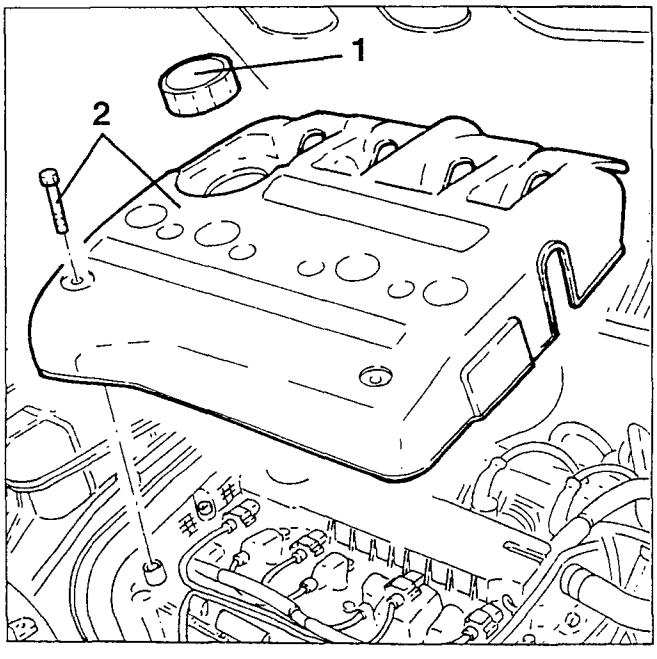
This is a three-way solenoid valve integrates in the pneumatic actuator controlling the variable geometry unit.
It is controlled by the injection ECU.
It enables the vacuum in the vacuum reservoir (inside the intake unit) to act on the rocking manifold control pneumatic actuator.



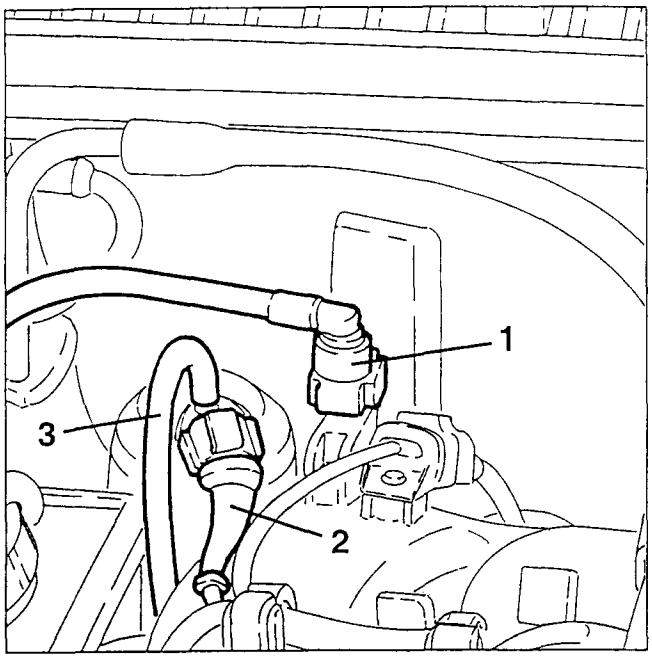
1. *Modular intake manifold solenoid valve*
2. *Modular intake device control actuator*
3. *Vacuum pipe*
4. *Atmospheric pressure air inlet*

REMOVAL/REFITTING

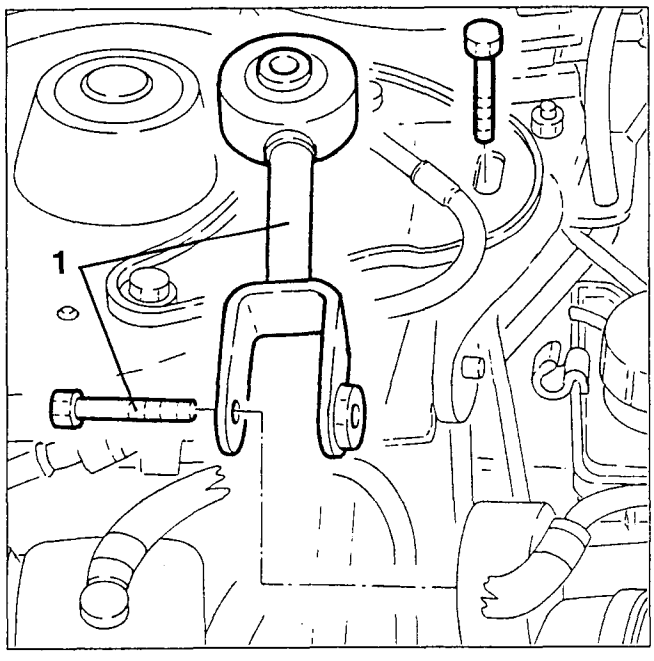
- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.



- Refit the engine oil filler cap.
1. Disconnect the fuel fume quick coupling pipe and release it from the clip on the power steering reservoir.
2. Disconnect the modular intake manifold actuator electric connection.
3. Disconnect modular intake manifold actuator vacuum pipe.

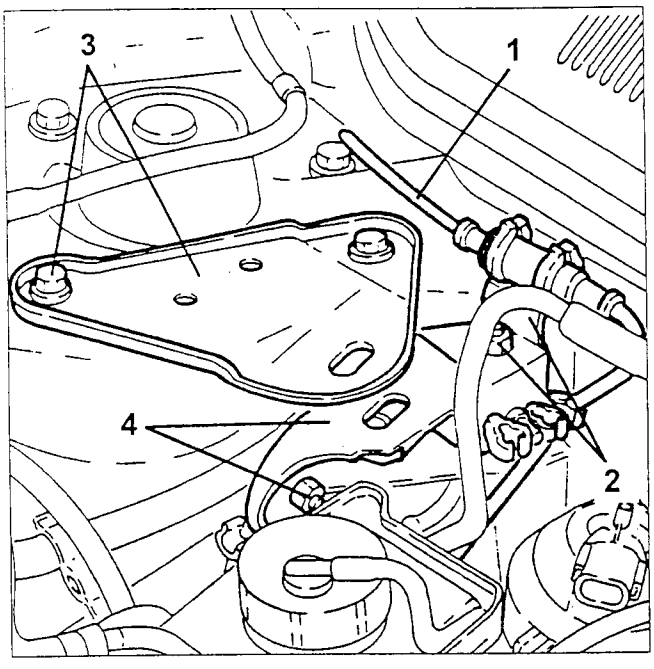


1. Remove the fastening screw and remove the engine reaction tie-rod.

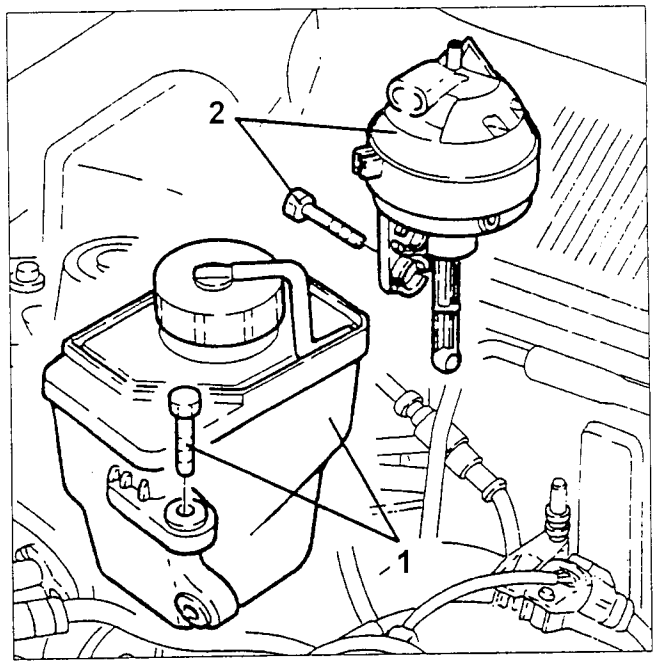


1. Disconnect the right-hand ABS sensor electric connection from the support rod.
2. Remove the fastening nut and remove the ABS sensor electric connection support rod.

3. Slacken the fastening screws and remove the upper support bracket of the power unit reaction rod.
4. Slacken the nut and fastening screw, then remove the power unit reaction rod support bracket.

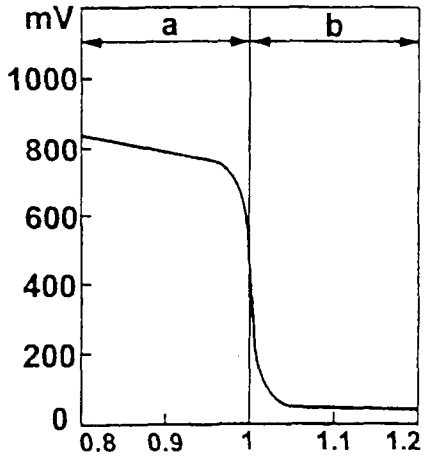


1. Slacken the fastening screws and move aside the power steering tank.
2. Slacken the fastening screws, disconnect the rod from the joint and remove the modular box control actuator.



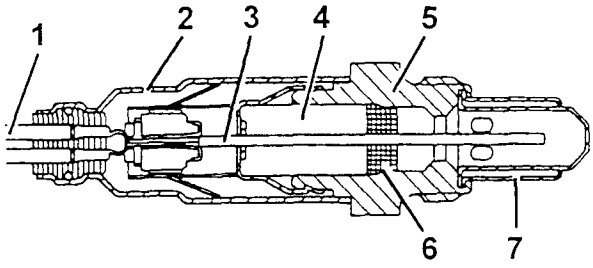
LAMBDA SENSOR

This is of the "planar" type and is fitted on the front section of the exhaust pipe. It informs the injection - ignition control unit about combustion (stoichiometric ratio).
The electronic control unit identifies the composition of the mixture (lean or fat) from the lambda sensor output voltage.
It adapts the amount of fuel injected to ensure an optimum composition of the mixture ($\lambda = 1$), to create the ideal conditions for treating the exhaust gases in the catalytic converter.
If the mixture is too fat ($\lambda < 1$), the amount of fuel must be reduced and if the mixture is too lean ($\lambda > 1$), the amount of fuel must be increased.



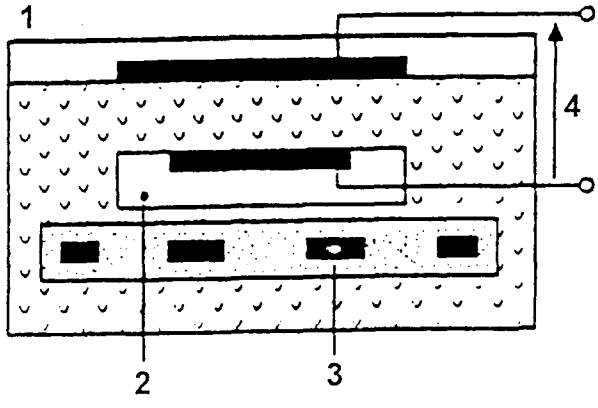
a. Fat mixture (lack of air)
b. Lean mixture (excess air)

The lambda sensor, placed in contact with the exhaust gas, generates an electric signal, the voltage of which depends on the concentration of oxygen in the gas.
This voltage is characterised by an abrupt change when the composition of the mixture departs from $\lambda = 1$.
Lambda sensor heating is controlled by the injection control unit proportionately with the temperature of the exhaust gas.
This prevents thermal shocks to the ceramic body due to contact with the condensed water contained in the exhaust gas when the engine is cold
The measurement cell and the heater are integrated in the "planar" (stratified) ceramic element with the advantage of obtaining quick heating of the cell, so that closed loop control ($\lambda = 1$) is enabled within 10 seconds from starting the engine.



1. Connection cable
2. Protective sleeve
3. Planar sensor element
4. Ceramic support pipe
5. Sensor housing
6. Ceramic seal
7. Protection pipe

The lambda sensor works on the principle of an oxygen concentration cell with solid electrolyte.
The measuring cell surfaces are coated with microporous layers of precious material.



1. Exhaust gas
2. Reference air passage
3. Heater
4. Lambda sensor voltage

GENERAL DESCRIPTION

An electronic control system supervises and governs all the engine parameters, optimising performance and consumption levels through response in real time to the different operating conditions.

It is the M 2.10.3 version of the tested and proven BOSCH MOTRONIC system.

Compared with the previous versions, this new M2.10.3 system adopts a control unit which is more advanced in design and structure and possesses a considerable number of possibilities for inserting special functions.

SYSTEM FUNCTIONS

Sequential and timed injection (S.E.F.I.)

The type of fuel injection with this control unit is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake ducts by the opening of the injectors is not simultaneous for all the cylinders.
It takes place for each cylinder in correspondence of the optimal injection point, calculated by the control unit following special maps according to engine load, speed and temperature).

NOTE: the instant considered in the design of the maps is that of the start of injection.

Static ignition

Electronic ignition has been adopted with "static distribution" (with semiconductors, without distributor.
This solution makes it possible to eliminate rotating components; it does not produce external sparks and reduces the risk of interferences; it also reduces the number of high voltage cables and connections.

Static ignition is made with a double coil, according to the so-called "lost spark" logic: this solution exploits the different conditions of pressure and environment existing contemporaneously in a pair of cylinders: when one of the cylinders is approaching the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas.
The voltage necessary to strike the arc between the spark plug electrodes is high (appr. 10 kW) in the cylinder in the bursting stroke, whereas in the cylinder in the exhaust stroke, it is extremely low (appr. 500 V).

The instant in which the control unit does not send the signal to one of the power stages, the passage of current in one of the primary circuits of the winding of the coil is cut off, generating by induction an increase of voltage (up to 30 kV loadless) on the secondary winding.

While the high voltage rises, one side of the coil secondary circuit is closed towards earth by the "lost spark" which strikes with about 500 V on the spark plug in the cylinder which is in the exhaust stroke.
This makes it possible to raise the voltage on the spark plug connected to the other side of the secondary circuit which is in contact with the mixture in the cylinder, thereby causing combustion.

Metering the air flow

The air flow meter is new in conception and design. It is of the "heated film type": the operating principle is based on a heated plate which is inserted in the intake duct through which the air that enters the engine flows.

The film plate is maintained at a constant temperature (appr. 120°C) by a heating coil in contact with it.

The mass of air that crosses the duct tends to subtract heat from the plate: therefore, in order to keep its temperature constant, a certain current must flow through the heating coil: this current is measured by a suitable Wheatstone bridge.

Thus, the current measured is proportionate with the mass of air flowing in the duct.

N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port") thereby eliminating problems of temperature, altitude, pressure, etc.

This new air flow meter does not incorporate the intake air temperature sensor, which is separate and is located just downstream of the flow meter itself.

Cylinder detection

Due to the different timed and sequential injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the compression stroke when the engine is started in order to start the correct injection sequence.

This sensor is a Hall effect device by which the voltage signal sent to the control unit "lowers" sharply when the tooth machined on the camshaft pulley passes in front of the it: a signal is sent every two turns of the crankshaft.

Fuel pump

The complex control logic of the fuel pump brought about by the control unit ensures that as soon as the engine stops, the supply to the pump is cut off immediately.
Moreover, the pump will not work with the engine stopped and the ignition key engaged.

In order to provide higher standards of safety, this logic, on this car, is integrated by the inertial switch device: this is an electromechanical switch which opens in the event of heavy impact, cutting off the circuit that connects the fuel pump to earth.
This way the pump stops instantaneously.
This device is particularly important, integrating the safety offered by the logic of the control unit, especially when the car is hit from behind or in other accidents that do not cause the engine to stop immediately.

OPERATING LOGIC

- Determination of the "operating point":
the engine "operating point" is detected by two sensors: the rpm sensor informs the control unit of the engine rotation speed; the air flow meter provides the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

- Adjustment of injection times (quantity of fuel):
The control unit commands the injectors extremely quickly and accurately calculating their opening time on the basis of the engine load (rpm and air flow rate), also taking account of the battery voltage and of the engine temperature. Injection is "sequential", i.e. the injectors are opened during the exhaust stroke of the corresponding cylinder.

- Ignition adjustment (calculation of spark advances):
the control unit calculates the advance on the basis of the engine load (rpm and air flow rate); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

- Cold starting control:
during cold starts the control unit utilizes special advance and injection time values.
When a determinate temperature/engine rpm ratio is reached, the control unit brings operation back to normal conditions.

- Control of enrichment during acceleration:
upon acceleration the control unit increases injection in order to reach the load required as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously signals the control unit of the need for "full power".

- Fuel cut off during deceleration:
with the throttle closed and engine rpm above a certain threshold, the control unit deactivates the injection of fuel; this way the rpms decrease rapidly towards idle speed and fuel consumption, controlled to a greater degree, is considerably reduced.
The threshold varies according to the temperature of the engine and of the speed of the car.

- Idle speed control:
the idle speed is adjusted via the special actuator which acts on the throttle by-pass.
This also serves as an additional air box and regulator for turning on the various services (eg. conditioner compressor): with the throttle at the stop limit, in fact the actuator adjusts the by-pass gap compensating the powers required by the services to ensure that the idle speed remains as constant as possible.

- Maximum rpm limiting:
once a certain threshold has been exceeded, the control unit automatically stops the injection of fuel in order to avoid overloading the engine and to protect it from "over- revving".

- Combustion control-lambda sensor:
the oxygen sensor (or "lambda" sensor) informs the control unit of the amount of oxygen contained in the exhaust, thus the correct air - fuel metering.
The optimal mixture is obtained with lambda coefficient = 1 (fuel injected = theoretic amount of fuel that can be burnt). The electric signal that the sensor sends to the control unit undergoes a sudden change exactly when the composition of the mixture departs from lambda = 1.
When the mixture is "lean" the control unit increases the amount of fuel, when the mixture is "fat" it decreases it: this way the engine operates as much as possible around the ideal lambda rating.
The lambda sensor signal is processed inside the control unit by a special integrator which prevents sharp "oscillations".

The sensor is heated with an electric coil so that it can quickly reach the correct operating temperature (appr.300°C).
This sensor therefore makes it possible to adjust the engine carburetion accurately.
This also enables operation within the limits specified by emission standards.

- Fuel vapour recovery:
the fuel vapours collected in various points of the supply circuit are collected in a special active carbon canister from which they are directed towards the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is under loading conditions that make correct combustion possible without adversely affecting engine operation: in fact the control unit compensates this quantity of fuel by reducing the delivery rate at the injectors.

- Connection with the conditioner compressor:
the control unit is connected with the conditioning system and operates the cutting in of the compressor in relation to engine operation.
Since this service absorbs a considerable amount of power, the control unit:

- adapts the idle rpm to the increased power each time the compressor cuts in; if the engine speed falls below 700 rpm, the compressor is turned off;

- in the case of a high request for power (high speed - over 6000 rpm - or full load - max. throttle opening), the control unit momentaneously cuts out the compressor.

- when the engine is being started it does not allow the compressor to cut in until normal operating conditions have been reached.

- Connection with the anti-theft device:
if the car is fitted with the electronic anti-theft system, the Motronic control unit receives the consent to operate from the anti-theft control unit via a special signal: if this signal is "low" - earth - the control unit operates normally. If the signal becomes "high" - voltage 0 or a.c. - the control unit is deactivated and the engine will not start at all.

SELF-DIAGNOSIS

The control unit is fitted with a self-diagnosis system which continuously checks the signals from the various sensors for plausibility comparing them with the limits allowed: if such limits are exceeded, the system detects a fault and stores it in the memory.

For certain parameters, in the event of a failure the abnormal parameters are replaced by suitable mean values to make it possible to take the car to a point of the Service Network.
These values, known as "recovery", depend on the other signals which are operating normally and they are defined individually by the operating logic of the control unit.
The self-diagnosis system also enables quick and effective fault finding connecting with the ALFA ROMEO Tester (See GROUP 55 "DIAGNOSIS OF THE ELECTRICAL SYSTEM"), through which it is possible to "read" all the errors stored.
It is also possible to check the operating parameters recorded by the control unit and operate the turning on of the single actuators to check whether they are working properly.

ERROR STORAGE:
Once an error has been found through suitable plausibility tests, it is stored in the "Error Memory" of the control unit.
Each error is associated with a CODE that can be "read" by the ALFA ROMEO TESTER.
If an error is "present" (recorded continuously and not sporadically) concerning operation of the engine, a warning light on the instrument cluster will turn on immediately.

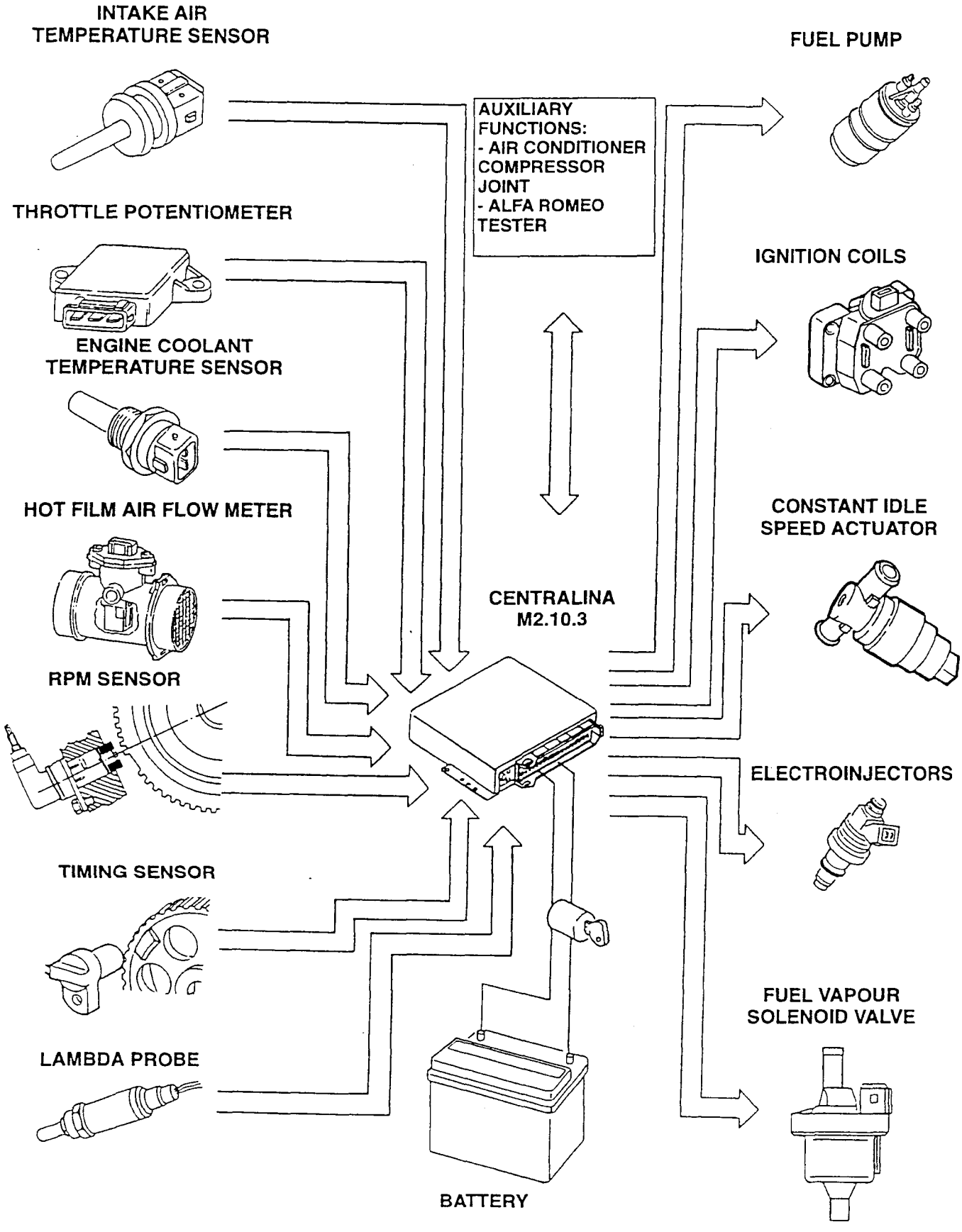
ERROR CANCELLING:
The errors stored in the control unit may be cancelled:

- after 10 times the engine is started without the error repeating.

- through the ALFA ROMEO TESTER

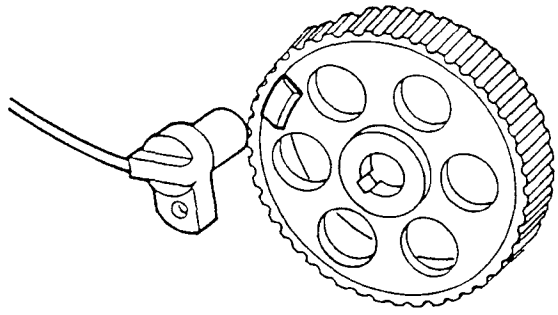
- disconnecting the power supply (battery) for a certain length of time.

OPERATING LAYOUT



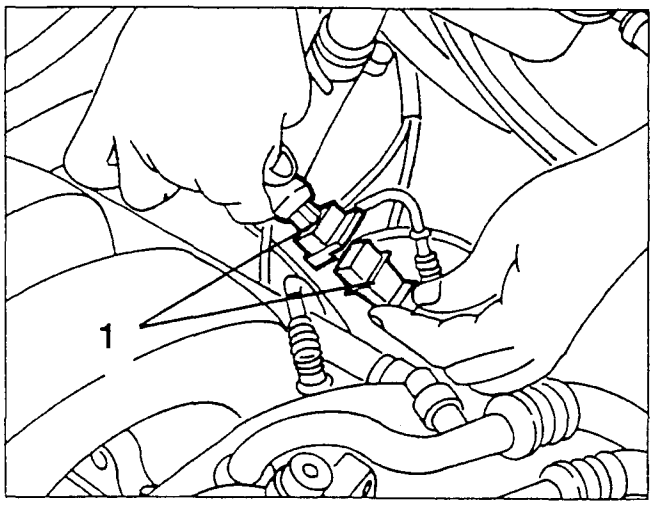
TIMING SENSOR

The timing sensor (cam angle sensor) comprises a Hall effect device.
The voltage signal "lowers" sharply when the tooth machined on the camshaft drive pulley opposite the sensor passes in front of it.

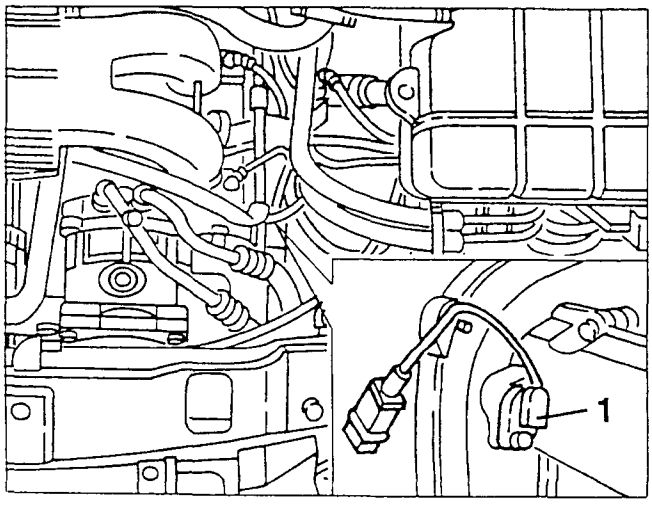


REMOVAL/REFITTING

1. Disconnect the electrical connection of the timing sensor.

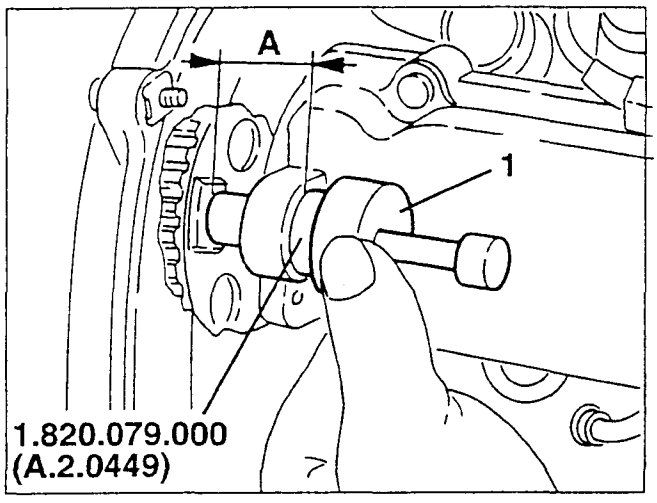


1. Slacken the fastening screw and remove the timing sensor releasing the wiring from the fastening clamps.

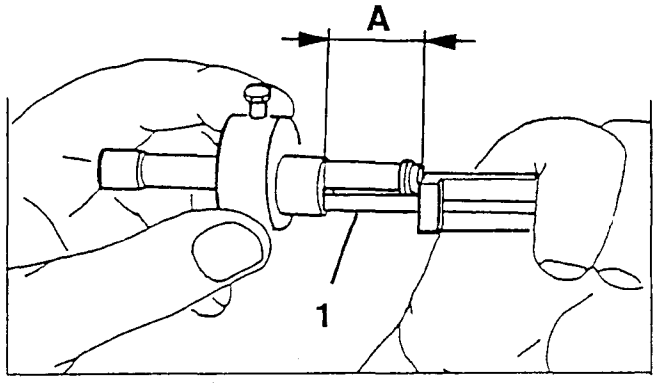


CHECKING THE AIR GAP

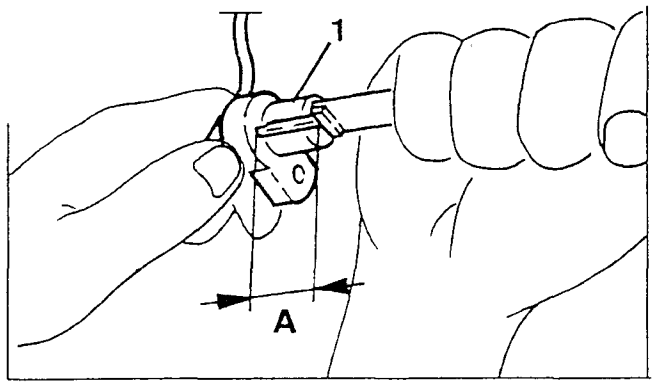
- Remove the timing sensor (see specific procedure).
1. Using tool N° 1.820.079.000 (A.2.0449), measure dimension "A".



1. Using a gauge measure dimension "A" .



1. With a dial gauge check the value of "B" on the sensor.



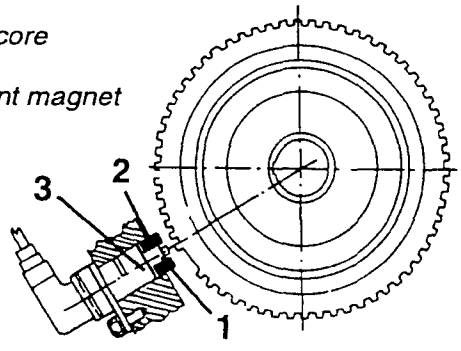
- Calculate the air gap of the timing sensor and check that it is within the specified limits.

A - B = 1.5 mm

RPM SENSOR

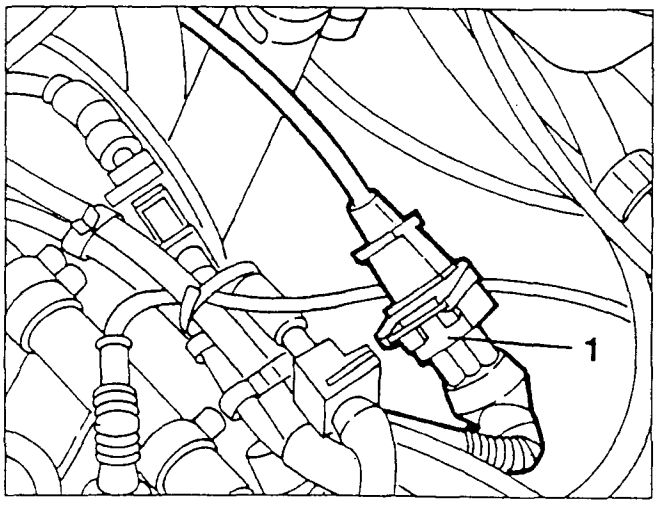
The sensor for detecting the rpm is of the inductive type which operates through the change of a magnetic field generated by the passage of the teeth of a toothed pulley (phonic wheel) fitted on the flywheel. The teeth which pass in front of the magnetic field generator change the gap between the pulley and the sensor; therefore, the dispersed flux, which consequently varies, induces an alternate sinusoidal voltage in the coils of the sensor, the amplitude of which depends on the peripheral speed of the phonic wheel, the gap between the tooth and the sensor,the shape of the teeth, the magnetic characteristics of the sensor and on the support system.
The output signal which varies in relation to the rpm is processed by the control unit to obtain a signal at each passage through zero and a constant rectangular oscillation of amplitude to enable the control of the digital circuits inside the control unit.
The interval between the start of one tooth and another is 6° with the exception of the reference mark which is made by eliminating two of the 60 teeth of the pulley.
The hollow due to the lack of two teeth gives the control unit a reference point of the crankshaft and each subsequent tooth of the phonic wheel informs the control unit of an increase in its angular position.

1. *Soft iron core*
2. *Winding*
3. *Permanent magnet*

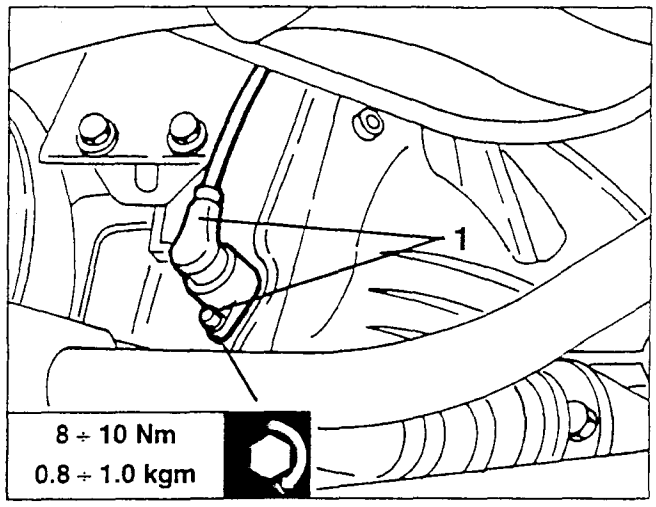


REMOVAL/REFITTING

1. Disconnect the connection of the timing sensor.

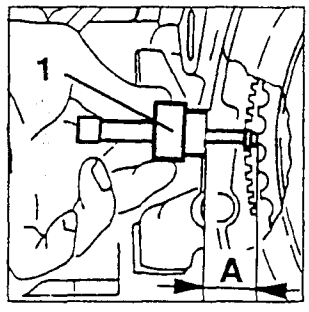


1. Slacken the fastening screw and remove the sensor.

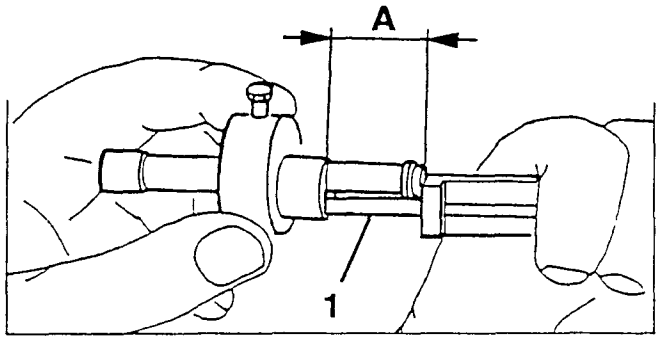


CHECKING THE AIR GAP

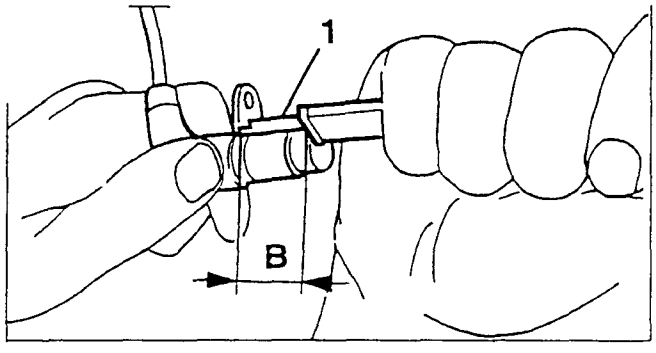
- Remove the rpm sensor (see specific procedure).
1. Using tool N° 1.820.079.000 (A.2.0449), measure dimension "A".



1. Using a gauge measure dimension "A".



1. With a dial gauge check the value of "B" on the sensor.

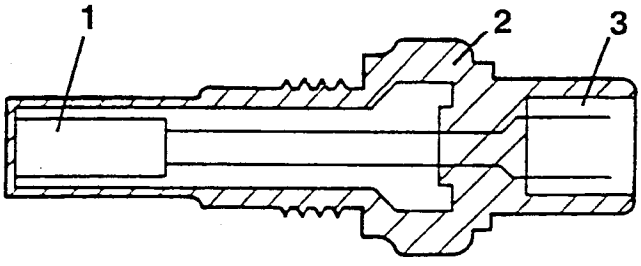


- Calculate the rpm sensor gap and check that it is within the specified limits.

A - B = 0.7 ± 0.1 mm

ENGINE COOLANT TEMPERATURE SENSOR (NTC)

This sensor detects the engine coolant temperature on the intake body through a thermistor (NTC) with a negative resistance coefficent, i.e. capable of lowering its resistance as the temperature increases.
The electric signal obtained reaches the electronic control unit where it is used to correct the air-fuel mixture.

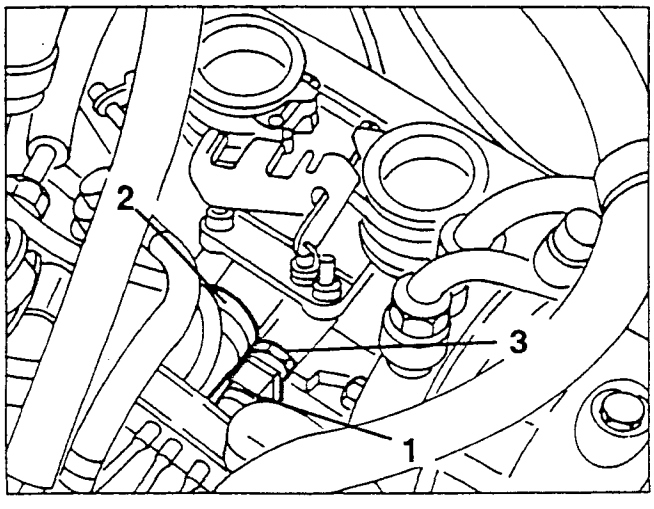


1. NTC resistance *2. Body* *3. Connector*

REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the coolant fluid.
- Remove the intake box and the throttle control shaft (see specific paragraphs).

1. Disconnect the electrical connection from the engine coolant temperature (NTC).
2. Disconnect the engine coolant pipe from the intake body.
3. Slacken and remove the engine coolant temperature sensor (NTC).



CHECKS AND INSPECTIONS

See GROUP 55 - "ELECTRIC SYSTEM DIAGNOSIS".

INERTIAL SWITCH

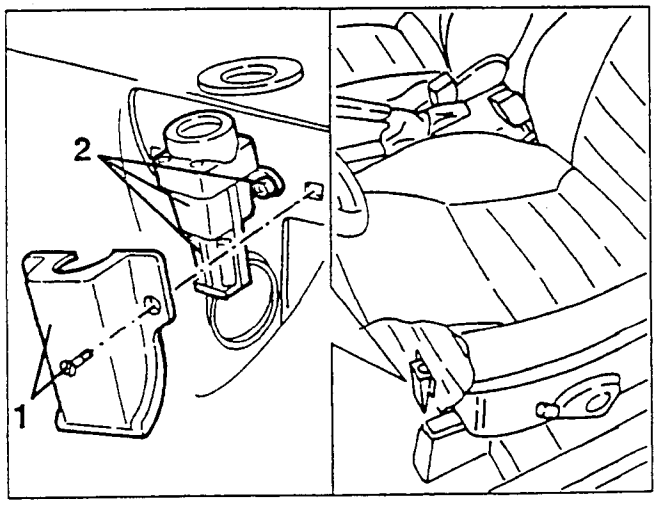
Under the driver's seat there is a safety switch which is triggered in the case of an impact, cutting off the fuel pump connection to earth, thereby also the supply to the injection system.
A steel ball fitted in a taper housing is normally held in place by the force of attraction of an adjacent magnet.
Under specific acceleration loads the ball releases itself from the magnetic force and gradually moves out of the taper support rising upwards following the angle of the taper.
A quick snap connection is fitted above the ball which forms the normally closed electric circuit.
When the mechanism is struck by the ball it changes position from a normally closed circuit to a normally open circuit interrupting the electric fuel pump earth circuit.
In the event of impact in any one of the three orthogonal directions, the switch will be triggered above 12 g peak equivalent to a speed of 25 kph.
The switch can be reset pressing the pushbutton protected by a flexible cover (this also protects against foreign particles which might prevent the switch from operating or reprogramme it.

NOTE: If after even a light crash, there is the smell of petrol or leaks are noted from the fuel supply system, do not reset the switch, but firstly seek the failure and repair it to prevent the hazard of fire.
Conversely, if there are no leaks and the car can be restarted, press the pushbutton to reactivate the fuel pump.

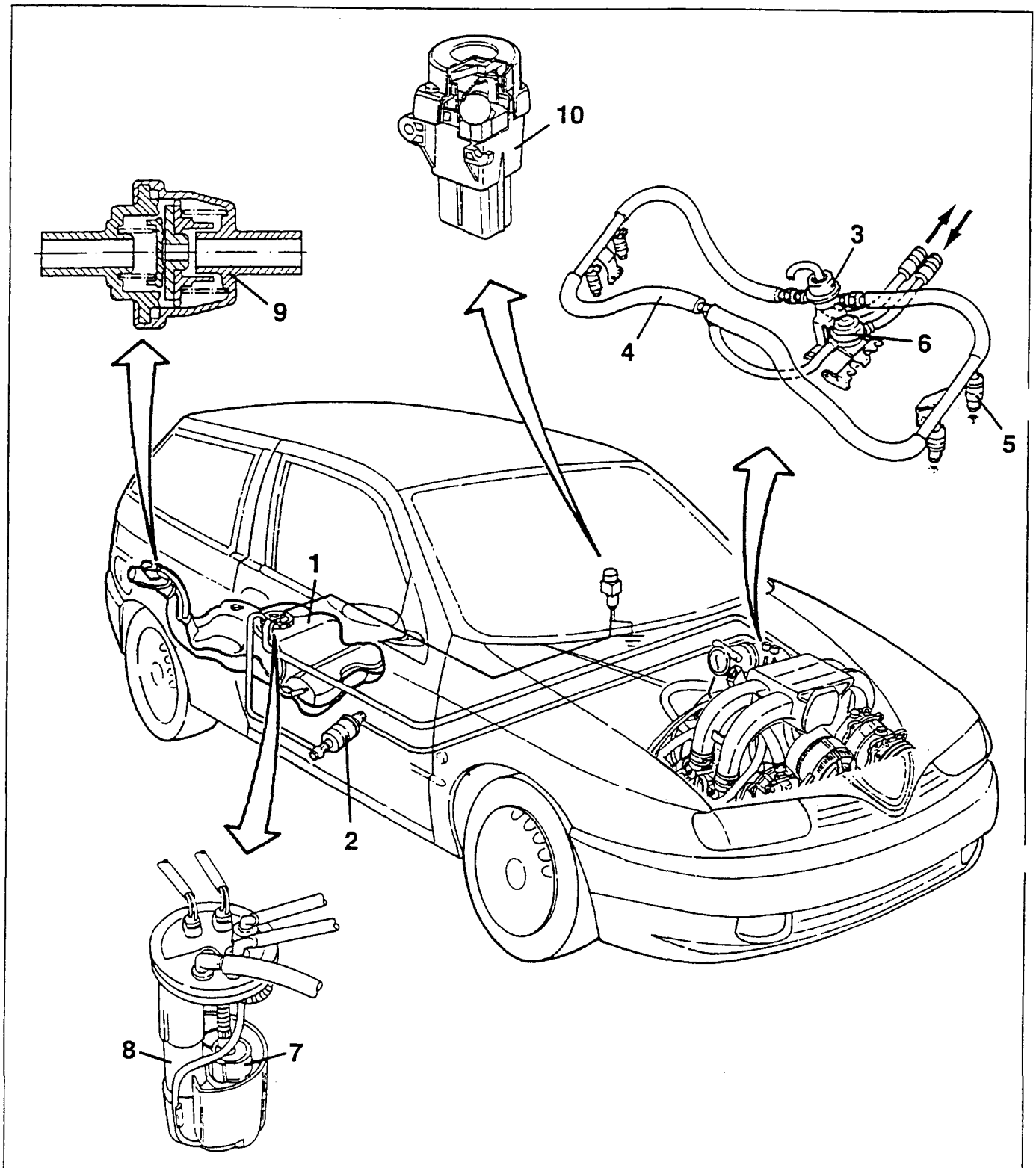
REMOVAL/REFITTING

- Disconnect the negative cable from the battery.

1. Loosen the two screws and remove the plastic cover.
2. Loosen the two screws and remove the inertial switch after disconnecting the relative connection.



FUEL SUPPLY SYSTEM DESCRIPTION



1. *Fuel tank*
2. *Filter*
3. *Pressure regulator*
4. *Distributor manifold*
5. *Electroinjectors*
6. *Pulse damper*
7. *Electric pump*
8. *Level gauge*
9. *Safet valve*
10. *Inertial safety switch*

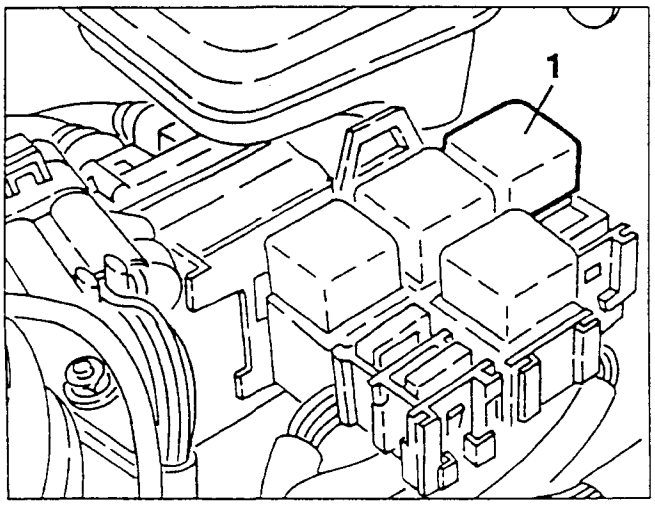
The fuel supply circuit comprises an electric pump located in the fuel tank which sends the fuel under pressure through a special hose to the filter.
From the filter the fuel is sent to the pulse damper and from this to the distribution manifold which distributes it to the injectors.
The fuel in excess returns to the tank via a special hose through the pressure regulator (controlled by the vacuum withdrawn by the idle speed air distributor).
The amount of fuel injected depends solely on the injection time which is controlled by the control unit.
The fuel supply system is fitted with an inertial switch under the driver's seat which is triggered in the event of of a crash, cutting off the connection to earth of the fuel pump thereby also the injection system supply.

Notes on serviceable fuels:
correct operation of the engine requires the use of unleaded fuels (95 R.O.N.) as the presence of lead would quickly bring about consumption of the catalytic converter at the exhaust.

WARNING

Before doing any work on components of the fuel supply system, in order to prevent any dangerous leaks, proceed as follows:
- Disconnect the fuel pump supply relay located in the injection-ignition control unit container.
- Run the engine until it cuts-out.

NOTE: On some vehicles the fuel pump relay (1) is located in the engine bay as shown in the diagram.



FUEL PIPE CONNECTION FITTINGS ("JOHN GUEST" TYPE)

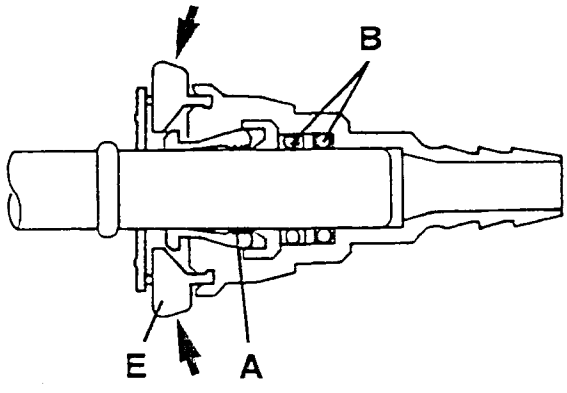
Cleaning for disconnection

Preferably use one of the following systems described in order of effectiveness.
a) Jet of warm water (max. 50°C) on the fitting and drying with jets of compressed air to prevent residual water in the interstices getting into the pipe after disconnection.
b) Jet of cold water and drying with compressed air.
c) Jet of hot water with neutral soap.
d) Jet of cold water with neutral soap.

Never use solvents and/or materials that are not compatible with the pipes in general and, for the fitting in particular, not compatible with nylon and acetolic resin.

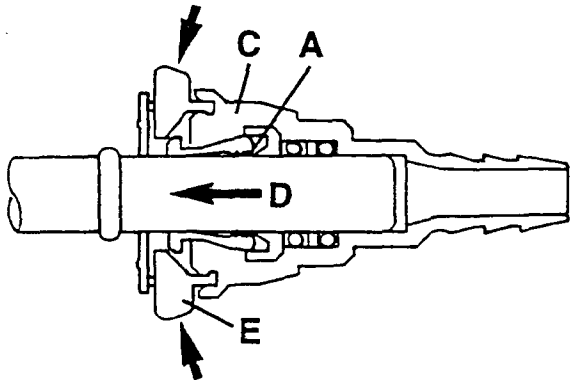
Disconnection operations

When installed, the fitting tends to act as follows for a certain length of time:
- pincer "A" grips the tang with its steel teeth. If they are in plastic the teeth might mark the tang slightly without adversely affecting tightness.
- the seals (O'Rings) "B" tend to stick to the surface of the tang in time whether it is of plastic or metal, as a result of this the coupling seems to be seized and impossible to release by only pressing the fins "E" and pulling the coupling.



Therefore, to disconnect proceed as follows:
- Turn 1/4 ÷ 1/2 of a turn to right and left several times (at least five) body "C" of the fitting in relation to the tang in order to eliminate friction of the seals on the tang and at the same time push the fitting towards the arrow "D" to loosen the grip of the pincers "A".
- Press with the fingers on the release buttons "E".
- Pull the fitting to disconnect it.

If disconnecting is still difficult, repeat these operations firstly checking that the pipe fitting is clean and that there is no mud or dirt in the interstices hindering the movement of the release mechanisms.



NOTE:
Never use pliers, screwdrivers, etc.. for disconnecting. If the coupling has not been tampered with and the above operations are correctly carried out, no tools are necessary.

FUEL PIPE CONNECTION FITTINGS ("HURON" TYPE)

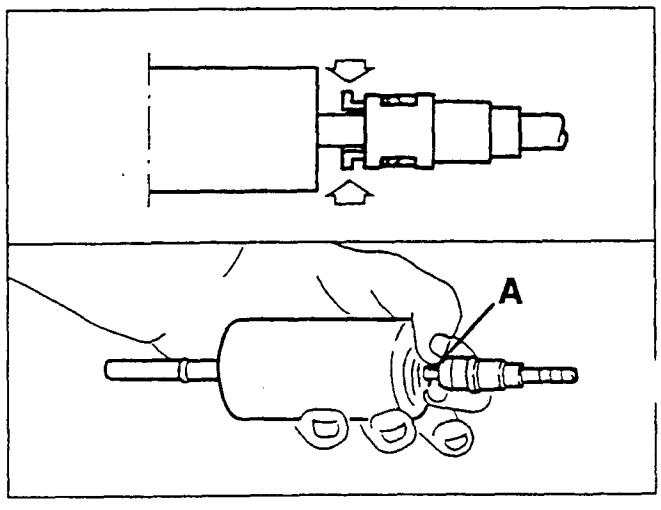
Operations to be carried out before disconnection

- Thouroughly clean the connector area with a jet of cold water (or hot, max 50°C) and dry with compressed air.
- A jet of water (hot or cold) may also be used with neutral soap.

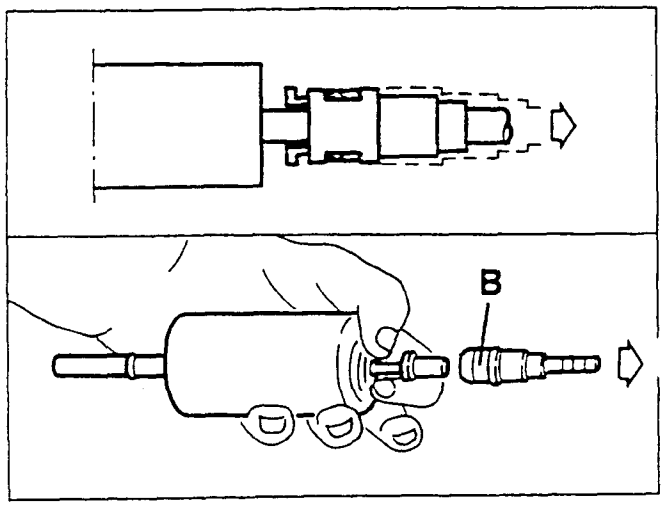
Never use solvents and/or materials that are not compatible with the pipes in general and for the connector in particular, not compatible with nylon and acetalic resin.

Operations for disconnection/connection

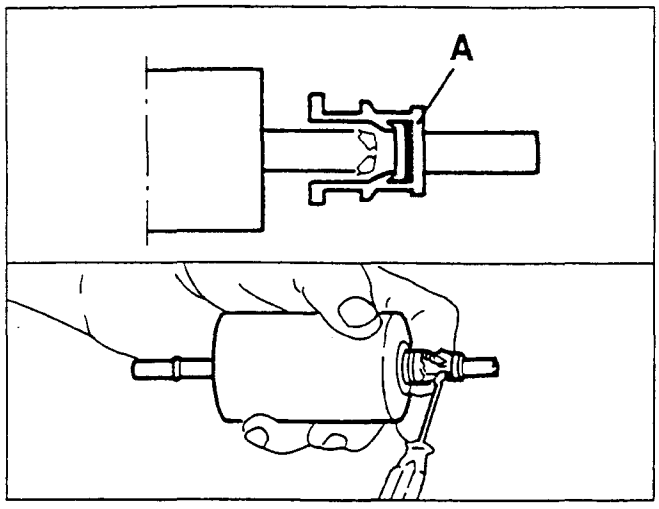
- Pinch the white transparent insert "A" between the thumb and forefinger and keep it pressed.



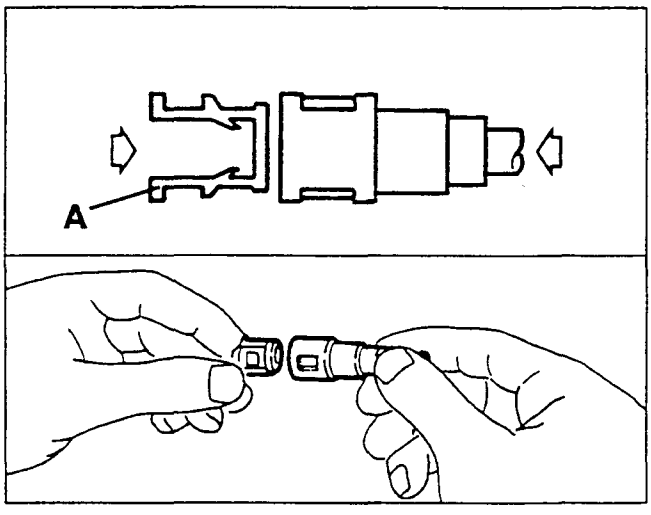
- With the other hand, grip the body "B" of the connector and pull in the direction of release.



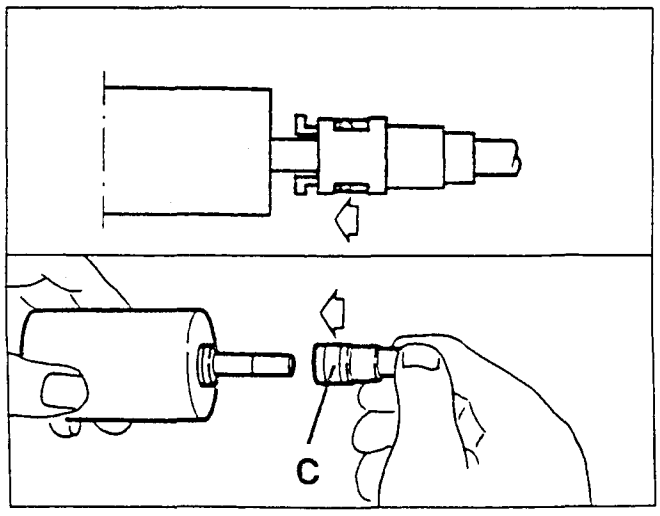
- Using a fine-tipped screwdriver in the points shown by the arrows, remove and retrieve the insert "A" taking care not to damage it.



- Refit insert "A" on the body of the quick coupling, fitted on the pipe, until it clicks meaning that it has been fitted correctly.

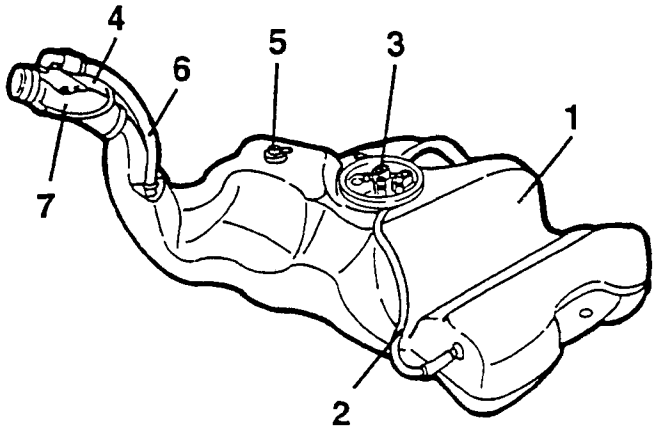


- Then connect the pipe with the quick coupling "C" pushing it until it clicks.
Try to remove the coupling to make sure that it has been installed correctly.



FUEL TANK

The fuel tank is made of plastic and has a capacity of appr. 51 litres, including a reserve of appr. 5 ÷ 8 litres.
The fuel filler neck is integrated with the main part of the tank and it is fitted with a new type of filler cap.
A mechanism inside the cap ensures that it is only tightened to the correct torque; over-tightening beyond the specified value is avoided as the cap will click past the resistance offered by the teeth.
The tank is fastened to the body on level with the luggage compartment floor and rear seat and it is shaped so that it does not interfere with the tubular frame of the rear suspension.
Due to the particular shape of the tank a pipe has been added to release the air to the upper section when filling with fuel.
The corrugated pipe on the filler prevents the fuel from splashing out.
On the filler there is also a two-way safety valve.
An opening is located in the upper section of the tank to house the pump-fuel level gauge assembly and for the multi-purpose valve.

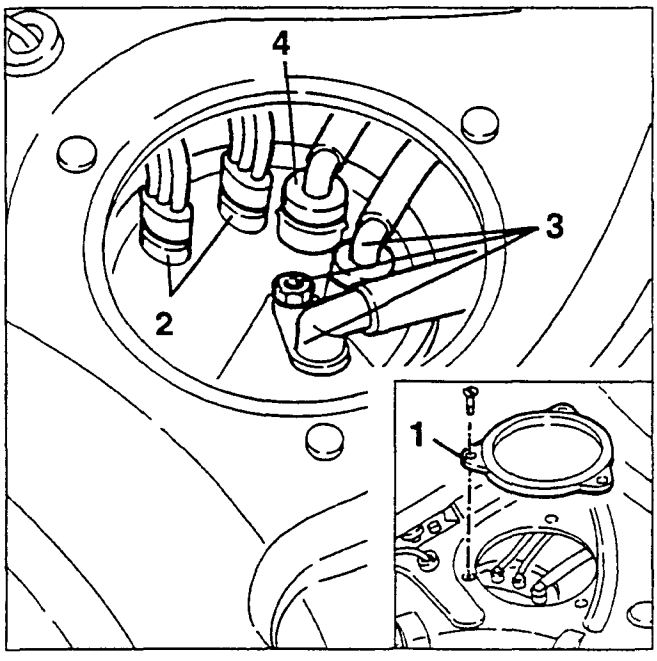


1. Fuel tank
2. Breather pipe
3. Fuel level meter pump assembly
4. Safety valve
5. Multi-purpose valve
6. Anti-bubbling tube
7. Filler neck

REMOVAL/REFITTING

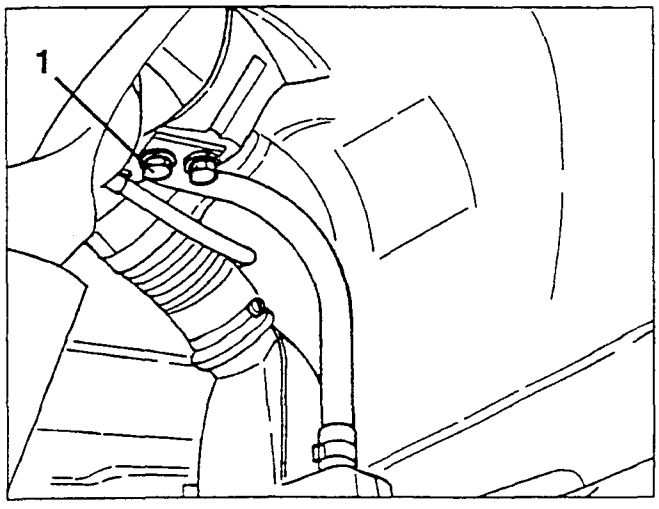
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Empty the tank by siphoning off the fuel through the filler neck using a special pump.
- Remove the right rear wheel.

1. Working in the luggage compartment tip back the covering and remove the pump access cover and fuel level meter.
2. Disconnect the two electrical connections from the pump-fuel level meter assembly.
3. Unscrew the nut on the safety plate and disconnect the connections from the fuel delivery and return hoses.
4. Unscrew the nut anf disconnect the air breather hose connecting the lower and upper parts of the tank.

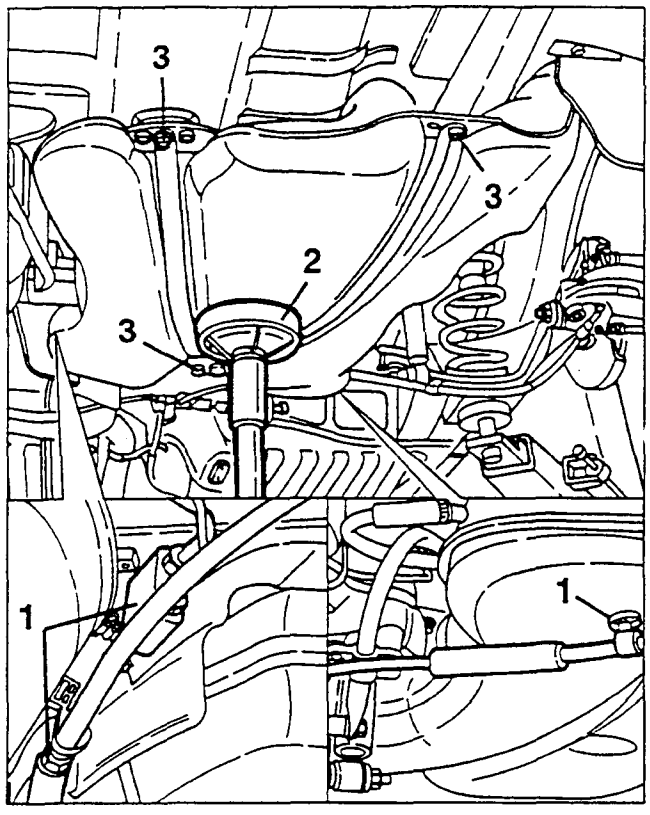


- Raise the car.

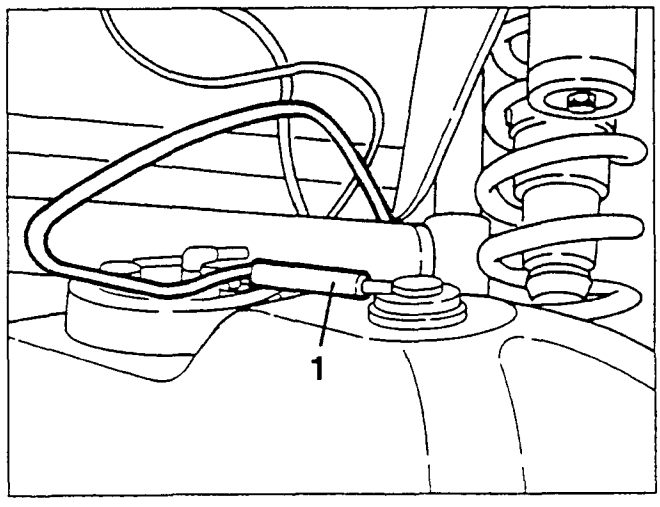
1. Working from the wheel arch, slacken the two screws fastening the filler neck.



1. Disconnect the handbrake cables and rear brake cables from their fastenings on the fuel tank.
2. Position a hydraulic jack under the tank.
3. Remove the plastic buttons and slacken the fuel tank fastening screws.

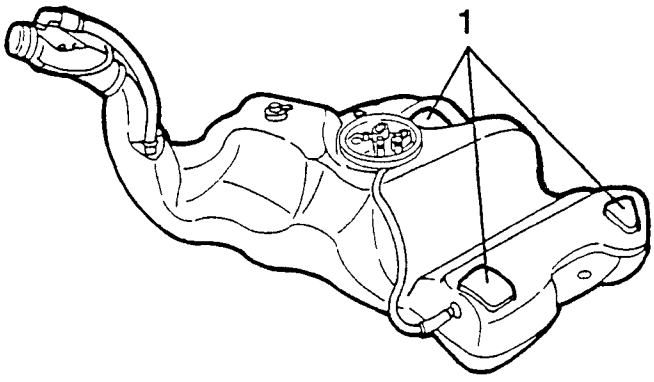


1. Lower the fuel tank using the hydraulic jack just enough to disconnect the fuel vapour breather valve from the multi-purpose valve.



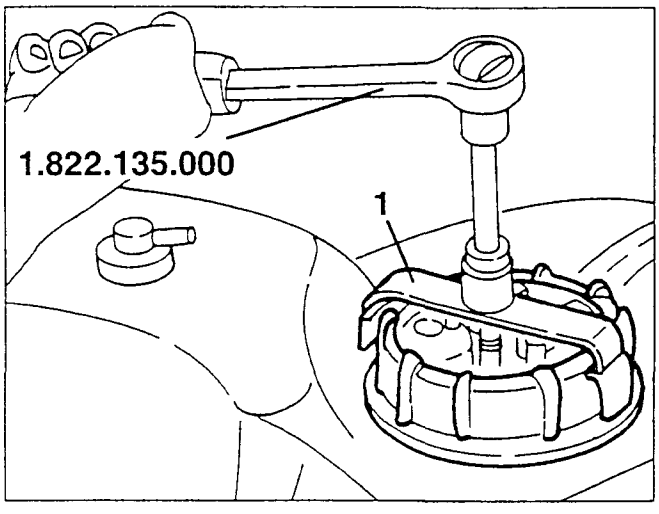
- Completely lower the hydraulic jack and remove the fuel tank.

When refitting the fuel tank check the presence of the rubber pads (1).

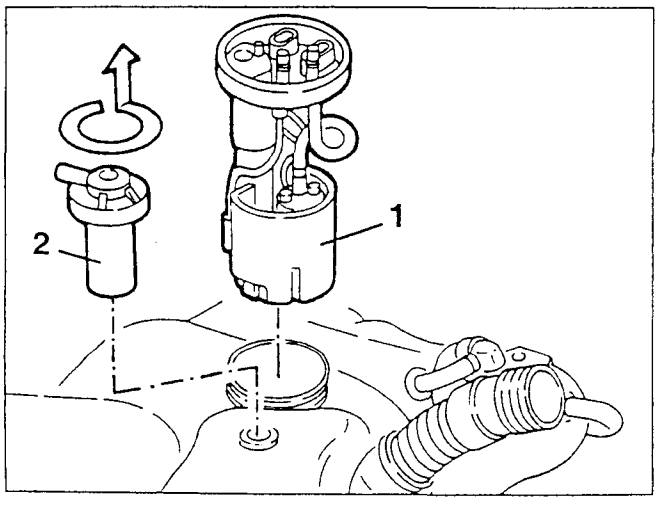


DIS-ASSEMBLY/REASSEMBLY

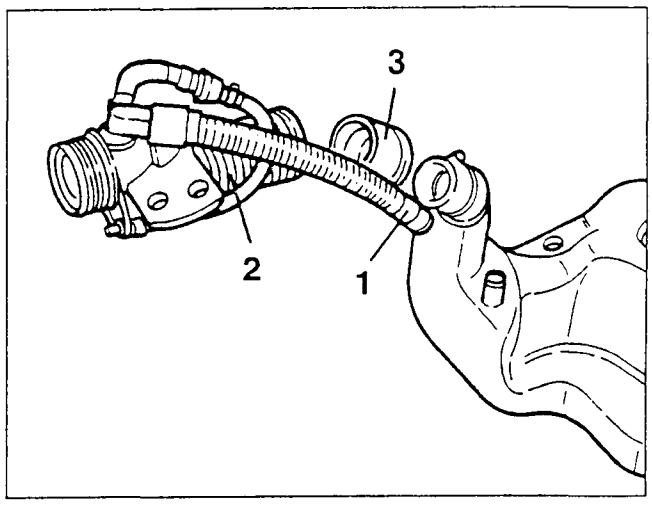
1. Remove the ringnut fastening the pump unit and fuel level gauge using tool N° 1.822.135.000.



1. Remove the fuel pump unit from the fuel tank.
2. Remove the multi-purpose valve from the fuel tank.



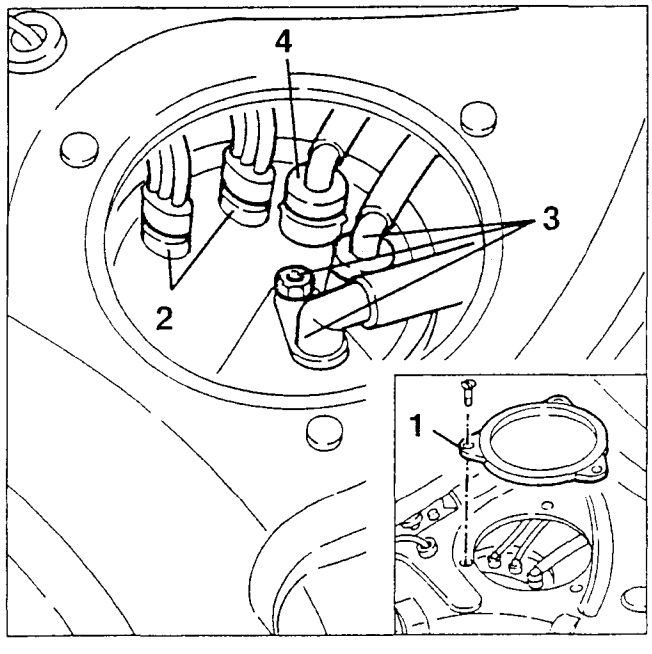
1. Disconnect the anti-bubbling pipe from the fuel tank.
2. Slacken the clamp and remove the fuel filler neck complete.
3. Remove the seal.



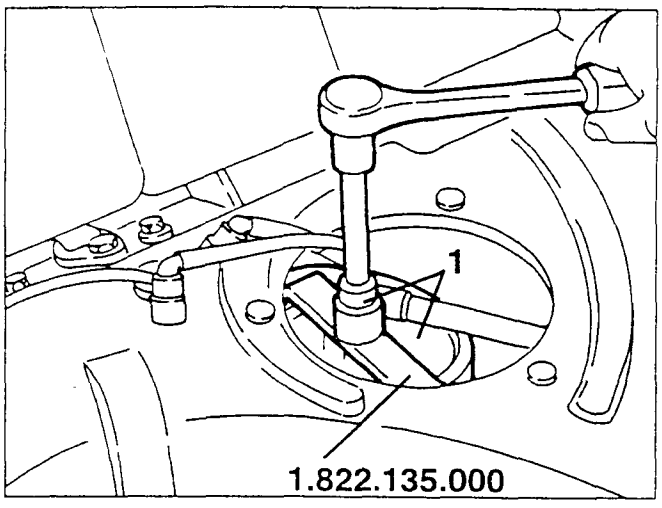
FUEL LEVEL METER-PUMP ASSEMBLY

REMOVAL/REFITTING

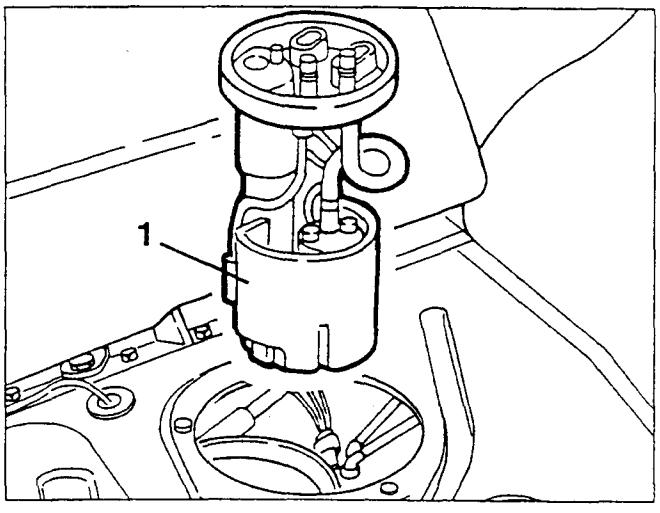
- Disconnect the negative cable from the battery.
1. Working in the luggage compartment tip the covering back and remove the fuel pump assembly access cover.
2. Disconnect the two electrical connections from the pump - fuel level meter assembly.
3. Disconnect the unions from the fuel delivery and return hoses.
4. Unscrew the nut and disconnect the air breather hose connecting the upper and lower parts of the fuel tank.



1. Remove the ring nut securing the fuel pump using tool 1.822.135.000.

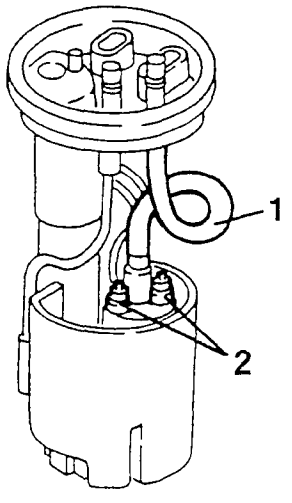


1. Withdraw the pump-fuel level meter assembly from the tank together with the gasket.

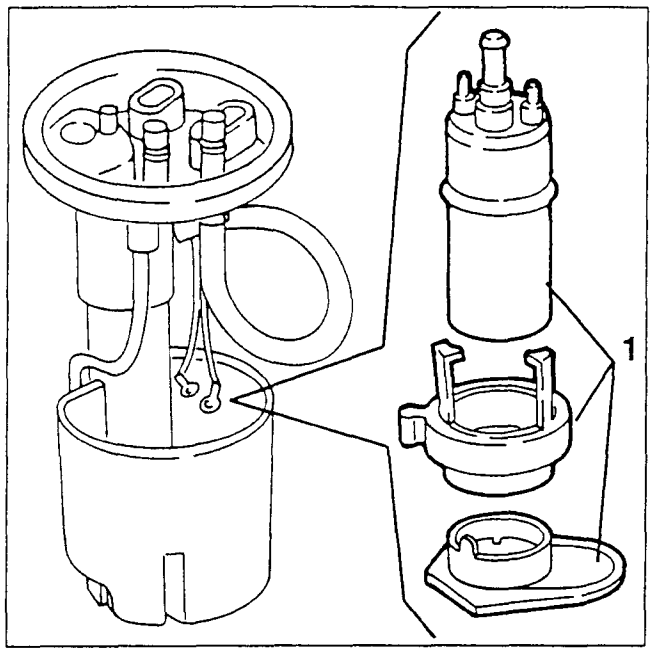


REMOVAL/REFITTING

1. Disconnect the fuel delivery hose from the electric pump.
2. Disconnect the two electrical connections from the electric pump.



1. Withdraw the electric pump with the intake filter and the support ring and if necessary separate them.



CHECKS AND INSPECTIONS

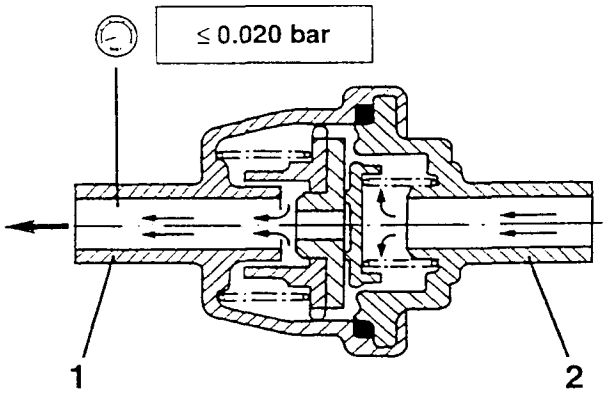
Clean the gauze filter thoroughly.
The presence of water in the fuel is particularly damaging to the pump as it causes internal rust. Carefully check the operation of the pump if the fuel is contaminated with water.
Also check the efficiency of the pump power supply contacts as any oxidation would cause a drop in voltage at the leads, resulting in the formation of bubbles and a reduction of the fuel injected.

WARNING:
When changing the pump, remember that it is supplied filled with protective oil and with the fittings suitably plugged. When assembling on the car it is not necessary to empty the oil from the pump as it is burnt immediately by the engine. If the protective oil is emptied fom the pump, it must be put into service within two weeks in order to prevent the formation of a film of dry oil on the motor collector which would make it unserviceable due to lack of electrical continuity.

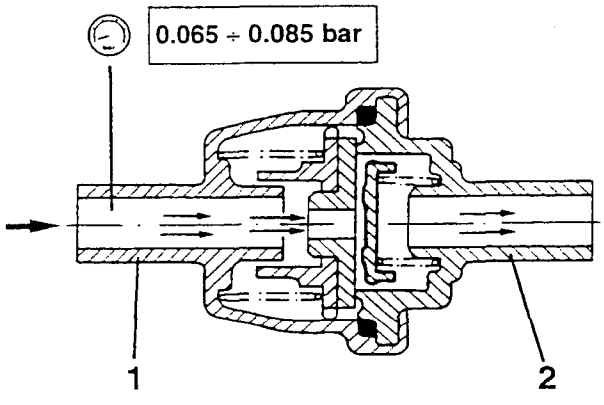
SAFETY VALVE

The purposes of this valve are the following:
- Ventilation of the fuel tank (together with the multi-purpose valve of the fuel vapour recirculation system)
- Fuel vapour release (only if the multi-purpose valve fails to operate).

The vacuum in the fuel tank determined by the withdrawal of fuel is countered by the opening of the safety valve set at ≤ 0.020 bar.



If the pressure inside the fuel tank exceeds 0.065 ÷ 0.085 bar, the valve opens to relieve part of the fuel vapour pressure to the atmosphere.

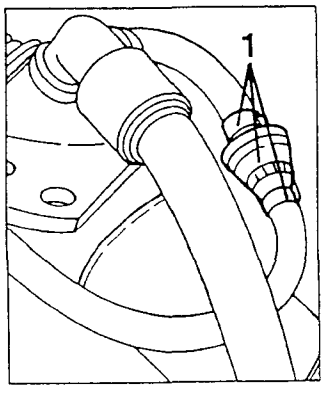


1. Fuel tank side 2. Atmosphere side

REMOVAL/REFITTING

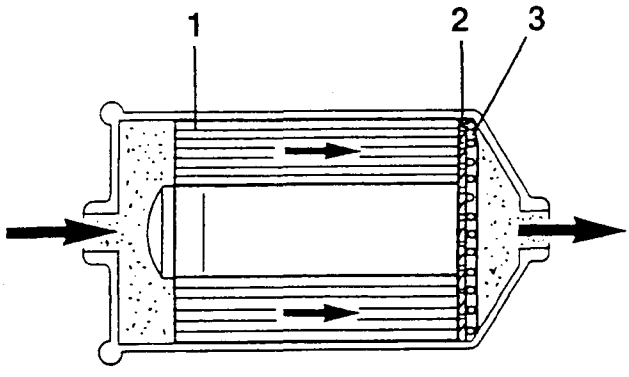
- Remove the right rear wheel.

1. Working from the right rear wheel arch, slacken the fastening clamps and remove the safety valve.



FUEL FILTER

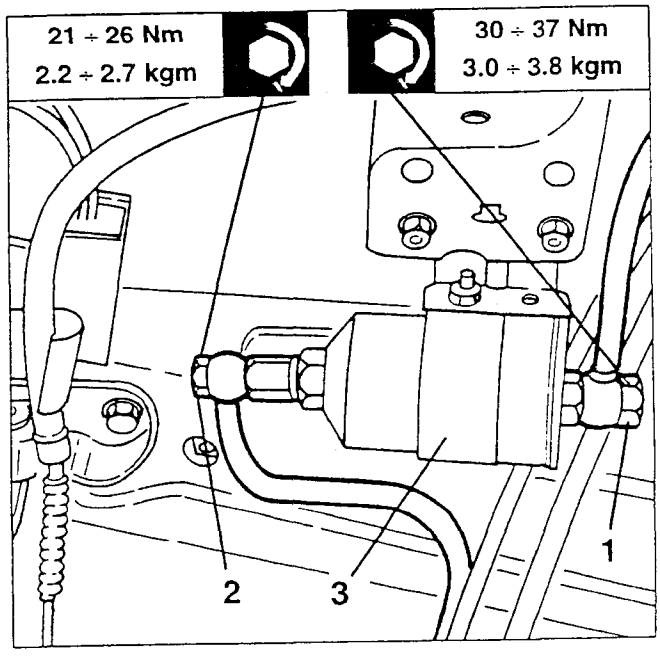
The filte is inserted in the fuel delivery pipe to the injectors, under the car floor, next to the fuel tank.
It is formed of an outer aluminium cover and an inner polyurethane support which carries a paper element with a high filtering power (~ 5 mm) and a surface of appr. 1400 cm^2.
Fuel filtering is indispensible to ensure correct operation of the electronjectors, given their sensitivity to foreign particles contained in the fuel circuit.
There is an arrow on the outer filter cover which indicates the direction in which the fuel flows and therefore the correct assembly position.



1. Paper filter 2. Fabric filter 3. Mesh

REPLACEMENT

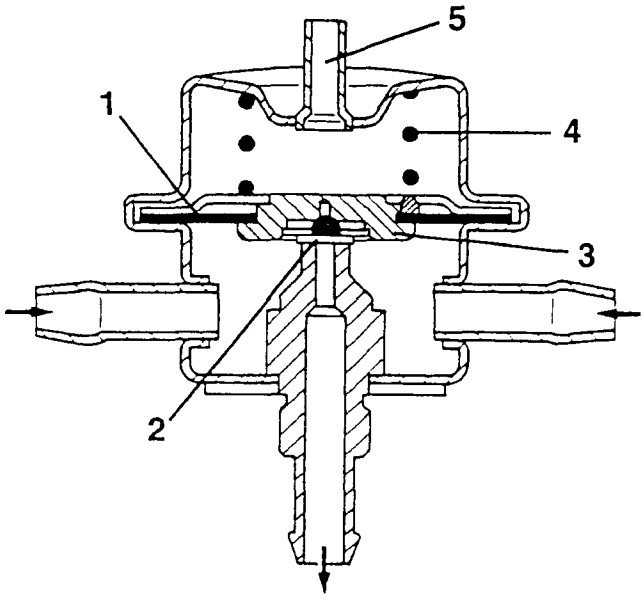
1. Disconnect the fuel inlet pipe fitting from the filter.
2. Disconnect the fuel outlet pipe fitting from the filter.
3. Slacken the fastening clamp and remove the fuel filter.



- Fit a new filter reversing the sequence described for removal and adhering to the following instructions:
• change the copper fitting seals;
• install the filter with the arrow stamped on it pointing in the direction of the flow of the fuel.

FUEL PRESSURE REGULATOR

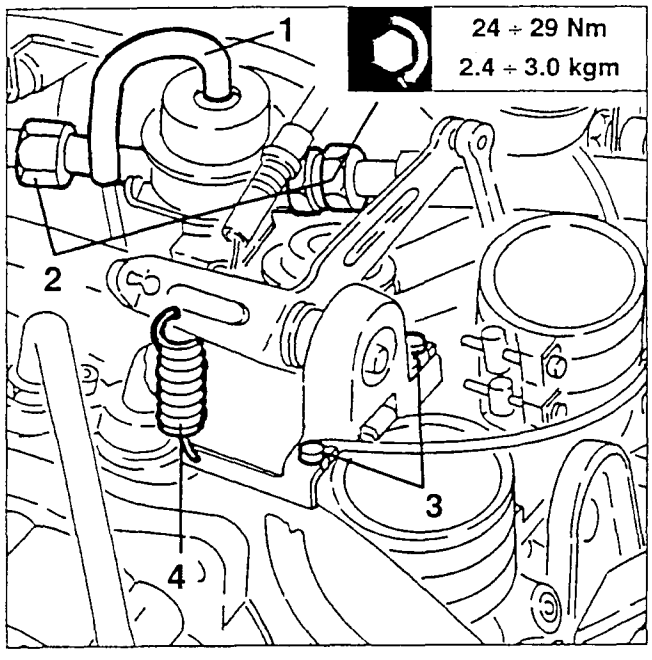
The task of the fuel pressure regulator is to keep the difference between the pressure of the fuel and the pressure in the intake manifold constant.
This way it is possible to meter the amount of fuel solely on the basis of the injector opening time.
The pressure regulator is fitted downstream of the fuel distributor manifold.
It is a limiting regulator controlled by a diaphragm which regulates the fuel pressure to 3 bar.
When the fuel pressure exceeds the maximum rating, the diaphragm acts on a valve which opens the return pipe, through which the excess fuel is returned to the fuel tank.
A tube connects the regulator spring chamber to the idle speed air distributor.
An interdependence is created by this tube between the pressure in the fuel system and the pressure in the intake manifold, so that the pressure between the inlet and outlet of the electroinjectors is always the same.



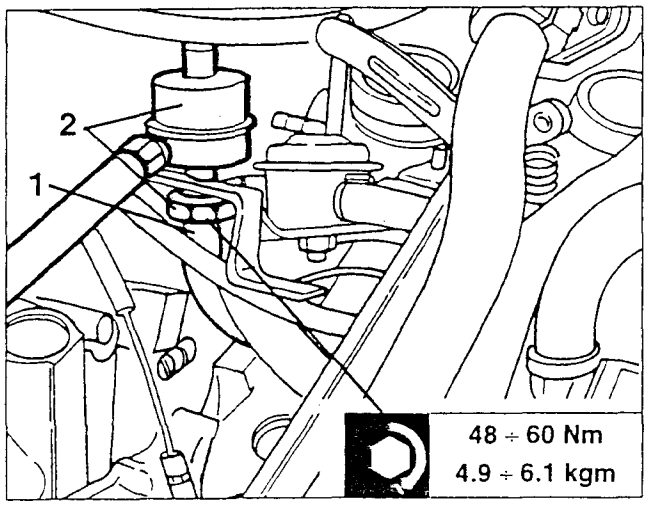
1. Diaphragm
2. Valve
3. Valve holder
4. Compression spring
5. Connection for vacuum takeoff

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the intake box (see specific paragraph).
1. Disconnect the vacuum takeoff pipe from the fuel pressure regulator.
2. Disconnect the fuel distributor fittings from the fuel pressure regulator.
3. Slacken the two nuts fastening the fuel pressure regulator and pulse damper support bracket.
4. Disconnect the throttle control shaft return spring.

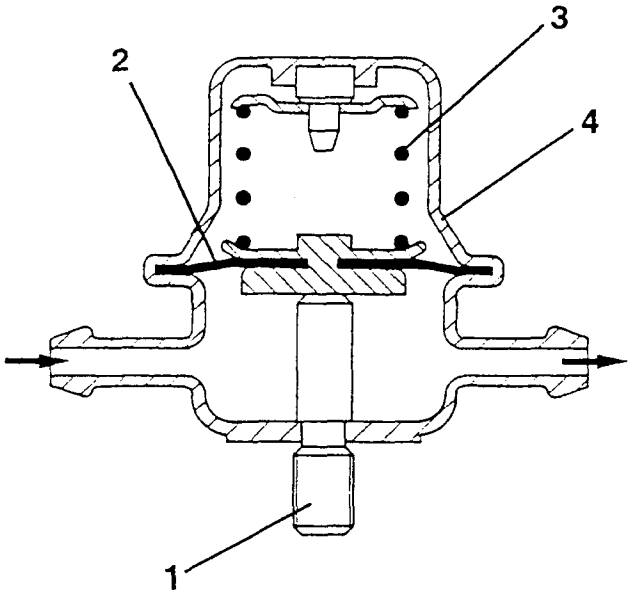


1. Raise the support bracket just enough to disconnect the excess fuel return pipe to the tank from the regulator.
2. Loosen the nut and remove the fuel pressure regulator.



PULSE DAMPER

The pulse damper is connected upstream of the fuel distributor and it serves to suppress the pulsing noises that can occur at low engine rpm.
The pulsing is generated by pressure differences of the fuel arising from the opening and closing of the electroinjectors or of the pressure regulator.

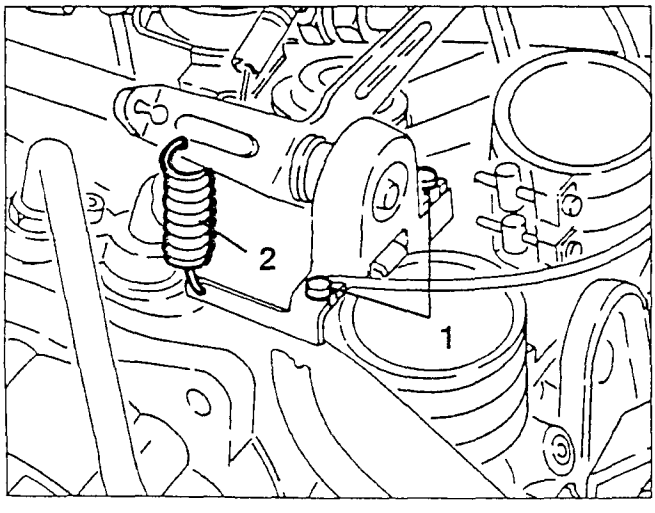


1. Fastening pin
2. Diaphragm
3. Spring
4. Covering

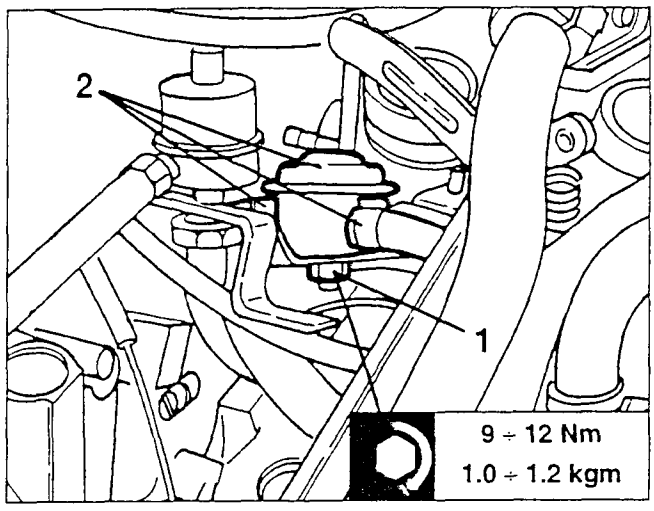
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the intake box (see specific paragraph).

1. Slacken the two nuts fastening the pulse damper and fuel pressure regulator support bracket.
2. Disconnect the throttle control shaft return spring.

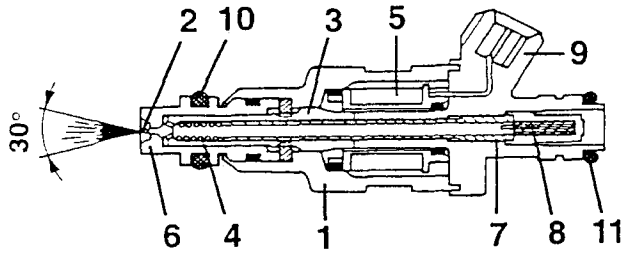


1. Turn the support bracket just enough to slacken the pulse damper fastening nut.
2. Raise the damper, disconnect the two fuel pipes and remove it.



ELECTROINJECTORS

The electroinjectors are installed on the bodies, immediately upstream of the intake valves.
The injector nozzle is formed so that the jet of fuel atomizes into a 30° cone.
The injectors are locked by the fuel distributor which presses them into their housings.
The injectors are also anchored to the fuel distributor by "safety catches".



1. Injector body
2. Needle
3. Magnetic core
4. Coil spring
5. Winding
6. Injector nose
7. Adjustable spring plate
8. Filter
9. Electrical connector
10. Vacuum seal ring
11. Fuel seal ring

Two O-rings ensure tightness on the intake bodies and on the fuel distributor manifold.
The electroinjectors have the task of metering the amount of fuel needed by the engine.
They are "all or nothing" devices i.e. they only have two possible conditions, either open or closed.
They will let the fuel pass when they are "open" and prevent it from being delivered when they are "closed".

They basically comprise a nozzle or ring controlled by an electromagnet and by a return spring.
In the rest position, the needle, which forms one piece with the core, is pushed by the spring onto the electroinjector nose to close the hole and ensure that unwanted fuel is unable to come out.
As soon as the winding is energized, the core is attracted, it compresses the spring opening the nozzle hole, thereby allowing the fuel to flow out.
Considering the physical characteristics of the fuel (viscosity, density) and the pressure difference (pressure regulator) constant, the amount of fuel injected depends on the injector opening time only.
The winding energizing time is normally called the "injection time".
Lastly, on the injector body there is a two-pin socket for electrical connection to the system.

CHECKING FOR CORRECT OPENING OF ELECTROINJECTORS

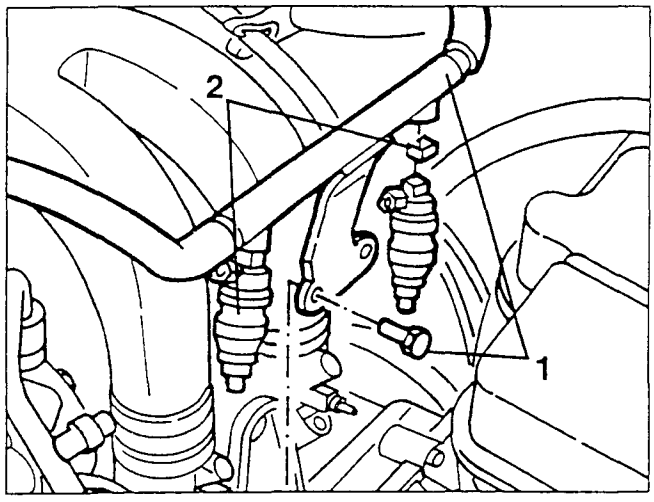
- Measure the percentage of CO at the exhaust.
- Disconnect the electroinjector connectors one by one; each time measure for a reduction of the CO percentage at the exhaust and check that this value remains constant at each check.
- If not, locate and replace the faulty electroinjector;
The efficiency of the electroinjectors can be checked visually by comparing the spark plug electrodes:
• a mixture which is too rich will be associated with a black colour.
• a mixture which is too lean will be associated with a light colour.

CHECKING THE SEALING OF ELECTROINJECTORS

- Remove the electroinjectors complete with fuel distributor manifold, keeping the fuel supply circuit connected.
- Disconnect the connectors from the electroinjectors.
- Operate the starter motor and check that there are no leaks of fuel from the electroinjectors; if so, replace the faulty injector.

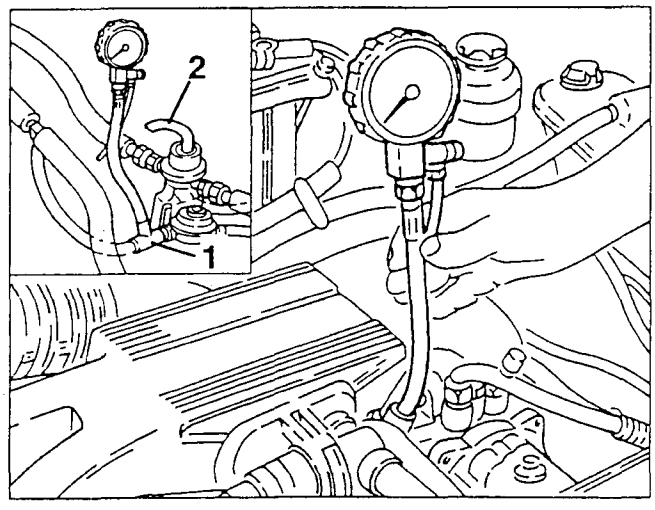
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Disconnect the electrical connections from the electroinjectors.
1. Slacken the screws fastening the fuel distributor manifold and remove it.
2. Remove the fastening clips and remove the electroinjectors.



CHECKING THE PRESSURE AND TIGHTNESS OF THE FUEL CIRCUIT

- Remove the intake box (see specific paragraph).
1. Disconnect the fuel outlet pipe from the pulse damper, then connect a pressure gauge using a T adapter between the damper and the disconnected pipe.
2. Disconnect the vacuum takeoff pipe from the pressure regulator to avoid any irregularities in the rotation speed from causing abnormal readings.
- Refit the intake box, start the engine and at idle speed, check that the fuel pressure is within the specified limits.

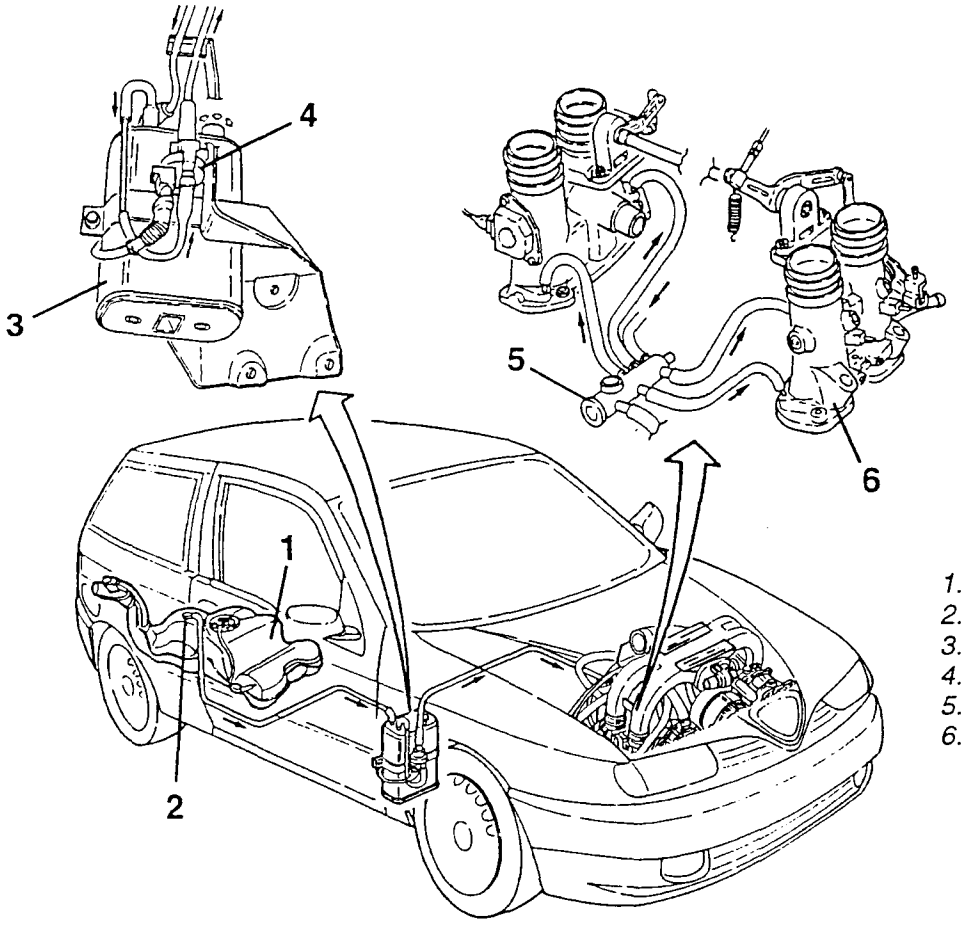


Fuel pressure at idle speed
2.8 ÷ 3.2 bar

- Reconnect the vacuum takeoff pipe to the pressure regulator and check that the fuel pressure falls by 0.5 bar and then rises again when the throttle valve is opened. If this fails to take place, look for leaks on the vacuum takeoff pipe.

- Keeping the vacuum takeoff pipe connected to the regulator and with the engine running at idle speed, choke the fuel outlet pipe from the regulator measuring the pressure increase up to 4 bar (avoid letting the pressure exceed this value).
- If the pressure fails to reach the above value and there are no leaks, check the fuel filter and/or the operation of the pump.

DESCRIPTION FUEL VAPOUR RECOVERY SYSTEM



1. *Fuel tank*
2. *Multi-purpose valve*
3. *Vapour filter (canister)*
4. *Solenoid valve*
5. *Idle speed air distributor*
6. *Intake bodies*

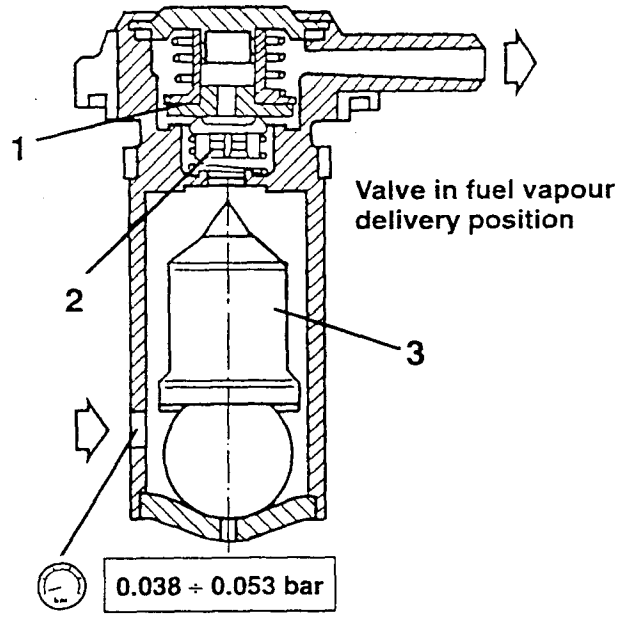
The fuel contained in the tank produces a considerable amount of vapours, which would pollute the environment if released.
The vapour control and recovery system gathers these vapours and burns them in the engine.
When the vapours inside the fuel tank reach a pressure of 0.038 ÷ 0.053 bar, they are sent through a multi- purpose valve to the fuel vapour filter canister where they are absorbed and stored by the active carbon contained in the filter.
There is a solenoid valve between the fuel vapour filter and the engine intake. When the solenoid valve is not activated the connection with the intake is closed and the fuel vapours are collected in the canister in the active carbon.
Under certain load conditions the control unit controls the opening of the solenoid valve allowing any fuel vapours in the canister to be withdrawn.

This condition remains even if at the exhaust the lambda sensor detects a reduction of oxygen which, due to the presence of too much fuel in the combustion chamber, is signalled to the control unit which delivers less fuel to the injectors so that the engine is always supplied normally.
Vice-versa, if the lambda sensor detects an increase of the oxygen, due to the lack of fuel vapours in the canister which leads the canister to draw in air, the control unit is signalled.
In this case the control unit closes the solenoid valve thus preventing the connection of the canister with the intake.

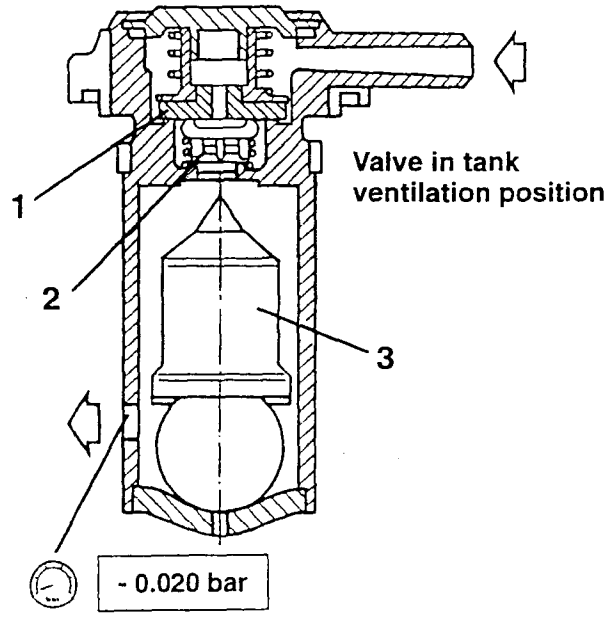
MULTI-PURPOSE VALVE

The purposes of this valve are:
- To send the fuel vapours to the canister
- Ventilate the fuel tank
- Prevent the fuel from spilling

When the pressure of the vapours in the tank reaches 0.038 ÷ 0.053 bar, a diaphragm countered by a spring allows them to be released to the canister.

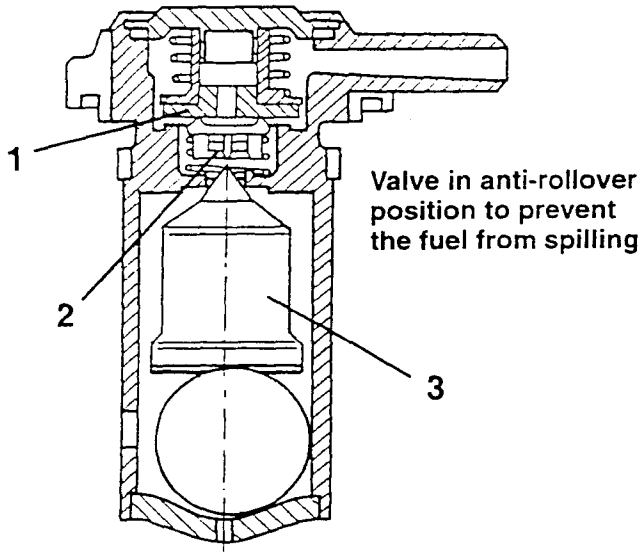


To ventilate the tank with vacuum ratings below -0.020 bar, a centre cup acts on the above-mentioned diaphragm countered by another spring and lets air into the tank.



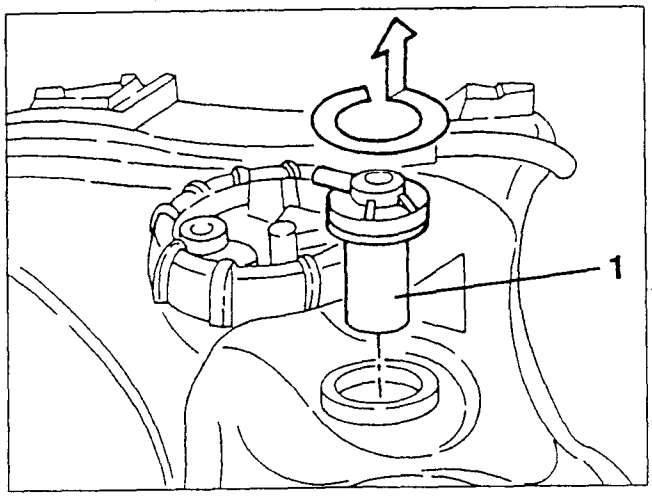
1. Fuel vapour relief valve to canister
2. Tank ventilation valve
3. Needle valve

In the lower part of the body there is a taper housing on which a ball of suitable weight is housed. This ball rolls on its housing and under the centrifugal thrust received from the car, it raises and closes a needle valve to prevent the fuel from spilling when the car sways and when it is parked on sloping ground.
The needle valve also acts as an anti-rollover valve.



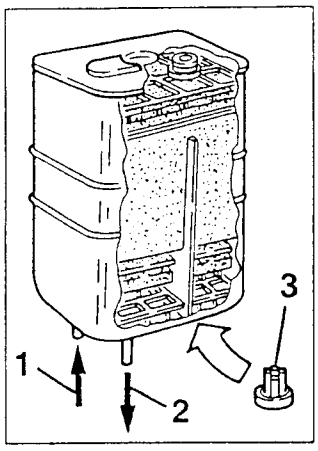
REMOVAL/REFITTING

- Remove the fuel tank (see specific paragraph).
1. Remove the multi-purpose valve from the fuel tank.



FUEL VAPOUR FILTER (CANISTER)

The filtering element comprises active carbons enclosed in a plastic container which absorb the fuel vapours leading from the fuel tank.

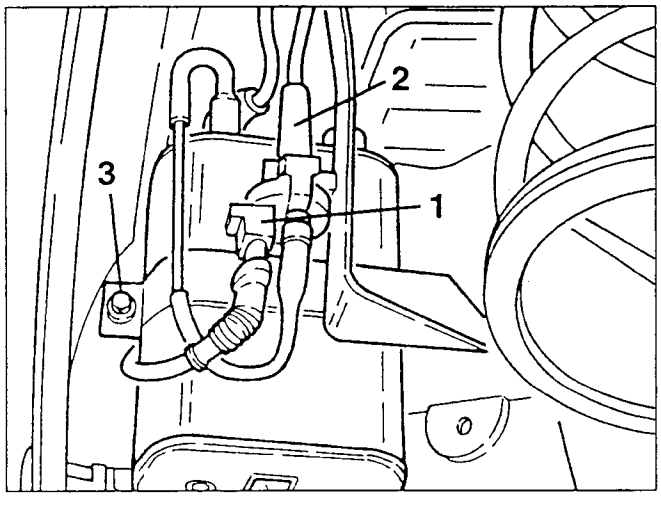


A one-way valve admits outside air when the vapours are sucked in. This is to carry out a washing action on the active carbon.
It is possible to test the tightness of the system connecting as described in the specific procedure to the housing of the one-way valve after removing the valve.

1. From the multi-purpose valve
2. To the solenoid valve
3. One-way washing valve

REMOVAL/REFITTING

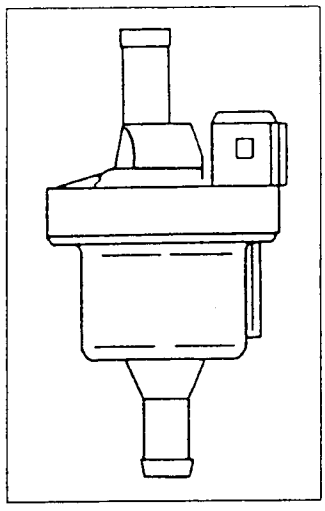
- Remove the right front wheel and wheel arch (see GROUP 70).
1. Disconnect the electrical connection from the fuel vapour solenoid valve.
2. Disconnect the vapour delivery pipe to the engine intake from fuel vapour solenoid valve.
3. Slacken the screw of the fuel vapour filter fastening clamp.



- Lower the fuel vapour filter just enough to disconnect the fuel vapour inlet pipe, then remove the filter.
- On the bench, separate the solenoid valve complete with connection pipe from the fuel vapour filter.

FUEL VAPOUR SOLENOID VALVE

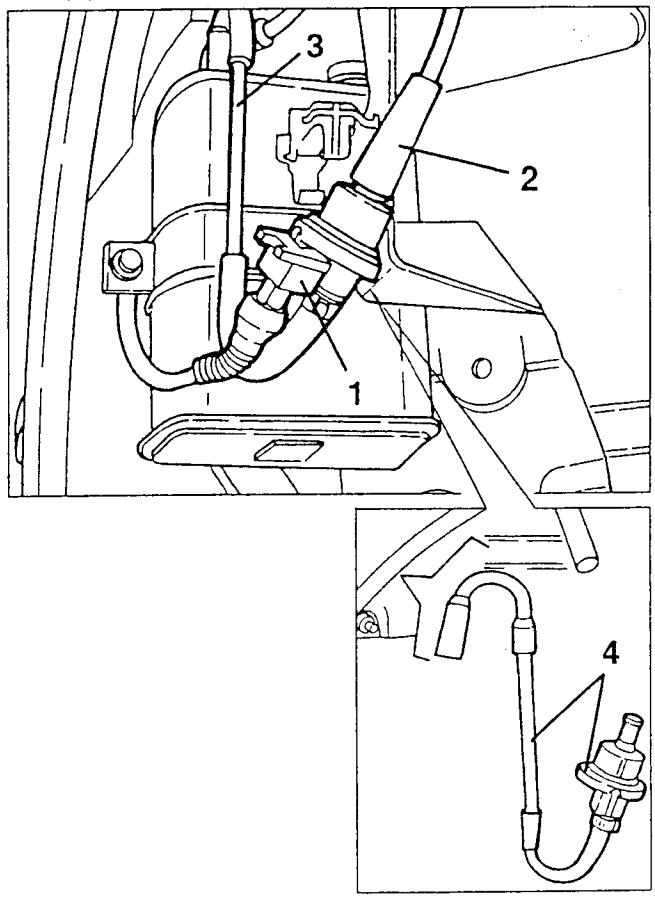
This valve is controlled by the Motronic control unit and its purpose is to let the fuel vapours stored in the canister pass through to send them to the engine intake.



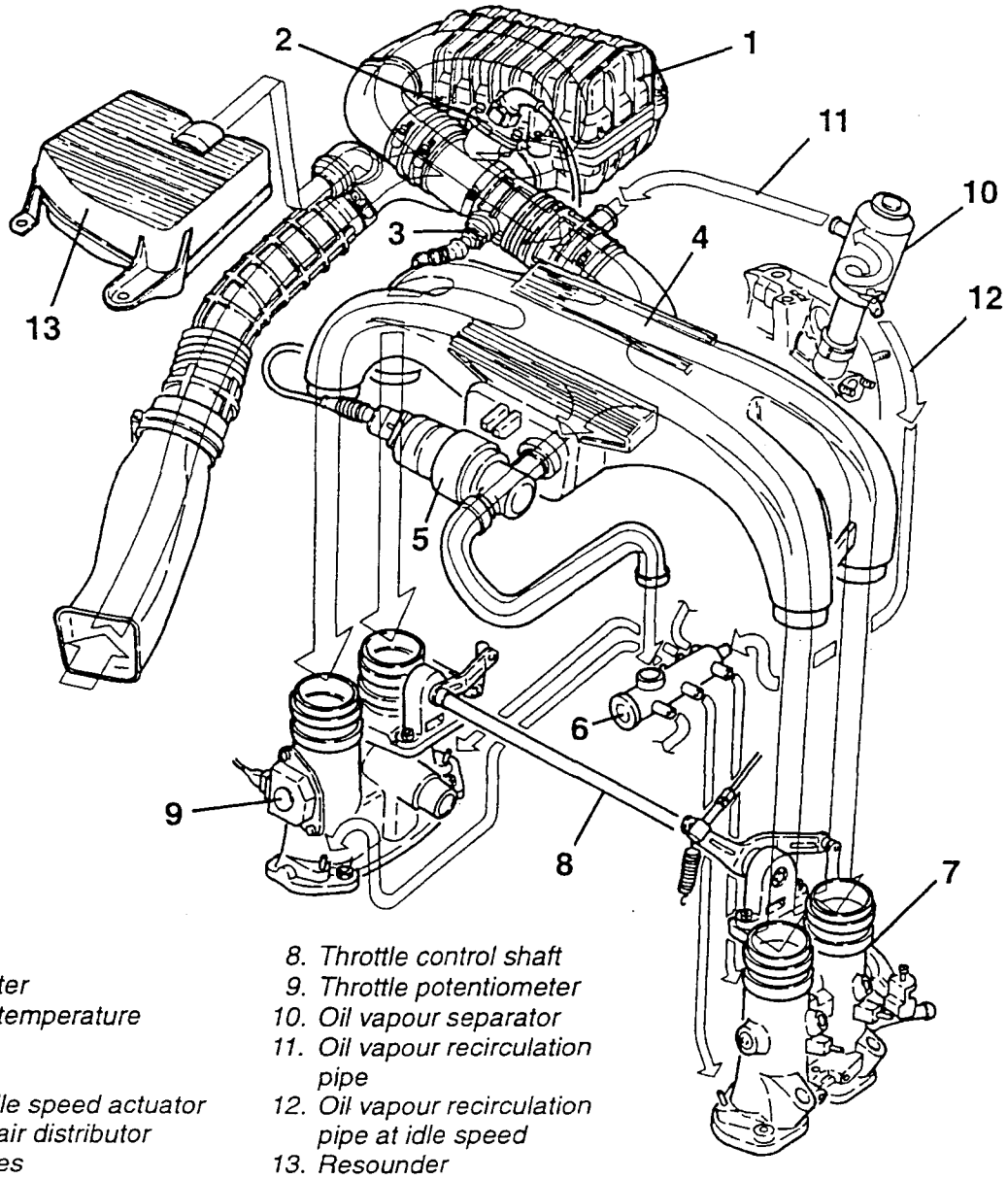
The valve enclosed in the casing comprises a mobile part or shutter, constrained to a plate spring; the fixed part is formed of a metal cylinder perforated inside on which the coil is wound.
The device is structured so that when the coil is supplied, the shutter is attracted against the cylinder, which replaces the fixed part of the valve and closes it.

REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and wheel arch (see GROUP 70).
1. Release the solenoid valve from the support bracket and disconnect the electrical connection.
2. Disconnect the fuel vapour delivery pipe to the engine intake from the solenoid valve.
3. Disconnect the solenoid valve connection pipe from the fuel vapour filter.
4. Remove the fuel vapour solenoid valve complete with pipe and separate them on the bench.



AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM



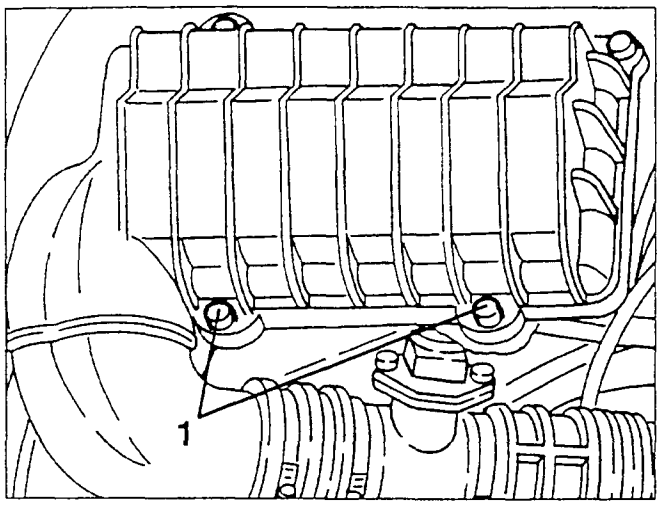
1. *Air filter*
2. *Air flow meter*
3. *Intaken air temperature sensor*
4. *Intake box*
5. *Constant idle speed actuator*
6. *Idle speed air distributor*
7. *Intake bodies*
8. *Throttle control shaft*
9. *Throttle potentiometer*
10. *Oil vapour separator*
11. *Oil vapour recirculation pipe*
12. *Oil vapour recirculation pipe at idle speed*
13. *Resounder*

The air taken in through a dynamic inlet is put into communication with a resonance capacity to dampen the noise fitted above the corrugated air intake sleeve.
After being filtered through a cartridge element, the air passes into the corugated sleeve where the hot film flow meter and intaken air temperature sensor are to be found.
From the corrugated sleeve the air enters the intake box from which it is sent to the bodies which are fitted with throttles controlled by the shaft connected to the accelerator cable and adjust the amount of air taken in by the engine.
There is an additional air electromagnetic valve on the intake box which py-passes the throttle valves with a series of pipes to keep the engine idle speed constant under particular conditions of the engine.

The fuel vapours and oil vapours (see specific paragraph) are ducted to the air supply system.
The oil vapours are developed when the engine is running and they are collected in the separator.
From the separator, the condensed oil falls back into the crankcase while the remaining vapours are sent to the engine through two pipes.
When the engine is running at idle speed, the oil vapours are ducted to the throttles through the connection to the idle speed air distributor.
At higher loads, the vapours are taken in by the engine upstream of the intake box through the connection to the corrugated sleeve.

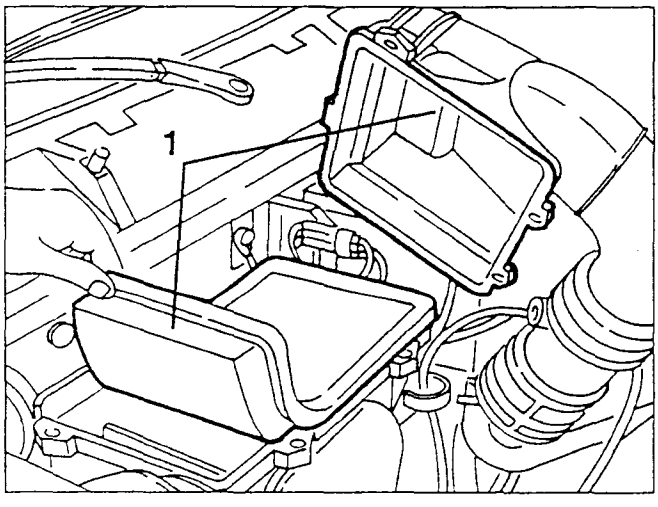
CHANGING THE AIR CLEANER CARTRIDGE

1. Slacken the four screws fastening the air cleaner cover.



1. Raise the air cleaner cover just enough to remove the filtering element.

WARNING:
Any cleaning operation on the filter might damage it and risk compromising the correct operation of the engine supply system.

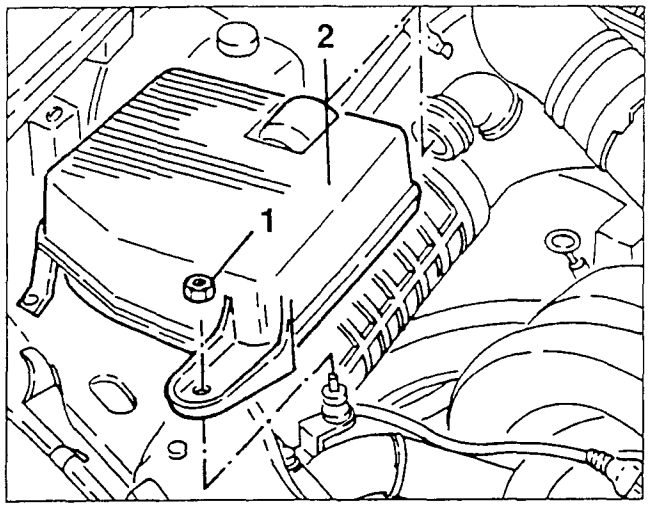


If the air cleaner shows traces of oil, check for any leaks in the whole circuit.

RESOUNDER

REMOVAL/REFITTING

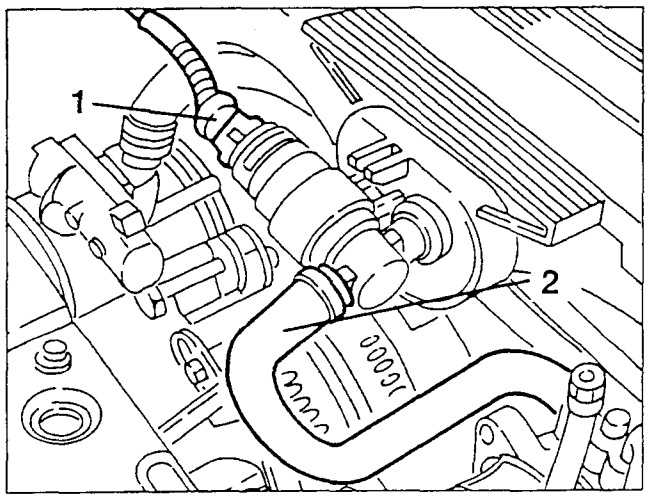
1. Slacken the two nuts fastening the resounder to the support brackets.
2. Remove the resounder disconnecting the air intake hose connection from the elbow.



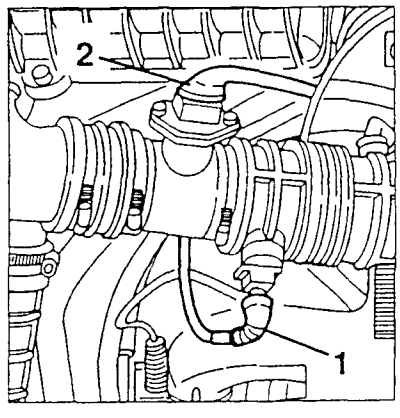
AIR INTAKE BOX

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the air intake pipe from the constant idle speed actuator.

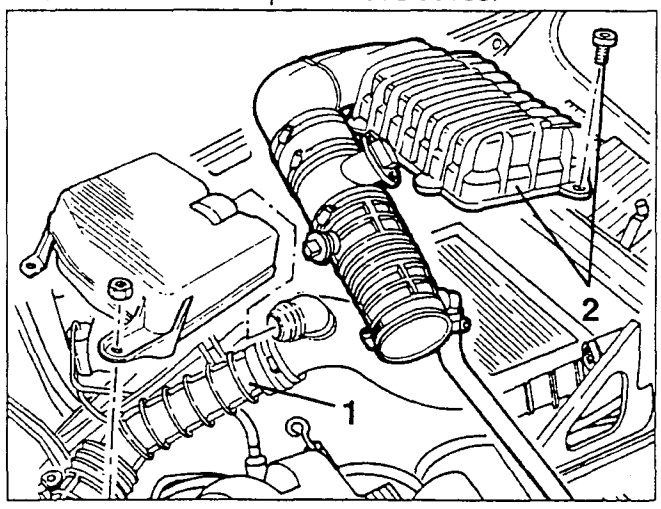


- Remove the resounder (see specific paragraph).
1. Disconnect the electrical connection from the intaken air temperature sensor.
2. Disconnect the electrical connection from the air flow meter.

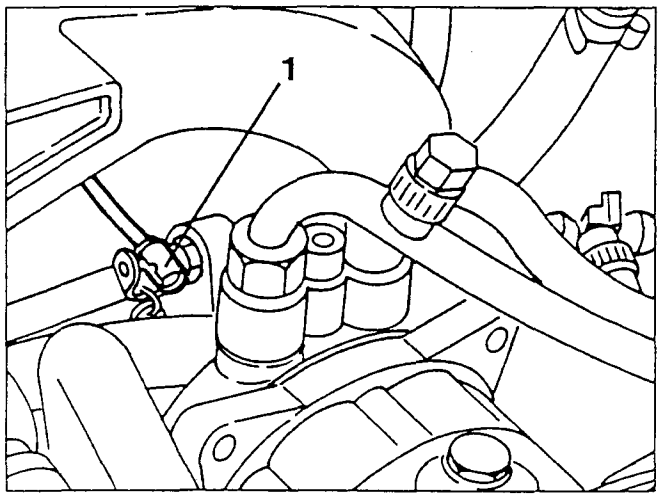


- Disconnect the oil vapour recovery pipe.
- Disconnect the corrugated sleeve from the intake box.

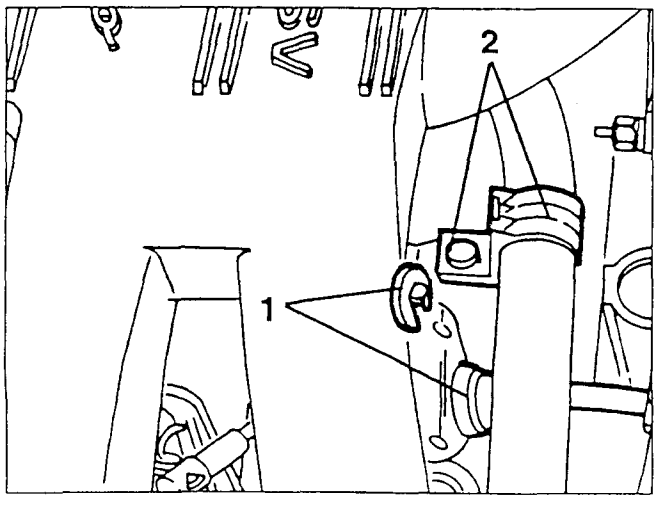
1. Remove the resounder.
2. Slacken the four fastening screws and remove the air cleaner cover complete with sleeves.



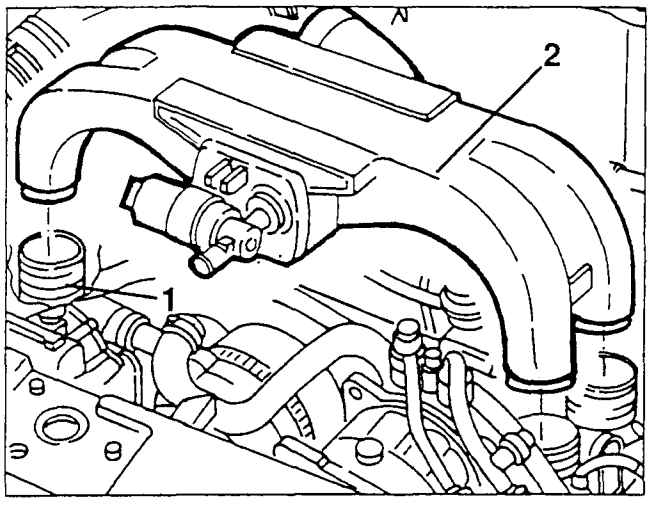
1. Disconnect the accelerator cable from the throttle control shaft.



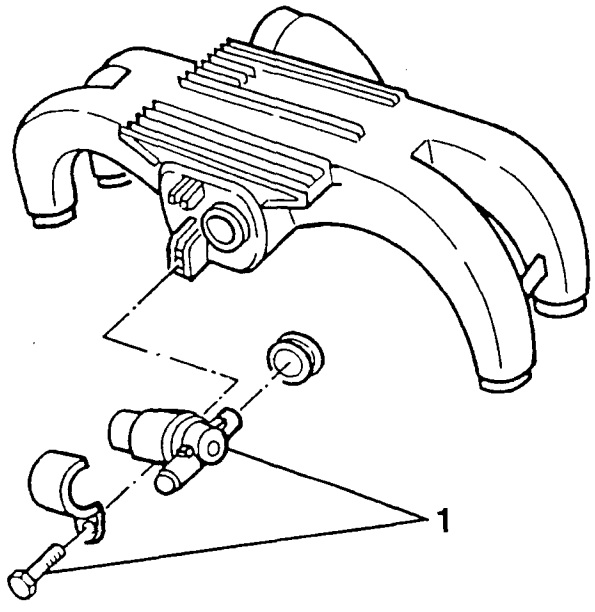
1. Remove the stop and withdraw the accelerator cable from the support bracket.
2. Slacken the power steering pipe support clamp fastening screw from the intake box.



1. Slacken the clamps fastening the air intake box to the sleeves of the bodies.
2. Raise the intake box just enough to disconnect the fuel distributor from the fastening clamp, then remove it.



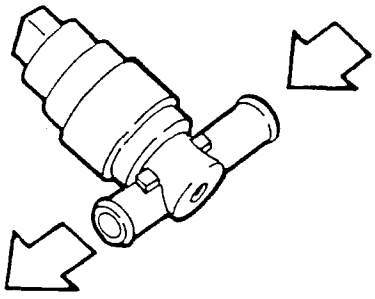
1. On the bench, slacken the fastening clamp screw and remove the constant idle speed actuator from the intake box.



CONSTANT IDLE SPEED ACTUATOR

A hose by-passes the throttle valve and connects with an idle speed actuator to be found on the intake box. The cross-section of the actuator determines the flow of air when the throttle valve is closed.
The cross-section may be adjusted through a rotating slider. To control idle speed a rotary actuator with double winding is used.
One of the windings moves the slider in the "opening" direction while the other turns it in the "closing" direction.

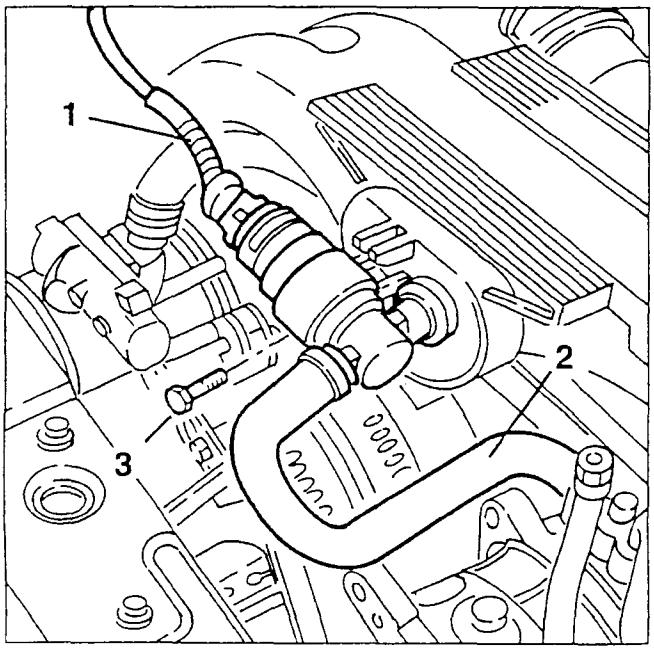
The two actuator windings, for idle speed, are supplied with two complementary duty-cycle signals i.e. they receive voltage and produce opposite forces on the rotor.



A determinate number of pulses, with the battery voltage and winding temperature constant, correspond to a well-defined angular position of the rotary valve and, therefore, a precise opening section of the by-pass. The idle speed regulator is controlled by a part of programme stored in the control unit.
The constant idle speed actuator is mainly used to determine the exact amount of air when starting and for maintaining an ideal idle speed condition under all engine conditions.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the air intake pipe from the constant idle speed actuator.
3. Slacken the clamp fastening screw and remove the constant idle speed actuator.

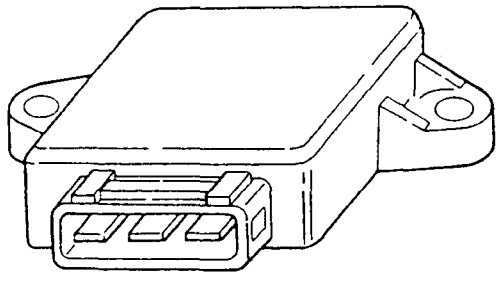


CHECKS AND INSPECTIONS

For checking the operation of the electromagnetic part of the actuator see GROUP 55 - "ELECTRIC SYSTEM DIAGNOSIS".

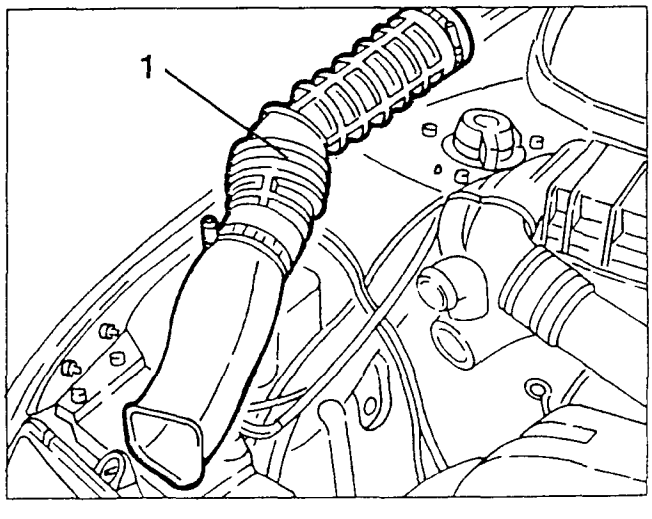
THROTTLE POTENTIOMETER

This is a potentiometer, the mobile part of which is controlled directly by the throttle valve shaft.
The potentiometer informs the control unit instantly when there is the need for "full power", anticipating the signal from the air flow meter which records a considerable increase of the air flow thereby obtaining an immediate response.
The potentiometer automatically detects the throttle contact position by a "self-adapting" function.
This dispenses with the need to adjust the potentiometer and makes it possible to follow any wear occurring on the throttle closed position over the course of time.

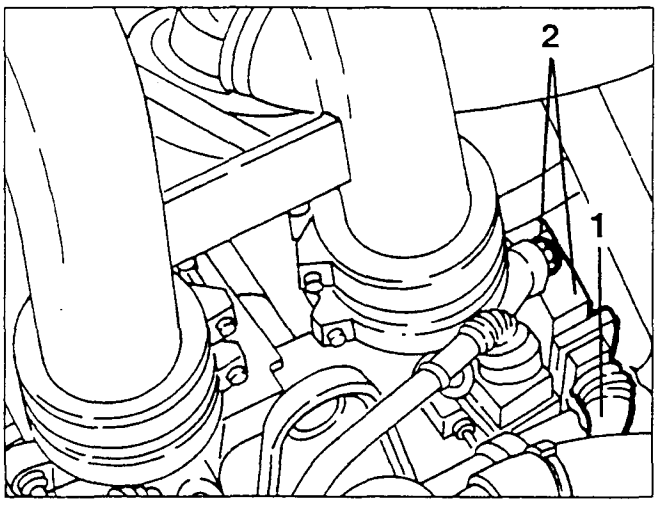


REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the resounder (see specific paragraph).
1. Slacken the clamp fastening to the air cleaner box, slacken the front fastening bolt and remove the air intake duct.



1. Disconnect the electrical connection from the throttle potentiometer.
2. Slacken the two fastening screws and remove the throttle potentiometer.

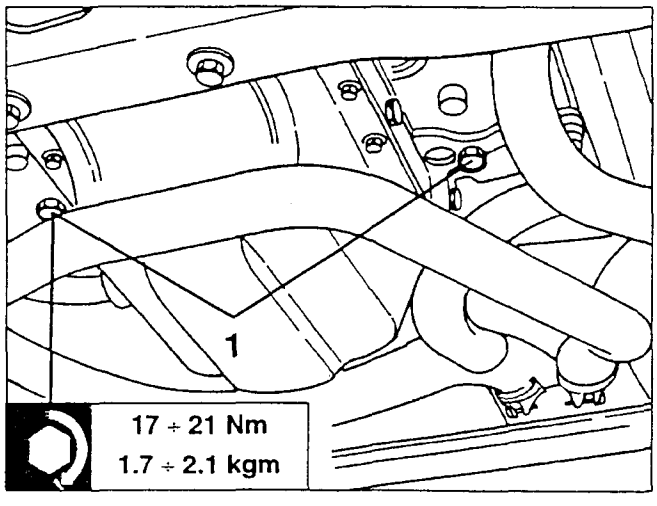


BODIES

REMOVAL/REFITTING

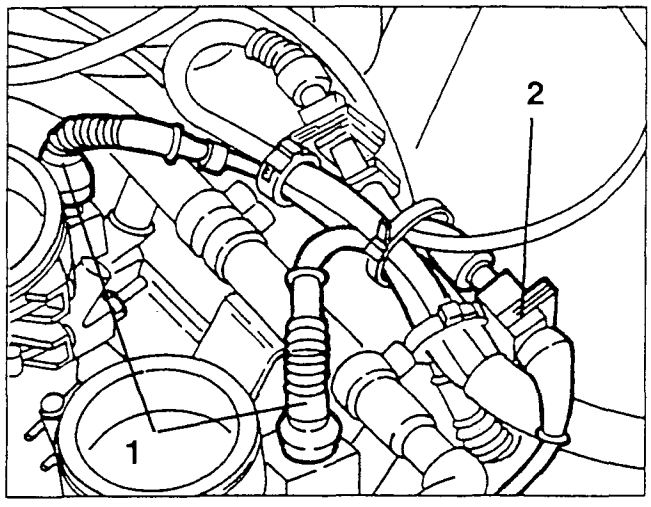
The following procedure describes the sequence for removing/refitting the left-hand body.
However, this procedure may be used for the right-hand body adapting it suitably owing to the different location of certain components.

1. Slacken the two plugs under the crankcase and drain the coolant fluid into a suitable recipient.

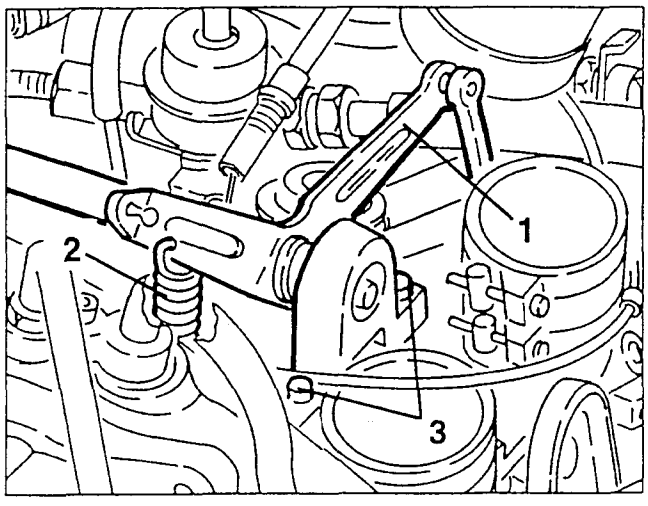


- Remove the air intake box (see specific paragraph).
1. Disconnect the electrical connections from the electroinjectors.

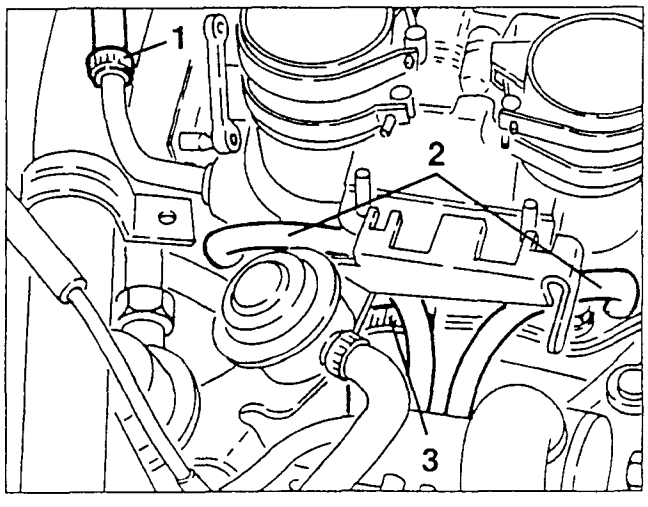
2. Disconnect the connection of the engine coolant temperature sensor (NTC).



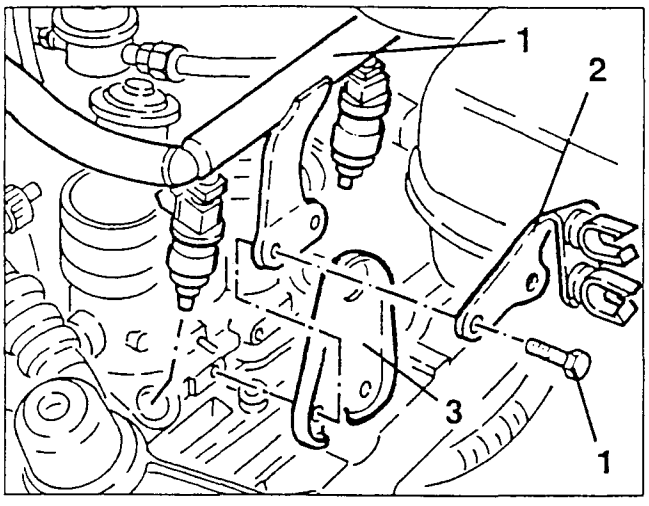
1. Disconnect the tierods from the throttle control shaft
2. Disconnect the spring.
3. Slacken the fastening nuts and remove the throttle control shaft, retrieving the spacers.



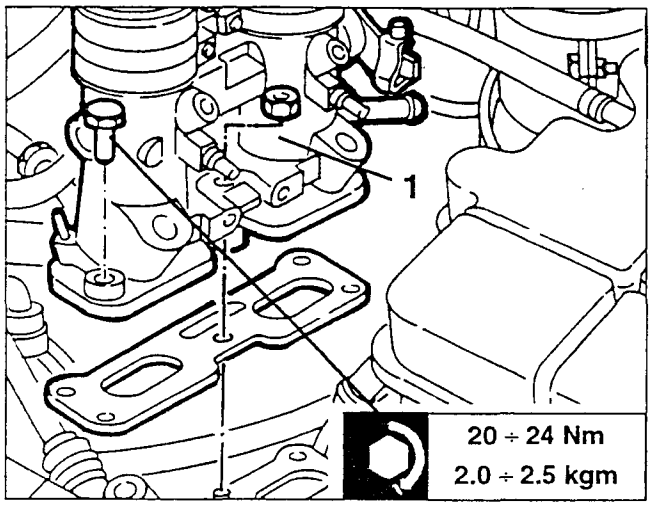
1. Disconnect the servobrake vacuum takeoff pipe.
2. Disconnect the two evaporative pipes from the body.
3. Disconnect the engine coolant sleeve from the body.



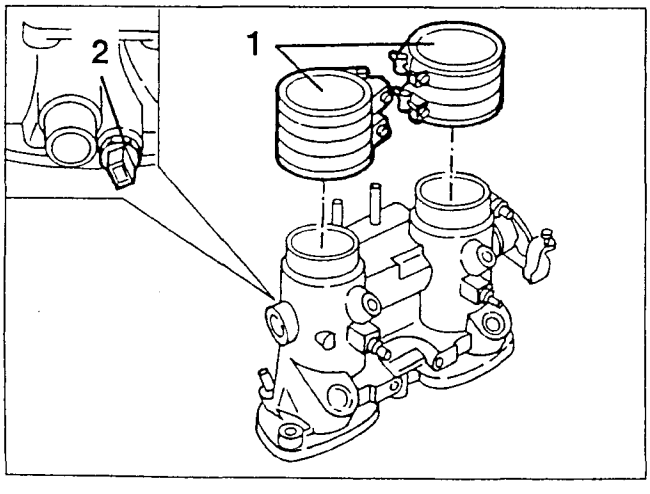
1. Slacken the two screws fastening the fuel distributor manifold and raise it removing the injectors from their housings.
2. Retrieve the cable support bracket.
3. Retrieve the engine lifting bracket.



1. Slacken the four screws and the nut fastening the body, then remove it.

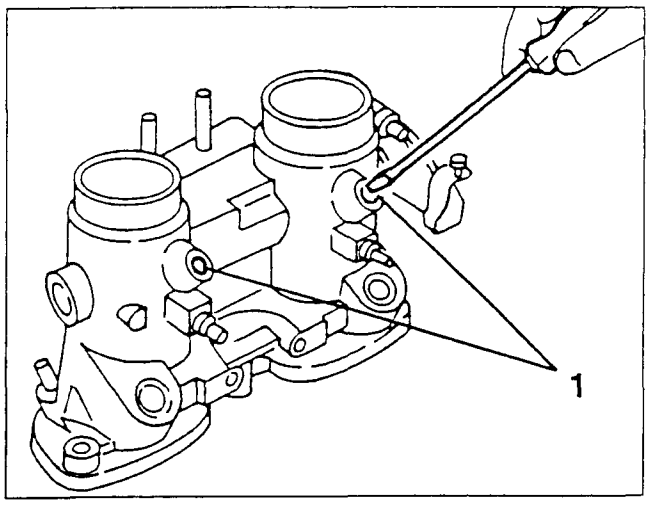


1. On the bench, slacken the fastening clamps and remove the sleeves from the body.
2. Slacken and remove the engine coolant temperature sensor (NTC).

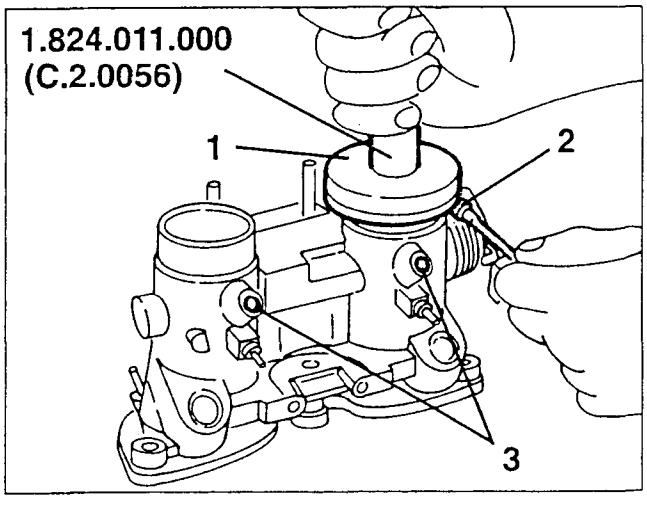


FLUX TEST ON THE BENCH

1. Remove the seals and unscrew the by-pass screws completely.



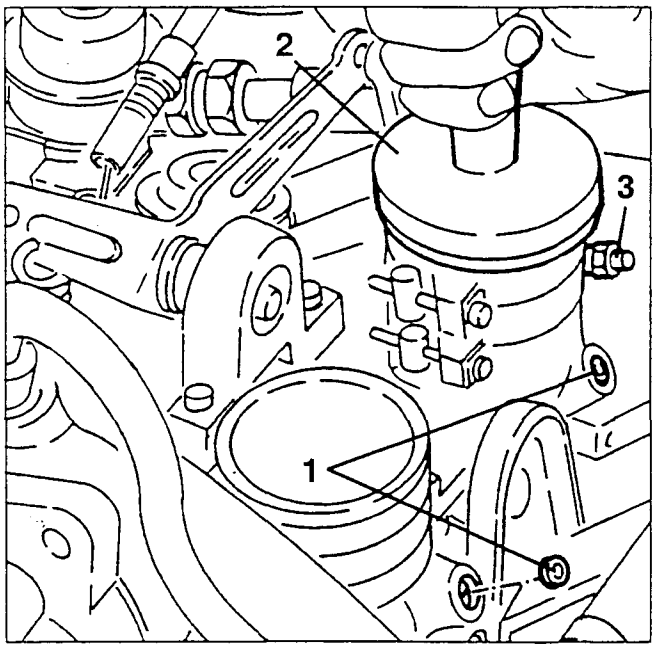
1. Set the flow meter to scale "K" and take the reading on each of the body tubes using tool N° 1.824.011.000 (C.2.0056) checking that the flow rate is 120 ÷ 130.
2. If not, turn the throttle adjustment screw until the specified value is obtained.
3. With the throttles adjusted, open the by-passes (unscrew) until a flow rate of 185 is obtained with the flow meter on scale "N".



FLUXING TEST ON THE CAR

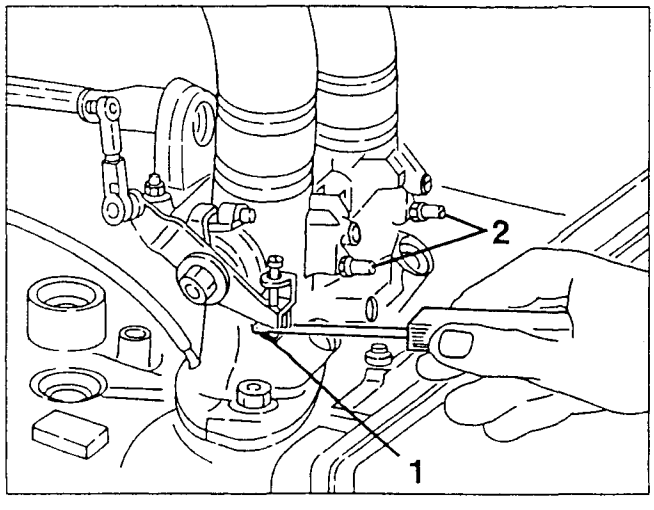
- Remove the air intake box complete with connection sleeves to the bodies (see specific paragraph).
- Set the flow meter to scale "N" and take the reading on each tube of the bodies using tool N° 1.824.011.000 (C.2.0056), checking that the flow rate is 185.
- If not, proceed as described below.

1. Remove the seals and tighten the by-pass screws completely.
2. Set the flow meter to scale "K" and take the reading on each of the body tubes checking that the flow rate is 120 ÷ 130.
3. If not, turn the throttle adjustment screw until the specified value is obtained.
- With the throttles adjusted, open the by-passes (unscrew) until a flow rate of 185 is obtained with the flow meter on scale "N".

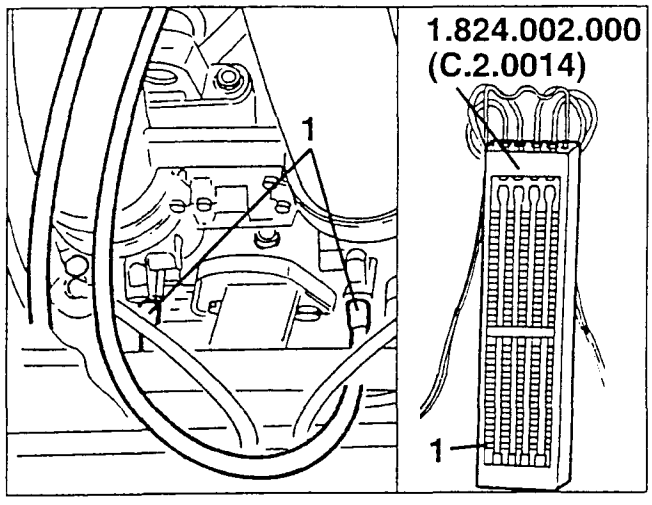


ALIGNING AND SYNCHRONISING THE INTAKE BODIES

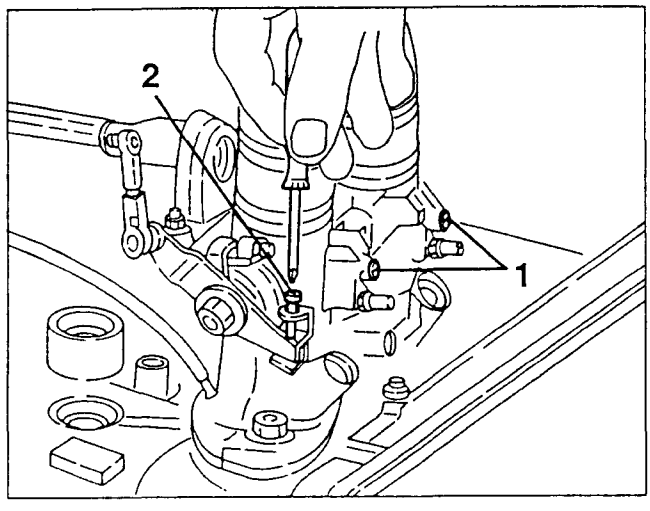
1. Check that the play on the two"loosened levers" of the throttles on the bodies is within the specified value of 1 mm.
2. Slacken the vacuum inlets.



1. Connect the sockets of vacuum gauge N° 1.824.002.003 (C.2.0014) to the vacuum takeoffs on the bodies.



1. Start the engine and at idle speed check that the difference between the cylinders does not exceed 25 mmHg, if it does adjust the by-pass screws.
- If the difference between the cylinders of the same head exceeds 25 mmHg despite adjustment, the body needs changing.
2. Accelerate slightly a few times and see that the pressure gauge columns move simultaneously; if synchronism is lacking, adjust the screws of the "loosened levers".

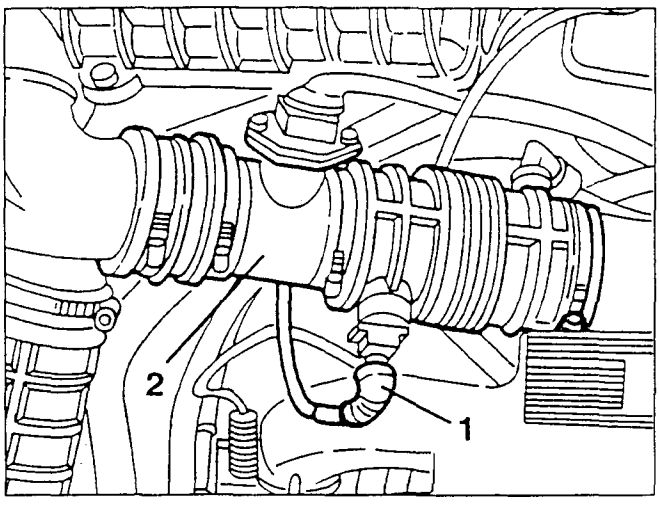


INTAKEN AIR TEMPERATURE SENSOR (NTC)

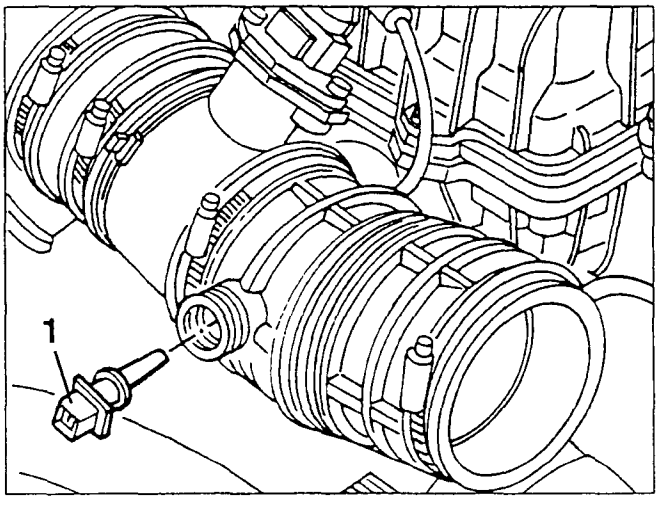
The intaken air temperature sensor is located on the corrugated air intake sleeve and it detects the air temperature through an NTC thermistor with a negative resistance coefficient, i.e. capable of lowering its resistance as the temperature increases.
The electrical signal obtained reaches the control unit where it is used to calculate the density of the air.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the intaken air temperature sensor.
2. Slacken the clamp and disconnect the corrugated sleeve from the intake box.

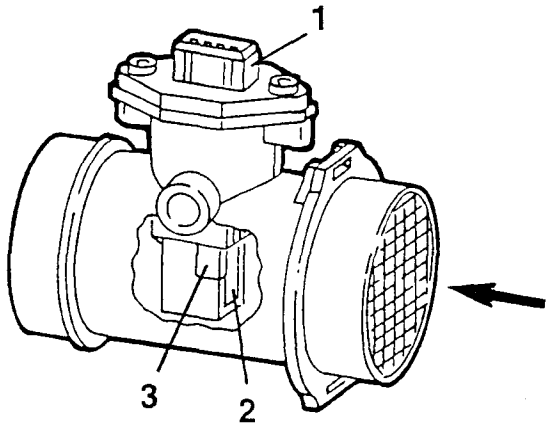


1. Remove the fastening clamp and withdraw the sensor from the corrugated sleeve.



AIR FLOW METER

The air flow meter is of the "heated film" type. Its operating principle is based on a heated diaphragm which is interposed in a measuring channel through which the engine intake air flows.
The hot film diaphragm is kept at a constant temperature (~ 120°C) by the heating coil in contact with it.
The mass of air that crosses the measuring channel tends to withdraw heat from the diaphragm, therefore to keep the temperature constant, a certain current needs to flow through the resistance.
This current is measured by a suitable Wheatstone bridge.
Therefore the current measured is proportionate with the mass of air flowing through.

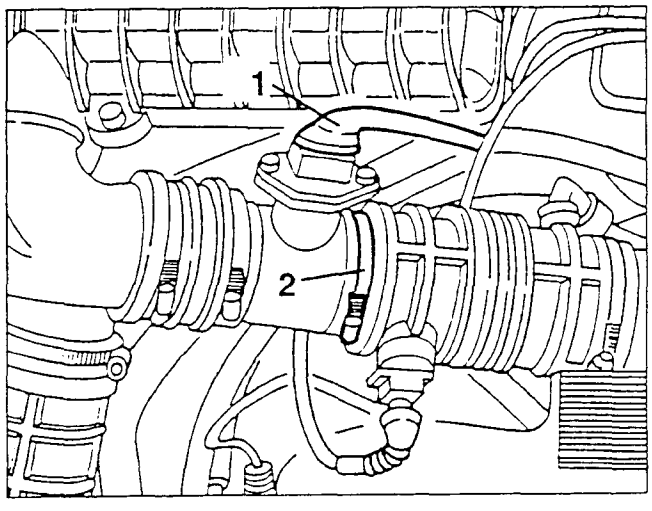


1. Connector
2. Measuring channel
3. Hot film sensor

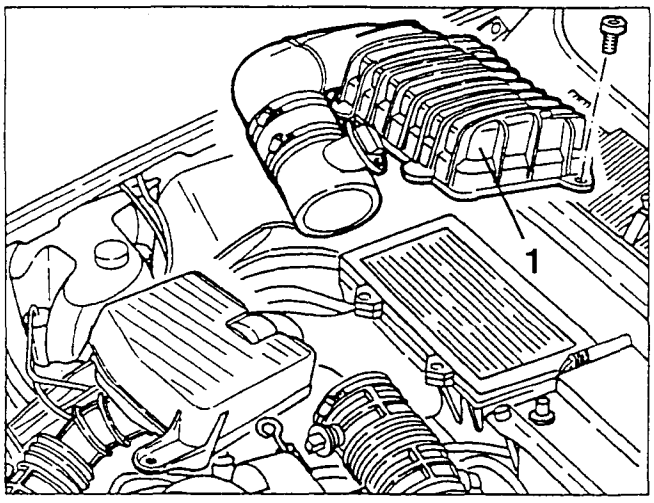
NOTE: This air flow meter measures directly the mass of air (and not the volume) thereby eliminating problems of temperature, altitude, pressure, etc.
The correct operation of the air flow meter depends on the conditions of the air cleaner which must therefore be checked often.

REMOVAL/REFITTING

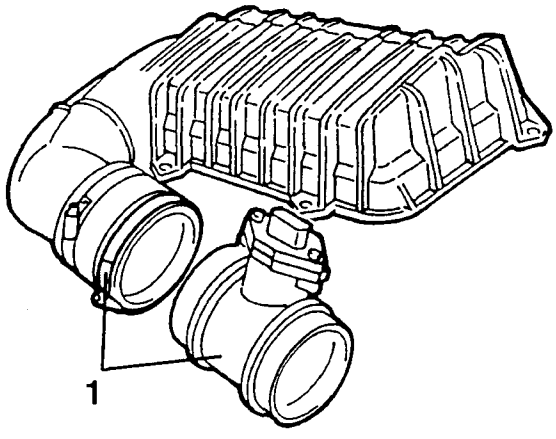
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the air flow meter.
2. Slacken the clamp fastening the corrugated sleeve to the air flow meter.



1. Slacken the four screws fastening the air cleaner cover and remove it complete with air flow meter.



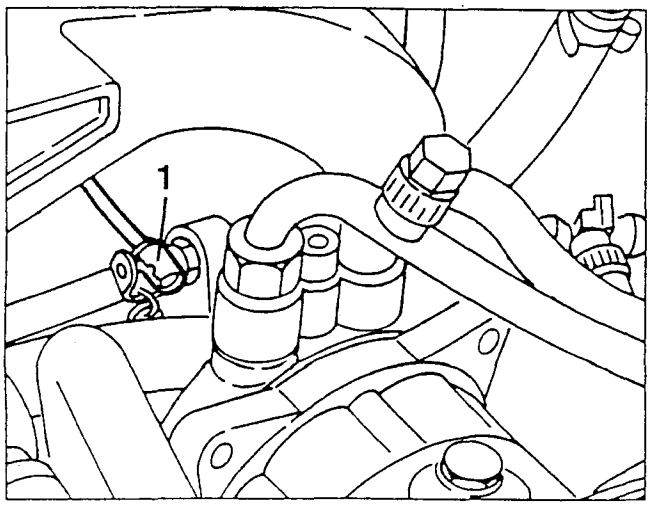
1. On the bench, slacken the fastening clamp and separate the air flow meter from the air cleaner cover.



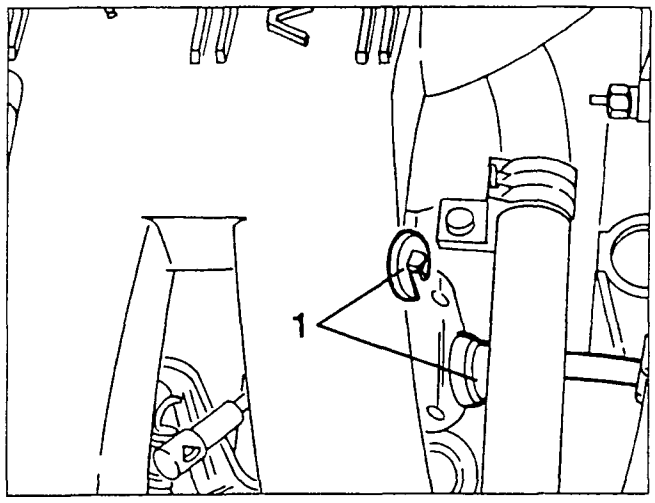
ACCELERATOR CABLE

REMOVAL/REFITTING

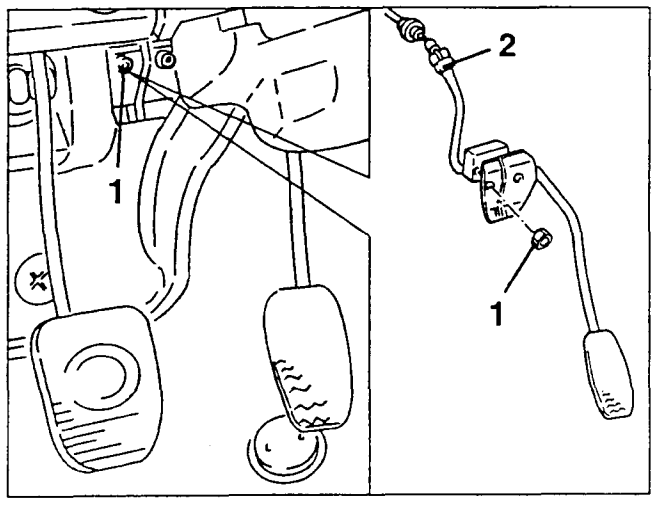
1. Move back the safety catch and disconnect the accelerator control cable from the throttle control shaft.



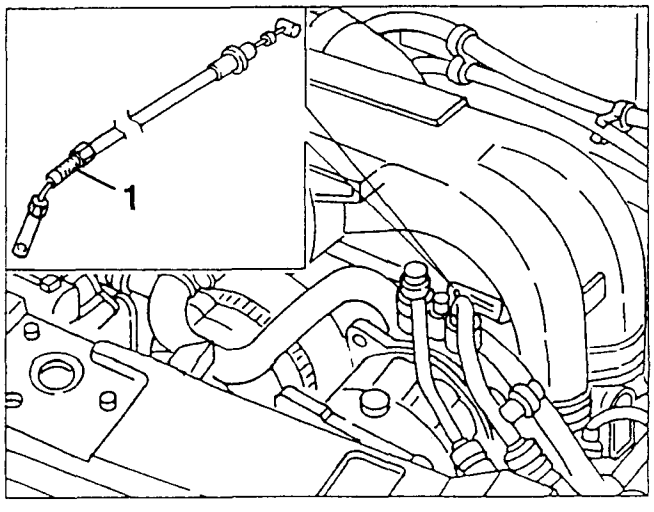
1. Remove the catch and remove the accelerator cable from the support bracket on the intake box.



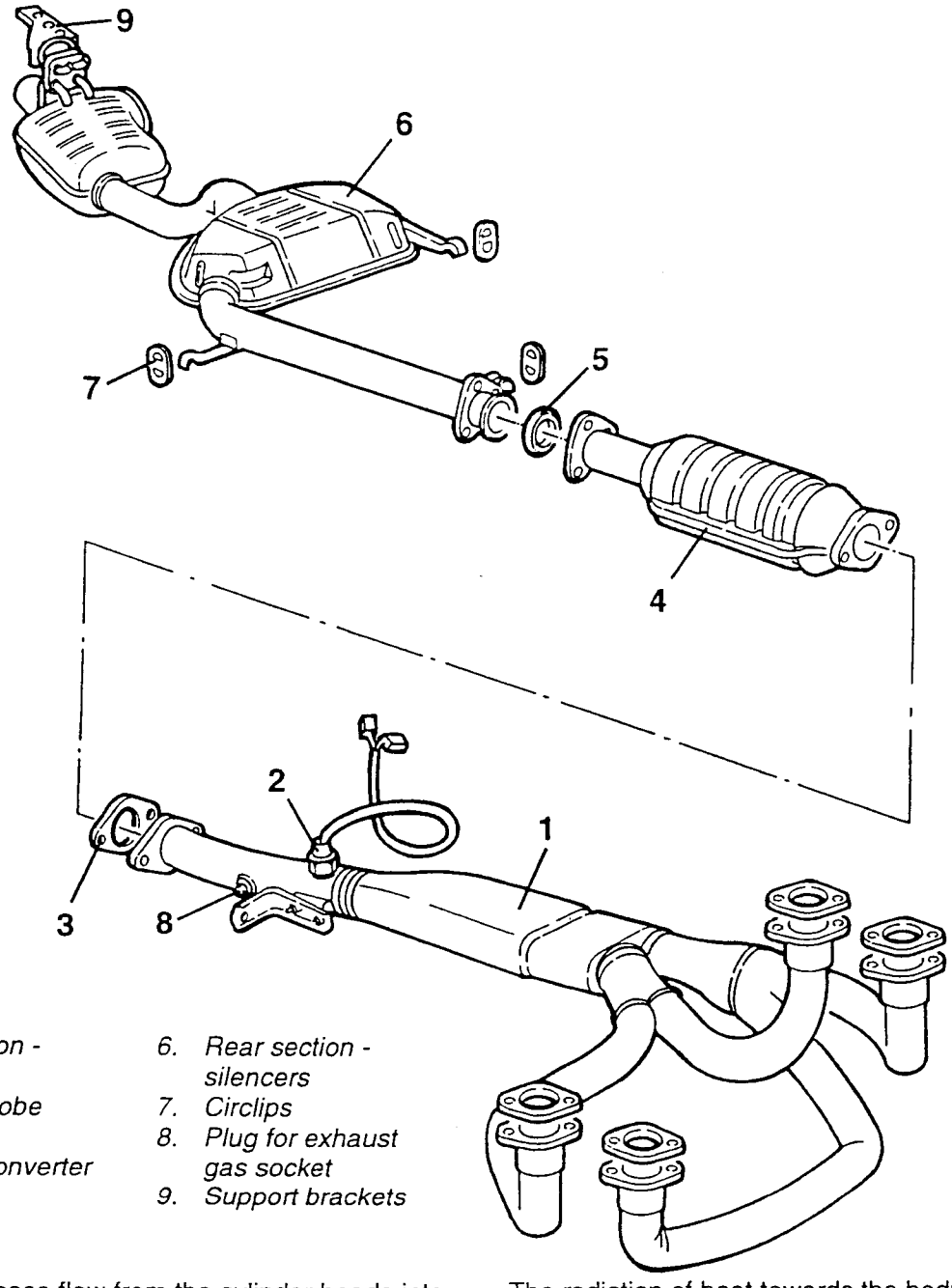
1. Working from the passenger compartment, slacken the two nuts fastening the accelerator pedal fastening bracket.
2. Move the pedal just enough to disconnect the accelerator cable from the fork on the pedal.



1. From the engine compartment, withdraw the complete accelerator cable.



EXHAUST SYSTEM DESCRIPTION



1. *Front section - manifolds*
2. *Lambda probe*
3. *Seals*
4. *Catalytic converter*
5. *Seal ring*
6. *Rear section - silencers*
7. *Circlips*
8. *Plug for exhaust gas socket*
9. *Support brackets*

The exhaust gases flow from the cylinder heads into the manifolds of the front section of the exhaust pipe. On the front section of the exhaust pipe the lambda sensor is fitted which informs the control unit of the amount of oxygen contained in the exhaust gas thus enabling the injection times to be adjusted to keep the stoichiometric ratio (air- fuel) at an optimum level. On the front section of the exhaust pipe, there is also the plug for the exhaust gas socket upstream of the catalytic converter. From the front section, the exhaust gases reach the catalytic converter where most of the pollutants are transformed. From the catalytic converter the exhaust gases reach the two silencers of the rear section of the exhaust pipe.
The various sections of the exhaust pipe are connected by flanges with seals and support to the body is made by brackets and circlips.

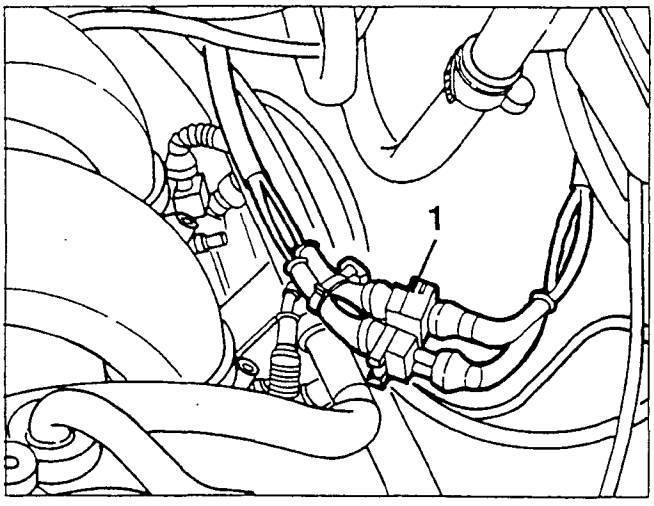
The radiation of heat towards the body, which is very high due to the catalytic converter, is limited by a set of heat shields.

During engine operation all the exhaust pipes and in particular the catalytic converter heat up considerably.
Before attempting any work, the system should be left to cool with the engine switched off.
NEVER TOUCH THE CATALYTIC CONVERTER WITHOUT ADEQUATE PROTECTION SUCH AS GLOVES. ETC.
DO NOT ALLOW EASILY INFLAMMABLE MATERIAL TO COME INTO CONTACT WITH THE CATALYTIC CONVERTER.

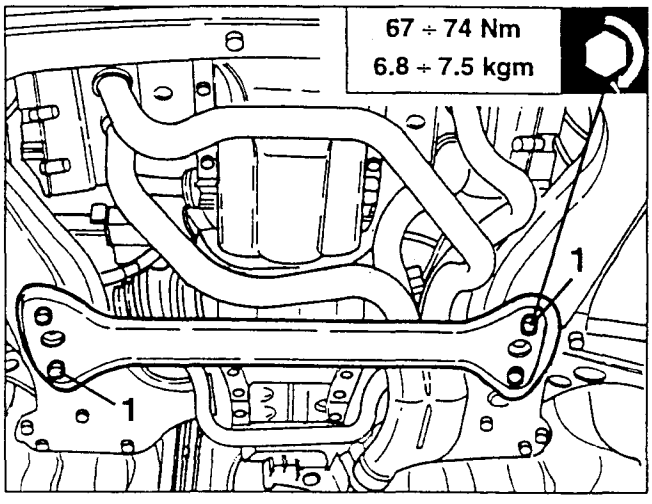
EXHAUST, FRONT SECTION

REMOVAL/REFITTING

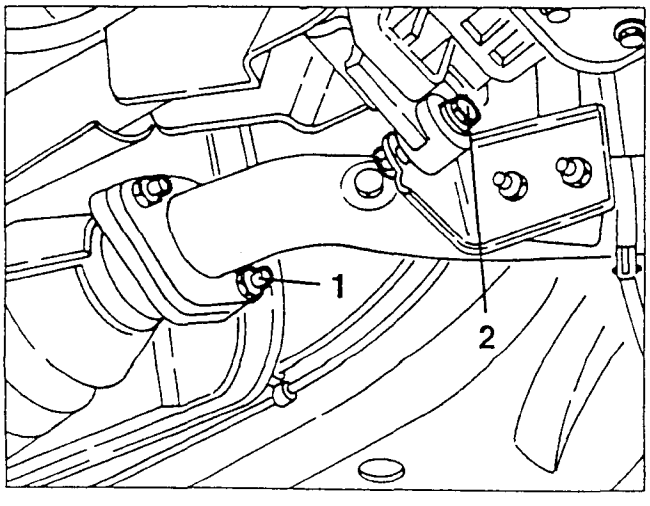
1. Disconnect the two electrical connections of the lambda sensor.



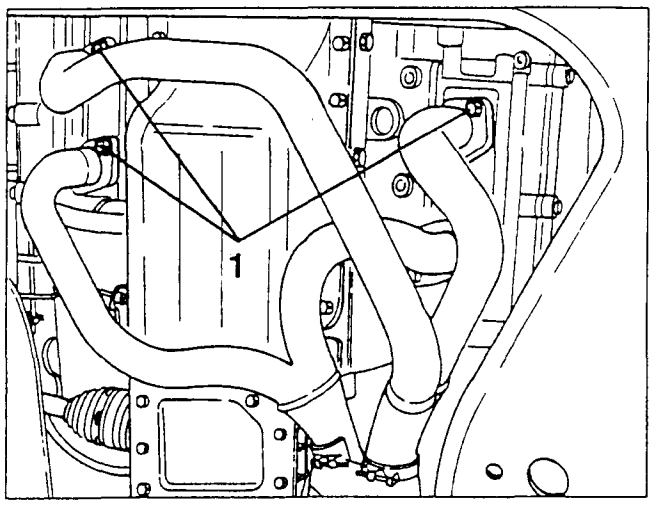
1. Slacken the fastening screws and remove the engine support frame crossmember.



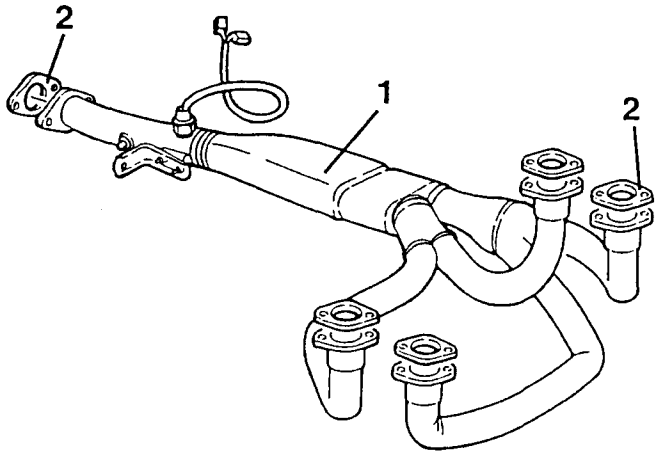
1. Disconnect the flange connecting the front section-catalytic converter.
2. Slacken the bolt fastening the exhaust pipe front section support bracket.



1. Slacken the nuts fastening the front section of the exhaust pipe to the cylinder heads.



1. Remove the front section of the exhaust pipe.
2. Remove the seals.



- Remove the lambda sensor and the support bracket from the front section of the exhaust pipe.

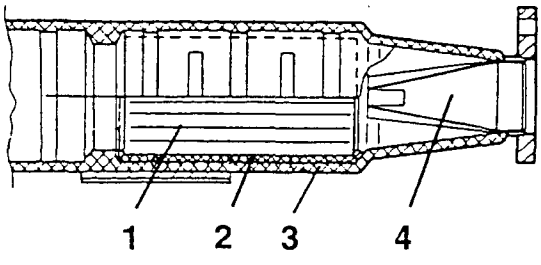
CATALYTIC CONVERTER

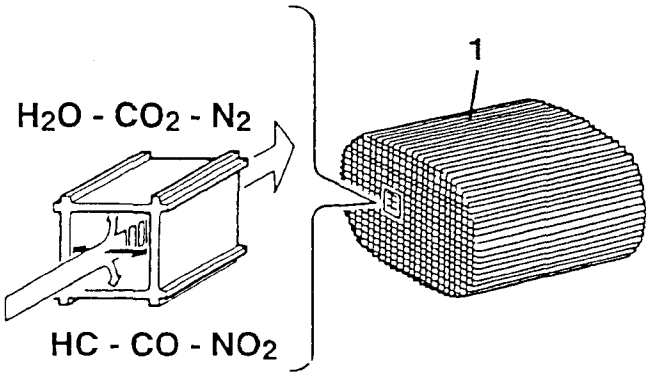
Closed loop mixture titration control is activated by the lambda sensor which detects the amount of oxygen contained in the exhaust gases upstream of the catalyst.
The measurements of the lambda sensor enable the control unit to continuously correct the mixture keeping the air/fuel ratio constant. This way harmful emissions to the exhaust are controlled and this is completed by the trivalent catalytic converter. The efficiency of the catalytic converter and as a result, the reduction of the harmfulness of the exhaust gases therefore depends on the air/fuel ratio with which the engine is supplied.

The trivalent catalytic converter makes it possible to contemporaneously reduce the three pollutants in the exhaust gases:
- unburnt hydrocarbons (HC);
- carbon monoxide (CO);
- nitric oxide (NOx)

Two types of chemical reactions take place inside the converter:
- oxidation of CO and HC, transformed into carbon dioxide (CO_2) and water (H_2O)
- reduction of NOx transformed into Nitrogen (N_2).

The converter comprises a monolith, a metal mesh support to dampen shocks and vibrations and an outer cover resistant to high temperatures and the weather.
The monolith is made with a honeycomb structure formed of ceramic material coated with a very fine layer of catalytically active substances, platinum or rhodium, which accelerate the decomposition of the harmful gases contained in the exhaust gases, which passing through the cells of the heart at temperatures of above 300° ÷ 350°C, activate the catalysts starting the oxidation and reduction reactions.
To optimise the efficiency and life of the catalist, a perforated steel sheet cone improves the diffusion of the exhaust gas in the cells of the ceramic heart.





1. Ceramic monolith 3. Outer cover
2. Metal support 4. Perforated steel sheet cone

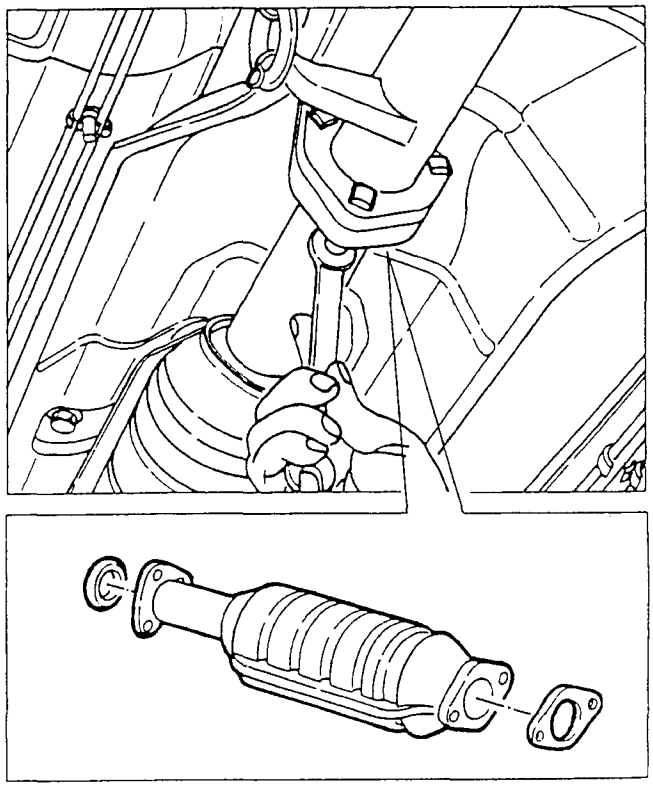
The causes which rapidly and irreversibly damage the catalytic converter are:
- the presence of lead in the fuel, which lowers the degree of conversion to levels that make its presence in the system useless;
- the presence of unburnt fuel in the converter: in fact a flow of petrol for 30 s in an environment at 800°C (inside temperature of the catalyst) is sufficient to melt or break the catalyst.

The ignition system must be in perfect operating conditions, therefore, for no reason at all should the spark plug cables be disconnected with the engine running and, in the event of tests, the silencer should be replaced with an equivalent length of pipe.
If used correctly, the converter will work efficioently for no less than 80.000 km or for at least five years.

WARNING:
The precious metals contained in the catalytic converter, also due to the high temperature, are subject to chemical attack by lead.
FOR THIS REASON, PETROL CONTAINING LEAD MUST NOT BE USED AS THIS WOULD QUICKLY AND IRREVERSIBLY DAMAGE THE CONVERTER. NEVER USE PETROL CONTAINING LEAD EVEN IN AN EMERGENCY OR FOR VERY SHORT PERIODS.

REMOVAL/REFITTING

- Set the car on a lift and raise it.
- Remove the fastening bolts of the connection flanges and remove the catalytic converter.

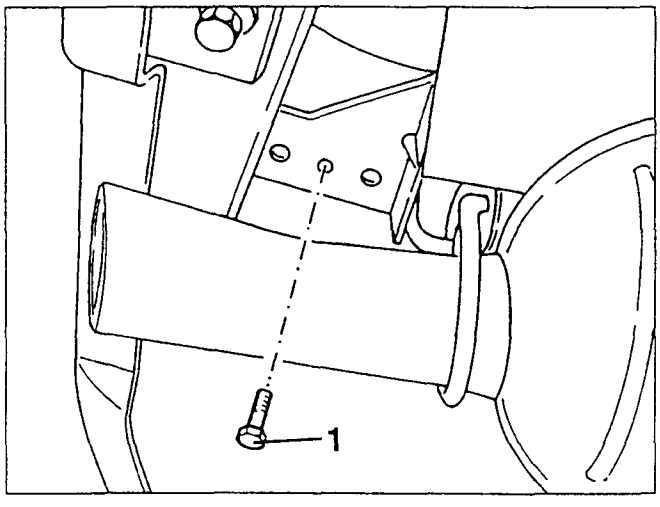


WARNING:
When the catalytic converter is removed, though outside it is cold, inside it might still be hot. For this reason NEVER DISCARD THE OLD CONVERTER ON INFLAMMABLE RUBBISH.
If an excessive temperature is signalled during operation of the catalytic converter it is advisable to immediately identify the cause in order to avoid irreversible damage to the material forming the silencer itself.

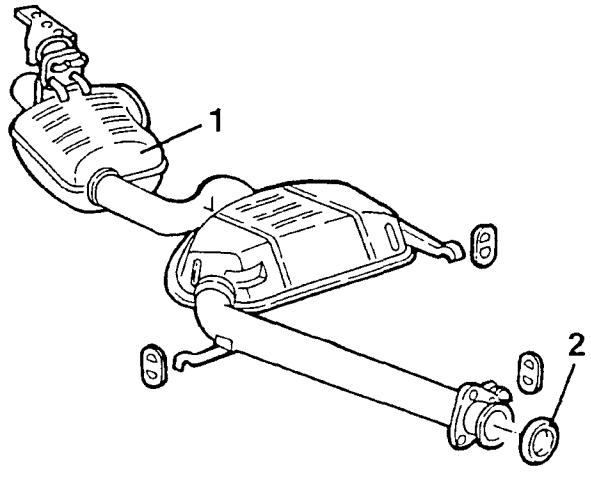
EXHAUST, REAR SECTION

REMOVAL/REFITTING

- Disconnect the handbrake left cable from the fastening clamps.
- Slacken the three bolts fastening the rear section of the exhaust pipe to the catalytic converter.
1. Slacken the exhaust pipe rear support bracket fastening screw.



1. Remove the rear section of the exhaust pipe releasing it from the support circlips.
2. Remove the seal ring.



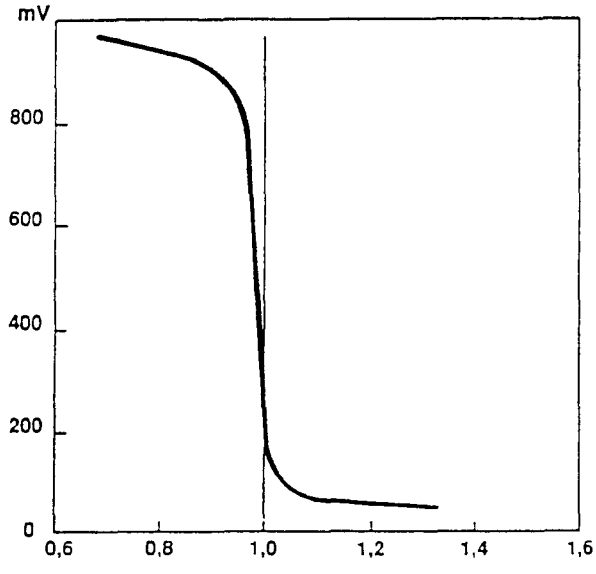
LAMBDA SENSOR

The lambda sensor informs the control unit of the injection and ignition system of the course of combustion of the air - fuel mixture and it enables the system to keep the stoichiometic ratio of the mixture as close as possible to the theoretical value.
Therefore, in order to obtain an optimum mixture, the quantity of air taken in by the engine must be the theoretical quantity required to burn all the fuel injected.
In this case it is said that the lambda factor (λ) is 1, in fact:

$$\lambda = \frac{\text{QUANTITA' DI ARIA ASPIRATA}}{\text{THEORETIC QUANTITY OF AIR THAT SERVES TO BURN ALL THE FUEL INJECTED}}$$

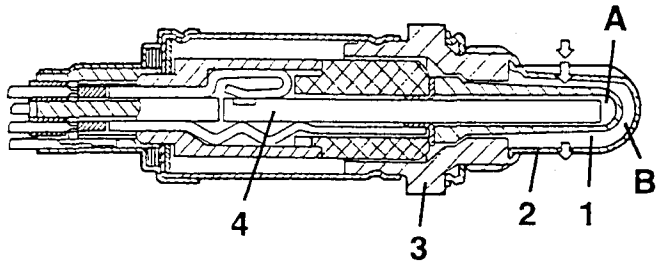
Therefore:
$\lambda = 1$ IDEAL MIXTURE;
$\lambda > 1$ LEAN MIXTURE;
$\lambda < 1$ RICH MIXTURE

The lambda sensor in contact with the exhaust gases generates an electric signal, the voltage of which depends on the concentration of oxygen contained in the gas.
This voltage changes sharply when the composition of the mixture departs from $\lambda = 1$.



The lambda sensor comprises a ceramic body based on zirconium dioxide, coated with a fine layer of platinum closed at one end, inserted in a metal tube and housed in a metal body which offers further protection and makes it possible to install it on the exhaust manifolds.
The outer part of the ceramic is exposed to the current of exhaust gas, while the inner part communicates with the environment air.

The operation of the sensor is based on the fact that with temperatures of above 300°C, the ceramic material used becomes a conductor of oxygen ions.
Under these conditions, if the quantity of oxygen at the two sides of the sensor (A and B) is in different percentage, a voltage change is generated between the two ends which is an index of measurement for the difference in the quantity of oxygen in the two environments (environment air side and exhaust gas side) and it alerts the control unit that the oxygen residues in the exhaust gas are not in sufficient percentage to warrant combustion with a low amount of harmful substances.
For temperatures below 300°C the ceramic material is not active, therefore the sensor does not send serviceable signals and a special circuit in the control unit stops loop adjustment of the mixture while the sensor heats up.
To ensure that the sensor quickly reaches its operating temperature it is fitted with an electrical resistance suitably supplied by the battery; this also makes it possible to install the sensor in cooler areas of the exhaust pipe.

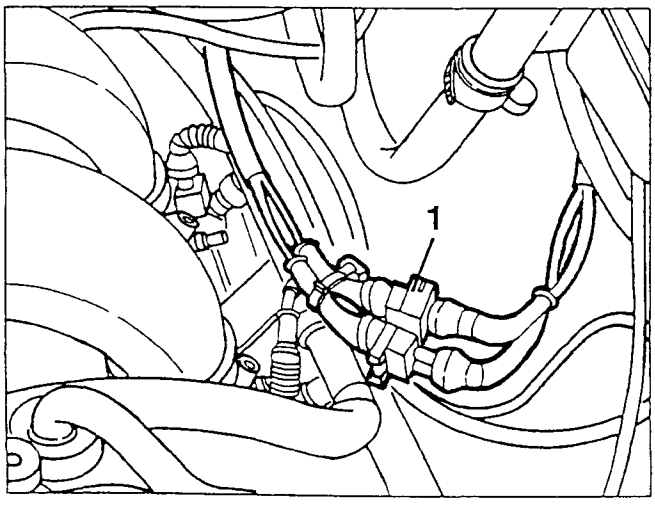


1. *Ceramic body*
2. *Protective tube*
3. *Metal body*
4. *Electric resistance*

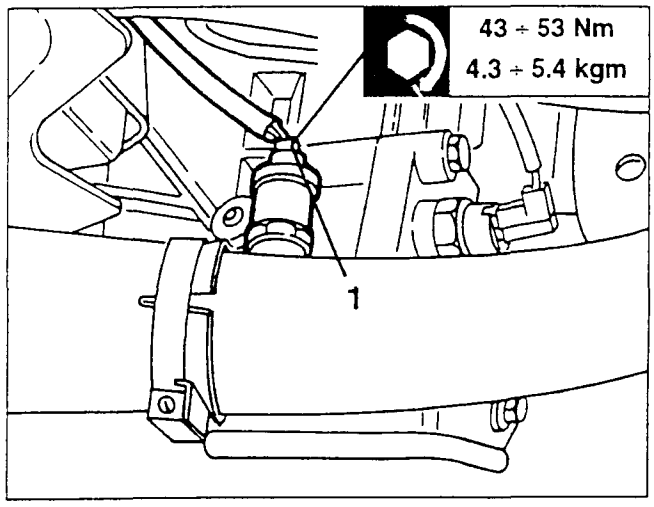
A. Inner ceramic part
B. Outer ceramic part

REMOVAL/REFITTING

1. Disconnect the two electrical connections of the lambda sensor.



1. Slacken and remove the lambda sensor complete with wiring.



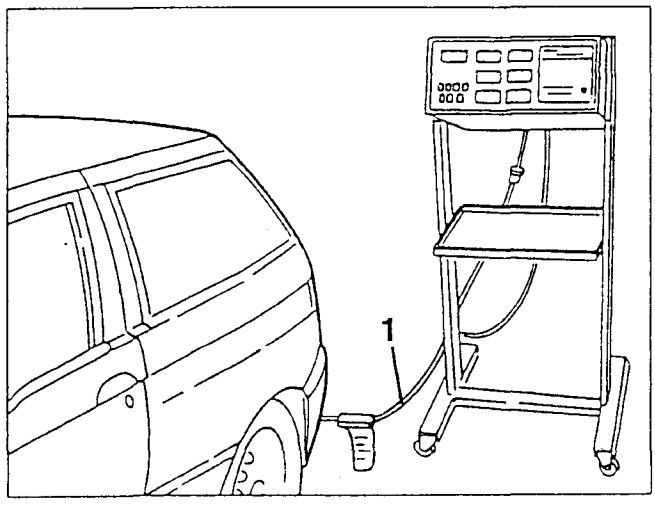
CHECKING EMISSIONS AT THE EXHAUST

The exhaust emissions must be checked in the open or in a suitable area equipped in accordance with current regulations.

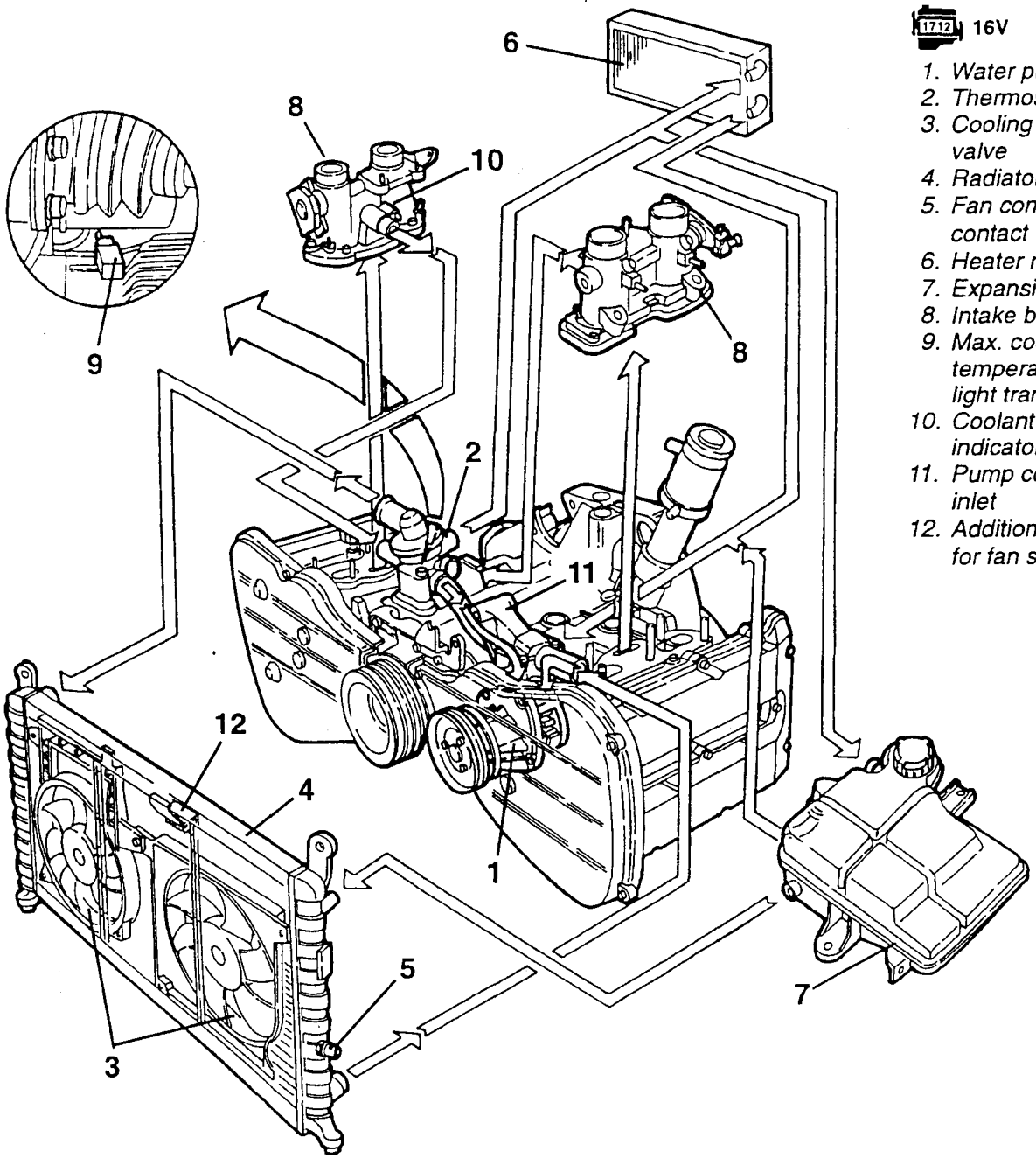
The check must be carried out with the engine at normal operating temperature (i.e. after the fan has turned on and then off) and at idle speed (see: GROUP 00 - "ENGINE TECHNICAL DATA").
If the idle speed is not within the specified limits check that the constant idle speed actuator is working properly.

- Check that the engine oil level is correct and that the air cleaner cartridge is clean.
- Start the engine and run it at idle speed.
1. Insert the probe of the analyzer in the end piece of the exhaust pipe and check that the percentages of CO and HC are within the specified limits.

CO at exhaust	% vol.	≤ 0.2
HC at exhaust	p.p.m.	≤ 50



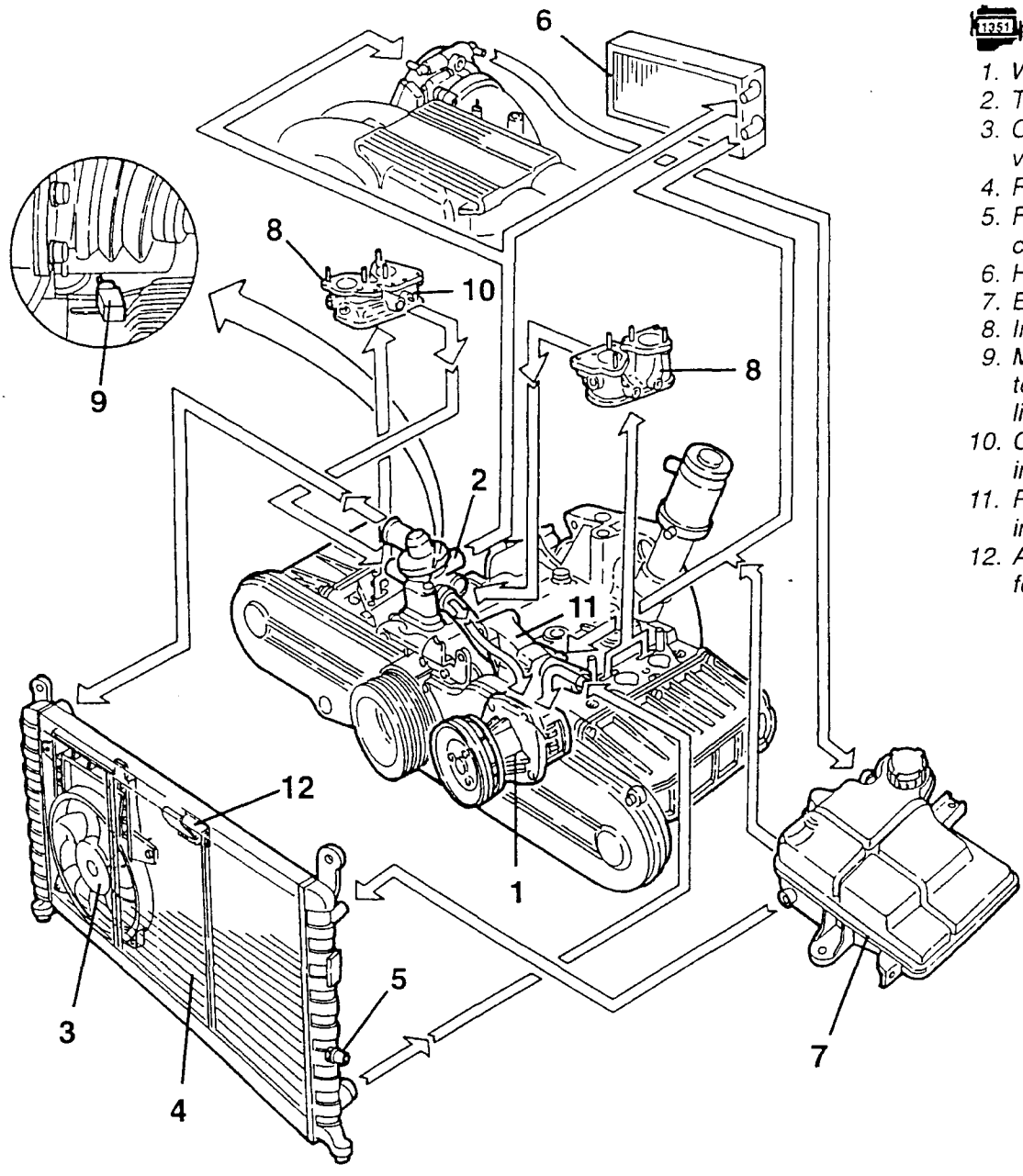
BOXER ENGINES COOLING SYSTEM DESCRIPTION



1712 16V

1. *Water pump*
2. *Thermostatic cup*
3. *Cooling solenoid valve*
4. *Radiator*
5. *Fan control thermal contact*
6. *Heater radiator*
7. *Expansion tank*
8. *Intake bodies*
9. *Max. coolant temperature warning light transmitter*
10. *Coolant temperature indicator transmitter*
11. *Pump coolant filter inlet*
12. *Additional resistance for fan speeds*

The cooling system is of the sealed type.
Circulation is forced by centrifugal pump operated by the crankshaft through the Poly-V belt.
A thermostatic valve fitted on the crankcase keeps the engine temperature at an optimum level: it opens when the coolant reaches a temperature of 86° ± 2°C.
The radiator cools the fluid by dynamic air and by a fan (two for versions with air conditioner) which is turned on by a thermal contact on the radiator.
For the air-conditioned versions, the thermal contact has two levels and, with the help of an additional resistance, it operates the fans in parallel at two different speeds.
For the versions without air conditioner, the thermal contact has one level and it operates the fan at one speed only.
The purpose of the header tank is to supply the circuit if the level falls and it absorbs the change in volume of the fluid due to changes in the temperature; it also bleeds air from the circuit through the plug with a special setting.
The circuit is fitted with a coolant fluid temperature gauge sender installed on the cylinder head which turns on the warning light on the instrument cluster when the coolant temperature exceeds 117° ± 3°C.



1351 1596

1. *Water pump*
2. *Thermostatic cup*
3. *Cooling solenoid valve*
4. *Radiator*
5. *Fan control thermal contact*
6. *Heater radiator*
7. *Expansion tank*
8. *Inlet manifolds*
9. *Max. coolant temperature warning light transmitter*
10. *Coolant temperature indicator transmitter*
11. *Pump coolant filter inlet*
12. *Additional resistance for fan speeds*

CIRCUIT OPERATION

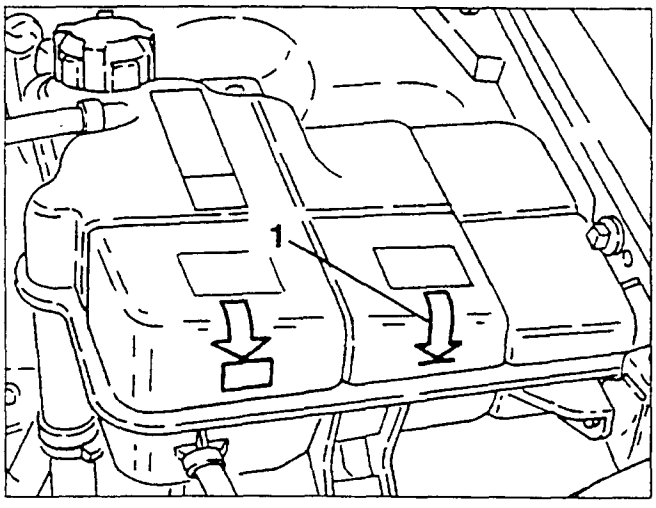
After the fluid has cooled the engine, it comes out of the cylinder head through the intake bodies and reaches the thermostat unit through special hoses.
From here, if the temperature is below 86° ± 2°C it is taken in by the pump through the inlet union.
If the temperature is higher than this value, the thermostat opens and the fluid is sent to the radiator.
After being cooled in the radiator, the fluid returns through a pipe to the inlet union and from this to the pump which ducts it back to the radiator.
A connection pipe is fited on the radiator for coupling with the header tank.

A pipe leading from the thermostatic cup takes the coolant fluid to the passenger compartment heater and, for the 16V versions, it branches with a return pipe to the header tank which also serves to bleed the air from the system.
For the 8V versions, a branch from the heater delivery pipe goes to heat the throttle valve from where it returns directly to the header tank.
A pipe leading from the heater joins the supply pipe leading from the header tank and goes to the pump inlet.

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

1. With the engine cold, visually check that the level of the coolant in the header tank is between the MIN. and MAX. marks.



- Re-tighten the drain plugs and check that all the hose clamps of the cooling system are firmly tightened.
- Fill until the MAX. mark on the header tank is reached.

The type and quantity of the coolant fluid is given in the table below:

Alfa Romeo Climafluid Super Permanent -40°C	6.7 litres

- Start the engine and bring it to normal operating temperature until the thermostat opens and releases the residual air from the circuit. - With the engine cold, top up to reach the level marked on the header tank.
- Re-tighten the pressurized cap on the header tank.

WARNING:
It is unwise to mix anti-freeze fluids of different types and brands!
Never use antirust additives: they might not be compatible with the anti-freeze in use!

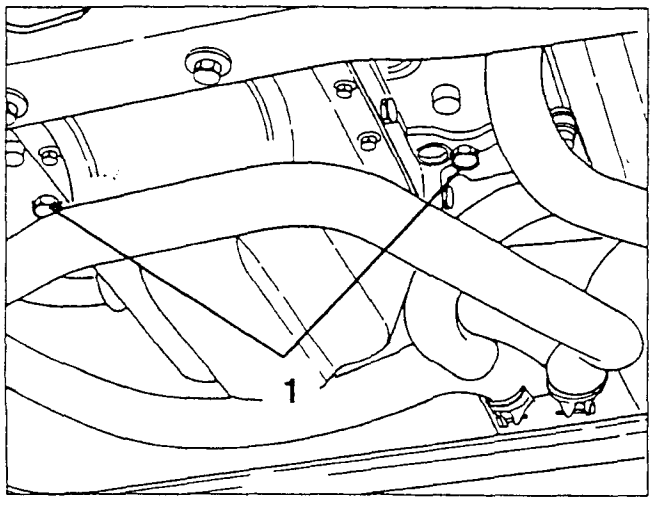
Changing

- Slacken and remove the header tank plug.

WARNING:
Absolutely never remove the header tank plug when the engine is hot!

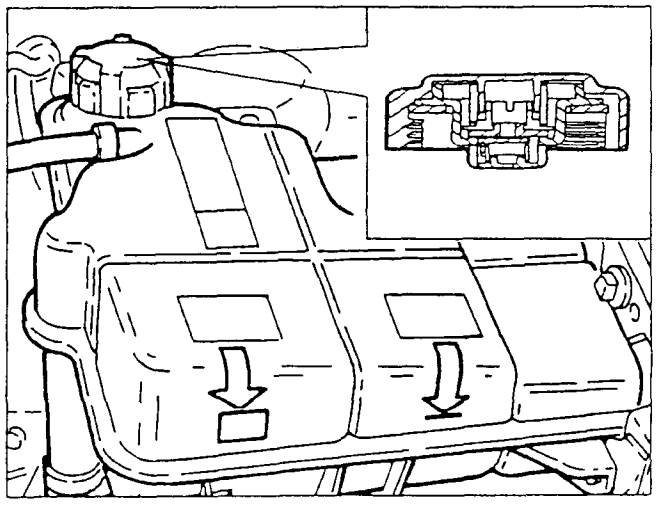
1. Slacken the two plugs under the crankcase and drain off the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can damage the paintwork: avoid touching any painted parts with it.



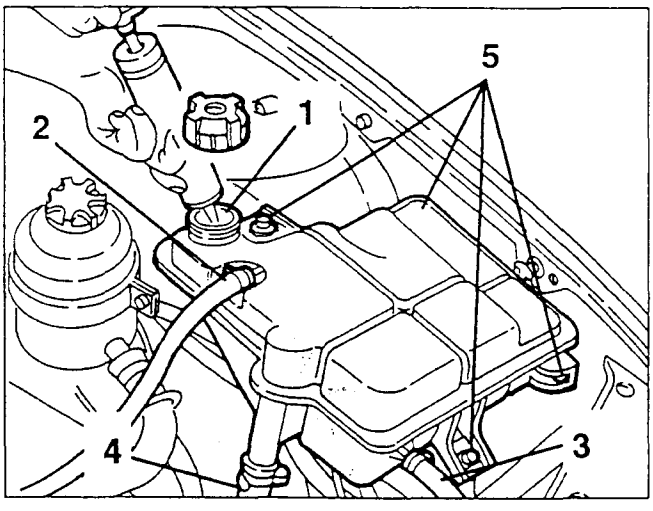
HEADER TANK

The purpose of the header tank is to supply the circuit and absorb the changes in volume of the coolant fluid due to changes in the temperature of the engine.
In addition, a special valve contained in the pressurised cap bleeds the air from the circuit.
This valve also has a washing purpose as it admits outside air when the circuit is under vacuum due to the cooling of the engine.
The level of the coolant in the header tank must be between the MIN and MAX. marks.



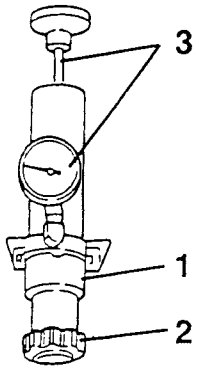
REMOVAL/REFITTING

1. Empty the coolant fluid from the header tank using a suitable syringe.
2. Disconnect the air relief and coolant return pipe from the header tank.
3. Disconnect the radiator connection pipe from the header tank.
4. Disconnect the system supply pipe from the header tank.
5. Slacken the three fastening screws and remove the header tank.



PRESSURIZED CAP SEAL TEST

1. Connect the union on the lower end of the testing device.
2. Fit the header tank pressurized cap on the union.
3. Pressurize working manually on the piston and check that the valve on the cap opens at the specified setting using a pressure gauge.

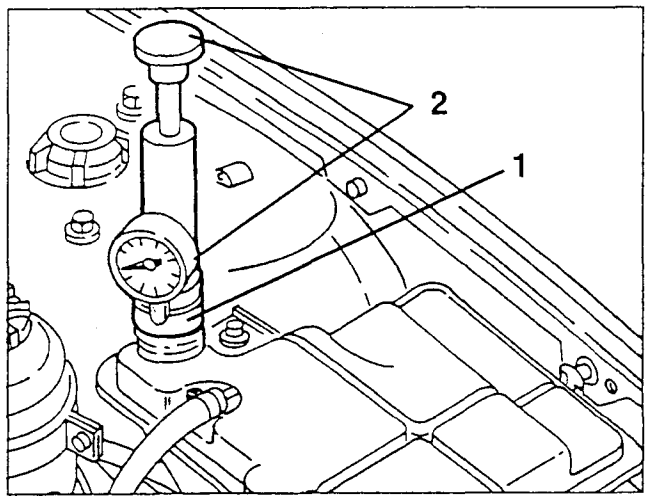


Pressurized cap setting pressure
0.98 ± 0.1 bar (1 ± 0.1 kg/cm^2)

ENGINE COOLING SYSTEM SEAL TEST

- Slacken and remove the pressurized cap from the header tank.

1. Screw the seal test device fitted with special union on the header tank union.
2. Pressurize the circuit manually and check on the test device that the pressure maintains the rating specified, if not, check the sleeves and radiator for leaks.



Hydraulic circuit test pressure
1.08 bar (1.1 kg/cm^2)

WARNING:
For safety reasons, during these tests never allow the pressure to exceed 1.38 bar (1.4 kg/cm^2).

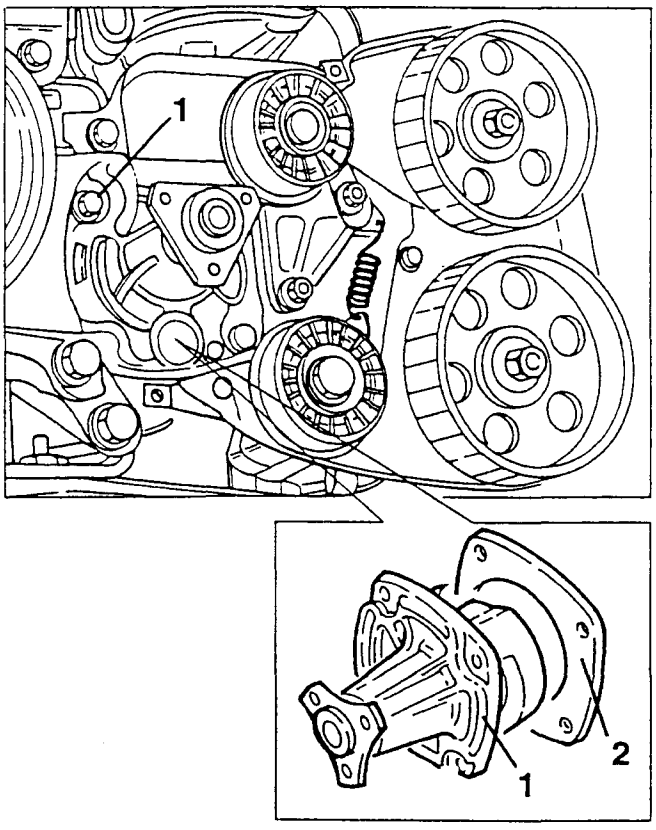
WATER PUMP

The water pump is of the centrifugal blade type. The pump casing is made from aluminium alloy and the impeller is in phenolic resin.
The pump is fastened to the crankcase and operated by a Poly V belt driven by the crankshaft. A gasket seals the joint between the crankcase and the pump.
The water pump operates constantly, thus ensuring continuous circulation of the coolant fluid.

REMOVAL/REFITTING 1712 16V

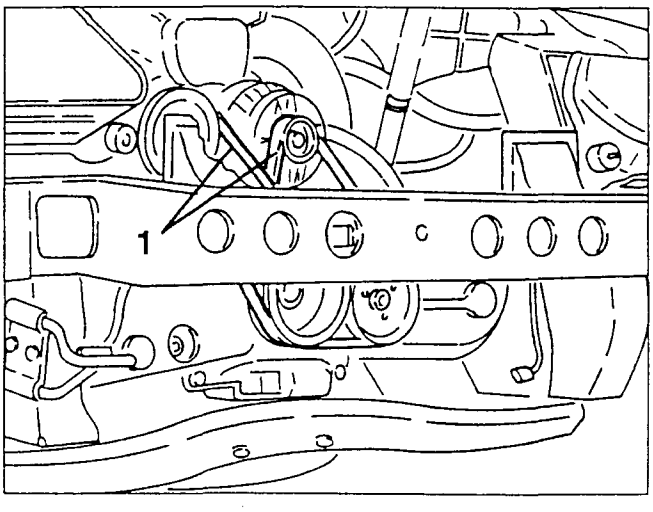
Proceed as described in GROUP 01 "REMOVAL/REFITTING CYLINDER HEADS" up to removal of the left-hand timing belt.

1. Slacken the four fastening screws and remove the water pump.
2. Remove the seals.

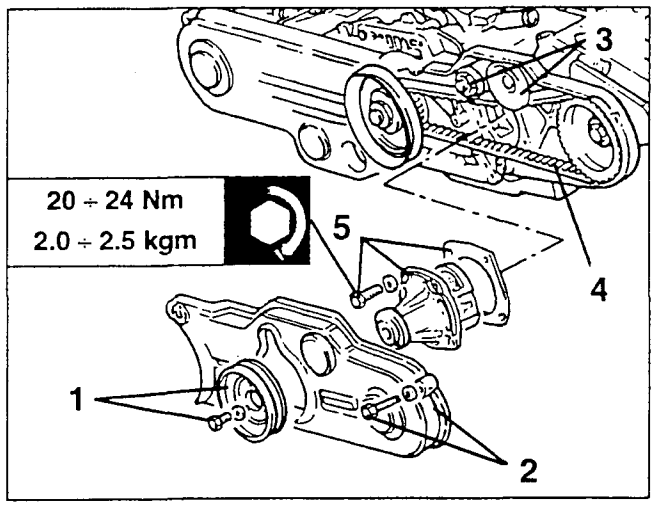


REMOVAL/REFITTING 1351 1596

- Remove the radiator (see specific paragraph).
1. Remove the auxiliary component belts.



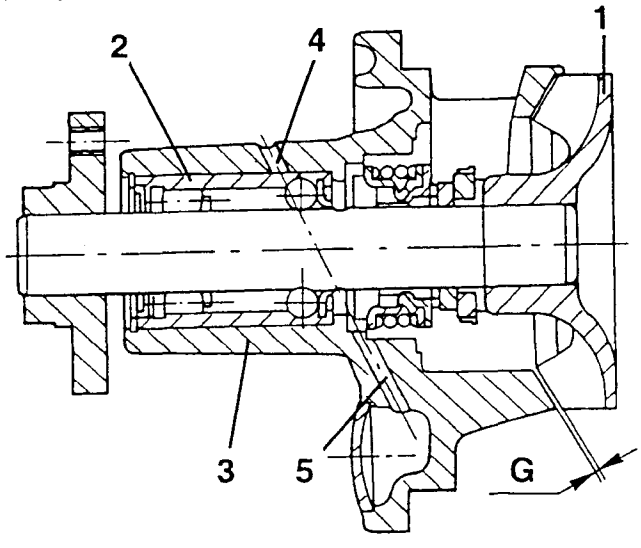
1. Slacken the fastening screws and remove the water pump pulley.
2. Slacken the fastening screws and remove the left-hand timing belt cover.
3. Loosen the nut securing the left-hand belt tensioner, press the belt guide to overcome the force of the spring and lock the nut.
4. Remove the left-hand timing belt from the camshaft drive pulleys.
5. Slacken the fastening screws and remove the water pump with its gasket.



CHECKS AND INSPECTIONS

- Check that the water pump and impeller are in good conditions and that there are no signs of oxidation or corrosion;
- check that the clearance "G" between the impeller and pump casing is with the specified limits;
- check that the front pump gasket is in good conditions and does not allow any leakage;
- check that the bearing shows no signs of wear of the races, balls and rollers;

If one of the above is found, change the whole water pump.

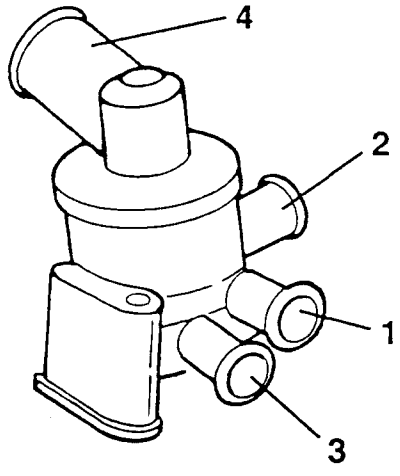


1. Impeller
2. Bearing
3. Pump casing
4. Air relief hole
5. Drain hole

Clearance between impeller and water pump
G = 0.5 ÷ 0.8 mm

THERMOSTAT UNIT

The thermostat unit is fitted on the upper side of the crankcase.
Its purpose is to ensure that the engine does not exceed the optimum temperature: until the coolant temperature reaches 86° ± 2°C, the thermostat valve diverts the fluid directly towards the pump; at higher temperatures the thermostat valve opening allows the fluid to flow towards the radiator.

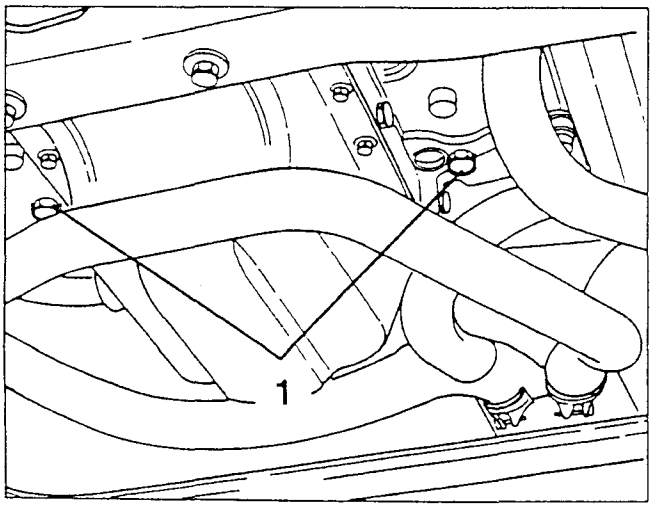


1. Return from bodies
2. Delivery to heater
3. Delivery to pump
4. Delivery to radiator

Total bulb stroke (at 100°C)
≥ 7 mm

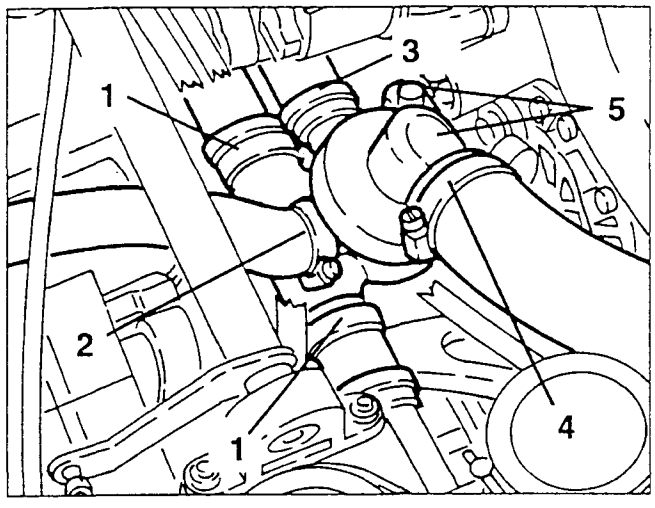
REMOVAL/REFITTING

- Set the car on a lift and raise it.
1. Unscrew the two plugs under the crankcase and drain the coolant into a suitable recipient.



WARNING:
The anti-freeze mixture used as coolant can damage the paintwork: avoid touching any painted parts with it.

- Remove the intake box (see GROUP 10).
1. Disconnect the coolant return sleeves from the thermostatic cup.
2. Disconnect the coolant delivery sleeve to the heater from the thermostatic cup.
3. Disconnect the coolant delivery sleeve to the pump inlet from the thermostatic cup.
4. Disconnect the coolant delivery sleeve to the radiator from the thermostatic cup.
5. Slacken the fastening screw and remove the thermostatic cup.



CHECKS AND INSPECTIONS

Check that the thermostat setting is within the specified limits.

Thermostat setting	
Start of opening temperature	86° ± 2°C
Valve stroke at 100°C	≥ 7 mm

- If the setting is incorrect, change the thermostat.

RADIATOR

The radiator is sized to dissipate the heat produced during operation of the engine.
It comprises a radiator core (front radiating surface 20.3 dm^2) and two side tanks fitted with unions for the inlet and outlet of the coolant fluid; the radiator core pipes and fins are in aluminium and the tanks are in plastic. .

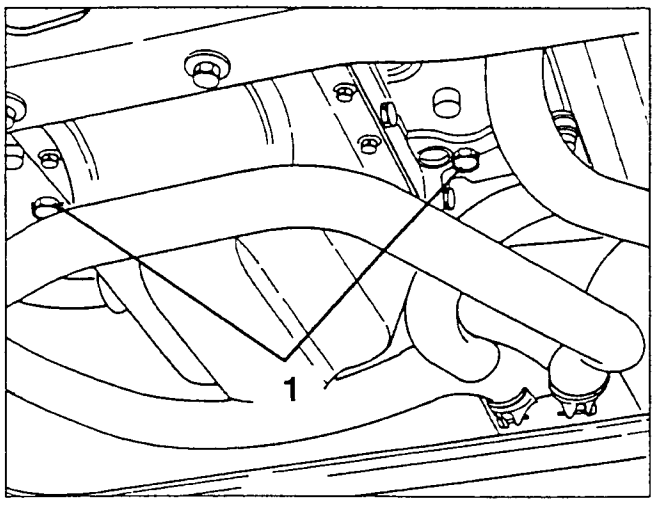
A thermal contact on the radiator controls the cooling fans.

REMOVAL/REFITTING (for versions with conditioner)

- Remove the cooling fans (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
- Raise the car.

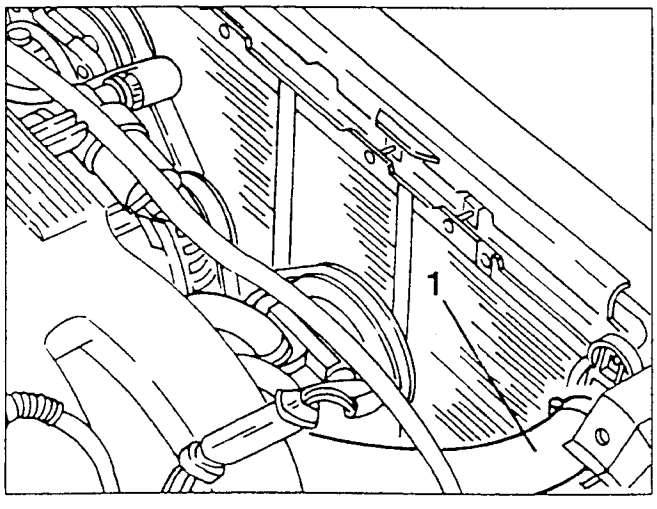
1. Unscrew the two plugs under the crankcase and drain off the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can damage the paintwork: avoid touching any painted parts with it.



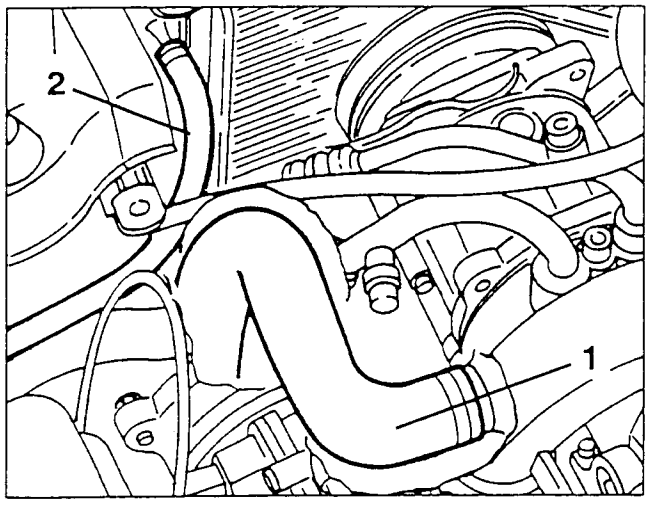
- Lower the car.

1. Disconnect the coolant inlet sleeve from the radiator.



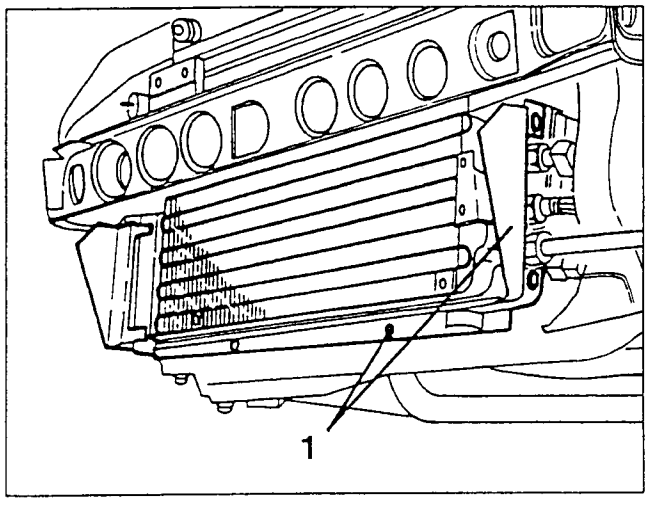
1. Disconnect the radiator coolant outlet sleeve from the union on the crankcase.

2. Disconnect the connection pipe to the header tank from the radiator.

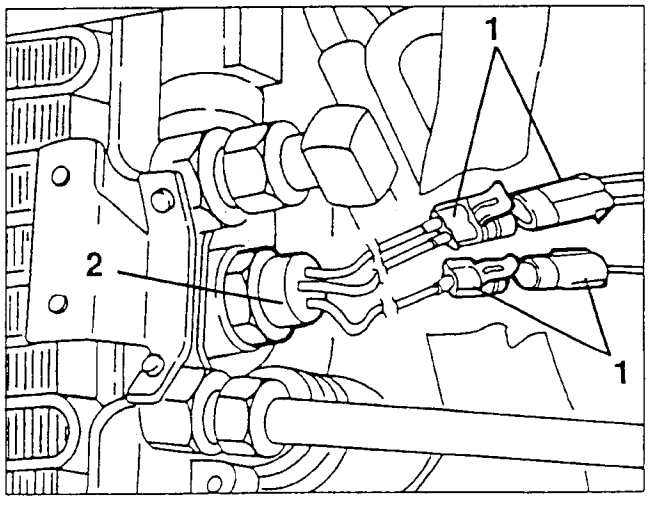


- Raise the car.

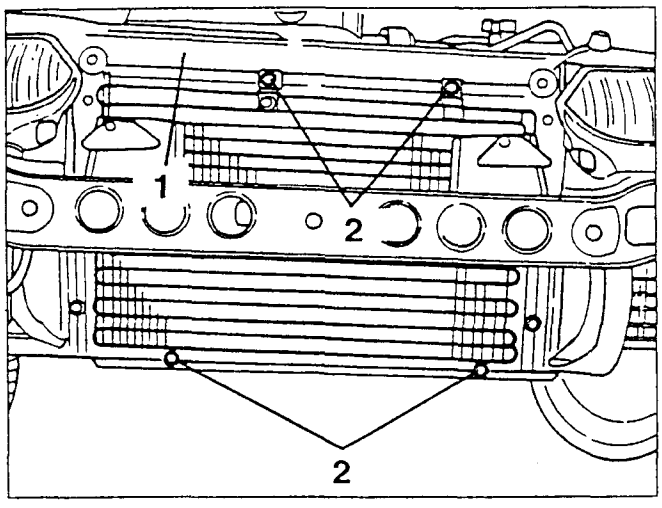
1. Slacken the fastening screws and remove the lower air duct.



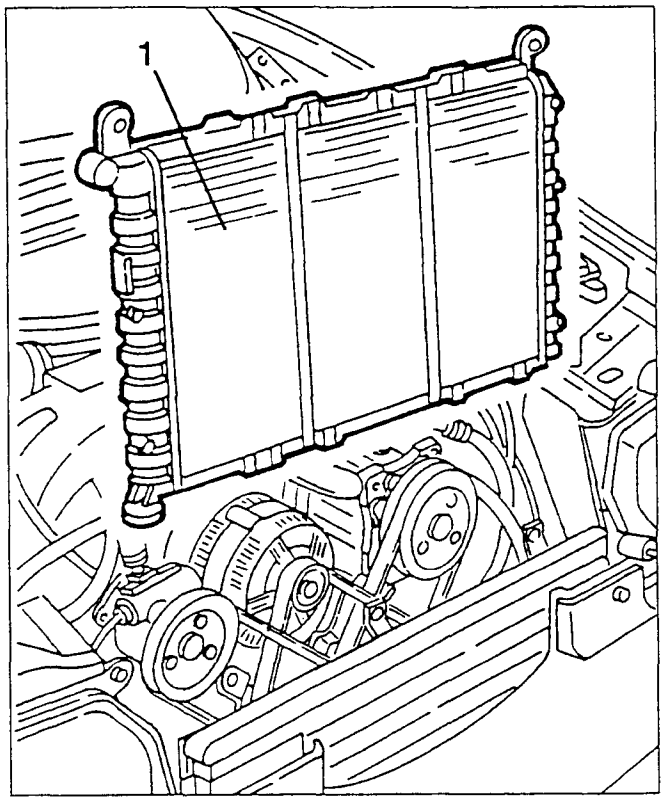
1. Disconnect the electrical connections of the fan control thermal contact.
2. Remove the fan control thermal contact.



1. Slacken the screws fastening the upper air duct to the radiator.
2. Slacken the four screws fastening the condenser to the radiator.



1. Remove the radiator pulling it upwards.

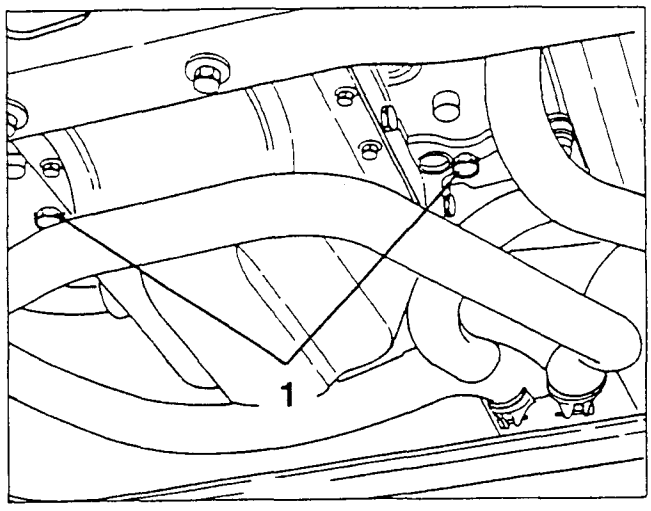


- On the bench remove the coolant outlet sleeve from the radiator.

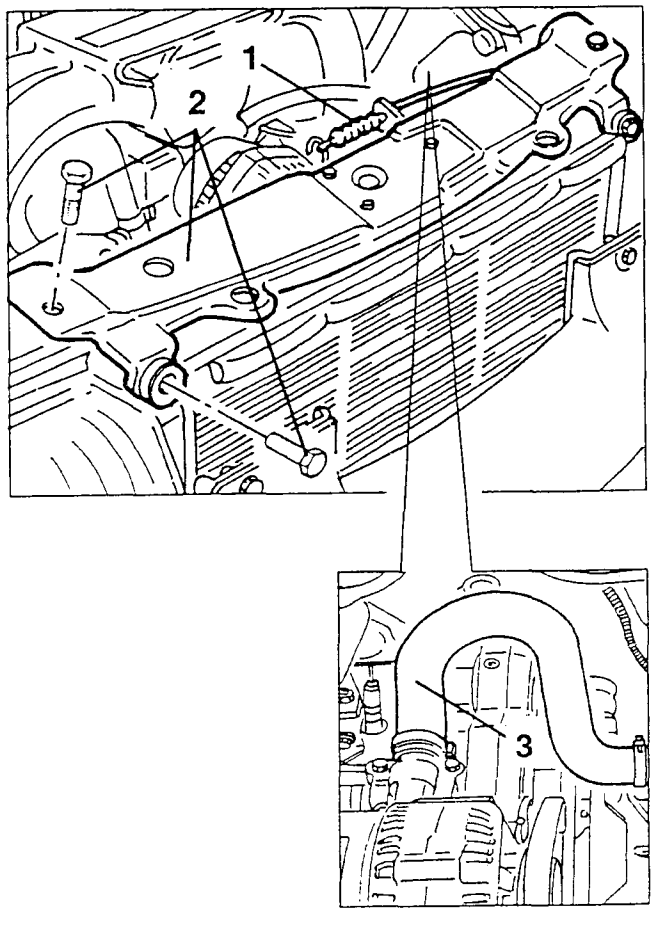
REMOVAL/REFITTING (for versions without conditioner)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.

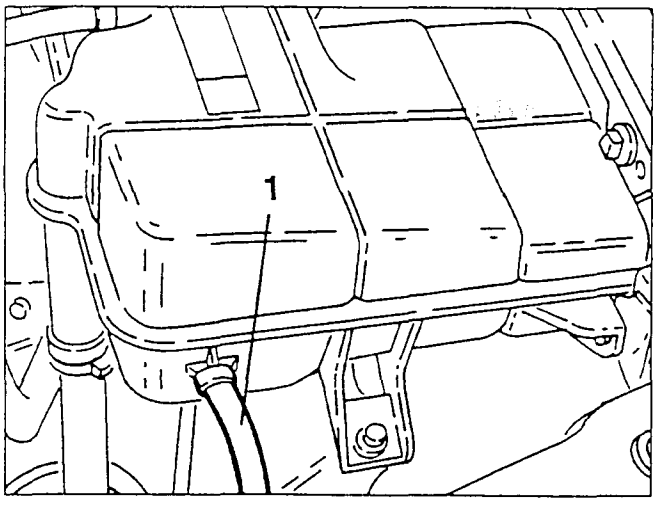
1. Unscrew the two plugs under the crankcase and drain the coolant into a suitable recipient.



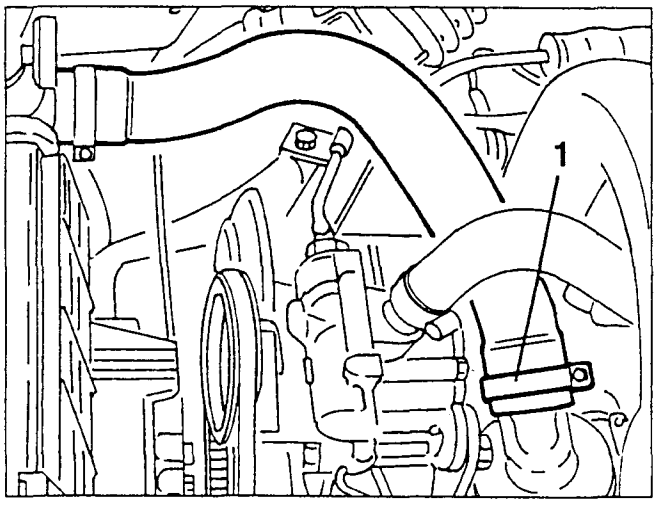
- Lower the car.
- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the bonnet opening cable from the lock.
2. Slacken the crossmember fastening screws and remove it.
- Remove the front bumper (see GROUP 70).
3. Disconnect the radiator outlet hose from the water pump coolant inlet union.



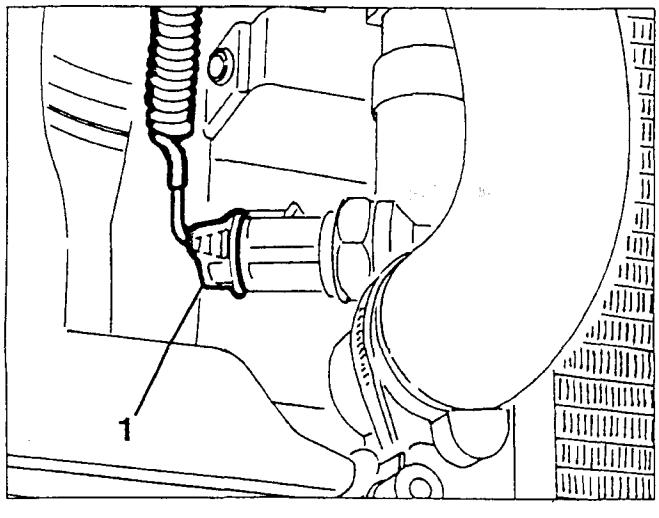
1. Disconnect the radiator connection pipe from the header tank.



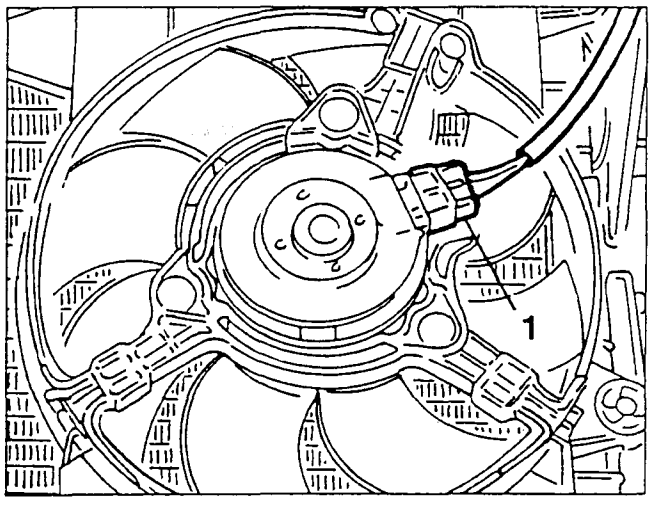
1. Disconnect the radiator coolant delivery sleeve from the thermostatic cup.



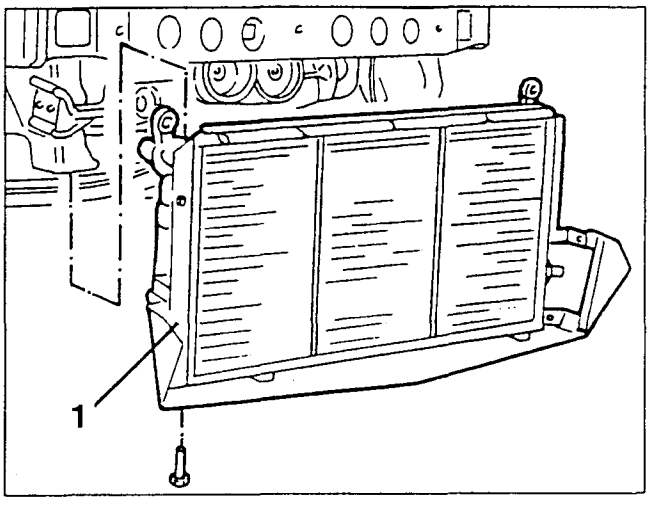
1. Disconnect the electrical connection from the fan control thermal contact.



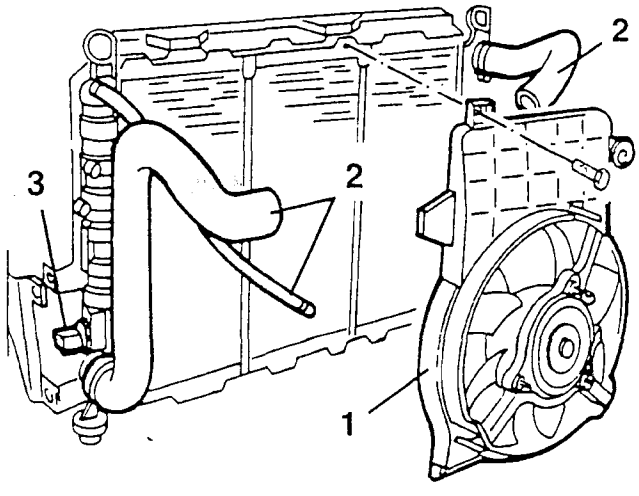
1. Disconnect the electrical connection from the cooling fan.



1. Slacken the two screws fastening the lower crossmember and remove it complete with the radiator and fan.



- Separate the lower crossmember from the radiator.
1. Slacken the four fastening screws and remove the fan from the radiator.
2. Remove the pipes from the radiator.
3. Slacken and remove the fan control thermal contact from the radiator.

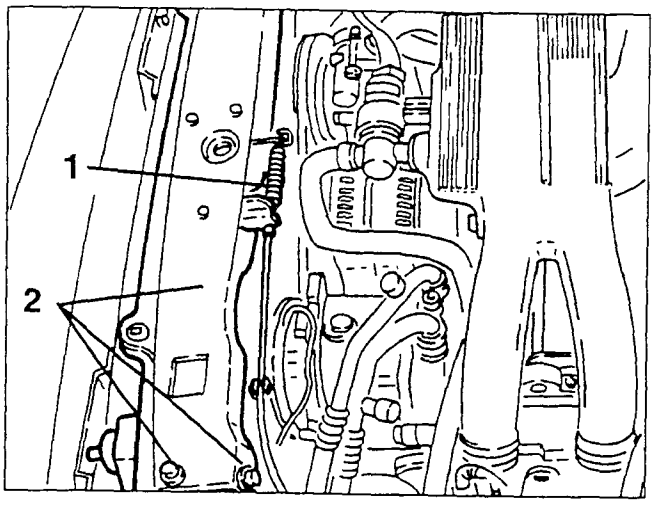


COOLING FANS

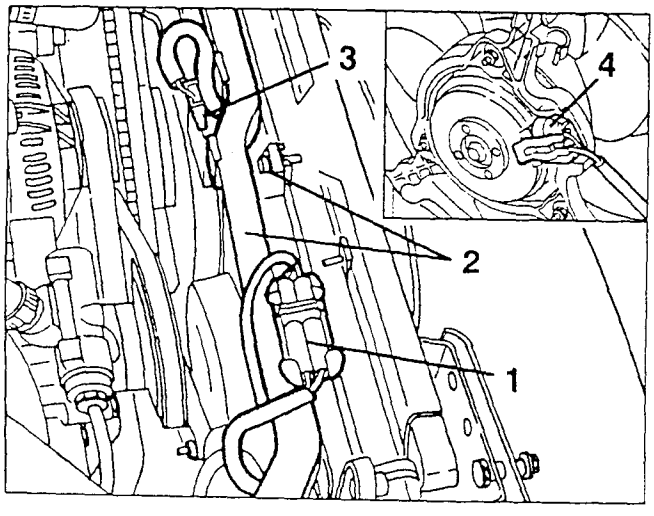
The cooling fan makes it possible to increase the heat dissipating capacity of the radiator.
The cars with air conditioner have two fans with two speeds, while the cars without air conditioner have only one fan with one speed.
The fans are controlled by a thermal contact on the radiator.

REMOVAL/REFITTING (for cars with conditioner)

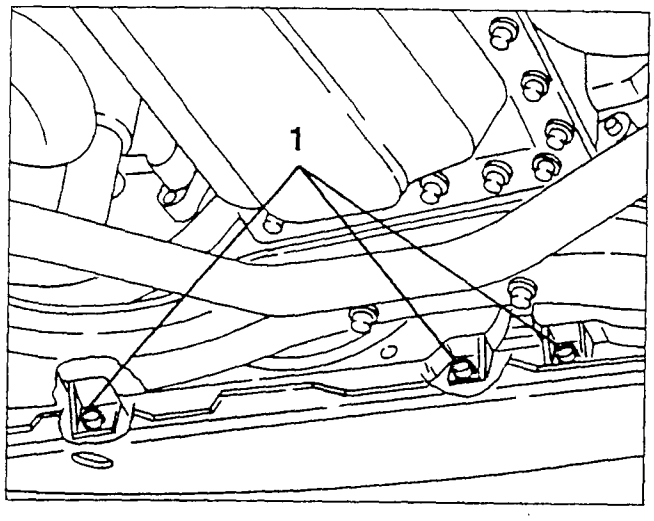
- Remove the radiator grille (GROUP 70).
1. Disconnect the bonnet opening cable.
2. Remove the upper radiator crossmember.



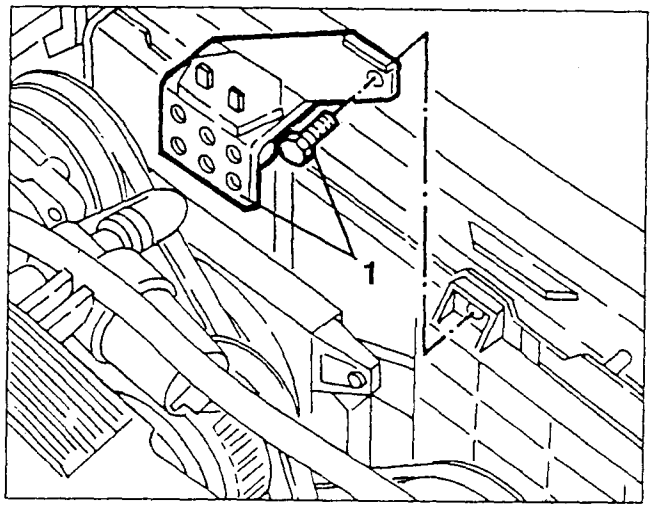
1. Remove the electrical connection without disconnecting it from above the fan.
2. Release the wiring from the groove, slacken the two fastening screws and remove it.
3. Disconnect the two electrical connections from the engine cooling fan additional resistance.
4. Disconnect the electrical connections from the cooling fans.



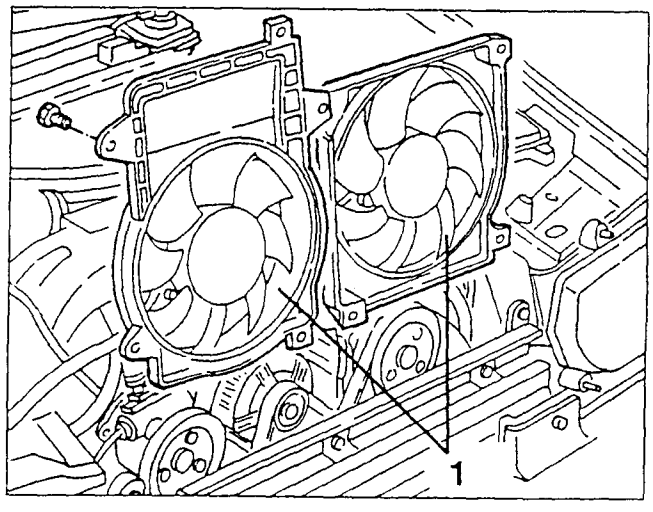
1. Slacken the three lower fastening screws of the cooling fans as illustrated.



- Slacken the remaining lower screw fastening the right fan.
1. Slacken the fan fastening screw illustrated and retrieve the additional resistance.



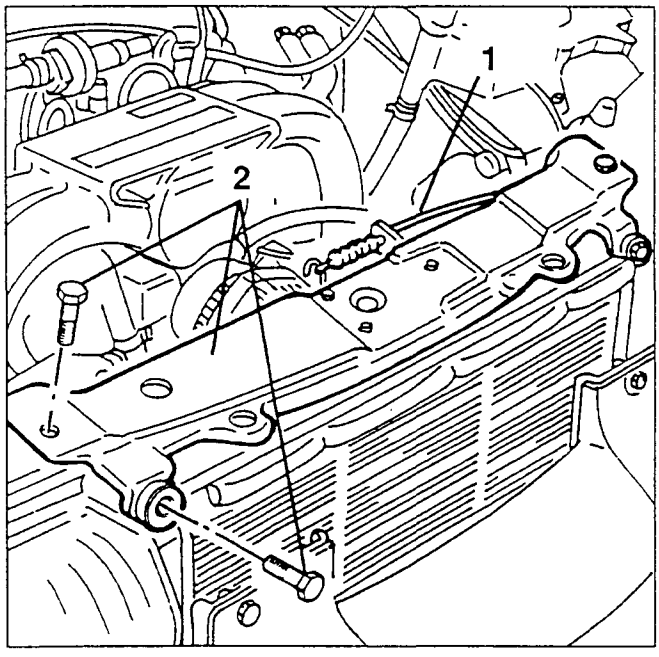
1. Slacken the remaining three upper fan fastening screws then remove the fans pulling them upwards beginning with the right-hand one.



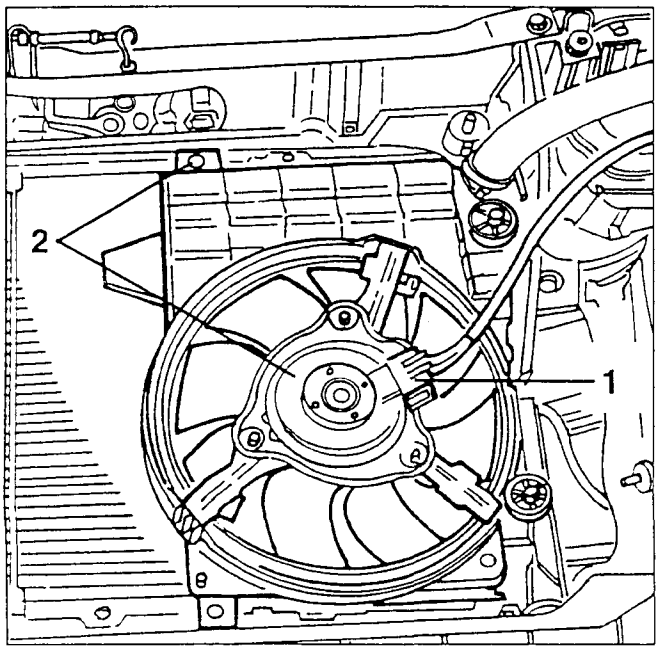
REMOVAL/REFITTING (for versions without conditioner)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the radiator grille (see GROUP 70).

1. Disconnect the bonnet opening cable from the lock.
2. Slacken the crossmember fastening screws and remove it.



1. Disconnect the electrical connection of the fan supply.
2. Slacken the four fastening screws and remove the fan pulling it upwards.



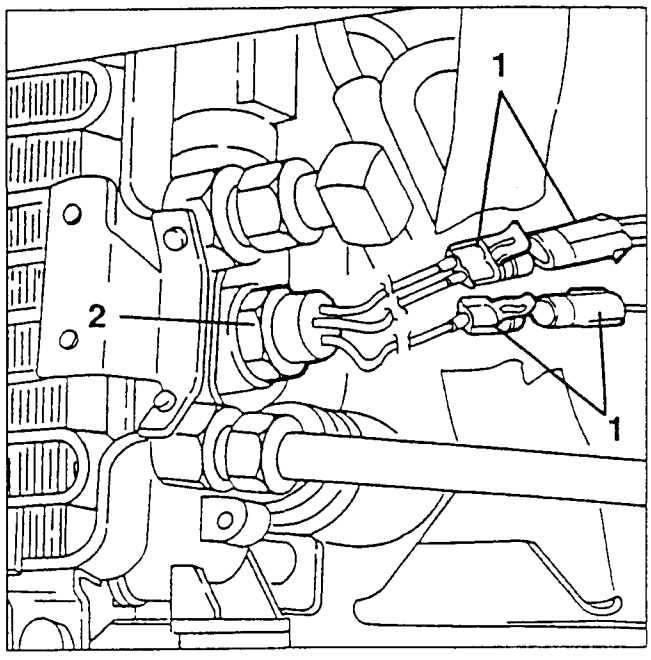
FAN THERMAL CONTACT

REMOVAL/REFITTING

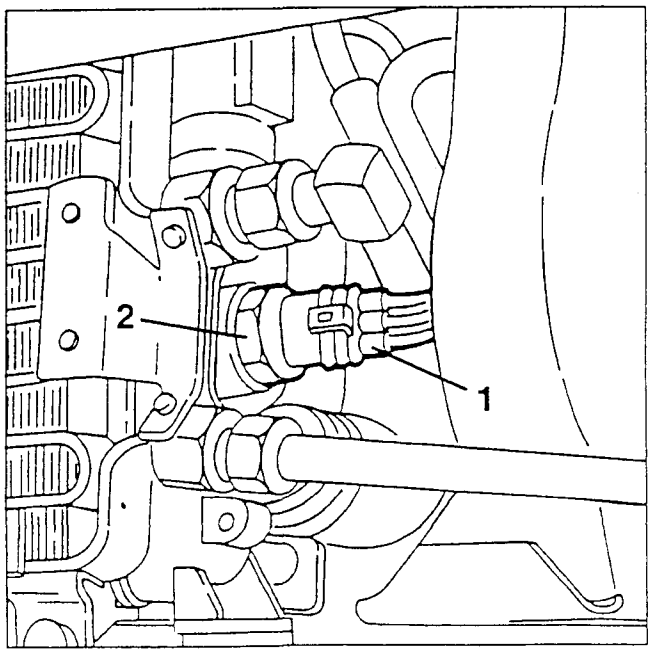
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the radiator grille and front bumper (see GROUP 70).

1. Disconnect the electrical connections of the fan control thermal contact.
2. Remove the fan control thermal contact and recover the coolant that comes out.

WITH CONDITIONER



WITHOUT CONDITIONER



CHECKS AND INSPECTIONS

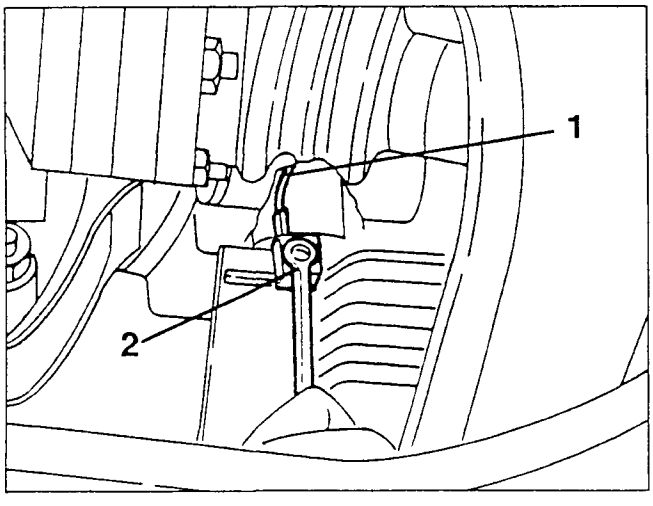
Check the setting of the thermal contact referring to the wiring diagram of the specific manual.

Cooling fan cut-in/cut-out temperatures		
1st speed	Cut in (contacts close)	92° ± 2°C
	Cut out (contacts open	87° ± 2°C
2nd speed (only for versions with conditioner)	Cut in (contacts close)	97° ± 2°C
	Cut out (contacts open)	92° ± 2°C

- If the values are not as specified, change the thermal contact.

MAXIMUM COOLANT TEMPERATURE WARNING LIGHT SENDER

1. Disconnect the electrical connection from the max. coolant temperature warning light sender.
2. Slacken the fastening screw and remove the max. coolant temperature warning light sender from the right-hand cylinder head.

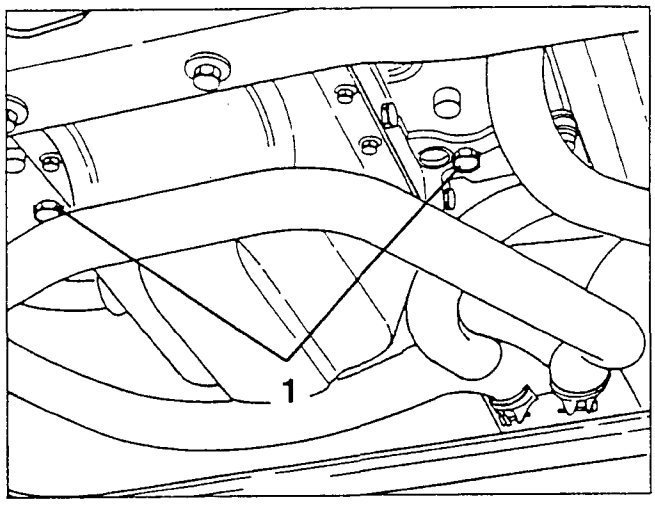


- Check the setting of the max. coolant temperature warning light sender. If the setting is incorrect, change the sender.

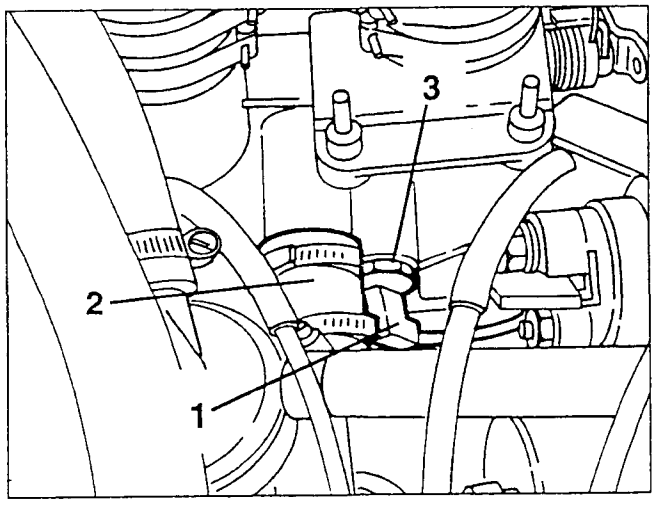
Cut in temperature	117° ± 3°C
Cut out temperature	100° ± 3°C

COOLANT TEMPERATURE GAUGE SENDER

1. Slacken the two plugs under the crankcase and drain the engine coolant fluid into a suitable recipient.



- Lower the car.
- Remove the intake box and the throttle control shaft (see GROUP 10).
1. Disconnect the electrical connection from the coolant temperature gauge sender.
2. Disconnect the coolant outlet sleeve from the right-hand body.
3. Slacken and remove the engine coolant temperature gauge sender.

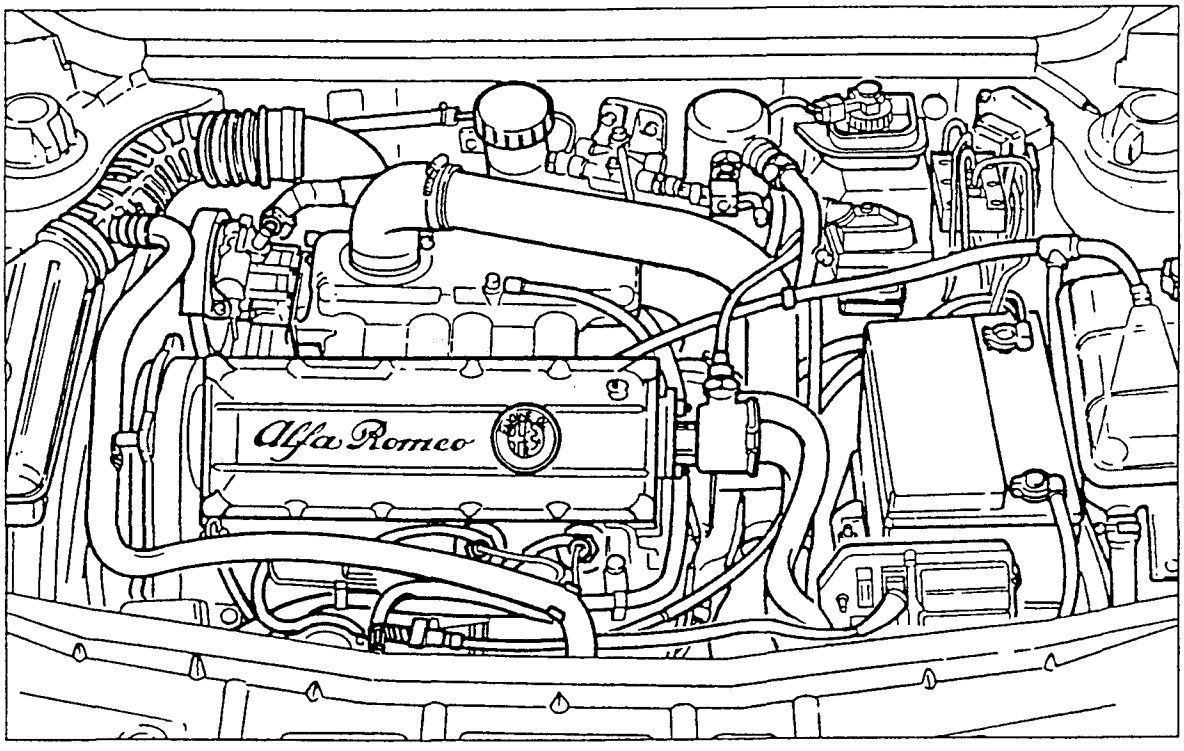


- Check the setting of the engine coolant temperature gauge sender (see: GROUP 55 - "DIAGNOSIS OF THE ELECTRICAL SYSTEM").

DESCRIPTION

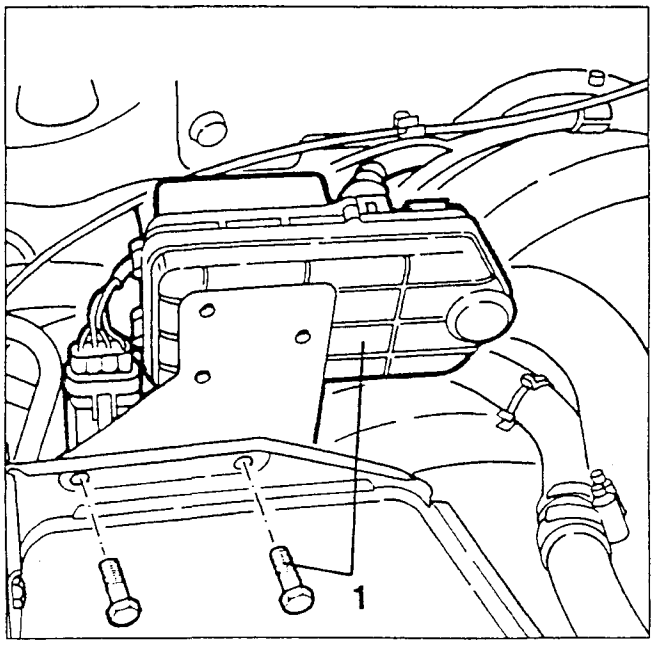
The information and illustrations given below enable the rapid removal of the power unit from its housing and its subsequent refitting.
The bench disassembly of the single components is described in the volume "ENGINE OVERHAULING".

The following procedure may be used only in part according to requirements.
Fur further information and details, refer to the chapters concerning the components or specific groups.

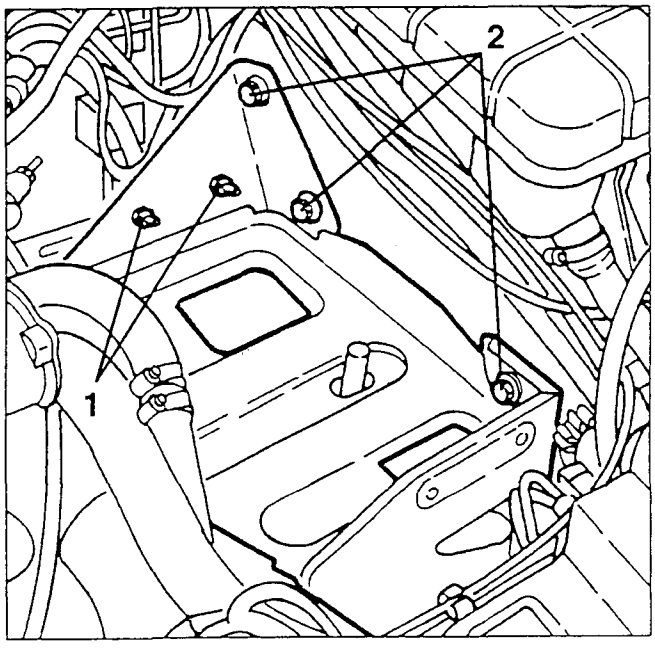


REMOVAL

- Remove the front wheels.
- Remove the radiator grille and front bumper (see GROUP 70).
- Drain off the air conditioning fluid.
1. Loosen the two screws and move the fan relays to one side.



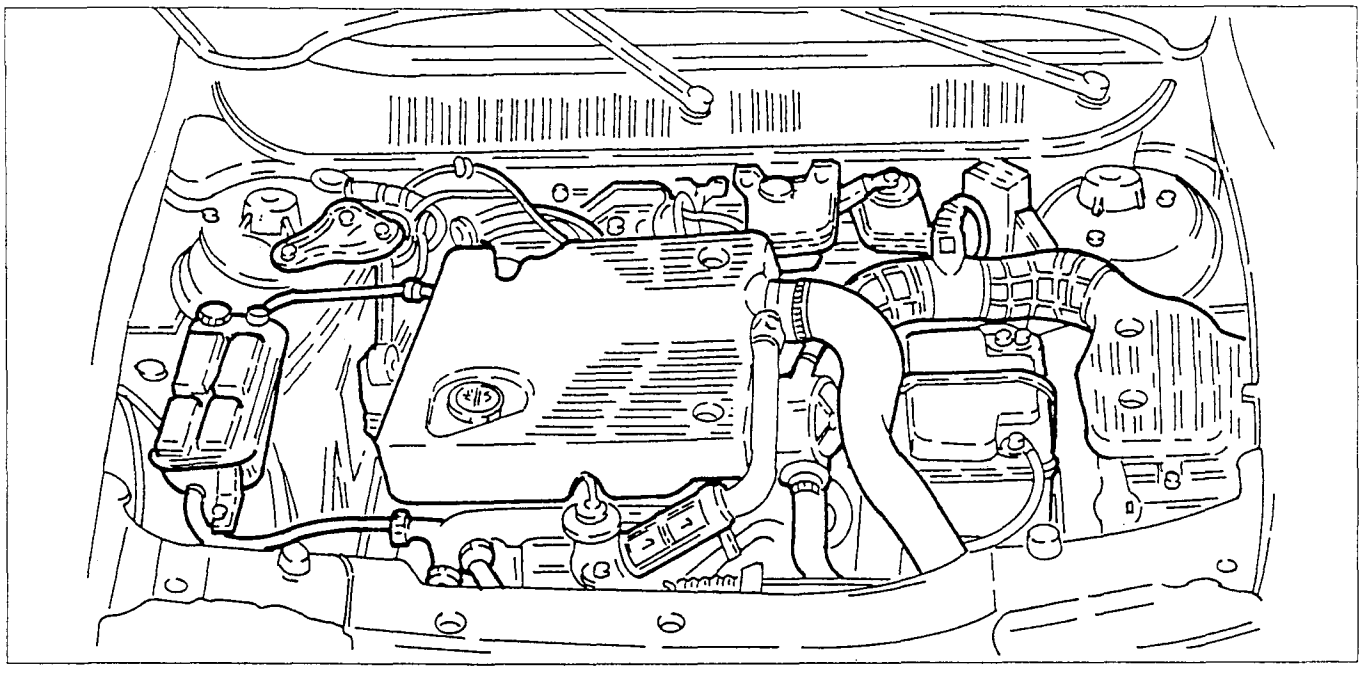
- Remove the conveyor for draining the battery acid.
1. Unscrew the two nuts securing the heater plug control unit bracket support at the battery support.
2. Unscrew the four screws and remove the battery support.



DESCRIPTION

The information and illustrations given below make it possible to quickly remove the power unit from its housing and then refit it.
Disassembly of the single components on the bench is described in the "ENGINE OVERHAULING" volume.

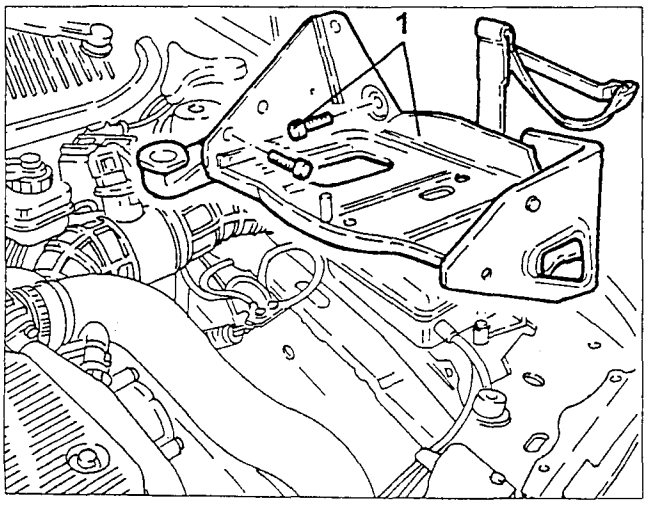
The following procedure may be used only in part depending on necessity.
For further information and details, refer to the chapters concerning the components or specific groups.



REMOVAL

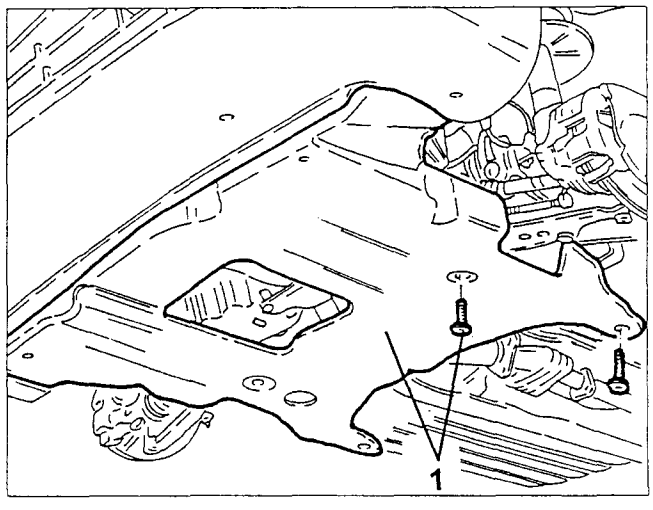
- Set the car on a lift.
- Remove the battery (see GROUP 55).
- Remove the battery acid drain duct.

1. Slacken the fastening screws and remove the battery holder.



- Remove the front wheels and dust guards.

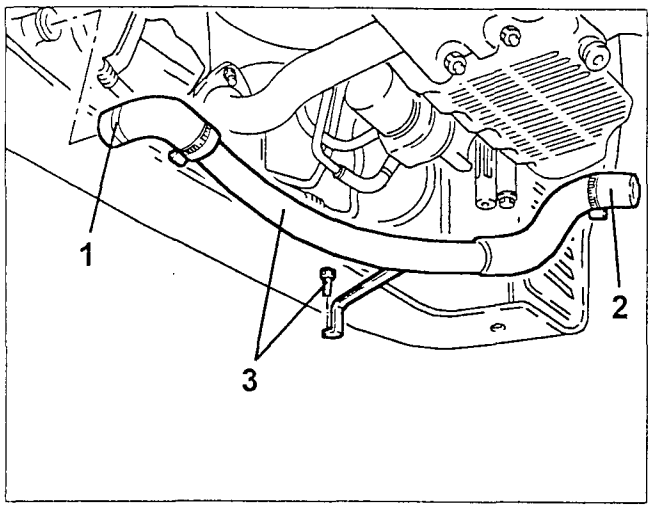
1. Slacken the fasteners and remove the under engine guard.



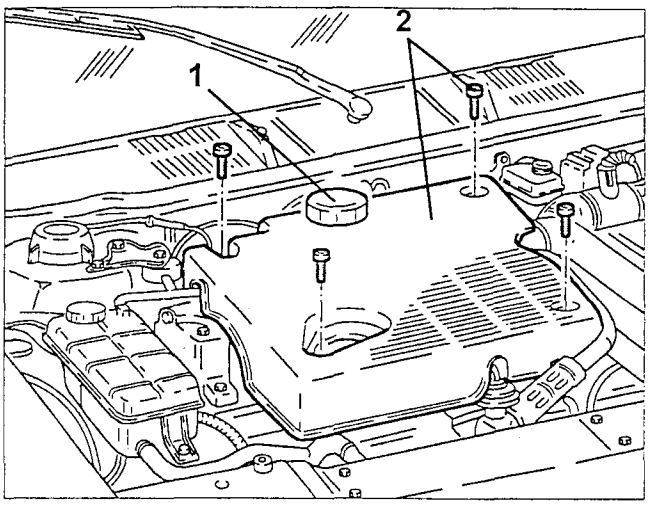
1. Drain the engine coolant fluid, disconnecting the coolant outlet sleeve from the radiator.

NOTE: Collect the coolant in a suitable container.

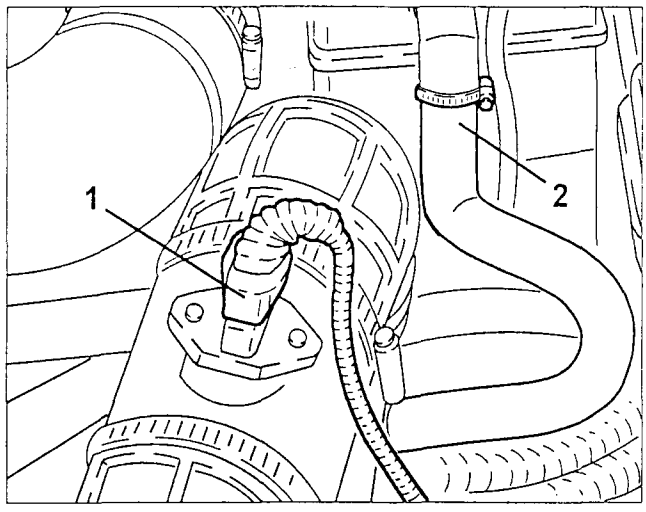
2. Disconnect the coolant outlet sleeve from the stiff coolant return pipe to the pump.
3. Slacken the fastening screw and remove the coolant outlet pipe from the radiator.



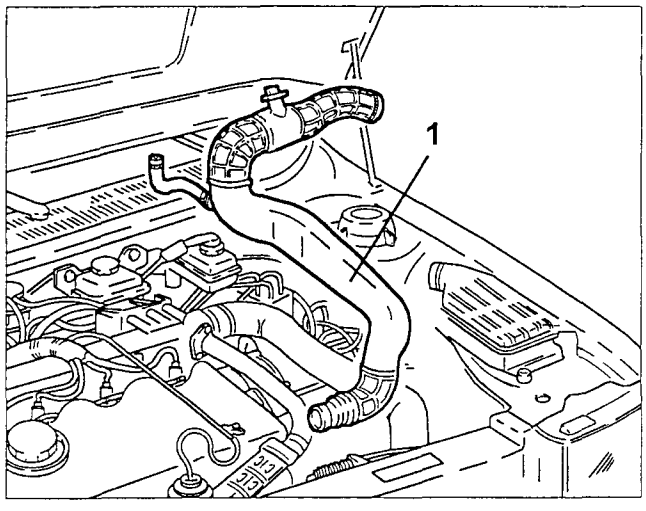
- Using a suitable syringe, siphon the oil from the power steering tank.
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.



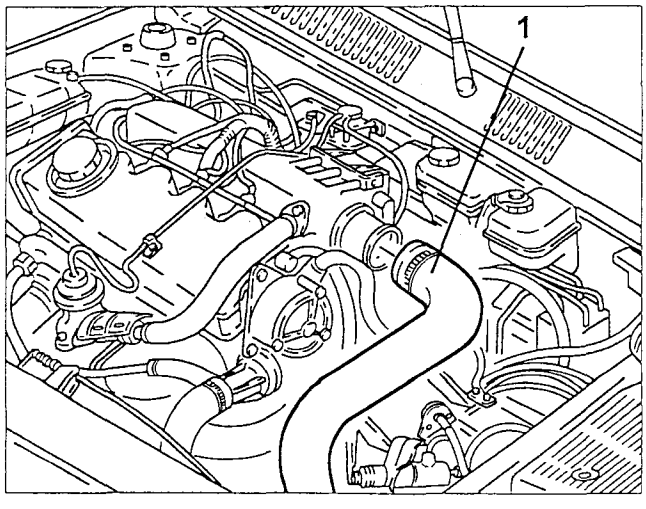
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the oil vapour re-circulation pipe from the oil vapour separator.



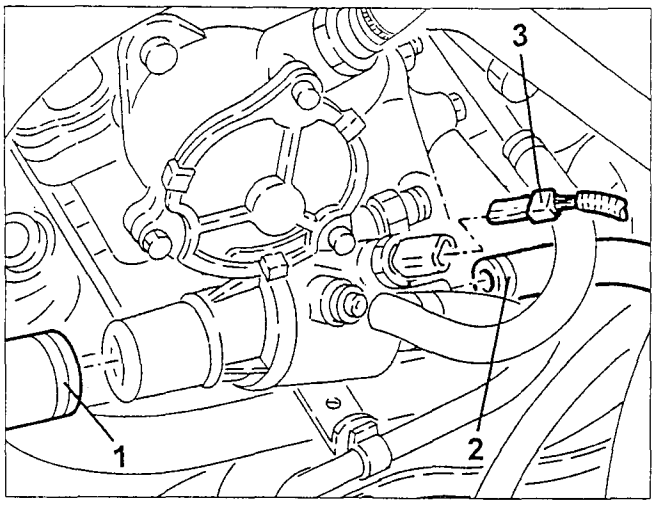
1. Slacken the clamps and remove the complete air delivery pipe from the filter to the turbocharger.



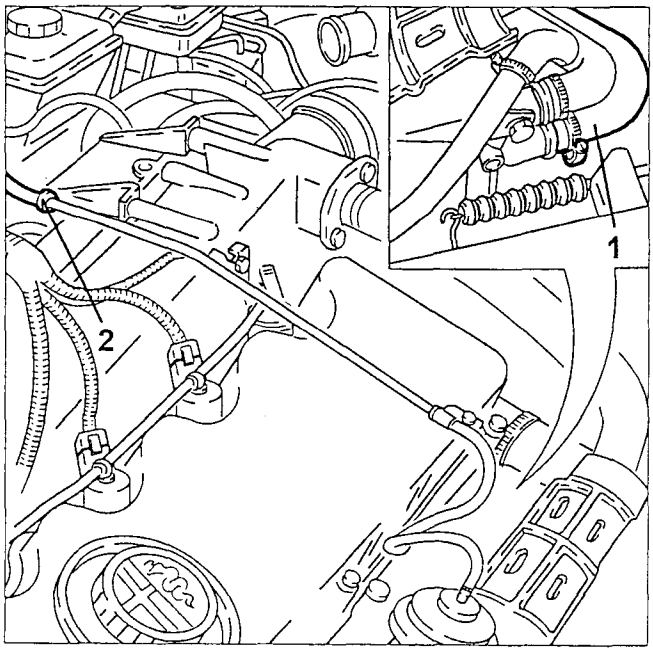
1. Disconnect the air delivery pipe from the intercooler from the intake box.



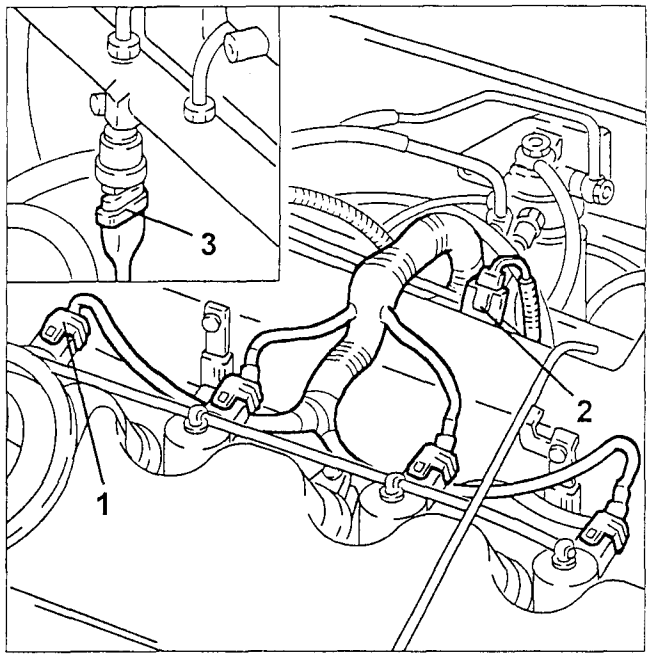
1. Disconnect the coolant delivery sleeve to the radiator from the thermostatic cup.
2. Disconnect the coolant delivery pipe to the climate control system heater from the thermostatic cup.
3. Disconnect the electrical connection from the engine coolant temperature sensor.



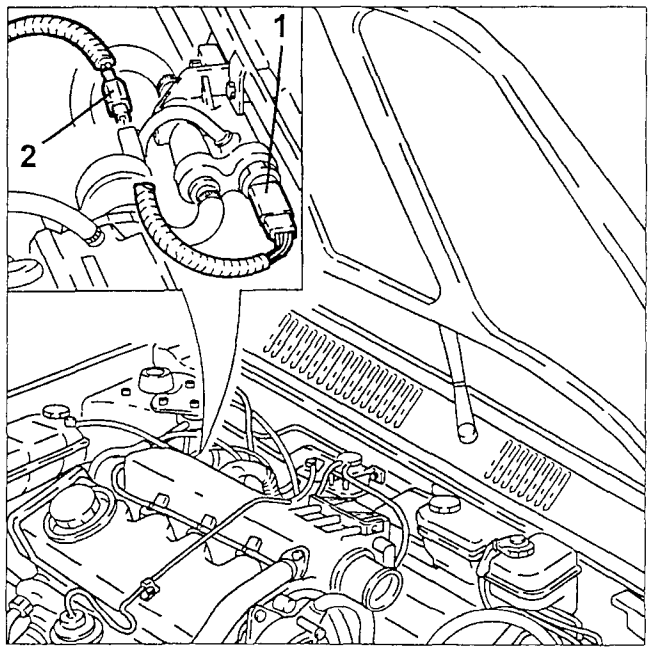
1. Disconnect the return pipe from the climate control system heater from the stiff water pump coolant return pipe.
2. Disconnect the connection of the E.G.R. valve modulated control pipe.



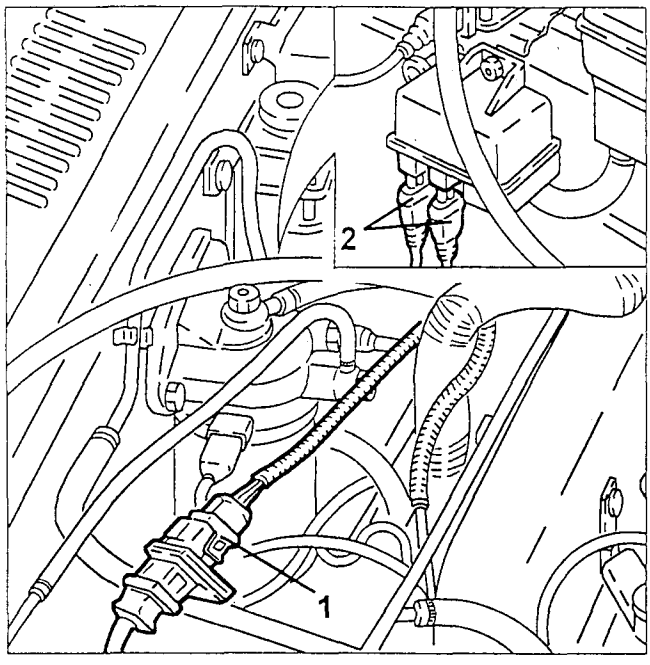
1. Disconnect the electrical connection of the injectors.
2. Disconnect the electrical connection from the overpressure sensor.
3. Disconnect the electrical connection from the fuel temperature sensor.



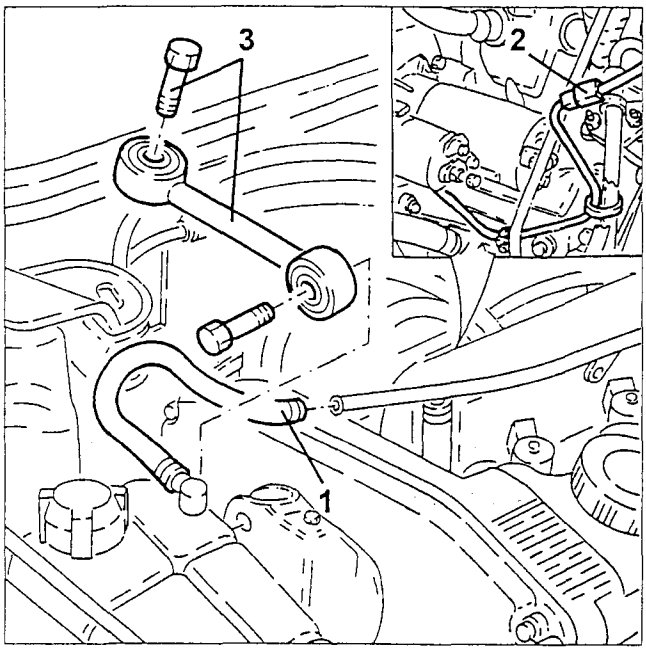
1. Disconnect the electrical connection from the fuel pressure sensor.
2. Disconnect the electrical connection from the fuel pressure regulator.



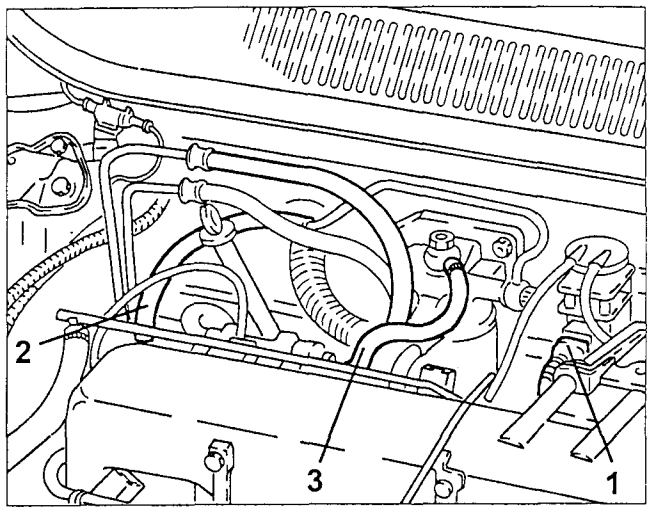
1. Disconnect the electrical connection of the cam angle sensor.
2. Disconnect the electrical connections from the glow plug warming control unit.



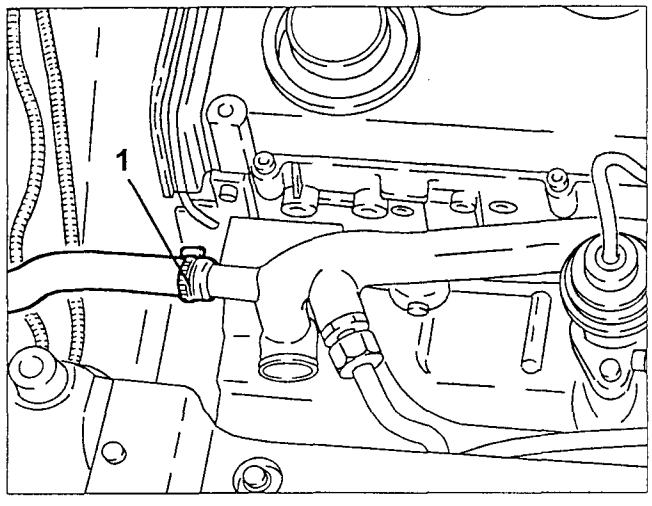
1. Disconnect the connection of the coolant return pipe to the header tank.
2. Disconnect the electrical connection of the rpm sensor.
3. Slacken the fastening screws and remove the power unit reaction rod.



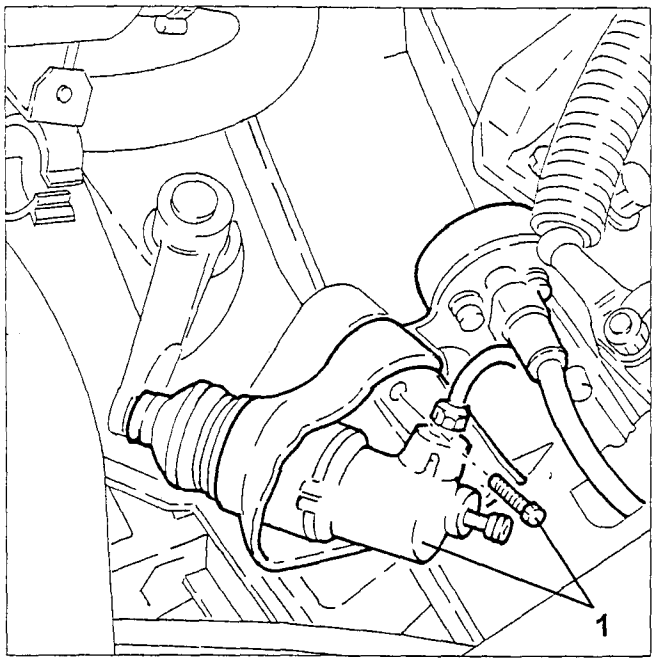
1. Disconnect the electrical connection E.G.R. modulation solenoid valve.
2. Disconnect the fuel delivery pipe from the pressure pump.
3. Disconnect the fuel return pipe from the fuel return manifold pipe.



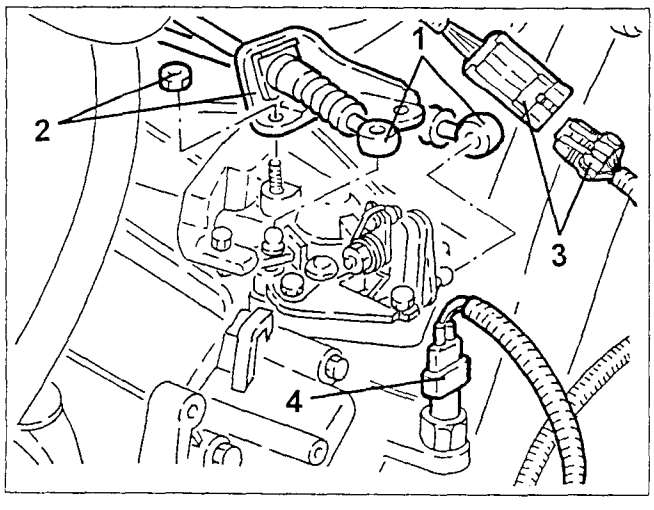
1. Disconnect the system supply pipe leading from the header tank from the stiff coolant return pipe to the water pump.



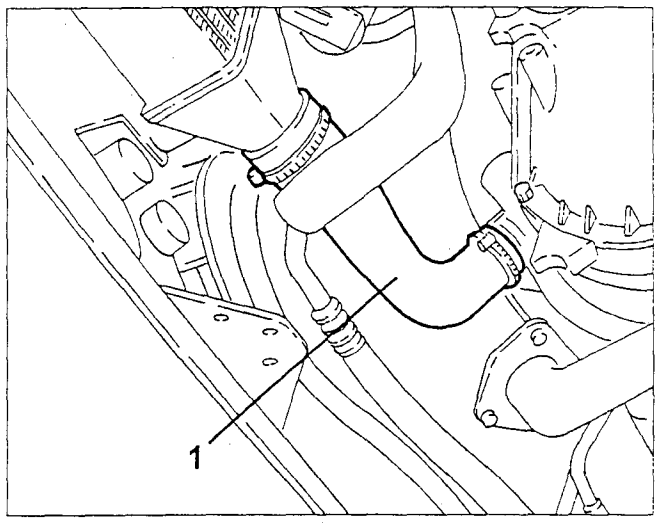
1. Slacken the fastening screws and move aside the operating cylinder complete with pipes and pulse damper.



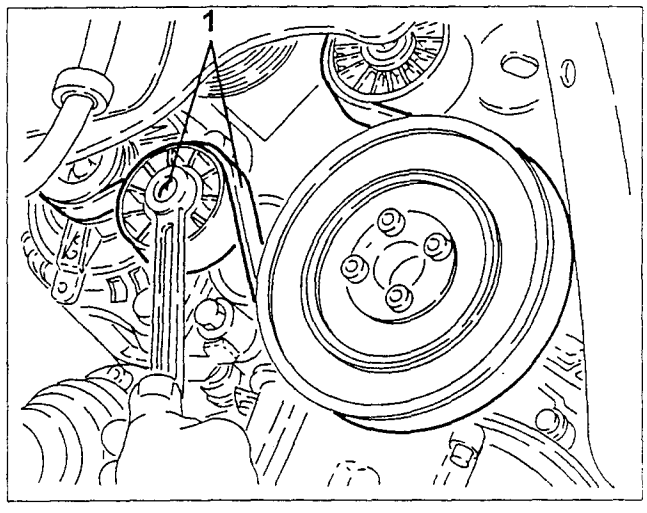
1. Disconnect the gear selection and engagement cables.
2. Slacken the nuts and move aside the support brackets complete with gear selection and engagement cables.
3. Disconnect the electrical connection of the speedometer sensor.
4. Disconnect the electrical connection from the reversing lights sensor.



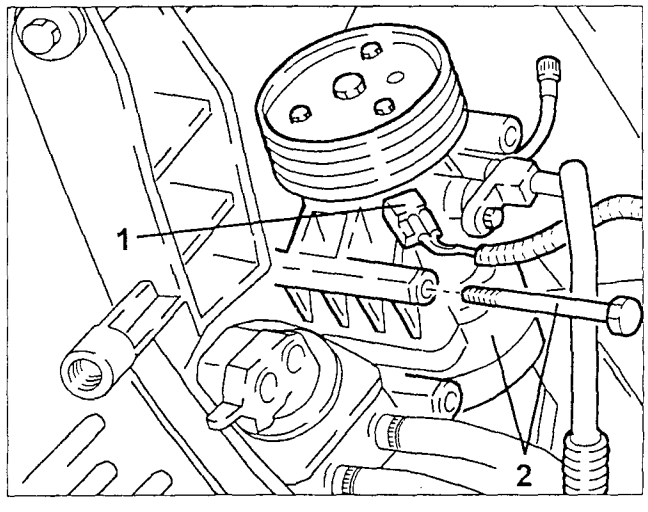
1. Remove the air delivery pipe from the turbocharger to the heat exchanger.



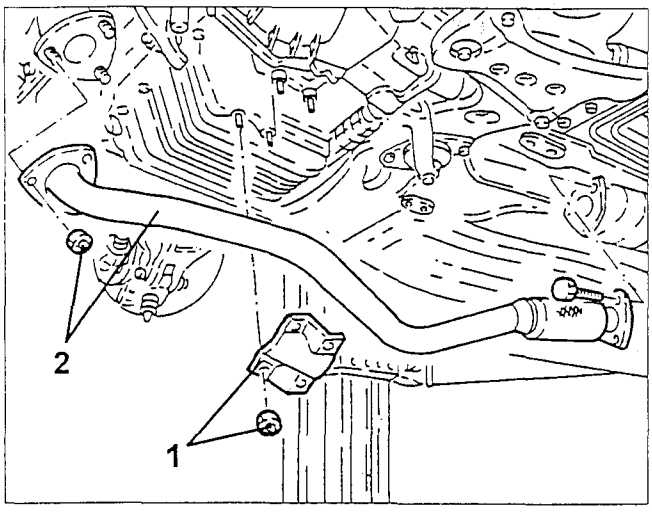
1. Working as illustrated on the tensioner, slacken the tension of the engine components belt and remove it.



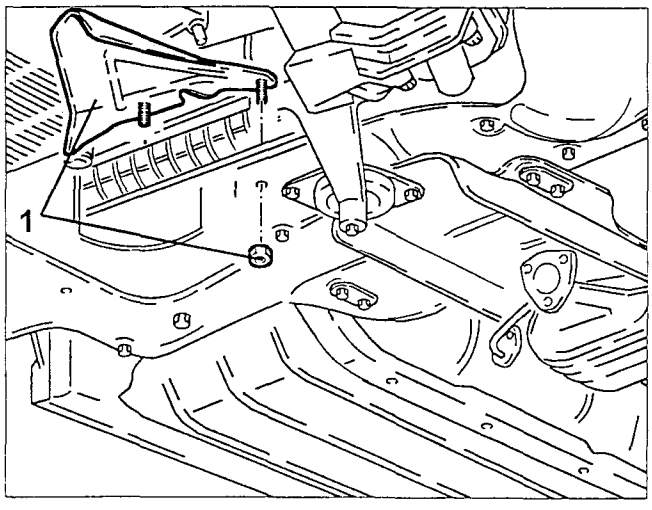
1. Disconnect the electrical connection from the conditioner compressor.
2. Slacken the fastening screws and move aside the conditioner compressor without disconnecting the associated pipes.



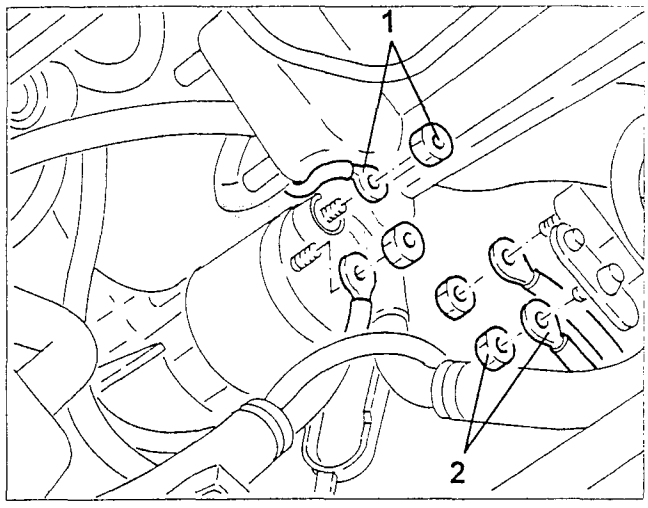
1. Slacken the fastening nuts and remove the reinforcement bracket.
2. Slacken the nuts and screws and remove the front section of the exhaust pipe.
- Remove the associated seals.



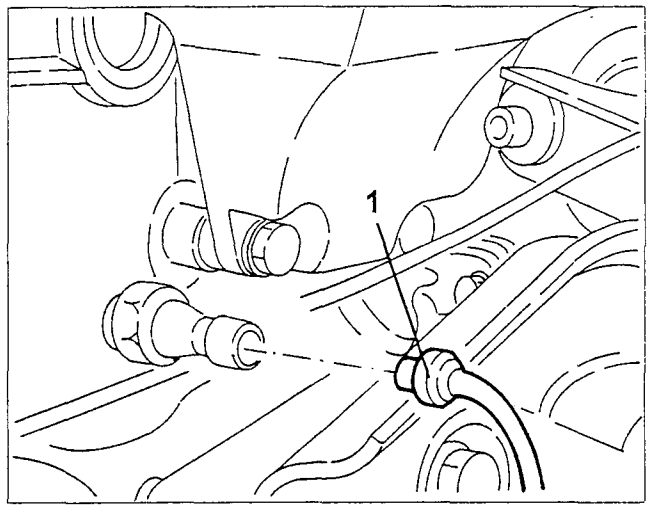
1. Slacken the nuts and remove the power steering box heat shield.



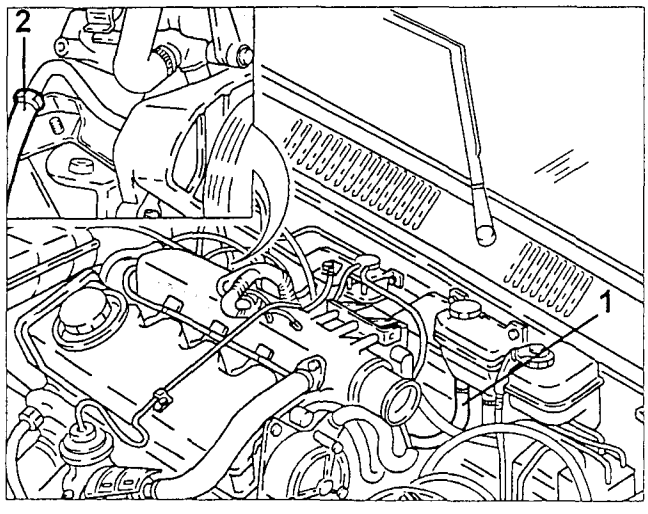
1. Disconnect the electrical connections from the starter motor.
2. Disconnect the electrical connections from the alternator.



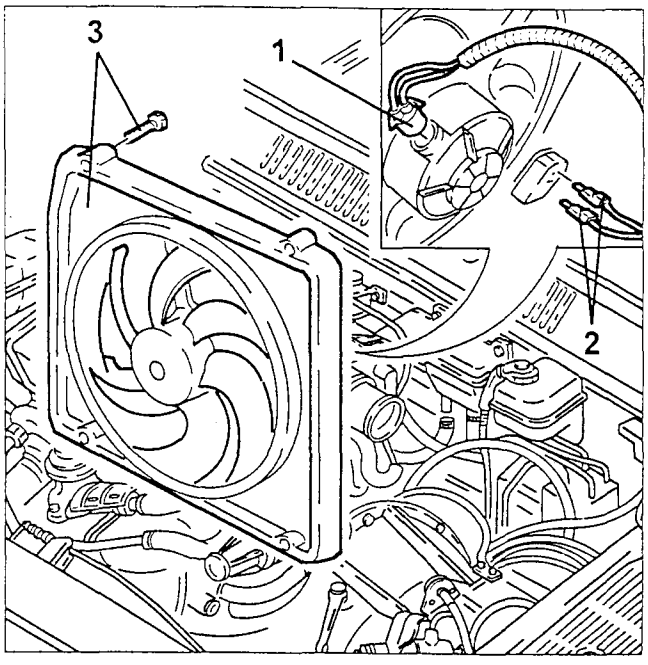
1. Disconnect the electrical connection from the *minimum engine oil pressure sensor*.



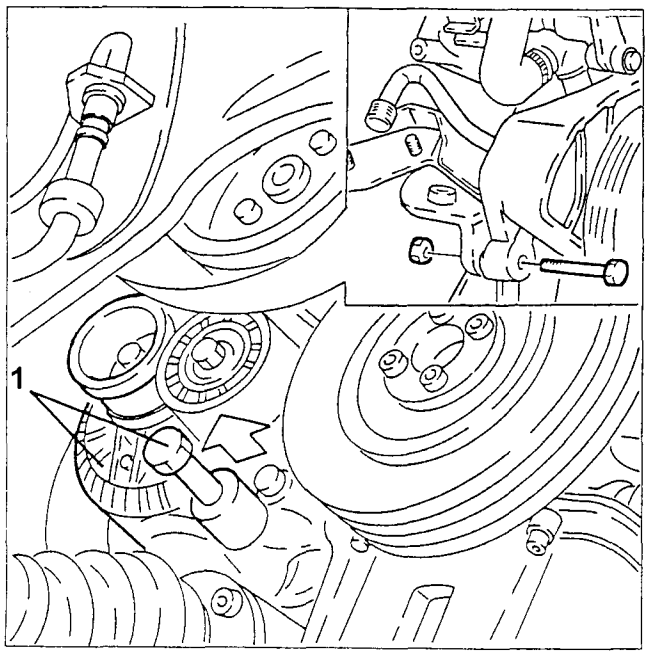
1. Disconnect the delivery pipe to the pump from the power steering fluid tank.
2. Disconnect the delivery pipe to the power steering box from the power steering pump.



1. Disconnect the electrical connection from the engine cooling fan.
2. Disconnect the electrical connections from the engine cooling fan resistor.
3. Slacken the fastening screws and remove the engine cooling fan.

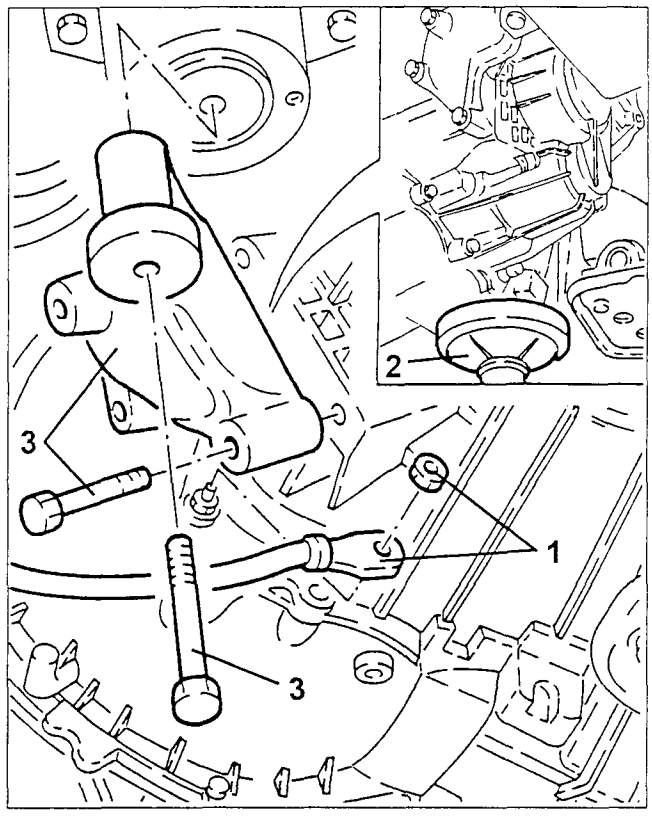


1. Slacken the fastening bolts and remove the alternator.



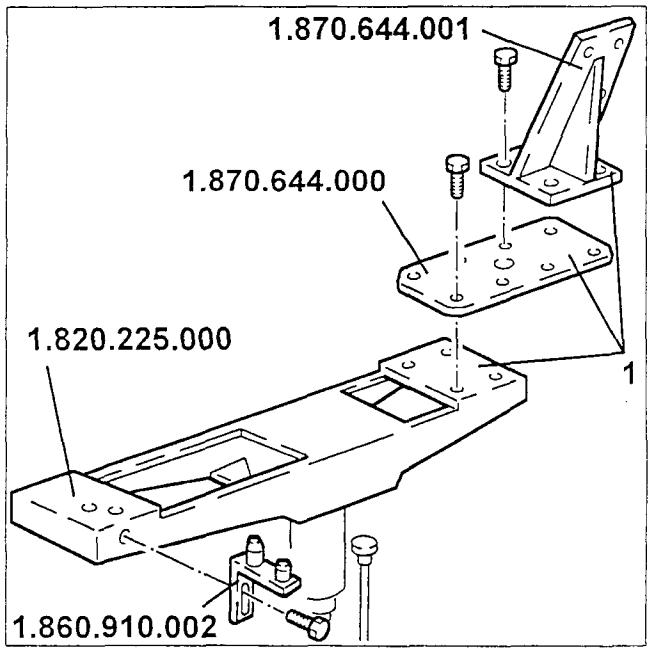
1. Disconnect the earth cable from the gearbox.
2. Place a hydraulic jack under the differential.

3. Slacken the fastening screws and remove the power unit gearbox side support.

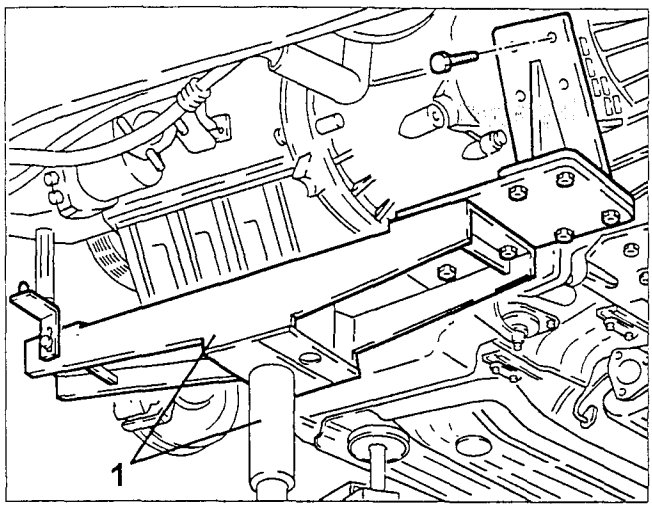


- Lower the hydraulic jack until the joint of the left axle shaft to the suspension crossmember rests on it.

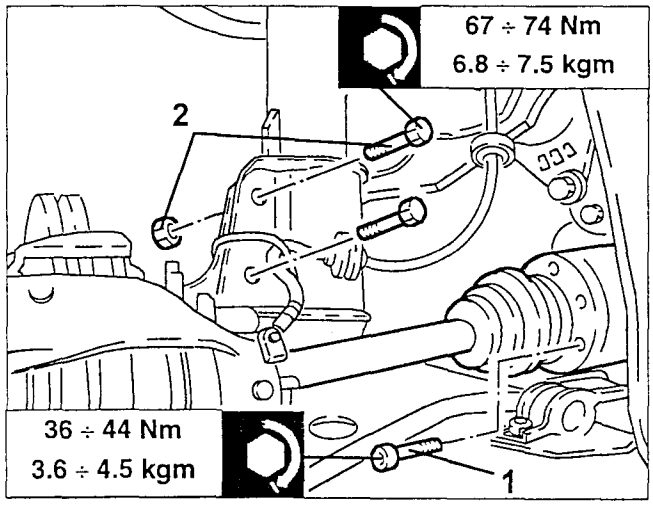
1. Assemble base no. 1.820.225.000, the gearbox side supports no. 1.870.644.000 and 1.870.644.001 and the timing gear side support no. 1.860.910.002 on a hydraulic jack.



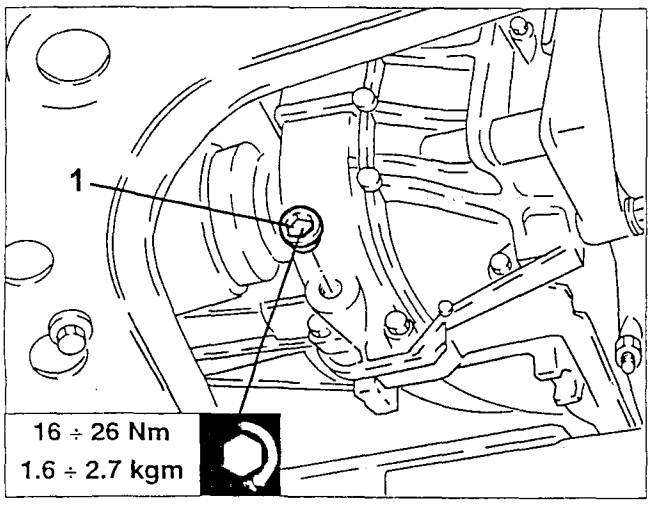
1. Place the hydraulic jack complete with tools under the engine and fasten the gearbox side support with the corresponding screws.



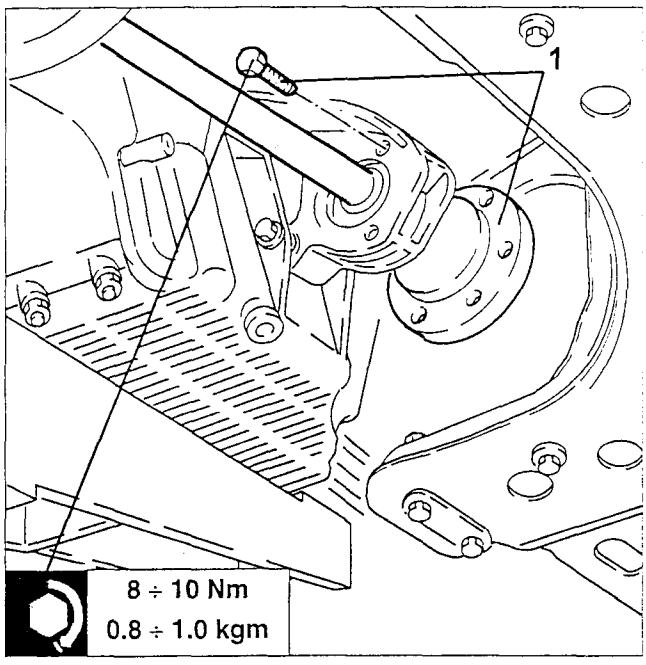
1. Slacken the axle shaft fastening bolts.
2. Slacken the two bolts fastening the right shock absorber to the upright to prevent interference of the axle shaft with the oil sump.



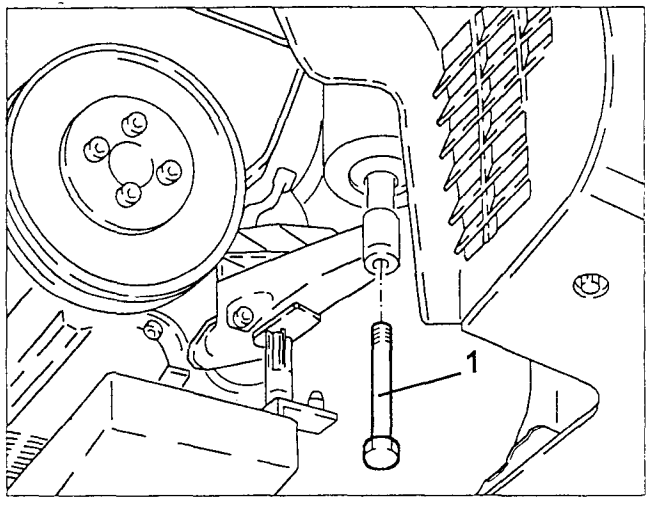
1. Slacken the drain cap and drain the gearbox/differential oil.



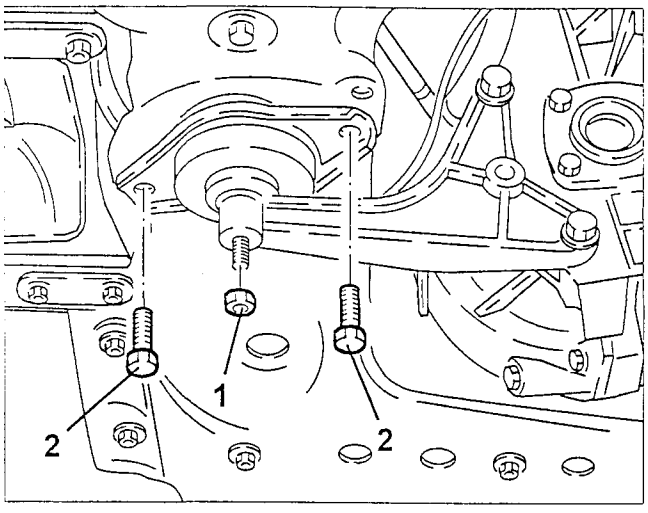
1. Slacken the fastening screws and remove the intermediate axle shaft.



1. Slacken the screw fastening the timing gear side rigid engine support to its flexible pad.

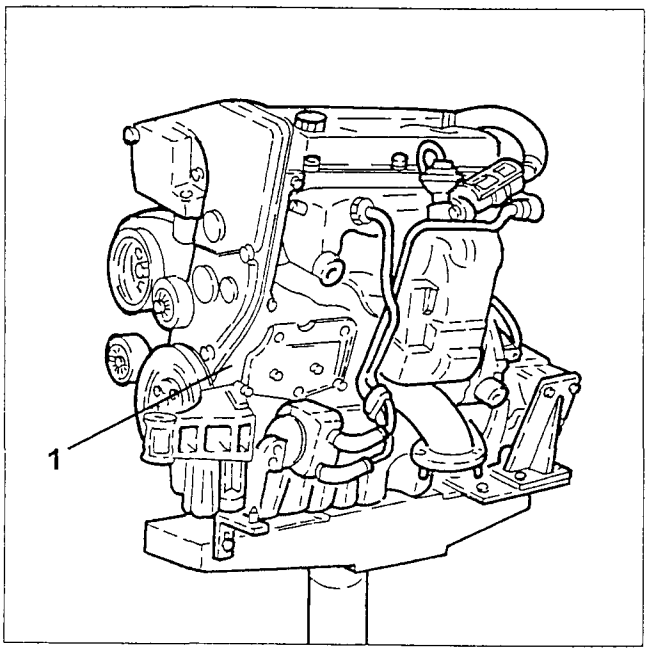


1. Slacken the nut fastening the power unit rear stiff support to its flexible pad.
2. Slacken the screws fastening the power unit rear support flexible pad to the suspension crossmember.



1. Lower the hydraulic jack and remove the power unit from the engine compartment.

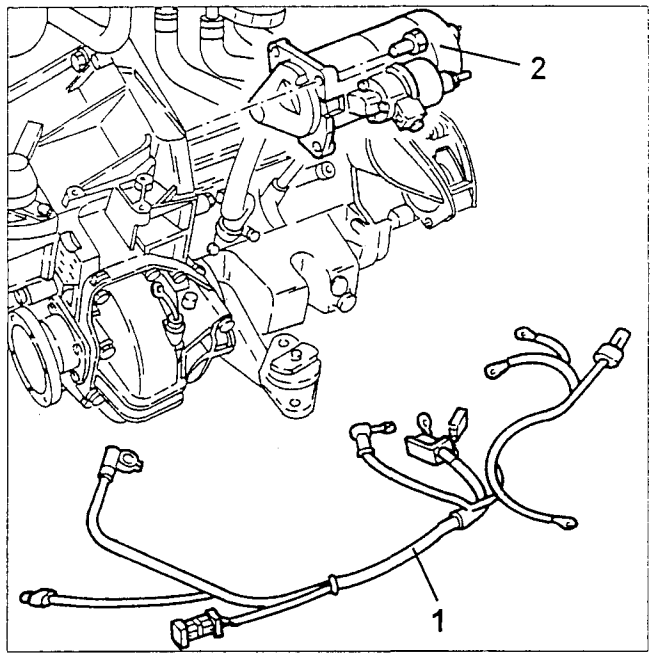
WARNING: The hydraulic jack used for removing the power unit must have a a capacity of at least 1000 kg.



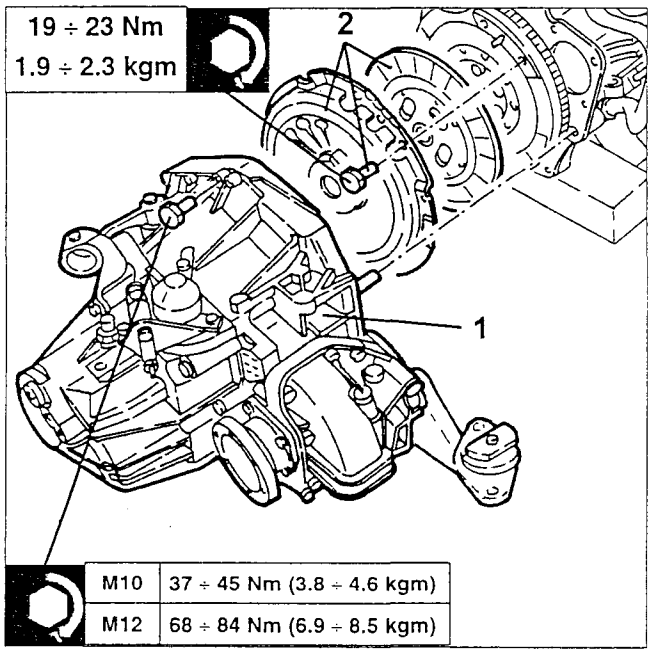
- Support the power unit with a hydraulic hoist as well as with the hydraulic jack used for removal.

WARNING: For moving the power unit use a hydraulic hoist after freeing it from the hydraulic jack.

- Release the power unit from the support tools, then place it on a special work bench.
1. Scollegare e rimuovere il cablaggio elettrico dal gruppo motopropulsore.
2. Slacken the fastening screws and remove the starter motor.

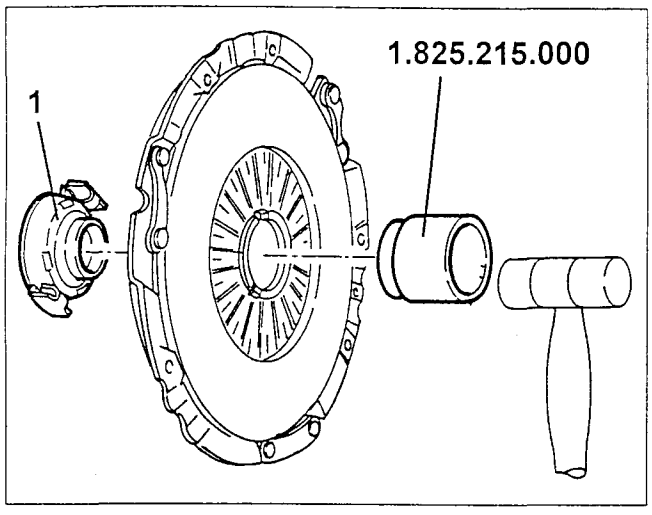


1. Slacken the fasteners and remove the gearbox/differential unit from the engine.
2. Slacken the fastening screws, then remove the clutch box complete with thrust bearing and clutch plate.

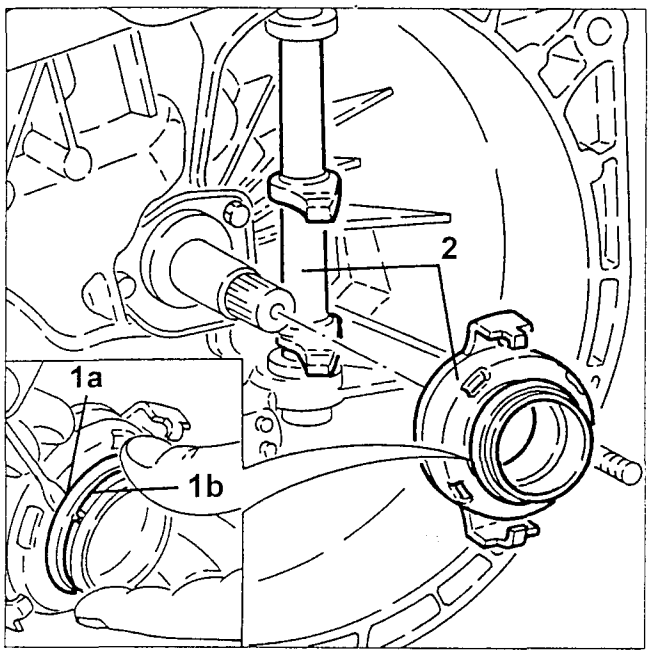


REFITTING

Reverse the sequence followed for removal, following the instructions given below.
1. Remove the thrust bearing from the clutch box using tool no. 1.825.215.000.



- Install the clutch plate and clutch box centring them with tool no. 1.820.124.000.
- Tighten the clutch box fastening screws to the specified torque.
1. Raise the plastic taper ring (1a) of the thrust bearing until covering the spring (1b).
2. Install the thrust bearing on the main shaft and hook it to the fork pin.



- Assemble the gearbox - differential unit and fasten it with its nuts and screws tightening to the specified torque.
- Work on the clutch control lever to engage the thrust bearing on the clutch box.

- Prepare the engine compartment for inserting the power unit, placing all the electric cables, pipes, etc. so that they do not interfere with refitting.
- Take due care when installing the power unit to avoid damaging the single components.

WARNING: Make sure that the power unit support points have been fastened correctly.

- After assembly, fill the various systems following the specified procedures (see Group 00).
- Carry out all the necessary checks and operations (see Group 00).

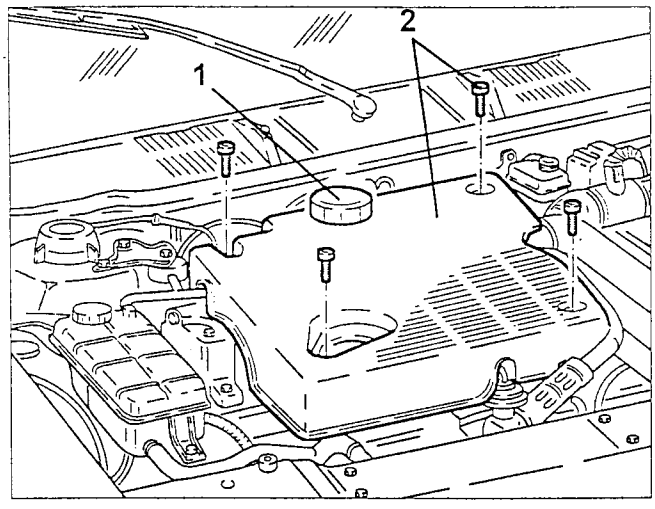
CYLINDER HEAD

REMOVAL/REFITTING

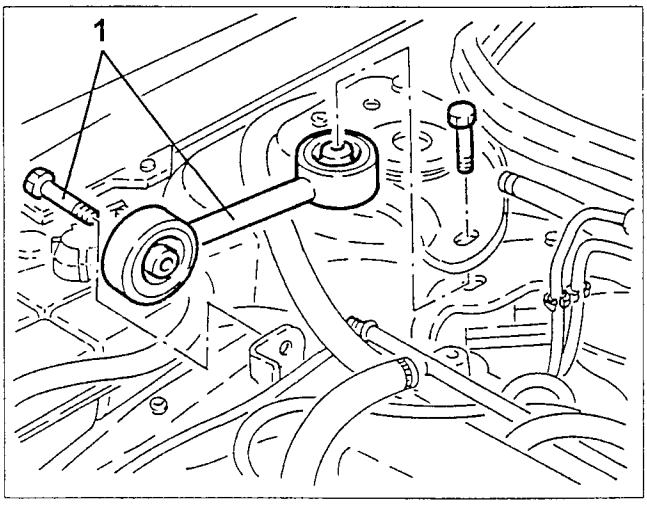
- Set the car on a lift.
- Remove the battery (see GROUP 55).

1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.

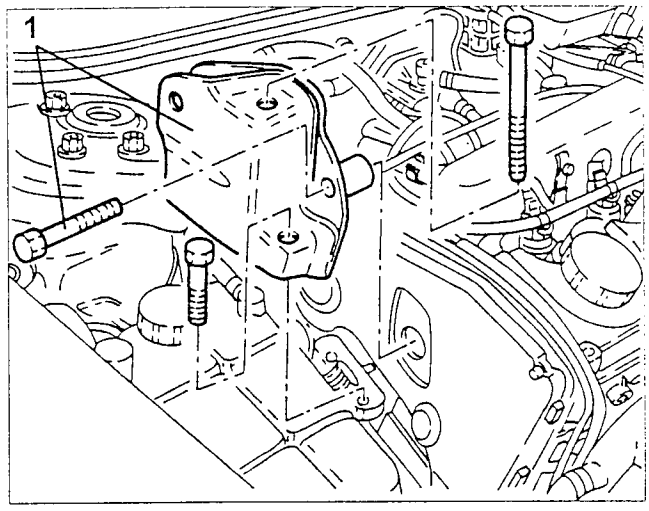
- Refit the engine oil filler cap.



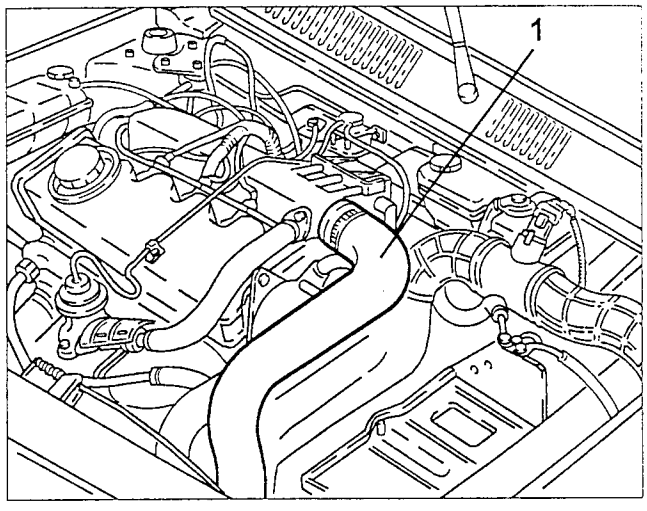
1. Slacken the fastening screws and remove the power unit reaction rod.



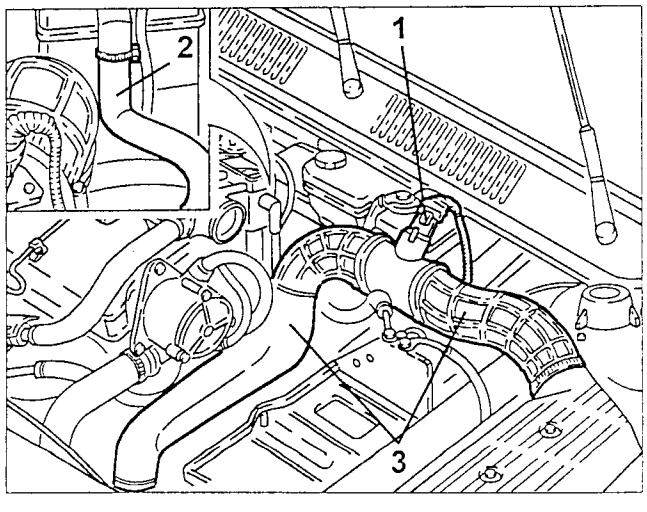
1. Slacken the fastening screws and remove the engine side reaction rod support bracket.



1. Disconnect and remove the air delivery pipe from the intercooler to the intake box.

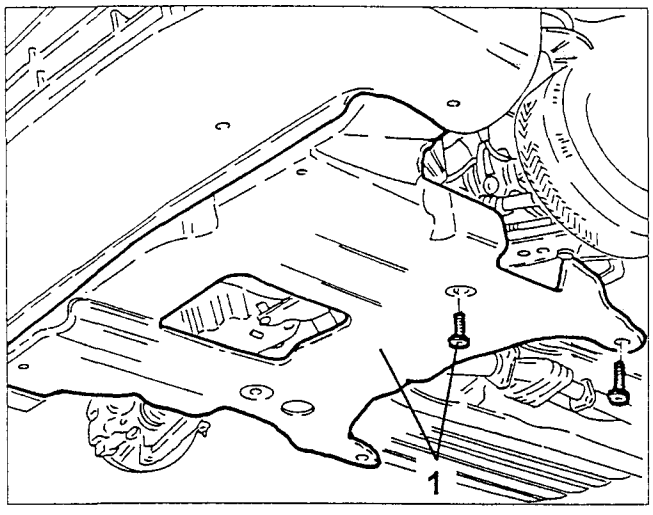


1. Disconnect the electrical connection fom the air flow meter.
2. Disconnect the oil vapour re-circulation pipe from the oil vapour separator.
3. Loosen the clamps and remove the complete air delivery pipe from the cleaner to the turbocharger.

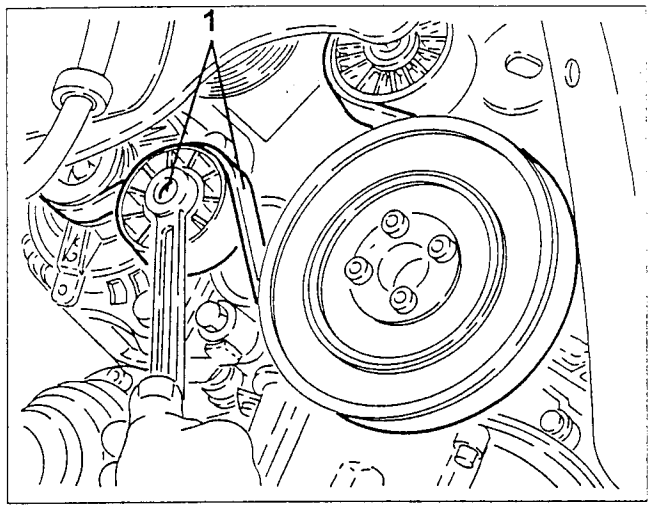


- Remove the right front wheel and dust guard.
- Remove the right front wheel arch.

1. Slacken the fastenings and remove the under engine guard.

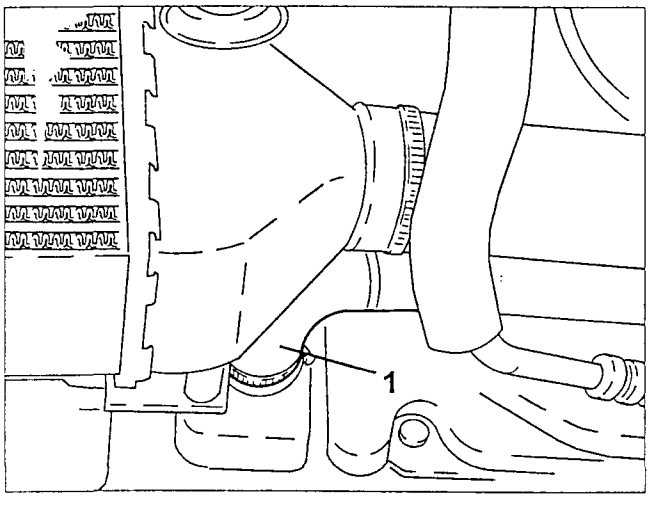


1. Working as illustrated on the tensioner, slacken the tension of the engine components belt and remove it.

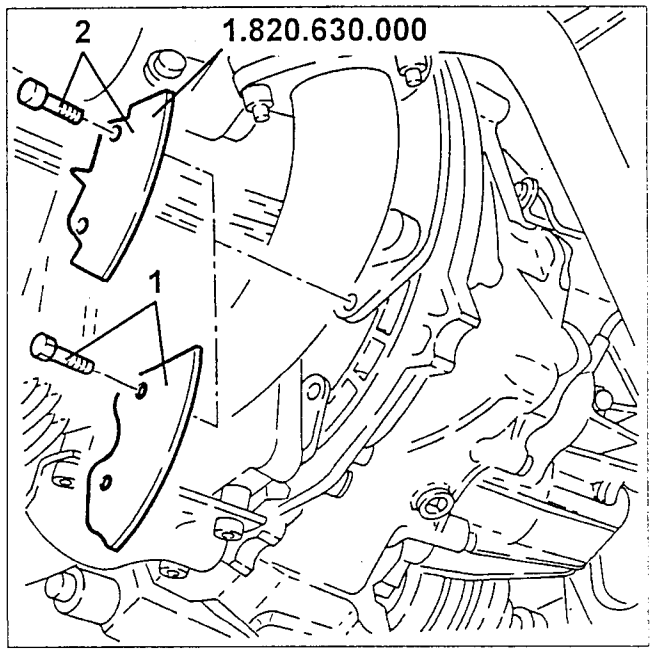


1. Drain the engine coolant fluid, disconnecting the coolant fluid outlet sleeve from the engine cooling radiator.

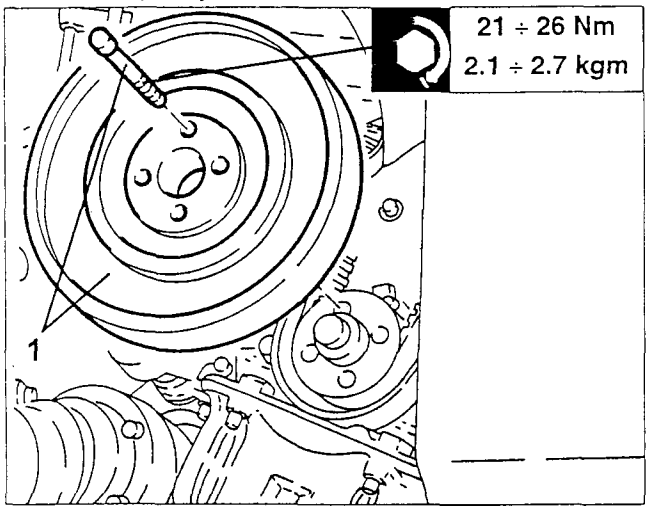
NOTE: Collect the engine coolant fluid in a suitable container.



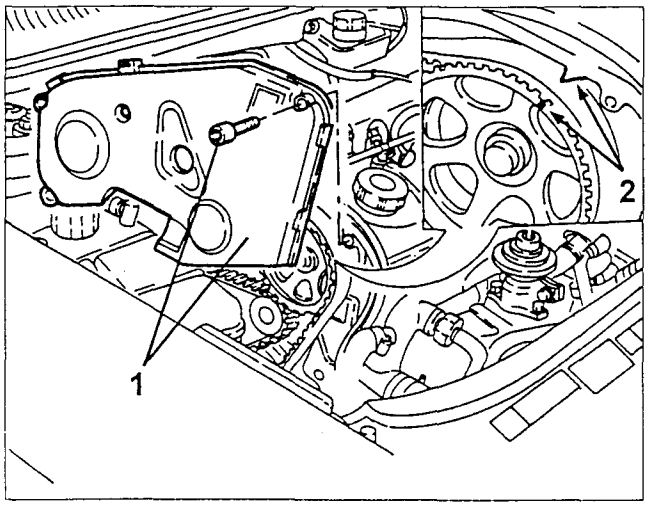
1. Slacken the screws and remove the flywheel lower guard.
2. Install flywheel stopper tool no. 1.820.630.000.



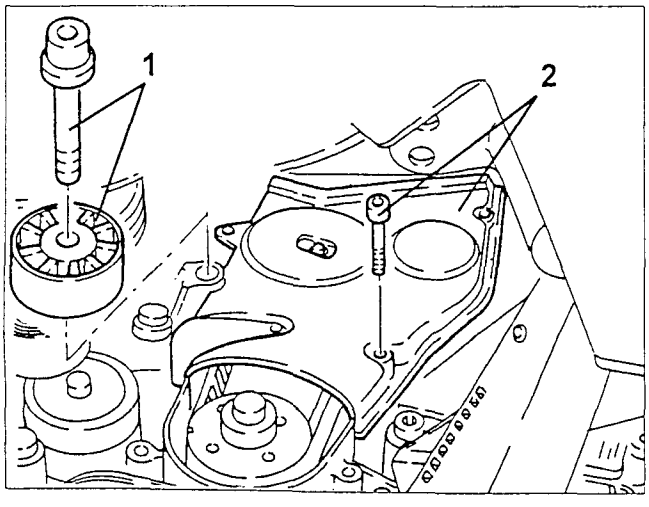
1. Slacken the fastening screws and remove the crankshaft pulley.



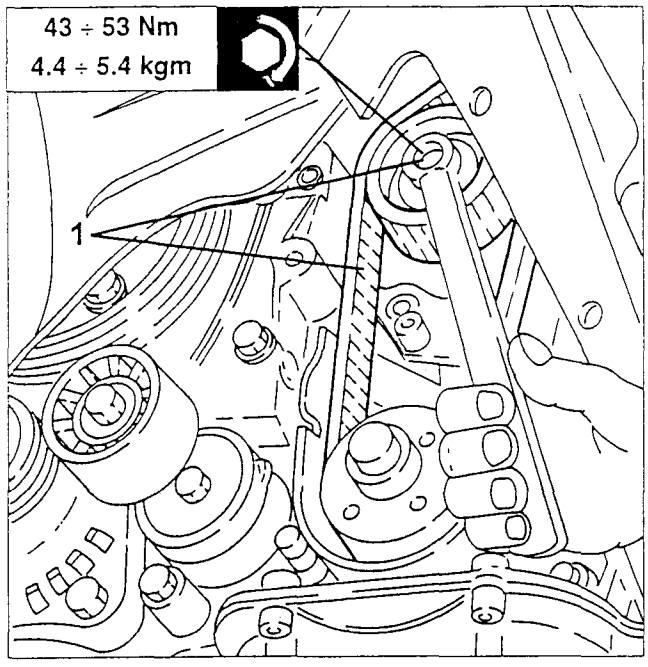
1. Slacken the fastening screws and remove the upper timing gear belt guard.
2. Working on the screw of the camshaft driving pulley, turn the crankshaft until aligning the timing references (1st cyl. at T.D.C.).



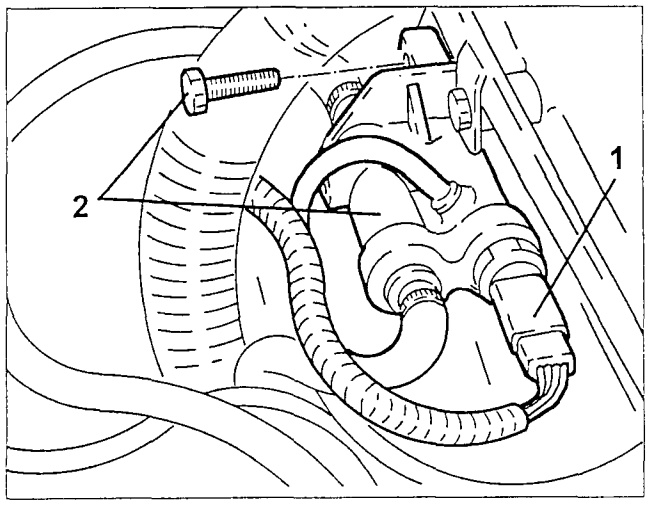
1. Slacken the fastening screw and remove the engine components belt fixed tensioner.
2. Slacken the fastening screws and remove the camshaft belt lower guard.



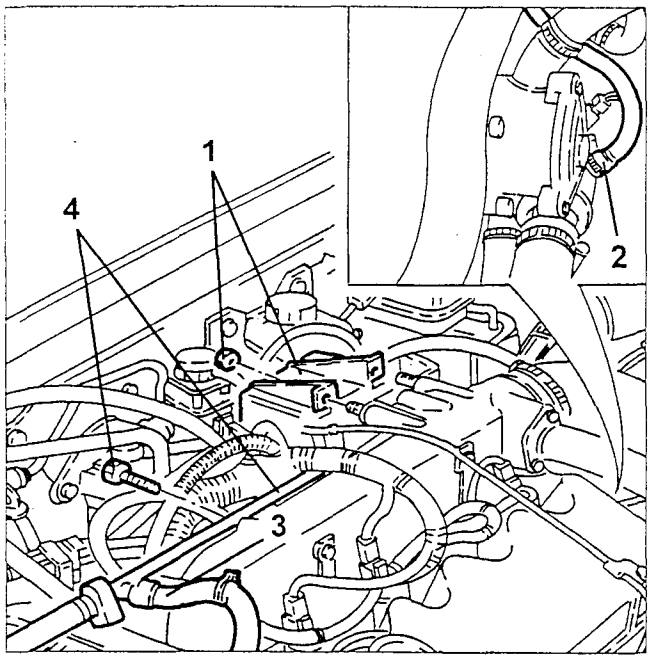
1. Loosen the nut fastening the camshaft belt tensioner, then remove the camshaft belt.



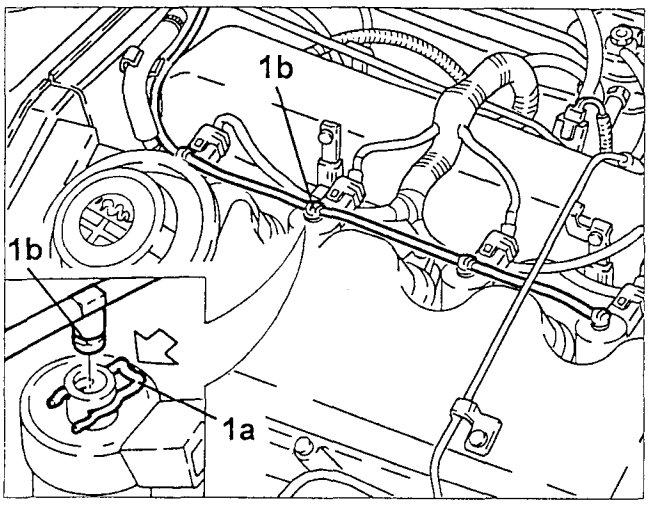
1. Disconnect the electrical connection from the fuel temperature sensor.
2. Slacken the screws and remove the fuel return manifold pipe.



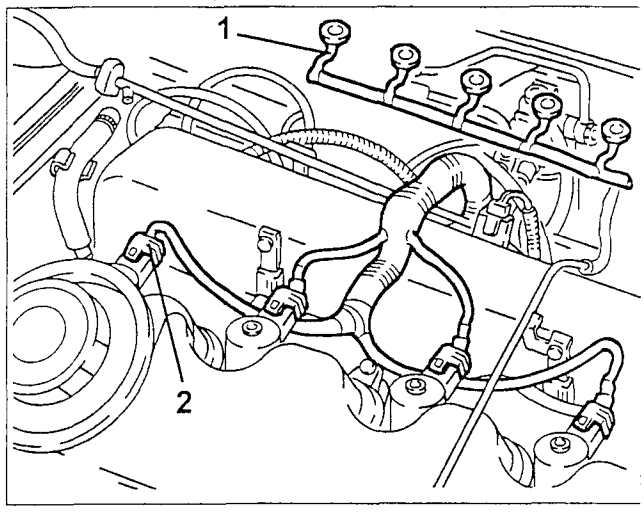
1. Slacken the fastening nuts and move aside the oil vapour separator.
2. Disconnect the coolant fluid return pipe to the header tank from the thermostat.
3. Disconnect the cylinder head coolant outlet pipe from the header tank coolant return pipe.
4. Slacken the fastening screws and move aside the coolant return pipe to the expansion tank.



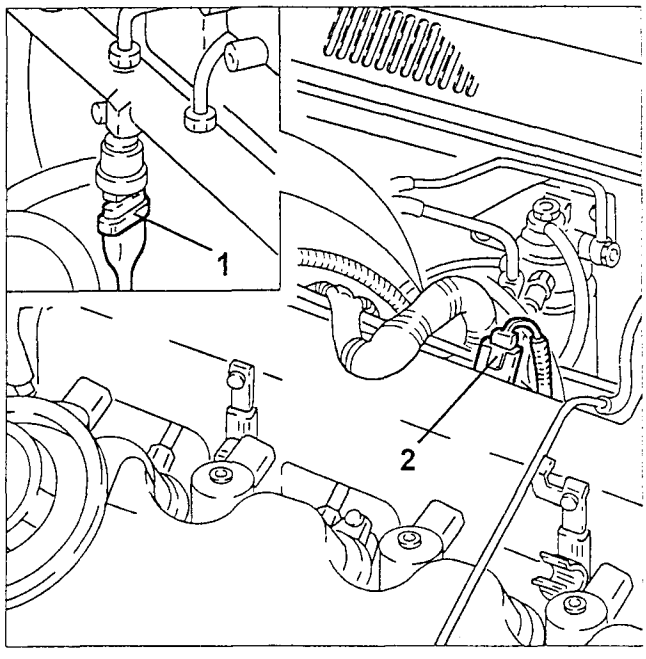
1. Push the catches (1a) by hand and disconnect the fuel return pipe for lubricating the injectors (1b) from the injectors.



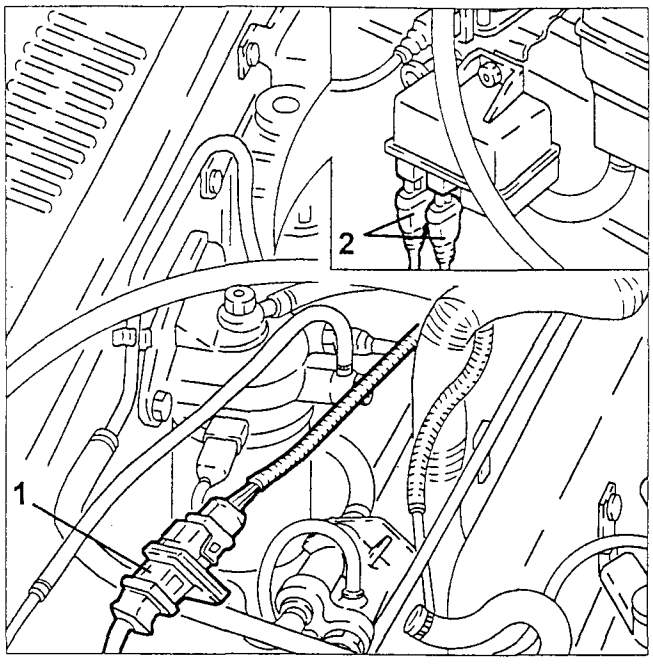
1. Disconnect the electrical connections from the glow plugs.
2. Disconnect the electrical connections from the injectors, then move the wiring aside.



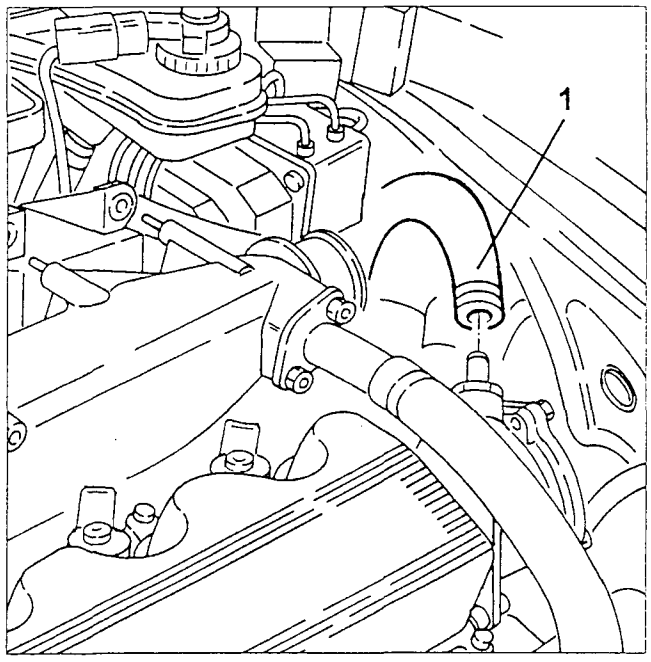
1. Disconnect the electrical connection from the fuel pressure sensor.
2. Disconnect the electrical connection from the supercharging sensor.



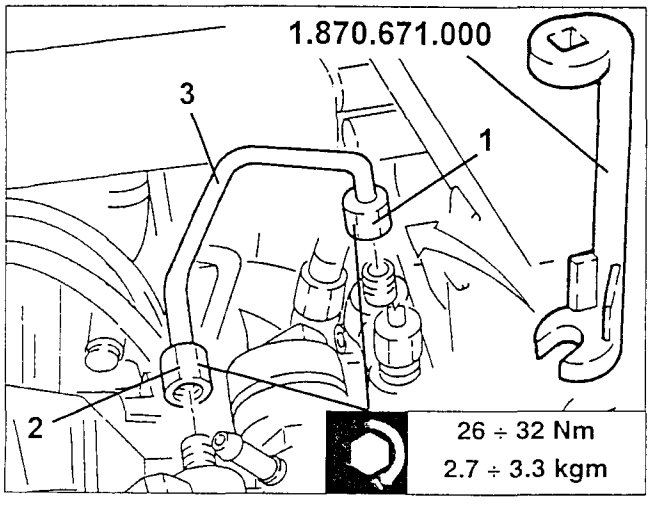
1. Disconnect the electrical connection of the cam angle sensor.
2. Disconnect the electrical connections from the glow plug control unit.



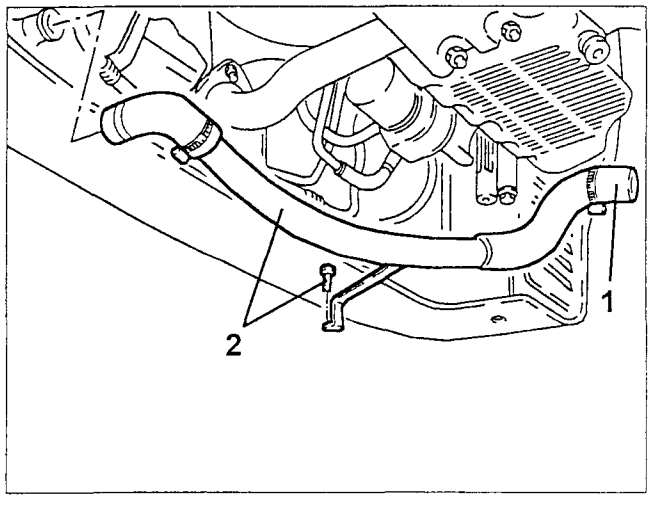
1. Disconnect the vacuum takeoff pipe from the vacuum pump.



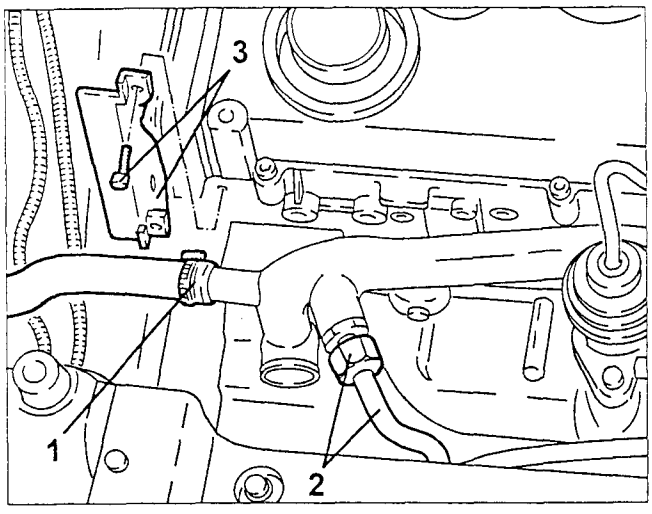
1. Slacken the manifold side coupling of the pipe from the pressure pump to the fuel manifold using tool no. 1.870.671.000.
2. Slacken the pressure pump side coupling of the delivery pipe from the pressure pump to the manifold using a suitable wrench.
3. Remove the fuel delivery pipe from the pressure pump to the single fuel manifold pipe.



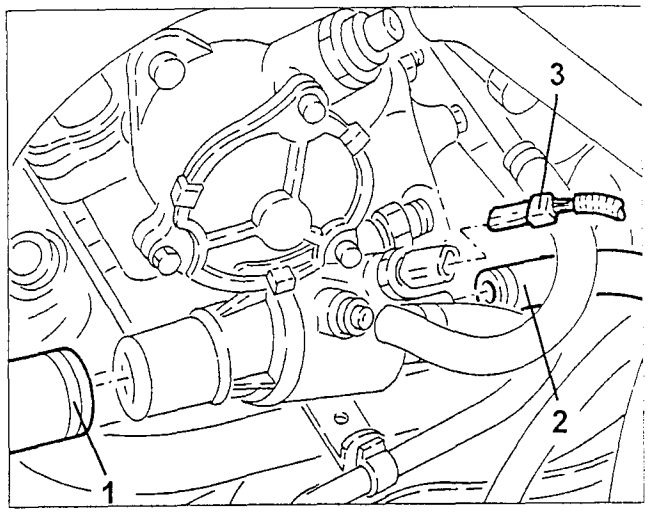
1. Disconnect the coolant fluid outlet sleeve from the stiff coolant return pipe to the pump.
2. Slacken the fastening screw and remove the radiator coolant fluid outlet pipe.



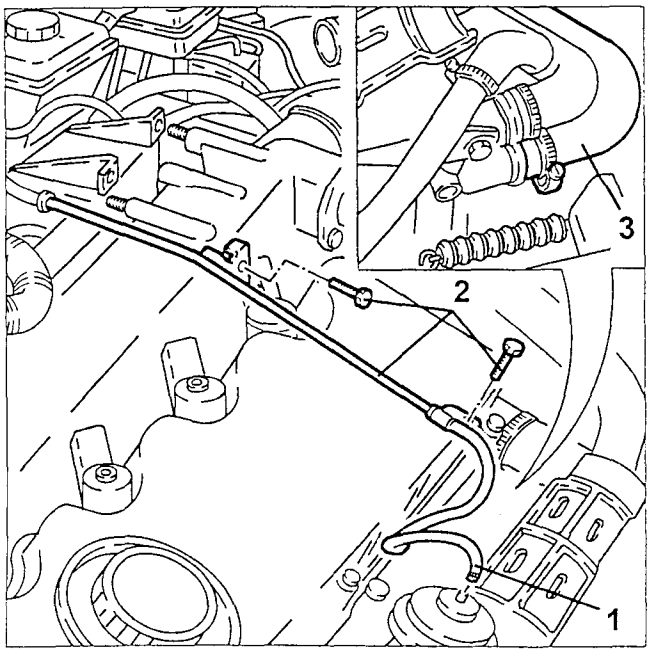
1. Disconnect the system supply pipe from the stiff coolant fluid return pipe to the pump.
2. Slacken the coupling and disconnect the engine oil heat exchanger outlet pipe from the stiff coolant fluid return pipe to the pump.
3. Slacken the fastening screws and remove the camshaft belt left side guard.



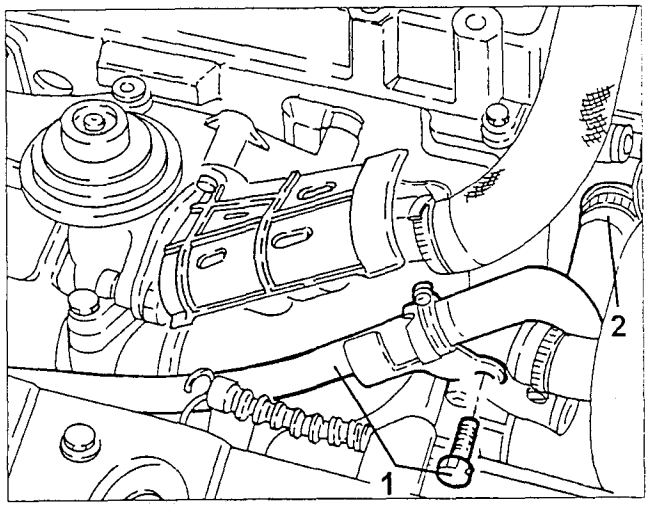
1. Disconnect the coolant fluid delivery sleeve to the radiator from the thermostat.
2. Disconnect the coolant fluid delivery pipe to the climate control system heater from the thermostat.
3. Disconnect the electrical connection from the coolant fluid temperature sensor.



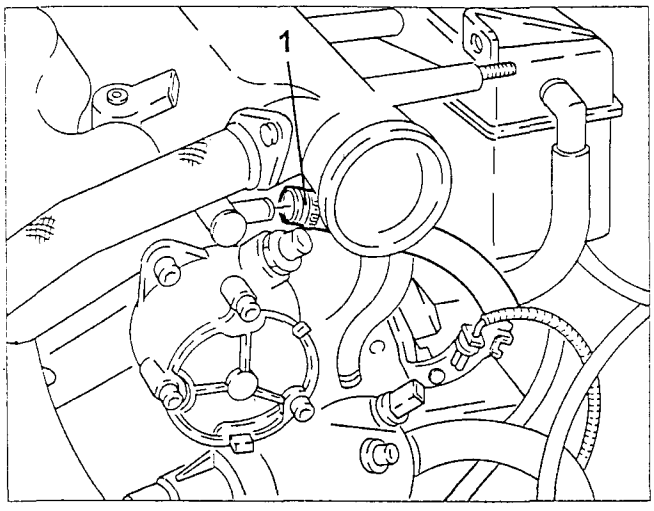
1. Disconnect the vacuum pipe from the E.G.R. valve.
2. Slacken the fastening screws move aside the vacuum pipe for the E.G.R. valve.
3. Disconnect the the return pipe from the climate control system heater from the stiff coolant fluid return pipe to the pump.



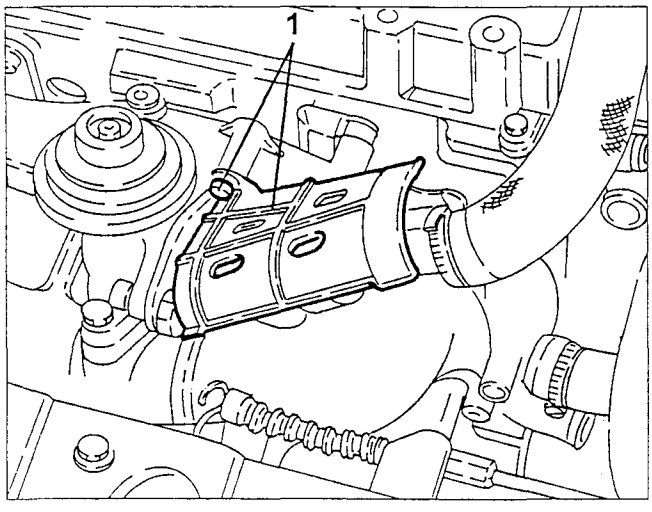
1. Slacken the screw fastening the coolant fluid delivery pipe to the engine oil heat exchanger.
2. Disconnect the coolant fluid delivery sleeve to the engine oil heat exchanger from the thermostat.



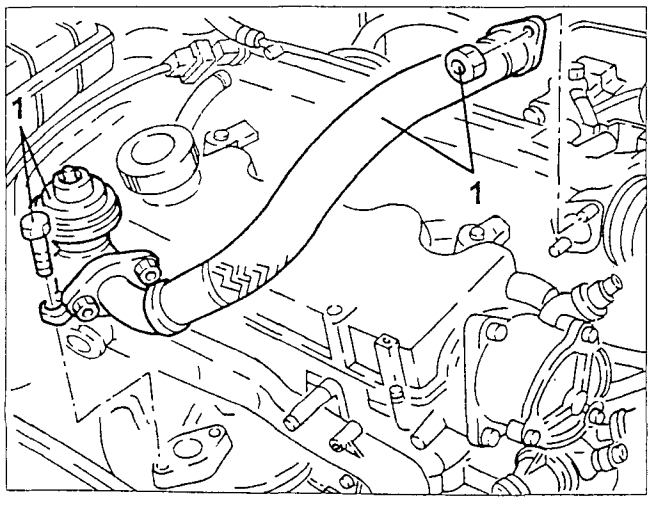
1. Disconnect the oil vapour recovery pipe from the coupling on the tappet cover.



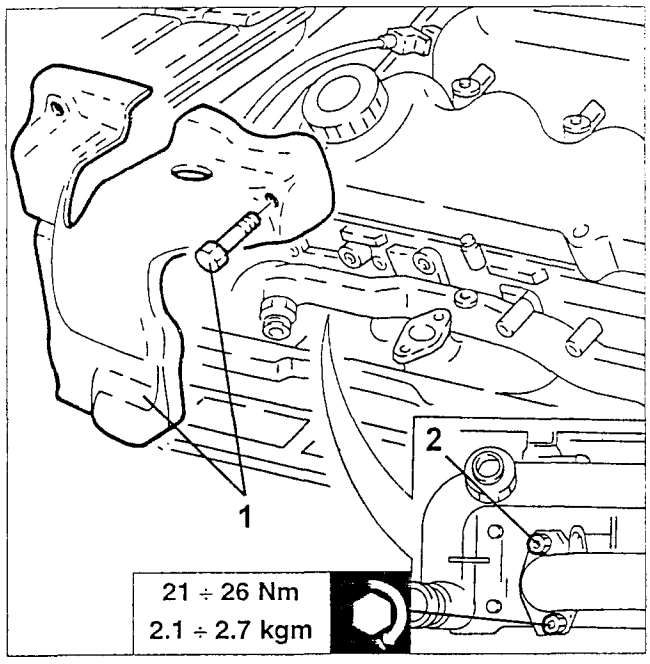
1. Slacken the fastening screws and remove the E.G.R. valve cover.



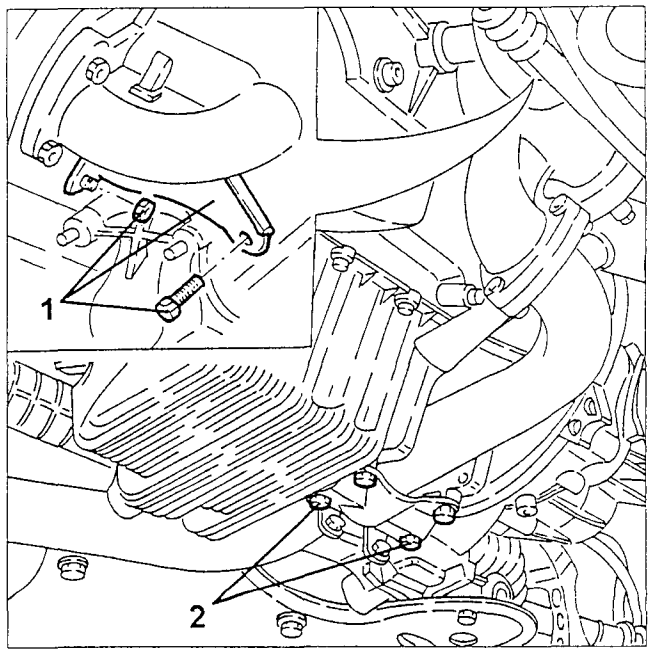
1. Slacken the nuts and screws, then remove the E.G.R. valve complete with gas re-circulation pipe.
- Remove the seals.



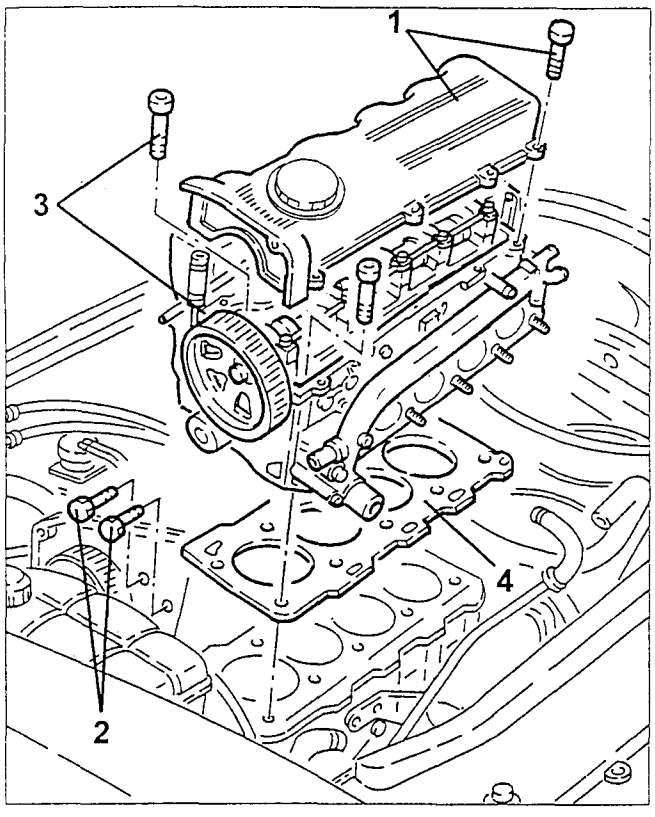
1. Slacken the fastening screws and remove the heat shield from the exhaust manifold.
2. Slacken the nuts fastening the exhaust manifold to the cylinder head.



1. Slacken the fastening screws and nut, then remove the turbocharger support bracket.
2. Loosen the nuts fastening the reinforcement bracket.



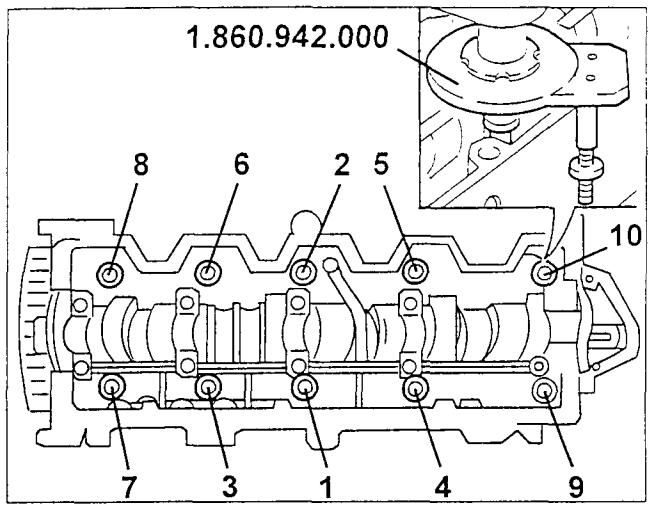
1. Slacken the fastening screws and remove the tappet cover complete with seals.
2. Slacken the screws fastening the pressure pump support to the air intake box.
3. Slacken the fastening screws and remove the cylinder head.
4. Remove the cylinder head seal.



- Strip down and overhaul the cylinder head proceeding as described in the "ENGINE OVERHAULING" volume.

Refit the cylinder head reversing the sequence followed for removal and following the instructions given below.
- Fit a new cylinder head seal on the crankcase making sure that it is of the same thickness as the one removed.
NOTE: The cylinder head seal is of the ASTADUR type.
Because of the special compound with which the seal is made it undergoes a polymerising process when the engine is running so that it hardens considerably during use..
To ensure that the seal polymerises it is necessary to:
- keep the seal closed in its nylon bag;
- take the seal out of the bag only shortly before assembly;
- do not lubricate or dirty the seal with oil.

- Place the cylinder head on the crankcase.
- Tighten the cylinder head fastening screws, proceeding as described below and bearing in mind that the tightening sequence for each step is the one illustrated.
NOTE: For angle tightening use goniometer no. 1.860.942.000 as illustrated.



Tightening procedure	
Tighten screws to a torque of:	65 Nm (6.6 kgm)
Turn the screws by an angle of:	90° + 90° + 90°

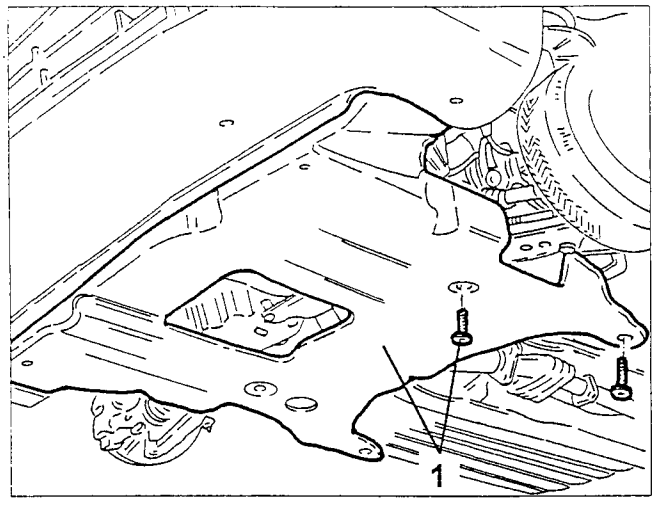
For refitting the camshaft drive belt and its timing and for fitting the engine components belt see GROUP 00.

OIL SUMP

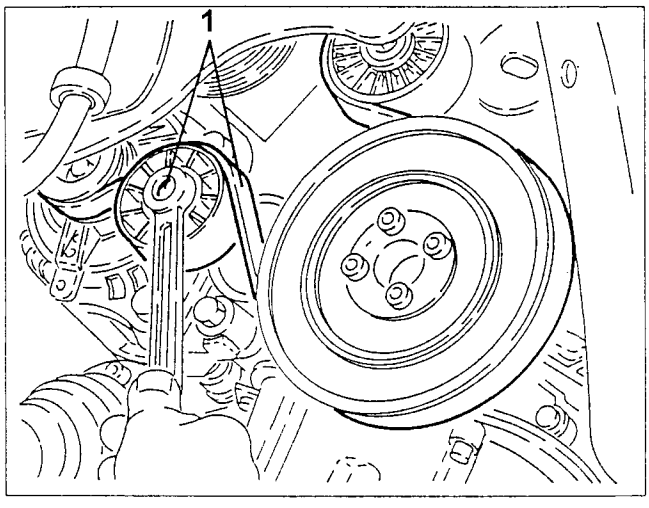
REMOVAL/REFITTING

- Set the car on a lift.
- Make sure the ignition key is in the "STOP" position, then disconnect the battery (-) terminal.
- Remove the right front wheel and dust guard.

1. Slacken the fasteners and remove the under engine guard.

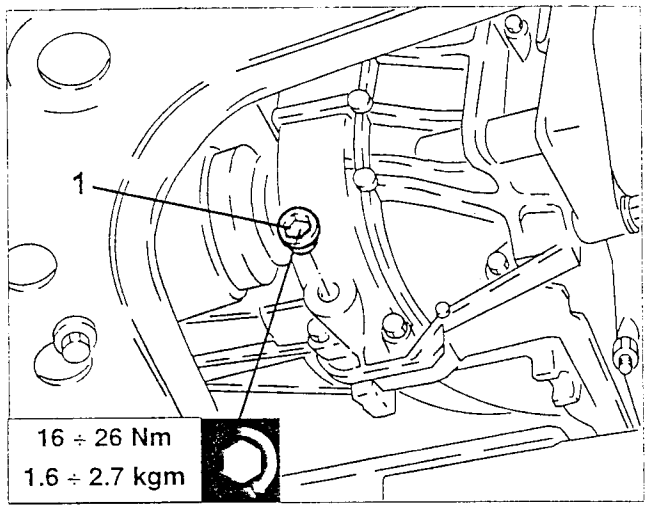


1. Working as illustrated on the tensioner, loosen the tension of the auxiliary components belt and remove it.

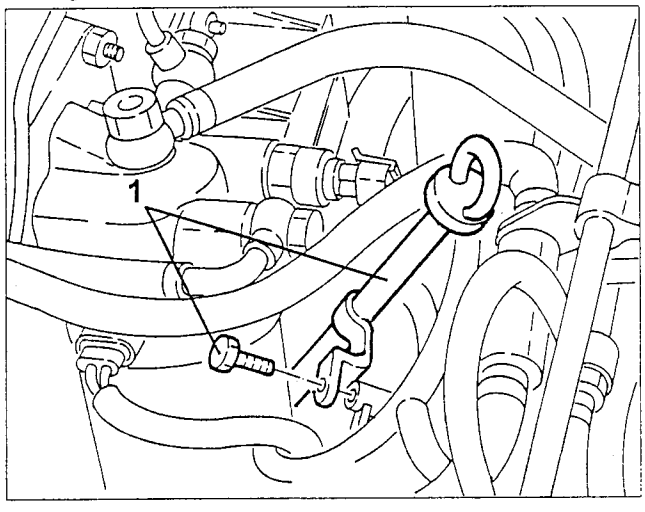


- Remove the front section of the exhaust pipe.

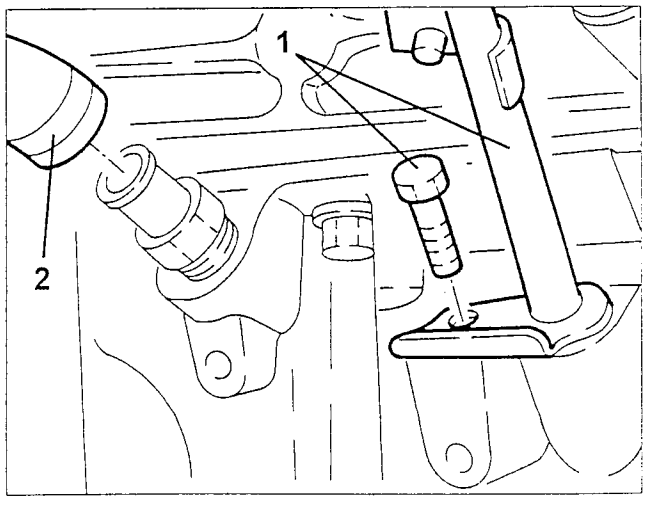
1. Slacken the drain cap and drain the gearbox - differential oil.



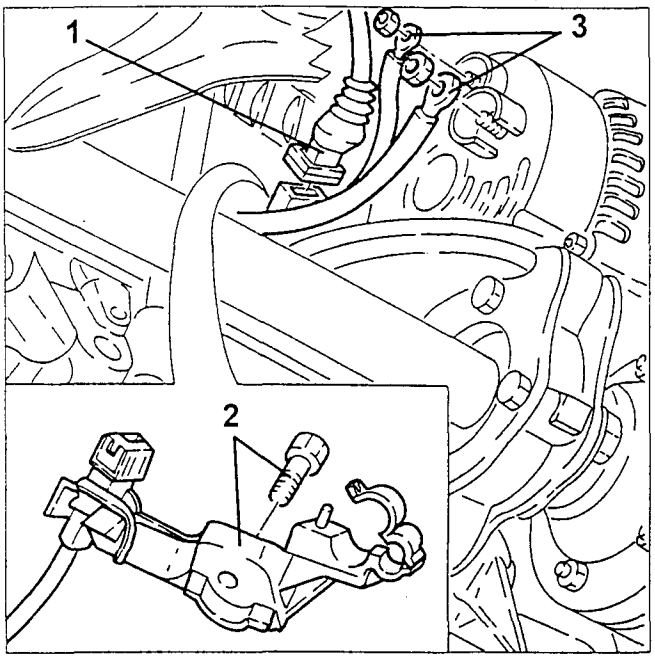
1. Slacken the upper screw of the engine oil dipstick guide pipe.



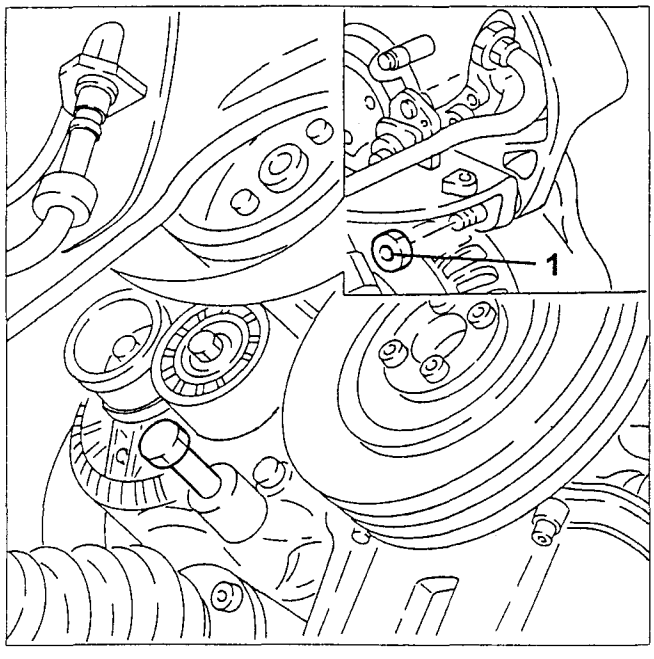
1. Slacken the lower screw of the engine oil dipstick guide pipe.
2. Disconnect the condensed oil recovery pipe from the oil sump.



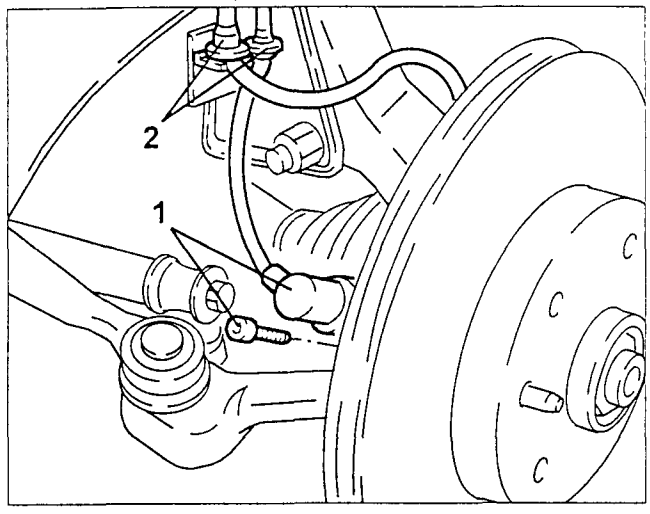
1. Disconnect the electrical connection of the rpm sensor.
2. Slacken the screw and move aside the electric wiring fastening bracket.
3. Disconnect the electrical connections from the alternator.



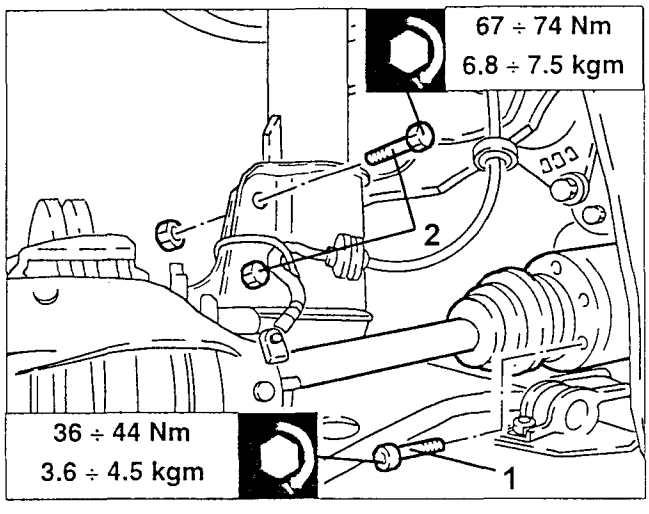
1. Slacken the nuts of the alternator fastening bolts.



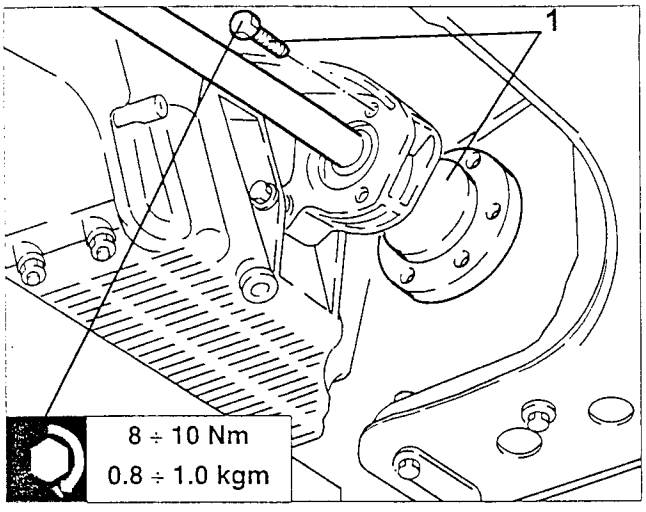
- Remove the guide pipe complete with engine oil dipstick.
1. Slacken the fastening screw and remove the right A.B.S. sensor from the upright.
2. Release the A.B.S. sensor cable and the right brake caliper hose from the support brackets.



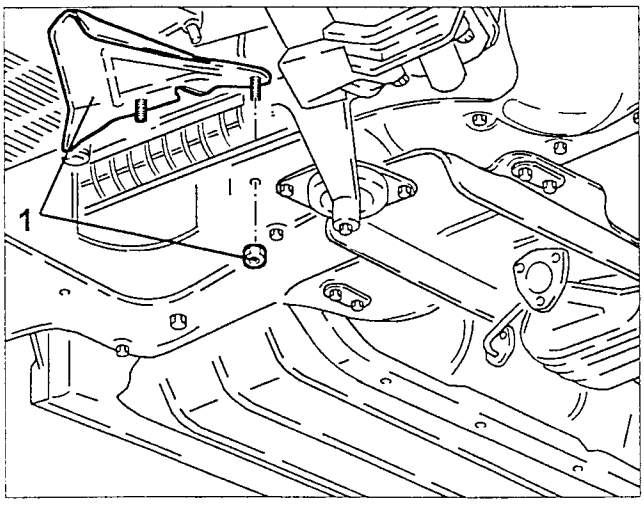
1. Slacken the bolts fastening the right axle shaft to the intermediate axle shaft.
2. Slacken the bolts fastening the shock absorber to the right front wheel upright, then withdraw only the upper bolt.
- Move the right axle shaft away from the intermediate axle shaft as necessary.



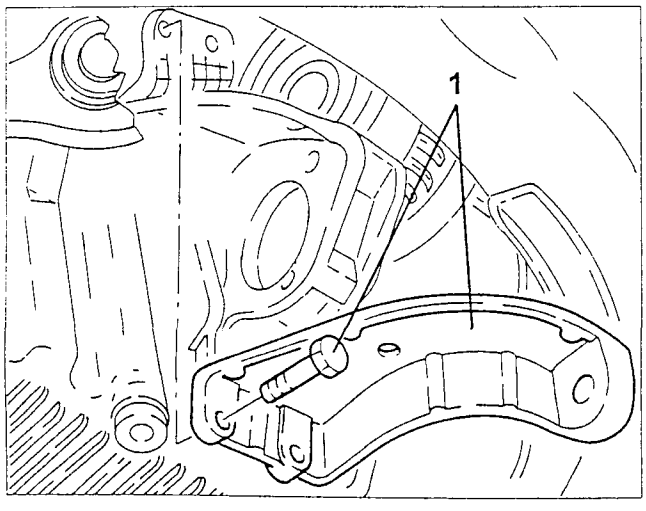
1. Slacken the screws fastening the intermediate axle shaft to its support and remove it from the differential.



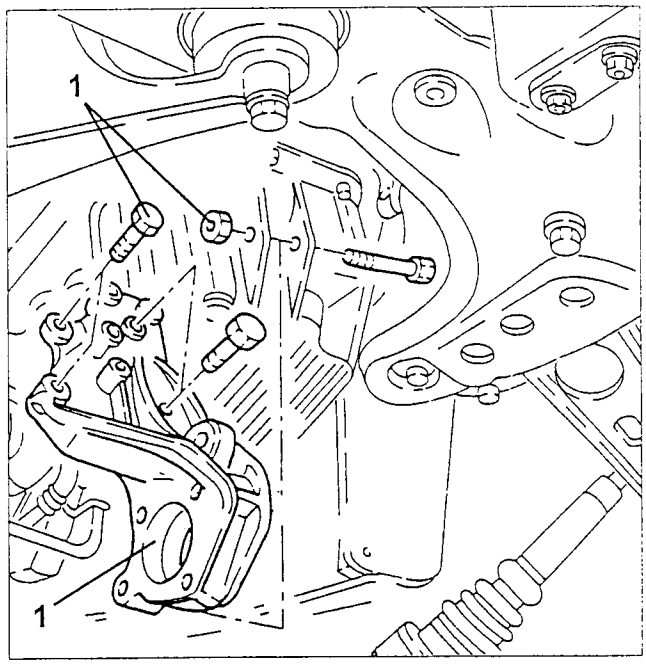
1. Slacken the fastening nuts and remove the front suspension crossmember guard.



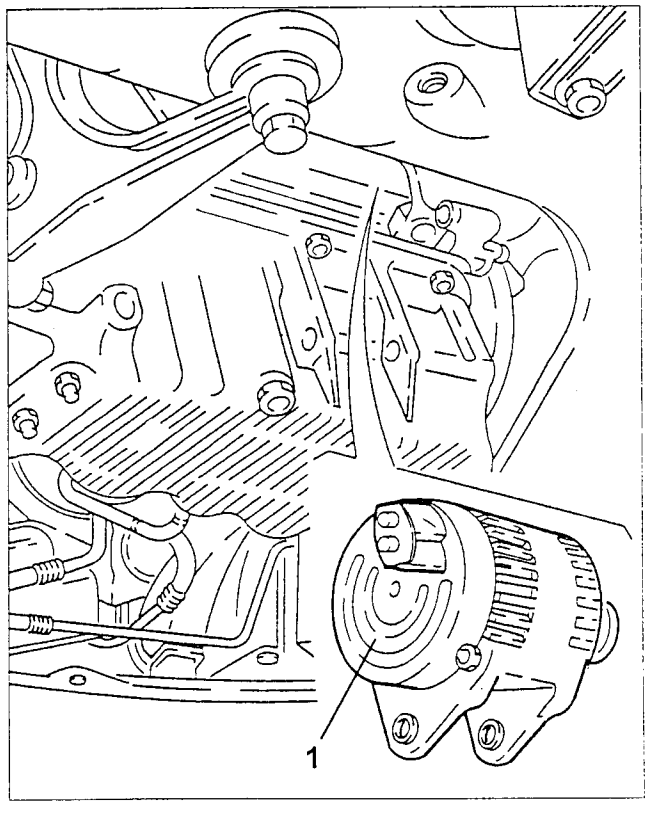
- Withdraw the screws from the alternator fastening bolts and move it aside.
1. Slacken the fastening screws and remove the rear alternator support bracket.



1. Slacken the screws and bolt, then remove the intermediate axle shaft bearing support.



1. Retrieve the alternator.

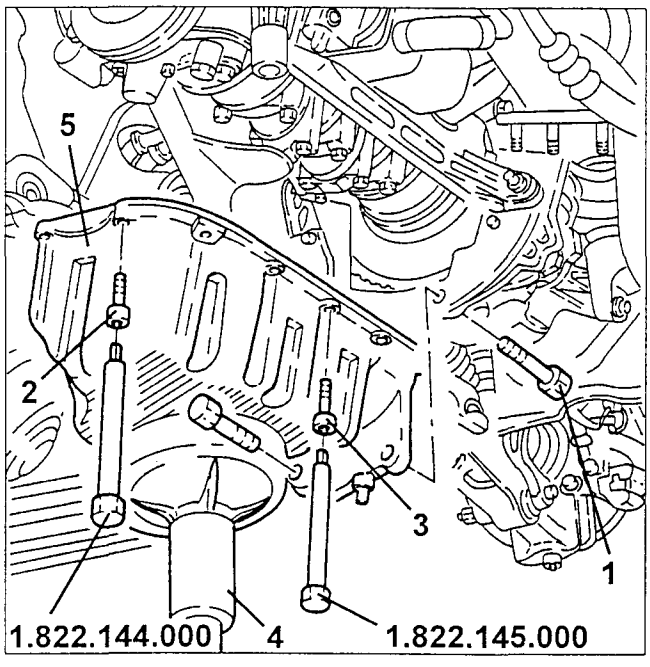


- Slacken the drain cap and drain the engine oil.

NOTE: Collect the engine oil in a suitable container.

1. Slacken the screws fastening the oil sump to the gearbox.
2. Slacken the front and rear screws fastening the sump to the crankcase using wrench no. 1.822.144.000.
3. Slacken the side screws fastening the sump to the crankcase using wrench no. 1.822.145.000.
4. Place a hydraulic jack under the oil sump.
5. Remove the oil sump.

NOTE: Before removing the sump heat it with a drier to facilitate detachment of the sealant.



- Remove all traces of sealant from the oil sump and crankcase contact surfaces.

GENERAL DESCRIPTION

The EDC-15C Common Rail is a high pressure electronic injection system for fast diesel engines with direct injection.
The main features are:
- availability of high injection pressures (1350 bar)
- possibility of modulating these pressures between 150 bar up to the maximum operating pressure of 1350 bar, regardless of the engine speed and load
- capability of operating at high engine speeds (up to 6000 rpm).
- injection control precision (advance and length of injection)
- reduction of consumption levels
- reduction of emissions.

The main functions of the system are mainly the following:
- fuel temperature control
- engine coolant temperature control
- injected fuel quantity control
- idle speed control
- fuel cut-off during deceleration
- cylinder balancing at idle speed control
- "anti-sawing" control
- exhaust smoke control during acceleration
- exhaust gas re-circulation control (E.G.R.)
- maximum torque limiting control
- maximum engine speed limiting control
- glow plug control
- climate control system engagement control (where fitted)
- auxiliary fuel pump control
- cylinder position control
- main and pilot injection advance control
- injection pressure closed loop control
- electric balance control
- supercharging pressure control
- self-diagnostics
- connection with Alfa Romeo CODE control unit (Immobiliser).

SYSTEM FUNCTIONS

The Common Rail system makes pre-injection (pilot injection) possible before the T.D.C. with the advantage of reducing the derivative of the pressure in the combustion chamber, reducing the combustion noise typical of direct injection engines.

The control unit controls the amount of fuel injected, adjusting the line pressure and injection times.
The information the control unit processes to control the amount of fuel to be injected is the following:
- engine rpm
- coolant fluid temperature
- supercharging pressure
- air temperature
- quantity of intake air
- battery voltage
- fuel oil pressure
- accelerator pedal position.

SYSTEM OERATING LOGIC

Self-diagnostics

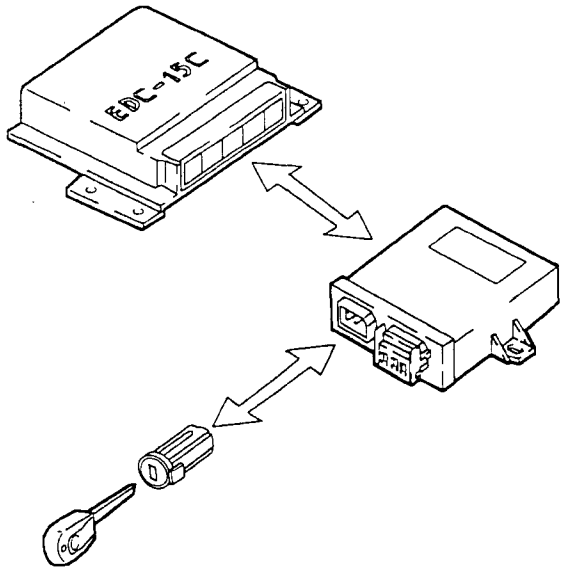
The control unit self-diagnostic system checks the signals leading from the sensors comparing them with the permissible limit data:
- fault signalling at starting
  • warning light on for 4 seconds indicates the test phase
  • warning light off after 4 seconds indicates no fault to components that may change the values set down by anti-pollution regulations
  • warning light on after 4 seconds indicates a fault.

- fault signalling during operation
  • warning light on indicates a fault
  • warning light off indicates no fault to components that may change the values set down by anti-pollution regulations.

- recovery
  • the control unit defines the type of recovery depending on the faulty components
  • the recovery parameters are managed by normally operating components.

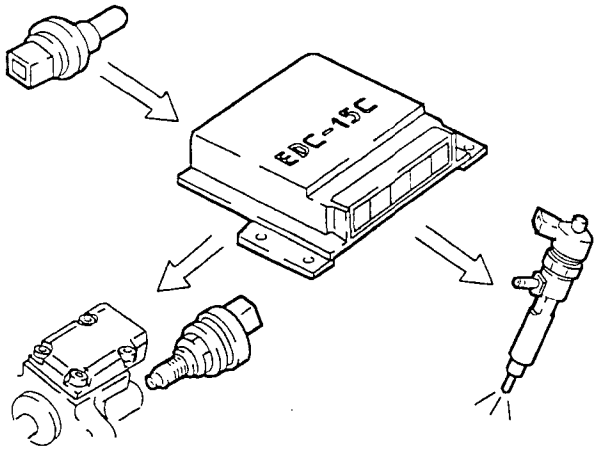
Recognition of the Alfa Romeo CODE

The moment the control unit receives the signal of the ignition key at "MAR" it converses with the Alfa Romeo CODE control unit to obtain consent to start the engine.



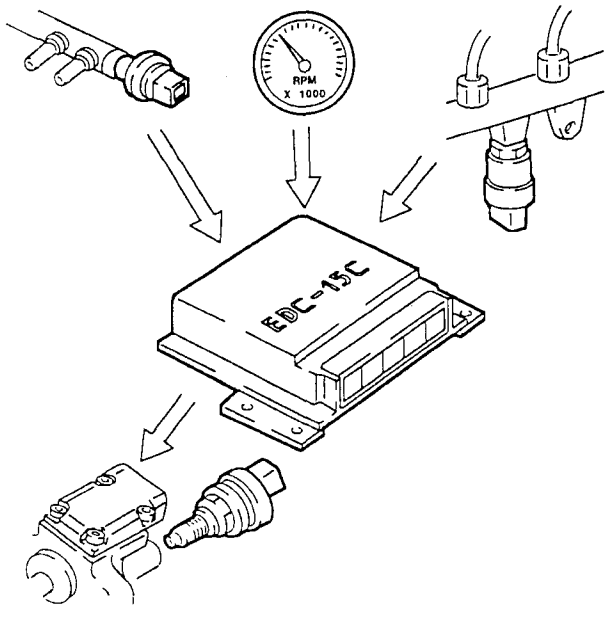
Engine coolant temperature control

With an engine coolant fluid temperature above 105°C the control unit:
- reduces the amount of fuel injected (reduces engine power)
- commands the cooling fans
- turns on the coolant fluid temperature warning light.



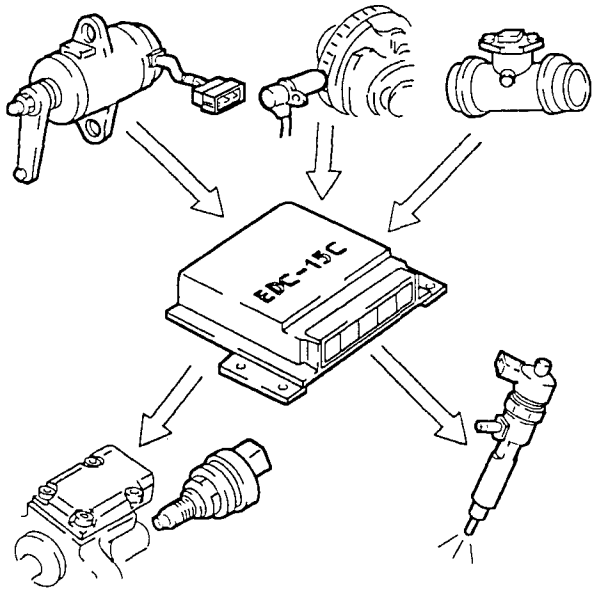
Fuel temperature control

With a fuel temperature at 110°C, detected by the sensor on the re-circulation manifold, the control unit commands the pressure regulator to reduce the line pressure (it does not change the injection times).



Injected fuel quantity control

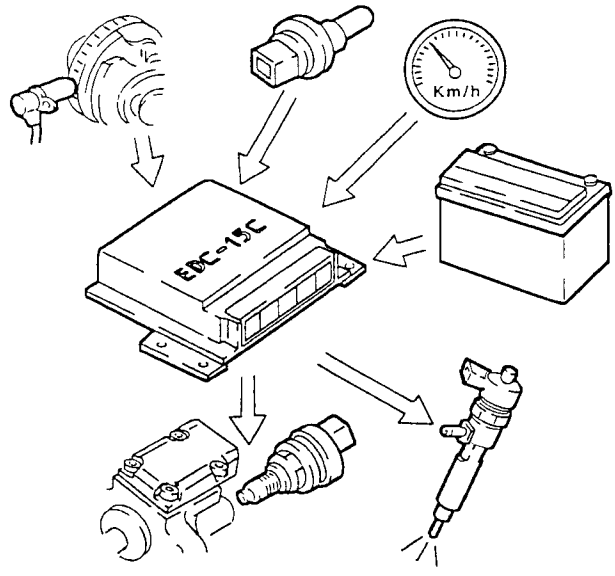
On the basis of the signals coming from the different sensors and the mapped values, the control unit:
- commands the pressure regulator
- changes the "pilot" injection time up to 3000 rpm
- changes the "main" injection time.



Idle speed control

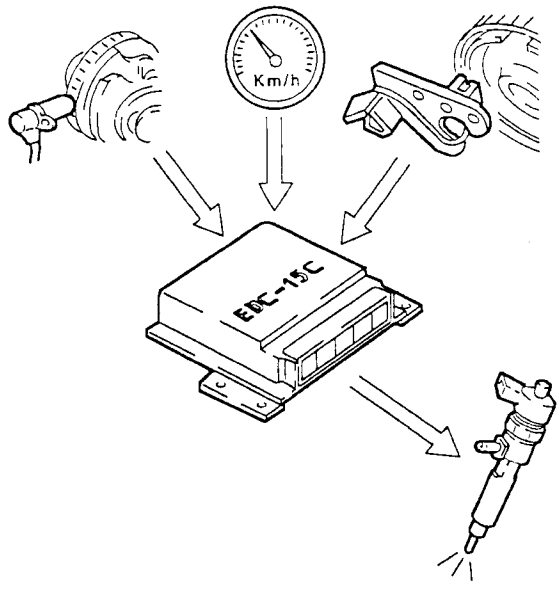
The control unit processes the signals coming from the different sensors and adjusts the quantity of injected fuel:
- commands the pressure regulator
- changes the injection times of the injectors.

Within certain thresholds the engine speed takes account of the battery voltage.



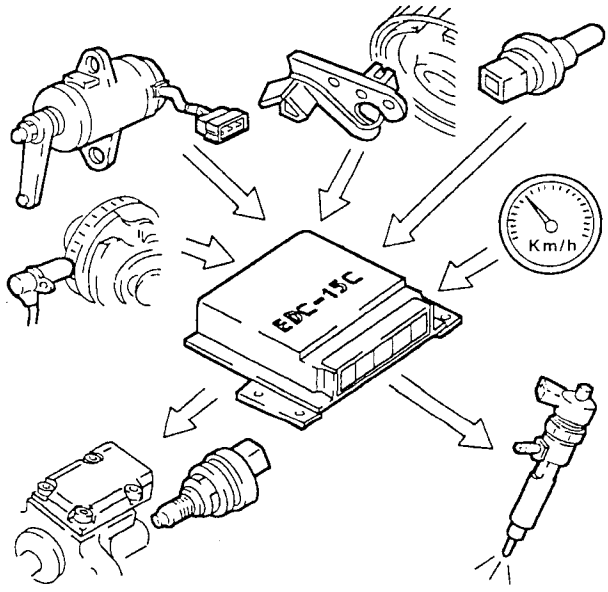
Cylinder balance control at idle speed

On the basis of the signals received from the sensors the control unit controls the regularity of the torque at idle speed:
- it changes the quantity of fuel injected to the single injectors (injection time).



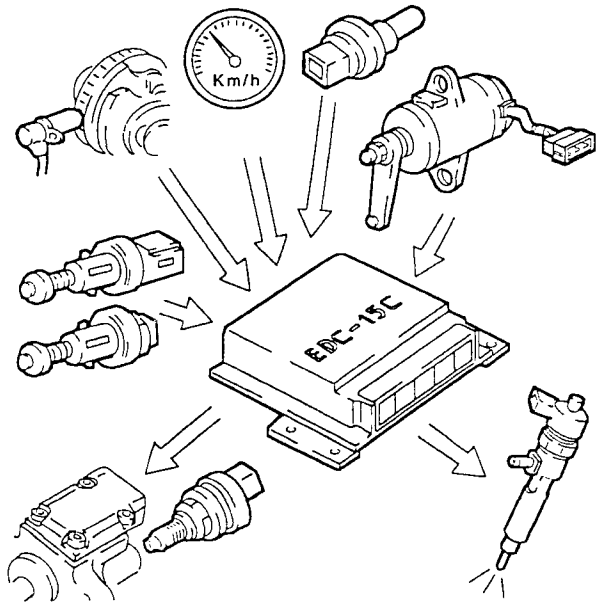
Fuel cut-off during deceleration

When the accelerator pedal is released, the control unit brings about the following logics:
- it cuts off the supply to the injectors
- it partially reactivates the supply to the injectors before reaching idle speed
- and commands the fuel pressure regulator.



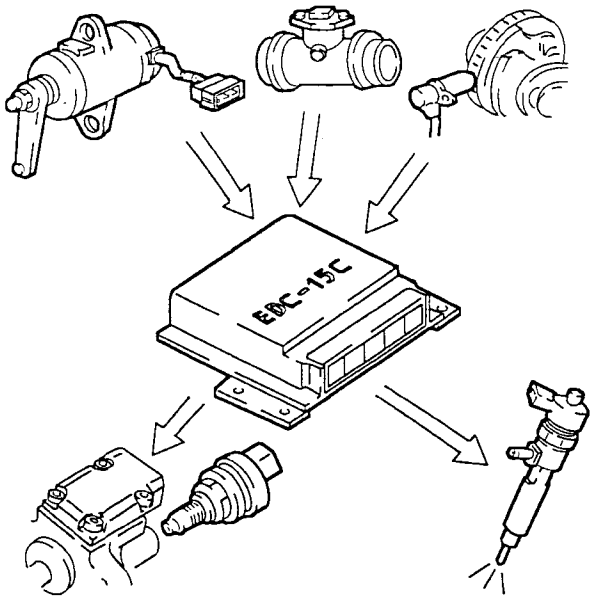
"Anti-sawing" control

The control unit processes the signals received from the different sensors and determines the quantity of fuel to be injected through:
- the fuel pressure regulator
- the injector opening time.



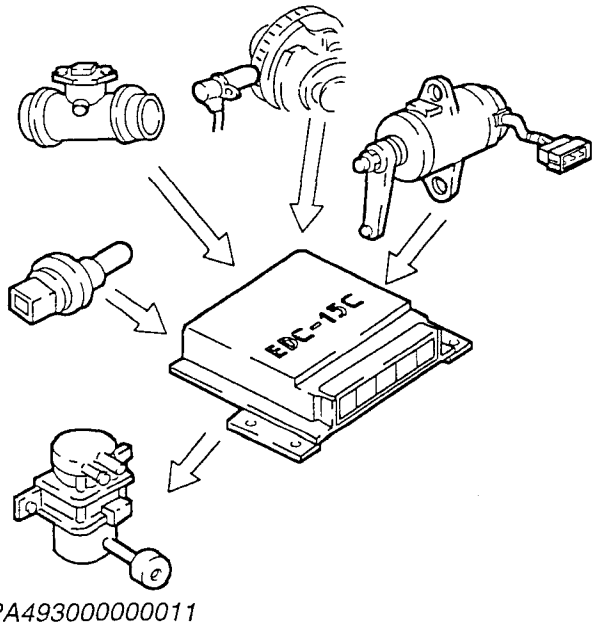
Exhaust smoke control during acceleration

With heavy acceleration, on the basis of the signals received from the air flow meter and rpm sensors, the control unit determines the optimum quantity of fuel to be injected:
- it commands the pressure regulator
- and changes the injection time of the injectors.



Exhaust gas re-circulation control (E.G.R.)

On the basis of the engine load and of the signal coming from the accelerator pedal potentiometer, the control unit limits the amount of intake air, activating the partial intake of exhaust gas.

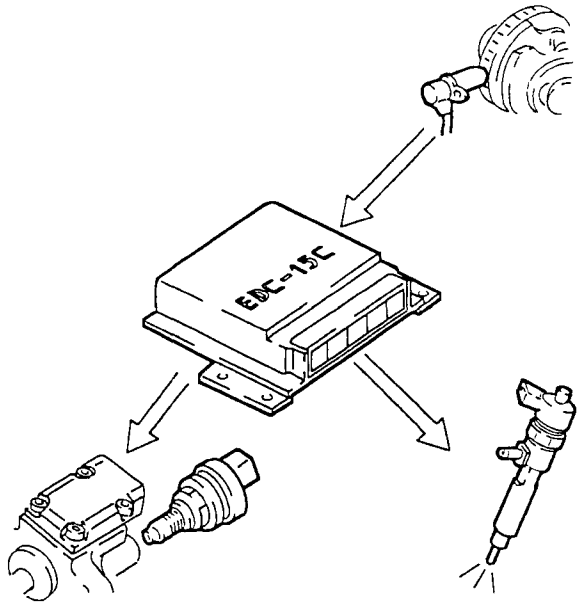


Maximum torque limiting control

In relation to the rpm, the control unit calculates the following on pre-defined maps:
- limit torque
- allowed smoke (limit)

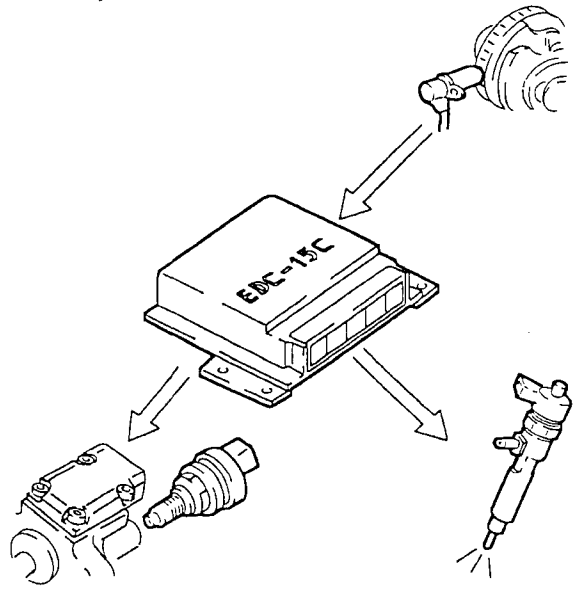
It compares these minimum values and corrects them with other parameters:
- coolant fluid temperature
- engine rpm
- car speed

and commands the amount of fuel to be injected (pressure regulator - injectors).



Maximum speed limiting control

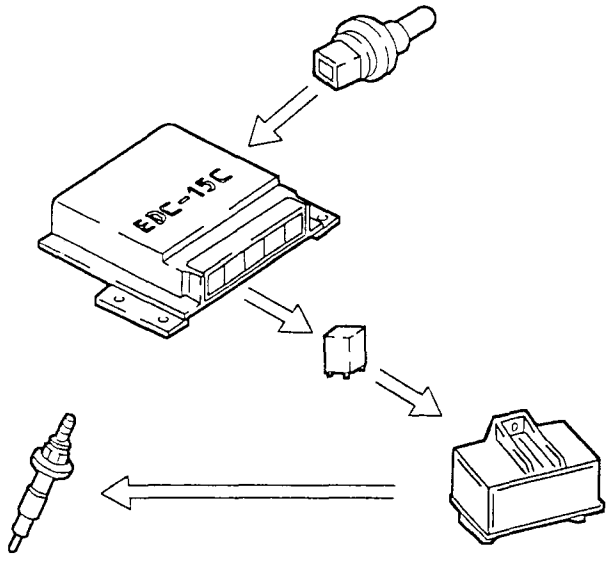
Depending on the rpm the control unit activates two operating strategies:
- at 5000 rpm it cuts off the fuel reducing the line pressure
- over 5400 rpm it deactivates the auxiliary pump and the injectors.



Glow plug control

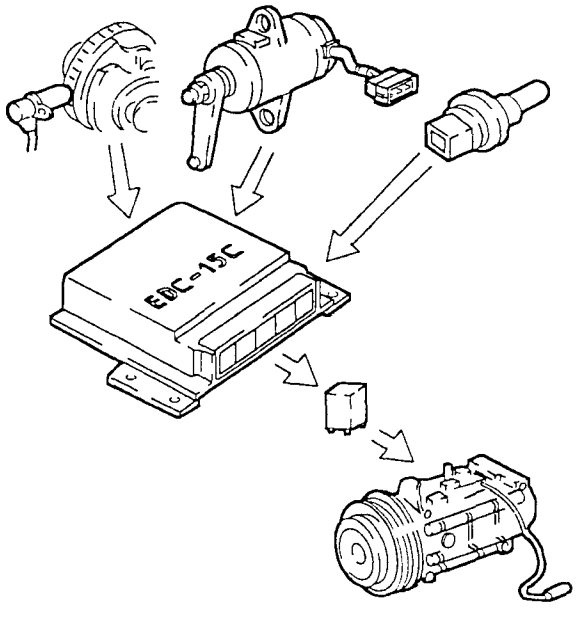
During:
- starting
- after-starting

the injection control unit times the operation of the glow plug control unit in relation to the temperature of the engine.



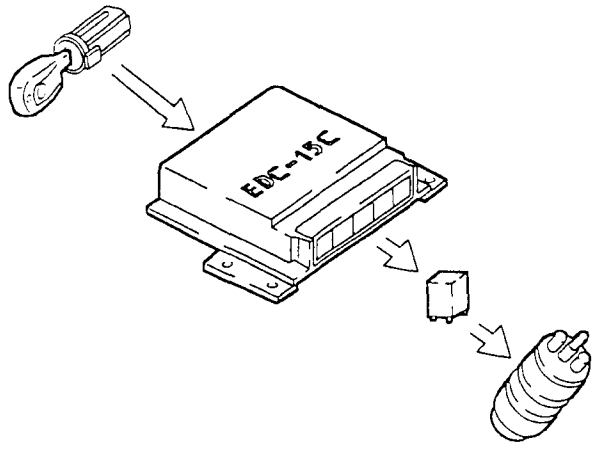
Air conditioning system engagement control

The control unit commands the air conditioner compressor:
- turning it on/off when the corresponding switch is pressed
- turning it off momentarily (about 6 sec.) in the event of heavy acceleration or the need for full power.



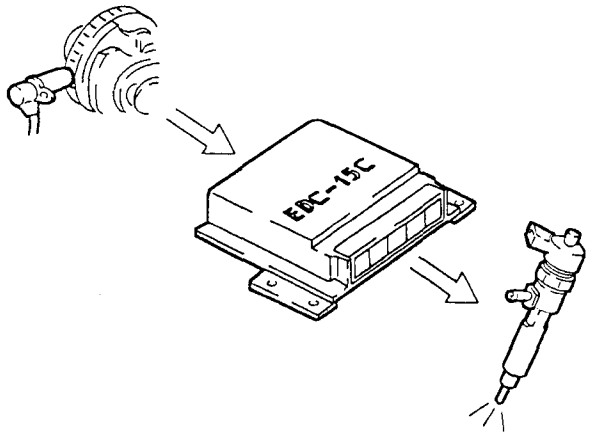
Auxiliary fuel pump control

Regardless of the engine speed, the control unit:
- supplies the auxiliary fuel pump with the ignition key at MAR
- cuts off the supply to the auxiliary pump if the engine is not started within a few seconds.



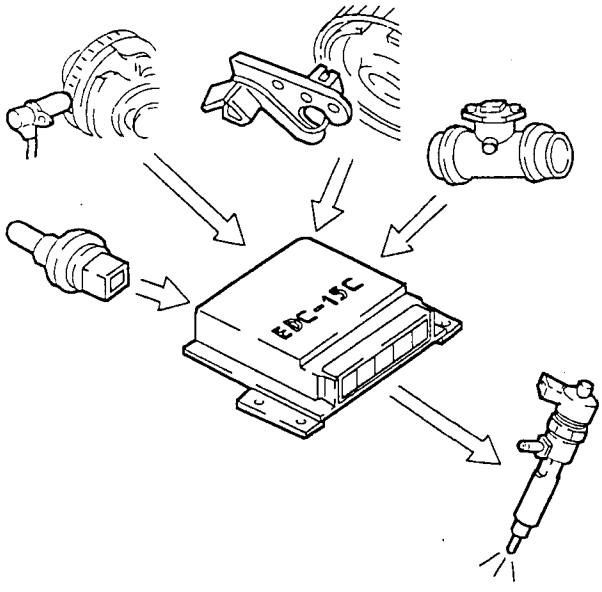
Cylinder position control

During each revolution of the engine, the control unit detects which cylinder is in the bursting stroke and commands the injection sequence at the suitable cylinder.



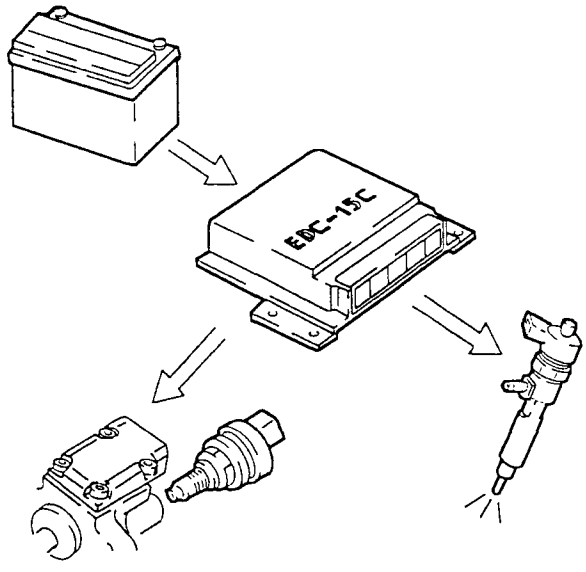
Main and pilot injection advance control

On the basis of the signals coming from the different sensors, including the absolute pressure sensor integrated in the control unit itself, the control unit defines the optimum injection point according to an internal map.



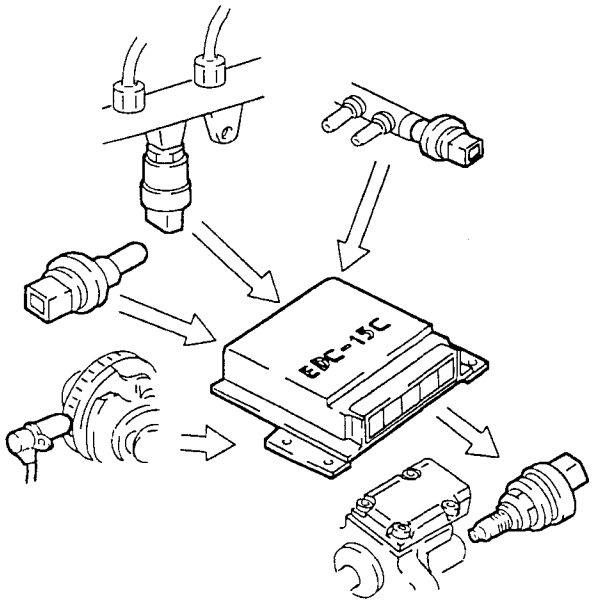
Electric balance control

The control unit changes the idle speed in relation to the battery voltage:
- it increases the injection time of the injectors
- and adjusts the line pressure.



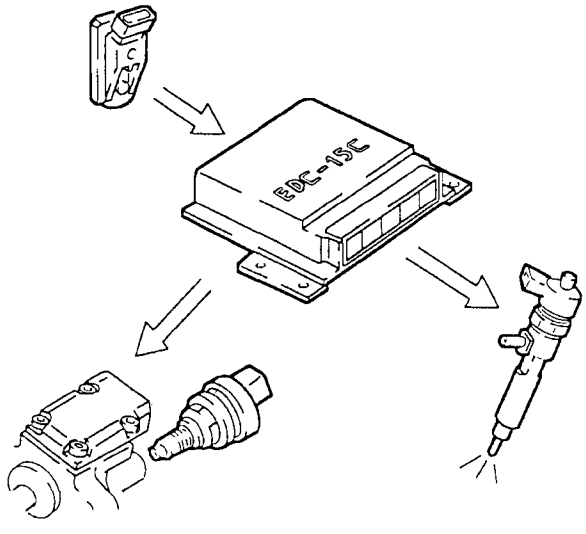
Closed loop injection pressure control

On the basis of the engine load, determined by processing the signals coming from the different sensors, the control unit commands the regulator to obtain an optimum line pressure.

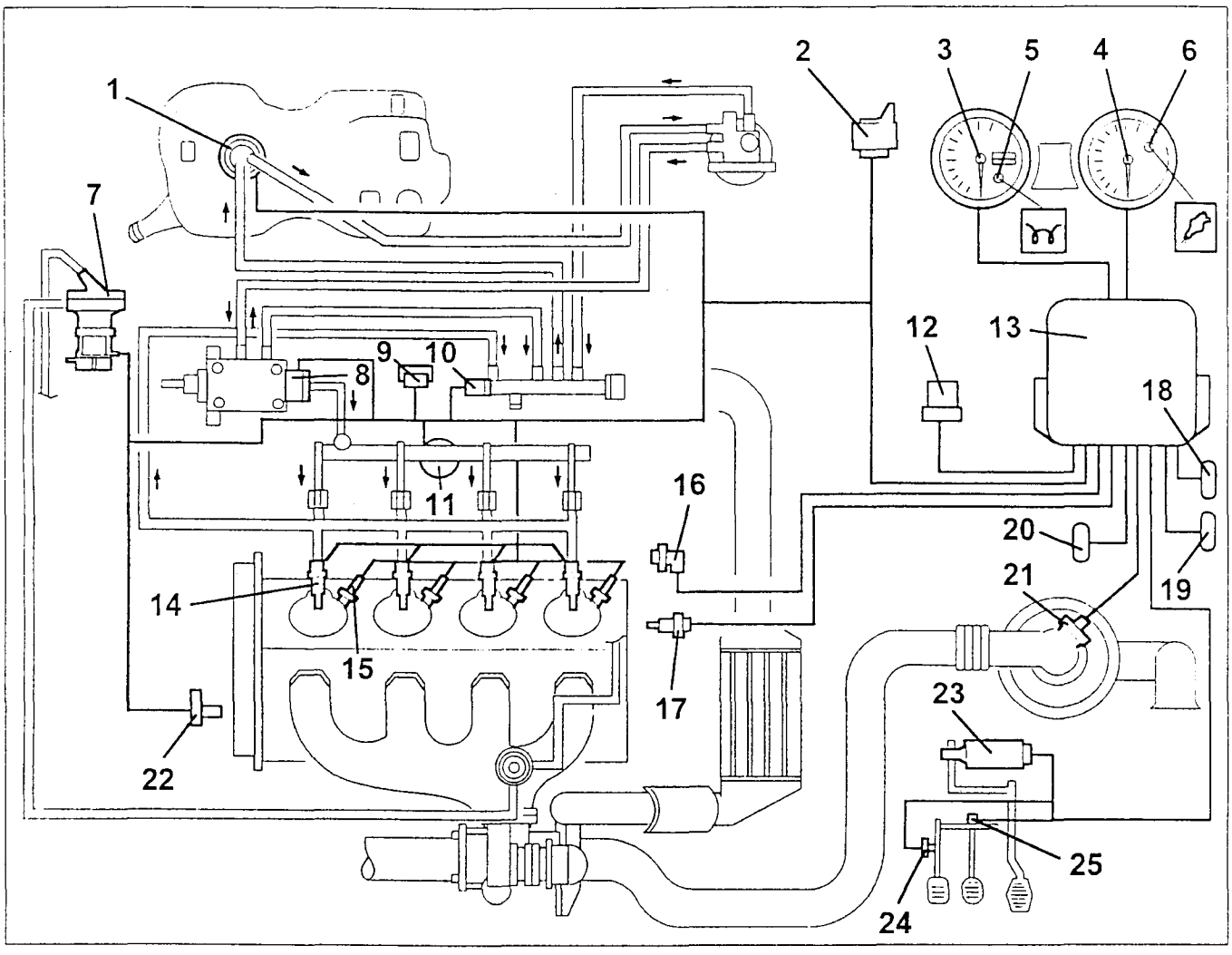


Supercharging pressure control

At the different engine speeds the control unit processes the signal leading from the supercharging sensor and defines the amount of fuel to be injected:
- it commands the pressure regulator
- and changes the injection time.

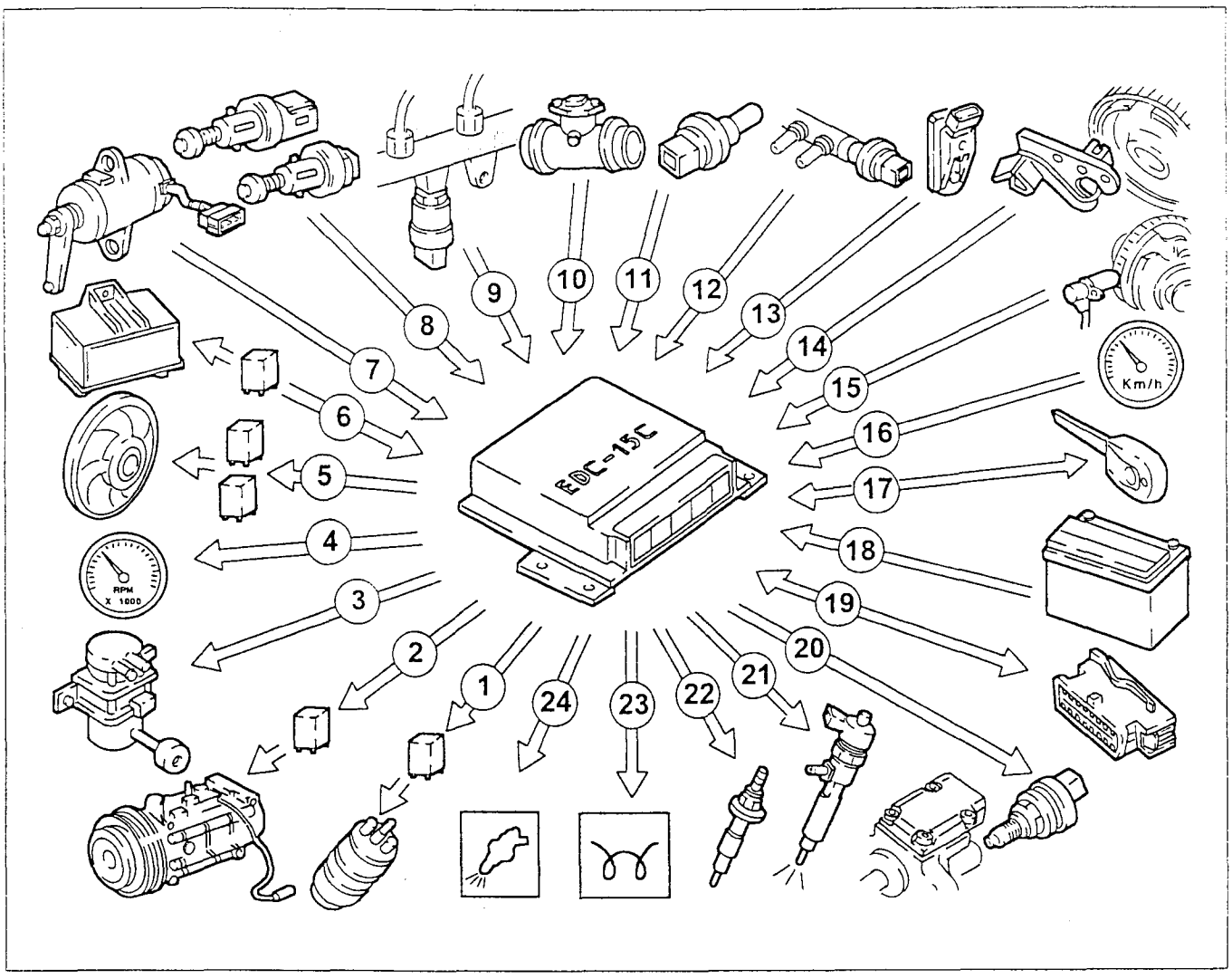


EDC-15C COMMON RAIL INJECTION SYSTEM COMPONENTS



1. *Auxiliary electric fuel pump*
2. *Glow plug control unit*
3. *Speedometer*
4. *Rev counter*
5. *Glow plug warning light*
6. *Check Engine warning light*
7. *E.G.R. valve modulator*
8. *Pressure regulator*
9. *Overpressure sensor*
10. *Fuel temperature sensor*
11. *Fuel pressure sensor*
12. *Relay*
13. *Injection control unit*
14. *Injectors*
15. *Glow plugs*
16. *Rpm sensor*
17. *Water temperature sensor*
18. *Climate control connector*
19. *Diagnostic connector*
20. *Alfa Romeo CODE connector*
21. *Air flow meter*
22. *Timing sensor*
23. *Accelerator pedal potentiometer*
24. *Clutch pedal switch*
25. *Brake pedal switch*

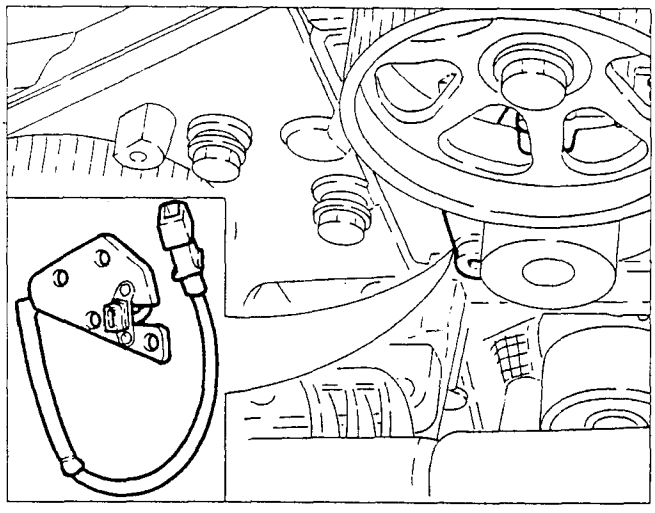
FUNCTIONAL LAYOUT OF EDC-15 COMMON RAIL INJECTION SYSTEM



1. *Electric fuel pump*
2. *Air conditioner compressor*
3. *Modulator for E.G.R. valve*
4. *Rev counter*
5. *Fans*
6. *Glow plug control unit*
7. *Accelerator pedal potentiometer*
8. *Brake - clutch switch*
9. *Fuel pressure sensor*
10. *Air flow meter*
11. *Coolant fluid temperature sensor*
12. *Fuel temperature sensor*
13. *Overpressure sensor*
14. *Timing sensor*
15. *Rpm sensor*
16. *Speedometer*
17. *Alfa Romeo CODE*
18. *Battery*
19. *Socket for diagnostics*
20. *Pressure regulator*
21. *Injectors*
22. *Glow plugs*
23. *Glow plug warning light*
24. *Check Engine warning light*

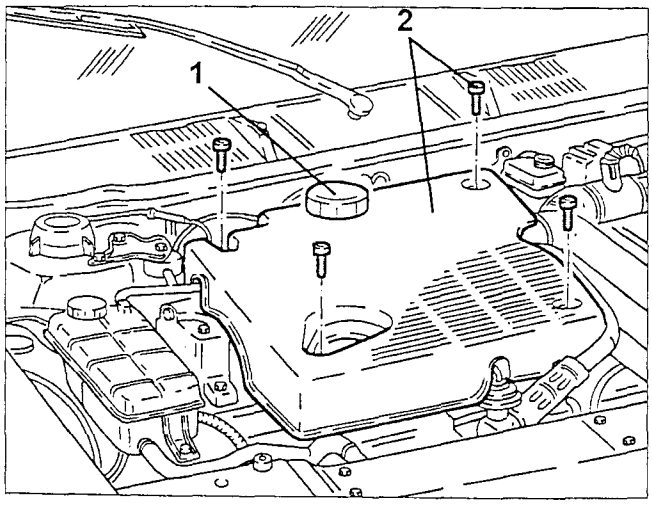
CAM ANGLE SENSOR

This hall effect sensor is fitted on the cylinder head and faces the camshaft drive pulley (exhaust).
On the latter there is an aperture which allows the timing sensor to signal the engine timing position.
The injection control unit uses the timing sensor signal to detect the T.D.C. at the end of compression.

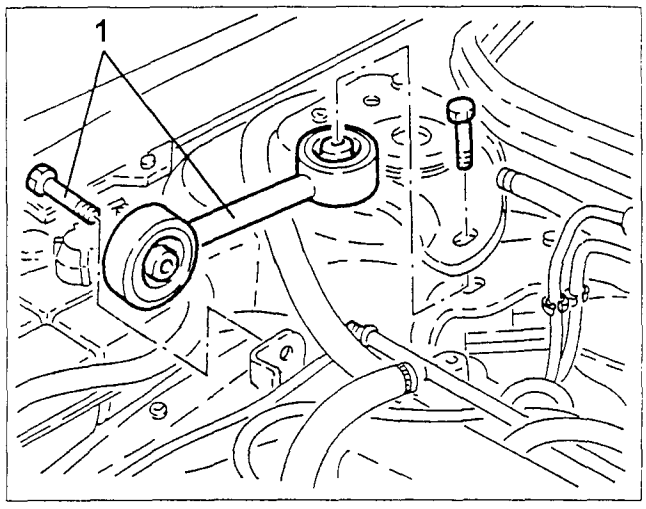


REMOVAL/REFITTING

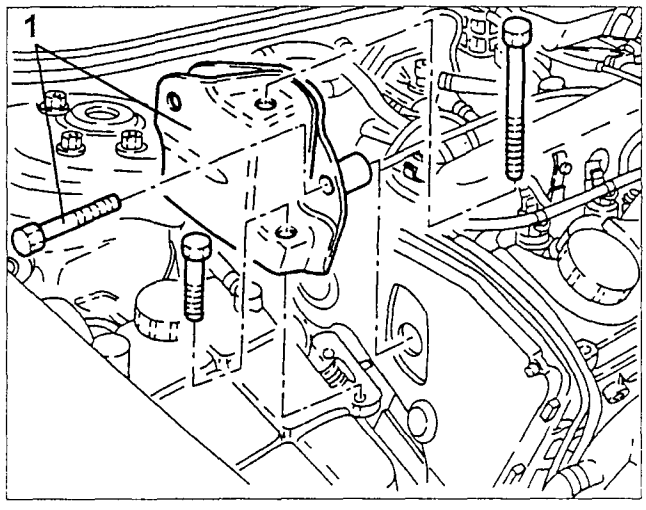
- Set the car on a lift.
- Make sure the ignition key is in the «STOP» position, then disconnect the battery (-) cable.
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.



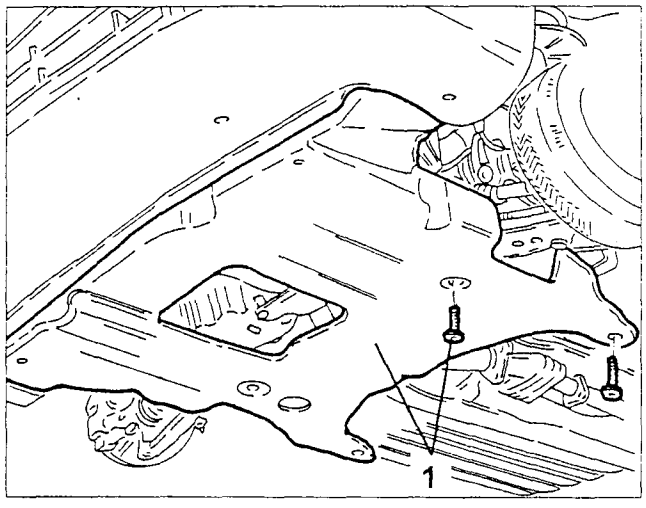
1. Slacken the fastening screws and remove the power unit reaction rod.



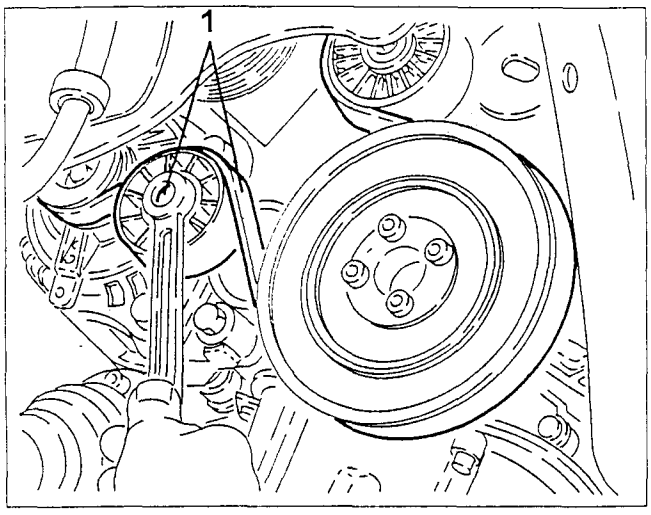
1. Slacken the fastening screws and remove the engine side reaction rod support bracket.



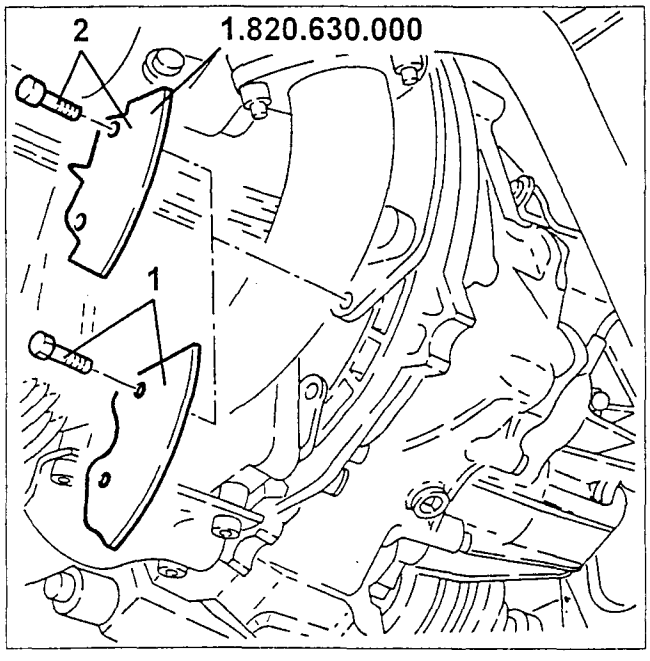
- Remove the right front wheel and dust guard.
- Remove the right front wheel arch.
1. Slacken the fastenings and remove the under engine guard.



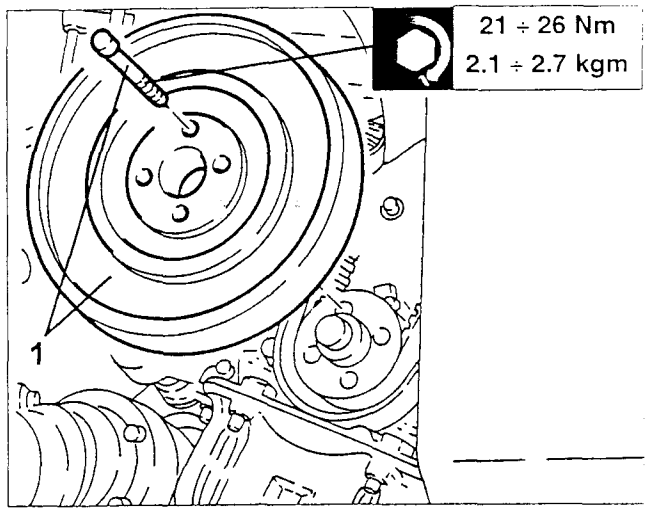
1. Working as illustrated, loosen the tension of the engine components belt and remove it.



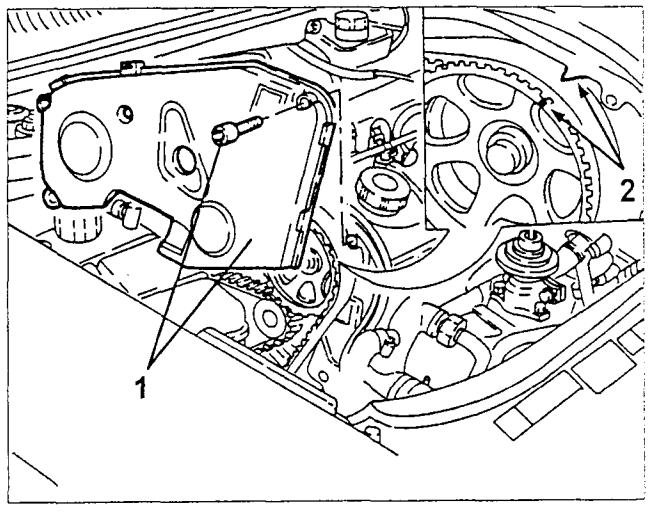
1. Slacken the screws and remove the lower flywheel guard.
2. Install flywheel stopper tool no. 1.820.630.000.



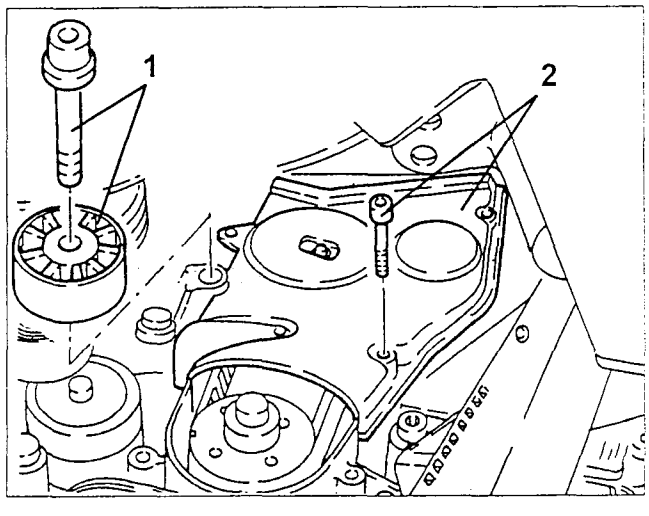
1. Slacken the fastening screws and remove the crankshaft pulley.



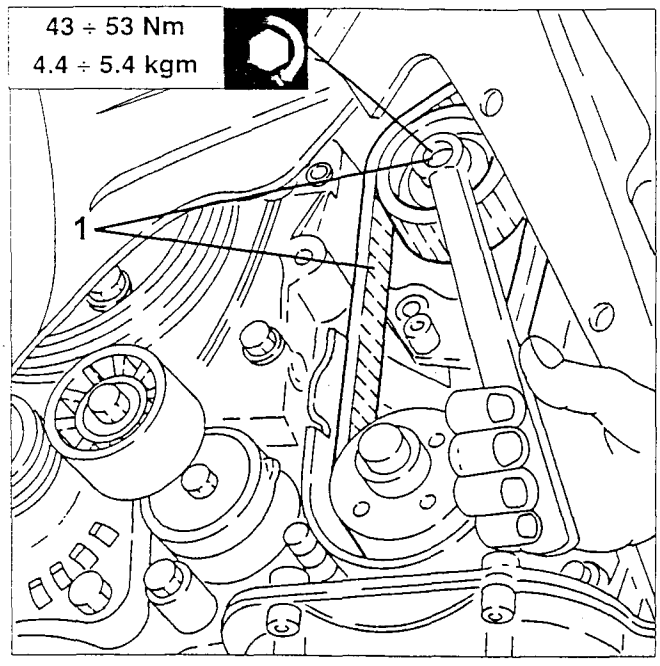
1. Slacken the fastening screws and remove the camshaft belt upper guard.
2. Working on the screw of the camshaft driving pulley, turn the crankshaft until aligning the timing references (1st cylinder at T.D.C.).



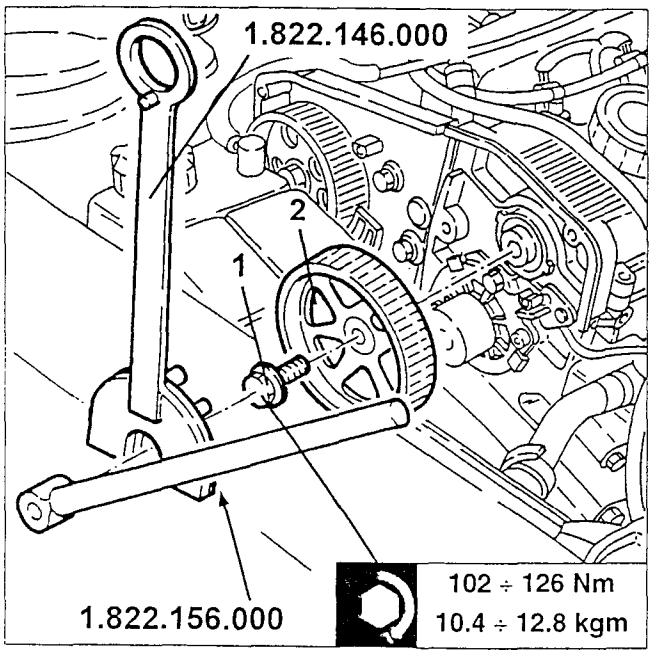
1. Slacken the fastening screw and remove the engine components belt fixed tensioner.
2. Slacken the fastening screws and remove the camshaft belt lower guard.



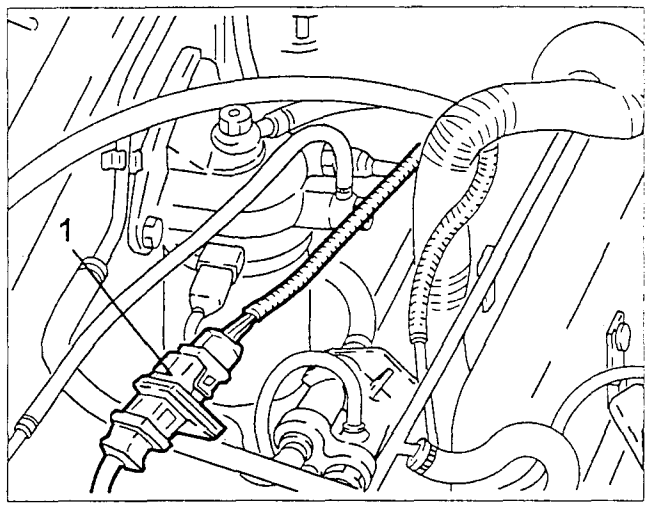
1. Loosen the nut fastening the camshaft belt tensioner, then remove the camshaft belt.



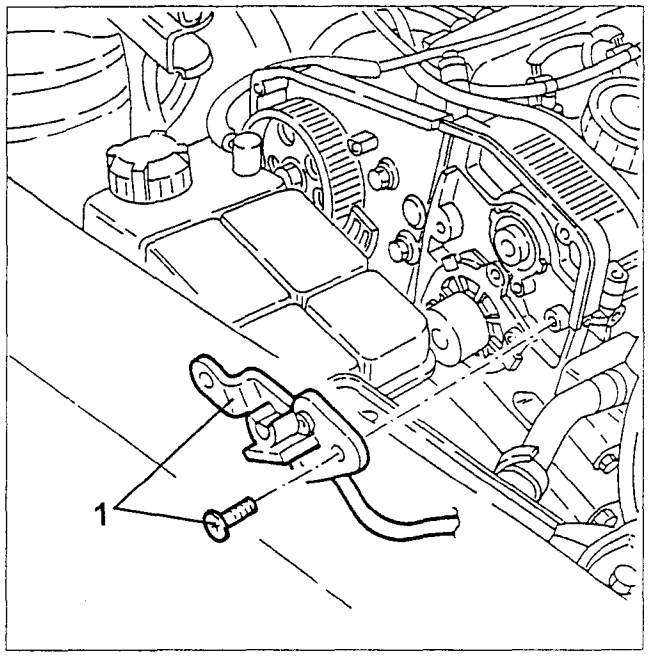
1. Slacken the fastening screw of the driven toothed pulley using tools no. 1.822.146.000 and no. 1. 822.156.000 as counter torque.
2. Remove the toothed driven pulley.



1. Disconnect the electrical connection of the cam angle sensor.



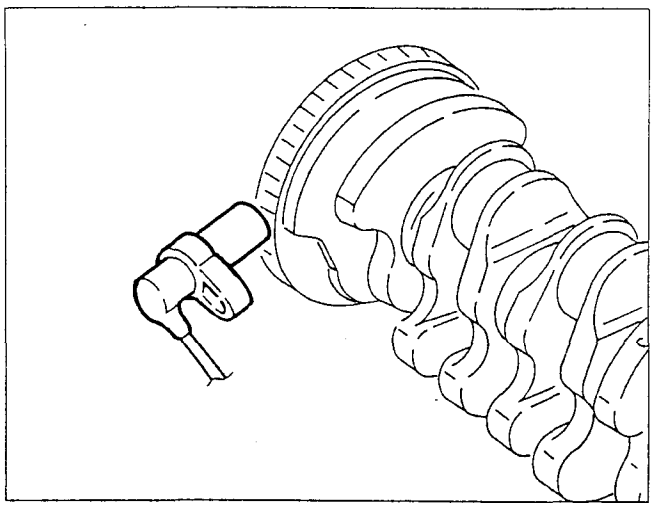
1. Slacken the fastening screws and remove the cam angle sensor.



Refit reversing the sequence followed for removal and refer to GROUP 00 for refitting the timing gear drive belt and timing and for refitting the engine components drive belt.

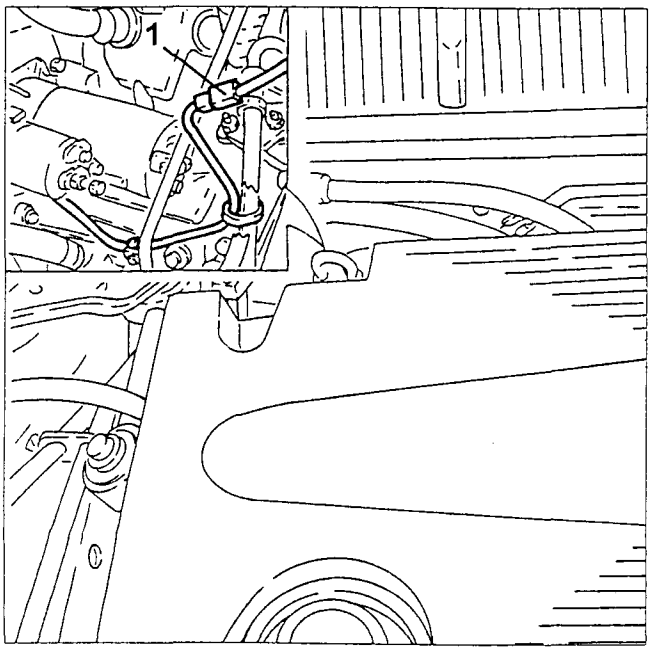
RPM SENSOR

This is fitted on the crankcase and "faces" the phonic wheel on the crankshaft.
It is of the inductive type, i.e. it works through the change of the magnetic field generated by the passage of the teeth of the phonic wheel (60-2 teeth).
The injection control unit uses the rpm sensor signal to:
- determine the speed of rotation
- determine the crankshaft angular position.

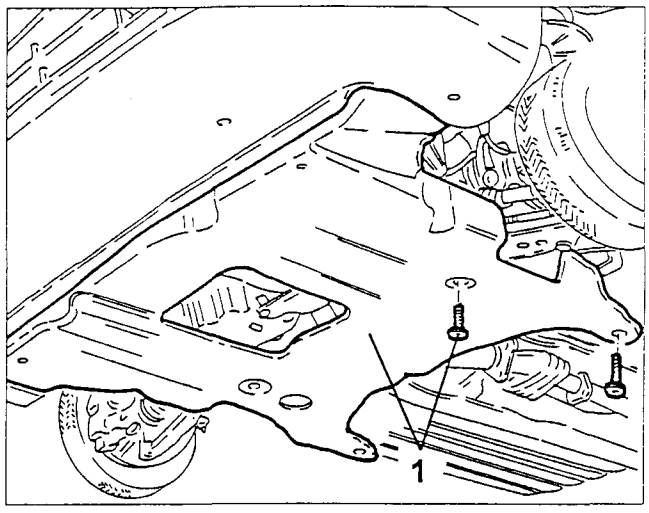


REMOVAL/REFITTING

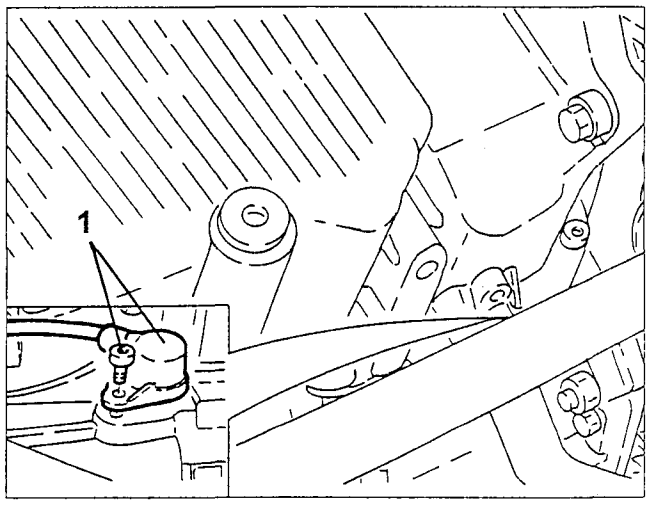
- Set the car on a lift.
- Make sure the ignition key is in the «STOP» position, then disconnect the battery (-) cable.
1. Disconnect the electrical connection of the rpm sensor and release it from the support bracket.



- Raise the car.
1. Slacken the fastenings and remove the under engine guard.

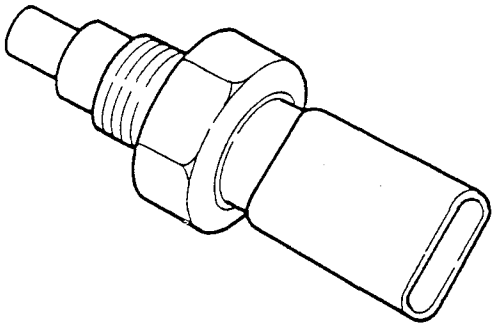


1. Slacken the fastening screw and remove the rpm sensor after releasing its wiring from the fasteners.



COOLANT FLUID TEMPERATURE SENSOR

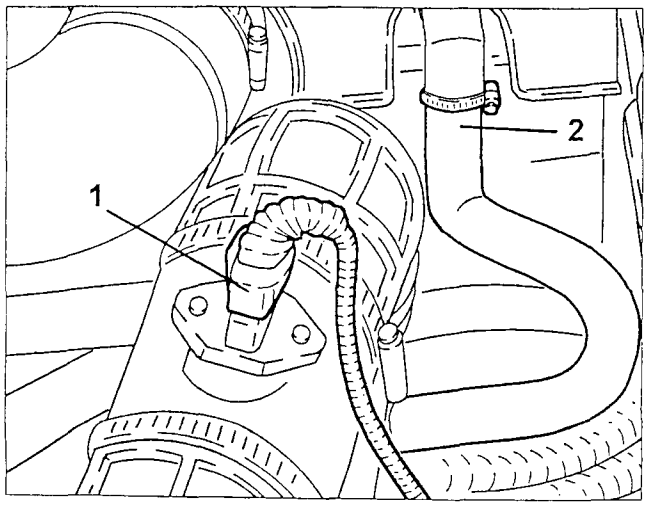
This is fitted on the thermostatic cup and detects the temperature of the water through a double NTC thermistor with a negative resistance coefficient.
One NTC thermistor sends the signal to the injection control unit while the other sends the signal to the instrument cluster for the temperature gauge and warning light.



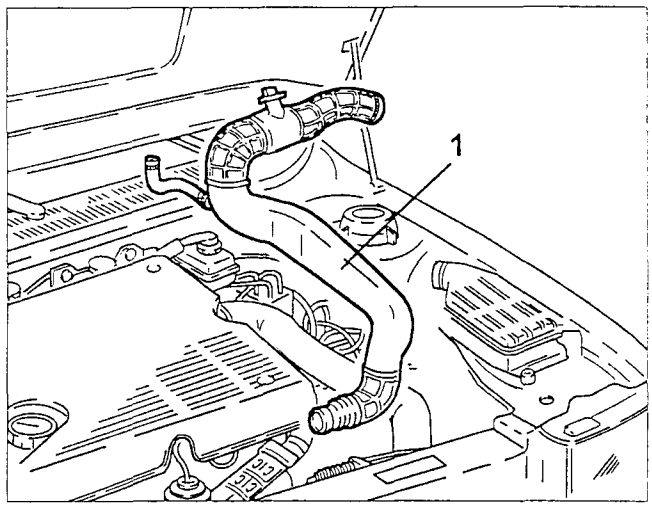
The sensor is made with semi-conductor technology, therefore, if the temperature of the sensor increases with the temperature of the water, the resistance value is reduced.
As the change in the resistance is not linear, at the same temperature increase it is higher for low temperatures than for high temperatures.

REMOVAL/REFITTING

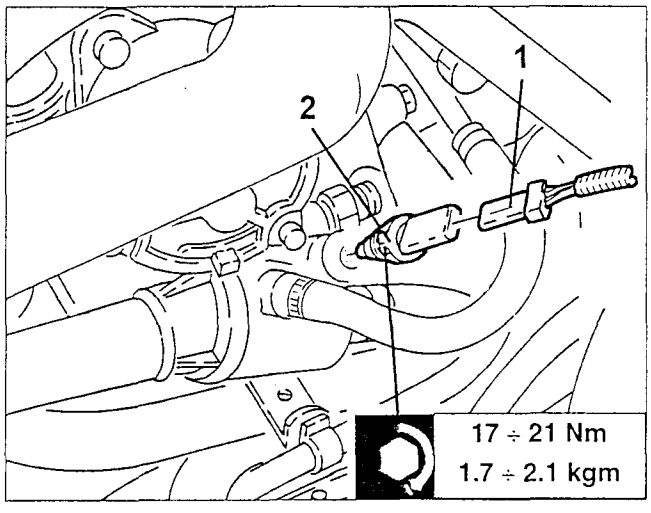
- Remove the battery (see Group 55).
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the oil vapour re-circulation pipe from the oil vapour separator.



1. Loosen the clamps and remove the complete air delivery pipe from the cleaner to the turbocharger.

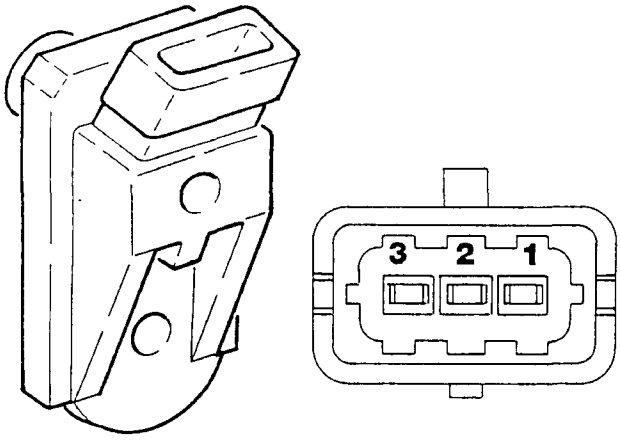


1. Disconnect the electrical connection from the engine coolant fluid temperature sensor.
2. Slacken and remove the engine coolant fluid temperature sensor.



OVERPRESSURE SENSOR

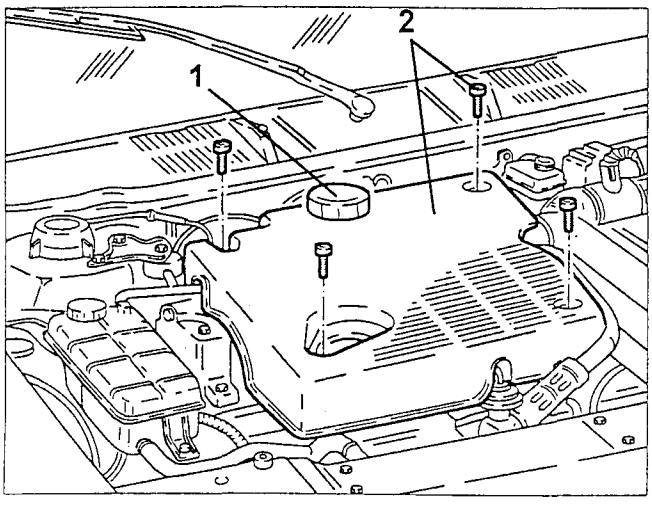
This is installed at the centre of the intake box and its purpose is to inform the injection control unit for:
- injection pressure adjustment
- injection length adjustment.



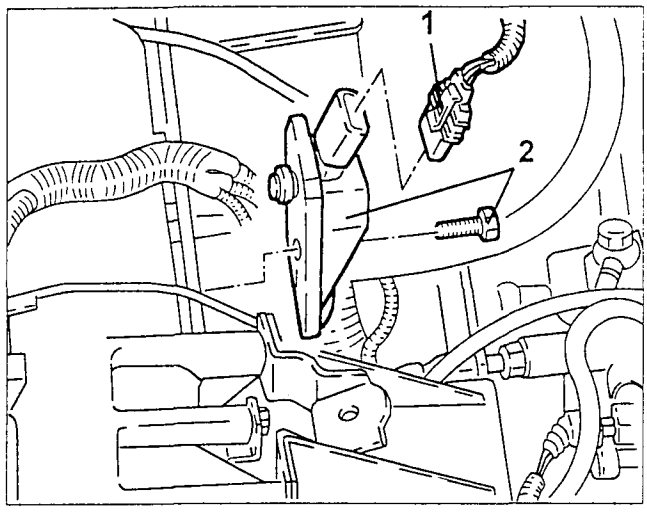
1. 5 V (from ECU)
2. Earth
3. Output signal

REMOVAL/REFITTING

- Make sure the ignition key is in the «STOP» position, then disconnect the battery (-) cable.
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.



1. Disconnect the electrical connection from the overpressure sensor.
2. Slacken the screw and remove the overpressure sensor.



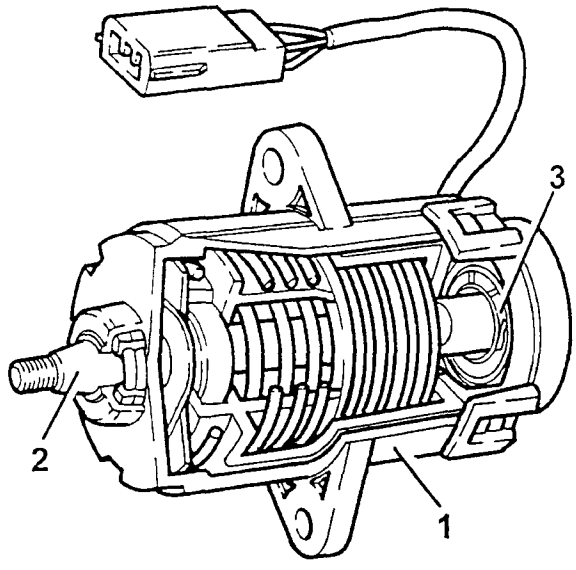
ACCELERATOR PEDAL POTENTIOMETER

The accelerator pedal is fitted with two integrated potentiometers:
- a main one
- and a safety one.

The control unit activates the following recovery strategies:
- in the event of a fault on one of the two potentiometers, it allows throttle opening up to a maximum of 40° in a very long time
- in the event of a complete failure of the two potentiometers, it shuts off throttle opening.

OPERATION

The sensor consists of a body (1), secured to the pedal assembly with a flange, which houses an axially positioned shaft (2) connected to two potentiometers (3).
There are two springs on the shaft; one (coil spring) ensures correct pressure resistance and the other ensures pedal return when released.
Operating range 0° to 70°; mechanical stop at 88°.

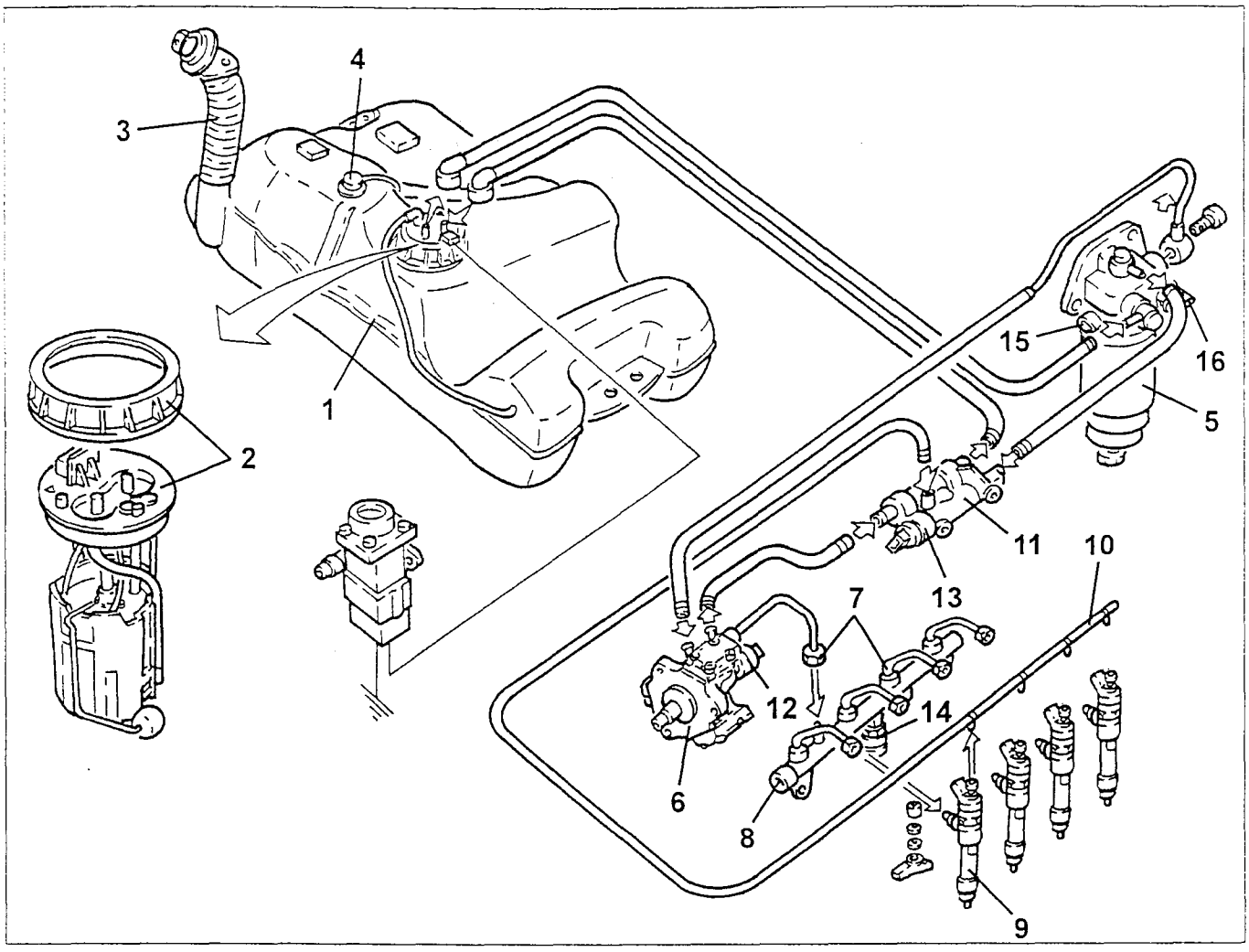


1. Body
2. Shaft
3. Potentiometers

REMOVAL/REFITTING

TO BE PUBLISHED SOON

DESCRIPTION OF FUEL SUPPLY SYSTEM



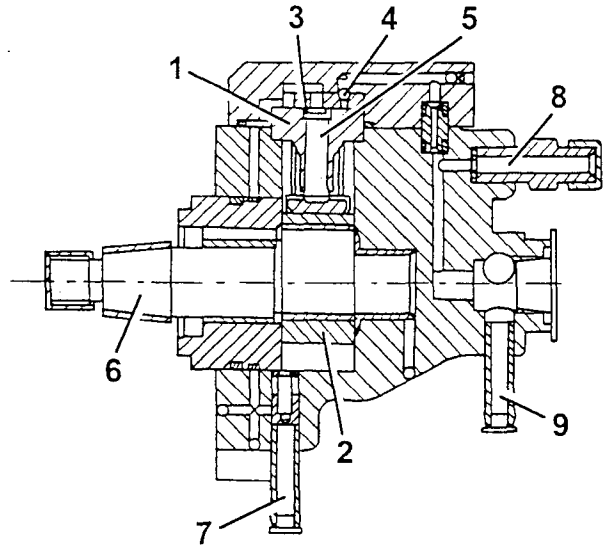
1. Fuel tank
2. Submerged pump assembly complete with level gauge control
3. Fuel filler pipe
4. Multi-function valve
5. Fuel filter cartridge
6. Pressure pump
7. High pressure pipes
8. Delivery manifold
9. Injectors
10. Injector re-circulation pipe
11. Return manifold
12. Pressure regulator
13. Fuel temperature sensor
14. Fuel pressure sensor
15. Fuel heater
16. Thermal switch

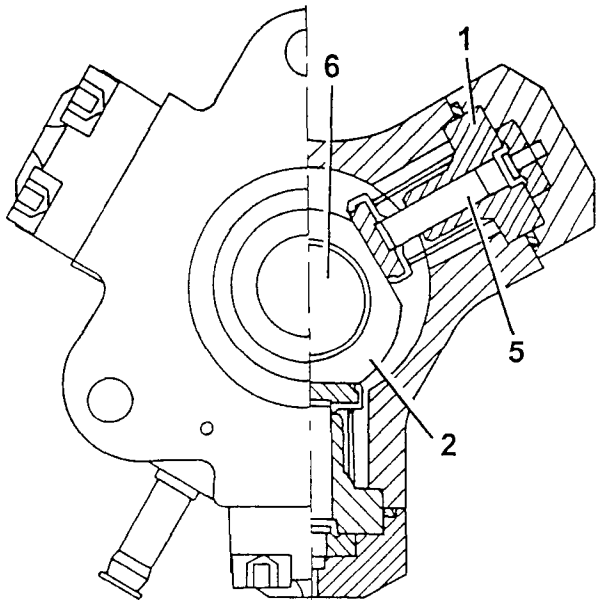
The fuel supply system is subdivided into a low pressure circuit and a high pressure circuit.
The low pressure circuit comprises:
- submerged auxiliary electric pump
- fuel oil filter
- return manifold.

The high pressure circuit comprises:
- fuel pump
- delivery manifold.

PRESSURE PUMP

This is of the "radial jet" with three radial pistons (total displacement 0.657 c.c.) and it is controlled by the timing gear belt with no need for timing.
Each pumping unit comprises:
- a piston (5) operated by a cam (2) integral with the spindle of the pump (6)
- a plate inlet valve (3)
- a ball delivery valve (4).



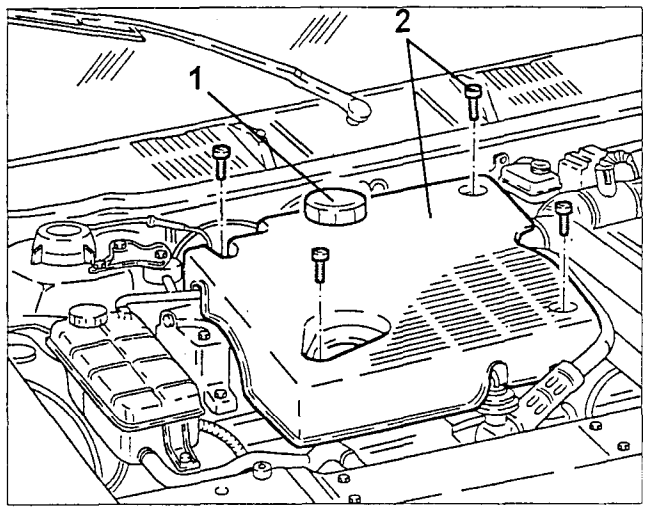


1. Cylinder
2. Cam
3. Plate inlet valve
4. Ball delivery valve
5. Piston
6. Pump spindle
7. Inlet - low pressure
8. Delivery - high pressure
9. Delivery - low pressure (re-circulation)

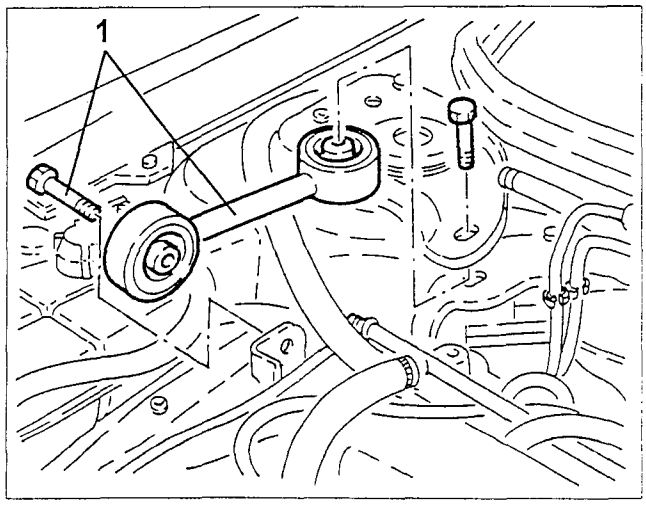
The pressure pump must be supplied with a pressure of at least 0.5 bar; therefore the fuel system is fitted with an auxiliary electric pump submerged in the fuel tank.
The maximum delivery pressure reaches 1350 bar.
The pressure pump is lubricated and cooled by the actual fuel oil through suitable grooves.

REMOVAL/REFITTING

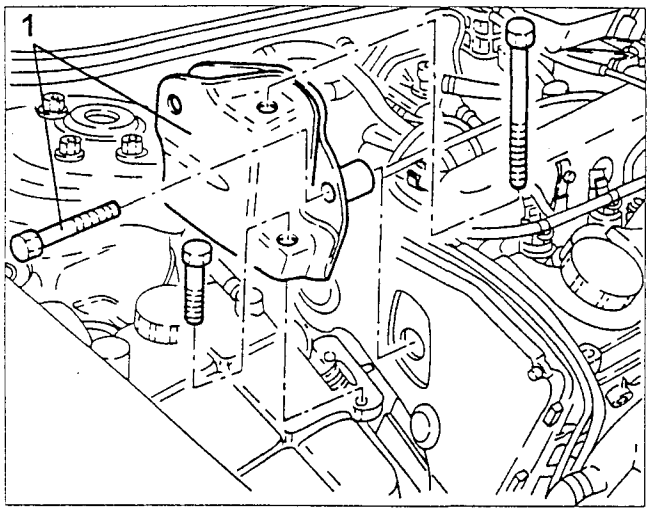
- Set the car on a lift.
- Make sure that the ignition key is at the "STOP" position, then disconnect the battery terminal (-).
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.



1. Slacken the fastening screws and remove the power unit reaction rod.

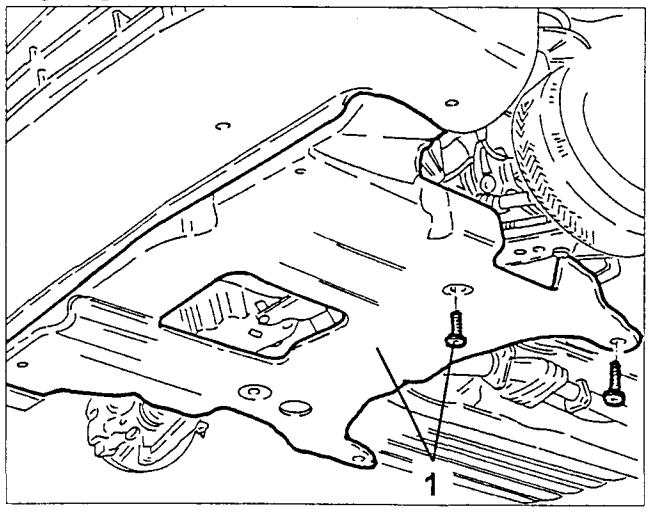


1. Slacken the fastening screws and remove the reaction rod engine side support bracket.

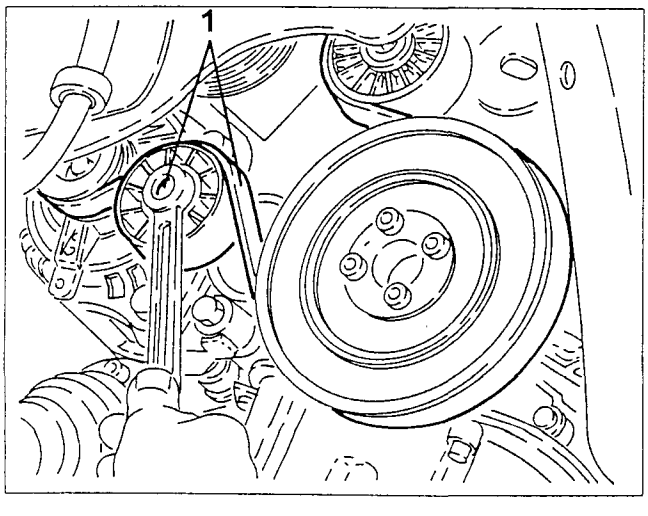


- Remove the right front wheel and its dust guard.
- Remove the right front wheel arch.

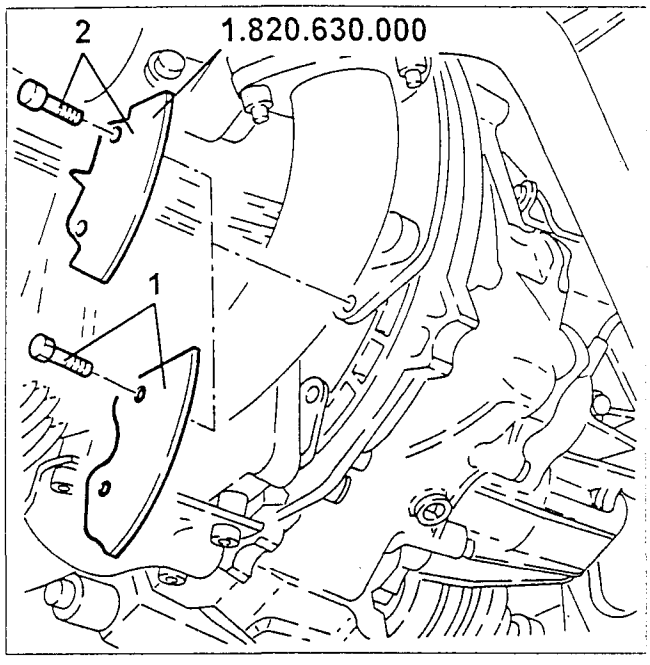
1. Slacken the fastenings and remove the under engine guard.



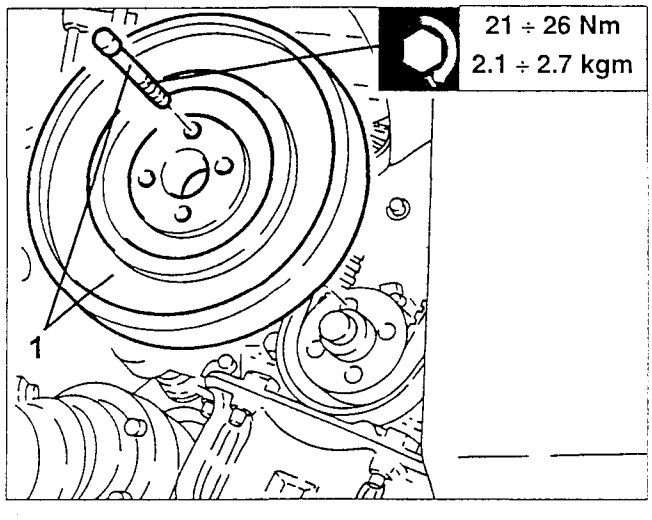
1. Proceeding as illustrated on the tensioner, slacken the tension of the engine components belt and remove it.



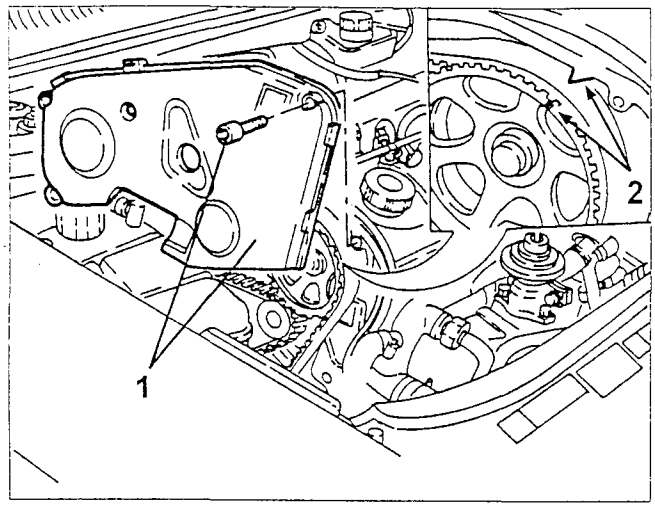
1. Slacken the screws and remove the lower flywheel guard.
2. Install flywheel stopper tool no. 1.820.630.000.



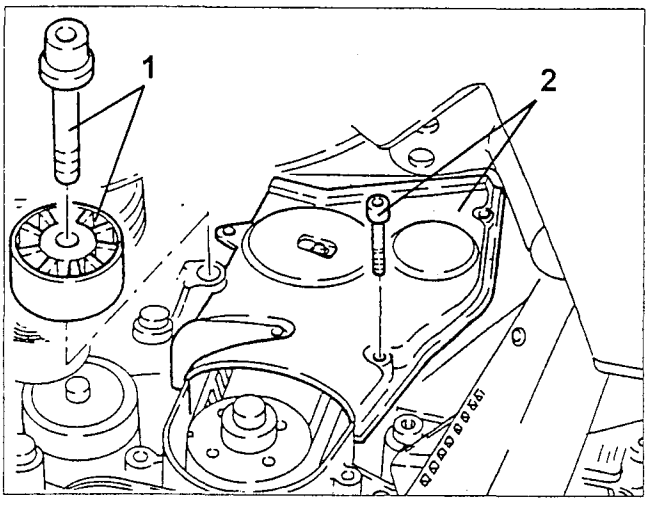
1. Slacken the fastening screws and remove the crankshaft pulley.



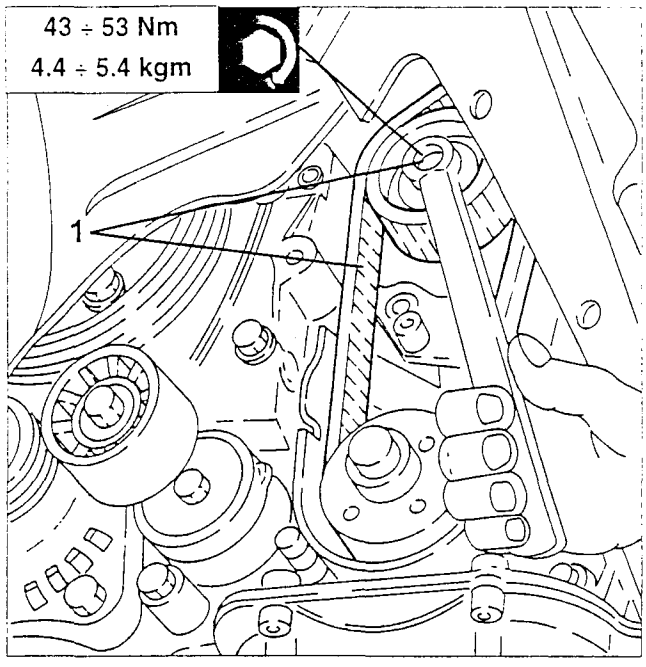
1. Slacken the fastening screws and remove the timing gear belt upper guard.
2. Working on the driving pulley screw, turn the crankshaft until the timing references are aligned (1st cyl. at T.D.C.).



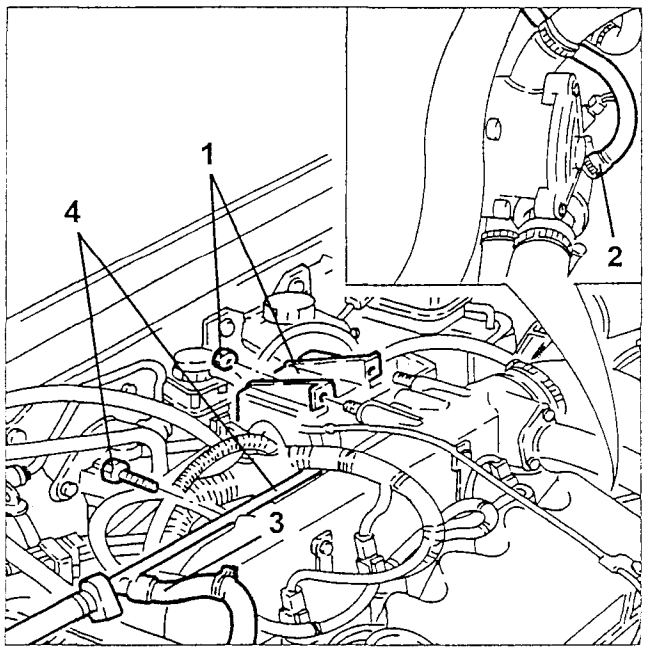
1. Slacken the fastening screw and remove the fixed tensioner of the engine components belt.
2. Slacken the fastening screws and remove the timing gear belt lower guard.



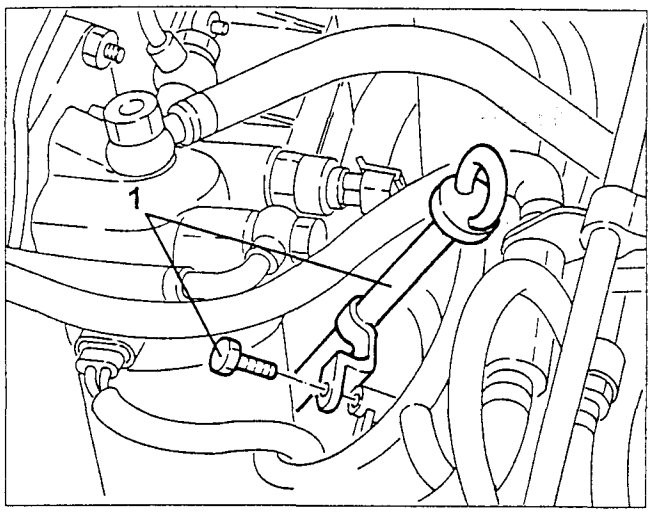
1. Slacken the nut fastening timing gear belt tensioner, then remove the timing gear belt.



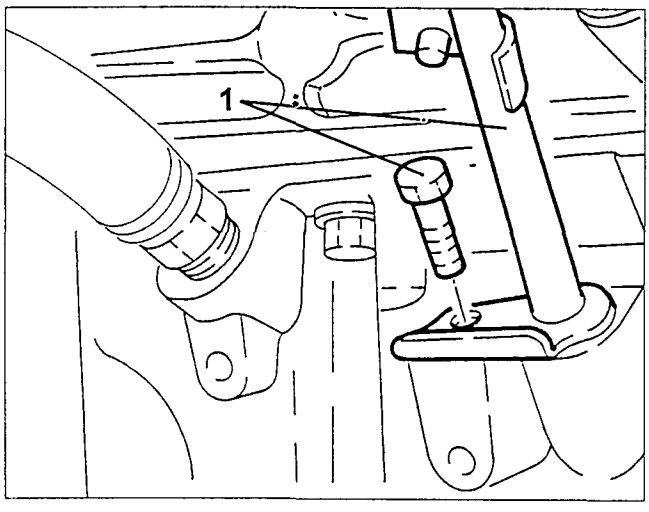
1. Slacken the fastening nuts and move the oil vapour separator.
2. Disconnect the coolant fluid return pipe to the header tank from the thermostat.
3. Disconnect the cylinder head coolant outlet pipe from the header tank coolant return pipe.
4. Slacken the fastening screws and move aside the header tank coolant return pipe.



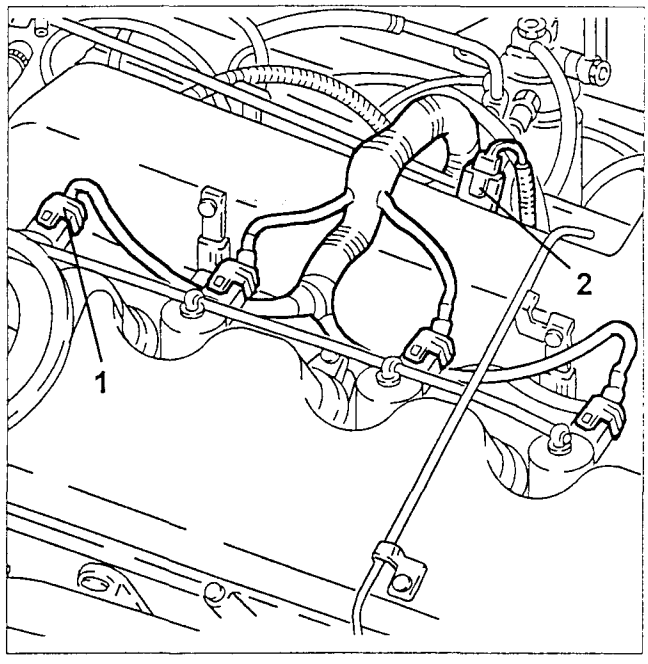
1. Slacken the upper screw of the engine oil dipstick guide pipe.



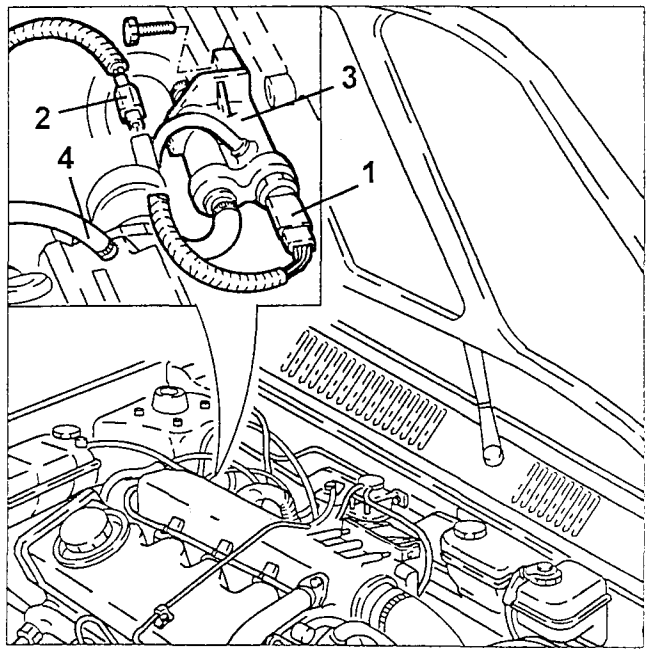
1. Slacken the lower screw of the engine oil dipstick guide pipe.



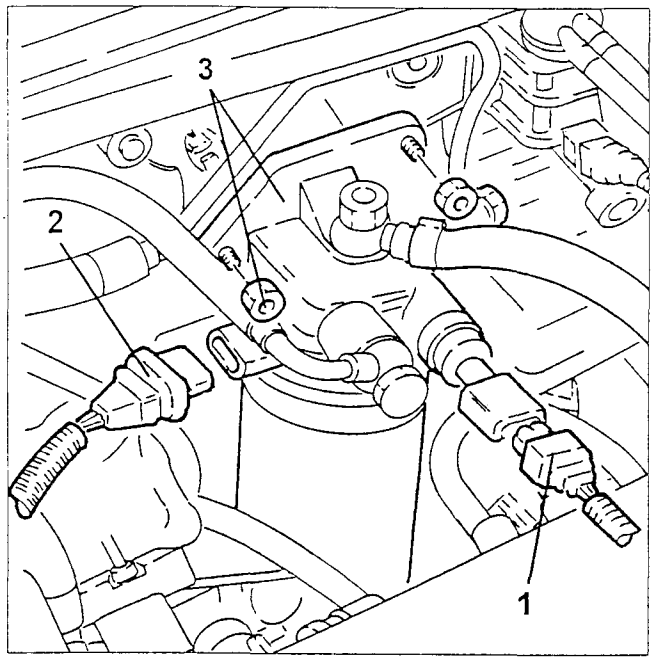
- Remove the guide pipe complete with engine oil dipstick.
1. Disconnect the electrical connections from the injectors.
2. Disconnect the electrical connection from the over-pressure sensor and move aside the wiring.



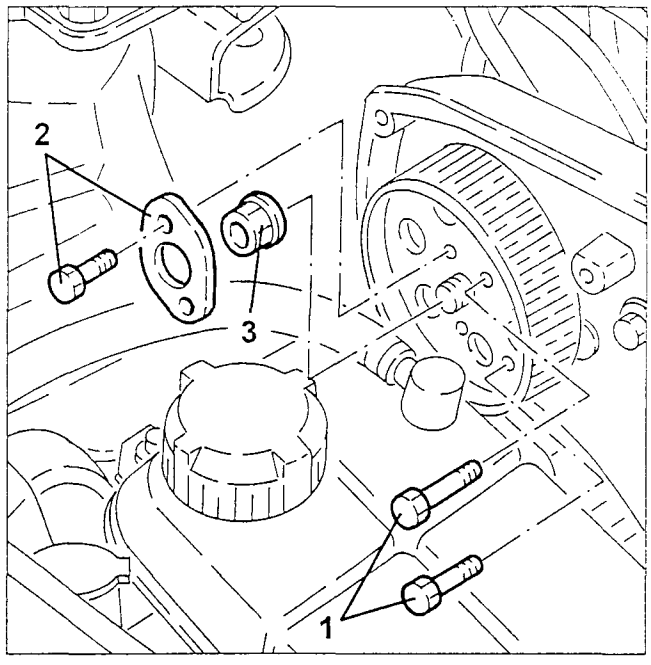
1. Disconnect the electrical connection from the fuel temperature sensor.
2. Disconnect the electrical connection from the fuel pressure regulator.
3. Slacken the screws and move the fuel return manifold pipe.
4. Disconnect the fuel inlet pipe from the pressure pump.



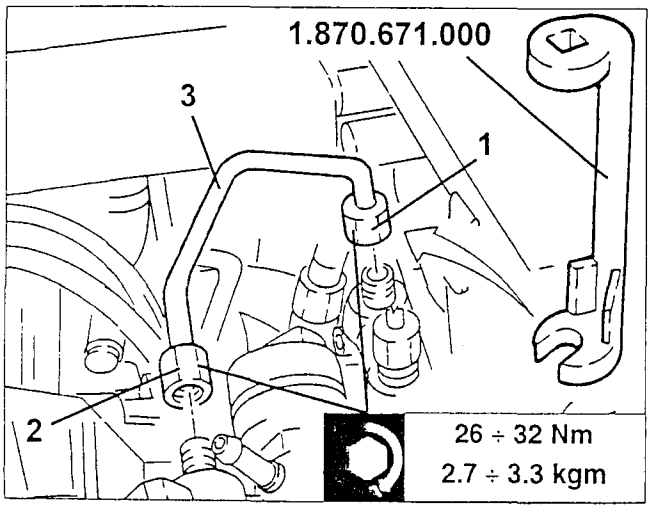
1. Disconnect the electrical connection from the fuel heater thermal switch.
2. Disconnect the electrical connection from the fuel heater.
3. Slacken the fastening nuts and move the fuel filter complete.



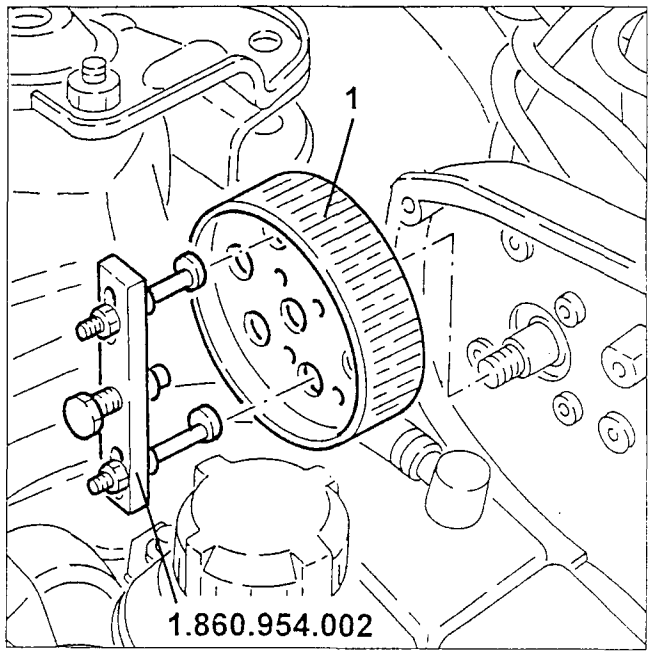
1. Tighten two screws in the special seats to lock the pressure pump drive pulley.
2. Slacken the screws and remove the safety flange.
3. Slacken nut fastening the pressure pump control pulley.



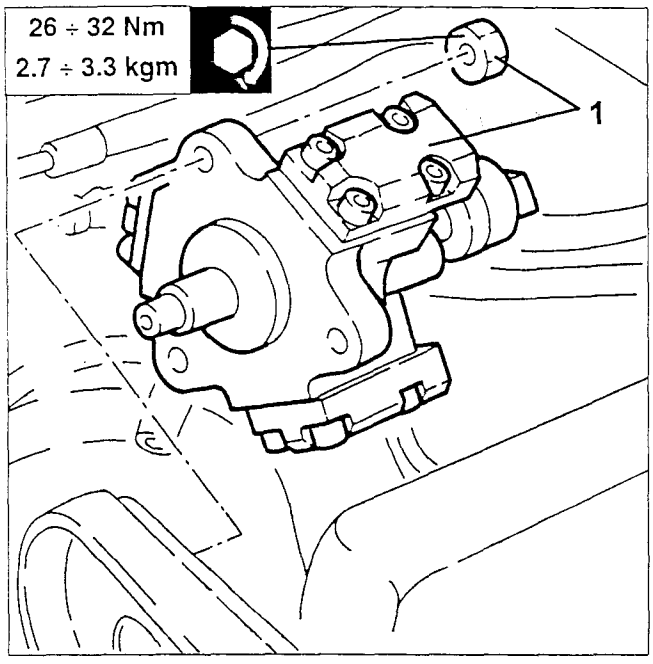
1. Slacken the manifold side coupling of the pipe between the pressure pump and fuel manifold using tool no. 1.870.671.000.
2. Slacken the pressure pump side coupling of the pressure pump delivery pipe to the manifold using a suitable wrench.
3. Remove the fuel delivery pipe from the pressure pump to the single fuel manifold pipe.



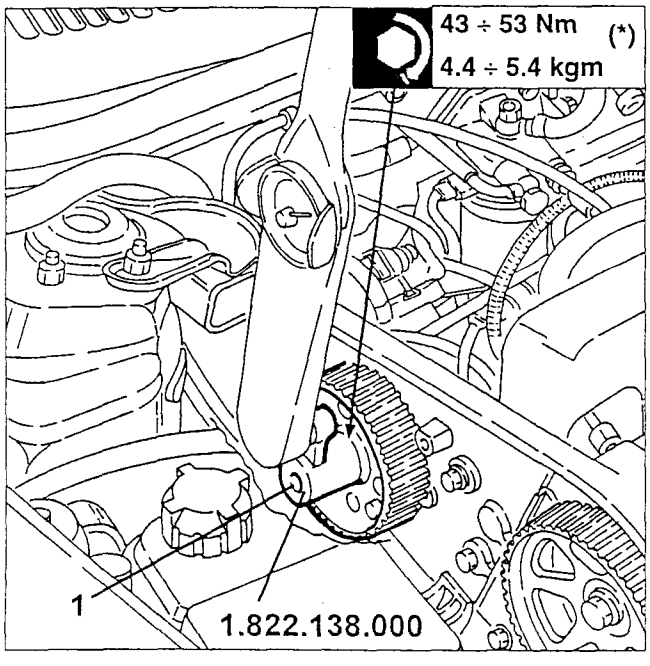
1. Remove the pressure pump control pulley using tool no. 1.860.954.002.



1. Slacken the fastening nuts and remove the pressure pump.



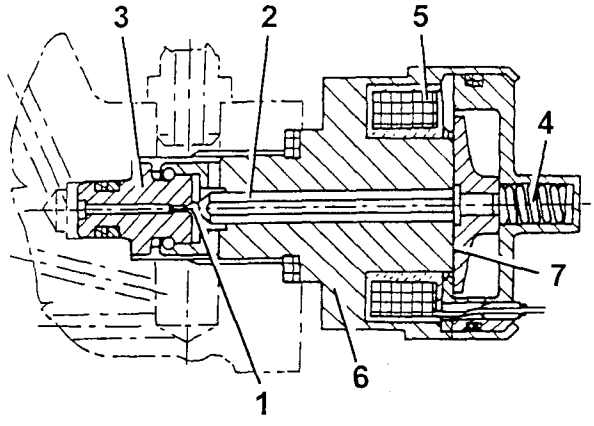
Reassemble, reversing the sequence followed for removal and following the instructions given below.
1. . Tighten the nut fastening the pressure pump control pulley to the specified torque using wrench no. 1.822.138.000.



(*): Nominal value

FUEL PRESSURE REGULATOR

This is fitted on the pressure pump and controlled by the injection control unit. It adjusts the pressure of the fuel supply to the injectors.
The pressure regulator mainly comprises:
- a ball shutter (1)
- a pin (2) for controlling valve (3)
- a pre-loading spring (4)
- a coil (5).



1. Ball shutter
2. Pin
3. Valve
4. Pre-loading spring
5. Coil
6. Body
7. Anchor

INJECTORS

These are fitted on the cylinder head and controlled by the injection control unit.
The injector can be subdivided into two parts:
- actuator/atomiser composed of a pressure rod (1), pin (2) and nozzle (3)
- solenoid control valve composed of a coil (4) and drive valve (5).

OPERATION

The injector works in three steps:

- **"rest position"**

The coil (4) is de-energised and the shutter (6) is in the closed position and does not allow the delivery of fuel into the cylinder Fc > Fa (Fc: due to the line pressure which acts directly on the control area 7 of the rod 1; Fa: due to the line pressure which acts in the supply volume 8).

- **"start of injection"**

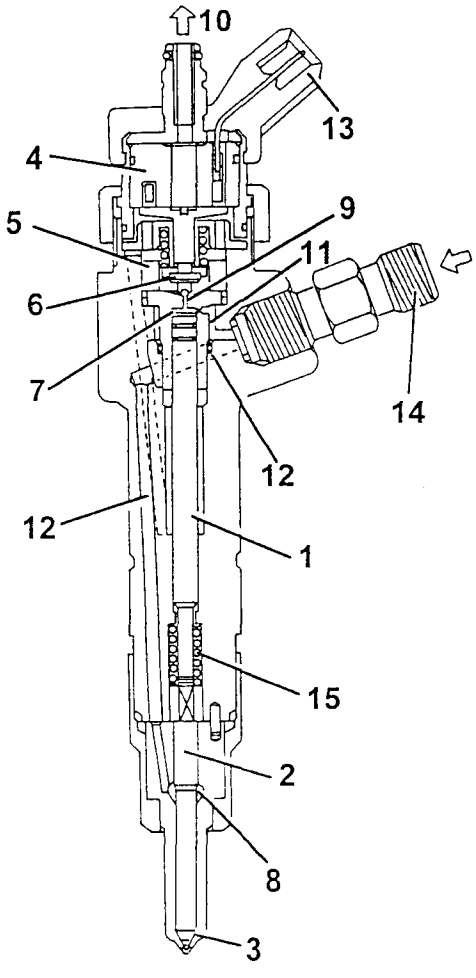
The coil (4) is energised and causes the shutter (6) to rise.

The fuel of the control volume (9) flows towards the return manifold (10) causing a pressure drop on the control area (7).

Simultaneously, the line pressure through the supply duct (12) exerts a force Fa > Fc in the supply volume (8) causing the pin (2) to rise, thereby sending fuel into the cylinders.

- **"end of injection"**

The coil (4) is de-energised and makes the shutter (6) return to the closed position which again creates a balance of force which returns the pin (2) to the closed position, resulting in the end of injection.



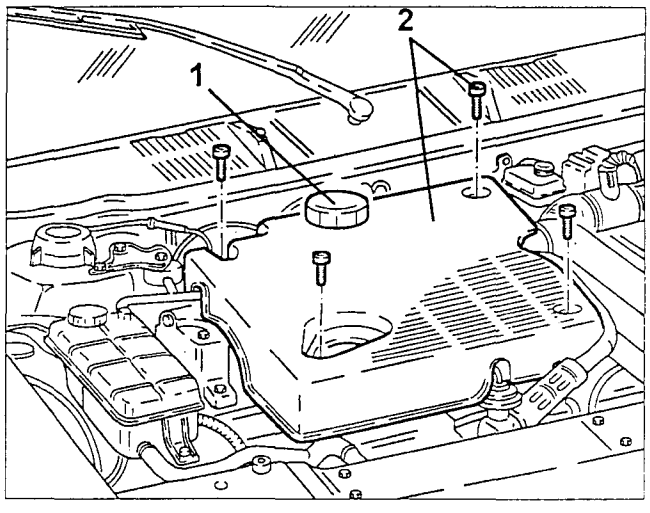
1. Pressure rod
2. Pin
3. Nozzle
4. Coil
5. Drive valve
6. Ball shutter
7. Control area
8. Supply volume
9. Control volume
10. Fuel return - low pressure
11. Control duct
12. Supply duct
13. Electrical connection
14. Fuel inlet - high pressure coupling
15. Spring

REMOVAL/REFITTING

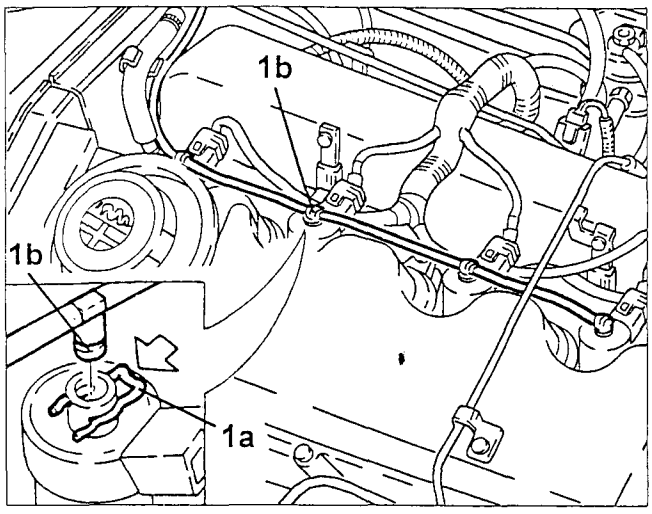
- Make sure that the ignition key is at "STOP", then disconnect the battery terminal (-).

1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.

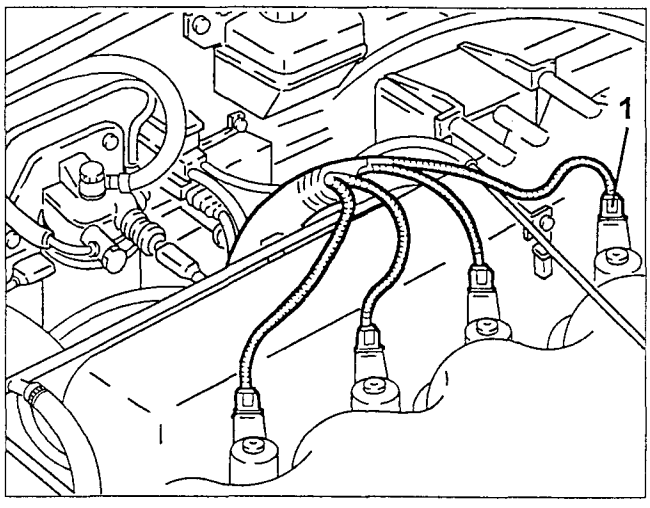
- Refit the engine oil filler cap.



1. Push the catches (1a) and disconnect the fuel return pipe for lubricating the injectors (1b) from the injectors.

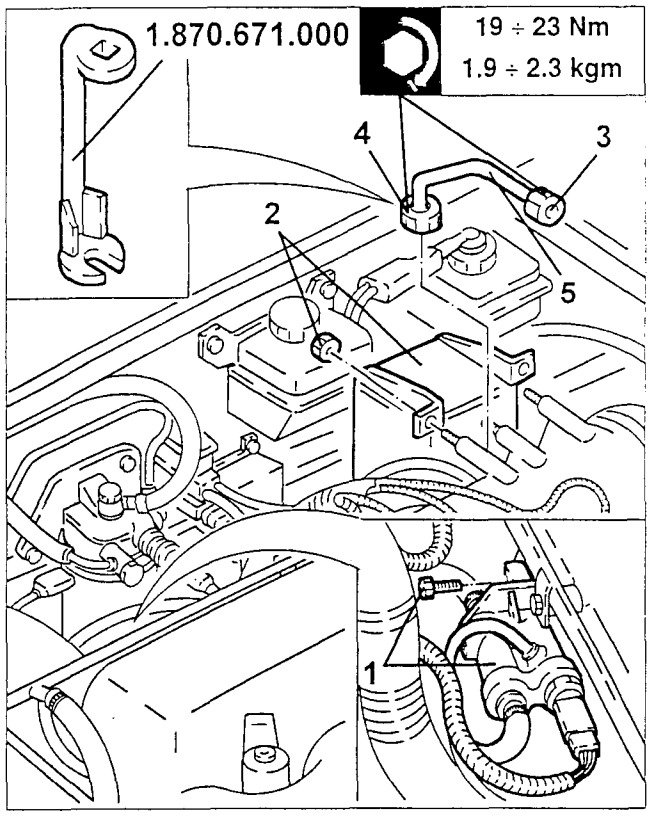


1. Disconnect the electrical connections from the injectors, then move aside the wiring after releasing it from the fastening clamps.

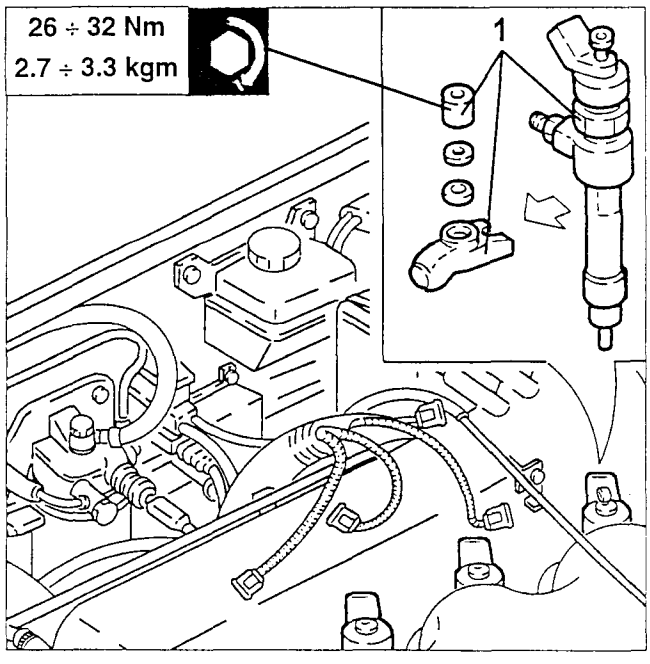


1. Slacken the screws and move aside the complete fuel return manifold pipe.
2. Slacken the nuts and move the oil vapour separator.
3. Slacken the injector side coupling of the pipes from the fuel manifold to the injectors using a suitable wrench.
4. Slacken the manifold side coupling of the pipes from the fuel manifold to the injectors using tool no. 1.870.671.000.

5. Remove the fuel delivery pipes from the single fuel manifold to the injectors.

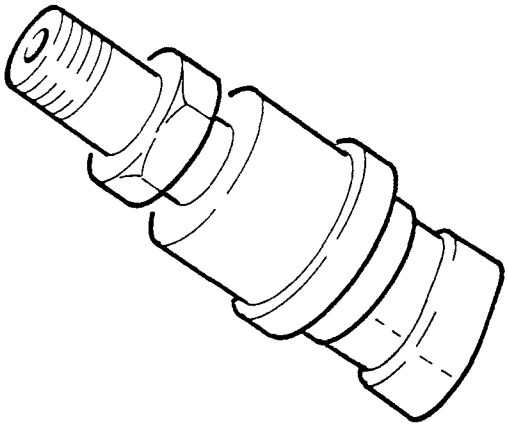


1. Slacken the fastening nuts, then remove the brackets and injectors.



FUEL PRESSURE SENSOR

This is fitted at the centre of the "rail" fuel distributor manifold and its task is to supply the injection control unit a feedback signal to:
- adjust the injection pressure
- adjust the injection time.



DELIVERY MANIFOLD

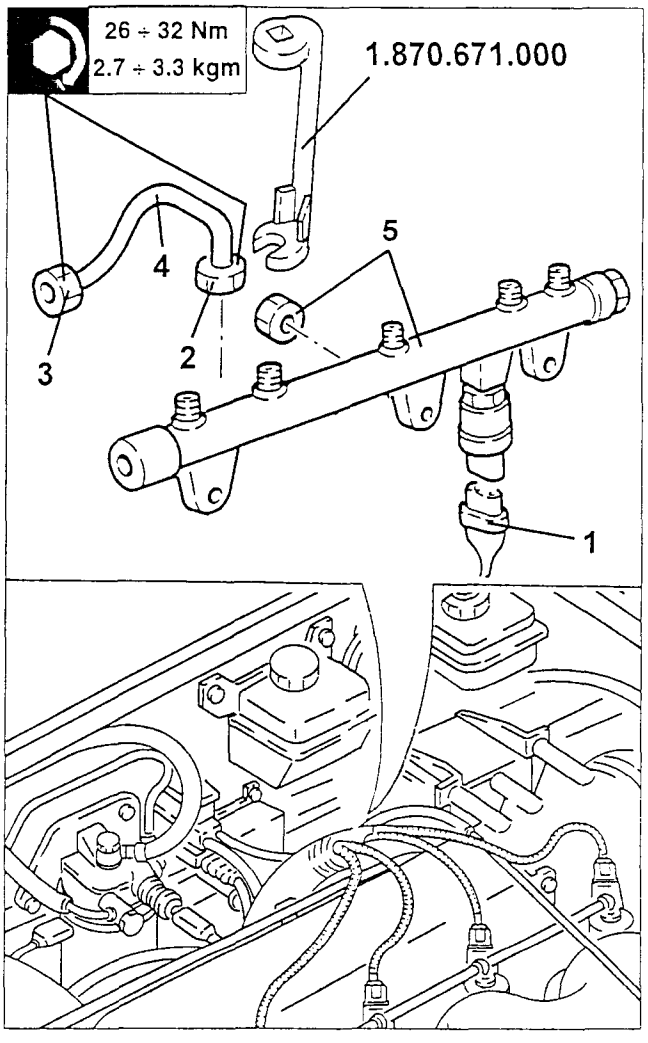
The delivery manifold is fitted on the intake side of the cylinder head.
With its volume of approx. 33 c.c. It dampens fuel pressure oscillations due to:
- operation of the pressure pump,
- opening of the injectors.

The fuel pressure sensor is fitted at the centre of the delivery manifold.
The high-pressure hydraulic connections (between manifold - pump and manifold - injectors) are made through steel pipes with an inside diameter of 2 mm and an outside diameter of 6 mm.

REMOVAL/REFITTING

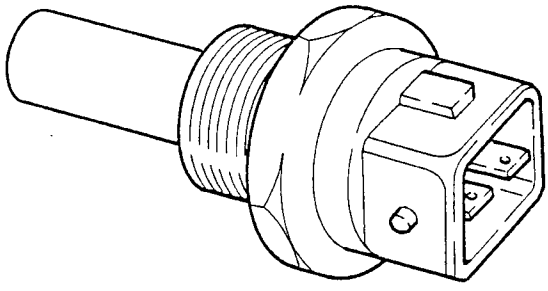
- Make sure that the ignition key is in the «STOP» position, then disconnect the battery (-) terminal.
- Remove the pipes from the fuel manifold to the injectors (see specific procedure).

1. Disconnect the electrical connection from the fuel temperature sensor.
2. Slacken the manifold side coupling of the pipe from pressure pump to fuel manifold using tool no. 1.870.671.000.
3. Slacken the pressure pump side coupling of the delivery pipe from the pressure pump to the manifold using a suitable wrench.
4. Remove the fuel delivery pipe from the pressure pump to the single fuel manifold pipe.
5. Slacken the nuts and remove the fuel delivery manifold.

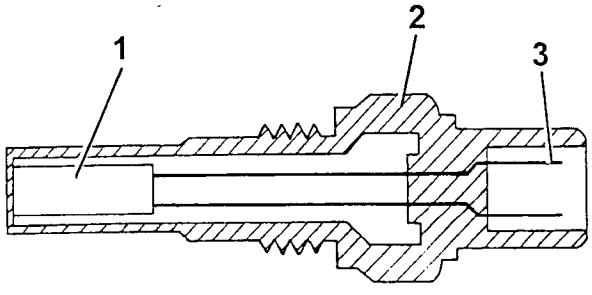


FUEL TEMPERATURE SENSOR

This is fitted on the return manifold and detects the temperature of the fuel through an NTC thermistor with a negative resistance coefficient.



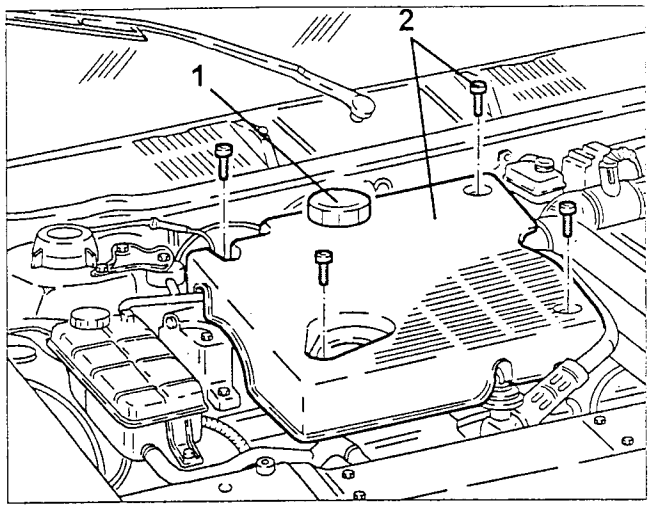
The sensor is made with semi-conductor technology; therefore, if the temperature of the sensor increases as the fuel temperature increases, the resistance rating lowers.
As the change in resistance is not linear, with the same increase in temperature, it is higher for low temperatures than for higher ones.



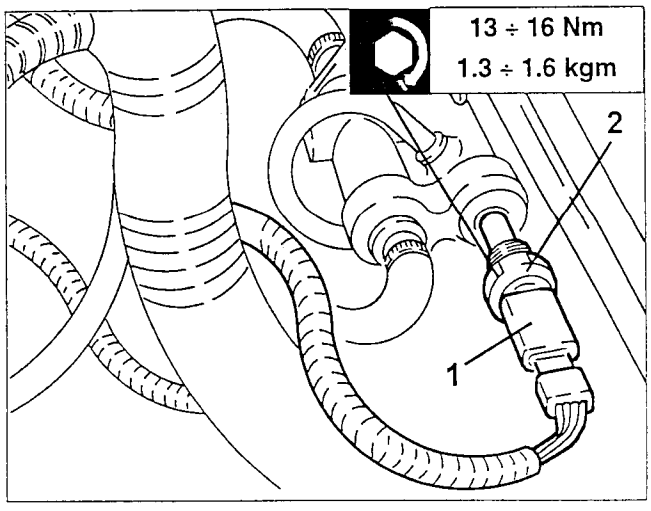
1. Resistance
2. Sensor body
3. Supply connector

REMOVAL/REFITTING

- Make sure that the ignition key is in the «STOP» position, then disconnect the battery (-) terminal.
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.

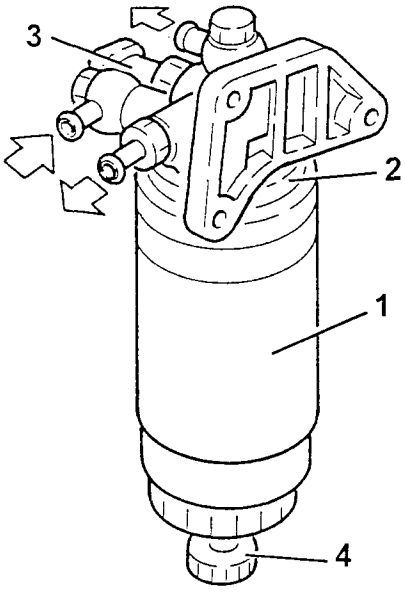


1. Disconnect the electrical connection from the fuel temperature sensor.
2. Slacken and remove the fuel temperature sensor from the fuel return manifold pipe.



FUEL FILTER

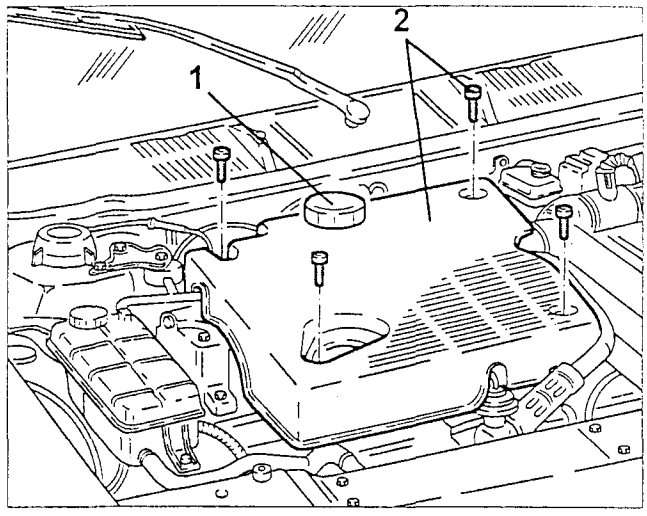
The fuel filter is installed in the engine compartment on the bulkhead.
It is of the cartridge type with a filtering element (1) formed of a pack of paper disks with a filtering surface of 5300 cm^2 and a filtering power of 4 ÷ 5 µm.
The filter is fitted with a fuel pre-heating device (2) controlled by a thermal switch (3) fitted on the filter itself.
When the fuel temperature is below 6 °C an electrical resistance heats it up to a maximum of 15 °C before sending it to the pressure pump.
At the base of the fuel filter cartridge there is a cap (4) for draining the water in the filter.



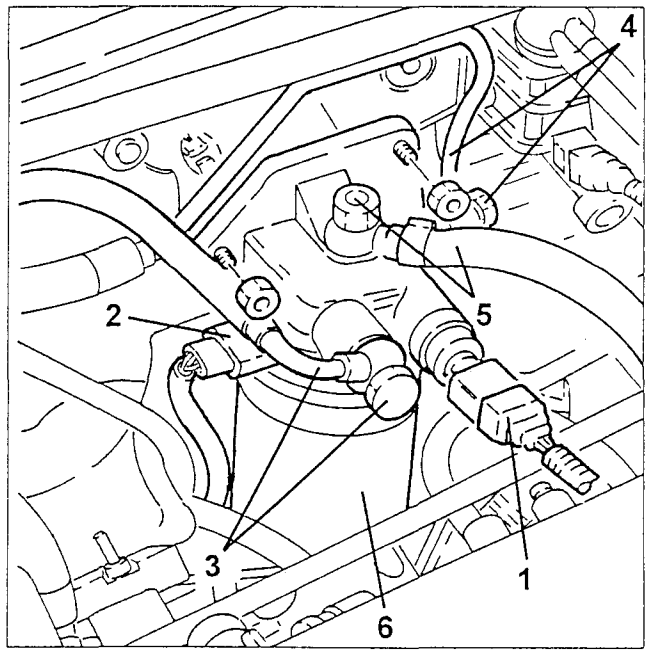
1. Filtering element
2. Fuel pre-heating device
3. Thermal switch
4. Water drain cap

REMOVAL/REFITTING

- Make sure that the ignition key is in the «STOP» position, then disconnect the battery (-) terminal.
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.



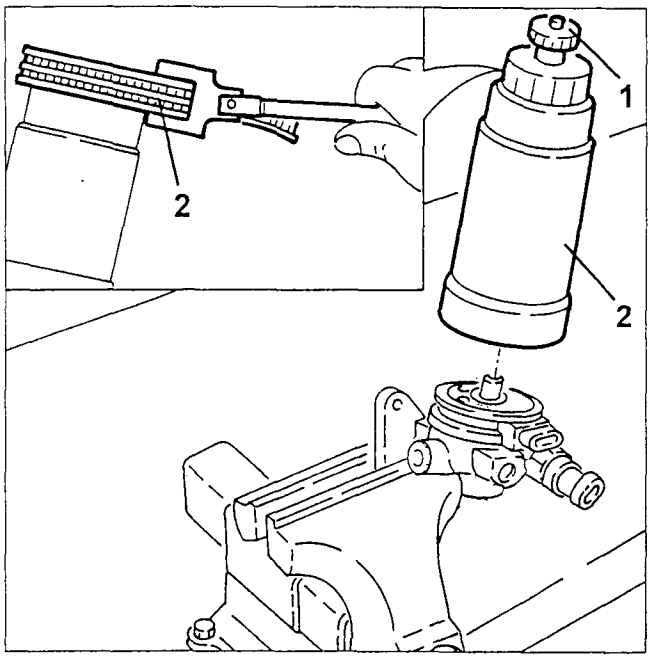
1. Disconnect the electrical connection from the fuel heater thermal switch.
2. Disconnect the electrical connection from the fuel pre-heating device.
3. Slacken the coupling and disconnect the fuel delivery pipe from the fuel filter.
4. Slacken the coupling and disconnect the delivery pipe to the pressure pump from the fuel filter.
5. Slacken the coupling and disconnect the delivery pipe to the return manifold from the fuel filter.
6. Slacken the fastening nuts and remove the fuel filter complete.

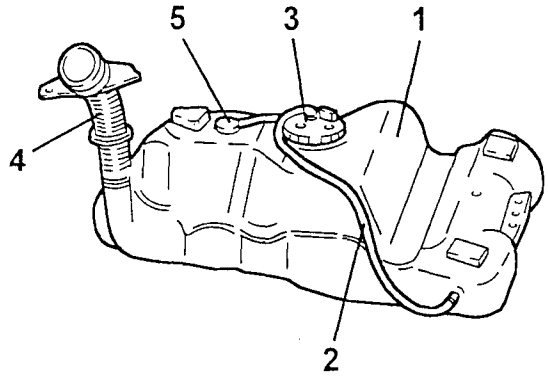


- Put the fuel filter in a vice clamp with protective jaws.

1. Remove the water drain cap from the fuel filter.
2. Slacken and remove the fuel filter filtering element using a suitable tool.

WARNING: When refitting tighten the filtering element completely by hand.





1. Fuel tank
2. Breather pipe between the lower and upper part of the tank
3. Submerged pump assembly complete with level gauge control
4. Fuel filter
5. Multi-function valve

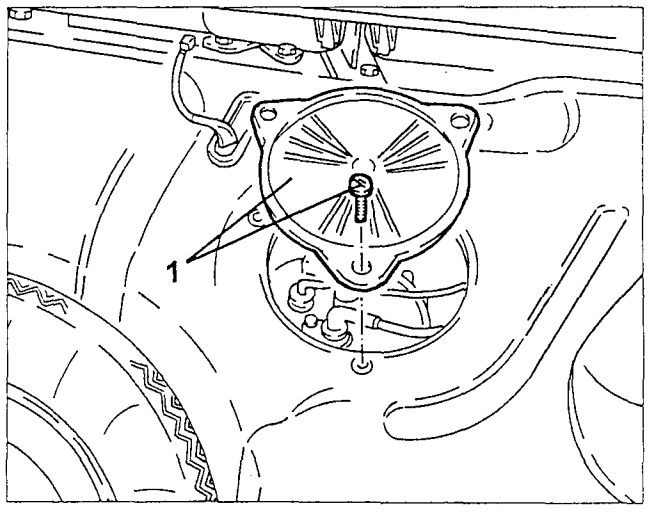
FUEL TANK

The fuel tank is made of plastic and has a capacity of about 61 litres, including a reserve of approx. 5 ÷ 8 litres.
The fuel filler is on the main body and the fuel cap has a special closing system which prevents it from being closed above the specified torque (locking above the foreseen value is prevented by a snap device).
The fuel tank is fastened under the body in correspondence with the boot surface and the rear - seat, its shape is designed so as not to interfere with the with the rear suspension axle.
The particular shape of the fuel tank requires the presence of a pipe to vent the air in the upper part when refuelling.
In the upper part the tank has apertures for housing the submerged pump assembly complete with level gauge control and multi-function valve.

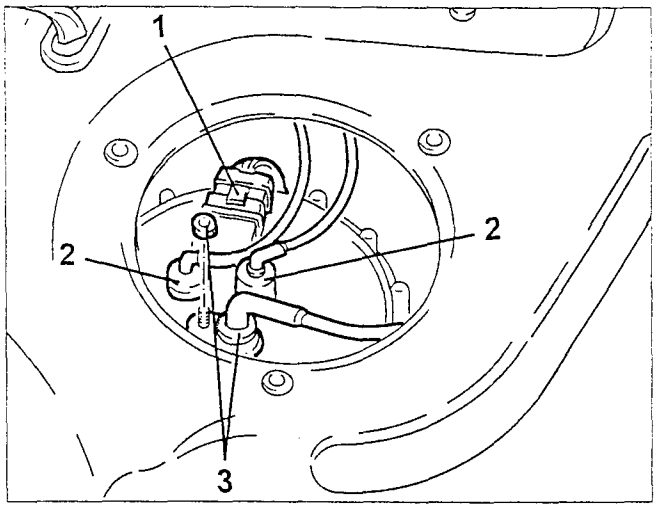
REMOVAL/REFITTING

- Set the car on a lift.
- Make sure that the ignition key is in the «STOP» position, then disconnect the battery (-) terminal.
- Siphon the fuel from the tank using suitable equipment.
- Remove the right rear wheel.
- Working from the boot, tilt the rear seat back and move aside the trim.

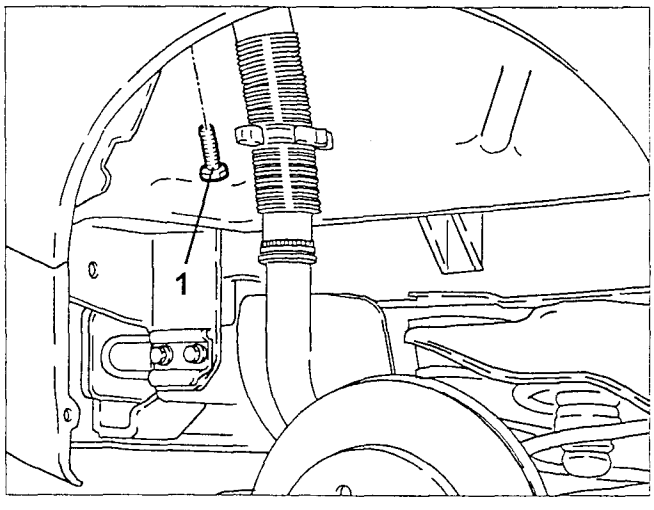
1. Slacken the fastening screws and remove the lid for access to the submerged pump assembly complete with level gauge control.



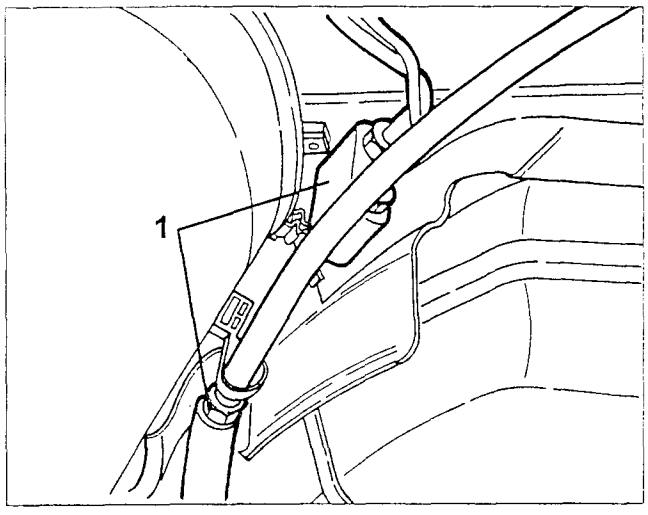
1. Disconnect the electrical connection from the submerged pump assembly complete with level gauge control.
2. Disconnect the quick couplings of the fuel delivery and return pipes from the submerged pump assembly complete with level gauge control.
3. Slacken the nut and disconnect the breather pipe between the lower and upper part of the tank.



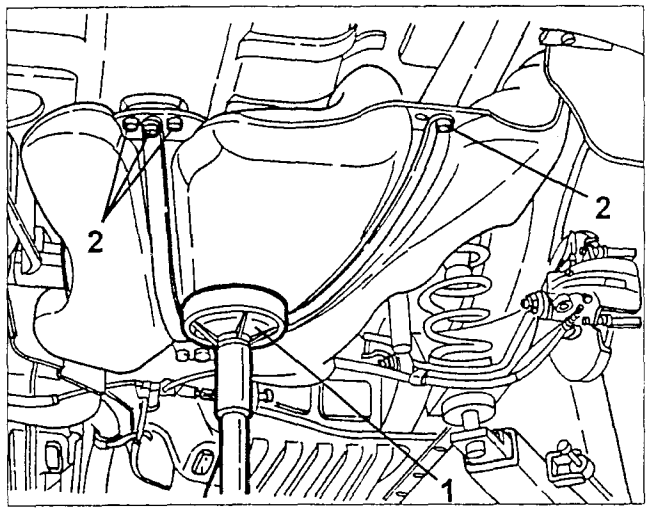
1. Working from the wheel arch, slacken the screw fastening the fuel filler to the body.



1. Release the handbrake cables and brake pipes from the fasteners on the tank.

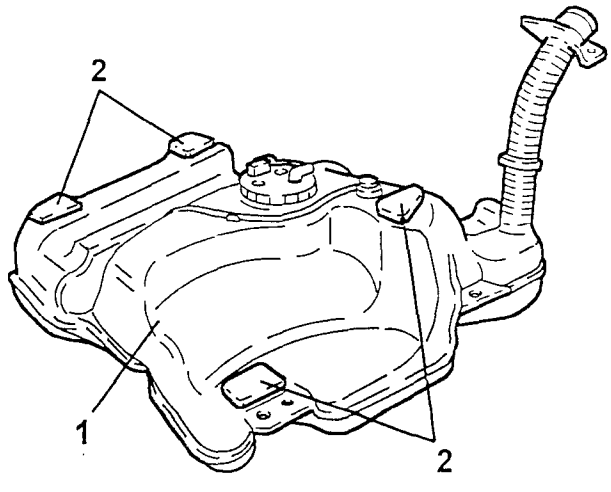


1. Set a hydraulic jack under the fuel tank.
2. Remove the plastic nails and slacken the fuel tank fastening screws.



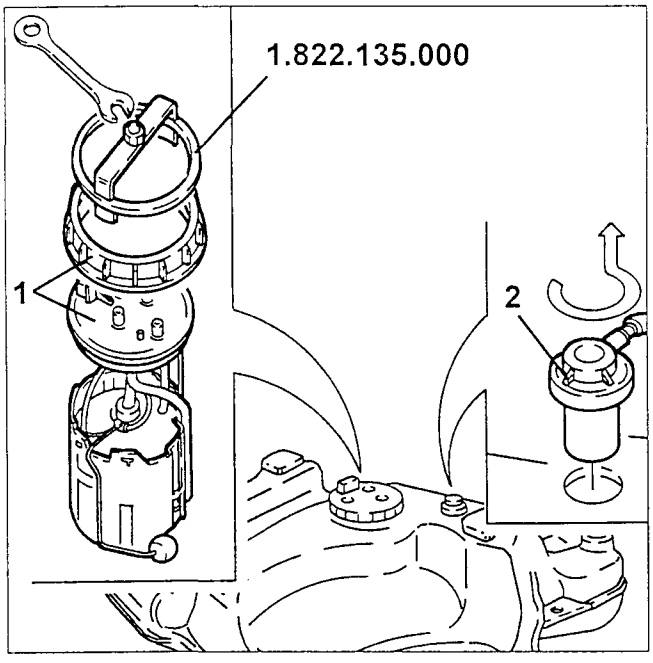
1. Lower the hydraulic jack and remove the fuel tank.

WARNING: When refitting the tank check for the presence on it of the rubber pads (2).



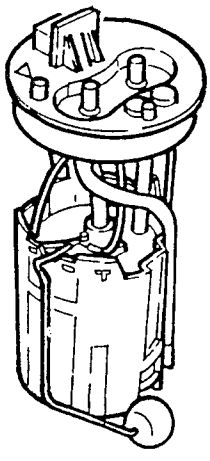
DISASSEMBLY/REASSEMBLY

1. Using tool no. 1.822.135.000, remove the lock ring, then withdraw the submerged pump assembly complete with level gauge control from the tank.
2. Remove the multi-function valve complete with pipe from the fuel tank.



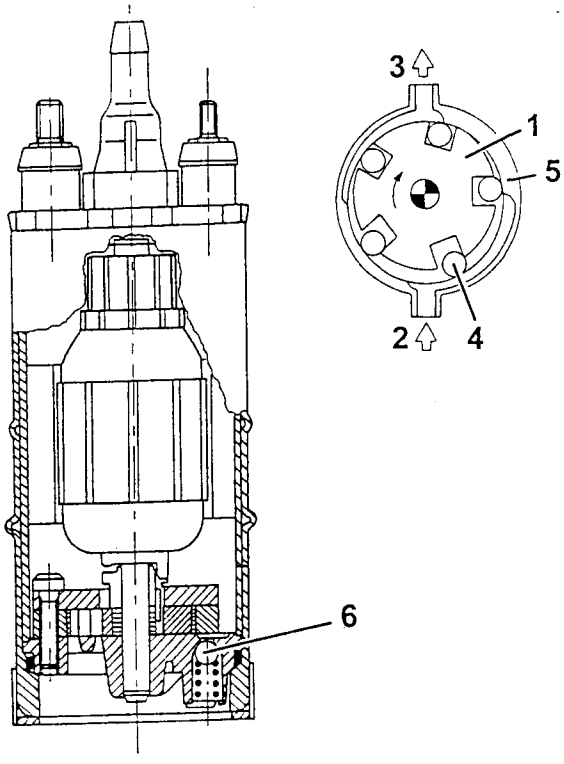
SUBMERGED PUMP ASSEMBLY COMPLETE WITH LEVEL GAUGE CONTROL

This mainly comprises:
- an electric pump of the type with pins
- a fuel level gauge
- a fuel filter.



ELECTRIC FUEL PUMP

The electric pump submerged in the fuel is of the volumetric type with pins, with motor with brushes and with permanent magnet energising.
The impeller (1) turns, drawn by the motor, creating volumes which move from the inlet port (2) to the delivery port (3).
These volumes are delineated by the pins (4) which adhere to the outer ring (5) while the motor turns.
The pump is fitted with two valves, a non-return one to prevent the fuel circuit from emptying (with pump stopped) and the second one is an overpressure valve (6), which re-circulates delivery with the intake when the pressure exceeds 5 bar.

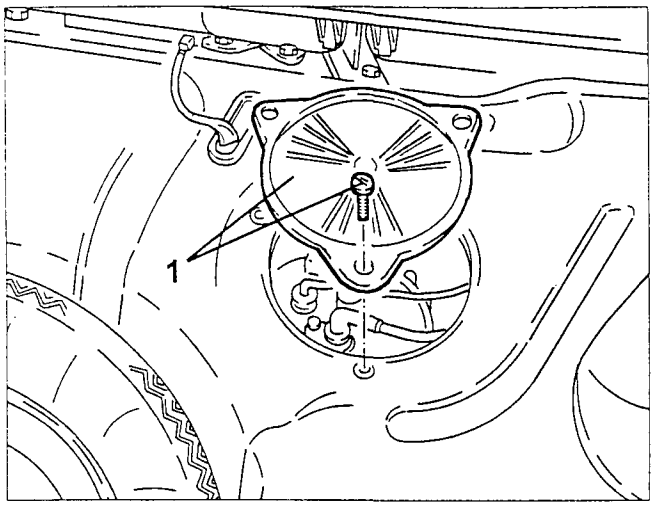


1. Impeller
2. Intake port
3. Delivery port
4. Pins
5. Outer ring
6. Overpressure valve

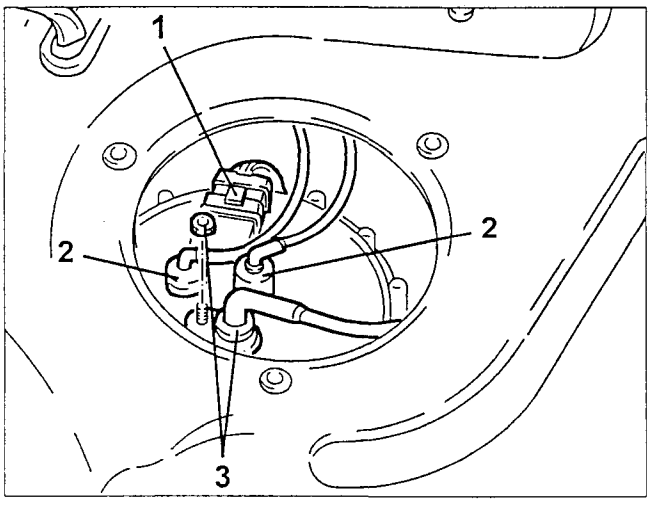
REMOVAL/REFITTING

- Make sure that the ignition key is in the «STOP» position, then disconnect the battery (-) terminal.
- Working from the boot, tilt the rear seat back and move aside the trim.

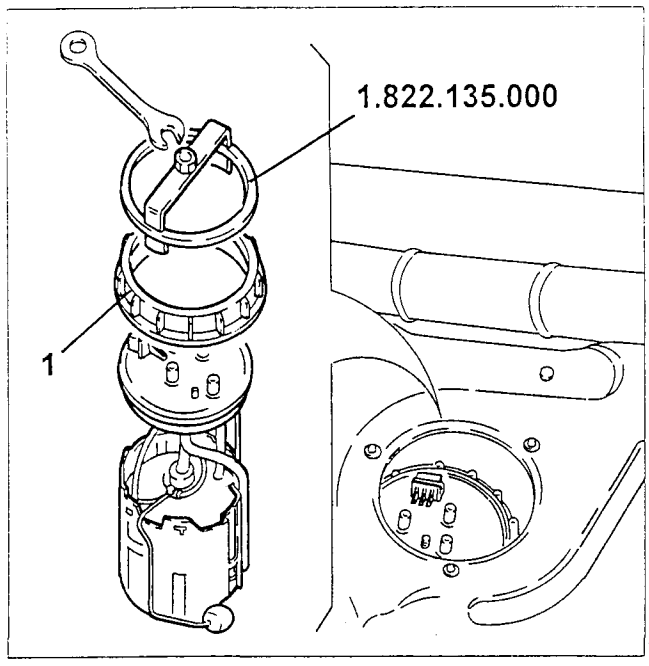
1. Slacken the fastening screws e remove the lid for access to the submerged pump assembly complete with level gauge control.



1. Disconnect the electrical connection from the submerged pump assembly complete with level gauge control.
2. Disconnect the quick couplings of the fuel delivery and return pipes from the submerged pump assembly complete with level gauge control.
3. Slacken the nut and disconnect the breather pipe between the lower and upper part of the tank.

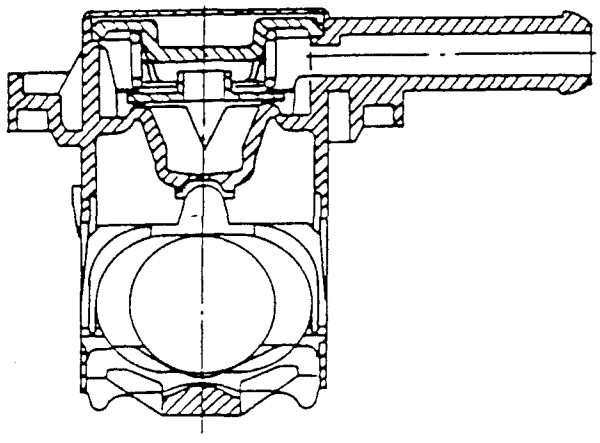


1. Using tool no. 1.822.135.000, remove the lock ring, then withdraw the submerged pump assembly complete with level gauge control from the fuel tank.



MULTI-FUNCTION VALVE

The functions of this valve are the following:
- pressurising the fuel tank
- retaining
- tightness in the event of overturning.



FUEL TANK PRESSURISING

The fuel tank is kept under pressure between 55 ÷ 75 mbar using a fluoro-silicone rubber valve resting on a sealing edge.
The valve is supported with a stainless steel plate countered by a spring.
When the pressure in the tank exceeds the specified limit, it overcomes the resistance of the spring and allows the valve to rise, thereby allowing the vapours through to the atmosphere.

The valve closes again when the pressure returns within limits.

RETAINING

In particular vehicle operating conditions, a vacuum can be created inside the fuel tank due to the effect of:
- changes in temperature
- fuel consumption.

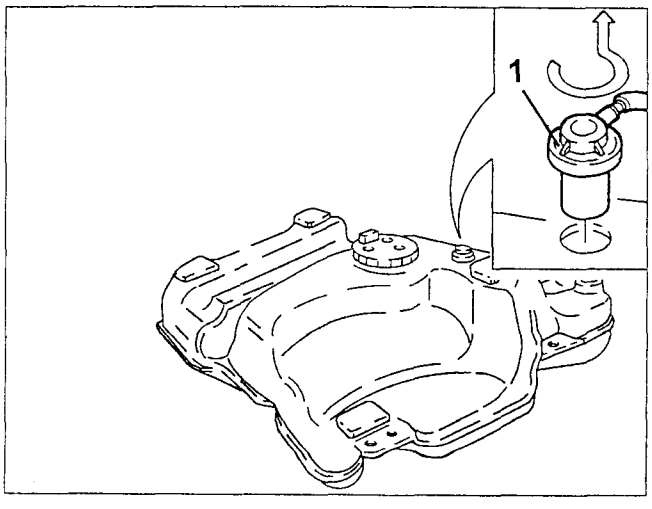
In this case, the function of the valve is to restore the pressure in the tank by admitting air.
A possible fault of this function may cause "sawing" or vehicle stoppage, because of the difficulty in supplying the electric pump.
This function is carried out directly by the goose-necked valve made directly on the fluorine-silicone rubber.

SEALING IN THE CASE OF OVERTURNING (ROLL-OVER)

This function is to prevent fuel from spilling from the tank if the vehicle is overturned or sloped heavily.
During normal operation of the vehicle (bends, acceleration, braking, etc.) the fuel is shaken and could spill to the canister.
The high degree of sensitivity of the roll-over prevents this from occurring.
The roll-over closing angle is below 33°.

REMOVAL/REFITTING

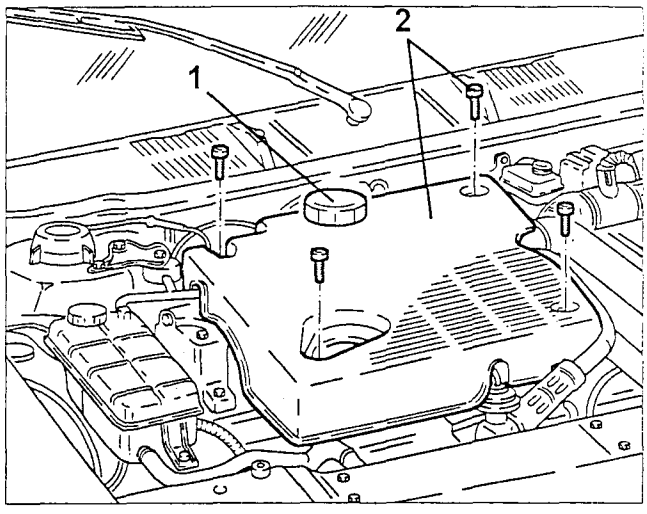
- Remove the fuel tank (see specific procedure).
1. Remove the multi-function valve complete with pipe from the fuel tank.



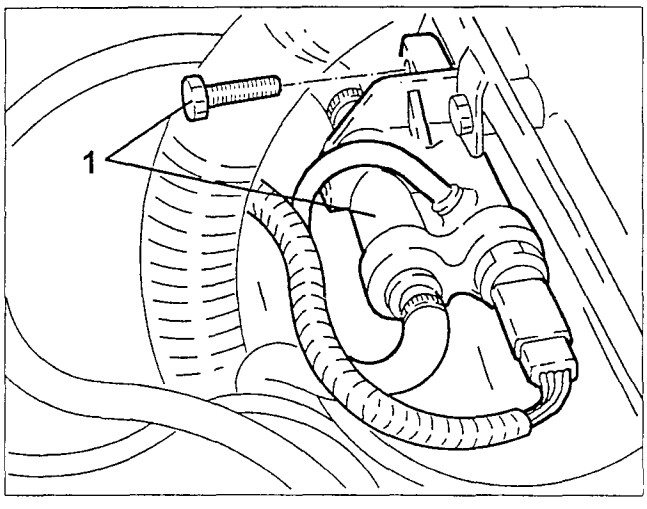
PIPE FROM PRESSURE PUMP TO FUEL MANIFOLD

REMOVAL/REFITTING

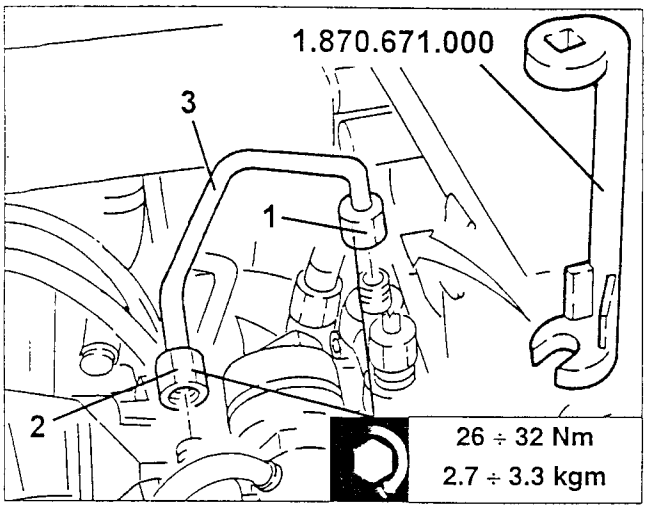
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
3. Refit the engine oil filler cap.



1. Slacken the screws and move aside the fuel return manifold pipe.



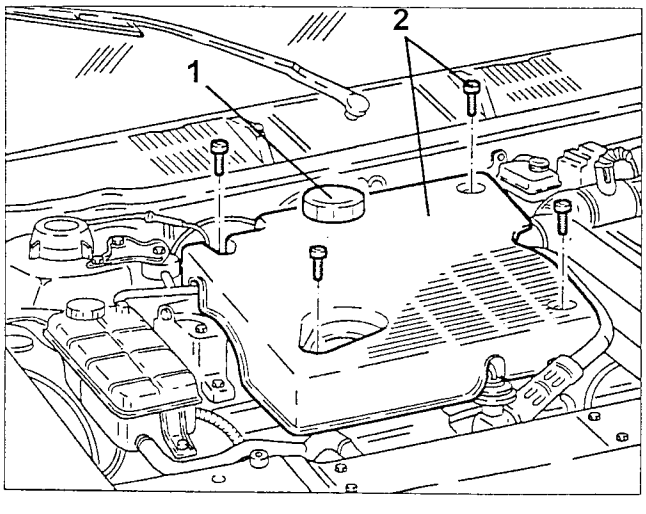
1. Slacken the manifold side coupling of the pipe from the pressure pump to the fuel manifold using tool no. 1.870.671.000.
2. Slacken the pressure pump side coupling of the delivery pipe from the pressure pump to the manifold using a suitable wrench.
3. Remove the fuel delivery pipe from the pressure pump to the single fuel manifold pipe.



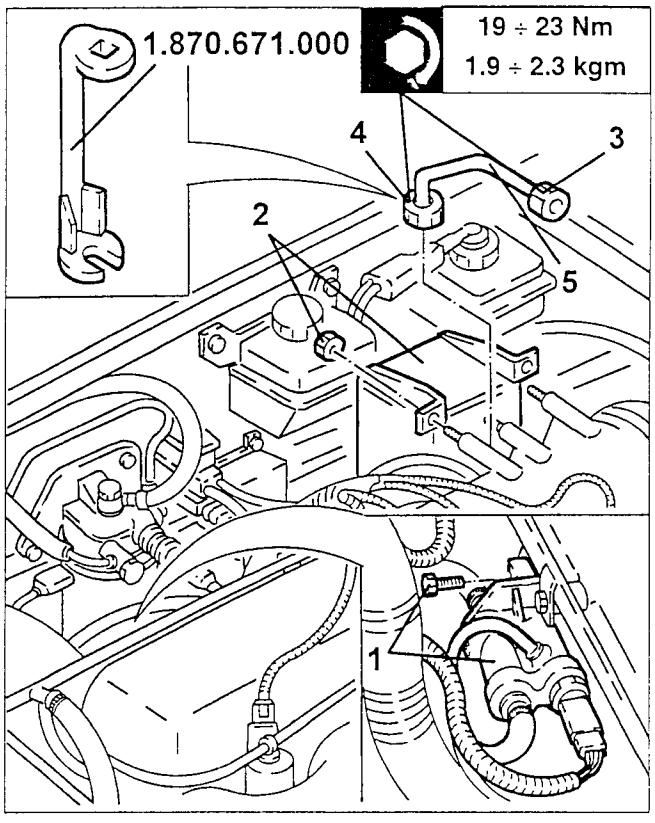
PIPES FROM FUEL MANIFOLD TO INJECTORS

REMOVAL/REFITTING

1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.



1. Slacken the screws and move aside the complete fuel return manifold pipe.
2. Slacken the nuts and move the oil vapour separator.
3. Slacken the injector side coupling of the pipes from the pipes for the fuel manifold to the injectors using a suitable wrench.
4. Slacken the manifold side coupling of the pipes from the pipes for the fuel manifold to the injectors of the pipes from the pipes for the fuel manifold to the injectors using tool no. 1.870.671.000.
5. Remove the fuel delivery pipes from the single fuel manifold to the injectors.

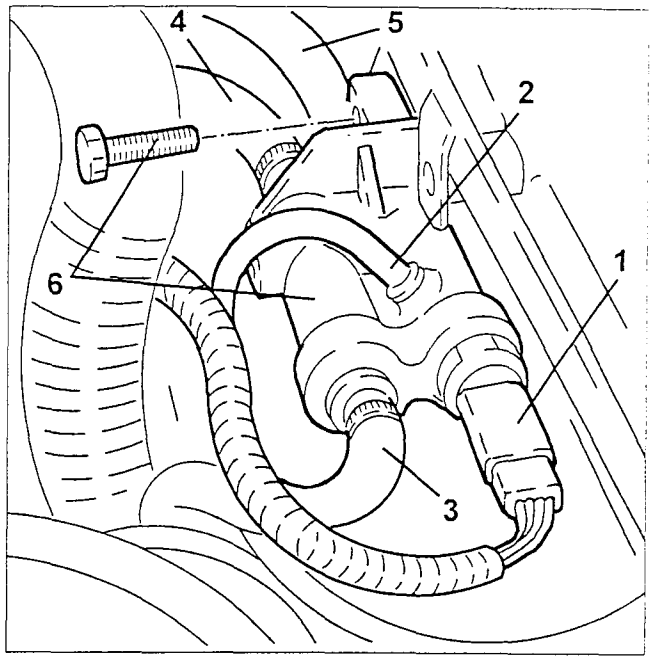


FUEL RETURN MANIFOLD

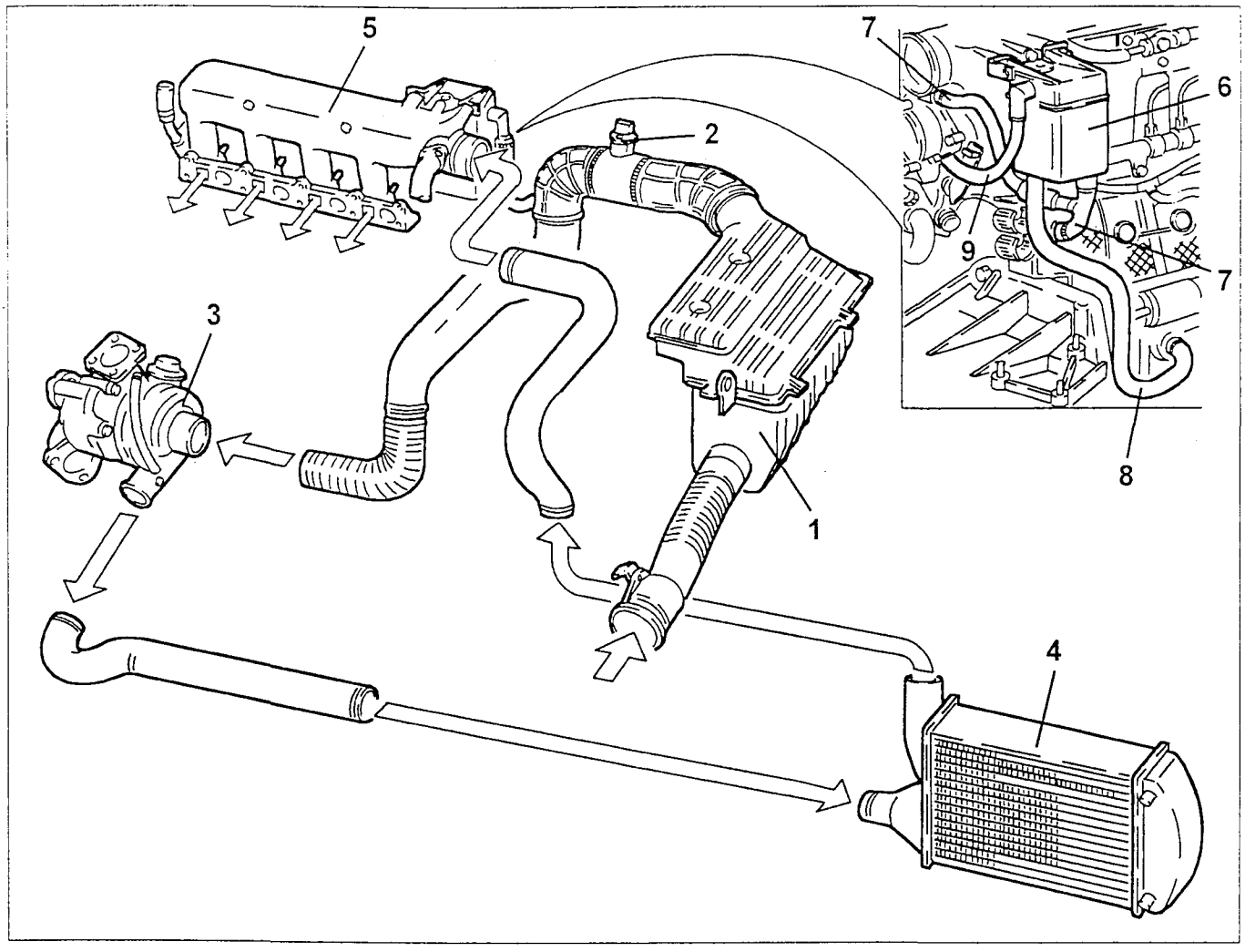
REMOVAL/REFITTING

- Remove the engine oil filler cap.
- Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.

1. Disconnect the electrical connection from the fuel temperature sensor.
2. Disconnect the fuel return pipe from the injectors from the fuel return manifold pipe.
3. Disconnect the fuel return pipe from the pressure pump from the fuel return manifold pipe.
4. Disconnect the fuel return pipe to the tank from the fuel return manifold pipe.
5. Disconnect the fuel return pipe from the fuel filter from the fuel return manifold pipe.
6. Slacken the screws and remove the fuel return manifold pipe.



DESCRIPTION OF AIR SUPERCHARGING AND OIL VAPOUR RE-CIRCULATION SYSTEM



1. Air cleaner complete
2. Air flow meter
3. Turbocharger
4. Air-air heat exchanger
5. Intake box
6. Oil vapour separator
7. Oil vapour recovery pipes
8. Condensed oil recovery pipe
9. Oil vapour re-circulation pipes

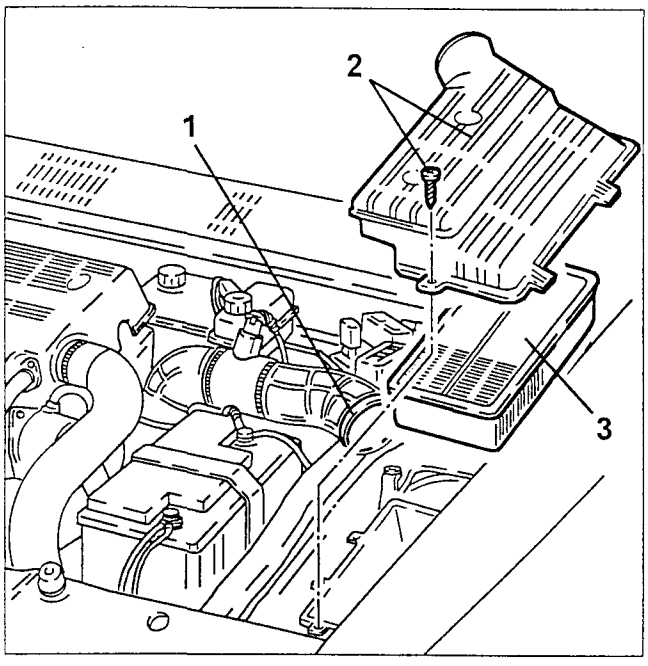
The air taken in through a dynamic inlet and filtered through a cartridge element reaches the turbocharger (3) from which it is sent under pressure to the intercooler (4).
Here, the air is cooled by an air - air heat exchanger and sent to the intake box from which it is sent to the cylinders.
Oil vapour emissions are controlled by a separator (6) which collects the vapours released from the crankcase cylinder head with pipes (7).

The difference in temperature between the separator and the oil vapours causes partial condensation.
The condensed vapours are sent to the crankcase through pipe (8).
The remaining vapours are sent to the turbocharger air intake sleeve through pipe (9).
For details of the single components, see the following paragraphs.

AIR CLEANER

CHANGING THE AIR CLEANER CARTRIDGE

1. Slacken the clamp fastening the corrugated sleeve to the air cleaner cover.
2. Slacken the fastening screws and remove the air cleaner cover.
3. Remove the air cleaner cartridge.



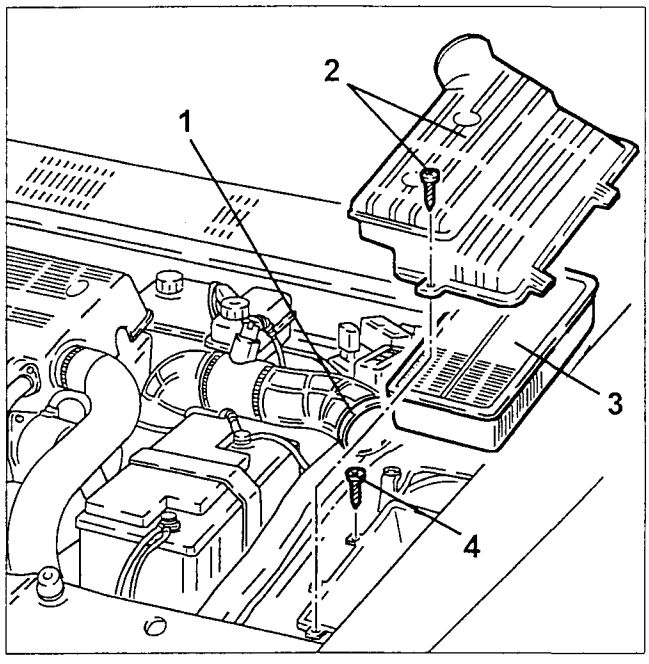
WARNING: Any attempt to clean the cleaner may damage it, risking compromising correct operation of the supply system.

- Carefully clean the air cleaner cartridge container.
- Check the conditions of the cartridge and, if necessary, replace it.
- Assemble the air cleaner cover and fasten it with its screws.
- Tighten the clamp fastening the corrugated sleeve to the air cleaner cover.

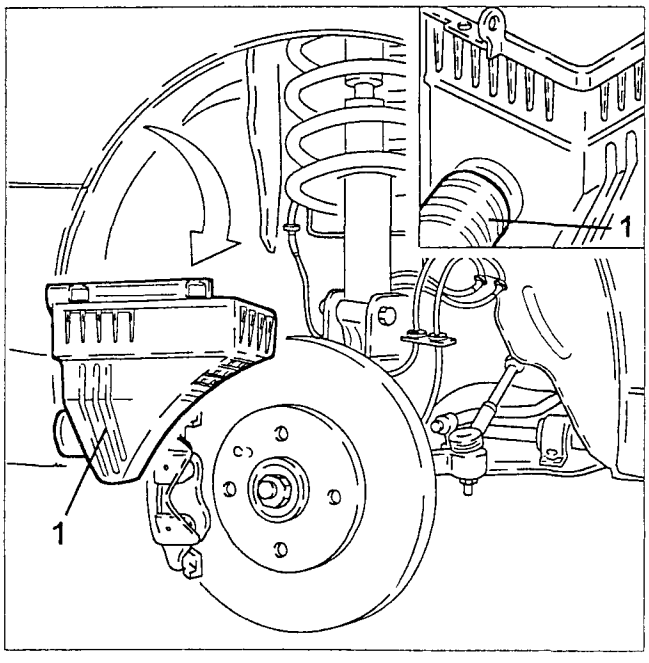
REMOVAL/REFITTING

- Set the car on a lift.
- Remove the left front wheel, dust guard and wheel arch.

1. Slacken the clamp fastening the corrugated sleeve to the air cleaner cover.
2. Slacken the fastening screws and remove the air cleaner cover.
3. Remove the air cleaner cartridge.
4. Slacken the fastening screws of the air cleaner box.

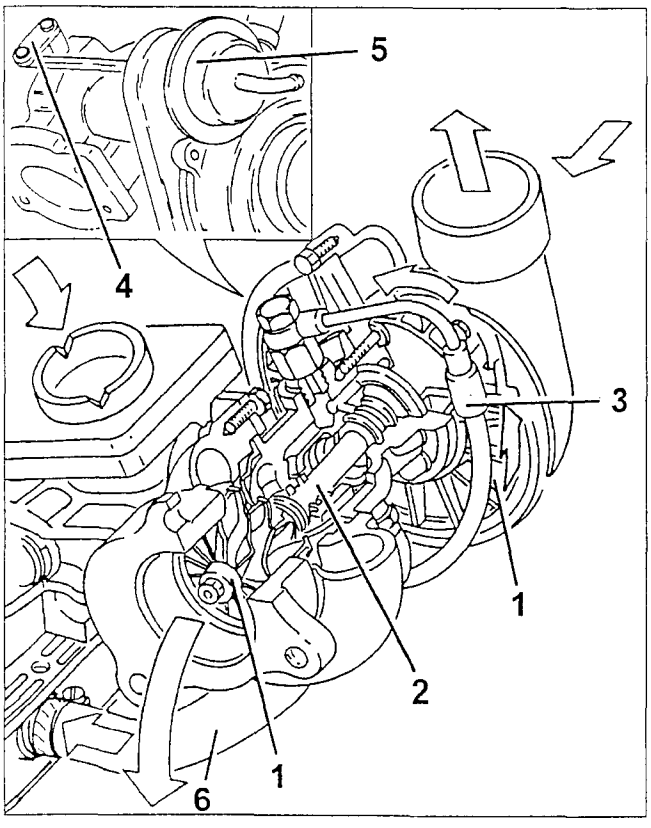


1. Remove the air cleaner box withdrawing it from the wheel arch after disconnecting it from the air inlet sleeve.



TURBOCHARGER

This mainly comprises two impellers (1) keyed onto the same shaft (2), which turns on floating bearings lubricated through a branch (3) of the engine lubricating circuit.
The oil used disperses part of the great amount of heat released to the turbine by the exhaust gas.
On the turbocharger a WASTE-GATE valve (4) is fitted which is controlled by a pneumatic actuator (5) which makes it possible to shutter the passage of exhaust gas to the turbine depending on the engine's need of power/torque.

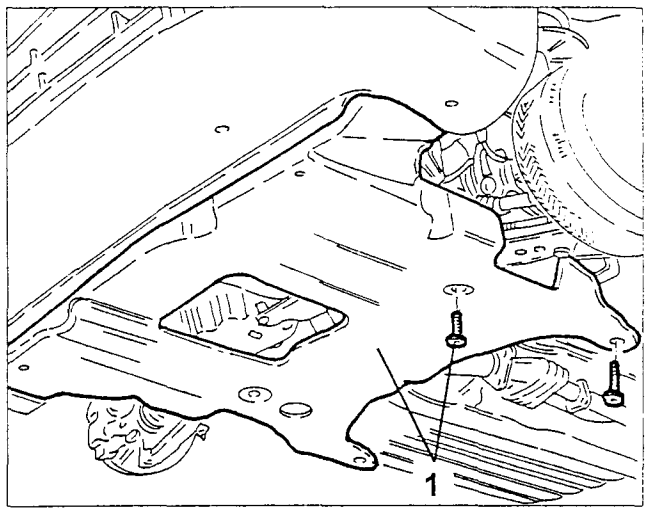


1. Impellers
2. Shaft
3. Oil delivery pipe to turbocharger
4. WASTE-GATE valve
5. Pneumatic actuator
6. Oil outlet pipe from turbocharger

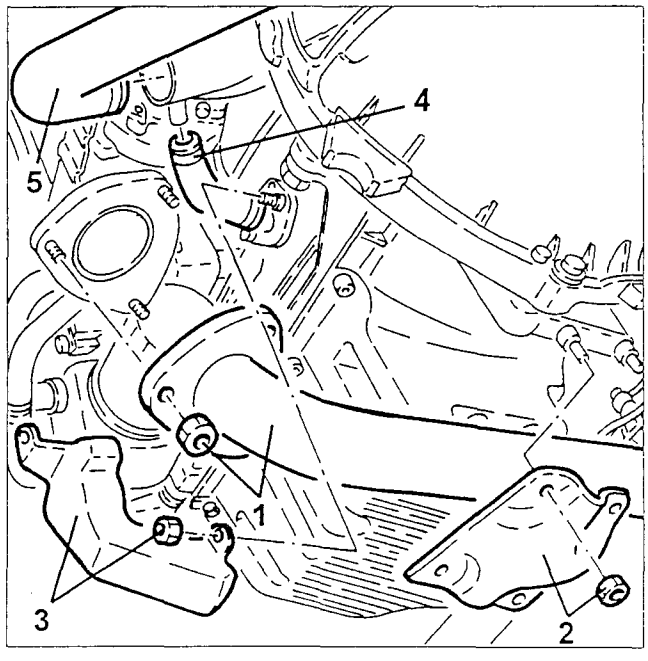
REMOVAL/REFITTING

- Set the car on a lift.
- Make sure that the ignition switch is at the "STOP", then disconnect the battery (-) terminal.

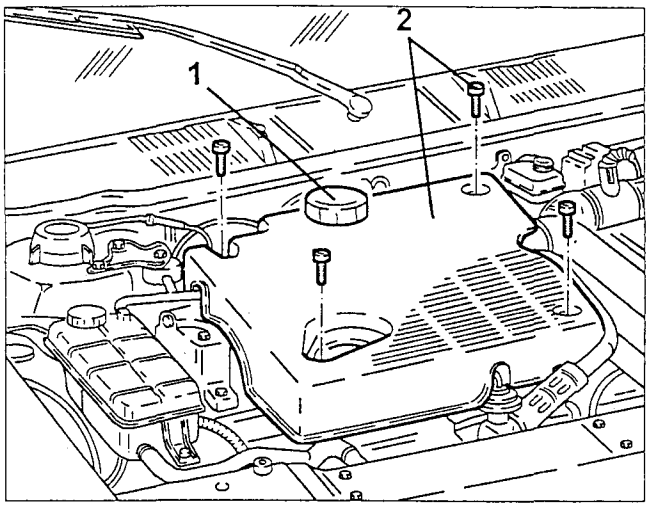
1. Slacken the fasteners and remove the under engine guard.



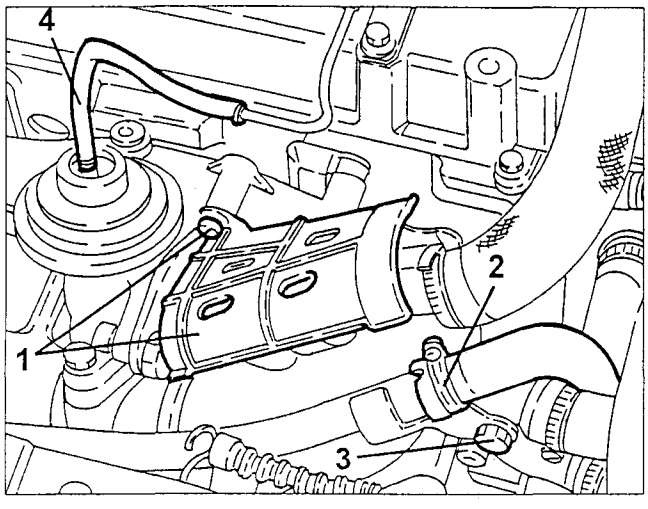
1. Slacken the nuts fastening the front section of the exhaust pipe to the exhaust manifold.
2. Slacken the fastening nuts and remove the reinforcement plate.
3. Slacken the fastening nuts and remove the guard of the oil outlet pipe from the turbocharger.
4. Disconnect the oil outlet pipe from the turbocharger.
5. Disconnect the air delivery sleeve to the heat exchanger at the turbocharger.



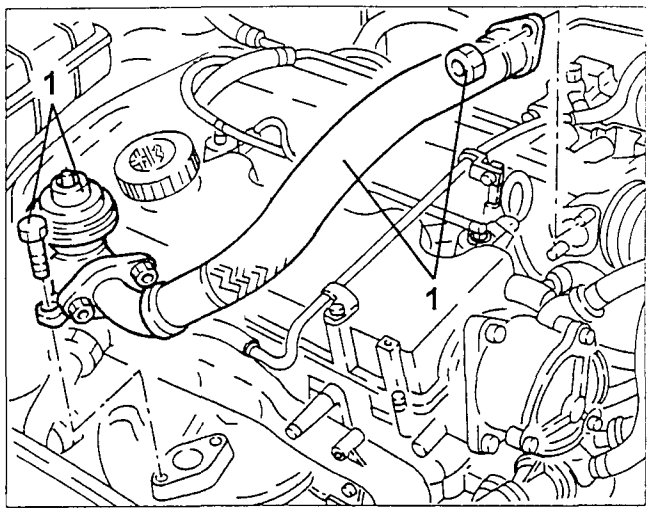
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.



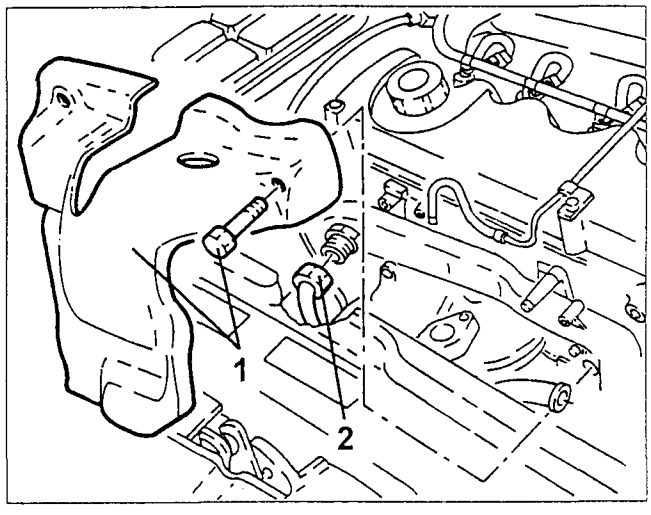
1. Slacken the fastening screws and remove the E.G.R. valve cover.
2. Disconnect the fluid delivery sleeve to the engine oil heat exchanger from the stiff pipe.
3. Slacken the fastening screw of the stiff coolant fluid delivery pipe to the engine oil heat exchanger.
4. Disconnect the vacuum pipe from the E.G.R. valve.



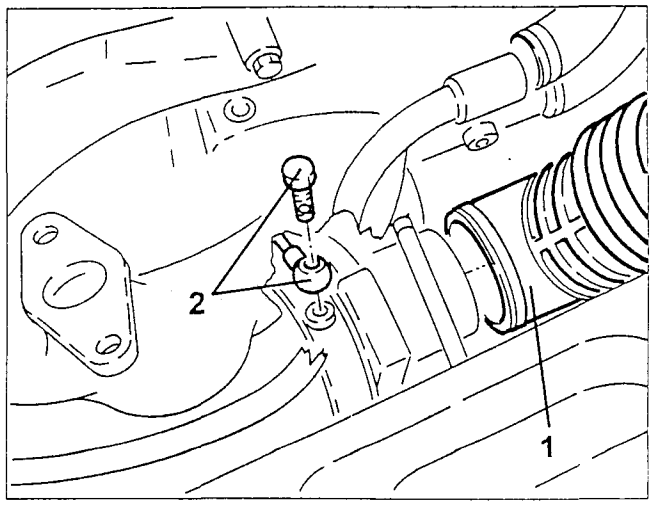
1. Slacken the nuts and screws and remove the E.G.R. valve complete with exhaust gas re-circulation pipe.
- Remove the seals.



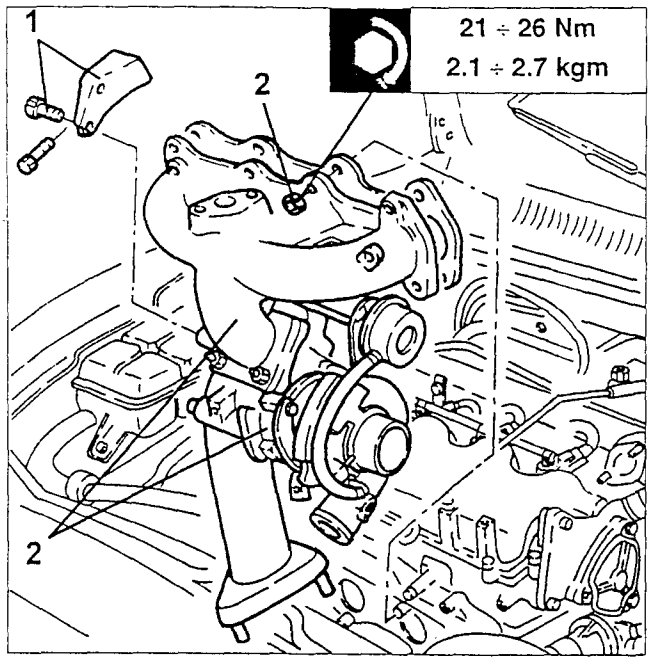
1. Slacken the fastening screws and remove the heat shield from the exhaust manifold.
2. Disconnect the engine oil heat exchanger outlet pipe from the stiff water pump inlet pipe.



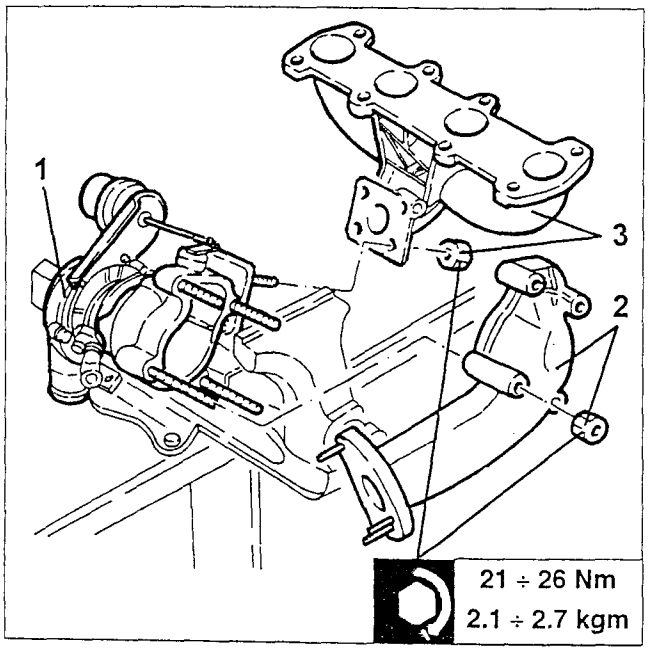
1. Disconnect the air inlet sleeve from the turbo-charger.
2. Slacken the coupling and disconnect the oil inlet pipe from the turbocharger.



1. Slacken the fastening screws and remove the bracket connecting the turbocharger to the crankcase.
2. Slacken the nuts and remove the turbocharger complete with exhaust manifold and exhaust pipe connection sleeve.

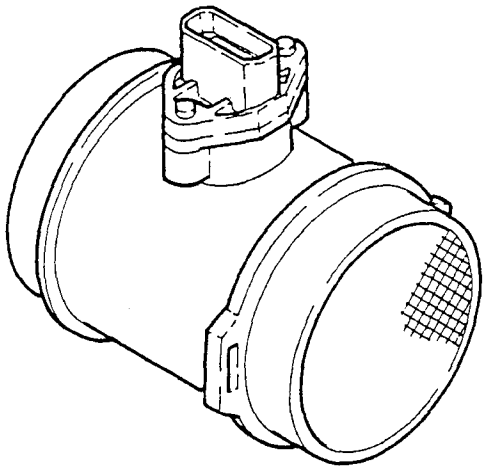


1. Put the turbocharger in a vice clamp on the bench.
2. Slacken the fastening nuts and remove the exhaust pipe connection sleeve.
3. Slacken the fastening nuts and separate the exhaust manifold from the turbocharger.

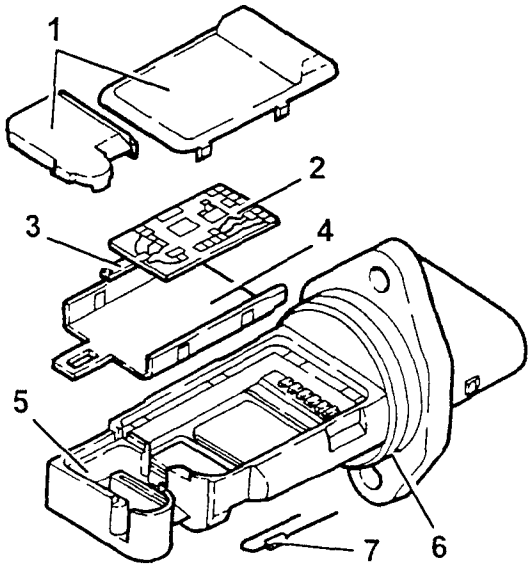


AIR FLOW METER

The air flow meter is located on the air intake sleeve and it is of the "heated film" type.



The intake air temperature sensor is incorporated in the air flow meter.



1. Covers
2. Electronic board
3. Sensor
4. Support plate
5. Support
6. O-Ring
7. Temperature sensor

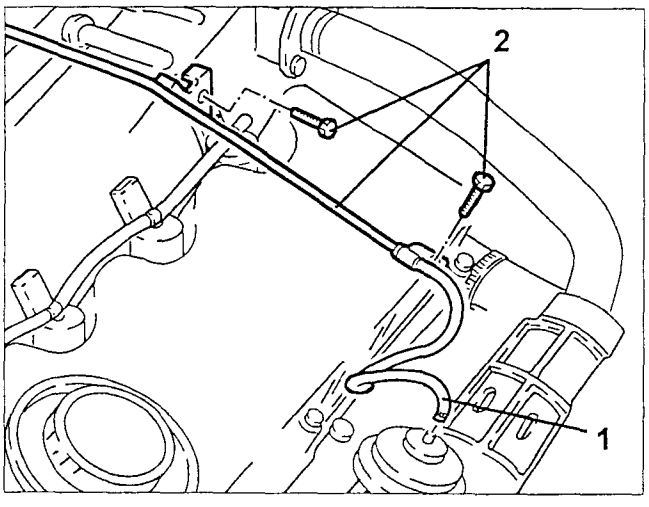
WARNING: The air flow meter cannot be disassembled.

The operating principle is based on a heated diaphragm interposed in a measurement channel through which the intake air that goes to the engine flows.
The hot film diaphragm is kept at a constant temperature (about 120 °C above the temperature of the incoming air) by the heating resistance.
The mass of air that crosses the measurement channel tends to withdraw heat from the diaphragm, therefore, to keep it at a constant temperature, a certain current must flow through the resistance.
This current is measured by a suitable Wheatstone bridge.
Therefore, the current is proportionate with the mass of flowing air.
The air flow meter directly measures the mass of air (not the volume) thereby eliminating problems of temperature, altitude, pressure, etc.

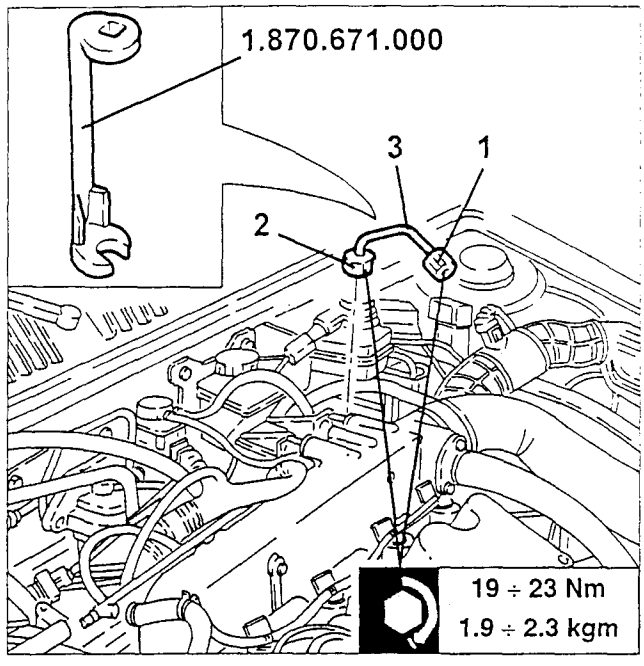
AIR BOX

REMOVAL/REFITTING

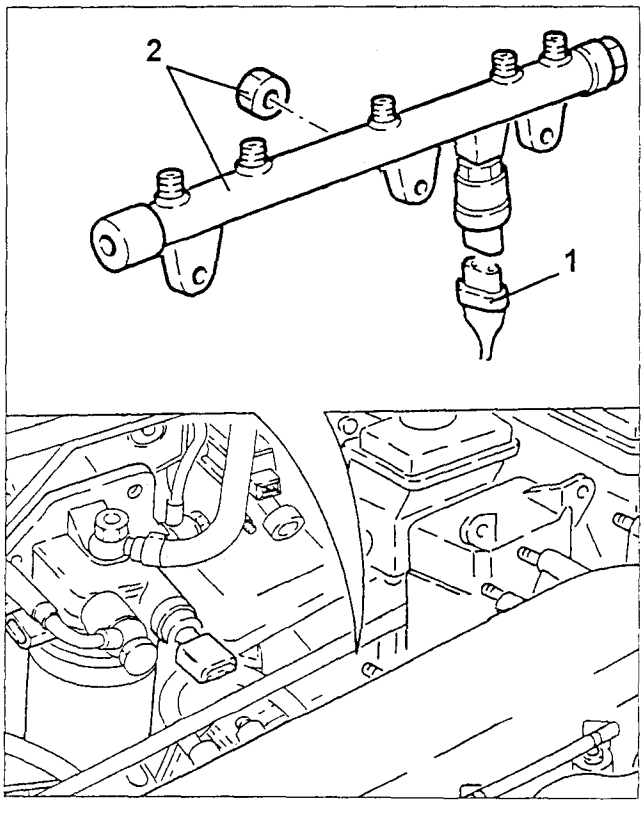
- Remove the pressure pump (see specific paragraph).
1. Disconnect the vacuum pipe from the E.G.R. valve.
2. Slacken the fastening screws and move aside the E.G.R. valve vacuum pipe.



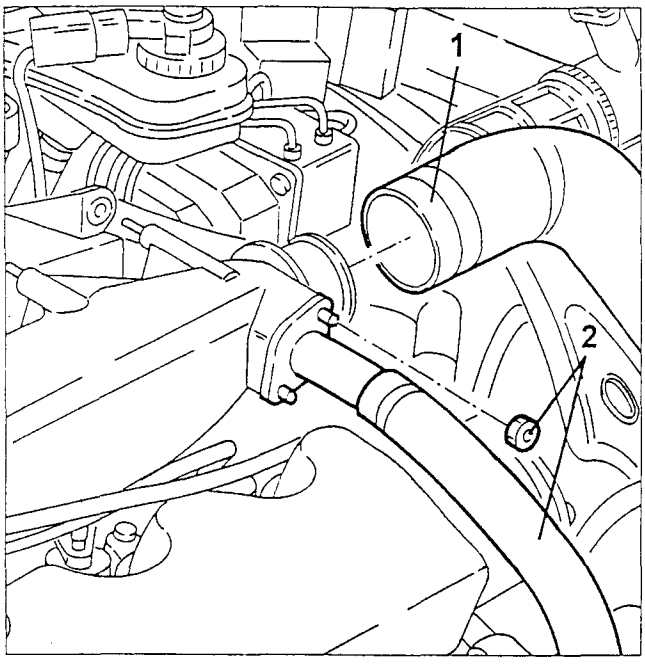
- Disconnect the electrical connections from the glow plugs.
1. Slacken the injector side coupling of the pipes from the fuel manifold to the injectors using a suitable wrench.
2. Slacken the manifold side coupling of the pipes from the fuel manifold to the injectors using tool no. 1.870.671.000.
3. Remove the fuel delivery pipes from the single fuel manifold to the injectors.



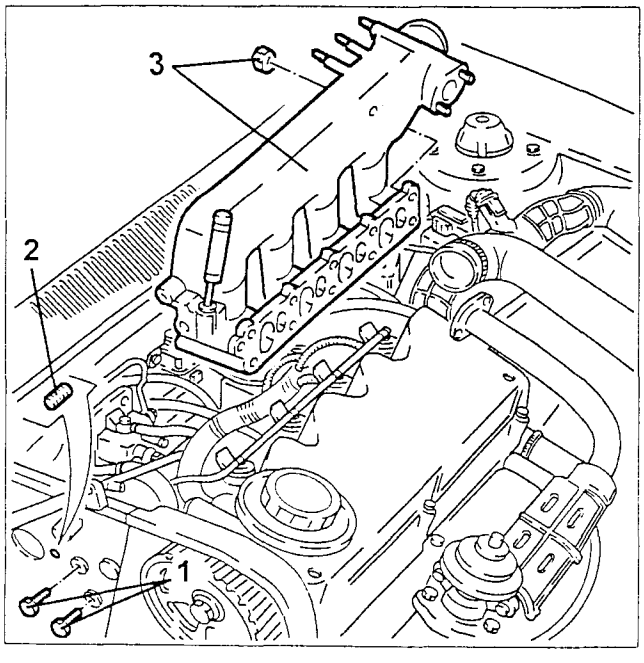
1. Disconnect the electrical connection from the fuel pressure sensor.
2. Slacken the fastening nuts and remove the fuel delivery manifold.



1. Disconnect the air inlet sleeve from the air box.
2. Slacken the nuts and disconnect the exhaust gas recovery pipe from the air box.



1. Slacken the screws fastening the pressure pump support to the air box.
2. Slacken the stud illustrated of the pressure pump support to aid removal of the air box.
3. Slacken the fastening nuts and remove the air box complete with seal.

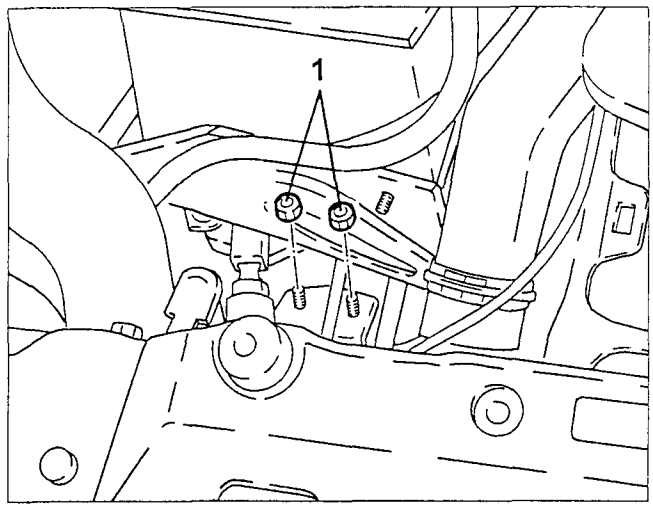


INTERCOOLER

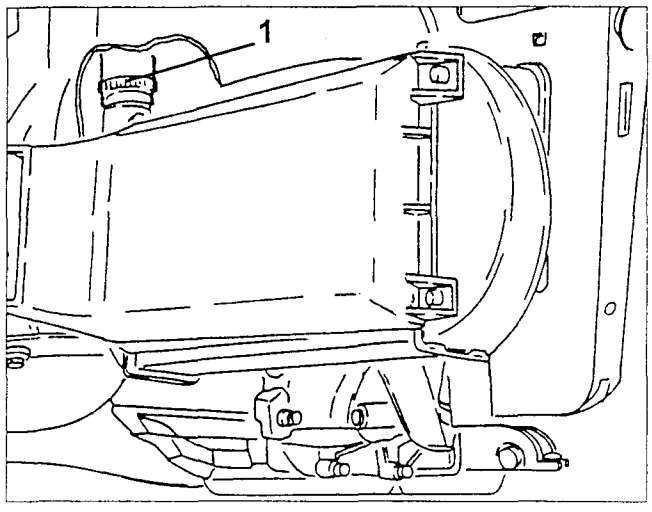
REMOVAL/REFITTING

- Set the car on a lift.
- Make sure that the ignition switch is in the "STOP" position, then disconnect the battery (-) terminal.

1. Slacken the nuts fastening the air conditioning system drier filter support.

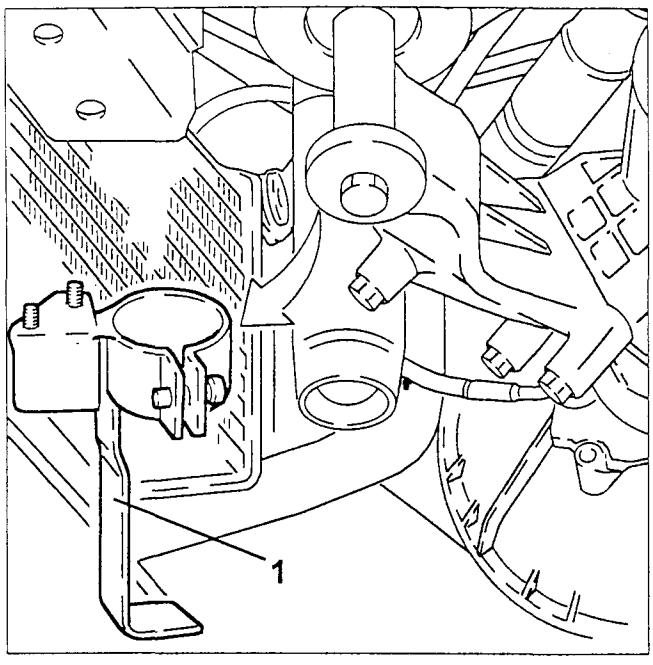


1. Loosen the clamp fastening the intercooler air outlet sleeve.

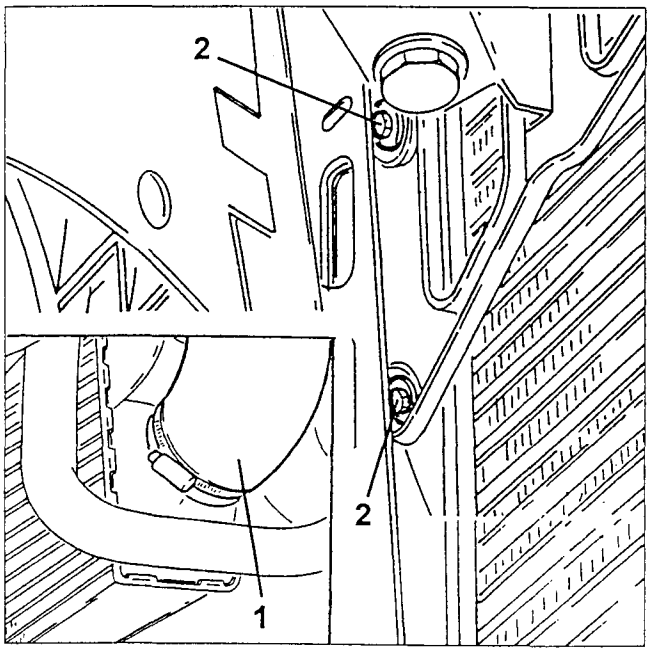


- Remove the front bumper (see specific paragraph).

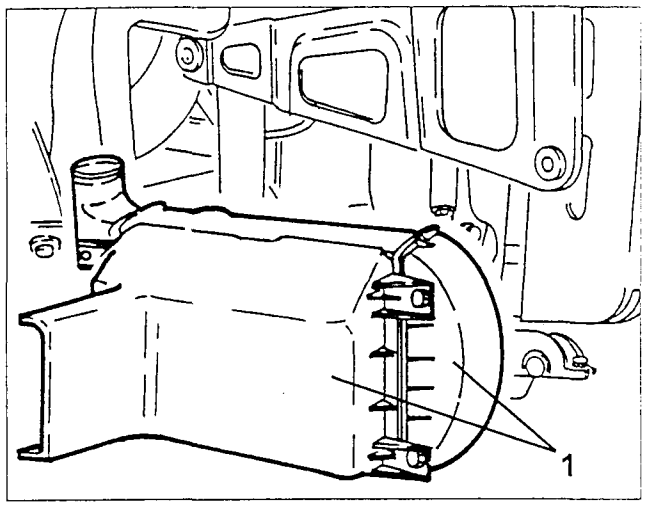
1. Loosen the screw and remove the air conditioning system drier filter support.



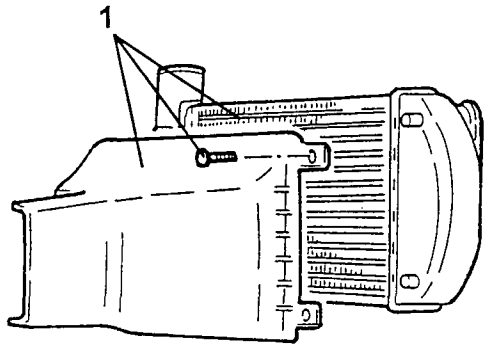
1. Loosen the clamp and disconnect the air inlet sleeve from the intercooler.
2. Slacken the screws fastening the intercooler to the support bracket.



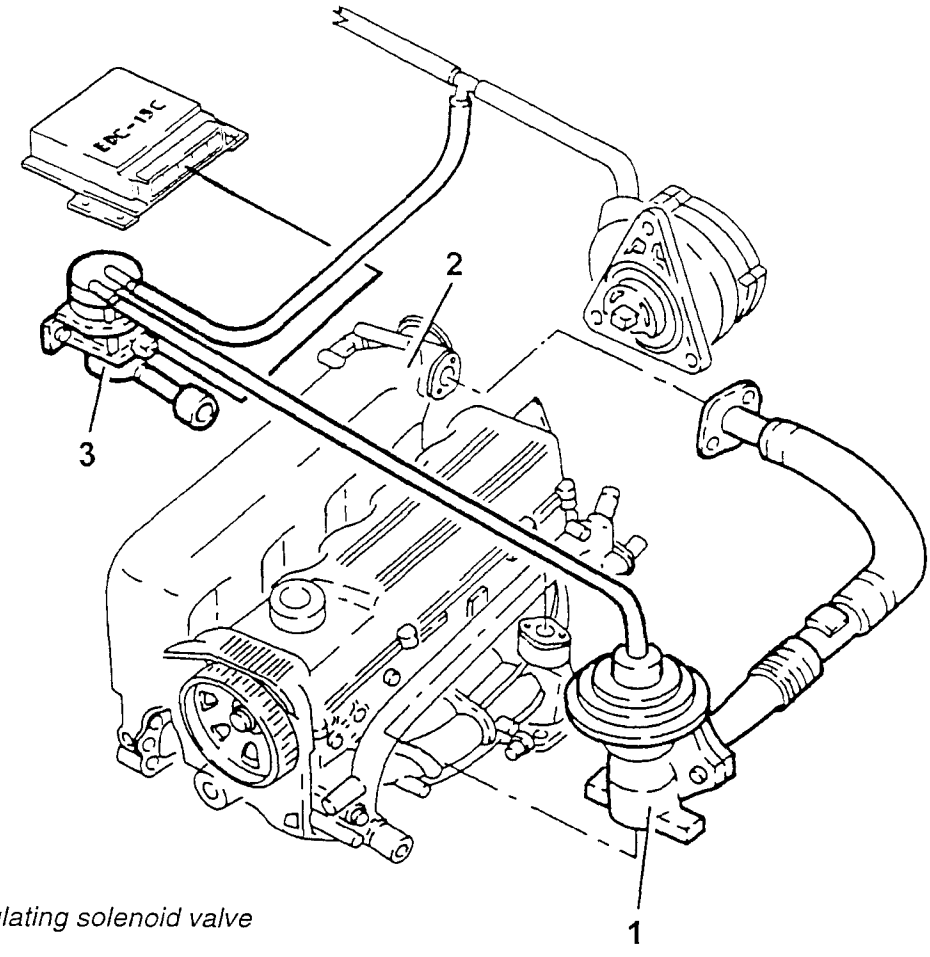
1. Remove the intercooler complete with air duct.



1. On the bench, slacken the fastening screws and separate the intercooler from the air duct.



DESCRIPTION OF EXHAUST GAS RE-CIRCULATION SYSTEM (E.G.R.)



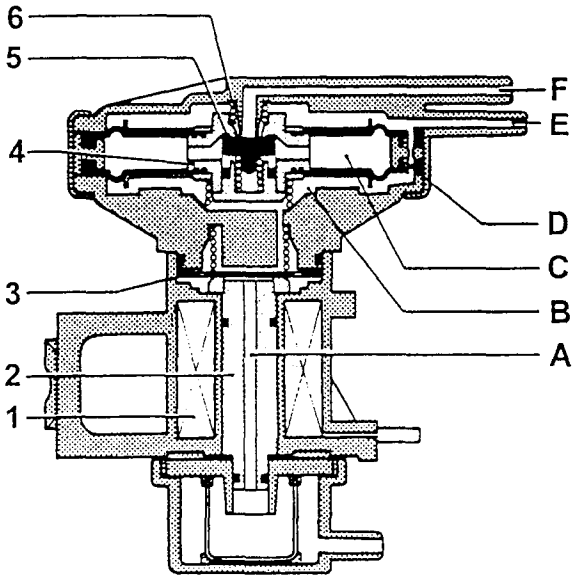
1. E.G.R. valve
2. Air box
3. E.G.R. modulating solenoid valve

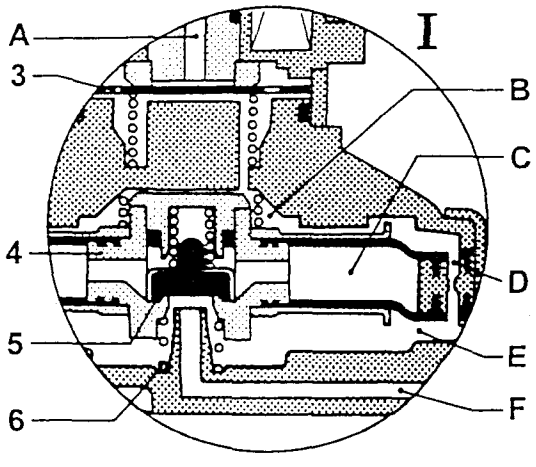
In order to further reduce emissions of NOx (nitric oxide) the supply system is fitted with an E.G.R. valve (1).
The E.G.R. valve (Exhaust Gas Re-circulation) withdraws part of the exhaust gases and re-admits them to the intake box (2).

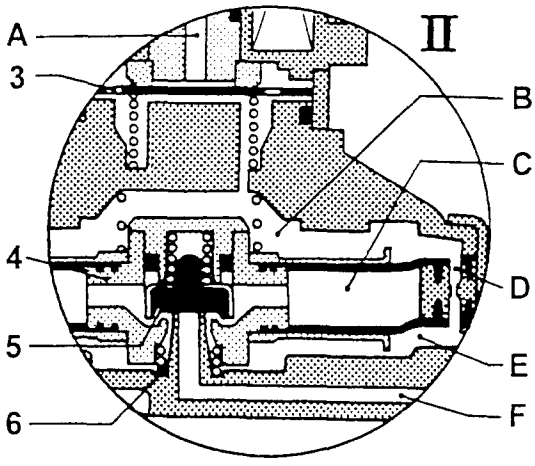
The E.G.R. valve is operated by the vacuum modulated by the electromagnetic valve (3) controlled by the injection control unit.

E.G.R. MODULATING SOLENOID VALVE

The vacuum reaches chamber E of duct F (case I), because the force of the spring (6) acts on the mobile equipment (4) and the diversion valve (5) lets it through.
Through the compensation hole D, the vacuum then involves chamber B and the surface of the plate shutter (3).
When the forces acting on the plate (3) are balanced, the atmospheric pressure in duct A enters chamber B, moving the mobile equipment downwards (case II), this way the shutter of the valve (5) closes duct F and puts chamber E in communication with chamber C at atmospheric pressure, lowering the vacuum of duct E.
The lowered vacuum or the higher absolute pressure in chamber E makes the mobile equipment (4) rise again (4) (case I), closing passage C and taking the valve (5) to the ideal condition (E in communication with F), to repeat the cycle.

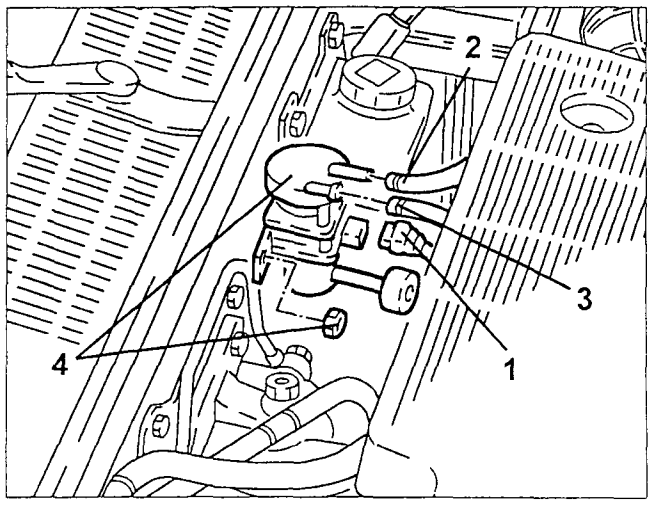






REMOVAL/REFITTING

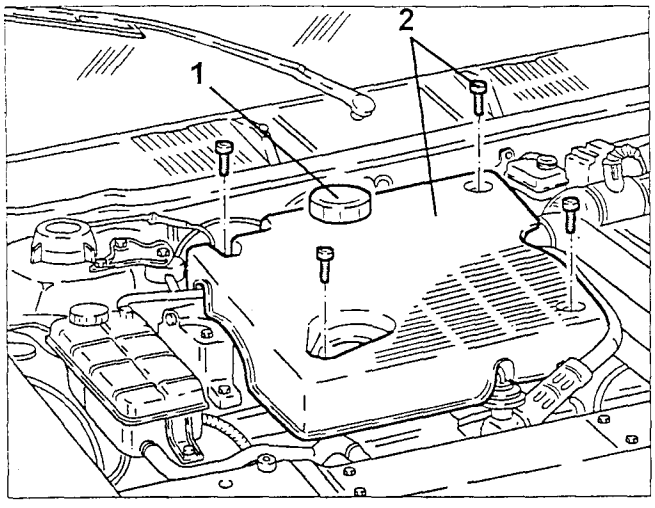
- Make sure that the ignition key is at the "STOP" position, then disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the E.G.R. modulating solenoid valve.
2. Disconnect the vacuum pipe from the E.G.R. modulating solenoid valve.
3. Disconnect the E.G.R. valve control pipe from the E.G.R. modulating solenoid valve.
4. Slacken the fastening nuts and remove the E.G.R. modulating solenoid valve.



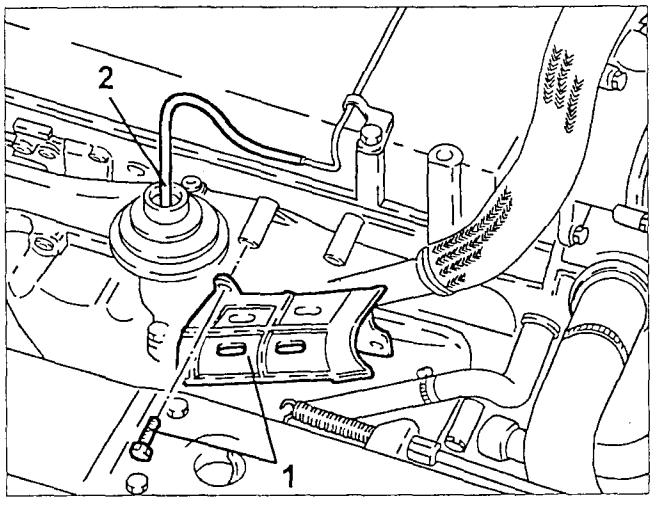
E.G.R. VALVE

REMOVAL/REFITTING

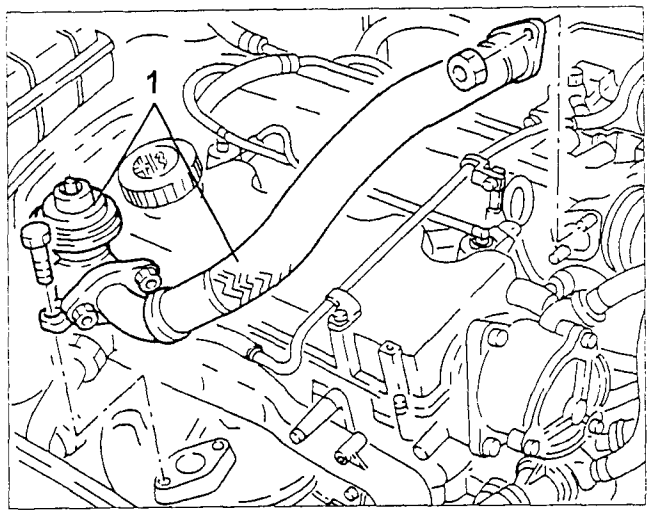
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Remove the engine oil filler cap.



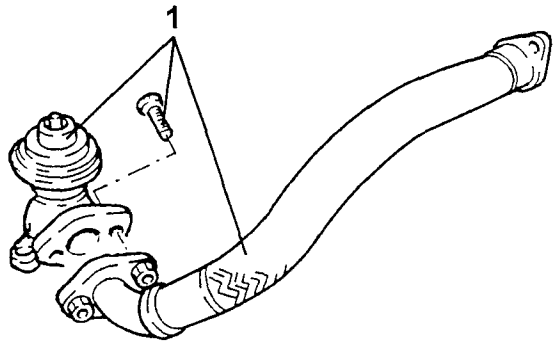
1. Slacken the fastening screws and remove the E.G.R. valve cover.
2. Disconnect the vacuum pipe from the E.G.R. valve.



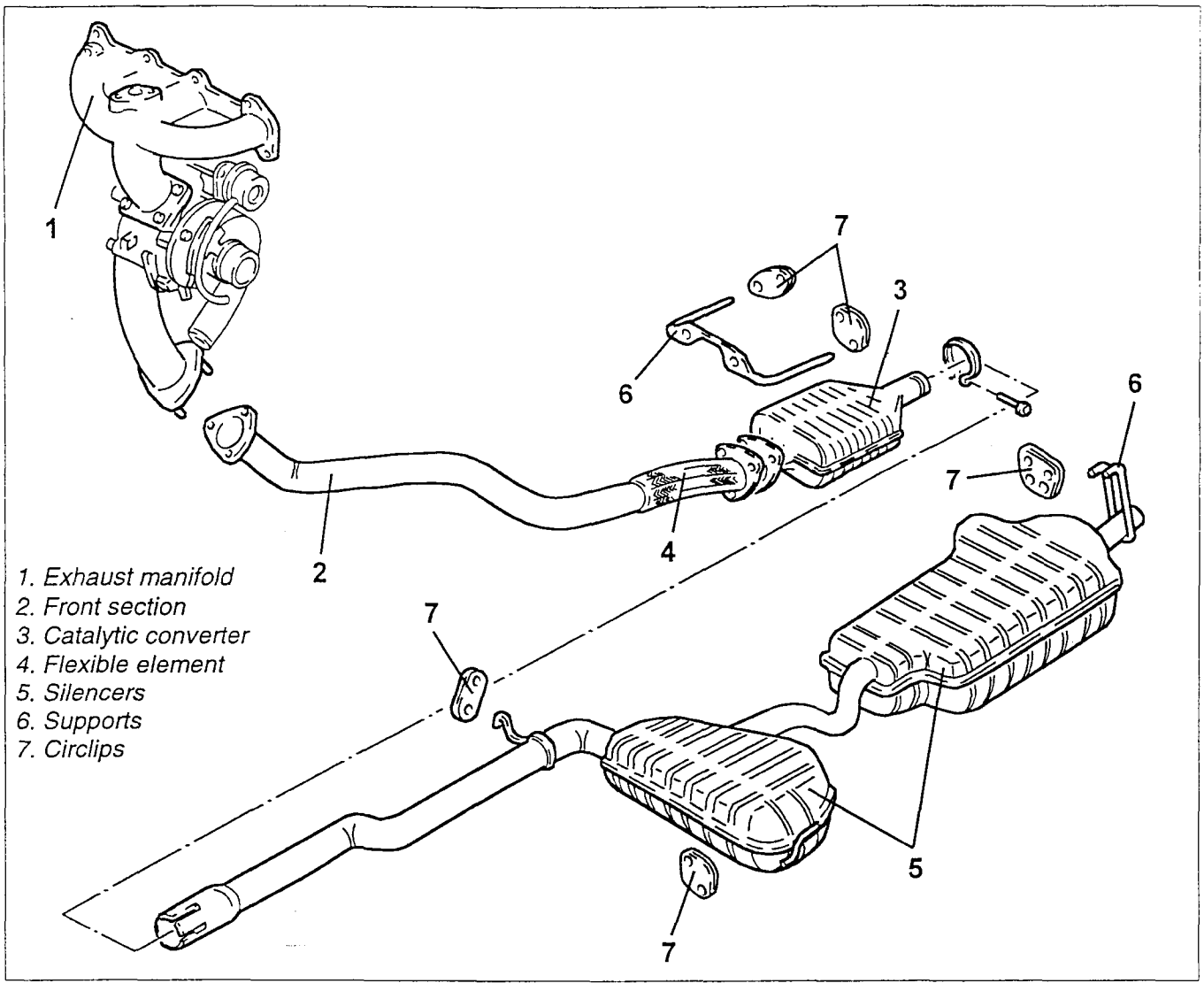
1. Slacken the nuts and screws and remove the E.G.R. valve complete with exhaust gas re-circulation pipe.
- Remove the seals.



1. Working on the bench, slacken the fastening screws and separate the E.G.R. valve from the exhaust gas re-circulation pipe.



DESCRIPTION OF EXHAUST SYSTEM



1. Exhaust manifold
2. Front section
3. Catalytic converter
4. Flexible element
5. Silencers
6. Supports
7. Circlips

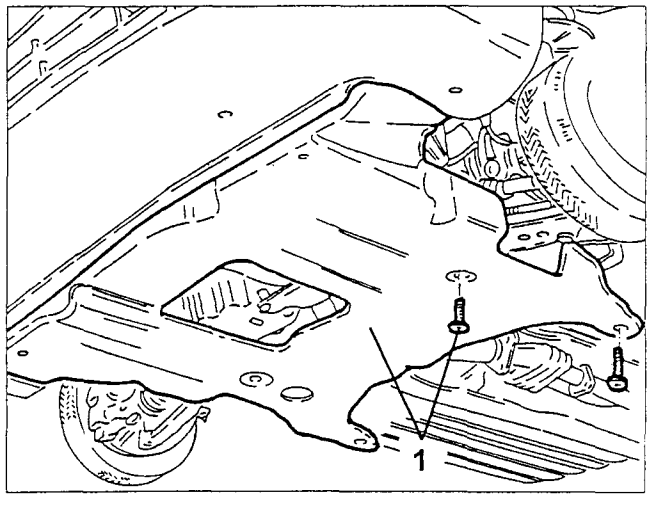
The engine exhaust gases flow through the manifold (1) to the turbocharger and then through a pipe (2) to the oxidising catalytic converter (3).
In the front section of the exhaust pipe there is a flexible element (4) to limit the transmission of vibrations.
The rear section of the exhaust pipe comprises a single silencer (5).
Special shields limit the radiation of heat towards the body.
The different components are supported by supports (6) and circlips (7) fastened under the body.

EXHAUST, FRONT SECTION

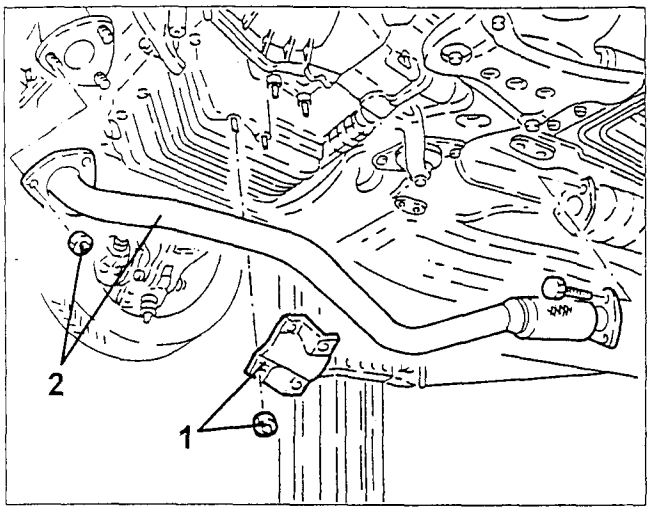
REMOVAL/REFITTING

- Set the car on a lift.

1. Slacken the fastenings and remove the under engine guard.

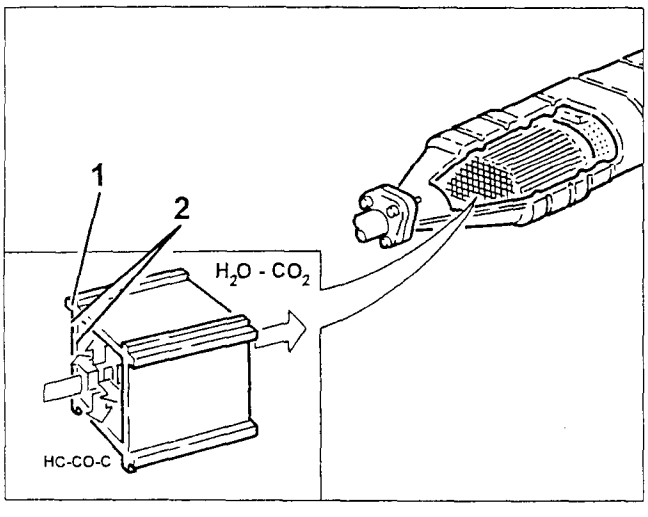


1. Slacken the fastening nuts and remove the reinforcement bracket.
2. Slacken the nuts and screws and remove the front section of the exhaust pipe.
- Remove the seals.



CATALYTIC CONVERTER

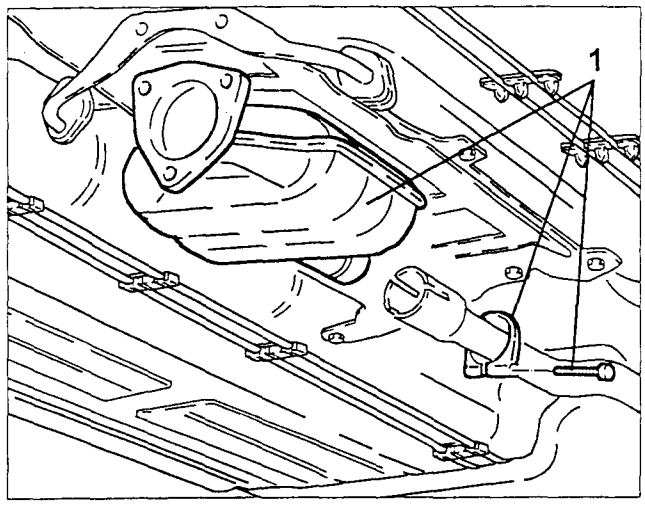
The oxidising catalyst is a post-treatment device for oxidising the CO, HC's and particulate, turning them into carbon dioxide (CO_2) and water vapour (H_2O).
The catalytic converter consists of a one-piece ceramic honeycomb (1), the cells of which are impregnated with platinum (2), a substance which catalyses the reactions of oxidisation.



The exhaust gases that cross the cells heat the catalyst, triggering conversion of the pollutants into inert compounds.
The chemical oxidisation reaction of CO, HC and particulate is effective with temperatures between 200 and 350°C.
In fact beyond 350°C the sulphur contained in the fuel oil begins to oxidise, giving rise sulphur and sulphuric dioxide.

REMOVAL/REFITTING

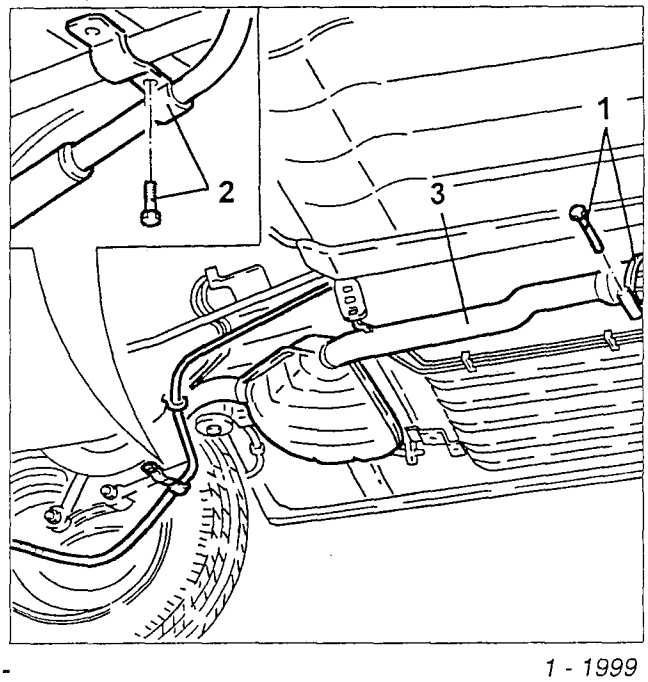
- Set the car on a lift.
- Remove the front section of the exhaust pipe (see specific paragraph).
1. Loosen the fastening clamp and remove the catalytic converter.



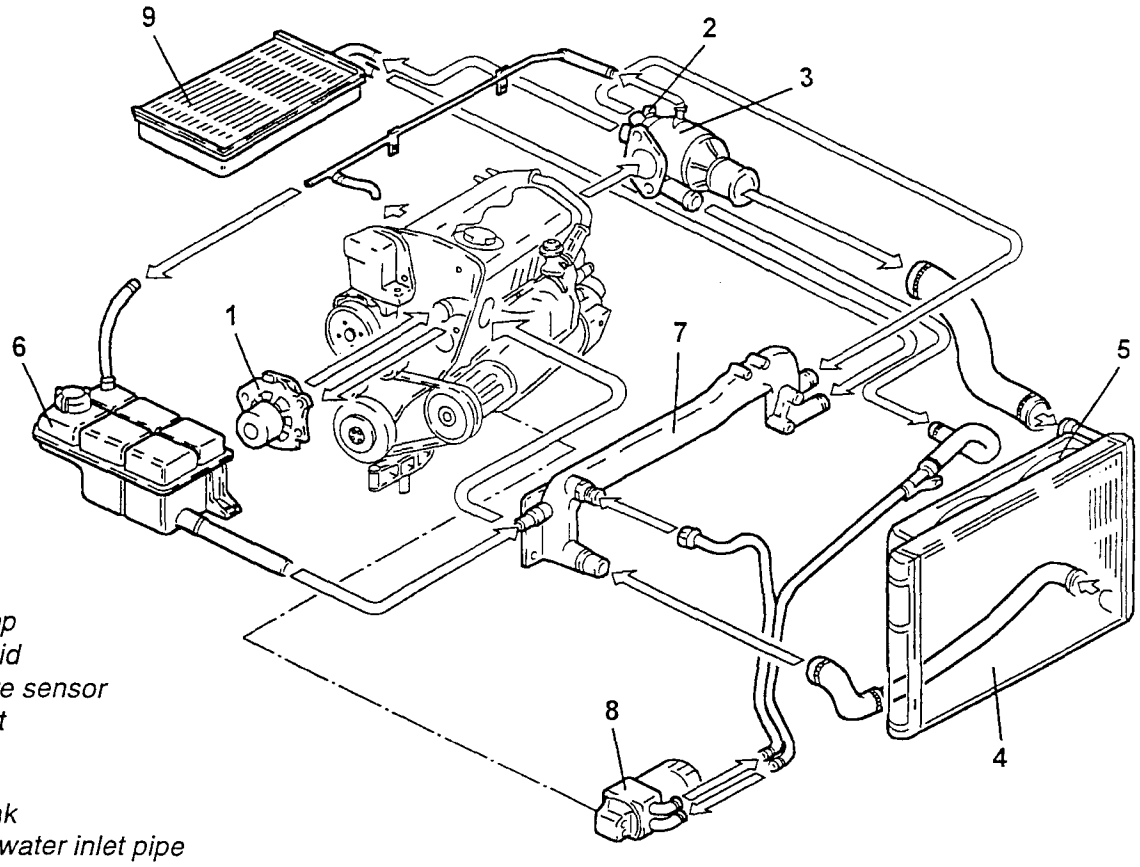
EXHAUST, REAR SECTION

REMOVAL/REFITTING

- Set the car on a lift.
1. Loosen the clamp fastening the rear section of the exhaust pipe to the catalytic converter.
2. Release the handbrake cable from the fastenings.
3. Remove the exhaust pipe rear section after freeing it from its flexible supports.



DESCRIPTION OF ENGINE COOLING SYSTEM

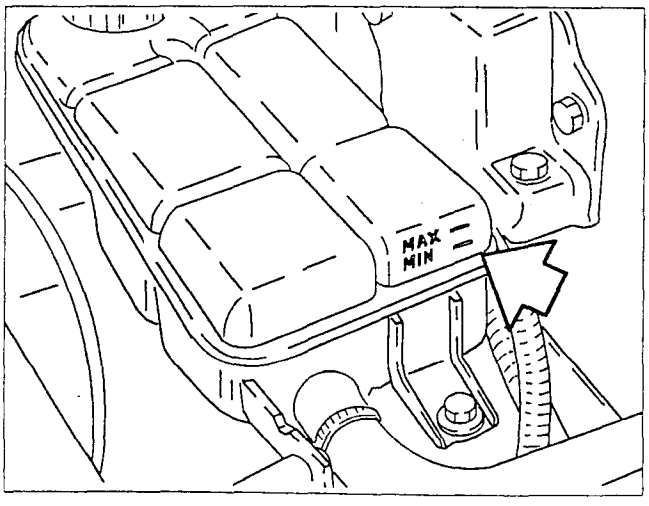


1. Water pump
2. Coolant fluid temperature sensor
3. Thermostat
4. Radiator
5. Fans
6. Header tank
7. Stiff pump water inlet pipe
8. Water - oil heat exchanger
9. Heater radiator

CHECKING THE LEVEL AND CHANGING ENGINE COOLANT FLUID

Checking

- Check that the level (cold) of the coolant fluid in the header tank is between the MIN and MAX marks.

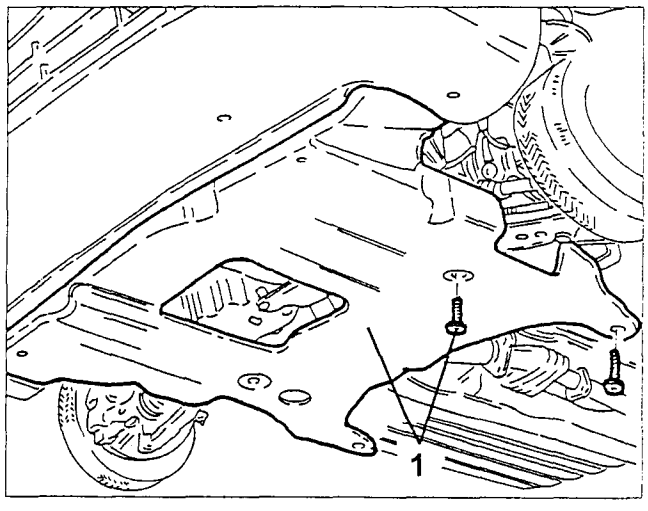


Changing

- Set the car on a lift.
- Slacken and remove the header tank cap.

WARNING: Absolutely never remove the header tank cap when the engine is hot.

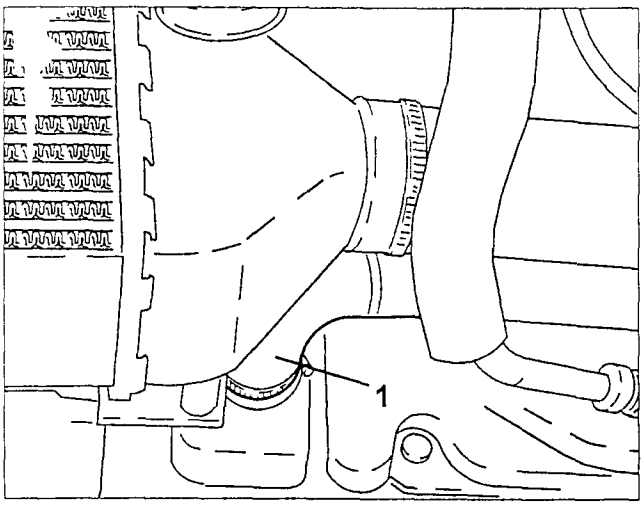
1. Slacken the fasteners and remove the under engine guard.



1. Drain the engine coolant fluid, disconnecting the radiator outlet sleeve.

NOTE: Collect the engine coolant fluid in a suitable container.

WARNING: The antifreeze fluid used as engine coolant is harmful to paint. Therefore, avoid any contact with painted parts.



- Re-connect the sleeve to the radiator and any disconnected pipes, checking that all the clamps are tightened.
- Fill with fluid of the type and quantity specified until reaching the MAX mark on the header tank.
- Start the engine and bring it to normal operating temperature so that the thermostat opens to release the air left in the circuit.
- When the engine is cold, top up to the MAX mark on the header tank.
- Screw the pressurised cap back on the header tank.

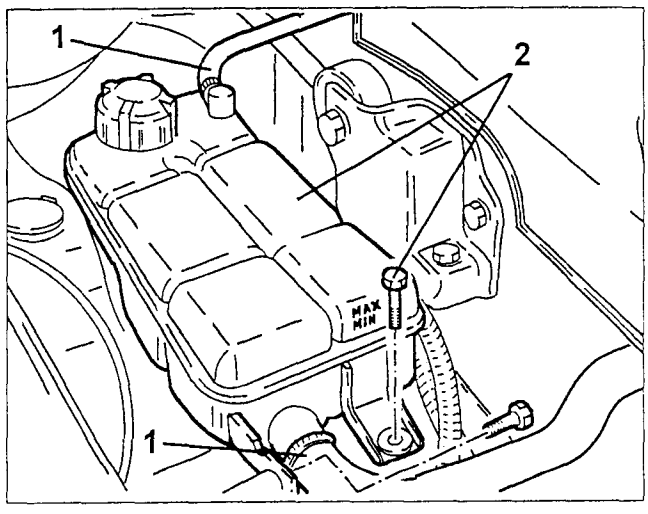
WARNING: Antifreeze fluids of different types or brands should not be mixed.
Do not use antirust additives: they might be incompatible with the antifreeze used.

HEADER TANK

The header tank supplies the circuit and absorbs the changes in volume of the coolant fluid with the changing temperature of the engine.
The tank also allows air out of the circuit, through a special calibrated valve in the pressurised cap and a pipe connected to it.
This valve also carries out a washing action admitting air from outside when there is a vacuum - in the circuit caused by cooling of the engine.

REMOVAL/REFITTING

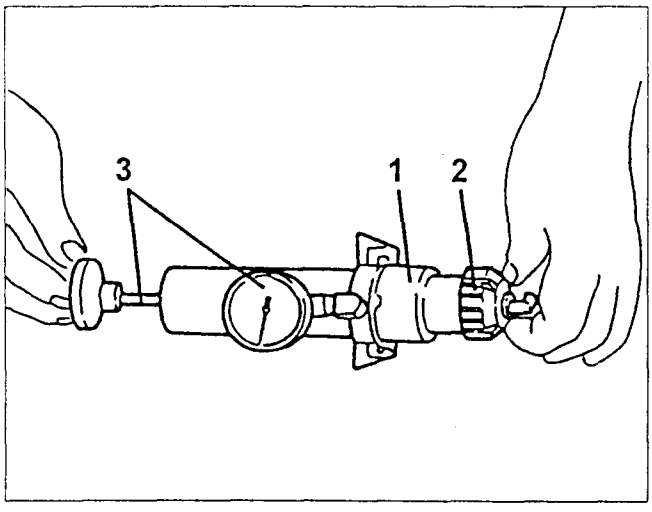
- Drain the engine coolant fluid (see specific paragraph).
1. Loosen the clamps and disconnect the coolant fluid inlet and outlet pipes from the header tank.
2. Slacken the fastening screws and remove the header tank.



PRESSURISED CAP TIGHTNESS TEST

1. Slacken the coupling on the lower end of the testing tool.
2. Install the header tank pressurised cap on the coupling.
3. Pressurise working manually on the piston and check on the pressure gauge that the cap relief valve opens at the specified setting rate.

Pressurised cap setting pressure
0.98 ± 0.1 bar



ENGINE COOLING SYSTEM TIGHTNESS TEST

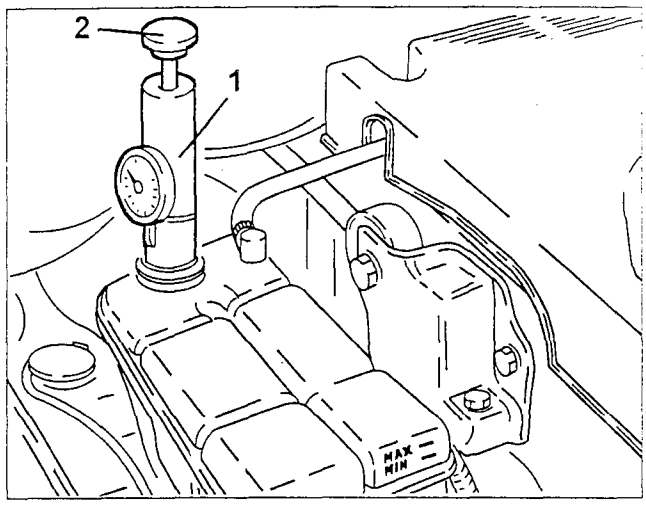
- Slacken and remove the pressurised cap from the header tank.

WARNING: Absolutely never remove the cap from the header tank when the engine is hot.

1. Screw the hydraulic circuit tightness test tool, fitted with the special coupling, on the header tank filler.
2. Manually pressurise the circuit and check on the tool that the pressure stays at the specified rating. If not, check that there are no leaks from the sleeves or radiator.

Hydraulic circuit control pressure
0.98 ± 0.1 bar

WARNING: For safety reasons, during these checks with the test tool, never allow the pressure to exceed 1.38 bar.



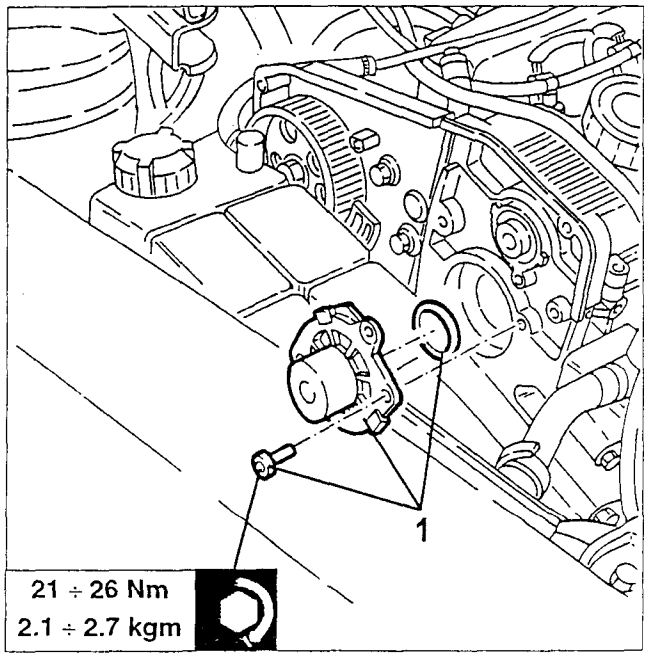
WATER PUMP

This is of the centrifugal type with vanes with aluminium alloy pump casing and phenolic resin impeller. It is fastened to the crankcase and operated directly through the camshaft belt.

REMOVAL/REFITTING

- Remove the cam angle sensor (see specific paragraph).

1. Slacken the fastening screws and remove the water pump complete with O-Ring.



Refit reversing the sequence followed for removal and refer to GROUP 00 for installing the valve gear drive belt and timing and for installing the engine components belt.

THERMOSTAT

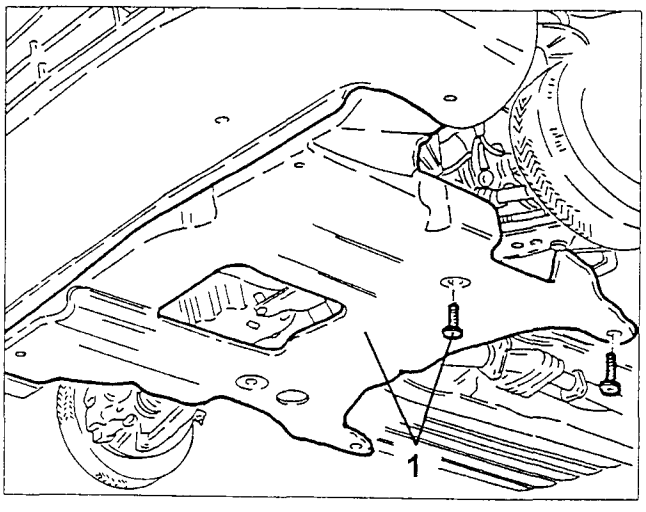
This is fitted on the rear of the cylinder head and it keeps the engine at the optimum temperature:
- With the temperature < 80 ± 2°C the thermostatic valve (closed) diverts the fluid directly towards the pump
- with the temperature > 80 ± 2°C the thermostatic valve (open) ducts the coolant fluid towards the radiator.

The engine water temperature sensor connected to the injection control unit and instrument cluster is fitted on the thermostat.

REMOVAL/REFITTING

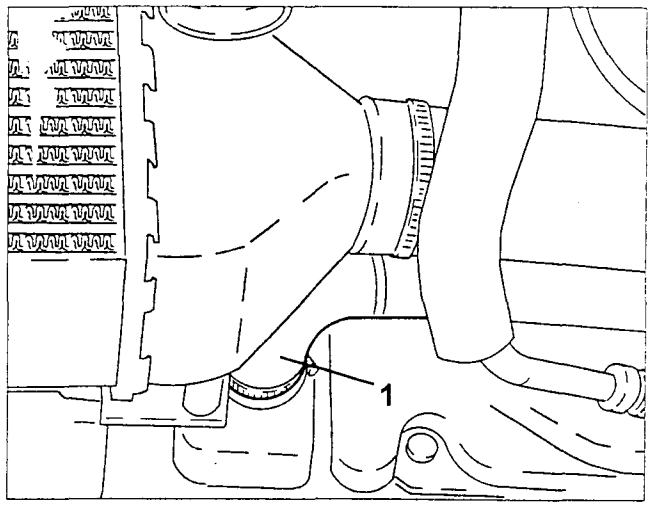
- Set the car on a lift.

1. Slacken the fastenings and remove the under engine guard.



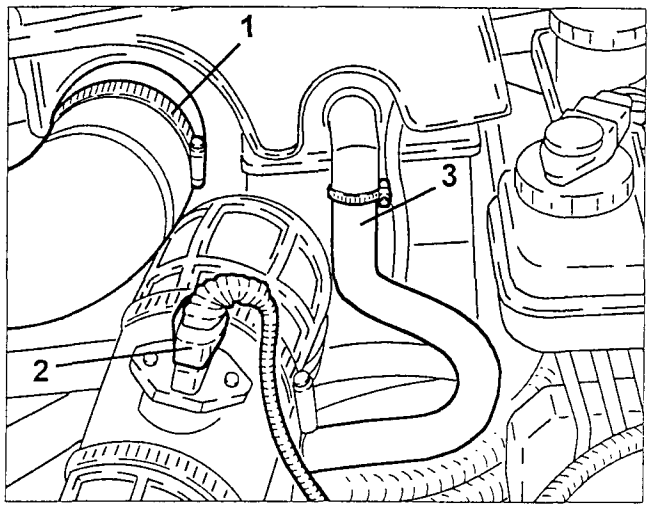
1. Drain the engine coolant fluid, disconnecting the radiator outlet sleeve.

NOTe: Collect the engine coolant fluid in a suitable container.

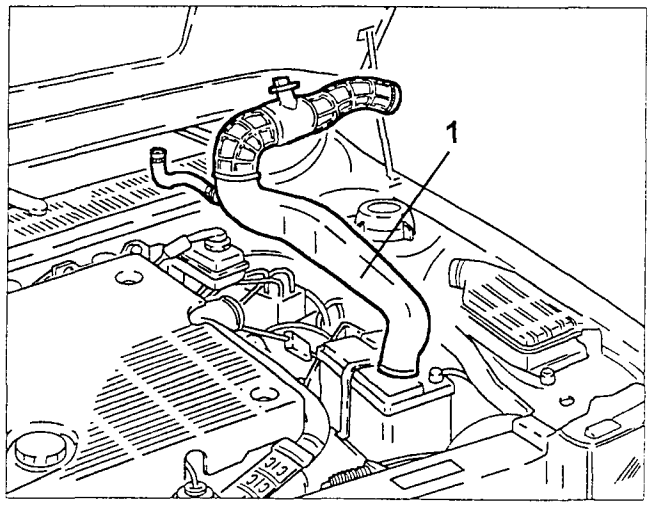


- Remove the battery (see GROUP 55).

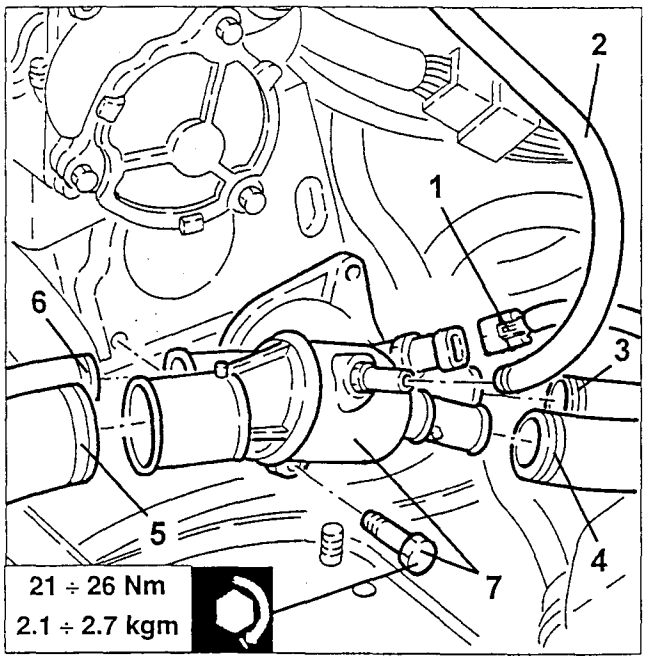
1. Disconnect the air inlet sleeve from the air box.
2. Disconnect the electrical connection from the air flow meter.
3. Disconnect the oil vapour re-circulation pipe from the oil vapour separator.

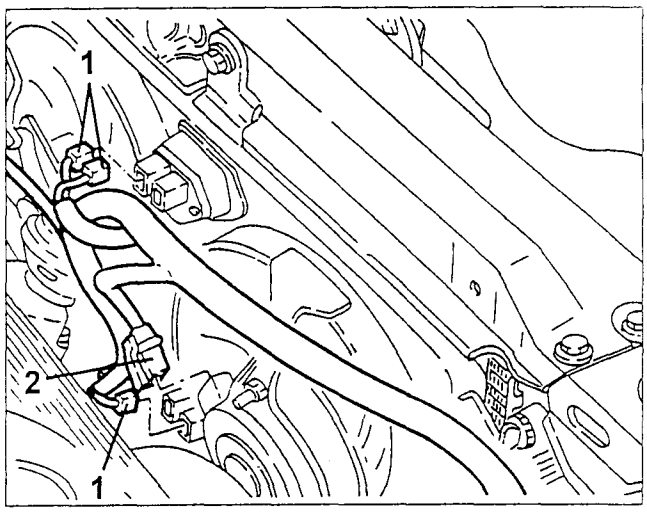


1. Loosen the clamps and remove the complete air delivery pipe from the cleaner to the turbocharger.

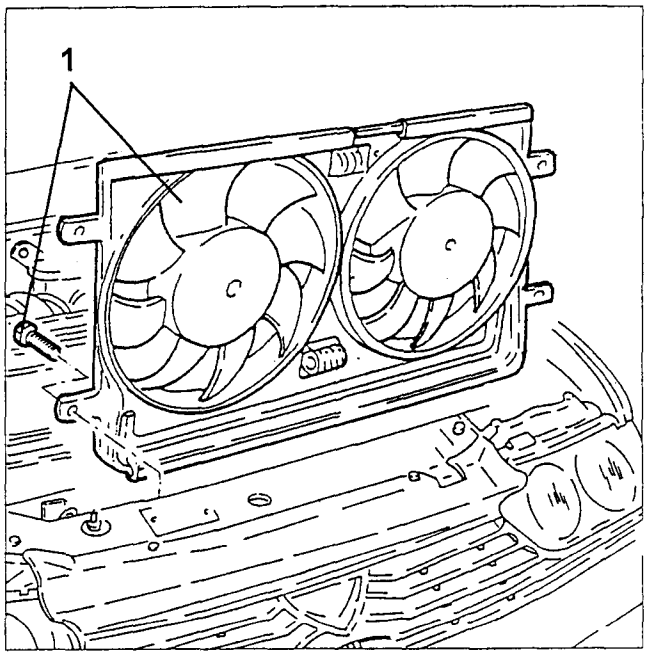


1. Disconnect the electrical connection from the engine coolant temperature sensor.
2. Disconnect the return pipe to the header tank from the thermostat.
3. Disconnect the delivery pipe to the climate control system heater from the thermostat.
4. Disconnect the delivery pipe to the stiff pump fluid inlet pipe from the thermostat.
5. Disconnect the coolant fluid delivery sleeve to the radiator from the thermostat.
6. Disconnect the delivery pipe to the engine oil heat exchanger from the thermostat.
7. Slacken the fastening screws and remove the thermostat complete with seal.





1. Slacken the fastening screws and remove the cooling fans.



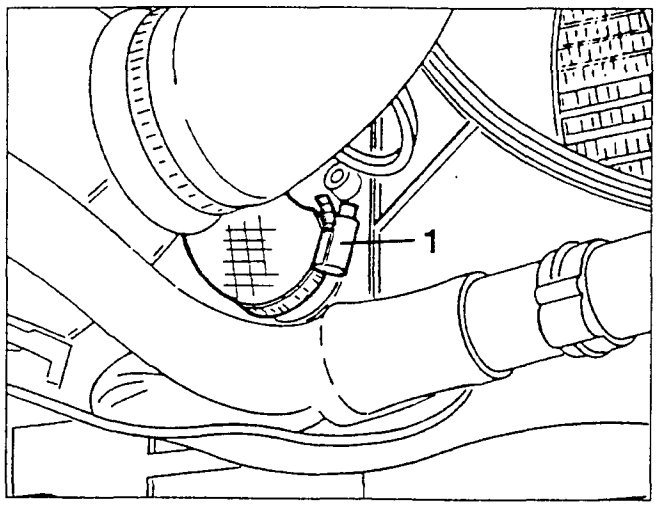
FANS

The two-speed cooling fans disperse the heat of the radiator and/or of the air conditioning system condenser.
They are controlled directly by the injection control unit according to a specific operating logic.

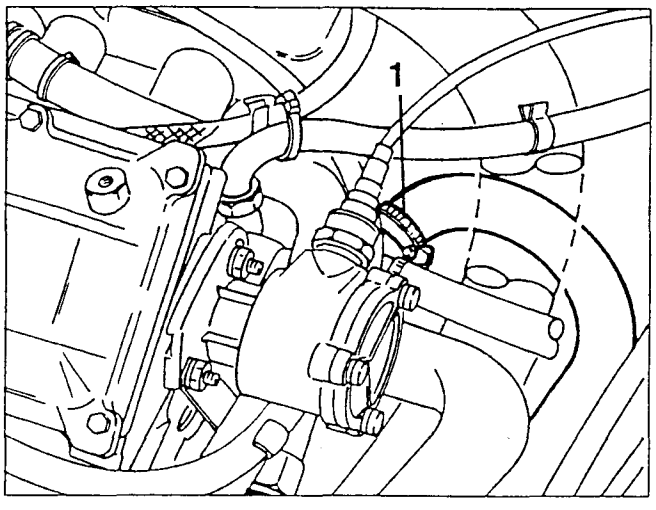
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connections from the additional resistances of the fans.
2. Disconnect the electrical connections of the supply to the cooling fans.

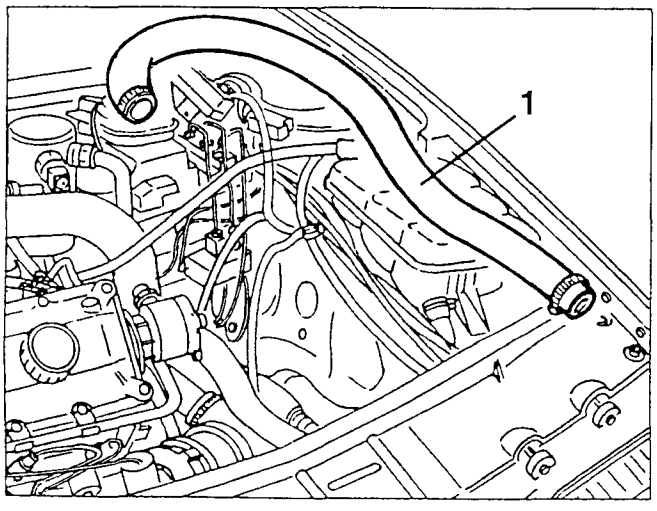
- Raise the vehicle.
1. Drain off the engine coolant, by disconnecting the liquid outlet sleeve from the radiator and recover it in a suitable container.



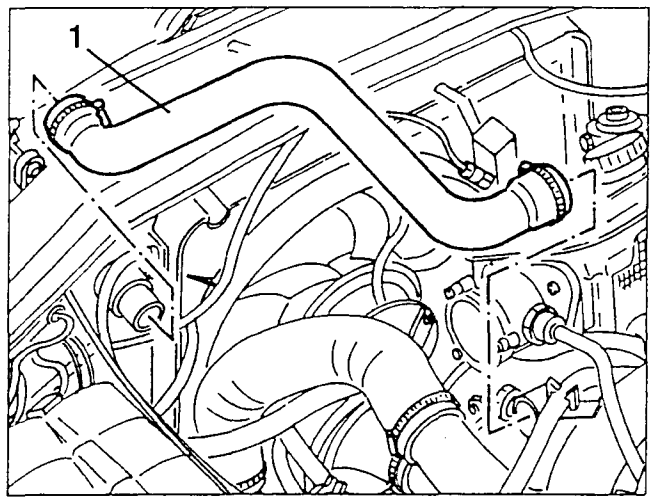
- Lower the vehicle.
1. Disconnect the engine coolant from radiator return sleeve from the thermostatic cup.



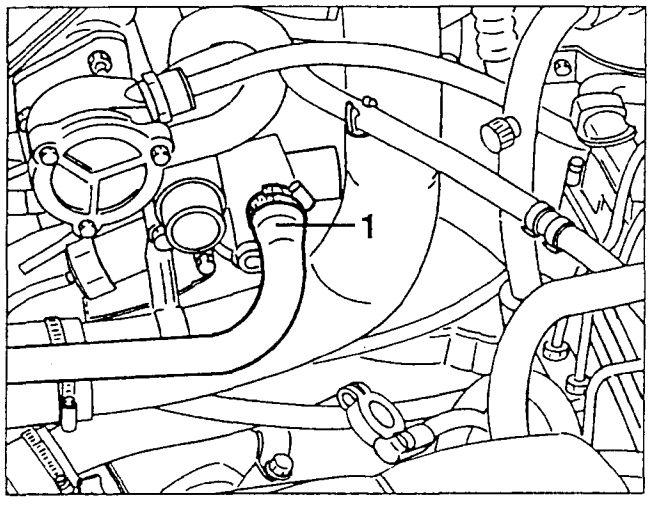
1. Remove the engine coolant from radiator to thermostatic cup delivery sleeve.



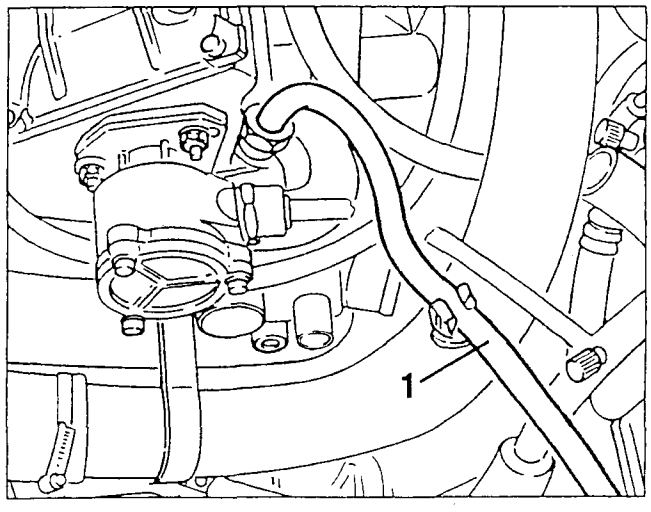
1. Remove the engine coolant from thermostatic cup to radiator delivery sleeve.



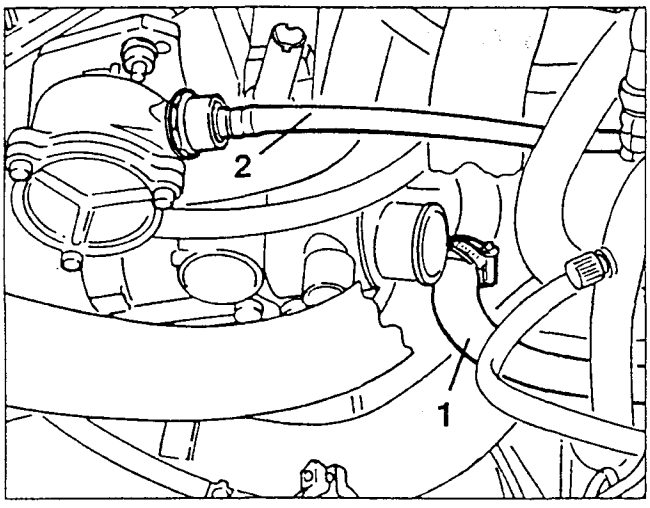
1. Disconnect the system loading sleeve originating from the expansion tank from the thermostatic cup.



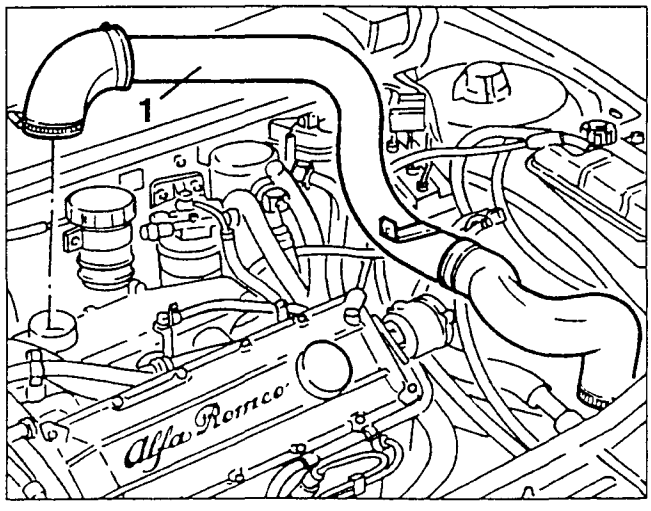
1. Disconnect the engine coolant to expansion and system deaereating tank return pipe from the cylinder head.



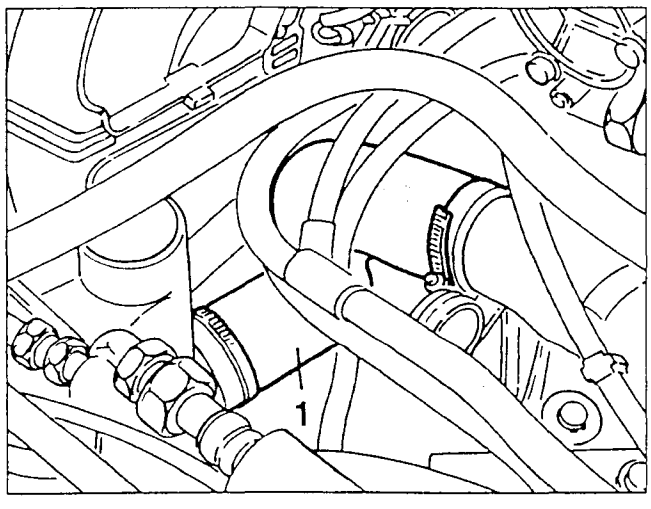
1. Disconnect the engine coolant from heater return sleeve from the engine coolant to pump manifold.
2. Disconnect the vacuum pipe from the vacuum pump for the servo brakes.



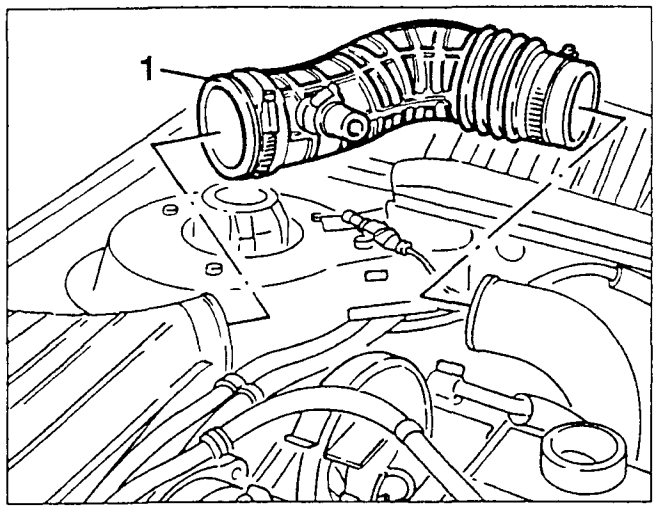
1. Remove the air from intercooler to air intake box delivery manifold.



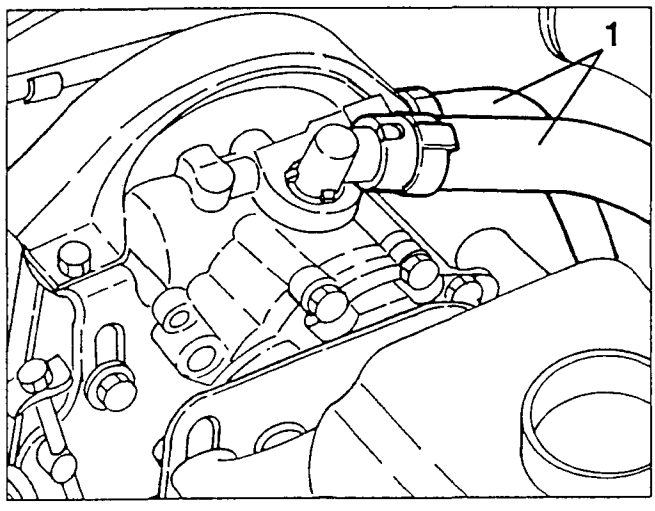
1. Remove the air from turbocharger to intercooler delivery sleeve.



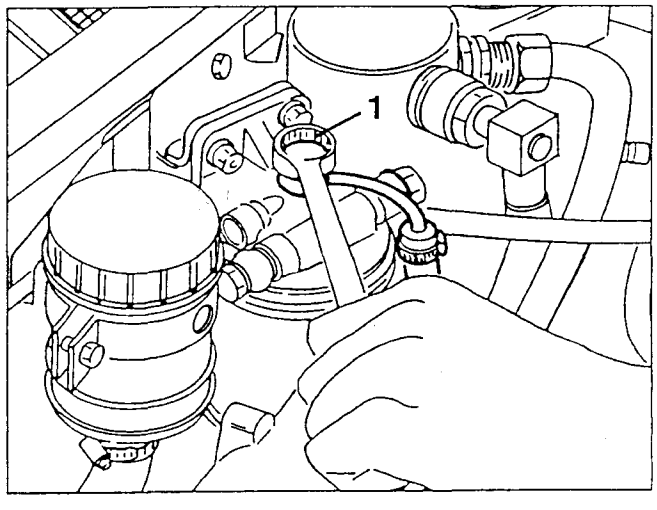
- Disconnect the oil vapour recirculation pipe from the intaken air corrugated sleeve.
1. Remove the corrugated air intake from filter to turbocharger sleeve.



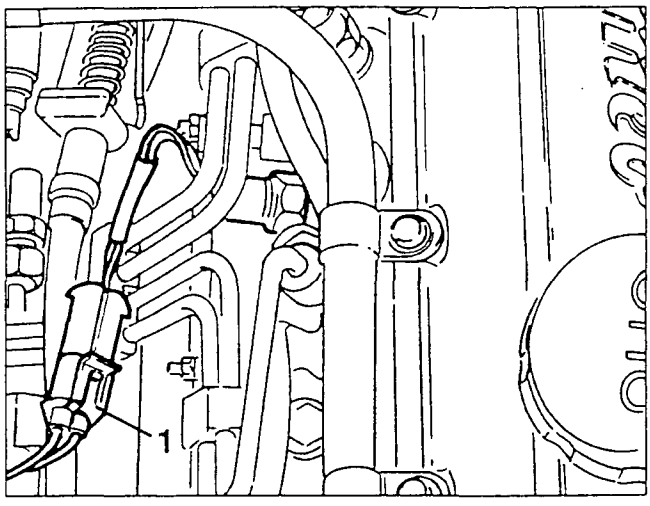
- Using a suitable syringe, drain oil from the power steering system reservoir.
1. Disconnect the intake and oil delivery connectors from the power steering pump.



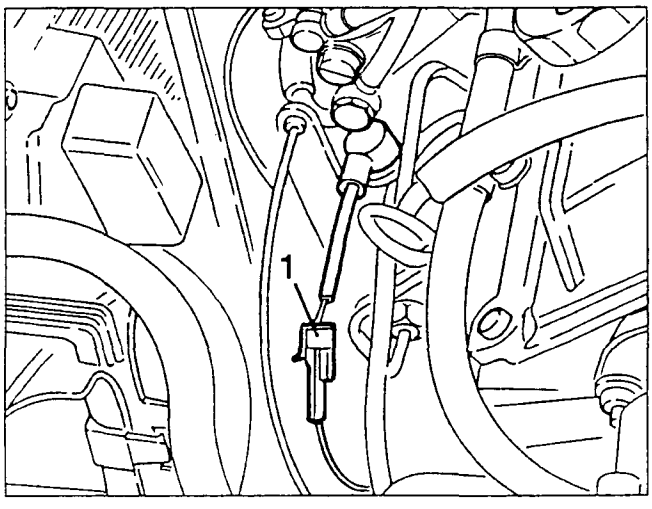
1. Disconnect the fuel delivery to injection pump pipe from the filter.



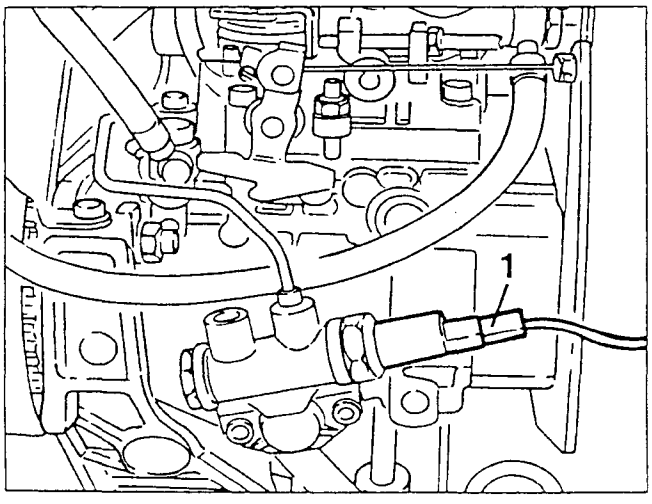
1. Disconnect the electrical connection from the engine coolant temperature indicator transmittor and max. temperature warning light contact.



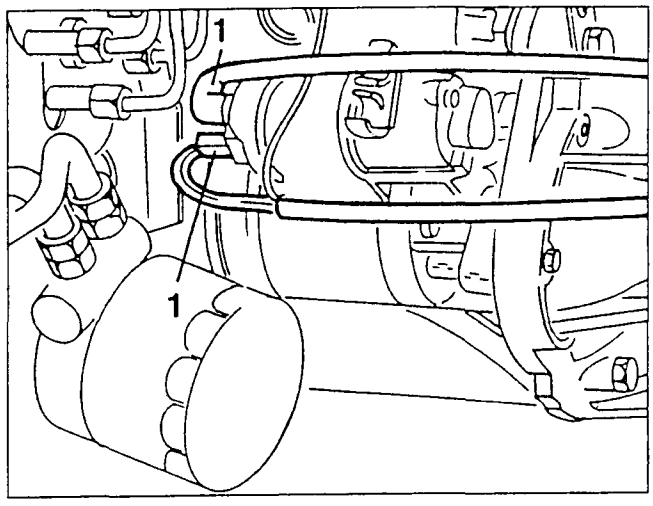
1. Disconnect the electrical connection of the engine stop solenoid valve.



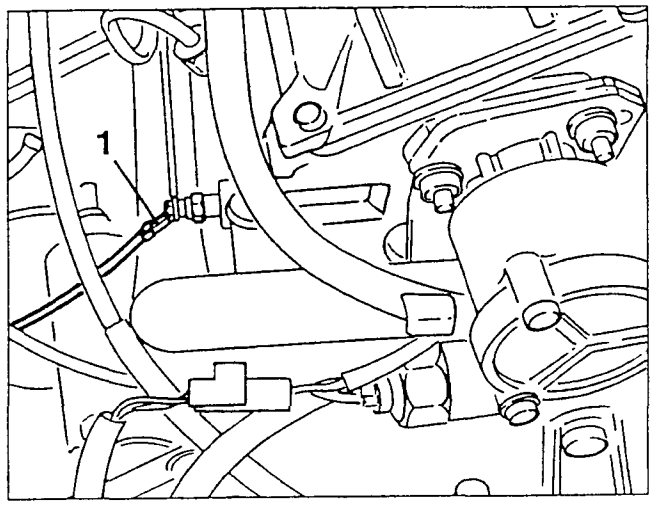
1. Disconnect the electrical connection of the KSB cold injection advance automatic control device.



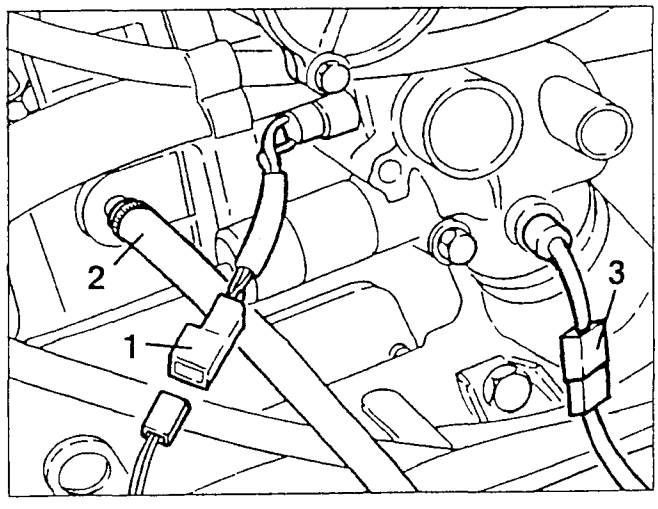
1. Disconnect the electrical power supply and starter motor energizing connections.



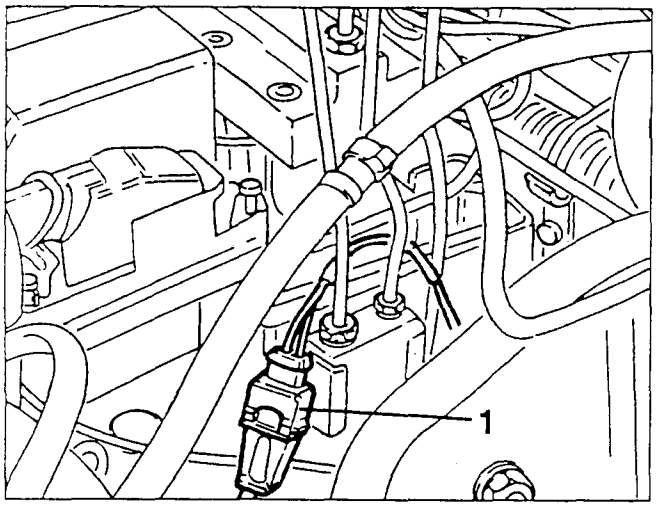
1. Disconnect the power supply electrical connection to the heater plug .



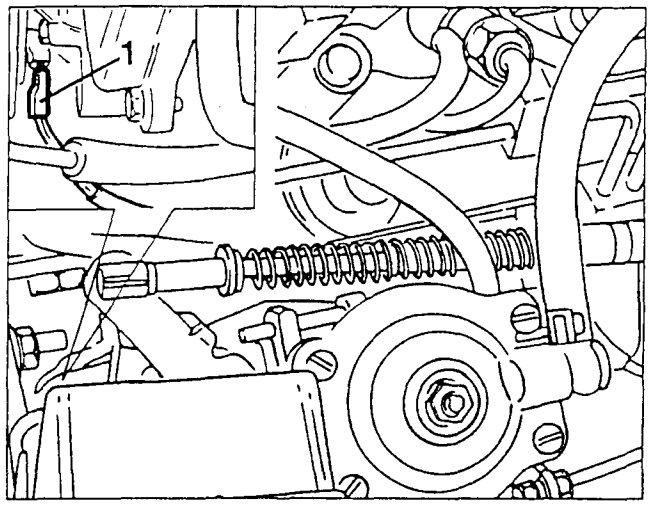
1. Disconnect the electrical connection of the KSB consensus thermoswitch.
2. Disconnect the engine coolant to heater delivery pipe from the cylinder heads.
3. Disconnect the electrical connection of the conditioner compressor cut-off thermal contact.



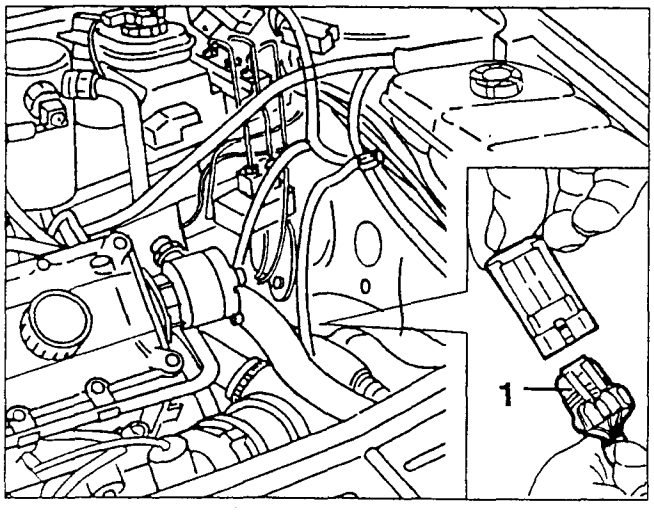
1. Disconnect the electrical connection for the electronic revs counter.



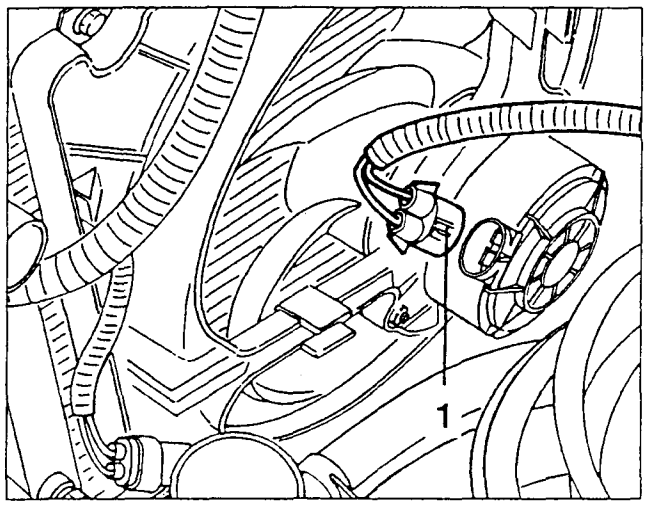
1. Disconnect the two electrical connections from the air conditioning compressor.



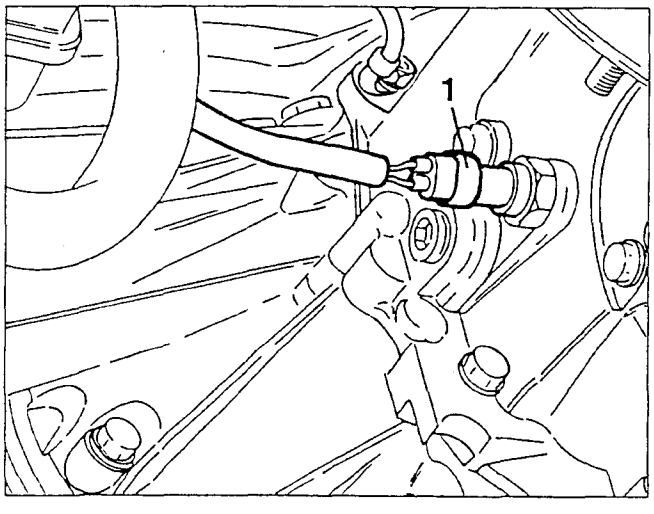
1. Disconnect the electrical connection of the mileage recorder sensor.



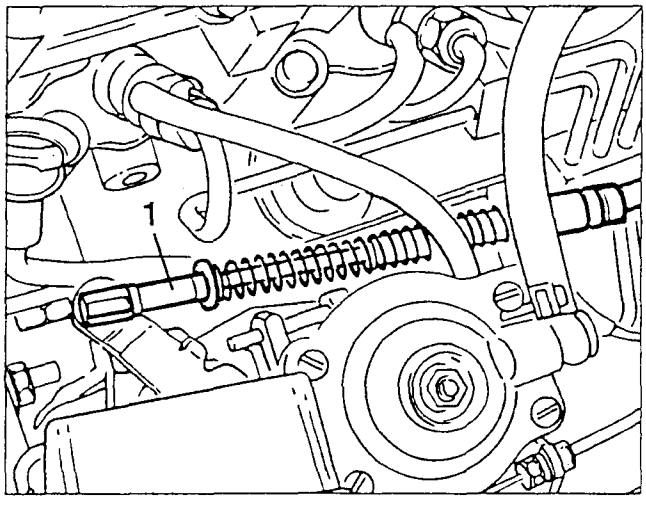
1. Disconnect the electrical connection from the cooling electric fan.



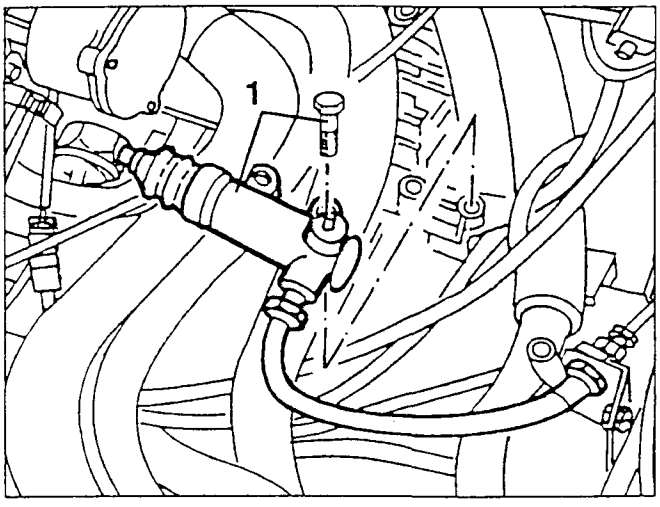
1. Disconnect the electrical connection from the reverse switch.



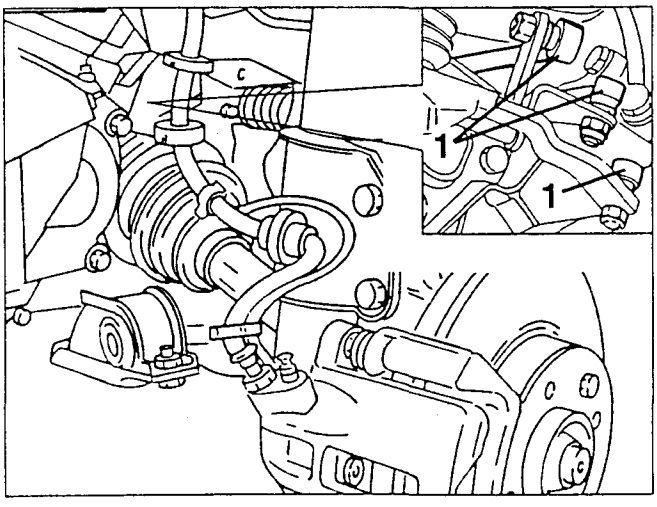
- Remove engine cooling electric fan (see specific paragraph).
1. Disconnect the accelerator control cable.



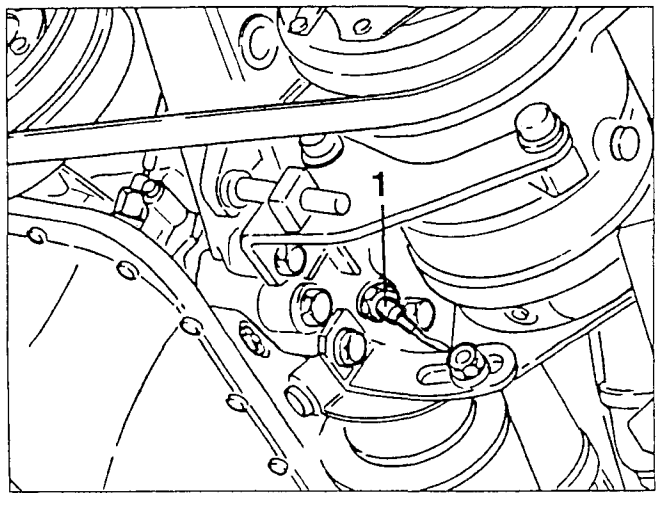
1. Slacken the screws fastening the clutch control cylinder, then move it to one side without disconnecting the control hose.



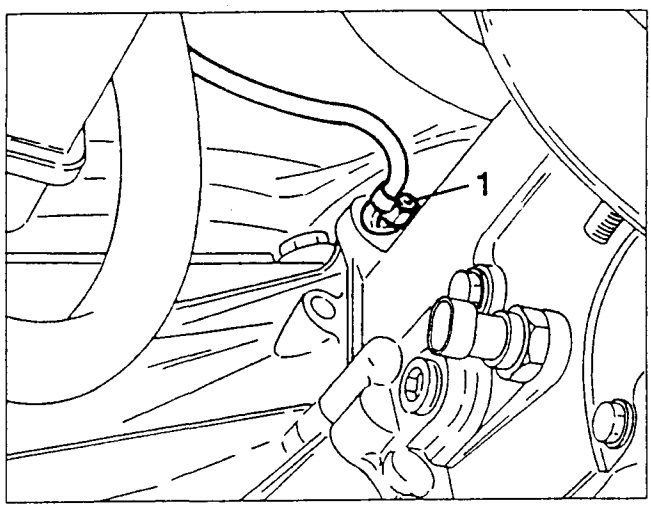
- Raise the vehicle.
1. Disconnect the gear control rod.



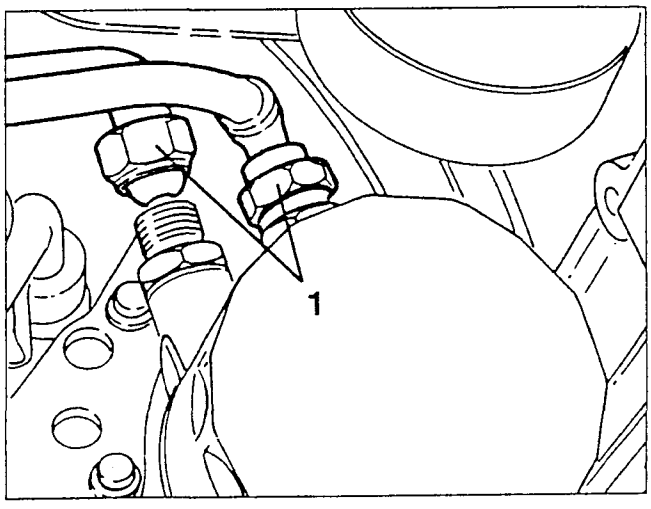
1. Disconnect the electrical connection from the engine oil minimum pressure warning light sensor.



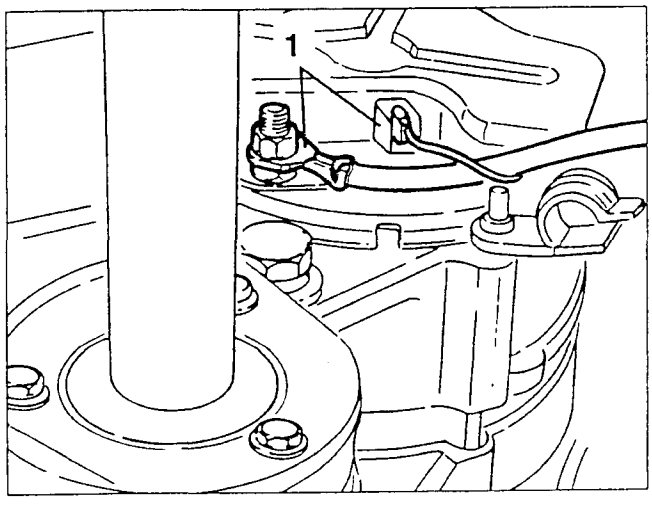
1. Disconnect the ground point of negative (-) terminal of battery.



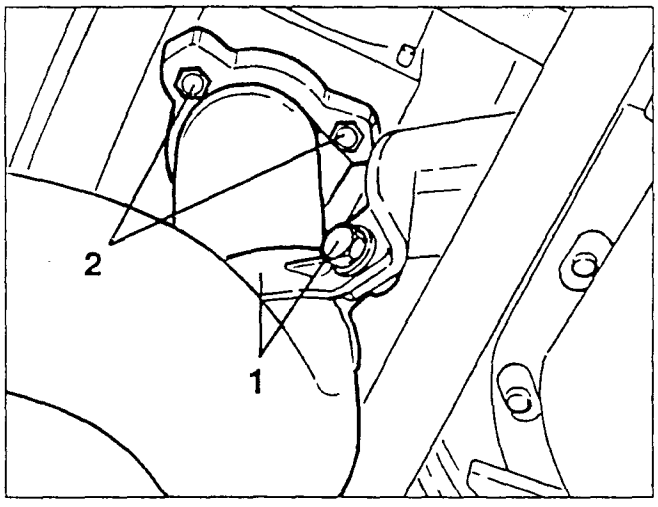
- Drain off engine oil (see GROUP 00).
1. Disconnect the two oil to radiator delivery and return connectors from the oil filter support.



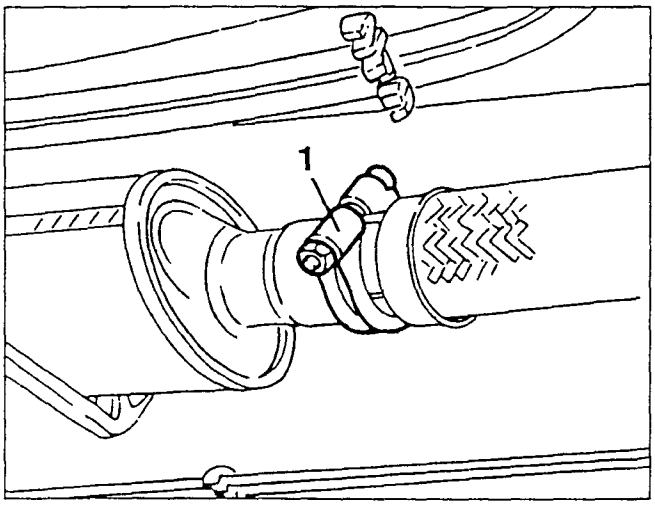
1. Disconnect the electrical connections from the alternator.



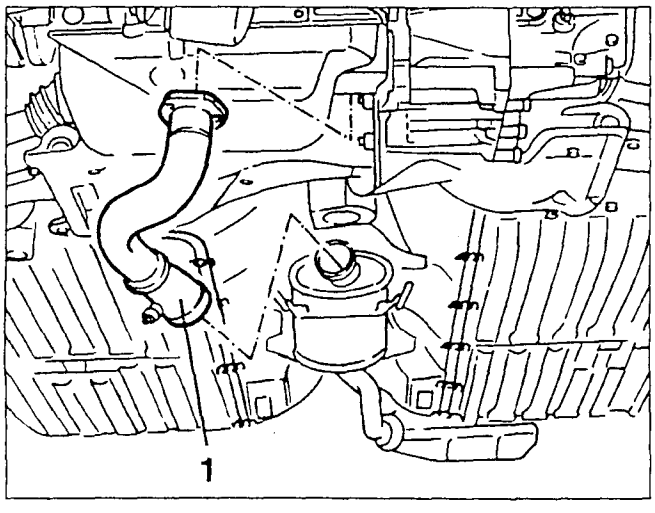
1. Remove the support clamp on the first section of the exhaust pipe.
2. Unscrew the fastening screws of the flanges connecting the front section of the exhaust pipe to the turbocharger.



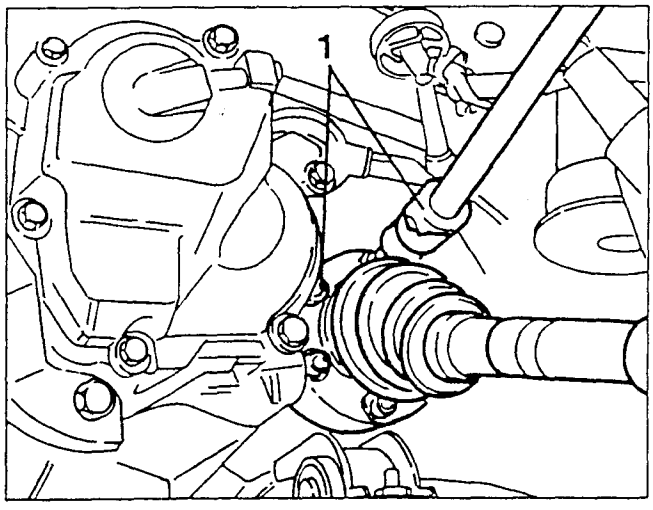
1. Loosen the clamp fastening the front section of the exhaust pipe to the central section.



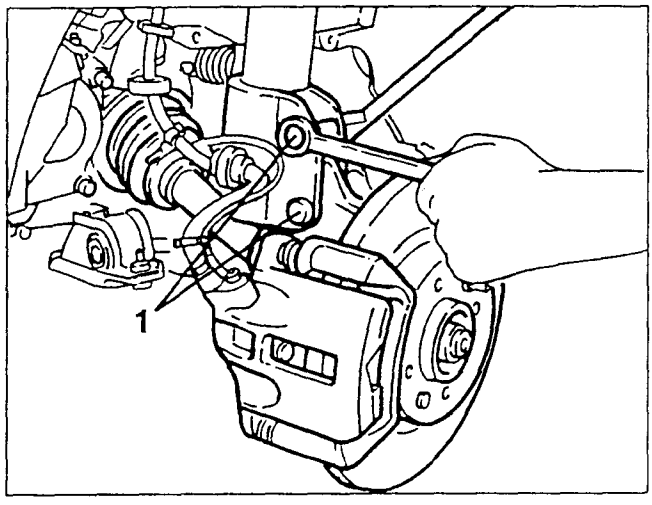
1. Remove the front section of the exhaust pipe.



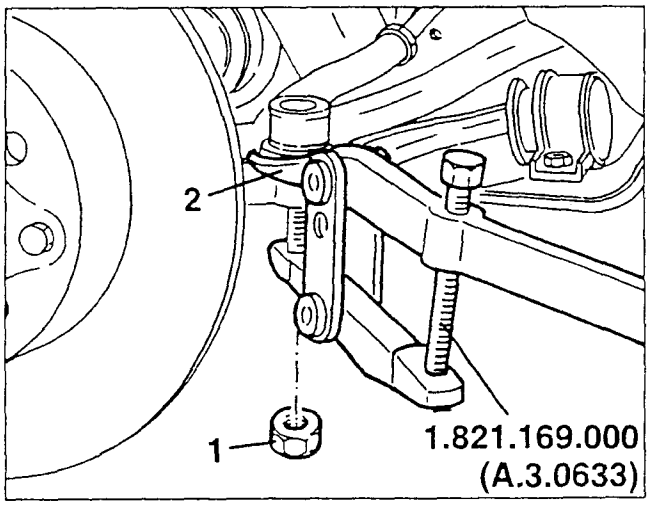
1. Disconnect the lefthand homokinetic connection from the relative flange.



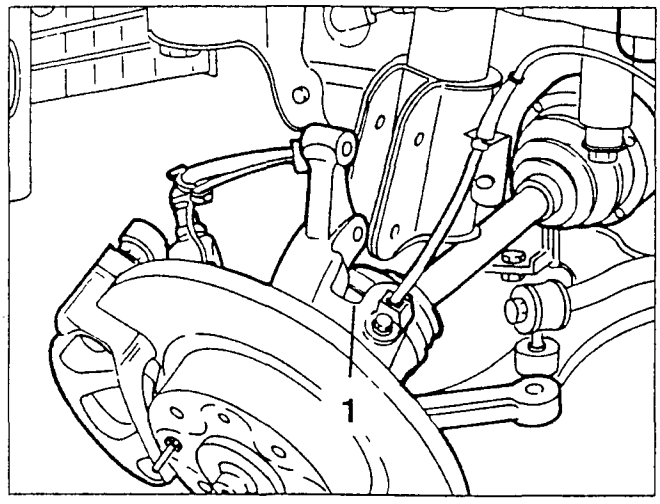
1. Disconnect the complete upright from the lefthand shock absorber.



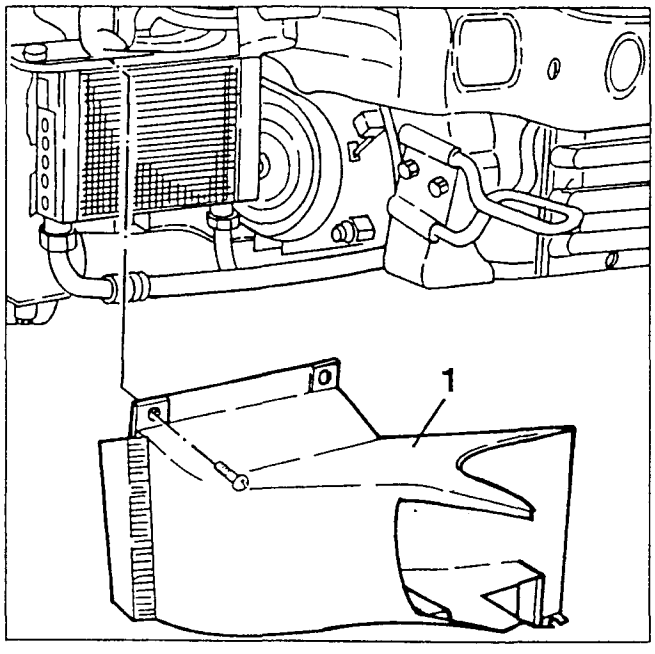
1. Unscrew the fastening nut of the lefthand steering rod ball joint.
2. Using extractor N° 1.821.169.000 (A.3.0633) separate the steering rod from the control lever on the upright.



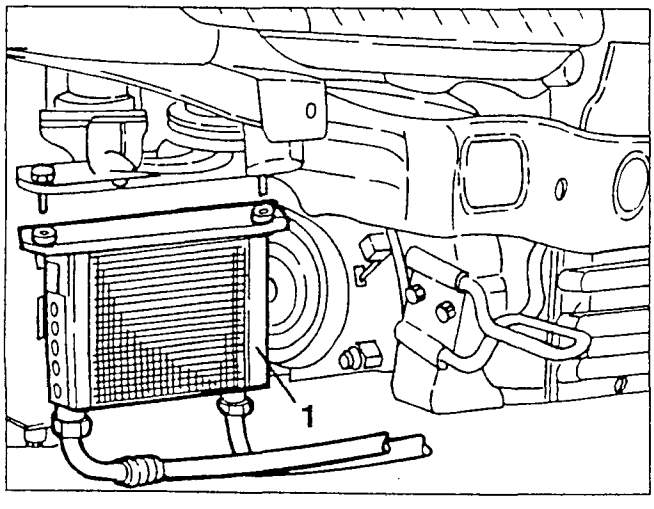
1. Tip forward, as far as possible, the wheel hub and move the axle shaft forward in this way.
- Carry out the same operations on the righthand axle shaft.



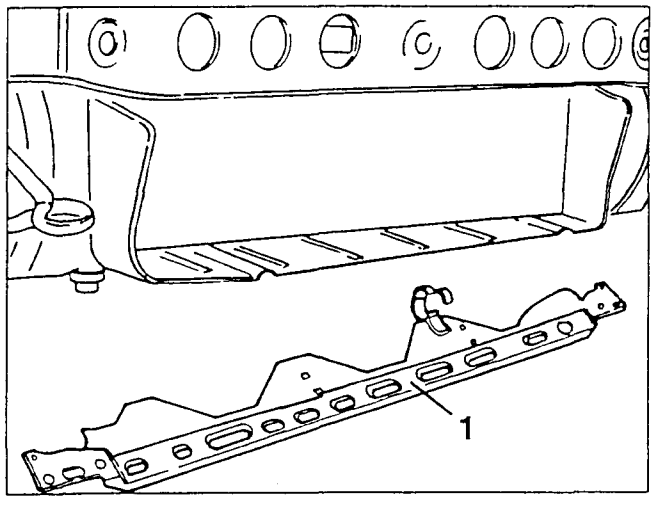
1. Remove the air to engine oil cooling radiator conveyor.



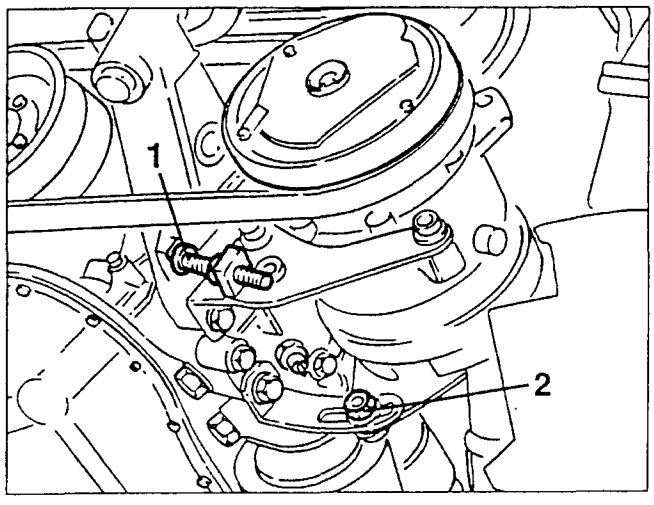
1. Unscrew the fastening screws and remove the oil radiator complete with tubes.



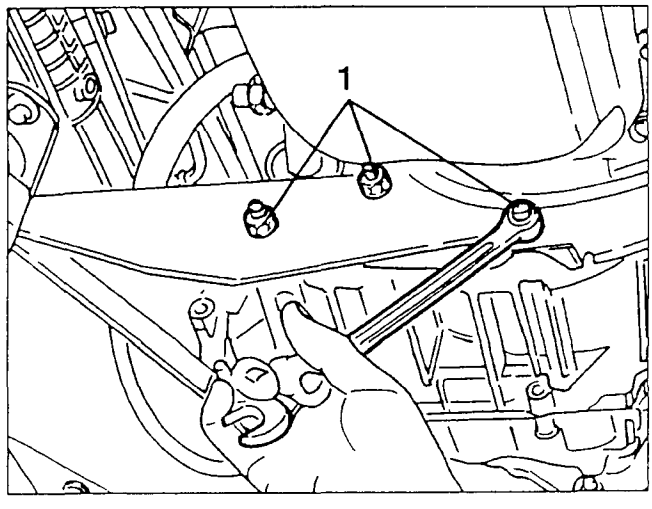
1. Unscrew the fastening screws and remove the lower radiator support cross member.



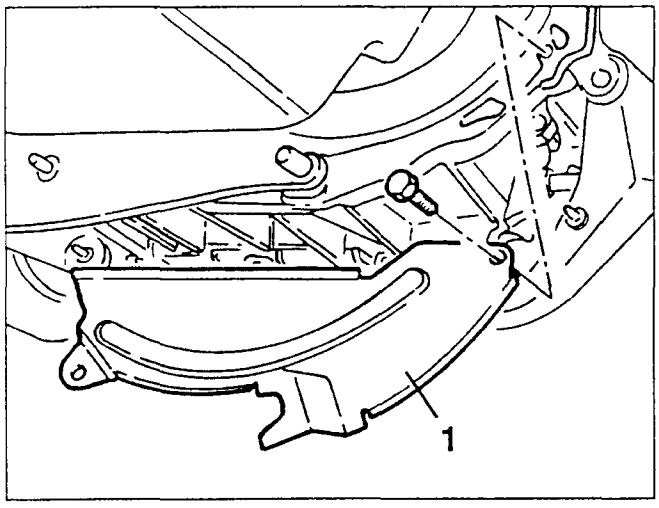
1. Acting on the micrometric tightener, loosen the air conditioning control belt.
2. Unscrew the fastening screws of the air conditioning compressor.



1. Loosen the three gearbox fastening nuts to the relative support bracket.

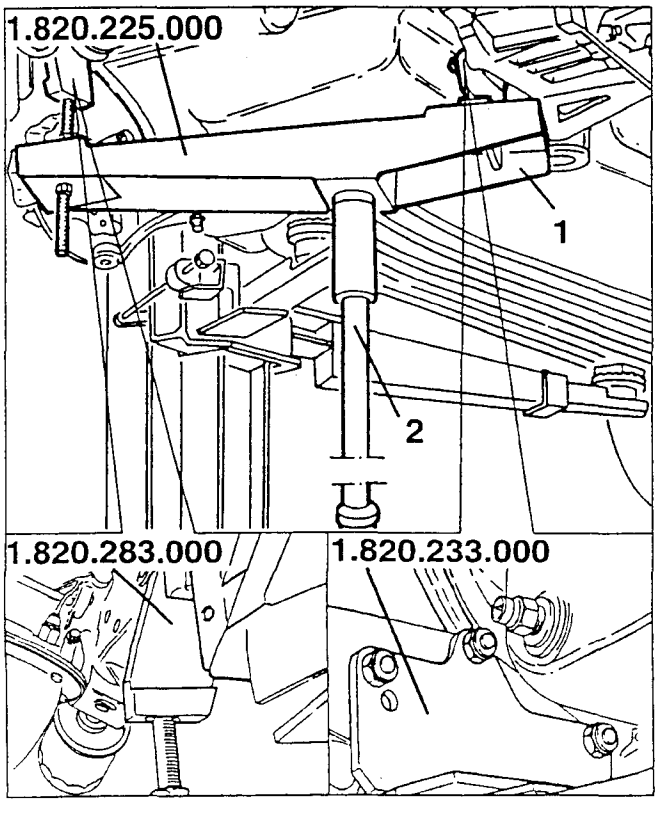


1. Unscrew the fastening screws and remove the small flywheel protection panel.

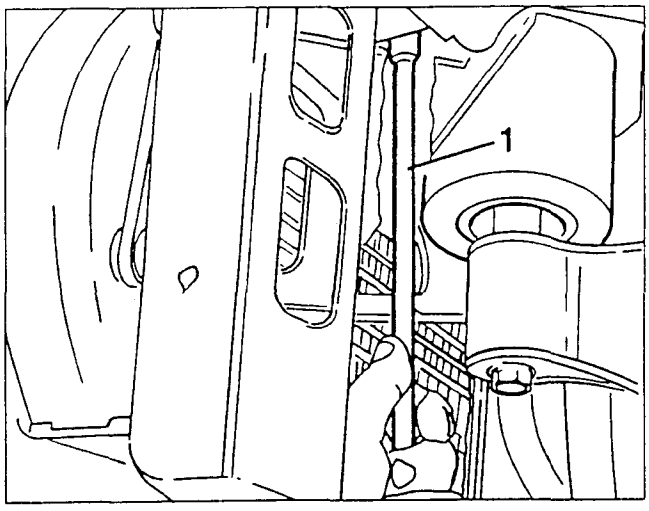


1. Install the support tools N° 1.820.233.000, N° 1.820.283.000 and N° 1.820.225.000 ready to remove the engine from the vehicle, positioning them as indicated in the figure.
2. Position a hydraulic jack under the tools of the engine support.

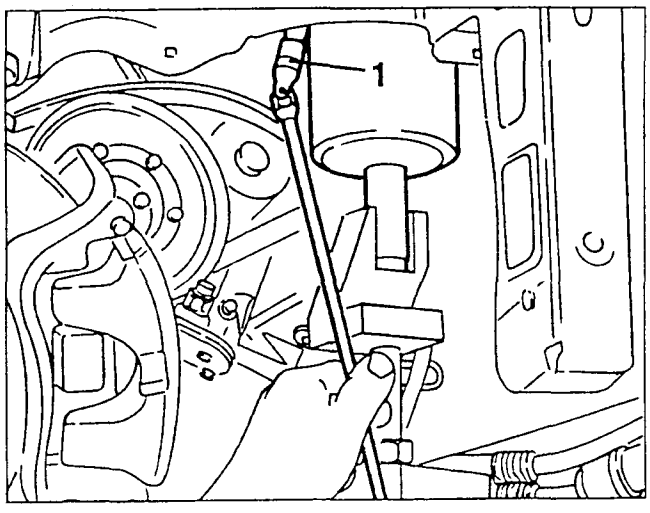
CAUTION:
The hydraulic jack must have a capacity of at least 1000 kg.



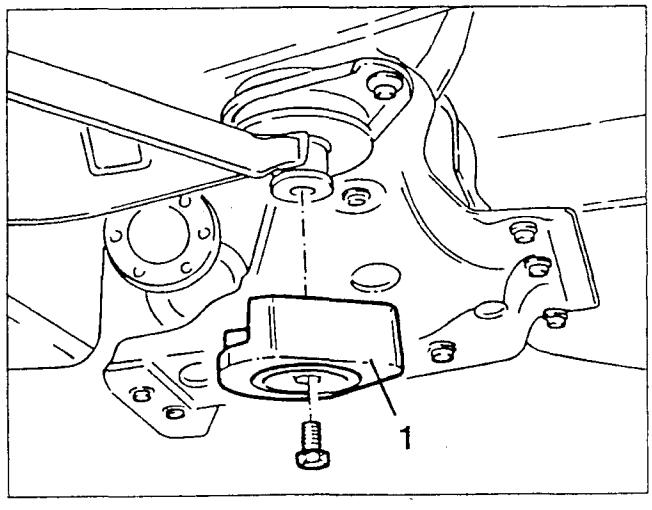
1. Unscrew the screws fastening the gearbox side support to the body



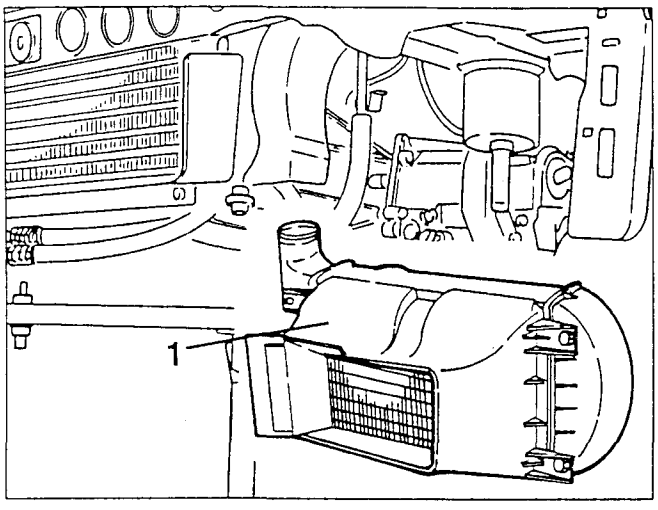
1. Unscrew the screws fastening the timing side support to the body.



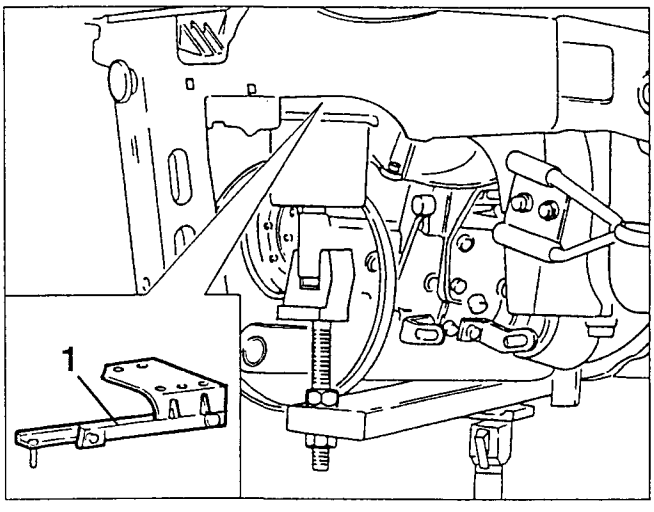
1. Unscrew the screws fastening the rear support to the body and recover the buffer.



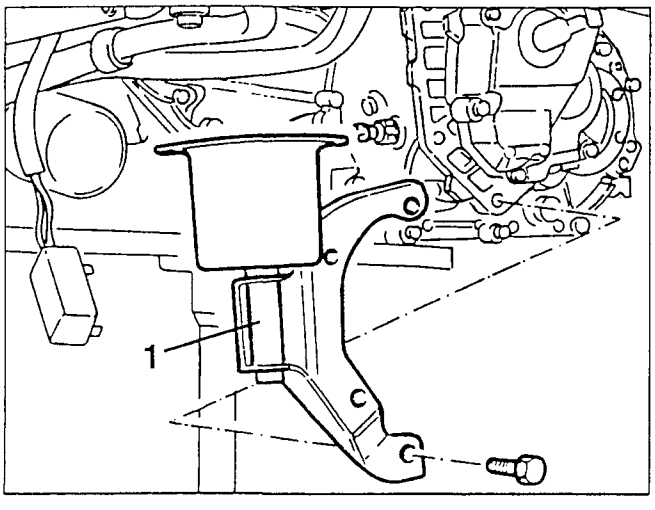
1. Lower the engine slightly and take the intercooler and manifold.



1. Take the oil radiator support rod.



1. Remove the complete gearbox side bracket.



IMPORTANT:
Disconnect electric wires from clips and shift them away from the engine.

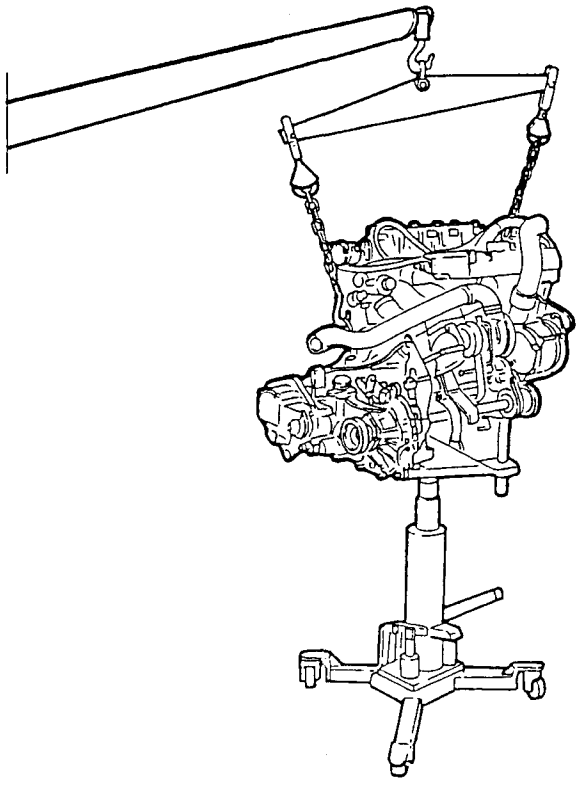
- Lower the hydraulic jack and remove the engine from the engine compartment.

IMPORTANT:
When lowering check there are no attached wires or pipes.

IMPORTANT:
Pay attention not to damage parts.

- Support the engine with an hydraulic lift and the hydraulic jack used for removal.

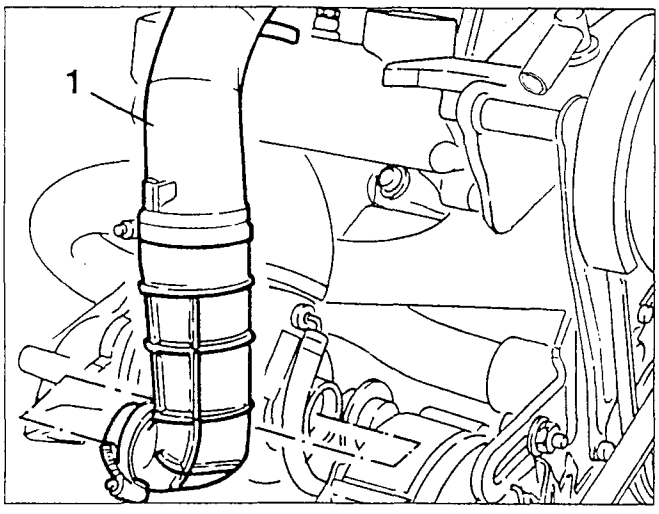
NOTE: Some engines are not equipped with a gearbox side lifting bracket.
In this case, fit the bracket, supplied as a spare part, and torque the fastening screw at 47 ÷ 58 Nm.



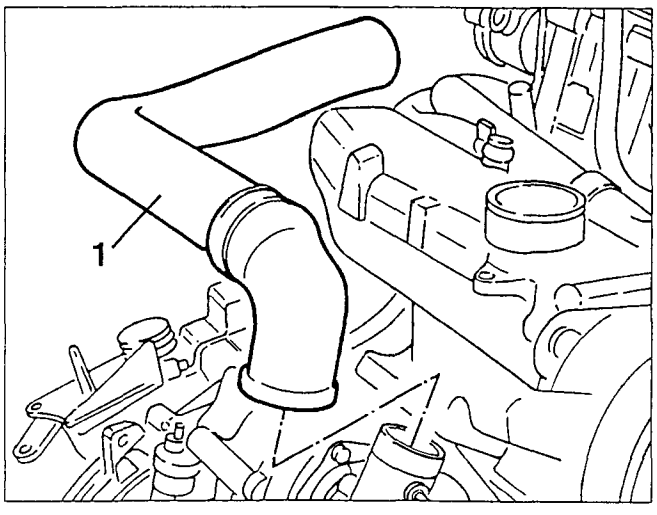
IMPORTANT:
Use a hydraulic crane to move the engine after releasing it from the hydraulic jack.

REMOVING LEFT-HAND SIDE COMPONENTS

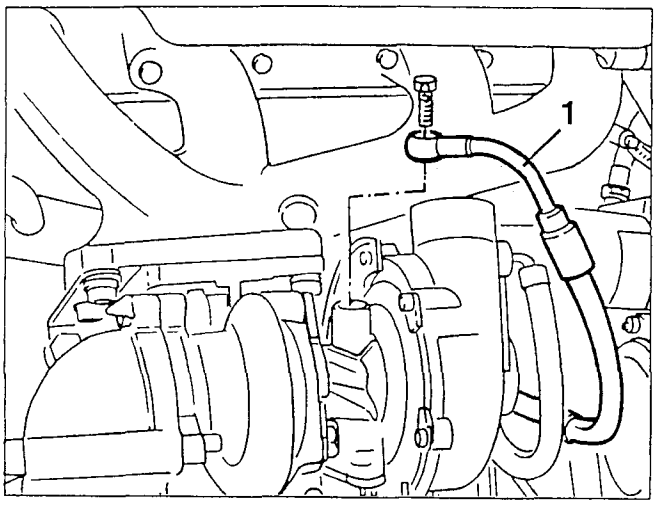
1. Remove the air intake manifold from the turbo compressor.



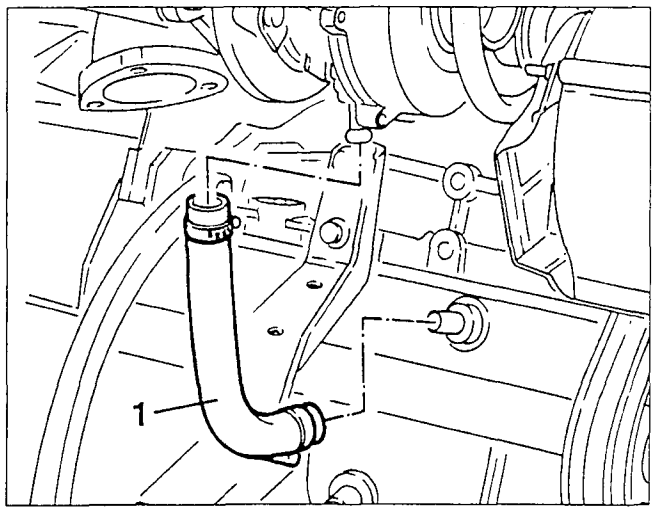
1. Remove the intercooler air intake manifold from the turbo compressor.



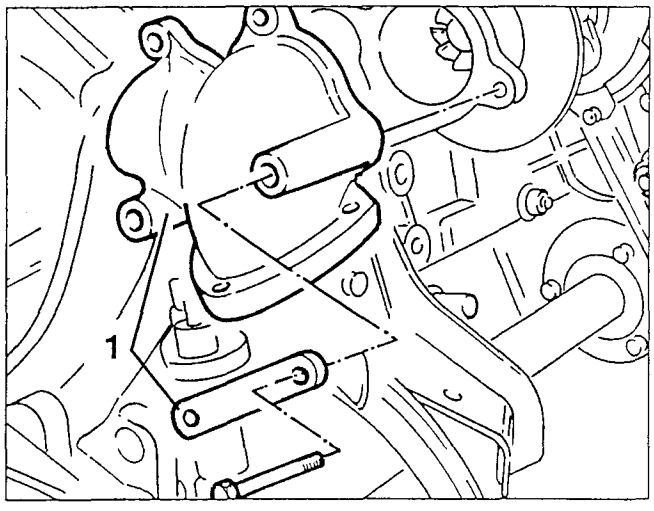
1. Remove the oil delivery pipe from the turbo compressor.



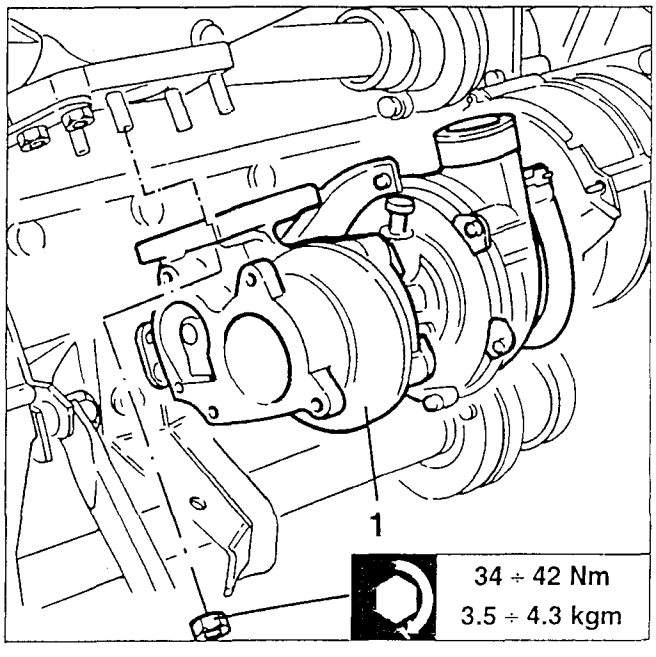
1. Remove the oil return to sump pipe from the turbo compressor.



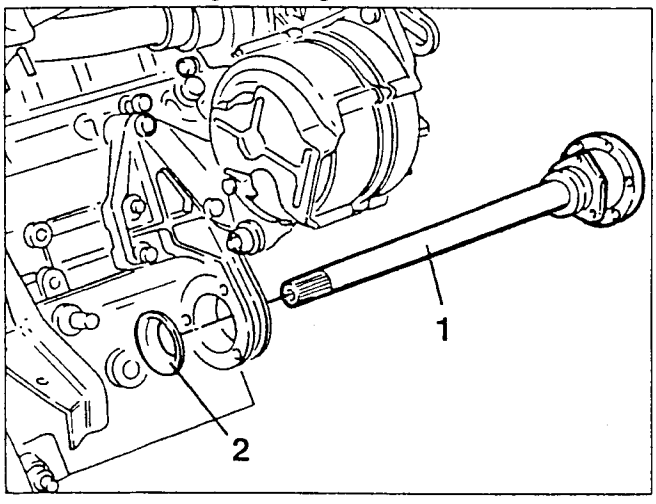
1. Release the safety plates and remove the turbo compressor scroll.



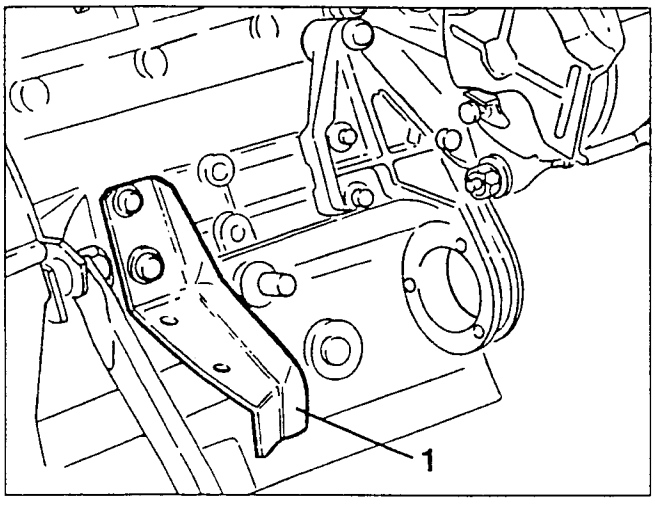
1. Remove the fastening nuts and remove the turbo compressor.



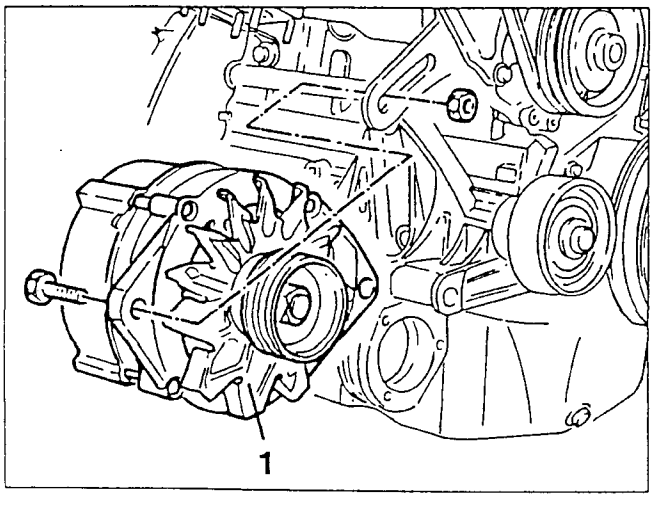
- Drain off oil from the gearbox by unscrewing relative plug.
1. Unscrew the fastening screws and remove intermediary shaft.
2. Remove dust guard ring.



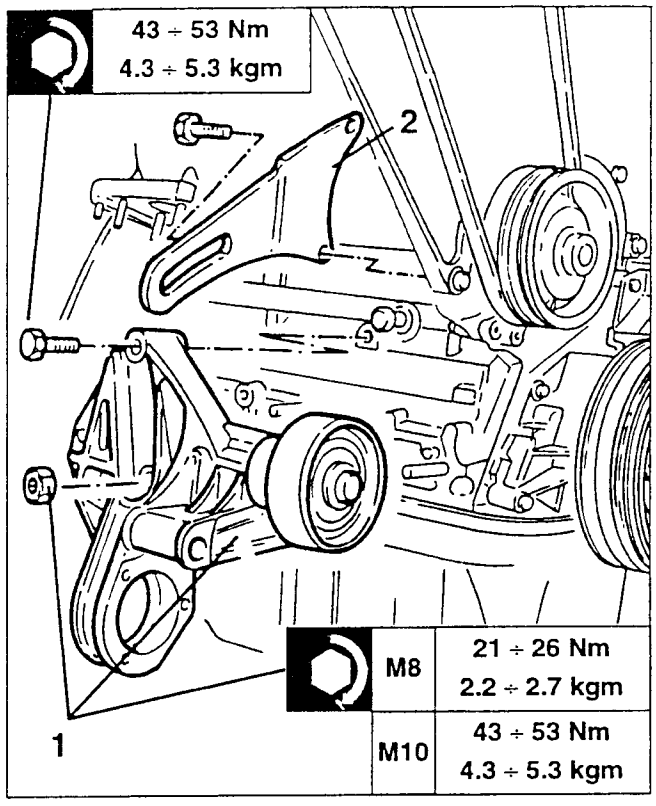
1. Remove the small support plate on the front section of the exhaust pipe.



- Loosen the two alternator fastening bolts and remove the control belt.
1. Unscrew completely the fastening screws and remove the alternator.

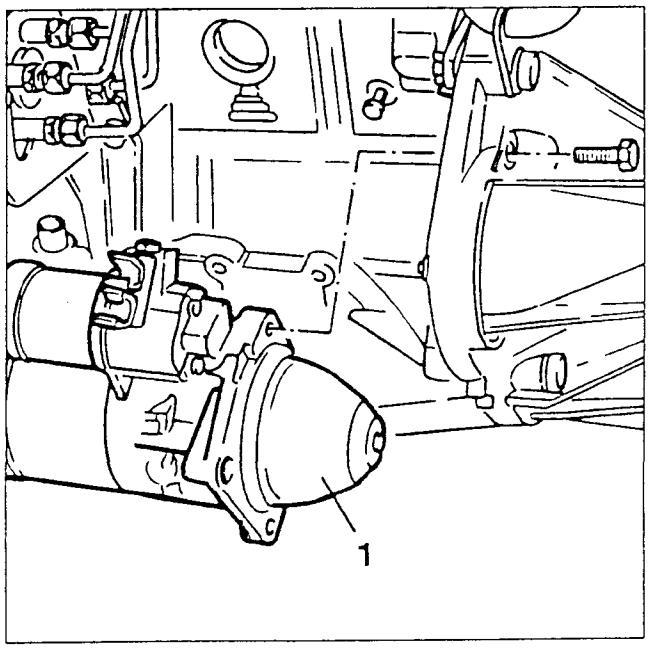


1. Remove the alternator support bracket and the intermediary shaft complete with alternator - water pump control belt jockey pulley.
2. Remove the alternator support upper bracket.

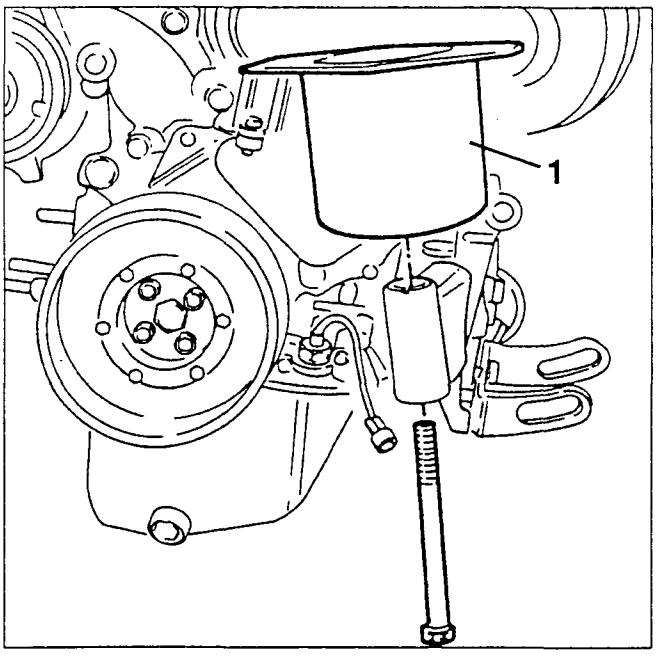


REMOVAL OF RIGHTHAND SIDE COMPONENTS

1. Unscrew the fastening screws and remove the starter motor.



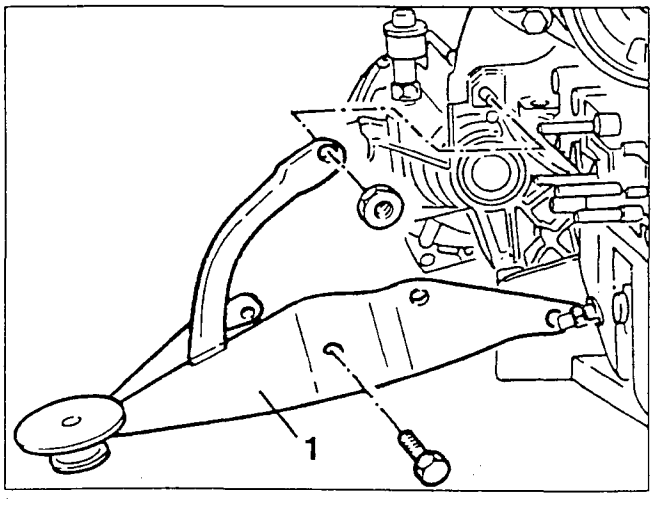
1. Remove the engine unit elastic support timing side.



REMOVAL OF GEARBOX-DIFFERENTIAL GROUP

1. Removal of engine unit rear support.

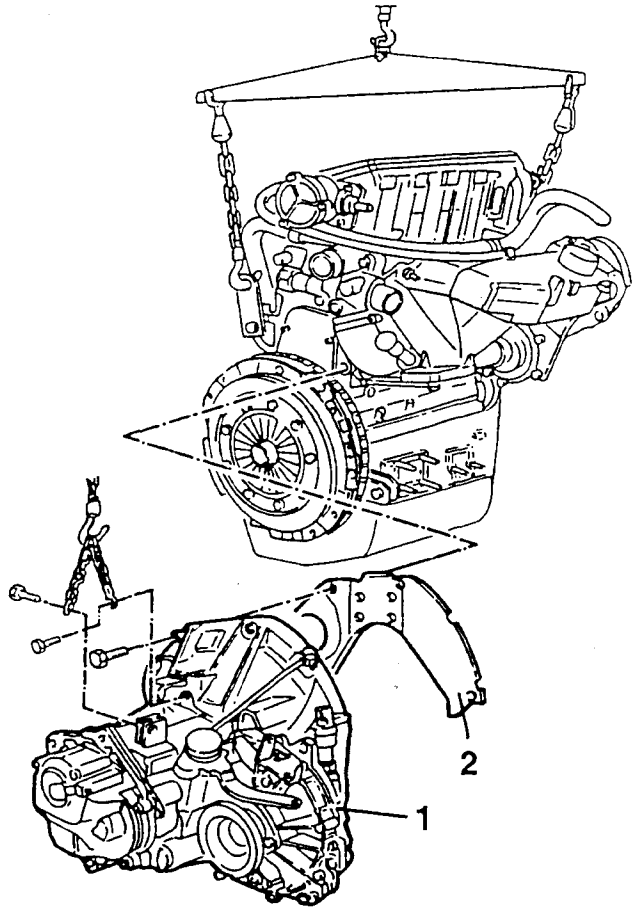
CAUTION:
Stretch the chains of the engine support hydraulic lift, so that the engine is blocked by the support tool when the support is removed.



- Raise the engine enough to separate it from the support tool and the hydraulic jack.

1. Using a hydraulic lift unscrew the fastening screws and remove the gearbox - differential unit from the engine.

2. Recover the protective casing.



NOTE: See the specific volume for complete gearbox overhauling.

REFITTING

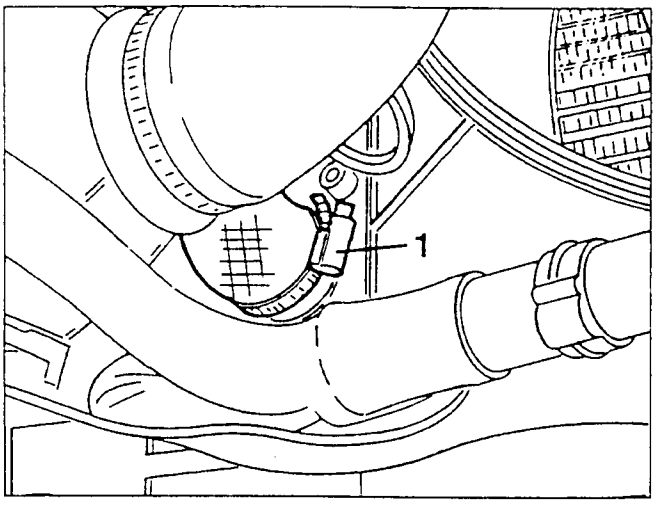
Repeat the above operations in the reverse order and note the following:
- Prepare the engine compartment for the insertion of the engine unit, positioning all the electrical cables, pipes etc. so as to avoid them becoming caught when the engine is installed.
- Be particularly careful when installing the engine unit that the components are not damaged in any way.
- When installation is completed, check belt tensioning, refill the cooling system, the power steering system and the engine lubricating system with the correct amount (see GROUP 00).
- Check the level of oil other fluids.
- Carry out all checks and interventions indicated in GROUP 00.

CAUTION:
Ensure that the engine unit support points are correctly fixed.

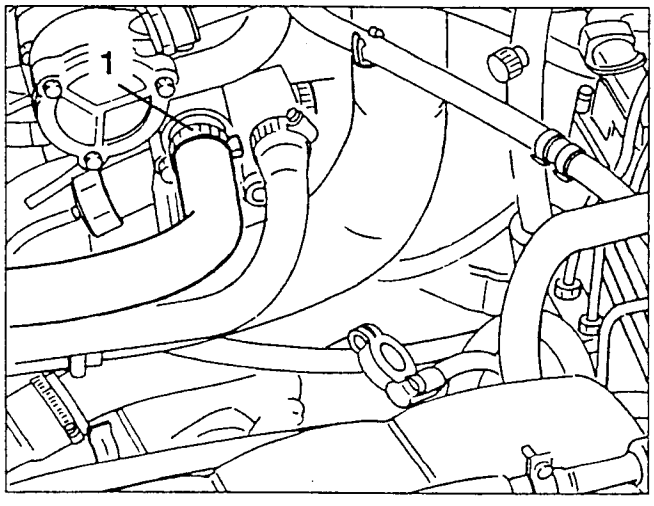
CYLINDER HEADS

REMOVAL/REFITTING

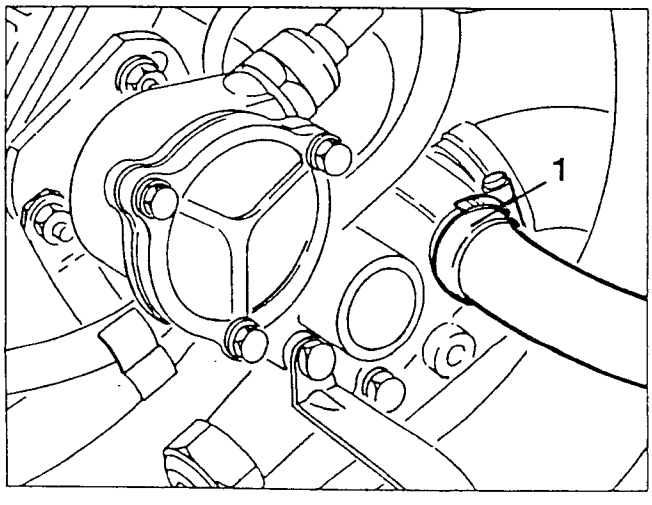
- Remove the battery.
1. Drain off the engine coolant, by disconnecting the liquid from radiator outlet sleeve.



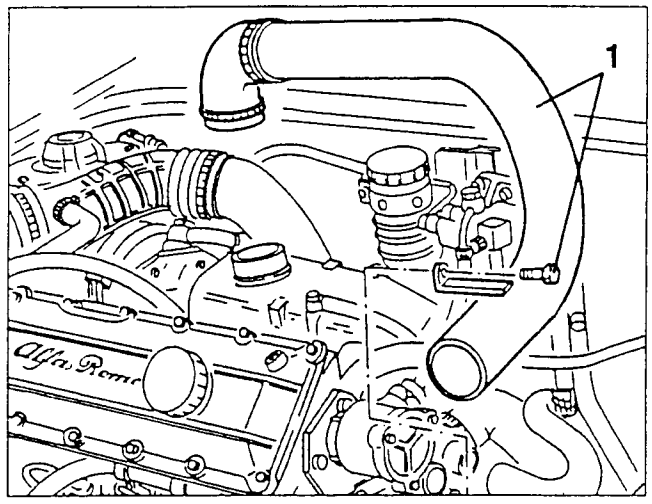
1. Disconnect the engine coolant to radiator delivery sleeve from the thermostatic cup.



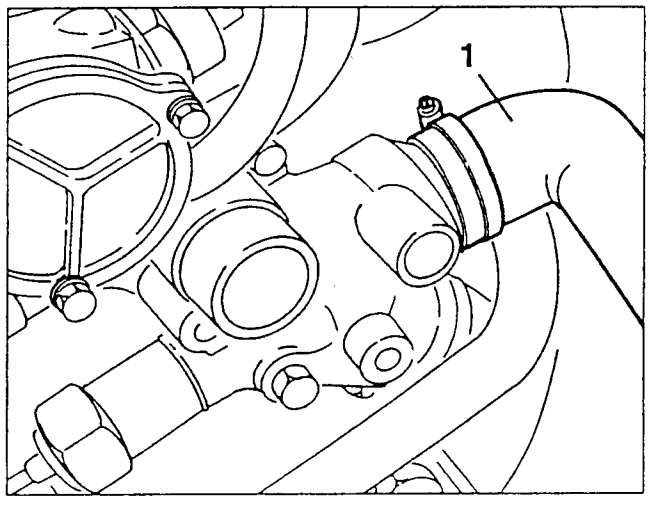
1. Disconnect the system loading sleeve originating from the expansion tank from the thermostatic cup.



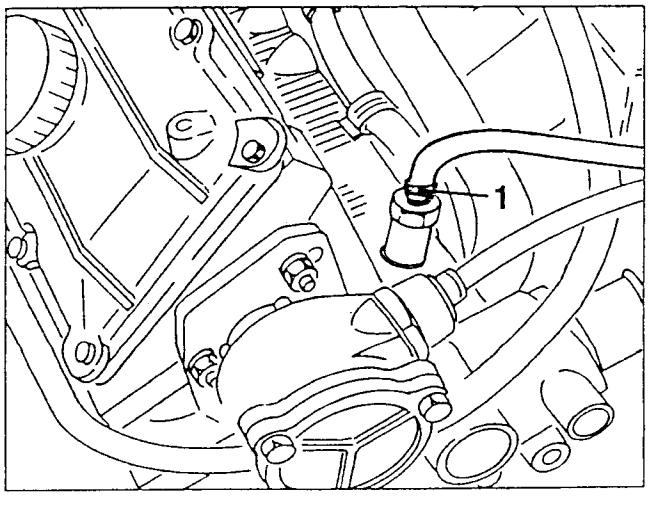
1. Remove the second section of the air from intercooler to air intake box delivery manifold.



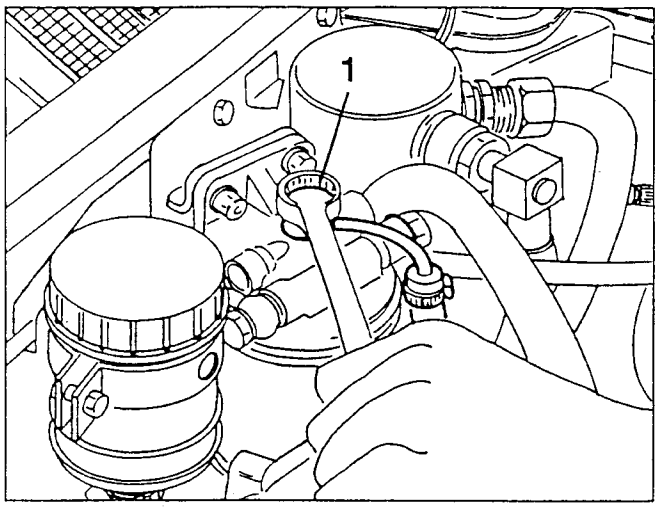
1. Disconnect the engine coolant from radiator return sleeve from the thermostatic cup.



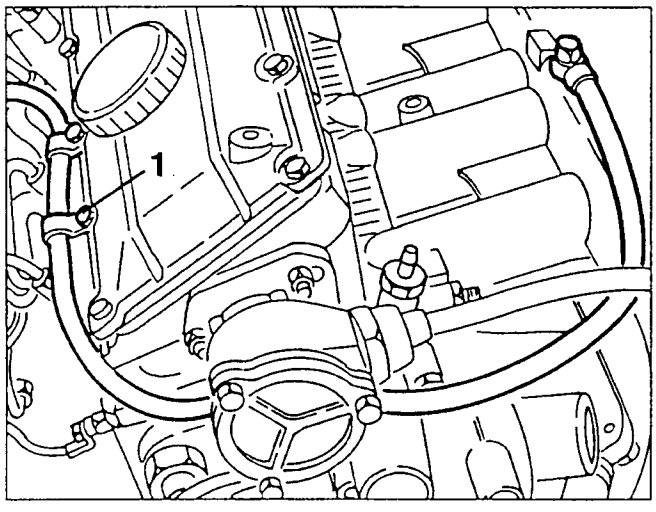
1. Disconnect the engine coolant to expansion tank and deaereating system delivery sleeve from the cylinder heads.



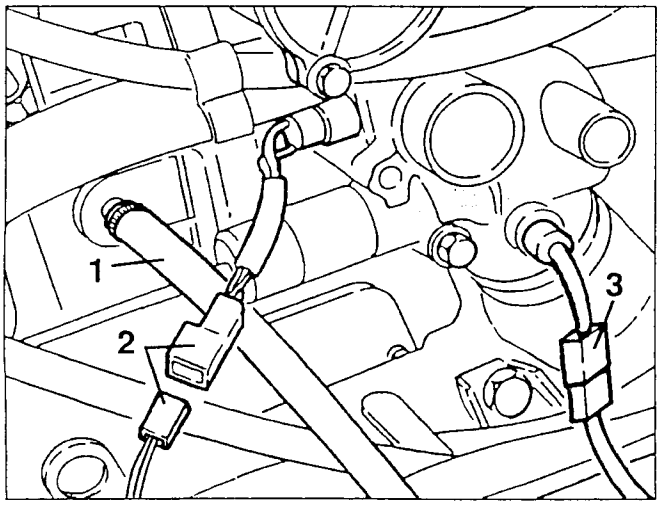
- Disconnect the oil vapour recirculation pipe from the corrugated air intake sleeve.
1. Disconnect the delivery pipe to the injection pump from the fuel filter.



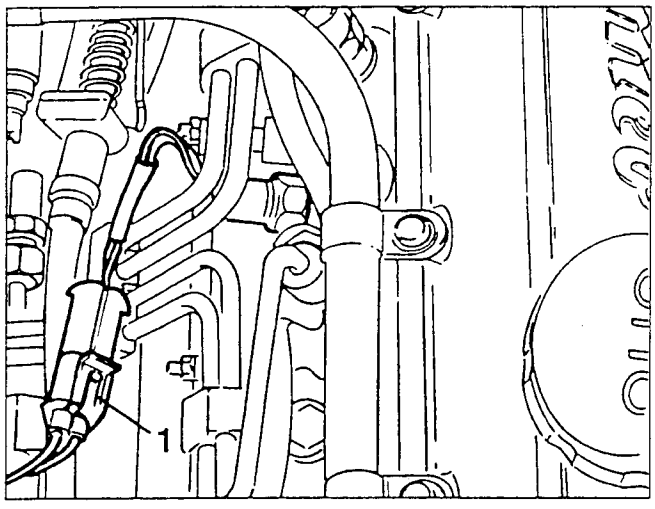
1. Disconnect the overpressure pipe for the flow rate limiting device from the intake box and timing gear cover.



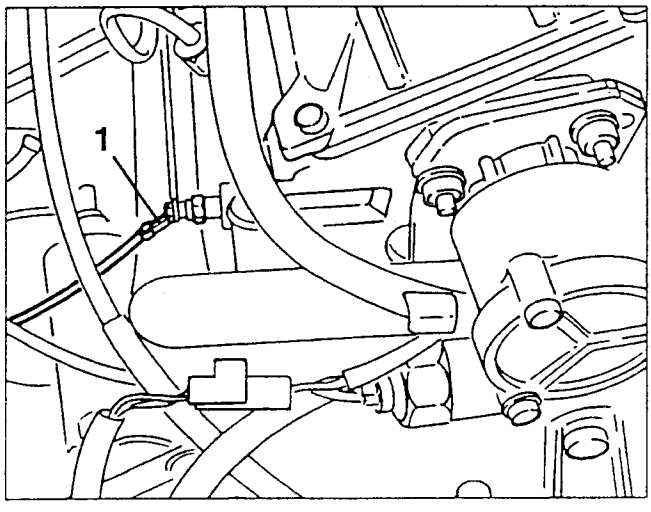
1. Disconnect the engine coolant to heater delivery pipe.
2. Disconnect the electrical connection of the KSB consensus thermoswitch.
3. Disconnect the electrical connection of the conditioner compressor cut-off thermal contact.



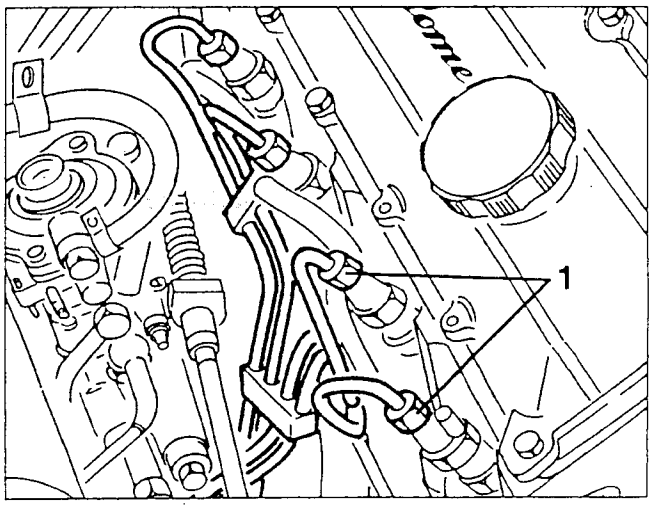
1. Disconnect the electrical connection of the engine coolant temperature indicator transmittor and the maximum temperature warning light contact.



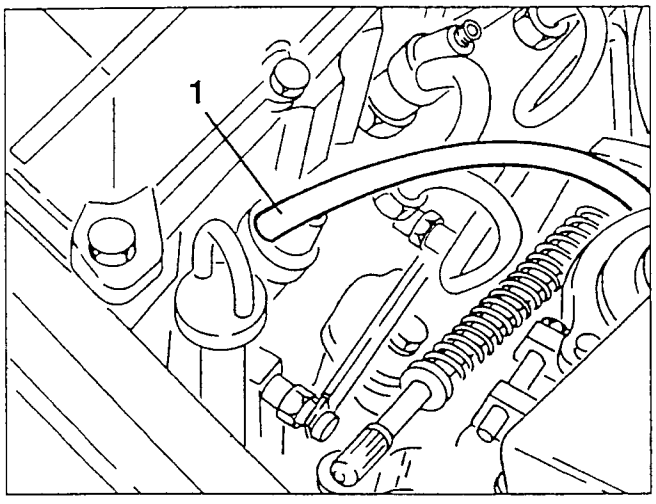
1. Disconnect the heater plugs supply electrical connection.



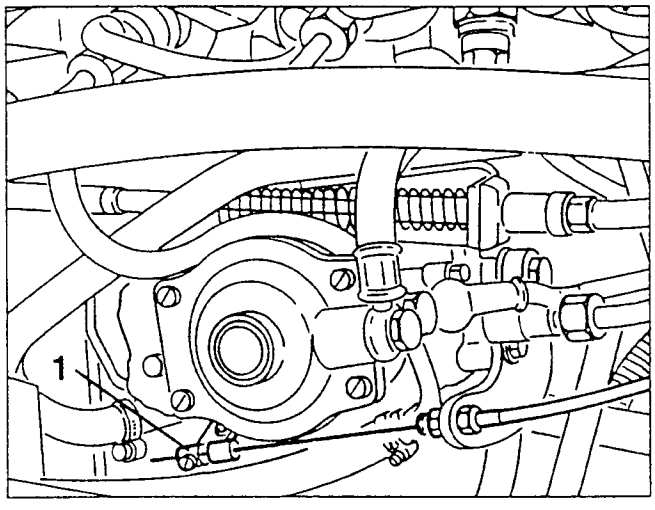
1. Disconnect the fuel from injection pump arrival pipe from the injectors.



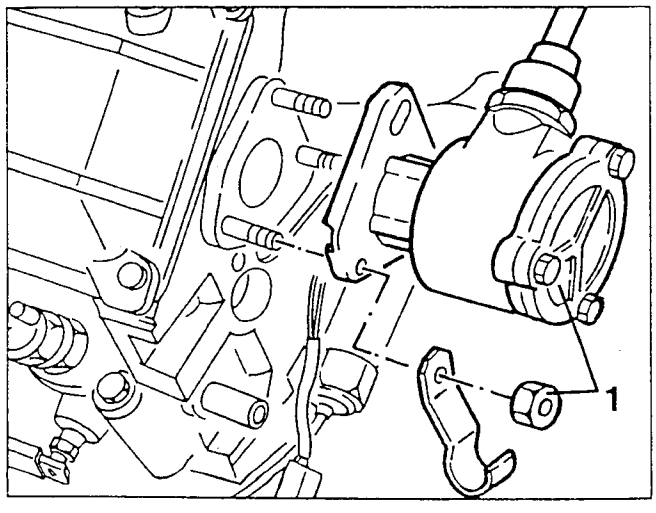
1. Disconnect the fuel return pipe from the injectors to the injection pump.



1. Disconnect the automatic idle speed device from the injection pump.

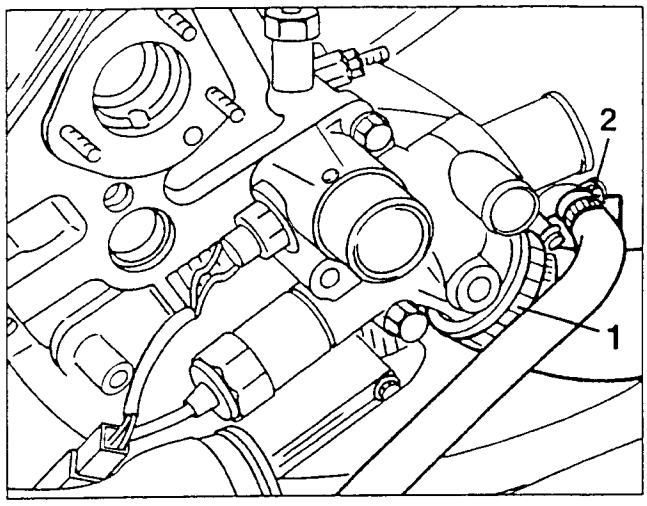


1. Unscrew the screws and remove the rotor vacuum pump for the servo brake from the cylinder heads.

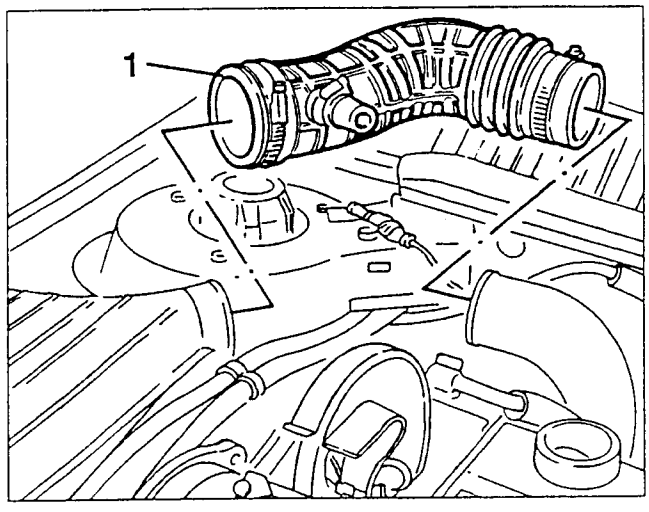


1. Disconnect the sleeve of the engine coolant to pump return manifold from the thermostatic cup.

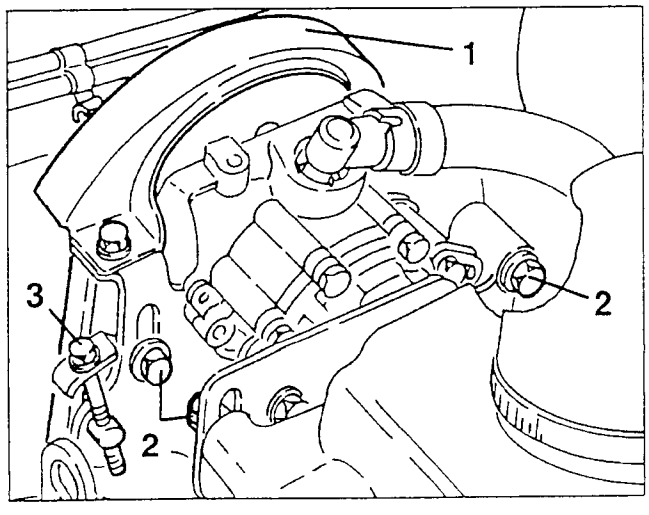
2. From the pump coolant fluid return manifold disconnect the sleeve for the fluid returning from the heater.



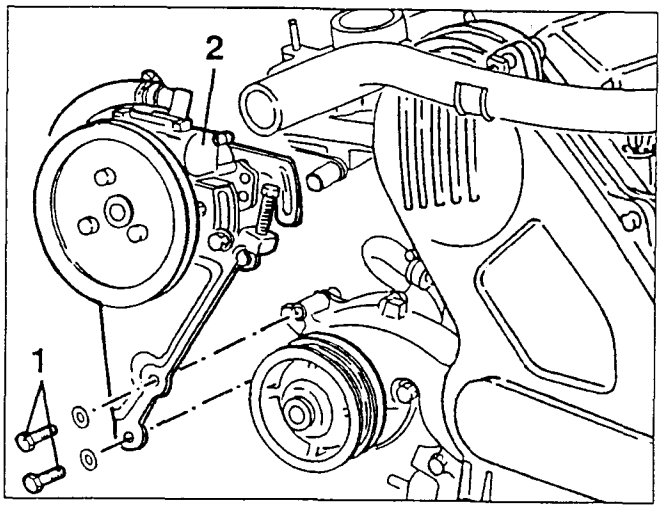
1. Remove the corrugated air from filter to turbocharger intake sleeve.



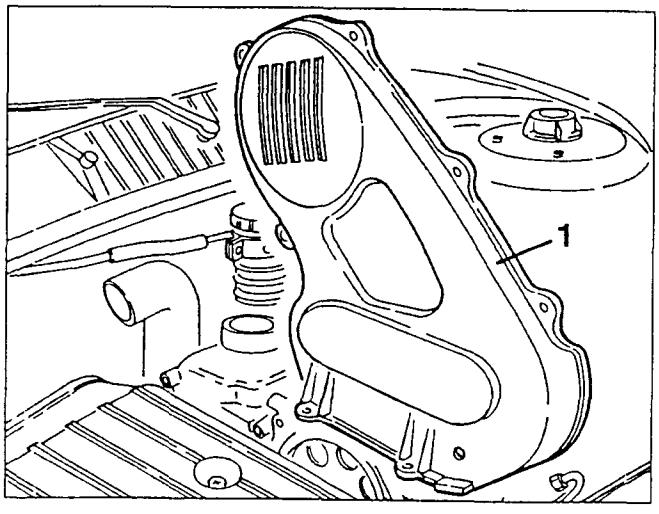
1. Remove the power steering pump belt guard.
2. Loosen the power steering fastening screws, indicated in the figure.
3. Decrease the voltage of the power steering pump control belt by acting on the micrometric tensioning screw.



1. Unscrew completely the screws loosened beforehand and the two screws indicated in the figure.
2. Remove the power steering pump complete with front bracket without disconnecting the tubes and move them sideways.

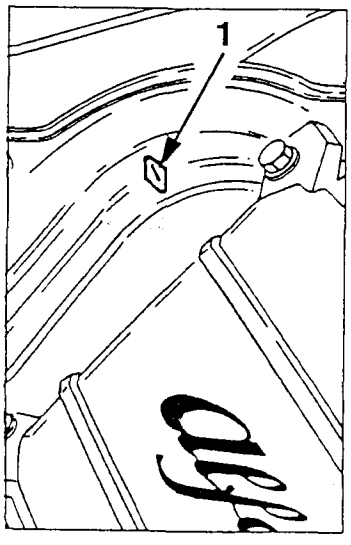


1. Remove the timing belt front cover.

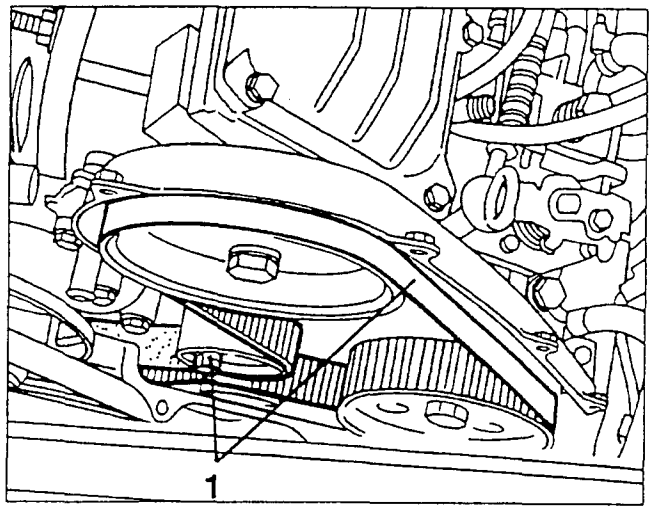


- Remove the right front wheel and mud flap.

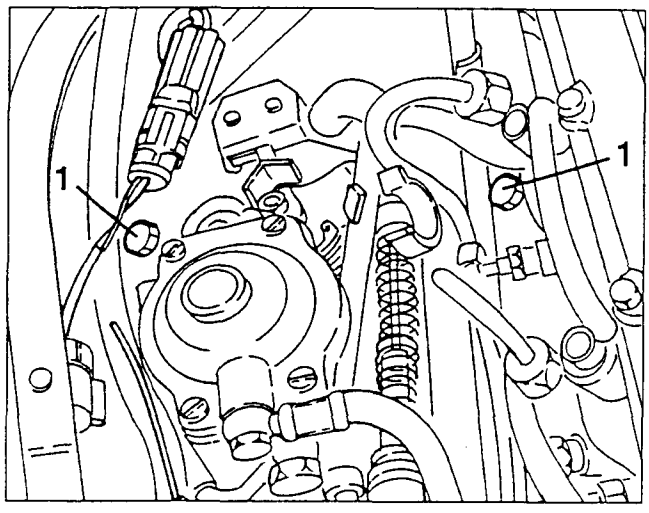
1. Acting on the auxiliary part belt control pulley, rotate the crankshaft in order to rotate the camshaft control pulley so that the notch engraved on it corresponds with the hole on the timing belt rear cover.



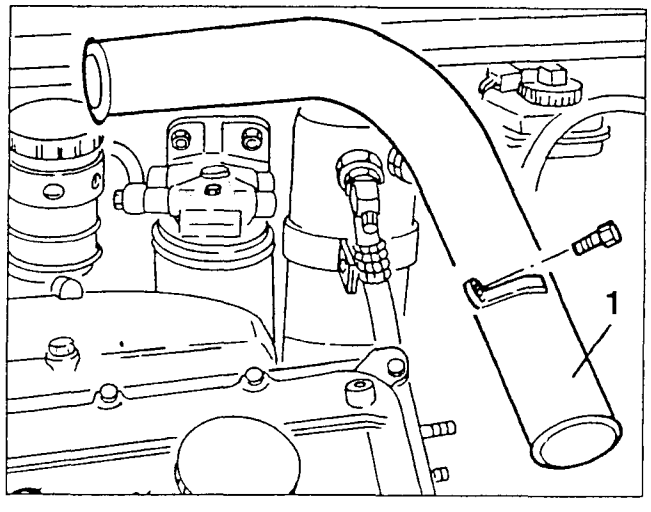
1. Loosen the jockey pulley fastening screw and extract the timing belt from the camshaft control pulley.



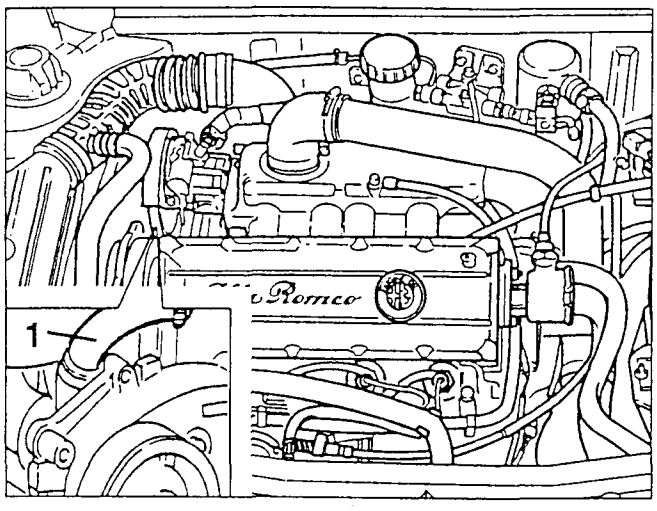
1. Unscrew the screws securing the timing belt rear cover.



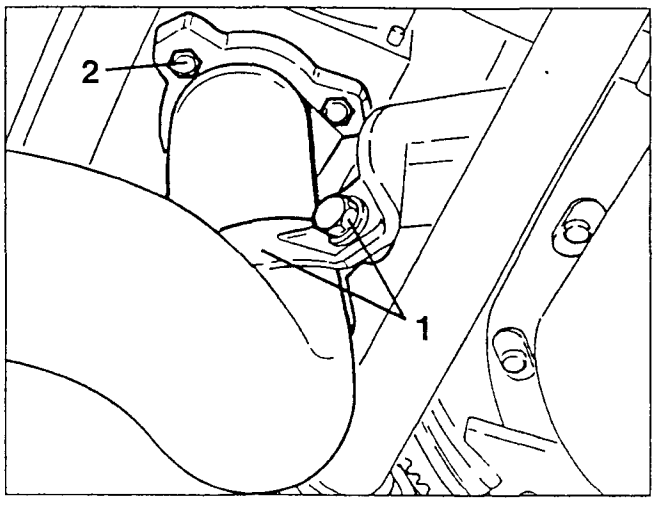
- Unscrew the screws securing the engine oil level dipstick.
1. Remove the first section of the air delivery manifold from the turbocharger to the intercooler.



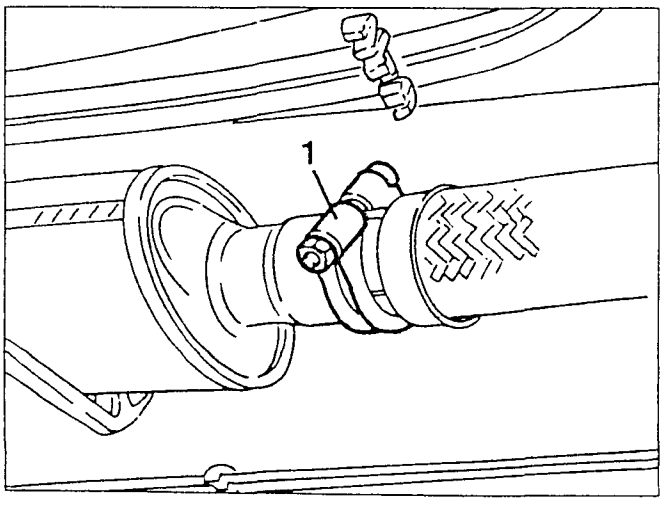
1. Disconnect the engine coolant to pump return pipe from the cylinder heads.



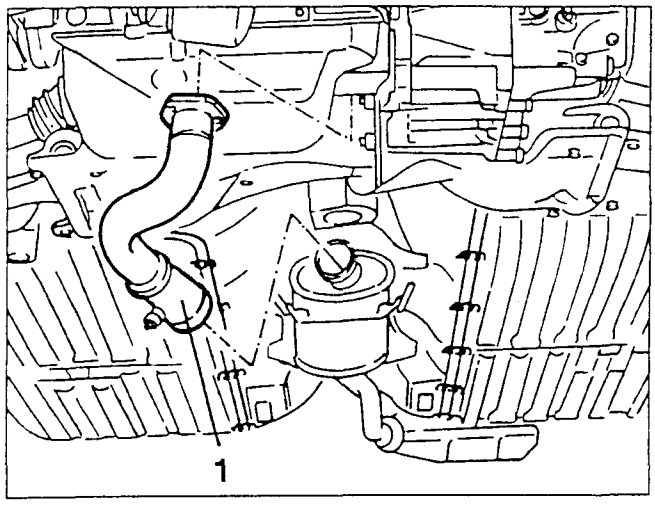
- Raise vehicle.
1. Remove the support clamp on the first section of the exhaust pipe.
2. Unscrew the screws securing the flange which connects the front section of the exhaust pipe to the turbocharger.



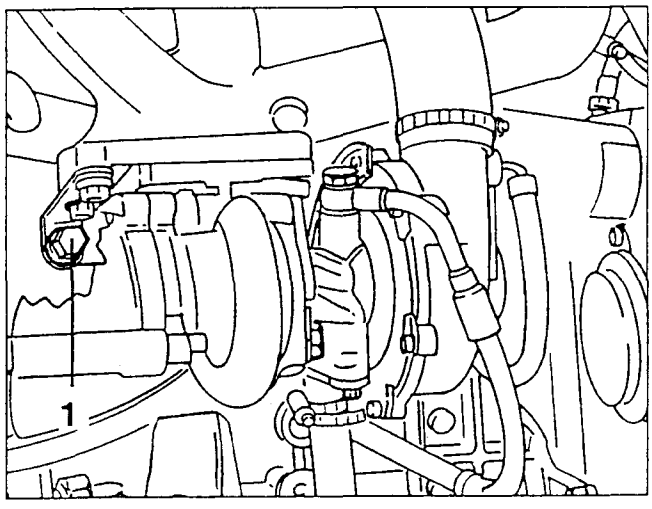
1. Loosen the clamp securing the front section of the exhaust pipe to the central section.



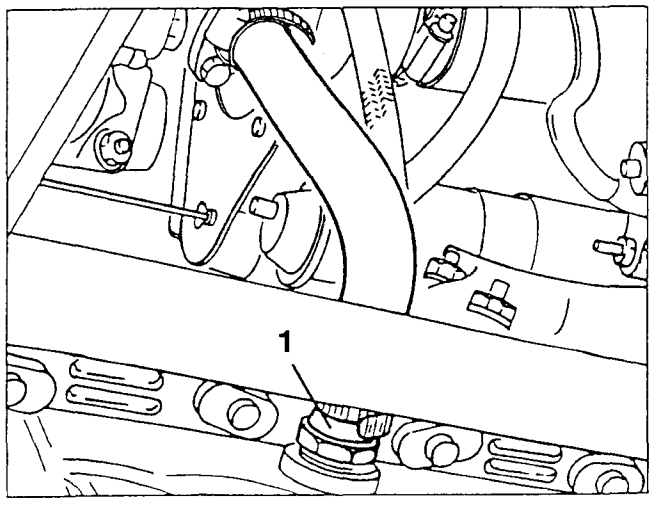
1. Remove the front section of the exhaust pipe.



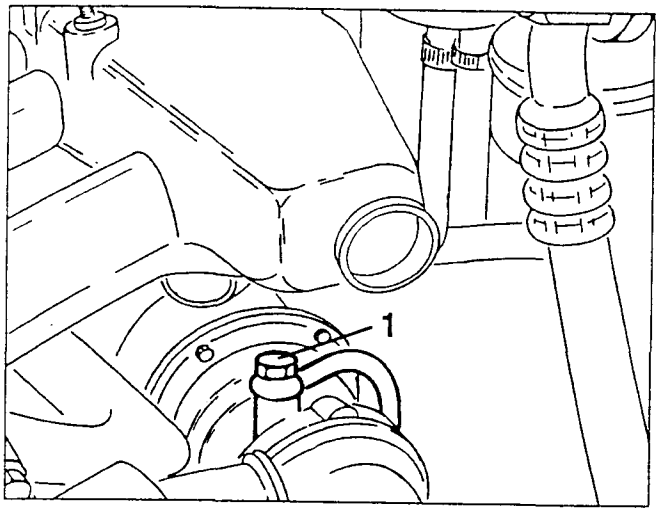
- Remove the support to the front section of the exhaust pipe.
1. Unscrew the screw securing the turbocharger support bracket to the engine block.



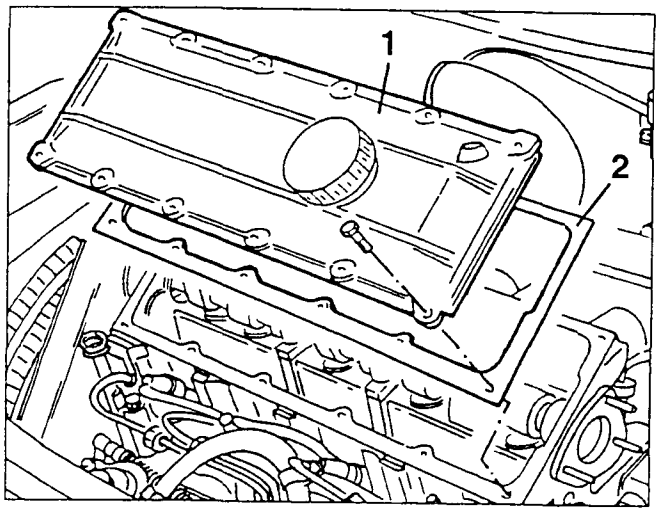
1. Disconnect the oil from turbocharger return pipe from the sump.



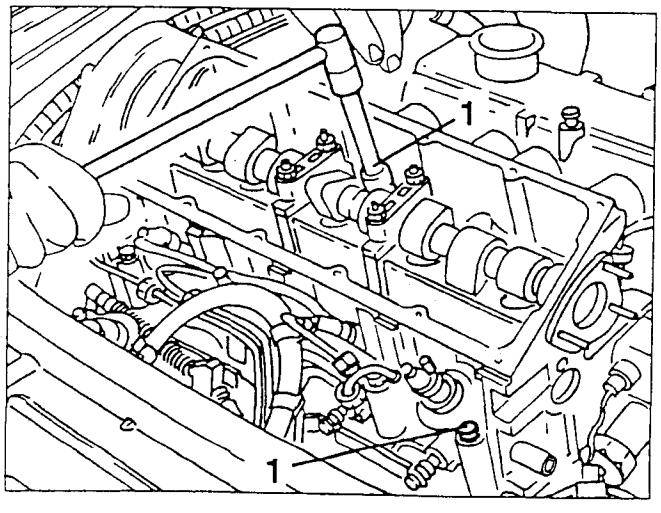
- Raise vehicle.
1. Disconnect the oil arrival pipe from the turbocharger.



1. Unscrew the screws and remove the timing cover.
2. Remove gasket.

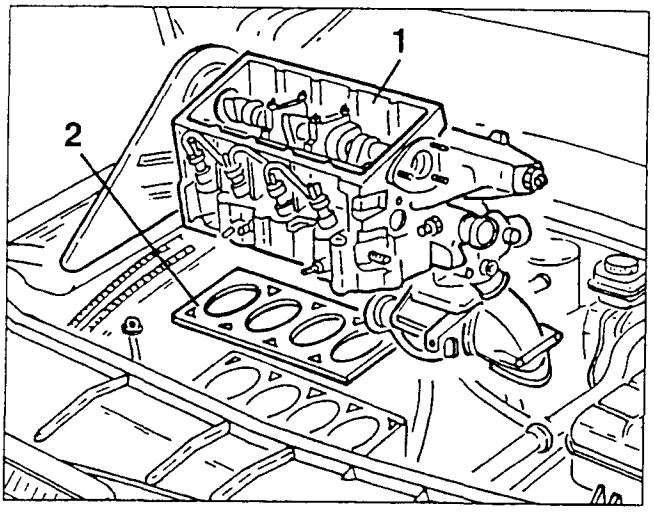


1. Unscrew the screws securing the cylinder heads.

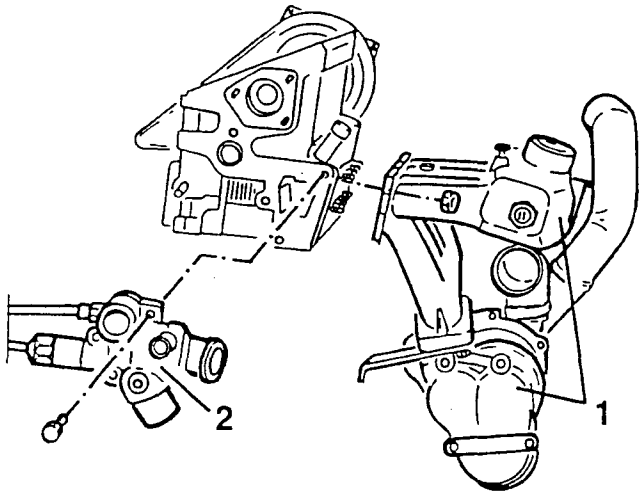


1. Remove complete cylinder heads (two operators necessary).

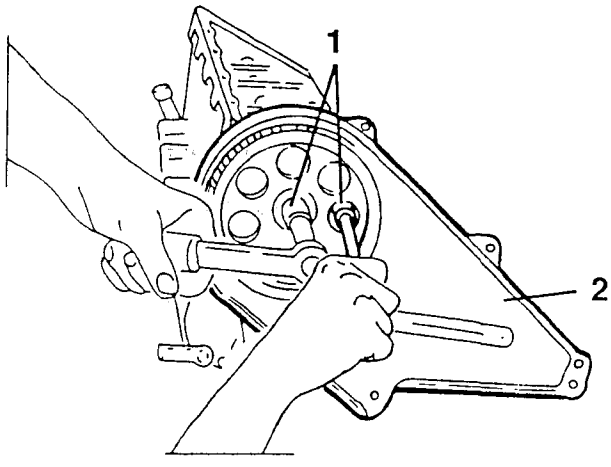
2. Remove gasket.



1. At the bench, remove the air intake box and the exhaust manifolds with turbocharger from cylinder heads.
2. Remove the thermostatic cup from the cylinder heads.



1. Using a wrench of 13 mm, unscrew the screws and remove the timing control pulley.
2. Remove the timing belt rear cover.



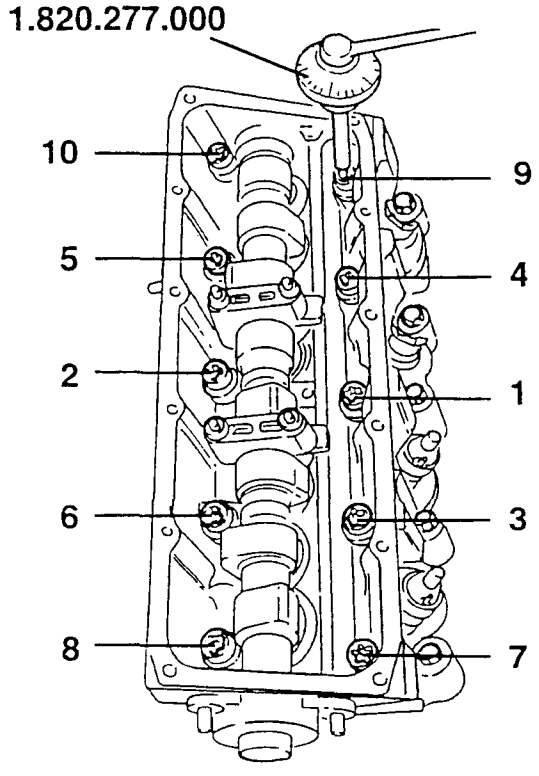
WARNINGS FOR REFITTING

Repeat the above operations in the reverse order taking note of the following indications:
- Position a new cylinder head gasket on the engine block making sure that it is the same thickness as the one that has been removed.

NOTE: **The cylinder head gasket is the ASTADUR type.**
This gasket, due the special material from which it is made, undergoes a polymerization process when the engine is functioning so that it hardens significantly.

INSTALLING CYLINDER HEAD GASKET
In order that the polymerization process takes place, the following indications should be adhered to:
- keep the gasket in its packaging;
- only remove it from the packaging a short time before installation;
- do not lubricate or dirty the gasket with oil;
- during installation, thoroughly clean the surfaces of the cylinder heads and the engine block.

- Install the complete cylinder head on the engine block.
- Tighten the **internal screws** securing the cylinder heads operating as described below and follow the tightening order indicated in the figure.



- Tigheten the **internal screws** to a toque of 100 Nm (10.2 kgm).
- Tighten the **internal screws** with angle of 90° + 90° with tool N° 1.820.277.000.
- Tighten **external** cylinder head **screws** to the engine block to the prescribed torque:

26 ÷ 32 Nm **2.6 ÷ 3.2 kgm**

NOTE: **For external cylinder head screws no particular order need be followed.**

CAUTION:
The ASTADUR gaskets are connected with cylinder heads screws of the tighten *to yield point* type.
If the ASTADUR gasket is used, it is no longer necessary to tighten the cylinder screws.

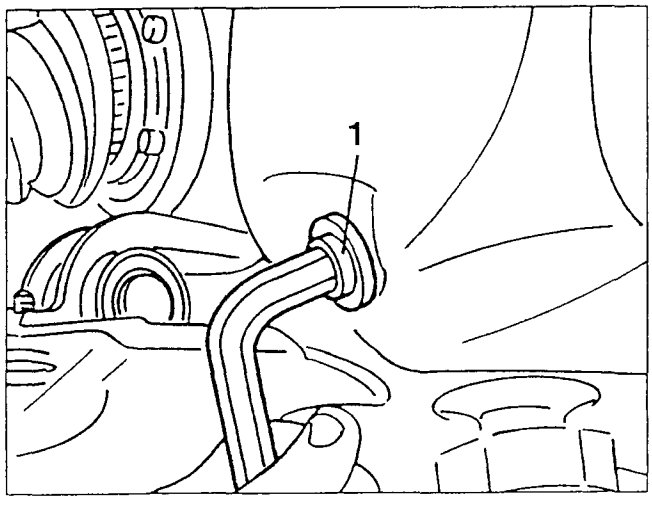
To install the timing drive belt, and check the timing, installation and tensioning of the power steering drive belt, see GROUP 00.

OIL SUMP

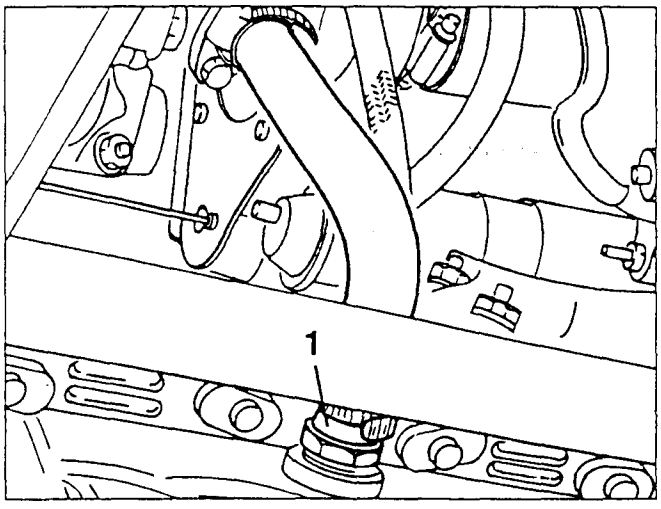
REMOVAL/REFITTING

- Position the vehicle on the lift.
- Disconnect the negative (-) battery cable.
- Raise the vehicle.

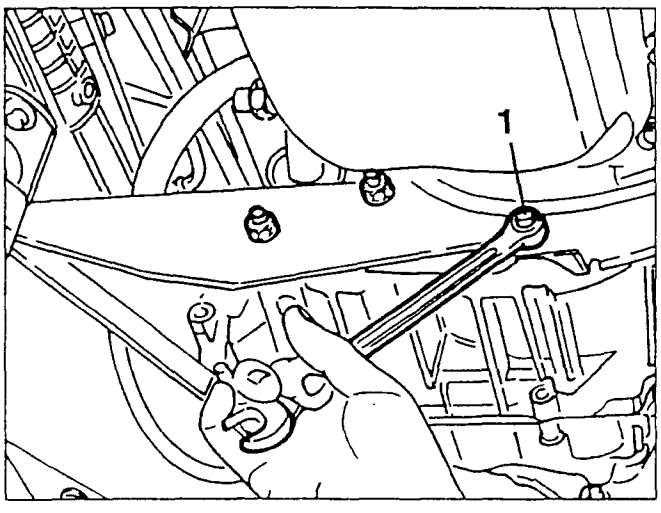
1. Unscrew the plug, leave the engine oil to drain, and recover it in a suitable container.



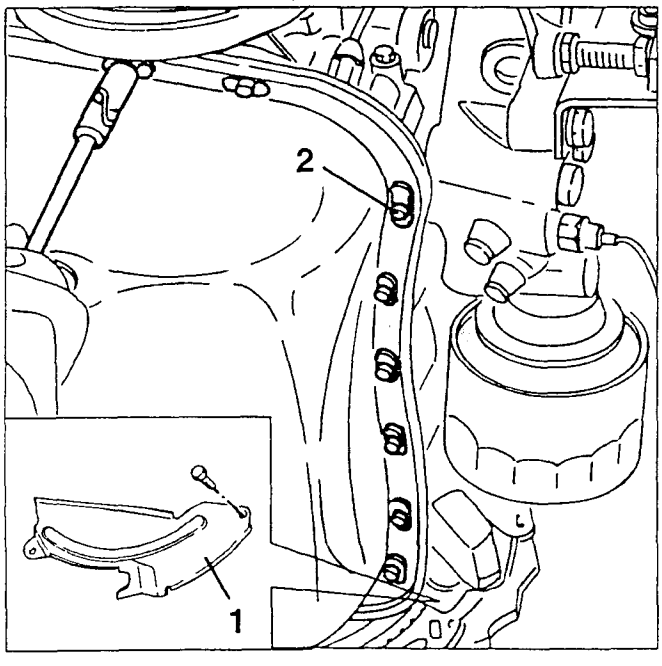
1. Disconnect the oil from turbocharger return pipe from the sump.



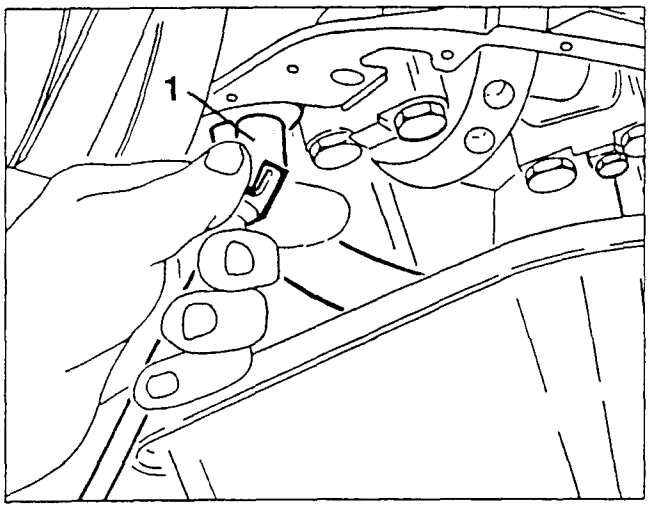
1. Loosen the front nut securing the gearbox to the relative support bracket.



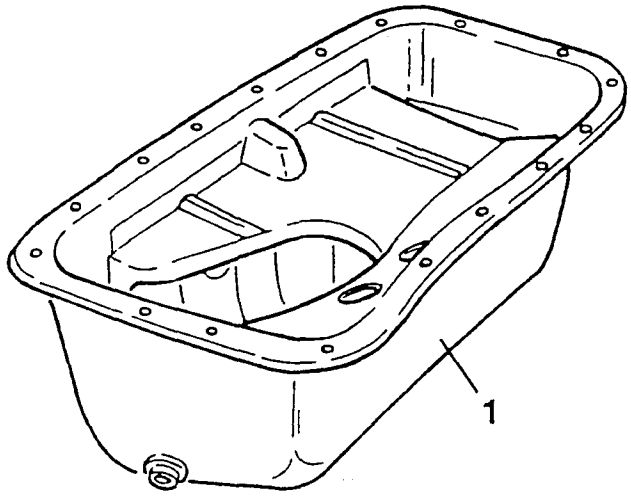
1. Unscrew the screws and remove the flywheel protection.
2. Unscrew the oil sump screws.



1. Lower the sump enough to loosen the oil pump suction device screws.

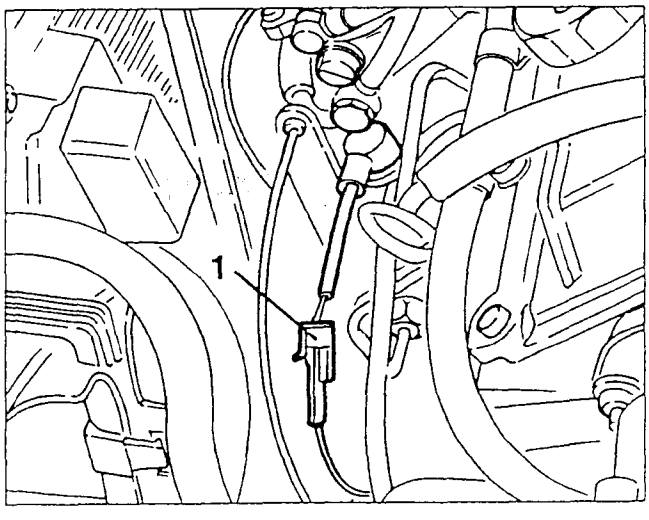


1. Remove the oil sump and the relative gasket.

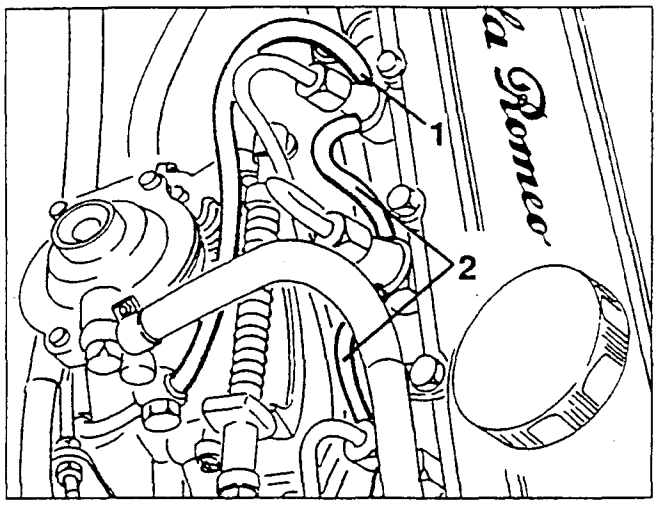


CYLINDER COMPRESSION TEST

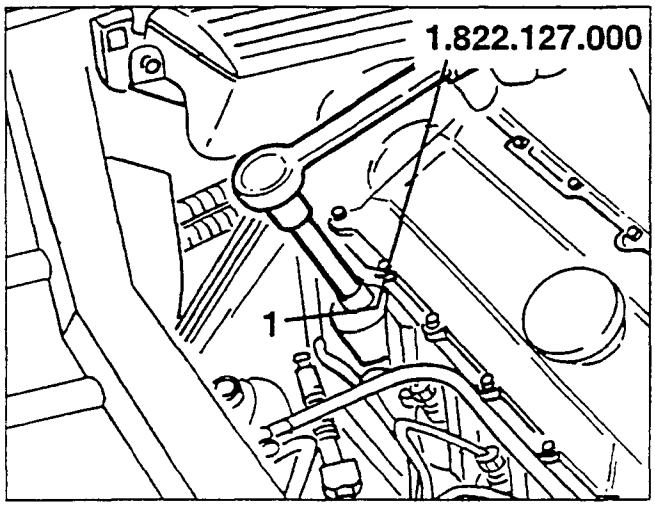
- Start up engine and bring it to a normal running temperature.
1. Turn off engine and disconnect the electrical connection of the engine stop solenoid valve.



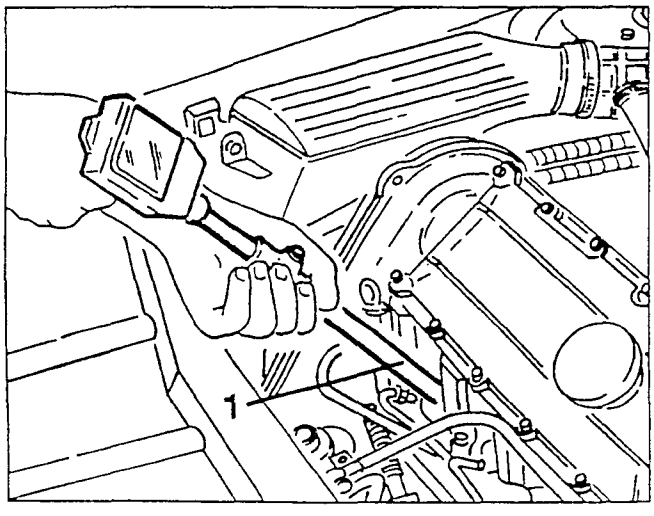
1. Disconnect the fuel to injection pump return pipe from the injectors.
2. Disconnect the fuel from injection pump arrival pipe from the injectors.



1. Remove the injectors from the cylinder heads using tool N° 1.822.127.000.



1. Using a suitable tool and operating as indicated by the manufacturer, carry out the cylinder compression test.



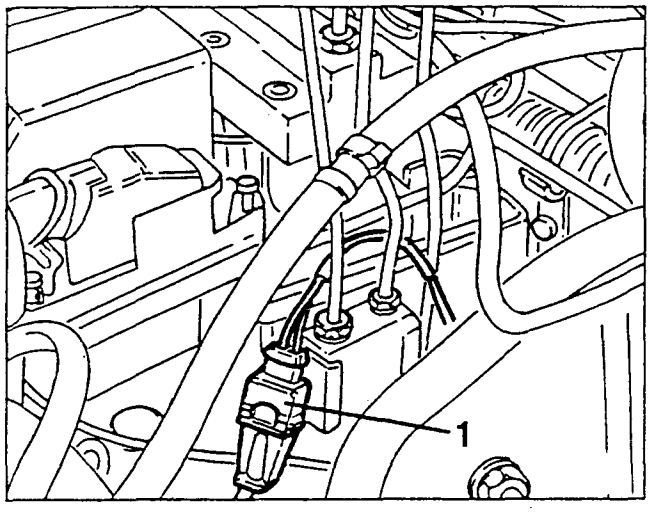
NOTE: If the pressure values in the cylinders are significantly different, search for the causes by checking the valve seals and, if necessary, the elastic seal rings and the pistons.

RPM SENSOR

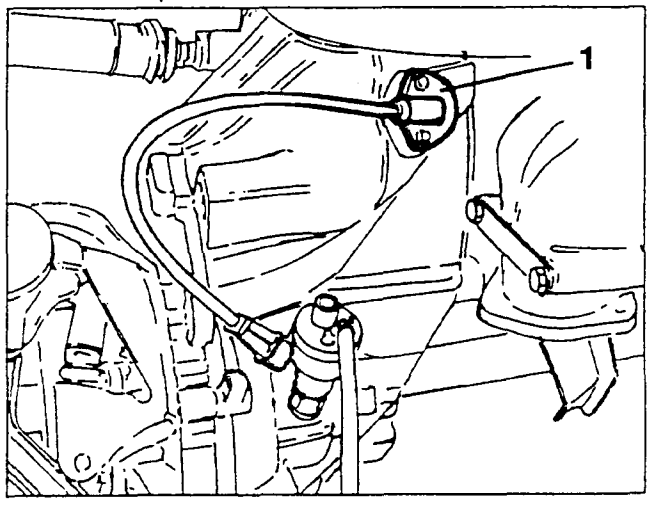
This is fitted on the flywheel ring gear so that it constantly reads the engine rpm.
The sensor is inductive and detects engine rpm through the change in the magnetic field produced by the passage of the teeth of the flywheel ring gear.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the rpm sensor connection.



1. Raise the car, slacken the fastening screw and remove the rpm sensor.

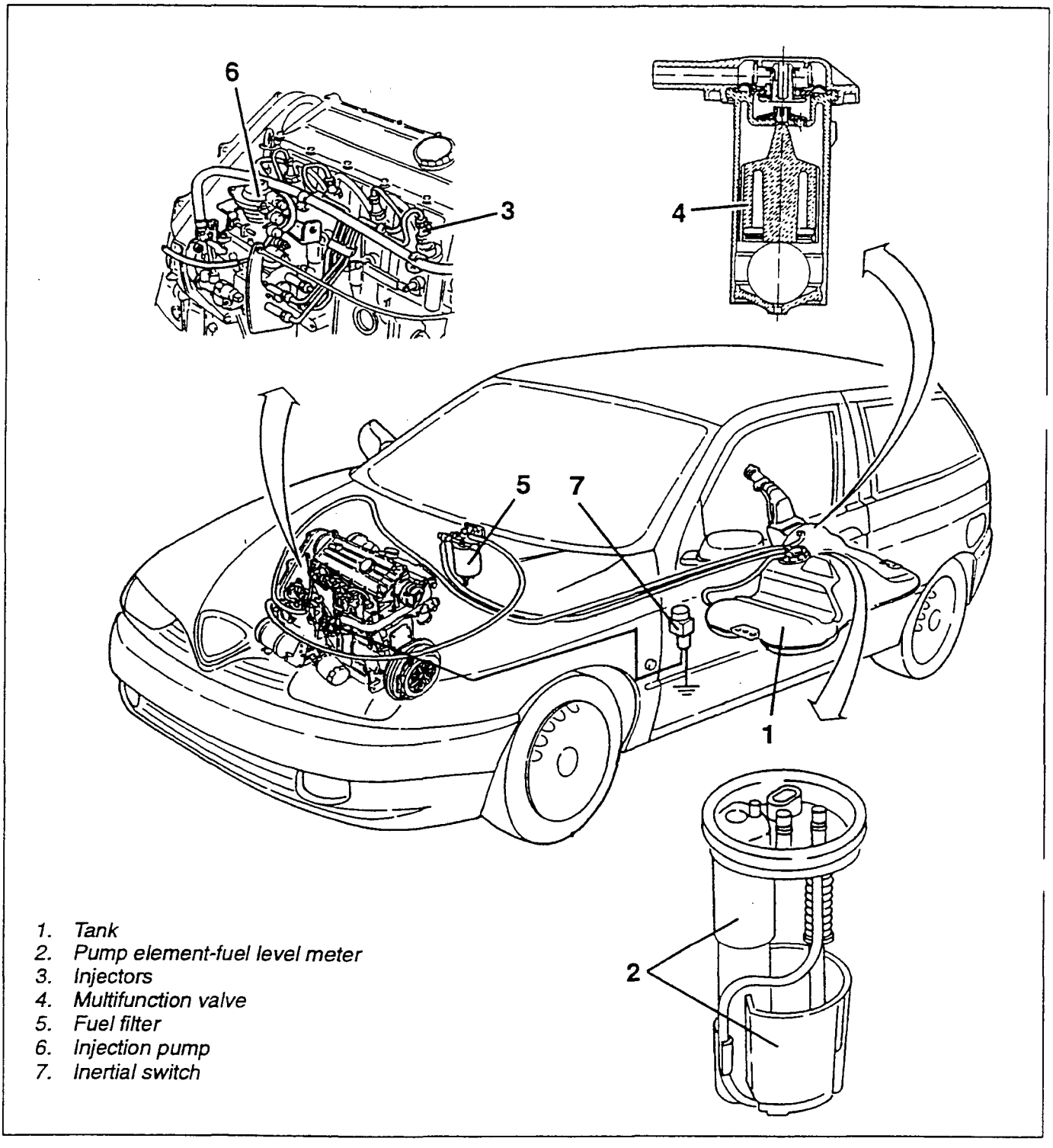


CHECKING THE GAP

For this procedure refer to Boxer 16V engine.

Gap	0.25 ÷ 1.3 mm

FUEL SUPPLY SYSTEM DESCRIPTION



1. *Tank*
2. *Pump element-fuel level meter*
3. *Injectors*
4. *Multifunction valve*
5. *Fuel filter*
6. *Injection pump*
7. *Inertial switch*

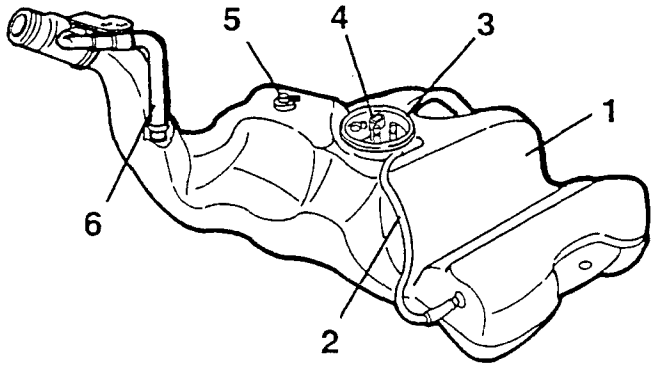
The fuel supply system consists of a suction device, situated in the tank, through which the fuel is sucked, filtered and sent to the fuel filter.
Here it is filtered and, if necessary, heated; it is then sent to the injection pump which sends it under pressure, through suitable metal pipes, to the injectors which force it into the precombustion chamber.
A pipe collects the fuel which has been drawn by the injectors and sends it to a three way connector on the injection pump from where, together with any excess fuel, it returns to the tank.
The fuel supply system is fitted with an inertial switch located under the driver's seat, which is triggered in the event of a crash cutting of the circuit that supplies the engine stop electromagnet on the injection pump thereby stopping the engine immediately.

CAUTION:
Before operating on any of the fuel supply components, closely follow the indications below:
- Check that all the necessary safety equipment is available in the workshop (extinguishers, etc.).
- Disconnect the battery earth cable to avoid the voltage cables accidentally coming into contact with the bodywork causing sparks which may cause fires.
- Place the drained fuel in a suitable container with a safety lid.
- Do not smoke or use naked flames nearby.

Note regarding refuelling:

Pay very close attention that the fuel tank is not accidently filled with petrol; if this should happen, **do not start the engine**, but empty the tank and bleed the entire diesel supply system; if these indications are not followed the engine will be seriously damaged.
Always refuel before the tank is completely empty, to prevent air from entering the supply system; if this happens the entire system must be bled before the engine is started.

FUEL TANK



1. *Tank*
2. *Air breather pipe between the low and high part of the tank.*
3. *Pump element-fuel level meter*
4. *Filler neck*
5. *Multifunctional valve*
6. *Antibubbling pipe*

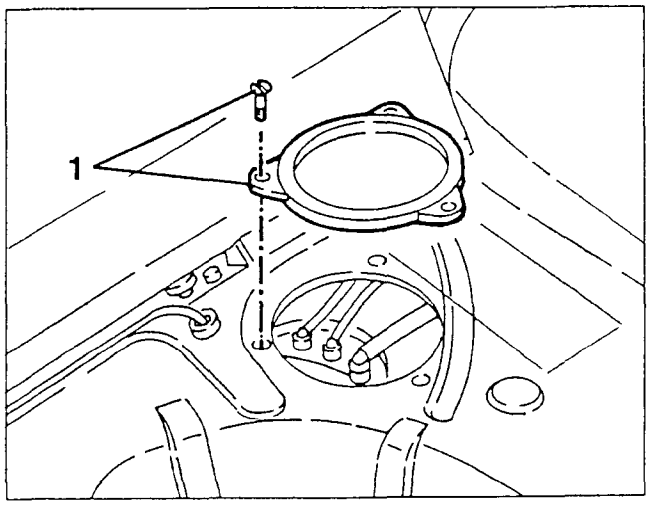
The fuel tank is made from plastic and has a capacity of **51 litres**, including a **5 ÷ 8 litres** reserve.
The refuelling neck is integrated into the main part of the tank which is fitted with the most recent type of filler cap.
A mechanism within the cap ensures that it is tightened to the prescribed torque; overtightening is prevented by a clicking device.
The tank is fixed under the body in correspondance with the parcel shelf and the back seat, there is a compartment designed in the most suitable way to prevent interference with the rear suspension axle.
The particular shape of the tank requires a breather pipe which allows air to be taken in the upper part of the tank during refuelling.
The corrugated pipe on the filler neck acts as an antibubbling pipe.
Higher up, the tank has an opening which houses the suction device - fuel level meter assembly and the multifunctional valve.

REMOVAL/REFITTING

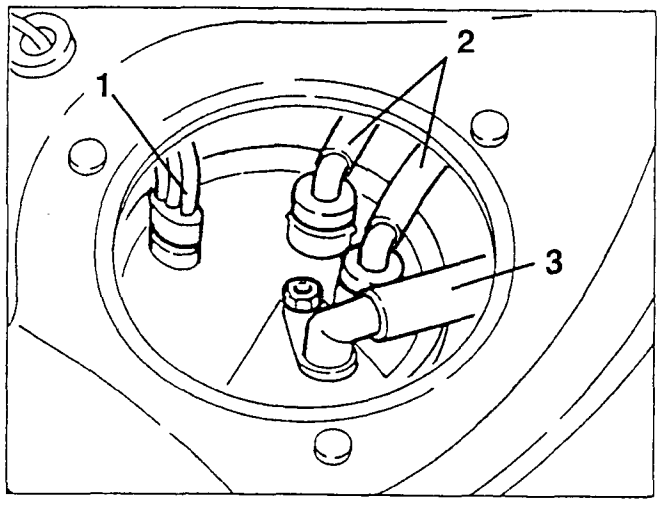
- Position the vehicle on a lift.
- Disconnect the battery (-) terminal
- Empty the tank by sucking the fuel through the filler neck with a suitable pump.

CAUTION:
Place the fuel drained from the tank in a suitable container.

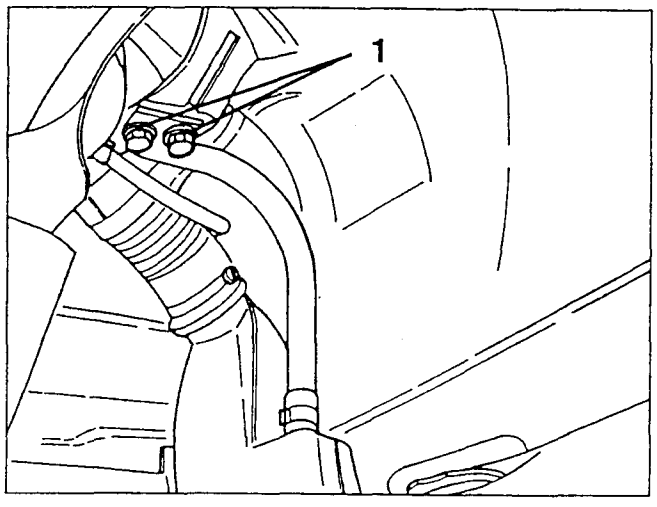
- Remove the rear right wheel.
1. Working from the luggage compartment, pull back the trim and remove the lid to gain access to the pump elemento-fuel level meter.



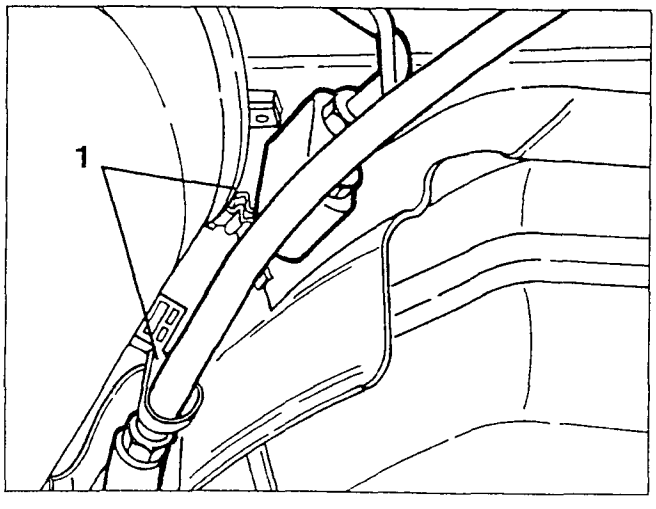
1. Disconnect the electrical connection from the fuel level meter.
2. Disconnect the connection from the fuel delivery and return hoses.
3. Loosen the nut and disconnect the air breather hose connecting the upper and lower parts of the tank.



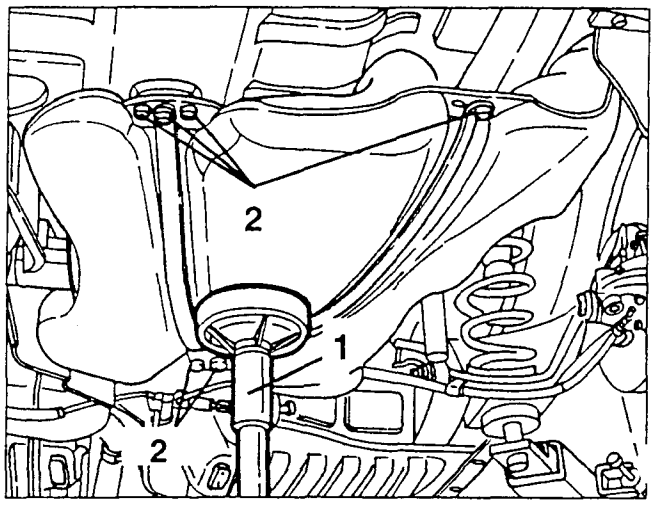
1. Operating from the wheel arch, unscrew the screws securing the filler neck to the body.



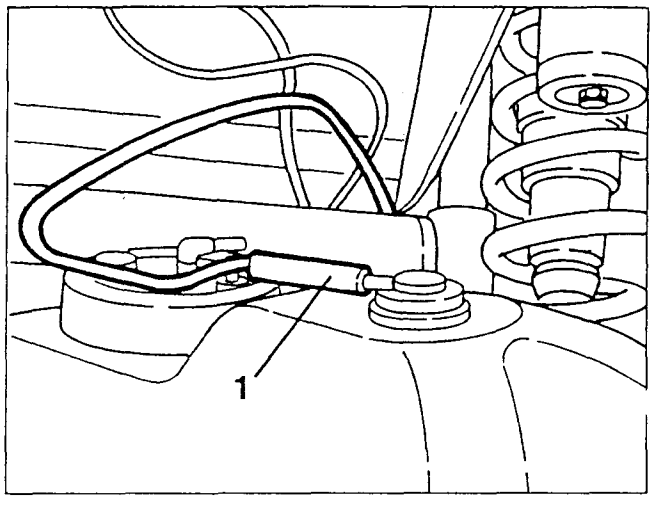
1. Disconnect the handbrake cables and brake pipes from the fastenings on the fuel tank.



1. Set a hydraulic jack under the fuel tank.
2. Prise off the plastic buttons and slacken the fuel tank fastening screws.

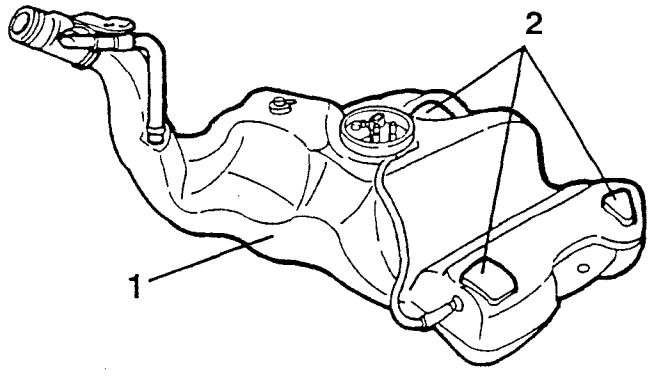


1. Using the hydraulic jack, lower the fuel tank just enough to disconnect the fuel vapour breather pipe from the multipurpose valve.



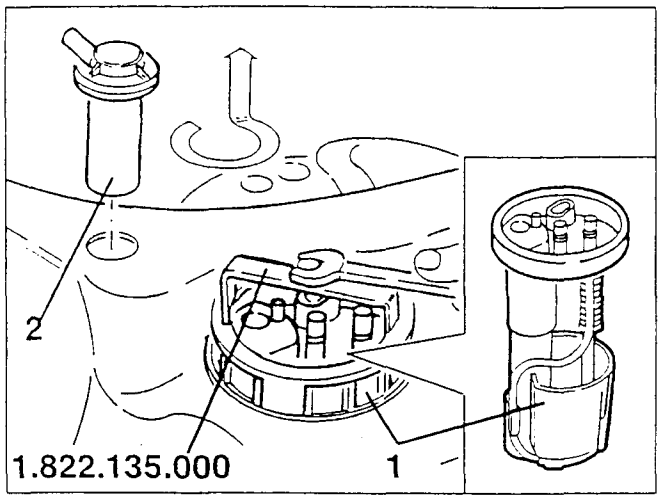
1. Completely lower the hydraulic jack and remove the fuel tank.

When refitting the fuel tank, check the presence of the rubber pads (2) on it.

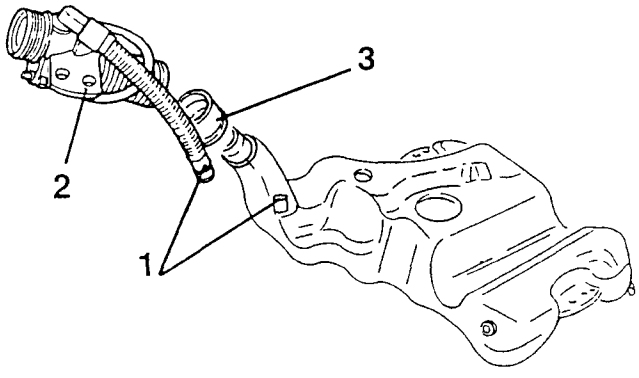


DISASSEMBLY/REASSEMBLY

1. Using tool N° 1.822.135.000 remove the ring-nut and withdraw the pump element-fuel level meter from the tank.
2. Remove the multifunctional valve.

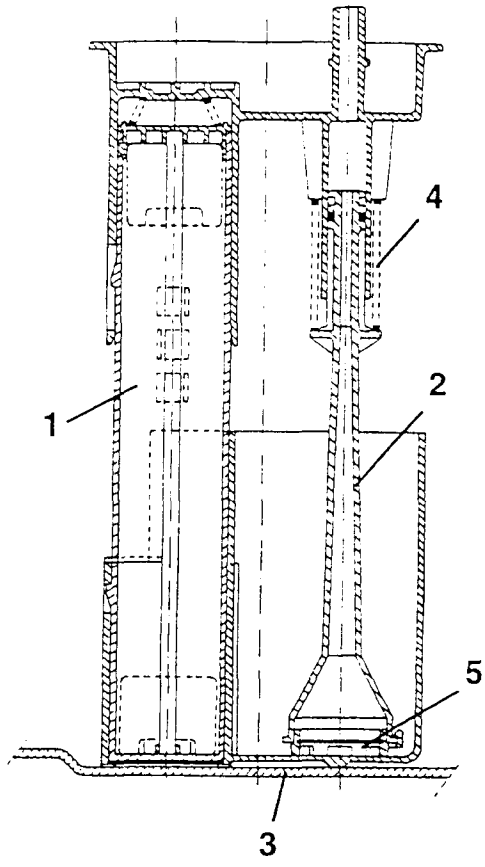


1. Disconnect the anti-flow back tube from the fuel tank.
2. Slacken the clamp and remove the complete fuel filter.
3. Remove the seal.



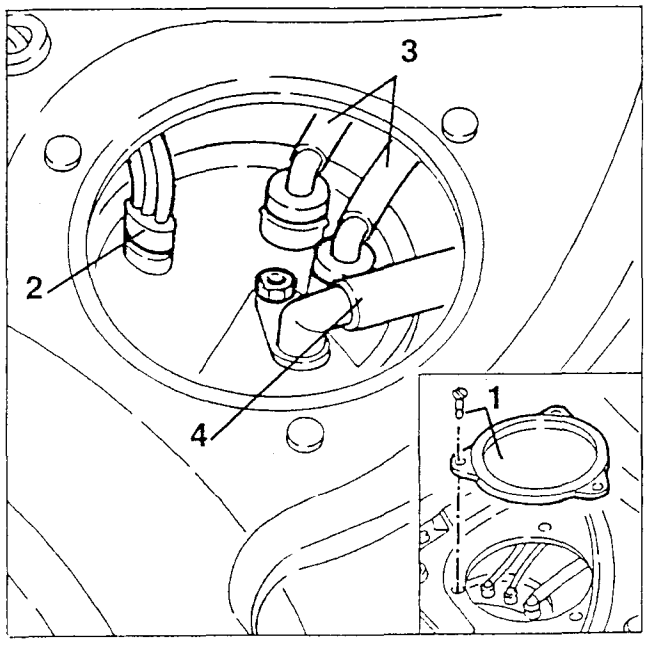
PUMP ELEMENT-FUEL LEVEL METER

This is fixed to the tank using a threaded plastic ring nut.
The fuel level gauge (1) incorporated in the suction unit cannot be replaced alone.
This suction system consists of an "elastic" intake tube (2) which runs along the bottom of the tank (3) itself via a spring (4) fitted on the tube itself.
The suction device (5) is fitted on the end of the intake tube with a built-in wire gauze filter.

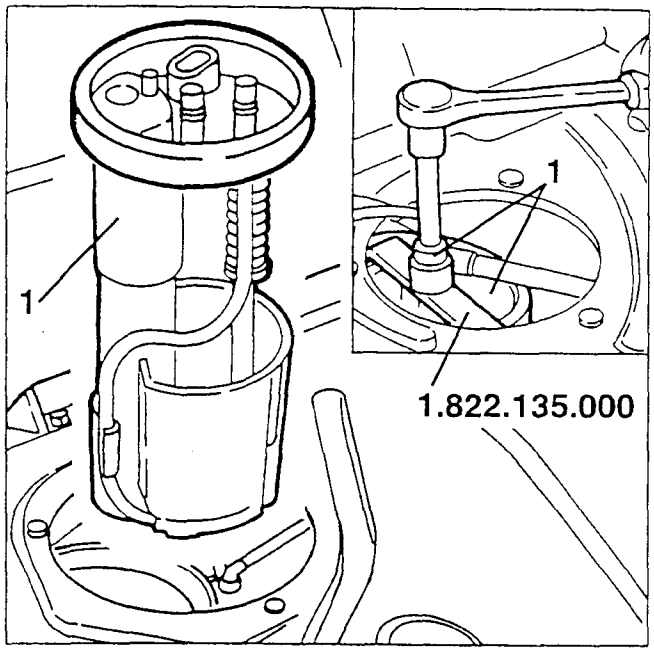


REMOVAL/REFITTING

- Disconnect the negative cable from the battery.
1. Working in the luggage compartment tip back the covering and remove the pump element-fuel level meter access cover.
2. Disconnect the electrical connection from the fuel level meter.
3. Disconnect the fuel delivery and return hose unions.
4. Loosen the nut and disconnect the air breather hose connecting the lower and upper parts of the tank.



1. Using tool N° 1.822.135.000 remove the ring-nut and withdraw the pump element-fuel level meter from the tank.



MULTIFUNCTION VALVE

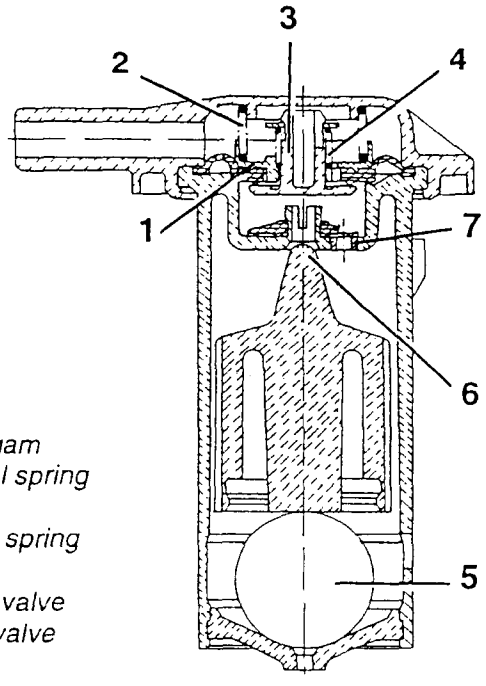
The functions of this valve are:

- **Fuel vapour breather pipe**

when the pressure reaches a value of **0.055 ÷ 0.075 bar** the diaphragm (1) opposed by a spring (2) allows the fuel vapours in the atmosphere to be sucked in.

- **Tank ventilation**

to ventilate the tank with vacuum values lower than **-0.020 bar**, the cup (3) acting on the diaphragm (1) opposed by a spring (4), allows air to be intaken into the tank.



1. *Diaphrgam*
2. *External spring*
3. *Cup*
4. *Internal spring*
5. *Sphere*
6. *Needle valve*
7. *Safety valve*

- **Anti roll-over and anti-tipping up**

In the lower part of the valve body there is a conic seating, which houses a suitable weighted sphere (5) which, rotating on that seating, under the centrifugal thrust which the vehicle transmits to it, lifts and closes the needle valve (6) to prevent the fuel from spilling if the vehicle rolls or turns over.

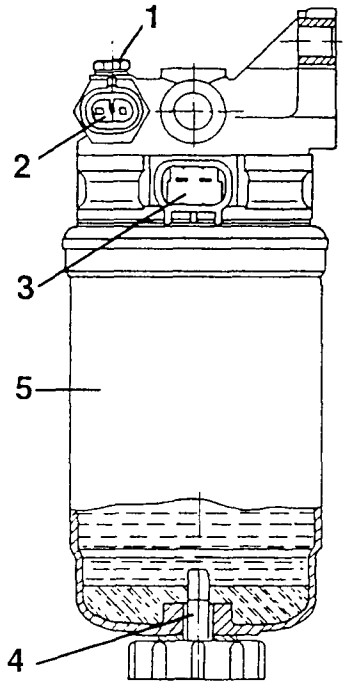
If the needle valve (6) blocks and its conic end blocks the passage of the fuel vapours out into atmosphere, there is a safety valve (7) which prevents pressure from building up in the tank.

The safety valve diaphragm (7) opens allowing the passage of fuel vapours through a calibrated hole when the tank reaches a pressure of 0.1 ÷ 0.2 bar.

REMOVAL/REFITTING

Follow "REMOVAL/REFITTING FUEL TANK".

FUEL FILTER



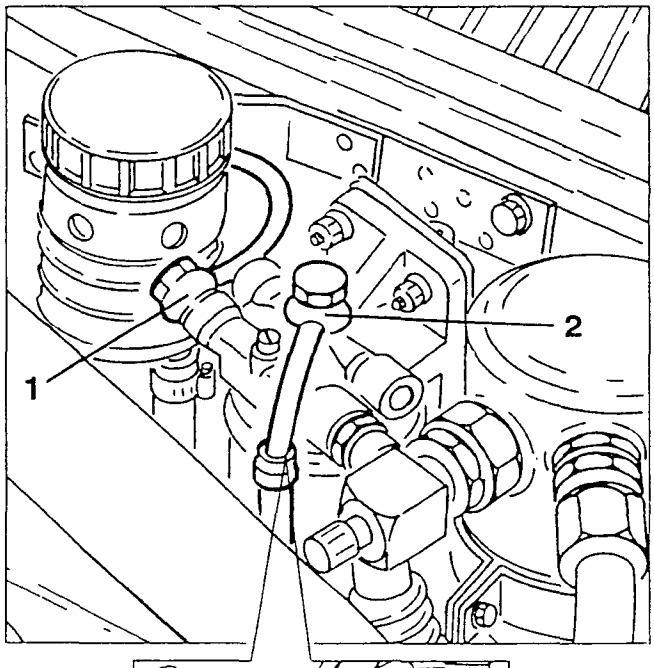
1. *Bleed screw*
2. *Fuel preheating device control sensor*
3. *Fuel preheating device supply connector*
4. *Water drain cap*
5. *Fuel filter cartridge*

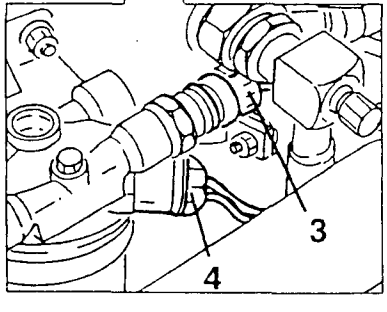
The fuel filter is fitted in the engine compartment and is inserted into the fuel from tank to injection pump delivery pipe.

It is of the cartridge type with a filtering element consisting of a pack of paper disks with a filtering surface of 5300 cm^2 and a filtering degree of 4 ÷ 5 µm.
The filter is fitted with a fuel preheating device, controlled by a thermo switch fitted on the filter itself. When the diesel temperature is lower than **6°C** an electric resistance heats it to a maximum temperature of **15°C** before sending it to the injection pump.
At the base of the fuel filter cartridge is a cap used to drain water from the filter.

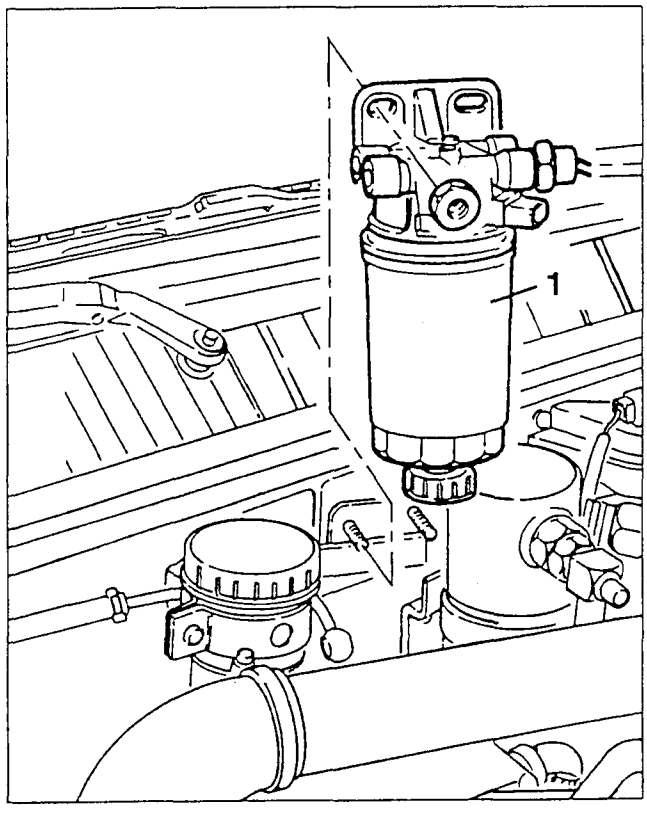
REPLACEMENT OF FUEL FILTER CARTRIDGE FILTER

- Disconnect the negative (-) battery cable.
1. Disconnect the fuel from tank arrival pipe connector from the filter.
2. Disconnect the fuel to injection pump delivery pipe connector from the filter.
3. Disconnect the electrical connection from the fuel preheating device control sensor.
4. Disconnect the electrical supply connection of the fuel preheating device.

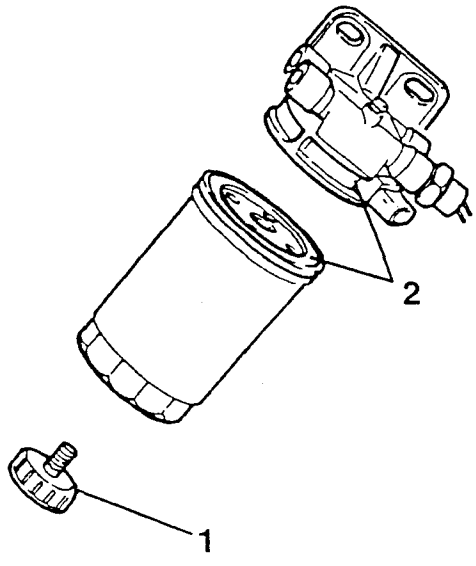




1. Unscrew the two nuts and remove the complete fuel filter.



1. Working on a bench remove the water drainage cap from the fuel filter.
2. Unscrew the filter cartridge with the relative gasket from the support.

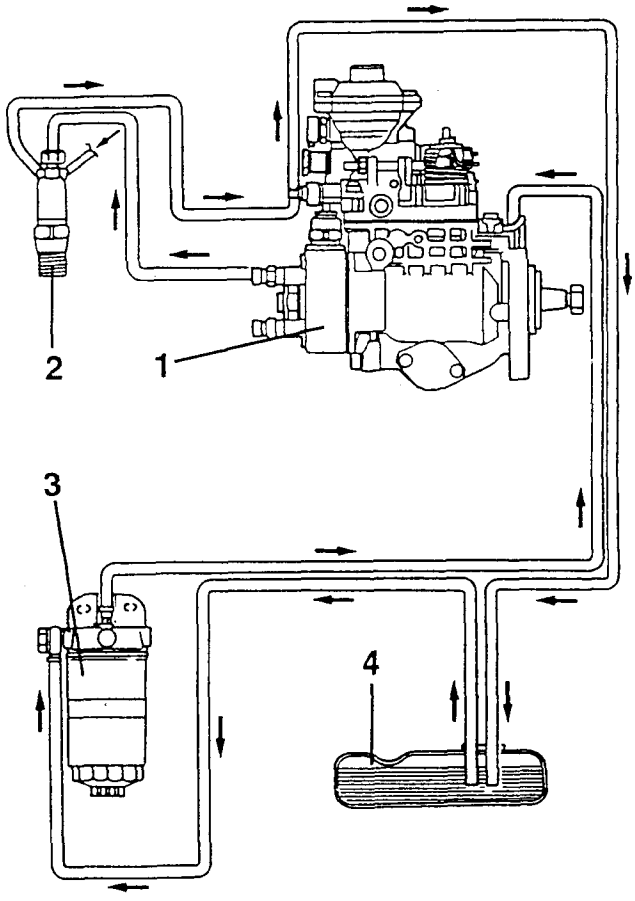


- Fit a new cartridge with relative gasket on the fuel filter support.
- Fit the water drainage cap onto the fuel filter and then refit by reversing the procedure followed for removal.
- Bleed the air from the fuel supply system (see specific paragraph).

BLEED AIR FROM THE FUEL INJECTION PUMP HYDRAULIC CIRCUIT

If the engine stops because it has run out of fuel, or if the fuel low pressure tubes become disconnected, or if the fuel filter has been replaced, the following indications should be followed to facilitate the self-triggering of the injection pump:
- loosen the delivery connectors on the injectors;
- start-up the engine until fuel starts to come out from the injectors' open connectors;
- close the injector connectors whilst the engine is still running.

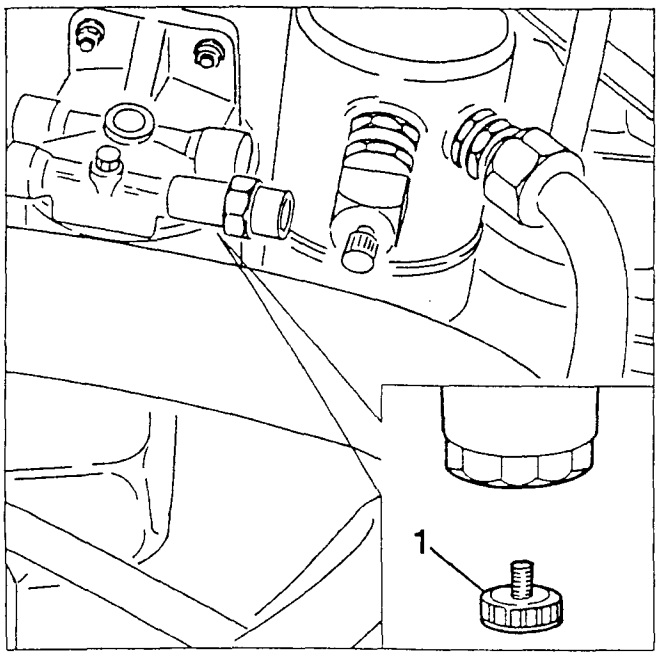
If it is not possible to start the engine, check all the fuel intake pipe joints and connections and replace the seal washers, in order to stop air from entering.



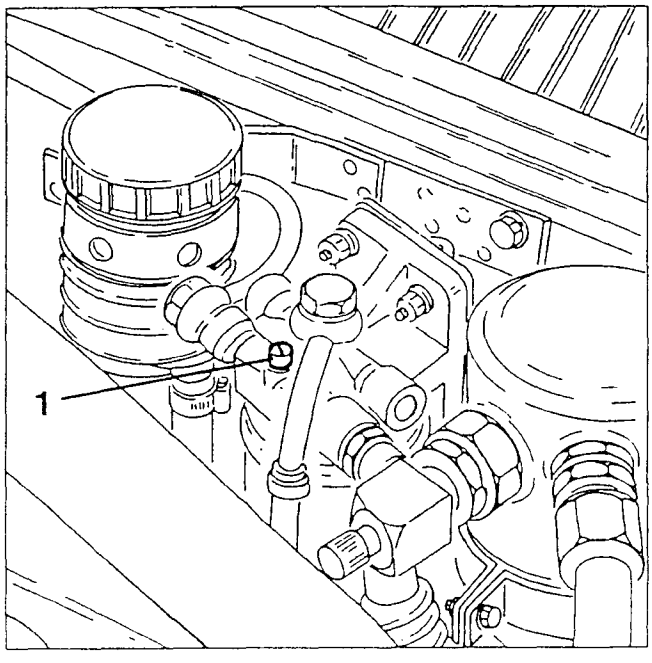
1. *Injection pump*
2. *Injector*
3. *Fuel filter*
4. *Tank*

BLEED AIR FROM FUEL FILTER

1. Loosen the water drainage cap located under the fuel filter.

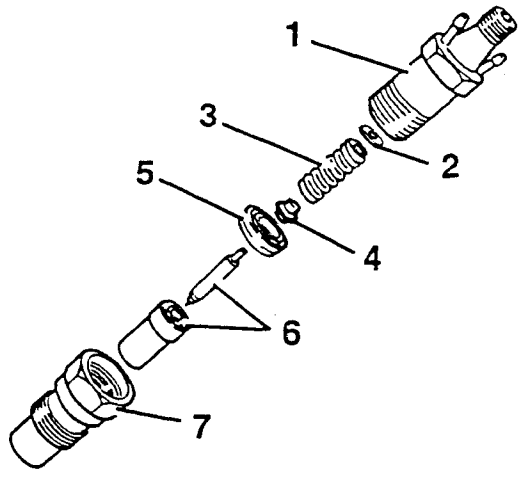


1. Unscrew the air bleed screw located above the fuel filter.



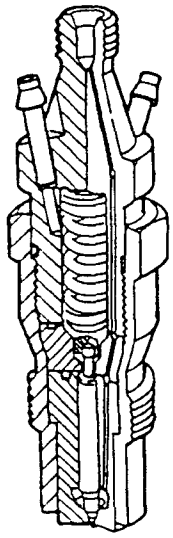
INJECTORS

The injectors' task is to spray the fuel supplied by the injection pump into the engine combustion chamber.
The injector consists of a nozzle and a nozzle holder.



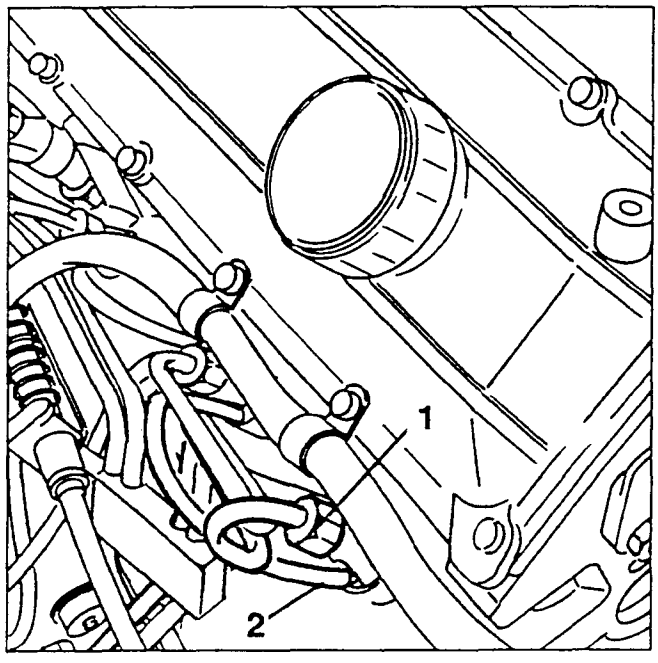
1. *Upper nozzle holder*
2. *Adjusting washer*
3. *Spring*
4. *Pressure rod*
5. *Spacer*
6. *Nozzle*
7. *Lower nozzle holder*

The compressed fuel from the injection pump arrives in the nozzle chamber below the conic end (pressure shoulder).
When the fuel pressure exceeds the spring setting value (150 ÷ 158 bar), the nozzle needle is lifted and finely atomized fuel flows out under pressure.
The force to open the needle is determined by the adjustable spring preload in the nozzle holder.
When injection is completed the spring pushes against the needle through the pressure rod in its seating.
Given the high fuel pressure, a small quantity of fuel returns between the pressure rod stem and its seating on the nozzle body.
This fuel is drained through a hole connected to the fuel to tank return pipe.
The diameter of the pipe between the pump and the injectors is small enough to reduce the volume of the diesel contained in the pipe, which is subjected to the compression effect.
The use of thick walled pipes prevents elastic pulsations which may be great enough and of a frequency that could alter the injection.
These pipes must be short to prevent the pressure waves, due to the injector closing, from returning to the nozzle and lifting it which would allow more diesel to flow out at the incorrect time.

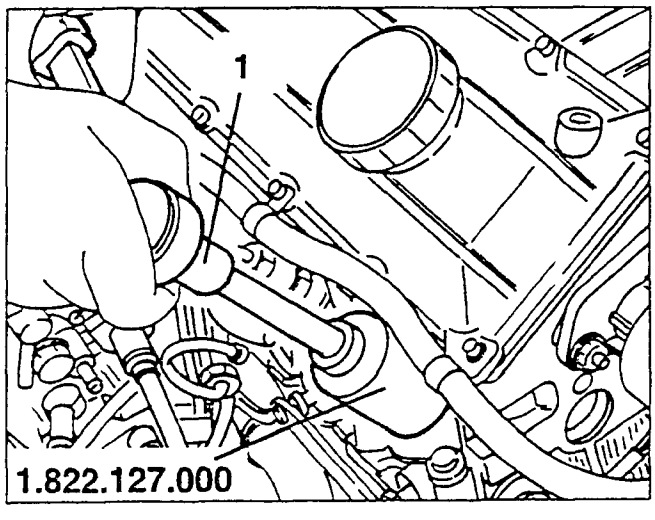


REMOVAL/REFITTING

1. Disconnect the fuel from injection pump delivery pipe from the injector.
2. Disconnect the two fuel to injection pump return pipes from the injector (one for the fourth injector).



1. Remove the injector from the cylinder heads, using tool N° 1.822.127.000.

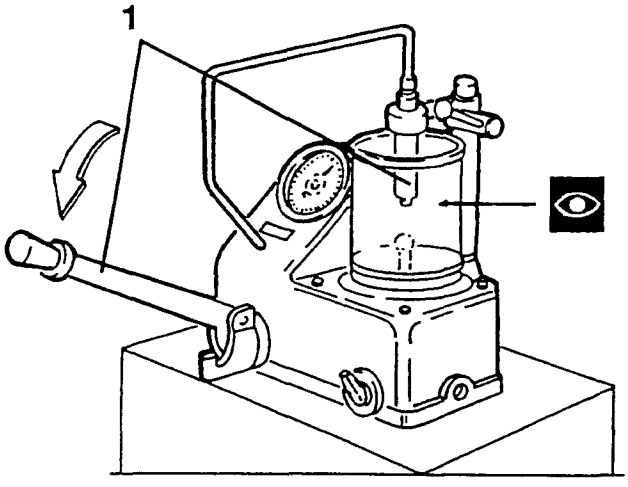


- At the bench unscrew the nozzle holder and disassemble the injector.

CHECKS AND INSPECTIONS

- Before inspecting the injector, thoroughly clean the outer part, in particular the end of the nozzle. Any deposits should be eliminated with a suitable metal brush (brass).
1. Position the injector in the piece of equipment, activate the equipment's lever until the specified pressure is reached; when these conditions have been obtained, check that nozzle does not drip for **10 seconds**; if this is not the case, replace it.

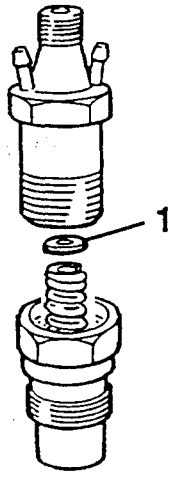
Injector seal control pressure
130 ÷ 138 bar



- With the injector still on the test equipment, activate the equipment lever and check that the fuel atomizing takes place at the specified pressure.

Injector setting pressure
150 ÷ 158 bar

- If this is not the case and depending on the pressure value obtained, disassemble the injector and replace the adjusting washer with one with the correct thickness.



The thickness of spare washers is 1.000 to 1.975 mm, with 0.025 mm increases.

INERTIAL SWITCH

Also the Turbodiesel system has a security system with inertial switch to be found under the driver's seat: this device is an electromechanical switch, which in the event of a heavy crash opens to cut off the circuit that supplies the engine stop electromagnet: this way the engine is stopped immediately.
The supply to other "risky" circuits, i.e. always supplied, is also cut off (cold advance, glow plugs, engine stop solenoid valve).
This greatly reduces the hazard of fire which, though restricted, is also a risk on diesel vehicles.

REMOVING/REFITTING

Refer to the instructions for the Boxer 16V engine.

DISTRIBUTOR INJECTION PUMP

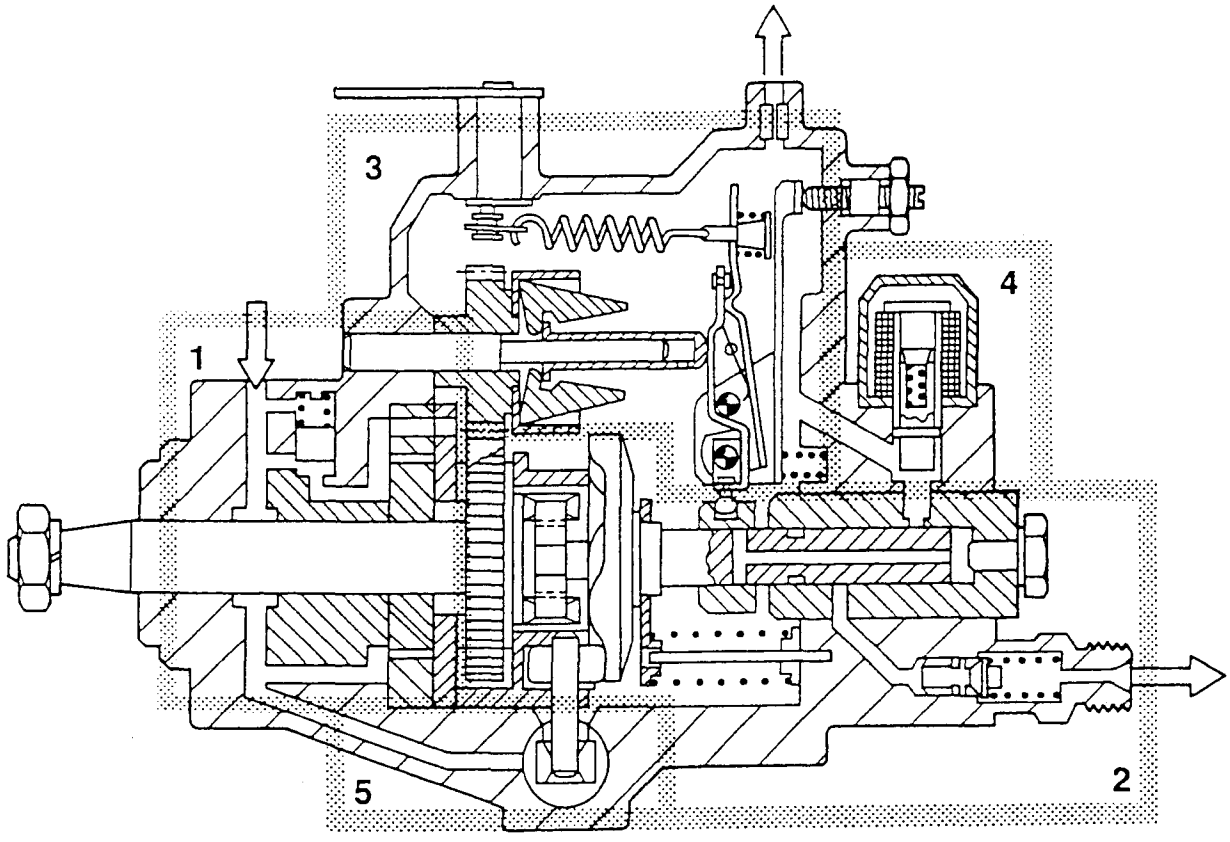
GENERAL DATA

Unlike the in line injection pump, the VE distributor pump has a single pumping element (pump cylinder and piston) even for engines with more cylinders. The diesel pumped from the piston is distributed through a groove at the outlets; there are the same number of grooves as there are engine cylinders.

The injection pump casing is made up of the following units:

- Blade type fuel pump
- High pressure pump with distributor
- r.p.m. mechanical adjusting device
- Stop device
- Injection advance hydraulic variator

The pump distibutor can be fitted with different correction devices, which allow it to adapt to any of the engine's specific requirements.
The reasons why these correction devices are necessary, their structure and their functioning is explained further on.
On the injection pump in correspondence of the accelerator control cable fastening lever, there is a switch which informs the air conditioner control unit about the "full load" condition, as a result of this the control unit cuts out the compressor.



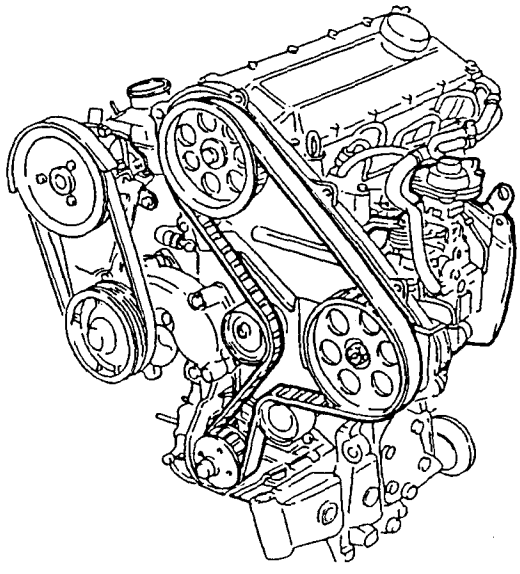
1. **Blade type fuel pump**
   This pump sucks in the diesel and sends it to the pump internal chamber.
2. **High pressure pump with distributor**
   This pump generates the injection pressure, pumps and distributes the diesel.
3. **R.p.m. mechanical adjuster**
   This device adjusts the r.p.m. and corrects the flow ensuring it remains within the established limits.
4. **Stop device**
   Interrupts the diesel supply
5. **Injection advance variator**
   Depending on the r.p.m. this device varies the start time of the delivery.

STRUCTURE

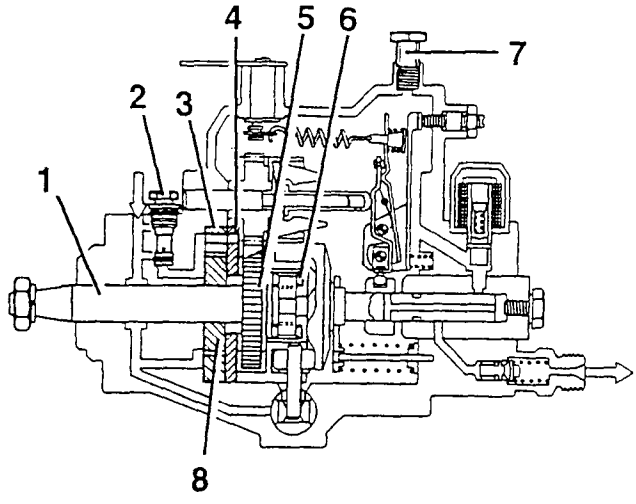
The distributor pump control shaft is supported in the pump casing and the blade type fuel pump is fitted on it.
The roller holder ring is located behind the fuel pump, which is also located in the pump casing, even though it is not integral with the control shaft.
The cam disk, which rests on the roller holder ring and is activated by the control shaft, generates a rotation-lift type movement which is transmitted to the piston distributor.
The piston distributor is guided in the distributor head, which is screwed to the pump casing.
The electric stop device which interrupts the fuel supply, the threaded cap with the bleed screw and the connectors for the delivery valves are fixed in the distributor head.
The mechanical stop device, on the other hand, is located in the regulating device cover.
The adjusting lever group is made up of control, starting and tension levers and its fulcrum is housed in the distributor pump. The adjustng lever group varies the position of the adjusting cursor on the pump piston.
The adjusting spring, hooked to the shaft of the control and tension levers, is located in the upper part of the casing.
The control lever, which affects the funtioning of the pump, is located through the shaft in the regulating device cover.
The regulating device cover, which also acts as a cover for the upper part of the pump, also houses the adjusting screws for the full load flow, the flow throttler and the r.p.m. adjusting screw.
The hydraulic injection advance variator is fitted transversally to the longitudinal axis under the lower part of the distributor pump.
The functioning of the variator is influenced by the pressure in the internal chamber, which, in turn, is determined by the fuel pump and by the pressure regulating valve. The variator is fixed with two covers on the sides of the pump.

ACTIONING THE PUMP

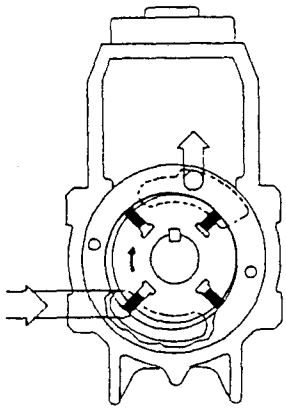
The distributor pump is activated by the engine timing belt. In four stroke engines, the r.p.m. of the pump is exactly half of the those of the engine crankshaft.
In other words the distributor pump has the same number of revs as the camshaft.
The desmodronic actioning (system of rigid bodies the movement of which is blocked so that they have only one grade of freedom) takes place in such a way that the rotation of the control shaft of the distribution pump is synchronised perfectly with the crankshaft.
The desmodronic actioning is achieved through a drive belt, a coupling pinion, gears.
Righthand and lefthand rotating distributor pumps exist and so their injection is order is also different, but in such a way that the drainage holes open in the same geometric order.
To avoid confusion with the numbering of the engine cylinders, the distributor pump drainage holes are marked with A, B, C, etc.



A part of the diesel that has been pumped returns in the intake side pipe (upstream from the pump) through the pressure regulating valve.
The diesel used as a coolant and for the automatic bleeding of the distributor pump returns to the tank through the flow throttler fitted on the regulator cover.



1. *Control shaft*
2. *Pressure regulating valve*
3. *Eccentric ring*
4. *Support ring*
5. *Regulating control pinion*
6. *Tooth of the control shaft*
7. *Flow throttler*
8. *Blade pump*



FUEL SUPPLY

Low pressure supply

In the injection systems with distributor pump, the blade type fuel pump sucks the diesel from the tank and sends it into the pump.
The fuel pump sends an almost constant amount of fuel for every rotation.
The pressure regulating valve is necessary to obtain a pressure defined om the basis of the r.p.m. within the pump. In this way, the pressure increases in direct proportion to the r.p.m.; ie. the higher the r.p.m the higher the pressure.

Blade type fuel pump
The fuel pump is fitted on the control shaft within the pump.
The impeller is fitted concentrically to the control shaft and is motored over by a key.
The impeller is housed in an eccentric ring located in the casing.
The centrifugal force, generated by the rotary movement, pushes the four impeller blades outwards and against the eccentric ring.
This centrifugal movement of the blades is facilitated by the diesel, which is between the lower part of the blade and the wall of the impeller cavity.
Through the inflow hole on the casing of the pump, the diesel arrives in the kidney shaped chamber (formed by the impeller, blade and eccentric ring) and from here it is pumped into the inner chamber of the pump through the second kidney shaped chamber, which is diametrically opposed to the first. During this cycle, a part of the diesel passes to the pressure regulating valve through the second hole.

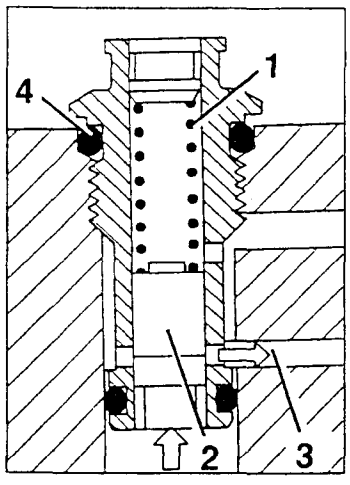
Pressure regulating valve

The pressure regulating valve is fitted directly, close to the fuel pump, and is connected to the kidney shaped upper chamber through a hole.

This is a spring loaded sliding valve, which modifies the internal pressure of the pump on the basis of the amount of fuel delivered.

When the diesel pressure exceeds a certain value, the valve cursor opens the return hole and the diesel returns in the intake side of the valve through a small channel. When the diesel pressure is low, the thrust of the spring keeps the return hole closed.

The opening pressure of the regulating valve is determined by the setting of the spring load.

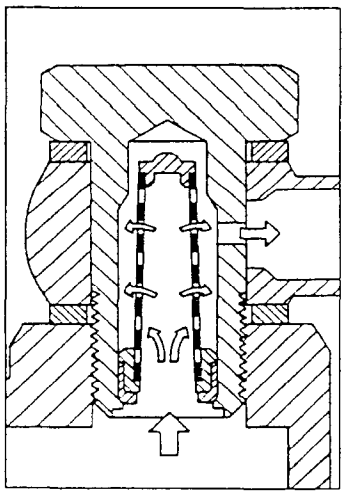


1. *Spring*
2. *Cursor*
3. *Fuel return hole at intake side*
4. *O-Ring*

Flow throttler

The flow throttler is screwed to the regulator cover and is connected with the inside of the distributor pump.

This allows a small amount of diesel to flow back to the tank through a very small hole (diameter 0.6mm). This hole resists the flow of diesel and maintains the pressure constant within the pump. As the pressure value within pump is strictly connected to the r.p.m., the flow throttler and the regulating valve function interdependently.



High pressure supply

Distributor piston actioning

The rotating movement of the control shaft is transmitted to the distributor piston through a coupling. The teeth of the control shaft and the cam disks interlock with the Oldham coupling.

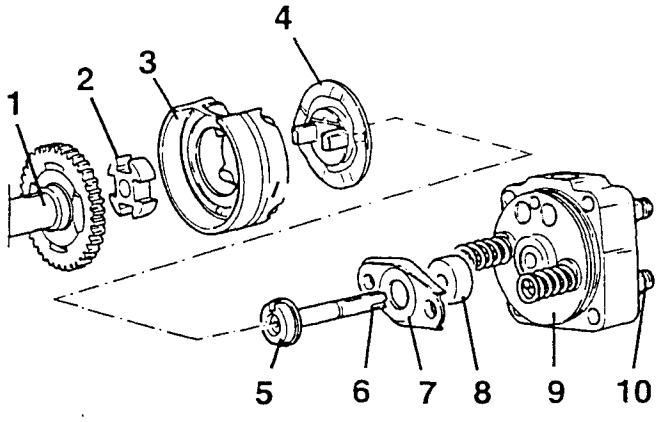
By sliding along the roller holding ring, the cam disks transform the simple rotational movement of the control shaft into a rotational- rising movement.

The distributor pumping element and its adaptor are connected to the cam disk and are fixed with a key, which also acts as a motoring over device.

The piston distributor is pushed towards the top dead center (TDC) by the cam disk and in towards the bottom dead center (BDC) by the thrust spring, which are positioned symmetrically.

The thrust springs rest on the hydraulic head and act on the piston distributor through a beam, and prevent the cam disks from being raised by the rollers on the ring following strong centrifugal force.

The length of the springs is fixed in such a way that the piston can not be pushed out of its guide in the hydraulic head.



1. *Regulating control pinion*
2. *Oldham coupling*
3. *Roller holding ring*
4. *Cam disk*
5. *Compensation washers*
6. *Distribution Timing*
7. *Beam*
8. *Regulating cursor*
9. *Distributor head*
10. *Delivery connector*

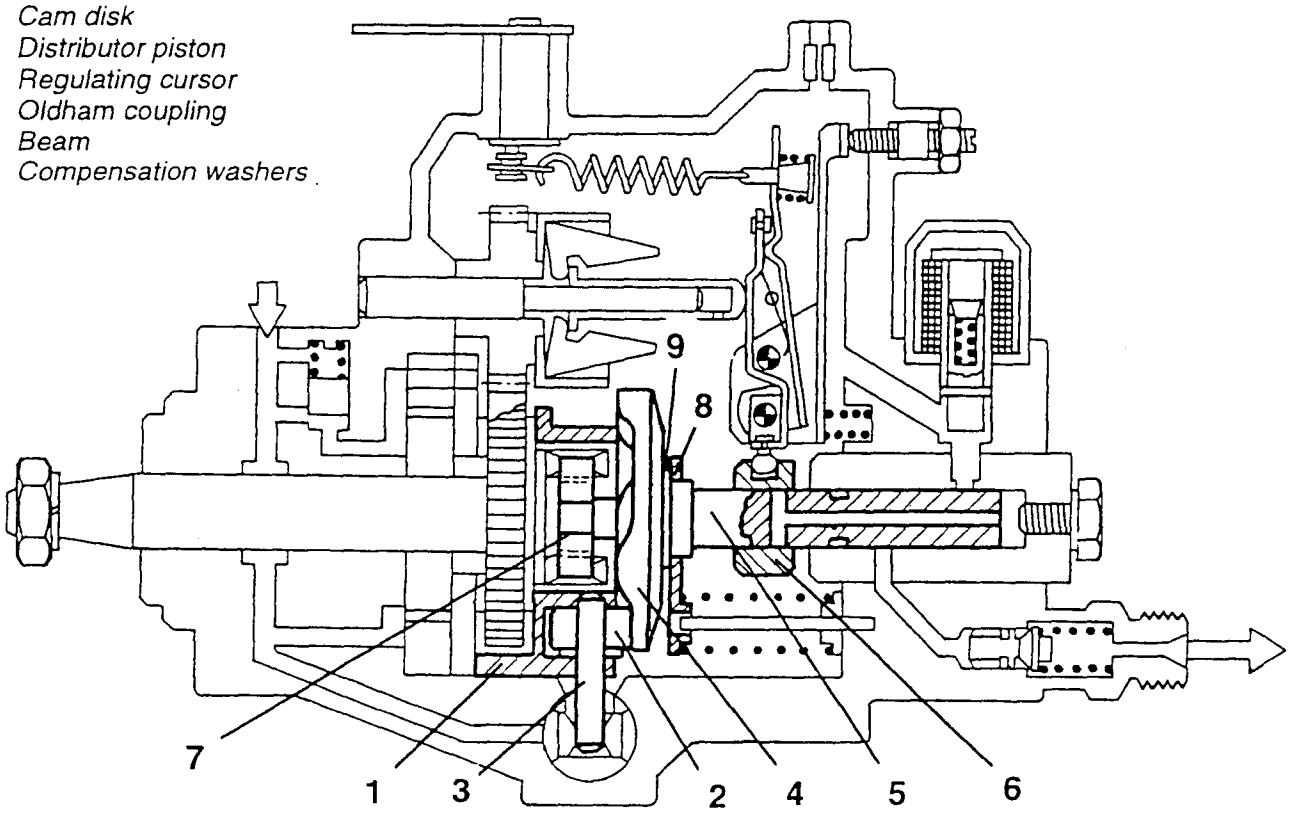
Cam disk and shape of the cams

As well as activating the distributor piston, the cam disks also influence the pressure and the length of the injection on the basis of the following two parameters: cam lift and speed of the lift. The injection conditions must be individually adapted to the shape of the cam and to the combustion procedure of the different types of engine, for which the profile of the cam sliding track must be calculated and reproduced on the disk. The cam disk obtained in this way is then fitted on the injection pump. For this reason, it is not possible to interchange the cam disks intended for different injection pumps.

Pumping element group
The distributor head, distributor piston and the regulating cursor are adapted (lapped) with micrometric accuracy to ensure the seal, even at very high pressures.

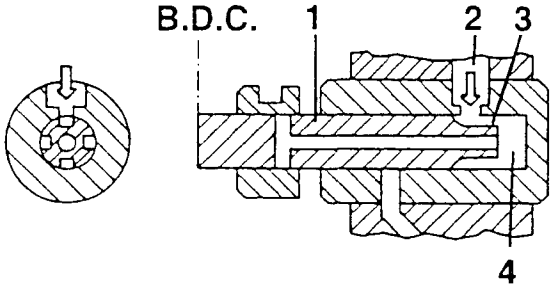
Small leaks are inevitable, but also necessary to ensure that the distributor piston is lubricated.
For this reason the complete pumping element must be replaced, and never only the piston and the distributor head, or the regulating cursor.

1. *Roller holder ring*
2. *Rollers*
3. *Journal*
4. *Cam disk*
5. *Distributor piston*
6. *Regulating cursor*
7. *Oldham coupling*
8. *Beam*
9. *Compensation washers*

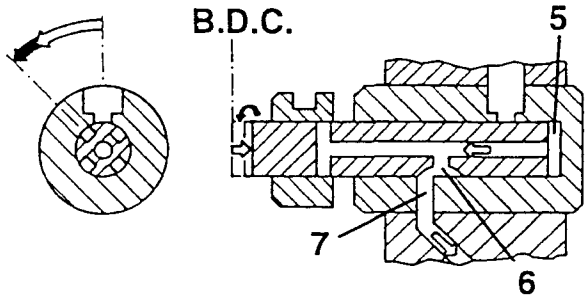


Fuel dosage
The fuel delivery is a dynamic process carried out by the injection pump in several stages. The pressure necessary for the injection is generated by the pump piston.
In four stroke engines, the piston distributor completes one fourth of a revolution between BDC and TDC.
The distributor piston passes from the TDC and BDC with a axial- rotational movement and frees an inflow hole in the distributor head through one of the control grooves; the diesel under pressure passes from within the distributor piston to the high pressure chamber, above the piston, through an inflow hole.
Once the BDC has been reached, the distributor piston's movement is inverted in order to return to the TDC and the inflow hole which was opened before is closed, whilst a exhaust hole (with a set section) in the distributor head is opened.
The pressure which has built up in the high pressure chamber and the longitudinal hole opens a delivery valve, and the diesel is forced through the delivery pipe to the injector.
The effective stroke ends as soon as the distributor piston transversal hole is uncovered by the regulating cursor (end of the delivery).
From this moment onwards, the diesel is no longer delivered, and so the delivery valve closes the delivery pipe. As the piston moves towards the TDC, the diesel returns into the pump through a connection opened between the transversal hole and the inside of the pump.
This piston stage is called the "residual rise".
During its axial-rotational return movement, the piston closes its transversal hole, whilst the control groove opens the fuel inflow hole which fills up the high pressure chamber once again (above the piston).

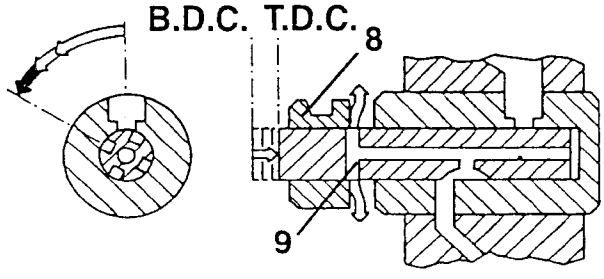
■ Diesel inflow
With the piston (1) in BDC, the diesel passes into the high pressure chamber (4) through the inflow channel (2) and the control groove (3).



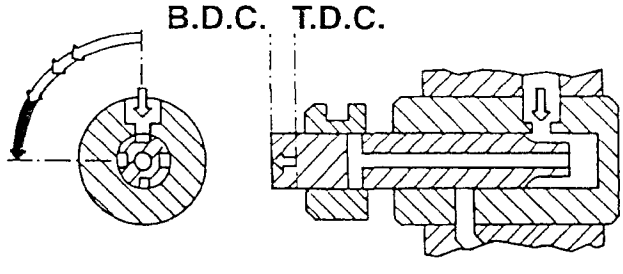
■ Diesel delivery
As the piston rises, the inflow channel closes and compresses the diesel in the high pressure chamber (5), whilst the rotational movement of one of its grooves (6) opens the exhaust hole (7) on the corresponding engine cylinder.



■ End of delivery
The delivery of the diesel ends as soon as the regulating cursor (8) opens the "end of delivery" hole (9).



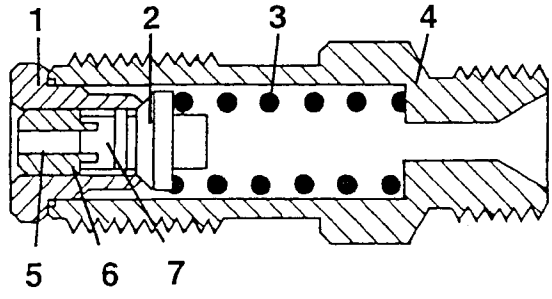
■ Diesel inflow
The piston returns with an axial-rotational movement to the BDC and closes the "end of delivery" hole.
The high pressure chamber fills up again.



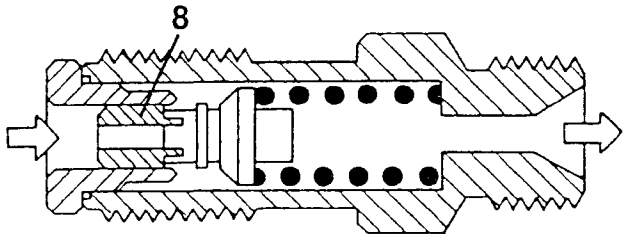
Delivery valve

The delivery valve prevents the fuel in the pipe from flowing into the distributor head and quickly lowers the pressure in the injection pipe to prevent the nozzle from dripping.
It is in this way that the nozzle closes completely at the exact point in which the injection stage ends.
At the same time the stability of the pressure in the delivery pipe between one injection stroke and the next is ensured, irrespective of the flow at that moment.
The delivery valve is a hydraulic piston valve, which is opened by the diesel and closed by the spring.
During the interval between the two subsequent distributor piston delivery strokes, the valve for the same cylinder remains closed, and so the delivery pipe and the distributor head exhaust hole are isolated.
During the delivery stroke, high pressure builds up which raises the delivery valve from its seating and opens it; the diesel passes through a ring groove and the longitudinal grooves connected to it, the valve holder connector, the delivery pipe and the nozzle holder upto the nozzle.
As soon as the delivery end has been reached (transversal hole of the distributor piston is open) the pressure in the high pressure chamber falls to the pressure value within the pump, and the spring pushes the valve back into its seating.

■ Valve open



■ Valve closed



1. *Valve holder*
2. *Valve seating*
3. *Valve spring*
4. *Delivery connector*
5. *Stem*
6. *Pressure reducing piston*
7. *Ring groove*
8. *Longitudinal groove*

Delivery valve with return throttler
The necessary and accurate reduction in the pressure at the end of the injection stroke, generates pressure waves which strike the delivery valve causing the nozzle needle to open repeatedly or vacuums in the injection pipe.
These secondary effects provoke repeated injections, which adversely affect the pollution value of the exhaust gases, or cavitations which subject the injection and nozzle pipes to wear.
To avoid these pressure waves, a throttler has been fitted upstream from the delivery valve which acts only in the return direction.
This throttler is formed by a valve in a flat seating and a compression spring, so that it remains inactive in the flow direction and generates a damping effect in the return direction.

R.P.M. REGULATOR

The running performance of diesel vehicles is only satisfactory when the engine reacts quickly to the movements of the accelerator pedal.
During acceleration from zero, the engine must not stop.
Depending on the position of the accelerator pedal, the vehicle must accelerate or decelerate without jerking.
When the accelerator remains in the same position and the inclination remains constant, the speed should also remain the same.
When the accelerator pedal is released the engine must decelerate the vehicle.
These requirements of diesel engines are satisfied by the injection pump r.p.m. regulator.

Tasks of the r.p.m. regulator

- **Regulate the idle speed.**
  The diesel engine idle speed must not fall below the set value.
- **Regulate peak r.p.m.**
  By decreasing the engine load, the highest r.p.m of the full load is maintained at the upper idle speed level. The regulating device recognises this situation and calls the regulating cursor back in the "stop" direction, so that the engine receives less diesel.

As well as its regulating function, the regulator also performs some control functions:

- unblocking and blocking the diesel supplement necessary for start up;
- varying the full load flow on the basis of the r.p.m. (adequately).

Some adaptation devices are necessary for these complementary functions.

Regulating accuracy

The percentage deviation of the r.p.m. (P grade) is the parameter used to measure the accuracy of the regulator.
This is the percentage increase in the r.p.m. which is produced when there is a reduction in the engine loa but without the position of the control lever varying.
Following this, the increase in the r.p.m. within the regulated field must not exceed a certain value.
The peak r.p.m. is taken as the maximum value.
This r.p.m. is set when the engine reduces its speed from full load to zero load.
The increase in the r.p.m. is inversely proportional to the variation in the load, ie. the greater the reduction in the load, the larger the increase in the r.p.m.
The engine usage conditions determine the grade P to be chosen.
For example, for generators, a low P grade is preferable, in order that the variations in the load produce a limited variation in the r.p.m.
On the contrary, for autovehicles a higher P grade is preferable in order that the regulating is more stable and the running performance is better even when the variations in the load are smaller (acceleration or deceleration).
A high P grade would cause a reduction in the eng ne's elasticity (jerking) during load variations.

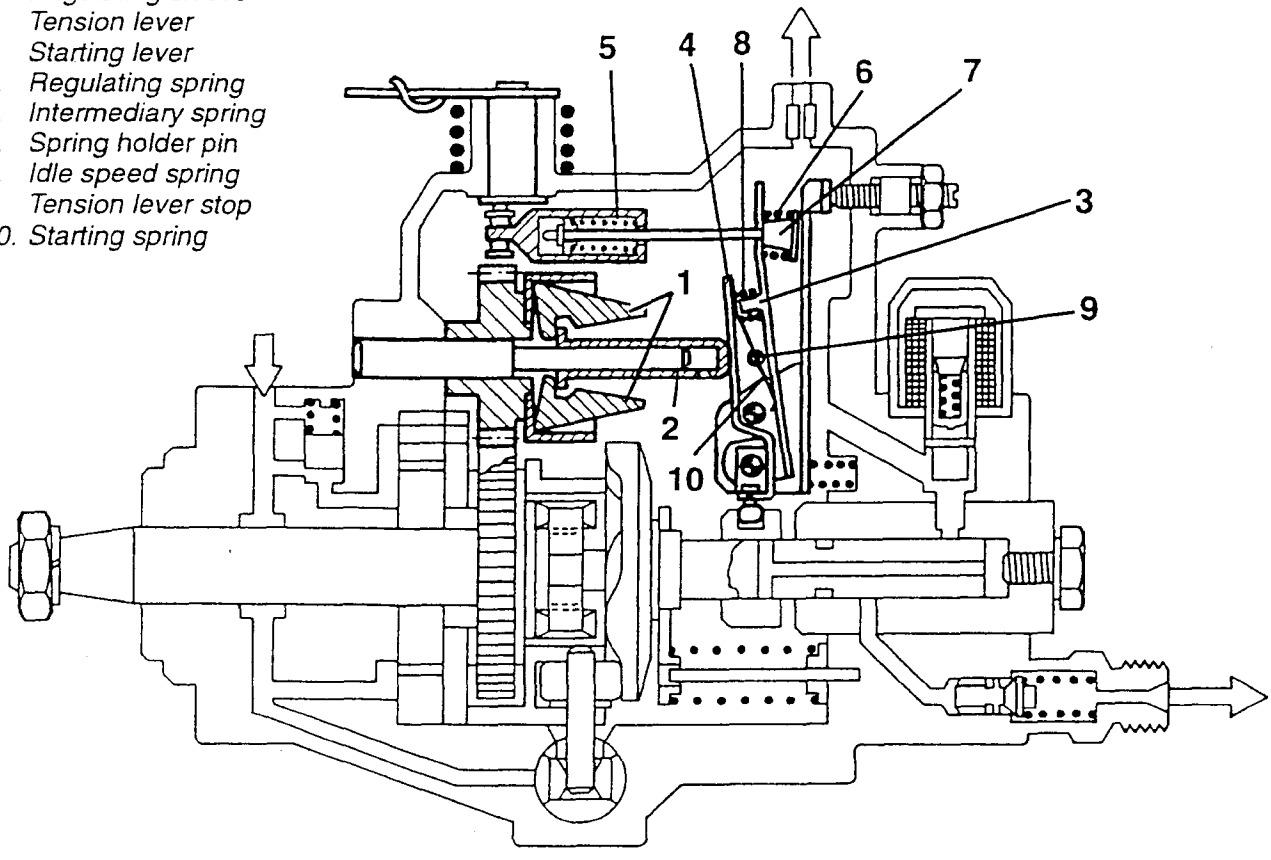
Idle speed and peak r.p.m regulator

This regulator adjusts the idle speed and the peak r.p.m. only, whilst the intermediary speeds are set directly by the accelerator pedal.

Structure
The control shaft activates the regulating unit, which is made up of centrifugal masses with relative casing, regulating spring and lever assembly.
The regulating group rotates around the regulator axis, which is integrated with the pump casing.

The radial movement of the centrifugal masses is transformed into an axial movement by the regulating sleeve.
The stroke of the regulating sleeve generates a thrust which varies the position of the regulating mechanism, which is made up of a control lever, tension lever and starting lever.
The control lever is housed in the shaft in the pump casing and can be adjusted by the delivery adjusting screw.
The tension and starting levers are pivoted on a common fulcrum and connected with a r.p.m. control lever. On the lower part of the starting lever, a spheric pin is fixed, which is pivoted to the adjusting cursor; whilst on the upper part, the starting spring is fixed.
The idle speed spring is fixed on the upper part of the tension lever by a pin, to which the regulating pressure spring, guided in a capsule, is hooked.
The external control lever and the internal r.p.m. control lever are fixed onto a common shaft.
The position of the regulating mechanism is defined by the common action of the spring's force and the thrust of the sleeve.
The control movement is transmitted to the regulating cursor, which determines the distributor piston delivery.

1. *Centrifugal masses*
2. *Regulating sleeve*
3. *Tension lever*
4. *Starting lever*
5. *Regulating spring*
6. *Intermediary spring*
7. *Spring holder pin*
8. *Idle speed spring*
9. *Tension lever stop*
10. *Starting spring*



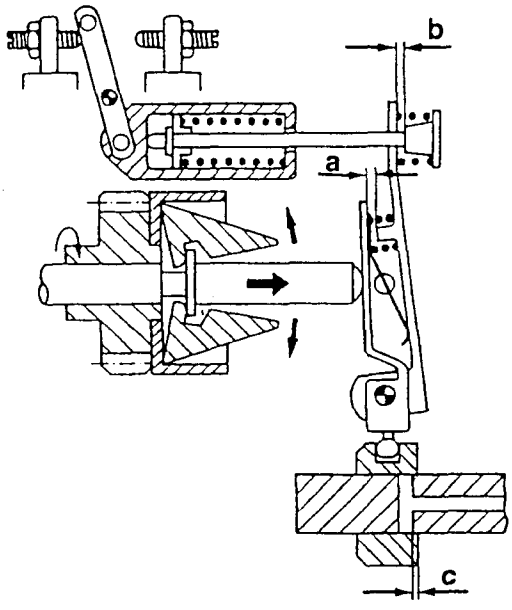
Starting

The regulating sleeve is in the start position because the centrifugal masses are at rest, and for this reason the start spring pushes the start lever against the regulating sleeve.
The regulating cursor on the distributor piston is found in the start supplement position.

Regulating the idle speed

After the engine has been started and the accelerator pedal has been released, the r.p.m. control lever returns to the "idle speed" position, activated by the return spring.
As the r.p.m. increases, the centrifugal force of the masses increases, which presses the regulating sleeve against the start lever.

The adjustment is carried out by the idle speed spring fitted on the tension lever. As the start lever rotates, it pushes against the regulating cursor in the "reduced flow" direction. The position of the regulating cursor is established by the combined action of the centrifugal force and the spring.

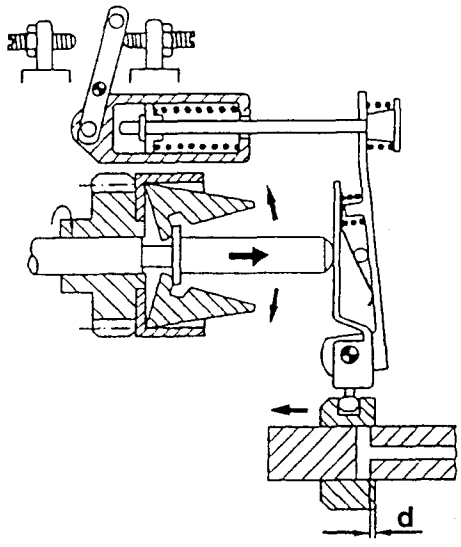


a. Start spring and idle speed stroke
b. Intermediary spring stroke
c. Idle speed minimum effective stroke

Operating under load

When the driver presses the accelerator pedal, the r.p.m. control lever rotates by a set angle and cancels the effect of the start and idle speed spring and so the intermediary lever enters into play in their place. The intermediary spring of the regulator allows a greater idle speed limit to be obtained.
If the control lever of the r.p.m. is made to rotate even more in the "full load" direction, the intermediary spring performs its stroke until the guiding pin knocks againts the tension lever.
From that moment the effect of the intermediary spring ceases and the non regulated ranges begin, the amplitude of which is determined by the load of the regulating spring.
Within the non reghulaed ranges, the regulating spring can be considered as though it were rigid.
The movement of the r.p.m. control lever (ie. the accelerator pedal) set by the driver is transmitted directly to the regulating cursor by the regulating mechanism.
If the r.p.m. control lever remains in the same position and there is a decrease in the engine load and the flow does not change, the engine speed will increase.

The limitation of the max speed starts to function within the nominal speed range only after the sleeve thrust has won over the force of the regulating spring's load.
When the engine is completely unloaded, it reaches the idle speed speed upper limit and stops the engine from racing.



d. Effective stroke of full load

VARIATION OF THE INJECTION ADVANCE

Injection advance variator

The injection advance variator advances the start of the delivery of the distributor pump with respect to the crankshaft and in relation to the r.p.m. to compensate for delays in injection and ignition.

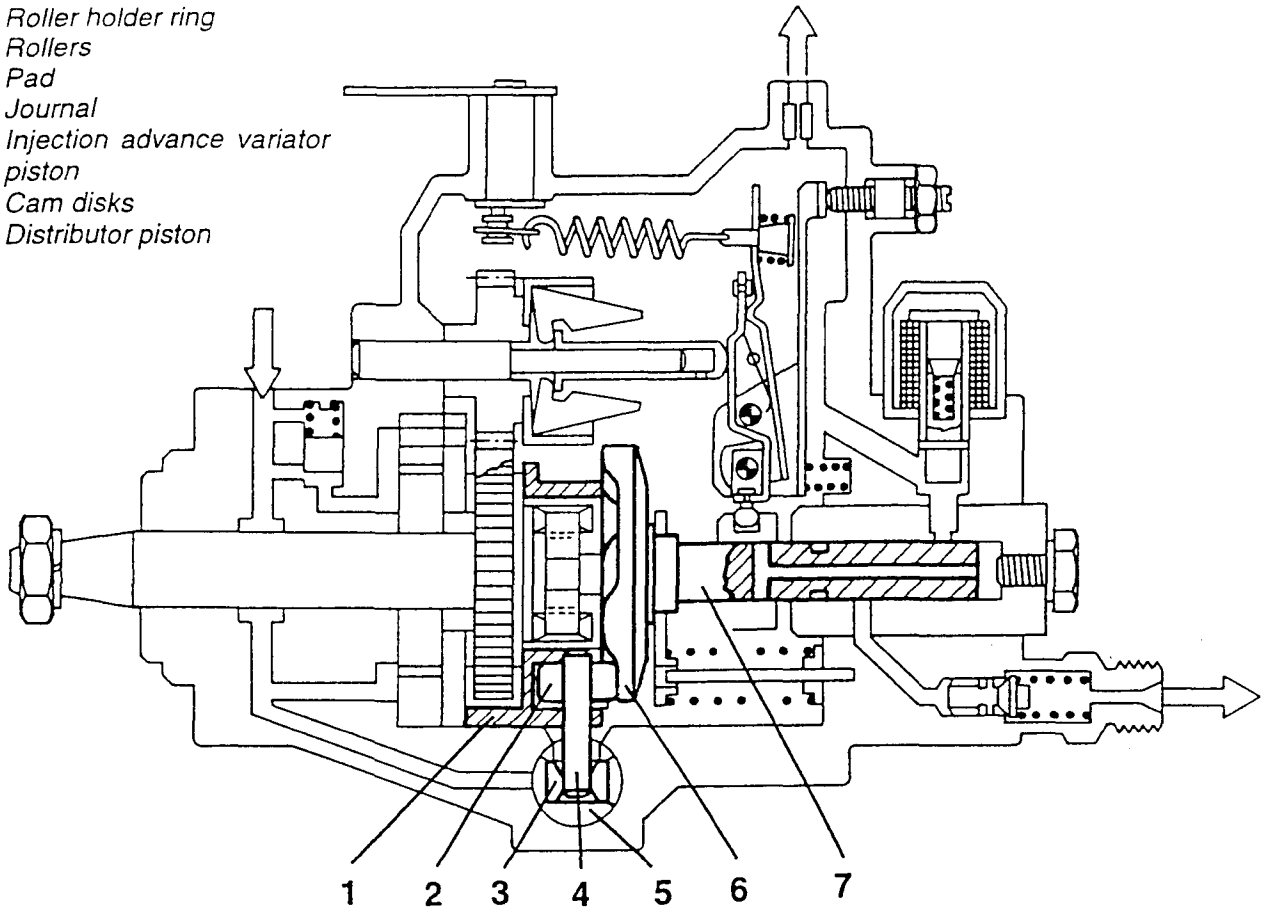
Structure

The hydraulic control injection advance variator is incorporated onto the lower side of the distributor pump casing, perpendicularly to the longitudinal axis of the pump.
The variator piston is guided into the pump casing and closed at the ends by two covers.
In the variator piston there is a hole through which the diesel passes; a pressure spring is fitted in a position diametrically opposed to the hole.
The varitor piston is connected with a roller holder ring through a journal and a pad.

Function

During the injection pump delivery process, the nozzle is opened by a wave of pressure which spreads at the speed of sound through an injection pipe.

1. *Roller holder ring*
2. *Rollers*
3. *Pad*
4. *Journal*
5. *Injection advance variator piston*
6. *Cam disks*
7. *Distributor piston*

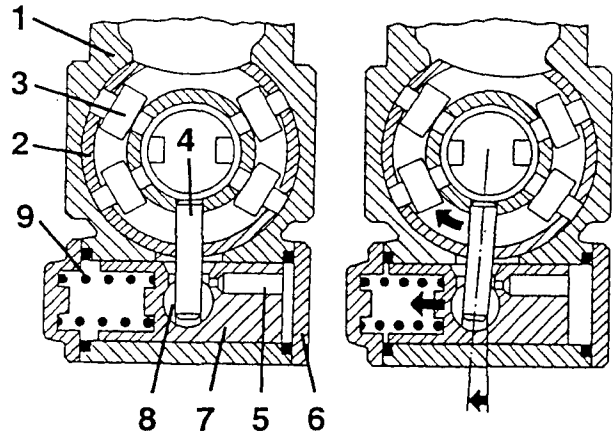


As the spreading time passes irrespective of the r.p.m., the crank angle between the start of the delivery and the start of the injection becomes even greater as the r.p.m. increases.
It is therefore necessary to correct this by anticipating the start of the delivery.
The spreading time of the pressure wave is established by the size of the injection pipe and by the speed of sound, which for diesel is approx. 1500 m/s. This time is known as the "injection delay".
So the start of the injection is delayed with respect to the delivery.
Following this phenomenom, the nozzle opens later at higher speeds than at lower speeds with respect to the position of the engine piston.
After having been injected, the diesel takes a set period of time to pass from the gas state and to form a mixture which together with air is inflammable.
The preparation time for the mixture does not depend on the r.p.m.
In diesel engines, the time which passes between the start of injection and the start of combustion is called the "ignition delay".
The ignition delay depends on the inflammability quality of the diesel (indicated by the cetane number), by the compression ratio, by the air temperature and by the polverization of the fuel.
The ignition delay is usually around 1 millisecond. When the engine speed is increasing and when the start of delivery is constant, the crank angle between the start of injection increases so that combustion does not start at the right moment (with reference to the position of the engine piston).
As optimal combustion and the maximum power of the Diesel engine are only reached when the crankshaft, ie. the piston, has reached a clearly defined position, it is necessary to advance the start of delivery of the distributor pump in time with the increase in the engine speed to compensate for the time lost due to injection and ignition delays.
This correction is performed by the injection advance variator, that intervenes in function with the r.p.m.

Functioning
The injection advance variator piston is kept in the start position by the loaded spring.
During functioning, the fuel pressure within the pump is regulated in relation to the r.p.m. through a delivery valve and the flow throttler.
So the piston head, on the opposite side to the spring, is loaded with the same pressure as the fuel within the pump.
The pressure of the fuel only wins over the spring load and pushes it against the variator piston above a certain r.p.m.

The axial movement of the piston is transmitted through a journal and a pad to the rotating roller holder ring, which changes its timing with the cam disks as it rotates, ie. the roller holder ring is moved by a specified angle with respect to the cam disks and to the distributor piston.

■ Rest position ■ Work position



1. *Pump casing*
2. *Roller holder ring*
3. *Rollers*
4. *Journal*
5. *Hole in variator piston*
6. *Cover*
7. *Variator piston Injection advance*
8. *Pad*
9. *Injection advance variator spring*

CORRECTION DEVICES

The distributor injection pump is built according to a modular principal, and so different supplementary correction devices can be fitted to it which satisfy the needs of the engine. The modular system permits several corrections to be made which allow the torques, power, consumption and exhaust gases to be brought to optimum levels. In this chapter the correction devices and their effect on diesel engines are described.

Adjusting

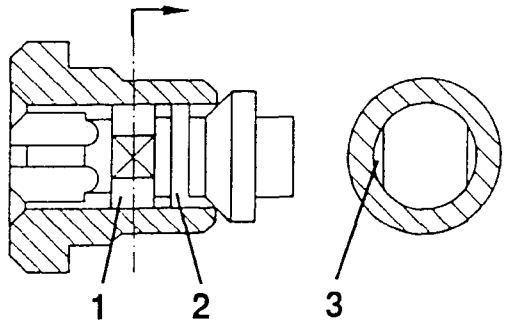
The expression "adjusting" means the adaptation of the flow of diesel to the engine fuel requirement curve, in relation with the r.p.m.
Some requirements characteristic of full load (optimization of the exhaust gases, the torque curves and the fuel consumption) make this adjusting indispensable.
The quantity of injected fuel must correspond to the engine's requirements in that moment.

The fuel consumption decreases slightly as the r.p.m. increases.
If the pump is not adjusted it will send more at faster speeds than at lower ones, as long as the position of the regulating cursor on the distributor pump remains unchanged.
This delivery excess is caused by the throttling effect on the transversal hole of the distributor piston.
If the pump flow is fixed so that the max torque is reached at a low r.p.m., when the speed increases the engine is no longer able to burn the diesel injected without creating smoke.
The engine will overheat if an excessive amount of fuel is injected.
If, on the other hand, the maximum flow is fixed so that the engine reaches full load at high speeds, the engine is no longer able to provide its maximum power at low speeds because the flow is reduced as the r.p.m. decreases.
So the power supply is not "optimal", and consequently the volume of diesel injected must be adjusted to the engine's requirements.
In the distributor pump this adjustment is ensured by the delivery valve and by the modified lever group.
The adjustment of the full load through the regulating lever group takes over when the positive adjustment with the delivery valve is no longer enough or when a negative adjustment is necessary.

Positive adjustment

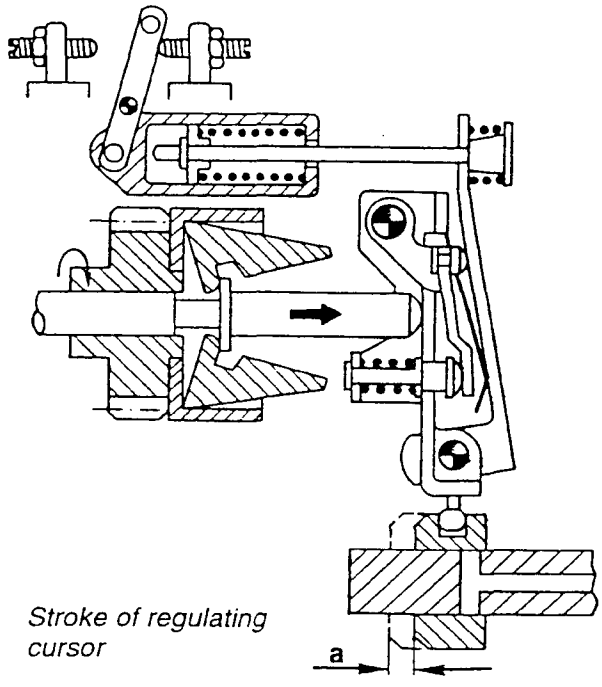
The positive adjustment of the full load is necessary when an excessive amount of diesel is injected at a high r.p.m. value.
To reduce this excessive delivery, the delivery is reduced by increasing the r.p.m.

■ Positive adjustment with the delivery valve
It is possible to adjust the delivery valves, even within very tight limits. In this case, the delivery valves have an extra supplementary collar as well as the plunging collar, upon which one or two flat surfaces have been grinded.
The sections produce the throttling effect, which reduces the flow in relation to the increase in r.p.m. of the pump.



1. *Plunging collar*
2. *Adjusting collar*
3. *Throttling section*

■ Positive adjustment with the regulating levers
The specific r.p.m. at which point adjustment should be started depends on the different settings of the adjusting spring loading.
As soon as this r.p.m. has been reached, a balance should be made established between the force of the sleeve and the spring load force, and the adjusting lever rests against the tension lever through the stop journal.
The free end of the adjusting lever rests against the adjusting journal.
As the r.p.m. increases, the thrust of the sleeve against start lever also increases; the fulcrum common to both the start and adjusting levers changes position.
At the same time, the adjusting lever levers the stop journal and pushes the adjusting journal towards its stop.
Afterwards the start lever rotates around the fulcum and pushes the regulating cursor towards the "injection volume reduction" direction.
The adjusting phase stops as soon as the collar of the adjusting pin knocks against the start lever.

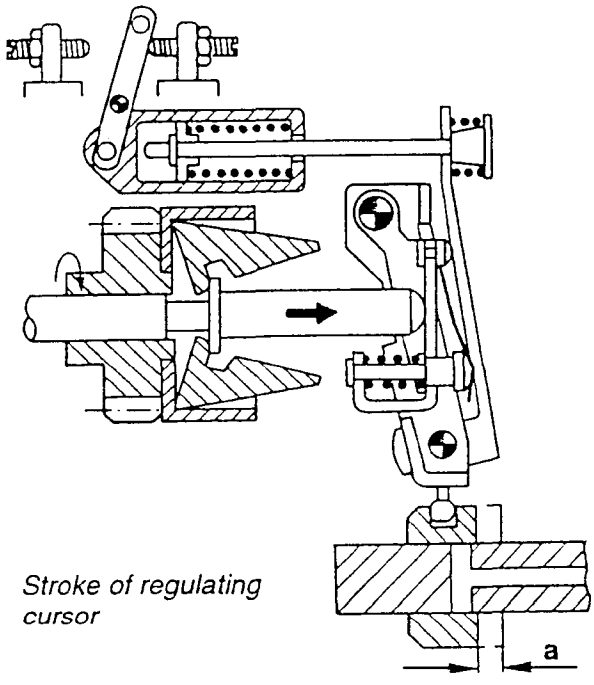


a. *Stroke of regulating cursor*

Negative adjusting

The negative adjusting of the full load may be necessary in engines which tend to develop black smoke at a low r.p.m. or which need a significant increase in the torque.
Boosted engines also need to be fitted with the negative adjustment, when the full load stop dependent on the boosting pressure (LDA) is not fitted.
In these cases, the increase in the r.p.m. produces a significant increase in delivery.

■ Negative adjustment with the regulating lever group
The adjustment lever rests with the stop journal against the tension lever after having totally compressed the start spring.
The adjusting journal also rests against the tension lever.
When the force of the sleeve increases following the increase in the r.p.m., the adjusting lever presses against the preloaded adjusting spring.
As soon as the force of the sleeve exceeds the force of the adjusting spring, the adjusting lever is pushed towards the journal collar.
Consequently the fulcrum common to the starting and adjusting levers changes position.
At the same time, the starting lever rotates in its fulcrum pushing the regulating cursor towards the "greatest flow" position.
The adjustment ends at the moment in which the adjustment lever rests against the journal collar.



a. *Stroke of regulating cursor*

Correction depending on the boosting pressure

The full load stop (LDA) reacts to the exhaust gas turbocharger boosting pressure in relation to the boosting pressure.

Full load stop dependent on the boosting pressure (LDA)

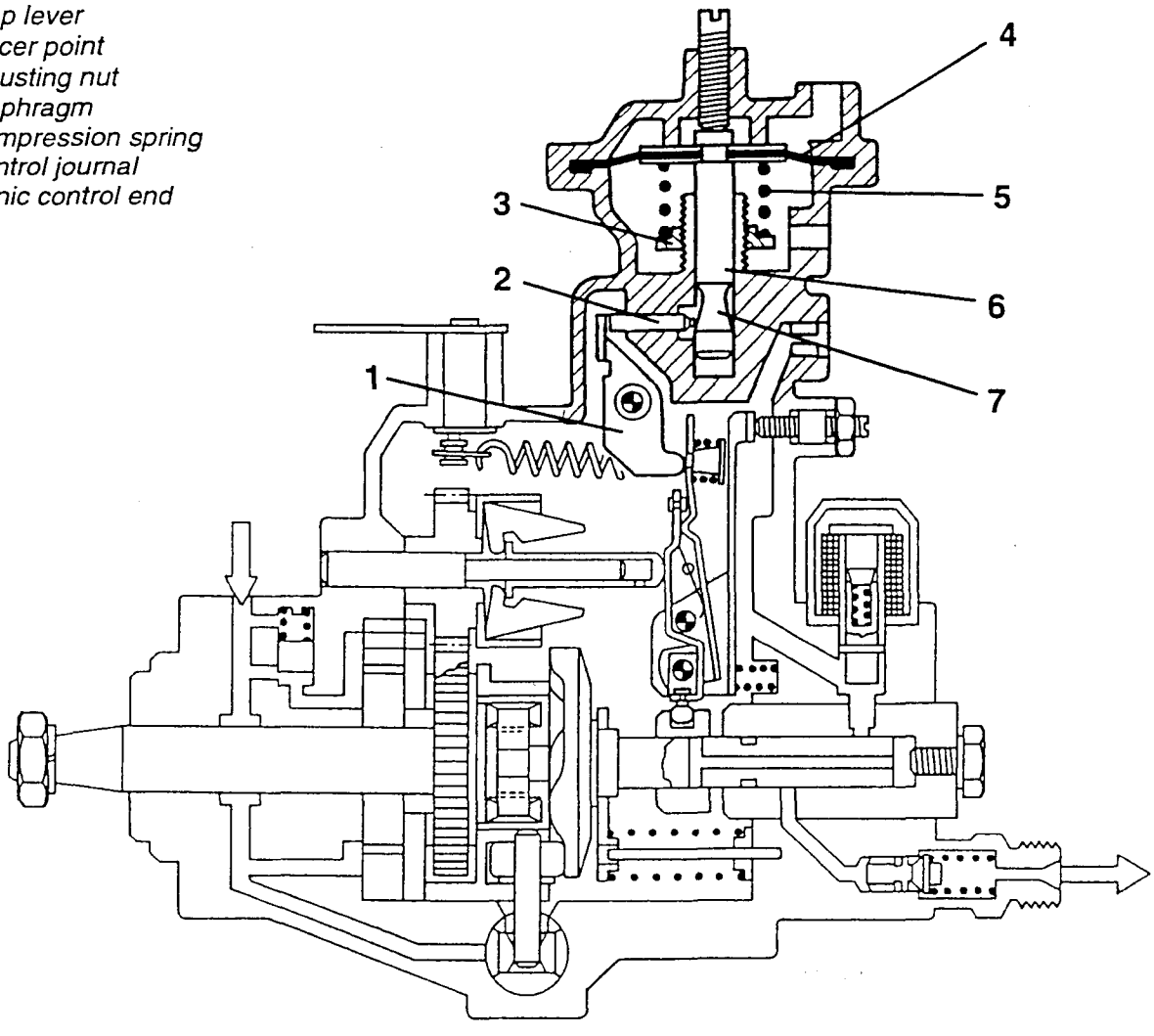
■ Function
The full load stop dependent on the boosting pressure is fitted on turbocharged engines.

In these diesel engines the flow of diesel is strictly connected to the volume of air filling the engine cylinders (working with turbocharger). If the turbocharged diesel engine turns over with a reduced volume of air, the fuel flow must also be adapted to the reduced volume of air. This function is performed by the full load stop dependent on the boosting pressure, which reduces the full load flow below a certain boosting pressure (selectable).

■ Structure

The full load stop dependent on the boosting pressure is fitted on the upper part of the distributor pump, on which the attachment is also located for the boosting pressure and the exhaust hole.
A diaphragm divides the inside of the stop capsule into two watertight chambers.
A compression spring acts against the diaphragm, the opposite end of which rests against an adjusting nut, used to set the preload spring.
In this way the intervention point of the full load stop is regulated with the boosting pressure of the turbocharger.
The diaphragm is integrated with the control journal.
The control journal has a conic end upon which the spine shaped tracer point runs.
The tracer point transmits the movements of the full load stop to the stop lever, which varies the position of the full load stop.
The initial position of the diaphragm and the control journal is set by a suitable dowel on the upper side of the LDA stop.

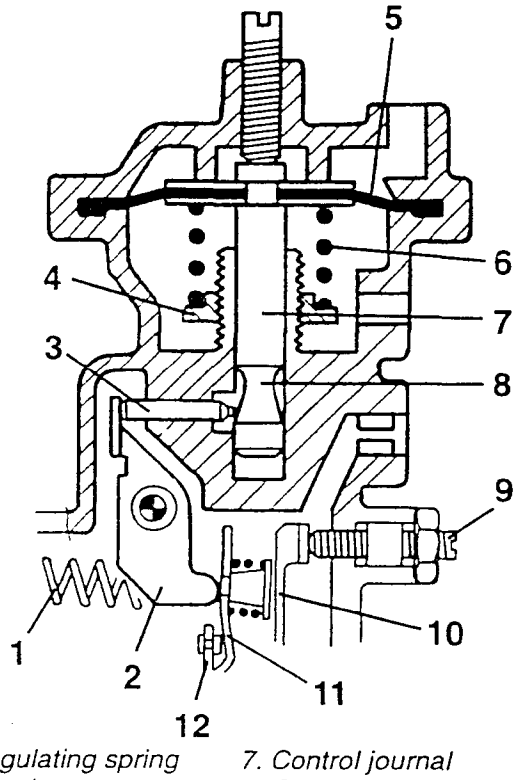
1. *Stop lever*
2. *Tracer point*
3. *Adjusting nut*
4. *Diaphragm*
5. *Compression spring*
6. *Control journal*
7. *Conic control end*



■ Functioning

At low r.p.m., the boosting pressure generated by a turbocharger is not enough to win over force of the spring, and so the diaphragm remains in the starting position.
The increase in the boosting pressure on the diaphragm pushes it downwards together with the control journal with the conic end, and wins over the force of the compression spring.

The movement of the journal with the conic end makes the tracer point move, which in turn makes the lever rotate around the fulcrum.
The traction force of the regulating spring establishes a dynamic coupling between the tension lever, the stop lever, the tracer point and the conic end of the lever; for this reason the tension lever follows the rotating movement of the stop lever.
The start lever follows the tension lever as they are pivoted on a common fulcrum and both move the regulating cursor towards the "greater flow".
In this way the amount of diesel is adapted to the increased volume of air in the engine combustion chamber.
As the boosting pressure falls, the compression spring pushes the diaphragm and the control journal upwards.
Now the regulating mechanism moves in the opposite direction and the amount of diesel is reduced in parallel with the decrease in the boosting pressure.
When the turbocharger is disenabled, the LDA stop returns to the start position and limits the flow of full load so as to ensure a combustion without smoke.
The flow of full load with boosting is regulated by the full load stop screw, which is fitted on the regulator cover.



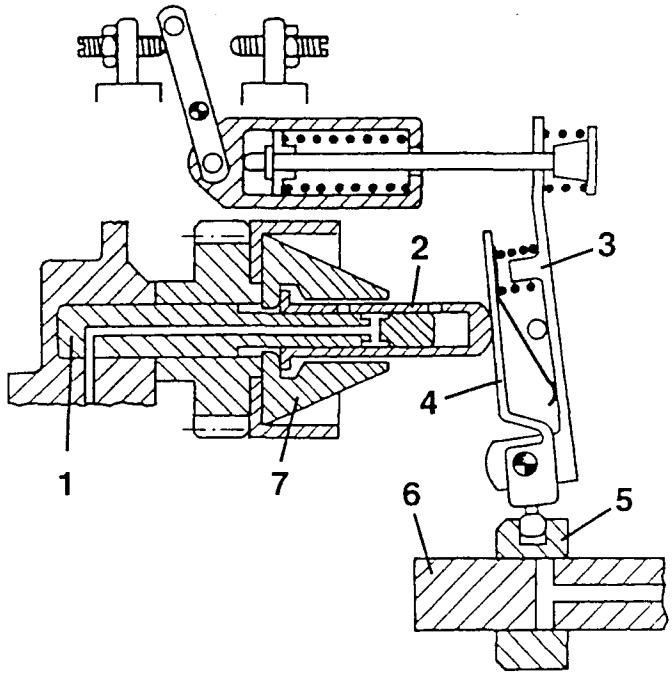
1. *Regulating spring*
2. *Stop lever*
3. *Tracer point*
4. *Adjusting nut*
5. *Diaphragm*
6. *Compression spring*
7. *Control journal*
8. *Control conic end*
9. *Full load adjusting screw*
10. *Adjusting lever*
11. *Tension lever*
12. *Starting lever*

Correction dependent on the load

The start of the delivery must be corrected either by an "advance" or a "delay" depending on the load of the diesel engine.

Start of delivery dependent on the load (LFB)

■ Function
The start of the delivery dependent on the load is calculated in such a way so as to correct with a "delay" when the load decreases (eg. from full load to partial load) even if the control lever position remains unchanged.
When the load increases, the point in which the delivery starts (ie. the injection point) is corrected by an "advance".
With this correction the engine functions more evenly.



1. *Regulating axis*
2. *Regulating sleeve*
3. *Tension lever*
4. *Start lever*
5. *Regulating cursor*
6. *Distributor piston*
7. *Centrifugal masses*

■ Structure
The correction of the "delivery start dependent on the load" has been realized by modifying the regulator sleeve, the regulator axis and the pump casing.
A transversal hole has been made in the regulator sleeve amd a longtudinal hole and two transversal holes have been made in the regulator axis.
A hole has also been made in the pump casing in order to connect the inside of the pump with the intake side of the blade type fuel pump.

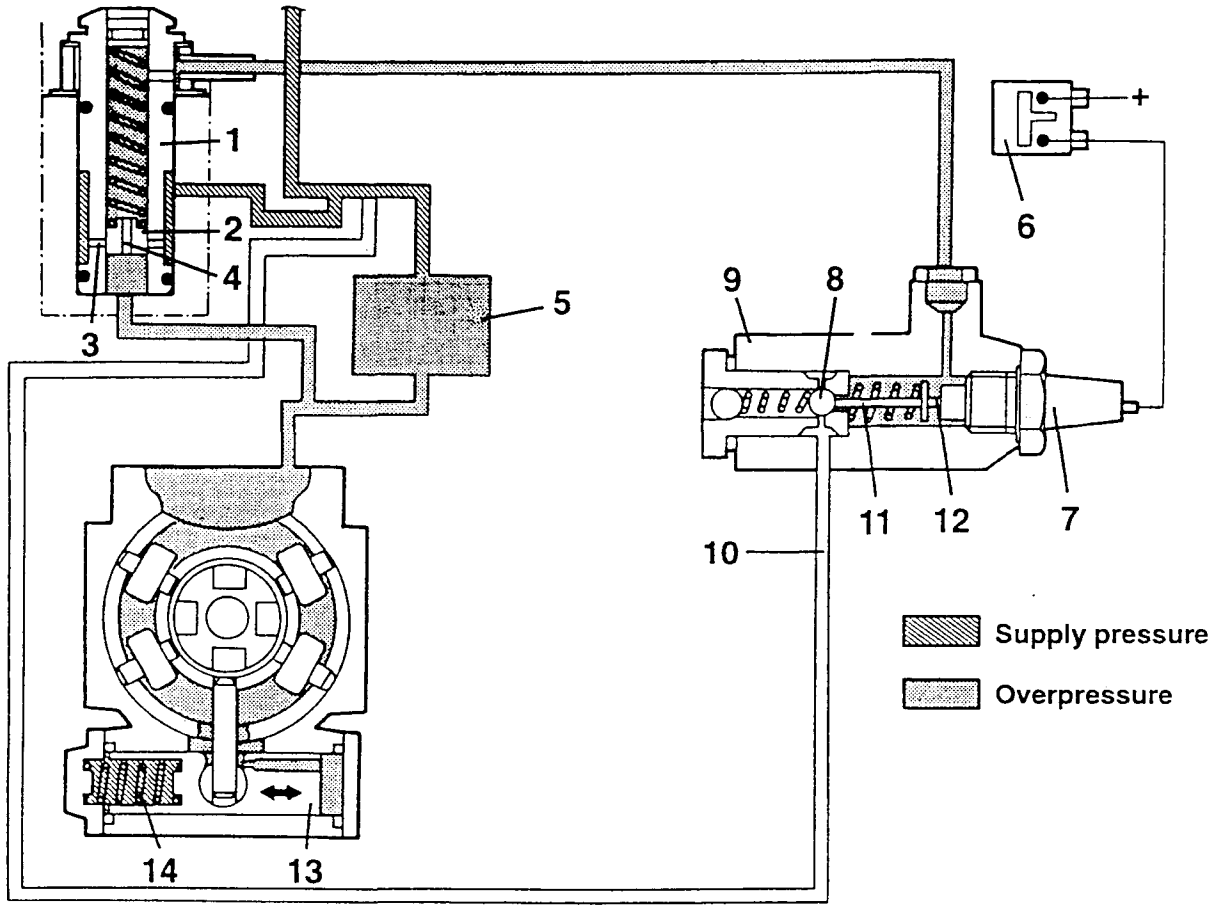
Injection advance when cold automatic device (KSB)

This automatic device has a double function:
- it advances the start of the injection in order to favour a normal functioning when the engine is cold
- it improves start up.

Functioning

The fuel flow of the fuel pump or transfer pump (5) is greater than the requested value for injection, and so the excess flow is drained off through the regulating valve of the transfer pressure (1) to the intake pump, which generates pressure within the pump body (transfer pressure).
The transfer pump flow (5) and consequently the transfer pressure vary in function with the r.p.m.
This transfer pressure acts on one side of the injection advance variator piston (13), pressing against the reaction spring (14) and varying the start injection.

With cold engine:
With engine coolant temperatures ≤ 60 °C the spheric valve (8) of the KSB device is closed because the thrust effect of the cap (11) of the thermal wax bulb (7) is missing.
With the spheric valve (8) in the closed position, the drainage of part of the fuel through the calibrated hole (4) on the piston valve (2) is eliminated; this causes an increase in the transfer pressure, and consequently in advance, because the whole flow must pass through the only drainage holes (3).
The increase in the transfer pressure is felt on the piston (13) of the injection start advance variator (through the articulated cap of the roller holder cage).

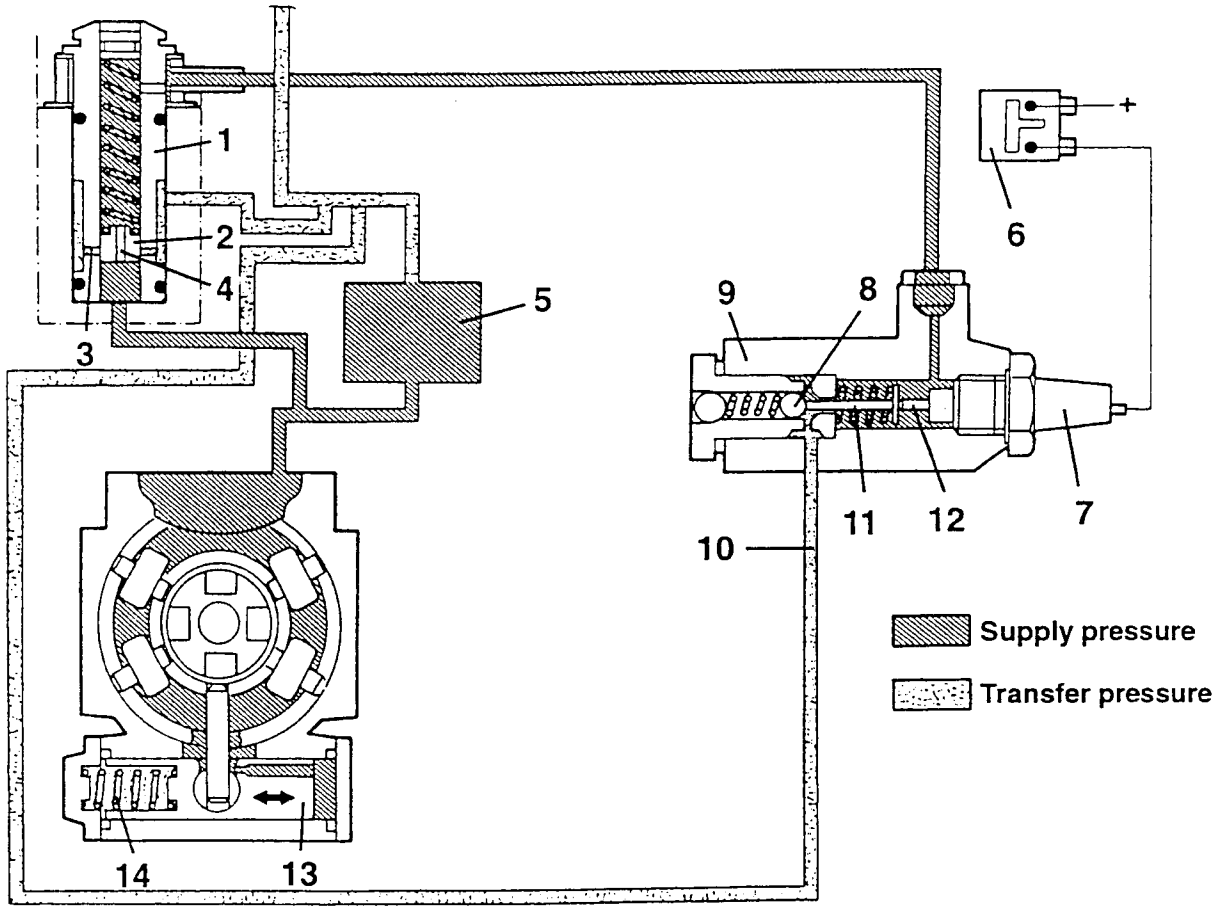


1. *Transfer pressure regulating valve*
2. *Piston valve*
3. *Drainage holes*
4. *Piston calibrated hole*
5. *Transfer pump*
6. *Thermoswitch*
7. *Thermal wax bulb*
8. *Sphere for pressure seal*
9. *Body of automatic advance device*
10. *Drainage hole*
11. *Sphere control cap*
12. *Cap of thermal bulb*
13. *Advance variator piston*
14. *Reaction spring for piston*

With hot engine:

When the engine coolant temperature reaches 60 °C, the thermoswitch (6), on the thermostat body closes and gives the consensus for the wax bulb (7) to be supplied (electrically), which makes the cap (12) come out, due to the expansion effect of the wax, and which in turn opens the spheric valve (8).

The opening of the spheric valve (8) causes a decrease in the transfer pressure (consequently the piston advance stroke 13 is eliminated) because a part of the flow is drained by the calibrated hole (4) as well as by the holes (3), which connects the pressure regulating valve (1) with the supply channel, located upstream from the transfer pump (5).



1. *Regulating valve transfer pressure*
2. *Piston valve*
3. *Drainage holes*
4. *Piston calibrated hole*
5. *Transfer pump*
6. *Thermoswitch*
7. *Thermal wax bulb*
8. *Sphere for pressure seal*
9. *Automatic advance device body*
10. *Drainage hole*
11. *Sphere control cap*
12. *Thermal bulb cap*
13. *Advance variator piston*
14. *Reaction spring for the piston*

Correction dependent on the atmospheric pressure

From certain altitudes and upwards, the intaken air mass is less due to the reduced air density.
The full load flow injected is not completely burned; smoke and engine overheating are the direct consequences.
To eliminate this disadvantage, a full load stop is fitted, which corrects the full load flow on the basis of the atmospheric pressure.

Full load stop dependent on the atmospheric pressure (ADA)

■ Structure
As with the LDA stop, the full load stop dependent on the atmospheric pressure is fitted on the regulator cover.
This has a barometric capsule in place of the diaphragm.
The compression spring is housed between the regulator cover and the spring plate; this serves to set the point at which the barometric capsule intervenes.
The barometric capsule is in contact with the atmosphere through a breather hole.

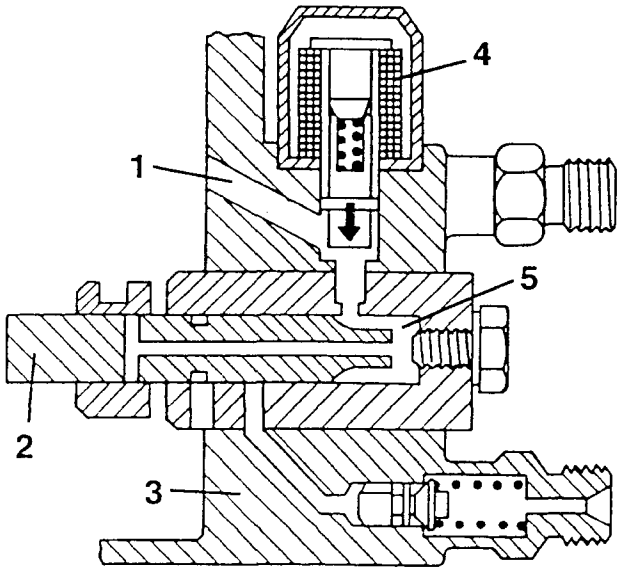
■ Functioning
The decrease in the atmospheric pressure within the limits in which the barometric capsule functions, causes it to lengthen.
The control journal moves and wins over the spring's counterthrust, the tracer point slides on the conic control end and moves it horizontally.
The rest of the correction process takes place as already described for the LDA stop.

STOP

The diesel engine is stopped by interrupting the supply of fuel.

Functioning

Due to its working principle (spontaneous ignition) the diesel engine can only be stopped by interrupting the supply of fuel (electric stop device).
The electromagnetic fuel supply interruption valve is fitted on the upper part of the pump distributor head.
When enabled, ie. when the engine is functioning, the electromagnet keeps the inflow hole into the high pressure chamber open (valve impeller is energized).
By disenabling the ignition, the electrical supply to the electromagnet coil is interrupted; the magnetic field falls, the spring presses the impeller and the valve against the seating of the latter.
Consequently, the inflow hole into the high pressure chamber is interrupted and the distributor piston can no longer deliver the fuel.
The electric stop can not be realized with electrical circuits conceived differently (return and thrust electromagnets).

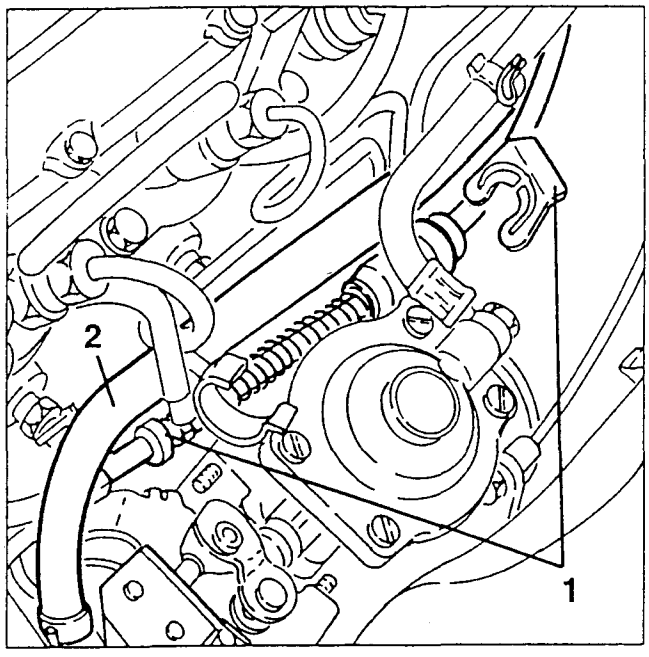


1. Inflow hole
2. Distributor piston
3. Distributor head
4. Return and thrust electromagnet
5. High pressure chamber

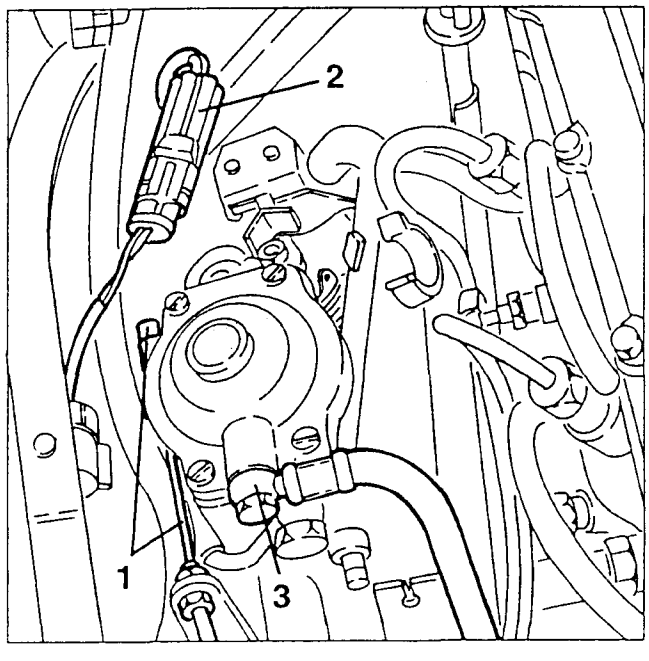
REMOVAL/REFITTING

- Position the vehicle on a lift.
- Disconnect the negative (-) battery cable.
- Disconnect the oil vapour recirculation hose from the corrugated sleeve and move it to one side.

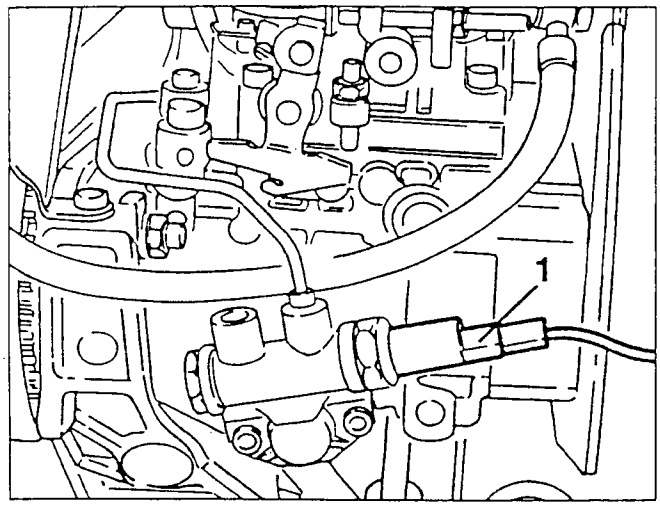
1. Disconnect the accelerator control cable from the injection pump.
2. Disconnect the fuel arrival pipe from the injection pump.



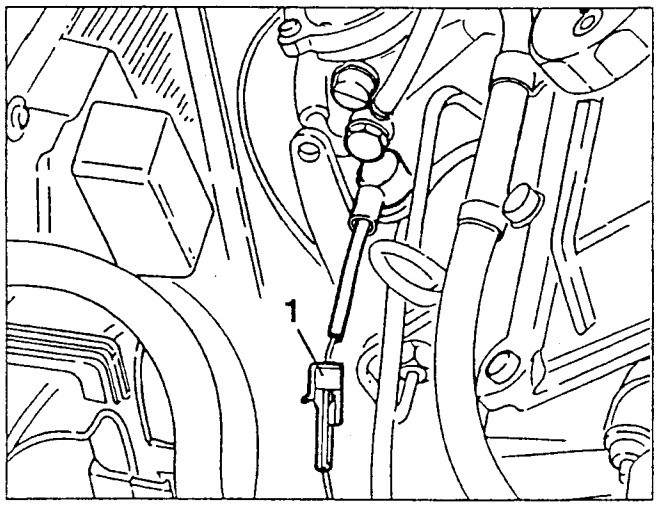
1. Disconnect the automatic idle speed device control cable from the injection pump.
2. Disconnect the electrical connection of the full load switch.
3. Disconnect the overpressure pipe connector for the flow limiter from the injection pump.



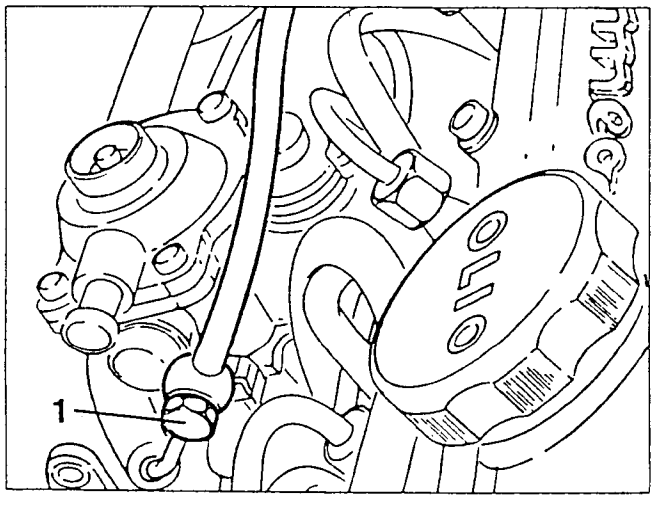
1. Disconnect the electrical connection of the automatic injection advance when cold device KSB.



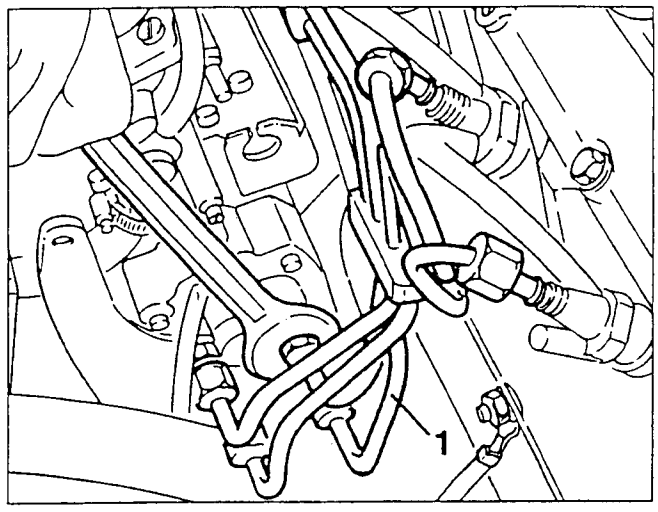
1. Disconnect the electrical connection of the engine stop solenoid valve.



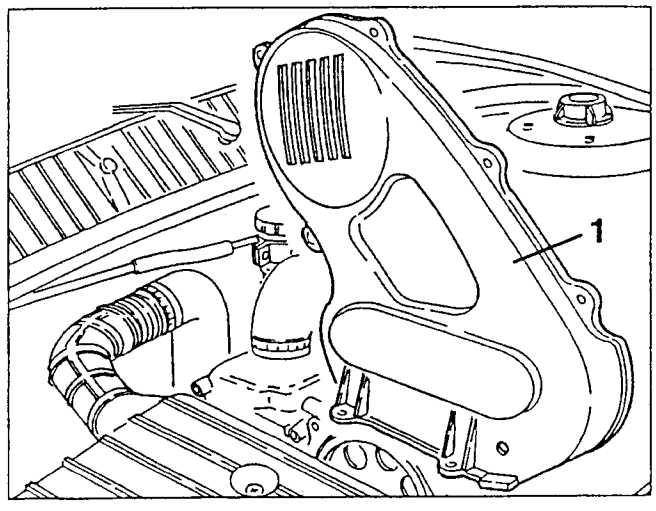
1. Disconnect the excess fuel to tank return pipe connector from the injection pump and remover it.



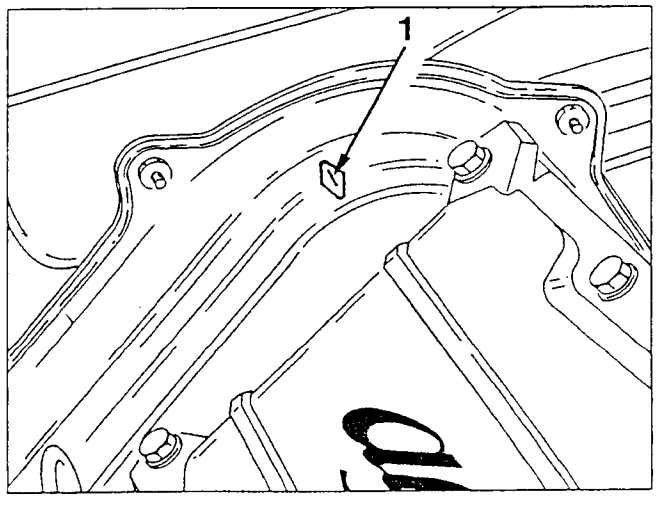
1. Remove the fuel delivery pipes from the pump to the injectors.



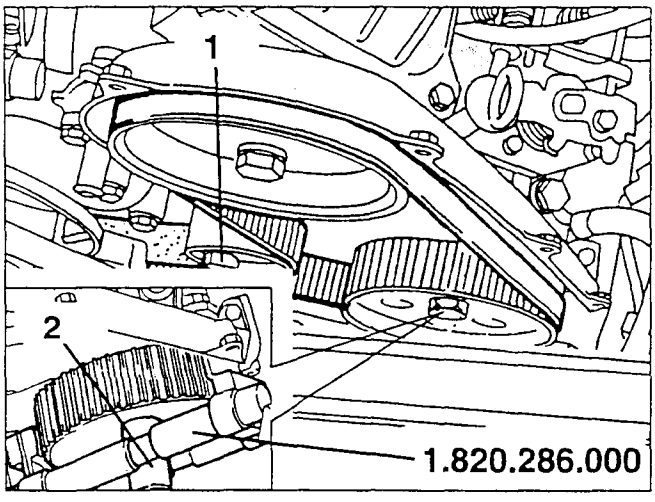
1. Unscrew the screws and remove the timing belt front cover.



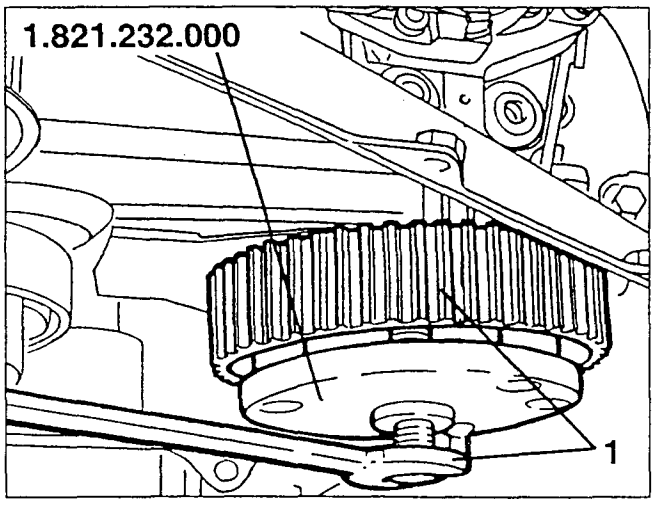
1. Check that the notch on the camshaft control pulley is in line with the hole on the timing belt rear guard.



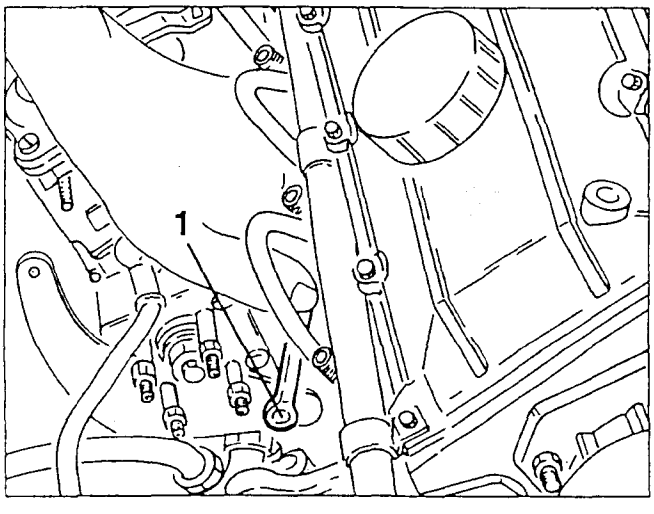
1. Loosen the nuts securing the belt tensioner jockey pulley and extract the timing belt.
2. Using tool N° 1.820.286.000, unscrew the nut securing the injection pump control pulley.



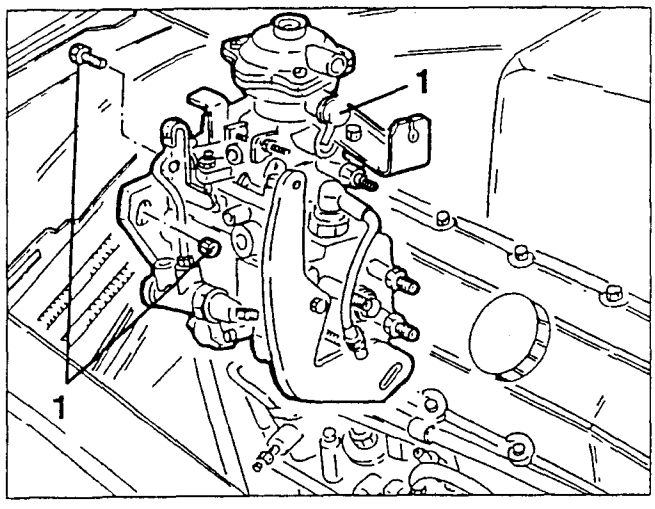
1. Using tool N° 1.821.232.000 remove the injection pump control pulley.



1. Unscrew the screws securing the injection pump support rear bracket.

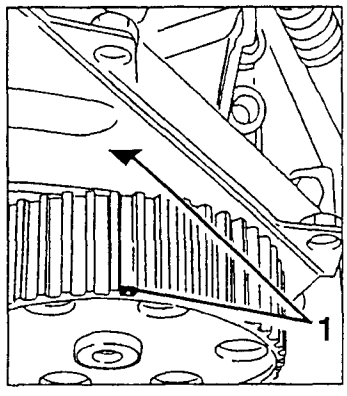


1. Unscrew the two upper nuts and lower screws securing the injection pump to the support and remove it.

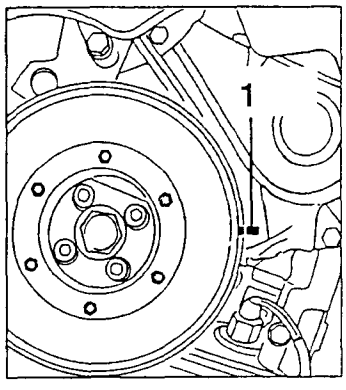


To refit the injection pump, reverse the sequence of the operations described for removal, with the exception of the timing operations given below.

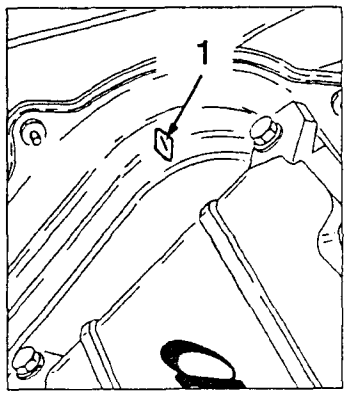
1. Turn the injectiom pump control pulley so that the notch engraved on it corresponds with the rise on the timing belt rear cover.



1. Check that the notch on the auxiliary parts control pulley is in line with the notch on the timing belt lower cover.



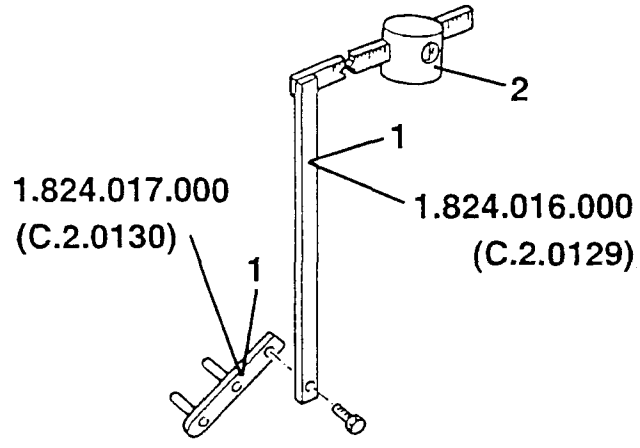
1. Check that the notch on the camshaft control pulley is in line with the hole on the timing belt rear cover.



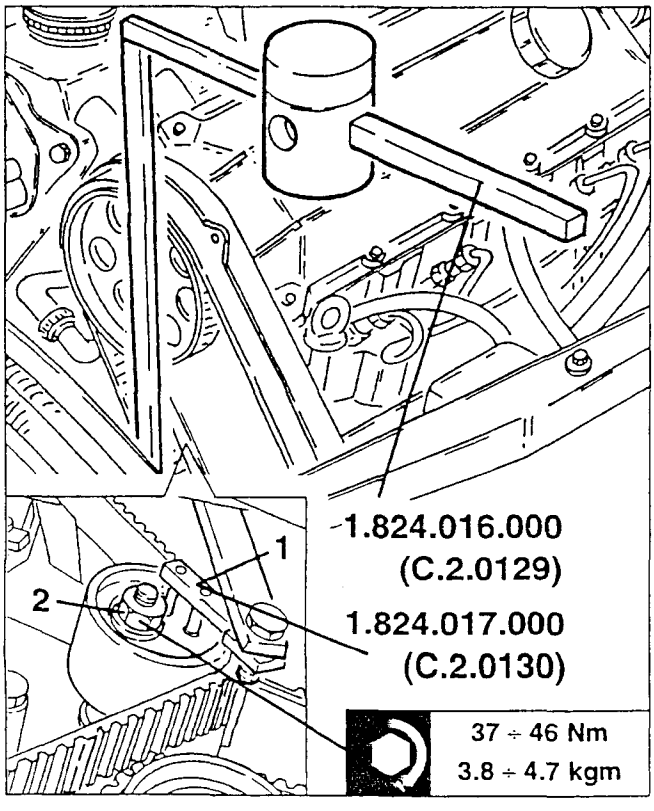
- Install the timing drive belt, and check that the teeth over the whole pulley are correctly coupled.

When the belt is fitted, do not under any circumstances bend the belt otherwise the structure of the fibres may be compromised.

1. Fit support N° 1.824.017.000 (C.2.0130) onto tool N° 1.824.016.000 (C.2.0129).
2. Position the weight with the knurled part at a distance of 120 mm on the millimetric rod and block it there.

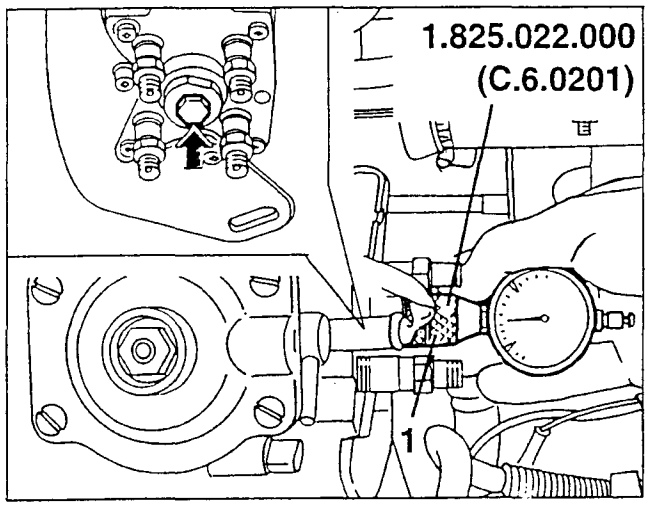


1. Apply the tool, assembled in this way, on the belt tensioner as illustrated in the figure amd acting on the joint, turn the millimetric rod so that it is horizontal.
- Set the drive belt by making the crankshaft complete two revolutions in the normal rotation direction.
2. Tighten the belt tensioner nuts to the correct torque.

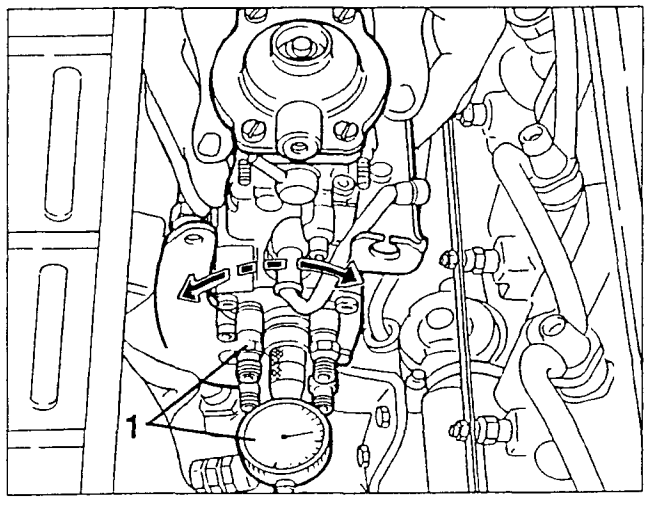


During this latest phase, the millimetric rod may move from its horizontal position; if this is the case it must be returned to its original position by acting on the belt tensioner and the operation must be repeated.

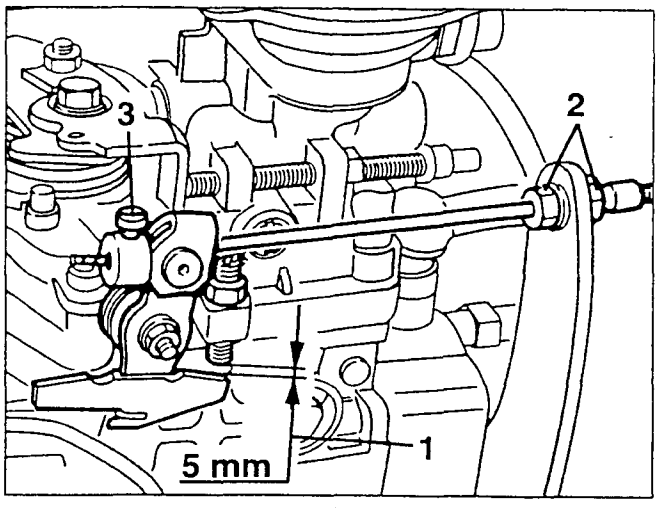
- Remove the tools for tensioning the belt.
- Check the correct engine timing again as described previously.
- After having refitted the injection pump, check that it is timed by operating as follows:
1. Remove the plug on the pump cover and in its place screw tool N° 1.825.022.000 (C.6.0201) complete with a comparator with tracer point in contact with the crown of the piston distributor.



- Rotate the crank shaft in the opposite direction to the rotating direction until the piston distributor of the pump reaches the B.D.C.; set the dial gauge to 0.
- Rotate the crank shaft in the direction of rotation until the cylinder piston N° 1 is at T.D.C.
In this position, the piston distributor of the pump must have completed a stroke of **0.8 mm.**
1. If the prescribed stroke is not completed, the pump body must be rotated in its slot until the correct value, then tighten the screws securing.

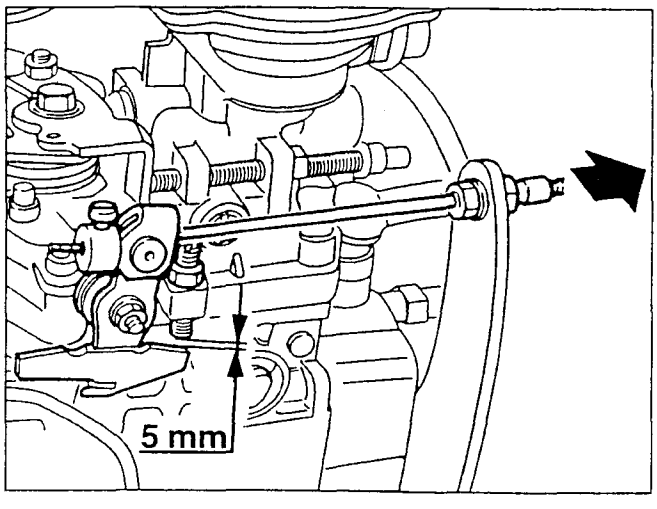


- After having connected the automatic idle speed device control cable to the injection pump, adjust as follows.
1. Check that when the engine is cold (with the automatic minimum idle speed set at **1180 ÷ 1220 r.p.m.**), there is a gap of **5 mm** between the end of the lever and the adjusting screw.
2. If the gap measured does not correspond to the specified value adjust the nut and locknut.
3. If the correct gap is not obtained even after adjusting, act on the bushing anchoring the cable.



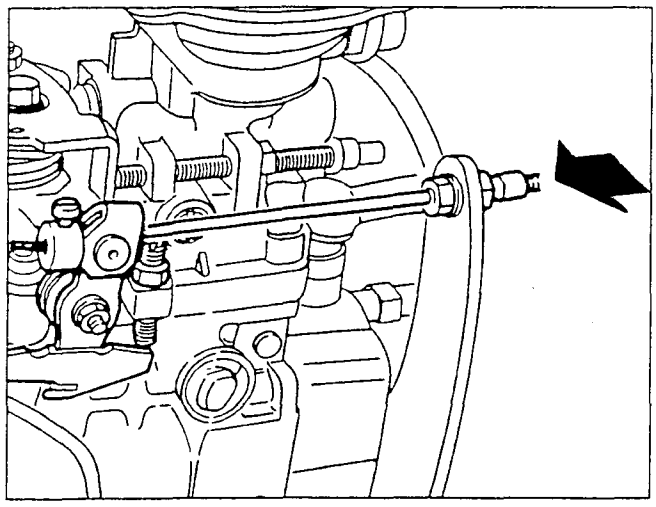
AUTOMATIC IDLE SPEED DEVICE

Functioning when engine is cold:



The thermostatic sensor, screwed to the thermostatic cup, acts through a connecting cable on the automatic idle speed control lever.
When the engine is cold, the thermostatic sensor is in the rest position as the engine coolant has not reached the temperature at which it starts to intervene (60°C ± 2°C).
In these conditions the control lever of the device is kept in the idle speed position by the cables and there must be a gap of **5 mm** between the end of the lever and the idle speed adjusting screw.

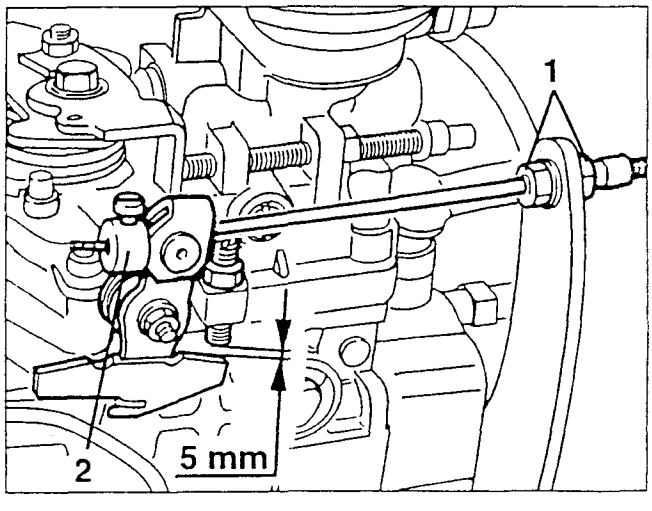
Functioning when engine is hot



When the engine coolant reaches the intervention temperature of (60° ± 2°C), the thermostatic sensor starts to act and the cap slowly moves in function with the gradual increase in the engine coolant temperature.
Consequently the cable allows the lever to move until the idle speed position is reached, ie. when the end of the lever is in contact with the idle speed adjusting screw.

Adjusting the automatic idle speed

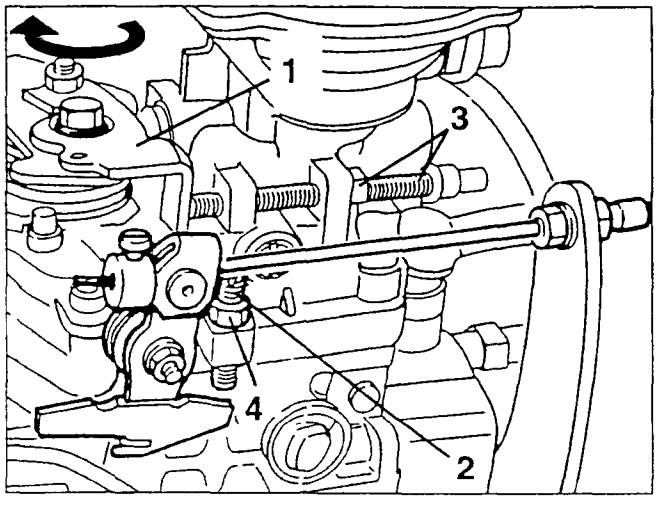
- When the engine is cold, in order that the prescribed automatic idle speed of (**1180 ÷ 1220 r.p.m.**) is obtained, there must be a **5 mm** gap between the end of the control lever and the idle speed adjusting screw.
1. If the gap measured does not correspond to the specified value adjust the nut and locknut.
2. If the correct gap is not obtained even after adjusting, act on the bushing anchoring the cable.



Asdjusting the idle speed

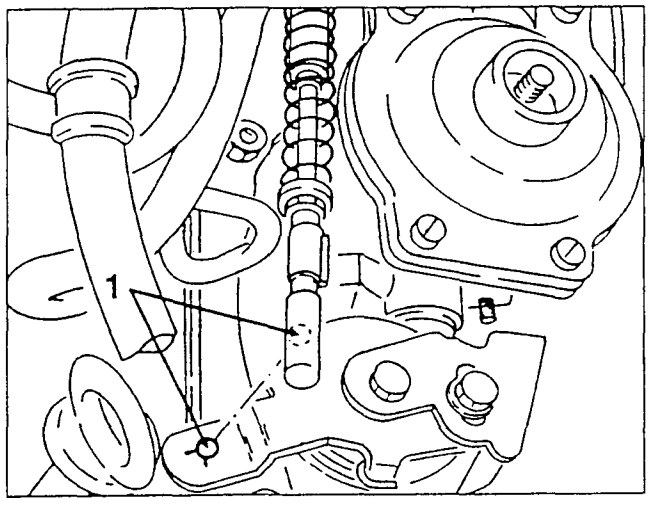
NOTE: Before adjusting the idle speed, check that this adjustment is not conditioned by the position of the residual flow adjustment screw.

- Start up the engine and bring it to a normal operating speed.
1. Activate the accelerator control lever and move it by **1 ÷ 2 mm** from the rest position, without increasing the engine revs.
- If this is not the case, unscrew the residual flow adjustment screw and repeat the test until the condition described above no longer occurs.
2. Once the test has been carried out, adjust the idle speed by acting on the adjusting screw until the prescribed r.p.m. is obtained (**880 ÷ 920 r.p.m.**).
3. When the adjustment is complete, screw the residual flow adjusting screw until an increase in the r.p.m. **~ 10 r.p.m.** is obtained, then unscrew it by **0.5 ÷ 1 turn** and block it with a suitable lock nut.
4. Block the idle speed adjusting screw with a suitable lock nut.

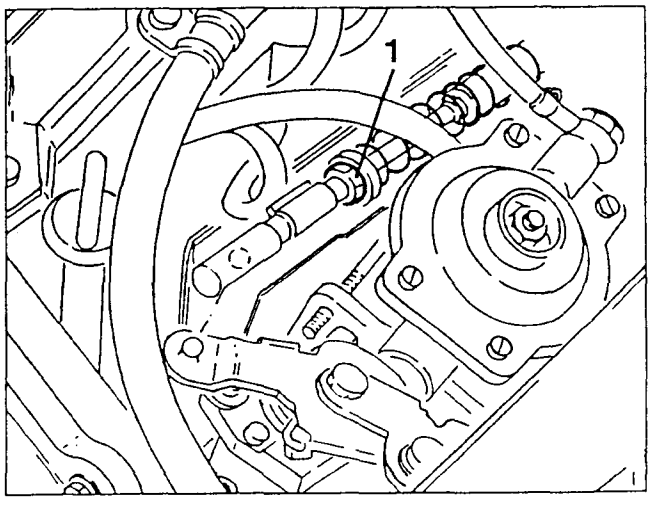


ADJUSTING ACCELERATOR CABLE

- Disconnect the accelerator cable from the control lever.
1. With the accelerator pedal completely raised, check that the sphere on the control lever corresponds with the hole on the pawl of the accelerator cable.



1. If this is not the case, loosen the nut on the accelerator cable pawl and unscrew/screw it until it corresponds.
- Reconnect the accelerator cable to the control lever on the injection pump.

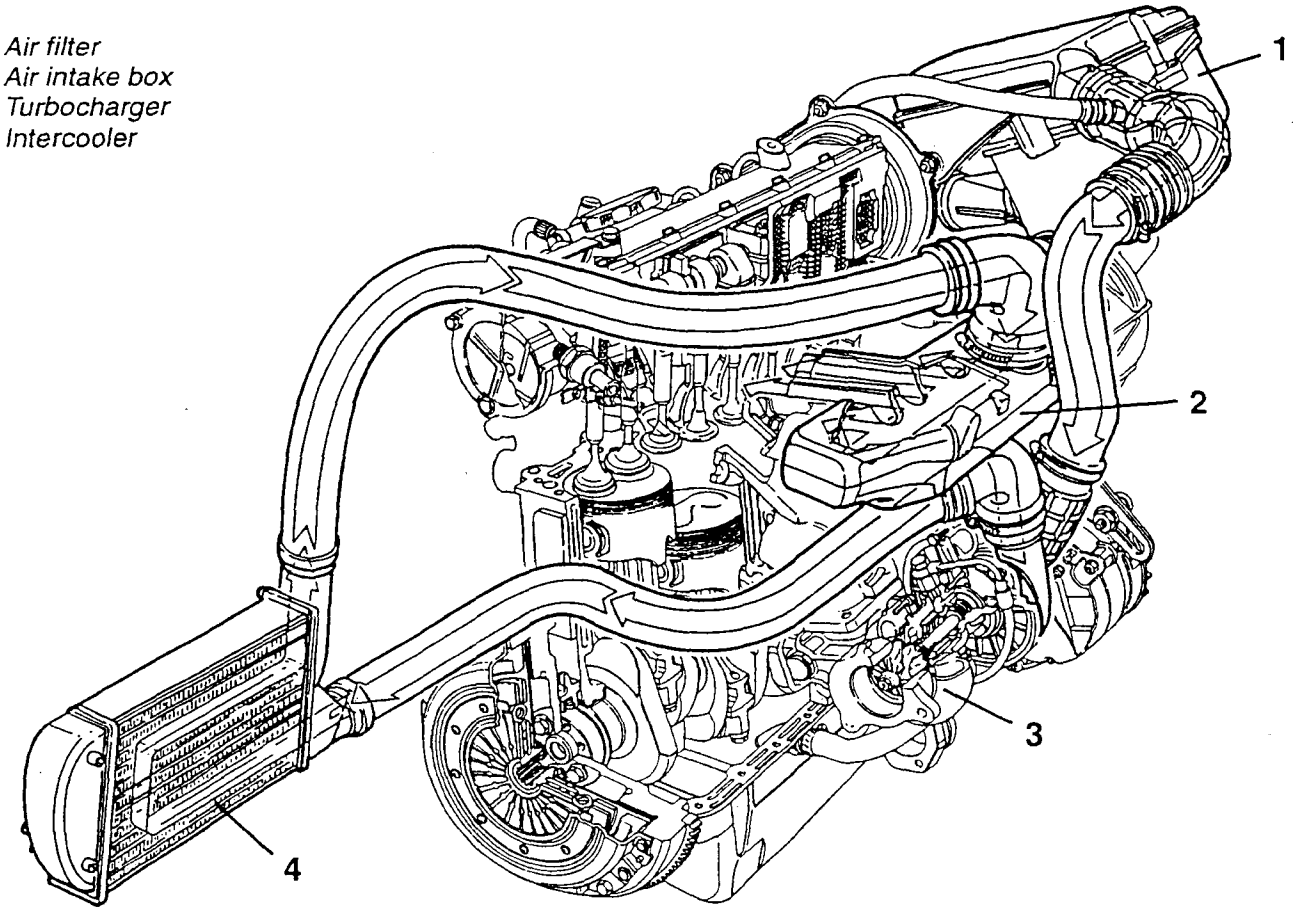


AIR BOOSTING SYSTEM DESCRIPTION

The engine power is directly proportional to the air mass and the corresponding fuel quantity introduced into the cylinders.
It is therefore possible to increase the engine power by introducing, during each cycle, an amount of air greater than the amount that the engine is able to intake through the "pumping" of the pistons.
This increased quantity of air (in weight) allows a proportionally increased quanity of fuel to be burned and the pressure, work and power developed by the engine to be increased.

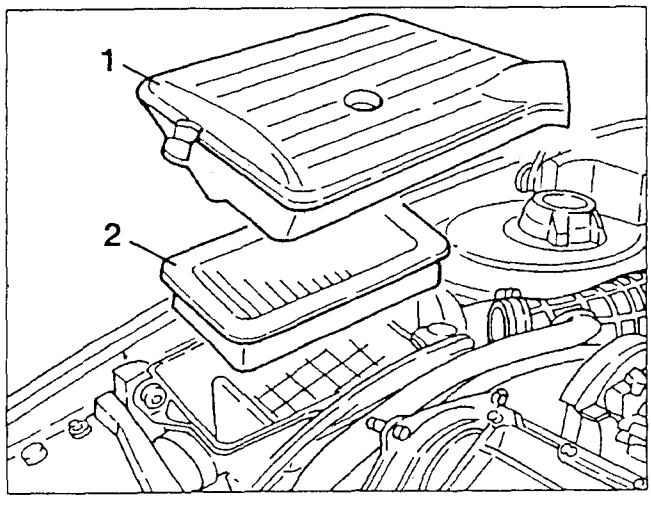
Adopting the boosting system also increases the engine's turbulence which reduces consumption.
The air intaken through a dynamic inlet and filtered through a cartridge element, arrives at the turbocharger from where it is sent, under pressure, to the intercooler.
Here the air is cooled by an air - air thermic exchange and sent to the air intake box from where it is sent into the cylinders.
As regards the treatment of the individual components, see the paragraphs below.

1. *Air filter*
2. *Air intake box*
3. *Turbocharger*
4. *Intercooler*



AIR FILTER

Th filter is of the cartrdige type, with a filtering element which is easy to replace and which traps the particles and dust present in the air sucked into the engine and also acts as an "intake silencer".



REPLACEMENT OF AIR FILTER CARTRIDGE

- Disconnect the corrugated sleeve from the air filter cover.
- Unscrew the screws securing the air filter cover.
1. Remove the air filter cover.
2. Remove the air filter cartridge.

Any filter cleaning operation may damage it and risk compromising the correct functioning of the engine supply system.

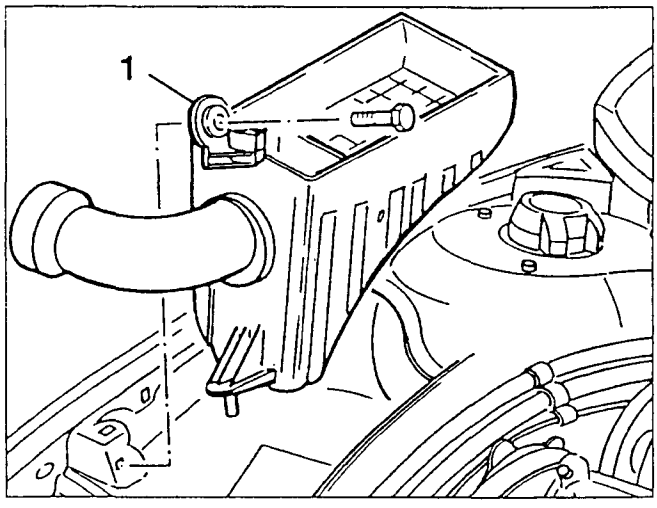
- Carefully clean the air filter cartridge container.
- Check the condition of the cartridge and, if necessary, replace it.
- Refit the cover and fix it with the relative screws.
- Connect the corrugated sleeve to the air filter cover.

If the filter shows traces of oil, check the whole circuit for possible infiltrations.

REMOVAL/REFITTING

- Remove the air filter cartridge (see specific procedure).

1. Unscrew the screws and remove the air filter box.

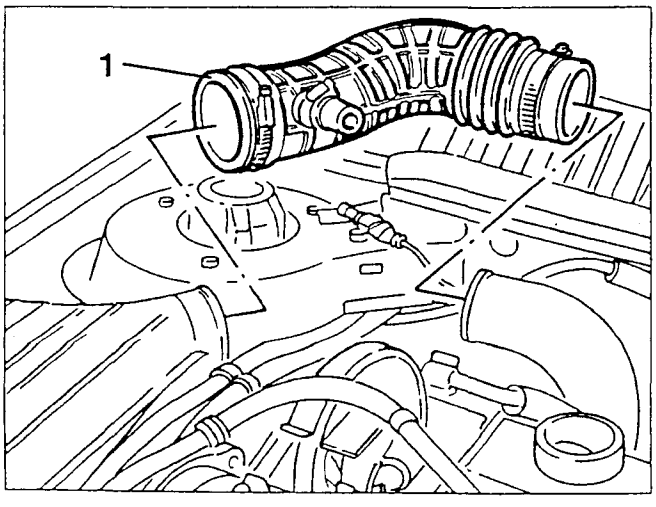


AIR INTAKE BOX

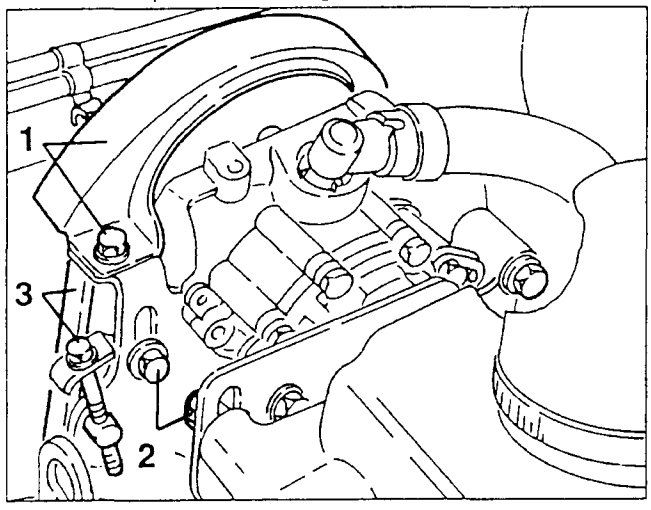
REMOVAL/REFITTING

- Disconnect the negative (-) clamp from the battery.
- Disconnect the oil vapour recirculation pipe from the air intake corrugated sleeve.

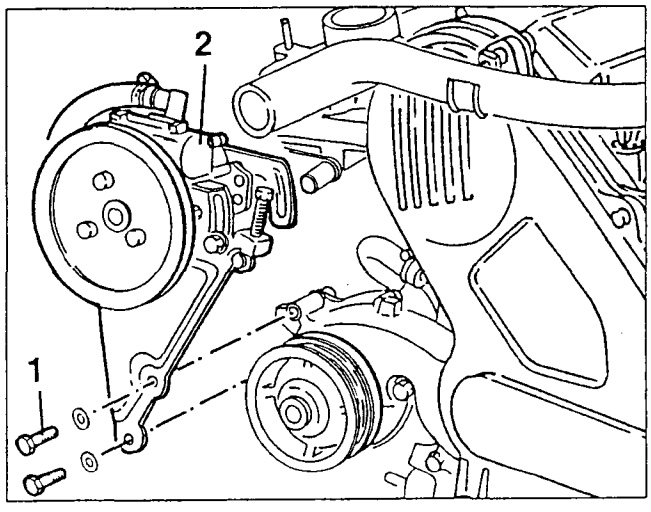
1. Remove the corrugated air intake sleeve from the filter to the turbocharger.



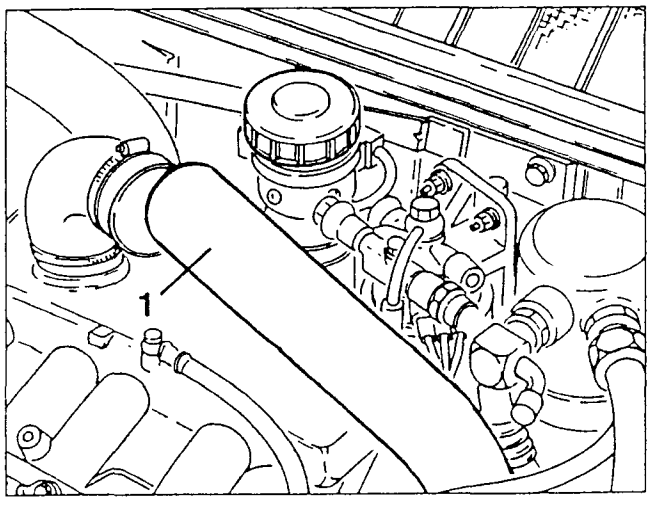
1. Remove the power steering pump belt guard.
2. Loosen the screws securing the power steering pump.
3. Loosen the screw of the micrometric tensioner and remove the power steering pump drive belt.



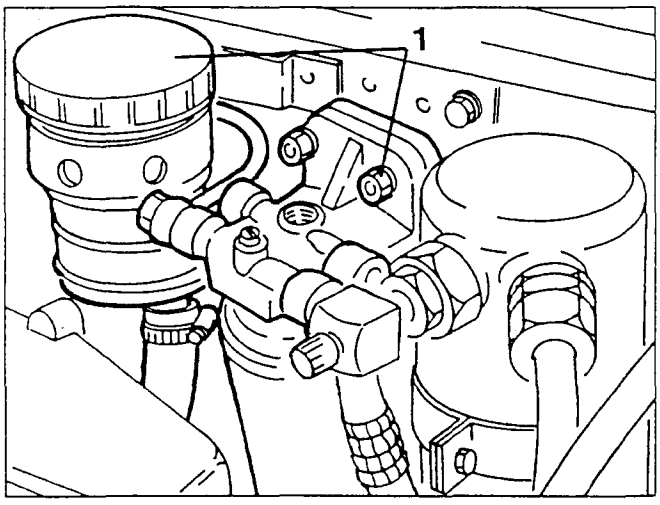
1. Unscrew completely the screws loosened beforehand and the two screws indicated in the figure.
2. Remove the power steering pump complete with front bracket without disconnecting the pipes and move it sideways.



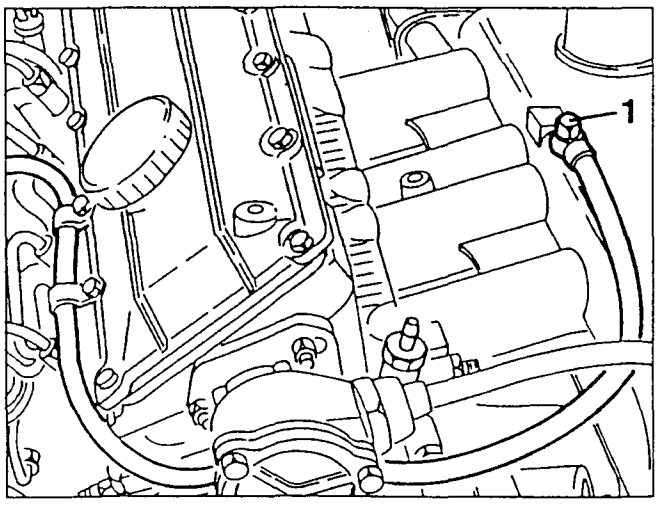
1. Disconnect the stiff air pipe leading from the intercooler from the elbow on the intake box.



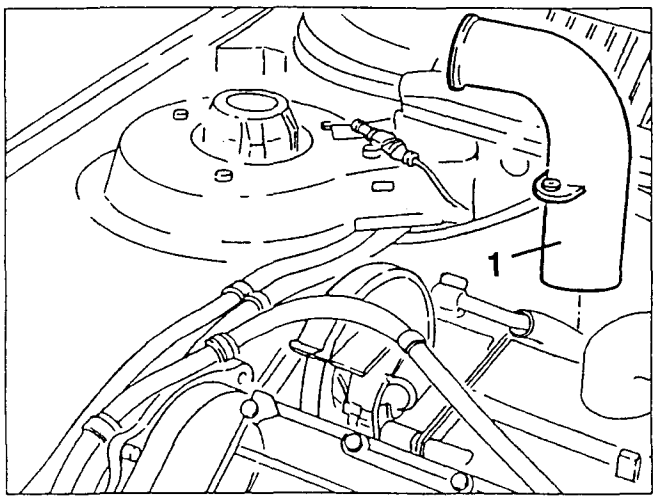
1. Slacken the fastenings of the fuel filter and power steering reservoir, then move them aside without disconnecting their hoses.



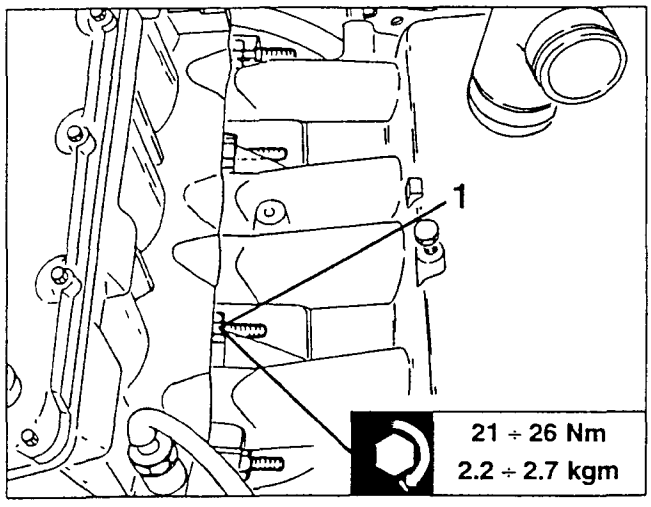
1. Disconnect the connector of the overpressure pipe for the flow limiter from the air intake box.



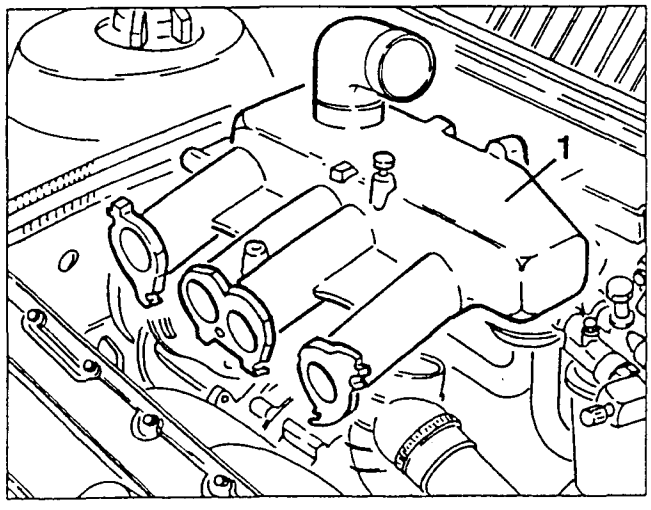
1. Remove the air intake pipe from the turbocharger.



1. Unscrew the screws securing the air intake box to the cylinder heads.



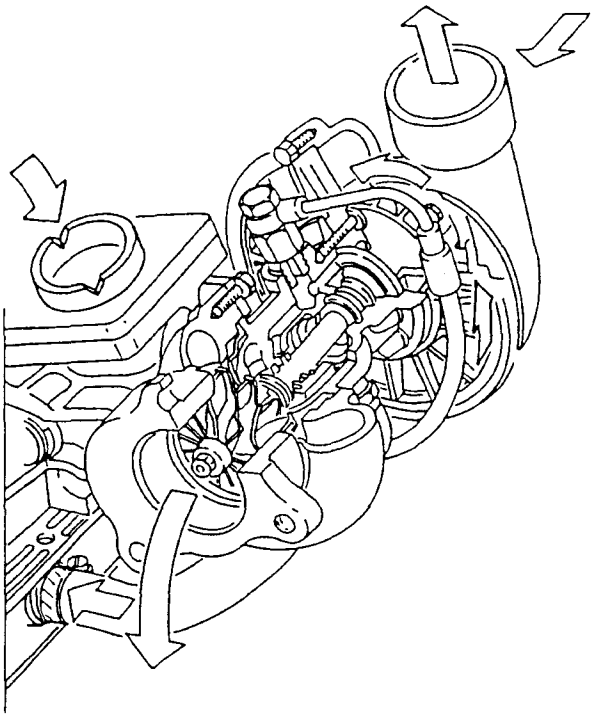
1. Remove the air intake box.



TURBOCHARGER

This consists of two rotors keyed onto the same shaft, which rotates on lubricated floating bearings through a branch of the engine lubrication circuit.
The oil is also used to absorb some of the heat given off by the turbine exhaust gas.
A "turbine" rotor connected to the exhaust manifold rotates thanks to the energy of the exhaust gas conveyed on it.
The turbine makes the other "compressor" rotor, connected to the intake manifold, move (at the same speed).
Thanks to its rotational speed and the particular form of its blades, the rotor draws external air and compresses it in the intake manifold and consequently in the engine cylinders.

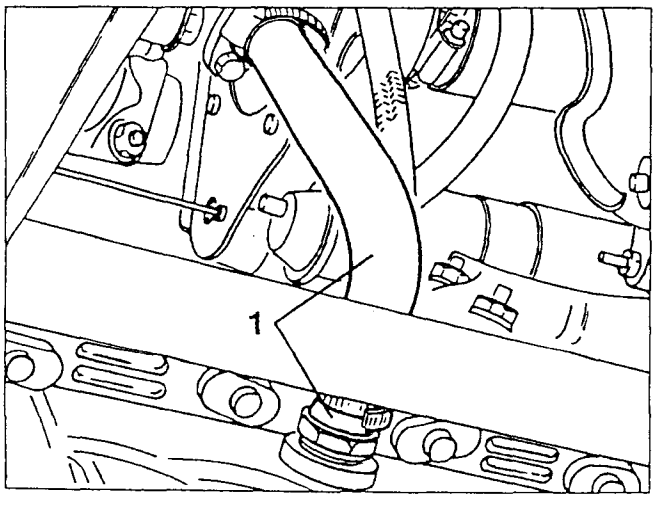
If the r.p.m. increases, the turbine and the compressor also increase their speed of rotation and increase the quantity of air supplied to the engine.
A WASTE-GATE valve is fitted on the turbocharger which allows the exhaust gas to by-pass (or not by-pass) the turbine in accordance with the engine power/torque requested.



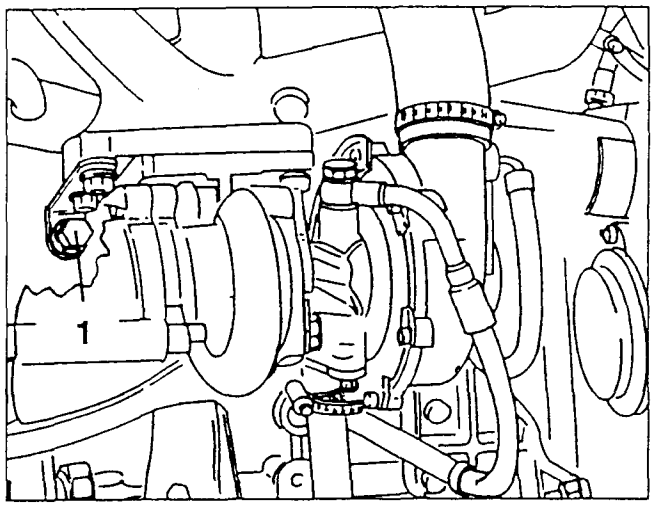
REMOVAL/REFITTING

- Remove the air intake box (see specific procedure).
- Raise the vehicle.
- Remove the front section of the exhaust pipe (see specific procedure).

1. Disconnect the oil from turbocharger outlet pipe from the sump.

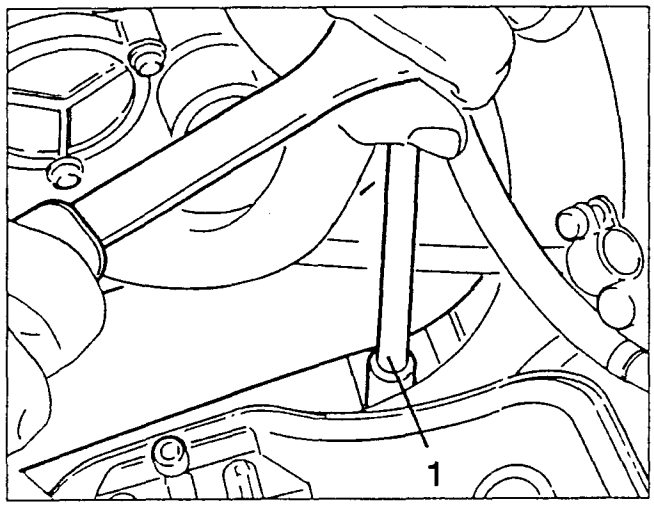


1. Unscrew the screws at the base of the turbocharger support bracket.

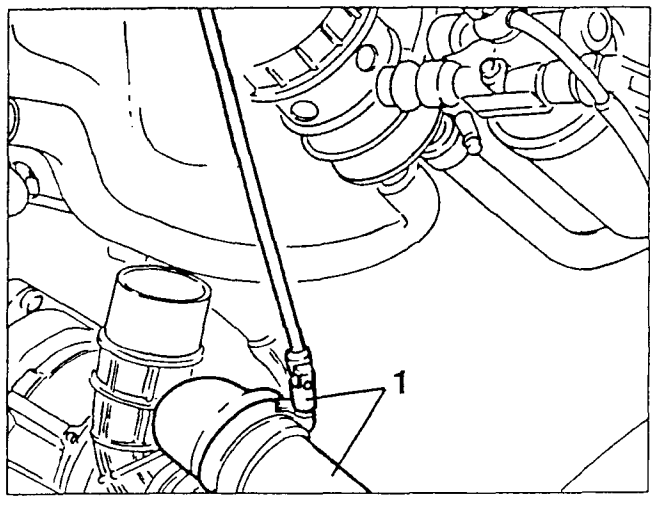


- Lower the vehicle.

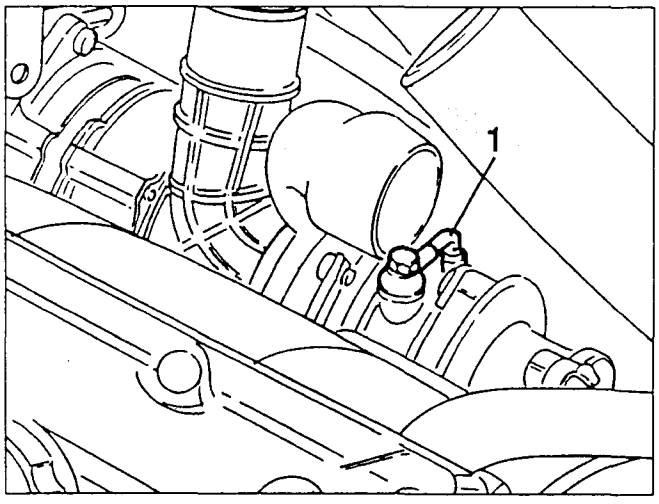
1. Remove the battery and slacken the screw fastening the air delivery pipe from the turbocharger to the intercooler.



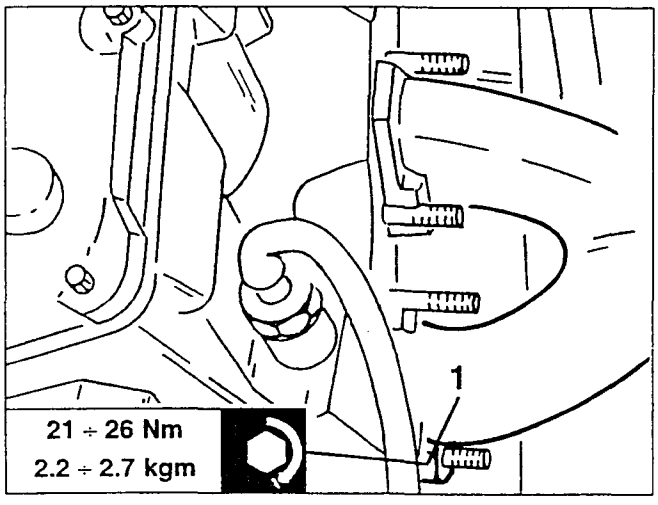
1. Disconnect the air to intercooler delivery pipe from the turbocharger.



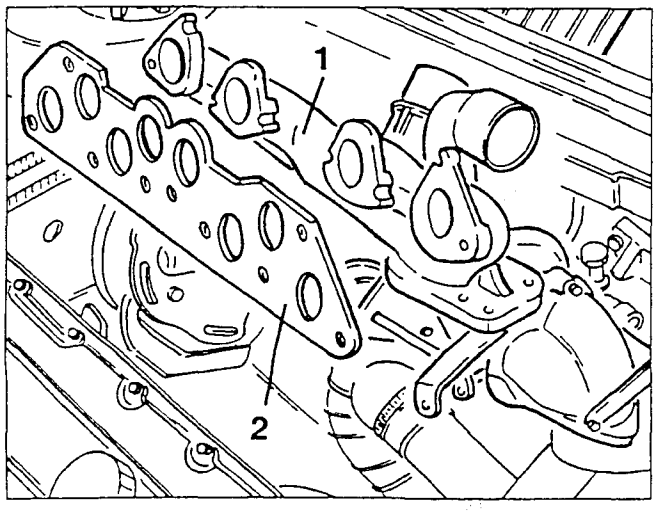
1. Disconnect the oil from engine block arrival pipe from the turbocharger.



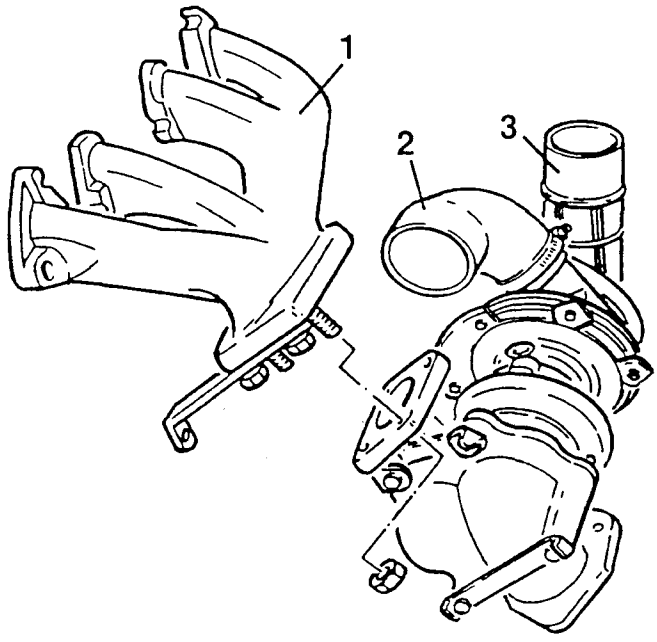
1. Unscrew the nuts securing the exhaust manifold to the cylinder heads.



1. Remove the exhaust manifold assembly, turbocharger and sleeves.
2. Remove the gasket.



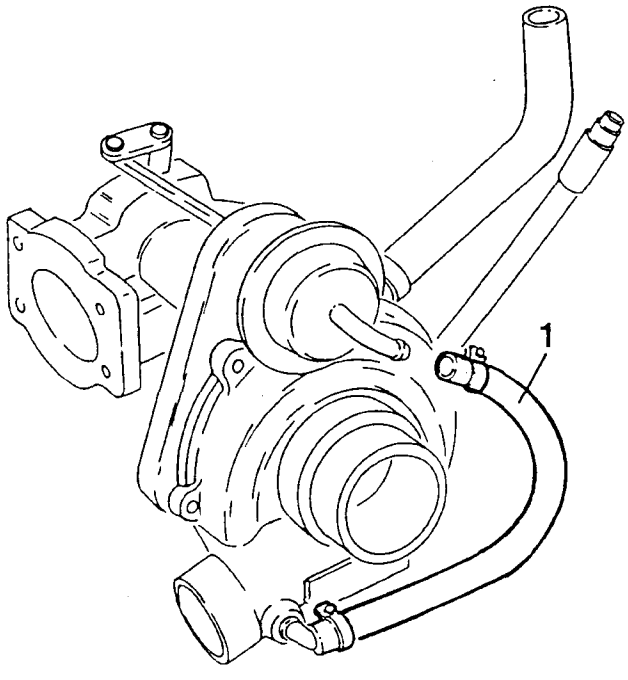
1. At the bench, unscrew the nuts and separate the exhaust manifold from the turbocharger.
2. Remove the air outlet sleeve from the turbocharger.
3. Remove the air inlet sleeve from the turbocharger.



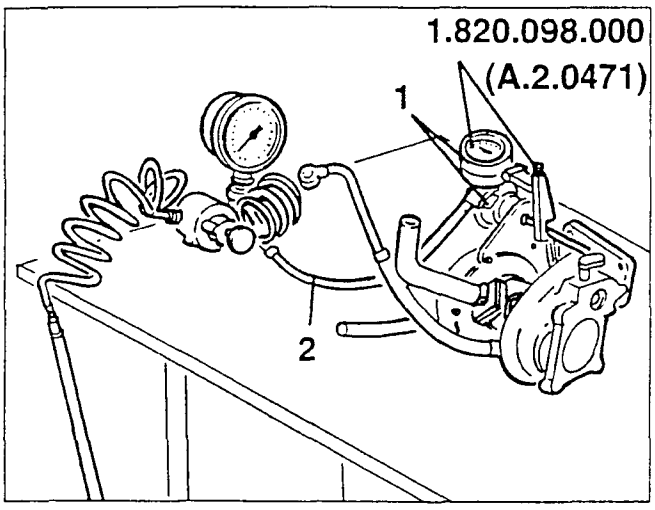
CHECK SETTING OF WASTE-GATE OVER PRESSURE VALVE

- Remove the turbocharger from the engine (see specific paragraph).

1. Disconnect the actuator control pipe from the WASTE-GATE over pressure valve actuator.



1. At the bench apply tool N° 1.820.098.000 (A.2.0471) equipped with a comparator to the WASTE-GATE over pressure valve actuator.
2. Connect a compressed air pipe with a pressure gauge to the actuator.

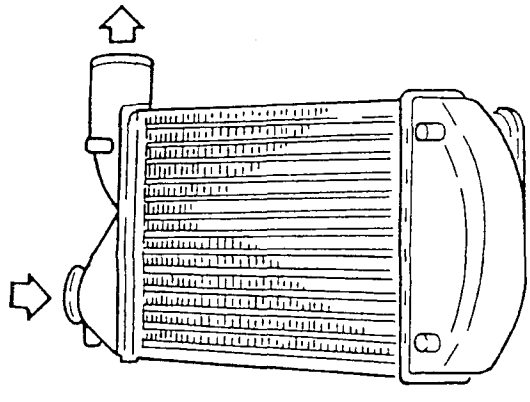


- Inject air at the pressure indicated and check on the comparator that the actuator's stroke is of the prescribed value.

WASTE-GATE valve setting	
Control pressure	Corresponding actuator stroke
0.96 ÷ 1.04 bar	2 mm
1.10 ÷ 1.19 bar	4 mm

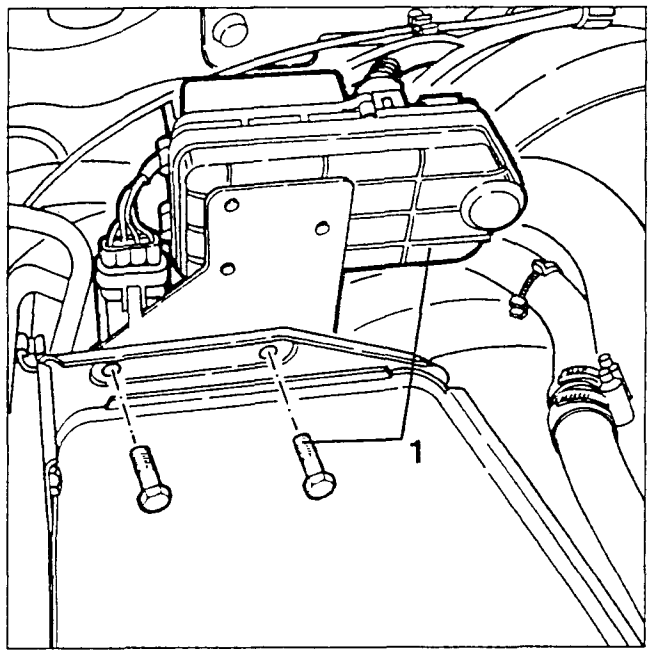
INTERCOOLER

This is an air-air heat exchanger which allows the performance level of the engine to be improved, as lowering the temperature of the air in the cylinders improves their filling up because of the increased density.
The intercooler is positioned in front of the lefthand front wheel arch.

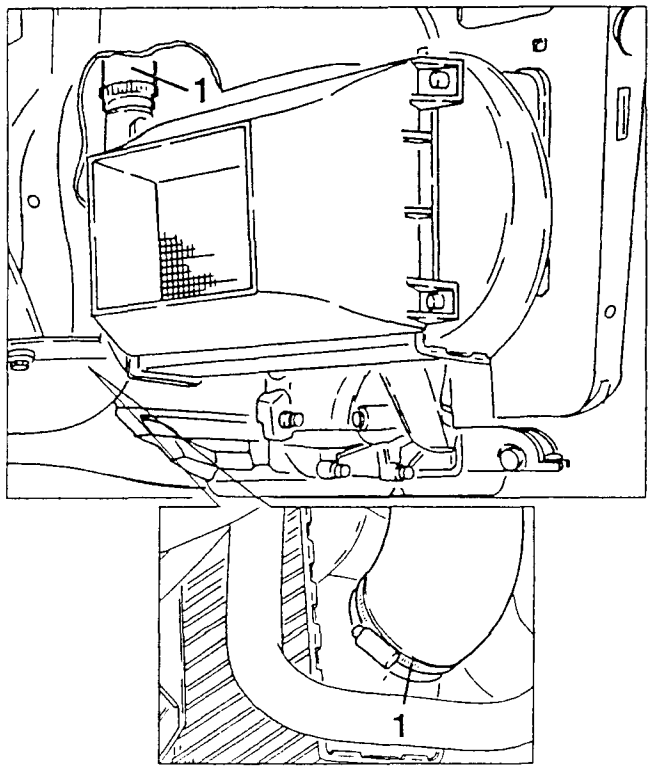


REMOVAL/REFITTING

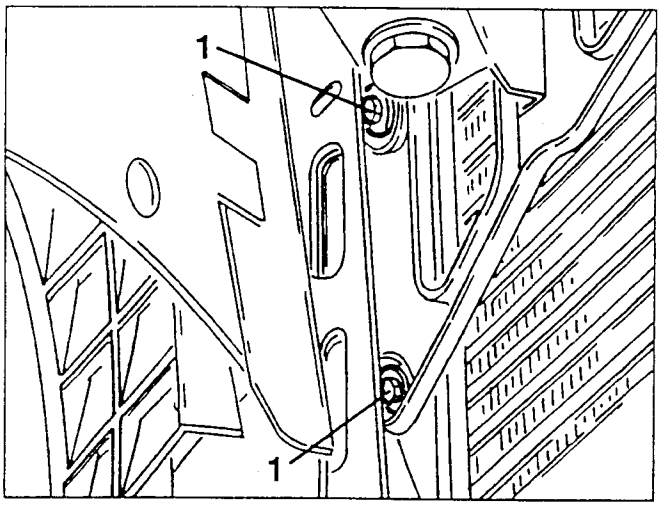
- Position the vehicle on the lift.
- Remove the battery.
- Remove the left front wheel.
- Remove the front bumper (see GROUP 70).
1. Slacjen the two screws fastening the relay and electrical connection bracket to the battery, then move it to one side.



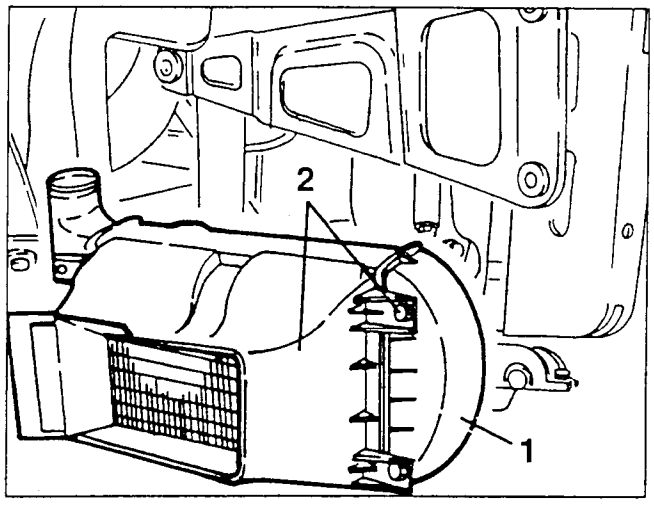
- Raise the vehicle.
1. Disconnect the air inlet and outlet pipe from the intercooler.



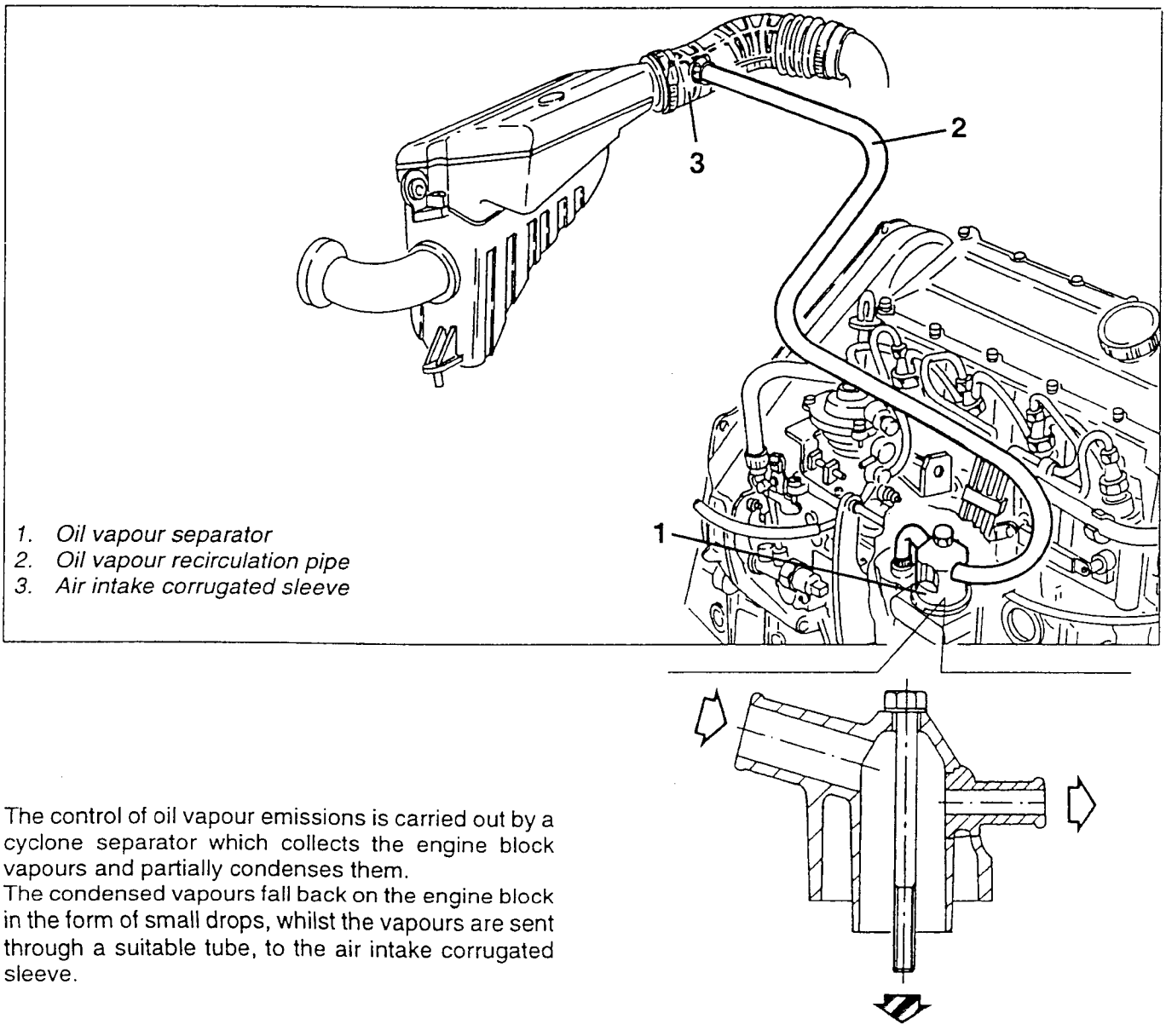
1. Unscrew the three screws securing the intercooler to the support bracket.



1. Remove the intercooler.
2. If necessary, slacken the fastening screws and separate the duct from the intercooler.



OIL VAPOUR RECIRCULATION SYSTEM

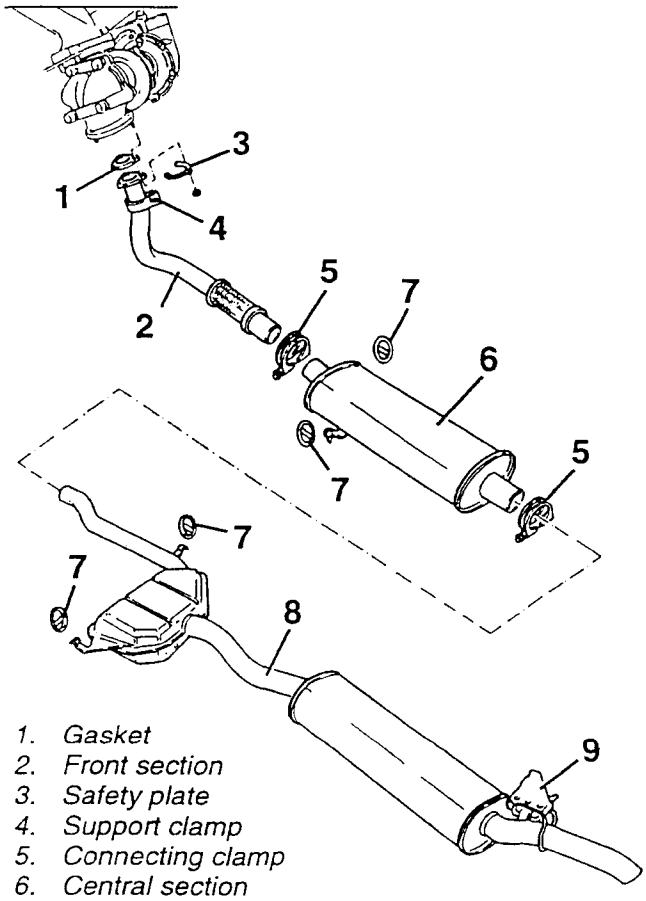


1. *Oil vapour separator*
2. *Oil vapour recirculation pipe*
3. *Air intake corrugated sleeve*

The control of oil vapour emissions is carried out by a cyclone separator which collects the engine block vapours and partially condenses them.
The condensed vapours fall back on the engine block in the form of small drops, whilst the vapours are sent through a suitable tube, to the air intake corrugated sleeve.

DESCRIPTION

The engine exhaust gases flow through a manifold into the turbine for engine boosting.
From the turbine, through an elbow, the exhaust gases reach the front section of the exhaust pipe.
In the front section of the exhaust pipe, there is a flexible bellow type section which compensates for the thermic expansion and vibrations from the engine.
From the front section the exhaust gases flow into the central silencer and from here to the two rear silencers.
The connection of the various sections of the exhaust pipes is achieved with clamps and they are supported by rings and elastic supports.



1. *Gasket*
2. *Front section*
3. *Safety plate*
4. *Support clamp*
5. *Connecting clamp*
6. *Central section*
7. *Elastic rings*
8. *Rear section*
9. *Rear support*

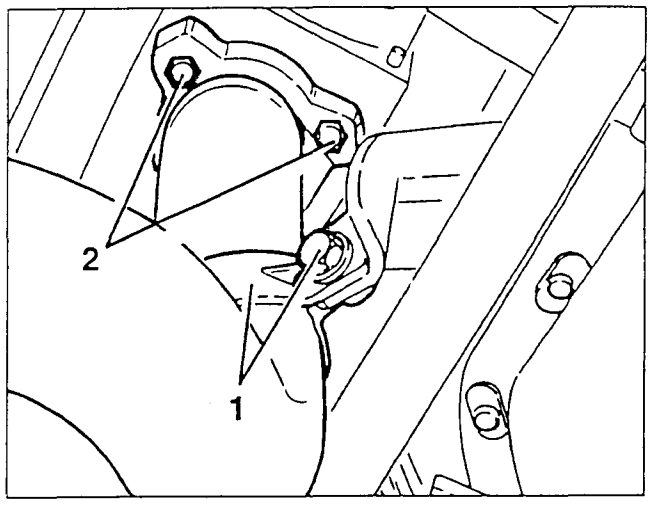
FRONT SECTION

REMOVAL/REFITTING

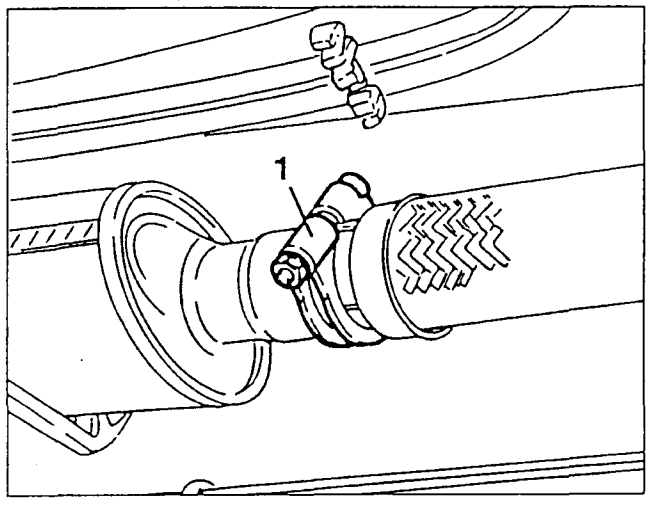
- Raise the vehicle.

1. Unscrew the bolt securing the clamp on the exhaust pipe front section.

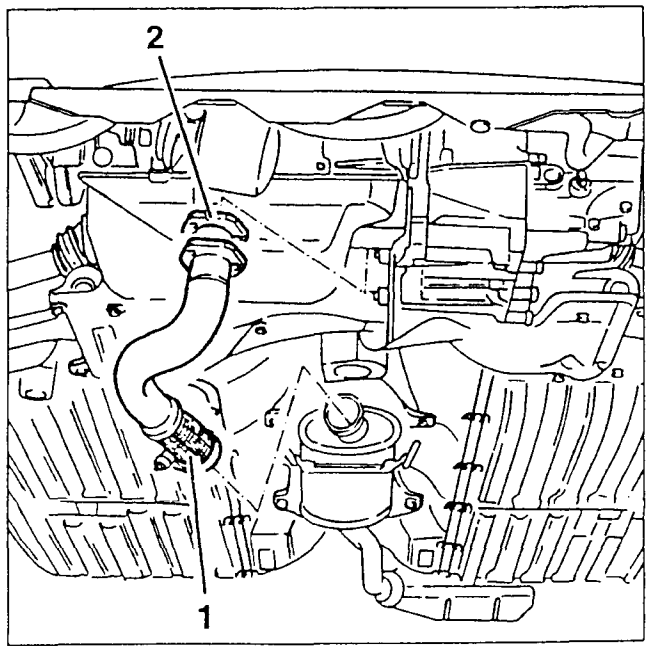
2. Unscrew the screws securing the front section of the exhasut pipe to the turbocharger.



1. Loosen the clamp securing the front section of the exhaust pipe central section.



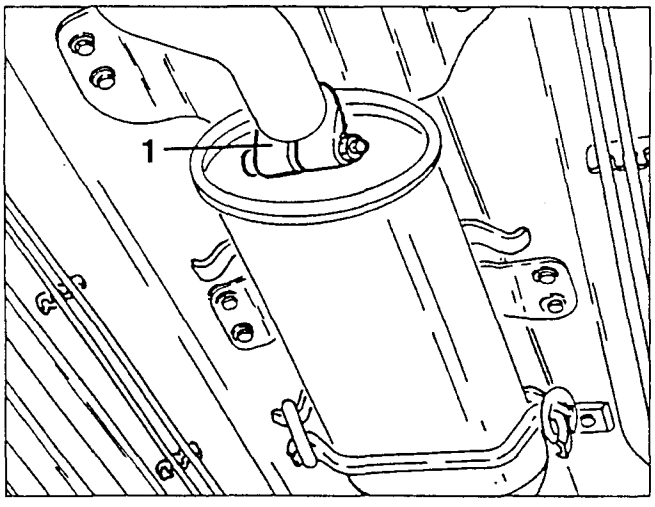
1. Remove the front section of the exhaust pipe.
2. Remove the gasket.



CENTRAL SECTION

REMOVAL/REFITTING

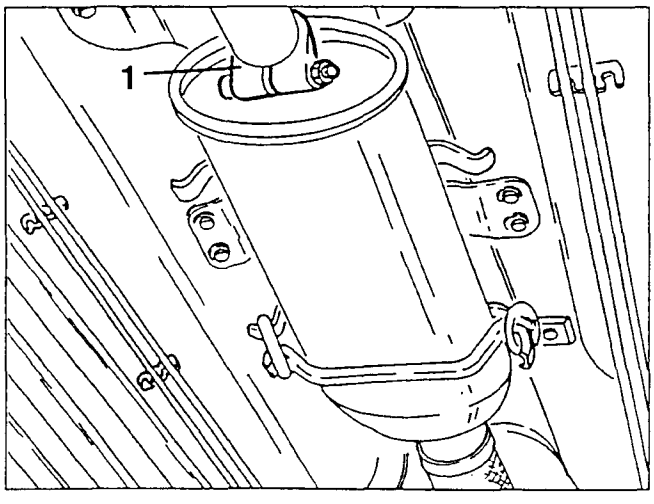
- Remove the front section of the exhaust pipe (see specific procedure).
1. Loosen the clamp securing and remove the central section.



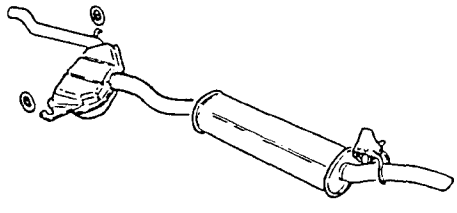
REAR SECTION

REMOVAL/REFITTING

1. Loosen the clamp securing the rear section of the exhaust pipe to the central section.

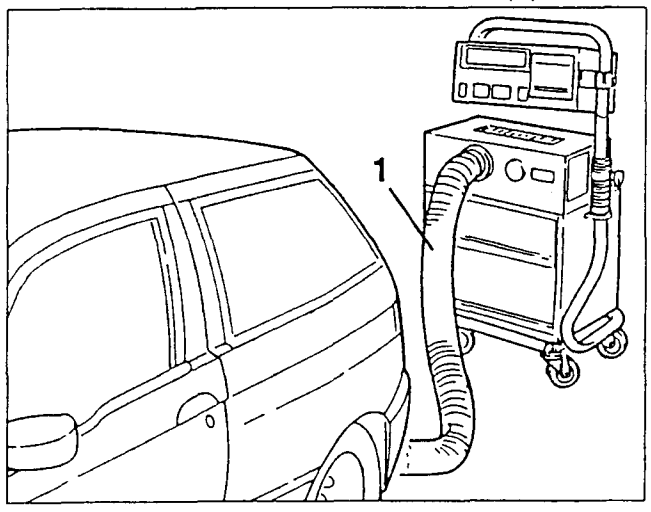


- Unscrew the screws securing the brake piper support bracket and the handbrake cable.
- Unscrew the screw securing the exhaust pipe rear elastic support to the body and remove it.



CHECK SMOKE LEVEL AT EXHAUST

- Start up the engine and bring to a normal running temperature.
1. Insert the exhaust gas drawing pipe of the opacimeter in the end section of the exhaust pipe.



- Make all the necessary connections and adjust the equipment in accordance with the procedures indicated by the manufacturer.
- Press the accelerator down fully three times until the maximum power speed is reached or until the revs limiter intervenes.
- Take the measurements after five consecutive cold accelerations and record the maximum values.
- To obtain the test value, calculate the arithmetic average of the three values closest together.

NOTE: Where there is more than one set of three values suitable, choose the one which gives the highest average value.

- Check that the smoke level falls within the prescribed values.

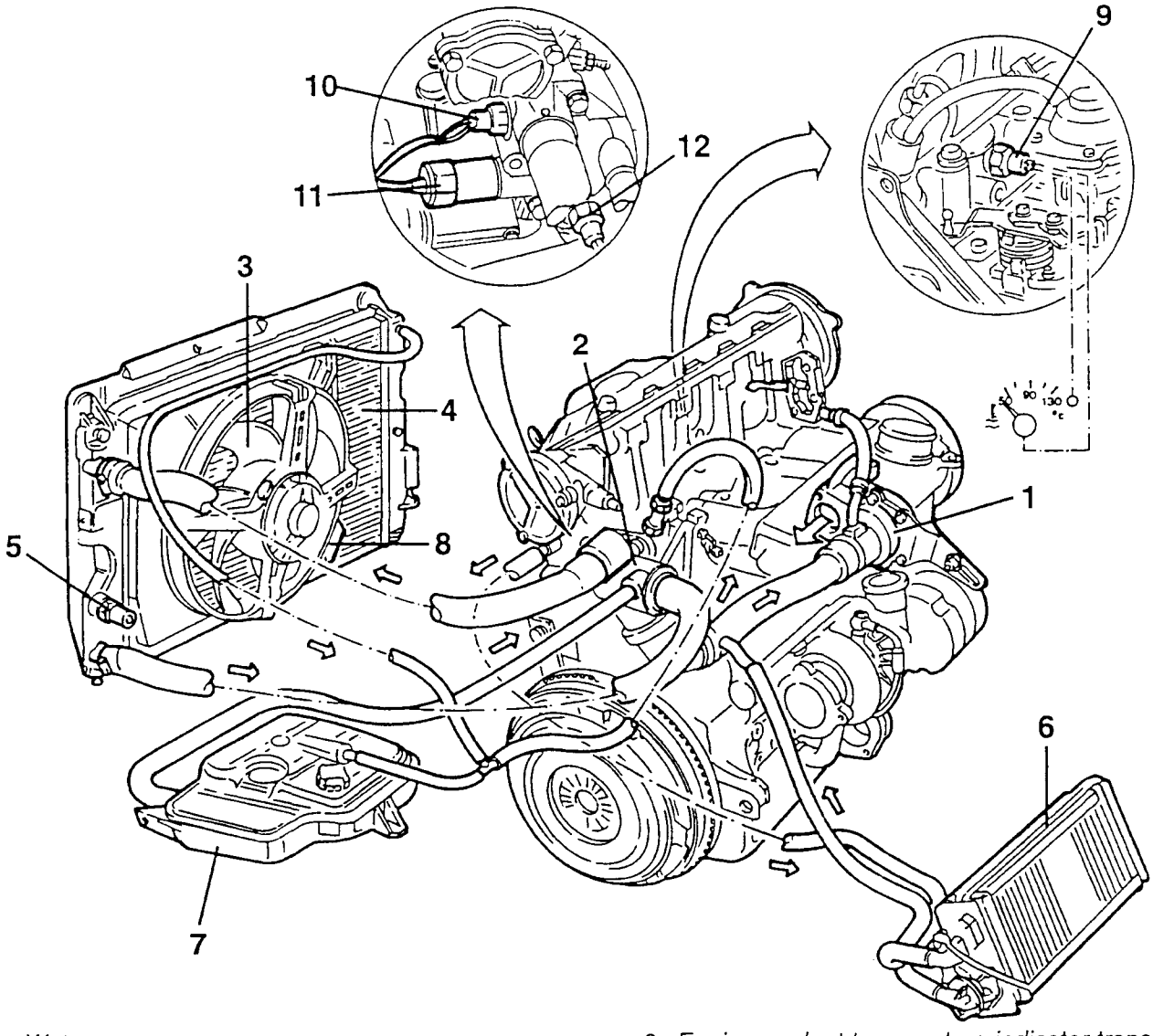
Maximum smoke level value at exhaust
< 70 %

- If the smoke level value at the exhaust is greater than the prescribed value, the following checks should be carried out:

- check condition of air filter;
- check timing of injection pump;
- check valve clearance and setting of timing;
- check setting and clean injectors;
- check compression ratio.

- If, regardless of the above checks, the smoke level remains outside the prescribed limits, the injection pump must be overhauled.

ENGINE COOLING SYSTEM DESCRIPTION



1. *Water pump*
2. *Thermostatic cup*
3. *Cooling electric fan*
4. *Radiator*
5. *Electric fan thermocontact*
6. *Heater*
7. *Expansion tank*
8. *Electric fan additional resistance*
9. *Engine coolant temperature indicator transmittor and max. temperature warning light contact*
10. *Cold injection advance automatic device (KSB) thermoswitch*
11. *Automatic idle speed device thermostat sensor*
12. *Air conditioning compressor cut-off thermal contact*

The cooling system is of the sealed type and the flow of coolant is forced by a centrifugal pump activated by the crankshaft by the Poly V belt.
A thermostatic valve, positioned on the rear side of the cylinder heads, keeps the engine temperature at optimal levels:
it opens when the coolant reaches a temperature of ~ 80 °C, allowing the passage of liquid to the radiator.
This radiator cools the liquid by dynamic air and through a two speed electric fan controlled by a two stage thermocontact located on the radiator.

An additional resistance and a relay activate the second speed of the electric fan when the temperature reaches 92 °C.
In versions fitted with an automatic heater/ventilation system with air conditioner, the second speed is enabled after the first speed has been enabled for approx. 10 seconds as well as when the second temperature stage has been reached.
The expansion tank's function is to supply the system should the level fall and it functions like a sort of lung by absorbing the variations in coolant volume due to the variations in temperature; this also ensures that air is bled from the system.

The system is also fitted with a sensor which has the following functions: coolant temperature transmittor, indicator and temperature maximum warning light contact for the warning light on the instrument panel which lights up when the coolant temperature exceeds 115 °C.

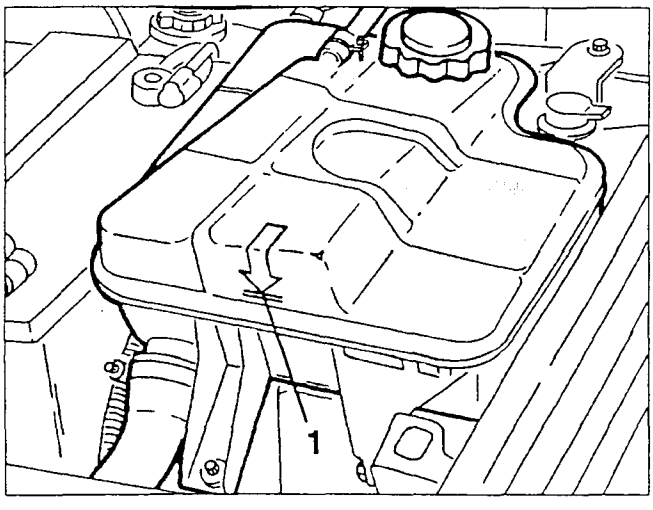
SYSTEM OPERATION

The coolant, after having cooled the engine, reaches the thermostat unit through the cylinder heads.
From here, if the temperature is lower than 80 °C, it is sucked up by the pump through a return manifold.
If the temperature exceeds this value, the coolant is sent, through the thermostat towards the radiator.
After having been cooled, the liquid returns, through the manifold, to the pump which channels it once again towards the engine.
From the radiator and the cylinder heads, there are two coolant to expansion tank return pipes which also aereate the system.
The tank supplies the system through a connection pipe to the thermostatic cup.
The coolant arrives at the heater in the passenger compartment from the cylinder heads through a suitable pipe and returns to the intake manifold of the water pump through another pipe.

CHECK LEVEL AND REPLACE THE ENGINE COOLANT

Check

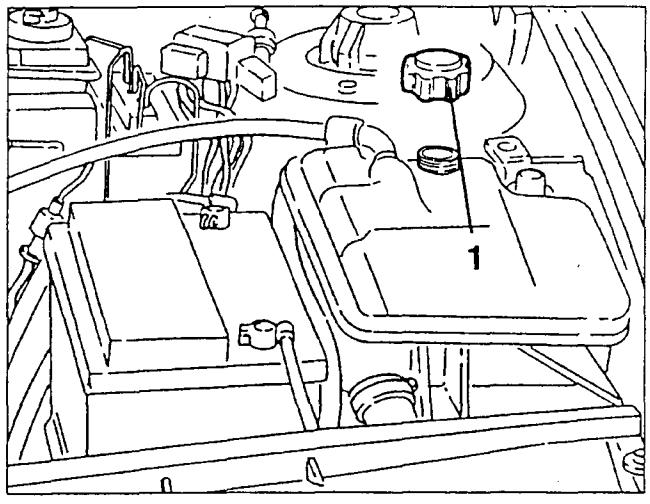
1. Visually check that the level of the coolant when the engine is cold reaches the notch indicated by the arrow on the expansion tank, if not top up the system with the recommended coolant.



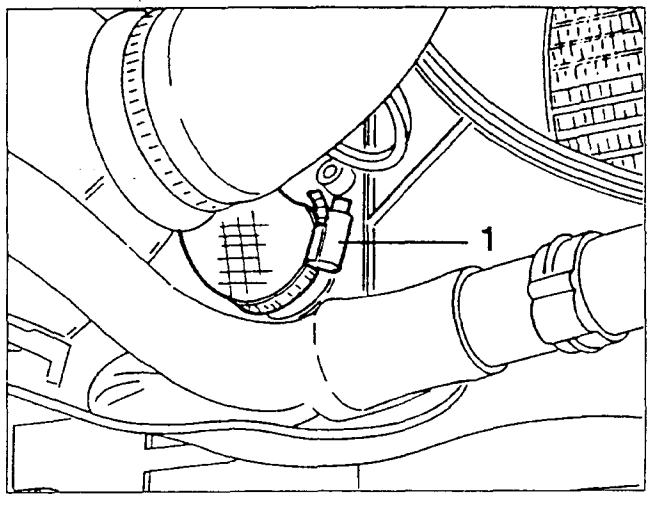
Replacement

- Position the vehicle on the lift.
1. Unscrew and remove the expansion tank cap.

CAUTION:
Do not, under any circumstances remove the expansion tank cap when the engine is hot!



- Raise the vehicle.
1. Drain off the engine coolant by disconnecting the coolant from radiator outlet sleeve, and recover it in a suitable container.



- Reconnect the radiator sleeve and all the pipes which have been disconnected, and check that all the clamps have been tightened.
- Top up the expansion tank to the notch.
- The quality and approximate quantity of engine colant are contained in the table below:

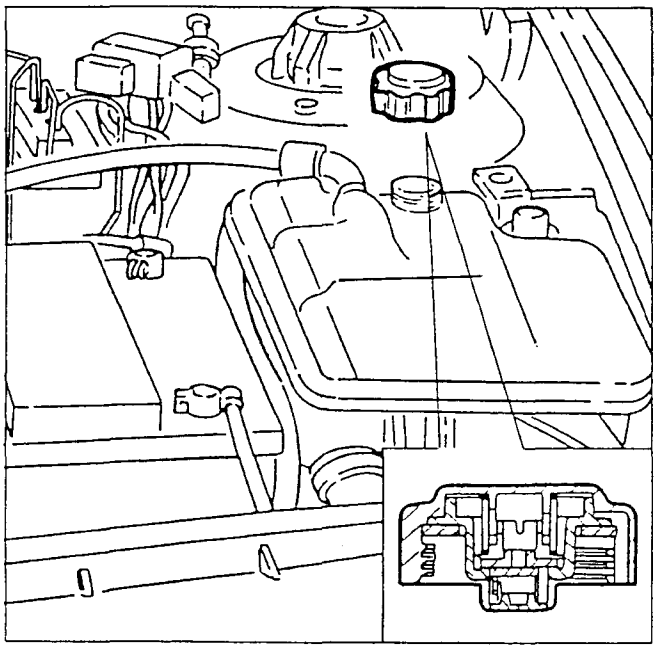
Alfa Romeo Climafluid Super Permanent -40°C	8.9 Litres

- Start the engine and bring it to a normal running temperature so that the thermostat opens and frees the residual air present in the system.
- When the engine is cold, top up to the level indicated on the expansion tank.
- Screw the pressurized cap on the expansion tank.

CAUTION:
It is not advisable to mix the antifreeze liquid with different types and brands!
Do not use antirust additives: they may not be compatible with the type of antifreeze used.

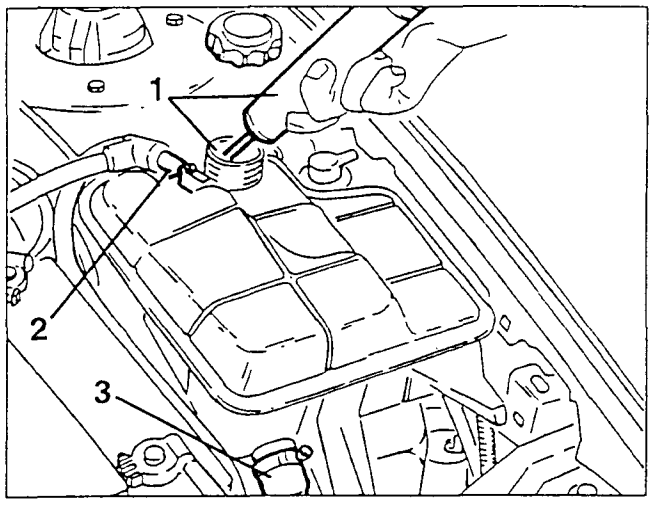
EXPANSION TANK

The function of the expansion tank is to supply the system and absorb the variations in coolant volume due to the variations in temperature.
The tank also allows air to be bled from the system through a valve on the pressurized cap, which is collected by the pipe originating from the thermostatic cup.
This valve also washes air coming from outside, to compensate for the vacuum created as the engine cools.

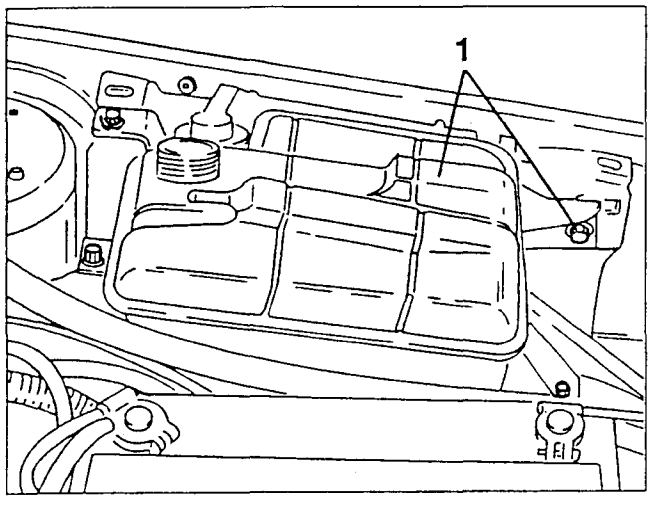


REMOVAL/REFITTING

1. Drain the engine coolant expansion tank, using a suitable syringe.
2. Disconnect coolant return and deaeretaing pipe from the expansion tank.
3. Disconnect the coolant supply pipe from the expansion tank.

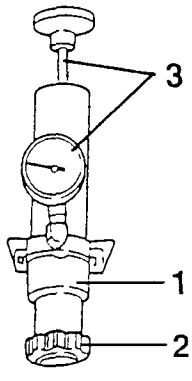


1. Unscrew the screws securing the expansion tank to the body and remove it.



ENGINE COOLANT PRESSURIZED CAP SEALING TEST

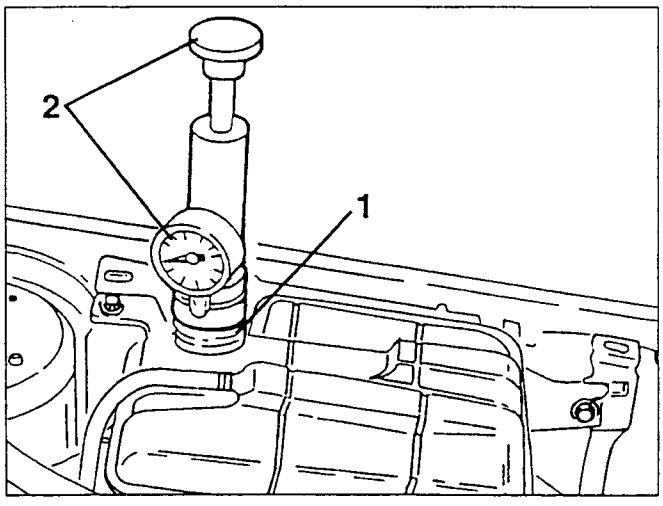
1. Screw the connector on the lower end of the test instrument.
2. Fit the expansion tank pressurized cap on the connector.
3. Manually operate on the piston, pressurize and check on the pressure gauge that the exhaust valve on the cap opens at the prescribed setting value.



Pressurized cap setting
0.98 ± 0.1 bar (1 ± 0.1 kg/cm^2)

ENGINE COOLING SYSTEM SEALING TEST

- Unscrew and remove the pressurized cap from the expansion tank.
1. Screw the sealing test instrument on the neck of the expansion tank, equipped with the suitable connector.
2. Manually pressurize the system and check that the pressure remains at the prescribed value. Otherwise check that there are no losses from sleeves or from the radiator.

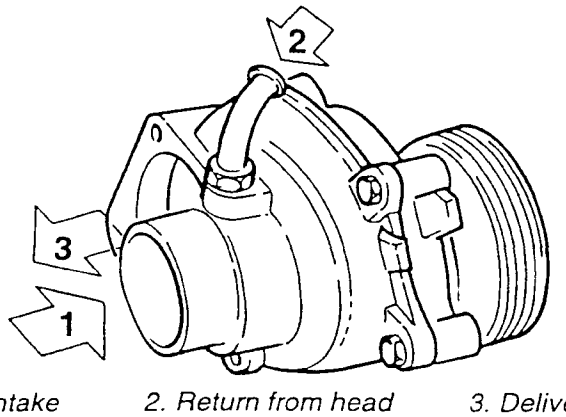


Hydraulic system test pressure
1.08 bar (1.1 kg/cm^2)

CAUTION:
For safety motives do not let the pressure exceed 1.38 bar (1.4kg/cm2) during the checks with the test instrument.

WATER PUMP

The water pump is of the centrifugal blade type with the pump body made from an aluminium alloy and the impeller in a phenolic resin.



1. Intake 2. Return from head 3. Delivery

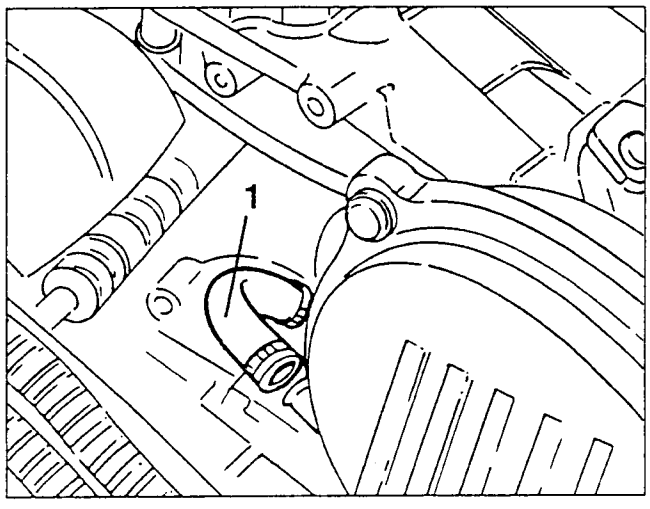
It is fixed on the engine block and is activated, through a Poly V belt, by the crankshaft. A gasket guarantees the seal between the engine block and the pump.
The water pump functions constantly guaranteeing that the engine coolant circulates constantly.

REMOVAL/REFITTING

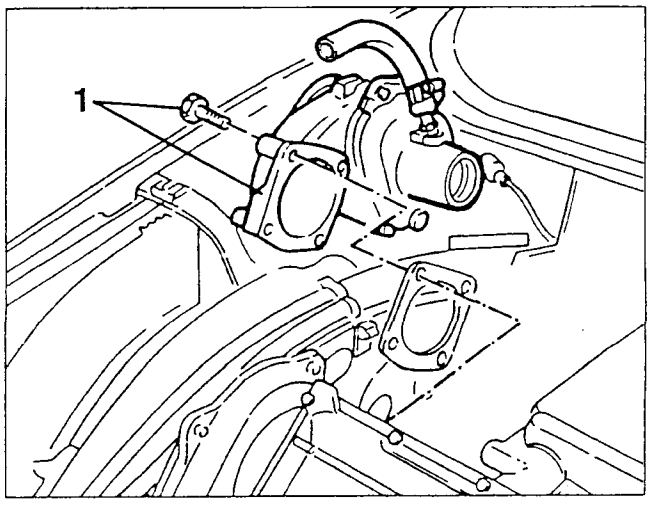
- Position the vehicle on the lift.
- Disconnect the (-) lead of the battery.
- Drain the engine coolant.

CAUTION:
The antifreeze mixture used as an engine coolant damages paint; avoid any contact with painted parts.

- Remove the alternator (see specific paragraph).
1. Disconnect the coolant to pump return pipe from the cylinder heads.

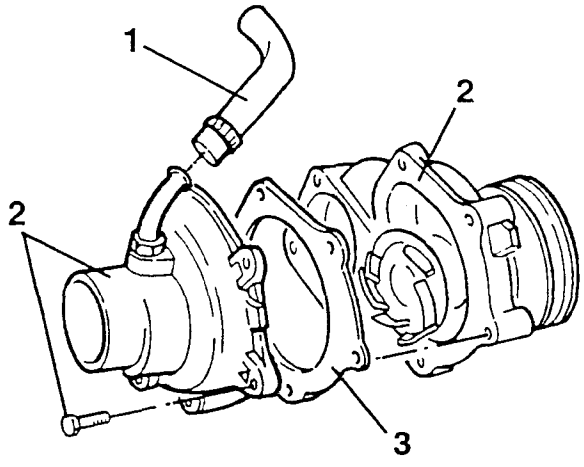


1. Unscrew the screws and remove the water pump by extracting it from the engine coolant return manifold.



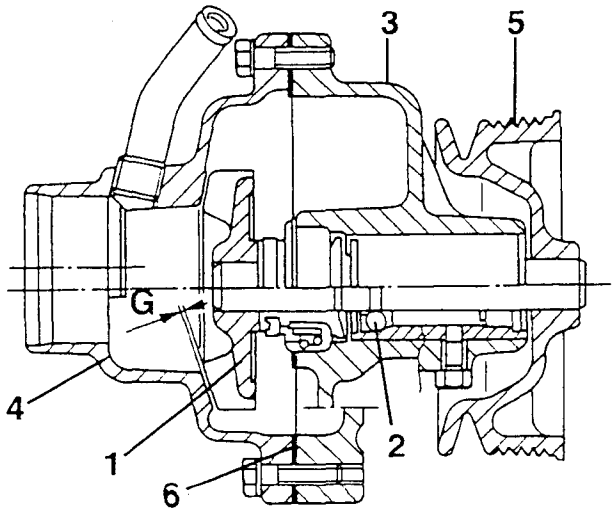
When the pump is fitted, lightly grease the engine return to pump manifold with the prescribed grease.

1. At the bench, remove the coolant from cylinder heads return pipe from the water pump.
2. Unscrew the screws and disassemble the pump body.
3. Remove the gasket.



CHECKS AND INSPECTIONS

- Check that the pump body and the rotor are in good condition and that there are no signs of oxidation or corrosion;
- Check that the clearance between the rotor and the pump body fall within the prescribed values;
- Check that the gasket between the pump and the engine block and gasket between the front cover and the rear cover are in good condition and do not permit infiltrations;
- Check that the bearing does not crawl during rotation.

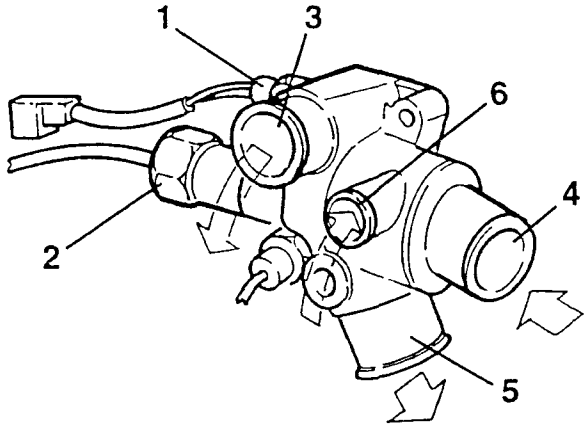


1. *Impeller*
2. *Bearing*
3. *Front body*
4. *Rear body*
5. *Control pulley*
6. *Gasket*

Clearance between impeller and pump body
G = 0.53 ÷ 1.37 mm

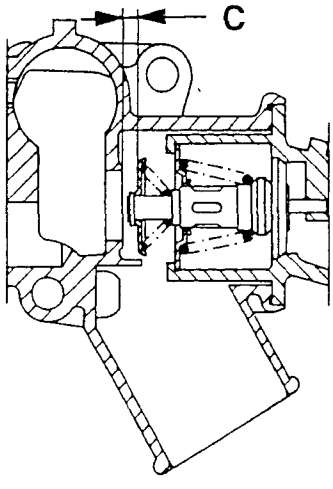
If one of these faults is found, replace the whole water pump.

THERMOSTAT UNIT



1. *Injection advance when cold automatic device (KSB) thermoswitch*
2. *Automatic idle speed device thermostatic sensor*
3. *Delivery to radiator*
4. *Return from radiator*
5. *Delivery to pump intake manifold*
6. *Arrival from expansion tank*
7. *Conditioner compressor cutoff thermal contact*

The thermostat unit is fitted on the rear side of the cylinder heads.
Its function is to ensure that the engine does not exceed the optimal temperature: whilst the temperature remains below **80° ± 2 °C**, the thermostatic valve directs the coolant towards the pump; at higher temperatures, the thermostatic valve opens allowing the passage of coolant towards the radiator.



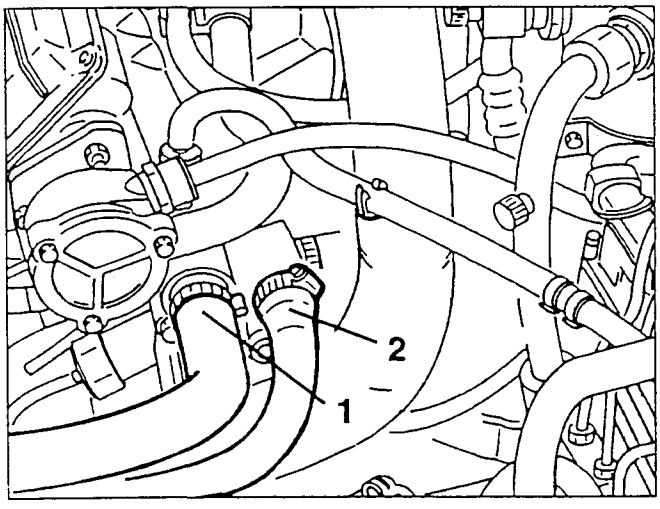
Thermostat opening start temperature	80° ± 2 °C
Stroke of valve "C" 90 °C	≥ 7.5 mm

REMOVAL/REFITTING

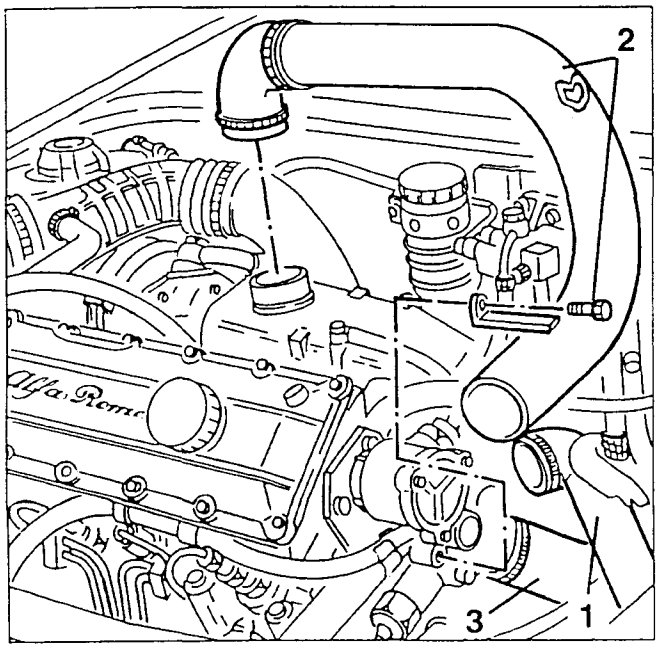
- Remove the battery.
- Drain the engine coolant, by disconnecting the outlet sleeve from the radiator and recover it in a suitable container.

CAUTION:
The antifreeze mixture used as an engine coolant damages paintwork: avoid all contact with painted parts.

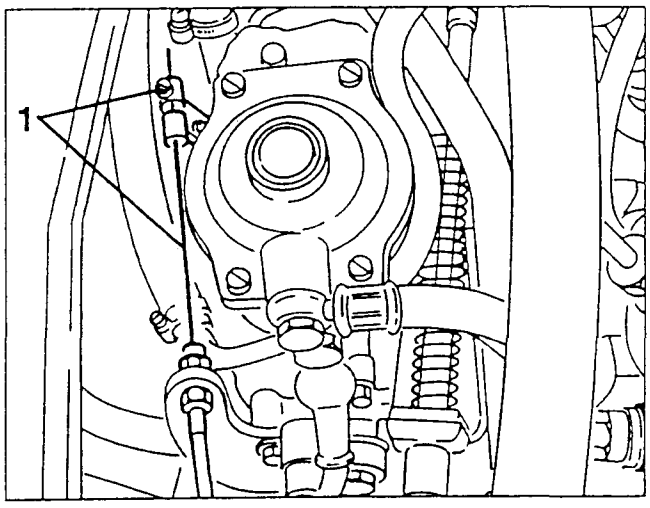
1. Disconnect the coolant to radiator delivery sleeve from the thermostatic cup.
2. Disconnect the supply sleeve originating from the expansion tank from the thermostatic cup.



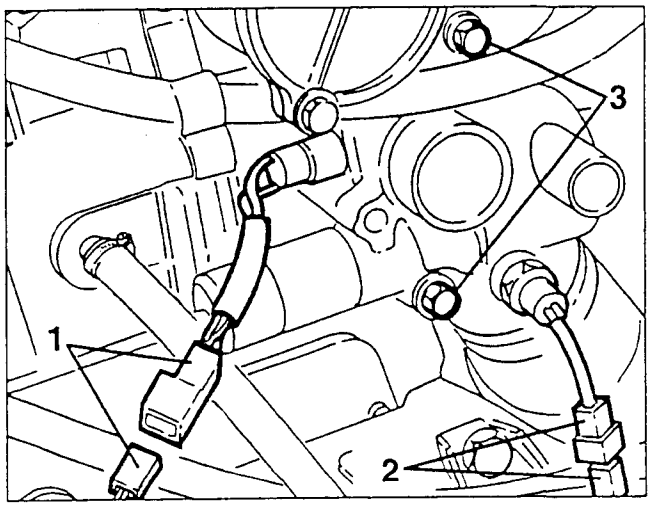
1. Disconnect the coolant from radiator return sleeve from the thermostatic cup.
2. Remove the second section of the air delivery pipe from the intercooler to the air intake box.
3. Loosen the coolant from pump return sleeve clamp from the thermostatic cup.



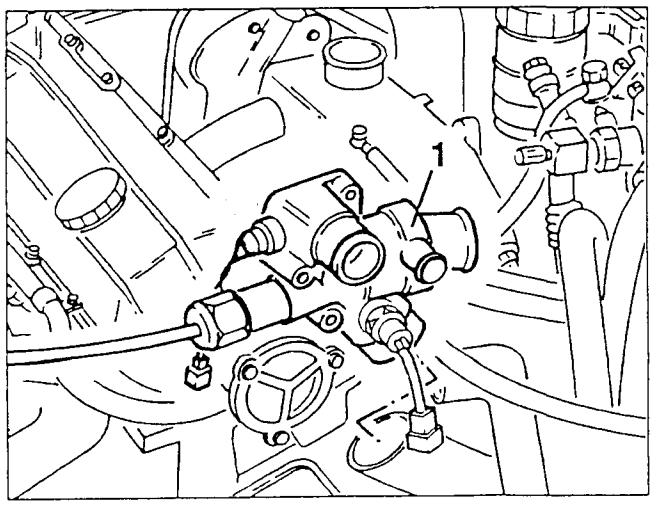
1. Disconnect the automatic idle speed device control cable from the injection pump.



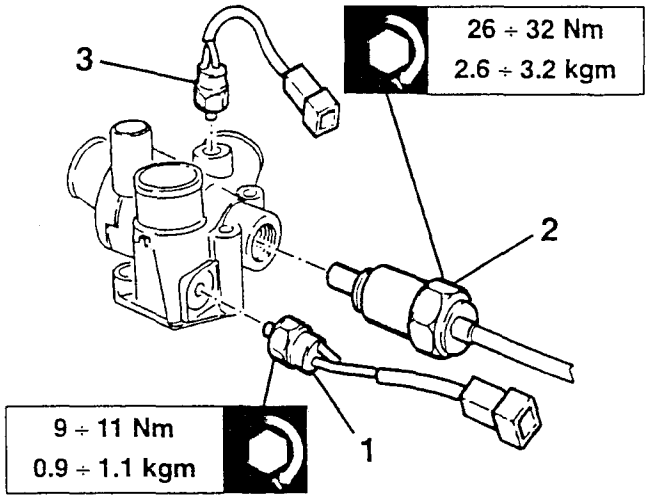
1. Disconnect the thermoswitch electrical cable for the injection advance when cold automatic device (KSB).
2. Disconnect the electrical connection from the air conditioning compressor cut-off thermal contact.
3. Unscrew the screws securing the thermostatic cup to the cylinder heads.



1. Remove the thermostatic cup by extracting it from the water to pump return sleeve.



1. At the bench, remove the thermoswitch for the injection advance when cold automatic device (KSB) from the thermostatic cup.
2. Remove the thermostatic sensor for the automatic idle speed device from the thermostatic cup.
3. Remove the air conditioning compressor cut-off thermal contact from the thermostatic cup.

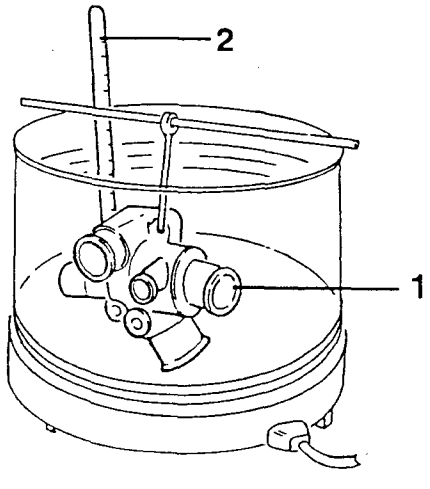


At reassembly regulate the automatic idle speed device cable (see specific paragraph).

CHECKS AND INSPECTIONS

Check the setting of the thermostat by operating in the following way:
1. Hang the thermostat in a container full of water and heat it.
2. Check, by way of a thermometer, that the thermostat starts to open at the temperature indicated in the table.

CAUTION:
Neither the thermometer nor the thermostat must touch the bottom of the container.



- Also check that the total stroke of the bulb at the temperatures indicated, corresponds with that in the table.

Thermostat setting	
Start of opening	80° ± 2 °C
Valve stroke at 90 °C	≥ 7.5 mm

- If the correct values are not found replace the thermostat.

RADIATOR

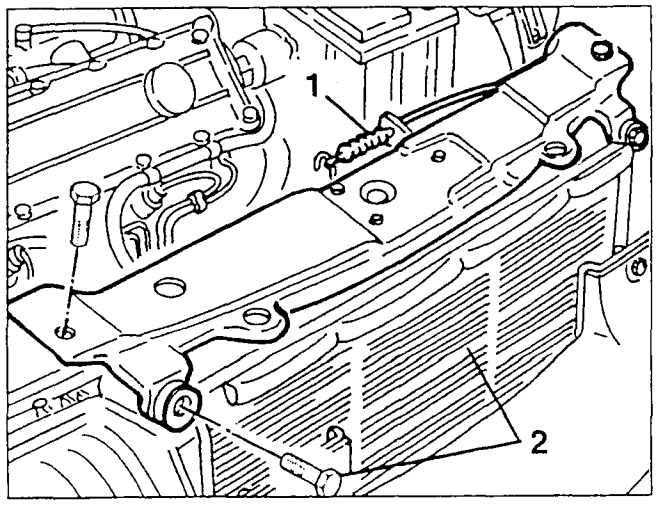
The radiator is sized to satisfy the heat dissipation requirements when the engine is running.
It is made up of a radiator core and two side tanks fitted with necks for the inlet and outlet of coolant; the pipes and fins of the radiator core are in aluminium, the tanks are plastic.
On the radiator, a thermocontact is fitted to control the cooling electric fan.

REMOVAL/REFITTING

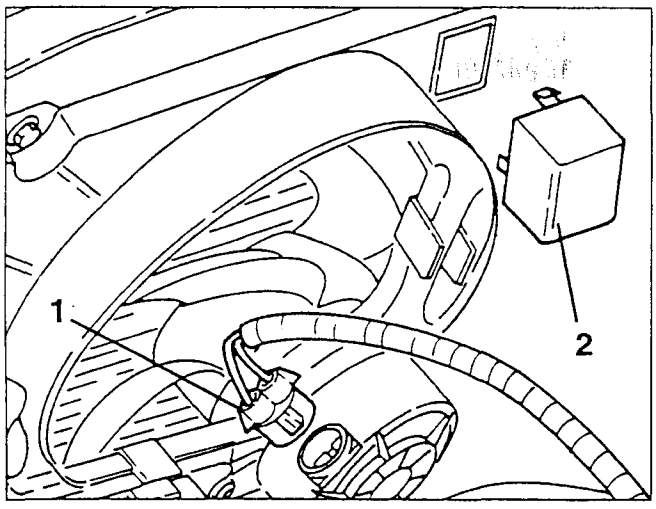
- Disconnect the (-) lead of the battery.
- Drain off the engine coolant by disconnecting the coolant from the radiator outlet sleeve and recover it in a suitable container.

CAUTION:
The antifreeze mixture used as an engine coolant damages paintwork; avoid all contact with painted parts.

- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the bonnet release cable from its lock.
2. Loosen the screws and remove the upper cross-member.



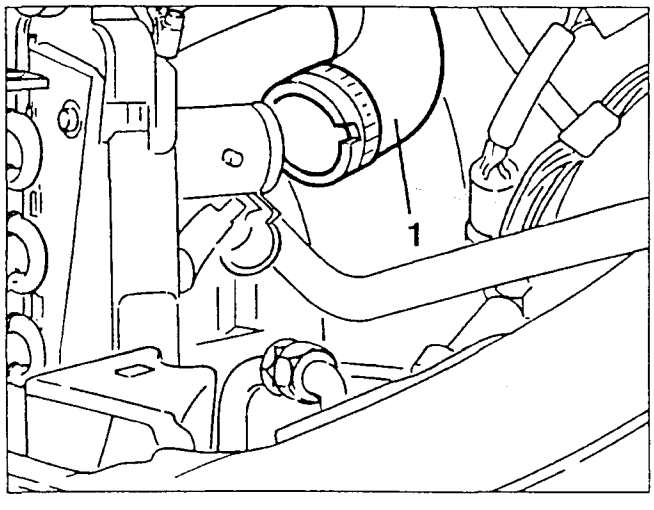
1. Disconnect the electrical connection to the cooling electric fan motor.
2. Remove the relay box from the electic fan conveyor.



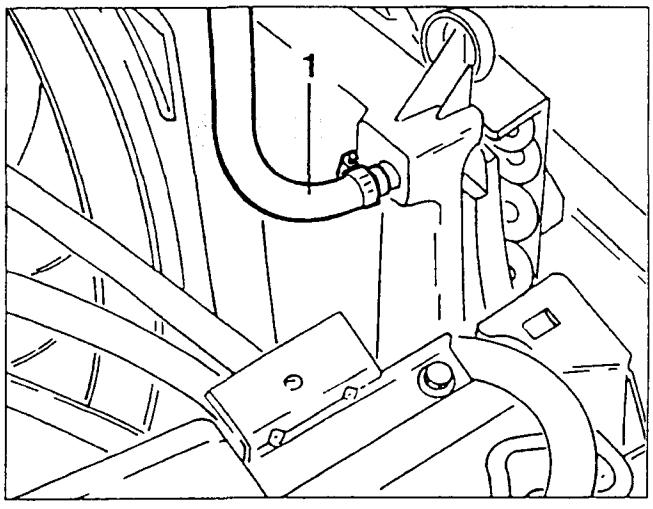
1. Disconnect the two electrical connectors from the electric fan additional resistance.



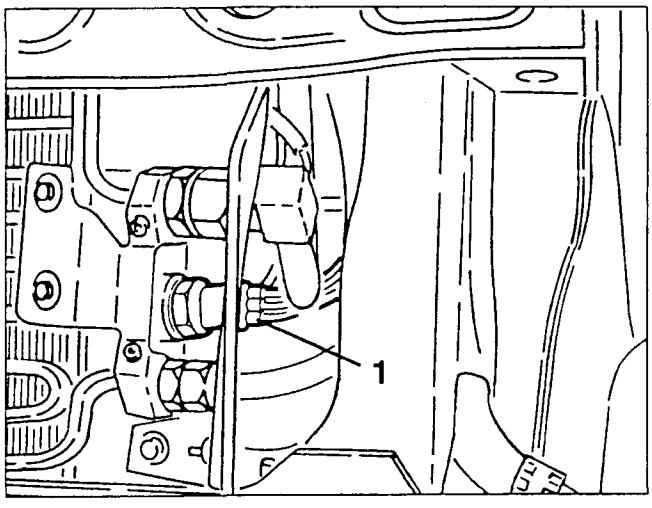
1. Disconnect the engine coolant entry sleeve from the radiator.



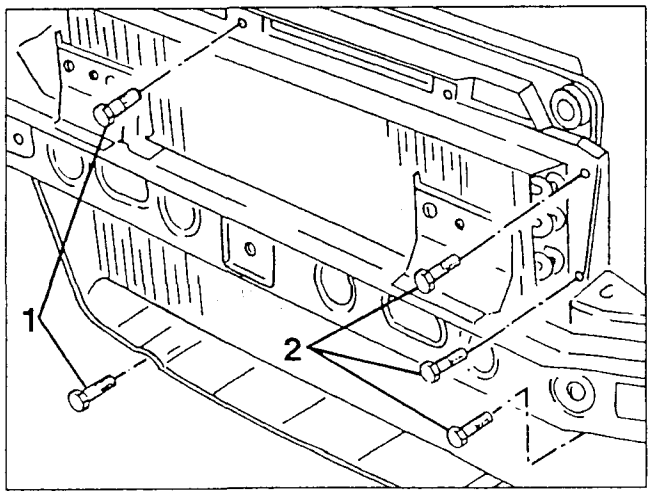
1. Disconnect the coolant to expansion tank delivery and system deaereating pipe.



1. Disconnect the electrical connector of the cooling electric fan thermocontact.



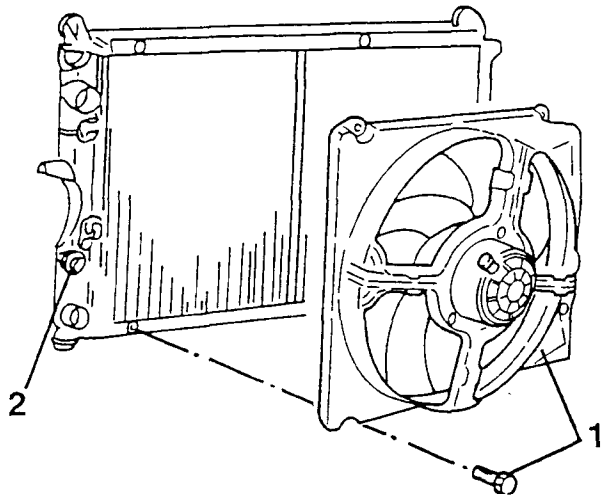
1. Unscrew the screws securing the radiator to the condensor.
2. Unscrew the screws securing the air conveyor to the radiator.



- Free the electrical cables from the clamps on the radiators, then remove it by extracting it upwards.

DISASSEMBLY/REASSEMBLY

1. Unscrew the four screws and remove the cooling electric fan from the radiator.
2. Remove the cooling electric fan control thermocontact from the radiator.

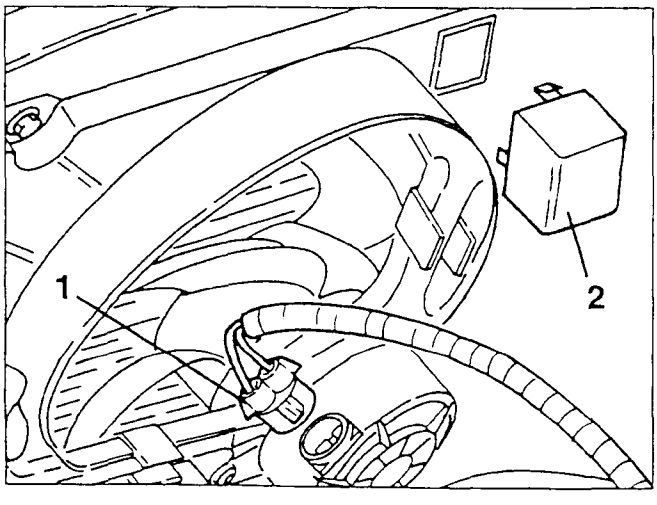


COOLING ELECTRIC FAN

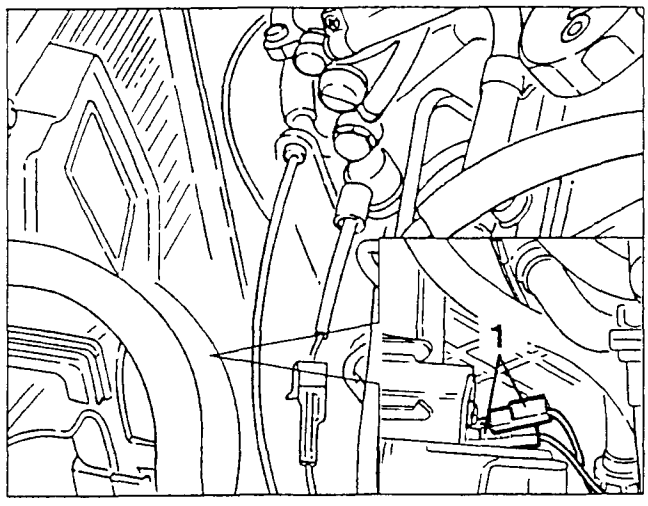
The two speed cooling electric fan allows the engine's heat dissipation capacity to be increased.
A two stage thermocontact detects if the coolant reaches an excessively high temperature and activates the electric fan: the first stage contact closes at **88° ± 2 °C** and opens at **83° ± 2 °C** (first speed), the second stage closes at **92° ± 2 °C** and opens at **87° ± 2 °C** (second speed).
In versions fitted with the automatic heater/ventilation system with air conditioner, the second speed is enabled after the first one has been enabled for 10 seconds and after the second temperature stage has been reached.

REMOVAL/REFITTING

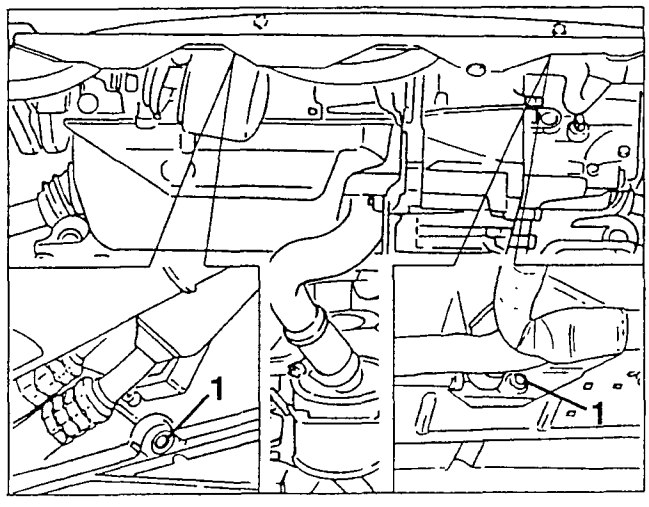
1. Disconnect the electrical fan connection.
2. Remove the relay box.



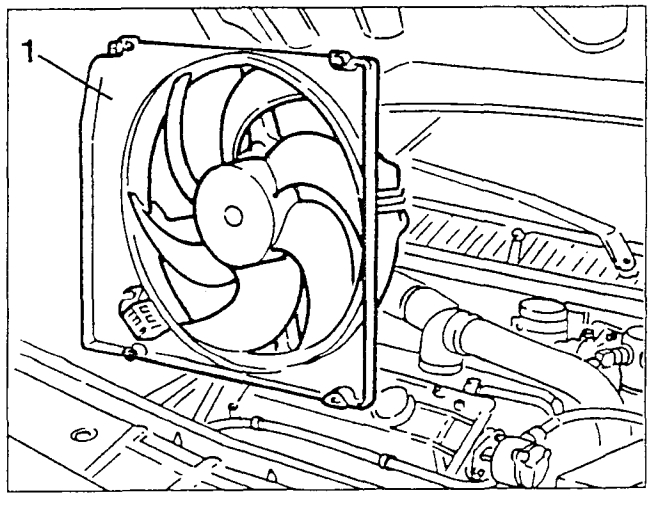
1. Disconnect the two electrical connections from the electric fan additional resistance.



- Raise the vehicle.
1. Unscrew the lower screws securing the cooling electric fan to the radiator.

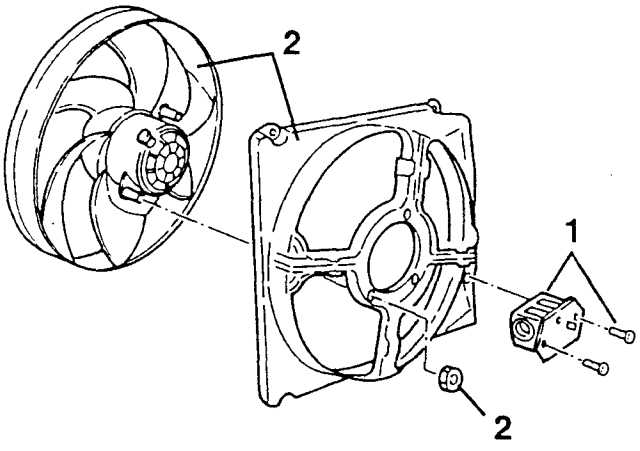


- Raise the vehicle.
- Unscrew the upper screws securing the cooling electric fan to the radiator.
1. Remove the cooling electric fan by extracting it upwards.



DISASSEMBLY/REASSEMBLY

1. Unscrew the screws and remove the additional resistance from the electric fan conveyor.
2. Unscrew the three nuts and separate the electric fan from the conveyor.



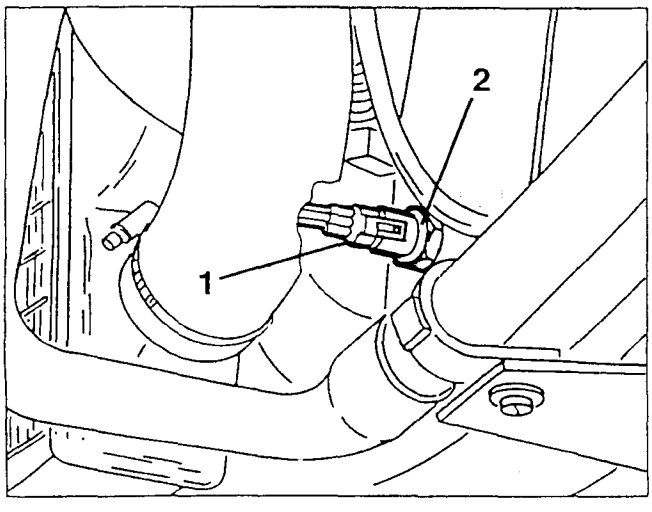
ELECTRIC FAN THERMOCONTACT

REMOVAL/REFITTING

- Position the vehicle on the lift.
- Disconnect the (-) negative lead of the battery.
- Raise the vehicle.
- Drain off the engine coolant, by disconnecting the coolant from radiator outlet sleeve and recover it in a suitable container.

CAUTION:
The antifreeze mixture used as an engine coolant liquid damages paintwork: avoid contact with all painted parts.

1. Disconnect the two electrical connections of the electric fan thermocontact.
2. Remove the electric fan thermocontact from the radiator.



CHECKS AND INSPECTIONS

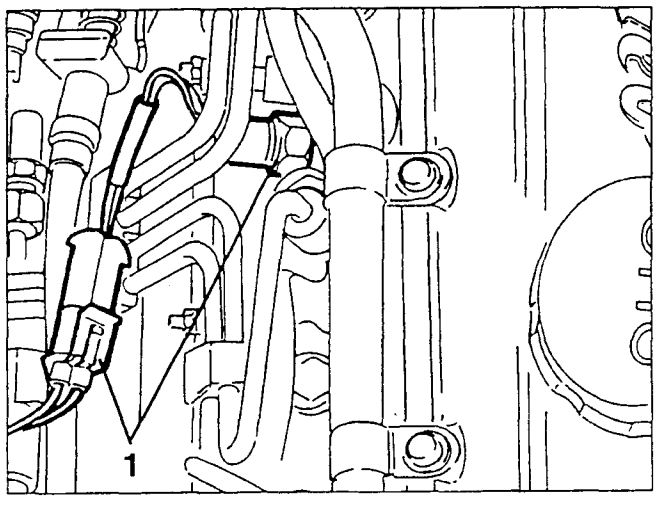
Cooling electric fan cut-in/cut-out temperature		
1[a] speed	Cut-in (contacts closed)	88 ° ± 2 °C
	Cut-out (contacts open)	83 ° ± 2 °C
2[a] speed	Cut-in (contacts closed)	92 ° ± 2 °C
	Cut-out (contacts open)	87 ° ± 2 °C

- If the correct values are not found, replace the thermocontact.

ENGINE COOLANT TEMPERATURE INDICATOR TRANSMITTOR AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

REMOVAL/REFITTING

1. Disconnect the connection and remove the sender from the cylinder head.



CAUTION:
Plug the sensor seating on the cylinder heads to avoid engine coolant leaks.

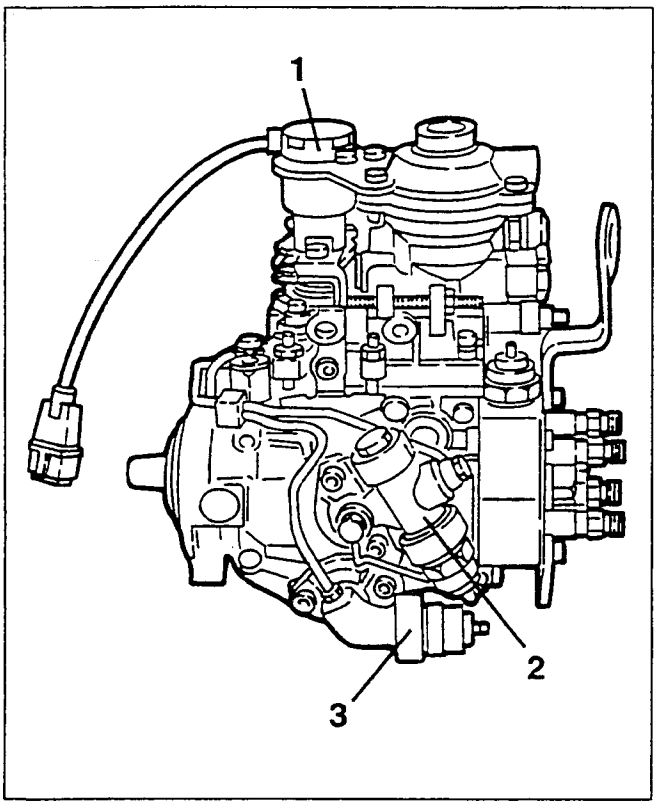
CHECKS AND INSPECTIONS

Contact closing temperature	115° ± 3 °C
Contact opening temperature	85 °C

If the correct values are not found, replace the transmittor.

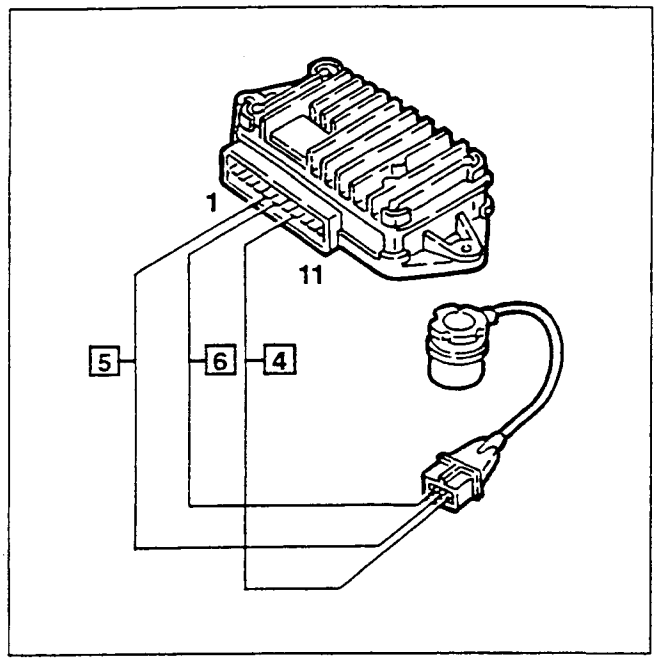
VE - R - 508 INJECTION PUMP

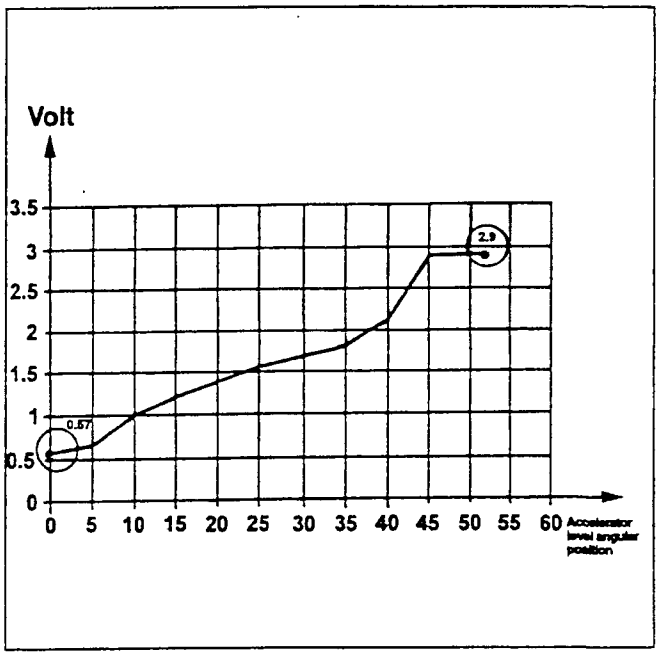
The injection pump installed on this model possesses some specific innovations which optimise the operating features under all conditions.
These innovations are:
- the adoption of an accelerator lever potentiometer (1) fitted on the injection pump;
- the adoption of a solenoid valve (2) for controlling the KSB device;
- the adoption of a solenoid valve (3) for controlling the LFB device.



The following pages describe how these devices work.

to command the opening of the E.G.R. valve of the exhaust gas recirculation system.





ACCELERATOR LEVER POTENTIOMETER

The potentiometer fitted on the injection pump detects the angular position of the accelerator lever and informs the control unit of the engine load.
The rotation of the lever changes the resistance inside the potentiometer, therefore, with a constant supply of 3.7 ± 0.2 V from the control unit, output voltages are obtained which are variable between 0.57 V at idle speed > 2.5 V at maximum load.
Therefore, this voltage rate is an important operating datum for the engine and it is used by the control unit

AUTOMATIC COLD INJECTION ADVANCE DEVICE (KSB)

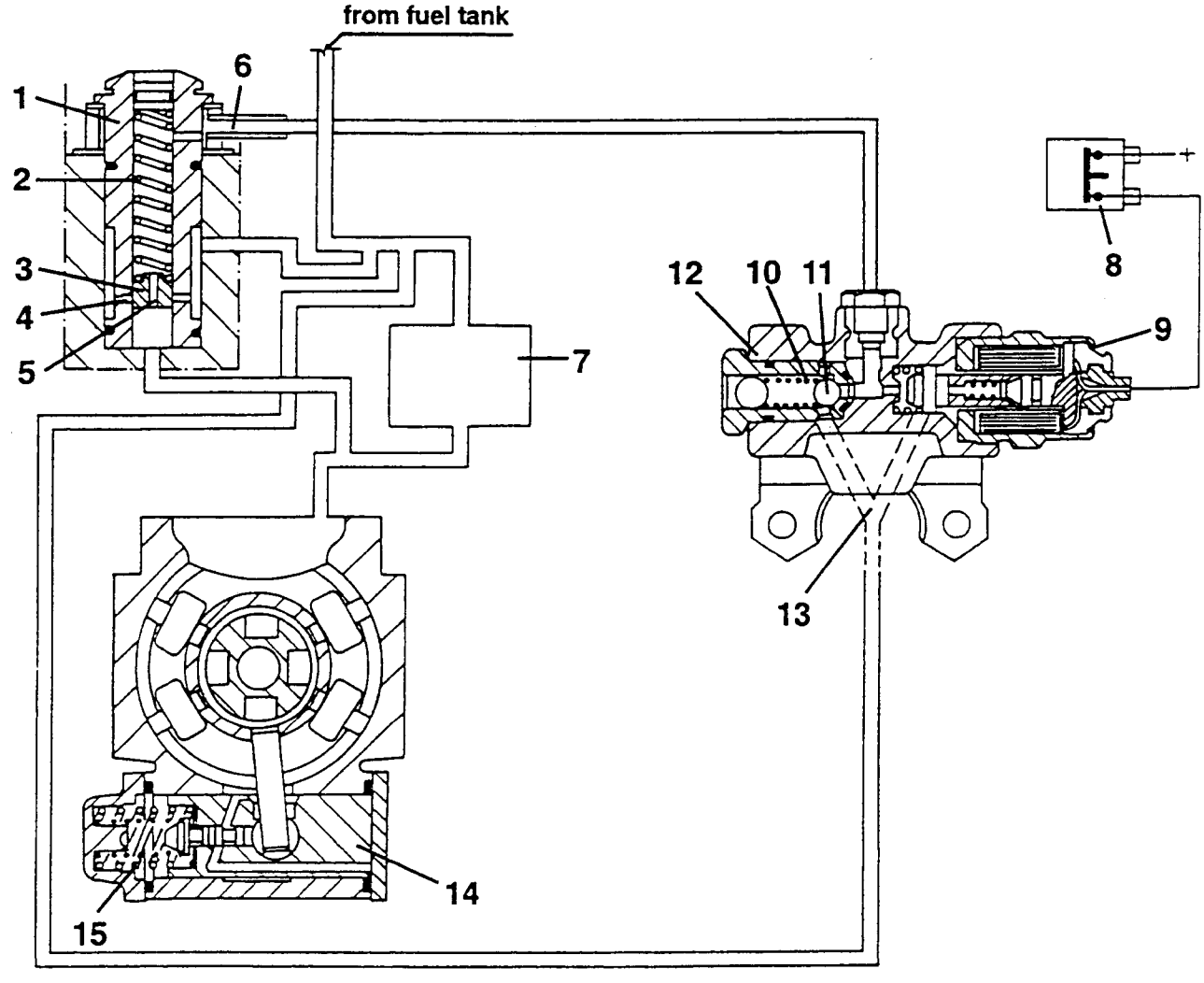
The automatic KSB device has a dual purpose:
- advancing the start of injection to enable smoother operation when the engine is cold;
- improving starting.

Operation

The fuel flow rate of the supply or transfer pump (7) is higher than needed for injection, so the excess fuel is discharged through the transfer pressure adjustment valve (1) at the pump inlet, generating a pressure inside the pump casing (transfer pressure).
The flow rate of the supply pump (7) consequently the transfer pressure change in relation to the engine rpm.
This transfer pressure acts on one side of the piston of the injection advance variator (14), pushing against the reaction spring (15), thereby changing the start of injection.

Cold engine

With an engine coolant temperature of ≤ 60°C the solenoid (9) of the KSB device is supplied, eliminating the relief of part of the fuel through the calibrated hole (5) of the piston valve (3); this causes an increase of the transfer pressure, thus of the advance, because the whole reflux flow must pass (flow) only through the outlet holes.
The increase of the transfer pressure acts on the piston (14) of the advance variator which overcomes the force of the reaction spring (15) changes the start of injection advance (through the prod hinged with the roller cage).

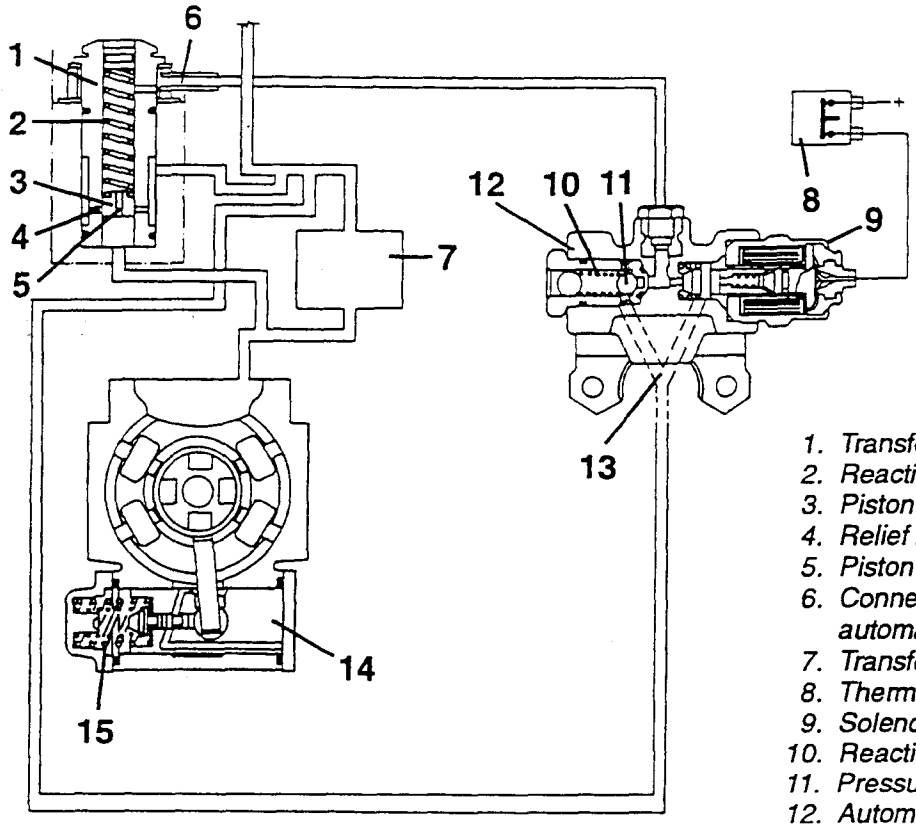


1. *Transfer pressure adjustment valve*
2. *Reaction spring for piston valve*
3. *Piston valve*
4. *Relief holes*
5. *Piston calibrated hole*
6. *Connection duct between valve and automatic advance device*
7. *Transfer pump*
8. *Thermal switch*
9. *Solenoid valve*
10. *Reaction spring*
11. *Pressure seal ball*
12. *Automatic advance device body*
13. *Relief hole*
14. *Piston of advance variator*
15. *Reaction spring for piston of advance variator*

Warm engine

When the temperature of the coolant fluid exceeds 60°C, the thermal switch (8), on the thermostat body, opens deactivating the electrical supply of the solenoid (9) which, due to the load of the reaction spring (10), causes the valve to open admitting the flow towards the duct (13).

The opening of the valve causes a lowering of the transfer pressure (consequently the over-advance stroke of piston 14 is annulled) because part of the reflux flow is relieved through holes (4) and also by the calibrated hole (5), which puts the pressure adjustment valve (1) into communication with the supply duct, upstream of the transfer pump (7).



1. *Transfer pressure adjustment valve*
2. *Reaction spring for piston valve*
3. *Piston valve*
4. *Relief holes*
5. *Piston calibrated hole*
6. *Connection duct between valve and automatic advance device*
7. *Transfer pump*
8. *Thermal switch*
9. *Solenoid valve*
10. *Reaction spring*
11. *Pressure seal ball*
12. *Automatic advance device body*
13. *Relief hole*
14. *Piston of advance variator*
15. *Reaction spring for piston of advance variator*

AUTOMATIC DELAYING DEVICE IN RELATION TO THE LOAD LFB

The pump is fitted with a device which changes the advance according to the load (LFB) (1), this is obtained by sending part of the fuel at transfer pressure towards the advance variator (7).
In this version an ON-OFF solenoid valve has been introduced which with the engine temperature below 60°C, cuts off the flow towards the advance variator (7) thereby annulling the effect of the delaying device.

Operation

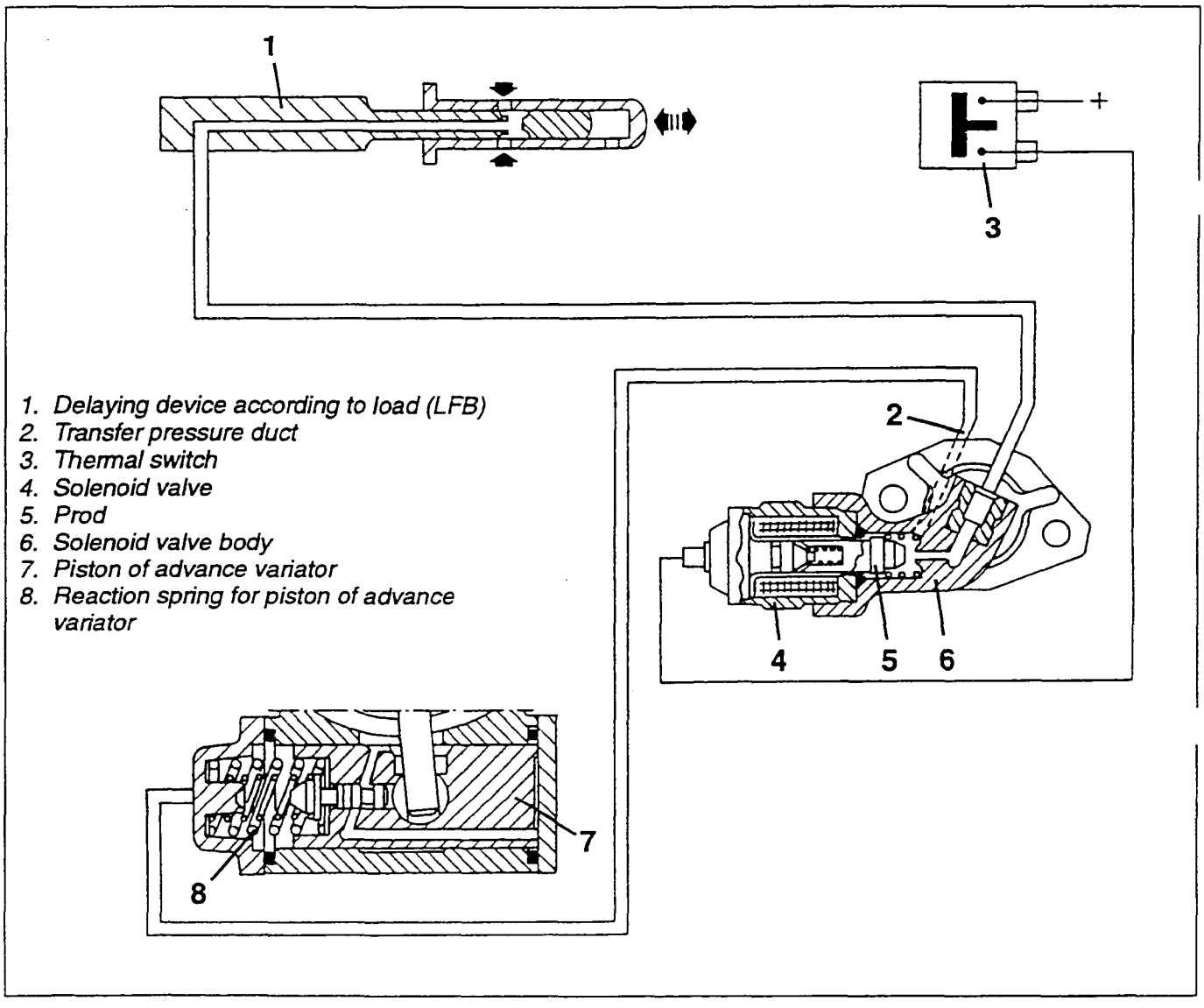
The LFB device modulates the flow of fuel between the transfer pressure chamber and the advance variator, according to the engine rpm.
Modulation takes place in relation to the extension of the sliding sleeve forming part of the device and it is controlled by centrifugal masses turned by the pump main shaft.
Experiments on engines of this type have revealed the presence of phenomena which adversely affect operation due to the engagement of the LFB device when the engine is cold, this is why the device needs to be fitted with a solenoid valve which prevents it from operating with coolant fluid temperatures below 60°C.

Cold engine

When the engine coolant temperature is below 60°C the thermostatic switch (3) is closed, supplying the solenoid (4) which cuts off the flow between the delaying according to load device (1) and the advance variator (7).
In this case the LFB device is inhibited.

Warm engine

When the temperature of the coolant fluid reaches 60°C, the thermal switch (3) on the thermostat body opens, cutting off the supply of the solenoid (4).
The prod (5) of the valve (6) withdraws allowing the passage of the flow towards duct (2) consequently towards the advance variator (7). In this condition the LFB device comes into operation in full.



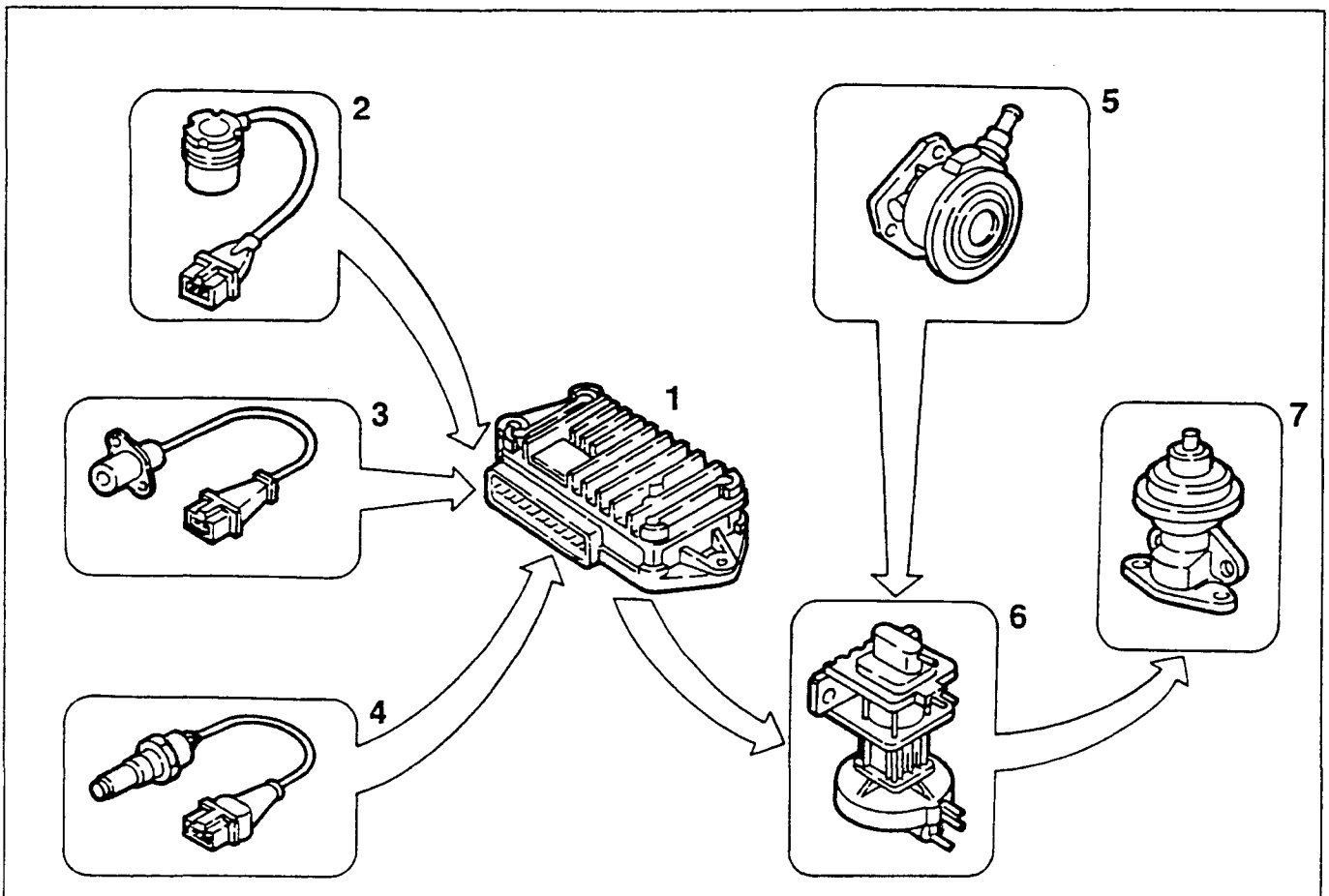
1. *Delaying device according to load (LFB)*
2. *Transfer pressure duct*
3. *Thermal switch*
4. *Solenoid valve*
5. *Prod*
6. *Solenoid valve body*
7. *Piston of advance variator*
8. *Reaction spring for piston of advance variator*

AUTOMATIC FAST IDLE

Though the injection pump adopted is fitted with an automatic fast idle device it does not use it (no connection with thermostatic switch).
However the presence of parts forming the device make it possible to adjust the idle speed particularly accurately.

GENERAL DESCRIPTION

This system makes it possible to send to the intake part (5 ÷ 15%) of the exhaust gas, under determinate operating conditions of the engine.
This way the fuel mixture is diluted with the inert gases lowering the temperature peak in the combustion chamber: this reduces the formation of nitric oxides (NOx), thereby reducing them by 30 ÷ 50% at the exhaust.
The recirculation of burnt gas is only allowed at medium-low loads, when the air-fuel ratio is very high and engine operation is not adversely affected by the presence of inert gas instead of air.
The recirculation system is controlled by a control unit (1) which at the input receives signals of the potentiometer (2) on the acelerator lever and from the rpm sensor (3) and coolant temperature sensor (4), and at the output it supplies a command signal for the modulating solenoid valve (Borg Warner) (6) for E.G.R. control.
The latter is connected with the environment through a filter and on the basis of the command signal received it transmits more or less vacuum, leading from the servobrake air pump (5), to the E.G.R. valve (Pierburg) (7).
This valve, if the vacuum is sufficient, opens, putting the exhaust manifold into communication with the intake box.
It is then possible to send the quantity of recirculated gas adjusting the opening of the E.G.R. valve continuously using the maps of the degree of opening in relation to the signals received.

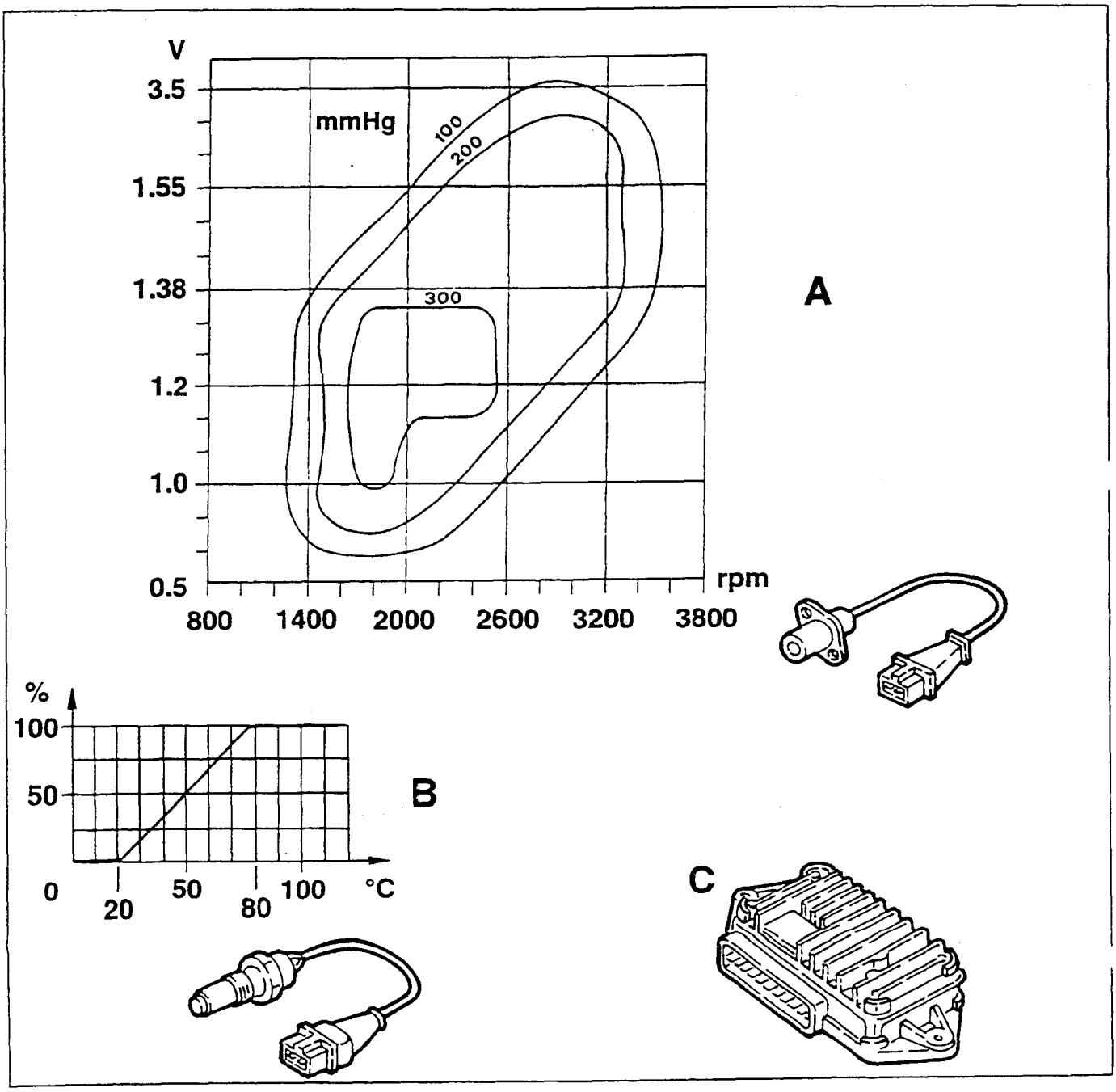


1. *Electronic control unit*
2. *Accelerator lever potentiometer*
3. *Rpm sensor*
4. *Engine coolant fluid temperature sensor*
5. *Servobrake air pump*
6. *E.G.R. control modulating solenoid valve (Borg Warner)*
7. *E.G.R. valve (Pierburg)*

ELECTRONIC CONTROL UNIT

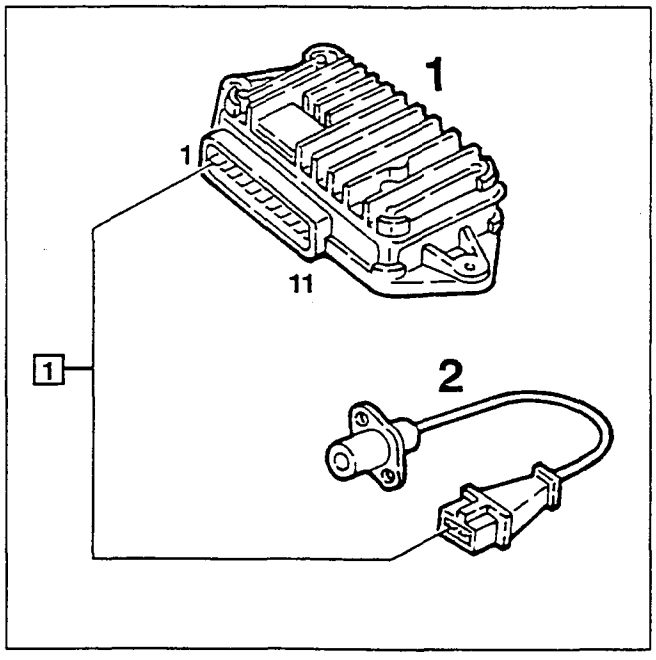
This is a digital unit with microprocessor to which the data on the engine operating conditions converge, transmitted from the engine load sensor (through the accelerator lever potentiometer), the rpm sensor and the engine coolant temperature sensor.
On the basis of these signals the control unit (C) is capable of driving the modulating solenoid valve with a square-wave signal because of the E.G.R. memorised inside it.
The map is shown (see diagram A) on the plane of the angular position of the accelerator lever/engine turning speed and as level curve parameters, it has E.G.R. valve control vacuum ratings in mmHg.

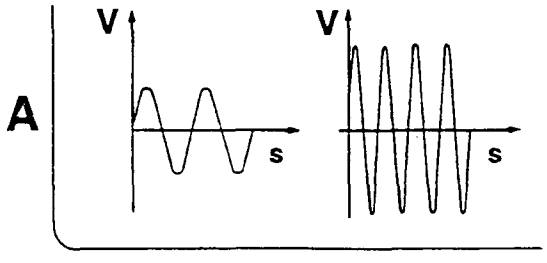
Correction in relation to the temperature is carried out in a second time, still by the control unit: correction (B) corresponds to a resetting of the intensity values for temperatures below 20°C, and a reduction from 100% to 0% variable between temperatures from 20°C to 80°C.
For engine coolant temperatures above 80°C, no corrections of the solenoid valve control current take place.
Lastly, the control unit has an electrical connection for the serial output for the ALFA TESTER, through which it is possible to see any faults detected during operation for servicing purposes.

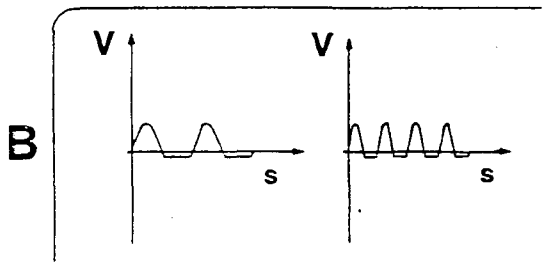


RPM SENSOR

The rpm sensor (2) fitted on the gearbox cover in correspondence of the flywheel ring gear, is a passive electromagnetic detector with a gap of 0.25 ÷ 1.3 mm between the upper part of the teeth of the ring gear and its winding.
At the passage of each tooth of the ring gear, the sensor supplies a sinusoidal voltage, variable in amplitude and frequency depending on the engine rpm (diagram A).
The control unit (1) stabilizes the positive half wave in amplitude and cuts the negative one (diagram B).

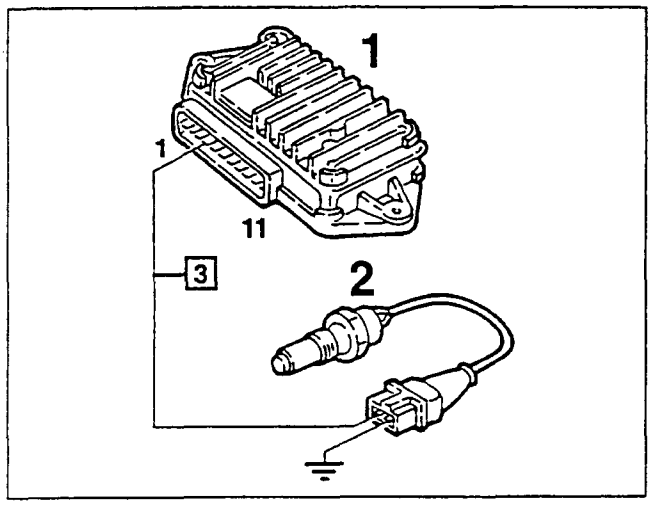


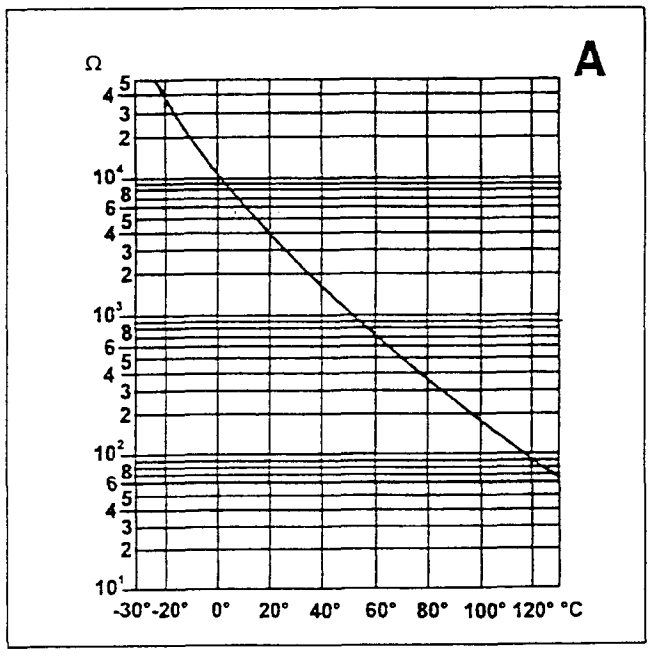




ENGINE COOLANT FLUID TEMPERATURE SENSOR

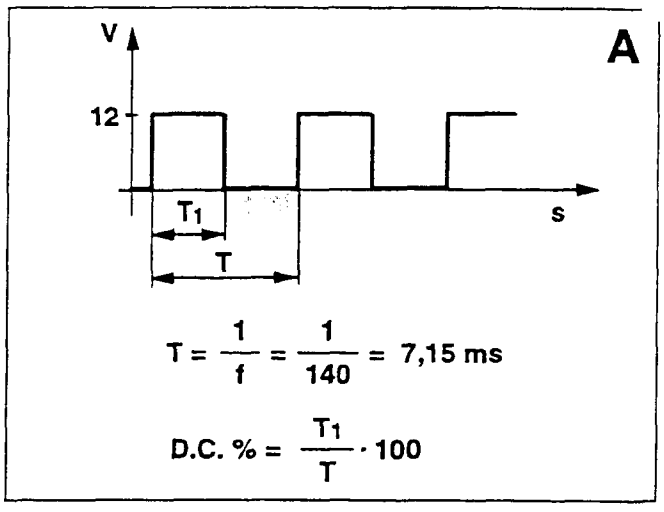
The sensor is fitted on the thermostat body with the sensitive part in contact with the coolant fluid.
It comprises an NTC resistance (Negative Temperature Coefficient) which changes its resistance inversely proportionately with the temperature, as shown in diagram A.
The electronic control unit (1) supplies the coolant fluid temperature sensor (2) according to the rating of its resistance, and detects the temperatur of the coolant fluid on the basis of the change of voltage proportionate with the intensity of the current circulating in the sensor, in order to correct the control of the modulating solenoid valve.
This prevents the engine from taking in too much unburnt gas when the optimal operating temperature has not been reached, or when particularly harsh environmental conditions do not allow it to reach this temperature.
Therefore, this sensor guarantees good operating conditions of the engine after starting, avoiding a lowering of the amount of oxygen in the intake air, to warrant the best conditions possible for combustion when the engine is cold.

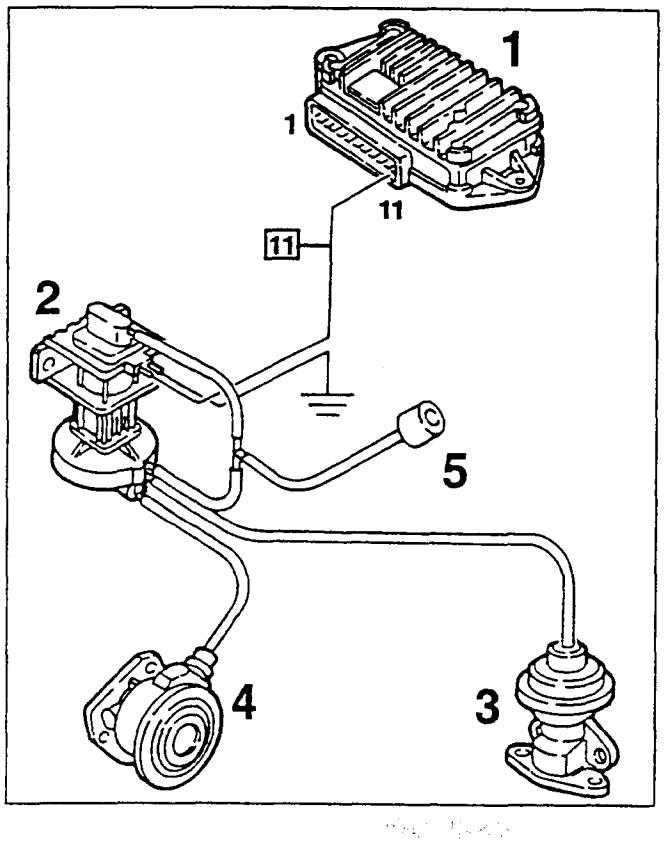




BORG WARNER MODULATING SOLENOID VALVE

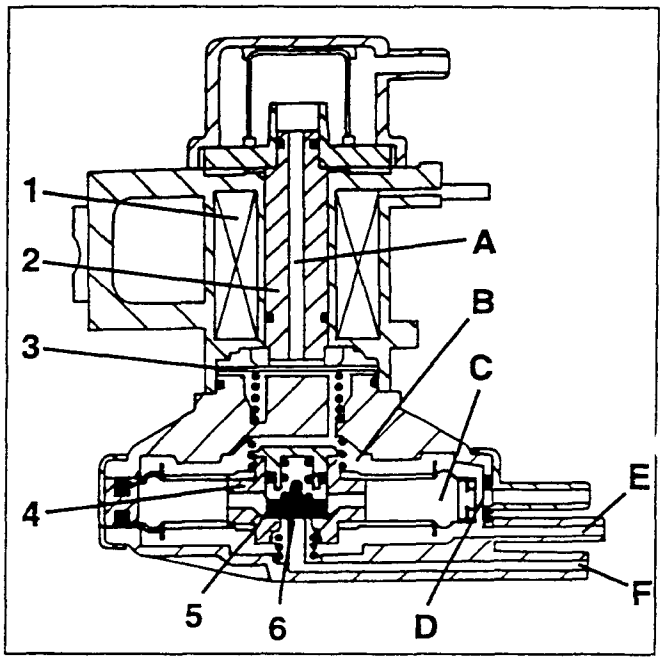
The Borg Warner solenoid valve (2) is fitted in the rear section of the engine compartment, in a vertical position on the bulkhead which separates the engine bay from the passenger compartment.
It is connected to the E.G.R. pneumatic system with a takeoff for the vacuum leading from the servobrake air pump (4), with an outlet to be connected to the Pierburg E.G.R. valve (3) and with two atmospheric pressure sockets which withdraw from a filter (5).
The solenoid valve is driven directly by the electronic control unit (1) with a square-wave signal with a frequency of 140 Hz, a voltage rate of 12V and variable Duty-Cycle (see diagram A) which determines a current from 0 to appr. 800 mA, the condition in which the highest vacuum rating is sent to the E.G.R. valve.
The Duty-Cycle is the ratio between the time in which the signal is at 12 V and the total period of the cycle (1/140 s).
It should be noted that the vacuum modulated does not depend on the value of the input vacuum, but only on the Duty-Cycle of the controlling electric signal.





1. *Electronic control unit*
2. *E.G.R. control modulating solenoid valve (Borg Warner)*
3. *E.G.R. valve (Pierburg)*
4. *Servobrake air pump*
5. *Atmosphere takeoff filter*

OPERATION

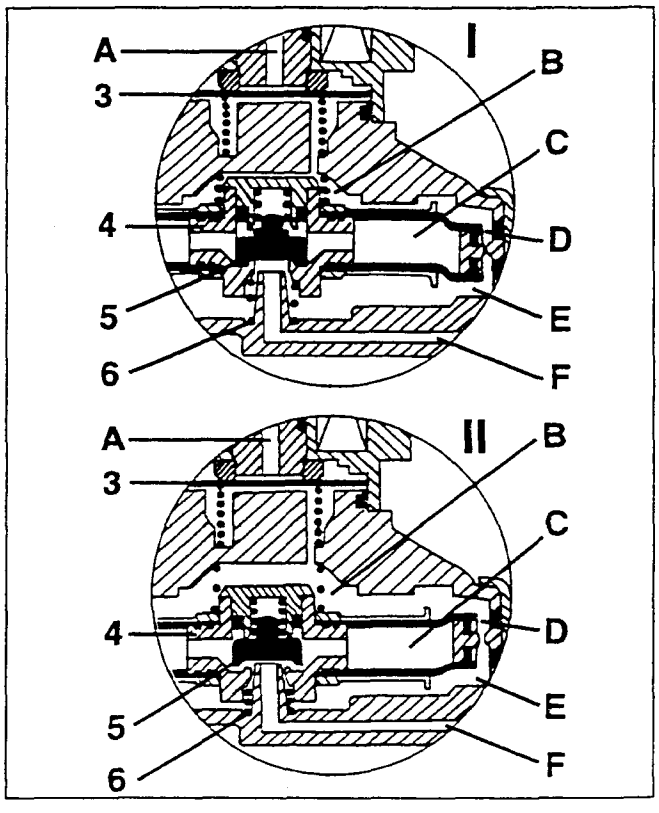


1. *Electromagnetic coil*
2. *Magnetic core*
3. *Mobile modulating disk*
4. *Mobile equipment*
5. *Diverter valve*
6. *Counter spring*

A. *Atmospheric pressure inlet duct*
B. *Upper modulated pressure chamber*
C. *Atmospheric pressure chamber and duct*
D. *Compensation hole for chambers B and E*
E. *Lower chamber and connection duct to E.G.R.* valve
F. *Vacuum inlet from servobrake air pump*

Maintenance position

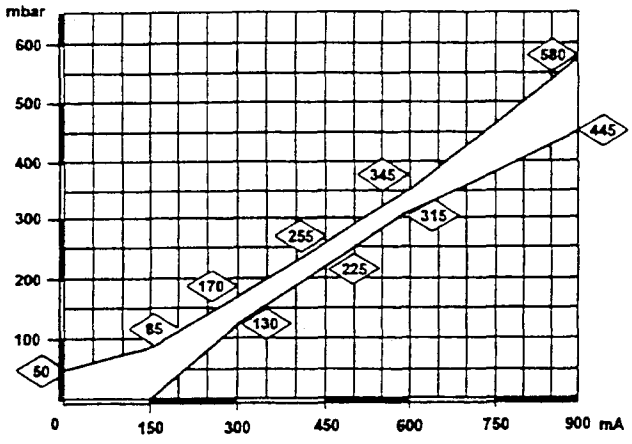
The vacuum reaches chamber E from duct F (pos. I), as the force of the spring (6) acts on the mobile equipment (4) and the diverter valve (5) allows it to pass.
Through the compensation hole D, the vacuum then involves chamber B and the lower surface of the disk shutter (3).
Once the forces acting on the disk (3) are balanced, the atmospheric pressure in duct A enters chamber B, moving the movile equipment downwards (pos. II), this way the shutter of the valve (5) closes duct F and puts chamber E into communication with chamber C at atmospheric pressure, lowering the vacuum in duct E.
The decreased vacuum or increased absolute pressure in chamber E makes the mobile equipment rise (4) (pos. I), closing the passage C-E and bringing valve (5) to the ideal position (E in communication with F), to repeat the cycle.



Adjustment phase

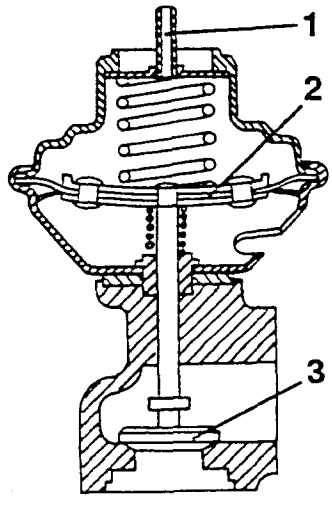
As the engine operating conditions change, the control unit sends a different Duty-Cycle signal to the E.G.R. control modulating valve.
With the increase of the Duty-Cycle the mean current and the force of attraction on the shutter disk (3) increase.
In this new condition chamber B is put into communication with duct A at a higher vacuum rating, to overcome the electromagnetic force of the coil.

The cycles are repeated keeping a vaccum in chamber E in relation only to the Duty-Cycle.
The vacuum that controls and modulates the opening section of the E.G.R. valve therefore depends solely on the value of the signal sent by the electronic control unit.

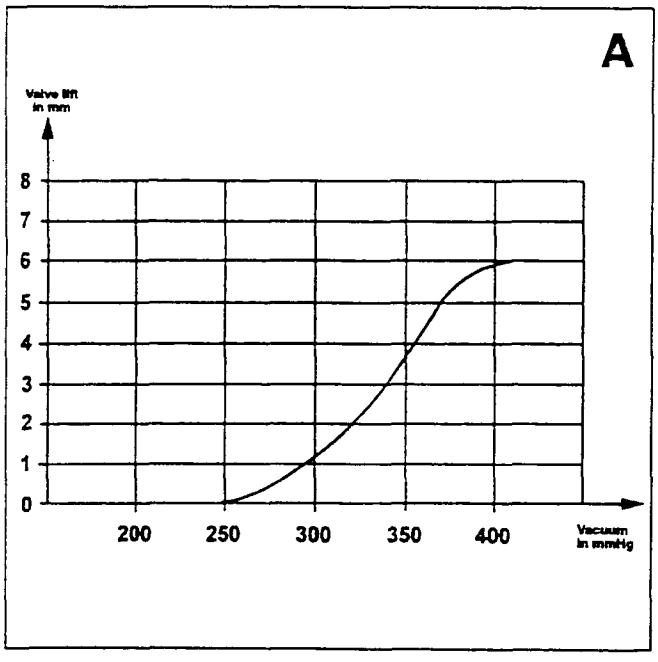


PIERBURG E.G.R. VALVE

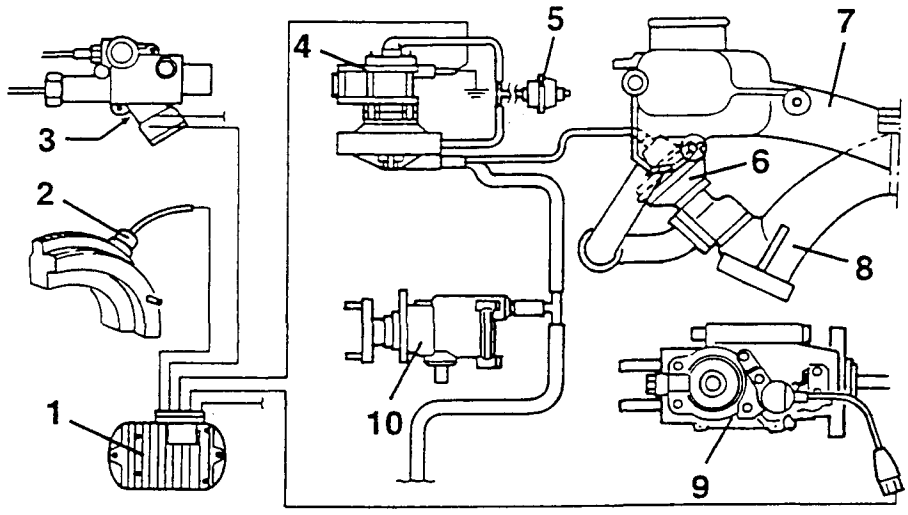
This valve is driven by a vacuum generated by the servobrake air pump and modulated by the modulating solenoid valve.
The E.G.R. valve is driven as follows:
- if following the signal from the electronic control unit, the modulating solenoid valve sets duct (1), under vacuum, the diaphragm (2) and the shutter (3) connected to it rise, opening the section of passage for the gas in relation to the vacuum rating in duct (1): this enables the circulation of a suitable quantity of burnt gas towards the intake box;
- if it is not energised, the solenoid valve puts duct (1) into communication with the atmosphere, thereby closing the shutter (3): this prevents the recirculation of burnt gas to ensure correct operation of the engine cold, at idle speed and at medium-high load.



The opening of the section of passage of the exhaust gas depends on the modulated pressure rating, which reaches duct (1), as shown indicatively in diagram (A). On this indicative diagram, the vacuum ratings are expressed in mmHg.
The complete opening of 6 mm of the E.G.R. is obtained with vacuum ratings of above 420 mmHg.

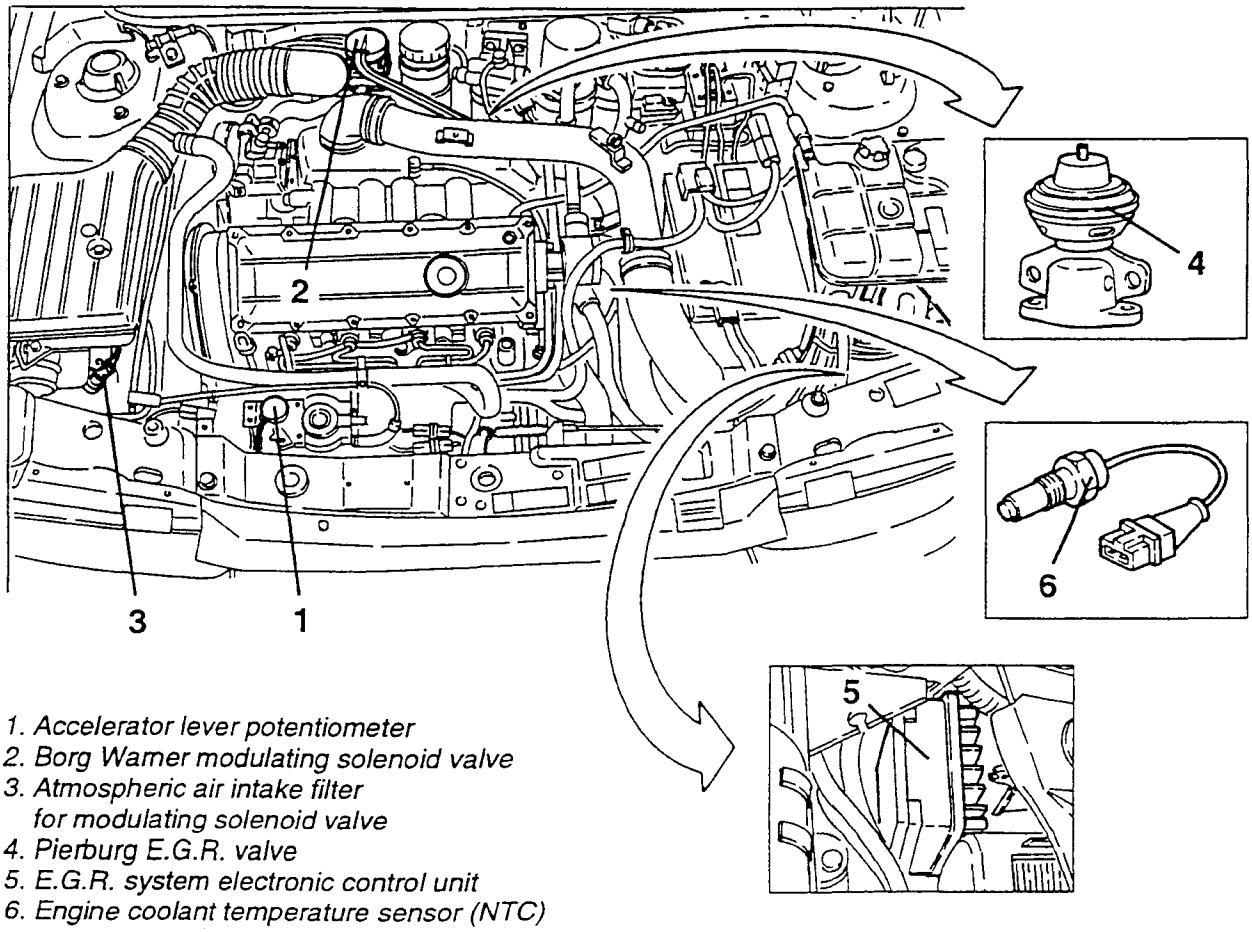


E.G.R. SYSTEM LAYOUT



1. *E.G.R. system electronic control unit*
2. *Rpm sensor*
3. *Engine coolant temperature sensor (NTC)*
4. *Borg Warner modulating solenoid valve*
5. *Atmospheric air intake filter for modulating solenoid valve*
6. *Pierburg E.G.R. valve*
7. *Intake box*
8. *Exhaust manifold*
9. *Accelerator lever potentiometer*
10. *Vacuum pump for servobrake*

LOCATION OF COMPONENTS IN THE ENGINE COMPARTMENT



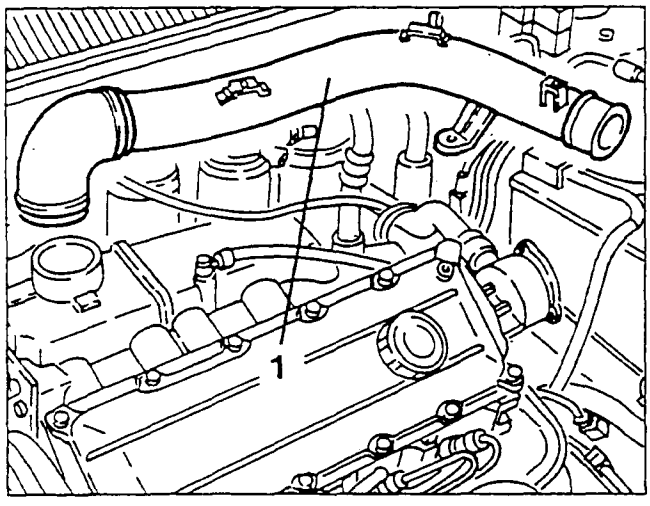
1. *Accelerator lever potentiometer*
2. *Borg Warner modulating solenoid valve*
3. *Atmospheric air intake filter for modulating solenoid valve*
4. *Pierburg E.G.R. valve*
5. *E.G.R. system electronic control unit*
6. *Engine coolant temperature sensor (NTC)*

REMOVING/REFITTING

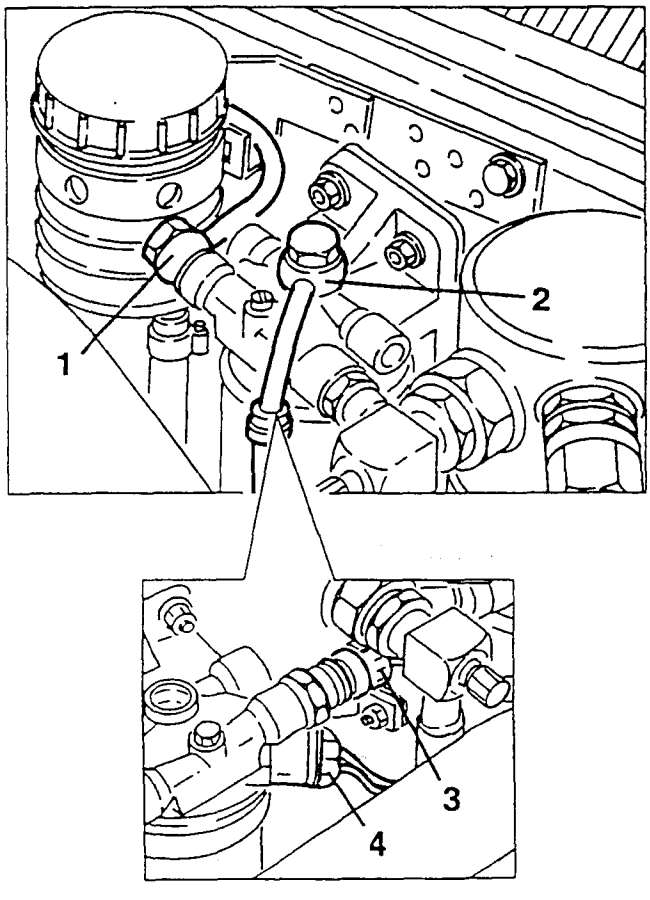
PIERBURG E.G.R. VALVE

- Disconnect the battery (-) terminal.

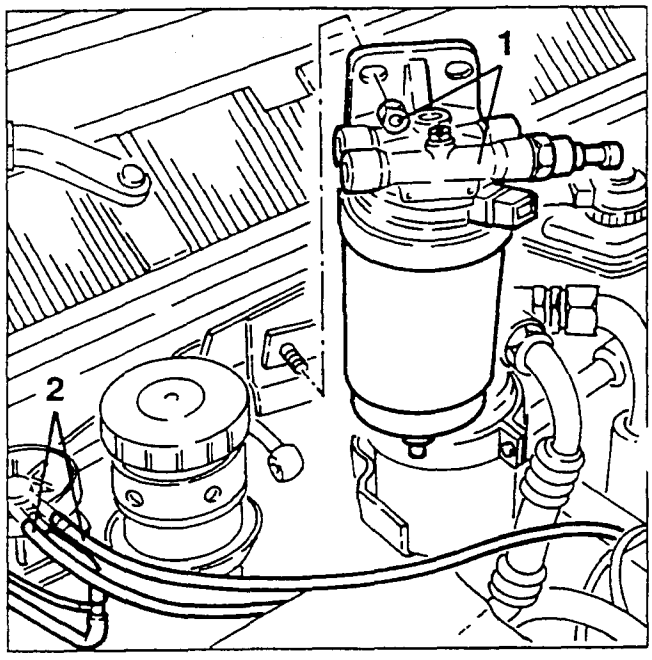
1. Release the battery cable from the fastening bracket, slacken the fastening clamps, then remove the second section of the air delivery pipe from the intercooler to the intake box.



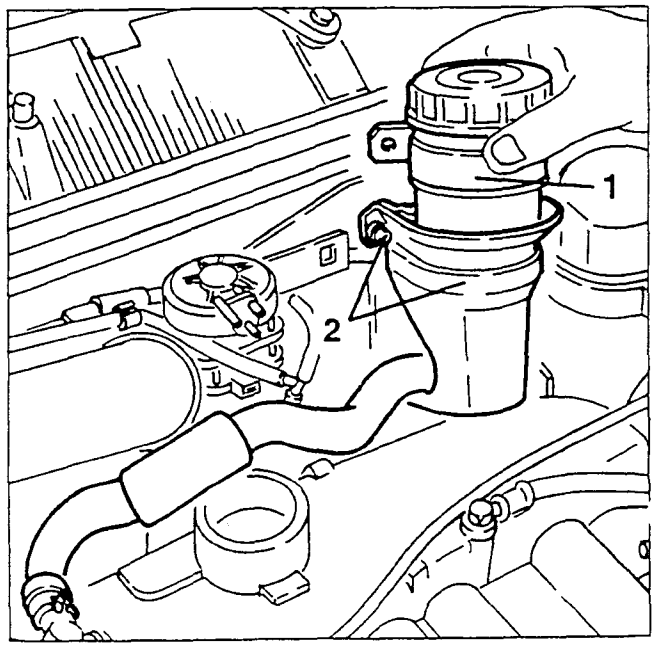
1. Disconnect the fuel tank delivery pipe fitting from the filter.
2. Disconnect the injection pump delivery pipe fitting from the filter.
3. Disconnect the electrical connection from the fuel warming device sensor.
4. Disconnect the electrical connection supplying the fuel warming device.



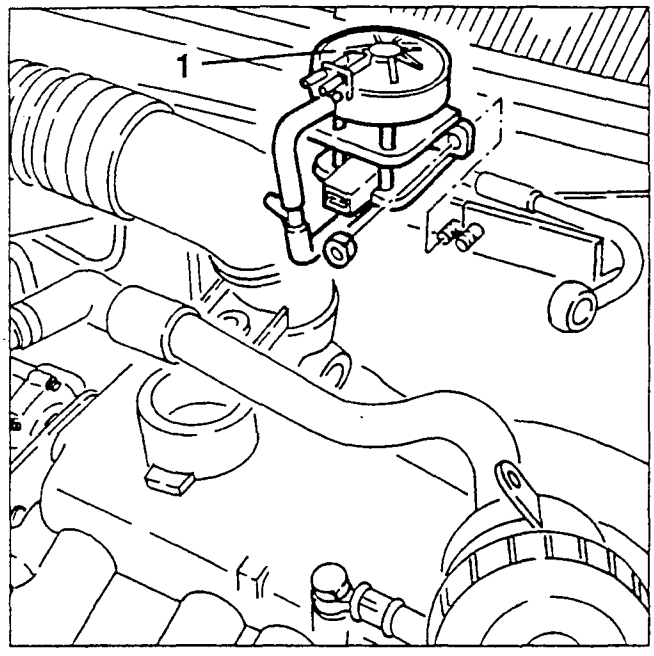
1. Loosen the two fastening nuts and remove the fuel filter complete.
2. Disconnect the pipes from the Borg Warner modulating solenoid valve.



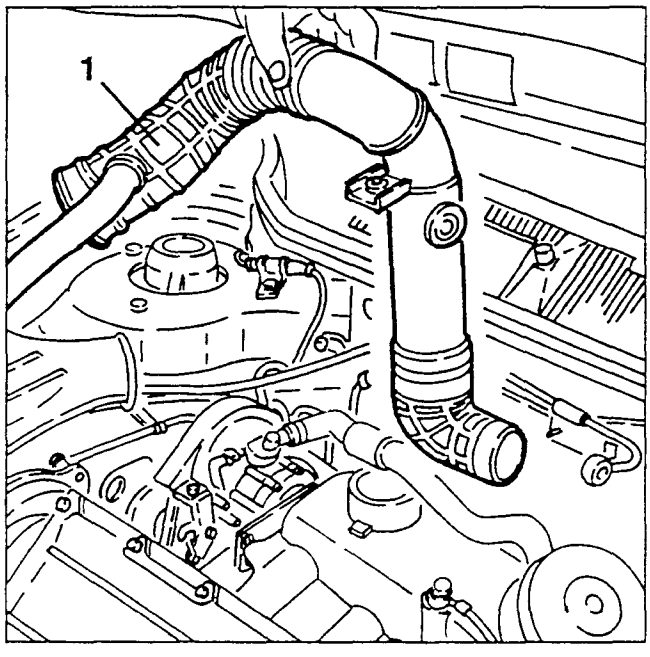
1. Loosen the two screws fastening the power steering oil tank complete with cover and raise it just enough without disconnecting the pipes.
2. Loosen the two fastening screws and remove the heat shield from the power steering oil tank, then move the tank to one side to prevent it from hindering the following operations.



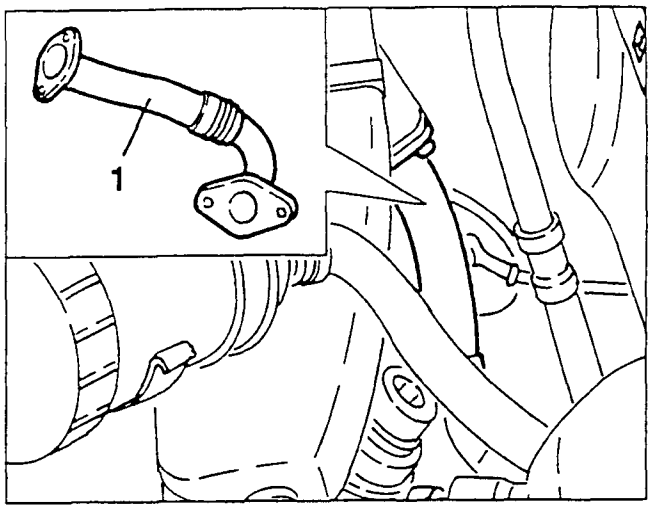
1. Disconnect the electrical connection, slacken the two fastening nuts, then remove the Borg Warner modulating solenoid valve.



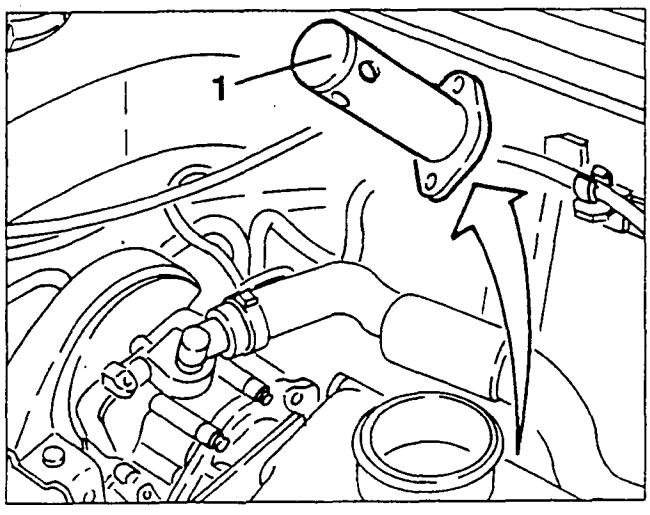
1. Slacken the fastening clamps, release from the intermediate fastening, then remove and set on one side the air delivery pipe from the filter to the turbocharger without disconnecting the oil vapour recirculation pipe.



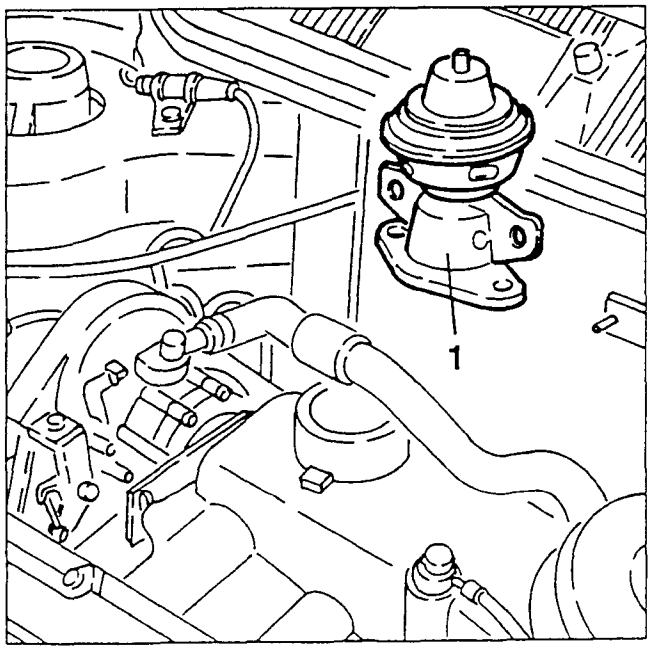
1. Loosen the fastenings screws and remove the exhaust gas delivery pipe from the E.G.R. valve to the intake box.
- Retrieve the seals.



1. From the exhaust gas inlet hole in the intake box retrieve the recirculated exhaust gas "diffuser".

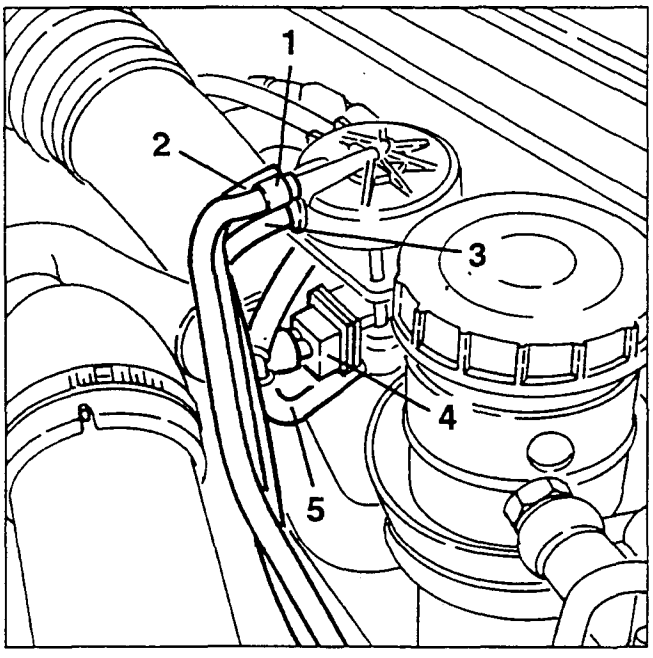


1. Loosen the fastening nuts and remove the Pierburg E.G.R. valve from the exhaust manifold.

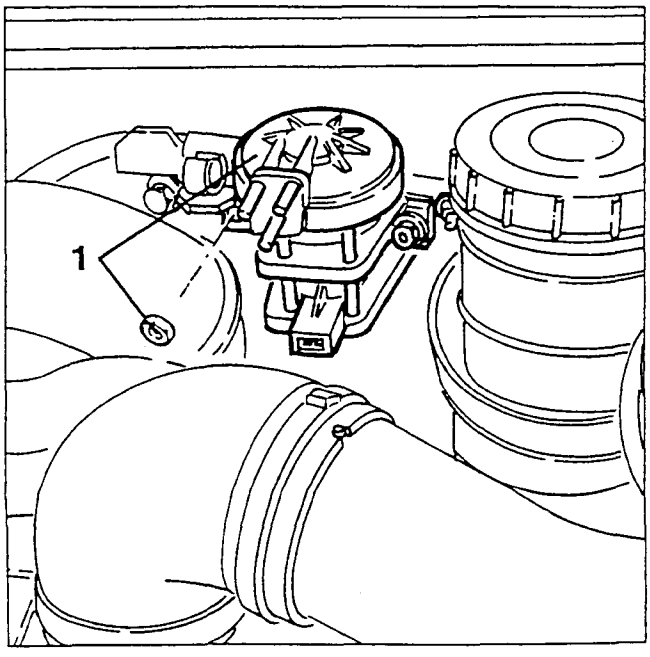


BORG WARNER MODULATING SOLENOID VALVE

- Disconnect the battery (-) terminal.
1. Disconnect the vacuum takeoff pipe from the modulating solenoid valve.
2. Disconnect the pipe connecting with the E.G.R. valve from the modulating solenoid valve
3. Disconnect the upper atmospheric air takeoff pipe from the modulating solenoid valve.
4. Disconnect the electrical connection from the modulating solenoid valve.
5. Disconnect the lower atmospheric air takeoff pipe from the modulating solenoid valve.

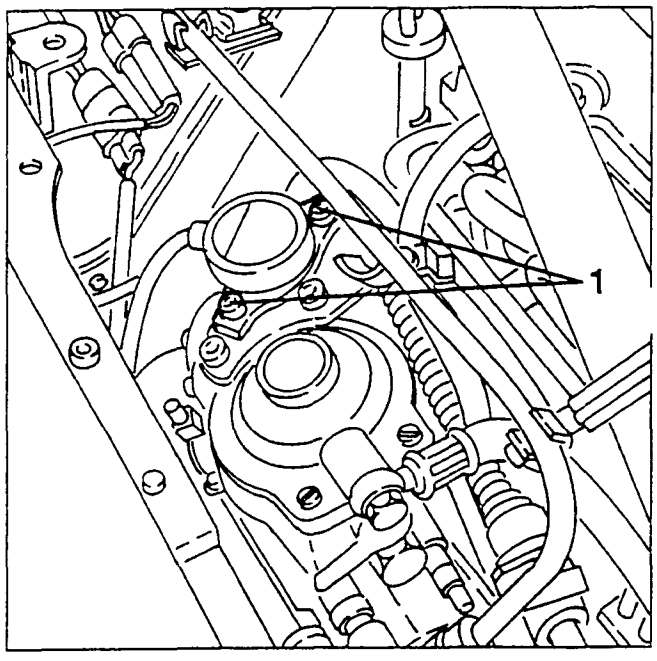


1. Loosen the two fastening nuts and remove the Borg Warner modulating valve complete.

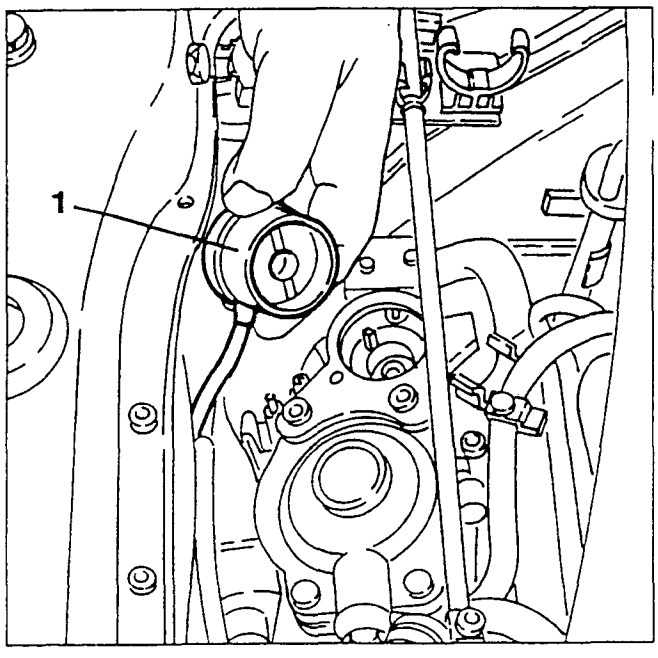


ACCELERATOR LEVER POTENTIOMETER

- Disconnect the battery (-) terminal.
- Disconnect the electrical connection of the accelerator lever potentiometer.
1. Slacken the two fastening screws and remove the brackets fastening the accelerator lever potentiometer.



1. Remove the accelerator lever potentiometer complete with wiring.

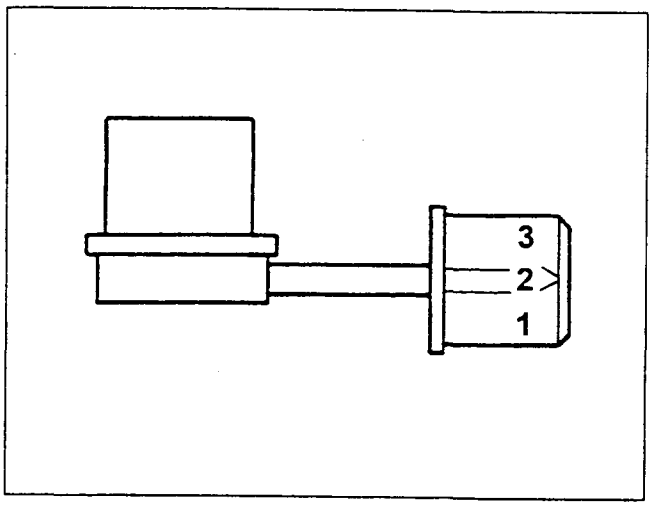


When refitting check the accelerator lever potentiometer setting proceeding as described below.

Checking the potentiometer setting

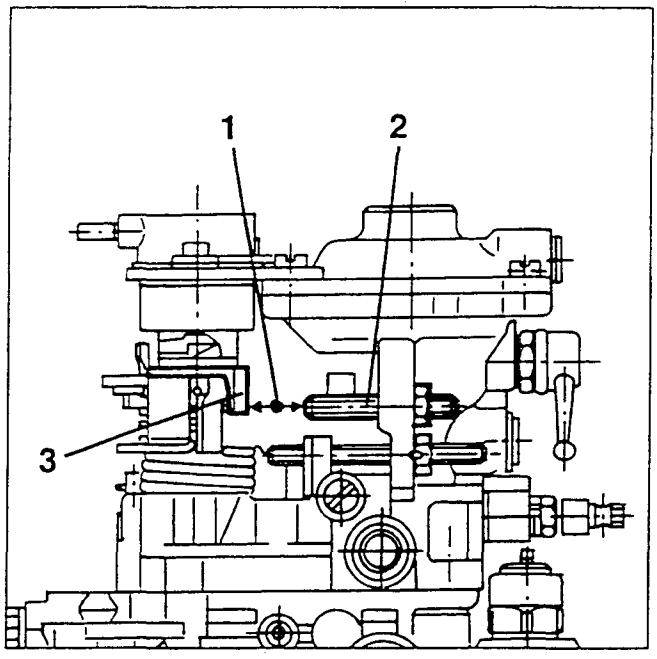
1. With the control panel on, check that the voltage between PIN 3 (positive) and PIN 1 (negative) of the accelerator lever potentiometer electrical connection is within the specified limits.

Voltage to be found between PIN 3 (positive) and PIN 1 (negative)
3.7 ± 0.2 Volt



PIN 1 - negative
PIN 2 - signal
PIN 3 - positive

- The output signal of the potentiometer, to be measured between PIN 2 and PIN 3 (positive) of the potentiometer should be checked setting a 12 mm spacer between the third stop screw and the tooth on the accelerator lever as illustrated.



1. 12 mm spacer
2. Third stop screw
3. Tooth on accelerator lever

- After setting the accelerator lever tooth against the spacer, check that the potentiometer output signal is within the specified limits.

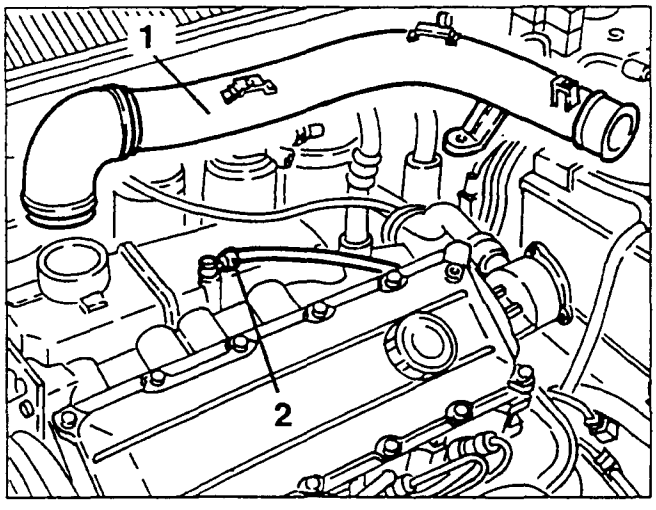
Potentiometer output signal measured between PIN 2 and PIN 3 (positive)
1.37 ± 0.1 Volt

- If the potentiometer output signal is not within the specified limits, slacken the potentiometer fastening screws and turn it until the required voltage is obtained.

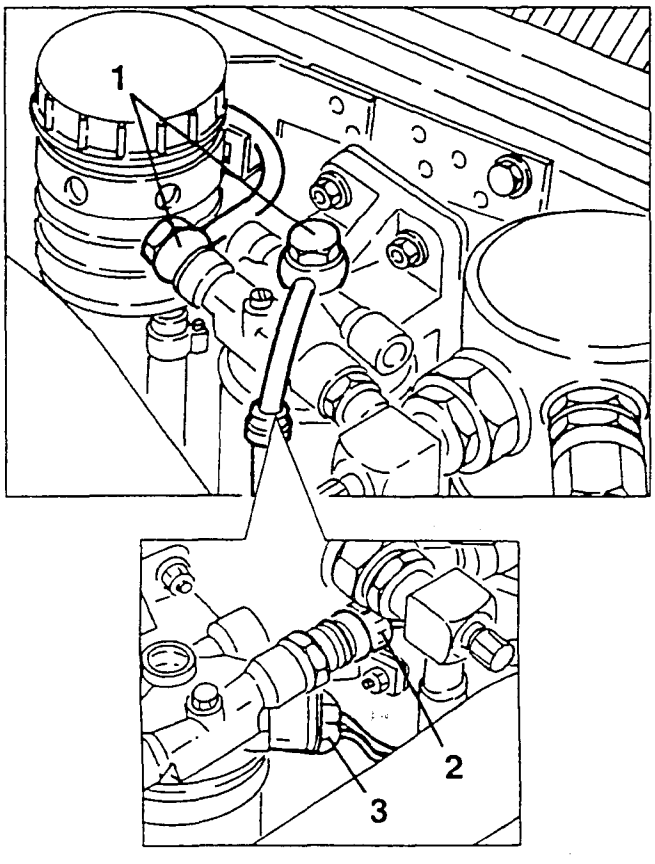
INTAKE BOX

REMOVING/REFITTING

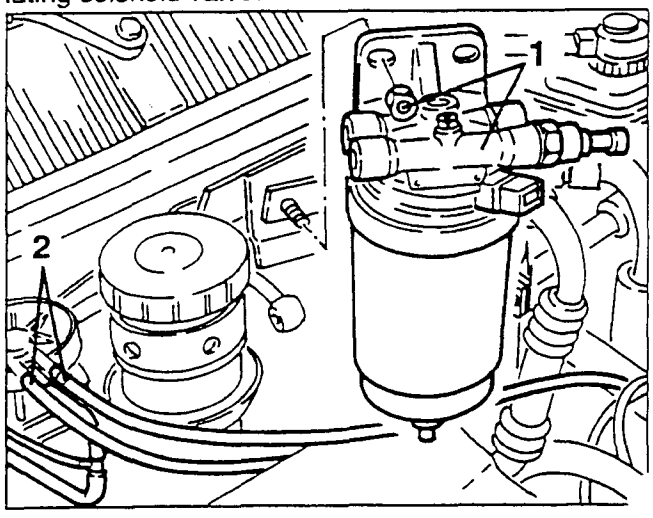
- Disconnect the battery (-) terminal.
1. Release the battery cable from the fastening bracket, slacken the fastening clamps, then remove the second section of the air delivery pipe from the intercooler to the intake box.
2. From the intake box disconnect the fitting of the overpressure pipe for the flow-rate limiting device.



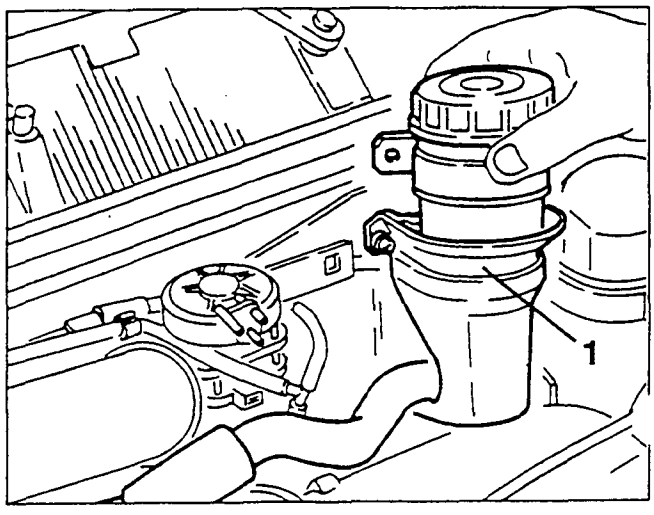
1. From the filter disconnect the fittings of the fuel inlet and delivery pipes.
2. Disconnect the electrical connection of the fuel warming device sensor.
3. Disconnect the electrical connection supplying the fuel warming device.



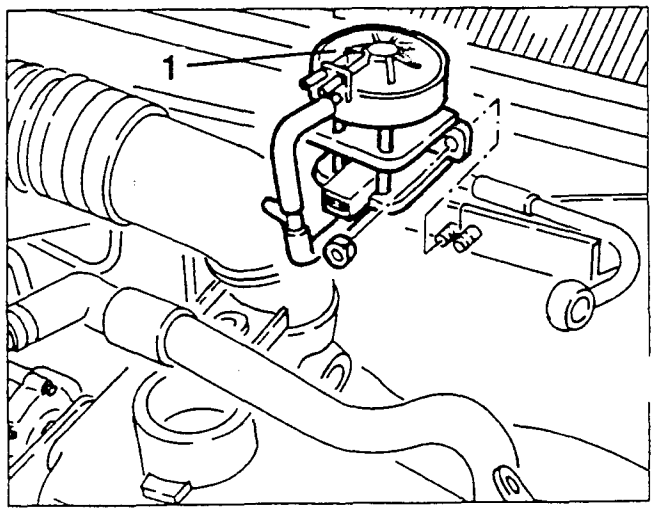
1. Slacken the two fastening nuts and remove the fu filter complete.
2. Disconnect the pipes from the Borg Warner modulating solenoid valve.



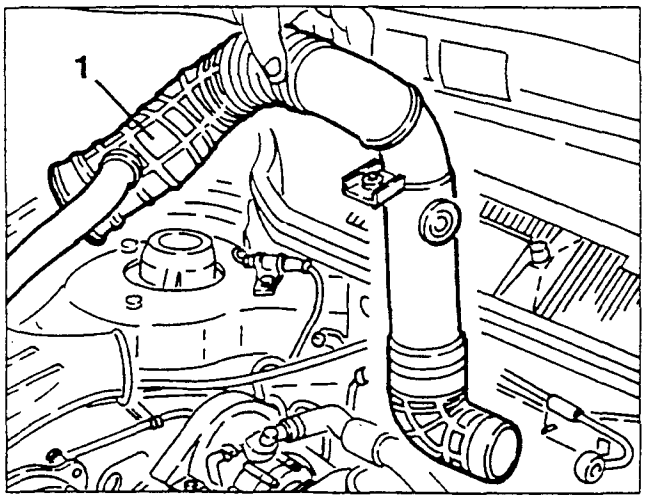
1. Slacken the two fastening screws, raise the power steering tank just enough without disconnecting the pipes, then remove the cover from the tank and set it aside.



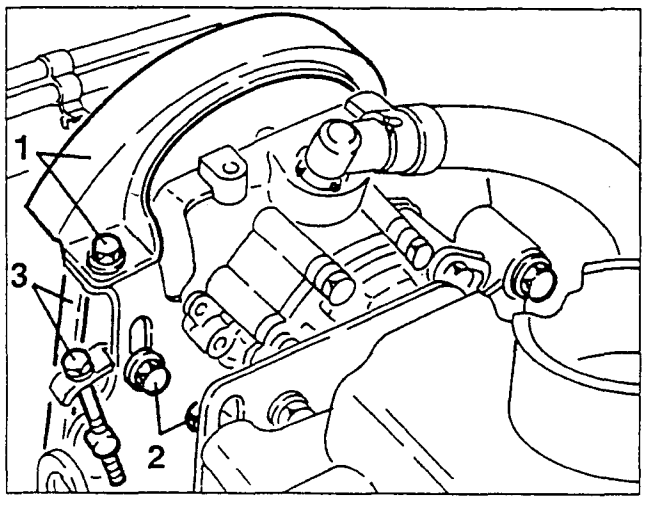
1. Disconnect the electrical connection, slacken the two fastening nuts, then remove the Borg Warner modulating solenoid valve.



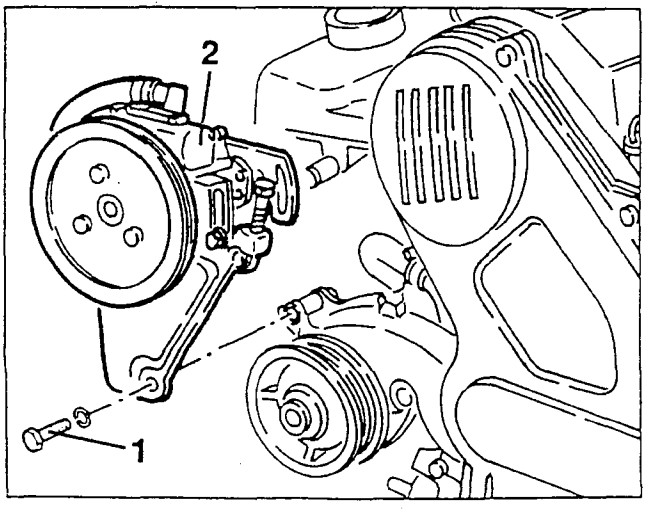
1. Loosen the clamps and move aside the air delivery pipe from the filter to the turbocharger without disconnecting the oil vapour recirculation pipe.



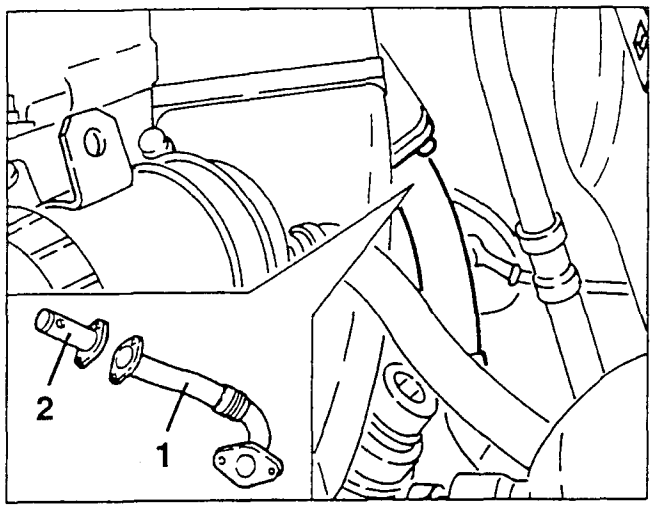
1. Remove the power steering pump belt guard.
2. Loosen the power steering pump fastening screws.
3. Loosen the tensioner screw, then remove the pump drive belt.



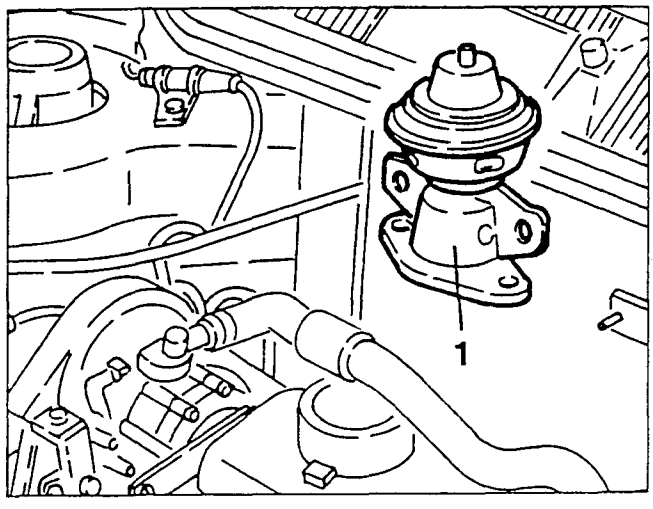
1. Completely back off the screws loosened previously and the screw illustrated.
2. Remove the power steering pump complete with front bracket without disconnecting the pipes and move it to one side.



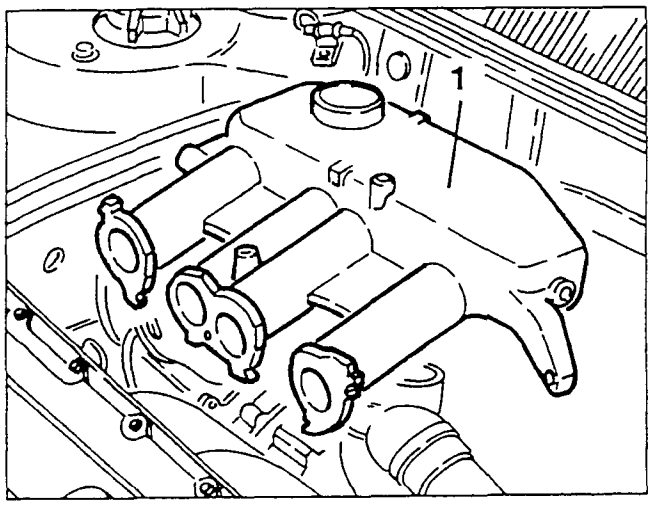
1. Slacken the fastening screws and remove the exhaust gas delivery pipe from the E.G.R. valve to the intake box.
- Retrieve the seals.
2. From the exhaust gas inlet hole in the intake box retrieve the recirculated exhaust gas "diffuser".



1. Slacken the fastening nuts and remove the Pierburg E.G.R. valve from the exhaust manifold.



1. Slacken the fastenings of the intake box to the cylinder head and to the air delivery pipe from the turbocharger, then remove it.



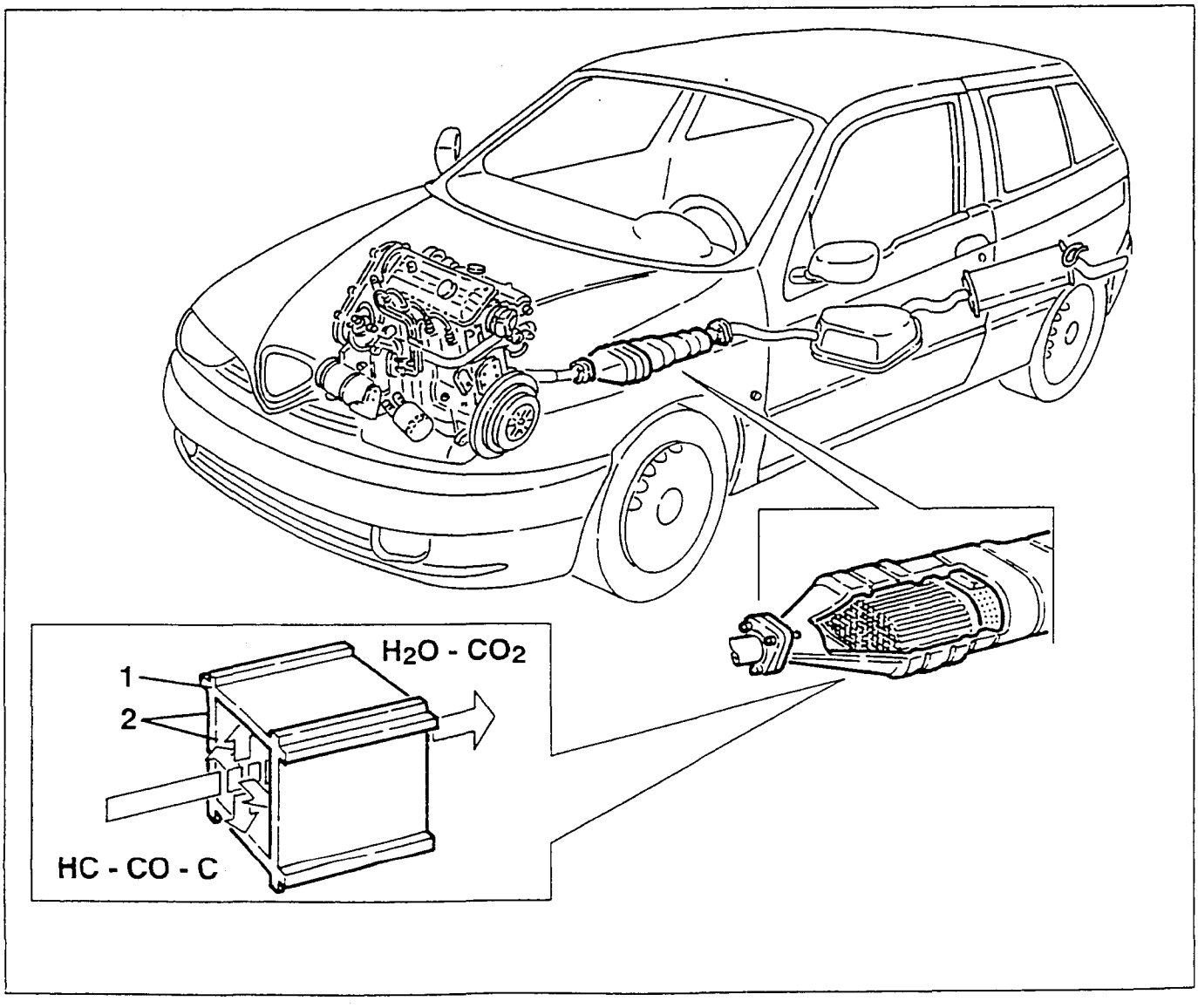
WHITE

DEGUSSA CATALYTIC CONVERTER

The oxidative catalyst is a simple and effective after-treatment device, used to oxidise CO, HC and particulate, transforming them into carbon dioxide (CO_2) and water vapour (H_2O).
The Degussa catalytic converter is cylindrical in shape and comprises a single piece ceramic honeycomb (1), the cells of which are impregnated with platinum (2), a catalysing substance with oxidising reactions. The total volumetric capacity is 600 cm^3 with a density of 400 cells per square inch.
The exhaust gases that cross the cells heat the catalyst, triggering conversion of the pollutants into inert compounds.
The chemical oxidising reaction of CO, HC and particulate is effective with temperatures above 200°C. They should however not exceed 350°C because at this temperature the sulphur contained in fuel oil begins to oxidise, originating sulphur dioxide (SO_2) and sulphuric dioxide (SO_3), which are the cause of acid rain.

Correct sizing of the catalytic converter makes it possible to contain the temperature, obtaining the maximum percentage of conversion of polluting emissions, while limiting oxidation of the sulphur compounds.
The catalytic converter also treats the saturated unburnt hydrocarbons and the aromatic hydrocarbons produced by combustion, while the substances forming part of the particulate, such as carbon in the form of smut, metals, water and sulphur compounds are expelled at the exhaust.

The reduction efficiency of the single pollutants is as follows:
- 50% of CO;
- 50% of HC;
- 35% of particulate.

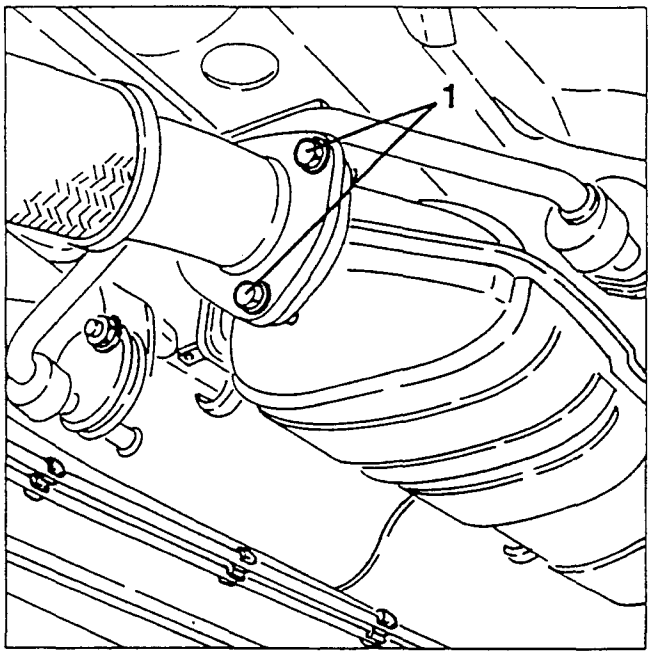


WHITE

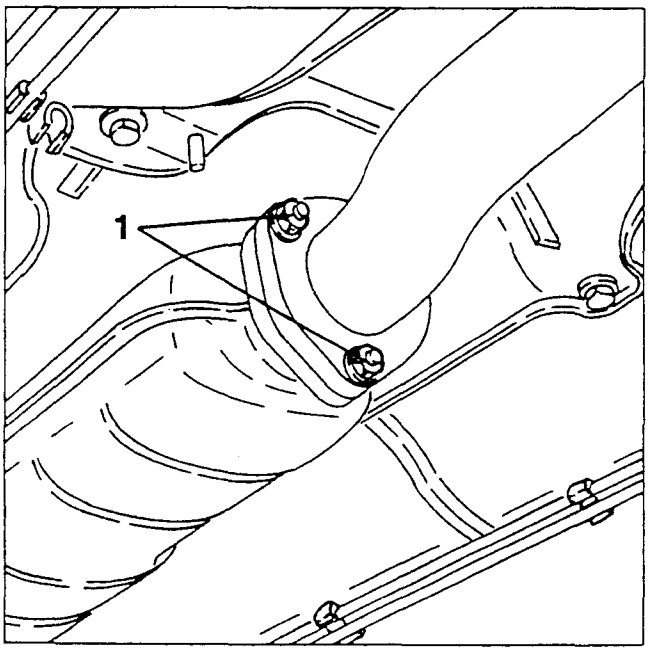
REMOVING/REFITTING

- Set the car on a lift and raise it.

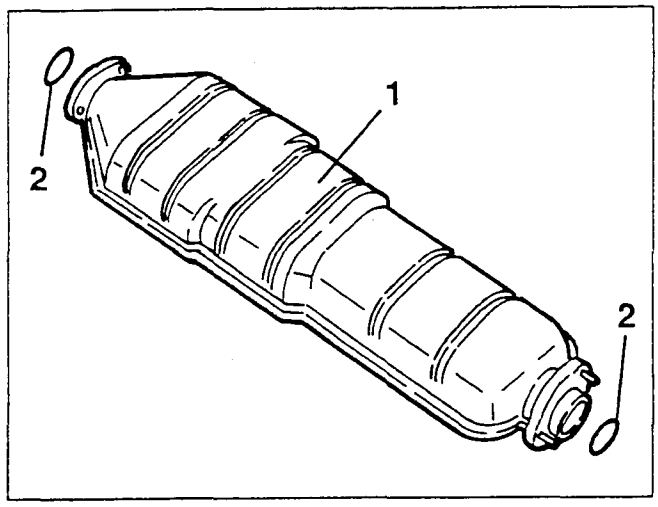
1. Slacken the three bolts fastening the front section of the exhaust piping to the catalytic converter releasing the support bracket.



1. Slacken the three bolts fastening the catalytic converter to the rear section of the exhaust piping.



1. Remove the catalytic converter.
2. Retrieve the seal rings.



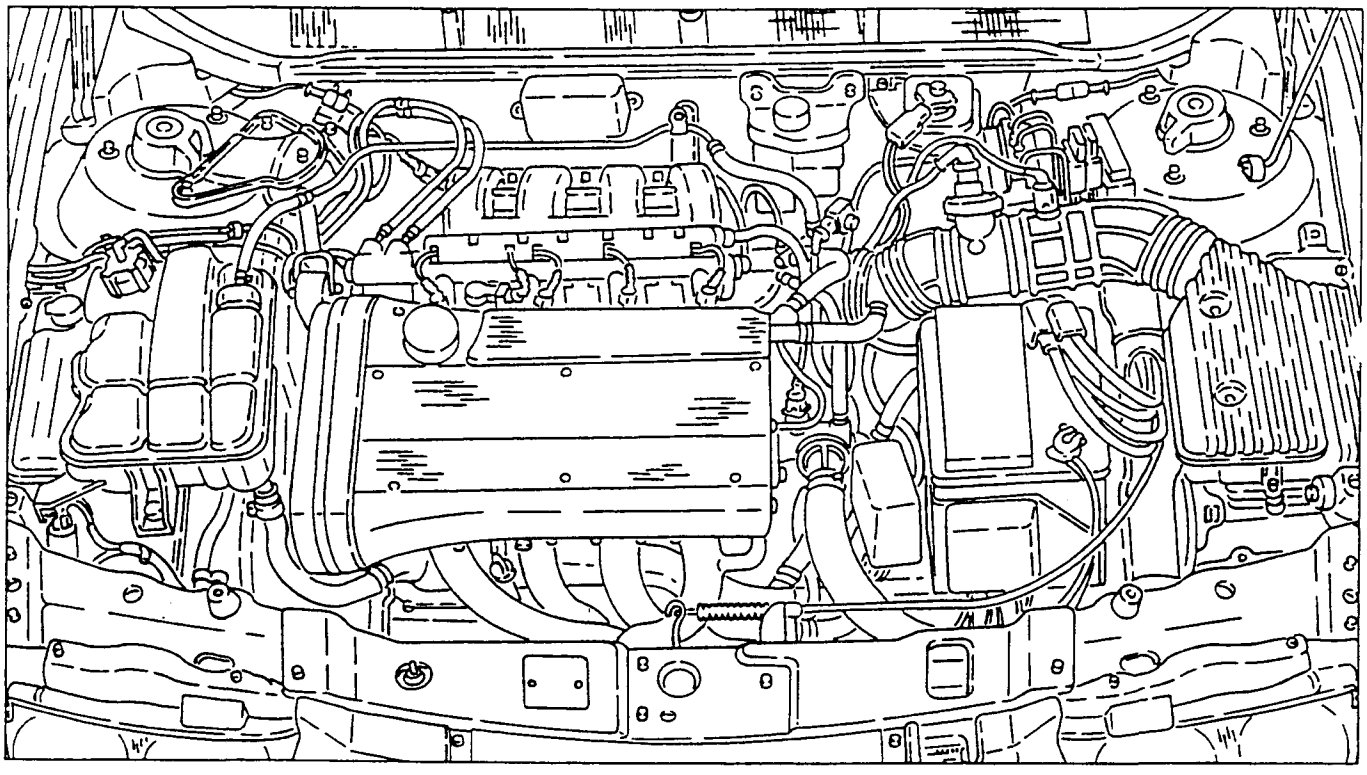
NOTE:

FOR REMOVING/REFITTING THE FRONT AND REAR SECTIONS OF THE EXHAUST PIPING REFER TO THE PROCEDURES GIVEN FOR VERSION 1929 TD BEARING IN MIND THAT THEIR CONNECTION TO THE CATALYTIC CONVERTER IS MADE BY FLANGES WITH SEALS RATHER THAN BY CLAMPS.

GENERAL DESCRIPTION

The information and illustrations given below enable the rapid removal of the engine assembly from its housing in the engine compartment and its subsequent refitting. Dis-assembly of the single components on the bench is described in the volume "ENGINE OVERHAULING".

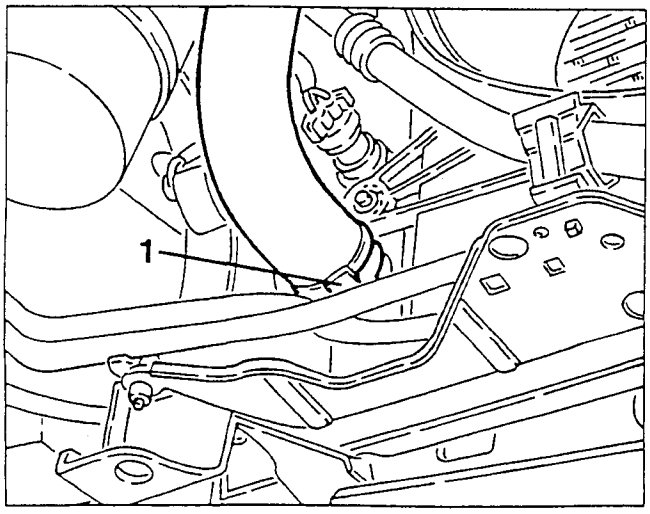
This is to be considered a single, complete procedure with the possibility of adopting only parts of it according to necessity.
For further information and details, see the chapters referring to the specific components or groups.



REMOVAL

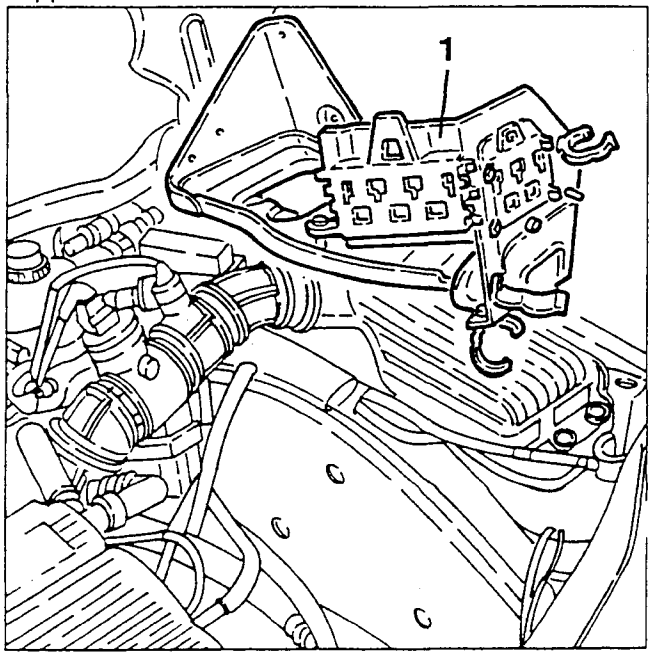
- Set the car on a 2 column lift.
- Remove the battery.
- Remove the front wheels and mud flaps.

1. Raise the car and drain the engine coolant fluid disconnecting the radiator outlet sleeve.



- Remove the relays from the battery support and set them to one side together with their wirings so that they do not hinder the following operations.

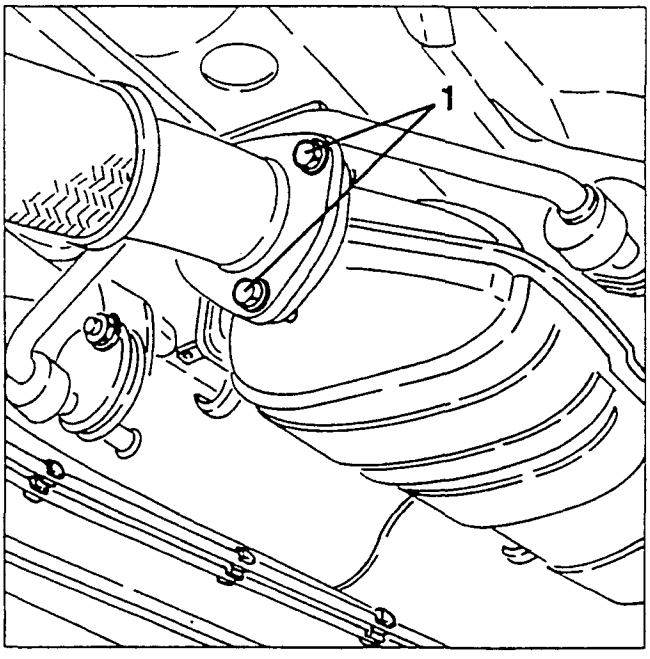
1. Slacken the fastening screws, then remove the battery support after removing it from the rear cable support bracket.



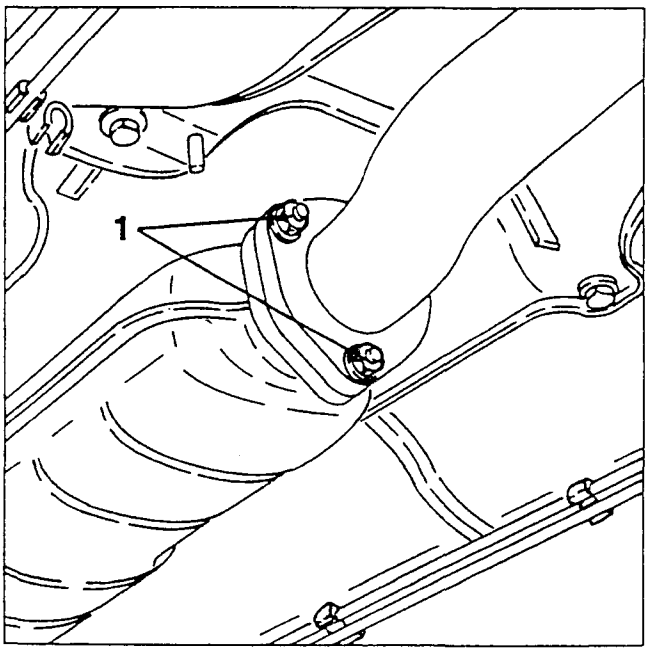
REMOVING/REFITTING

- Set the car on a lift and raise it.

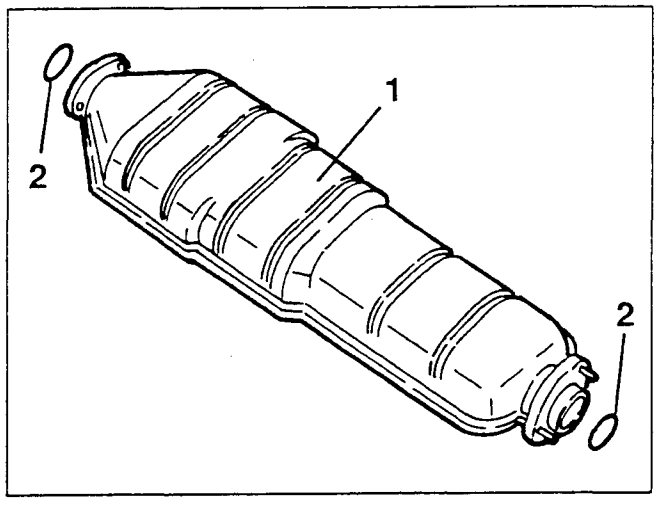
1. Slacken the three bolts fastening the front section of the exhaust piping to the catalytic converter releasing the support bracket.



1. Slacken the three bolts fastening the catalytic converter to the rear section of the exhaust piping.



1. Remove the catalytic converter.
2. Retrieve the seal rings.



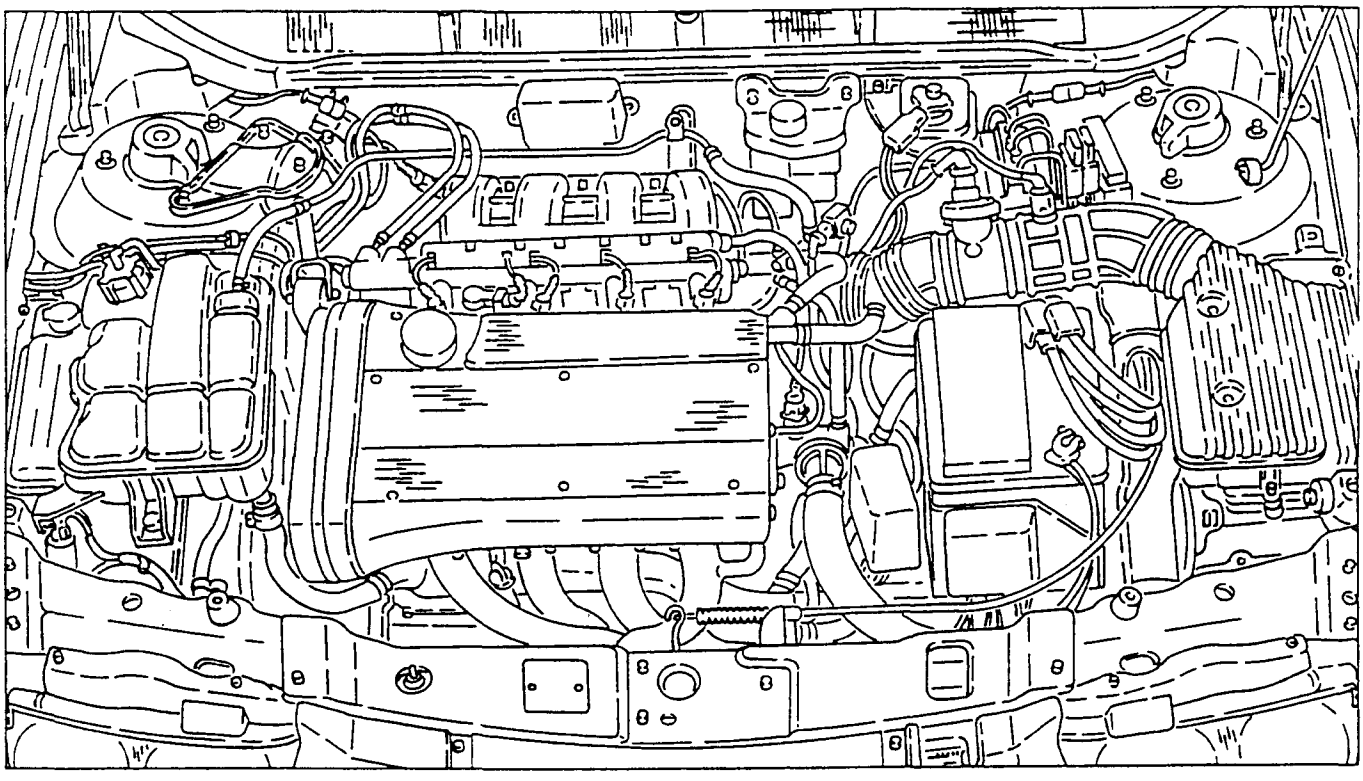
NOTE:

FOR REMOVING/REFITTING THE FRONT AND REAR SECTIONS OF THE EXHAUST PIPING REFER TO THE PROCEDURES GIVEN FOR VERSION 1929 TD BEARING IN MIND THAT THEIR CONNECTION TO THE CATALYTIC CONVERTER IS MADE BY FLANGES WITH SEALS RATHER THAN BY CLAMPS.

GENERAL DESCRIPTION

The information and illustrations given below enable the rapid removal of the engine assembly from its housing in the engine compartment and its subsequent refitting. Dis-assembly of the single components on the bench is described in the volume "ENGINE OVERHAULING".

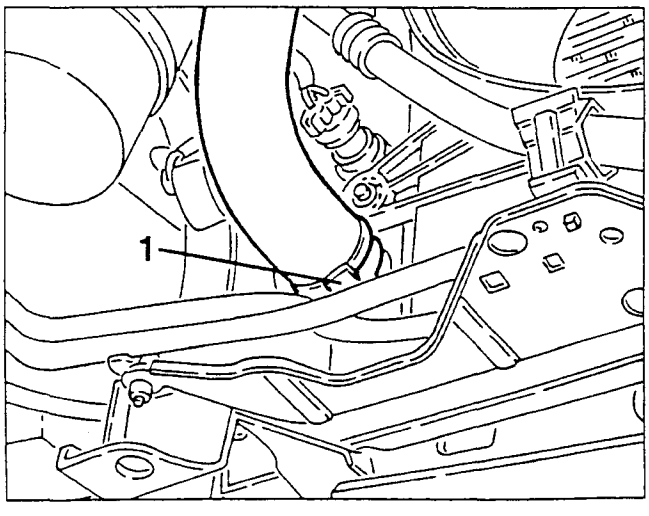
This is to be considered a single, complete procedure with the possibility of adopting only parts of it according to necessity.
For further information and details, see the chapters referring to the specific components or groups.



REMOVAL

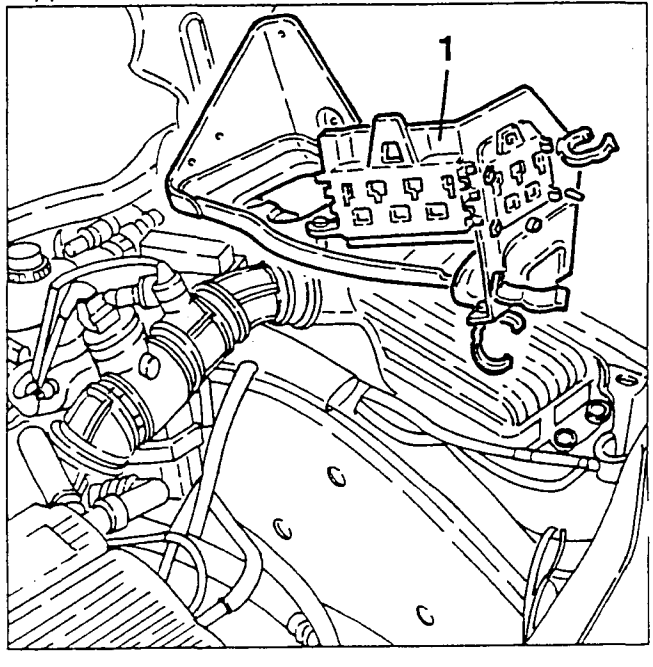
- Set the car on a 2 column lift.
- Remove the battery.
- Remove the front wheels and mud flaps.

1. Raise the car and drain the engine coolant fluid disconnecting the radiator outlet sleeve.

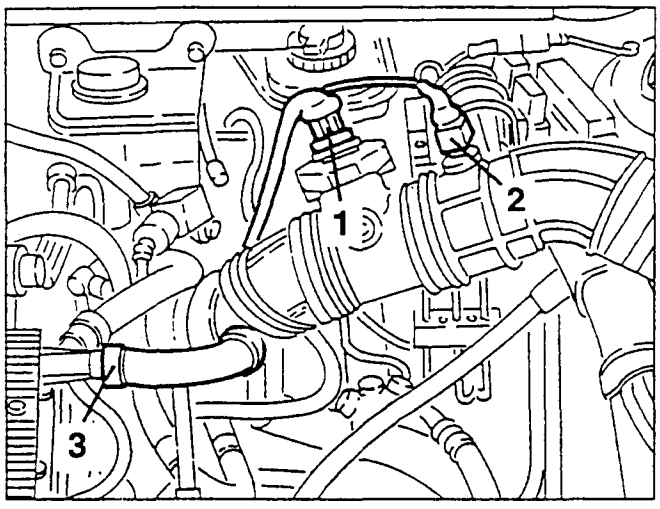


- Remove the relays from the battery support and set them to one side together with their wirings so that they do not hinder the following operations.

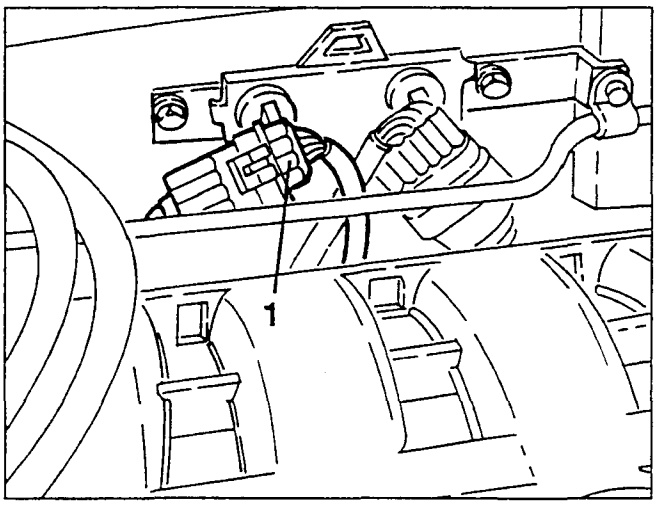
1. Slacken the fastening screws, then remove the battery support after removing it from the rear cable support bracket.



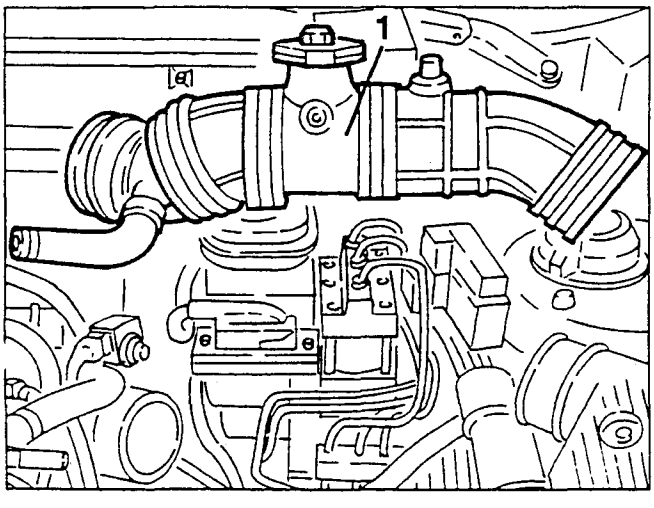
1. Disconnect the electrical connection from the air-flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor (NTC).
3. Slacken the fastening clamp and disconnect the oil recirculation pipe from the cylinder head.



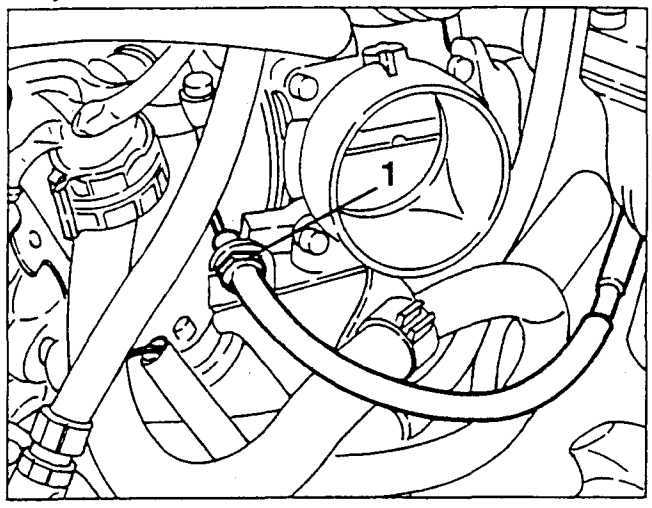
1. Disconnect the electrical connection of the lambda probe.



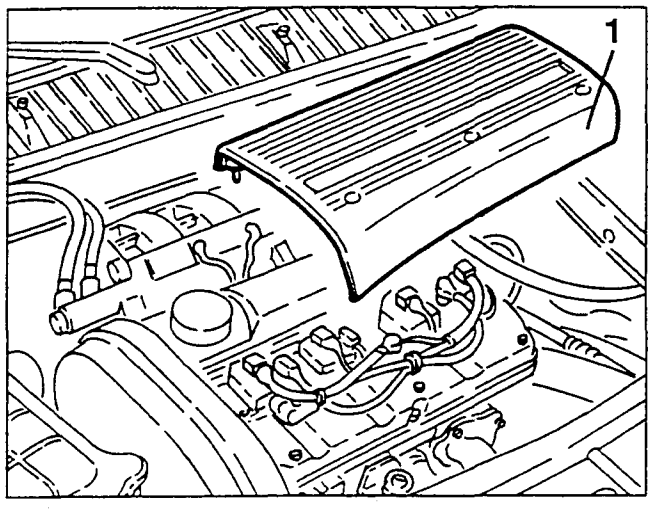
1. Slacken the fastening clamps and remove the corrugated sleeve complete.



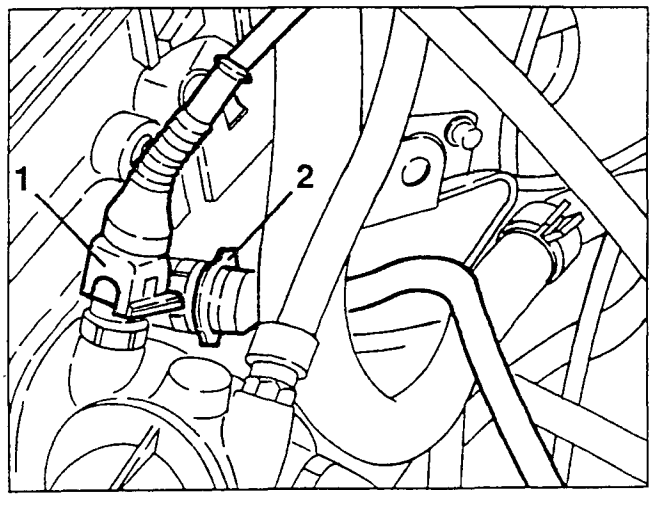
1. Disconnect the accelerator cable from the throttle body.



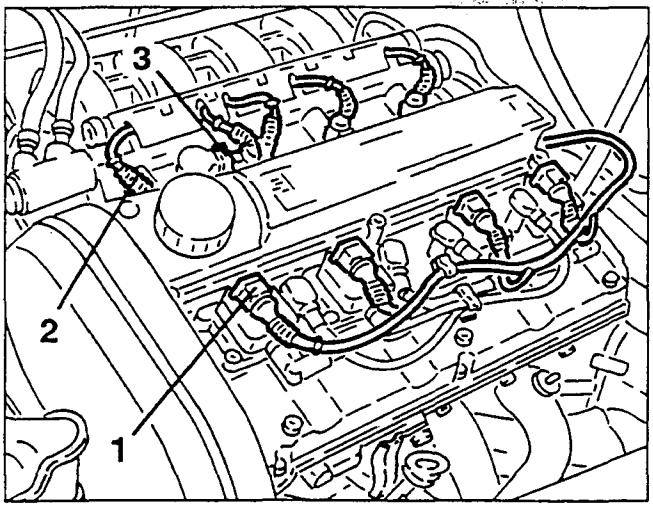
1. Slacken the fastening screws and remove the ignition coils cover.



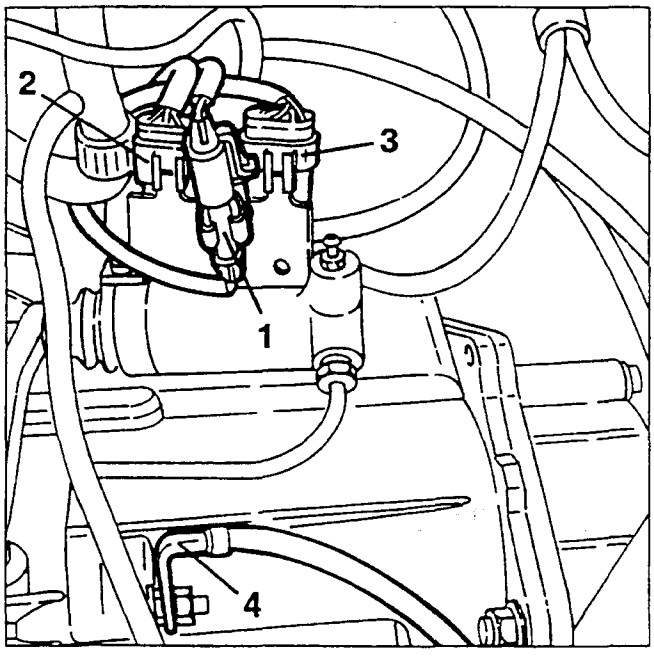
1. Disconnect the electrical connection from the engine coolant fluid temperature sensor (NTC).
2. Disconnect the electrical connection from the engine coolant temperature warning light transmitter, then move aside the wiring.



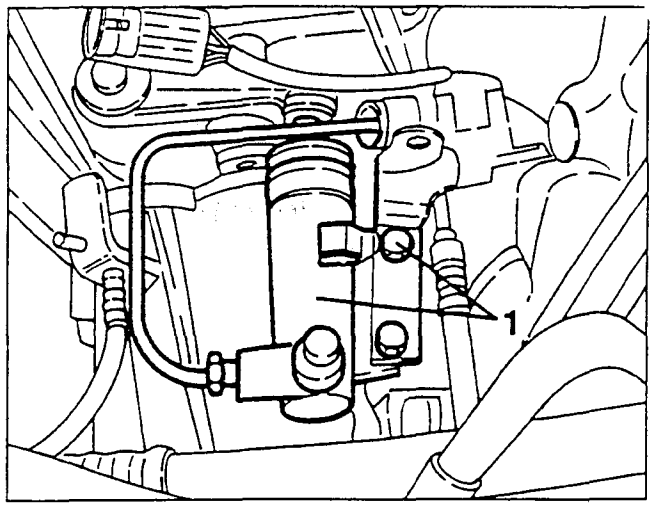
1. Disconnect the electrical connections ignition coils.
2. Disconnect the electrical connections from the electroinjectors.
3. Disconnect the electrical connection from the timing variator solenoid.
- Disconnect the earth cable from the cylinder head.



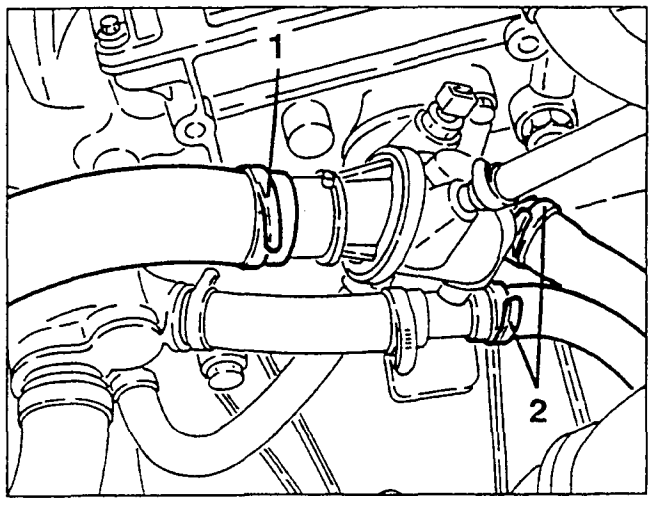
1. Disconnect the electrical connection of the starter motor.
2. Disconnect the electrical connection of the tachometric sensor.
3. Disconnect the electrical connection of the injection system.
4. Disconnect the earth cable from the gearbox cover.



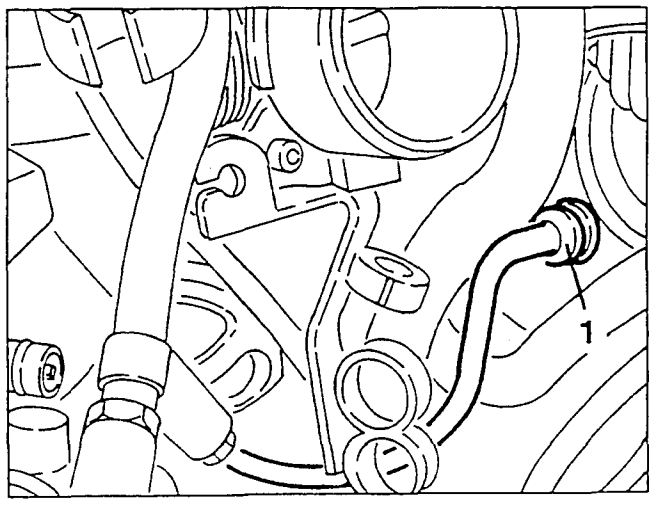
1. Slacken the fastening screws, then move the clutch control cylinder without disconnecting the pipes.



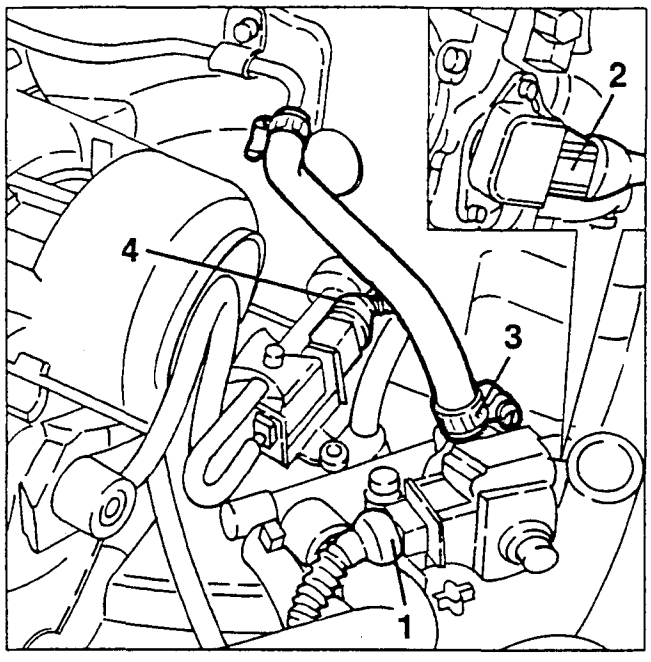
1. Disconnect the coolant fluid delivery and return pipes from the thermostatic cup to the climate control system heater and release them from the bracket.
2. Disconnect the coolant fluid delivery pipe to the radiator from the thermostatic cup.



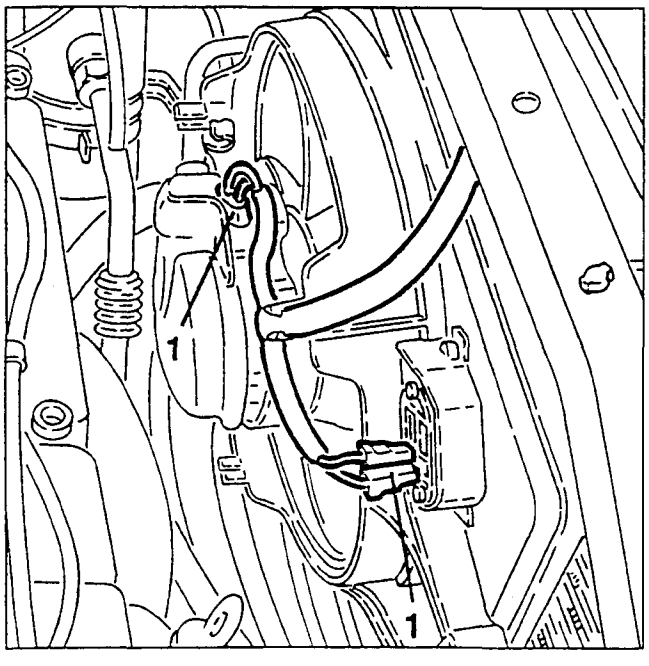
1. Disconnect the vacuum takeoff pipe from the servobrake.



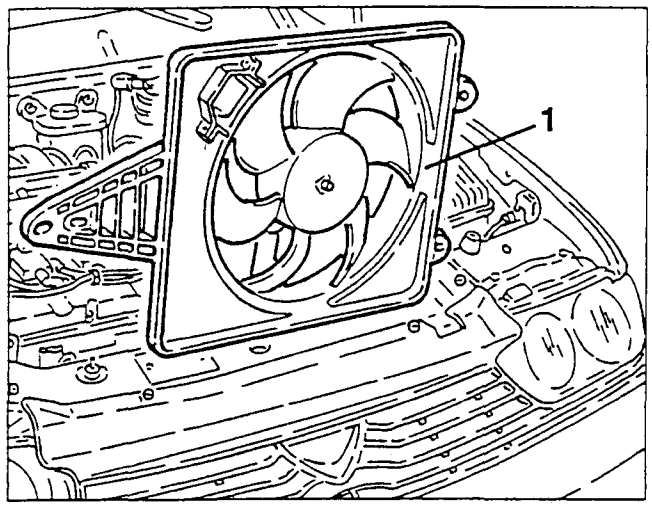
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection from the throttle potentiometer.
3. Disconnect the the coolant delivery pipe to the header tank from the throttle body.
4. Disconnect the electrical connection from the E.G.R. modulation solenoid valve.



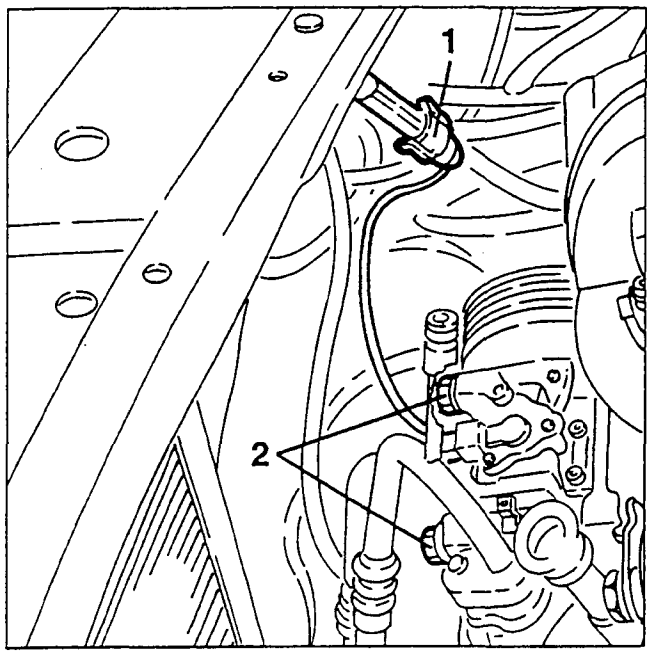
1. Disconnect the electrical connections from the cooling fan.



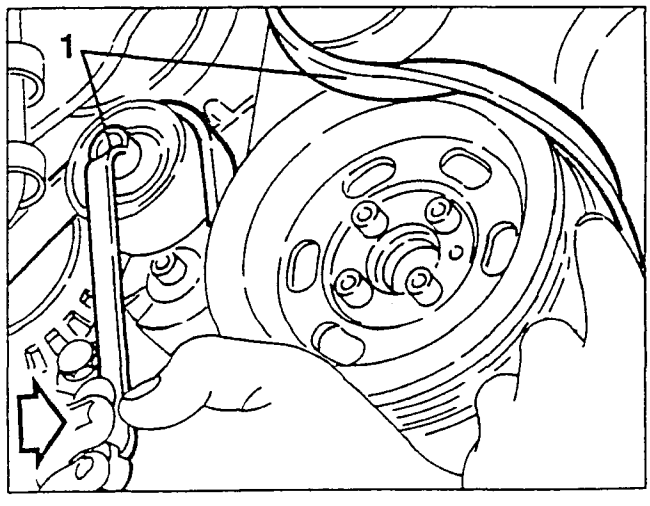
1. Slacken the fastening screws and remove the cooling fan.



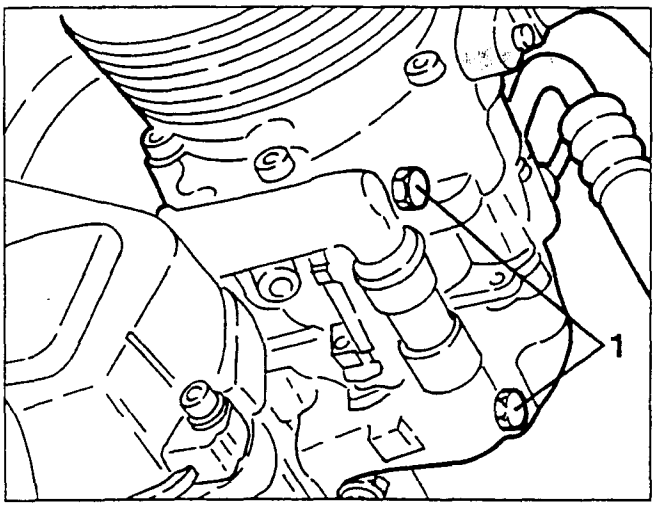
1. Disconnect the electrical connection supplying the conditioner compressor.
2. Slacken the two upper screws fastening the conditioner compressor.



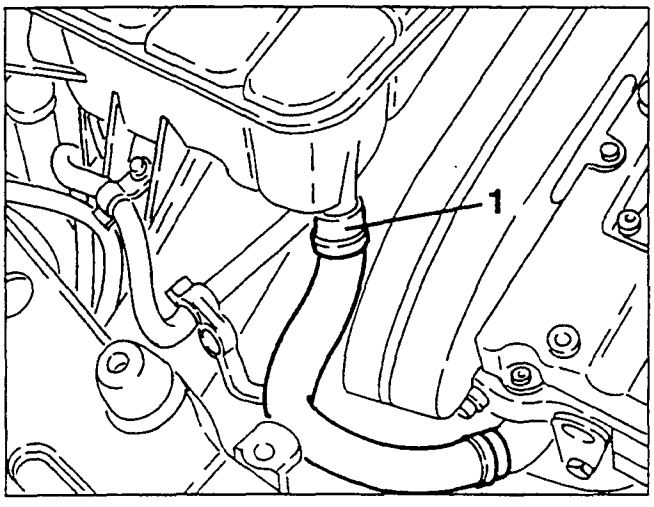
1. Raise the car and working as illustrated on the guide pulley, loosen the tension of the auxiliary components drive belt and remove it.



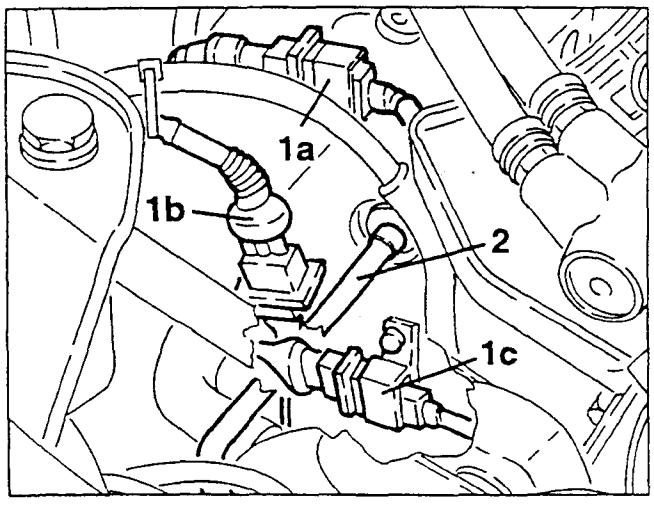
1. Slacken the two lower screws fastening the conditioner compressor, then, without disconnecting the piping, fasten it to one side to prevent hindrance in the following operations.



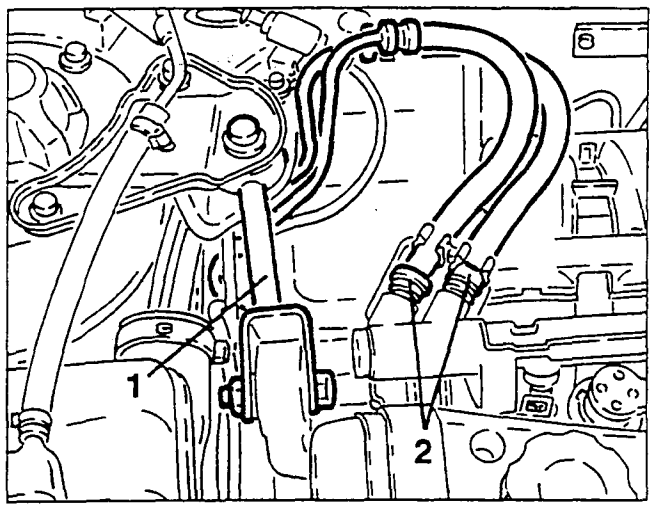
1. Lower the car and disconnect the system supply pipe from the header tank.



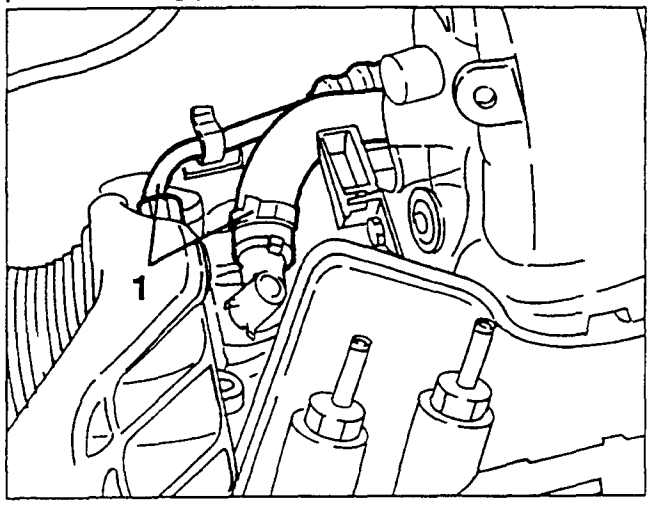
1. Disconnect the electrical connections of the timing sensor (1a), pinging sensor (1b) and rpm and timing sensor (1c).
2. Disconnect the fuel vapour recirculation pipe from the intake box.



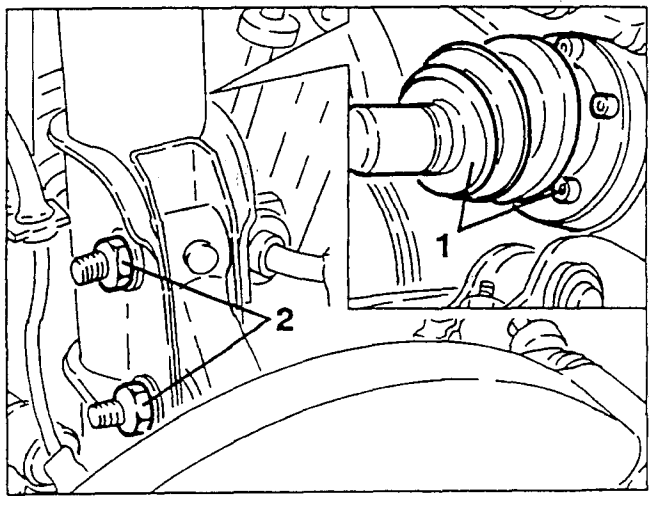
1. Slacken the fastening screws and remove the engine stay connecting rod.
2. Disconnect the fuel inlet and outlet pipes from the distributor manifold.



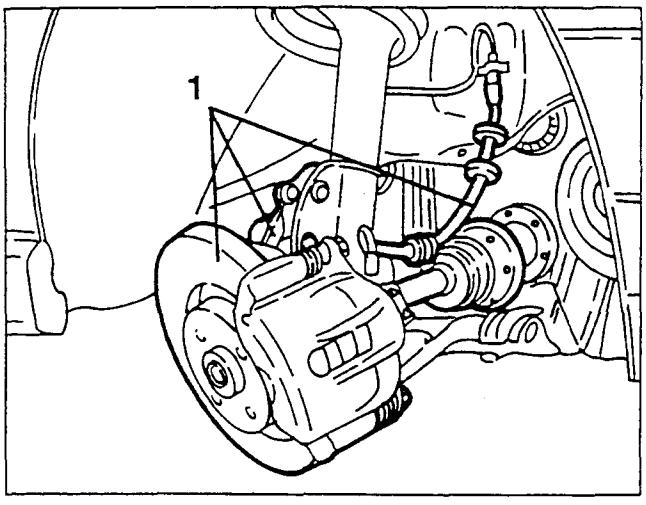
- Using a suitable syringe, drain the oil from the power steering tank.
1. Disconnect the oil inlet and delivery pipes from the power steering pump.



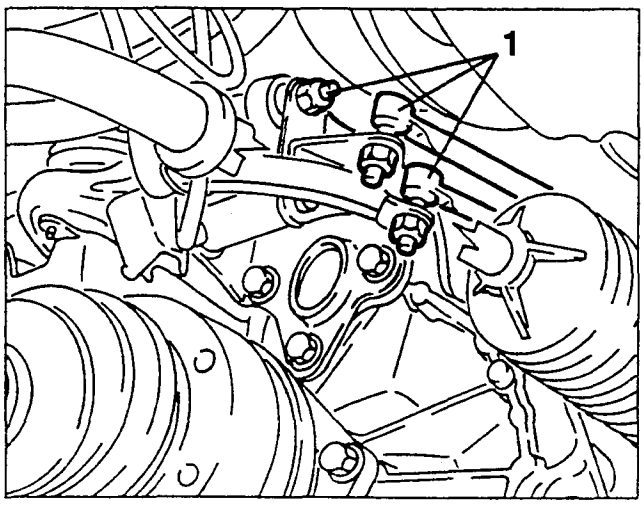
1. Raise the car, slacken the fastening bolts and disconnect the axle shafts.
2. Slacken the two bolts fastening the uprights to the shock absorbers, then remove only the upper bolt.



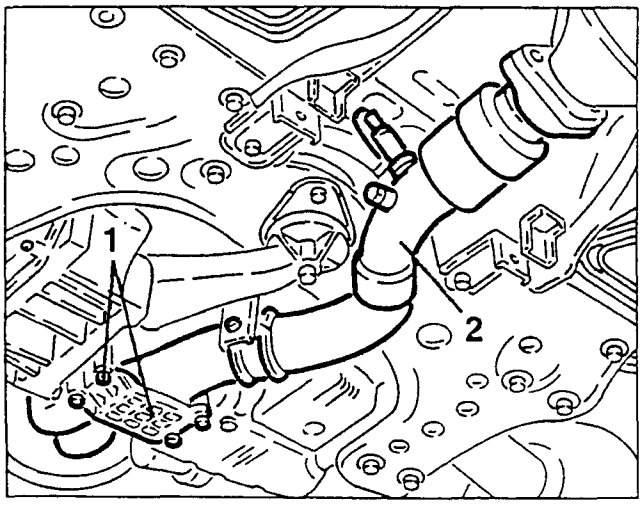
1. Release the brake pipes and A.B.S. sensor cables from their clamps, then turn the wheel hubs forwards as far as possible to move the axle shafts forwards.



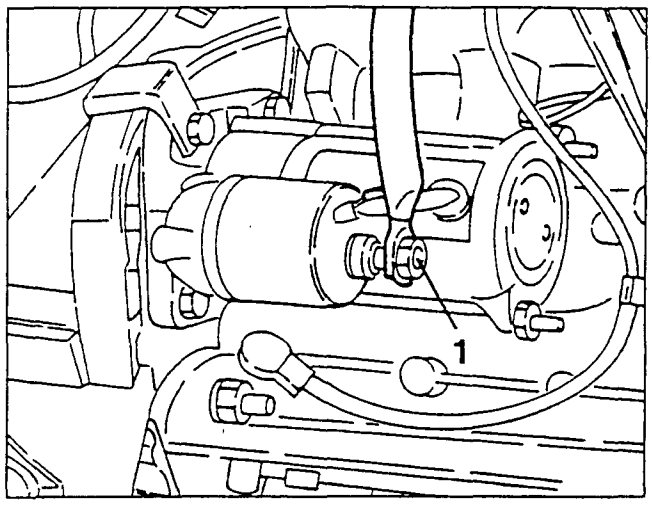
1. Working from the wheelhouse, slacken the fastening nuts and disconnect the gearshift control rods.



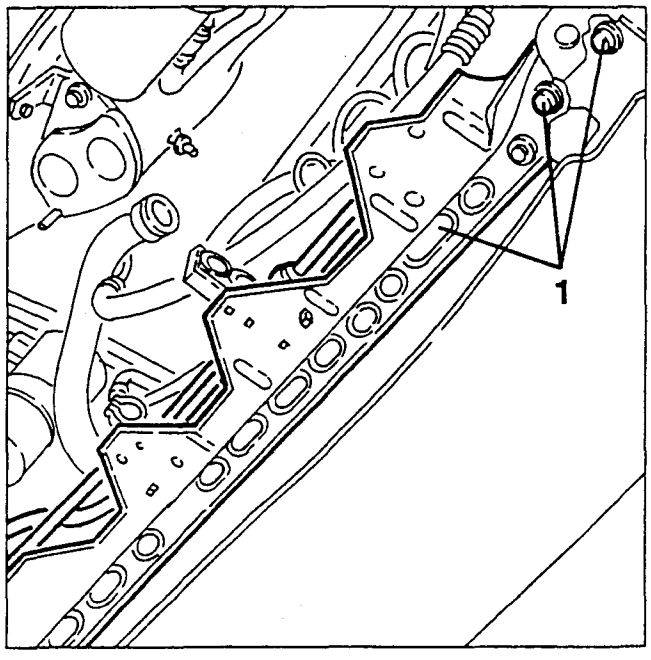
1. Slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda probe after slackening their fastenings.



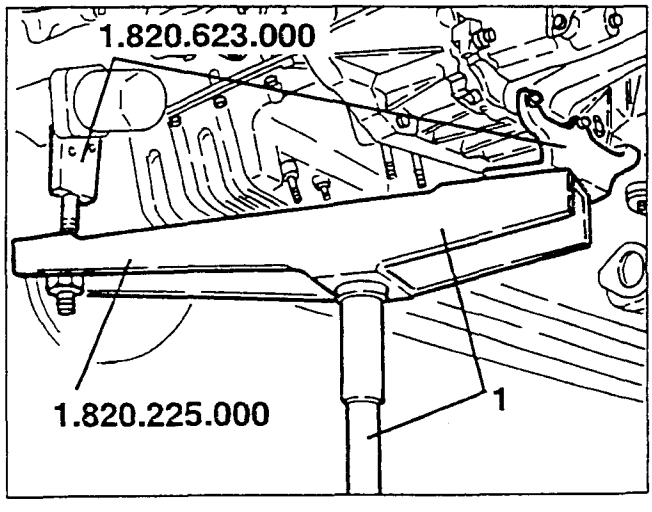
1. Disconnect the electrical connections from the starter motor.



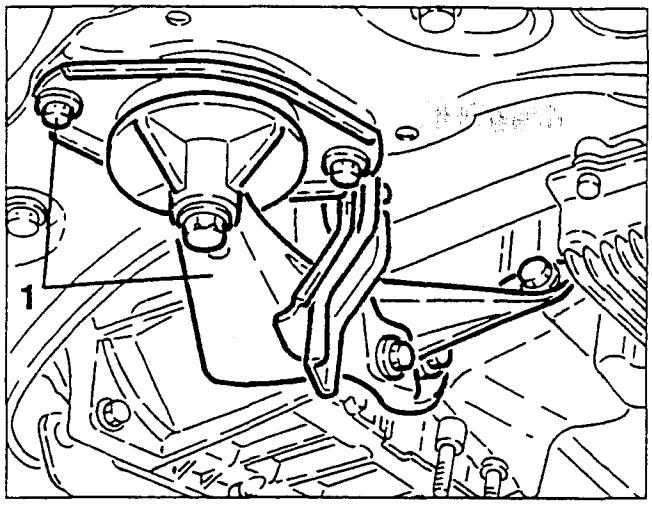
1. From the lower crossmember prise the power steering pipes, then slacken the fastening screws and remove them.



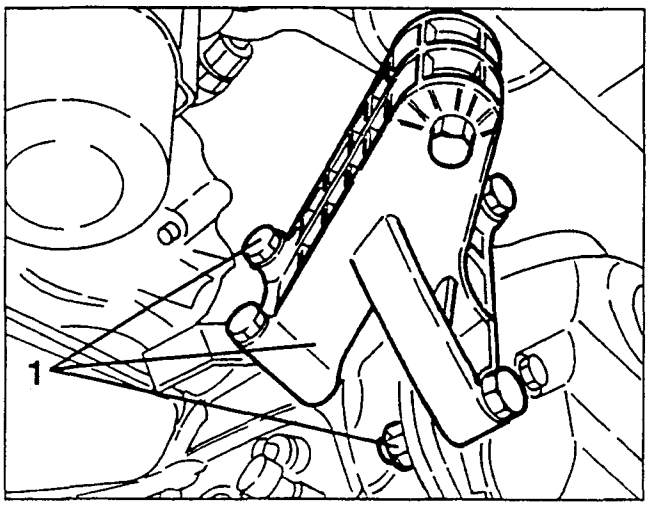
1. Position a hydraulic jack complete with tools no. 1.820.225.000 and no. 1.820.623.000 as illustrated.



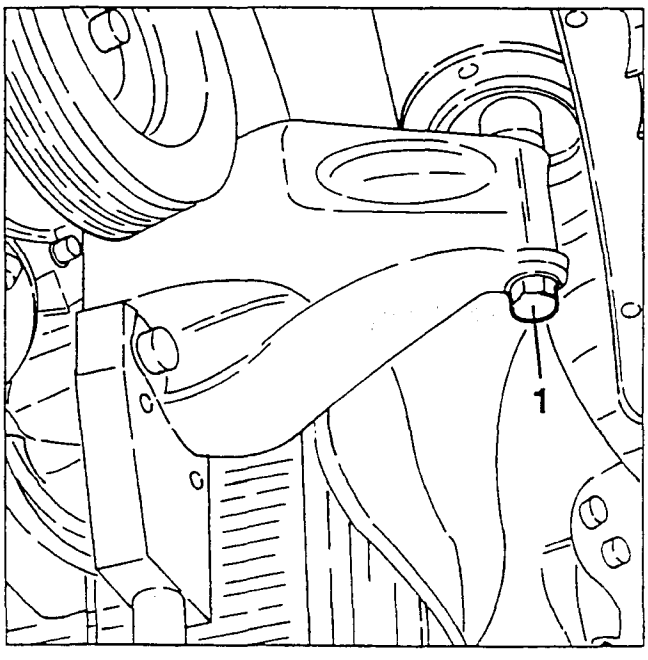
1. Slacken the fastening screws and remove the rear power unit support.



1. Slacken the fastening screws and bolts and remove the gearbox side power unit support.

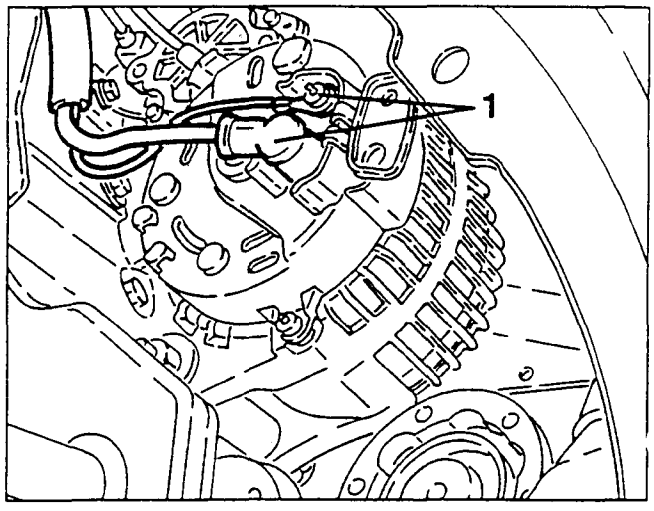


1. Slacken the screw fastening the camshaft side power unit support.

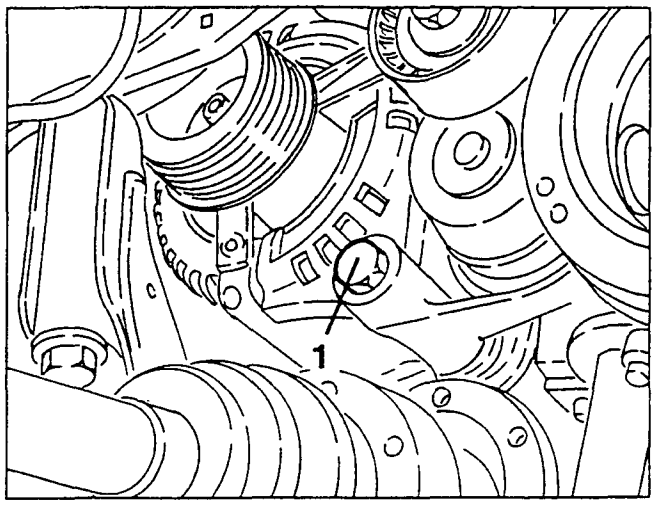


- Lower the power unit just enough with a hydraulic jack to be able to remove the alternator, proceeding as described below:

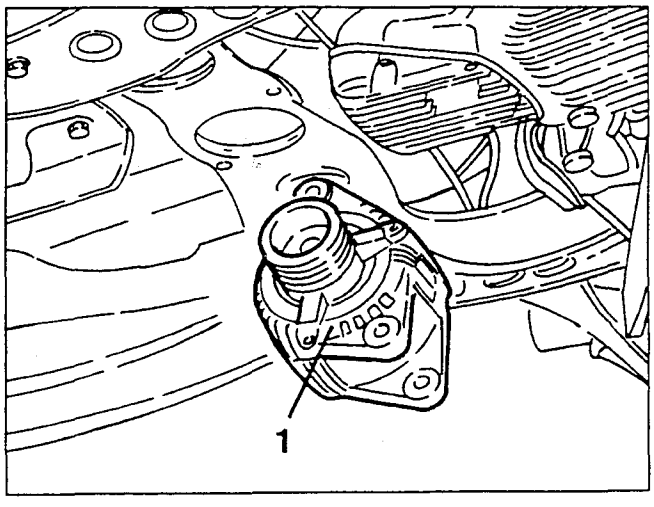
1. Disconnect the electrical connections of the alternator.



1. Slacken the two bolts fastening the alternator to the support bracket.



1. Remove the alternator withdrawing it from under the car as illustrated.



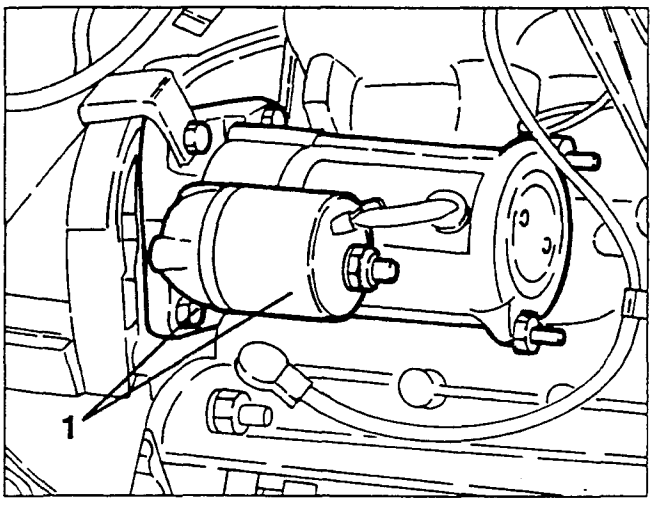
- Lower the hydraulic jack and remove the power unit from the engine compartment.

WARNING:
The hydraulic jack must have a capacity of at least 1000 kg.

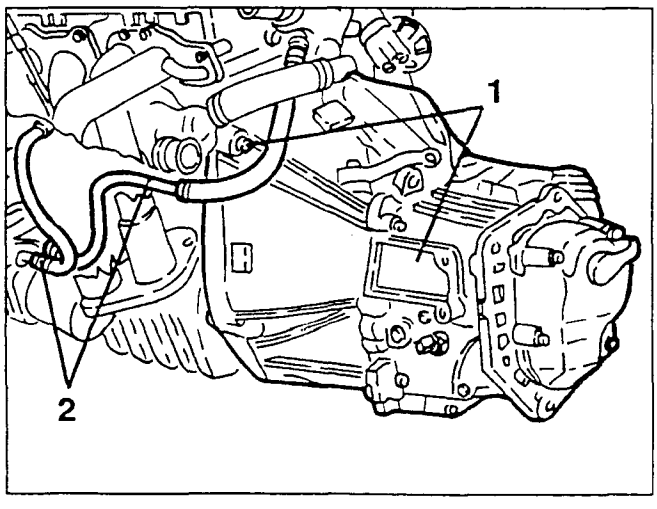
- Support the power unit with a hydraulic hoist besides the hydraulic jack used for removal.

WARNING:
For moving the power unit, use a hydraulic hoist after freeing it from the hydraulic jack.

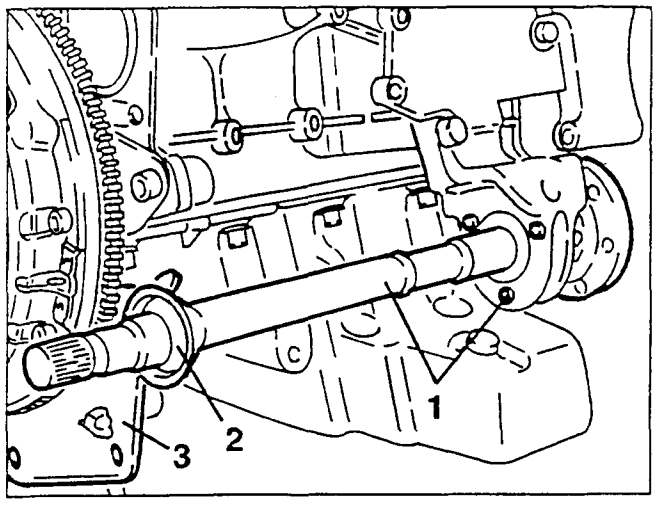
- Release the power unit from the support tools then position it on a suitable workbench.
1. Slacken the fastening screws and remove the starter motor.



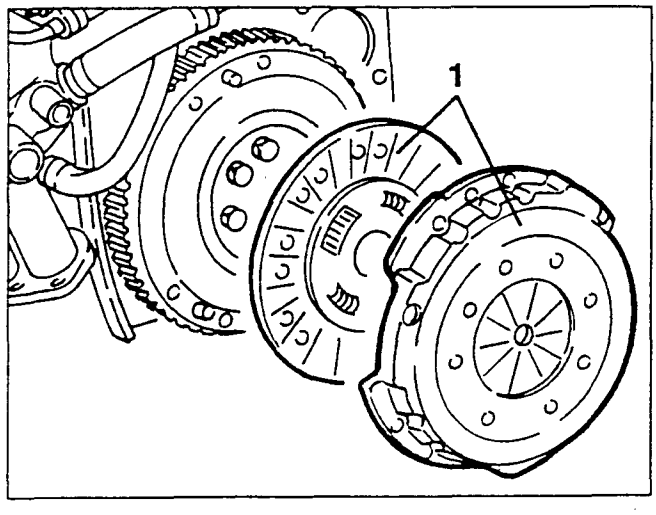
1. Slacken the fastening screws and nuts and remove the gearbox and differential unit.
2. Remove the two heat exchanger coolant delivery and return pipes.



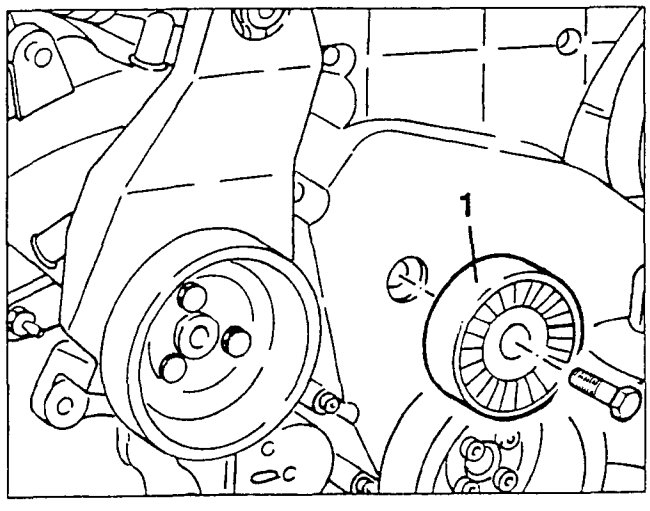
1. Slacken the three fastening screws and remove the lay shaft.
2. Remove the dust guard ring.
3. Remove the lower flywheel cover.



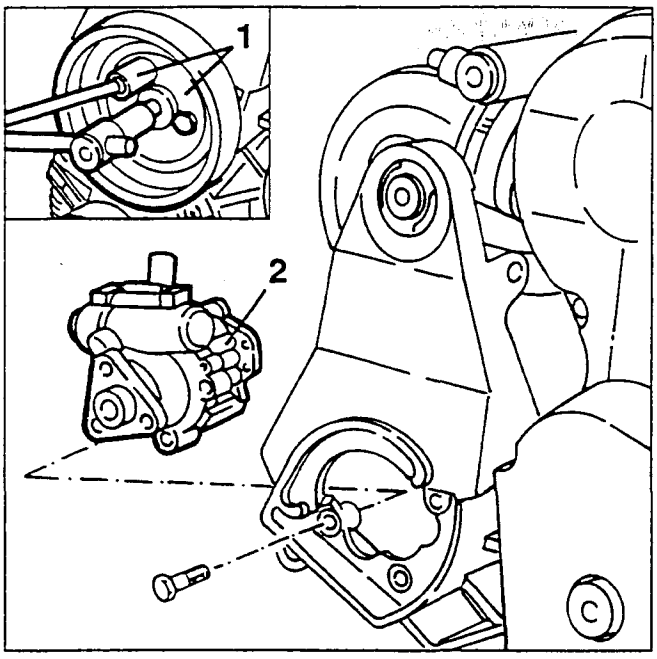
1. Slacken the fastening screws and remove the pressure plate body and clutch plate.



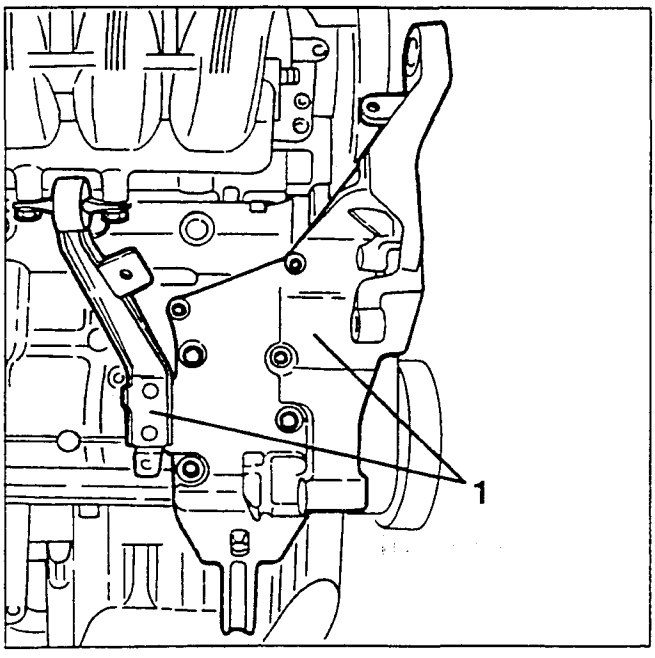
1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.



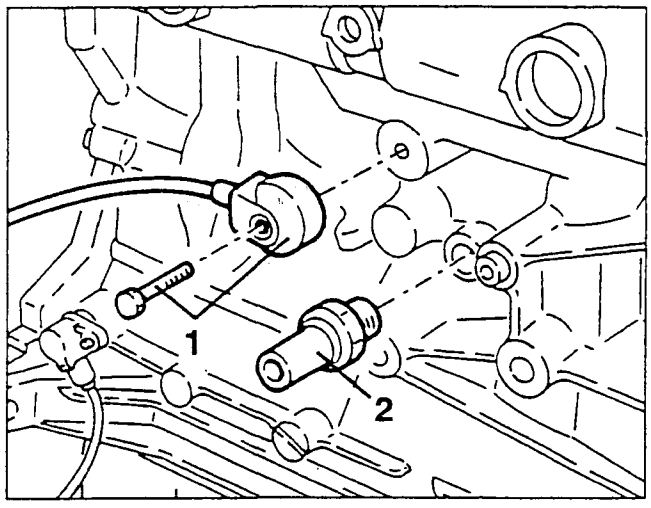
1. Using a 3/8" Allen wrench as counter torque, slacken the three fastening screws and remove the power steering pump pulley.
2. Slacken the three fastening screws and remove the power steering pump.



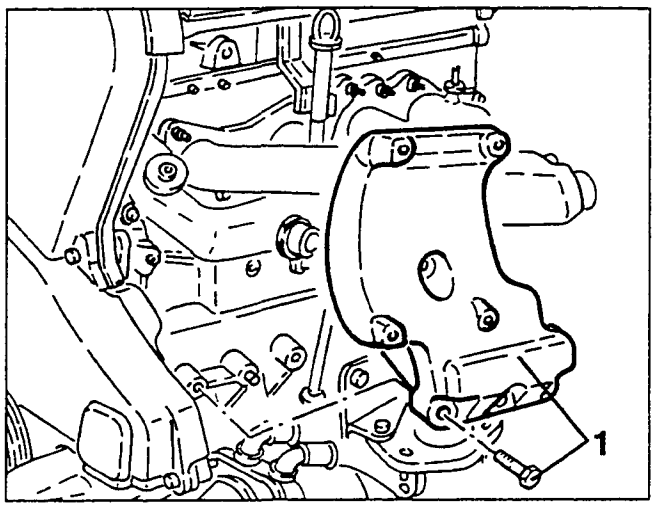
1. Slacken the fastening screws and remove the power steering pump support and alternator complete with intake box support.



1. Slacken the fastening screw and remove the pinging sensor from the crankcase.
2. Slacken and remove the engine oil pressure meter.



1. Slacken the four fastening screws and remove the air conditioning compressor support.



REFITTING

Reverse the sequence of the operations followed for removal, observing the following instructions:
- Prepare the engine compartment to accommodate the power unit, arranging all the electric cables, pipes, etc. so that they do not interfere with refitting operations.

WARNING:
Make sure that the power unit supporting points have been fastened correctly.

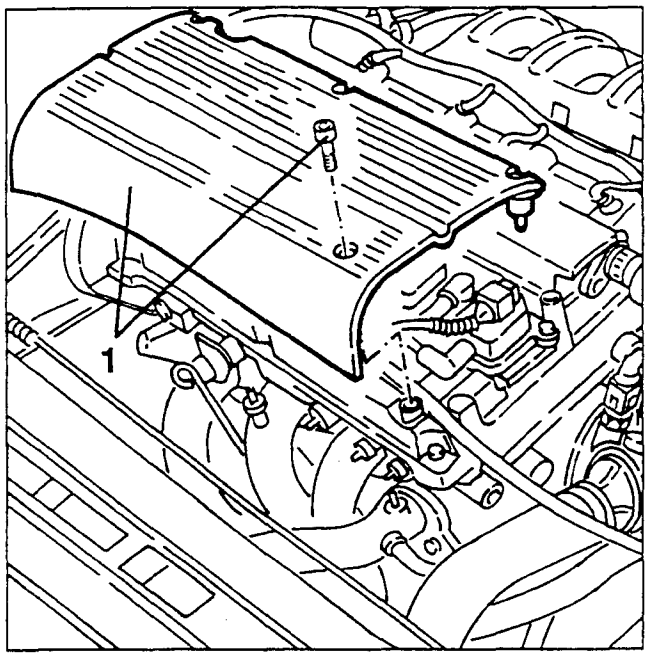
- After assembly, check the correct tensioning of the belts, fill the various systems as specified (see GROUP 00).
- Carry out all the necessary checks and operations (see GROUP 00).

CYLINDER HEAD

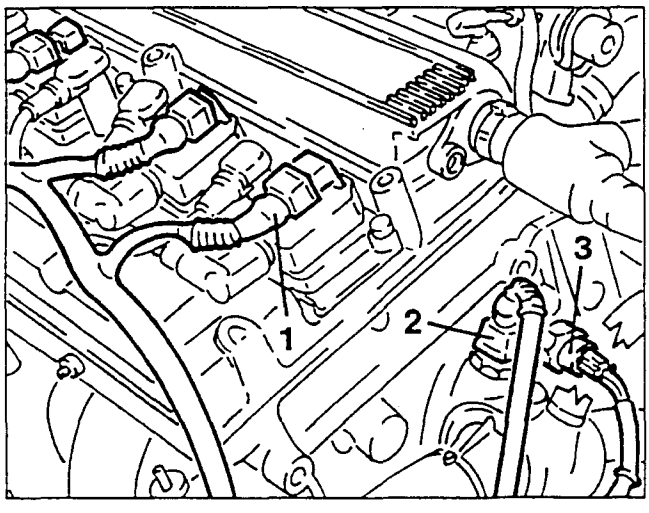
REMOVING/REFITTING

- Follow the first steps of the procedure "REMOVING/REFITTING ENGINE" up to removal of the corrugated sleeve.

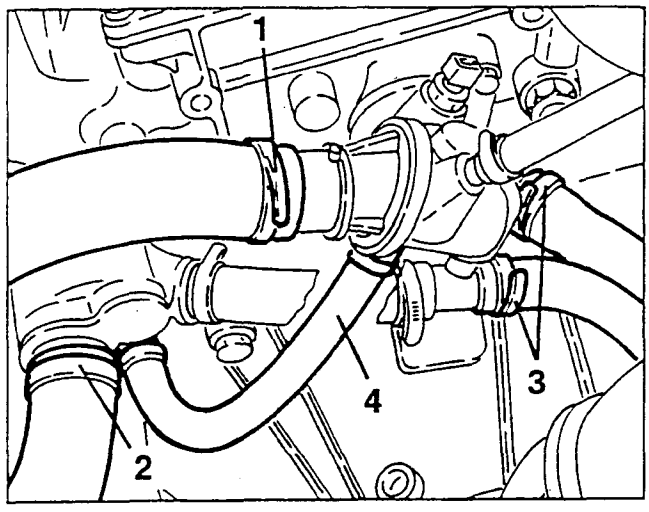
1. Slacken the fastening screws and remove the ignition coils cover.



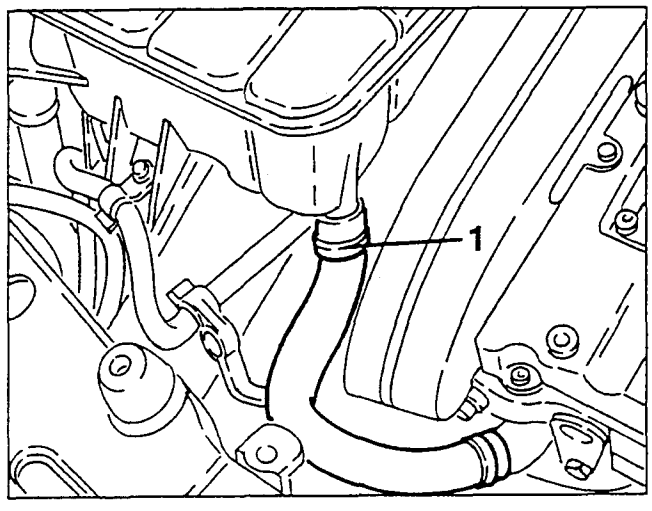
1. Disconnect the electrical connections from the ignition coils.
2. Disconnect the electrical connection from the coolant temperature sensor.
3. Disconnect the electrical connection from the engine coolant temperature gauge transmitter and maximum temperature warning light contact.



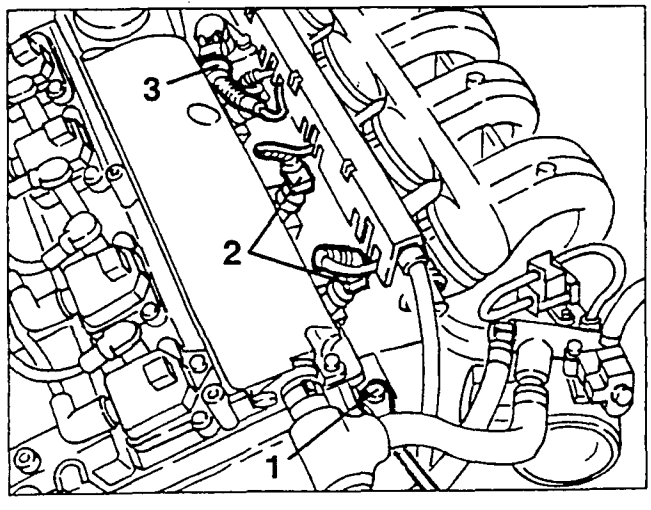
1. Disconnect the coolant delivery sleeve to the radiator from the thermostatic cup.
2. Disconnect the return sleeve from the radiator from the coolant return manifold to the pump.
3. Disconnect the coolant delivery and return pipe for the climate control unit heater from the thermostatic cup.
4. Disconnect the coolant delivery pipe to the heat exchanger for the engine lubrication circuit from the thermostatic cup.



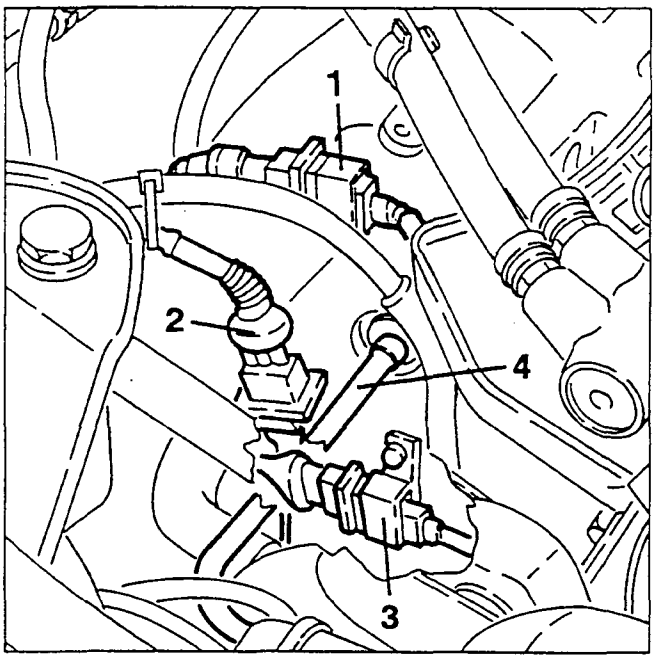
1. Disconnect the system supply pipe from the header tank.



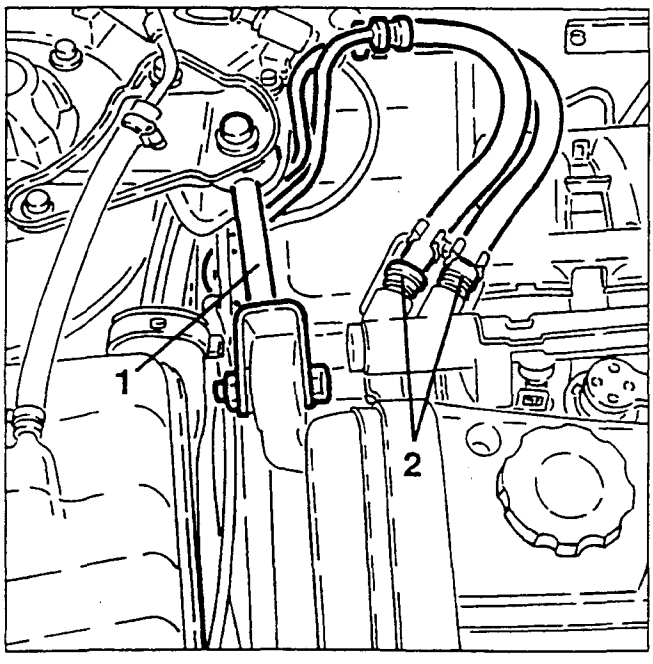
1. Disconnect the earth cable from the cylinder head.
2. Disconnect the electrical connections from the injectors.
3. Disconnect the electrical connection from the timing variator and move the associated wiring to one side.



1. Disconnect the electrical connection of the timing sensor.
2. Disconnect the electrical connection pinging sensor.
3. Disconnect the electrical connection timing and rpm sensor.
4. Disconnect the fuel vapour recirculation pipes from the air intake box.

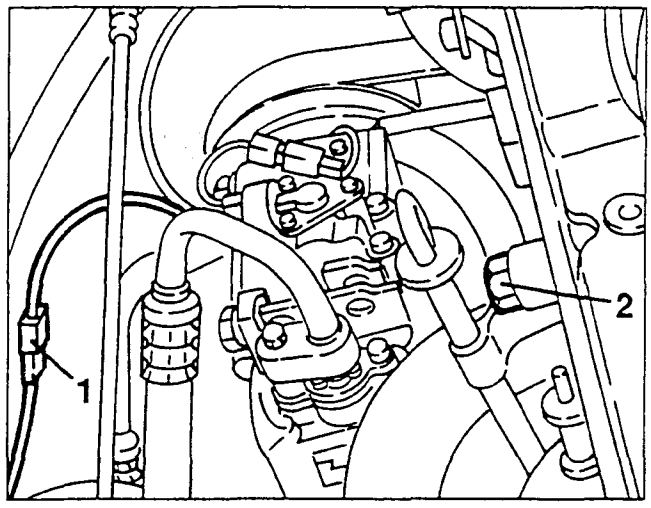


1. Slacken the fastening screws and remove the engine stay connecting rod.
2. Disconnect the fuel inlet and outlet pipes from the distributor manifold.

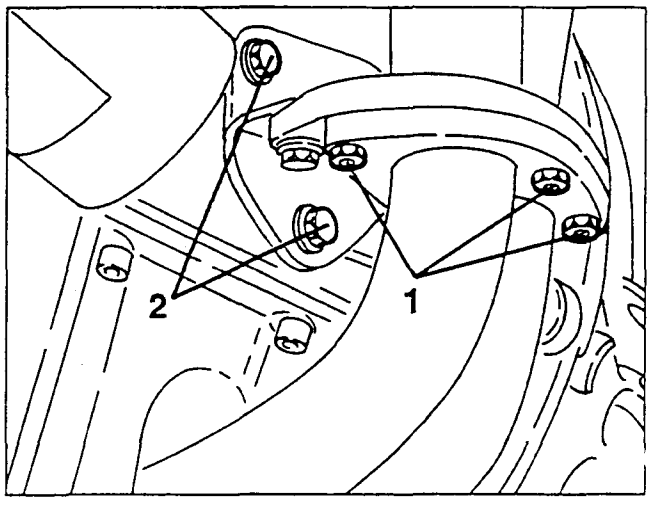


1. Disconnect the intermediate electrical connection from the air conditioning system compressor.

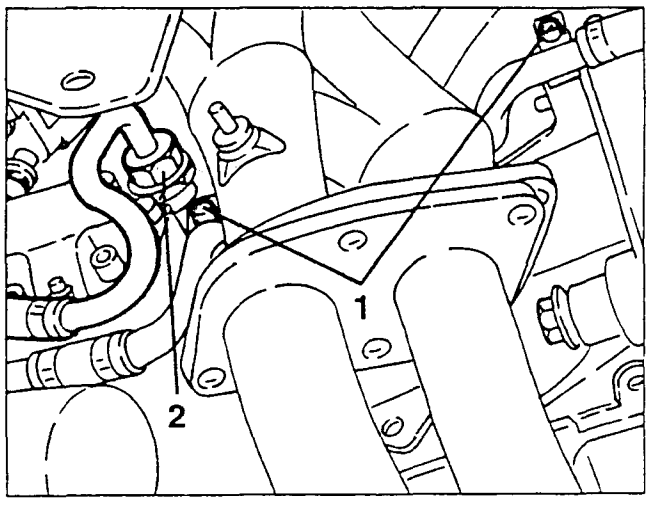
2. Slacken the engine oil dipstick fastening screw.



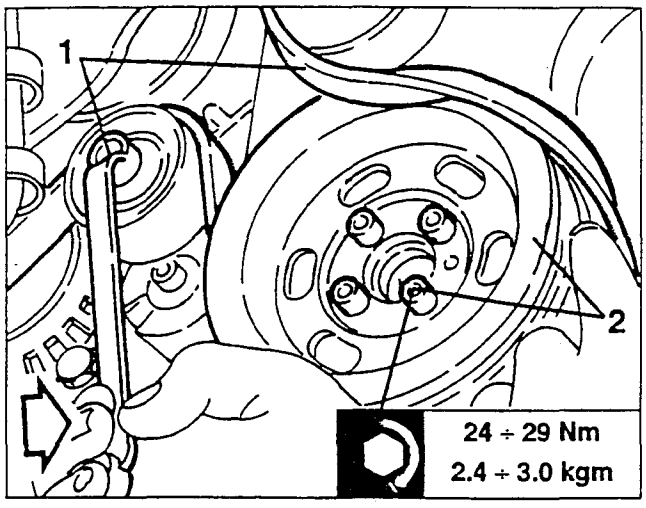
1. Raise the car and slacken the bolts fastening the front section of the exhaust pipe to the manifolds.
2. Slacken the screws fastening the exhaust manifold support bracket to the crankcase.



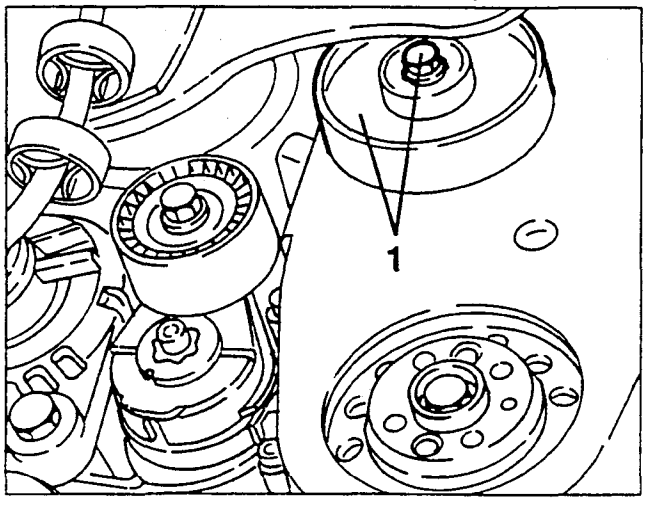
1. Slacken the two screws fastening the coolant delivery pipe to the heat exchanger.
2. Disconnect the coolant outlet pipe from the heat exchanger.



1. Working as illustrated on the guide pulley, loosen the tension of the auxiliary components drive belt and prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.

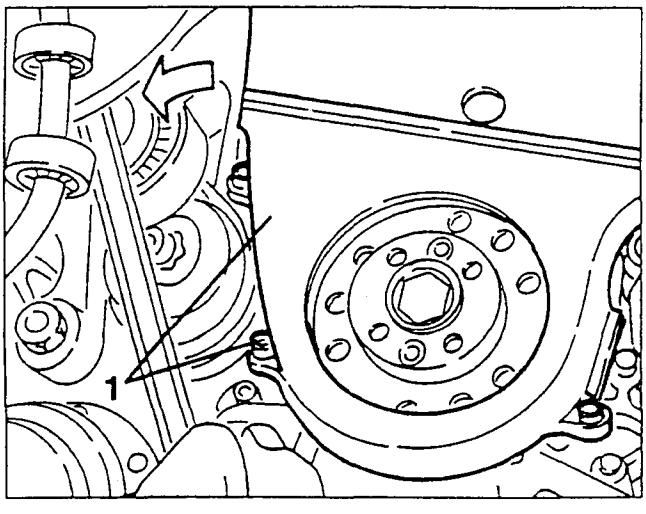


1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.

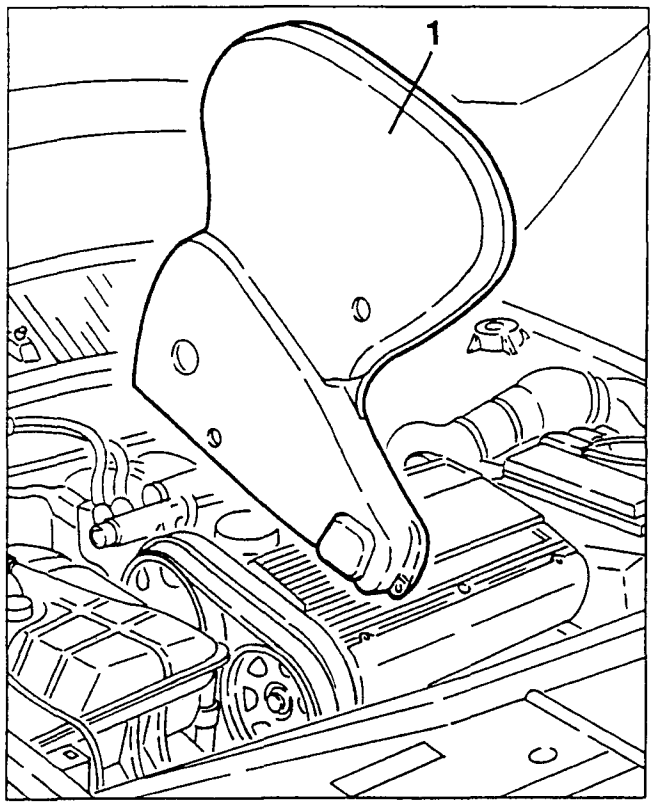


1. Slacken the fastening screws and remove the lower cover of the timing belts and counter-rotating shafts.

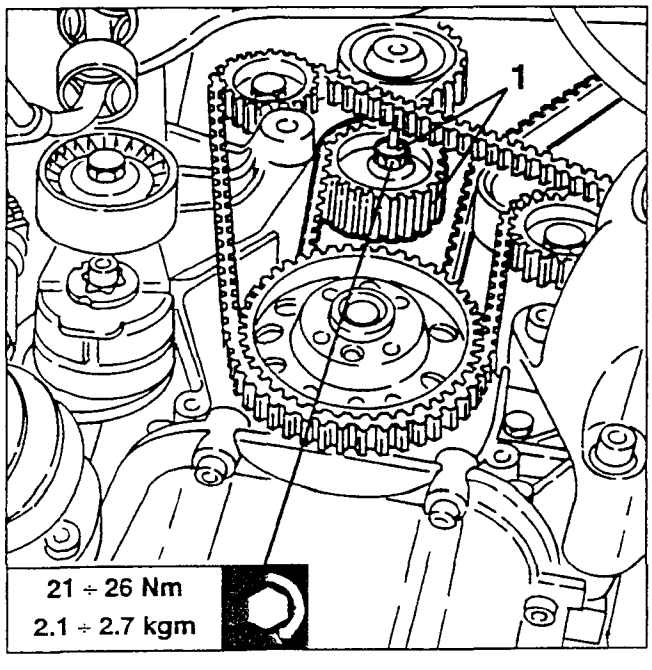
NOTE: To gain access to the rear screw, turn the belt tensioner as illustrated.



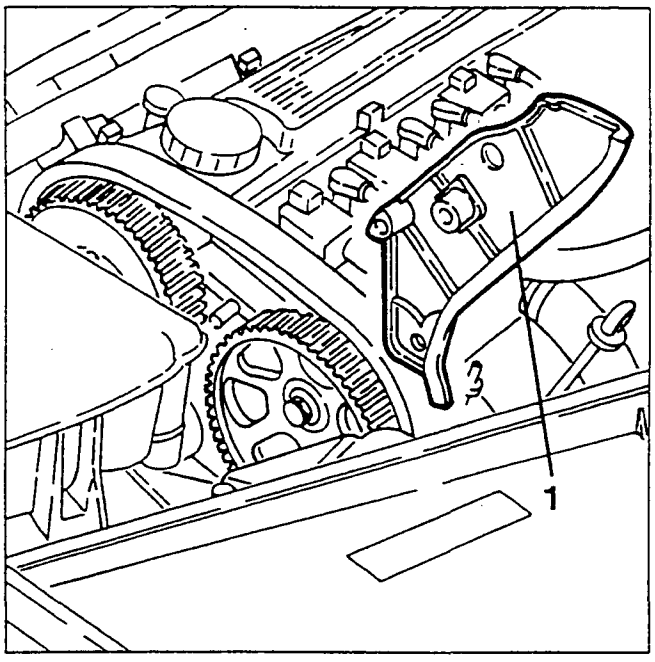
- Slacken the lower screws of the upper cover for the timing gear and counter-rotating shafts drive belts.
1. Lower the car, slacken the remaining fastening screws and remove the upper cover.



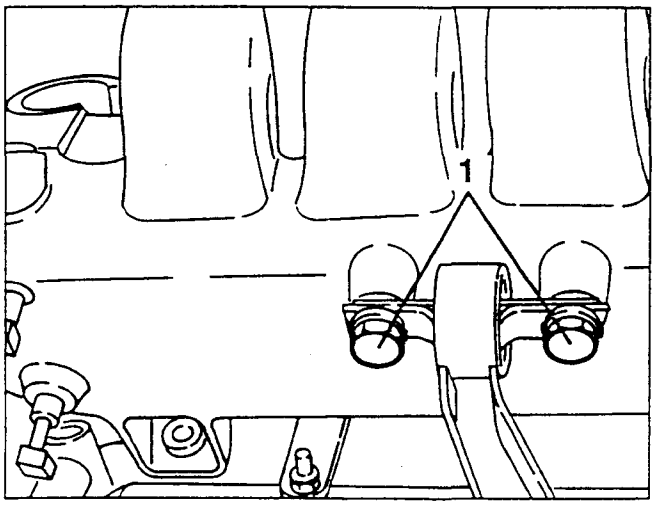
1. Working on the timing gear belt tensioner, loosen the tension of the belt, then prise it off the camshaft driving pulleys.



1. Slacken the fastening screws and remove the two timing gear belt side covers.

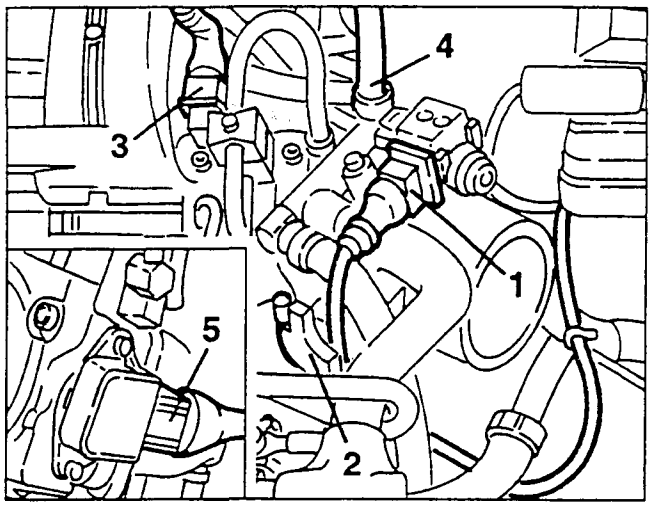


- Remove the bracket connecting the cylinder head to the engine stay rod support.
1. Raise the car and slacken the two screws fastening the support to the intake box.

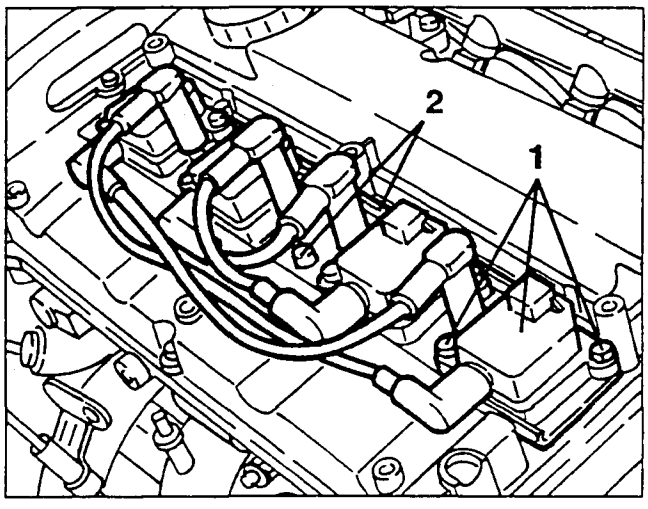


- Disconnect the vacuum takeoff pipe from the servo-brake.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the accelerator cable from the throttle body.
3. Disconnect the electrical connection from the E.G.R. modulation solenoid valve.
4. Disconnect the coolant fluid delivery pipe to the header tank from the throttle body.

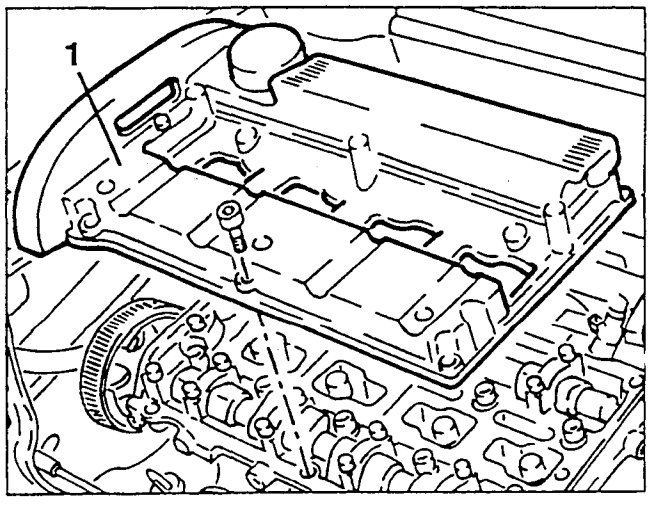
5. Disconnect the electrical connextion from the throttle potentiometer.



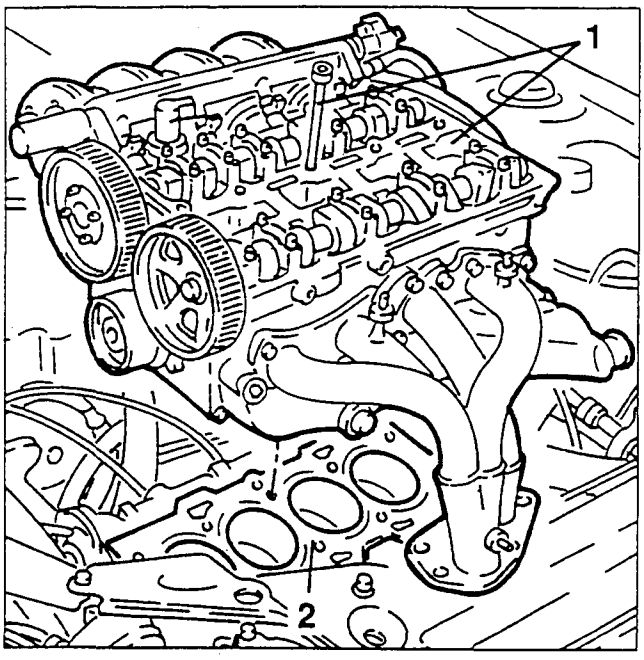
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



- Disconnect the oil vapour recovery pipe from the cylinder head.
1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.



1. Slacken the cylinder head fastening screws and remove it.
2. Remove the gasket.



- Strip down the cylinder head and overhaul as described in the volume "OVERHAULING - ENGINES".

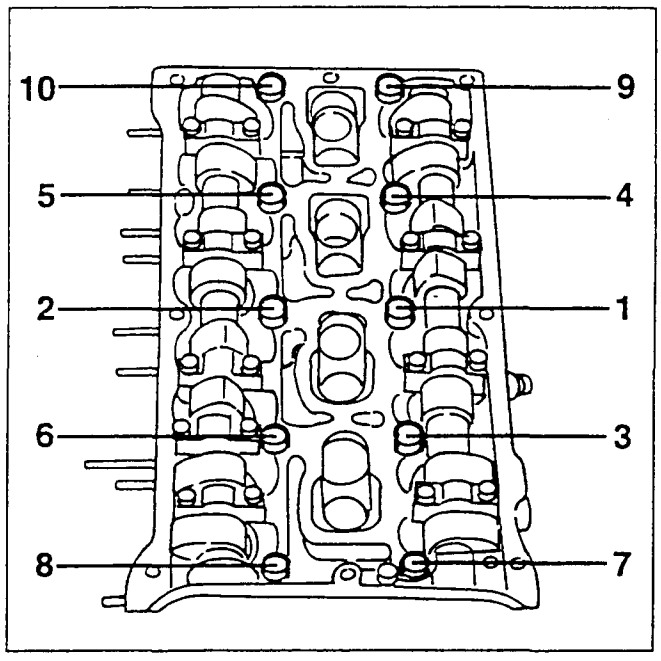
Re-assemble the cylinder head reversing the sequence described for removal and following the instructions given below.
- Turn the crankshaft to move the pistons of the 1st and 4th cylinder to the T.D.C.
- Position a new gasket on the cylinder head.

NOTE: The cylinder head gasket is in aramidic fibre and cylinder head retightening is unnecessary throughout the life of the engine.

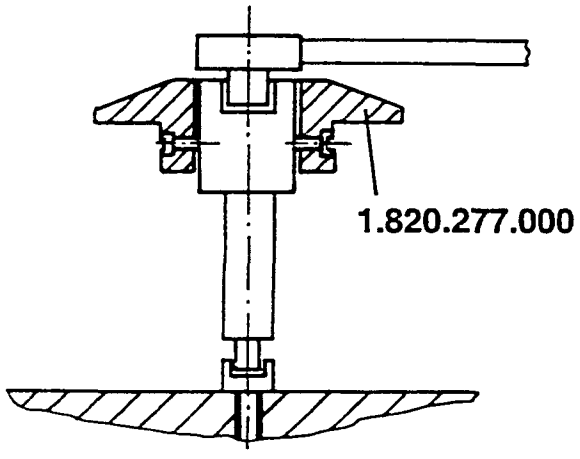
WARNING: Before assembly, accurately clean the cylinder head and crankcase surfaces.

- Assemble the complete cylinder head on the crankcase.
- Tighten the cylinder head fastening screws as described below and bearing in mind that, for each step, the tightening sequence is the one illustrated.

Tightening procedure	
Set in all the screws to a torque of:	20 Nm (2.0 kgm)
Tighten the screws to the preliminary torque of:	40 Nm (4.1 kgm)
Turn all the screws with an angle of:	90° + 90° + 90°



- For angle tightening use graduated disk no. 1.820.277.000 as illustrated.



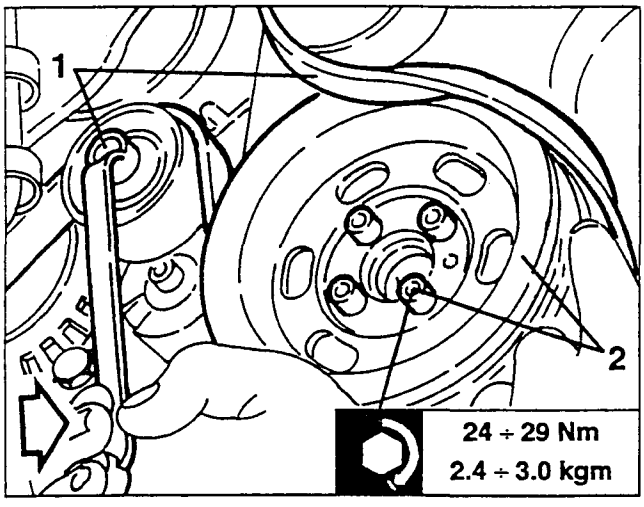
For re-assembly of the timing gear drive belt and timing and for assembly of the auxiliary components drive belt see GROUP 00.

OIL SUMP

REMOVAL/REFITTING

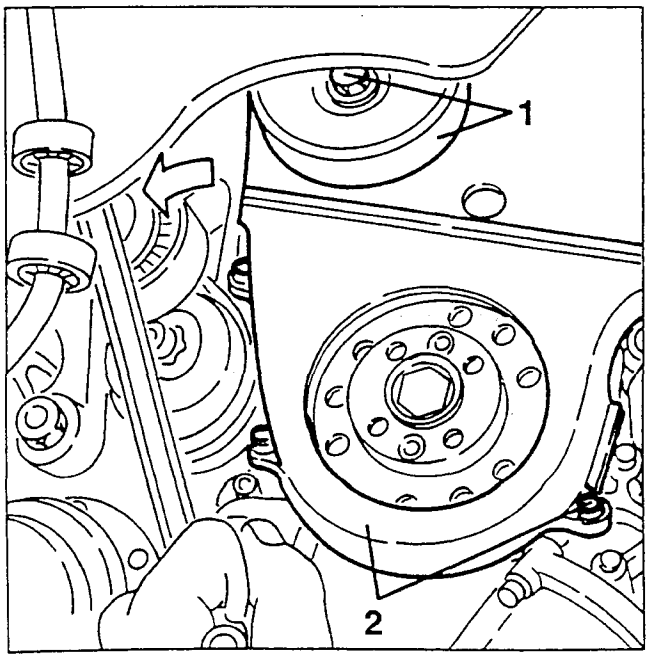
- Set the car on a lift.
- Drain the engine oil (see GROUP 00).
- Remove the right front wheel and mud flap.

1. Raise the car and working as illustrated on the belt tensioner, loosen the tension of the auxiliary components drive belt prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.



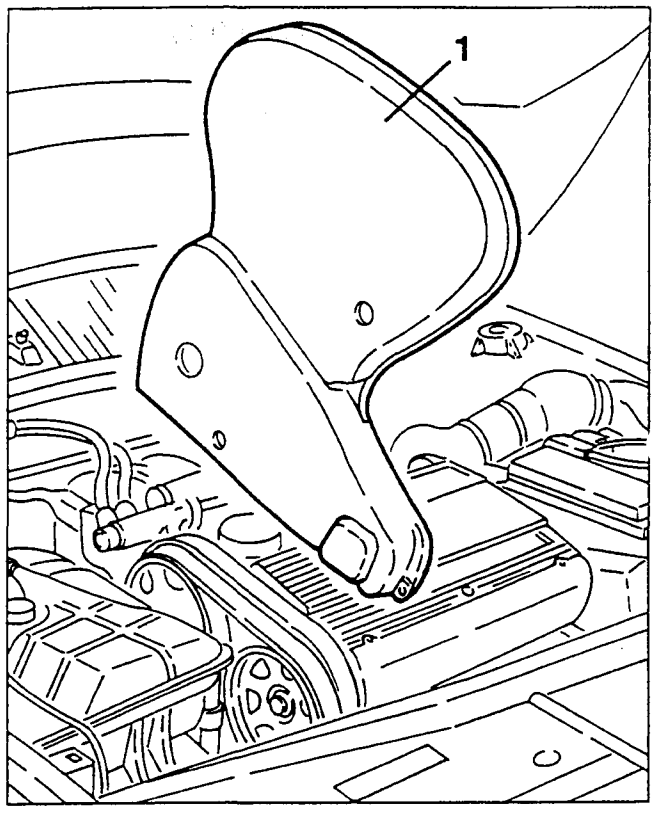
1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.
2. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft belts.

NOTE: To gain access to the rear screw, turn the belt tensioner as illustrated.



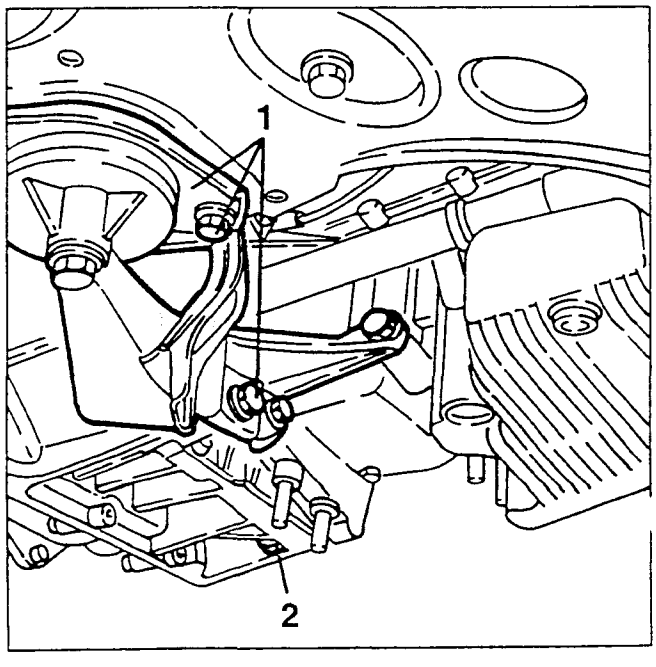
- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft belts.

1. Lower the car, slacken the remaining fastening screws and remove the upper cover.

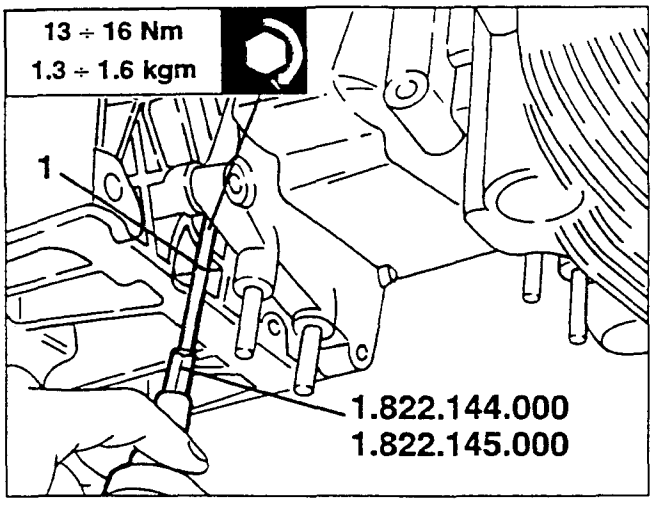


- Remove the front section of the exhaust pipe.
- Position a hydraulic jack under the gearbox.

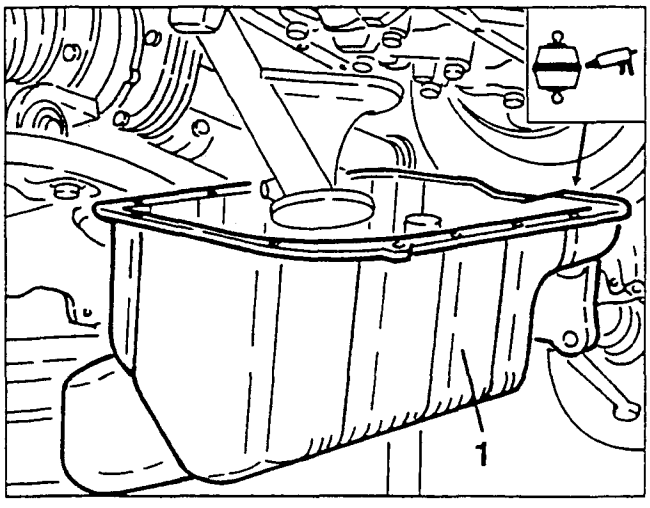
1. Slacken the fastening screws and remove the power unit rear support.
2. Slacken the screws fastening the gearbox to the oil sump.



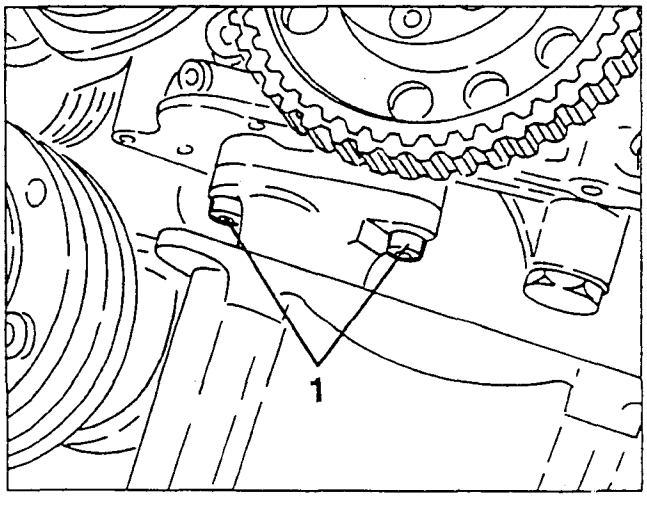
1. Slacken the oil sump fastening screws using tools no. 1.822.144.000 and no. 1.822.145.000 for those to which access is not possible.



1. Lower the hydraulic jack as required and remove the oil sump.



NOTE: if difficulty is encountered in removing the oil sump, slacken the fastening screws (1) of the suction device.



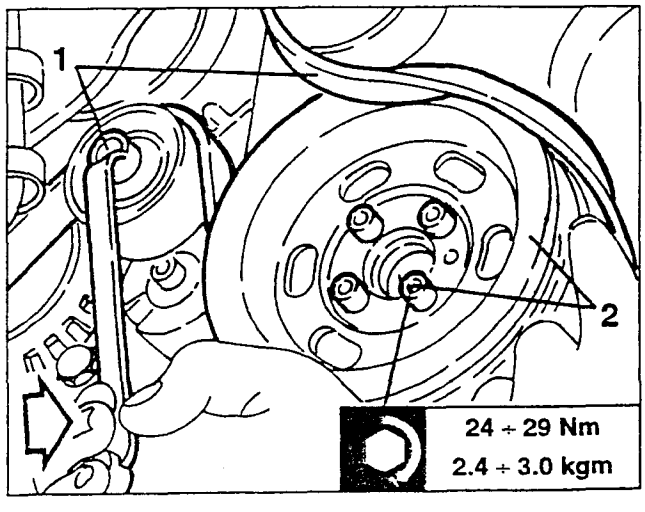
1. Slacken the fastening screws and remove the suction device.
- Remove the seal.



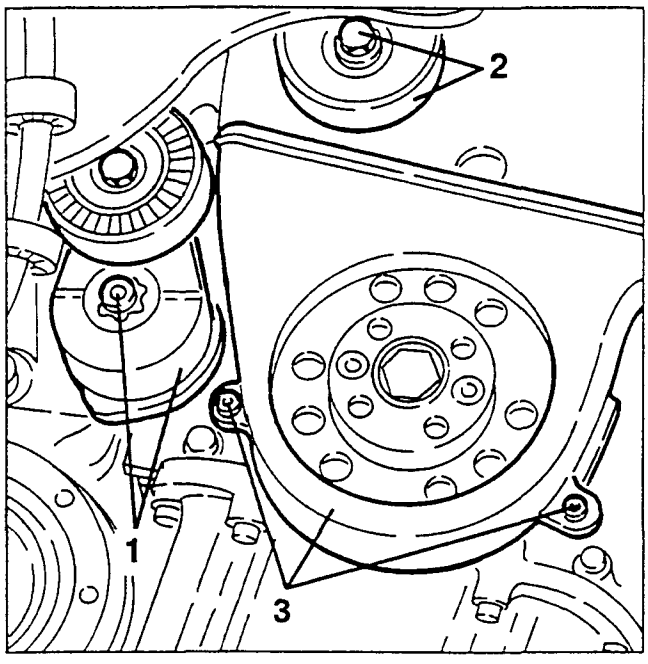
CHANGING THE CRANKSHAFT FRONT OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

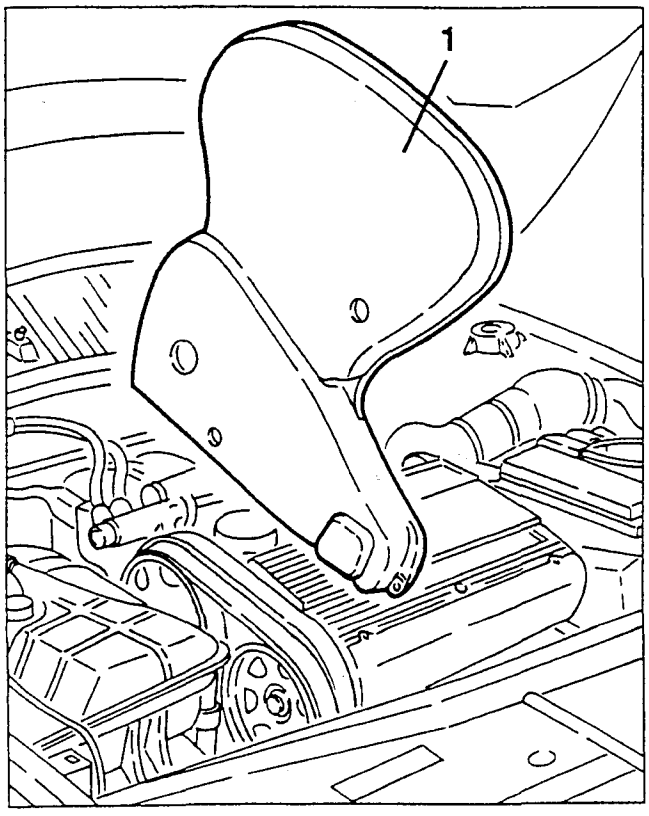
1. Raise the car and working as illustrated on the belt tensioner, loosen the tension of the auxiliary components drive belt prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.



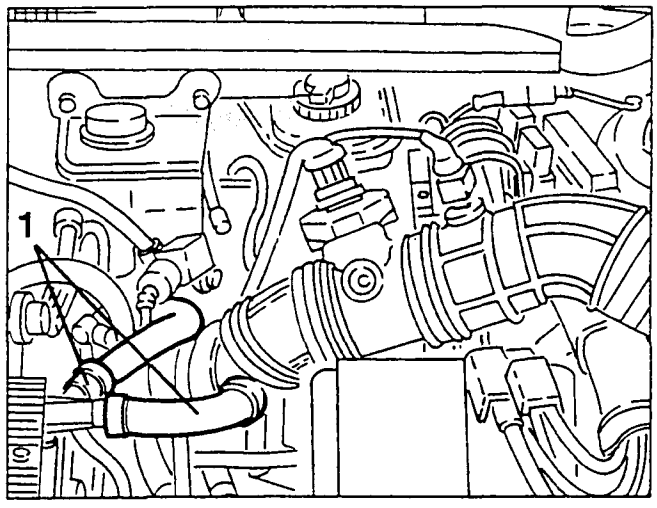
1. Slacken the fastening screw and remove the belt tensioner.
2. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.
3. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft drive belts.



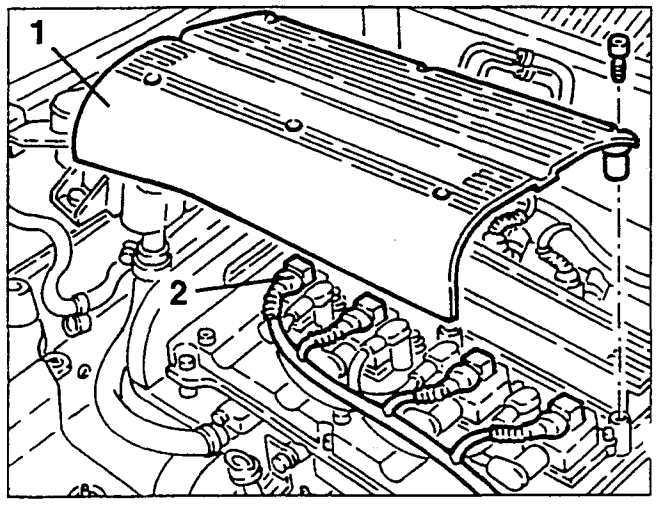
- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft drive belts.
1. Lower the car, slacken the fastening screws and remove the upper cover.



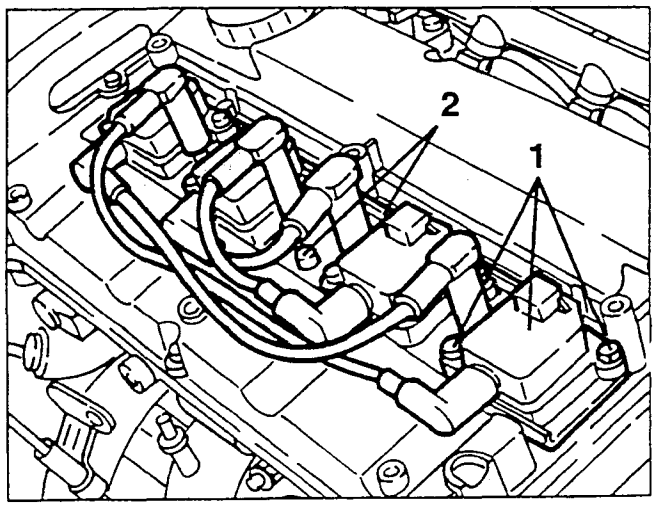
1. Disconnect and remove the oil vapour recovery pipes.



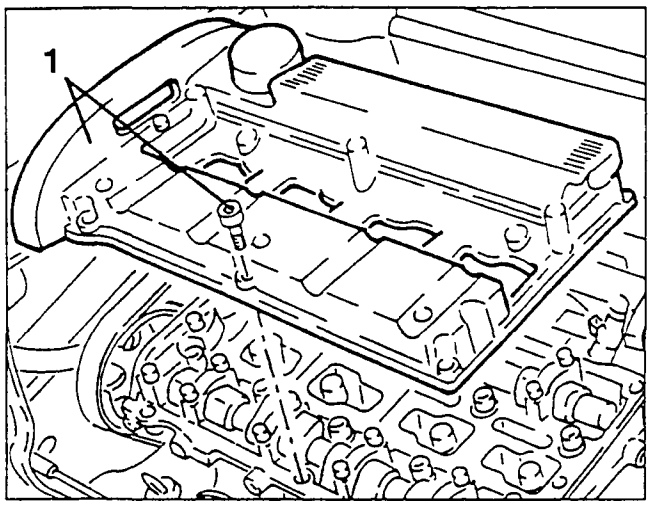
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



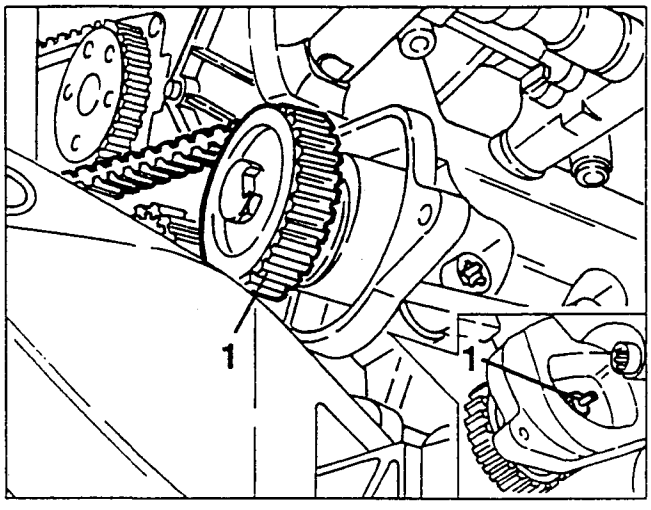
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



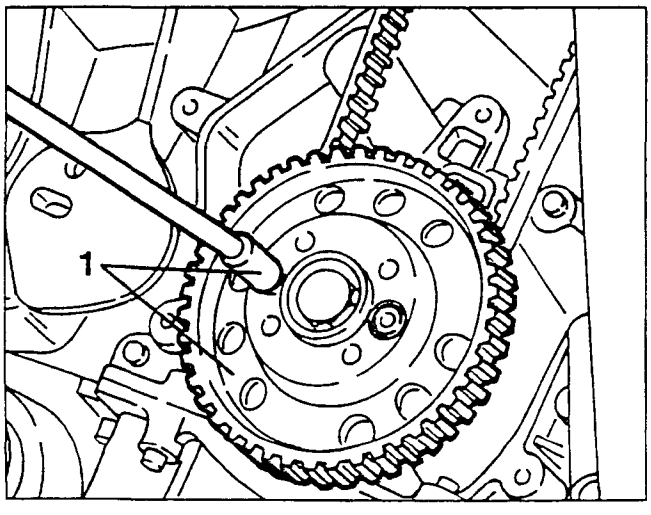
1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.



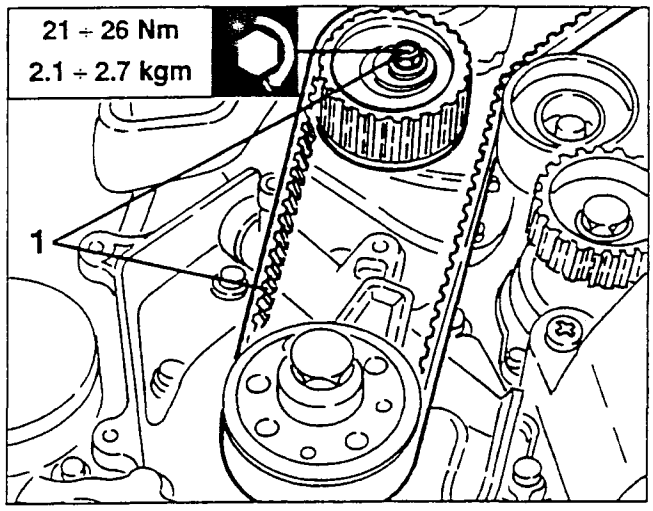
1. Loosen the tension of the counter-rotating shaft belt slackening the fastening nut of the corresponding belt tensioner, then prise and remove the belt.



1. Slacken the two fastening screws and remove the counter-rotating shaft belt driving pulley.

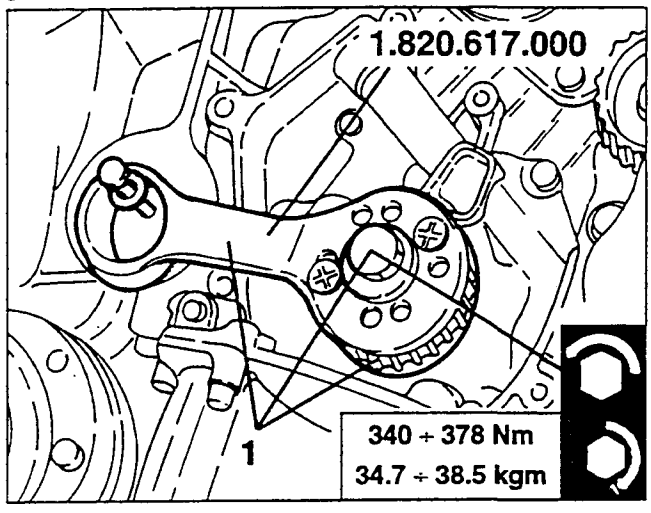


1. Working on the timing gear belt tensioner, loosen the tension of the belt, then prise it off.



Solution for engines before change

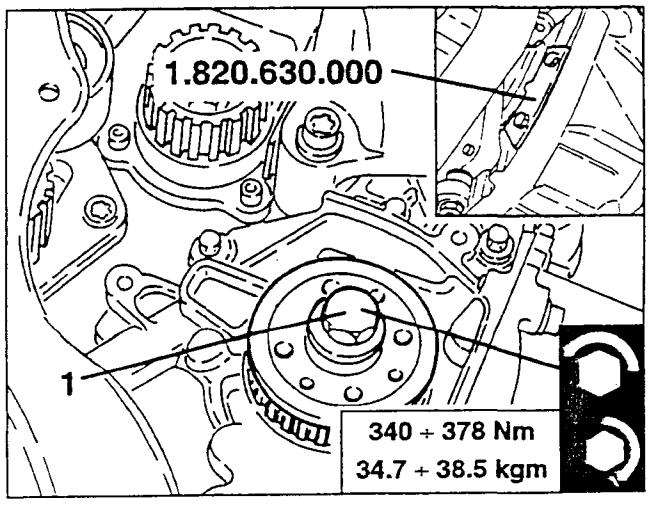
1. Using tool no. 1.820.617.000 as counter-torque slacken the screw (left-handed) fastening the timing gear drive belt pulley, then remove it.



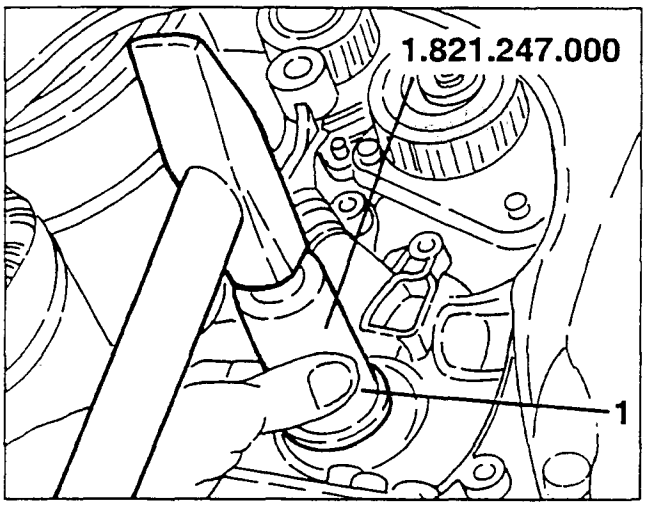
Solution for engines after change

- Slacken the fastening screws and remove the lower flywheel cover.

1. Install flywheel stopper tool no. 1.820.630.000 as illustrated, slacken the fastening screw (left-handed), then remove the timing gear pulley.



1. Remove the oil seal and install a new one using tool no. 1.821.247.000.

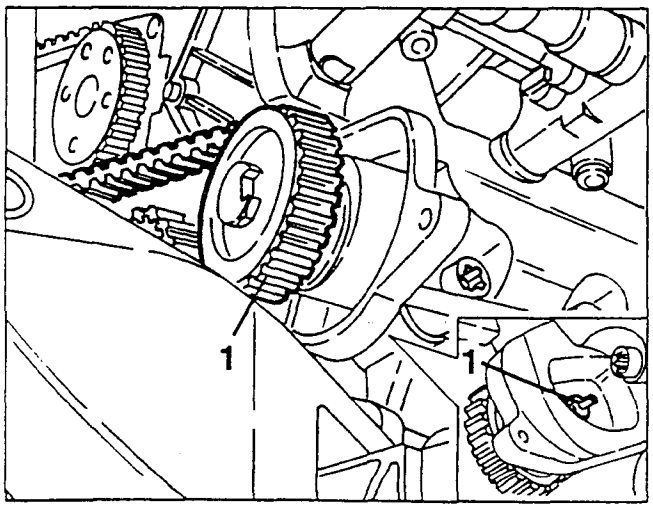


- Re-assemble reversing the sequence followed for removal.
Refer to GROUP 00 for re-assembly of the timing gear belts, counter-rotating shaft belts and their timing and for assembly of the auxiliary components drive belt.

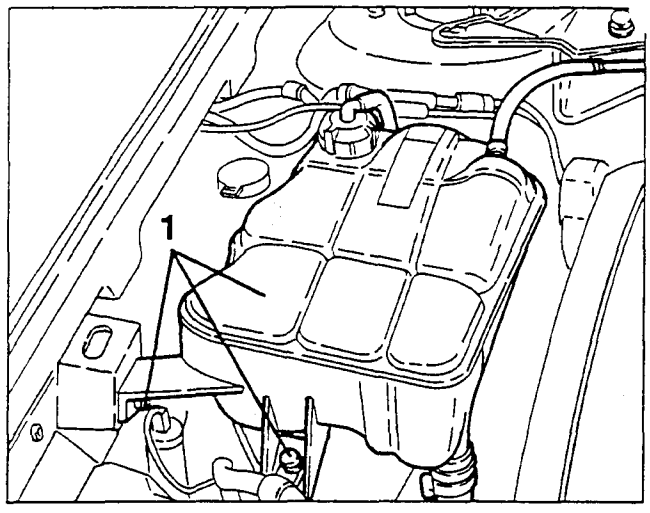
CHANGING THE COUNTER-ROTATING SHAFT SEALS

- Proceed as described in the procedure for "Changing the crankshaft front oil seal" up to removal of the upper cover for the timing gear and counter-rotating shaft belts.

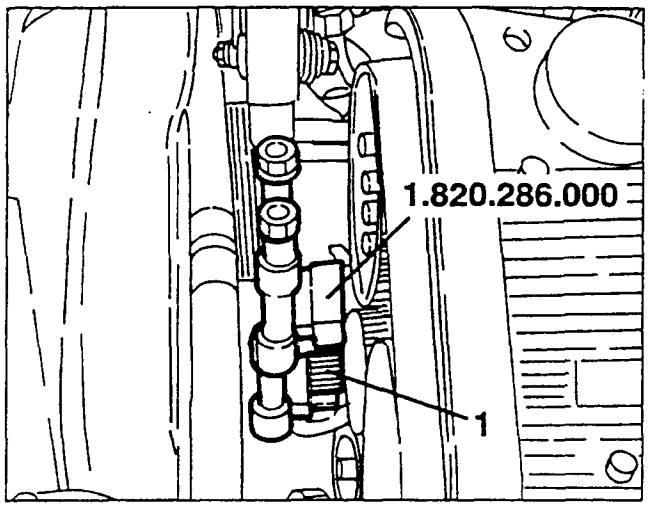
1. Loosen the tension of the counter-rotating shaft belt slackening the nut fastening the corresponding belt tensioner, then prise and remove the belt.



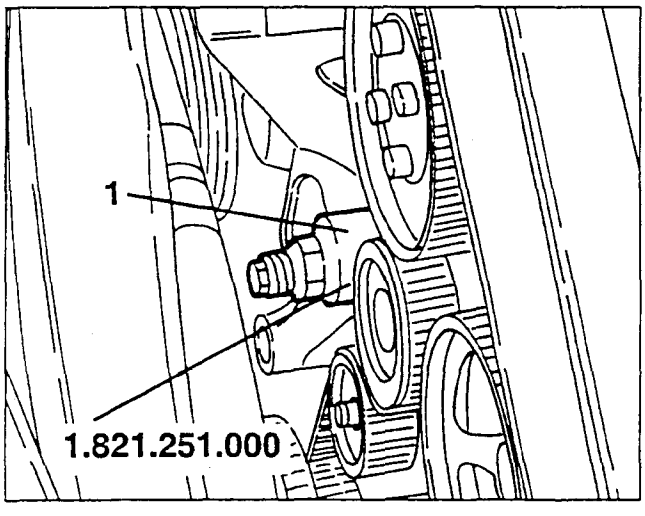
1. Slacken the screws and move the header tank to one side without disconnecting the piping.



1. Using tool no. 1.820.286.000 slacken the screw fastening the counter-rotating shaft pulley and remove it.



1. Remove the oil seal and install a new one using tool no. 1.821.251.000.

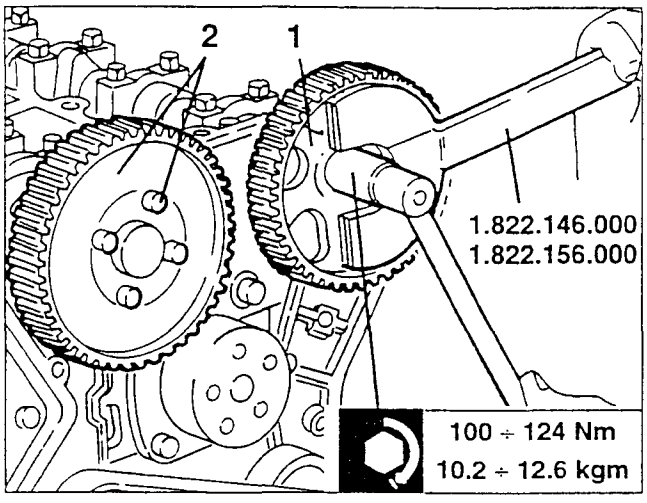


- Carry out re-assembly reversing the sequence described for removal referring to GROUP 00 for assembly of the counter- rotating shaft belt and for assembly of the auxiliary components drive belt.

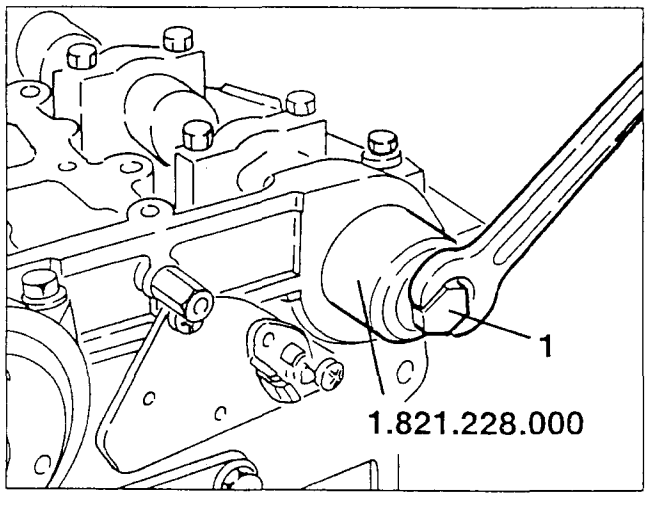
CHANGING THE CAMSHAFT OIL SEALS

- Proceed as described in the procedure for "Changing the crankshaft front oil seal" up to removing the timing gear drive belt.

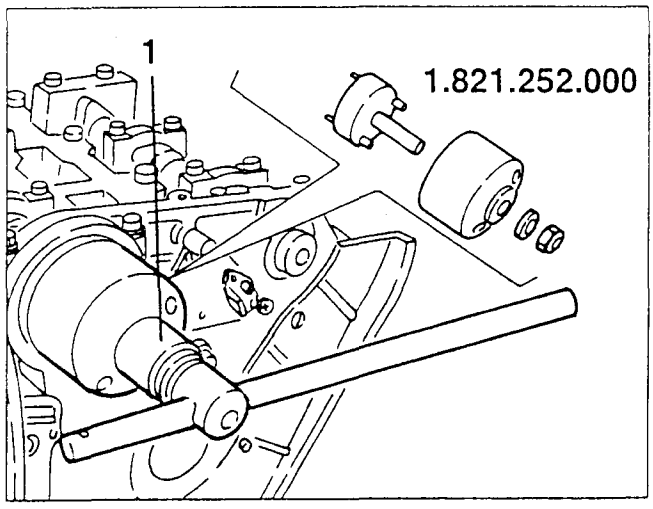
1. Using tool no. 1.822.146.000 complete with tool no. 1.822.156.000 slacken the screw fastening the camshaft pulley on the exhaust side and remove it.
2. Slacken the four screws and remove the camshaft drive pulley on the intake side.



- Remove the camshaft oil seals.
1. Install a new camshaft front oil seal on the exhaust side using tool no. 1.821.228.000.



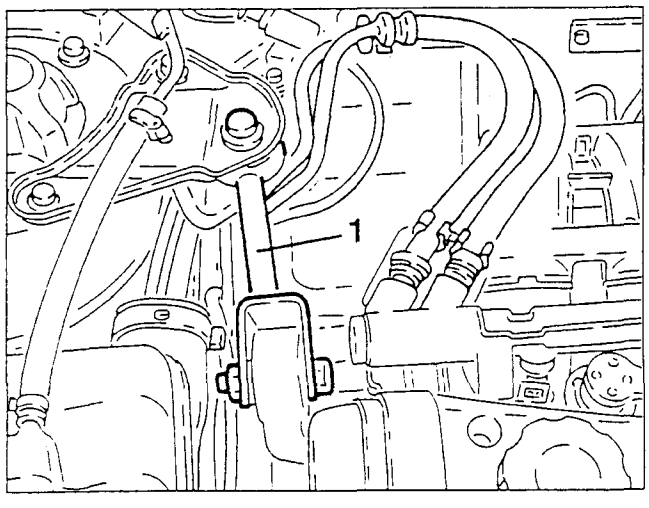
1. Install a new camshaft front oil seal on the intake side using tool no. 1.821.252.000.



- Carry out re-assembly reversing the sequence described for removal
Refer to GROUP 00 for assembly of the timing gear and counter- rotating shaft belts and for assembly of the auxiliary components drive belt.

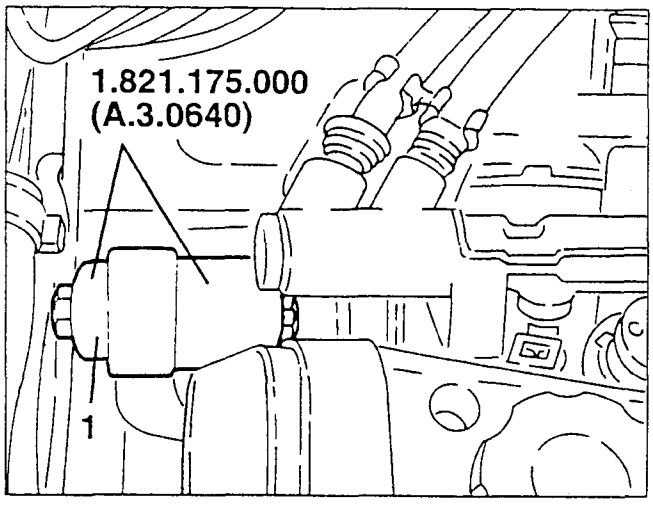
CHANGING THE FLEXIBLE BUSHING OF THE ENGINE STAY ROD ANCHOR BRACKET

1. Slacken the fastening screws and remove the engine stay rod.

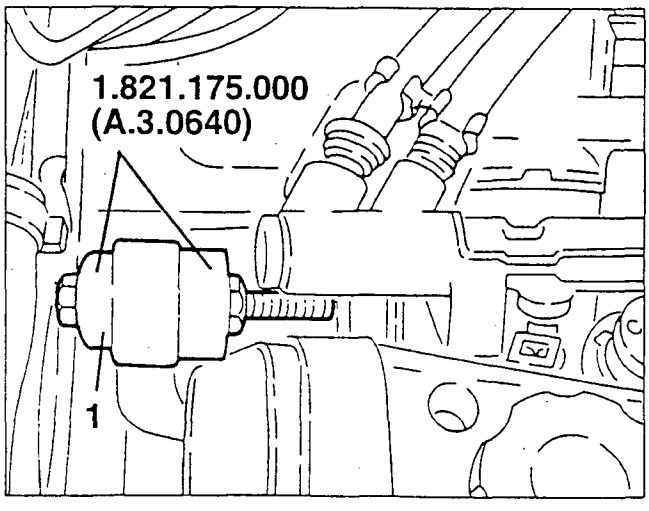


- Slacken the fastening screws and move the header tank to one side without disconnecting the piping.

1. Using tool no. 1.821.175.000 (A.3.0640) as illustrated remove the flexible bushing from the engine stay rod anchor bracket.



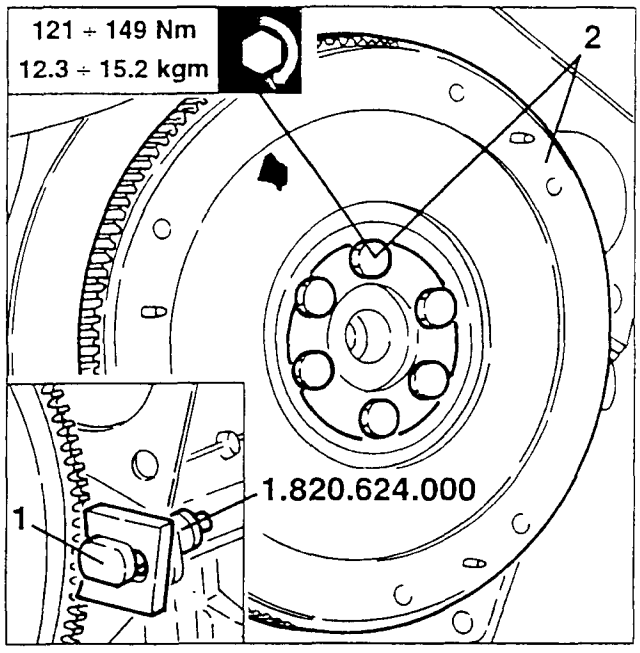
1. Refit a new flexible bushing still using tool no. 1.821.175.000 (A.3.0640) as illustrated.



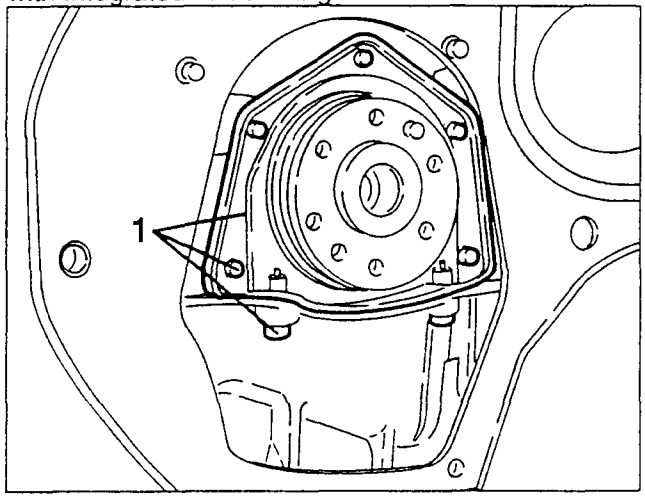
- Complete re-assembly reversing the sequence followed for removal.

CHANGING THE REAR CRANKCASE COVER (with oil seal)

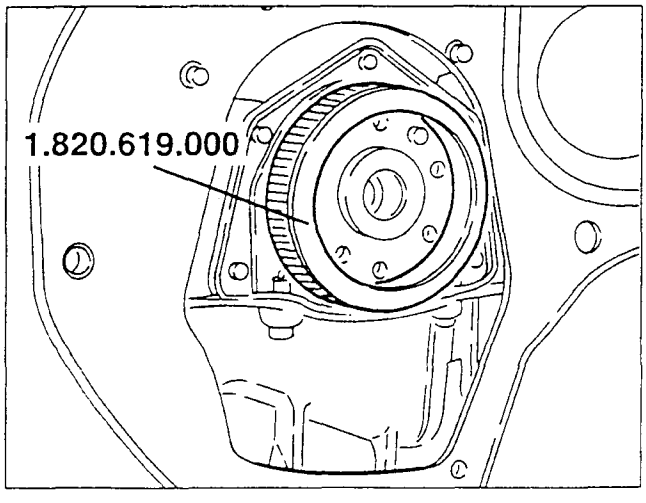
- Remove the gearbox (see specific paragraph).
- Remove the clutch (see specific paragraph).
1. Fit flywheel stopper tool no. 1.820.624.000.
2. Slacken the fastening screws and remove the flywheel.



1. Slacken the screws fastening the oil sump to the crankcase, then remove the rear crankcase cover with integrated oil seal ring.



- Refit the rear cover proceeding as follows:
- Fit tool no. 1.820.619.000 on the oil seal of the rear crankcase cover.
- Assemble the tool - rear cover assembly and tighten the screws fastening the crankcase and the oil sump, then remove the tool.

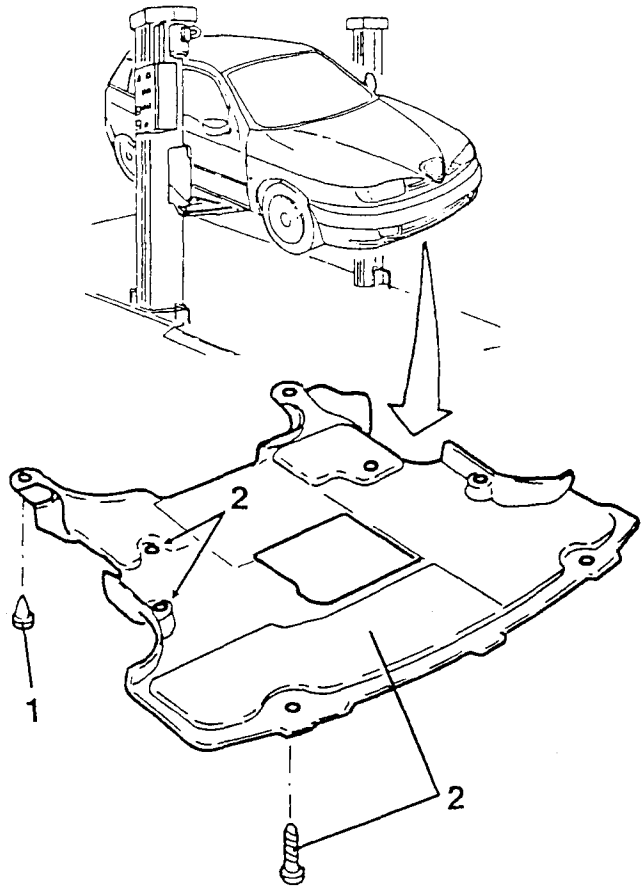


GUARD UNDER ENGINE

REMOVING/REFITTING

- Set the car on a lift and raise it.

1. Remove the two plastic buttons fastening the guard under the engine to the body.
2. Slacken the six fastening screws and remove the guard under the engine.



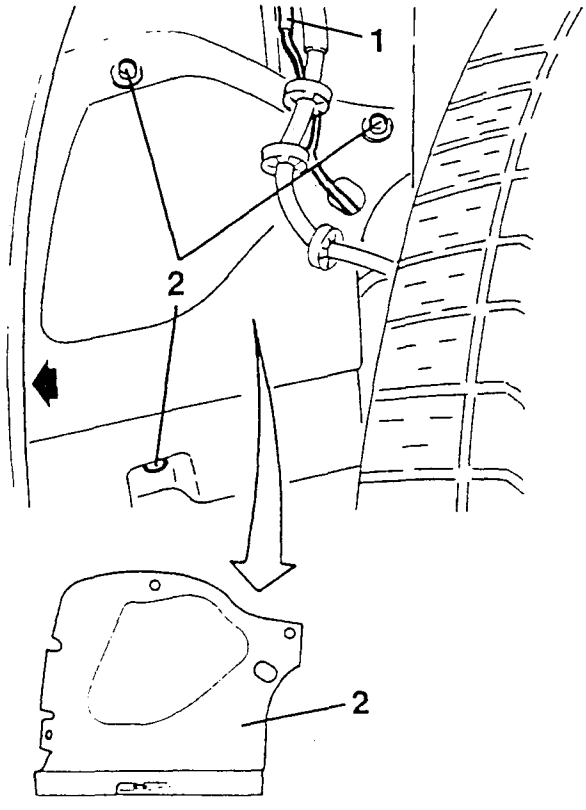
WHEEL HOUSE GUARDS

REMOVING/REFITTING

- Set the car on a lift and raise it.
- Turn the wheel just enough to gain access to the left guard.

1. Disconnect the electrical connection of the brake pad wear signalling cable and remove the latter from the hole on the left guard.
2. Slacken the fastenings and remove the left wheel house guard.

- Carry out the same procedure for removing/refitting the right wheel house guard.



WHITE

GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions: this sophisticated latest generation system consists of a single control unit which controls both ignition (static with lost spark) and injection (timed).
This is the M 2.10.3 version of the proven and reliable BOSCH MOTRONIC system.
Compared with the previous versions this new M 2.10.3 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions.
As a result of the use of new sensors and revision of the control programmes, the system makes it possible to achieve considerable improvements in terms of consumption and emission levels and vehicle handling.
Another feature of this system is self-adaptation, i.e. the capability to recognise the changes that take place in the engine and to compensate them, according to functions which mainly correct:
- the mixture titration
- the caburetion parameters according to the command of the evaporative solenoid valve
- an adaptive programme for idle speed control.

FUNCTIONS OF THE SYSTEM

Sequential and timed injection (S.E.F.I.)

With this control unit, fuel injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds by the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimal point of injection, calculated by the control unit according to special maps depending on the load, speed and temperature of the engine.
NOTE: the instant considered in the design of the maps is that of the start of injection (the cylinder is in the exhaust stroke - intake valve still closed).

Static ignition

An electronic ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences; lastly it reduces the number of high voltage cables and connectors; as the power modules for controlling the primary windings of the coil are inside the control unit.
Static ignition takes place through four coils, according to the so-called "lost spark" logic: this solution exploits the different pressures and environments existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas.
In a 4-cylinder in line engine, the paired cylinders are 1/4 and 2/3.
The solution adopted for this engine (T.SPARK - 16 valves) has required the adoption of a larger "central" spark plug and a smaller "side" spark plug. Each of the four coils supplies the small spark plug of the cylinder below and simultaneously the large one of the paired cylinder.
NOTE: This way it is impossible to invert the spark plug cables during servicing operations.

Metering the air flow rate

The air flow meter adopted is of a more modern design known as the "hot film" type.
Outside, the air-flow meter looks like a part of duct between the intake manifold and the air cleaner. Inside the air-flow meter there is an electronic circuit and a plate that is crossed by the air which passes into the duct. The film plate is kept at a constant temperature (appr. 120°C over the temperature of the incoming air) by a heating resistance placed in contact with it. The mass of air flowing through the manifold tends to withdraw heat from the plate: therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.
N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure, etc.), enabling an optimum ratio between the weight of the air and the weight of the fuel.

Cylinder detection

Following the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence. The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.
Conversely, the rpm sensor sends a reference signal for each turn of the engine and each subsequent tooth of the phonic wheel informs the control unit of an increase of the angular position of the crankshaft, so that injection is sent correctly from the suitable cylinder and the spark to the corresponding pair of cylinders.

Fuel pump

The control logic of the fuel pump carried out by the control unit (mainly based on the rpm signal) immediately cuts off the supply to the pump as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.
In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously. This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents in which the engine does not stop immediately.

Timing variator

This T.SPARK - 16 valve engine is fitted with an electro- mechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts intake timing (advance) in such a way that a larger amount of air is taken in. This device is activated by the control unit only after exceeding a determinate rpm and engine load to avoid adversely affecting correct operation of the engine at low speeds.

Percentage of exhaust gas recirculation

Nox (nitric oxide) is developed at high temperatures in the combustion chambers. To reduce these emissions an E.G.R. (Exhaust Gas Recirculation) system is adopted which by recirculating part of the exhaust gases, lowers the temperature, thus the Nox produced, in the combustion chambers.
In fact, part of the exhaust gas is withdrawn through the special EGR Valve and re-admitted to the intake box where it is mixed with the intaken air and burnt again in the engine. The EGR valve is modulated by a solenoid valve controlled by the injection control unit and, as a result of the type of control, in addition to reducing the amount of Nox, consumption levels are also optimised.
The percentage of exhaust gas to be returned to the engine is established by the control unit taking account of a specific characteristic curve which depends on the load, speed and temperature of the engine.

OPERATING LOGIC

– **Identification of the "operating point":**
the "point of operation of the engine" is located mainly through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

– **Adjustment of injection times (quantity of fuel):** the control unit controls the injectors very quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine. Injection is "sequential", i.e. the injectors are opened in correspondence of the exhaust stroke of the corresponding cylinder.

– **Ignition adjustment (calculation of advances):**
the control unit calculates the advance on the basis of the engine load (rpm and air flow); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

– **Cold starting control:**
during cold starts the control unit uses special advance values and injection times.
When a determinate temperature/rpm ratio is reached, the control unit resumes normal operating conditions.

– **Control of enrichment during acceleration:**
upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

– **Fuel cut-off during deceleration:**
with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The cut-off threshold value varies according to the temperature of the engine and the speed of the car.

– **Control of idle speed:**
the adjustment of the engine idle speed is carried out through the special actuator fitted directly on the throttle body which acts on the throttle by-pass: in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.

– **Maximum Rpm limiting:**
above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

– **Combustion control -lambda probe-:**
the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.
The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture).
The electric signal sent by the probe to the control unit changes abruptly when the composition of the mixture departs from lambda = 1.
When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
The signal from the lambda probe is processed inside the control unit by a special integrator which prevents sudden "oscillations".
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).
Through this probe it is therefore possible to adjust engine carburetion precisely.
Among other items, this makes it possible to meet emission limit regulations.

– **Timing variator control:**
The electro-mechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts the intake timing according to the load and rpm of the engine. This device is activated by the control unit at higher engine operating speeds (above 1,600 rpm and with load above 30%).

– **Knocking control:**
Through a knock sensor the control unit is informed if any pinging or "knocking" occurs and it corrects the spark advance "delaying" it accordingly; a further correction also takes account of the air temperature, in fact, when the temperature of the intake air is high, pinging is more accentuated.
N.B. The intaken air temperature sensor to be found just downstream of the air-flow meter, is not used to calculate the engine load but to control the knocking parameters.

– **Fuel vapour recovery:**
the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

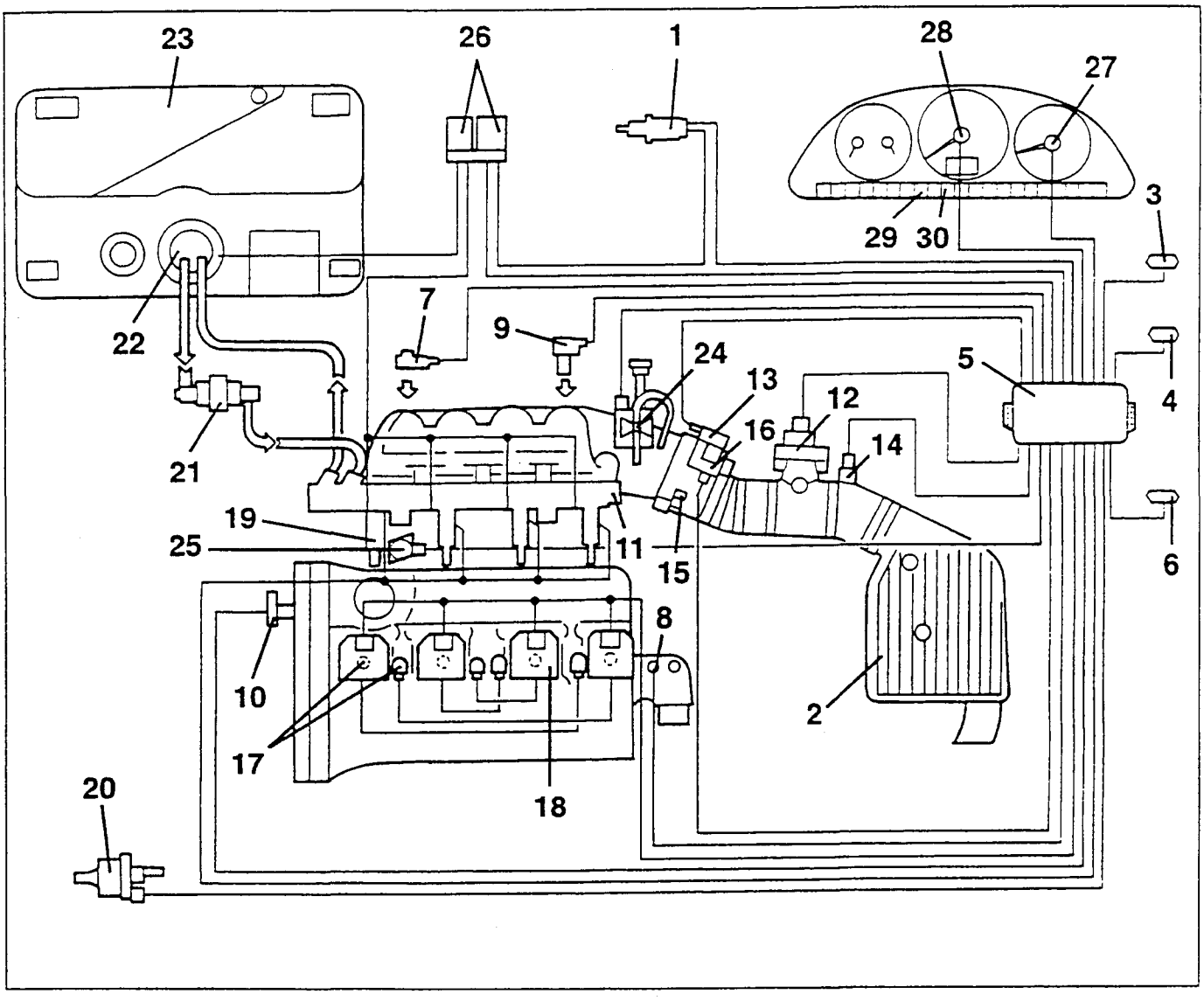
– **E.G.R. valve control**
The percentage of exhaust gas to be returned to the engine is determined by the control unit taking account of a specific characteristic curve which depends on the engine load and speed: recirculation is only activated when the engine speed is between 2500 and 4000 rpm., also in relation to the temperature of the engine (higher recirculation percentage with high temperatures).

– **Connection with the air conditioner compressor:**
the control unit is connected with the air conditioner compressor and it cuts in the compressor in relation to operation of the engine. As this service absorbs a considerable amount of power, the control unit:
- adapts the engine idle speed each time the compressor cuts in; if the engine speed falls below 700 rpm, the compressor is turned off;
- when there is the need for high power - high speed - over 6000 rpm, it momentaneously cuts out the compressor
- when the engine is being started the compressor is disabled until normal operating conditions have been reached.

– **Connection with ALFA ROMEO CODE system:**
on cars fitted with "electronic key" (ALFA ROMEO CODE), as soon as the Motronic control unit receives the signal that the key has been turned to MARCIA, it "asks" the Alfa Romeo CODE system for consent to start the engine: this consent is given only if the Alfa Romeo CODE control unit recognizes the code of the key engaged in the ignition switch as correct. This dialogue between the two control units takes place on diagnosis line K already used for the Alfa Romeo Tester (see specific paragraph).
N.B. Before working on the system you are advised to read the corresponding chapter.

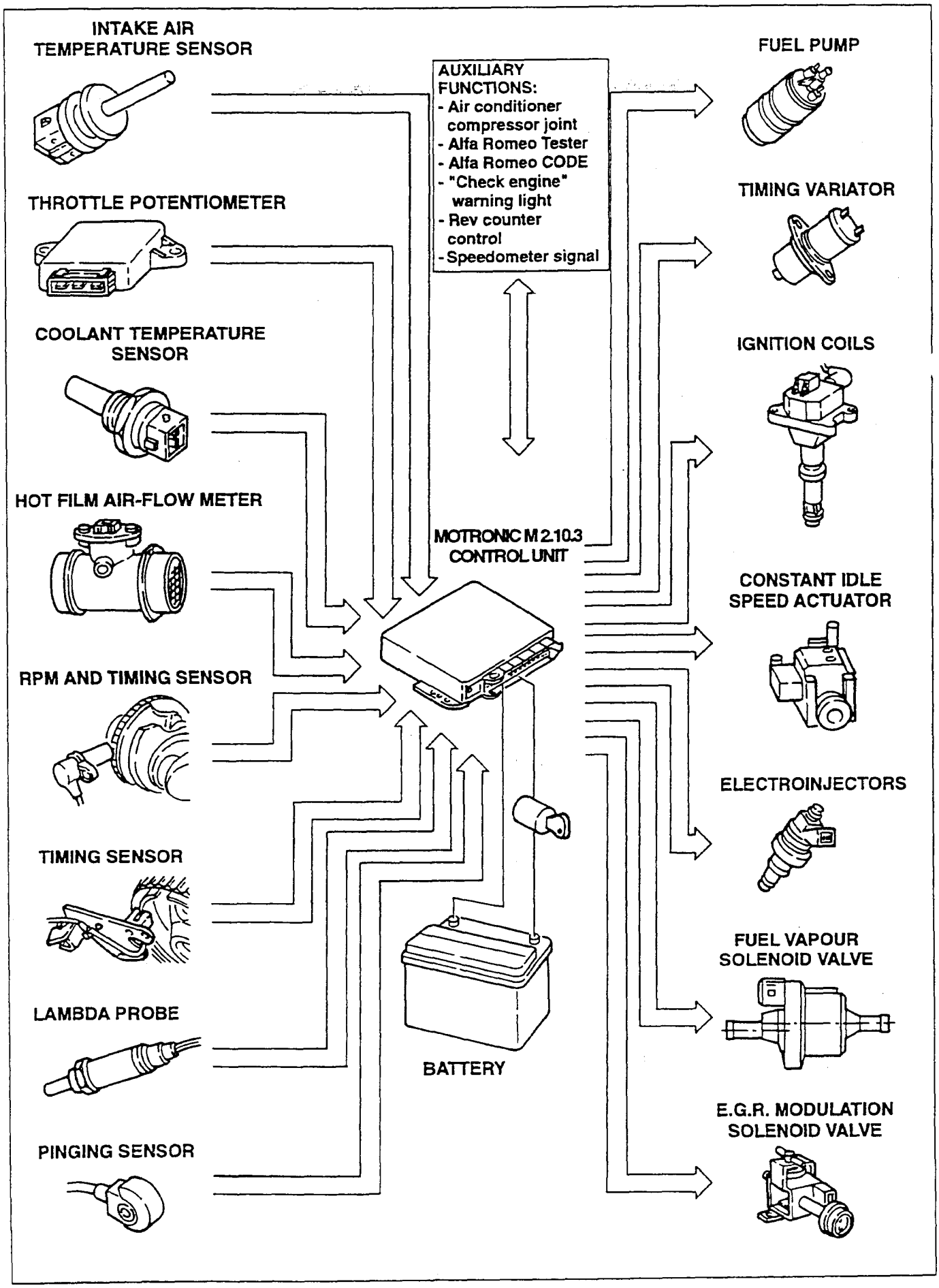
– **Self-diagnosis:**
the control unit possesses a **self-diagnosis system**, which continuously monitors the plausibility of the signals from the various sensors and compares them with the limits allowed: if these limits are exceeded, the system detects a fault and turns on the corresponding warning light on the instrument cluster.
The warning light turns on when the engine is started to indicate the initial test of the entire system (appr. 4 seconds), it then turns off if no errors have been memorised: otherwise it stays on.
For certain parameters, the control unit replaces the abnormal values with suitable ones so that the car can "limp" to a point of the Service Network.
These "recovery" values depend on the other correct signals and they are defined individually by the control unit operating logic.
The self-diagnosis system also enables quick and effective location of faults connecting with the ALFA ROMEO Tester (see "Fault-finding"), through which all the errors memorised can be displayed. It is also possible to check the operating parameters recorded by the control unit and operate the single actuators to check whether they are working properly.

COMPONENTS OF THE MOTRONIC M 2.10.3 ELECTRONIC INJECTION AND IGNITION SYSTEM



1. *Lambda sensor*
2. *Air cleaner*
3. *Climate control system connector*
4. *Diagnosis socket (Alfa Romeo Tester)*
5. *Injection - ignition control unit*
6. *Alfa Romeo CODE control unit connector*
7. *Pinging sensor*
8. *Coolant temperature sensor (NTC)*
9. *Rpm and timing sensor*
10. *Timing sensor*
11. *Fuel pressure regulator*
12. *Air-flow meter*
13. *Throttle potentiometer*
14. *Intake air temperature sensor (NTC)*
15. *Throttle body*
16. *Constant idle speed actuator*
17. *Spark plugs*
18. *Ignition coils*
19. *Electroinjectors*
20. *Fuel vapour solenoid valve*
21. *Fuel filter*
22. *Electric fuel pump*
23. *Fuel tank*
24. *E.G.R. modulation solenoid valve*
25. *Timing variator*
26. *Set of relays*
27. *Rev counter*
28. *Speedometer*
29. *"Check engine" warning light*
30. *Alfa Romeo CODE warning light*

FUNCTIONAL LAYOUT OF MOTRONIC M 2.10.3 INJECTION - IGNITION SYSTEM



GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions.
This is the M 2.10.4 version of the proven and reliable BOSCH MOTRONIC system.
Compared with the previous versions this new M 2.10.4 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions engine cooling fan).
Owing to the use of new sensors and updated programmes the system also makes it possible to achieve considerable improvements in terms of consumption, emission levels and vehicle handling.
Another feature of this system is self-adaptation, namely the capability of detecting the changes that take place in the engine and compensate them, according to functions which mainly correct:
- mixture titration;
- carburetion parameters according to the command of the evaporative solenoid valve;
- the adaptation plan for idle speed control.

FUNCTIONS OF THE SYSTEM

Sequential and timed injection (S.E.F.I.)

With this control unit injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds actuated through the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimum point of injection, calculated by the control unit according to special maps according to the load, speed and temperature of the engine.

Static ignition

An ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences; lastly it reduces the number of high voltage cables and connectors.
Static ignition takes place through four coils, according to the logic known as "lost spark".
Each of the four coils supplies the spark plug of the cylinder below and simultaneously that of the cylinder paired cylinder but in the same position (central with central, side with side).
NOTE: this way it is impossible to invert the spark plug cables during servicing operations.
This solution exploits the different environment conditions existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the spark is useful, whereas for the corresponding cylinder which is at the end of the exhaust stroke in the presence of exhaust gas, the spark is lost.
This T.SPARK - 16 valve engine requires the adoption of two spark plugs of different size: a "central" larger one and a smaller "side" one.

Metering the air flow rate

The air flow metering system has been newly designed and it is of the "heated film" type.
Outside the air-flow meter looks like a part of duct between the intake manifold and the air cleaner. Inside the air-flow meter there is an electronic circuit and a plate that is crossed by air which passes into the duct. The film plate is kept at a constant temperature appr. 120°C above the temperature of the incoming air) by a heating resistance placed in contact with it.
The mass of air flowing through the duct tends to withdraw heat from the plate; therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.
N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure, etc.)
This air flow meter does not incorporate the intaken air temperature sensor which is separate, to be found just upstream of the air flow meter itself.

Cylinder detection

Following the adoption of the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence.
The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.
Conversely, the rpm sensor sends a reference signal each turn of the engine and each subsequent tooth of the phonic wheel informs the control unit of an increase in the angular position of the crankshaft, so that the correct injection and ignition are sent to the appropriate cylinder.

Fuel pump

The complex control logic of the fuel pump carried out by the control unit (chiefly based on the rpm signal) immediately cuts off the supply to the engine as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.
In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously.
This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents which do not cause the engine to stop immediately.

Timing variator

This T. SPARK 16 valve engine is fitted with an electromechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts the intake timing (advance) so that timing that offers the best performance levels is obtained.
This mechanism is activated by the control unit only after exceeding a determinate engine rpm and load so that correct operation of the engine at low speed is not adversely affected.

OPERATING LOGIC

- Identification of the "operating point":
the "point of operation of the engine" is located mainly through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

- Adjustment of injection times (quantity of fuel):
the control unit controls the injectors very quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine.
Injection is "sequential and timed", i.e. the injectors are opened in correspondence of the exhaust stroke of the associated cylinder.

- Ignition adjustment (calculation of advances):
the control unit calculates the advance on the basis of the engine load (rpm and air flow); the value is also corrected according to the temperature of the intaken air and that of the engine. Ignition is "static" as described previously.

- Cold starting control:
during cold starts the control unit uses special advance values and injection times in order to reach the required load more rapidly.

- **Control of enrichment during acceleration:**
upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible. This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

- **Fuel cut-off during deceleration:**
with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The cutoff threshold values varies according to the temperature of the engine and the speed of the car.

- **Control of idle speed:**
the adjustment of the engine idle speed is carried out through the special actuator, fitted directly on the throttle body, which acts on the throttle by-pass.
This device acts as a regulator for cutting in the various services (e.g. conditioner compressor): in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.
The system also controls the cutting in of the radiator cooling fan, if necessary, compensating the engine idling speed.

- **Maximum Rpm limiting:**
above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

- **Combustion control -lambda probe-:**
the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.
The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture).
The electric signal sent by the probe to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300°C).
Through this probe it is also possible to adjust engine carburetion precisely. Among other items, this makes it possible to meet emission limit regulations.

- **Timing variator control:**
the electromechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts intake timing depending on the engine load and rpm. This device is activated by the control unit over idle speed (over 1,600 rpm and with load above 30%).

- **Pinging control:**
the control unit is informed about pinging or "knocking" through the pinging sensor and it corrects ignition advance delaying it accordingly.

- **Fuel vapour recovery:**
the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

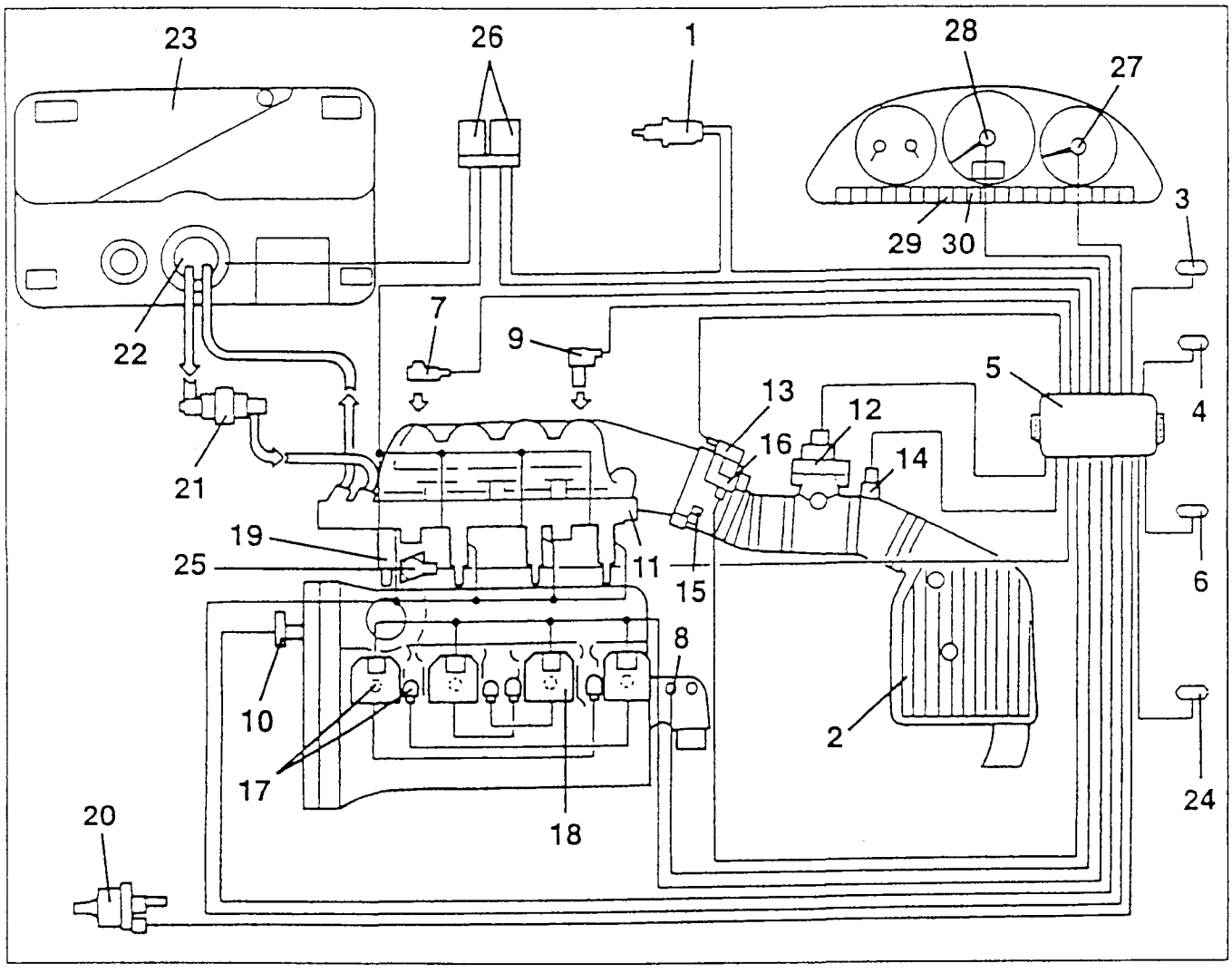
- **Connection with the conditioner compressor:**
the control unit is connected with the air conditioning system and controls the cutting in of the compressor and fan according to the operating conditions of air conditioning system.

- **Connection with the radiator cooling fan:**
in this version the cooling fan control thermal contact on the radiator has been eliminated.
The fan command for the first and second speed is supplied by the injection control unit depending on the temperature measured by the coolant fluid temperature sensor of the MOTRONIC system.

- **Connection with the Alfa Romeo Code system:**
on cars fitted with "electronic key" (Alfa Romeo CODE), as soon as the Motronic control unit receives the "key at MARCIA" signal, it asks the Alfa RomeoCODE system for consent to start the engine: this consent only takes place if the Alfa Romeo CODE control unit recognises the code of the key engaged in the ignition switch as correct. This conversation between the two control units takes place on diagnosis line K already used by the Alfa Romeo Tester.

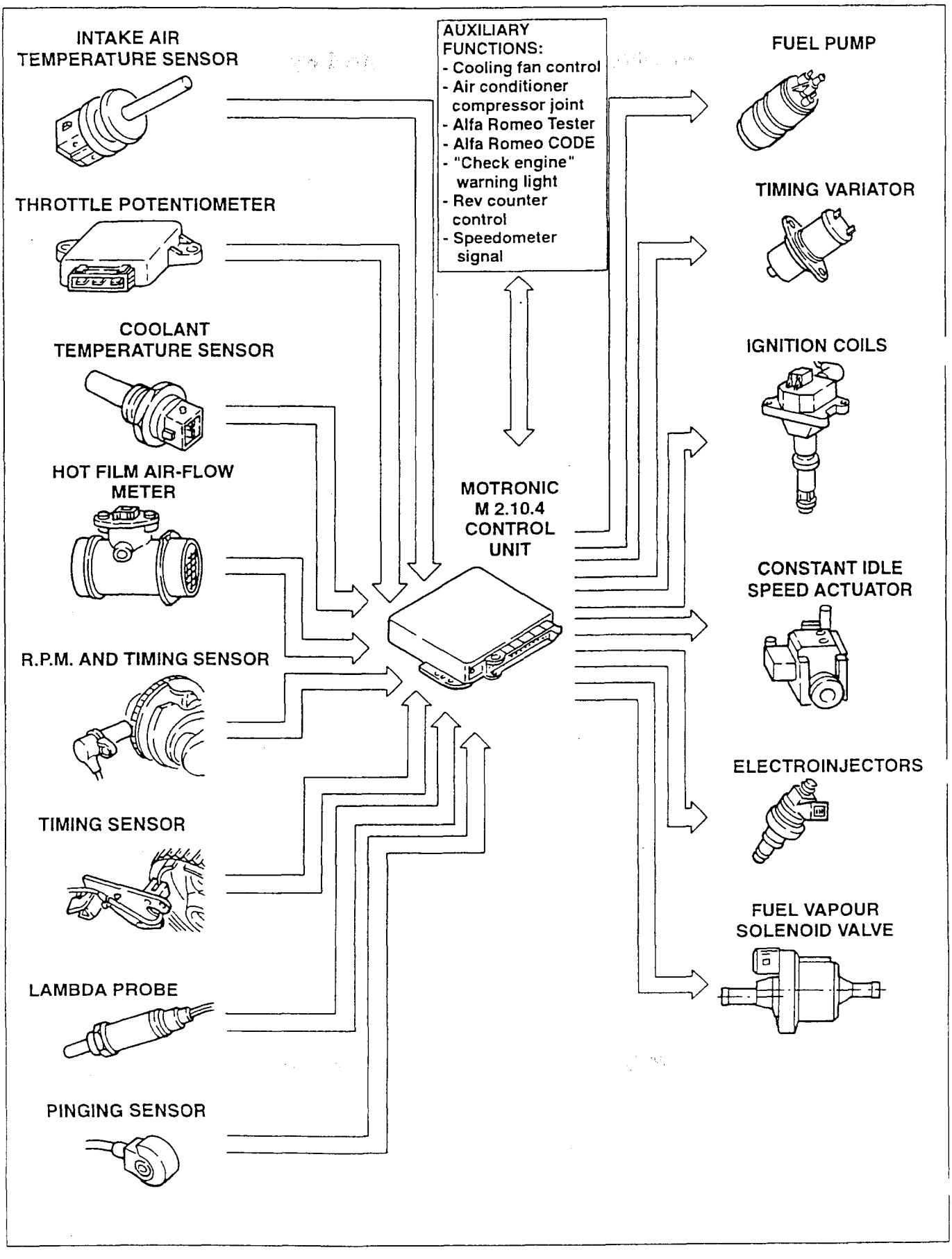
- **Self-diagnosis:**
The control unit possesses a diagnosis system which continuously monitors the signals leading from the various sensors checking their plausibility and comparing them with the permissible limits: if these limits are exceeded, the system detects a fault and turns on the warning light on the instrument cluster.
The warning light turns on when the engine is started to indicate the initial test of the whole system (appr. 4 seconds), then it goes off if no errors are memorised: otherwise it stays on.
For certain parameters, the control unit replaces the abnormal values with suitable mean ones to enable the car to "limp" to a point of the Service Network. These are known as "recovery" values, they depend on the other correct signals and are defined individually by the control unit operating logic. The system also makes it possible to quickly locate faults by connecting with the Alfa Romeo Tester (see "Fault- finding"), through which all the errors memorised can be displayed.
It is also possible to check the operating parameters recorded by the control unit and command the turning on of the single actuators to check whether they are working properly.

COMPONENTS OF THE MOTRONIC M2.10.4 ELECTRONIC INJECTION AND IGNITION SYSTEM



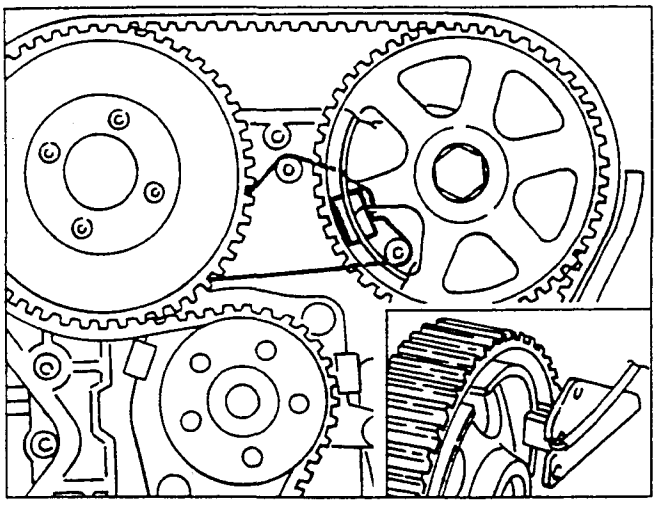
1. *Lambda sensor*
2. *Air cleaner*
3. *Climate control system connector*
4. *Diagnosis socket (Alfa Romeo Tester)*
5. *Injection - ignition control unit*
6. *Alfa Romeo CODE control unit connector*
7. *Pinging sensor*
8. *Coolant temperature sensor (NTC)*
9. *Rpm and timing sensor*
10. *Timing sensor*
11. *Fuel pressure regulator*
12. *Air-flow meter*
13. *Throttle potentiometer*
14. *Intake air temperature sensor (NTC)*
15. *Throttle body*
16. *Constant idle speed actuator*
17. *Spark plugs*
18. *Ignition coils*
19. *Electroinjectors*
20. *Fuel vapour solenoid valve*
21. *Fuel filter*
22. *Electric fuel pump*
23. *Fuel tank*
24. *Connector coupling engine cooling system*
25. *Timing variator*
26. *Set of relays*
27. *Rev counter*
28. *Speedometer*
29. *"Check engine" warning light*
30. *Alfa Romeo CODE warning light*

FUNCTIONAL LAYOUT OF MOTRONIC M2.10.4 INJECTION - IGNITION SYSTEM



TIMING SENSOR

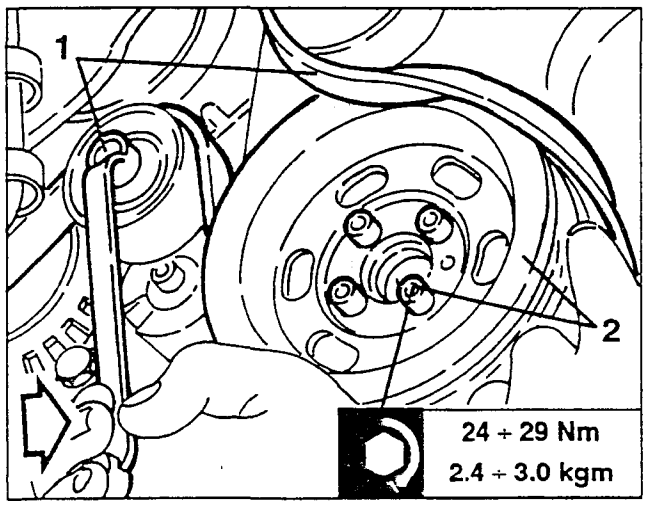
The timing sensor (cam angle sensor) comprises a Hall effect device.
The voltage signal "lowers" sharply when the tooth machined on the camshaft drive pulley opposite the sensor passes in front of it.



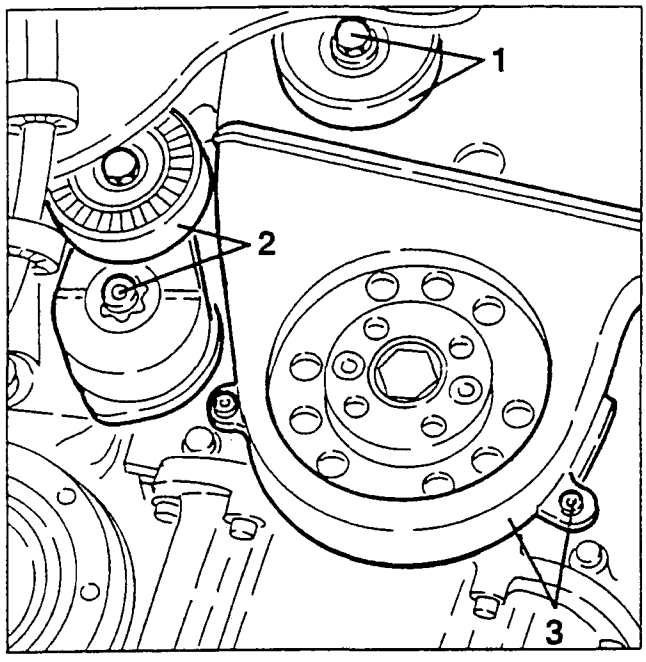
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxliary components drive pulley.

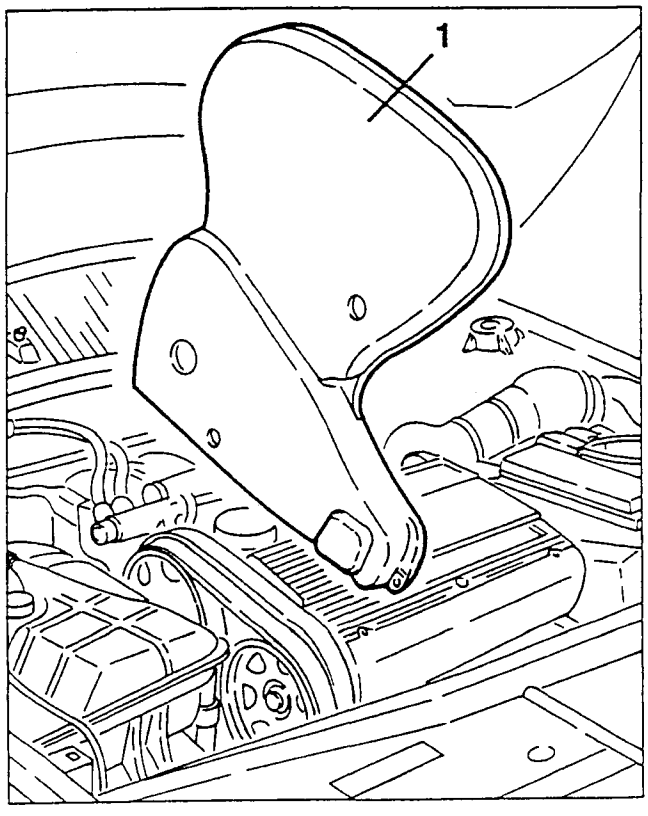


1. Slacken the fastening screw and remove the belt tensioner.
2. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.
3. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft drive belts.

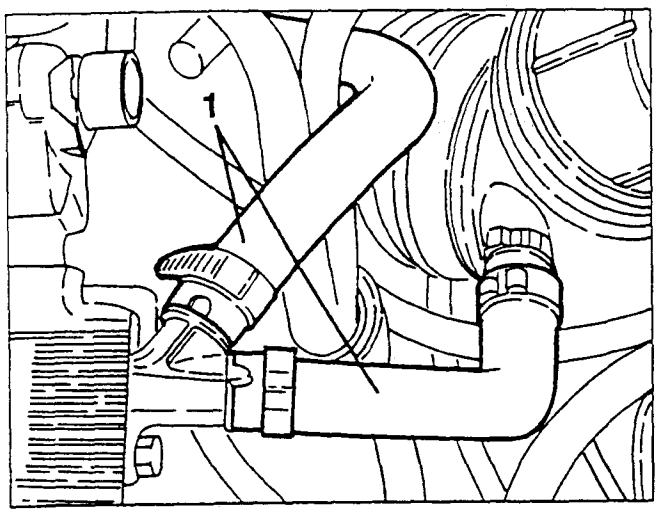


- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft drive belts.

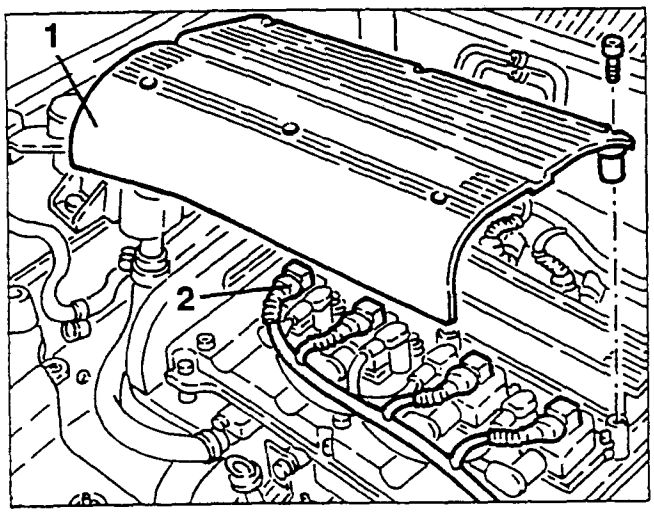
1. Lower the car, slacken the fastening screws and remove the upper cover.



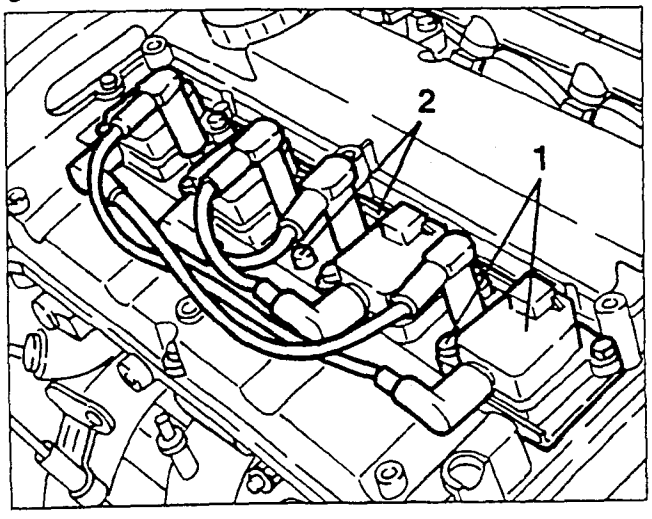
1. Disconnect and remove the oil vapour recovery pipes.



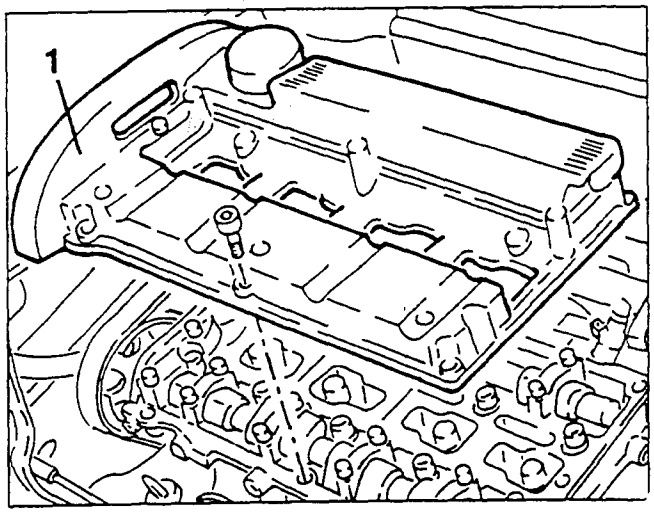
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



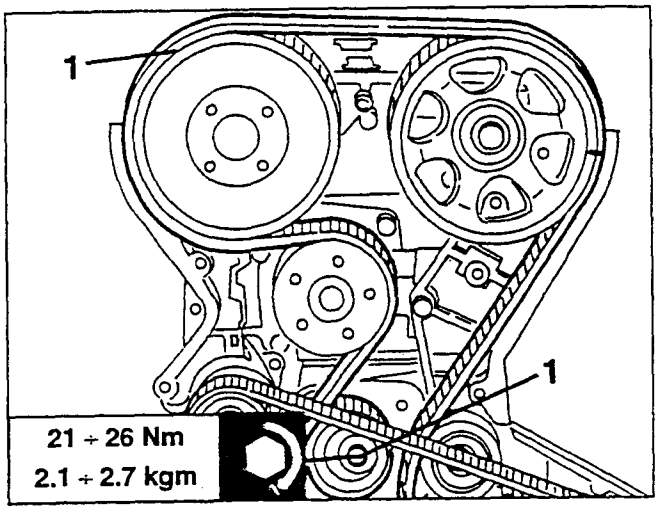
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



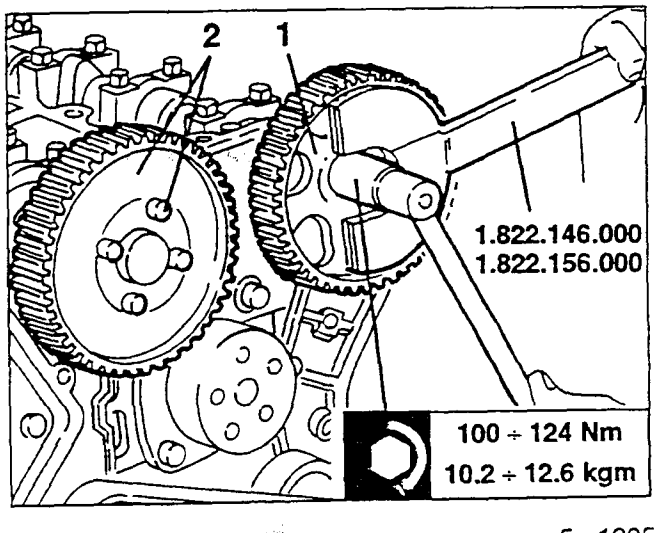
1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.



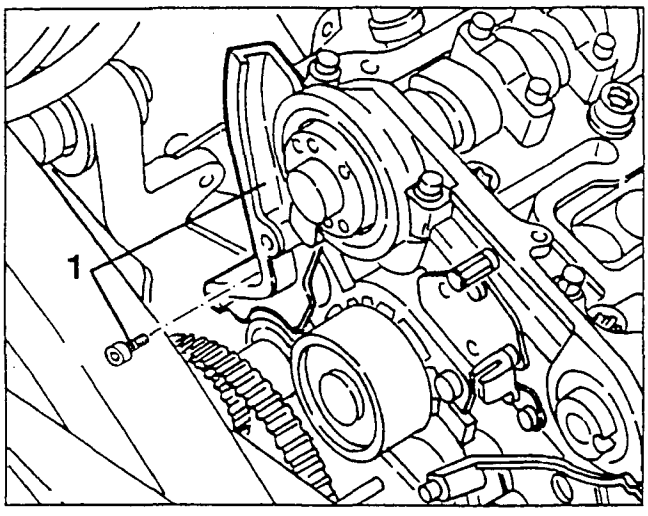
1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.



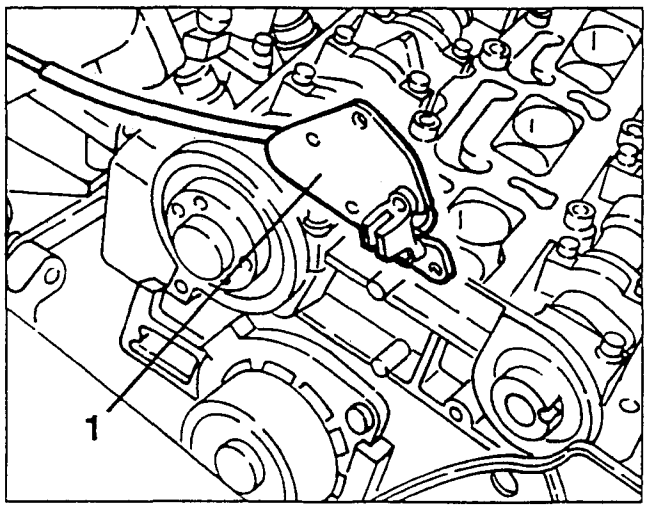
1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear exhaust side drive pulley and remove it.
2. Slacken the four screws fastening the timing gear intake side drive pulley and remove it.



1. Slacken the fastening screws and remove the intake side cover.



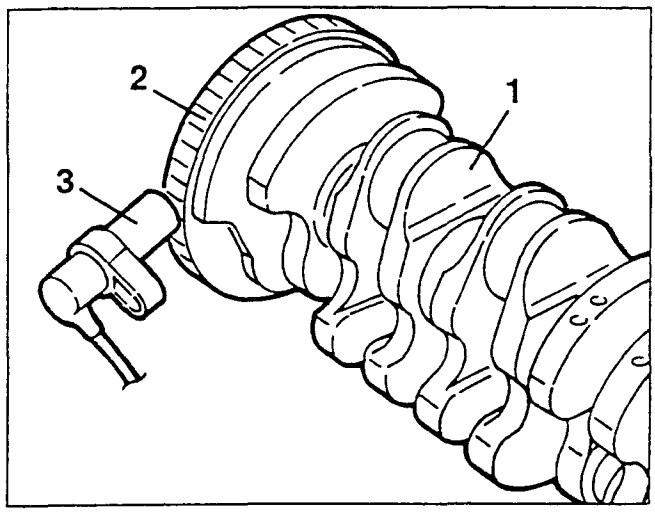
1. Disconnect the electrical connection, slacken the two fastening screws and remove the timing sensor complete with support plate.



For re-assembly of the timing gear drive belt, valve gear timing and assembly and tensioning the auxiliary components drive belt see GROUP 00.

RPM AND TIMING SENSOR

The sensor for detecting the rpm and engine timing is of the inductive type which operates through the change of a magnetic field generated by the passage of the teeth of a toothed pulley (phonic wheel) shrunk onto the crankshaft.
The teeth which pass in front of the magnetic field generator change the gap between the pulley and the sensor; therefore, the dispersed flux, which consequently varies, induces an alternate sinusoidal voltage in the coils of the sensor, the amplitude of which depends on the peripheral speed of the phonic wheel, the gap between the tooth and the sensor, the shape of the teeth, the magnetic characteristics of the sensor and on the support system.



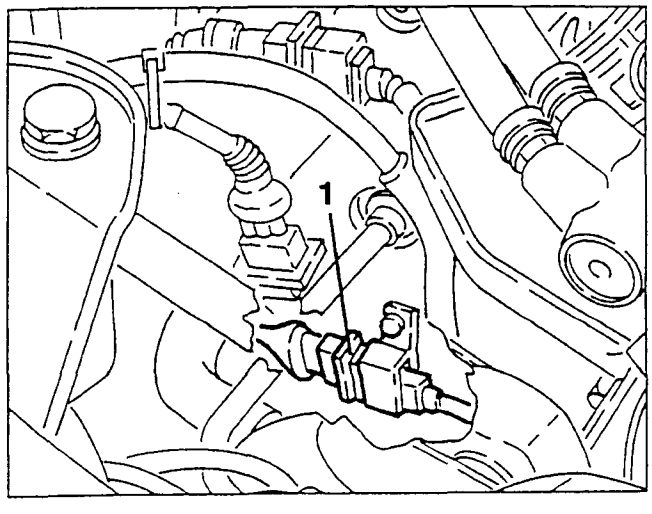
1. Crankshaft
2. Phonic wheel
3. Rpm and timing sensor

The output signal which varies in relation to the rpm is processed by the control unit to obtain a signal at each passage through zero and a constant rectangular oscillation of amplitude to enable the control of the digital circuits inside the control unit.
The interval between the start of one tooth and another is 6° with the exception of the reference mark which is made by eliminating two of the 60 teeth of the pulley.
The hollow due to the lack of two teeth gives the control unit a reference point of the crankshaft and each subsequent tooth of the phonic wheel informs the control unit of an increase in its angular position.

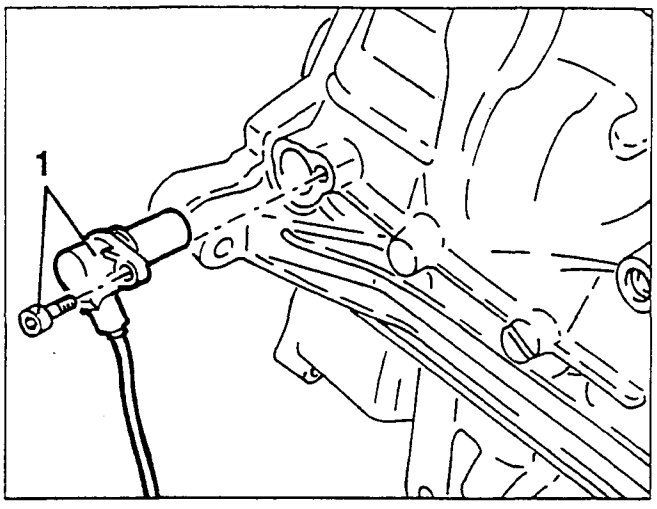
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Disconnect the timing sensor electrical connection.



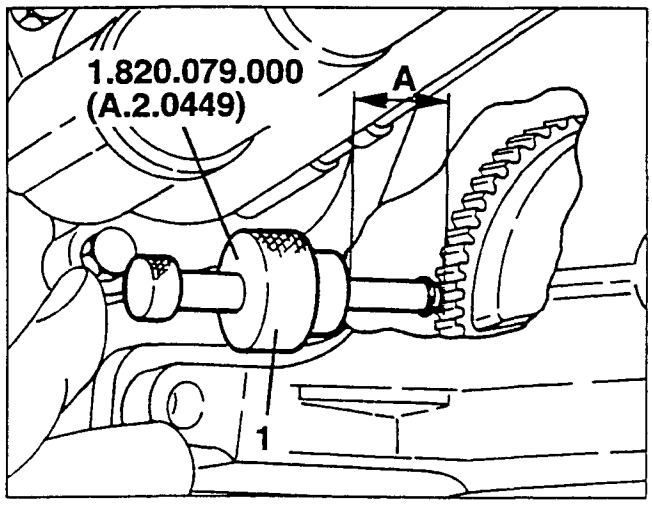
1. Raise the car, slacken the fastening screw and remove the rpm and timing sensor.



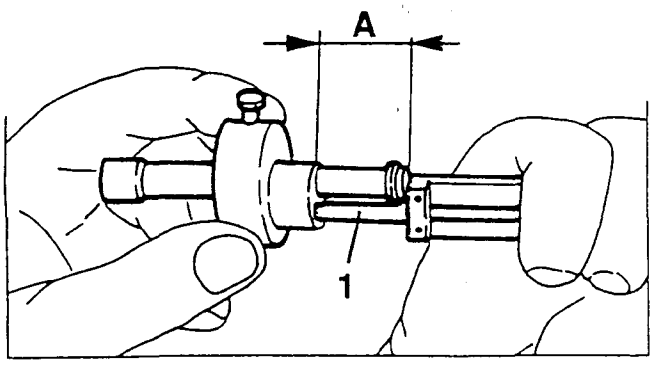
CHECKING THE GAP

- Set the car on a lift and remove the front section of the exhaust pipe.
- Remove the rpm and timing sensor (see specific paragraph).

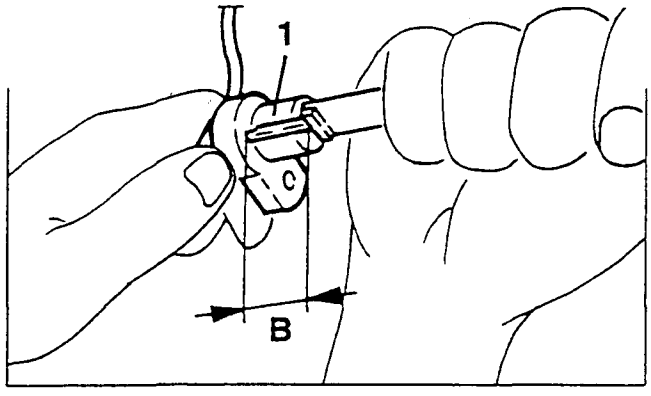
1. Using tool no. 1.820.079.000 (A.2.0449), find dimension "A".



1. Using a gauge measure dimension "A".



1. Using a gauge measure dimension "B" on the sensor.

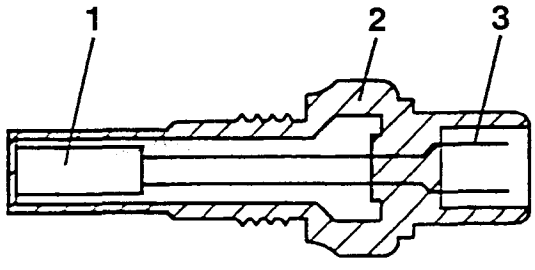


- Calculate the rpm and timing sensor gap and check that it is within the specified limits.

Rpm and timing sensor gap
A - B = 0.5 ÷ 1.5 mm

ENGINE COOLANT TEMPERATURE SENSOR (NTC)

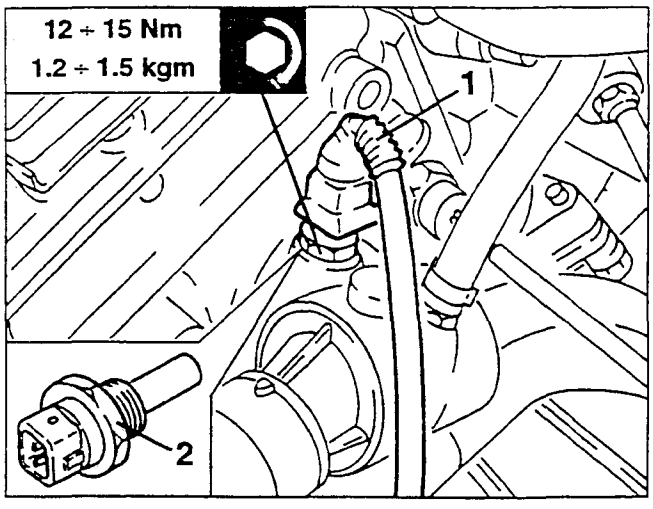
This sensor detects the engine coolant temperature on the thermostatic cup through a thermistor (NTC) with a negative resistance coefficent, i.e. capable of lowering its resistance as the temperature increases. The electric signal obtained reaches the electronic control unit where it is used to correct the air-fuel mixture.



1. NTC resistance
2. Body
3. Connector

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).
2. Slacken and remove the engine coolant temperature sensor from the thermostatic cup.

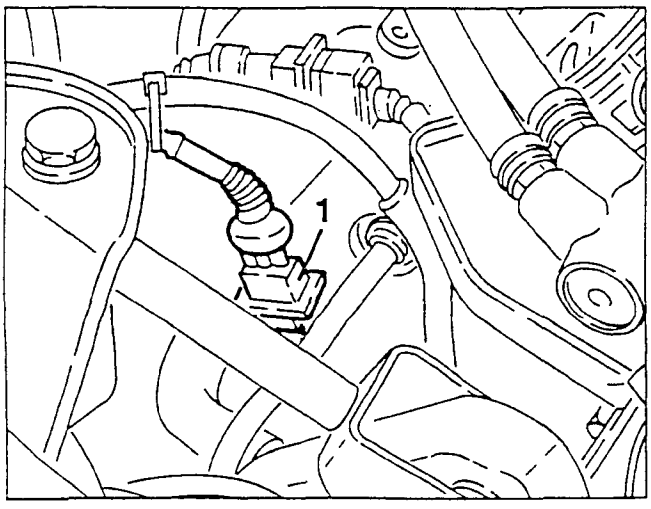


KNOCKING SENSOR

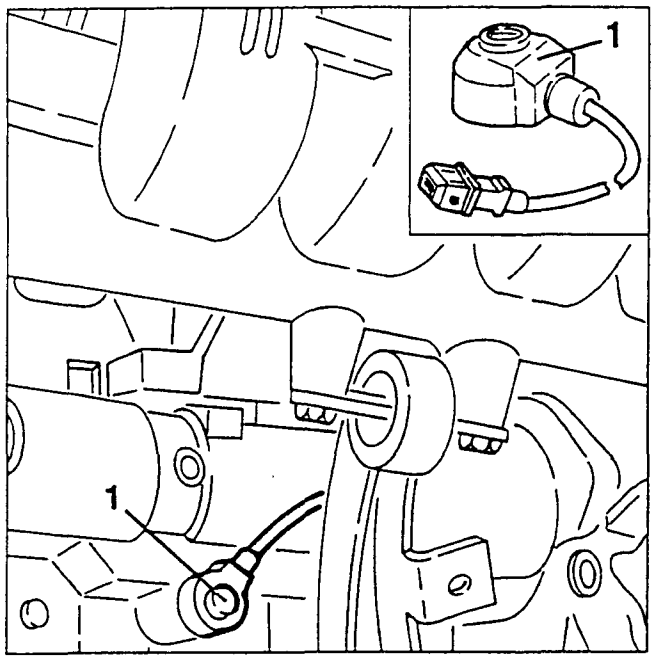
The knocking sensor detects the intensity of the vibrations (pinging in the cylinder head) caused by knocking in the combustion chamber.
In this condition the control unit increases the amount of fuel and reduces the advance ratings calculated from the special map, in order to eliminate knocking as quickly as possible: in fact the advance curves are reduced by appr. 2°, then if necessary by another 2° etc:, until pinging ceases, after which the normal advance corresponding to the original map is resumed.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection of the pinging sensor.



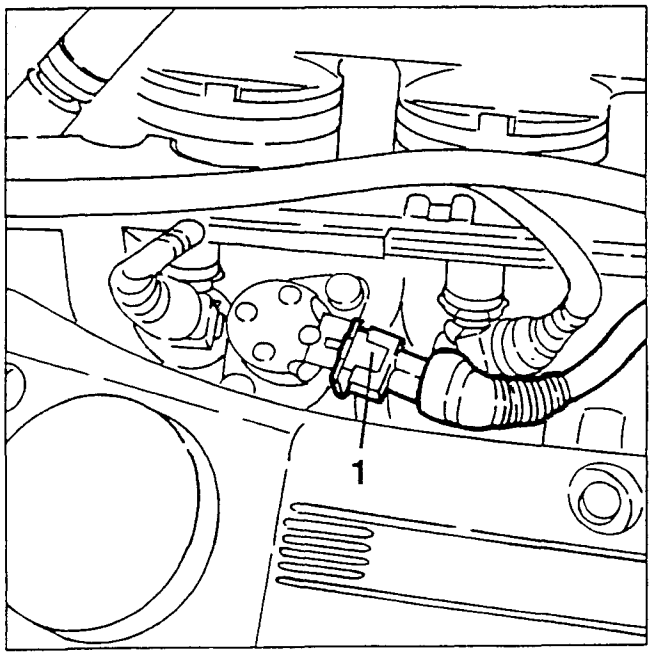
- Remove the front section of the exhaust piping.
1. Slacken the fastening screw and remove the pinging sensor.



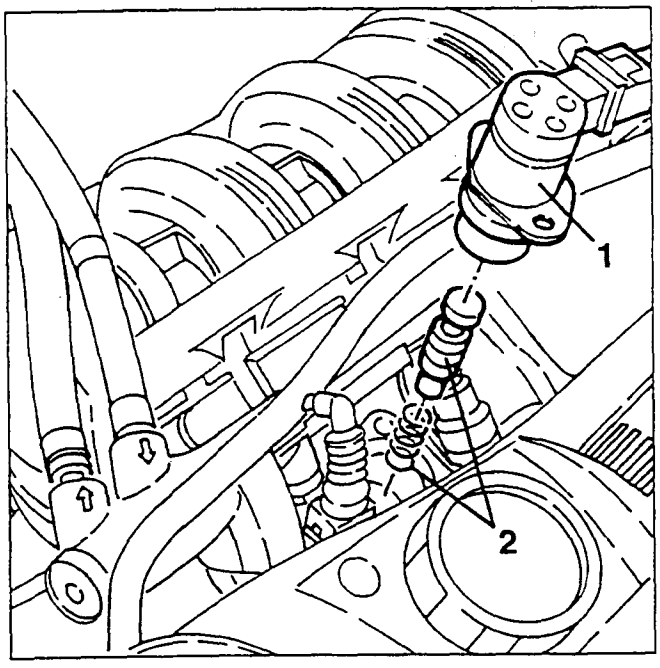
TIMING VARIATOR SOLENOID

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the timing variator solenoid.



1. Slacken the two fastening screws and remove the timing variator solenoid.
2. Remove the valve complete with the timing variator spring.



INERTIAL SWITCH

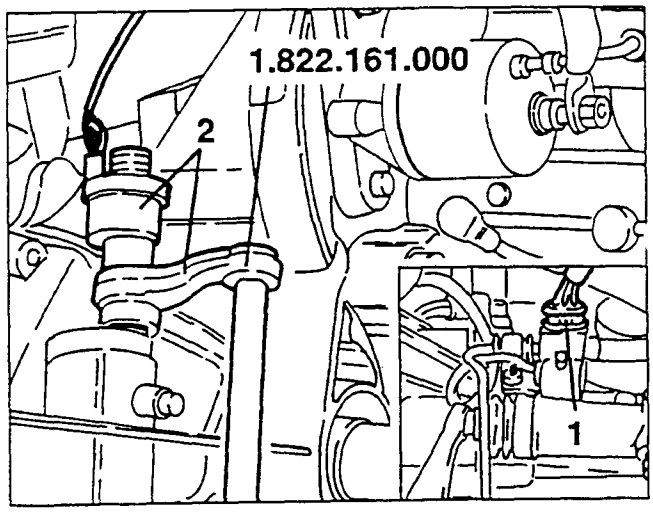
See 1712 16V Boxer engine.

SPEEDOMETER SENSOR

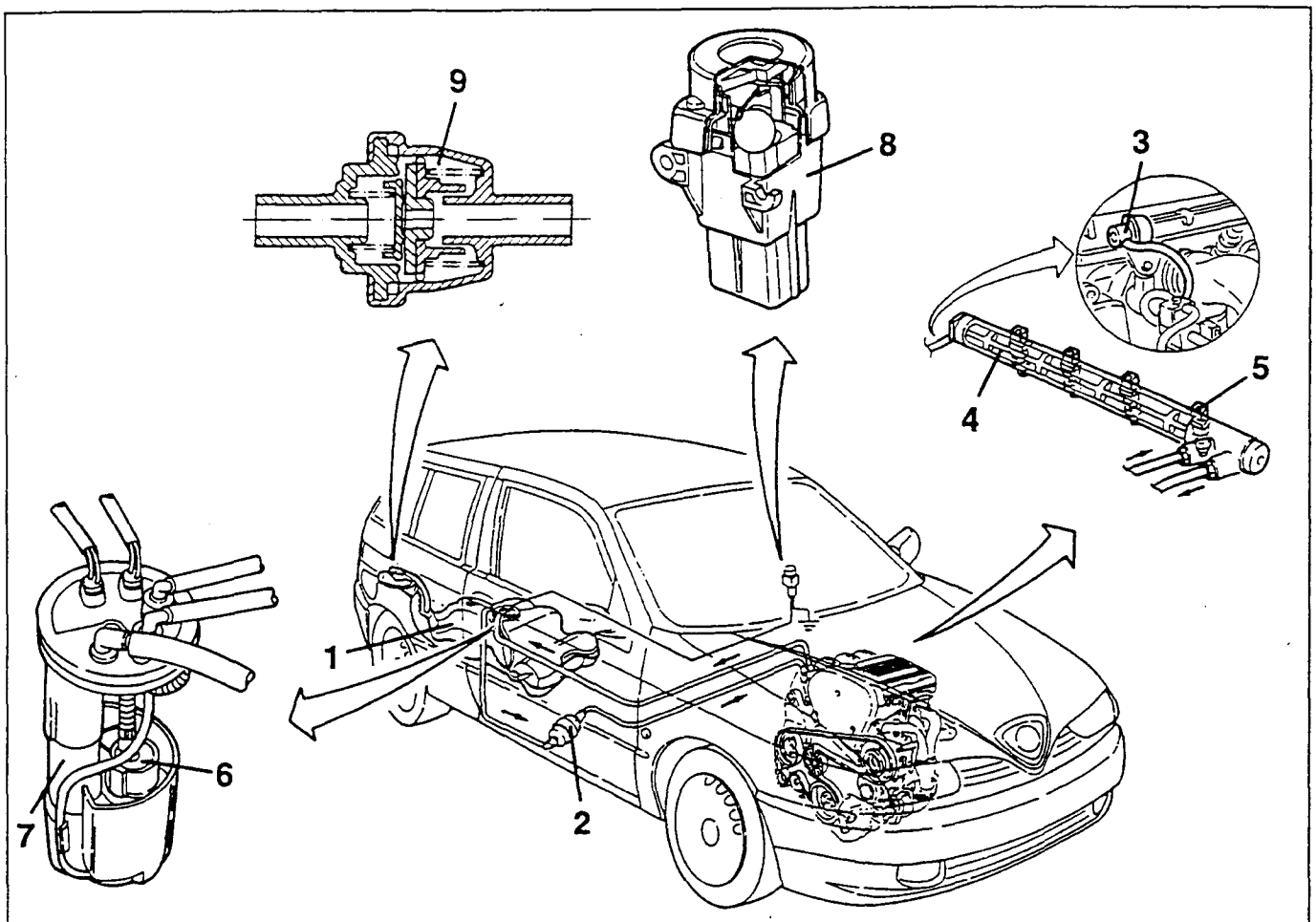
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection of the speedometer sensor.
2. Raise the car and using wrench no. 1.822.161.000, slacken and remove the speedometer sensor.



DESCRIPTION OF FUEL SUPPLY SYSTEM



1. Fuel tank
2. Filter
3. Pressure regulator
4. Distributor manifold
5. Electroinjectors
6. Electric fuel pump
7. Fuel level gauge
8. Inertial switch
9. Safety valve

The fuel supply circuit comprises an electric fuel pump (6) located in the fuel tank (1) which sends the fuel under pressure through a special tube to the filter (2). From the filter the fuel is sent to the distributor manifold (4) and controlled by the vacuum withdrawn from the intake box it returns to the fuel tank through the distributor and a special pipe.
The amount of fuel injected depends solely on the inejection time which is controlled by the control unit.
The different sections of the fuel pipes are connected by special connectors (for their disconnection see specific paragraph).

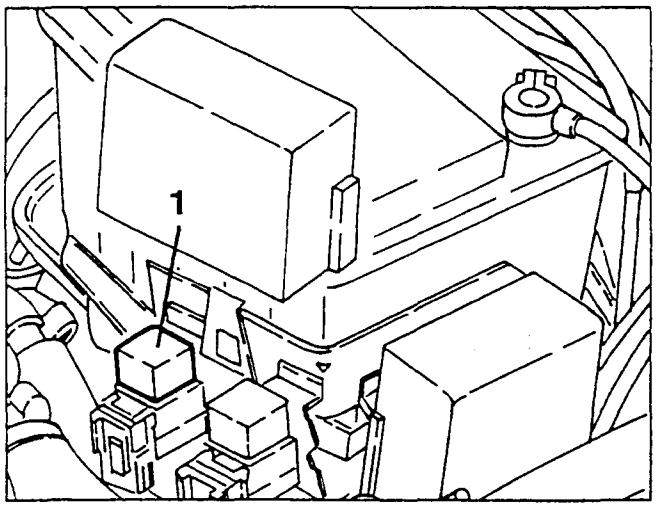
The fuel supply system is fitted with an inertial switch (8) which is triggered in the event of a crash, cutting off the connection to earth of the fuel pump thereby also the injection system supply.

Notes on serviceable fuels:
correct operation of the engine requires the use of unleaded fuels (95 R.O.N.) as the presence of lead would quickly bring about consumption of the catalytic converter at the exhaust.

NOTE: For the description and removing/refitting of the components of the fuel supply system not described here, refer to the 1712 16V Boxer engine.

CAUTION

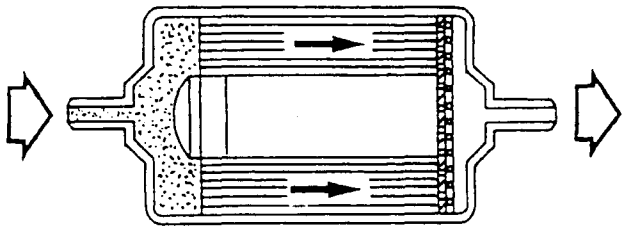
Before doing any work on the components of the fuel supply system, proceed as follows to prevent dangerous leaks of fuel:
- Remove the protective cap and disconnect the fuel pump supply relay (1).



- Run the engine until it stops.

FUEL FILTER

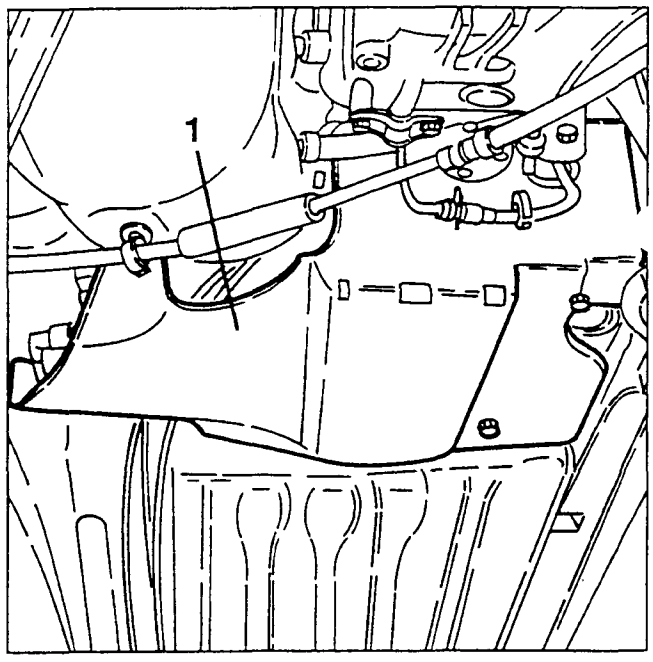
The filter is inserted in the delivery pipe to the injectors, under the car floor next to the fuel tank.
It is formed of an outer aluminium casing and an inner polyurethane support which carries a paper element with high filtering power.
Filtering of the fuel is absolutely necessary to ensure correct functioning of the injectors as they are highly sensitive to foreign matter in the supply circuit.



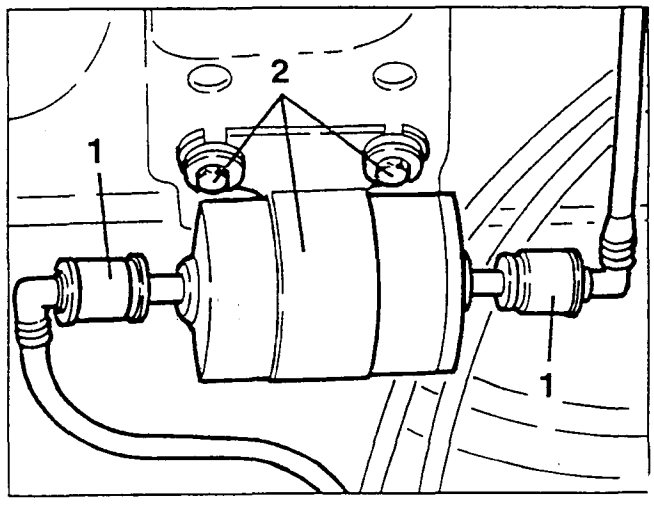
An arrow on the outer casing of the filter points in the direction of the flow of the fuel, therefore the correct assembly position.

REPLACEMENT

- Set the car on a lift and raise it.
1. Slacken the fastening screws and remove the plastic cover to gain access to the fuel filter.



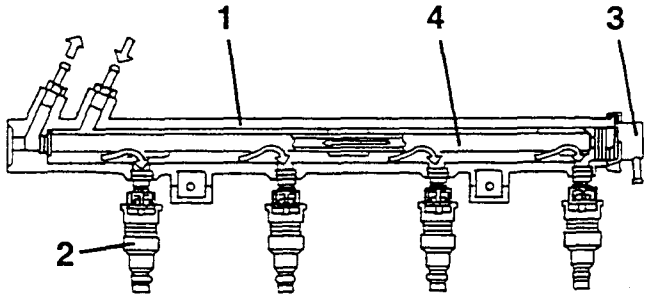
1. Disconnect the connections of the fuel inlet and outlet pipes from the filter (see "FUEL PIPE FITTINGS" - Boxer 18V engine)
2. Slacken the two screws fastening the suppor bracket, then remove it complete with fuel filter.
- Separate the fuel filter from the support bracket on the bench.



- Install the new filter so that the arrow stamped on it points in the direction of the flow of fuel.

FUEL DISTRIBUTOR MANIFOLD

This device is die-cast and incorporates the pressure regulator and the injectors fastened on the manifold itself by special catches.
The fuel returns to the tank through a pipe contained inside the manifold connected to the fuel pressure regulator.

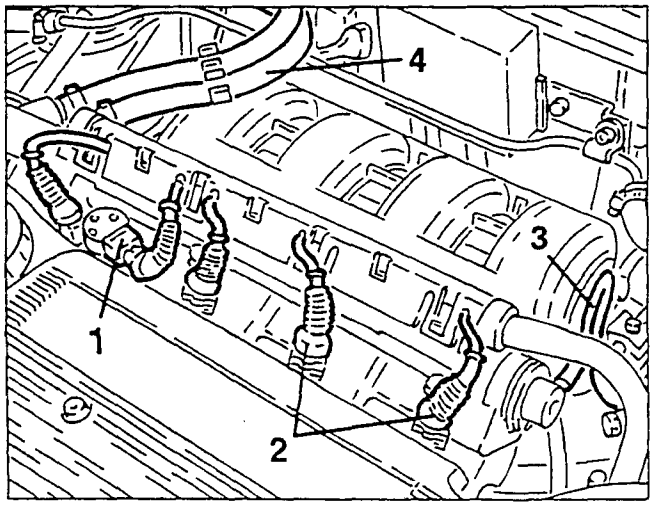


1. Fuel distributor manifold
2. Electroinjectors
3. Pressure regulator
4. Excess fuel return pipe

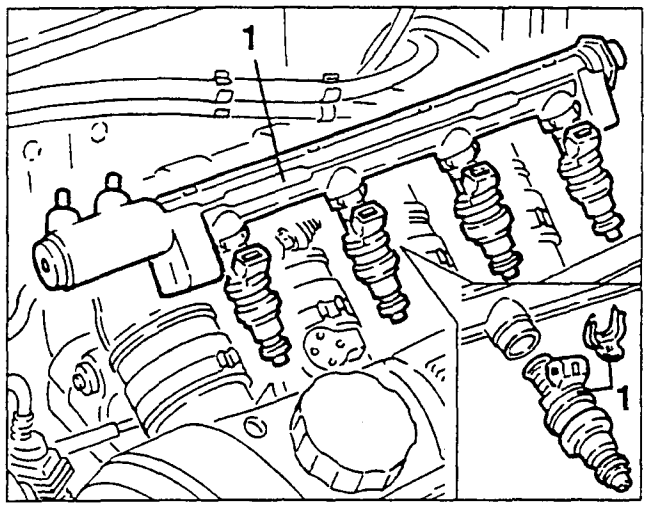
NOTE: Never wash the fuel distributor manifold with aggressive fluids, this operation may only be carried out on the outside using a brush. Otherwise, damage may occur to the seals (O-rings) and to the return circuit plastic piping.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the timing variator electromagnet.
2. Disconnect the electrical connection from the injectors, then move aside the wiring after removing the cover.
3. Disconnect the vacuum takeoff pipe from the pressure regulator.
4. Disconnect the fuel return and delivery pipes from the distributor manifold.



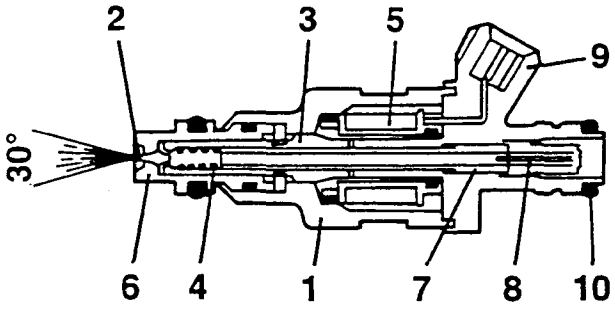
1. Slacken the two fastening screws and remove the fuel distributor manifold complete with injectors and pressure regulator and, if necessary, separate them on the bench.



ELECTROINJECTORS

The electroinjectors are installed on a new aluminium distributor manifold which on one side incorporates the pressure regulator.
The injector nozzle is formed so that the jet of fuel atomizes into a 30° cone.
The injectors are locked by the fuel distributor which presses them into their housings machined on the intake ducts.
The injectors are also anchored to the fuel distributor by "safety catches" and sealed by two O-Rings.
The electroinjectors have the task of metering the amount of fuel needed by the engine.
They are "ON-OFF" devices i.e. they only have two possible conditions, either open or closed.
They will let the fuel pass when they are "open" and prevent it from being delivered when they are "closed".
They basically comprise a nozzle controlled by an electromagnet and by a return spring.
In the rest position, the needle, which forms one piece with the core, is pushed by the spring onto the electroinjector nose to close the hole and ensure that unwanted fuel is unable to come out.
As soon as the winding is energized, the core is attracted, it compresses the spring opening the nozzle hole, thereby allowing the fuel to flow out.

Considering the physical characteristics of the fuel (viscosity, density) and the pressure difference (pressure regulator) constant, the amount of fuel injected depends on the injector opening time only.
The winding energizing time is normally called the "injection time".



1. Injector body
2. Needle
3. Magnetic core
4. Helical spring
5. Winding
6. Injector nose
7. Adjustable pressure plate
8. Filter
9. Electrical connection
10. Seal rings

CHECKING FOR CORRECT OPENING OF ELECTROINJECTORS

- Measure the quantity of CO at the exhaust.
- Disconnect the electroinjector connectors one by one; each time measure for a reduction of the CO quantity at the exhaust and check that this value remains constant at each check.
- If not, locate and replace the faulty electroinjector; in any case a visual index of the efficiency of the electroinjectors is given by the spark plug electrodes:
• a mixture which is too rich corresponds to a black colour.
• a mixture which is too lean corresponds to a light colour.

CHECKING THE SEALING OF ELECTROINJECTORS

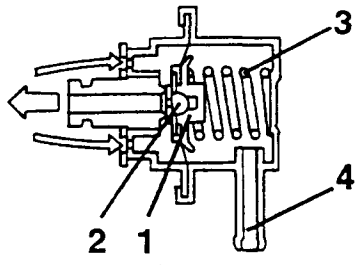
- Remove the electroinjectors complete with fuel distributor manifold, keeping the fuel supply circuit connected.
- Disconnect the electrical connections from the electroinjectors.
- Operate the starter motor and check that there are no leaks of fuel from the electroinjectors; if so replace the faulty injector.

REMOVAL/REFITTING

Proceed as described in the procedure "Fuel distributor manifold - Removal/Refitting".

FUEL PRESSURE REGULATOR

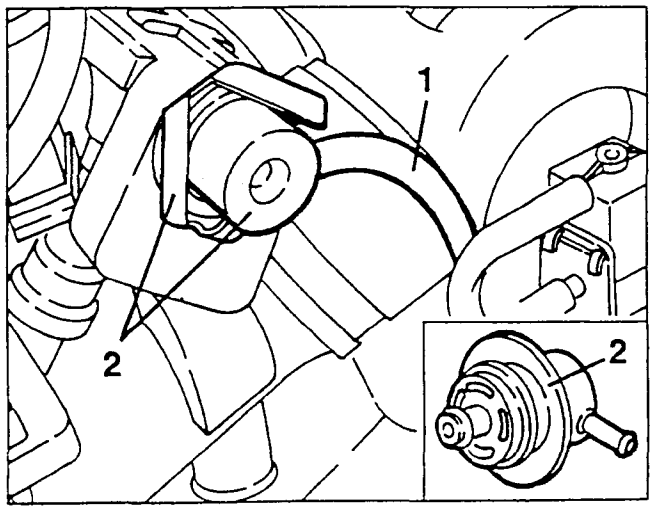
The purpose of the pressure regulator is to keep the difference between the pressure of the fuel and the pressure in the intake box constant.
This way it is possible to meter the amount of fuel solely on the basis of the injector opening time.
The pressure regulator is fitted ddirectly on the fuel distributor manifold.
It is a limiting regulator a diaphragm which regulates the fuel pressure to appr. 3 bar.
When the fuel pressure exceeds the maximum rating, the diaphragm acts on a valve which opens the return pipe, through which the excess fuel is returned to the fuel tank.
A tube connects the regulator spring chamber to the air intake box.
An interdependence is created by this connection between the pressure in the fuel circuit and the pressure in the intake manifold, so that the pressure between the inlet and outlet of the electroinjectors is always the same, when they are open.



1. Diaphragm
2. Flow valve
3. Adjustment spring
4. Vacuum takeoff

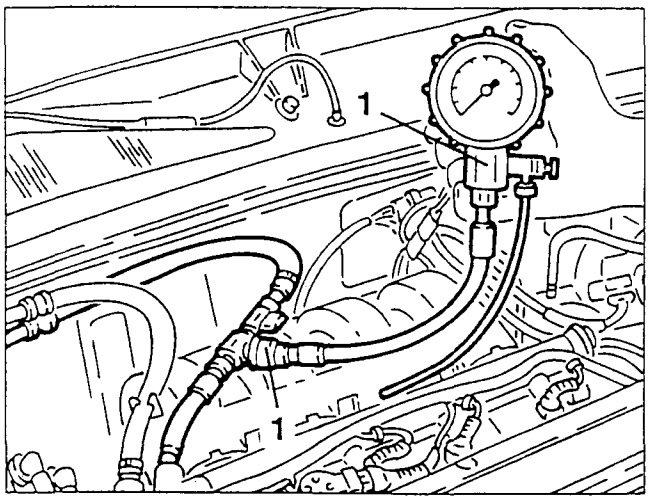
REMOVAL/REFITTING

1. Disconnect the vacuum takeoff pipe from the fuel pressure regulator.
2. Remove the catch and withdraw the fuel pressure regulator complete with O-Ring from the fuel distributor manifold.



CHECKING THE PRESSURE AND TIGHTNESS OF THE FUEL CIRCUIT

1. Disconnect the fuel delivery pipe from the distributor manifold, then connect a pressure gauge, using a "T" adapter, between the damper and the disconnected pipe.

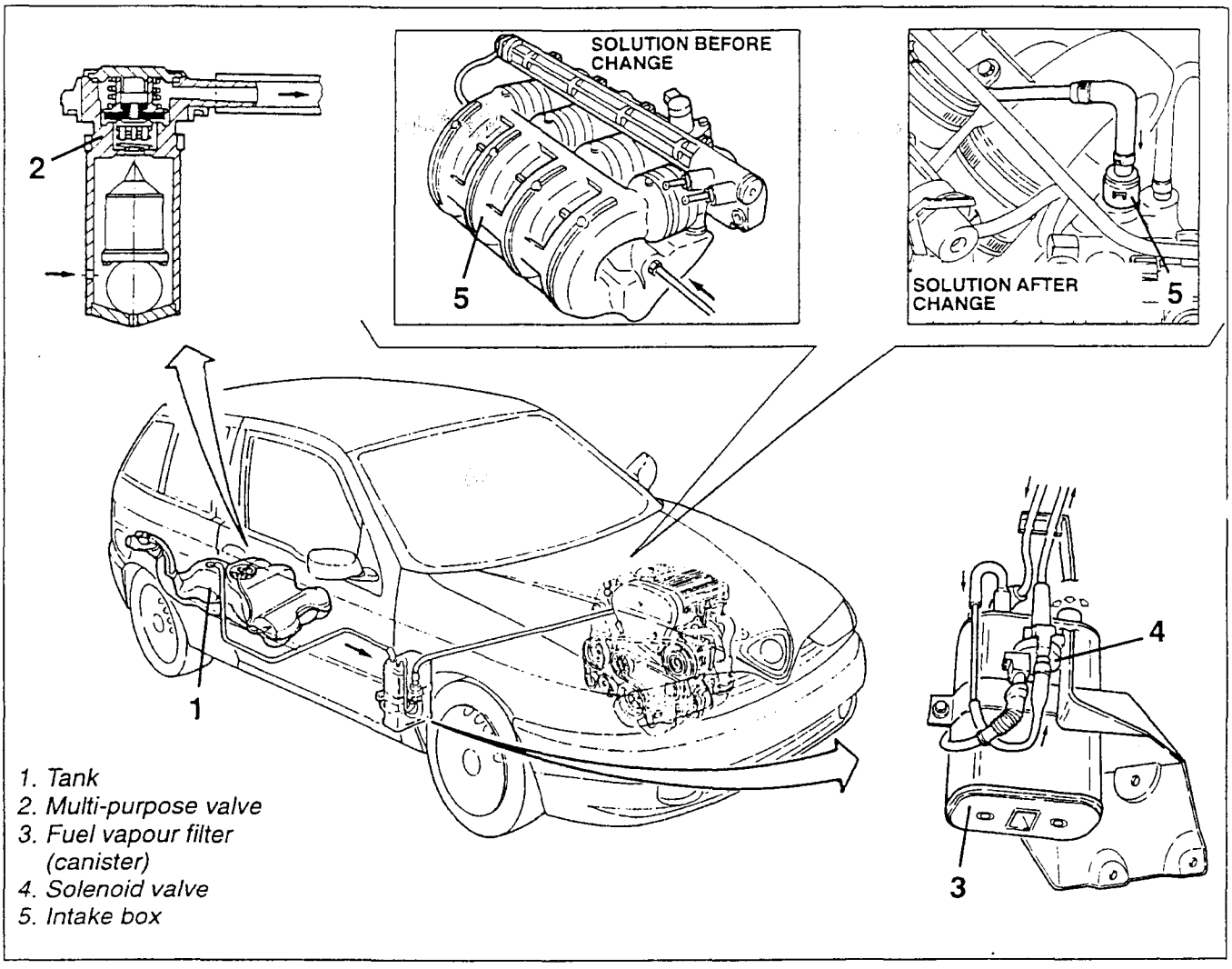


- Disconnect the fuel pressure regulator vacuum takeoff pipe to avoid any irregularities in the rotation speed from causing abnormal readings.
- Start the engine and at idle speed check that the fuel pressure is within the specified limits.

Fuel pressure at idle speed
2.8 ÷ 3.2 bar

- Reconnect the vacuum takeoff pipe on the regulator and check that the fuel pressure falls by ~ 0.5 bar and then rises again when the throttle valve opens.
If this fails to occur, look for any leaks in the vacuum takeoff pipe.
- Keeping the vacuum takeoff pipe connected to the regulator and with the engine running at idle speed, choke the distributor manifold outlet pipe noting the increase in pressure up to ~ 4 bar (do not allow the pressure to exceed this rating).
- If the pressure does not reach this rating and no leaks are detected, check the fuel filter and/or that the pump is working properly.

DESCRIPTION OF FUEL VAPOUR RECOVERY SYSTEM



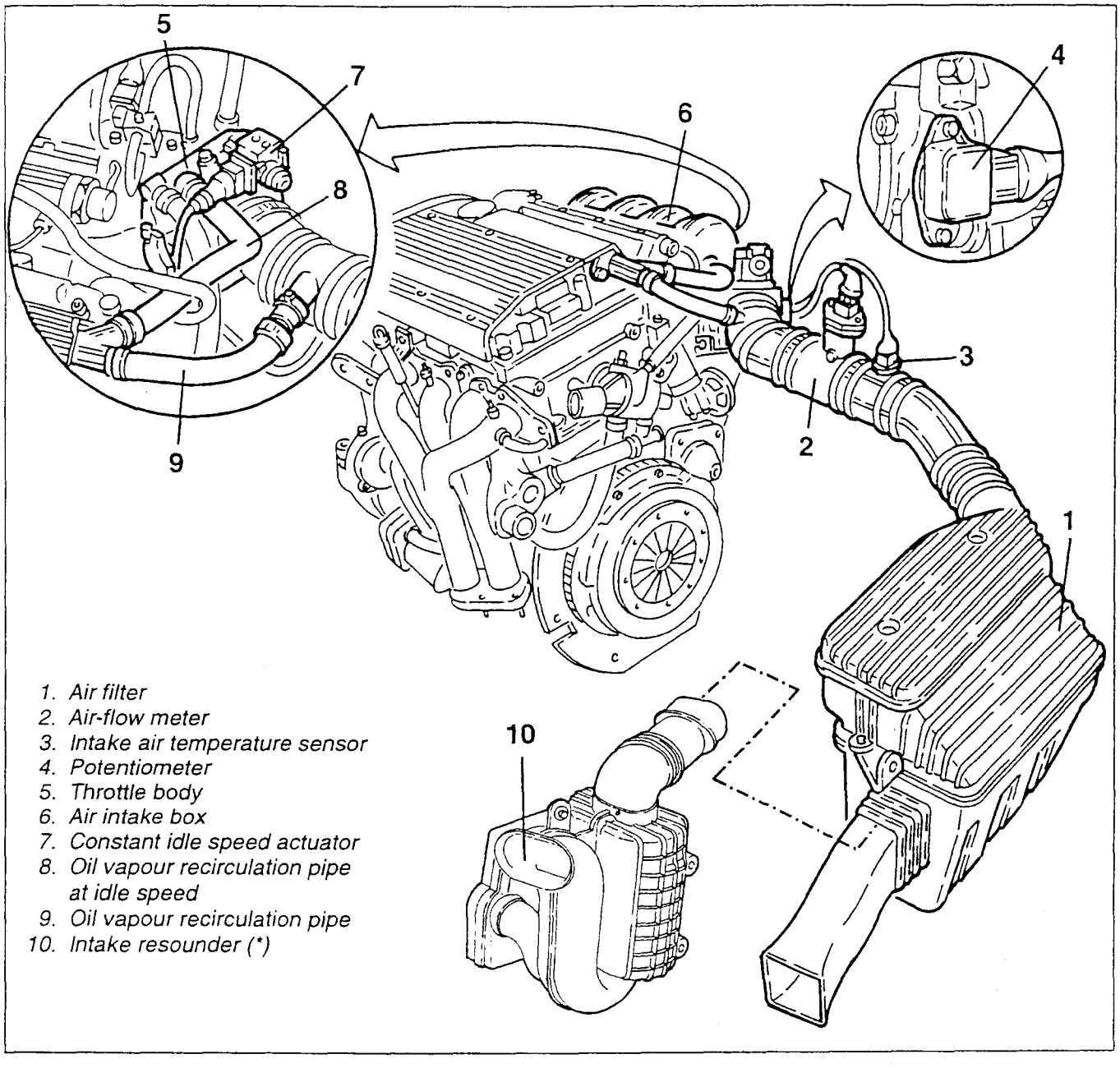
1. Tank
2. Multi-purpose valve
3. Fuel vapour filter (canister)
4. Solenoid valve
5. Intake box

The fuel contained in the tank (1) produces a considerable amount of vapours, which would pollute the environment if released.
The vapour control and recovery system gathers these vapours and burns them in the engine.
When the pressure inside the fuel tank reaches 0.038 ÷ 0.053 bar, the multi-purpose valve (2) opens to send the vapours to the fuel vapour filter "canister" (3) via a special pipe. The canister absorbs and stores the vapours in the active carbon contained in the filter.
There is a solenoid valve (4) between the fuel vapour filter and the intake box (5): when the solenoid valve is not activated the connection with the intake is closed and the fuel vapours are collected in the canister.
Under certain load conditions the Motronic control unit controls the opening of the solenoid valve allowing any fuel vapours in the canister to be withdrawn.

This condition remains even if at the exhaust the lambda sensor detects a reduction of oxygen which, due to the presence of too much fuel in the combustion chamber, is signalled to the control unit which delivers less fuel to the injectors so that the engine is always supplied under optimal conditions.
If there is a lack of fuel vapours in the canister, resulting in withdrawing only air, the lambda sensor detects this and signals the control unit of an increase in the oxygen.
In this case the control unit closes the solenoid valve thus preventing the connection of the canister with the intake box, thereby eliminating the excess air.

NOTE: For the description and removing/refitting of the components of the fuel vapour recovery system see the 1712 16V BOXER engine

DESCRIPTION OF AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM



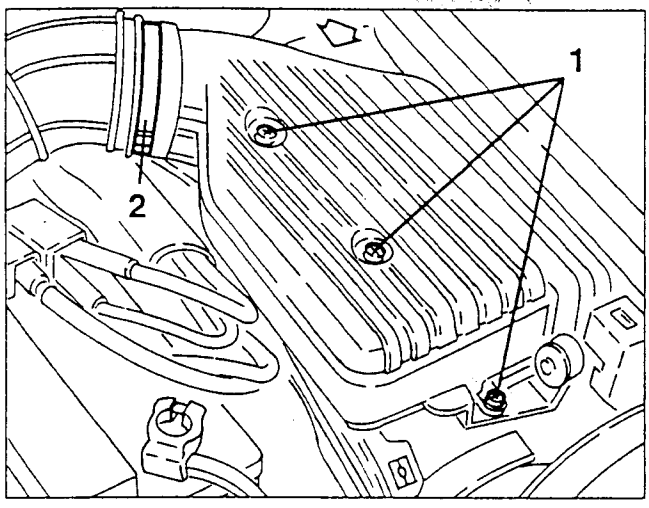
1. *Air filter*
2. *Air-flow meter*
3. *Intake air temperature sensor*
4. *Potentiometer*
5. *Throttle body*
6. *Air intake box*
7. *Constant idle speed actuator*
8. *Oil vapour recirculation pipe at idle speed*
9. *Oil vapour recirculation pipe*
10. *Intake resounder (*)*

(*): From chassis no. ..... the air intake system is fitted with intake resounders (for removing refitting see specific parafraph).

The air, drawn in through a dynamic inlet and filtered by a cartridge element (1), reaches the throttle body (5) through the corrugated sleeve on which the hot film air-flow meter (2) and the intake air temperature sensor (3) are fitted.
The latter, controlled by the accelerator cable, adjusts the amount of air drawn into the box (6).
On one side of the throttle body there is the potentiometer (4) fastened to the pivot pin of the throttle itself which informs the control unit of the position of the throttle.
Still on the throttle body there is an additional air solenoid valve (7) which by-passes the throttle via a special groove to keep engine idle rpm constant under particular operating conditions of the engine.
The fuel vapours (see specific paragraph) and the oil vapours flow to the air supply system.
The oil vapours are formed when the engine is running and they are collected in the cylinder head from which the condensed oil returns to the crankcase, while the remaining vapours are sent to the intake through two pipes. When the engine is running at idle speed the oil vapours are ducted to the throttle body through the special pipe (8).
At higher loads, the vapours are sent upstream of the throttle valve through a pipe (9) connected with the corrugated sleeve and then burnt in the engine.

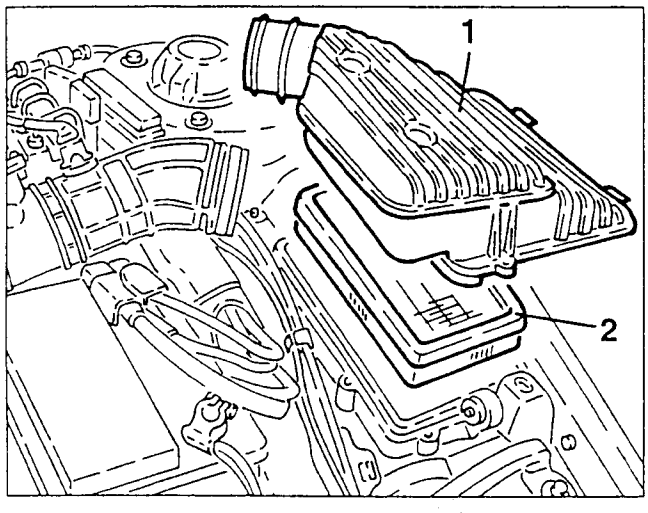
CHANGING THE AIR CLEANER CARTRIDGE

1. Slacken the four air cleaner cover fastening screws.
2. Slacken the clamp fastening the air claner cover to the corrugated sleeve.



1. Remove the air cleaner cover.
2. Remove the air cleaner cartridge.

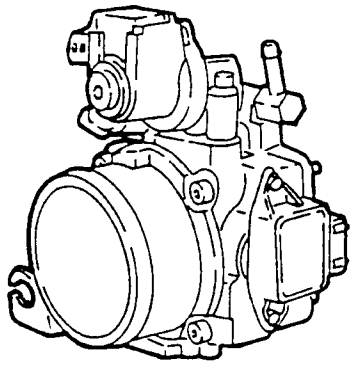
WARNING:
Any filter cleaning operation might damage it, thereby adversely affecting the correct operation of the engine.



THROTTLE BODY

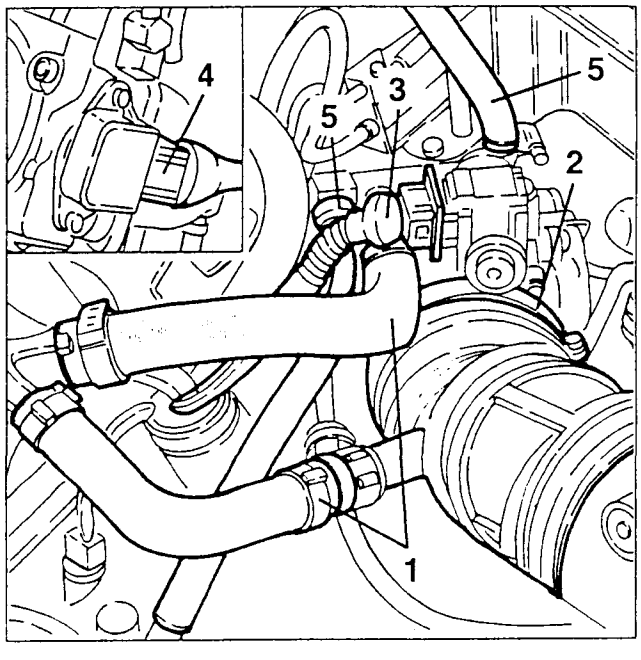
The throttle body adjusts the amount of air sent to the intake box in relation to the position of the accelerator pedal.

In fact, the accelerator acts on a specific sector of pulley locked on the throttle valve pivot pin.
A coil spring allows the throttle to return to the closed position.
To prevent the formation of ice on the throttle valve which would prevent it from closing, the throttle body is heated by the engine coolant fluid.
The constant idle speed actuator is installed directly on the throttle body.

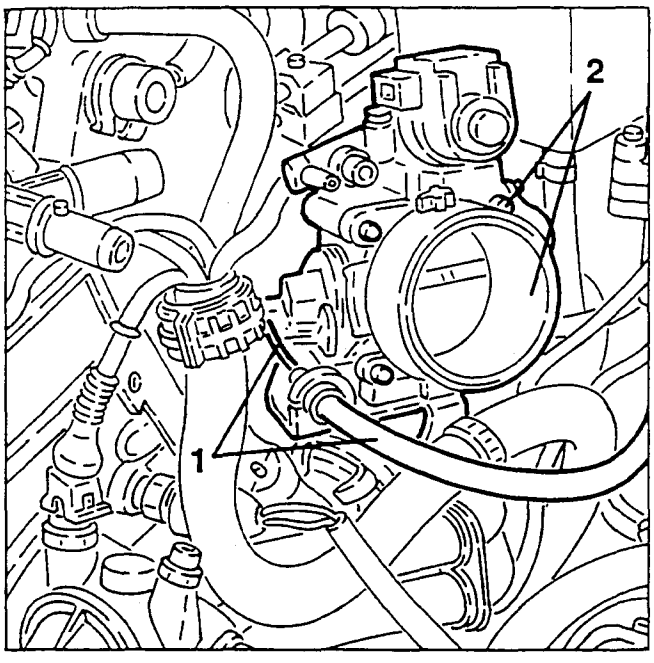


REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the oil vapour recirculation pipes from the throttle body and from the corrugated sleeve.
2. Slacken the fastening clamp and disconnect the corrugated sleeve from the throttle body.
3. Disconnect the electrical connection from the constant idle speed actuator.
4. Disconnect the electrical connection from the throttle potentiometer.
5. Disconnect the two engine coolant fluid inlet and outlet pipes from the throttle body.



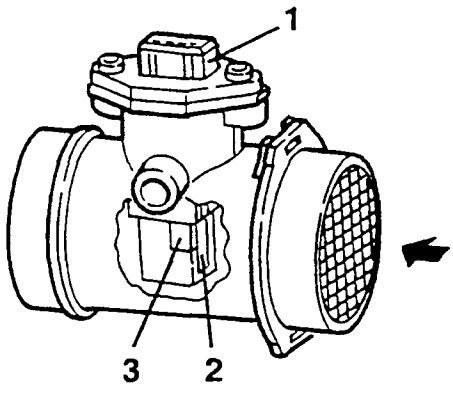
1. Disconnect the accelerator cable from the throttle.
- Release the pipes from the fastenings on the bracket under the throttle body.
2. Slacken the four fastening screws and remove the throttle body complete with potentiometer and constant idle speed actuator and separate them on the bench.
- Remove the throttle body seal.



AIR-FLOW METER

The air flow meter is of the "heated film" type.
Its operating principle is based on a heated diaphragm interposed in a measurement duct through which the air admitted to the engine flows.
The hot film diaphragm is kept at a constant temperature (~ 120°C above the temperature of the incoming air) by the heating resistance in contact with it.
The mass of air crossing the measurement duct tends to withdraw heat from the diaphragm, therefore, in order to keep its temperature constant, a certain amount of current must flow through the resistance.
This current is measured by a suitable Wheatstone bridge.
Thus, the current is proportionate with the mass of flowing air.

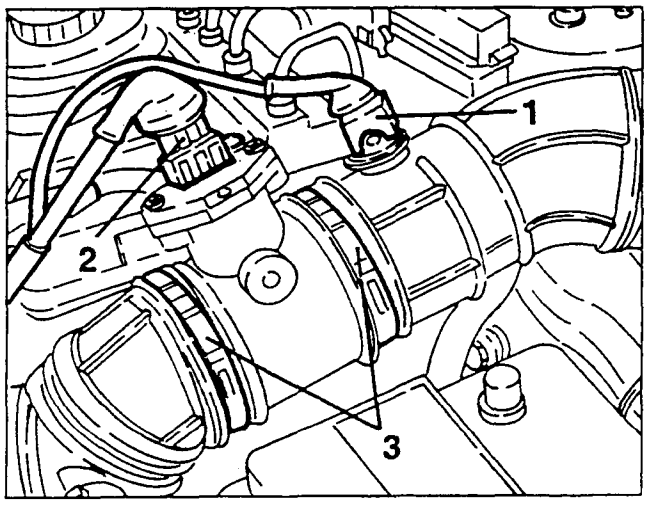
This air-flow meter measures directly the mass of air and not the volume) thereby eliminating problems of temperature, altitude, pressure, etc.
The correct operation of the air flow meter depends on the condition of the air cleaner, which must therefore be checked often.



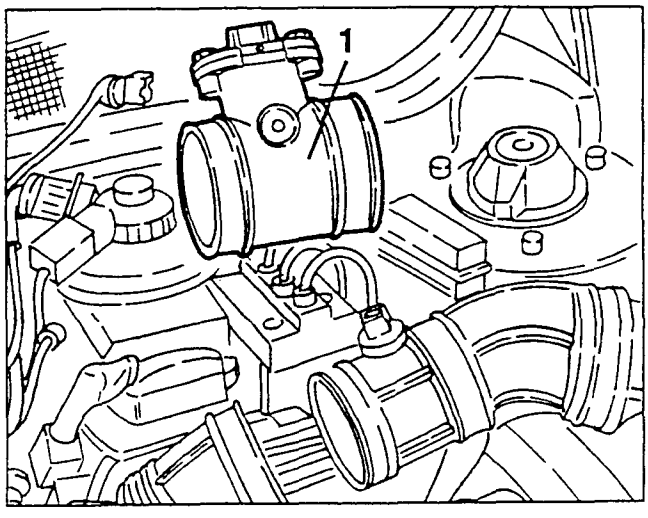
1. Connector *2. Measurement duct*
3. Hot film sensor

REMOVAL/REFITTING

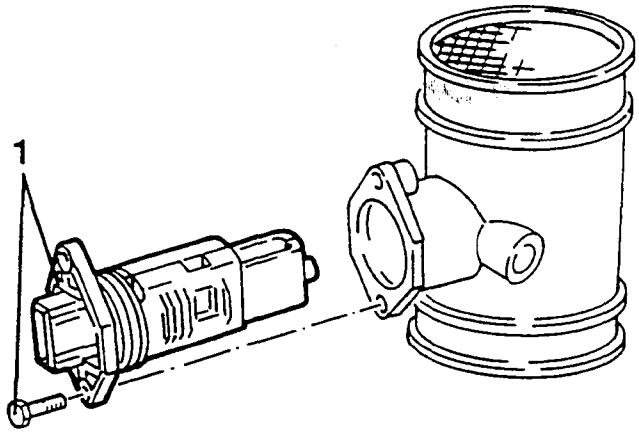
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection of the intake air temperature sensor.
2. Disconnect the electrical connection from the air-flow meter.
3. Slecken the two clamps fastening the corrugated sleeve to the air-flow meter.



1. Withdraw and remove the air-flow meter from the corrugated sleeve.



1. If necessary, slacken the two fastening screws and remove the air-flow meter from its support.

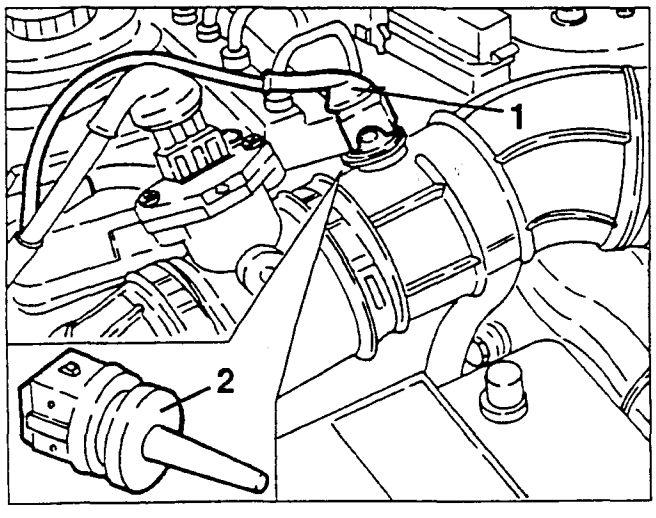


INTAKE AIR TEMPERATURE SENSOR (NTC)

The intake air temperature sensor is located on the air intake corrugated sleeve and measures the temperature of the air through an NTC thermistor with a negative resistance coefficient, i.e. capable of lowering its resistance as the temperature increases.
The electric signal obtained reaches the electronic control unit where it is used to calculate the density of the air.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the intake air temperature sensor.
2. Withdraw and remove the intake air temperature sensor from the corrugated sleeve.

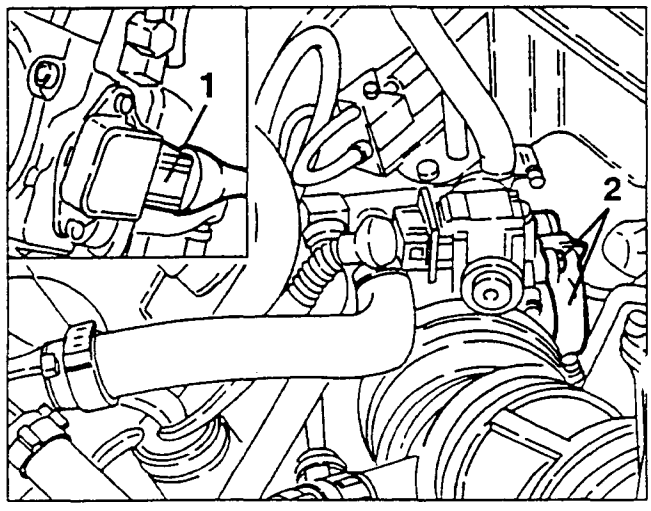


THROTTLE POTENTIOMETER

This is a potentiometer the mobile part of which is controlled directly by the throttle valve shaft.
The potentiometer signals the control unit instantaneously when there is the need for "full power", anticipating the signal from the air-flow meter which records a considerable increase of the flow of air, thereby obtaining a more immediate response.
The potentiometer automatically detects the throttle closed position through a "self-adapting" function.
This eliminates the need for potentiometer adjustment operations and makes it possible to follow in time any wear occurring on the throttle closing position.

REMOVAL/REFITTING

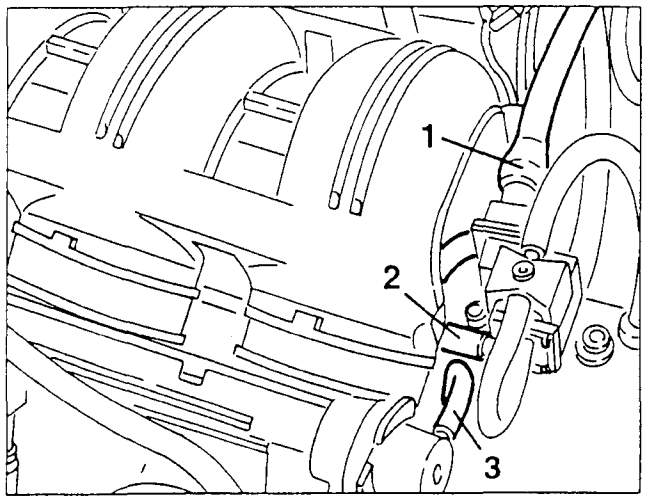
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the throttle potentiometer.
2. Slacken the two fastening screws and remove the throttle potentiometer.



CONSTANT IDLE SPEED ACTUATOR

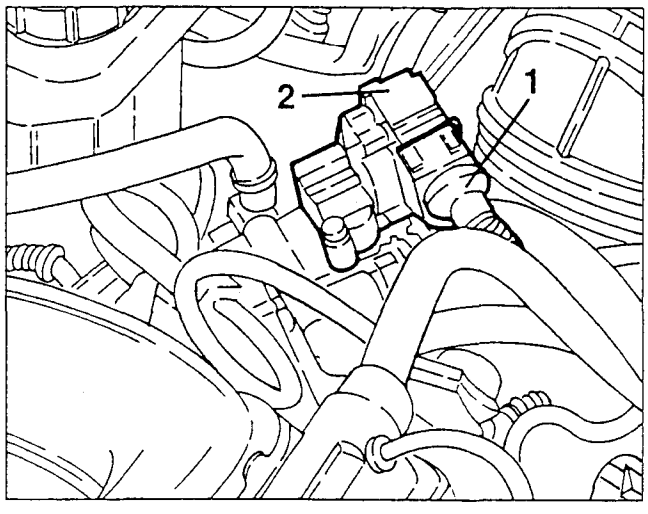
Idle speed rpm is controlled by an actuator fitted directly on the throttle body, but since it is more compact and can be operated individually, it is on the whole more cost- effective and reliable. The actuator adjusts the amount of air taken in by the engine wher the throttle valve is closed. This makes it possible to compensate the power required by the various services (conditioner compressor, power steering, alternator) so that the engine speed remains unaffected.

The opening and closing controls are independent due to a double electromagnetic circuit with considerable advantages in terms of prompt adjustment.
In fact, as the control unit is "self-adaptive", it is necessary to follow and "detect" the changes that occur in the engine (different internal frictions at different temperatures, settling of the engine over the course of time etc.) so that idle speed remains constant under all conditions.
Lastly, in the event of a fault, a spring moves the actuator to an intermediate degree of opening to enable the car to reach an authorised service centre.

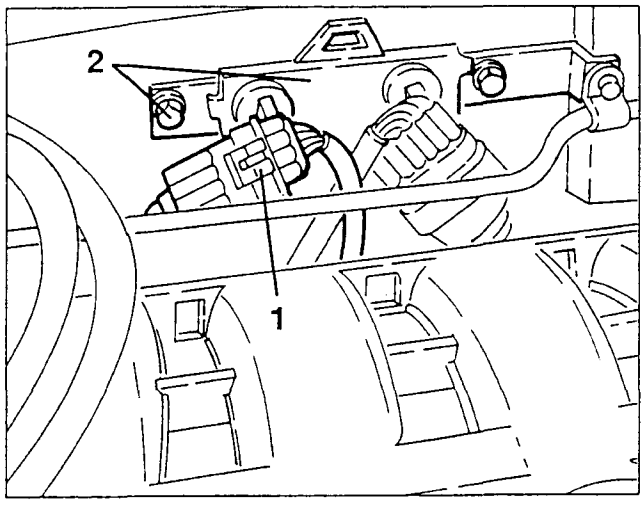


REMOVAL/REFITTING

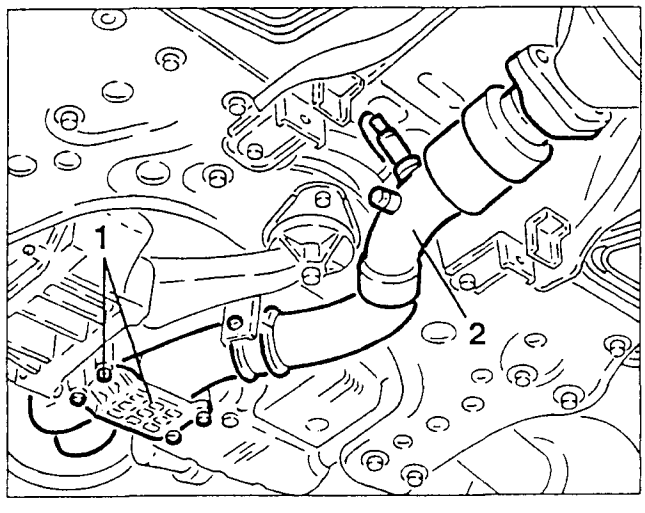
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Slacken the two fastening screws and remove the constant idle speed actuator from the throttle body.
- Remove the seal.



- Disconnect the vauum takeoff pipe from the servobrake.
1. Disconnect the lamda probe connector.
2. Slacken the fastening screws and remove the electrical connection support bracket.



1. Raise the car, slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda probe after slackening the fastenings.

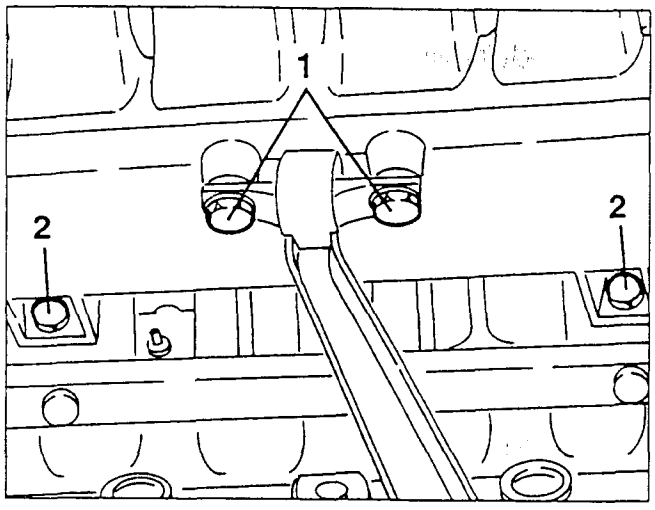


AIR INTAKE BOX

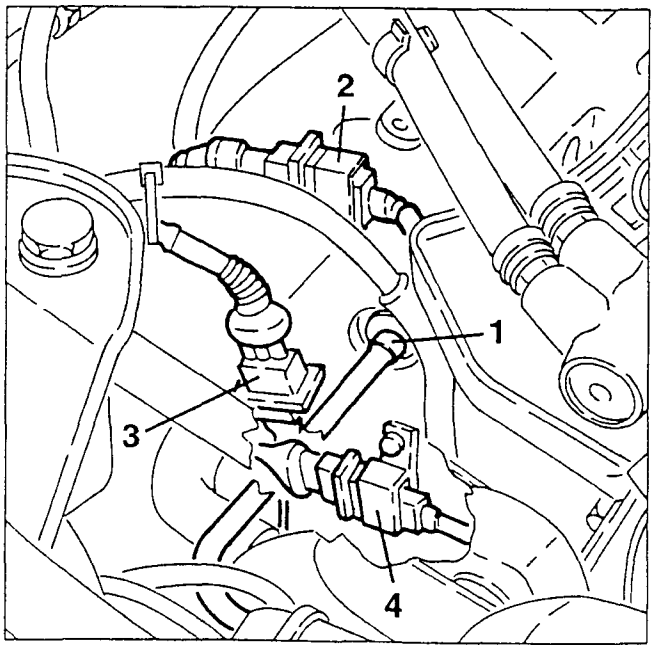
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the throttle body (see specific paragraph).
1. Disconnect the electrical connection from the E.G.R. modulation solenoid valve.
2. Disconnect the E.G.R. valve connection pipe from the modulation solenoid valve.
3. Disconnect the vacuum takeoff pipe for the fuel pressure regulator.

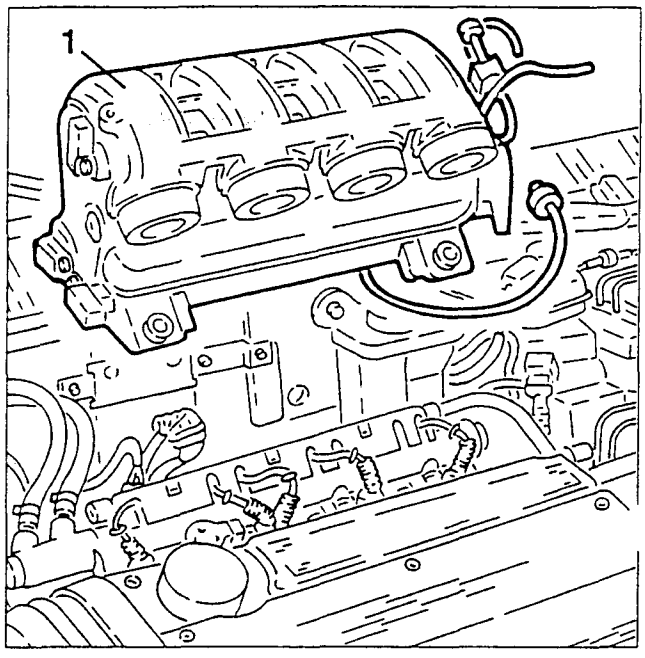
1. Slacken the two screws fastening the support to the intake box.
2. Slacken the two screws fastening the intake box to the cylinder head.



1. Lower the car and disconnect the fuel vapour recirculation pipe from the intake box.
2. Disconnect the electrical connection of the the timing sensor.
3. Disconnect the electrical connection of the pinging sensor.
4. Disconnect the electrical connection of the rpm and timing sensor.



1. Slacken the fastening clamps and remove the intake box pulling it upwards.

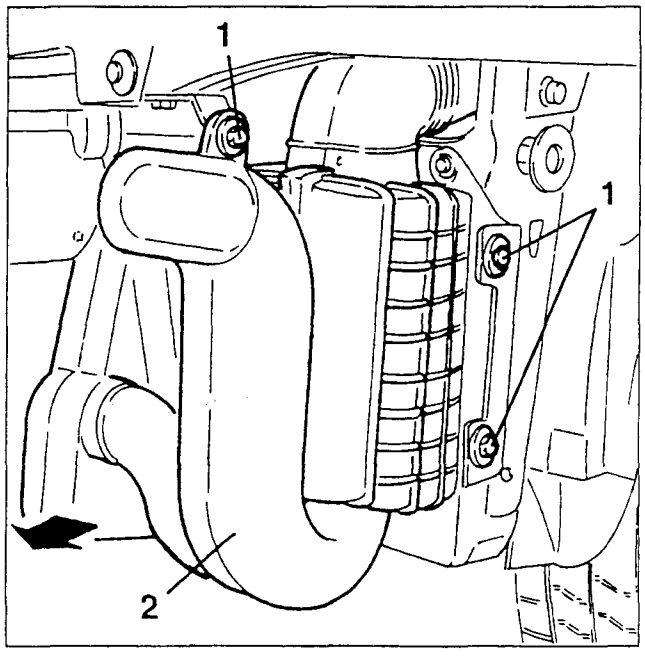


AIR INTAKE RESOUNDER

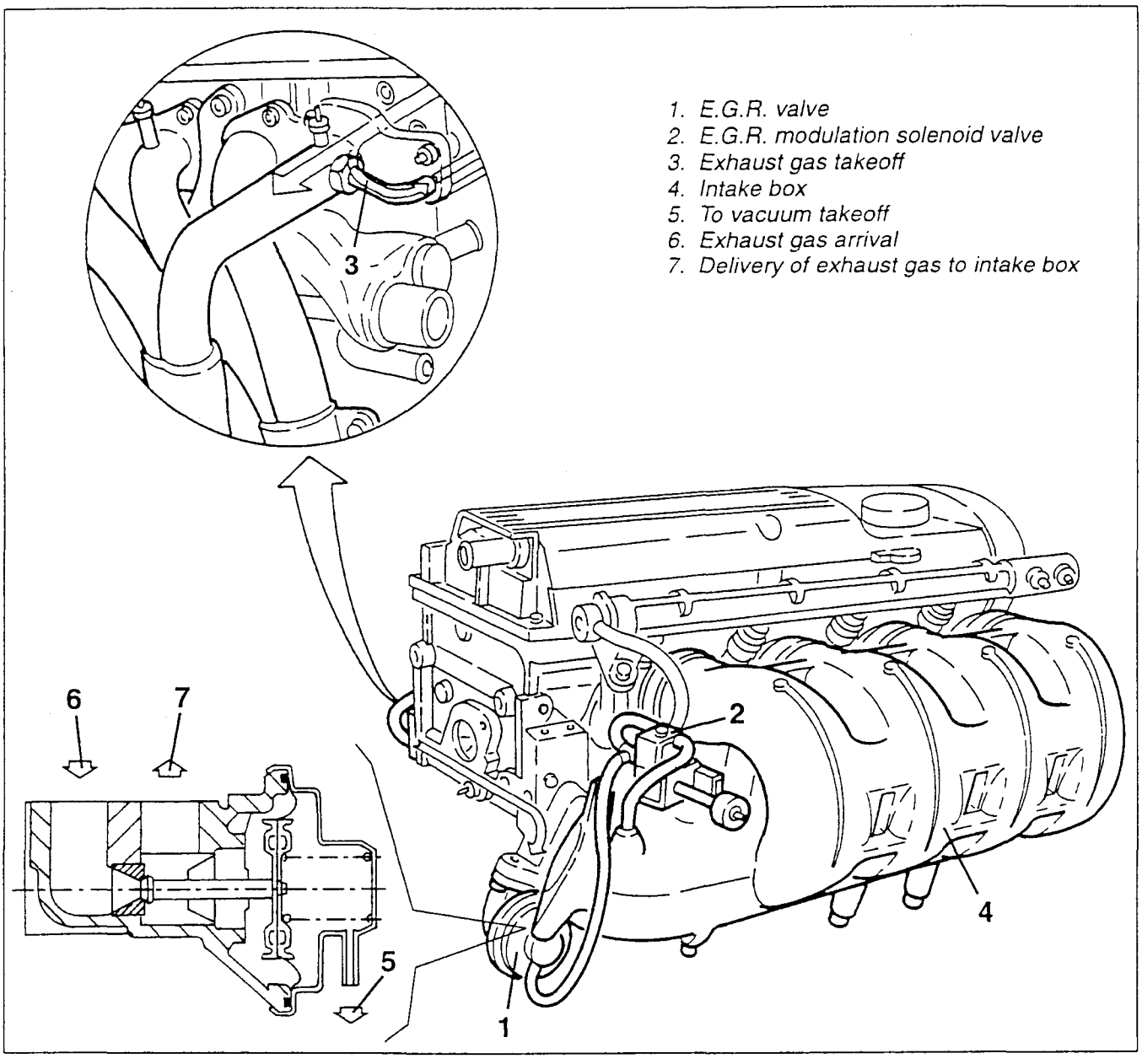
REMOVING/REFITTING

- Set the car on a lift and raise it.
- Remove the front bumper.

1. Slacken the three screws fastening the air intake resounder.
2. Remove the air intake resounder withdrawing it forwards.



DESCRIPTION OF EXHAUST GAS RECIRCULATION SYSTEM
(Specific for versions with M2.10.3 injection - ignition system)



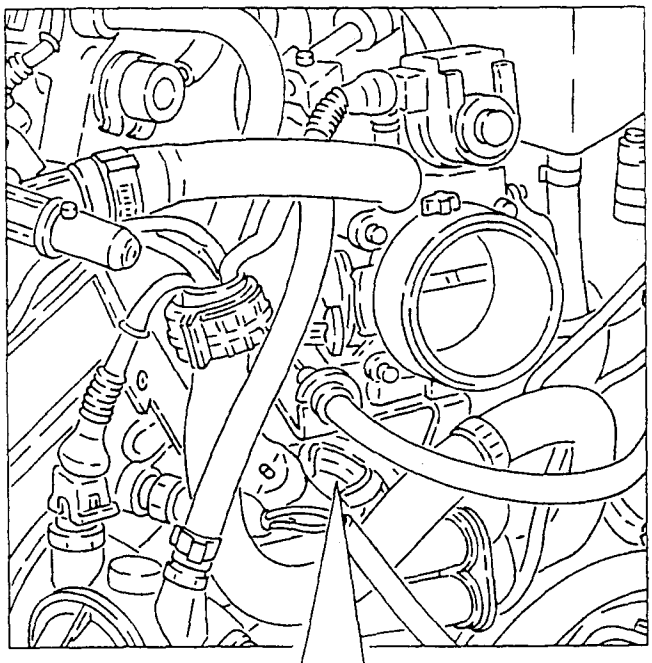
To further reduce emissions of NOx (nitric oxides) the supply system is fitted with an E.G.R. valve (1).
The E.G.R. valve (Exhaust Gas Recirculation) withdraws part of the exhaust gas and returns it to the intake box (4), where it is mixed with the intake air and burnt in the engine.
The E.G.R. valve is operated by the vacuum modulated by the solenoid valve (2) controlled by the MOTRONIC control unit.
The amount of exhaust gas sent to the engine is determined by the MOTRONIC control unit, taking account of the characteristic curve of the E.G.R. control depending on the engine load and speed and on the temperature of the coolant fluid.

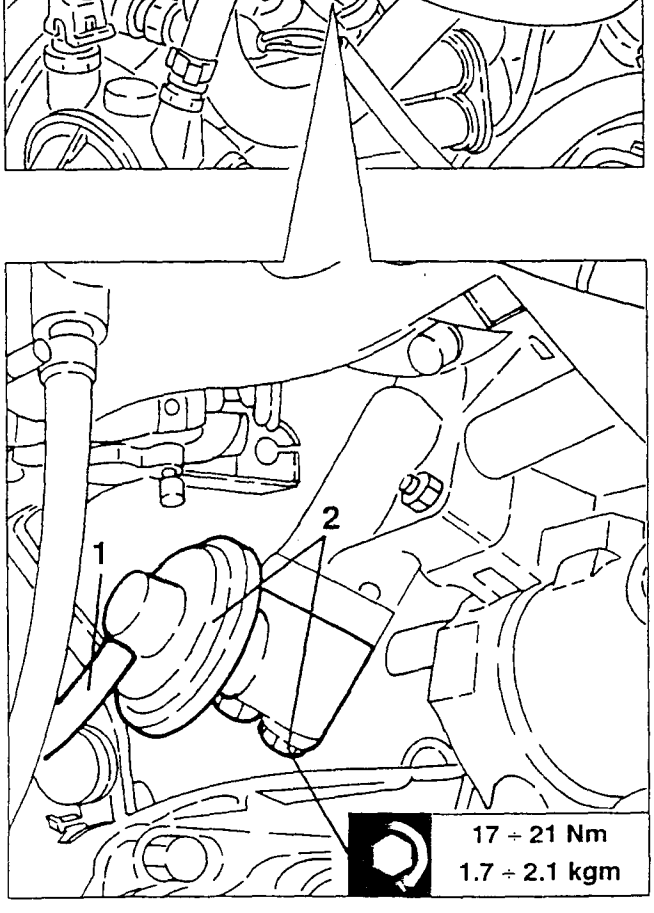
Through the MOTRONIC control unit the solenoid valve modulates the vacuum to be sent to the E.G.R. valve for opening.
The E.G.R. valve is not activated at idle speed, in neutral gear and for engine speeds below 2000 rpm.
When the engine coolant fluid temperature excedds 60°C the E.G.R. valve is operational and it it is completely closed at engine speeds in excess of 4600 rpm.

E.G.R. VALVE

REMOVAL/REFITTING

- Remove the battery.
- Loosen the fastening clamp and disconnect the corrugated sleeve from the throttle body.
1. Disconnect the connection pipe with the modulation solenoid valve from the E.G.R. valve.
2. Slacken the two fastening screws and remove the E.G.R. valve from the intake box.

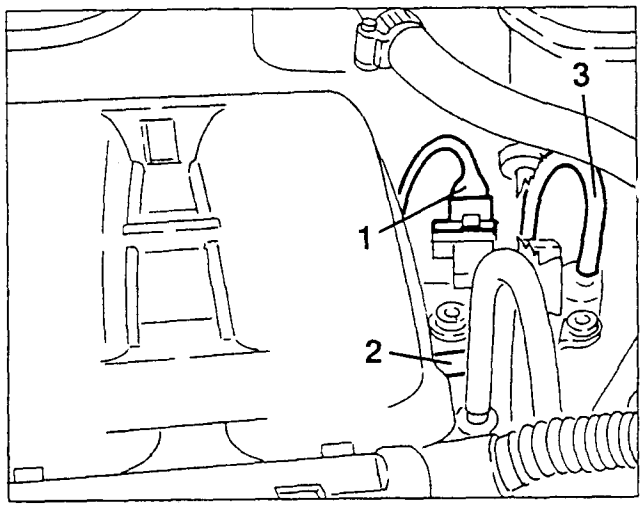




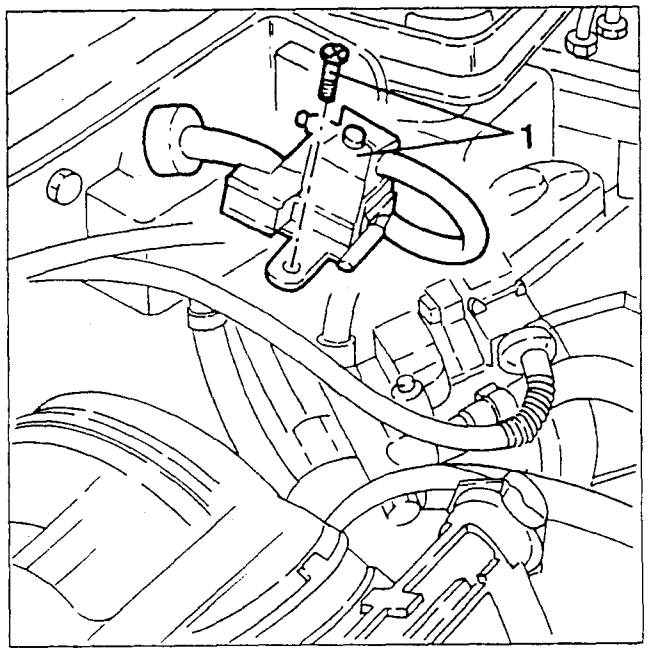
E.G.R. MODULATING SOLENOID VALVE

REMOVAL/REFITTING

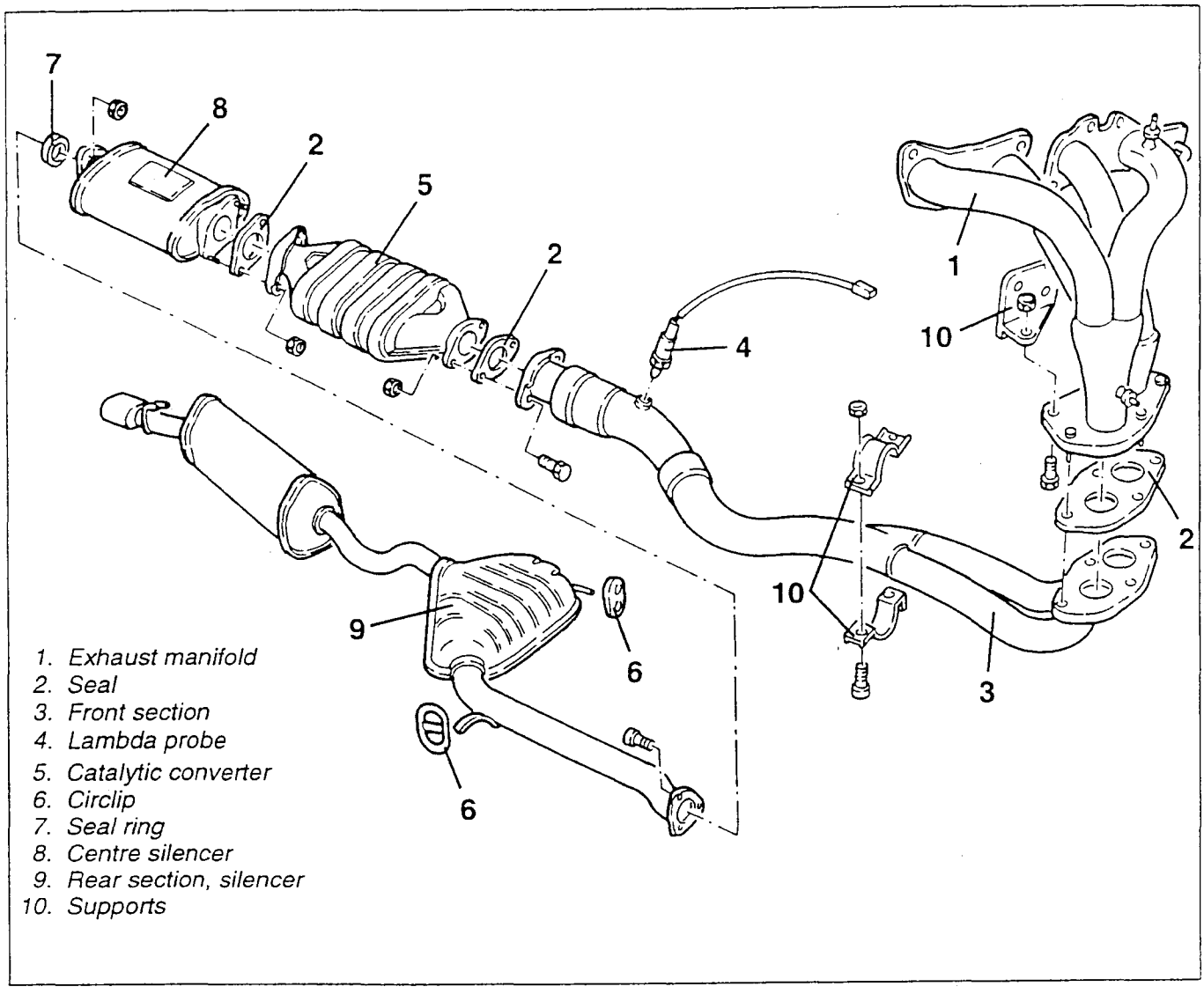
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the E.G.R. modulating solenoid valve.
2. Disconnect the connection pipe with the E.G.R. valve from the modulation solenoid valve.
3. Disconnect the vacuum takeoff pipe from the E.G.R. modulation solenoid valve.



1. Slacken the two fastening screws and remove the E.G.R. modulation solenoid valve.



DESCRIPTION OF EXHAUST SYSTEM (Specific for versions before change)



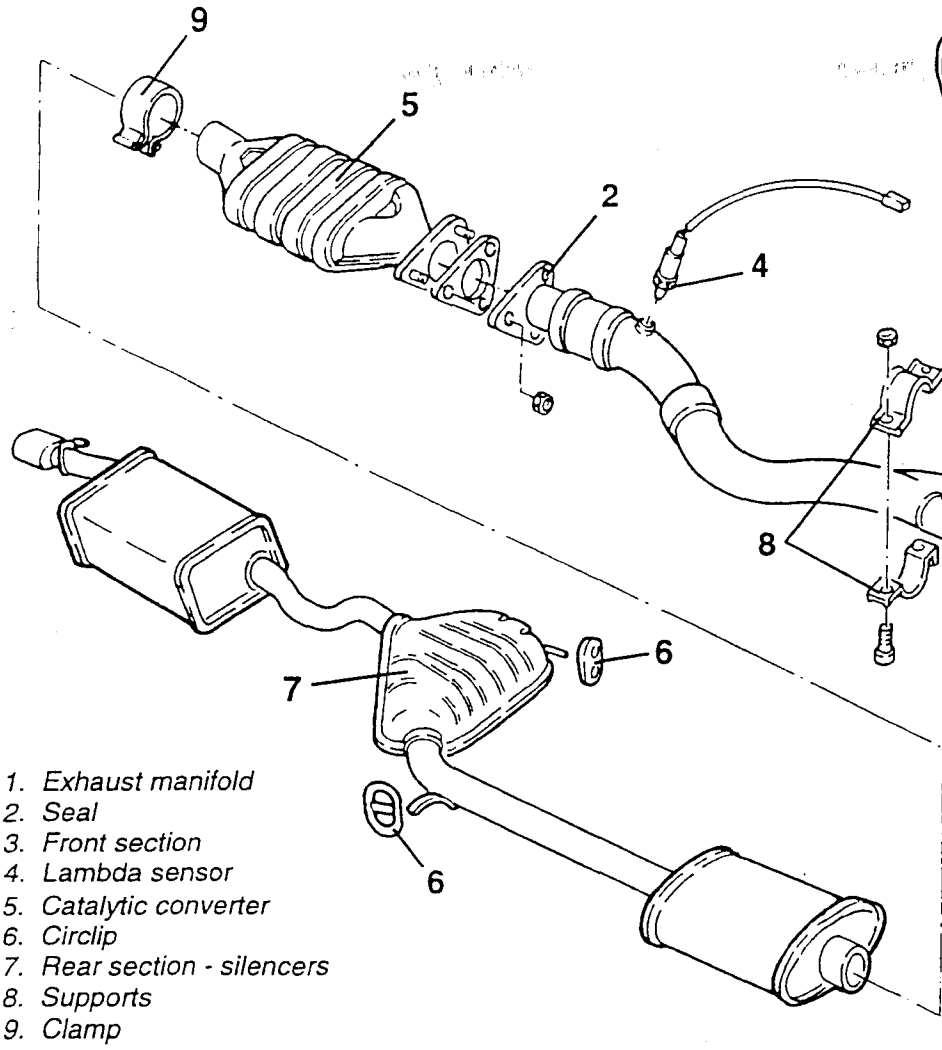
1. *Exhaust manifold*
2. *Seal*
3. *Front section*
4. *Lambda probe*
5. *Catalytic converter*
6. *Circlip*
7. *Seal ring*
8. *Centre silencer*
9. *Rear section, silencer*
10. *Supports*

The exhaust gases from the cylinder head converge in two double manifolds (1) connected below by a single flange.
From here, through the front section of the exhaust pipe (3), they reach the three-way catalytic converter (5) where most of the pollutants are transformed.
On the front section of the exhaust pipe, there is a flexible piece which makes it possible to limit the transmission of vibrations and the exhaust gas takeoff socket downstream of the catalytic converter.
The lambda sensor (4) is fitted on the front section of the exhaust pipe at the the inlet of the catalytic converter and it informs the control unit about the oxygen content in the exhaust gas, making it possible to adapt injection times to keep the stoichiometric ratio (air - fuel) at an optimum level.
The exhaust gas leaves the catalytic converter and crosses the three special silencers (8 - 9).

The connection between the different pieces of the exhaust pipe is made by flanges with seals. Restraint to the body is by brackets with flexible supports.
Heat radiation towards the body which is very high owing to the presence if the catalytic converter, is limited by a set of heat guards between the exhaust pipe and the body itself.

When the car is running, all the exhaust pipes and the catalytic converter in particular, heat up considerably.
Before doing any work it is therefore necessary to wait for a suitable length of time with the engine off.
Never touch the catalytic converter without adequate protection such as gloves, etc.
Do not put easily inflammable materials near the catalytic converter.

DESCRIPTION OF EXHAUST SYSTEM (Specific for versions after change)



1. *Exhaust manifold*
2. *Seal*
3. *Front section*
4. *Lambda sensor*
5. *Catalytic converter*
6. *Circlip*
7. *Rear section - silencers*
8. *Supports*
9. *Clamp*

The exhaust gases from the cylinder head converge in two double manifolds (1) connected below by a single flange.
From here, through the front section of the exhaust pipe (3), they reach the three-way catalytic converter (5) where most of the pollutants are transformed.
On the front section of the exhaust pipe, there is a flexible piece which makes it possible to limit the transmission of vibrations and the exhaust gas takeoff socket downstream of the catalytic converter.
The lambda sensor (4) is fitted on the front section of the exhaust pipe at the the inlet of the catalytic converter and it informs the control unit about the oxygen content in the exhaust gas, making it possible to adapt injection times to keep the stoichiometric ratio (air - fuel) at an optimum level.
The exhaust gas leaves the catalytic converter and crosses the three special silencers joined in a single section of pipe.
The connection between the different pieces of the exhaust pipe is made by flanges with seals, except for the one between the catalytic convertitor and the silencers which is by a "spy glass" coupling with special clamp. Restraint to the body is by brackets with flexible supports.
Heat radiation towards the body which is very high owing to the presence if the catalytic converter, is limited by a set of heat guards between the exhaust pipe and the body itself.

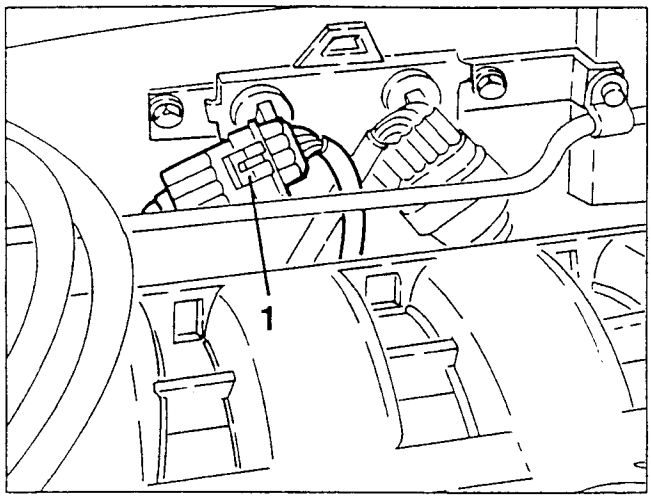
When the car is running, all the exhaust pipes and the catalytic converter in particular, heat up considerably.
Before doing any work it is therefore necessary to wait for a suitable length of time with the engine off.
Never touch the catalytic converter without adequate protection such as gloves, etc.
Do not put easily inflammable materials near the catalytic converter.

EXHAUST, FRONT SECTION

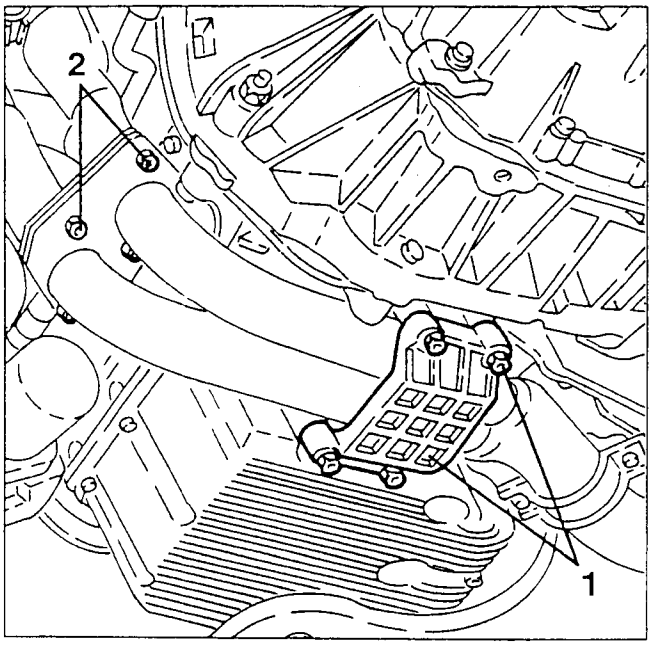
REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

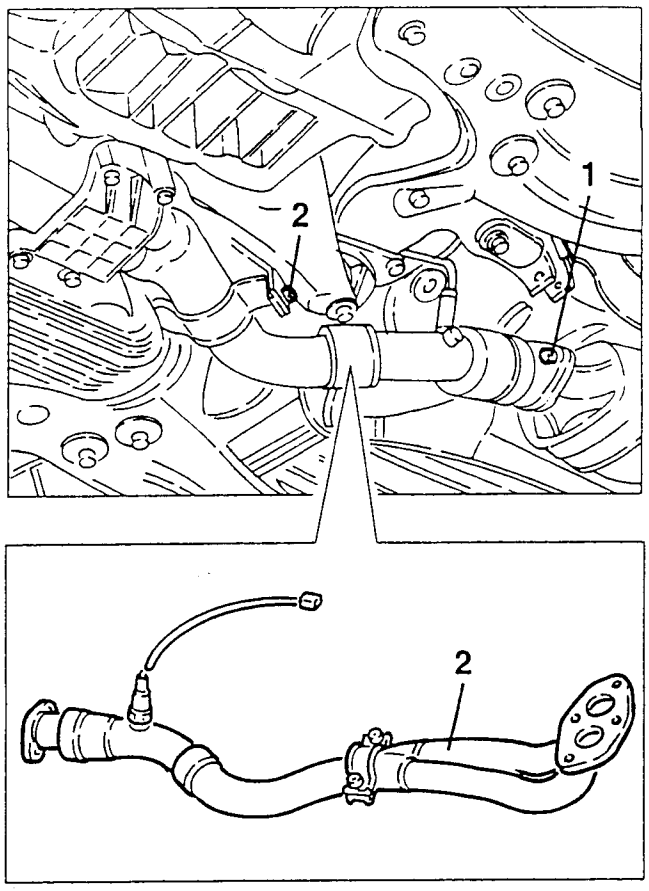
1. Disconnect the lambda sensor electrical connection.



1. Raise the car, slacken the fastening nuts and remove the bracket.
2. Slacken the nuts fastening the exhaust pipe front section to the manifold.



1. Slacken the bolts fastening the exhaust pipe front section to the catalytic converter.
2. Slacken the support bracket bolt, then remove the exhaust pipe front section with the lambda sensor.
- Remove the seals.



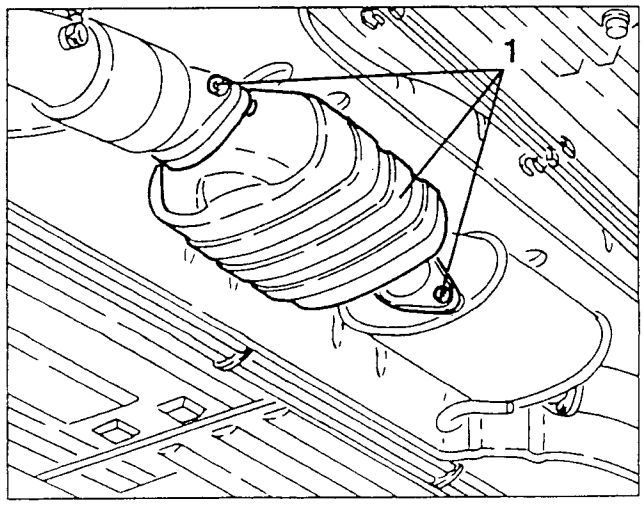
CATALYTIC CONVERTER

NOTE: For the description of the catalytic converter see Boxer 1712 16V engine.

REMOVING/REFITTING (Specific for versions before change)

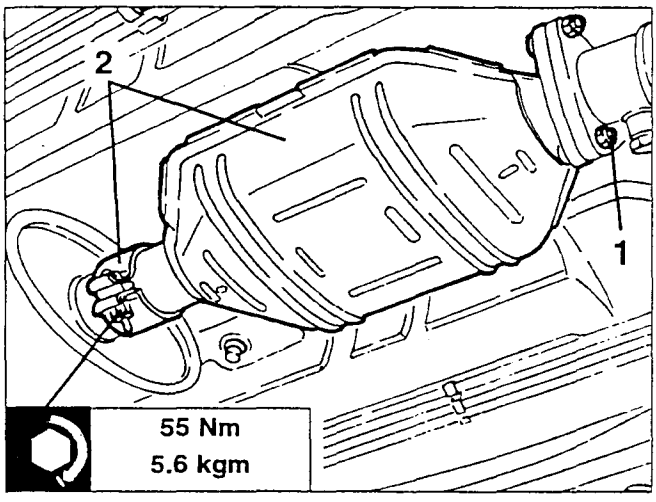
- Set the car on a lift and raise it.

1. Slacken the bolts fastening the catalytic converter to the front section and to the exhaust pipe centre silencer, then remove it.
- Remove the seals.



REMOVING/REFITTING (Specific for versions after change)

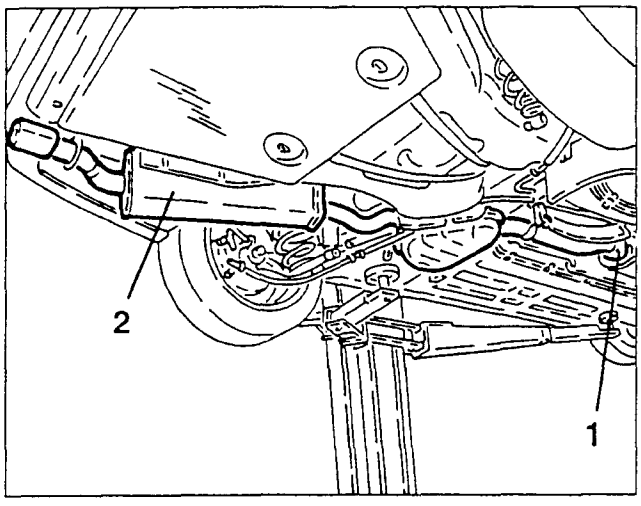
- Set the car on a lift and raise it.
1. Slacken the three nuts fastening the catalytic converter to the front section.
2. Slacken the clamp fastening the catalytic converter to the rear section, then remove it.
- Remove the seal.



EXHAUST, REAR SECTION

REMOVING/REFITTING (Specific for versions before change)

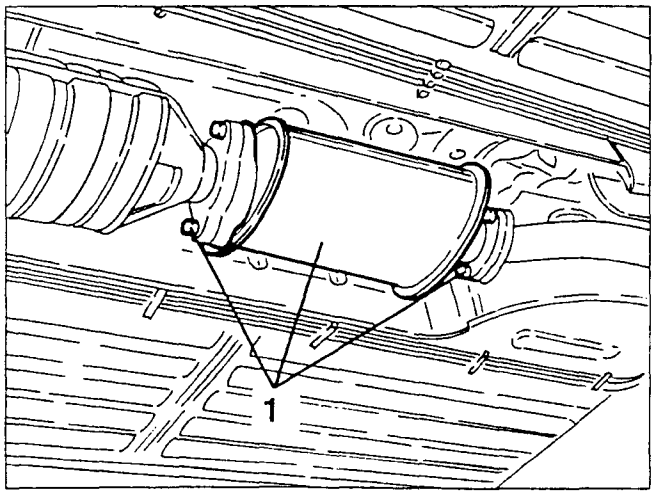
- Set the car on a lift and raise it.
1. Slacken the bolts fastening the exhaust pipe rear section from the centre silencer.
2. Remove the exhaust pipe rear section freeing it from the supporting circlips and withdrawing from the handbrake control cable.



CENTRE SILENCER (Specific for versions before change)

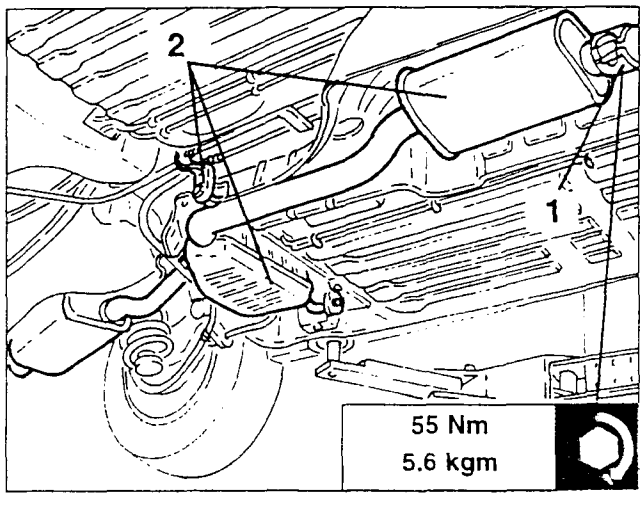
REMOVING/REFITTING

- Set the car on a lift and raise it.
1. Slacken the bolts fastening the centre silencer to the catalytic converter and the exhaust pipe rear section, then remove it.
- Remove the seals.



REMOVING/REFITTING (Specific for versions after change)

- Set the car on a lift and raise it.
1. Slacken the clamp fastening the exhaust pipe rear section of the catalytic converter.
2. Remove the exhaust pipe rear section freeing it from the supporting circlips and withdrawing it from the handbrake control cable.



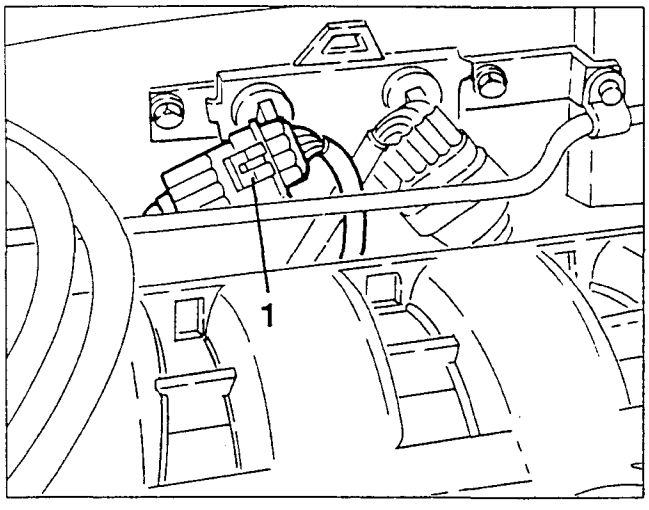
LAMBDA SENSOR

NOTE:
For the description of the lambda sensor see Boxer 1712 16V engine.

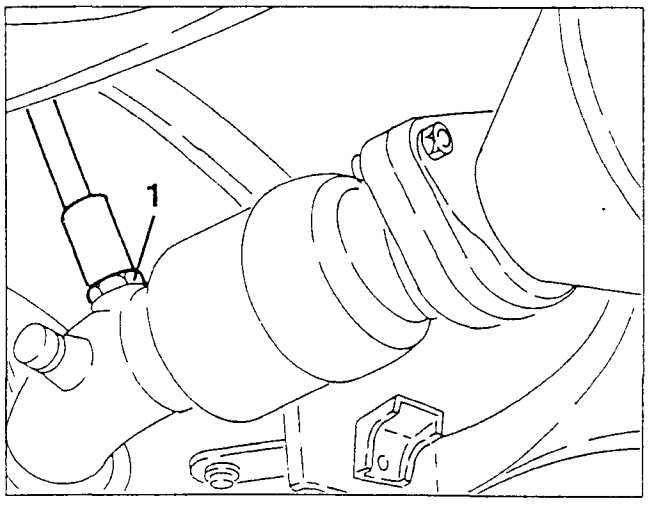
REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Disconnect the lambda sensor electrical connection.



1. Raise the car, then slacken and remove the lambda sensor complete with electric wiring.



CHECKING EMISSIONS AT EXHAUST

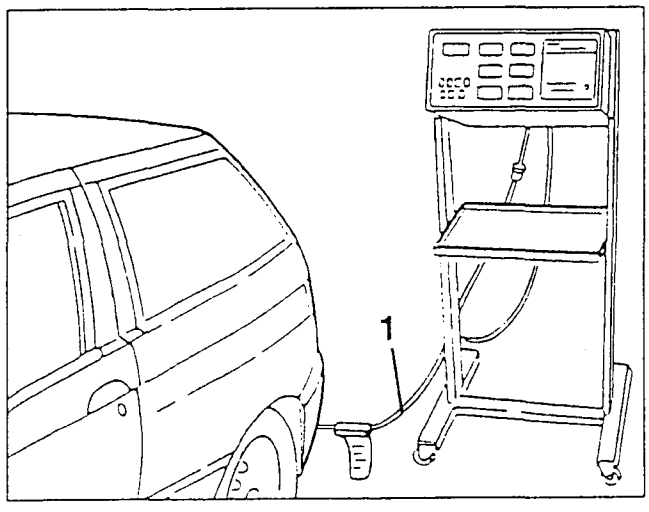
Exhaust emission should be checked outdoors or at least in a suitable place according to current regulations.

The engine should be at normal operating temperature (i.e. when the fan has come on and turned off) and at idle speed (see GROUP 00 - "TECHNICAL SPECIFICATIONS OF THE ENGINE").
If idle speed is not within the specified limits check that the constant idle speed actuator is working properly.

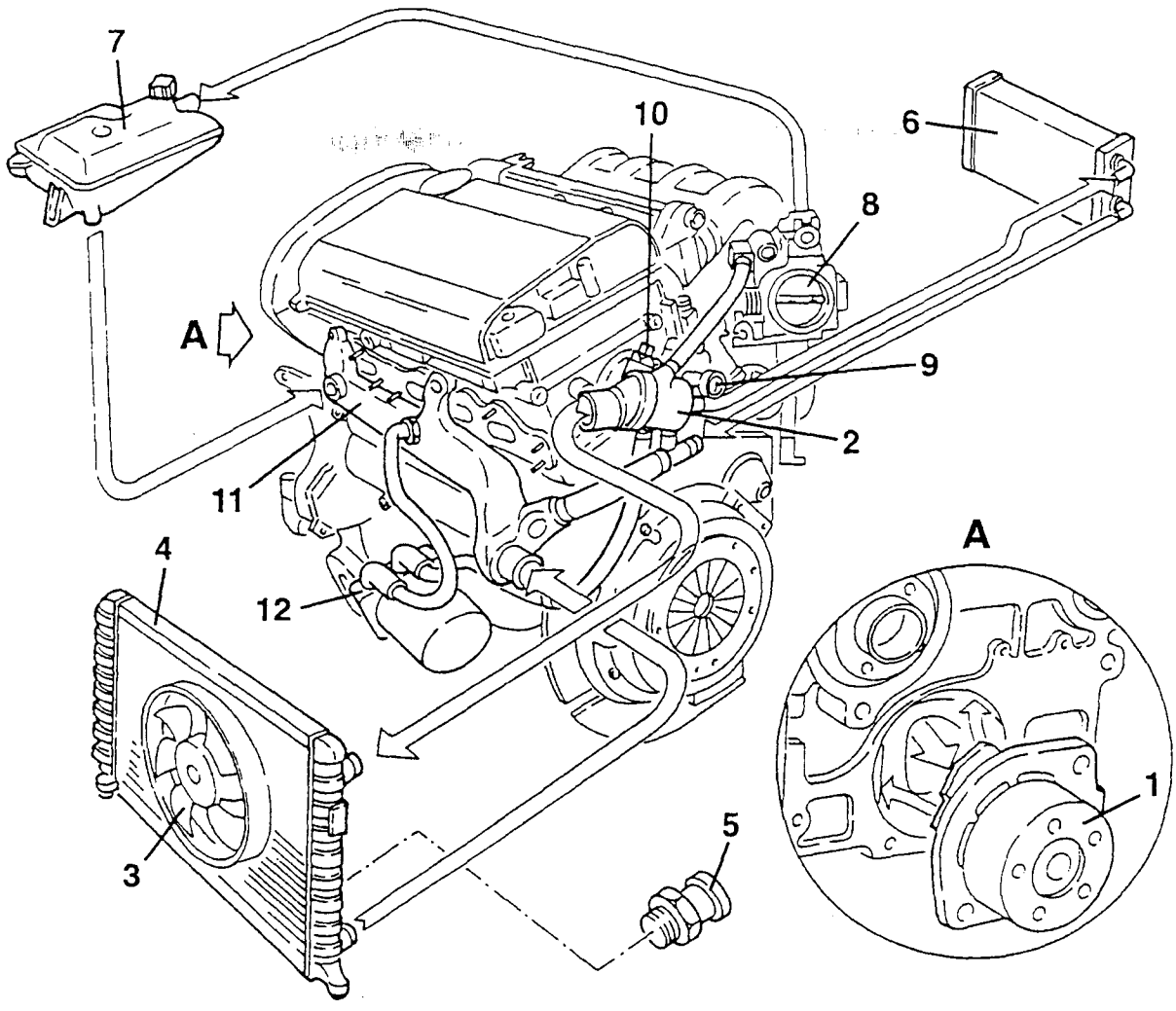
- Check that the engine oil level is correct and that the air cleaner cartridge is clean.
- Start the engine and keep it at idle speed.

1. Isert the feeler of the analyser in the end of the exhaust pipe and check that the amount of CO and HC are within the specified limits.

CO at the exhaust	≤ 2.2 g x km
HC + NOx at the exhaust	0.5 g x km



DESCRIPTION OF ENGINE COOLING SYSTEM



1. *Water pump*
2. *Thermostatic cup*
3. *Cooling fan*
4. *Radiator*
5. *Fan control thermal contact (Specific for versions with M2.10.3 injection - ignition system)*
6. *Climate control heater*
7. *Header tank*
8. *Throttle body*
9. *Coolant fluid temperature gauge transmitter and maximum temperature warning light contact*
10. *Coolant fluid temperature sensor*
11. *Longitudinal manifold*
12. *Coolant fluid - engine oil heat exchanger*

The cooling system is of the sealed type with forced circulation by centrifugal pump (1) located on the cylinder head and controlled by the timing gear belt.
A thermostatic valve (2), on the rear of the cylinder head, keeps the engine at optimum temperatures; it opens when the coolant fluid reaches a temperature of 83 °C.
In addition to dynamic air, the radiator (4) cools the engine fluid also by a two-speed fan (3) which is engaged by:
- for versions with M2.10.3 injection-ignition system, by a thermal contact (5) on the radiator;
- for versions with M2.10.4 injection-ignition system, directly by the MOTRONIC control unit, depending on the signal received by the engine coolant fluid temperature sensor (NTC).
(For further details about the fan see ELECTRIC-ELECTRONIC DIAGNOSIS - Sect. 26 for versions with air conditioner and Sect. 27 for versions with heater).
The purpose of the header tank (7) is to supply the circuit if the level falls and it acts as a lung absorbing the changes in volume of the fluid as the temperature changes; it also vents air from the circuit.
The circuit is fitted with coolant fluid temperature transmitter for the gauge and a maximum temperature thermal contact (9) for the warning light.

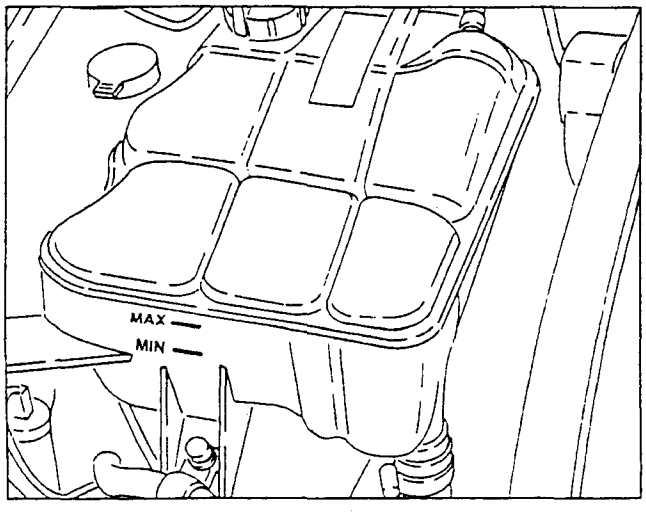
OPERATION OF THE CIRCUIT

After the fluid has cooled the engine, it leaves the cylinder head and reaches the thermostatic unit (92). From here, if the temperature is below 83 °C, it is drawn into the pump (1) through a longitudinal coolant return manifold located on the left-hand side of the cylinder head.
Conversely, if the temperature exceeds this value, the fluid is directed to the radiator (4) through the opening of the thermostat.
After being cooled in the radiator, the fluid returns, still through the longitudinal manifold, to the pump which directs it to the engine.
From the thermostatic cup the fluid is also sent to:
- heat the throttle body (8) from which it flows to the expansion tank (7) also venting air from the system;
- the climate control system heater (6) from which it returns to the longitudinal manifold;
- the heat exchanger (12) for cooling the engine oil before being ducted directly into the longitudinal manifold through which it returns to the pump.
The expansion tank supplies the engine cooling system via a special pipe connected with the longitudinal manifold.

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

- Check that when the engine is cold the level of the coolant fluid in the header tank is between the MIN and MAX marks.



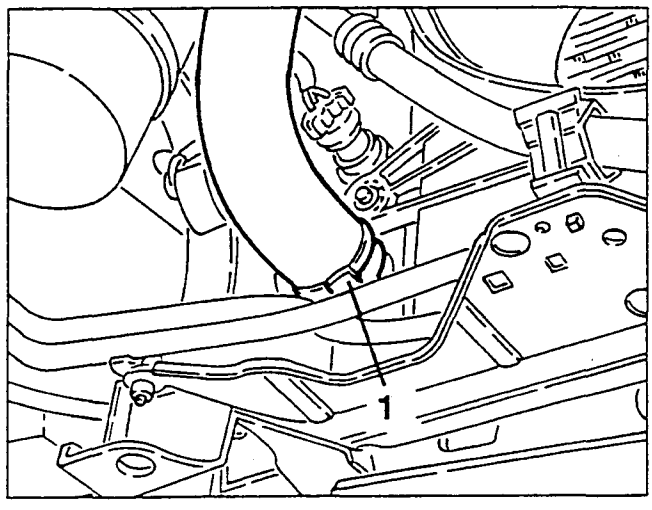
Draining and replenishing

- Set the car on a lift.
- Slacken and remove the header tank plug.

WARNING:
Absolutely never remove the header tank plug when the engine is hot!

- Raise the car.
1. Slacken the radiator outlet hose and drain the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can harm the paintwork: therefore avoid any contact with painted components.

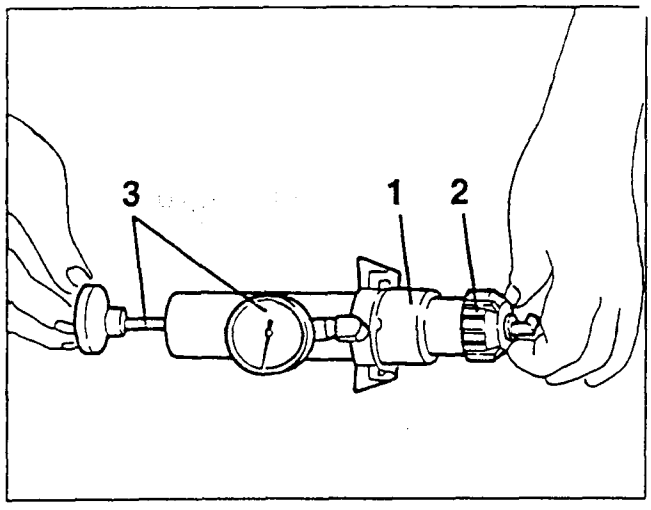


- Reconnect the sleeve to the radiator and any disconnected pipes, checking that all the clamps are firmly tightened.
- Fill with fluid of the specified type and quantity until reaching the MAX mark on the header tank.
- Start the engine and bring it to normal operating temperature so that the thermostat opens to release the amount of residual air in the circuit.
- With the engine cold, top up until reaching the MAX mark on the header tank.
- Retighten the pressurised cap on the header tank.

WARNING:
It is unwise to mix anti-freeze fluids of different types or brands!
Never use antirust additives: they might not be compatible with the anti-freeze in use!

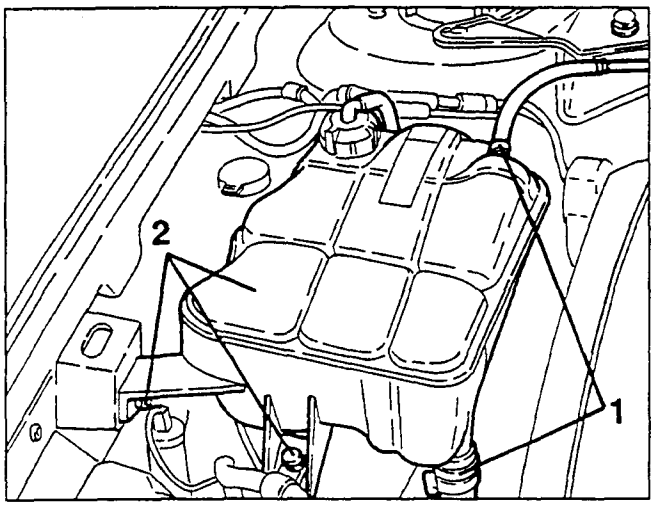
EXPANSION TANK

The expansion tank supplies the circuit and absorbs the variations in coolant volume due to the changes in engine temperature.
In addition, a special calibrated valve contained in the pressurised cap and a pipe connected to it relieve air from the circuit from the pipe leading from the throttle body.
This valve also acts as a washing function enabling outside air to enter the system to compensate for the vacuum created as the system cools.



REMOVAL/REFITTING

- Drain the engine cooling system (see relative paragraph).
1. Loosen the two clamps and disconnect the coolant delivery and return hoses from the expansion tank.
2. Unscrew the three screws and remove the expansion tank.



ENGINE COOLING SYSTEM LEAK TEST

- Slacken and remove the pressurised cap from the header tank.
1. Screw the instrument for the hydraulic circuit leak test with the special fitting on the header tank filler.
2. Manually pressurise the circuit and check on the instrument that the pressure stays within the specified limit. If not, check for leaks from the sleeves or radiator.

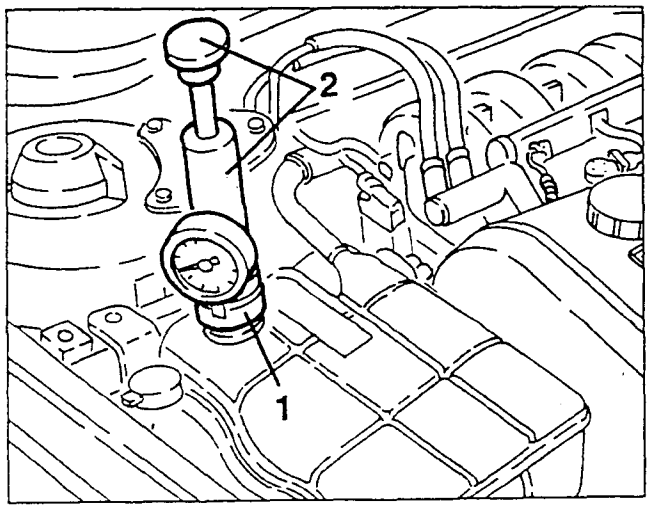
Hydraulic circuit control pressure
1.08 bar

WARNING:
During these checks with the tester, for safety reasons, never allow the pressure to exceed 1.38 bar.

PRESSURIZED CAP SEALING TEST

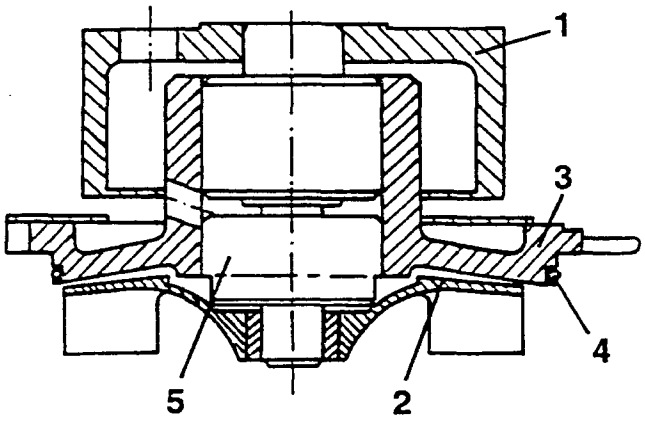
- Perform the test using a seal test tool.
1. Screw the fitting to the lower end of the test tool.
2. Install the expansion tank pressurized cap onto the fitting of the test tool.
3. Manually operate the piston of the test tool and pressurize the cap. Check that the valve opens at the specified pressure read from the manometer.

Pressurized cap setting
0.98 ± 0.1 bar



WATER PUMP

The water pump is of the centrifugal type with blades. It is fastened to the cylinder head and operated by the crankshaft via the timing gear belt. An O-Ring ensures tightness between the cylinder head and the pump. The water pump is kept running constantly to ensure that the coolant fluid circulates continuously.

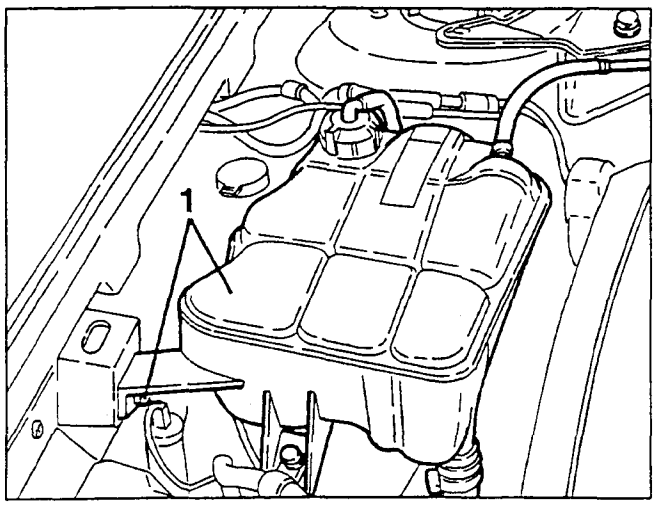


1. *Pulley*
2. *Impeller*
3. *Pump casing*
4. *O-Ring*
5. *Bearing*

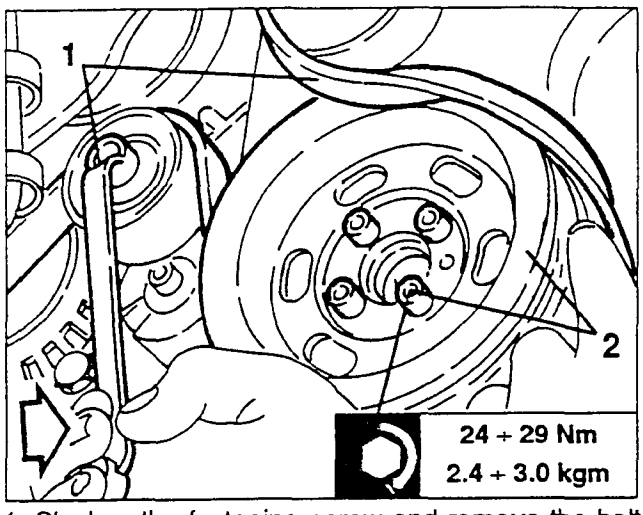
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the engine cooling system (see relative paragraph).

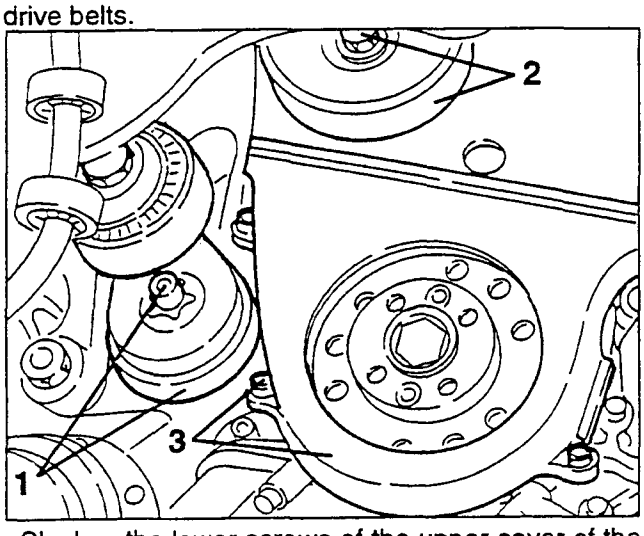
1. Slacken the screws and move the header tank to one side without disconnecting the piping.



1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxliary components drive pulley.

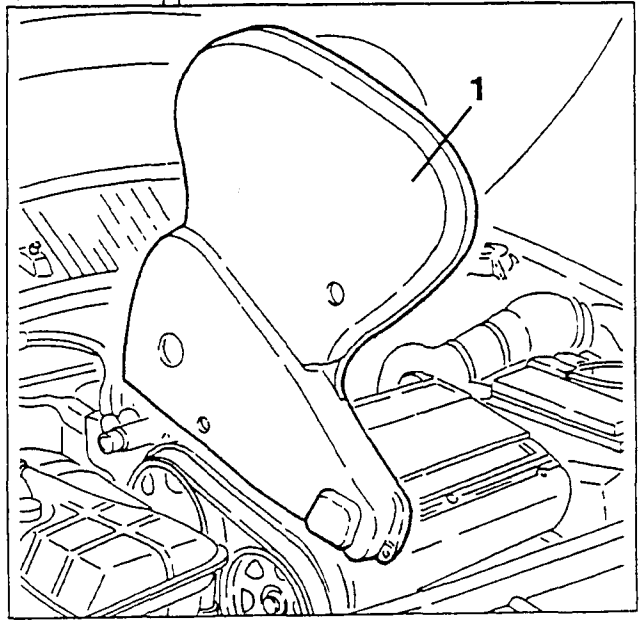


1. Slacken the fastening screw and remove the belt tensioner.
2. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.
3. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft drive belts.

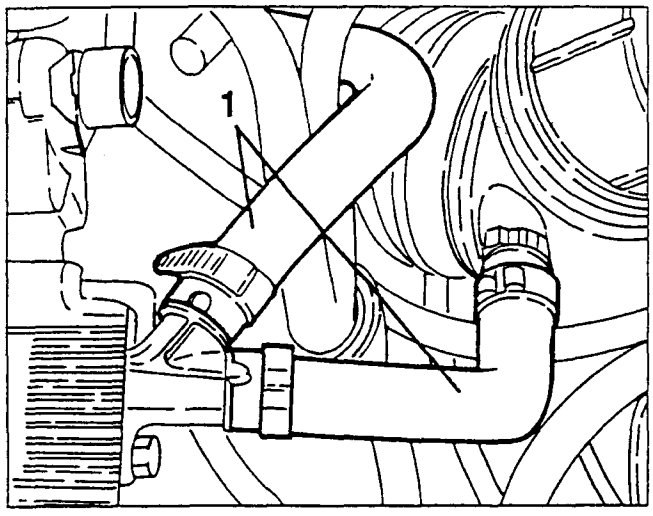


- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft drive belts.

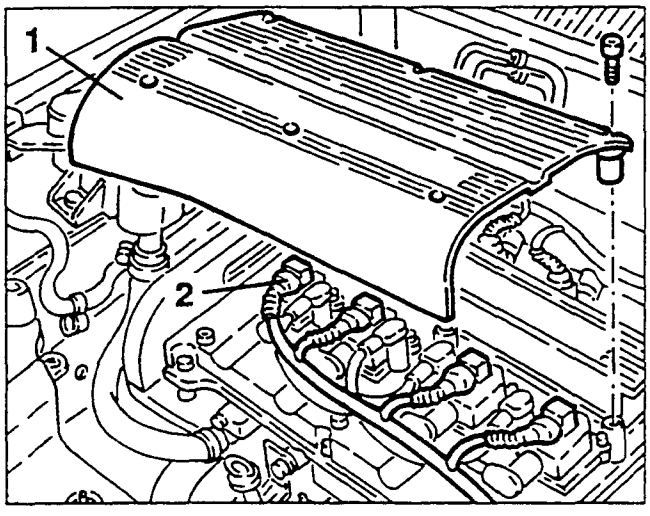
1. Lower the car, slacken the fastening screws and remove the upper cover.



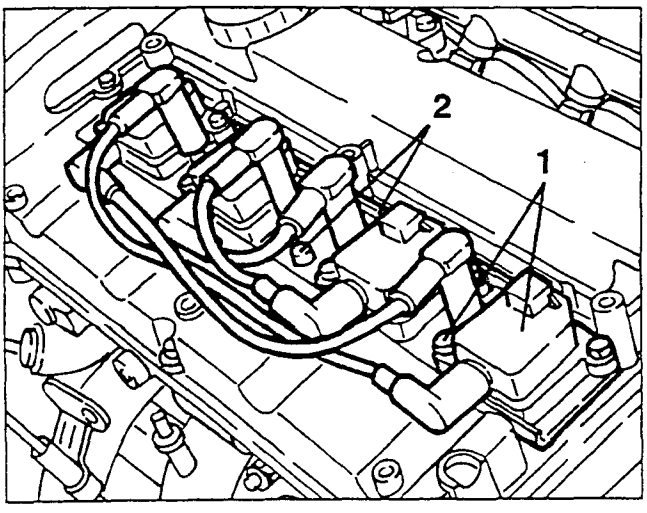
1. Disconnect and remove the oil vapour recovery pipes.



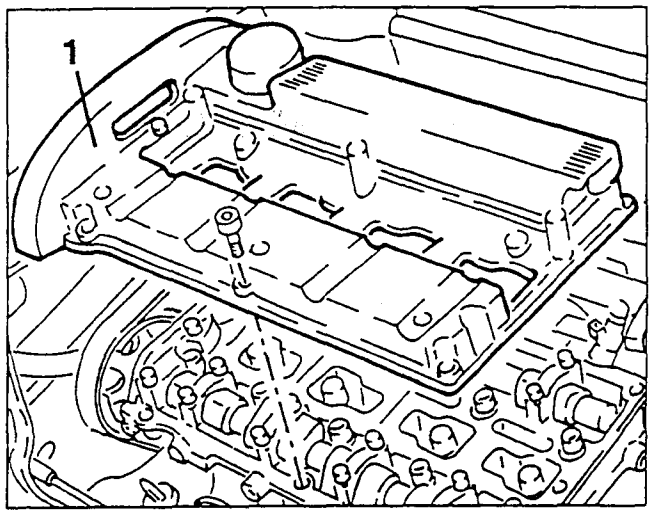
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



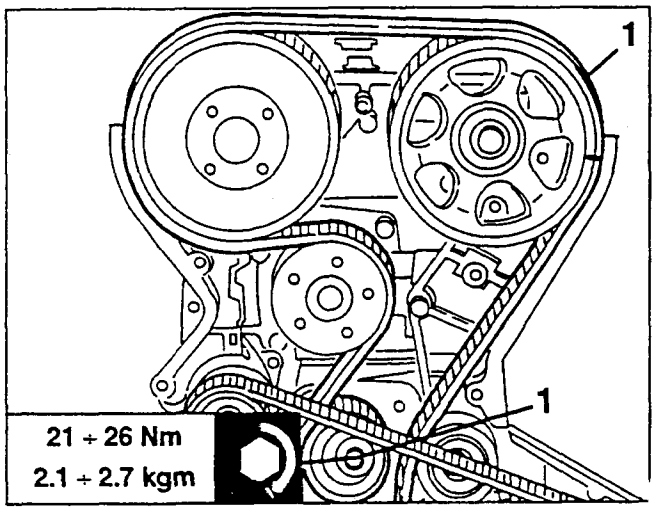
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



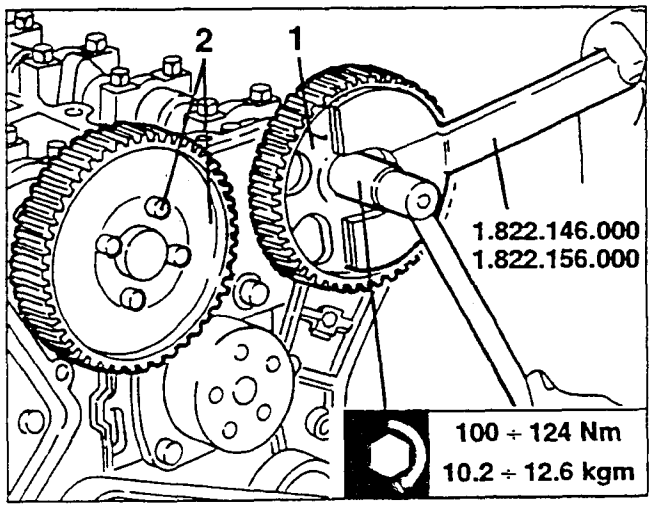
1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.



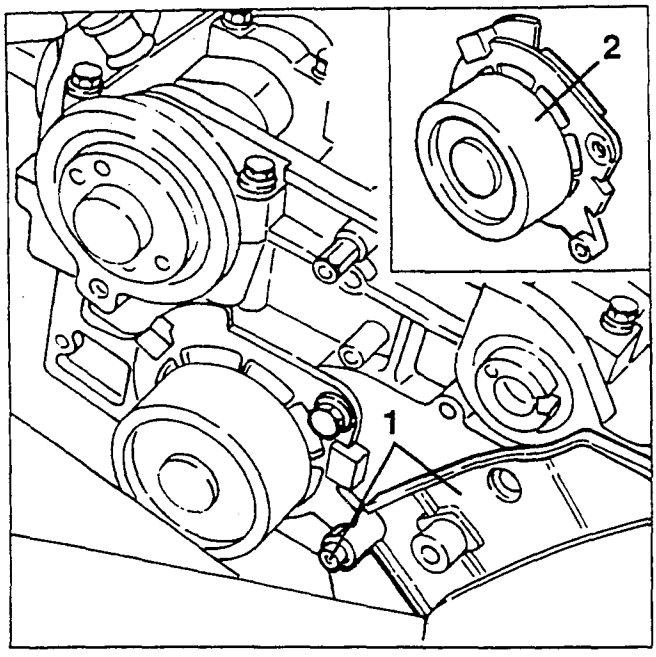
1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.



1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear exhaust side drive pulley and remove it.
2. Slacken the four screws fastening the timing gear intake side drive pulley and remove it.



1. Slacken the fastening screws and remove the side protection on the exhaust side.
2. Remove the two fastening screws and remove the water pump complete with O-Ring.



- Refit reversing the sequence followed for removal.

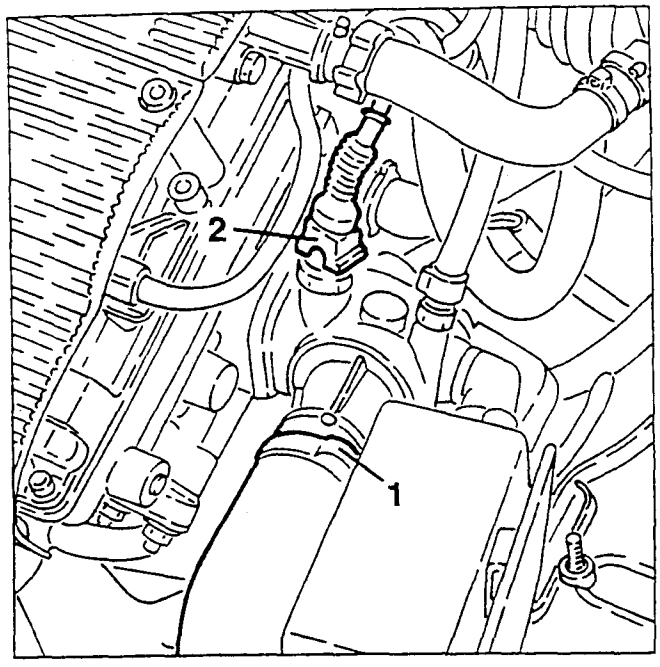
For refitting the timing gear drive belt and timing and for assembly of the auxiliary components drive belt see GROUP 00.

THERMOSTAT UNIT

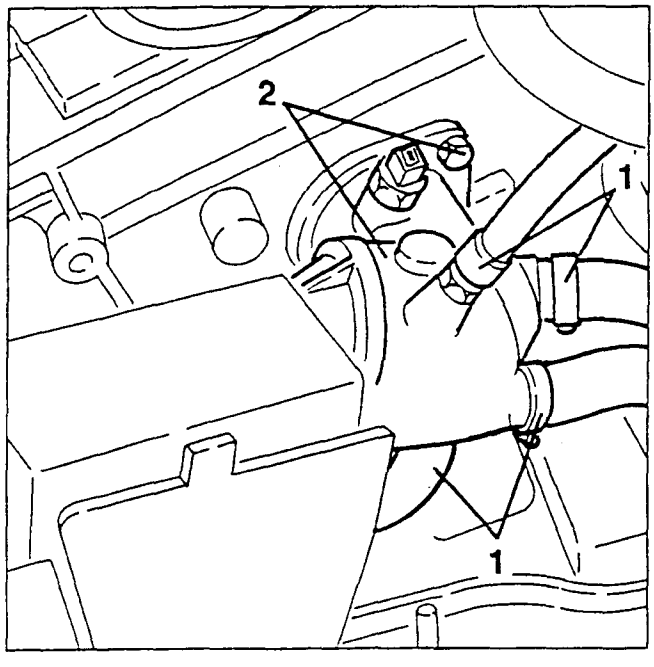
The thermostat unit is fitted on the rear end of the cylinder head.
Its purpose is to prevent the engine from exceeding the optimum temperature: until the coolant temperature reaches 83 °C, the thermostatic valve diverts the coolant fluid towards the pump; at higher temperatures, the opening of the thermostatic valve enables the passage of the fluid towards the radiator.
On the thermostat unit there is a sensor (NTC) for detecting the coolant temperature to be sent to the control unit.

REMOVING/REFITTING

- Remove the battery.
1. Drain the engine coolant fluid disconnecting the radiator delivery sleeve from the thermostatic cup.
2. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).



1. Disconnect all the pipes connected to the thermostat unit.
2. Slacken the fastening screws and remove the thermostat unit.



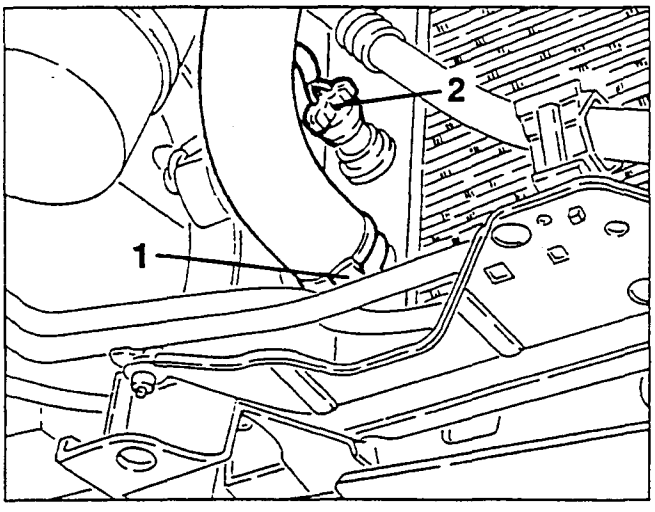
RADIATOR

The radiator is sized to meet the heat dispersal requirements when the engine is running.
It comprises a radiant mass and two side reservoirs fitted with inlet and outlet unions for the coolant fluid; the pipes and radiant mass fins are in aluminium, the reservoirs are in plastic.

REMOVING/REFITTING (for versions without air conditioner)

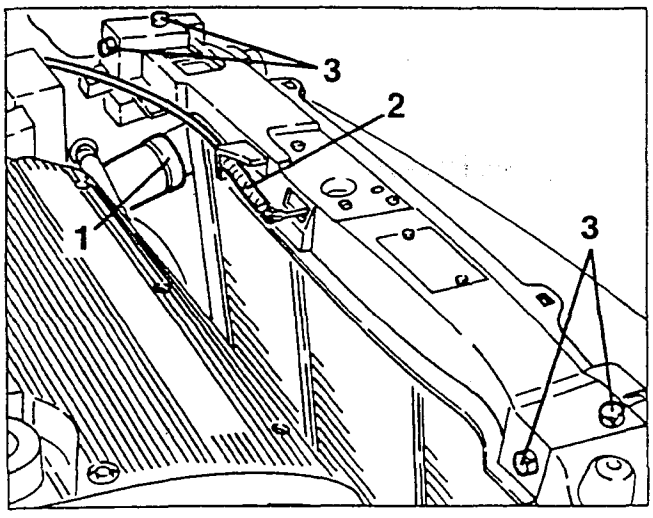
- Set the car on a lift.
- Disconnect the battery (-) terminal
- Remove the cooling fan (see specific paragraph)

1. Raise the car and drain the coolant fluid disconnecting the radiator outlet sleeve.
2. Disconnect the electrical connection from the fan drive thermal contact.

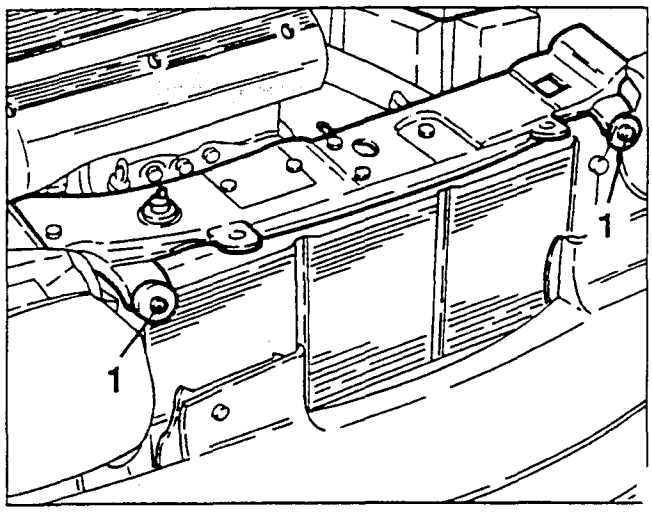


- Lower the car and remove the radiator grille (see GROUP 70).

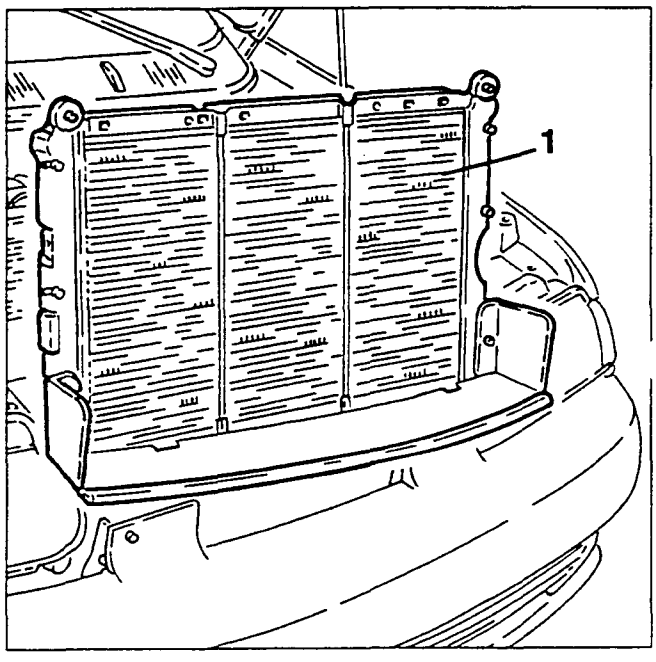
1. Disconnect the coolant inlet sleeve from the radiator.
2. Disconnect the bonnet opening cable from the lock.
- Disconnect the electrical connection from the anti-theft button on the radiator upper crossmember.
3. Slacken the four screws fastening the upper radiator crossmember to the body.



1. Slacken the two screws fastening the radiator to the upper crossmember, then remove the crossmember after releasing it from the electric wiring.



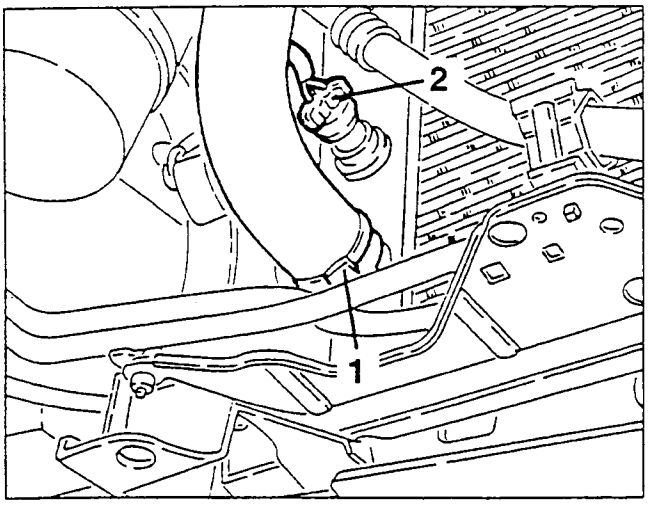
1. Remove the radiator complete with duct and fan drive thermal contact, pulling it upwards.



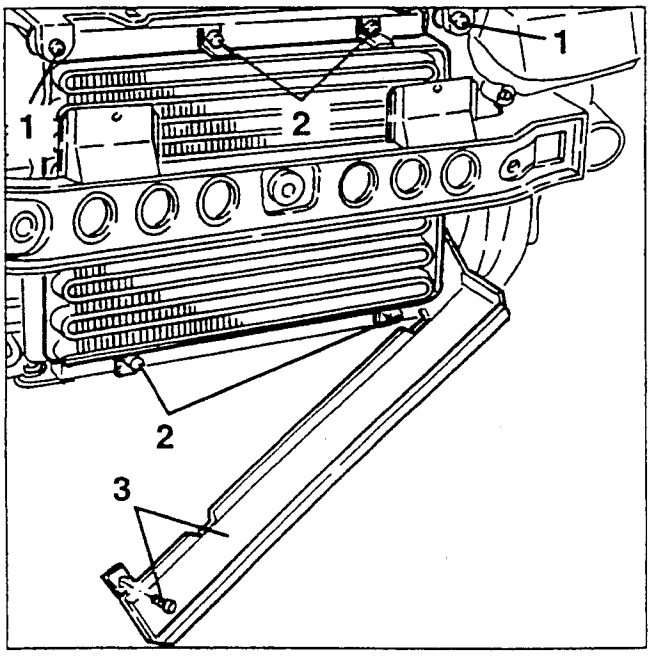
REMOVING/REFITTING (for air-conditioned versions)

- Set the car on a lift.
- Disconnect the battery (-) terminal
- Remove the radiator grille and front bumper (see GROUP 70)
- Remove the cooling fan (see specific paragraph).

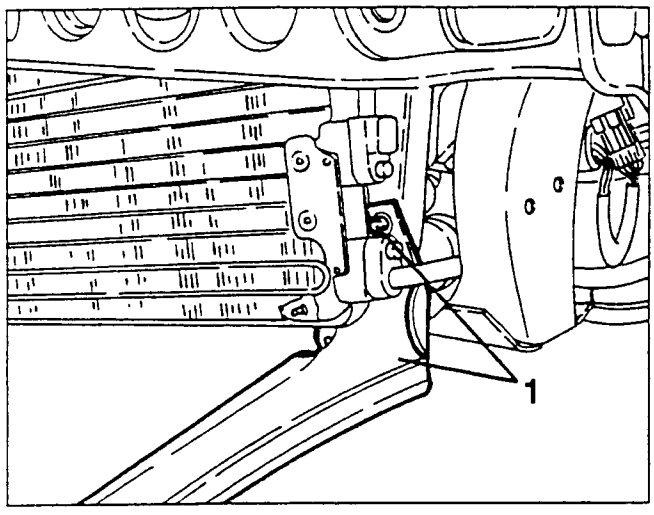
1. Raise the car and drain the coolant fluid disconnecting the radiator outlet sleeve.
2. Disconnect the electrical connection from the fan drive thermal contact.



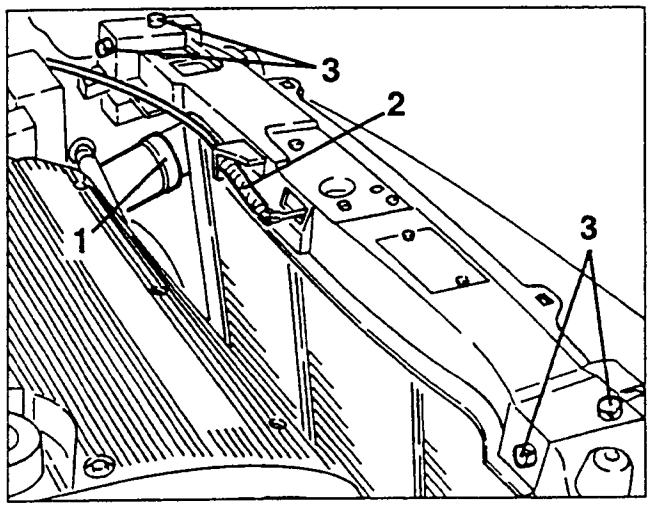
1. Lower the car, slacken the two screws fastening the radiator to the upper crossmember and retrieve the spacers.
2. Slacken the four screws fastening the conditioner condenser to the radiator, then support it suitably keeping it connected to the piping.
3. Slacken the screw on the right-hand side fastening the air duct to the radiator, then lower it as illustrated to gain access to the left-hand screw.



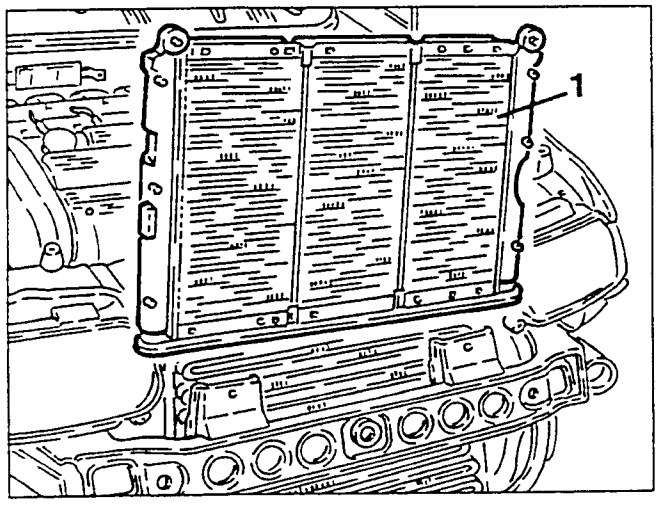
1. Slacken the left-hand screw fastening the air duct to the radiator, then remove it.



1. Disconnect the coolant inlet sleeve from the radiator.
2. Disconnect the bonnet opening cable from the lock.
- Disconnect the electrical connection from the anti-theft button on the radiator upper crossmember.
3. Slacken the four screws fastening the upper radiator crossmember to the body, then remove the crossmember after releasing it from the electric wiring.



1. Remove the radiator complete with fan drive thermal contact, pulling it upwards.

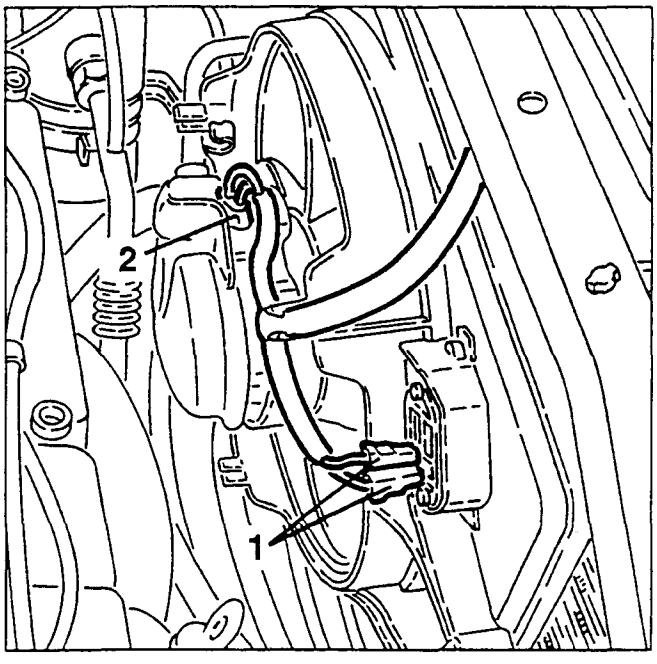


COOLING FAN

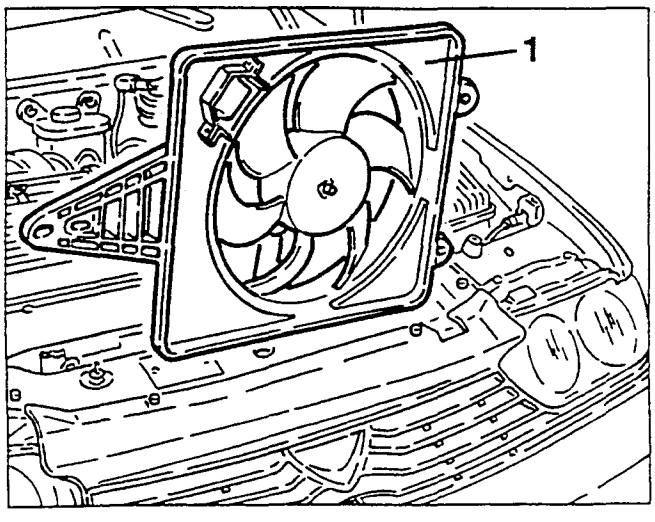
The two-speed cooling fan makes it possible to increase the heat dispersal capacity of the radiator.
A thermal contact with double threshold where the first contact takes place at 92 °C and the second, through an additional resistance, at 97 °C activates the fan at two different speeds.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connections of the fan additional coil.
2. Disconnect the cooling fan electrical supply connection.

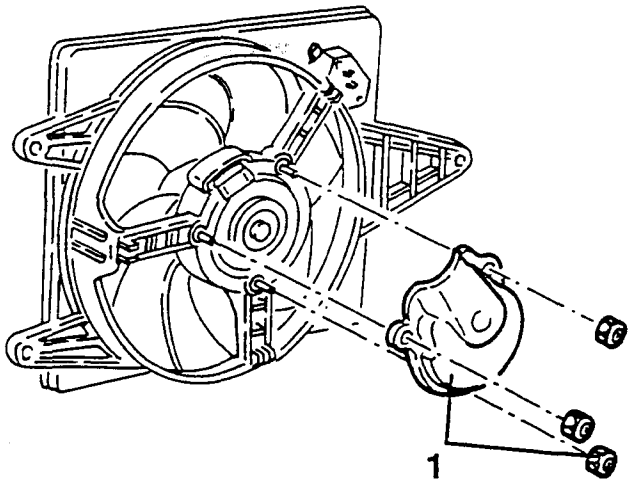


1. Slacken the fastening screws and remove the cooling fan.

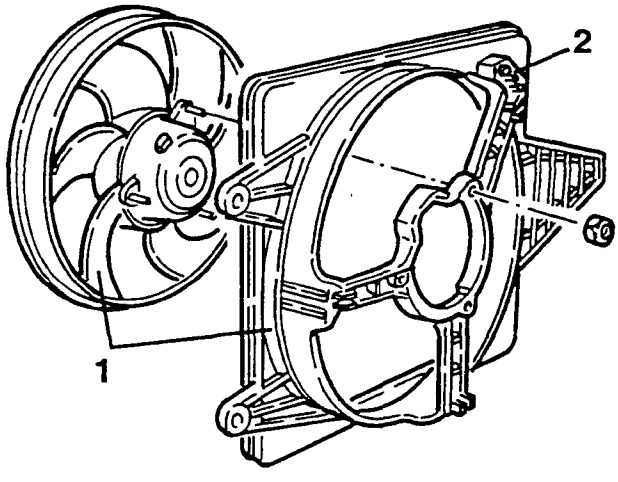


DIS-ASSEMBLY

1. Slacken the three fastening nuts and remove the heat shield.



1. Slacken the three fastening nuts, then separate the fan from the duct.
2. Remove the additional resistance slackening the two fastening screws.

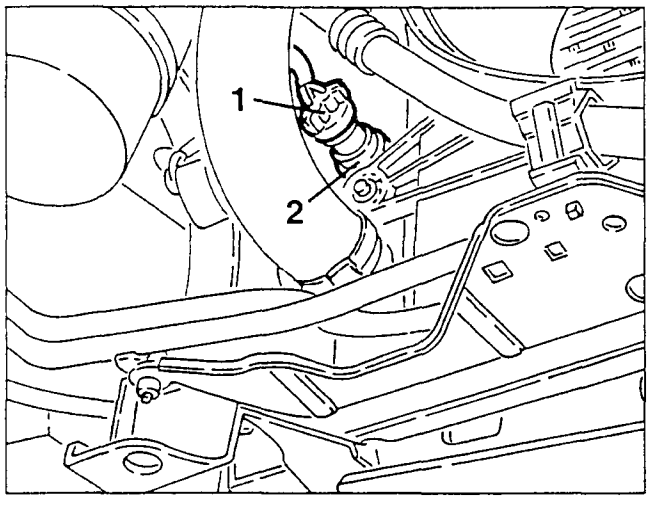


FAN CONTROL THERMAL CONTACT (Specific for versions with M2.10.3 injection - ignition system)

REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Raise the car and disconnect the electrical connection from the fan control thermal contact.
2. Slacken and remove the fan control thermal contact and recover the coolant that comes out.



CHECKS AND INSPECTIONS

Check the setting of the thermal contact referring to the wiring diagram of the specific manual.

Cooling fan cut-in/cut-out temperature		
1st speed	Cut in (contacts close)	92 ± 2°C
	Cut out (contacts open)	87 ± 2°C
2nd speed	Cut in (contacts close)	97 ± 2°C
	Cut out (contacts open)	92 ± 2°C

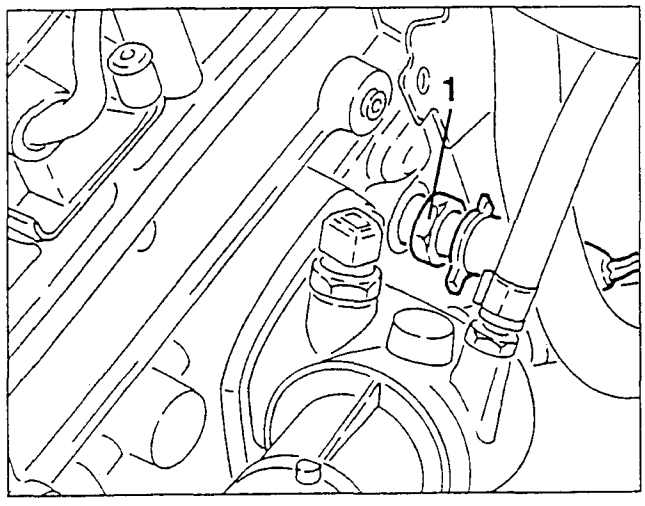
- If the values are not as specified, change the thermal contact.

COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Disconnect the electrical connection from the coolant temperature sensor (NTC).

1. Disconnect the electrical connection from the coolant temperature gauge transmitter and maximum temperature warning light contact, then remove it recovering the coolant that comes out.



CHECKS AND INSPECTIONS

Check the setting of the transmitter referring to the wiring diagram of the specific manual.

Temperature (°C)	Resistance (Ω)
60 (Water test liquid)	525 ÷ 605
90 (Water test liquid)	195 ÷ 245
120 (Glycerine test liquid)	82 ÷ 94

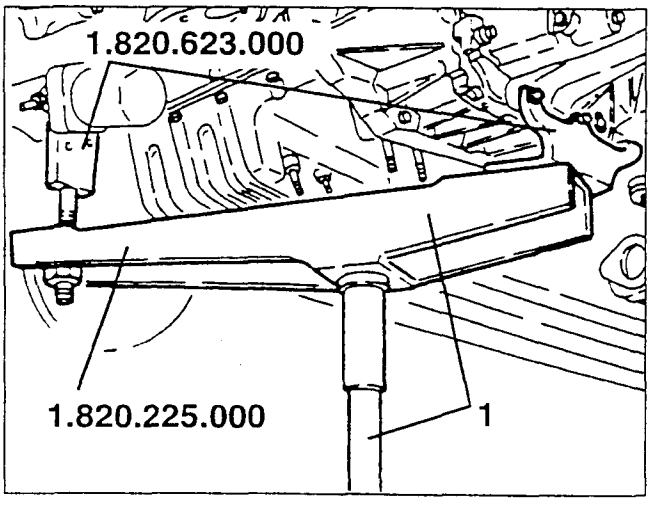
Contact closing temperature	122 ± 2°C
Contact opening temperature	112 ± 3°C

THE FOLLOWING PROCEDURE IS VALID FOR ALL ENGINES 1598 T. SPARK 16V AND 1747 T. SPAR 16V WHILE FOR ENGINE 1370 T. SPARK 16V IT IS VALID ONLY FOR VERSIONS WITH GEARBOX C.510.5 (UP TO CHASSIS NO. .....)

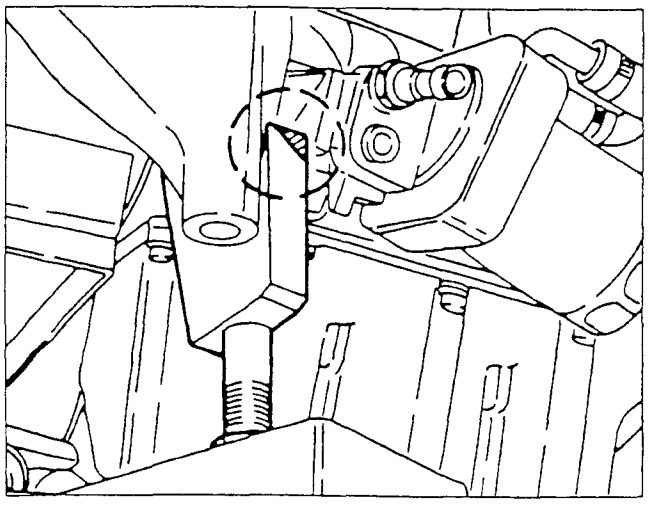
REMOVAL

Proceed as described for 1970 T. SPARK 16V engine removal with the exception of the following steps.

1. Set a hydraulic jack complete with tools no. 1.820.225.000 and no. 1.820.623.000 as illustrated.



NOTE: The camshaft side engine support part of tool no. 1.820.623.000, is to be relieved in the area illustrated to avoid interference with the oil filter support.

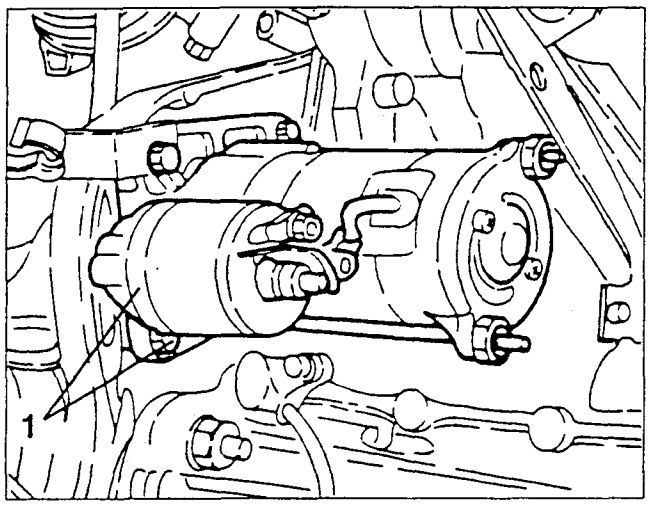


Complete removal of the engine from the car working as described for 1970 T. SPARK 16V engine.

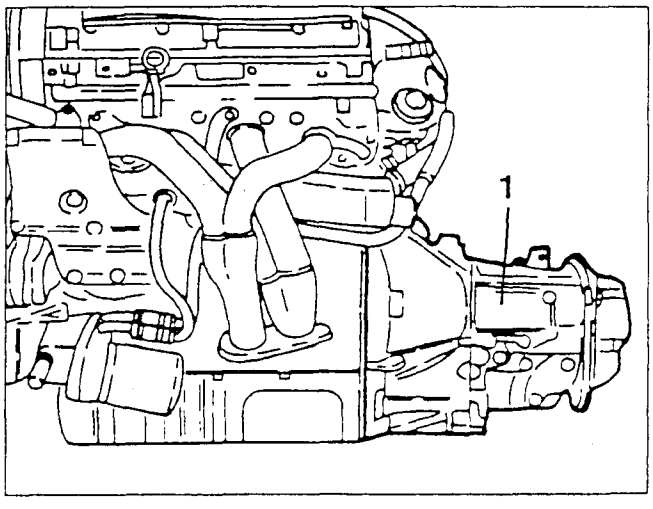
Once on the bench, remove the components as described below to make it possible to set the engine on the overhauling stand.

- Free the power unit from the support tools, then position it on a special work bench.

1. Slacken the fastening screws and remove the starter motor.



1. Slacken the fastening nuts and remove the gearbox and differential unit.



20

ENGINE OVERHAUL

8 documents - 202 factory pages

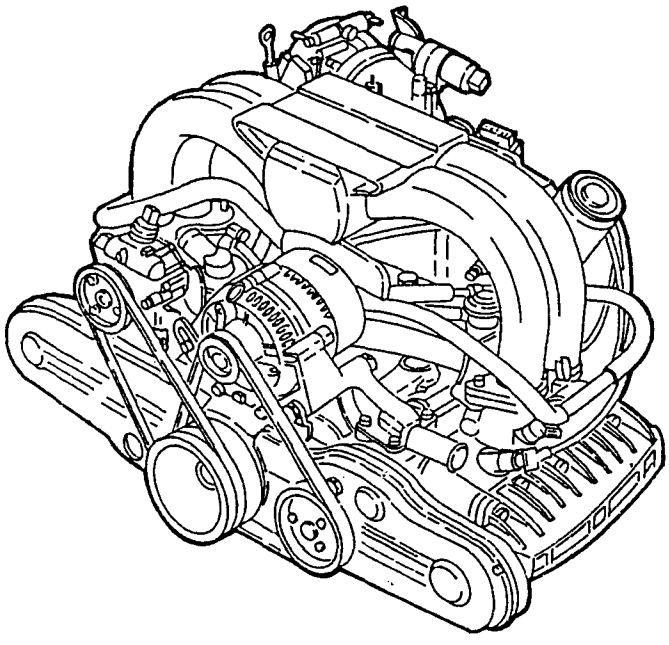
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- Lubrication 3

OVERHAULING
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- Engine dis - assembly 4
- Dis - assembly of cylinder heads 10
- Checks and inspections cylinder heads 11
- Checks and inspections crankcase 15
- Cautions for re - assembly 19
- Checking the electrical components of the lubrication circuit 22

DESCRIPTION

The engine has 4 opposed cylinders, double camshaft for each cylinder head, two valves per cylinder controlled by hydraulic tappets and BOSCH MP3.1 multipoint electronic injection and static ignition for the 1.6 engine and IAW for the 1.3 engine.
The clutch - gearbox - differential unit is connected behind the engine and forms an integral part of the power unit.

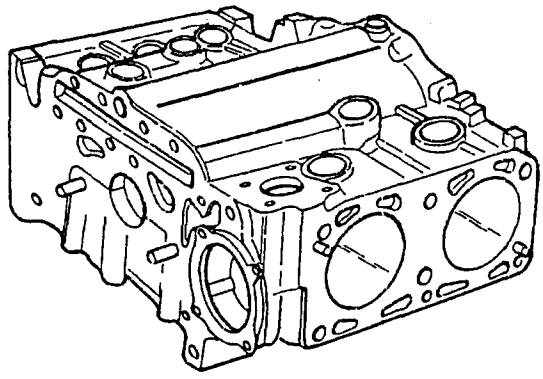


The latter is front mounted and set longitudinally with a 3° inclination.
The power unit is fastened to the body by "suspension" type mounts through a support frame connected to the gearbox - differential unit. The various connections of the power unit to the support frame and to the rear support are made with appropriate flexible mounts to absorb engine vibrations.
The fuel supply system, with unleaded petrol, combined with the suitable antipollution systems described in the specific paragraphs, ensure low exhaust emission levels meeting "USA 83" regulations.

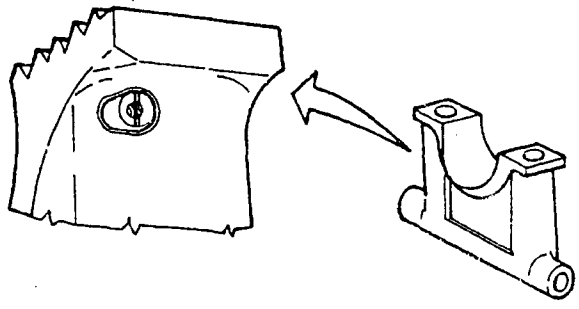
CRANKCASE

This is a single cast iron block with high mechanical strength.
The crankshaft is supported by 3 main bearings which house the same number of thin-walled half bearings.
The cylinders are machined directly in the crankcase and they are selected in five classes of dimensions. If cylinder wear exceeds the specified values, they must be bored to the specified diameters according to the oversizes of the pistons available from Spares (see CPT).

Special grooves machined in the crankcase walls allow the circulation of coolant fluid and lubricating oil.

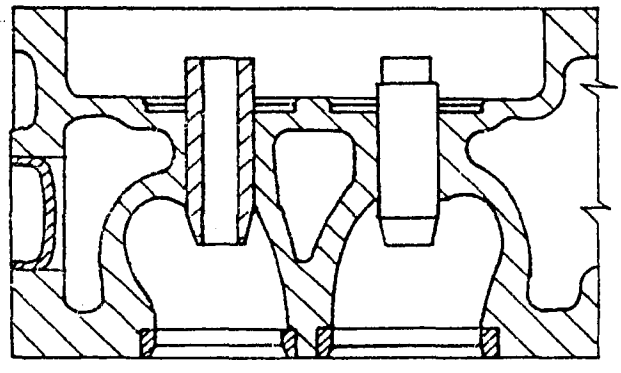


Oil spray jets installed on the front and centre main bearing caps spray oil on the piston crowns to partially cool them.



CYLINDER HEADS

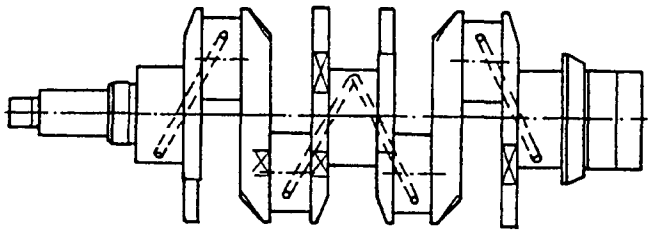
This is one-piece, compact and chill-cast in aluminium and silicium alloy.
The camshaft bearings are fastened on the sylinder heads, these too, are made from aluminium and silicium alloy.
The camshafts, controlled through toothed belts, turn on three supports.
The valve guides are force-fitted in their housings on the cylinder heads by interference and the inside diameter is perfected after assembly using a specific reamer and checked using a pair of no-no go gauges.
The seals between the cylinder heads and crankcase are of the ASTADUR type.



Due to the special material with which they are made, these seals are polymerized when the engine is running and harden considerably during use, therefore it is no longer necessary to tighten the cylinder heads at the first service coupon.

CRANKSHAFT

This is forged in high-strength, hardened and tempered steel. It rests on three main bearings and its end float is adjusted by two half rings housed in the rear main bearing.
Six counterweights accurately balance the rotating masses.
A set of grooves run inside the shaft to lubricate the main and connecting rod journals.

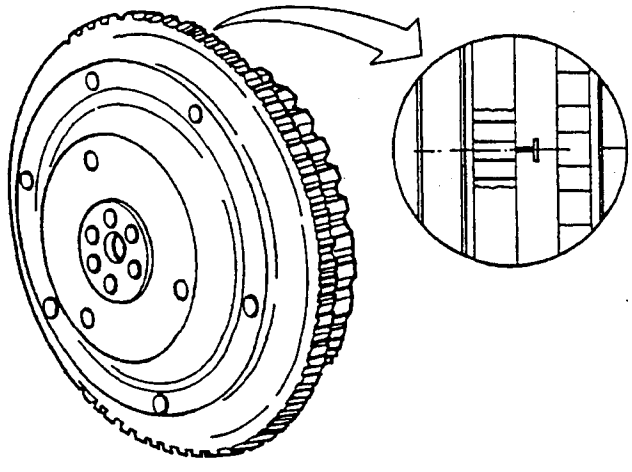


MAIN AND CONNECTING ROD HALF BEARINGS

These are of the three-metal, thin shell type subdivided into two dimensional classes.
The main half bearings have a hole and groove for lubricating the rod journals.

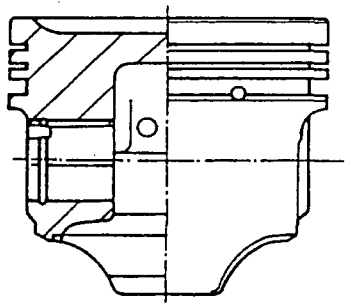
FLYWHEEL

This is in cast iron, with two ring gears in hardened and tempered steel: one for connection with the starter motor and one for the rpm sensor facing it.
The "T" notch for checking engine timing is stamped on the flywheel.

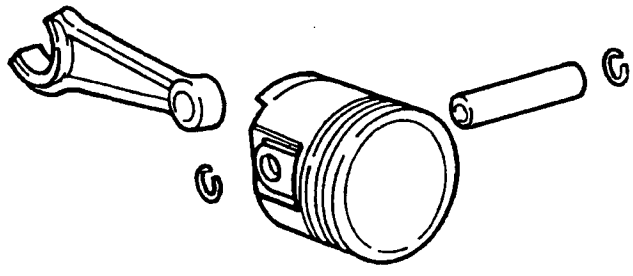


PISTONS AND CONNECTING RODS

The pistons in aluminium silicium alloy are subdivided into five dimensional classes and they are available as Spares in three other oversize classes.



The connecting rods are in hardened and tempered alloy steel, with a copper alloy bush for coupling with the piston gudgeon pin.
As the pins are floating on both the piston hubs ar on the bush force-fitted in the connecting rod small end, their side stroke stop is made by two expanding circlips which are housed in special hollows machined on the actual hubs.



The right cylinder head pistons are positioned with the arrow stamped on the piston crown facing upwards and those of the left cylinder heads with the arrc pointing downwards.

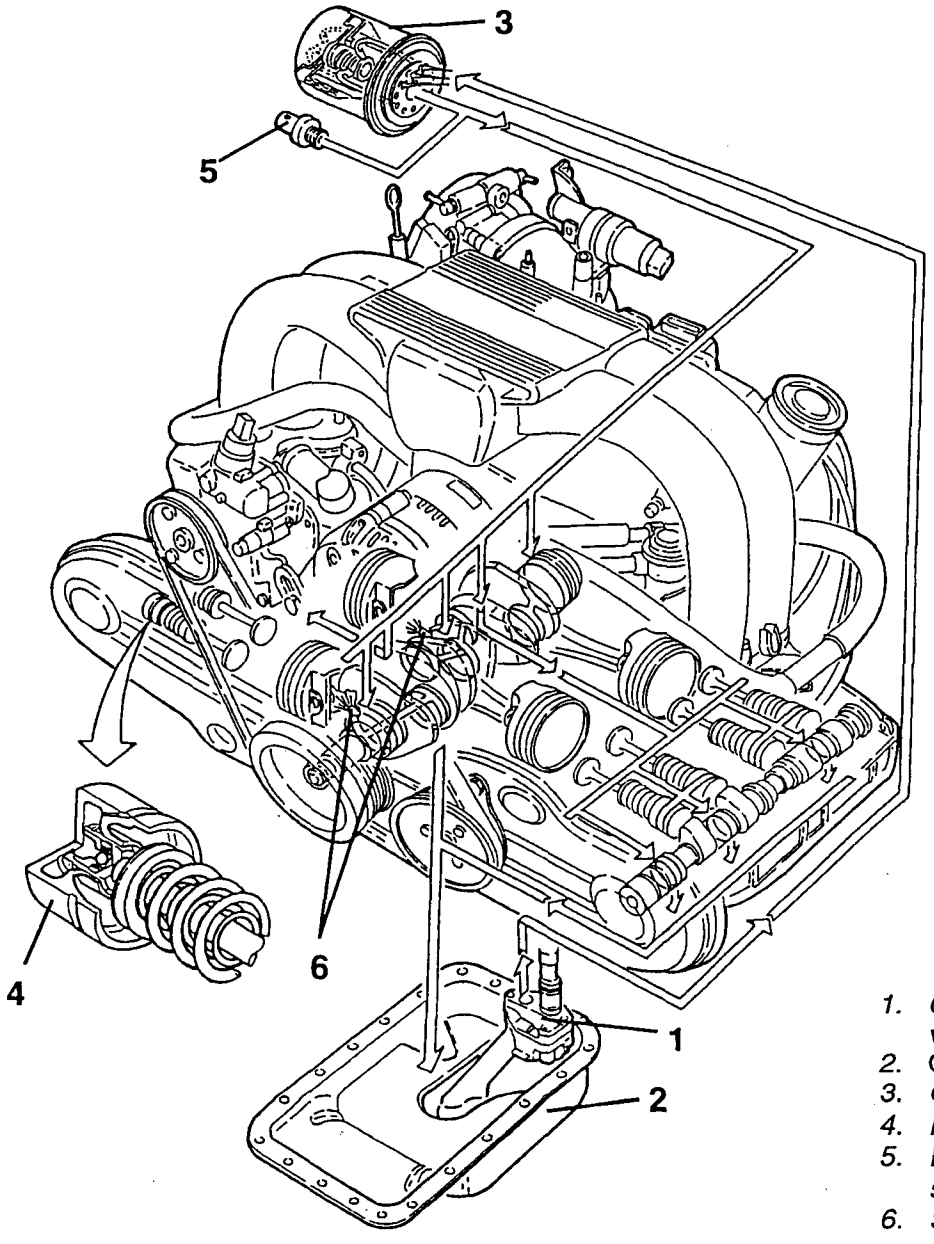
TIMING

Direct drive by toothed belts, with overhead camshafts in case-hardened alloy steel. The hydraulic tappets in contact with the cams operate the valves directly.
This device, which has also been adopted in the 1712 16V, automatically eliminates "valve play" when the engine is running, thereby enormously reducing the need for periodic maintenance. The exhaust valve stem is chromium-plated and inside it has a hollow filled 50 ÷ 60% with sodium which improves dispersion of the heat to which they are subjected.
The valve seats are sintered in material suitable fo use with unleaded petrol.

LUBRICATION

Lubrication is forced by gear pump. The oil pump is fitted on the rear engine cover and it is operated by a shaft that receives motion from a gear installed behind on the crankshaft. The oil withdrawn from the sump through a suction device is filtered by the mesh filter on the actual suction device and then sent under pressure by the pump through a groove to the oil filter with full-flow cartridge fitted with a safety by-pass valve which ensures that the oil can still pass if the filter is clogged.
The maximum lubricating pressure is adjusted by a special limiting valve fitted on the pump. After being filtered, the oil flows through a transversal duct into the main longitudinal delivery duct machined in the crankcase. From here, it is ducted through three grooves to the lubricating grooves of the crankshaft main and rod bearings.

To improve cooling of the pistons on the right main bearing spray jets have been fitted on the front and centre main caps.
Through two transversal grooves and suitable branches machined in the crankcase and cylinder heads the oil reaches the camshaft bearings and allows the hydraulic tappets to work.
The cylinder head lubrication oil gathered in the trays of the camshaft bearings and the lubrication oil of the main and rod journals falls back into the sump.
The lubrication system is fitted with an oil vapour recirculation system which recovers the vapours coming from the sump.
Low oil pressure is signalled by a warning light on the dashboard connected to a sensor inserted on the rear engine cover.



1. *Oil pump with pressure limiting valve*
2. Oil sump
3. *Oil filter with by-pass valve*
4. *Hydraulic tappet*
5. *Low oil pressure warning light sensor*
6. *Spray jets*

INTRODUCTION

The instructions given in the following paragraphs refer to the complete overhaul of the engine on the bench, after removing the power unit from the engine. The instructions are subdivided as follows:

- **Dis-assembly of the engine:**
removal of the engine accessories and components and dis- assembly into its main component parts.

- **Dis-assembly and checks of the crankcase:**
complete overhauling of the crank mechanisms.

- **Cautions for re-assembly:**
these include specific re-assembly operations where they differ substantially from the instructions for dis-assembly.

- **Checks and inspections of electrical components of the lubrication circuit.**

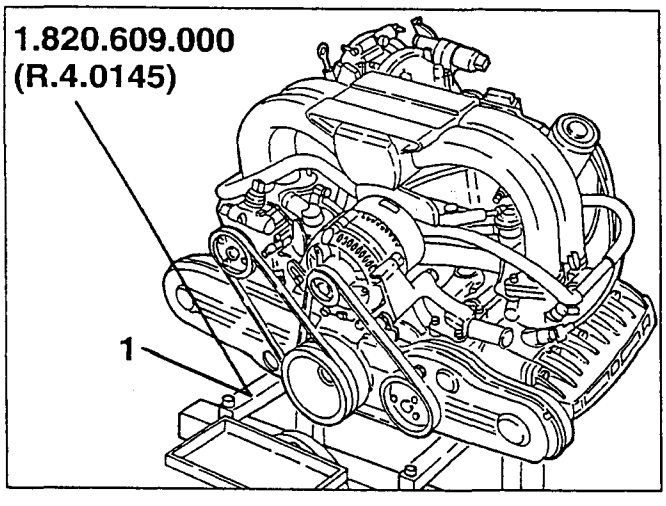
For re-assembly, the sequence for all the dis-assembly instructions described hereafter, should be reversed unless otherwise specified.

The following procedures refer to complete overhauling of the whole engine; it is however possible to use individual parts of these instructions when dealing with specific components.

ENGINE DIS-ASSEMBLY

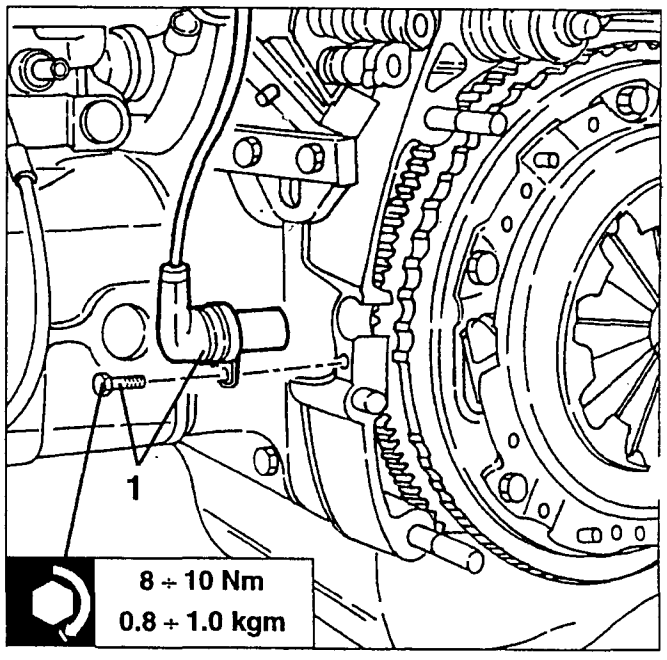
Preliminary operations

1. Set the engine on a special overhauling stand using supports N° 1.820.609.000 (R.4.0145).



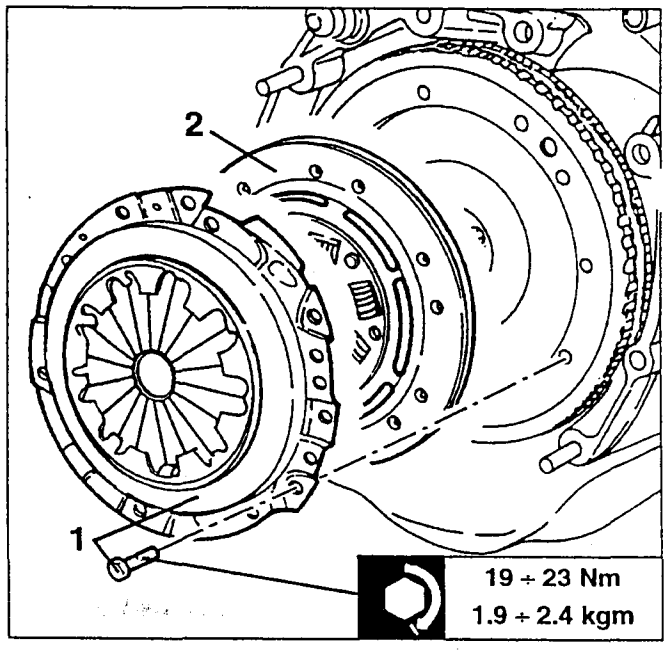
Removing the rpm sensor

1. Slacken the fastening screw and remove the sensor.



Removing the clutch plate

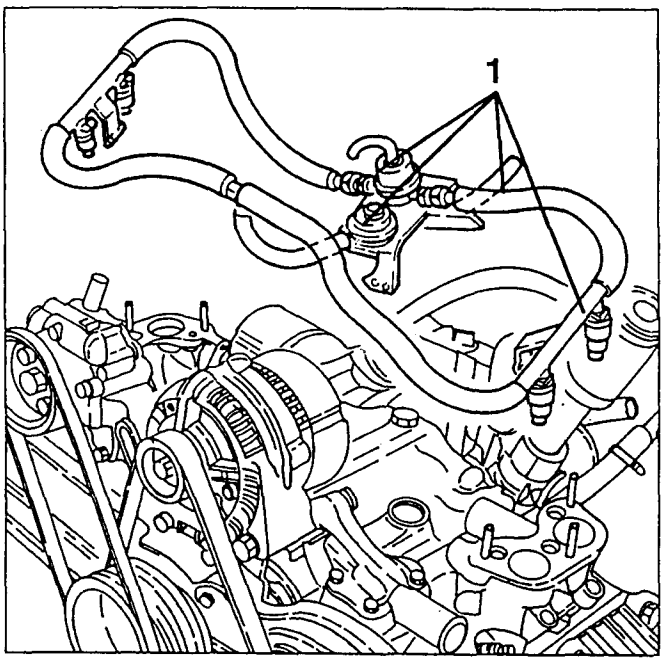
1. Slacken the fastening screws and remove the pressure plate.
2. Remove the clutch plate.



Removing the fuel distributor manifold

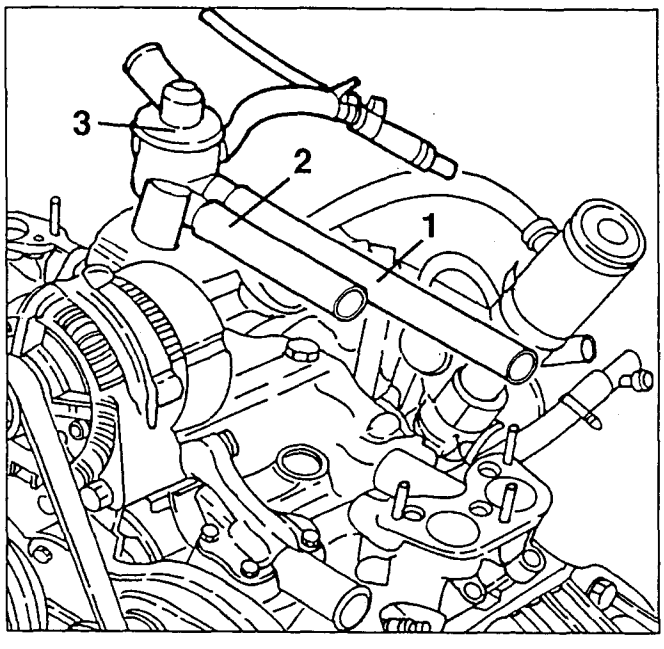
1. Slacken the fastening screws and remove the fuel distributor manifold complete with injectors, pulse

damper and pressure regulator.



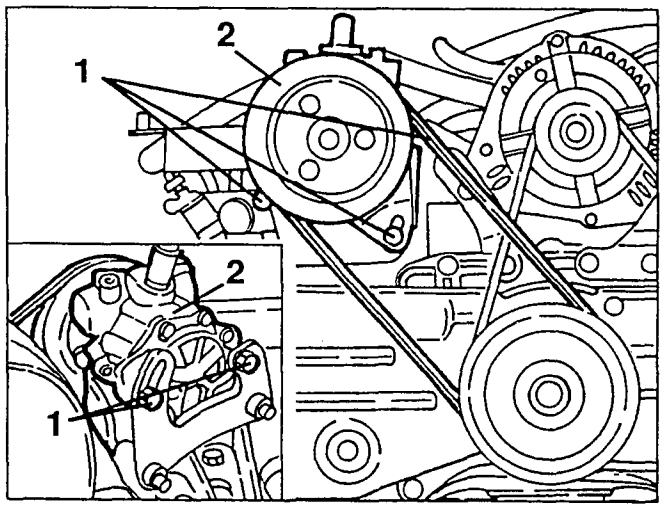
Removing the thermostat unit

1. Disconnect the coolant outlet pipes from the intake manifolds.
2. Disconnect the pump-thermostat connection pipe from the coolant inlet union.
3. Slacken the fastening screw and remove the thermostat unit complete with hoses.

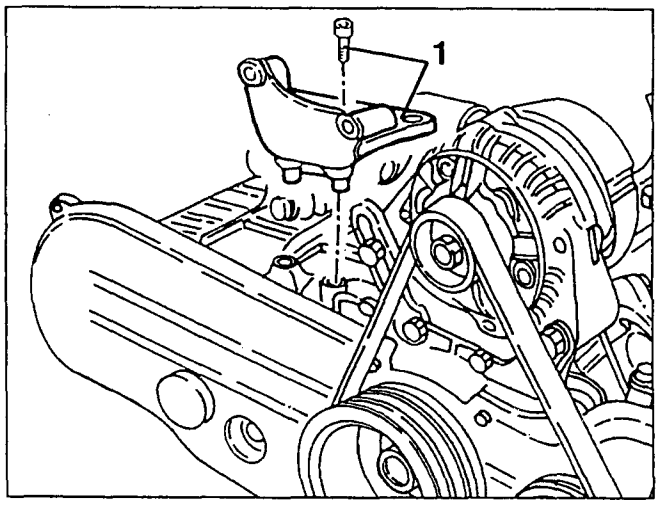


Removing the power steering pump

1. Slacken the power steering pump fastening screws; prise and remove the drive belt.
2. Completely unscrew the screws slackened previously and remove the power steering pump.

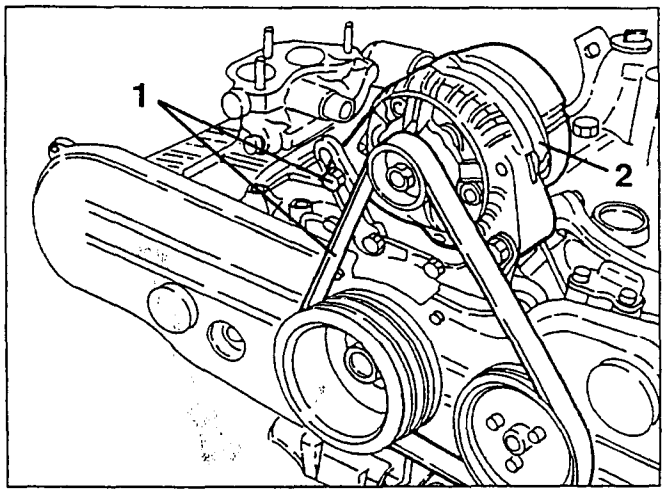


1. Slacken the two fastening screws and remove the power steering pump support bracket.



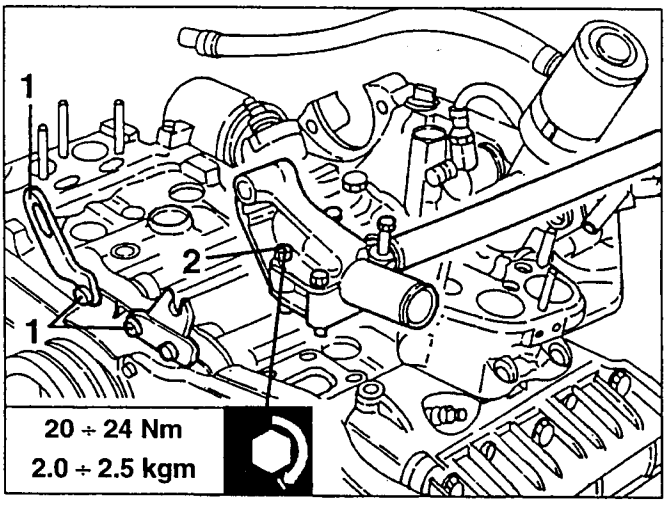
Removing the alternator

1. Slacken the two alternator fastening bolts; prise and remove the drive belt.
2. Completely back off the two bolts slackened previously and remove the alternator.



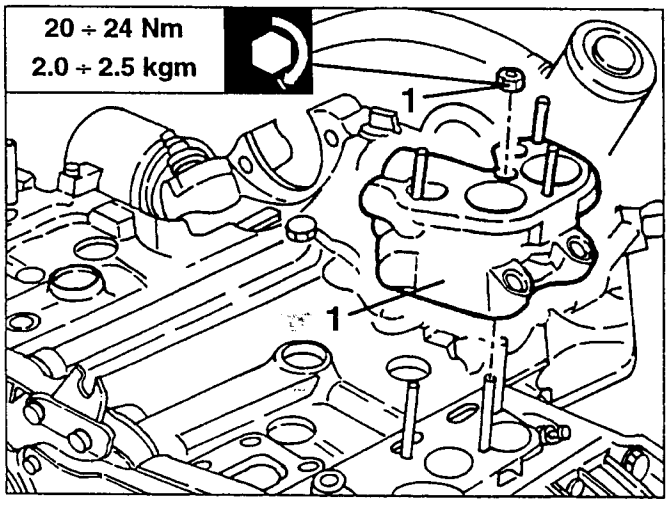
Removing the brackets

1. Slacken the fastening screws and remove the alternator support brackets.
2. Slacken the fastening screws and remove the water pump inlet union.



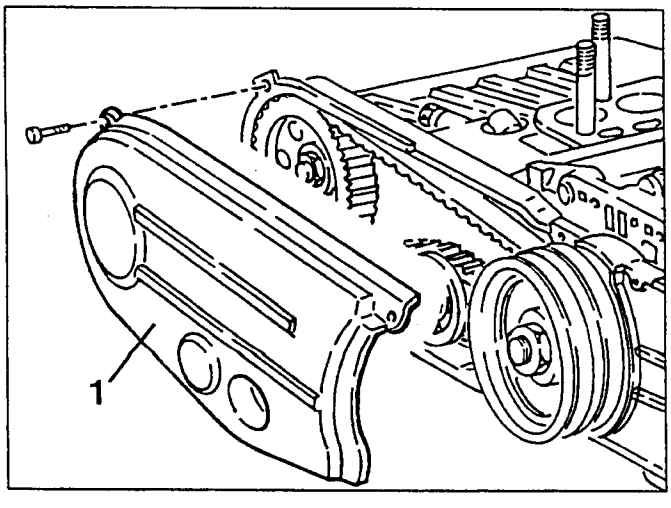
Removing the intake manifolds

1. Slacken the fastening nuts and remove the manifolds.

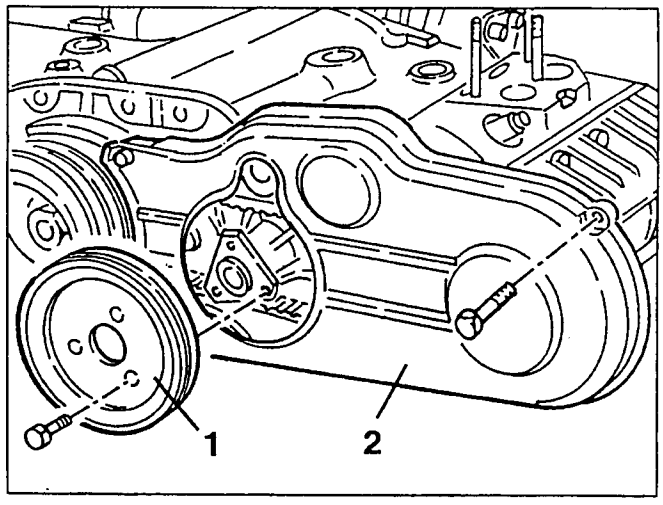


Removing the pulleys

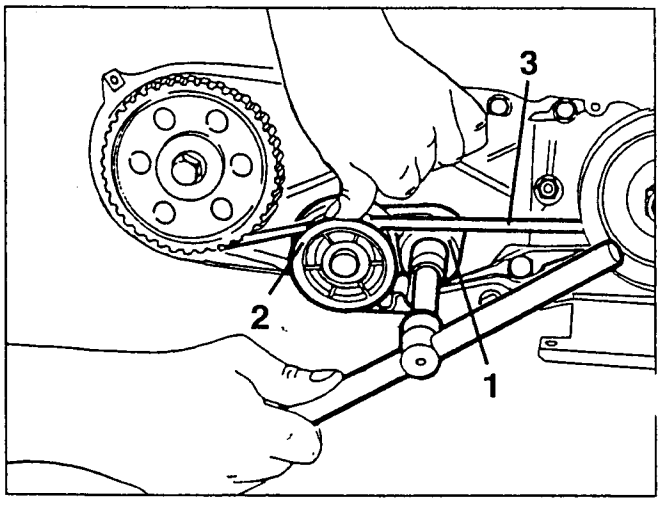
1. Slacken the fastening screws and remove the right timing belt front cover.



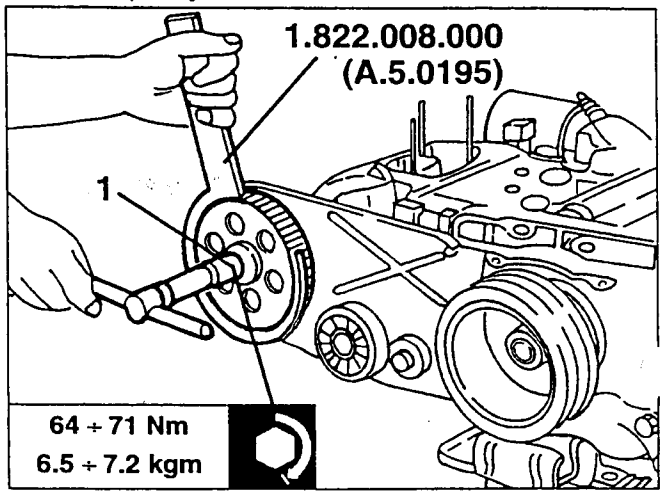
1. Remove the water pump pulley.
2. Remove the left front guard.



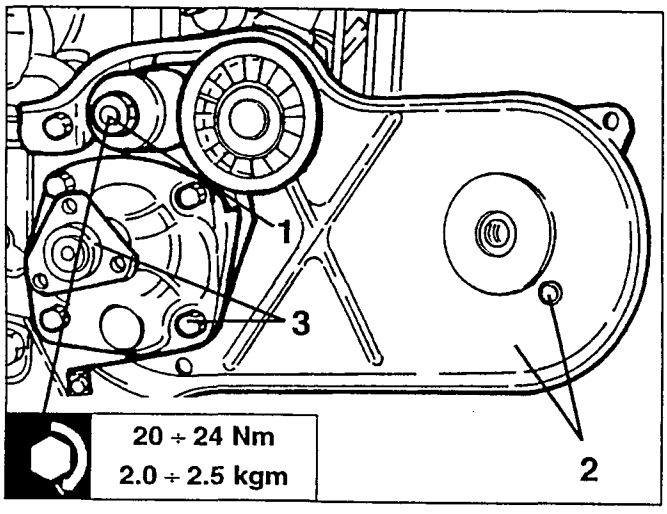
1. Slacken the belt tensioner fastening nut.
2. Press on the belt tensioner guide pulley to overcome the spring tension load and lock the fastening nut.
3. Remove the timing belt firstly from the camshaft pulley and then from the crankshaft pulley.



1. Using tool N° 1.822.008.000 (A.5.0195) as counter-torque, slacken the fastening screws and remove the camshaft pulleys.

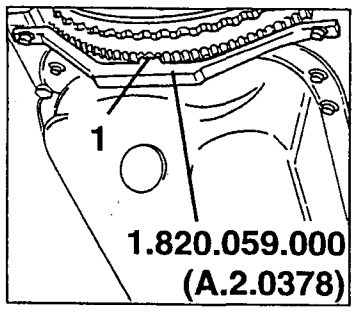


1. Slacken the fastening nuts and remove the belt tensioners.
2. Slacken the fastening screws and remove the timing belt rear guards.
3. Slacken the fastening screws and remove the water pump with its seals.

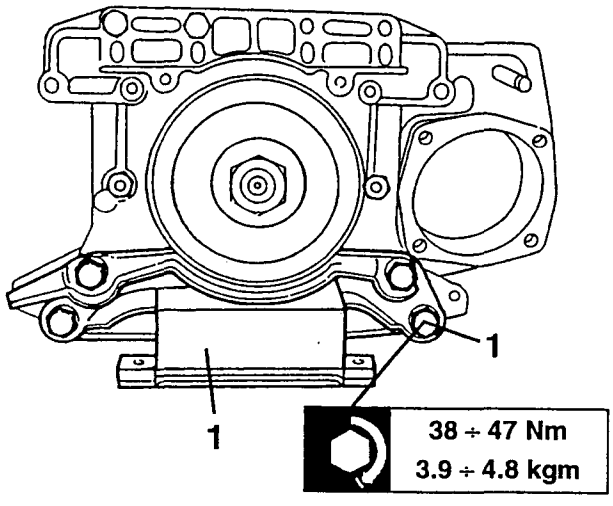


Removing the crankshaft pulleys

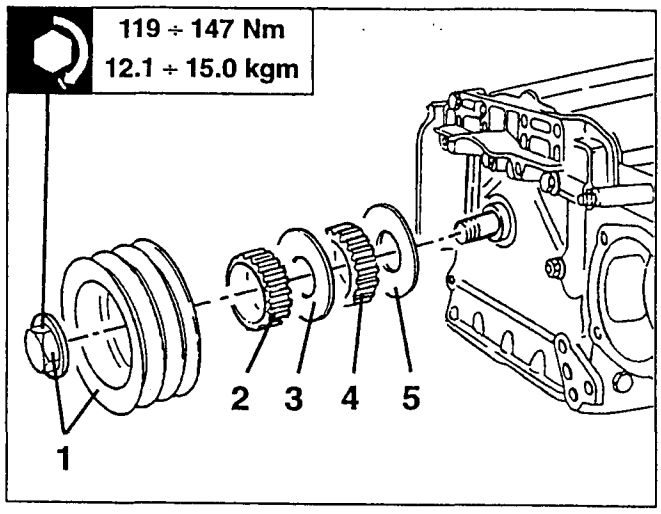
1. Using tool N° 1.820.059.000 (A.2.0378) prevent the flywheel from turning.



1. Slacken the four fastening screws and remove the front flexible support.



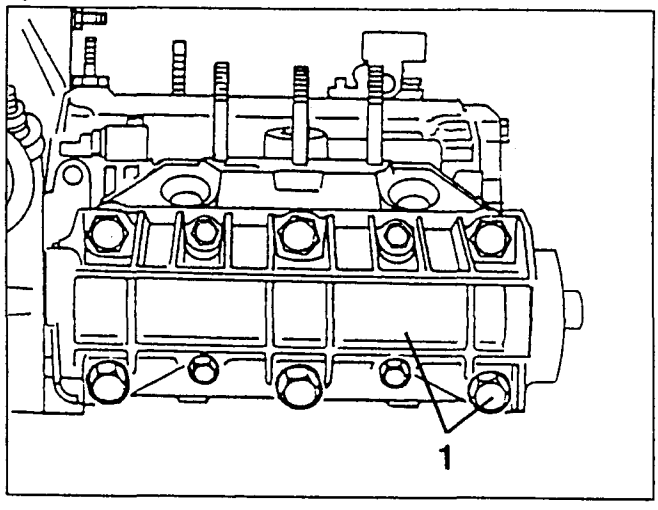
1. Slacken the fastening nut and remove the auxiliary drive pulley.
2. Remove the right timing belt toothed pulley.
3. Remove the spacer.
4. Remove the left timing belt drive pulley.
5. Remove the belt contact washer.



- Remove tool N° 1.820.059.000 (A.2.0378) fitted previously to lock the flywheel.

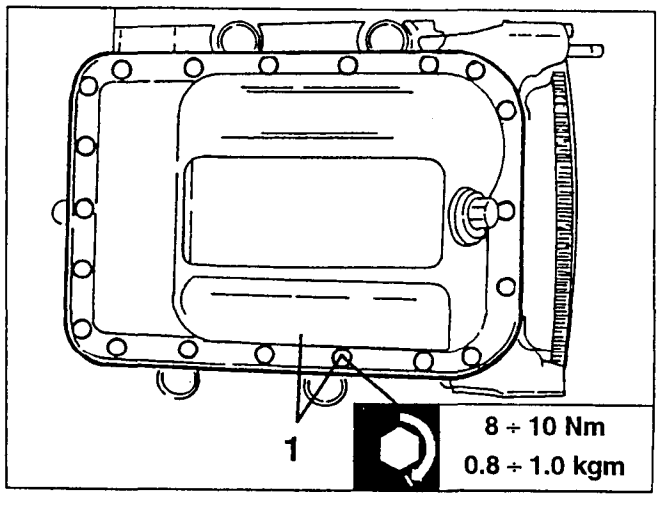
Removing the cylinder heads

1. Slacken the fastening screws and remove the cylinder heads from the crankcase with their seals.

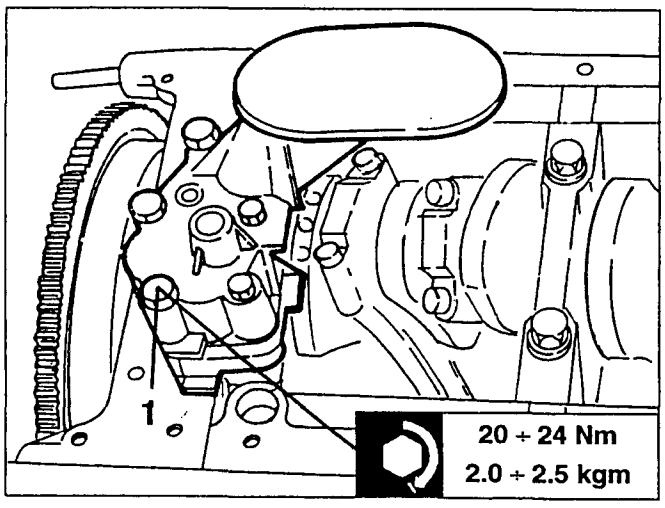


Removing the oil sump and pump

1. Slacken the fastening screws and remove the oil sump with its seal.



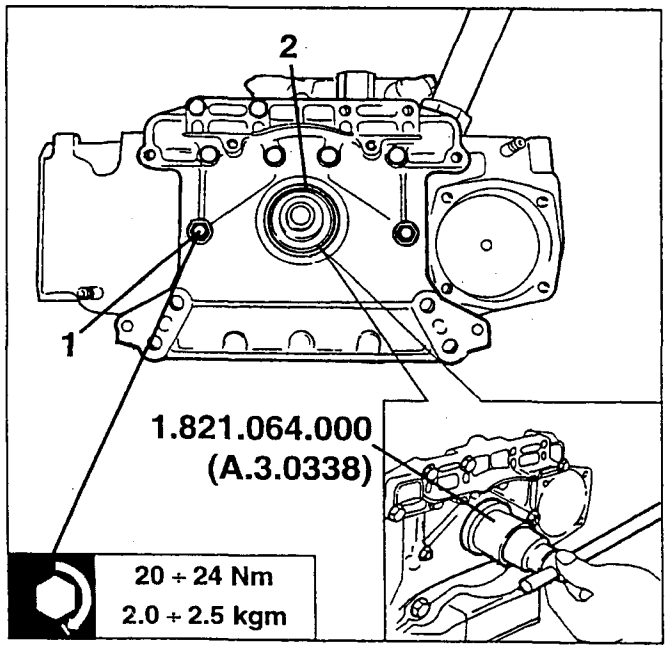
1. Slacken the screws fastening the oil pump to the crankcase rear cover and remove it.



Removing the crankcase front cover

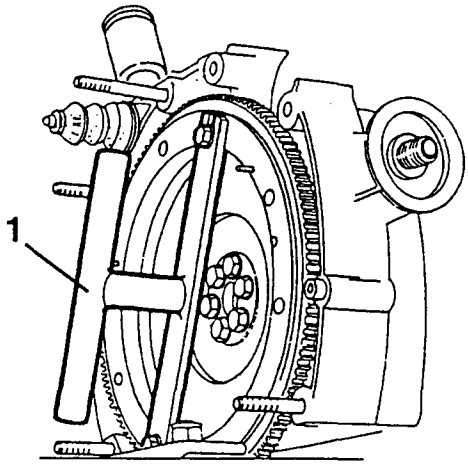
1. Slacken the fastening screws and nuts and remove the crankcase front cover with its seal.
2. Lever with a screwdriver to remove the oil guard from the front cover.

When refitting insert the oil guard on the front cover using tool N° 1.821.064.000 (A.3.0338).

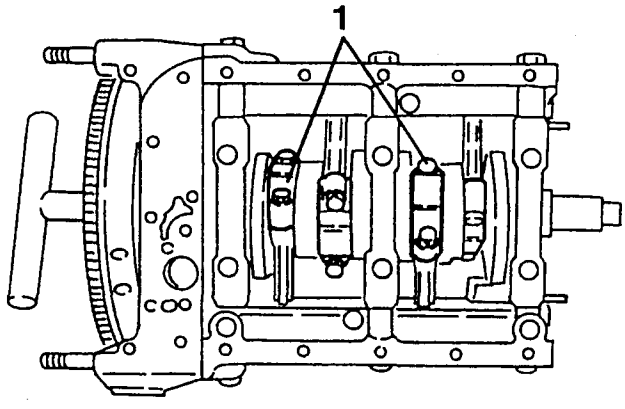


Removing the piston and connecting rods

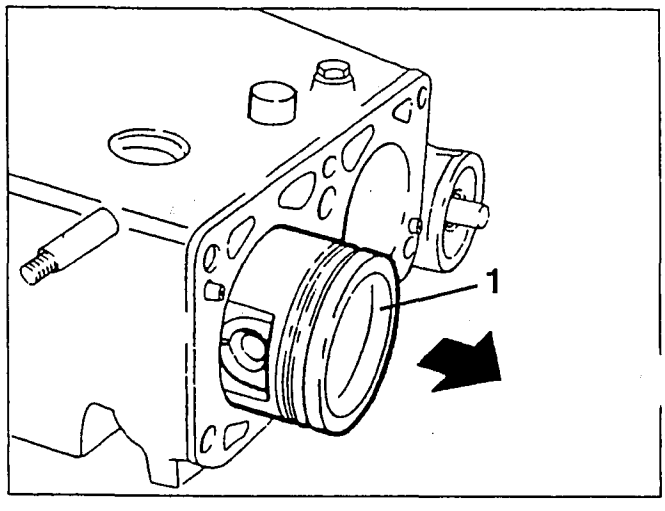
- Fit a suitable tool on the flywheel to allow the crankshaft to turn, then turn it to gain access to the connecting rod cap fastening screws.



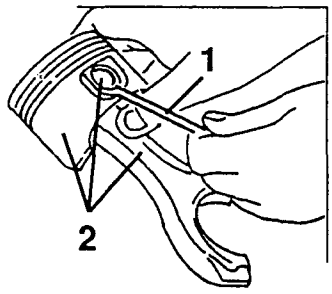
1. Slacken the fastening screws and remove the connecting rod caps with their half bearings.



1. Remove the pistons from the crankcase complete with connecting rods and half bearings.

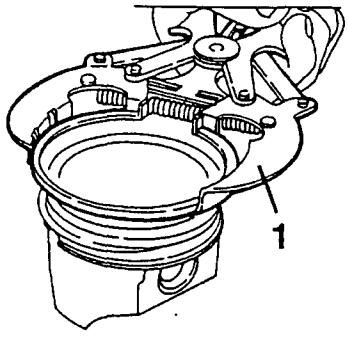


1. Remove the two gudgeon pin circlips.
2. Remove the gudgeon pin and separate the connecting rod from the piston.



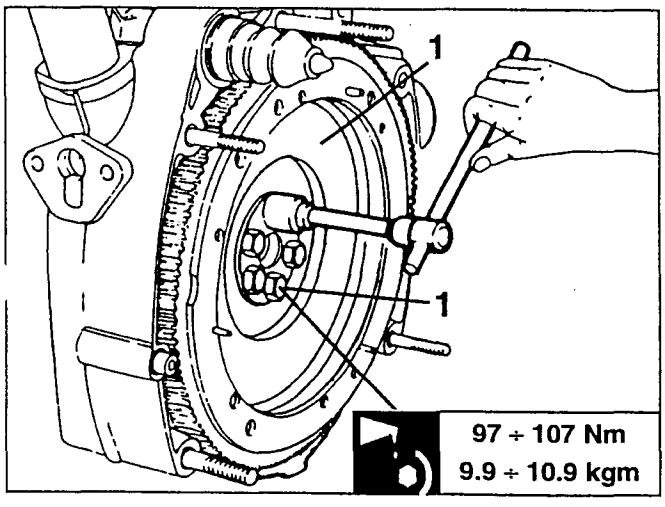
1. Using a suitable tool remove the seal rings and oil scraper ring from the piston.

Work carefully to avoid breaking any rings that might be re- used.



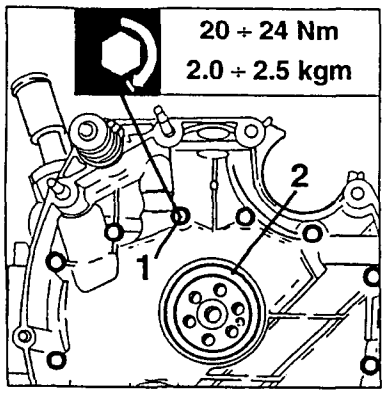
Removing the flywheel

- Remove the tool for turning the crankshaft fitted previously and install tool N° 1.820.059.000 (A.2.0378) to prevent the flywheel from turning.
1. Slacken the fastening screws and remove the flywheel and safety plate.



Removing the rear crankcase cover

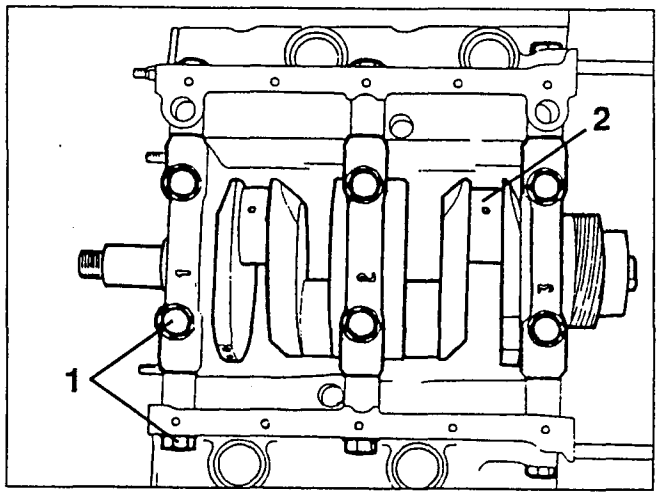
1. Slacken the fastening screws and remove the rear crankcase cover and its seal.
2. Lever with a screwdriver to remove the oil guard from the rear cover.
- Remove the seal ring from the main lubricating duct.



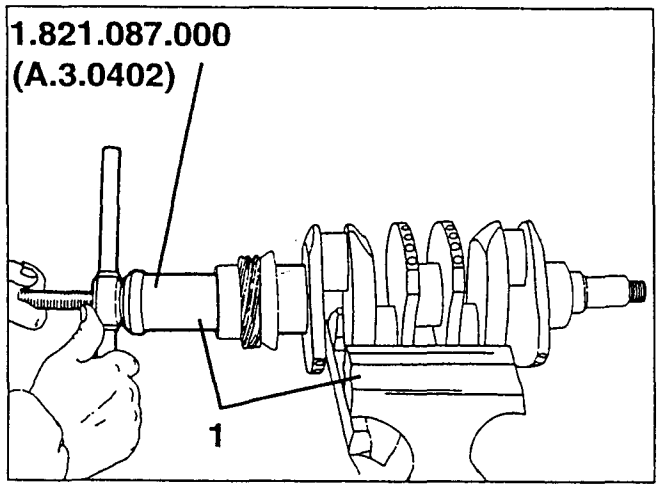
When refitting, use tool N° 1.821.063.000 (A.3.0337) to insert the oil seal ring on the rear cover.

Removing the crankshaft

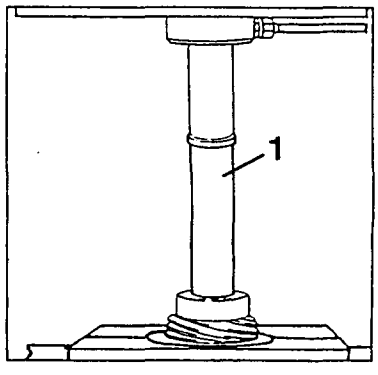
1. Slacken the fastening screws and remove the main bearing caps with the corresponding bearing halves.
2. Remove the crankshaft from the crankcase and retrieve the half bearings and half thrust rings.



1. Fasten the crankshaft in a vice with protective jaws and using puller tool N° 1.821.087.000 (A.3.0402), remove the rear guide bush from the drive shaft.



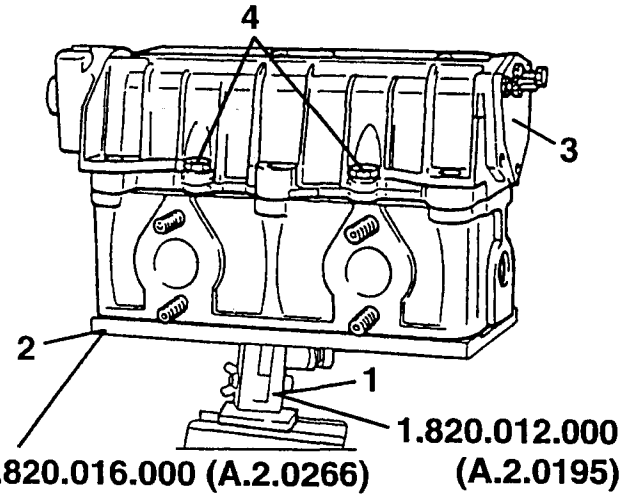
1. Working on the press using a suitable plate, remove the oil pump drive gear from the crankshaft.



DIS-ASSEMBLY OF CYLINDER HEADS

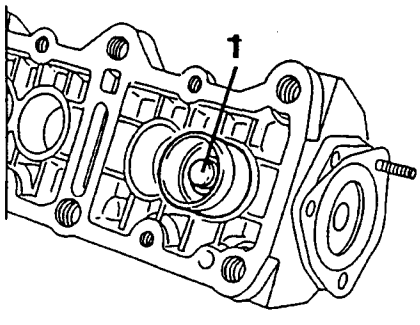
Preliminary operations

1. Clamp the swivelling stand N° 1.820.012.000 (A.2.0195) in a vice.
2. Fasten tool N° 1.820.016.000 (A.2.0226) on the swivelling stand and fasten the cylinder head onto it.
3. Slacken the fastening screws and remove the camshaft rear cover and the corresponding seal.
4. Slacken the fastening screws and remove the camshaft bearing and seal taking care to recover the engine oil.

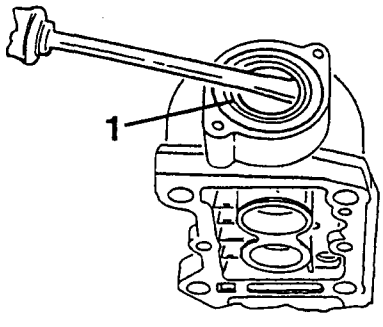


Removing the camshaft

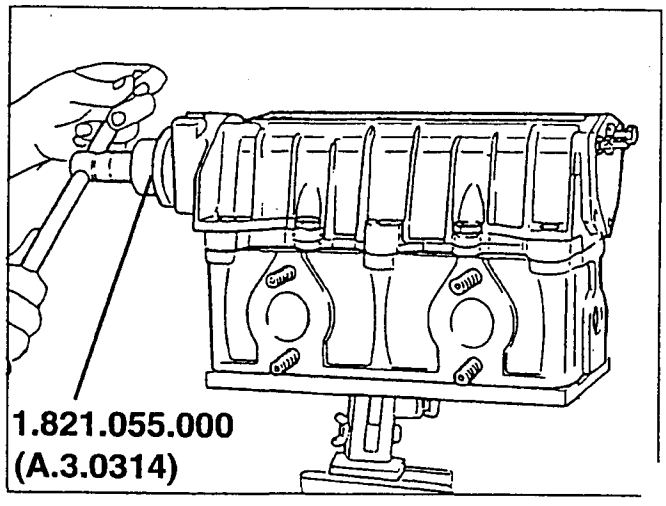
1. Remove the cups from the housings on the camshaft bearing.



- Remove the camshaft pulling it out from the side.
1. Remove the front oil seal ring from its housing on the camshaft bearing.

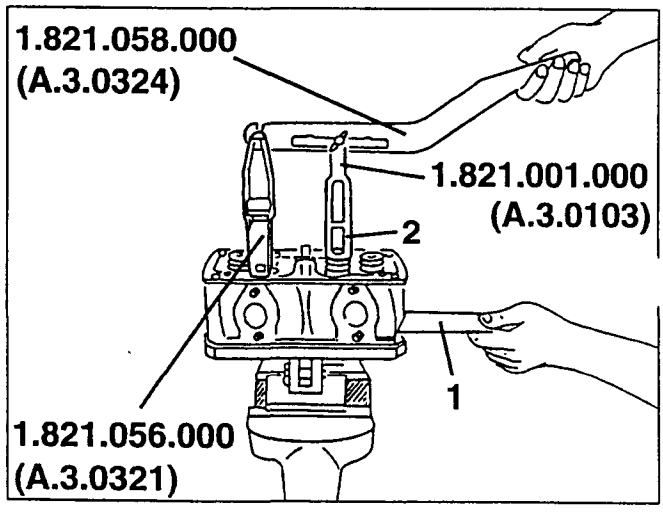


Remove the camshaft front oil seal ring working with the cylinder head assembled using tool N° 1.821.055.000 (A.3.0314).



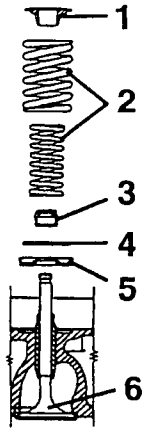
Dis-assembly of valves

1. Insert the valve seal plate in the head support tool.
2. Using tools N° 1.821.001.000 (A.3.0103), N° 1.821.058.000 (A.3.0324) and N° 1.821.056.000 (A.3.0321) remove the half tapers from the valve stem.

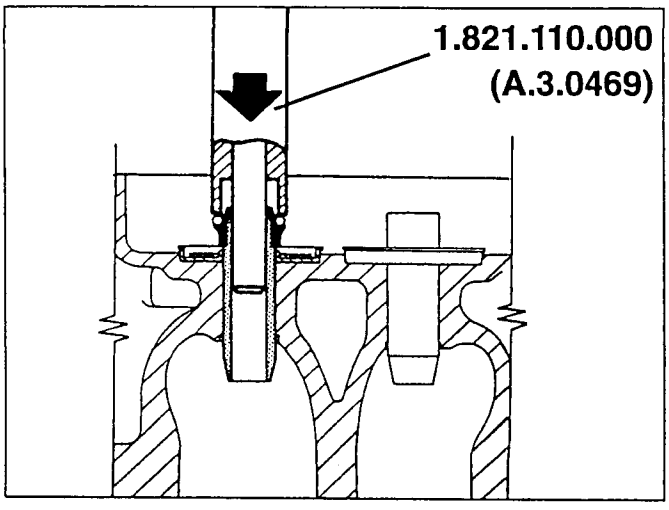


Remove:

1. Upper plate.
2. Inner and outer spring.
3. Oil seal cap.
4. Spring contact ring.
5. Lower plate.
6. Remove the plate from the head support tool and remove the valves from the lower side of the head.



When refitting use tool N° 1.821.110.000 (A.3.0469) to insert the oil seal cap.

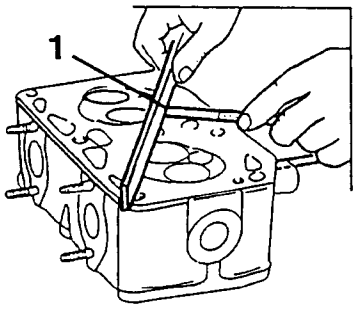


CHECKS AND INSPECTIONS CYLINDER HEADS

Checking the lower surface of cylinder heads

1. Check that the lower surface of the cylinder heads is level and check that it is within the specified limits.

Maximum head lower plane flatness
0.03 mm



- If the lower surface of the head is excessively distorted, both heads should be refaced without exceeding the minimum allowed value.

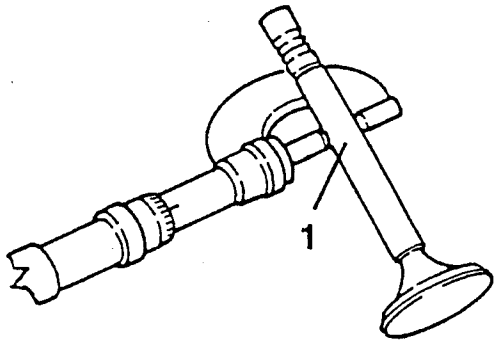
Minimum height of cylinder heads after refacing
77.676 ÷ 77.750 mm

CAUTION:
Exceeding the allowed height limit after refacing involves serious engine operating failures.

Checking the clearance between valve guides and valve stems

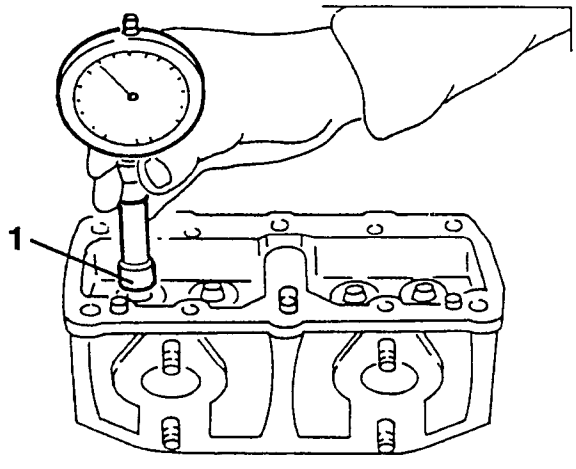
1. Measure the diameter of the valve stems and check that it is within the specified limits.

Diameter of valve stems	
Intake	7.985 ÷ 8.000
Exhaust	7.968 ÷ 7.983



1. Measure the inside diameter of the valve guides and check that it is within the specified limits.

Inside diameter of valve guide
8.013 ÷ 8.031 mm

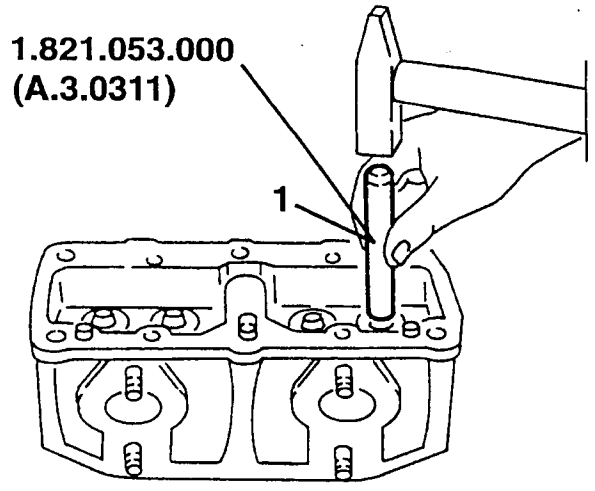


- Calculate the clearance between valve guides and stems and check that it is within the specified limit, if not, change any worn parts.

Radial clearance between valve guides and stems stems	
Intake	0.013 ÷ 0.046
Exhaust	0.030 ÷ 0.063

Changing the valve guides

1. Using puller tool N° 1.821.053.000 (A.3.0311), remove the worn valve guides.



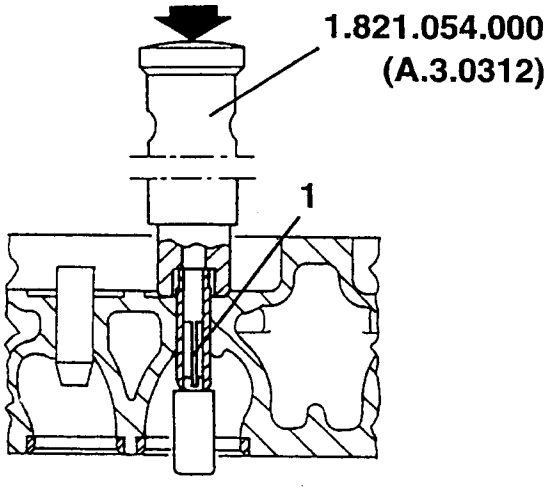
- Check that the outside diameter of the valve guides and their seats on the head are within the specified limits and that their assembly interference is correct.

Outside diameter of valve guides	
13.050 ÷ 13.068 mm	

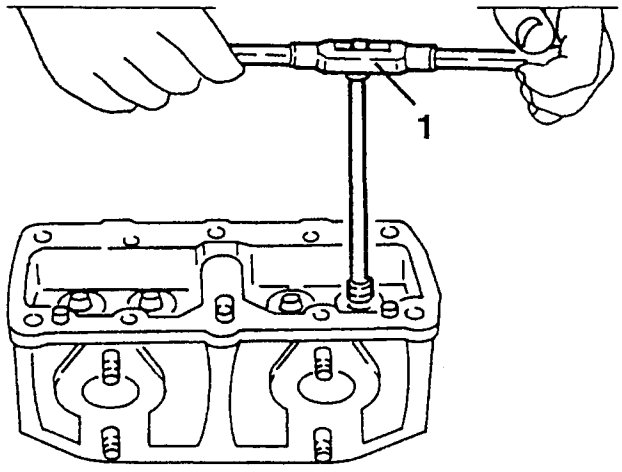
Diameter of valve guide seats	
13.000 ÷ 13.018 mm	

Interference between valve guides and seats	
0.032 ÷ 0.068 mm	

1. Insert the new valve guides using tool N° 1.821.054.000 (A.3.0312).



1. Bore the valve guide inside diameter using the reamer to calibrate the holes to the specified diameter.



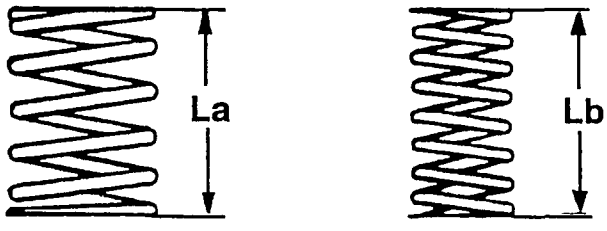
Inside diameter of valve guides	
8.013 ÷ 8.031 mm	

Checking the valve springs

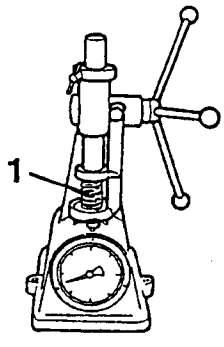
- Check that the "free" length of the valve springs is within the specified limits.

NOTE: The rest surfaces must be parallel with each other and perpendicular to the axis of the spring with a maximum error of 2°.

Length of valve springs		
outer spring	La	~ 45 mm
inner spring	Lb	~ 44 mm



- Using a torque meter, check that the characteristic data of the springs are within the specified limits.



Outer spring length (mm)		Control load (kg)
Valve closed	32.2	23.0 ÷ 24.4
Valve open	23.2	43.3 ÷ 46.1

Length of inner spring (mm)		Control load (kg)
Valve closed	30.2	11.6 ÷ 12.4
Valve open	21.2	20.4 ÷ 21.8

Turning the valve seats

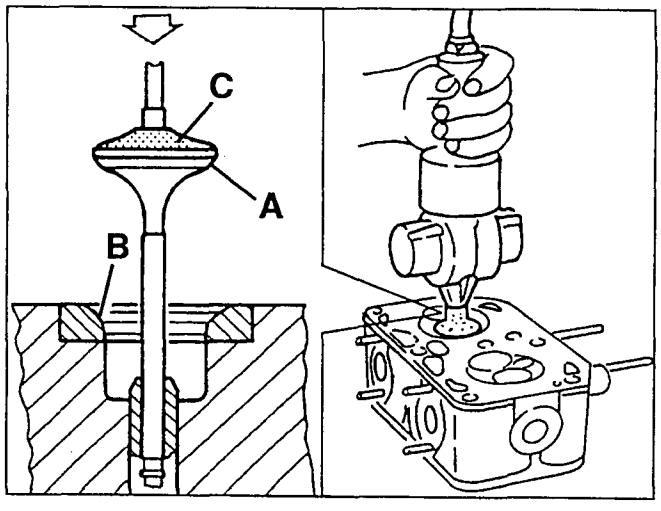
1. Turn the valve seats using suitable tools with the cylinder heads cold

Taper of contact area with valve "β"	90° ÷ 90°30'
Taper of upper valve seat area "α"	120°
Taper of lower valve seat area "γ"	Int. 70°
	Exh. 30°

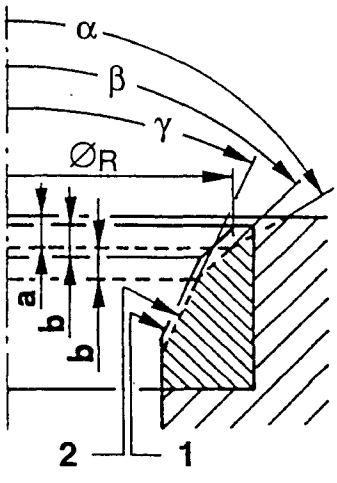
Dimension "a" at refacing limit	**2.9 mm**
Height "b" valve contact area	Int. 1.07 ÷ 1.37 mm
	Exh. 1.26 ÷ 1.56 mm

Reference diameter $\varnothing_R$	
Intake	39.0 mm
Exhaust	31.9 mm

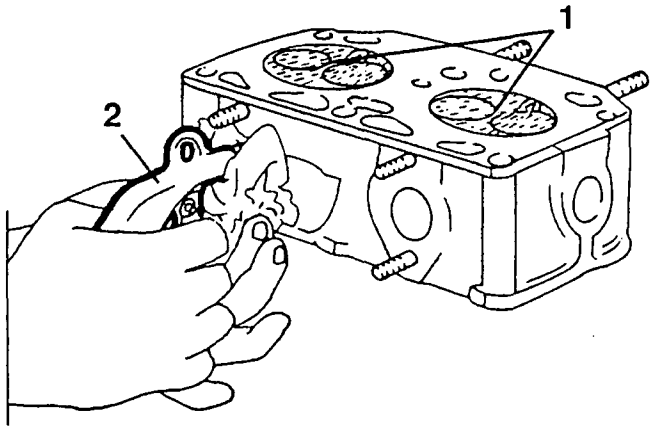
- After machining grind each valve in its housing as follows:
• coat the contact surfaces "A" and "B" of the valves and seats with abrasive paste (SIPAL AREXONS Carbosilicium for valves).
• lubricate the valve stem with engine oil.
• fit the lower surface of the valve mushroom to the suction cup "C" of a pneumatic grinder.
• insert the valve in its guide and grind.
• after grinding, thoroughly clean the valve and the seat.



- When changing the valve guides, thus refacing and grinding the valve seats, it is advisable to check the valve tightness with the spark plugs in place, proceeding as follows:
1. Fill the hollow of the combustion chamber with petrol.
2. Admit low pressure air to the intake manifolds and check that no air bubbles form in the petrol.
- Check the tightness of the exhaust valves in the same way, admitting air to the exhaust manifolds.
- If any leaks are noted, make sure that the valves are perfectly settled in their seats and repeat the check; if the result is negative, grinding must be repeated.



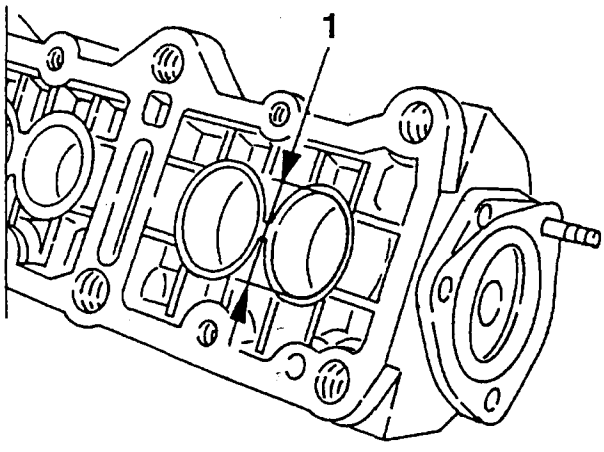
1. Original profile
2. Profile after max. refacing



Checking the clearance between cups and seats

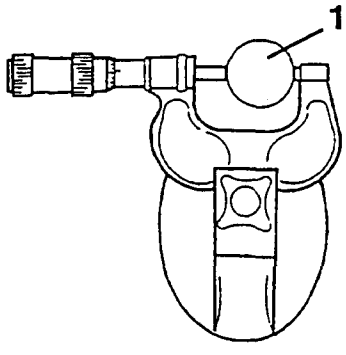
1. Check that the diameter of the seats is within the specified limits.

Diameter of valve cup seats
35.000 ÷ 35.025 mm



1. Check that the outside diameter of the cups is within the specified limits.

Diameter of valve cups
34.959 ÷ 34.975 mm



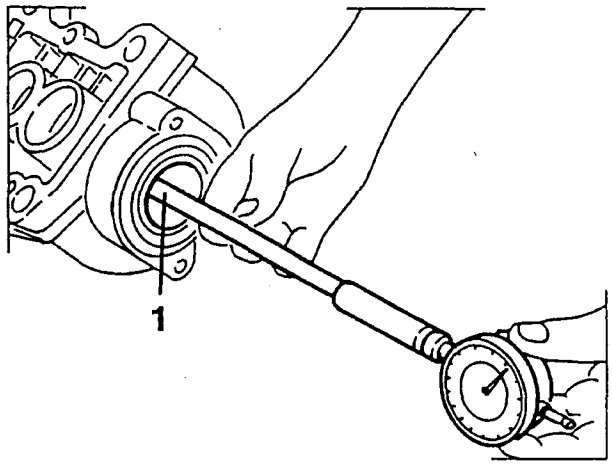
- Calculate the clearance between the cups and their seats and check that it is within the specified limit.

Clearance between cups and seats
0.025 ÷ 0.066 mm

Camshafts and timing system bearings

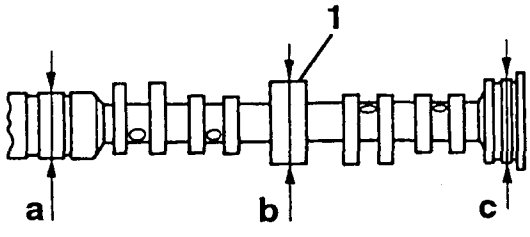
1. Check that the diameter of the camshaft supports is within the specified limits.

Diameter of camshaft supports	
Front	35.015 ÷ 35.040 mm
Centre	48.000 ÷ 48.025 mm
Rear	49.200 ÷ 49.225 mm



1. Check that il diameter of the camshaft journals is within the specified limits.

Diameter of camshaft journals	
Front "a"	34.940 ÷ 34.961 mm
Centre "b"	47.940 ÷ 47.956 mm
Rear "c"	49.140 ÷ 49.156 mm



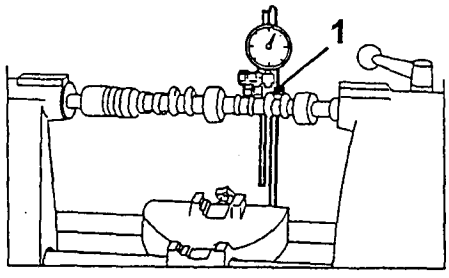
- Calculate the clearance between the camshaft journals and their bearings and check that it is within the specified limit.

Clearance between camshafts and bearings	
Front	0.054 ÷ 0.100 mm
Centre - Rear	0.044 ÷ 0.085 mm

1. Check that the cam lifts exceed the minimum permissible limit.

Minimum cam lift	
Intake	9.8 mm (*)
Exhaust	9.0 mm

(*): 9.0 mm for 1351 c.c. engines after change and 1596 c.c. Rochester engine.



CHECKING AND INSPECTING THE CRANKCASE

- Visually inspect the crankcase for cracks and signs of excessive wear on the sliding surfaces; check that all the threads are intact.
- Remove the plugs of the lubrication and cooling ducts and clean the ducts with a suitable detergent, then dry them with a jet of air and refit new plugs.
- Accurately clean the crankcase surfaces of any fragments of seals or sealants.

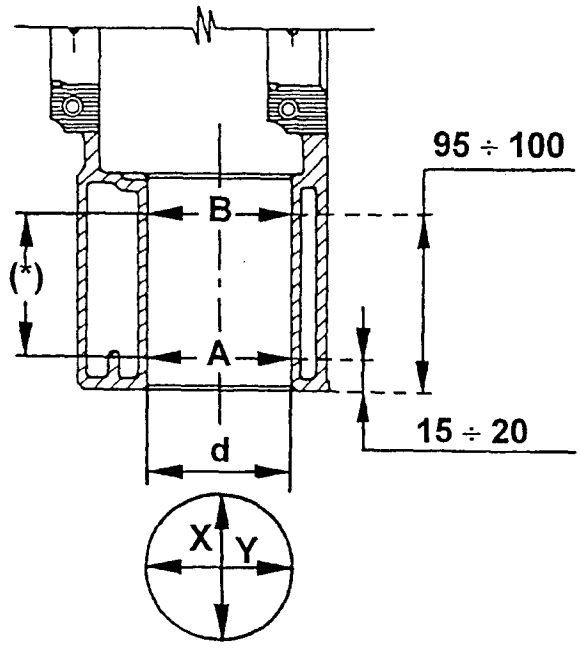
Checking cylinders

- Using a bore gauge on a dial gauge, measure the inside diameter of the cylinders and check that it is within the specified limits.

Inside diameter "d" (mm)		
Engine	AR 33501	AR 33201
Class A	80.000 ÷ 80.010	84.000 ÷ 84.010
Class B	80.010 ÷ 80.020	84.010 ÷ 84.020
Class C	80.020 ÷ 80.030	84.020 ÷ 84.030
Class D	80.030 ÷ 80.040	84.030 ÷ 84.040
Class E	80.040 ÷ 80.050	84.040 ÷ 84.050

Maximum taper
A - B = 0.02 mm

Maximum ovalisation
X - Y = 0.02 mm



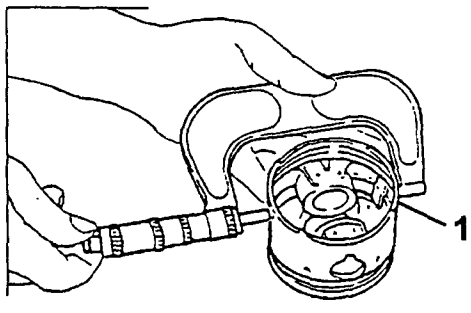
(*) Area for dimensional control

Checking pistons

1. Measure the outside diameter of the pistons and check that it is within the specified limits.

Piston outside diameter (mm) (1)		
Engine	AR 33501	AR 33201
Class A (Blue)	79.960 ÷ 79.970	83.950 ÷ 83.960
Class B (Pink)	79.970 ÷ 79.980	83.960 ÷ 83.970
Class C (Green)	79.980 ÷ 79.990	83.970 ÷ 83.980
Class D (Yellow)	79.990 ÷ 80.000	83.980 ÷ 83.990
Class E (White)	80.000 ÷ 80.010	83.990 ÷ 84.000

(1) To be measured at right angles to the gudgeon pin hole at a distance of 14 mm from the lower edge of the skirt for "Borgo" pistons and 11.5 mm from the gudgeon pin axis for "Mondial" pistons.



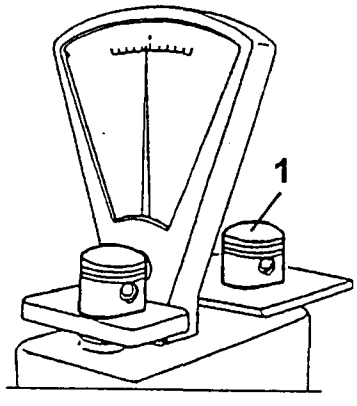
- Calculate the clearance between cylinder and piston and check that it is within the specified limits.

Clearance between cylinder - piston
0.03 ÷ 0.05 mm

- If dimensions are found to be out of tolerance, it is necessary to reface the cylinders bearing in mind that spare pistons have three oversizes; it is therefore necessary to make the diameter of the cylinders to the tolerances given in GROUP 00.
- Assemble the main bearing caps on the crankcase and tighten the fastening screws to the specified torque.
-Bore the cylinders to obtain the tolerances given in GROUP 00.

Facing should be carried out in such a way that the machining signs are crossed by an angle of 90° ÷ 120°.

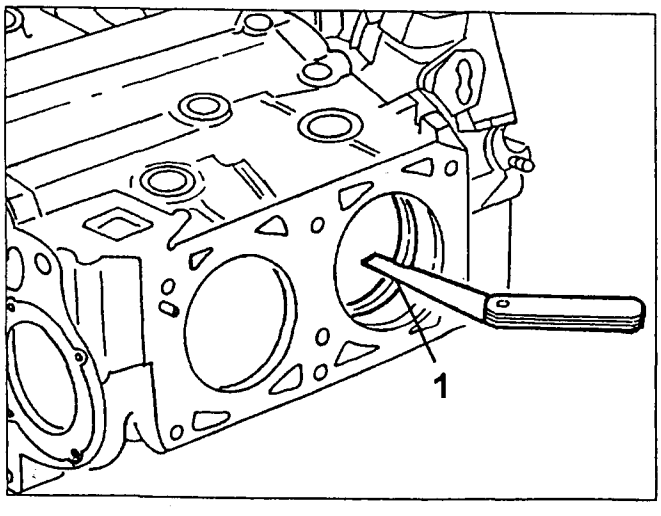
1. Check that the difference in weight between pistons complete with gudgeon pins and seal rings is within the specified limit.



Difference in weight between pistons
≤ 2 g

Checking seal ring gap

1. Insert the seal rings in the cylinder liner, check that they adhere to the whole circumference and check that the gap is within the specified limits.

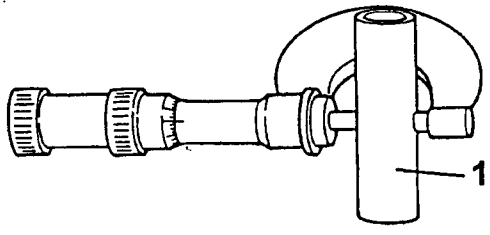


Ring gap (mm)		
Engine	AR 33501	AR 33201
First ring	0.30 ÷ 0.45	0.30 ÷ 0.50
Second ring	0.30 ÷ 0.45	0.30 ÷ 0.50
Oil scraper ring	0.25 ÷ 0.40	0.25 ÷ 0.40

Checking the clearance between gudgeon pins and seats on pistons

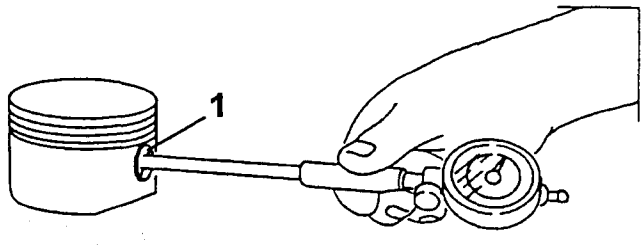
1. Measure the outside diameter of the gudgeon pins and check that it is within the specified limits.

Gudgeon pin outside diameter
20.996 ÷ 21.000 mm



1. Measure the diameter of the hole on the piston corresponding to the gudgeon pins and check that it is within the specified limits.

Gudgeon pin hole diameter in pistons
21.004 ÷ 21.008 mm



- Calculate the clearance between the gudgeon pins and their seats on the pistons and check that it is within the specified limits.

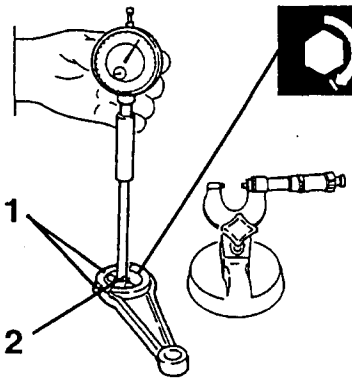
Clearance between gudgeon pins and seats on pistons
0.004 ÷ 0.012 mm

Checking the clearance between connecting rod journals and the corresponding half bearings

1. House the rod half bearings in the connecting rod big end and on the corresponding cap, then join them tighteniin them tightening the fastening screws to the specified torque.
2. Measure the diameter of the connecting rod big end and check that it is within the specified limits.

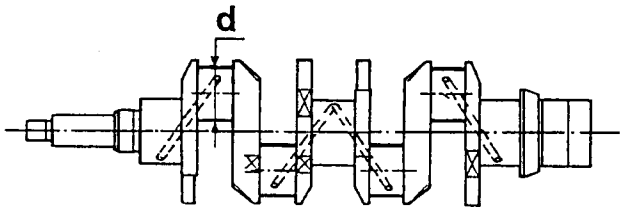
Inside diameter of connecting rod half bearings	
Class A - Blue	50.024 ÷ 50.048 mm
Class B - Red	50.032 ÷ 50.056 mm

53 ÷ 58 Nm 5.4 ÷ 5.9 kgm



1. Measure the diameter of the connecting rod journals and check that it is within the specified limits.

Diameter of connecting rod journals	
Class A - Red	49.992 ÷ 50.000 mm
Class B - Blue	49.984 ÷ 49.992 mm



Due to the nitriding treatment the crankshaft has been subjected to, no grinding operations are possible; therefore it must be changed in the event of excessive wear.

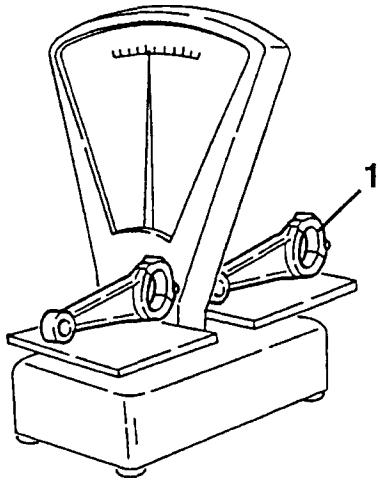
- Calculate the clearance between the rod journals and half bearings and check that it is within the specified limits.

Clearance between rod journals and half bearings
0.032 ÷ 0.064 mm

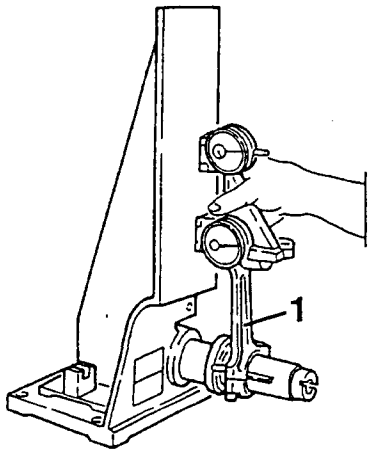
Checking the connecting rods

1. Check that the difference in weight between the rods complete with half bearings, caps and screws is within the specified limit.

Difference in weight between connecting rods
≤ 2 g



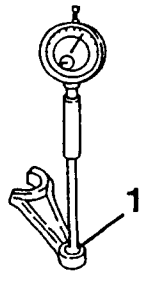
1. Check that the rods are perpendicular using a reference plane as illustrated.



If perpendicularity is not perfect, the connecting rod must be changed to avoid abnormal stresses when the engine is running, resulting in uneven wear of the piston and of the rod itself.

Checking the clearance between pins and small end bushings

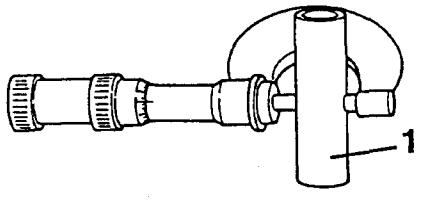
1. Measure the inside diameter of the small end bushing and check that it is within the specified limits, if not, change the bushing.



Inside diameter of small end bushing
21.007 ÷ 21.015 mm

1. Measure the outside diameter esterno of the pins and check that it is within the specified limits.

Outside diameter of pins
20.996 ÷ 21.000 mm



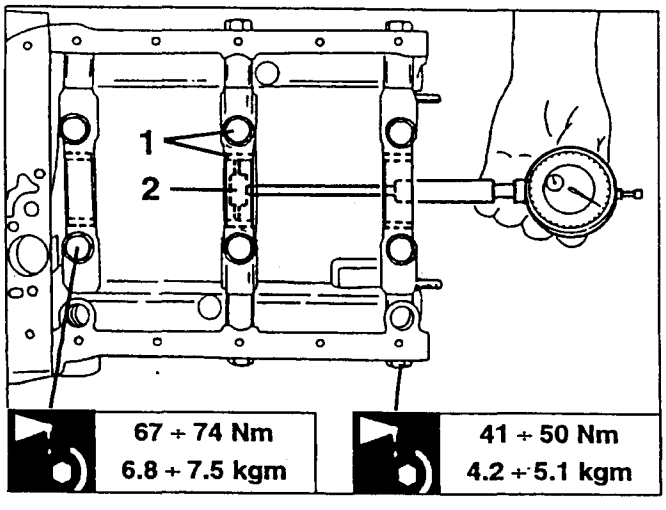
- Calculate the clearance between the pins and the small end bushing and check that it is within the specified limits.

Clearance between pins and small end bushing
0.007 ÷ 0.019 mm

Checking the clearance between main bearing journals and half bearings

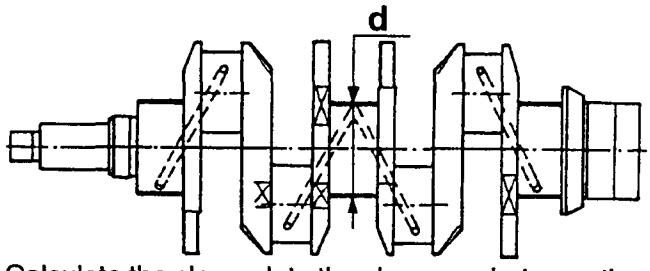
1. House the half bearings and fit the main bearing caps on the crankcase tightening the fastening screws to the specified torque.
2. Measure the diameter of the main bearings and check that it is within the specified limits.

Diameter of main bearings (mm)		
Engine	AR 33501	AR 33201
Class A Red	63.610 ÷ 63.635	63.618 ÷ 63.640
Class B Blue		63.616 ÷ 63.638



1. Measure the diameter of the main bearing journals and check that it is within the specified limits.

Diameter of main bearing journals (mm)		
Engine	AR 33501	AR 33201
Class A Red	59.944 ÷ 59.957	59.954 ÷ 59.964
Class B Blue		59.944 ÷ 59.954

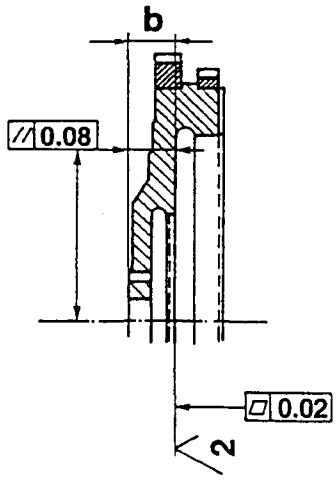


- Calculate the clearculate the clearance between th.. main bearing journals and half bearings and check that it is within the specified limits.

Working clearance between main bearing journals and half bearings	
AR 33501	0.028 ÷ 0.063 mm
AR 33201	0.023 ÷ 0.057 mm

Checking the engine flywheel

- Check that the ring gear teeth are not cracked or show signs of seizure; if they do, proceed as follows to change them:
- remove the old ring gears;
- accurately clean the contact surfaces of the new ring gears and of the flywheel;
- evenly heat the new ring gears to 120° ÷ 140° C and fit them on the flywheel;
- leave to cool naturally, do not force cool.



- Check that the surface of the flywheel on which the clutch driven plate works has no nicks, material removal or signs of overheating. If not, check that dimension "B" shown in the diagram is above the specified limit and that the machining allowance enables refacing.

Refacing dimension
B ≥ 21.15

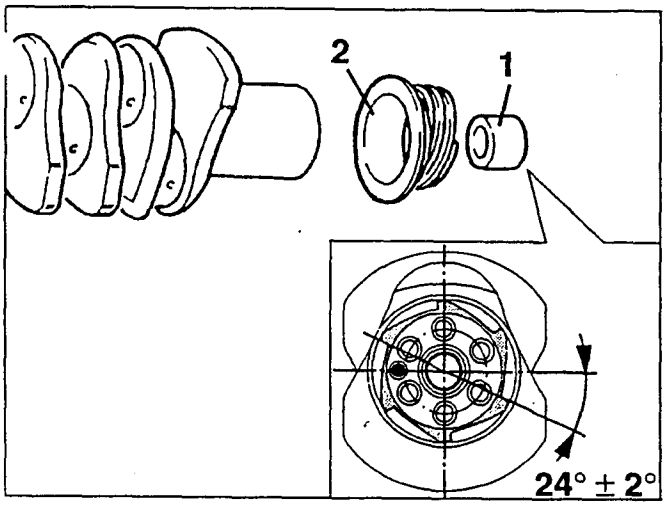
CAUTIONS FOR RE-ASSEMBLY

For re-assembly operations reverse the sequence of those described for dis-assembly unless otherwise indicated below.

- Check valve tightness when the cylinder heads are assembled.

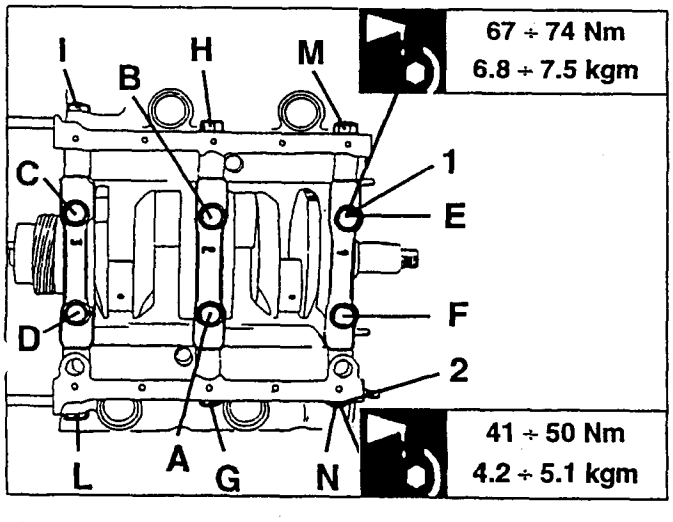
Reassembling the crankshaft

1. If removed previously, the crankshaft rear bushing should be refitted using tool n° 1.821.104.000 (A.3.0450).
2. Heat the oil pump drive gear to 150°C and shrink it onto the crankshaft directing it as illustrated.



Tightening the main bearing caps

- Assemble the main bearing caps on the crankcase bearings in the correct position and tighten the fastening screws in oil without locking them.
1. Tighten the main bearing cap fastening screws to the respective crankcase bearings two or three times in the sequence shown from A to F.
2. Then in two or three operations, tighten the screws fastening the main bearing caps to the crankcase in the sequence shown from G to N.

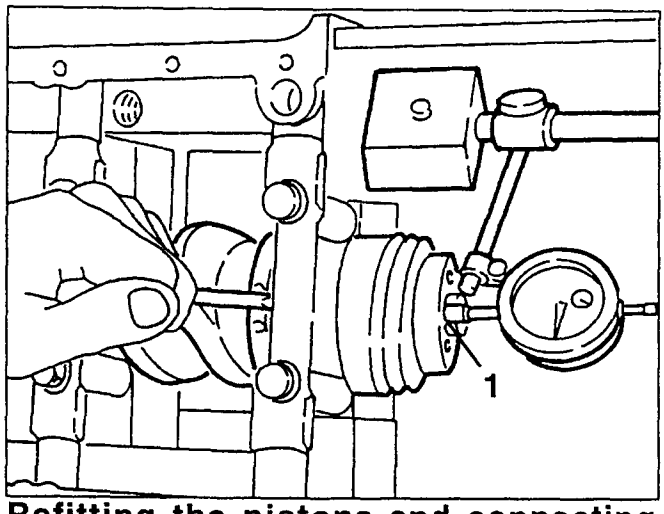


- Turn the crankshaft by hand and check that it turns smoothly.

Checking the crankshaft end float

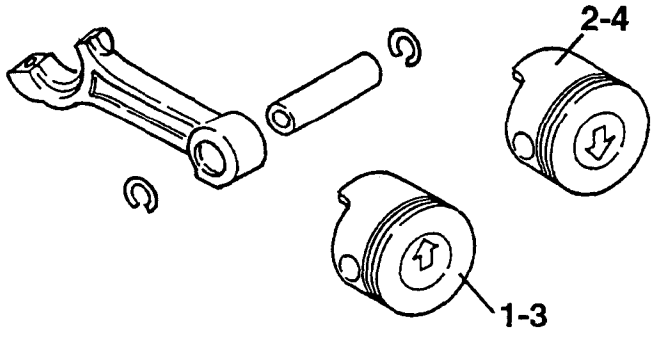
1. Using a dial gauge on a magnetic base, measure the crankshaft end float and check that it is within the specified limits.

Crankshaft end float
0.06 ÷ 0.25 mm

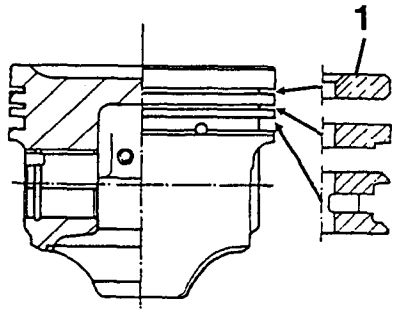


Refitting the pistons and connecting rods

1. Assemble the pistons and connecting rods so that the pistons of the right cylinder head 1-3 have the arrow stamped on the crown pointing upwards and the pistons of the left head 2-4 have the arrow pointing downwards.

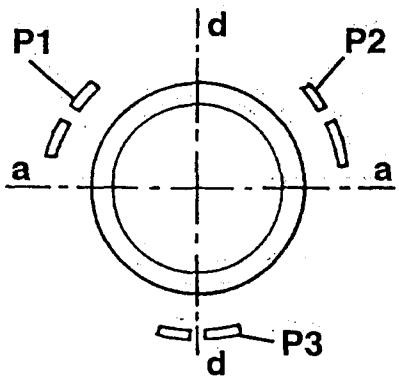


1. Insert the rings on the piston making sure that the wording on the flat surface faces upwards.

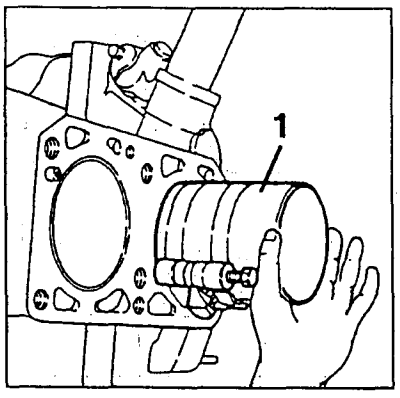


- Direct the rings on the pistons with the cuts offset by 120°.

P1. Position of upper ring;
P2. Position of lower ring;
P3. Position of oil scraper ring;
aa. Gudgeon pin axis;
dd. Direction of thrust;



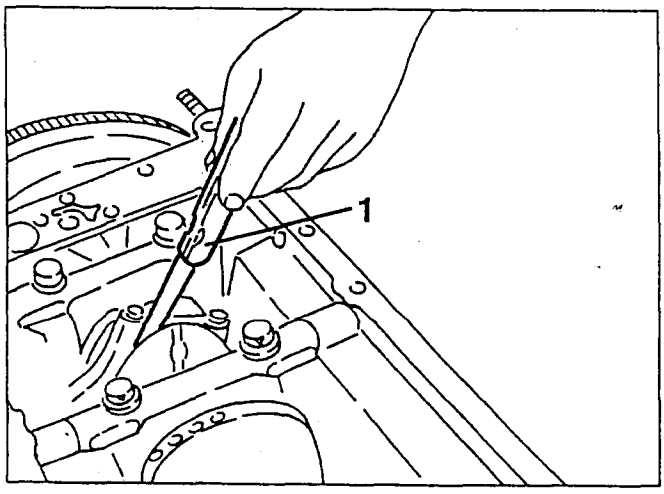
1. Assemble the half bearings on the connecting rod big end and insert the piston-connecting rod assembly in the corresponding cylinders using the special tool.



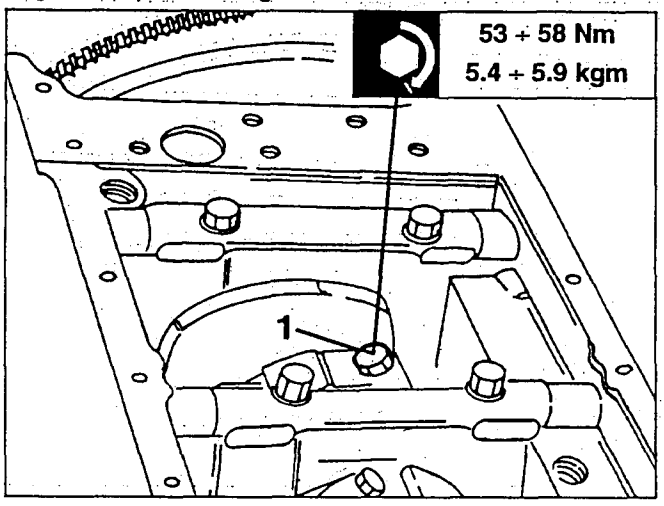
When assembling direct the pistons with the arrow stamped on the crown pointing in the direction of rotation of the engine, i.e. upwards for the right head pistons and downwards for the left head pistons.
The position of the connecting rod big end must make it possible to read the identification number.

1. Position the connecting rod caps with the corresponding half bearings and check that there is the specified play between the crankshaft shoulder and the connecting rod-cap profile.

Clearance between crankshaft shoulder and connecting rod - cap profile
0.15 mm

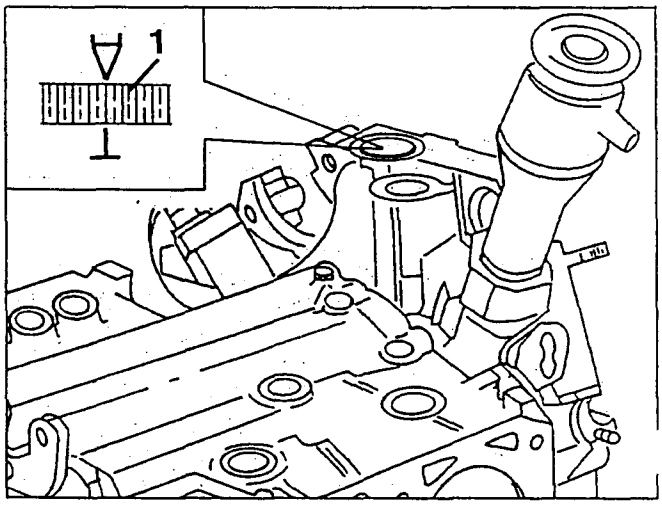


1. Suitably turn the crankshaft to tighten the connecting rod cap fastening screws.

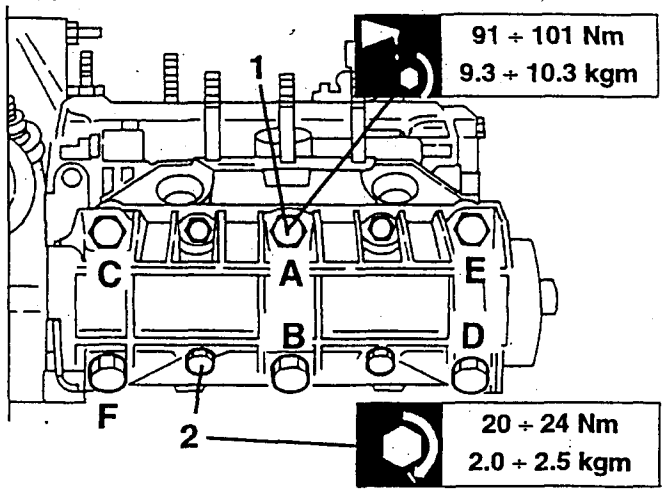


Refitting the cylinder heads

1. Turn the crankshaft to take piston no. 1 to the T.D.C. (bursting stroke); notch "T" on he flywheel coinciding with the impression on the cover.



1. Assemble the cylinder heads on the crankcase with the seals interposed and tighten the screws in to or three operations following the sequence illustrated (A - F).
2. Tighten the four screws fastening the camshaft support in crossed order.

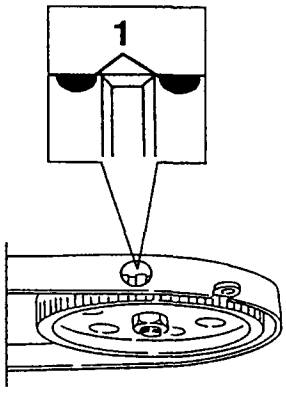


When working with the engine assembled on the car, use the extension wrench N° 1.822.010.000 (A.5.0198), the tightening torques become:

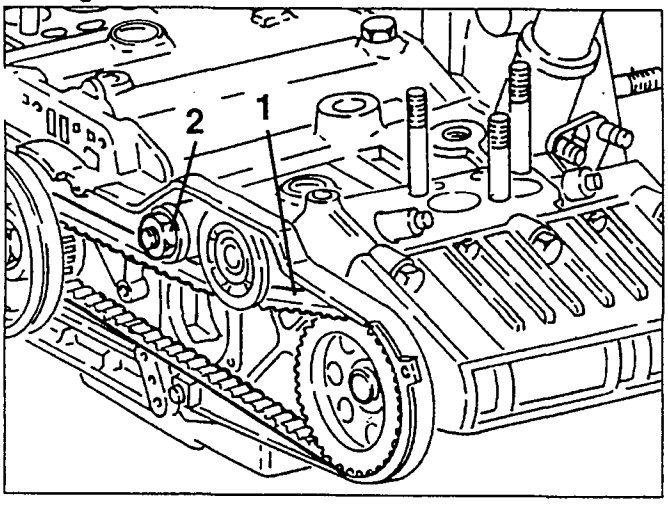
for torque wrench with 300 mm arm	64 ÷ 71 Nm 6.5 ÷ 7.2 kgm
for torque wrench with 400 mm arm	69 ÷ 77 Nm 7.0 ÷ 7.8 kgm

Assembling the timing belts

1. Turn the left camshaft so that the tooth and the two adjacent grooves milled on the timing pulley can be seen through the special holes on the rear guard.
- Turn the crankshaft until the notch "T" on the flywheel is aligned with the fixed reference on the rear cover.

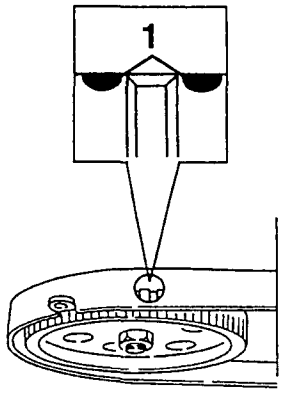


1. Fit the left timing belt.
2. Slacken the belt tensioner fastening nut so that it can exert the load impressed by the spring on the belt, then tighten the nut.

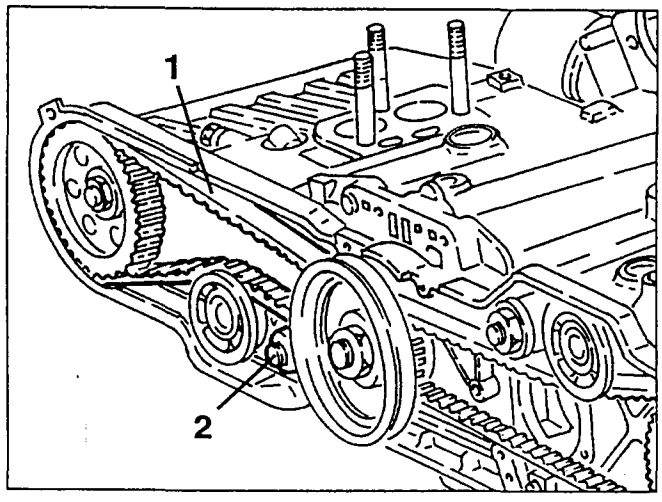


CAUTION:
The belt should be keyed with the belt pulling branch opposite the tensioners taut.

1. Turn the right camshaft so that the tooth and the two adjacent grooves milled on the timing pulley can be seen through the special holes on the rear guard.
- Turn the crankshaft until the notch "T" on the flywheel is aligned with the fixed reference on the rear cover.

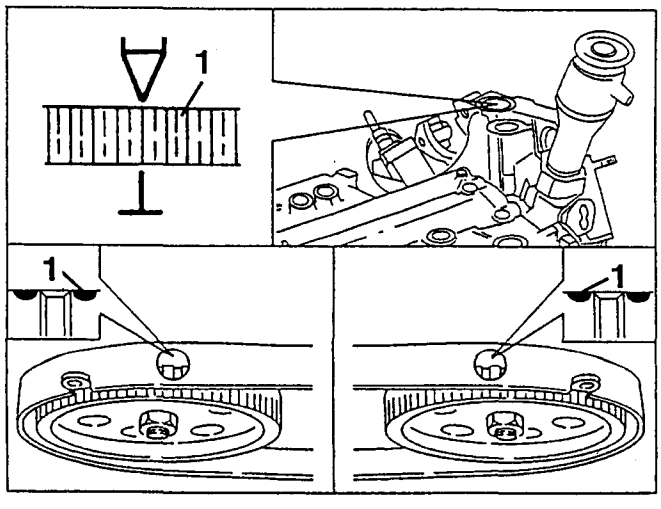


1. Fit the right timing belt.
2. Slacken the belt tensioner fastening nut so that it can exert the load impressed by the spring on the belt, then tighten the nut.

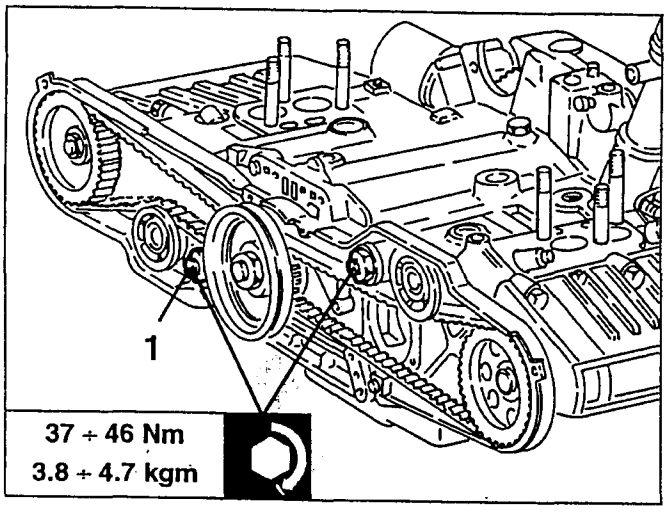


CAUTION:
Use special wrench N° 1.822.008.000 (A.5.0195) to prevent the pulley from turning.

- Turn the crankshaft a few times in its direction of rotation to allow the belts to take their final position.
1. Check the engine timing.



- Turn the crankshaft by 90° in its direction of rotation until the impression ● on the flywheel is aligned with the fixed reference.
1. Slacken the right belt tensioner nut, then tighten it to the specified torque.
- Turn the crankshaft by 360° in its direction of rotation until the impression ● on the flywheel is aligned with the fixed reference.
- Proceed in the same manner to tighten the left belt tensioner.

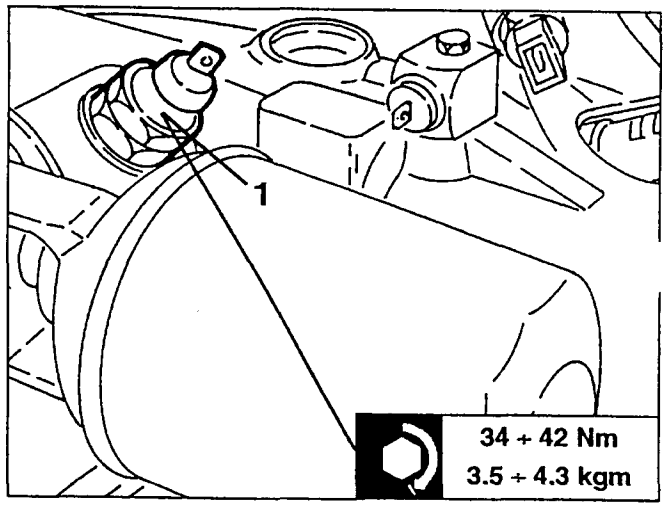


Upon completion of these operations check again that the timing references correspond.

CHECKING THE ELECTRICAL COMPONENTS OF THE LUBRICATION CIRCUIT

Minimum engine oil pressure warning light sensor

1. Check the setting of the minimum engine oil pressure warning light sensor. If the value fails to meet specifications, change the sensor.



Contact opening/closing pressure	0.2 ÷ 0.5 bar

For the other sensors and electrical components located in the engine compartment, refer to the specific Groups in which an extensive description is given.

INDEX

GENERALITIES

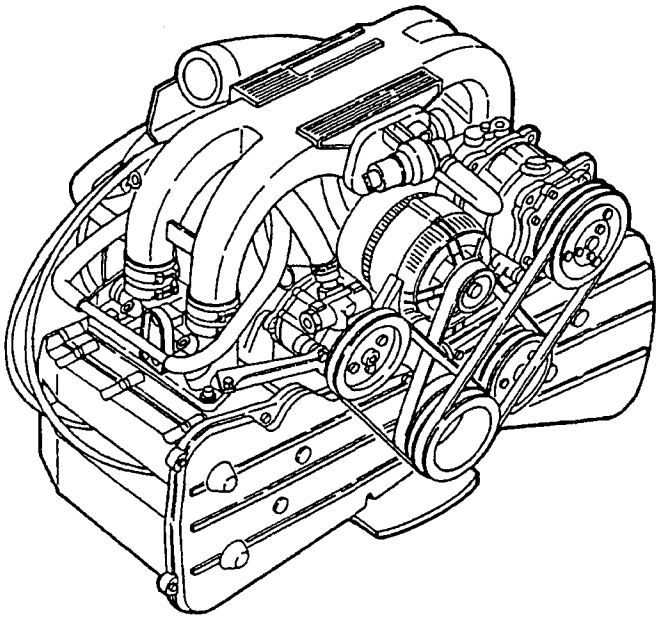
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OVERHAULING

- Introduction 5
- Engine dis - assembly 5
- Dis - assembly of cylinder heads 12
- Checks and inspections for cylinder heads 13
- Checks and inspections crankcase 16
- Cautions for re - assembly 20
- Checking the electrical components of the lubrication circuit 23

DESCRIPTION

The engine has 4 opposed cylinders, double camshaft for each cylinder head, four valves per cylinder controlled by hydraulic tappets, BOSCH M2.10.3 multipoint electronic injection and static ignition controlled by a single control unit.
The clutch - gearbox - differential unit is connected behind the engine and forms an integral part of the power unit.

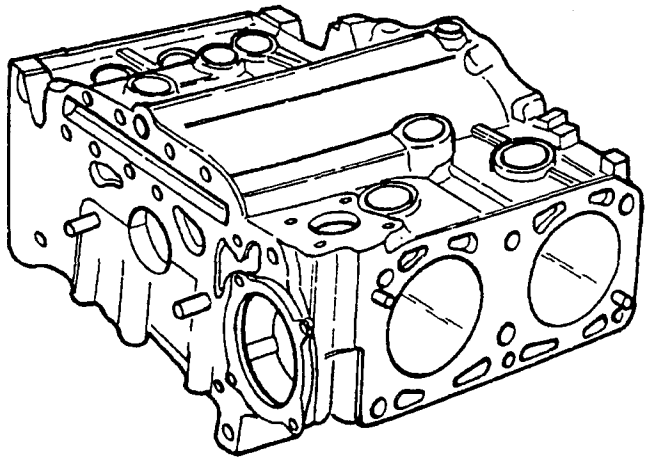


The latter is front mounted and set longitudinally with a 3° inclination.
The power unit is fastened to the body by "suspension" type mounts through a support frame connected to the gearbox - differential unit.
The various connections of the power unit to the support frame are made with appropriate flexible mounts to absorb engine vibrations.
The fuel supply system, with unleaded petrol, combined with the suitable antipollution systems described in the specific paragraphs, ensure low exhaust emission levels meeting "USA 83" regulations.

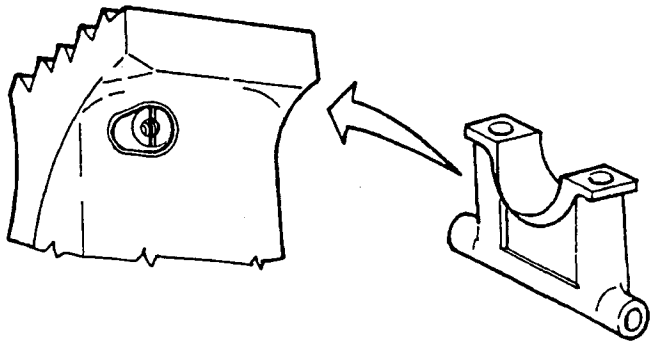
CRANKCASE

This is a single cast iron block with high mechanical strength.
The crankshaft is supported by 3 main bearings which house the same number of thin-walled half bearings.
The cylinders are machined directly in the crankcase and they are selected in five classes of dimensions.
If cylinder wear exceeds the specified values, they must be bored to the specified diameters according to the oversizes of the pistons available from Spares (see CPT).

Special grooves machined in the crankcase walls allow the circulation of coolant fluid and lubricating oil.

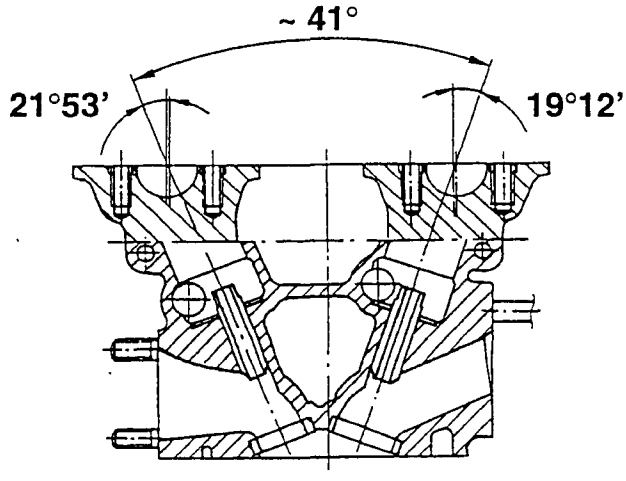


Oil spray jets installed on the front and centre main bearing caps spray oil on the piston crowns to partially cool them.

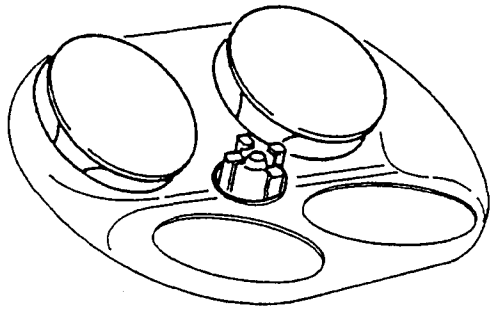


CYLINDER HEADS

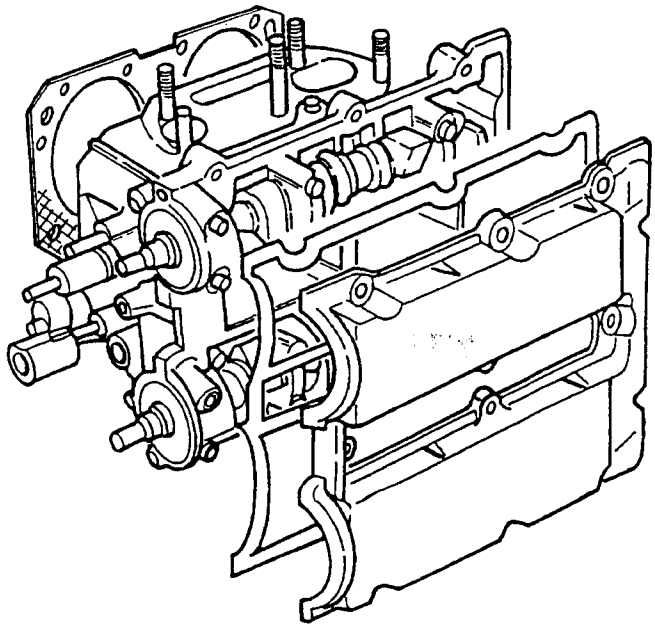
This is one-piece, compact and chill-cast in aluminium and silicium alloy.
The four valves per cylinder are fitted in their guides arranged in a "V" of ~ 41° and they are controlled by two camshafts through hydraulic tappets.



Due to the arrangement of the spaces, the combustion chamber accommodates the four mushrooms of the valves and the centre hole of the spark plug without weakening the structure of the head.
The solution with the spark plug in the centre of the four valves (two inlet valves and two smaller exhaust valves) enables even distribution of the mixture and optimum development of combustion with improved thermal yield of the engine and lower harmful emissions at the exhaust.

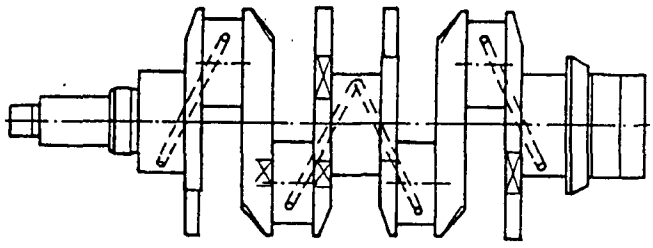


The camshafts turn on three supports and they are driven through toothed belts.
The valve seats are fitted on the cylinder heads after heating them to a temperature of 100° ÷ 120°C.
The valve guides are force-fitted in their housings on the cylinder heads with intereference and the inside diameter is perfected after assembly using a specific reamer and checked using a pair of go-no go gauges.
The seals between the cylinder heads and crankcase are of the ASTADUR type.
Due to the special material with which they are made, these seals are polymerized when the engine is running and harden considerably during use, therefore it is no longer necessary to tighten the cylinder heads at the first service coupon.



CRANKSHAFT

This is forged in high-strength, hardened and tempered steel.
It rests on three main bearings and its end float is adjusted by two half rings housed in the rear main bearing.
Six counterweights accurately balance the rotating masses.
A set of grooves run inside the shaft to lubricate the main and connecting rod journals.

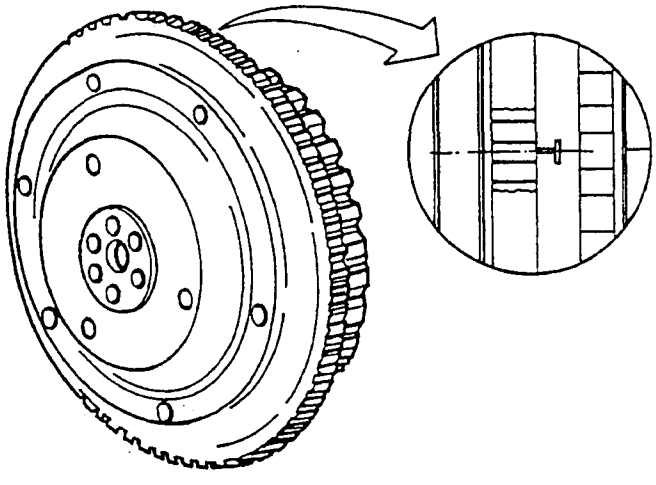


MAIN AND CONNECTING ROD HALF BEARINGS

These are of the three-metal, thin shell type subdivided into two dimensional classes.
The main half bearings have a hole and groove for lubricating the rod journals.

FLYWHEEL

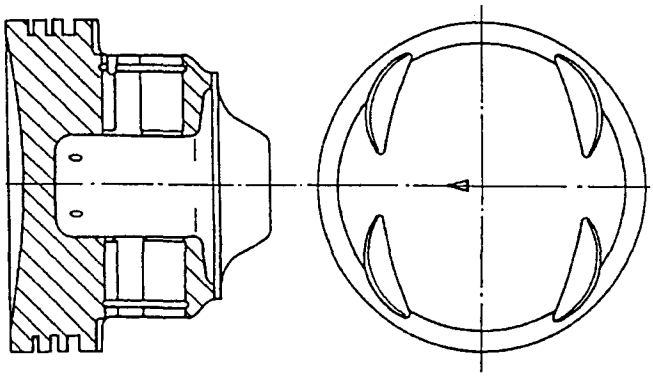
This is in cast iron, with two ring gears in hardened and tempered steel: one for connection with the starter motor and one for the rpm sensor facing it.
The "T" notch for checking engine timing is stamped on the flywheel.



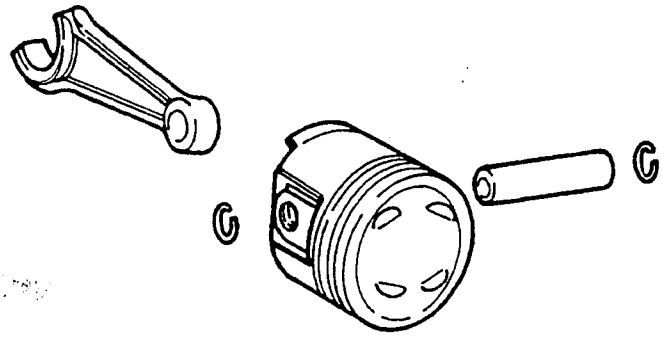
PISTONS AND CONNECTING RODS

The pistons in aluminium silicium alloy are subdivided into five dimensional classes and they are available as Spares in three other oversize classes.

The piston crown is concave and has four notches to prevent interference with the valve mushrooms.



The connecting rods are in hardened and tempered alloy steel, with a copper alloy bush for coupling with the piston gudgeon pin.
As the pins are floating on both the piston hubs and on the bush force-fitted in the connecting rod small end, their side stroke stop is made by two expanding circlips which are housed in special hollows machined on the actual hubs.

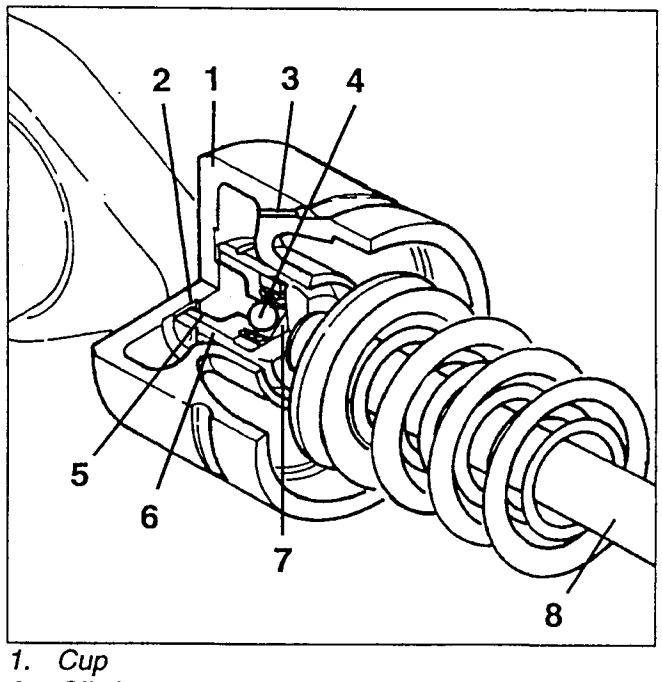


The right cylinder head pistons are positioned with the arrow stamped on the piston crown facing upwards and those of the left cylinder heads with the arrow pointing downwards.

TIMING

Direct drive by toothed belts, with overhead camshafts in case-hardened alloy steel.
The hydraulic tappets in contact with the cams operate the valves directly.
This device automatically eliminates "valve play" when the engine is running, thereby enormously reducing the need for periodic maintenance.

The exhaust valve stem is chromium-plated and inside it has a hollow filled 50 ÷ 60% with sodium which improves dispersion of the heat to which they are subjected.
The valve seats are sintered in material suitable for use with unleaded petrol.



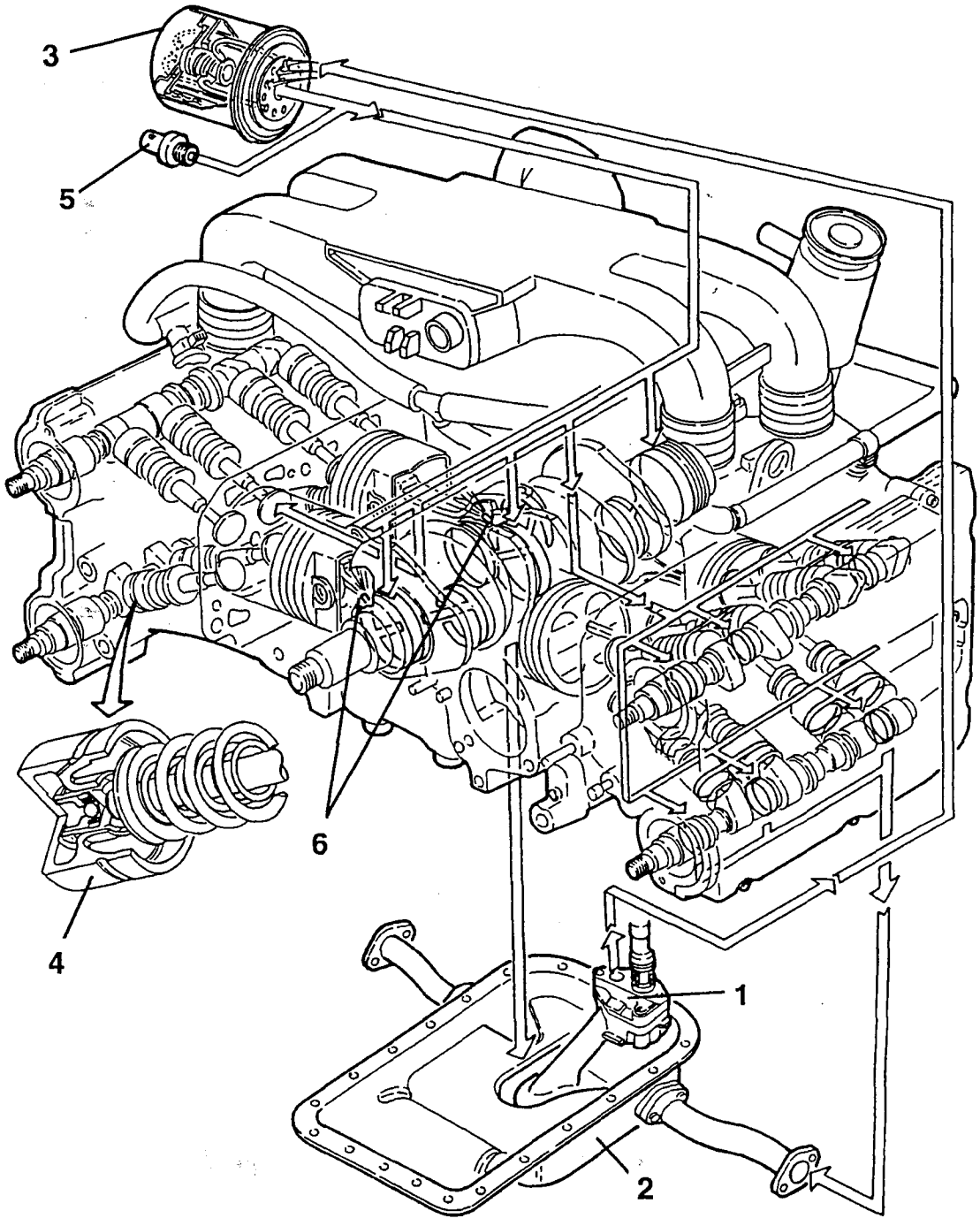
1. *Cup*
2. *Oil circulation between inlet chambers*
3. *Oil inlet groove*
4. *Check valve*
5. *Piston*
6. *Cilinder*
7. *Pressure chamber*
8. *Valve stem*

LUBRICATION

Lubrication is forced by gear pump. The oil pump is fitted on the rear engine cover and it is operated by a shaft that receives motion from a gear installed behind on the crankshaft. The oil withdrawn from the sump through a suction device is filtered by the mesh filter on the actual suction device and then sent under pressure by the pump through a groove to the oil filter with full-flow cartridge fitted with a safety by-pass valve which ensures that the oil can still pass if the filter is clogged.
The maximum lubricating pressure is adjusted by a special limiting valve fitted on the pump. After being filtered, the oil flows through a transversal duct into the main longitudinal delivery duct machined in the crankcase. From here, it is ducted through three grooves to the lubricating grooves of the crankshaft main and rod bearings.

To improve cooling of the pistons on the right main bearing spray jets have been fitted on the front and centre main journals.
Through two transversal grooves and suitable branches machined in the crankcase and cylinder heads the oil reaches the camshaft bearings and allows the hydraulic tappets to work.
The lubrication oil of the main and rod journals falls back into the sunp.

The cylinder head lubricating oil collected in the trays of the camshaft bearings returns to the sump through two special outside connection hoses.
The lubrication system is fitted with an oil vapour recirculation system which recovers the vapours from the sump.
A warning light on the instrument cluster connected to a sensor in the rear engine cover indicates low engine oil pressure.



1. *Oil pump with pressure limiting valve*
2. Oil sump
3. *Oil filter with by-pass valve*
4. *Hydraulic tappet*
5. *Low oil pressure warning light sensor*
6. *Spray jets*

INTRODUCTION

The instructions given in the following paragraphs refer to the complete overhaul of the engine on the bench, after removing the power unit from the engine. The instructions are subdivided as follows:

- Dis-assembly of the engine:
removal of the engine accessories and components and dis- assembly into its main component parts.

- Dis-assembly and checks of the crankcase:
complete overhauling of the crank mechanisms.

- Cautions for re-assembly:
these include specific re-assembly operations where they differ substantially from the instructions for dis-assembly.

- Checks and inspections of electrical components of the lubrication circuit.

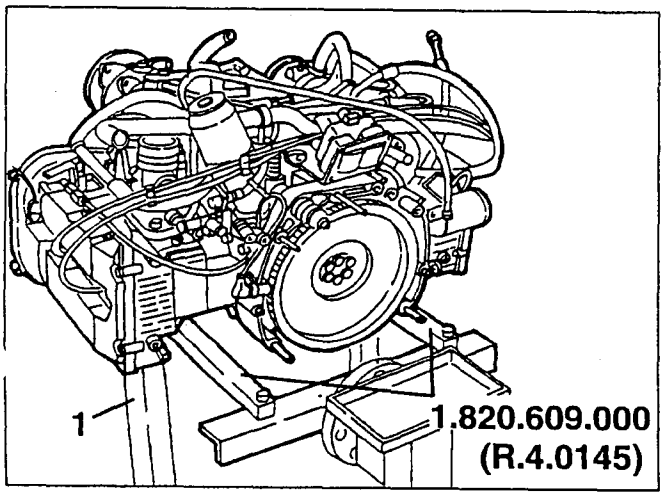
For re-assembly, the sequence for all the dis-assembly instructions described hereafter, should be reversed unless otherwise specified.

The following procedures refer to complete overhauling of the whole engine; it is however possible to use individual parts of these instructions when dealing with specific components.

ENGINE DIS-ASSEMBLY

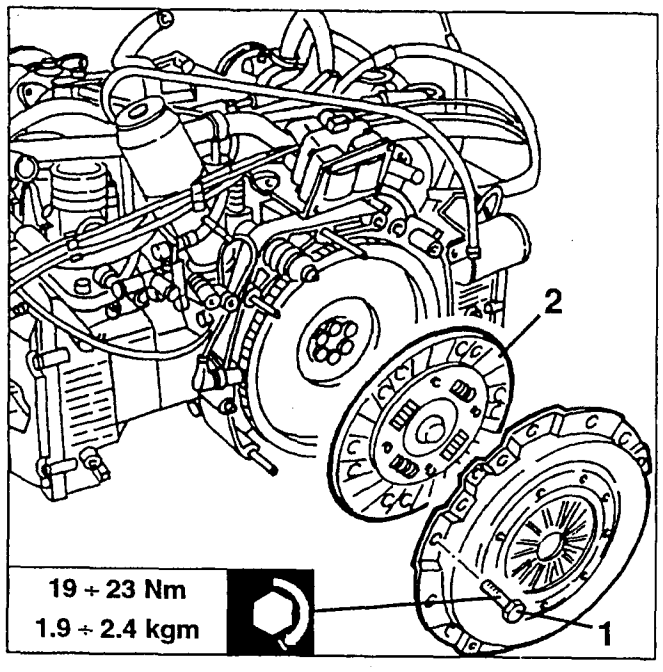
Preliminary operations

1. Set the assembly on a special overhauling stand using supports N° 1.820.609.000 (R.4.0145).



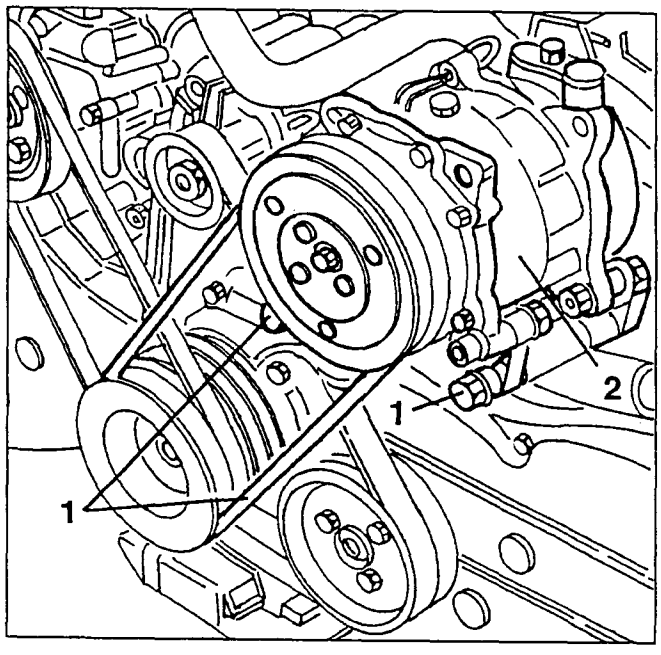
Removing the clutch plate

1. Slacken the fastening screws and remove the clutch pressure plate.
2. Remove the clutch plate.



Removing the conditioner compressor

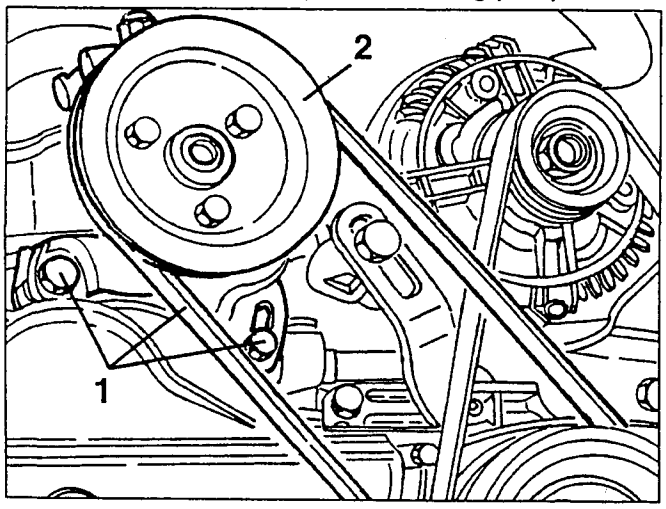
1. Slacken the compressor fastening bolt and screw; prise and remove the drive belt.
2. Completely unscrew the bolt and screw slackened previously and remove the compressor.



Removing the power steering pump

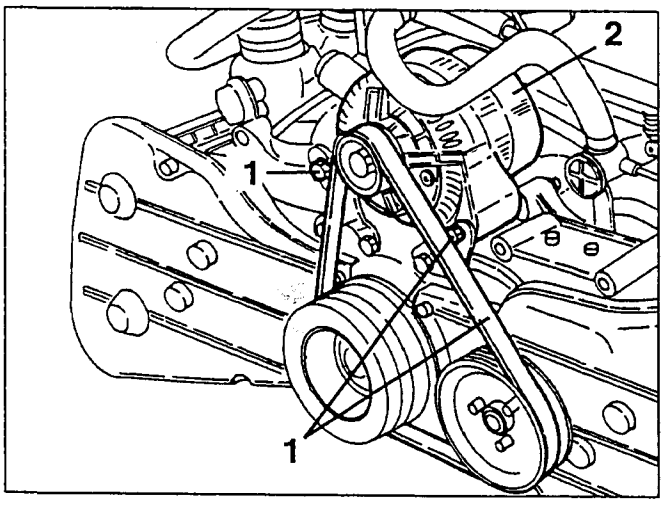
1. Slacken the two power steering pump fastening bolts; prise and remove the drive belt.

2. Completely unscrew the two bolts slackened previously and remove the power steering pump.



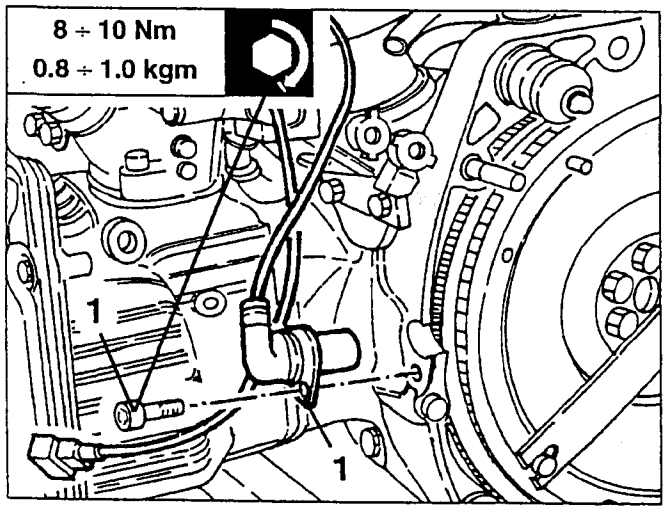
Removing the alternator

1. Slacken the two alternator fastening bolts; prise and remove the drive belt.
2. Completely unscrew the two bolts slackened previously and remove the alternator.

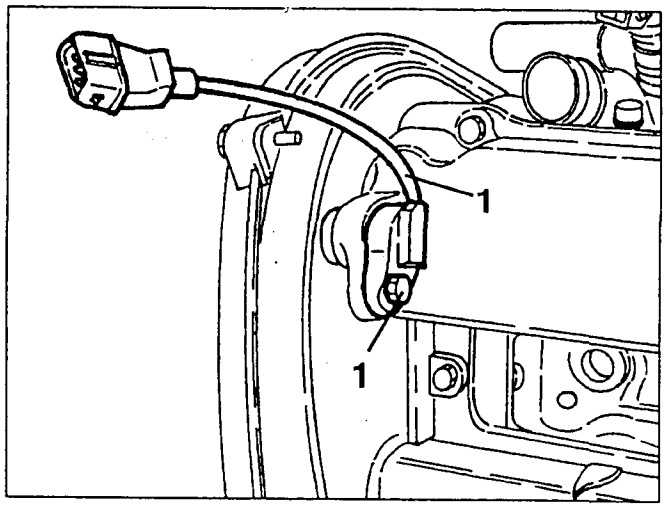


Removing the rpm and timing sensor

1. Slacken the fastening screw and remove the rpm sensor.

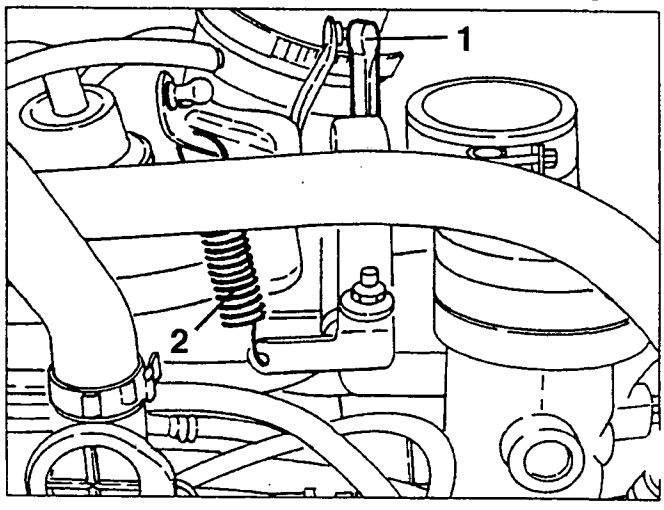


1. Slacken the fastening screw and remove the timing sensor.

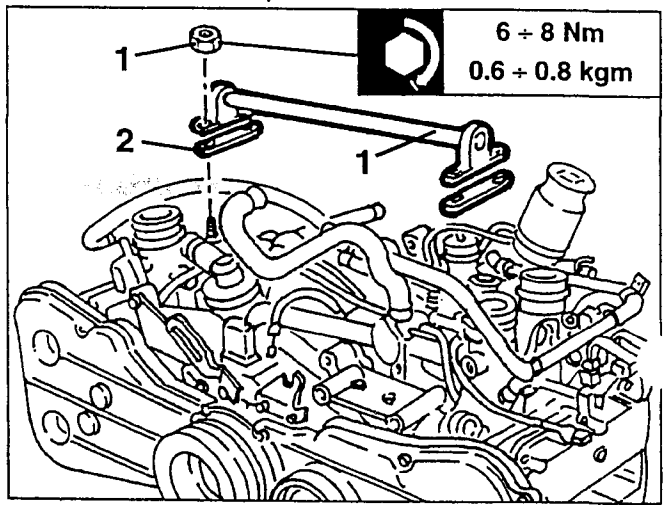


Removing the throttle control shaft

1. Disconnect the throttle valve control tie-rods.
2. Slacken the throttle control shaft return spring.

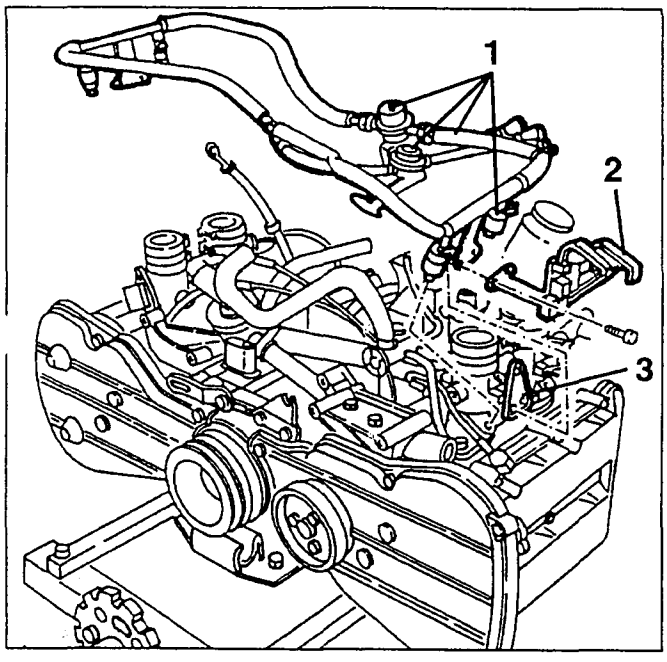


1. Slacken the fastening nuts and remove the throttle control shaft.
2. Retrieve the two spacers.



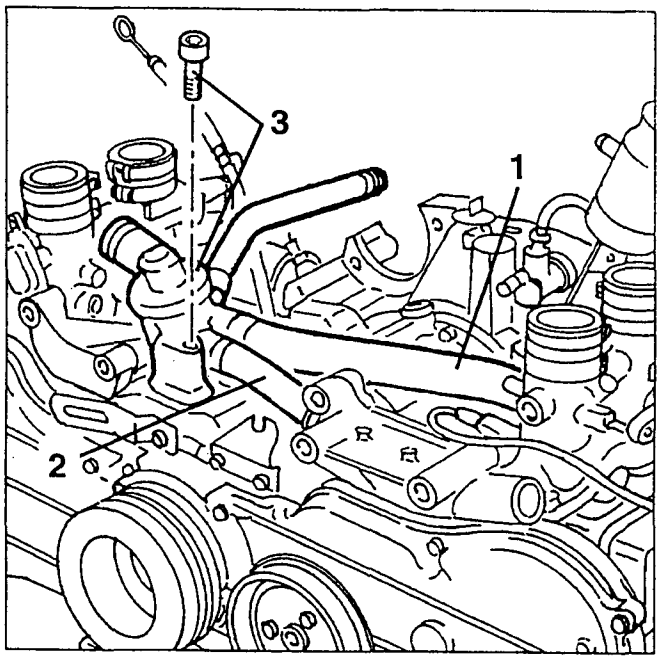
Removing the fuel distributor manifold

1. Slacken the screws fastening the fuel manifold support brackets and remove it complete with injectors, pulse damper and pressure regulator.
2. Retrieve the cable and hose support bracket.
3. Retrieve the engine lifting brackets.



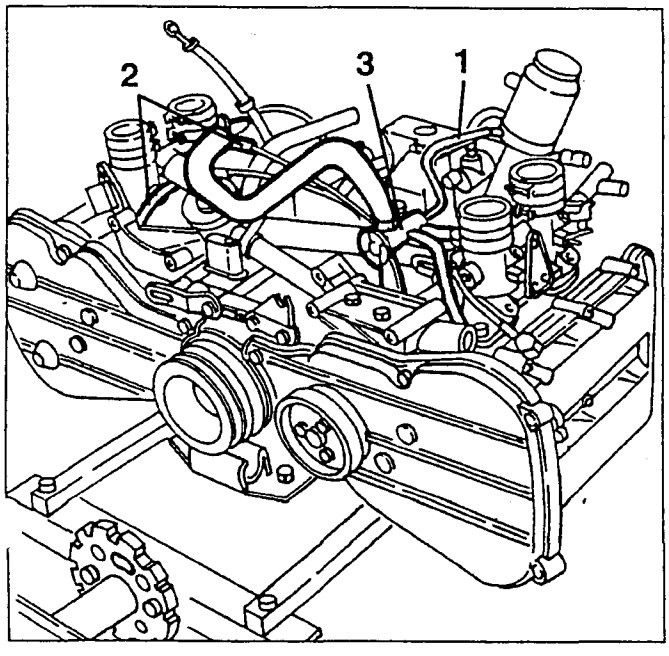
Removing the thermostat unit

1. Disconnect the coolant outlet hoses from the intakes.
2. Disconnect the thermostat unit connection pipe from the pump coolant inlet union.
3. Slacken the fastening screw and remove the thermostat unit complete with hoses.



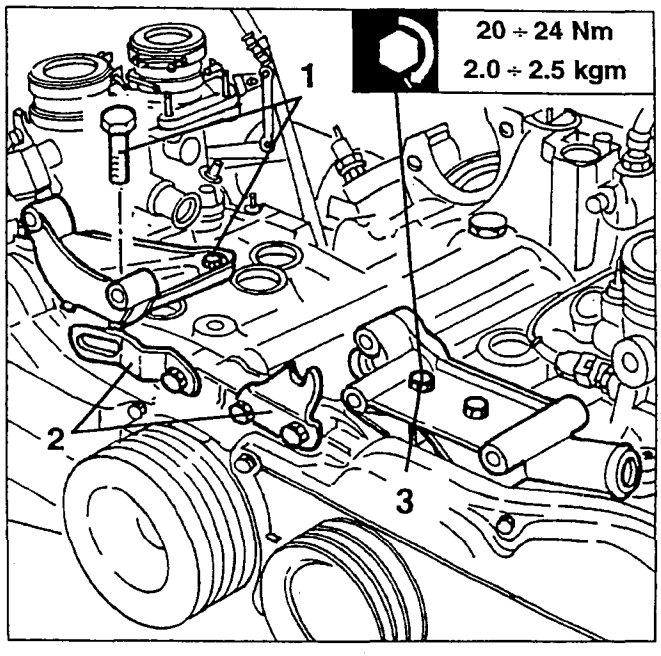
Removing the idle air distributor

1. Disconnect the oil vapour recirculation pipe from the separator.
2. Disconnect the additional air hoses for idle speed from the intakes.
3. Slacken the fastening screw and remove the idle air distributor complete with hoses.

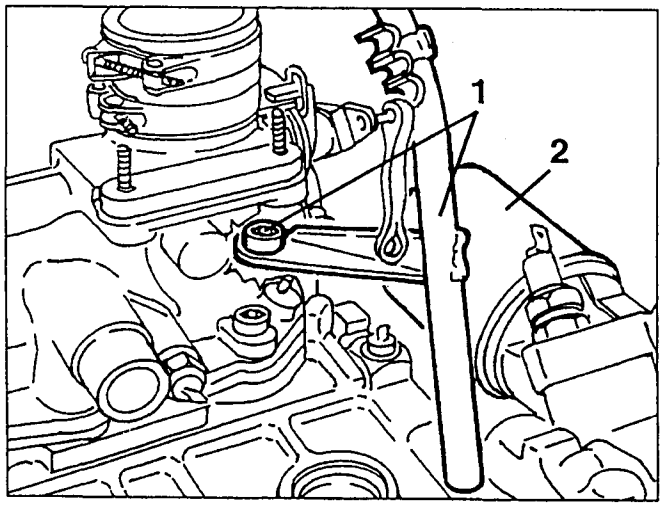


Removing the brackets

1. Slacken the fastening screws and remove the power steering pump support bracket.
2. Slacken the fastening screws and remove the alternator support bracket.
3. Slacken the fastening screws and remove the water pump inlet union and conditioner compressor support; retrieve the seal.

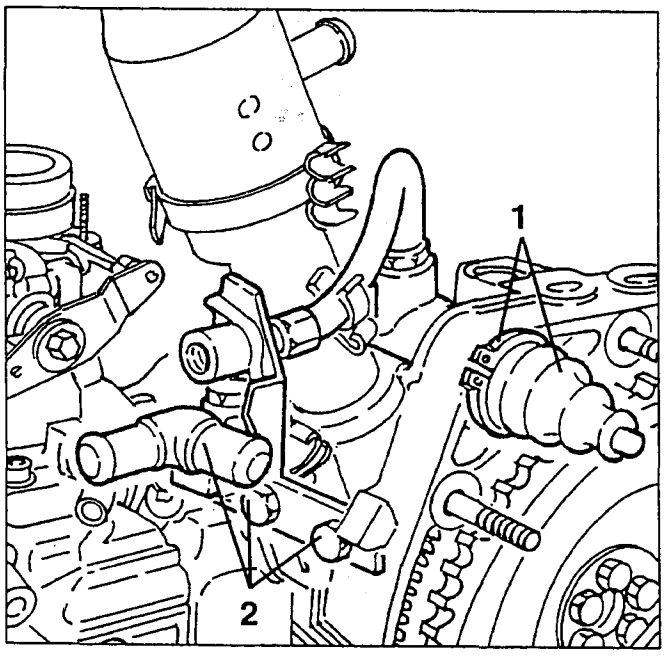


1. Slacken the fastening screw and remove the oil dipstick complete with guide.
2. Using a suitable tool, remove the engine oil filter.



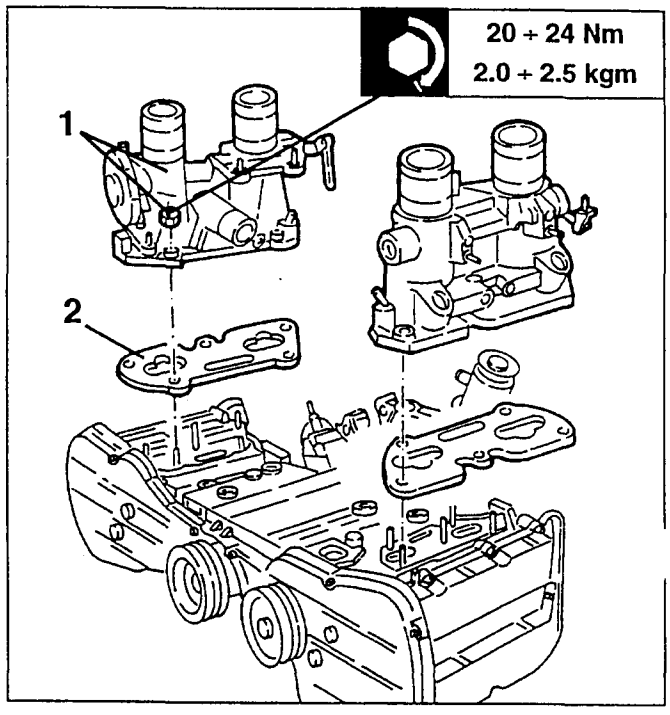
Removing the clutch control cylinder

1. Remove the fastener ring and remove the clutch control cylinder complete with hose after disconnecting the latter from the support bracket.
2. Slacken the fastening screws and remove the engine cooling system three-way support bracket and the clutch control cylinder hose.



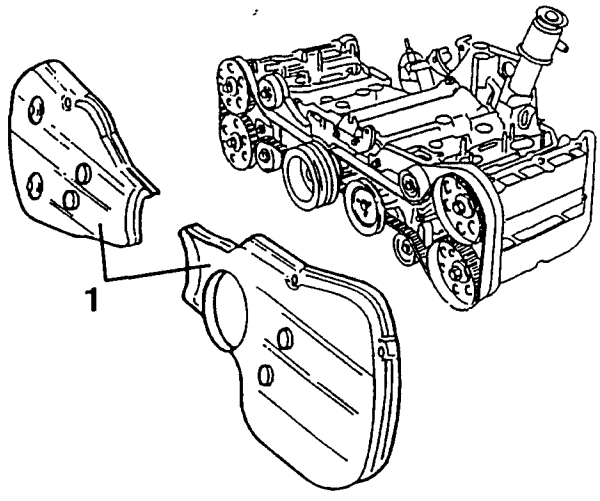
Removing the intake bodies

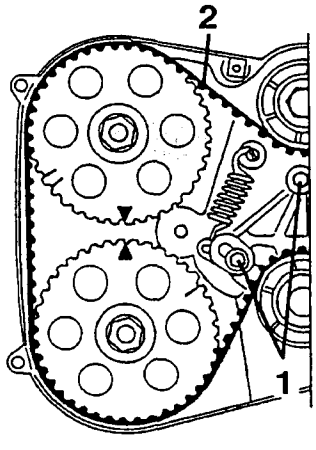
1. Slacken the fastening nuts and remove the intake bodies.
2. Retrieve the seals.



Removing the timing drive pulley

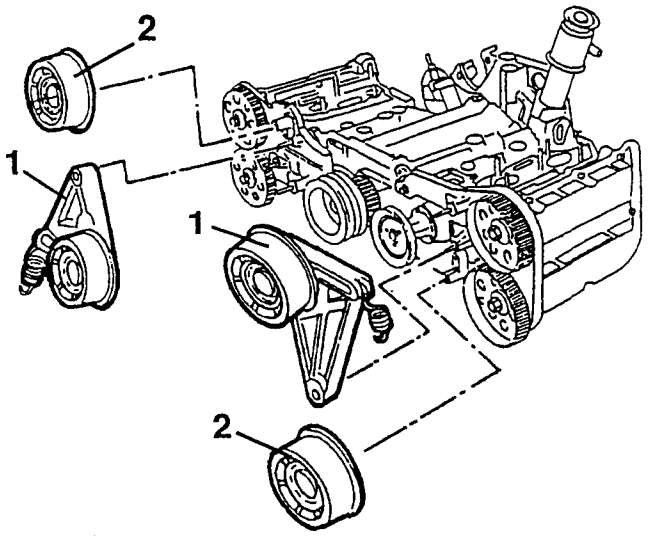
1. Slacken the fastening screws and remove the timing belt front guards.



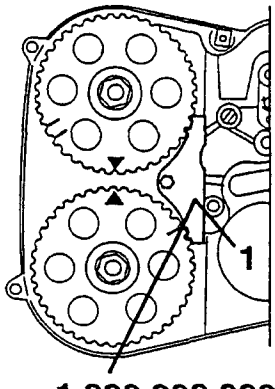


1. Release the two nuts fastening the right belt tensioner, then press on the pulley until overcoming the spring tension load and lock the belt tensioner in the slack position.
2. Prise and remove the right timing drive belt and repeat the above-mentioned procedure to remove the left one.

1. Slacken the fastening nuts and remove the belt tensioner complete with springs.
2. Slacken the fastening screws and remove the pulleys.

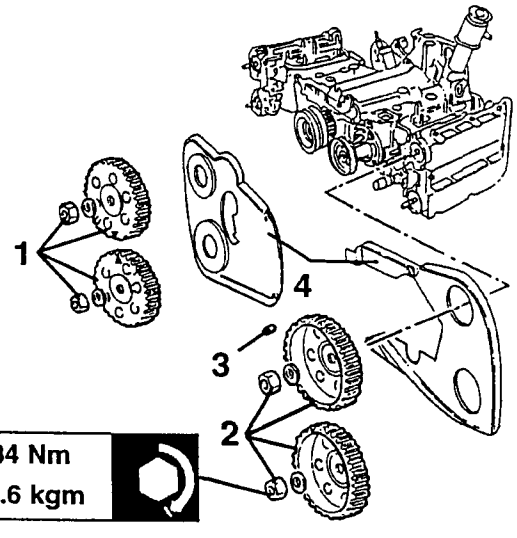


1. Fit the pulley locking tool N° 1.820.206.000.



1.820.206.000

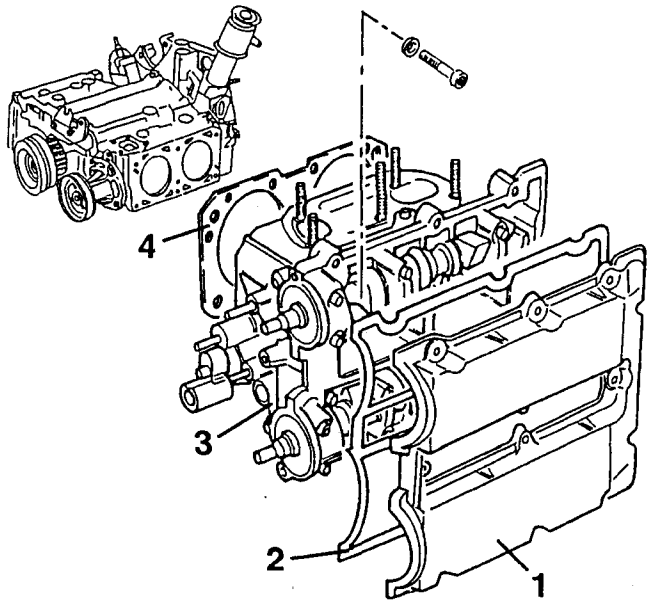
1. Slacken the fastening screws and remove the right head pulleys.
2. Using tool N° 1.820.206.000, slacken the fastening nuts and remove the left head pulleys.
3. Retrieve the keys.
4. Slacken the fastening screws and remove the rear guards.



76 ÷ 84 Nm 7.7 ÷ 8.6 kgm	

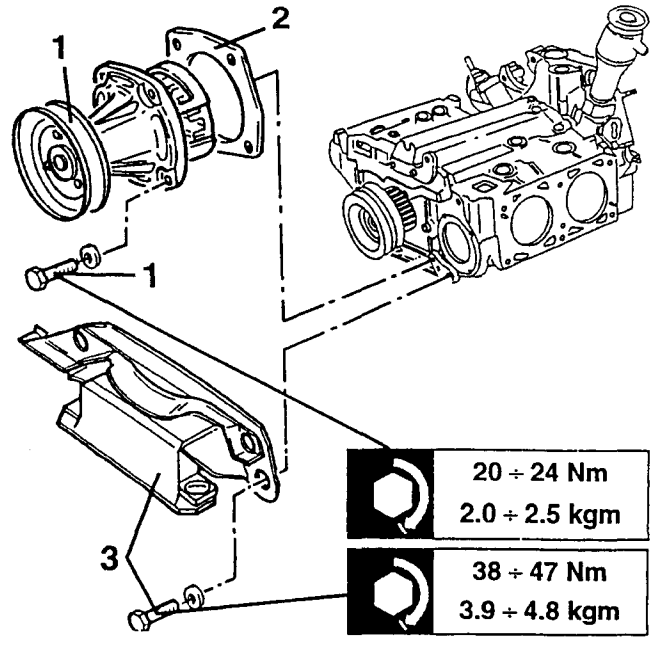
Removing the cylinder heads

1. Slacken the fastening screws and remove the head cover.
2. Remove the seal.
3. Slacken the six fastening screws and remove the cylinder head from the crankcase.
4. Remove the cylinder head seal.
- Proceed in the same manner to remove the other cylinder head.



Removing the water pump

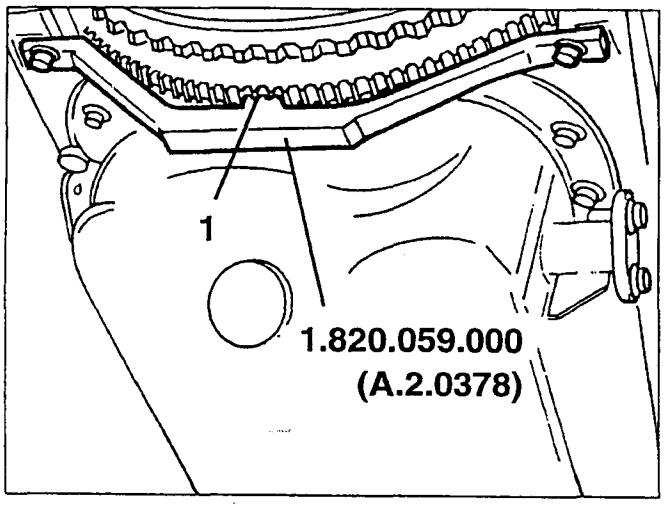
1. Slacken the four fastening screws and remove the water pump from the crankcase.
2. Remove the seal.
3. Slacken the four fastening screws and remove the front flexible mount.



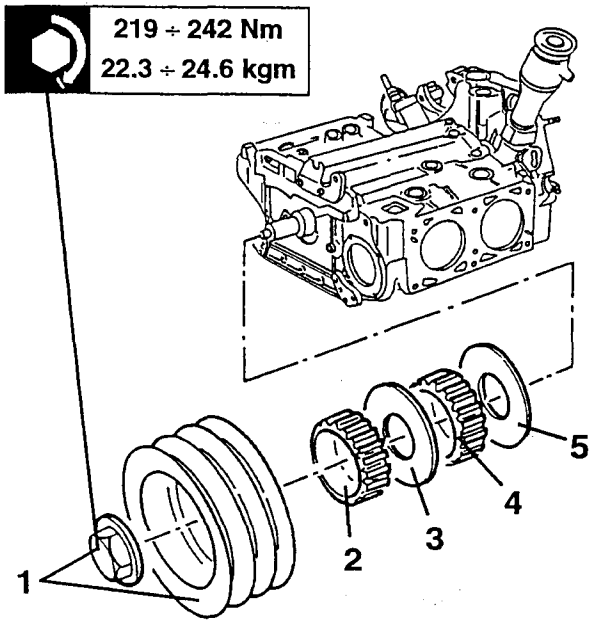
20 ÷ 24 Nm 2.0 ÷ 2.5 kgm	
38 ÷ 47 Nm 3.9 ÷ 4.8 kgm	

Removing the crankshaft pulley

1. Using tool N° 1.820.059.000 (A.2.0378), prevent the flywheel from turning.

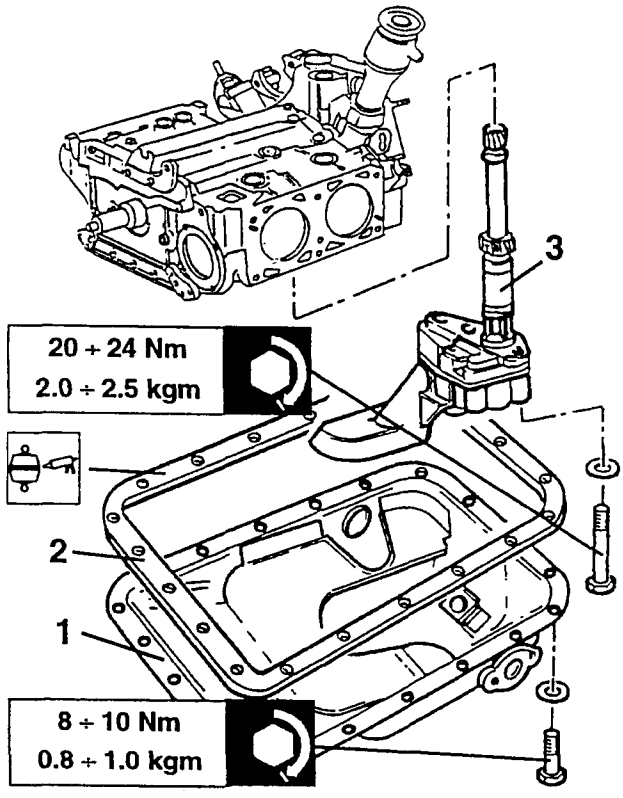


1. Slacken the fastening nut and remove the auxiliary drive pulley.
2. Remove the right timing belt toothed pulley.
3. Remove the spacer.
4. Remove the left timing belt toothed pulley.
5. Remove belt guide washer.



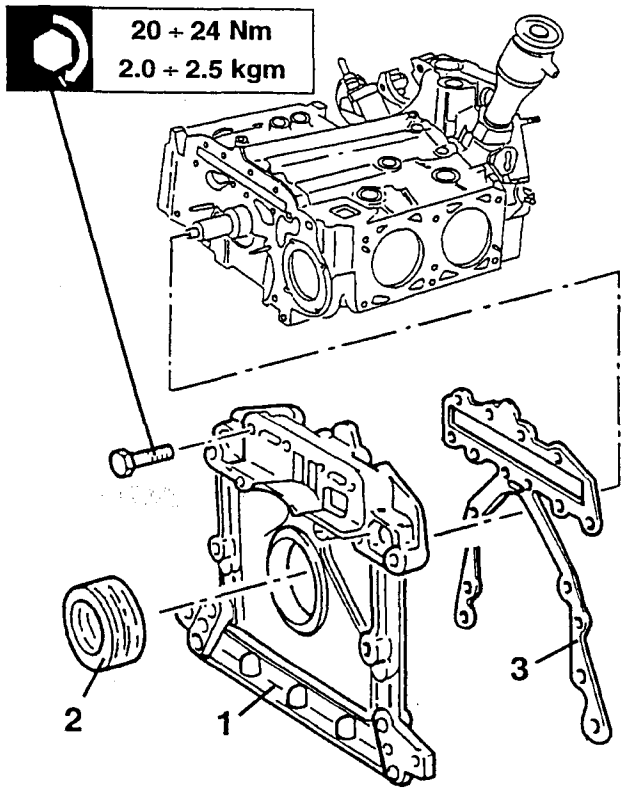
Removing the oil sump and pump

1. Slacken the fastening screws and remove the oil sump.
2. Remove the seal.
3. Slacken the fastening screws and remove the oil pump.

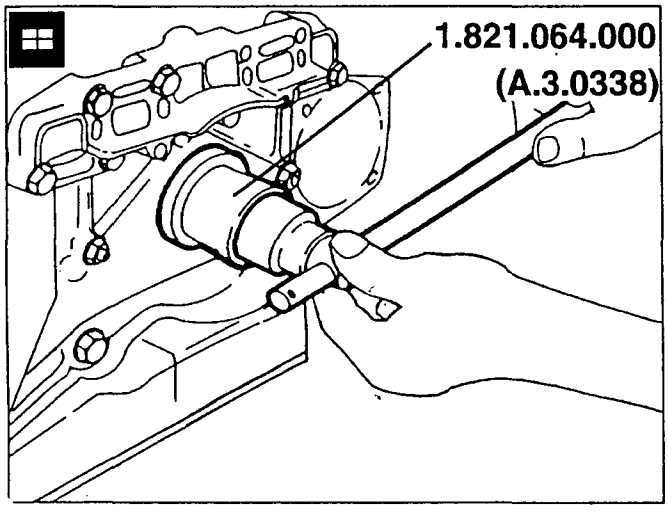


Removing the front crankcase cover

1. Slacken the fastening screws and nuts and remove the front crankcase cover.
2. Remove the oil seal from the front cover.
3. Remove the seal.

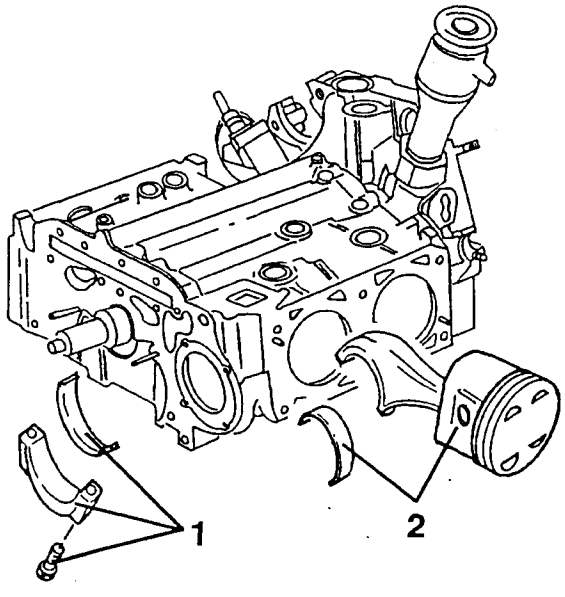


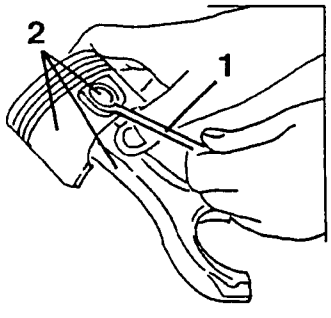
When refitting insert the oil seal on the front cover using tool N° 1.821.064.000 (A.3.0338).



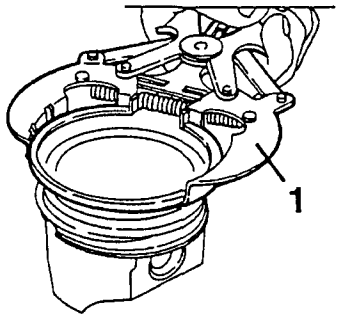
Removing the pistons and connecting rods

- Fit a suitable tool on the flywheel to allow the crankshaft to turn, then turn it to gain access to the connecting rod cap fastening screws.
1. Slacken the fastening screws and remove the connecting rod caps with their half bearings.
2. Remove the pistons complete with connecting rods and half bearings.





1. Remove the two gudgeon pin circlips.
2. Remove the gudgeon pin and separate the connecting rod from the piston.

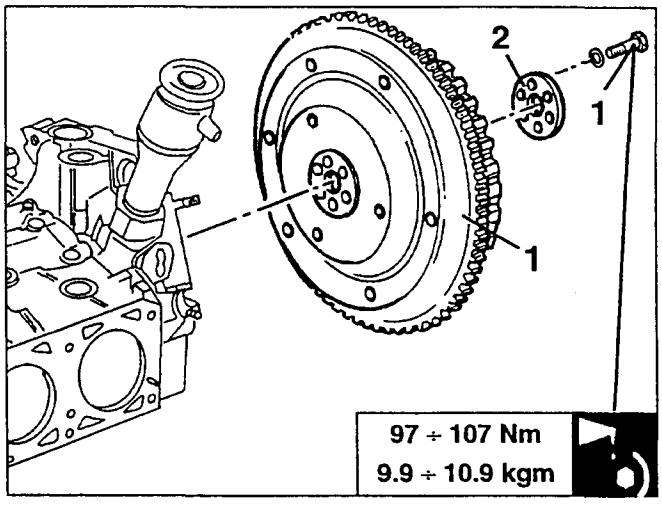


1. Using a suitable tool remove the seal rings and oil scraper ring from the piston.

Work carefully to avoid breaking any rings that might be re- used.

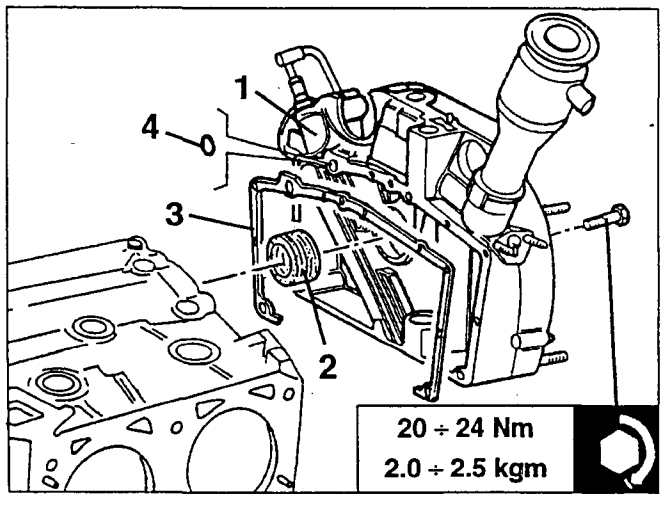
Removing the flywheel

- Remove the tool for turning the crankshaft fitted previously and install tool N° 1.820.059.000 (A.2.0378).
1. Slacken the fastening screws and remove the flywheel.
2. Retrieve the safety plate.

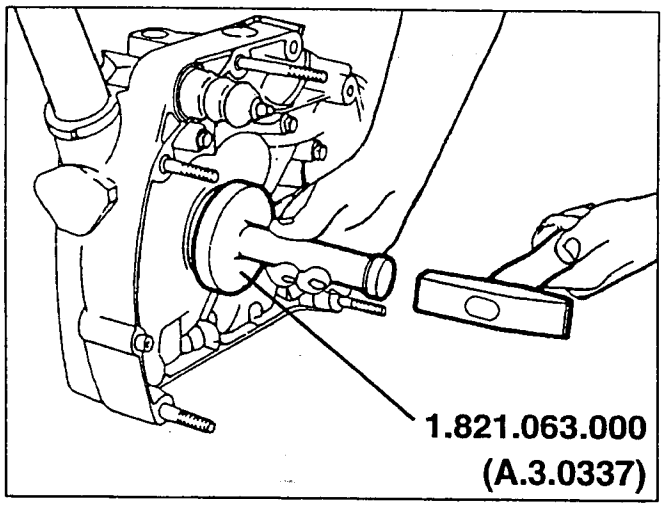


Removing the rear crankcase cover

1. Slacken the fastening screws and remove the rear crankcase cover.
2. Remove the oil seal from the cover.
3. Remove the seal.
4. Remove the seal ring from the main lubricating duct.



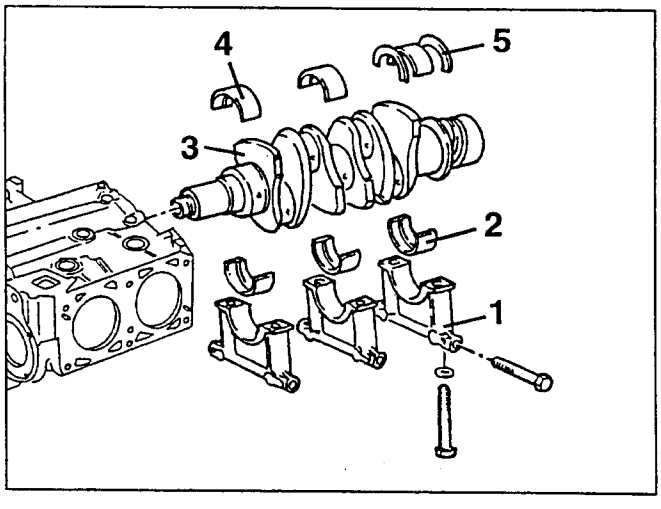
When refitting, use tool N° 1.821.063.000 (A.3.0337) to insert the oil seal on the rear cover.



Removing the crankshaft

1. Slacken the fastening screws and remove the main bearing caps.
2. Retrieve the corresponding bearing halves.
3. Remove the crankshaft from the crankcase.
4. Retrieve the main bearing halves.
5. Retrieve the thrust half rings.

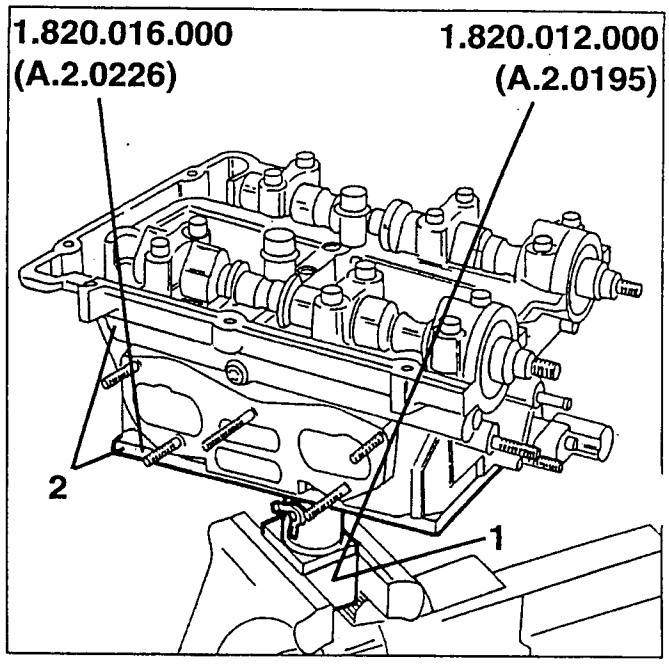
When refitting, install the two main bearing caps with oil spray jets with the jets pointing towards the right cylinder head.



DIS-ASSEMBLY OF CYLINDER HEADS

Preliminary operations

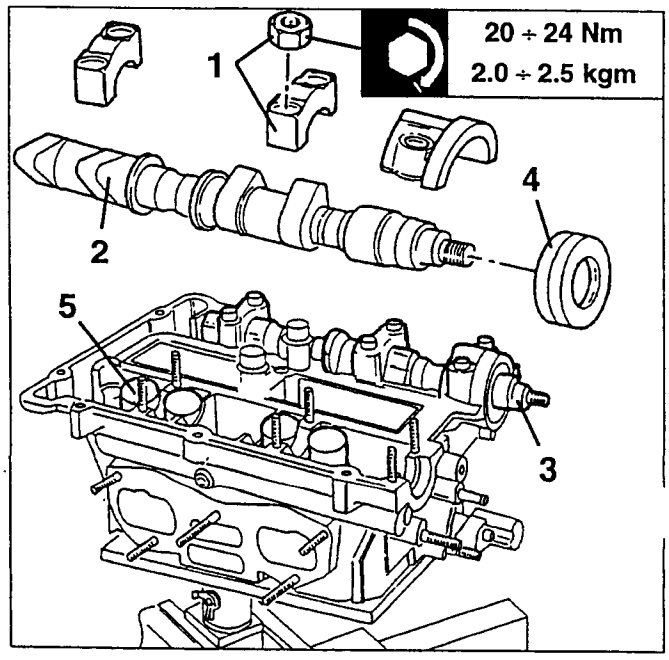
1. Clamp the swivelling stand N° 1.820.012.000 (A.2.0195) in a vice.
2. Fasten tool N° 1.820.016.000 (A.2.0226) on the swivelling stand and fasten the cylinder head on the latter.



Removing the camshafts

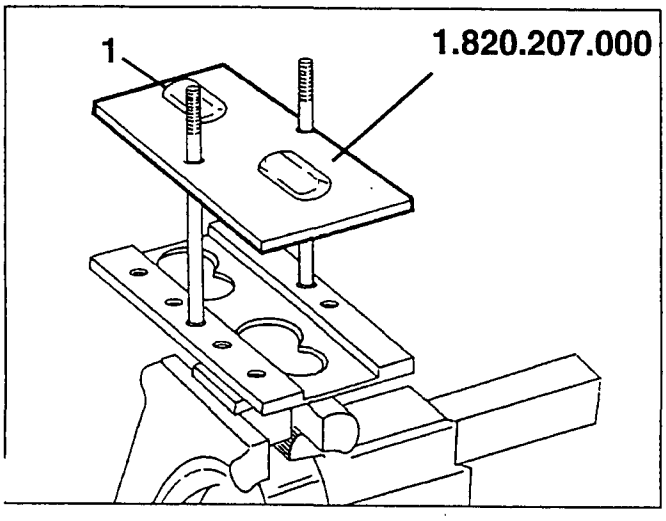
1. Slacken the fastening nuts and remove the camshaft caps.
2. Remove the intake side camshaft.
3. Remove the exhaust side camshaft.
4. Remove the two oil rings.
5. Remove the cups and set them in order for re-assembly.

CAUTION:
The intake and exhaust camshafts a' not interchangeable.



Dis-assembly of valves

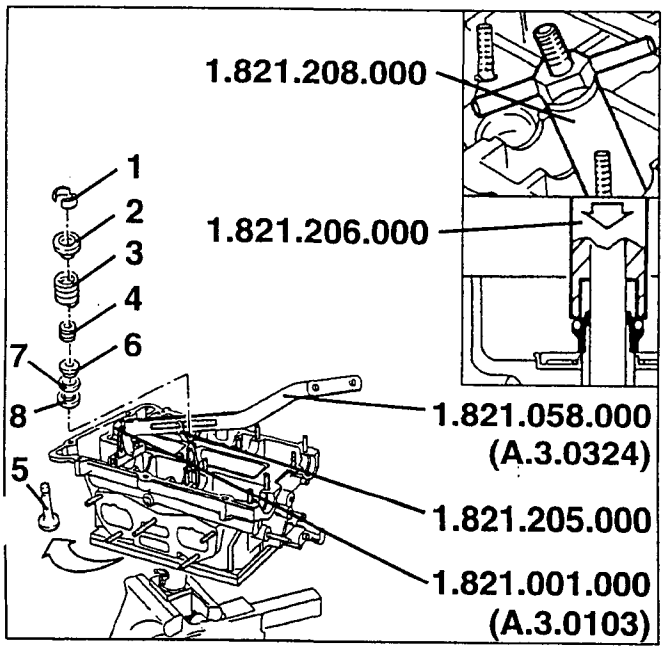
1. Interpose tool N° 1.820.207.000 between the cylinder head and the support stand.



1. Using tools N° 1.821.001.000 (A.3.0103), N° 1.821.058.000 (A.3.0324) and N° 1.821.205.000 remove the valve stem half cones.
2. Remove the upper plate.
3. Remove the outer spring.
4. Remove the inner spring.
5. Raise the head from tool N° 1.820.207.000 and retrieve the valve.
6. Using tool N° 1.821.208.000 remove the oil seal cap.

When refitting use tool N° 1.821.206.000 to insert the oil seal caps.

7. Remove the spring contact ring.
8. Remove the lower plate.

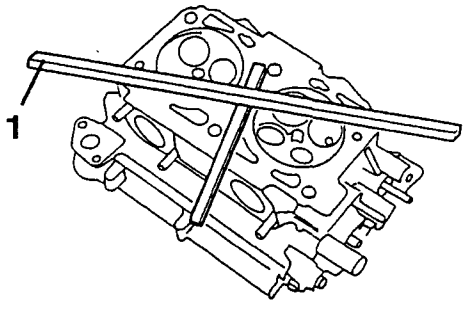


CHECKS AND INSPECTIONS FOR CYLINDER HEADS

Checking the lower surface of cylinder heads

1. Check that the lower plane of the cylinder heads is level: if the lower plane is excessively worn, reface both heads.

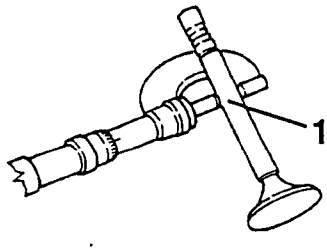
Maximum head lower plane flatness error
0.03 mm



Checking the clearance between valve guides and stems

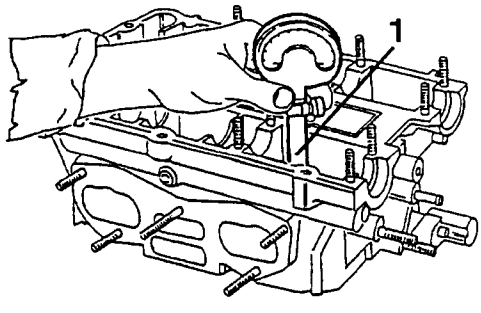
1. Measure the diameter of the valve stems and check that they are within the specified limits.

Diameter of valve stems
6.965 ÷ 6.980 mm



1. Measure the inside diameter of the valve guides and check that they are within the specified limits.

Inside diameter of valve guides
7.000 ÷ 7.015 mm

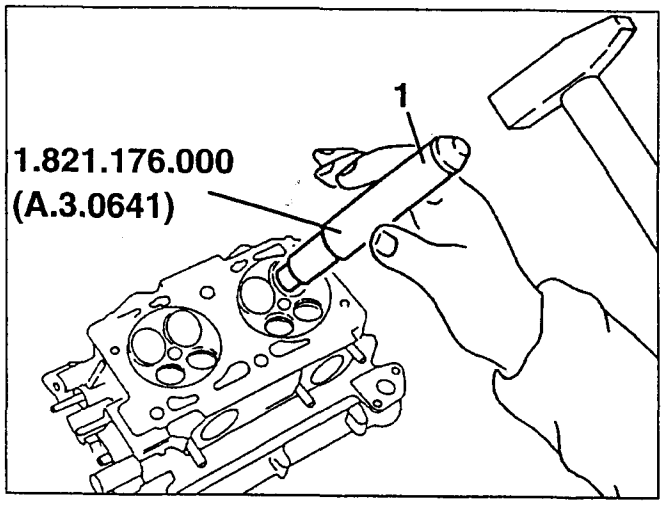


- Calculate the clearance between valve guides and stems and check that they are within the specified limit, if not change any worn parts.

Radial clearance between valve guides and stems
0.02 ÷ 0.05 mm

Changing the valve guides

1. Remove the worn valve guides using puller tool N° 1.821.176.000 (A.3.0641).



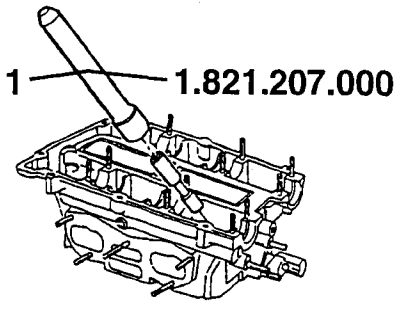
- Check that the outside diameter of the valve guides and of their seats on the head are within the specified limits and that interference is within the specified tolerance.

Valve guide outside diameter	
Intake	12.040 ÷ 12.051 mm
Exhaust	12.050 ÷ 12.068 mm

Diameter of valve guide seats
12.000 ÷ 12.018 mm

Interference between seats and valve guides	
Intake	0.022 ÷ 0.051 mm
Exhaust	0.032 ÷ 0.068 mm

1. Insert the new valve guides using tool N° 1.821.207.000.



NOTE: The guide valves are supplied also with a 0.2 mm oversize on the outside diameter.

- Ream the inside diameter of the valve guides to calibrate the holes to the specified diameter.

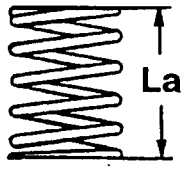
Inside diameter of valve guides "d"
7.000 ÷ 7.015 mm

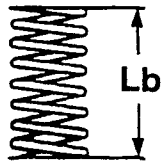
Checking the valve springs

- Check that the "free" length of the valve springs is within the specified limits.

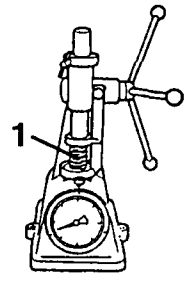
NOTE: The rest surfaces must be parallel with each other and perpendicular to the axis of the spring with a maximum error of 2

Length of valve springs	
outer spring "La"	~ 51.8 mm
inner spring "Lb"	38 mm





1. Using a torque meter, check that the characteristic data of the springs are within the specified limits.



Outer spring		
Spring length mm		Control load kg
Valve closed	32.5	21.4 ÷ 22.6
Valve open	22.9	35.5 ÷ 35.7

Inner spring		
Spring length mm		Control load kg
Valve closed	30.5	13.6 ÷ 14.4
Valve open	20.9	31.9 ÷ 33.7

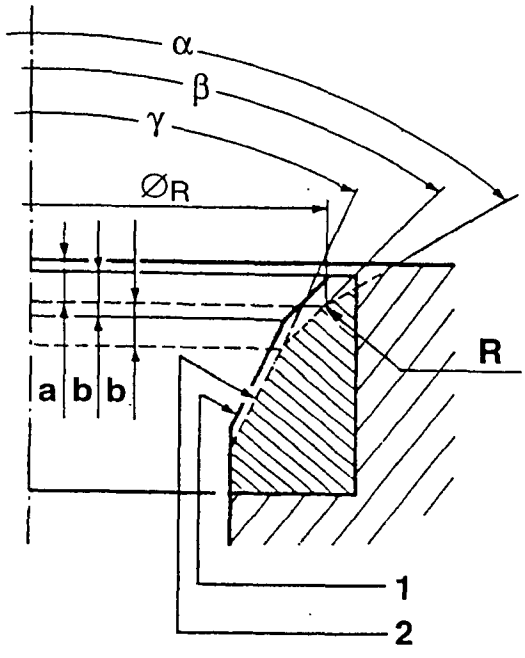
Turning the valve seats

1. Turn the valve seats using suitable tools with the cylinder heads cold.

Taper "β" valve contact area	90° ± 20'
Taper "α" upper valve seat area	Int. 150°
	Exh. 120°
Taper "γ" lower valve seat area.	Int. 75°
	Exh. 60°

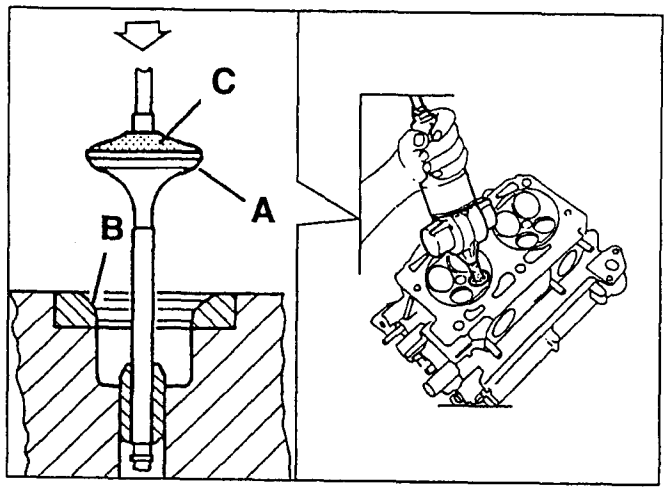
Dimension "a" at refacing limit	Int. 0.4 mm
	Exh. 1.1 mm
Height "b" valve contact area	Int. R = 0.9 mm
	Exh. b = 1.1 mm

Reference diameter ∅R	
Intake	31.0 mm
Exhaust	24.5 mm



1. Original profile
2. Profile after max. refacing

- After machining grind each valve in its housing as follows:
- coat the contact surfaces "A" and "B" of the valves and seats with abrasive paste (SIPAL AREXONS arbosilicium for valves).
- lubricate the valve stem with engine oil.
- fit the lower surface of the valve mushroom to the suction cup "C" of a pneumatic grinder.
- insert the valve in its guide and grind.
- after grinding, thoroughly clean the seat.

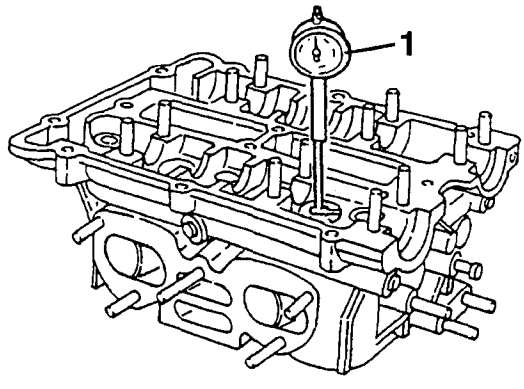


- When changing the valve guides, thus refacing and grinding the valve seats, it is advisable to check the valve tightness with the spark plugs in place, proceeding as follows:
- Fill the hollow of the combustion chamber with petrol.
- Admit low pressure air to the intake manifolds and check that no air bubbles form in the petrol.
- Check the tightness of the exhaust valves in the same way, admitting air to the exhaust manifolds.
- If any leaks are noted, make sure that the valves are perfectly settled in their seats and repeat the check; if the result is negative, grinding must be repeated.

Checking the clearance between cups and seats

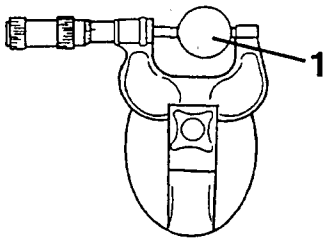
1. Check that the diameter of the seats is within the specified limits.

Diameter of valve cup seats
33.000 ÷ 33.025 mm



1. Check that the outside diameter of the cups is within the specified limits.

Diameter of valve cups
32.959 ÷ 32.975 mm



- Calculate the clearance between cups and seats, checking that it is within the specified limits.

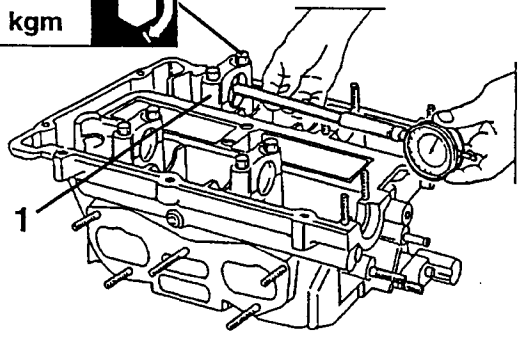
Clearance between cups and seats
0.025 ÷ 0.066 mm

Camshafts and timing system bearings

1. Assemble the camshaft caps and tighten the screws to the specified torque, then check that the diameter of the bearings is within the specified limits.

Diameter of camshaft bearings
27.000 ÷ 27.033 mm

20 ÷ 24 Nm
2.0 ÷ 2.5 kgm



- Check that the diameter of the camshaft journals is within the specified limits.

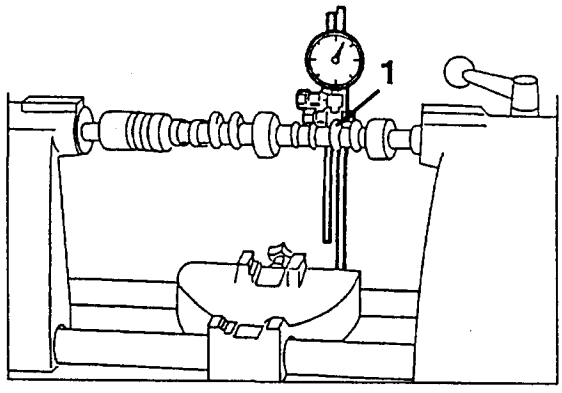
Diameter of camshaft journals
26.959 ÷ 26.980 mm

- Calculate the clearance between the camshaft journals and their bearings and check that it is within the specified limits.

Clearance between camshafts and bearings
0.02 ÷ 0.074 mm

1. Check that the cam lifts are within the specified limits.

Minimum cam lift	
Intake	9.5 mm
Exhaust	9.4 mm



CHECKS AND INSPECTIONS CRANKCASE

- Visibly check the crankcase for cracks and signs of excessive wear of the sliding surfaces; check that all the threads are intact.
- Remove the lubrication and cooling groove caps, and clean the ducts with a suitable detergent, then dry with a jet of air and fit new caps.
- Accurately remove any traces of seals or sealar from the crankcase surfaces.

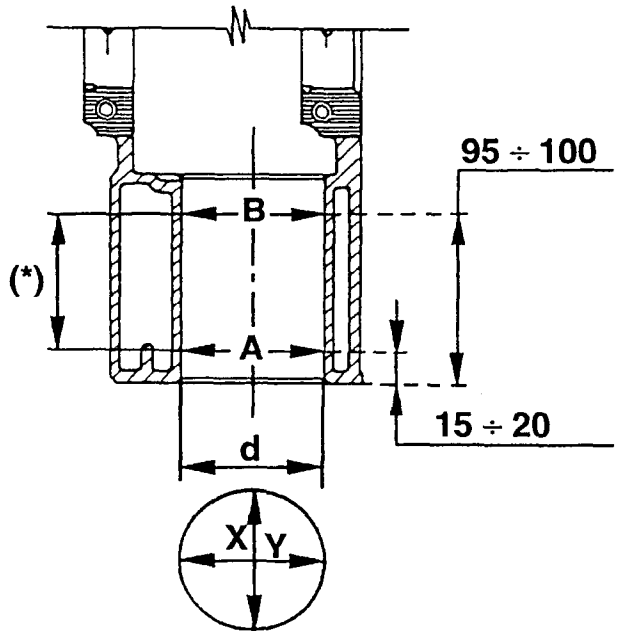
Checking the cylinders

- Use a bore meter fitted on a dial gauge to measure the inside diameters of the cylinders and check that it is within the specified limits.

Inside diameter "d"	
Class A	87.000 ÷ 87.010 mm
Class B	87.010 ÷ 87.020 mm
Class C	87.020 ÷ 87.030 mm
Class D	87.030 ÷ 87.040 mm
Class E	87.040 ÷ 87.050 mm

Maximum taper
A - B = 0.02 mm

Maximum ovalization
X - Y = 0,02 mm



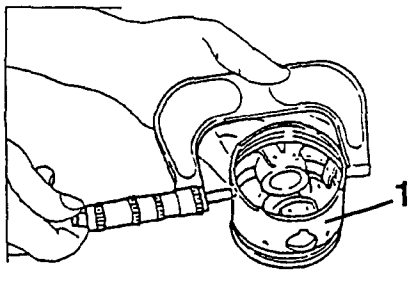
(*) Area for dimensional inspection

Checking the piston

1. Measure the outside diameter of the pistons and check that it is within the specified limits.

Outside diameter of pistons (mm) (1)	
Class A (Blue)	86.950 ÷ 86.960
Class B (Pink)	86.960 ÷ 86.970
Class C (Green)	86.970 ÷ 86.980
Class D (Yellow)	86.980 ÷ 86.990
Class E (White)	86.990 ÷ 87.000

(1) The outer diameter of the piston must be measured perpendicular to the gudgeon pin hole a t a distance of 13.9 mm from the axis of the gudgeon pin.



- Calculate the clearance between the cylinder and piston and check that it is within the specified limits.

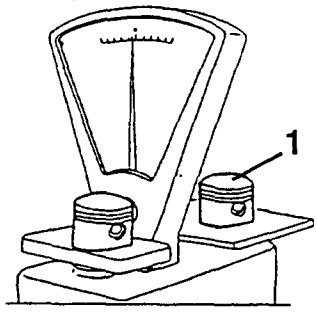
Clearance between cylinders - pistons
0.04 ÷ 0.06 mm

- If the dimensions are not within tolerance, the liners should be refaced, bearing in mind that pistons in three oversizes are available as spares; therefore the diameter is to be made within the tolerances given in the "Technical Characteristics and Specifications" GROUP 00.
- Fit the main bearings caps on the crankcase and tighten the fastening screws to the specified torque.
- Then bore the cylinders to within the tolerances given in the "Technical Characteristics and Specifications" GROUP 00.

Grinding should be carried out so that the *signs of machining are crossed with an* angle of 90° ÷ 120°.

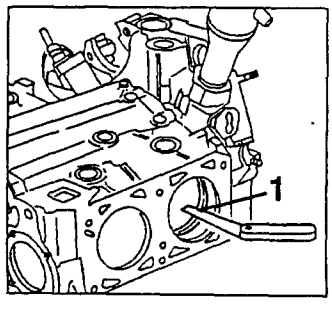
1. Check that the difference in weight between the pistons complete with gudgeon pins and seal rings is within the specified limits.

Difference in weight betwen pistons
≤ 2 g



Checking the seal ring gap

1. Insert the rings in the cylinder liner, check that they adhere to the whole circumference and that the gap is within the specified limits.

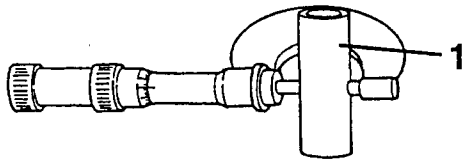


Ring gap	
First ring	0.30 ÷ 0.50 mm
Second ring	0.30 ÷ 0.50 mm
Oil scraper ring	0.25 ÷ 0.50 mm

Checking the play between pins and seats on pistons

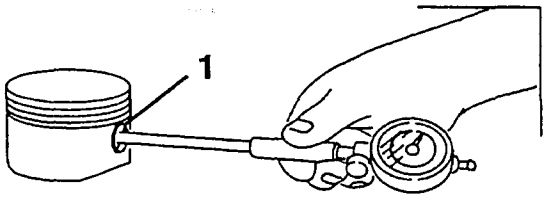
1. Measure the outside diameter of the pins and check that it is within the specified limits.

Outside diameter of pins
20.996 ÷ 21.000 mm



1. Measure the diameter of the pin mating hole on the piston and check that it is within the specified limits.

Diameter of pin hole on pistons
21.004 ÷ 21.008 mm



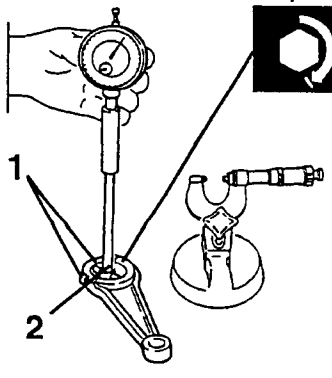
- Calculate the clearance between the pins and their seats on the pistons and check that it is within the specified limits.

Clearance between pins and seats on pistons
0.004 ÷ 0.012 mm

Checking the clearance between connecting rod journals and the corresponding half bearings

1. House the rod half bearings in the connecting rod big end and on the corresponding cap, then join them tightening the fastening screws to the specified torque.
2. Measure the diameter of the connecting rod big end and check that it is within the specified limits.

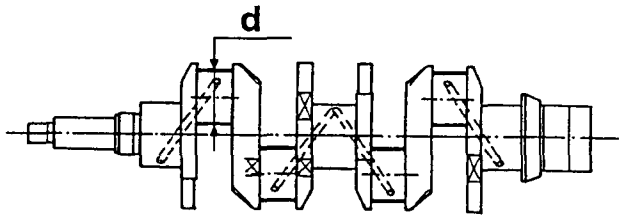
53 ÷ 58 Nm 5.4 ÷ 5.9 kgm



Inside diameter of connecting rod half bearings	
Class A - Blue	50.032 ÷ 50.056 mm
Class B - Red	50.024 ÷ 50.048 mm

1. Measure the diameter of the connecting rod journals and check that it is within the specified limits.

Diameter of connecting rod journals	
Class a - Blue	49.992 ÷ 50.000 mm
Class B - Red	49.984 ÷ 49.992 mm



NOTE: Due to the nitriding treatment the crankshaft has undergone, no grinding operations are possible; therefore it must be changed in the event of excessive wear.

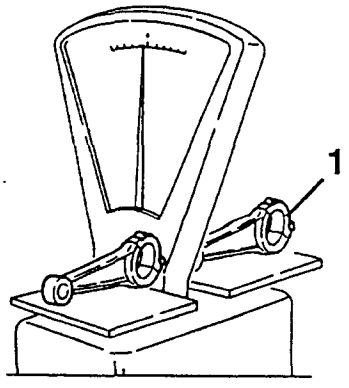
- Calculate the clearance between the rod journals and the corresponding half bearings and check that it is within the specified limits.

Clearance between rod journals and half bearings
0.032 ÷ 0.064 mm

Checking the connecting rods

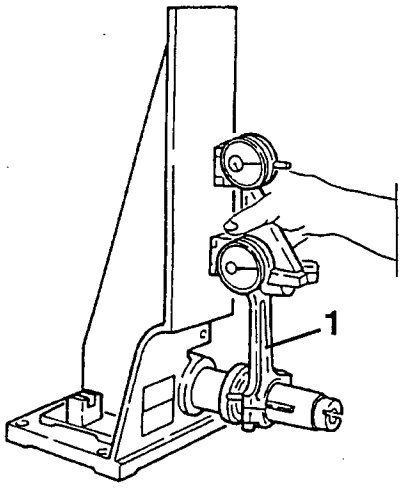
1. Check that the difference in weight between the rods complete with half bearings, caps and screws is within the specified limits.

Difference in weight between connecting rods
≤ 2 g



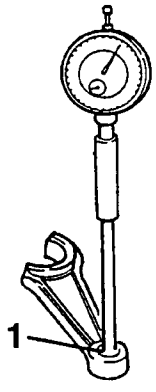
1. Check that the rods are perpendicular using a reference plane as illustrated.

NOTE: **If perpendicularity is not perfect, the connecting rod must be changed to avoid abnormal stresses when the engine is running, resulting in uneven wear of the piston and of the rod itself.**



Checking the clearance between pins and small end bushing

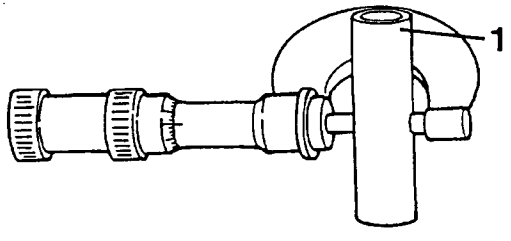
1. Measure the inside diameter of the small end bushing and check that it is within the specified limits, if not, change the bushing.



Inside diameter of small end bushing
21.007 ÷ 21.015 mm

1. Measure the outside diameter of the pins and check that it is within the specified limits.

Outside diameter of pins
20.996 ÷ 21.000 mm



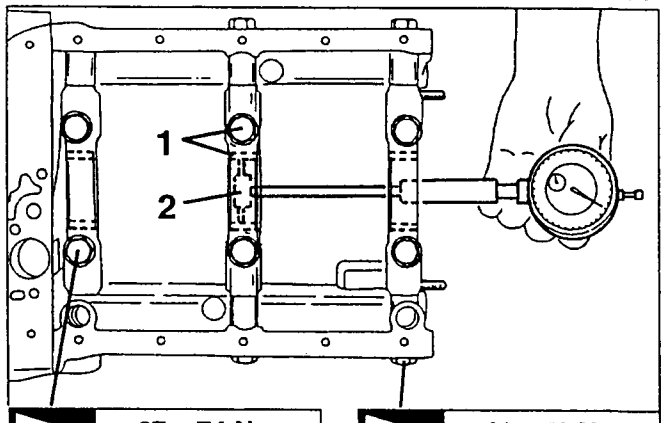
- Calculate the clearance between the pins and the small end bushing and check that it is within the specified limits.

Clearance between pins and small end bushing
0.007 ÷ 0.019 mm

Checking the clearance between main bearing journals and the corresponding half bearings

1. House the half bearings and fit the main bearing caps on the crankcase tightening the fastening screws to the specified torque.
2. Measure the diameter of the main bearings and check that it is within the specified limits.

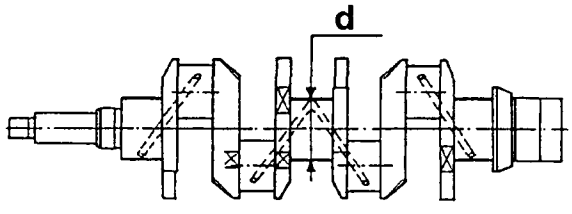
Diameter of main bearings	
Class A - Red	59.987 ÷ 60.009 mm
Class B - Blue	59.979 ÷ 60.001 mm



67 ÷ 74 Nm 6.8 ÷ 7.5 kgm	41 ÷ 50 Nm 4.2 ÷ 5.1 kgm

1. Measure the diameter of the main bearing journals and check that it is within the specified limits.

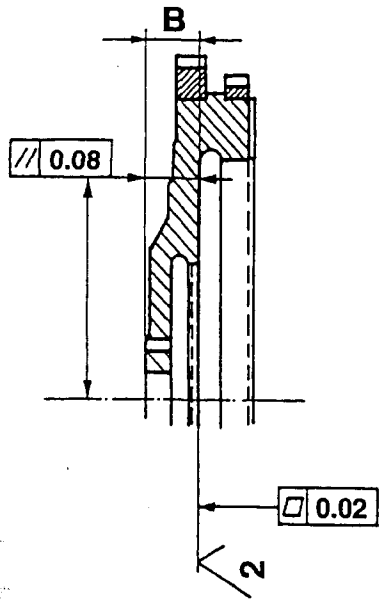
Diameter of main bearing journals	
Class A - Red	59.954 ÷ 59.964 mm
Class B - Blue	59.944 ÷ 59.954 mm



Clearance between main bearing journals/half bearings
0.023 ÷ 0.055 mm

Checking the engine flywheel

- Check that the ring gear teeth are not cracked or show signs of seizure; if they do, proceed as follows to change them:
• remove the old ring gears;
• accurately clean the contact surfaces of the new ring gears and of the flywheel;
• evenly heat the new ring gears to 120° ÷ 140° C and fit them on the flywheel;
• leave to cool naturally, do not force cool.
- Check that the surface of the flywheel on which the clutch driven plate works has no nicks, material removal or signs of overheating. If not, check that dimension "B" shown in the diagram is above the specified limit and that the machining allowance enables refacing.



Refacing dimension
B ≥ 21.15 mm

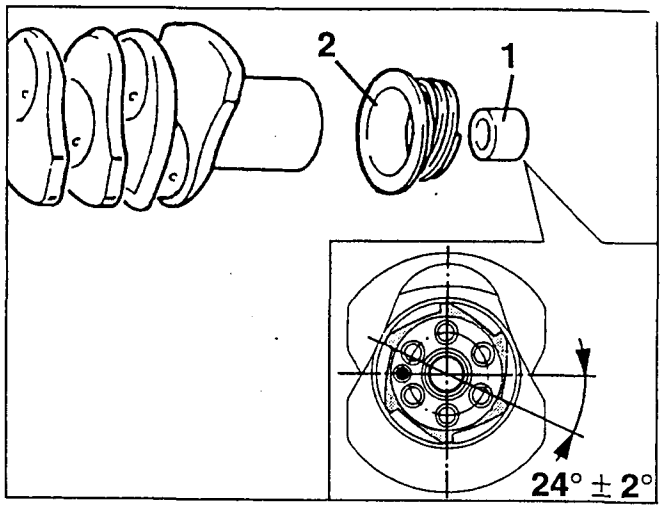
CAUTIONS FOR RE-ASSEMBLY

For re-assembly operations reverse the sequence of those described for dis-assembly unless otherwise indicated below.

- Check valve tightness when the cylinder heads are assembled.

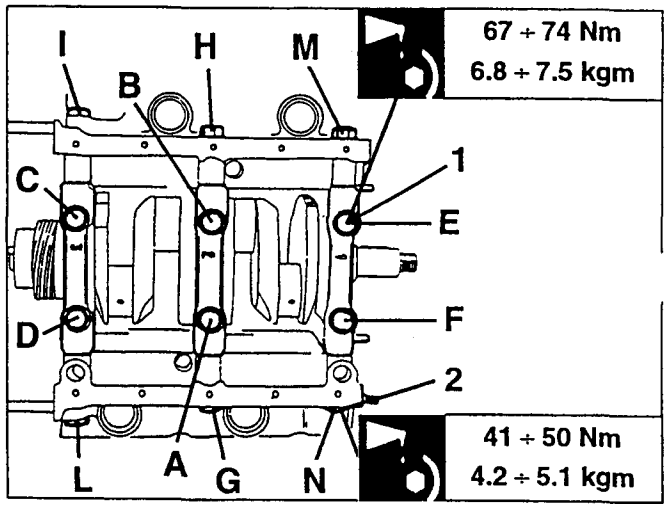
Reassembling the crankshaft

1. If removed previously, the crankshaft rear bushing should be refitted using tool N° 1.821.104.000 (A.3.0450).
2. Heat the oil pump drive gear to 150°C and shrink it onto the crankshaft directing it as illustrated.



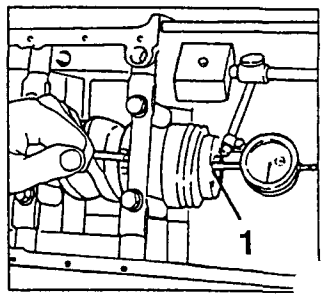
Tightening the main bearing caps

- Assemble the main bearing caps on the crankcas bearings in the correct position and tighten the fastening screws in oil without locking them.
1. Tighten the main bearing cap fastening screws to the respective crankcase bearings two or three times in the sequence shown (from A to F).
2. Then in two or three operations, tighten the screws fastening the main bearing caps to the crankcase in the sequence shown (from G to N).
- Turn the crankshaft by hand and check that it turns smoothly.



Checking the crankshaft end float

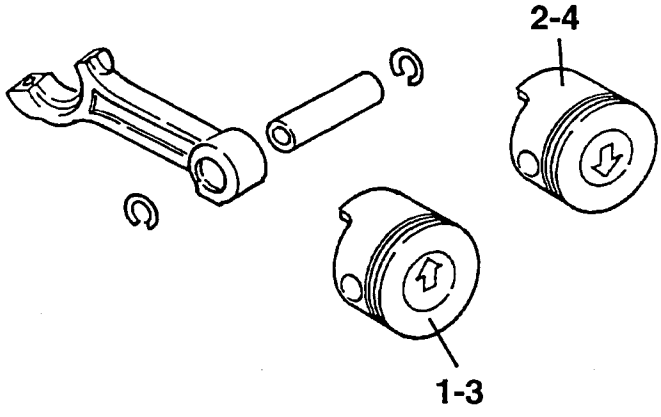
1. Using a dial gauge on a magnetic base, measure the crankshaft end float and check that it is within the specified limits.



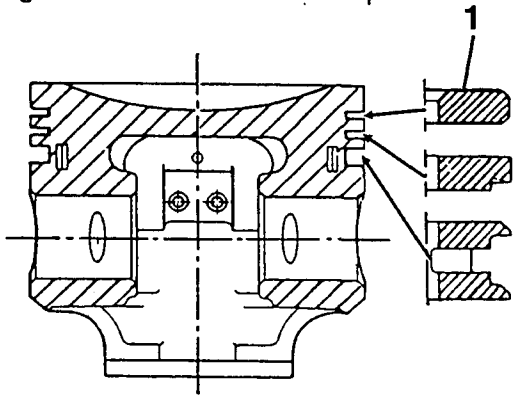
Crankshaft end float
0.35 mm

Reassembling the pistons and connecting rods

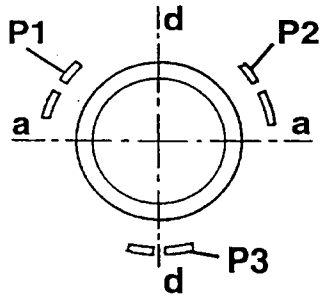
1. Assemble the pistons and connecting rods so that the pistons of the right cylinder head 1-3 have the arrow stamped on the crown pointing upwards and the pistons of the left head 2-4 have the arrow pointing downwards.



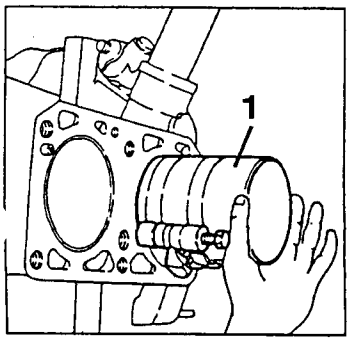
1. Insert the rings on the piston making sure that the wording on the flat surface faces upwards.



- Direct the rings on the pistons with the cuts offset by 120°.

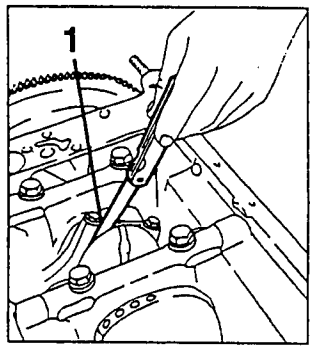


P1. *Position of upper ring;*
P2. *Position of lower ring;*
P3. *Position of oil scraper ring;*
aa. *Gudgeon pin axis;*
dd. *Direction of thrust.*



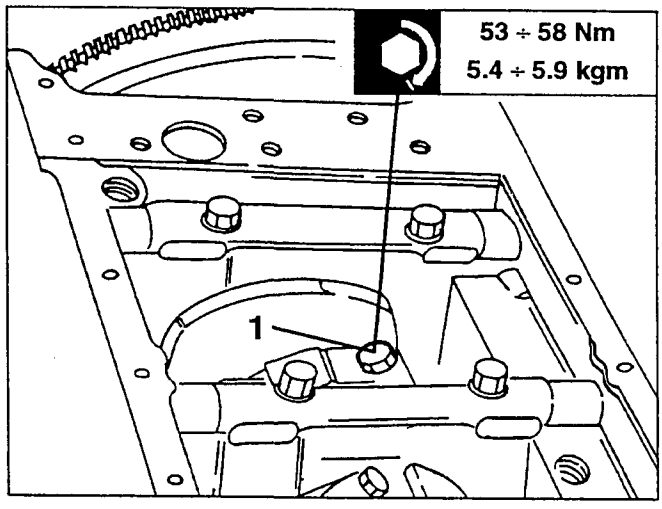
1. Assemble the half bearings on the connecting rod big end and insert the piston-connecting rod assembly in the corresponding cylinders using the special tool.

When assembling direct the pistons with the arrow stamped on the crown pointing in the direction of rotation of the engine, i.e. upwards for the right head pistons and downwards for the left head pistons.
The position of the connecting rod big end must make it possible to read the identification number.



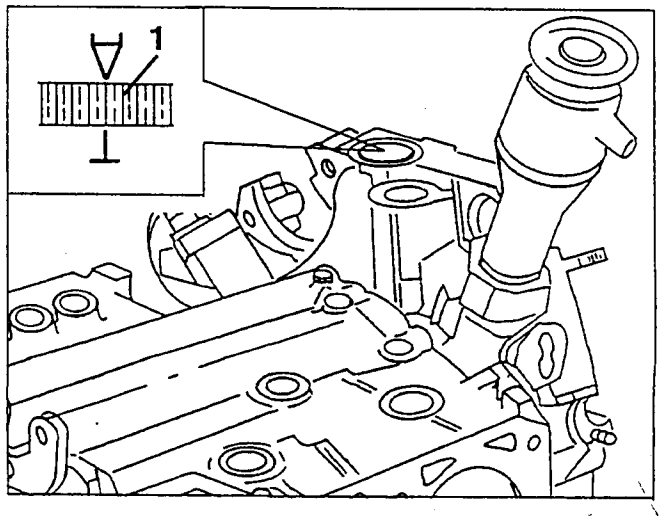
1. Position the connecting rod caps with the corresponding half bearings and check that there is the specified play between the crankshaft shoulder and the connecting rod-cap profile.

1. Suitably turn the crankshaft to gain access to the connecting rod cap fastening screws and tighten them to the specified torque.



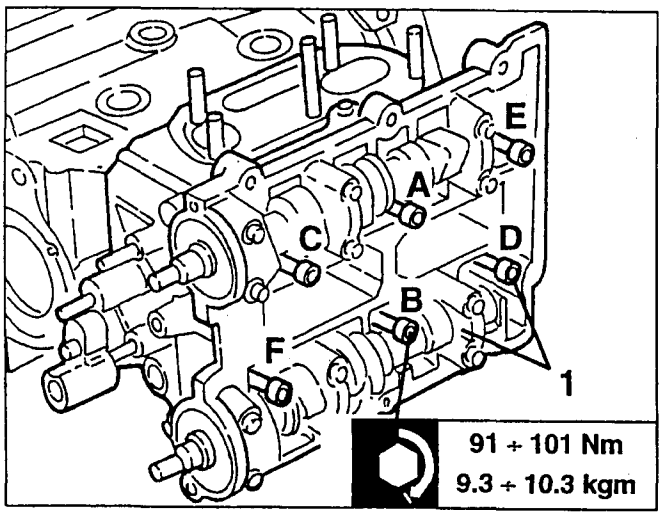
Reassembling the cylinder heads

1. Turn the crankshaft to take piston no. 1 to the T.D.C. (bursting stroke); making sure that the notch "T" on the flywheel coincides with the fixed reference of the rear cover.



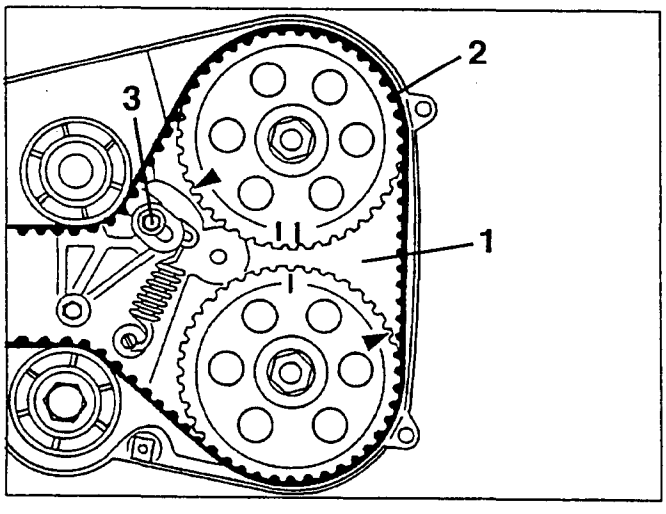
CAUTION:
Turn the camshafts to a neutral position.

1. Assemble the cylinder heads with the seals interposed on the crankcase and tighten the fastening screws in two or three operations to the specified torque following the sequence indicated (from A to F).



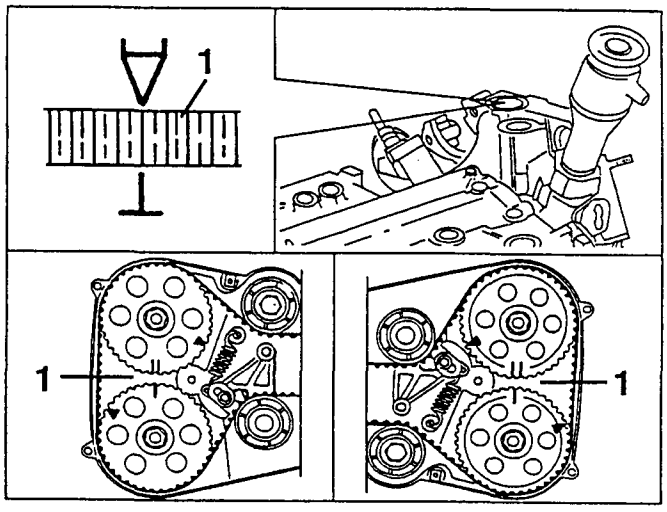
Assembling the timing belts

1. Turn the camshafts of the left head so that the area between the two notches of the intake pulley coincides with the notch of the exhaust pulley.
- Turn the crankshaft until the notch "T" on the flywheel is aligned with the fixed reference of the rear cover.
2. Fit the left timing belt.
3. Slacken the belt tensioner fastening nut so that it can exert the load impressed by the spring on the belt.

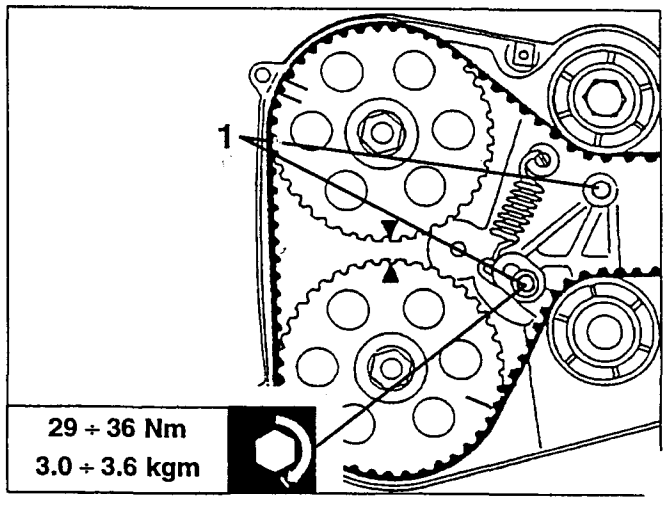


- Repeat the previous operations for assembly and timing of the right timing belt.
- Turn the crankshaft a few times in its direction of rotation to allow the belts to take their final position.

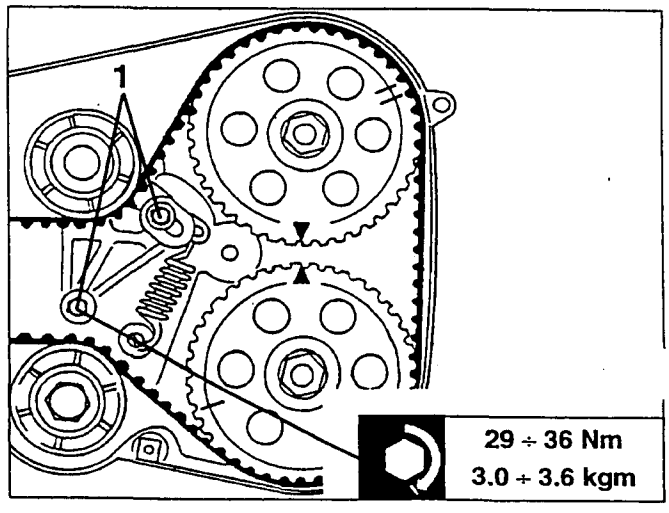
1. Check engine timing.



- Turn the crankshaft 90° to obtain: the impression ● on the flywheel aligned with the fixed index ar alignment of the notches ▲ on the pulleys.
1. Slacken the fastening nuts of the right belt tensioner to settle it then tighten them to the specified torque.



- Turn the crankshaft 360° to obtain: the impression ● on the flywheel aligned with the fixed index and alignment of the notches ▲ on the pulleys.
1. Slacken the fastening nuts of the left belt tensioner to settle it then tighten them to the specified torque.



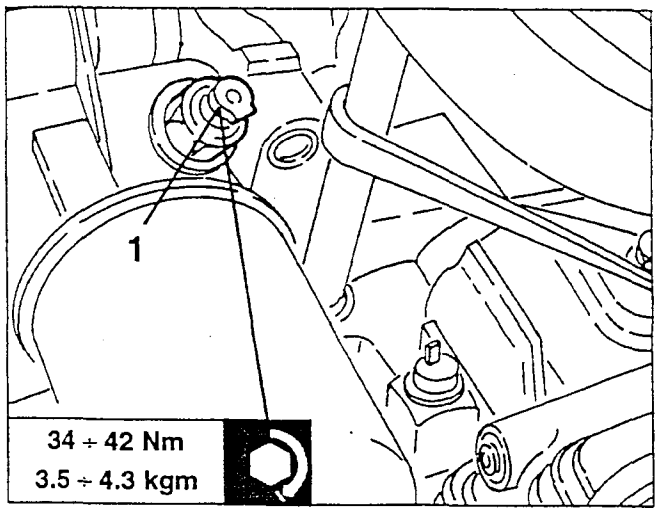
- Turn the crankshaft a few turns and check again that the timing references correspond.

CHECKING THE ELECTRICAL COMPONENTS OF THE LUBRICATION CIRCUIT

Minimum engine oil pressure warning light sensor

1. Check the setting of the minimum engine oil pressure warning light sensor. If the value fails to meet specifications, change the sensor.

Contact opening/closing pressure	0.2 ÷ 0.5 bar



For the other sensors and electrical components located in the engine compartment, refer to the specific Groups in which an extensive description is given.

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ENGINE OVERHAUL

REPAIR INSTRUCTIONS

THIS UPDATE ALSO REPLACES THE PAGES OF SERVICE NEWS WITH PREVIOUS DATE

INTRODUCTION

This manual shows the overhaul procedures for the engine groups taking it that these groups have already been removed from the vehicle and set on a suitable stand.

The title-page of the manual lists the codes of the engine given in the text.

The specific manual for the vehicle in question, Volume I - Group 00 - Technical data - Identification of models, should be consulted to rapidly identify the engine belonging to the various models of vehicle.

This chapter also gives the technical data relative to the engine.

How to use this manual

The aim of this manual is to supply the Alfa Romeo Service Personnel with a tool enabling them to rapidly identify faults and to render the corrective interventions precise and efficient.

The manual illustrates the procedures relative to the dismantling operations and checks for the various engine groups. The procedures are illustrated in detail as is the use of the tools required. Appropriate symbols and explanations next to the main technical drawings facilitate a rapid and complete consultation of the manual.

The procedures illustrate complete disassembly procedures for the components which should only be carried out in their entirety when strictly necessary. The "refitting" procedures are normally obtained by reversing the operations followed for removal and only those assembly procedures which are significantly different are given in full.

All the information given in this manual is accurate at the time of publication.

Alfa Romeo reserves the right to make any modifications to its products that it deems necessary without warning. However the technical information and updates to this manual will be supplied as soon as possible.

Symbology

A specific symbology has been used in this manual to permit a rapid identification of the main technical information supplied.

The list of symbols is given below.


removal/disassembly




refitting/re-assembly



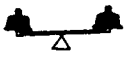

tighten to the torque


caulk nut


adjustment/regulation


visual check


lubricate


weight difference


angular value


pressure


temperature


brake system air purge


surfaces to be treated


interference


play


intake


exhaust


Lubricate only with engine oil


left-hand thread


torque for tightening in oil


engine r.p.m.


ovalization


taper


eccentricity


flatness


diameter


linear dimension


parallelism


service with grease


heating temperature


seal


service with engine oil


grease


CAUTION!


WARNING!

Warnings for the operator

All the operations must be carried out with the greatest care to prevent damage occurring to the vehicle or persons.

- The use of Alfa Romeo specific tools are indicated for some procedures. These tools must be used to ensure safety and to avoid damaging parts involved in the procedure.
- To free parts which are solidly stuck together, tap with an aluminium or lead mallet if the parts are of metal. Use a wooden or resin mallet for light alloy parts.
- When dismantling ensure parts are marked correctly if required.
- When refitting lubricate the parts, if necessary, to prevent seizing and binding during the initial period of operation.
- Using adhesive paper or clean rags cover those parts of the engine which, following disassembly, present openings which may allow dust or foreign material to enter.
- When refitting, the tightening torques and adjustment data must be respected.
- When substituting the main component(s) the seal rings, oil seals, flexible washers, safety plates, self-locking nuts and all worn parts must also be replaced.
- Avoid marking the internal coverings in the passenger compartment.

Substitution of groups or disconnected parts must be carried out using original spare parts only. Only in this way can the suitability and perfect operation of each organ be guaranteed.

- The words **CAUTION** and **WARNING** accompany those procedures where particular care should be taken to prevent damage occurring to people or vehicle parts.



CAUTION:
used when insufficient care could cause damage to people



WARNING:
used when insufficient care could cause damage to the vehicle or its component parts.

- The safety regulations applied to workshops should be respected. Where necessary the manual also lists the specific precautions to be taken to prevent dangerous situations from arising.



When using chemical products follow the safety indications given on the safety cards which the supplier is obliged to deliver to the user (in Italy in compliance with D.M. n.46/1992).

NOTE:
It is possible that for certain subjects were not completed in time for printing.
However these subjects are given and highlighted in the indices of the single groups.
It is the duty of the Technical Services to supply documentation regarding these subjects as soon as possible through updates or "Technical Bulletins".

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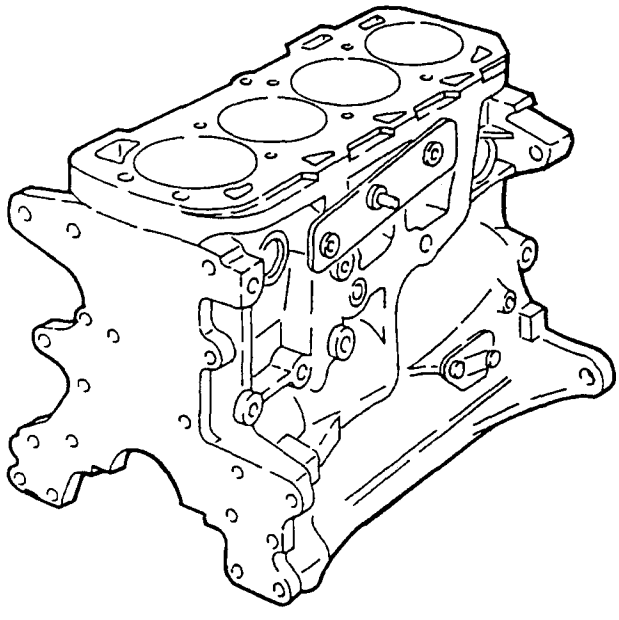
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- Checking and inspecting the crankcase. 18
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DESCRIPTION

Turbodiesel engine, direct injection without pre-combustion chamber, 4 cylinders in line, 1910 c.c., two valves per cylinder, one overhead camshaft, air supercharging by turbocharger and intercooler, Bosch Common Rail EDC-15C electronic injection system.

CRANKCASE

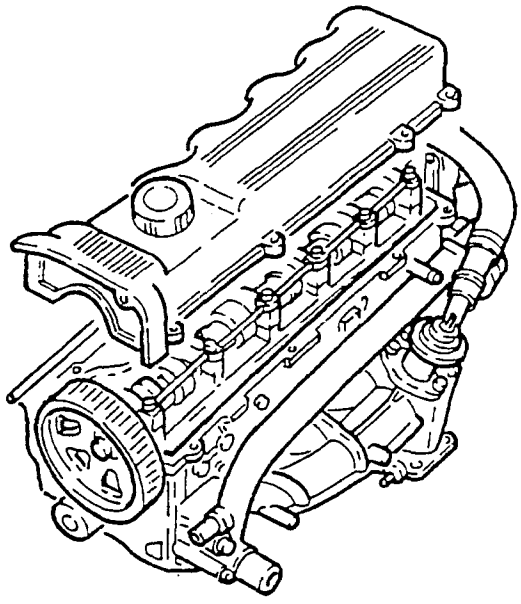
The crankcase is in spheroidal cast iron with integral cylinder liners of the closed-deck type.
The crankshaft is supported by five main bearings.
Special grooves machined in the crankcase walls allow the flow of coolant fluid and lubricating oil.
A jet is installed in the lower part which sprays oil to cool the piston skirts and lubricate the gudgeon pin.



CYLINDER HEAD

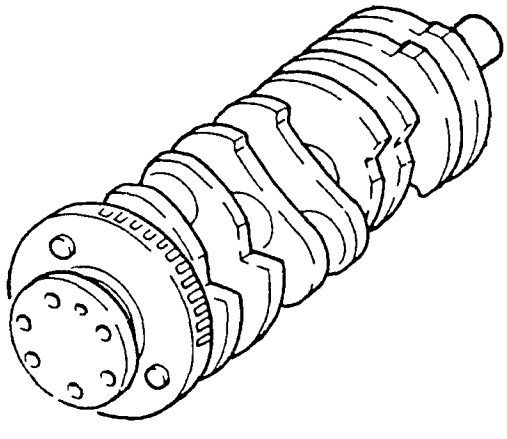
The cylinder head is in one piece and made from aluminium and silicon alloy.
The two parallel and vertical valves per cylinder are installed in their valve guides and controlled by a single overhead camshaft, the cams of which act on mechanical tappets.
The valve guides are force-fitted in their seats on the cylinder head by interference and the inside diameter is perfected after assembly using a special bore.

Unlike heads with pre-combustion chamber, the whole combustion process takes place in the combustion chamber machined in the piston.
The seal between the cylinder head and crankcase is made from aramidic fibre and there is no need to retighten the head throughout the whole life of the engine.



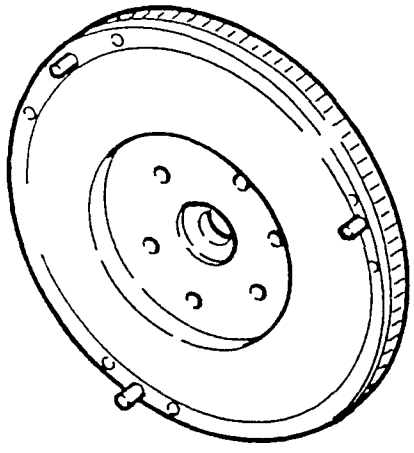
CRANKSHAFT

This is in cast iron and rests on five main bearings and its end float is adjusted by two half rings housed in the rear main bearing.
Eight counterweights accurately balance the rotating masses.
A groove runs inside the shaft to lubricate the main bearing and connecting rod journals.
The phonic wheel for the rpm sensor is installed at the rear.



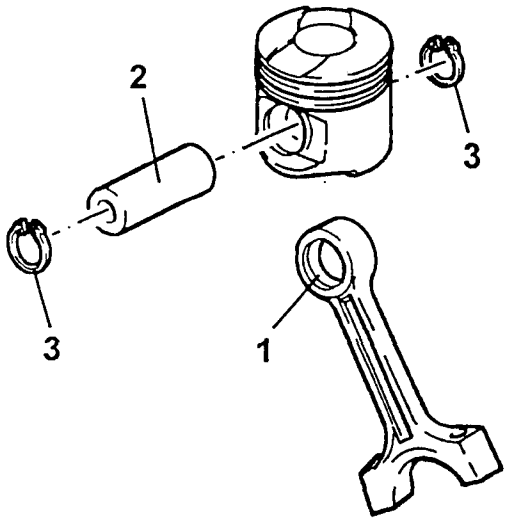
FLYWHEEL

This is in cast iron, with inserted ring gear, in hardened and tempered steel, and suitably balanced.

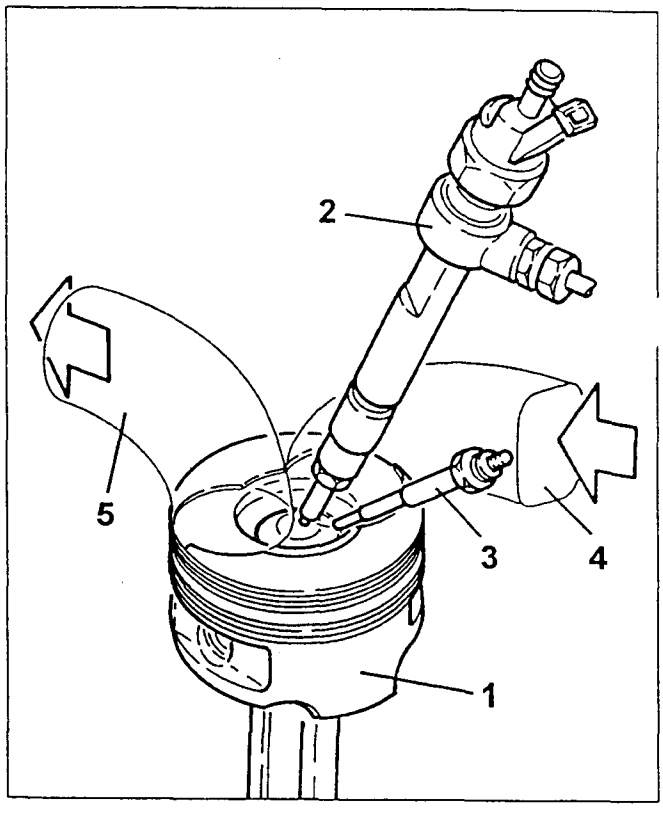


PISTONS AND CONNECTING RODS

The connecting rods are in hardened and tempered steel, with force-fitted copper bush (1) for mating with the gudgeon pin (2) of the piston.
The floating type gudgeon pins are retained by two expansion circlips (3) which are housed in the special hollows machined on the piston hubs.

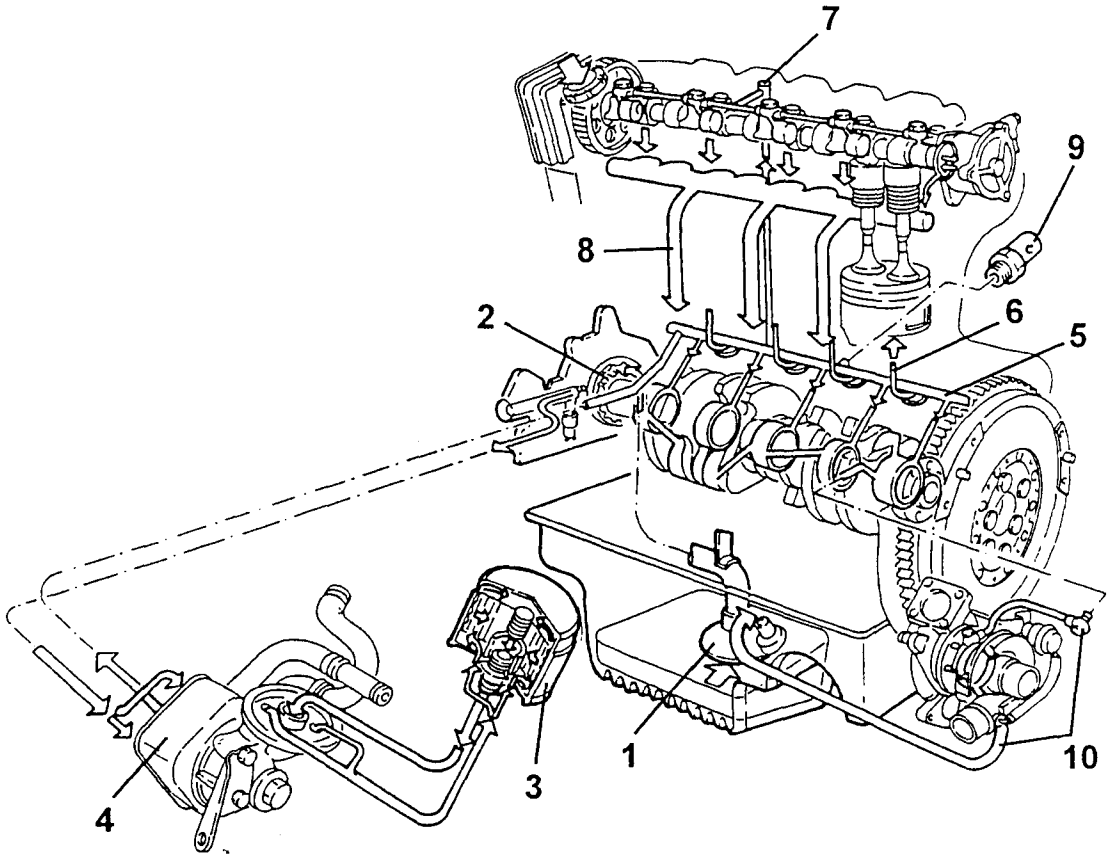


The pistons are in aluminium and silicon alloy with self-heating inserts and are subdivided into three dimensional classes.
The "OMEGA" shaped combustion chamber, which improves combustion yield, is machined on the piston crown.
Mating with the gudgeon pin is through two copper alloy bushes.



1. *Piston*
2. *Injector*
3. *Glow plug*
4. *Air inlet*
5. *Exhaust gas outlet*

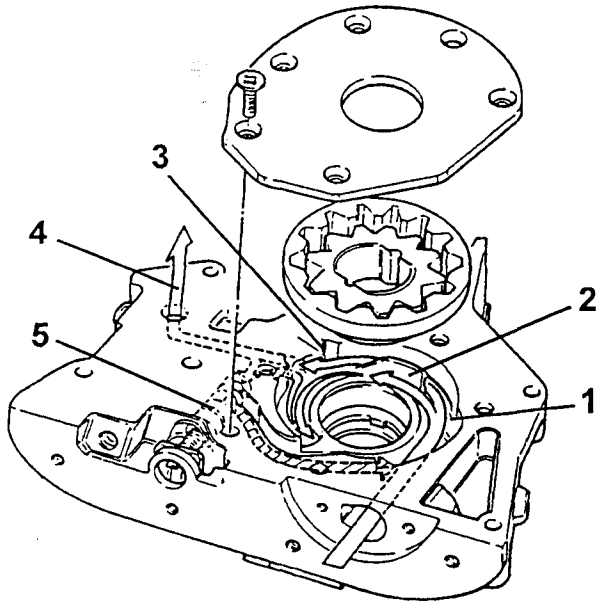
LUBRICATION SYSTEM



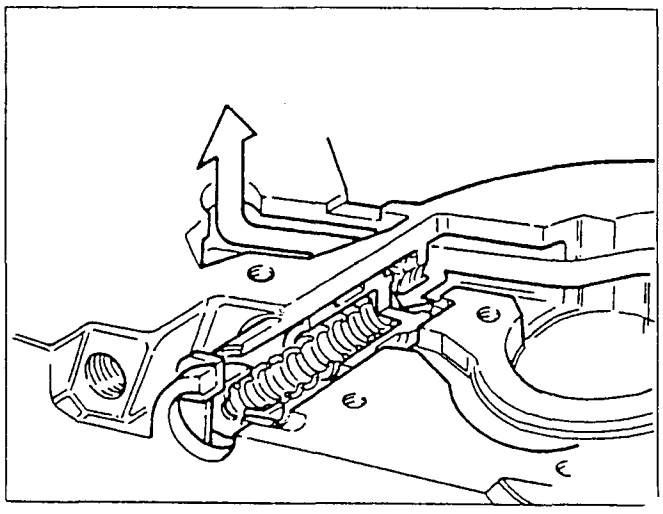
1. *Suction device with filtering mesh*
2. *Oil pump*
3. *Oil filter cartridge*
4. *Heat exchanger (water/oil)*
5. *Main longitudinal groove*
6. *Spray jets (piston skirt cooling)*
7. *Vertical groove (lubricating camshaft bearings)*
8. *Oil return to sump*
9. *Switch for engine oil pressure warning light*
10. *Turbocharger lubrication pipes*

OIL PUMP

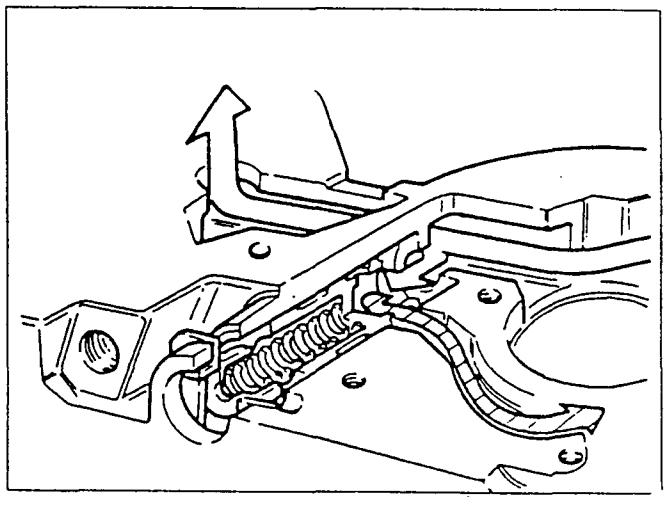
The engine oil is withdrawn from the sump by the vacuum created by the rotation of the gears shrunk onto the crankshaft.
The vacuum is present starting from the separation partition (2) of the gears up to the oil sump suction device.
On the other hand, the pressure develops starting from the separation partition (2) in all the engine oil delivery ducts (4).
When the pressure exceeds 5 bar, the thrust exerted on the limiting valve (5) overcomes the reaction of the spring below and moves the valve until it opens the connection duct between the pressure chamber (3) and the low pressure chamber (1).



Closing operating position of the engine oil pressure limiting valve



Short circuit operating position of the limiting valve



INTRODUCTION

The instructions contained in the following paragraphs refer to complete engine bench overhaul after removing the engine from the vehicle. The instructions are organised as follows:
- **Engine removal:**
removal of engine accessories and components and disassembly of the main engine assemblies.
- **Cylinder head disassembly and overhauling:**
complete overhauling of component parts.
- **Crankcase overhauling:**
complete overhauling of component parts.
- **Refitting precautions:**
specific refitting operations which mainly differ from the removal instructions.
- Lubrication electrical circuit checks.

All the disassembly procedures described in the following paragraphs should be reversed for refitting, unless specifically indicated.

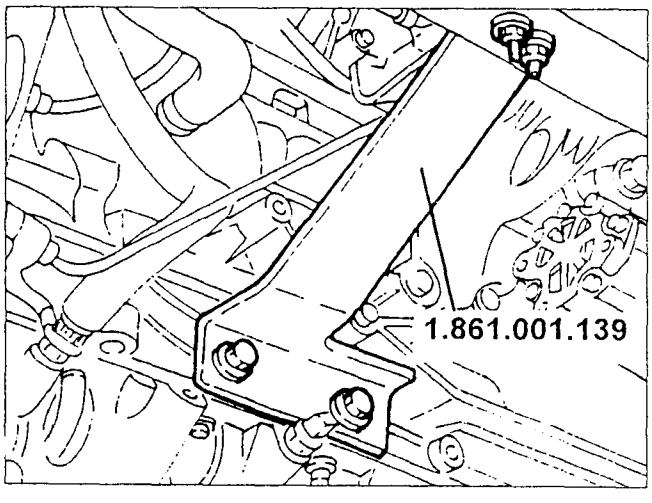
The following procedures refer to complete engine overhauling. Some procedures, however, can be used separately for some parts only when required for specific components.

ENGINE REMOVAL

PRELIMINARY OPERATIONS

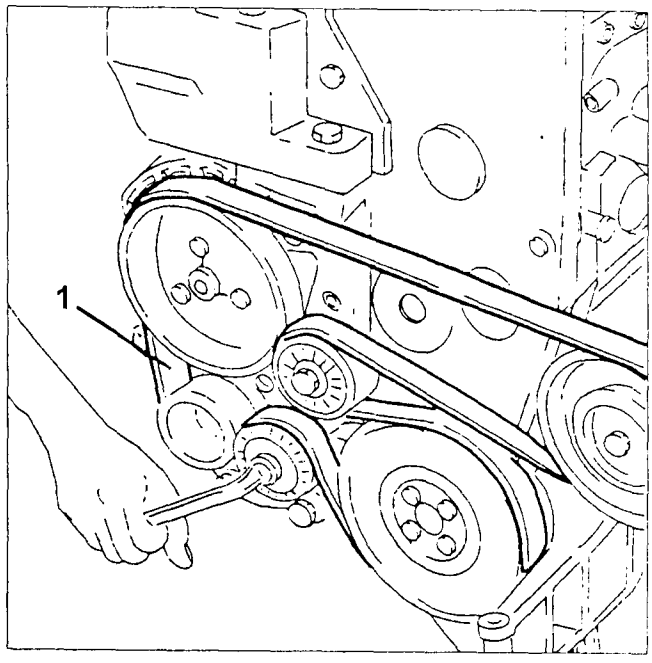
- Position the engine on a stand with common suitable tools.

NOTE: Tool no. 1.861.001.139 can be used to support the engine on the overhaul stand.

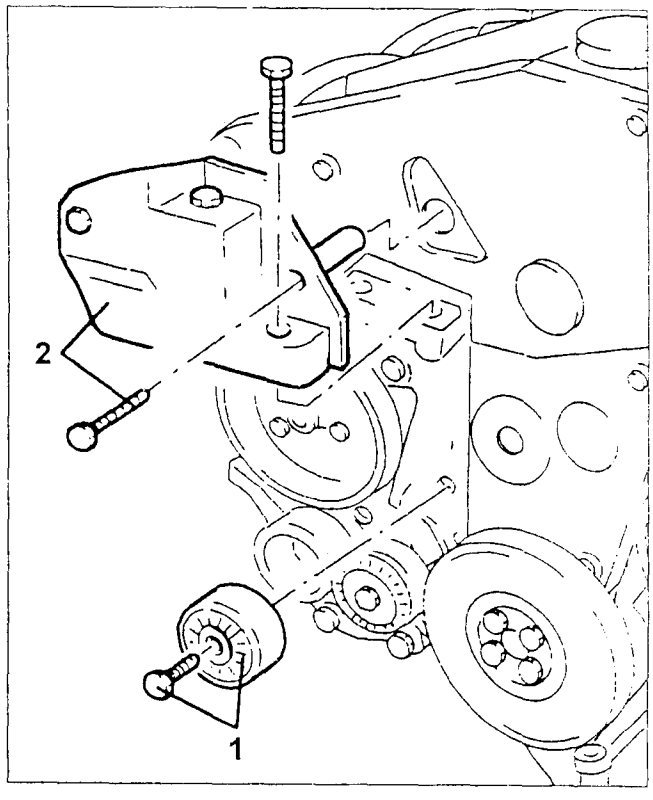


SINGLE ENGINE UNIT BELT REMOVAL

- Loosen the single engine unit belt by means of a wrench on the automatic belt take-up device.
1. Remove the single engine unit belt.

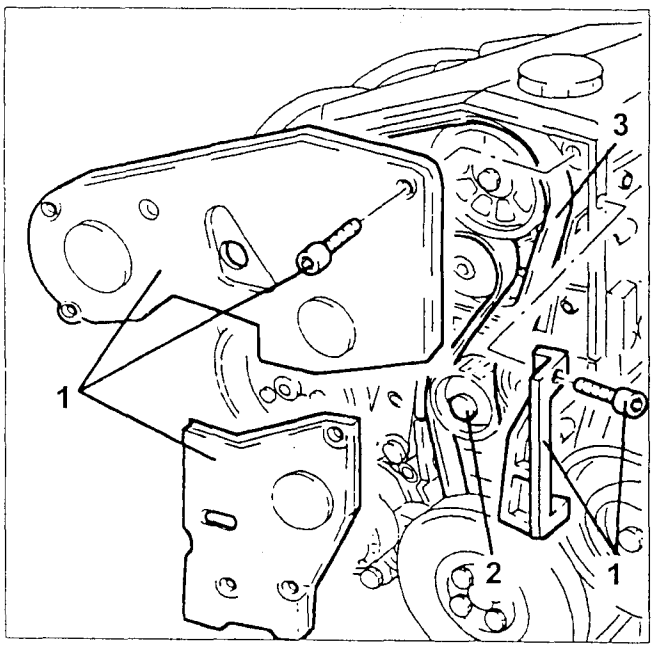


1. Loosen the fastening screw and remove the single engine unit belt runner.
2. Loosen the fastening screws and remove the engine tie-rod bracket.

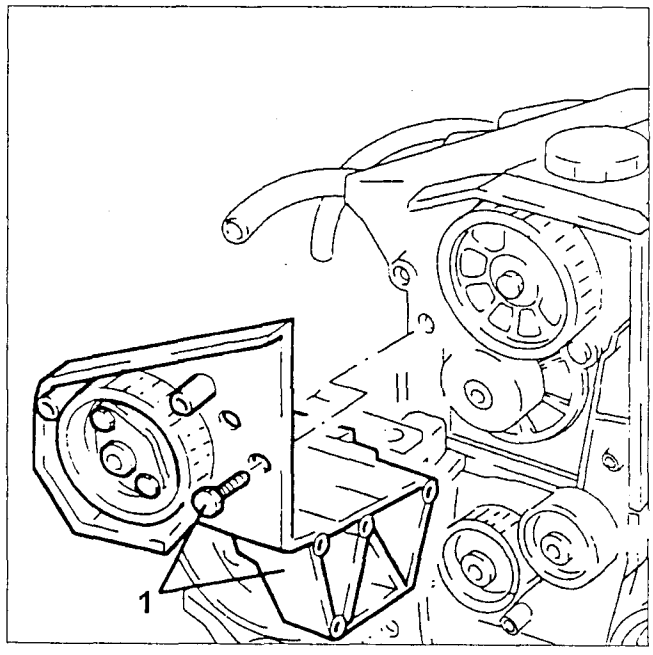


TIMING BELT REMOVAL

1. Loosen the screws and remove the timing belt guard.
2. Loosen the timing belt take-up device nut.
3. Remove the timing belt.



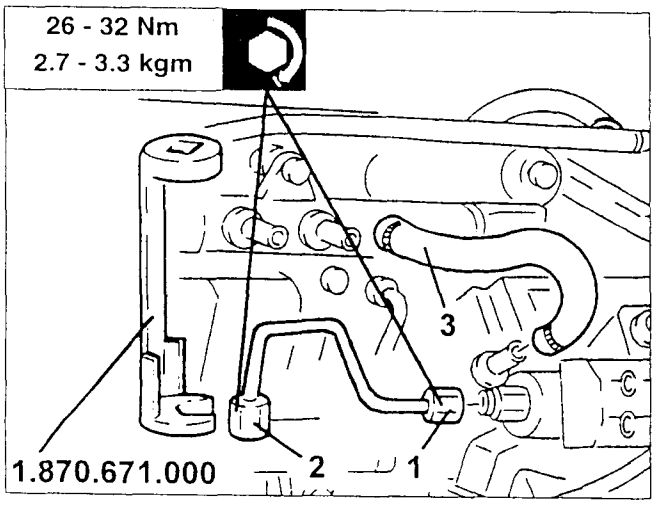
1. Loosen the remaining front screws and remove the pressure pump and bracket.



PRESSURE PUMP REMOVAL

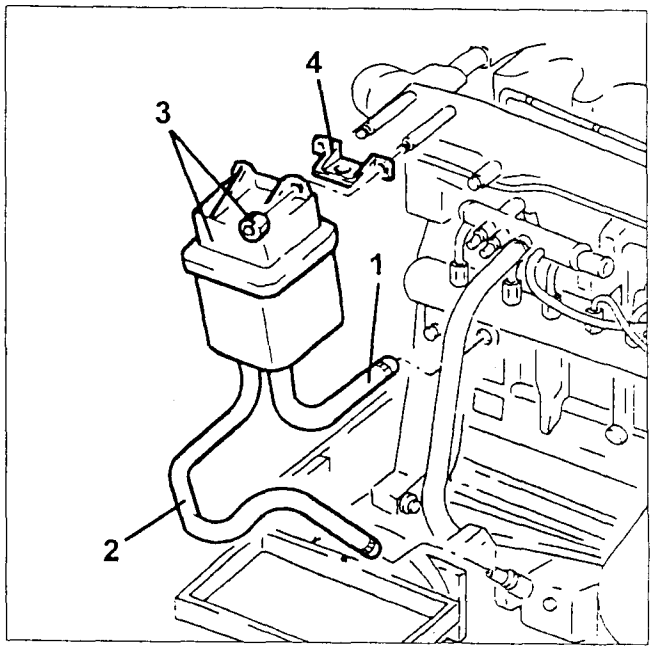
- Loosen the screws and remove the engine oil level dipstick.
- Loosen the pressure pump bracket side screws.

1. Disconnect the pressure pump-fuel manifold pipe pump side fitting with a suitable tool.
2. Loosen the pressure pump-fuel manifold pipe manifold side fitting with tool no. 1.870.671.000.
3. Disconnect the pressure pump-fuel return pipe on pipe side.

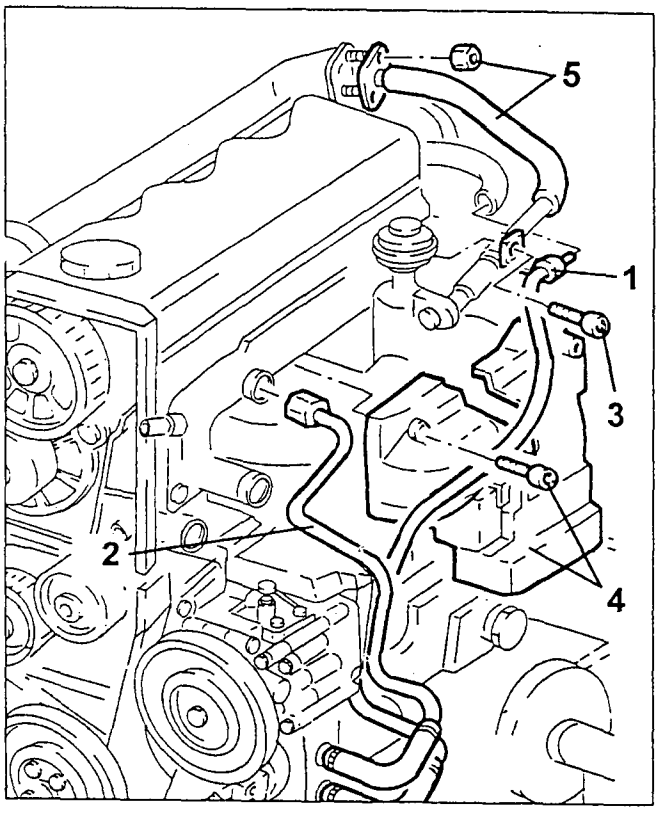


TURBO COMPRESSOR REMOVAL

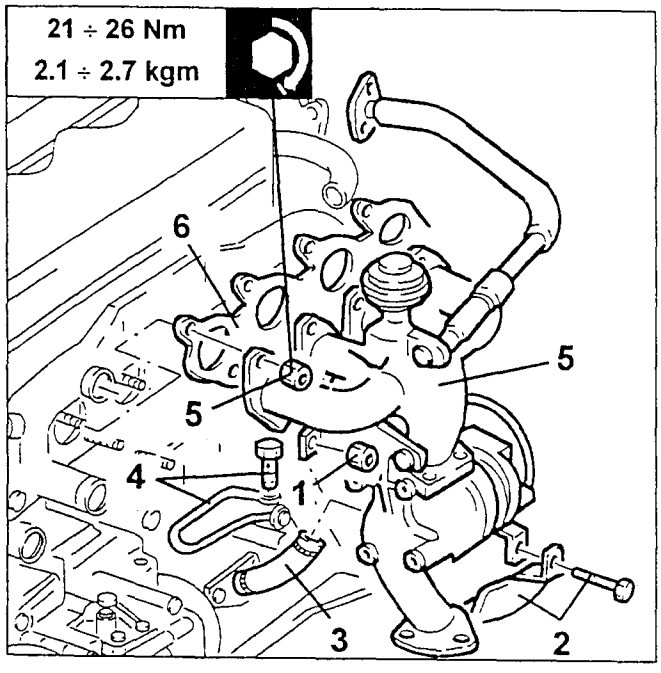
1. Disconnect the crankcase oil vapour recovery pipe.
2. Disconnect the condense oil recovery pipe from the crankcase sump.
3. Loosen the nuts and remove the oil vapour separator.
4. Remove the bracket.



1. Disconnect the coolant delivery pipe to the water-oil heat exchanger from the thermostat.
2. Disconnect from the water pump fluid inlet stiff pipe the outlet pipe from the water-oil heat exchanger.
3. Slacken the screw fastening the water inlet pipe to the water-oil heat exchanger.
4. Slacken the screws and remove the heat shield from the turbocharger.
5. Slacken the nuts and disconnect the exhaust gas recirculation pipe from the intake box.
- Remove the seal.

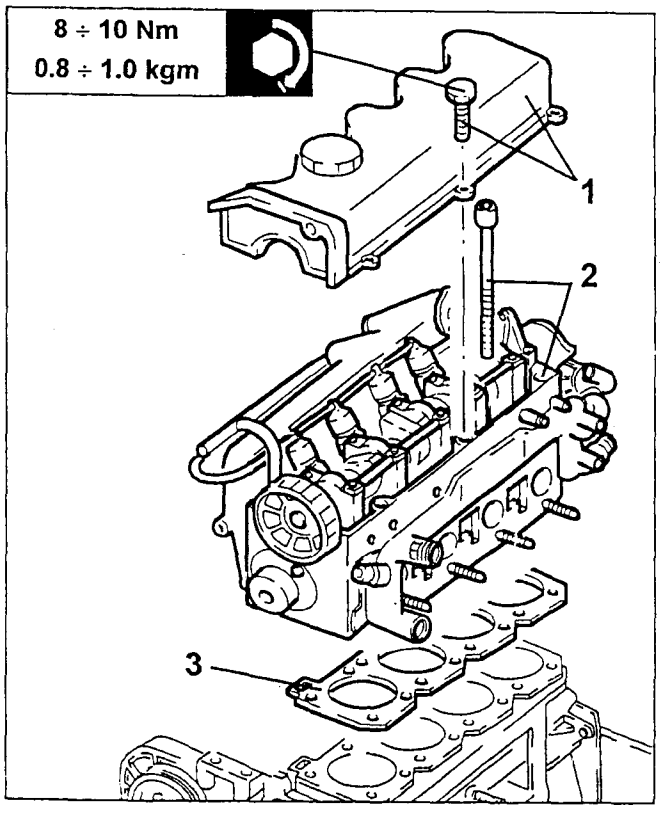


- Slacken the screw of the exhaust gas recirculation pipe support bracket.
1. Slacken the nut fastening the exhaust manifold bracket to the crankcase.
2. Slacken the screws and remove the cover of the oil return pipe to the sump from the turbocharger.
3. Disconnect the oil return pipe to the sump from the turbocharger.
4. Disconnect the oil inlet pipe from the turbocharger.
5. Slacken the fastening nuts and remove the exhaust manifold complete with turbocharger and E.G.R. valve.
6. Remove the seal.



REMOVING THE CYLINDER HEAD

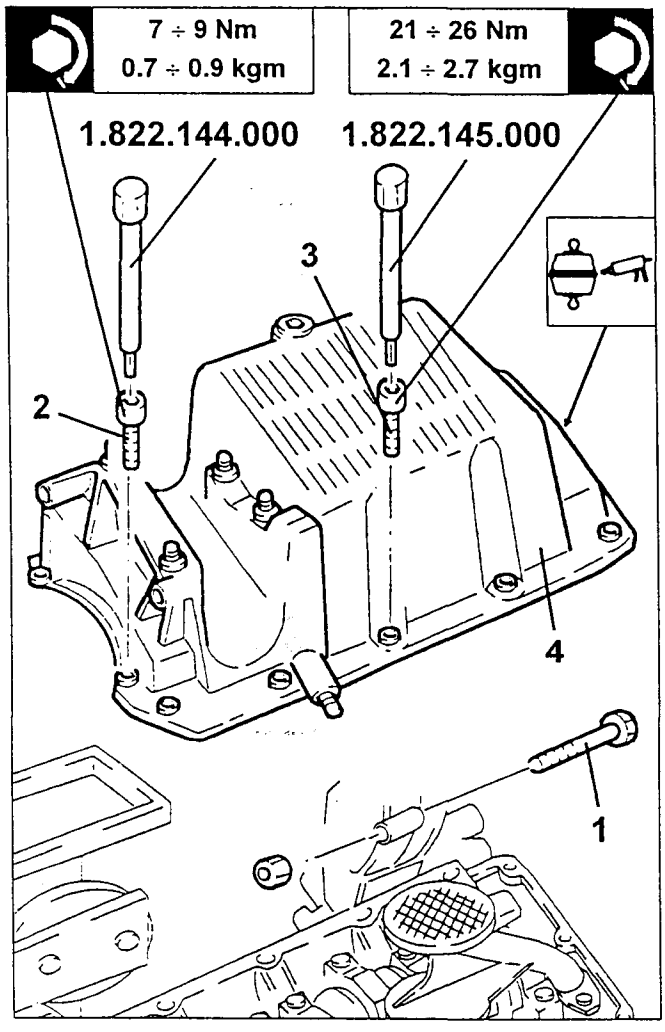
1. Slacken the fastening screws and remove the tappet cover complete with seal.
2. Slacken the fastening screws and remove the cylinder head complete.
3. Remove the cylinder head seal.



REMOVING THE CRANKCASE SUMP

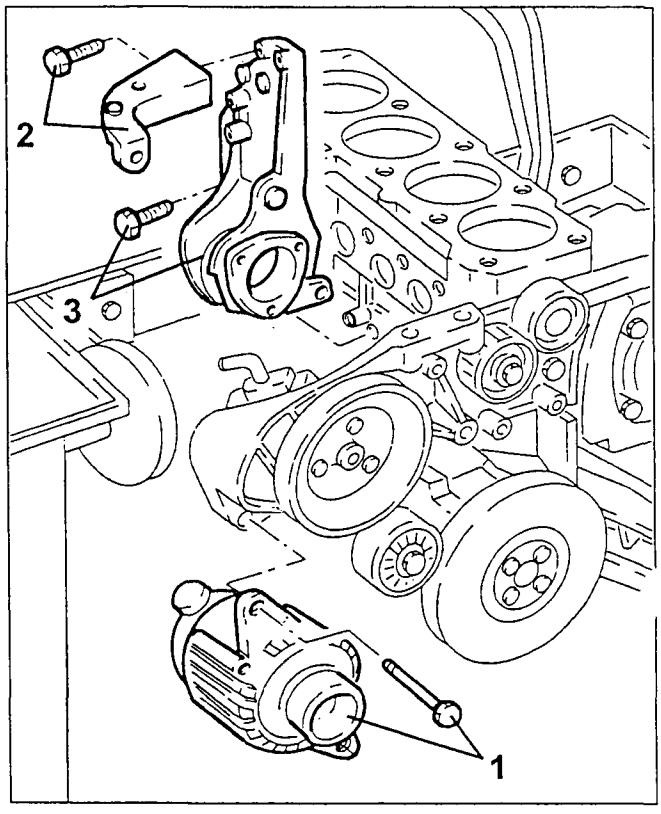
- Turn the engine by 180° on the overhauling stand.
1. Slacken the bolt connecting the crankcase sump to the layshaft support.
2. Slacken the front and rear screws of the crankcase sump using tool no. 1.822.144.000.
3. Slacken the side screws of the crankcase sump using tool no. 1.822.145.000.
4. Remove the crankcase sump.

Coat silicone sealant around the whole perimeter of the sump.



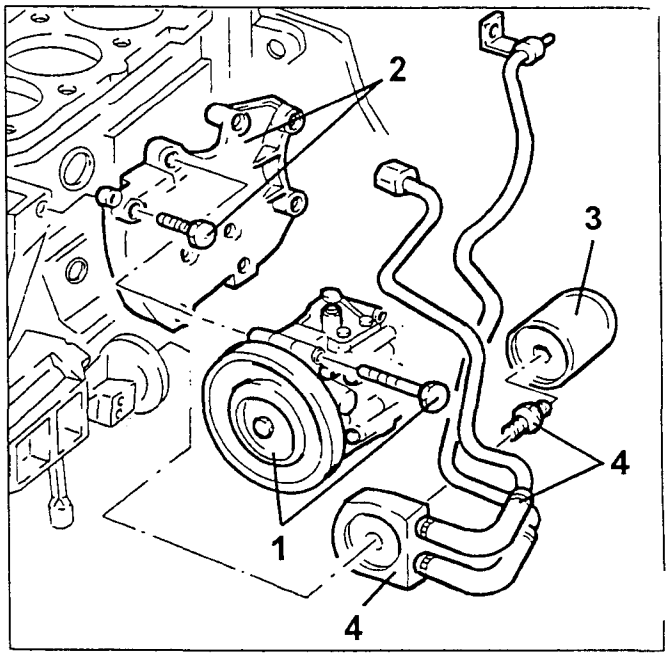
REMOVING THE ALTERNATOR

- Turn the crankcase 180° on the overhauling stand.
1. Slacken the fastening bolts and remove the alternator.
2. Slacken the fastening screws and remove the rear alternator support bracket.
3. Slacken the fastening screws and remove the layshaft support.



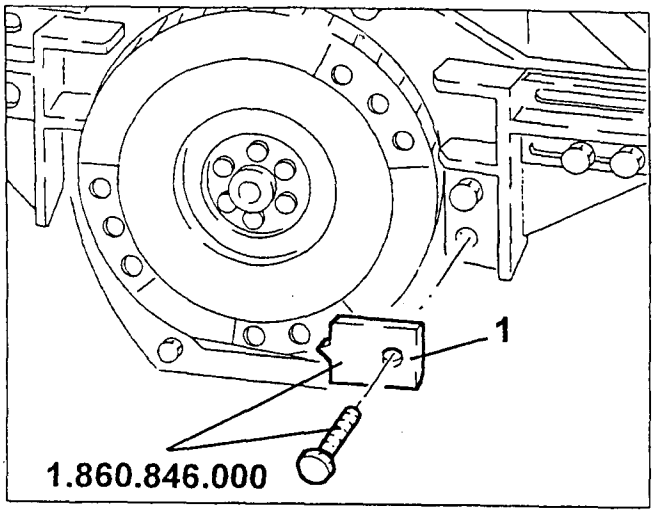
REMOVING THE AIR CONDITIONER COMPRESSOR

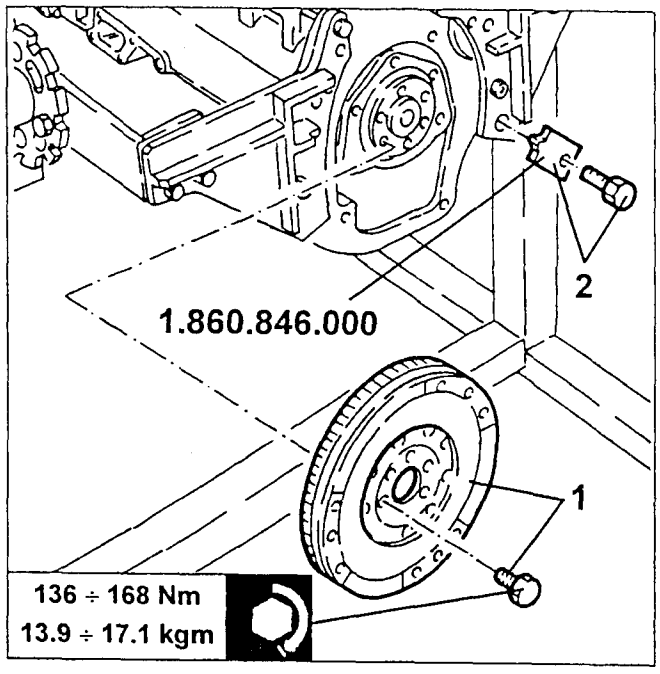
1. Slacken the fastening screws and remove the air conditioner compressor.
2. Slacken the fastening screws and remove the air conditioner compressor support.
3. Remove the engine oil filter and cartridge.
4. Slacken the pin and remove the water-oil heat exchanger complete with pipes.



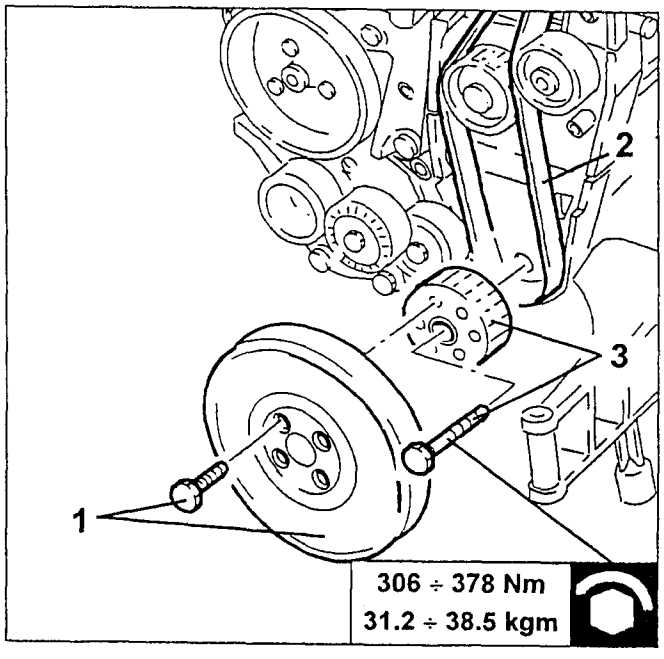
REMOVING THE FLYWHEEL

1. Assemble the flywheel stopper tool no. 1.860.846.000.





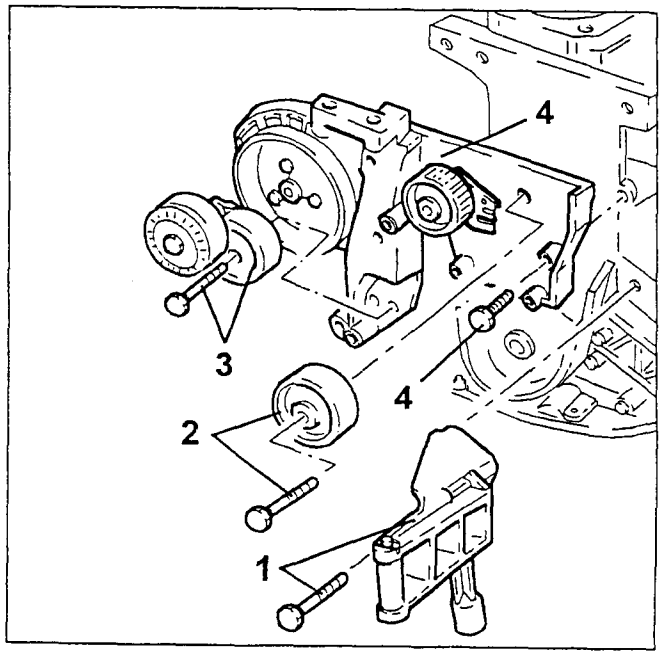
1. Slacken the fastening screws and remove the crankshaft pulley.
2. Remove the camshaft belt.
3. Slacken the screw (left-handed) and remove the driving toothed pulley.



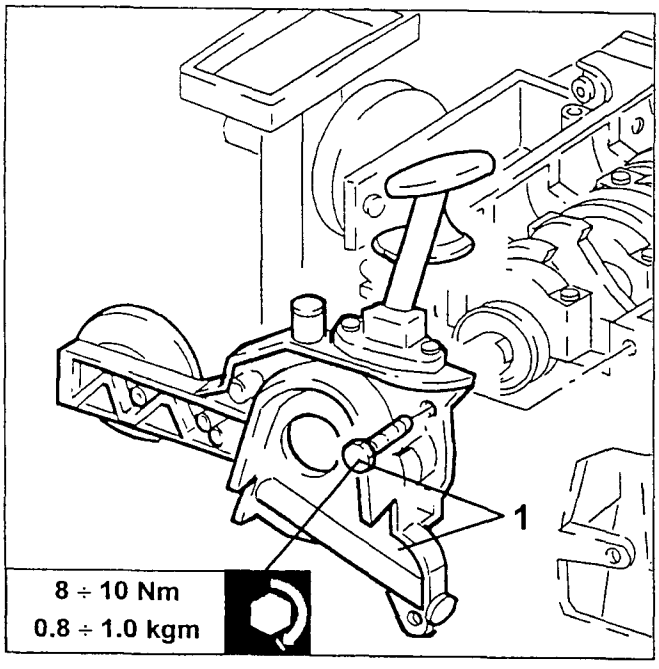
1. Slacken the fastening screws and remove the flywheel.
2. Remove the flywheel stopper tool no. 1.860.846.000.

REMOVING THE CRANKCASE FRONT COVER

1. Slacken the fastening screws and remove the power unit rigid support on the camshaft side.
2. Slacken the fastening screw and remove the camshaft drive fixed tensioner.
3. Slacken the fastening screw and remove the engine parts drive belt automatic tensioner.
4. Slacken the screws and remove the support complete with power steering pump and mobile camshaft drive tensioner.



1. Slacken the screws and remove the front crankcase cover with incorporated oil pump complete with intake horn.
- Remove the seal.



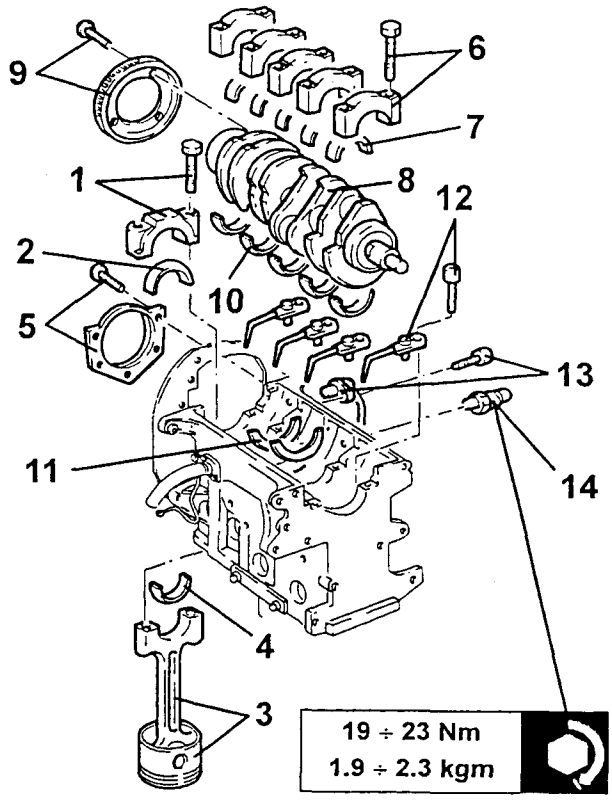
REMOVING THE PISTONS AND CONNECTING RODS

- Assemble tool no. 1.860.815.000 for turning the crankshaft.
- Turn the crankshaft 180° on the overhauling stand.
- Turn the crankshaft using the tool installed previously until the cylinder concerned reaches the B.D.C.
1. Slacken the fastening screws and remove the connecting rod cap.
2. Remove the lower connecting rod half bearing.
3. Remove the connecting rod-piston assembly.
4. Remove the upper connecting rod half bearing.
- Proceed in the same way for removing the pistons and connecting rods of the remaining cylinders.
- Remove the tool no. 1. 860.815.000 used for turning the crankshaft.
5. Slacken the fastening screws and remove the crankcase rear cover with incorporated oil seal.
- Check that the crankshaft end float is within the specified limits using a magnetic base with dial gauge.

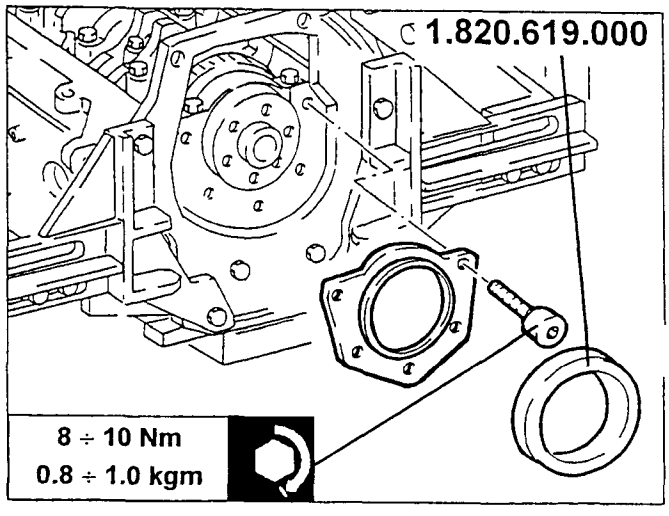
Crankshaft end float
0.049 ÷ 0.211

- If the crankshaft end float is not within the specified limits, when reassembling grind the seat on the crankcase and use suitably oversized half thrust rings.
6. Slacken the fastening screws and remove the main bearing caps.
7. Remove the lower main half bearings.
8. Remove the crankshaft.

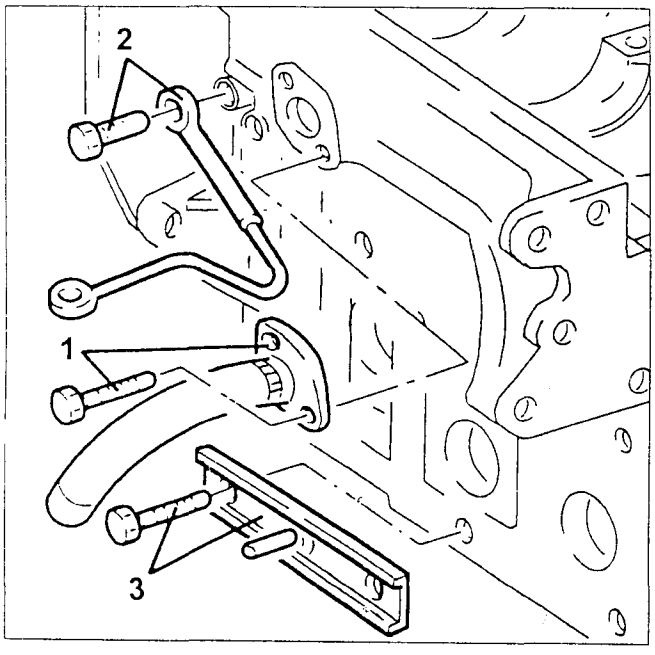
9. Slacken the fastening screws and remove the phonic wheel from the crankshaft.
10. Remove the upper main half bearings.
11. Remove the half thrust rings.
12. Slacken the fastening screws and remove the jets for cooling the pistons from the crankcase.
13. Slacken the fastening screw and remove the rpm and timing sensor.
14. Remove the minimum engine oil pressure warning light sensor.



When refitting the crankcase rear cover with incorporated oil seal ring use tool no. 1.820.619.000 for centering the oil seal.



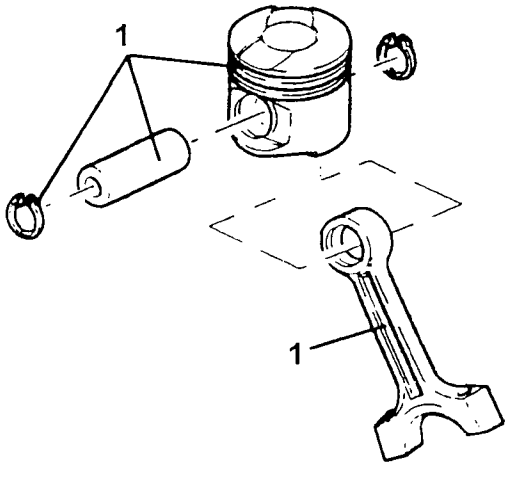
1. Loosen the fastening screw and remove the flange and turbo compressor oil return pipe.
2. Loosen the fitting and remove the turbo compressor oil delivery pipe.
3. Loosen the fastening screws and remove the turbo compressor bracket.



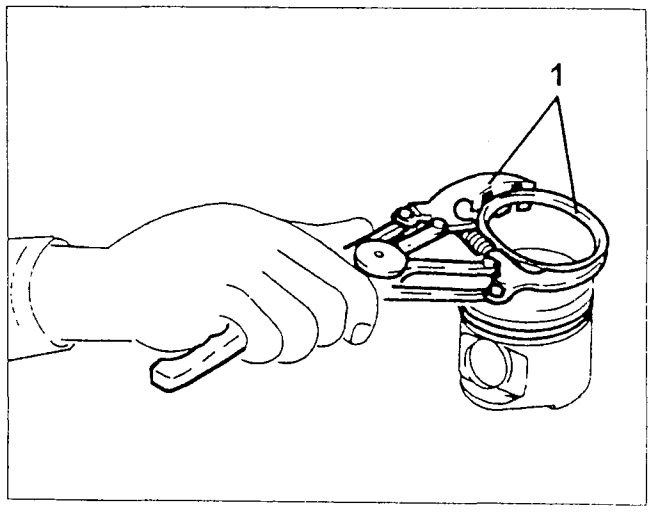
- Turn the crankcase by 90° on the overhaul stand.
- Loosen the screws and remove the crankcase from the bracket then place it on a specific stand.
- Loosen the fastening screws and remove the flywheel protection.

CONNECTING ROD - PISTON REMOVAL

1. Remove the washers, remove the pin and separate the connecting rod from the piston.



1. Remove the gas rings with a suitable tool.

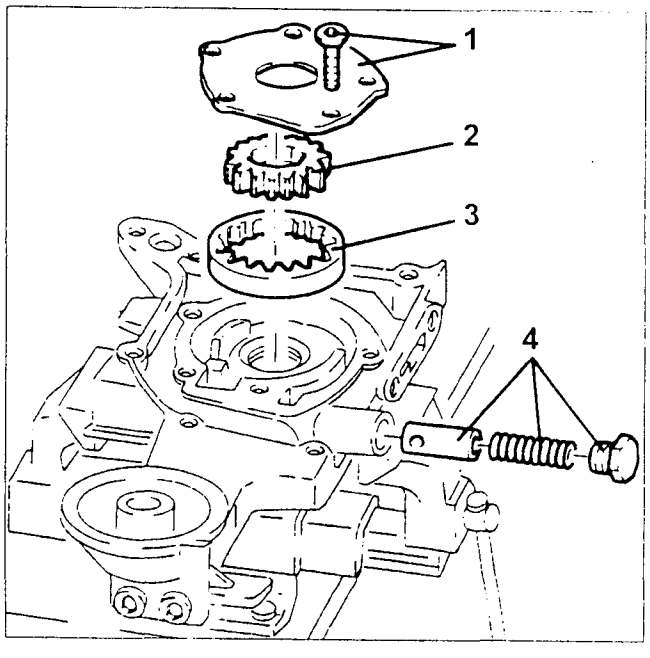


OIL PUMP DISASSEMBLY

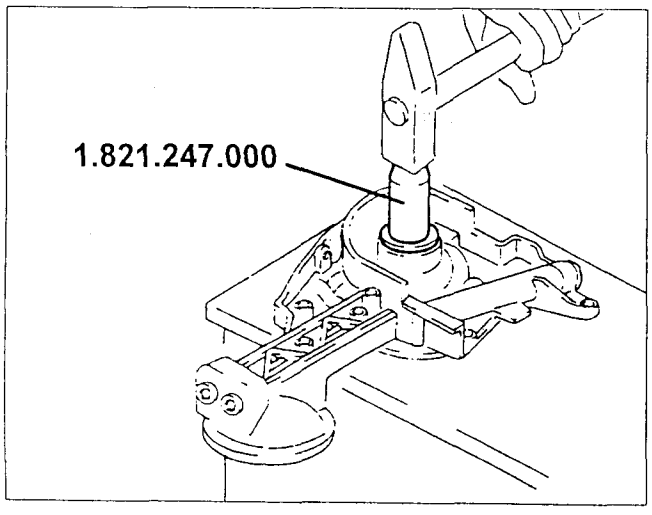
- Loosen the fastening screws and separate the suction device from the oil pump.
1. Loosen the fastening screws and remove the oil pump cover.
2. Remove the drive gear.
3. Remove the driven gear.

When refitting the oil pump, manually turn the gears to make sure they turn without seizing.

4. Remove the cap and remove the oil pressure limiting valve.
- Remove the crankshaft front oil seal.



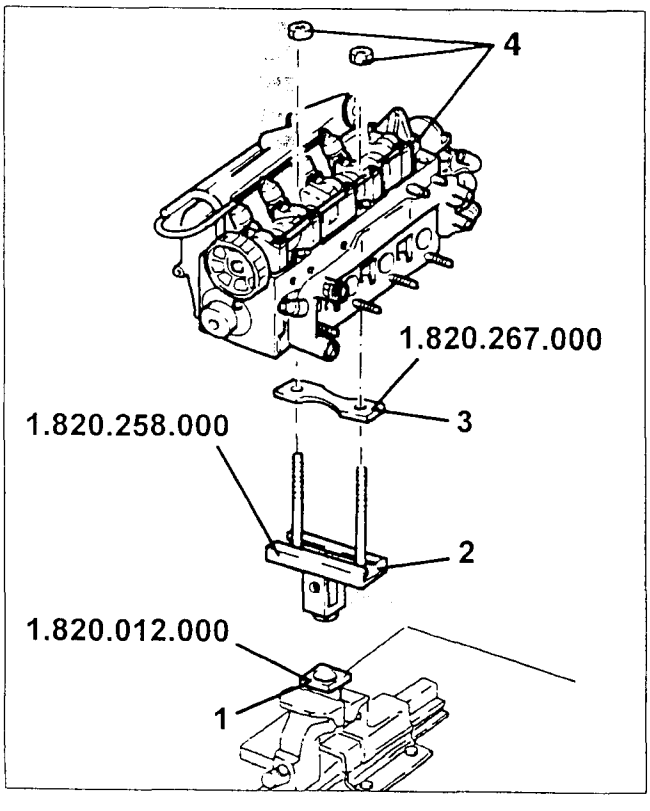
When refitting, insert a new crankshaft front oil seal with tool no. 1.821.147.000.



CYLINDER HEAD DISASSEMBLY

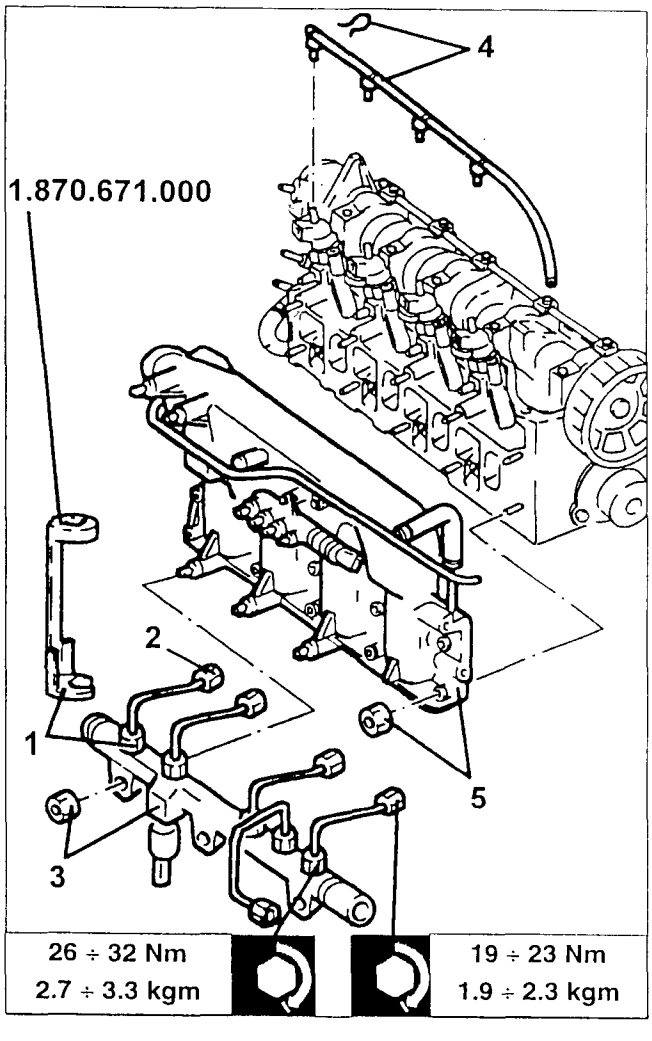
PRELIMINARY OPERATIONS

1. Position stand no. 1.820.012.000 in a vice.
2. Fit tool no. 1.820.258.000.
3. Fit shim no. 1.820.267.000.
4. Position the cylinder head on the bracket and fasten the respective nuts.



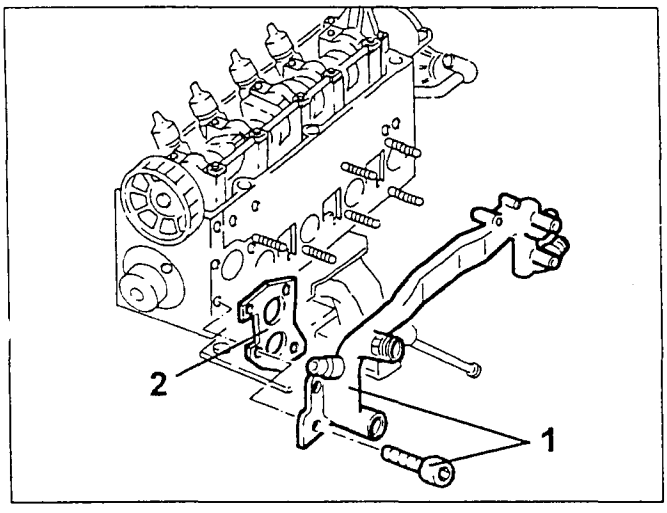
INTAKE MANIFOLD REMOVAL

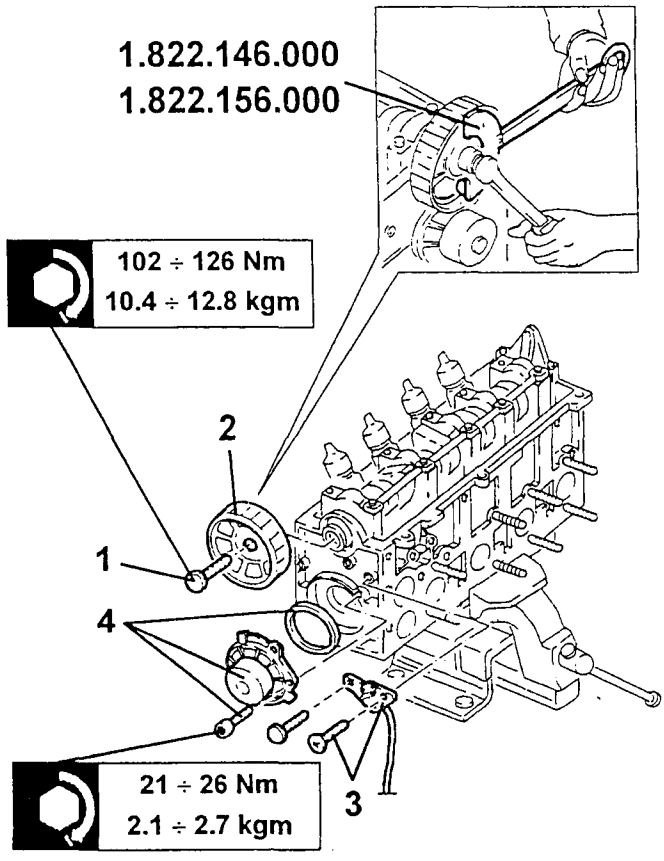
1. Loosen the fuel manifold- injector fittings on manifold side with tool no. 1.870.671.000.
2. Loosen the fuel manifold-injector fitting on injector side with a suitable tool.
3. Loosen the nuts and remove the single fuel manifold with pipes and fuel pressure sensor.
4. Remove the retainers and remove the fuel return pipe for injector lubrication.
- Loosen the nuts and disconnect the pre-heat glow plug power wiring.
- Disconnect the expansion reservoir coolant return pipe from the thermostat.
5. Loosen the fastening nuts and remove the complete air intake manifold.



REMOVING THE STIFF WATER PUMP FLUID INLET PIPE

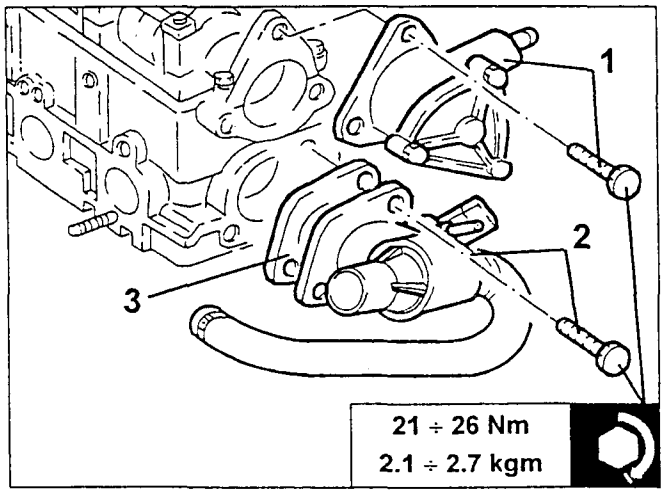
- Disconnect the delivery pipe to the pump stiff inlet pipe.
1. Slacken the fastening screws and remove the stiff water pump inlet pipe.
2. Remove the seal.





REMOVING THE WATER PUMP

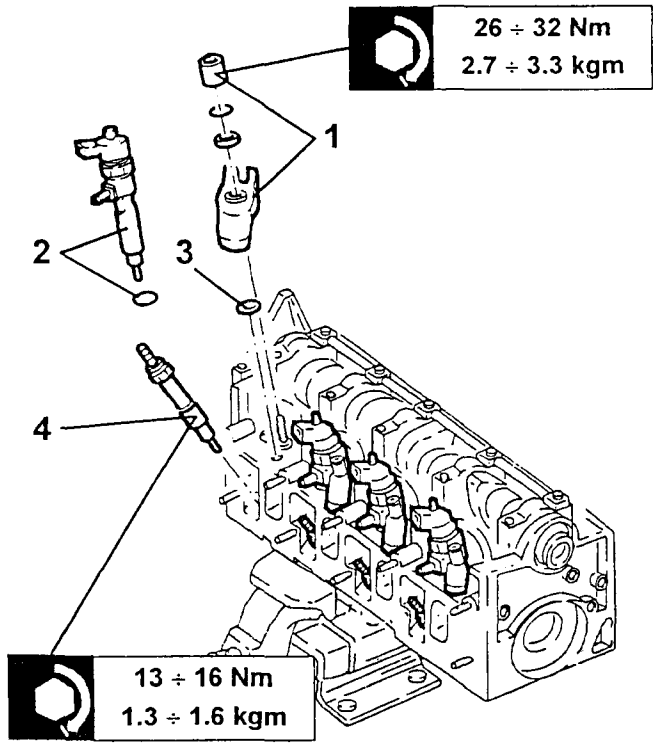
1. Slacken the fastening screws and remove the vacuum pump complete with O-Ring.
2. Slacken the fastening screws and remove the thermostat complete with pipe and sensors.
3. Remove the seal.



1. Slacken the screw of the driven toothed pulley using tools no. 1.822.146.000 and no. 1.822.156.000.
2. Remove the driven toothed pulley.
3. Slacken the fastening screws and remove the cam angle sensor.
4. Slacken the fastening screws and remove the water pump complete with O-Ring.

REMOVING THE INJECTORS

1. Slacken the fastening nuts and remove the injector brackets.
2. Remove the injectors complete with seal.
3. Remove the injector bracket support pads.
4. Remove the glow plugs.

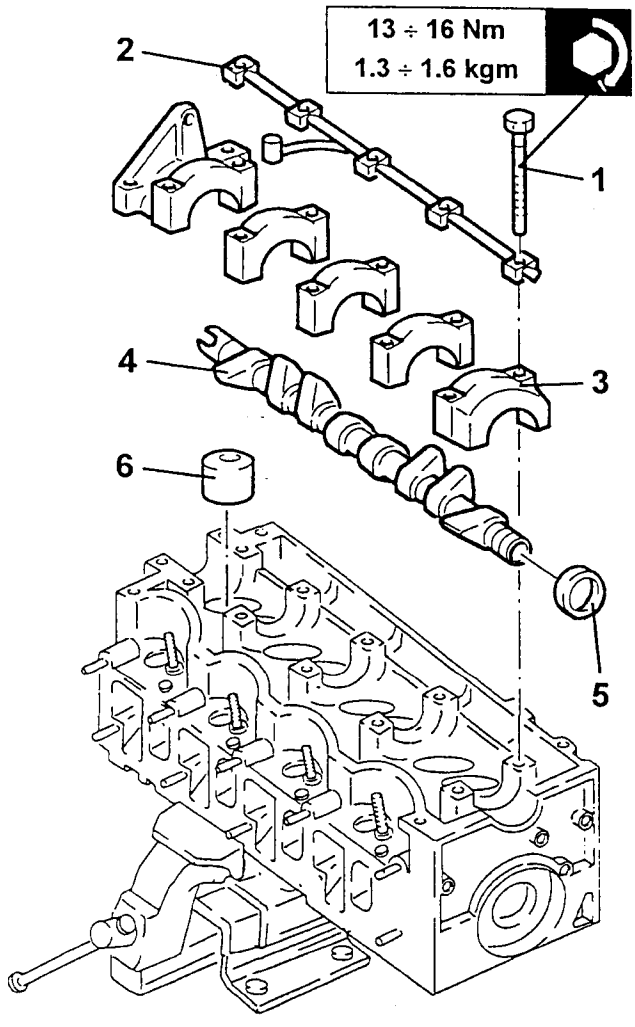


REMOVING THE CAMSHAFT

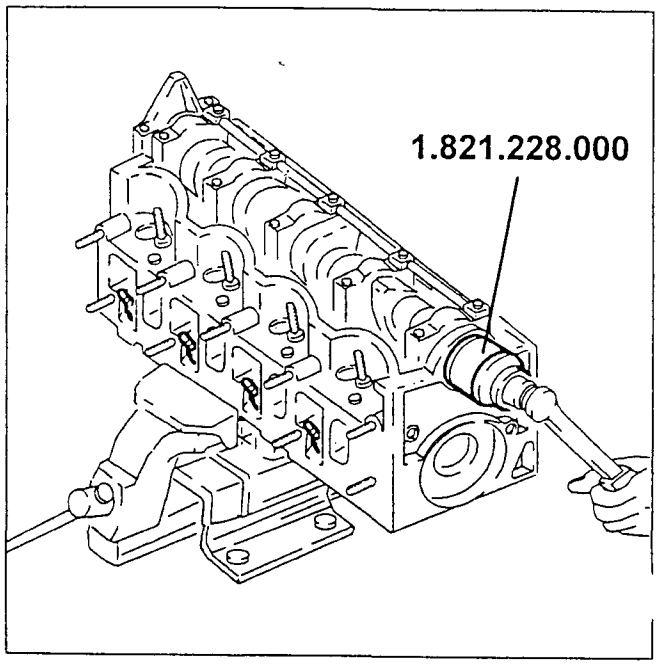
- Check that the camshaft end float is within the specified limits using a dial gauge.

Camshaft end float
0.100 ÷ 0.230 mm

- If the camshaft end float is not within the specified limits, when reassembling the cylinder head change the worn parts.
1. Slacken the camshaft cap screws.
2. Remove the camshaft support lubrication pipe.
3. Remove the camshaft caps.
4. Remove the camshaft.
5. Remove the camshaft front oil seal.
6. Remove the cups complete with valve clearance adjustment pads.

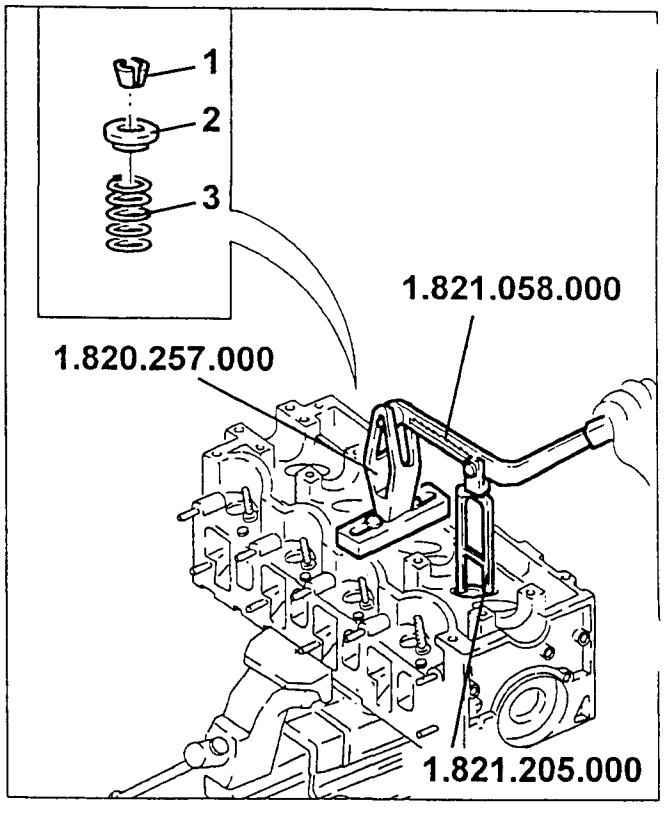


When reassembling insert a new camshaft front seal, using tool no. 1.821.228.000.

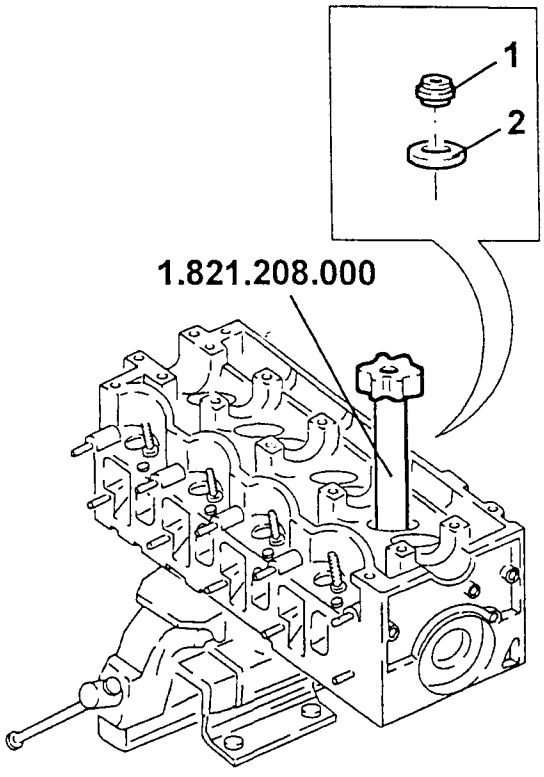


REMOVING THE VALVES

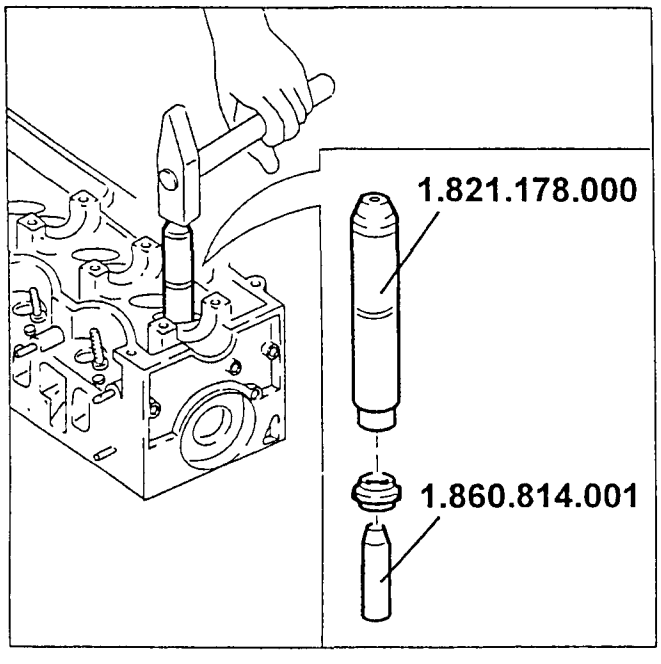
- Remove the cylinder head from the support tools.
- Place a suitable wooden board between the support tools and the cylinder head to support the valves.
- Refit the cylinder head on the support tools and fasten it with the nuts.
1. Remove the half tapers using support no. 1.820.257.000, lever no. 1.821.058.000 and cage no. 1.821.205.000.
2. Remove the valve upper plates.
3. Remove the valve springs.



1. Remove the valve guide oil seals using tool no. 1.821.208.000.
2. Remove the valve lower plates.

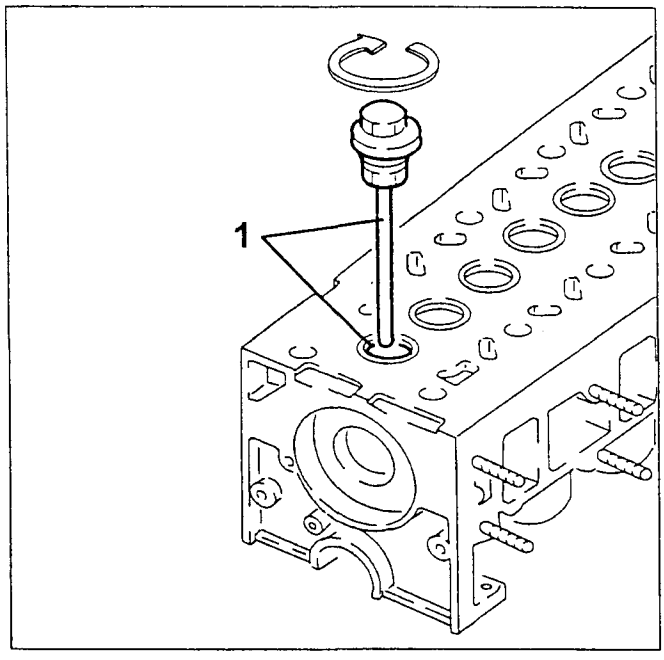


When reassembling insert new valve guide oil seals, using tools no. 1.860.814.001 and no. 1.821.178.000.

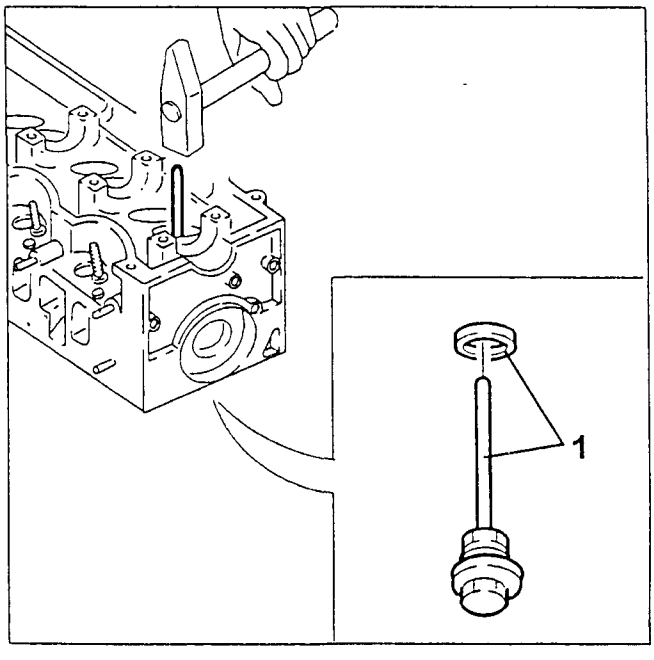


REPLACING VALVE SEATS AND VALVE GUIDES

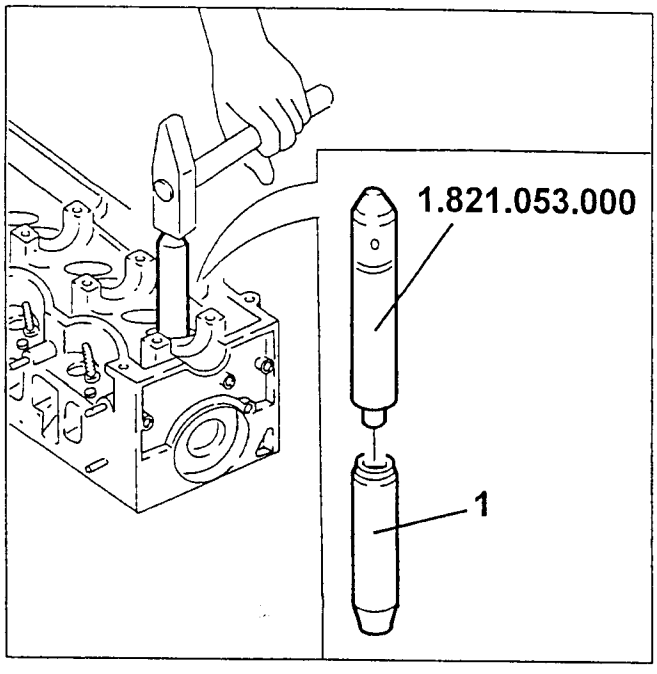
- Remove the cylinder head from the support tools and retrieve the valves.
- Place the cylinder head on the work bench.
1. Thread the special puller tool on the valve seat.



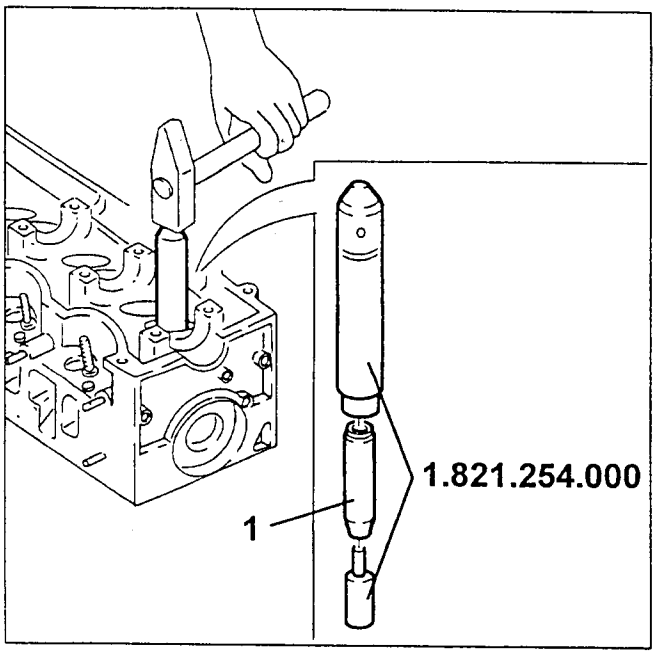
- Overturn the cylinder head on the work bench.
1. Remove the valve seat using the puller tool.
- Proceed in the same way on the remaining valve seats.



1. Remove the valve guides using tool no. 1.821.053.000.



1. Install new valve guides using tool no. 1.821.254.000.



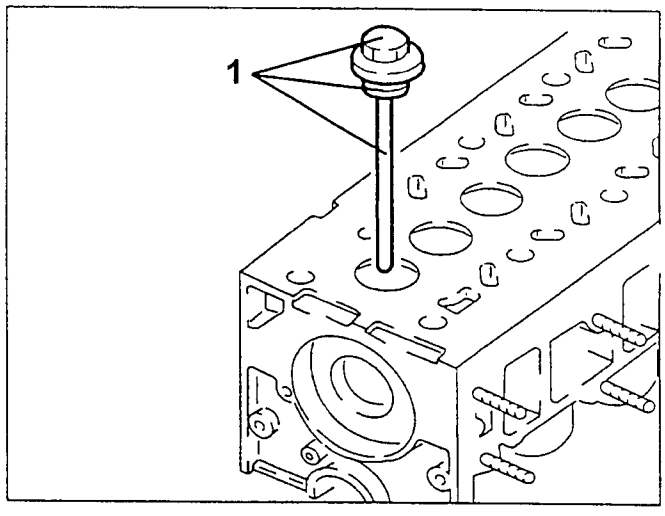
- Bore the inside diameter of the valve guides to the specified value.

Valve guide inside diameter
8.022 ÷ 8.040 mm

- Check that the outside diameter of the seats of the valves to be installed is within the specified limits.

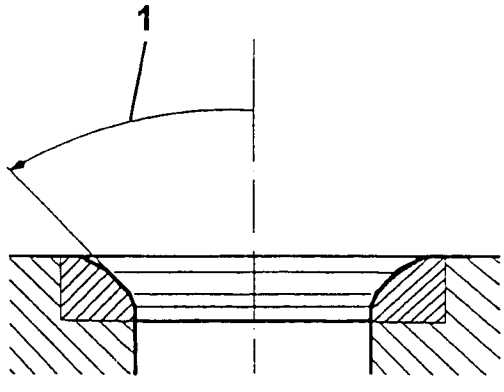
Valve seat outside diameter	
Intake	36.135 ÷ 36.150 mm
Exhaust	35.142 ÷ 35.157 mm

1. Install the valve seats using suitable equipment.



1. Grind the valve seats to the specified dimension.

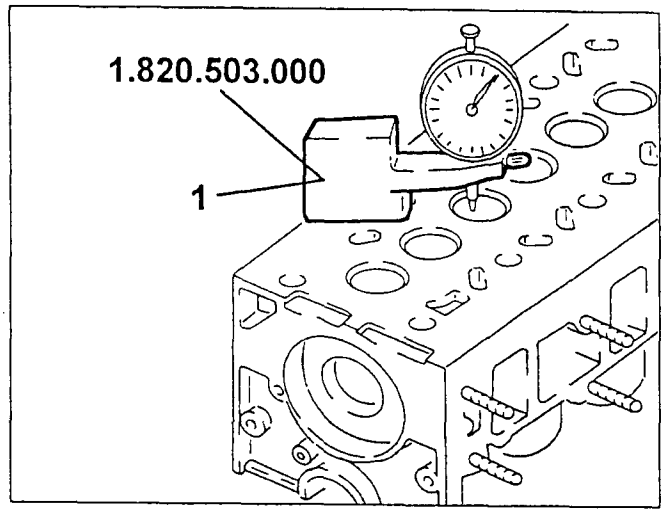
Angle of contact band with valve
90° ± 20'



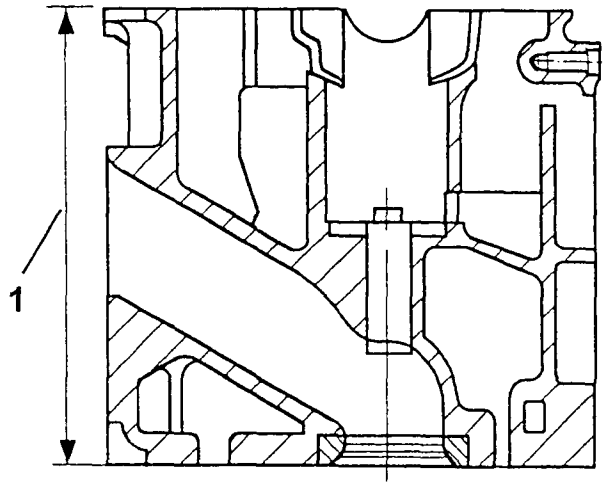
- Grind the valve seats using suitable equipment.
- Assemble the valves temporarily.

1. Check that the embedding of the valves from the surface of the cylinder head is within the specified limits by measuring using tool no. 1.820.503.000 complete with dial gauge.

Valve embedding from cylinder head surface
0.1 ÷ 0.5 mm



If the embedding of the valves from the cylinder head surface is not within the specified limits, grind the valve seats again.



CHECKING THE VALVES

- Check that the valves have no signs of scoring or seizing.
- Check that the valve stem diameter is within the specified limits; if not, replace the worn valves.

Valve stem diameter
7.974 ÷ 7.992 mm

CHECKING AND INSPECTING CYLINDER HEAD

CHECKING THE CYLINDER HEAD LOWER SURFACE

- Remove all traces of the old seal from the lower surface of the cylinder head.
- Check that the flatness of the cylinder head lower surface is within the specified limits.

Maximum error of flatness of cylinder head lower surface
0.1 mm

1. If the flatness of the cylinder head lower surface is not within the specified limits, grind the cylinder head lower surface without exceeding the minimum permissible height.

Minimum permissible height of cylinder head after refacing
140.85 ÷ 141.15 mm

CHECKING THE CUPS

- Check that the outside diameter of the cups is within the specified limits; if not, replace the worn parts.

Outside diameter of valve cups
36.975 ÷ 36.995 mm

- Check that the diameter of the cup seats is within the specified limits; if not, replace the cylinder head.

Diameter of valve cup seats
37.000 ÷ 37.025 mm

CHECKING VALVE SPRINGS

- Check that the free length of the springs is within the specified limits.

Valve spring free length
53.9 mm

- Use a torque meter to check that the specifications of the valve springs are within the specified limits; if not, replace the strained parts.

Spring length (mm)		Check load N (kg)
With valve closed	36	367 ÷ 396 (37.4 ÷ 40.4)
With valve open	26.5	560 ÷ 610 (57.1 ÷ 62.2)

CHECKING THE CAMSHAFT

- Check that the diameter of the camshaft pins is within the specified limits; if not, replace the worn camshaft.

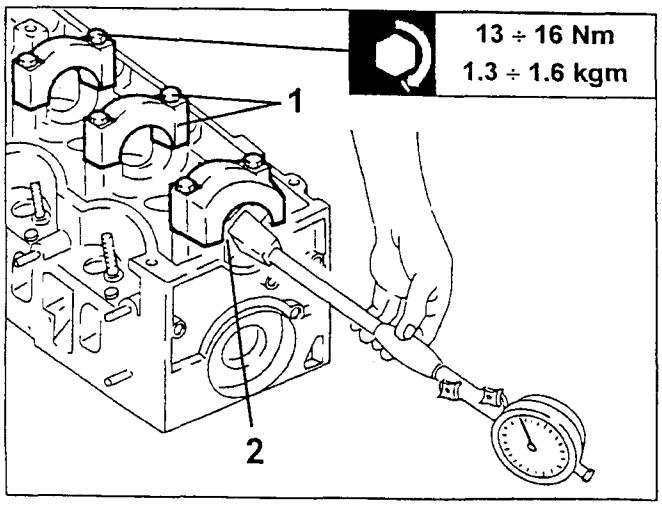
Diameter of camshaft pins
26.000 ÷ 26.015 mm

- Check that the nominal lift of the camshaft cams is within the specified limits; if not, replace the worn camshaft.

Nominal cam lift
8.5 mm

1. Assemble the camshaft caps on the cylinder head and tighten the screws to the specified torque.
2. Check that the diameter of the camshaft supports is within the specified limits; if not, replace the cylinder head.

Diameter of camshaft supports
26.045 ÷ 26.070 mm



CHECKING AND INSPECTING THE CRANKCASE

CHECKING THE SYLINDER HEAD RESTING SURFACE

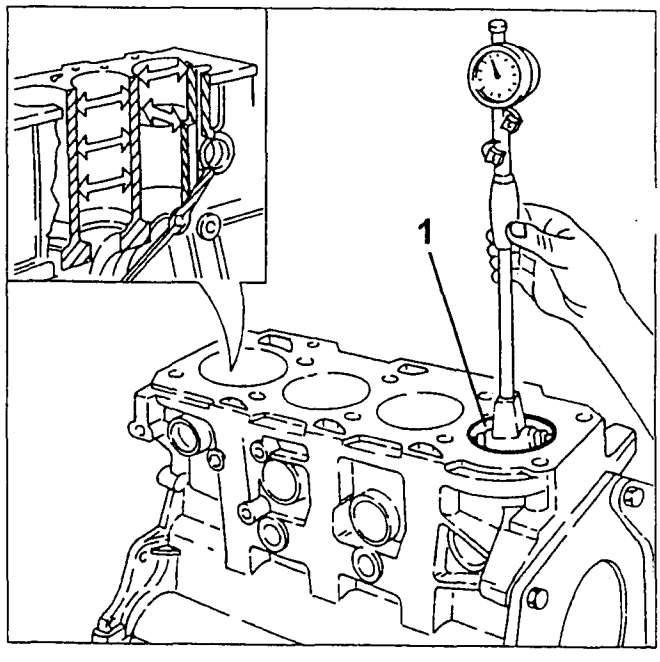
- Check the cylinder head resting surface for cracks or surface scores.
- Check that the flatness of the cylinder head resting surface is within the specified limits; if not, grind the resting surface of the cylinder head.

Flatness of cylinder head resting surface
< 0.1 mm

CHECKING THE CYLINDER LINERS

1. Measure the diarneter of the cylinder liners as illustrated.

Cylinder liner inside diameter	
Class A	82.000 ÷ 82.010 mm
Class B	82.010 ÷ 82.020 mm
Class C	82.020 ÷ 82.030 mm



- Check that the cylinder liner taper is within the specified limits.

Cylinder liner taper
< 0.005 mm

- Check that the cylinder liner ovalisation is within the specified limits.

Cylinder liner ovalisation
< 0.05 mm

- If the cylinder liner diameter is not within the specified limits, bore the cylinder liners according to the specified oversizes.

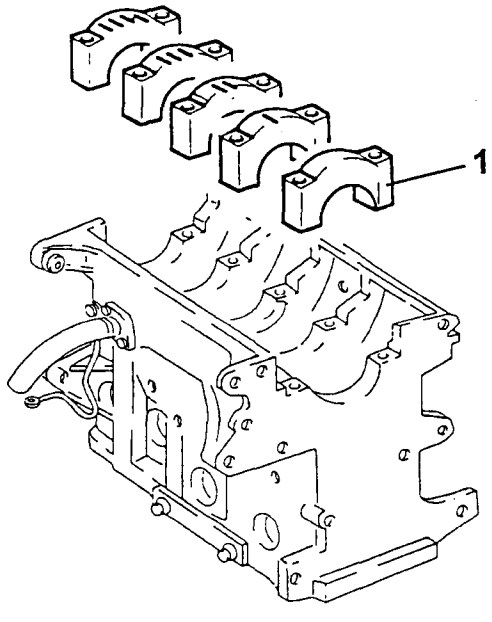
NOTE: In the case of boring all the cylinder liners must have the same oversize.

Cylinder liner oversize
0.1 mm

CHECKING THE MAIN BEARING PINS

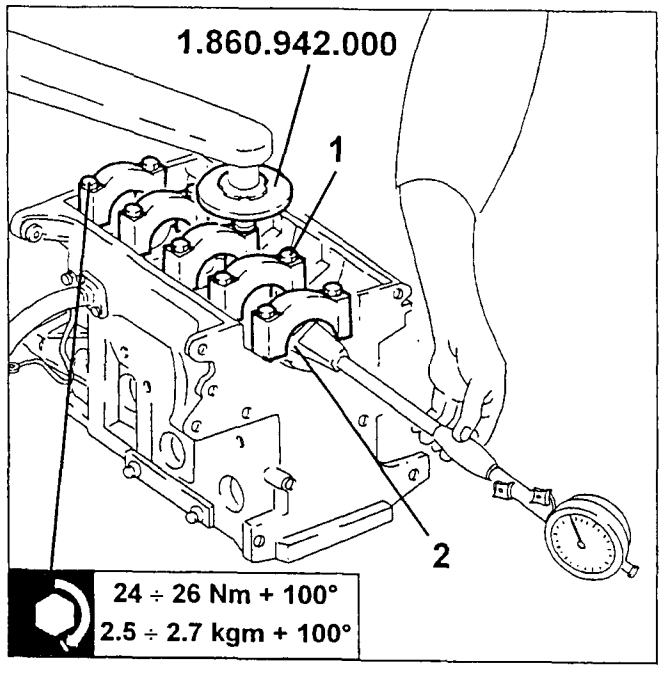
1. Assemble the main bearing caps.

NOTE: The main bearings are notched consecutively (from 0 to four starting from the engine front) to define their assembly position.



1. Tighten the main bearing cap screws to the specified torque using tool no. 1.860.942.000 for angle tightening.
2. Check that the diameter of the main bearing pin seats is within the specified limits.

Main bearing pin seat diameter
63.691 ÷ 63.732 mm



CHECKING THE CRANKSHAFT

- Check that the lubricating ducts of the crankshaft are not scaled or clogged.
- Check that the main bearing pin diameter is within the specified limits.

Main bearing pin diameter	
Class A	59.994 ÷ 60.000 mm
Class B	59.988 ÷ 59.994 mm
Class C	59.982 ÷ 59.988 mm

- If the main bearing pin diameter is not within the specified limits, grind them according to the specified undersize.

Main bearing pin undersizes
0.127 mm

- Check that the connecting rod pin diameter is within the specified limits.

Diameter of connecting rod pins	
Class A	50.799 ÷ 50.805 mm
Class B	50.793 ÷ 50.799 mm
Class C	50.787 ÷ 50.793 mm

- If the connecting rod pin diameter is not within the specified limits, grind them according to the specified undersize.

Undersizes of connecting rod pins
0.127 mm

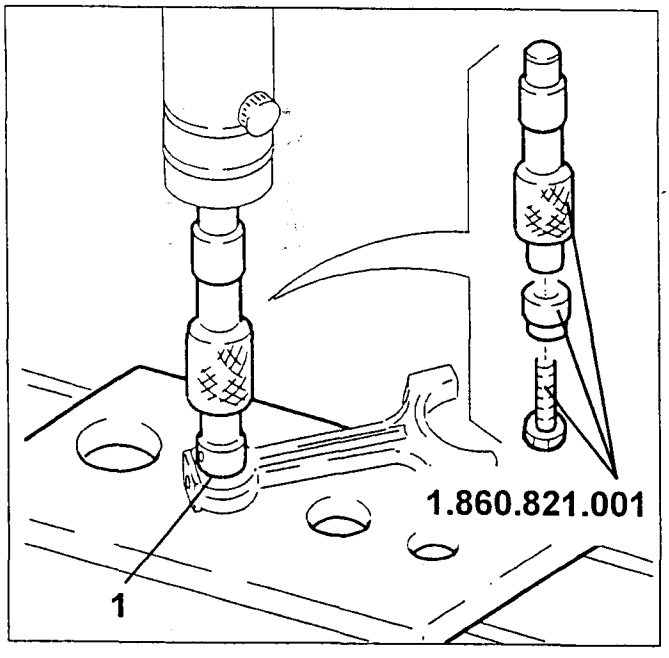
CHECKING AND IF NECESSARY REPLACING SMALL END BUSHES

- Check that the inside diameter of the small end bushes is within the specified limits.

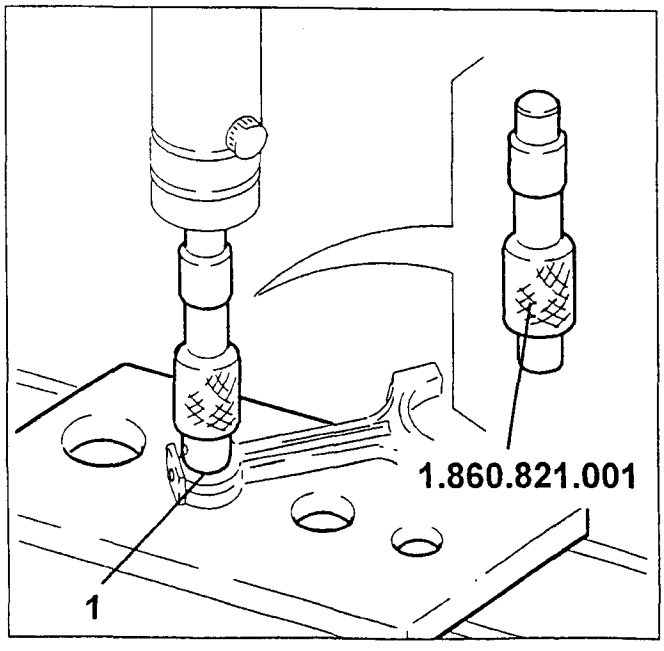
Inside diameter of small end bush
26.006 ÷ 26.012 mm

- If the diameter of the small end bushes is not within the specified limits, replace the worn bushes as described below.

1. Remove the small end bush under a hydraulic press and using puller tool no. 1.860.821.001.

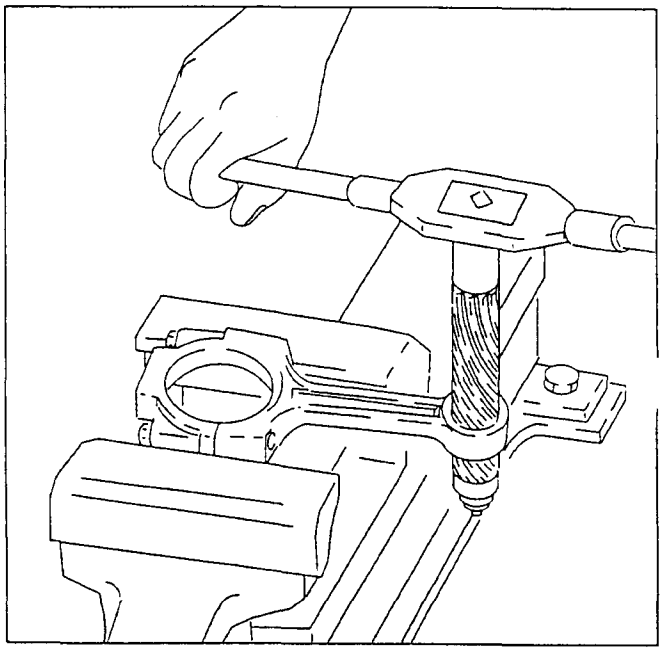


1. Install a new bush in the connecting rod small end under a hydraulic press and using installing tool no. 1.860.821.001 and a suitable reaction plate.



- Bore the inside diameter of the small end bush to the specified limits.

Inside diameter of small end bush
26.006 ÷ 26.012 mm



CHECKING THE PISTONS

- Check that the inside diameter of the piston bushes is within the specified limits; if not, replace the piston complete with seal rings, gudgeon pins and bushes.

Inside diameter of bushes in pistons
25.999 ÷ 26.004 mm

- Check that the outside diameter of the piston gudgeon pins is within the specified limits; if not, replace the worn gudgeon pins.

Outside diameter of piston gudgeon pins
25.982 ÷ 25.988 mm

- Insert the seal rings in the cylinder liner and check that the gap between the ends is within the specified limits; if not, change the rings.

Seal ring gap	
First ring	0.25 ÷ 0.40 mm
Second ring	0.25 ÷ 0.50 mm
Oil scraper ring	0.25 ÷ 0.50 mm

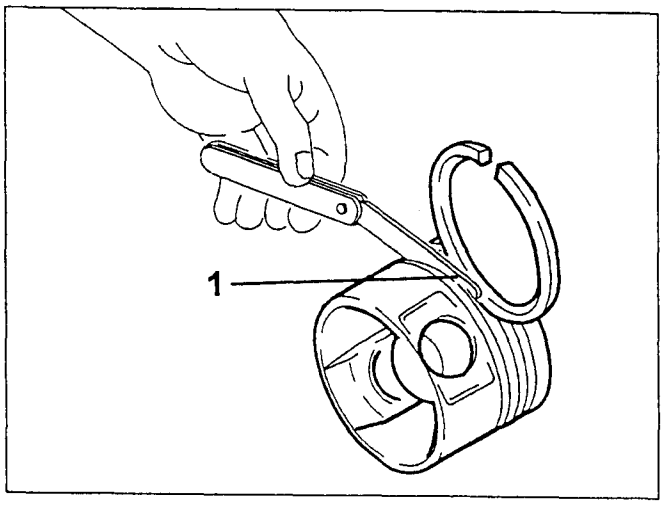
- Check that the outside diameter of the pistons is within the specified limits; if not, replace the piston complete with seal rings and gudgeon pin.

Outside diameter of pistons	
Class A	81.783 ÷ 81.797 mm
Class B	81.793 ÷ 81.807 mm
Class C	81.803 ÷ 81.817 mm

NOTE: The outside diameter of the piston should be measured at right angles to the gudgeon pin axis and 8 mm from the lower edge of the skirt.

1. Check that the end floats between the second ring/scraper ring and their seats on the piston are within the specified limits.

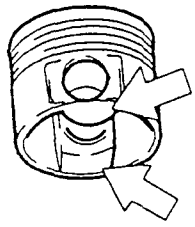
Piston ring end float	
Second ring	0.020 ÷ 0.060 mm
Oil scraper ring	0.030 ÷ 0.065 mm



- Check that the difference in weight between the pistons is within the specified limits.

Difference in weight between pistons
± 5 g

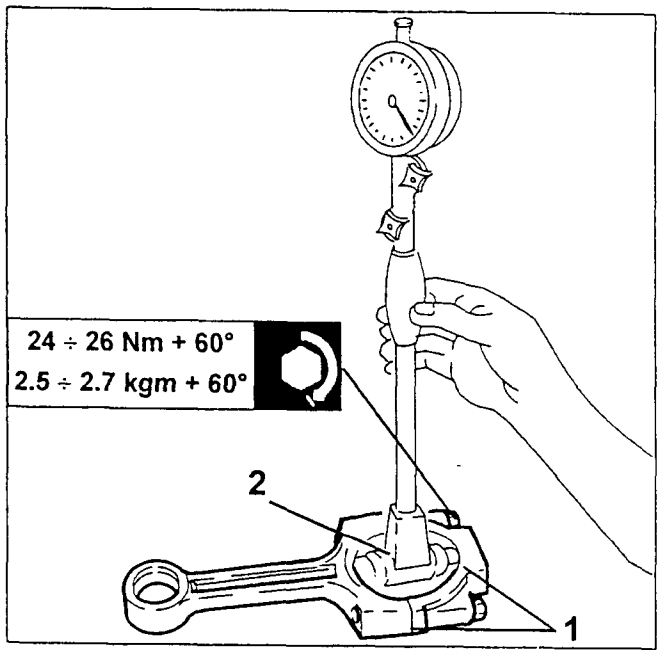
NOTE: The arrows indicate the areas from which it is possible to remove material to obtain an equal weight.



CHECKING THE CONNECTING RODS

1. Fit the caps on the connecting rods and fasten them with their screws to the specified torque.
2. Check that the diameter of the connecting rod big end is within the specified limits; if not, replace the connecting rods.

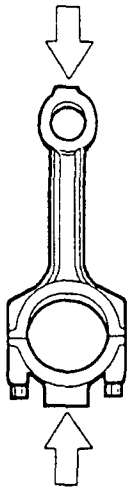
Inside diameter of big end
53.883 ÷ 53.923 mm



- Check the squaring of the connecting rods using suitable equipment; if squaring is less than perfect, replace the connecting rod.
- Check that the difference in weight between the connecting rods complete with half bearings, caps and screws is within the specified limits.

Difference in weight between connecting rods
± 2.5 g

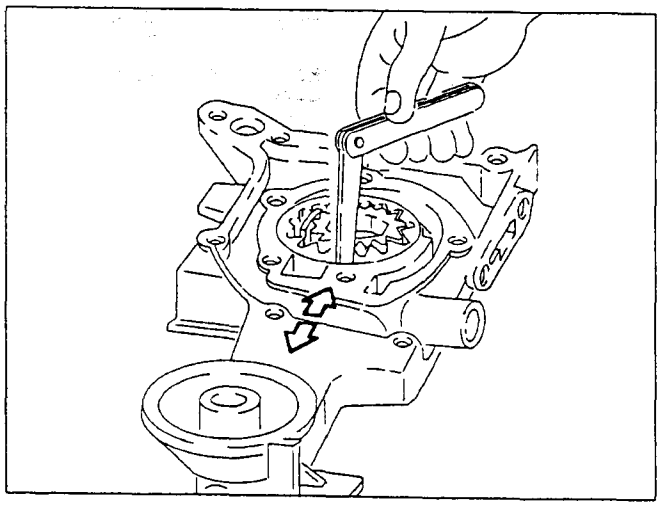
NOTE: The arrows indicate the areas from which it is possible to remove material to obtain an equal weight.



CHECKING AND INSPECTING THE OIL PUMP

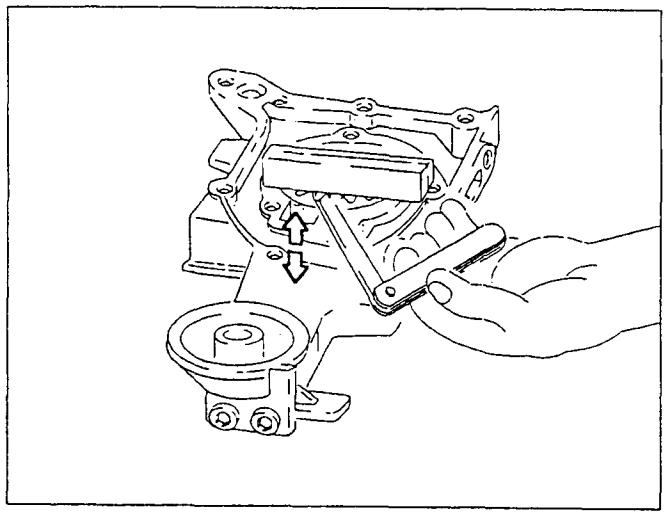
- Check that the radial clearance between the pump casing and the driven gear is within the specified limits; if not, replace the oil pump complete.

Radial clearance between oil pump casing and driven gear
0.080 ÷ 0.186 mm



- Check that the end float between the pump cover resting surface and the gear upper side is within the specified limits; if not replace the complete oil pump.

End float between oil pump cover resting surface and gear upper side
0.025 ÷ 0.070 mm



- Check that the height of the spring for the oil pressur limiting valve is within the specified limits; if no replace the spring.

Spring length (mm)	Check load N (kg)
35	117 ÷ 125 (11.9 ÷ 12.7)

REASSEMBLY INSTRUCTIONS

For reassembly operations, reverse the sequence of the operations followed for removal, unless otherwise specified in the instructions given below.

Checking and adjusting valve clearance

- Check that the valve clearance in the closed position, is within the specified limits.

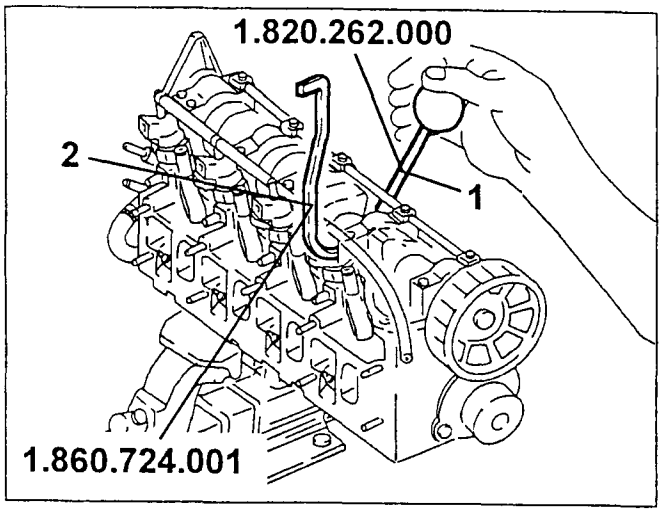
Valve clearance (with valves in closed position)	
Intake	0.25 ÷ 0.35 mm
Exhaust	0.30 ÷ 0.40 mm

If the valve clearance is not within the specified limits, proceed as follows.

1. Lower the tappet in question using tool no. 1.820.262.000.
2. Assemble tool no. 1.860.724.001 to keep the tappets down.

NOTE: Direct the notches on the edge of the tappets to facilitate removal of the plate.

- Remove the valve clearance adjustment pad and replace it with another one of suitable thickness.
- Remove the tool used to keep the tappets lowered.

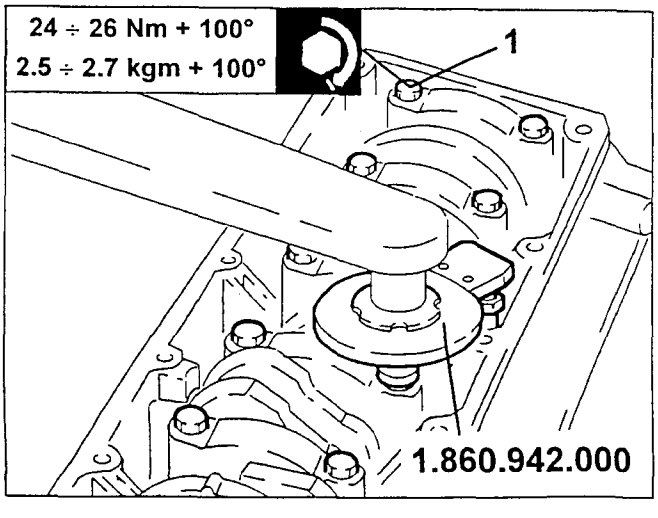


CRANKSHAFT REASSEMBLY

- After assembling the crankshaft, fit the main bearings caps complete with half bearings.

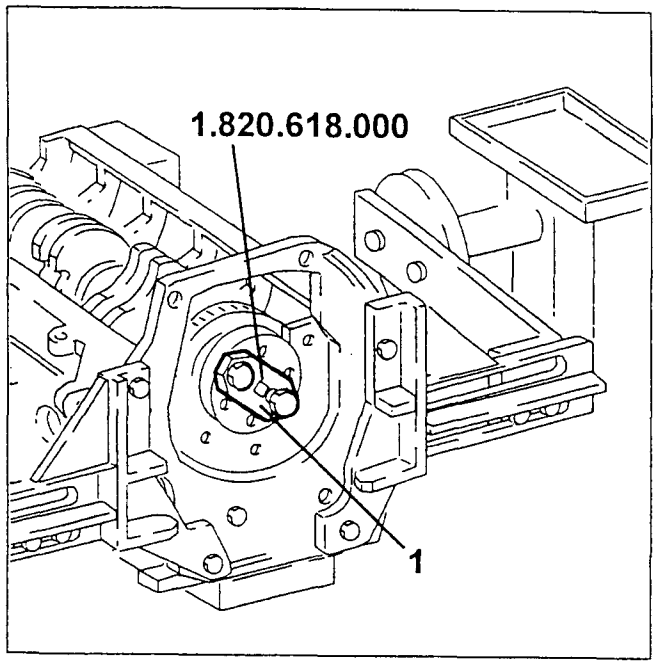
NOTE: The main bearing caps are notched consecutively (from 0 to four starting from the engine front) to define their assembly position.

1. Tighten the main bearing cap screws to the specified torque using tool no. 1.860.942.000 for angle tightening.

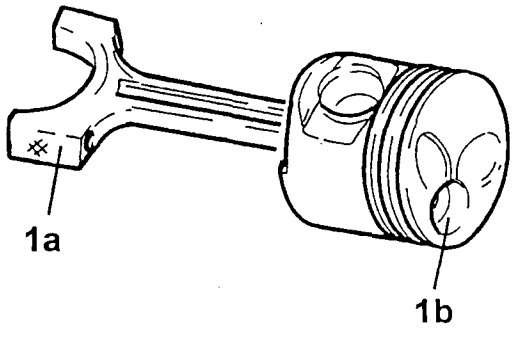


ASSEMBLING PISTONS AND CONNECTING RODS

1. Assemble tool no. 1.820.618.000 to make it possible to turn the crankshaft.



- Assemble the piston rings using a suitable tool.
1. Connect the connecting rods to the corresponding pistons so that the number stamped on the big end (1a) faces the combustion chamber (1b) machined on the piston.
- Assemble the gudgeon pins and fasten them with their circlips.



- Turn the crankshaft using the tool installed previously until the cylinder concerned reaches its B.D.C.

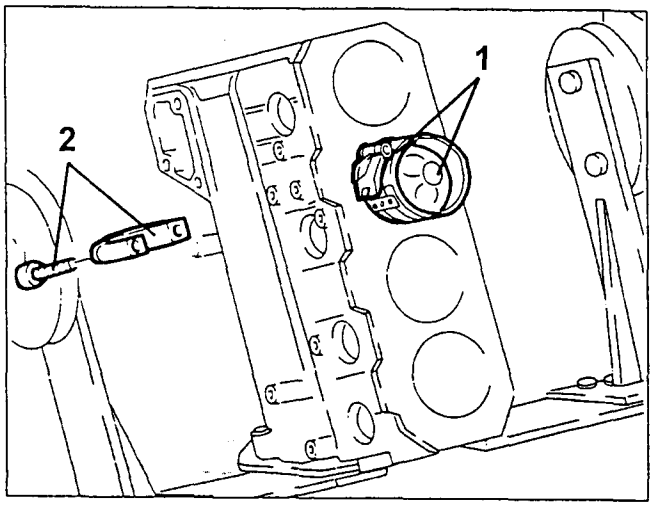
1. Assemble the connecting rod-piston set complete with half bearing using a suitable installing tool.

NOTE: The connecting rod-piston sets should be assembled in the crankcase with the combustion chamber on the piston facing towards the intake side.

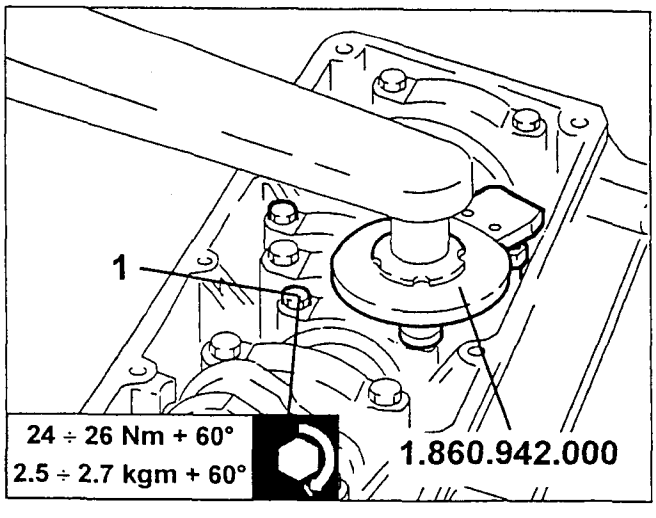
2. Assemble the connecting rod cap complete with half bearing and fasten it with its screws without locking them.

NOTE: The connecting rod caps should be assembled so that the number stamped on them points towards the same side as the one stamped on the connecting rod big end (intake side).

- Proceed in the same way to assemble the pistons and connecting rods of the remaining cylinders.

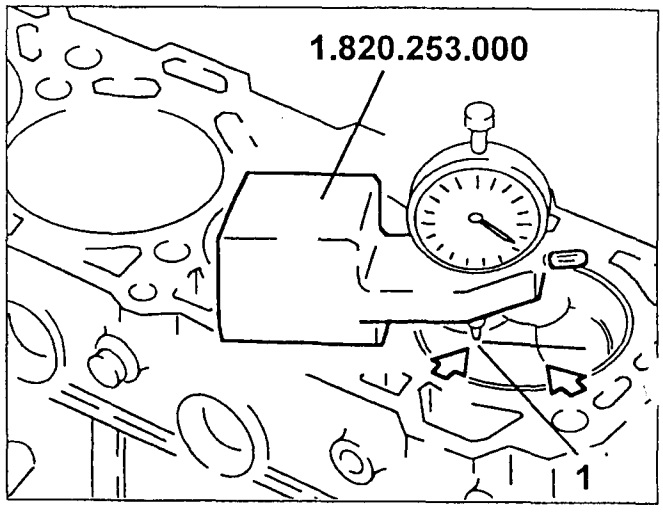


1. Tighten the connecting rod cap screws to the specified torque using tool no. 1.860.942.000 for angle tightening.



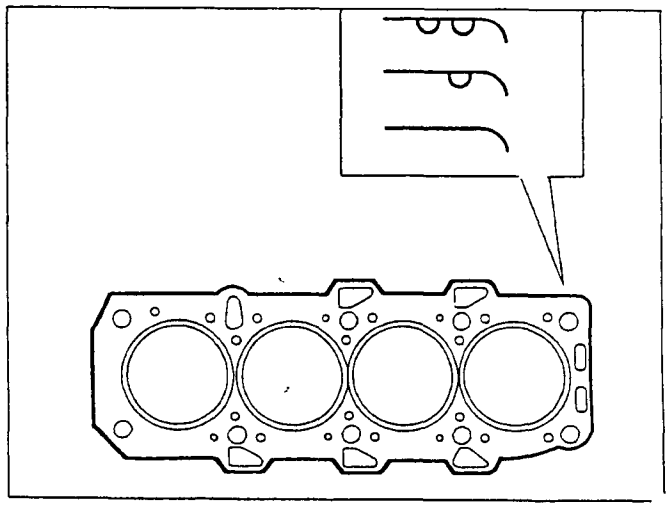
REFITTING THE CYLINDER HEAD

1. Measure the protrusion of the pistons on two points at 180°, on the gudgeon pin axis using tool no. 1.820.253.000 and calculate the average of the two values measured for each piston.



- Choose the thickness of the cylinder seal to be used, according to the maximum value between the averages of the protrusion of each single piston.

Maximum average piston protrusion	Cylinder head seal thickness to be used
0.795 ÷ 0.881 mm	1.55 ÷ 1.65 mm (no notch)
0.881 ÷ 0.967 mm	1.65 ÷ 1.75 mm (one notch)
0.967 ÷ 1.055 mm	1.75 ÷ 1.85 mm (two notches)

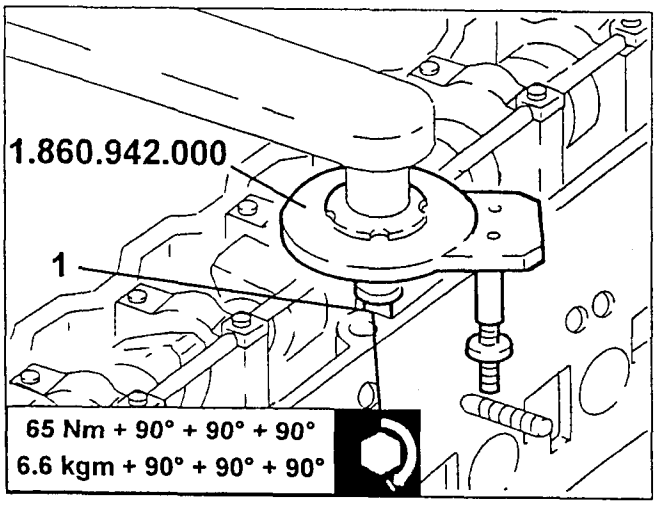


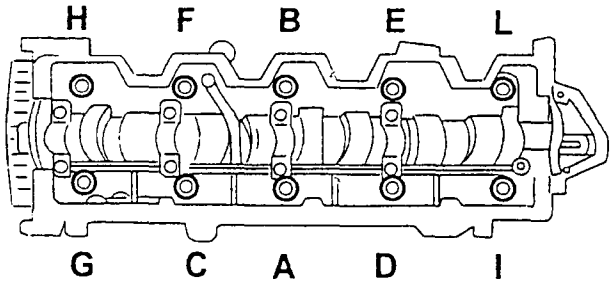
- Position the cylinder head centering bushes on the crankcase.
- Assemble the cylinder head seal of the chosen thickness.

NOTE: The cylinder head seal is of the ASTADUR type.
The material with which it is made undergoes a polymerising process when the engine is running, therefore it hardens considerably during use.
To ensure that the seal polymerises it is necessary to:
- keep the seal closed in its wrapper until assembly
- do not lubricate or soil the seal and contact surfaces with oil.

- Position the cylinder head on the crankcase.
1. Tighten the cylinder head screws to the specified torque using tool no. 1.860.942.000 for angle tightening.

NOTE: For each tightening sequence, follow the order given below.

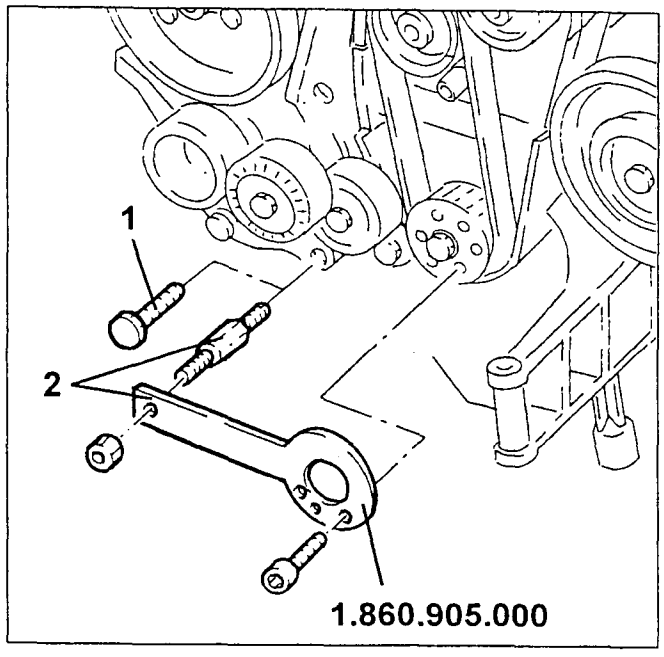




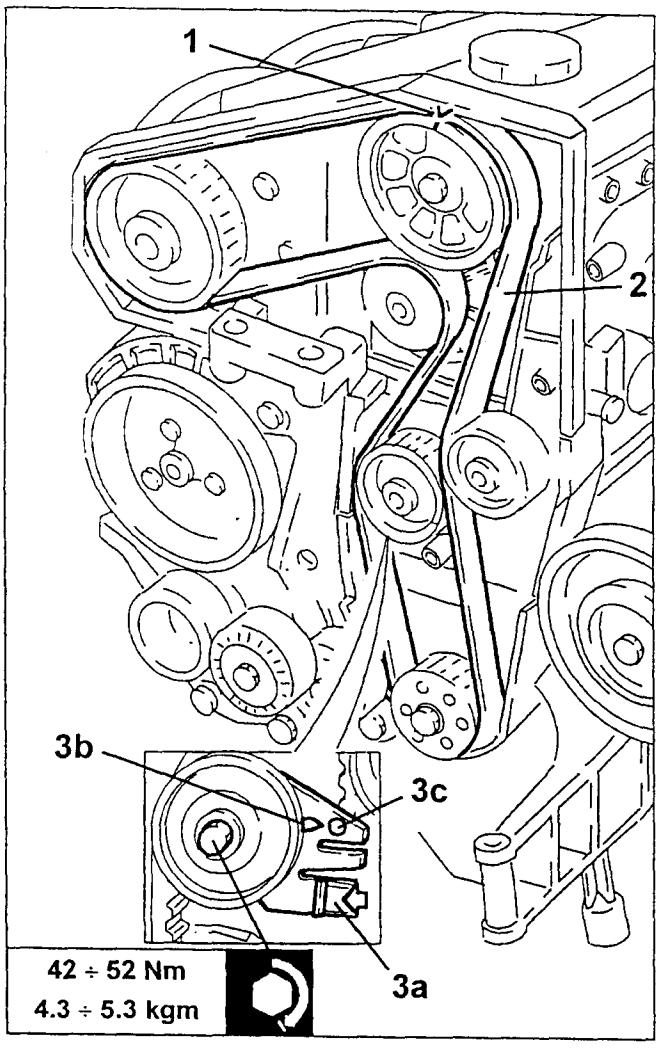
CAMSHAFT DRIVE BELT ASSEMBLY AND CHECKING VALVE GEAR TIMING

1. Remove the oil pump screw indicated.
- Temporarily assemble the camshaft toothed drive belt on the drive pulley.
2. Assemble tool no. 1.860.905.000.

NOTE: To make it possible to insert the dowel on the camshaft toothed belt drive pulley with the hole on the tool, turn the crankshaft with small movements.



1. Turn the driven toothed pulley until the timing notches coincide.
2. Completely fit the camshaft toothed drive belt.
3. Lever with a screwdriver in the hole (3a) until the index of the tensioner (3b) coincides with the reference hole (3c) and in this position, tighten the camshaft belt tensioner nut to the specified torque.
- Turn the crankshaft twice.
- Check again that the timing references coincide and also the tensioning references on the camshaft belt tensioner.



WHEN ENGINE REASSEMBLY HAS BEEN COMPLETED carry out all the checks and inspections of routine maintenance (see GROUP 00)and the checks concerning the fuel supply system and the cooling system (see GROUP 10).

CHECKING LUBRICATION CIRCUIT ELECTRIC COMPONENTS

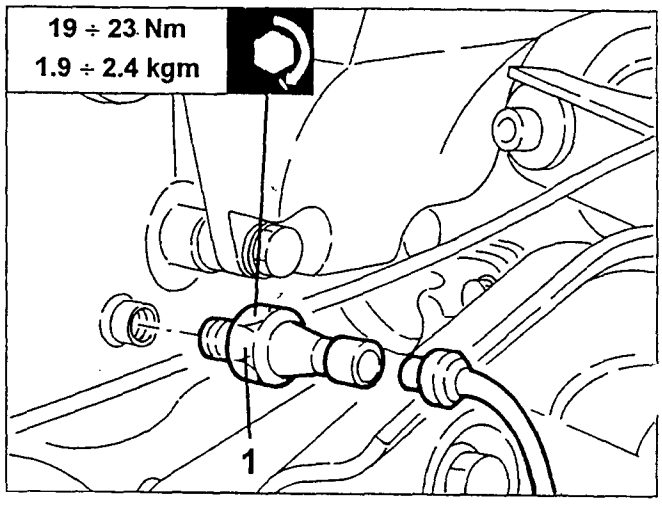
- Engine oil minimum pressure warning light

For all the other sensors and electric components located in the engine compartment, refer to the specific Groups in which they are described in detail.

ENGINE OIL MINIMUM PRESSURE WARNING LIGHT SENSOR

1. Check the setting of the engine oil minimum pres ure warning light sensor. If the values are not as specified, replace the sensor.

Contact opening/closing pressure	0.2 ÷ 0.5 bar



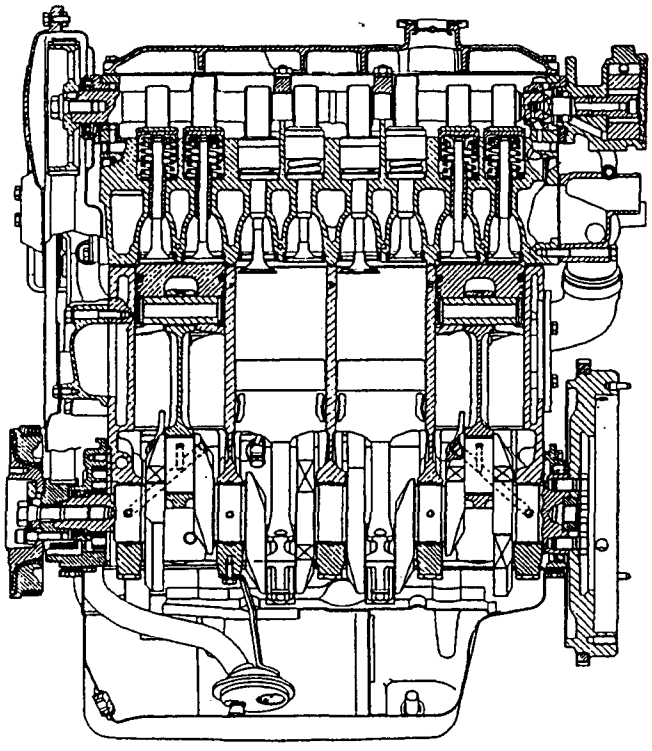
INDEX

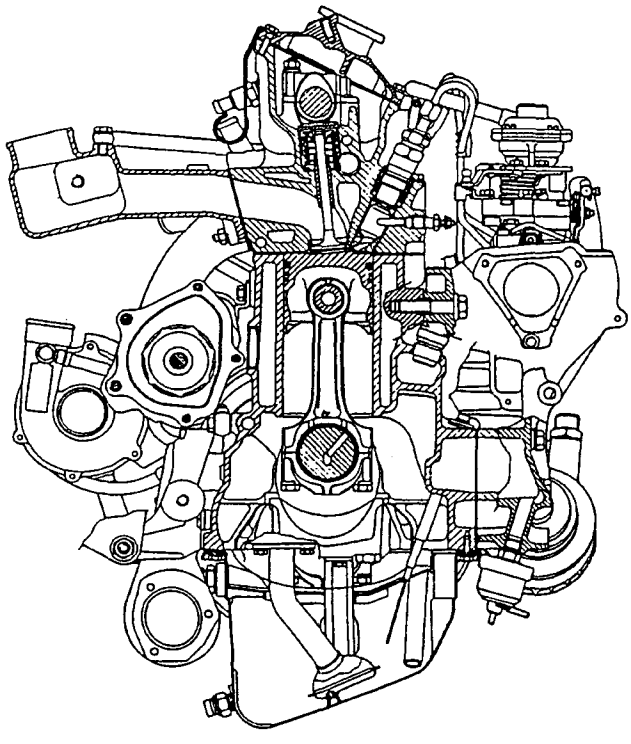
GENERALIES
- Description 1
- Lubrication 4

OVERHAULING
- Introduction 7
- Engine dis - assembly 7
- Disassembly of cylinder heads 17
- Cylinder head checks and inspections 19
- Engine block checks and inspections 23
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- Inspection of lubrication circuit electrical components 33

DESCRIPTION

The engine is of the four cylinder in line type with onhead camshaft timing controlled by a drive belt, two valves per cylinder, turbine type air boosting system IHI, and indirect injection with low turbulence combustion prechamber.
The clutch - gearbox unit is connected behind the engine and forms an integral part of the engine unit.
It is front mounted and set transversally at an inclination of 18°30' forwards.

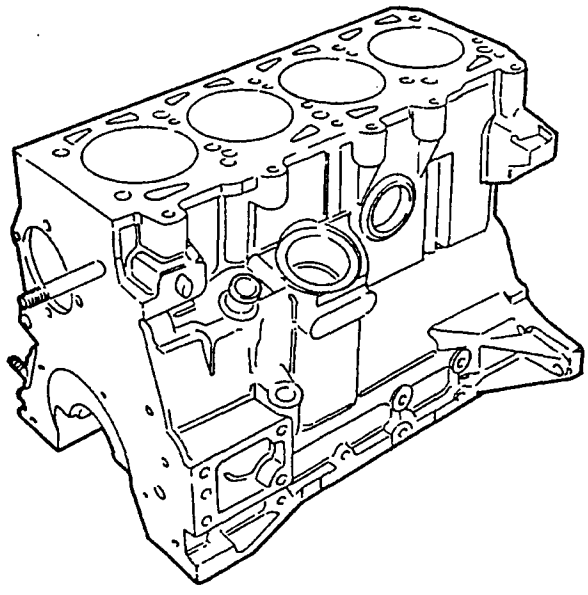




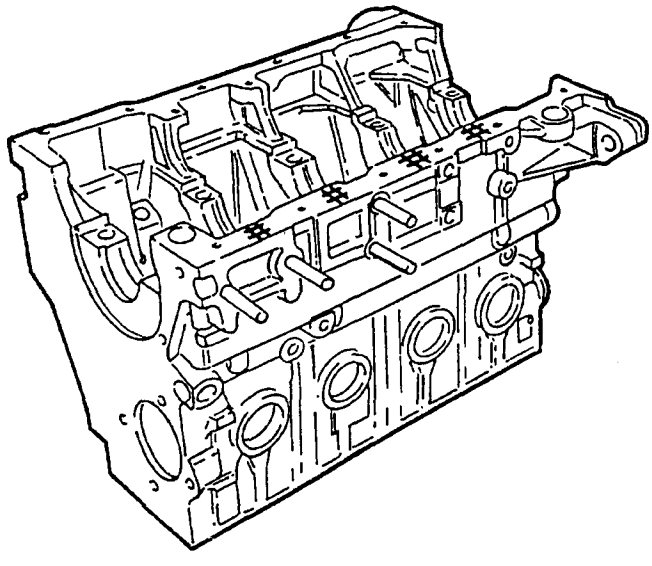
It is installed on the frame by suspension type mounts and fixed by two elastic damping supports at the front and by an elastic damping fork type support at the rear.

ENGINE BLOCK

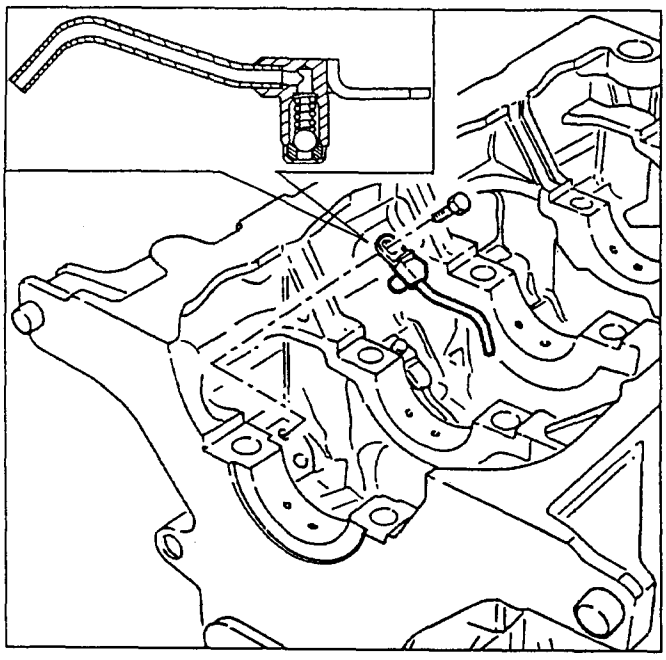
This is a single block in iron with a high mechanical resistance.
The crankshaft is supported by five main supports which also house the same number of bearing halves with thin shells.
The cylinder liners are the integral type.
Grooving in the walls of the block allow circulation of engine coolant and lubricating oil.



The letters showing which class the cylinder liners belong to are printed on the block in the position shown in the figure below.

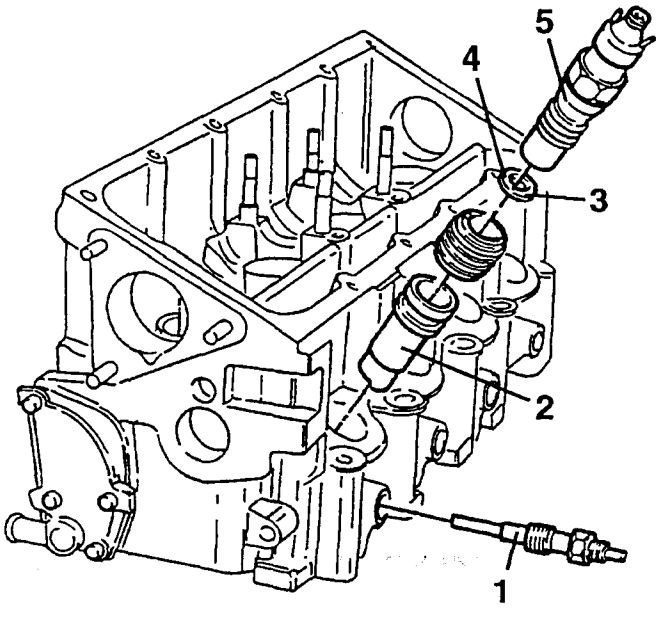


The lower part of the engine houses an oil spray jet which cools the piston skirt and lubricates the grudgeon pin.



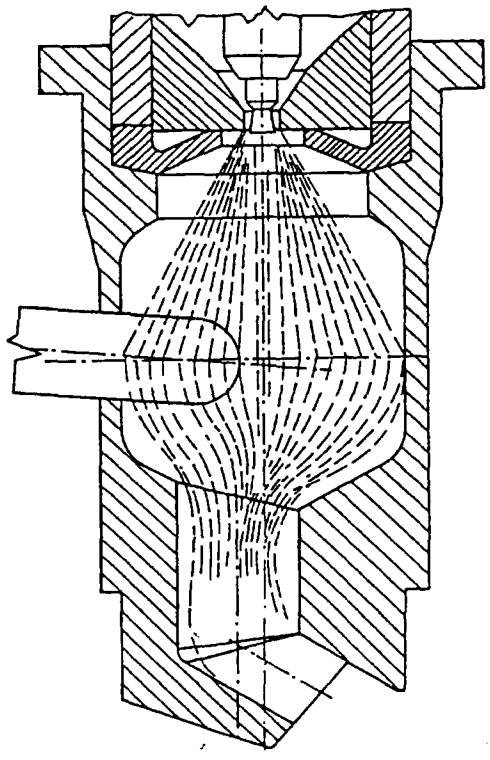
CYLINDER HEADS

They are the monolith type, compact and chill cast in an aluminium and silicon alloy.
The seatings housing the precombustion chambers and the injectors are found on the cylinder heads.



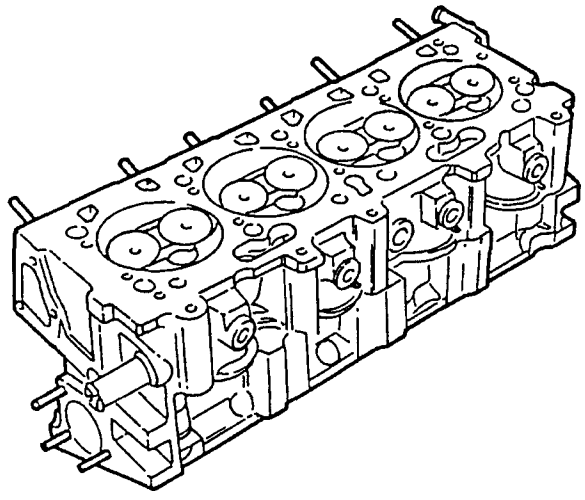
1. *Heater plugs*
2. *Precombustion chamber with washer*
3. *Bushing securing precombustion chamber in cylinder head*
4. *Engine compression elastic sealing washer*
5. *Injector*

The steel, low turbulence type precombustion chambers are positioned in suitable housings and fixed by a ring nut, within which the injector is then screwed.
The seatings for the heater plugs are located in the lower part of the cylinder heads; the incandescence bulb is inserted into a suitable hole in the precombustion chamber and is consequently in direct contact with the injected fuel.
In the precombustion chamber, which is shaped like two offset cylinders, the compressed air from the piston hits the conic jet of fuel injected: the front of the flame uses up the whole amount of oxygen, and continues through the sump and flows into the cylinder. In this way, combustion is rather "slow", which is indispensable if the engine is to run softly and silently.



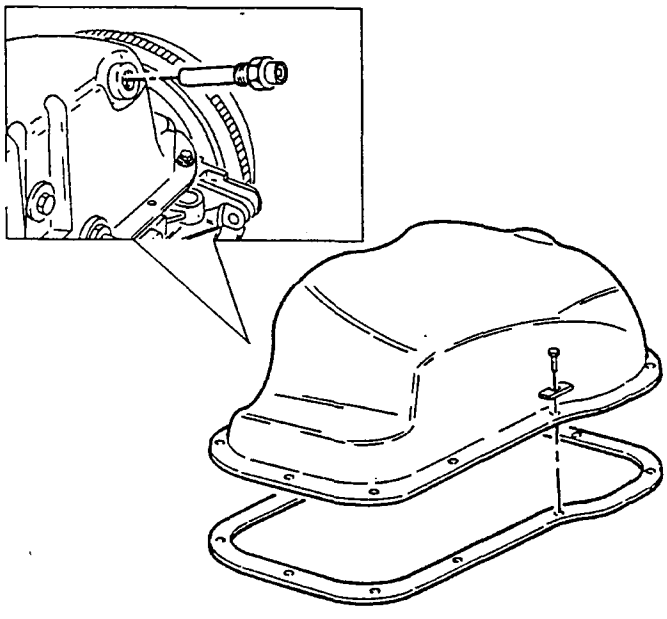
The cam shaft is supported by four supports; the front and rear ones are removable and the central ones are obtained from the cylinder heads.
The valve guides are fitted in the relative seatings of the cylinder heads with interference and the internal diameter is then perfected, after assembly, with a specific boring machine and checked by a pair of "fit-does not fit" gauges.
The seal between the cylinder heads and the engine block is the ASTADUR type.
This seal, due to the special material from which it is made, undergoes a polymerization process when th engine is running, and hardens significantly durin use; adopting this type of seal, it is no longer necessary to tighten the cylinder head at the first service.

The cylinder head seal is supplied in three different thicknesses and the correct one is chosen on the basis of the average protrusion of the pistons from the upper surface of the engine block; this maintains the compression ratio within the prescribed limits.



OIL SUMP

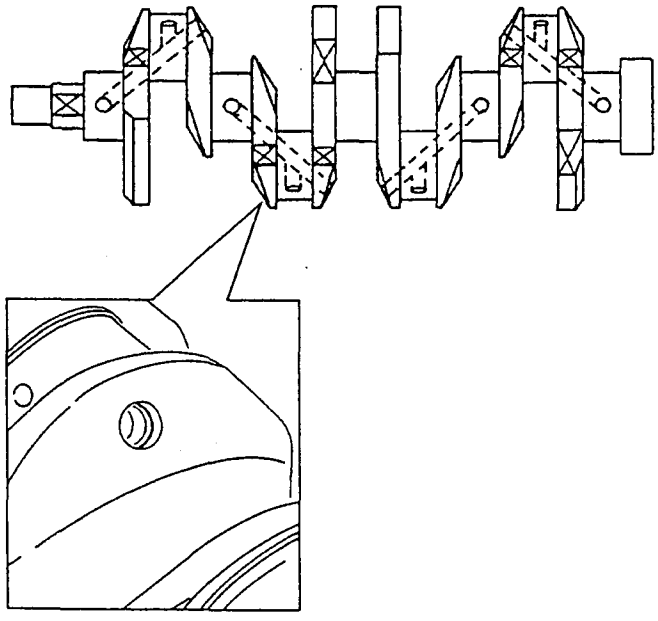
Made from stamped plate, it is also fitted with anti-splash walls.
The oil sump also contains the seating of the engine oil temperature sensor and the oil return from turbo-charger connection is also fitted here.
A suitably positioned gasket acts as seal between the sump and the engine block.



CRANKSHAFT

This is forged in a high resistance steel alloy and hardened and tempered.
In order to improve its mechanical resistance and wear characteristics, the crankshaft is subjected to a soft nitriding treatment.

After the interventions to grind down the main and rod journals, the crankshaft should be again subjected to the nitriding treatment, to reset its initial characteristics.
After this operation, the crankshaft should be checked to ensure that the deformation falls within prescribed limits, and that it can not be straightened; otherwise it must be replaced.
The crankshaft rests on five main supports and the radial clearance is regulated by two half rings housed on the rear main support.
Eight counterweights ensure that the rotating masses are equally balanced.
A channel runs inside the shaft to lubricate the main and rod journals. The machining holes on these channels are blocked with plugs; when the engine is overhauled they should be removed and cleaned thoroughly.



MAIN AND ROD BEARING HALVES

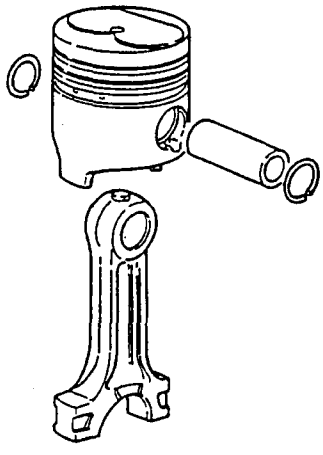
They are the thin shell, three metal type and are divided into two dimensional classes, they are supplied to parts in another five decrease classes.
The main bearing halves have three holes to lubricate the main journals.

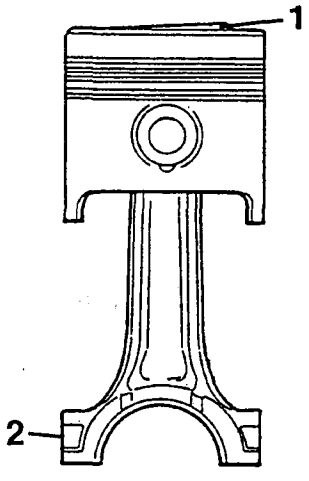
FLYWHEEL

Made from cast iron, with a ring gear in tempered steel, it is suitably balanced.
The flywheel has a precise position which must be respected during assembly: after the pistons of the first and fourth cylinders have been brought to T.D.C. the flywheel must be assembled making sure that the notch engraved on it faces upwards.

PISTONS AND RODS

The pistons are made from an aluminium-silicium alloy and are divided into five dimensional classes.
The crown of the piston has a lift which connects with the combustion chamber of the cylinder heads.
The hole of the grudgeon pin is in axis with respect to the piston axis.
Close to the second and third seal ring housings, there are two grooves. The first is a labyrinth which reduces the passage of combustion gases in the sump, so as to reduce the formation of oil vapours; the second one serves to collect the oil "scraped" from the two rings to avoid it entering the combustion chamber.
The seating of the first seal ring is made on a molybdenum coating.
There are three seal rings: the first, seal type, is surface treated with a molybdenum coating, the second is the seal and oil scraper type, the third is the spring oil scraper type.
The visible scanso at the base of the piston skirt stops it from interfering with the oil sprayerin the engine block at B.D.C.
The rods are in tempered and hardened steel, with a copper alloy bushing fixed for connection to the piston grudegon pin.
As the grudgeon pins are floating on both the piston hubs and the bushing fixed at the foot of the rod, they are stopped from moving laterally by two expanding elastic rings which are housed in the grooves on the hubs themselves.
The piston - rod connection must be made so that the lower part of the lift (1) on the piston is facing the same way as the number of the cylinder (2) to which the rod belongs stamped on it.



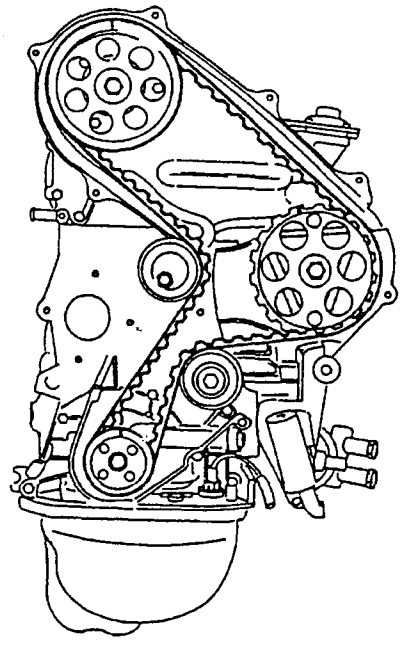


1. *Lift on piston crown*
2. *Number of cylinder to which rod belongs.*

The installation of the piston - rod assembly must be done in such a way that the numbers stamped on the rod face towards the intake-exhaust side.

TIMING

Direct drive by drive belt, with on head cam shaft in iron with induction hardening on the cams.



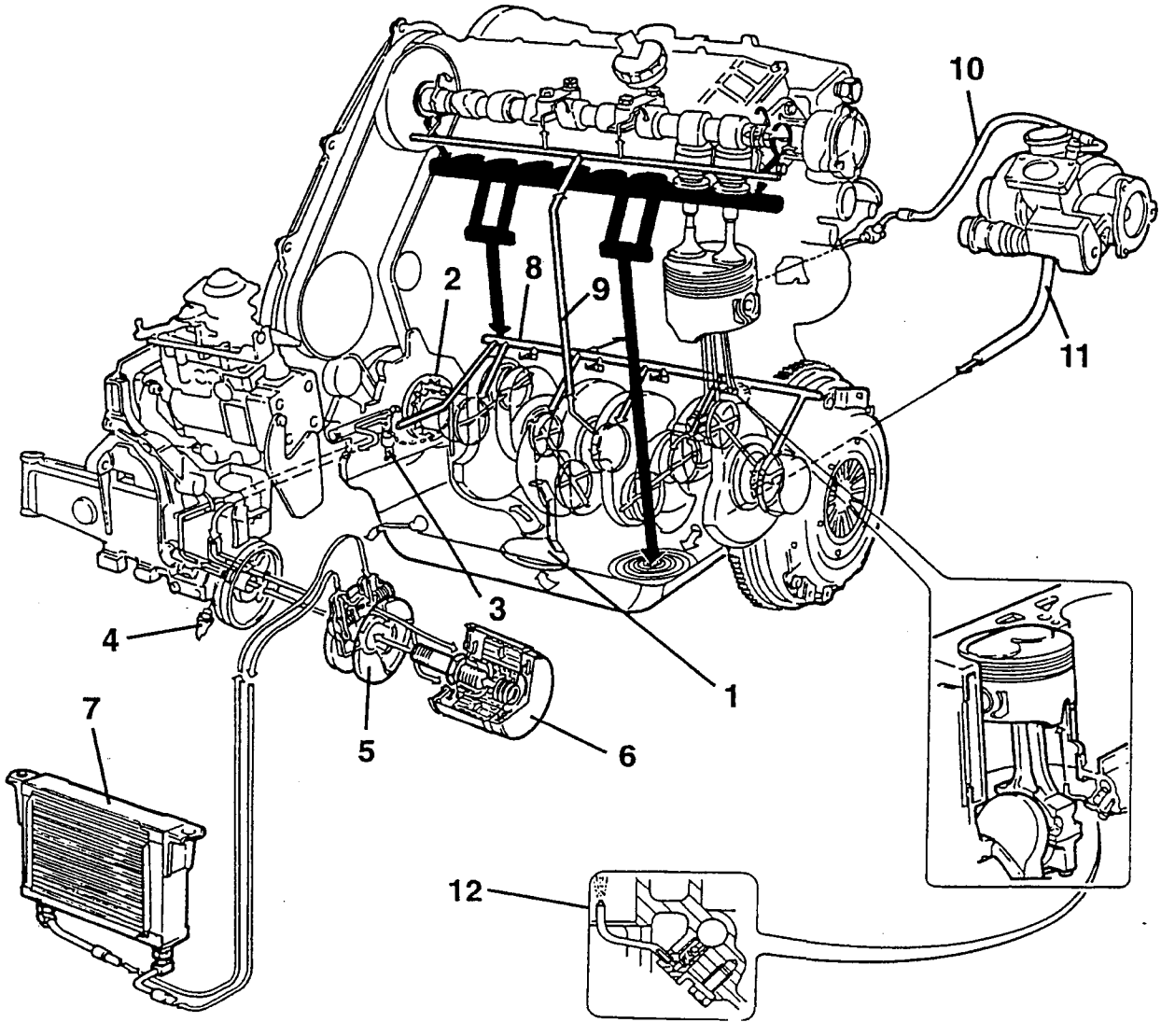
The mechanical tappets are made up of a cap in casehardened and phosphor-plated steel, in contact with the cam, used to regulate the valve clearance.
The command is transmitted from the cap to the cup in carbonitrided steel which directly controls the valve.
The intake and exhaust valves are made in a steel alloy and the stem is chrome-plated.
The valve seatings and valve guides are in iron.
Small rubber plugs are mounted on the top of the valve guides to catch any oil between the stem and the valve guides.

LUBRICATION

The oil, taken from the sump using a suction device, is filtered by the net type filter which is part of the suction device itself and then reaches the oil pump.
The oil pump which is the rotating lobe type is front mounted on the engine block and activated directly by the crankshaft through keying.
The oil sent under pressure by the pump, after having passed the pressure relief valve, reaches a thermostatic valve that:
- for temperatures lower than **75 °C**, ensures that the oil passes directly into the cartridge filter and then to the engine;
- for temperatures greater than **90 °C**, it opens allowing the oil to pass into the coolant radiator so that its temperature is lowered and a better lubrication is guaranteed.

The oil, after having been filtered by the cartridge filter (total flow with safety by-pass valve, which guarantees that the oil passes even if the cartridge becomes clogged up), makes it way towards the oil minimum pressure warning light sensor, and arrives at the main longitudinal pipe which runs around the engine block through a transversal channel.
The oil is then sent along secondary ducts to lubricate the main and rod journals.
A vertical duct in the engine block and cylinder heads lubricates the cam shaft supports.
From the main duct the oil is sent to the turbo charger through an external tube to lubricate the control shaft and from here directly to the sump.

To improve the cooling of the piston skirts, sprayers with a small built in ball valve which opens when the pressure reaches **1.25 ÷ 1.75 bar** are located on the engine block; this guarantees that the main supports are sufficiently lubricated during engine start up and at idle speed.
The lubrication system is equipped with an oil vapour recirculation system which allows the vapours originating from the engine block to be recovered.
An oil temperature sensor is also fitted on the oil sump whilst the engine oil level sensor is positioned on the oil pump cover.

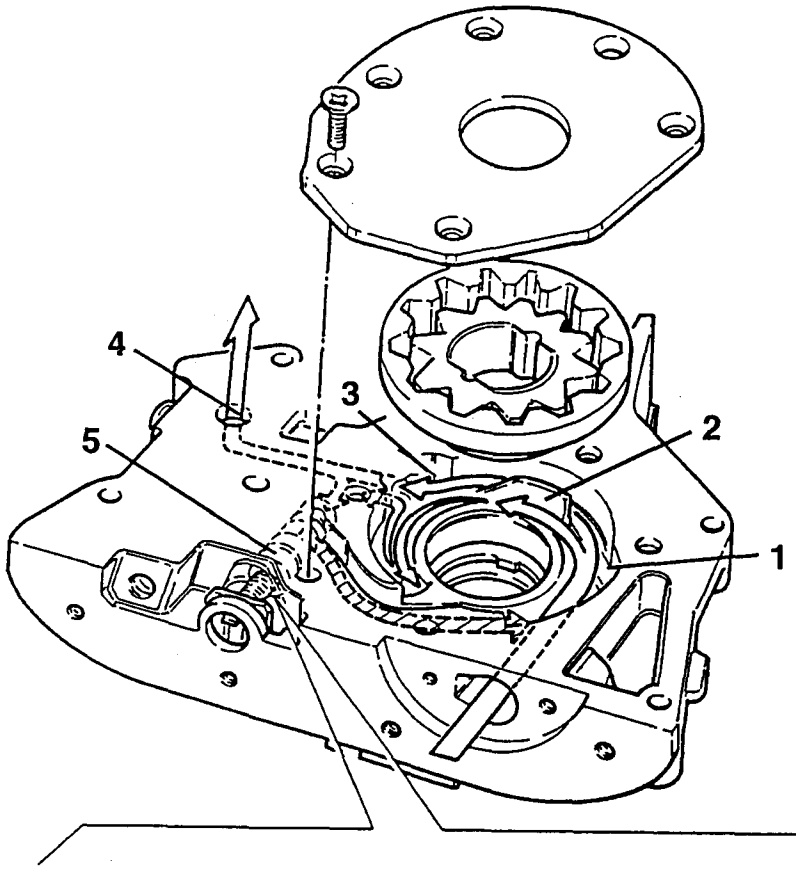


1. *Suction device with wire gauze filter*
2. *Oil pump*
3. *Pressure relief valve*
4. *Minimum oil pressure warning light sensor*
5. *Oil filter support with thermostatic valve*
6. *Oil filter with safety by-pass valve*
7. *Engine oil cooling radiator*
8. *Oil delivery duct to various parts*
9. *Oil vertical delivery duct to cam shaft supports*
10. *Oil delivery tube to turbocharger*
11. *Oil return to sump from turbocharger tube*
12. *Sprayers*

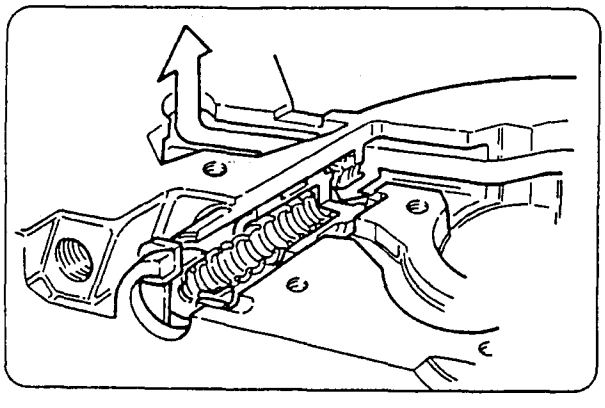
OIL PUMP

The oil is sucked from the sump thrugh a vacuum created by the gears on the crankshaft rotating.
The vacuum starts from the separating panel (2) of the gears upto the oil sump suction device.

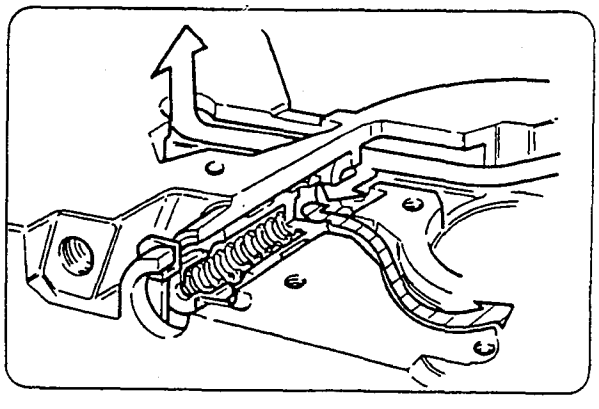
The pressure develops from the separating panel (2) in all the engine oil delivery ducts (4).
When the pressure exceeds 5 bar, the thrust exercised on the relief valve (5) causes the spring positioned below to react and moves the valve enough to open the connection duct between the pressure chamber (3) and the low pressure chamber (1), limiting the maximum pressure in the circuit.



1. *Low pressure chamber*
2. *Separating panel*
3. *Pressure chamber*
4. *Oil delivery duct*
5. *Pressure relief valve*



Closing functioning position of the engine oil pressure relief valve.



Functioning position in short circuit of the relief valve.

.NTRODUCTION

The instructions given in the following paragraphs refer to the complete overhaul of the engine on a bench after removal from a vehicle.
The instructions are divided as follows:
- **Disassembly and reassembly of engine:**
removal of the engine accessories and components and dis- assembly into its main component parts.
- **Disassembly and overhaul of cylinder heads:**
complete overhaul of all the components of the cylinder heads.
- **Engine block checks and inspections:**
complete overhaul of the components of the crank mechanisms.
- **Precautions for refitting:**
comprising the refit operations where they significantly differ from the disassembly instructions.

.ll the disassembly procedures described in the part which follows, when carried out in the reverse order, are also valid for refitting purposes unless otherwise indicated.

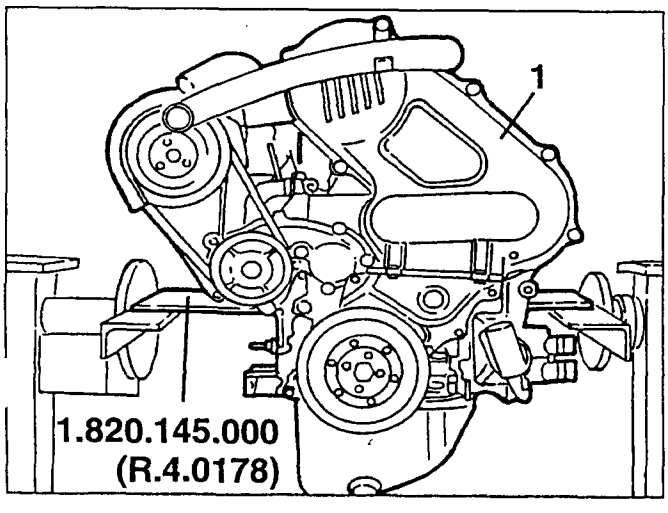
- Checks and inspections of the lubrication system electrical components:
checks and controls of the electrical components relative to the engine lubrication system.

The procedures which follow refer to the complete overhaul of the whole engine unit; it is however possible to use individual parts of these instructions when dealing with specific components.

:NGINE DIS-ASSEMBLY

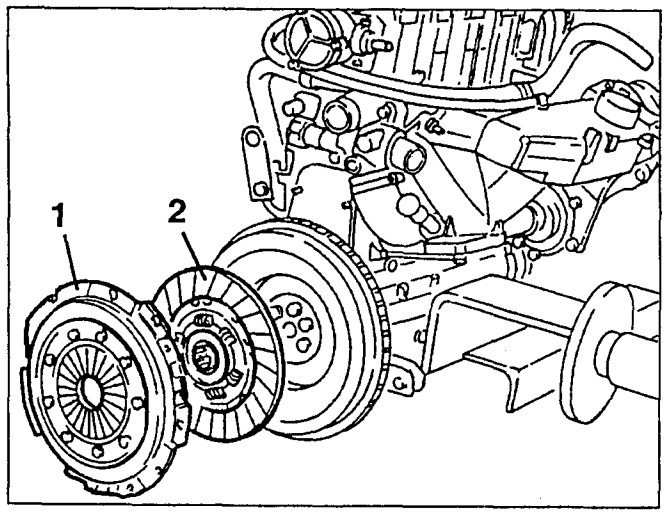
Preliminary operations

1. Set the assembly on a special overhauling stand using supports brackets N° 1.820.145.000 (R.4.0178).



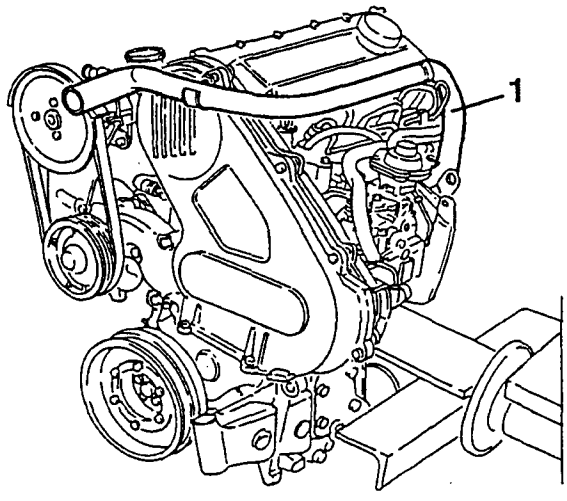
Removal of clutch plate

1. Remove the disk pressure plate body.
2. Remove the clutch disk.

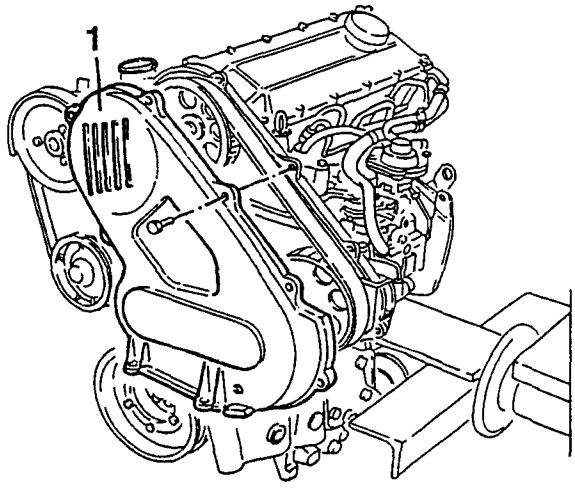


Removal of timing belt

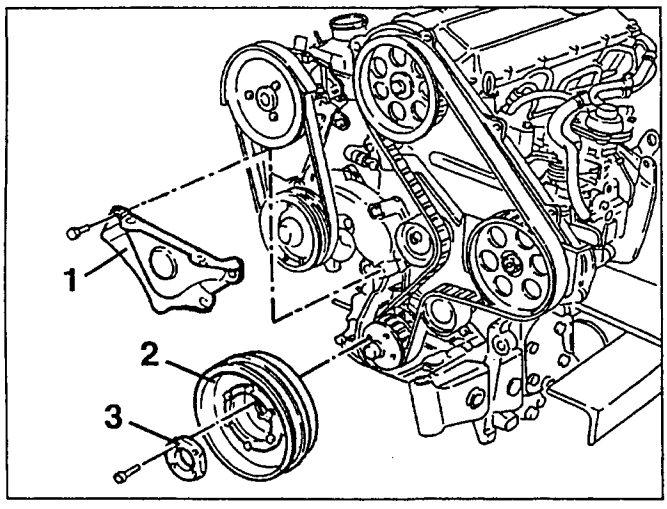
- Install a suitable tool on the flywheel which will allow the crankshaft to rotate.
1. Remove the oil vapour recirculation sleeve.



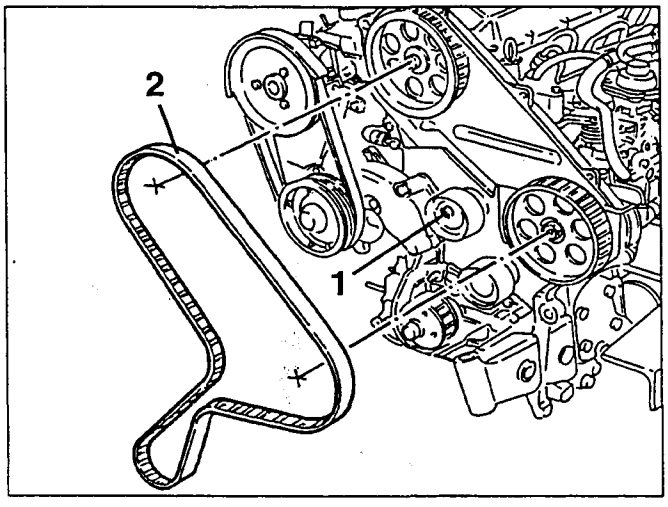
1. Remove the timing belt cover.



1. Remove the timing belt lower cover.
2. Remove the auxiliary parts belt control pulley.
3. Recover the spacer.

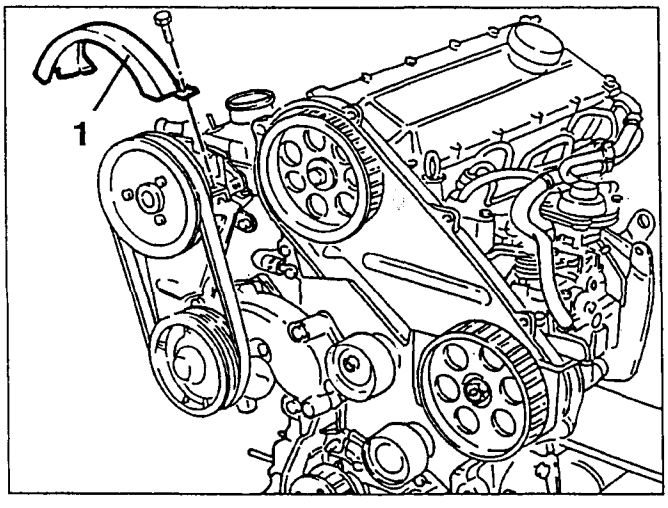


1. Loosen the fastening nut of the timing belt stretcher.
2. Remove the timing control belt.

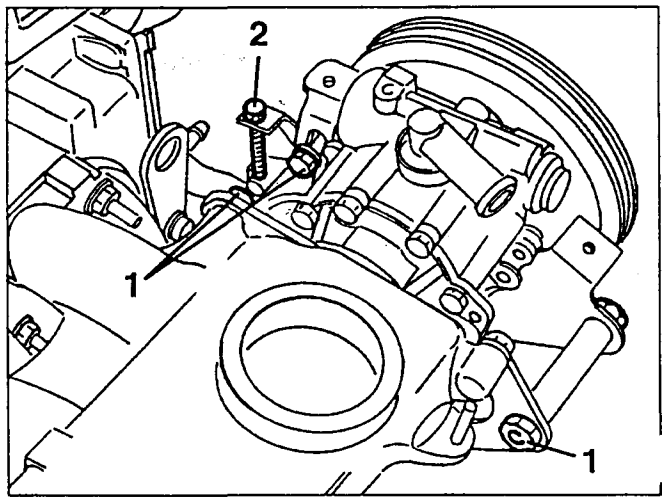


Removal of power steering pump

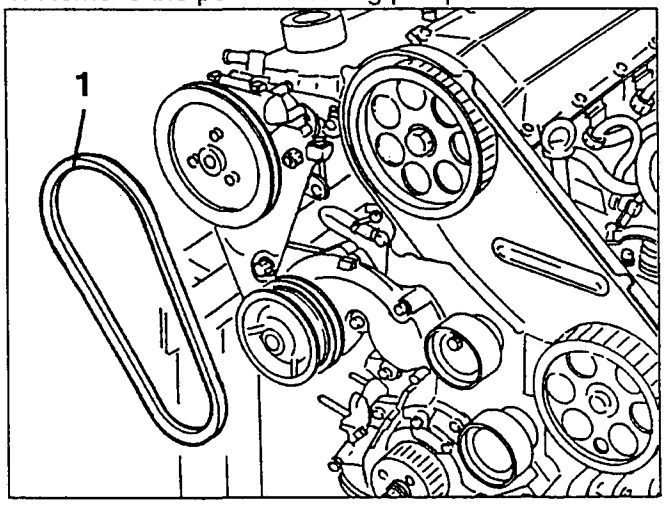
1. Remove the power steering pump belt guard.



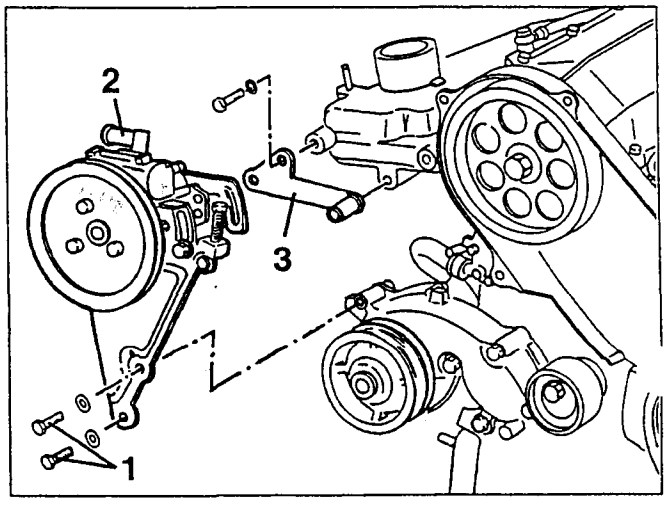
1. Loosen the fastening screws of the power steering pump indicated in the figure.
2. Decrease the tension of the power steering pump control belt by acting on the screws of the micrometric stretcher.



1. Remove the power steering pump control belt.

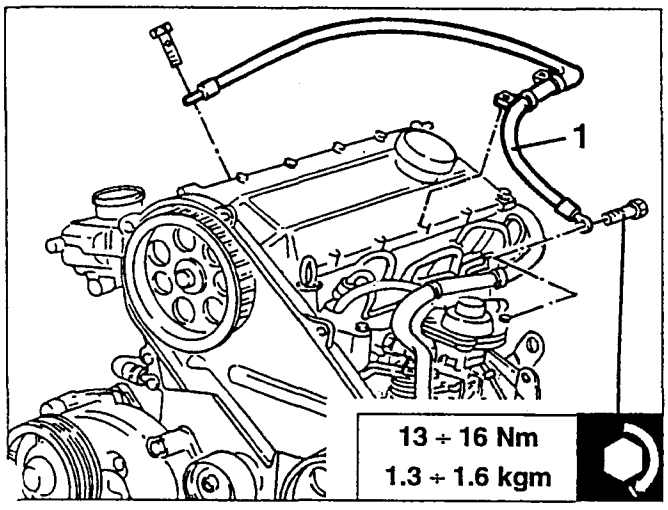


1. Unscrew completely the screws which have been loosened beforehand and the two screws indicated in the figure.
2. Remove the power steering pump complete with front bracket.
3. Remove the power steering pump front support bracket.

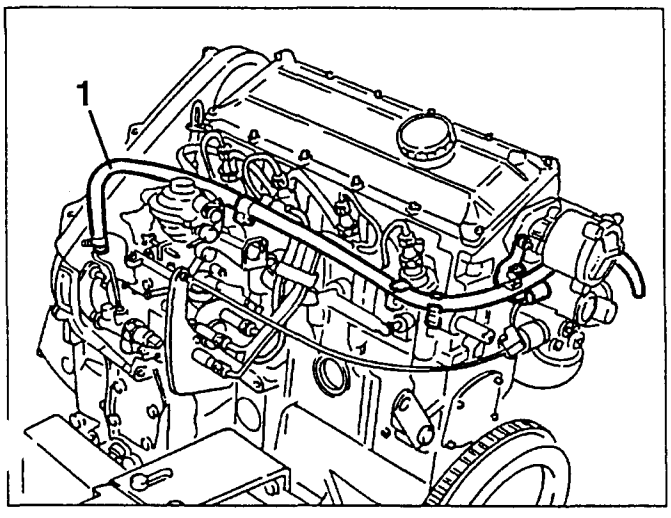


Removal of air intake box

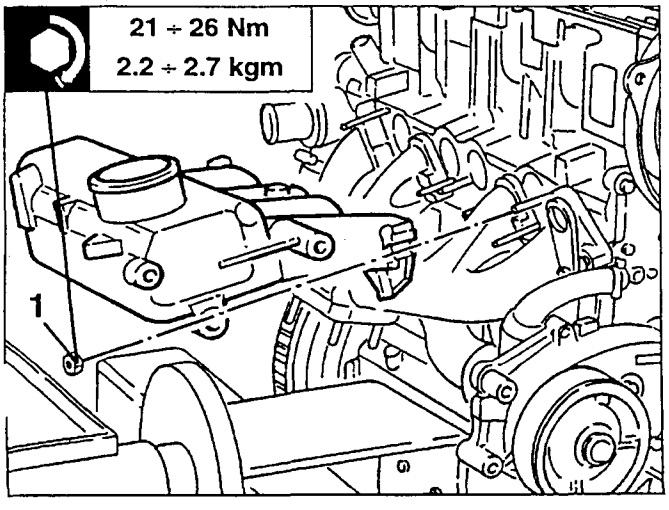
1. Remove the over pressure pipe for the flow limiter on the injection pump.



1. Remove the fuel arrival from filter to injection pump pipe.

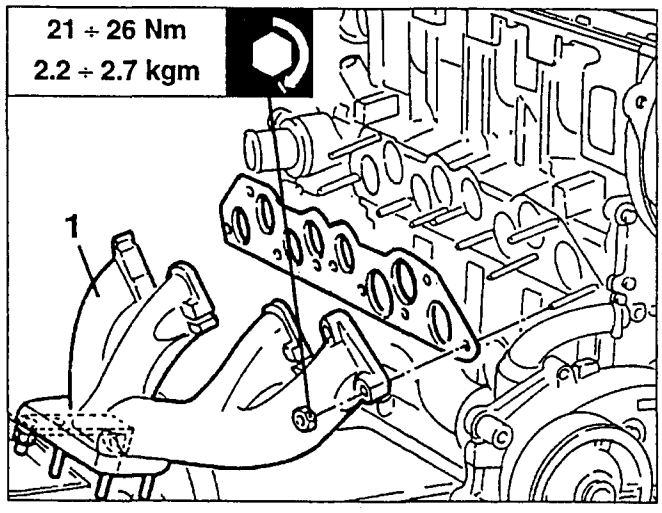


1. Unscrew the fastening screws and remove the air intake box.



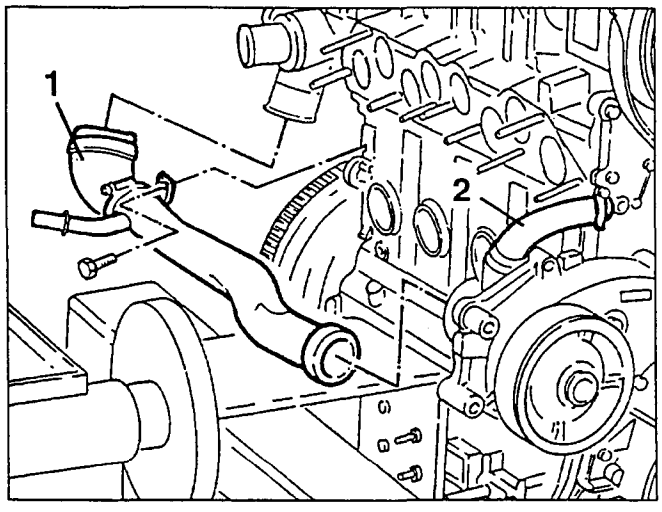
Removal of exhaust manifold

1. Unscrew the fastening screws and remove the exhaust manifold.

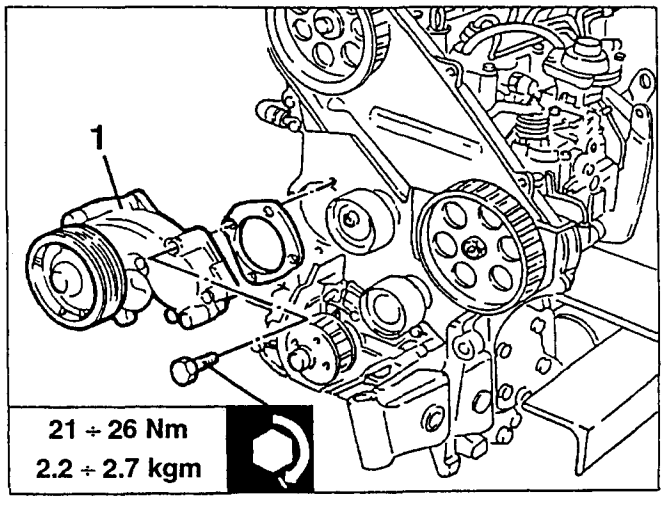


Removal of water pump

1. Remove the engine coolant to pump return manifold.
2. Disconnect the engine coolant to pump return pipe from the cylinder heads.

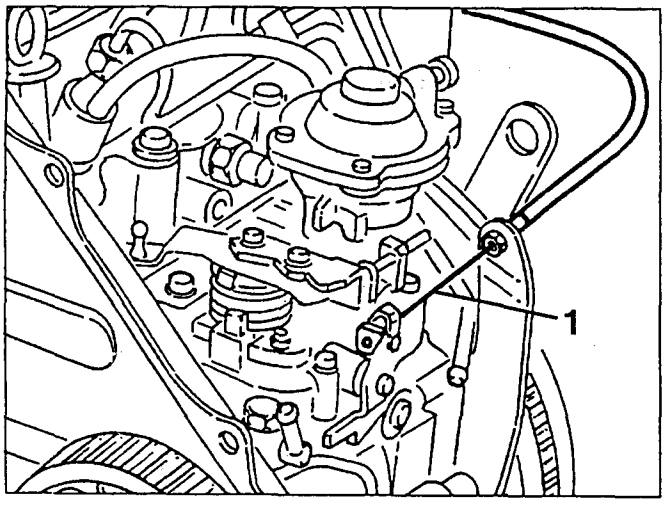


1. Unscrew fastening screws and remove water pump.

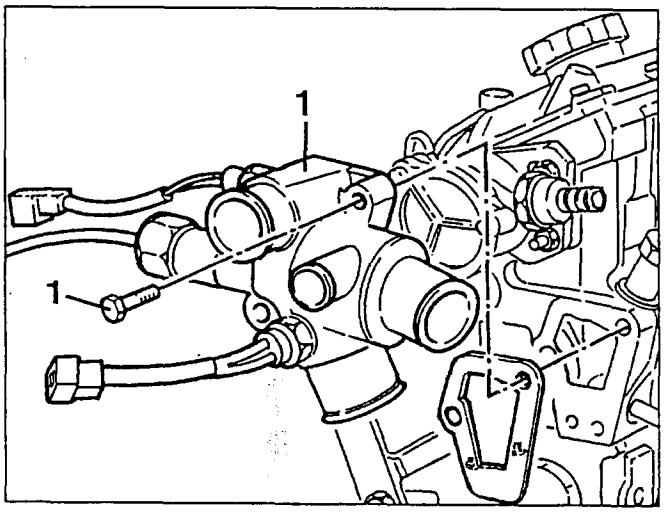


Removal of thermostatic cup

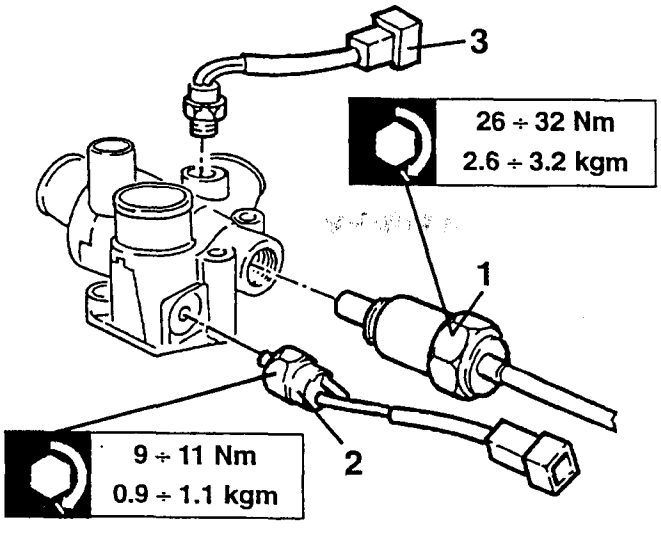
1. Disconnect the cable of the idle speed automatic control device.



1. Unscrew the screws and remove the complete thermostatic cup.

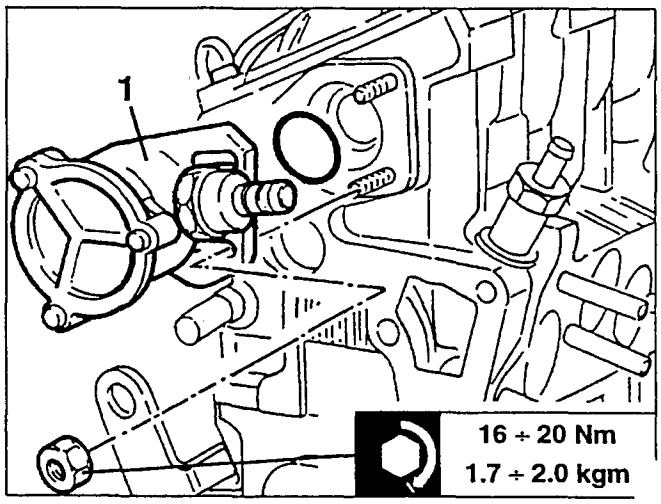


1. Remove the thermostatic sensor of the idle speed automatic device.
2. Remove the KSB consensus thermoswitch.
3. Remove the air conditioning compressor cut-off thermal contact.



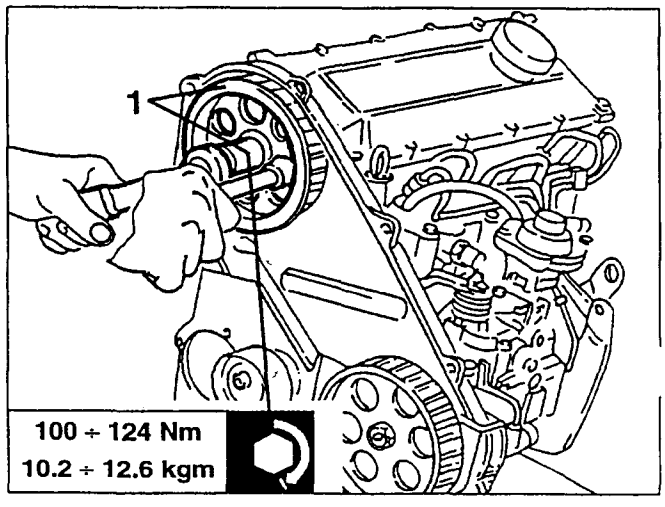
Removal of servobrake vacuum pump

1. Unscrew the fastening screws and remove the vacuum pump for the servo brake.

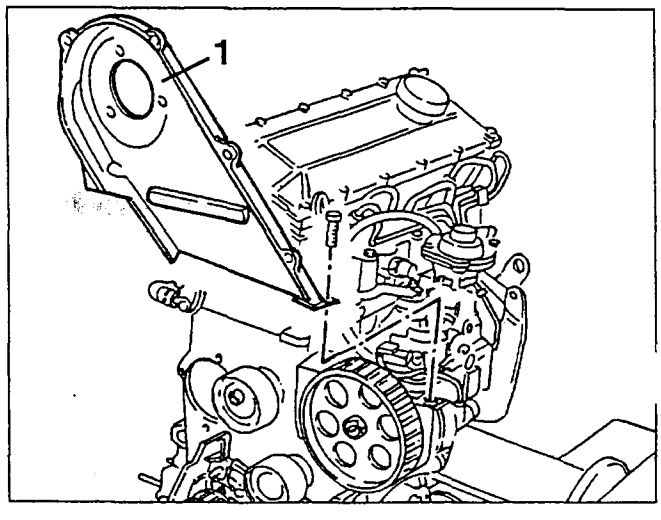


Removal of injection pump

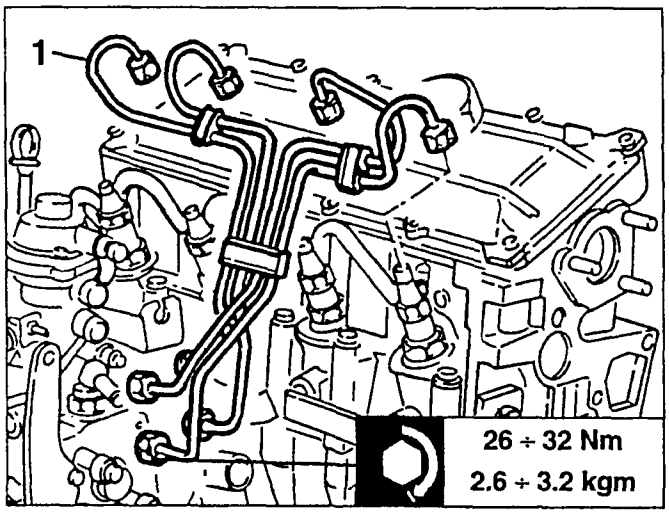
1. Using a 13 mm spanner as a counter rotation tool loosen the screw and remove the timing command pulley.



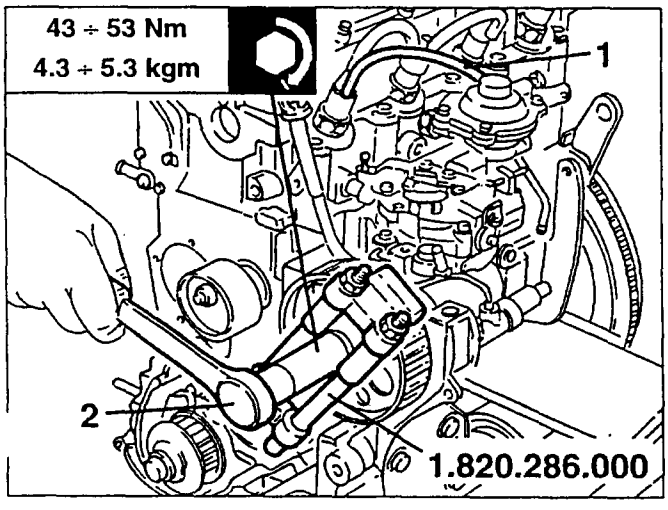
1. Remove the timing belt rear cover.



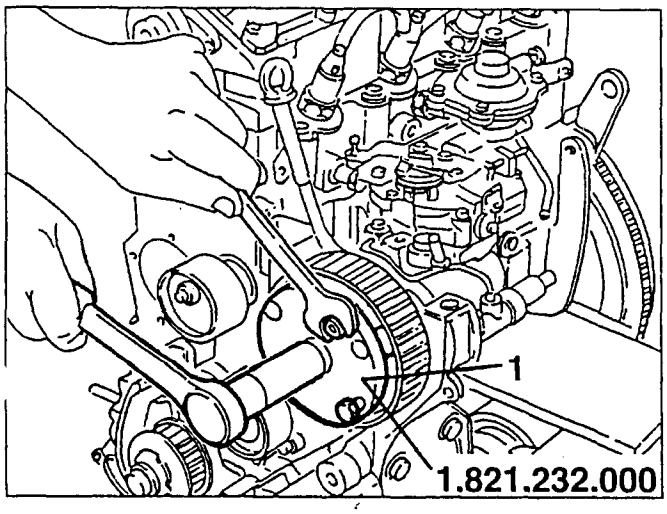
. Remove the fuel from injection pump to electroinjectors delivery pipe.



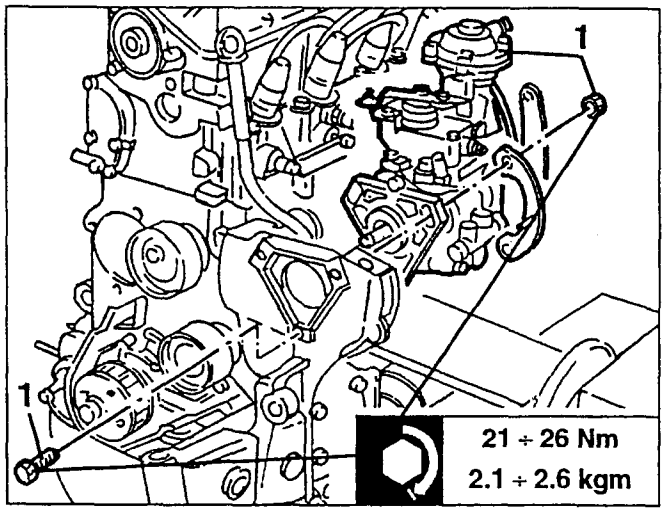
1. Disconnect the fuel to injection pump return pipe from injector.
2. Using tool N° 1.820.286.000 unscrew the fastening nut of the injection pump control pulley.



1. Using tool N° 1.821.232.000 remove the injection pump control pulley.

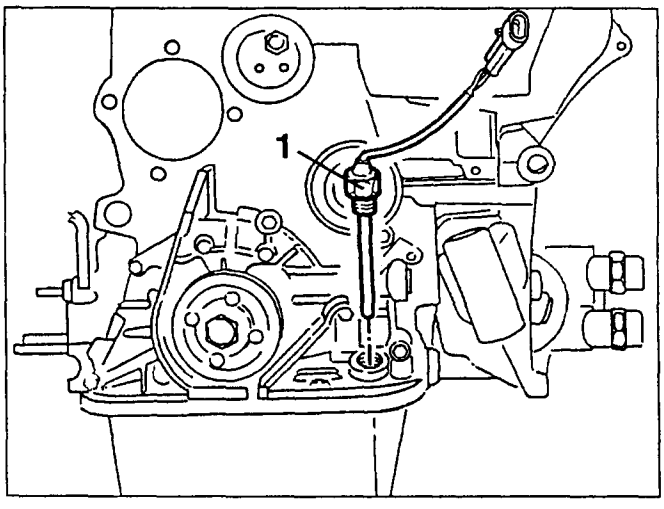


1. Unscrew the fastening screws and nuts and remove the injection pump.

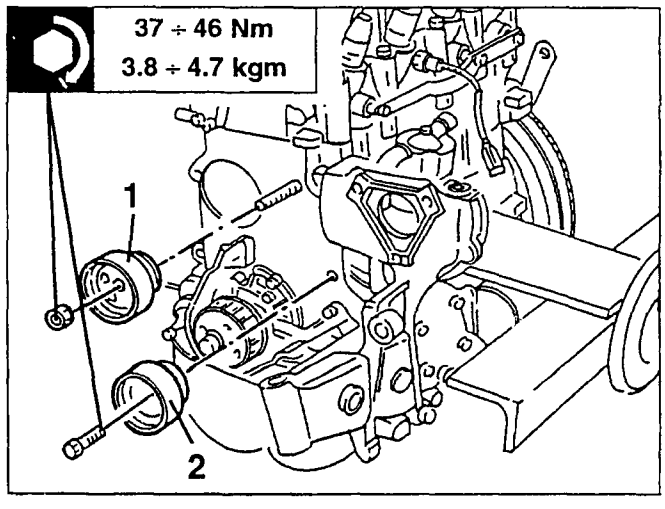


Removal of oil filter support bracket and injection pump

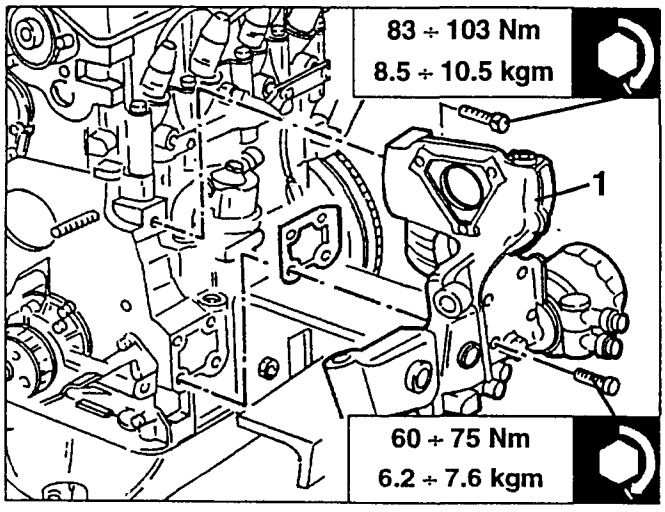
- Remove the guide and engine oil dipstick.
1. Remove engine oil level sensor.



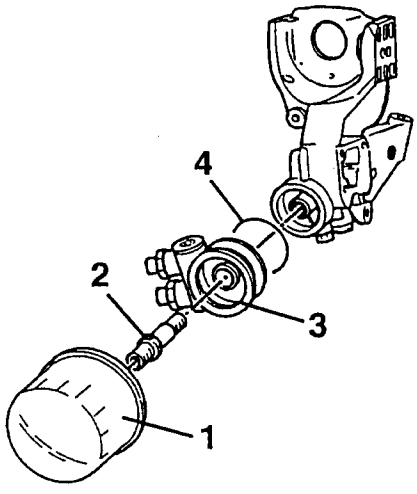
1. Remove the timimg belt stretcher.
2. Remove the timing belt jockey pulley.



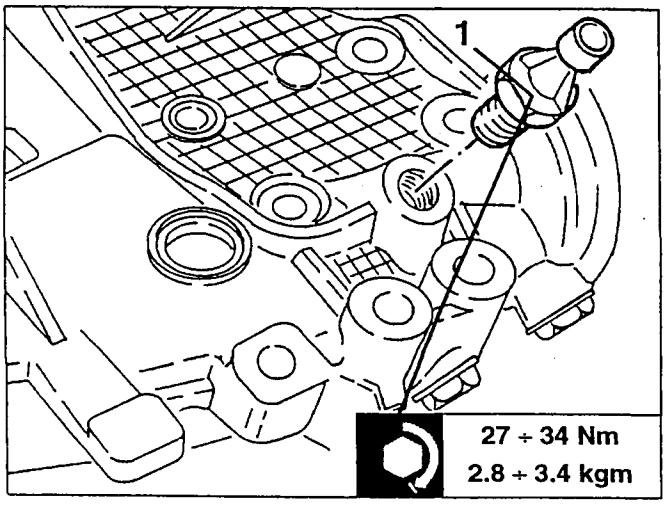
1. Unscrew the fastening screws and remove the oil filter support bracket and the injection pump.



1. At the bench remove the oil filter from the support bracket.
2. Remove fastening journal.
3. Remove oil filter support.
4. Remove O-Ring.

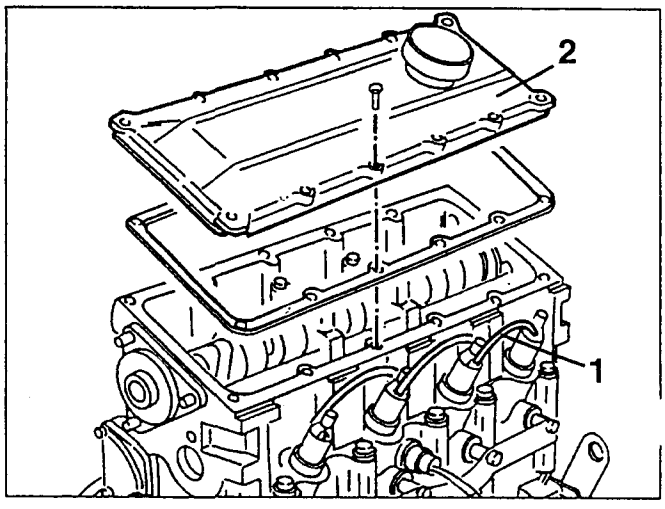


1. Remove the engine oil minimum pressure sensor from the bracket.

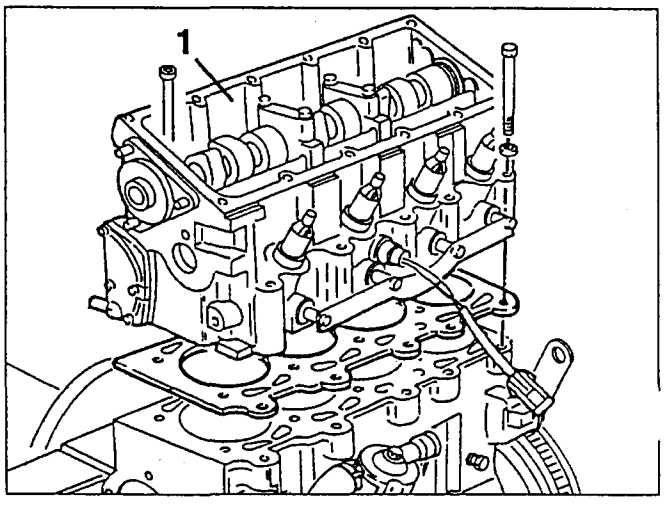


Removal of cylinder heads

1. Remove the fuel to injection pump return pipe from the injectors.
2. Unscrew the fastening screws and remove the timing cover.

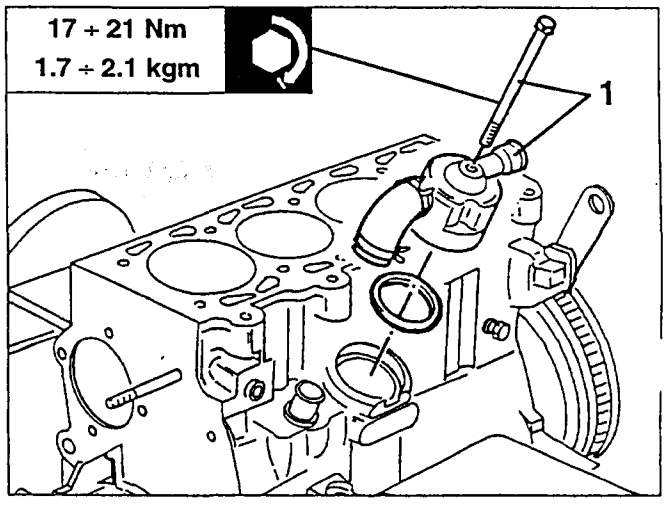


1. Unscrew the fastening screws and remove the cylinder heads.

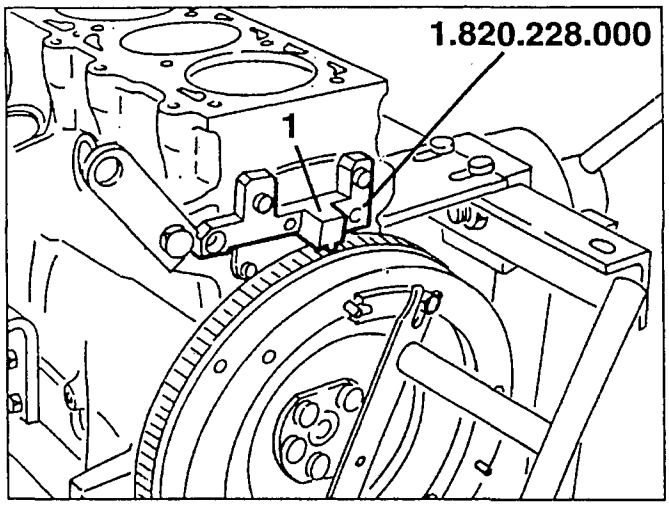


Removal of oil sump

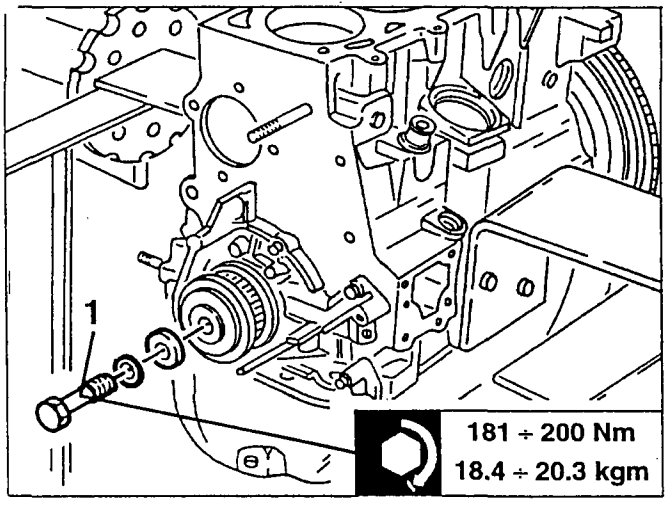
1. Remove the oil vapour separator from engine block.



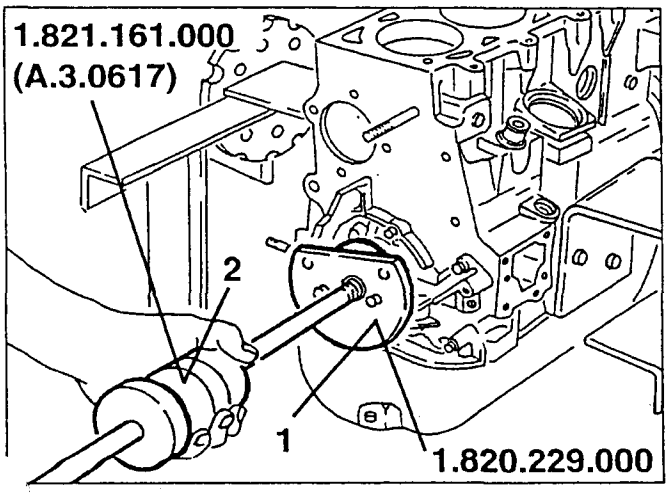
. Install flywheel stop tool N° 1.820.228.000.



1. Unscrew the fastening screws of the timing control elt pulley.

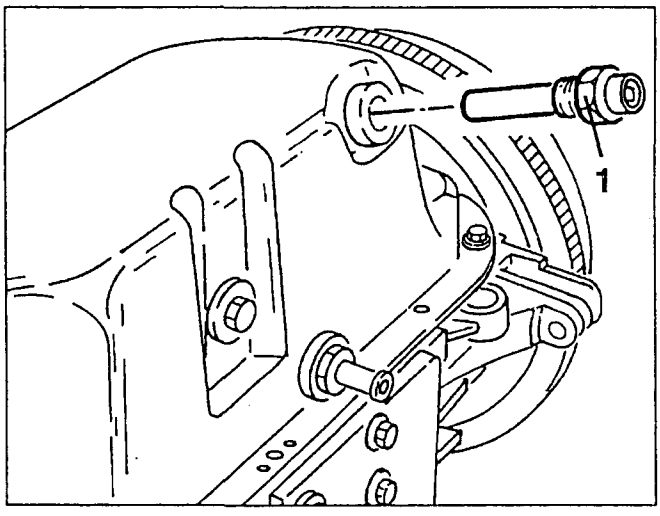


. Install tool N° 1.820.229.000 on the timing control pulley.
2. Using ram N° 1.821.161.000 (A.3.0617), remove the timing control pulley.

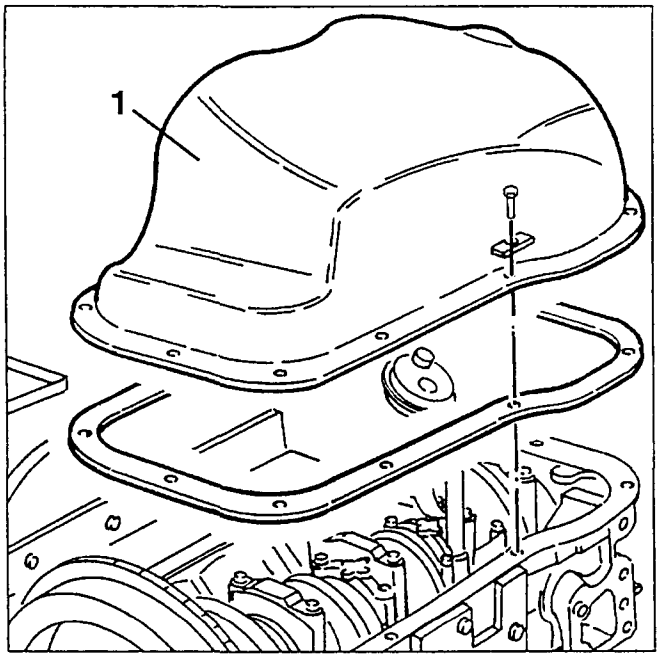


- Remove flywheel stop tool N° 1.820.228.000 installed previously.

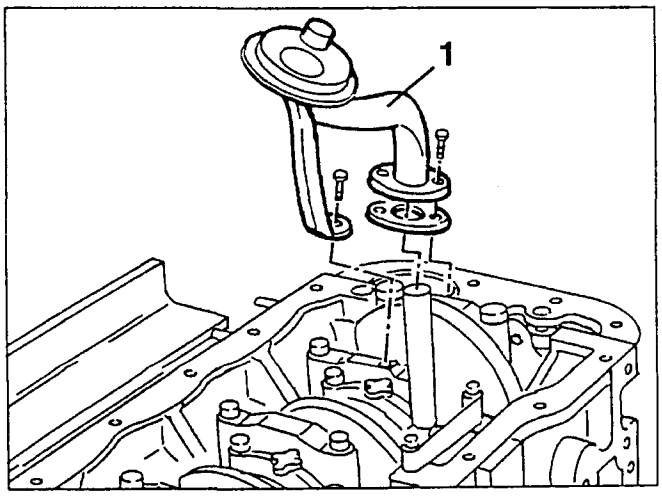
- Rotate the engine block 180° on the rotating overhaul stand.
1. Remove the engine oil temperature sensor from the oil sump.



1. Unscrew the fastening screws and remove the oil sump.

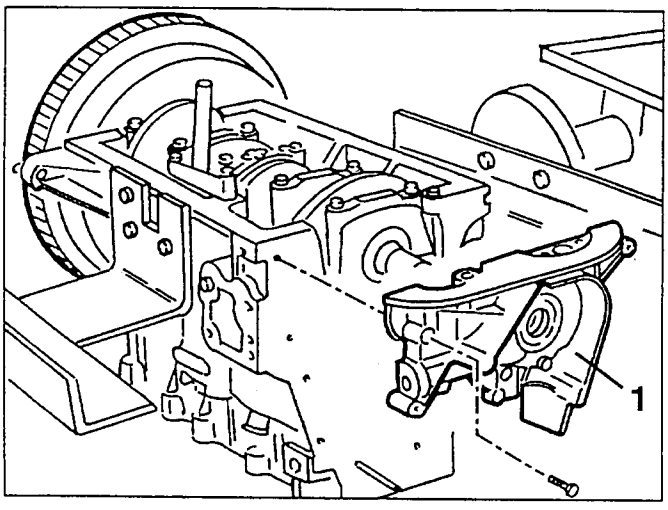


1. Remove the suction device for the engine oil pump.



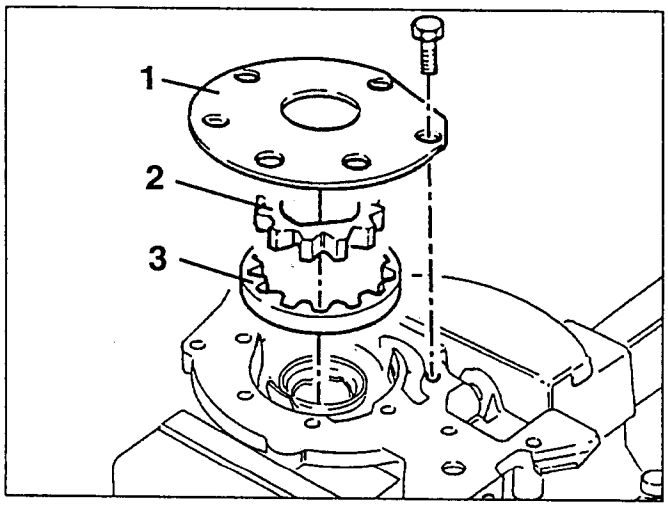
Removal of engine block front cover

1. Remove the engine block front cover with built-in oil pump.

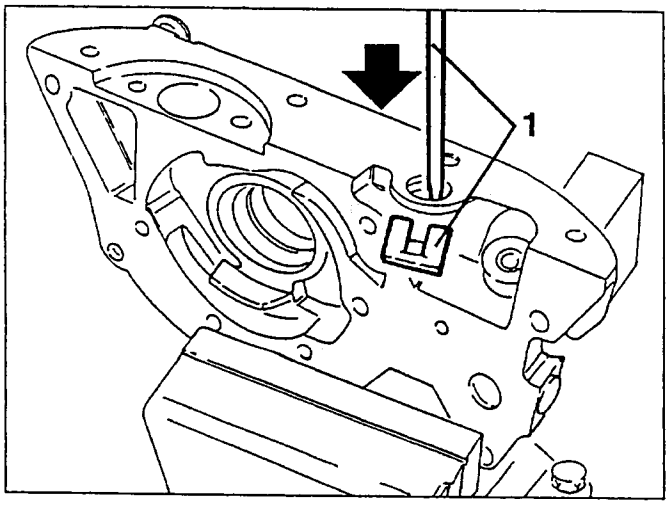


Disassembly of oil pump

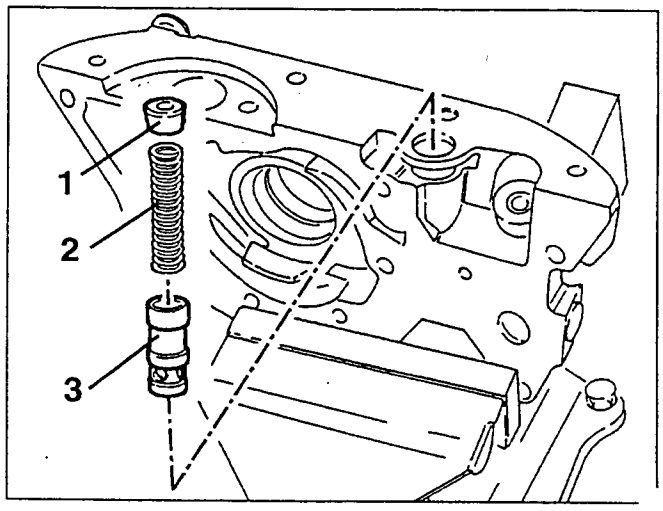
1. Unscrew fastening screws and remove cover.
2. Remove driving gear.
3. Remove driven gear.



1. With a suitable punch press the oil pressure relief valve and extract the stop plate.

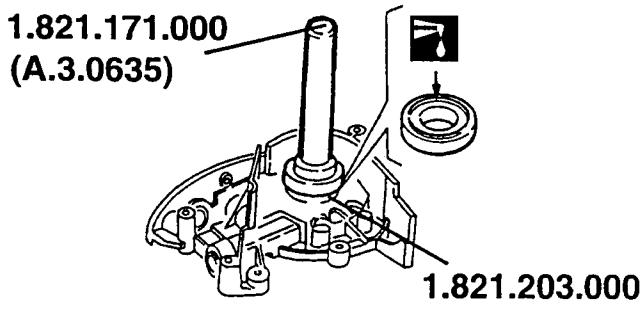


1. Remove the spring stop.
2. Remove the spring.
3. Remove the valve box.



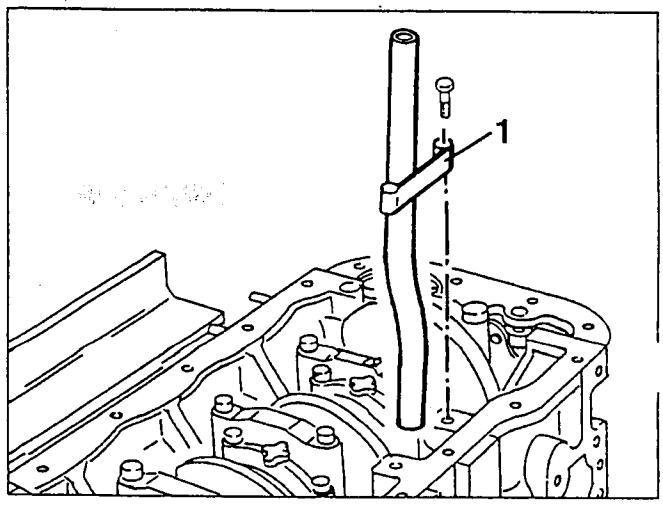
- Remove the oil seal ring from the engine block front cover.

During reassembly fit the oil seal ring on the engine block front cover using tools N° 1.821.171.000 (A.3.0635) and N° 1.821.203.000.

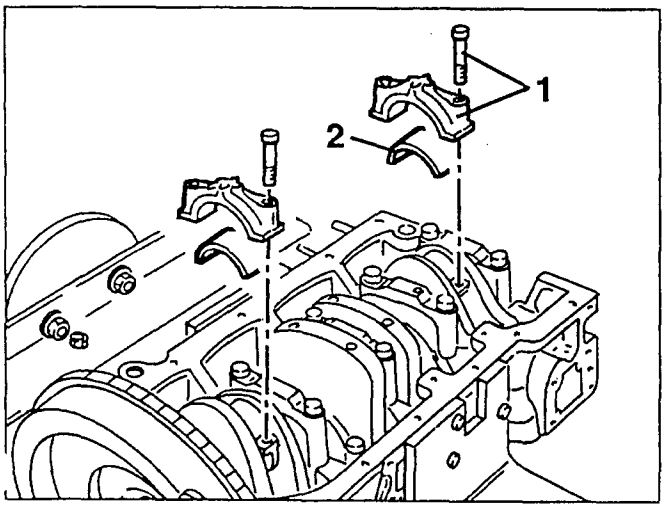


Removal of pistons and rods

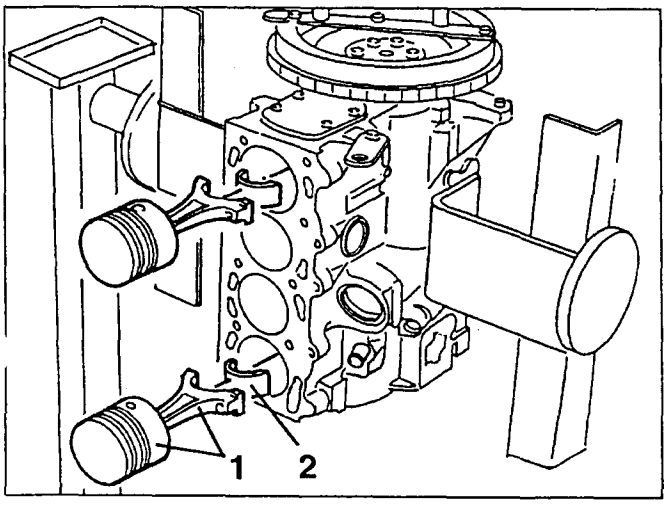
- Remove the flywheel stop tool installed previously.
1. Remove the engine oil dipstick.



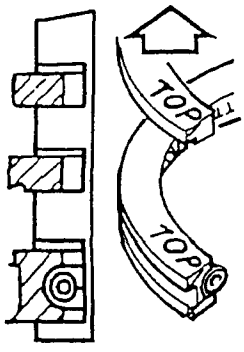
· Rotate the crankshaft so that the first and fourth piston is at B.D.C.
1. Unscrew the fastening screws and remove the first and fourth cylinder rod caps.
2. Recover the rod bearing halves.

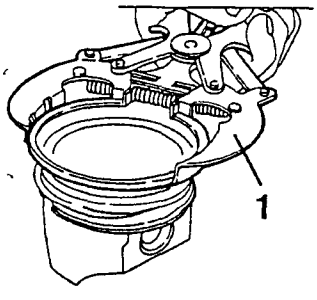


- Rotate the engine block by 90° on the overhauling stand.
1. Remove the piston-rod assembly of the first and fourth cylinders.
2. Recover the rod bearing halves.



- Rotate the engine block and repeat the procedure for the second and third cylinders.
1. Using a suitable tool extract the seal rings and oil scraper ring from the piston.

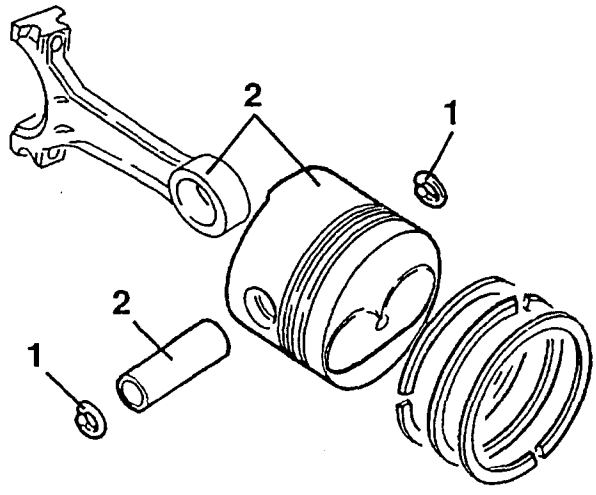




During refitting rotate the seal rings so that the wording "TOP", stamped on the rings themselves, faces upwards.

1. Extract the two elastic rings which block the grudgeon pin.
2. Extract the grudgeon pin and separate the piston from the rod.

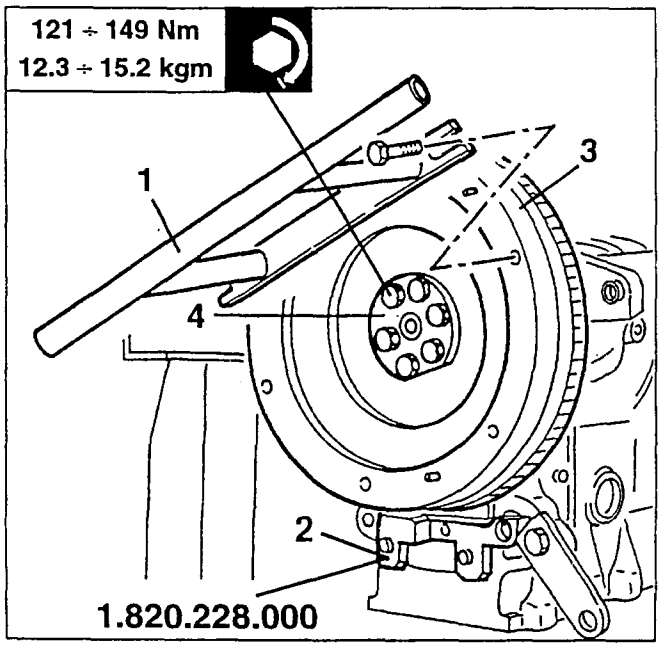
During refitting, follow the precautions contained in the relative paragraph.



Removal of engine flywheel

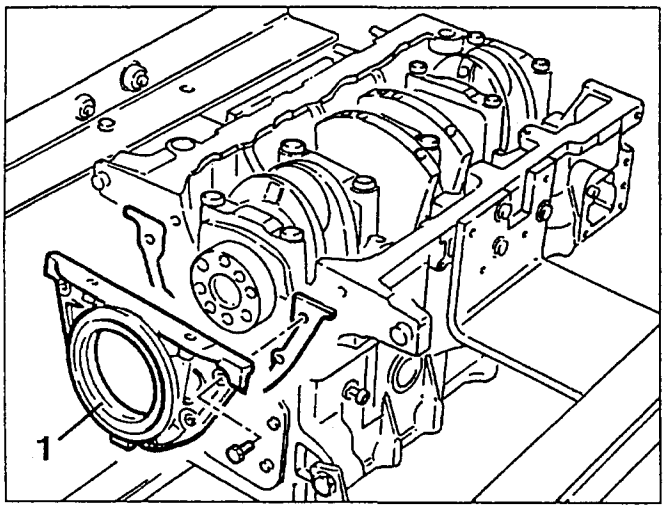
1. Remove the tool used to rotate the crankshaft, installed previously, from the flywheel.
2. Install the flywheel stop tool N° 1.820.228.000.
3. Unscrew the fastening screws and remove the engine flywheel.
4. Recover the safety washer.
- Remove the flywheel stop tool.

During reassembly, bring the first and fourth cylinders to the T.D.C., install the flywheel ensuring that the notch faces upwards.



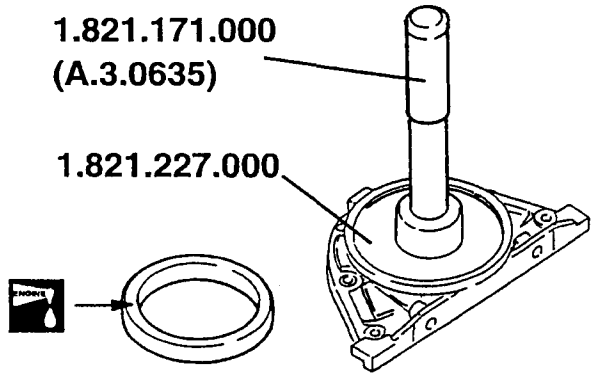
Removal of crankshaft

1. Remove the engine rear cover.

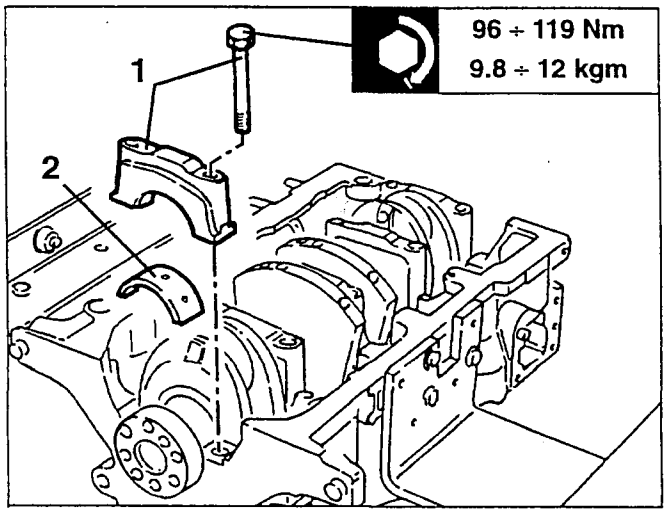


- Remove the oil seal ring from the engine rear cover.

During reassembly fit a new oil seal ring on the rear engine cover using tools N° 1.821.171.000 (A.3.0635) and N° 1.821.227.000.

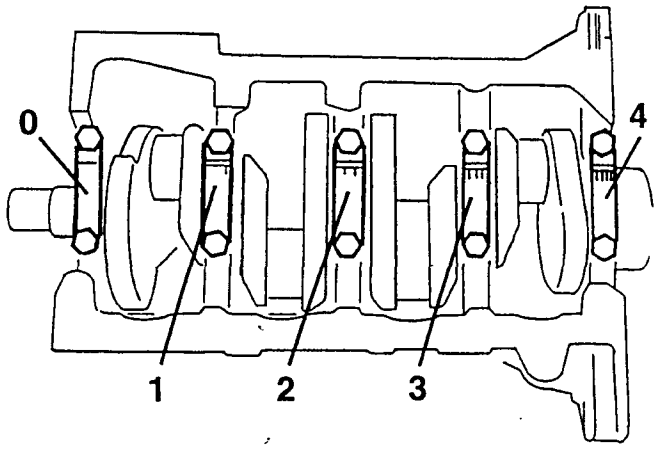


1. Unscrew the fastening screws and remove the main journals.
2. Remove the main bearing halves from the caps.

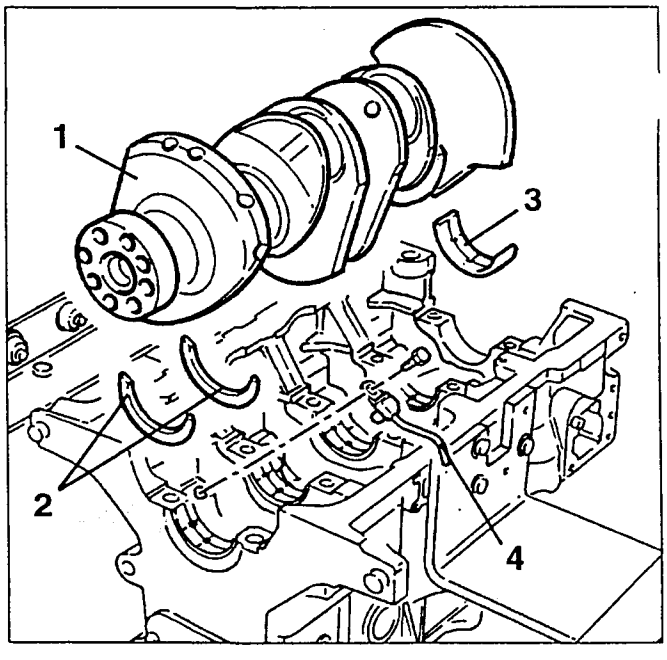


NOTE: Highlight the position of the various components should they be re-used during assembly.

CAUTION:
The position of each cap is dictated by a series of notches (from zero to four starting from the front side of the engine) engraved on the caps themselves.



1. Remove the crankshaft.
2. Recover the thrust half rings.
3. Recover the main bearing halves from the supports.
4. Remove the engine oil sprayers used to lubricate and cool the pistons from the engine block.

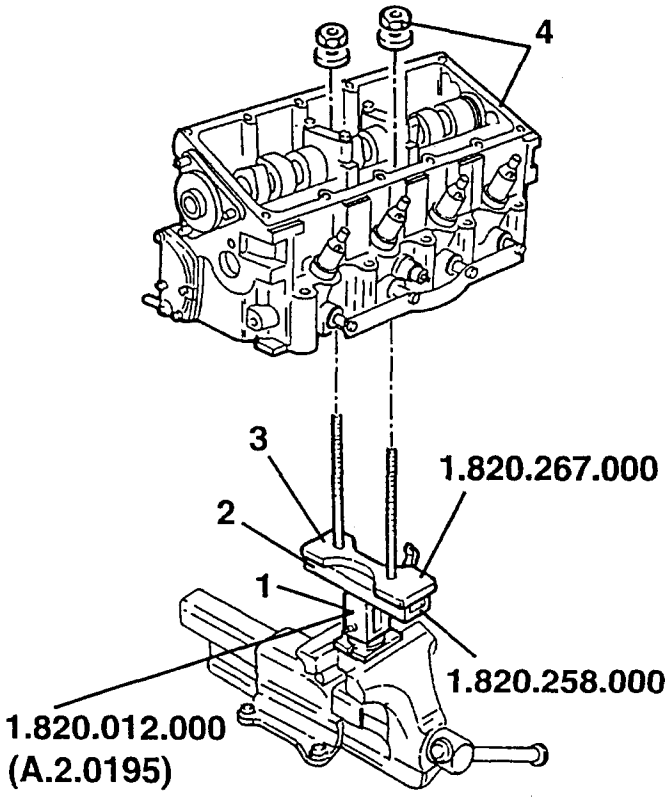


During crankshaft reassembly check that the axial play falls within prescribed limits (see "Precautions for reassembly").

DISASSEMBLY OF CYLINDER HEADS

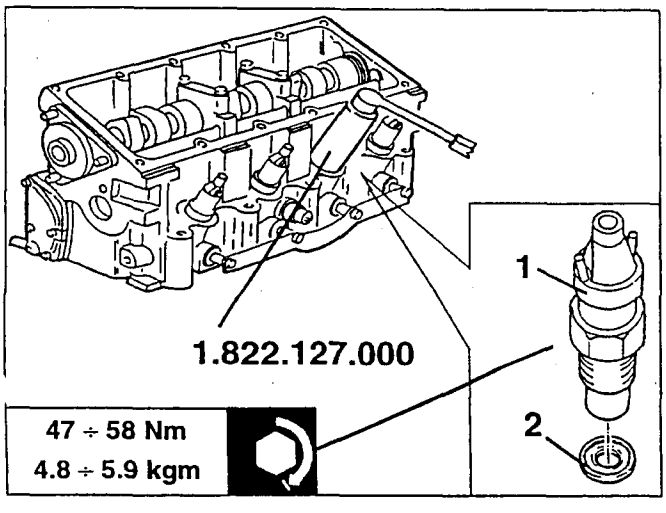
Preliminary operations

1. Clamp the moveable support N° 1.820.012.000 (A.2.0195) into a vice.
2. Install cylinder head support fork N° 1.820.258.000 and lock it to the support.
3. Insert tool N° 1.820.267.000 for the disassembly of the valves into the fork.
4. Insert the cylinder heads into the studs of the forks and lock them there.

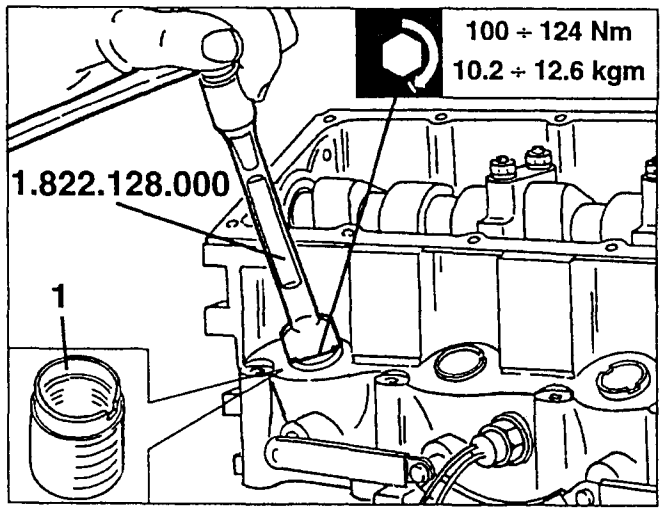


Removal of injectors

1. Using tool N° 1.822.127.000 remove the injectors.
2. Recover the engine compression seal elastic washer.

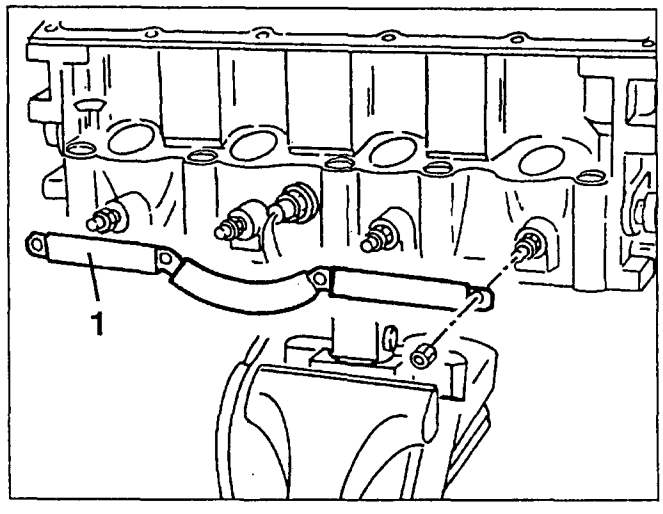


1. Using tool N° 1.822.128.000 remove the combustion prechamber fixing bushing.

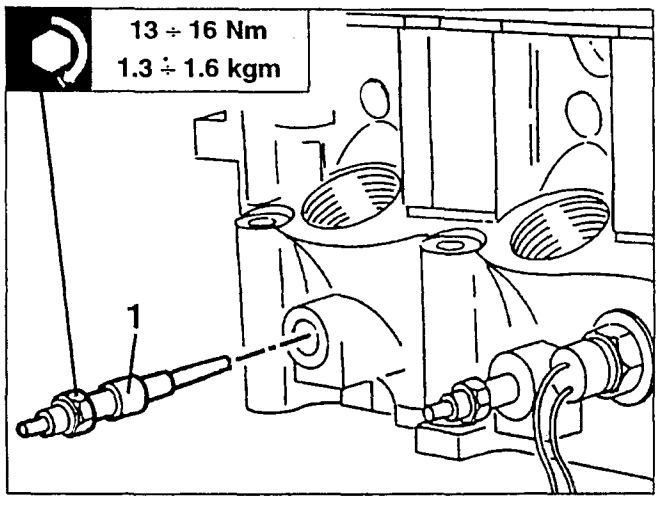


Removal of heater plugs

1. Remove the heater plugs supply connecting strip.

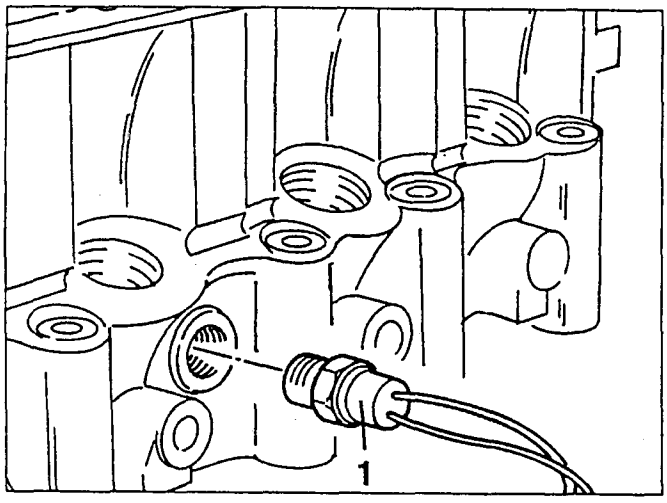


1. Remove the heater plugs.



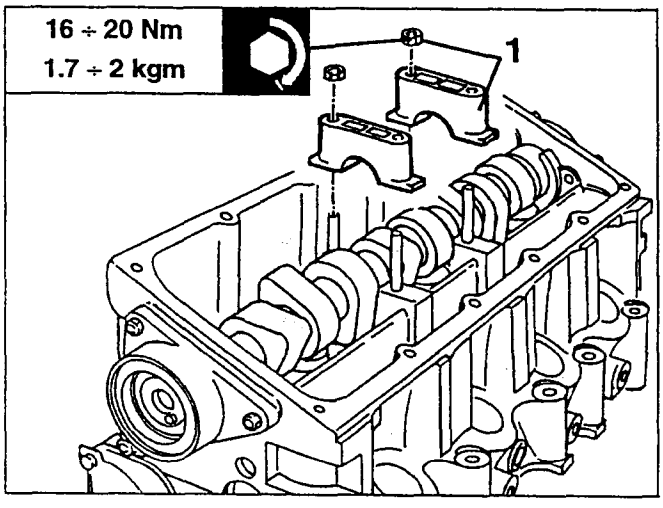
Removal of coolant temperature sensor

1. Remove the engine coolant temperature indicator transmittor and the max. temperature warning light contact.

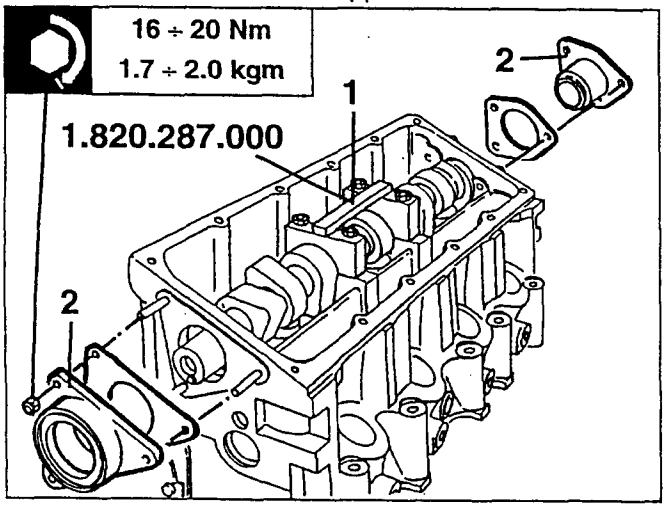


Removal of cam shaft

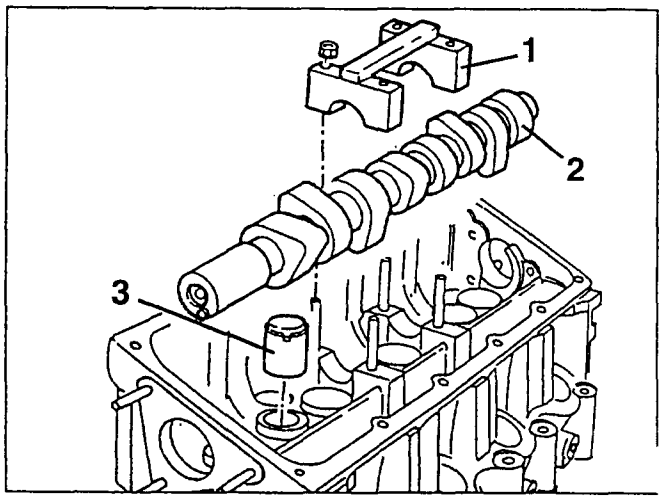
1. Unscrew the fastening nuts and remove the cam shaft caps.



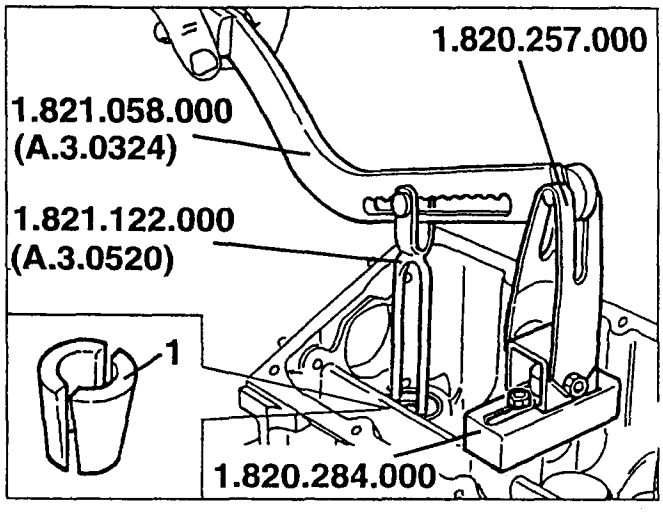
1. Install tool N° 1.820.287.000.
2. Remove the camshaft support.



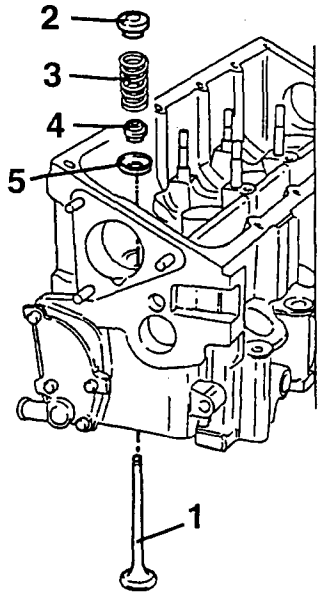
1. Remove tool installed previously.
2. Extract the camshaft.
3. Remove the valve cups complete with valve clearance adjusting plates.



- Operate on each valve as follows.
1. Using the equipment indicated in figure, remove the cotters.

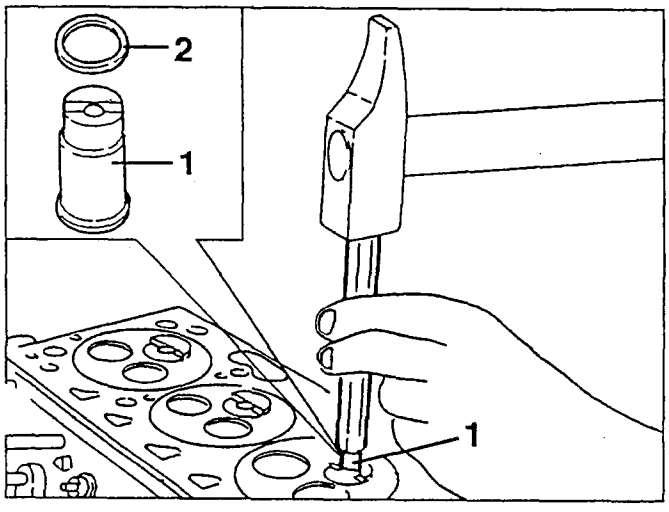


1. Extract the valve.
2. Remove the upper cap.
3. Recover the spring.
4. Using tool N° 1.821.208.000 remove the small rubber oil seal.
5. Remove the lower cap.

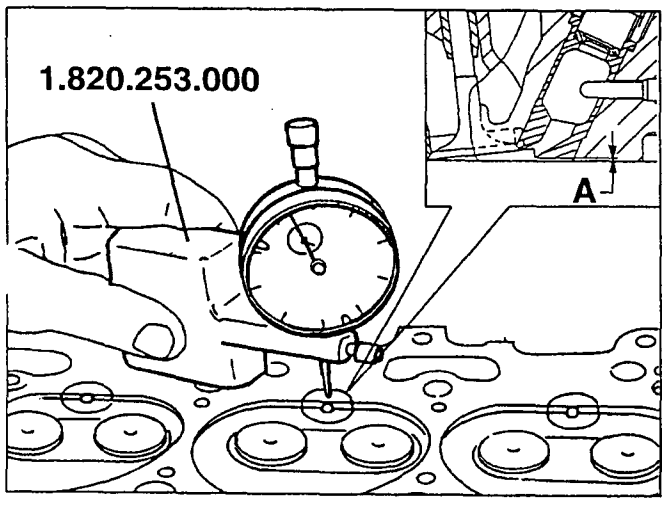


To reassemble the small rubber oil seal, use inserting tool N° 1.821.206.000.

Remove the cylinder heads from the support tools.
1. Using a suitable punch, force the combustion prechamber from its seating.
2. Remove seal ring.



During reassembly of the combustion prechamber, check that it does not protrude from plane of the cylinder heads more than the prescribed limits using tool N° 1.820.253.000.



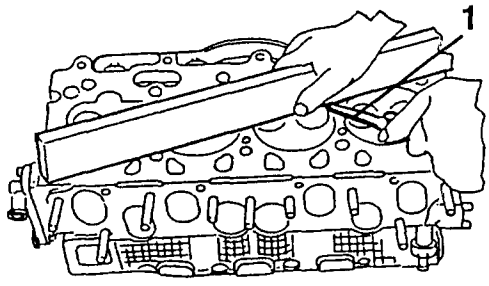
Distance "A" that precombustion chamber protrudes from plane of cylinder heads
- 0.765 ÷ + 0.055

CYLINDER HEAD CHECKS AND INSPECTIONS

Checking lower plane of cylinder heads

1. Check that the lower plane is level and, if necessary, reface.

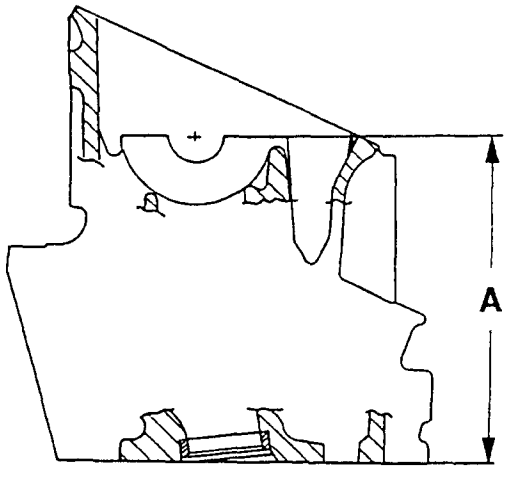
Maximum head lower plane error
0.1 mm



1. After resurfacing, check that the height of the cylinder heads exceeds the minimum value.

CAUTION:
do not exceed the minimum value as this could cause serious engine malfunction.

Minimum height "A" of head after facing
144.85 mm

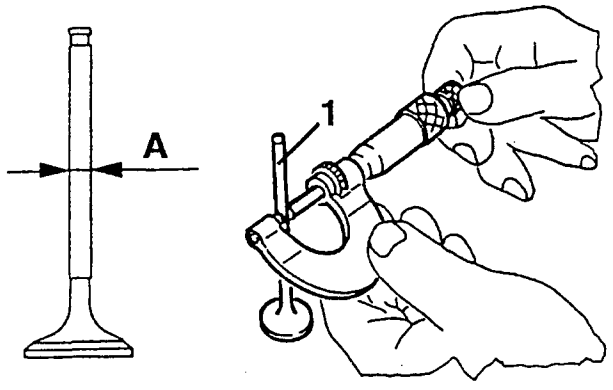


- Check that the surfacing of the lower plane of the head is of the required quality.

Clearance between valve guides and valve stems

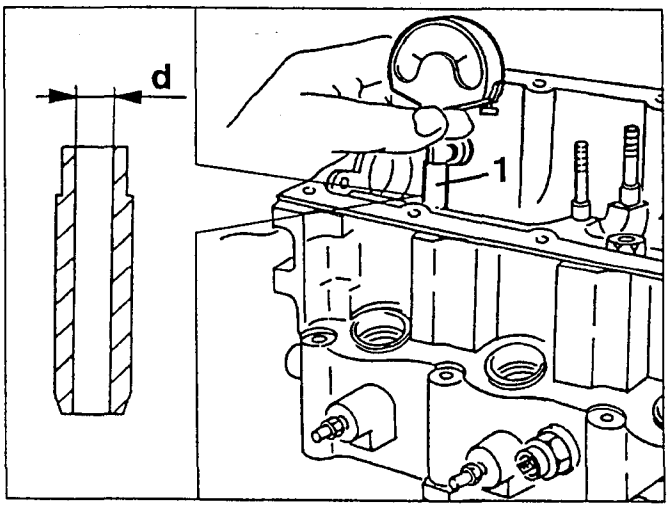
1. Measure the diameter of the valve stems and check that it falls within the prescribed limits:

Diameter of valve stems "A"	
intake and exhaust	7.974 ÷ 7.992 mm



1. Measure the inner diameter of the valve guides and check that it falls within prescribed limits.

Inner diameter of valve guides "d"	
intake and exhaust	8.022 ÷ 8.040 mm

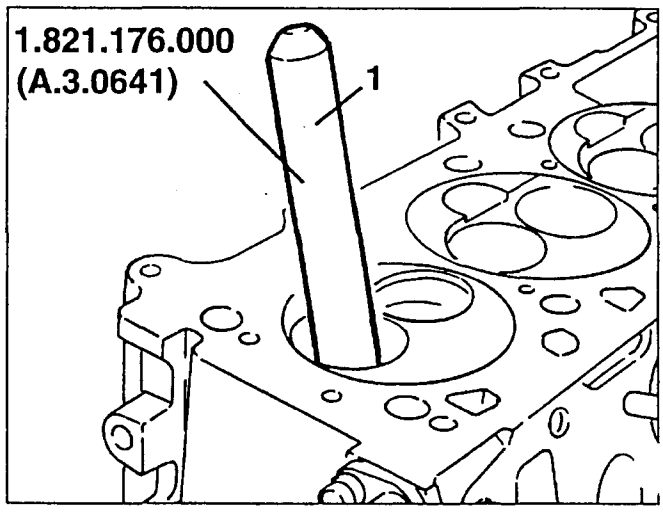


- Calculate the clearance between the guide valves and valve stems and check that it falls within the prescribed limits, if this is not the case replace the worn parts.

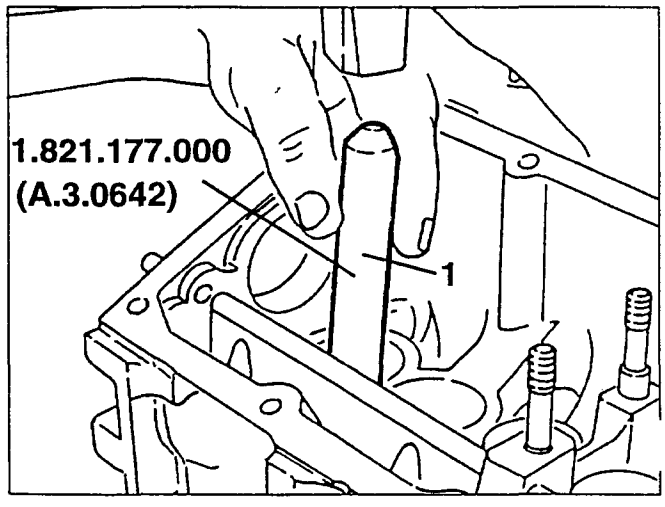
Radial clearance between valve guides and valve stems	
intake and exhaust	0.030 ÷ 0.066 mm

Replacement of valve guides

1. Extract the worn valve guides using extractor N° 1.821.176.000 (A.3.0641).

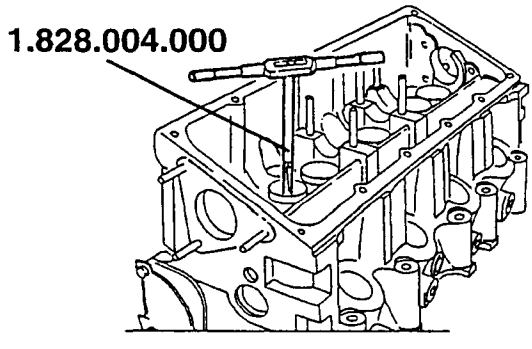


1. Insert the new valve guides using inserting tool N° 1.821.177.000 (A.3.0642).



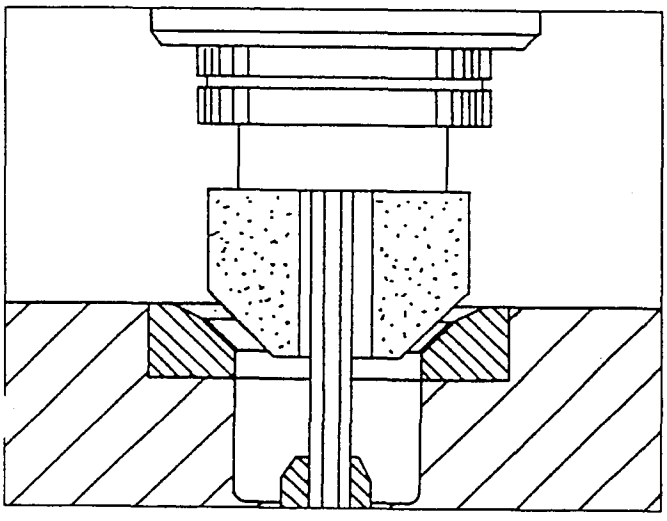
1. Using tool N° 1.828.004.000, bore the valve guides to gauge the holes to the prescribed diameter.

Inner diameter of valve guides "d"	
intake and exhaust	8.022 ÷ 8.040 mm



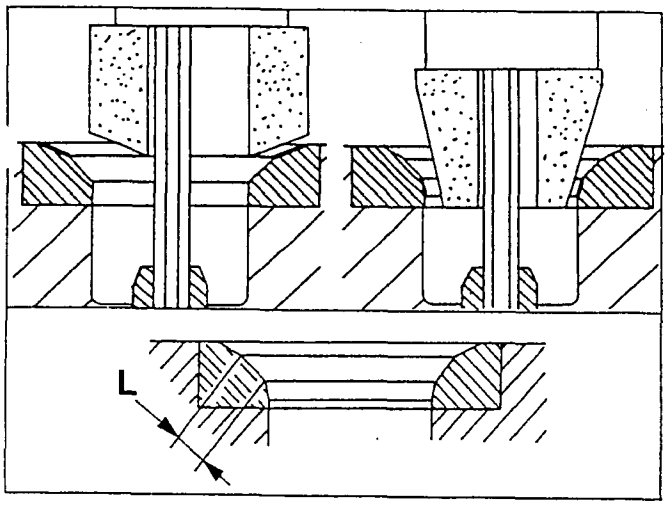
Turning of valve seatings

- If necessary, turn the valve seating using a suitable tool as follows:
• turn valve seatings with grinder at a 44° 30'.

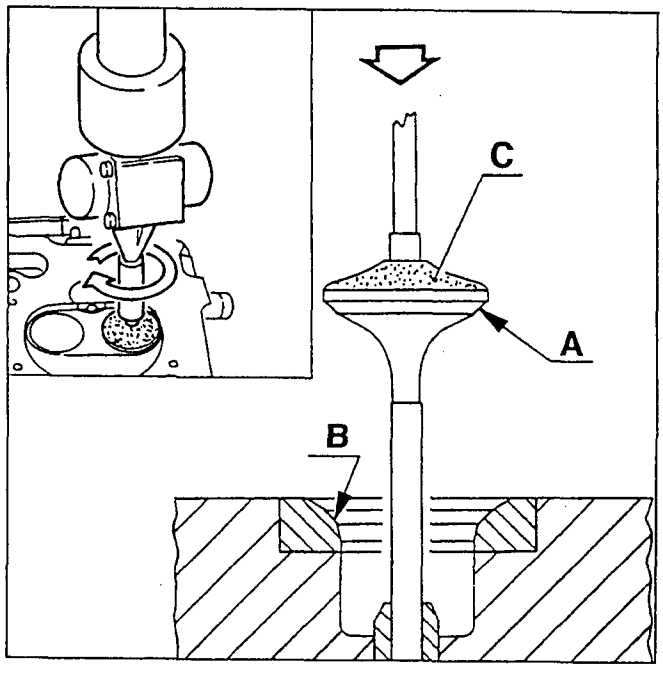


• turn valve seatings with grinder at 20° and at 75° as indicated in the figure until the prescribed value "L" is obtained.

Length "L" valve seating section with taper at 45°
~ 2.7 mm



- After turning, grind each valve in its seating as follows:
• spread the stop limit surfaces "A" and "B" of the valves and seatings with abrasive paste (SIPAL A-REXONS Carbosilicium for valve).
• lubricate the valve stem with engine oil.
• Fix the lower surface of the valve head to the suction cup "C" of a pneumatic lap.
• insert the valve into the respective guide and grind.
• after grinding, clean both the valves and their seatings thoroughly.



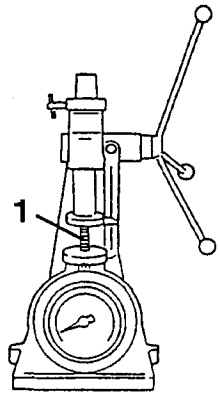
Valve springs

- Check that the "free" length of the valve springs falls within prescribed limits.

NOTE:
The planes must be parallel to each other and perpendicular to the axis of the spring with a maximum error of 2°.

Lenght of valve spring (L)
53.9 mm

1. Using a dynamometer, check that the spring's characteristics fall within prescribed limits.

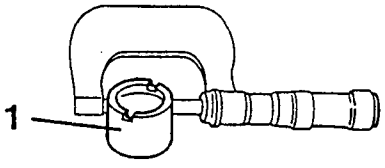


Lenght of spring mm		Control load daN (kg)
Valve closed	36	36.7 ÷ 39.6 (37.4 ÷ 40.4)
Valve open	26.5	55.9 ÷ 60.8 (57 ÷ 62)

Cclearance between valve cups and relative seatings

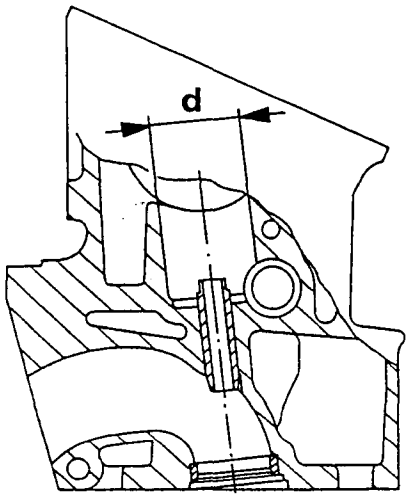
1. Measure the external diameter of the valve cups and check that it falls within the prescribed limits.

Diameter of valve cups	
intake and exhaust	36.975 ÷ 36.995 mm



- Measure the diameter of the valve cup seatings on the cylinder heads and check that it falls within prescribed limits.

Diameter of valve cup seatings "d"	
intake and exhaust	37.000 ÷ 37.025 mm



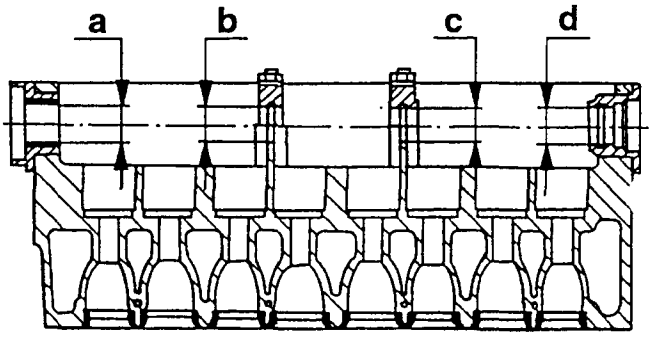
- Calculate the clearance between valve cups and relative seatings to check that it falls within prescribed limits, if not replace the worn parts.

Clearance between cups and relative seatings
0.005 ÷ 0.050 mm

Check camshaft radial clearance

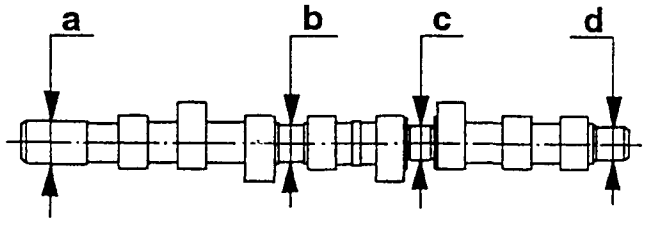
- Install the lateral supports and camshaft central caps and tighten the relative nuts to the prescribed torque.
- Measure the diameter of the camshaft supports and check that they fall within the prescribed values.

Diameter of camshaft supports	
First support (a)	29.990 ÷ 30.015 mm
Second support (b)	25.545 ÷ 25.570 mm
Third support (c)	24.045 ÷ 24.070 mm
Fourth support (d)	23.990 ÷ 24.015 mm



- Measure the diameter of the camshaft journals and check that they fall within the prescribed values.

Diameter of camshaft journales	
First journal (a)	29.945 ÷ 29.960 mm
Second journal (b)	25.500 ÷ 25.515 mm
Third journal (c)	24.000 ÷ 24.015 mm
Fourth journal (d)	23.945 ÷ 23.960 mm



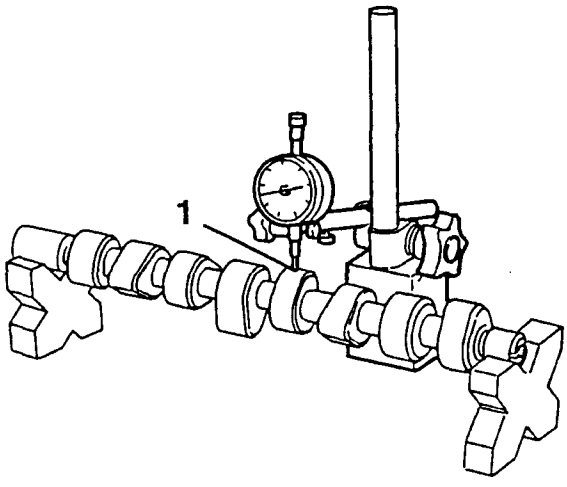
- Calculate the radial clearance between the camshaft journals and the relative supports and check that they fall within the prescribed limits, if not replace the worn parts.

Camshaft radial clearance
0.03 ÷ 0.07 mm

Check height of cams

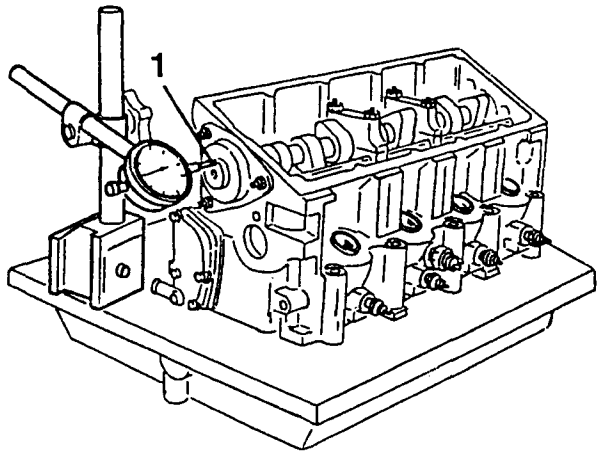
1. Measure the height of the camshaft cams and check that they fall within prescribed limits.

Minimum cam height	
intake and exhaust	8.5 mm



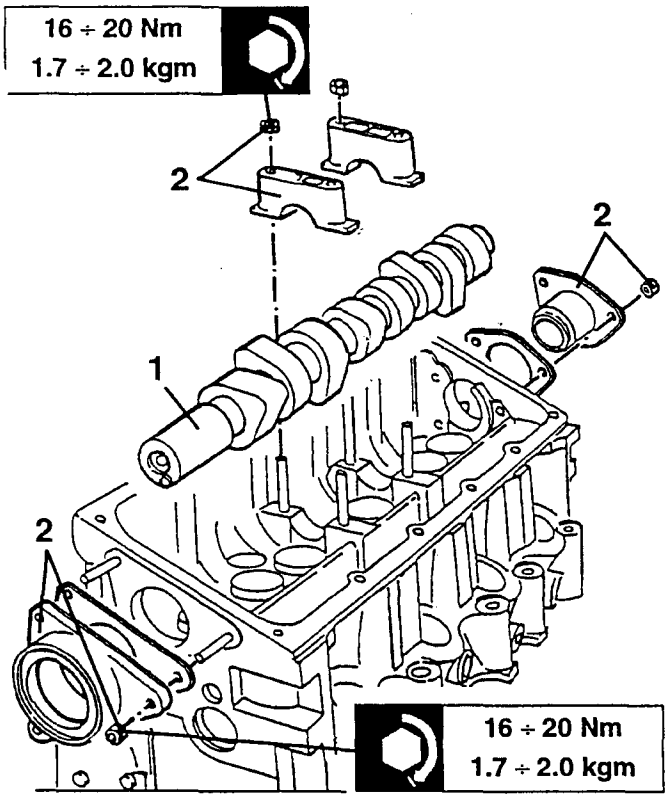
1. Apply a comparator on a suitable magnetic base and measure the axial clearance of the camshaft checking that it falls within the prescribed limits.

Camshaft axial clearance
0.1 mm



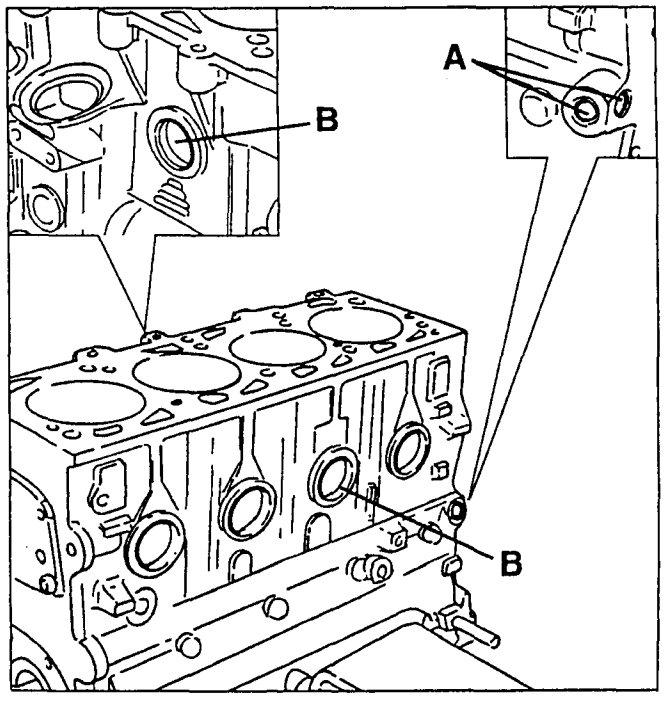
Check camshaft axial clearance

1. Position the camshaft on the cylinder heads.
2. Install the central caps and the lateral supports and tighten the relative nuts to the presecribed torque.



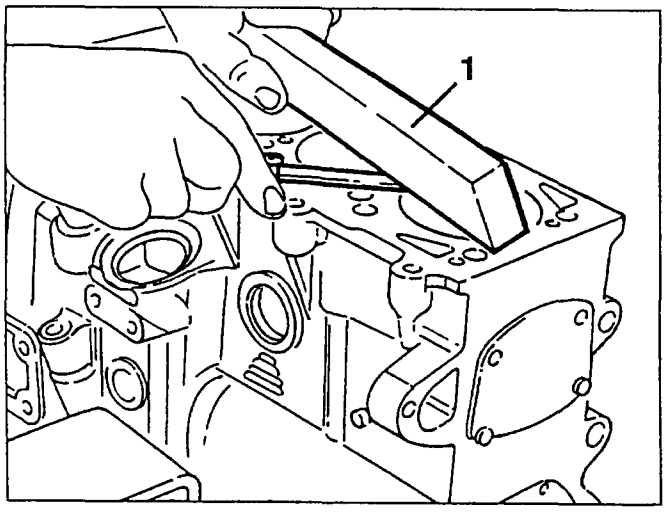
ENGINE BLOCK CHECKS AND INSPECTIONS

- Visibly check the engine block for cracks and signs of excessive wear; check the integrity of the threading.
- Remove the plugs from the lubricating and cooling ducts "A" and "B" and clean the ducts with a suitable detergent, then dry with a jet of air and replace the plugs.
- Thoroughly Clean off any fragments of gasket from the engine block plane.



1. Check the planarity of the cylinder head plane and check that it falls within prescribed values, and if necessary, reface.

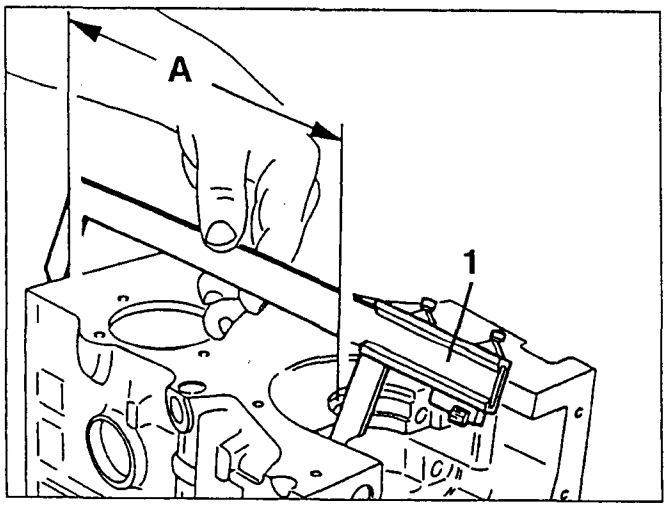
Maximum planarity error of cuylinder head plane
0.1 mm



1. After refacing, check that the engine block height "A" exceeds the minimum value.

CAUTION:
do not exceed minimum value otherwise engine may seriously malfunction.

Minimum height "A" of engine block after facing
231.93 ÷ 232.07 mm

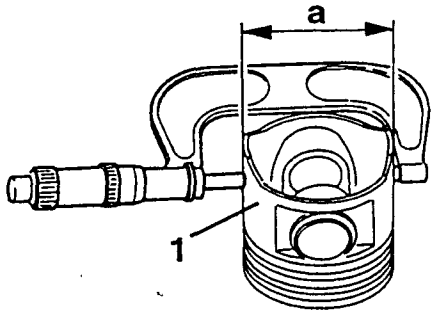


Check clearance between liners and pistons

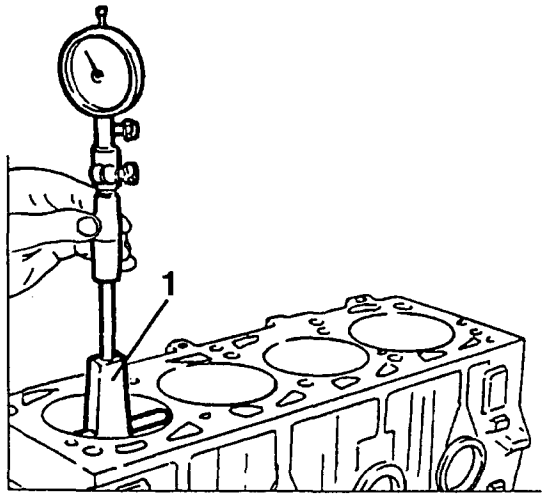
1. Measure the external diameter of the pistons and check that it falls within the prescribed values.

External diameter "a" (1)	
Class A	82.530 ÷ 82.540 mm
Class B	82.540 ÷ 82.550 mm
Class C	82.550 ÷ 82.560 mm
Class D	82.560 ÷ 82.570 mm
Class E	82.570 ÷ 82.580 mm

(1) The external diameter of the piston must be measured perpendicularly to the hole of the grudgeon pin and at a distance of 15mm from the lower edge of the skirt.



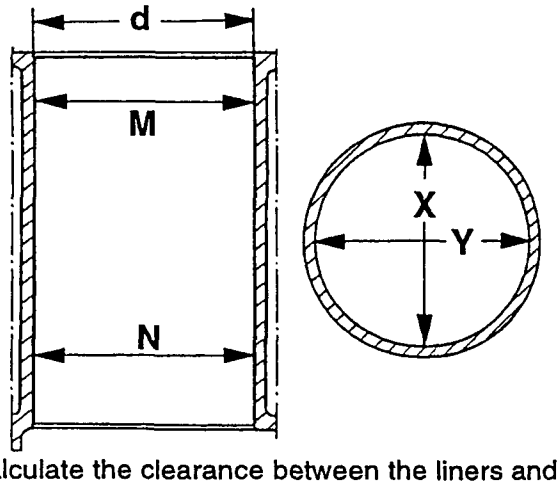
1. Measure the diameter of the cylinder liners and check that it falls within the prescribed values.



Inner diameter "d"	
Class A	82.600 ÷ 82.610 mm
Class B	82.610 ÷ 82.620 mm
Class C	82.620 ÷ 82.630 mm
Class D	82.630 ÷ 82.640 mm
Class E	82.640 ÷ 82.650 mm

Check that the taper and the ovalization of the liners falls within the prescribed values.

△	**Maximum taper**
	M - N = 0.005 mm
○	**Maximum ovalization**
	X - Y = 0.05 mm

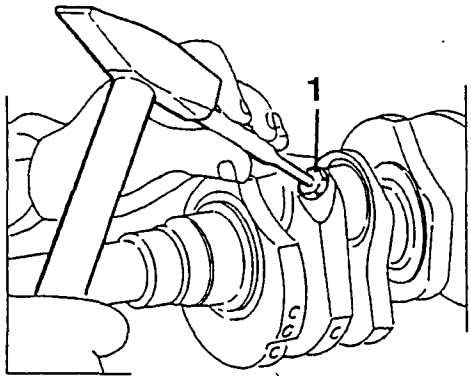


- Calculate the clearance between the liners and the pistons and check that it falls within prescribed limits.

	Clearance between liners and pistons
	0.060 ÷ 0.080 mm

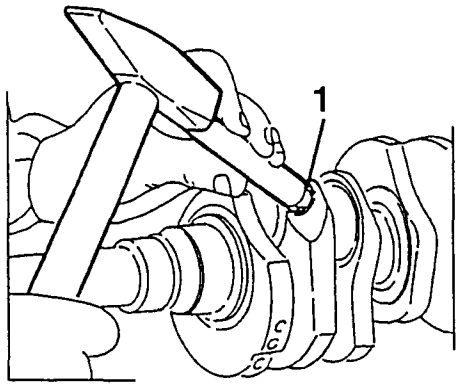
Cleaning of crankshaft lubrication ducts

1. Punch a hole in the crankshaft lubrication duct plugs, then extract them and remove any shavings created by the calking operation.

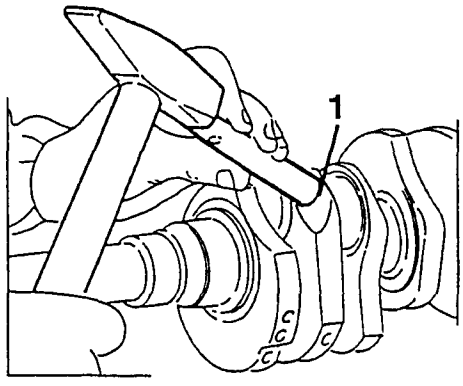


- Thoroughly clean the lubrication ducts using a suitable detergent, then dry with a jet of compressed air.

1. Apply the prescribed sealant on the new plugs and insert them, using a suitable tool, into the holes of the lubrication duct.



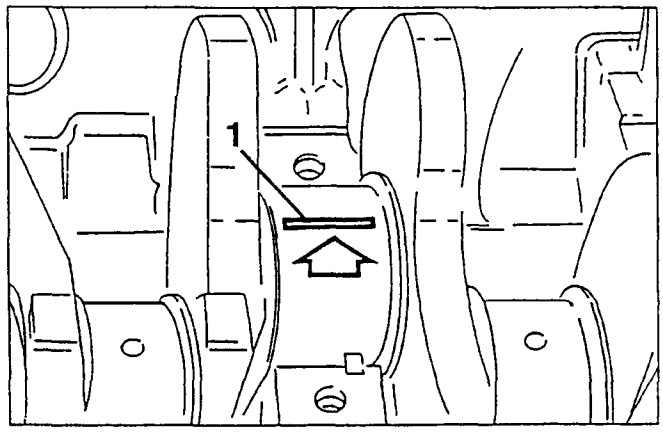
1. Calk the plugs using a suitable tool.



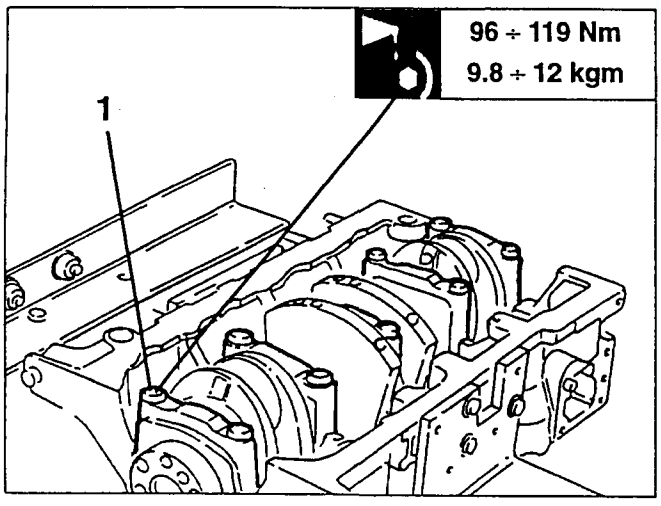
Measure the assembly clearance between the main journals and relative bearings halves using a gauged wire (plastigage)

NOTE: Check each journal without removing the crankshaft during the checking operation.
The bearing halves must be housed in their respective seatings.

1. Rest a piece of calibrated wire across the whole width of the main journal being checked, paying particular attention that it does not correspond with the lubrication hole.

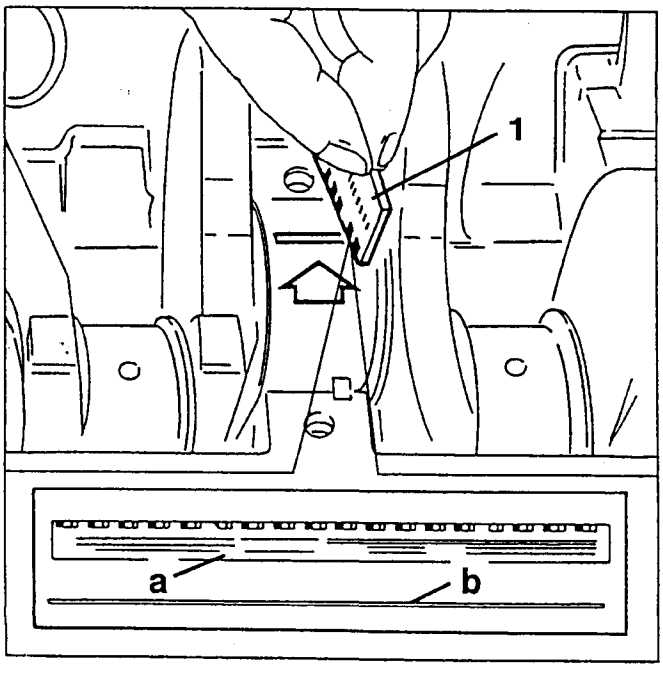


1. Tighten the lubricated main cap fastening screws to the prescribed torque.



1. Remove the main cap and compare the width of the gauged wire pressed with the scale indicated on the sachet.
From the comparison between the width of the pressed wire and the scale, it is possible to determine the clearance between the journals and the relative bearing halves.
- Proceed in the same way for the other main journals.

Radial clearance between main journals and bearing halves	
Class A (red)	0.027 ÷ 0.066 mm
Class B (blue)	0.024 ÷ 0.063 mm



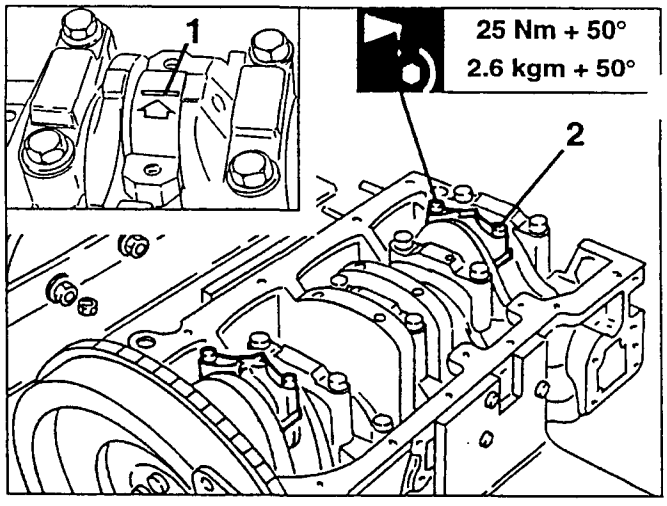
a. Sachet with comparison scale
b. Gauged wire

Measure assembly clearance between rod journals and relative bearing halves using a gauged wire (plastigage)

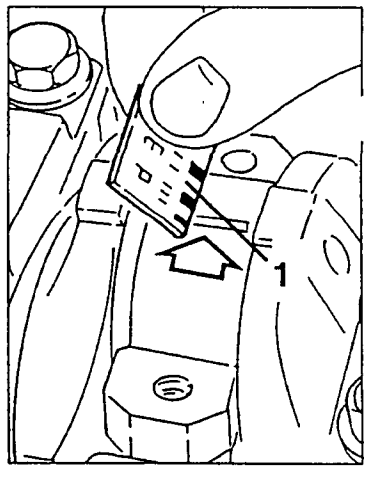
1. Rest a piece of gauged wire across the whole width of the rod journal paying particular attention that it does not correspond with the lubrication holes.

NOTE: The bearing halves must be housed in their respective seatings.

2. Tighten the lubricated rod cap fastening screws to the prescribed torque.



1. Remove the rod cap and compare the width of the pressed gauged wire with the scale indicated on the sachet.
- From the comparison between the width of the pressed wire and the scale, it is possible to determine the clearance between the bearings halves and the rod journals.



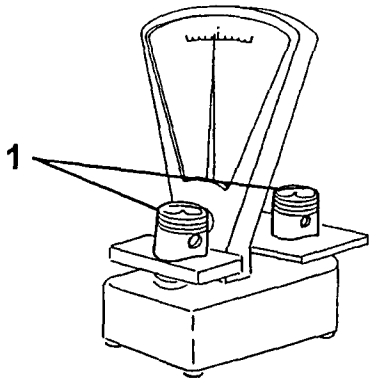
- Proceed in the same way for the other rod journals.

Radial clearance between the rod journals and bearing halves	
Class A (red)	0.026 ÷ 0.063 mm
Class B (blue)	0.023 ÷ 0.060 mm

Checking and differences in weight between single pistons and single connecting rods

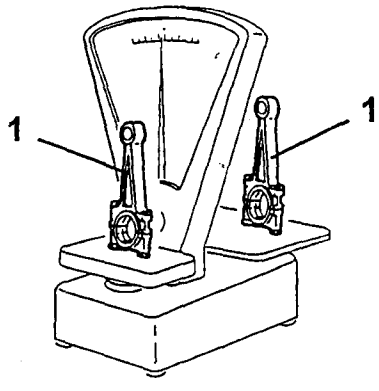
1. Weigh the pistons complete with seal rings, scraper ring, gudgeon pin and check that the difference in weight is within the specified limit.

Difference in weight between pistons
± 5 g



1. In the same way, check that the difference in weight between the connecting rods, complete with half bearings, caps and screws, is within the specified limit.

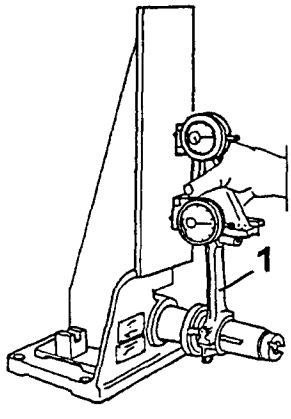
Difference in weight between connecting rods
± 2.5 g



Checking connecting rod squareness

1. Check the squareness of the connecting rods using a reference plane.

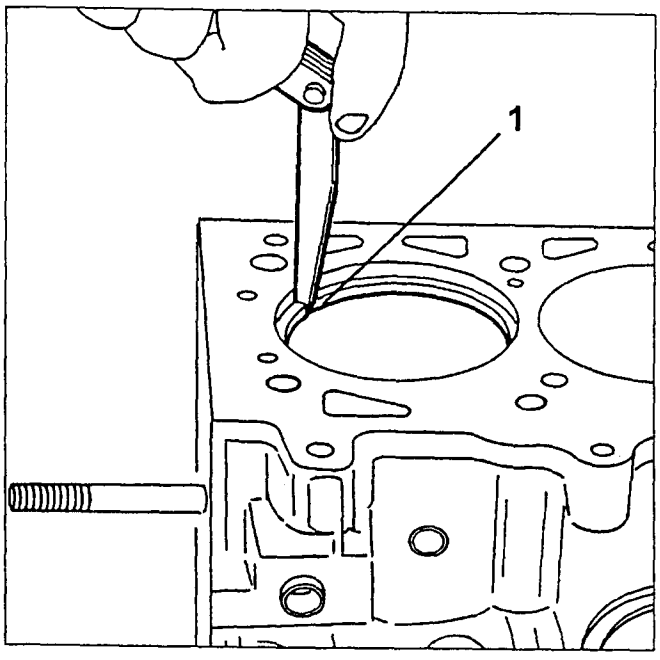
If imperfect squaring is noted, it is necessary to replace the connecting rod to avoid abnormal stresses, which would result in uneven wear of the piston and of the connecting rod itself.



Checking the seal ring gap

1. Insert the seal rings in the cylinder liner and use a thickness gauge to check that the gap is within the specified limits.

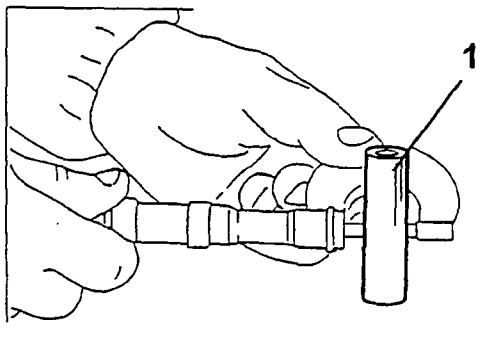
Ring gap	
First ring	0.20 ÷ 0.35 mm
Second ring	0.30 ÷ 0.50 mm
Oil scraper ring	0.25 ÷ 0.50 mm



Checking the clearance between gudgeon pin and seat on piston

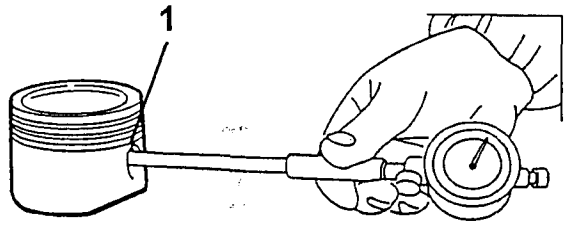
1. Measure the outside diameter of the gudgeon pins and check that it is within the specified limits.

Gudgeon pin outside diameter		
Version before change	Class 1	25.987 ÷ 25.990 mm
	Class 2	25.990 ÷ 25.993 mm
Version after change		25.987 ÷ 25.991 mm



1. Measure the diameter of the hole on the piston paired with the gudgeon pins and check that it is within the specified limits.

Gudgeon pin hole diameter in pistons		
Version before change	Class 1	25.993 ÷ 25.996 mm
	Class 2	25.996 ÷ 25.999 mm
Version after change		25.994 ÷ 25.999 mm

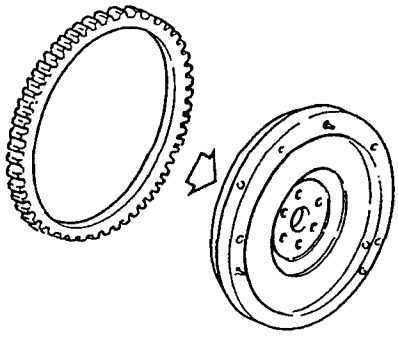


- Calculate the clearance between the gudgeon pins and their seats on the pistons and check that it is within the specified limits.

Clearance between gudgeon pins and seats on pistons	
Version before change	0.003 ÷ 0.009 mm
Version after change	0.003 ÷ 0.012 mm

Changing the flywheel ring gear

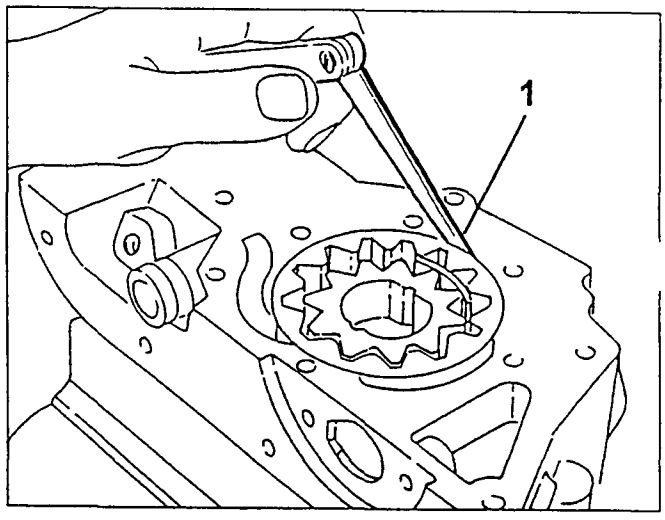
- Check that the flywheel ring gear is intact and, if necessary, replace it proceeding as follows:
- remove the old ring gear using a hydraulic press.
- carefully clean the contact surfaces of the new ring gear and of the flywheel.
- evenly heat the new ring gear to a temperature of 80 °C and fit it on the flywheel.
- allow to cool in a natural environment; do not force cool.



Inspecting and checking the oil pump

1. Check that the clearance between the pump casing housing and the driven gear is within the specified limit.

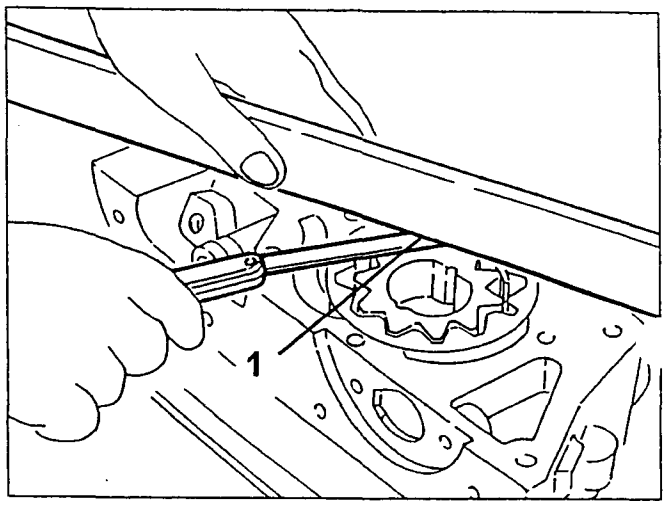
Clearance between pump casing housing and driven gear
0.080 ÷ 0.186 mm



1. Check that the clearance between the resting surface of the pump cover and the upper side of the gears is within the specified limit.

WARNING:
If the clearances are not within the specified limits, change the front cover with incorporated oil pump.

Clearance between pump cover resting surface and upper side of gear
0.025 ÷ 0.056 mm



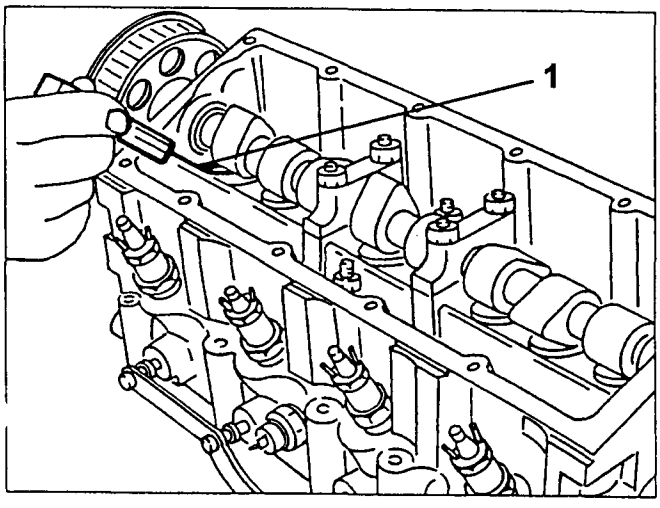
INSTRUCTIONS FOR REASSEMBLY

For reassembly operations, reverse the sequence followed for disassembly, unless otherwise specified below.

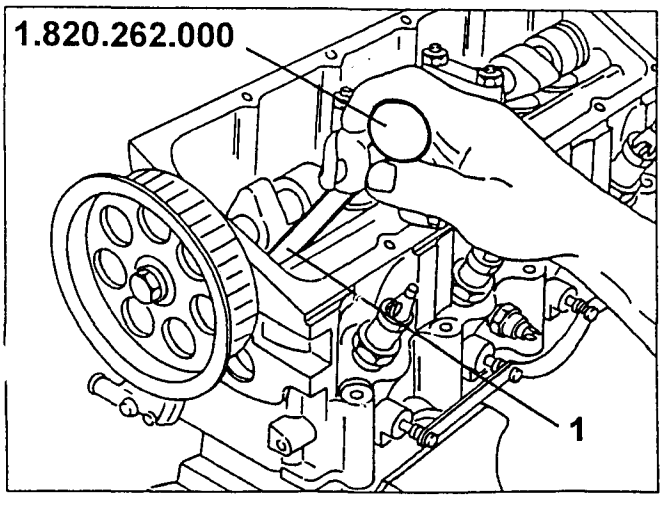
Checking and adjusting valve clearance

- After refitting the camshaft measure the valve clearance as follows:
• Turn the camshaft to take the intake and exhaust valves to the closed position.
1. Check that the clearance between the lowered radius of the cam and the corresponding tappet is within the specified limits.

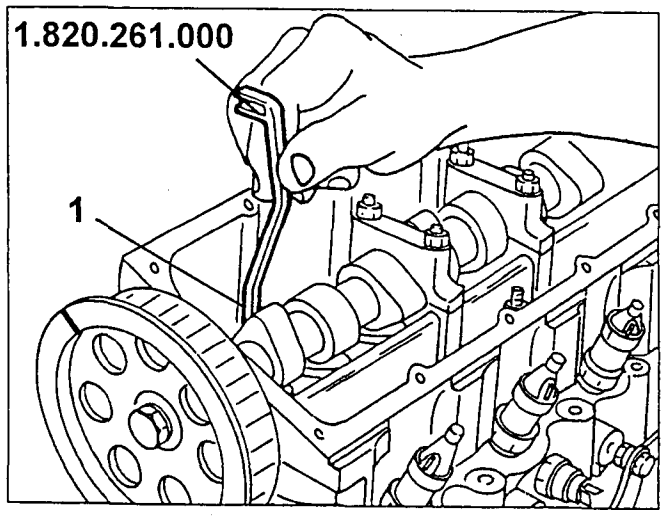
Valve operating clearance (with engine cold)	
Intake	0.30 ± 0.05 mm
Exhaust	0.35 ± 0.05 mm



- If the clearance is not within the specified limits, proceed as follows:
1. Using the pressure lever no. 1.820.262.000 lower the tappet.

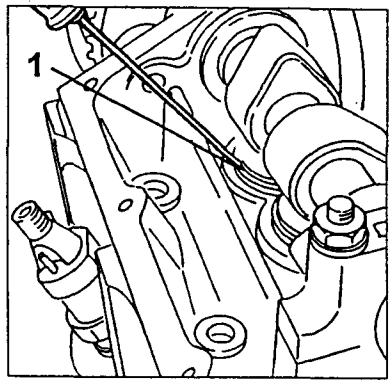


1. Position tool no. 1.820.261.000 directing the notches on the edge of the tappets to facilitate removal of the plate.



1. Prise and remove the tappet adjustment plate.

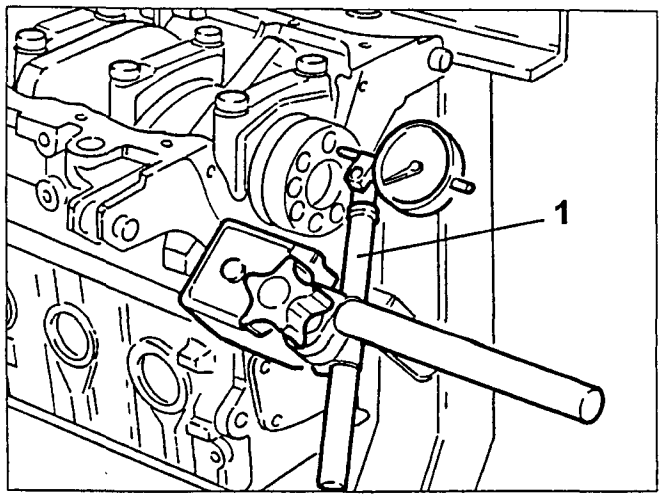
- Replace the removed plate by another one of suitable thickness to restore the correct valve clearance.



Checking the crankshaft end float

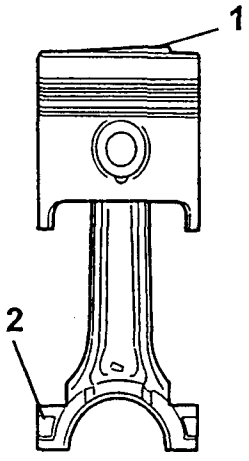
1. Using a dial gauge on a magnetic base, measure the crankshaft end float and check that it is within the specified limits.

Crankshaft end float
0.049 ÷ 0.211 mm



Refitting pistons and connecting rods

- Turn the crankshaft until the connecting rod pins of the 1st and 4th cylinder reach the position corresponding to the B.D.C.
- Assemble the pistons - connecting rods in the sequence illustrated below.



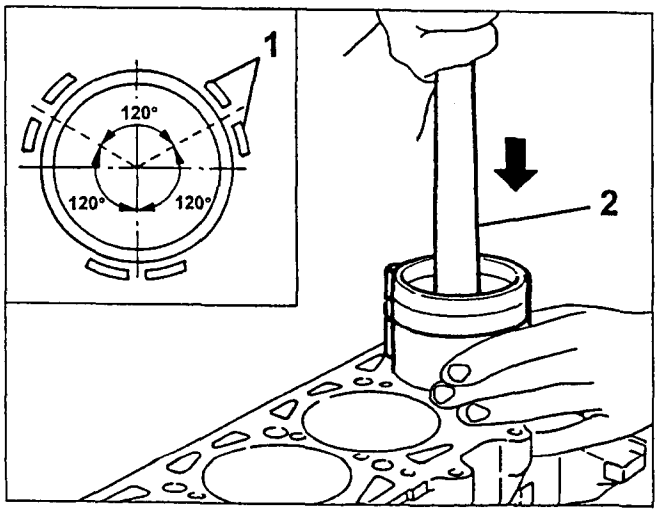
1. Protrusion on piston crown
2. Number of cylinder to which connecting rod belongs

- House the corresponding half bearings on the connecting rod big ends.

Carefully clean the outer surfaces of the half bearings and their seats.

1. Place the rings in the pistons with the notches offset by 120°.
2. Using a suitable tool, insert the pistons and connecting rods in the 1st and 4th cylinder.

Assemble the connecting rod-piston sets directing the number of the cilinder stamped on the connecting rod small end towards the intake - exhaust side.

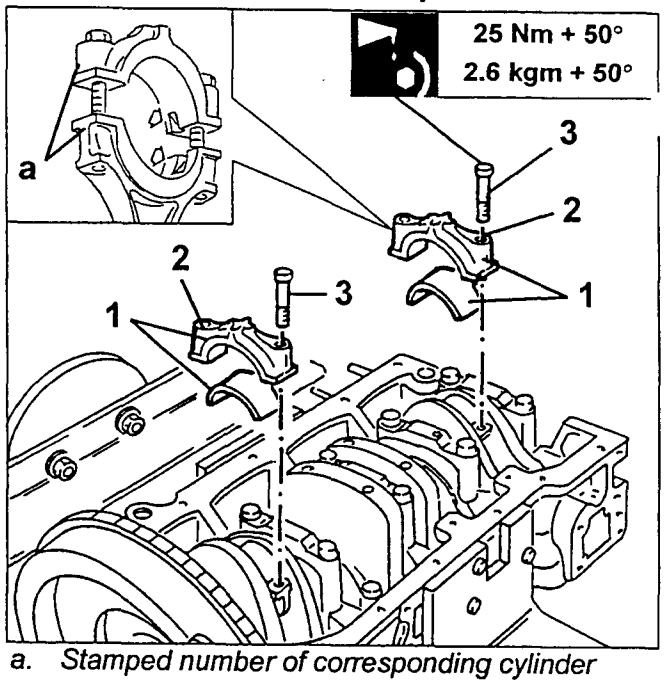


- Turn the crankcase 180°.
1. House the corresponding half bearings on the connecting rod caps.

2. Assemble the connecting rod caps of the first and fourth cylinder with the safety notch on the same side as the one on the connecting rod.

On the side, the connecting rod caps have the number of the cylinder to which to which they belong; during reassembly this number should be on the same side as the one stamped on the connecting rod big end.

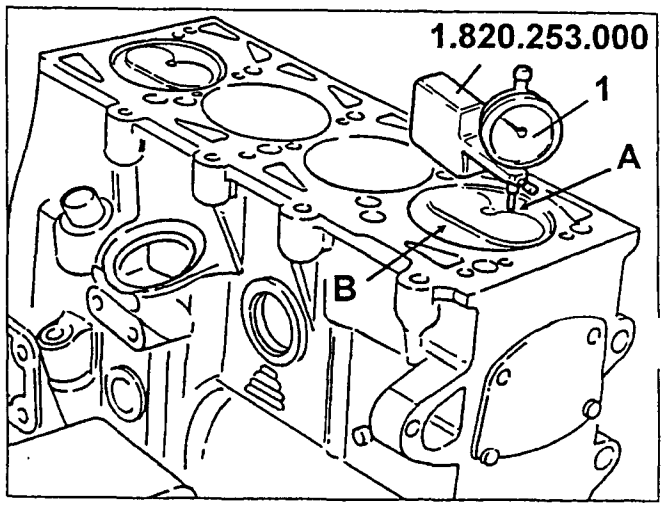
3. Tighten the connecting rod cap fastening screws to the specified torque in oil.
- In the same way reassemble the pistons and connecting rods of the 2nd and 3rd cylinder.



a. Stamped number of corresponding cylinder

Cylinder head refitting

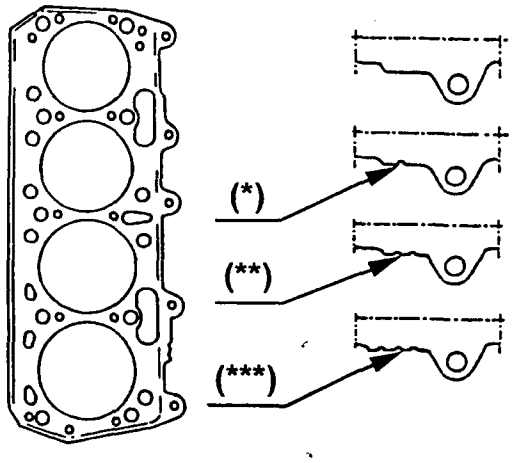
1. Using tool no. 1.820.253.000 fitted with dial gauge, find for each cylinder in points A and B the protrusion/recess of the piston; calculate the average of the values and consider the highest average among the pistons to define the seal.



- Choose the cylinder head seal of suitable thickness according to the table given below.

Average piston protrusion		Thickness o cylinder head seal
up to engine no. 1762797	from engine no. 1762798	
< 0.7 mm	< 1.05 mm	1.67 mm
0.7 ÷ 0.8 mm	1.05 ÷ 1.15 mm	1.75 mm (*)
0.8 ÷ 0.9 mm	1.15 ÷ 1.25 mm	1.85 mm (**)
> 0.9 mm	> 1.25 mm	1.93 mm (***)

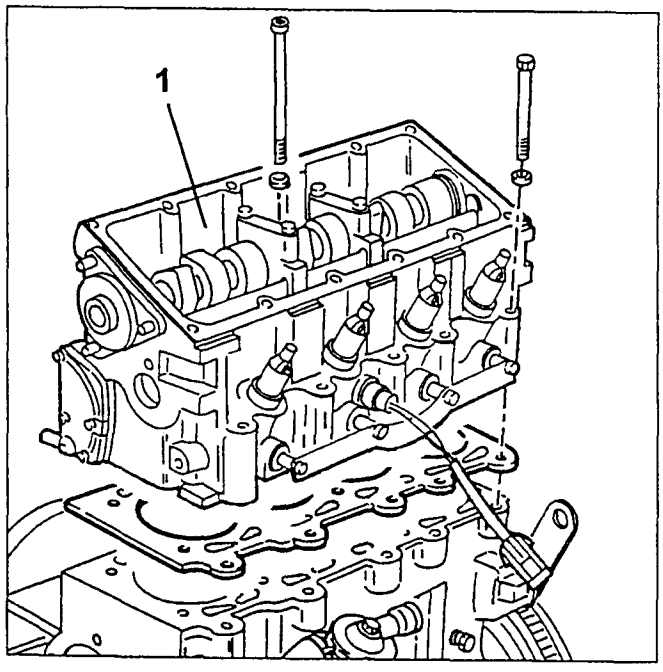
(*) marked by 1 notch on the outer edge
(**) marked by 2 notches on the outer edge
(***) marked by 3 notches on the outer edge



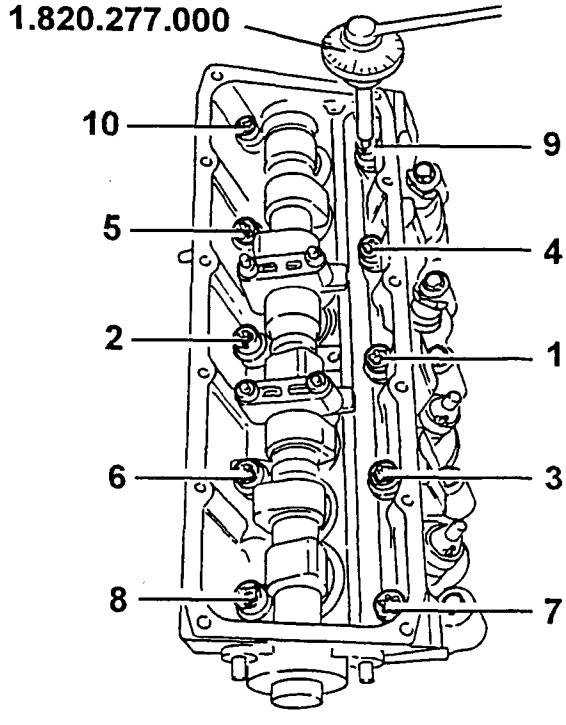
The cylinder head seal is of the ASTADUR type. Due to the special material with which it is made, this seal polymerises when the engine is running therefore it hardens considerably.

CYLINDER HEAD SEAL ASSEMBLY
For the cylinder head seal to polymerise, it is necessary:
- to keep the seal in its original package;
- take the wrapper off shortly before assembly;
- not to lubricate or soil the seal with oil;
- during assembly, carefully clean the surfaces of the cylinder and crankcase.

1. Assemble the cylinder head on the crankcase.



- Tighten the **inner screws** fastening the cylinder head as described below, bearing in mind that, for each step, the tightening sequence is the one shown below.
- Tighten the **inner screws** to a torque of 100 Nm (10.2 kgm).
- Angle tighten by 90° + 90° the **inner screws** using graduated disk no. 1.820.277.000.



- Tighten the **outer screws** fastening the cylinder head to the crankcase to a torque of 26 ÷ 32 Nm (2.6 ÷ 3.2 kgm).

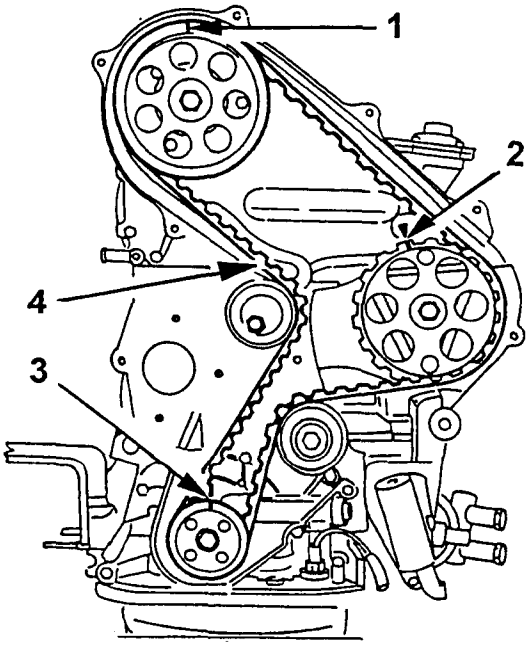
NOTE: **For tightening the cylinder head outer screws no particular sequence is required.**

WARNING:
ASTADUR seals are paired with cylinder head fastening screws of the type with tightening to the yield point.
With the adoption of ASTADUR seals it is no longer necessary to tighten the cylinder head fastening screws at the first service coupon.

Camshaft drive belt assembly and checking valve gear timing

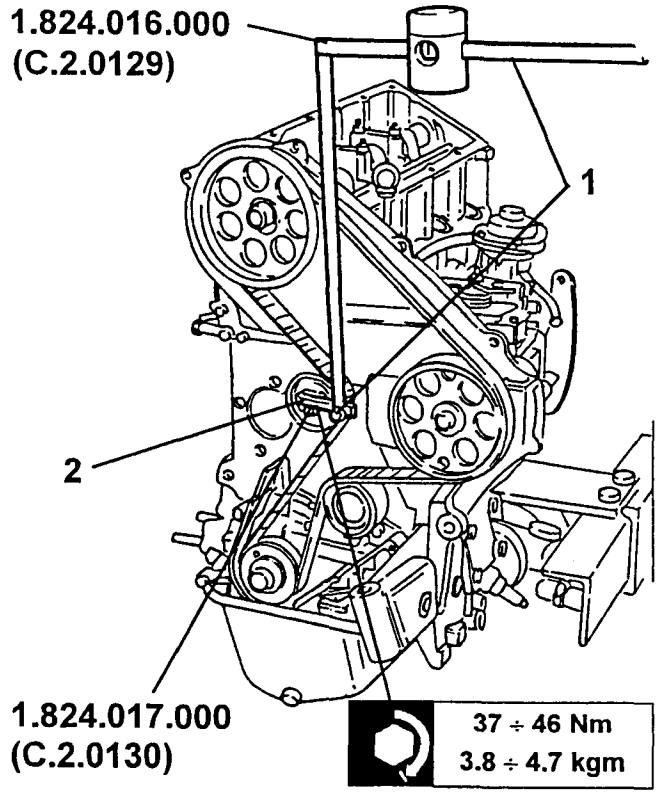
- Refit the camshaft toothed pulleys, the pulley guide and the belt tensioner.
1. Direct the camshaft drive pulley so that the notch on it corresponds with the hole on the camshaft belt rear cover.
2. Direct the injection pump drive pulley so that the notch on it corresponds with the relief on the camshaft belt rear cover.
3. Turn the crankshaft until the reference notch of the camshaft belt drive pulley is aligned with the relief on the engine front cover.
4. Assemble the toothed belt, checking correct mating of the teeth on all the toothed pulleys.

When assembling the toothed belt, to avoid damaging the structure of the fibres that form it, never cause sharp bends.



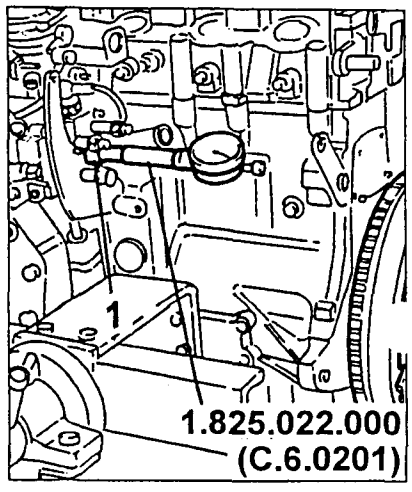
- On tool no. 1.824.016.000 (C.2.0129) assemble support no. 1.824.017.000 (C.2.0130), then position the weight, with the knurled piece, at a distance of 120 mm on the millimetred rod and lock it.
1. Apply the tool assembled in this way on the belt tensioner, as illustrated. Working on the joint, direct the millimetred rod so that it is horizontal.
- Settle the toothed belt turning the crankshaft twice in its normal direction of rotation.
2. Tighten the belt tensioner fastening nut to the specified torque.

During this phase, the millimetred rod may move from its horizontal position; in this case it is necessary to work on the belt tensioner again to restore the original position of the millimetred rod and repeat the operation.

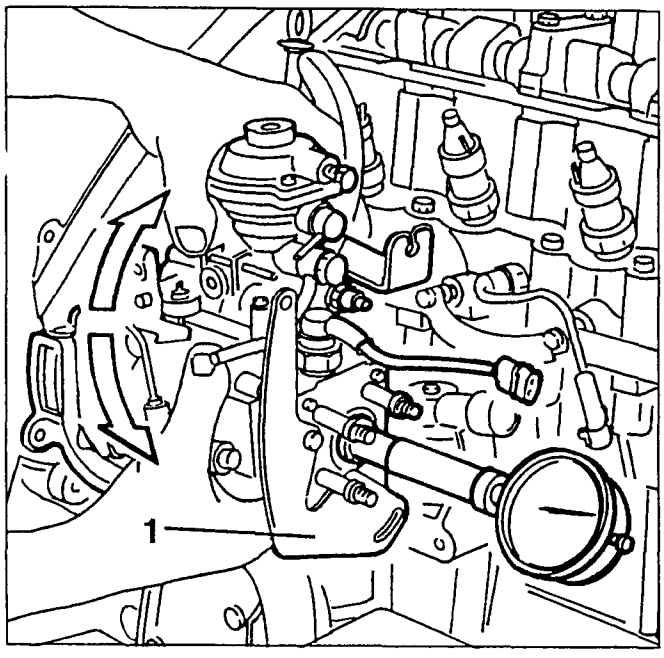


Injection pump timing

1. Remove the plug on the pump cover and in its place screw on tool no. 1.825.022.000 (C.6.0201) complete with dial gauge with the feeler in contact with the crown of the distributor piston.



- Using a suitable tool, rotate the engine in the opposite direction to the normal rotating direction until the timing piston of the pump reaches the B.D.C. indicated by the comparator; when in this position set the latter to zero.
- Rotate the engine in the normal rotating direction until the piston of cylinder N° 1 is at the T.D.C.
In this position the piston will have carried out a **0.8 mm** stroke as indicated on the comparator.
1. If this stroke is not indicated, the pump body must be rotated in its slot until the correct value, as indicated on the comparator, is obtained then tighten the screws fastening the pump to the support.



WHEN REASSEMBLY IS COMPLETED carry out all the checks and inspections required by ordinary maintenance (see GROUP 00) and the checks regarding the supply system (see GROUP 04) and the cooling system (see GROUP 07).

INSPECTION OF LUBRICATION CIRCUIT ELECTRICAL COMPONENTS

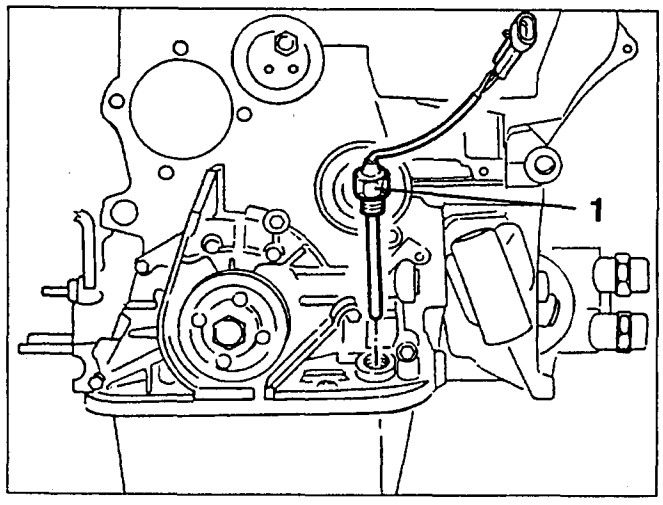
- Engine oil level sensor.
- Engine oil temperature sensor.
- Engine oil minimum pressure warning light.

As regards the other sensors and electrical components located in the engine compartment, refer to the specific groups where they are described in detail.

Engine oil level sensor

1. Check the setting of the engine oil level sensor; If the prescribed values are not found, replace the sensor.

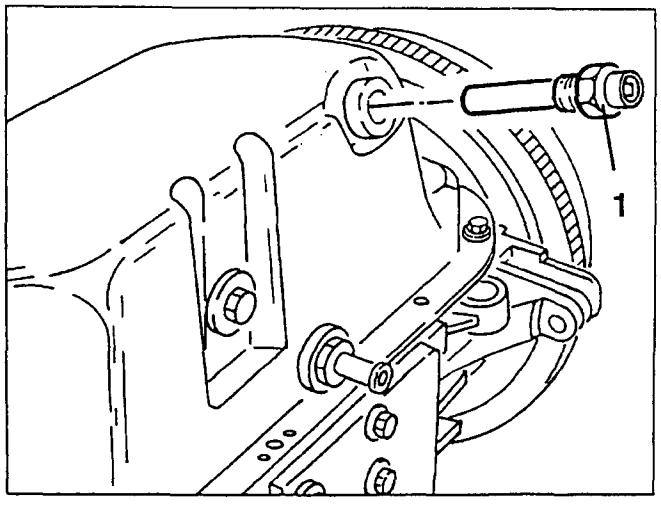
Circuit resistance	12Ω ± 5%



Oil temperature sensor

1. Check the setting of the engine oil temperature sensor; If the prescribed values are not found, replace the sensor.

Temperature °C	Resistance Ω
60 ± 0.5	525 ÷ 605
90 ± 0.5	195 ÷ 215
120 ± 0.5	82 ÷ 94
140 ± 0.5	49 ÷ 55

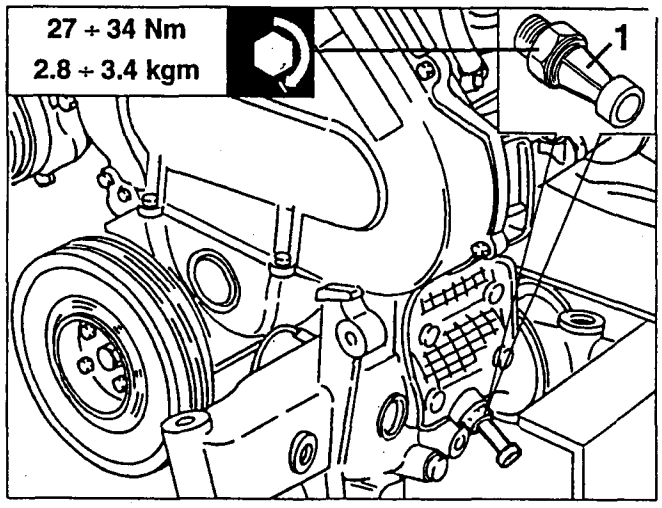


Engine oil minimum pressure warning light sensor

1. Check the setting of the engine oil minimum pressure warning light sensor; if the prescribed value is not found, replace the sensor.



Contact opening/closing pressure	0.2 ÷ 0.5 bar



INDEX

GENERALITIES 1598 T. SPARK 16V 1747 T. SPARK 16V

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OVERHAULING 1598 T. SPARK 16V 1747 T. SPARK 16V

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GENERALITIES 1370 T. SPARK 16V

- Description . . . . . (*)
- Lubrification . . . . . (*)

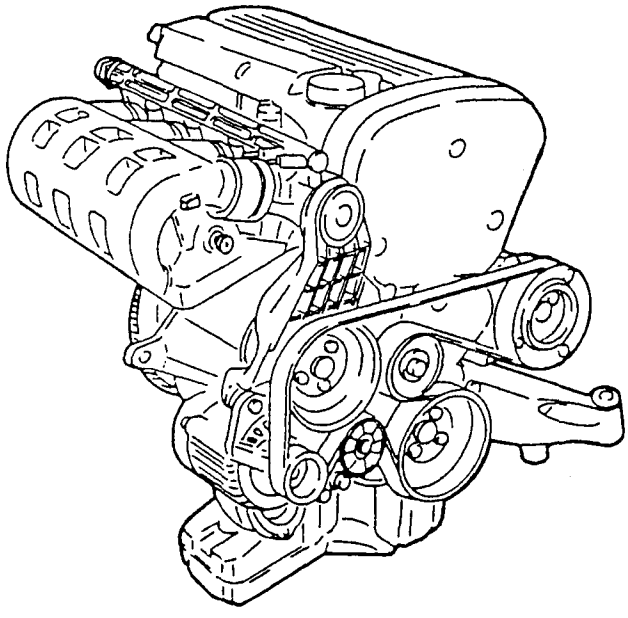
OVERHAULING 1370 T. SPARK 16V

- Introduction. . . . . (*)
- Engine dis-assembly . . . . . (*)
- Cylinder head dis-assembly. . . . . (*)
- Checks and inspection cylinder head. 32
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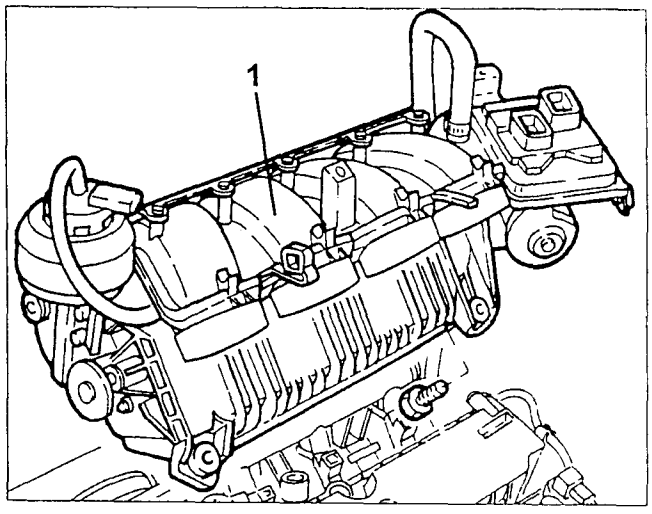
(*): See 1598 T. SPARK 16V 1747 T. SPARK 16V

DESCRIPTION

Four cylinder in line engine with double camshaft in head, four valves per cylinder, phase variator, static injection and twin ignition controlled by a single ECU.
The rear engine is connected to the clutch-gearbox-differential unit which constitutes a sole assembly.
The engine is installed frontally and transverse at a 18°30 slant.
The engine is "suspended" by means of two damper mounts to the underbody and one scissors mount to the suspension crossmember. To contain vibrations, the engine top is connected to the underbody by means of a shock-proof connecting rod.
All belts are fitted with automatic take-up devices to ensure long belt working life.
The fuel feed system (unleaded petrol) is fitted with suitable pollution prevention devices which ensure low exhaust emissions as per "EEC PHASE 2" standards.

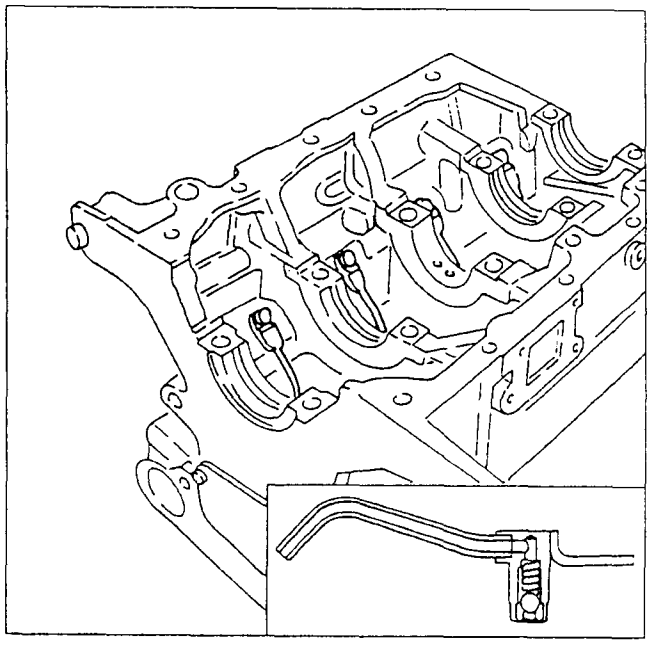


M1.5.5 injection-ignition engines are fitted with a plastic intake manifold (with variable geometry 1747 cc versions) instead of an aluminium intake manifold.
The fuel feed system is returnless, i.e. with a single feed pipe.

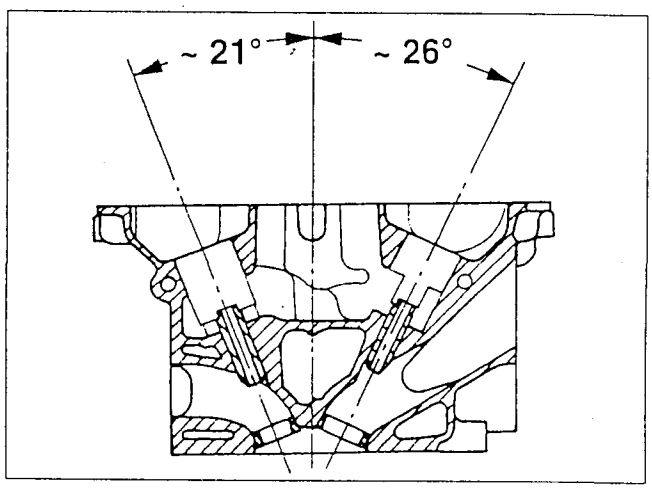


CRANKCASE

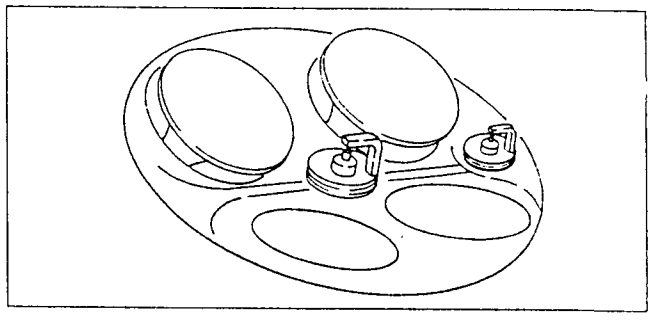
The engine block is made of high mechanical resistance cast iron.
The crankshaft is supported by means of five main journals which house five thin casing half-bearings.
The cylinders are directly cut into the crankcase and are selected according to three size classes plus three oversized classes.
Specific ducts in the crankcase walls ensure the passage of coolant and lubrication oil.
A nozzle, which sprays oils on the top of the piston thus ensuring partial cooling, is fitted in the lower part of each cylinder.



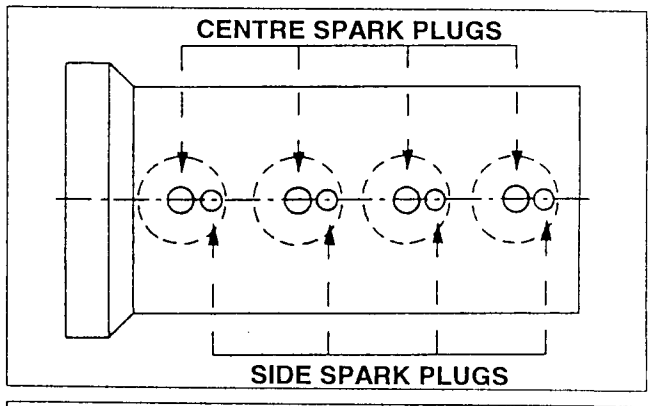
CYLINDER HEAD



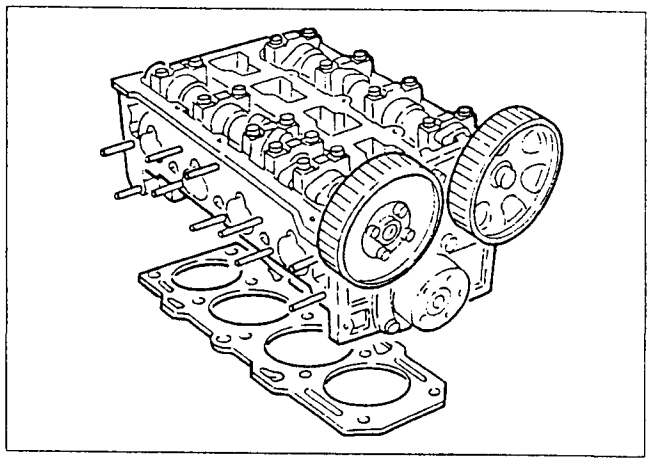
Monolith, compact, mould-cast aluminium and silicon alloy.
The four valves per cylinder are fitted in their respective V guides at approximately 47° and are controlled by two camshafts by means of hydraulic tappets.



The space is organised so that the combustion chambers can house the four valve caps and the central and side spark plug holes without weakening the head structure.
The central spark plugs (larger) at tightened at a torque of 25 - 35 Nm, while the side (smaller) spark plugs are fastened at a torque of 10 - 12 Nm.
They should be replaced every 100,000 km.
The twin spark plugs positioned in this fashion, the two intake valves and the two exhaust valves ensure uniform distribution of the mixture and optimal combustion with improved engine thermal performance and reduced harmful emission in exhaust.



The camshaft on intake side turns on six journals. The camshaft on exhaust side turns on five journals. The shafts are controlled with a timing belt.
The valve seats are fitted in the cylinder head after it is heated to a temperature of 80°C. The seats are then cooled with liquid nitrogen. The valve guides are fitted in their seats in the cylinder head. Interference and internal diameter is perfected after assembly with a specific borer and controlled by means of a go-no-go set of gauges. The cylinder head and crankcase seal is made of aramide fibre. No head re-torque is required for the entire life of the engine.

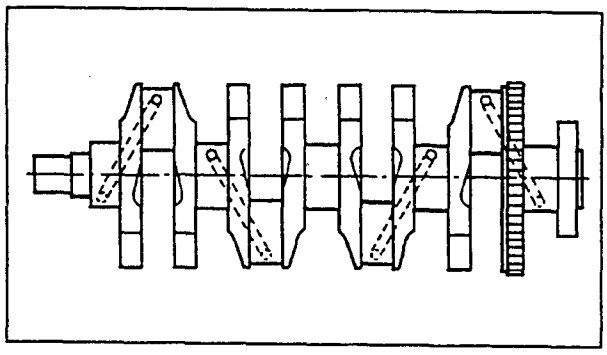


OIL SUMP

The oil sump is a structural part of the engine with mechanical functions.
It contains the engine oil and is directly connected to the gearbox and to the rear engine mount.
It is made of die-cast aluminium alloy and features internal shock-proof partitions.
It is fastened to the crankcase with a specific sealant.

CRANKSHAFT

This is forged in high strength alloy steel, induction tempered on the journals and rolled on the grooves.
It rests on five main bearings and its end float is adjusted by two half rings housed in the centre main bearings.
Eight counterweights accurately balance the rotating masses.
A groove runs inside the shaft to lubricate the main and connecting rod journals.
At the rear of the crankshaft there is the phonic wheel for detecting the rpm and timing sensor.



MAIN AND ROD BEARING HALVES

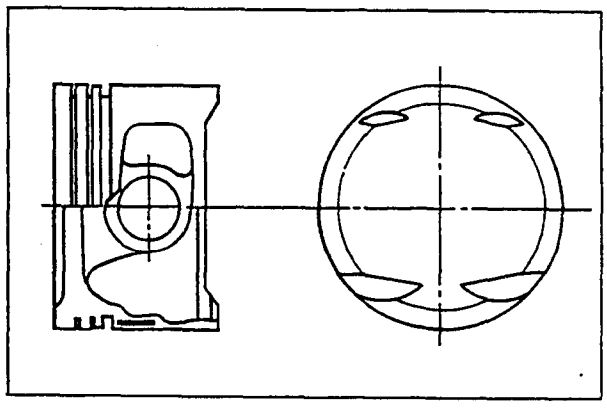
These are of the three-metal, thin shell type and they are divided into three dimensional classes.

FLYWHEEL

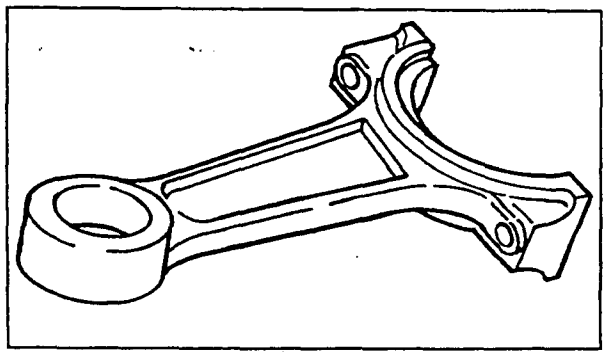
This is in cast iron with a hardened ring gear and suitably balanced.

PISTONS AND CONNECTING RODS

The pistons are in aluminium-silicium alloy with self-heating inserts and are divided into three dimensional classes. To ensure correct assembly an arrow is stamped on the piston crown to indicate the direction of rotation of the engine.
The piston crown is concave and has four notches to prevent interference with the valve mushrooms.

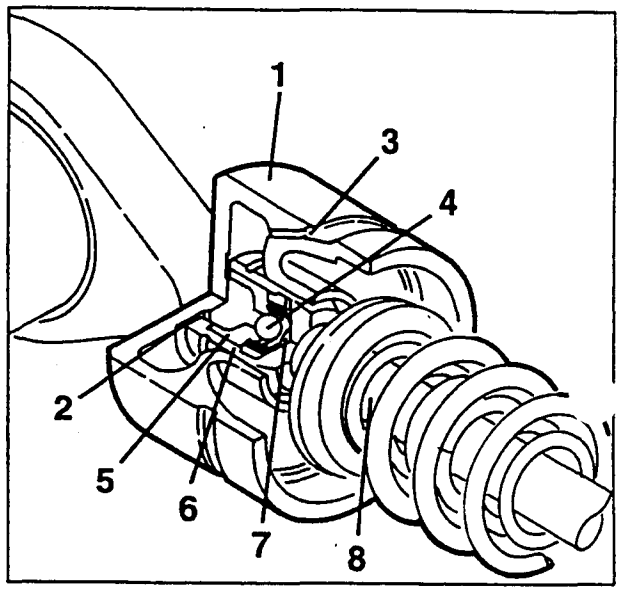


The connecting rods are in hardened and tempered alloy steel, with a bushing in copper alloy force-fitted for coupling with the piston gudgeon pin.
As the gudgeon pins are floating on the piston hubs and on the bushing force-fitted in the connecting rod small end, their side movement is stopped by two expanding circlips housed in the special hollows machined on the actual hubs.



VALVE GEAR TIMING

Direct drive by toothed belts with automatic tensioner and with overhead camshaft in cast iron with induction tempered cams and bearings. The hydraulic tappets, in contact with the cams, control the valves directly. This device automatically eliminates "valve play" when the engine is running thereby dramatically reducing the need for periodical maintenance.



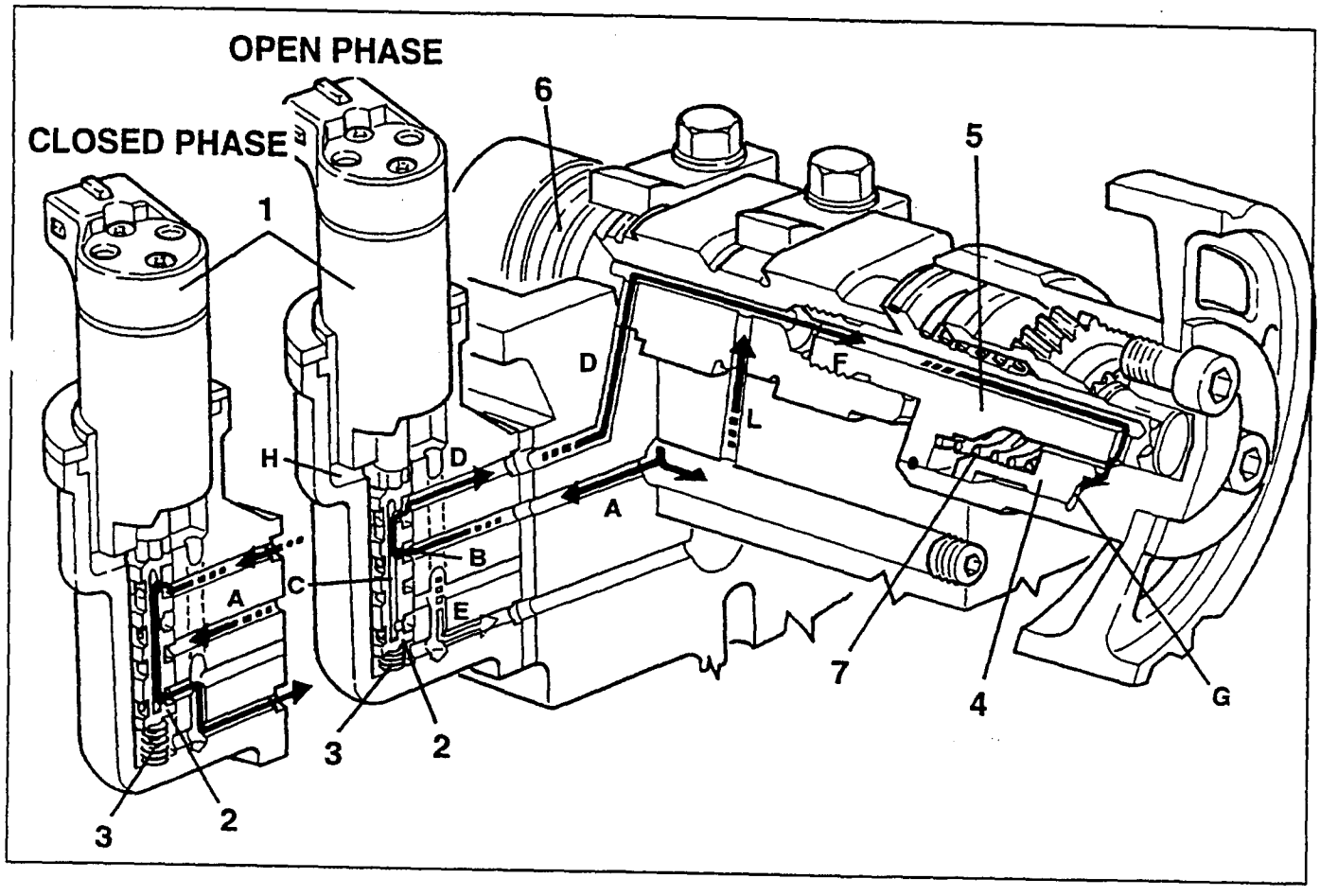
1. *Cup*
2. *Oil passage between chambers*
3. *Oil inlet groove*
4. *Check valve*
5. *Piston*
6. *Cylinder*
7. *Pressure chamber*
8. *Valve stem*

The stem of the exhaust valves is chromium plated and has a cavity inside filled 50 ÷ 60% with sodium to improve dispersion of the heat to which they are subjected.
The valve seats are sintered and made from material suitable for the use of unleaded petrol.

TIMING VARIATOR

This is of the simplified type which ensures considerable timing precision, rapid intervention and high mechanical reliability. It is coupled to the intake pulley and fitted with two half bearings which support it. The inner parts nitrided and an O-Ring keeps the oil inside when the engine is not running. In order to reduce the size of the engine, the actuation valve seat has been machined on the intake manifold with suitable grooves which also involve the cylinder head, to regulate the flow of oil to the variator.
- The purpose of this device is to change the intake valve timing according to the engine load and speed required; this parameter is received and processed by the control unit in the form of an electric signal sent by the air flow meter and rpm sensor and transmitted as a command to the electromagnet via a relay.
- When the closed phase is required (idling and full power area), the electromagnet (1) is de-energized, thus the valve distributor (2) pushed by the counter spring (3), stays up preventing the passage of the oil leading from groove (A) from reaching the variator.
In this case the timing of the intake valves remains unchanged (closed).
- If the open phase is required (average speeds at high torque), the electromagnet (1) is energized, thus pushing the valve distributor (2) downwards. In this position the oil, leading from groove (A), enters chamber (B) of the piston, from where it passes through a special hole into groove (C) machined inside the latter.
The oil can only leave this groove through the upper hole (in communication with the oil delivery duct (D) to the variator) as the lower hole no longer leads to the exhaust duct (E) because the valve distributor (2) is lowered.
The oil passes through duct (D) and (F) and reaches the chamber (G) moving piston (4) axially towards the engine. The outside of piston (4) is fitted with helical teeth and as a result of the above-mentioned axial movement it is forced to move clockwise (as seen from the timing side). The rotation is transmitted through a straight-toothed grooved profile to the pinion (5) which is screwed onto the threaded lug of the camshaft (6) and transmits rotation to the shaft. This way the timing of the intake valves is changed by 25°.
When the electromagnet is de-energized, the valve distributor (2) returns to its initial position, shutting off the flow of pressurised oil to the piston (4), but allowing the oil to return to the exhaust due to the thrust of the counter spring (7).

- Duct (L) enables the camshaft journal to be lubricated under the various operating conditions.
- The oil which leaks into the electromagnet chamber (H) is discharged through the drainage hole (E).



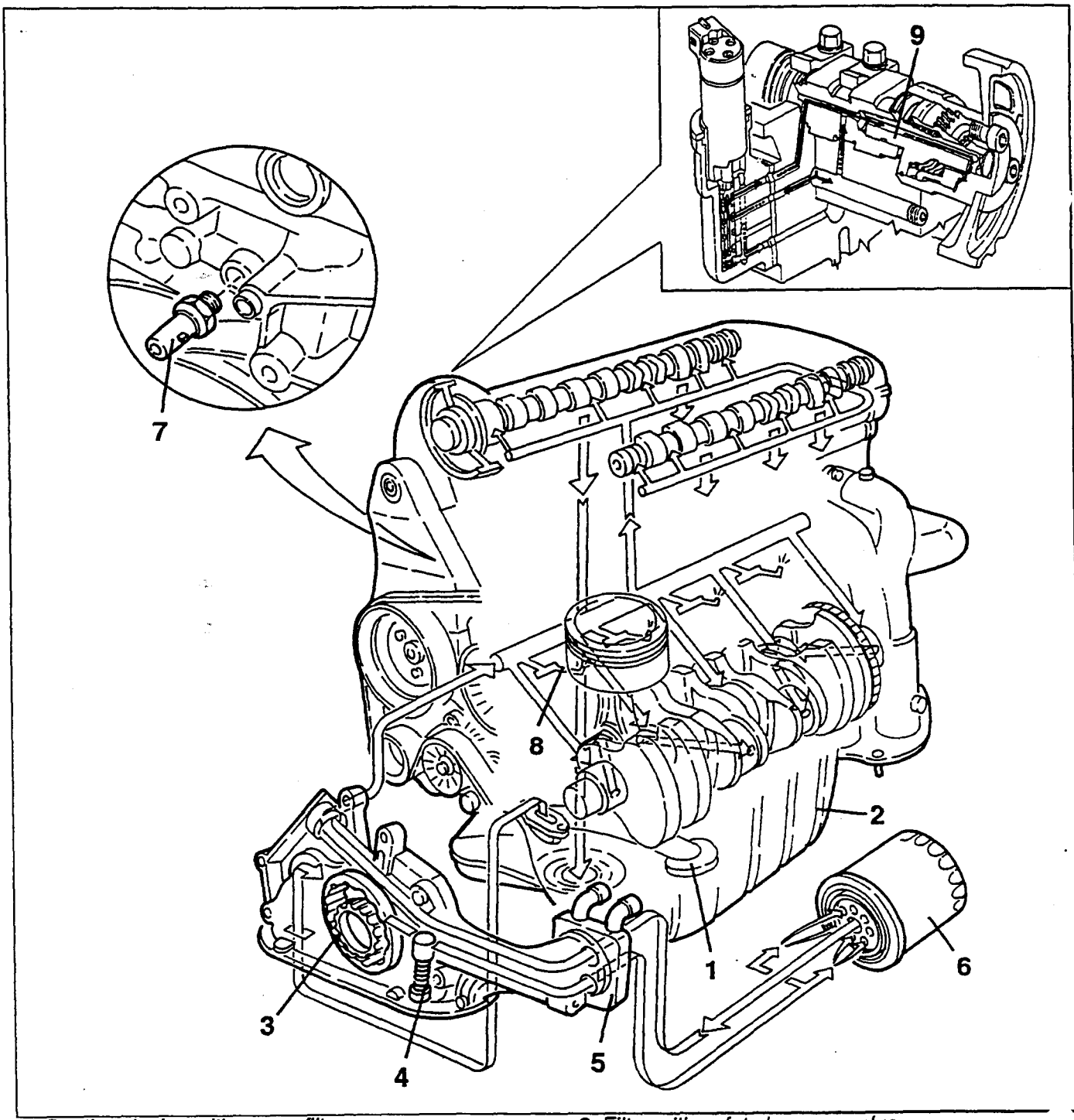
LUBRICATION

The rotary lobe pump (3) fitted on the front of the crankcase is activated directly by the crankcase through keying.
The oil withdrawn from the sump by a suction device (1) is filtered by the gauze filter on the suction device and then sent under pressure by the pump through a duct to the full-flow cartridge oil filter (6) fitted with a by-pass safety valve, which ensures that the oil passes even if the cartridge is clogged.
A water-oil heat exchanger (5) is installed on the filter support to keep the oil temperature within the optimum limits.
The maximum lubricating pressure is regulated by a special limiting valve (4) fitted on the pump.
After being filtered, the oil passes through a duct machined on the front engine cover and reaches the main longitudinal delivery duct in the crankcase.
From here, it is then sent along five ducts to the grooves of the main bearings and from these to those of the connecting rod journals via special ducts machined in the crankshaft.
To improve the cooling of the piston skirts the crankcase is fitted with spray jets (8) with built-in ball valve which opens at a pressure of **2.25 ÷ 2.75 bar.**

From the main longitudinal duct in the crankcase, a vertical duct branches off which lubricates the camshaft bearings. On the intake side of the camshaft lubricating duct there are two special channels through which the oil for operating the timing variator passes. The recovery circuit is formed of a few ducts located in the cylinder head which collect the oil leading from the outlets and then drain it from the head from which it falls back into the sump.

The lubricating system is fitted with an oil vapour recirculation system which recovers the vapours leading from the sump and from the cylinder head. The system is fitted with a minimum engine oil pressure sensor (7) which indicates insufficient lubricating pressure by turning on the warning light on the instrument cluster.

On some versions there is also the engine oil temperature sensor, minimum engine oil warning light sensor and the engine oil pressure sender (see the corresponding paragraph for further details).



1. Suction device with gauze filter
2. Oil sump
3. Oil pump
4. Pressure limiting valve
5. Heat exchanger
6. Filter with safety by-pass valve
7. Engine oil minimum pressure warning light sensor
8. Spray jets
9. Timing variator

INTRODUCTION

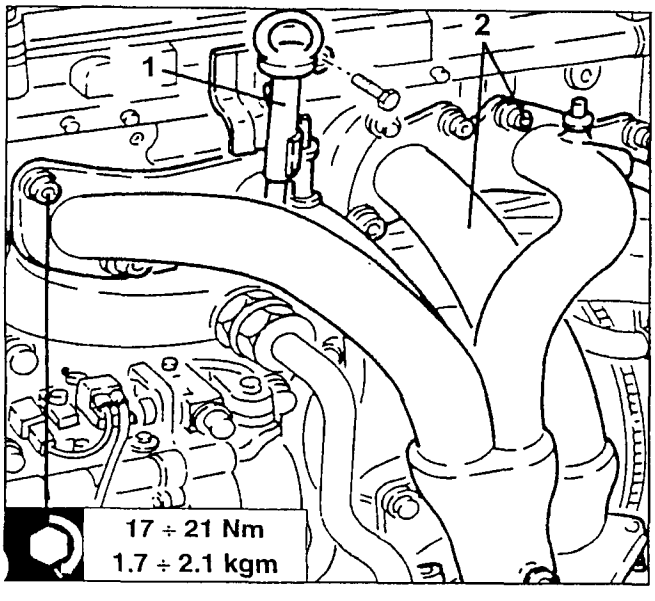
The instructions contained in the following paragraphs refer to complete engine bench overhaul after removing the engine from the vehicle. The instructions are organised as follows:
- **Engine removal:**
removal of engine accessories and components and disassembly of the main engine assemblies.
- **Cylinder head disassembly and overhauling:**
complete overhauling of component parts.
- **Crankcase overhauling:**
complete overhauling of component parts.
- **Refitting precautions:**
specific refitting operations which mainly differ from the removal instructions.
- **Lubrication electrical circuit checks.**

All the disassembly procedures described in the following paragraphs should be reversed for refitting, unless specifically indicated. The following procedures refer to complete engine overhauling. Some procedures, however, can be used separately for some parts only when required for specific components.

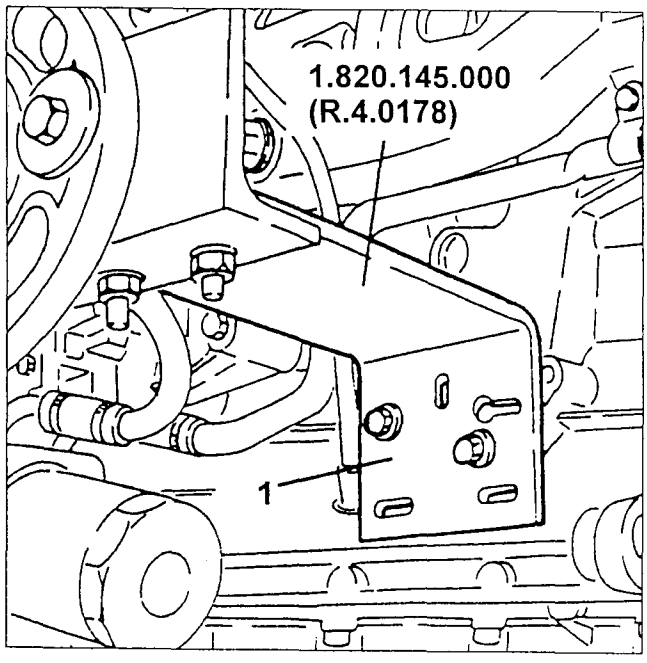
ENGINE REMOVAL

PRELIMINARY OPERATIONS

- Loosen the fastening nuts and remove the exhaust manifold guard.
1. Loosen the fastening screw and remove the oil dipstick.
2. Loosen the fastening nuts and remove the exhaust manifold.

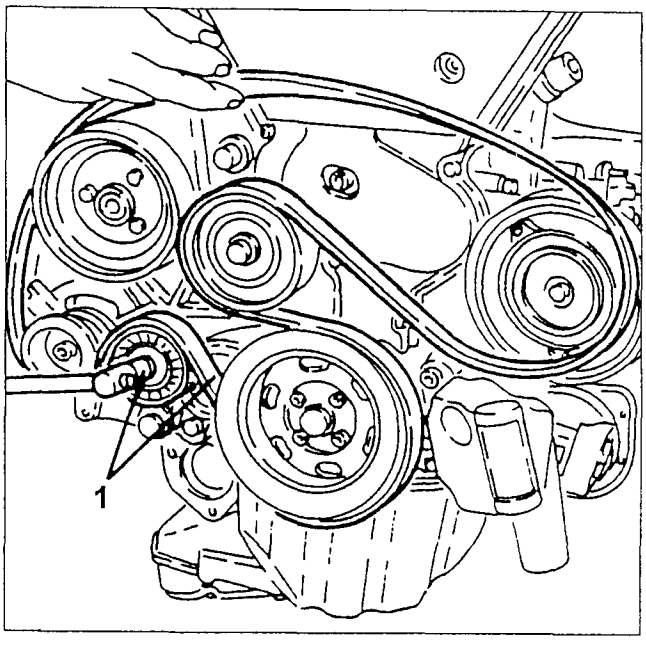


1. Position the engine on a specific overhaul stand with brackets no. 1.820.145.000 (R.4.0178).

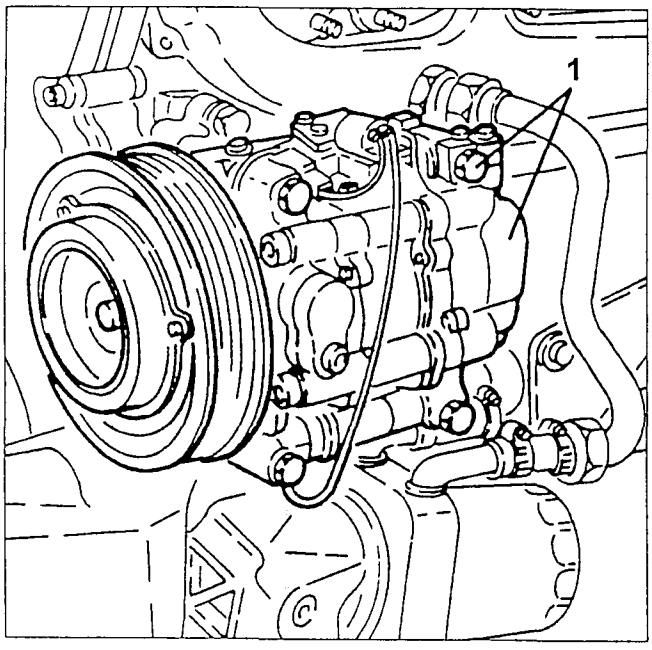


CLIMATE CONTROL COMPRESSOR REMOVAL

1. Loosen the belt-take up device as shown in the figure. Loosen the auxiliary unit drive belt and remove it.

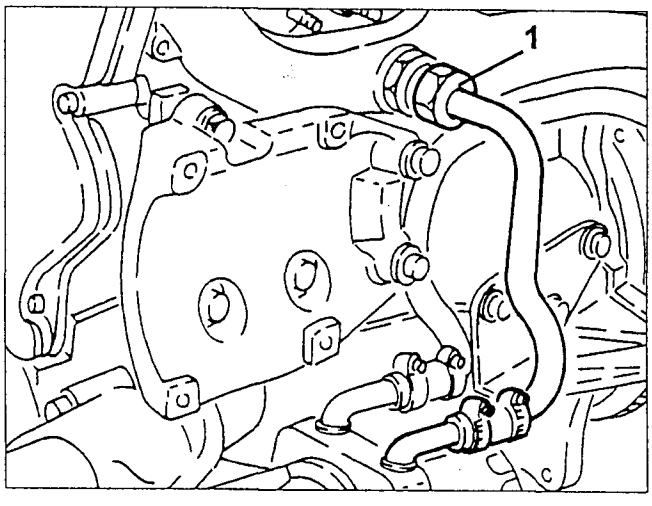


1. Loosen the four fastening screws and remove the climate control compressor.

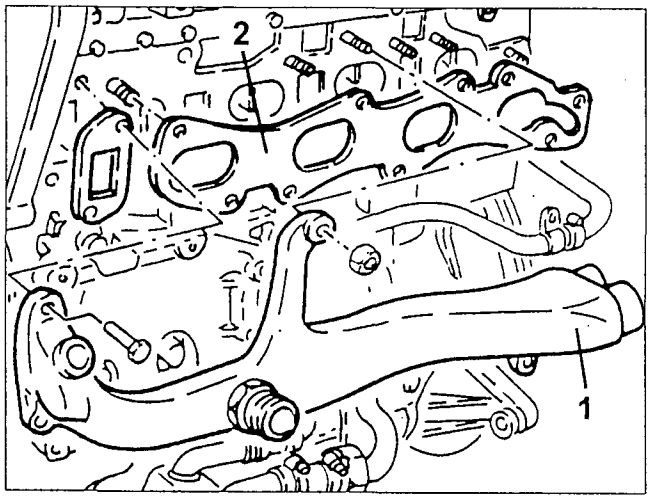


ENGINE COOLANT MANIFOLD REMOVAL

1. Disconnect the engine oil heat exchanger outlet pipe from the pump coolant return manifold.

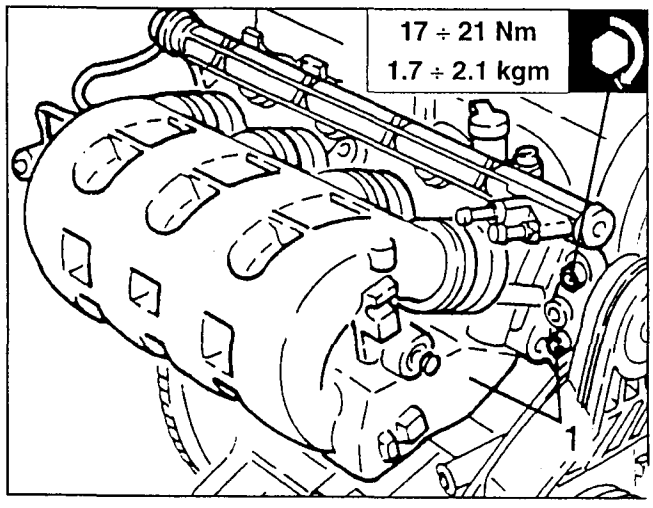


1. Loosen the fasteners and remove the pump coolant manifold and respective seal.
2. Remove the exhaust manifold seal.



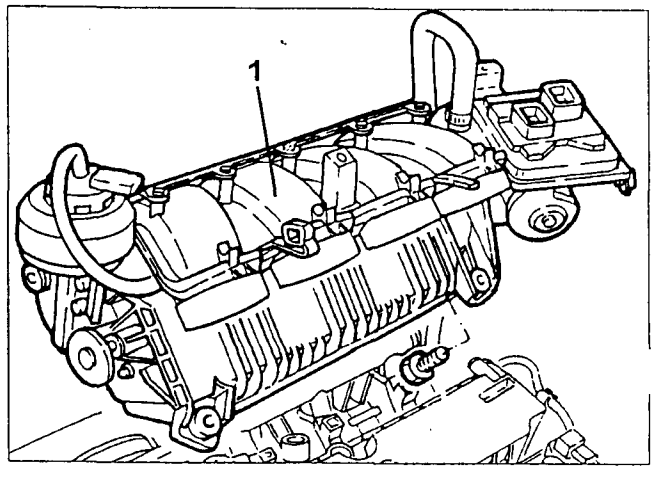
INTAKE MANIFOLD REMOVAL (pre-change versions)

1. Loosen the fastening nuts and remove the intake manifold.
- Remove the respective seal.



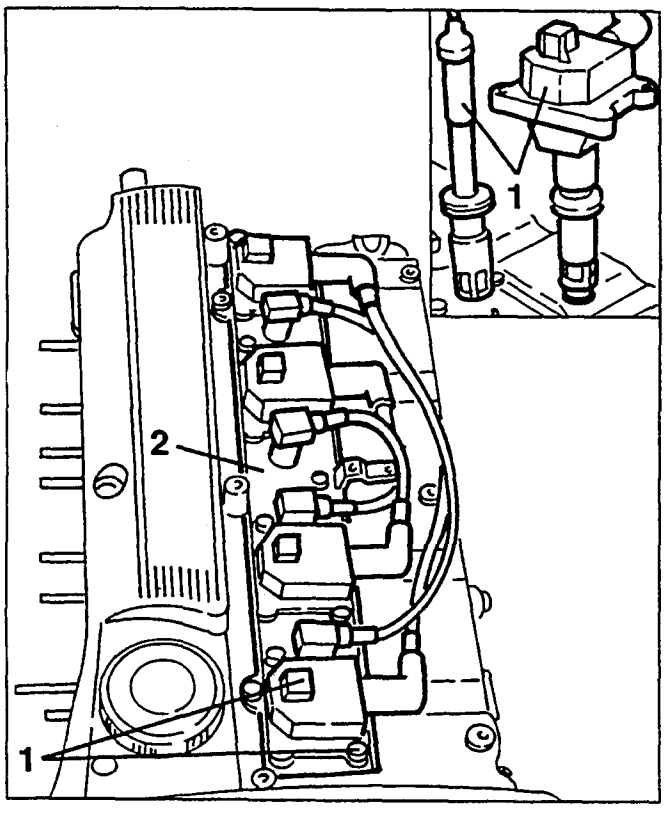
INTAKE MANIFOLD REMOVAL (post-change versions)

1. Loosen the fastening nuts and remove the intake manifold.
- Remove the respective seal.



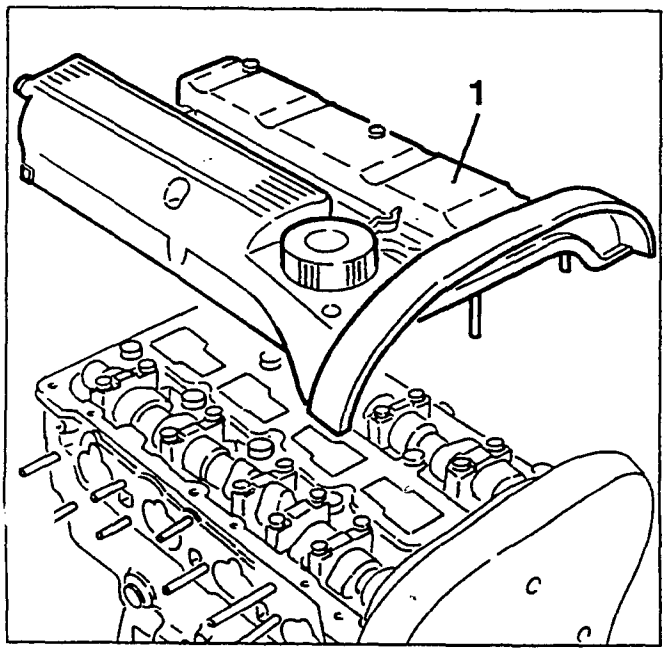
REMOVING THE IGNITION COILS

1. Slacken the fastening screws and remove the ignition coils complete with spark plug cables.
2. Slacken the fastening screws and ignition coils support bracket.
- Remove the spark plugs.

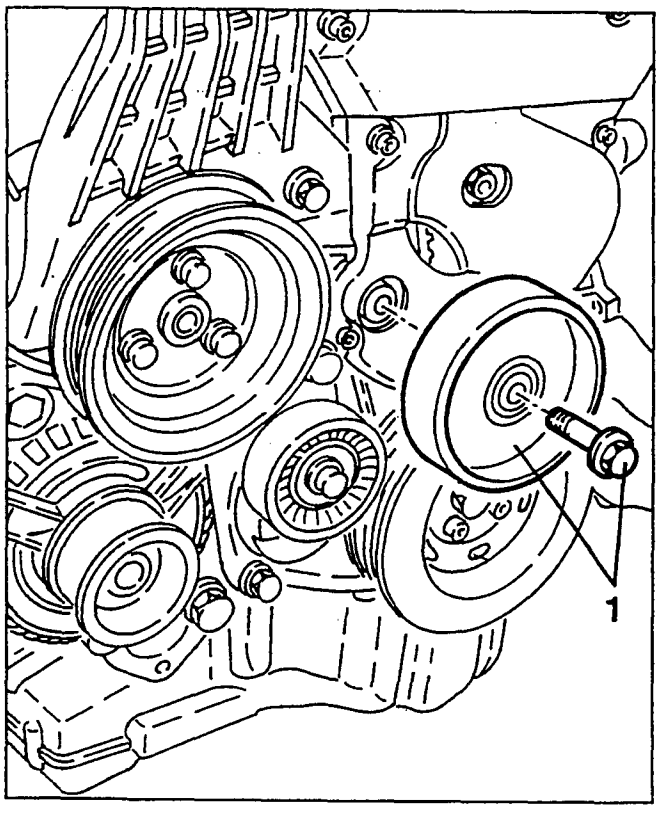


REMOVING THE TIMING GEAR DRIVE BELT

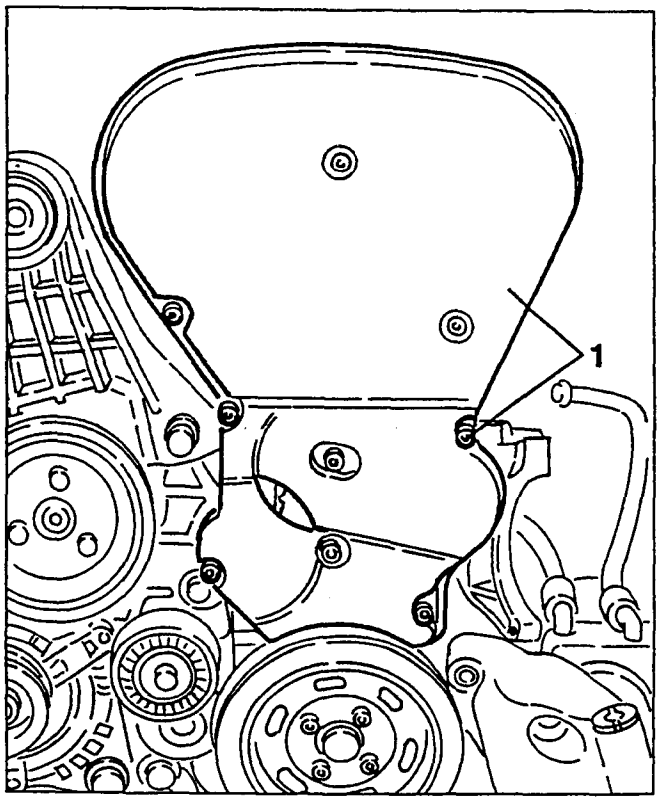
1. Slacken the fastening screws and remove the tappet cover complete with seal.



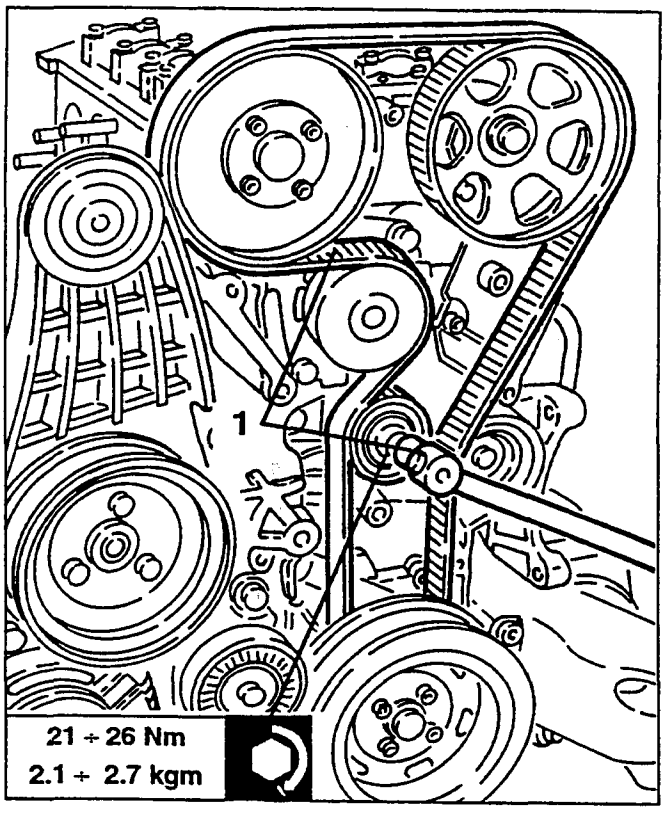
1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.



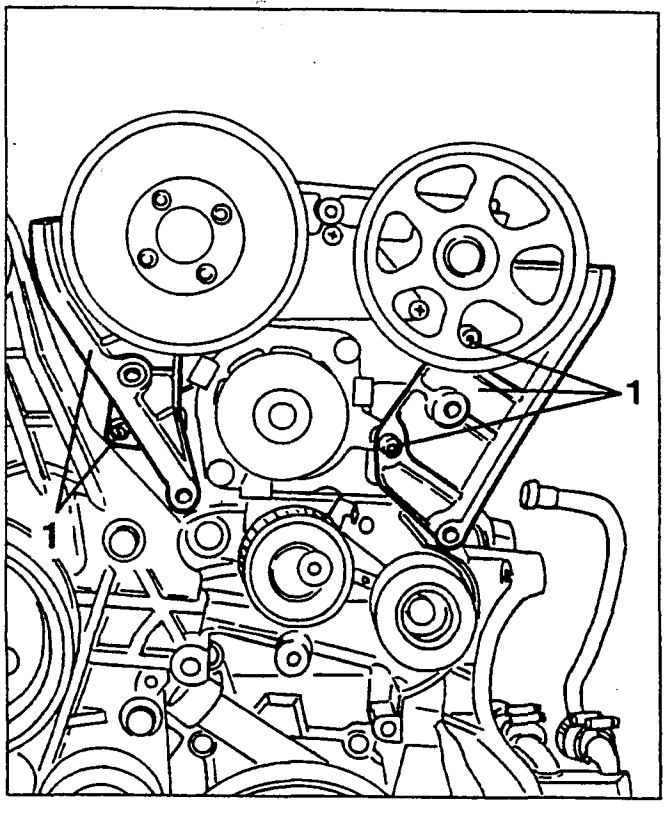
1. Slacken the fastening screws and remove the timing gear belt protective cover.



1. Slacken the timing gear belt tensioner, then remove the belt from the camshaft drive pulleys.

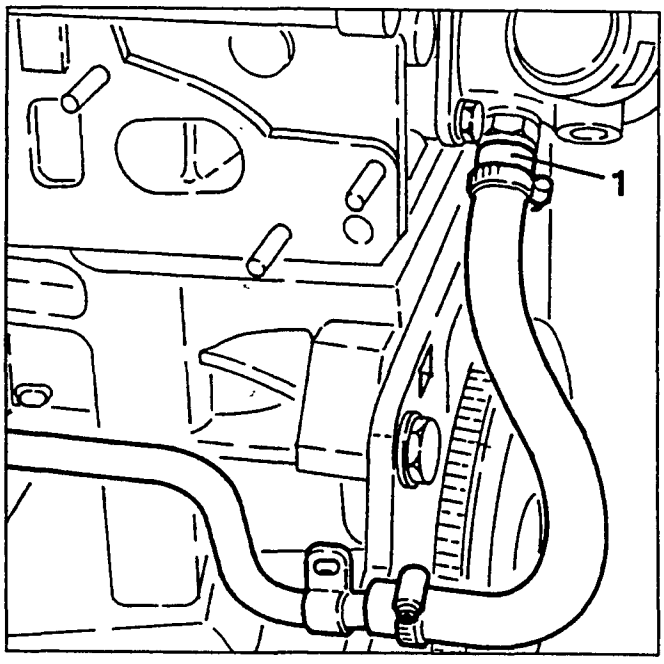


1. Slacken the fastening screws and remove the timing gear belt side guards.

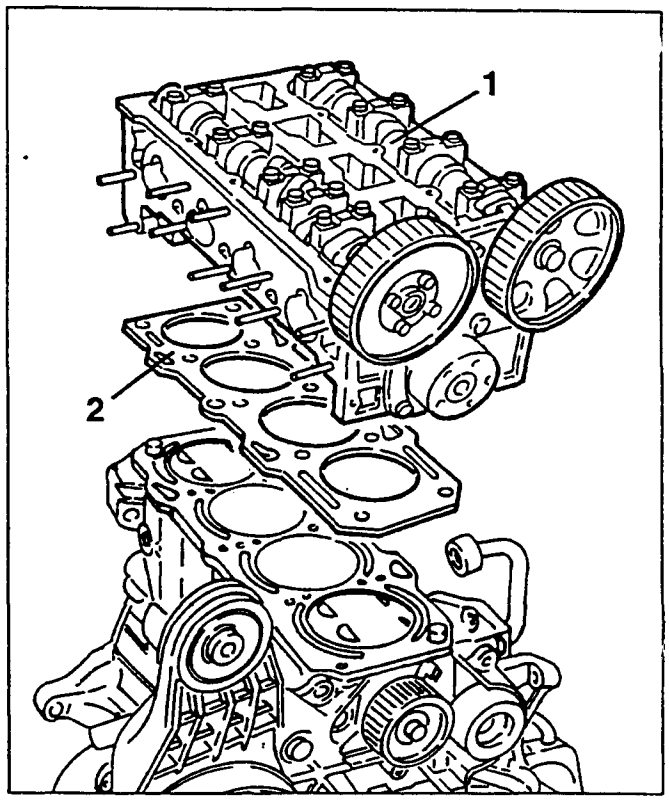


REMOVING THE CYLINDER HEAD

1. Disconnect the coolant fluid delivery pipe to the engine oil heat exchanger from the thermostatic cup.

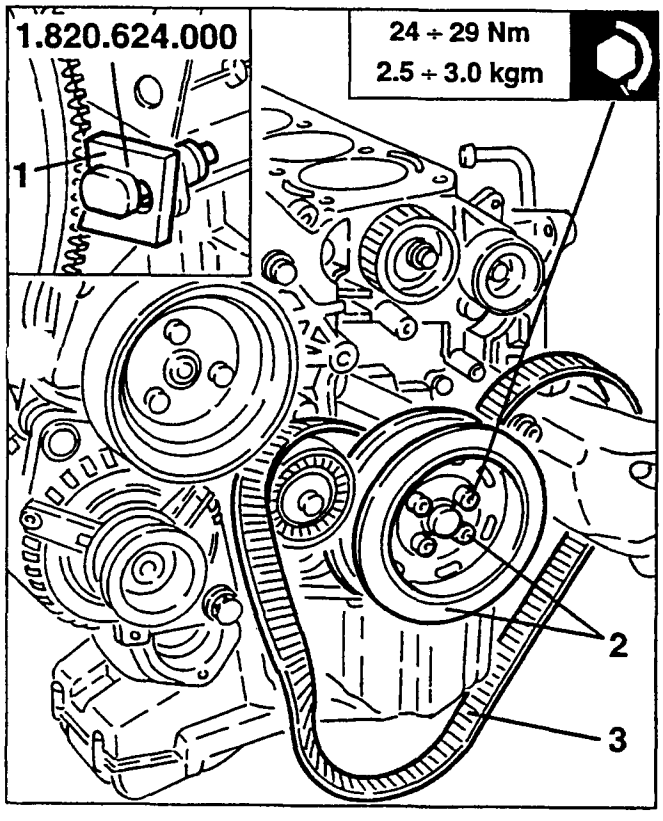


1. Slacken the fastening screws and remove the cylinder head.
2. Remove the associated seal.



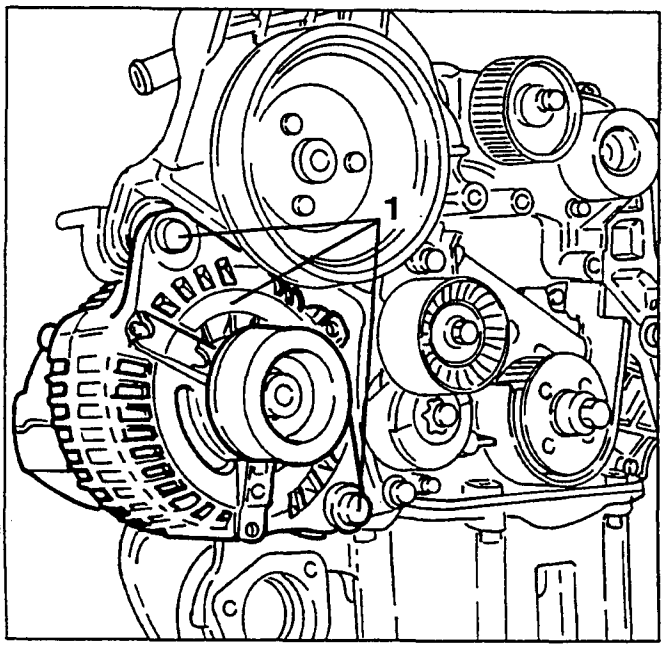
REMOVING THE AUXILIARY COMPONENTS BELT DRIVE PULLEY

1. Install the flywheel stopper tool no. 1.820.624.000.
2. Slacken the four fastening screws and remove the auxiliary components drive belt pulley.
3. Withdraw and remove the timing gear drive belt.

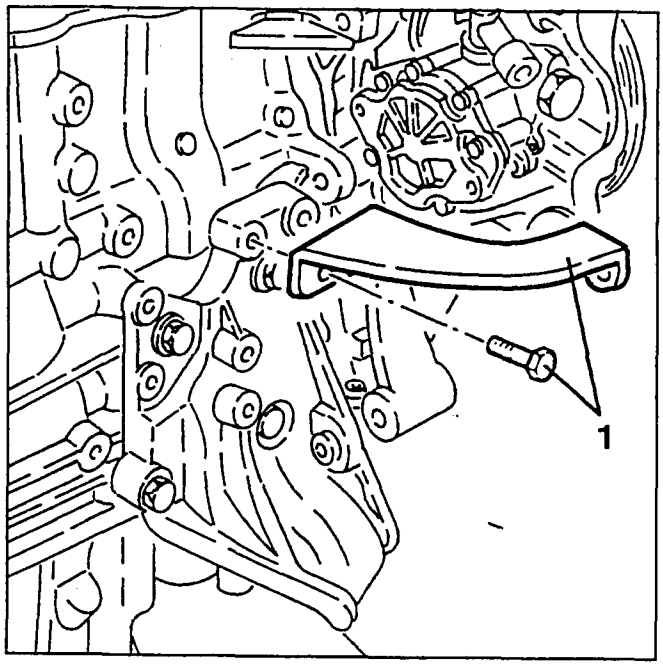


REMOVING THE ALTERNATOR

1. Slacken the two fastening bolts and remove the alternator.

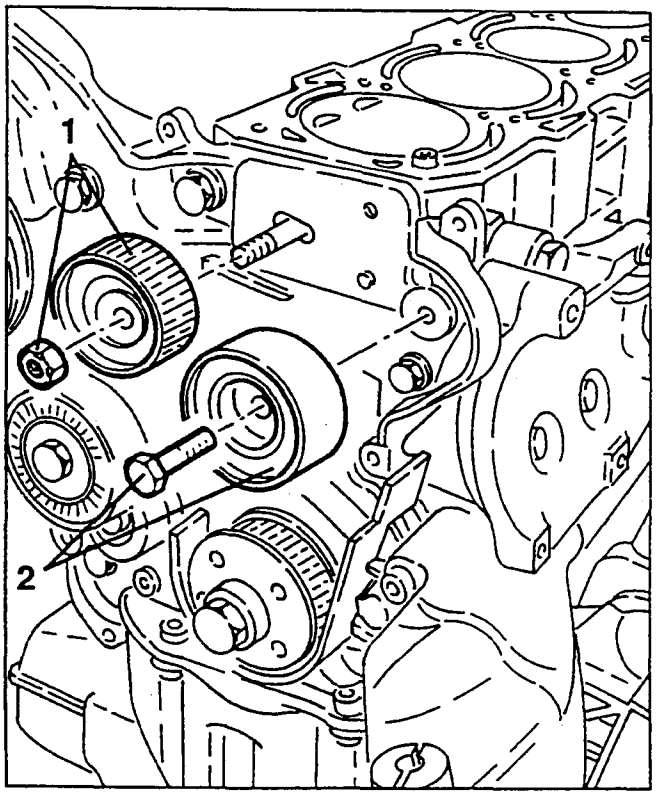


1. Slacken the two fastening screws and remove the upper alternator support bracket.

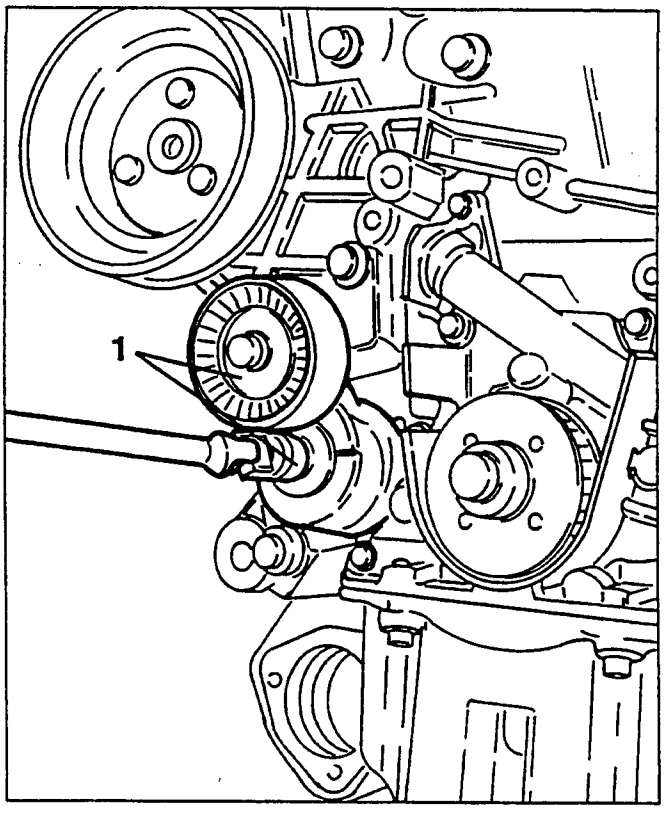


REMOVING THE ALTERNATOR AND POWER STEERING PUMP SUPPORT

1. Slacken completely the nut loosened previously and remove the timing gear belt tensioner.
2. Slacken the fastening screw and remove the timing gear belt guide pulley.

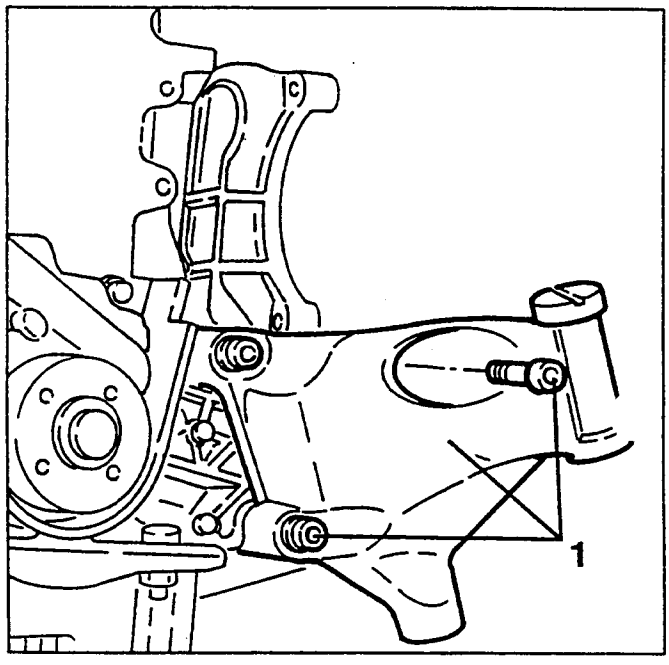


1. Slacken the fastening screw and remove the auxiliary components drive belt tensioner.

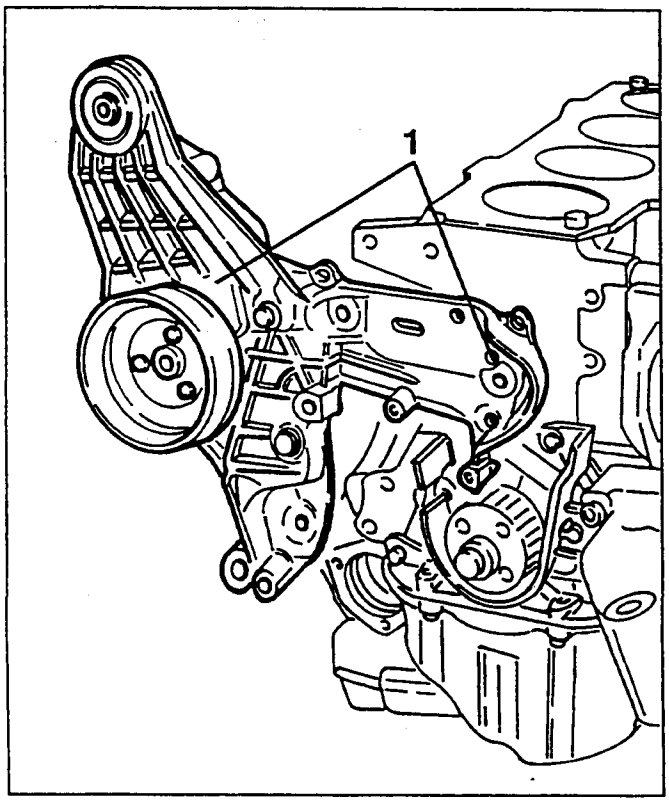


REMOVING THE POWER UNIT FRONT SUPPORT

1. Slacken the three fastening screws and remove the power unit front support.

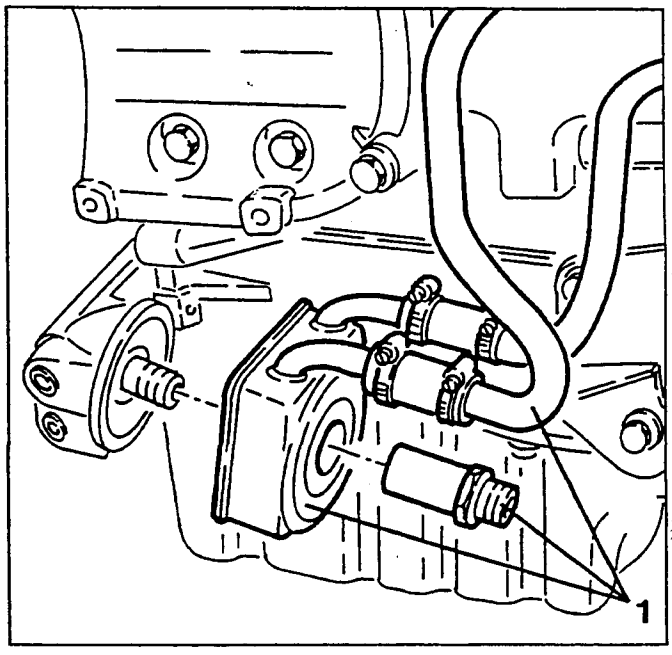


1. Slacken the fastening screws and remove the alternator and power steering pump support complete with the pump and, if necessary, separate them on the bench.



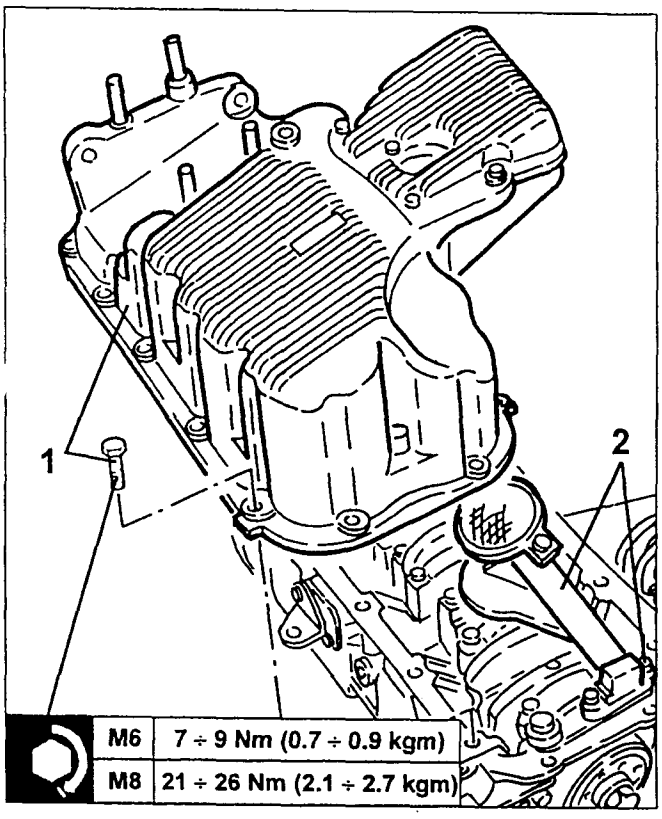
REMOVING THE ENGINE OIL COOLING FLUID HEAT EXCHANGER

- Remove the engine oil filter.
1. Slacken the fastening pin and remove the heat exchanger complete with coolant fluid inlet and o pipes.
- Remove the O-Ring.



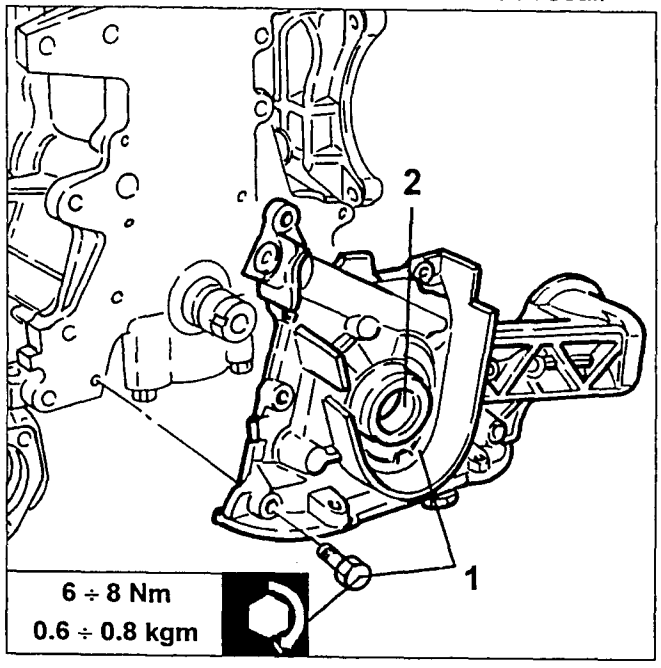
REMOVING THE OIL SUMP

1. Turn the engine on the overhauling stand, then slacken the fastening screws and remove the oil sump.
2. Slacken the two fastening screws and remove the suction device with its seal.



REMOVING THE ENGINE OIL PUMP

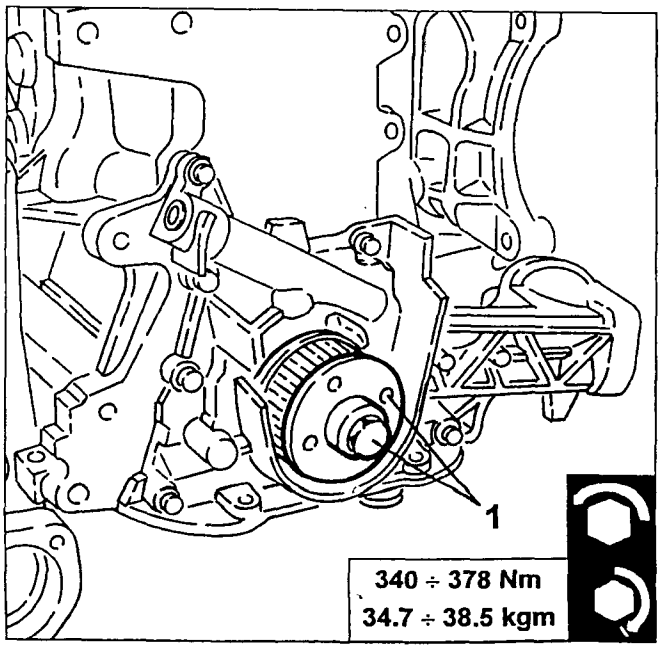
1. Slacken the fastening screws and remove the engine front cover with incorporated oil pump.
2. Prise and remove the crankshaft front oil seal.



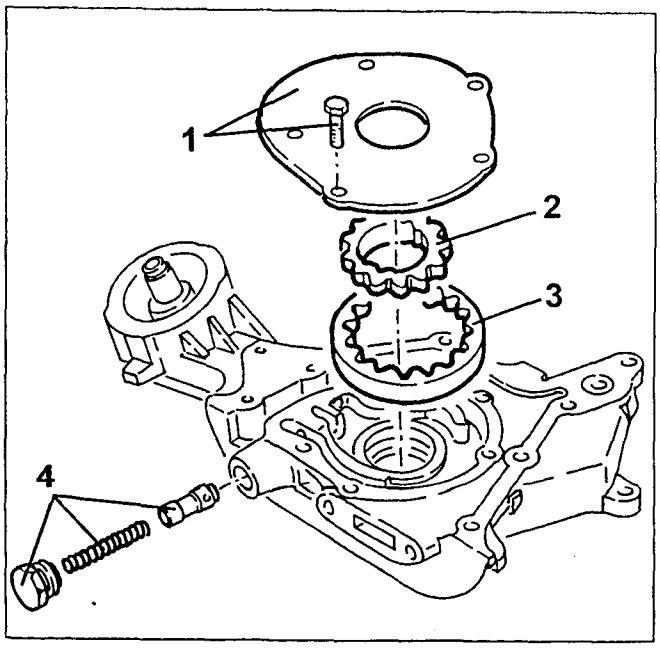
When refitting the crankshaft front oil seal, after fitting it on the oil pump assembly and assembling this on the crankcase, use tool no. 1.821.247.000.

REMOVING THE TIMING GEAR DRIVE BELT PULLEY

1. Slacken the left-handed screw and remove the camshaft drive belt pulley.

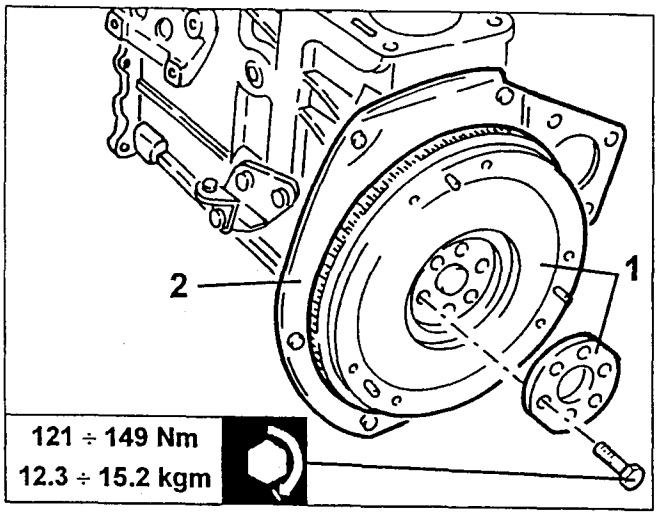


1. On the bench, slacken the fastening screws and remove the engine oil pump cover.
2. Remove the driving gear.
3. Remove the driven gear.
4. Slacken the fastening pin and remove the spring and the engine oil pump overpressure sliding valve.



REMOVING THE FLYWHEEL

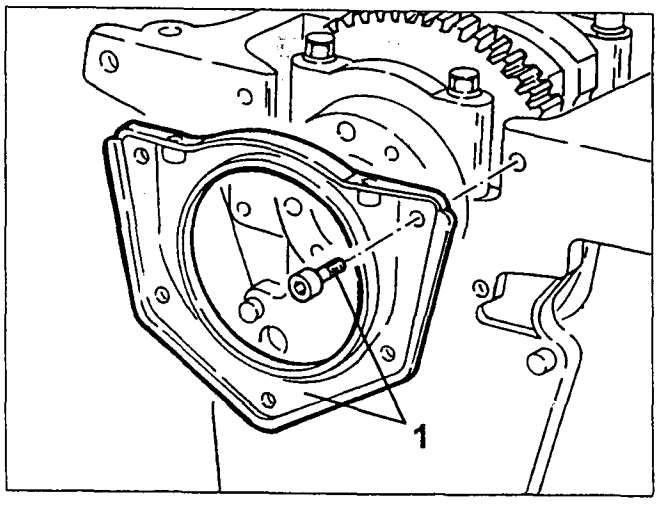
1. Slacken the fastening screws and remove the flywheel.
2. Retrieve the flywheel cover.



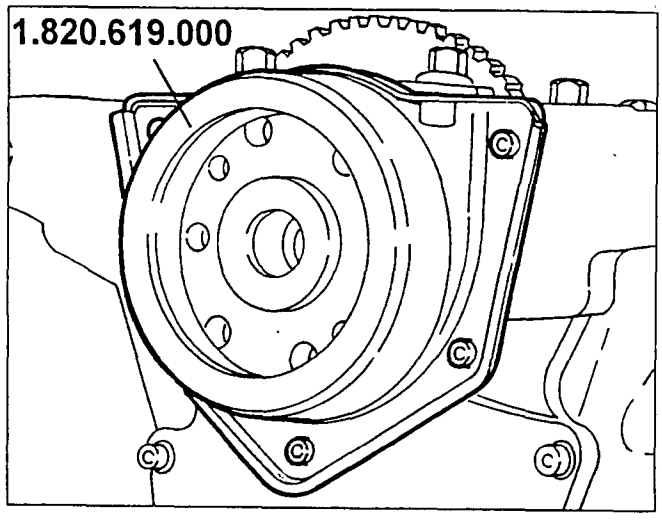
- Remove the flywheel stopper tool installed previously.

REMOVING THE CRANKCASE REAR COVER

1. Slacken the fastening screws and remove the crankcase rear cover with incorporated oil seal ring.

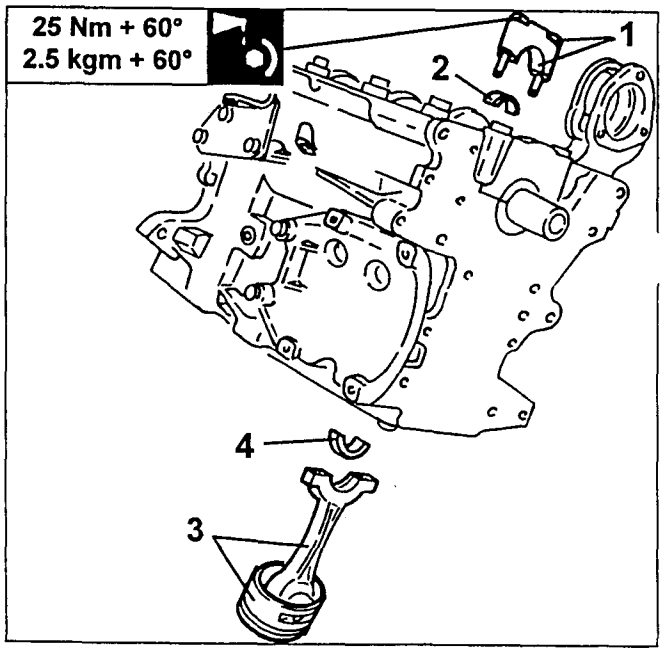


Refit the rear cover as follows:
• fit tool no. 1.820.619.000 on the oil seal of the rear crankcase cover;
• fit the tool - rear cover together and tighten the screws fastening to the crankcase; the tool should be removed only after also tightening the screws fastening the rear cover to the oil sump.



REMOVING THE PISTONS AND CONNECTING RODS

- Turn the crankshaft so that the pistons of the 1st and 4th cylinder reach the T.D.C.
1. Slacken the fastening screws and remove the connecting rod caps of the 1st and 4th cylinder.
2. Remove the corresponding connecting rod half bearings.
3. Withdraw the pistons and connecting rods of the 1st and 4th cylinder
4. Remove the corresponding connecting rod half bearings.



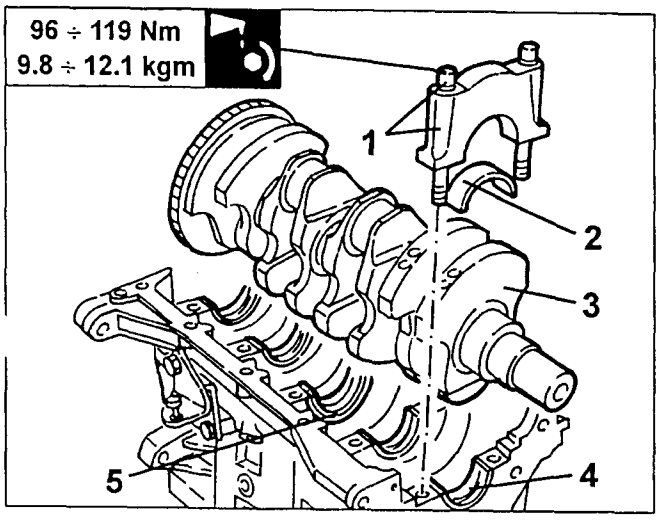
- Proceed in the same way for the 2nd and 3rd cylinder.
- Using a suitable tool, remove the seal rings and scraper ring from the piston.

WARNING: Proceed with care to avoid accidentally breaking any re-usable rings.

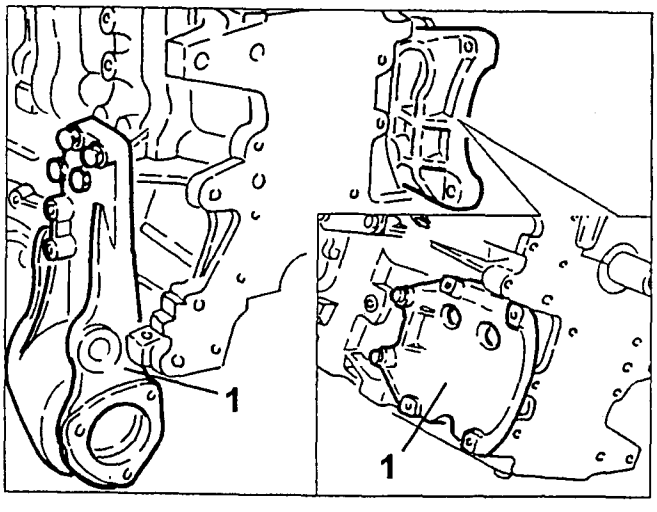
- Remove the two gudgeon pin circlips.
- Remove the gudgeon pin and separate the piston from the connecting rod.

REMOVING THE CRANKSHAFT

1. Slacken the fastening screws and remove the main bearing caps.
2. Remove the corresponding main half bearings.
3. Remove the crankshaft.
4. Remove the main half bearings from the supports.
5. Remove the two half thrust rings.



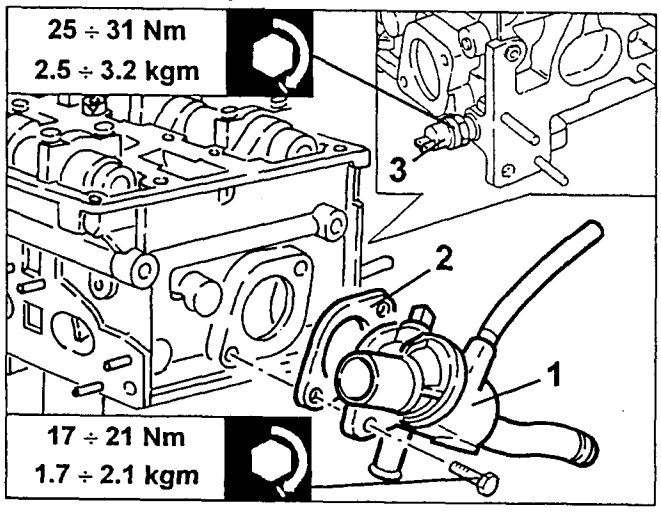
- If necessary, slacken the fastening screw and remove the engine oil spray jets for lubricating and cooling the pistons from the crankcase.
1. If necessary, slacken the fastening screws and remove the air conditioner compressor and layshaft support brackets from the crankcase.



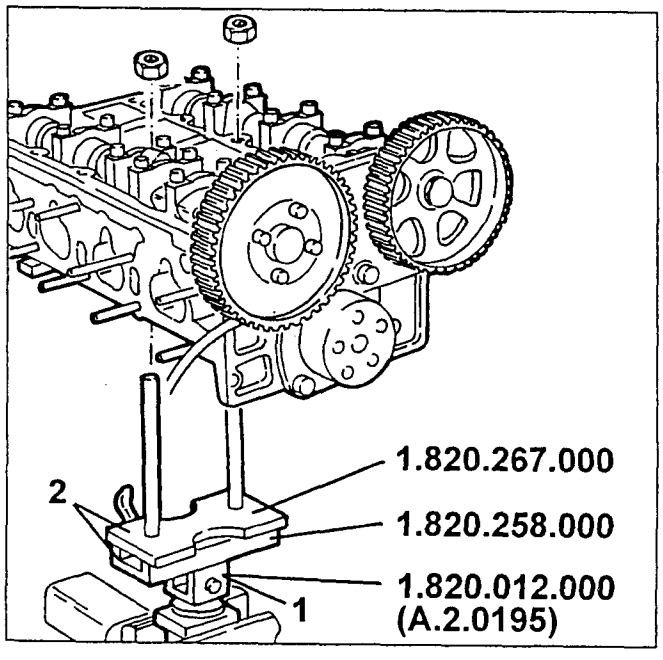
CYLINDER HEAD DISASSEMBLY

PRELIMINARY OPERATIONS

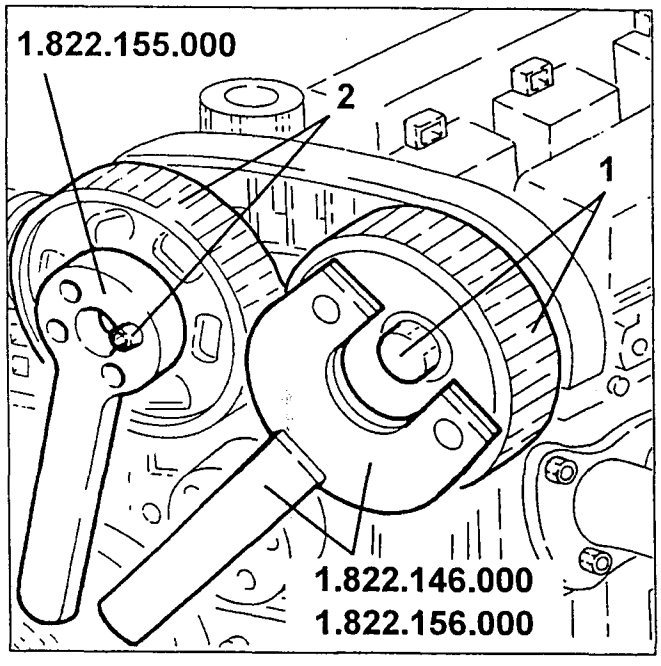
1. Slacken the fastening screws and remove the thermostatic cup complete with piping from the cylinder head.
2. Remove the corresponding seal.
3. Remove the engine coolant temperature gauge transmitter and maximum temperature warning light contact from the cylinder head.



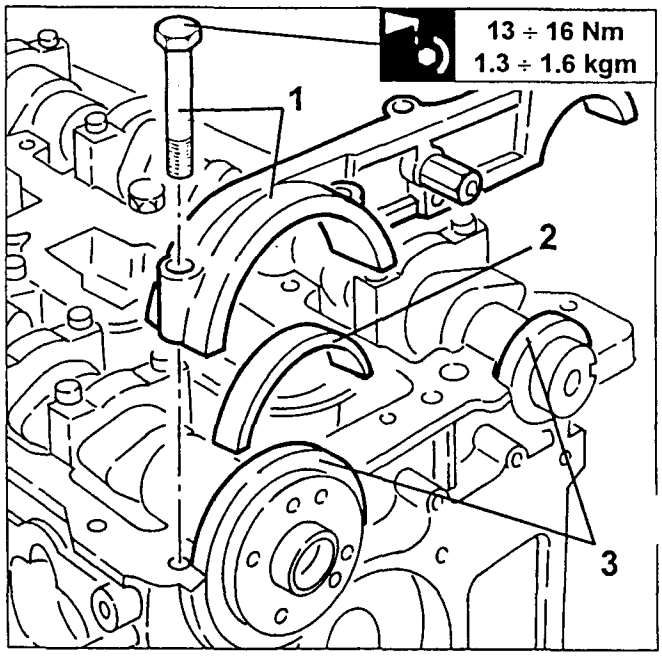
1. Fasten swivel support no. 1.820.012.000 (A.2.0195) in a vice.
2. Fasten tools no. 1.820.258.000 and no. 1.820.267.000 on the swivel support, then fasten the cylinder head on them.



1. Slacken the fastening screw using tools no. 1.822.146.000 and no. 1.822.156.000 and remove the exhaust side camshaft drive pulley.
2. Slacken the fastening screws using tool no. 1.822.155.000 and remove the intake side camshaft drive pulley.

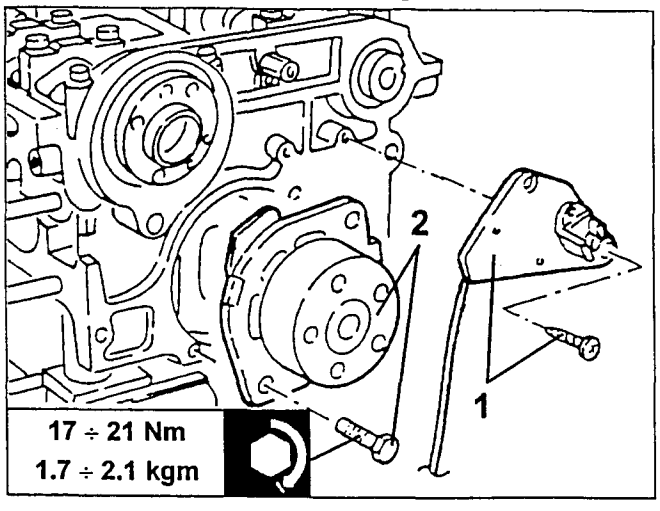


2. Remove the intake side half bearing.
3. Remove the oil seal rings from the camshafts.

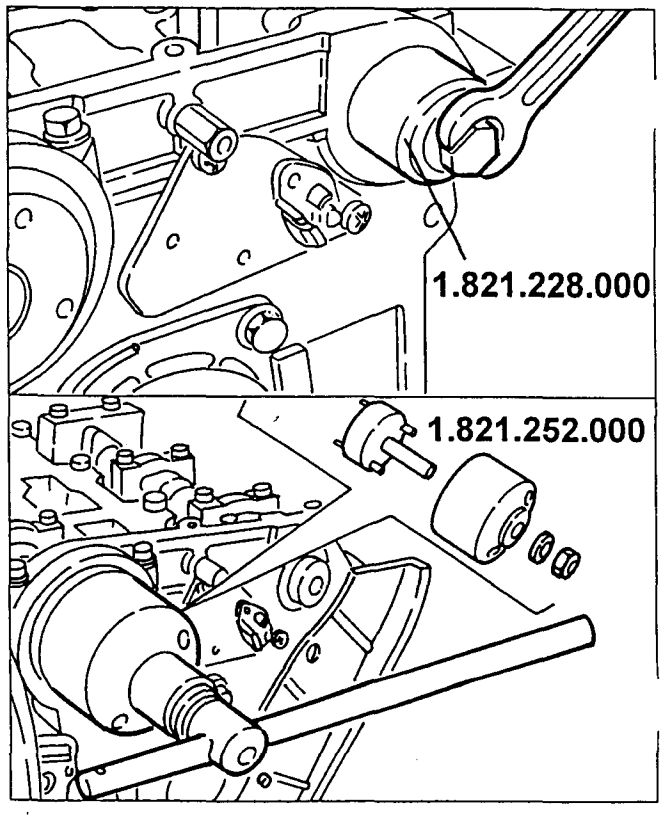


REMOVING THE WATER PUMP

1. Slacken the two fastening screws and remove the timing sensor complete with support.
2. Slacken the two fastening screws and remove the water pump complete with O-ring.



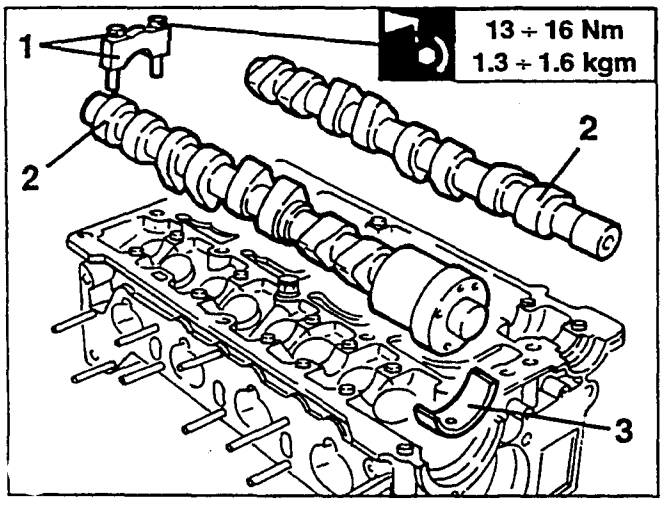
When refitting using tool no. 1.821.228.000 insert the exhaust side oil seal.
Using tool no. 1.821.252.000 insert the intake side oil seal.



REMOVING THE CAMSHAFTS

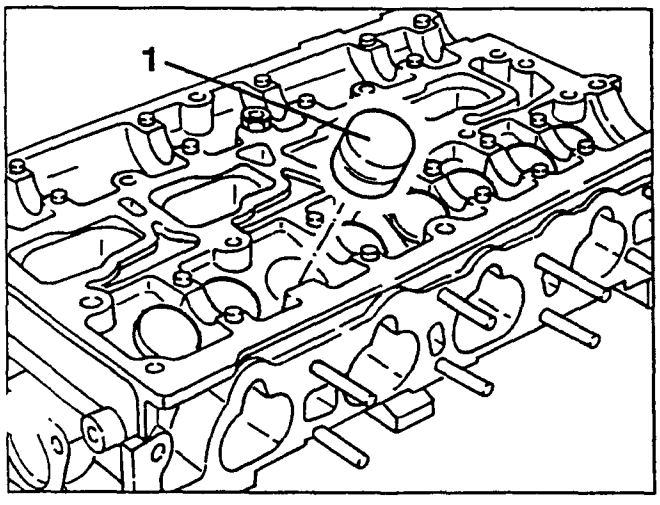
1. Slacken the four fastening screws and remove the camshaft front cap.

1. Slacken the fastening screws and remove the camshaft caps.
2. Remove the camshafts.
3. Remove the intake side half bearing.

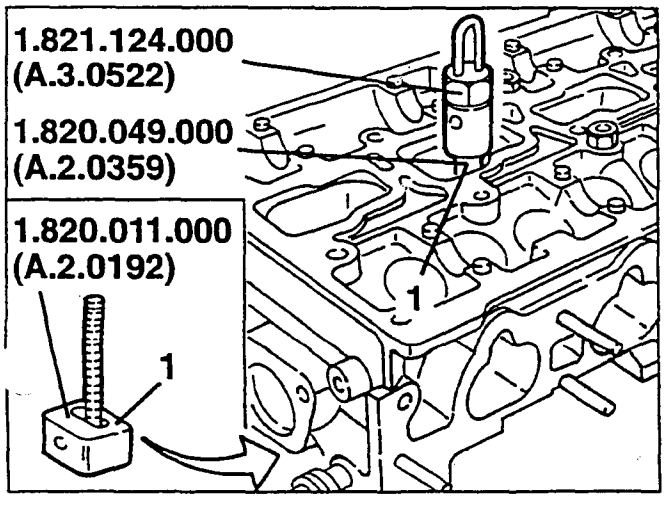


VALVES DIS-ASSEMBLY

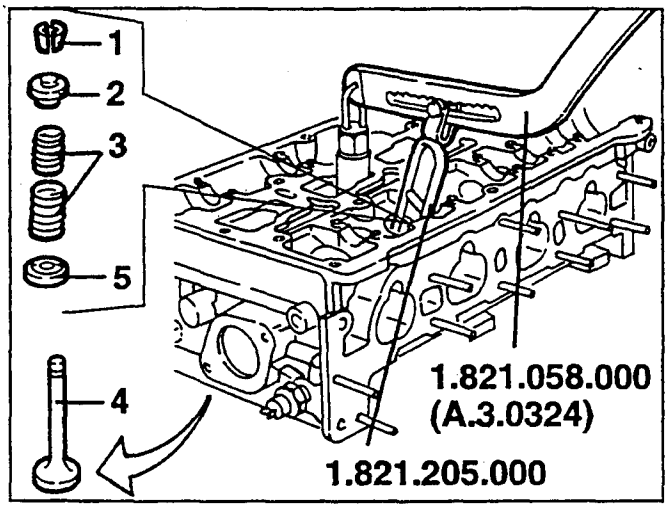
1. Withdraw the hydraulic tappets from their housings.



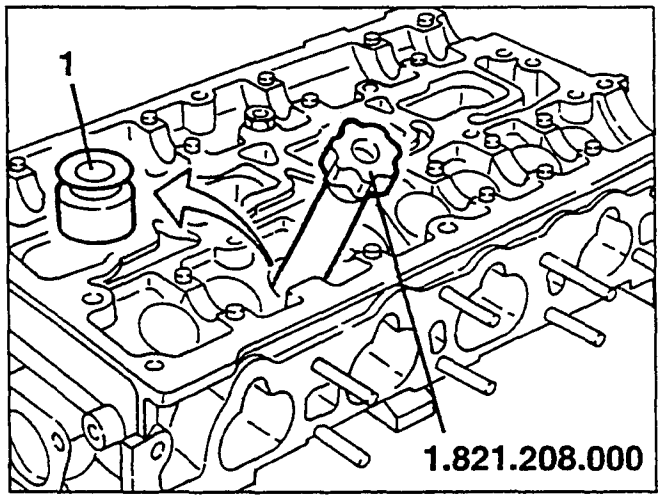
1. On the cylinder head assemble tools no. 1.820.011.000 (A.2.0192), no.1.820.049.000 (A.2.0359) and no. 1.821.124.000 (A.3.0522).



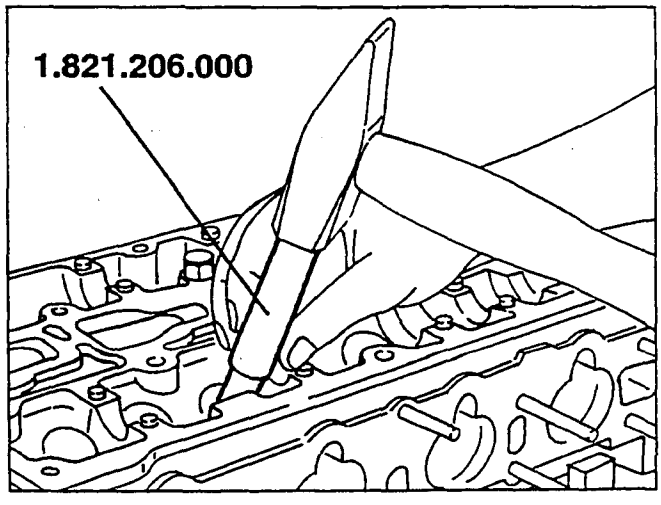
1. Using lever no. 1.821.058.000 (A.3.0324) and cage no. 1.821.205.000, remove the half cones from the valve stem.
2. Remove the upper plate.
3. Remove the outer and inner springs.
4. Remove the tools and retrieve the valve.
5. Remove the valve lower plate.



1. Using tool no. 1.821.208.000, remove the oil seal cap.



When refitting the oil seal cap use tool no. 1.821.206.000.

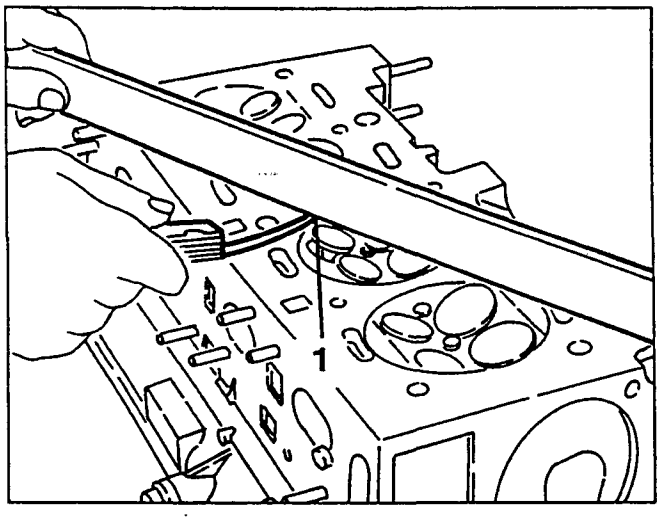


CHECKS AND INSPECTION CYLINDER HEAD

Checking the lower surface of the cylinder head

1. Check the flatness of the lower cylinder head surface; reface if it is excessively worn.

Maximum flatness error of cylinder head lower surface
0.1 mm

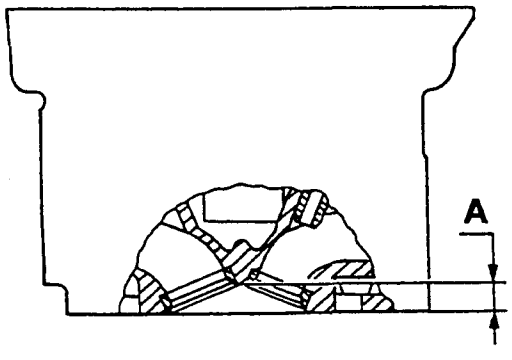


- After refacing, check that the depth of the combustion chamber, on the head, exceeds the minimum allowed limit.

WARNING:
Exceeding the minimum allowed limit involves serious engine operating failures.

Minimum depth "A" of the combustion chamber in the head
13 ± 0.2 mm

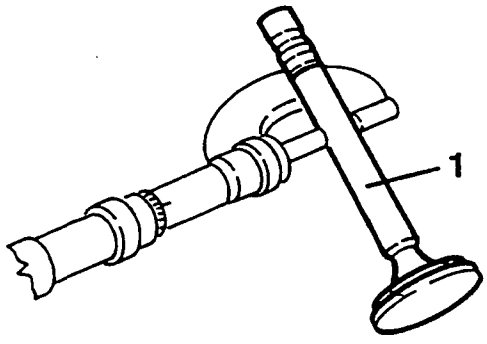
- Check that the finishing of the lower cylinder head surface is satisfactory.



Checking the clearance between valve guides and valve stems

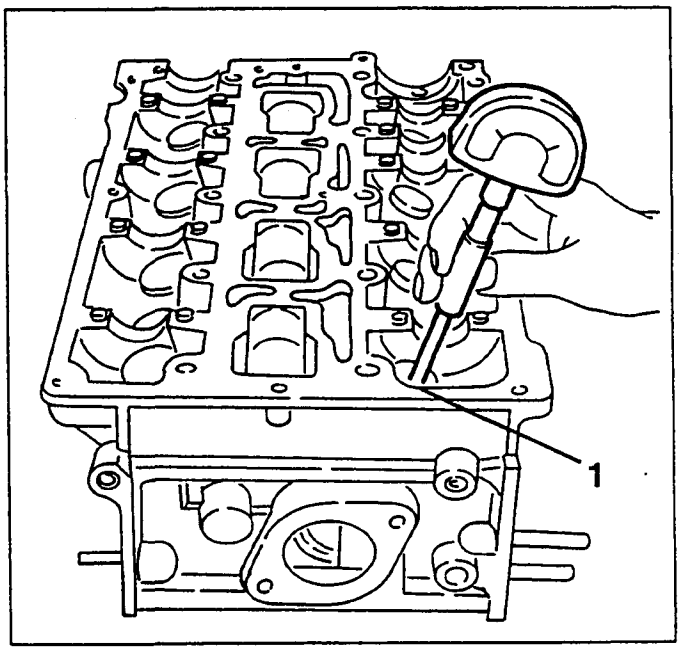
1. Measure the diameter of the valve stems and check that it is within the specified limits.

Diameter of valve stems	
Intake	6.975 ÷ 6.990 mm
Exhaust	6.960 ÷ 6.975 mm



1. Measure the inside diameter of the valve guides and check that it is within the specified limits.

Inside diameter of valve guides
7.022 ÷ 7.040 mm

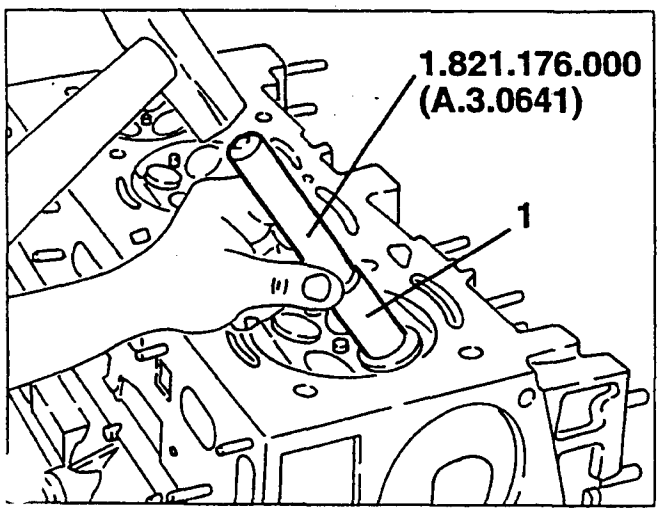


- Calculate the clearance between valve guides and stems and check that it is within the specified limits, if not, change any worn parts.

Radial clearance between valve guides and stems	
Intake	0.032 ÷ 0.065 mm
Exhaust	0.047 ÷ 0.080 mm

Changing the valve guides

1. Using puller tool no. 1.821.176.000 (A.3.0641), remove the worn valve guides.



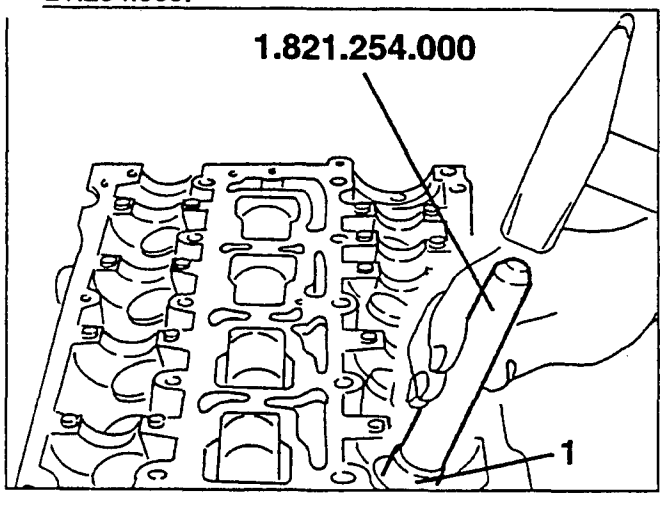
- Check that the outside diameter of the valve guides and their seats on the head are within the specified limits and that their assembly interference is correct.

Outside diameter of valve guides
13.010 ÷ 13.030 mm

Diameter of valve guide seats
12.950 ÷ 12.977 mm

Interference between valve guides and seats
0.033 ÷ 0.080 mm

1. Insert the new valve guides using tool no. 21.254.000.



- Bore the valve guide inside diameter to calibrate the holes to the specified diameter.

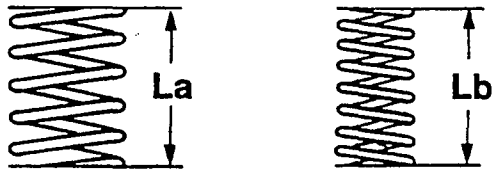
Inside diameter of valve guides
7.022 ÷ 7.040 mm

Checking the valve springs

- Check that the "free" length of the valve springs is within the specified limits.

NOTE: The rest surfaces must be parallel with each other and perpendicular to the axis of the spring with a maximum error of 2°.

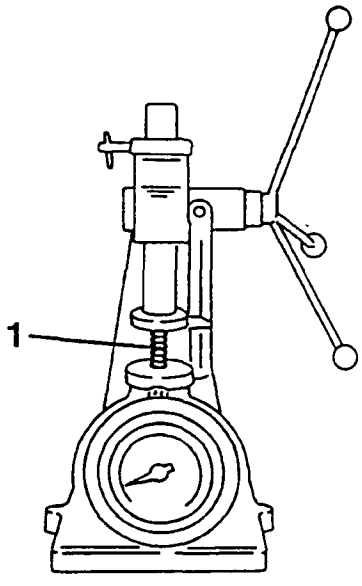
Free length of valve springs	
outer spring "La"	46 mm
inner spring "Lb"	39 mm



1. Using a torque meter, check that the characteristic data of the springs are within the specified limits.

Outer spring		
Length of spring mm		Control load N (Kg)
With valve closed	34	271 ÷ 294 (27.6 ÷ 30)
With valve open	24.5	485 ÷ 524 (49.4 ÷ 53.4)

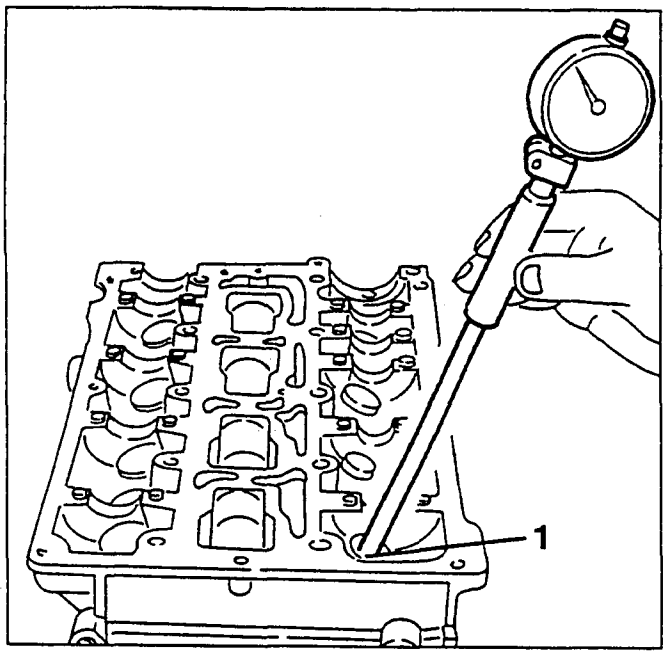
Inner spring		
Length of spring mm		Control load N (Kg)
With valve closed	29.5	96 ÷ 106 (9.8 ÷ 10.8)
With valve open	20	201 ÷ 221 (20.5 ÷ 22.5)



Checking the clearance between the cups and their seats

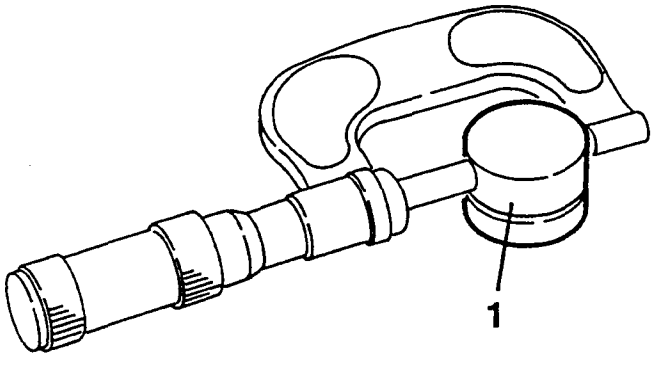
1. Check that the diameter of the cup seats is within the specified limits.

Diameter of valve cup seats
33.000 ÷ 33.025 mm



1. Check that the outside diameter of the cups is within the specified limits.

Diameter of valve cups
32.959 ÷ 32.975 mm



- Calculate the clearance between the cups and their seats checking that it is within the specified limits.

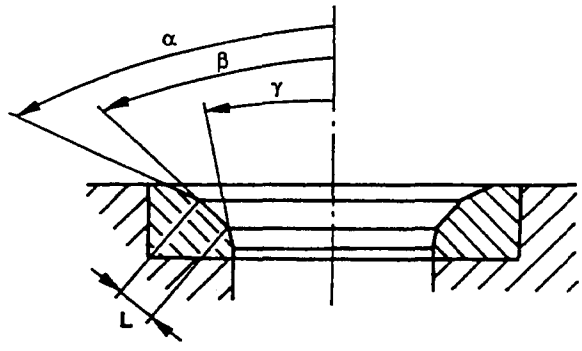
Clearance between cups and seats
0.025 ÷ 0.066 mm

Turning the valve seats

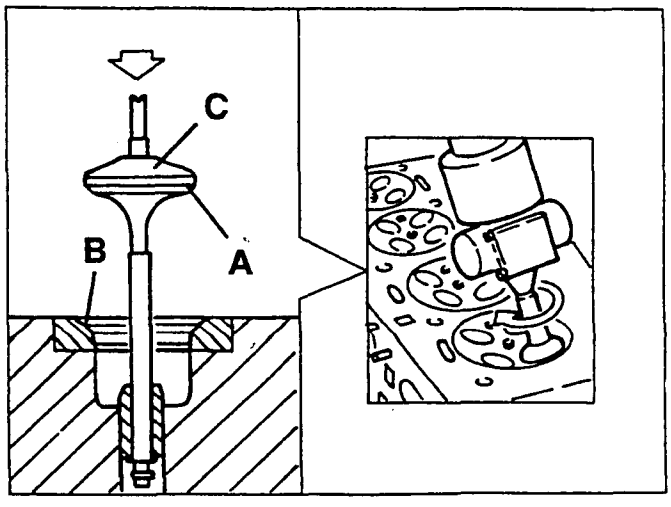
- If necessary, turn the valve seats using suitable equipment within the following limits.

Taper of contact area with valve "β"	90° ± 10'
Taper of upper valve seat area "α"	150°
Taper of lower valve seat area "γ"	30°

Dimension "L" contact area with valve	
Intake	6.5 mm
Exhaust	5.5 mm



- After machining, grind each valve in its seat as follows:
- coat the contact surfaces "A" and "B" of the valves and their seats with abrasive paste (SIPAL AREX(Carbosilicium for valves);
- lubrificate the valve stem with engine oil;
- fit the lower surface of the valve mushroom to the suction cup "C" of a pneumatic grinder;
- insert the valve in its guide and grind;
- after grinding, thoroughly clean the valve and the seat.



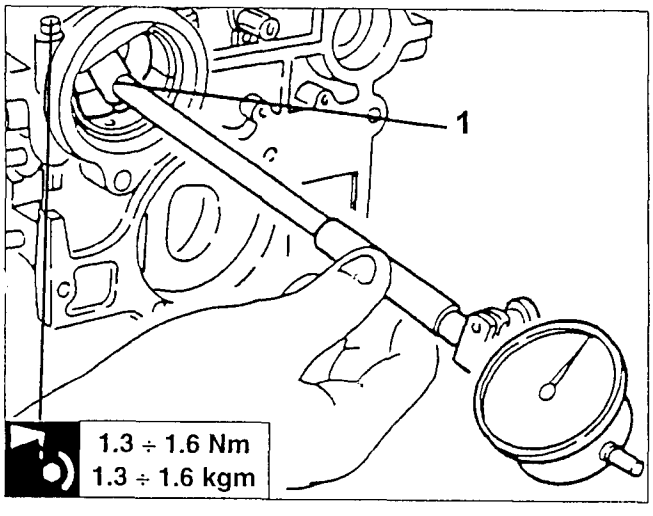
- If valve seat machining and grinding is required, perform a valve tightness test (with the spark plugs fitted) as follows:
• fill the combustion chamber with petrol;
• let low pressure air into the intake manifolds and check no air bubbles form in the petrol;
• perform the same test on the exhaust valve by letting air into the exhaust manifolds;
• if leaks are found, make sure the valves are perfectly fitted in their seats. Repeat the tightness test. If the outcome is negative, repeat the grinding operation.

Camshaft and journals

1. Fit the camshaft bearings and fasten the respective screws at the prescribed torque. Then check whether the journal bearing diameter falls within prescribed values.
NOTE: Fit the respective half-bearings on the front journal, intake side.

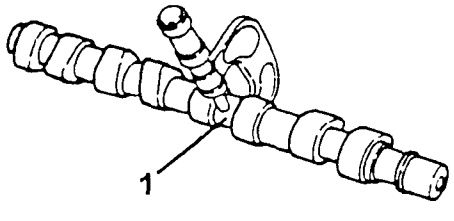
Camshaft journal bearing diameter
26.045 ÷ 26.070 mm 50.034 ÷ 50.071 mm (*)

(*) Front journal, intake side, with half-bearings fitted (for phase variator)



1. Check whether the camshaft journal fall within the prescribed values.

Camshaft journal diameter
26.000 ÷ 26.015 mm



- Calculate the play between the camshaft bearings and respective journals and check whether it falls within the prescribed values.

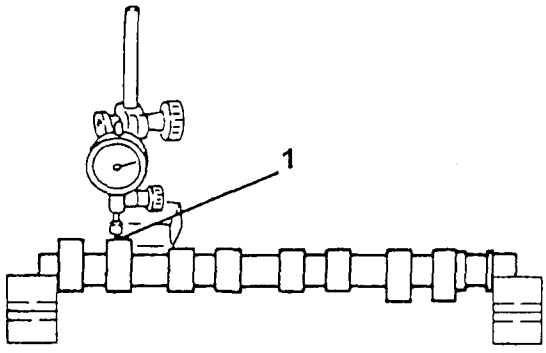
Play between camshaft and journal	
0.03 ÷ 0.07 mm	0.034 ÷ 0.086 mm (*)

(*) Specific for phase variator

1. Check whether the cam rising falls within prescribed values.

Nominal cam raising		
Intake	8.3 mm pre-change 9.0 mm post-change (*) (1)	9.5 mm (2)
Exhaust	7.5 mm (1)	9.5 mm (2)

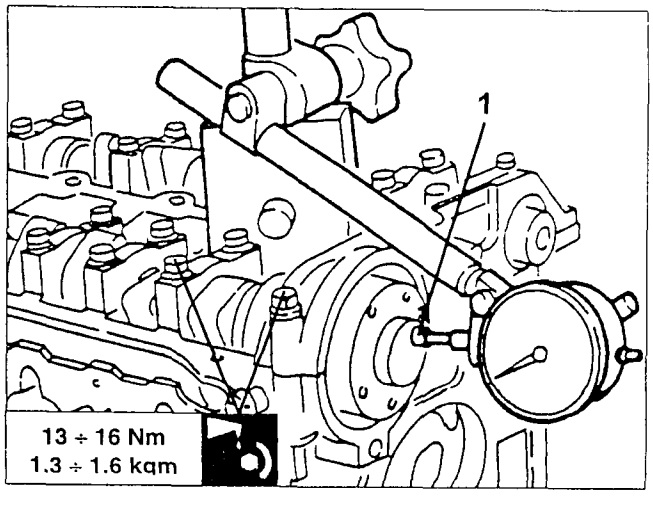
(*): with M1.5.5 injection-ignition
(1): 1598 c.c. (2) 1747 c.c.



Crankshaft axial play

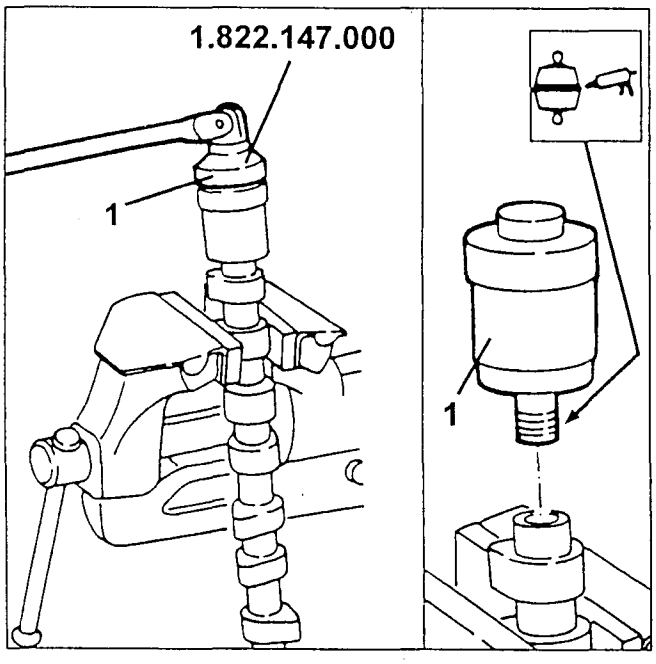
- Position the camshafts on the cylinder head, fit the respective bearings and fasten the screws as prescribed.
1. Check whether crankshaft axial play falls within prescribed values by means of a centesimal gauge applied with its magnetic base.

Crankshaft axial play
0.10 ÷ 0.23 mm

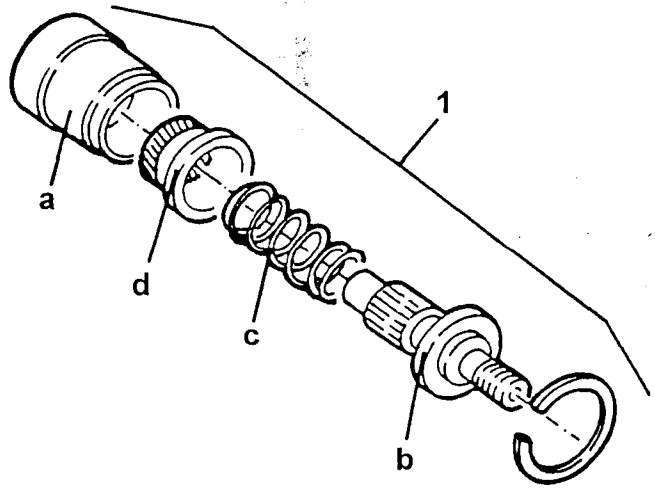


Camshaft phase variator disassembly

- Position the camshaft, intake side, in a vice with padded jaws.
1. Loosen and remove the phase variator from the camshaft with tool no. 1.822.147.000.



1. Remove the retainer ring and extract the pinion (b), the spring (c) and the piston (d) from the phase variator casing (a).



IMPORTANT:
Attain to the following instructions when refitting the phase variator:
- Make sure the glue on the camshaft phase variator coupling thread does not obstruct the oil ducts.
- Wait for approximately two hours before fitting the camshaft on the cylinder head.

CRANKCASE CHECKS AND TESTS

- Inspect the crankcase for cracks or signs of excessive wear on sliding surfaces. Check intactness of all threading.
- Remove the lubrication and cooling duct caps and clean the ducts with a suitable detergent. Dry with a jet of compressed air and fit new caps.
- Clean the crankcase surfaces from fragments of seals or sealant.

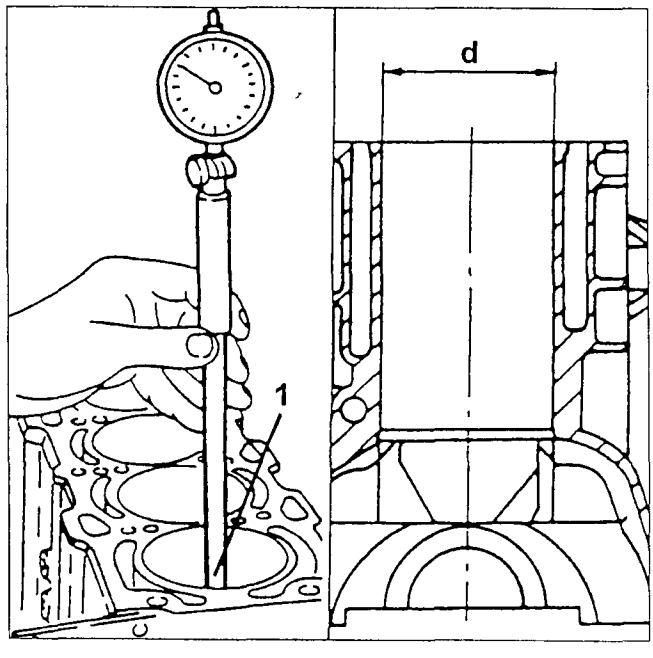
Cylinder checks

1. Measure the internal diameter of the cylinders with a gauge and check it falls within the prescribed values.

Internal diameter "d"	
Class A	82.000 ÷ 82.010 mm
Class B	82.010 ÷ 82.020 mm
Class C	82.020 ÷ 82.030 mm
0.1 mm oversize	

Maximum cylinder taper
0.010 mm

Maximum cylinder ovality
0.005 mm

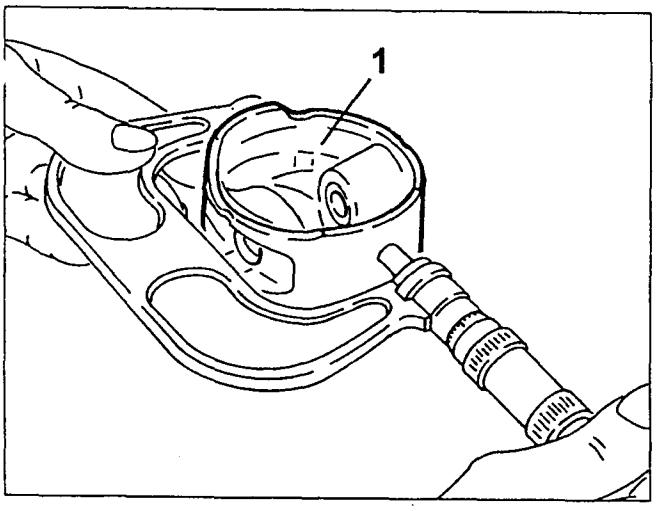


Checking the pistons

1. Measure the outside diameter of the pistons and check that it is within the specified limits.

Outside diameter of pistons (1)	
Class A (Blue)	81.952 ÷ 81.962 mm
Class B (Pink)	81.960 ÷ 81.970 mm
Class C (Green)	81.968 ÷ 81.978 mm
Oversize of 0.1 mm	

(1) To be measured at right angles to the gudgeon pin hole at a distance of 12.5 mm from the lower edge of the piston skirt.

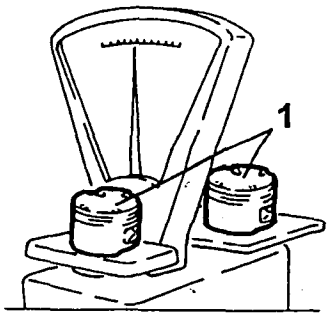


- Calculate the clearance between the cylinder and the piston and check that it is within the specified limits.

Clearance between piston and cylinder
0.038 ÷ 0.062 mm

1. Check that the difference in weight between the pistons complete with gudgeon pins and seal rings is within the specified limits.

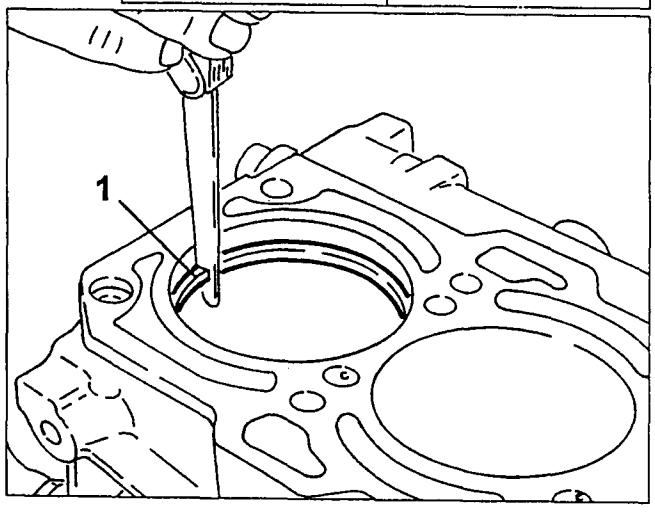
Difference in weight between pistons
± 5 g



Checking the seal ring gap

1. Insert the seal rings in the cylinder, check that they adhere to the whole circumference and that the gap is within the specified limits.

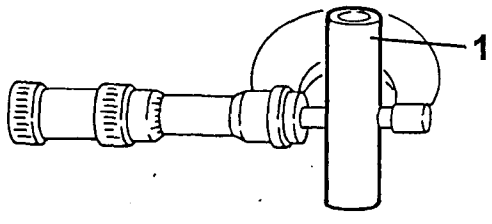
Ring gap	
First ring	0.25 ÷ 0.50 mm
Second ring	0.30 ÷ 0.50 mm
Oil scraper ring	0.25 ÷ 0.45 mm



Checking the play between gudgeon pins and seats on pistons

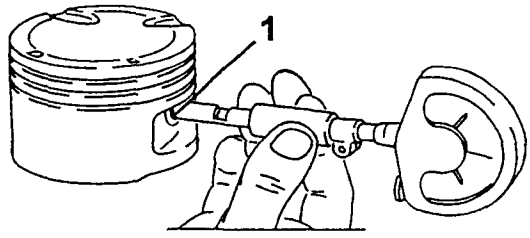
1. Measure the outside diameter of the gudgeon pins and check that it is within the specified limits.

Outside diameter of gudgeon pins
19.996 ÷ 20.000 mm



1. Measure the diameter of the pin mating hole in the piston and check that it is within the specified limits.

Diameter of pin seat in pistons
20.002 ÷ 20.007 mm



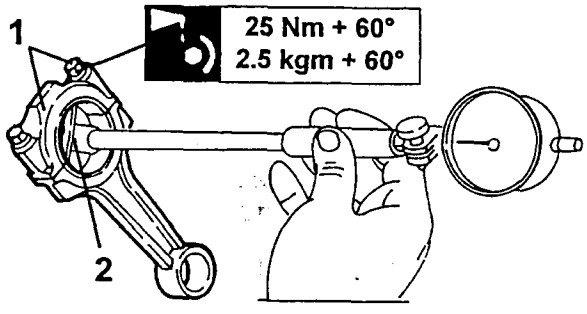
- Calculate the clearance between the pins and their seats on the pistons and check that it is within the specified limits.

Clearance between pins and seats on pistons
0.002 ÷ 0.011 mm

Checking clearance between connecting rod journals and corresponding half bearings

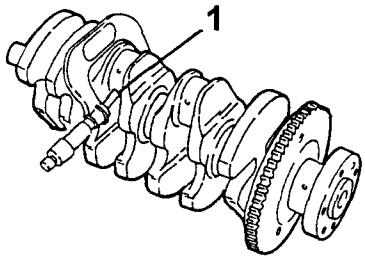
1. House the rod half bearings in the connecting rod big end and on the corresponding cap, then join them tightening the fastening screws to the specified torque.
2. Measure the diameter of the connecting rod big end and check that it is within the specified limits.

Inside diameter of connecting rod half bearings (mm)		
Class	1598	1747
Class A (Red)	48.274 ÷ 48.294	50.835 ÷ 50.855
Class B (Bleu)	48.268 ÷ 48.288	50.827 ÷ 50.847
Class C (Yellow)	48.262 ÷ 48.282	50.819 ÷ 50.839



1. Measure the diameter of the connecting rod journals and check that it is within the specified limits.

Diameter of connecting rod journals (mm)		
Class	1598	1747
Class A (Red)	48.238 ÷ 48.244	50.799 ÷ 50.805
Class B (Bleu)	48.232 ÷ 48.238	50.793 ÷ 50.799
Class C (Yellow)	48.226 ÷ 48.232	50.787 ÷ 50.793



- Calculate the clearance between the rod journals and the corresponding half bearings and check that it is within the specified limits.

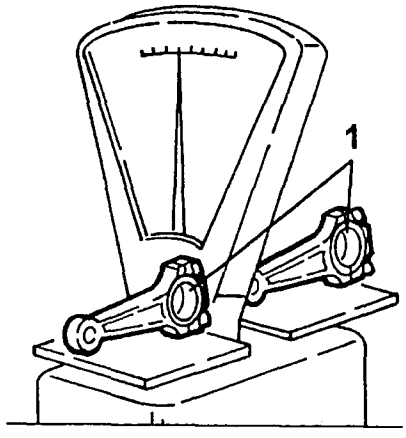
Clearance between rod journals and half bearings
0.03 ÷ 0.056 mm (1) 0.026 ÷ 0.056 mm (2)

(1): 1598 (2): 1747

Checking the connecting rods

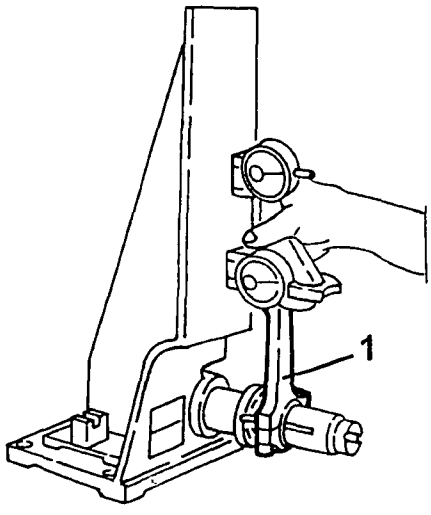
1. Check that the difference in weight between the connecting rods complete with half bearings, caps and screws is within the specified limits.

Difference in weight between connecting rods	≤ 5 g



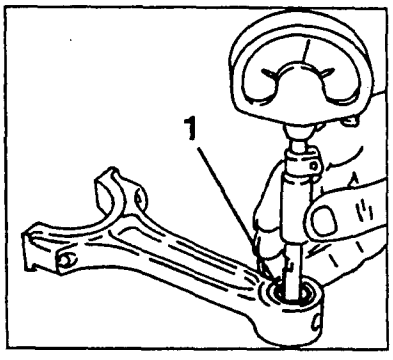
1. Check that the connecting rods are perpendicular using a reference plane as illustrated.

NOTE: If perpendicularity is not perfect, the connecting rod must be changed to avoid abnormal stresses when the engine is running, resulting in uneven wear of the piston and of the rod itself.



Checking the clearance between pins and small end bushings

1. Measure the inside diameter of the small end bushing and check that it is within the specified limits, if not, change the bushing.



Inside diameter of small end bushing
20.006 ÷ 20.012 mm

1. Measure the outside diameter of the pins and check that it is within the specified limits.

Outside diameter of pins
19.996 ÷ 20.000 mm

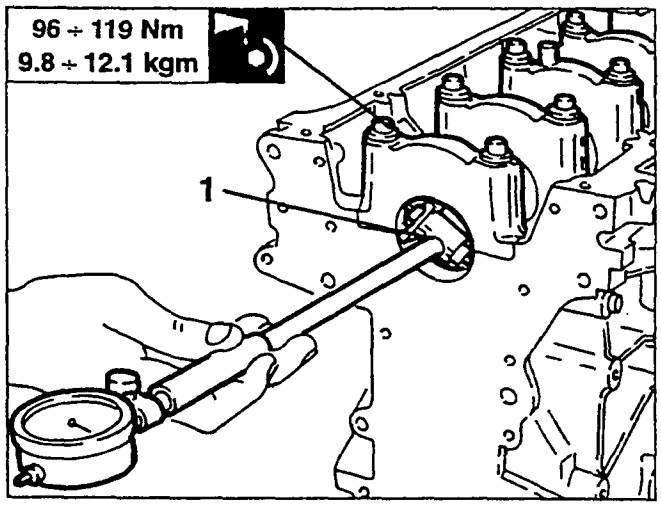
- Calculate the clearance between the pins and small end bushings and check that it is within the specified limits.

Clearance between pins and small end bushing
0.006 ÷ 0.016mm

Checking the clearance between main bearing journals and half bearings

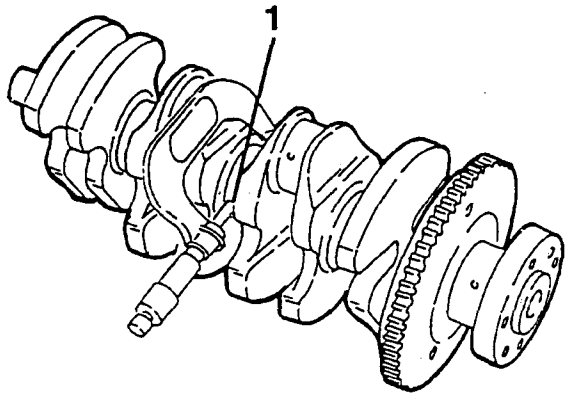
1 House the half bearings and fit the main bearings s on the crankcase tightening the fastening screws to the specified torque.
2. Measure the diameter of the main bearings and check that it is within the specified limits.

Diameter of the main bearings (mm)			
Pos.	Classe	1598	1747
Side	Class A (Red)	53.025 ÷ 53.046	53.031 ÷ 53.056
	Class B (Blue)	53.019 ÷ 53.040	53.017 ÷ 53.046
	Class C (Yellow)	53.013 ÷ 53.034	53.007 ÷ 53.032
Centre	Class A (Red)	53.035 ÷ 53.056	53.041 ÷ 53.066
	Class B (Blue)	53.029 ÷ 53.050	53.027 ÷ 53.056
	Class C (Yellow)	53.023 ÷ 53.044	53.017 ÷ 53.042



1. Measure the diameter of the main bearing journals and check that it is within the specified limits.

Diameter of main bearing journals	
Class A (Red)	52.994 ÷ 53.000 mm
Class B (Bleu)	52.988 ÷ 52.994 mm
Class C (Yellow)	52.982 ÷ 52.988 mm



- Calculate the clearance between the main bearing journals and half bearings and check that it is within the specified limits.

Clearance between main bearing journals and half bearings (mm)		
Pos.	1598	1747
Side	0.025 ÷ 0.052	0.019 ÷ 0.062
Centre	0.035 ÷ 0.062	0.029 ÷ 0.072

Checking the engine flywheel

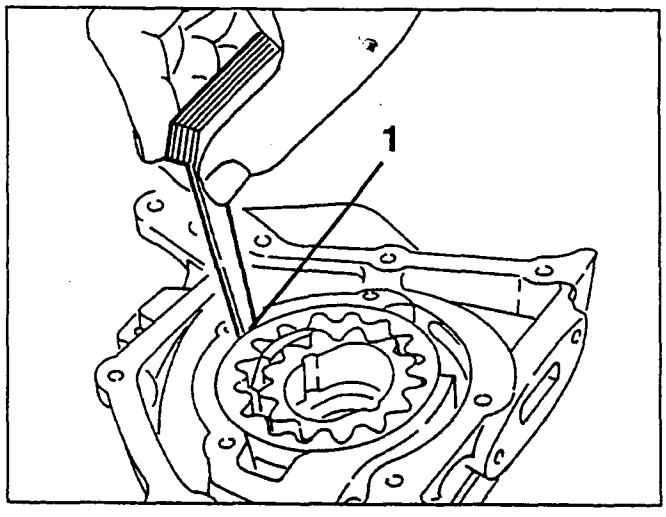
- Check that the ring gear teeth are not cracked or show signs of seizure; if they do, change the ring gear as described below:
- working under the press remove the old ring gear;
- accurately clean the contact surfaces of the new ring gear and of the flywheel;

• evenly heat the new ring gear to 80° ÷ 100° C and fit it on the flywheel: leave to cool naturally, do not force cool.

Checking the oil pump

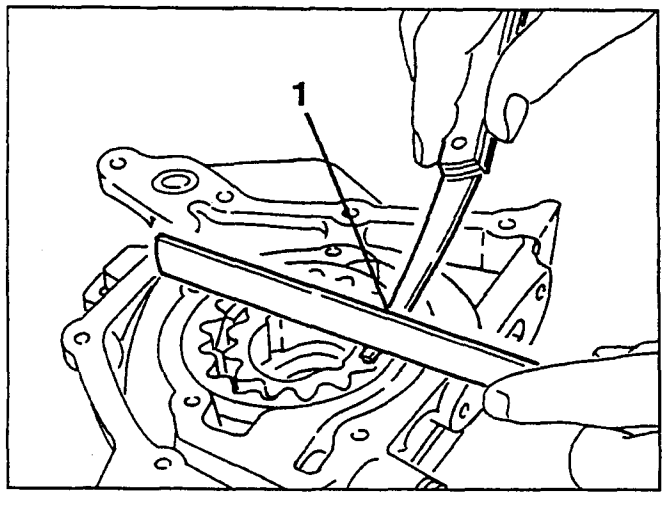
1. Check that the clearance between the pump casing and the driven gear is within the specified limit.

Clearance between pump casing and driven gear
0.080 ÷ 0.186 mm



1. Check that the clearance between the pump cover rest surface and the upper side of the gears is within the specified limit.

Clearance between pump cover rest surface and upper side of gears
0.025 ÷ 0.070 mm



WARNING: If the clearances measured are not within the specified limits, change the front crankcase cover with oil pump incorporated.

- Using a torque meter check the characteristic values of the engine oil pressure limiting valve control spring.

Control load Kg	Spring length mm
6.4 ÷ 7.2	36

INSTRUCTIONS FOR RE-ASSEMBLY

For re-assembly operations reverse the sequence described for dis-assembly, unless otherwise indicated below.

- Check valve tightness when the cylinder head assembled (see "Turning the valve seats").

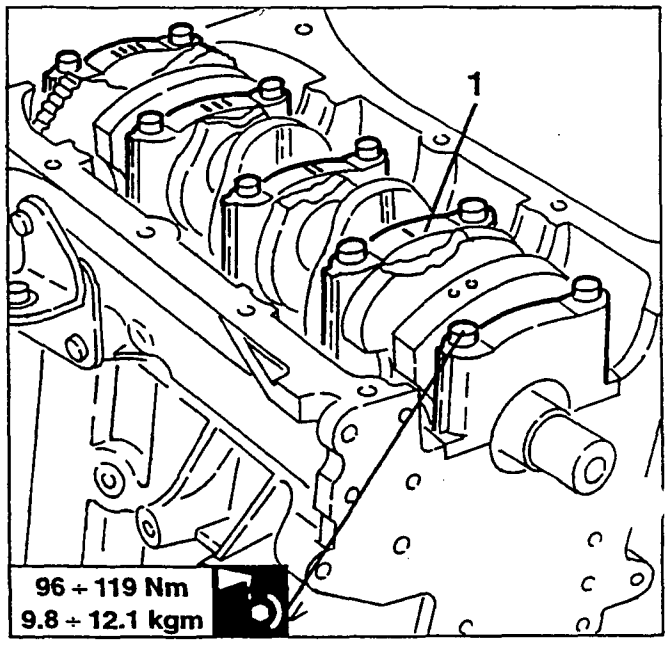
Reassembling the crankshaft

- Assemble the crankshaft on the crankcase complete with half bearings and half thrust rings.

Reassemble the half thrust rings with the grooved surfaces facing the crankshaft.

1. Assemble the main bearing caps complete with half bearings on the supports and tighten the fastening screws two or three times starting from the centre main bearing cap.

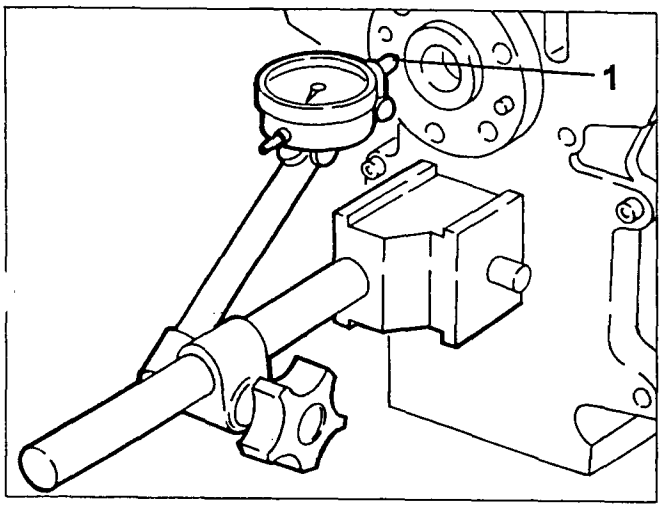
The position of each cap is given by a series of consecutive notches (from zero to four start from the front of the engine) etched on the caps themselves.



Checking the crankshaft end float

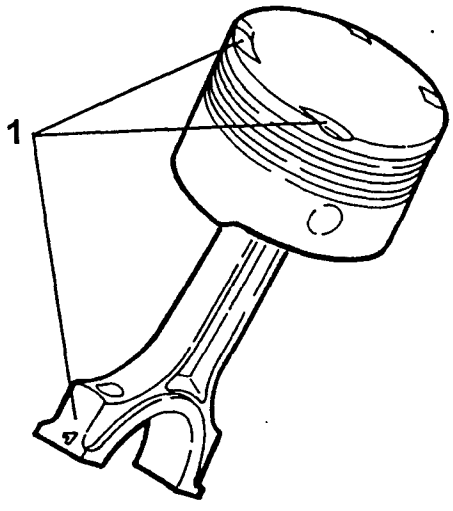
1. Using a dial gauge on a magnetic base, measure the crankshaft end float and check that it is within the specified limits.

Crankshaft end float
0.059 ÷ 0.221 mm



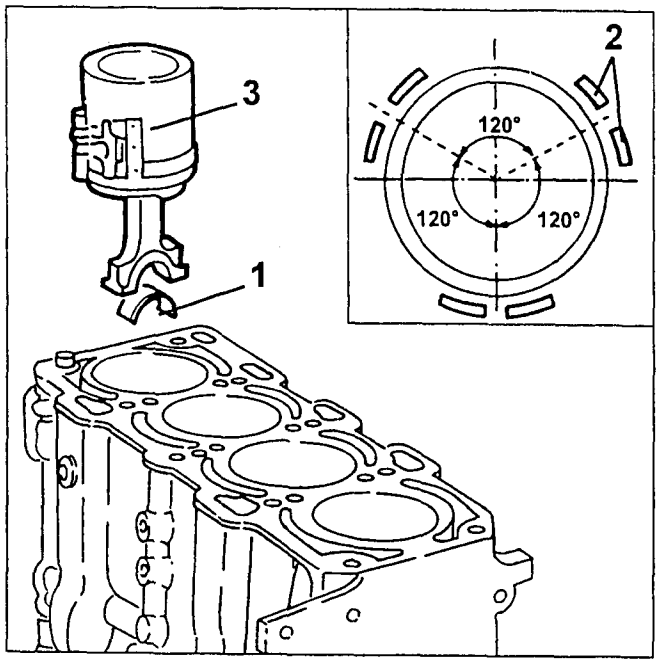
Refitting the pistons and connecting rods

1. Assemble the piston and connecting rod so that the number stamped on the connecting rod big end is on the same side as the large notches (for intake valves) on the piston crown.



- Turn the crankshaft until the connecting rod journals of the 1st and 4th cylinder are in the position corresponding to the B.D.C.
1. House the half bearings on the connecting rod big ends.
2. Insert the rings in the pistons with the cuts offset by 120° and the word TOP printed on them facing upwards.
3. Using a suitable tool, insert the pistons and connecting rods in the 1st and 4th cylinder.

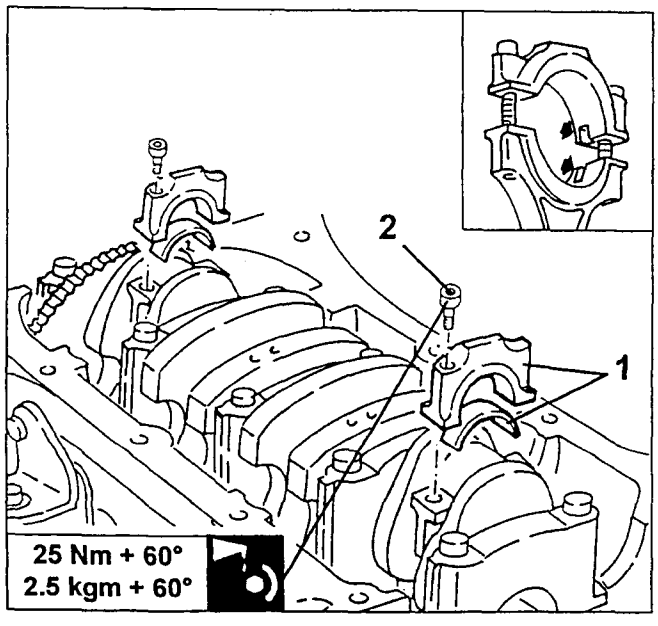
Assemble the connecting rod - piston unit in the crankcase directing the arrow stamped on the piston crown in the direction of rotation of the engine.



- Turn the crankcase 180°.
1. House the half bearings on the connecting rod caps, then assemble those of the 1st and 4th cylinder directing the safety notch towards the same side as the corresponding notch on the connecting rod big end.

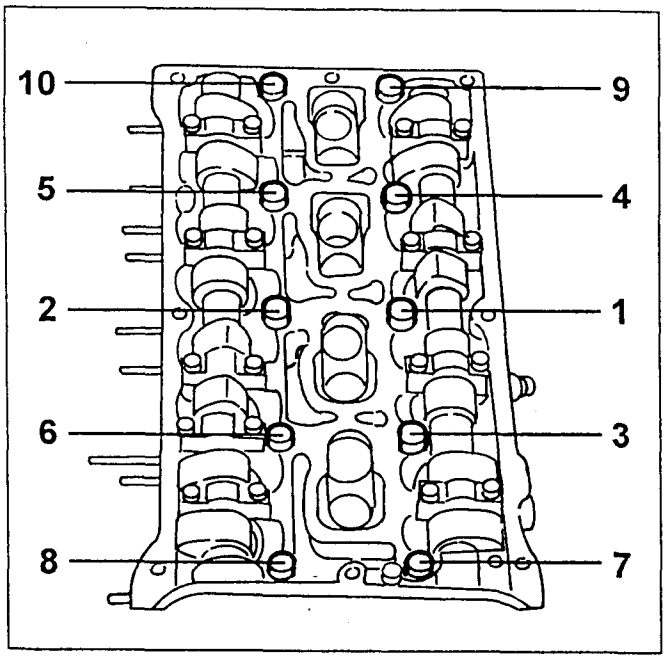
On one side, the connecting rod caps have the number of the cylinder to which they belong; when refitting, this number must always be on the same side as the one stamped on the connecting rod big end.

2. Tighten the connecting rod cap fastening screws in oil to the specified torque.
- In the same way, reassemble the pistons and connecting rods of the 2nd and 3rd cylinder.



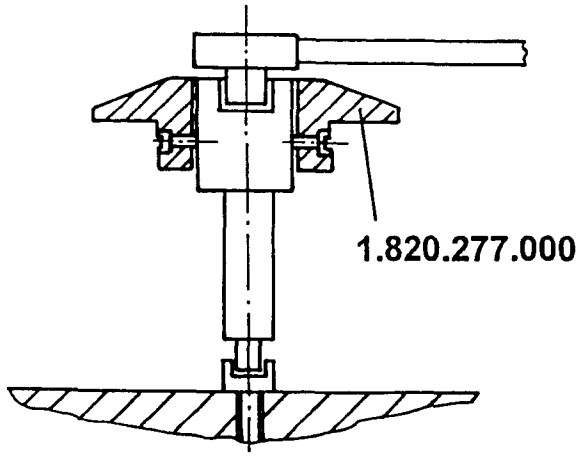
Reassembling the cylinder head

- Turn the crankshaft to take the pistons of the 1st and 4th cylinder to the T.D.C.
- Position the gasket on the crankcase, then the cylinder head.
- Tighten the cylinder head fastening screws as described below and bearing in mind that the tightening sequence is the one shown below for each phase.



Tightening procedure	
Set in all the screws to a torque of:	20 Nm (2.0 kgm)
Tighten the screws to the preliminary torque of:	40 Nm (4.1 kgm)
Turn all the screws with an angle of:	90° + 90° + 90°

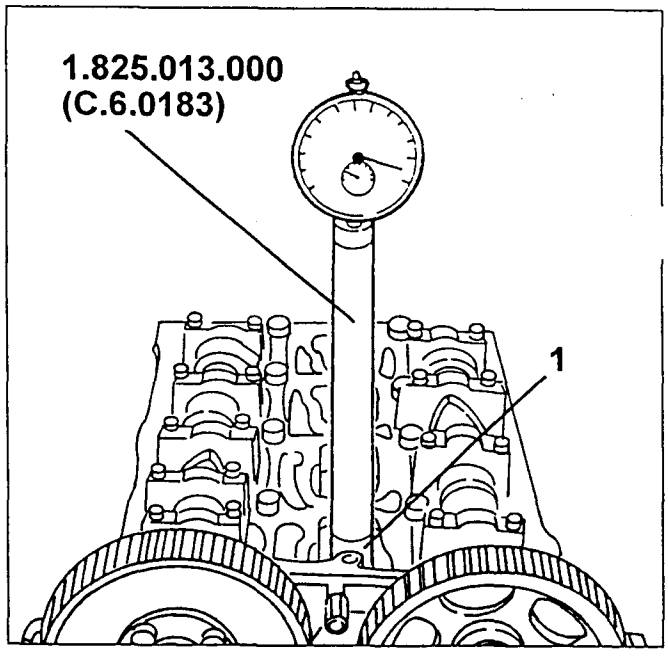
- For angle tightening use the graduated disk no. 1.820.277.000 as illustrated.



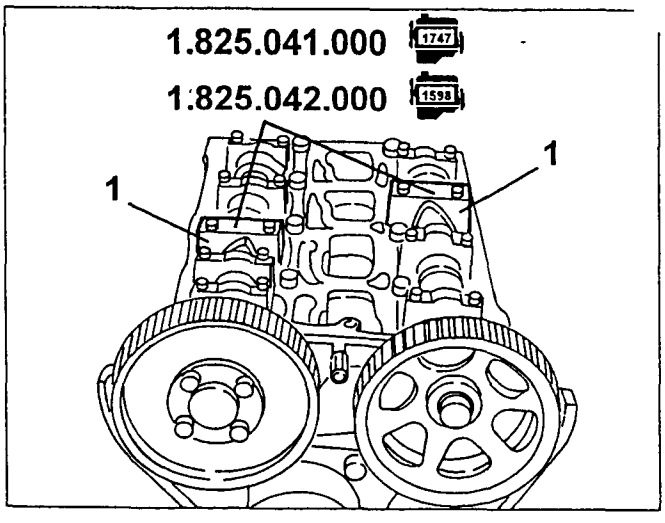
The gasket between the cylinder head and the crankcase is in aramidic fibre and cylinder head retightening is unnecessary throughout the life of the engine.

Assembling the timing gear drive belt and checking timing

- Assemble the camshaft toothed pulleys without tightening the fastening screws, the timing drive belt pulleys and the corresponding belt tensioners.
1. Install tool no. 1.825.013.000 (C.6.0183) fitted with a dial gauge in the seat of the centre spark plug of the 1st cylinder.
- Turn the crankshaft until the piston of the first cylinder reaches the T.D.C. in the bursting stroke.



1. Remove the camshaft caps illustrated and in their place insert templates, tightening the fastening screws to a maximum torque of **10 Nm (1 Kgm)** and checking for correct coupling with the cams.

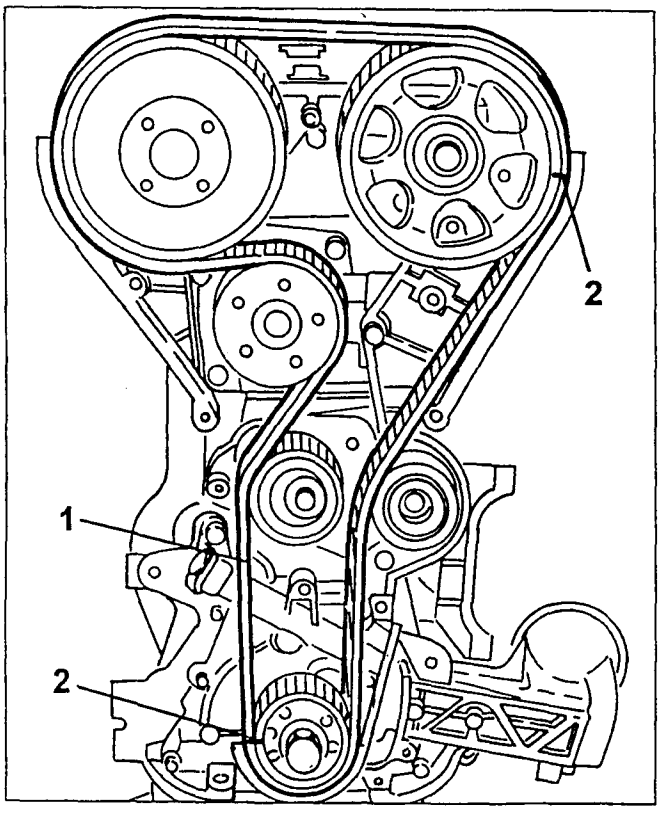


NOTE: For turning the camshafts, use tool n 1.822.155.000 for the intake side and tools no. 1.822.146.000 and no. 1.822.156.000 for the exhaust side, to be applied on the corresponding pulleys.

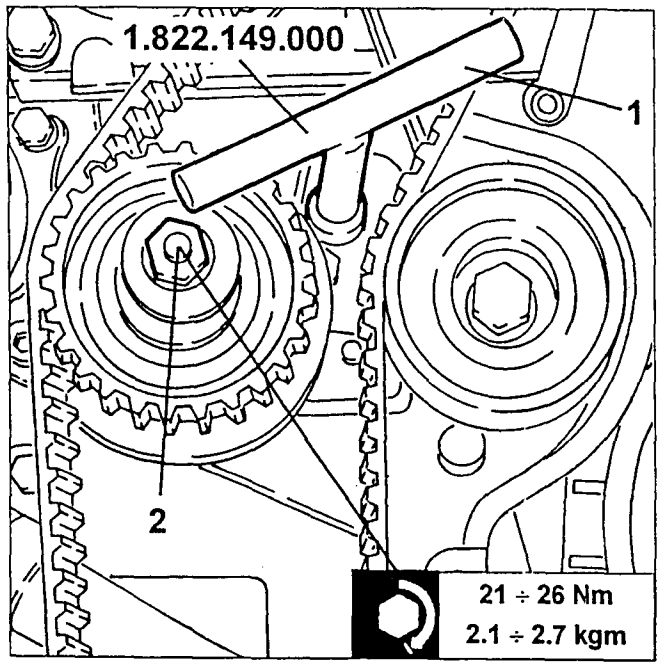
1. Assemble the timing gear drive belt taking care to check correct coupling with the pulley teeth, installing it in the following sequence:
- crankshaft pulley
- fixed tightening pulley
- exhaust side camshaft pulley
- intake side camshaft pulley
- automatic tensioner pulley
- coolant fluid pump pulley

2. The notches painted on the belt must coincide with the indexes made on the crankshaft pulley and on the exhaust side camshaft pulley.

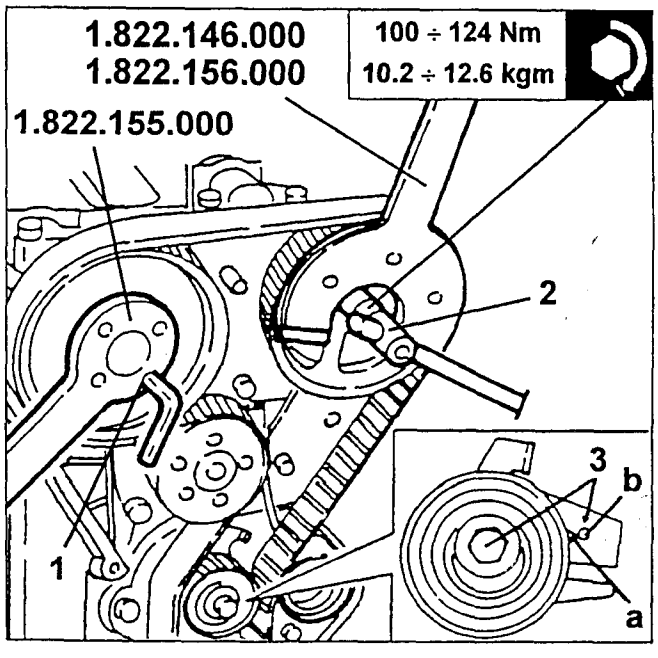
WARNING:
When assembling the toothed belt, to avoid damaging the structure of the fibres that form it, never cause sharp bends.
For correct assembly the belt has an arrow on it which shows the direction of rotation of the engine.



1. Using tool no. 1.822.149.000 as illustrated, tension the belt to the maximum.
2. Tighten the nut fastening the automatic camshaft belt tensioner.



1. Using tool no. 1.822.155.000, tighten the screws fastening the intake side camshaft drive pulley.
2. Using tool no. 1.822.146.000 complete with tool no. 1.822.156.000, tighten the screw fastening the exhaust side camshaft drive pulley.
- Remove the two templates from the camshafts and turn the crankshaft twice in its direction of rotation until the piston of the 1st cylinder reaches the T.D.C. in the bursting stroke.
3. Release the nut fastening the automatic tensioner, then using tool no. 1.822.149.000, move the mobile index (a) to coincide with the reference hole (b).
- Tighten the automatic tensioner fastening nut to the specified torque.
- Turn the crankshaft twice in its direction of rotation until the piston of the 1st cylinder reaches the T.D.C. in the bursting stroke and check that all the timing references coincide.

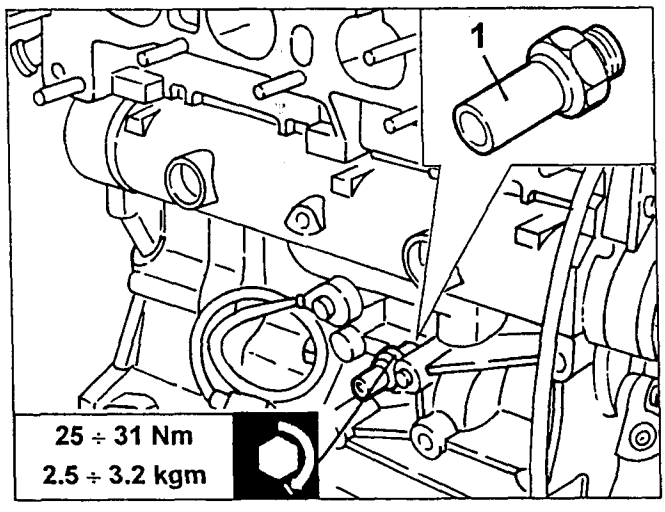


CHECKING LUBRICATION CIRCUIT ELECTRIC COMPONENTS

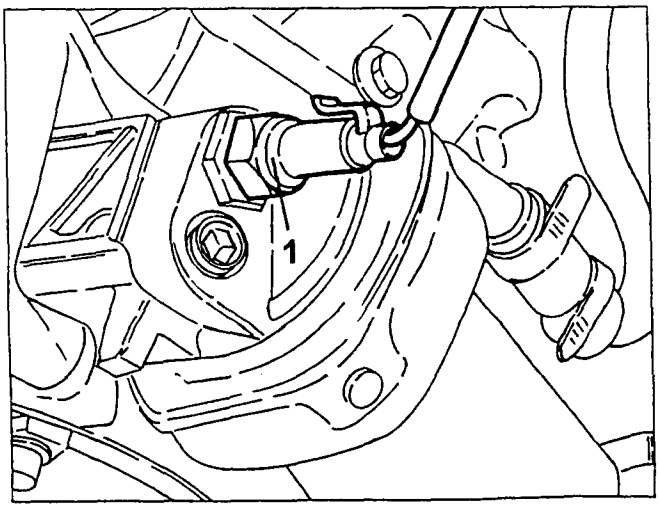
ENGINE OIL MINIMUM PRESSURE WARNING LIGHT SENSOR

1. Check the setting of the engine oil minimum pressure warning light sensor. If the ratings are not as specified, replace the sensor.

Contact opening/closing pressure
0.2 ÷ 0.5 bar



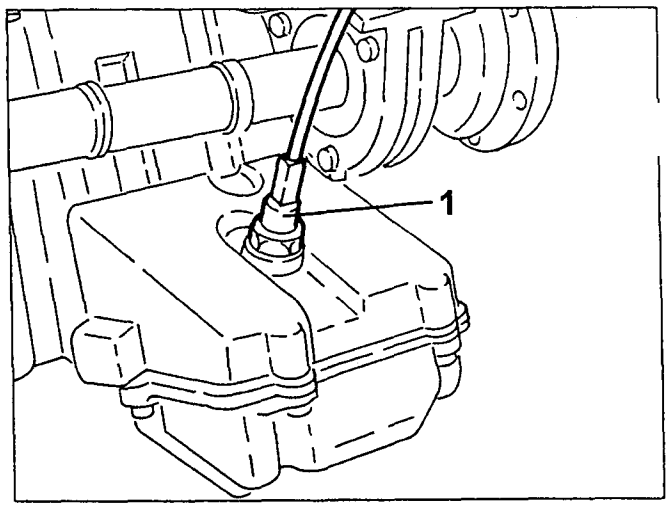
NOTE: In some versions the engine oil minimum pressure warning light sensor (1) is fitted on the oil filter support as illustrated below.



ENGINE OIL TEMPERATURE SENSOR

1. Check the setting of the engine oil temperature sensor. If the ratings are not as specified, replace the sensor.

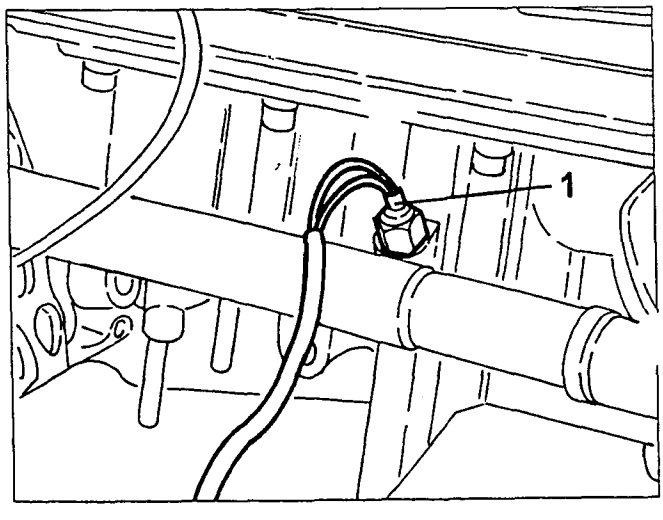
Temperature (°C)	Resistance (Ω)
50	800 ÷ 900
70	350 ÷ 450
90	180 ÷ 220



LOW ENGINE OIL LEVEL WARNING LIGHT SENSOR

1. Check the setting of the low engine oil level warning light sensor. If the ratings are not as specified, replace the sensor.

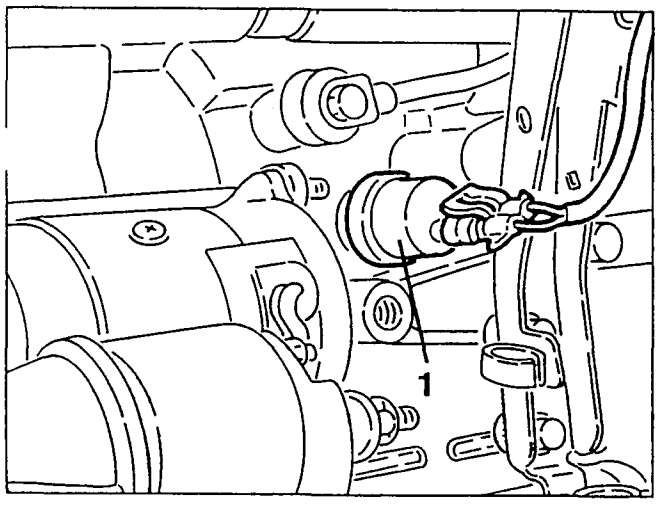
Circuit resistance	12 Ω ± 5%



ENGINE OIL PRESSURE SENDER

1. Check the setting of the engine oil pressure sender. If the values are not within the specified limits, change the sensor.

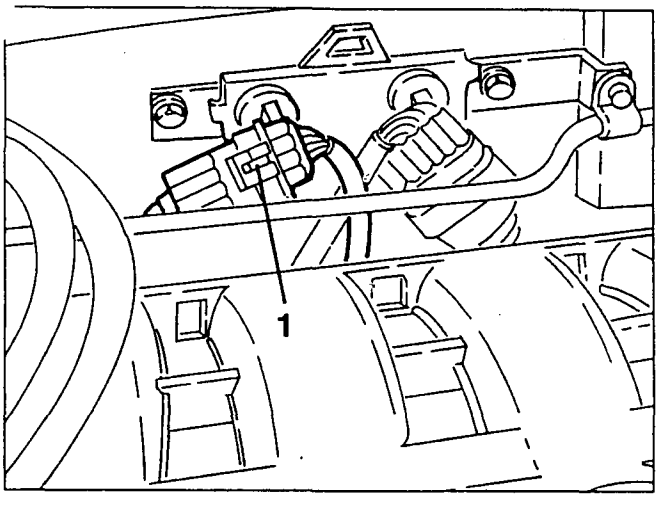
Pressure (bar)	Resistance (Ω)
0	305 ± 15
2	190 ± 15
4	118 ± 15
8	20 ± 20



Removing/Refitting

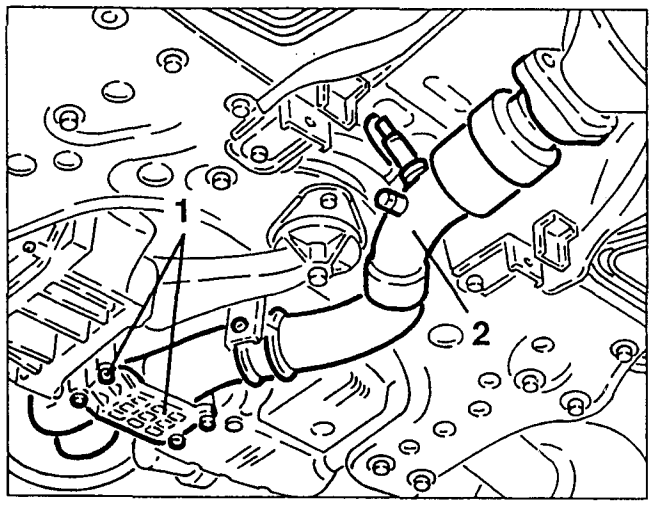
- Set the car on a lift.
- Disconect the battery (-) terminal.

1. Disconect the electrical connection of the lambda probe.

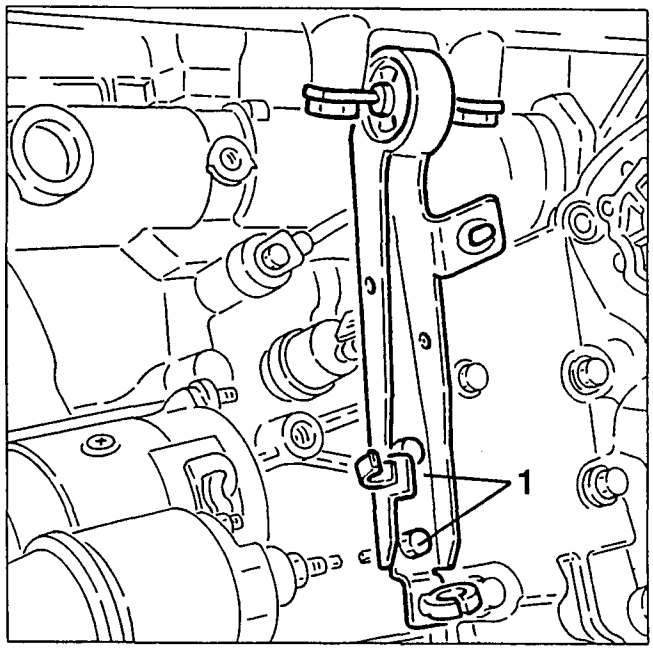


- Raise the car.

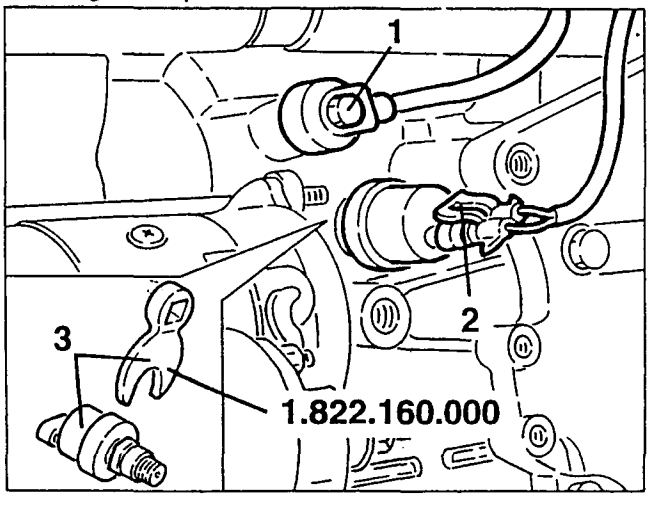
1. Slacken the fastening screws and remove reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda probe after slackening the fastenings concerned.



1. Slacken the fastening screws and remove the intake box support bracket.



1. Slacken the fastening screw and move aside the pinging sensor.
2. Disconect the electrical connection from the engine oil pressure transmitter.
3. Using tool no. 1.822.160.000 slacken and remove the engine oil pressure transmitter.

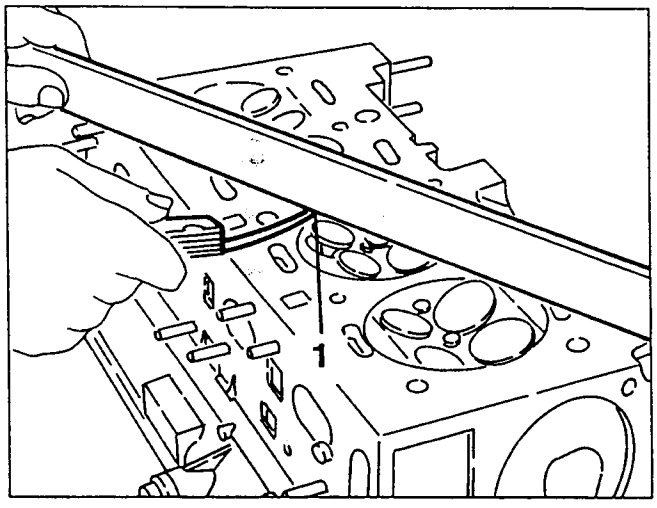


CHECKS AND INSPECTION CYLINDER HEAD

Checking the lower surface of the cylinder head

1. Check the flatness of the lower cylinder head surface; reface if it is excessively worn.

Maximum flatness error of cylinder head lower surface
0.1 mm

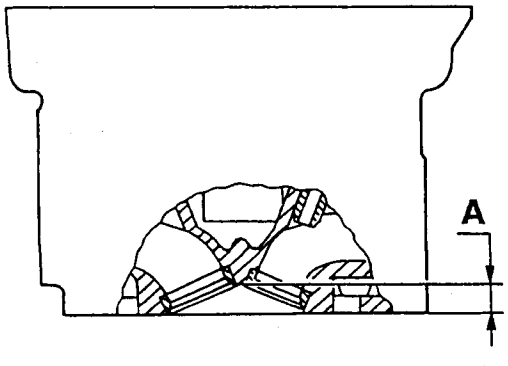


- After refacing, check that the depth of the combustion chamber, on the head, exceeds the minimum allowed limit.

WARNING:
Exceeding the minimum allowed limit involves serious engine operating failures.

Minimum depth "A" of the combustion chamber in the head
13 ± 0.2 mm

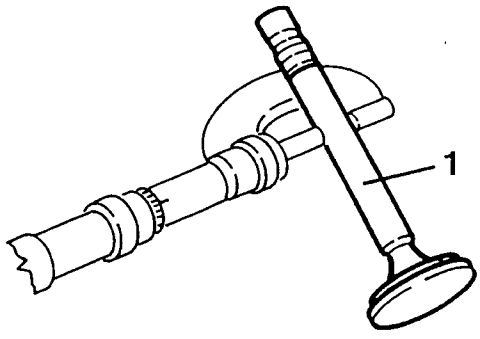
- Check that the finishing of the lower cylinder head surface is satisfactory.



Checking the clearance between valve guides and valve stems

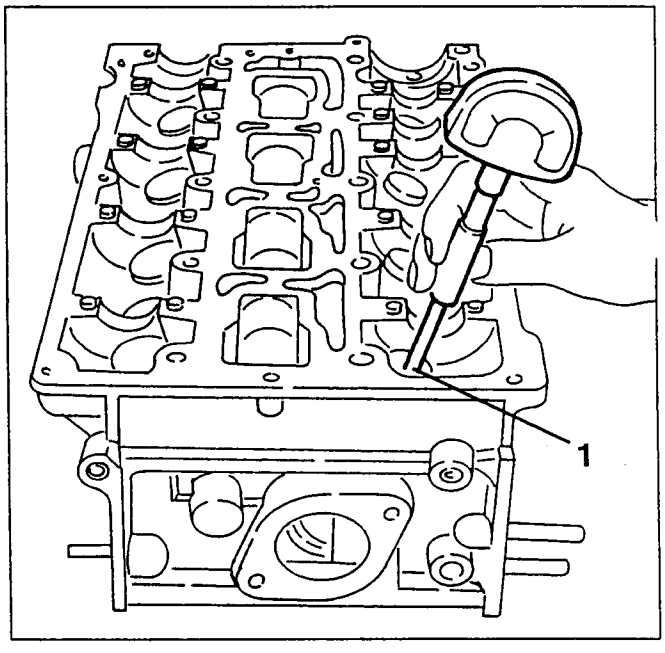
1. Measure the diameter of the valve stems and check that it is within the specified limits.

Diameter of valve stems	
Intake	6.975 ÷ 6.990 mm
Exhaust	6.960 ÷ 6.975 mm



1. Measure the inside diameter of the valve guides and check that it is within the specified limits.

Inside diameter of valve guides
7.022 ÷ 7.040 mm

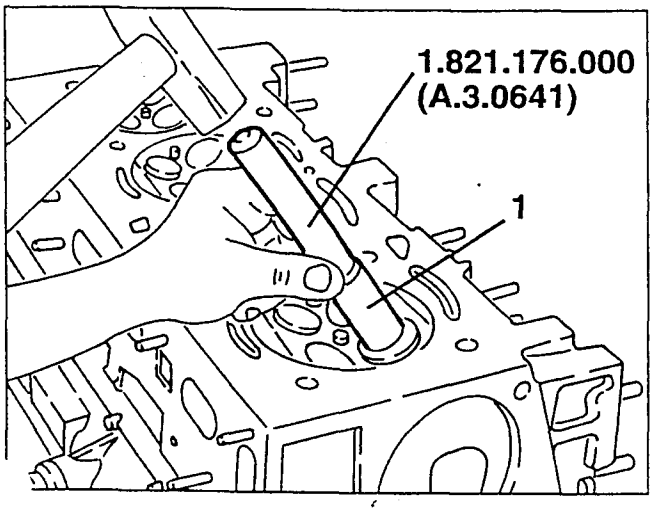


- Calculate the clearance between valve guides and stems and check that it is within the specified limits, if not, change any worn parts.

Radial clearance between valve guides and stems	
Intake	0.032 ÷ 0.065 mm
Exhaust	0.047 ÷ 0.080 mm

hanging the valve guides

1. Using puller tool no. 1.821.176.000 (A.3.0641), remove the worn valve guides.



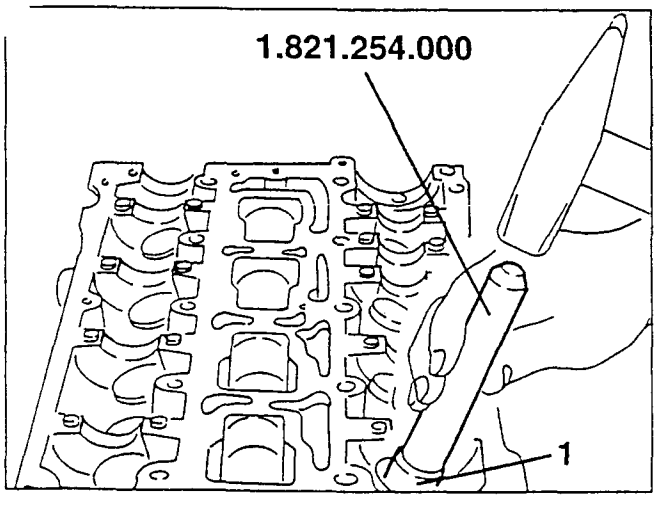
- Check that the outside diameter of the valve guides and their seats on the head are within the specified limits and that their assembly interference is correct.

Outside diameter of valve guides
13.010 ÷ 13.030 mm

Diameter of valve guide seats
12.950 ÷ 12.977 mm

Interference between valve guides and seats
0.033 ÷ 0.080 mm

1. Insert the new valve guides using tool no. 1.821.254.000.



- Bore the valve guide inside diameter to calibrate the holes to the specified diameter.

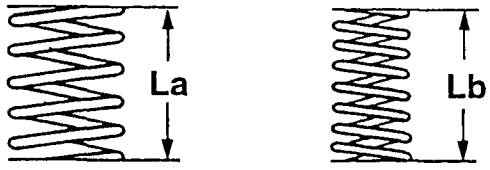
Inside diameter of valve guides
7.022 ÷ 7.040 mm

Checking the valve springs

- Check that the "free" length of the valve springs is within the specified limits.

NOTE: The rest surfaces must be parallel with each other and perpendicular to the axis of the spring with a maximum error of 2°.

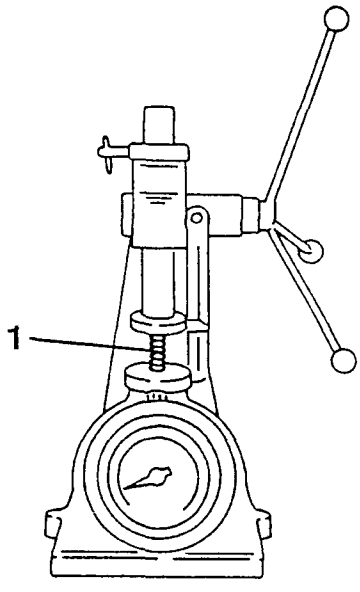
Free length of valve springs	
outer spring "La"	46 mm
inner spring "Lb"	39 mm



1. Using a torque meter, check that the characteristic data of the springs are within the specified limits.

Outer spring		
Length of spring mm		Control load N (Kg)
With valve closed	34.0	271 ÷ 294 (27.6 ÷ 30)
With valve open	24.5	485 ÷ 524 (49.4 ÷ 53.4)

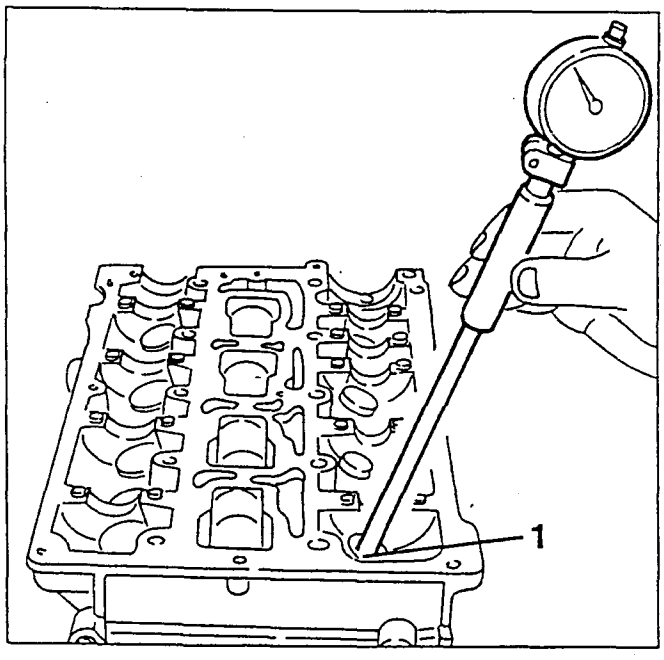
Inner spring		
Length of spring mm		Control load N (Kg)
With valve closed	29.5	96 ÷ 106 (9.8 ÷ 10.8)
With valve open	20.0	201 ÷ 221 (20.5 ÷ 22.5)



Checking the clearance between hydraulic tappets and their seats

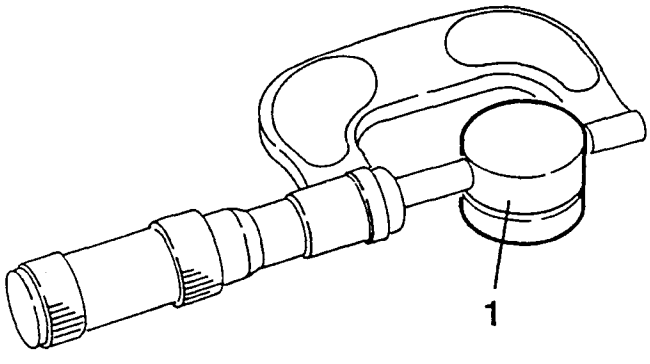
1. Check that the diameter of the hydraulic tappets seats is within the specified limits.

Diameter of hydraulic tappets seats
33.000 ÷ 33.025 mm



1. Check that the outside diameter of the hydraulic tappets is within the specified limits.

Diameter of hydraulic tappets
32.959 ÷ 32.975 mm



- Calculate the clearance between the hydraulic tappets and their seats checking that it is within the specified limits.

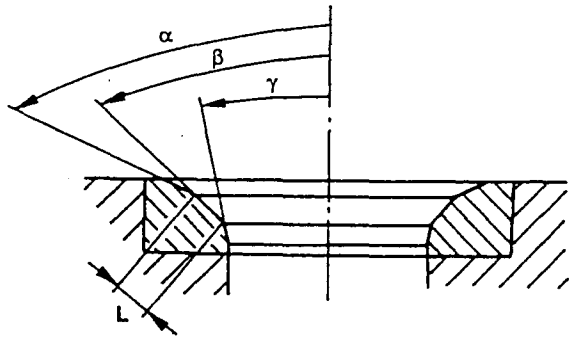
Clearance between hydraulic tappets and seats
0.025 ÷ 0.066 mm

Turning the valve seats

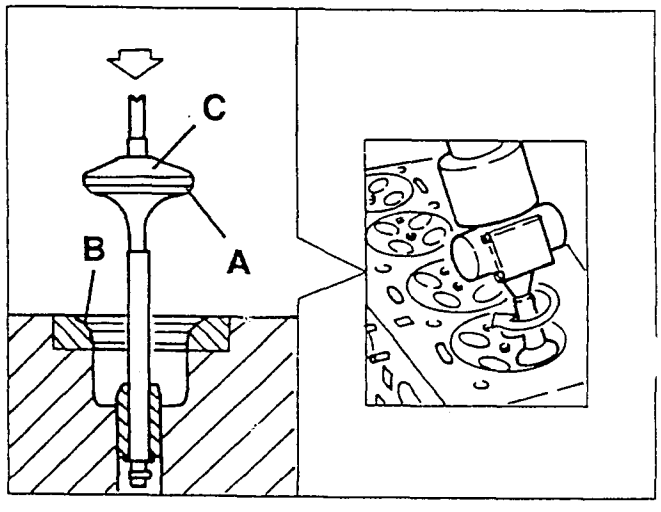
- If necessary, turn the valve seats using suitable equipment within the following limits.

Taper of contact area with valve "β"	90° ± 10'
Taper of upper valve seat area "α"	150°
Taper of lower valve seat area "γ"	30°

Dimension "L" contact area with valve	
Intake	0.8 mm
Exhaust	1 mm



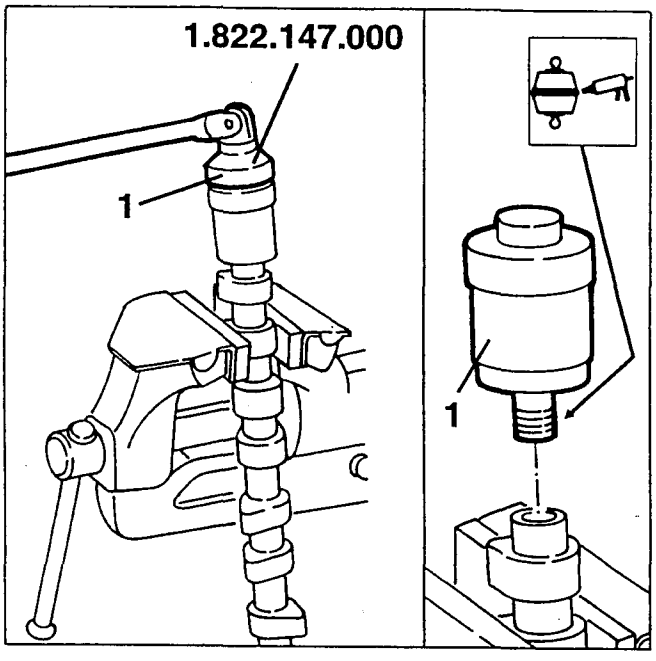
- After machining, grind each valve in its seat as follows:
- coat the contact surfaces "A" and "B" of the valves and their seats with abrasive paste (SIPAL AREXO' Carbosilicium for valves);
- lubrificate the valve stem with engine oil;
- fit the lower surface of the valve mushroom to the suction cup "C" of a pneumatic grinder;
- insert the valve in its guide and grind;
- after grinding, thoroughly clean the valve and the seat.



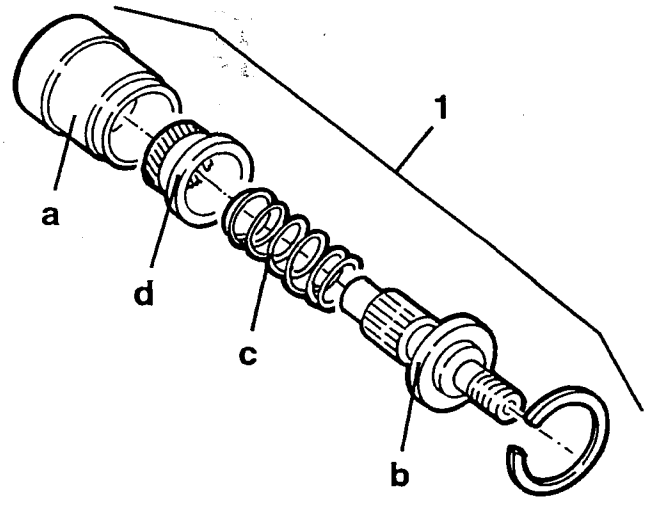
Removing the timing variator from the camshaft

- Position the camshaft intake side in a vice fitted with protective jaws.

1. Using tool no. 1.822.147.000, slacken and remove the timing variator from the camshaft.



1. Remove the stop ring and remove the outer body (a) of the variator pinion (b), spring (c) and the piston (d).



WARNING:
When refitting the timing variator, follow the instructions given below:
- Make sure that the mastic on the thread coupling the timing variator to the camshaft does not obstruct the oil ducts.
- Wait for about two hours before assembling the shaft on the cylinder head.

CHECKS AND INSPECTION CRANKCASE

- Visibly check the crankcase for cracks and signs of excessive wear of the sliding surfaces; check that all the threads are intact.
- Remove the lubrication and cooling groove caps and clean the ducts with a suitable detergent, then dry with a jet of air and fit new caps.
- Accurately remove any traces of seals or sealants from the crankcase surfaces.

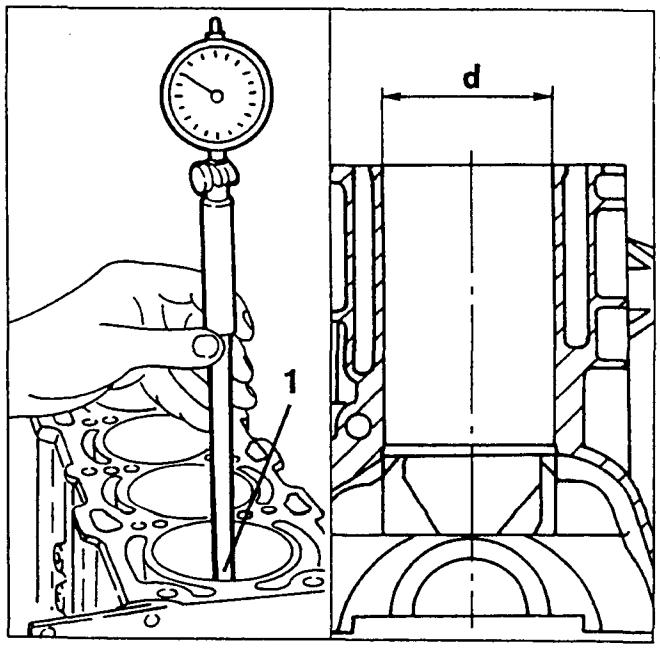
Checking the cylinders

1. Using a bore gauge fitted on a dial gauge, measure the inside diameter of the cylinders and check that it is within the specified limits.

Inside diameter of the cylinders "d"	
Class A	83.000 ÷ 83.010 mm
Class B	83.010 ÷ 83.020 mm
Class C	83.020 ÷ 83.030 mm
Oversize of 0.1 mm	

Maximum cylinder taper
0.010 mm

Maximum cylinder ovalization
0.005 mm



- When turning and grinding the valve seats it is advisable to check the valve tightness with the spark plugs in place, proceeding as follows:
• fill the hollow of the combustion chamber with petrol;
• admit low pressure air into the intake manifolds and check that no bubbles form in the petrol;
• check the tightness of the exhaust valves in the same way, admitting air to the exhaust manifolds;
• if any leaks are noted, make sure that the valves are perfectly settled in their seats and repeat the check; if the result is negative, grinding must be repeated.

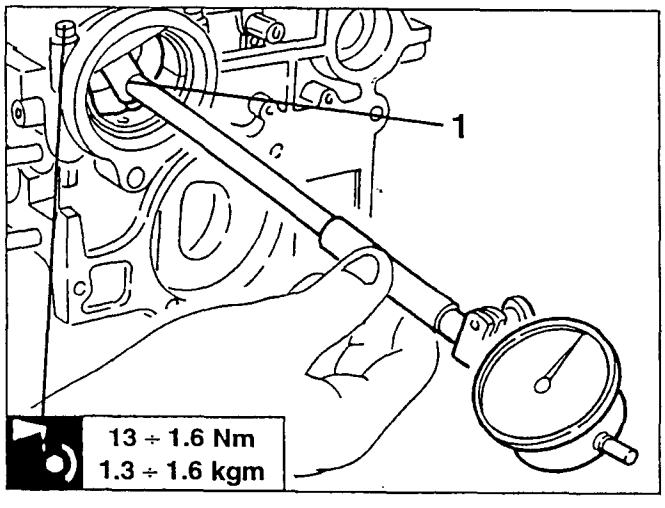
Camshafts and timing system bearings

1. Assemble the camshaft caps and tighten the fastening screws to the specified torque, then check that the diameter of the supports is within the specified limits.

NOTA: The half bearings should be assembled on the intake side front support.

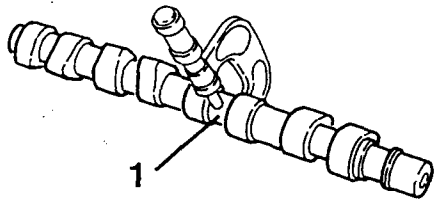
Diameter of camshaft supports
26.045 ÷ 26.070 mm 50.034 ÷ 50.071 mm (*)

(*) Front intake side support with half bearings assembled (for timing variator)



1. Check that the diameter of the camshaft journals is within the specified limits.

Diameter of camshaft journals
26.000 ÷ 26.015 mm



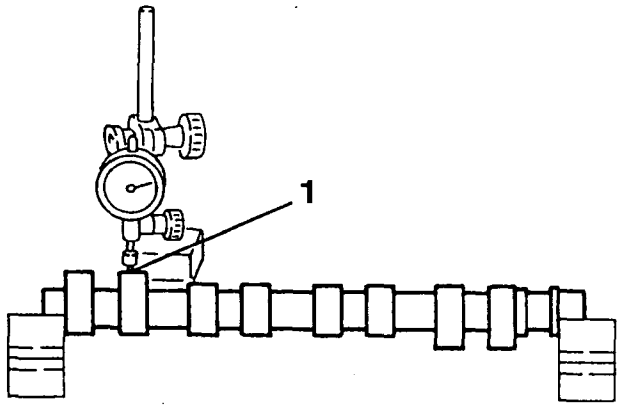
- Calculate the clearance between the camshaft journals and their bearings and check that it is within the specified limits.

Clearance between camshafts and bearings	
0.03 ÷ 0.07 mm	0.034 ÷ 0.086 mm (*)

(*) Specific for timing variator

1. Check that the cam lifts are within the specified limits.

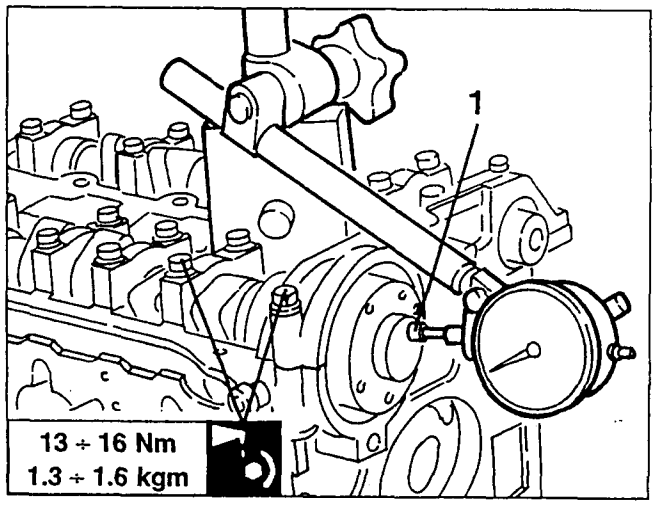
Cam nominal lift	
Intake	8.3 mm
Exhaust	7.5 mm



Checking the camshaft end float

- Place the camshafts on the cylinder head, assemble the corresponding caps and tighten the fastening screws to the specified torque.
1. Install a centesimal dial gauge and measure the end float of the camshafts checking that it is within the specified limits.

Camshafts end float
0.10 ÷ 0.23 mm

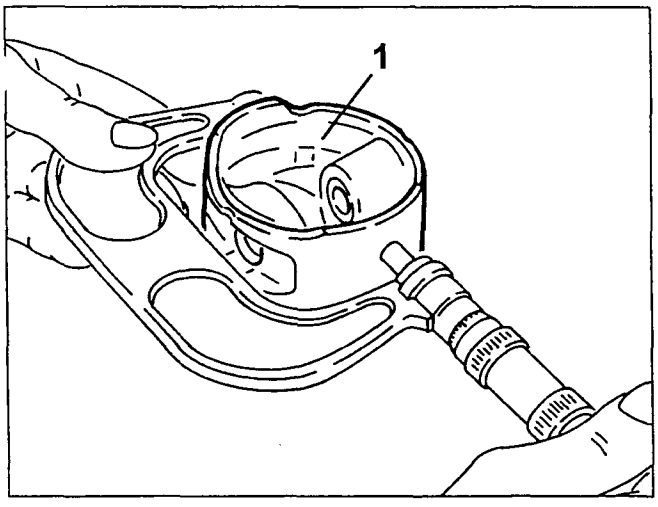


Checking the pistons

1. Measure the outside diameter of the pistons and check that it is within the specified limits.

Outside diameter of pistons (1)	
Class A - Blue	81.952 ÷ 81.962 mm
Class B - Pink	81.960 ÷ 81.970 mm
Class C - Green	81.968 ÷ 81.978 mm
Oversize of 0.1 mm	

(1) To be measured at right angles to the gudgeon pin hole at a distance of 12.5 mm from the lower edge of the piston skirt.

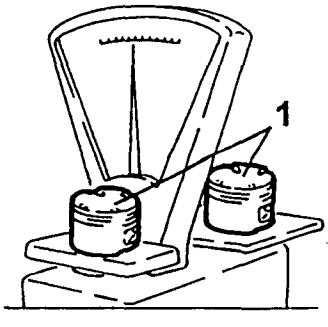


- Calculate the clearance between the cylinder and the piston and check that it is within the specified limits.

Clearance between piston and cylinder
0.040 ÷ 0.060 mm

1. Check that the difference in weight between the pistons complete with gudgeon pins and seal rings is within the specified limits.

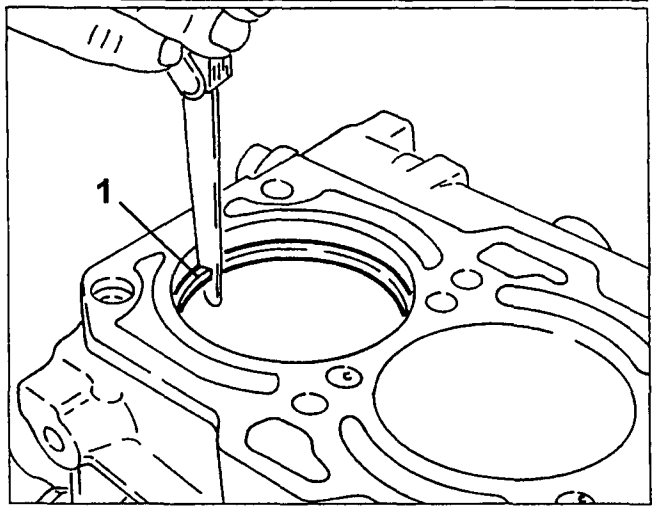
Difference in weight between pistons
± 5 g



Checking the seal ring gap

1. Insert the seal rings in the cylinder, check that they adhere to the whole circumference and that the gap is within the specified limits.

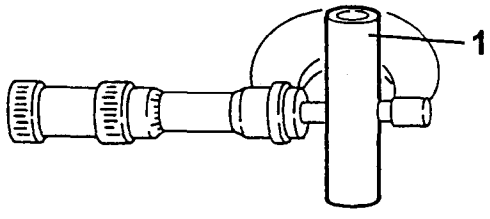
Ring gap	
First ring	0.25 ÷ 0.50 mm
Second ring	0.30 ÷ 0.50 mm
Oil scraper ring	0.25 ÷ 0.50 mm



Checking the play between gudgeon pins and seats on pistons

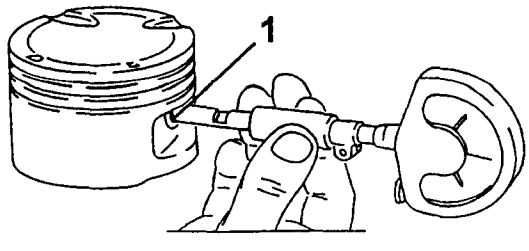
1. Measure the outside diameter of the gudgeon pins and check that it is within the specified limits.

Outside diameter of gudgeon pins
19.996 ÷ 20.000 mm



1. Measure the diameter of the pin mating hole in the piston and check that it is within the specified limits.

Diameter of pin seat in pistons
20.002 ÷ 20.007 mm



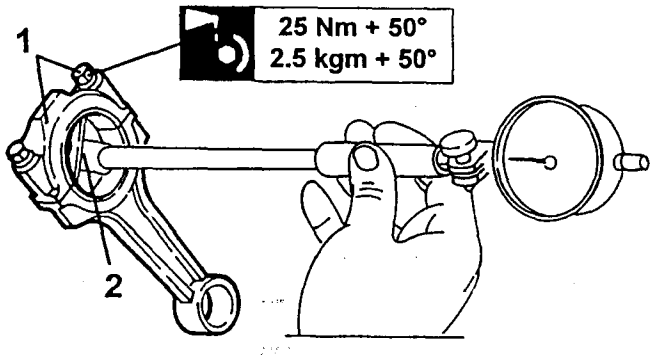
- Calculate the clearance between the pins and their seats on the pistons and check that it is within the specified limits.

Clearance between pins and seats on pistons
0.002 ÷ 0.011 mm

Checking clearance between connecting rod journals and corresponding half bearings

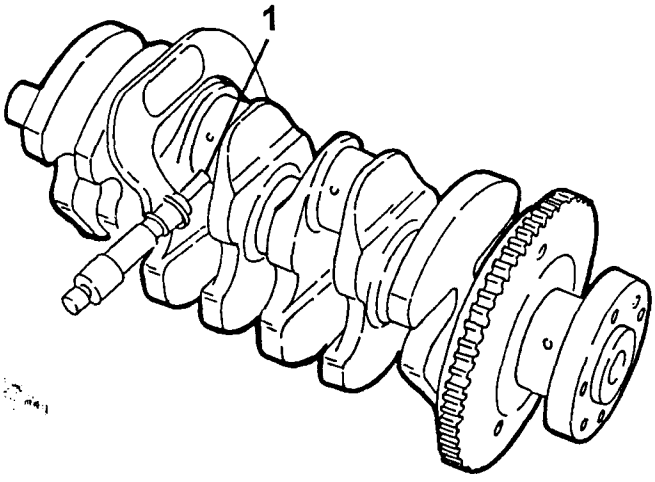
1. House the rod half bearings in the connecting rod big end and on the corresponding cap, then join them tightening the fastening screws to the specified torque.
2. Measure the diameter of the connecting rod big end and check that it is within the specified limits.

Inside diameter of connecting rod half bearings	
Class A - Red	40.920 ÷ 40.940 mm
Class B - Bleu	40.914 ÷ 40.934 mm
Class C - Yellow	40.908 ÷ 40.928 mm



1. Measure the diameter of the connecting rod journals and check that it is within the specified limits.

Diameter of connecting rod journals	
Class A - Red	40.884 ÷ 40.890 mm
Class B - Bleu	40.878 ÷ 40.884 mm
Class C - Yellow	40.872 ÷ 40.878 mm



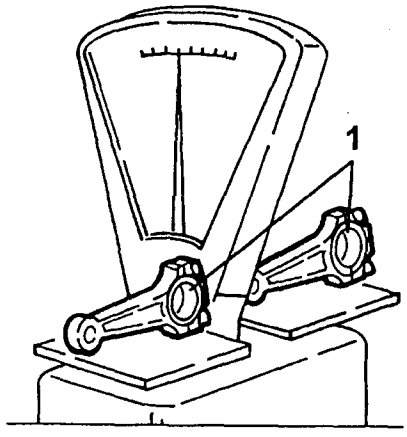
- Calculate the clearance between the rod journals and the corresponding half bearings and check that it is within the specified limits.

Clearance between rod journals and half bearings
0.030 ÷ 0.056 mm

Checking the connecting rods

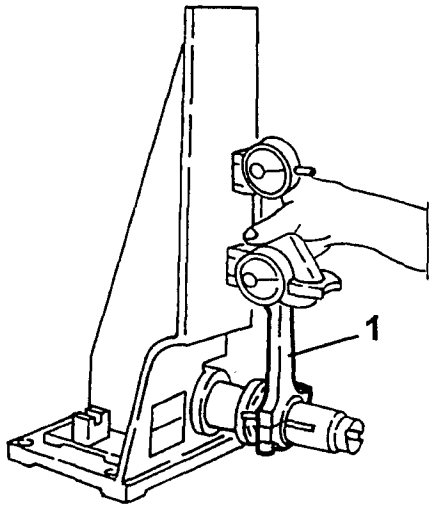
1. Check that the difference in weight between the connecting rods complete with half bearings, caps and screws is within the specified limits.

Difference in weight between connecting rods
≤ 5 g



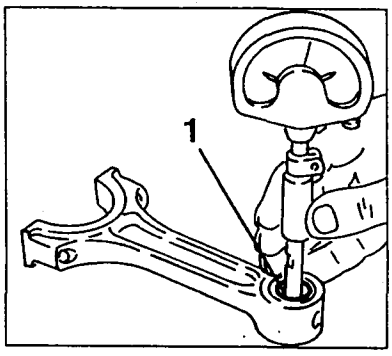
1. Check that the connecting rods are perpendicular using a reference plane as illustrated.

NOTE: If perpendicularity is not perfect, the connecting rod must be changed to avoid abnormal stresses when the engine is running, resulting in uneven wear of the piston and of the rod itself.



Checking the clearance between pins and small end bushings

1. Measure the inside diameter of the small end bushing and check that it is within the specified limits, if not, change the bushing.



Inside diameter of small end bushing
20.006 ÷ 20.012 mm

- Measure the outside diameter of the pins and check that it is within the specified limits.

Outside diameter of pins
19.996 ÷ 20.000 mm

- Calculate the clearance between the pins and small end bushings and check that it is within the specified limits.

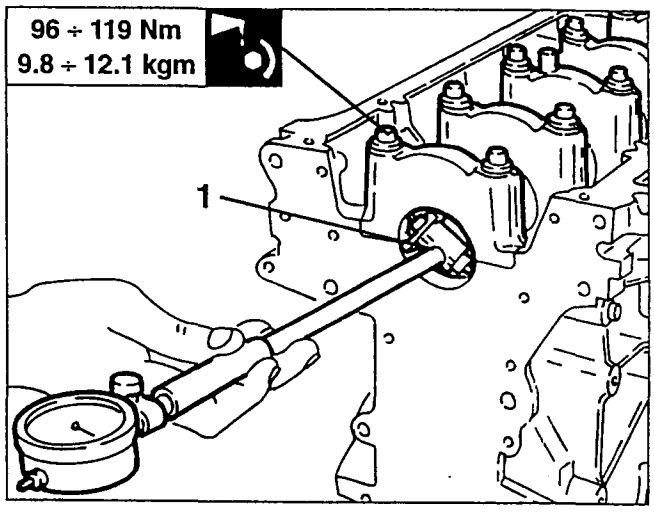
Clearance between pins and small end bushing
0.006 ÷ 0.016 mm

Checking the clearance between main bearing journals and half bearings

1. House the half bearings and fit the main bearings caps on the crankcase tightening the fastening screws to the specified torque.
2. Measure the diameter of the main bearings and check that it is within the specified limits.

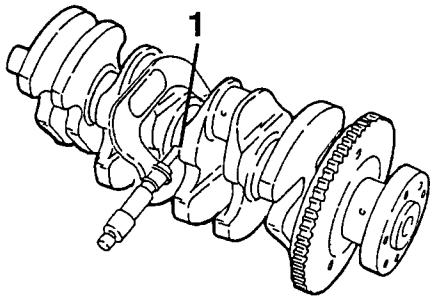
Diameter of the main bearings	
Side	
Class A - Red	53.031 ÷ 53.056 mm
Class B - Blue	53.017 ÷ 53.046 mm
Class C - Yellow	53.007 ÷ 53.032 mm
Centre	
Class A - Red	53.041 ÷ 53.066 mm
Class B - Blue	53.027 ÷ 53.056 mm
Class C - Yellow	53.017 ÷ 53.042 mm

96 ÷ 119 Nm
9.8 ÷ 12.1 kgm



1. Measure the diameter of the main bearing journals and check that it is within the specified limits.

Diameter of main bearing journals	
Class A - Red	52.994 ÷ 53.000 mm
Class B - Bleu	52.988 ÷ 52.994 mm
Class C - Yellow	52.982 ÷ 52.988 mm



- Calculate the clearance between the main bearing journals and half bearings and check that it is within the specified limits.

Clearance between main bearing journals and half bearings	
Side	
Class A - Red	0.031 ÷ 0.062 mm
Class B - Blue	0.023 ÷ 0.058 mm
Class C - Yellow	0.019 ÷ 0.050 mm
Centre	
Class A - Red	0.041 ÷ 0.072 mm
Class B - Blue	0.033 ÷ 0.068 mm
Class C - Yellow	0.029 ÷ 0.060 mm

Checking the engine flywheel

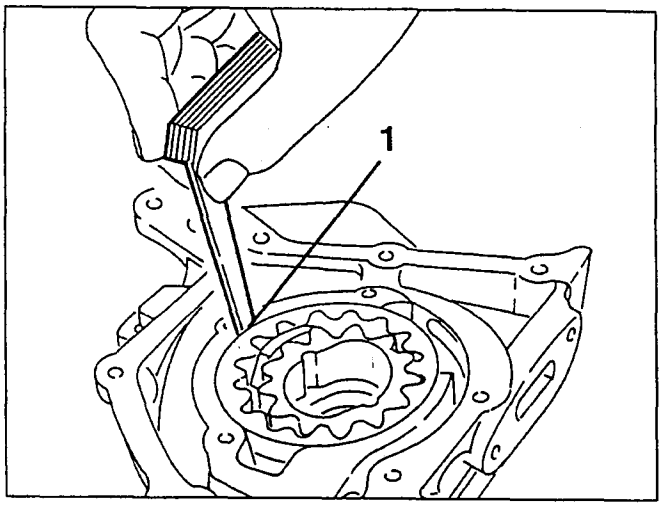
- Check that the ring gear teeth are not cracked or show signs of seizure; if they do, change the ring gear as described below:
• working under the press remove the old ring gear;

• accurately clean the contact surfaces of the new ring gear and of the flywheel;
• evenly heat the new ring gear to 80° ÷ 100° C and fit it on the flywheel: leave to cool naturally, do not force cool.

Checking the oil pump

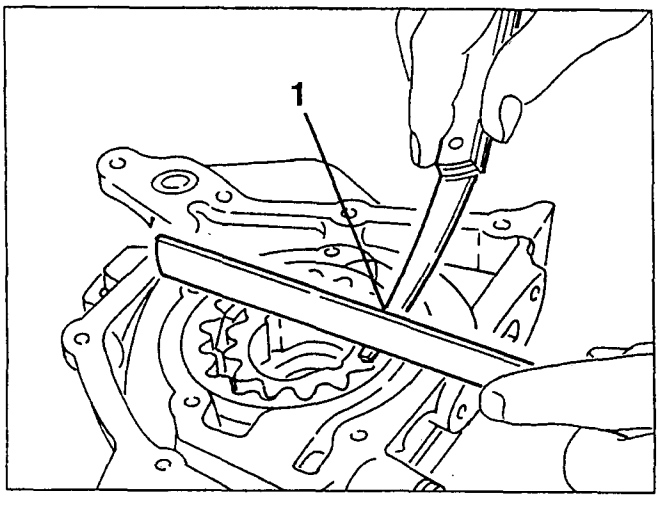
1. Check that the clearance between the pump casing and the driven gear is within the specified limit.

Clearance between pump casing and driven gear
0.080 ÷ 0.186 mm



1. Check that the clearance between the pump cover rest surface and the upper side of the gears is within the specified limit.

Clearance between pump cover rest surface and upper side of gears
0.025 ÷ 0.070 mm



WARNING: If the clearances measured are not within the specified limits, change the front crank-case cover with oil pump incorporated.

- Using a torque meter check the characteristic value of the engine oil pressure limiting valve control spring.

Control load Kg	Spring length mm
6.4 ÷ 7.2	36

INSTRUCTIONS FOR RE-ASSEMBLY

For re-assembly operations reverse the sequence described for dis-assembly, unless otherwise indicated below.

- Check valve tightness when the cylinder head is assembled (see "Turning the valve seats").

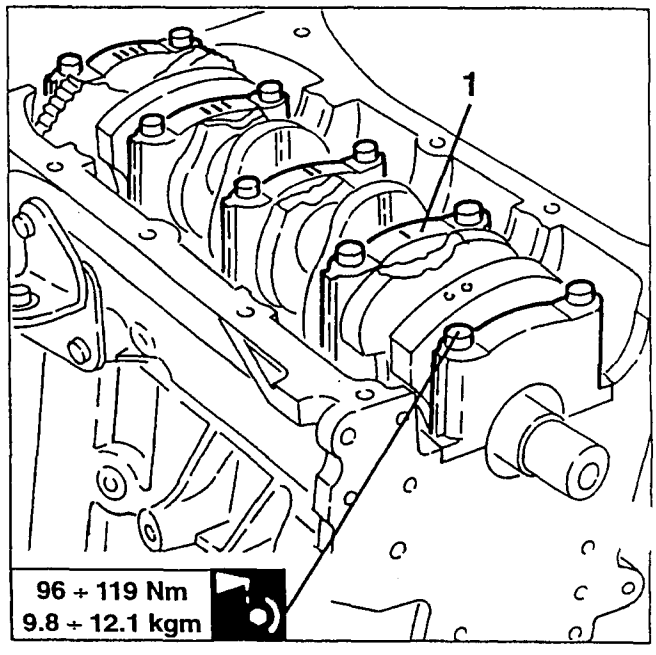
Reassembling the crankshaft

- Assemble the crankshaft on the crankcase complete with half bearings and half thrust rings.

Reassemble the half thrust rings with the grooved surfaces facing the crankshaft.

1. Assemble the main bearing caps complete with half bearings on the supports and tighten the fastening screws two or three times starting from the centre main bearing cap.

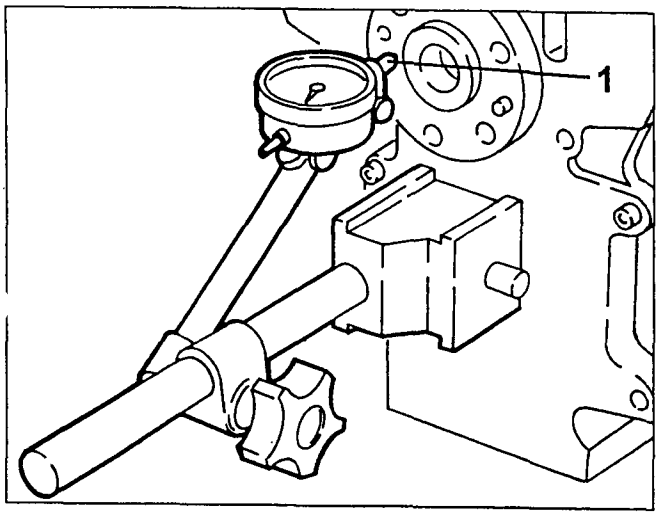
The position of each cap is given by a series of consecutive notches (from zero to four start from the front of the engine) etched on the caps themselves.



Checking crankshaft end float

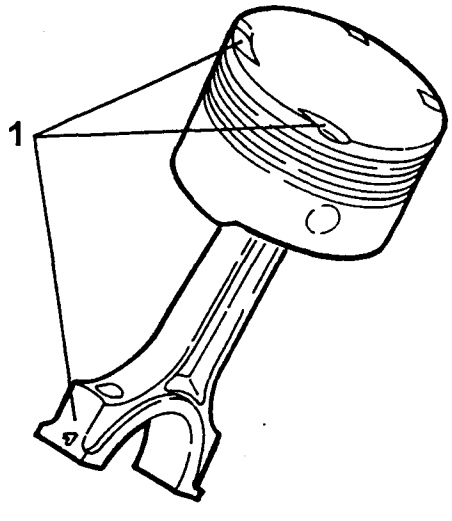
1. Using a dial gauge on a magnetic base, measure the crankshaft end float and check that it is within the specified limits.

Crankshaft end float
0.059 ÷ 0.221 mm



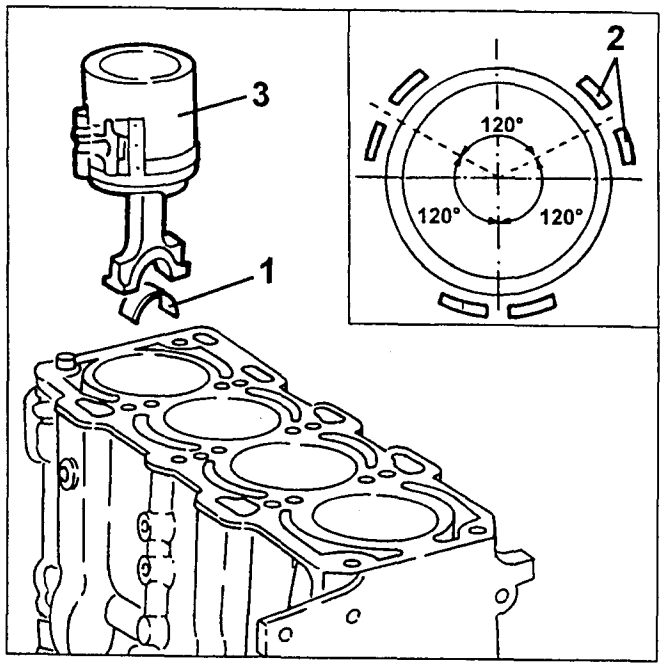
Refitting pistons and connecting rods

1. Assemble the piston and connecting rod making sure that the number stamped on the big end is on the same side as the large notches (for intake valves) on the piston crown.



- Turn the crankshaft until the connecting rod pins of the 1st and 4th cylinder reach the position corresponding to the B.D.C.
1. House the corresponding half bearings on the connecting rod big ends.
2. Place the rings in the pistons with the notches offset by 120° and the word TOP stamped on them facing upwards.
3. Using a suitable tool, insert the pistons and connecting rods in the 1st and 4th cylinder.

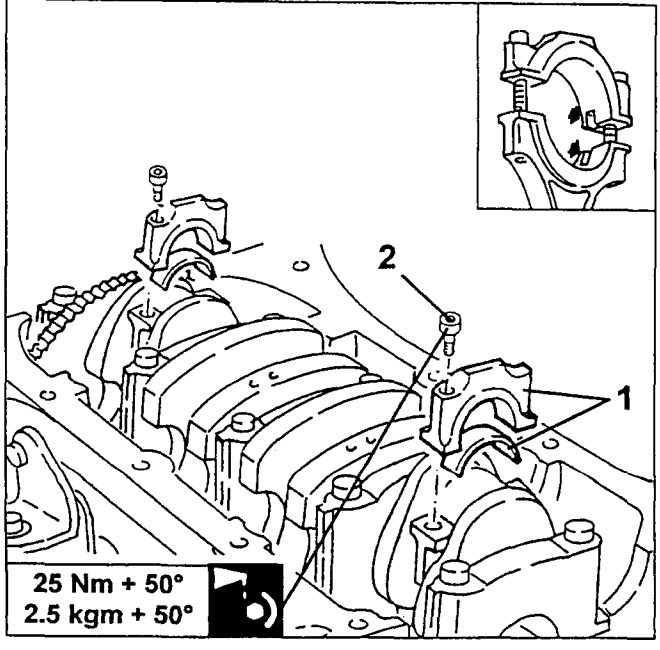
Assemble the connecting rod - piston sets in the crankcase directing the arrow stamped on the piston crown in the direction of rotation of the engine.



- Turn the crankcase 180°.
1. House the corresponding half bearings on the connecting rod caps, then assemble those of the 1st and 4th cylinder directing the safety notch towards the same side as the corresponding notch on the connecting rod big end.

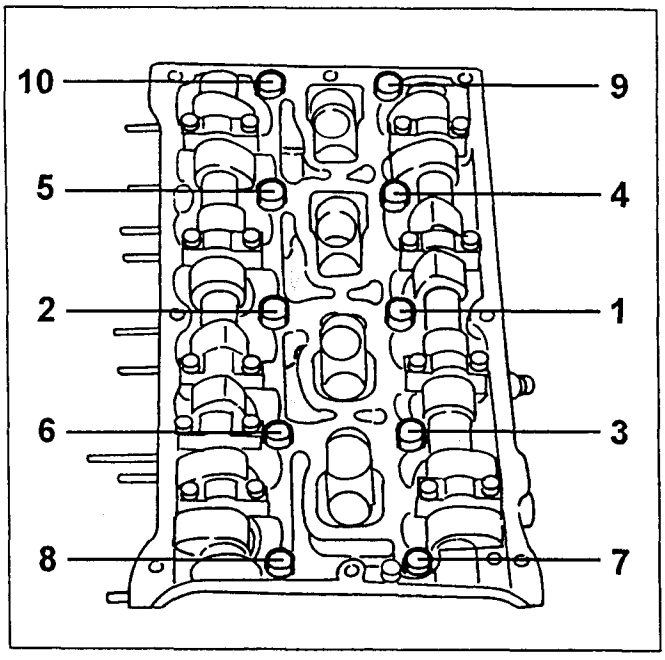
On the side, the connecting rod caps have the number of the cylinder to which to which they belong; during reassembly this number should be on the same side as the one stamped on the connecting rod big end.

2. Tighten the connecting rod cap fastening screws to the specified torque in oil.
- In the same way reassemble the pistons and connecting rods of the 2nd and 3rd cylinder.



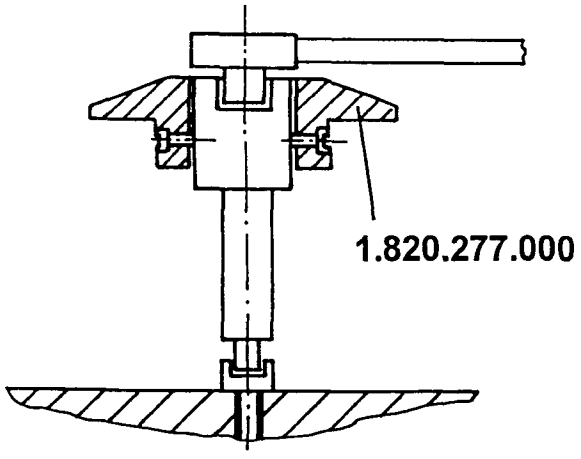
Cylinder head reassembly

- Turn the crankshaft until the pistons of the 1st and 4th cylinder reach the T.D.C.
- Position the seal on the crankcase and then the cylinder head.
- Tighten the cylinder head fastening screws proceeding as described below and bearing in mind that, for each step the tightening sequence is the one shown below.



Tightening sequence	
Approach all the screws to a torque of:	20 Nm (2.0 kgm)
Tighten the screws to a preliminary torque of:	40 Nm (4.1 kgm)
Turn the screws by an angle of:	90° + 90° + 90°

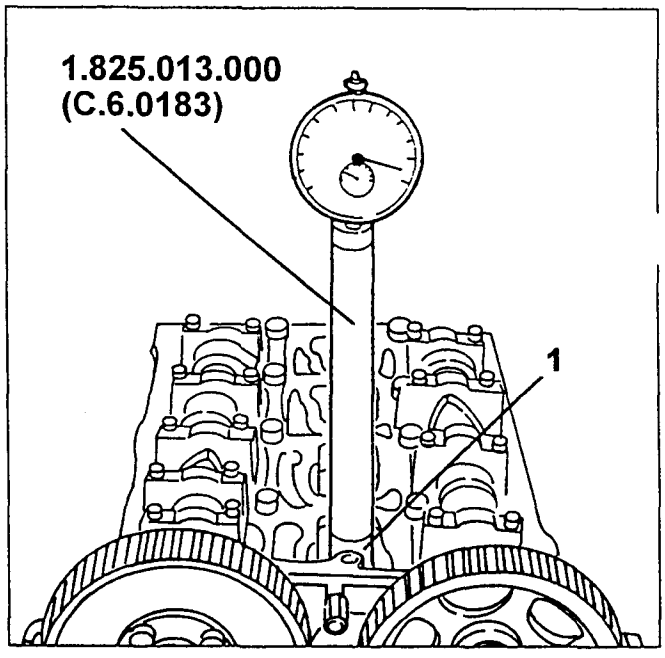
- For angle tightening use graduated disk no. 1.820.277.000 as illustrated.



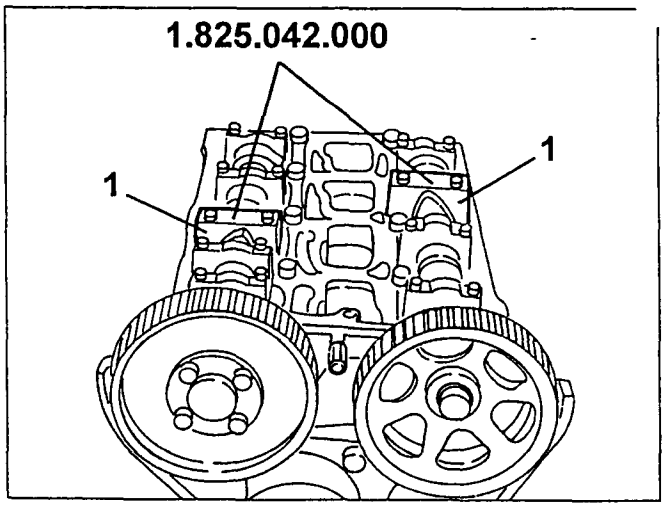
The seal between the cylinder head and crankcase is of the type in aramidic fibre and no further head tightening is scheduled throughout the whole life of the engine.

Camshaft drive belt assembly and checking valve gear timing

- Assemble the camshaft toothed drive pulleys without tightening the fastening screws, the camshaft belt drive pulleys and the corresponding belt tensioner.
1. Assemble tool no. 1.825.013.000 (C.6.0183) fitted with dial gauge in the seat of the centre spark plug of the 1st cylinder.
- Turn the crankshaft until the piston of the 1st cylinder reaches the T.D.C. in the bursting stroke.



1. Remove the camshaft caps illustrated and in place of them, fit templates no. 1.825.042.000 tightening the fastening screws to a maximum torque of **10 Nm (1 Kgm)** and checking correct mating with the cams

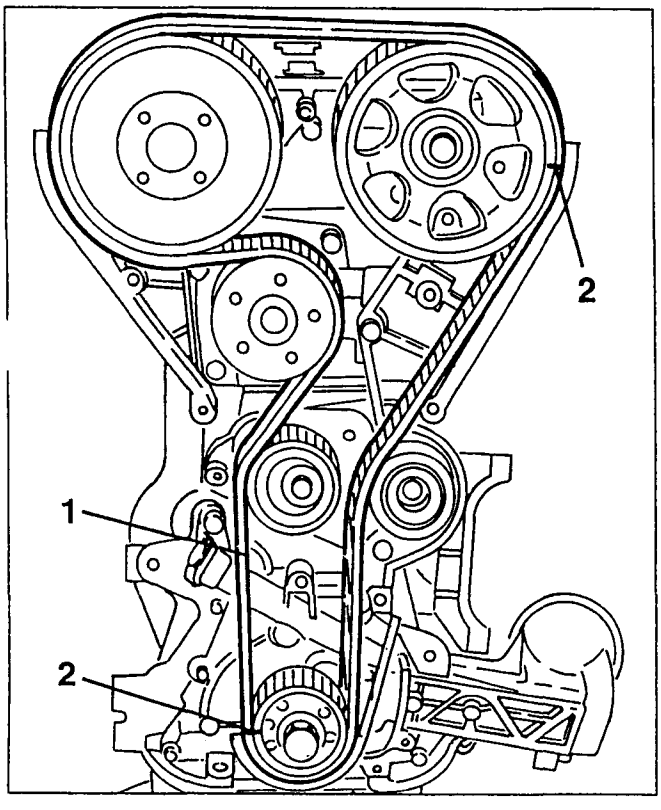


NOTE: For turning the camshafts, use tool n. 1.822.155.000 for the intake side and tools no. 1.822.146.000 and no. 1.822.156.000 for the exhaust side, to be applied to the corresponding pulleys.

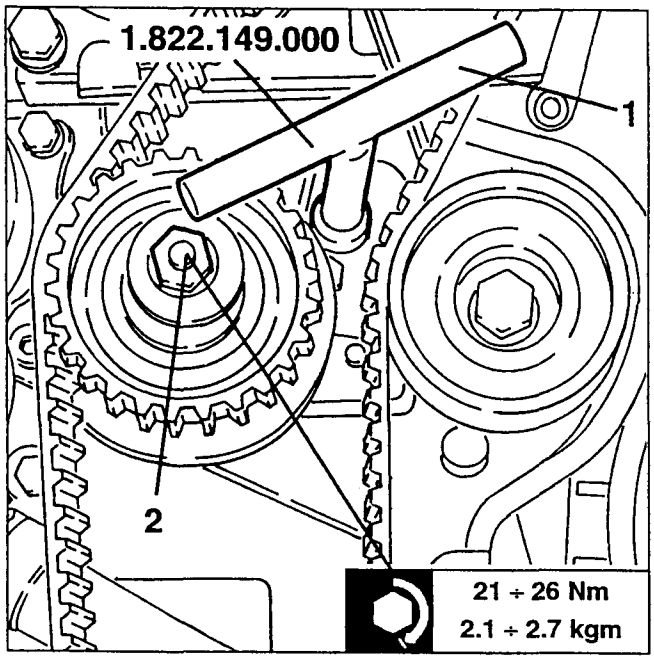
. Assemble the timing gear drive belt ensuring correct coupling with the teeth of the pulleys, fitting it in the following sequence:
- crankshaft pulley
- fixed pulley guide
- camshaft pulley on exhaust side
- camshaft pulley on intake side
- automatic tensioner guide
- coolant fluid pump guide pulley

2. The notches painted on the belt must coincide with the indexes machined on the crankshaft pulley and on the camshaft pulley exhaust side.

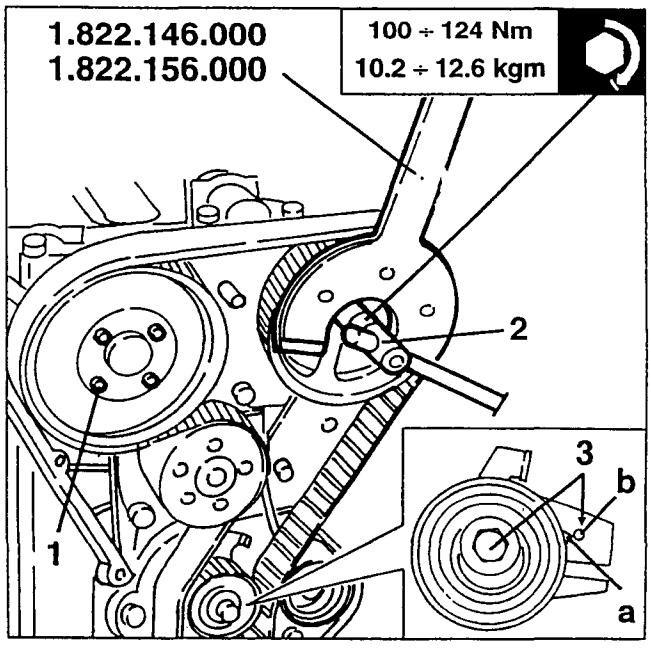
WARNING:
When assembling the toothed belt, avoid bending it sharply as this can lead to damage of the structures forming the belt.
The arrow on the belt indicates the direction of rotation of the engine.



Using tool no. 1.822.149.000 as illustrated, apply the maximum tension on the belt.
2. Tighten the nut fastening the automatic timing gear belt tensioner.



1. Tighten the screws fastening the intake side camshaft drive pulley.
2. Using tool no. 1.822.146.000 complete with tool no. 1.822.156.000, tighten screw fastening the camshaft drive pulley on the exhaust side.
- Remove the two templates from the camshafts and turn the crankshaft twice in its direction of rotation to take the piston of the 1st cylinder to the T.D.C. in the bursting stroke.
3. Release the nut fastening the automatic tensioner, then using tool no. 1.822.149.000, move the mobile index (a) coinciding with the reference hole (b).
- Tighten the automatic tensioner fastening nut to the specified torque.
- Turn the crankshaft twice in its direction of rotation until the piston of the 1st cylinder reaches the T.D.C. in the bursting stroke and check that all the references coincide.

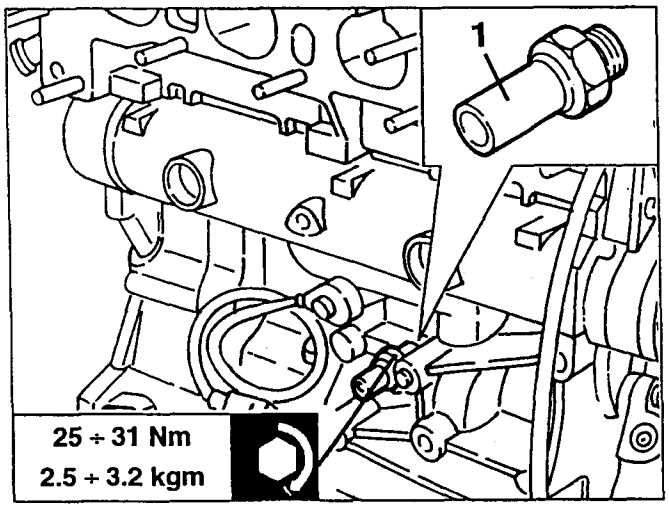


CHECKING THE ELECTRIC COMPONENTS OF THE LUBRICATION CIRCUIT

MINIMUM ENGINE OIL PRESSURE SENSOR

1. Check the setting of the minimum engine oil pressure sensor. If the value fails to meet specifications, change the sensor.

Contacts opening/closing pressure
0.2 ÷ 0.5 bar



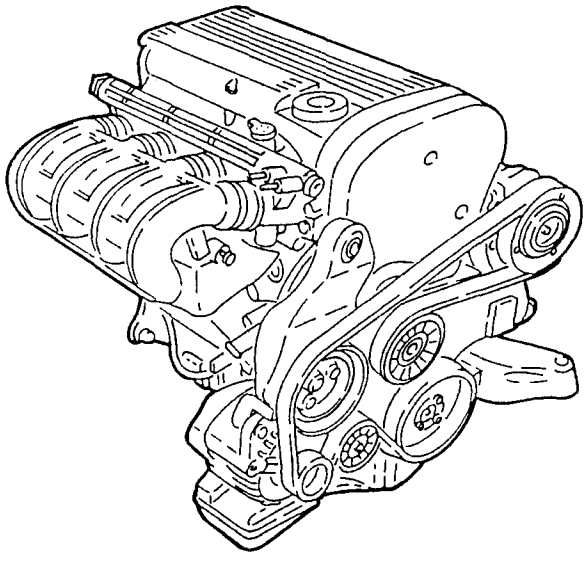
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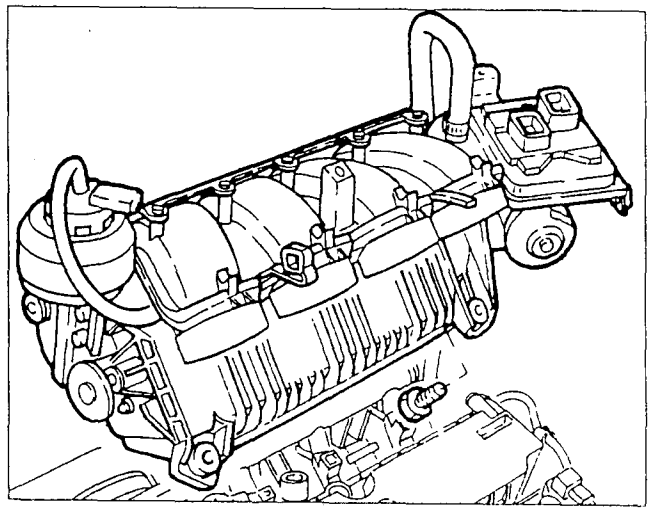
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DESCRIPTION

Four cylinder in line engine with double camshaft in head, four valves per cylinder, phase variator, static injection and twin ignition controlled by a single ECU.
The rear engine is connected to the clutch-gearbox-differential unit which constitutes a sole assembly. The engine is installed frontally and transverse at a 18°30 slant. The engine is "suspended" by means of two damper mounts to the underbody and one scissors mount to the suspension crossmember. To contain vibrations, the engine top is connected to the underbody by means of a shock-proof connecting rod.
All belts are fitted with automatic take-up devices to ensure long belt working life.
The fuel feed system (unleaded petrol) is fitted with suitable pollution prevention devices which ensure low exhaust emissions as per "EEC PHASE 2" standards.

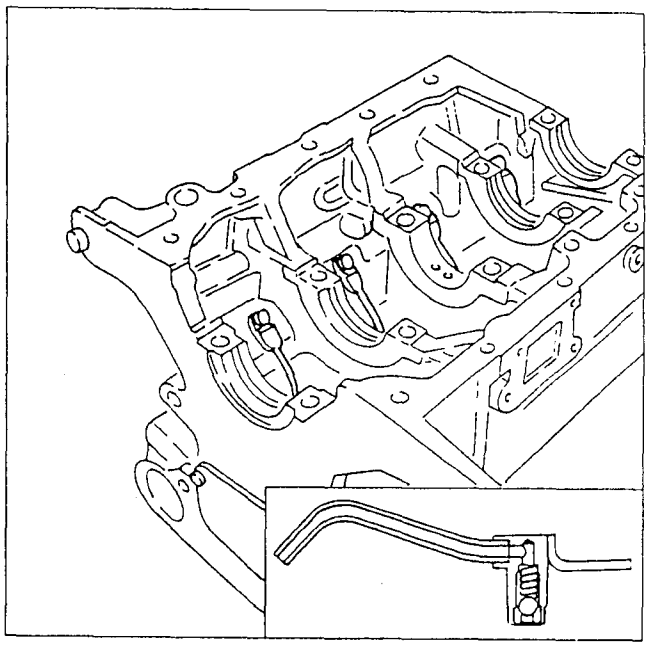


AR 32301 engines are fitted with a plastic intake manifold with variable geometry instead of an aluminium intake manifold.
The fuel feed system is returnless, i.e. with a single feed pipe.

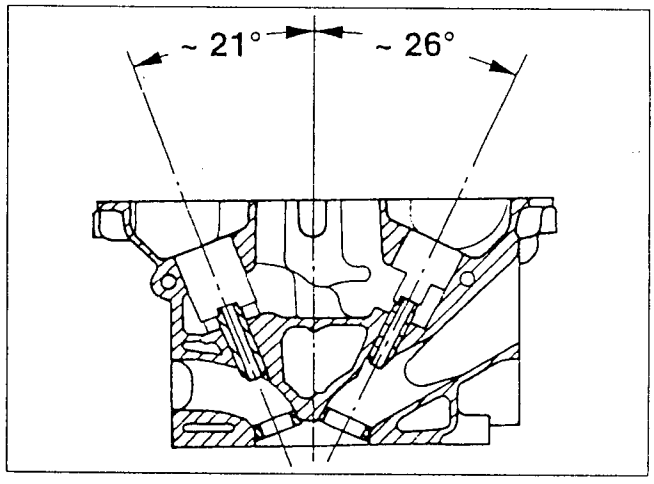


CRANKCASE

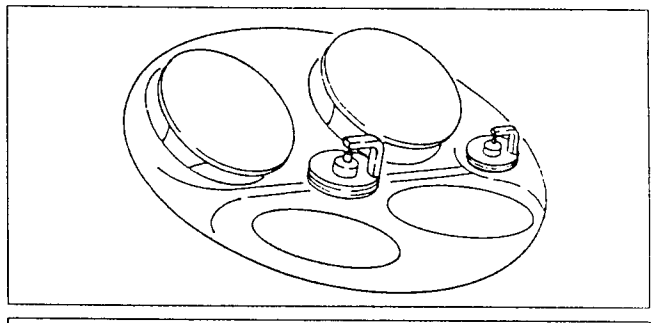
The engine block is made of high mechanical resistance cast iron.
The crankshaft is supported by means of five main journals which house five thin casing half-bearings.
The cylinders are directly cut into the crankcase and are selected according to three size classes plus three oversized classes.
Two counter-rotating shafts, supported by means of a central bushing and ball bearings in the front and rear parts are housed in the crankcase.
Specific ducts in the crankcase walls ensure the passage of coolant and lubrication oil.
A nozzle, which sprays oils on the top of the piston thus ensuring partial cooling, is fitted in the lower part of each cylinder.



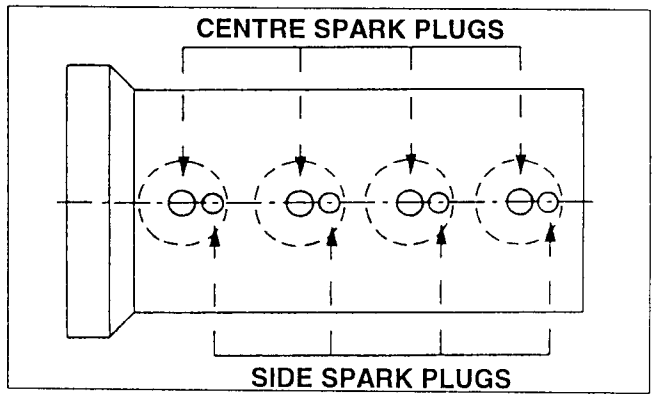
CYLINDER HEAD



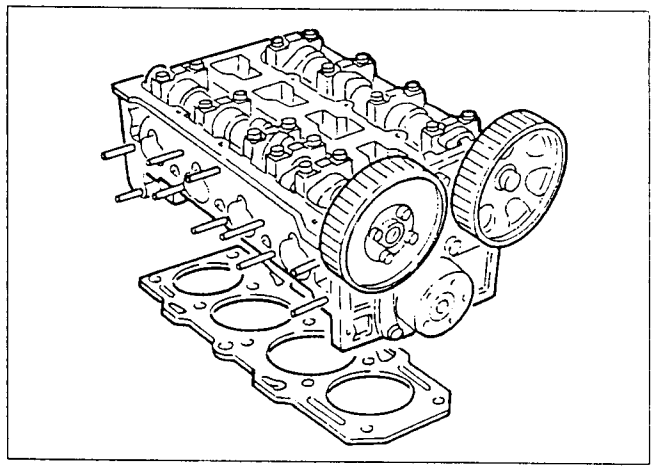
Monolith, compact, mould-cast aluminium and silicon alloy.
The four valves per cylinder are fitted in their respective V guides at approximately 47° and are controlled by two camshafts by means of hydraulic tappets.



The space is organised so that the combustion chambers can house the four valve caps and the central and side spark plug holes without weakening the head structure.
The central spark plugs (larger) are tightened at a torque of 25 - 35 Nm, while the side (smaller) spark plugs are fastened at a torque of 10 - 12 Nm.
They should be replaced every 100,000 km.
The twin spark plugs positioned in this fashion, the two intake valves and the two exhaust valves ensure uniform distribution of the mixture and optimal combustion with improved engine thermal performance and reduced harmful emission in exhaust.



The camshaft on intake side turns on six journals. The camshaft on exhaust side turns on five journals. The shafts are controlled with a timing belt.
The valve seats are fitted in the cylinder head after it is heated to a temperature of 80°C. The seats are then cooled with liquid nitrogen. The valve guides are fitted in their seats in the cylinder head. Interference and internal diameter is perfected after assembly with a specific borer and controlled by means of a go-no-go set of gauges. The cylinder head and crankcase seal is made of aramide fibre. No head re-torque is required for the entire life of the engine.

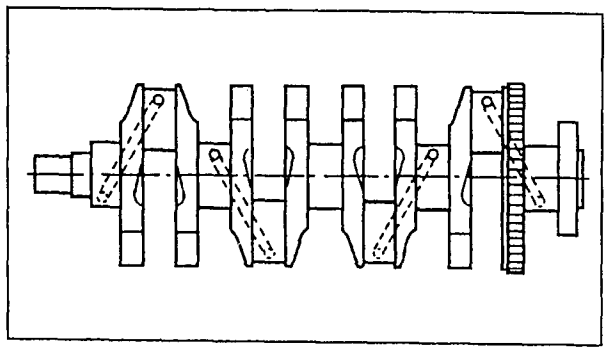


OIL SUMP

The oil sump is a structural part of the engine with mechanical functions.
It contains the engine oil and is directly connected to the gearbox and to the rear engine mount. It is made of die-cast aluminium alloy and features internal shock-proof partitions.
It is fastened to the crankcase with a specific sealant.

CRANKSHAFT

This is forged in high strength alloy steel, induction tempered on the journals and rolled on the grooves.
It rests on five main bearings and its end float is adjusted by two half rings housed in the centre main bearings.
Eight counterweights accurately balance the rotating masses.
A groove runs inside the shaft to lubricate the main and connecting rod journals.
At the rear of the crankshaft there is the phonic wheel for detecting the rpm and timing sensor.



MAIN AND ROD BEARING HALVES

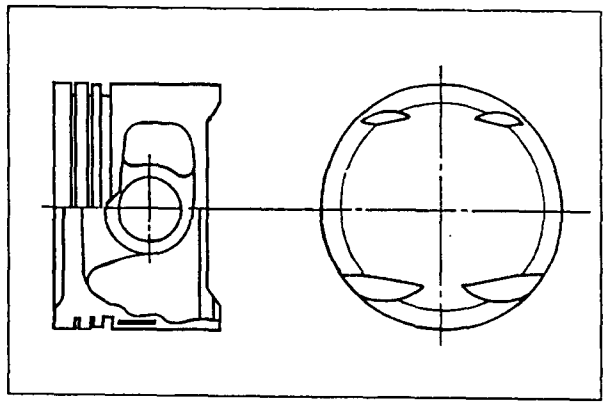
These are of the three-metal, thin shell type and they are divided into three dimensional classes.

FLYWHEEL

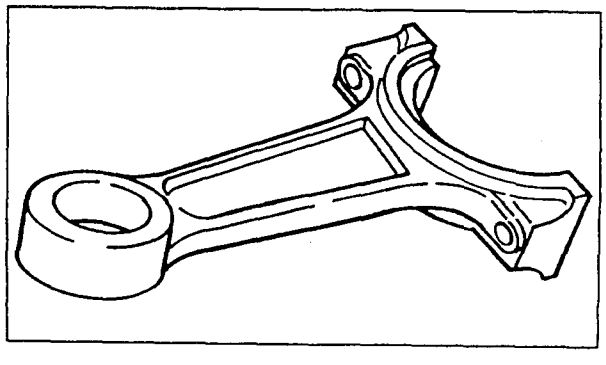
This is in cast iron with a hardened ring gear and suitably balanced.

PISTONS AND CONNECTING RODS

The pistons are in aluminium-silicium alloy with self-heating inserts and are divided into three dimensional classes. To ensure correct assembly an arrow is stamped on the piston crown to indicate the direction of rotation of the engine.
The piston crown is concave and has four notches to prevent interference with the valve mushrooms.



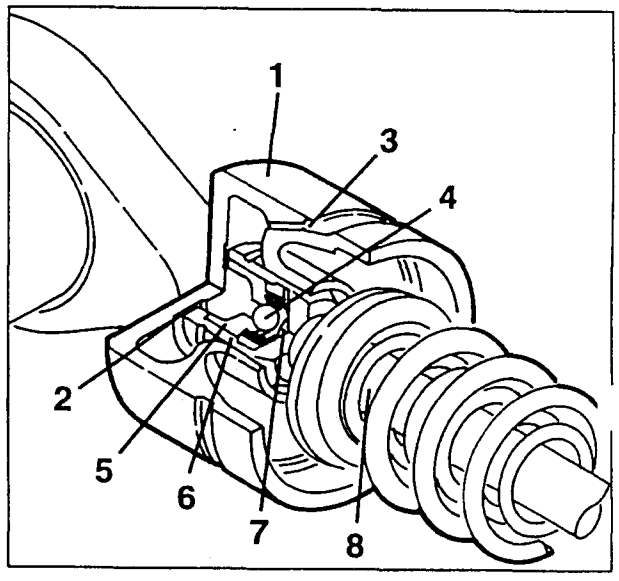
The connecting rods are in hardened and tempered alloy steel, with a bushing in copper alloy force-fitted for coupling with the piston gudgeon pin.
As the gudgeon pins are floating on the piston hubs and on the bushing force-fitted in the connecting rod small end, their side movement is stopped by two expanding circlips housed in the special hollows machined on the actual hubs.



VALVE GEAR TIMING

Direct drive by toothed belts with automatic tensioner and with overhead camshaft in cast iron with induction tempered cams and bearings. The hydraulic tappets, in contact with the cams, control the valves directly. This device automatically eliminates "valve play" when the engine is running thereby dramatically reducing the need for periodical maintenance.

1. *Cup*
2. *Oil passage between chambers*
3. *Oil inlet groove*
4. *Check valve*
5. *Piston*
6. *Cylinder*
7. *Pressure chamber*
8. *Valve stem*

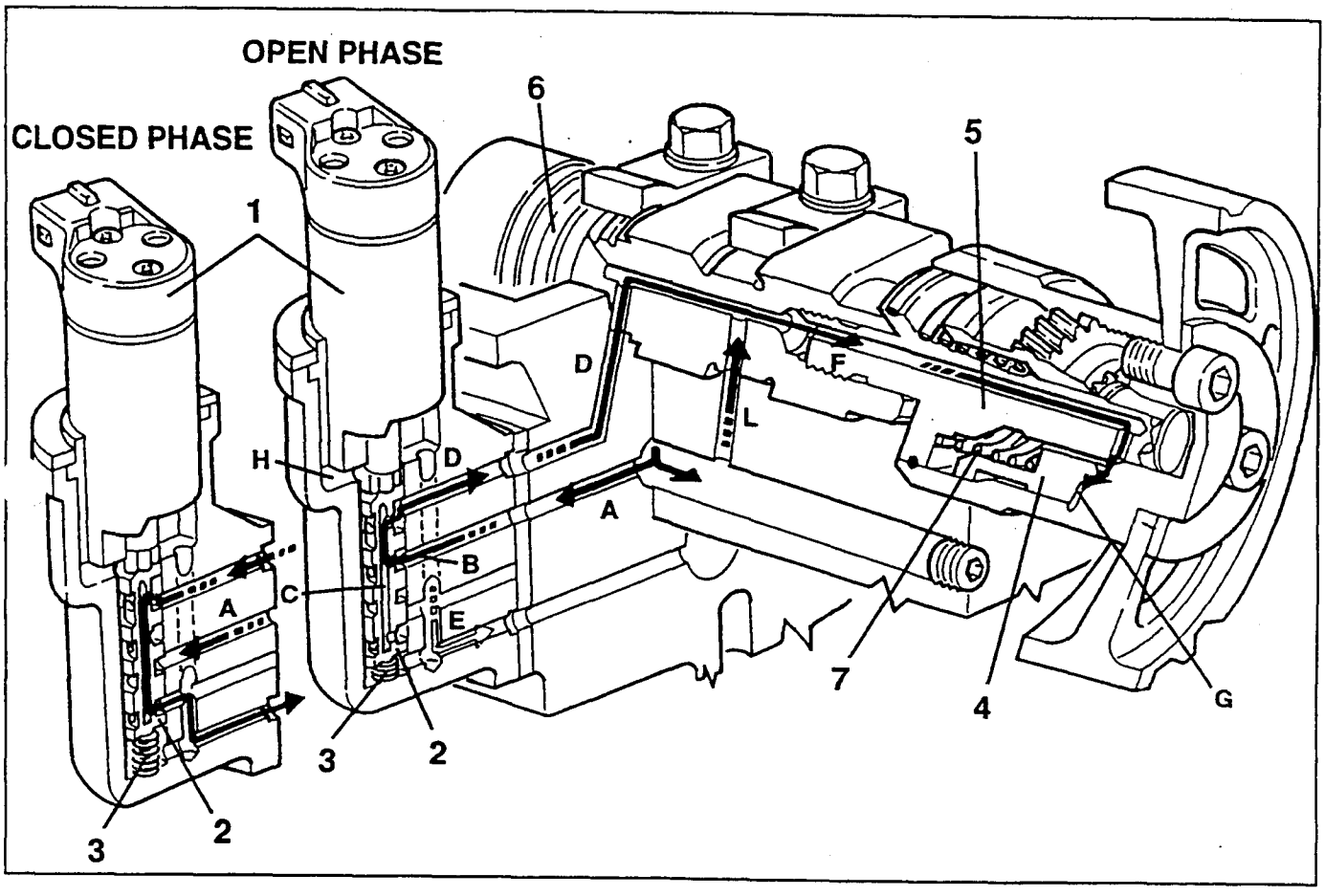


The stem of the exhaust valves is chromium plated and has a cavity inside filled 50 ÷ 60% with sodium to improve dispersion of the heat to which they are subjected.
The valve seats are sintered and made from material suitable for the use of unleaded petrol.

TIMING VARIATOR

This is of the simplified type which ensures considerable timing precision, rapid intervention and high mechanical reliability. It is coupled to the intake pulley and fitted with two half bearings which support it. The inner parts ar nitrided and an O-Ring keeps the oil inside when the engine is not running. In order to reduce the size of the engine, the actuation valve seat has been machined on the intake manifold with suitable grooves which also involve the cylinder head, to regulate the flow of oil to the variator.
- The purpose of this device is to change the intake valve timing according to the engine load and speed required; this parameter is received and processed by the control unit in the form of an electric signal sent by the air flow meter and rpm sensor and transmitted as a command to the electromagnet via a relay.
- When the closed phase is required (idling and full power area), the electromagnet (1) is de-energized, thus the valve distributor (2) pushed by the counter spring (3), stays up preventing the passage of the oil leading from groove (A) from reaching the variator.
In this case the timing of the intake valves remains unchanged (closed).
- If the open phase is required (average speeds at high torque), the electromagnet (1) is energized, thus pushing the valve distributor (2) downwards. In this position the oil, leading from groove (A), enters chamber (B) of the piston, from where it passes through a special hole into groove (C) machined inside the latter.
The oil can only leave this groove through the upper hole (in communication with the oil delivery duct (D) to the variator) as the lower hole no longer leads to the exhaust duct (E) because the valve distributor (2) is lowered. The oil passes through duct (D) and (F) and reaches the chamber (G) moving piston (4) axially towards the engine. The outside of piston (4) is fitted with helical teeth and as a result of the above-mentioned axial movement it is forced to move clockwise (as seen from the timing side). The rotation is transmitted through a straight-toothed grooved profile to the pinion (5) which is screwed onto the threaded lug of the camshaft (6) and transmits the rotation to the shaft. This way the timing of the intake valves is changed by 25°.
When the electromagnet is de-energized, the valve distributor (2) returns to its initial position, shutting off the flow of pressurised oil to the piston (4), but allowing the oil to return to the exhaust due to the thrust of the counter spring (7).

- Duct (L) enables the camshaft journal to be lubricated under the various operating conditions.
- The oil which leaks into the electromagnet chamber (H) is discharged through the drainage hole (E).



Vibration damper device with counter-rotating shafts

combustion engines, in addition to the forces acting on the piston crowns caused by the expanding gases, there is the action of the following:
- centrifugal forces of inertia, caused by the rotating masses;
- alternated forces of inertia of the 1st and 2nd order generated by the masses with reciprocating motion.

The purpose of the balancing of the engine is to eliminate the vibrations that these imbalances caused during operation.
The imbalances produced by the centrifugal forces and by the alternated forces of inertia of the 1st order are eliminated by suitably counter-weighting the crankshaft.
The imbalance caused by the alternated forces of inertia of the 2nd order is generally not eliminated in 4-cylinder in line engines, in which the task of partially absorbing it is left to the engine bearings.
In this engine though, a device has been adopted which is capable of nullifying the vibrations caused by the above-mentioned forces: it comprises 2 shafts, located in the crankcase, with eccentric masses, which counter rotate with respect to one another.

The counter-rotating shafts are pulled by a special double-toothed belt, a set of gears and an automatic tensioner which make it possible to obtain twice the speed of the crankshaft and perfect synchronism with it.

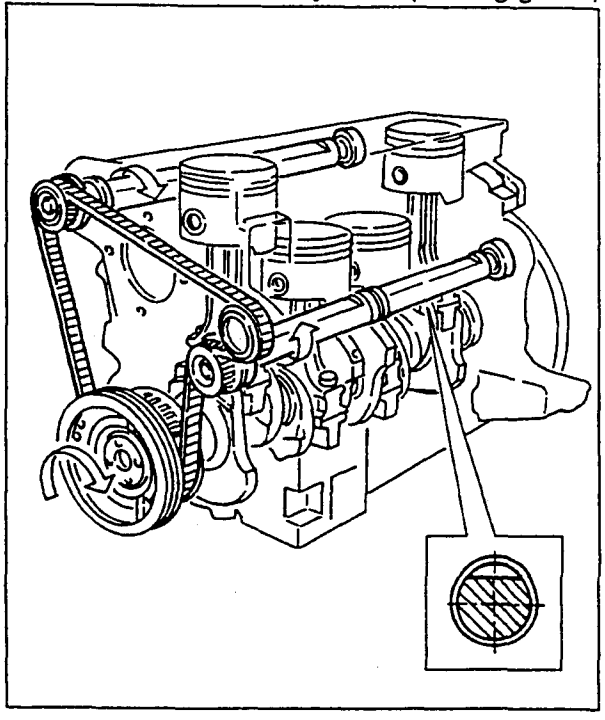
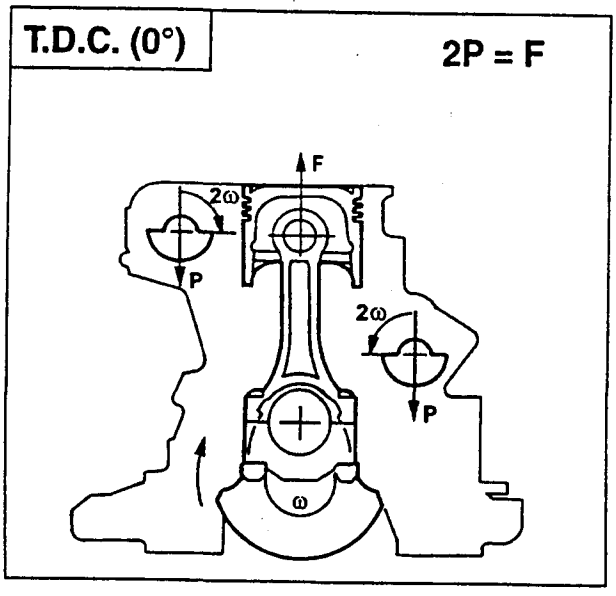
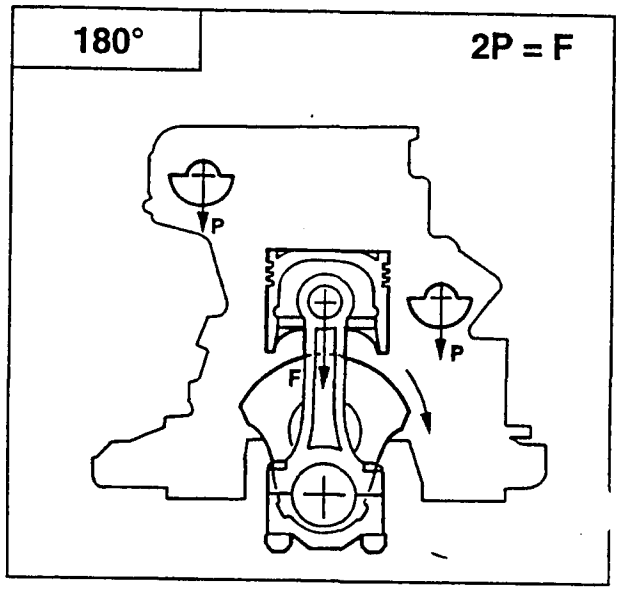
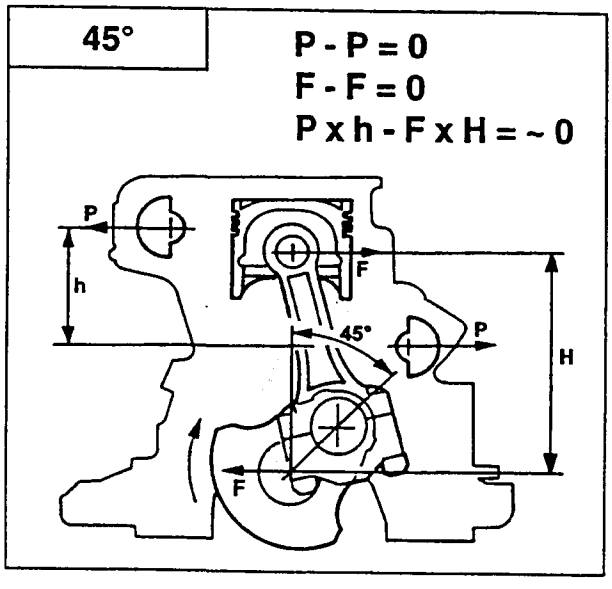
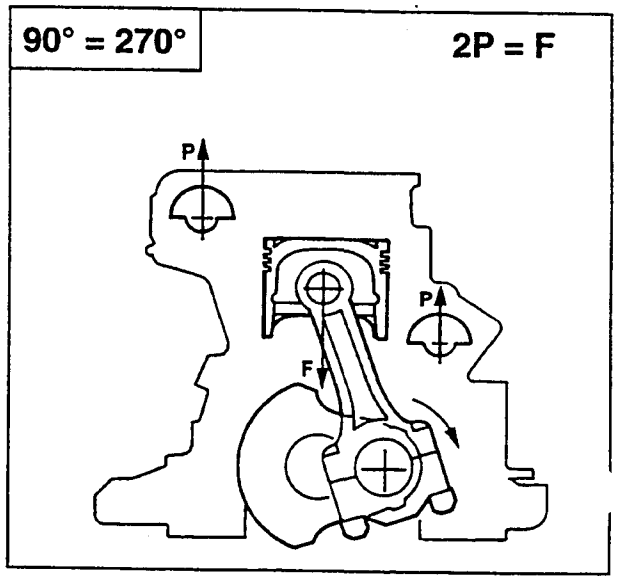


Illustration of the alternated forces of inertia of the 2nd order and of the balancing masses in the main operating positions.





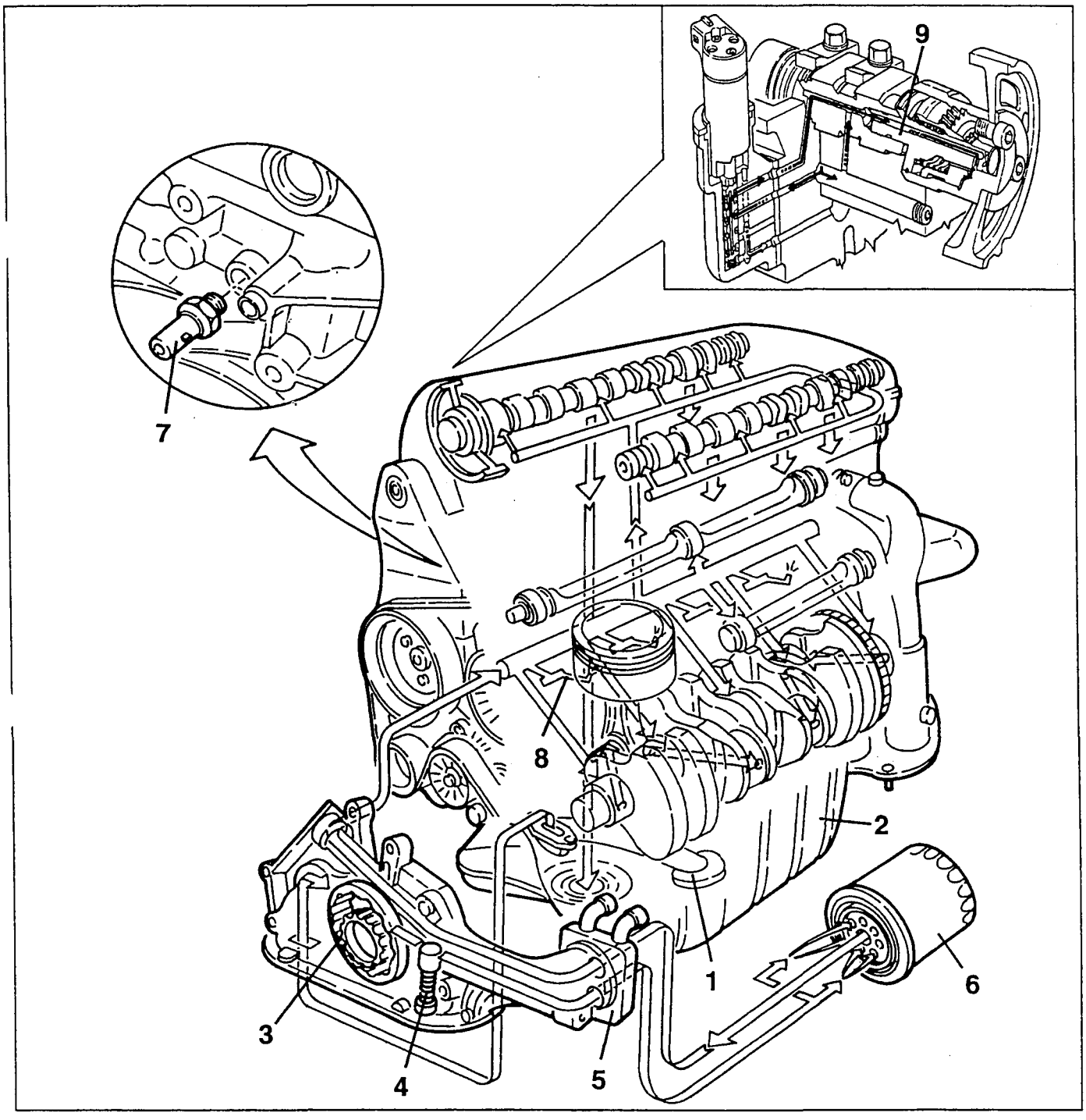




LUBRICATION

The rotary lobe pump (3) fitted on the front of the crankcase is activated directly by the crankcase through keying. The oil withdrawn from the sump by a suction device (1) is filtered by the gauze filter on the suction device and then sent under pressure by the pump through a duct to the full-flow cartridge oil filter (6) fitted with a by-pass safety valve, which ensures that the oil passes even if the cartridge is clogged.
A water-oil heat exchanger (5) is installed on the filter support to keep the oil temperature within the optimum limits.
The maximum lubricating pressure is regulated by a special limiting valve (4) fitted on the pump.
After being filtered, the oil passes through a duct machined on the front engine cover and reaches the main longitudinal delivery duct in the crankcase.
From here, it is then sent along five ducts to the grooves of the main bearings and from these to those of the connecting rod journals via special ducts machined in the crankshaft.
Another two vertical ducts machined in the crankcase lubricate the centre bearing of the counter-rotating shafts.
To improve the cooling of the piston skirts the crankcase is fitted with spray jets (8) with built-in ball valve which opens at a pressure of **2.25 ÷ 2.75 bar.**

From the main longitudinal duct in the crankcase, a vertical duct branches off which lubricates the camshaft bearings. On the intake side of the camshaft lubricating duct there are two special channels through which the oil for operating the timing variator passes. The recovery circuit is formed of a few ducts located in the cylinder head which collect the oil leading from the outlets and then drain it from the head from which it falls back into the sump.
The lubricating system is fitted with an oil vapour recirculation system which recovers the vapours leading from the sump and from the cylinder head.
The system is fitted with a minimum engine oil pressure sensor (7) which indicates insufficient lubricating pressure by turning on the warning light on the instrument cluster.



1. Suction device with gauze filter
2. Oil sump
3. Oil pump
4. Pressure limiting valve
5. Heat exchanger
6. Filter with safety by-pass valve
7. Engine oil minimum pressure warning light sensor
8. Spray jets
9. Timing variator

INTRODUCTION

The instructions given in the following paragraphs refer to the complete overhauling of the engine on the bench, after having removed the power unit from the car. The instructions are subdivided as follows:

- Engine dis-assembly:
removal of the engine accessories and components and dis- assembly into the main units forming part of it.

- Dis-assembly and overhauling of the cylinder head:
complete overhauling of all the components of the head.

- Crankcase overhauling:
complete overhauling of the crank mechanism.

- Instructions for re-assembly:
these include the specific re-assembly operations which differ substantially from the dis-assembly instructions.

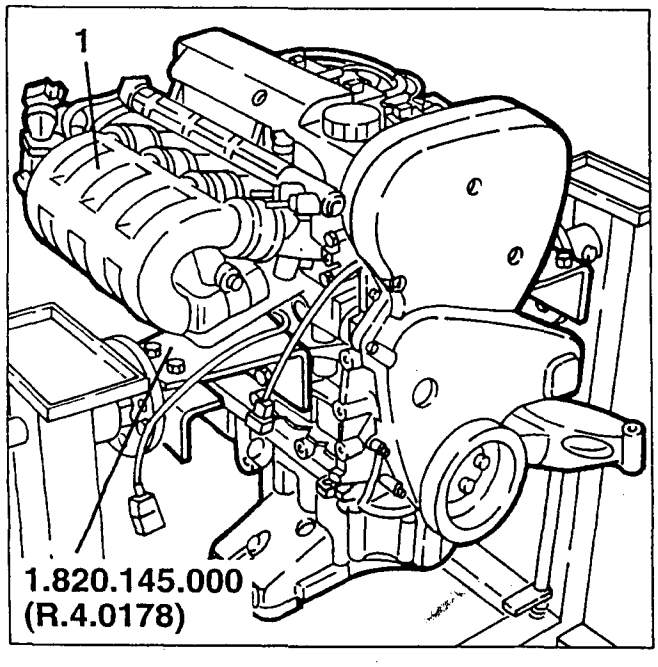
- Checking and inspecting electric components of the lubrication circuit.

All the dis-assembly procedures described hereafter are also valid for re-assembly reversing the sequence described, unless otherwise specified.
The following procedures refer to the complete overhauling of the whole engine; it is however possible to use only certain parts of them separately, when necessary for dealing with specific components.

ENGINE DIS-ASSEMBLY

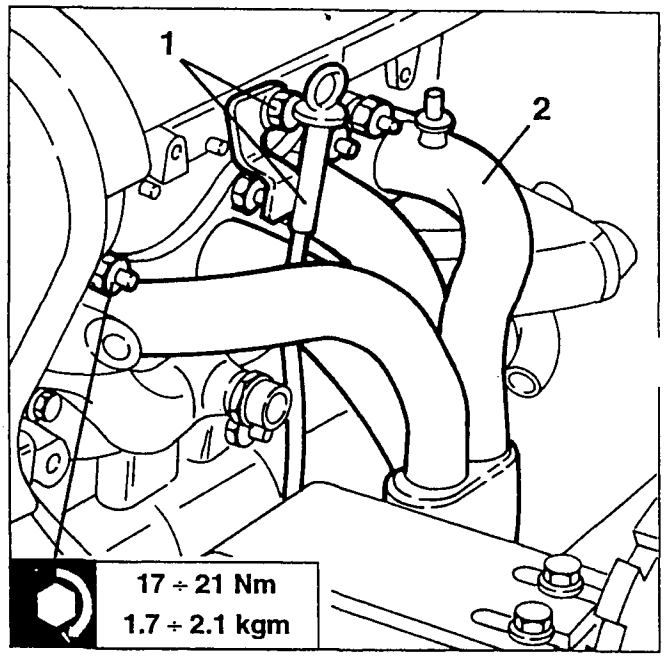
PRELIMINARY OPERATIONS

1. Set the engine on a special overhauling stand using supports no. 1.820.145.000 (R.4.0178).



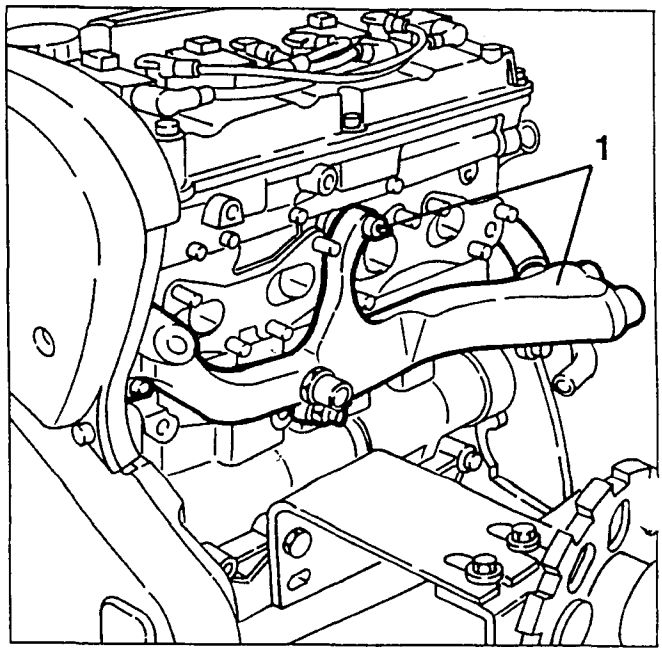
REMOVING THE EXHAUST MANIFOLD

1. Slacken the fastening screw and remove the complete engine oil dipstick.
2. Slacken the fastening nuts and remove the exhaust manifold.



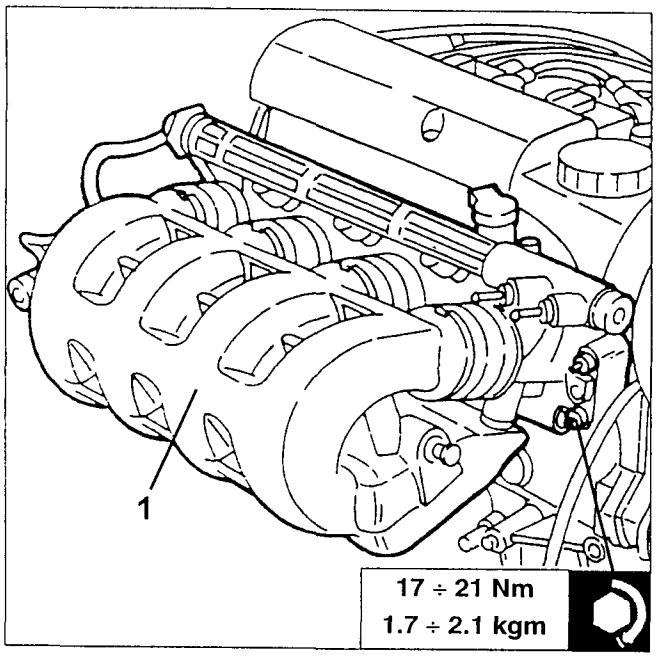
REMOVING THE ENGINE COOLANT FLUID MANIFOLD

1. Remove the coolant return manifold, after disconnecting the pipe connecting to the thermostatic cu, and slackening the associated fastenings.
- Remove the exhaust manifold seal.



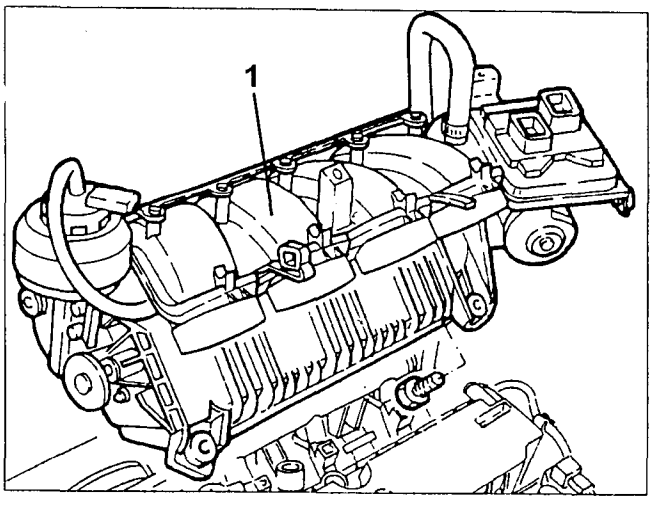
INTAKE MANIFOLD REMOVAL (pre-change versions)

1. Loosen the fastening nuts and remove the intake manifold.
- Remove the respective seal.



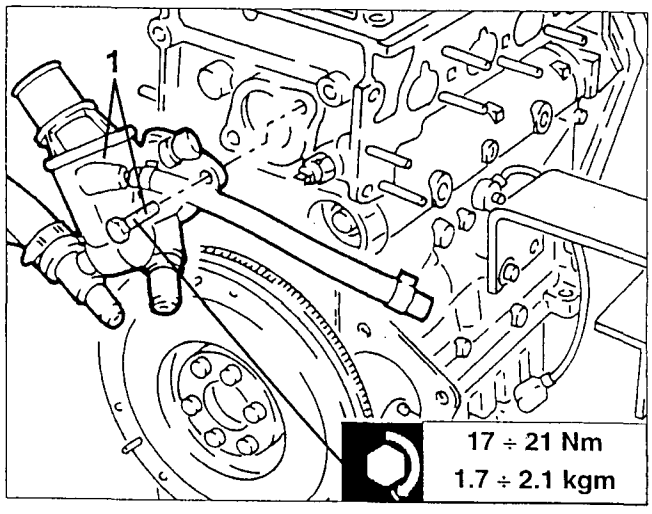
INTAKE MANIFOLD REMOVAL (post-change versions)

1. Loosen the fastening nuts and remove the intake manifold.
- Remove the respective seal.



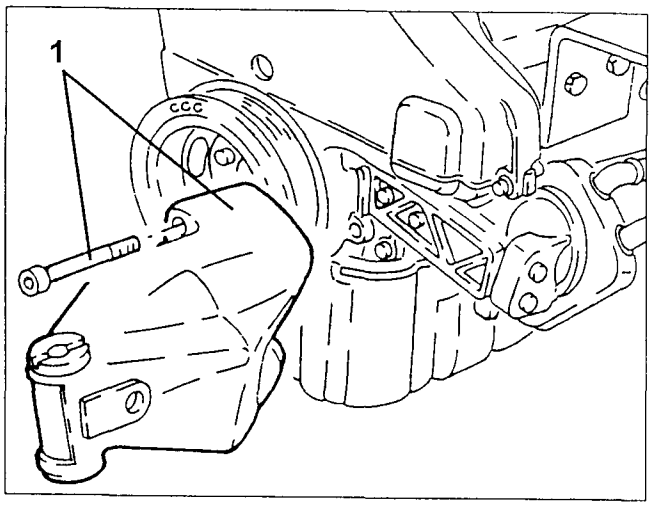
THERMOSTAT UNIT REMOVAL

1. Remove the two fastening screws and remove the thermostat unit with coolant temperature sensor (NTC) and pipes
- Remove the respective seal.



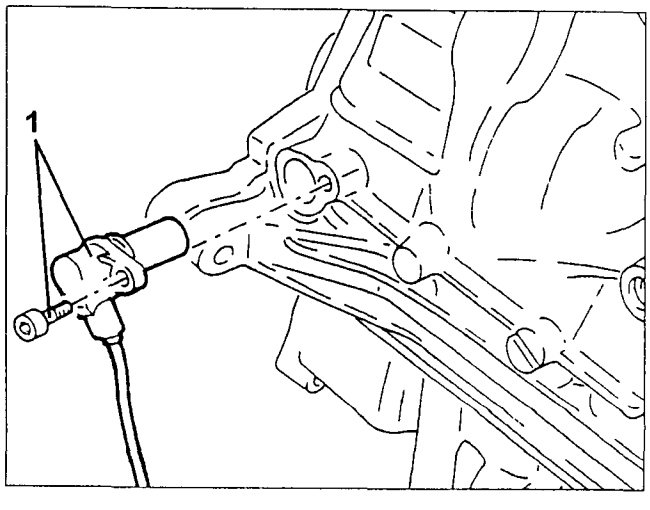
FRONT ENGINE REMOVAL JOURNAL

1. Loosen the three fastening screws and remove the front engine journal.



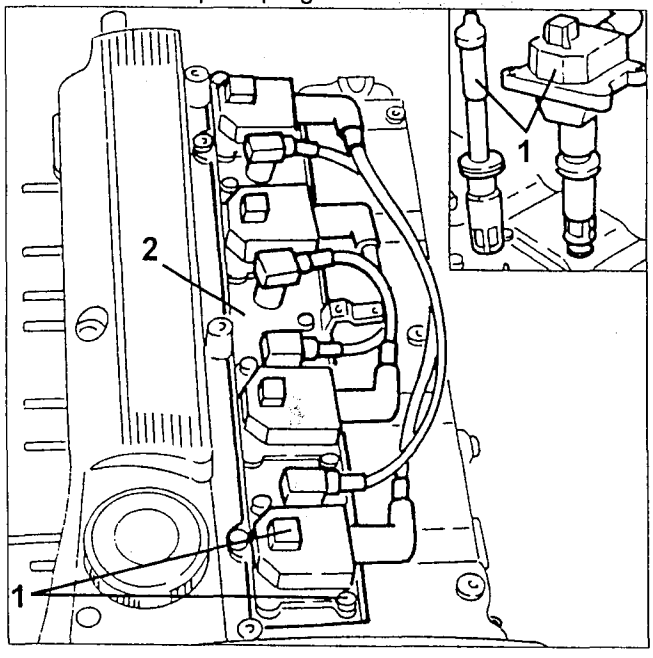
RPM AND STROKE SENSOR REMOVAL

1. Loosen the fastening screw and remove the rpm and stroke sensor.



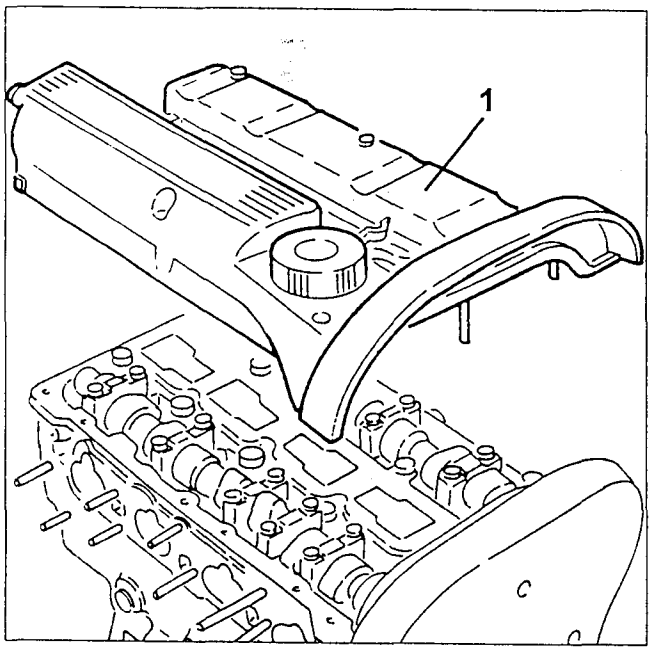
IGNITION COIL REMOVAL

1. Loosen the fastening screws and remove the ignition coils and spark plug wires.
2. Loosen the fastening screws and remove the ignition coil bracket.
- Remove the spark plugs.

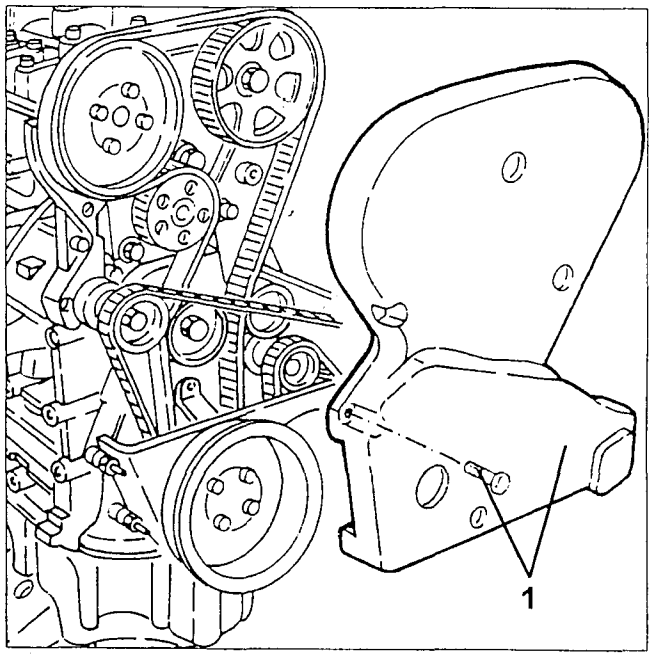


COUNTER-ROTATING SHAFT BELT AND TIMING BELT REMOVAL

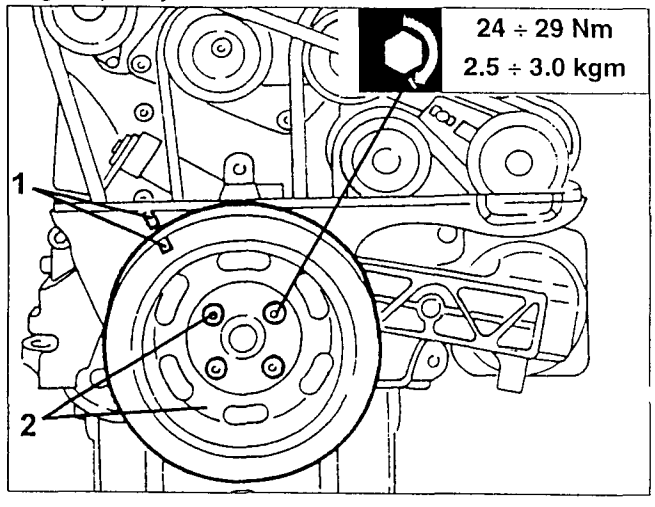
1. Loosen the fastening screws and remove the hydraulic tappet cover and seal.



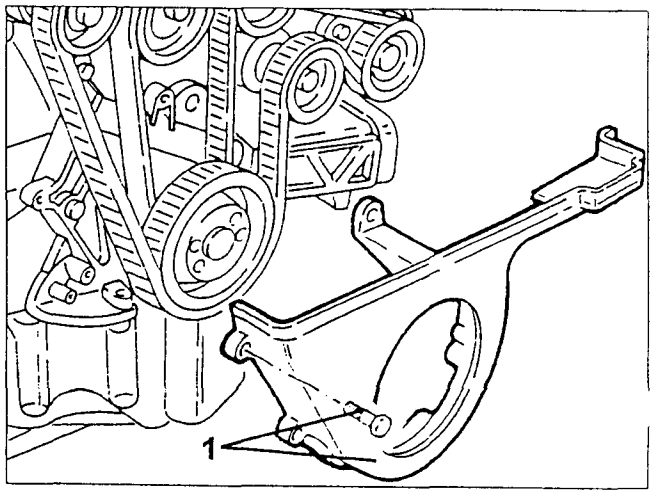
1. Loosen the fastening screws and remove the upper timing belt and counter-rotating shaft belt cover.



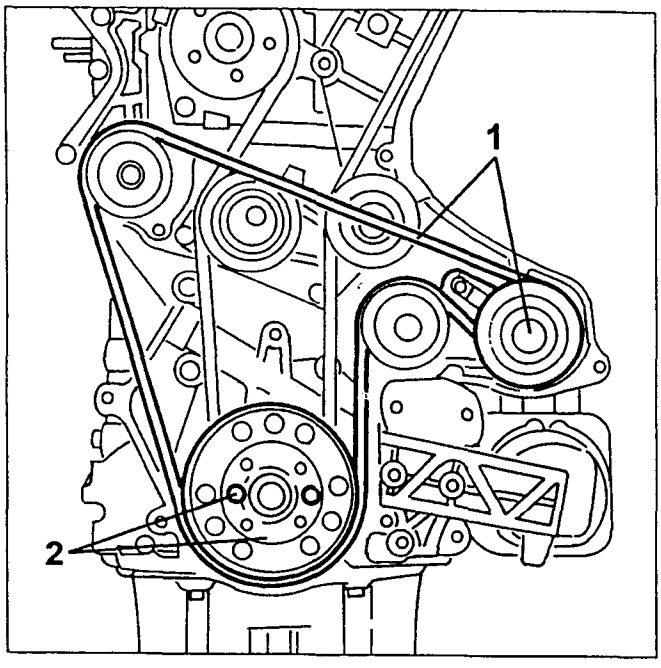
1. Turn the crankshaft until the notch on the engine pulley corresponds to that on the lower belt cover (cylinder 1 at DTC, firing stroke).
2. Loosen the fastening screws and remove the engine pulley.



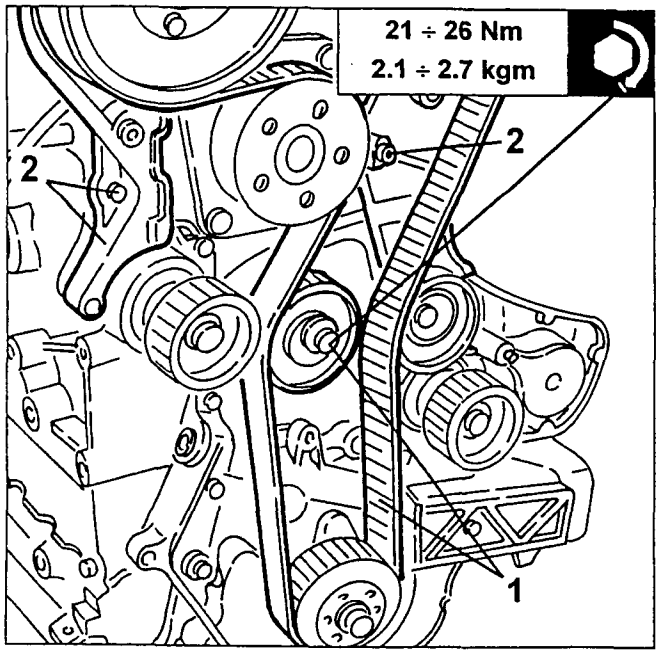
1. Loosen the three fastening screws and remove the lower belt cover.



1. Slacken the counter-rotating shaft belt tensioner then prise and remove the belt.
- Completely unscrew the fastening nut and remove the counter-rotating shaft belt tensioner.
2. Slacken the two fastening screws and remove the counter-rotating shaft belt drive pulley.

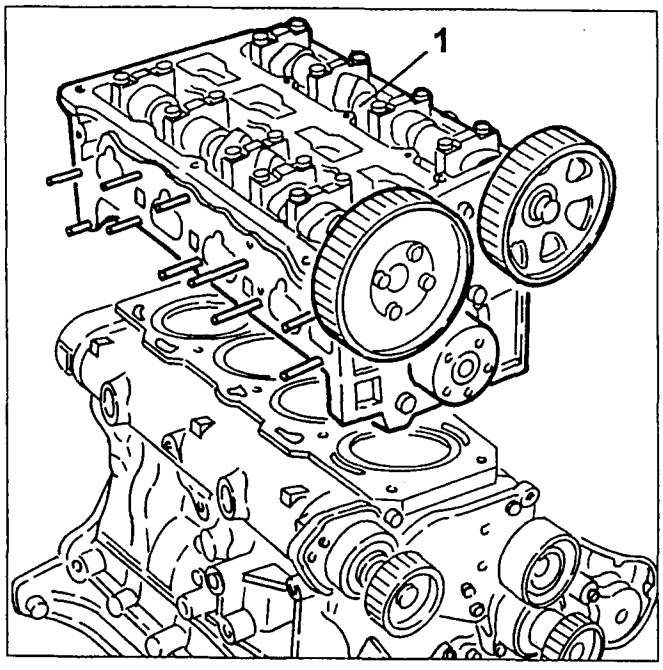


1. Slacken the camshaft belt tensioner, then prise and remove the belt.
- Completely unscrew the fastening nut and remove the camshaft belt tensioner.
2. Slacken the fastening screws and remove the side guards of the camshaft belt and counter-rotating shaft belt.



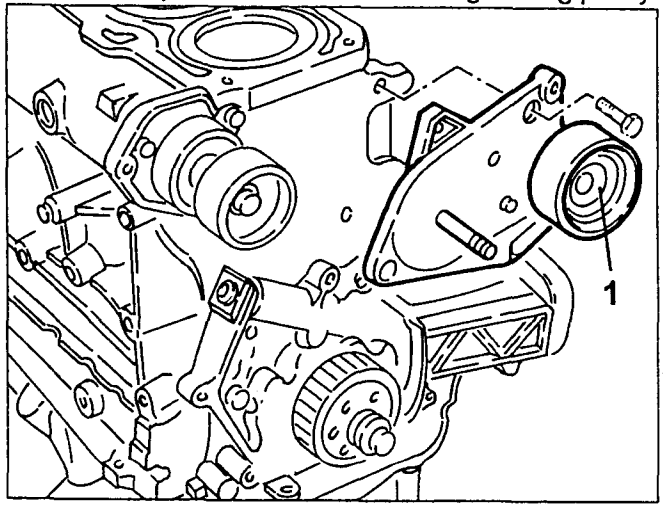
REMOVING THE CYLINDER HEAD

1. Slacken the fastening screws and remove the cylinder head.
- Remove the seal.

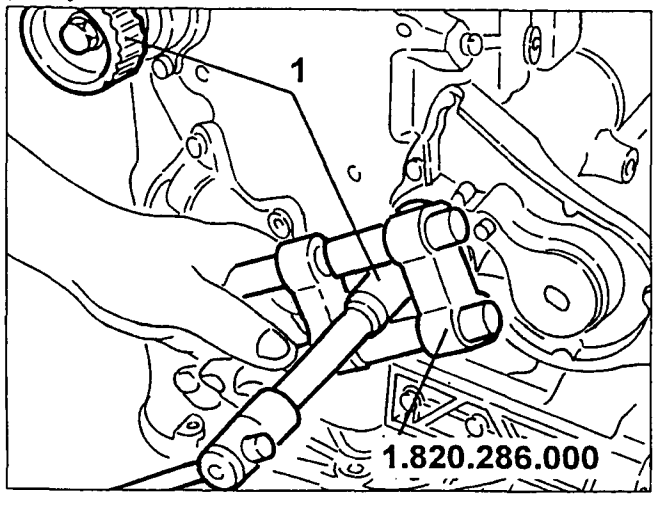


REMOVING THE COUNTER-ROTATING SHAFTS

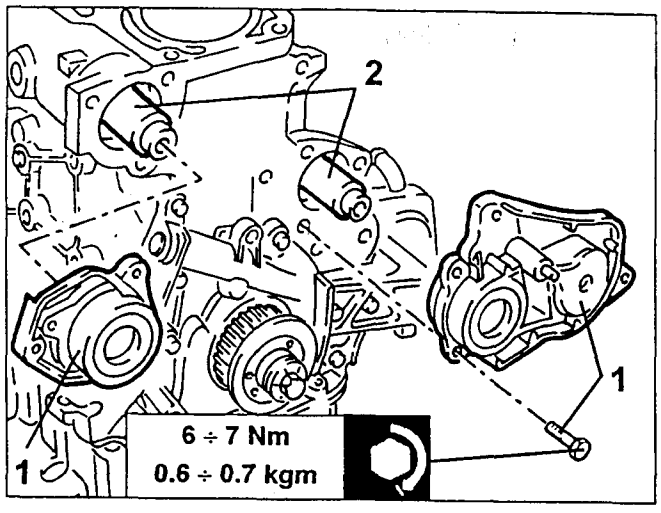
1. Slacken the three fastening screws and remove the bracket complete with the camshaft tightening pulley.



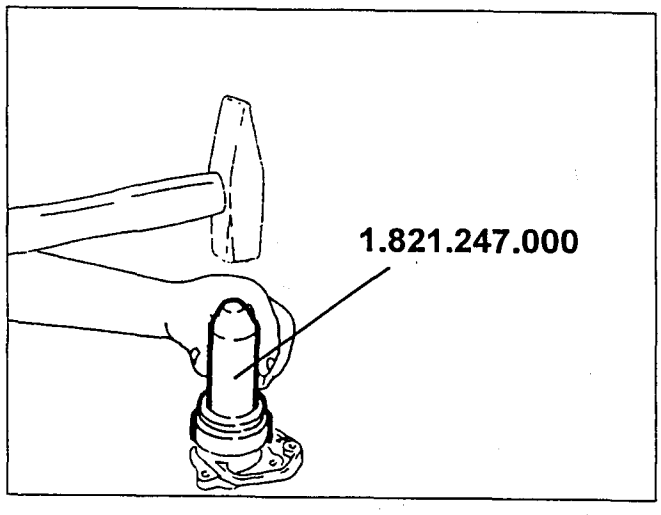
1. Using tool no. 1.820.286.000, slacken the fastening screws and remove the counter-rotating shaft drive pulleys.



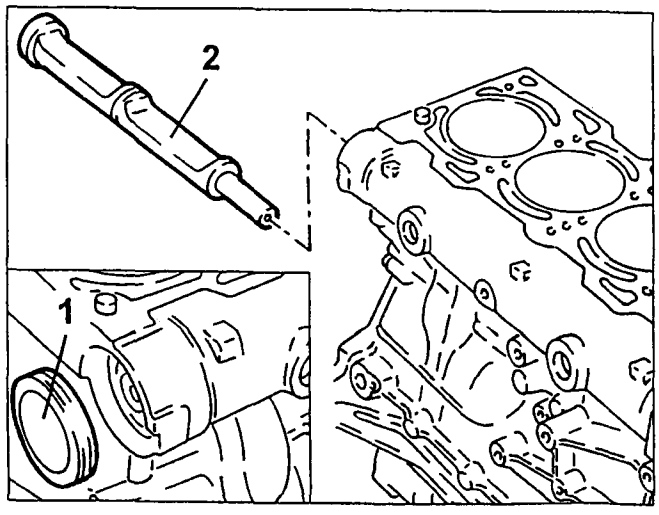
1. Slacken the fastening screws and remove the counter-rotating shaft front contcovers complete with oil seal rings.
2. Withdraw the two spacers from the counter-rotating shafts.



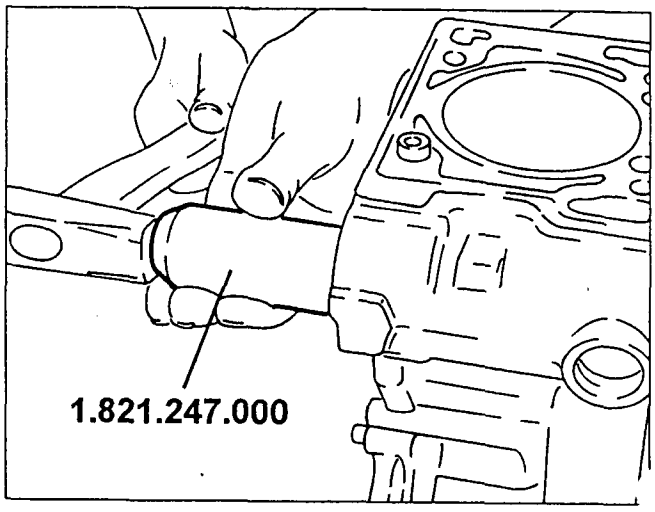
When refitting the oil seal rings, use tool no. 1.821.247.000.



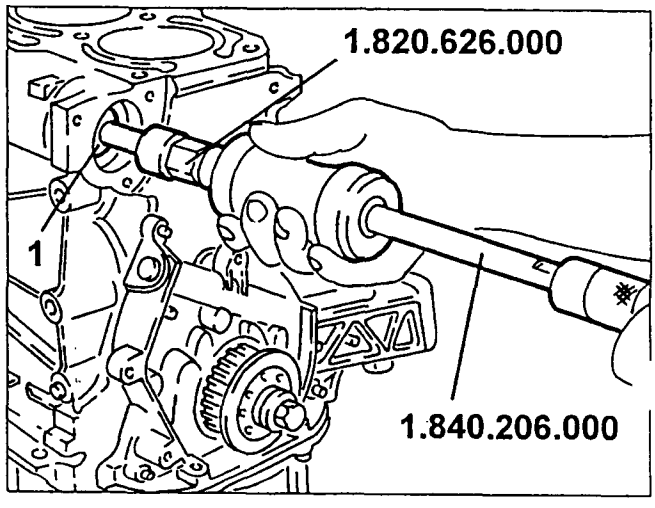
1. Prise and remove the counter-rotating shaft rear plugs.
2. Using a plastic mallet remove the counter-rotating shafts from the rear of the engine.



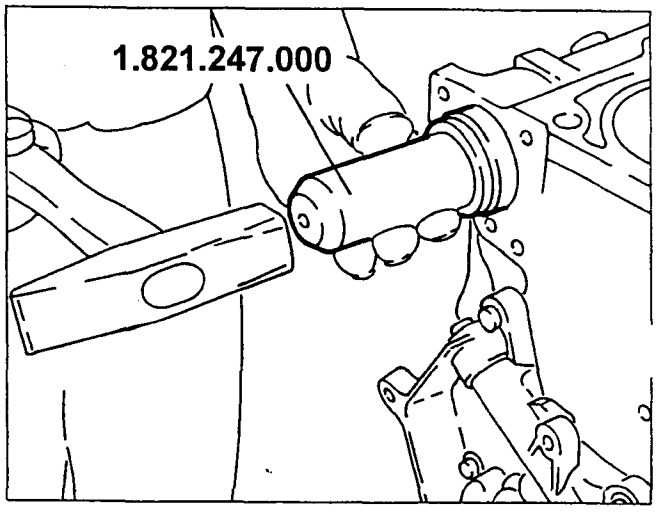
When refitting, insert the counter-rotating shafts complete with rear bearings using tool no. 1.821.247.000.



- Using a suitable puller tool remove the rear bearings from the counter-rotating shafts.
1. Using tools no. 1.820.626.000 and no. 1.840.206.000 remove the two front bearings from the counter-rotating shafts.

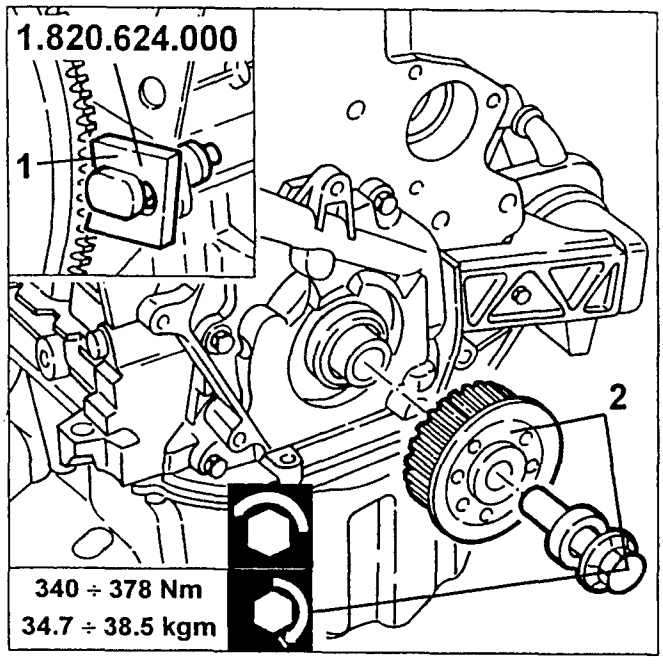


When refitting insert the counter-rotating shaft front bearings using tool no. 1.821.247.000.



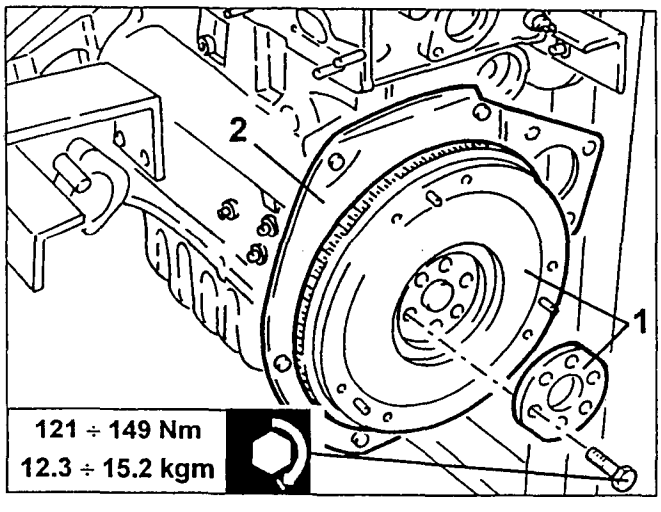
REMOVING THE CAMSHAFT DRIVE BELT PULLEY

1. Install flywheel stopper tool no. 1.820.624.000.
2. Slacken the left-handed screw and remove the camshaft drive belt pulley.



REMOVING THE FLYWHEEL

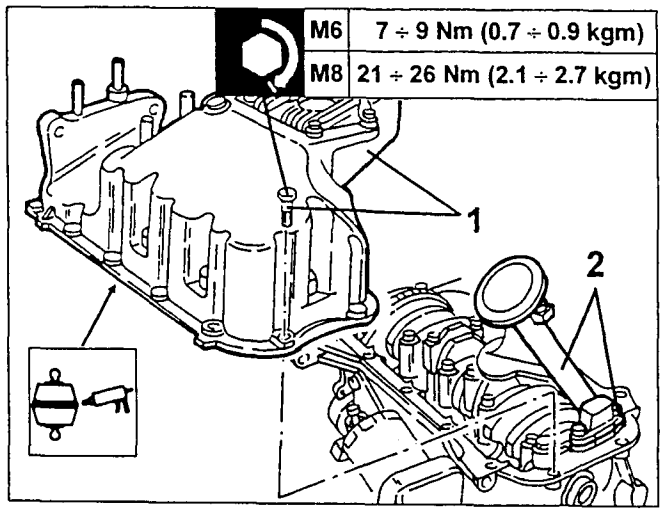
1. Slacken the fastening screws and remove the flywheel.
2. Retrieve the flywheel cover.



- Remove the flywheel stopper tool installed previously.

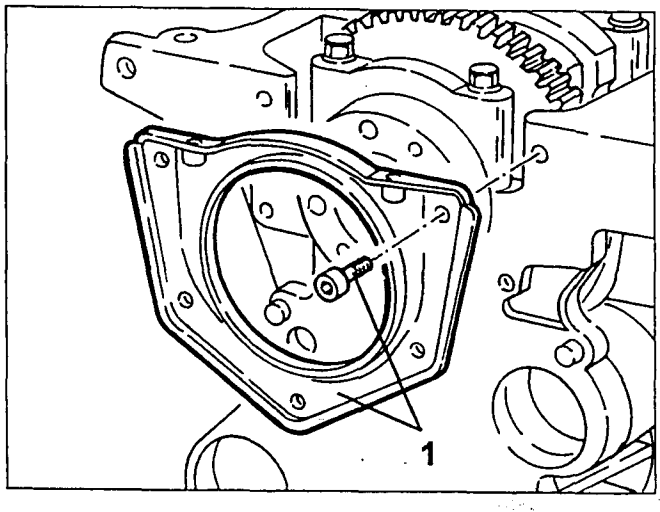
REMOVING THE OIL SUMP

1. Turn the engine on the overhauling stand, then slacken the fastening screws and remove the oil sump.
2. Slacken the two fastening screws and remove the oil suction device with its seal.



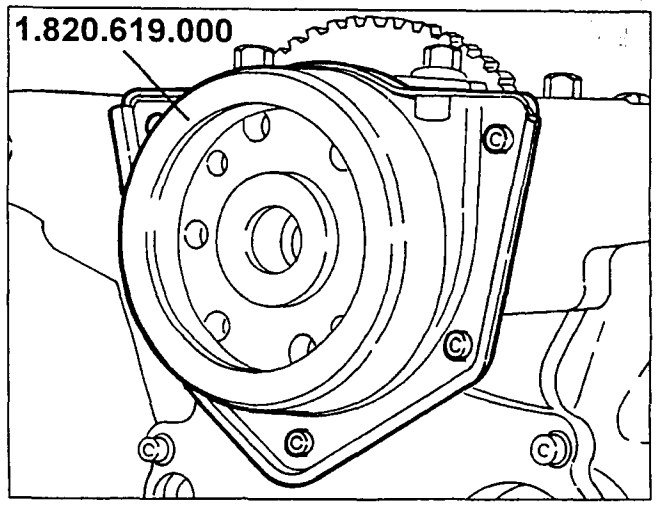
REMOVING THE CRANKCASE REAR COVER

1. Slacken the fastening screws and remove the crankcase rear cover with incorporated oil seal ring.



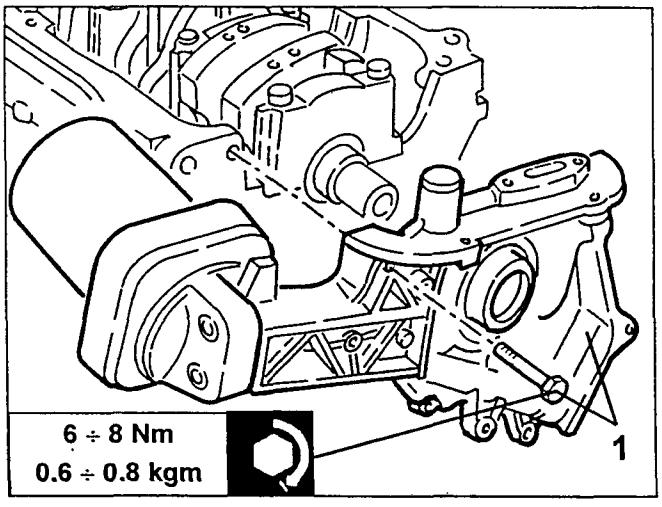
Refit the rear cover as follows:

- **Fit tool no. 1.820.619.000 on the oil seal of the rear crankcase cover;**
- **fit the tool - rear cover together and tighten the screws fastening to the crankcase; the tool should be removed only after also tightening the screws fastening the rear cover to the oil sump.**



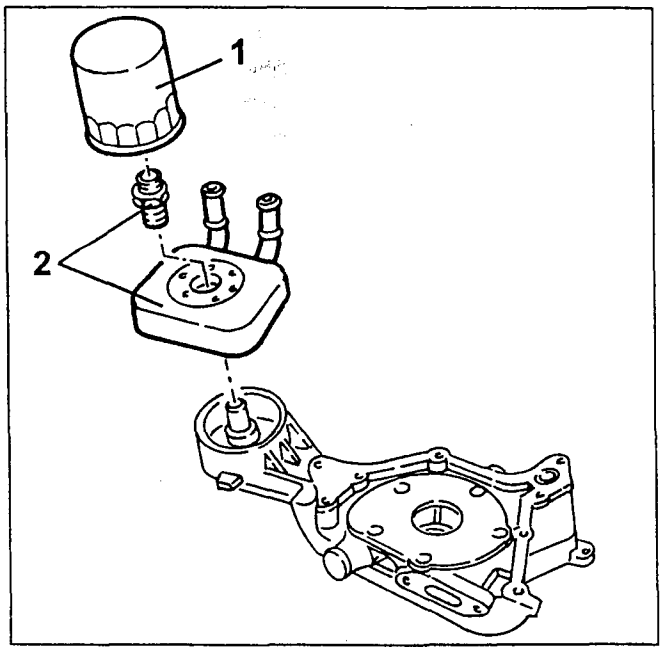
REMOVING THE ENGINE OIL PUMP ASSEMBLY

1. Slacken the fastening screws and remove the engine front cover with incorporated oil pump, filter and heat exchanger.

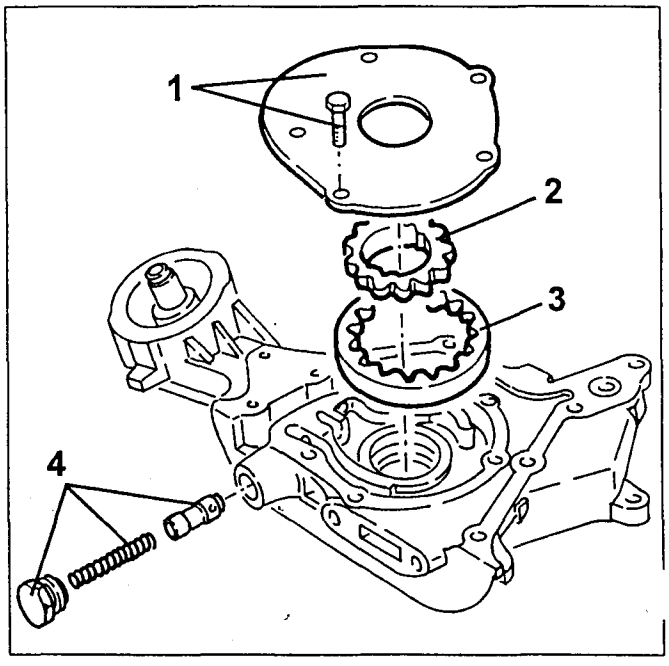


- Prise and remove the crankshaft front oil seal.
When refitting the crankshaft front oil seal, after fitting it on the oil pump assembly and assembling this on the crankcase, use tool no. 1.821.247.000.

1. On the bench, slacken and remove the oil filter.
2. Remove the fastening pin and remove the engine oil-coolant fluid heat exchangr complete with O-Ring.

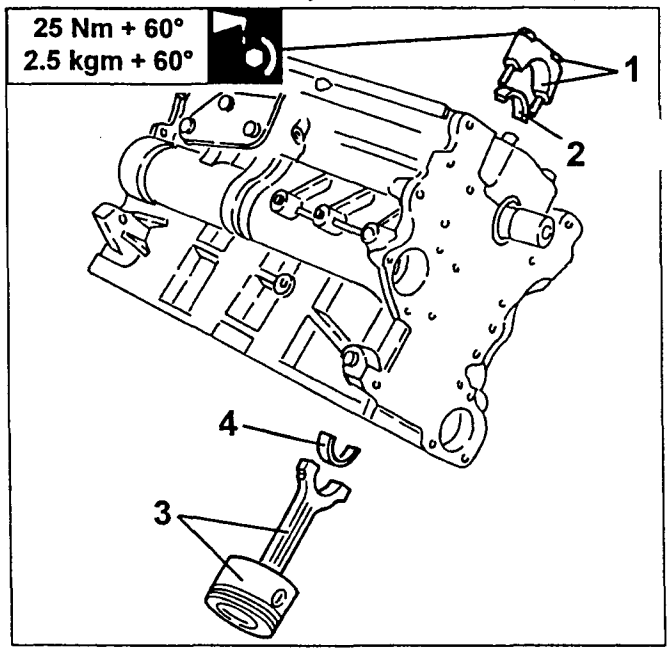


1. Slacken the fastening screws and remove the engine oil pump cover.
2. Remove the driving gear.
3. Remove the driven gear.
4. Slacken the fastening pin and remove the spring and the engine oil pump overpressure sliding valve.



REMOVING PISTONS AND CONNECTING RODS

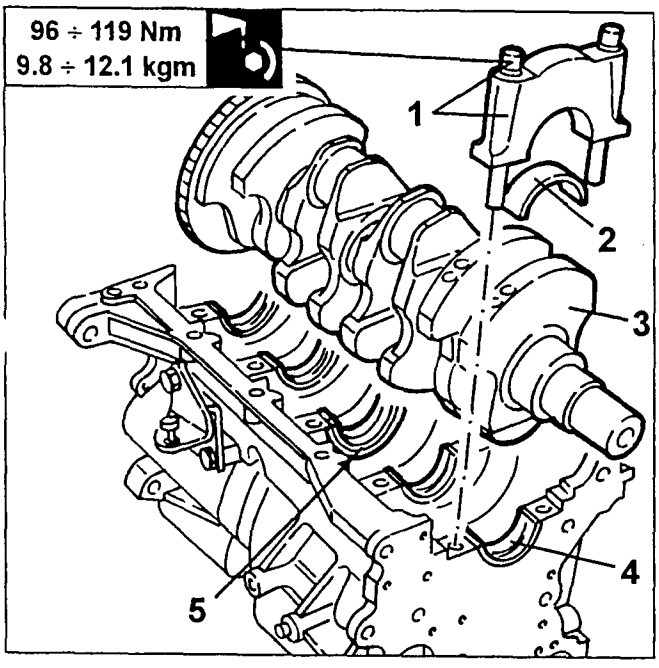
- Turn the crankshaft so that the pistons of the 1st and 4th cylinder reach the T.D.C.
1. Slacken the fastening screws and remove the connecting rod caps of the 1st and 4th cylinder.
2. Remove the corresponding connecting rod half bearings.
3. Withdraw the pistons and connecting rods of the 1st and 4th cylinder.
4. Remove the corresponding connecting rod half bearings.
- Proceed in the same way for the 2nd and 3rd cylinder.



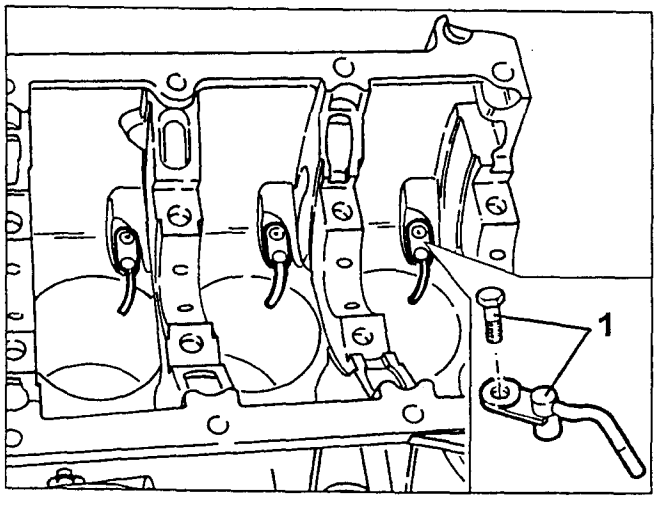
- Using a suitable tool, remove the seal rings and scraper ring from the piston.
WARNING: Proceed with care to avoid accidentally breaking any re-usable rings.
- Remove the two gudgeon pin circlips.
- Remove the gudgeon pin and separate the piston from the connecting rod.

REMOVING THE CRANKSHAFT

1. Slacken the fastening screws and remove the main bearing caps.
2. Remove the corresponding main half bearings.
3. Remove the crankshaft.
4. Remove the main half bearings from the supports.
5. Remove the two half thrust rings.



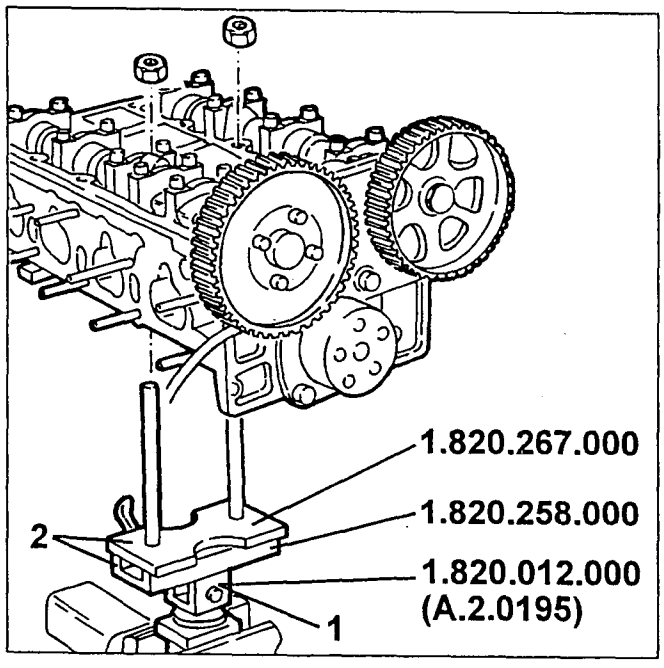
1. If necessary, slacken the fastening screw and remove the oil spray jets for lubricating and cooling the pistons from the crankcase.



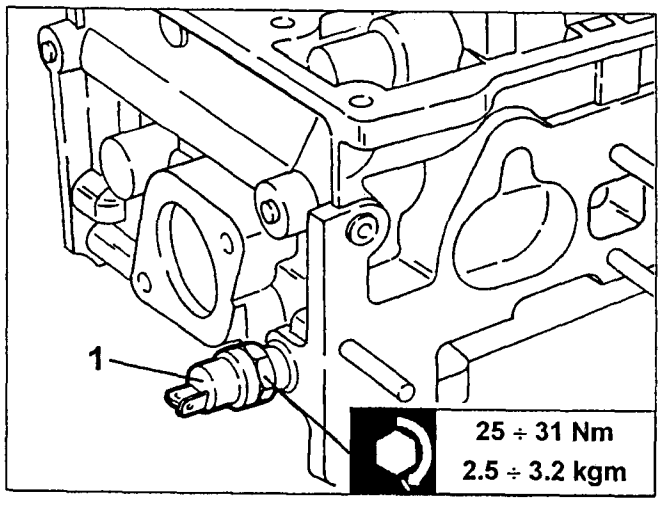
CYLINDER HEAD DISASSEMBLY

PRELIMINARY OPERATIONS

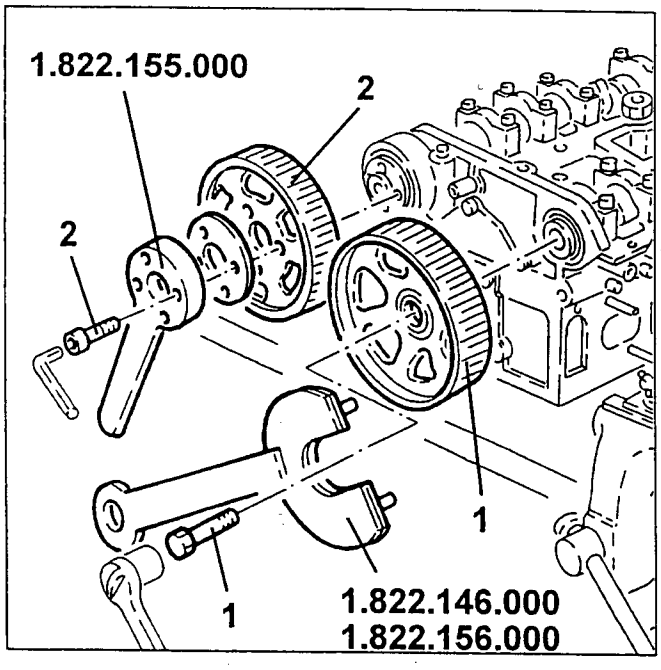
1. Fasten swivel support no. 1.820.012.000 (A.2.0195) in a vice.
2. Fasten tools no. 1.820.258.000 and no. 1.820.267.000 on the swivel support, then fasten the cylinder head on them.



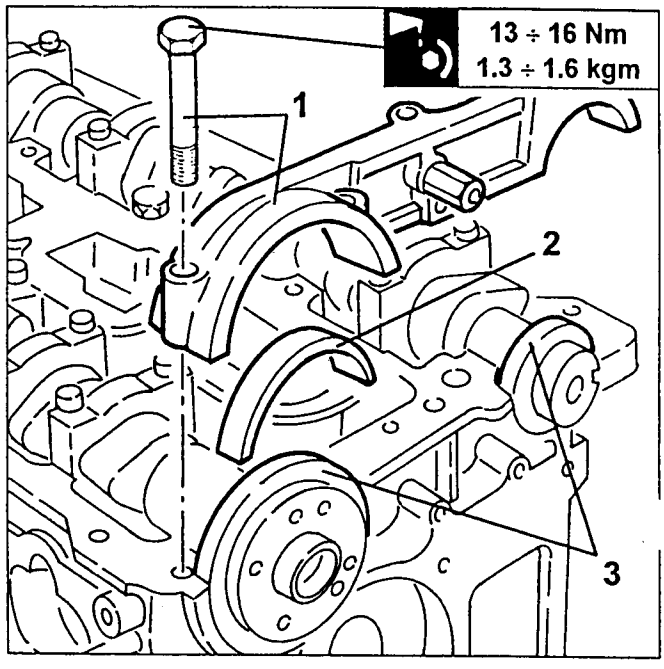
1. Remove the engine coolant temperature gauge transmitter and maximum temperature warning light contact from the cylinder head.



1. Slacken the fastening screw using tools no. 1.822.146.000 and no. 1.822.156.000 and remove the exhaust side camshaft drive pulley.
2. Slacken the fastening screws using tool no. 1.822.155.000 and remove the intake side camshaft drive pulley.

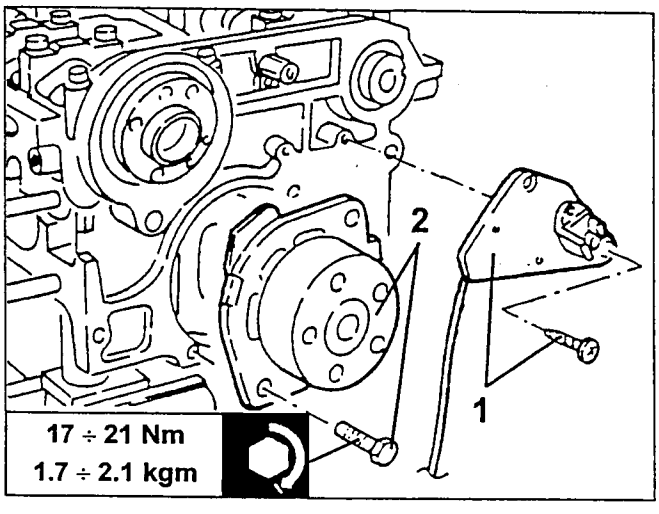


2. Remove the intake side half bearing.
3. Remove the oil seal rings from the camshafts.

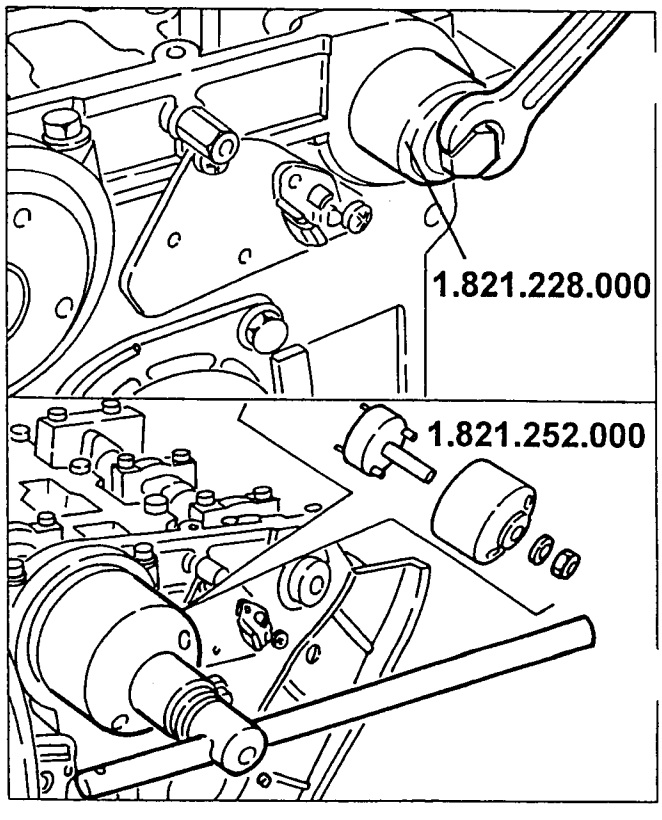


REMOVING THE WATER PUMP

1. Slacken the two fastening screws and remove the timing sensor complete with support.
2. Slacken the two fastening screws and remove the water pump complete with O-ring.



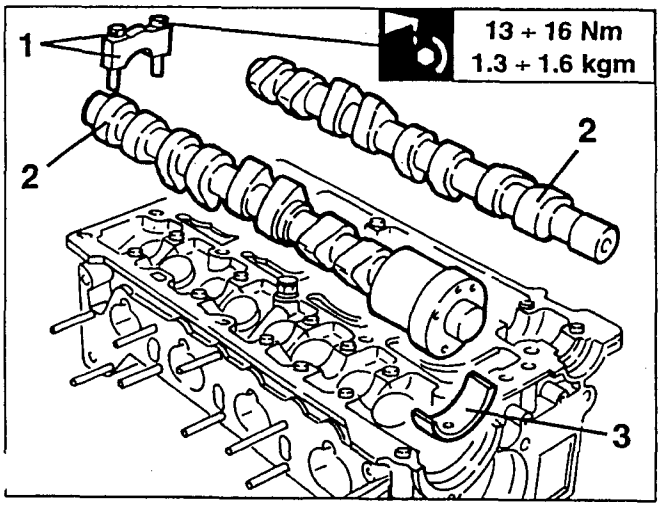
When refitting using tool no. 1.821.228.000 insert the exhaust side oil seal.
Using tool no. 1.821.252.000 insert the intake side oil seal.



REMOVING THE CAMSHAFTS

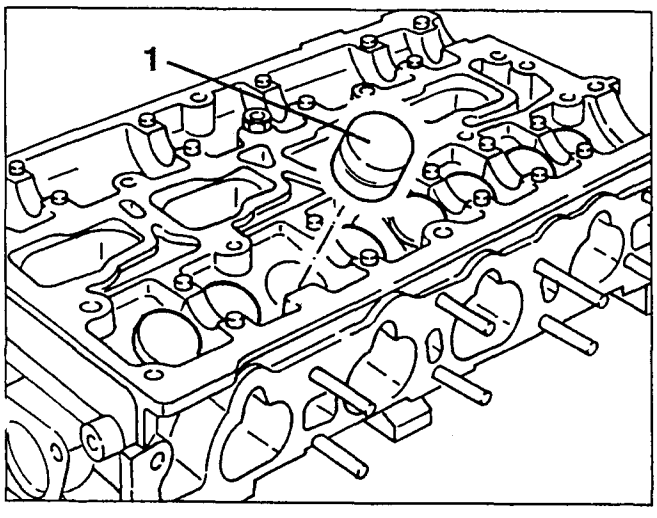
1. Slacken the four fastening screws and remove the camshaft front cap.

1. Slacken the fastening screws and remove the camshaft caps.
2. Remove the camshafts.
3. Remove the intake side half bearing.

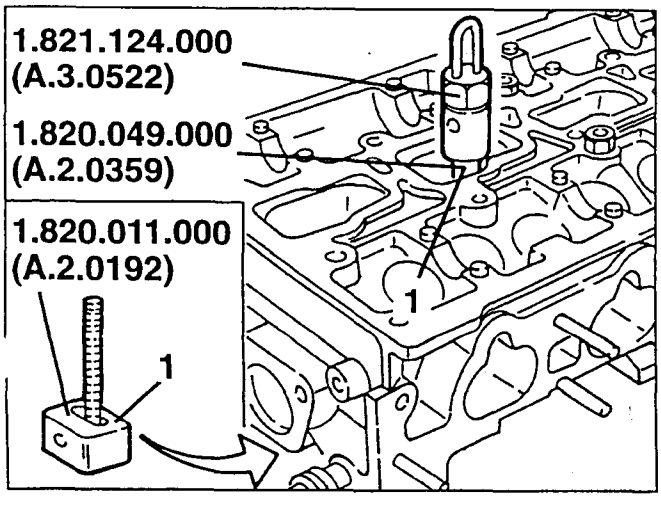


VALVES DIS-ASSEMBLY

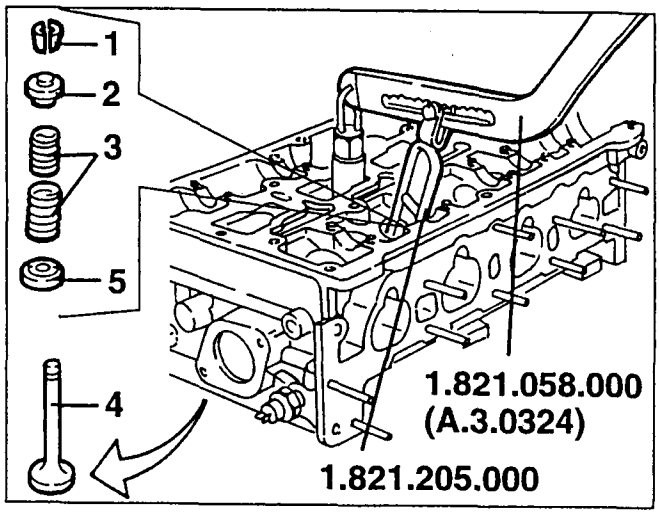
1. Withdraw the hydraulic tappets from their housings.



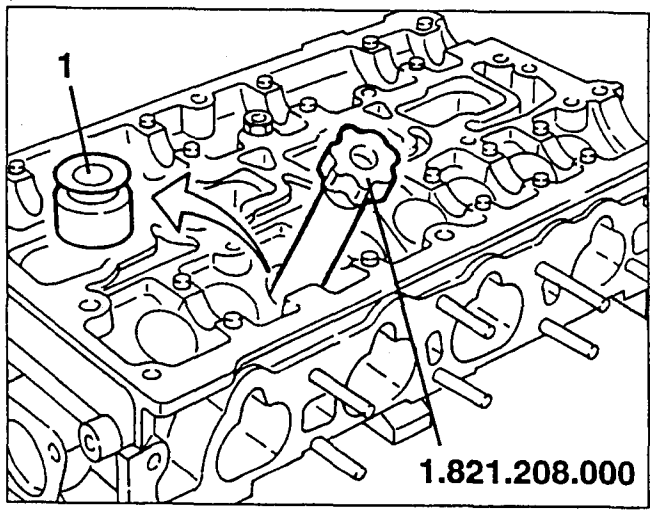
1. On the cylinder head assemble tools no. 1.820.011.000 (A.2.0192), no.1.820.049.000 (A.2.0359) and no. 1.821.124.000 (A.3.0522).



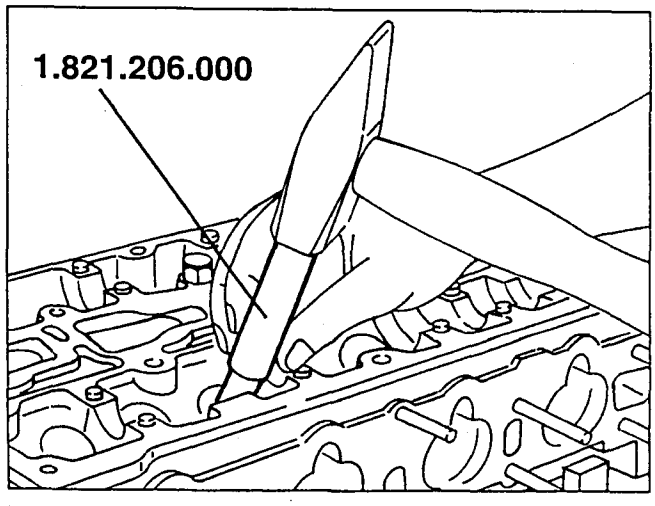
1. Using lever no. 1.821.058.000 (A.3.0324) and cage no. 1.821.205.000, remove the half cones from the valve stem.
2. Remove the upper plate.
3. Remove the outer and inner springs.
4. Remove the tools and retrieve the valve.
5. Remove the valve lower plate.



1. Using tool no. 1.821.208.000, remove the oil seal cap.



When refitting the oil seal cap use tool no. 1.821.206.000.

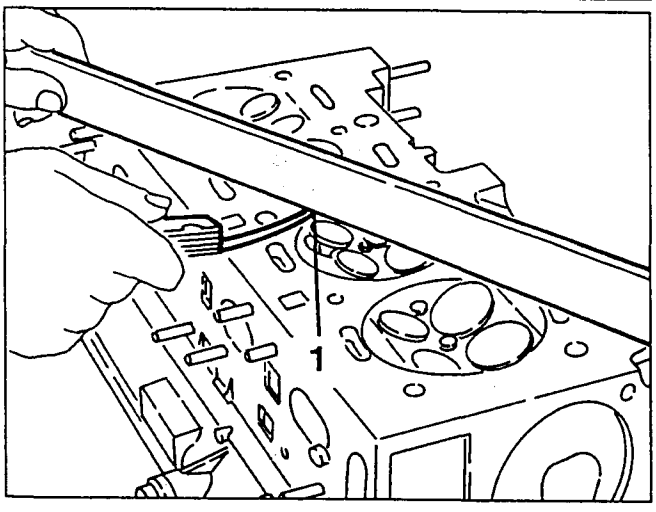


CHECKS AND INSPECTION CYLINDER HEAD

Checking the lower surface of the cylinder head

1. Check the flatness of the lower cylinder head surface; reface if it is excessively worn.

Maximum flatness error of cylinder head lower surface
0.1 mm

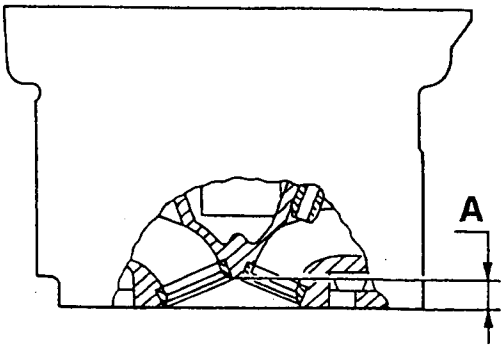


- After refacing, check that the depth of the combustion chamber, on the head, exceeds the minimum allowed limit.

WARNING:
Exceeding the minimum allowed limit involves serious engine operating failures.

Minimum depth "A" of the combustion chamber in the head
13 ± 0.2 mm

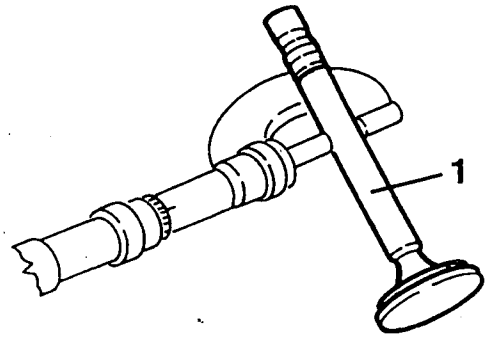
- Check that the finishing of the lower cylinder head surface is satisfactory.



Checking the clearance between valve guides and valve stems

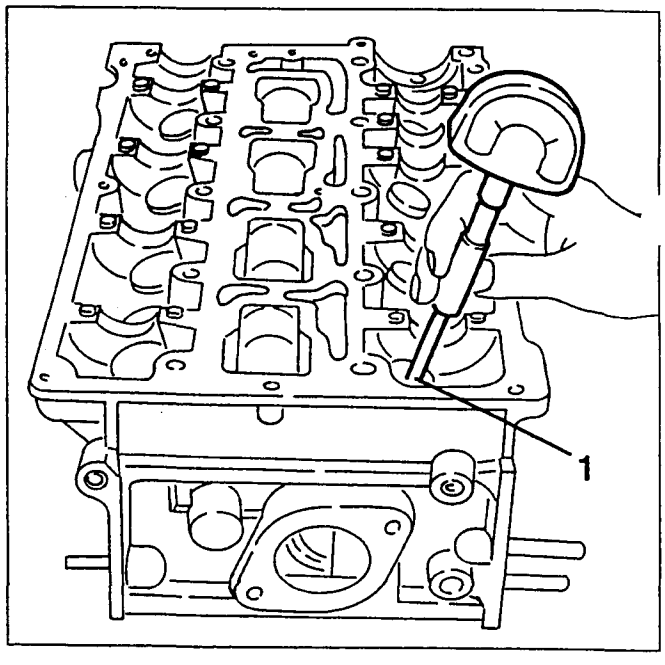
1. Measure the diameter of the valve stems and check that it is within the specified limits.

Diameter of valve stems	
Intake	6.975 ÷ 6.990 mm
Exhaust	6.960 ÷ 6.975 mm



1. Measure the inside diameter of the valve guides and check that it is within the specified limits.

Inside diameter of valve guides
7.022 ÷ 7.040 mm

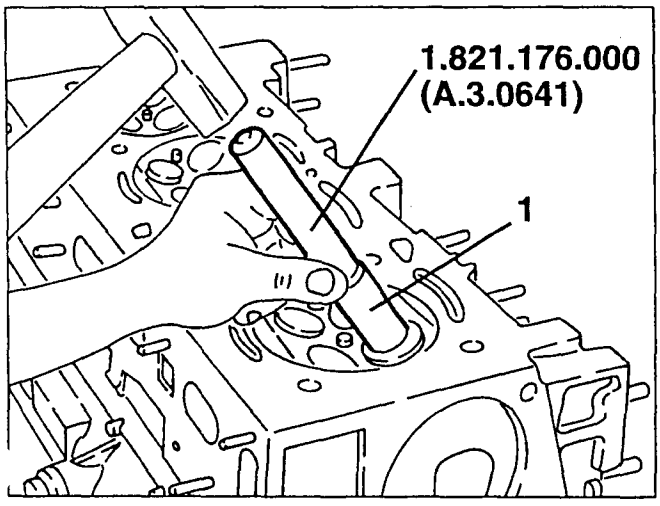


- Calculate the clearance between valve guides and stems and check that it is within the specified limits, if not, change any worn parts.

Radial clearance between valve guides and stems	
Intake	0.032 ÷ 0.065 mm
Exhaust	0.047 ÷ 0.080 mm

Changing the valve guides

1. Using puller tool no. 1.821.176.000 (A.3.0641), remove the worn valve guides.



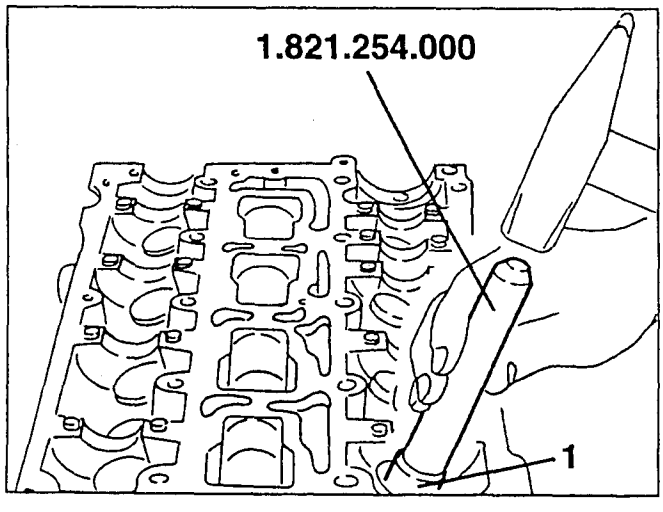
- Check that the outside diameter of the valve guides and their seats on the head are within the specified limits and that their assembly interference is correct.

Outside diameter of valve guides
13.010 ÷ 13.030 mm

Diameter of valve guide seats
12.950 ÷ 12.977 mm

Interference between valve guides and seats
0.033 ÷ 0.080 mm

1. Insert the new valve guides using tool no. 1.821.254.000.



- Bore the valve guide inside diameter to calibrate the holes to the specified diameter.

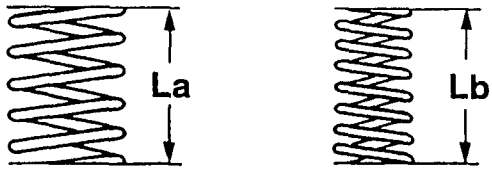
Inside diameter of valve guides
7.022 ÷ 7.040 mm

Checking the valve springs

- Check that the "free" length of the valve springs is within the specified limits.

NOTE: The rest surfaces must be parallel with each other and perpendicular to the axis of the spring with a maximum error of 2°.

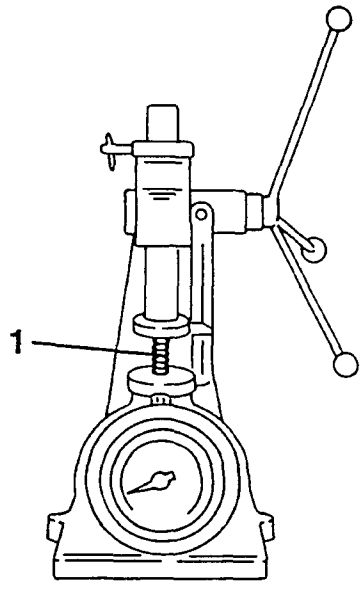
Free length of valve springs	
outer spring "La"	46 mm
inner spring "Lb"	39 mm



1. Using a torque meter, check that the characteristic data of the springs are within the specified limits.

Outer spring		
Length of spring mm		Control load N (Kg)
With valve closed	34	271 ÷ 294 (27.6 ÷ 30)
With valve open	24.5	485 ÷ 524 (49.4 ÷ 53.4)

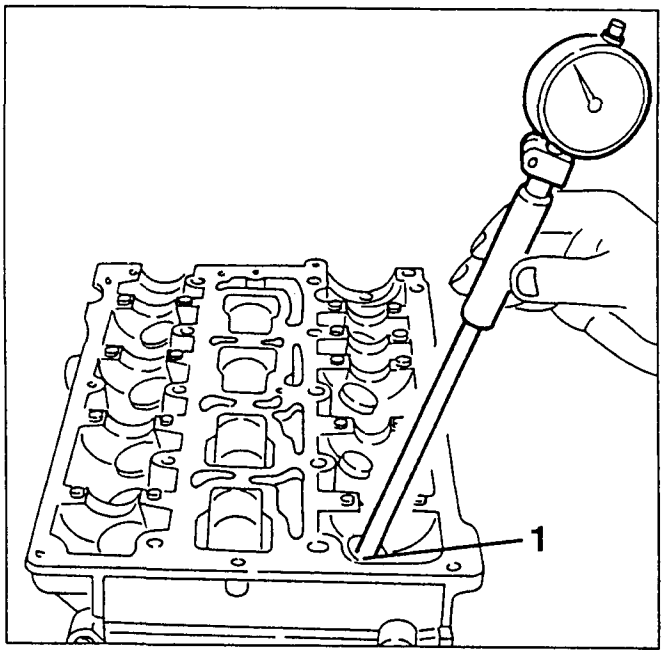
Inner spring		
Length of spring mm		Control load N (Kg)
With valve closed	29.5	96 ÷ 106 (9.8 ÷ 10.8)
With valve open	20	201 ÷ 221 (20.5 ÷ 22.5)



Checking the clearance between the cups and their seats

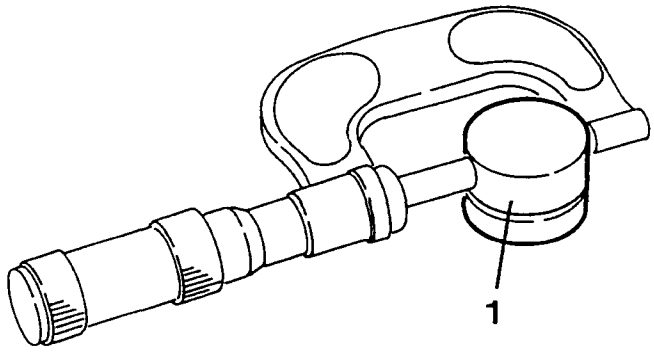
1. Check that the diameter of the cup seats is within the specified limits.

Diameter of valve cup seats
33.000 ÷ 33.025 mm



1. Check that the outside diameter of the cups is within the specified limits.

Diameter of valve cups
32.959 ÷ 32.975 mm



- Calculate the clearance between the cups and their seats checking that it is within the specified limits.

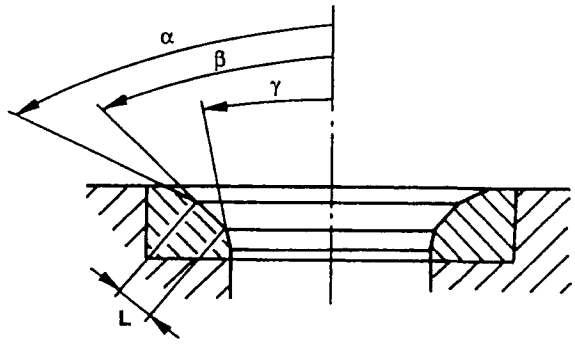
Clearance between cups and seats
0.025 ÷ 0.066 mm

Turning the valve seats

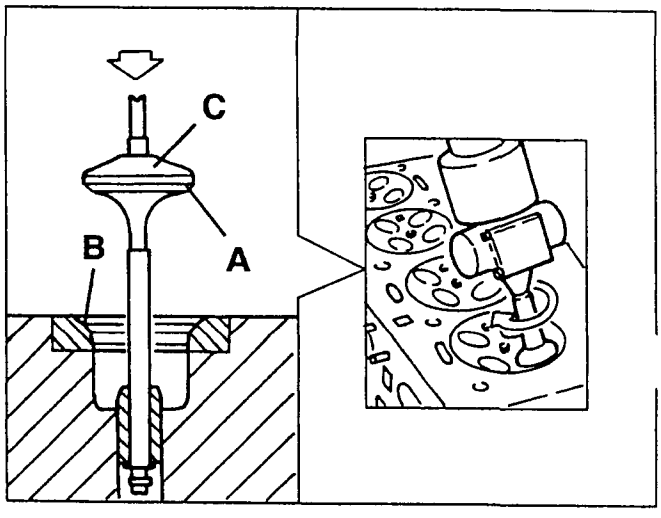
- If necessary, turn the valve seats using suitable equipment within the following limits.

Taper of contact area with valve "β"	90° ± 10'
Taper of upper valve seat area "α"	150°
Taper of lower valve seat area "γ"	30°

Dimension "L" contact area with valve	
Intake	6.5 mm
Exhaust	5.5 mm



- After machining, grind each valve in its seat as follows:
- coat the contact surfaces "A" and "B" of the valves and their seats with abrasive paste (SIPAL AREXON Carbosilicium for valves);
- lubrificate the valve stem with engine oil;
- fit the lower surface of the valve mushroom to the suction cup "C" of a pneumatic grinder;
- insert the valve in its guide and grind;
- after grinding, thoroughly clean the valve and the seat.



When turning and grinding the valve seats it is advisable to check the valve tightness with the spark plugs in place, proceeding as follows:
- fill the hollow of the combustion chamber with petrol;
- admit low pressure air into the intake manifolds and check that no bubbles form in the petrol;
- check the tightness of the exhaust valves in the same way, admitting air to the exhaust manifolds;
- if any leaks are noted, make sure that the valves are perfectly settled in their seats and repeat the check; if the result is negative, grinding must be repeated.

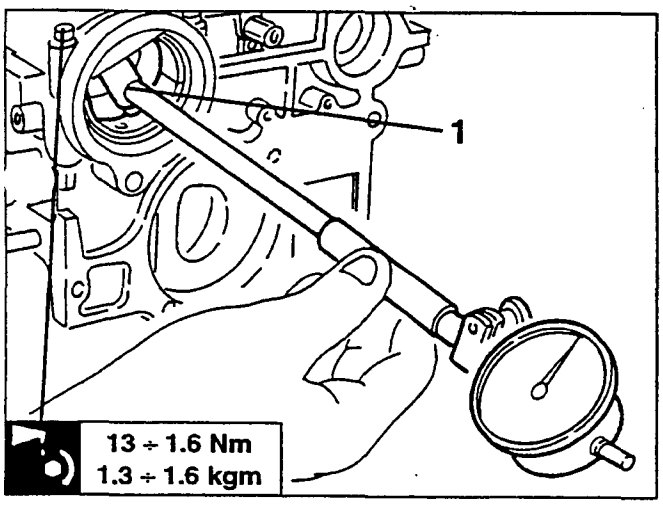
Camshafts and timing system bearings

Assemble the camshaft caps and tighten the fastening screws to the specified torque, then check that the diameter of the supports is within the specified limits.

NOTA: The half bearings should be assembled on the intake side front support.

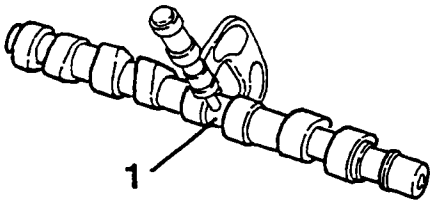
Diameter of camshaft supports
26.045 ÷ 26.070 mm 50.034 ÷ 50.071 mm (*)

(*) Front intake side support with half bearings assembled (for timing variator)



1. Check that the diameter of the camshaft journals is within the specified limits.

Diameter of camshaft journals
26.000 ÷ 26.015 mm



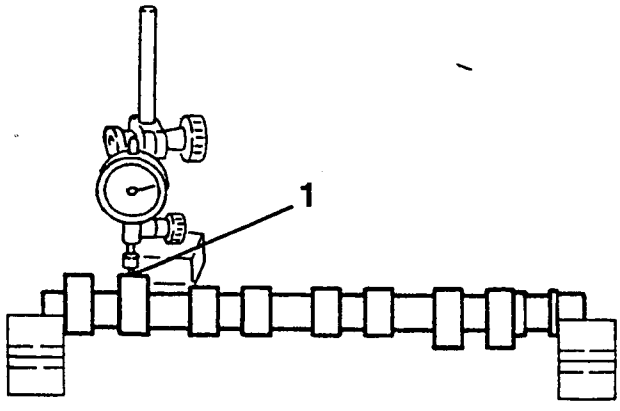
- Calculate the clearance between the camshaft journals and their bearings and check that it is within the specified limits.

Clearance between camshafts and bearings	
0.03 ÷ 0.07 mm	0.034 ÷ 0.086 mm (*)

(*) Specific for timing variator

1. Check that the cam lifts are within the specified limits.

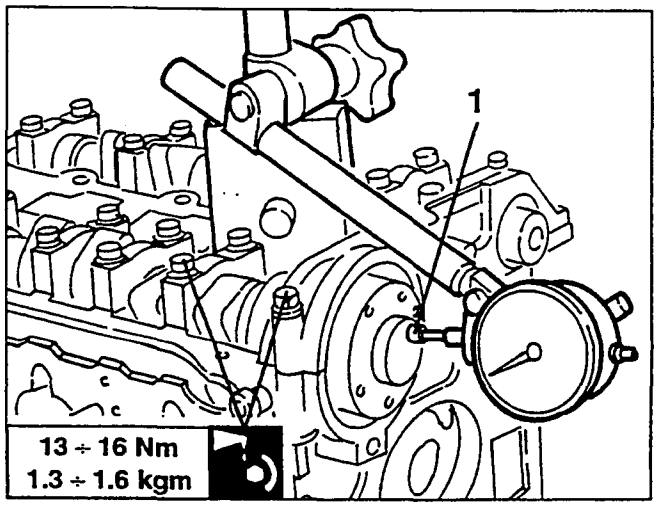
Cam nominal lift	
Intake	9.50 mm
Exhaust	9.50 mm



Checking the camshaft end float

- Place the camshafts on the cylinder head, assemble the corresponding caps and tighten the fastening screws to the specified torque.
1. Install a centesimal dial gauge and measure the end float of the camshafts checking that it is within the specified limits.

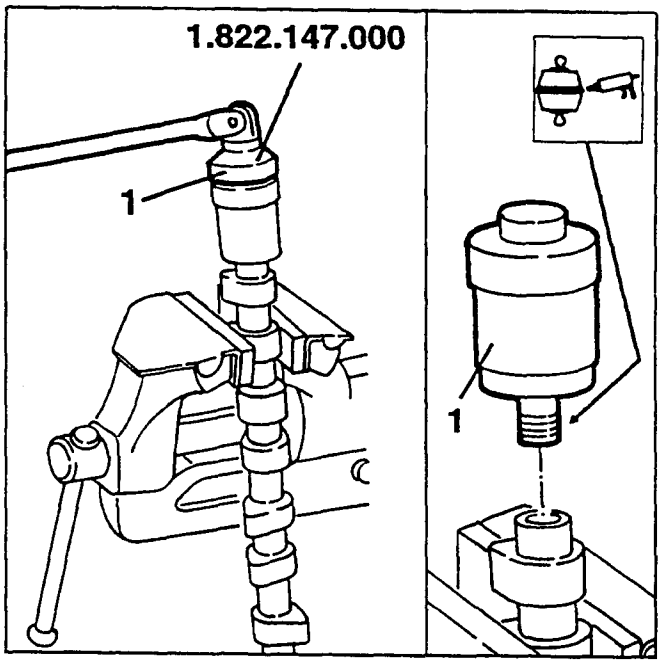
Camshafts end float
0.10 ÷ 0.23 mm



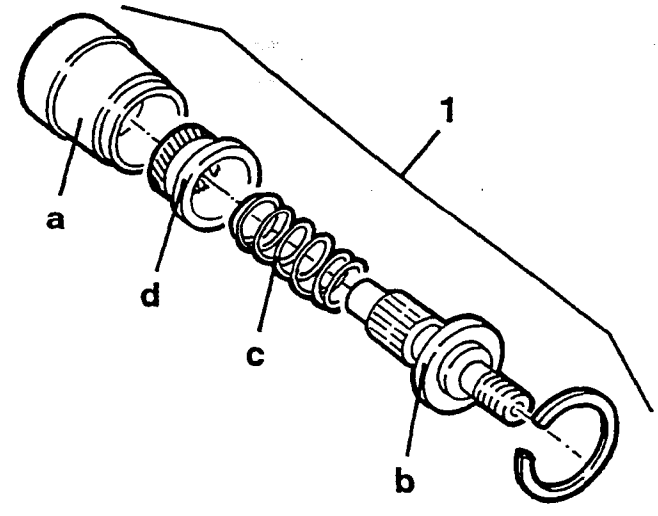
Removing the timing variator from the camshaft

- Position the camshaft intake side in a vice fitted with protective jaws.

1. Using tool no. 1.822.147.000, slacken and remove the timing variator from the camshaft.



1. Remove the stop ring and remove the outer body (a) of the variator pinion (b), spring (c) and the piston (d).



WARNING:
When refitting the timing variator, follow the instructions given below:
- Make sure that the mastic on the thread coupling the timing variator to the camshaft does not obstruct the oil ducts.
- Wait for about two hours before assembling the shaft on the cylinder head.

CHECKS AND INSPECTION CRANKCASE

- Visibly check the crankcase for cracks and signs of excessive wear of the sliding surfaces; check that all the threads are intact.
- Remove the lubrication and cooling groove caps and clean the ducts with a suitable detergent, then dry with a jet of air and fit new caps.
- Accurately remove any traces of seals or sealants from the crankcase surfaces.

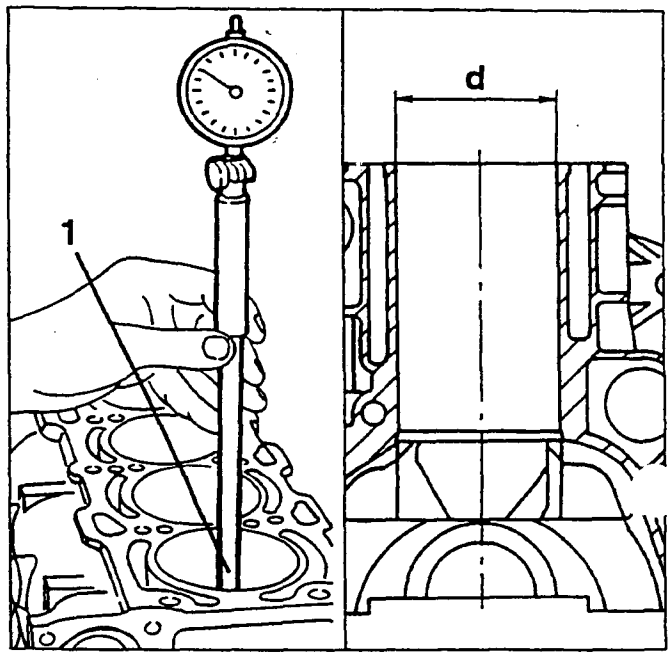
Checking the cylinders

1. Using a bore gauge fitted on a dial gauge, measure the inside diameter of the cylinders and check that it is within the specified limits.

Inside diameter "d"	
Class A	83.000 ÷ 83.010 mm
Class B	83.010 ÷ 83.020 mm
Class C	83.020 ÷ 83.030 mm
Oversize of 0.1 mm	

Maximum cylinder taper
0.010 mm

Maximum cylinder ovalization
0.005 mm

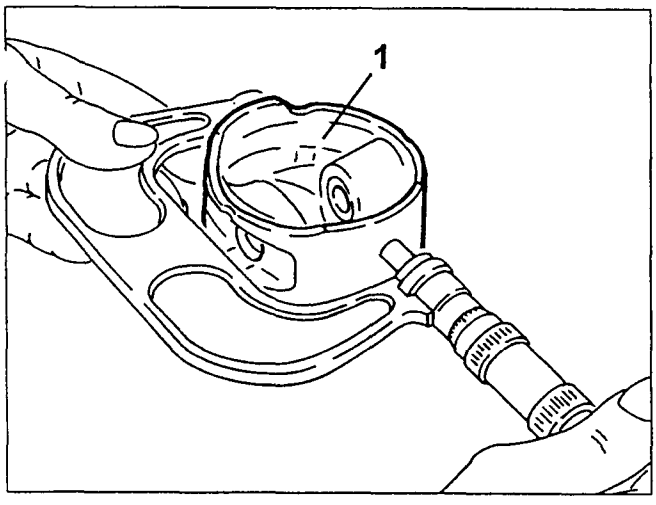


Checking the pistons

1. Measure the outside diameter of the pistons and check that it is within the specified limits.

Outside diameter of pistons (1)	
Class A (Blue)	82.952 ÷ 82.962 mm
Class B (Pink)	82.959 ÷ 82.971 mm
Class C (Green)	82.968 ÷ 82.978 mm
Oversize of 0.1 mm	

(1) To be measured at right angles to the gudgeon pin hole at a distance of 12.5 mm from the lower edge of the piston skirt.

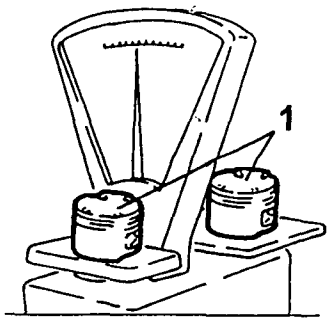


- Calculate the clearance between the cylinder and the piston and check that it is within the specified limits.

Clearance between piston and cylinder
0.038 ÷ 0.062 mm

1. Check that the difference in weight between the pistons complete with gudgeon pins and seal rings is within the specified limits.

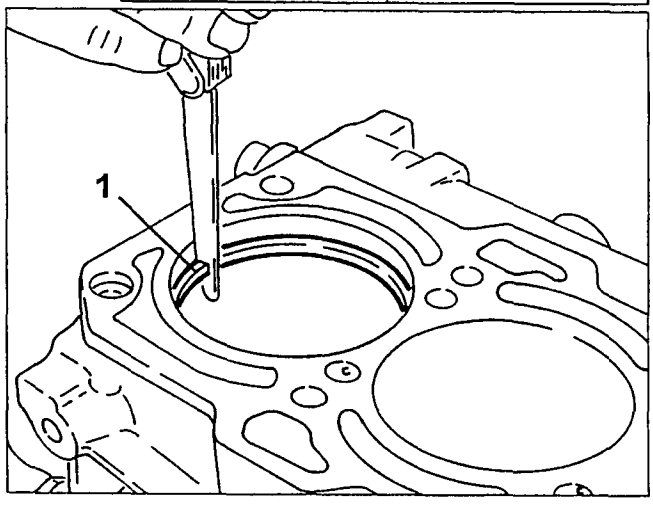
Difference in weight between pistons
± 5 g



Checking the seal ring gap

1. Insert the seal rings in the cylinder, check that they adhere to the whole circumference and that the gap is within the specified limits.

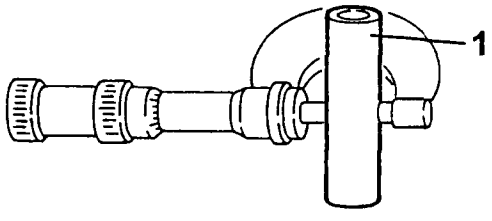
Ring gap	
First ring	0.25 ÷ 0.50 mm
Second ring	0.30 ÷ 0.50 mm
Oil scraper ring	0.25 ÷ 0.45 mm



Checking the play between gudgeon pins and seats on pistons

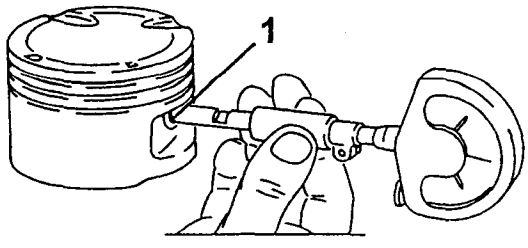
1. Measure the outside diameter of the gudgeon pins and check that it is within the specified limits.

Outside diameter of gudgeon pins
19.996 ÷ 20.000 mm



1. Measure the diameter of the pin mating hole in the piston and check that it is within the specified limits.

Diameter of pin seat in pistons
20.002 ÷ 20.007 mm



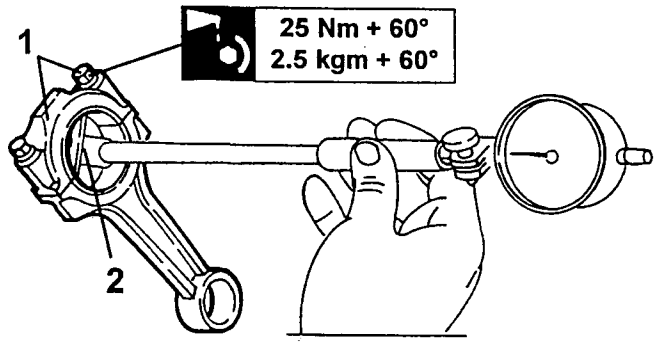
- Calculate the clearance between the pins and their seats on the pistons and check that it is within the specified limits.

Clearance between pins and seats on pistons
0.002 ÷ 0.011 mm

Checking the clearance between connecting rod journals and the corresponding half bearings

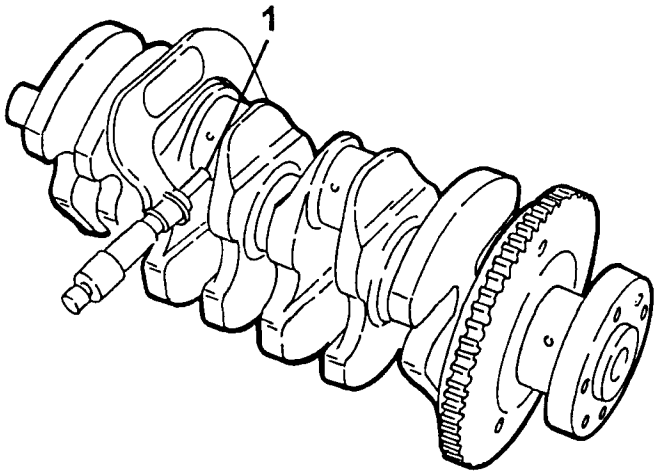
1. House the rod half bearings in the connecting rod big end and on the corresponding cap, then join them tightening the fastening screws to the specified torque.
2. Measure the diameter of the connecting rod big end and check that it is within the specified limits.

Inside diameter of connecting rod half bearings	
Class A	50.835 ÷ 50.855 mm
Class B	50.829 ÷ 50.849 mm
Class C	50.823 ÷ 50.843 mm



1. Measure the diameter of the connecting rod journals and check that it is within the specified limits.

Diameter of connecting rod journals	
Class A	50.799 ÷ 50.805 mm
Class B	50.793 ÷ 50.799 mm
Class C	50.787 ÷ 50.793 mm



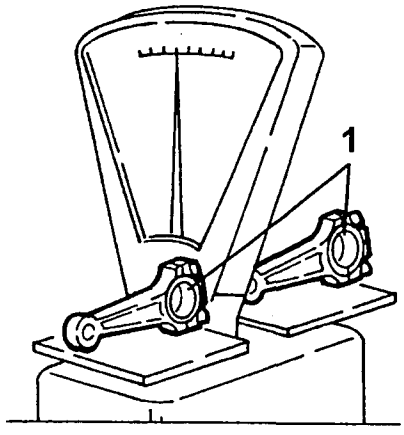
- Calculate the clearance between the rod journals and the corresponding half bearings and check that it is within the specified limits.

Clearance between rod journals and half bearings
0.03 ÷ 0.056 mm

Checking the connecting rods

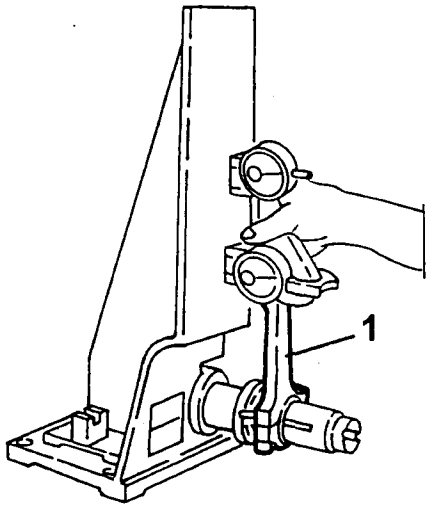
1. Check that the difference in weight between the connecting rods complete with half bearings, caps and screws is within the specified limits.

Difference in weight between connecting rods
≤ 5 g



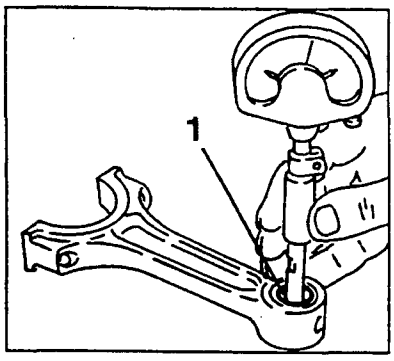
1. Check that the connecting rods are perpendicular using a reference plane as illustrated.

NOTE: If perpendicularity is not perfect, the connecting rod must be changed to avoid abnormal stresses when the engine is running, resulting in uneven wear of the piston and of the rod itself.



Checking the clearance between pins and small end bushings

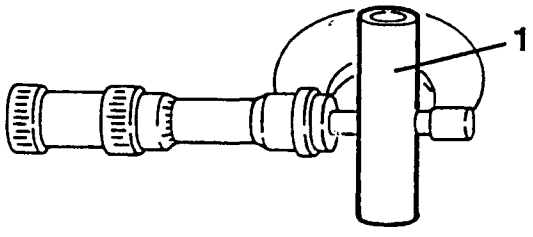
1. Measure the inside diameter of the small end bushing and check that it is within the specified limits, if not, change the bushing.



Inside diameter of small end bushing
20.006 ÷ 20.012 mm

1. Measure the outside diameter of the pins and check that it is within the specified limits.

Outside diameter of pins
19.996 ÷ 20.000 mm



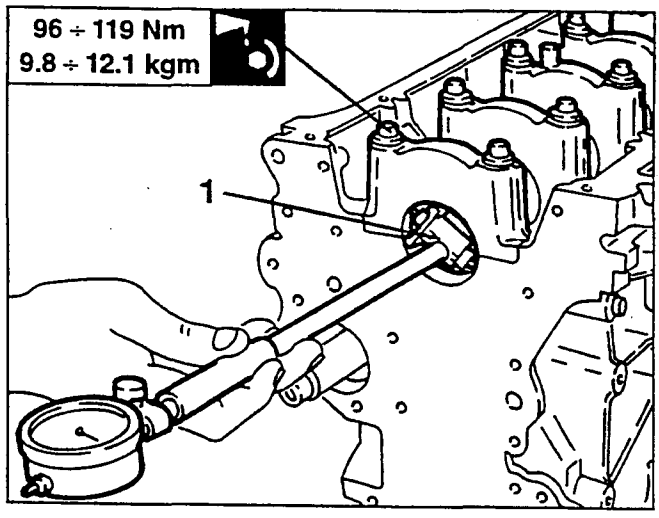
- Calculate the clearance between the pins and small end bushings and check that it is within the specified limits.

Clearance between pins and small end bushing
0.006 ÷ 0.016 mm

Checking the clearance between main bearing journals and half bearings

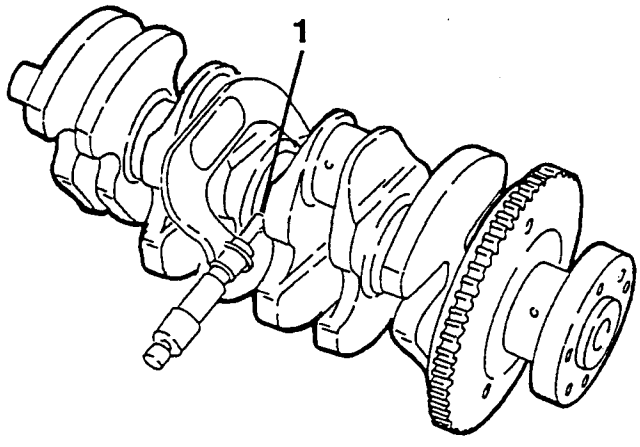
1. House the half bearings and fit the main bearings caps on the crankcase tightening the fastening screws to the specified torque.
2. Measure the diameter of the main bearings and check that it is within the specified limits.

Diameter of main bearings	
Class A (Red)	53.025 ÷ 53.046 mm
Class B (Blue)	53.019 ÷ 53.040 mm
Class C (Yellow)	53.013 ÷ 53.034 mm



1. Measure the diameter of the main bearing journals and check that it is within the specified limits.

Diameter of main bearing journals	
Class A	52.994 ÷ 53.000 mm
Class B	52.988 ÷ 52.994 mm
Class C	52.982 ÷ 52.988 mm



- Calculate the clearance between the main bearing journals and half bearings and check that it is within the specified limits.

Clearance between main bearing journals and half bearings
0.025 ÷ 0.052 mm

Checking the engine flywheel

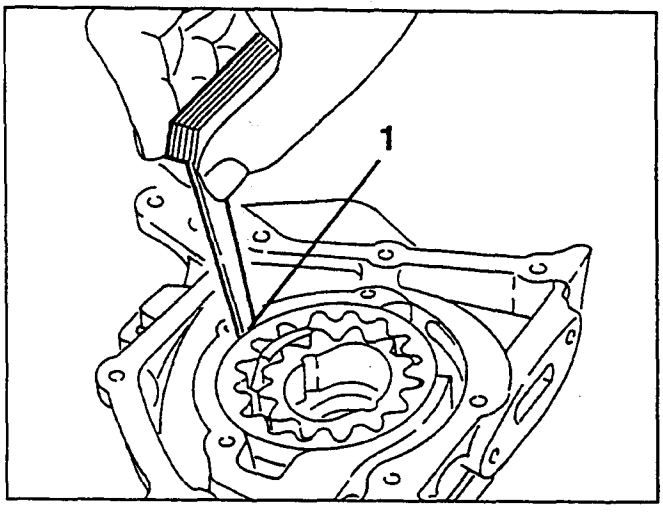
- Check that the ring gear teeth are not cracked or show signs of seizure; if they do, change the ring gear as described below:
- working under the press remove the old ring gear;
- accurately clean the contact surfaces of the new ring gear and of the flywheel;

• evenly heat the new ring gear to 80° ÷ 100° C and fit it on the flywheel: leave to cool naturally, do not force cool.

Checking the oil pump

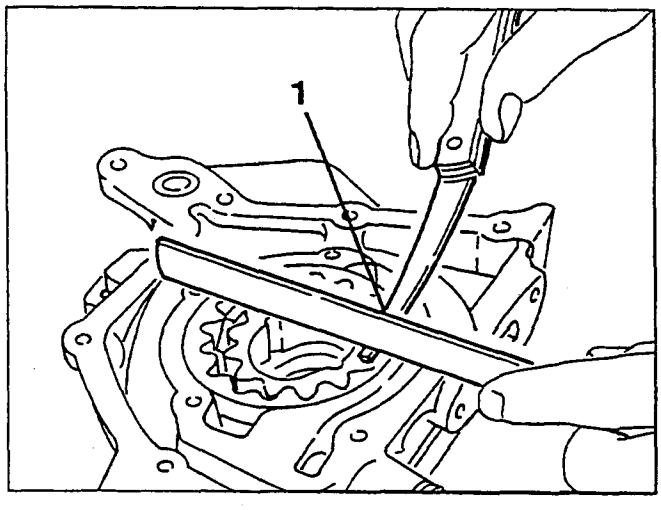
1. Check that the clearance between the pump casing and the driven gear is within the specified limit.

Clearance between pump casing and driven gear
0.080 ÷ 0.186 mm



1. Check that the clearance between the pump cover rest surface and the upper side of the gears is within the specified limit.

Clearance between pump cover rest surface and upper side of gears
0.025 ÷ 0.070 mm



WARNING: If the clearances measured are not within the specified limits, change the front crankcase cover with oil pump incorporated.

- Using a torque meter check the characteristic values of the engine oil pressure limiting valve control spring.

Control load Kg	Spring length mm
6.8	36

INSTRUCTIONS FOR RE-ASSEMBLY

For re-assembly operations reverse the sequence described for dis-assembly, unless otherwise indicated below.

- Check valve tightness when the cylinder head assembled (see "Turning the valve seats").

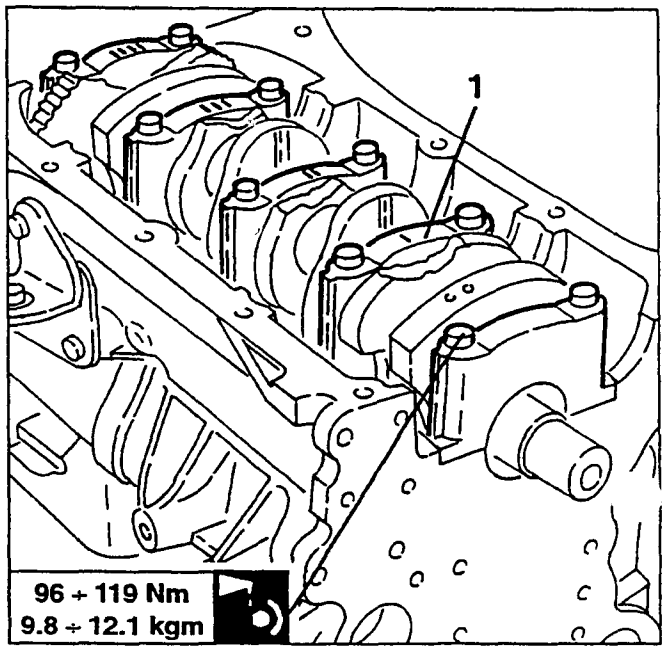
Reassembling the crankshaft

- Assemble the crankshaft on the crankcase complete with half bearings and half thrust rings.

Reassemble the half thrust rings with the grooved surfaces facing the crankshaft.

1. Assemble the main bearing caps complete with half bearings on the supports and tighten the fastening screws two or three times starting from the centre main bearing cap.

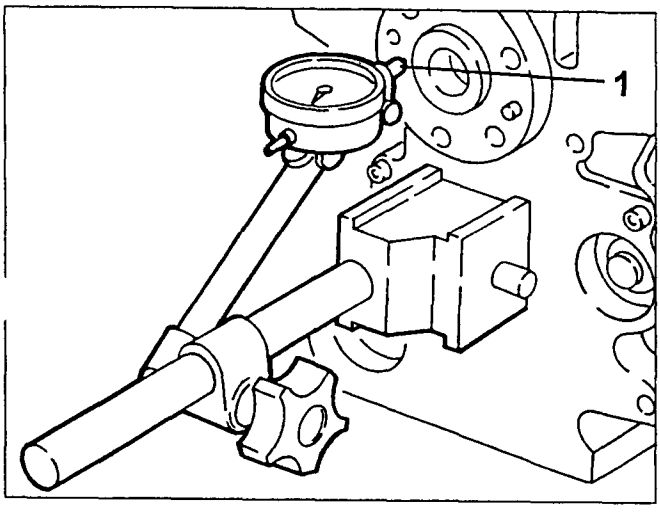
The position of each cap is given by a serie consecutive notches (from zero to four start...g from the front of the engine) etched on the caps themselves.



Checking the crankshaft end float

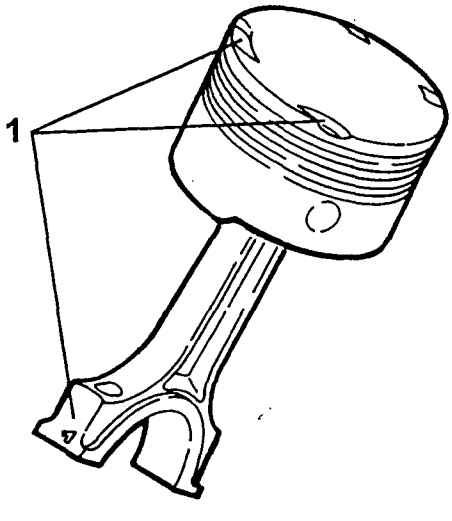
1. Using a dial gauge on a magnetic base, measure the crankshaft end float and check that it is within the specified limits.

Crankshaft end float
0.059 ÷ 0.221 mm



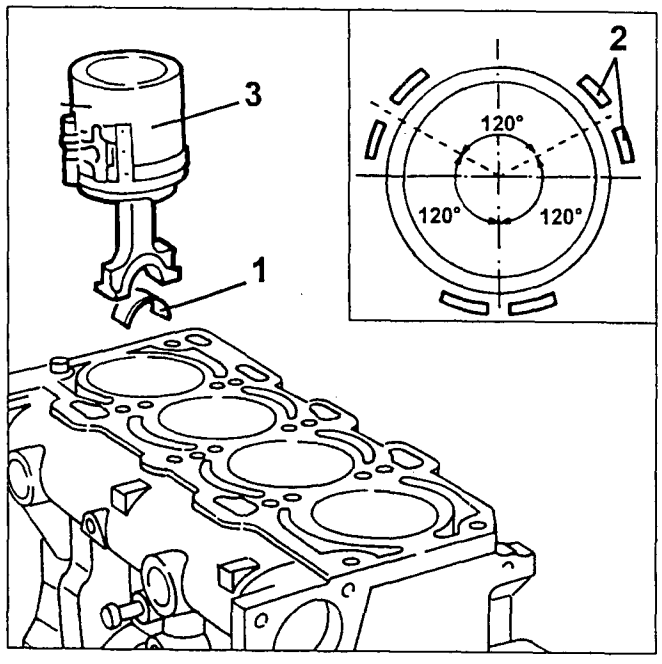
Refitting the pistons and connecting rods

1. Assemble the piston and connecting rod so that the number stamped on the connecting rod big end is on the same side as the large notches (for intake valves) on the piston crown.



- Turn the crankshaft until the connecting rod journals of the 1st and 4th cylinder are in the position corresponding to the B.D.C.
1. House the half bearings on the connecting rod big ends.
2. Insert the rings in the pistons with the cuts offset by 120° and the word TOP printed on them facing upwards.
3. Using a suitable tool, insert the pistons and connecting rods in the 1st and 4th cylinder.

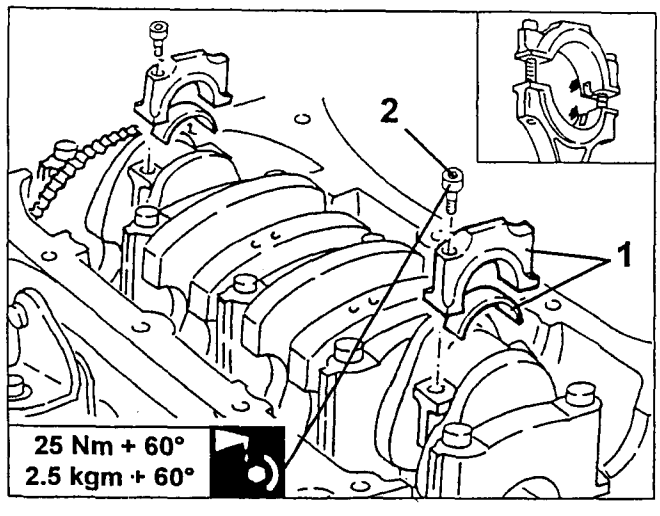
Assemble the connecting rod - piston unit in the crankcase directing the arrow stamped on the piston crown in the direction of rotation of the engine.



- Turn the crankcase 180°.
1. House the half bearings on the connecting rod caps, then assemble those of the 1st and 4th cylinder directing the safety notch towards the same side as the corresponding notch on the connecting rod big end.

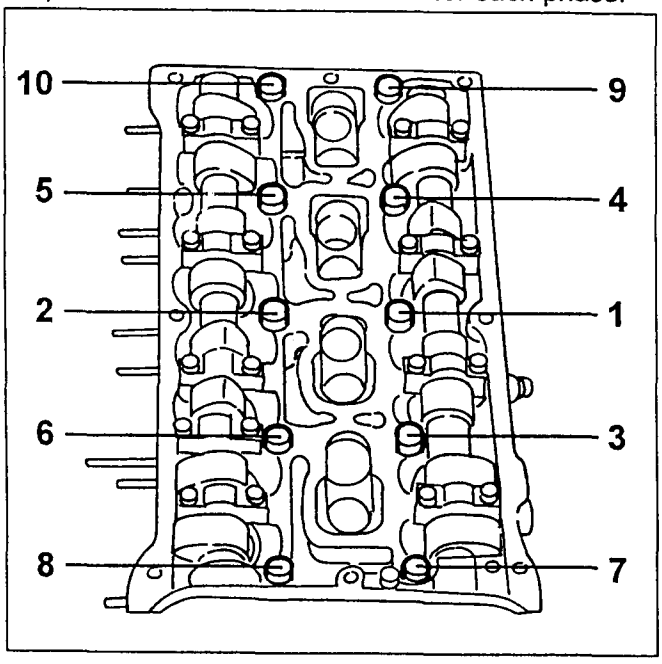
On one side, the connecting rod caps have the number of the cylinder to which they belong; when refitting, this number must always be on the same side as the one stamped on the connecting rod big end.

2. Tighten the connecting rod cap fastening screws in oil to the specified torque.
- In the same way, reassemble the pistons and connecting rods of the 2nd and 3rd cylinder.



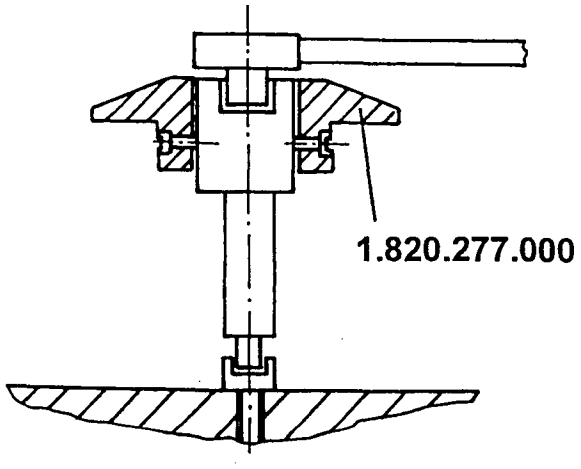
Reassembling the cylinder head

- Turn the crankshaft to take the pistons of the 1st and 4th cylinder to the T.D.C.
- Position the gasket on the crankcase, then the cylinder head.
- Tighten the cylinder head fastening screws as described below and bearing in mind that the tightening sequence is the one shown below for each phase.



Tightening procedure	
Set in all the screws to a torque of:	20 Nm (2.0 kgm)
Tighten the screws to the preliminary torque of:	40 Nm (4.1 kgm)
Turn all the screws with an angle of:	90° + 90° + 90°

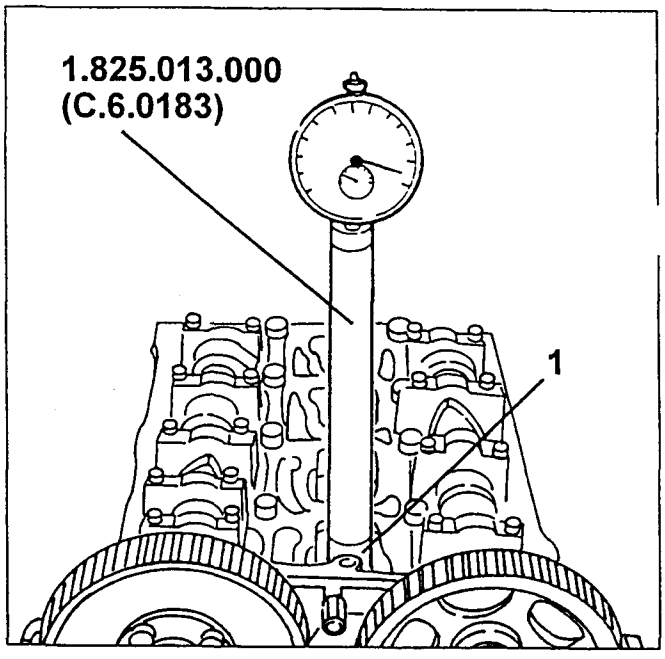
- For angle tightening use the graduated disk no. 1.820.277.000 as illustrated.



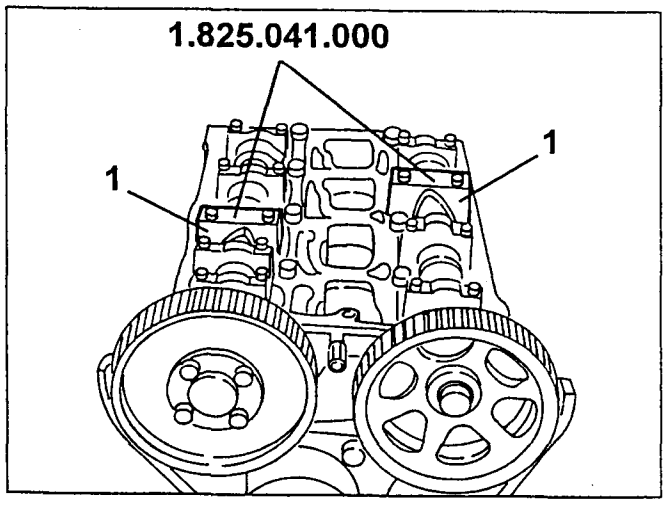
The gasket between the cylinder head and the crankcase is in aramidic fibre and cylinder head retightening is unnecessary throughout the life of the engine.

Assembling the timing gear drive belt and checking timing

- Assemble the camshaft toothed pulleys without tightening the fastening screws, the timing drive belt pulleys and the corresponding belt tensioners.
1. Install tool no. 1.825.013.000 (C.6.0183) fitted with a dial gauge in the seat of the centre spark plug of the 1st cylinder.
- Turn the crankshaft until the piston of the first cylinder reaches the T.D.C. in the bursting stroke.



1. Remove the camshaft caps illustrated and in their place insert templates no. 1.825.041.000 tightening the fastening screws to a maximum torque of **10 Nm (1 Kgm)** and checking for correct coupling with th cams.

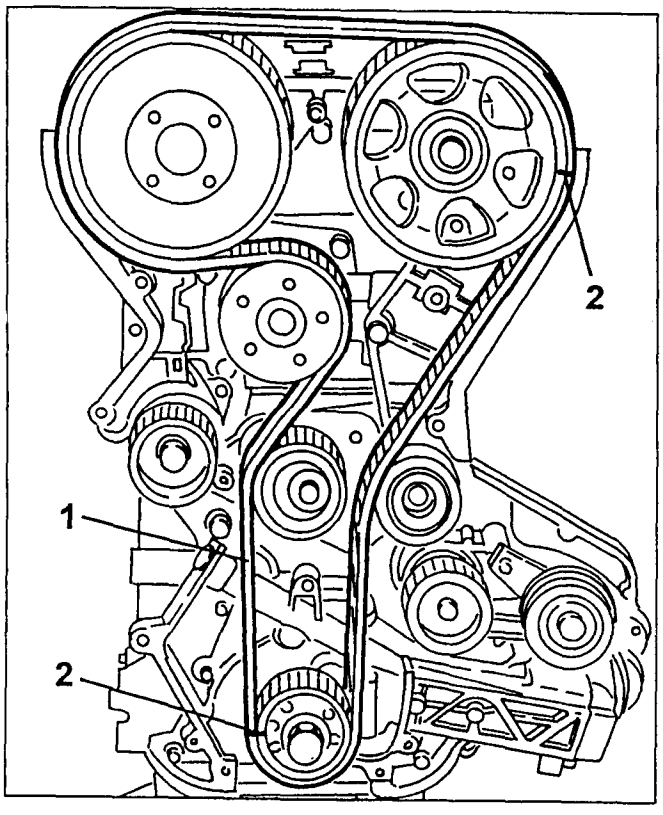


NOTE: For turning the camshafts, use tool no. 1.822.155.000 for the intake side and tools no. 1.822.146.000 and no. 1.822.156.000 for the exhaust side, to be applied on the corresponding pulleys.

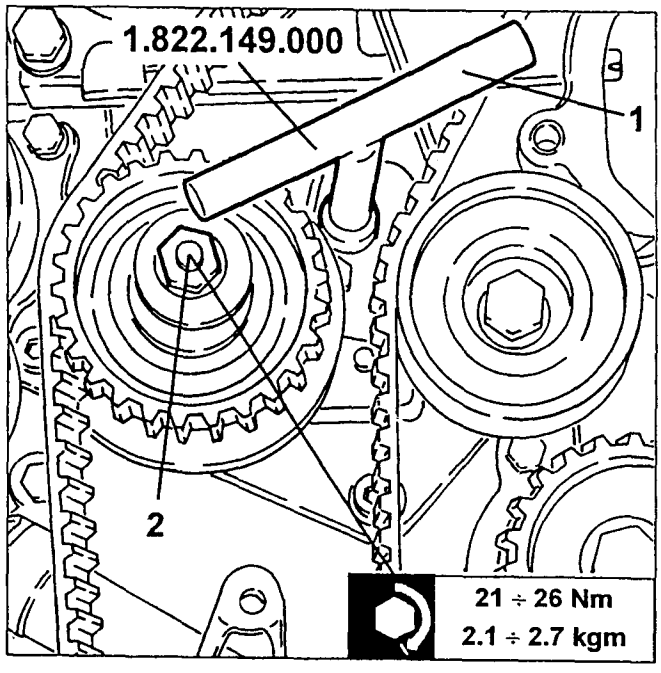
1. Assemble the timing gear drive belt taking care to check correct coupling with the pulley teeth, installing it in the following sequence:
- crankshaft pulley
- fixed tightening pulley
- exhaust side camshaft pulley
- intake side camshaft pulley
- automatic tensioner pulley
- coolant fluid pump pulley

2. The notches painted on the belt must coincide with the indexes made on the crankshaft pulley and on the exhaust side camshaft pulley.

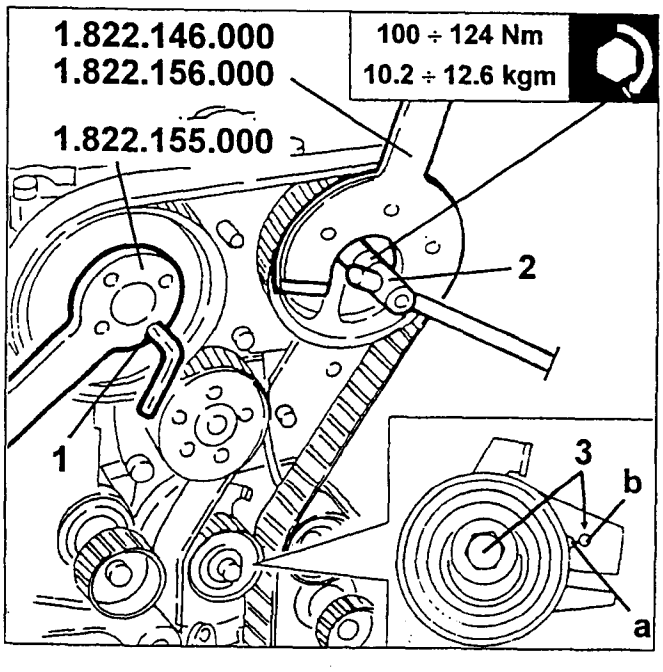
WARNING:
When assembling the toothed belt, to avoid damaging the structure of the fibres that form it, never cause sharp bends.
For correct assembly the belt has an arrow on it which shows the direction of rotation of the engine.



1. Using tool no. 1.822.149.000 as illustrated, tension the belt to the maximum.
2. Tighten the nut fastening the automatic camshaft belt tensioner.



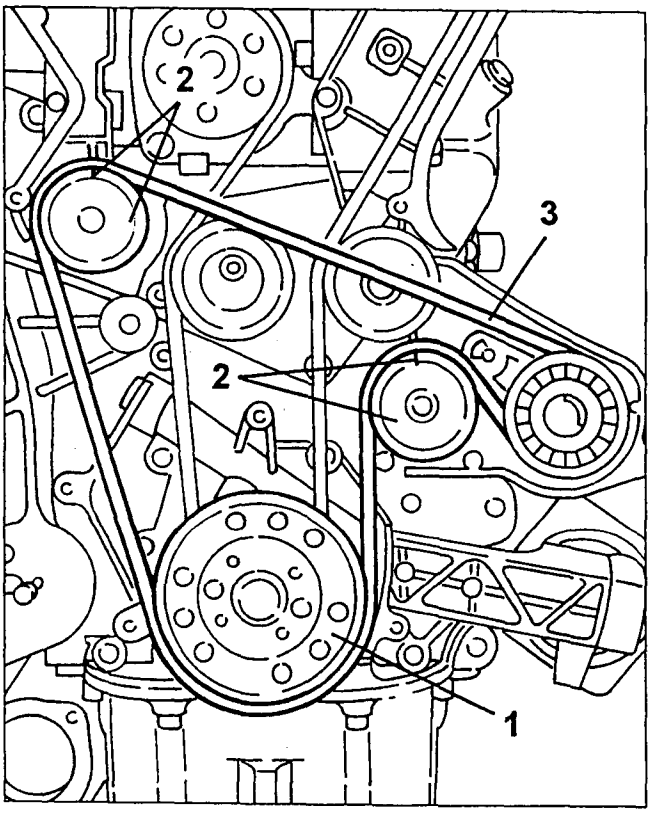
1. Using tool no. 1.822.155.000, tighten the screws fastening the intake side camshaft drive pulley.
2. Using tool no. 1.822.146.000 complete with tool no. 1.822.156.000, tighten the screw fastening the exhaust side camshaft drive pulley.
- Remove the two templates from the camshafts and turn the crankshaft twice in its direction of rotation until the piston of the 1st cylinder reaches the T.D.C. in the bursting stroke.
3. Release the nut fastening the automatic tensioner, then using tool no. 1.822.149.000, move the mobile index (a) to coincide with the reference hole (b).
- Tighten the automatic tensioner fastening nut to the specified torque.



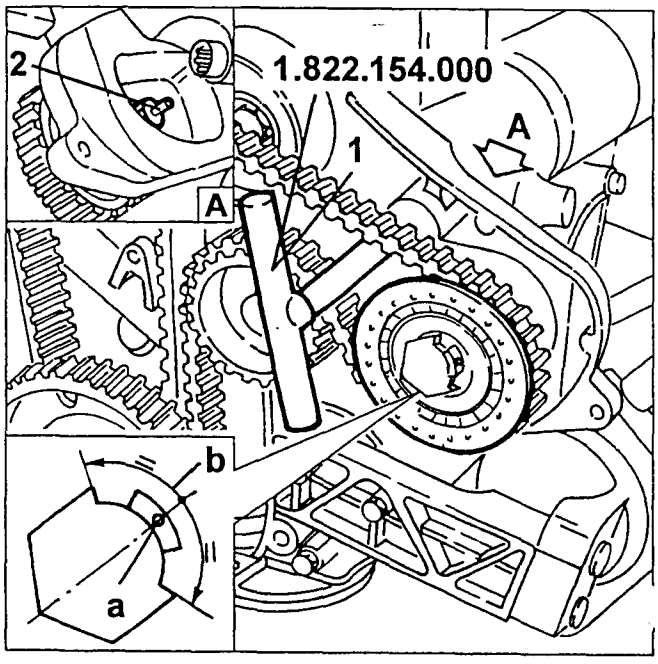
Assembly of counter-rotating shaft drive belt and checking valve gear timing

1. Move the piston of cylinder no. 1 to the T.D.C. in the bursting stroke, then assemble the counter-rotating shaft drive pulley.
2. Position the counter-rotating shaft pulleys so that the notches on them correspond with the reliefs on the rear covers (tooth at the side of the reference notch on the vertical).
3. Assemble the counter-rotating shaft drive belt checking correct mating of the teeth on all the toothed pulleys.

WARNING:
When assembling the toothed belt, to avoid damaging the structure of the fibres that form it, never cause sharp bends.



1. Using tool no. 1.822.154.000, as illustrated, tension the counter-rotating shaft drive belt until the reference hole (a) on the tensioner reaches the centre of the rotation sector (b).
2. Tighten the nut fastening the counter-rotating shaft automatic tensioner.



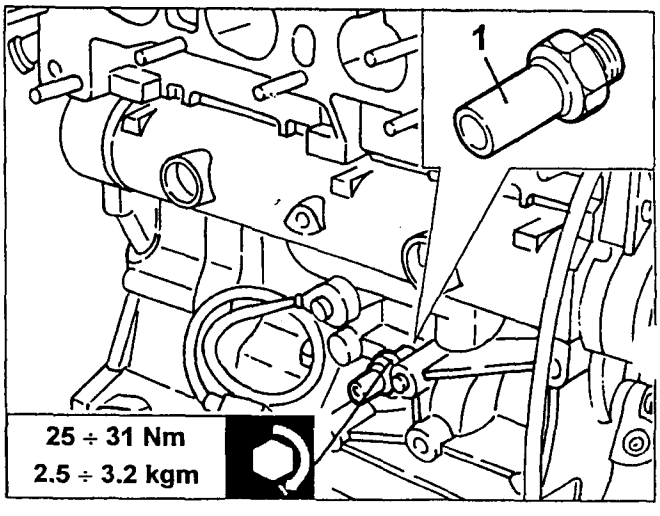
- Turn the crankshaft twice in its direction of rotation until the piston of the 1st cylinder reaches the T.D.C. in the bursting stroke and check that all the timing references correspond.

CHECKING LUBRICATION CIRCUIT ELECTRIC COMPONENTS

ENGINE OIL MINIMUM PRESSURE WARNING LIGHT SENSOR

1. Check the setting of the engine oil minimum pressure warning light sensor. If the ratings are not as specified, replace the sensor.

Contact opening/closing pressure
0.2 ÷ 0.5 bar



30

TRANSMISSION AND DRIVELINE

3 documents - 90 factory pages

INDEX

CLUTCH COMMAND

- Clutch pump 1
- Clutch pedal.....1

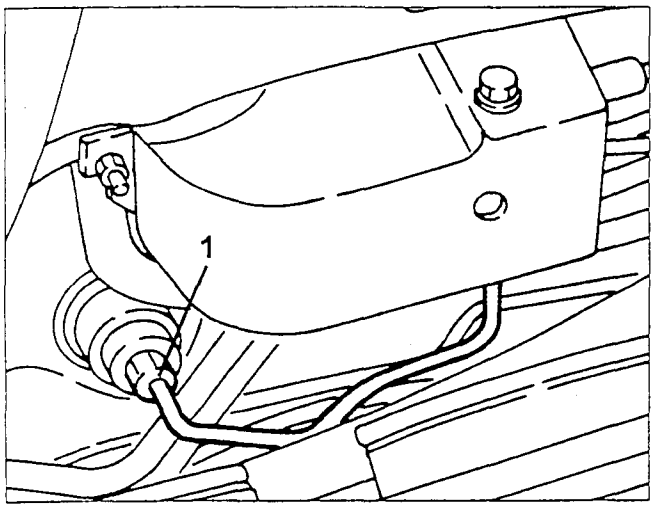
- Clutch pump ('98 Models) 2
- Clutch pedal ('98 Models).....2

For the information not given here, see the corresponding groups of "145 - 146 - Base Manual".

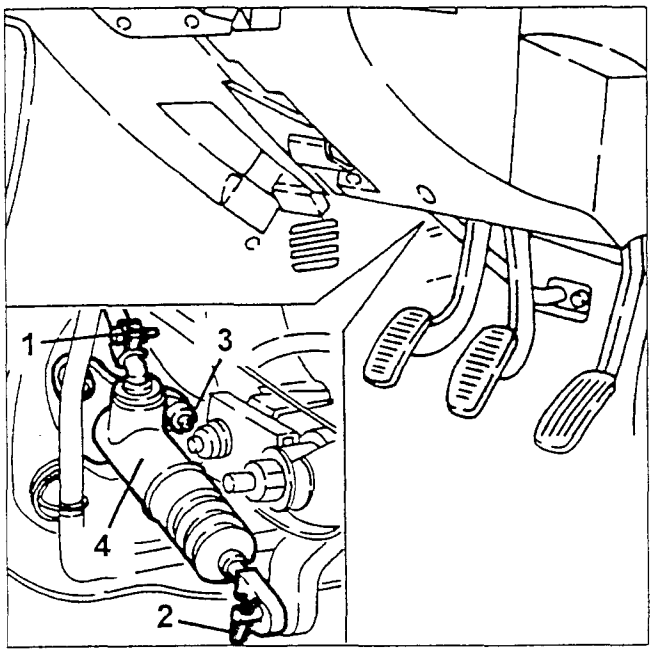
CLUTCH PUMP

REMOVAL/REFITTING

- Empty the brake/clutch fluid reservoir with a suitable syringe.
- Remove the air intake manifold (see specific paragraph).
1. From inside the engine compartment, disconnect the pipe fitting from the clutch pump.



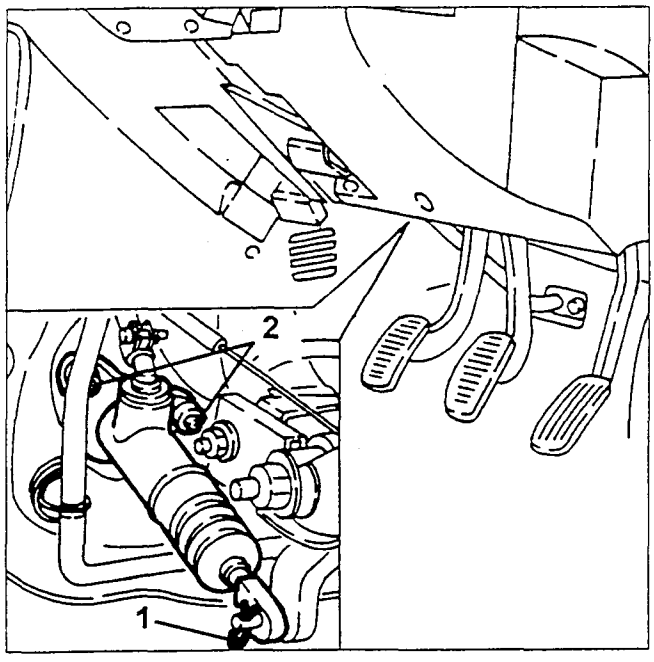
1. From inside the passenger compartment, disconnect the reservoir fluid feed pipe from the clutch pump.
2. Remove the split pin.
3. Remove the two clutch pump fastening nuts.
4. Remove the clutch pump by releasing it from the pedal pin.



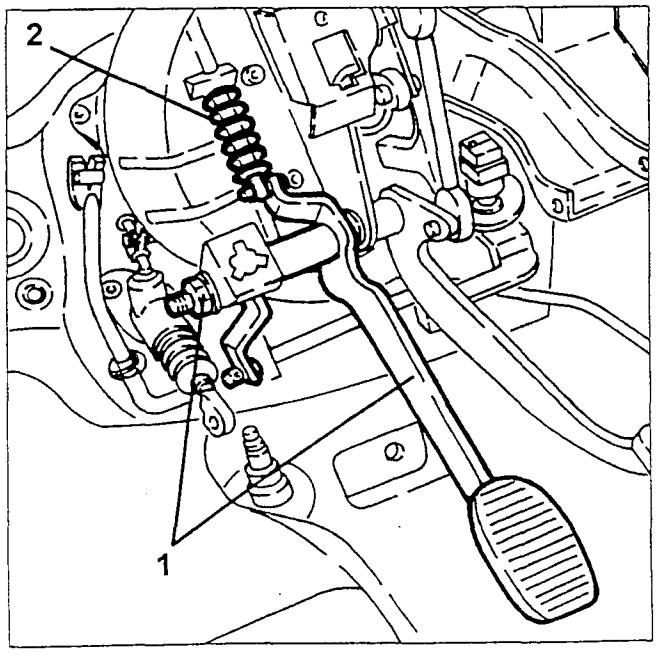
CLUTCH PEDAL

REMOVAL/REFITTING

- Remove the steering column (see ASSEMBLY 41).
1. Remove the clutch pump retaining split pin from the pedal pin.
2. Loosen the two clutch pump fastening nuts and release the pump from the pedal pin.



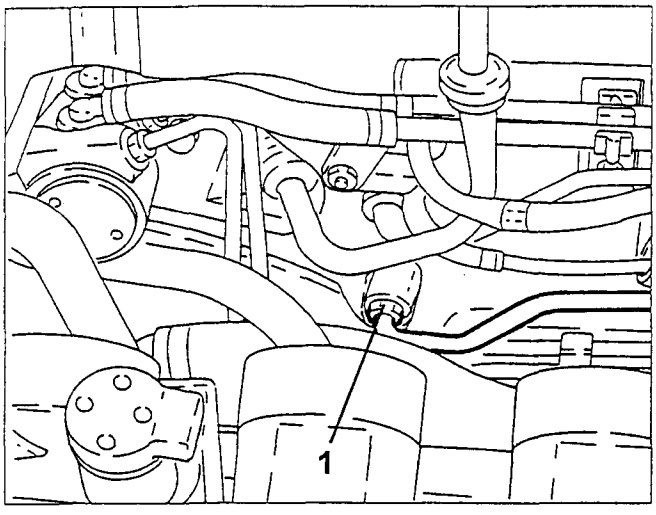
- Loosen the two valve bracket fastening screws.
1. Loosen the fastening bolt and remove the clutch pedal.
2. Take the clutch pedal return spring.
- At the stand, remove the clutch pedal bushing, if required.



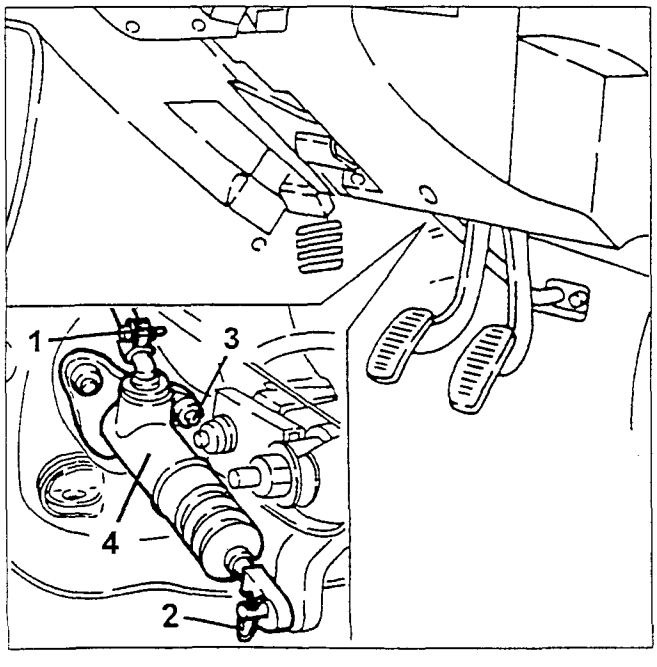
CLUTCH PUMP ('98 MODELS)

REMOVAL/REFITTING

- Empty the brake/clutch fluid reservoir with a suitable syringe.
- Remove the modular air intake manifold (see specific paragraph).
1. From inside the engine compartment, disconnect the pipe fitting from the clutch pump.



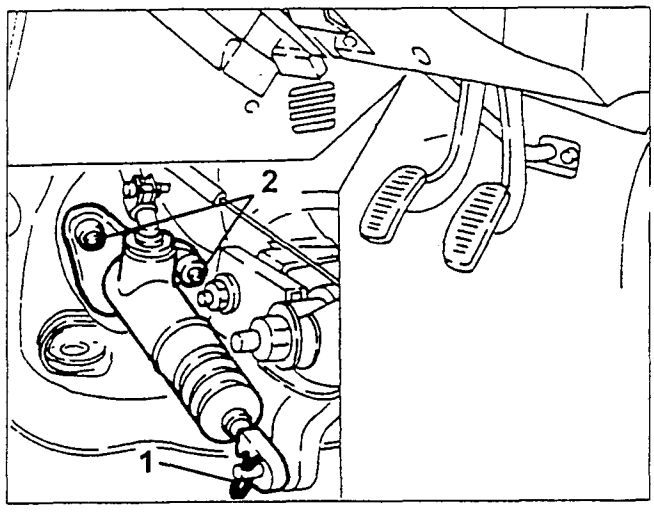
- Remove the accelerator pedal (see specific paragraph).
1. From inside the passenger compartment, disconnect the reservoir feed pump from the clutch pump.
2. Remove the split pin.
3. Remove the two clutch pump fastening nuts.
4. Remove the clutch pump by releasing it from the pedal pin.



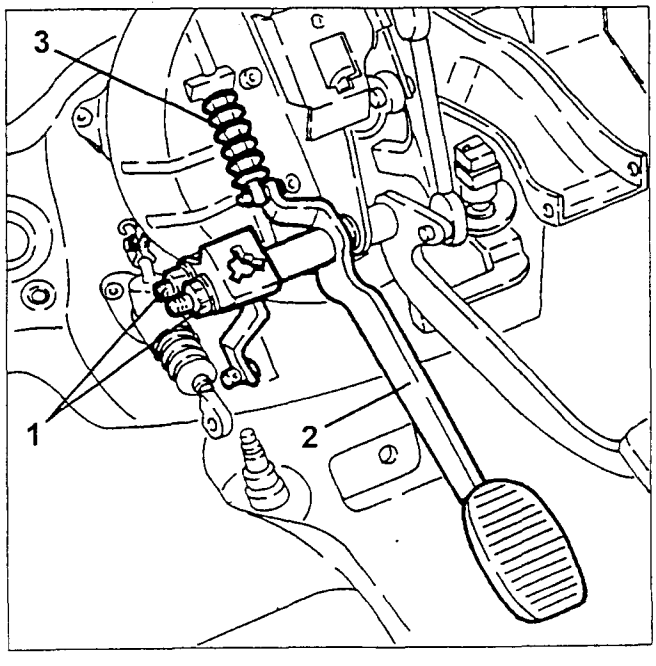
CLUTCH PEDAL ('98 MODELS)

REMOVAL/REFITTING

- Loosen the fastening screw and release the steering column from the power steering unit pinion.
- Remove the accelerator pedal (see specific paragraph).
1. Remove the clutch pump split pin from the respective pedal pin.
2. Loosen the two clutch pump fastening nuts and release it from the respective pedal pin.



- Loosen the two valve bracket fastening screws.
1. Loosen the nuts and remove the clutch pedal bracket.
2. Release the screw just enough to remove the clutch pedal.
3. Take the clutch pedal return spring.
- At the stand, remove the clutch pedal bushing, if required.



CLUTCH

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- Clutch plate and pressure plate 1370 T. SPARK 16V with gearbox C.513.5 from chassis n° 18

CLUTCH COMMAND 1370 1598 1747 T. SPARK 16V

- Clutch pump . . . . . (*)
- Clutch pedal . . . . . (*)
- Clutch control cylinder . . . . . (▲)
- Bleeding air from the hydraulic system . . . . . (*)
- Minimum brake - clutch fluid level sensor . . . . . (▲)

(*): See engine 1929 TD

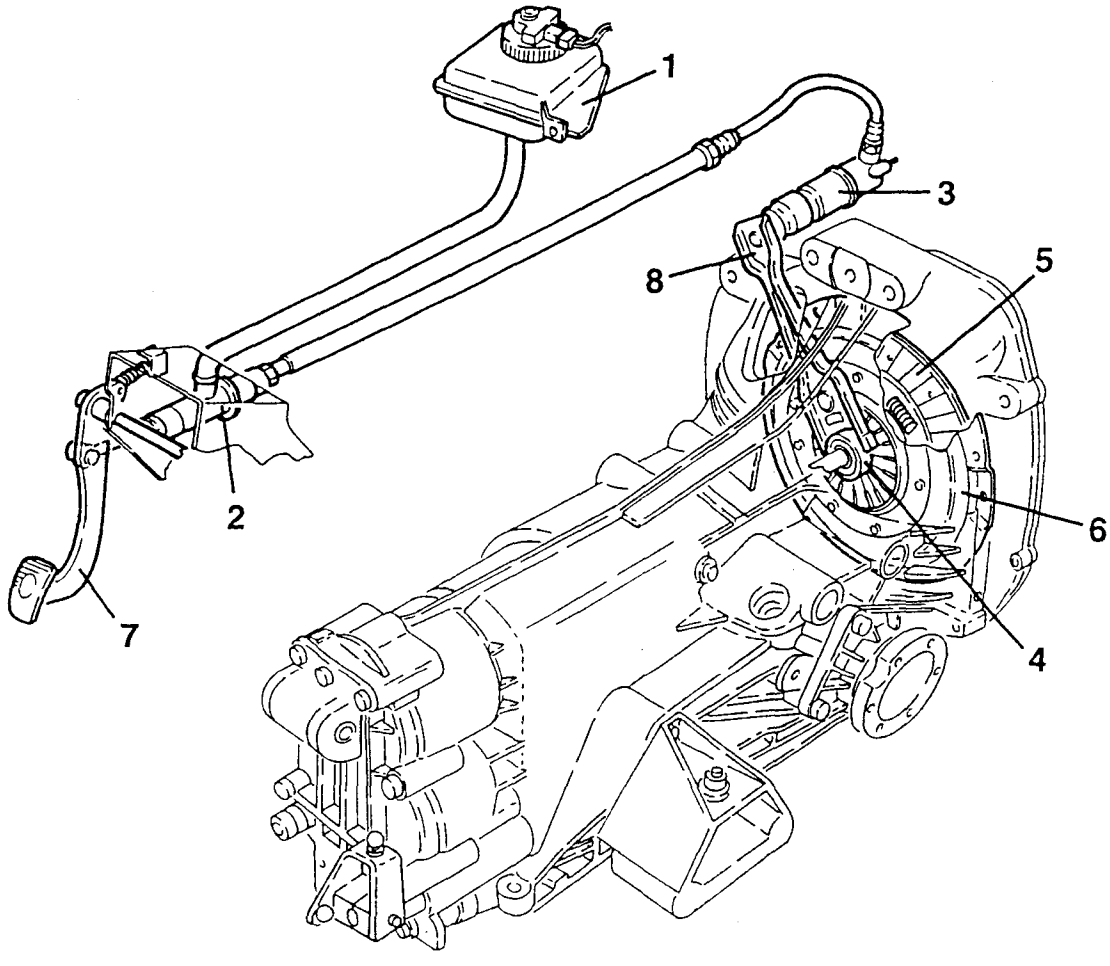
(▲): See engine 1970 T. SPARK 16V

DESCRIPTION

The clutch adopted is a dry single-plate type with diagraphm pressure plate springs.
The clutch is released through a hydraulic device formed of a reservoir (1) shared with the braking system, a pump (2) fastened to the pedal unit, a control cylinder (3) fastened to the rear engine cover and a thrust bearing (4).
The pedal-operated pump transmits the fluid pressure increase through a hose to the control cylinder.
A prod on the control cylinder acts on the clutch release control fork which moves the self-centering thrust bearing overcoming the action of the diaphragm pressure plate springs.

In addition to reducing the effort exerted on the pedal, the adoption of the hydraulic clutch release device makes it possible to:
- increase reliability of the control compared with the conventional mechanical system.
- improve progression, due to the damping of the hydraulic system during disengagement which prevents jerking, particularly when the torque transmitted is high.
- achieve greater operating precision, as this device enables constant height adjustment of the clutch pedal.
- increase driving comfort because of the reduction of the level of vibrations transmitted from the engine, due to the damping effect of the oil.

In order to comply with current regulations on the subject of environmental pollution, ecological (asbestos-free) clutch plate friction gaskets have been adopted.

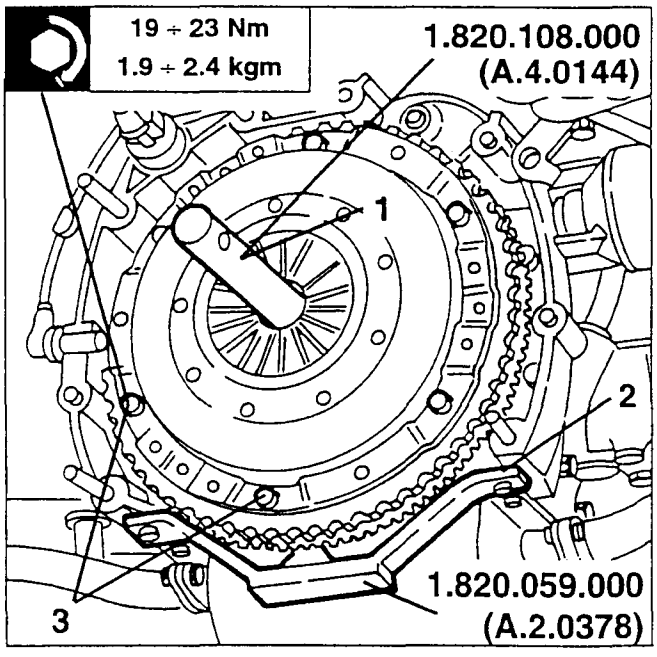


1. *Brake-clutch system reservoir*
2. *Clutch pump*
3. *Clutch control cylinder*
4. *Thrust bearing*
5. *Clutch plate*
6. *Pressure plate*
7. *Clutch control pedal*
8. *Fork*

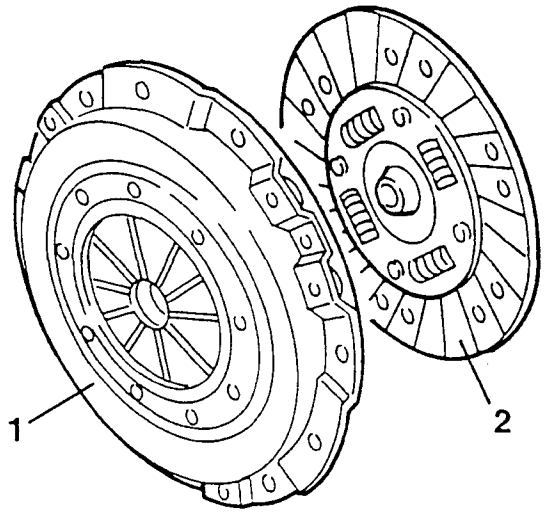
CLUTCH PLATE AND PRESSURE PLATE

REMOVAL/REFITTING

- Remove the gearbox-differential unit (see GROUP 21).
1. Install the flywheel locking tool N° 1.820.059.000 (A.2.0378).
2. Install tool N° 1.820.108.000 (A.4.0144) in the clutch plate hub.
3. Slacken the screws fastening the pressure plate to the engine flywheel.



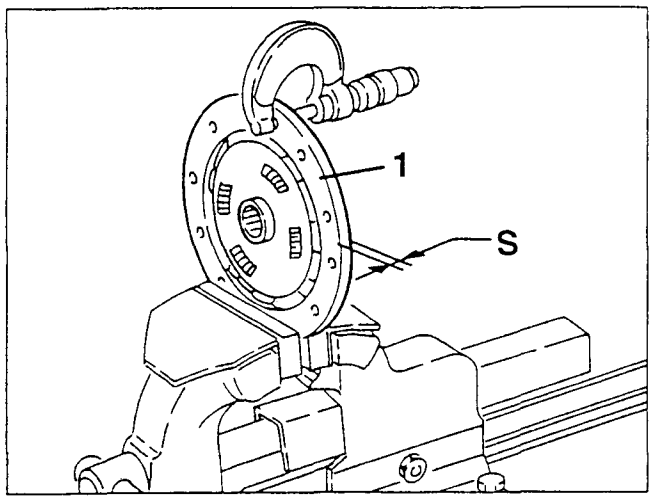
1. Remove the pressure plate.
2. Remove the clutch plate.



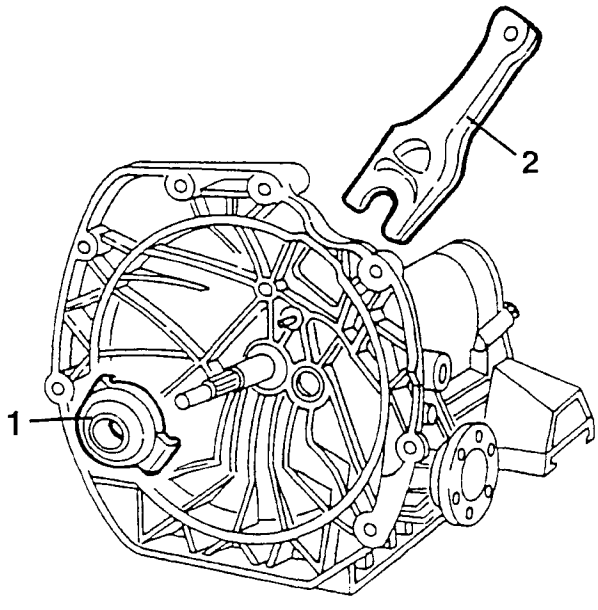
CHECKS AND INSPECTIONS

1. Check the gaskets for even wear and that the thickness of the clutch plate is not below the minimum specified.

Thickness "S" of clutch plate (mm)	
New	At the wear limit
7.7	6.1



- Check that there are no signs of burning or vitrification, that fastening is correct and that the springs are intact.
Check that the clutch plate hub is intact, runs smoothly and that there is no excessive play on the drive shaft coupling.
- Check the working surfaces of the flywheel and pressure plate for signs of overheating, uneven wear, nicks or missing parts.
1. Also check the thrust bearing for noise, excessive play and freedom of movement on the drive shaft.
If necessary, change any worn parts.
2. Check the clutch control fork for cracks, distorsion and excessive wear in the working areas. Change it if necessary.

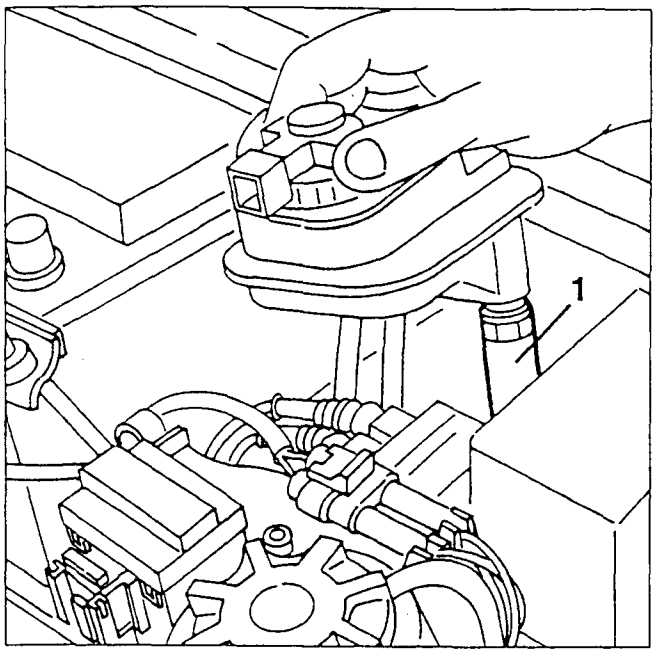


CLUTCH PUMP

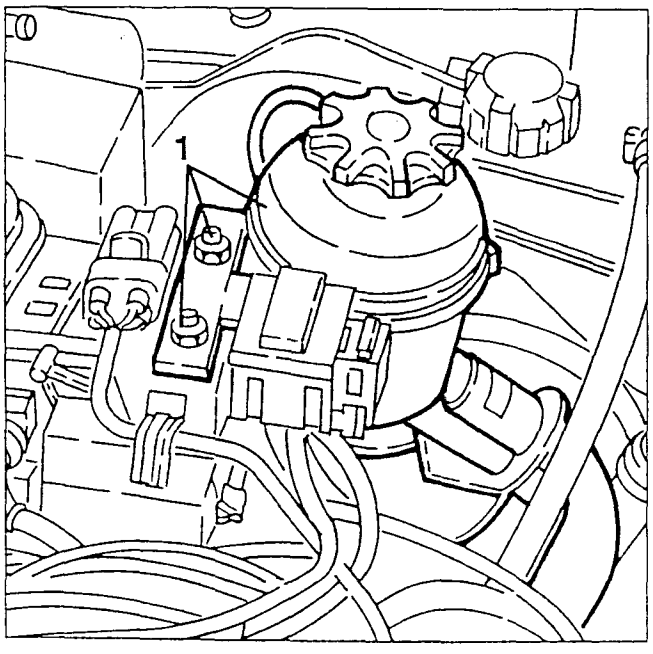
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Empty the brake - clutch fluid reservoir using a suitable syringe.

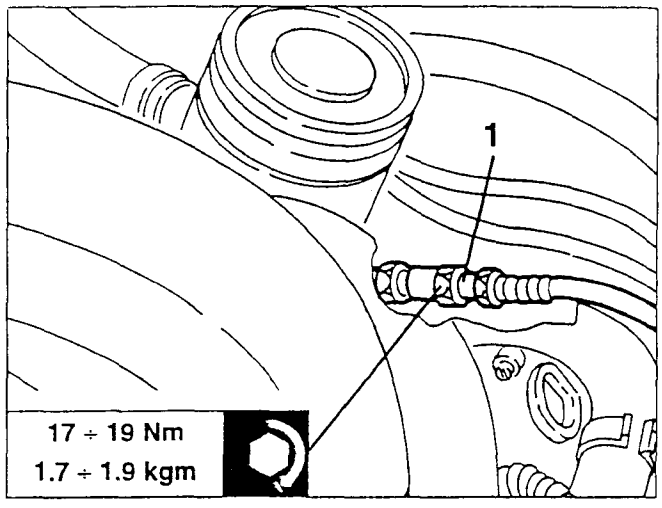
1. Slacken the fastening screw and raise the brake - clutch fluid reservoir just enough to disconnect the connection pipe to the clutch pump from it.



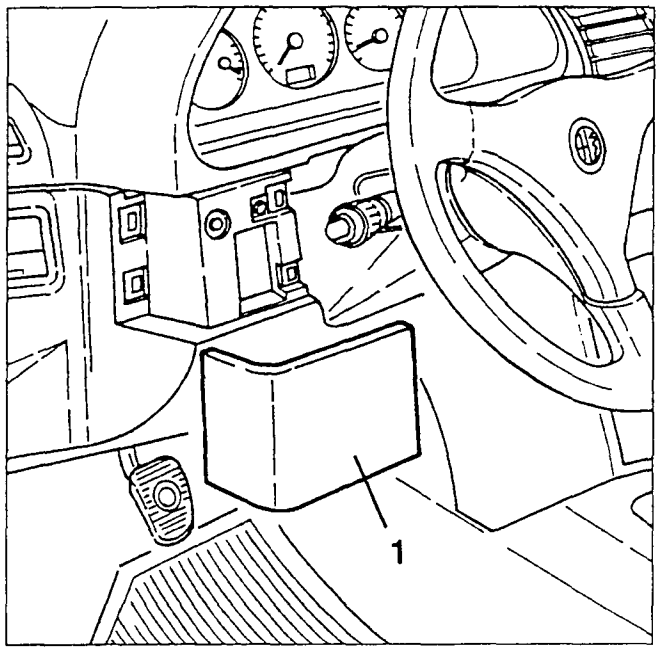
1. Slacken the two fastening nuts and move the power steering tank sideways without disconnecting the hoses.



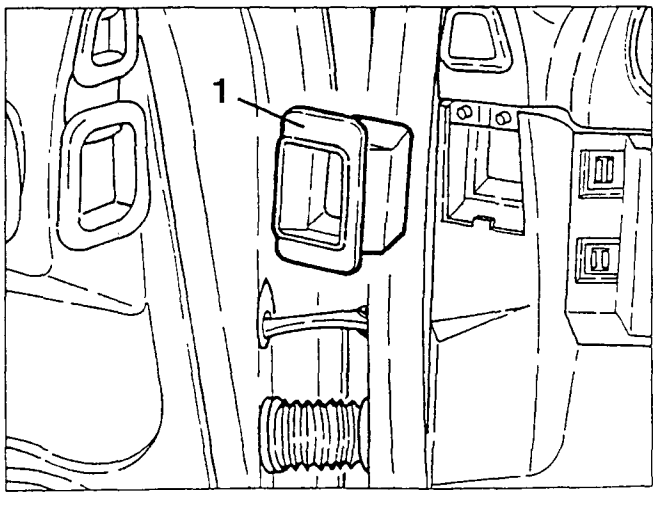
1. Disconnect the intermediate fitting of the hose connecting the pump to the clutch cylinder and freethe hoses in question of their hose clamps.



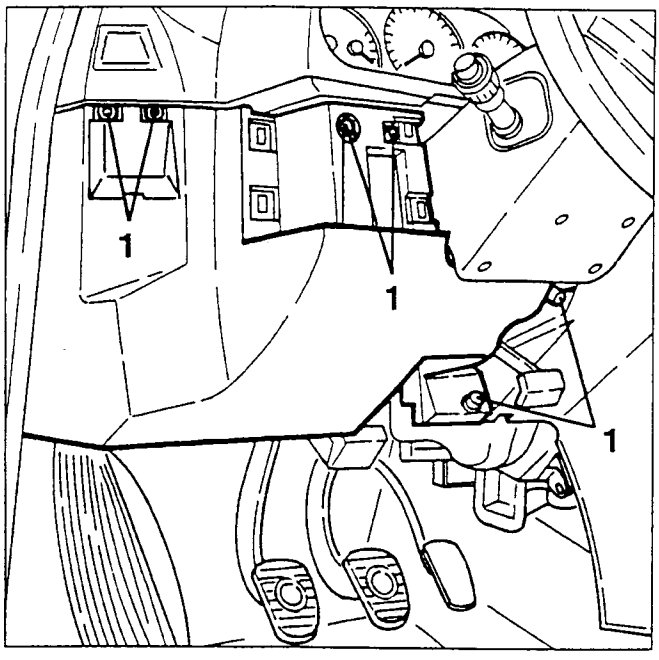
1. Working from the passenger compartment, slacken and remove the left dashboard trim.



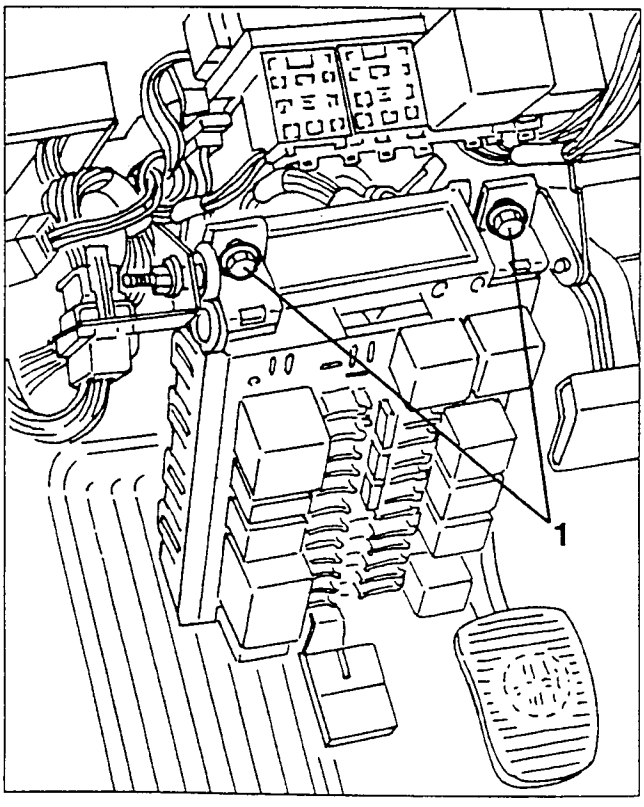
1. Remove the driver's air vent from the dashboard.



1. Slacken the six fastening screws and remove the fusebox cover.

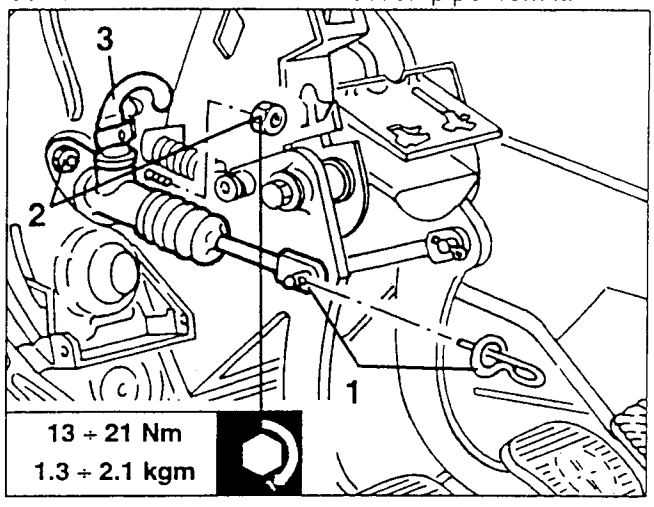


1. Slacken the fusebox fastening nuts and move it sideways.
- Slacken the fasteners of the fusebox support bracket and move it sideways.



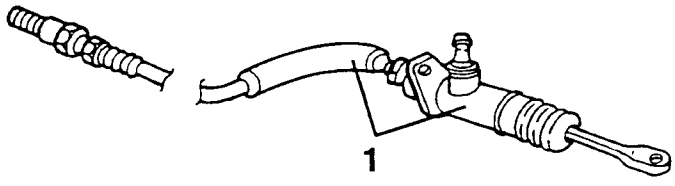
1. Remove the safety catch and disconnect the clutch pump from the pedal.
2. Slacken the two clutch pump fastening nuts.

3. Move the clutch pump backwards enough to disconnect the reservoir connection pipe from it.



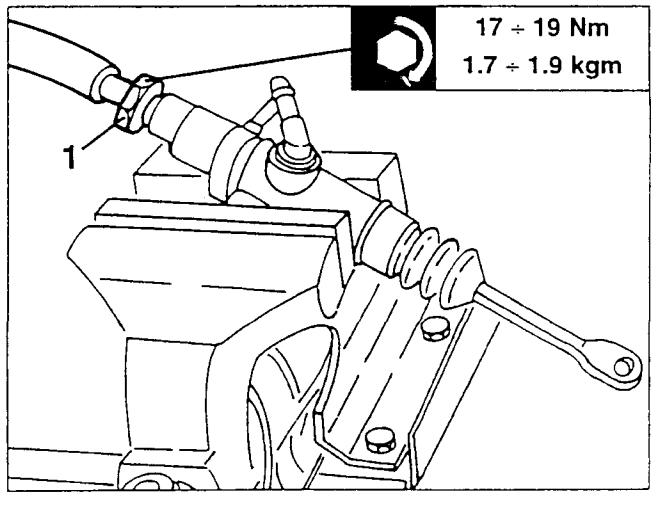
1. Remove the clutch pump complete with connection pipe to the clutch cylinder.

When refitting the pump bleed the air from the system (see specific paragraph).

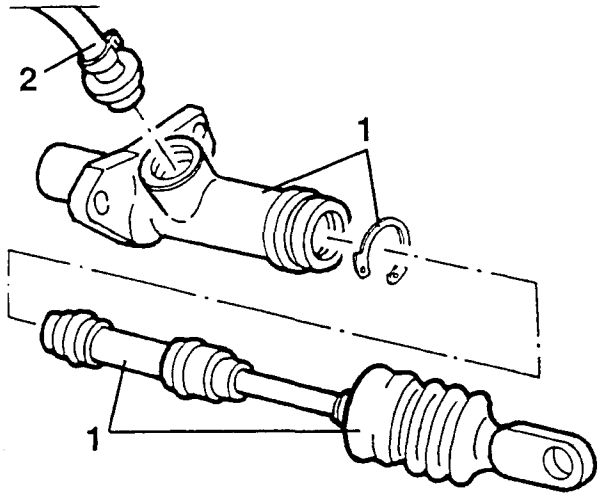


DIS-ASSEMBLY/RE-ASSEMBLY

- Position the clutch pump in a vice with protective jaws.
1. Slacken and remove the clutch cylinder connection pipe from the pump.



1. Remove the protection boot, remove the retainer ring and withdraw the piston from the pump body.
2. Remove the seal with fluid inlet connection from the reservoir.



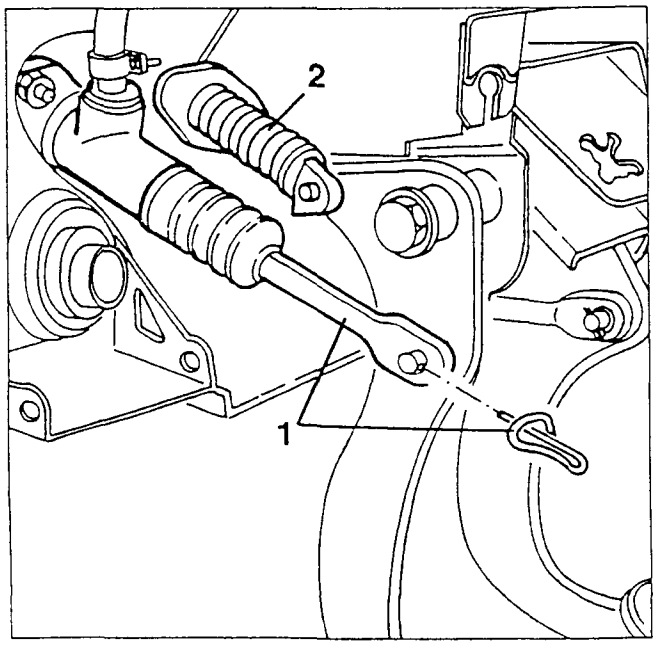
CHECKS AND INSPECTIONS

- Check that the piston and the inner surface of the cylinder show no signs of marking, scoring, scraping or rust. If the cylinder body reveals signs of scraping or seizure, change the pump assembly.

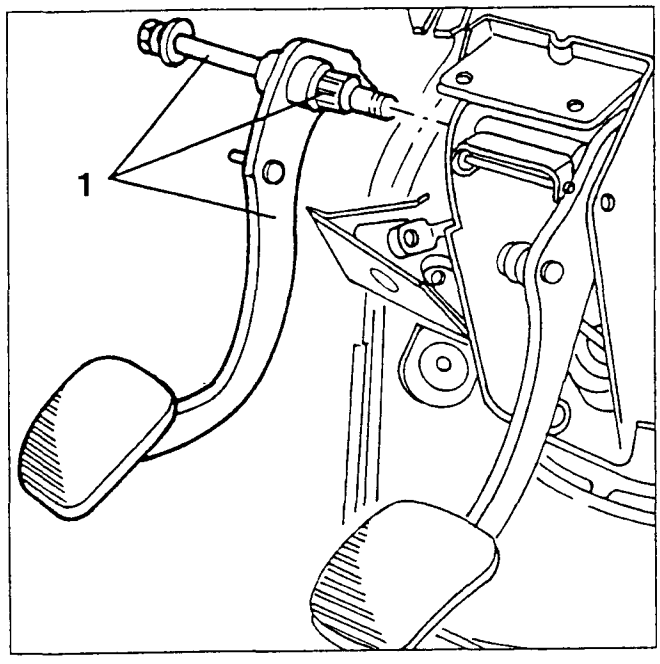
CLUTCH PEDAL

REMOVAL/REFITTING

1. Remove the safety catch and disconnect the clutch pump from the pedal.
2. Remove the return spring.



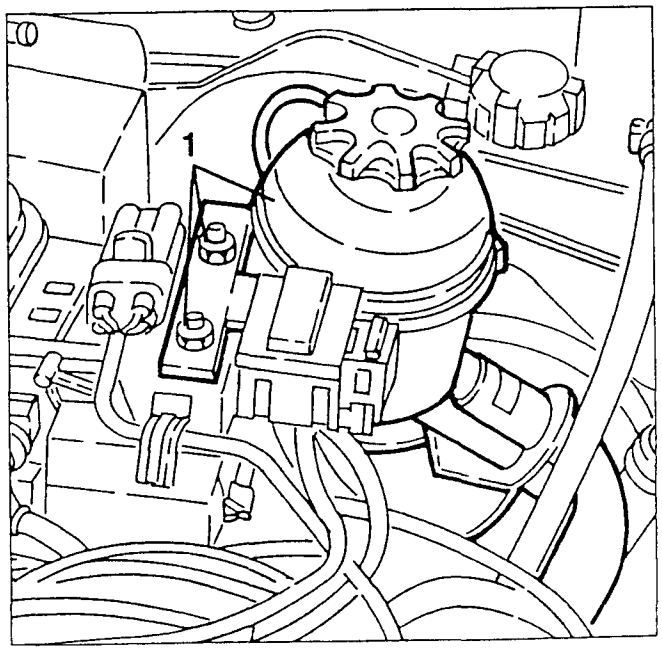
1. Slacken the fastening bolt and withdraw the clutch pedal complete with bush



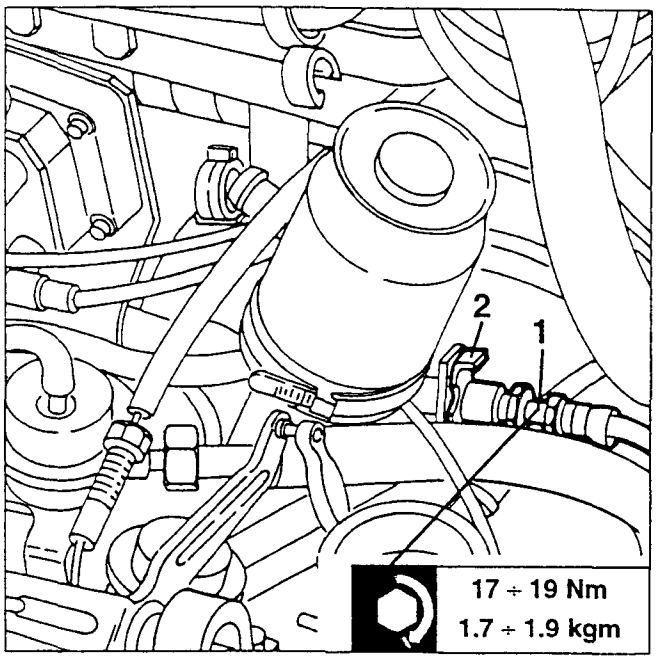
CLUTCH CONTROL CYLINDER

REMOVAL/REFITTING

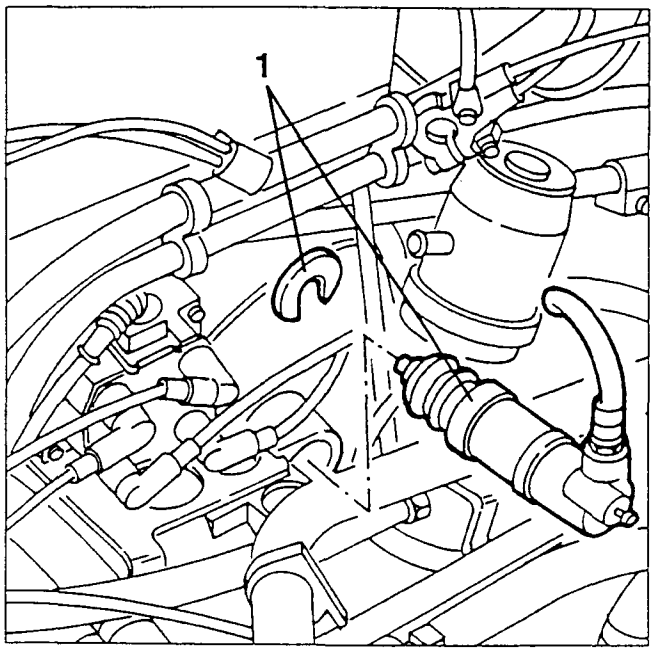
- Remove the intake box (see GROUP 10).
- Empty the brake - clutch fluid reservoir, using a suitable syringe.
1. Slacken the two fastening nuts and move the power steering tank sideways without removing the hoses.



1. Disconnect the intermediate union of the hose connecting the pump to the clutch cylinder.
2. Remove the pipe fastening plate.



1. Remove the retainer ring and remove the clutch control cylinder.

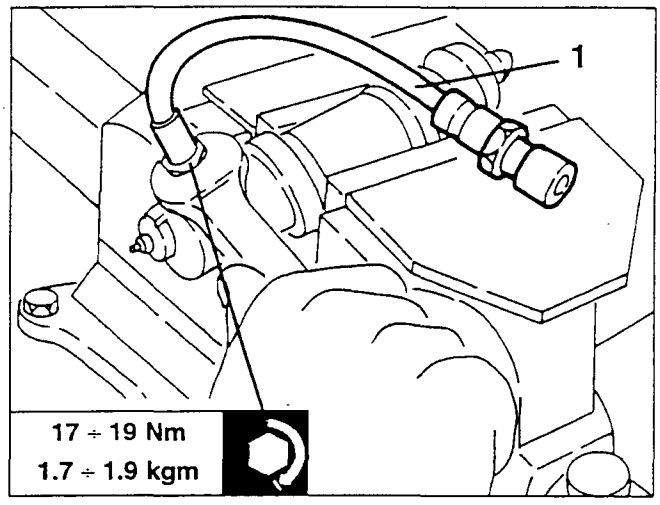


When refitting the cylinder bleed the air from the system (see specific paragraph).

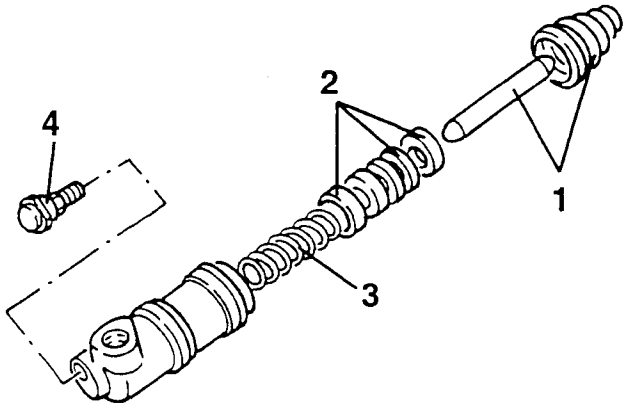
DIS-ASSEMBLY/RE-ASSEMBLY

- Place the clutch control cylinder in a vice with protective jaws.

1. Slacken and remove the connection pipe to the clutch pump from the clutch control cylinder.

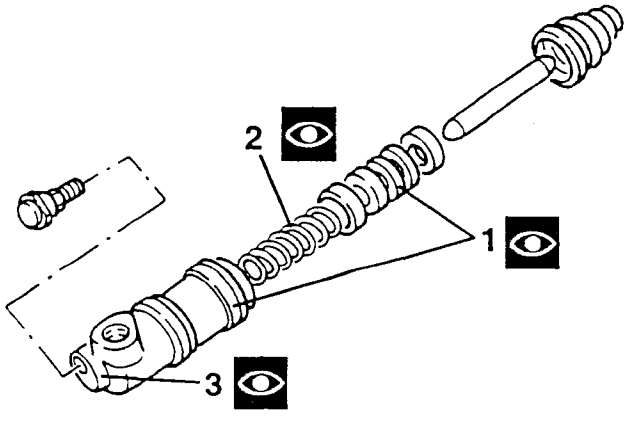


1. Withdraw the prod with its boot from the control cylinder, then separate them.
2. Remove the piston and the corresponding seals.
3. Remove the spring.
4. *Only if necessary, remove the bleed screw from the control cylinder body.*



CHECKS AND INSPECTIONS

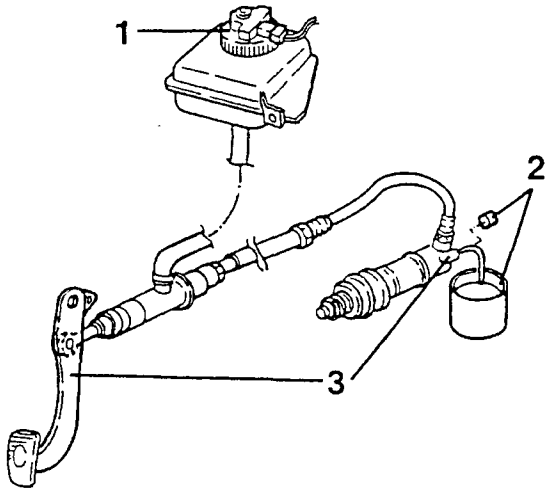
1. Check the piston and inner cylinder surface for signs of scoring and traces of rust.
2. Check that the spring is intact.
3. Check that the air bleeding outlet is not clogged.



BLEEDING AIR FROM THE HYDRAULIC SYSTEM

CAUTION:
Never re-use the hydraulic fluid resulting from the bleeding operation.

1. Remove the cap on the clutch and brake fluid supply reservoir and if necessary top up the level with the specified fluid.
2. Remove the protective cap from the relief screw on the cylinder and push a hose onto the screw with the other end in a transparent container full of the same hydraulic fluid as the circuit.
3. Slacken the relief screw while pressing the clutch pedal allowing it to return slowly; repeat this operation until all the air trapped in the circuit has been eliminated.
- Then with the clutch pedal completely depressed, tighten the relief screw, remove the hose and refit the protective cap.



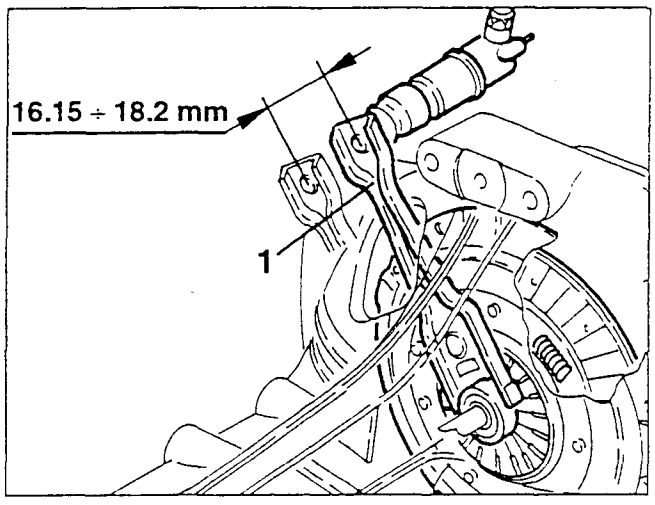
CAUTION:
During the bleeding operation, the level of the fluid in the reservoir must never fall below the "MIN" mark.

- Top up the level of the fluid in the reservoir and refit the cap.

CAUTION:
Brake/clutch fluid can damage the paintwork, therefore proceed with care.

- After bleeding, check that the clutch and gears disengage and engage properly.

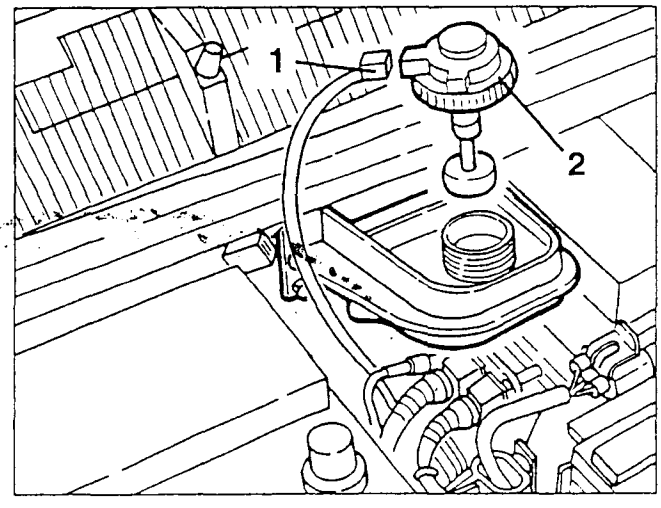
1. Also check that the disengagement stroke of the clutch control cylinder is within the specified limits.
This stroke is not adjustable and depends on the volume of the fluid displaced by the clutch pump piston.



MINIMUM BRAKE - CLUTCH FLUID LEVEL SENSOR

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the minimum brake - clutch fluid level sensor.
2. Slacken the cap with the built-in minimum brake - clutch fluid level sensor and remove it.

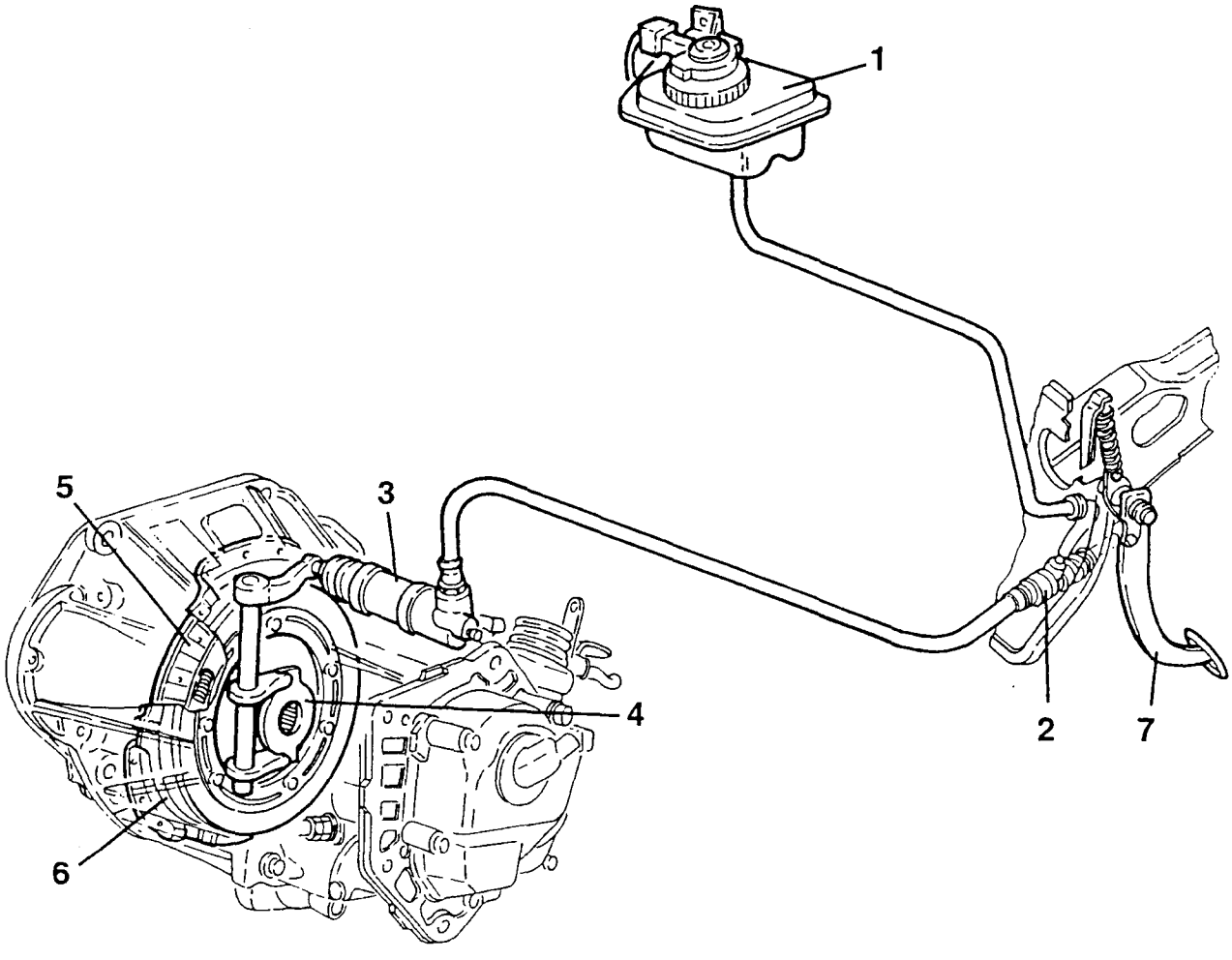


DESCRIPTION

The clutch adopted is a dry single-plate type with diaphragm pressure plate springs.
The clutch is released through a hydraulic device formed of a reservoir (1) shared with the braking system, a pump (2) fastened to the pedal unit, a control cylinder (3) fastened to the gearbox cover and a thrust bearing (4).
The pedal-operated pump transmits the fluid pressure increase through a hose to the control cylinder piston. A prod on the latter acts on the control fork which moves the thrust bearing overcoming the action of the diaphragm pressure plate springs.

In addition to reducing the effort exerted on the pedal, the adoption of the hydraulic clutch release device makes it possible to:
- increase reliability of the control compared with the conventional mechanical system.
- improve progression, due to the damping of the hydraulic system during disengagement which prevents jerking, particularly when the torque transmitted is high.
- achieve greater operating precision, as this device enables constant height adjustment of the clutch pedal.
- increase driving comfort because of the reduction of the level of vibrations transmitted from the engine, due to the damping effect of the oil.

In order to comply with current regulations on the subject of environmental pollution, ecological (asbestos-free) clutch plate friction gaskets have been adopted.

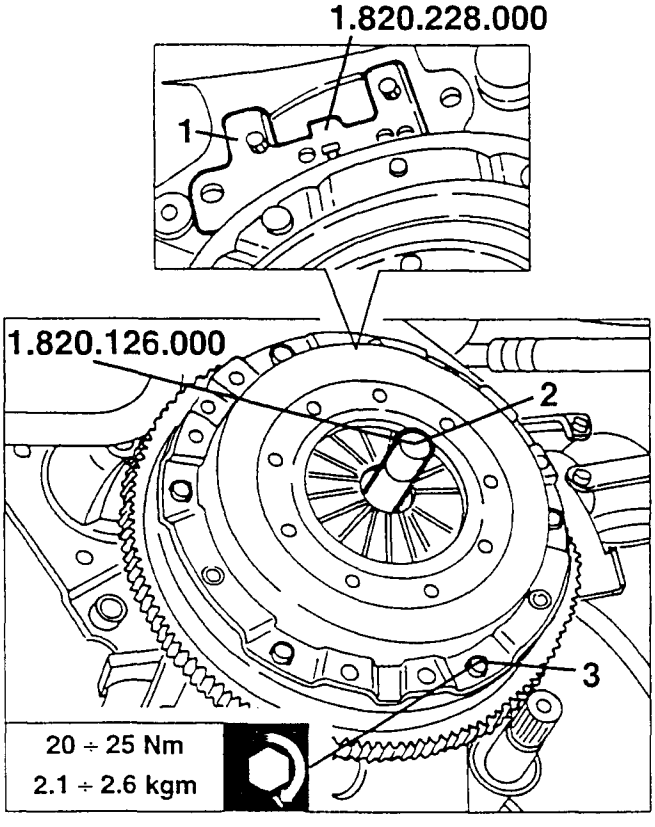


1. *Brake-clutch system reservoir*
2. *Clutch pump*
3. *Clutch control cylinder*
4. *Thrust bearing*
5. *Clutch plate*
6. *Pressure plate*
7. *Clutch control pedal*

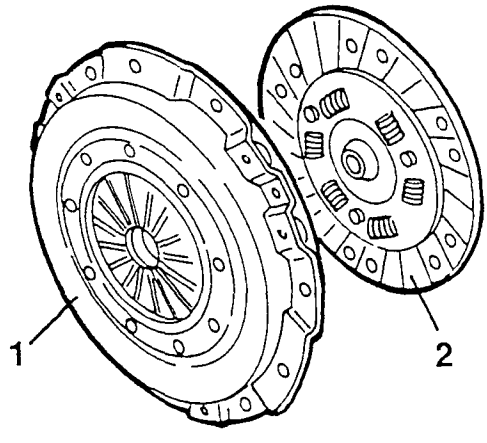
CLUTCH PLATE AND PRESSURE PLATE

REMOVAL/REFITTING

- Remove the gearbox-differential unit (see GROUP 21).
- If only the clutch plate is being replaced, mark its position between the pressure plate and flywheel in order to simplify re-assembly operations.
1. Install the flywheel locking tool N° 1.820.228.000.
2. Install tool N° 1.820.126.000 in the clutch plate hub.
3. Slacken the screws fastening the pressure plate to the flywheel.

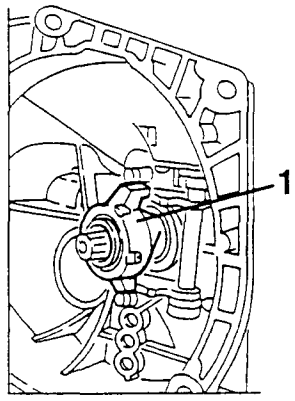


1. Remove the pressure plate.
2. Remove the clutch plate.

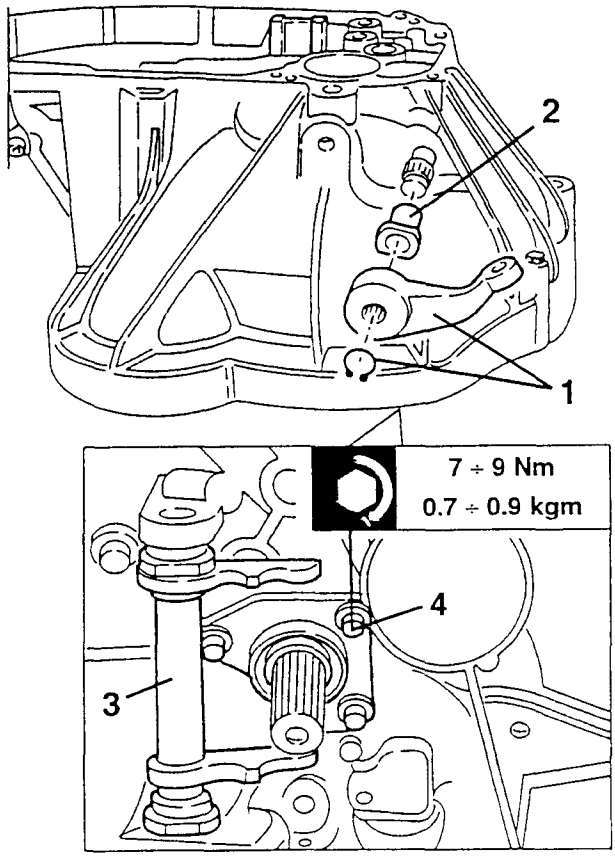


1. Withdraw the thrust bearing from its sleeve in the gearbox cover.

When refitting the bearing, make sure that it runs smoothly and noiselessly, if not, replace it.



- Only if necessary:
1. Remove the seeger lockring and withdraw the clutch engagement control lever.
2. Remove the anti-slip bush from the gearbox cover.
3. Working from inside the gearbox cover remove the clutch engagement sleeve control fork and pin.
4. Slacken the screws fastening the thrust bearing sleeve and remove it.

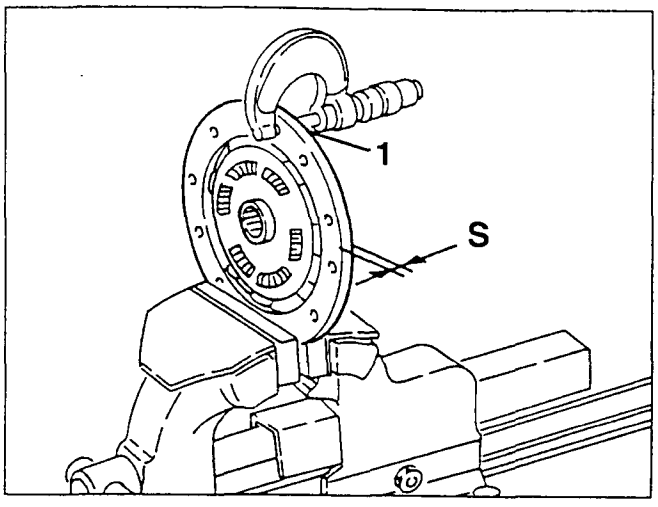


When refitting, install a new anti-slip bush each time the pin has too much play.
When refitting, grease the bushes and the sleeve with the specified product.
The sleeve complete with oil guard must be changed whenever it leaks oil.

CHECKS AND INSPECTIONS

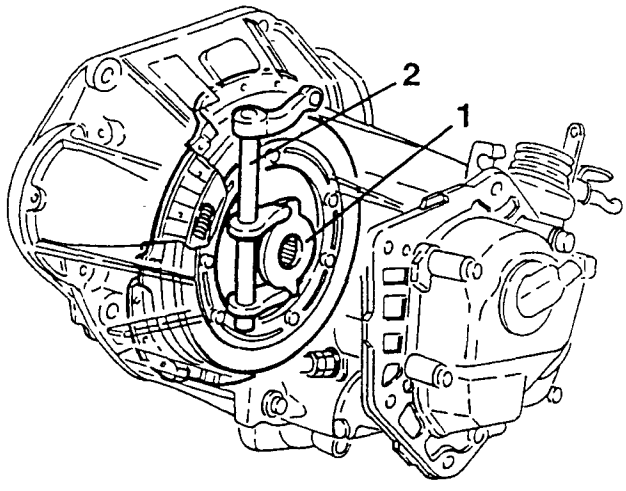
1. Check the gaskets for even wear and that the thickness of the clutch plate is not below the minimum specified.

Thickness "S" of clutch plate (mm)	
New	At the wear limit
7.1 ÷ 7.7	6.1



- Check that there are no signs of burning or vitrification, that fastening is correct and that the springs are intact.

Check that the clutch plate hub is intact, runs freely and that there is no excessive play on the drive shaft coupling.
- Check the working surfaces of the flywheel and pressure plate for signs of overheating, uneven wear, nicks or missing parts.
1. Check the thrust bearing for noise, excessive play and freedom of movement on the drive sleeve.
2. Check the fork for cracks, distorsion, freedom of movement and excessive wear on the working surfaces.

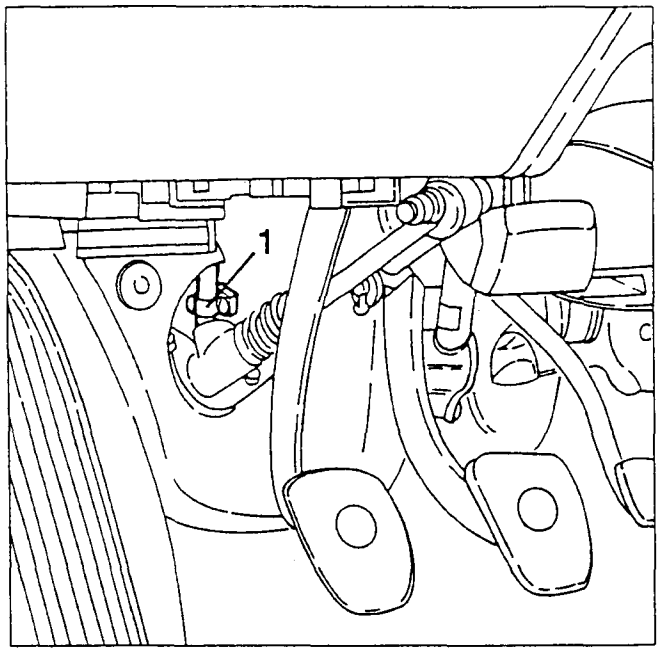


CLUTCH PUMP

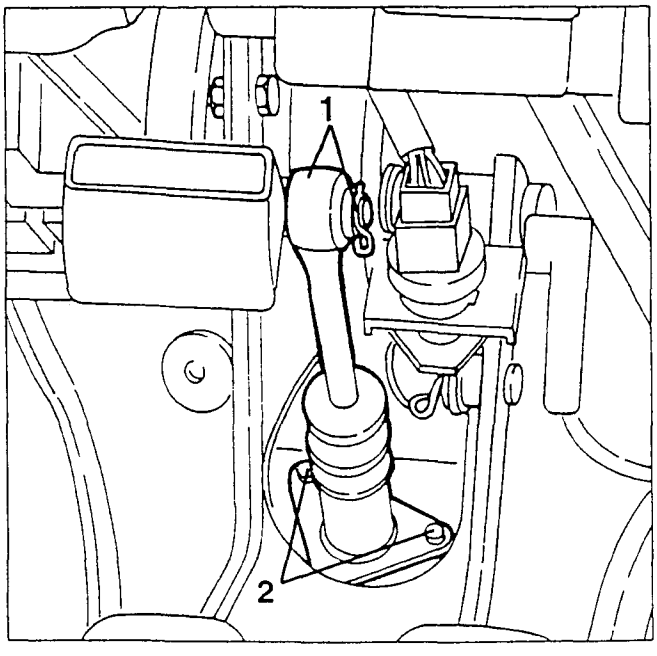
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Empty the brake-clutch fluid reservoir using a suitable syringe.

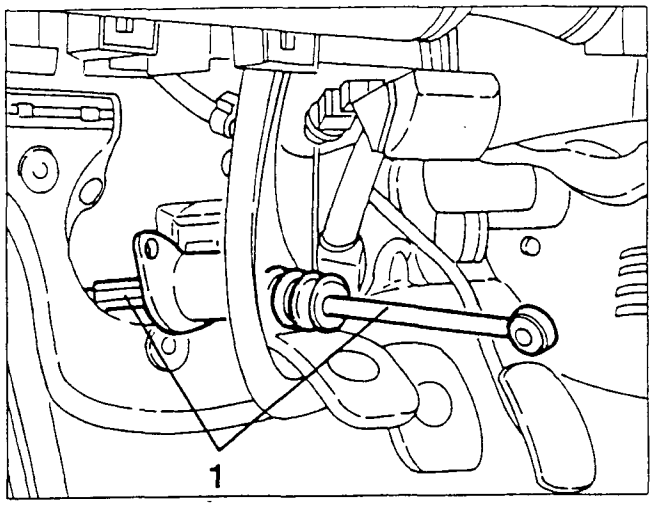
1. Disconnect the reservoir connection hoses from the clutch pump.



1. Remove the safety catch and disconnect the clutch pump from the pedal.
2. Slacken the two nuts fastening the clutch pump.

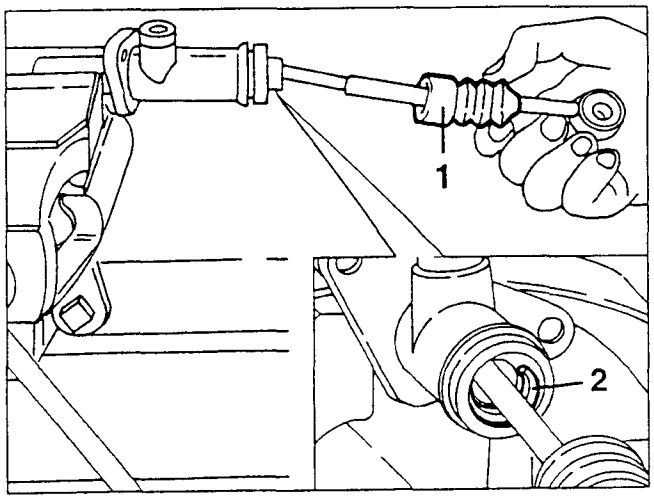


1. Move the clutch pump backwards just enough to disconnect the union of the cylinder connection pipes, then remove it.

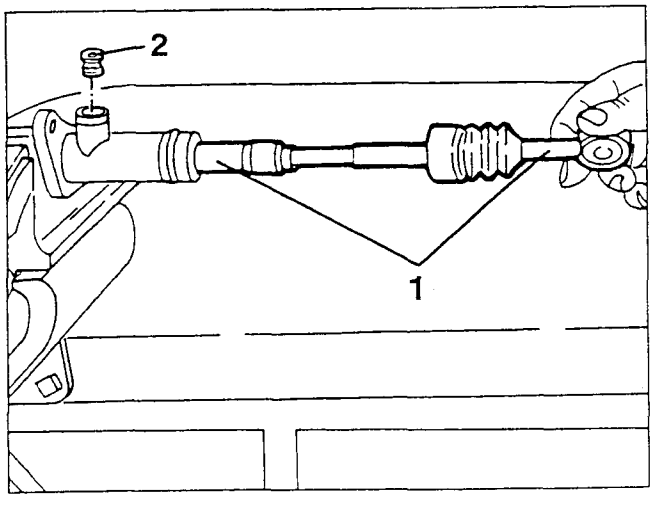


DIS-ASSEMBLY/RE-ASSEMBLY

1. Prise off the protective boot.
2. Remove the piston retainer ring.



1. Remove the piston and the operating lever.
2. Remove the gasket.

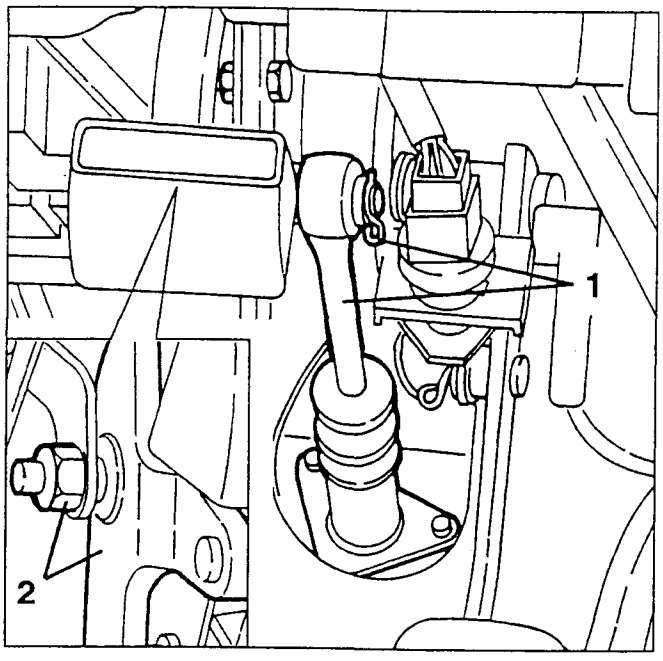


- Check the piston and the cylinder inner surface for marks, scores, scratches or rust and change the pump assembly if necessary.

CLUTCH PEDAL

REMOVAL/REFITTING

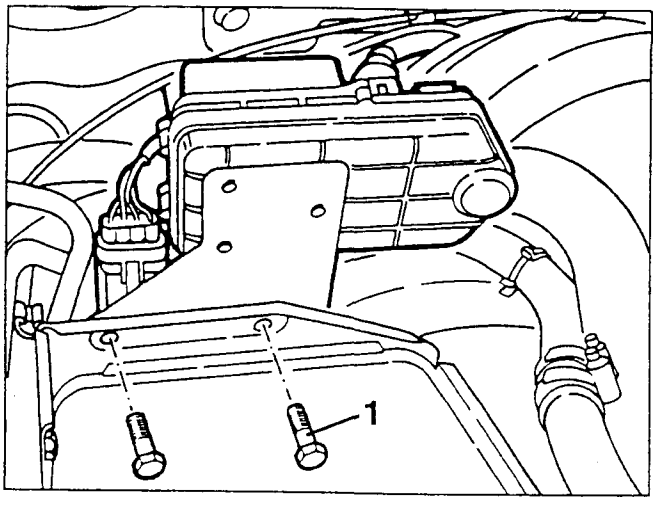
1. Remove the safety catch and disconnect the clutch pump from the pedal.
2. Slacken the fastening bolt and remove the clutch pedal.



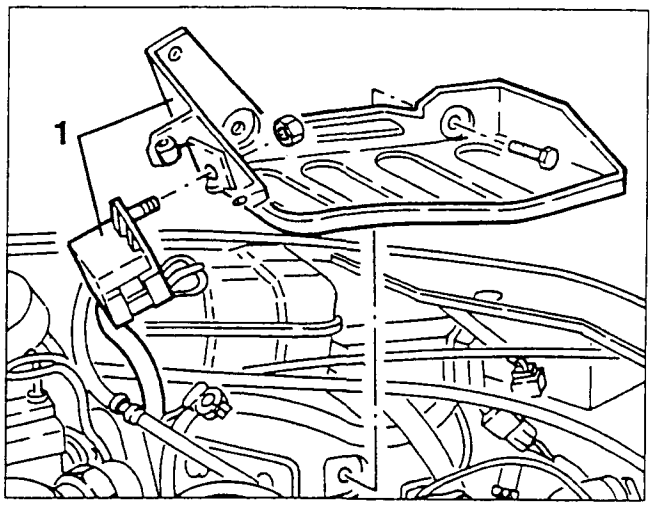
CLUTCH CONTROL CYLINDER

REMOVAL/REFITTING

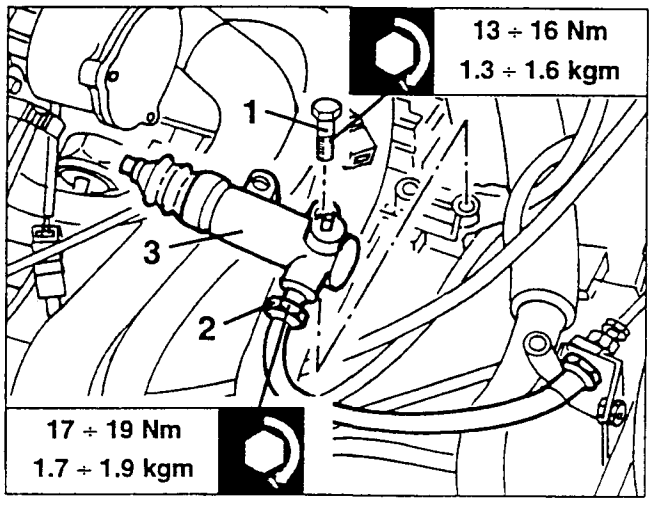
- Remove the battery (see GROUP 55).
- Empty the brake-clutch fluid reservoir using a suitable syringe.
1. Slacken the two fastening screws and move the fan relays to one side.



- Remove the battery acid drain duct.
1. Slacken the battery bracket fastening screws, then remove it after disconnecting the glow plug control unit cables from it.

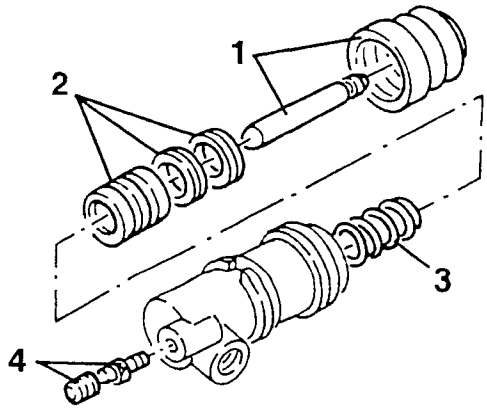


1. Slacken the two screws fastening the clutch control cylinder.
2. Disconnect the pump inlet hose fitting from the clutch control cylinder.
3. Remove the clutch control cylinder.



DIS-ASSEMBLY/RE-ASSEMBLY

1. Prise off the rubber boot and remove it together with the control prod.
2. Remove the piston from the cylinder body with its seals.
3. Remove the spring.
4. Only if necessary, remove the air relief screws.



WARNING
Always change the gaskets when re-assembling.

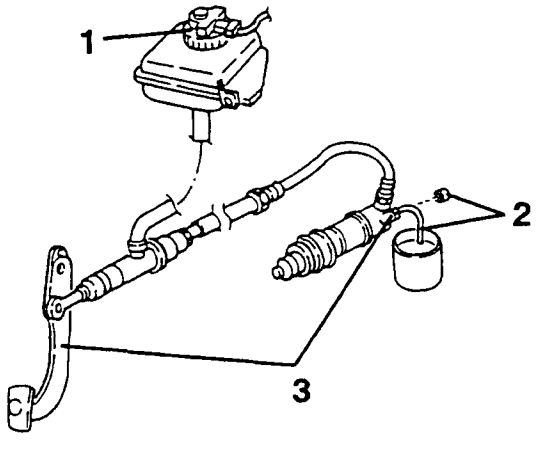
CHECKS AND INSPECTIONS

- Check the piston and the cylinder inner surface for scores or traces of rust and change the cylinder assembly if necessary.
- Check that the spring is intact.
- Check that the air relief hole is not clogged.

BLEEDING AIR FROM THE HYDRAULIC SYSTEM

WARNING:
Never re-use the hydraulic fluid resulting from the bleeding operation.

1. Remove the cap on the clutch and brake fluid reservoir and if necessary top up the level with the specified fluid.
2. Remove the protective cap from the relief screw on the cylinder and push a hose onto the screw with the other end in a transparent container full of the same hydraulic fluid as the circuit.
3. Slacken the relief screw while pressing the clutch pedal allowing it to return slowly; repeat this operation until all the air trapped in the circuit has been eliminated.
- Then with the clutch pedal completely depressed, tighten the relief screw, remove the hose and refit the protective cap.

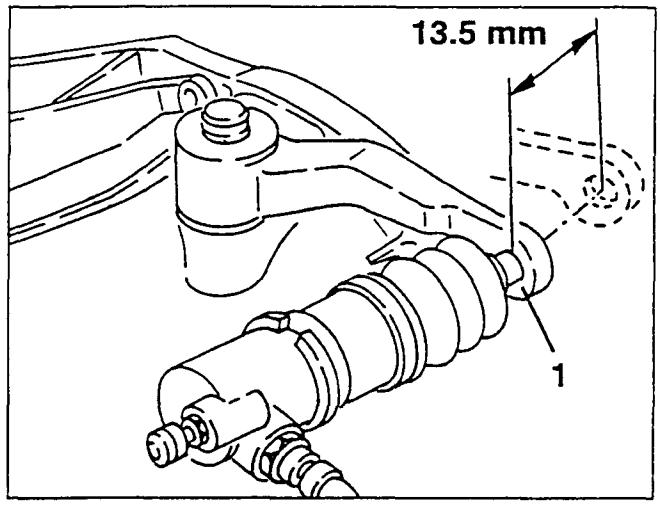


During the bleeding operation, the level of the fluid in the reservoir must never fall below the "MIN" mark.

- Top up the level of the fluid in the reservoir and refit the cap.

Brake/clutch fluid can damage the paintwork, therefore proceed with care.

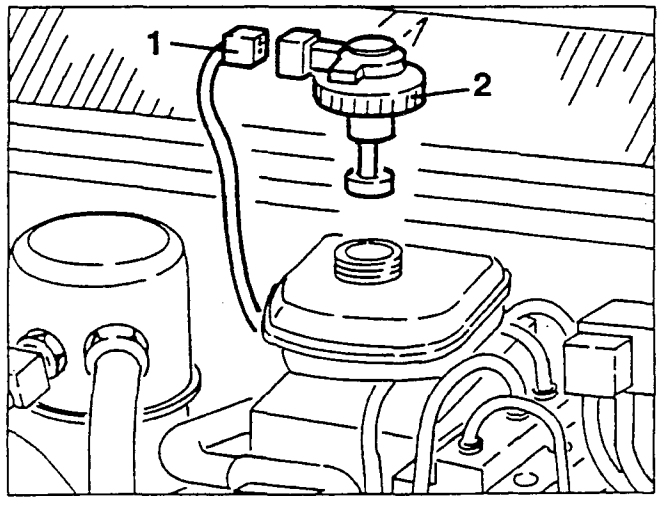
- After bleeding, check that the clutch and gears disengage and engage properly.
1. Also check that the disengagement stroke of the clutch control cylinder is within the specified limits.
This stroke is not adjustable and depends on the volume of the fluid displaced by the clutch pump piston.



MINIMUM BRAKE - CLUTCH FLUID LEVEL SENSOR

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the minimum brake-clutch fluid level sensor.
2. Slacken the cap with the built-in minimm brake-clutch fluid level sensor and remove it.



DESCRIPTION

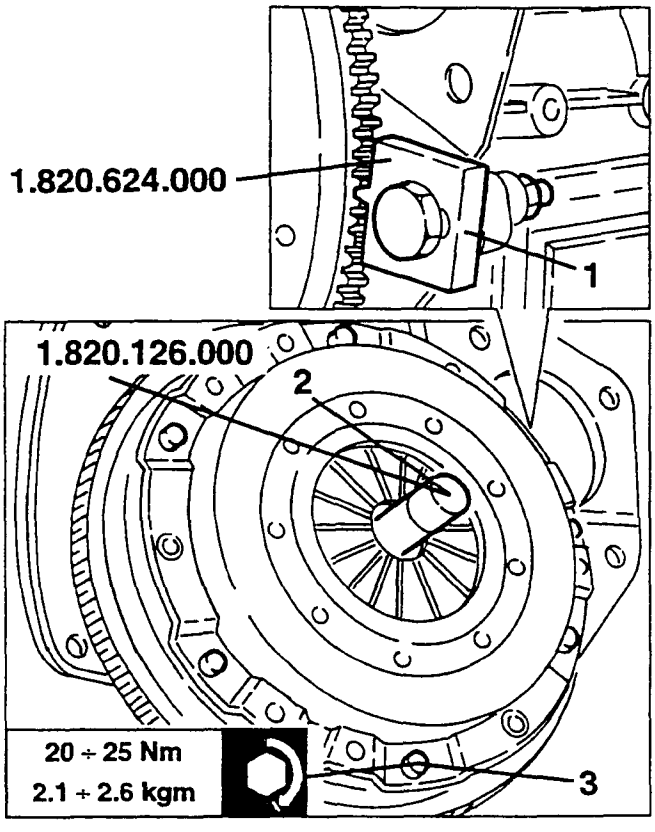
Refer to the instructions for the 1929 TD engine.

CLUTCH PLATE AND PRESSURE PLATE

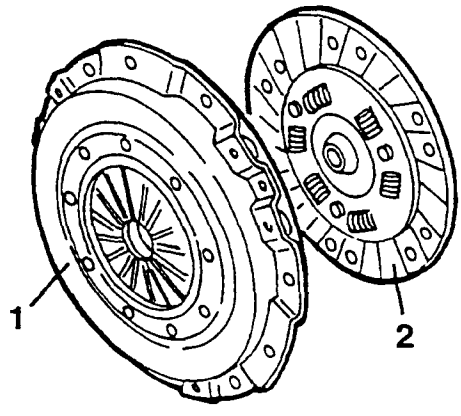
REMOVAL/REFITTING

- Remove the gearbox-differential unit (see GROUP 21).
- If only the clutch plate is being replaced, mark its position between the pressure plate and flywheel in order to simplify re-assembly operations.

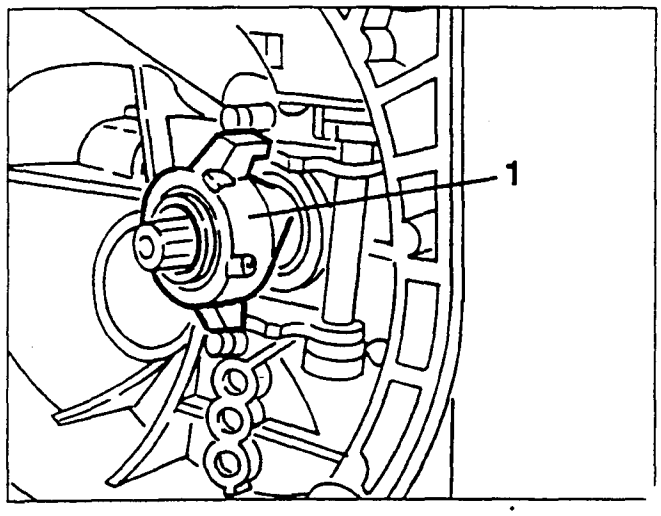
1. Install the flywheel locking tool N° 1.820.624.000.
2. Install tool N° 1.820.126.000 in the clutch plate hub.
3. Slacken the screws fastening the pressure plate to the flywheel.



1. Remove the pressure plate.
2. Remove the clutch plate.



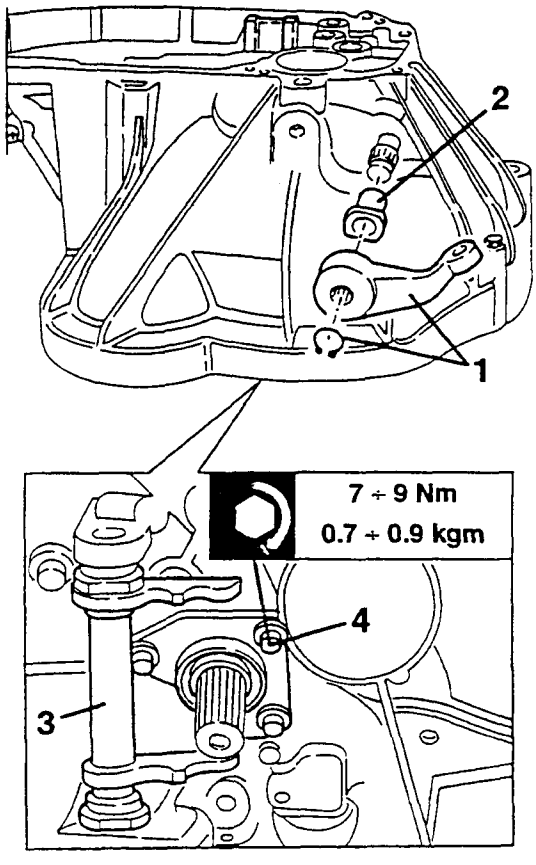
1. Withdraw the thrust bearing from its sleeve in the gearbox cover.



When refitting the bearing, make sure that it runs smoothly and noiselessly, if not, replace it.

- Only if necessary:

1. Remove the seeger lockring and withdraw the clutch engagement control lever.
2. Remove the anti-slip bush from the gearbox cover.
3. Working from inside the gearbox cover remove the clutch engagement sleeve control fork and pin.
4. Slacken the screws fastening the thrust bearing sleeve and remove it.

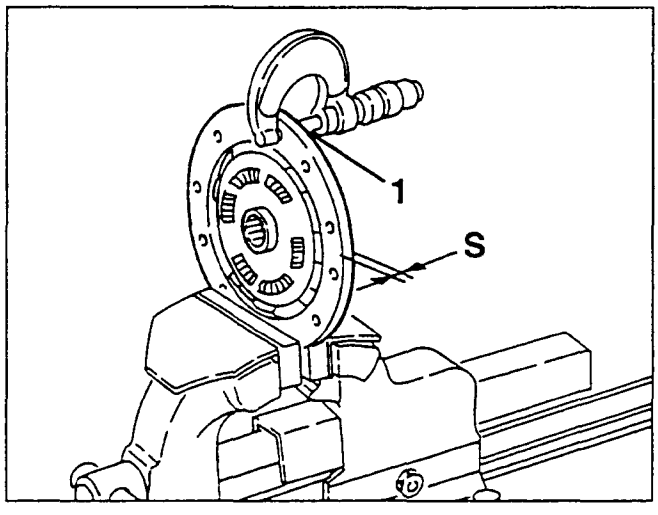


When refitting, install a new anti-slip bush each time the pin has too much play.
When refitting, grease the bushes and the sleeve with the specified product.
The sleeve complete with oil guard must be changed whenever it leaks oil.

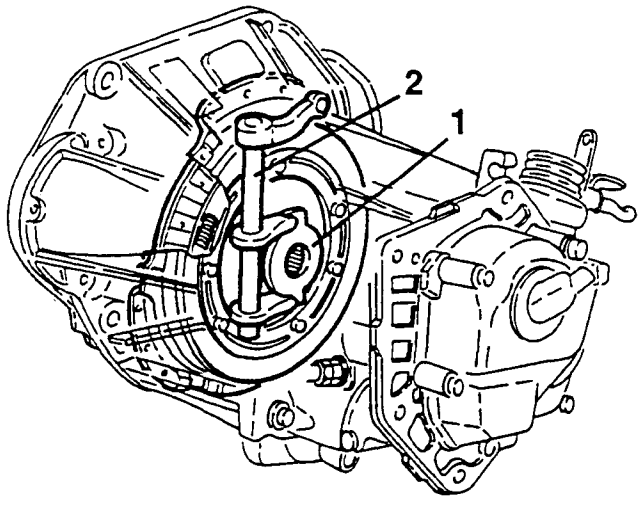
CHECKS AND INSPECTIONS

1. Check the gaskets for even wear and that the thickness of the clutch plate is not below the minimum specified.

Thickness "S" of clutch plate (mm)	
New	At the wear limit
7.1 ÷ 7.7	6.3



- Check that there are no signs of burning or vitrification, that fastening is correct and that the springs are intact.
- Check that the clutch plate hub is intact, runs freely and that there is no excessive play on the drive shaft coupling.
- Check the working surfaces of the flywheel and pressure plate for signs of overheating, uneven wear, nicks or missing parts.
1. Check the thrust bearing for noise, excessive play and freedom of movement on the drive sleeve.
2. Check the fork for cracks, distorsion, freedom of movement and excessive wear on the working surfaces.



CLUTCH PUMP

Refer to the instructions for the 1929 TD engine.

CLUTCH PEDAL

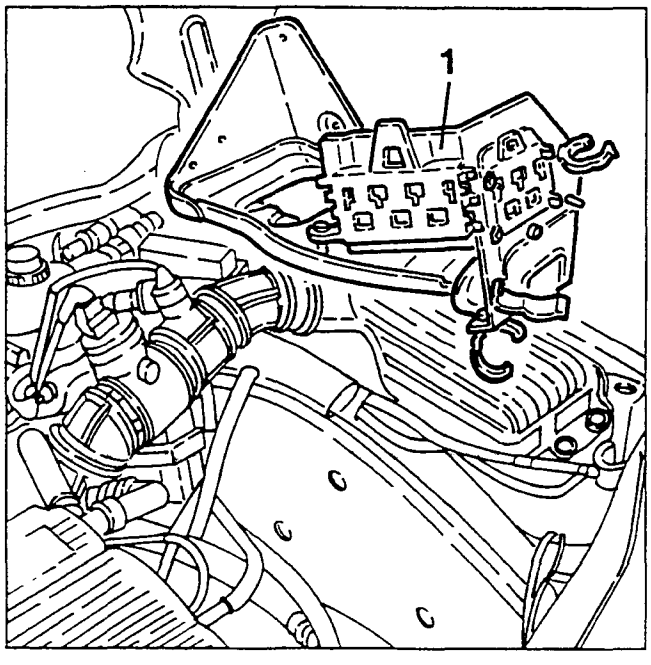
Refer to the instructions for the 1929 TD engine.

CLUTCH CONTROL CYLINDER

REMOVAL/REFITTING

- Remove the battery
- Remove the relay from the battery support and set them to one side with their wirings to prevent them from hindering subsequent operations.

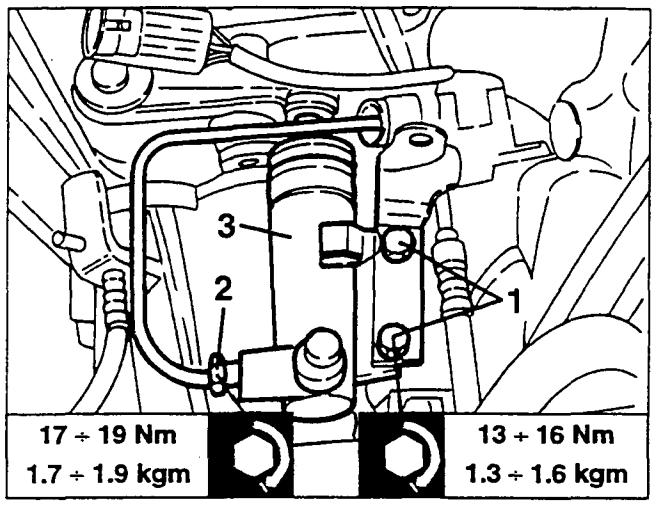
1. Slacken the fastening screws, then remove the battery support after removing the rear cable support bracket from it.



- Using a suitable syringe, empty the brake-clutch fluid reservoir.

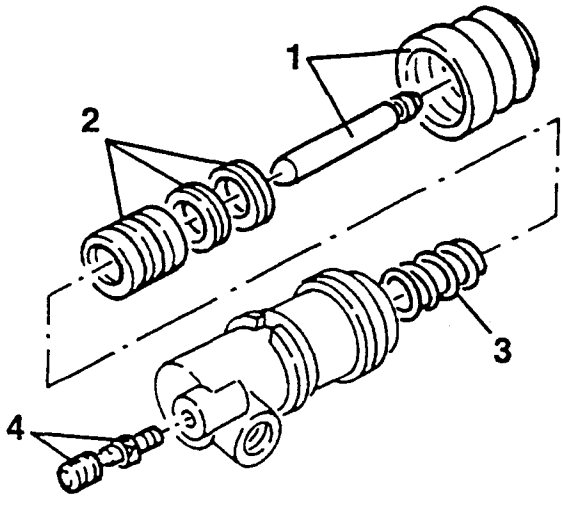
Move away the injection wiring to gain access to the clutch control cylinder.

1. Slacken the two screws fastening the clutch control cylinder.
2. Disconnect the fitting of the pump delivery pipe from the clutch control cylinder.
3. Remove the clutch control cylinder.



DIS-ASSEMBLY/RE-ASSEMBLY

1. Prise off the rubber boot and remove it together with the control prod.
2. Remove the piston from the cylinder body with its seals.
3. Remove the spring.
4. Only if necessary, remove the air relief screws.



WARNING
Always change the gaskets when re-assembling.

CHECKS AND INSPECTIONS

- Check the piston and the cylinder inner surface fo scores or traces of rust and change the cylinder assembly if necessary.
- Check that the spring is intact.
- Check that the air relief hole is not clogged.

BLEEDING AIR FROM THE HYDRAULIC SYSTEM

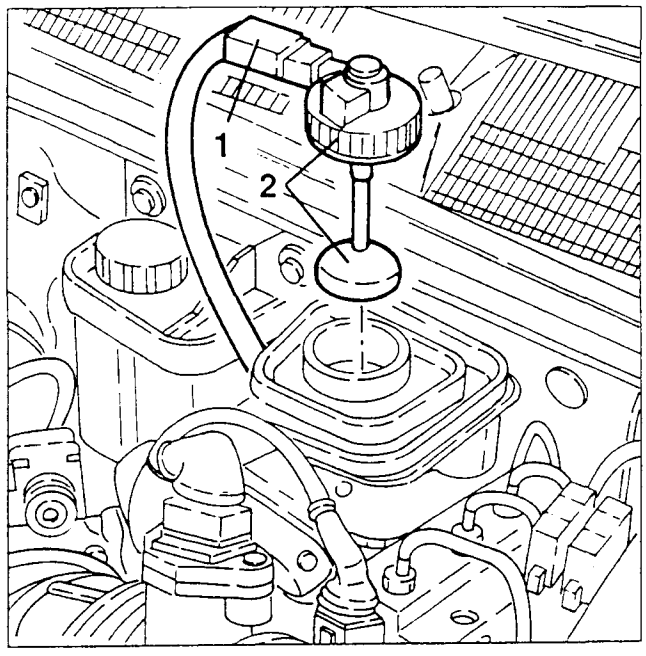
Refer to the instructions for the 1929 TD engine.

MINIMUM BRAKE - CLUTCH FLUID LEVEL SENSOR

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection from the minimum brake-clutch fluid level sensor.
2. Slacken the cap with the built-in minimm brake-clutch fluid level sensor and remove it.



DESCRIPTION

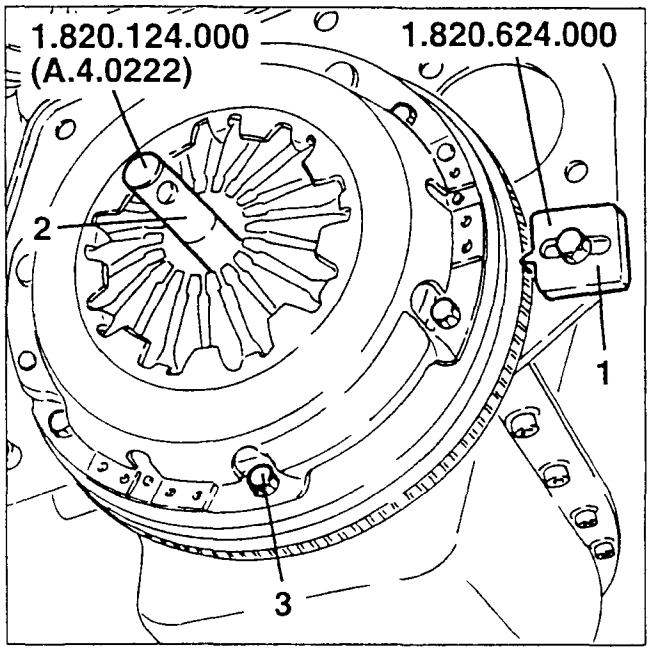
See the description of the 1929 TD engine

CLUTCH PLATE AND PRESSURE PLATE

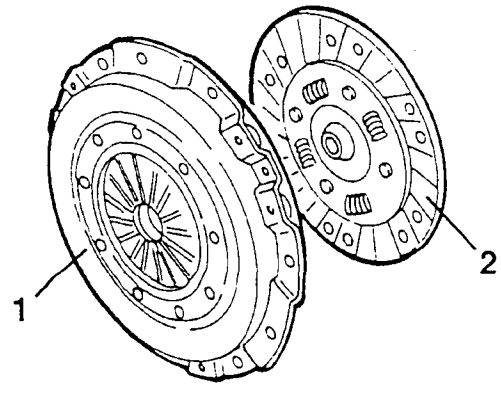
REMOVING/REFITTING

- Remove the gearbox differential unit (see GROUP 21).
- When changing the clutch plate only, mark the position between pressure plate and flywheel to facilitate refitting operations.

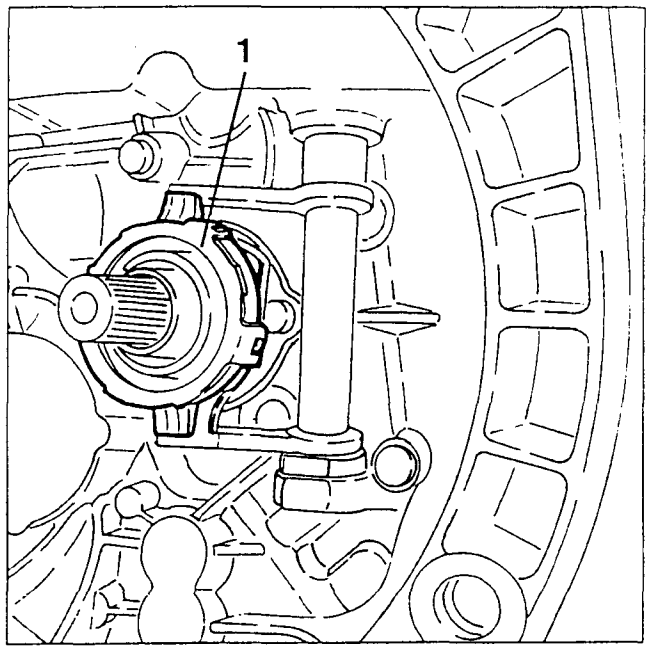
1. Install flywheel stopper tool no. 1.820.624.000.
2. Install tool no. 1.820.124.000 (A.4.0222) in the clutch plate hub.
3. Slacken the screws fastening the pressure plate to the flywheel.



1. Remove the pressure plate.
2. Remove the clutch plate.



1. Withdraw the thrust bearing from its sleeve on the gearbox cover.



When refitting the bearing must not stick or turn noisily, otherwise it must be replaced.

CHECKS AND INSPECTIONS

1. Check that lining wear is even and that the thickness of the clutch plate is not below the minimum specified limit.

Thickness "S" of clutch plate (mm)	
New	at wear limit
6.7 ÷ 7.3	5.9

- Check that there are no burns or signs of vitrification, that fastening is correct and that the springs are intact.
- Check that the clutch plate hub is intact, slides freely and that there is no excessive play on the engagement of the power takeoff shaft.
- Check the working surfaces of the flywheel and pressure plate for signs of overheating, eneven wear, nicks or material removal.
- Check the thrust bearing for noise, excessive play and that it runs freely on the guide sleeve.
- Check the fork for cracks, distortion, freedom of movement and excessive wear on the working surfaces.

FRONT AXLE

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- Right axle shaft damping mass 11

TRANSMISSION HALF-SHAFTS 1370 1598 1747 T. SPARK 16V

- Description . . . . . (▲)
- Removal/Refitting . . . . . (*)
- Dis-assembly of joint on gearbox side . . . . . (*)
- Refitting the joint on the gearbox side . . . . . (*)
- Dis-assembly on the joint on the wheel side . . . . . (*)
- Refitting the joint on the wheel side . . . . . (*)
- Removal/Refitting of intermediate shaft . . . . . (*)
- Left-hand axle shaft damping mass . . . . . (▲)

TRANSMISSION HALF-SHAFTS 1370 T. SPARK 16V

with gearbox C.513.5 from chassis n° .....

- Description 12
- Removal/Refitting 13
- Dis-assembly of joint on gearbox side 15
- Refitting the joint on the gearbox side 15
- Dis-assembly on the joint on the wheel side . . . . . (*)
- Refitting the joint on the wheel side . . . . . (*)
- Right axle shaft damping mass 16

(*): See engine 1929 TD

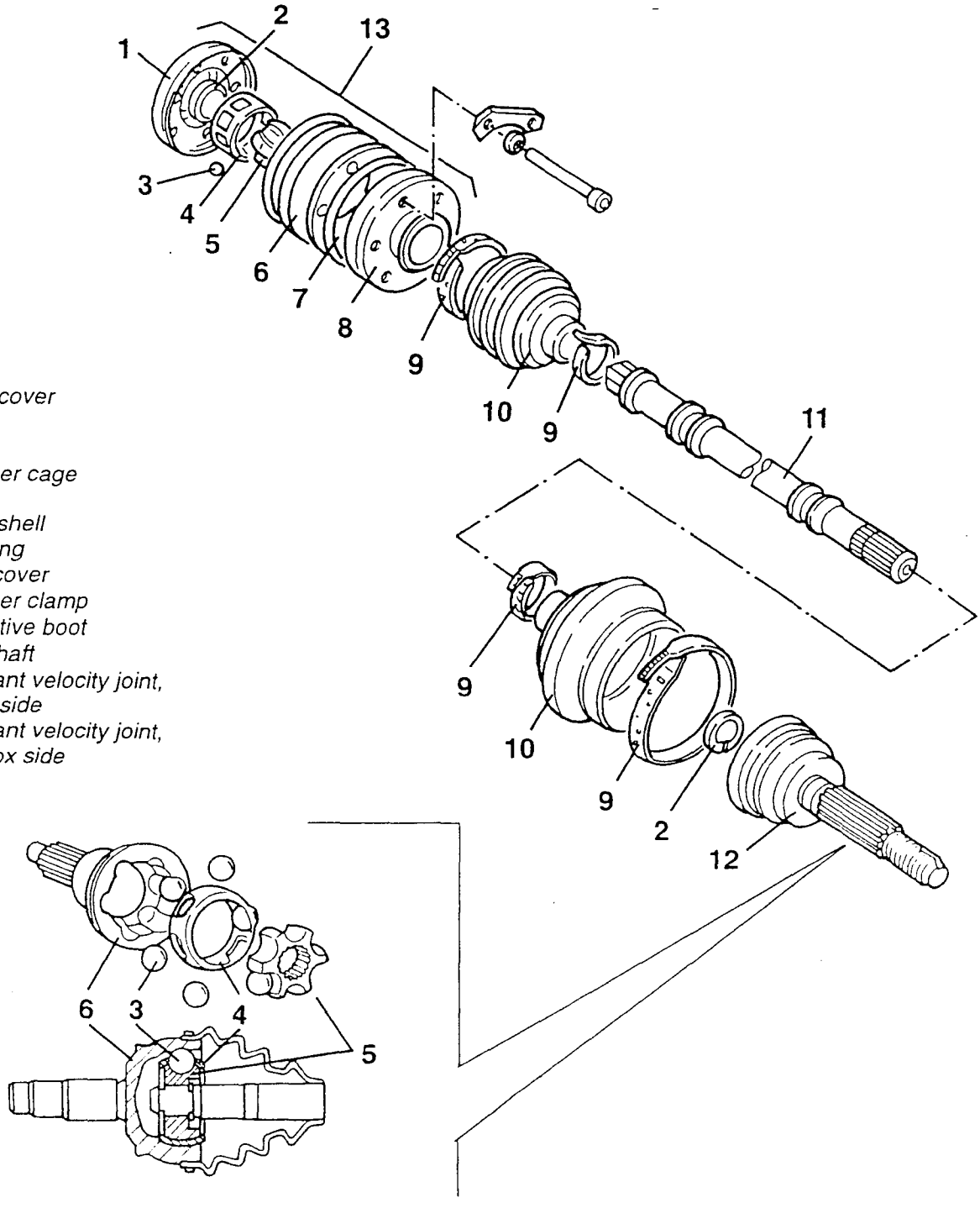
(▲): See engine 1970 T. SPARK 16V

DESCRIPTION

With the constant velocity joints the axleshafts form the set of devices which transmit motion from the gearbox to the driving wheels.
The assembly of these devices, commonly called "transmission" when in conjunction with the gearbox, comprises the following:
- right and left axle shafts;
- constant velocity joints on wheel and gearbox side.

The high-resistance steel axle shafts (11) have grooved ends to enable coupling with the constant velocity joints (12) and (13).

The housing for the flexible retainer rings (2) is made on these grooves.
The constant velocity joints are formed of an inner core (5) known as "drive", keyed onto the input shaft and an outer shell (6) called "driven", which forms the output element of the joint.
The inner core has six spherical grooves on its outer surface containing six balls (3), held in place by a cage (4).
These balls are the parts which actually transmit the motion and are also located in other grooves machined on the inner surface of the shell.



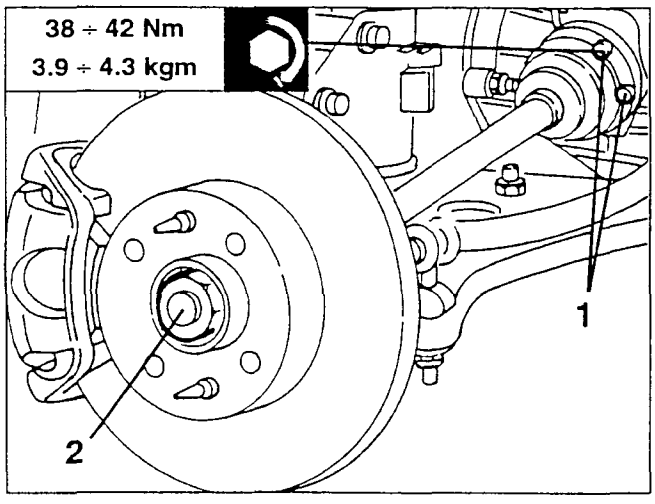
1. *Outer cover*
2. *Circlip*
3. *Ball*
4. *Retainer cage*
5. *Core*
6. *Outer shell*
7. *Seal ring*
8. *Inner cover*
9. *Retainer clamp*
10. *Protective boot*
11. *Axle shaft*
12. *Constant velocity joint, wheel side*
13. *Constant velocity joint, gearbox side*

REMOVAL/REFITTING

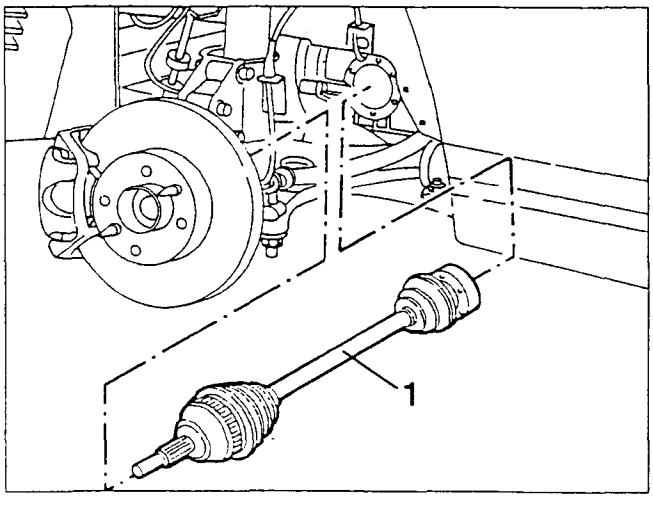
The following procedure refers to removal/refitting of the lefthand axle shaft.
However, it is possible to wholly follow this procedure also for removing the righthand axle shaft.
- Set the car on a lift.
- Remove the left front wheel.

1. Slacken the screws fastening the left axle shaft to the differential support and disconnect it retrieving the safety plates.
2. Remove the caulking and slacken the nut fastening the axle shaft constant velocity joint to the wheel hub.

When refitting, tighten the nut fastening the axle shaft to the wheel hub as described in GROUP 44 - Wheels and hubs - "Front wheel upright (Boxer versions)".



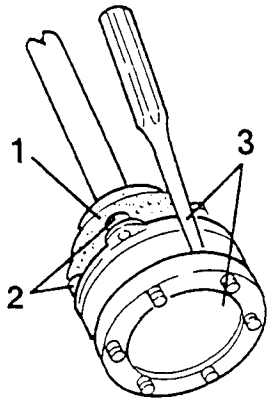
1. Pull out the axle shaft and remove it.



DIS-ASSEMBLY OF JOINT ON GEARBOX SIDE

- Fasten the axle shaft in a vice fitted with protective jaws.
- Remove the clamps of the gearbox side boot.

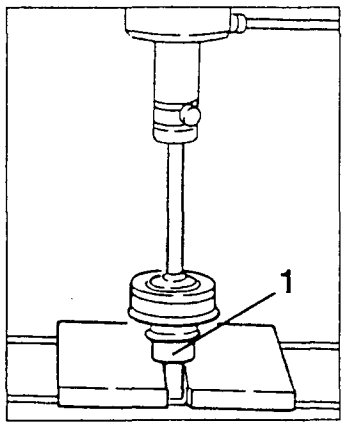
1. Back off the boot on the axle shaft.
2. Remove the safety plates located on the inner cover after removing the corresponding screws.
3. Remove the outer cover using a punch.



Change the boot and clamps when re-assembling.

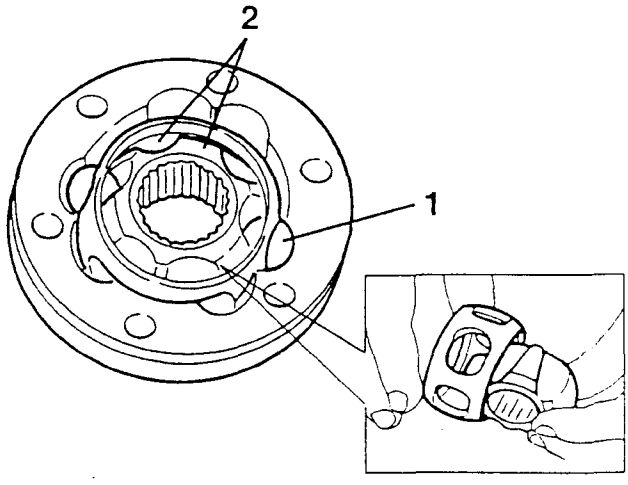
- Make a reference mark on the outer ring, on the cage and on the core of the joint to reposition correctly when re- assembling.
- Remove the flexible retainer ring.

1. Working under the press with two half plates and a punch, remove the constant velocity joint from the axle shaft.



- Slide the protective boot off the axle shaft and remove the inner cover from the constant velocity joint.
- Remove the two seal rings from the joint outer ring.

1. Remove the balls from the joint.
2. Remove the core and cage turning them suitably in the outer ring and separate them.

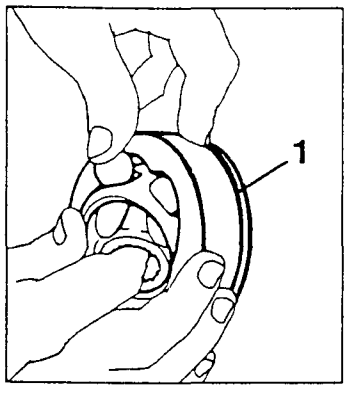


CHECKS

Degrease the joint components with fuel oil and check the balls and their housings for traces of wear and cracks.
Check the shaft for distorsion, cracks and signs of wear.

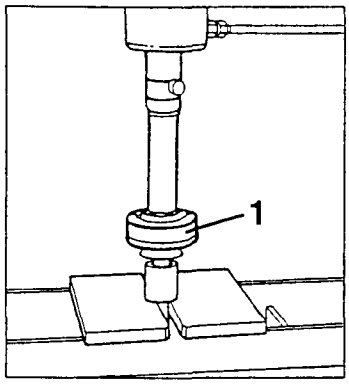
REFITTING THE JOINT ON THE GEARBOX SIDE

- Carefully grease the cage, core and balls with the specified grease and fill the inner chamber of the joint with 40 g of the specified grease.
- Fit the bellow on the axle shaft taking care not to scratch it on the teeth. For this purpose it is wise to tape the toothing.
- Assemble the core and cage reversing the sequence followed for their removal.
1. Insert the balls working as illustrated and check that the joint works properly.

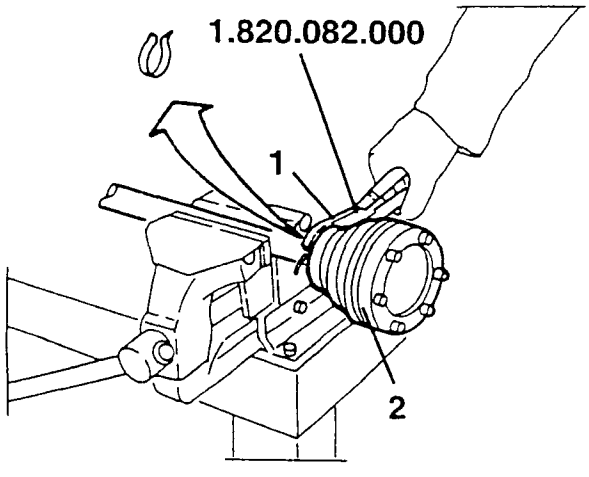


Do not mix the balls of this joint with the balls of the joint on the wheel side as their diameter is different.

1. Working under the press and using two half plates and a punch, insert the joint complete with inner cover on the axle shaft.



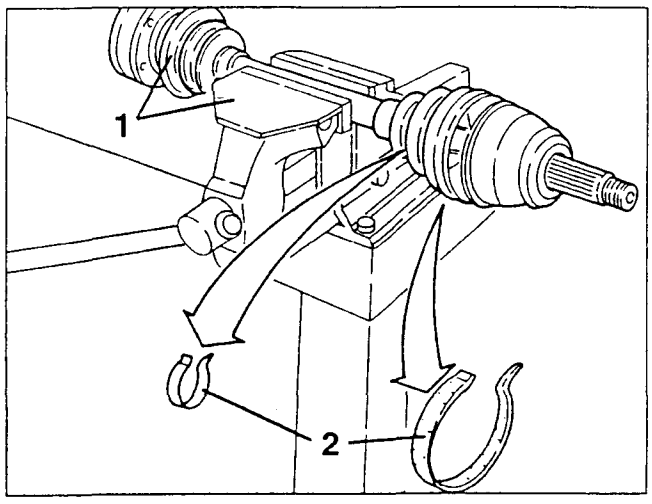
- Fill the joint with another 40 g of the specified grease.
- Fit the two seal rings on the outer ring of the joint.
1. Fit the bellow and using tool N° 1.820.082.000 install the inner clamp.
2. Using tool N° 1.820.084.000 install the outer clamp for fastening the boot.



- Fit the safety plates on the inner cover using the corresponding screws, then fit the outer cover on the screws.

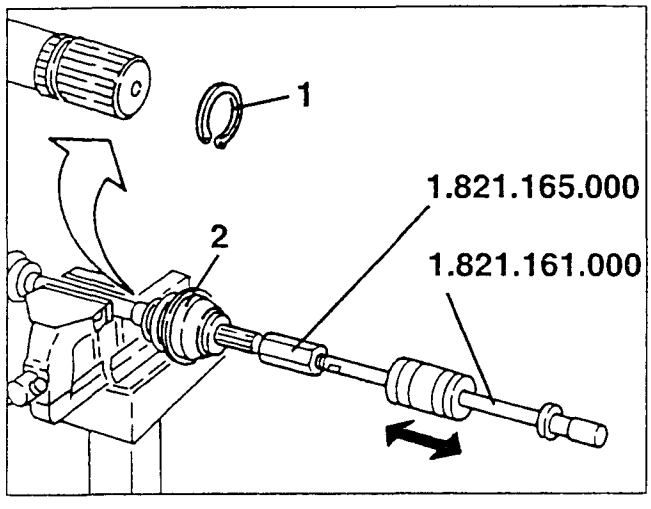
DIS-ASSEMBLY OF THE JOINT ON THE WHEEL SIDE

1. Fasten the axle shaft in a vice complete with protective jaws.
2. Remove the fastener clamps of the protective boot on the wheel side.



When refitting change the boot and clamps.

1. Remove the snap ring.
2. Using tools n° 1.821.165.000 and N° 1.821.161.000, remove the constant velocity joint from the axle shaft.

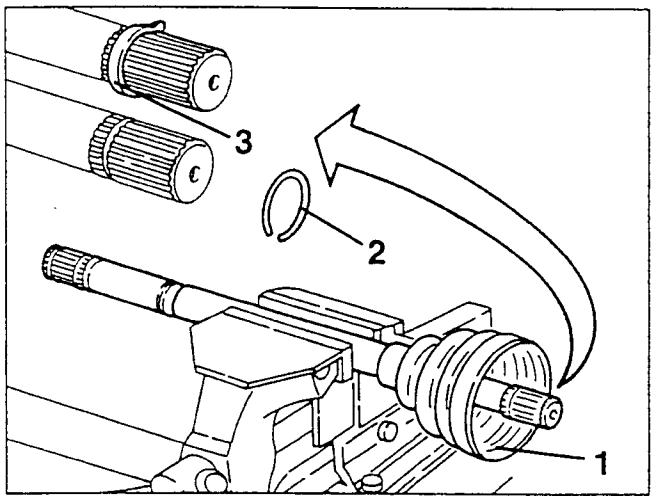


CHECKS

Degrease the joint components with fuel oil and check the balls and their housings for traces of wear and cracks.
Check the shaft for distorsion, cracks and signs of wear.

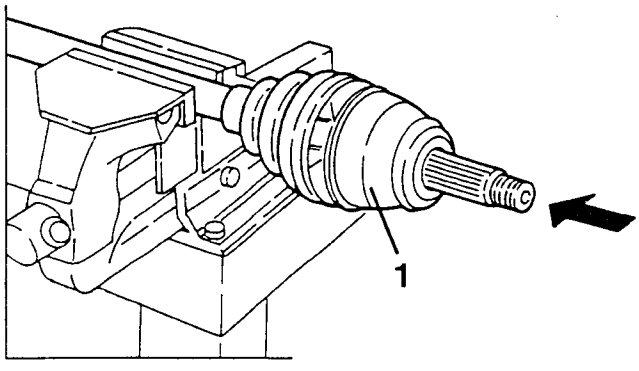
REFITTING THE JOINT ON THE WHEEL SIDE

1. Fit a new protective boot on the axle shaft.
2. Position the snap ring in its housing.
3. Compress the snap ring with the fastener clamp.

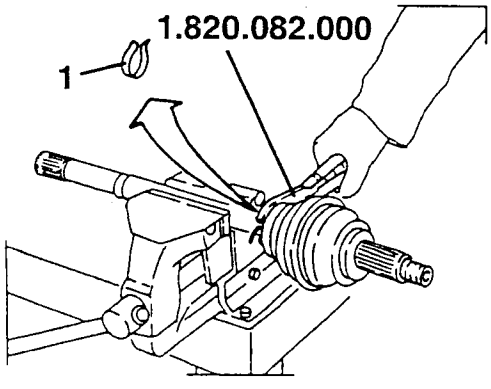


1. Position the joint on the axle shaft and push it into its housing using a soft hammer.

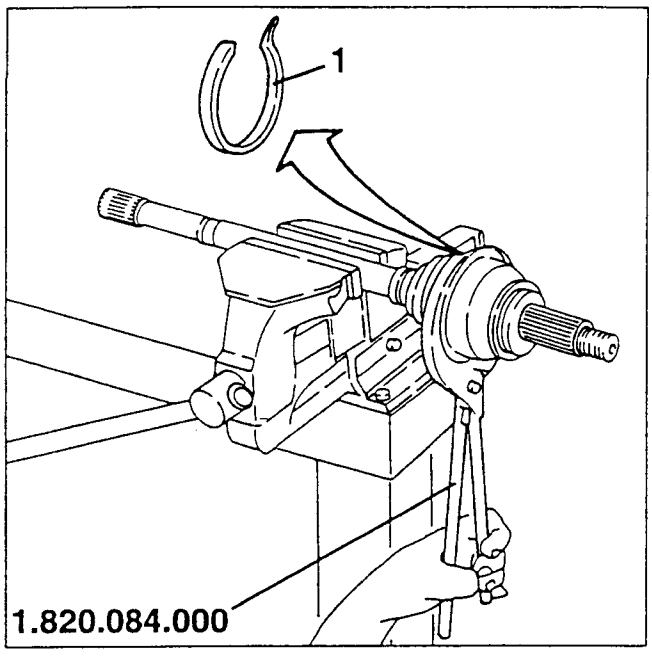
Fill the boot and grease the joint with appr. 120 g of the specified grease.



1. Using tool N° 1.820.082.000 fit the inner boot clamp.



1. Using tool N° 1.820.084.000 fit the outer boot clamp.

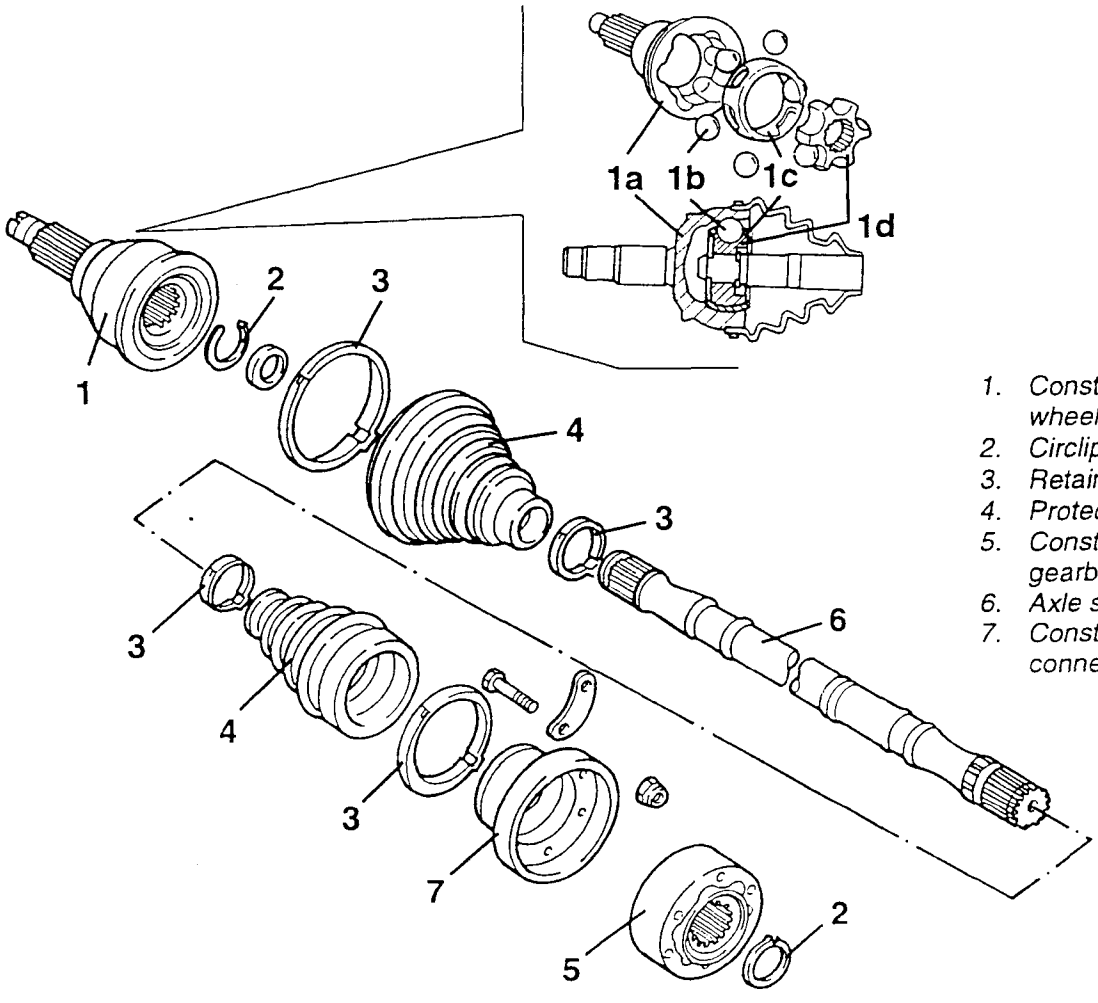


DESCRIPTION

With the constant velocity joints the axle shafts form the set of devices which transmit motion from the gearbox to the driving wheels.
The assembly of these devices, commonly called "transmission" when in conjunction with the gearbox, comprises the following:
- right and left axle shafts;
- constant velocity joints on wheel and gearbox side.
- intermediate shaft.

The high-resistance steel axle shafts (6) have grooved ends to enable coupling with the constant velocity joints (1) and (5).

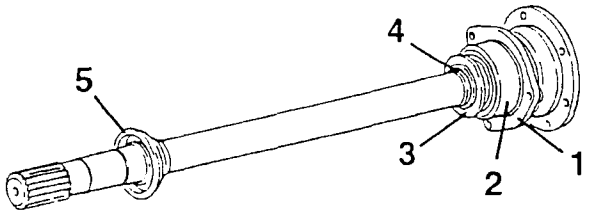
The housing for the flexible retainer rings (2) is made on these grooves.
The constant velocity joints are formed of an inner core (1d) known as "drive", keyed onto the input shaft and an outer shell (1a) called "driven", which forms the output element of the joint.
The inner core has six spherical grooves on its outer surface containing six balls (1b), held in place by a cage (1c).
These balls are the parts which actually transmit the motion and are also located in other grooves machined on the inner surface of the shell.



1. *Constant velocity joint, wheel side*
2. *Circlip*
3. *Retainer clamp*
4. *Protective boot*
5. *Constant velocity joint, gearbox side*
6. *Axle shaft*
7. *Constant velocity joint connection flange*

The intermediate shaft, also with grooved ends and, like the axle shafts, made from high-resistance steel, has the purpose of connecting the differential output with the right axle shaft to which it is connected by a flange.

For this purpose, to limit the projection between the connection points, the intermediate shaft is supported by a housing machined especially on the gearbox.



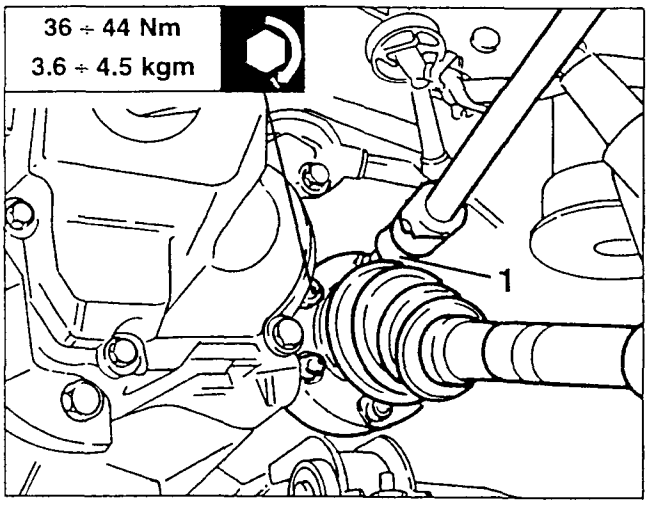
1. *Bearing retainer plate*
2. *Ball bearing*
3. *Flexible washer*
4. *Bearing retainer ring*
5. *Cup for bearing*

REMOVAL/REFITTING

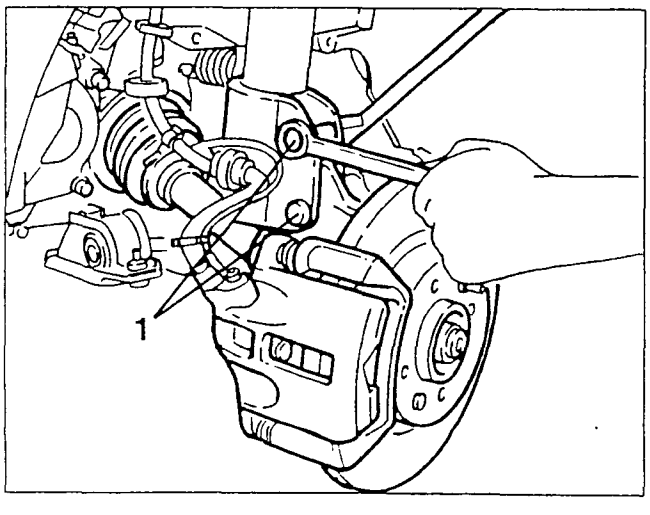
The following procedure refers to removal/refitting of the lefthand axle shaft.
However, it is possible to wholly follow this procedure also for removing the righthand axle shaft.

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the wheel and mudflap from the left front wheel house.
- Working from the left wheelhouse, disconnect the electrical connection of the brake pad wear sensor.
- Slacken the screw fastening the ABS inductive sensor support bracket.

1. Slacken the bolts fastening the left constant velocity joint from the differential flange retrieving the safety plates.



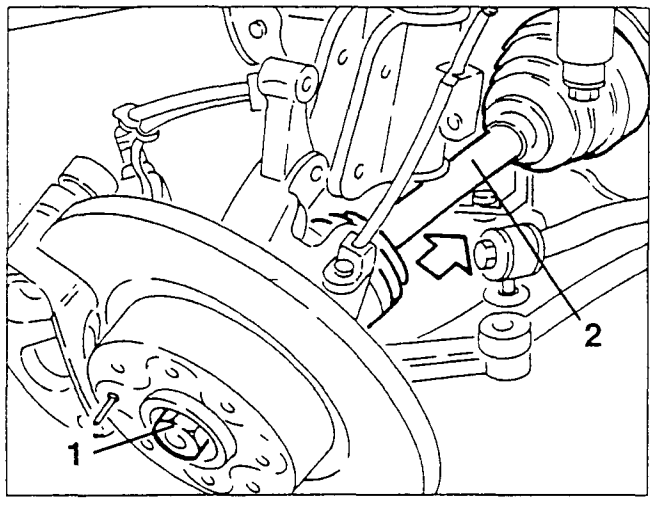
1. Slacken the two bolts fastening the left upright to the shock absorber, then remove the upper bolt only. This operation makes it possible to pull back the axle shaft just enough to disconnect the joint.



1. Remove the caulking and the nut fastening the joint to the wheel hub.

2. Pull the axle shaft and remove it.

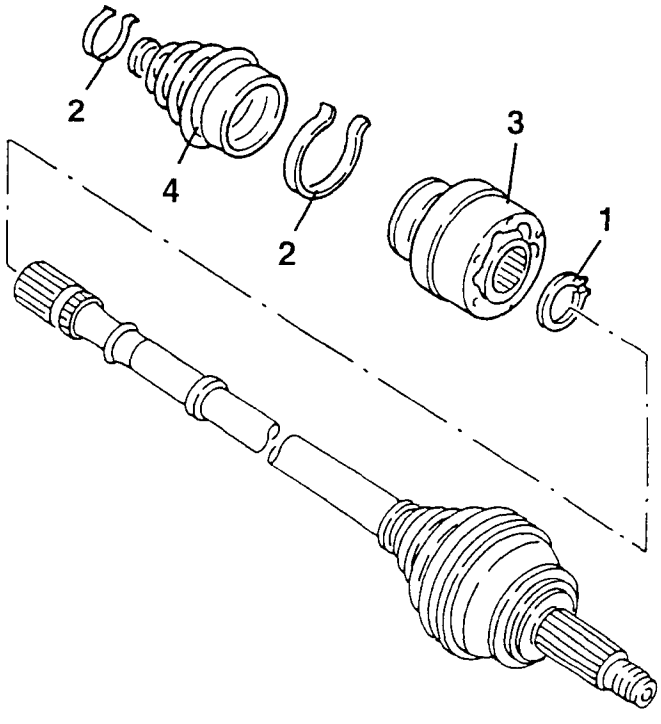
When refitting, tighten the nut fastening the axle shaft to the wheel hub as described in GROUP 44 - Wheels and hubs - "Front wheel upright (Boxer versions)".



DIS-ASSEMBLY OF JOINT ON GEARBOX SIDE

1. Remove the retainer ring.
2. Remove the gearbox side boot fastening clamps.
3. Pull the joint on the gearbox side off the axle shaft.
4. Separate the protective boot from the C.V. joint.

CAUTION:
When refitting, change the boot and clamps.



CHECKS

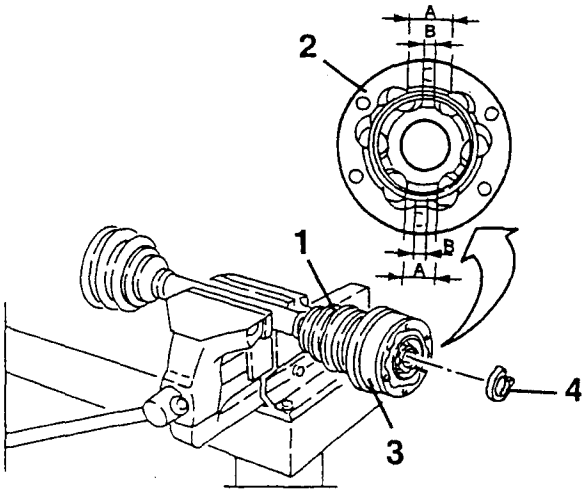
Degrease the joint components with fuel oil and check the balls and their housings for traces of wear and cracks.
Check the shaft for distorsion, cracks and signs of wear.

REFITTING THE JOINT ON THE GEARBOX SIDE

1. Fit a new boot on the axle shaft.
2. If previously dis-assembled, re-assemble the joint components as illustrated.

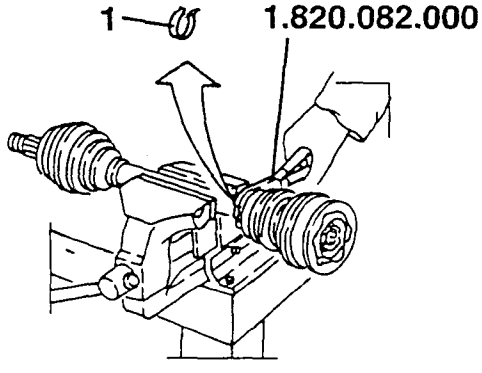
Fill the boot and grease the joint with 120 g of the specified grease.

3. Fit the joint on the gearbox side.
4. Fit the flexible retainer ring.

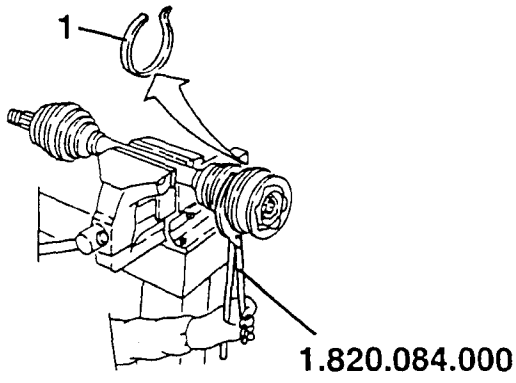


A = highest distance between ball housings
B = smallest distance between ball housings

1. Using tool n° 1.820.082.000 fit the inner boot clamp.



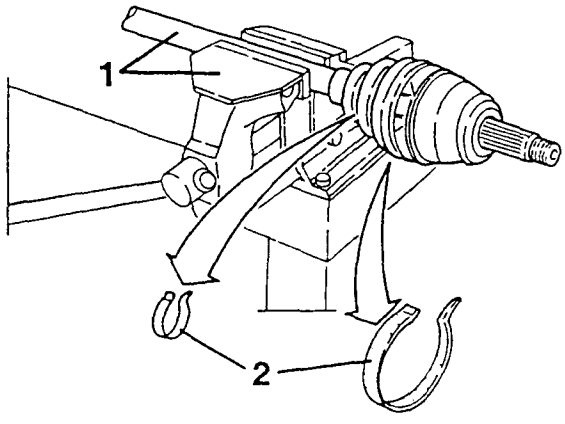
1. Using tool N° 1.820.084.000 fit the outer boot clamp.



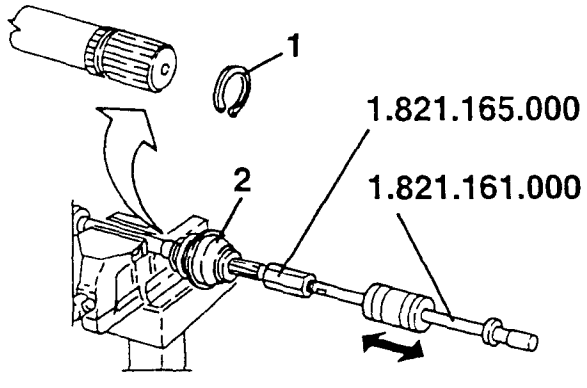
DIS-ASSEMBLY OF THE JOINT ON THE WHEEL SIDE

1. Fasten the axle shaft in a vice complete with protective jaws.
2. Remove the boot clamps on the wheel side.

When refitting, change the boot and clamps.



1. Remove the flexible retainer ring.
2. Using tools N° 1.821.165.000 and N° 1.821.161.000, remove the joint from the axle shaft.

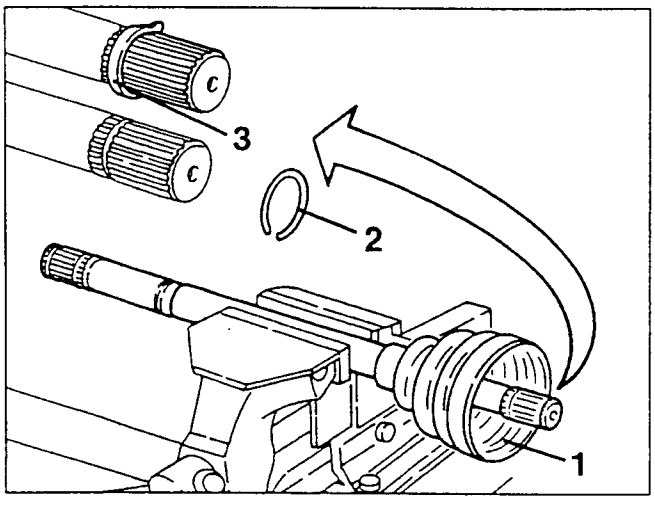


CHECKS

Degrease the joint components with fuel oil and check the balls and their housings for traces of wear and cracks.
Check the shaft for distorsion, cracks and signs of wear.

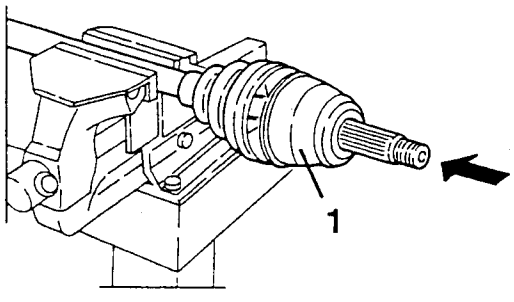
REFITTING THE JOINT ON THE WHEEL SIDE

1. Fit a new protective boot.
2. Position the flexible retainer ring.
3. Compress the flexible ring with the fastener clamp.

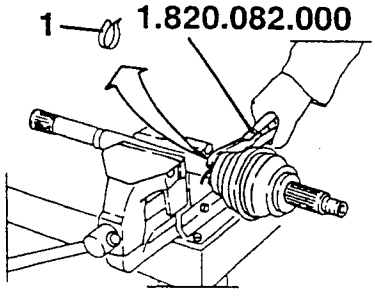


1. Position the C.V. joint on the axle shaft and push it into its housing using a soft mallet.

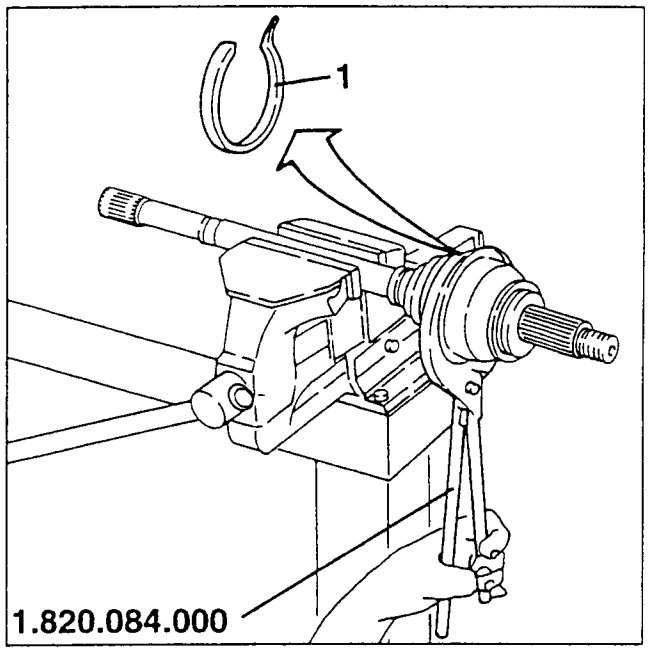
Fill the boot and grease the joint with appr. 120 g of the specified grease.



1. Using tool N° 1.820.082.000 fit the boot inner clamp.



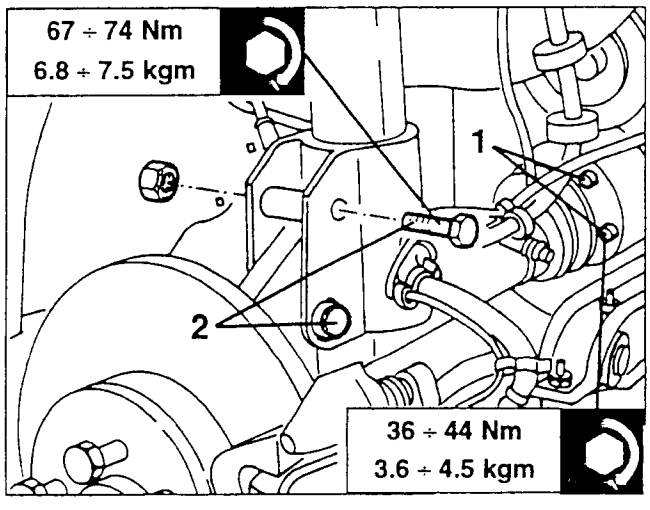
1. Using tool N° 1.820.084.000 fit the boot outer clamp.



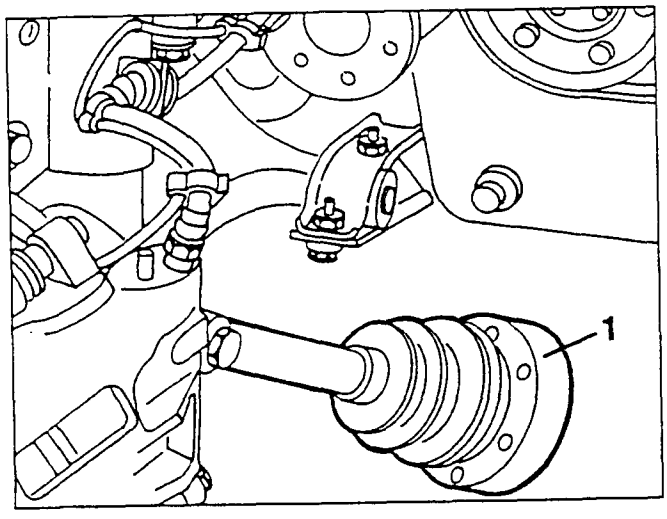
REMOVAL/REFITTING OF INTERMEDIATE SHAFT

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the wheel and mudflap from the right front wheel house.
- Working from the right wheelhouse, disconnect the electrical connection of the brake pad wear sensor.
- Slacken the screw fastening the ABS inductive sensor support bracket.

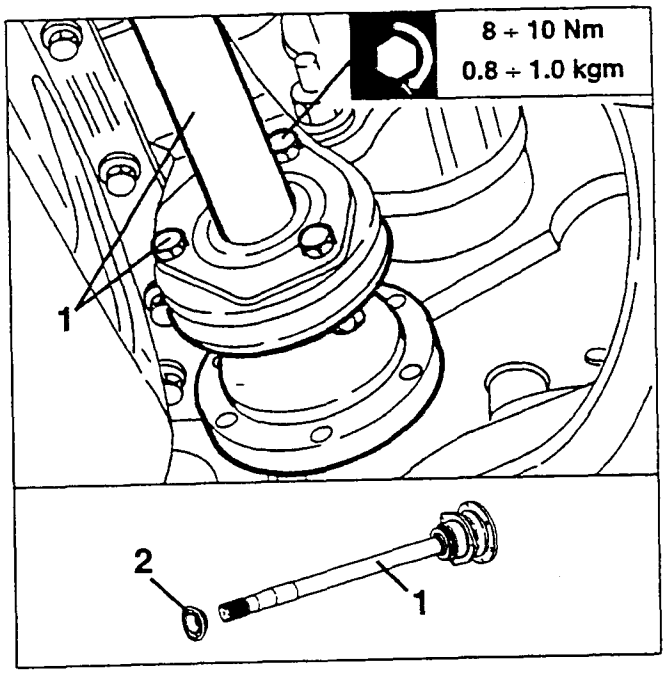
1. Slacken the two bolts fastening the left constant velocity joint from the intermediate shaft.
2. Slacken the two bolts fastening the right upright to the shock absorber, then remove the upper bolt only.



1. Pull back the axle shaft just enough to disconnect it from the intermediate shaft as illustrated.



1. Slacken the three fastening bolts and remove the intermediate shaft.
2. Retrieve the dust guard cup.

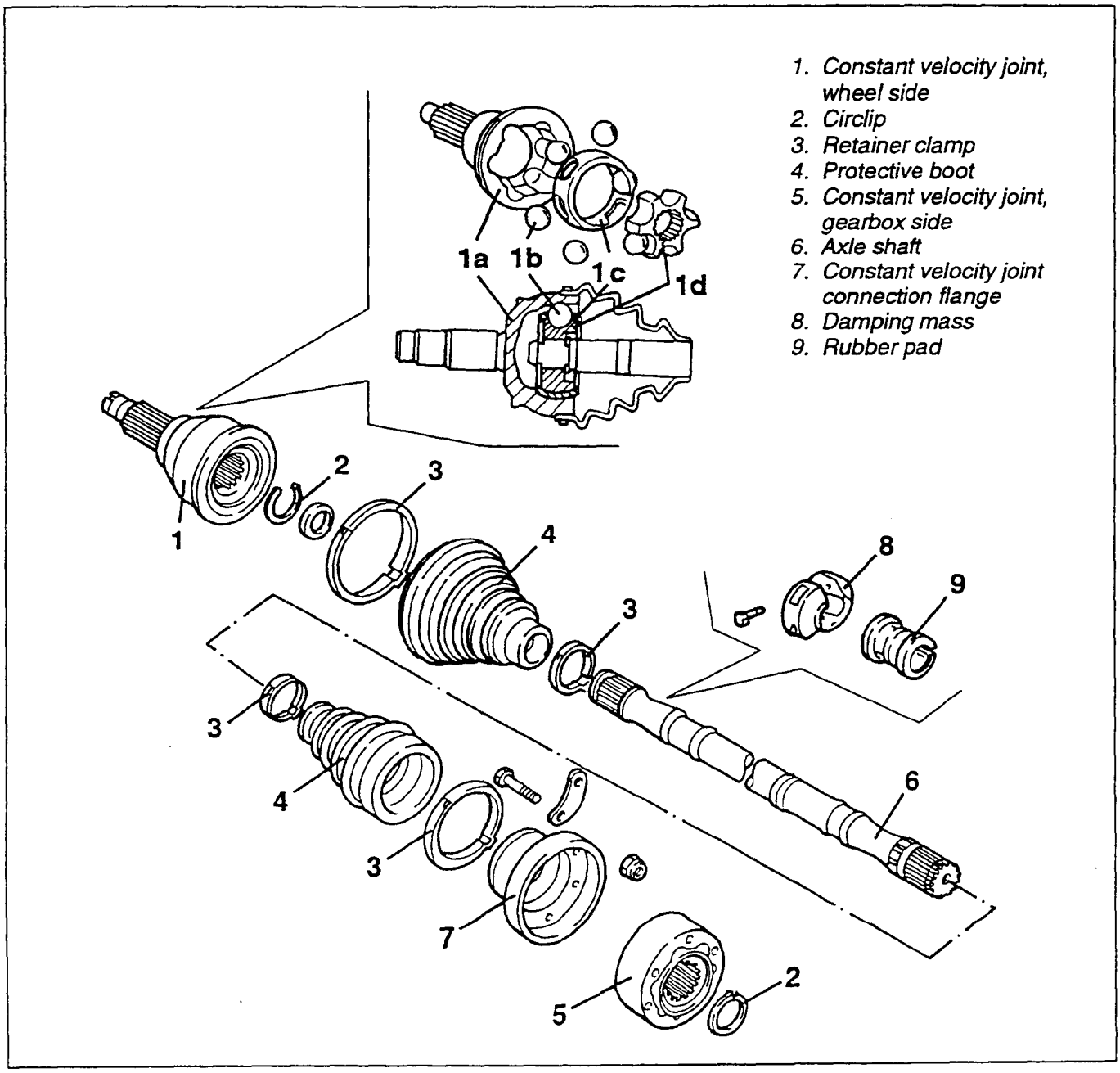


DESCRIPTION

With the constant velocity joints the axle shafts form the set of devices which transmit motion from the gearbox to the driving wheels.
The assembly of these devices, commonly called "transmission" when in conjunction with the gearbox, comprises the following:
- right and left axle shafts;
- constant velocity joints on wheel and gearbox side.
- intermediate shaft.

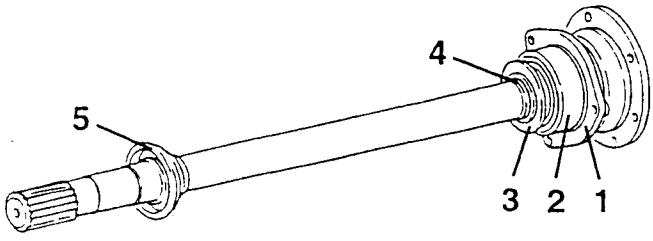
The high-resistance steel axle shafts (6) have grooved ends to enable coupling with the constant velocity joints (1) and (5).
The housings for the joint retainer circlips (2) are on the ends.

The constant velocity joints are formed of an inner core (1d) known as "drive", keyed onto the input shaft and an outer shell (1a) called "driven", which forms the output element of the joint.
The inner core has six spherical grooves on its outer surface containing six balls (1b), held in place by a cage (1c).
These balls are the parts which actually transmit the motion and are also located in other grooves machined on the inner surface of the shell.
The left-hand axle shaft is fitted with a vibration damping mass (8) formed of two half shells and a rubber pad (9) for positioning.



1. *Constant velocity joint, wheel side*
2. *Circlip*
3. *Retainer clamp*
4. *Protective boot*
5. *Constant velocity joint, gearbox side*
6. *Axle shaft*
7. *Constant velocity joint connection flange*
8. *Damping mass*
9. *Rubber pad*

The intermediate shaft, also with grooved ends and, like the axle shafts, made from high-resistance steel, has the purpose of connecting the differential output with the right axle shaft to which it is connected by a flange.
For this purpose, to limit the projection between the connection points, the intermediate shaft is supported by a housing machined especially on the gearbox.



1. *Bearing retainer plate*
2. *Ball bearing*
3. *Flexible washer*
4. *Bearing retainer ring*
5. *Cup for bearing*

REMOVAL/REFITTING

Refer to the instructions for the 1929 TD engine.

DIS-ASSEMBLY OF JOINT ON GEARBOX SIDE

Refer to the instructions for the 1929 TD engine.

REFITTING THE JOINT ON THE GEARBOX SIDE

Refer to the instructions for the 1929 TD engine.

DIS-ASSEMBLY OF THE JOINT ON THE WHEEL SIDE

Refer to the instructions for the 1929 TD engine.

REFITTING THE JOINT ON THE WHEEL SIDE

Refer to the instructions for the 1929 TD engine.

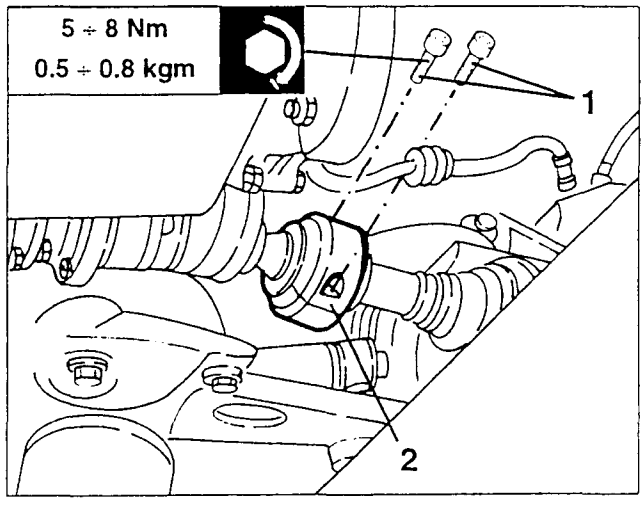
REMOVAL/REFITTING OF INTERMEDIATE SHAFT

Refer to the instructions for the 1929 TD engine.

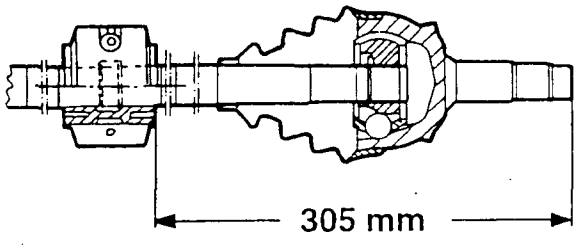
LEFT-HAND AXLE SHAFT DAMPING MASS

REMOVING/REFITTING

- On the left-hand side of the car, proceed as follows:
1. Slacken the screws fastening the two half shells forming the damping mass.
2. Remove the mass together with the rubber pad below.



Refit reversing the sequence followed for removal taking care to position the damping mass observing the dimension on the diagram.

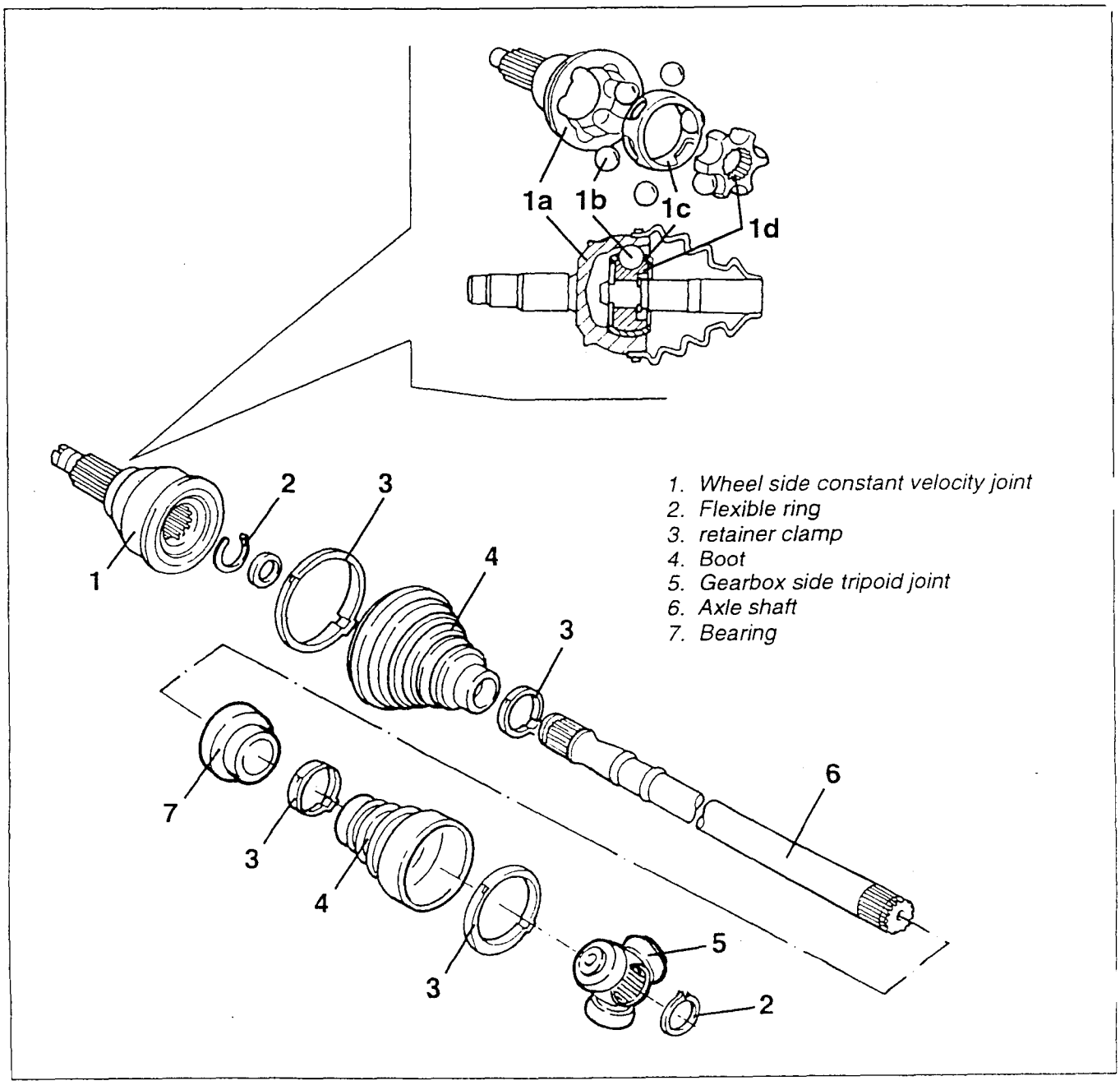


DESCRIPTION

The axle shafts, together with the constant velocity joints and the tripoid joints, form the set of device which transmit motion from the gearbox to the driving wheels.
The assembly of these devices, in conjunction with the gearbox is commonly known as the "transmission" and it comprises the following:
- right and left axle shafts;
- wheel side constant velocity joints;
- gearbox side tripoid joints.

The axle shafts (6), made from very tough steel, have with grooved ends to enable coupling with the constant velocity joint (1) and tripoid joint (5). On the ends there are the housings for the retainer circlips (2) of the joints themselves.

The constant velocity joints are formed of an inner core (1d) called "drive", shrunk onto the input shaft, and an outer shell (1a) called "driven", which forms the output of the joint.
The inner core has six spherical grooves on the outside containing the same number of balls (1b), held in place by a container cage (1c).
These balls, are the actual motion transmitting element, at the same time they are housed in the same number of grooves on the inner surface of the shell.
The right axle shaft is fitted with a vibration damping mass (8) formed of two halves and a rubber plug (9) for positioning.



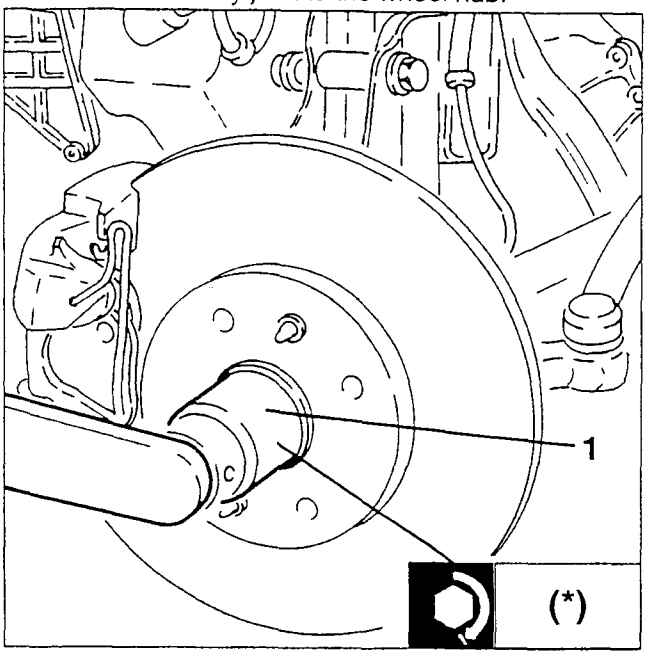
1. *Wheel side constant velocity joint*
2. *Flexible ring*
3. *retainer clamp*
4. *Boot*
5. *Gearbox side tripoid joint*
6. *Axle shaft*
7. *Bearing*

REMOVING/REFITTING

The following procedure refers to removing/refitting the left axle shaft.
E' it is however possible to use the whole procedure also for removing the right axle shaft.

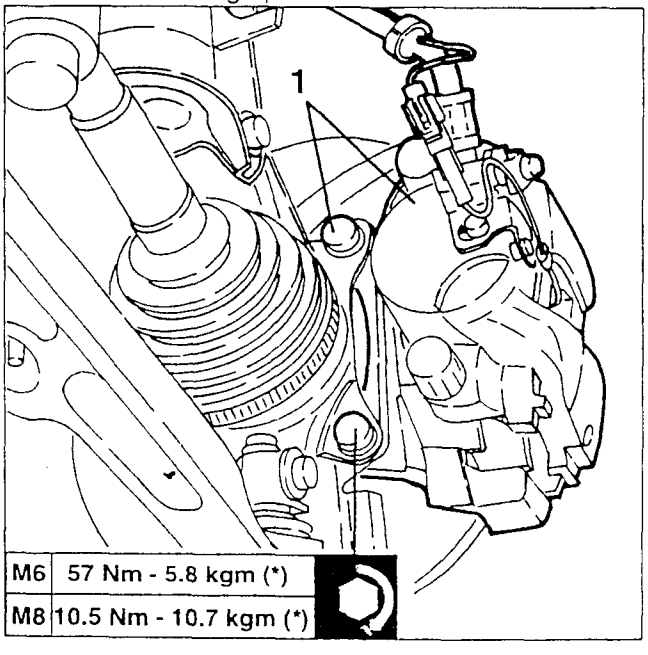
- Set the car on a lift.
- Remove the left front wheel.

1. Remove the caulking and slacken the nut fastening the constant velocity joint to the wheel hub.



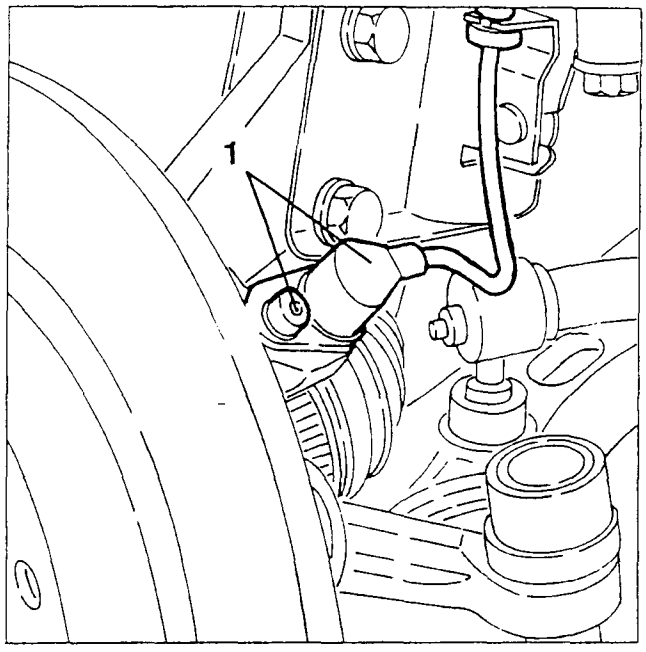
(*): When refitting tighten the fastening nut working as described in GROUP 44.

1. Slacken the two fastening screws and remove the brake caliper complete without disconnecting the hoses and fasten it on one side so that it does not hinder the following operations.

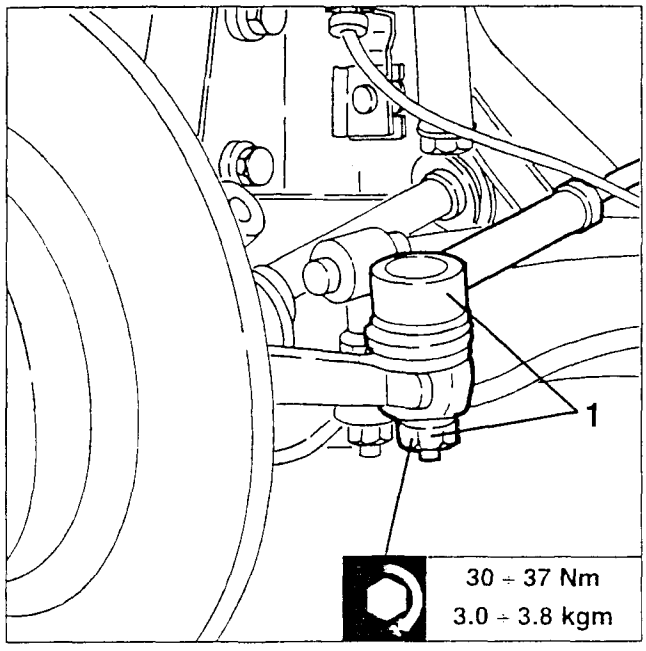


(*): Screws with "Driloc"; must be changed every time they are tightened or loosened.

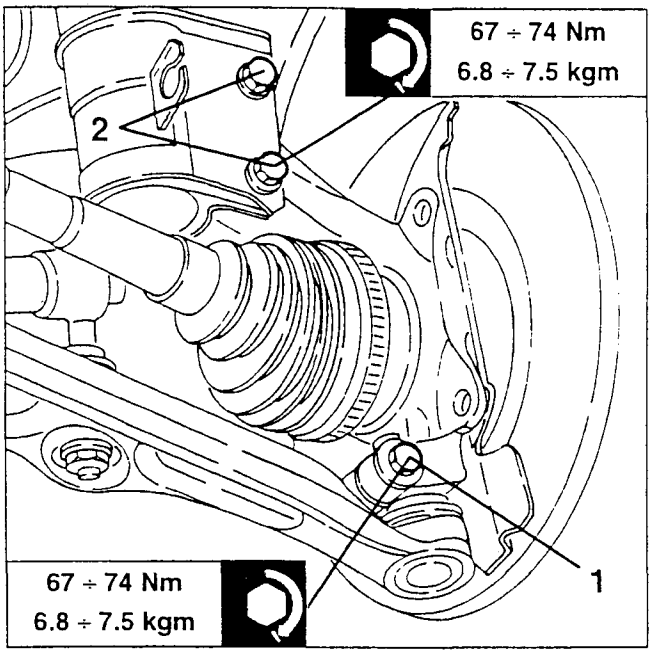
1. Slacken the fastening screw and remove the A.B.S. inductive sensor from the wheel upright.



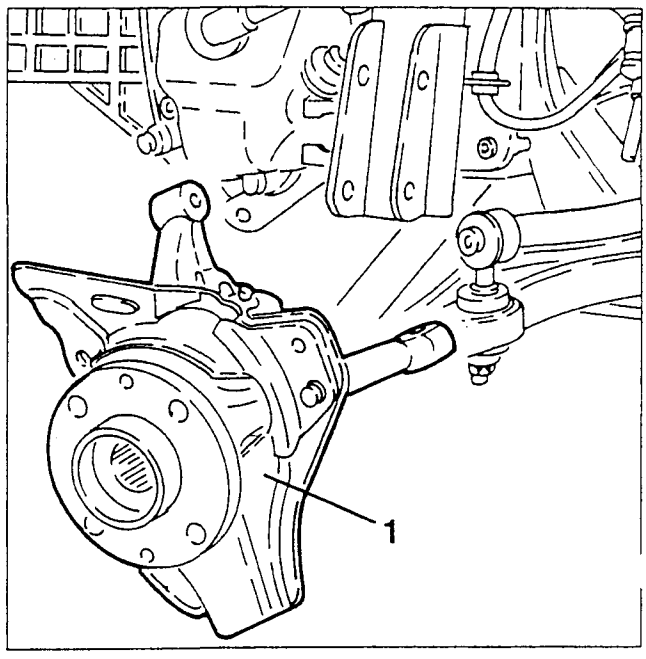
1. Slacken the fastening nut and disconnect the track rod from the wheel upright.



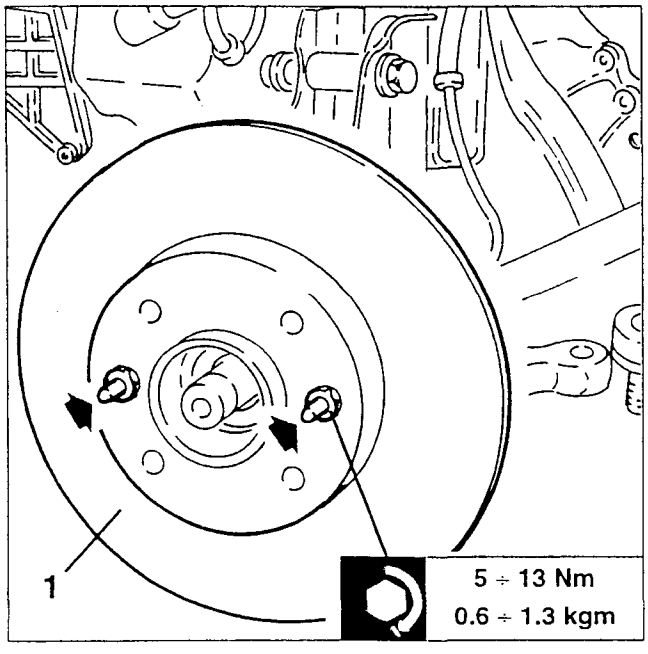
1. Slacken the bolt fastening the wishbone to the wheel upright.
2. Slacken the two bolts fastening the upright to the shock absorber.



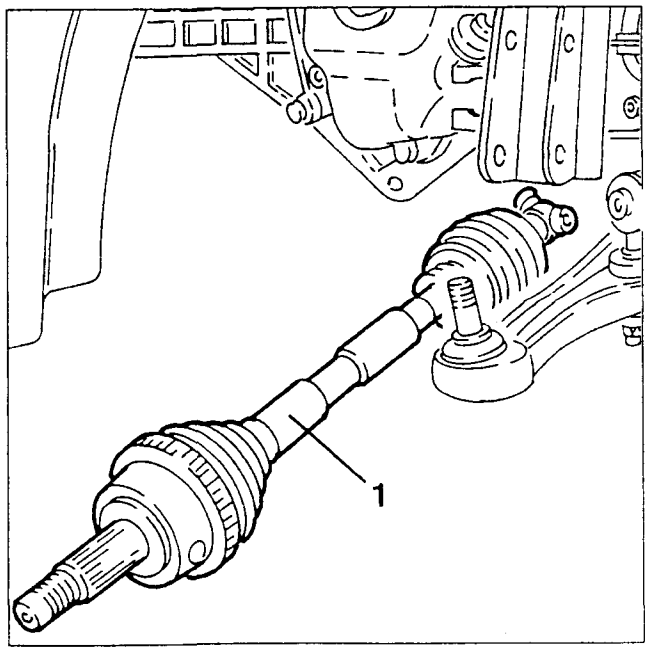
1. Withdraw and remove the wheel upright complete



1. Slacken the two fasteners and remove the brake disk.



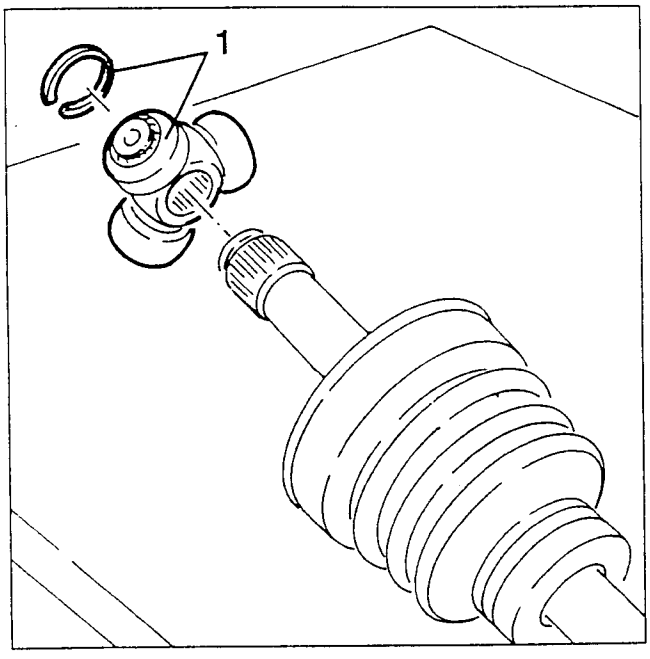
1. Slacken the clamp fastening the boot to the differential tripod joint, then withdraw and remove the axle shaft complete.



DISASSEMBLING THE GEARBOX SIDE CONSTANT VELOCITY JOINT

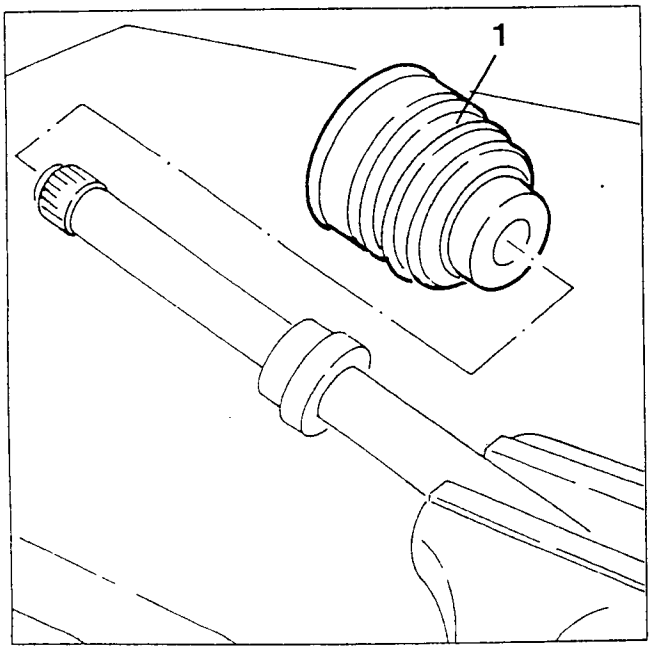
1. Remove the retainer circlip, then withdraw and remove the tripoid joint.

WARNING: If any faults are found in the tripoid joit it must be changed.

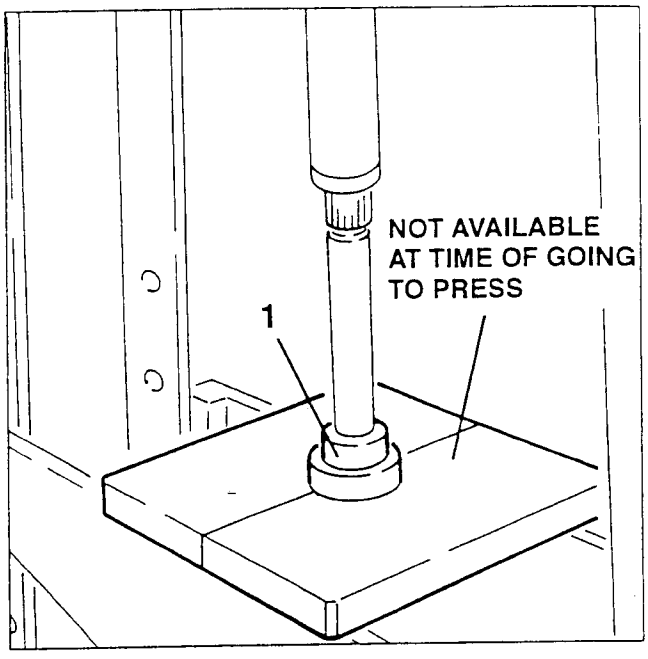


1. Slacken the fastening clamp and remove the boot.

WARNING: When reassembling replace the boot and its fastening clamps.

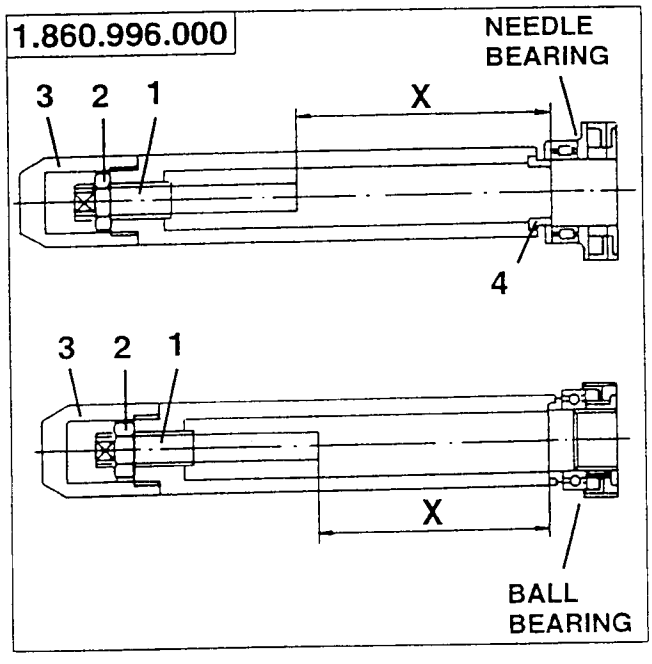


1. Working under the press and using half plates no. ....., prise and remove the bearing from the axle shaft.



REFITTING THE GEARBOX SIDE CONSTANT VELOCITY JOINT

For assembling the bearing on the axle shaft use drift no. 1.860.996.000.



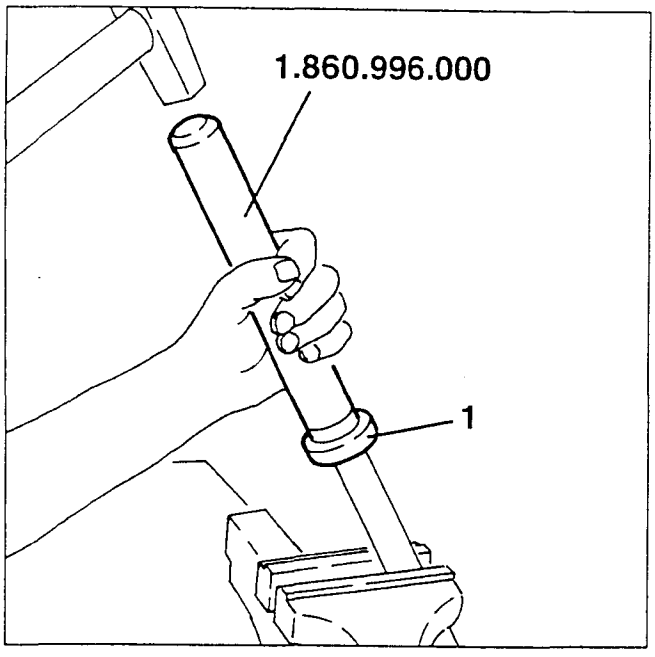
1. Screw for adjusting bearing force-fitting dimension
2. Screw locknut
3. Drift to be inserted when force the bearing
4. Adapter for force-fitting needle bearings

Adjust the above-mentioned tool so that dimension X for positioning the bearing is as specified.

Dimension "X" for positioning bearing (mm)		
Right axle shaft	108.8 (1)	107.7 (2)
Left axle shaft	143.8 (1)	142.7 (2)

(1): needle bearing (2): ball bearing

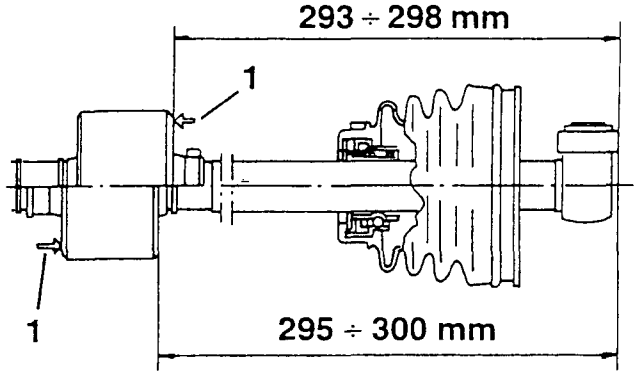
1. Using tool no. 1.860.996.000 adjusted as described previously, force fit the bearing on the shaft until the end contact screw of the tool contacts the axle shaft. This way correct positioning of the bearing is guaranteed.



- Fit the boot on the bearing and fasten it with its clamp.
Fit the tripoid joint on the axle shaft and fasten it with the retainer circlip.

RIGHT AXLE SHAFT DAMPING MASS

On the right axle shaft a vibration damping mass is installed.
When disassembling from the axle shaft it must be reassembled at the specified position.



(1): Direction of assembly

DISASSEMBLING THE WHEEL SIDE CONSTANT VELOCITY JOINT

See the instructions for 1929 TD

REMOVING THE WHEEL SIDE CONSTANT VELOCITY JOINT

See the instructions for 1929 TD

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GEARBOX

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1370 1598 1747 T. SPARK 16V ..... (*)

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REMOVAL/REFITTING 1370 T. SPARK 16V

With C.513.5 gearbox from chassis no. 24

- Operations on the car 1370 T. SPARK 16V

  with C.51315 gearbox from chassis no. 30

OUTER CONTROLS

1370 1598 1747 T. SPARK 16V

- Gearshift control rod ..... (*)
- Gearshift control lever ..... (*)

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OUTER CONTROLS 1910 JTD

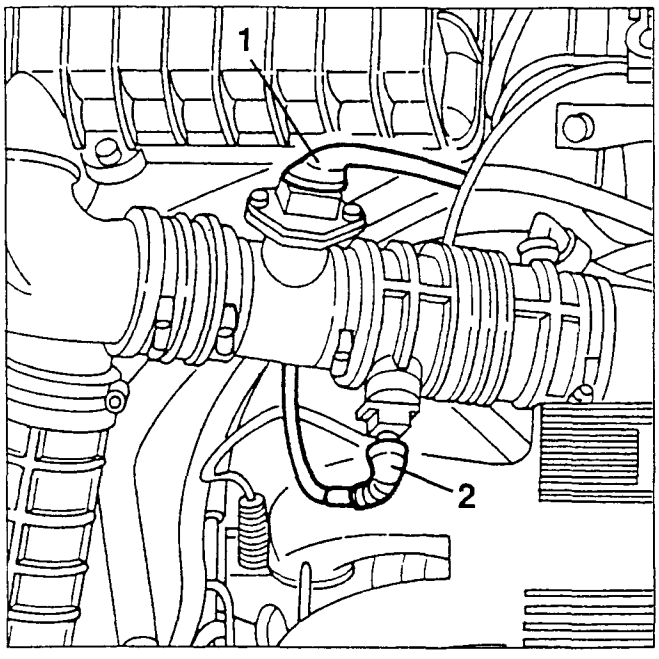
- Support for gearshift and handbrake control levers 42
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(*): See instructions given for 1970 T. SPARK 16V

REMOVAL/REFITTING

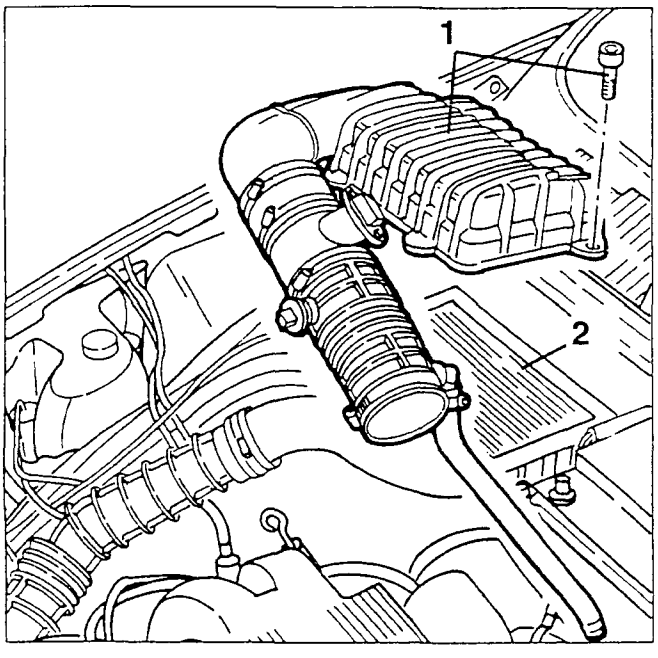
- Set the car on a lift.
- Remove the battery (see GROUP 55).
- Remove the gearbox cover (see GROUP 70).
- Remove the radiator grille and the front bumper (see GROUP 70).
- Remove the resonator

1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the electrical connection from the intaken air temperature sensor.

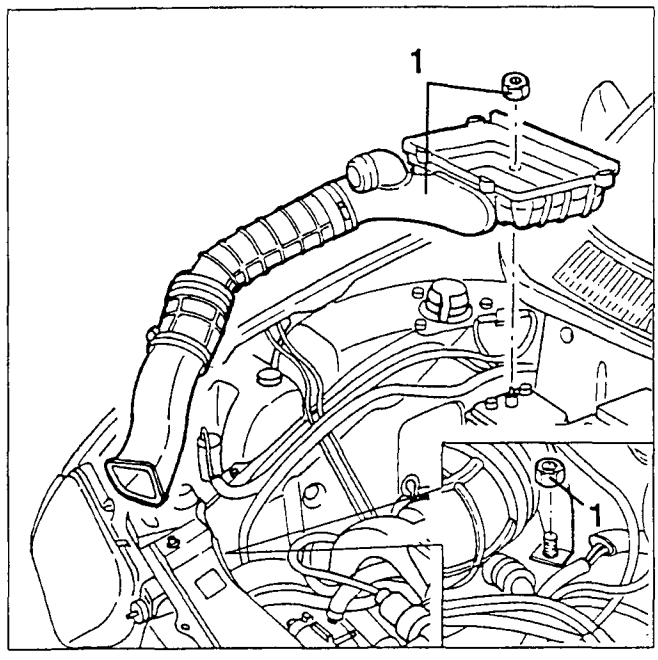


- Disconnect the oil vapour recovery pipe from the engine oil filler.
- Disconnect the corrugated sleeve from the intake box.

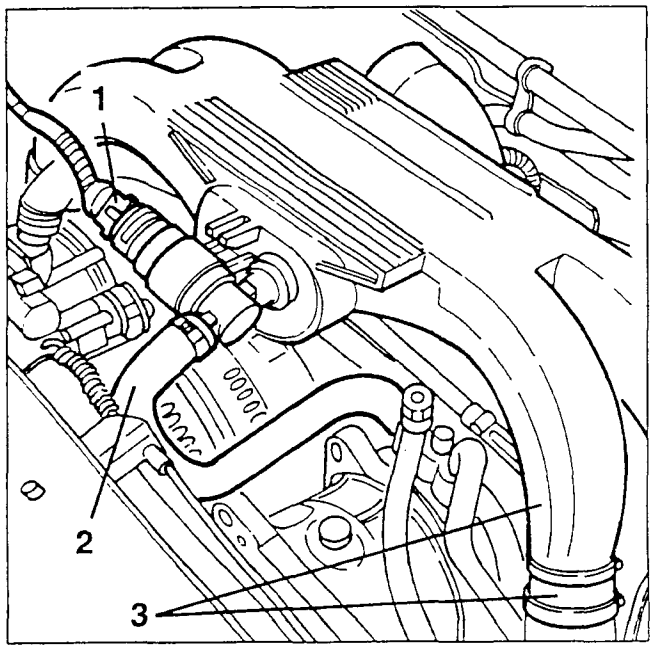
1. Slacken the four fastening screws and remove the air cleaner cover complete with sleeves.
2. Remove the filtering element.



1. Slacken the three nuts fastening the air cleaner box and the front bolt fastening the air inlet sleeve and remove it.



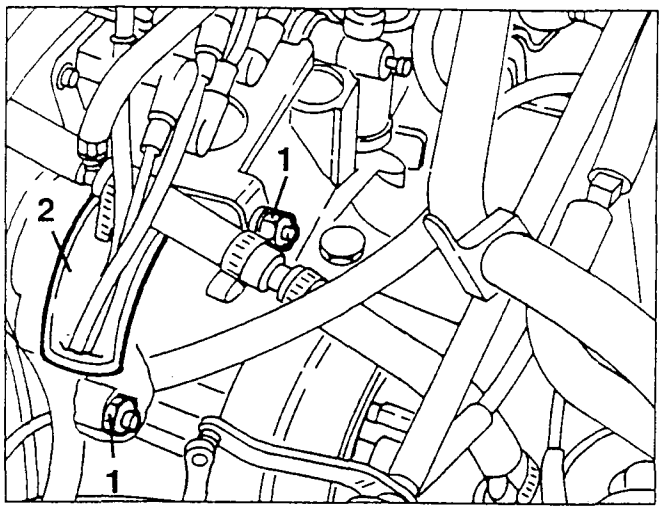
1. Disconnect the electrical connection from the idle speed actuator.
2. Disconnect the air intake pipe.
3. Slacken the clamps fastening the bodies, then remove the intake box releasing it from the cables and from the pipes fastened to the brackets below.



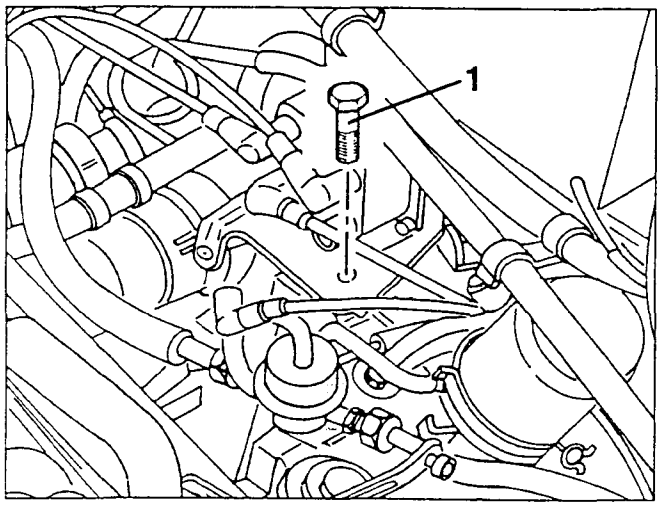
NOTE: Suitably plug the intake ducts to prevent foreign matter from getting into them.

1. Slacken the two bolts fastening the starter motor.

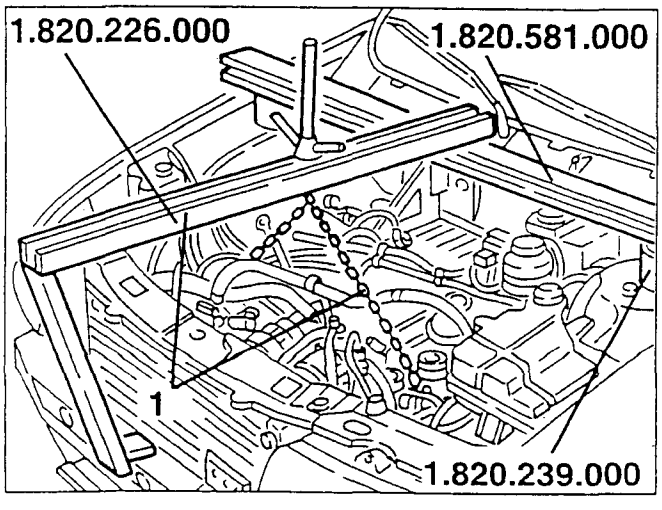
2. Retrieve the protective cover.



1. Slacken the screw fastening the ignition coils support bracket.

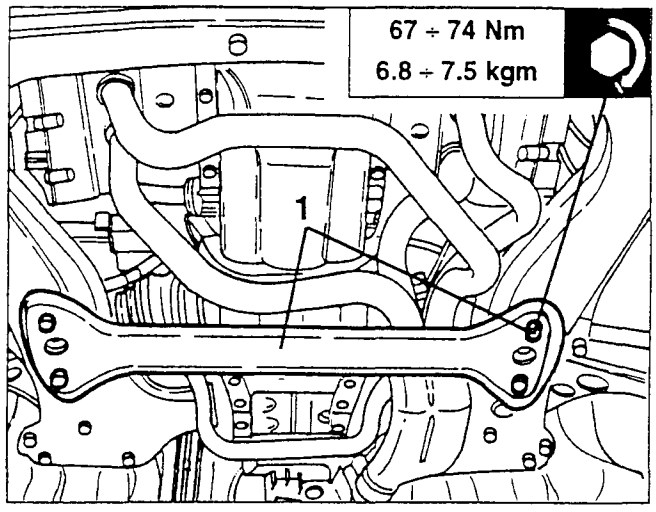


1. Using tools N° 1.820.239.000, N° 1.820.581.000 and N° 1.820.226.000 suitably support the engine.

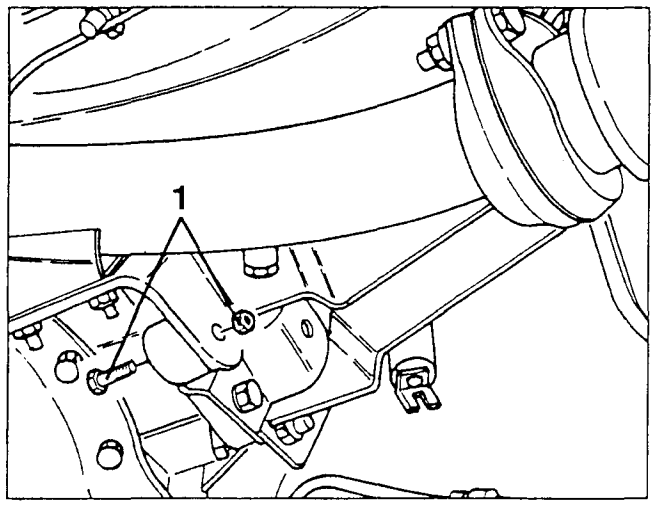


- Raise the car.

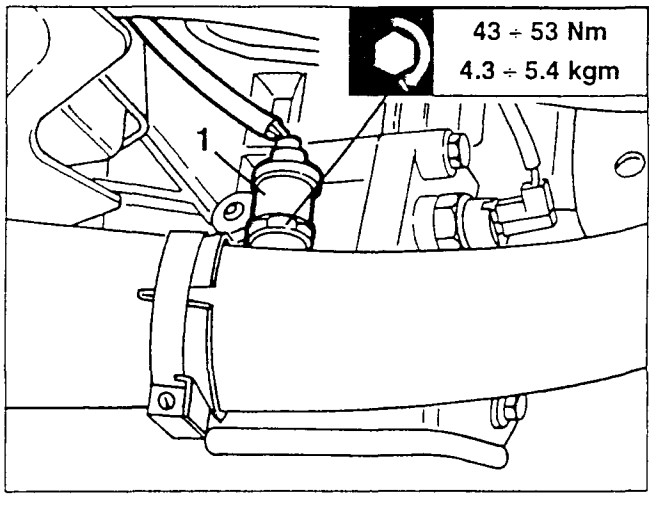
1. Slacken the fastening screws and remove the engine mount frame crossmember.



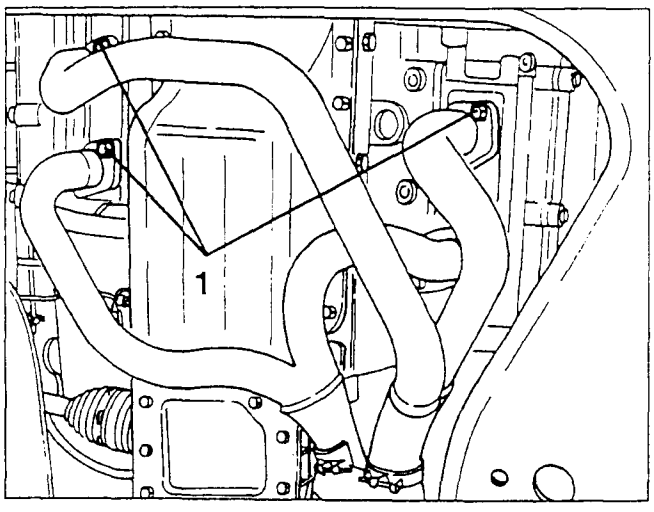
1. Slacken the bolt fastening the exhaust manifold support bracket.



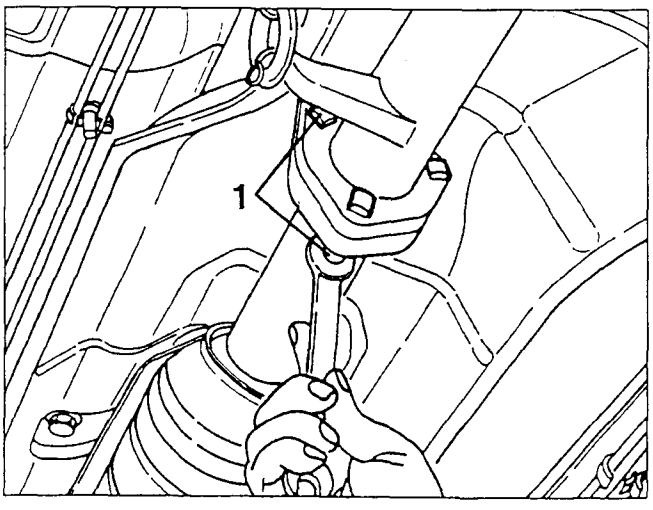
1. Remove the lambda sensor from the exhaust pipe.



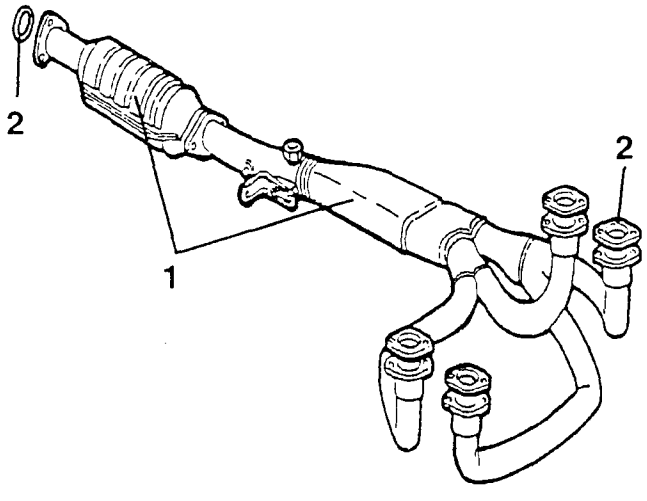
1. Slacken the nuts fastening the exhaust manifolds to the cylinder heads.



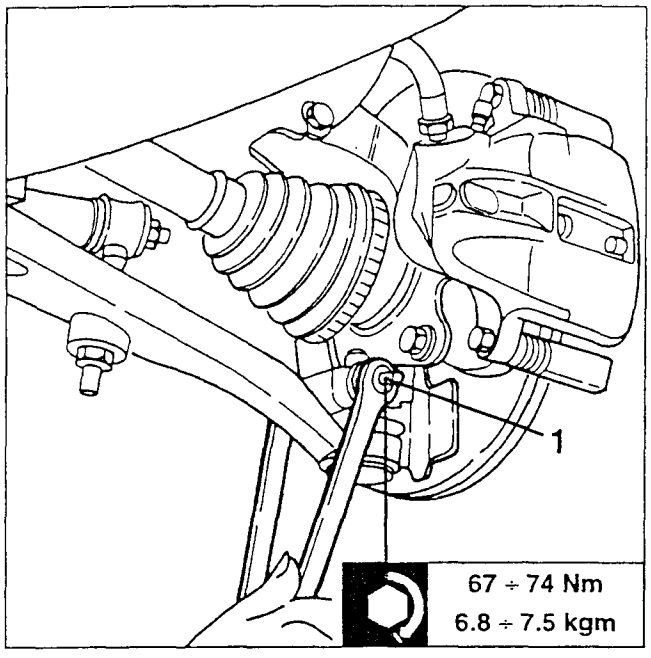
1. Slacken the three bolts fastening the catalytic converter to the exhaust silencers.



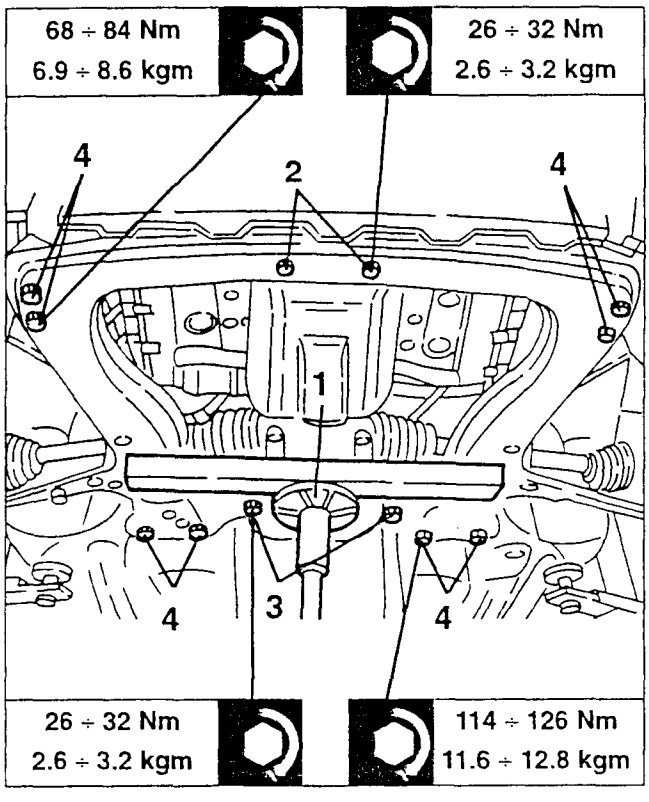
1. Remove the exhaust manifolds complete with the catalytic converter.
2. Retrieve the seals.
- Remove the catalyst heat guard.



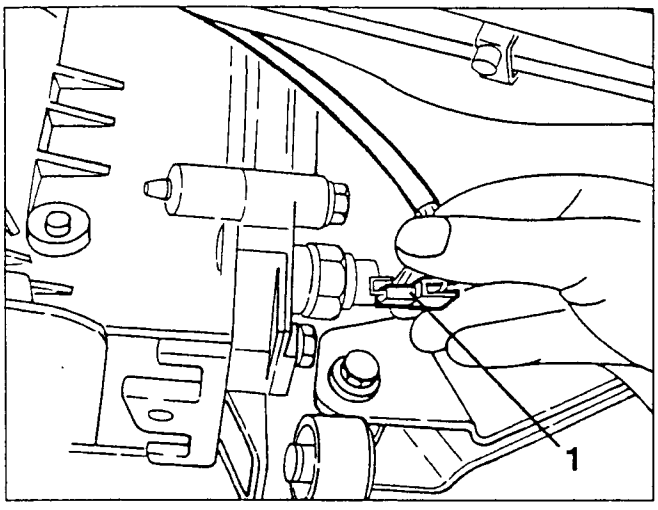
- Remove the front wheels.
1. Slacken the bolts fastening the wishbones to the wheel hubs.



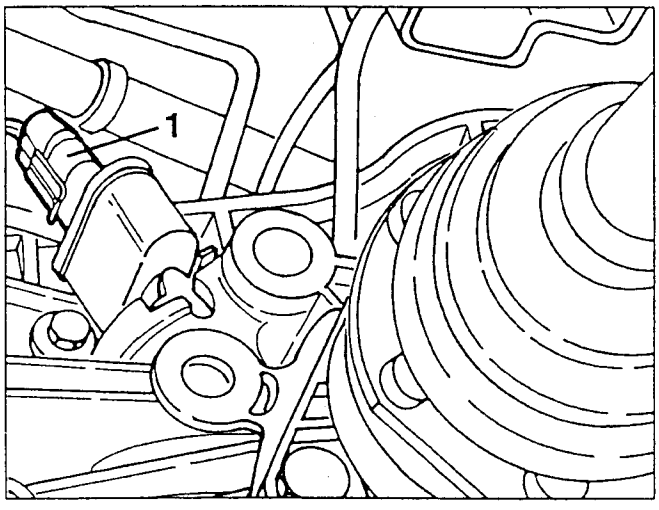
1. Suitably support the engine mount frame with a jack.
2. Slacken the two screws fastening the frame to the engine flexible mount.
3. Slacken the two screws fastening the frame to the gearbox flexible mounts.
4. Slacken the screws fastening the frame to the body and remove it complete with wishbones and stabilizer bar.



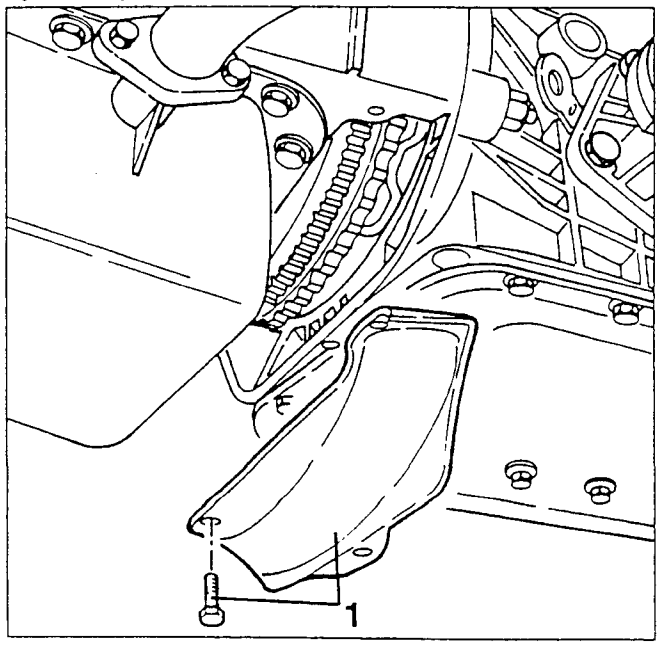
1. Disconnect the electrical connection from the reversing switch.



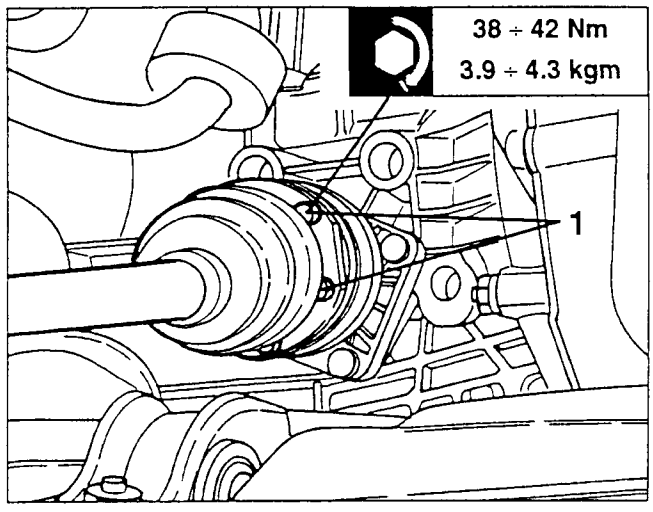
1. Disconnect the electrical connection from the speedometer sensor.



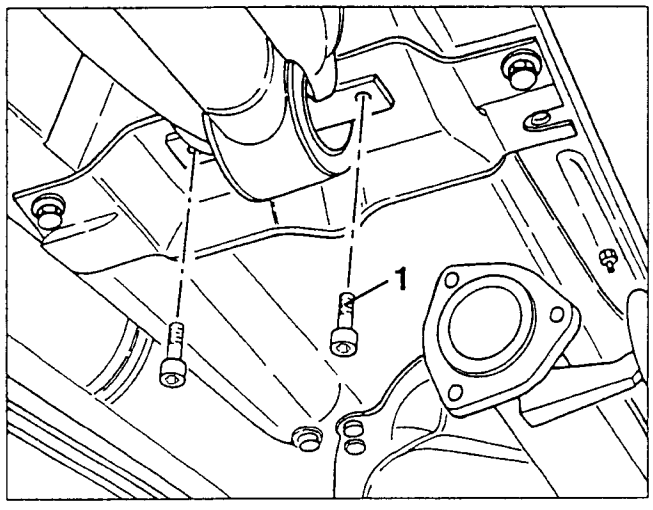
1. Slacken the three fastening screws and remove the flywheel guard.



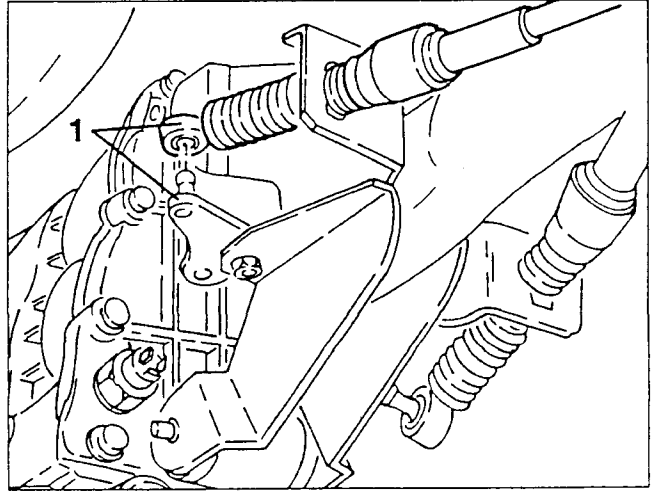
1. Slacken the fastening screws and disconnect the axle shafts.



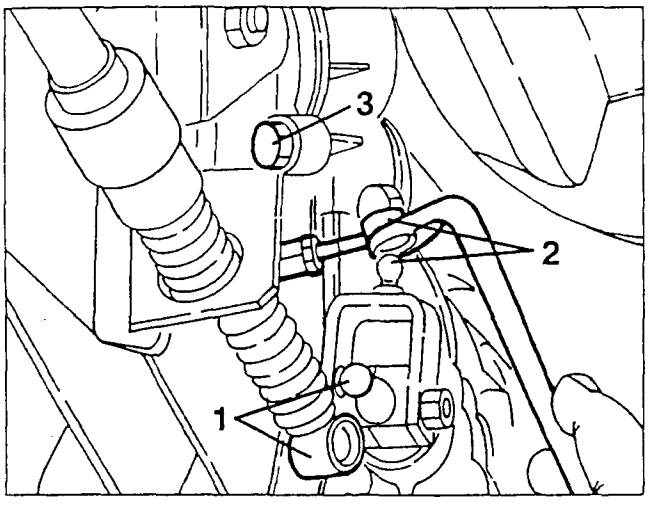
1. Slacken the two screws fastening the power unit rear support to the body and lower the power unit rearwards using the support tools.



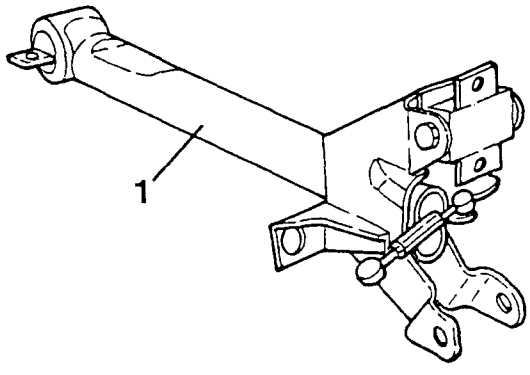
1. Disconnect the gear selector cable from the fastening on the transmission linkage.



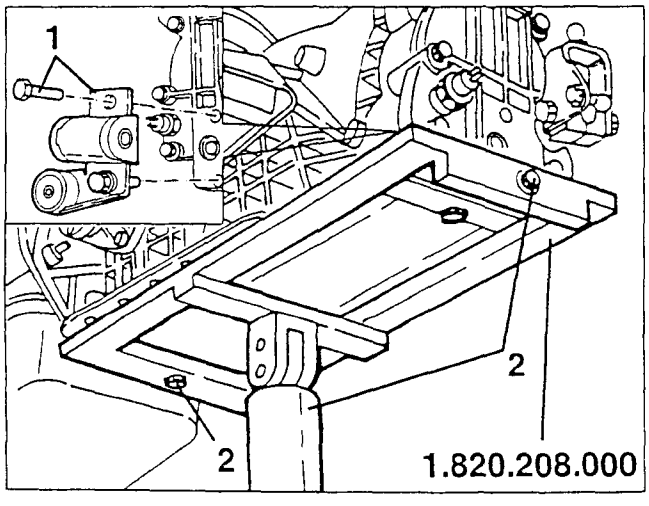
1. Disconnect the gear engagement cable from its fastening.
2. Disconnect the transmission rod of the gear selector cable from its fastening.
3. Slacken the bolt and the two upper screws fastening the rear power unit support to the gearbox cover.



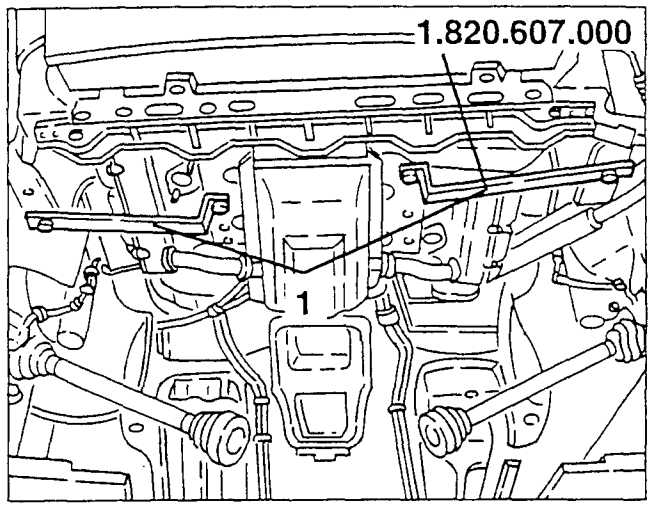
1. Remove the rear power unit support taking care to take the gearshift control cables off it.



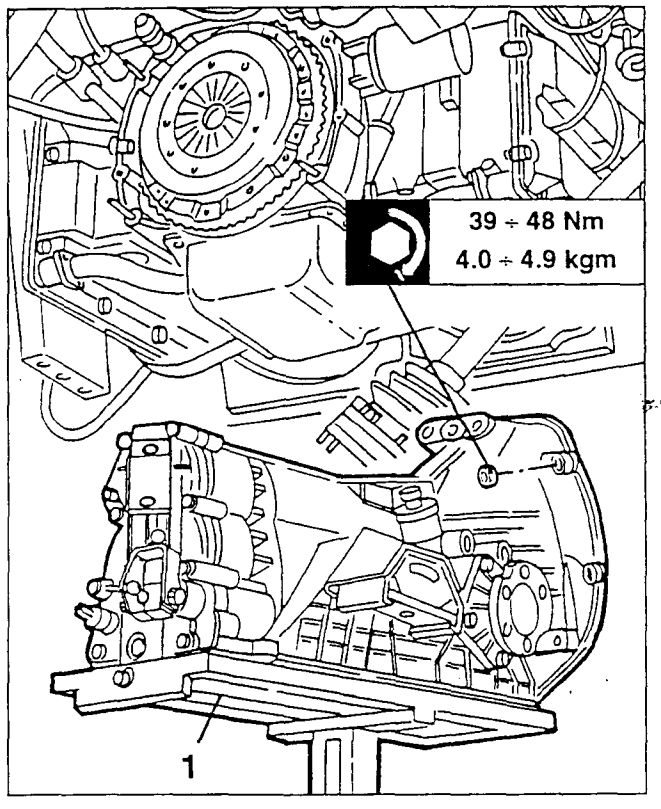
1. Slacken the two fastening screws and remove the lower flexible mount.
2. Install stand N° 1.820.208.000 fitted with a hydraulic jack as illustrated under the gearbox sump.



1. Fit two safety brackets N° 1.820.607.000 to support the engine.



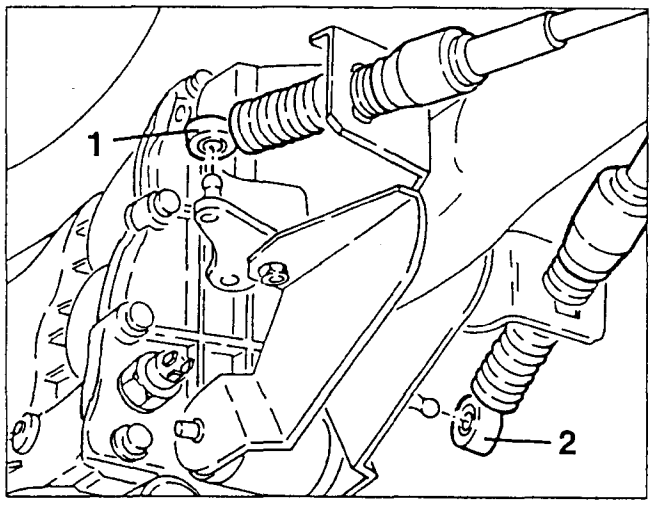
1. Slacken the fastening nuts, suitably move the gearbox- differential unit to free it from the dowels on the engine and to release the clutch shaft from the driven plate. Then lower the hydraulic jack and remove the gearbox-differential unit.



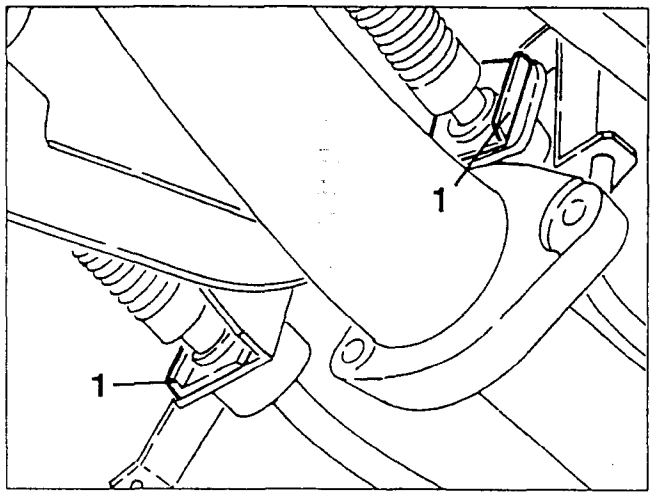
GEARBOX CONTROL CABLES

REMOVAL/REFITTING

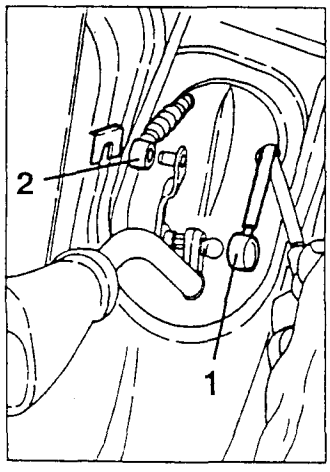
- Remove the catalytic converter and the corresponding heat guard (see GROUP 10).
1. Disconnect the gear selector cable from the fastening on the transmission linkage.
2. Disconnect the gear engagement cable from its fastening.



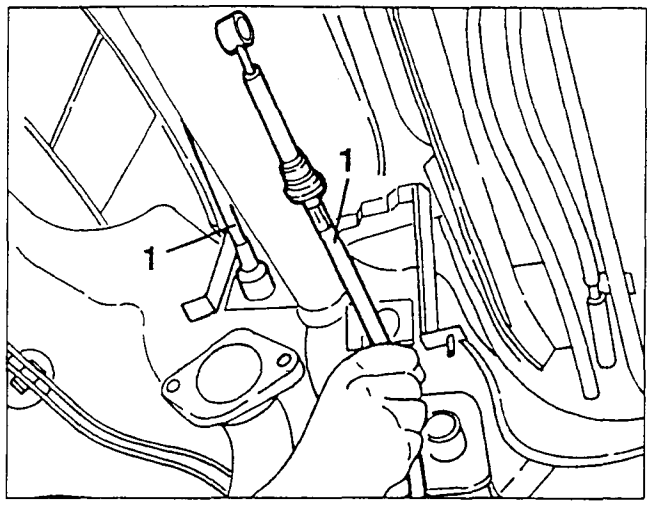
1. Remove the two gearshift control cable fastening clips from the power unit rear support.



- Remove the gearbox centre console (see GROUP 70).
1. Disconnect the gear selector cable from the fastening on the control lever.
2. Remove the catch and disconnect the gear selector cable from the control lever.

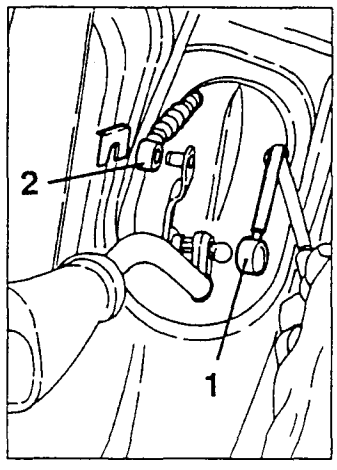


- Raise the car.
1. Withdraw and remove the two gearshift control cables.

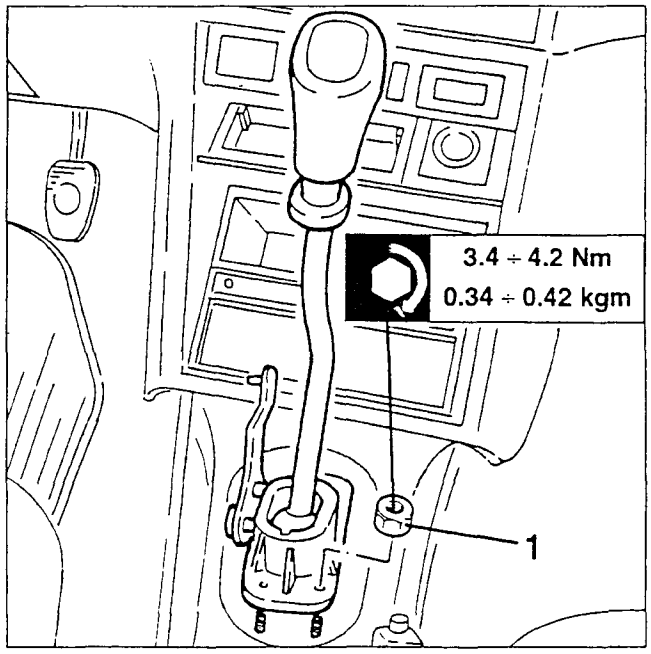


GEARSHIFT CONTROL LEVER

- Remove the gearbox centre console.
1. Disconnect the gear selector cable from the fastening on the control lever.
2. Remove the catch and disconnect the gear selector cable from the control lever.



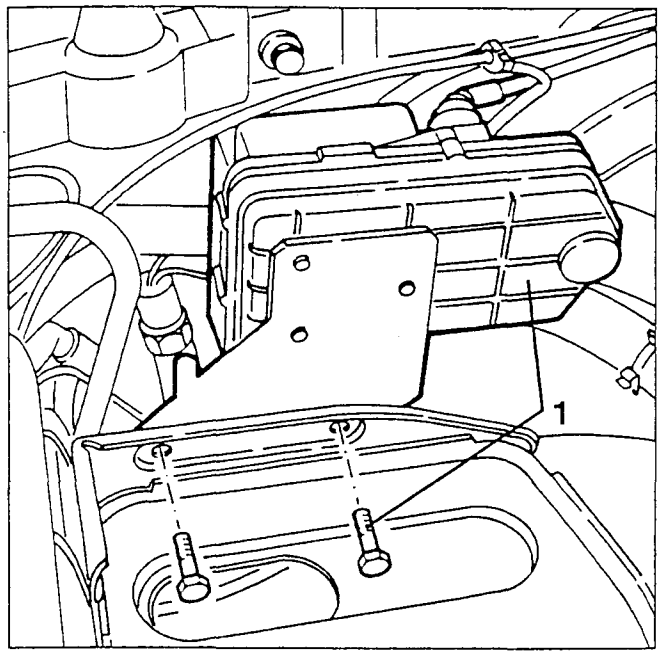
1. Slacken the three fastening nuts and remove the gearshift lever.



REMOVAL/REFITTING

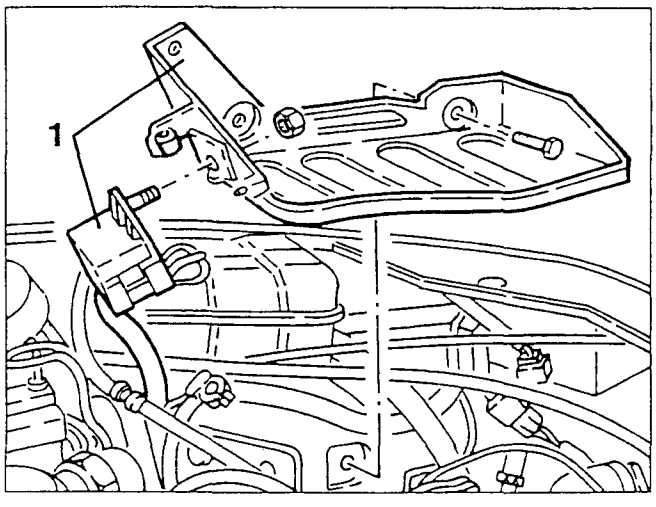
- Set the car on a lift.
- Remove the front wheels.
- Remove the radiator grille and the front bumper (see GROUP 70).
- Remove the battery (see GROUP 55).

1. Slacken the two fastening screws and move the air condtioner control unit to one side.



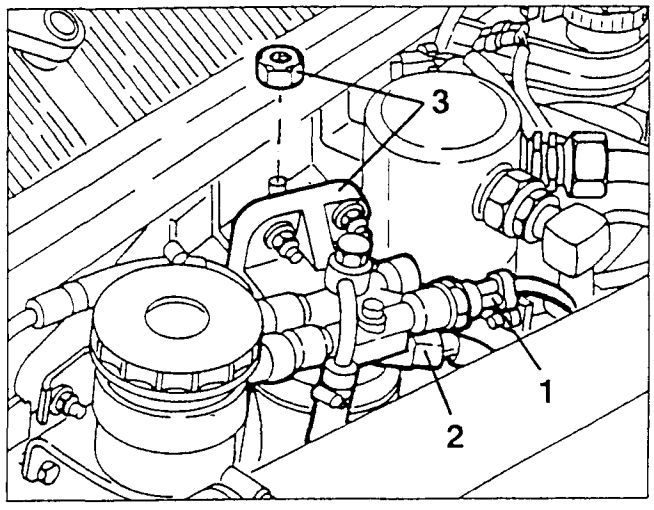
- Remove the battery acid drain duct.

1. Slacken the battery support bracket fastening screws, then remove it after disconnecting the glow plug warming control unit.

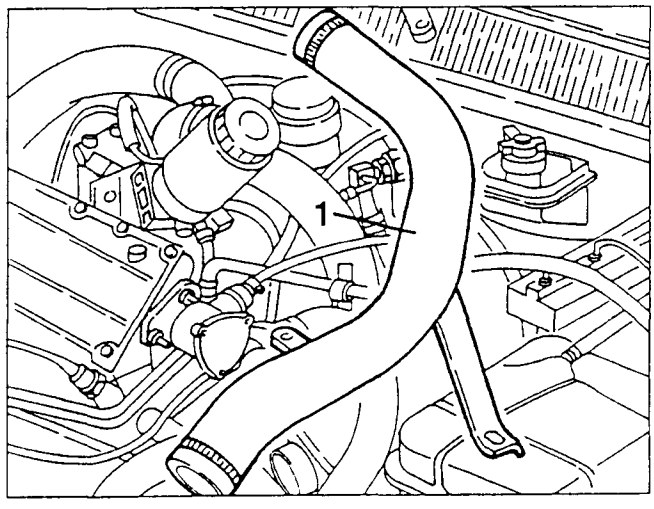


1. Disconnect the electrical connection from the fuel warming device sensor.
2. Disconnect the electrical connection supplying the fuel warming device.

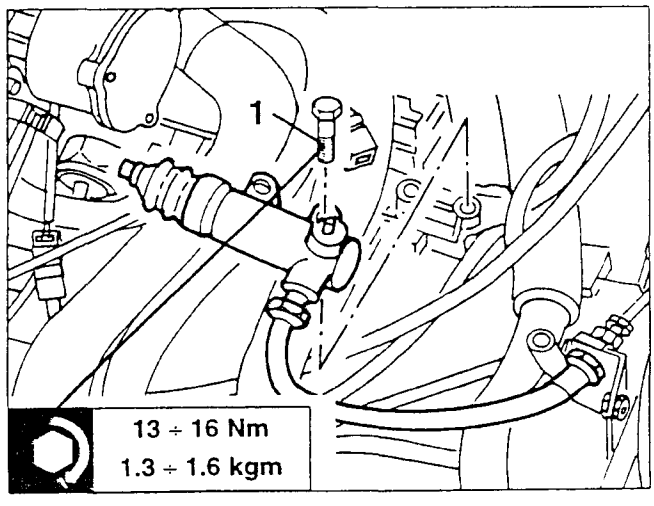
3. Slacken the nut fastening the fuel filter, then move it without disconnecting the hoses.



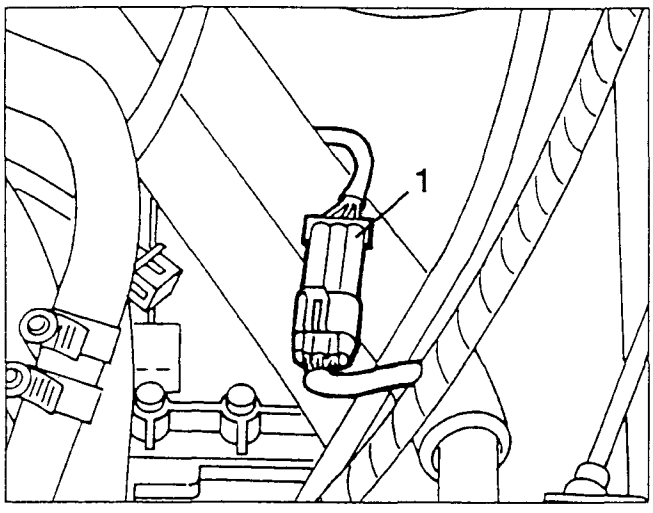
1. Slacken the clamps and screw of the intermediate bracket, then remove the stiff air delivery pipe from the turbocharger.



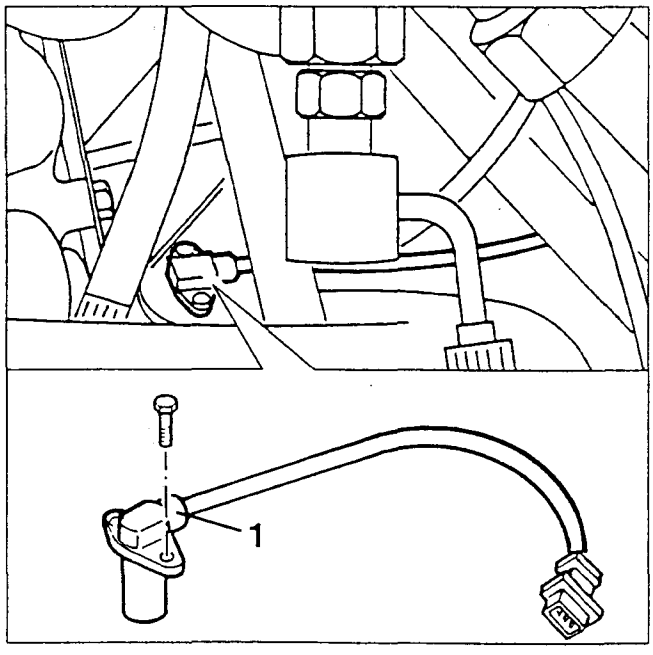
1. Slacken the two clutch control cylinder fastening screws and move it to one side without disconnecting the control hose.



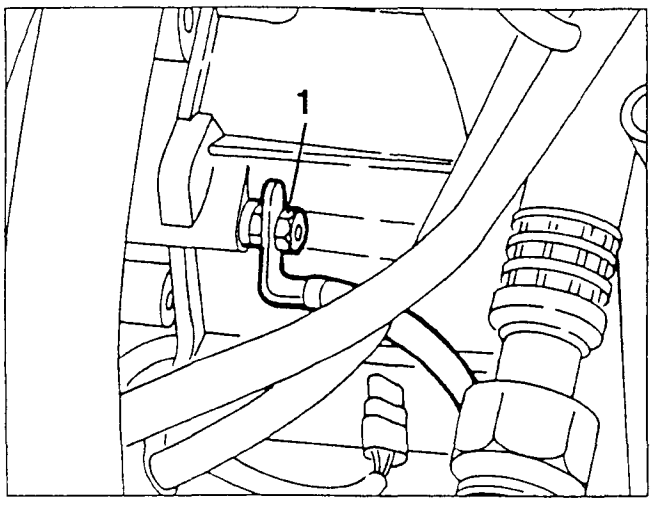
1. Disconnect the electrical connection of the speedometer sensor.



1. Disconnect the electrical connection, slacken the two fastening screws and remove the rpm sensor.

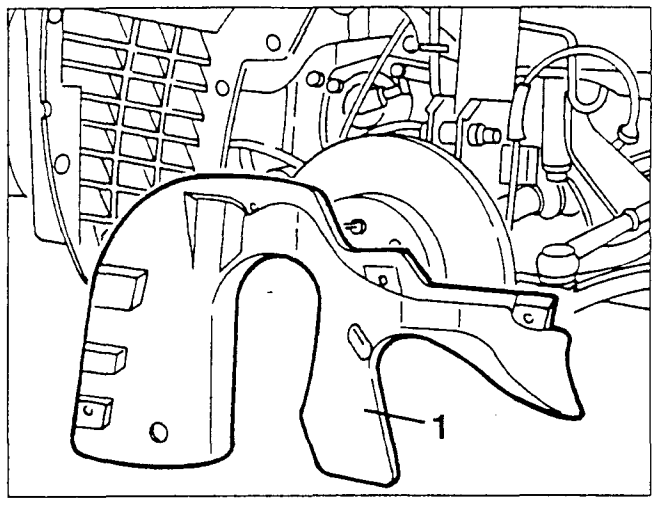


1. Disconnect the earth point of the battery (-) terminal.

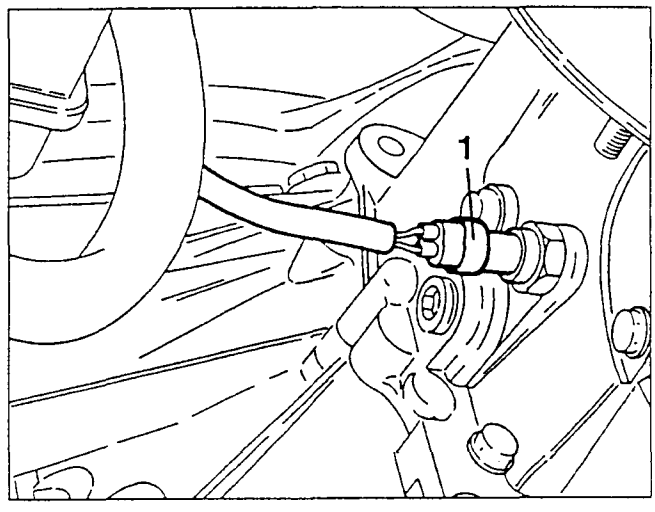


- Raise the car.
- Working from the lefthand wheel arch disconnect the electrical connection of the brake pad wear sensor.
- Slacken the screw fastening the ABS inductive sensor support bracket.

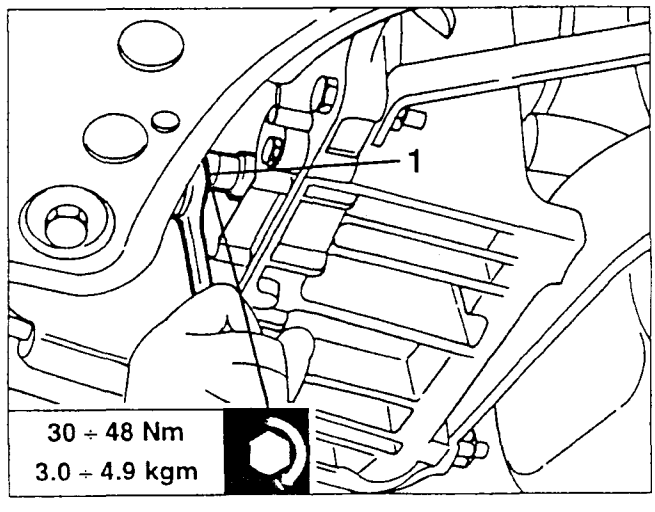
1. Remove the mud flaps from the wheel arches.



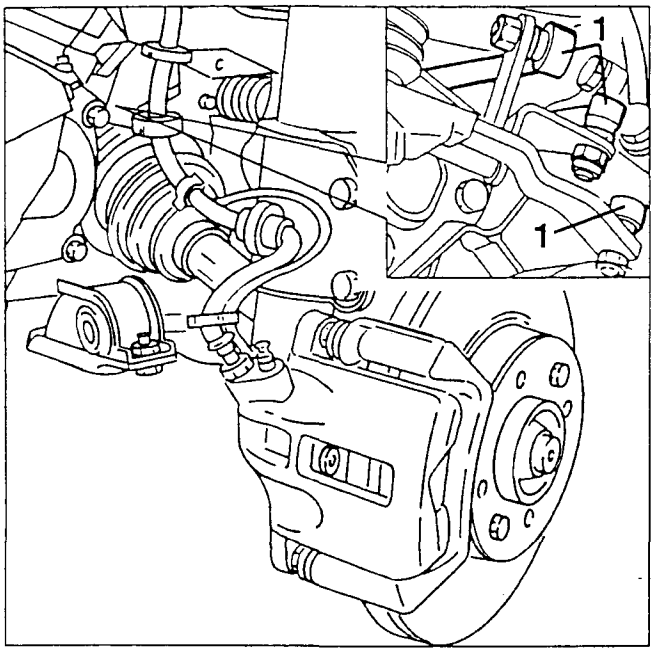
1. Disconnect the electrical connection from the reversing switch.



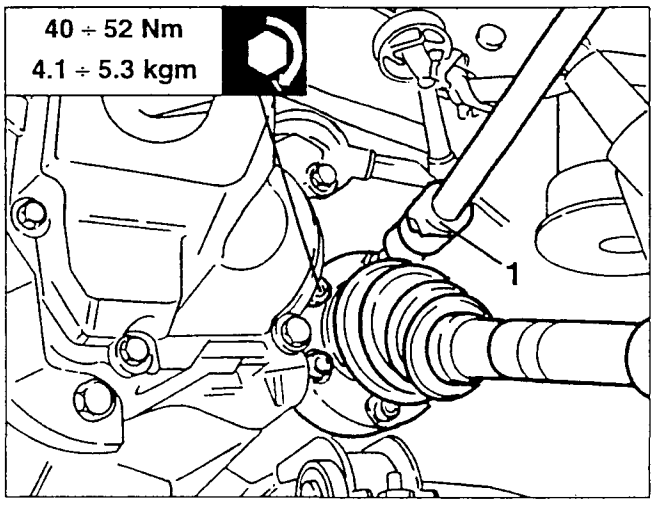
1. Remove the plug and drain the gearbox-differential oil into a suitable recipient.



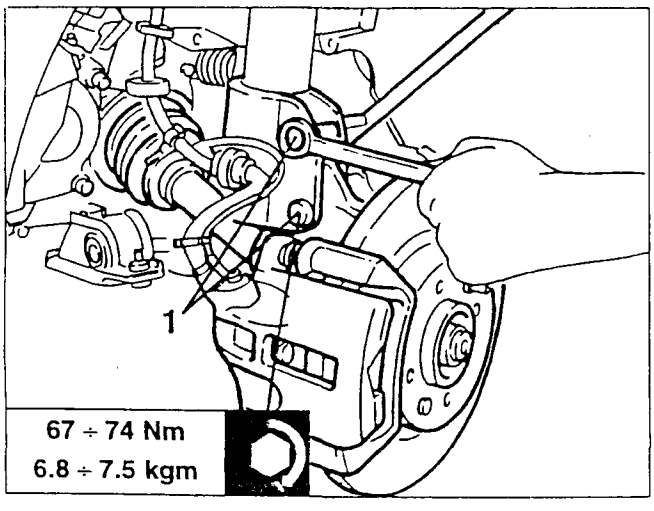
1. Working from the lefthand wheel arch, disconnect the gearshift control rods.



1. Slacken the axle shaft fastening screws.

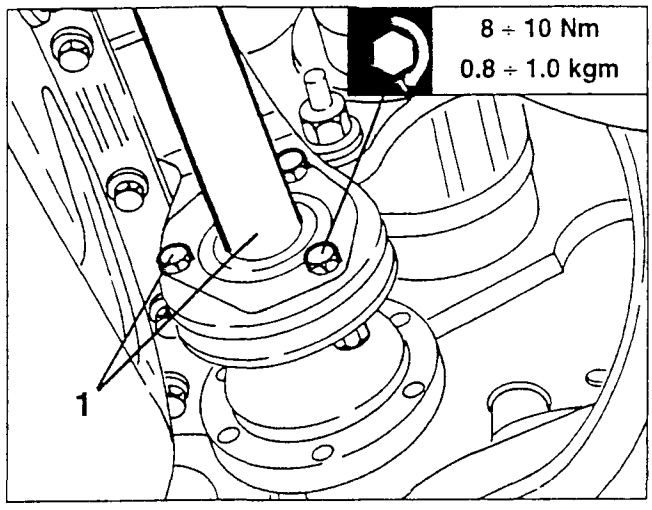


1. Slacken the two bolts fastening the right and left uprights to the corresponding shock absorbers, then withdraw the upper bolts only.

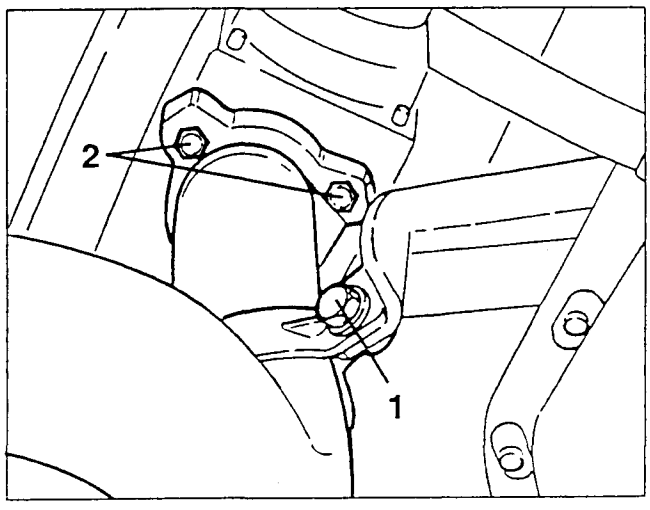


This operation makes it possible to move the axle shafts rearwards enough to disconnect them.

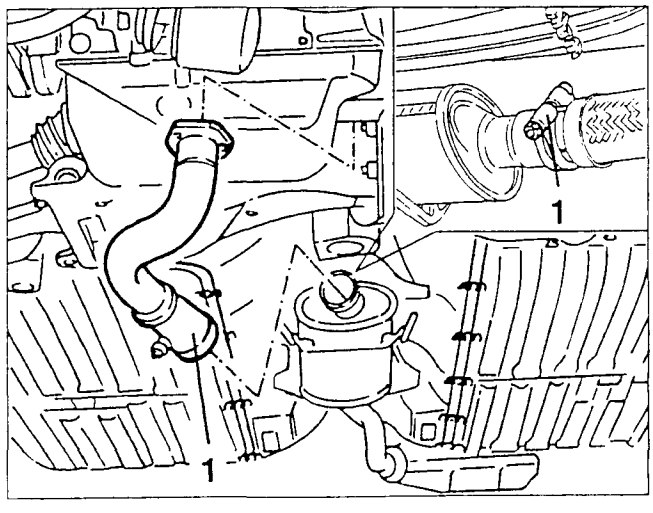
1. Slacken the three fastening bolts and remove the intermediate shaft from the differential.



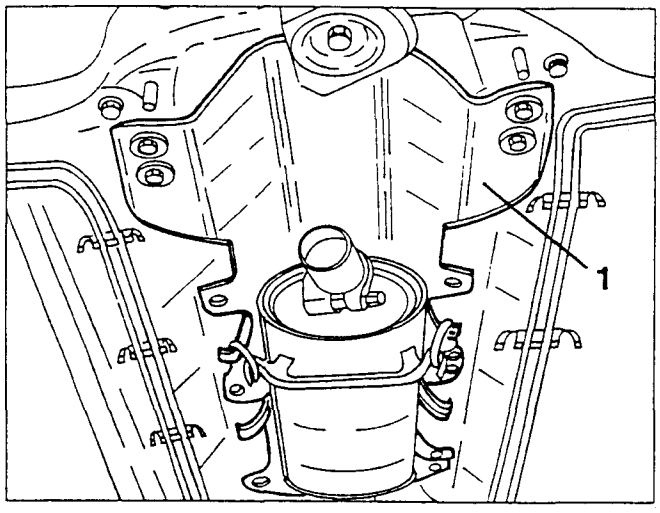
1. Remove the support clamp from the first section of the exhaust pipe.
2. Slacken the screws fastening the flanges connecting the exhaust pipe to the turbocharger.



1. Slacken the clamp fastening the front section of the exhaust pipe and remove it.

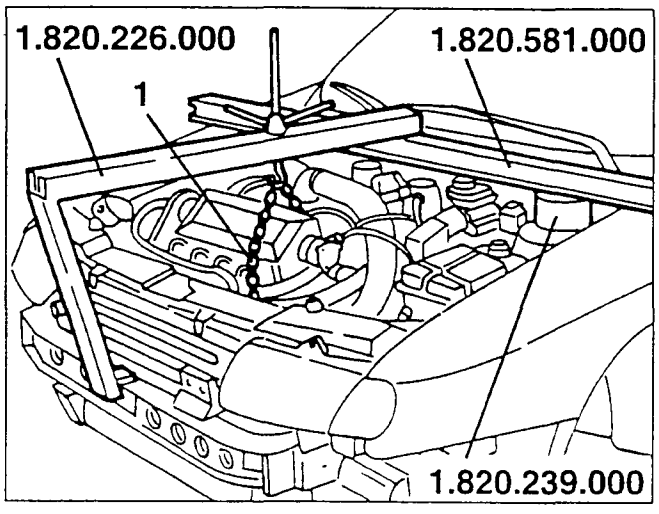


1. Slacken the screws and nuts fastening the "crocodile" to the body and lower it just enough to be able to remove the crossmember.

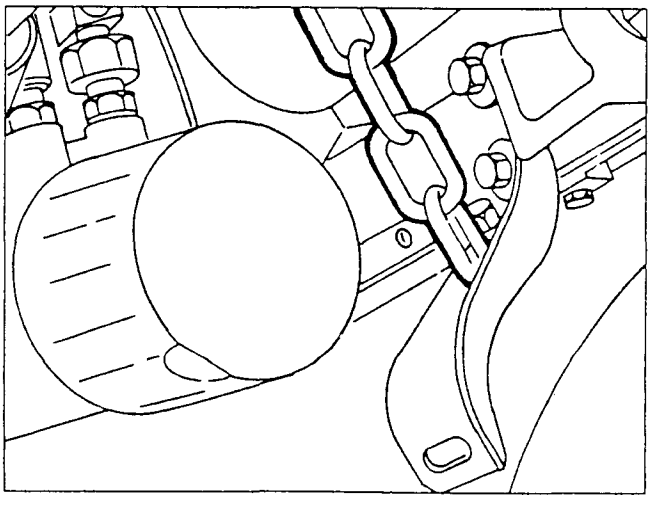


- Lower the car.

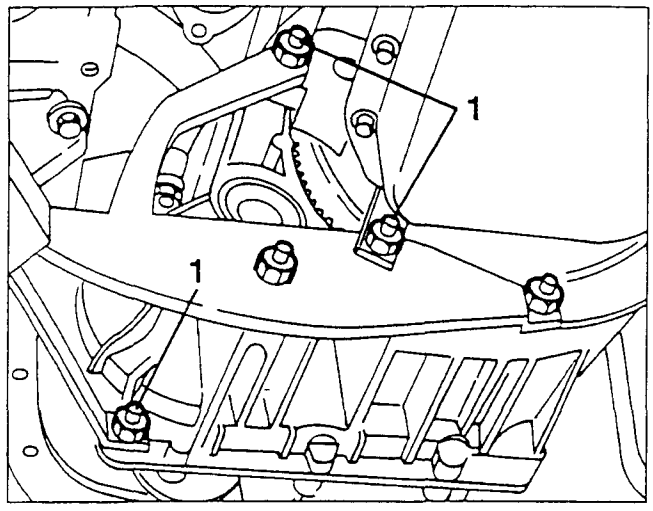
1. Using tools N° 1.820.239.000, N° 1.820.581.000 and N° 1.820.226.000 support the engine appropriately.



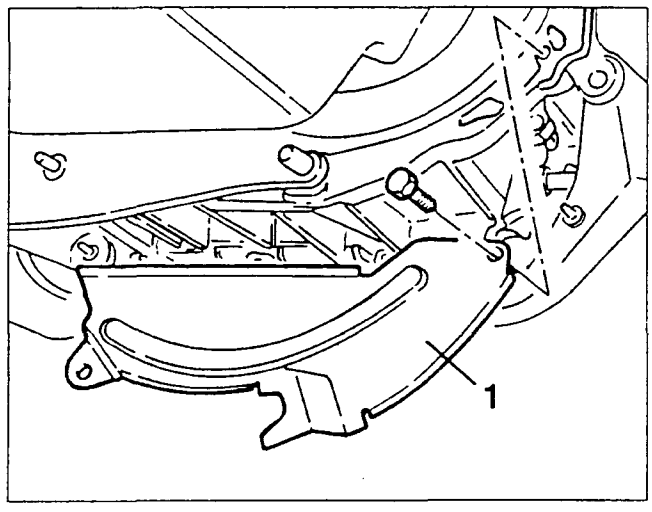
Fasten the chain on the rear side of the engine using the support bracket of the front section of the exhaust pipe.



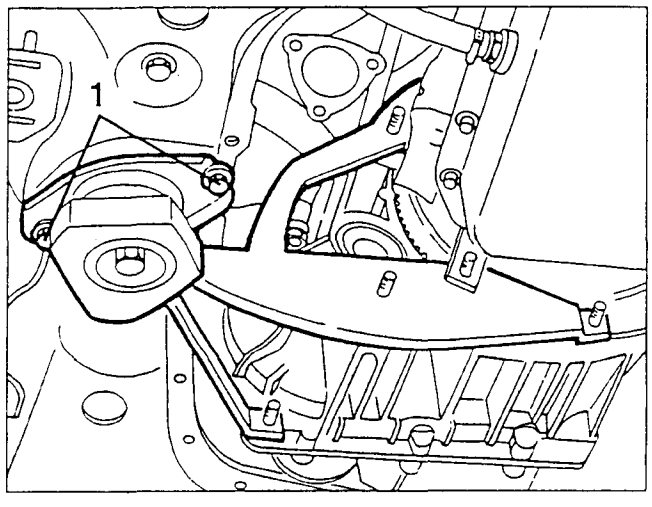
1. Slacken the four nuts and the bolt fastening the rear power unit support to the gearbox.



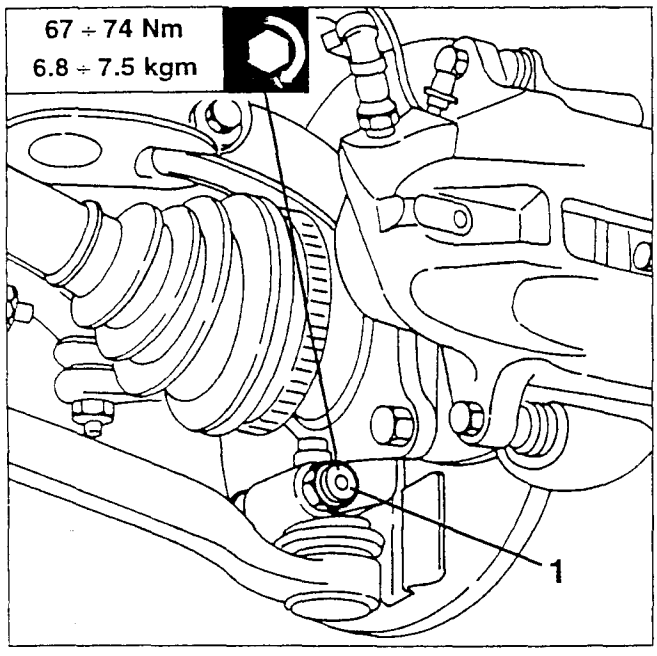
1. Slacken the two fastening screws and remove the flywheel guard.



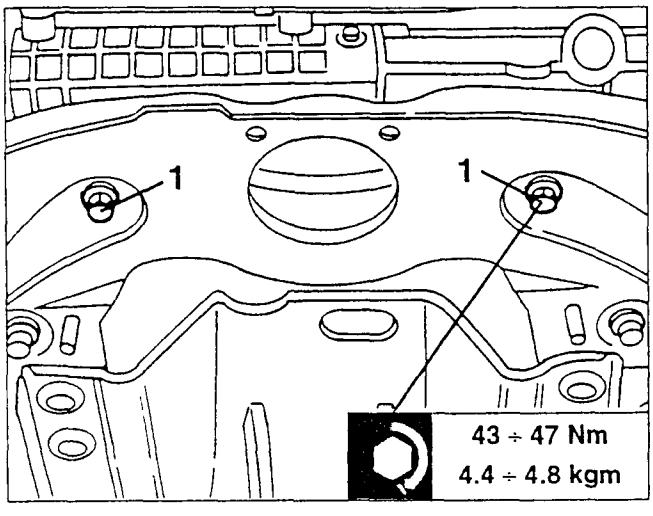
1. Slacken the two screws fastening the rear power unit support to the body and remove it.



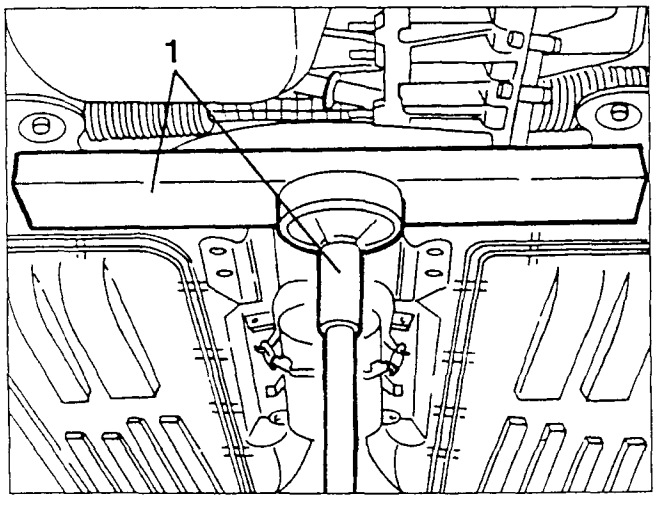
1. Slacken the two bolts fastening the right and left wishbone to the corresponding wheel hubs.



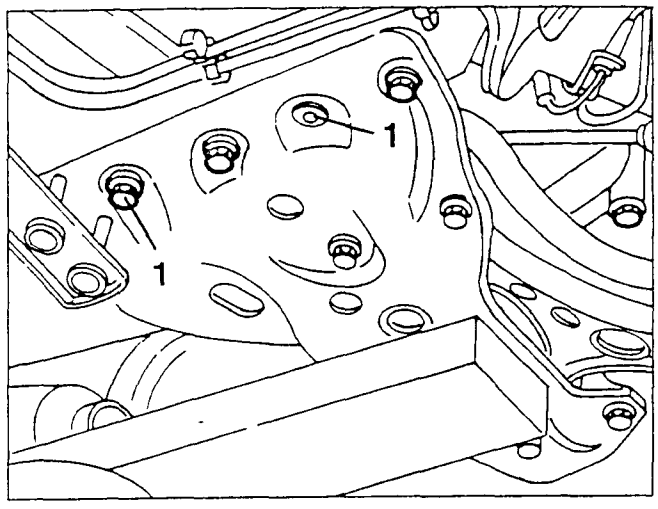
1. Slacken the two screws fastening the power steering box to the crossmember.



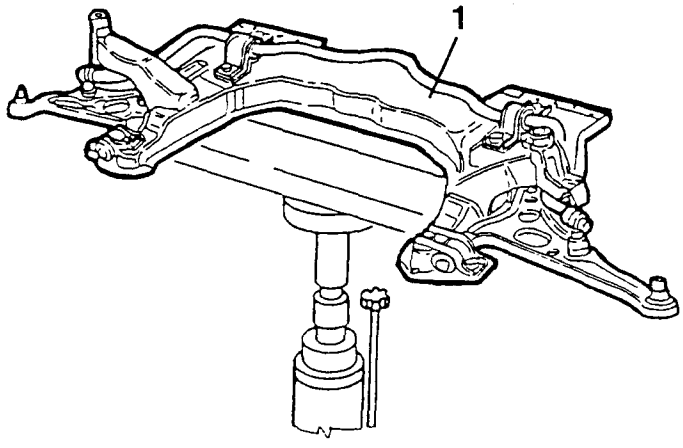
1. Position a hydraulic jack with special support under the crossmember.



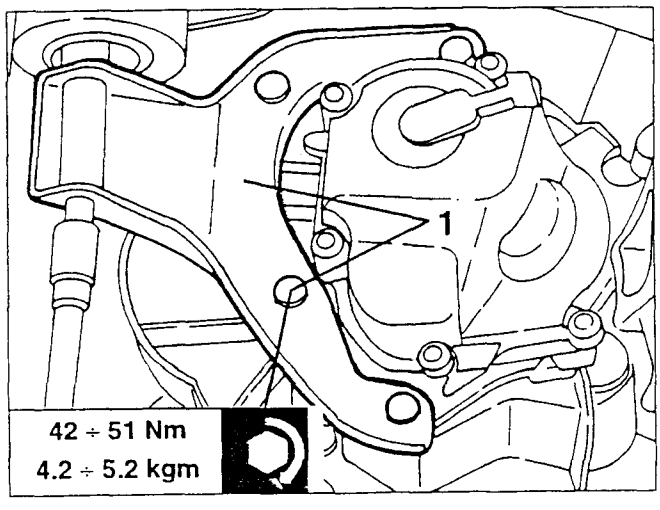
1. Slacken the fastening screws and remove the plastic crossmember fastening plugs.



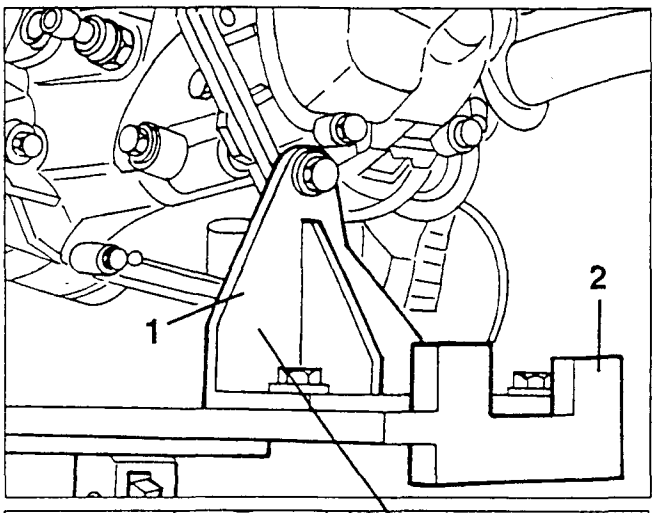
1. Lower the hydraulic jack and remove the crossmember complete with wishbones and stabilizer bar.

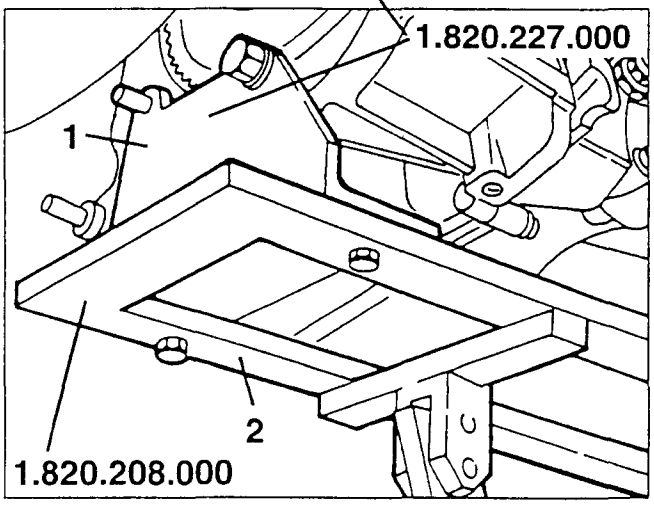


1. Slacken the fastening screws and remove the gearbox side power unit support.

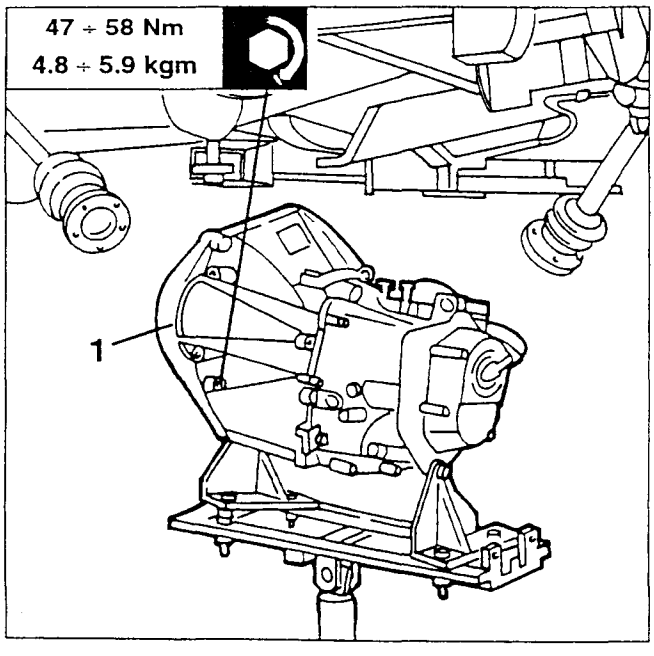


1. Fasten brackets N° 1.820.227.000 at the sides of the gearbox as illustrated.
2. To the brackets fastened previously fit support N° 1.820.208.000 and using a hydraulic jack support the gearbox-differential unit.





1. Slacken the screws fastening the gearbox-differential unit to the engine and to the starter motor, then remove it.



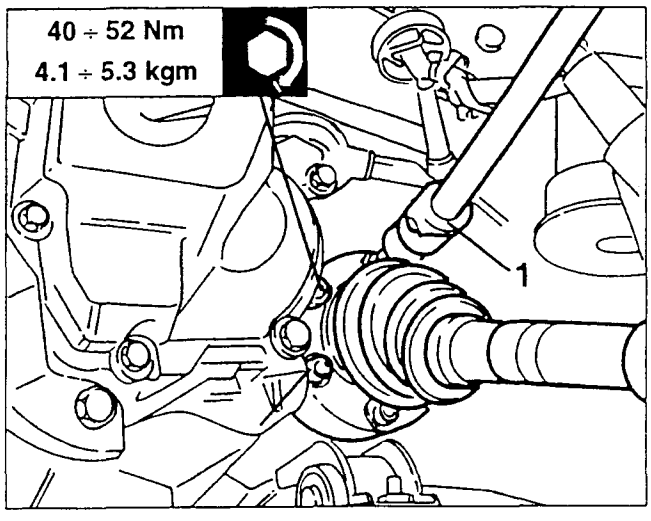
CAUTION:
After refitting the gearbox-differential unit, always check and if necessary, adjust, the clutch pedal (see GROUP 18).

OPERATIONS IN THE CAR

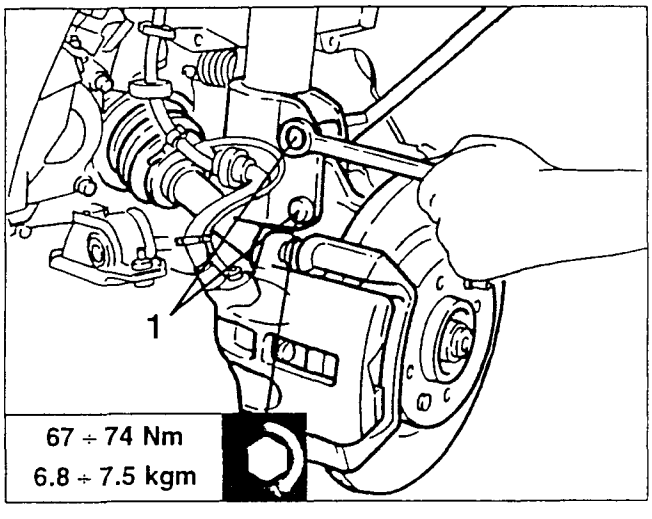
CHANGING THE GEARBOX SIDE DIFFERENTIAL CARRIER OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the left front wheel and mudflap.
- Working from the lefthand wheel arch, disconnect the electrical connection of the brake pad wear sensor.
- Slacken the screw fastening the ABS inductive sensor support bracket.

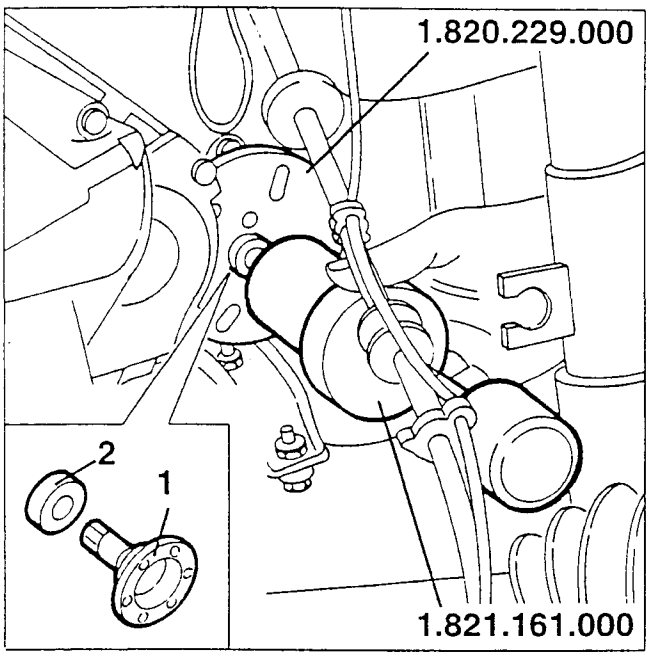
1. Slacken the left axle shaft fastening screws from the differential.



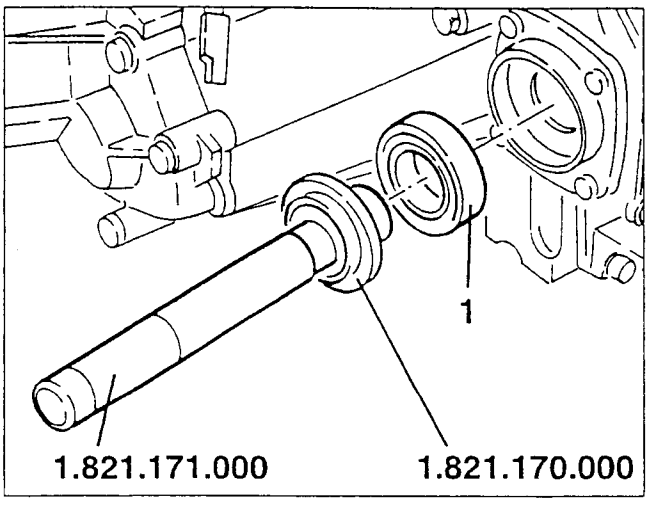
1. Slacken the two bolts fastening the left upright to the shock absorber, then withdraw the upper bolt only.



1. Using tools N° 1.820.229.000 and N° 1.821.161.000, remove the differential flange.
2. Remove the oil seal to be changed.



1. Using tools N° 1.821.170.000 and N° 1.821.171.000 install the new oil seal.

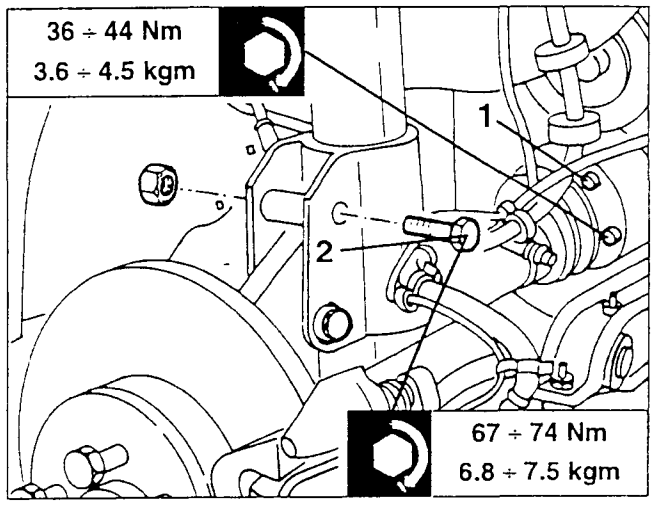


- Complete re-assembly reversing the procedure followed for removal.

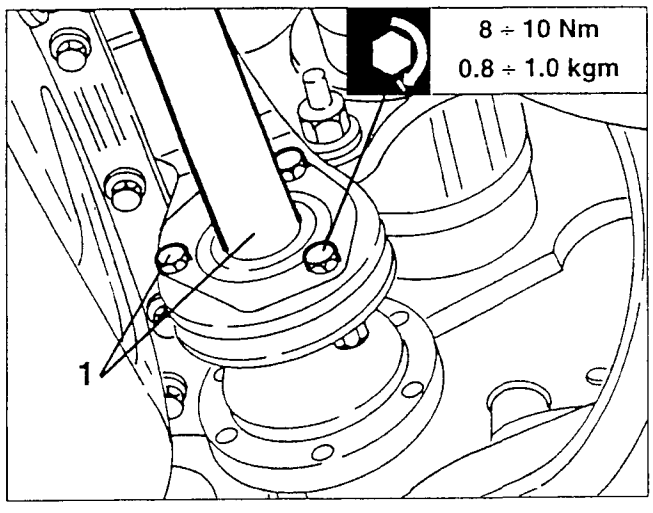
CHANGING THE DIFFERENTIAL CARRIER ENGINE SIDE OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the right front wheel and mudflap.
- Working from the righthand wheel arch, disconnect the electrical connection of the brake pad wear sensor.
- Slacken the screw fastening the ABS inductive sensor support bracket.

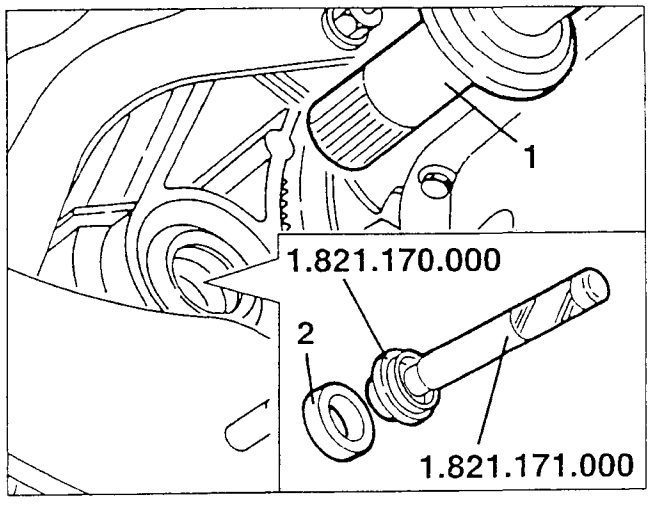
1. Slacken the left axle shaft fastening screws from the intermediate shaft.
2. Slacken the two bolts fastening the right upright to the shock absorber, then withdraw the upper bolt only.
- Move the axle shaft backwards just enough to disconnect it from the intermediate shaft and keep it as illustrated.



1. Slacken the three intermediate shaft fastening bolts.



1. Take the intermediate shaft off the differential.
2. Using tools N° 1.821.170.000 and N° 1.821.171.000 install the new ring.

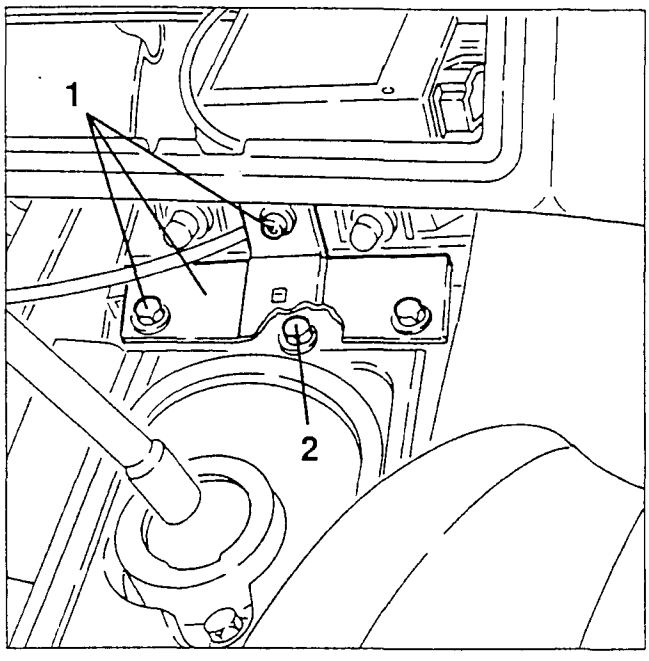


GEARSHIFT CONTROL ROD

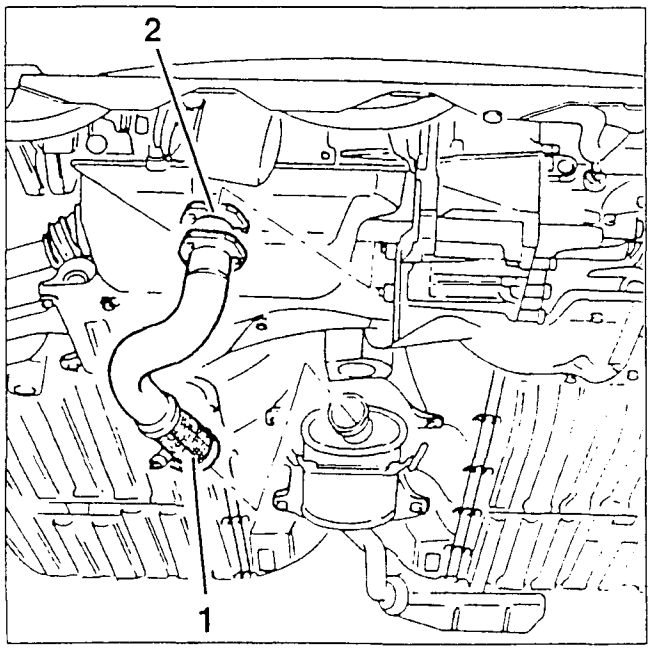
REMOVING/REFITTING

- Set the car on a lift.
- Remove the gearbox centre console (see GROUP 70).

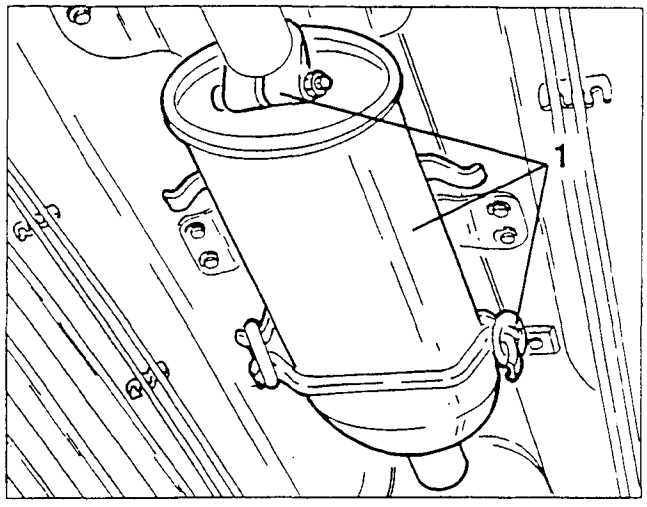
1. Slacken the fastening screws and remove the dashboard lower fastening bracket.
2. Slacken the gearshift controls support fastening screw.



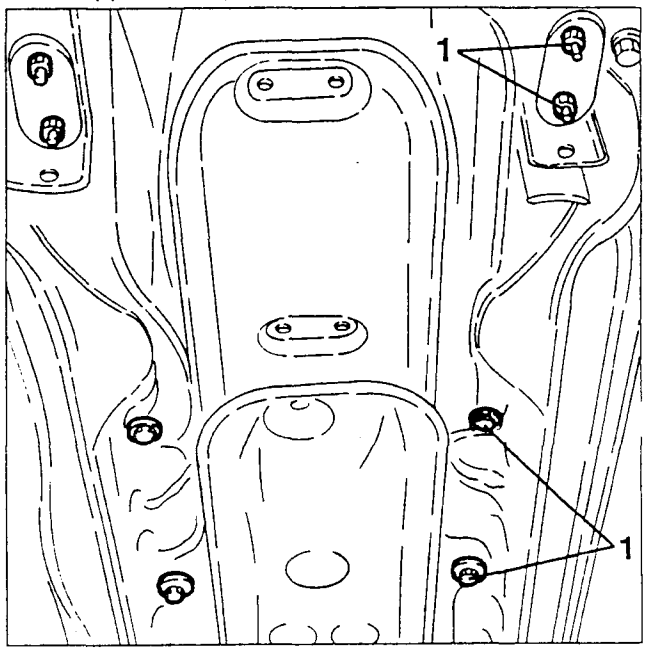
1. Remove the exhaust pipe front section.
2. Remove the seal.



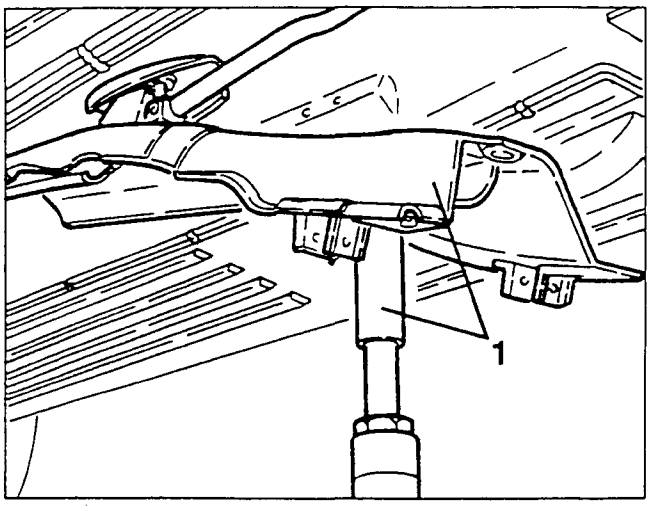
1. Slacken the clamp fastening the centre silencer to the rear section of the exhaust pipe, then remove it after freeing it from the support rings.



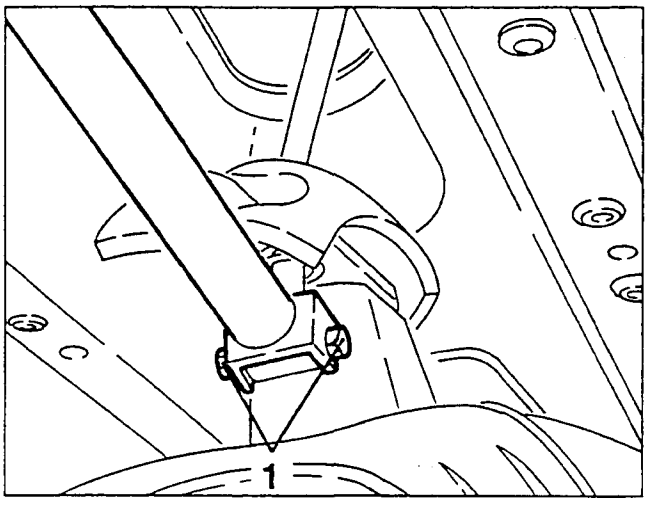
1. Slacken the fastening screws of the gearshift controls support except the two rear ones.



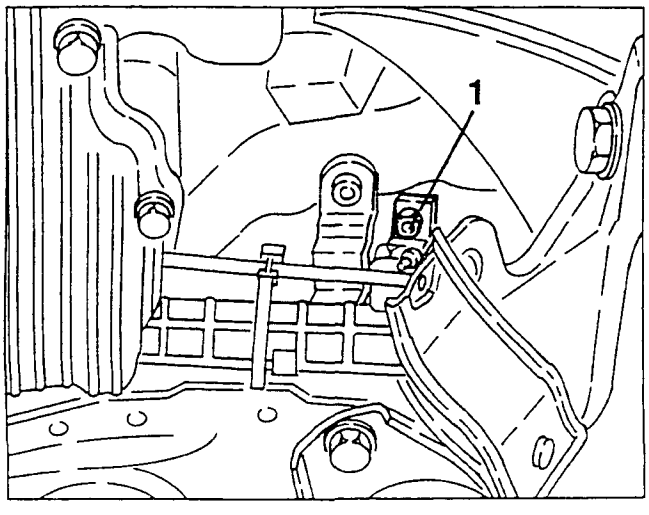
1. Using a hydraulic jack as support, lower the front of the gearshift controls support as illustrated.



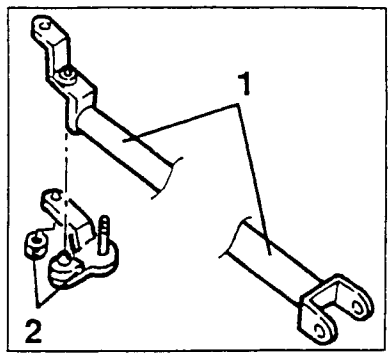
1. Disconnect the gearshift control lod from the lever slackening the fastening bolt.



1. Disconnect the gearshift control rod from the support on the power steering box slackening the fastening nut.



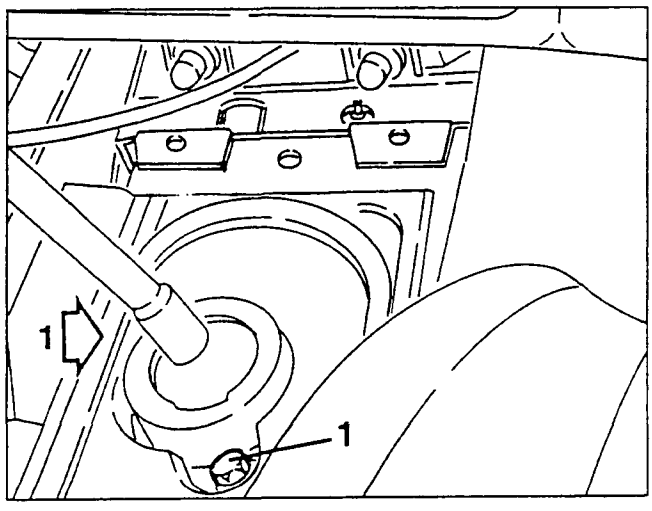
1. Remove the gearshift control rod.
2. If necessary remove the relay levers slackening the remaining fastening nut.



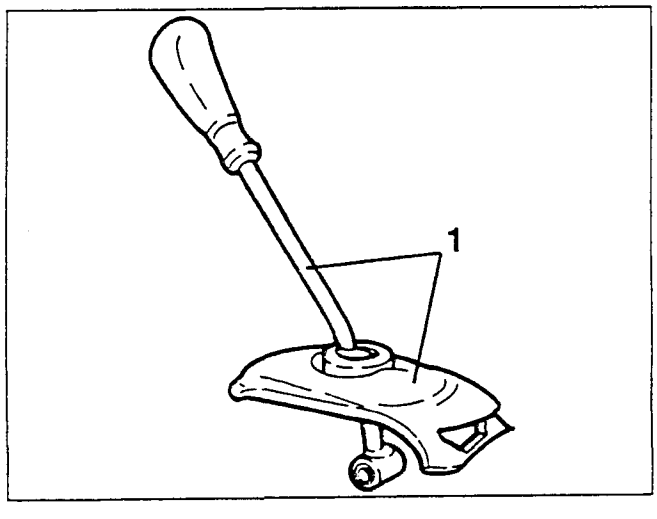
GEARSHIFT CONTROL LEVER

REMOVING/REFITTING

Proceed as described in the procedure "Gearshift control rod - Removing/Refitting" as far as disconnection of the gearshift control lever from the rod and taking care to slacken the two screws (1) fastening the gearshift control lever to the support, before slackening the fastenings of the gearshift controls support.



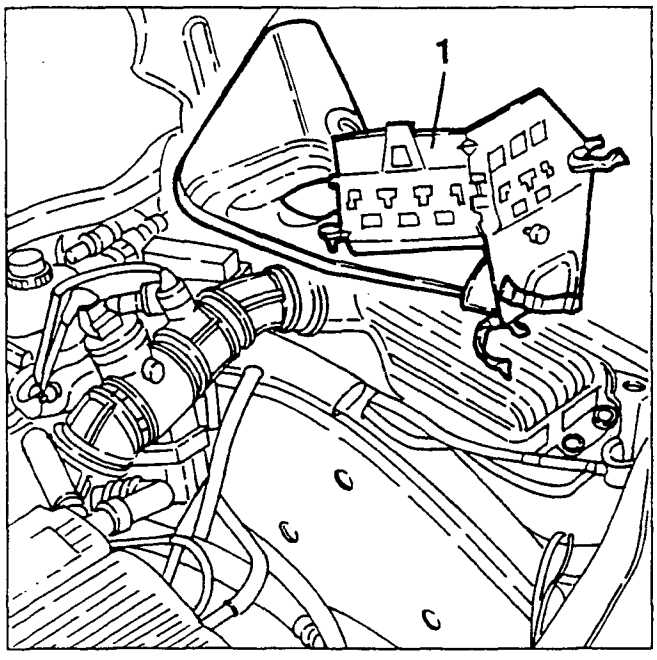
1. From under the car, retrieve the gearshift control lever complete with joint and frame.



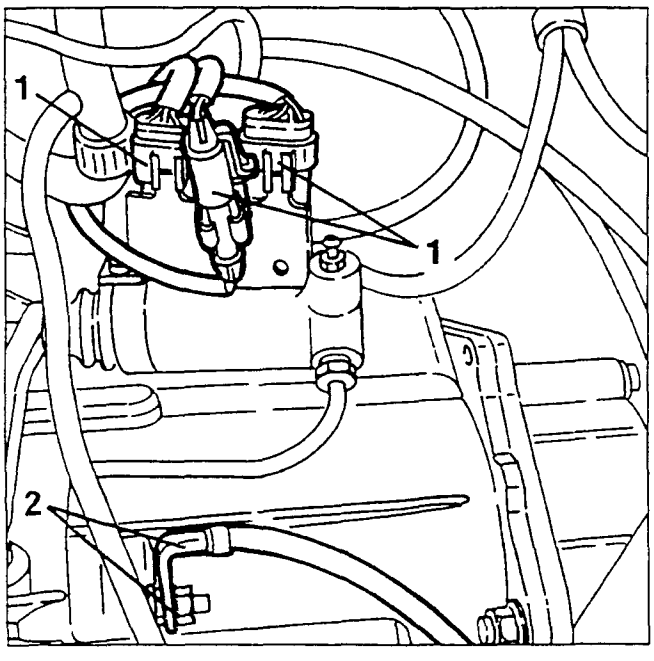
REMOVING/REFITTING

- Set the car on a lift.
- Remove the front wheels and mud flaps.
- Remove the battery.
- Remove the relays from the battery support moving them to one side with their wirings so that they do not hinder the following operations.

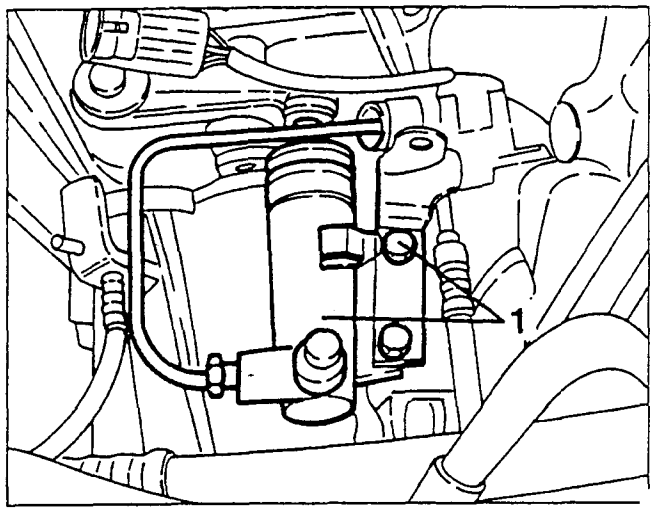
1. Slacken the fastening screws, then remove the battery support after removing the rear cable support bracket from it.



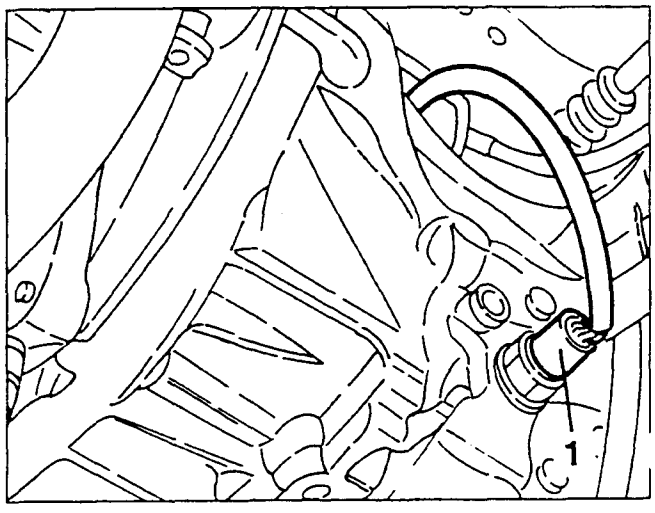
1. Remove the electrical connections from the support bracket fastened with the clutch control cylinder.
2. Disconnect the earth cable from the gearbox cover.



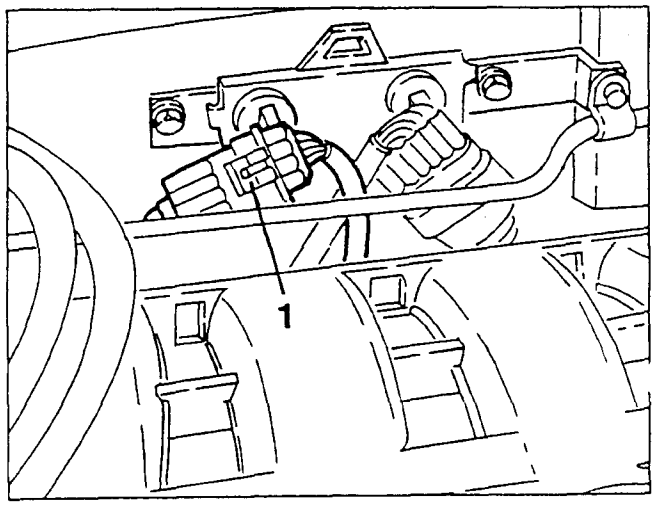
1. Slacken the fastening screws, then move aside th clutch control cylinder without disconnecting the hoses.



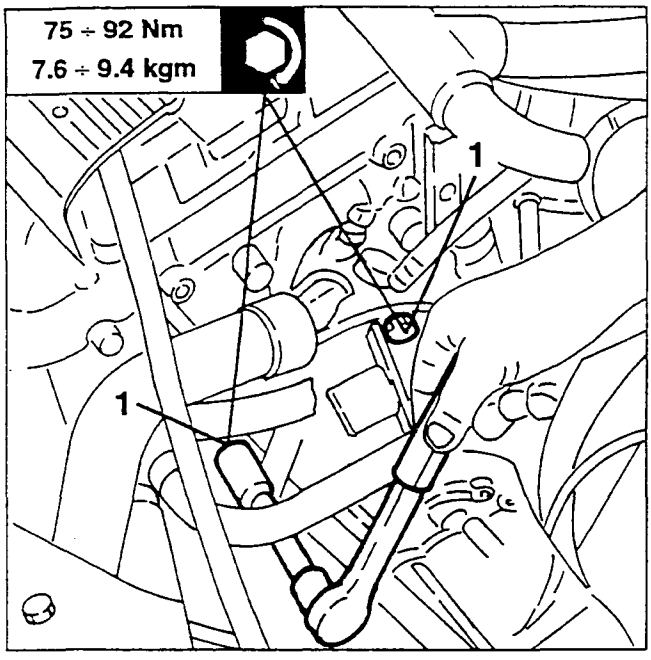
1. Disconnect the electrical connection from the reversing switch.



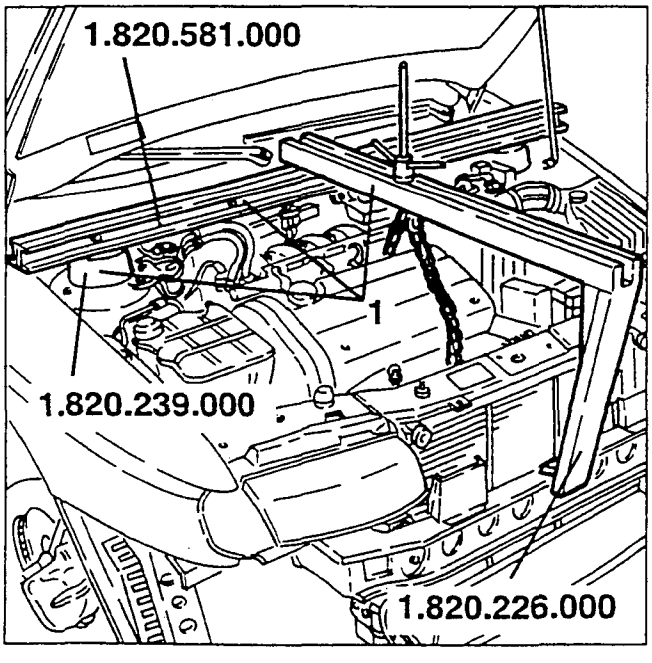
1. Disconnect the electrical connection of the lambda sensor.



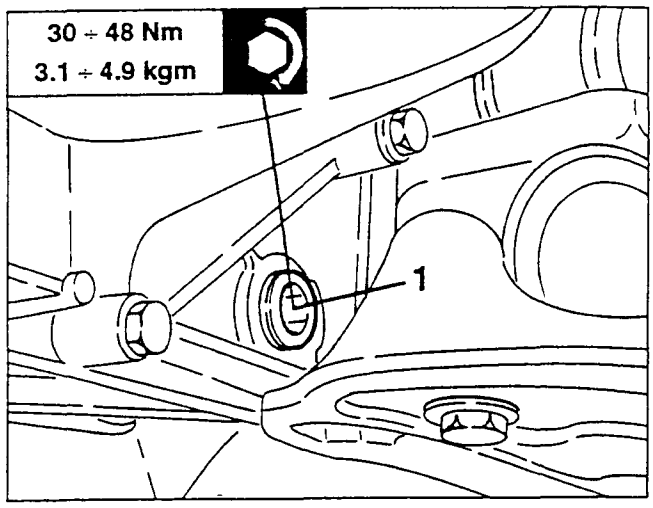
1. Slacken the two upper screws fastening the gearbox to the engine.



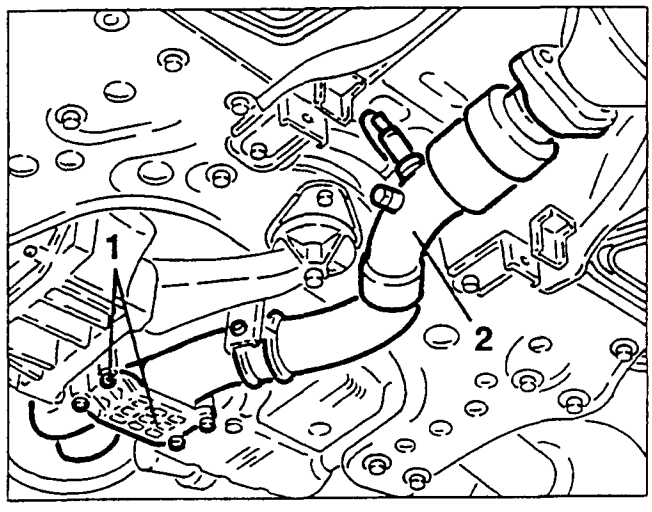
- Remove the front bumper (see GROUP 70).
1. Position the engine support no. 1.820.226.000, with the corresponding supports no. 1.820.239.000 and crossrail no. 1.820.581.000 as illustrated.
- Install two suitable support squares on the crankcase, then using a chain connect the support tool to the squares supporting the power unit in this manner.



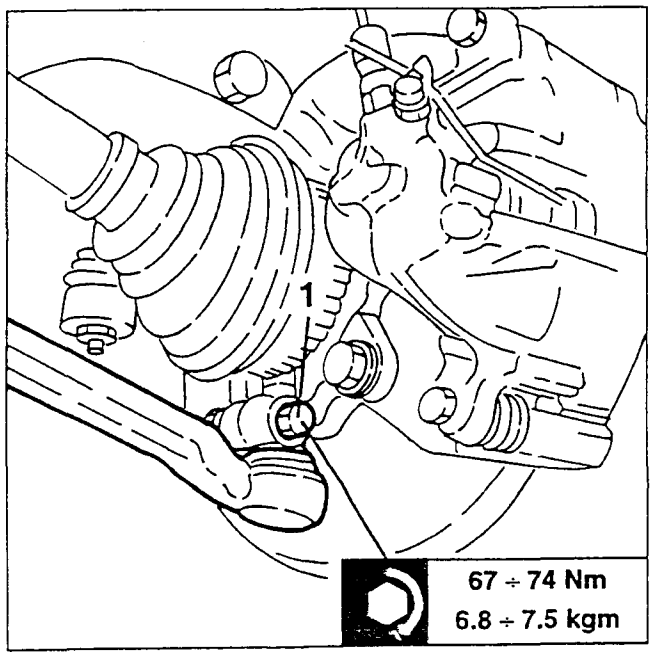
1. Raise the car, slacken the plug and drain the gearbox- differential oil into a suitable recipient.



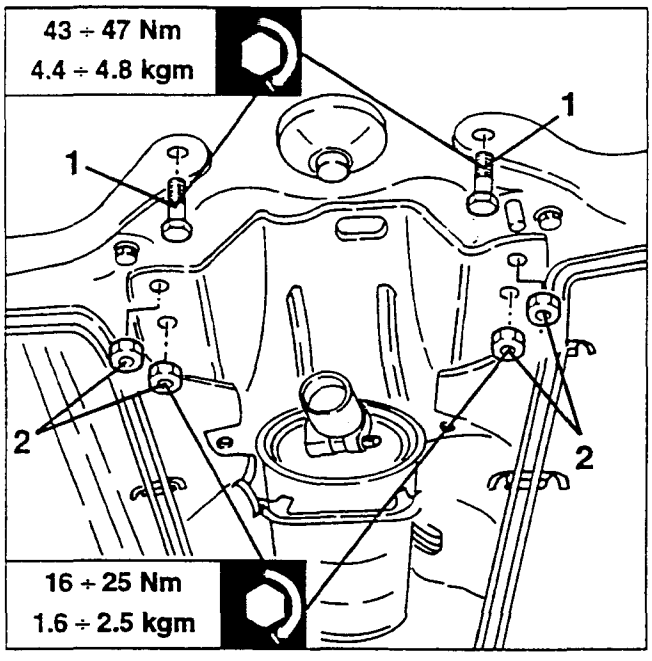
1. Slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda sensor after slackening the fastenings concerned.



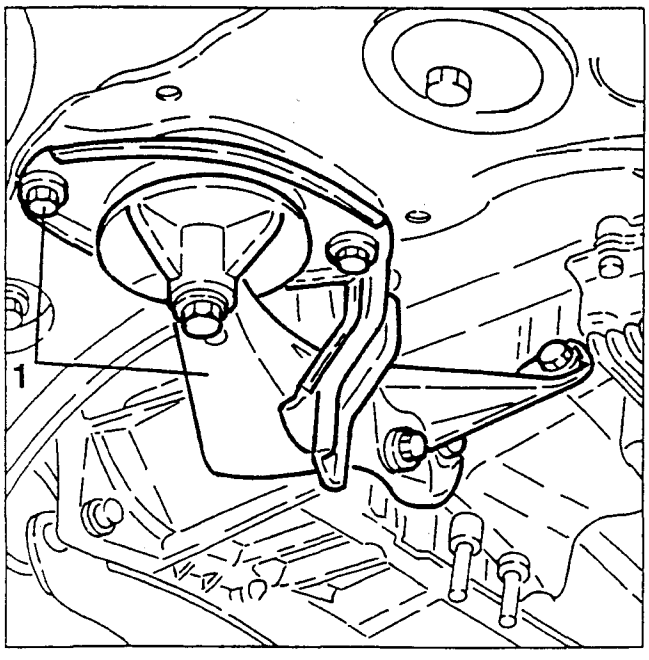
1. Slacken the bolts fastening the wishbones to the wheel uprights.



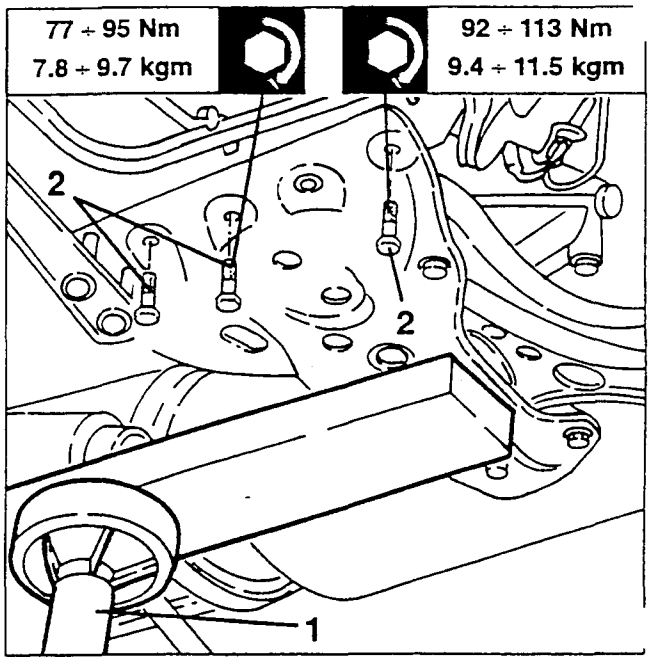
1. Slacken the two screws fastening the power steering to the front crossmember.
2. Slacken the four front nuts and slacken the other screws fastening the gearshift controls support, which must be slightly lowered to enable release from the front crossmember.



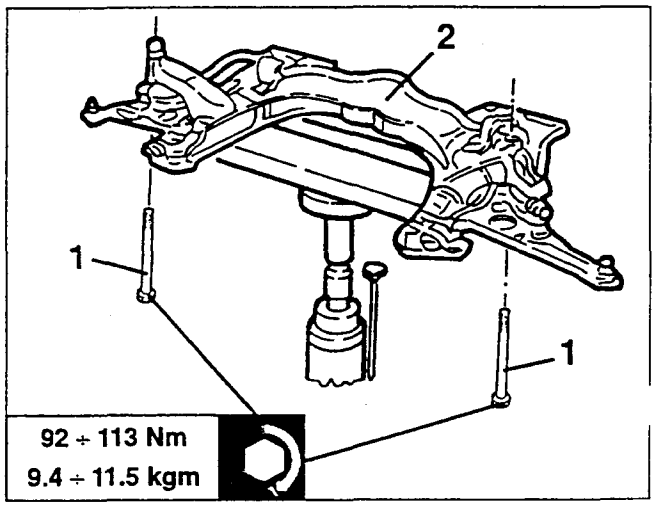
1. Slacken the fastening screws and remove the power unit rear support.



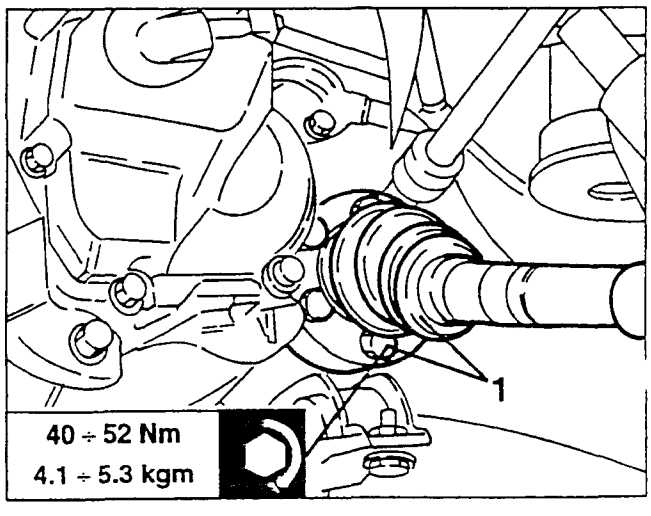
1. Set a hydraulic jack under the crossmember.
2. Slacken the six rear screws fastening the crossmember to the body.



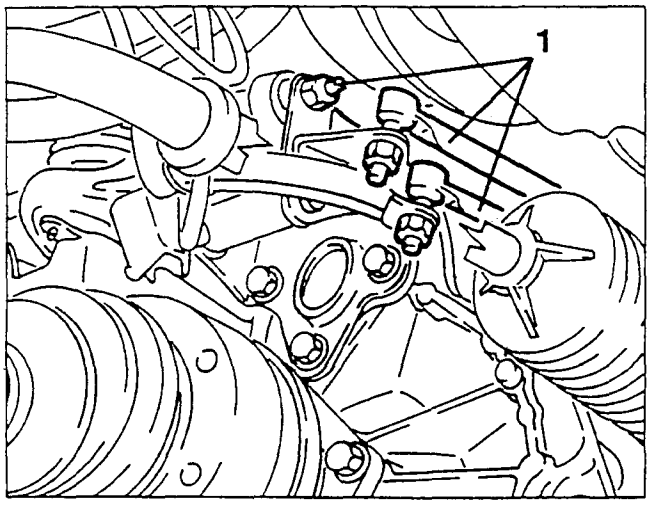
1. Slacken the two front screws fastening the crossmember to the body.
2. Lower the hydraulic jack and remove the crossmember.



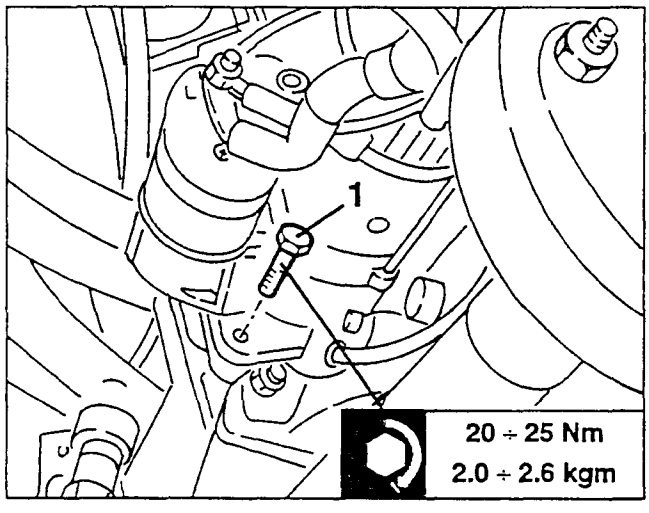
1. Slacken the fastening bolts and disconnect the left-hand CV joint of the differential side axle shaft.



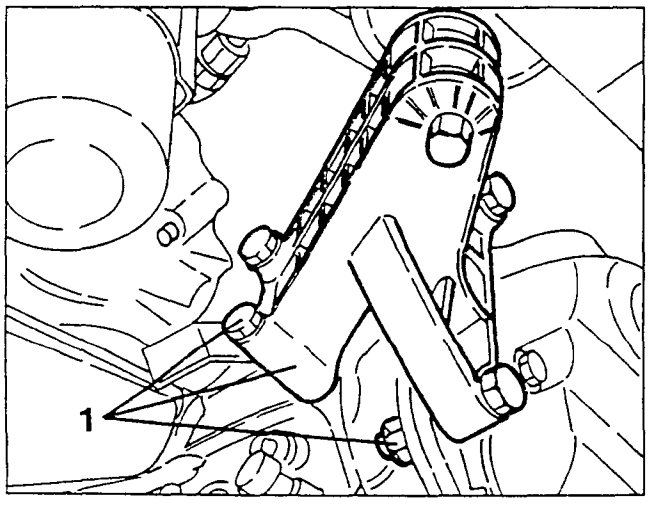
1. Working from the left-hand wheelhouse, slacken the fastening nuts and disconnect the gearshift control rods.



1. Slacken the three screws fastening the starter motor to the gearbox.



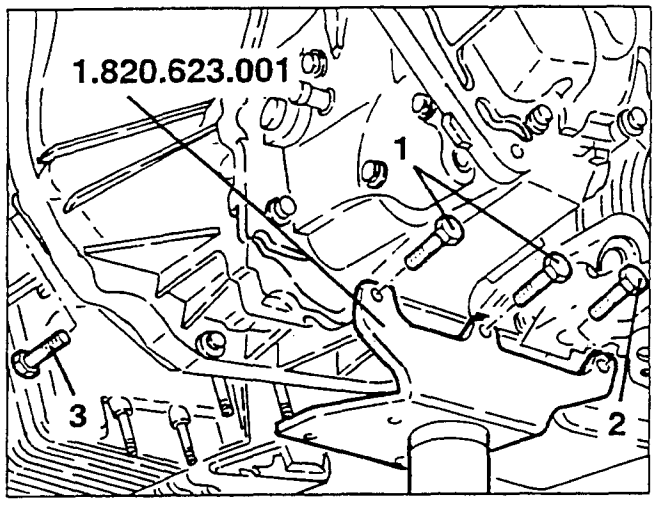
1. Slacken the fastening screws and bolts and remove the gearbox side power unit support.



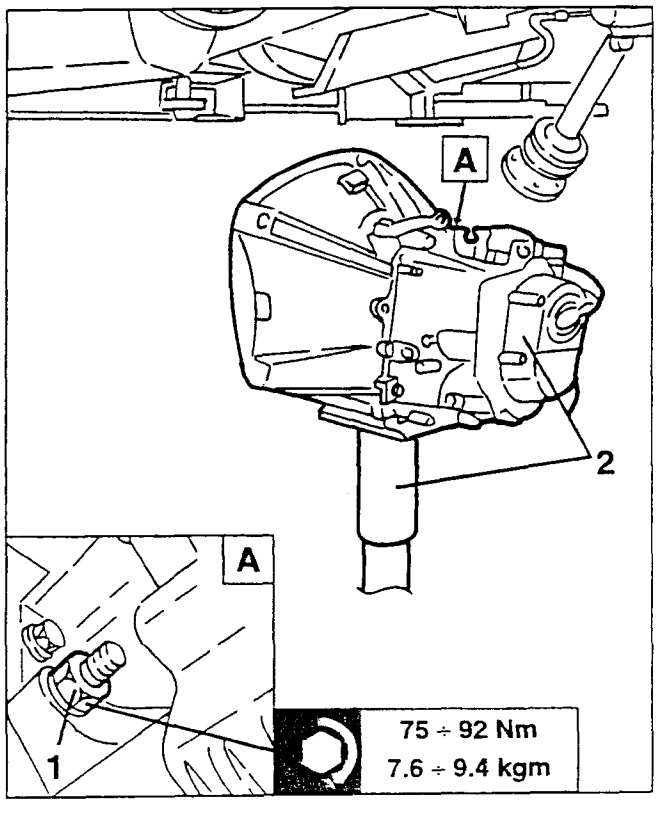
1. Slacken the two lower screws fastening the gearbox cover and in their holes insert bracket no. 1.820.623.001.

NOTE: For fastening the bracket use slightly longer screws than the ones removed.

2. Add a suitably sized bolt in the hole on the right of the bracket.
3. Slacken the screw fastening the gearbox to the engine.



1. Slacken the remaining nut fastening the gearbox to the engine.
2. Lower the hydraulic jack and remove the gearbox-differential unit.

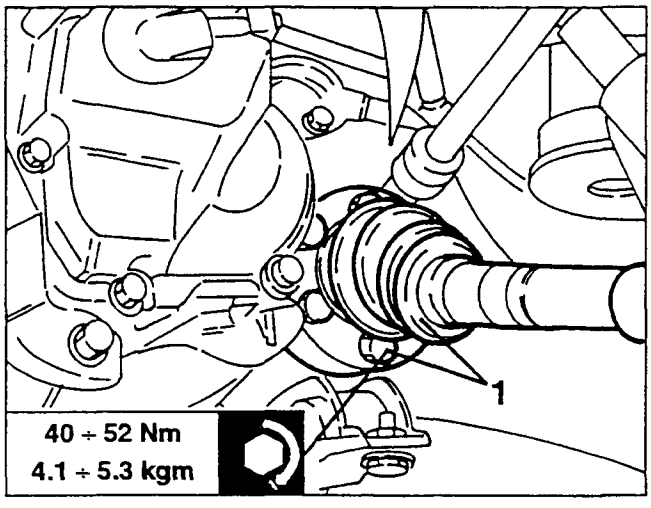


ON-VEHICLE OPERATIONS

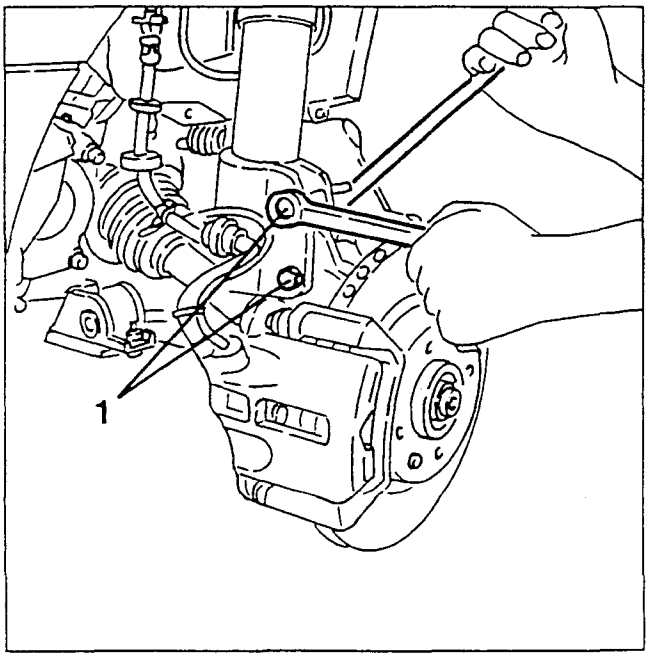
CHANGING THE DIFFERENTIAL CARRIER OIL SEAL GEARBOX SIDE

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the left front wheel and mud flaps.
- Working from the left front wheelhouse, disconnect the electrical connection of the brake pad wear sensor.
- Release the ABS inductive sensor cable from the support bracket.

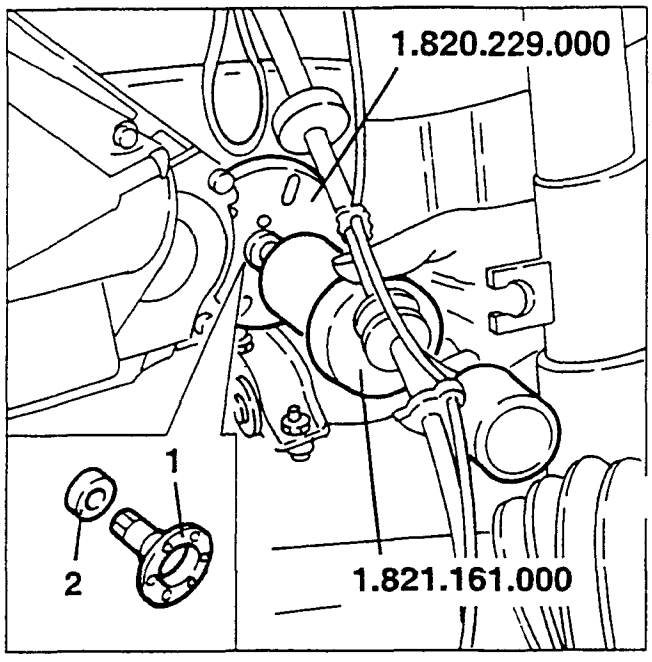
1. Slacken the fastening bolts and disconnect the left-hand CV joint from the differential side axle shaft.



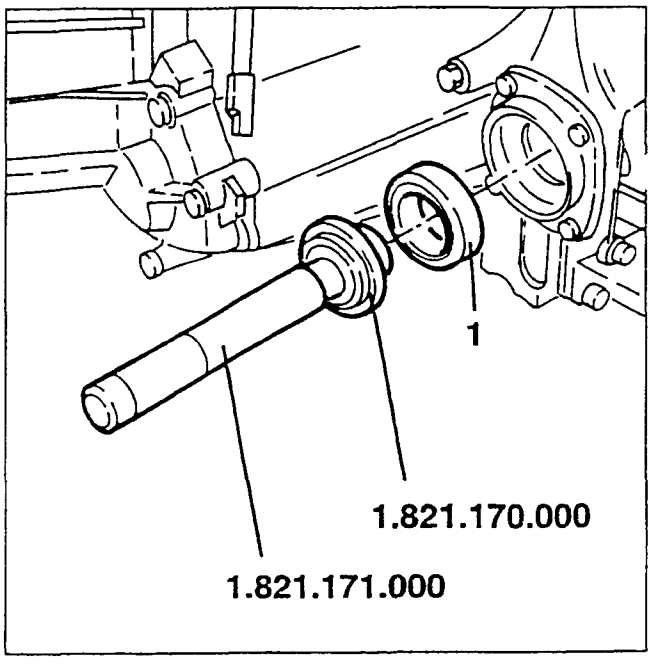
1. Slacken the two bolts fastening the left-hand upright to the shock absorber, then withdraw the upper bolt only.



1. Using tools no. 1.820.229.000 and nc 1.821.161.000, remove the flange from the differential.
2. Remove the oil seal to be changed.



1. Using tools no. 1.821.170.000 and no.1.821.171.000 install the new oil seal.



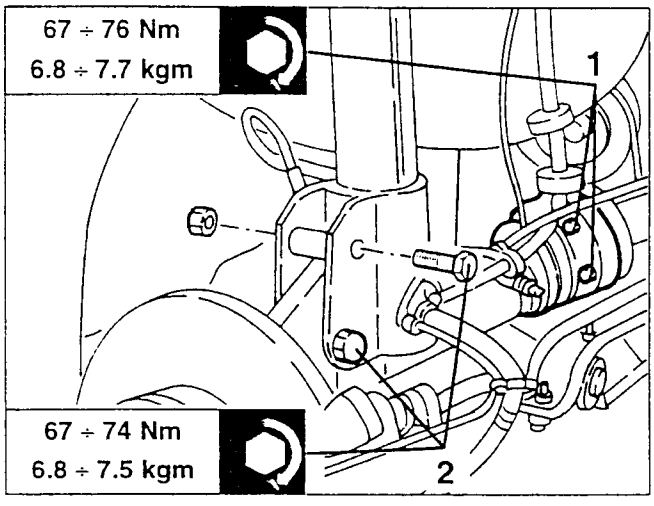
Complete re-assembly reversing the sequence followed for removal.

CHANGING THE DIFFERENTIAL CARRIER OIL SEAL ENGINE SIDE

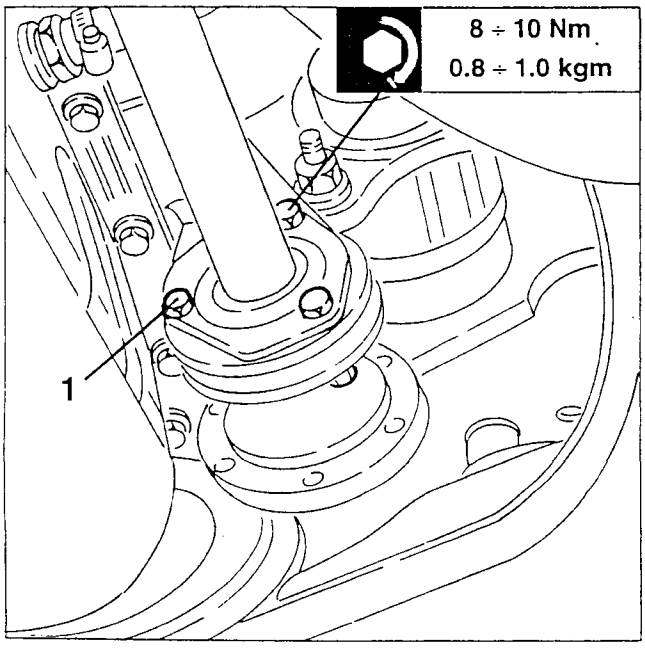
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the right-hand wheel and wheelhouse.
- Working from the left-hand wheelhouse, disconnect the electrical connection of the brake pad wear sensor.
- Release the A.B.S. inductive sensor cable from the support bracket.

1. Slacken the fastening bolts and disconnect right-hand CV joint from the intermediate shaft.
2. Slacken the two bolts fastening the right upright, then withdraw the upper bolt only.

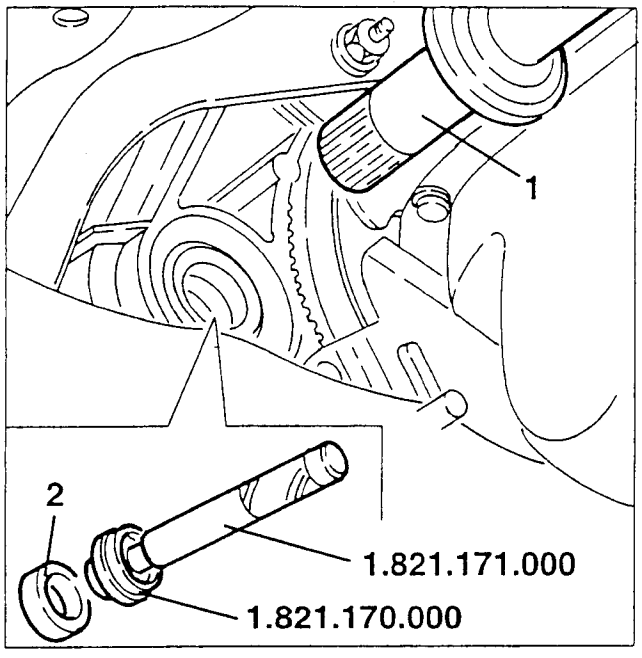
- Move back the right axle shaft just enough to disconnect it from the intermediate shaft.



1. Slacken the screws fastening the intermediate shaft.



1. Withdraw the intermediate shaft from the differential and remove the oil seal to be changed.
2. Using tools no. 1.821.170.000 and no. 1.821.171.000 install the new oil seal.



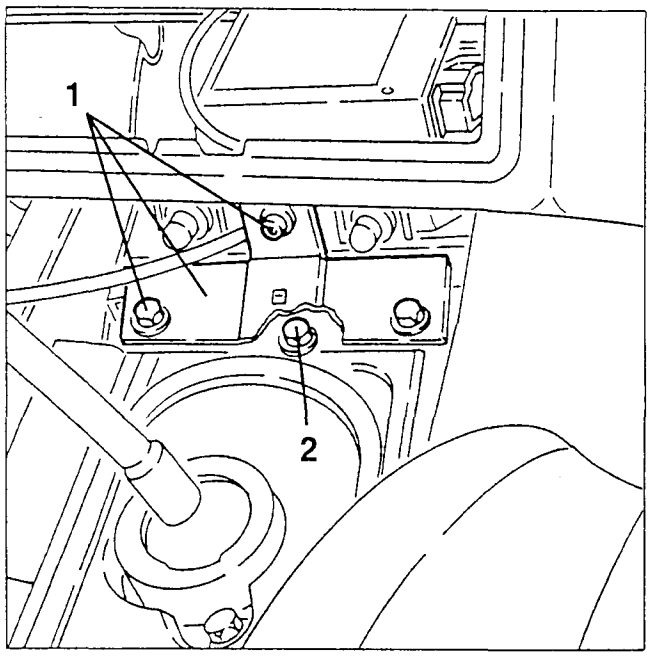
Complete re-assembly reversing the sequence followed for removal.

GEARSHIFT CONTROL ROD

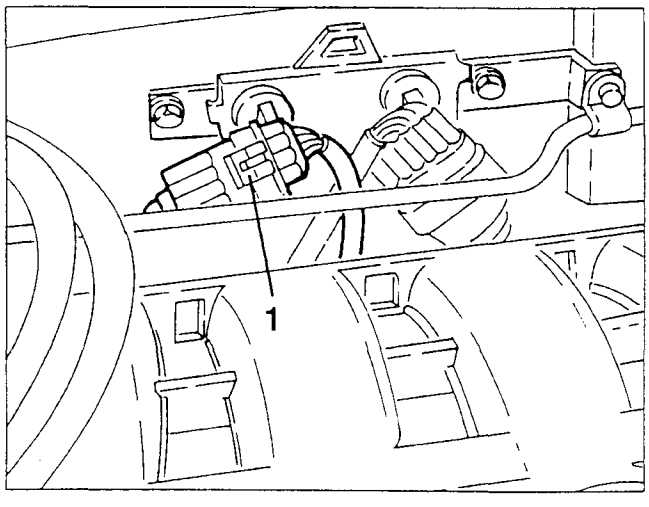
REMOVING/REFITTING

- Set the car on a lift.
- Remove the centre console (see GROUP 70).

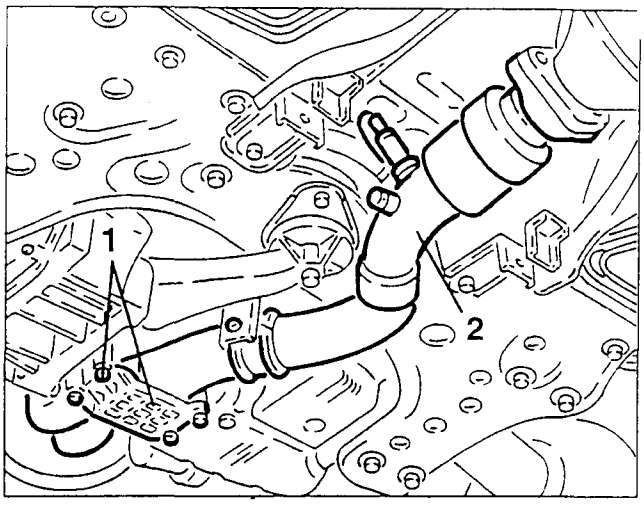
1. Slacken the fastening screws and remove the lower dashboard fastening bracket.
2. Slacken the screw fastening the gearshift controls support.



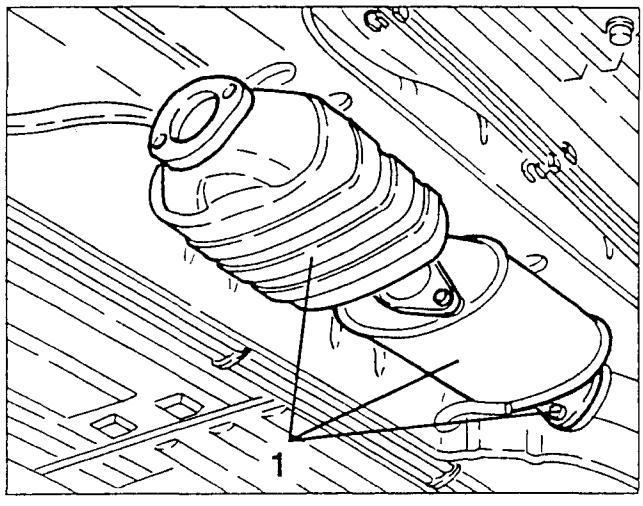
1. Disconnect the electrical connection of the lambda sensor.



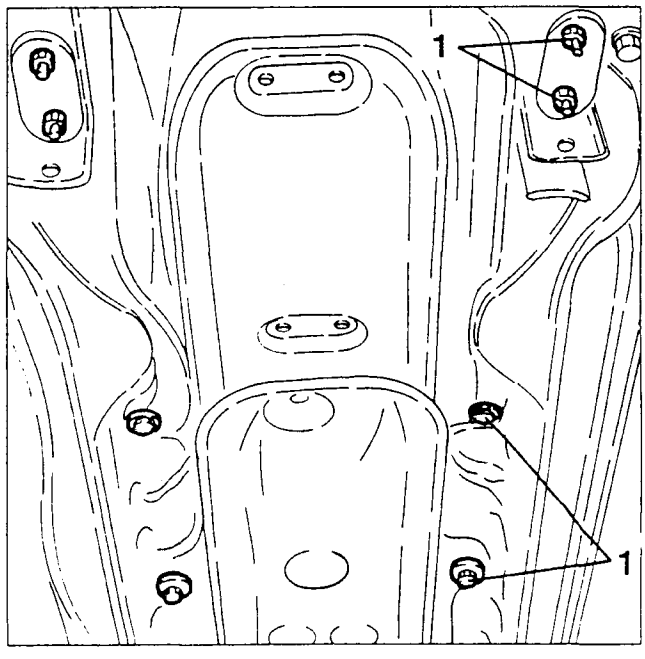
1. Raise the car, slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with the lambda sensor after loosening the fastenings.



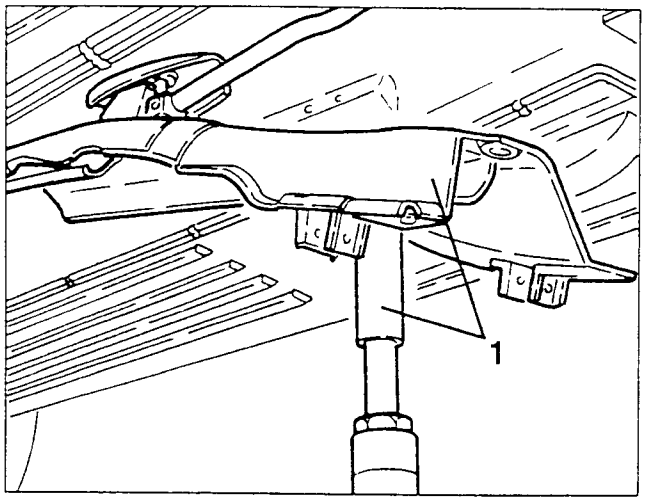
1. Slacken the fastening bolts and remove the catalytic converter complete with the first silencer of the exhaust system.



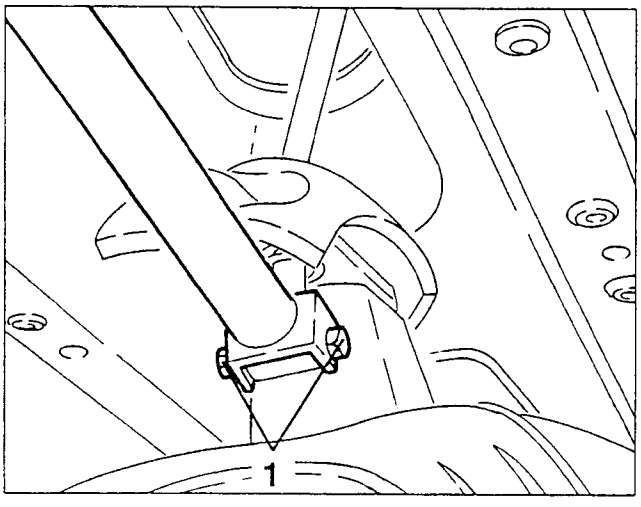
1. Slacken the screws fastening the gearshift controls support with the exception of the two rear ones.



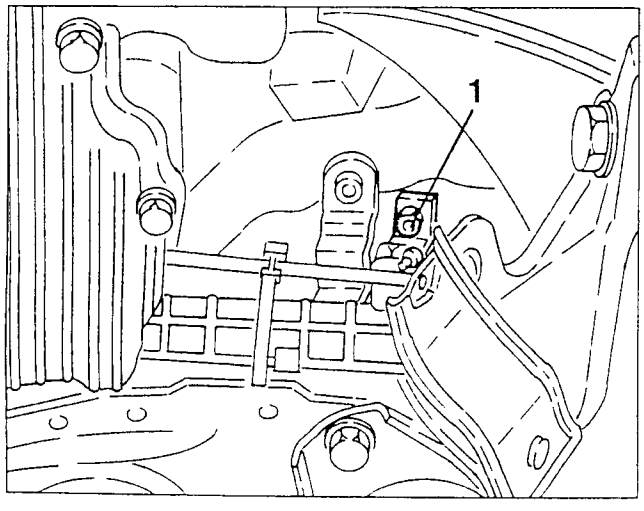
1. Using a hydraulic jack as support, lower the front of the gearshift controls support as illustrated.



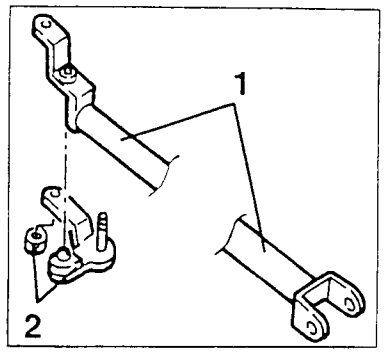
1. Disconnect the gearshift control lod from the lever slackening the fastening bolt.



1. Disconnect the gearshift control rod from the support on the power steering box slackening the fastening nut.



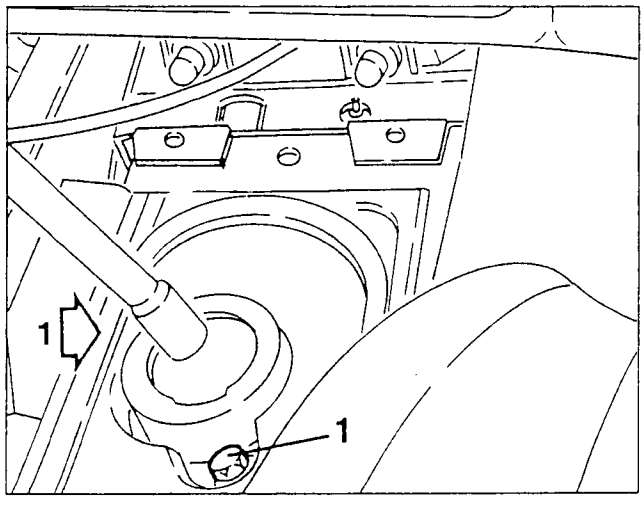
1. Remove the gearshift control rod.
2. If necessary remove the relay levers slackening the remaining fastening nut.



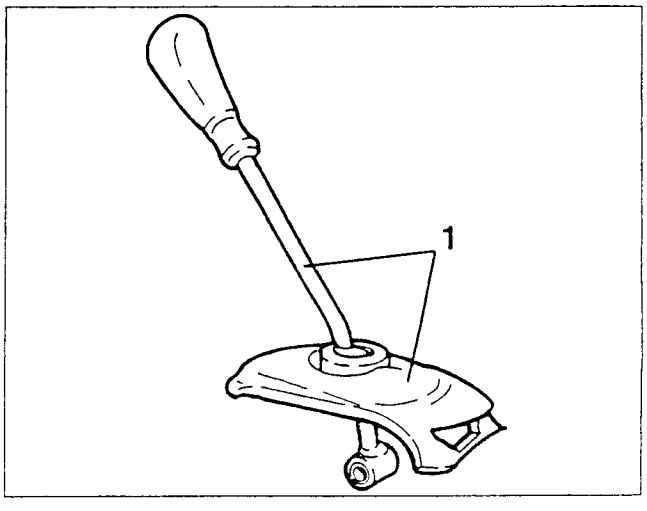
GEARSHIFT CONTROL LEVER

REMOVING/REFITTING

Proceed as described in the procedure "Gearshift control rod - Removing/Refitting" as far as disconnection of the gearshift control lever from the rod and taking care to slacken the two screws (1) fastening the gearshift control lever to the support, before slackening the fastenings of the gearshift controls support.



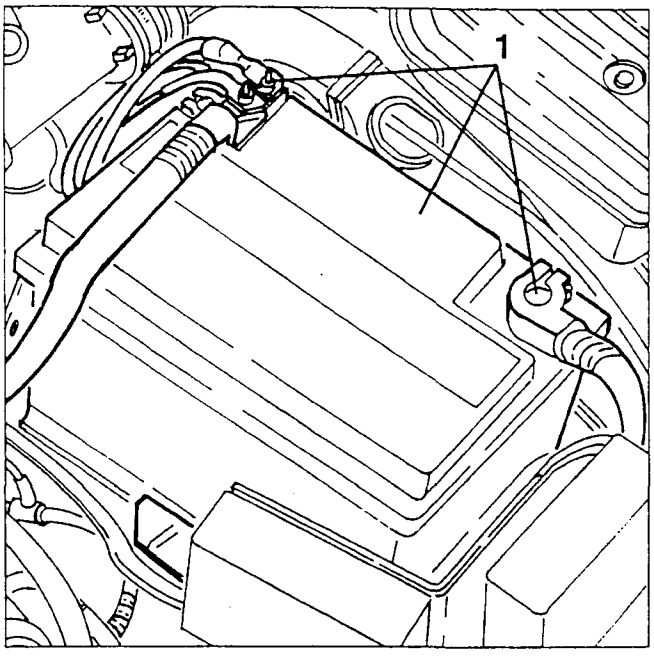
1. From under the car, retrieve the gearshift control lever complete with joint and frame.



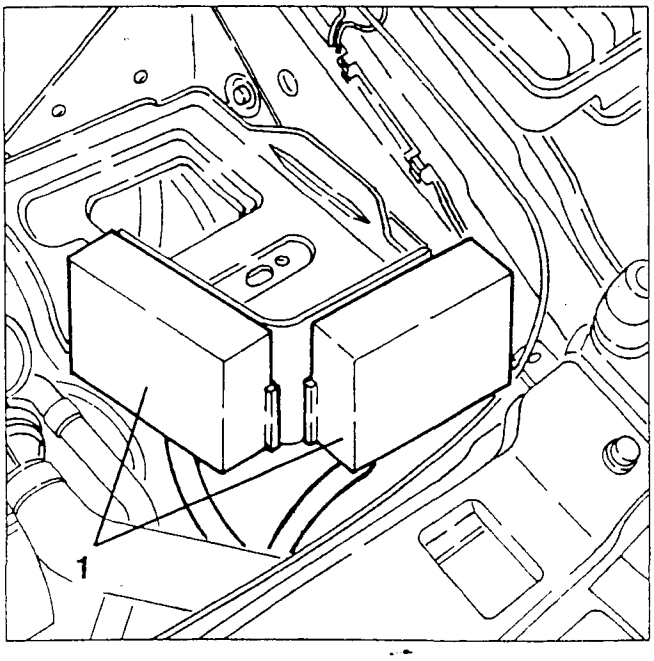
REMOVING/REFITTING

- Set the car on a lift.
- Remove the front wheels and mud flaps.

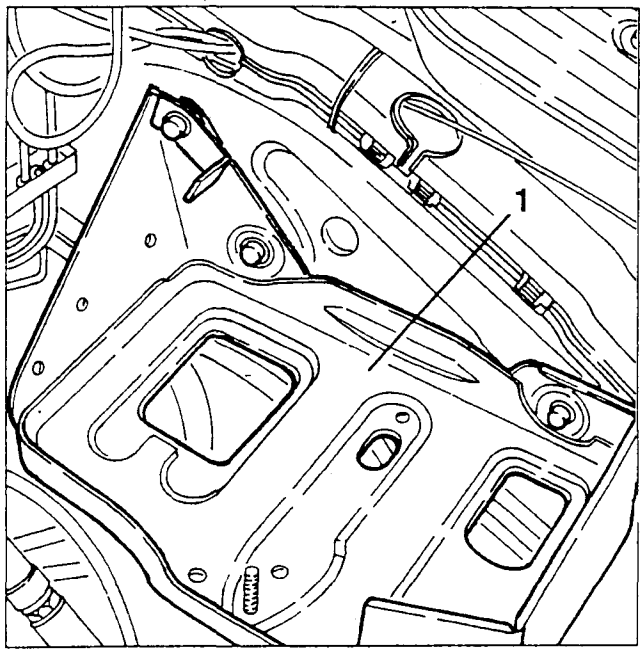
1. Remove the battery after disconnecting the terminals.



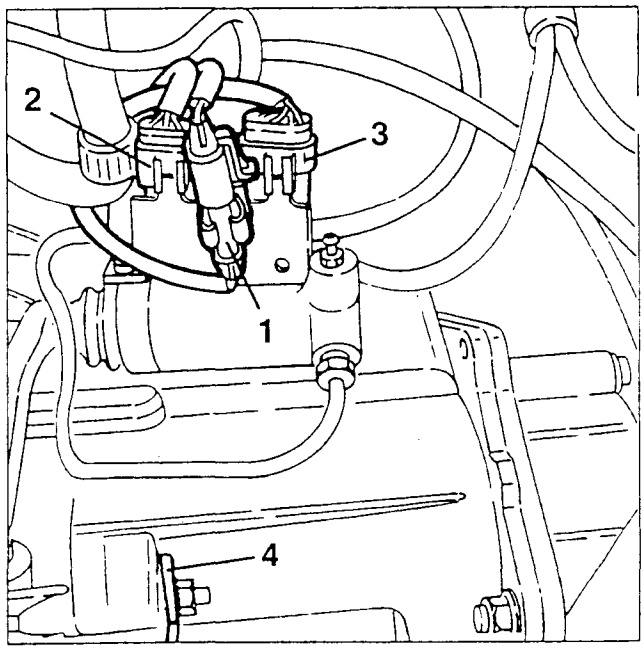
1. Release the two relay boxes from the battery support and set them aside.



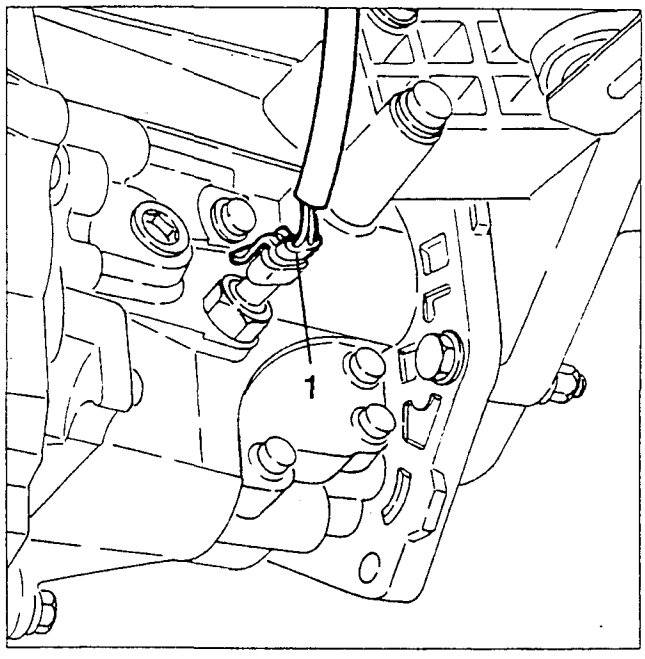
1. Slacken the fastening screws and remove the battery support complete with drain pipe after freeing this from the wheelhouse.



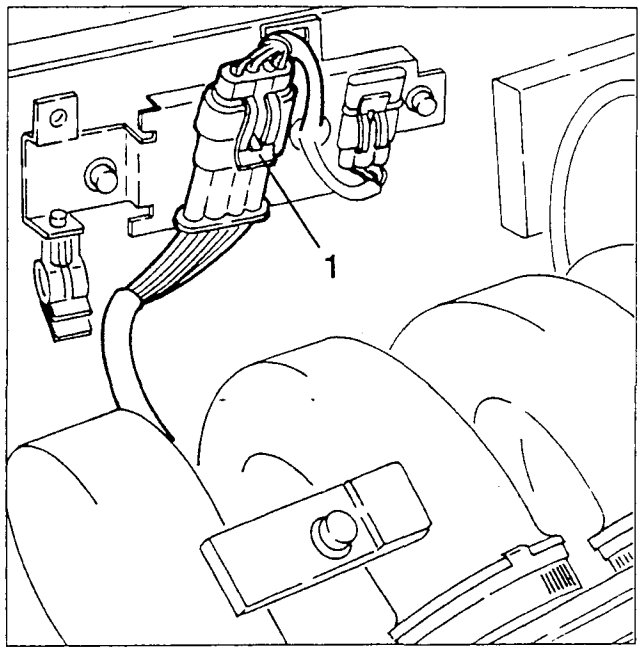
1. Disconnect the electrical connection of the starter motor.
2. Disconnect the electrical connection of the tachometric sensor.
3. Disconnect the electrical connection of the injection system.
4. Disconnect the earth cable from the gearbox cover.



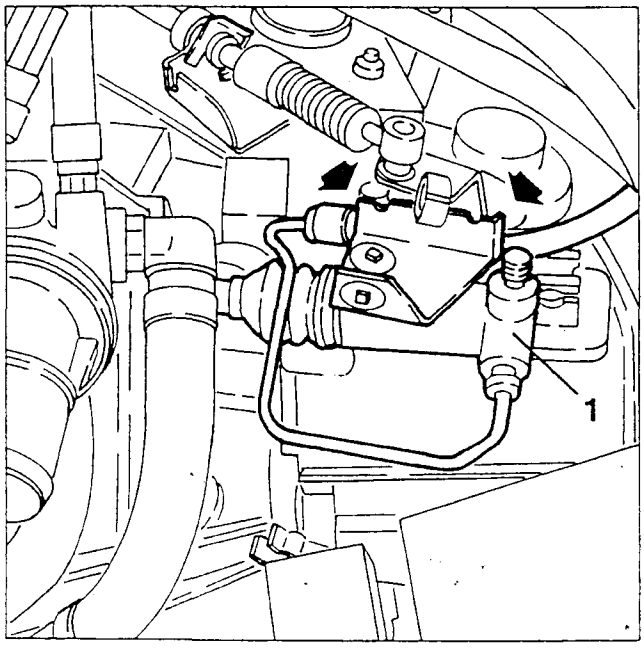
1. Disconnect the electrical connection from the reversing switch.



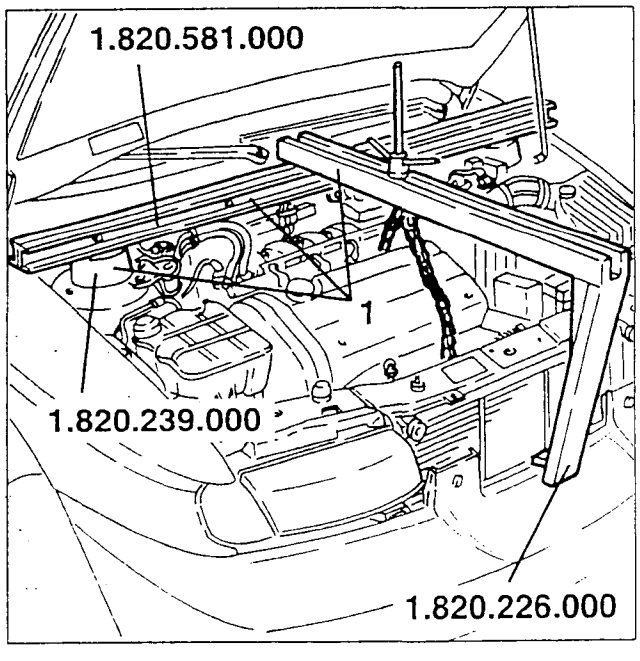
1. Remove the plastic cover, then disconnect the electrical connection of the lambda sensor.



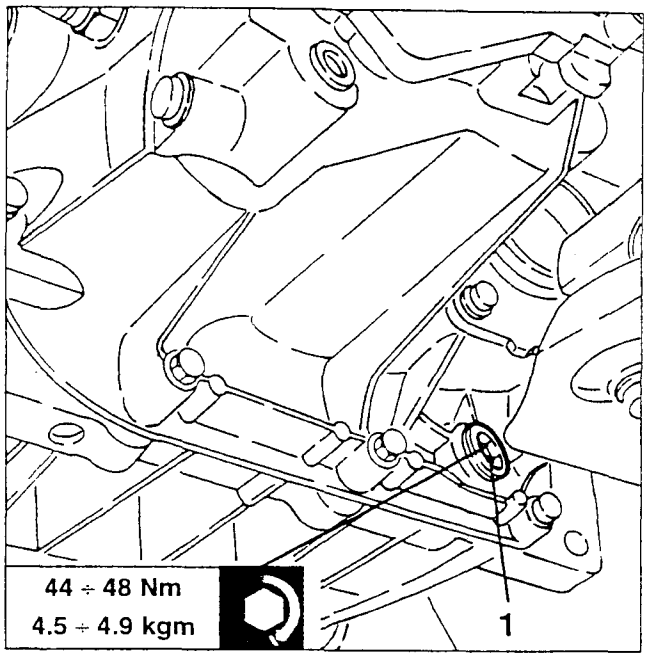
1. Slacken the fastening screws, then move the clutch control cylinder to one side without disconnecting the associated pipes.



- Remove the radiator grille (see GROUP 70).
1. Position engine support no. 1.820.226.000, with the corresponding supports no. 1.820.239.000 and cross rail no. 1.820.581.000 as illustrated.
- Install two suitable support squares on the crankcase, then using a chain, connect the support tool to the squares thereby supporting the power unit.

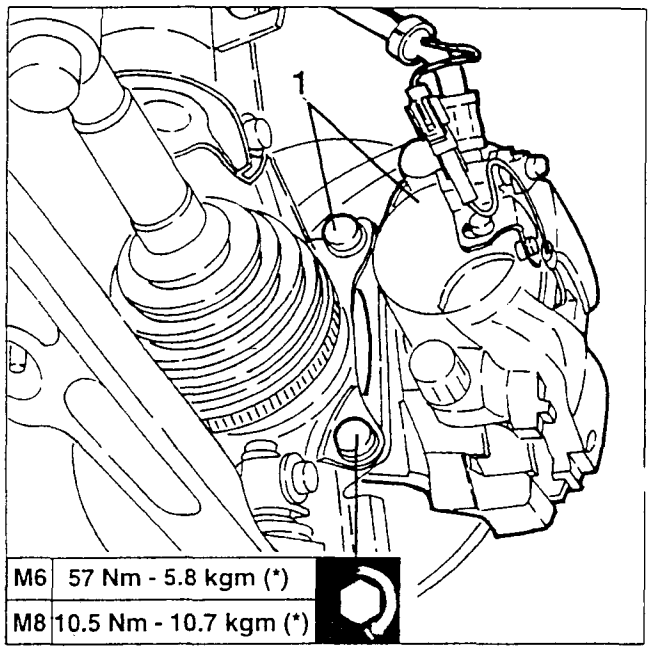


1. Slacken the plug and drain the gearbox-differential oil into a suitable container.



44 ÷ 48 Nm 4.5 ÷ 4.9 kgm	

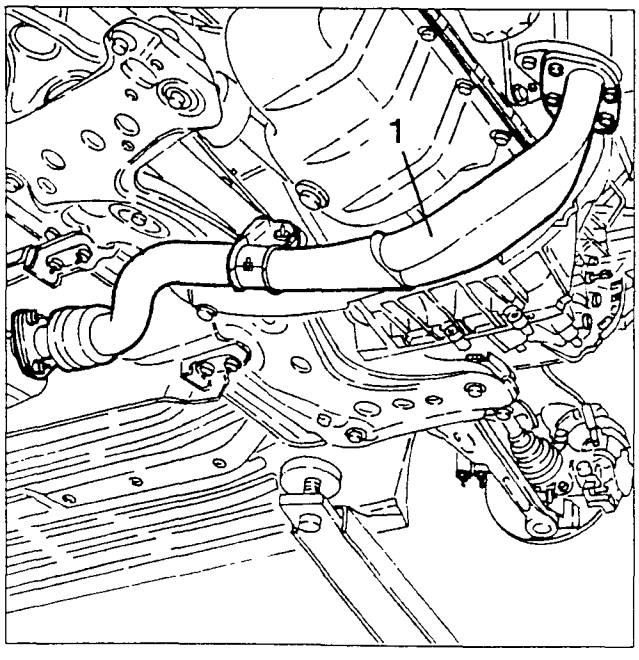
1. Slacken the two fastening screws and remove the left front brake caliper complete, without disconnecting the associated pipes and fasten it to one side to prevent it from hindering the following operations.



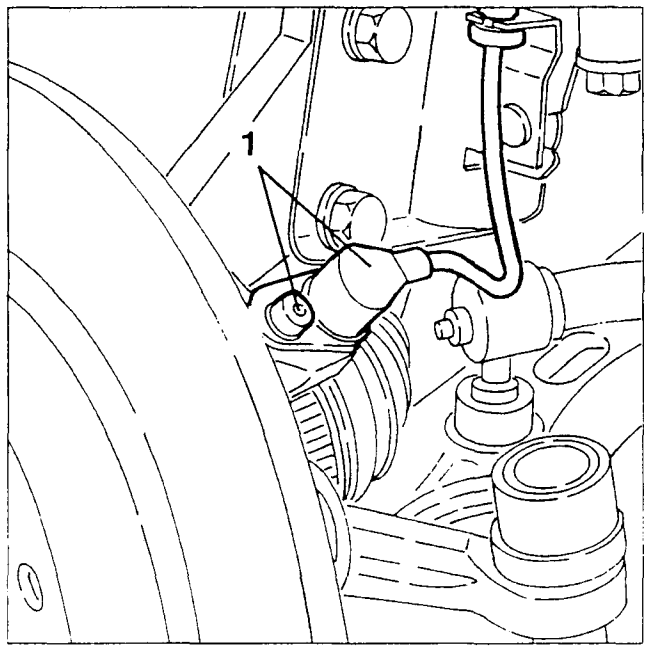
M6	57 Nm - 5.8 kgm (*)
M8	10.5 Nm - 10.7 kgm (*)

(*): Screws with "Driloc"; must be changed every time they are tightened or loosened.

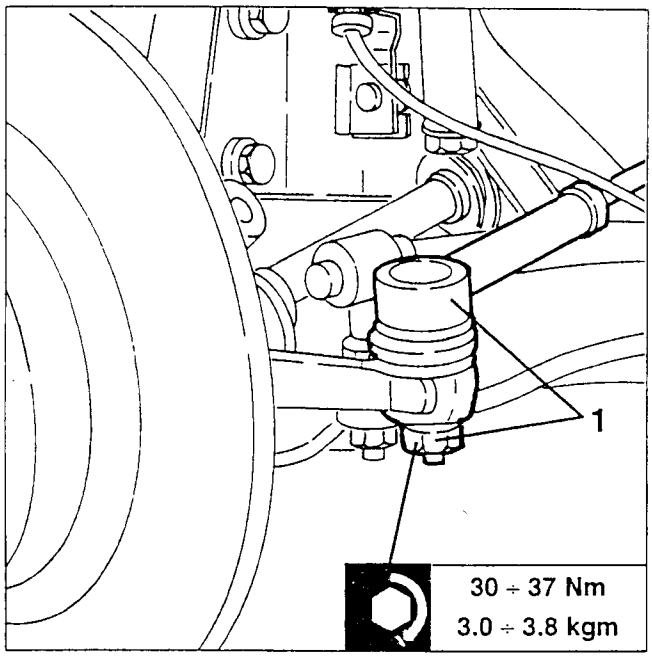
1. Slacken the fastenings and remove the front section of the exhaust pipe complete with lambda sensor.



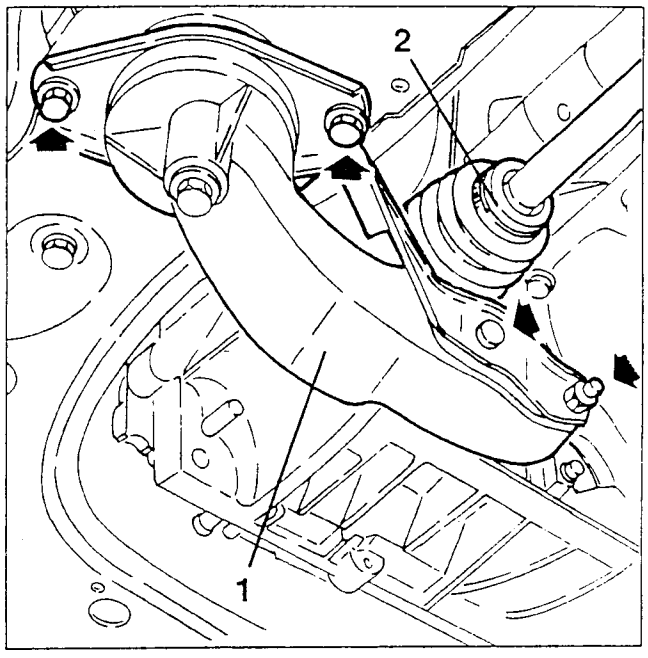
1. Slacken the fastening screw and remove the left front A.B.S. inductive sensor from the wheel upright.



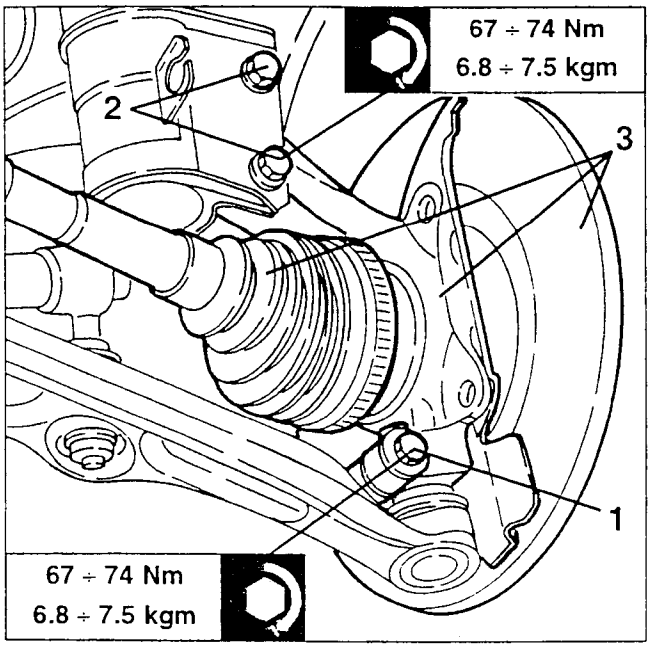
1. Slacken the fastening nut and disconnect the track rod from the wheel upright.



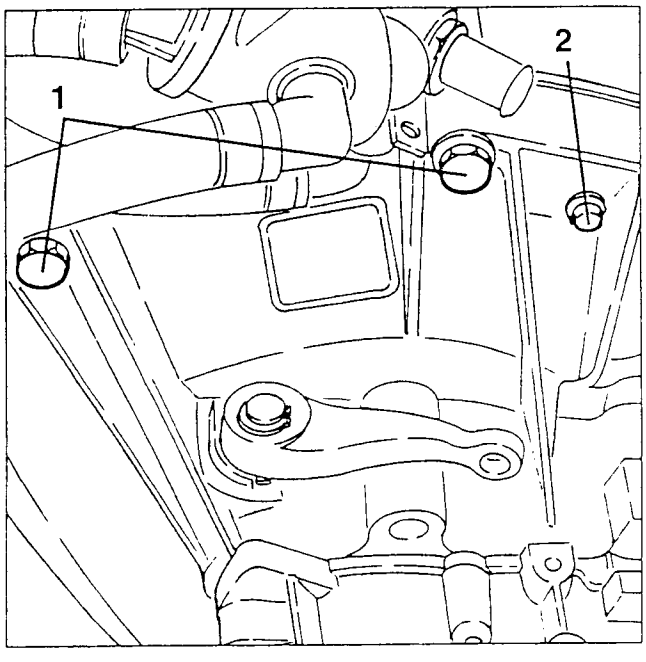
1. Slacken the fastening screws and remove the power unit rear support.
2. Slacken the clamp fastening the right axle shaft from the differential.



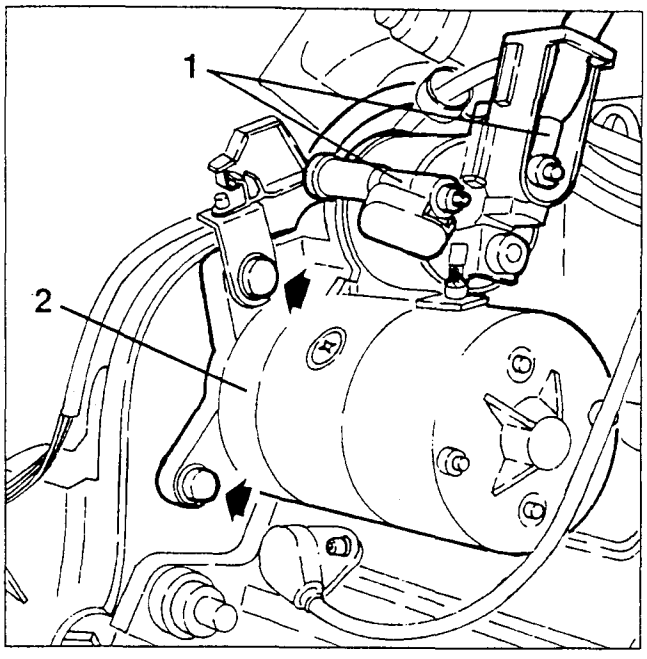
1. Slacken the bolt fastening the wishbone to the wheel upright.
2. Slacken the two bolts fastening the upright to the shock absorber.
3. Withdraw the axle shaft complete with wheel upright and brake disk after freeing the axle shaft boot from the differential.



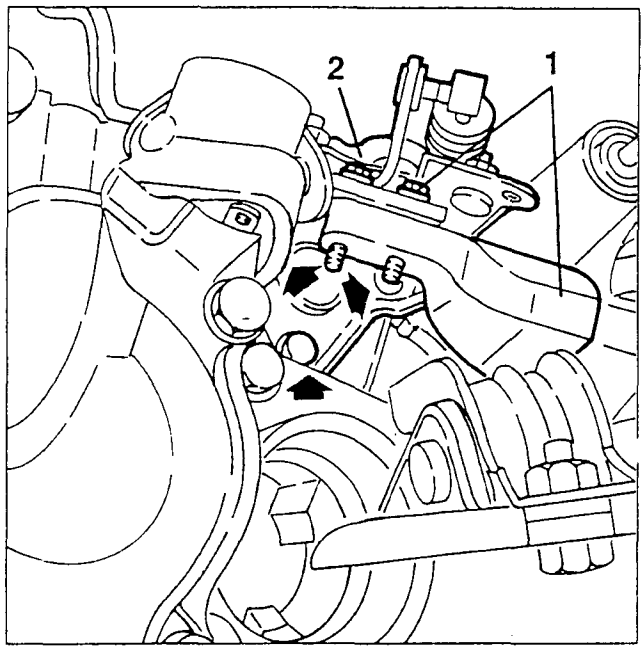
1. Slacken the two upper screws fastening the gearbox to the engine.
2. Slacken the screw fastening the starter motor to the gearbox.



1. Disconnect the electrical connections from the starter motor.
2. Slacken the remaining two fastening screws and remove the starter motor.

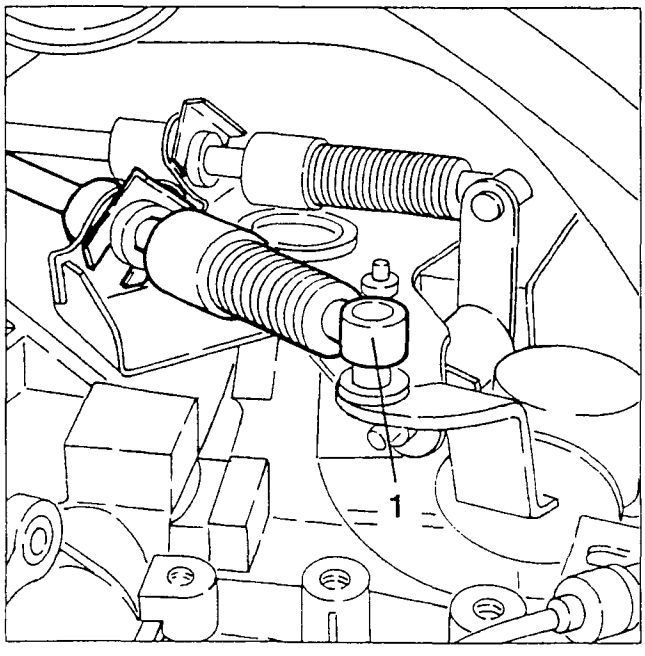


1. Slacken the two fastening screws and remove the damping mass.
2. Slacken the fastening screws and remove the gearshift control bowden connection bracket from the gearbox.



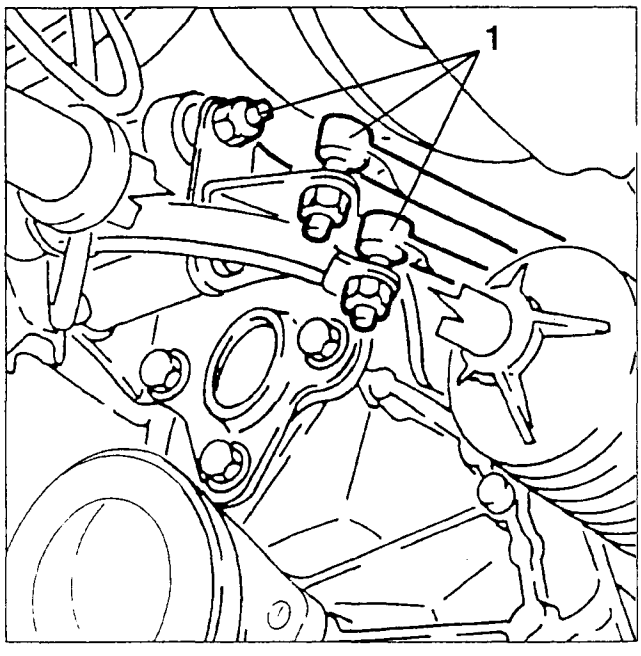
Specific for versions with bowden gearshift control

1. Disconnect the gearshift control bowden illustrated.

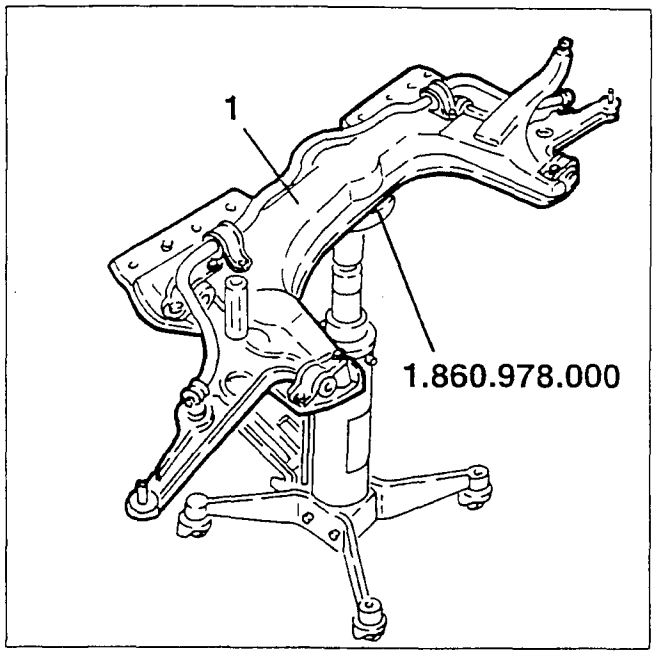


Specific for versions with rod gearshift control

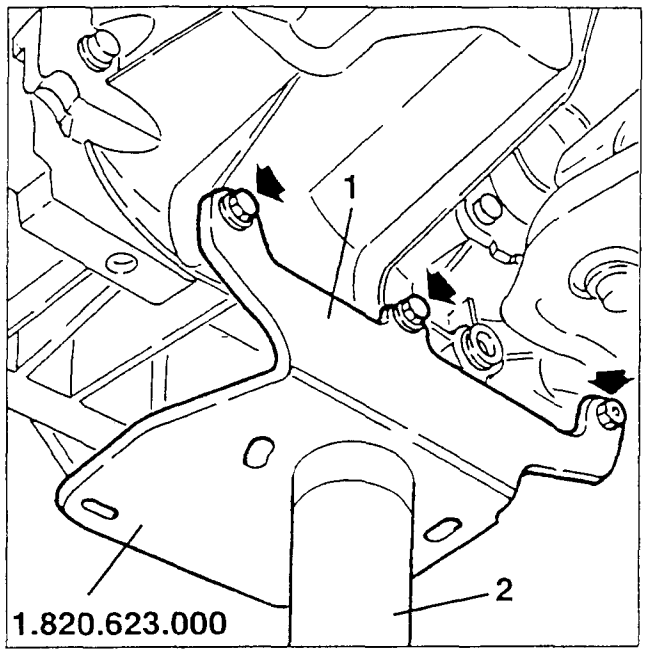
1. Slacken the fastening nuts and disconnect the gearshift control rods.



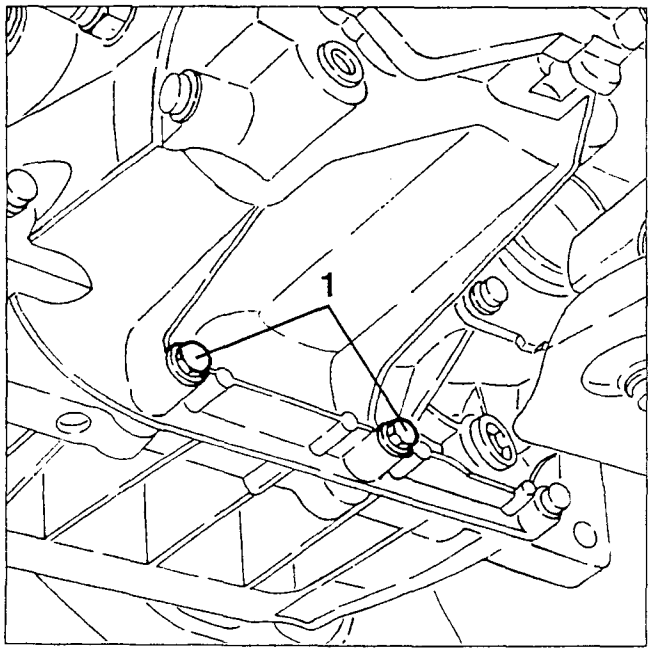
- Using a hydraulic jack support the front suspension crossmember using tool no. 1.860.978.000.
1. Slacken the screws and nuts fastening the crossmember, then remove it complete with wishbones, stabiliser bar and reinforcements.



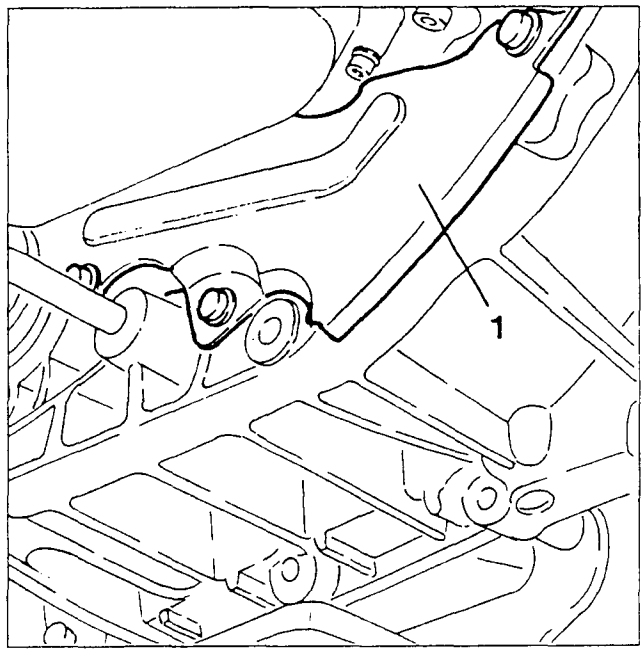
1. Position the bracket of tool no. 1.820.623.000 fastening it to the gearbox with the two screws removed previously and with a bolt in the hole already existing on the gearbox as illustrated.
2. Position a hydraulic jack under the support tool.



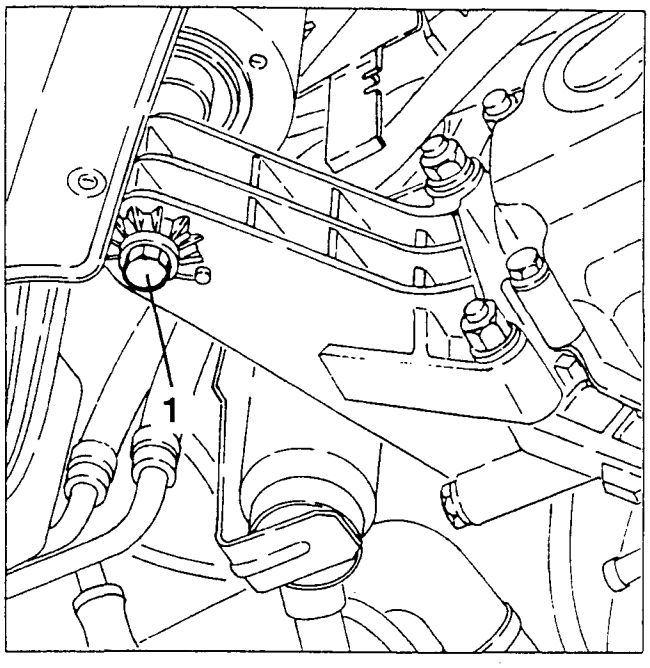
1. Slacken the two gearbox fastening screws illustrated.



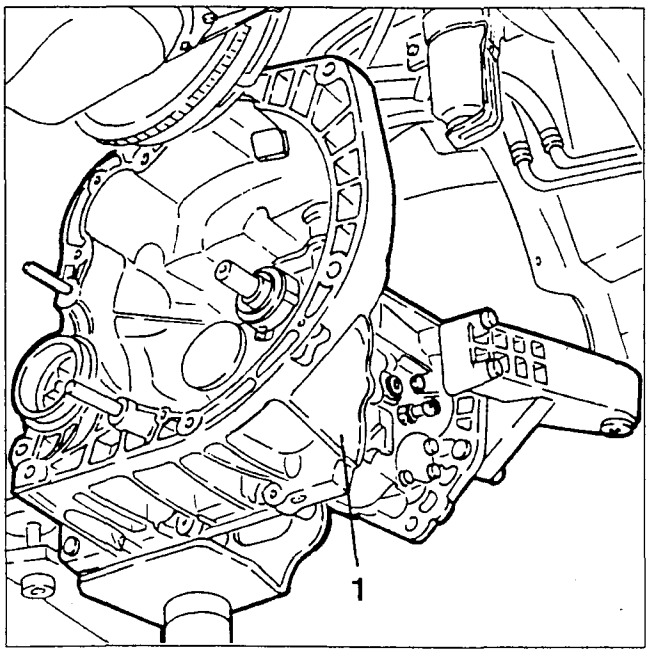
1. Slacken the fastening screws and remove the flywheel guard.



1. Slacken the screw fastening the gearbox side power unit support.



1. Slacken the remaining gearbox fasteners to the engine, then lower the hydraulic jack and remove it, freeing it from the right axle shaft.

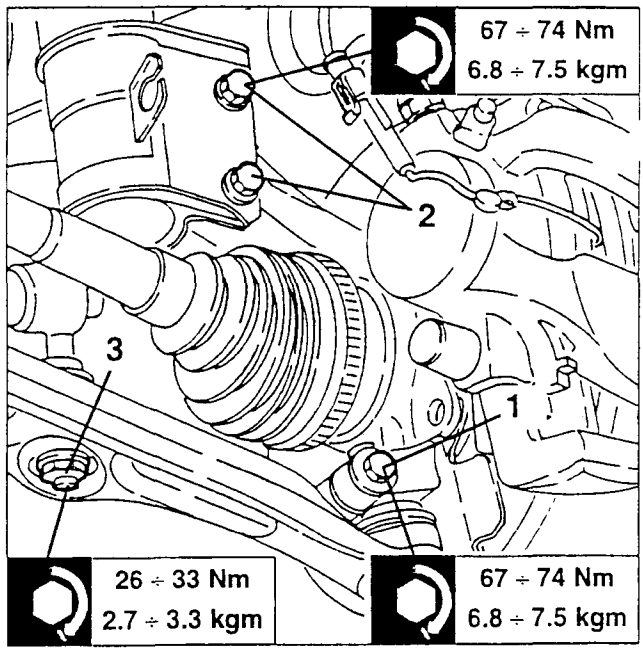


OPERATIONS IN THE CAR

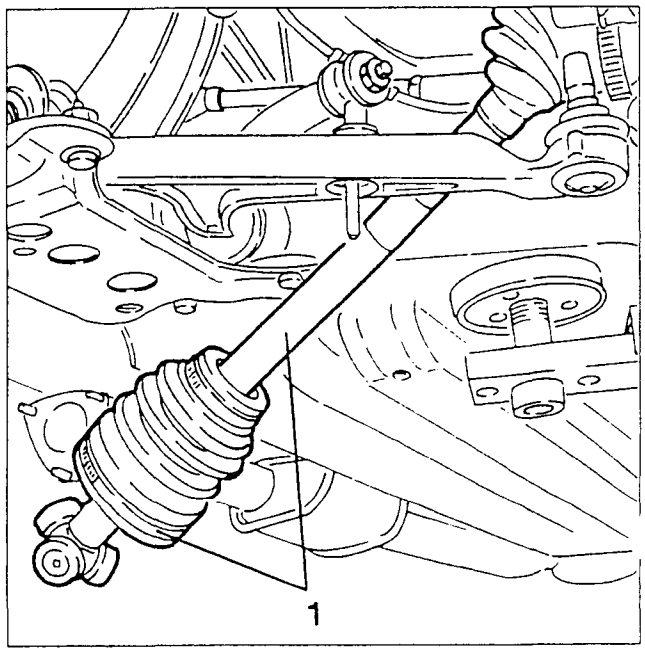
CAHNGING THE GEARBOX SIDE DIFFERENTIAL CARRIER OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car and remove the left front wheel and mud flap.

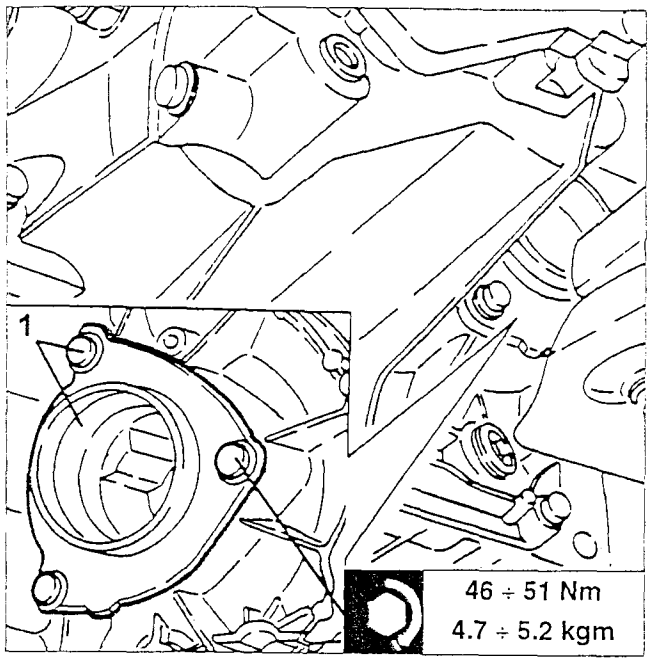
1. Slacken the bolt fastening the left wishbone to the left wheel upright.
2. Slacken the two bolts fastening the upright to the left shock absorber.
3. Slacken the nut fastening the stabiliser bar to the left wishbone.



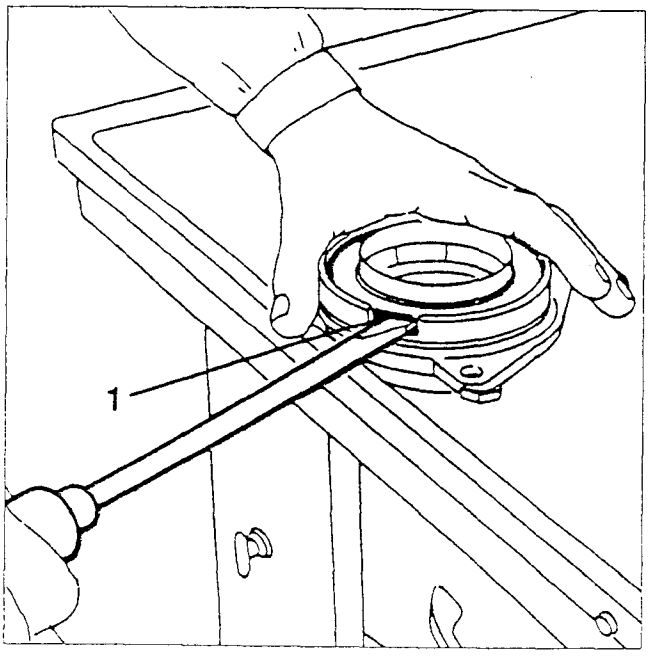
1. Slacken the boot fastening clamp, then withdraw outwards the axle shaft, wheel upright and brake disk assembly intil releasing the axle shaft from the differential.



1. Slacken the three fastening screws and remove the differential box sealing cover.

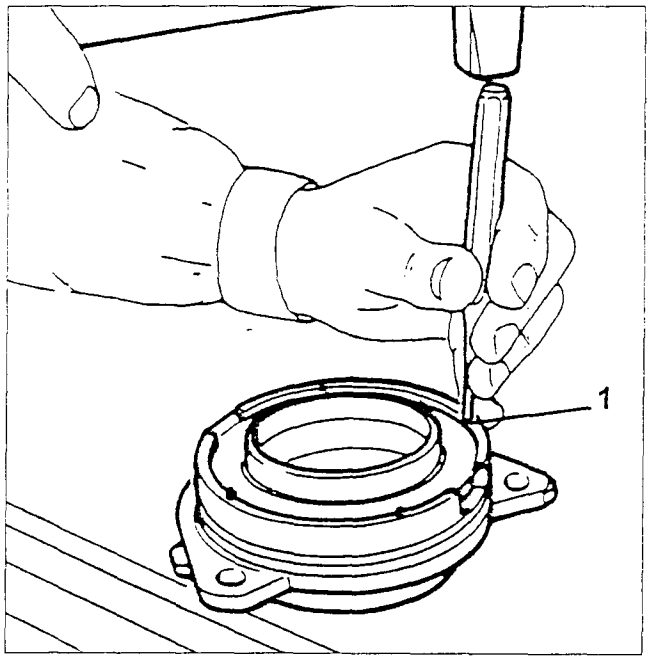


1. On the bench, remove the differential box sealing cover and oil seal using a screwdriver as illustrated.



- Remove the four caulkings to make it possible to install a new oil seal.

1. Install a new oil seal and remake the four caulkings removed previously using a punch and a hammer.

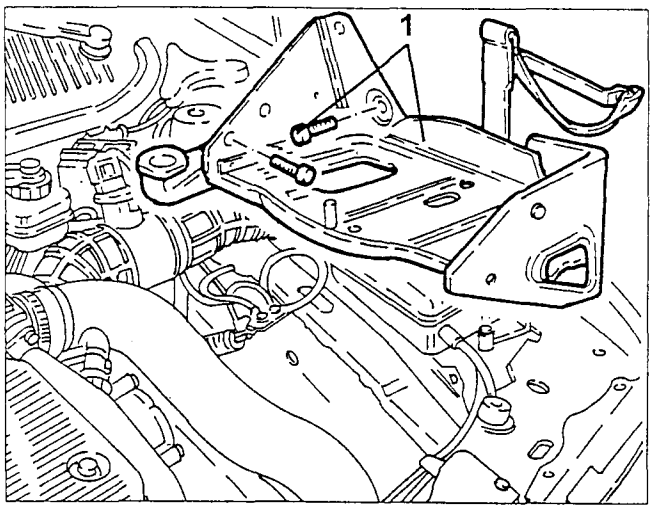


Complete re-assembly reversing the sequence followed for disassembly.

REMOVAL/REFITTING

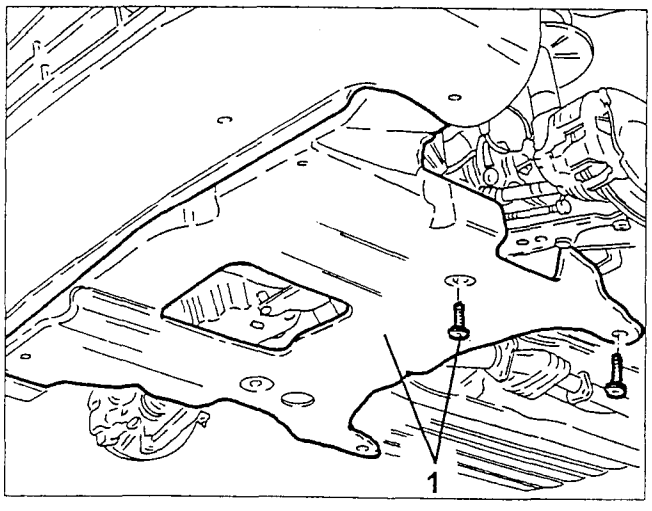
- Set the car on a lift.
- Remove the battery (see Group 55).
- Remove the battery acid drain duct.

1. Slacken the fastening screws and remove the battery holder.

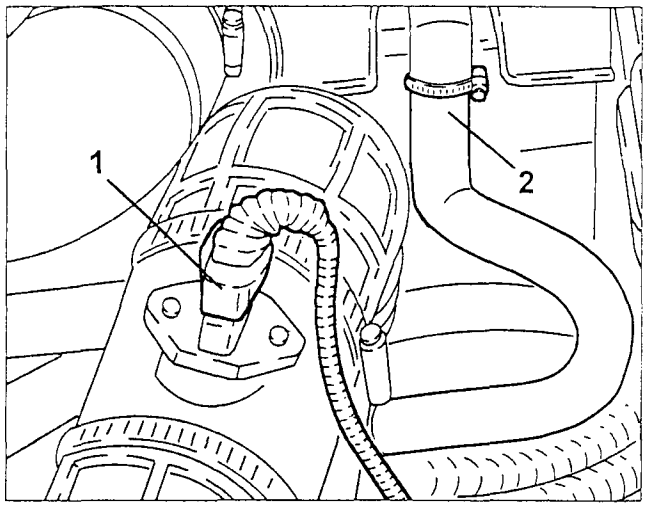


- Remove the front wheels and their dust guards.

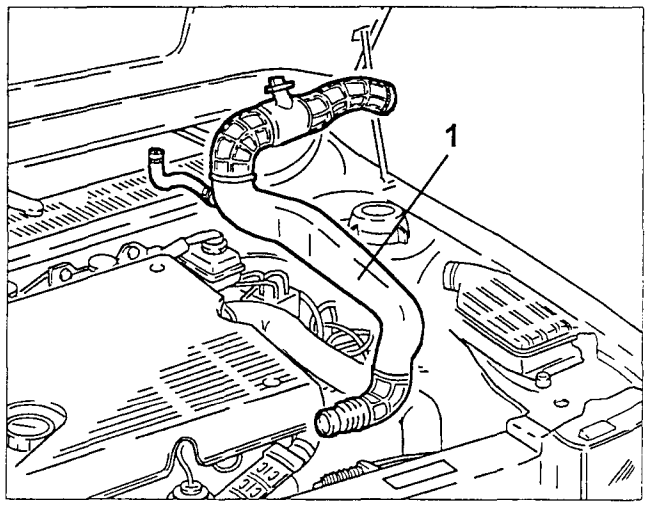
1. Slacken the fastenings and remove the under engine guard.



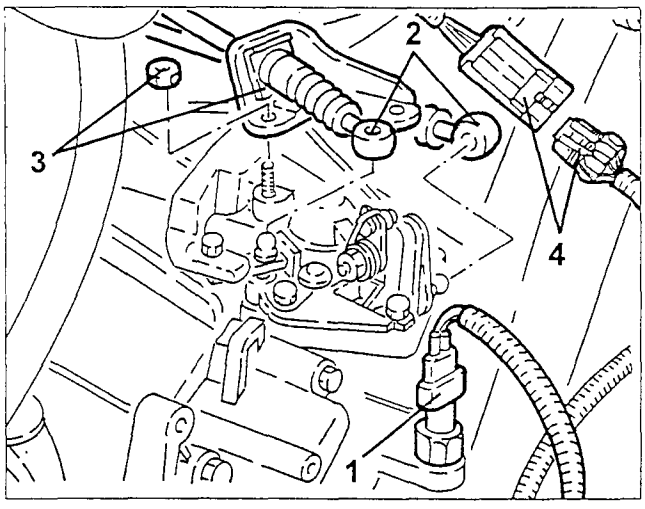
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the oil vapour re-circulation pipe from the oil vapour separator.



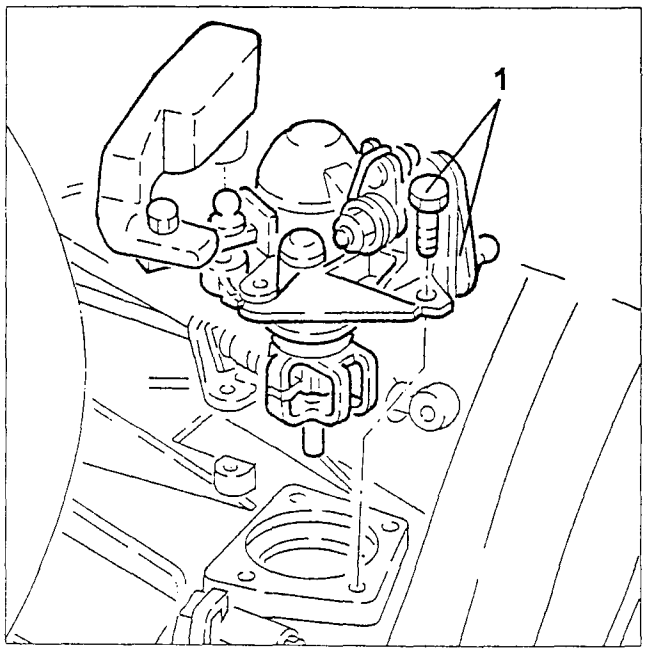
1. Loosen the clamps and remove the complete air delivery pipe from the cleaner to the turbocharger.



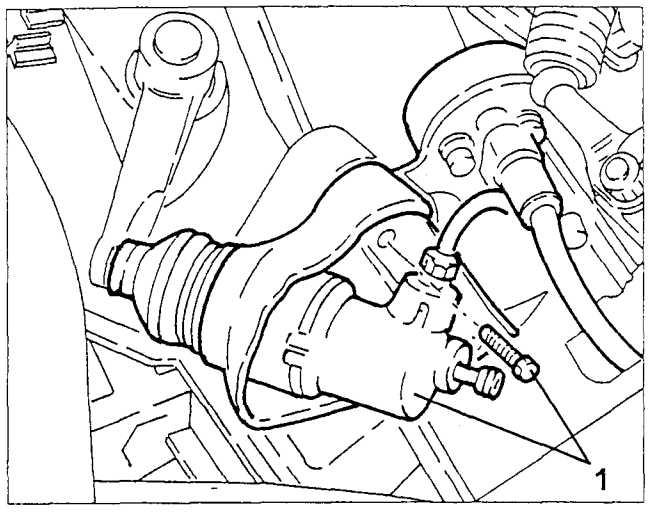
1. Disconnect the electrical connection from the reverse gear switch.
2. Disconnect the gearshift selection and engagement cables.
3. Slacken the nuts and move aside the support brackets complete with gearshift selection and engagement cables.
4. Disconnect the electrical connection of the speedometer sensor.



1. Slacken the fastening screws and remove the gear selection and engagement unit.

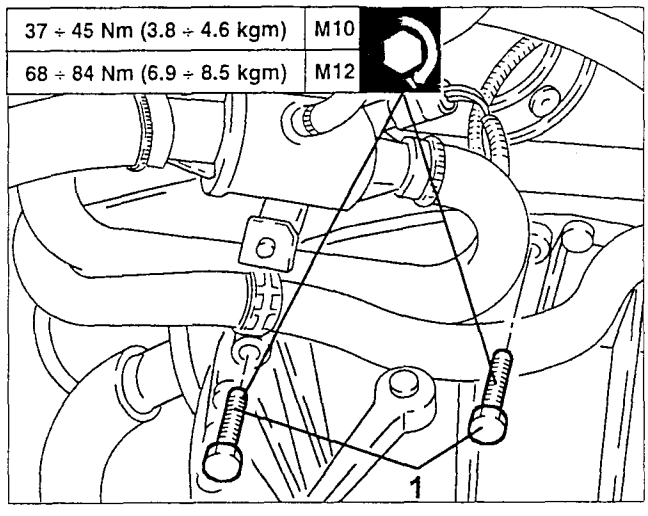


1. Slacken the fastening screws and move the operating cylinder complete with pipes and vibration damper.

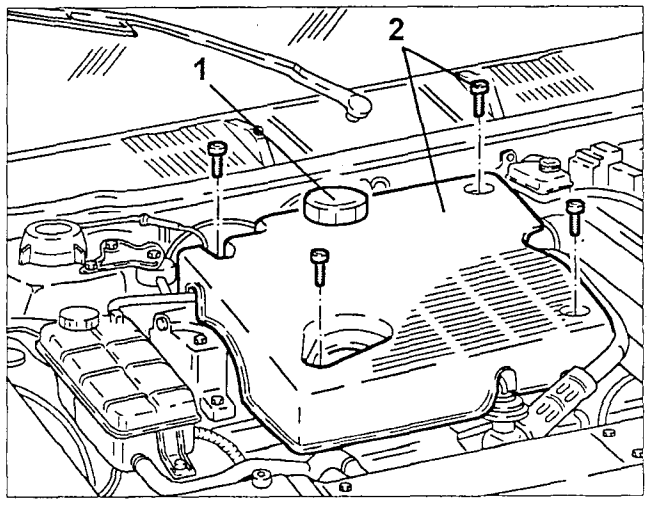


1. Slacken the two upper gearbox fastening screws.

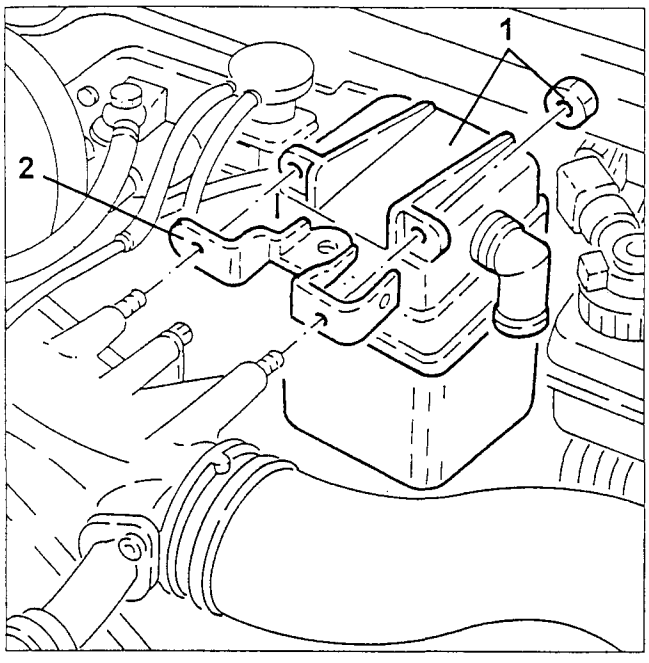
37 ÷ 45 Nm (3.8 ÷ 4.6 kgm)	M10
68 ÷ 84 Nm (6.9 ÷ 8.5 kgm)	M12



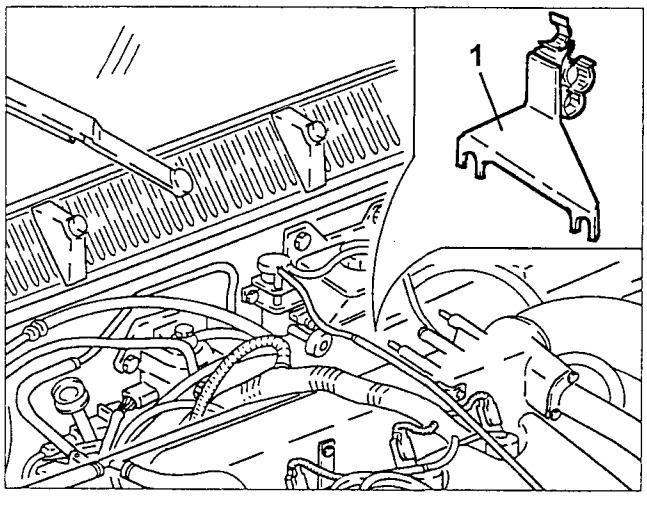
1. Remove the engine oil filler cap.
2. Slacken the fastening screws and remove the engine cover.
- Refit the engine oil filler cap.



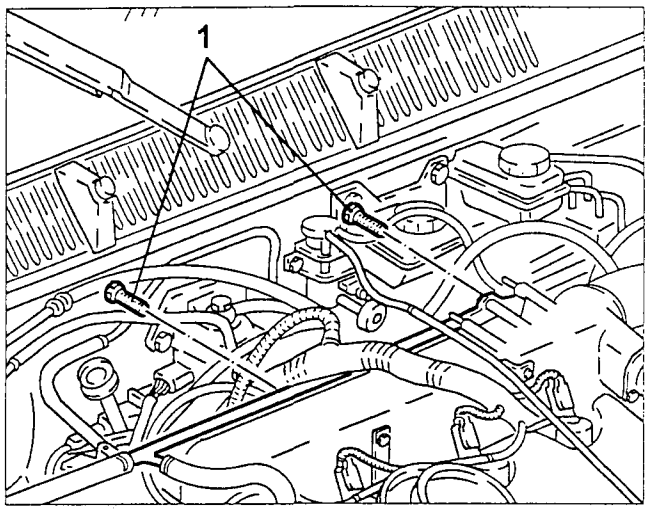
- Remove the front bumper (see GROUP 70).
1. Slacken the fastening nuts and move the oil vapour separator just enough to disconnect the corresponding pipes, then remove it.
2. Retrieve the bracket.



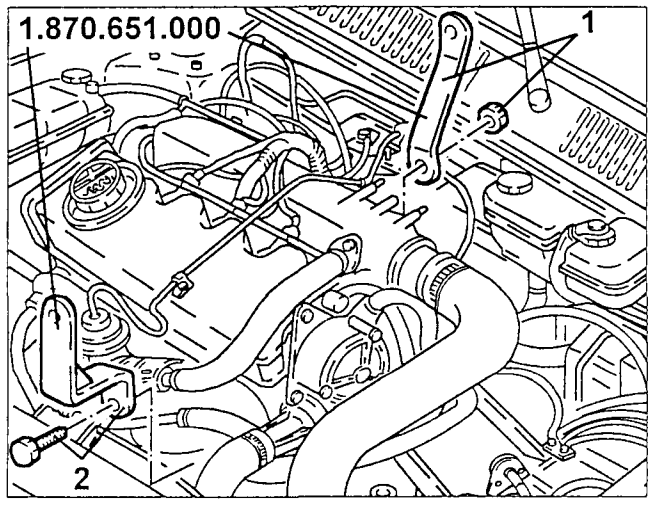
- Release the clamp fastening the oil vapour recovery pipe from the tappet cover.
- Release the delivery and return pipes to the climate control system heater from the fastening clamps.
1. Slacken the upper screws fastening the starter motor, then remove the pipe support bracket.



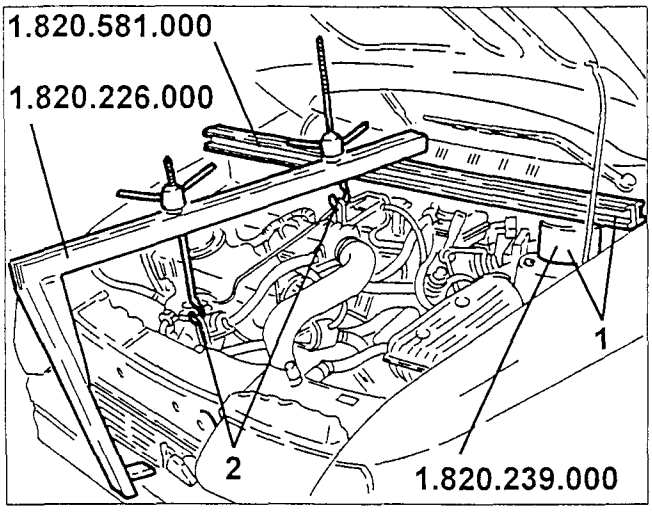
1. Slacken the fastening screws of the coolant fluid return pipe to the header tank.



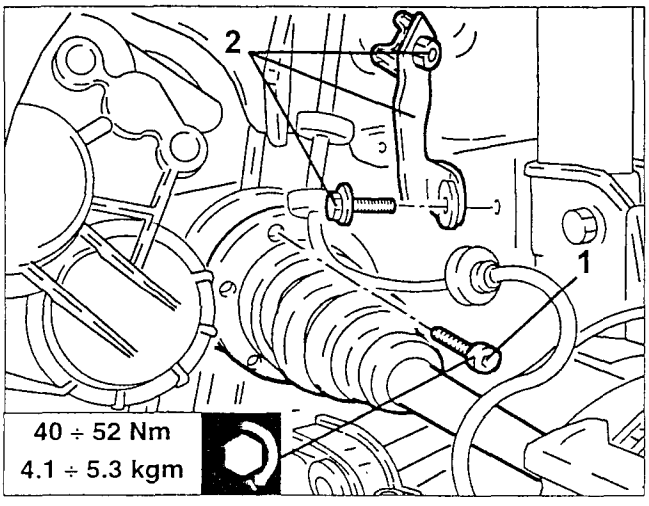
1. Install the rear bracket no. 1.870.651.000 and fasten it with an air box fastening nut.
2. Install the front bracket no. 1.870.651.000 and fasten it with the screw fastening the stiff coolant fluid delivery pipe to the engine oil heat exchanger.



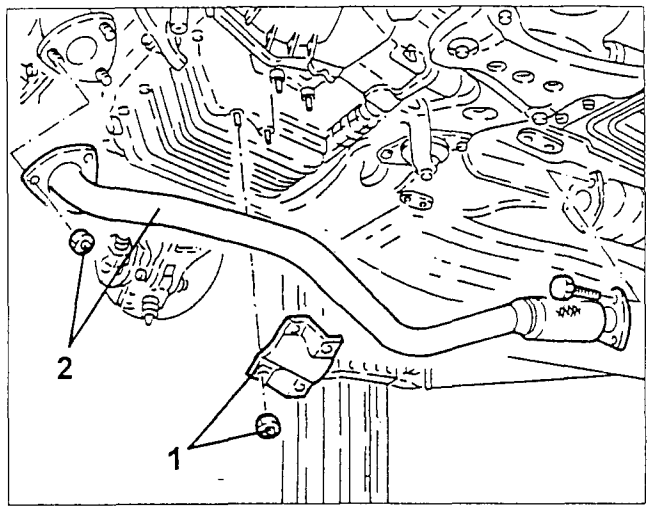
1. Install cross rail no. 1.820.581.000 complete with rest pads no. 1.820.239.000.
2. Install support no. 1.820.226.000 and connect the corresponding tie-rods to the brackets installed previously.



1. Slacken the bolts fastening the left axle shaft to the differential inner shaft.
2. Slacken the fastenings and remove the power steering pipe support bracket.

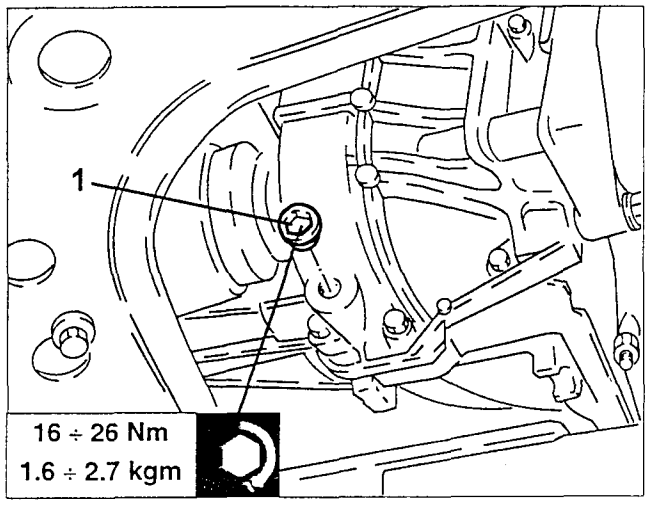


1. Slacken the fastening nuts and remove the reinforcement bracket.
2. Slacken the nuts and screws and remove the front section of the exhaust pipe.
- Remove the associated pipes.

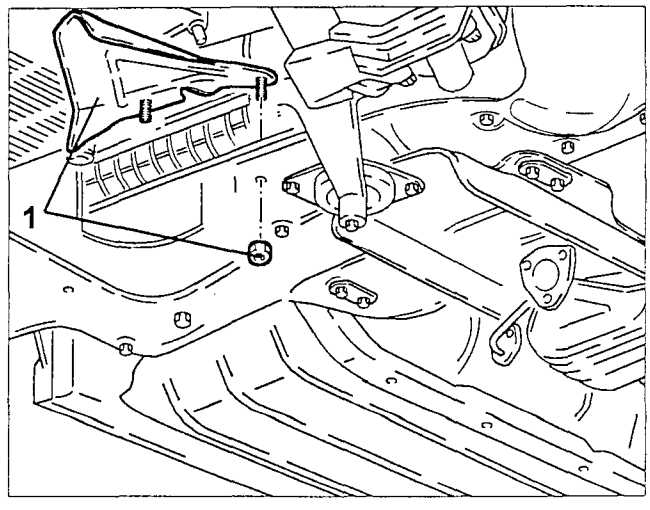


1. Slacken the drain cap and drain the gearbox/differential oil.

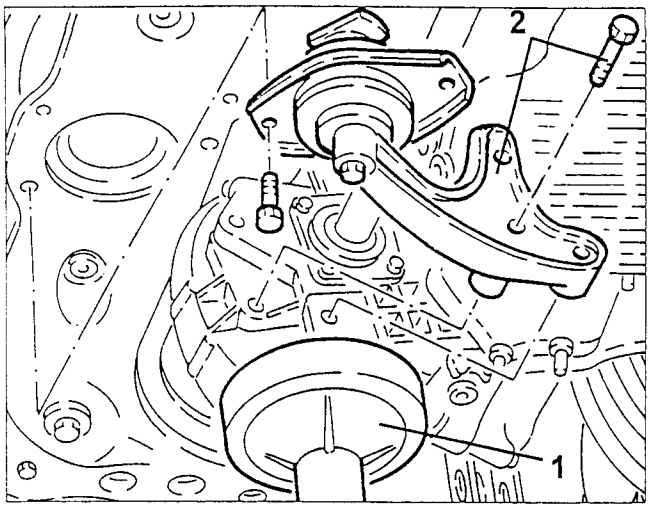
NOTE: Collect the gearbox/differential oil in a suitable container.



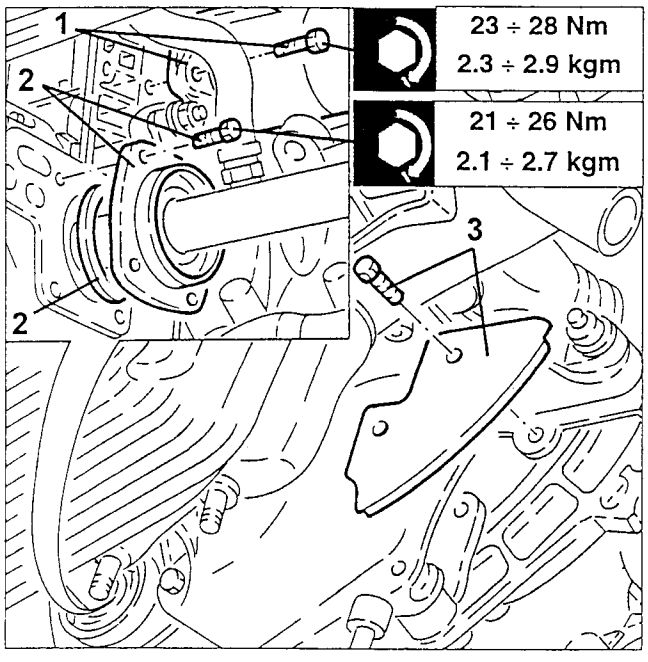
1. Slacken the nuts and remove the power steering box heat shield.



1. Set a hydraulic jack under the gearbox.
2. Slacken the fastening screws and remove the power unit rear rigid support.

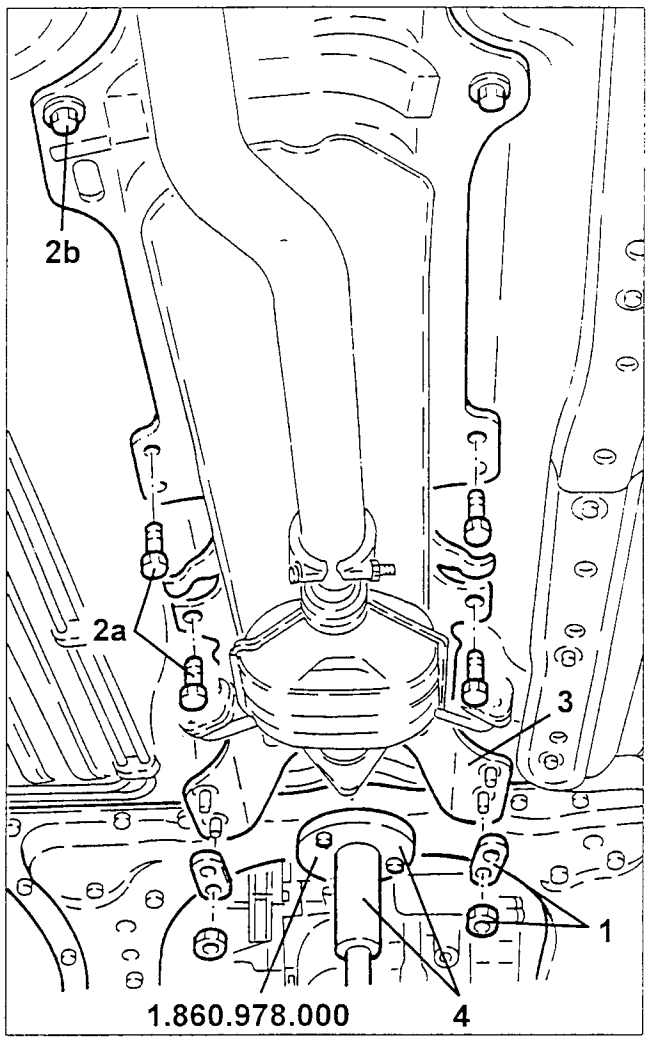


1. Slacken the lower screw fastening the starter motor, then move it aside.
2. Slacken the fastening screws and move the right differential flange complete with thrust ring.
3. Slacken the fastening screws and remove the lower flywheel guard.

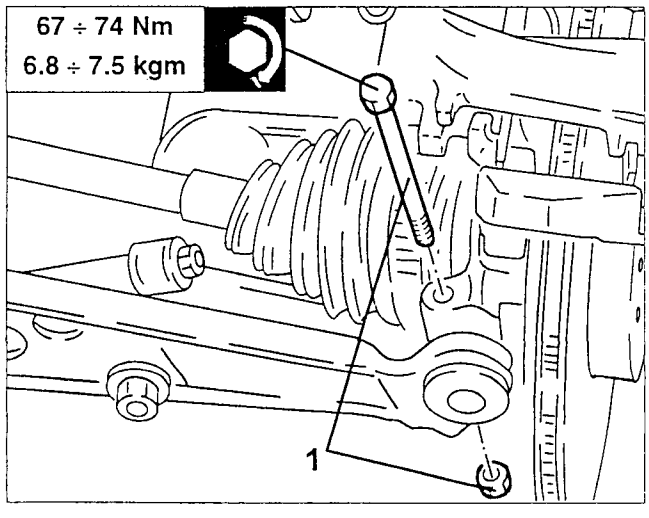


1. Slacken the nuts fastening the support for the gearshift and handbrake control levers and retrieve the corresponding plates.

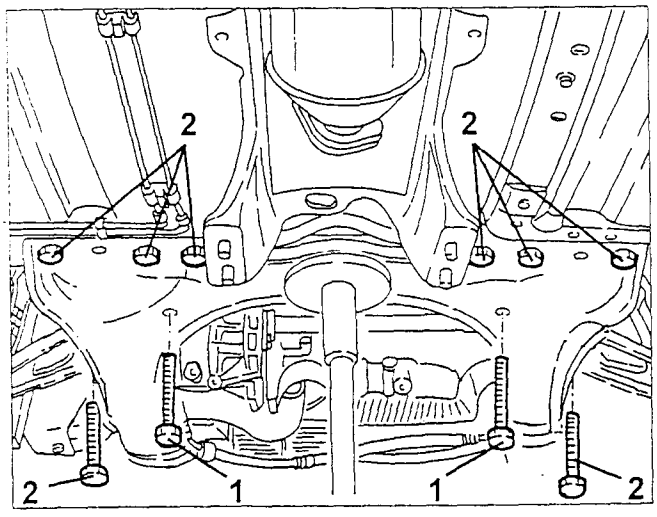
2. Slacken the front screws (2a) and slacken the rear screws (2b) fastening the support for the gearshift and handbrake control levers.
3. Lower the front of the support for the gearshift and handbrake control levers.
4. Support the front suspension cross rail with a hydraulic jack fitted with tool no. 1.860.978.000.



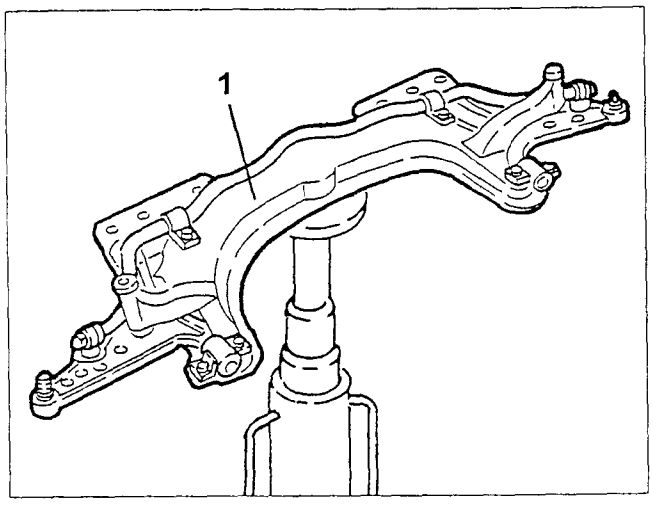
1. Slacken the bolts fastening the wishbones to the wheel uprights.



1. Slacken the screws fastening the power steering box to the front suspension cross rail.
- Slacken the screws fastening sound-absorbing protections to the front suspension cross rail.
2. Slacken the side and rear screws fastening the front suspension cross rail to the body.

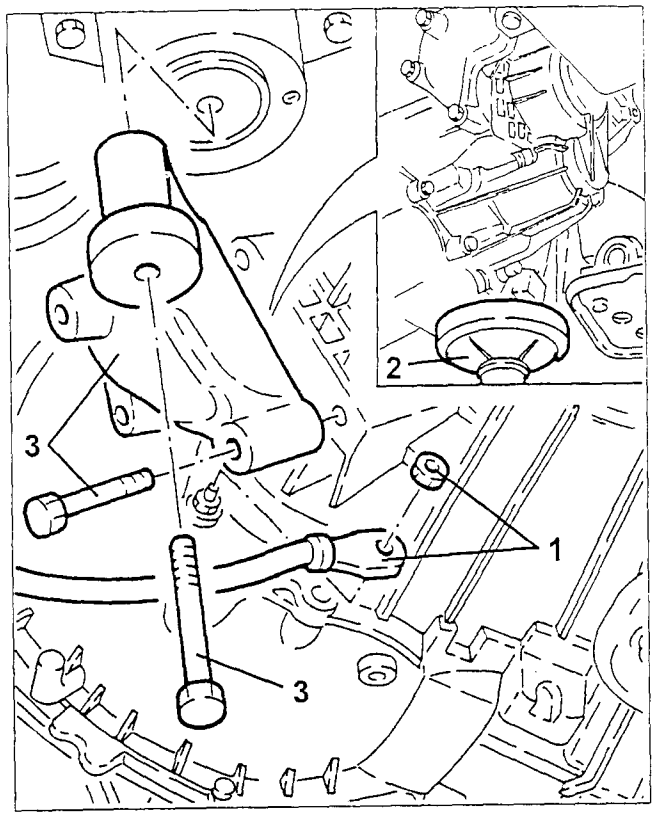


1. Lower the hydraulic jack and remove the front suspension cross rail complete with stabiliser bar and wishbones.

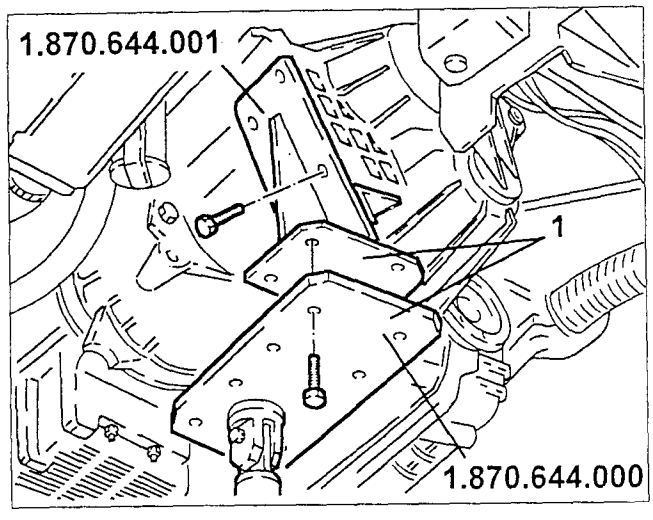


1. Slacken the nut and disconnect the gearbox earth cable.
2. Set a hydraulic jack under the gearbox.

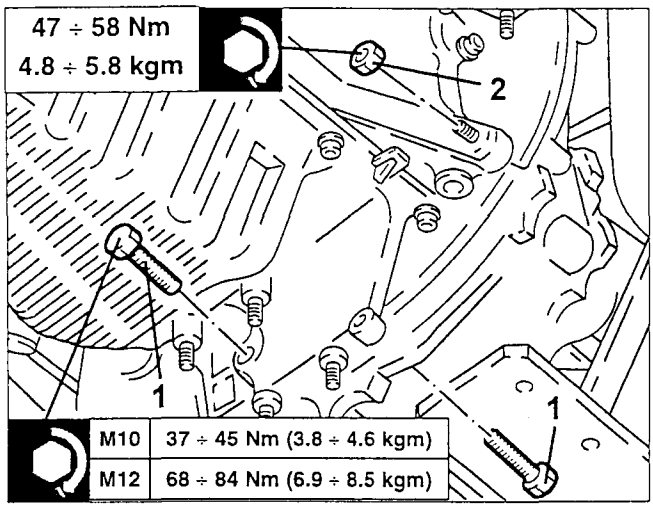
3. Slacken the screws and remove the gearbox stiff side support.



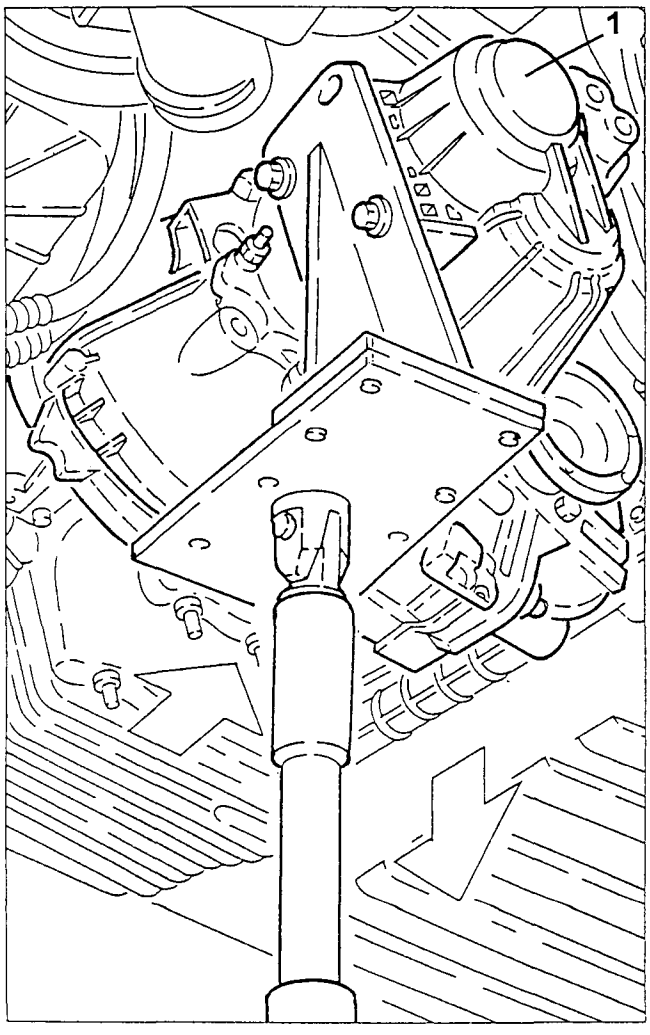
1. Support the gearbox with a hydraulic jack fitted with tools no. 1.870.644.000 and no. 1.870.644.001.



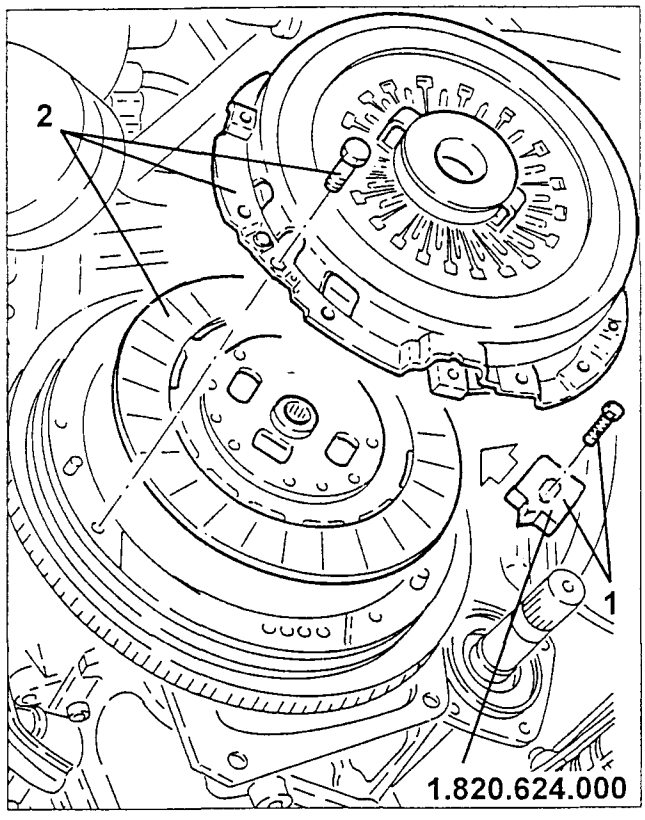
1. Slacken the screws fastening the oil sump to the gearbox.
2. Slacken the nuts fastening the gearbox to the crankcase.



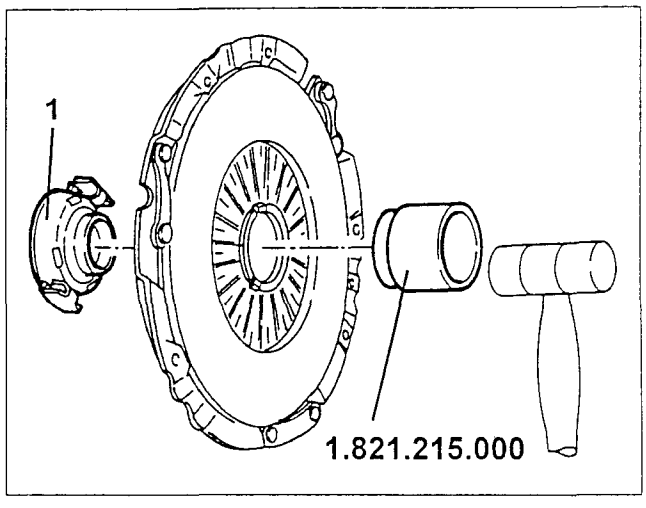
1. Remove the gearbox with differential firstly moving it away from the engine and then lowering it with the hydraulic jack.



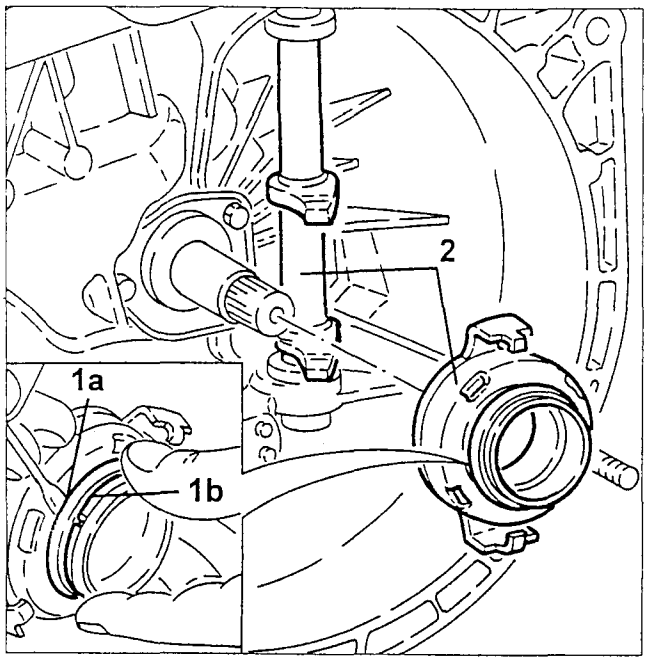
1. Install flywheel stopper tool no. 1.820.624.000.
2. Slacken the screws and remove the clutch box complete with thrust bearing and clutch plate.



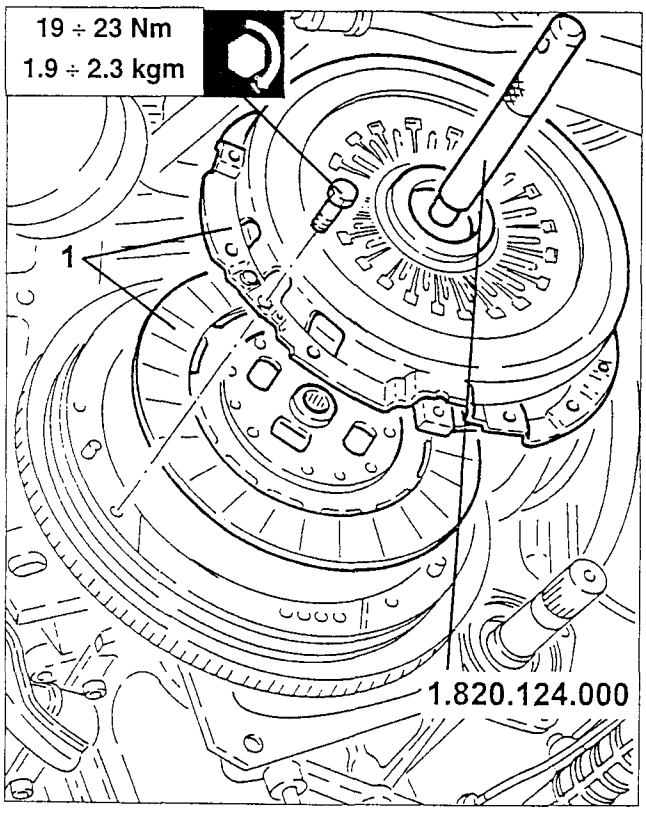
When refitting, follow the instructions given below.
1. Remove the thrust bearing from the clutch box using tool no. 1.821.215.000.



1. Raise the taper ring (1a) of the thrust bearing until covering the spring (1b).
2. Install the thrust bearing on the main shaft and couple it with the fork pin.

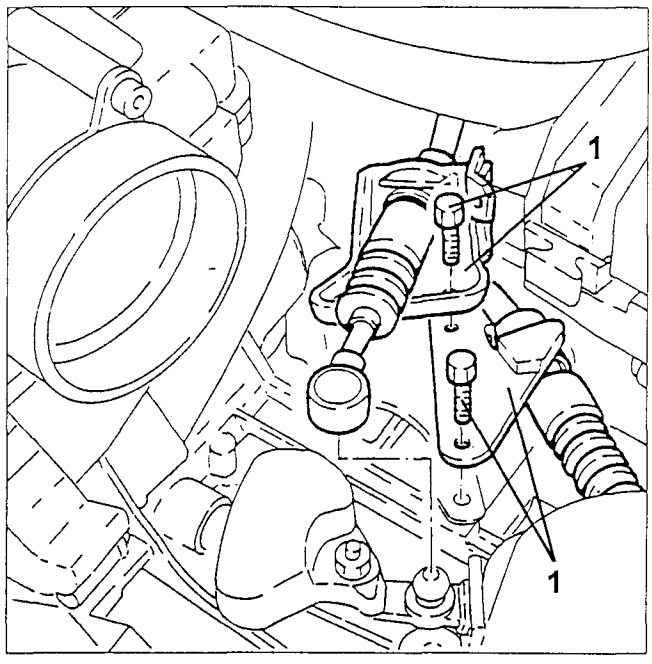


1. Install the clutch plate and clutch box centring them with tool no. 1.820.124.000.

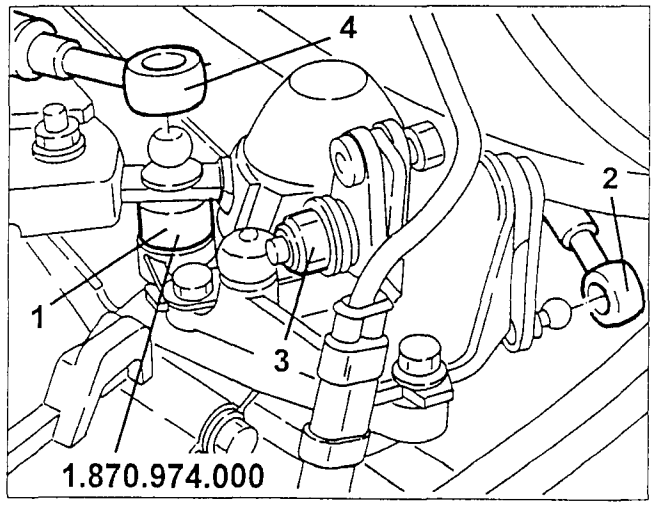


- After assembling the gearbox and fastening it with its screws, work on the clutch control lever to engage the thrust bearing on the clutch.

- Complete refitting, reversing the sequence followed for removal up to assembly of the gear selection/engagement unit, then adjust the gear selection/engagement cables as described below.
1. Refit the support brackets complete with gear selection and engagement cables and fasten them with their nuts.



1. Install tool no. 1.870.974.000 under the gear engagement cable catch ball.
2. Connect the gear selection cable.
3. Loosen the adjustment nut of the gear selection/engagement unit.
- Tighten the adjustment nut of the gear selection/engagement unit after positioning the gearshift lever to neutral and moving it completely to the right.
4. Connect the gearshift engagement cable.
- Position the gearshift lever at reverse and remove the tool no. 1.870.974.000.



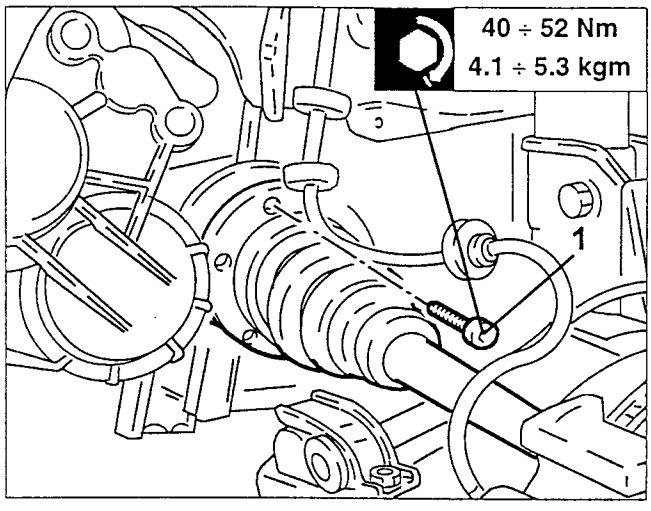
- Complete refitting, reversing the sequence followed for removal.

OPERATIONS ON THE CAR

REPLACING THE GEARBOX SIDE DIFFERENTIAL OIL SEAL

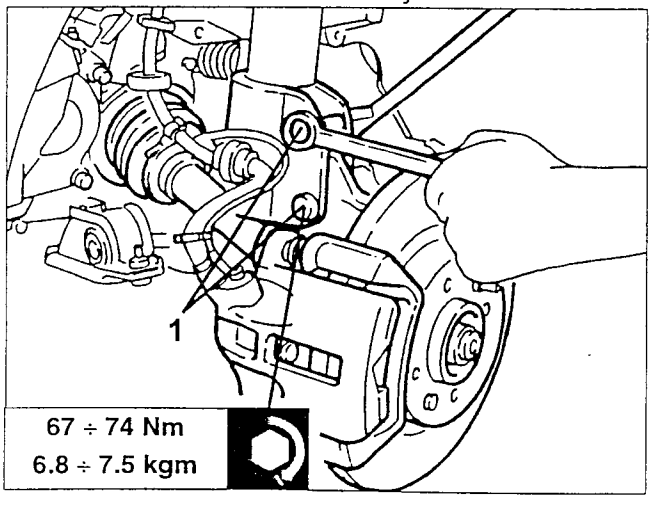
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the left front wheel and mud flap.
- Working from the left wheel arch, disconnect the electrical connection of the brake pad wear sensor.
- Slacken the screw fastening the active A.B.S. sensor cable support bracket.

1. Slacken the bolts fastening the left axle shaft to the differential left inner axle shaft.

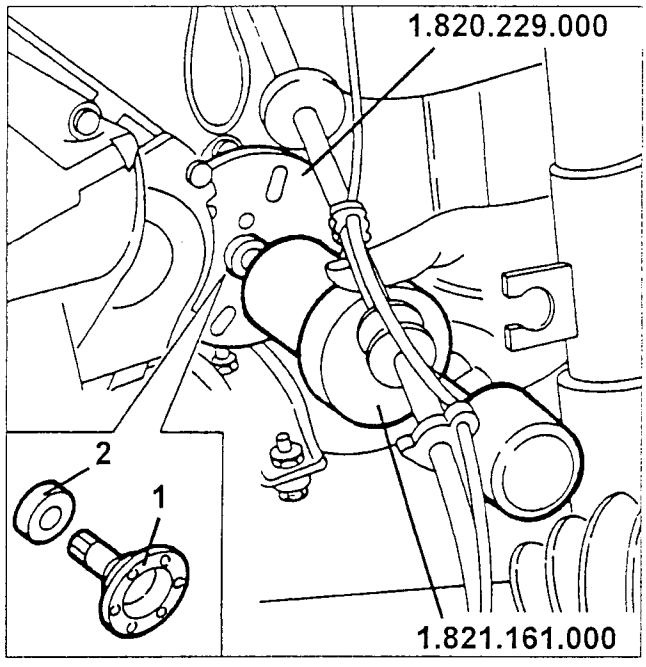


1. Slacken the bolts fastening the left upright to the shock absorber, then remove only the upper bolt.

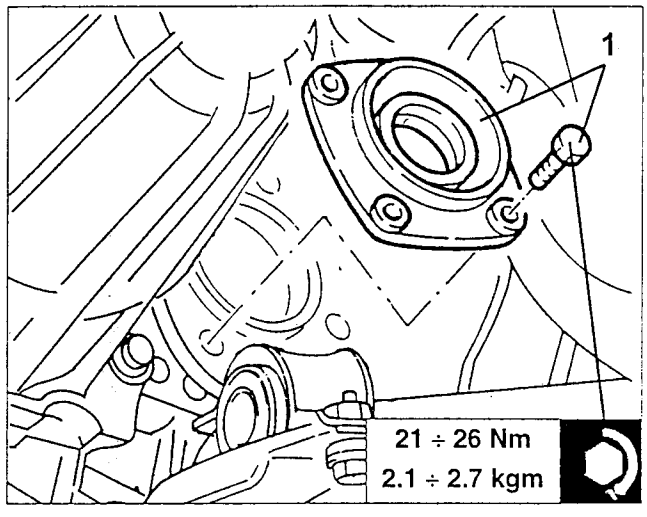
- Move the left axle shaft back from the differential left inner axle shaft as necessary.



1. Remove the differential left inner axle shaft using tools no. 1.821.161.000 and no. 1.820.229.000.

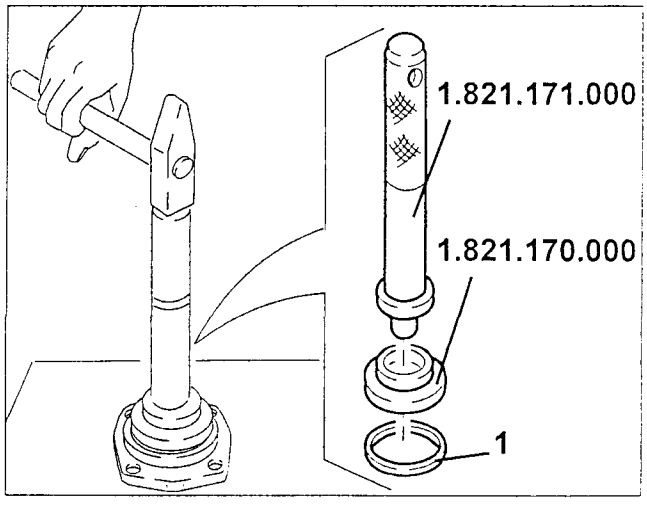


1. Slacken the fastening screws and remove the left flange from the differential complete with oil seal.



- Prise and remove the oil seal from the left differential flange.

1. Install a new oil seal on the left differential flange using tools no. 1.821.170.000 and no. 1.821.171.000.



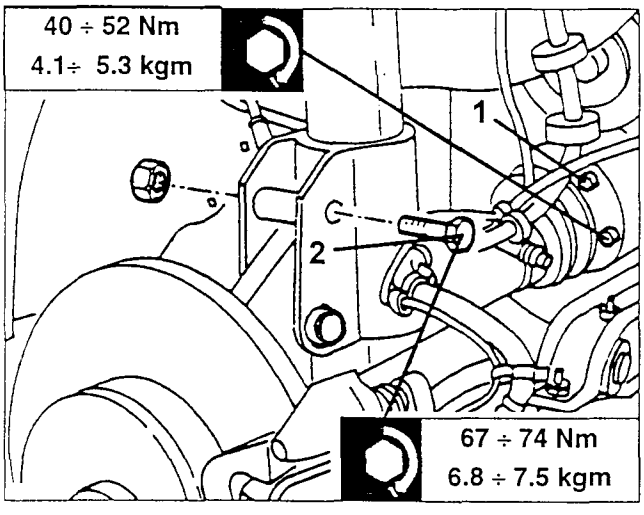
- Complete refitting reversing the sequence followed for removal.

SOSTIT CHANGING THE ENGINE SIDE DIFFERENTIAL OIL SEAL

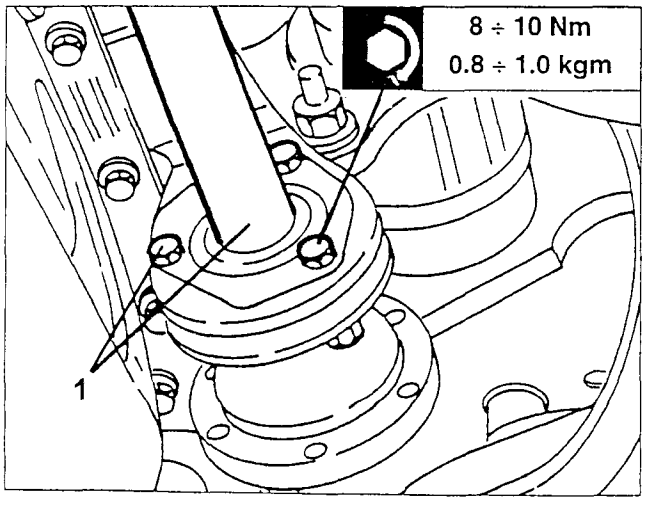
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.
- Remove the right front wheel and mud flap.
- Working from the right wheel arch, slacken the screw fastening the A.B.S. active sensor cable support bracket.

1. Slacken the bolts fastening the right axle shaft to the intermediate axle shaft.
2. Slacken the bolts fastening the right upright to the shock absorber then remove only the upper bolt.

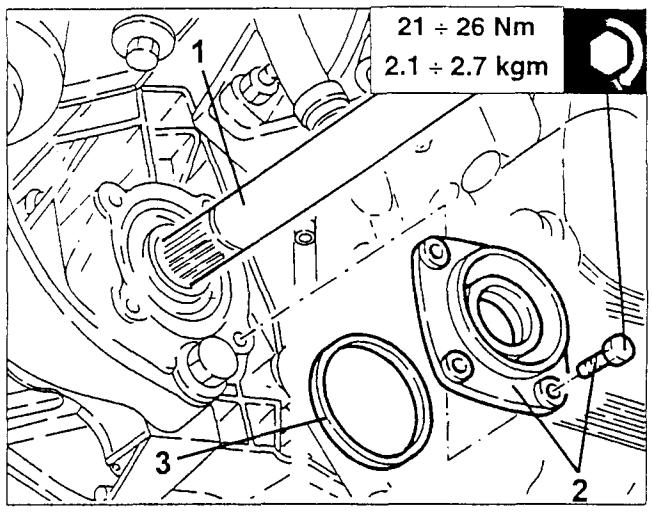
- Move the right axle shaft back from the intermediate axle shaft as necessary.



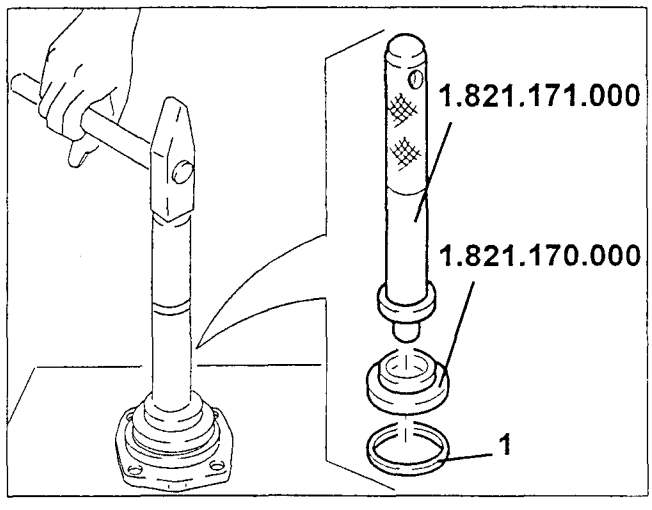
1. Slacken the screws fastening the intermediate axle shaft to its support.



1. Withdraw the intermediate axle shaft from the differential.
2. Slacken the fastening screws and remove the right flange from the differential complete with oil seal.
3. Remove the thrust washer.



1. Prise and remove the oil seal from the right differential flange.
2. Install a new oil seal on the right differential flange using tools no. 1.821.171.000 and no. 1.821.170.000.



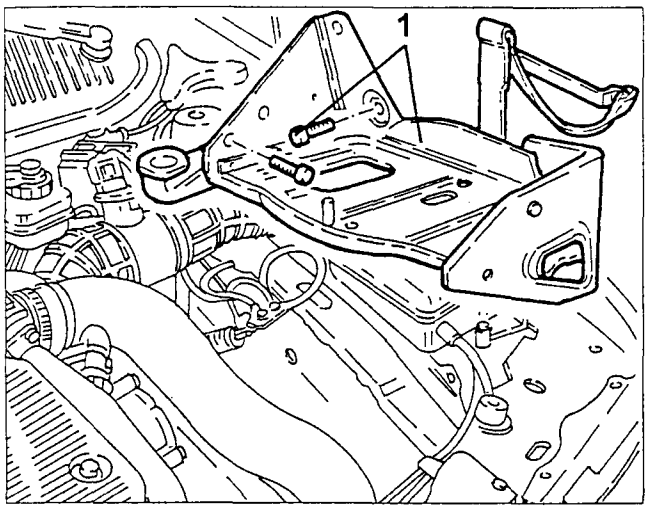
- Complete refitting reversing the sequence followed for removal.

SUPPORT FOR GEARSHIFT AND HANDBRAKE CONTROL LEVERS

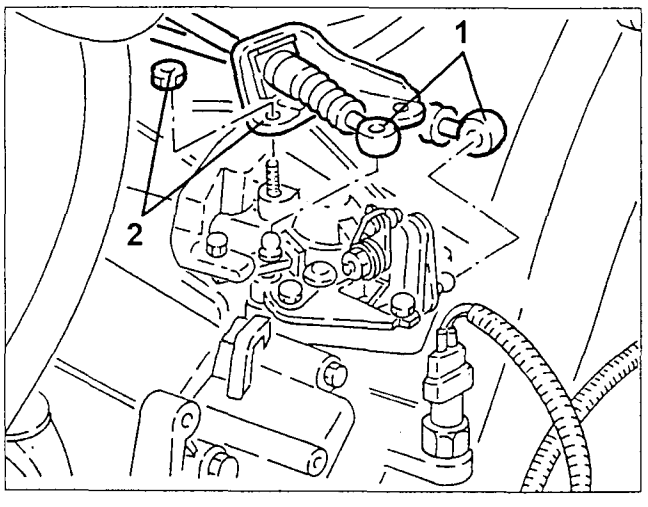
REMOVAL/REFITTING

- Set the car on a lift.
- Remove the battery (see Group 55).
- Remove the battery acid drain duct.

1. Slacken the fastening screws and remove the battery holder.

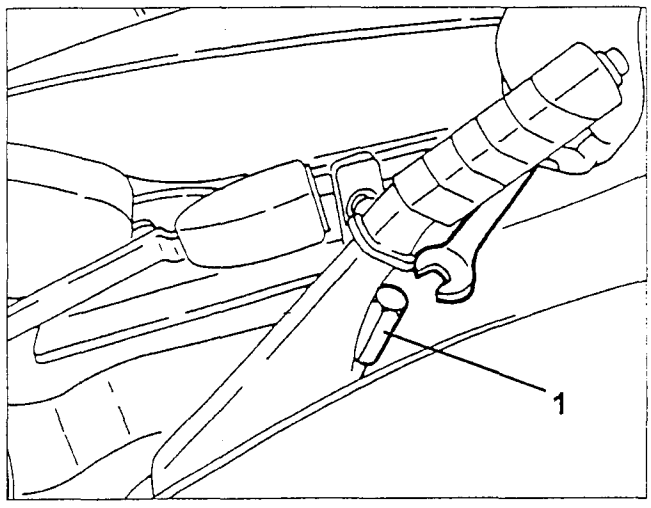


1. Disconnect the gear selection/engagement cables.
2. Slacken the fastening nuts and move aside the bracket complete with gear selection/engagement cables.



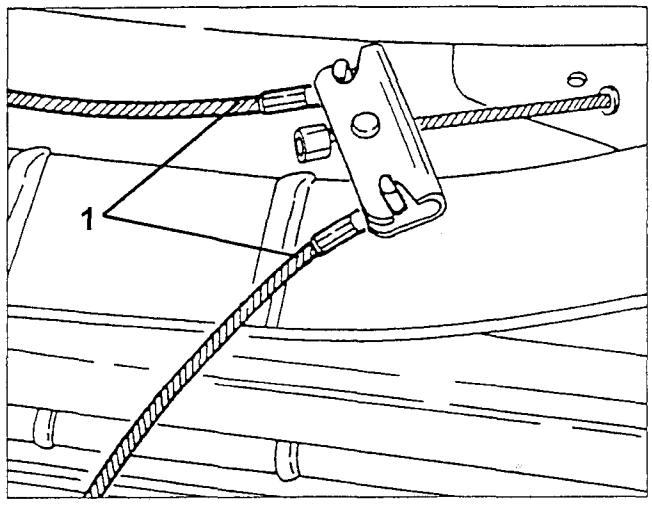
- Working from the passenger compartment, remove the gearshift lever cover and the handbrake lever cover.

1. Raise the handbrake lever and loosen the tensioning nut of the handbrake cables.

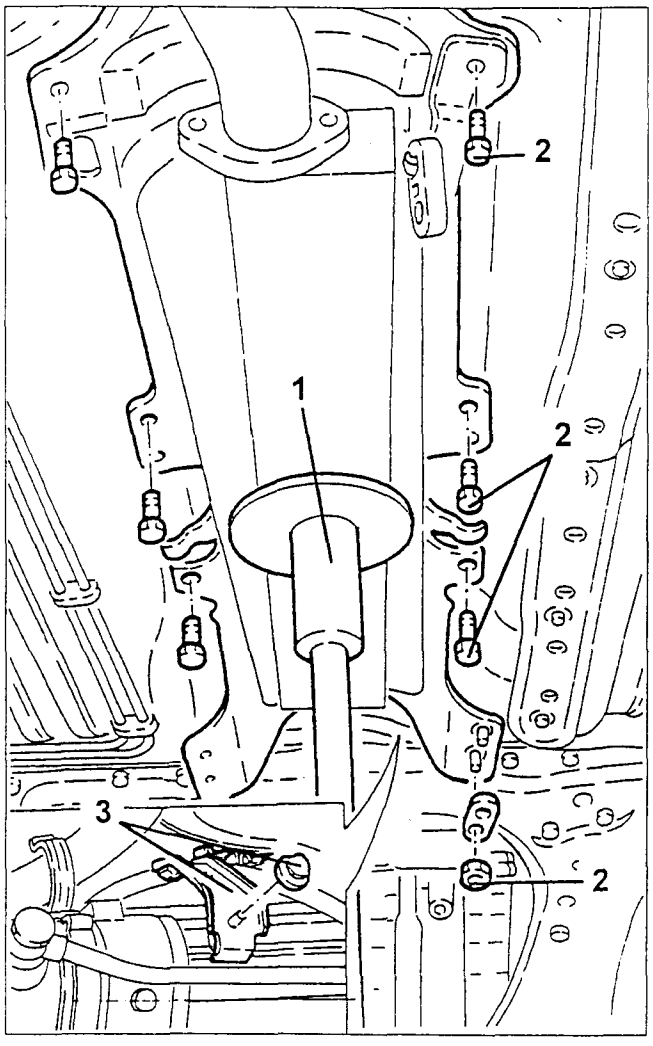


- Remove the catalytic converter (see Group 10).

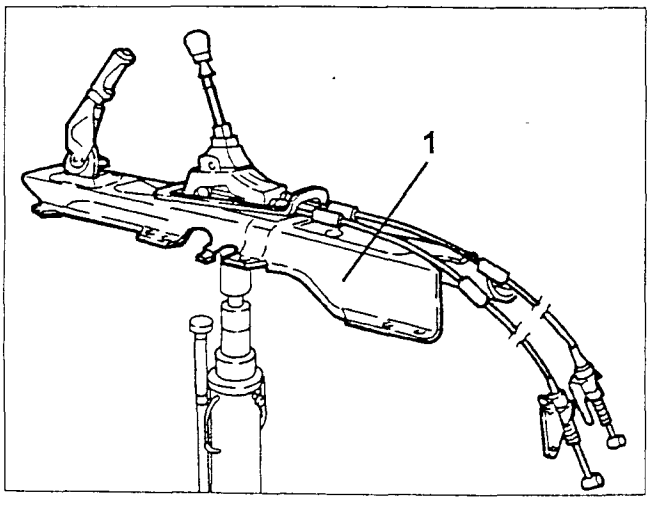
1. Disconnect the handbrake cables.



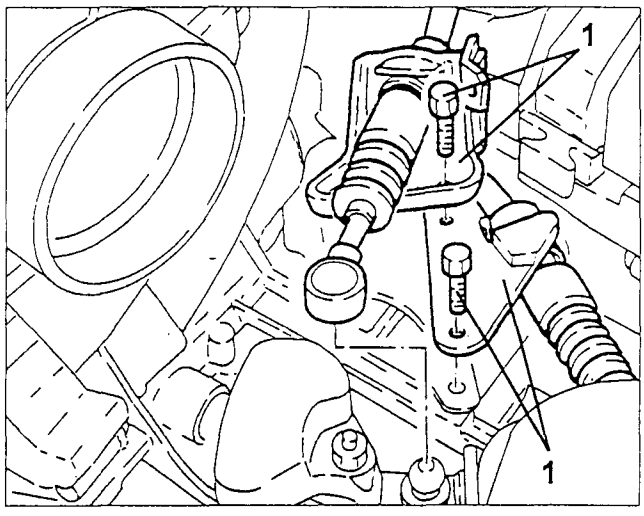
1. Place a hydraulic jack under the gearshift and handbrake lever support.
2. Slacken the screws and nuts fastening the gearshift and handbrake lever support to the body.
3. Lower the hydraulic jack enough to slacken the nut fastening the support of the gear selection/engagement cables.



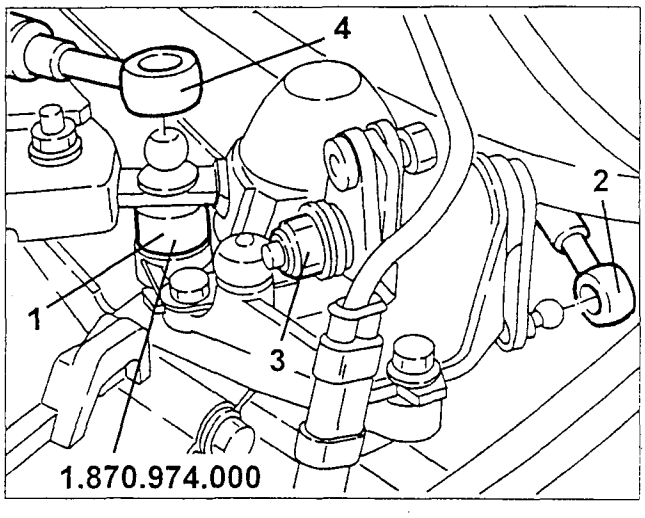
1. Lower the hydraulic jack completely and remove the complete gearshift and handbrake lever support.



- Complete installation reversing the sequence followed for removal up to assembly of the cables on the gear selection/engagement unit, then adjust the cables, proceeding as follows.
1. Refit the support brackets complete with selection and engagement cables and fasten them with their nuts.



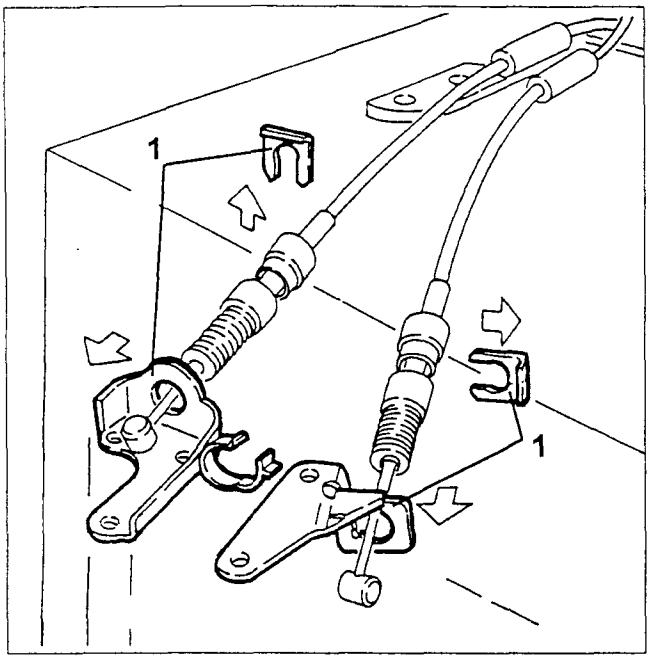
1. Install tool no. 1.870.974.000 under the gear engagement cable connection ball.
2. Connect the gear selection cable.
3. Loosen the adjustment nut of the gear selection/engagement unit.
- Tighten the adjustment nut of the gear selection/engagement unit after setting the gearshift lever to neutral and moving it fully right.
4. Connect the gear engagement cable.
- Position the gearshift lever to reverse and remove tool no. 1.870.974.000.



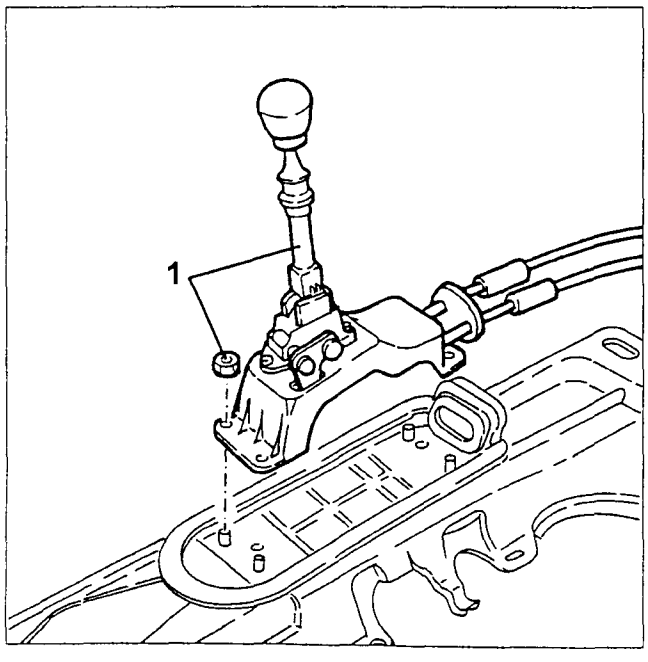
- Complete installation reversing the sequence followed for removal.

DISASSEMBLY AND REASSEMBLY

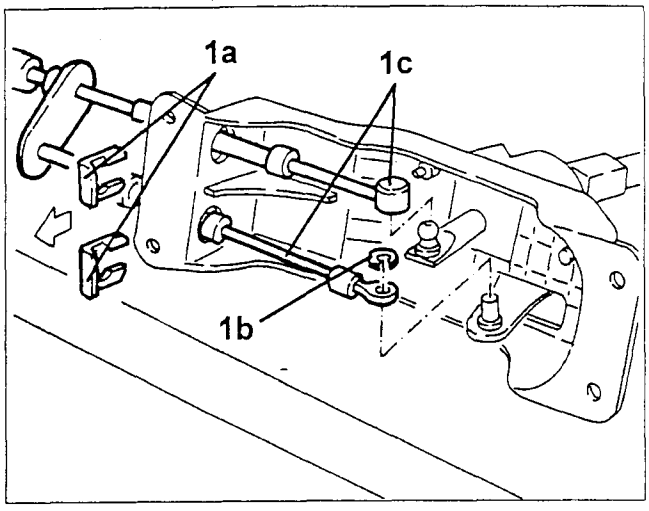
1. Withdraw the stopper plates and remove the support brackets of the gear selection/engagement cables.



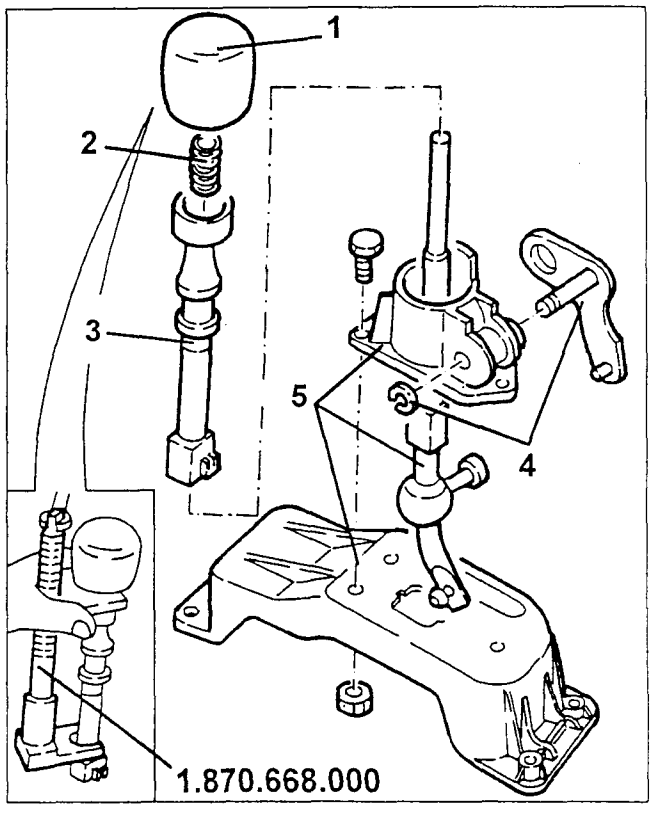
1. Slacken the fastening nuts and remove the gearshift control lever support complete with gear selection/engagement cables.



1. Remove the stopper plates (1a), circlip (1b), then disconnect and withdraw the gear selection/engagement cables (1c).



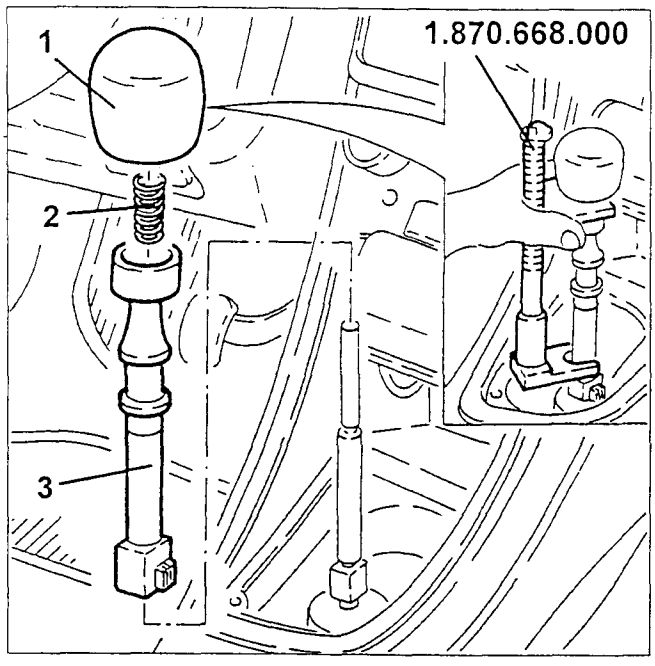
1. Remove the gearshift lever knob using tool no. 1.870.668.000.
2. Remove the spring.
3. Remove the reverse gear inhibitor.
4. Remove the circlip and remove the lever.
5. Slacken the bolts and separate the gearshift control rod from the supports.



REVERSE GEAR INHIBITOR

REMOVAL/REFITTING

- Remove the gearshift lever cover.
1. Remove the gearshift lever knob using tool no. 1.870.668.000.
2. Remove the spring.
3. Remove the reverse gear inhibitor.



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CHASSIS, STEERING, SUSPENSION AND BRAKES

3 documents - 100 factory pages

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BRAKES

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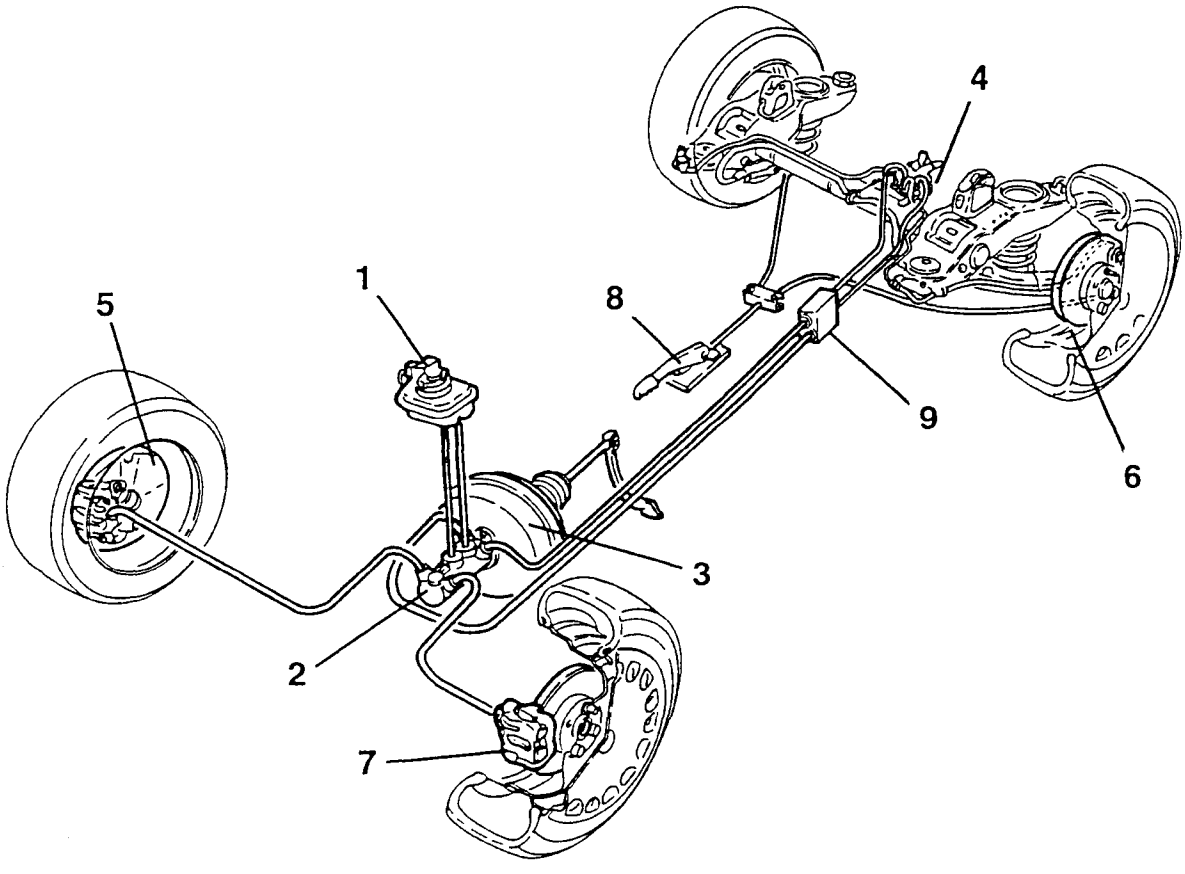
(*): See ABS BOSCH 5.3

DESCRIPTION

The braking system is hydraulically-operated with dual diagonally connected circuit with servobrake and braking load proportioning valve for the rear wheels; front disk brakes and rear drum brakes for the "lower" range without A.B.S. and disk brakes for the "higher" range fitted with A.B.S.
The system is of the conventional type and mainly comprises the following components:

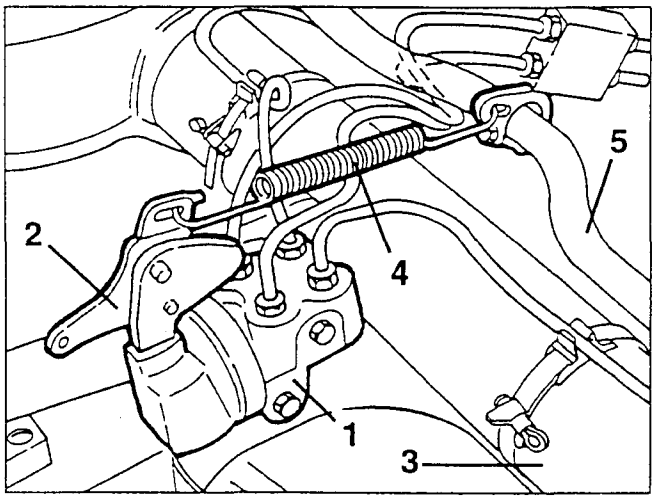
1. Brake fluid reservoir
(shared with the hydraulic clutch system)
2. Two-stage pump
3. Vacuum servo brake
4. Braking load proportioning valve
5. Front disk brakes
6. Rear drum brakes or disk
brakes depending on the versions
7. Floating type brake calipers
8. Mechanical handbrake
9. Four-way distributor

This solution is of the traditional type and obtained employing a series of devices aimed at:
a. meeting the current laws regarding the problems of environmental pollution.
The problem of environmental pollution has been faced by adopting brake linings of an ecological material (asbestos- free) in the same way as for the friction lining of the clutch.
b. reducing the temperature of the brake fluid to keep its chemical/physical characteristics unchanged.
The GIRLING floating type brake calipers with runner pins protected by boots only act on one side of the disk, thereby improving the dispersion of the heat produced during braking. Consequently the temperature of the brake fluid is also considerably reduced in comparison with traditional systems.
c. warranting a braking force suited to the characteristics of the vehicle under all circumstances.
The use of the two-stage pump and diagonal braking circuits makes it possible to still conserve 50% of the braking force in the event of a failure or seizing of a piston.

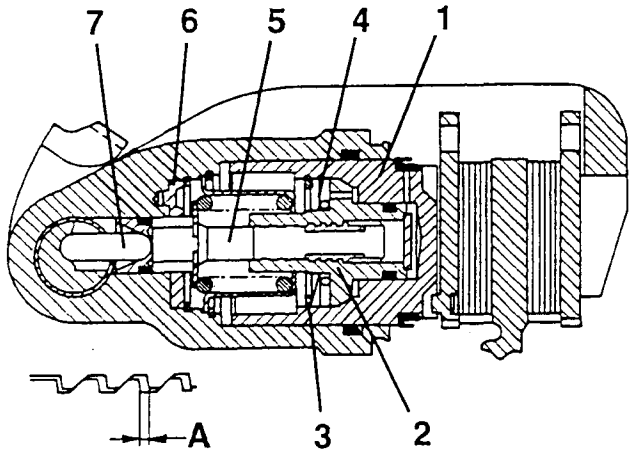


BRAKING LOAD PROPORTIONING VALVE (for versions without A.B.S.)

The braking system is fitted with a braking load proportioning valve (1), fastened to a bracket (2) integral with the rear axle (3) and connected by a spring (4) to the stabilizer bar (3), which regulates the pressure of the fluid acting on the rear wheels according to the load on the rear axle of the car.
This adjustment is carried out instant after instant by measuring the distance between the rear wheel axle and the body and its purpose is to prevent the rear wheels from locking if the load on the rear axle is lower causing the wheels to reduce their grip on the road surface.



The lead screw (2) backs off momentarily from its point of contact with the cylinder (1) but the action of the cup spring (4) turns the lead screw (2) on the shaft (5) until it returns into contact with the control cylinder (1). When the handbrake is operated, the mechanical force is transmitted from the control lever to the rod (7), then through the shaft-lead screw coupling it reaches the control cylinder (1) and from here to the brake linings without turning either the lead screw or the cylinder, because the cylinder has an obligatory engagement system which engages it on the brake lining plate during braking.



1. *Control cylinder*
2. *Lead screw*
3. *Safety ring*
4. *Cup spring*
5. *Shaft*
6. *Safety lock*
7. *Rod*

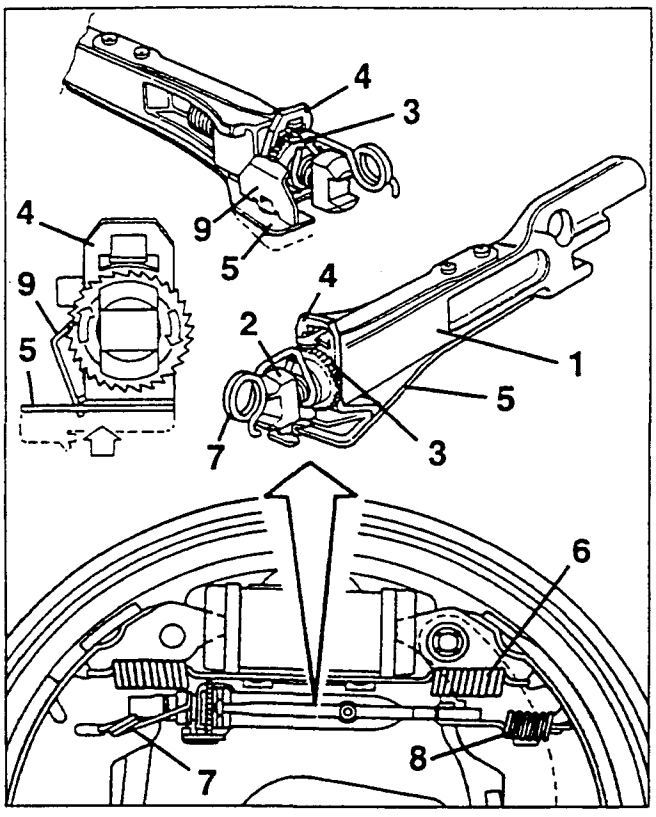
AUTOMATIC REAR BRAKE CALIPER ADJUSTMENT DEVICE (for versions with rear disk brakes)

This device, contained in the rear brake caliper cylinder automatically adjusts the distance between the brake disk and the friction lining.
It comprises a lead screw (2) which can rotate on the shaft (5) only in the direction of travel owing to the action of the cup spring (4).
The shaft (5) is unable to turn as it is constrained to the brake caliper body by the safety lock (6).
Between the shaft and the lead screw there is a threaded coupling (with four starts) with a preset clearance (A). During braking the control cylinder (1) pushed by the hydraulic pressure moves towards the braking lining with the lead screw (2), as the latter is constrained to the cylinder itself by the safety ring (3) and by the cup spring (4).
If the brake linings are excessively worn, even if the axial clearance (A) is taken up, it is not sufficient to absorb the whole stroke of the control cylinder (1) alone.

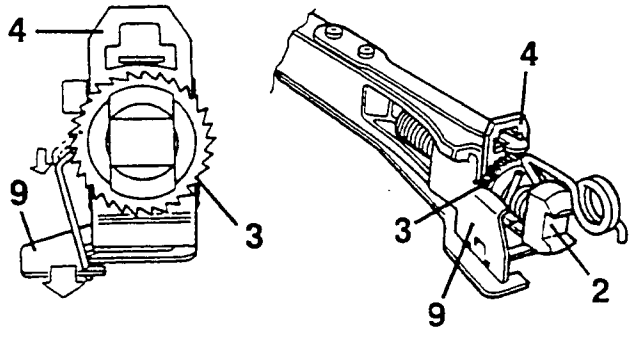
SELF-ADJUSTING DEVICE FOR PLAY TAKEUP BETWEEN SHOES AND DRUM (for versions with rear drum brakes)

This device automatically and continuously takes up the play between the shoes and drum each time the brakes are operated, if, in that moment, adjustment is necessary. The device comprises the tie-rod (1) inside which the adjustment screw (2) runs freely on which the toothed ring nut (3) is screwed.
In the rest position, the front shoe return spring (6) keeps the device compressed. Therefore, the ring nut (3) pushes the plate (4) into contact with the end of the tie-rod (1).
The plate (4) is also subjected to a thrust through the flexible blade (5). During the braking action, the two shoes move away from one another and come into contact with the drum; the two ends of the device are kept in contact with the shoes by springs (7) and (8).

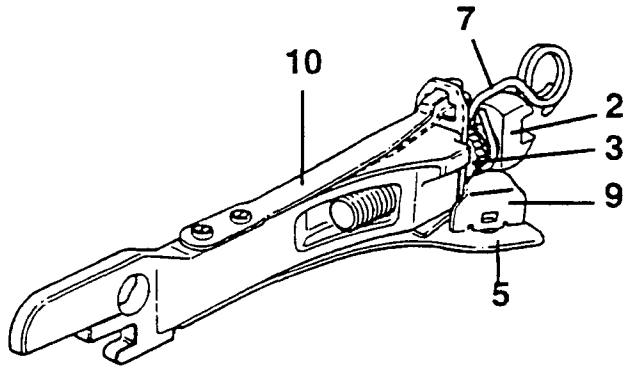
The plate (4) pushed by the flexible blade (5) reacts on the toothed ring nut (3) and the catch (9) permanently in contact with the ring nut, prevents it from turning.



When the brake is released, the self-adjusting device is again compressed by the action of the upper shoe return spring (6): the toothed ring nut (3) stops in the angular position taken during braking.
This stop during rotation is due to the friction between the plate (4) and the toothed ring nut (3). With the toothed ring nut (3) locked during rotation, if the condition of wear of the lining due to previous braking actions is sufficient, the catch (9) engages the next tooth.



The maximum stroke of the toothed ring nut (3) on the adjustment screw (2) is one tooth (0.020 ÷ 0.025 mm): an exception to this is settling of the brakes after dis-assembly, in which case the stroke is two teeth.
If after prolonged braking, the brakes overheat and the temperature reaches 100° ÷ 110°C, the flexible blade (10) comes into action, which flexes and blocks the plate (4) in the neutral position.

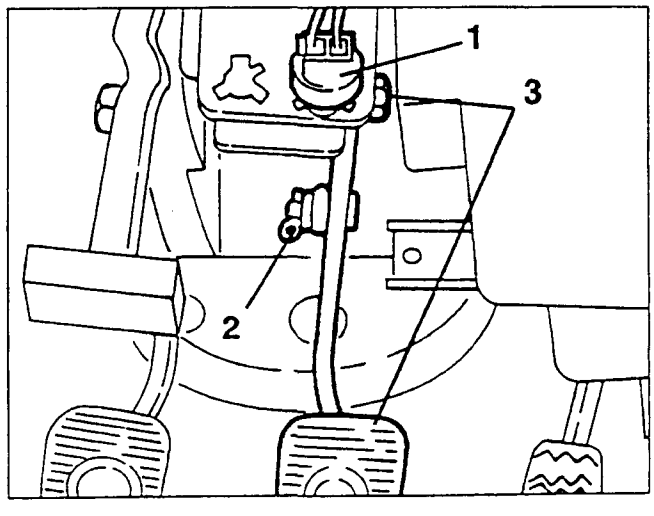


During braking the toothed ring nut (3) will no longer be subjected to the thrust of the flexible blade (5), therefore the catch (9) will take the same angle as the ring nut tooth, which will be free to run with the adjustment screw (2) on the catch (9) without taking up the play caused by the expansion of the drum.
When overhauling, before assembly of the brake linings, the toothed ring nut (3) must be moved to contact the spring (7) and slackened one half of a turn.

BRAKE PEDAL

REMOVAL/REFITTING

- Remove the fuse box and its support bracket (see GROUP 55).
1. Turn and remove the stop light from its housing.
2. Remove the pin fastening the brake pedal to the servobrake.
3. Slacken the fastening nut and remove the brake pedal.

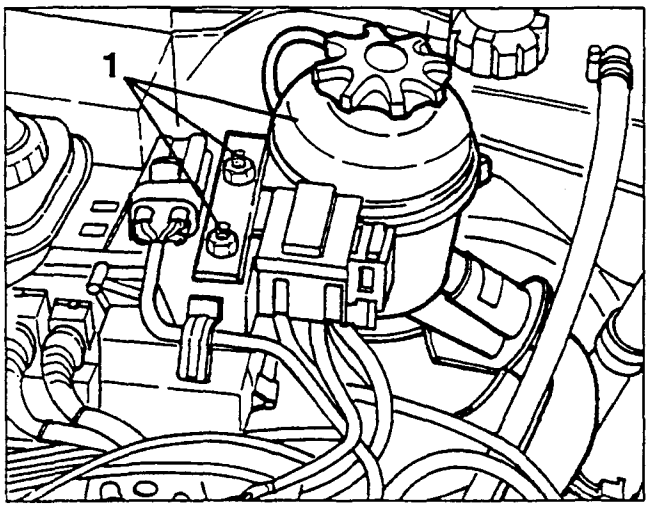


BRAKE/SERVOBRAKE PUMP

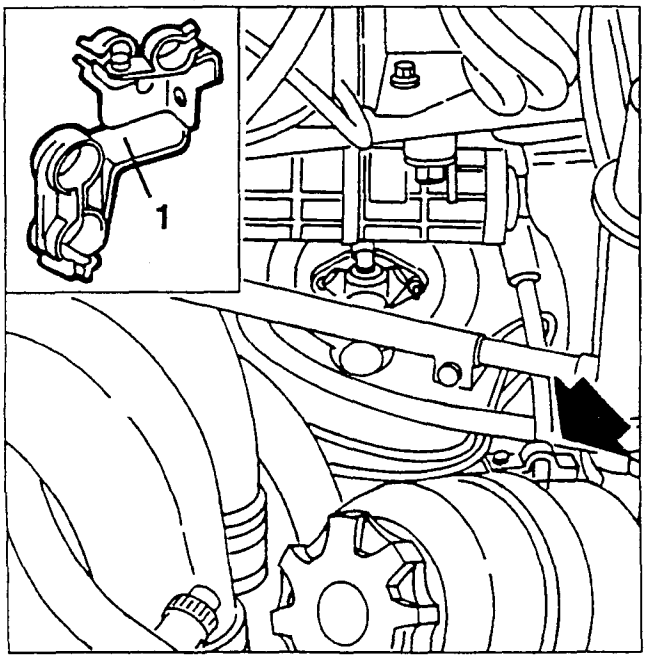
REMOVING/REFITTING
Specific for Boxer engines

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Using a suitable syringe, empty the brake-clutch fluid reservoir.
- Remove the front left wheel.
- Using a suitable syringe, empty the power steering tank.

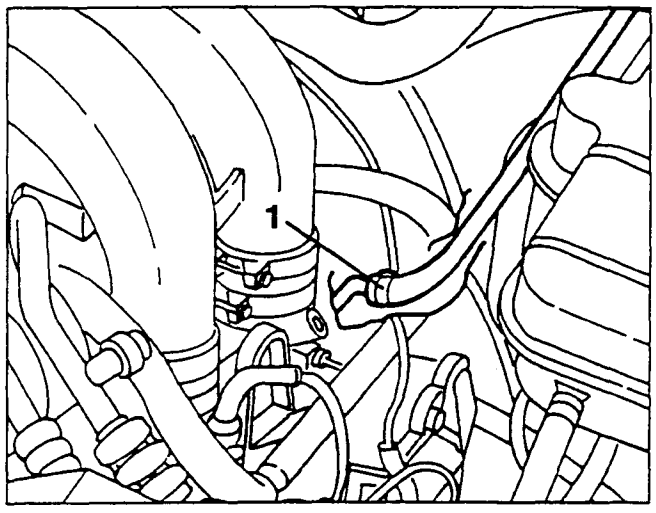
1. Slacken the two fastening nuts and move aside the power steering tank without disconnecting the pipes.



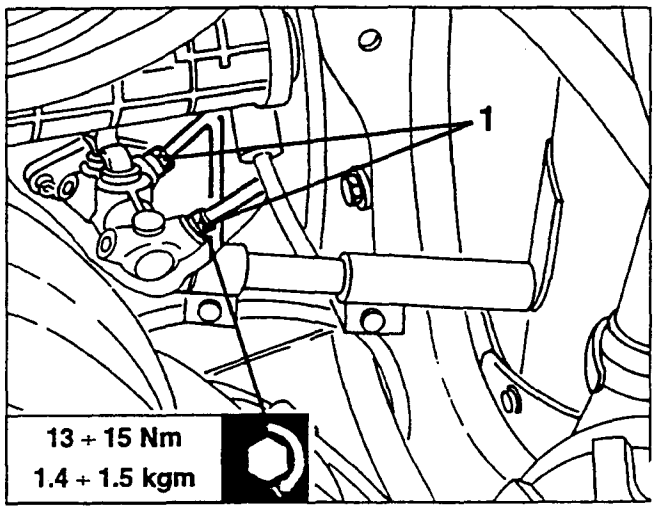
1.Release the power steering pipe, the clutch pipe and the air conditioner pipes from the fastening clamps, then slacken the two fastening screws and remove the bracket supporting the clamps.



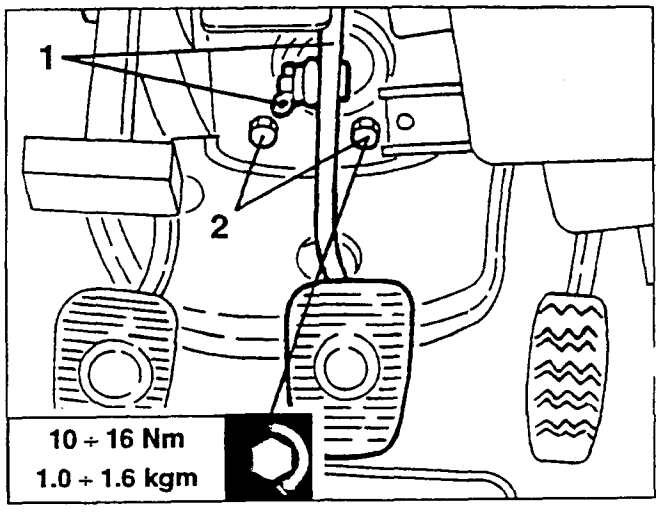
1. Disconnect the servobrake vacuum takeoff pipe.



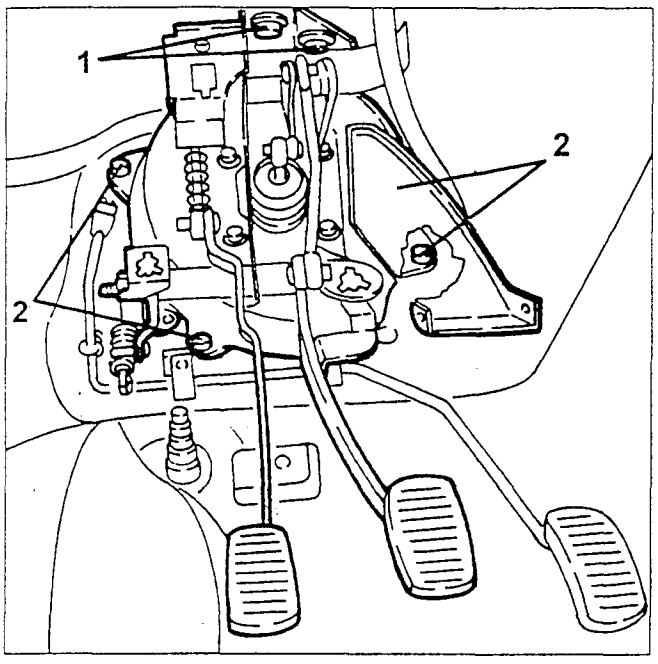
1. Disconnect the two fittings of the stiff delivery pipes from the brake pump.



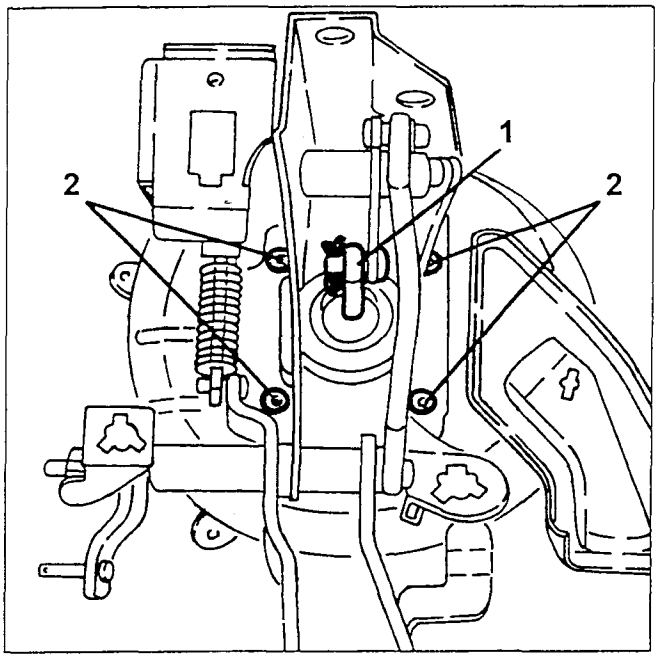
1. Working from the passenger compartment, remove the pin fastening the servobrake prod to the pedal, then disconnect them.
2. Slacken the four servobrake fastening screws.



1. Loosen the pedal board fastening screws.
2. Loosen the three brake booster fastening nuts and remove the brake booster, brake pump and pedal board assembly.



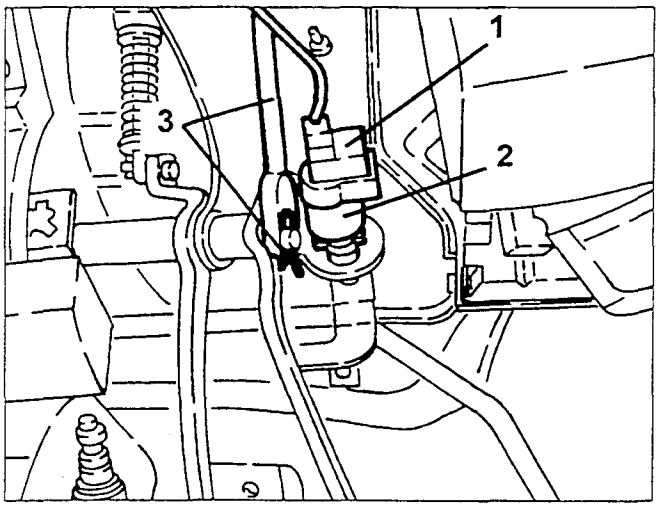
1. Remove the split pin and disconnect the brake pump from the linkage pin.
2. Loosen the four fastening screws and remove the brake pump/booster assembly from the pedal board.
- If required, separate the brake pump from the brake booster by removing the two fastening nuts. Please note that only the brake pump/booster assembly is abailable as a spare part.



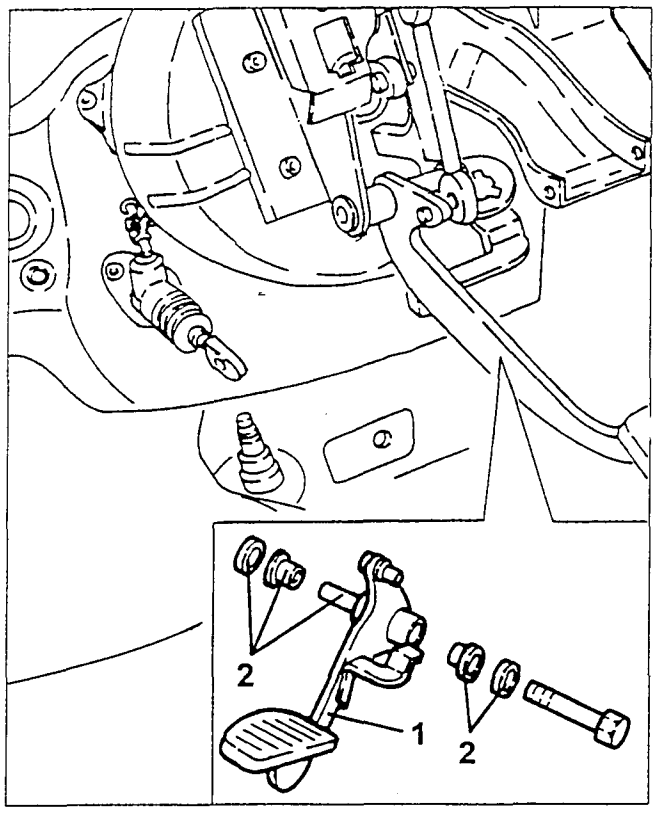
BRAKE PEDAL ('98 MODELS)

REMOVAL/REFITTING

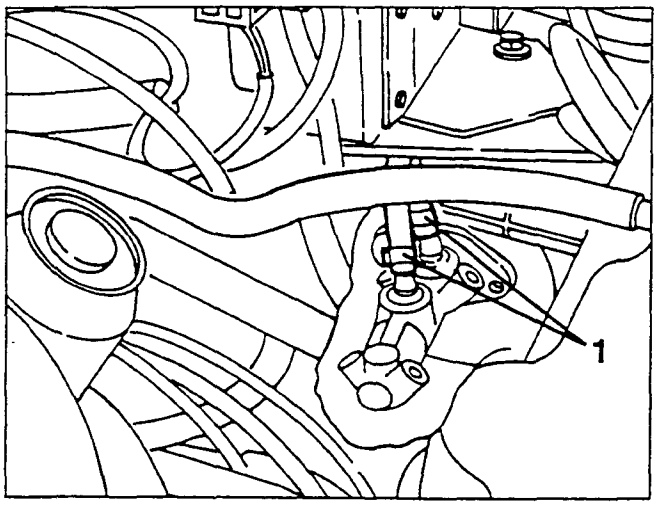
- Make sure the ignition key is at STOP and disconnect the (-) battery terminal.
- Remove the steering column (see ASSEMBLY 41).
1. From inside the passenger compartment, disconnect the brake light switch electrical connection.
2. Remove the brake light switch by turning it clockwise by 45°.
3. Remove the split pin and disconnect the brake pedal tie-rod.



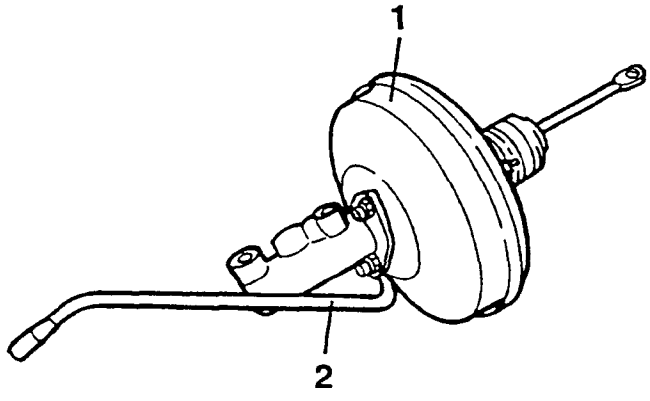
- Loosen the two valve bracket fastening screws.
- Remove the clutch pedal (see specific paragraph).
1. Remove the screw and remove the brake pedal.
2. At the bench, remove the plastic caps and the brake pedal bushing, if required.



1. Disconnect the two supply hoses from the brake pump.



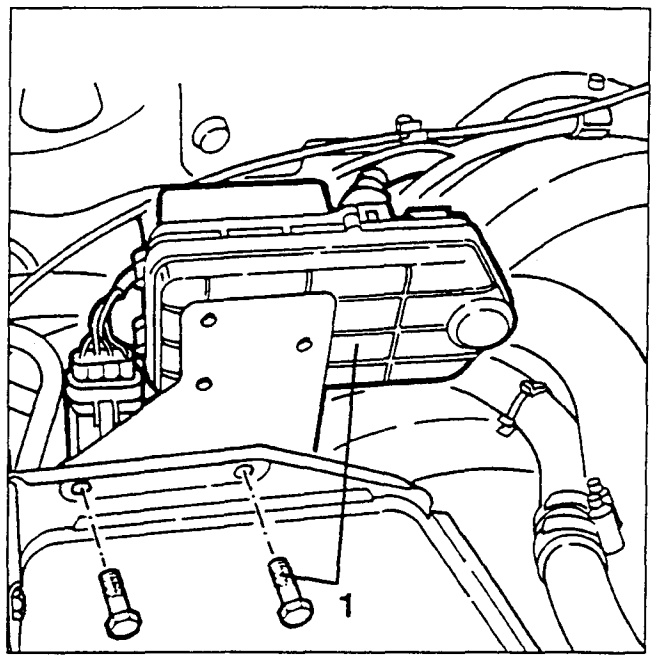
- Raise the car.
1. Remove the pump - servobrake unit retrieving it from the wheelhouse.
2. Remove the vacuum takeoff pipe from the servo-brake.
- If necessary, separate the pump from the servobrake slackening the two fastening nuts; Spares only supply the pump-servobrake unit complete.



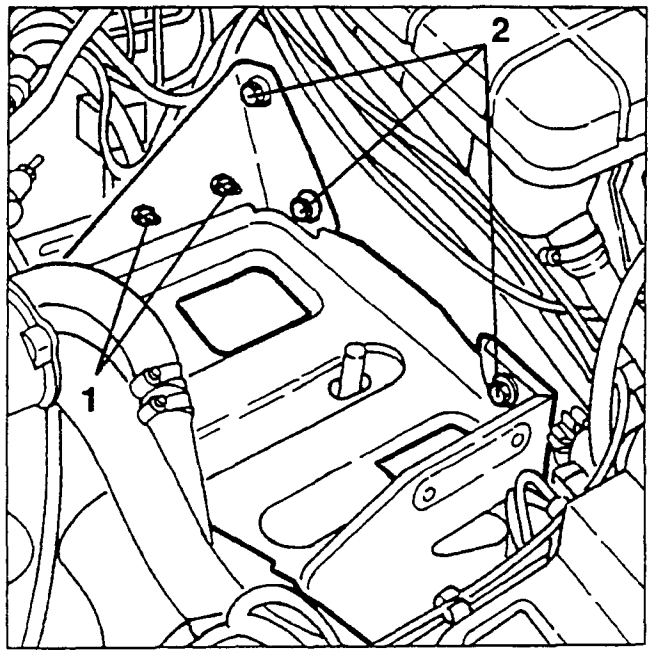
When refitting relieve the air from the braking system (see specific paragraph).

REMOVING/REFITTING
Specific for Turbodiesel engine

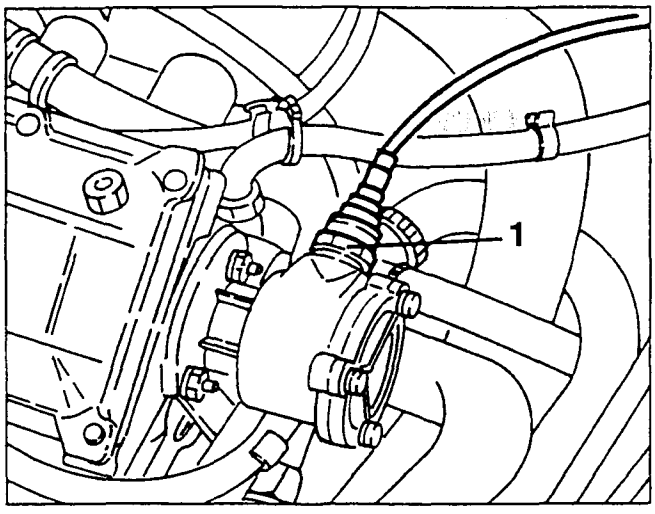
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Using a suitable syringe, empty the brake-clutch fluid reservoir.
- Remove the front left wheel.
- Remove the battery.
1. Slacken the two fastening screws and move aside the fan relays.



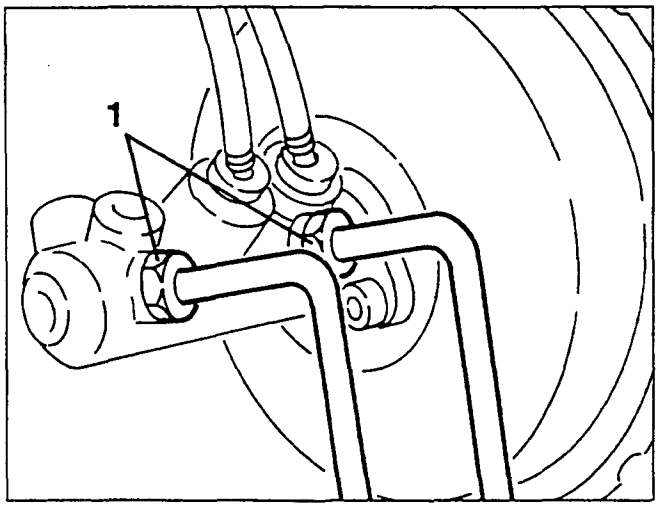
- Remove the duct for draining acid from the battery.
1. Slacken the two nuts fastening the glowplug warming control unit support bracket to the battery support.
2. Slacken the four fastening screws and remove the battery support.



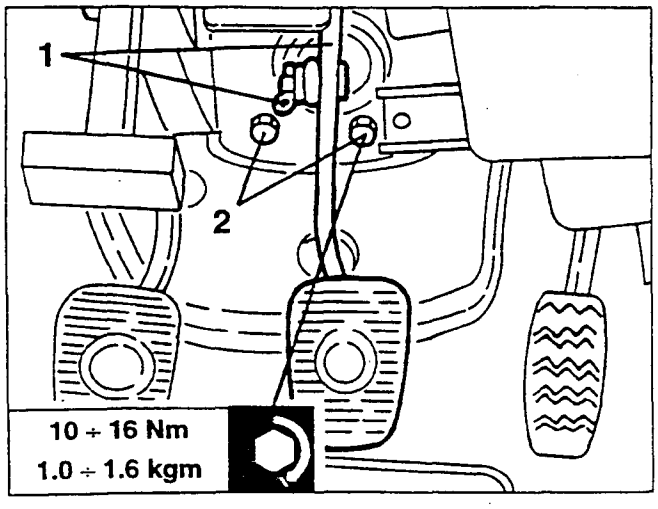
1. Disconnect the vacuum takeoff pipe from the servobrake air pump.



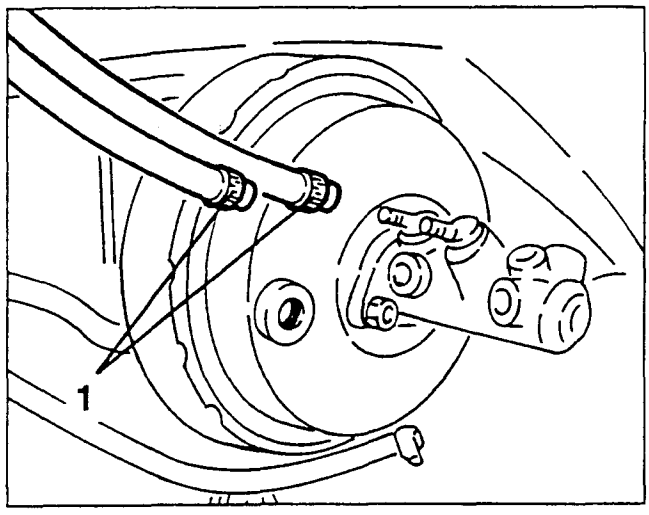
1. Disconnect the two unions of the stiff delivery pipes from the brake pump.



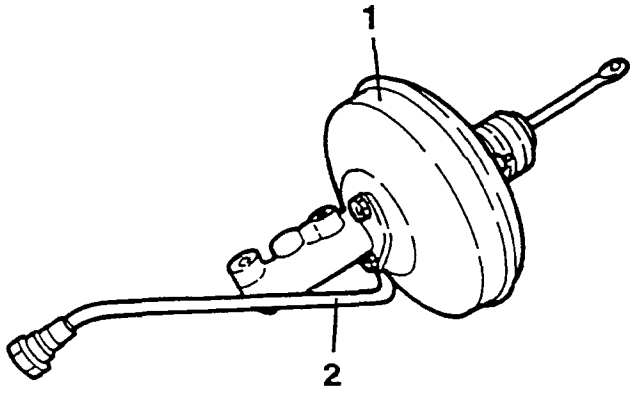
1. Working from the passenger compartment, remove the pin fastening the servobrake prod to the pedal, then disconnect them.
2. Slacken the four servobrake fastening nuts.



1. Disconnect the two supply hoses from the brake pump.



- Raise the car.
1. Remove the pump-servobrake unit retrieving it from the wheelhouse.
2. Remove the the vacuum takeoff pipe from the servobrake.
- If necessary, separate the pump from the servobrake slackening the two fastening nuts; Spares only supply the pump-servobrake unit complete.

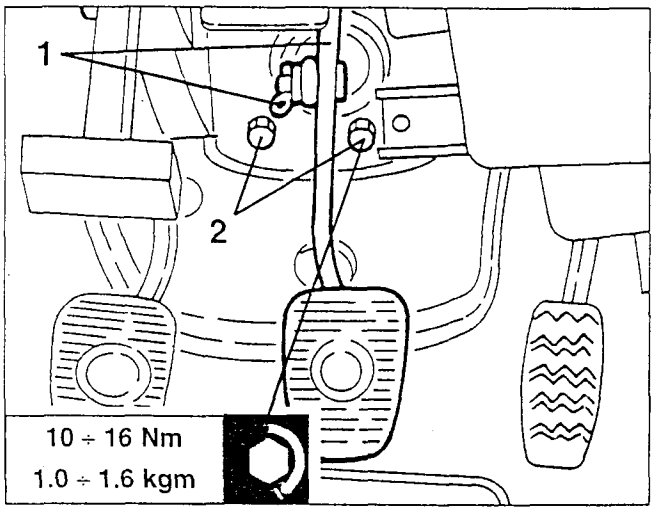


When refitting relieve the air from the braking system (see specific paragraph).

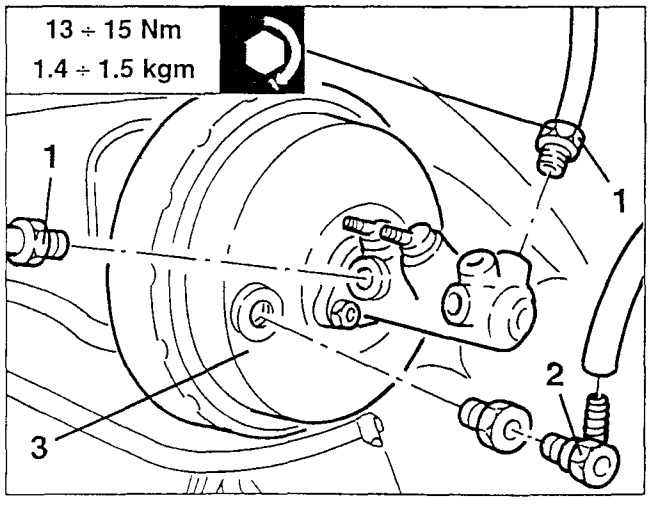
REMOVING/REFITTING
Specific for T. Spark 16V engine

- Disconnect the battery (-) terminal.
- Remove the hydraulic aggregate of the A.B.S. system complete with its support (see specific paragraph).

1. Perform the following operations inside the passenger compartment. Remove the brake booster shoe pin from the pedal and remove the pedal.
2. Remove the four brake booster fastening nuts.



1. Disconnect the two brake pump delivery pipes.
2. Disconnect the brake booster vacuum pipe.
3. Take the pump-brake booster unit.



- If required, split the pump from the brake booster by removing the two fastening nuts.
The pump-brake booster, however, is supplied as a single spare part.

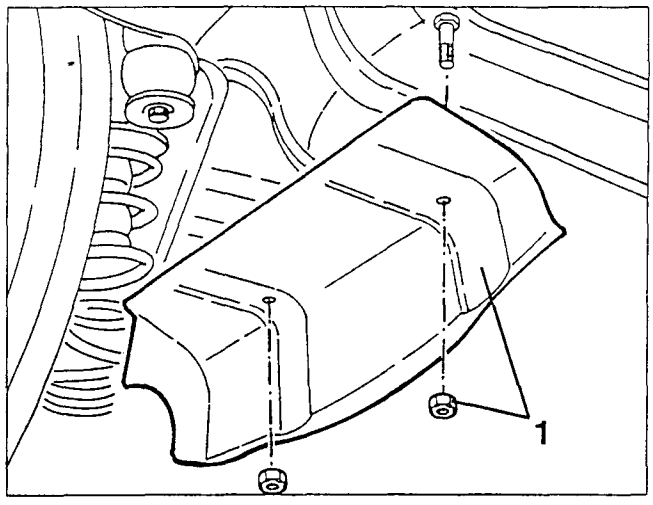
After refitting, bleed the air from the braking circuit (see specific chapter).

BRAKE FORCE DISTRIBUTOR

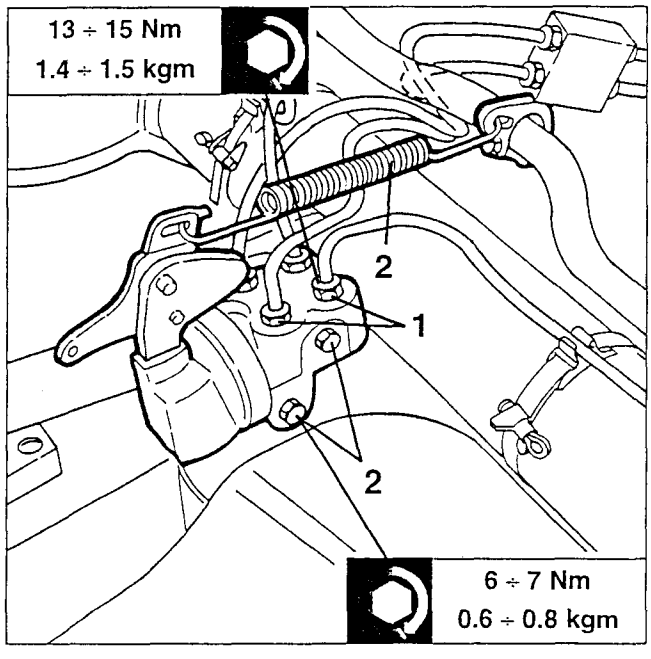
REMOVAL/REFITTING

- Position the vehicle on a shop jack.
- Empty the brake-clutch reservoir with a suitable syringe.
- Lift the vehicle.
- Remove the rear section of the exhaust pipe (see GROUP 10).

1. Remove the two fastening screws and remove the heat guard from the rear section of the exhaust pipe.



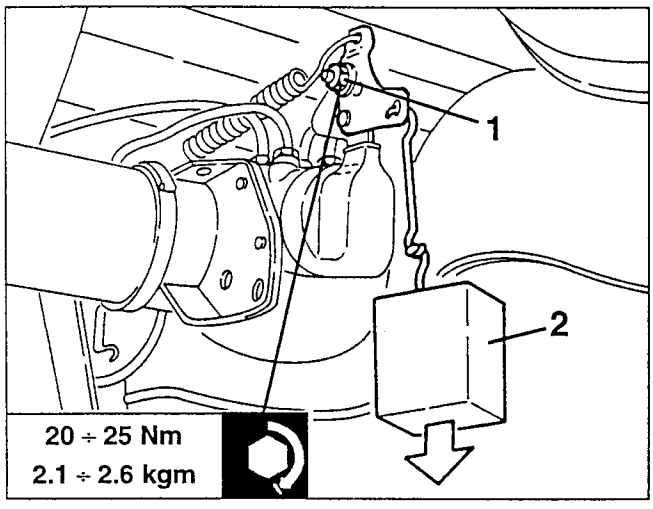
1. Remove the brake force distributor pipe fittings.
2. Remove the two fastening screws and remove the brake force distributor after having disconnected the respective spring.



After refitting, bleed the air from the braking circuit (see specific chapter).

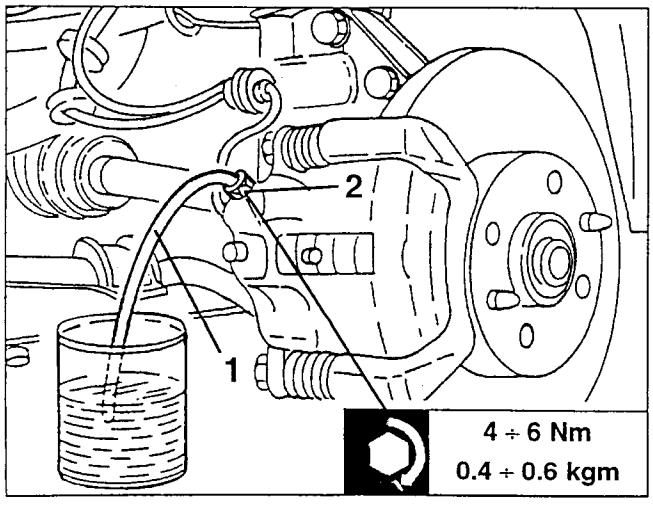
CALIBRATION

- Prepare the vehicle in running order and position it on a flat surface with the wheels on the ground to set the suspensions.
1. Loosen the brake force distributor rod fastening screw.
2. Apply a 3.5 kg weight **(2 kg from chassis no. 2039142 and 4030708)** for versions with rear drum brakes or a 8 kg weight **(7 kg from chassis no. 2039142 and 4030708)** for versions with rear disc brakes to the rod eye.
- Keep the rod in this position and tighten the fastening screw to the prescribed torque.



BRAKE SYSTEM AIR BLEEDING

- Fill the brake-clutch fluid reservoir to the max. level with the prescribed fluid.
- If required, remove the relevant wheel.
1. Fit a clear pipe to the bleeder valve. Place the other end of the pipe in a bowl containing the prescribed fluid.
2. Loosen the bleeder valve and press the brake pedal repeatedly (waiting a few seconds between presses). When fluid without air bubbles flows into the bowl, press the brake pedal fully and tighten the bleeder valve at the prescribed torque.



NOTE: Bleed each wheel separately.

IMPORTANT:
Check that during bleeding operations the fluid level does not drop under the minimum level.
Never re-use the fluid discharged during this operation.
Make sure the fluid does not drip on painted parts to avoid damaging them.

BRAKE SYSTEM PIPES

TESTS AND CHECKS

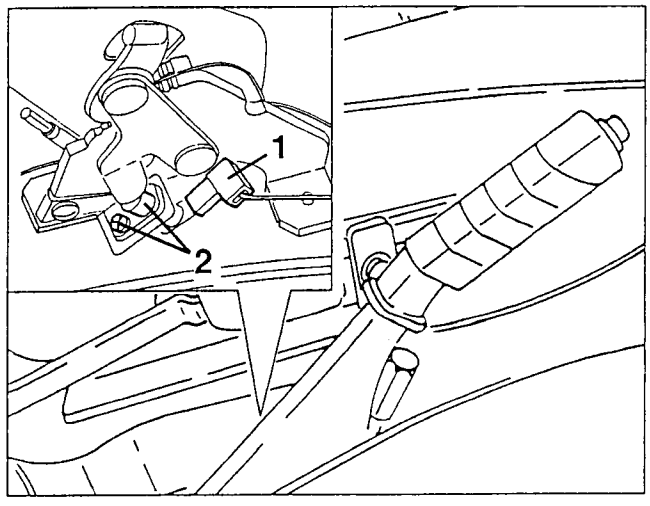
- Check the pipes and hoses are not enlarged, cracked or rusted. Check there are no leaks.
- To replace a pipe, drain the brake-clutch reservoir with a syringe and close the pipe ends to avoid dirt from getting inside the system.
- After refitting, bleed the air from the brake-clutch circuit (see specific chapter).

Never bend nor twist pipes.

HANDBRAKE WARNING LIGHT SWITCH

REMOVAL/REFITTING

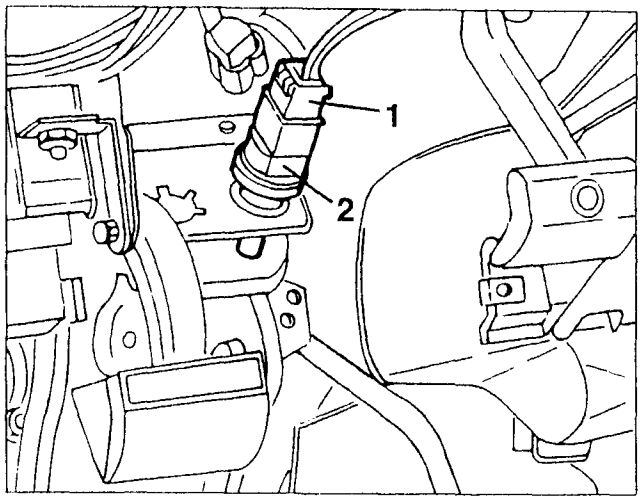
- Disconnect the (-) battery terminal.
- Remove the central oddment tray (see GROUP 70).
1. Disconnect the switch electric connection.
2. Remove the fastening screw and remove the switch.



STOP LIGHTS SWITCH

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the switch.
2. Turn the switch 45° clockwise and remove it.

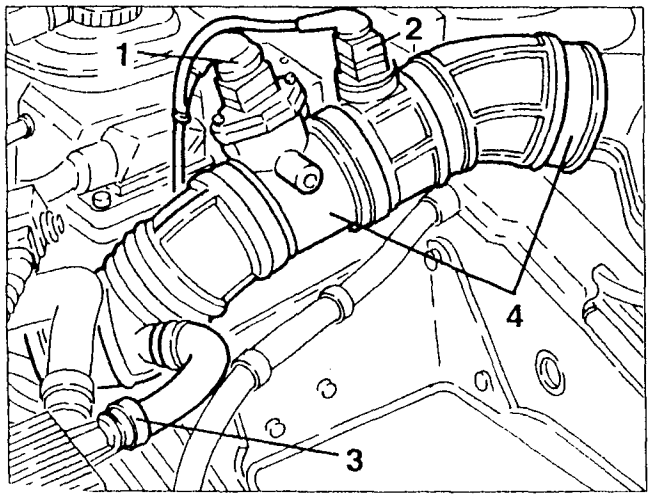


When refitting, adjust the stroke of the "mobile section" using the special ring nut.

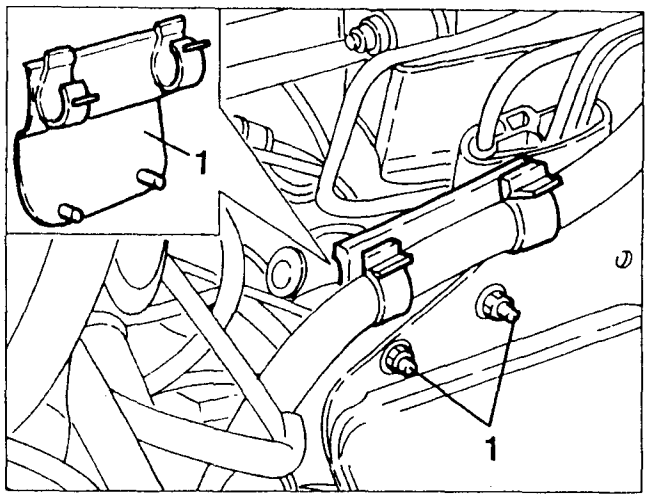
BRAKE-CLUTCH RESERVOIR (Specific for T. Spark 16V engines)

REMOVING/REFITTING

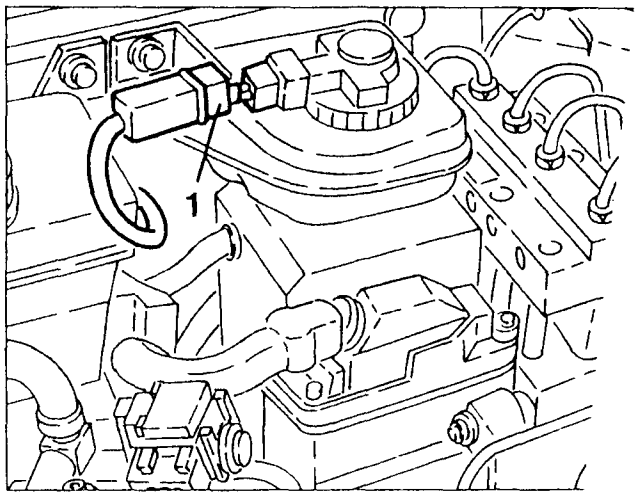
- Remove the battery.
1. Disconnect the electrical connection from the air-flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor.
3. Slacken the fastening clamp and disconnect the oil vapour, recirculation pipe from the cylinder head cover.
4. Slacken the fastening clamps and remove the corrugated sleeve complete.



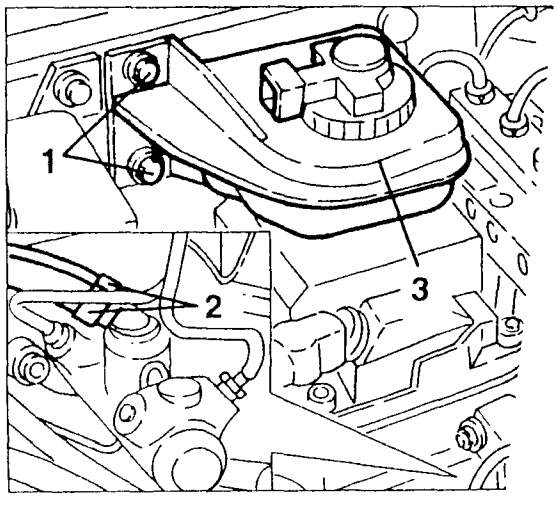
1. Slacken the two fastening nuts and remove the cable support bracket from the battery support.



1. Disconnect the electrical connection from the brake-clutch fluid minimum level sensor.



1. Slacken the two screws fastening the brake-c fluid reservoir.
2. From the brake pump disconnect the two s supply pipes leading from the reservoir.
3. Raise the brake-clutch fluid reservoir just e to disconnect the clutch system supply pipe remove it.

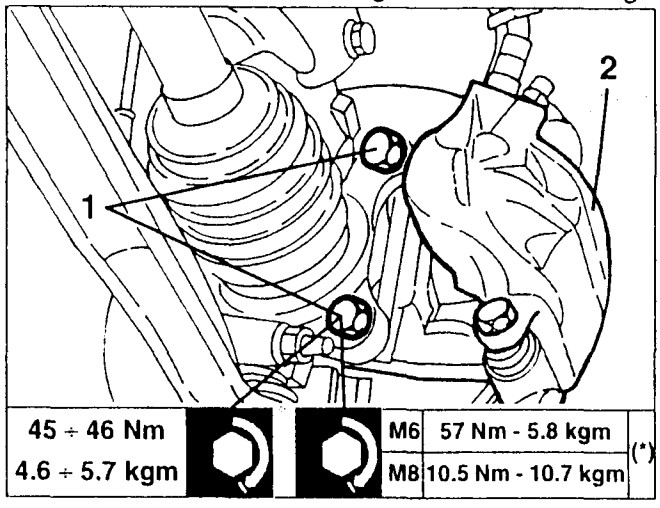


FRONT DISK BRAKES

REMOVAL/REFITTING

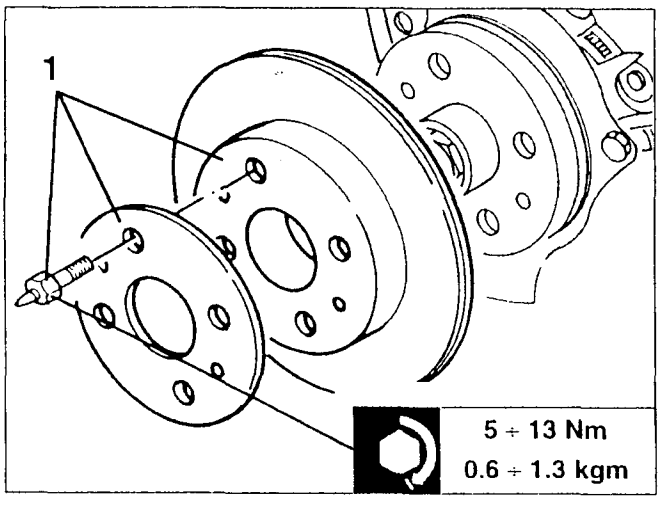
- Set the car on a lift.
- Remove the wheel on the side concerned.

1. Slacken the two screws fastening the brake caliper support plate.
2. Remove the complete brake caliper and move it to one side without disconnecting the hose and wiring.



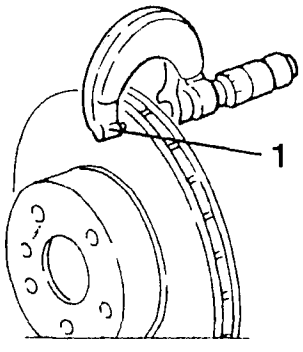
(*): For screws with "Driloc"; to be changed each time they are unscrewed or slackened.

1. Slacken the two fastening pins and remove the spacer and the brake disk.



CHECKS AND INSPECTIONS

1. Check the thickness of the disks and the working surfaces for signs of deep scoring and porosity. If necessary, grind them to within the specified tolerances.

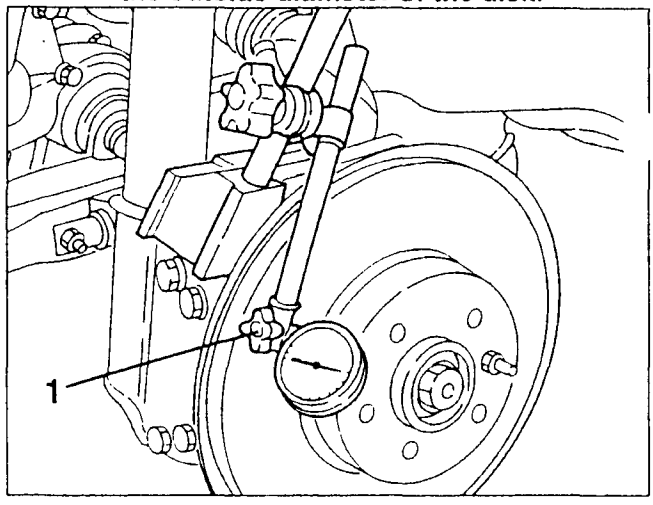


Thickness of disk	Wear limit	Grinding limit
Ventilated (*)	20.2 mm	21.1 mm
Ventilated	18.2 mm	19.1 mm
Not ventilated	10.2 mm	11.1 mm

(*): Specific for 1747 T. SPARK 16V and 1970 T. SPARK 16V

1. When changing the brake pads only, check that oscillation of the disk in relation to the axis of rotation is within the specified limits (0.15 mm max).

NOTE: The value must be measured 2 mm from the outside diameter of the disk.

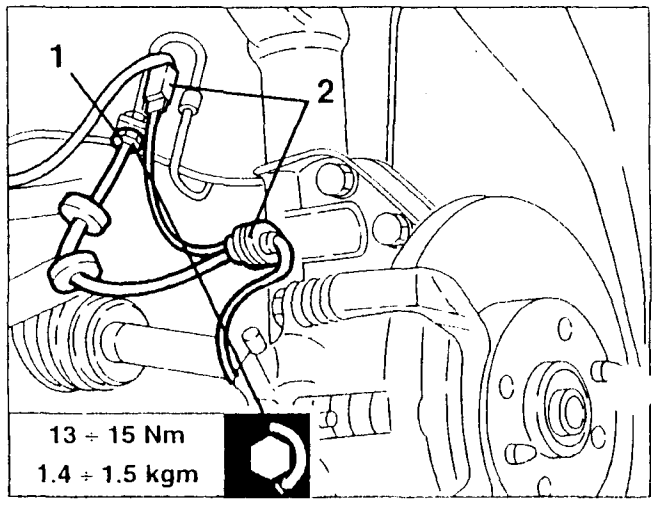


FRONT BRAKE CALIPER (Specific for versions before change)

REMOVAL/REFITTING

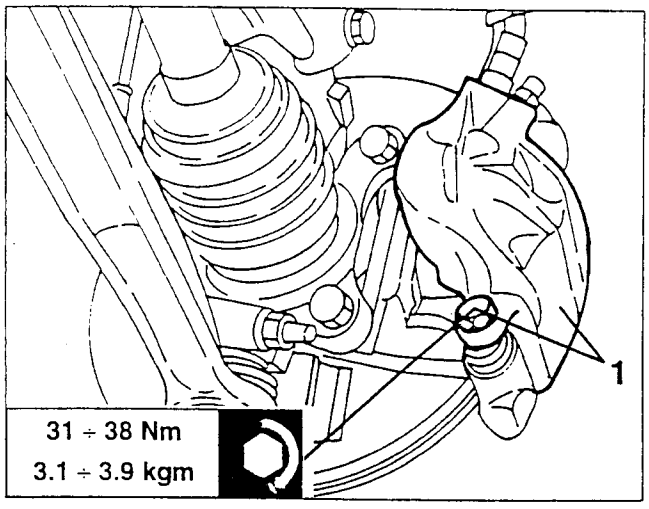
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the wheel on the side concerned.

1. Disconnect the intermediate coupling between the stiff pipe and the brake caliper fluid delivery hose.
2. Disconnect the electrical connection of the brake pad wear sensor, then free it from the fastening on the shock absorber.



1. Slacken the two fastening screws and remove the brake caliper with its pads.

NOTE: **When refitting change the caliper fastening screws and tighten them to the specified torque.**

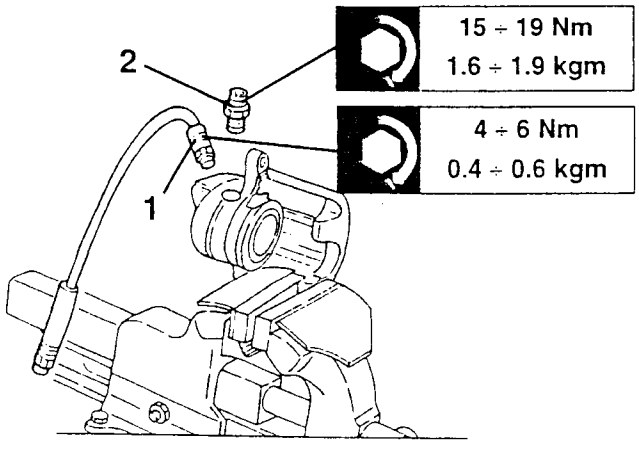


WARNING:
When refitting check that the rubber boots protecting the fastening pin threads are intact, if not, change them.
When refitting the brake pad with the wear sensor, it must be fitted on the inner side of the disk (brake caliper piston side): also check that the relief on the outer part of the same pad is positioned to the rear of the direction of travel.

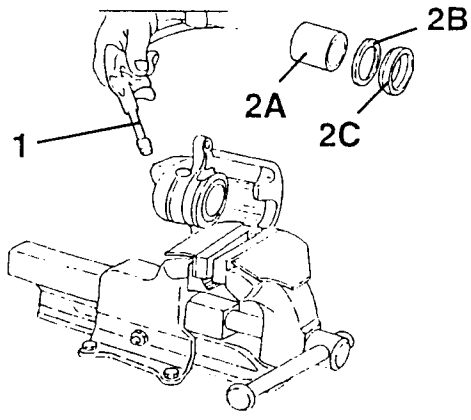
When refitting bleed the air from the brake system (see specific paragraph).

DIS-ASSEMBLY/REASSEMBLY

1. Disconnect the hose connection from the caliper.
2. Remove the relief screw.



1. Blow a jet of compressed air into the brake fluid inlet hole to bring the piston out.
2. Remove the piston (2A), seal (2B) and the protective boot (2C).

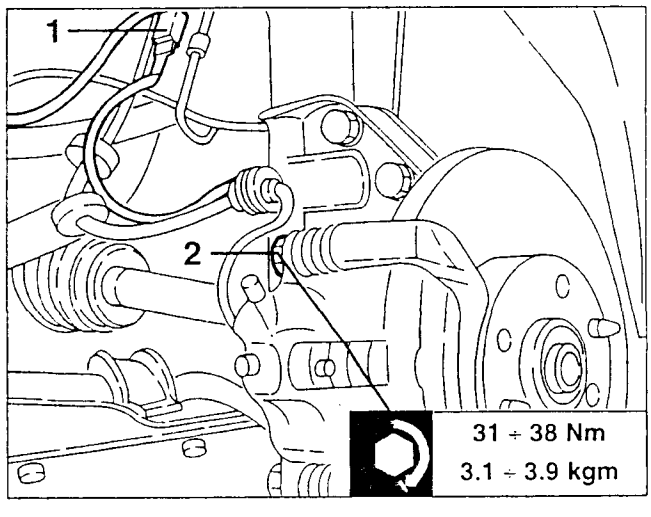


CHECKS AND INSPECTIONS

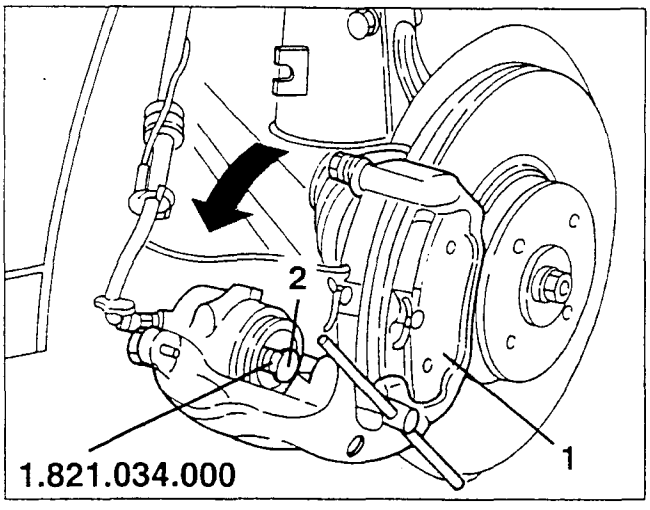
- The piston and caliper body must not reveal signs of abrasion or seizing; if they do, change the caliper complete with piston.
- Always change the protective boot and seal.
- Make sure that the relief screw is not clogged.
- Check the hose for swellings and cracks.
- Change the brake pads if the thickness of the friction material is below 1.5 mm.
- Check the brake caliper support bracket for cracks and distorsion.

CHANGING THE FRONT BRAKE PADS

- Remove the front wheel.
1. Disconnect the electrical connection of the brake pad wear sensor.
2. Slacken the upper screw fastening the caliper body.



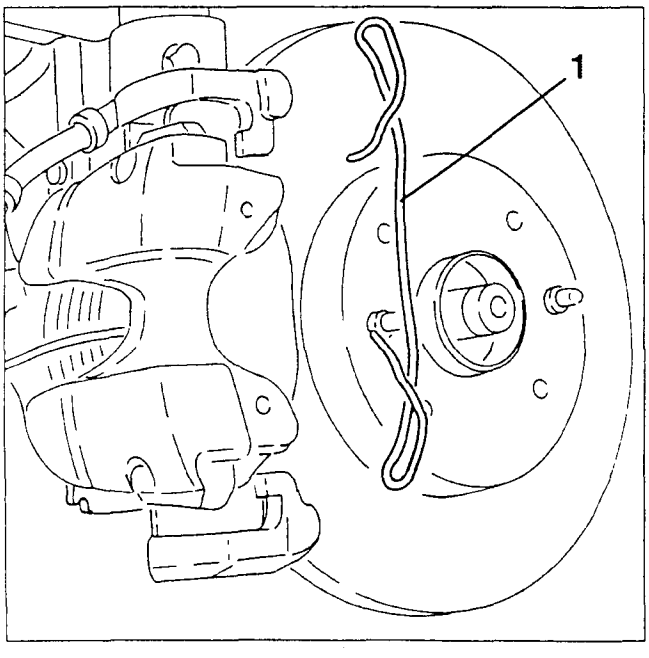
When refitting replace the caliper body fastening screws and tighten them to the specified torque.
1. Turn the caliper as illustrated and replace the brake pads.
NOTE: The brake pad with wear sensor, must be fitted on the inner side of the disk (brake caliper piston side); at the same time check that the relief, on the outer part of the pad is positioned at the rear with respect to the direction of travel.
2. When refitting the caliper adjust the position of the piston using tool no. 1.821.034.000.



FRONT BRAKE CALIPER
(Specific for versions after change)

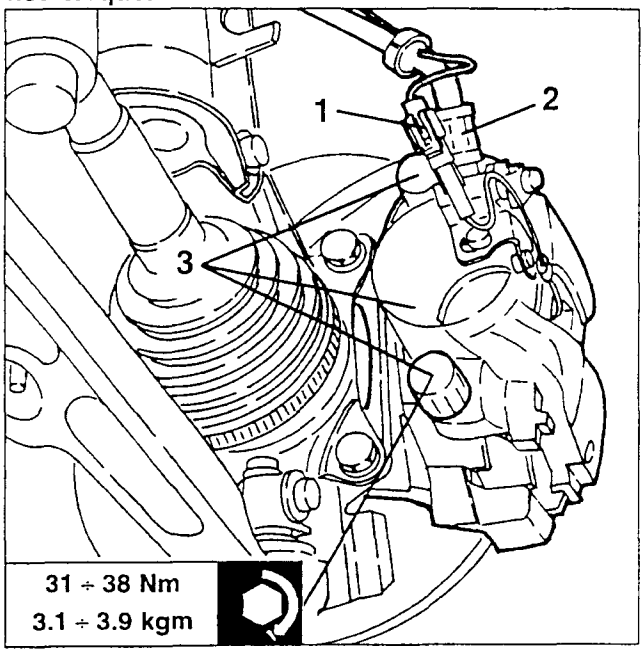
REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the the battery (-) terminal.
- Remove the wheel on the side concerned.
1. Remove the spring from the brake caliper.

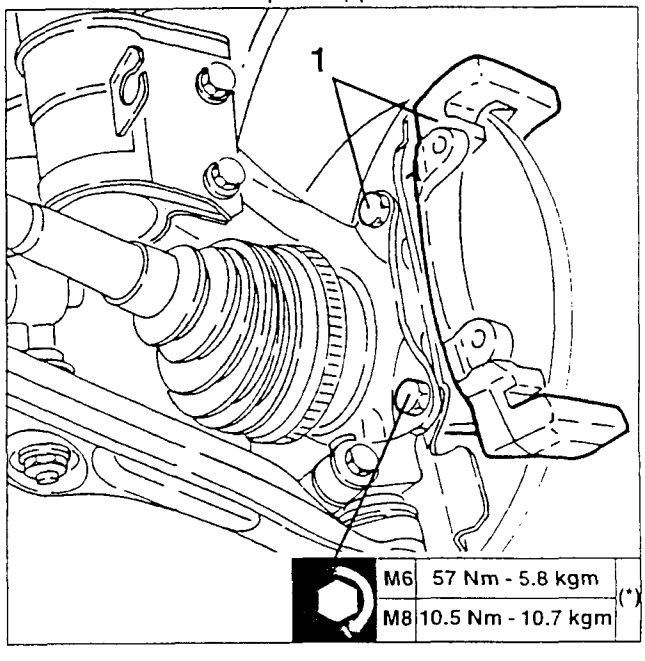


1. Disconnect the connection of the brake pad wear sensor.
2. Disconnect the brake fluid delivery pipe from the caliper.
3. Remove the protective caps, slacken the two fastening screws and remove the brake caliper and pads.

NOTE: When refitting sostituire caliper body fastening screws and tighten them to the specified torque.



1. If necessary, slacken the two fastening screws and remove the brake caliper support.



(*): For screws with "Driloc"; to be changed every time they are tightened or loosened.

When refitting relieve the air from the braking system (see specific paragraph).

DISASSEMBLY/REASSEMBLY

See the instructions for the version before the change

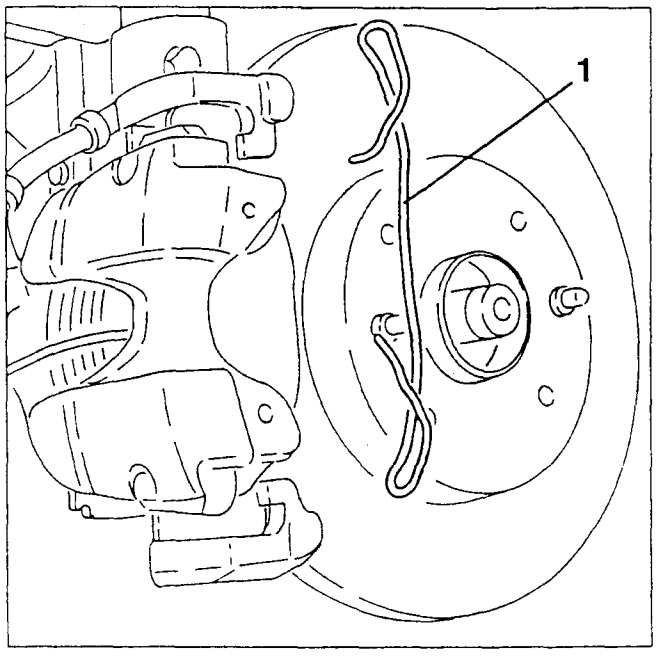
CHECKS AND INSPECTIONS

See the instructions for the version before the change

CHANGING THE FRONT BRAKE PADS

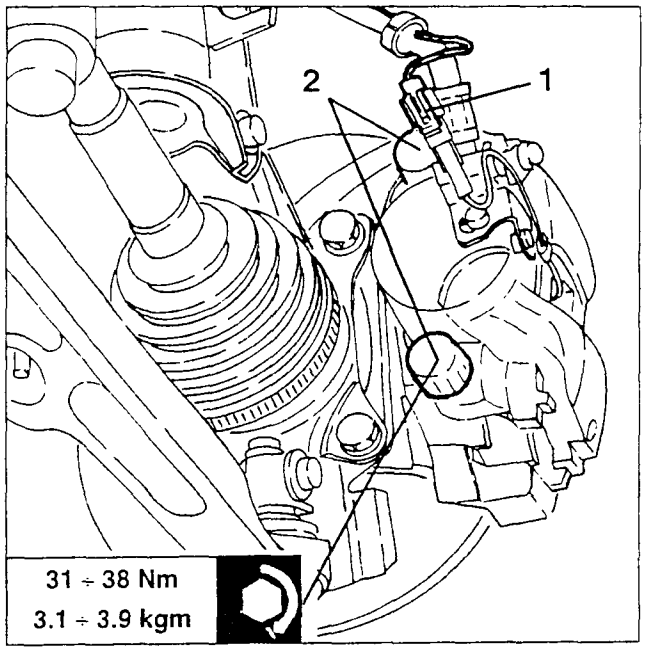
- Set the car on a lift.
- Remove the wheel on the side concerned.

1. Remove the spring from the brake caliper.

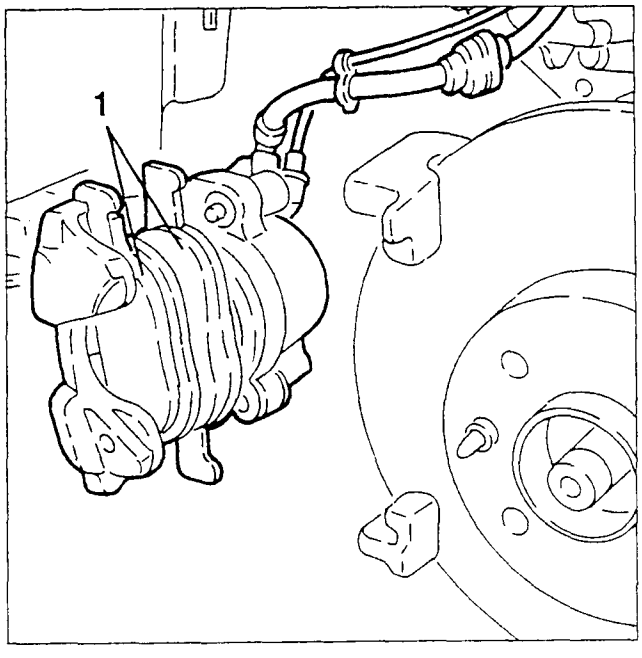


1. Disconnect the brake pad wear sensor electrical connection.
2. Remove the protective caps and slacken the two screws fastening the brake caliper to its support.

NOTE: When refitting change the caliper body fastening screws and tighten them to the specified torque.



1. Back the caliper off the support, without disconnecting the control piping, then remove the brake pads.

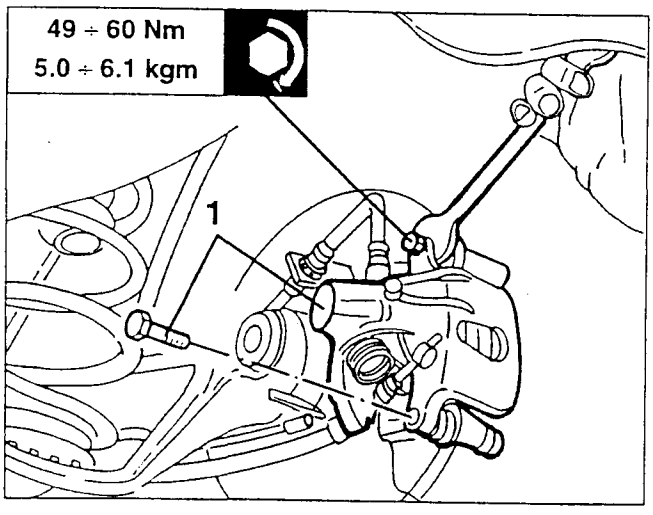


REAR DISK BRAKE

REMOVING/REFITTING

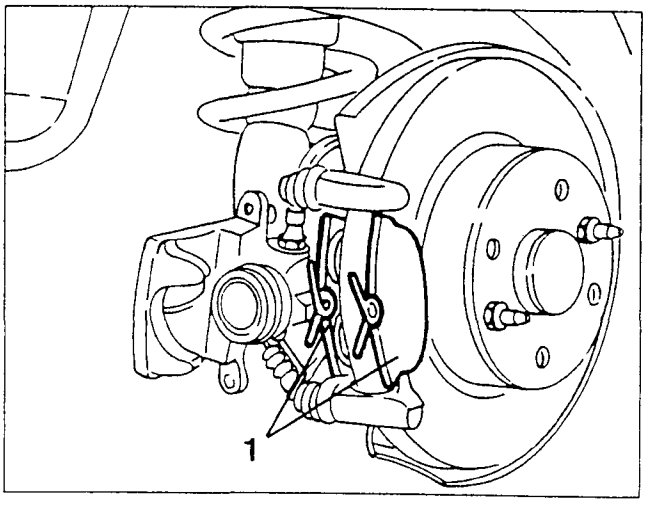
- Set the car on a lift.
- Remove the wheel on the side concerned.

1. Slacken the two screws fastening the brake caliper to its support and move it aside without disconnecting the pipe and the handbrake cable.

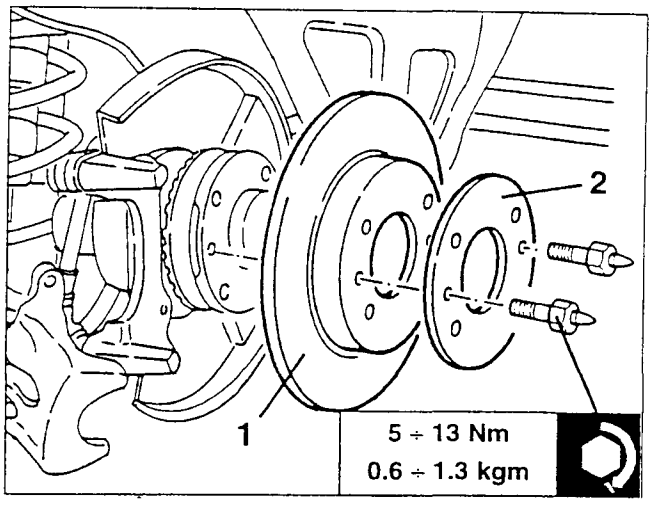


When refitting change the caliper body fastenins screws, tightening them to the specified torque.

1. Remove the brake pads.



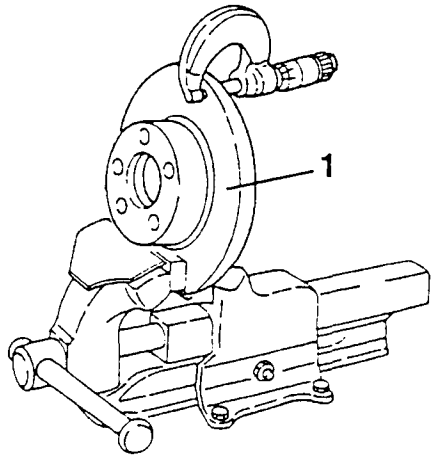
1. Slacken the two fastening pins and remove the brake disk.
2. Retrieve the spacer (where applicable).



CHECKS AND INSPECTIONS

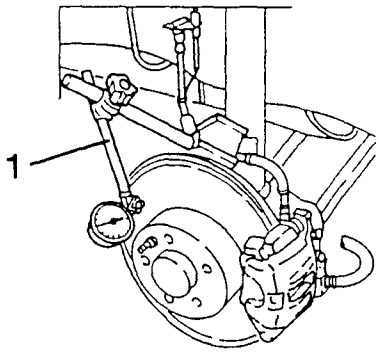
1. Check the thickness of the disks and check that the working surfaces have no deep scores or porosity. If necessary, grind observing the specified tolerances.

At wear limit	At grinding limit
9.2 mm	10.1 mm



1. When changing the brake pads only, check that oscillation of the disk in relation to the axis of rotation is within the specified limits (0.15 mm max).

NOTE: The value must be measured 2 mm from the outside diameter of the disk.

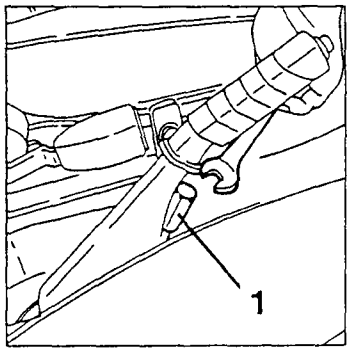


REAR BRAKE CALIPER

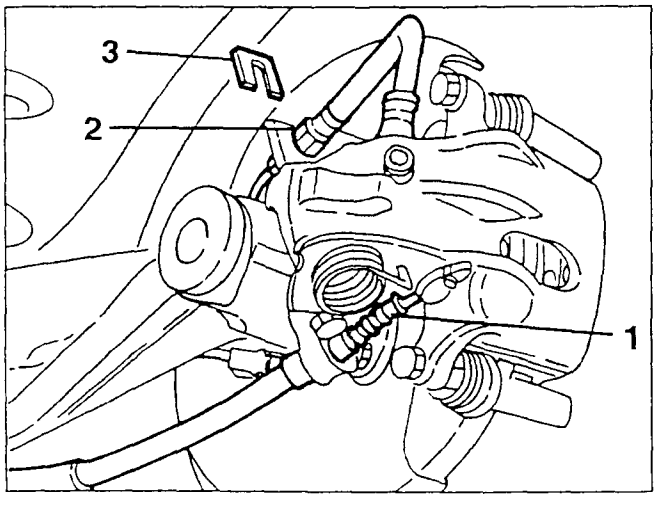
REMOVAL/REFITTING

- Set the car on a lift.
- Using a suitable syringe, empty the brake-clutch fluid reservoir.
- Remove the wheel on the side concerned.
- Remove the handbrake lever leather trim.

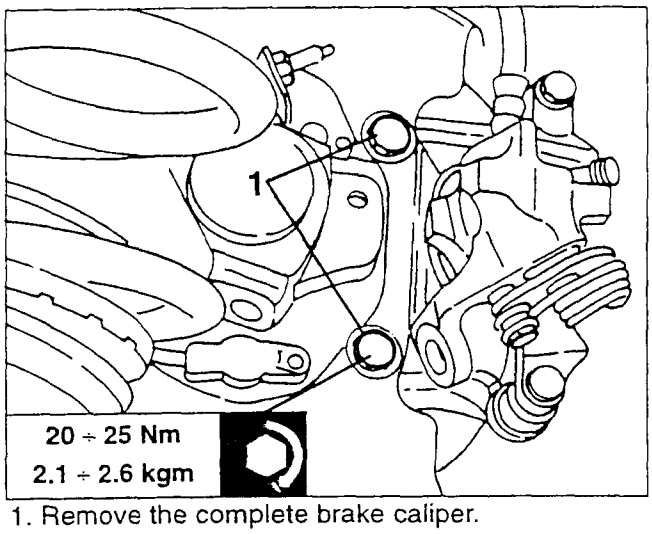
1. Using the handbrake lever adjustment nut, slacken the tension of the cables.



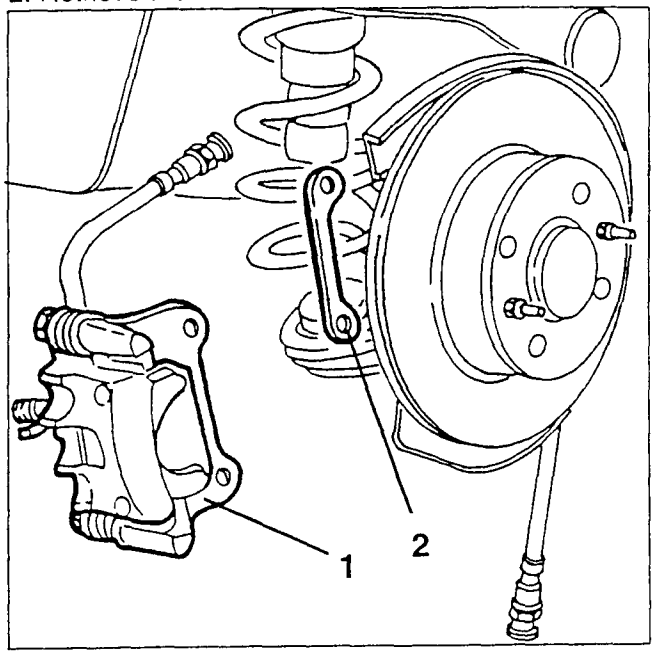
1. Disconnect the handbrake cable from the brake caliper.
2. Slacken the hose connection.
3. Remove the stopper and withdraw the hose connection.



1. Slacken the two screws fastening the complete brake caliper.

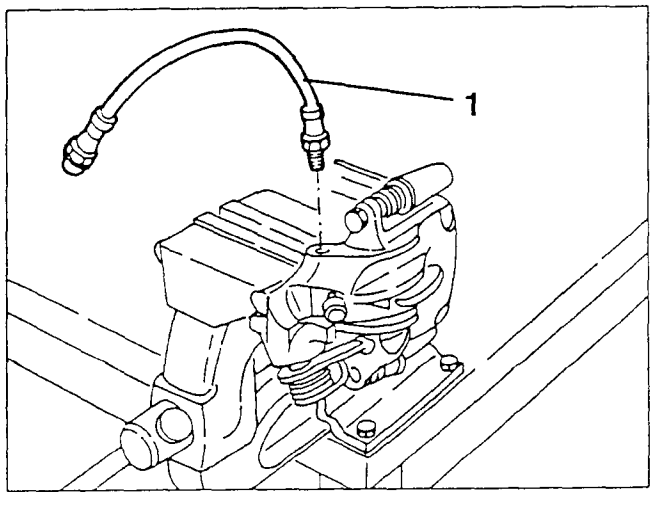


1. Remove the complete brake caliper.
2. Retrieve the shim.

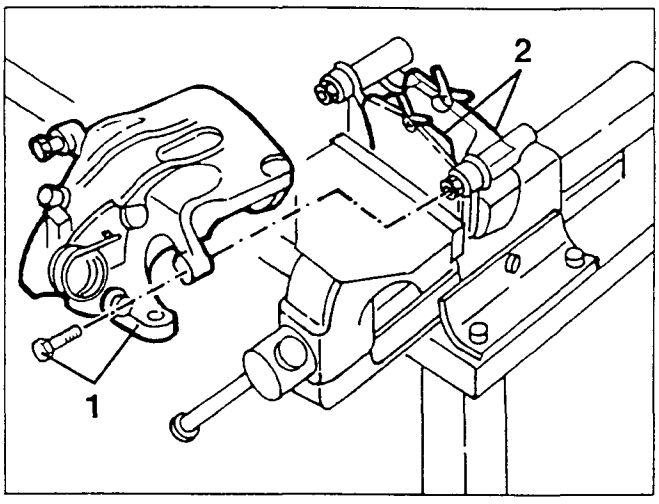


DIS-ASSEMBLY

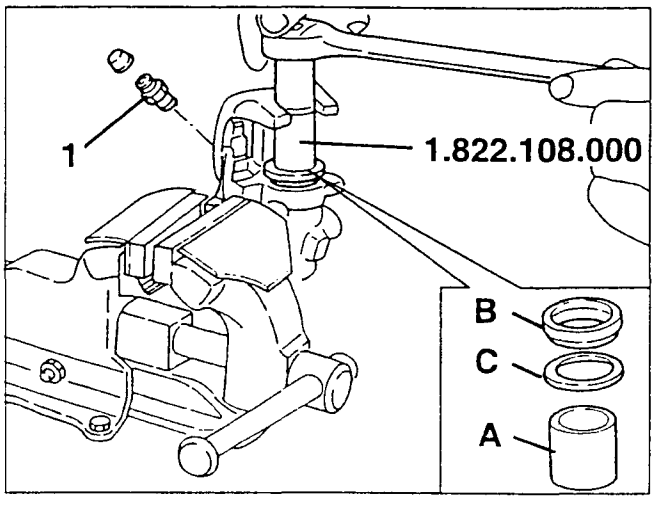
1. Disconnect the hose connection from the brake caliper.



1. Slacken the two screws fastening the brake caliper to its support bracket and remove it.
2. Retrieve the brake pads.



1. Remove the relief screw.
– Using tool N° 1.822.108.000 (A),dis-assemble the piston(A), the protective boot (B) and the seal (C).

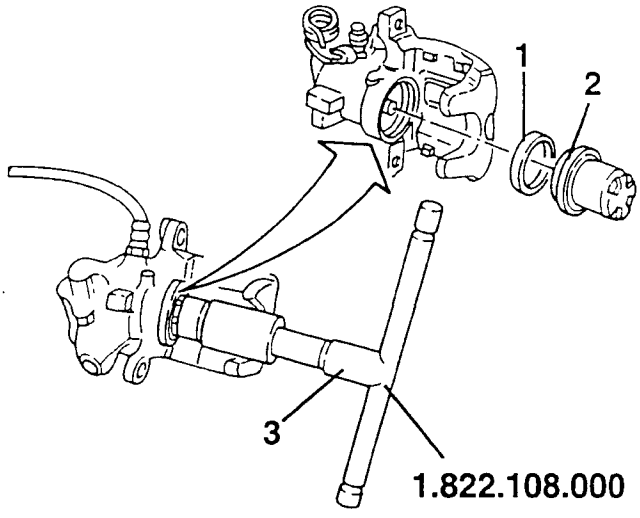


CHECKS AND INSPECTIONS

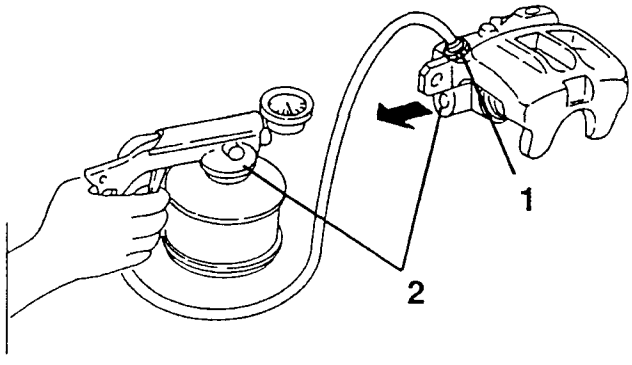
- The piston and caliper body must not reveal signs of abrasion or seizing; if they do, change the caliper complete with piston.
- Always change the protective boot and seal.
- Make sure that the relief screw is not clogged.
- Check the hose for swellings and cracks.
- Change the brake pads if the thickness of the friction material is below 1.5 mm.
- Check the brake caliper support bracket for cracks and distorsion.
- If the automatic handbrake cable stroke adjustment device is not working properly, change the complete caliper.

REASSEMBLY

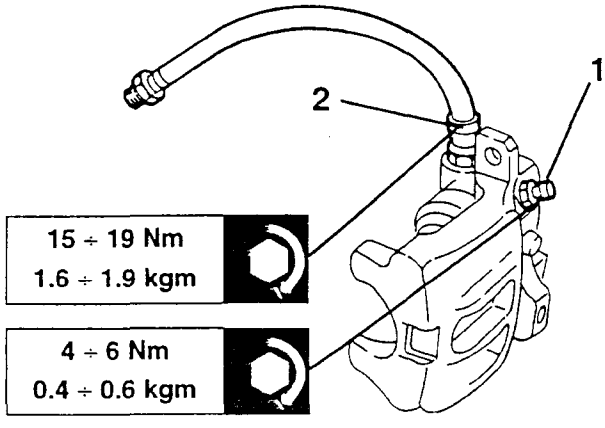
1. Fit the seal ring in the caliper body.
2. Position the protective boot on the rear section of the piston.
3. Fit the piston and adjust the position using tool N° 1.822.108.000.



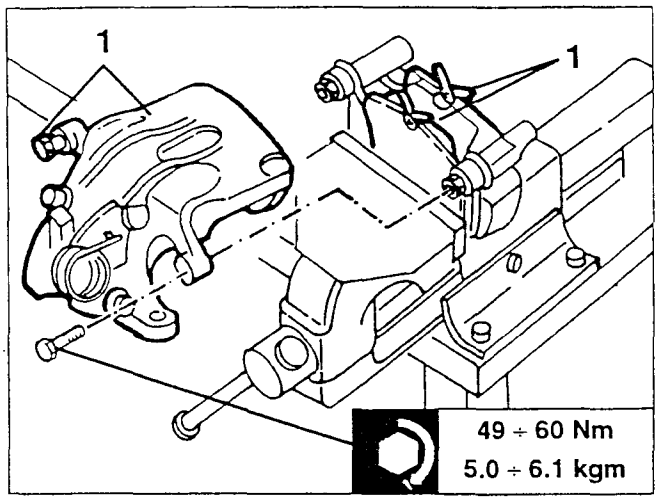
1. Partially tighten the relief screw.
2. Fill the caliper with the specified brake fluid until the fluid comes out of the hose connection hole free of air bubbles.



1. Lock the relief screw to the specified torque.
2. Assemble the hose and lock the connection to the specified torque.



1. Position the brake pads, then assemble the brake caliper on its support bracket tightening the new fastening screws to the specified torque.

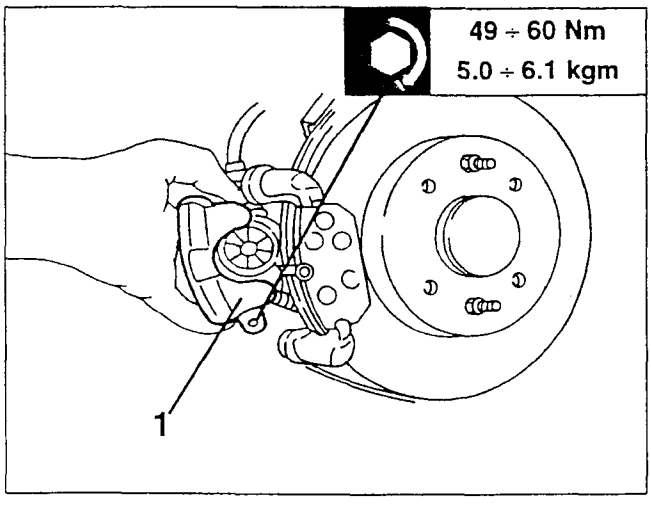


CHANGING THE REAR BRAKE PADS

- Remove the rear wheel.

1. Slacken the two screws fastening the caliper body and move it aside to simplify changing the pads.

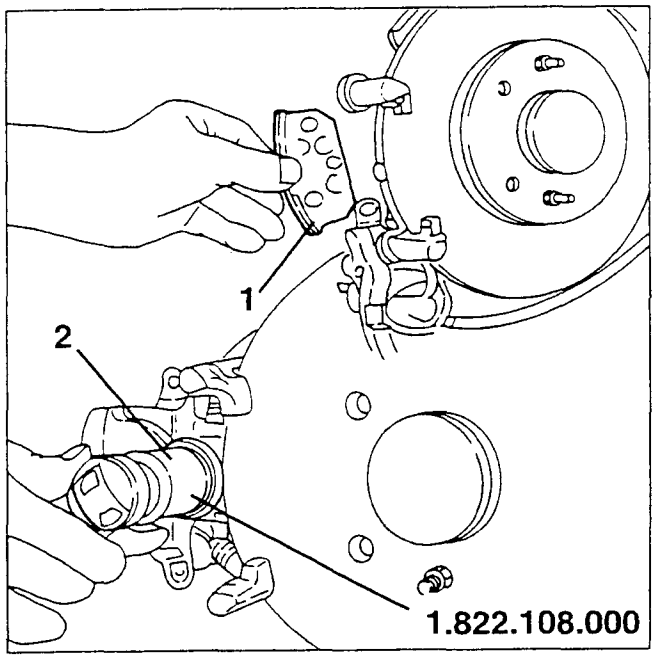
When refitting change the caliper body fastening screws, tightening them to the specified torque.



1. Change the brake pads.

NOTE: **There is no specific direction for assembling the rear brake pads.**

2. Using tool N° 1.822.108.000 move the piston backwards to simplify refitting the caliper, then refit the caliper itself.

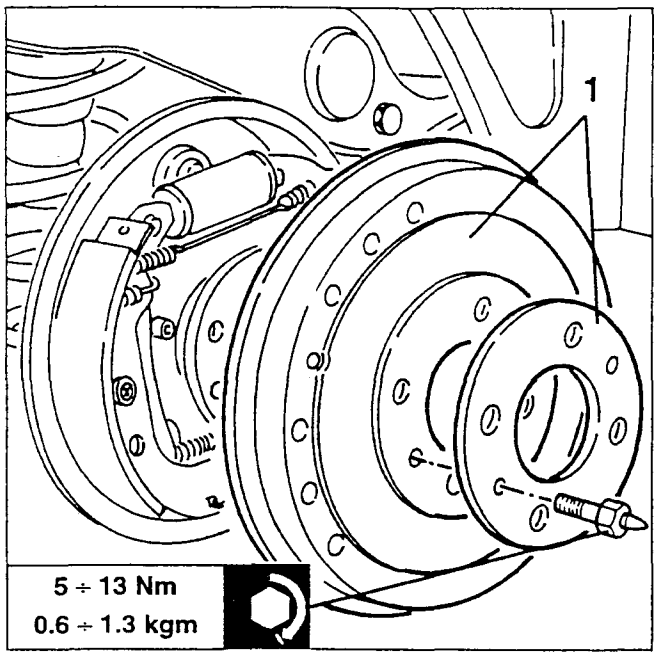


BRAKE DRUM

REMOVAL/REFITTING

- Set the car on a lift.
- Remove the wheel on the side concerned.

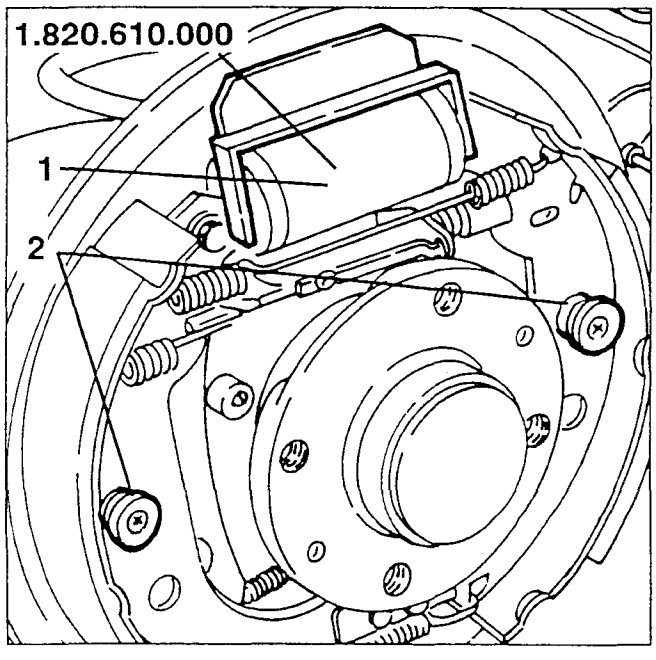
1. Slacken the two fastening pins and remove the spacer and drum.



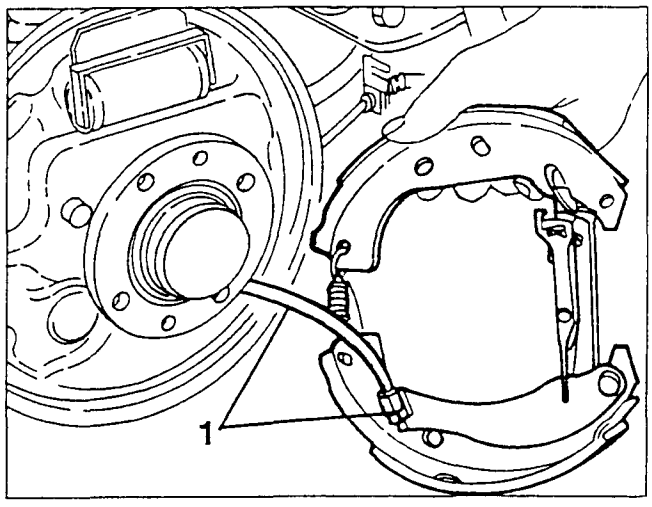
CHANGING THE BRAKE SHOES

- Remove the drum (see specific paragraph).

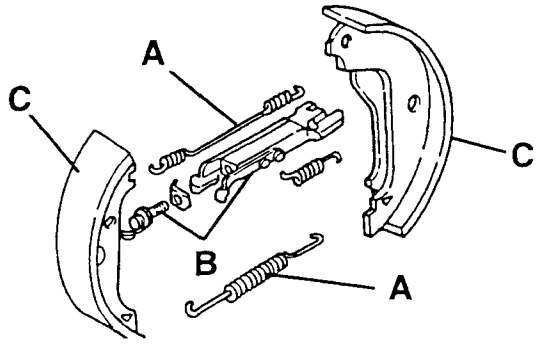
1. Install tool n° 1.820.610.000 for retaining the brake cylinder piston.
2. Slacken the two shoe fastening pins.



1. Move the shoe unit away just enough to disconnect the handbrake cable.



- On the bench remove the two shoe return springs (A) and the self-adjusting play takeup device (B) from the shoes (C).

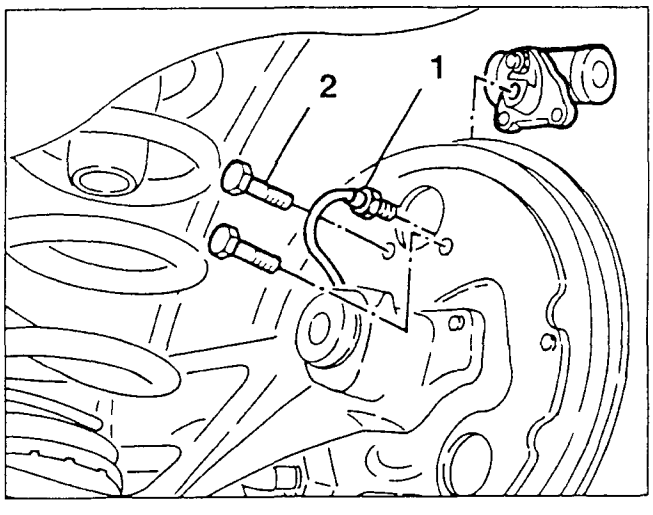


SHOE CONTROL CYLINDER

REMOVAL/REFITTING

- Remove the rear drum brake shoes.

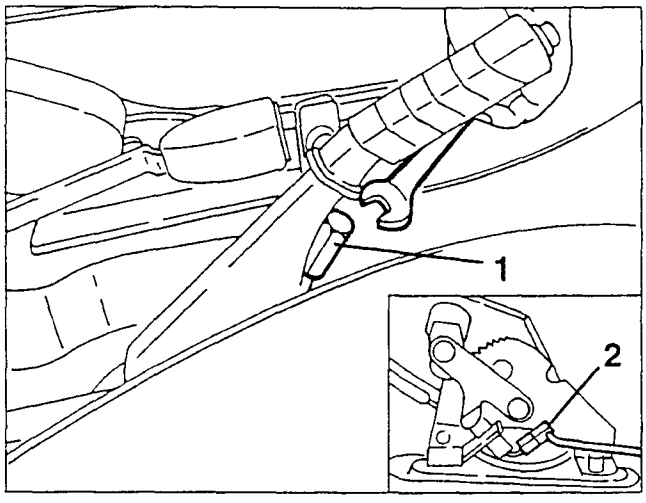
1. Disconnect the hose connection from the shoe control cylinder.
2. Slacken the two screws fastening the shoe control cylinder and remove it.



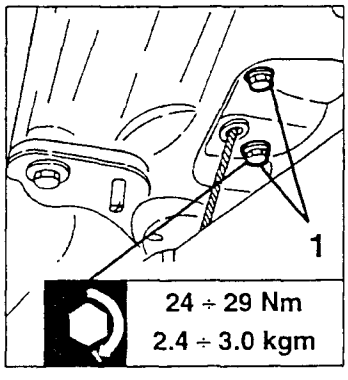
CONTROL LEVER

REMOVAL/REFITTING

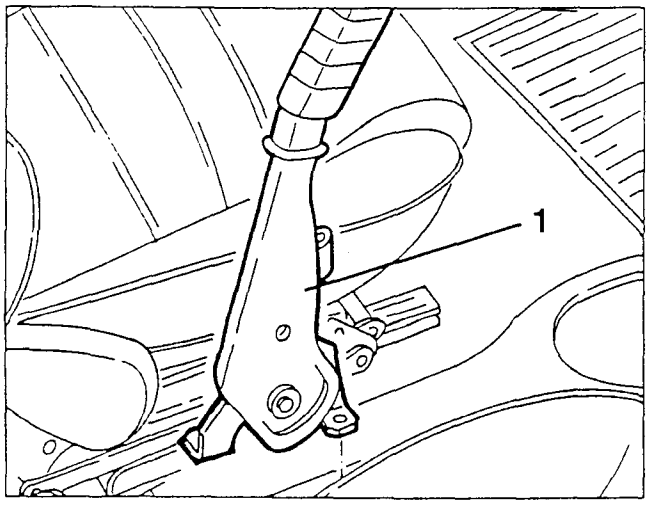
- Set the car on a lift.
- Remove the centre brake console (see GROUP 70).
1. Completely unscrew the handbrake lever adjustment nut and free the control cable.
2. Disconnect the electrical connection from the handbrake switch.



- Raise the car.
1. Slacken the fastenings of the exhaust pipe heat guard and slacken the two screws fastening the handbrake lever.



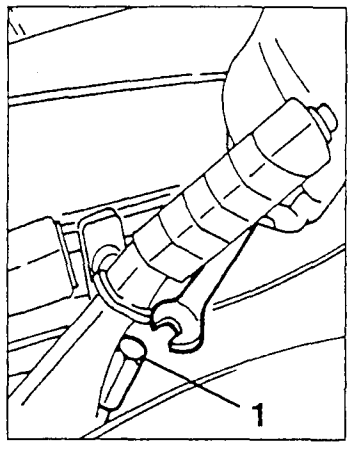
- Lower the car.
1. Remove the handbrake lever.



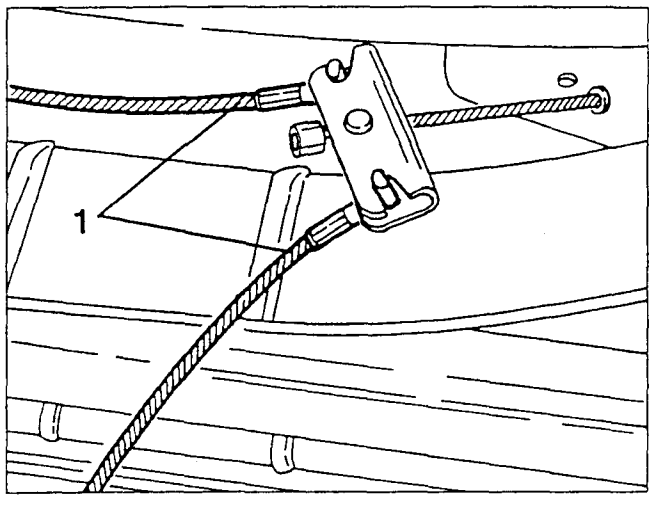
FRONT CONTROL CABLE

REMOVAL/REFITTING

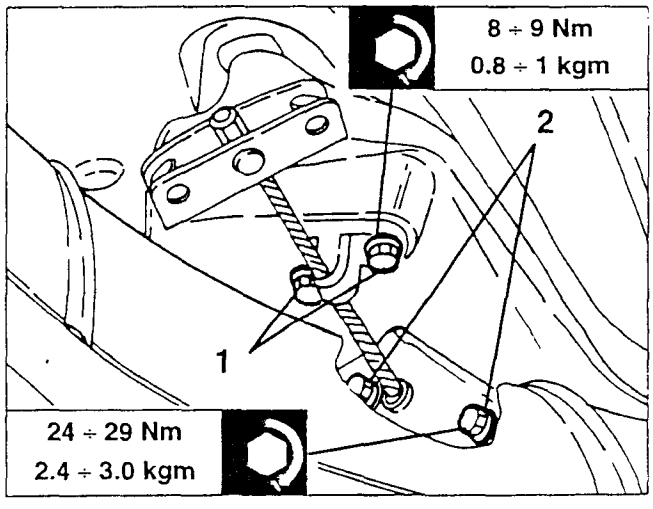
- Set the car on a lift.
- Remove the handbrake lever leather trim.
1. Completely unscrew the handbrake lever adjustment nut and free the control cable.



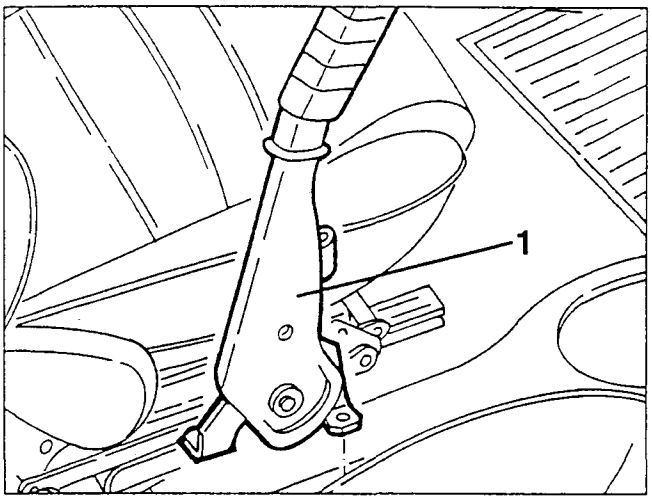
- Raise the car.
1. Disconnect the handbrake cables from the hooking bracket.



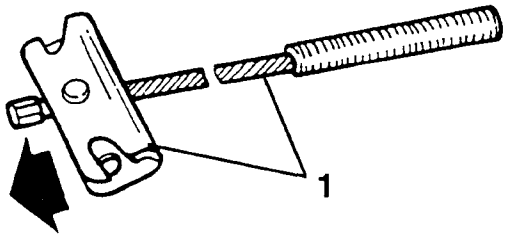
1. Slacken the fastenings of the exhaust pipe heat guard and slacken the two screws fastening the handbrake front cable support.
2. Slacken the two screws fastening the handbrake lever.



- Lower the car.
1. Remove the handbrake control lever.



1. Raise the car and retrieve the handbrake front cable withdrawing it from the grommet.

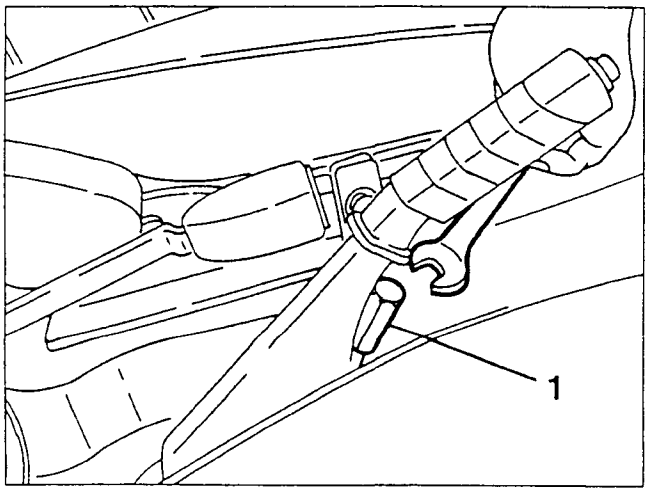


When refitting, make sure that the cable grommet is correctly positioned.

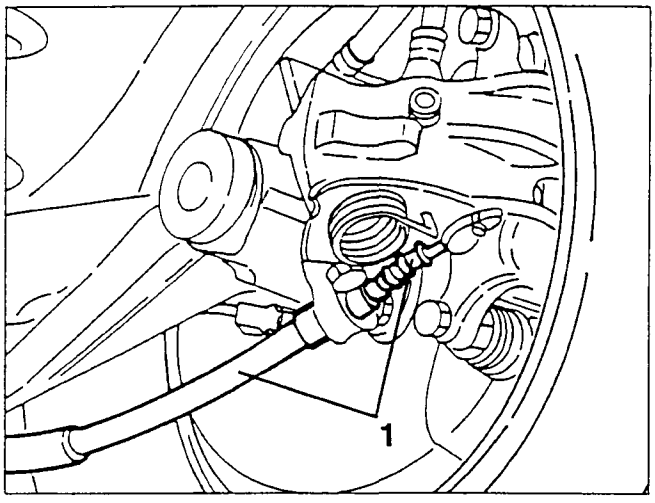
REAR CONTROL CABLES

REMOVAL/REFITTING

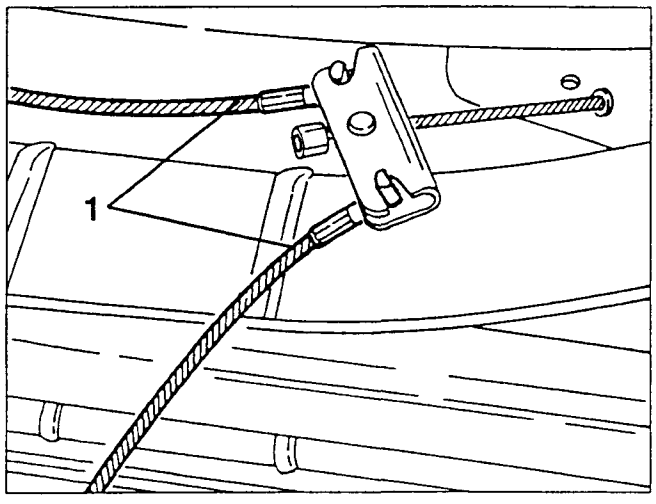
1. Remove the boot and slacken the tension of the handbrake cables using the special adjustment nut.



1. Disconnect the handbrake rear cables from the brake calipers.



- Free the handbrake rear cables from the support clamps.
1. Disconnect the handbrake rear cables from the hooking brackets and remove them.



ADJUSTING THE CONTROL CABLES

The handbrake should be adjusted only after changing the brake pads, or the control cables, or the brake caliper, as wear takeup is automatic.

- Disconnect the handbrake cables from the brake calipers and pump the brake pedal forcefully at least ten times.
- Reconnect the handbrake cables to the calipers.
- Move the handbrake lever to the third position on the toothed sector and tighten the adjustment nut until the rear wheels are braked.

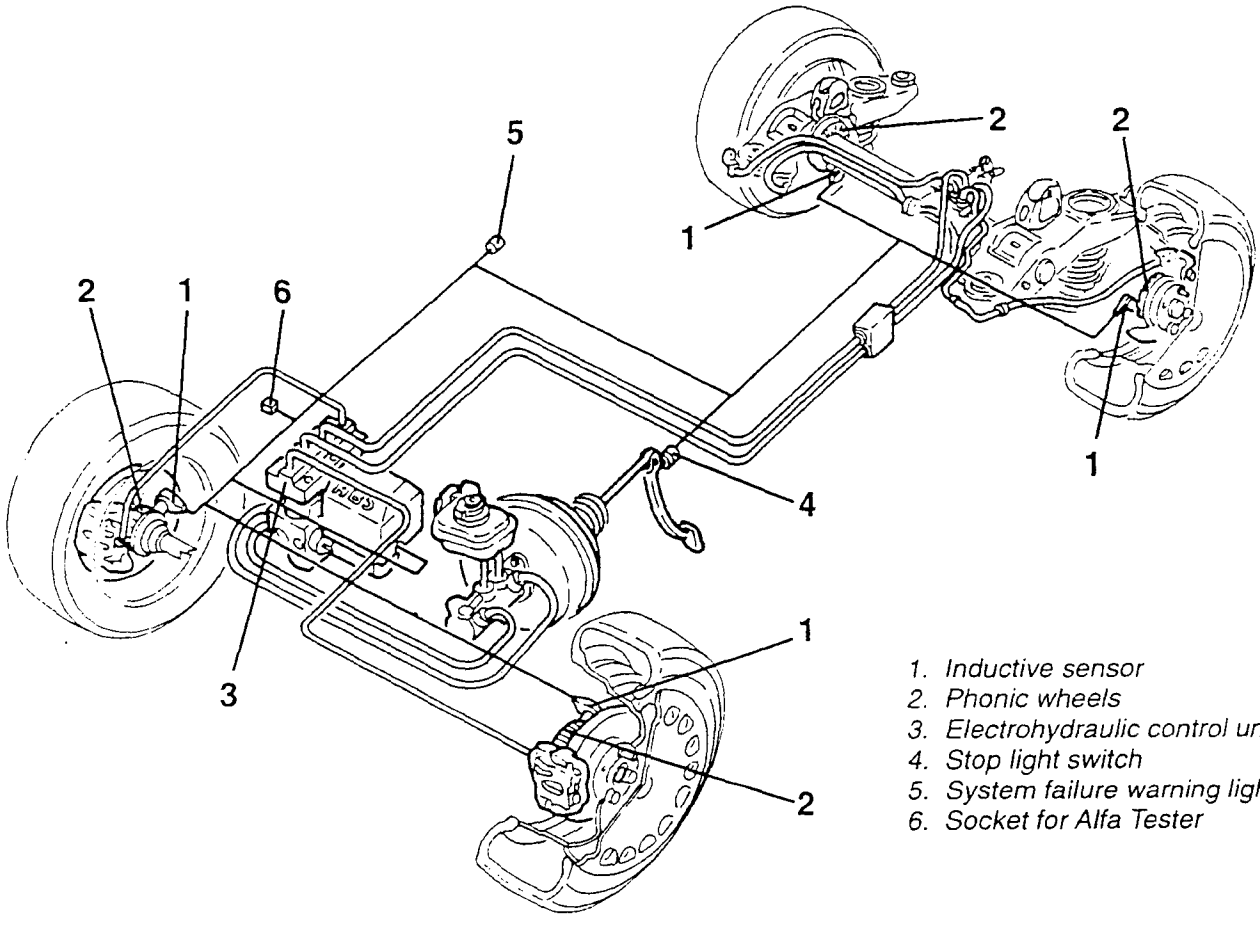
With the lever in the rest position, check that the wheels turn freely.

BOSCH 2E ABS

(up to chassis no. .....)

DESCRIPTION

The BOSCH 2E A.B.S. wheel anti-lock system, integrated with the conventional hydraulically-operated system can be split into the following parts:
- a control unit (3) which, compared with other types of anti-lock systms, integrates the electronic one with the electrohydraulic one controlling both electronic and system management;
- a diagnosis socket (6) for the Alfa Tester;
- four sensors (1), integral with the fixed part suspension facing the same number of phonic wheels (2);
- a switch (4), in correspondence with the brake pedal, for controlling the stop lights;
- a warning light (5), in the instrument cluster, to alert the driver of faults in the A.B.S. system.

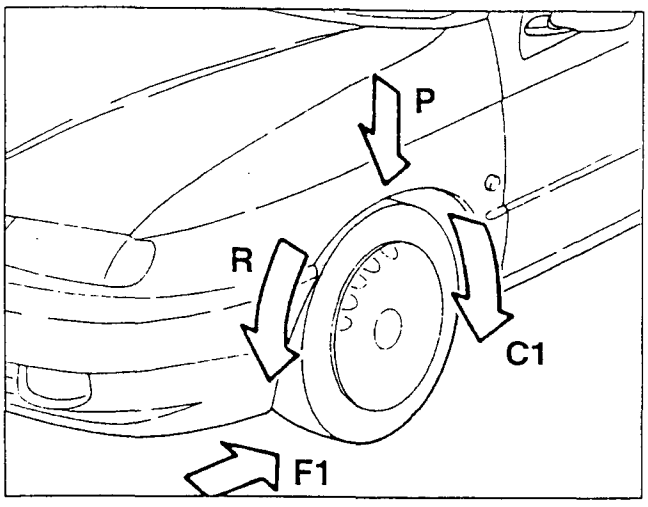


OPERATING PRINCIPLE

During daily use of the vehicle we are used to pressing the brake pedal according to the slowing down required of the vehicle. When the road surface is dry and clean, no particular inconveniences generally occur, as it is possible to reach heavy pressures before the tyre begins to skid.
Conversely, if the asphalt and tyre conditions is not perfect, it would be instinctive to keep higher safety distances as lengthening of the braking distance is foreseeable, owing to both physical problems of grip and in considerable difficulty in dosing the braking force in the best way possible.

If one finds oneself in an unexpected situation (such as uneven road surface, braking on road surfaces at the limit of grip, or panic braking) it would be extremely fiddicult to control the vehicle, resulting in longer stopping distances and the possible loss of control. All this takes place because the wheels skid during braking and it is therefore impossible for the tyre to absorbe the lateral forces acting on it.
During braking, the peripheral speed of the wheel tends to lower more than that of the vehicle; if the wheel locks and the car is still moving, the difference between these two speeds is at its highest level.

This difference in speed is known as "slipping coefficient" which represents the percentage of difference between the two speeds, therefore:
- slipping coefficient 0% if the wheel is free to roll;
- slipping coefficient 100% if the wheel is locked and the car is moving.



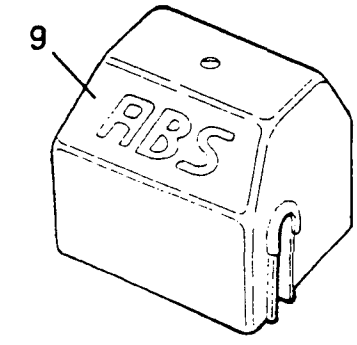
C1 Braking torque
F1 Braking force
P Weight bearing on the tyre
R Tyre rolling radius

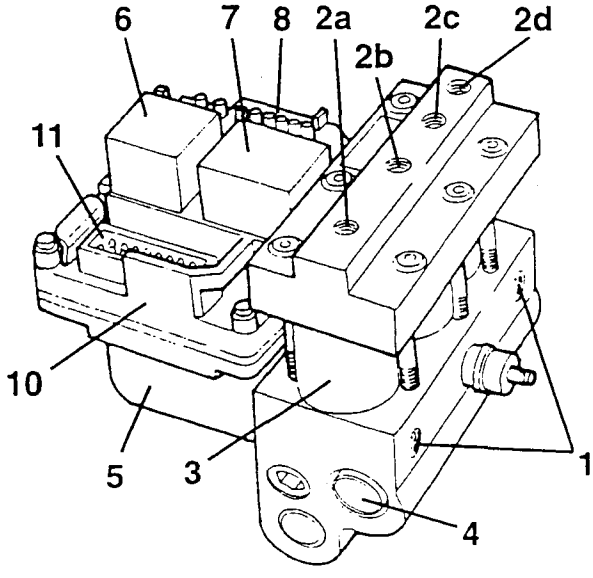
During braking, braking friction increases decidedly, for low values of the slipping coefficient, then lowering, gradually as the wheel slows down with respect to the speed of the car. Maximum braking efficiency is therefore obtained with slipping coefficient between 5% and 15% with a maximum of 20% depending on the tyre and road surface.
The purpose of the wheel anti-lock system (A.B.S.) is that of modulating the braking pressure so that the slipping coefficient is always kept between optimum values: this will make it possible to brake with the maximum braking friction and stop the vehicle in the smallest space possible allowed by the condition of the road surface and the wear of the tyres.

ELECTROHYDRAULIC CONTROL UNIT

The control unit in the engine compartment is connected through unions (1) to the brake pump and through unions (2) to the braking system pipes.
The unit cannot be overhauled with the exception of relays (6) and (7), and muste be changed entirely if a fault is found. To replace the above-mentioned relays and the multiple socket (8), it is necessary to remove the cover (9) after slackening the fastening screw.

From the sensors in correspondence with the phonic wheels, the control unit receives information about the turning speed of the wheels, and processes it electronically. It then generates command signals which make it possible to hydraulically change the pressure of the brake fluid in the caliper cylinders.
Depending on the behaviour of the wheels, the electrohydraulic unit changes the pressure of the brake fluid at the calipers in three separate steps, as described in the previous paragraph.



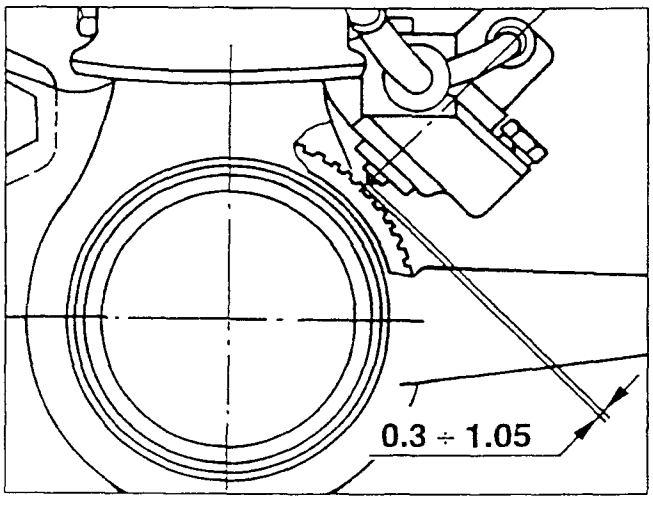


1. Unions for connecting hydraulic unit - brake pump
2. Unions for connecting hydraulic unit - pipes:
a) left front caliper (VL)
b) right rear caliper (HR)
c) left rear caliper (HL)
d) right front caliper (VR)
3. Solenoid valves
4. Sequential hydraulic valve
5. Electric recovery pump
6. Electric pump control relay
7. Solenoid valve safety and supply relay
8. Multiple connector
9. Cover
10. Electronic control unit
11. 15-pole connector for hydraulic control unit

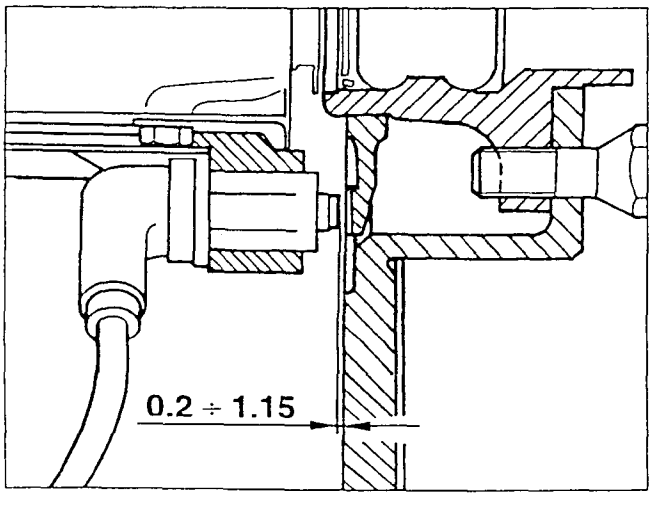
INDUCTIVE SENSORS

The sensors designed to detect the number of revolutions of the wheels of the car supply the control unit with the necessary continuity the information necessary for the control unit to correctly govern the operation of the hydraulic system.
The sensors measure the speed of travel, acceleration, deceleration and wheel slip. They are of the inductance type fitted in special housings on the front wheel uprights and on the rear brake caliper holder plates and it is not possible to adjust them.
As their position cannot be adjusted by shims, if the gap differs from the specified values, they must be changed.

Front wheels



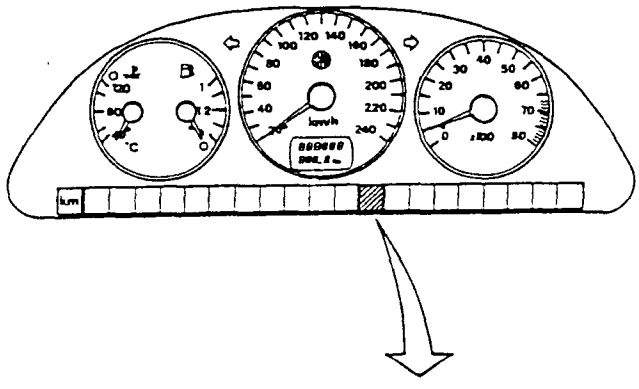
Rear wheels

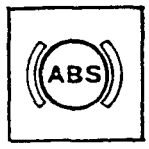


The lines of magnetic flux are closed by the teeth of the phonic wheel facing the sensor and turned by the wheel.The passage from solid to hollow, due to the presence or lack of a tooth causes a change in the magnetic flux sufficient to create an induced electromotive force at the terminals of the sensor and an alternating electric signal at the control unit.

FAILURE WARNING LIGHT

When the ignition switch is turned to MARCIA, the failure warning light turns on; as soon as the engine is started it will turn off. The control unit receives the engine running signal from the alternator. The A.B.S. device cuts in at appr. 3 kph and at about 6 kph the device performs the test cycle which excludes the wheel revolution sensors.
If the response from the components is positive, the warning light stays off; if the response is negative the warning light turns on and the system will cut out automatically leaving the conventional braking system to slow down the vehicle. In this case the warning light will flash.





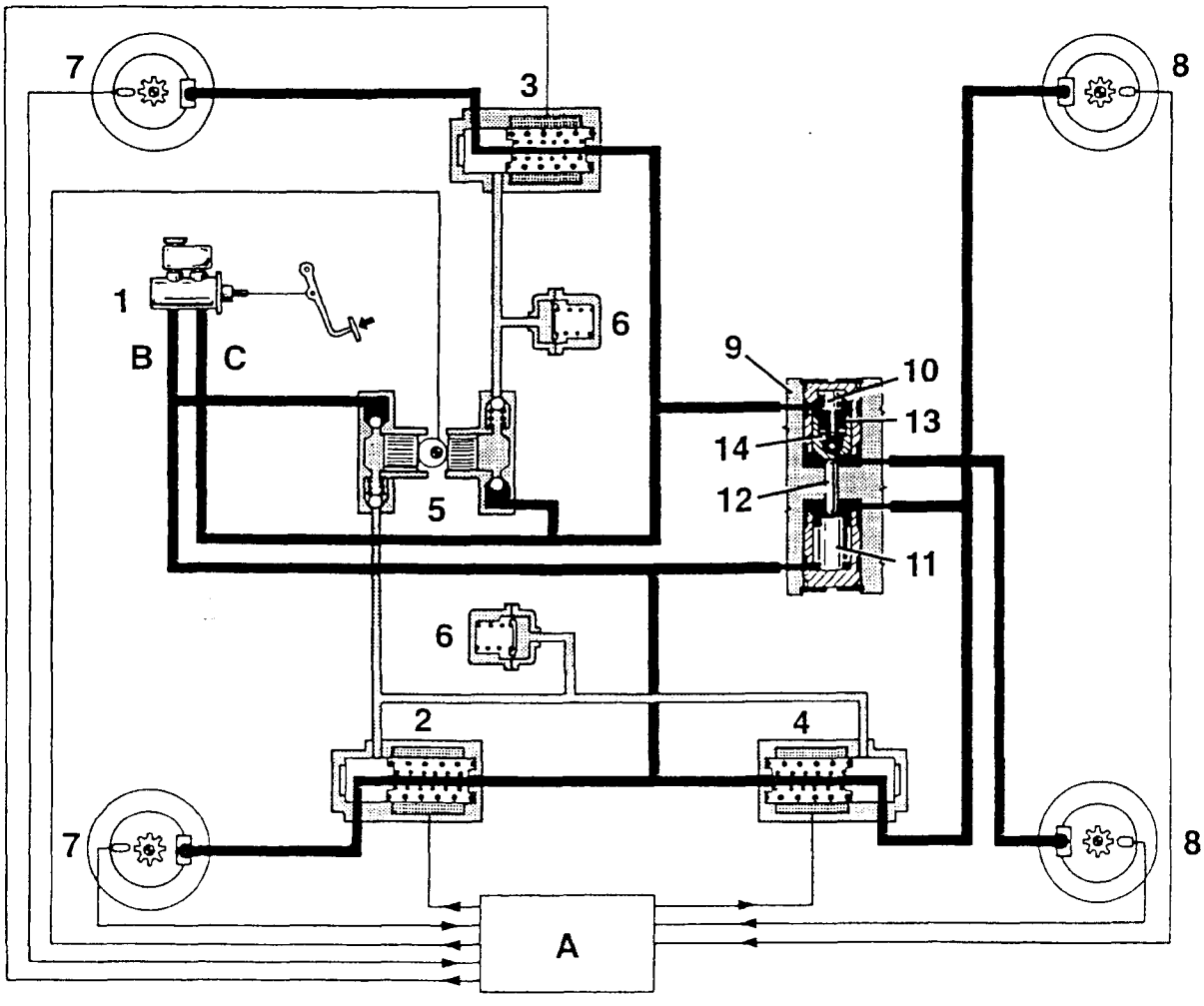
DESCRIPTION OF HOW THE WHEEL ANTI-LOCK DEVICE WORKS

Depending on the pulses received from the electronic control unit, the electrohydraulic unit changes the pressure of the brake fluid on the calipers in three phases:
1. Pressure increase phase
2. Pressure decrease phase
3. Pressure maintaining phase

Pressure increase phase

In this phase the solenoid valves of the electrohydraulic control unit are not energised and the pressure in the calipers originates from the pressure exerted on the brake pedal by the driver.
The pressure of the brake fluid at the outlet of the brake pump hose (B) reaches the left front wheel and the right rear wheel through solenoid valves (2) and (4), while from hose (C) it reaches the right front wheel and the left rear wheel through the solenoid valve (3) and the sequential valve (9).

The pressure of the brake fluid crosses the sequential valve (9) because the piston (10), pushed by the spring (13), keeps the valve (14) in the open position; piston (11) does not intervene as both its surfaces are affected by the same pressure.
The braking force increases and as a result the wheels reduce their speed in relation to that of the car (slipping increases), if a rear wheel tends to lock the sensor detects what is happening and the electronic control unit reduces the pressure.

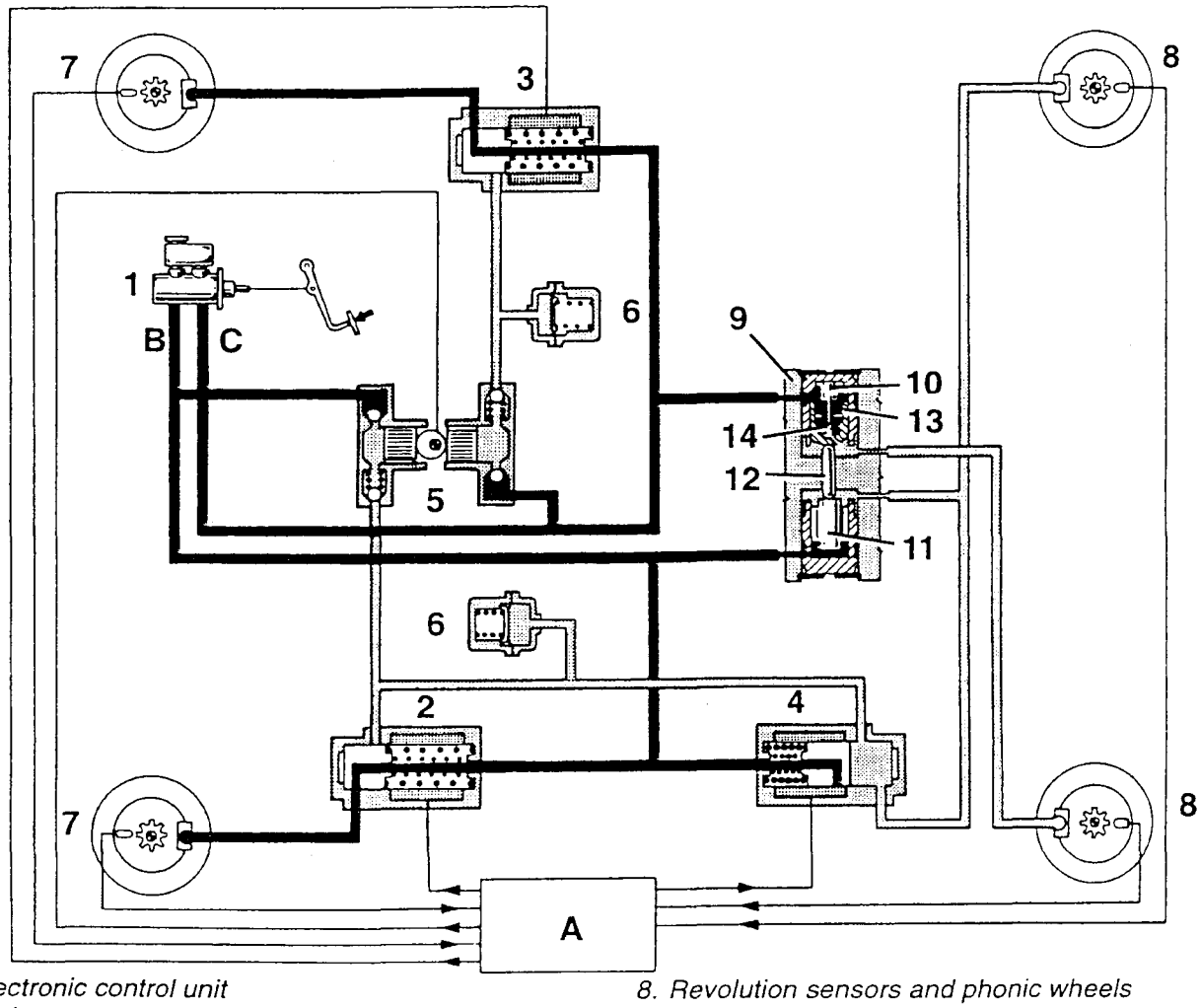


A. *Electronic control unit*
B. *Brake pump outlet hose*
C. *Brake pump outlet hose*
1. *Brake pump*
2. *Solenoid valve for front wheel brake circuit*
3. *Solenoid valve for front wheel brake circuit*
4. *Solenoid valve for rear wheel brake circuit*
5. *Electric recovery pump*
6. *Accumulators*
7. *Revolution sensors and phonic wheels for front wheels*
8. *Revolution sensors and phonic wheels for rear wheels*
9. *Hydraulic sequential valve*
10. *Piston*
11. *Piston*
12. *Stiff rod connecting pistons*
13. *Spring*
14. *Valve*

Pressure decreasing phase

The electronic control unit measures the tendency of the wheel to lock and the ABS device comes into operation.
The solenoid valve (4) is energised by a 5 Amp current and the connection between the brake pump and the right rear brake caliper is cut off, while the connection between the brake caliper and the recovery pump (5) is opened, being activated at the same time as the solenoid valve (4).
In this way the pressure of the brake fluid in the right rear brake caliper and in the piston chamber (11) connected to it, decreases. The subtracted brake fluid is recirculated into the main circuit through the recovery pump (5). This is the origin of the intermittent hydraulic pulsations which can be perceived by the driver through the brake pedal.

The accumulator (6) in the circuit stores the part of the brake fluid subtracted from the brake caliper and at the same time acts as a damping chamber for the pressure peaks during the recovery phase.
The lack of balance between the forces acting on the piston (11), causes it and the rod (12) to move. Through piston (10) the rod moves piston (11) causing valve (14) to close.
The result is the gradual decrease of the pressure in the left rear brake caliper caused by the increased volume in the piston chamber (10).
The balance of the forces acting on pistons (10) and (11) will be reached when the braking pressures in the rear brake calipers reach the same value.

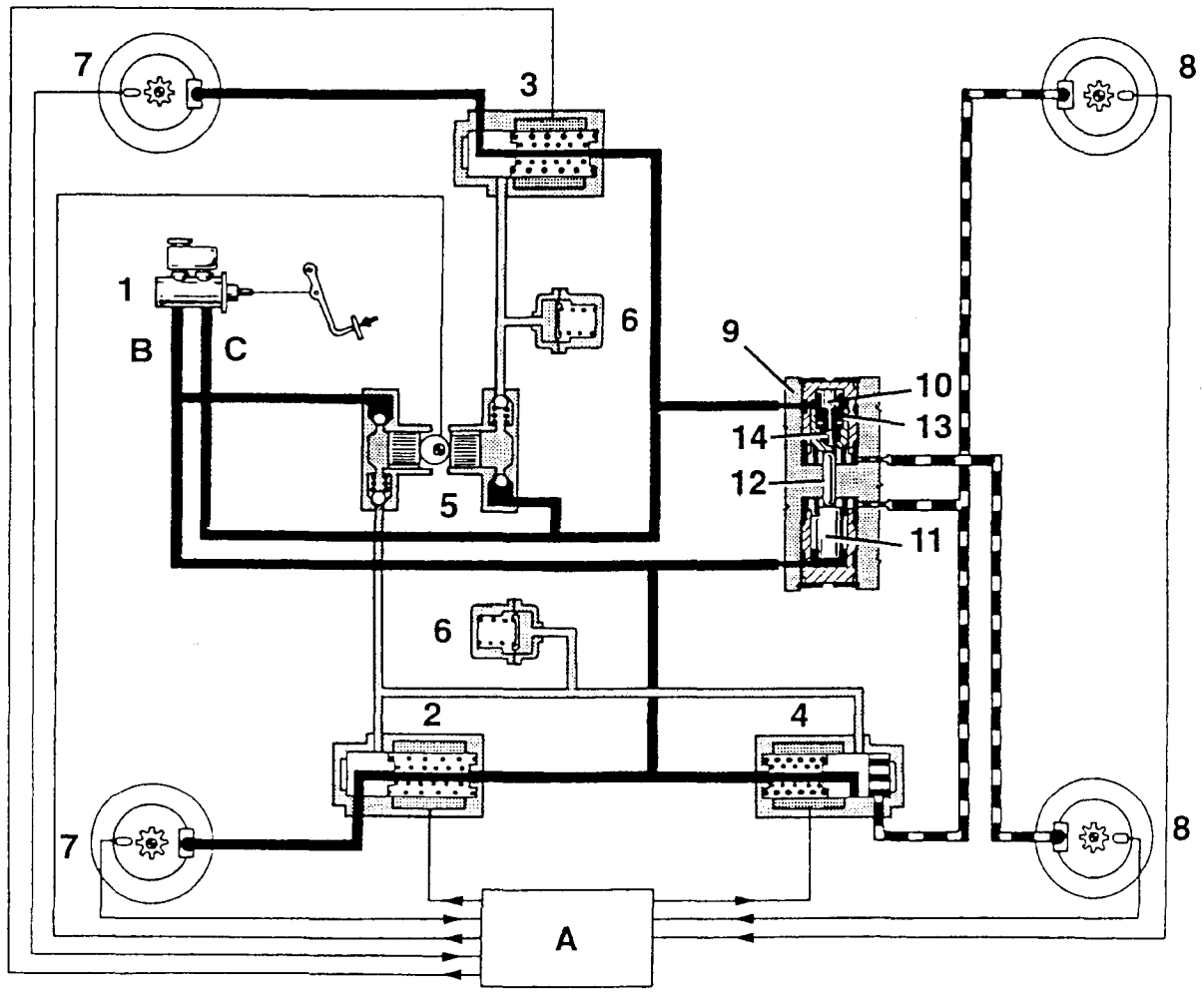


A. Electronic control unit
B. Brake pump outlet hose
C. Brake pump outlet hose
1. Brake pump
2. Solenoid valve for front wheel brake circuit
3. Solenoid valve for front wheel brake circuit
4. Solenoid valve for rear wheel brake circuit
5. Electric recovery pump
6. Accumulator
7. Revolution sensors and phonic wheels for front wheels
8. Revolution sensors and phonic wheels for rear wheels
9. Sequential hydraulic valve
10. Piston
11. Piston
12. Stiff rod connecting pistons
13. Spring
14. Valve

Pressure maintaining phase

In this phase there is an increase in both the speed and acceleration of the wheel.
The solenoid valve (4) is energised with a 2 Amp current; the connection between the brake pump and the rear brake calipers is still cut off (standby position).
The pressure on the rear brake calipers increases slightly as a result of the movement of the solenoid valve and it is then kept at a constant rate.

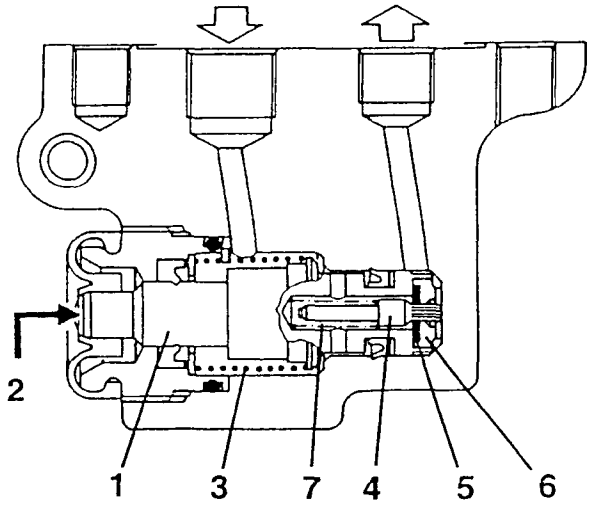
The braking force continues its slowing action even if the speed of the wheels nears that of the vehicle; once the permitted threshold has been reached it is necessary to increase the braking force again.
This cycle is repeated down to a speed of approximately 6 kph when the ABS system cuts itself off to allow the vehicle to come to a halt.



A. Electronic control unit
B. Brake pump outlet hose
C. Brake pump outlet hose
1. Brake pump
2. Solenoid valve for front wheel brake circuit
3. Solenoid valve for front wheel brake circuit
4. Solenoid valve for rear wheel brake circuit
5. Electric recovery pump
6. Accumulators
7. Revolution sensors and phonic wheels front wheels
8. Revolution sensors and phonic wheels for rear wheels
9. Hydraulic sequential valve
10. Piston
11. Piston
12. Stiff rod connecting pistons
13. Spring
14. Valve

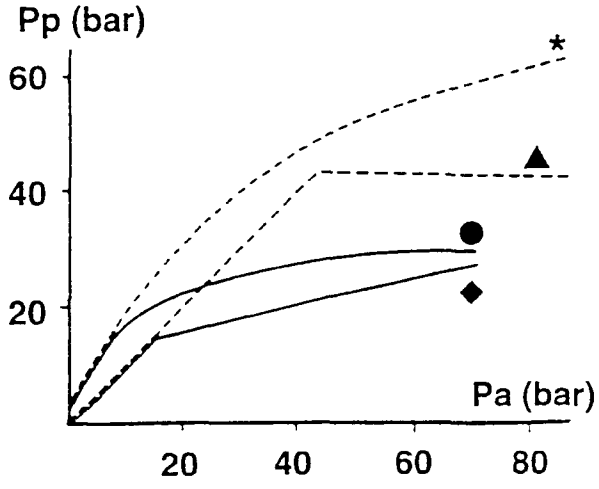
BRAKING LOAD PROPORTIONING VALVE

This is fastened on the half shells of the rear axle and differs from the conventional type in its operating system.
The load acting on the suspension arms is measured by the spring (2) which trabnsforms the variation in force applied on the device.
During braking the oil coming from the brake pump enters the proportioning valve, crosses it and moves on to the rear brakes with a pressure which, acting on the grooved plate (6) causes a thrust in the opposite direction to the one acting on the operating piston (1).
The operating piston (1) is held in the stop limit position by the combined action of the outer and inner springs (2) When the thrust acting on the grooved plate (6) exceeds that of the opposing force, the operating piston (1) moves to the left thus cutting off the connection between the brake pump and the rear calipers, causing a jump in pressure at a preset ratio of 0.30.
During operation of the ABS device, when the braking action decreases, the pressure in the rear section of the proportioning valve, acting through the grooving of the inner piston (4) overcomes the reaction of the spring (7) and moves the piston (4) to the left in order to balance the pressure inside the proportioning valve and keep the pressure jump constant at the preset ratio of 0.30.
The braking load proportioning valve which is integrated with the two branches of the braking circuit continues to operate even if the pressure on one of the two branches is lowered (breakage of a hose, connection, etc.).



1. *Operating piston*
2. *Force of the outer spring acting on the operating piston*
3. *Inner spring*
4. *Inner spring*
5. *Seal ring*
6. *Grooved plate*
7. *Spring for inner piston*

Characteristic curves of the pressure distribution between front and rear brakes actuated by the braking load proportioning valve.



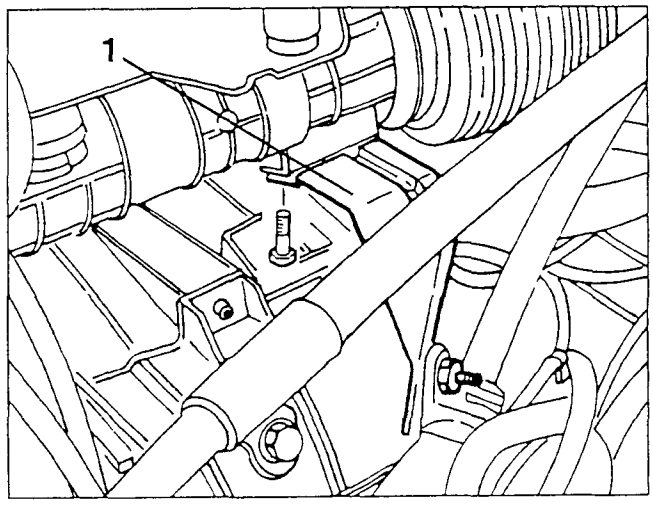
P_a Braking pressure on the front axle
P_p Braking pressure on the rear axle
* Ideal curve with fully loaded car
▲ Reale curve with fully loaded car
• Ideal curve with driver only
♦ Real curve with driver only

HYDRAULIC UNIT
Boxer engines

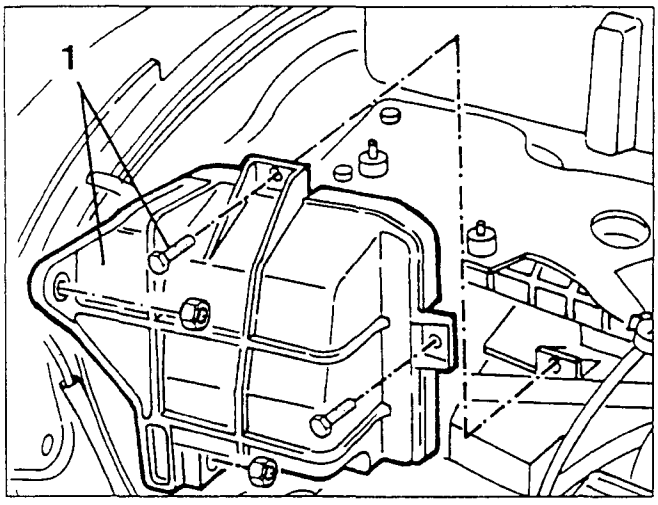
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Using a suitable syringe, empty the brake-clutch fluid reservoir.
- Remove the right front wheel.
- Remove the air cleaner complete (see GROUP 10).

1. Remove the power steering hose support bracket.

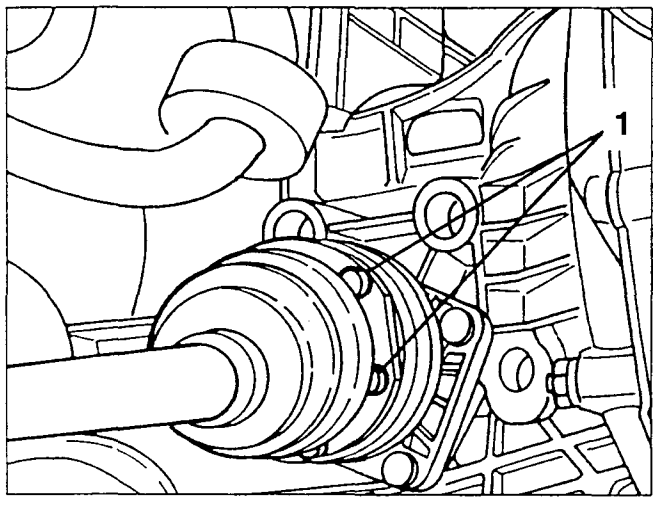


1. Slacken the fastening screws and nuts and remove the front half box of the hydraulic unit.

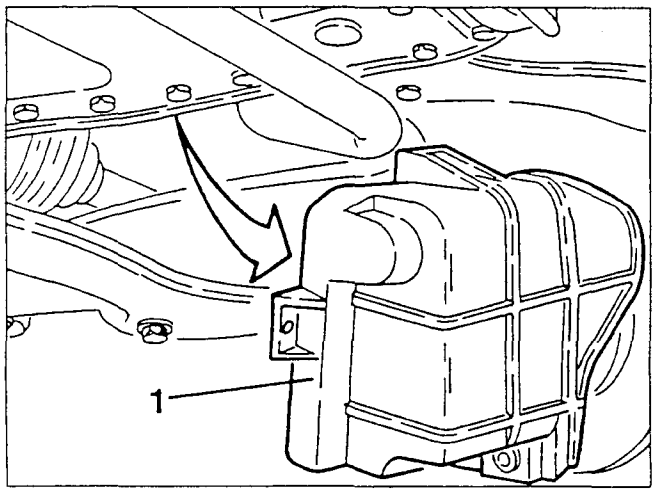


- Raise the car.

1. Slacken the fastening screws and disconnect the right axle shaft from the differential and move it to one side.

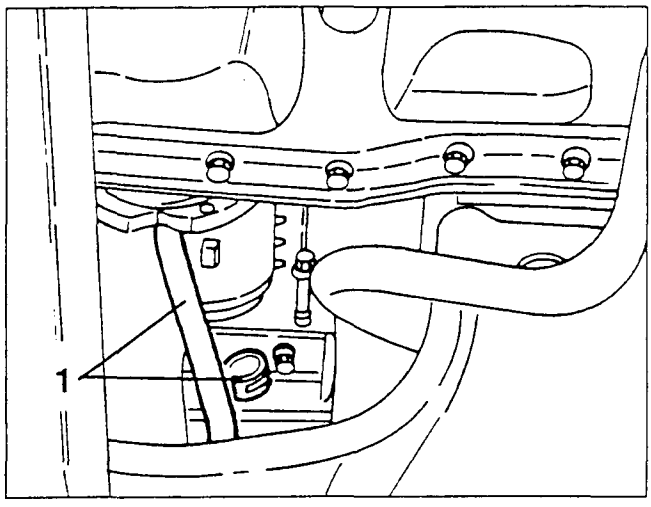


1. Slacken the remaining fastening nut and remove the rear half box from the hydraulic unit.

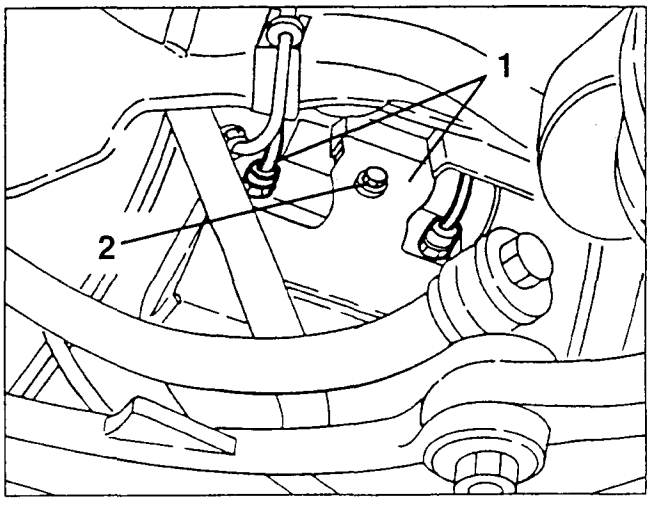


1. Free the cabling from the clamp located under the hydraulic unit.

- Slacken the fastening nut and disconnect the earth cable from the hydraulic unit.

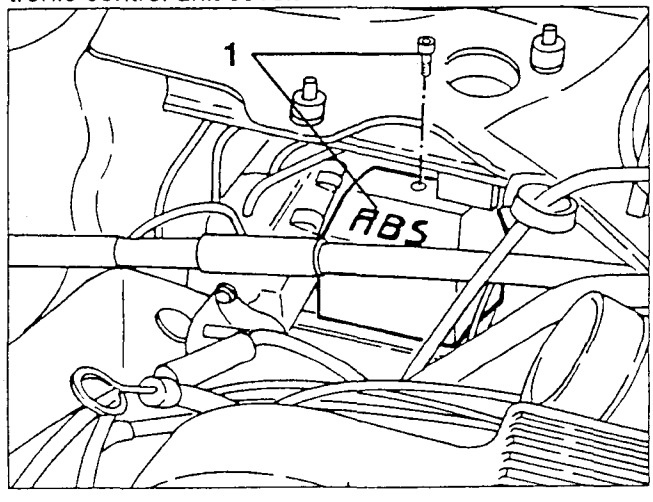


1. Disconnect the two stiff pipe connections to the brake pump from the hydraulic unit.
2. Slacken the three nuts fastening the hydraulic unit.

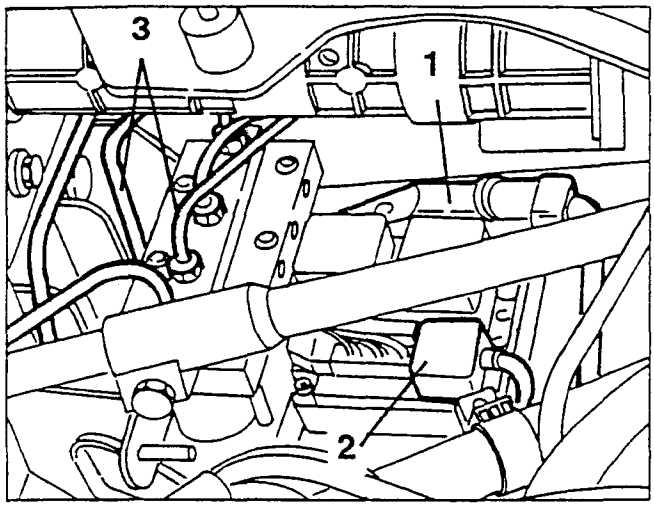


- Lower the car.

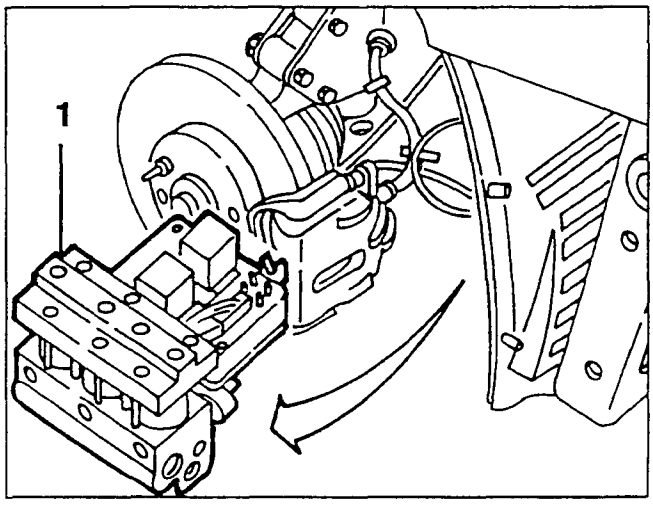
1. Slacken the fastening screw and remove the electronic control unit cover.



1. Disconnect the comb from the control unit wiring.
2. Disconnect the four-pin connector from the control unit.
3. Disconnect from the hydraulic unit the four connections of the brake hoses.



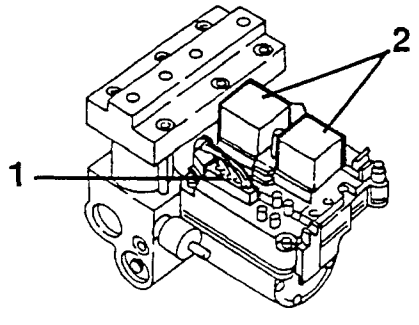
1. Remove the hydraulic unit raising it just enough to free it from its support, then withdraw it through the wheel house.



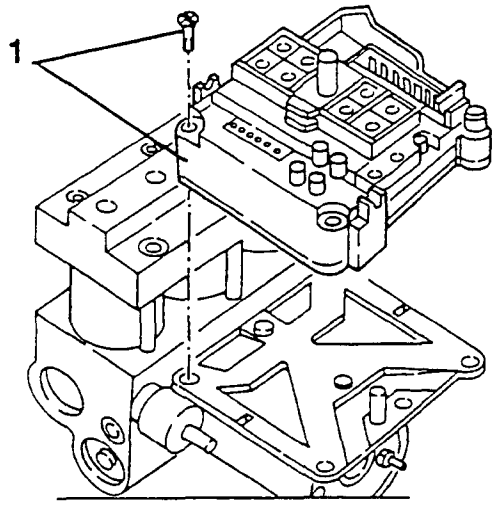
When refitting, bleed the air from the brake system (see specific paragraph).

DIS-ASSEMBLY/REASSEMBLY

1. Disconnect the electrical connection illustrated from the control unit.
2. Remove the two relays from the control unit.



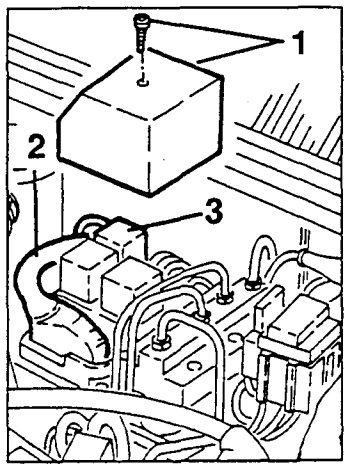
1. Slacken the fastening screws and remove the control unit.



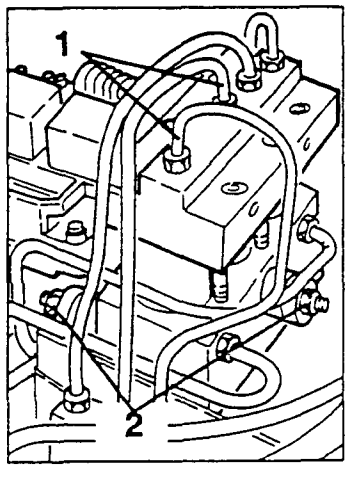
HYDRAULIC UNIT
Turbodiesel engine

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Using a suitable syringe, empty the brake-clutch fluid reservoir and then remove it.
1. Slacken the fastening screw and remove the control unit cover.
2. Disconnect the control unit connection.
3. Disconnect the four-pin electrical connection from the control unit.



1. Disconnect the connections of the unit.
2. Slacken the nuts fastening the flexible mounts of the hydraulic unit, then remove it.



When refitting, bleed the air from the brake system.

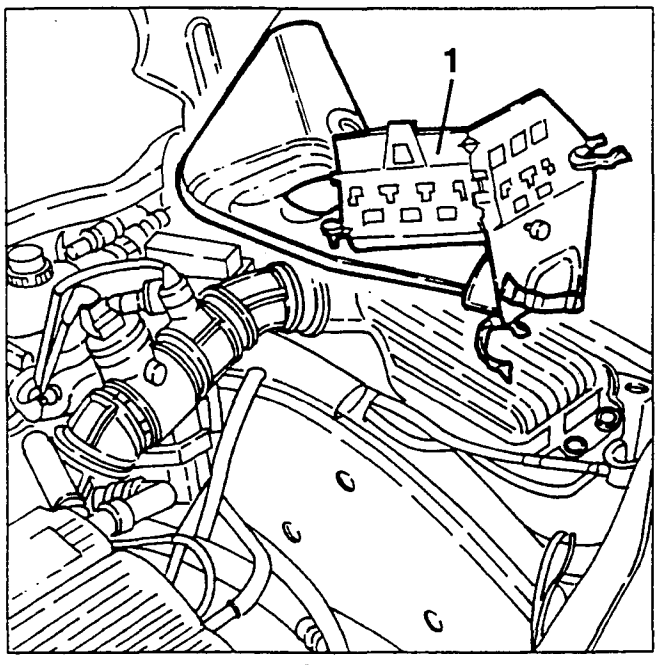
DIS-ASSEMBLY/REASSEMBLY

Proceed as described for the Boxer engines.

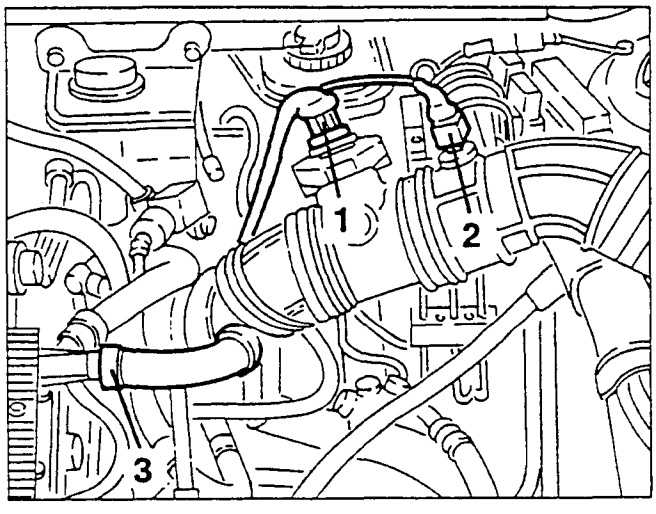
HYDRAULIC AGGREGATE
T. Spark 16V Engine

REMOVING/REFITTING

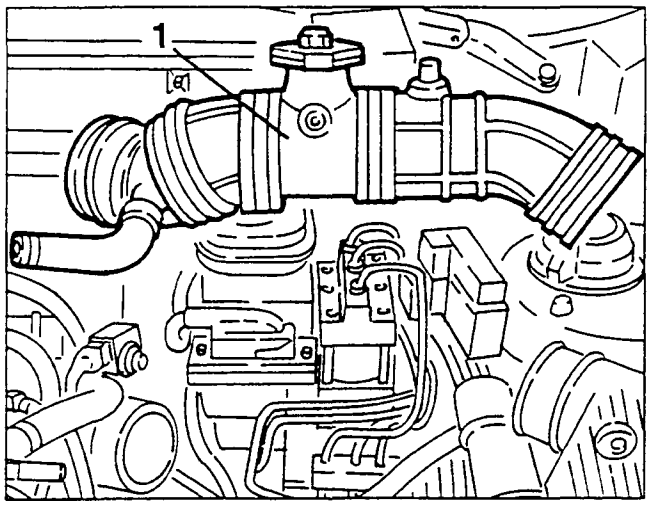
- Remove the battery.
- Remove the relays from the battery support and set them to one side with their wirings to prevent them from hindering the subsequent operations.
1. Slacken the fastening screws, then remove the battery support after removing the rear cable support from it.



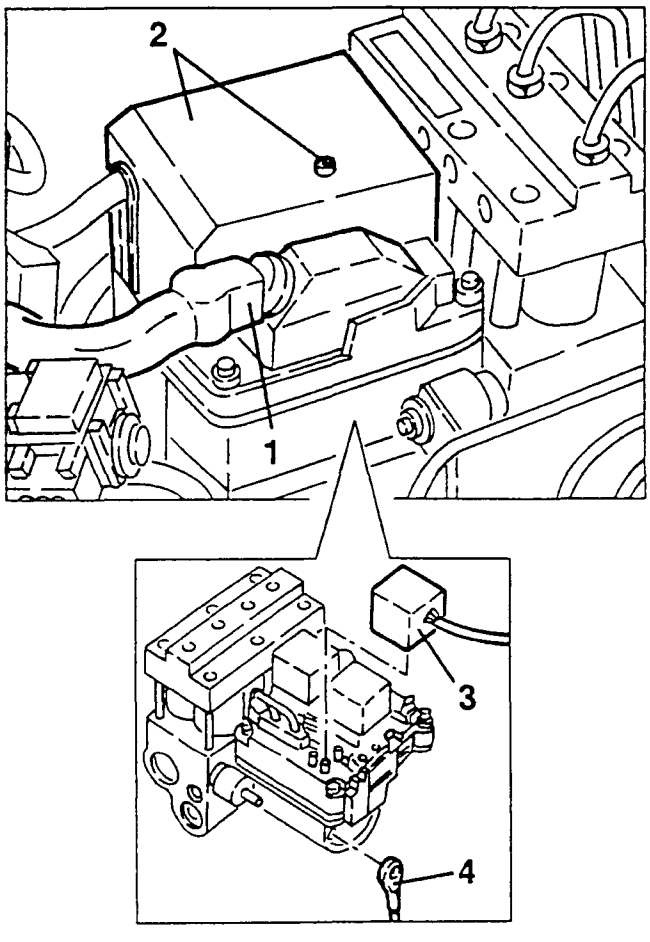
1. Disconnect the electrical connection from the air-flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor (NTC).
3. Slacken the fastening clamp and disconnect the oil vapour recirculation pipe from the cylinder head.



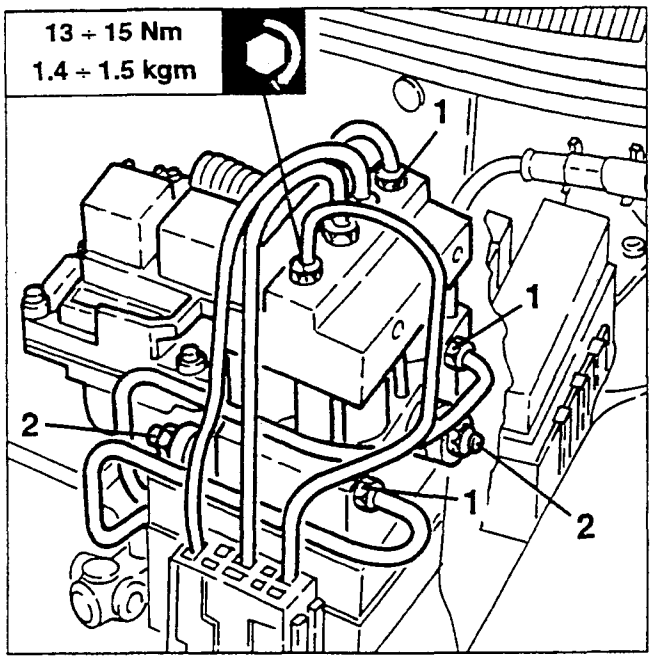
1. Slacken the fastening clamps and remove the corrugated sleeve complete.



- Move aside the fusebox at the side of the brake-clutch fluid reservoir to prevent it from hindering subsequent operations.
- Remove the brake-clutch fluid reservoir (see specific paragraph).
1. Disconnect the electrical connection of the A.B.S. control unit.
2. Slacken the fastening screw and remove the control unit cover.
3. Disconnect the four pin electrical connection from the control unit.
4. Disconnect the earth cable.



1. Disconnect the fittings of the pipes of the hydraulic aggregate.
2. Slacken the three nuts fastening the flexible supports of the hydraulic aggregate, then remove it.



When refitting relieve the air from the braking system (see specific paragraph).

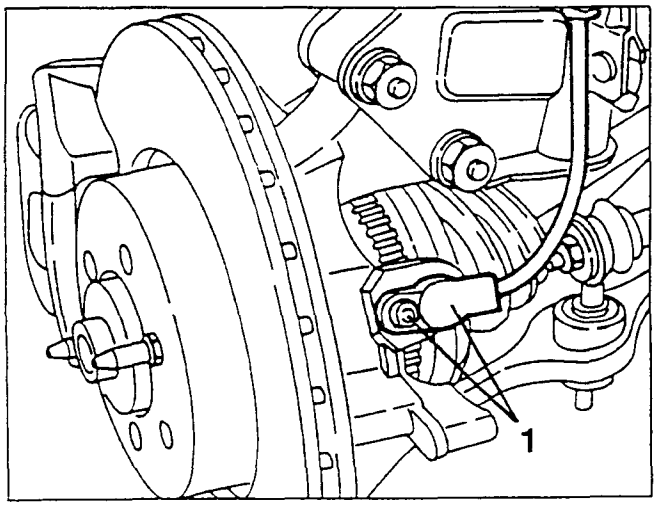
DISASSEMBLY/RE-ASSEMBLY

Proceed as described for Boxer engines.

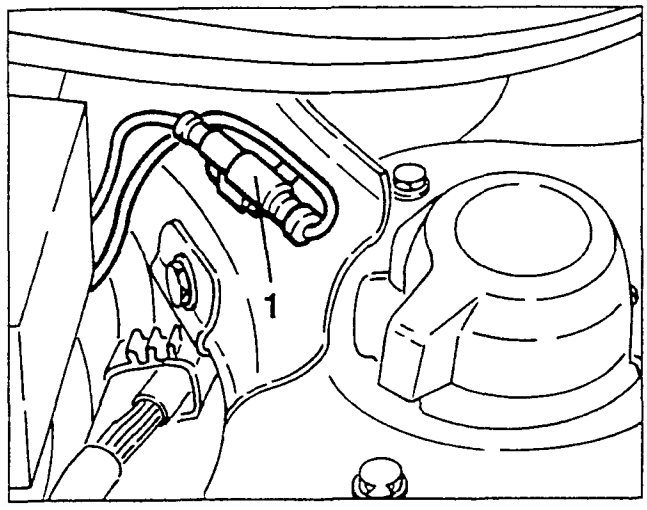
FRONT INDUCTIVE SENSORS

REMOVING/REFITTING

1. Slacken the screw fastening the A.B.S. inductive sensor from the wheel upright.



1. Disconnect the electrical connection near the shock absorber dome and remove the inductive sensor together with the wiring, after releasing it from the fasteners.

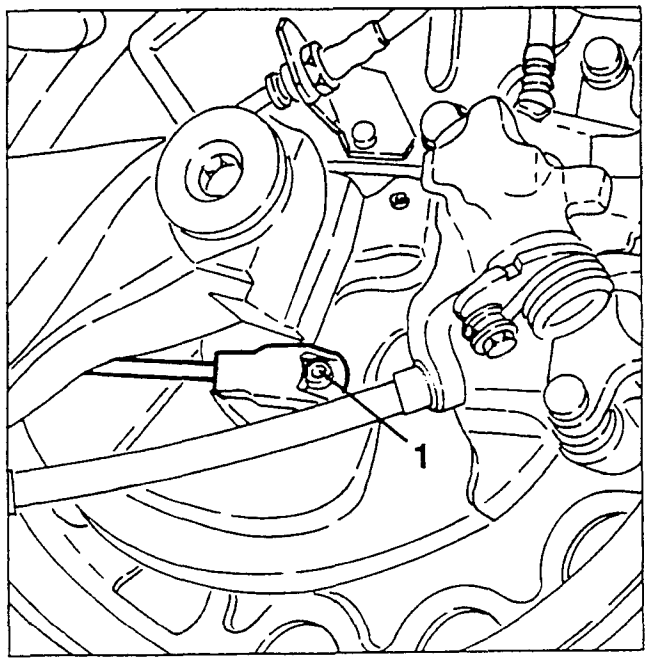


When refitting grease the seat of the inductive sensor with the specified grease.

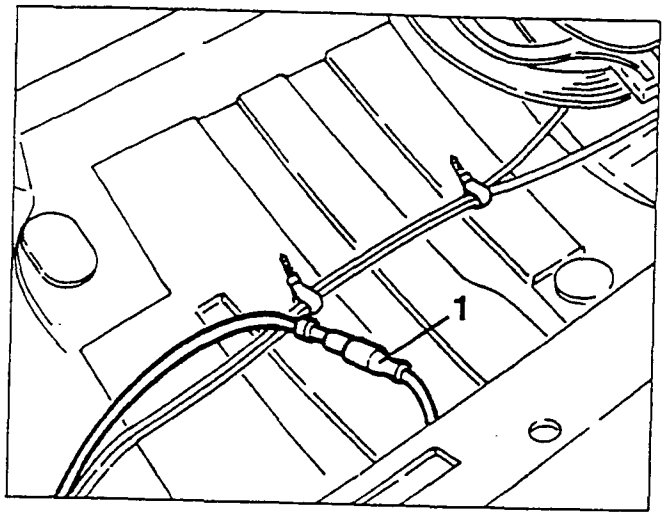
REAR INDUCTIVE SENSORS

REMOVING/REFITTING

1. Slacken the screw fastening the inductive sensor to the brake disk connection.



1. Tilt forward the rear seat cushion, disconnect the electrical connection of the inductive sensor and remove it.



When refitting grease the seat of the inductive sensor with the specified grease.

CHECKING THE GAP

- Using a thickness gauge, check the gap between the inductive sensor and the corresponding phonic wheel.

Front inductive sensors gap	0.3 ÷ 1.05 mm
Rear inductivei sensors gap	0.2 ÷ 1.15 mm

CAUTION:
The gap is not adjustable as shims for this purpose are not supplied.
Check that the sensor and the teeth of the phonic wheel are intactore if the gap is not within the specified tolerance.

BOSCH 5.3 ABS

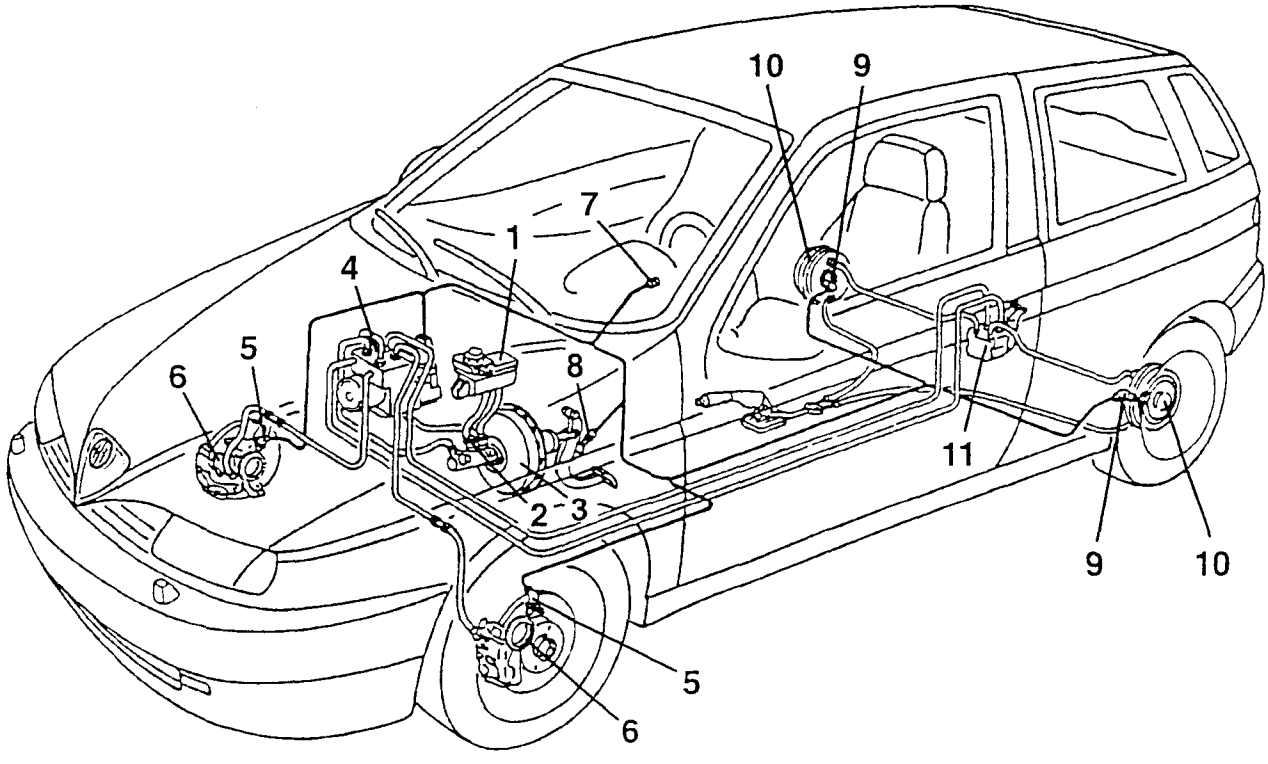
(from chassis no. .....)

DESCRIPTION

The Bosch 5.3 A.B.S. further optimises compactness (ease of assembly), lightness and reliability.
The use of new microhybrid electronic components, optimisation of the flows as a result of the study of the new, more compact shapes of the valve bodies and the reduction of the number of hydraulic components since they are pressed directly onto the valve seat of the nozzles which are previously assembled separately have made it possible to improve the characteristics of the solenoid valves.
The main components of the system are:
- new electronic control unit, more powerful and versatile than the previous ones;
- electrohydraulic control unit (4) which modulates the braking pressure at the brake calipers through eight solenoid valves, two for each wheel;
- four sensors (5) and (9), one for each wheel, which detect the angular rotation speed of the wheels.

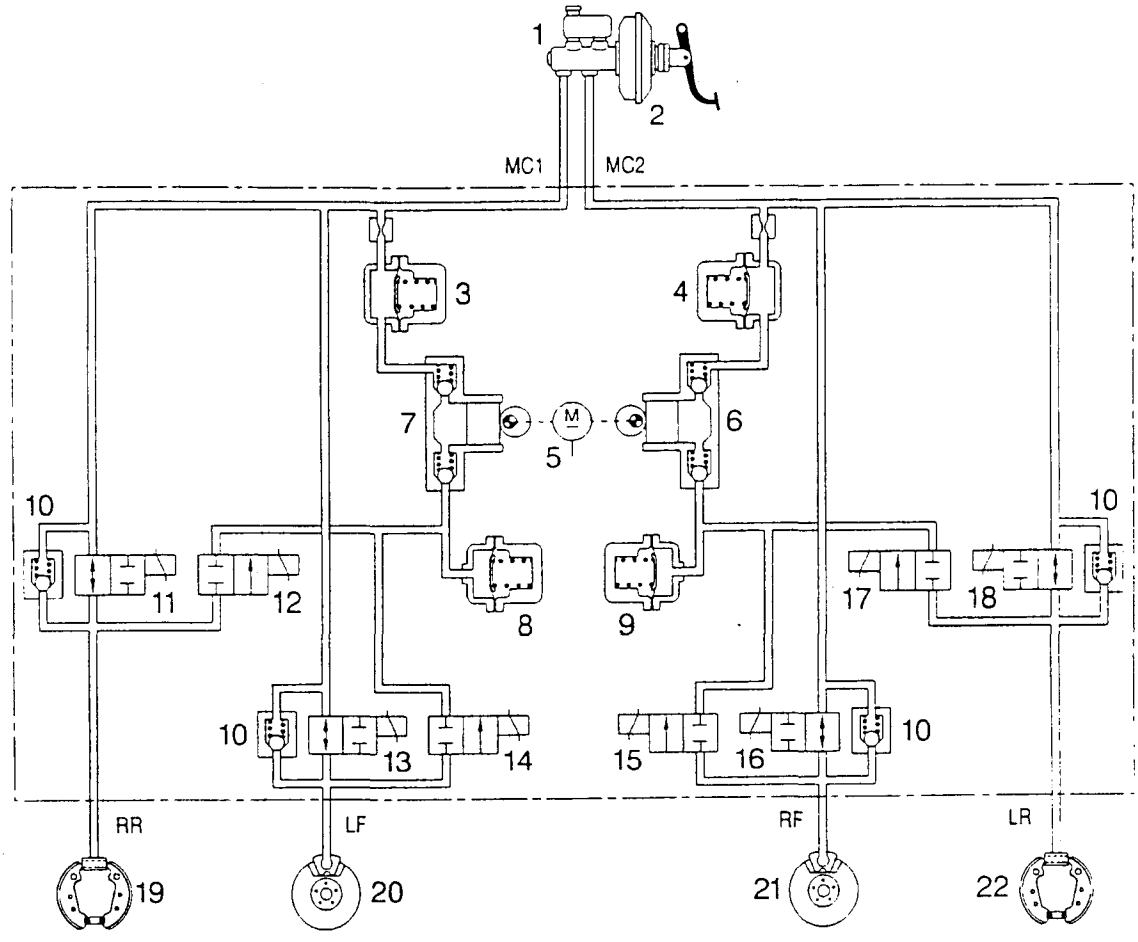
The system is completed by:
- the hydraulic system piping;
- a specific wiring loom;
- a switch on the brake pedal (8) for detecting the braking condition;
- a warning light (7), on the check panel.

In addition, under particular diagnosis conditions, the warning light (7), supplies information about the faults memorised by the control unit through a series of coded flashes (see Electric System Diagnosis").



1. *Brake fluid reservoir*
2. *Brake pump*
3. *Vacuum servobrake*
4. *Electrohydraulic control unit with electronic control unit incorporated*
5. *Front wheel rpm sensor*
6. *Front brakes*
7. *Failure warning light*
8. *Stop lights control switch*
9. *Rear wheel rpm sensor*
10. *Rear brakes*
11. *Braking load proportioning valve*

Hydraulic system layout



Braking system with double crossed circuit

1. *Brake control pump*
2. *Servobrake*
3. *High pressure accumulator (damping chamber)*
4. *High pressure accumulator (damping chamber)*
5. *Recovery pump drive motor*
6. *Recovery pump*
7. *Recovery pump*
8. *Low pressure accumulator (reservoir)*
9. *Low pressure accumulator (reservoir)*
10. *Fast pressure reduction valve*
11. *Right rear charge solenoid valve*
12. *Right rear discharge solenoid valve*
13. *Left front charge solenoid valve*
14. *Left front discharge solenoid valve*
15. *Right front charge solenoid valve*
16. *Right front discharge solenoid valve*
17. *Left rear charge solenoid valve*
18. *Left rear discharge solenoid valve*
19. *Right rear drum brake*
20. *Left front disk brake*
21. *Right front disk brake*
22. *Left rear drum brake*

MC1. Supply union for brake pump 1st stage
MC2. Supply union for brake pump 2nd stage
RR. Delivery union to right rear cylinder
FL. Delivery union to left front caliper
FR. Delivery union to right front caliper
RL. Delivery union to left rear cylinder

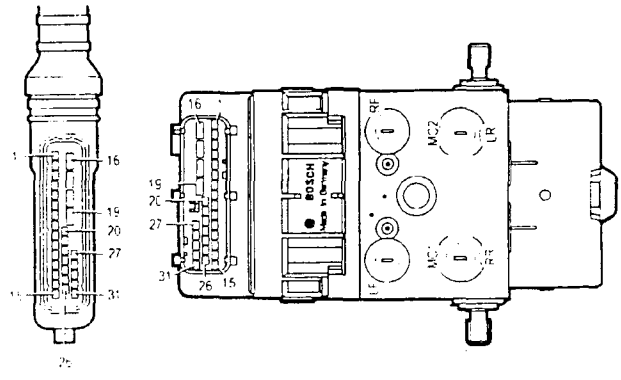
COMPONENTS

Electrohydraulic control unit

The electrohydraulic control unit comprises two sections fastened to one another: an electronic control unit and an electrohydraulic control unit.
On the basis of the signals received from the sensors and with the help of characteristic programmes mapped in its memories, the electronic control unit commands the electrohydraulic control unit.
The electrohydraulic control unit is connected to the brake pump and to the A.B.S. system components through the pipes of the braking system.
The main change with respect to the previous versions is the replacement of the three-way valves with two 2-way solenoid valves for each wheel.

Electronic control unit

The electronic control unit is formed of hybrid circuits with resistances, diodes, transistors and integrated logic circuits. The heart of the system are two CMOS microprocessors with 12K ROM which autonomously carry out the same programme and monitor one another mutually. Both receive the same input signals which each processes individually and only when the results obtained are identical, thedoes the control unit send the operative command to the electrohydraulic control unit.
Conversely, if for example there is a fault in the wheel anti-lock system, the device cuts itself out and braking takes place conventionally: simultaneously, the fault warning light on the check panel comes on.



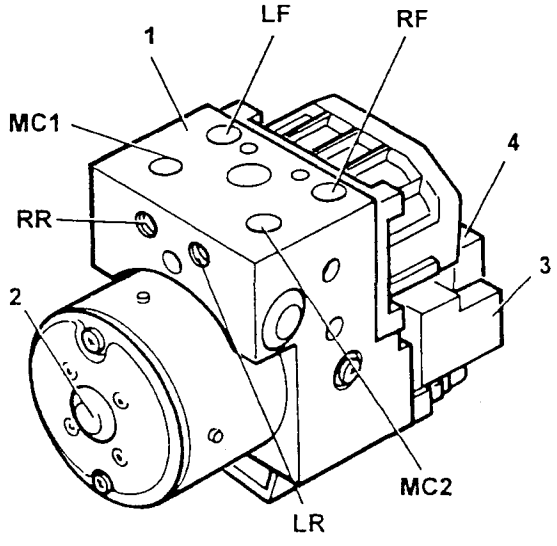
Operating logic

The signals (alternate or analogue) sent by the rpm sensors to the electronic control unit are transformed by the input amplifier into square wave signals.
The frequency of these signals gives the control unit the corresponding values of speed, acceleration or deceleration of the single wheels.
From the combination of the single wheel peripheral speeds, a reference speed is processed which is continuously updated and indicates the speed of the car at all times.
When the driver presses the brake pedal the wheels can each decelerate to a different extent: comparison of the peripheral speed of each wheel with the reference speed keeps the skidding of each wheel constantly under control.
If the braking force causes a wheel to skid with respect to the others, the electronic control unit sends the command to the solenoid valves of the electrohydraulic control unit to reduce the braking force on the wheel that has lost grip. This way the wheel concerned regains speed.
The memory of the electronic control unit also contains threshold acceleration and deceleration values that none of the wheels may ever exceed.
Therefore, through systematic, very rapid comparison of the wheel skidding, deceleration and acceleration values, rolling of the tyre during braking is kept under control.
As soon as the foreseen combined acceleration/deceleration and skid values are exceeded, the electronic control unit intervenes with commands to the solenoid valves of the electrohydraulic control unit, in the three adjustment phases to lower, maintain or return the pressure generated by the driver on the brake pedal to the brake calipers, bringing the braking condition to the optimum values set by the system.
These phases determine an intermittent but extremely fast adjustment cycle which is repeated until the car stops. The electronic control unit commands the different phases supplying the solenoid valves pulses with different current intensities. It also makes sure that both rear wheels are given the same braking force applicable to the rear wheel that is more subjected to locking, i.e. the one with lower grip (to ensure stability).
If a fault is detected, the wheel anti-lock device cuts out and alerts the driver by turning on the warning light on the check panel, while however ensuring operation of the conventional braking system.

The electronic control unit is informed that the driver is braking by the signal from the switch on the brake pedal. Besides controlling braking, this information is also helpful under certain particular conditions, such as for example if a sharp acceleration that makes the wheels skid is followed by heavy braking, or in the case of irregular road surfaces (humps, steps) that can involve changes in speed of the wheel due to causes not linked with the braking in progress.
In these conditions the microprocessors process a strategy connected with the changes of speed of the wheels of these particular moments, bringing braking back to the correct parameters. Since these are particular conditions of braking control, the lack of connection of the switch on the brake pedal to the control unit does not compromise the efficiency of the system. For this reason it is not signalled by the warning light, nor is the A.B.S. system disabled.

Further details about the operating principle of the ABS are given below.

Electrohydraulic control unit



1. Electrohydraulic control unit
2. Electric recovery pump
3. Electronic control unit
4. Control unit connector

The electrohydraulic control unit is connected to the brake pump and to the brake caliper cylinders through the brake system lines and together with the electronic control unit it forms the electrohydraulic control unit.
Its task is to change the pressure of the brake fluid in the brake caliper cylinders according to the command signals leading from the electronic control unit.
It comprises eight two-way solenoid valves (two for each hydraulic circuit) and an electric recovery pump (2) with double circuit.
The eight solenoid valves and the electric recovery pump are driven by the electronic control unit depending on the signals of the four rpm sensors. The pump makes it possible to recover the brake fluid during the pressure reduction phase making it available again upstream of the solenoid valves for the next pressure increase phase.
The unit is connected to the braking system through unions identified by the codes stamped on them as illustrated.

Pipe outlets

MC1	Supply union from brake pump - circuit 1
MC2	Supply union from brake pump - circuit 2
LF	Delivery union to left front brake caliper
LR	Delivery union to left rear brake caliper
RF	Delivery union to right front brake caliper
RR	Delivery union to right rear brake caliper

Inductive sensors

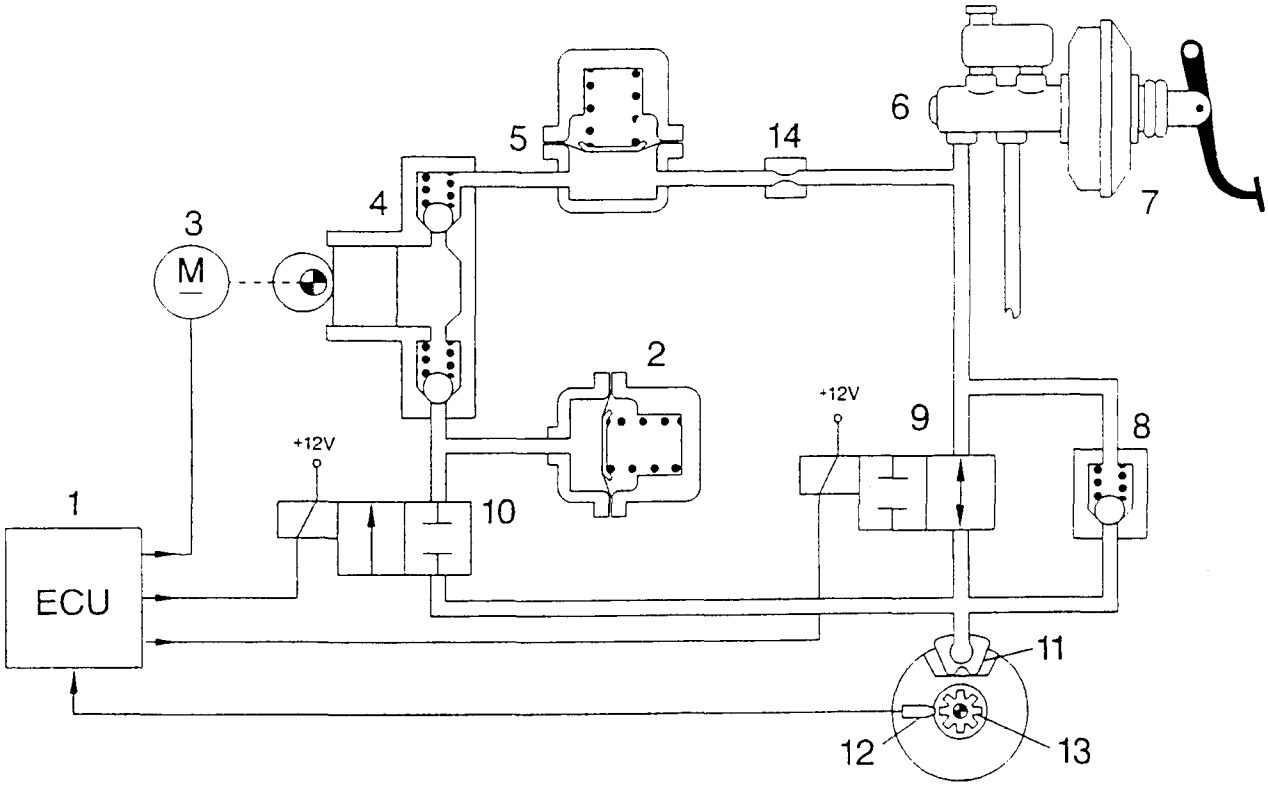
These are quite the same as those used for the previous versions.

DESCRIPTION OF HOW THE WHEEL ANTI-LOCK SYSTEM WORKS

Rest position

Each branch of the Bosch 5.3 ABS system is fitted with two 2-way solenoid valves; all the solenoid valves are managed by the control unit (1).

When the charge solenoid valve (9) is deactivated (not connected to earth by the control unit) it is in the opening position, thereby allowing the flow of brake fluid to the brake caliper.
The pressure is maintained by closing this valve, i.e. supplying it electrically.

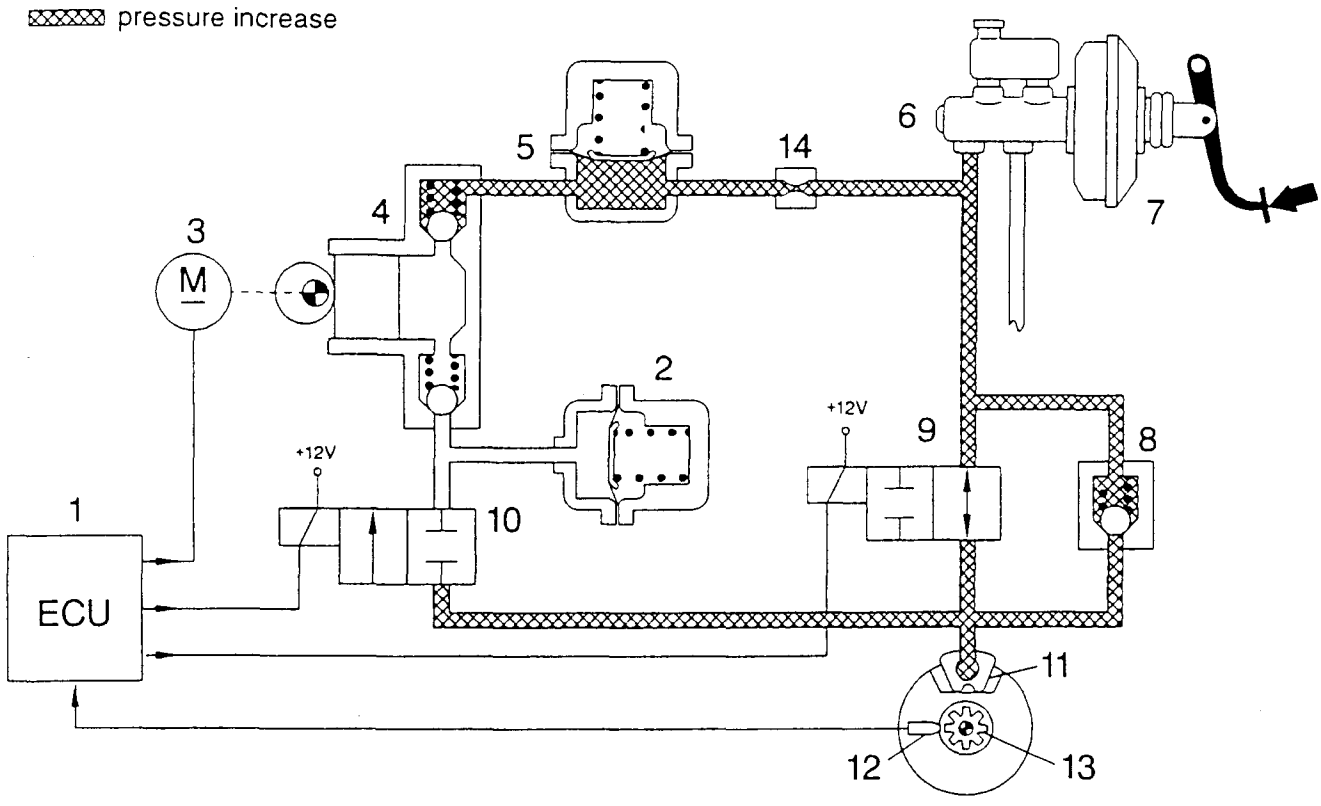


1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Revolution sensor
13. Phonic wheel
14. Restrictor

When the discharge solenoid valve (10) is deactivated (not connected to earth by the control unit) it is in the closed position and does not allow the fluid to be discharged on the low pressure accumulator (2).
The accumulators (2) and (5) have the task of temporarily storing the brake fluid made available during the pressure reduction phase.

The recovery pump (4) sends the brake fluid that flows back from the brake calipers during pressure reduction to the brake pump via the corresponding accumulator.
On the basis of the signals received from the rpm sensors on the front and rear wheels, the electronic control unit drives the electrohydraulic control unit, which in turn changes the pressure of the brake fluid sent to the calipers according to three phases: increase, maintenance or reduction of the pressure.

Pressure increase phase

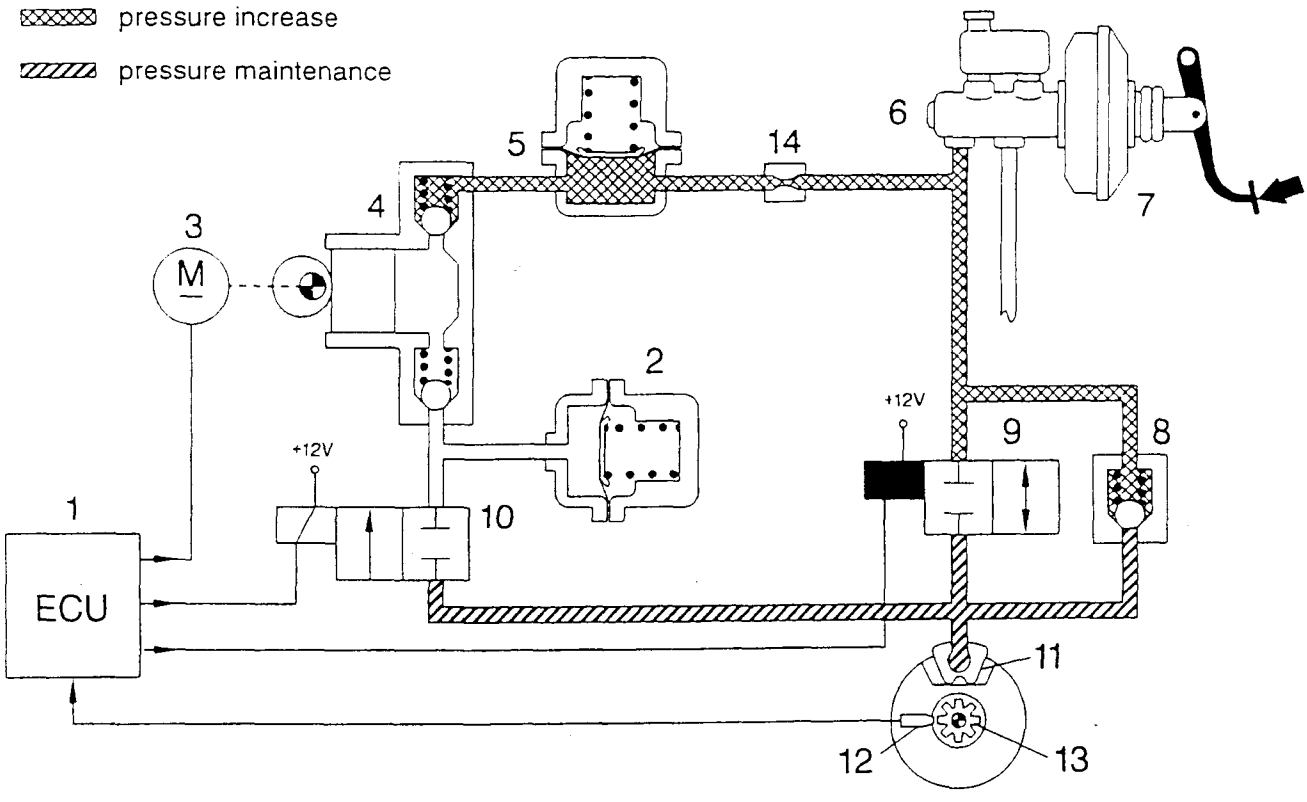


1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Revolution sensor.
13. Phonic wheel
14. Restrictor

When the driver presses the brake pedal, the pressure generated by the brake pump (6) reaches the brake caliper without undergoing changes, as the solenoid valves (9) and (10) of the hydraulic unit are not connected to earth by the electronic control unit.
When the braking force increases, deceleration of the wheel increases accordingly; this causes faster deceleration of the car (i.e. wheel slip increases).
The slip rate must not exceed a determinate value beyond which the wheel loses its grip on the ground and starts to slide, losing direction and lengthening braking distances.

The revolution sensor (12) signals that deceleration values have been reached that would compromise the grip of the wheel with the ground: at this point the electronic control unit (1) commands the solenoid valves of the electrohydraulic unit, reducing the braking force and allowing the wheel to increase speed and recover grip.

Pressure maintenance phase

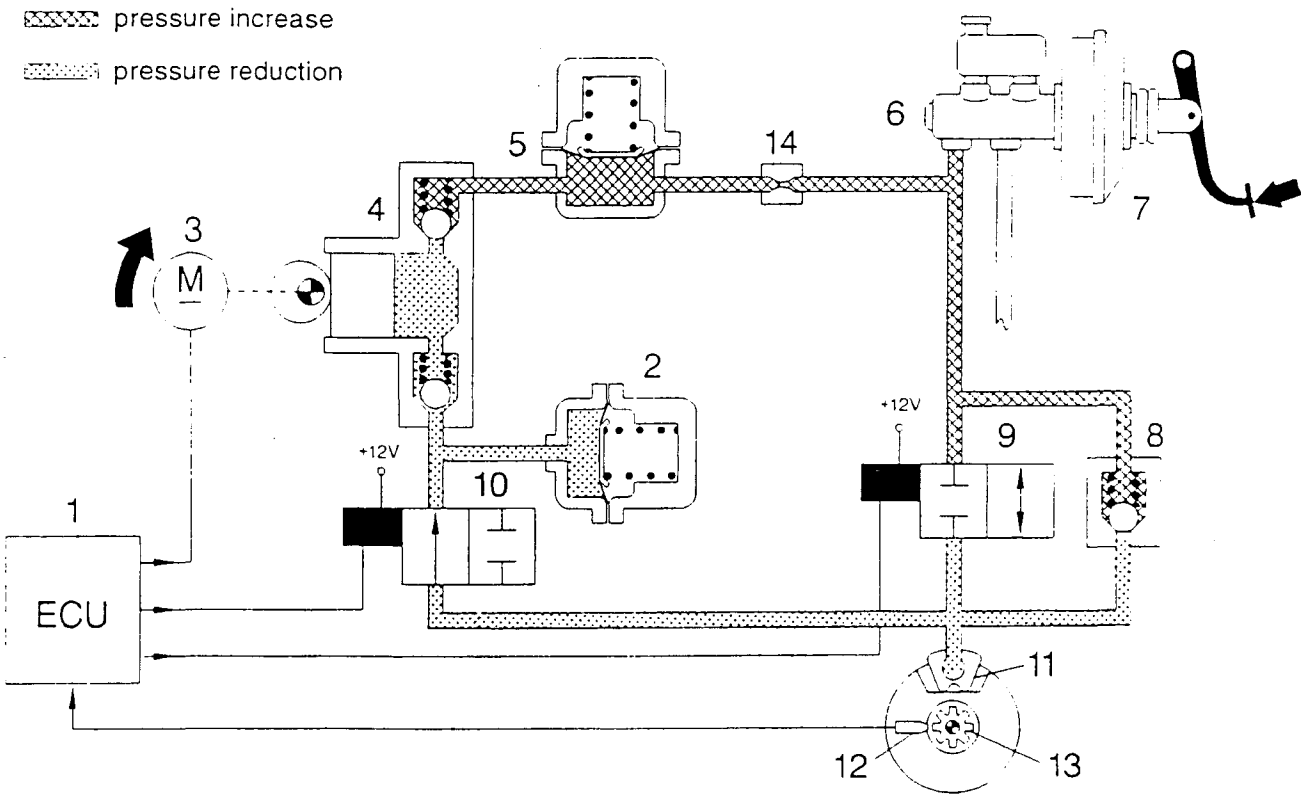


1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Revolution sensor
13. Phonic wheel
14. Restrictor

During this phase, the electronic control unit (1) connects the charge solenoid valve (9) to earth, so it closes, while the discharge solenoid valve (10) that is not connected to earth, is already closed.
The hydraulic connection between the brake pump (6) and the brake caliper (11) is cut off (standby position).
The pressure in the brake caliper (11) is kept constant at the rating reached previously, regardless of the pressure on the brake pedal.

Although the braking effort maintains a continuous slowing action, the wheel changes its speed, in relation to the grip on the ground, until the signal of the rpm sensor (12) gives a value similar to the reference speed calculated by the electronic control unit (1).
At this point, the control unit passes from the maintenance phase to the pressure increase phase (if the wheel accelerates) or reduction (if the wheel tends to lock).

Pressure reduction phase



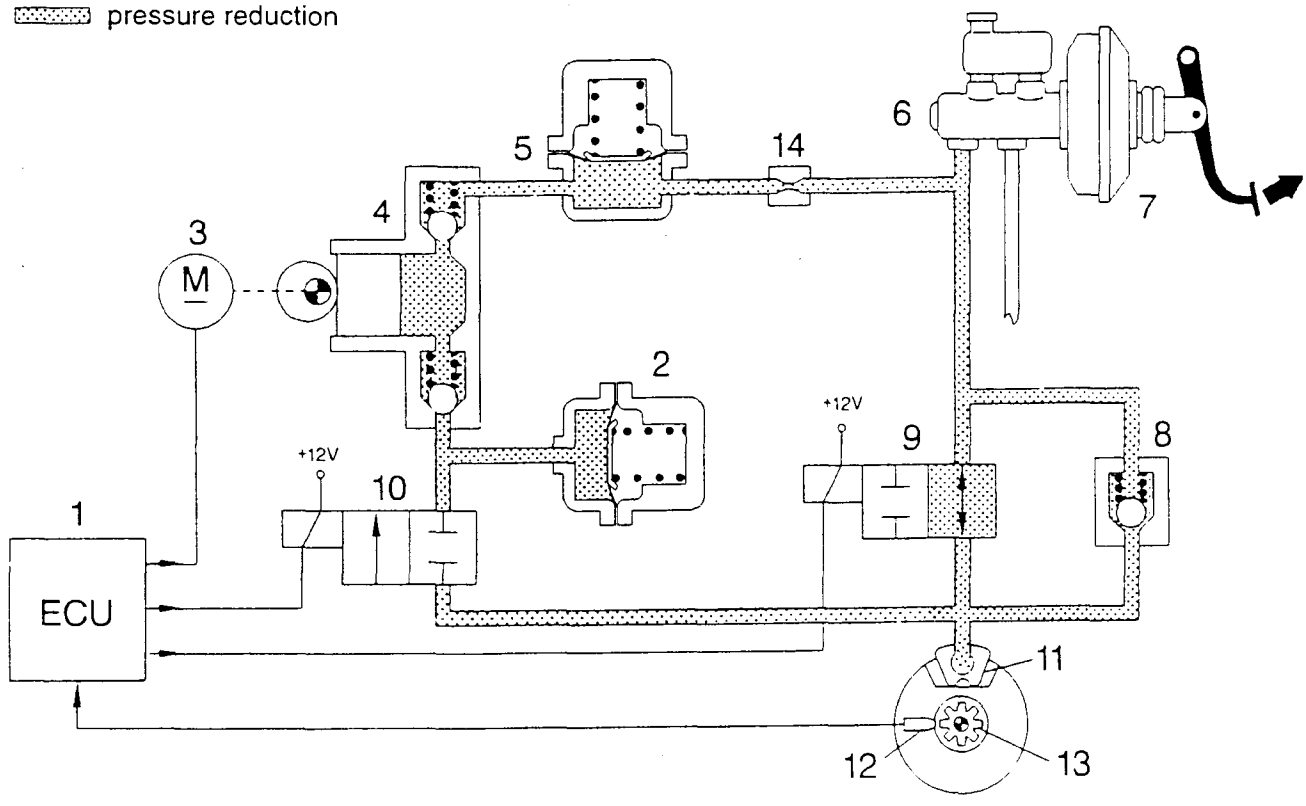
1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Rpm sensor
13. Phonic wheel
14. Restrictor

The electronic control unit (1) detects the tendency of the wheel to lock and activates the electrohydraulic unit to keep deceleration of the wheel within the thresholds allowed.
The electronic control unit (1) connects to earth the charge (9) and discharge (10) solenoid valves.
The charge solenoid valve (9) remains closed keeping the connection between the brake pump (6) and brake caliper (11) shut; The discharge solenoid valve (10) opens putting the brake caliper (11) into hydraulic connection with the low pressure accumulator (2) and the recovery pump (4), in order to withdraw part of the fluid at the brake caliper (11) and reduce the pressure on the caliper itself.
Simultaneously, the electronic control unit (1) supplies the drive motor (3) of the recovery pump (4) which makes it possible to re-admit the fluid taken from the brake caliper (11) to the main circuit. The accumulator (2) or low pressure reservoir in the circuit has the task of storing part of the brake fluid taken from the calipers. Through the circuit of the recovery pump (4), the fluid is withdrawn and sent, via the damping chamber (5) and the restrictor (14), into the main circuit of the brake pump (6). In this phase a series of pressure waves (or hydraulic thrusts) are generated which are dampened by the presence of the damping chamber (5) and the restrictor (14).
During braking, light pushes on the brake pedal are to be considered normal when the ABS system is operational. During this phase, due to the effect of the lowering of the braking force, the wheel tends to resume the reference speed calculated by the electronic control unit (1).
The type of braking is intermittent or by steps with a succession of the phases depending on the wheel rolling conditions and according to a repetitive cycle that is not perceived by the driver, in the form of jerks, owing to the quickness and frequency with which it occurs and because it is evened out by the inertia of the wheel which is prevented from reaching extreme skidding conditions because of the rapidity of the device.

With the car without A.B.S. the driver is able to act intermittently on the brake pedal with a frequency of 2 cycles per second (2 presses and 2 releases).
With the A.B.S. system, the cycles increase to 4, 10 per second (depending on grip).
Normally operation of the A.B.S. ceases at speeds below 2.75 km/h to allow the wheels lock completely when the car reaches a halt.

NOTA: The recovery pump is of the free piston type with double circuit, driven by an electric motor that turns constantly during the recovery phase.
The pistons are not coupled with the electric motor but they are moved by the cam, only upon arrival of the brake fluid.
Therefore, the pump can perform only one impelling stroke while suction is not possible owing to the lack of mechanical connection between motor and pump.

Brake pedal release



1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Revolution sensor
13. Phonic wheel
14. Restrictor

To enable rapid reduction of the pressure on the brake caliper (11) when the brake pedal is released, the system is fitted with a non return valve (8) in parallel with the inlet solenoid valve (9).

INSTRUCTIONS FOR REMOVING/REFITTING

The electrohydraulic control unit cannot be overhauled and it is fault-proof until it is tampered with. It must be replaced if found to be faulty.

After each replacement of a hydraulic unit, revolution sensor, electronic control unit or wiring (especially if after an accident) the entire A.B.S. system must be checked with the Tester.

After all operations on the hydraulic system of the A.B.S. or brake system, it is necessary to fill with DOT 4 brake fluid, relieve the air, and check the tightness of all the connection points.

The electrohydraulic control unit is supplied filled with DOT 4 brake fluid and with the solenoid valves not supplied. The operation for filling with fluid and relieving the air is the same as for a conventional system, but requires more time.

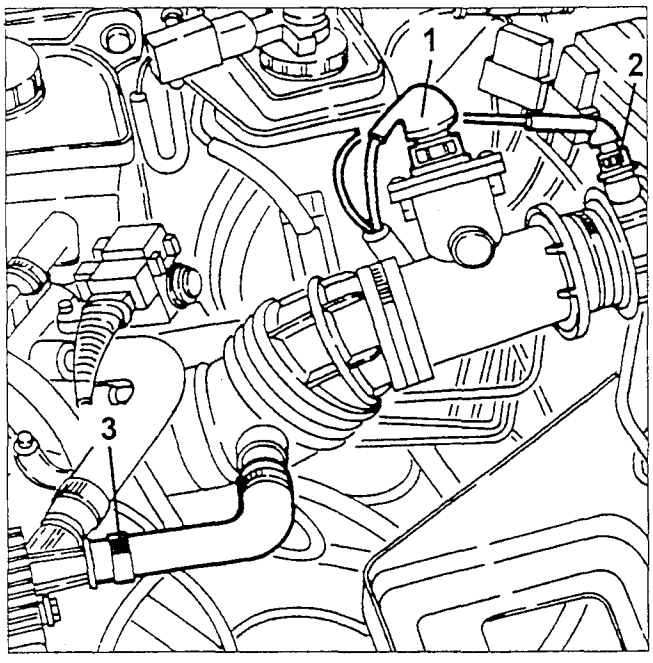
During removal of the electrohydraulic unit avoid overturning it to prevent spilling the oil contained in the hydraulic part.

When refitting pay attention to the unions: to prevent mistakes in connecting the various parts of the braking circuit during repair operations, the connections of the hydraulic modulator unit are of different sizes (M10x1 and M12x1), the unions are also identified by the codes stamped on them.

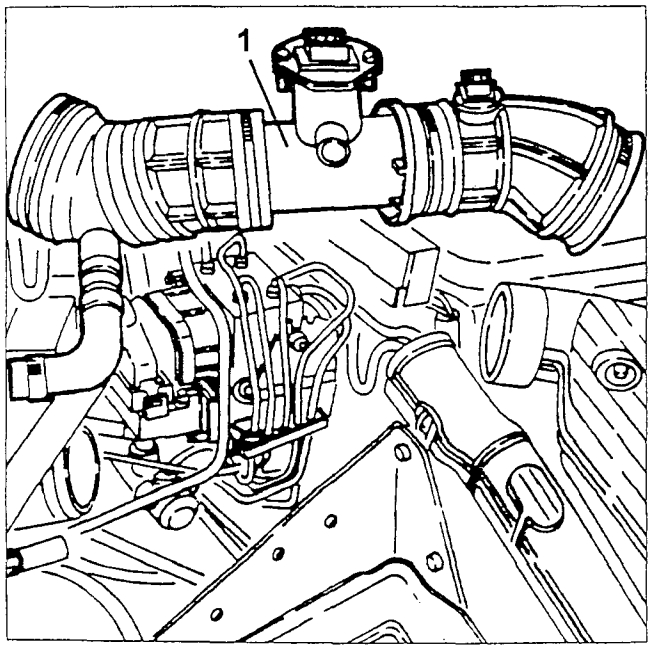
HYDRAULIC UNIT
T. Spark 16V Engines

DISCONNECTION/RE-CONNECTION

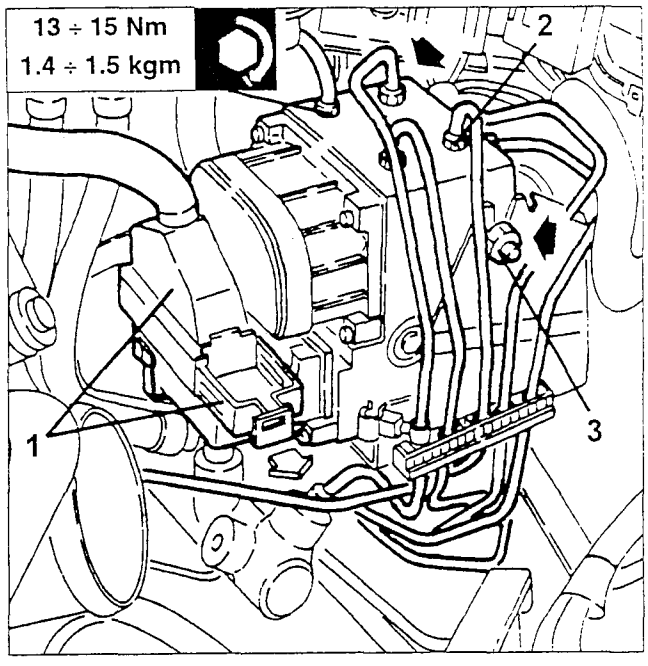
- Disconnect the battery terminals and remove it.
1. Disconnect the electrical connection from the air inflow tester.
2. Disconnect the electrical connection from the temperature sensor of sucked air.
3. Loosen the hose clamp and disconnect the pipe for oil vapours recirculation from the cover of the cylinder head.



1. Loosen the two hose clamps, hence remove the complete corrugated manifold.



- Let the brakes-clutch fluid drain out completely (see specific paragraph).
1. Pull forwards the blocking device of the gearcase comb, hence extract it from its seat.
2. Disconnect the pipe joints from the hydraulic unit.
3. Unscrew the two clamping nuts and remove the hydraulic unit.



ATTENTION: The hydraulic unit is not repairable. In case of defects or failure, it must be replaced.

While reconnecting, perform the air exhaustion operation from the braking system.(see specific paragraph).

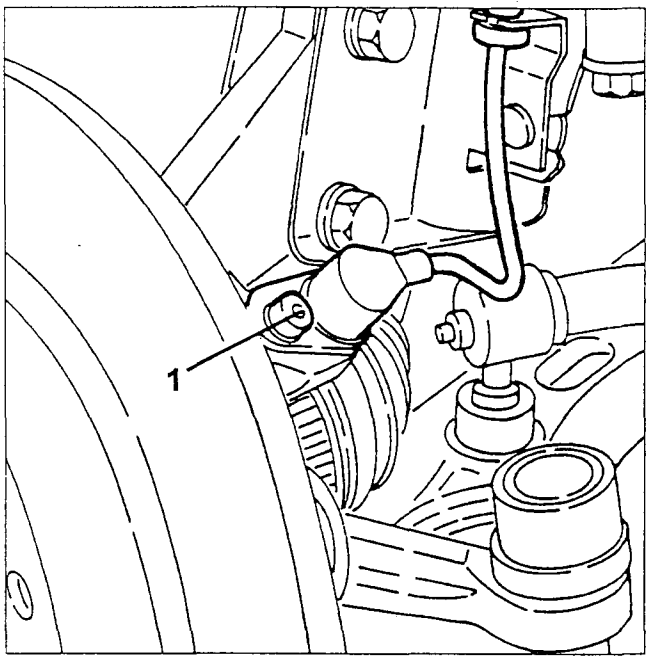
HYDRAULIC UNIT
Turbodiesel Engine

Refer to the corresponding procedure regarding the T. SPARK 16V motorization, considering that the accessibility of the hydraulic unit is differnt.

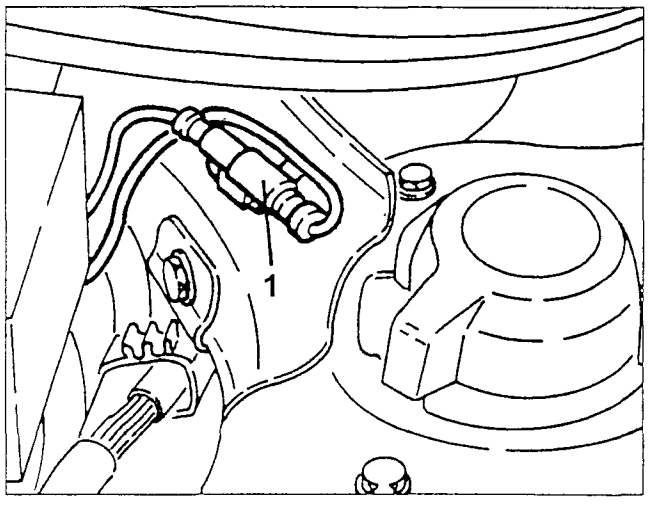
FRONT INDUCTIVE SENSORS

DISJOINING/ RE-JOINING

1. Unscrew the clamping screw of the ABS inductive sensor to the wheel post.



1. Disconnect the electrical connection located in proximity of the shock absorber dome and remove the sensor and the wiring after loosening the clamps.

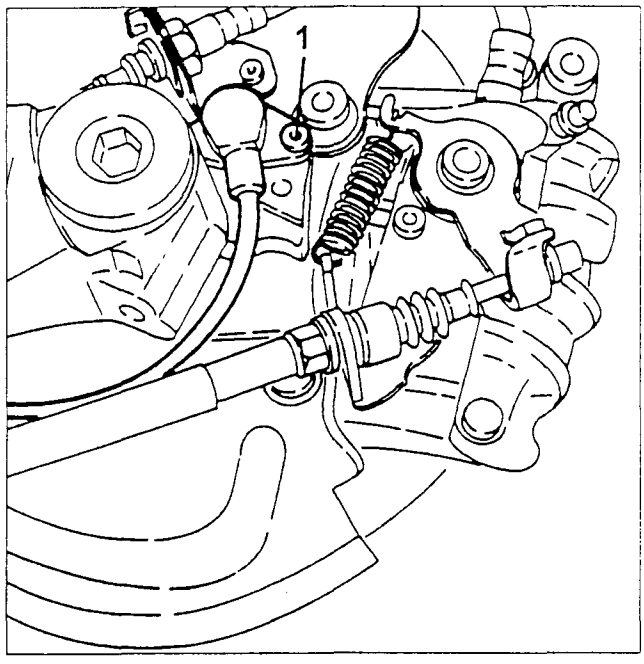


When re-joining, grease the sensor seat with the prescribed grease.

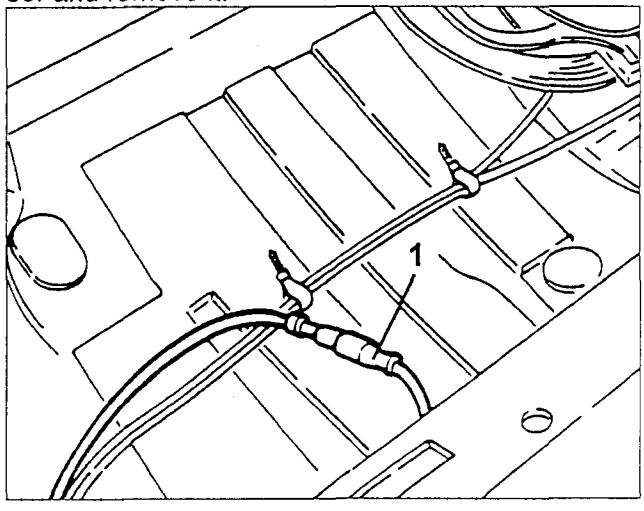
REAR INDUCTIVE SENSORS

DISJOINING/RE-JOINING

1. Unscrew the clamping screw of the inductive sensor to the wheel hub.



1. Turn the cushion of the back seat over, disconnect the electrical connection of the inductive sensor and remove it.



When re-joining, grease the sensor seat with the prescribed grease.

ENTREFER CHECKING

- Using a thickness gauge, estimate the entrefer value between the inductive sensor and the corresponding phonic wheel.

Front inductive entrefer sensors	0.3 ÷ 1.05 mm
Rear inductive entrefer sensors	0.2 ÷ 1.15 mm

WARNING: The entrefer is not adjustable as compatible thickness is not provided. Check the integrity of the sensor and of the teeth of the phonic wheel in case of a value besides the prescribed tolerance.

ABS BOSCH 5.3 WITH EBD (99s Models)

DESCRIPTION

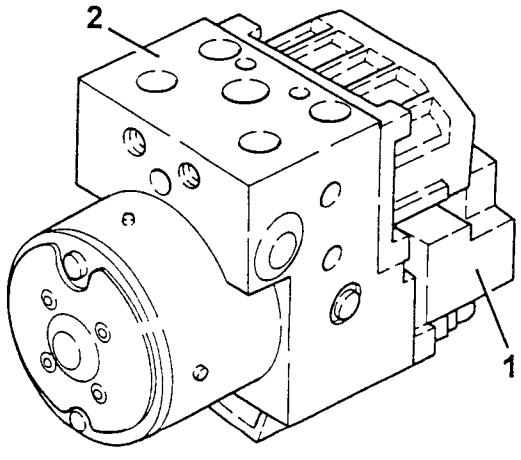
This A.B.S. system differs from the "A.B.S. BOSCH 5.3" system because it adopts:
- an electonic braking distribution frame (which replaces the traditional mechanical braking control system)
- active sensors in place of inductive ones.

The A.B.S. system is composed by:
- an integrated electronic gearcase
- an electrohydraulic gearcase which modulates the braking pressure through eight electrovalves, two for each wheel.
- four active sensors detecting the angular speed of the wheels rotation.

COMPONENTS

Electrohydraulic group

It is made by an electronic gearcase (1) and by an electrohydraulic one (2).



Electronic gearcase

The electronic gearcase has the following functions:
- to acquire the data coming from the active sensors of the wheel revolutions.
- to store the checking parameters defined during the vehicle's truing.
- to store the checking software
- to process the acquired data
- to control the braking process
- to detect failures and defects of the braking system components
- to strore the failure codes and activate the pilot lights ABS and EDB
- to transmit and to receive data through the diagnostics connectors.

Electrohydraulic gearcase

The electrohydraulic gearcase is made by:
- eight two-way electrovalves
- a double-circuit recovery pump
- two low pressure batteries
- two high pressure batteries.

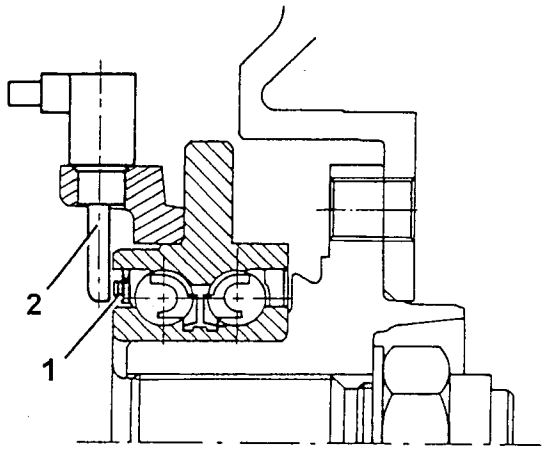
It modulates the fluid's pressure to the calipers through electrovalves and by:
- increasing the brakes fluid pressure
- maintaining the brakes fluid pressure
- discharging the brakes fluid pressure.

Active sensors

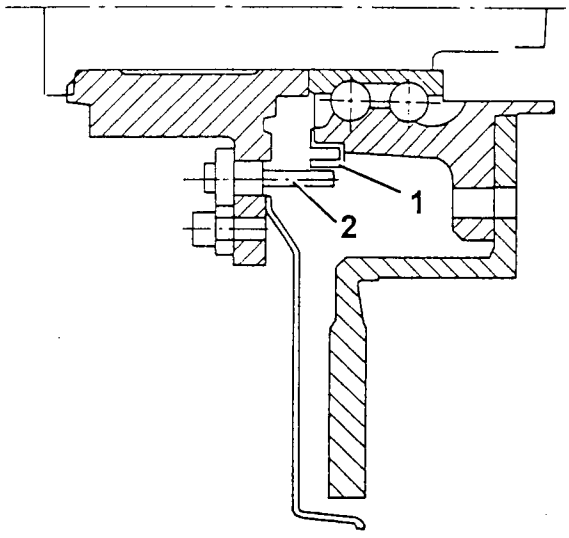
They are composed by two main elements:
- a magnetic multi-polar coder (1) integrated in the bearing of the wheel hub
- a picker up (2).

The advantages offered by the active sensors are:
- reduction in the electromagnetic sensitivity
- less weight and smaller dimensions
- simplification of transmission joints to eliminate phonic wheels.

Front active sensors



Rear active sensors



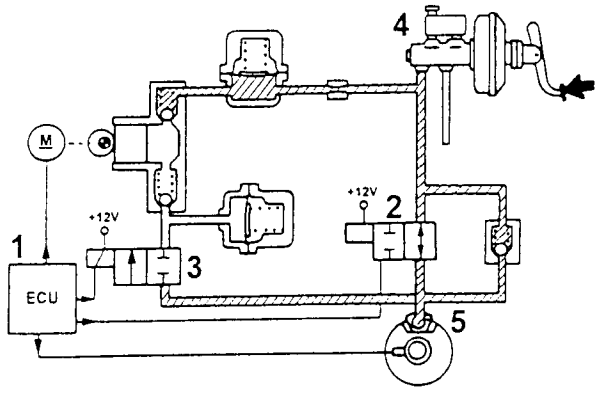
FUNCTIONING DESCRIPTION OF ABS SYSTEM

The electronic gearcase elaborates the signals coming from the active sensors and from the control switch of stoplights and modulates the brakes luid pressure under the conditions of:
- phase of pressure increase
- phase of pressure holding
- phase of pressure reduction.

Phase of pressure increase

By pressing of the brake pedal, the electronic gearcase (1):
- does not feed the charging electrovalve (N.A.) (2)
- does not feed the discharging electrovalve (N.C.) (3).

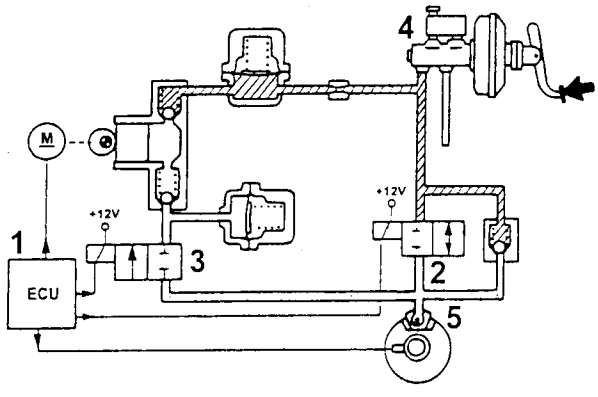
Therefore the pressure produced by the brake (4) reaches the calipers (5) without variations.



Phase of pressure holding

The electronic gearbox (1):
- feeds the charging electrovalve (N.A.) (2)
- does not feed the discharging electrovalve (N.C.) (3).

Therefore the hydraulic connection between the brakes pump (4) and the calipers (5) is interrupted.
The calipers' pressure (5) stays constant even while increasing the pressure onto the brake pedal.

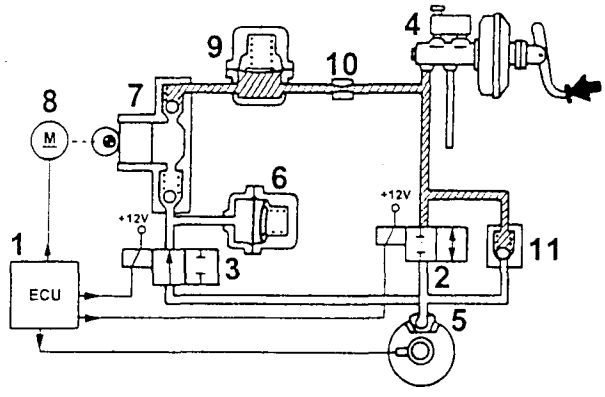


Phase of pressure reduction

The electronic gearcase (1):
- feeds the charging electrovalve (N.A.) (2)
- feeds the discharging electrovalve (N.C.) (3).

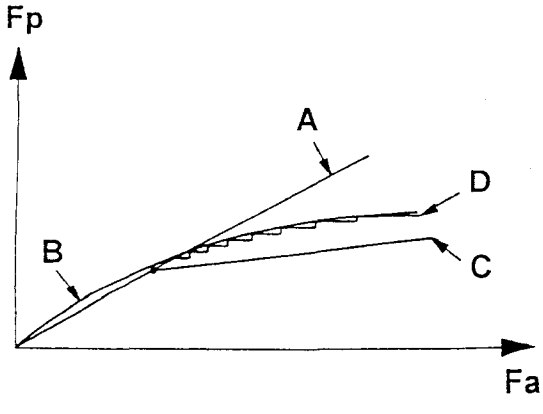
The hydraulic connection between the brakes pump (4) and the calipers (5) is interrupted and the discharging electrovalve (3) opens and puts into connection the caliper (5) with the low pressure battery (6)and the recovery pump (7).

The electronic gearcase (1) feeds,besides, the control motor (8) of the recovery pump (7) so to let the fluid taken away from the caliper (5) flow again.
The fluid goes through the high pressure battery (9)and the squeeze (10) which have a damping function.
The system is equipped with a one-way valve (11) which is parallel to the charging electrovalve(2) so enabling a fast reduction of the pressure onto the caliper (5) while releasing the brake pedal.



EBD (Electronic Brake force Distribution)

The EBD controls the distribution of the braking power and therefore replaces the traditional mechanical braking device so enabling to :
- intervene onto the rear calipers.
- improve distribution of the braking power
- intervene under any load condition (both statical and dynamical), of running and of car degradation (worn tyres, brakes and suspensions)
- implement a strategy following the ideal distribution curve.



Fa. Braking power of the front axle
Fp. Braking power of the rear axle
A. Distribution curve performed by the braking system
B. Ideal distribution curve
C. Traditional distribution curve
D. Distribution curve performed by EDB functioning

The EDB failing functioning is signalled by the simultaneous lighting of the pilot lights of:
- the A.B.S.
- the insufficient brake fluid and /or insertrd hand brake
It is therefore necessary to drive the car carefully to the closest authorized service center to have the system checked, should it fail.

Recovery

The electronic gearcase is equipped with a safety circuit which controls the ABS system's efficiency.
With the key inserted for four seconds, the safety circuit controls:
- the functioning of the electronic gearcase
- it starts the electrovalves to check the functioning
- it starts the recovery pump to check the functioning
- it checks the signals from the active sensors.

The safety circuit checks the presence of signal in the active sensors.

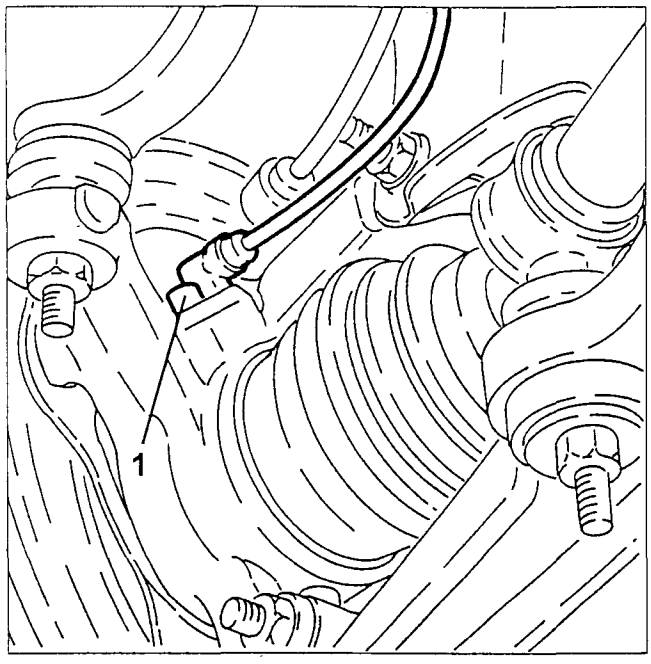
The safety circuit, with the car running, acts as follows:
- continously compares the angular speed of the wheels to the calculated reference speed.
- checks the memory's conditions
-checks the functioning of the two remote control switches and of the lectrovalves.
- constantly checks the battery voltage
- checks the efficiency of the brake pedal switch.

If, during the checking phase, the safety circuit has detected defects or failures, it acts as follows:
- disconnects the ABS guaranteeing the functioning of the traditional braking system.
- signals the failure condition to the driver through the lighting of the corresponding pilot light abord.

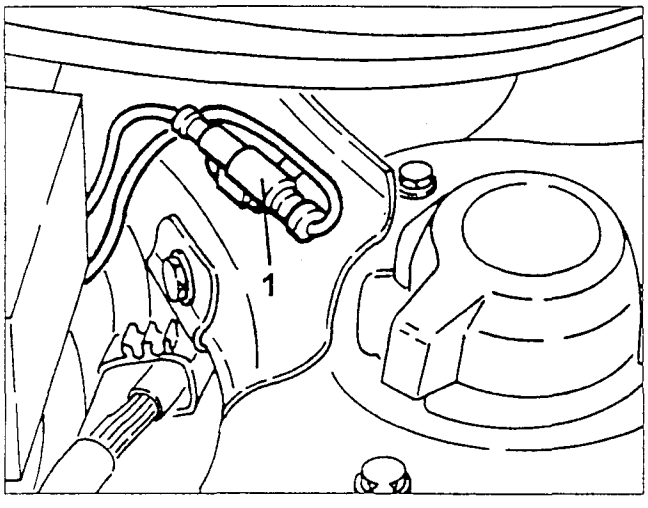
FRONT ACTIVE SENSORS

DISCONNECTION/RE-CONNECTION

1. Unscrew the clamping screw of the active ABS sensor to the wheel riser.



1. Diconnect the electrical connection close to the shock absorber dome and remove the sensor together with the wiring after having loosened the clamps.

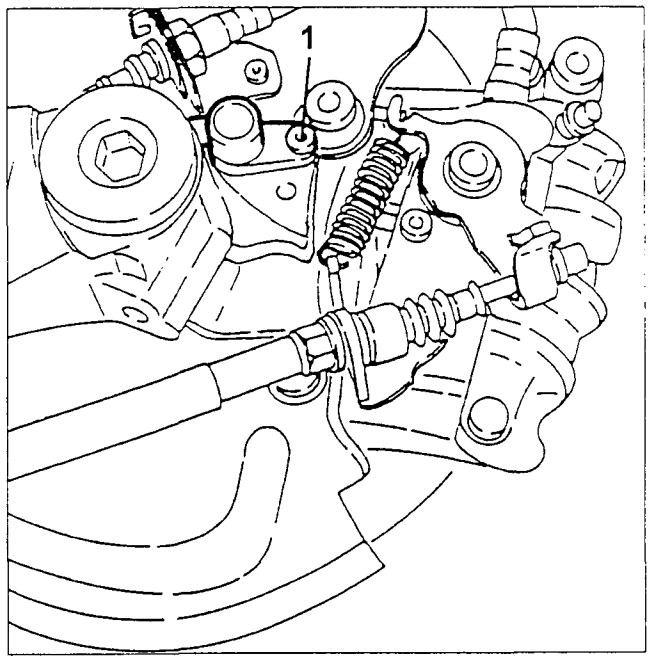


When re-connecting, grease the seat of the active sensor with the prescribed grease.

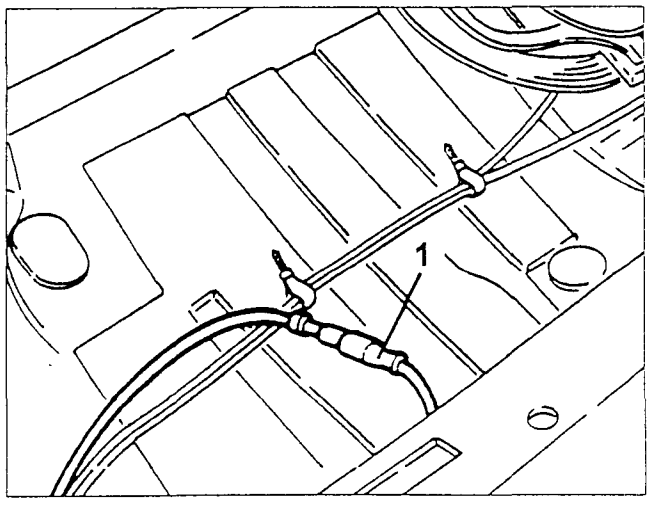
REAR ACTIVE SENSORS

DISCONNECTION/RE-CONNECTION

1. Unscrew the clamping screw of the active sensor to the wheel's hub.



1. Turn the back seat cushion forwards over, disconnect the electrical connection of the active sensor and remove it.



When re-connecting, grease the seat of the active sensor with the prescribed grease.

STEERING 41

INDEX

STEERING COMMAND AND LINKAGE 1351 1596 1712 16V

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POWER STEERING 1351 1596 1712 16V

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STEERING COMMAND AND LINKAGE 1929 TD 1970 T. SPARK 16V

- Description 7
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POWER STEERING 1929 TD 1970 T. SPARK 16V

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STEERING COOMAND AND LINKAGE 1370 1598 1747 T. SPARK 16V

- Description . . . . . (□)
- Steering wheel (with Air Bag) . . . . . (*)
- Steering wheel (without Air Bag) . . . . . (**)
- Ignition block . . . . . (**)
- Steering column . . . . . (□)

POWER STEERING 1370 1598 1747 T. SPARK 16V

- Power steering box . . . . . (□)
- Power steering pump . . . . . (□)
- Refilling the power steering circuit and bleeding the air . . . . . (□)

STEERING COMMAND AND LINKAGE - '98 Models

1747 T. SPARK 16V 1970 T. SPARK 16V

- Description 12
- Steering wheel (with Air Bag) . . . . . (*)
- Steering wheel (without Air Bag) . . . . . (**)
- Ignition block . . . . . (**)
- Steering column . . . . . (□)

POWER STEERING - '98 Models

1747 T. SPARK 16V 1970 T. SPARK 16V

- Power steering box . . . . . (□)
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- Power steering pump 14
- Refilling the power steering circuit and bleeding the air . . . . . (□)
- Power steering guards . . . . . (□)

(*): See GROUP 70 - Interior trim "Air Bag"

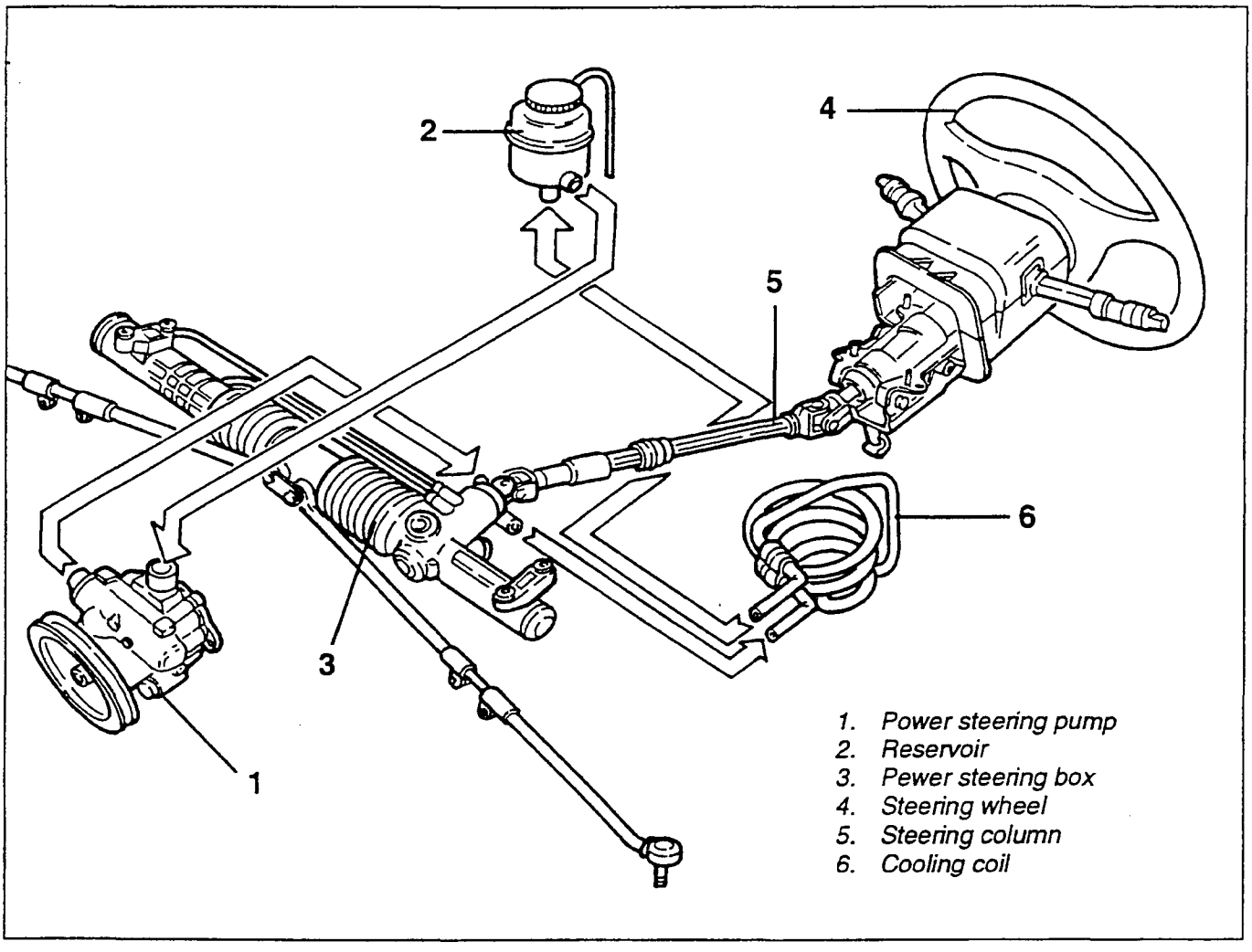
(**): See 1351 1596 1712 16V

(□): See 1970 T. SPARK 16V

DESCRIPTION

The power steering system enables the effort required to turn the steering wheel to be reduced when manoeuvring from a standstill and it keeps the steering steady at high speeds. The composition of the steering column (5), articulated in two parts ensures greater passive safety in the event of a frontal impact. The system comprises a pump (1) operated directly by the engine through a belt.

The pump withdraws oil through the delivery line from the reservoir (2) located in the engine compartment and sends it under pressure through a hose to the distribution valve located on the power steering box (3). The distributing valve connected by a hose to the reservoir allows the outgoing oil to return to the reservoir. Inside this hose there is a coil (6) which cools the oil.



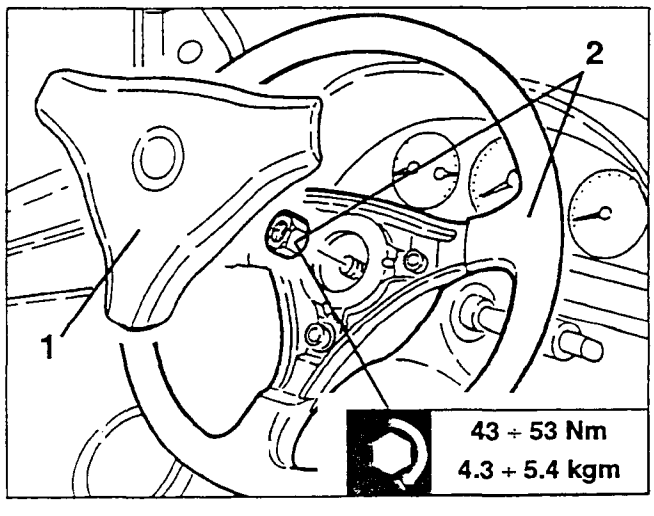
STEERING WHEEL (WITH AIR BAG)

For removing/refitting refer to GROUP 70 - INTERIOR TRIM "AIR BAG".

STEERING WHEEL (WITHOUT AIR BAG)

REMOVAL/REFITTING

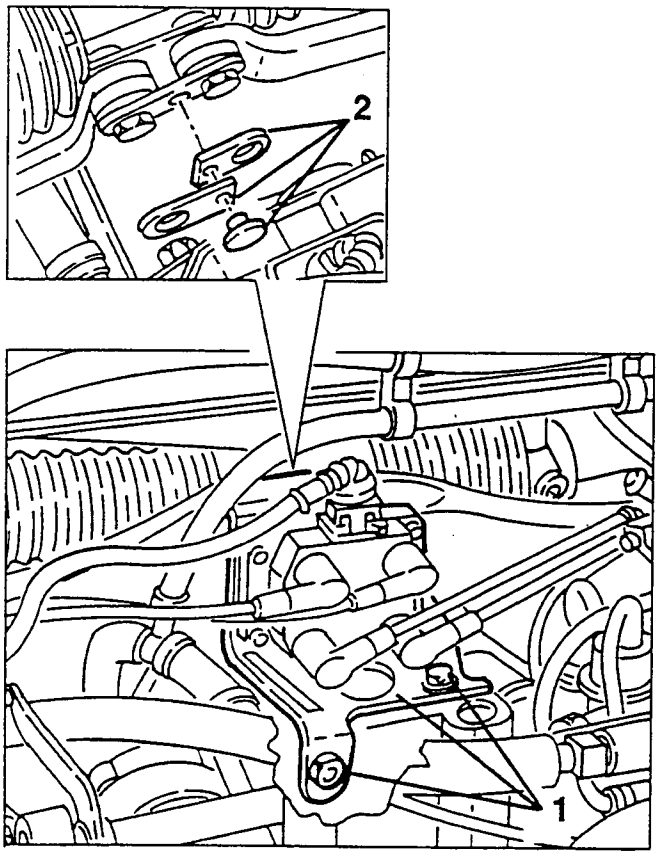
- Disconnect the battery (-) terminal.
1. Prise up the horn control and remove it after disconnecting the electrical connection.
2. Slacken the fastening nut and remove the steering wheel.



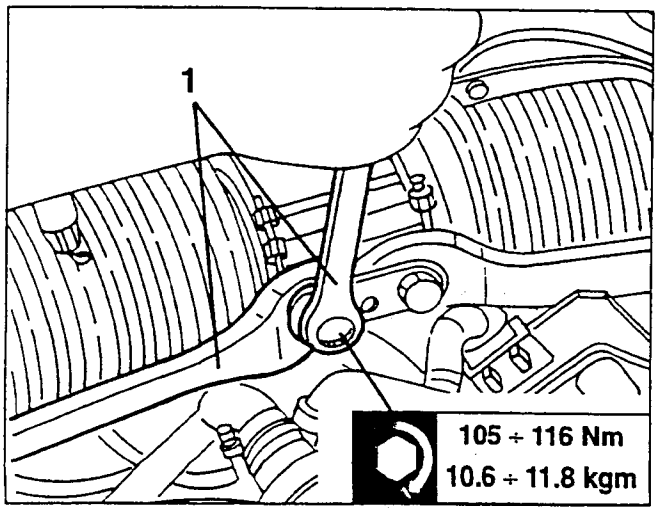
STEERING LINKAGES

REMOVAL/REFITTING

- Remove the air intake box (see GROUP 10).
1. Slacken the screw and nut fastening the ignition coil support bracket, then move it to one side.
2. Remove the plastic button and retrieve the two safety catches.

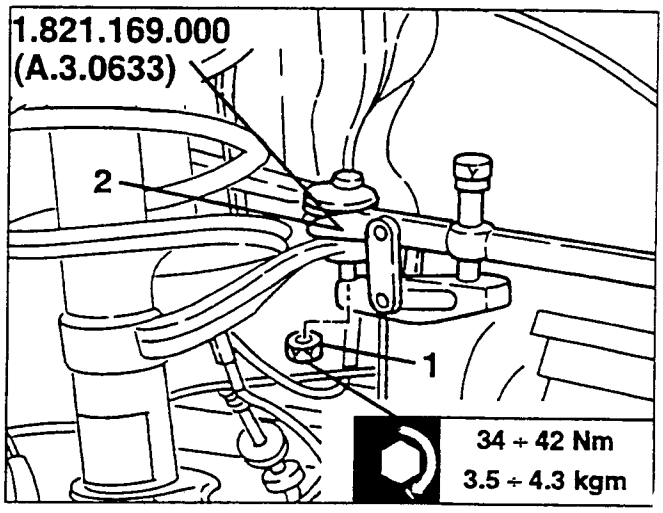


1. Slacken the fastening screw and disconnect the track rod concerned from the power steering box.

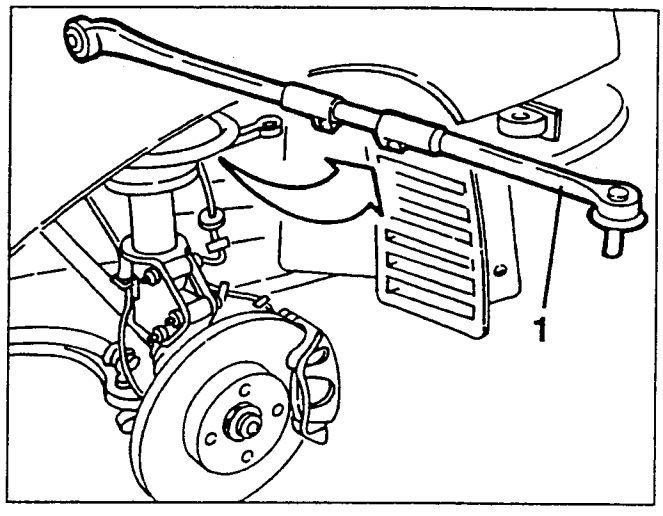


- Remove the wheel on the side concerned.
1. Slacken the nut fastening the track rod from the connection on the shock absorber.

2. Using tool N° 1.821.169.000 (A.3.0633), disconnect the steering knuckle from the connection on the shock absorber.

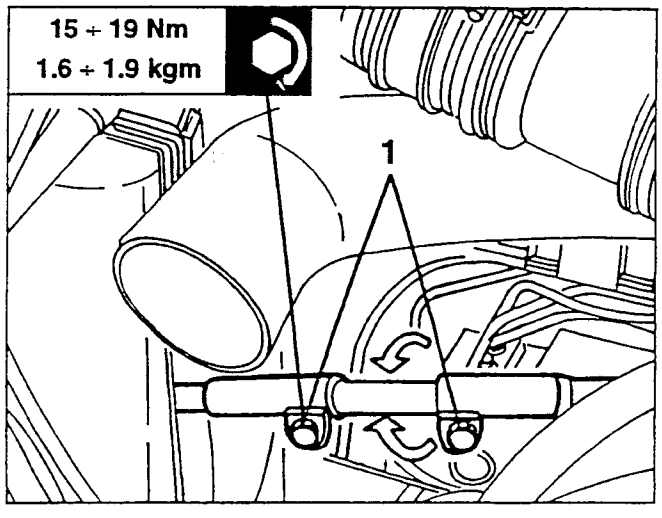


1. Working from the wheel house, remove the complete track rod.



When refitting, adjust the track rods as described below.

1. Slacken the two fastening screws and work on the adjustment coupling until the specified toe-in has been obtained (see GROUP 44).

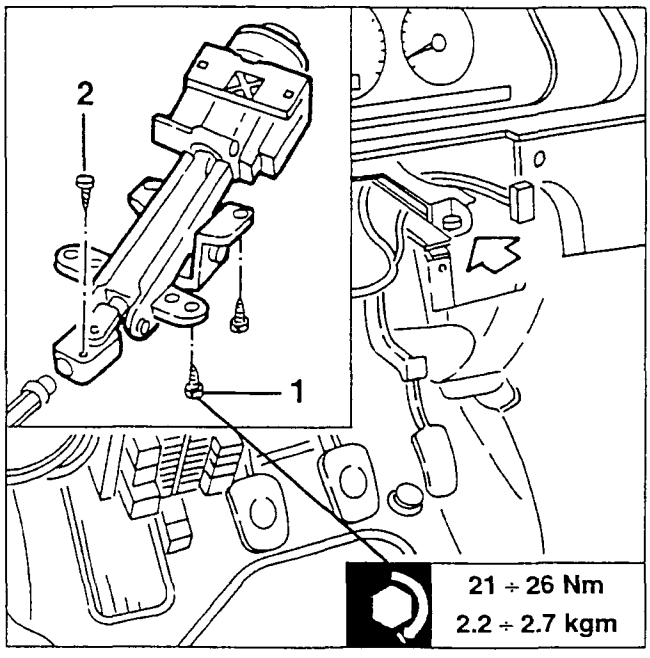


STEERING COLUMN

REMOVAL/REFITTING

- Remove the steering wheel (see specific paragraph).
- Remove the steering column control lever unit (see GROUP 55).
- Remove the fusebox cover (see GROUP 70).

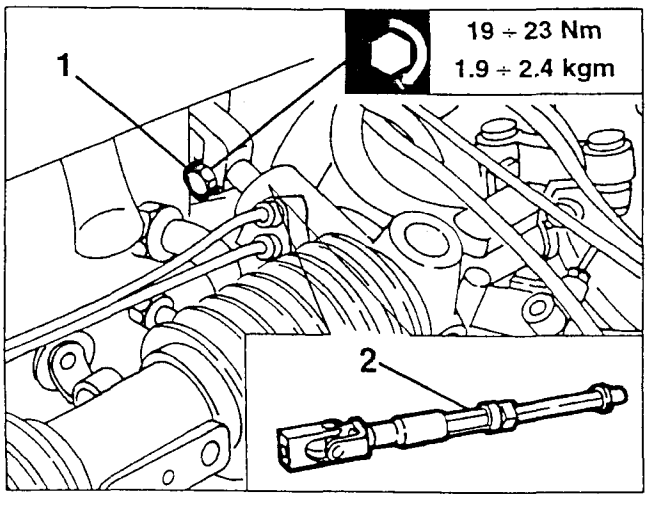
1. Slacken the four screws fastening the upper steering column to the body.
2. Slacken the screw fastening the upper steering column to the lower steering column, then remove the upper steering column.



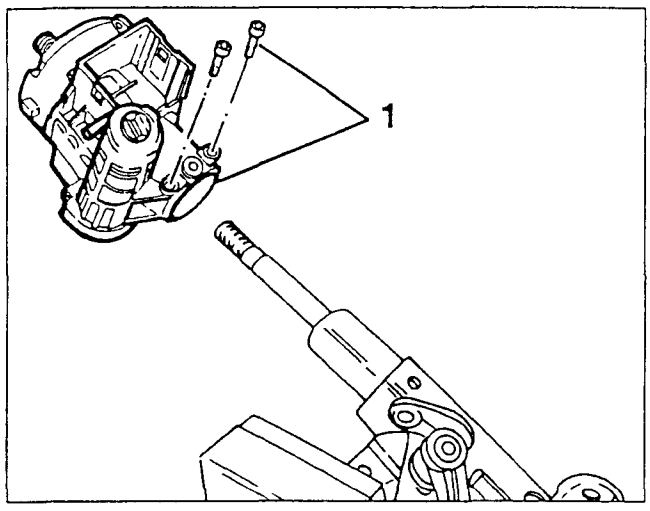
1. Slacken the screw fastening the lower steering column to the power steering box pinion.

To gain access to the screw, proceed as described in "Power steering box - Removal/Refitting" without disconnecting the track rods.

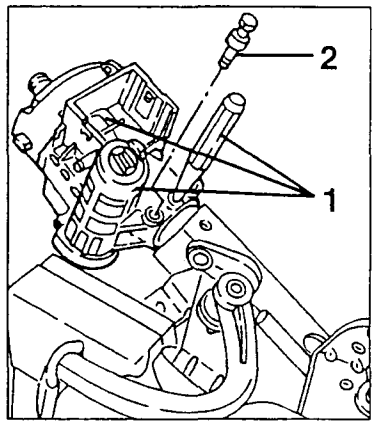
2. Still working from the engine compartment, remove the lower steering column.



1. On the bench, if necessary, using a suitable punch, slacken the two fastening pins and separate the control unit and ignition block support from the upper steering column.



When refitting, using a pin (1) as illustrated, correctly position the control unit and ignition block support, then fasten it with the special screws (2) with preset breakage load.

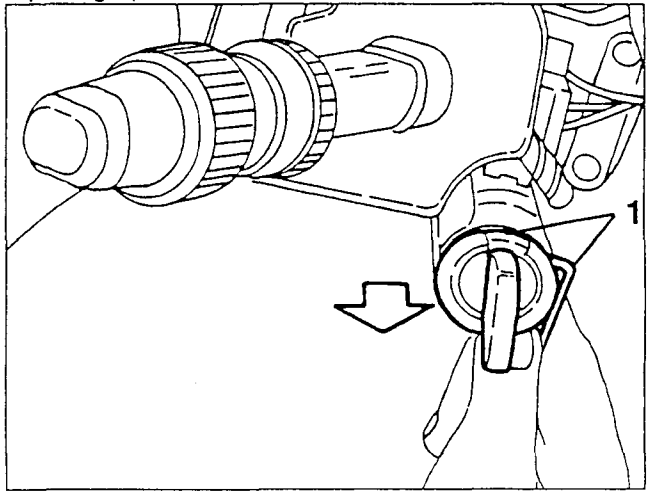


IGNITION BLOCK

REMOVAL/REFITTING

- Remove the steering column half cover (see GROUP 70).

1. Take the ignition block to the "MAR" position and working on the fastener catch with a punch withdraw it pulling upwards.

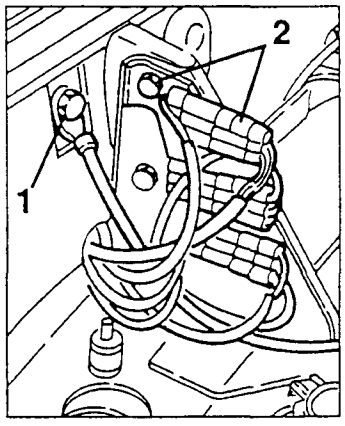


POWER STEERING BOX

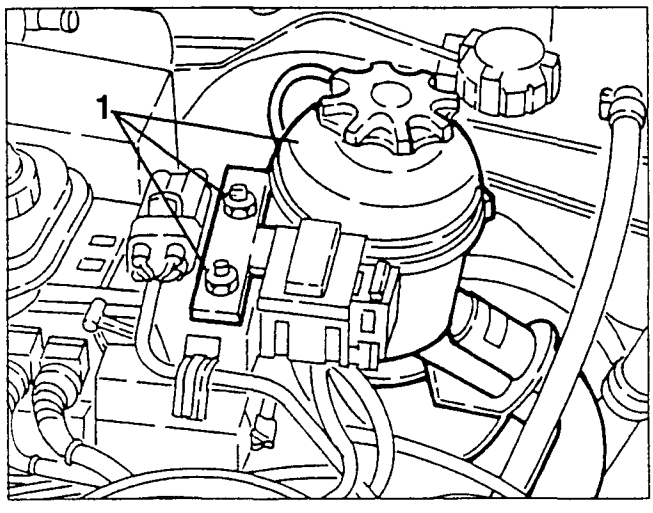
REMOVAL/REFITTING

- Empty the oil from the power steering reservoir, using a suitable syringe.
- Remove the battery and the acid drain tray (see GROUP 55).
- Remove the air cleaner unit and intake box complete (see GROUP 10).

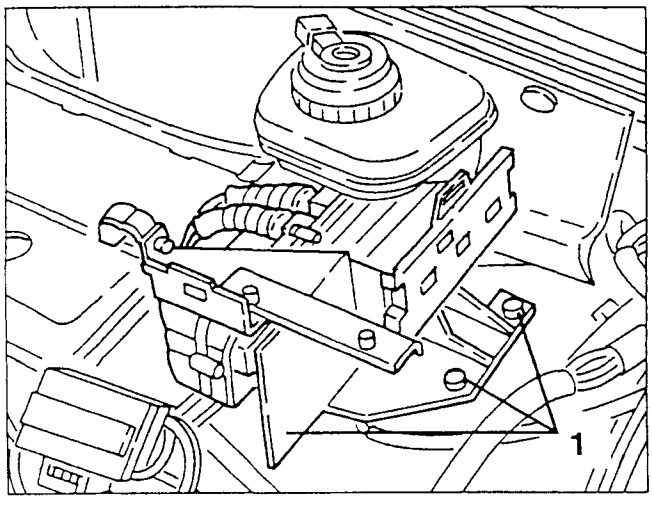
1. Disconnect the earth from the engine bulkhead.
2. Slacken the screw and remove the electrical connection support bracket.



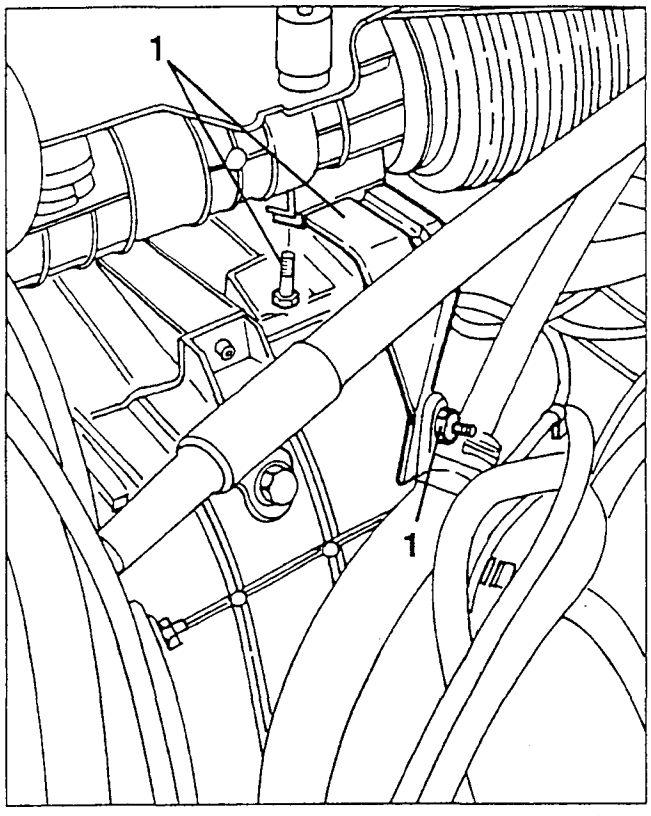
1. Slacken the two fastening nuts and move the power steering reservoir to one side without disconnecting the hoses.



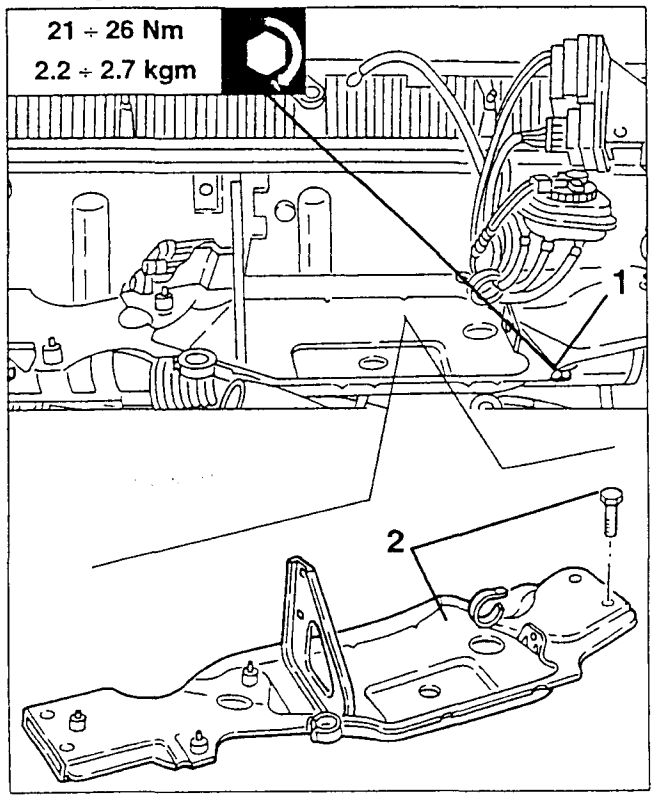
1. Remove the relay switches from the support bracket then move the bracket upwards after unscrewing the fastening screws.



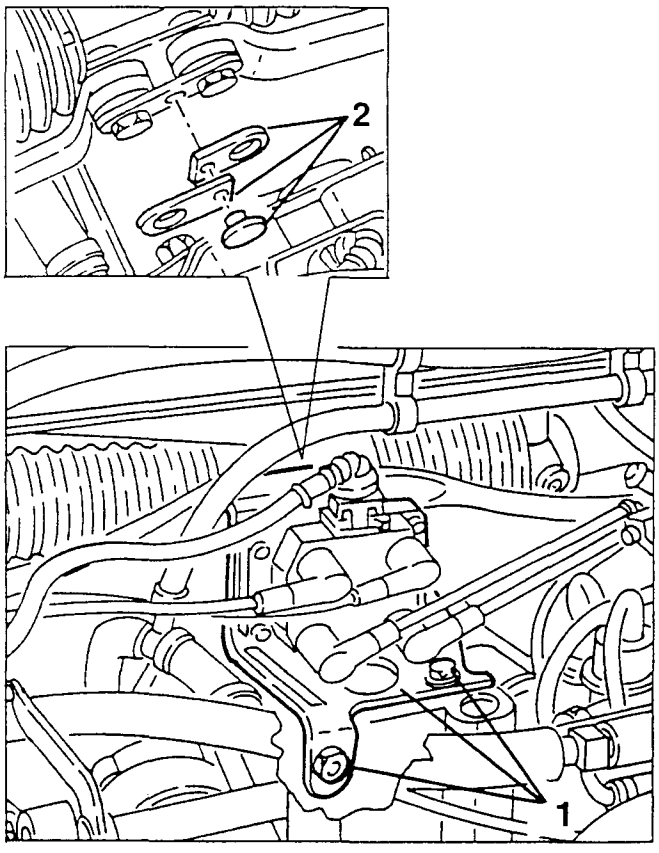
1. Slacken the fastening screw and bolt and remove the power steering hose support bracket.



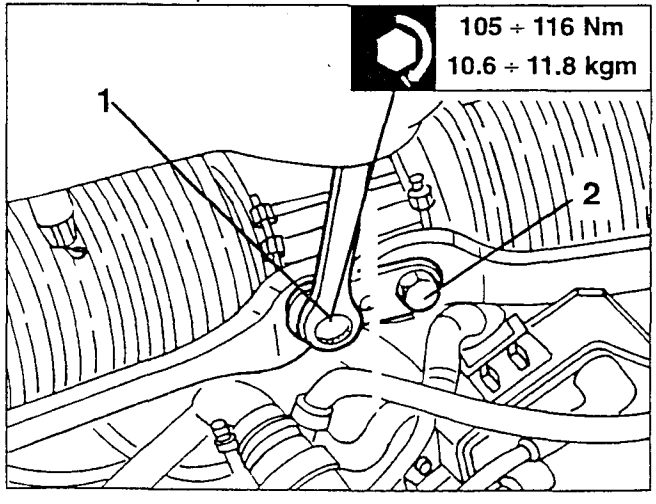
1. Slacken the four screws fastening the power steering box to the crossmember.
2. Slacken the five fastening screws and remove the crossmember supporting the battery and the power steering box.



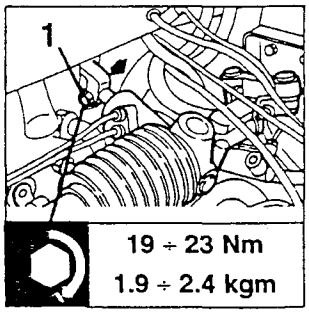
1. Slacken the screw and nut fastening the ignition coil support bracket then move it to one side.
2. Remove the plastic button and retrieve the two safety catches.



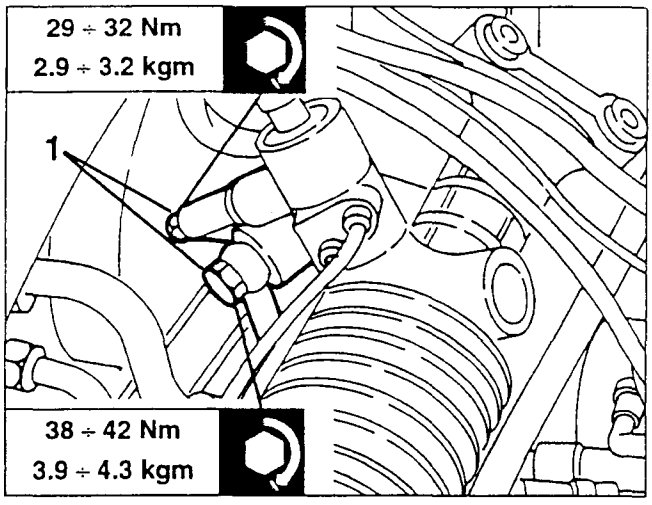
1. Slacken the screws fastening the power steering to the track rods.
2. Retrieve the plate.



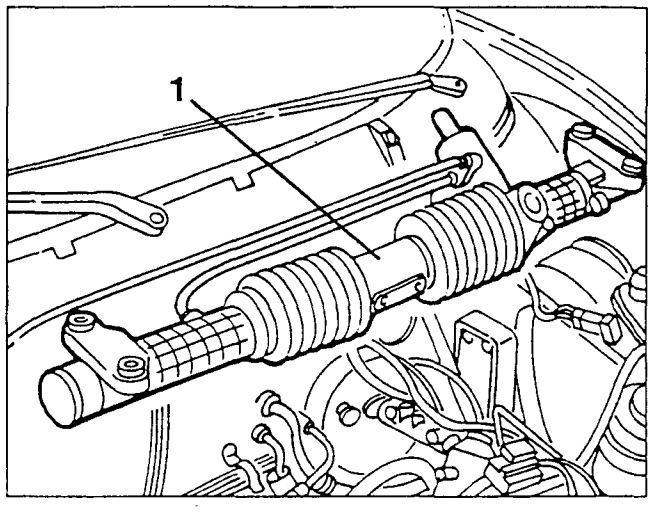
1. Slacken the screw fastening the steering column to the pinion of the power steering box, then move aside the latter.



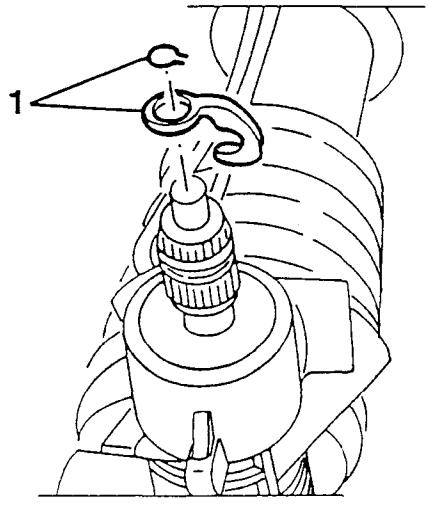
1. Disconnect the two oil inlet and outlet hoses from the power steering box.



1. Remove the power steering box.



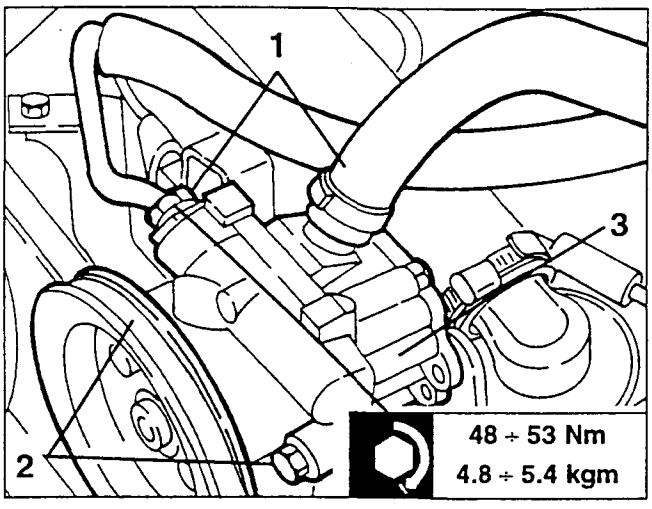
1. On the bench, if necessary, remove the circlip and withdraw the positioning plate from the power steering box pinion.



POWER STEERING PUMP

REMOVAL/REFITTING

- Empty the oil from the power steering reservoir, using a suitable syringe.
1. Disconnect the oil inlet and outlet hoses from the power steering pump.
2. Slacken the two bolts fastening the power steering pump and remove it from the drive belt.
3. Slacken completely the two fastening bolts and remove the power steering pump.



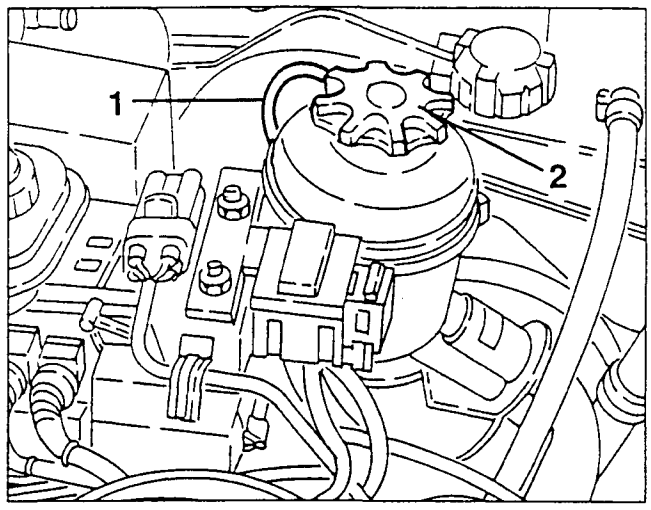
CHECKS AND INSPECTIONS

WARNING:
The power steering pump, like the steering box, should not be dis-assembled for any reason whatsoever and must be sent to the Manufacturer for overhauling.

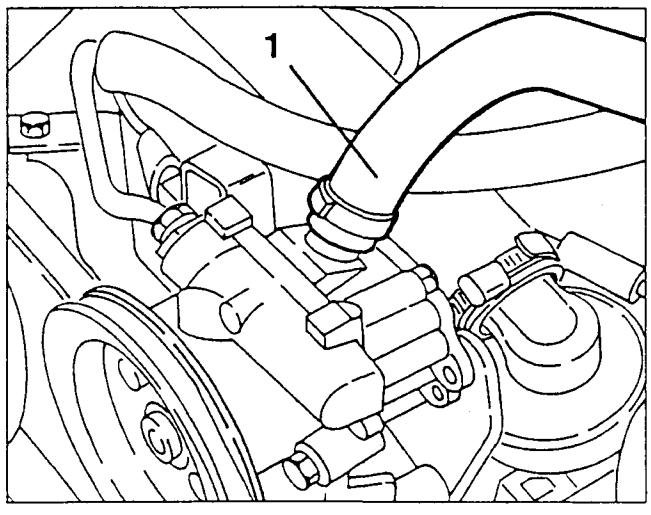
- Check the rolling torque of the steering wheel with the car stationary and the engine running. The torque must be between 0.6 daN with the engine at idle speed and 0.75 daN with the engine at maximum: if these limits are exceede check the pressure in the system with the wheels completely turned. Insert a pressure guage using a suitable Tee connection on the pressurised oil delivery hose leading from the pump to the power steering and turn the steering wheel fully in one direction. Further forcing the steering wheel, the pressure indicated on the pressure gauge should rise to appr. 85 bar. If this fails to happen, there is either a failure in the pump or in the distributing valve of the power steering box.

REFILLING THE POWER STEERING CIRCUIT AND BLEEDING THE AIR

1. Disconnect the reservoir breather pipe.
2. Remove the cap and fill the reservoir with the specified oil.



1. Disconnect the inlet hose on the power steering pump until oil flows out, then re-connect it.



- With the engine running at idle speed, ensure that the reservoir does not empty. Turn the steering wheel completely a few times to bleed the air from the system. Then top up the reservoir to the maximum level mark.

WARNING:
The power steering system is self-purging; the air is removed steering completely to the right and to the left with the engine running and the car stationary. This operation should be carried out each time the connection hoses are removed and refitted.

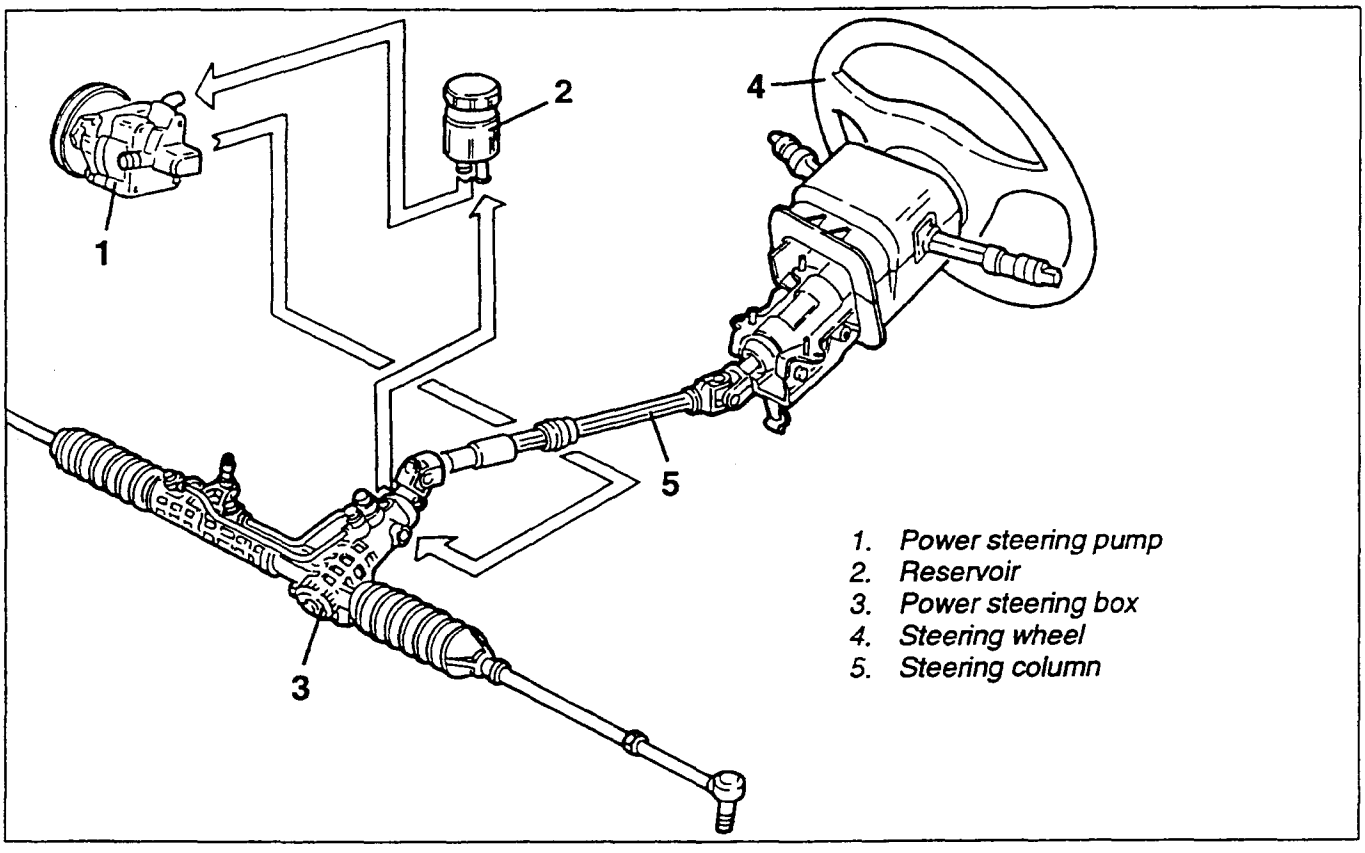
- Completely insert the breather pipe and refit the reservoir cover.

Stiffening of the steering might be due to slipping of the pump drive belt or to low oil level. In the event of a failure to the pump, operating cylinder or distributing valve, the power steering system will work like a normal mechanical gearbox.

DESCRIPTION

The power-assisted steering system enables the effort at the steering wheel to be reduced when manoeuvring from a standstill and keeps steering steady at high speeds. The conformation of the steering column (5) articulated in two sections, confers greater passive safety in the event of frontal impact.

The system comprises a pump (1) operated directly by the engine through a belt. The pump withdraws oil through the delivery hose from the reservoir (2) located in the engine compartment, and sends it under pressure through a hose to the distributing valve located in the power steering box (3). The distributing valve connected through a hose to the reservoir allows the oil from the operating cylinder to return to the reservoir.



1. *Power steering pump*
2. *Reservoir*
3. *Power steering box*
4. *Steering wheel*
5. *Steering column*

STEERING WHEEL (WITH AIR BAG)

For removing/refitting refer to GROUP 70 - INTERIOR TRIM "AIR BAG".

STEERING WHEEL (WITHOUT AIR BAG)

For removing/refitting refer to Boxer engines.

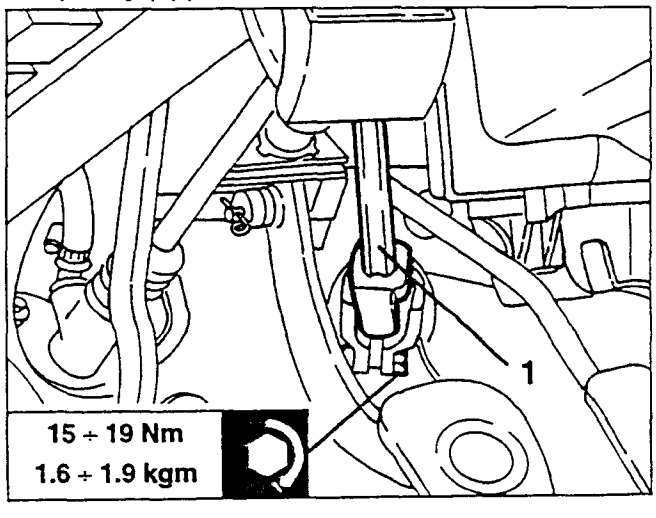
IGNITION BLOCK

For removing/refitting refer to Boxer engines.

STEERING COLUMN

REMOVAL/REFITTING

See the Boxer engines, with the exception of the remotion of the steering column (1) from the power steering box pinion as the steering column is removed completely (upper and lower section).

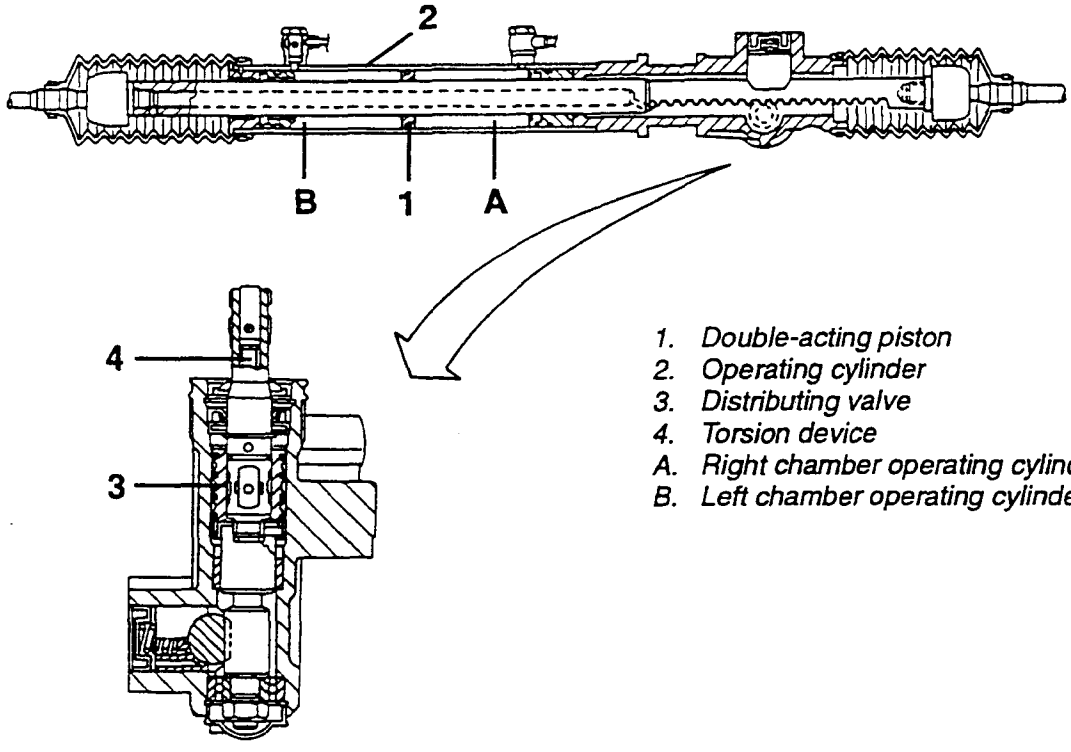


POWER STEERING BOX

DESCRIPTION

The power steering box assembly is similar to a conventional rack and pinion steering system with the exception of the following:
- an operating cylinder (2) has been made in the steering box in which a double-acting piston (1) runs that is integral with the rack rod;
- a distributing valve (3) with the corresponding ducts is located in the housing of the worm screw. This is controlled by a torsion device (4) in the end of the worm screw.

Depending on the torsion transmitted by the steering wheel to the device, the oil from the pump is sent to the reservoir, or to one of the two chambers A or B of the operating cylinder. The force generated by the pressure of the oil on the side surface of the piston determines its movement, thus also of the rack.



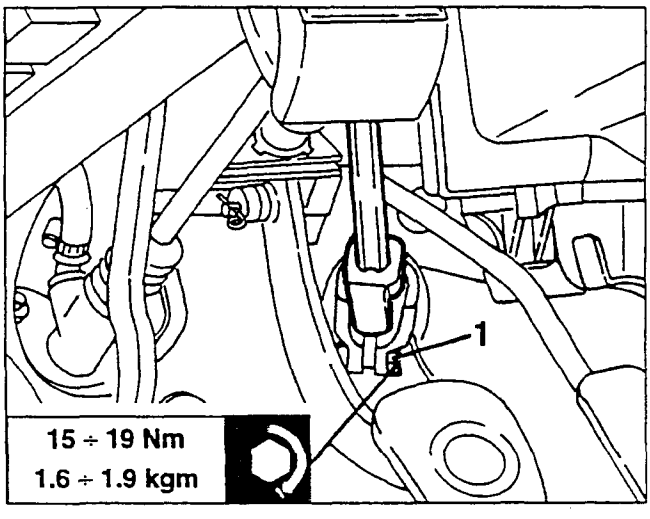
1. *Double-acting piston*
2. *Operating cylinder*
3. *Distributing valve*
4. *Torsion device*

A. *Right chamber operating cylinder*
B. *Left chamber operating cylinder*

REMOVAL/REFITTING

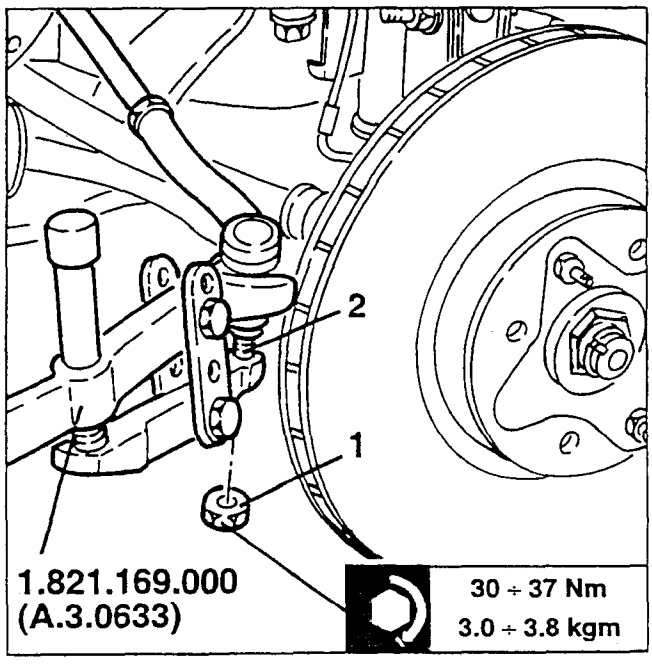
- Set the car on a lift.
- Using a suitable syringe, empty the power steering system reservoir.
- Remove the front wheels.

1. Working from inside the car, slacken the bolt fastening the steering column to the power steering box pinion.

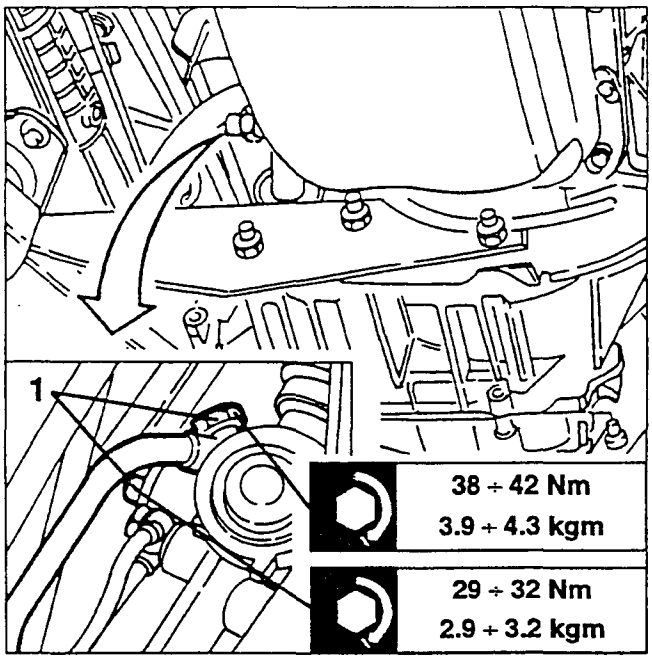


- Raise the car.

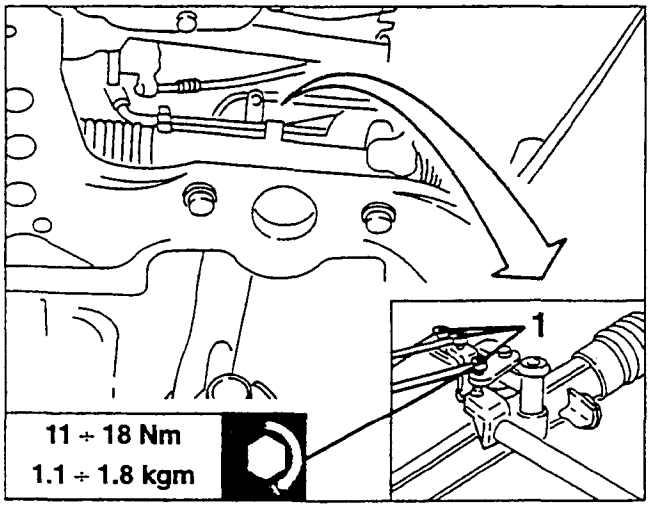
1. Slacken the nuts fastening the track rod ball joints to the wheel hubs.
2. Using tool N° 1.821.169.000 (A.3.0633), disconnect the ball joints from the hubs.



- Raise the car.
1. From the power steering box disconnect the couplings of the oil inlet and outlet hoses.



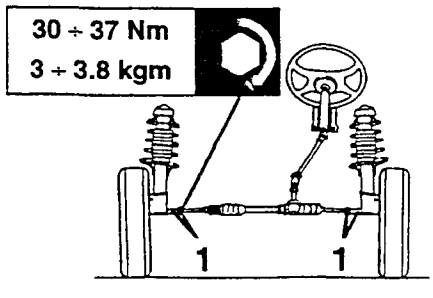
1. Disconnect the speed engagement rods from the support.



- Remove the front crossmember (see GROUP 44) and remove the power steering box.

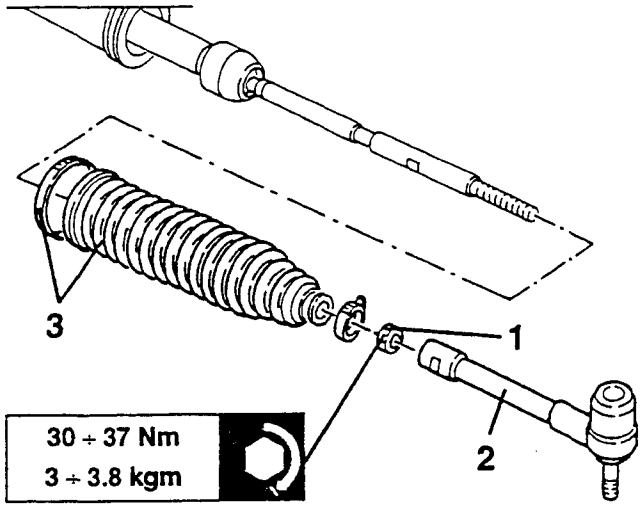
When refitting, if necessary, adjust the track rods as described below.

1. Slacken the two fastening nuts and tighten or slacken the track rods until the specified toe-in is obtained (see GROUP 44).



DIS-ASSEMBLY/REASSEMBLY

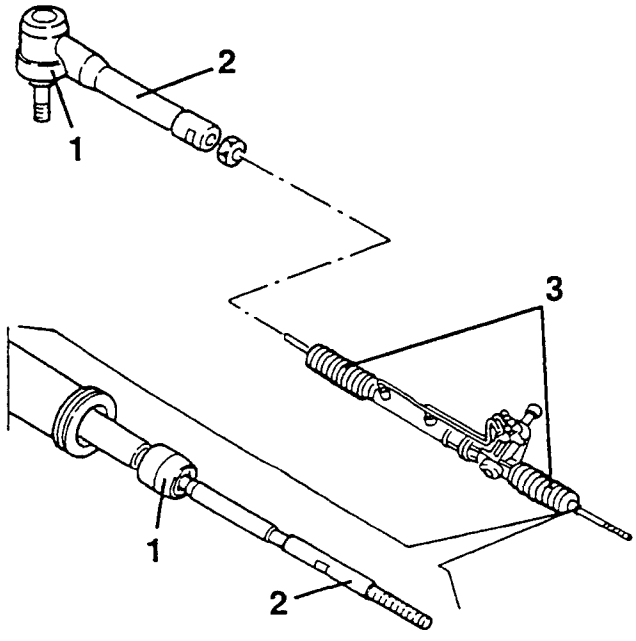
1. Slacken the locknut of the track rods.
2. Slacken the track rods and remove them from the arm.
3. Slacken the clamps and remove the bellows.



When refitting lubricate the contact area between the bellows and the shaft with silicone grease. When the clamp is installed and closed to the second or third from last tooth this will enable the arm to turn freely inside the bellows.

CHECKS AND INSPECTIONS

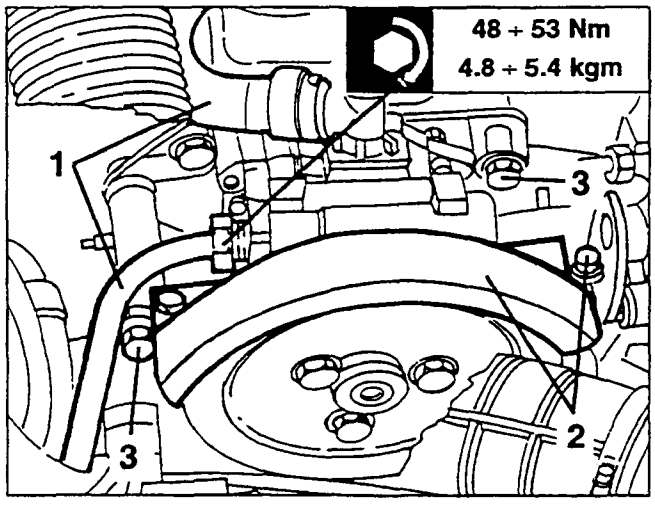
1. Check that the ball joints are not damaged or worn and that they can turn freely in their housings without sticking or excessive play.
2. Check that the track rods are not damaged or distorted.
3. Make sure that the bellows are intact.



POWER STEERING PUMP

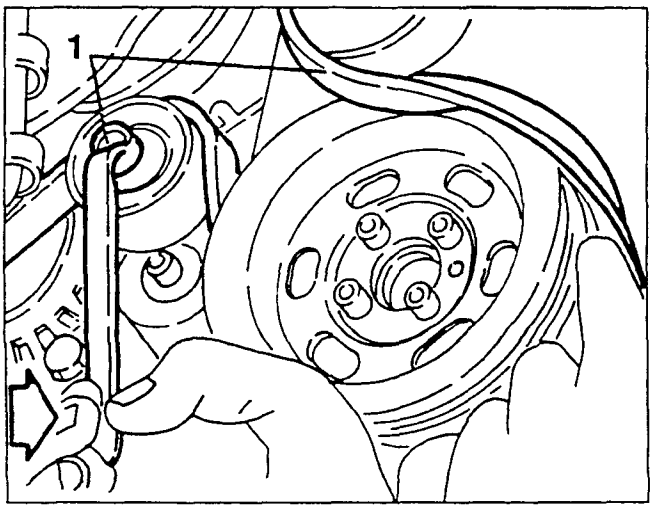
REMOVAL/REFITTING
Specific for Turbodiesel engine

- Empty the oil from the power steering system, using a suitable syringe.
1. From the power steering pump disconnect the oil inlet and outlet hoses.
2. Slacken the two screws and remove the power steering pump drive belt guard.
3. Slacken the screws fastening the power steering pump and working on the micrometric tensioner, slacken the belt tension and remove it.
- Remove the screws slackened previously and remove the power steering pump.

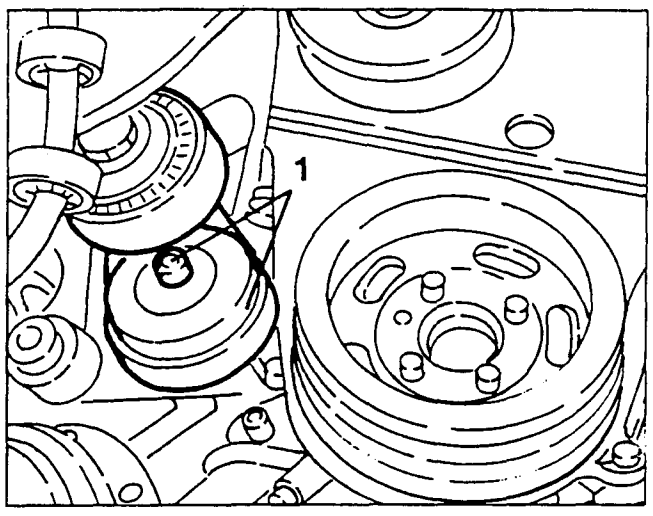


REMOVING/REFITTING
Specific for T.Spark 16V engine

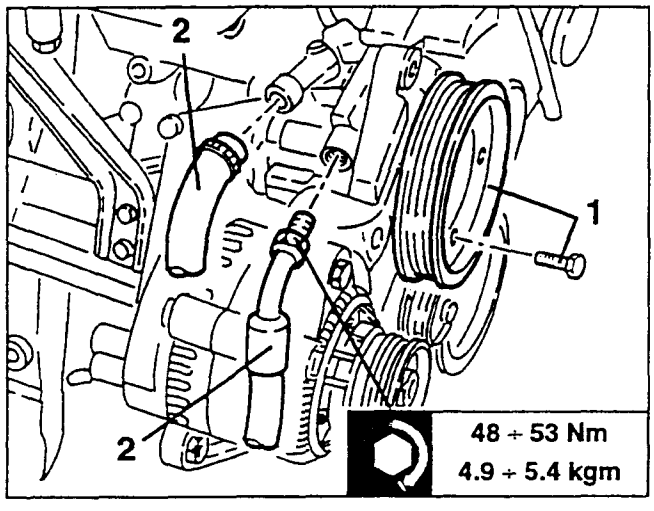
- Set the car on a lift.
- Remove the right front wheel and mud flap.
- Empty the power steering tank oil using a suitable syringe.
1. Raise the car and proceeding as illustrated on the belt tensioner, slacken the tension of the auxiliary components drive belt and remove it.



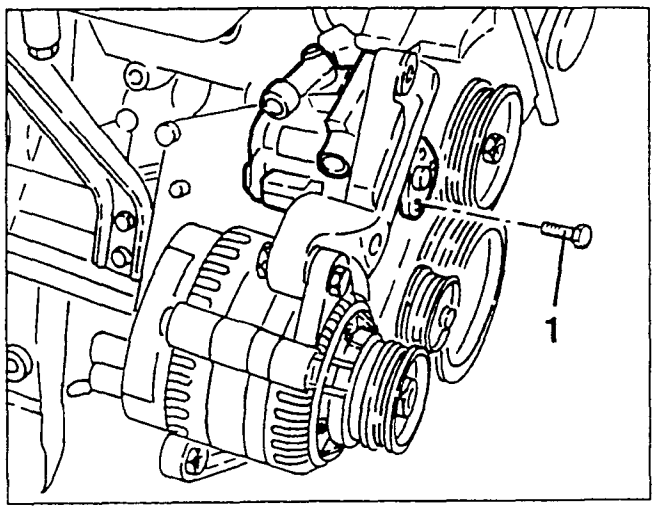
1. Slacken the screw fastening the belt tensioner.



1. Holding the pump shaft still, slacken the three screws fastening the power steering pump pulley and remove the latter.
2. Working from above, disconnect the two intake and delivery pipes from the power steering pump.



1. Slacken the three fastening screws and remove the power steering pump.



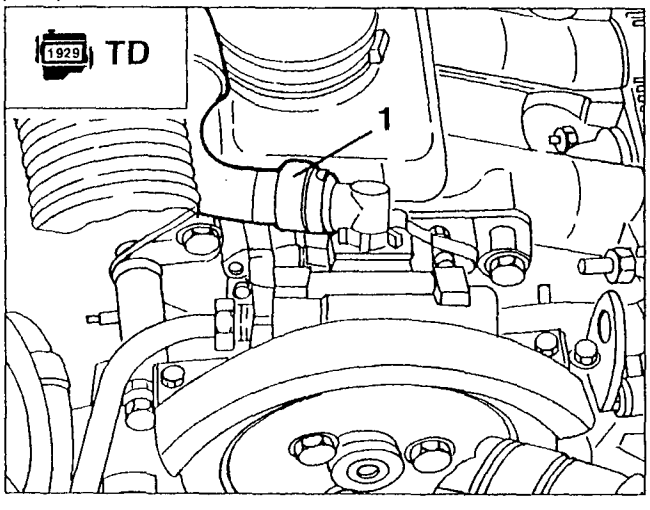
TESTS AND CHECKS

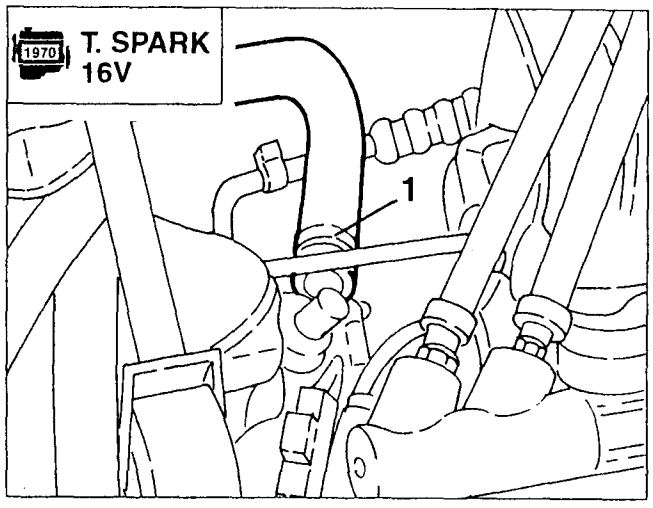
IMPORTANT:
Never disassemble the power steering pump or the power steering unit. These units can only be overhauled by the manufacturer.

Check the rolling torque with the vehicle stationary and the engine running.
The torque should be included between 0.6 daN when the engine is idling and 0.75 daN when the engine is running at maximum rating.
If these values are exceeded, check system pressure with the wheels completely steered.
For this test, connect a pressure gauge with a suitable T fitting on the pressurised oil pipe leading from the pump to the power steering unit and steering completely to one side.
When the steering wheel is forced, the pressure shown should increase to approximately 85 bar. If this does not happen, either the pump or the power steering distribution valves are faulty.

TOPPING-UP THE POWER STEERING CIRCUIT AND BLEEDING THE AIR

- Remove the filler cap and top up the reservoir with the prescribed type of oil.
1. Loosen the intake pipe clip on the power steering pump and bleed the circuit until oil flows out.





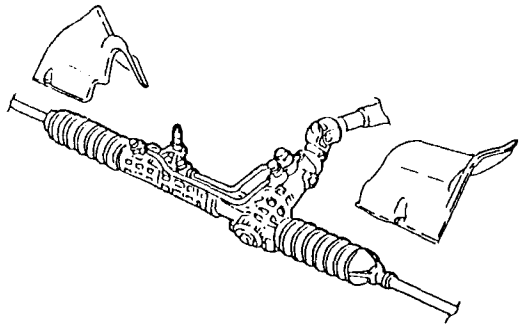
- Idle the engine. Check that the reservoir does not empty completely and turn the steering wheel completely to the left and to the right to bleed the air. Top up to the maximum notch on the reservoir.

IMPORTANT:
The power steering system is self-bleeding.
It is bleed by steering completely to the left and to the right with the engine running.
Perform this operation whenever the connecting pipes are connected/disconnected.

Steering stiffness can be caused by the pump drive pulley belt slipping or insufficient oil level.
If the pump, the operating cylinder or the distribution valve break down, the power steering unit will work like and ordinary mechanical steering system.

POWER STEERING GUARDS
Specific for 1970 T. SPARK 16V

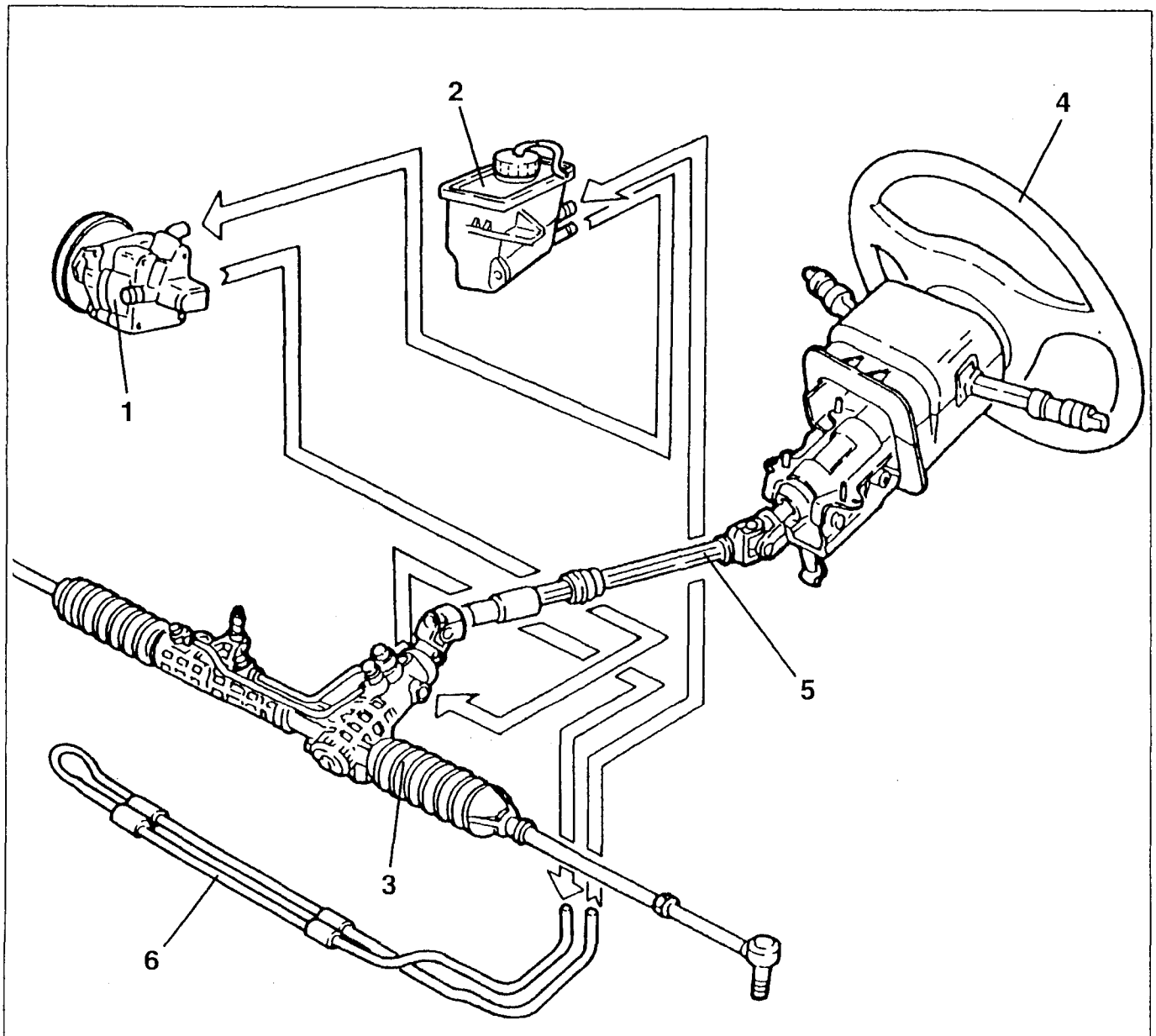
Two sound-proofing guards are fitted on the ends to the power steering unit, as shown in the illustration.



DESCRIPTION

The power steering unit reduces the force required to turn the steering wheel when the vehicle is stationary and ensures accurate steering at high speeds. Moreover, it allows a special steering column (5) structure in two sections which confers a higher degree of passive safety in the event of front crashes. The system consists of a pump (2) directly operated by the engine by means of a belt.

The pump collects oil via the delivery manifold from the reservoir (2) located in the engine compartment. It sends the pressurised oil through a pipe to the distribution valve located on the power steering unit (3).
The distribution valve is connected by means of a pipe to the reservoir to allow the oil let out of the cylinder flow back to the reservoir.
This pipe contains a oil cooling serpentine (6).

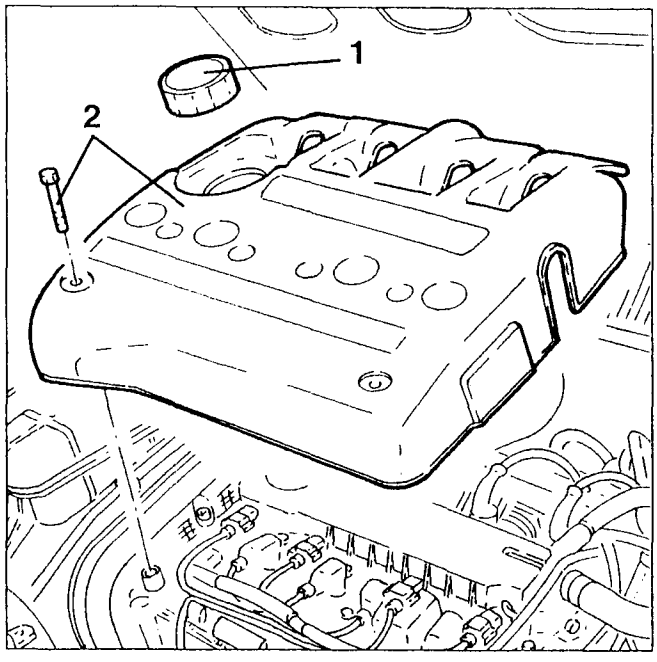


1. *Power steering pump*
2. *Reservoir*
3. *Power steering unit*
4. *Steering wheel*
5. *Steering column*
6. *Cooling serpentine*

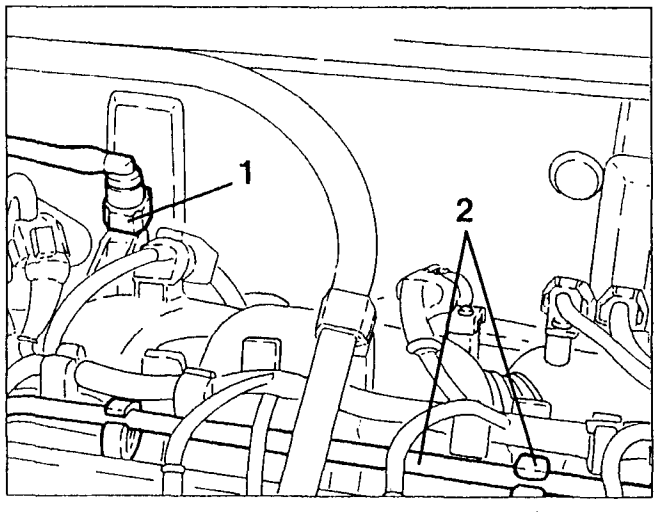
POWER STEERING RESERVOIR

REMOVAL/REFITTING

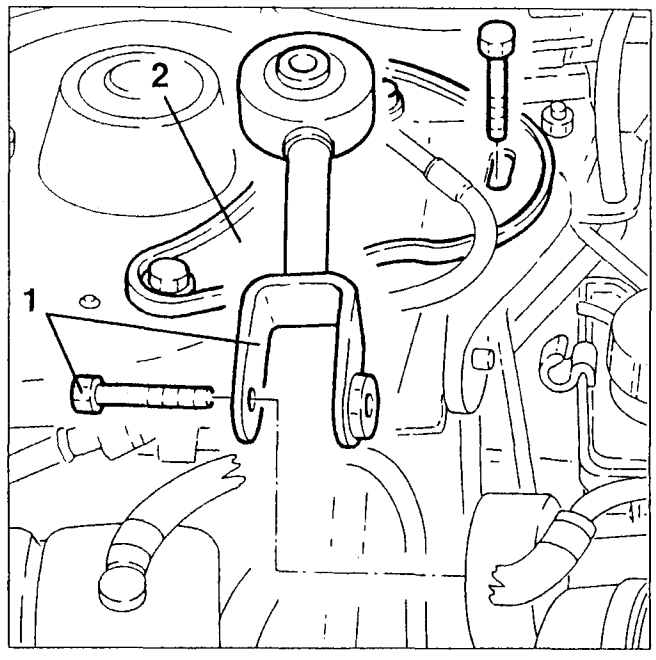
- Remove the power steering reservoir cap and suck the oil with a suitable syringe.
1. Remove the oil filler cap.
2. Remove the fastening screws and remove the tappet cover.



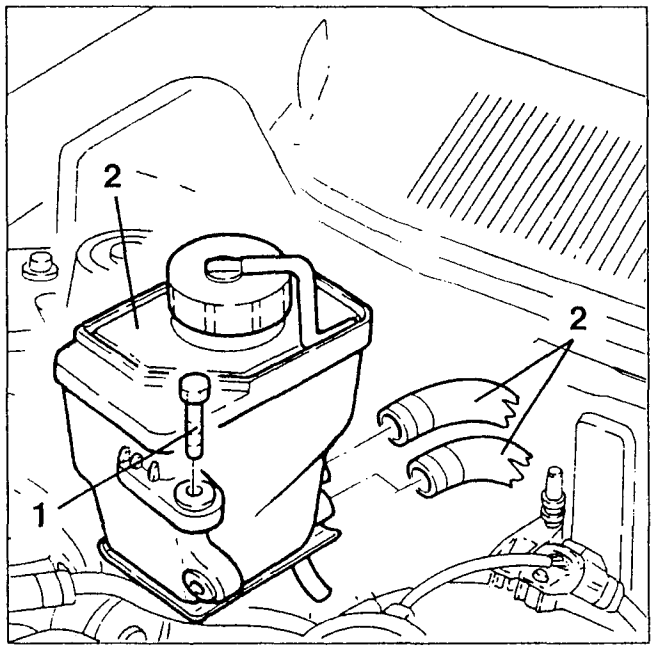
- Refit the engine oil filler cap.
1. Disconnect the fuel fume re-circulation quick coupling pipe.
- Release the fuel fume re-circulation pipe from the power steering reservoir clip and shift it.
2. Release the coolant return to reservoir pipe from the clips on the intake manifold.



1. Remove the fastening screws and remove the engine reaction tie-rod.
2. Remove the fastening screws and remove the upper engine reaction tie-rod support.



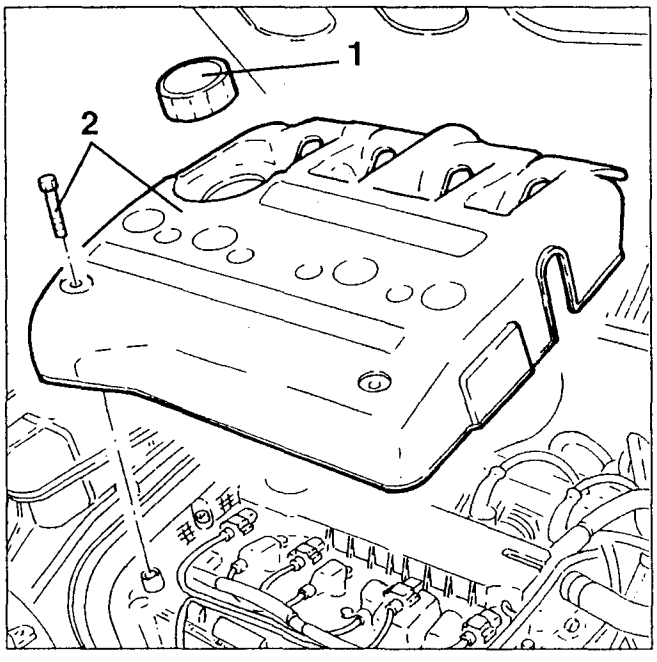
1. Remove the power steering reservoir fastening screws.
2. Disconnect the power steering reservoir delivery/return pipes and remove the reservoir.



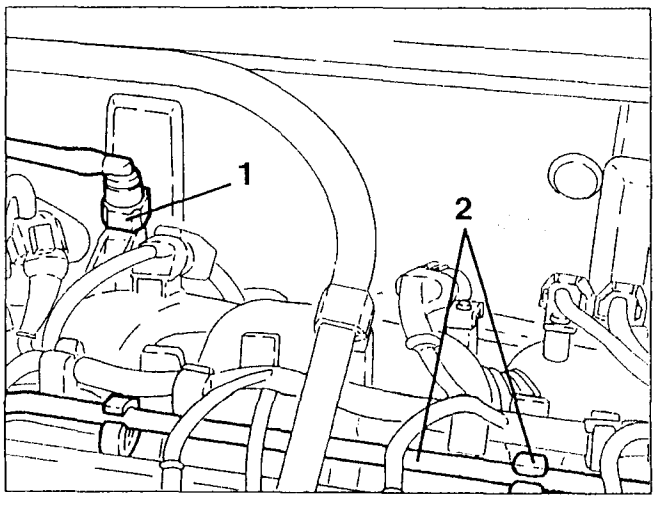
POWER STEERING PUMP

REMOVAL/REFITTING

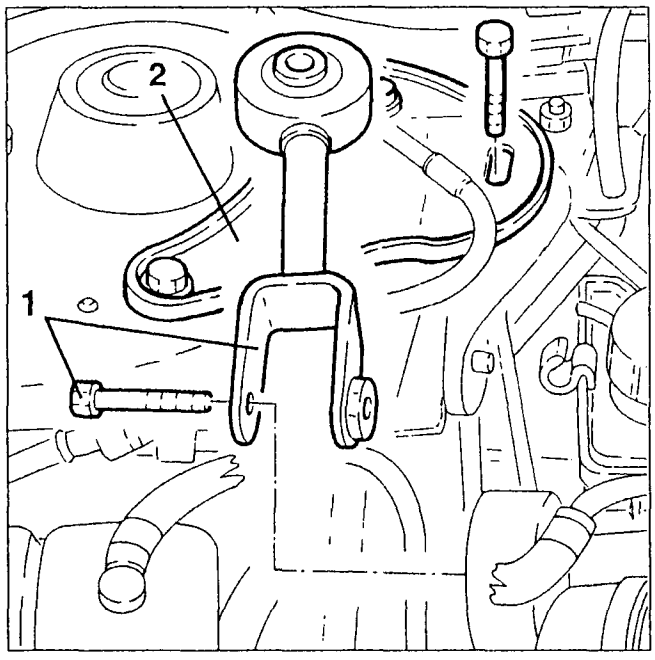
- Position the vehicle on a shop jack.
- Remove the power steering reservoir cap and suck the oil with a suitable syringe.
1. Remove the oil filler cap.
2. Remove the fastening screws and remove the tappet cover.



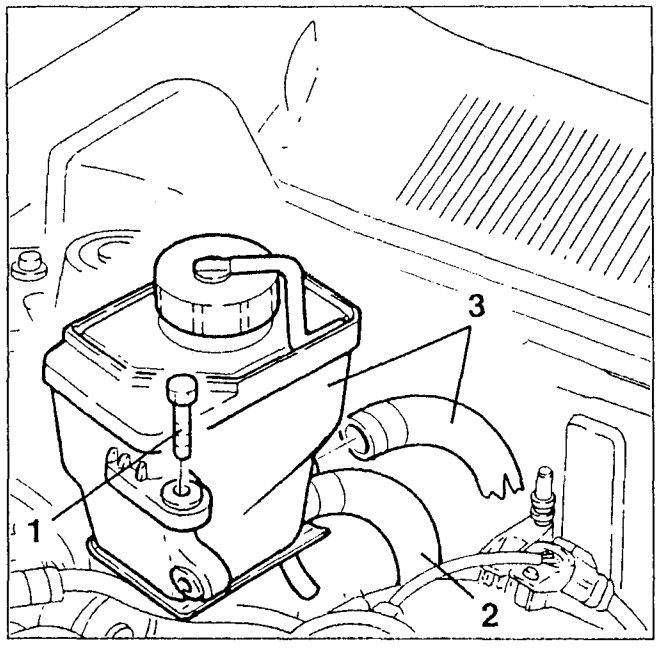
- Refit the engine oil filler cap.
1. Disconnect the fuel fume re-circulation quick coupling pipe.
- Release the fuel fume re-circulation pipe from the power steering reservoir clip and shift it.
2. Release the coolant return to reservoir pipe from the clips on the intake manifold.



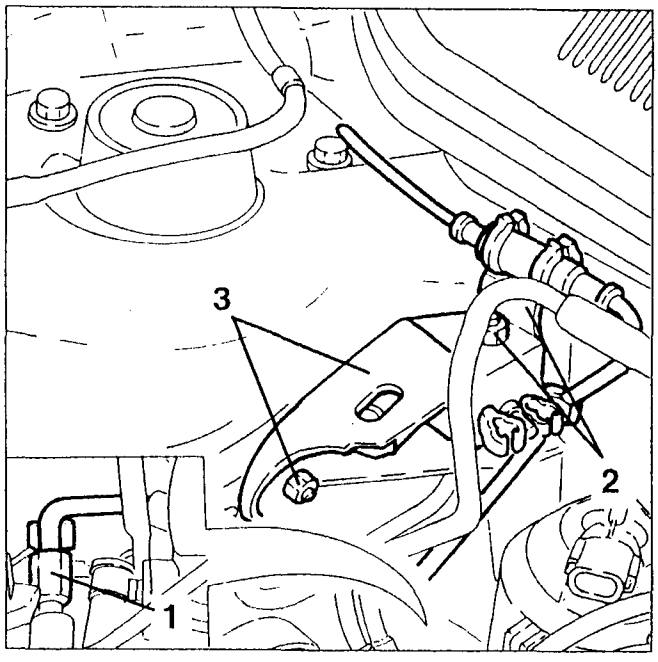
1. Remove the fastening screws and remove the engine reaction tie-rod.
2. Remove the fastening screws and remove the upper engine reaction tie-rod support.



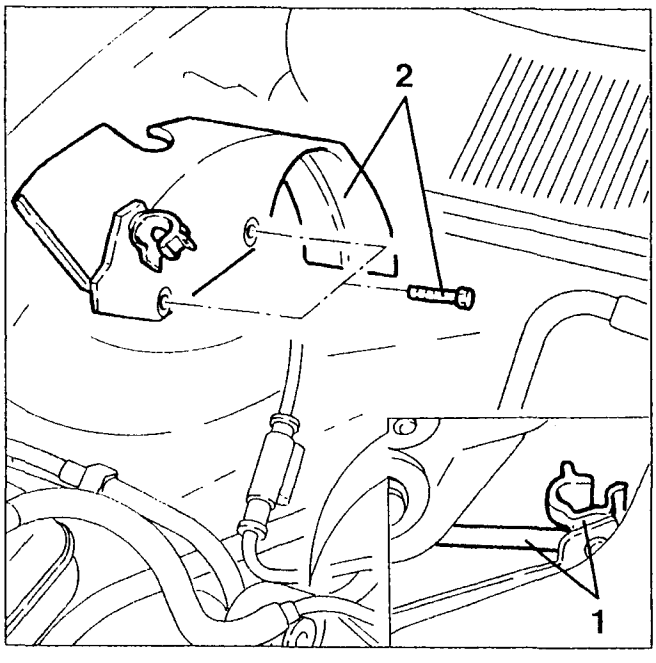
1. Remove the power steering reservoir fastening screws.
2. Disconnect the intake pipe from the power steering unit.
3. Disconnect the power steering reservoir delivery/return pipes and remove the reservoir.



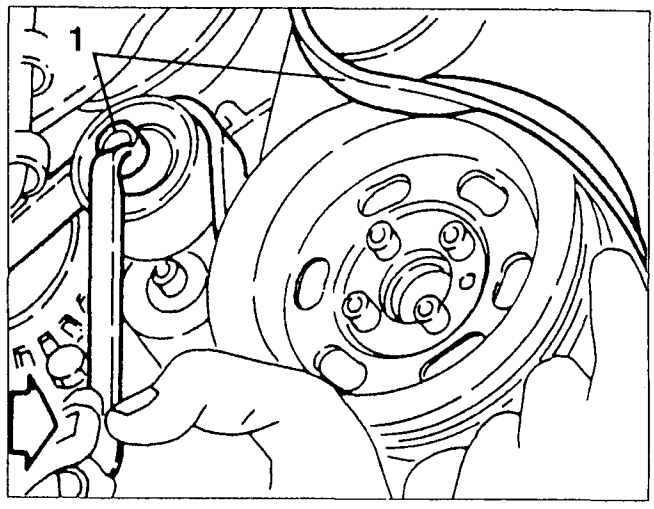
1. Disconnect the power steering unit delivery pipe from the pump.
2. Remove the fastening nut and shift the ABS electric connection support rod.
3. Remove the fastening nut and screw and remove the lower engine reaction tie-rod support.



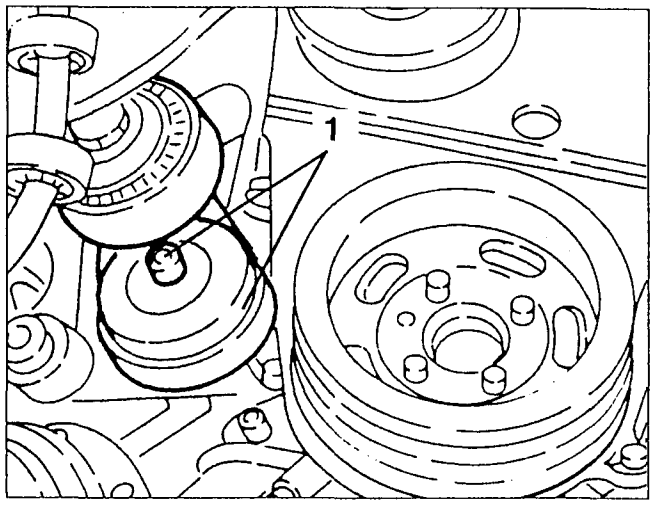
1. Release the timing sensor wiring from the clip on the guard.
2. Remove the fastening screws and remove the guard.



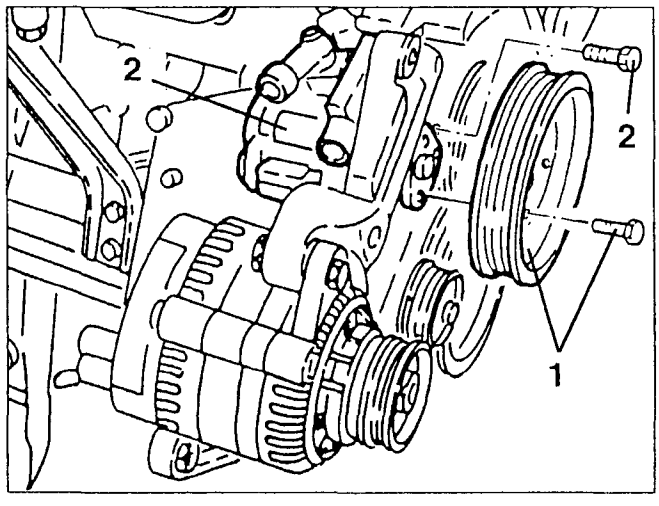
- Lift the vehicle.
1. Slacken the auxiliary unit belt, by means of the belt take-up, and remove it.



1. Remove the fastening screw and remove the belt take-up device.



1. Hold the pump shaft still and remove the power steering pump pulley. Remove the pulley.
2. Remove the fastening screws and remove the power steering pump.



SUSPENSION AND WHEELS

44

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FRONT SUSPENSION 1370 1598 1747 T. SPARK 16V

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HUBS AND WHEELS

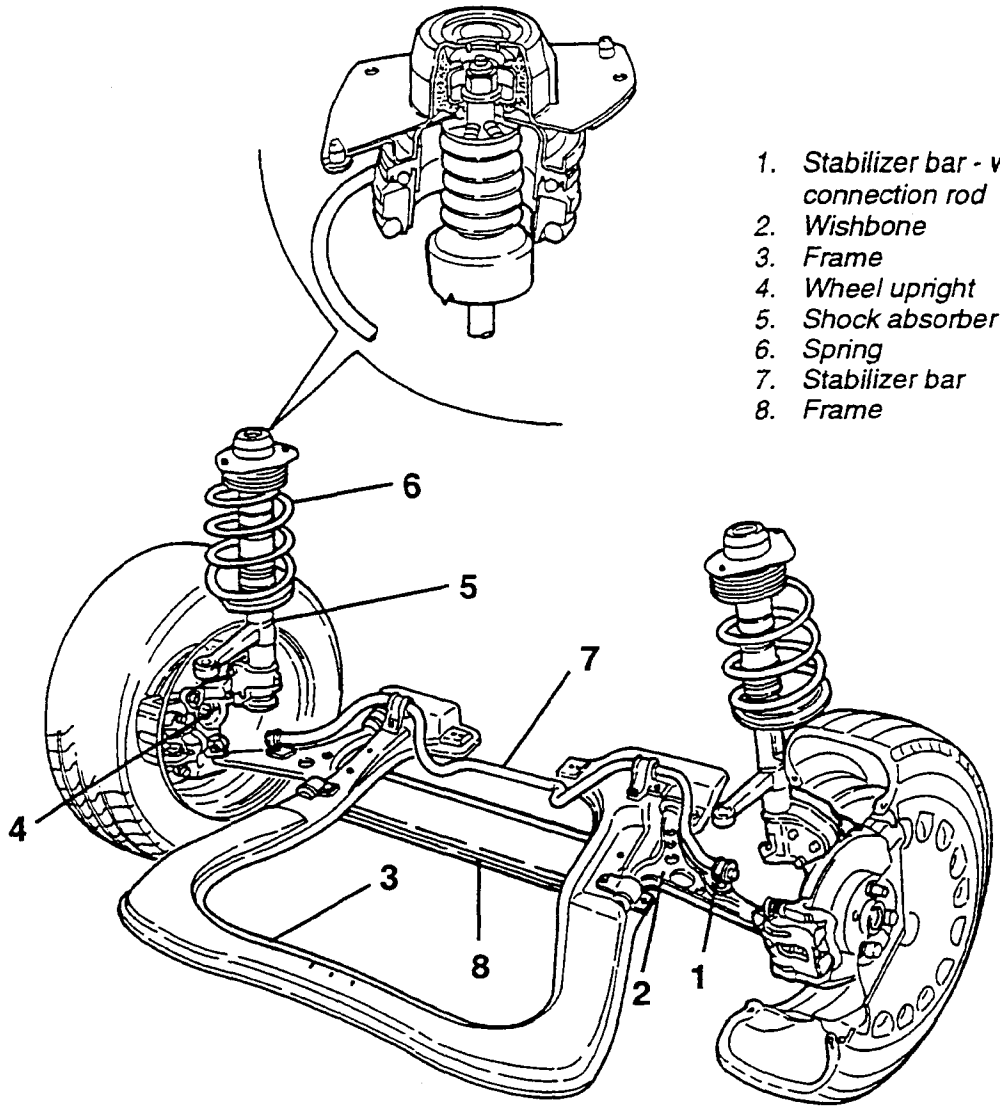
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(*): See 1970 T. SPARK 16V

DESCRIPTION

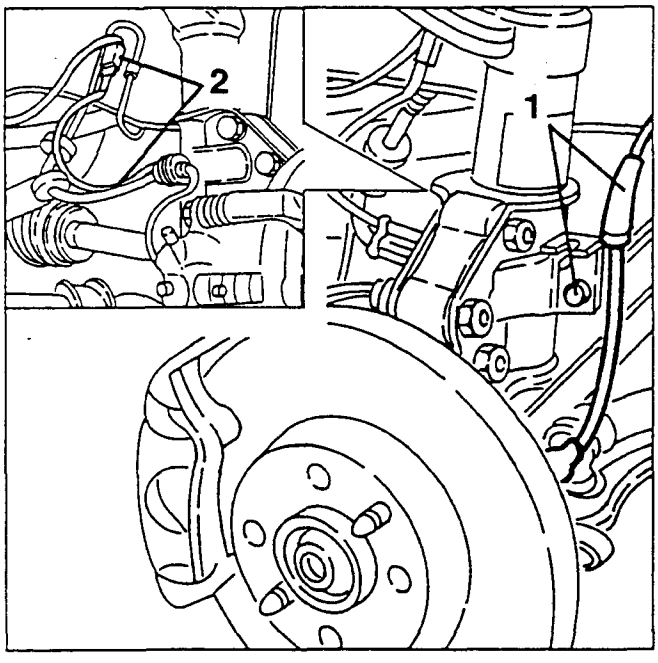


The front suspension to independent wheels is of the McPherson type with telescopic struts and negative kingpin offset.
The front suspension assembly can be broken down into the following main components:
- The frame (3) supporting the power unit which is rigidly fastened to the body which besides integrating the bearing structure, also supports the cast iron suspension wishbones (2).
- The telescopic struts which comprise the helical springs (6) and the shock absorbers (5).
The offset and tapered springs make it possible to reduce the thrust on the shock absorber stem and facilitate steering.
This solution also eliminates shock absorber noise when the car is on the move, consequently improving comfort.
The newly-designed shock-absorbers are pressurised with lamellar inlet valves with plates with particularly fine tolerances, thereby achieving outstanding results in terms of comfort and noiselessness over large obstacles while maintaining the necessary damping action.
- The cast iron wishbones (2), carry the ball joints connected with the wheel upright (4) and the silent-blocks with steel sheet reinforcement for fastening the wishbones themselves to the frame (3).
The rotation of the wishbones on the silent-block confers high transversal rigidity and low longitudinal rigidity to the suspension.
These operating conditions make it possible to:
- improve vehicle behaviour even under particularly critical roadholding conditions.
- improve driving comfort.
Increasing the rigidity of the suspension on one side of the vehicle and lowering it on the other, the stabilizer bar (7) serves to limit transversal inclination of the car body.
This makes it possible to increase the speed limits when comering as it counters the increase in the roll of the body caused by the centrifugal stresses which occur as the speed increases.

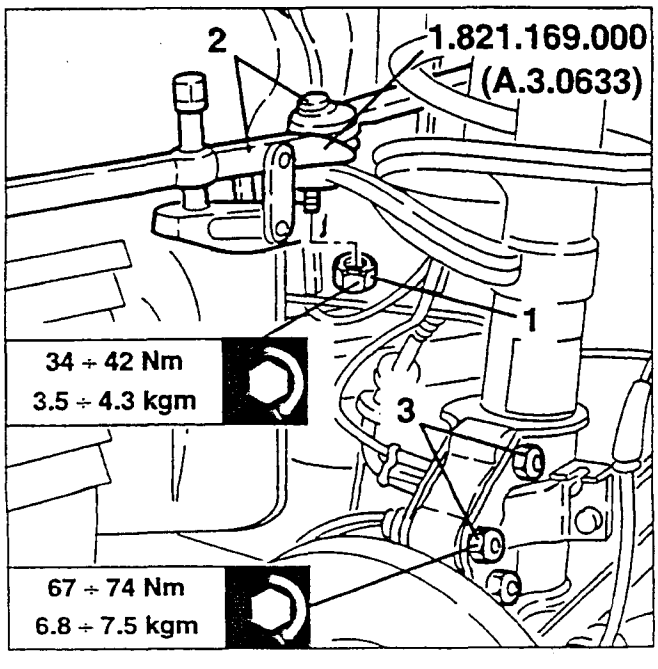
HELICAL SPRING AND SHOCK ABSORBER ASSEMBLY

REMOVAL/REFITTING

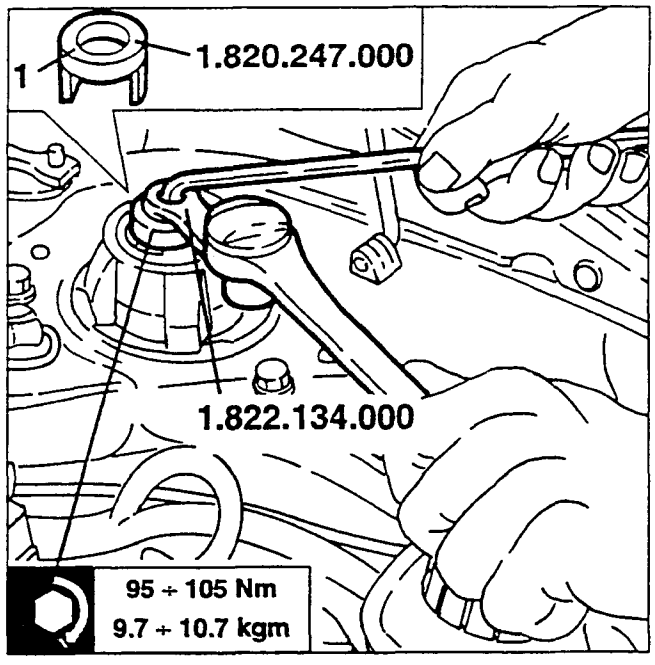
- Remove the front wheel on the side concerned.
1. Disconnect the cable of the A.B.S. inductive sensor from the fastening on the shock absorber.
2. Disconnect the cable of the brake pad wear sensor and the brake hose from the connection on the shock-absorber.



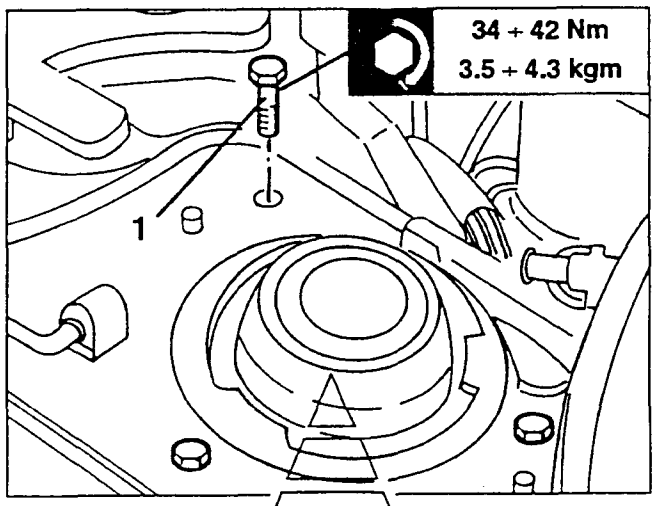
1. Unscrew the nut fastening the track rod from the connection on the shock absorber.
2. Using tool N° 1.821.169.000 (A.3.0633), disconnect the track rod from the connection on the shock absorber.
3. Slacken the three bolts fastening the shock absorber to the wheel upright.

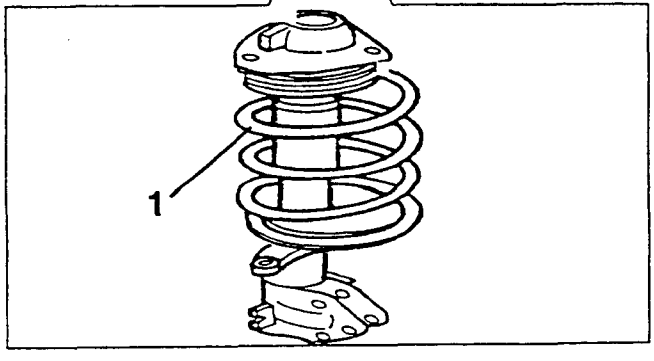


- Lower the car.
1. If needing to separate the spring from the shock absorber on the bench, remove the protective cover and using the shock absorber stem retainer tool N° 1.820.247.000 and the extension for wrench N° 1.822.134.000, slacken the centre spring retainer nut.



1. Slacken the three screws fastening the shock absorber to the body.
2. Remove the spring-shock absorber assembly from the wheel house.

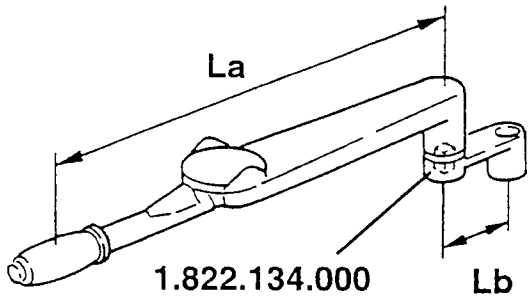




For tightening the spring retainer nut, use wrench N° 1.822.134.000 coupled to a torque wrench, the correct tightening torque must therefore be calculated by applying the following formula:

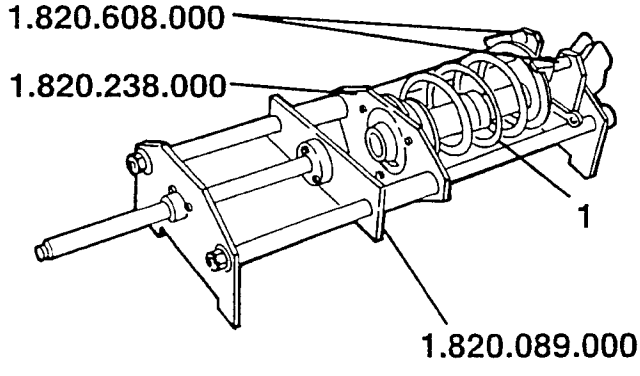
$$Cr = \frac{La \cdot Cn}{La + Lb}$$

La : length of torque wrench (in m)
Lb : length of wrench N° 1.822.134.000 (in m)
Cn : nominal torque (95 ÷ 105 Nm)

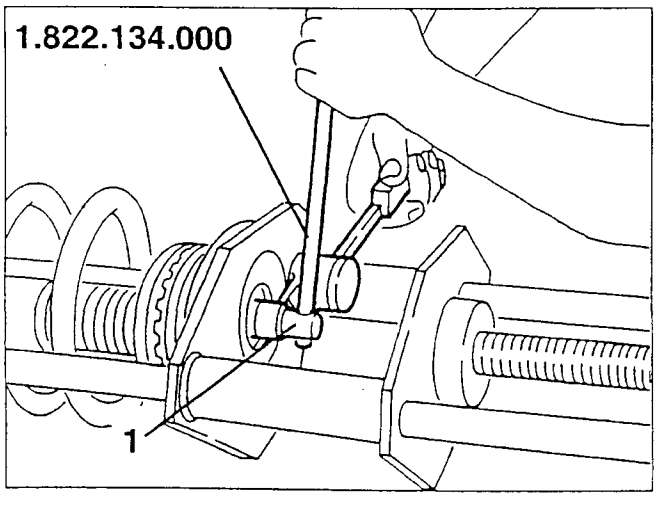


DIS-ASSEMBLY/RE-ASSEMBLY

1. Position the spring-shock absorber assembly on tool N° 1.820.089.000 fitted with rest plates N° 1.820.238.000 and blocks N° 1.820.608.000 and compress it.



1. Using wrench N° 1.822.134.000 unscrew the retainer nut loosened previously.



- Decompress the spring-shock absorber assembly and disassemble them.

CHECKS AND INSPECTIONS

- Check that the fastener components of the helical spring - shock absorber assembly show no signs of abnormality that might adversely affect operation.
- Check the conditions of the shock absorber and ensure that they work correctly and are not leaking, in any case change the whole shock absorber.
- Visually check the springs for cracks, distorsions and failures in general that might adversely affect operation.

The helical springs are subdivided into classes of stiffness and marked with coloured paint to simplify identification.If one or both of the springs is replaced, check that the new springs are marked with the same colour as those being replaced.

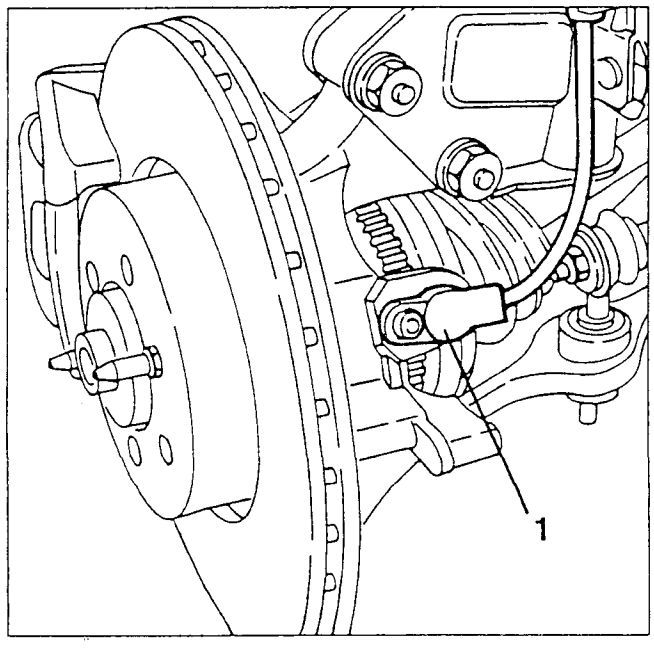
- Check that the rubber parts are intact and change them if they are damaged, deformed or obviously worn.

WISHBONES

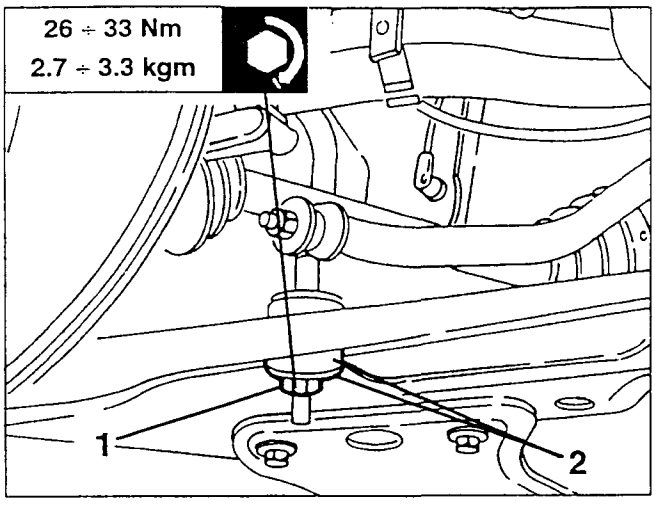
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the front wheel on the side concerned.
- Raise the car.

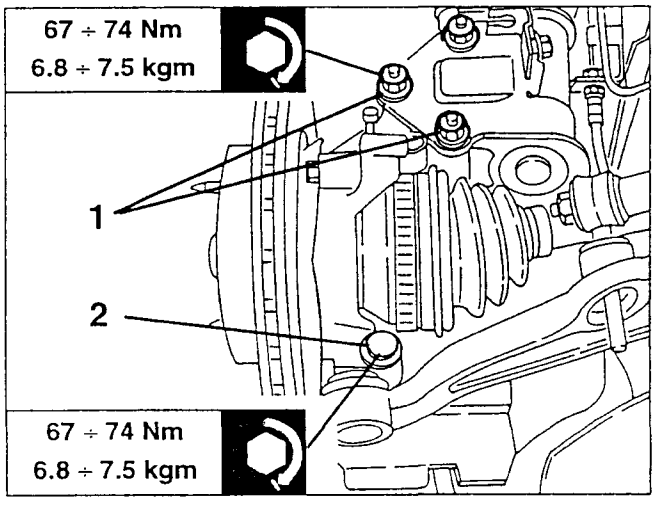
1. Slacken the fastening screw and remove the inductive A.B.S. sensor from the wheel upright.



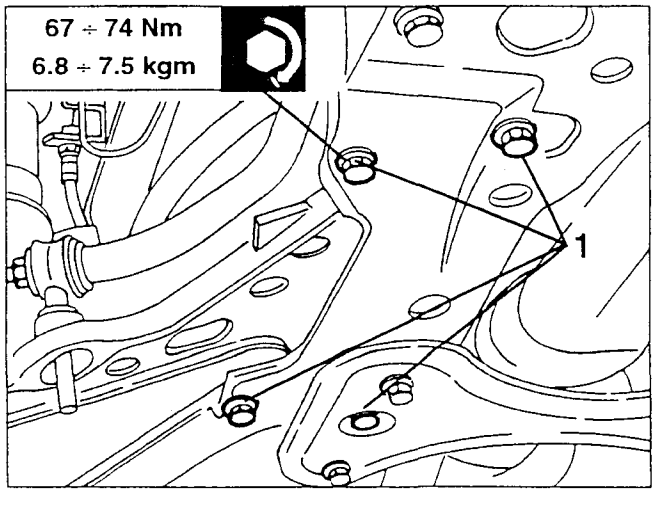
1. Unscrew the nut coupling the stabilizer bar connecting rods from the right and left wishbones.
2. Retrieve the washer and pad.



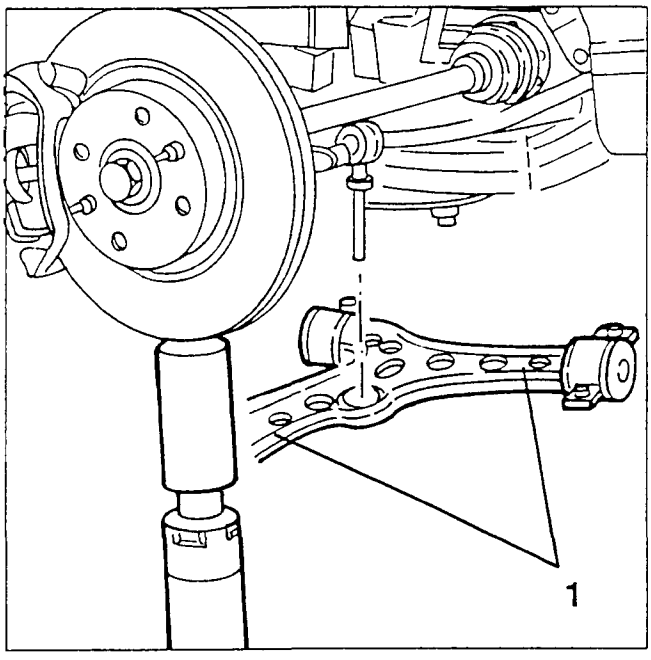
1. Slacken the three bolts fastening the wheel upright to the shock absorber stem.
2. Slacken the bolt fastening the wishbone to the wheel upright.



1. Slacken the four screws fastening the wishbone to the engine support frame.

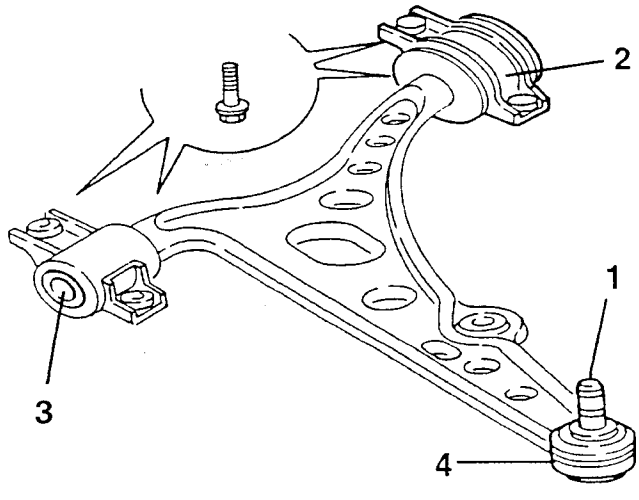


1. Support the suspension with a hydraulic jack as illustrated and remove the wishbone.



CHECKS AND INSPECTIONS

1. Check the wear conditions of the ball pin connection between the wishbone and the wheel upright and that it is intact, change it if necessary.
2. Check the wear conditions of the U-bolts between the wishbone and front frame and that they are intact, change them if necessary.
3. Check the conditions of wear of the rubber bushes of the U-bolts between the wishbone and the front frame and that they are intact, change them if necessary.
4. Check the conditions of wear of the rubber boots of the ball pin between the wishbone and the wheel upright and that they are intact, change them if necessary.

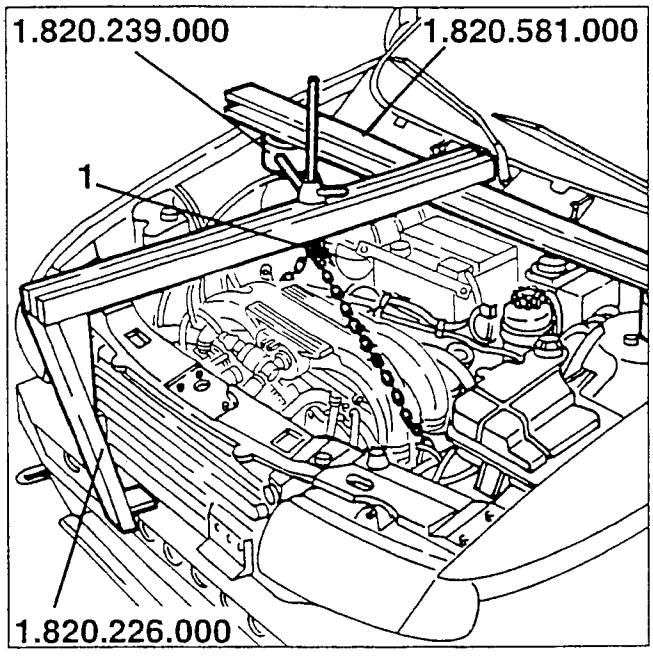


ENGINE SUPPORT FRAME AND STABILIZER BAR

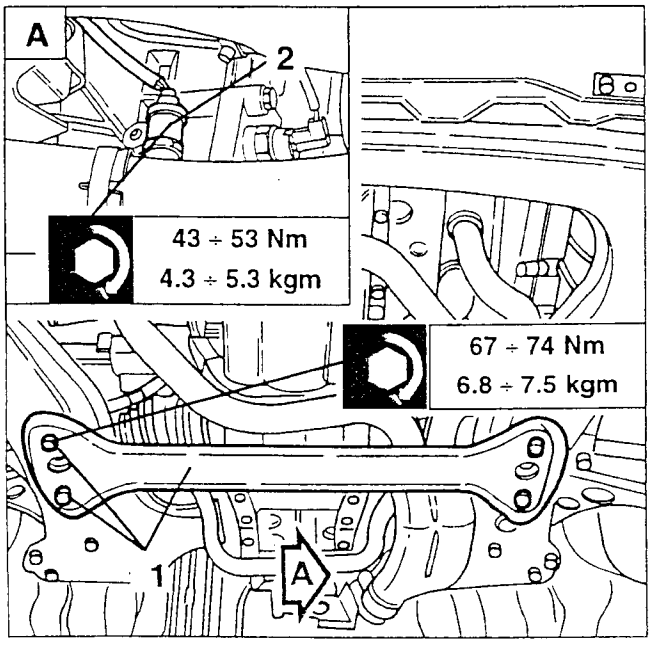
REMOVAL/REFITTING

- Set the car on a lift.
- Remove the front wheels.
- Remove the radiator grille and bumper (see GROUP 70).

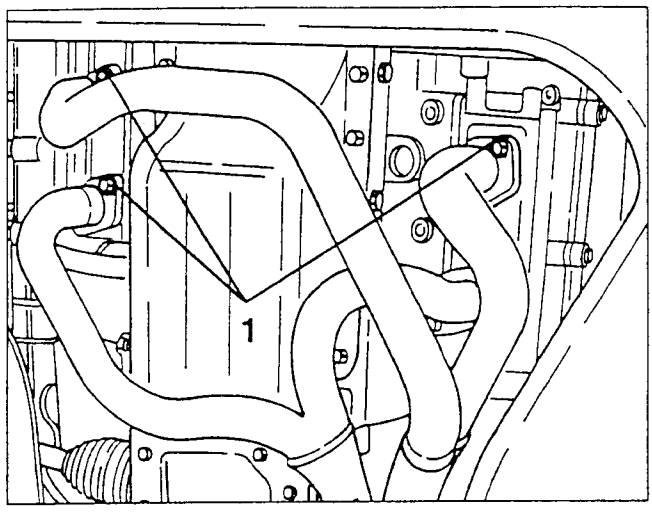
1. Using tools N° 1.820.239.000, N° 1.820.581.000 and N° 1.820.226.000 suitably support the engine.



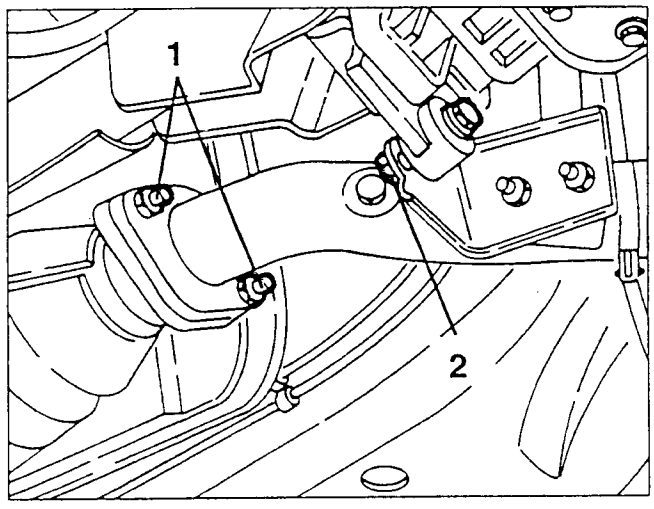
1. Slacken the four fastening screws and remove the engine support frame crossmember.
2. Slacken e remove the lambda sensor from the exhaust manifolds.



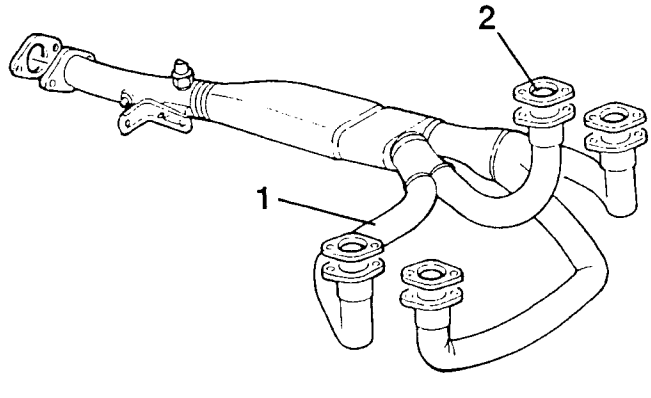
1. Slacken the nuts fastening the exhaust manifolds to the cylinder heads.



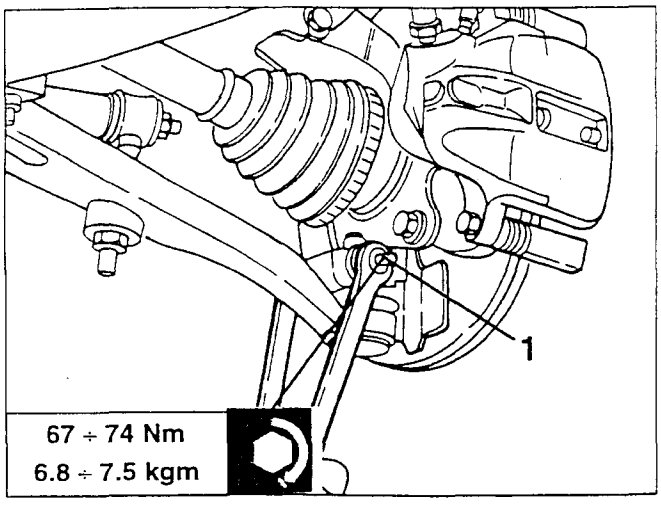
1. Slacken the two bolts fastening the exhaust manifolds to the catalytic converter.
2. Slacken the bolt fastening the exhaust manifold support bracket.



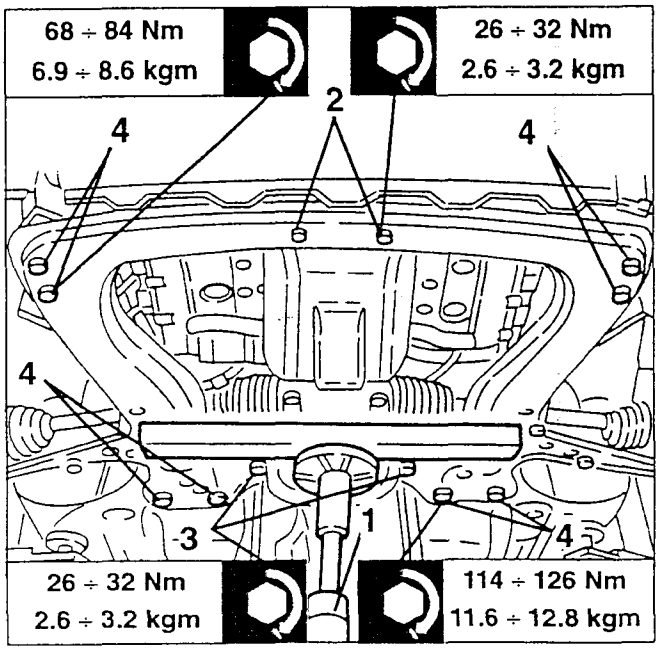
1. Remove the exhaust manifolds.
2. Remove the seals.



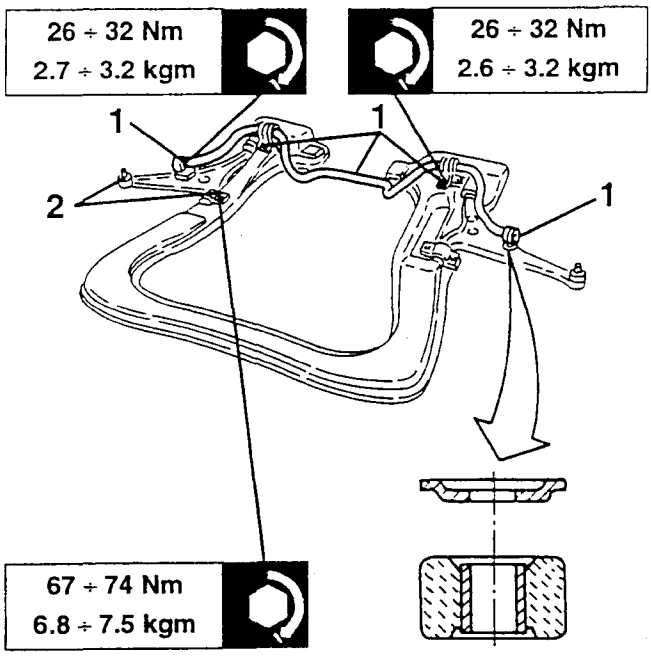
1. Slacken the bolts fastening the wishbones to the wheel uprights.



1. Suitably support the engine support frame with a hydraulic jack.
2. Slacken the two screws fastening the frame to the front flexible engine mount.
3. Slacken the two screws fastening the frame to the gearbox flexible mounts.
4. Slacken the screws fastening the frame to the body and remove it complete with wishbones and stabilizer bar.



1. If necessary, remove the stabilizer bar, slackening the nuts of the U-bolts securing the nuts fastening the connecting rods to the wishbones.
2. If necessary, remove the wishbones slackening the nuts of the U-bolts.

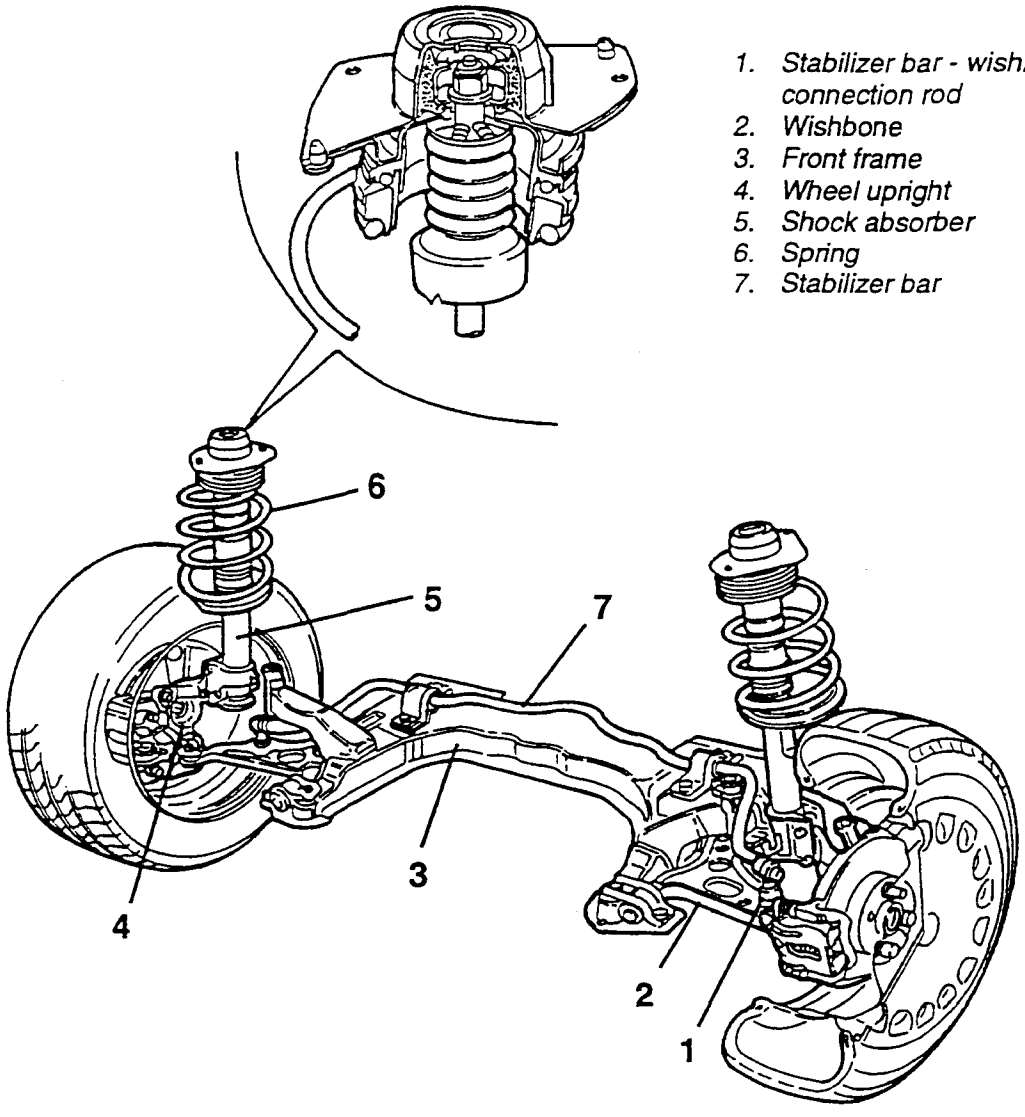


When refitting the stabilizer bar on the frame check that the washers are facing the flexible pad as illustrated, as incorrect assembly could compromise the life of the actual pad.

CHECKS AND INSPECTIONS

- Visually check the frame to make sure there are no cracks or distorsions that might adversely affect operation, if so, change it.
- Visually check the stabilizer bar for cracks and distorsions and change it if necessary.
- Check that the U-bolts joining the stabilizer bar to the frame are intact and free of distorsion or signs of oxidation, if not change them.
- Check that the flexible pads do not reveal signs of wear, if so, change them.

DESCRIPTION



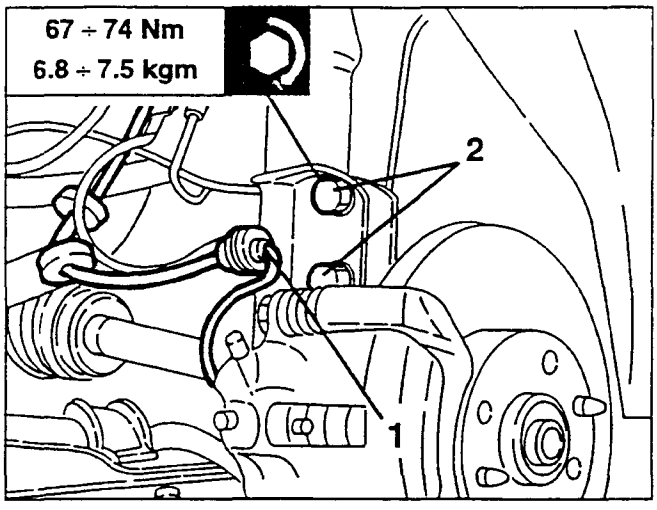
1. *Stabilizer bar - wishbone connection rod*
2. *Wishbone*
3. *Front frame*
4. *Wheel upright*
5. *Shock absorber*
6. *Spring*
7. *Stabilizer bar*

The front suspension to independent wheels is of the Mc Pherson type with telescopic struts and negative kingpin offset.
The front suspension assembly can be broken down into the following main components:
- The frame (3) supporting the power unit which is rigidly fastened to the body and besides integrating the bearing structure, it also supports the cast iron suspension wishbones (2).
- The telescopic struts which comprise the helical springs (6) and the shock absorbers (5).
The offset and tapered springs make it possible to reduce the thrust on the shock absorber stem and facilitate steering.
This solution also eliminates shock absorber noise when the car is on the move, consequently improving comfort.
The newly-designed shock-absorbers are pressurised with lamellar inlet valves with plates with particularly fine tolerances, thereby achieving outstanding results in terms of comfort and noiselessness over large obstacles while maintaining the necessary damping action.
- The cast iron wishbones (2), carry the ball joints connected with the wheel upright (4) and the silent-blocks with steel sheet reinforcement for fastening the wishbones themselves to the frame (3).
The rotation of the wishbones on the silent-block confers high transversal rigidity and low longitudinal rigidity to the suspension.
These operating conditions make it possible to:
- improve vehicle behaviour even under particularly critical roadholding conditions.
- improve driving comfort.
Increasing the rigidity of the suspension on one side of the vehicle and lowering it on the other, the stabilizer bar (7) serves to limit transversal inclination of the car body.
This makes it possible to increase the speed limits when cornering as it counters the increase in the roll of the body caused by the centrifugal stresses which occur as the speed increases.

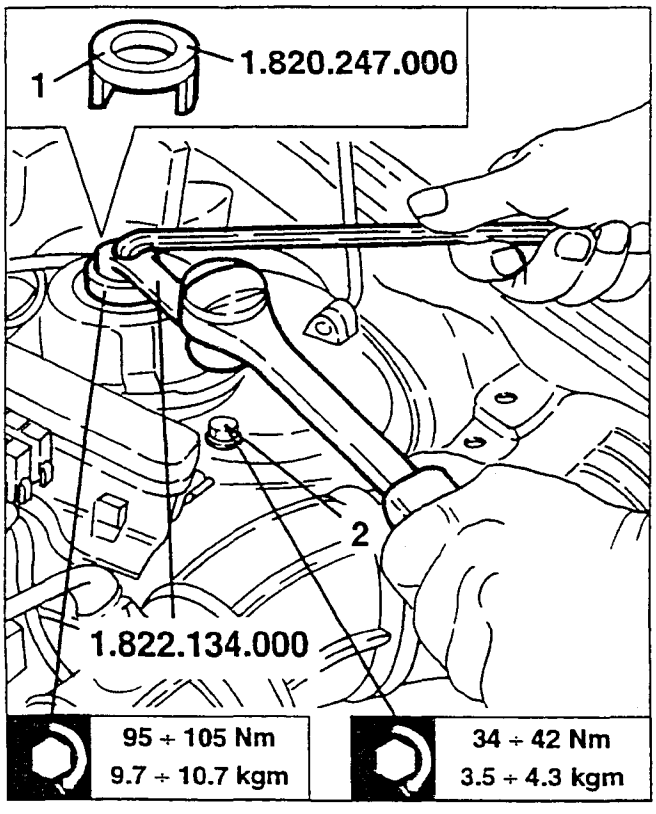
HELICAL SPRING AND SHOCK ABSORBER ASSEMBLY

REMOVAL/REFITTING

- Remove the front wheel on the side concerned.
1. Disconnect the brake hose retainer grommet from the vertical guide with shock absorber.
2. Slacken the two bolts fastening the shock absorber guide to the wheel upright.



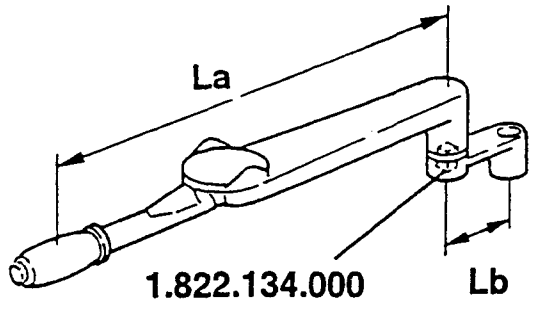
1. Using the shock absorber stem retainer tool N° 1.820.247.000, extension for wrench N° 1.822.134.000 and a 6 mm hexagon socket wrench, slacken the centre spring retainer nut.
2. Slacken the three screws fastening the shock absorber to the dome and remove the helical spring assembly and shock absorber.



For tightening the spring retainer nut, use wrench N° 1.822.134.000 coupled to a torque wrench, therefore the true tightening torque must be calculated applying the following formula:

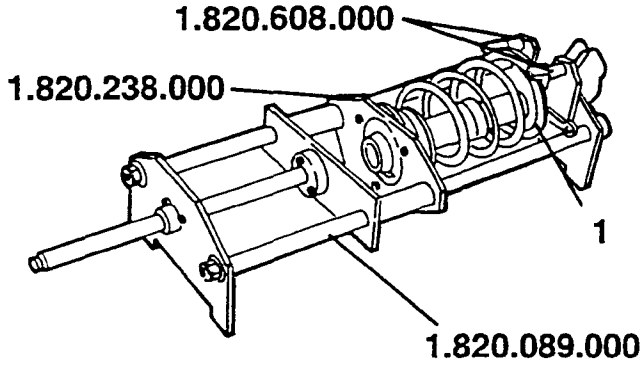
$$Cr = \frac{La \cdot Cn}{La + Lb}$$

La : length of torque wrench (in m)
Lb : length of wrench N° 1.822.134.000 (in m)
Cn : nominal torque (95 ÷ 105 Nm)

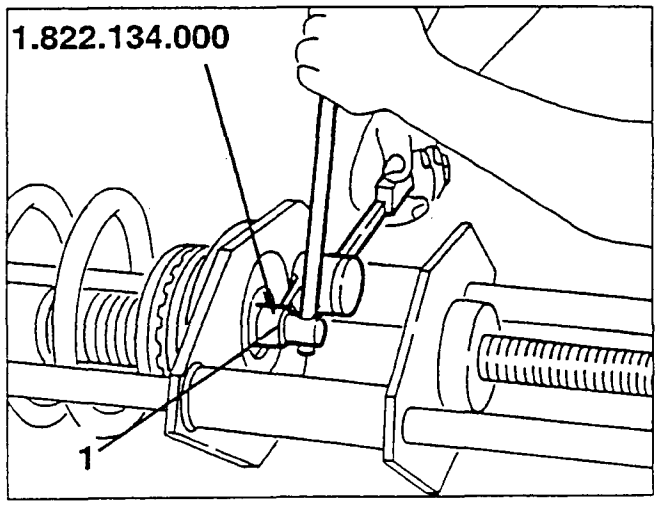


DIS-ASSEMBLY/RE-ASSEMBLY

1. Position the spring-shock absorber assembly on tool N° 1.820.089.000 fitted with resting plates N° 1.820.238.000 and blocks N° 1.820.608.000 and compress.



1. Using wrench N° 1.822.134.000 unscrew the spring retainer nut slackened previously.



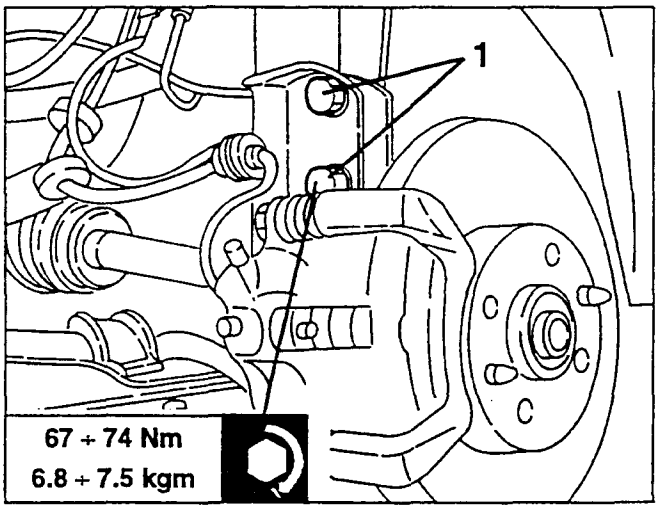
- Decompress the spring-shock absorber assembly and separate them.

For CHECKS AND INSPECTIONS proceed as described for the Boxer engines.

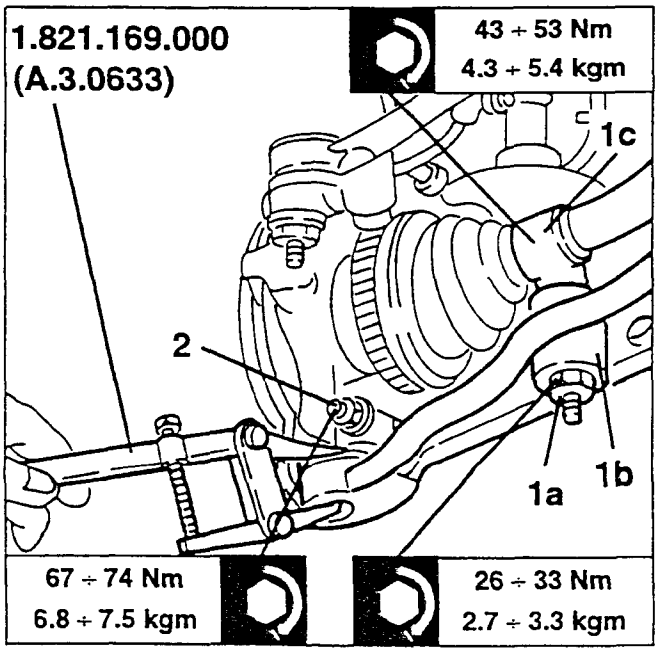
WISHBONE

REMOVAL/REFITTING

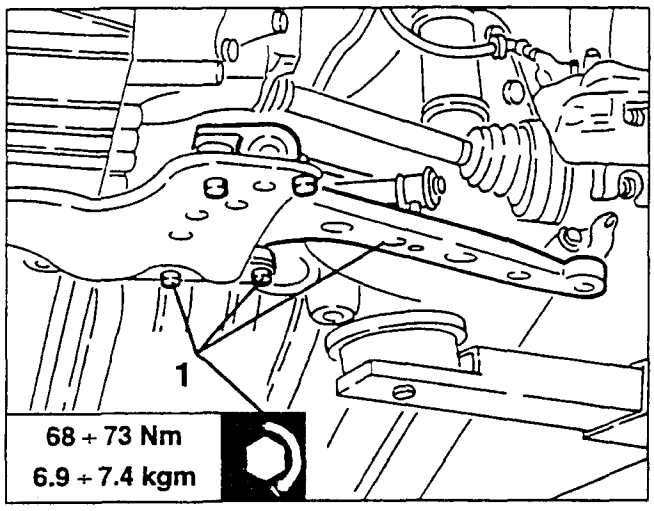
- Remove the front wheel on the side concerned.
1. Slacken the two bolts fastening the wheel upright to the shock absorber stem.



1. Slacken the nut fastening the connecting rod to the wishbone (1a) and remove it together with the rubber pad (1b) then slacken the nut fastening the connecting rod- stabilizer bar and remove it.
2. Slacken the bolt fastening the ball pin coupling the wishbone and wheel upright, then, using tool N° 1.821.169.000 (A.3.0633), disconnect the ball joint from the wishbone.



1. Slacken the screws fastening the U-bolts coupling the wishbone to the front crossmember and remove the wishbone.

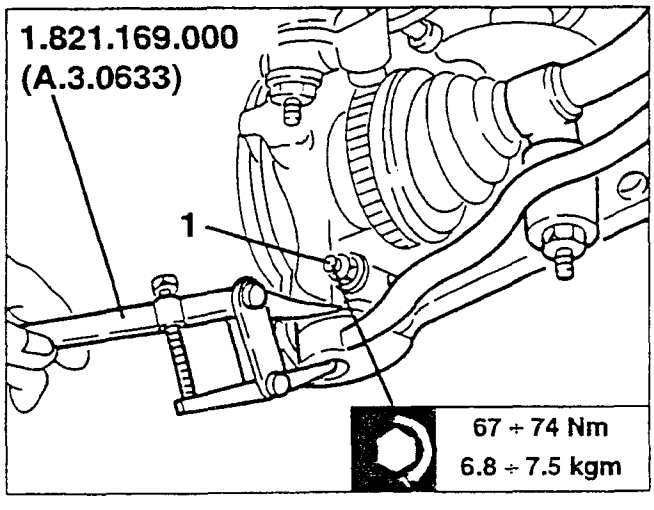


For CHECKS AND INSPECTIONS proceed as described for the Boxer engines.

FRONT CROSSMEMBER AND ANTIROLL BAR

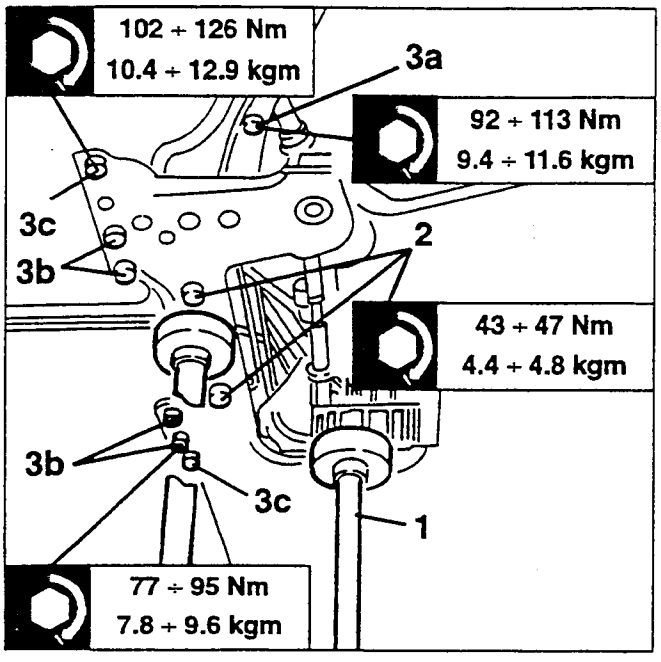
REMOVAL/REFITTING

When needing to change only the antiroll bar or only the front crossmember it is still necessary to remove the whole crossmember, proceeding as described below:
- Remove the front section of the exhaust pipe (see GROUP 10).
1. Slacken the bolt fastening the ball pin coupling between the wishbone and the wheel upright, then using tool N° 1.821.169.000 (A.3.0633), disconnect the ball joint from the wishbone.



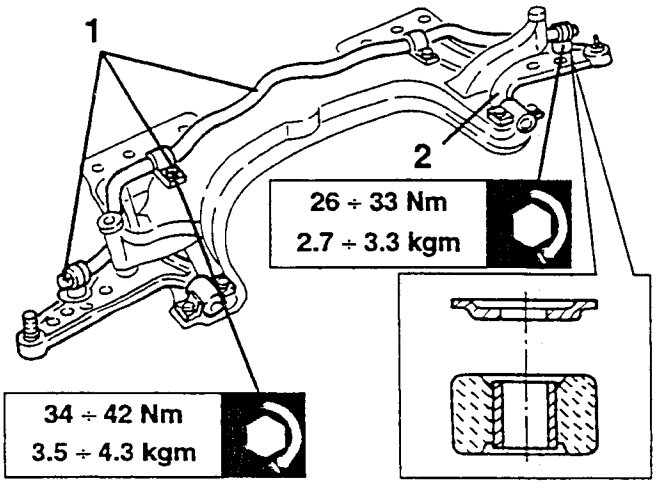
- Remove the power unit centre support (see GROUP 10).

1. Using a hydraulic jack, support the front crossmember.
2. Slacken the screws fastening the steering box to the crossmember.
3. Firstly slacken the two front screws (3a) fastening the crossmember to the body and then the six rear screws (3b) and (3c); then lower the jack and remove the front crossmember together with the stabilizer bar.

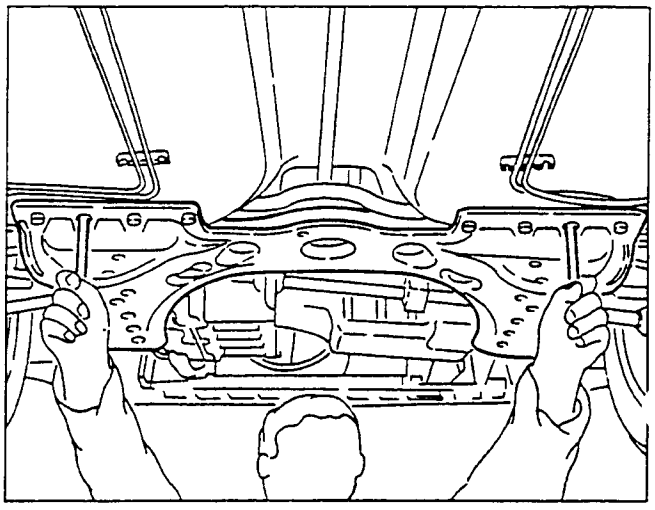


1. If necessary, remove the stabilizer bar, slackening the nuts fastening the U-bolts supporting the bar itself on the crossmember and the nuts fastening the stabilizer bar connecting rods to the wishbones.
2. If necessary, remove the wishbones.

- When refitting the stabilizer bar on the crossmember make sure that the washers are facing towards the rubber pad, as incorrect assembly might adversely affect the life of the pad itself.

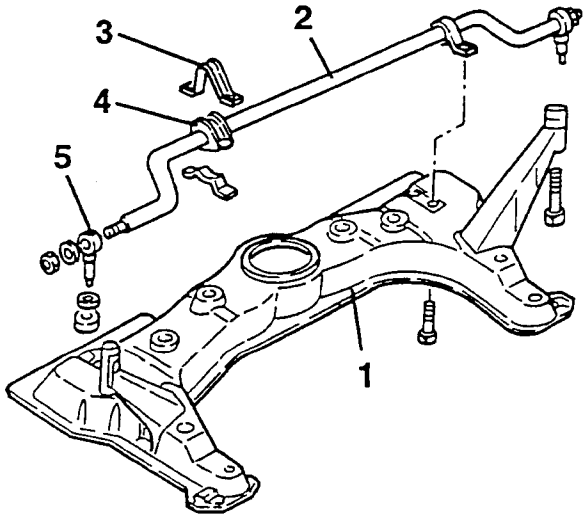


- When refitting the front crossmember it is necessary to fasten it temporarily using two 17.5 mm diameter pins, centre it with the holes on the body and then fasten it definitively tightening the screws to the specified torque.

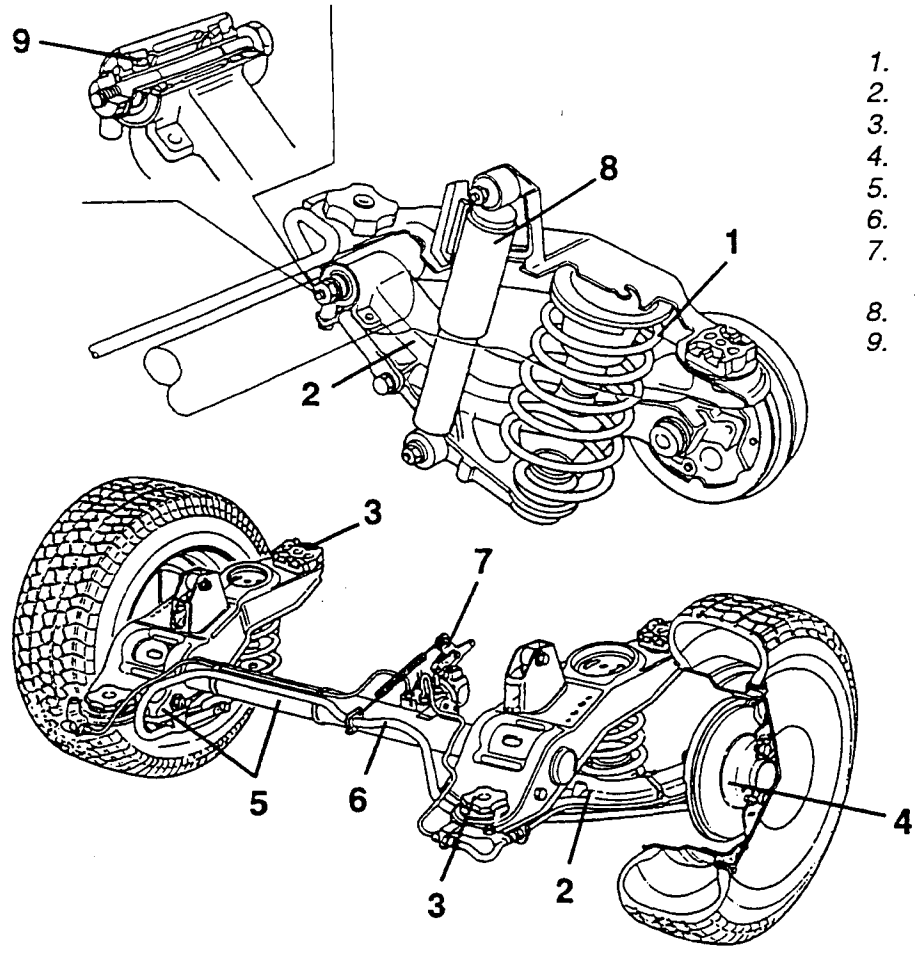


CHECKS AND INSPECTIONS

1. Visually check the crossmember for cracks and distorsions that might adversely affect its operation and change it, if necessary.
2. Visually check the stabilizer bar for cracks and distorsion and change it if necessary.
3. Check that the U-bolts connecting the stabilizer bar to the crossmember are intact and show no signs of distorsion or oxidation and if necessary, change them.
4. Check the rubber pads for signs of wear and change them if necessary.
5. Check that the ball pins connecting the stabilizer bar to the wishbones are intact and show no signs of distorsion or oxidation, if necessary, change them.



DESCRIPTION



1. *Spring*
2. *Arm*
3. *Flexible pad*
4. *Wheel hub*
5. *Rigid axle*
6. *Stabilizer bar*
7. *Braking load proportioning valve*
8. *Shock absorber*
9. *Taper roller bearings*

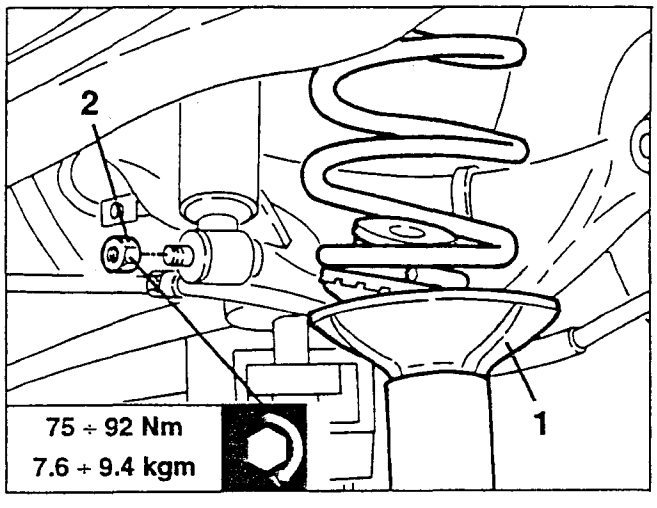
The rear suspension to independent wheels with longitudinal arms offers the advantage of being significantly reduced in size thereby enabling the adoption of a particularly low and wide luggage compartment.
The inherent problem with this type of suspension is that the wheels vary their inclination following the rolling of the vehicle.
This has been solved through the adoption of a stabilizer bar integral with the longitudinal arms.
The rear suspension assembly can be broken down into the following main components:
- Rear rigid axle (5), in tubular sheet metal, fastened to the body through flexible plugs (3).
- Longitudinal arms (2) integrated with the axle by screws and hinged on taper roller bearings (9). They support the wheel hub (4) and part of the braking system.
- The stabilizer bar (6) connected to the longitudinal arms limits the transversal lean of the car and by its own rotation also controls the operation of the braking load proportioning valve (7) which is connected to it.
- Helical springs (1) which limit the thrust on the shock absorber stem.
- Shock absorbers (8) which are pressurized with lamellar inlet valves that warrant a high degree of riding comfort.

SHOCK ABSORBERS

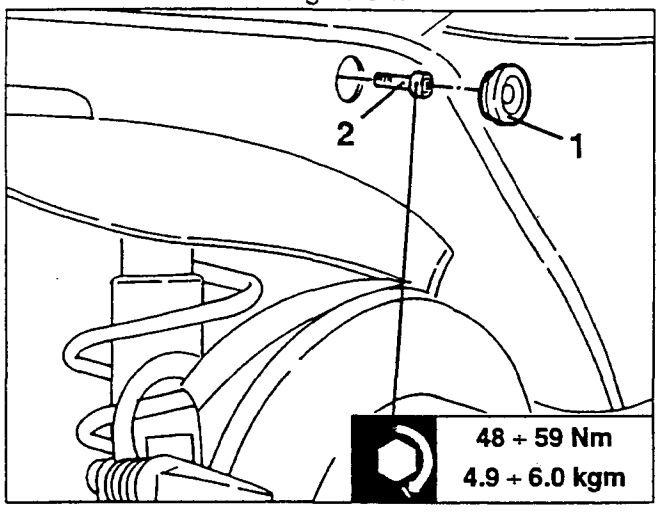
REMOVAL/REFITTING

- Set the car on a lift.
- Remove the wheel on the side concerned.

1. Raise the car and using a hydraulic jack placed under the longitudinal arm, preload the spring.
2. Slacken the lower nut fastening the shock absorber to the suspension longitudinal arm.

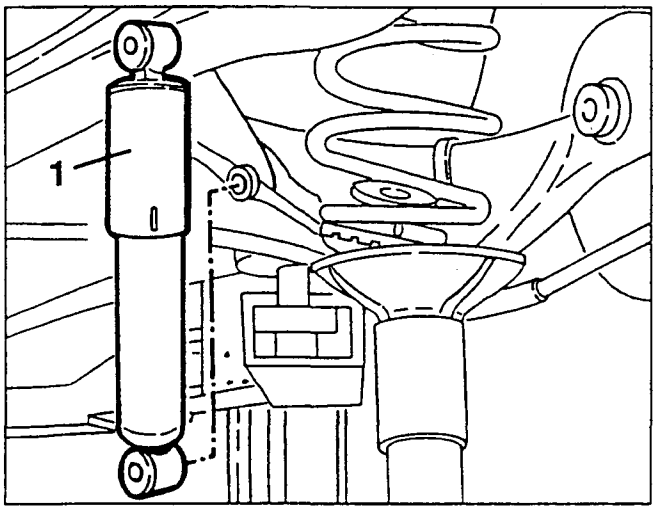


1. Remove the protective cap covering the access hole containing the upper shock absorber fastening screw.
2. Working through the wheel arch unscrew the upper shock absorber fastening screw.



NOTE: As the body is boxed around the area affected by the operation, pay particular attention not to drop the screw inside the boxed section.

1. Remove the shock absorber.



CHECKS AND INSPECTIONS

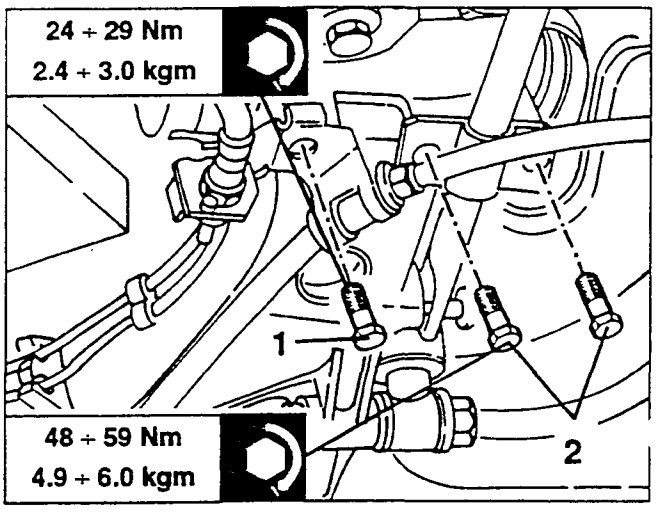
- Check that the shock absorber is working properly and does not leak, when necessary, always replace the whole shock absorber.

HELICAL SPRING

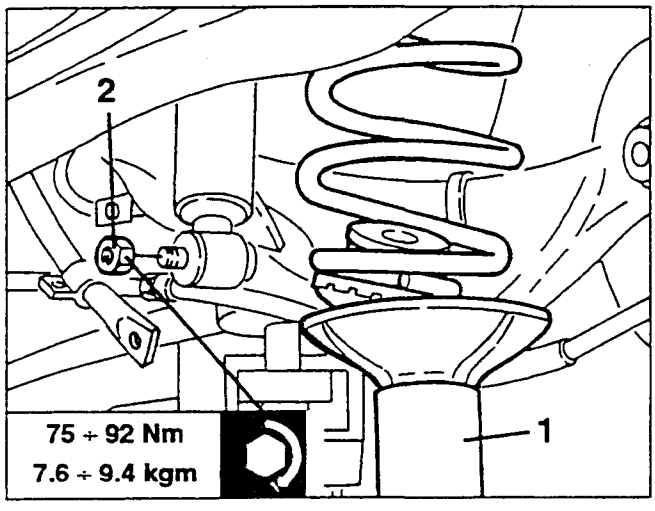
REMOVAL/REFITTING

- Set the car on a lift.
- Remove the wheel on the side concerned.

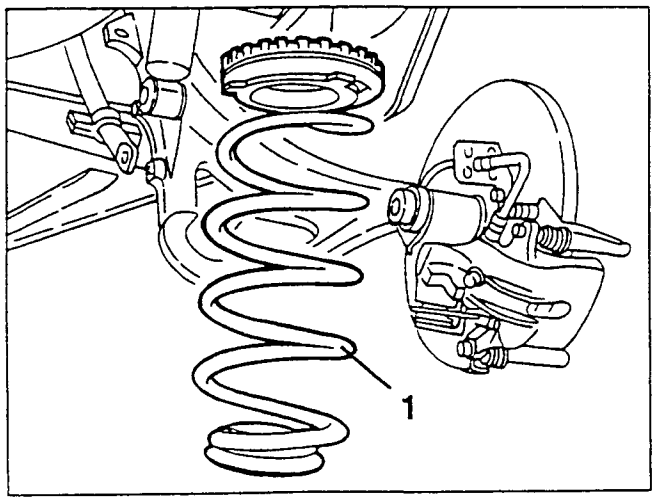
1. Slacken the fastening screw of the handbrake cable and brake hose support bracket.
2. Slacken the screws fastening the stabilizer bar on both sides of the suspension.



1. Place a hydraulic jack under the longitudinal arm and preload the spring.
2. Slacken the shock absorber fastening bolt.



1. Lower the hydraulic jack and remove the spring complete with rebound rubbers.

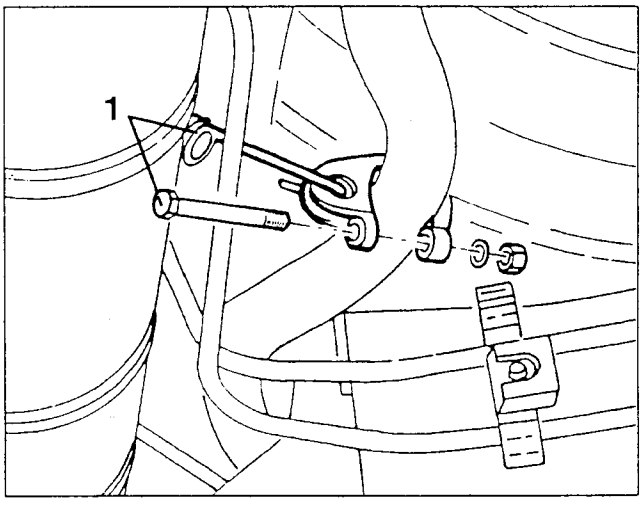


STABILISER BAR

REMOVING/REFITTING

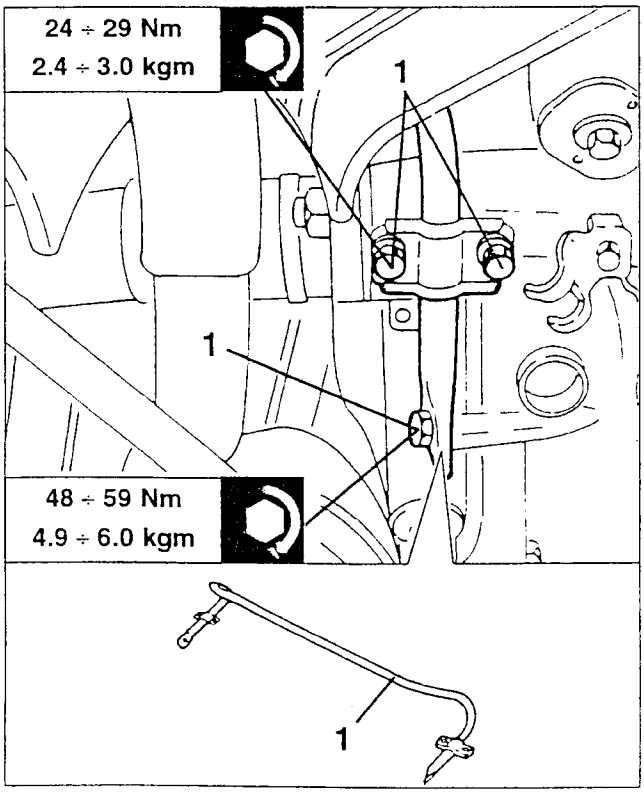
- Set the car on a lift.
- Remove the fuel tank (see GROUP 10).

1. Slacken the bolt and disconnect the braking load proportioning valve spring from the stabiliser bar.



- Slacken the two nuts fastening the first exhaust silencer guard.
- Slacken the screw fastening the exhaust pipe rear support, then lower it as required.

1. Slacken the three screws per side fastening the stabiliser bar, then remove it.



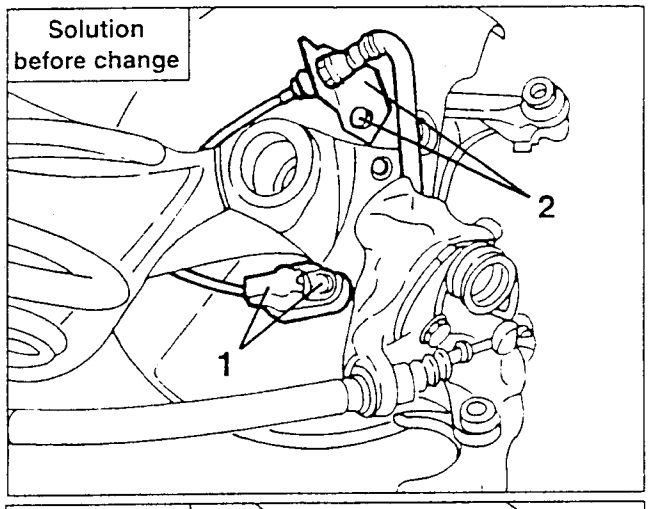
WARNING:
When refitting adjust the braking load proportioning valve (see GROUP 33).

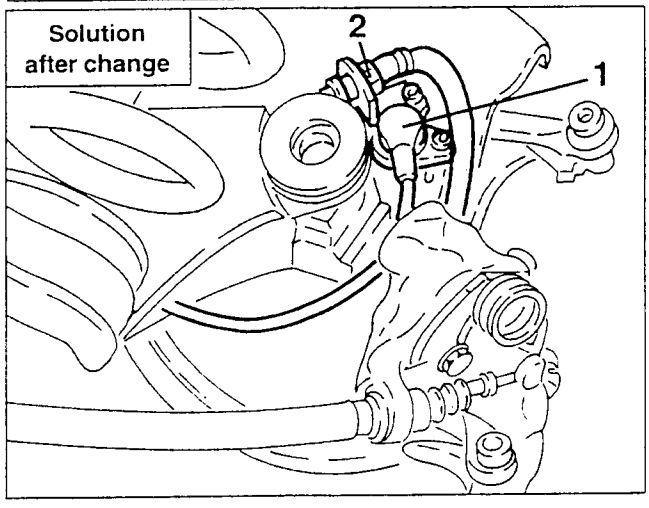
LONGITUDINAL ARM

REMOVING/REFITTING

- Remove the the wheel hub (see specific paragraph).

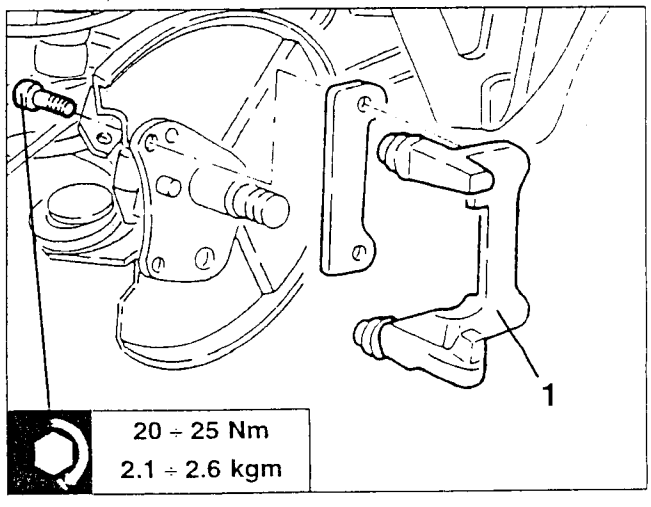
1. Slacken the fastening screw and remove the A.B.S. inductive sensor.
2. Slacken the fastening screw and remove the brake piping support bracket.





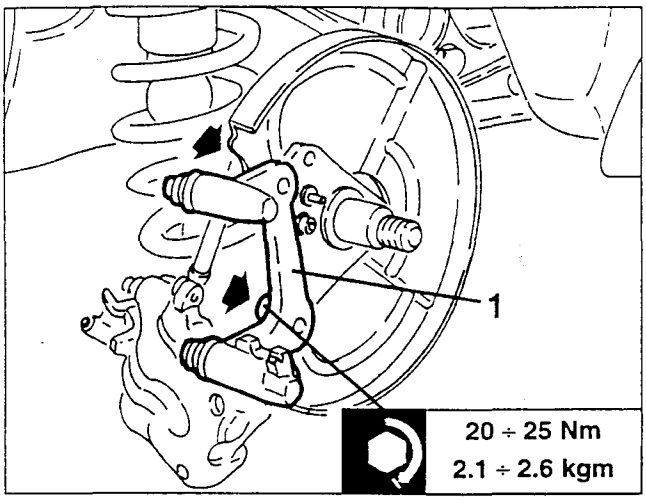
Solution before change

1. Slacken the two fastening screws and remove the brake caliper support and retrieve the spacer.

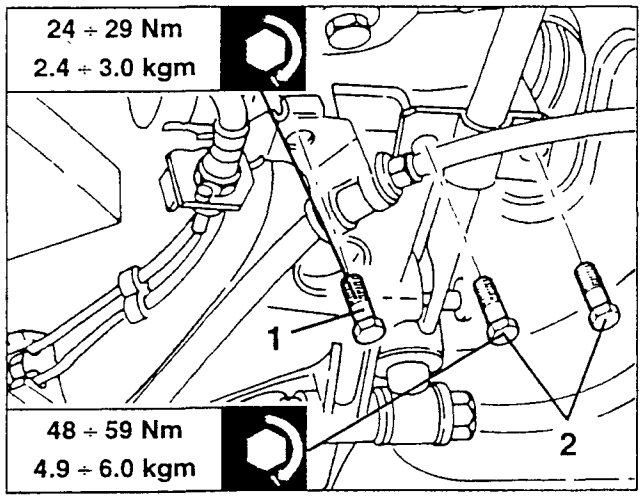


Solution after change

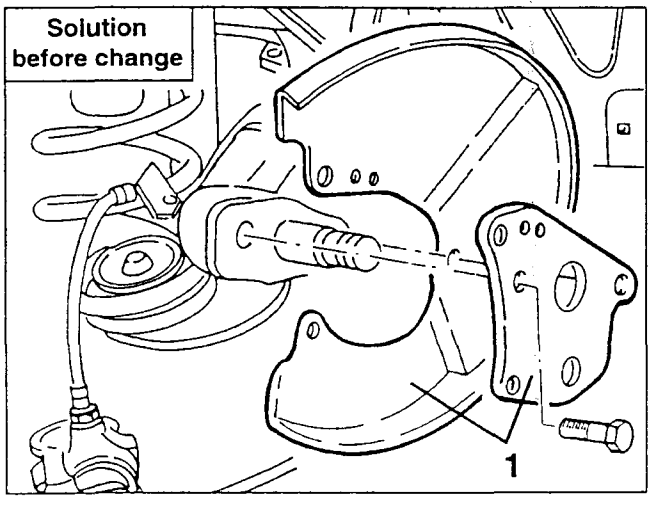
1. Slacken the two fastening screws and remove the brake caliper support.



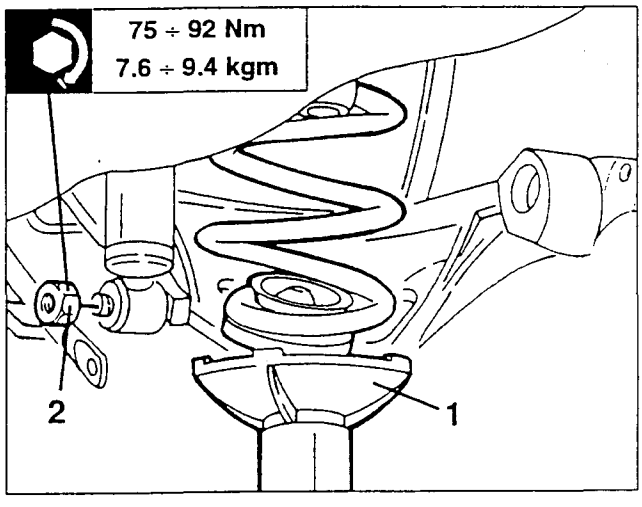
1. Slacken the screw fastening the handbrake cable support bracket, brake pipe and A.B.S. sensor cable.
2. Slacken the three screws per side fastening the stabiliser bar.

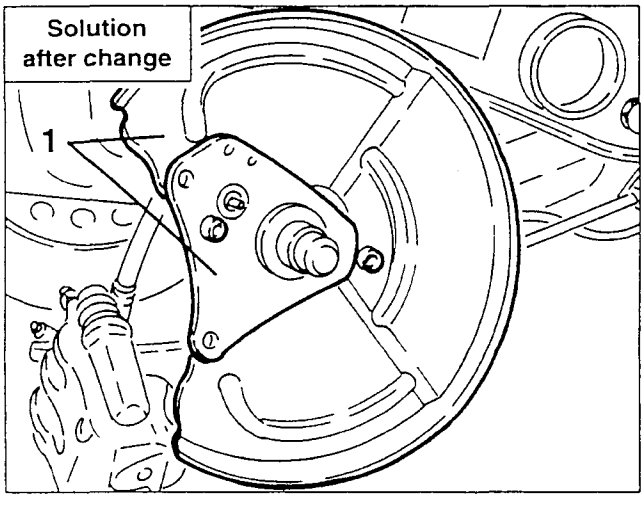


1. Slacken the two fastening screws and remove the brake disk guard and stiffener plate.

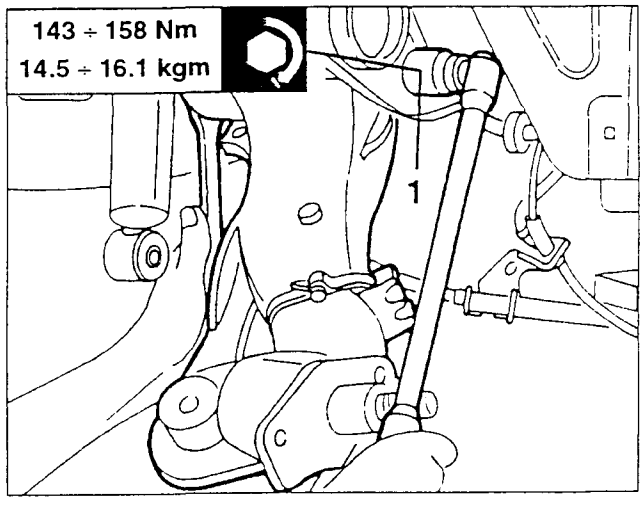


1. Set a hydraulic jack under the longitudinal arm of the suspension and preload the spring.
2. Slacken the shock absorber lower fastening bolt, lower the hydraulic jack and remove the spring.





1. Slacken the fastening bolt and remove the longitudinal arm.

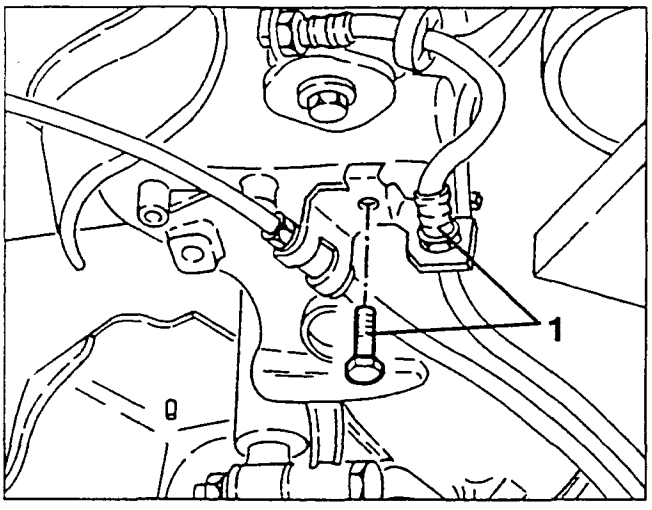


RIGID REAR AXLE

REMOVAL/REFITTING

- Set the car on a lift.
- Remove the rear wheels.
- Remove the fuel tank and the rear section of the exhaust pipe (see GROUP 10).
- Remove the stabilizer bar (see specific paragraph).

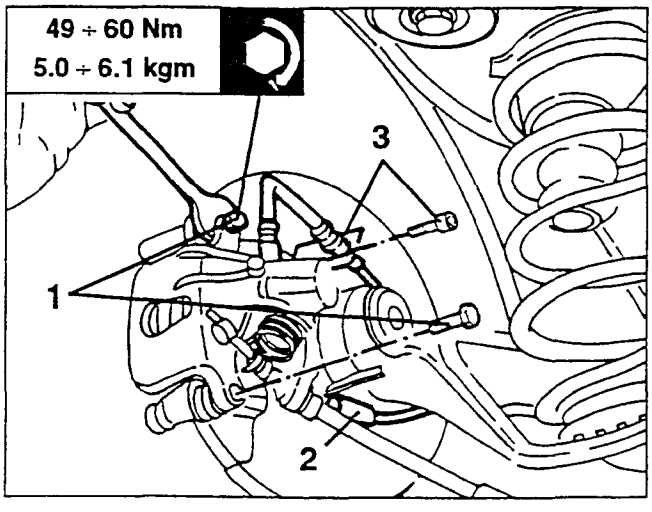
1. Slacken the screws fastening the A.B.S. sensor and brake hose support bracket.



1. Slacken the two screws fastening the brake caliper without disconnecting it from the pipes and cables.

When refitting replace the screw securing the brake calipers and tighten them to the specified torque.

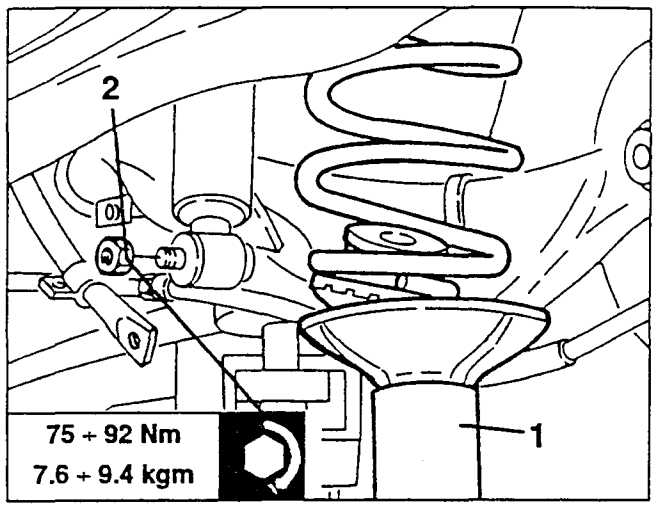
2. Slacken the fastening screw and remove the A.B.S. inductive sensor.
3. Slacken the fastening screw of the brake pipe support plate from the disk guard.



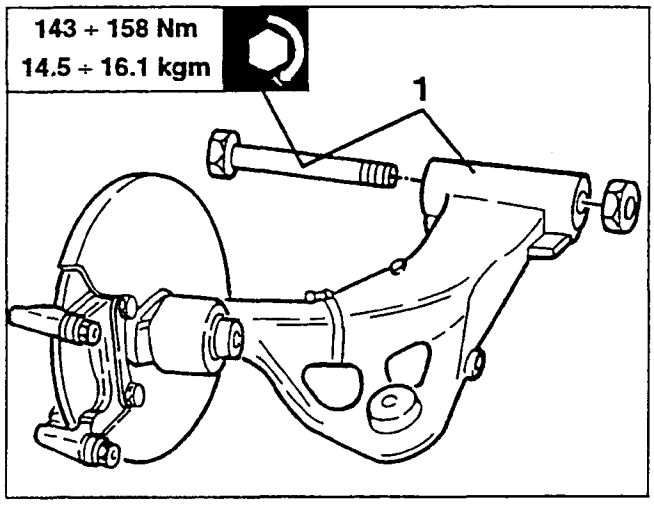
- Move aside the brake calipers complete with pipes and cables so that they do not hinder the subsequent operations

1. Using a hydraulic jack, placed under the suspension longitudinal arm, preload the spring.

2. Slacken the shock absorber lower fastening bolt, lower the hydraulic jack and remove the spring.

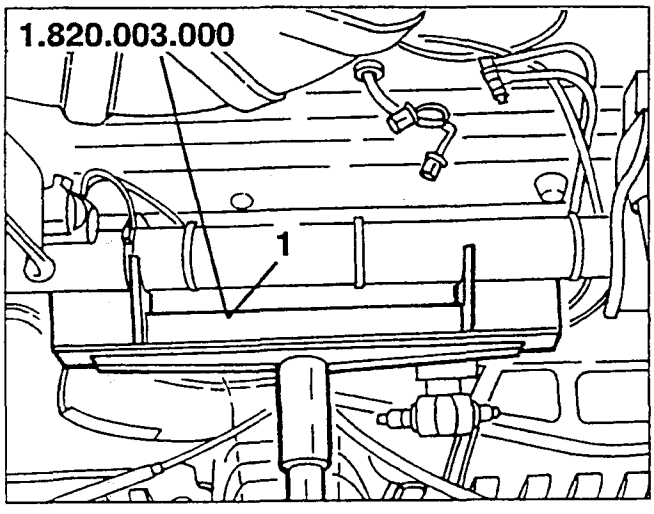


1. Slacken the fastening bolt and remove the longitudinal arm complete.

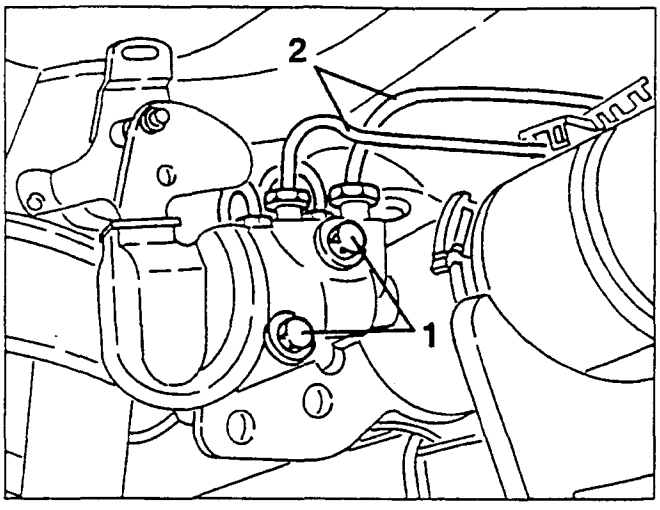


- Remove the other longitudinal arm in the same manner.

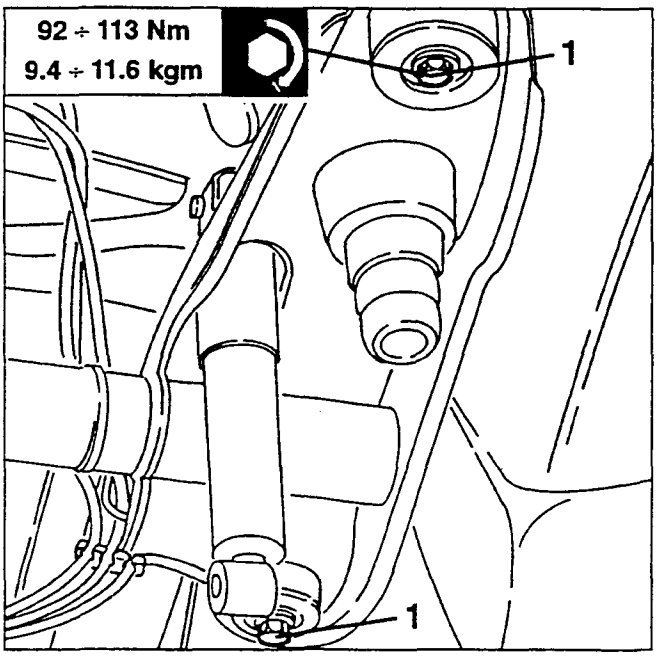
1. Place a hydraulic jack fitted with tool N° 1.820.003.000 under the rear axle.



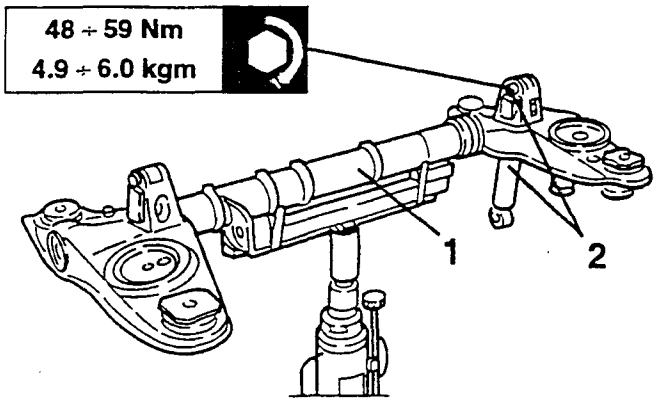
1. Slacken the braking load proportioning valve fastening screws.
2. Free the brake pipes from the fasteners on the axle.



1. Slacken the two screws per side fastening the rigid axle flexible mounts to the body.



1. Lower the hydraulic jack and remove the rigid axle.
2. If necessary, slacken the shock absorber upper fastening bolts and separate them from the axle.



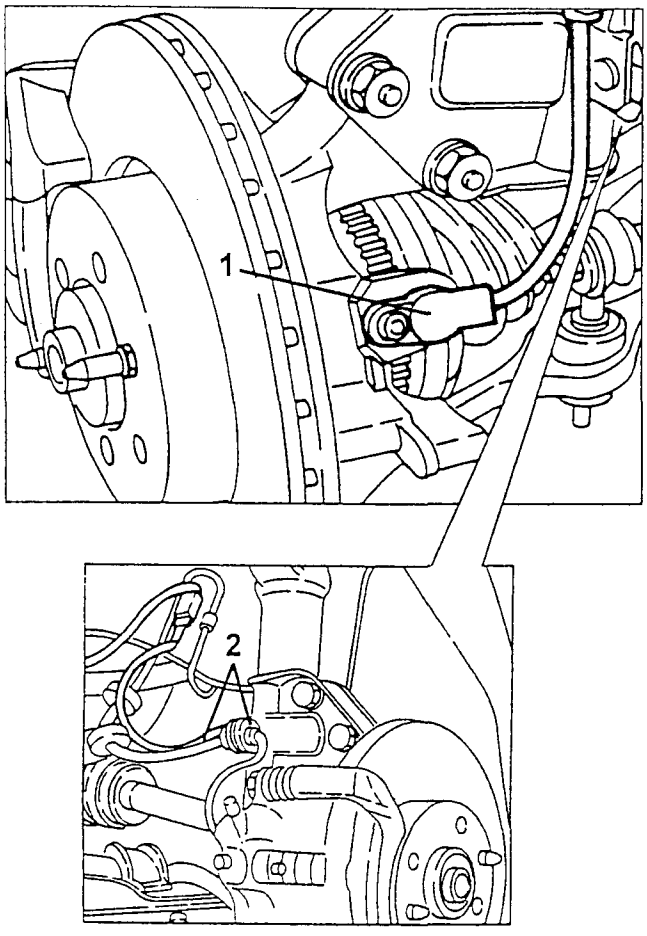
CHECKS AND INSPECTIONS

- Check the rear rigid axle for distorsions, cracks or misalignment between the two side arms.
- Check the conditions of the rebound rubbers.
- If any of the above faults are encountered, replace the whole axle.

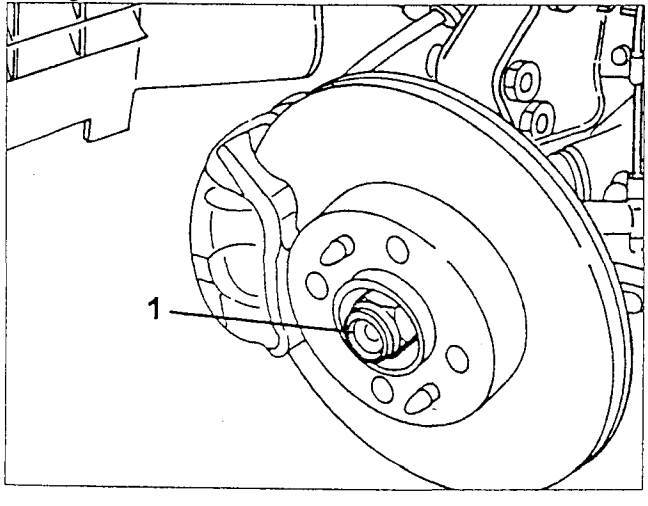
FRONT WHEEL UPRIGHT (Boxer versions)

REMOVAL/REFITTING

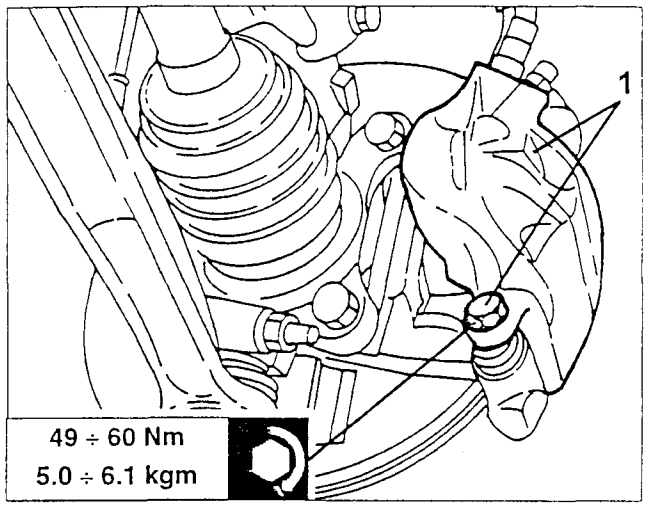
1. Slacken the fastening screw and remove the inductive A.B.S. sensor from the wheel upright.
2. Disconnect the brake pad wear sensor cable and the brake hose from the coupling on the shock absorber.



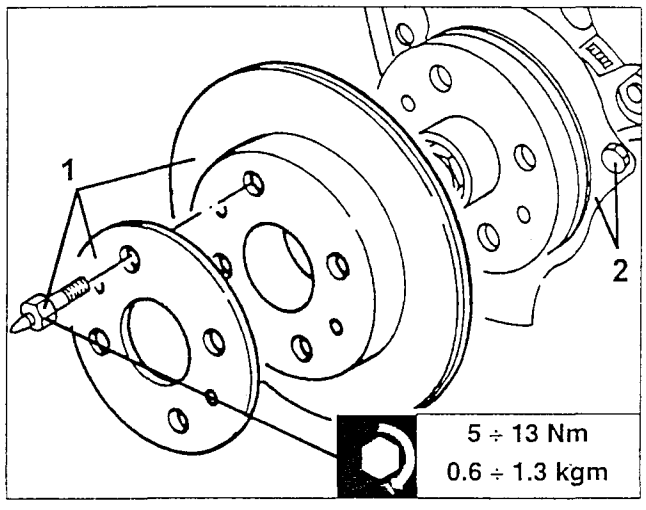
1. Remove the caulking and slacken the nut fastening the axle shaft to the wheel hub.



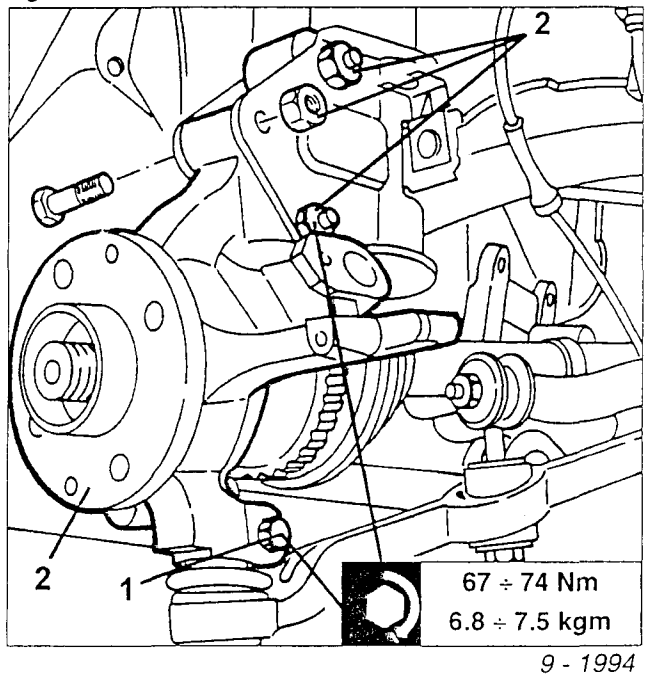
1. Slacken the two brake caliper fastening screws, then move it aside without disconnecting the pipe.
When refitting, change the brake caliper fastening screws and tighten them to the specified torque.



1. Slacken the two pins and remove the spacer and brake disk.
2. Slacken the remaining fastening screw and remove the brake disk protective cover.



1. Slacken the bolt fastening the wishbone to the wheel upright.
2. Slacken the three bolts fastening the wheel upright to the shock absorber stem, then remove it.



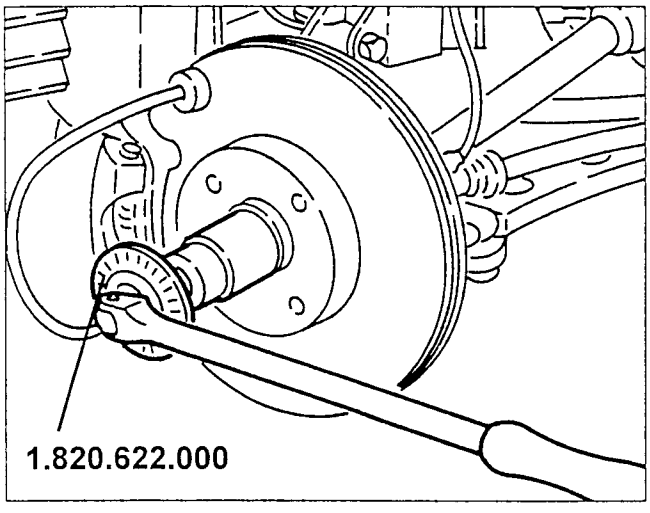
PA493000000002

When refitting, caulk the wheel hub fastening nut, proceeding as described below:
- Always use a new nut.
- Carefully clean the threaded tang of the axle shaft using a metal brush and then blowing with compressed air.
- Clean the axle shaft tang thread with ethyl spirits or heptane.
- Tighten the new nut to the specified torque.

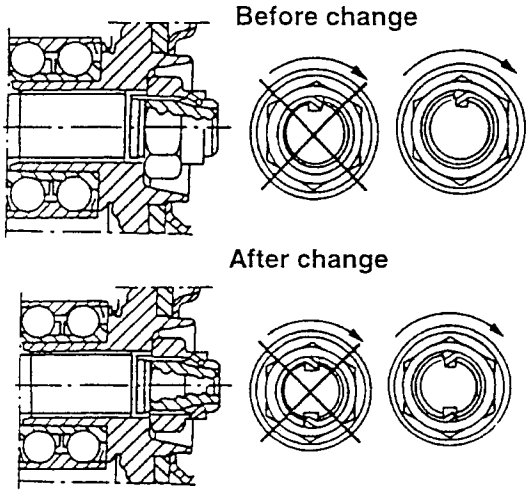
Before change	266 ÷ 294 Nm 27.1 ÷ 30.0 kgm
After change	67 ÷ 74 Nm + 62° (*) 6.8 ÷ 7.5 kgm + 62°

(*): Check that the maximum torque when tightening 62° is between 200 and 360 Nm

- For angle tightening the nut use tool no. 1.820.622.000 as illustrated.



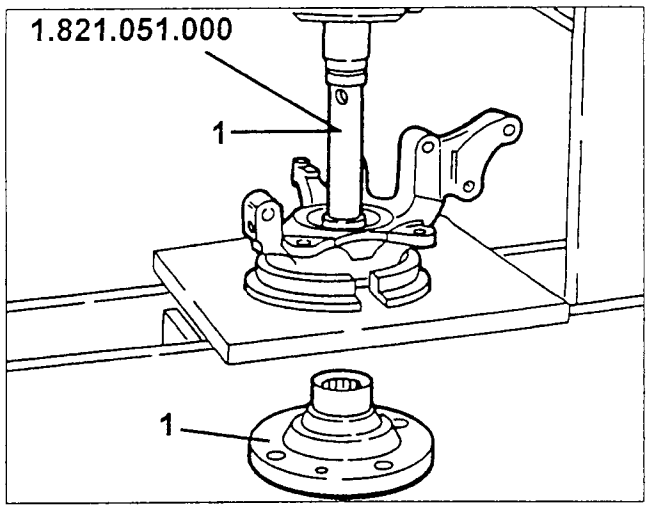
1. Using a chisel, caulk the nut collar with one or two caulks as illustrated.



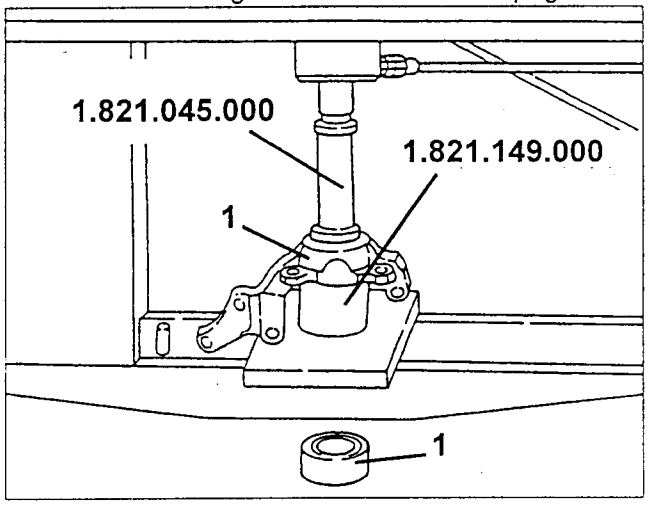
DISASSEMBLY

- Place the complete upright in a vice grip with protective jaws and remove the hub retainer circlip.

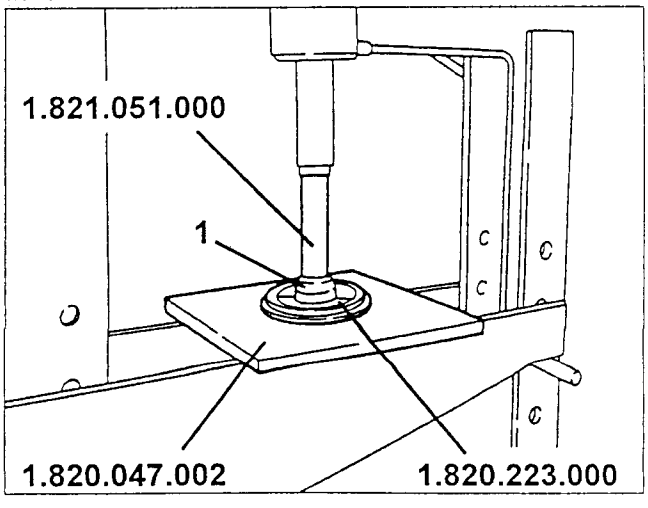
1. Working on the press and using puller tool no. 1.821.051.000 withdraw the wheel hub from the upright.



1. Working on the press, using support no. 1.821.149.000 and puller tool no. 1.821.045.000 remove the bearing outer race from the upright.

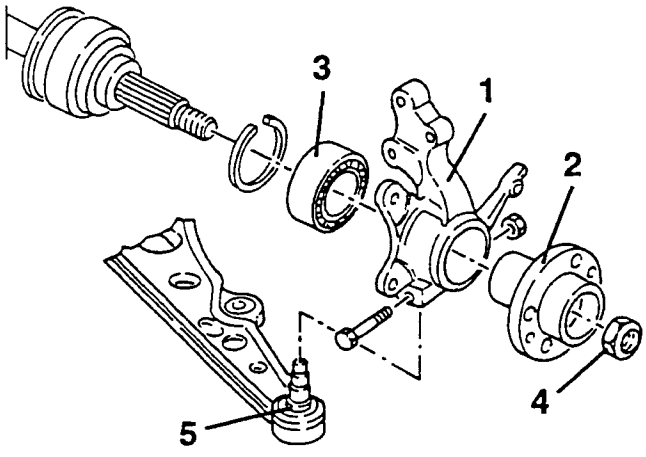


- Move the bearing inner race away from the wheel hub contact using a suitable tool.
1. Working on the press, and using plate no. 1.820.047.002, half rings no. 1.820.223.000 and puller tool no. 1.821.051.000, withdraw the bearing inner race from the wheel hub.



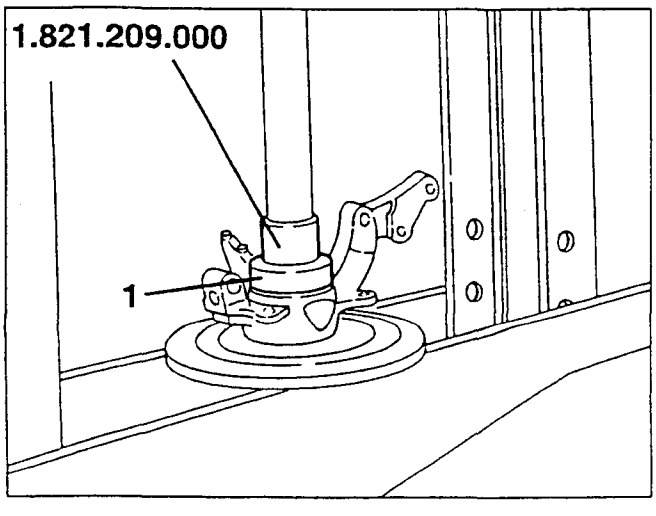
CHECKS AND INSPECTIONS

1. Check the inner surfaces of the wheel upright for traces of seizing and the wishbones for damage and obvious signs of bumps, distorsion or traces of breakage and change the upright if necessary.
2. Check the surfaces of the wheel hub for damage and obvious signs of bumps or traces of breakage and change it if necessary.
3. Check the conditions of the roller bearing for cracks, seizing or sticking and if necessary change the bearing.
4. In any case, always change the C.V. joint locknut before refitting.
5. Check the conditions of the ball pin fastening the wheel upright to the wishbone for distorsion, excessive wear, cracks, sticking or signs of oxidation and, if necessary, change the ball pin.

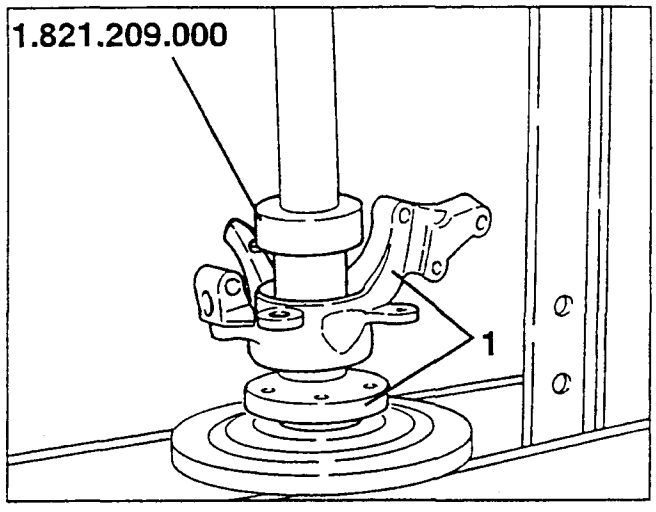


RE-ASSEMBLY

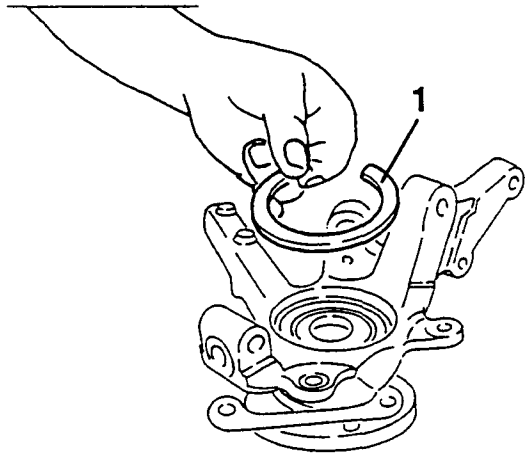
1. Working under the press and using installing tool N° 1.821.209.000 insert the bearing in the wheel upright.



1. Working under the press and using tool N° 1.821.209.000, overturned with respect to the previous step, insert the hub in the wheel upright.



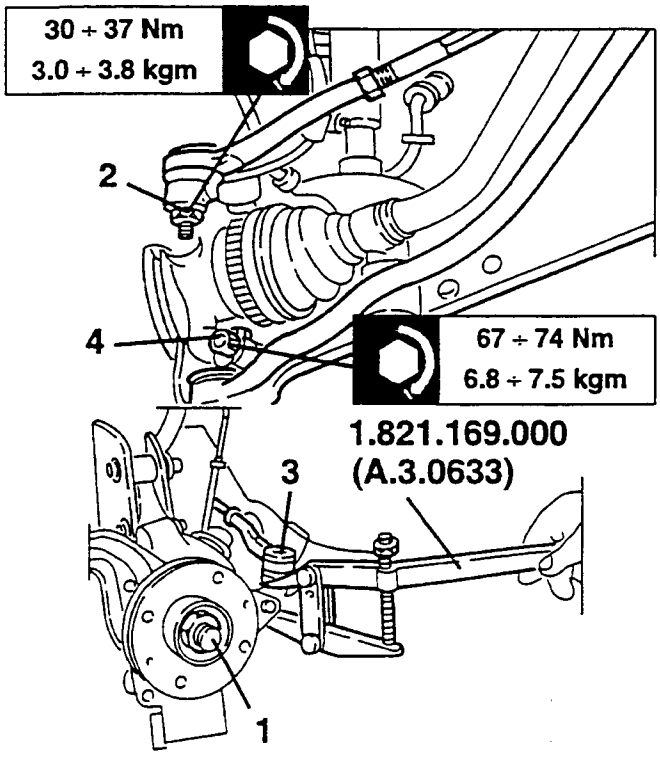
1. Install the bearing retainer ring in the housing on the wheel upright.



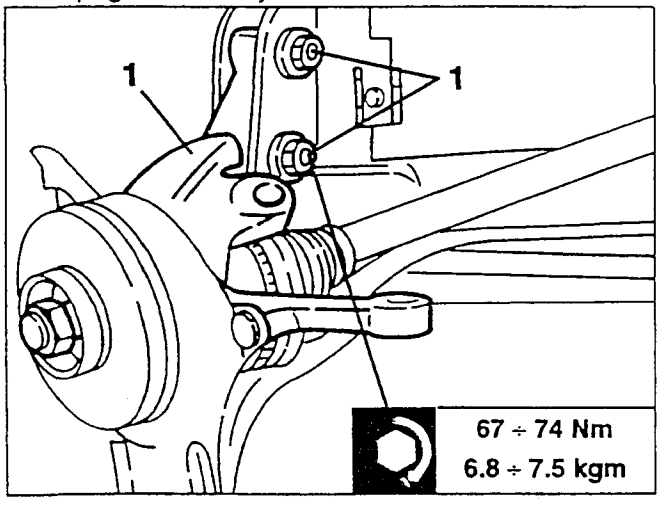
FRONT WHEEL UPRIGHT (Turbodiesel and T. Spark 16V versions)

REMOVAL/REFITTING

1. Remove the caulking and slacken the nut fastening the wheel hub to the constant velocity joint.
- Remove the complete caliper and set it aside without disconnecting the brake piping (see GROUP 33).
2. Slacken the nut of the ball joint connecting the side track rod to the wheel upright.
3. Using tool no. 1.821.169.000 (A.3.0633), disconnect the ball joint from the wheel upright.
4. Slacken the bolt connecting the wishbone to the upright and pull it off the ball pin.
When refitting, tighten the nut fastening the axle shaft to the wheel hub as deescribed for the "Front wheel upright (Boxer versions)".

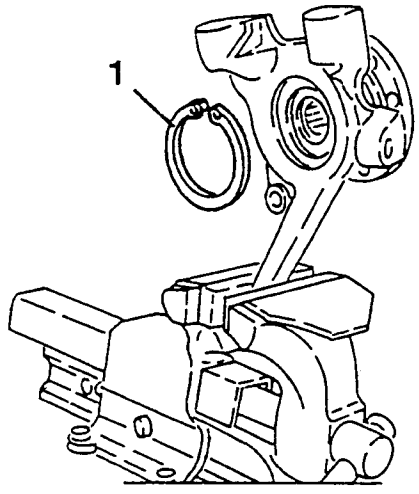


1. Slacken the two bolts and remove the wheel hub/upright assembly.

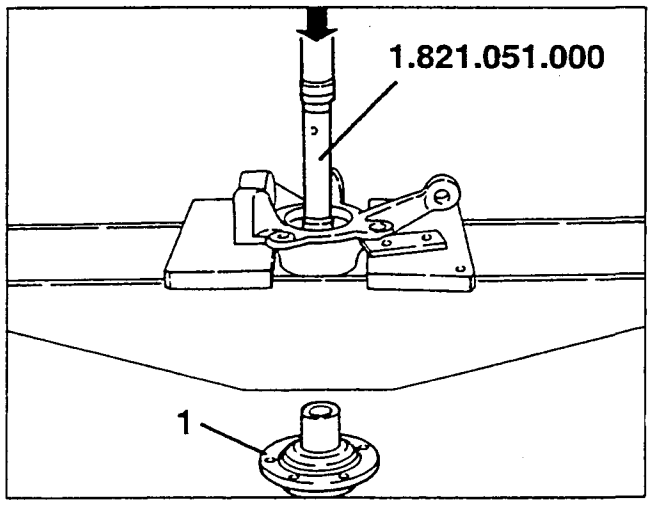


DISASSEMBLY

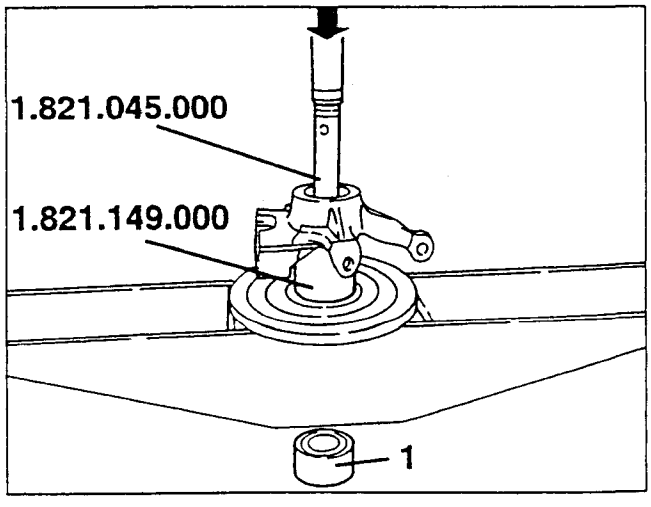
1. Clamp the wheel upright/hub assembly in a vice fitted with protective jaws and remove the hub retainer ring.



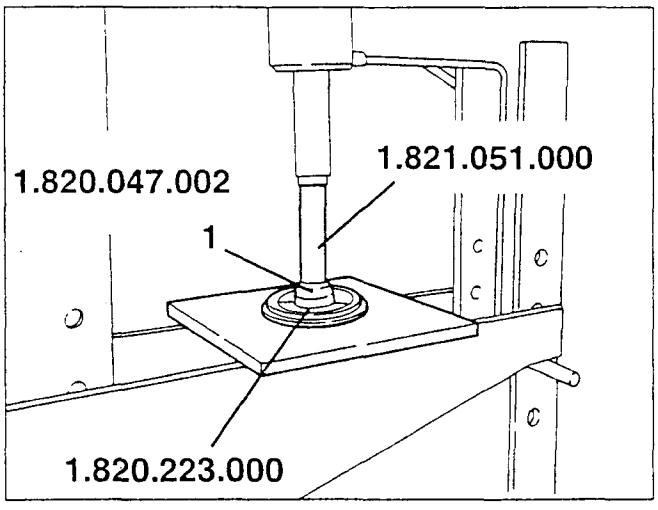
- Remove the brake disk protection.
1. Working at the press and using puller tool no. 1.821.051.000 pull the wheel hub off the upright.



1. Working at the press, using support no. 1.821.149.000 and puller tool no. 1.821.045.000 remove the outer bearing race from the upright.

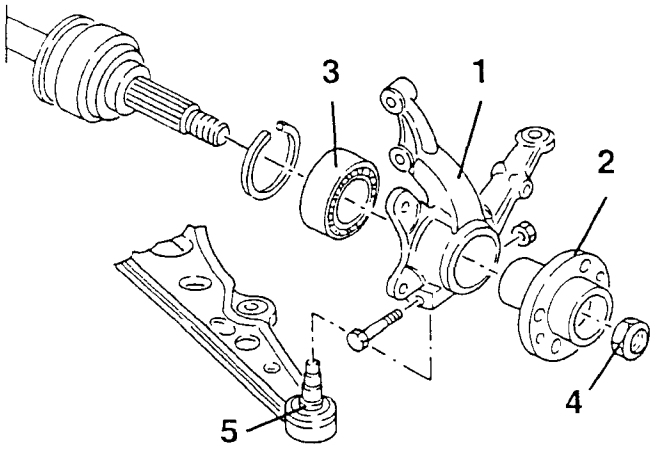


- Using a suitable tool move away the bearing inner race from the contact surface of the wheel hub.
1. Working at the press and using plate no. 1.820.047.002, half rings no. 1.820.223.000 and puller tool no. 1.821.051.000, withdraw the bearing inner race from the wheel hub.



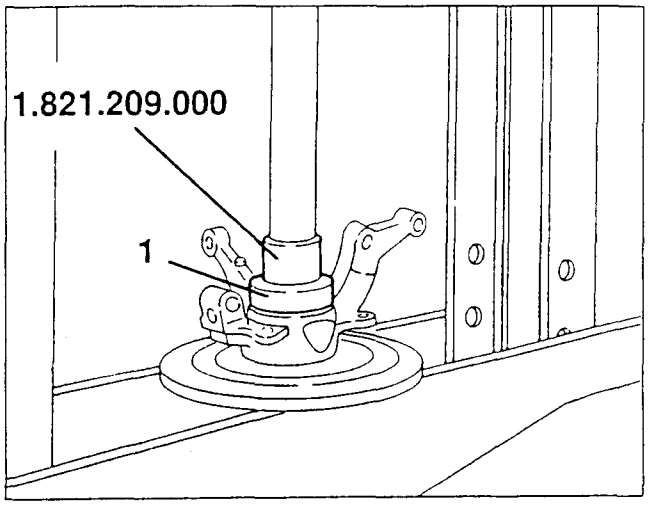
CHECKS AND INSPECTIONS

1. Check the wheel upright inner surface for signs of seizing, and that the arms reveal no signs of damage, bumps, distorsions or traces of breakage, in which case the upright must be replaced.
2. Check the surfaces of the wheel hub for damage or clear signs of bumps or traces of breakage, in which case, the wheel hub must be replaced.
3. Check the conditions of the rolling bearing for cracks, seizure or jamming, if necessary replace the bearing.
4. Always, and in any case, change the constant velocity locking nut before re-assembly.
5. Check the conditions of the ball pin fastening the wheel upright to the wishbone for distorsion, excessive wear, cracks, sticking, or signs of rust and, if necessary, replace the ball pin.

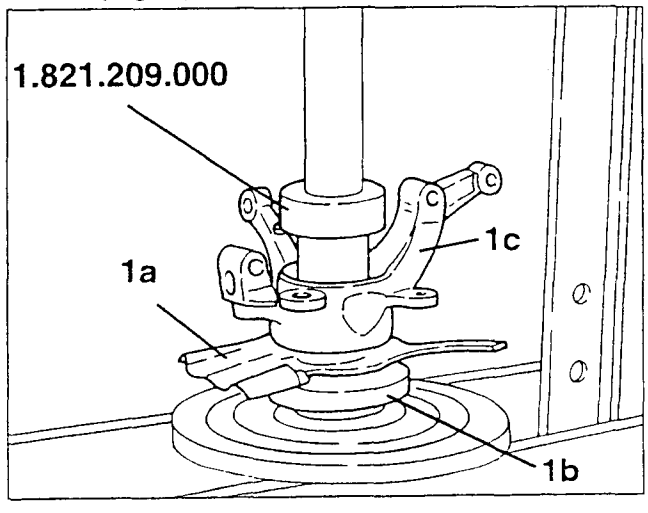


RE-ASSEMBLY

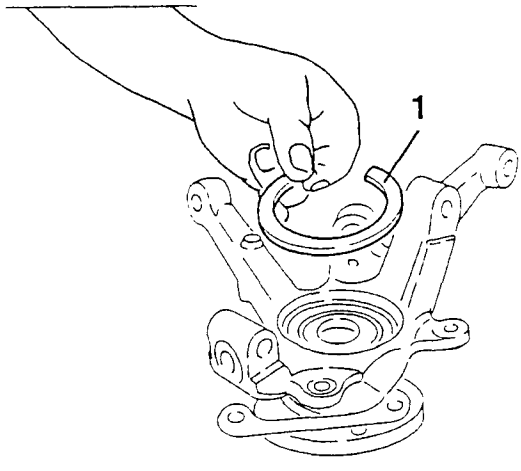
1. Working at the press and using installing tool no. 1.821.209.000 insert the bearing in the wheel upright.



1. Set the brake disk protection (1a) on the wheel hub (1b) then, working under the press using the installing tool no. 1.821.209.000 in the overturned position with respect to the previous step, insert the hub in the wheel upright (1c).



1. Assemble the bearing retainer clip in its housing on the wheel upright.



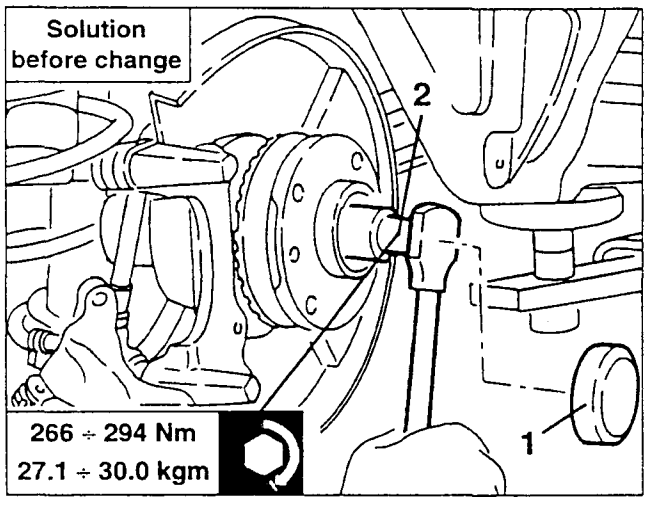
REAR WHEEL HUB

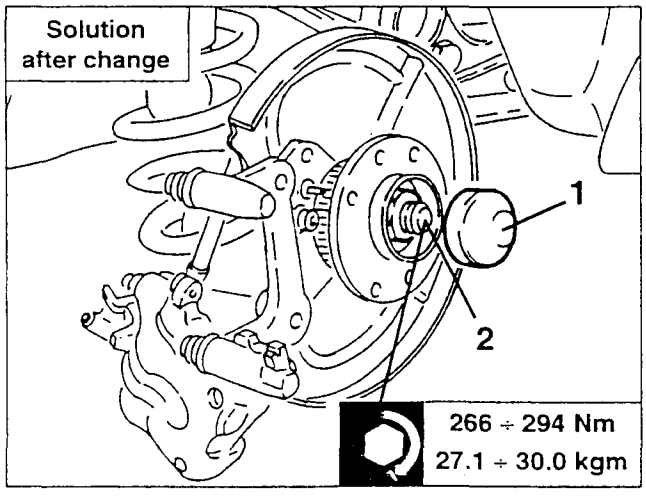
REMOVING/REFITTING

- Set the car on a lift.
- Remove the wheel on the side concerned.
- Remove the brake disk (see GROUP 33).

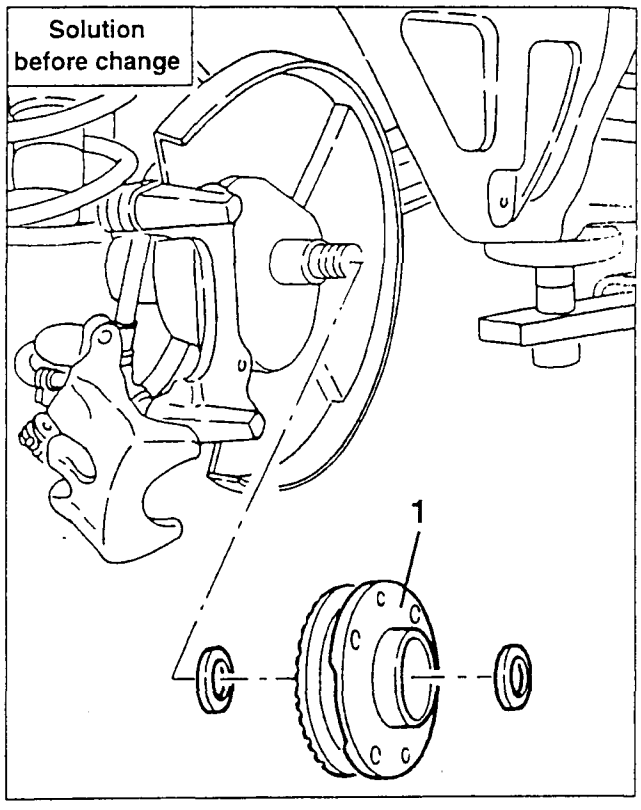
In the case of cars with rear drum brakes, remove the drums (see GROUP 33) and proceed as described below for cars with rear drum brakes.

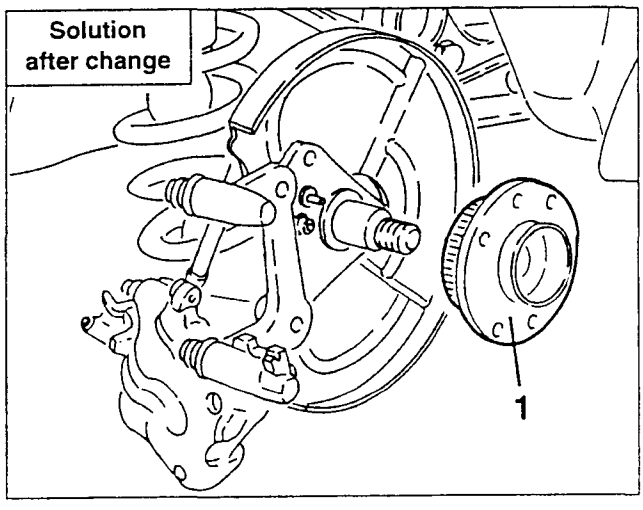
1. Remove the dust guard of the rear steering knuckle.
2. Slacken the wheel hub fastening nut as illustrated.





1. Remove the wheel hub.





CHECKS AND INSPECTIONS

- Check the conditions of wear of the wheel bearing, keyed inside the hub. In the event of excessive play or noise, it is necessary to replace the hub complete.
- Check the conditions of wears of the spacer and, if necessary, change them.
- Replace the wheel hub fastening nut.

WHEELS

The wheels (tyres and rims) installed are the most suited to the characteristics of the car and guarantee the highest degree of safety and comfort under all normal driving conditions.
Before replacing rims or tyres check the table listing the permitted types.
Never alter the rim-tyre arrangement originally fitted on the vehicle.

RIMS

Steel or alloy rims must be fitted using the specific studs for each type of rim.
Therefore, when steel rims are being replaced by alloy rims or vice-versa, it is absolutely necessary to use the specific studs for the type of wheel installed.

TYRES

The tyres installed on the car are of the tubeless type.
To maintain driving comfort, the highest degree of safety and prolong the life of the tyre, follow the instructions given below:
- Ensure that the wheels are balanced and that the front and rear vehicle trim is correct.
- Never insert tools of any kind between the rim and tyre.
- If the rim gets damaged, replace it.
- For balancing use counterweights specifically for tubeless tyres.
- Tyre pressure (including the spare) must be as specified.
- Inner tubes must not be used on tubeless tyres.

To allow even wear on the front and rear tyres the wheels should be swapped around every 10,000 ÷ 15,000 km keeping them on the same side of the car to avoid switching the direction of rotation.

CAUTION:
Do not swap tyres between sides.

Some types of tyres are fitted with wear indicators and must be replaced as soon as these indicators can be seen on the tread.
Periodically check that the wear on the tread is even.
You are reminded that wear on the tread gradually increases the likelihood of aquaplaning on wet surfaces.
Knocking against pavements, holes in the road and obstacles of various types, lengthy driving on rough roads can cause lesions to the tyres which are not always easy to see.
They may cause deformation, swelling and cuts on the side of the tyre which are often invisible but which could cause sudden deflation or bursting of a tyre.

TYRE PRESSURE AND WEAR

The correct tyre pressure does not only determine the life of the tyre but also affects safety as it influences the degree of road holding of the vehicle.
The pressure in each tyre, including the spare, must be checked at regular intervals and before long journeys. The tyres should be checked when cold; use a pressure gauge in accordance with the specified ratings.
Incorrect pressure results in abnormal wearing of the tyre.
A. Normal pressure
A correct tyre pressure guarantees extended life and better performance as the tread works on its entire width resulting in more uniform wearing.
This situation also involves:
- improved roadholding of the car.
- smoother and more accurate steering.
- lower fuel consumption due to the decreased rolling resistance of the wheel.

B. Insufficient pressure
A low tyre pressure results in uneven wear on the tread (greater on the sides) and overheating of the tyre that can cause the detachment of the parts of the tyre and damage to the casing. This damage may cause sudden deflation or bursting.
C. Overinflation
Conversely, overinflation results in:
- Uneven wear of the tread, higher in the middle.
- Decreased comfort.
- Greater vulnerability to shocks.

WHEEL BALANCING

Each wheel, complete with tyre has been statically and dynamically balanced in the factory. When the tyres are changed the wheels must be rebalanced to avoid unstability, wearing of the steering components and uneven wear of the tyres.

WARNING:
Only original Alfa Romeo counterweights should be used when balancing wheels in light alloy.

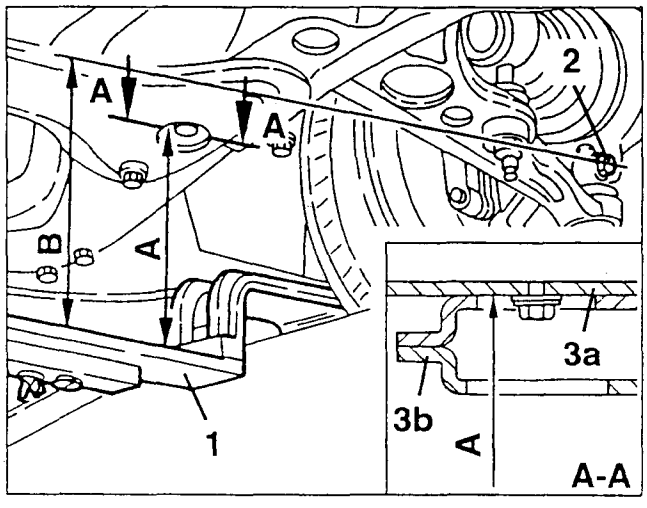
CHECKING FRONT WHEEL ALIGNMENT

PRELIMINARY OPERATIONS

- Inflate the tyre to the correct pressure.
- Place the vehicle on a vehicle lift.
- Set the car in the unladen condition (with fuel and fluids).
- Bounce the vehicle a few times to settle the suspension.

For Boxer versions only

1. Position the reference tool on the resting plane of the vehicle.
2. Using a surface gauge measure distance "B" between the resting plane of the vehicle and the centre of the screw securing the ball pin.
- Using a millimeter rule measure the distance.
3. Using a surface gauge measure distance "A" between the resting plane of the vehicle and the lower surface of the chassis 3a and cross member 3b.
- Using a millimeter rule measure the distance.

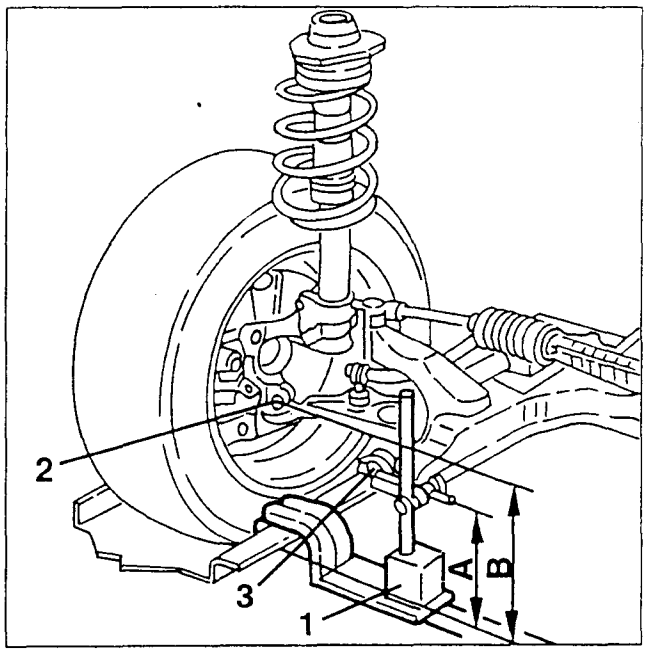


- Calculate the difference between "A" and "B" and check that it is within the specified limits.

Front alignment B - A
40 ± 5 mm

For Turbodiesel and T. Spark 16V versions

1. Position the reference tool on the resting plane of the vehicle.
2. Using a surface gauge measure distance "B" between the resting plane of the vehicle and the centre of the screw securing the ball pin.
- Using a millimeter rule measure the distance.
3. Using a surface gauge measure distance "A" between the resting plane of the vehicle and centre of the pin of the swinging arm.
- Using a millimeter rule measure the distance.



- Calculate the difference between "A" and "B" and check that it is within the specified limits.

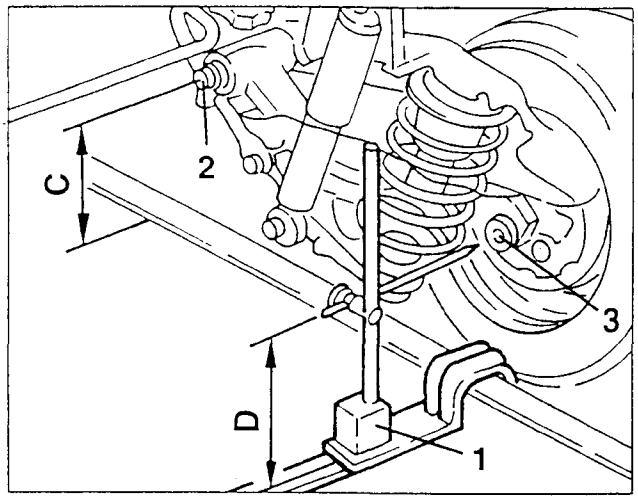
Front alignment B - A	
Turbodiesel 1.4 T. Spark 16V 1.6 T. Spark 16V	-13 ± 5 mm
1.8 T. Spark 16V 2.0 T. Spark 16V	-26 ± 5 mm

CHECKING REAR WHEEL ALIGNMENT

PRELIMINARY OPERATIONS

- Inflate the tyres to the correct pressure.
- Place the vehicle on a vehicle lift.
- Set the car in the unladen condition (with fuel and fluids).
- Bounce the vehicle a few times to settle the suspension.

1. Position the reference tool on the resting plane of the vehicle.
2. Using a surface gauge measure the distance "C" between the vehicle's resting plane and the pivot of the rear swinging arm.
- Using a millimeter rule measure the distance.
3. Using a surface gauge measure distance "B" between the resting plane of the vehicle and the centre of the rear wheel.
- Using a millimeter rule measure the distance.



- Calculate the difference between "C" and "D" and check that it is within the specified limits.

Rear alignment C - D
7 ± 5 mm (*) -2 ± 5 mm

(*): Specific for Boxer versions.

NOTE: If the alignment values are not within the specified limits replace both suspension springs.

CHECKING CHARACTERISTIC ANGLES

PRELIMINARY OPERATIONS

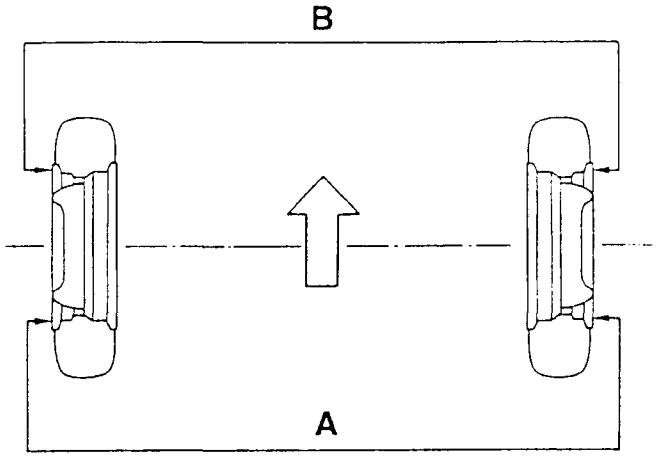
- Inflate the tyres to the correct pressure.
- Check that the eccentricity and orthogonality of the wheel rims do not exceed:
• 1 mm for steel rims
• 0.3 mm for alloy rims

CHECKING FRONT WHEEL TOE-IN AND TOE-OUT

- Using a suitable tool check that the toe-in and toe-out values are within the specified limits.

Front wheel toe-in/toe-out A - B (*)	
Boxer	3.5 ± 1 mm
Turbodiesel 1.4 T. Spark 16V 1.6 T. Spark 16V	-1 ± 1 mm
1.8 T. Spark 16V 2.0 T. Spark 16V	0 ± 1 mm

(*): Values measured unladen in running order (with specified fluids)



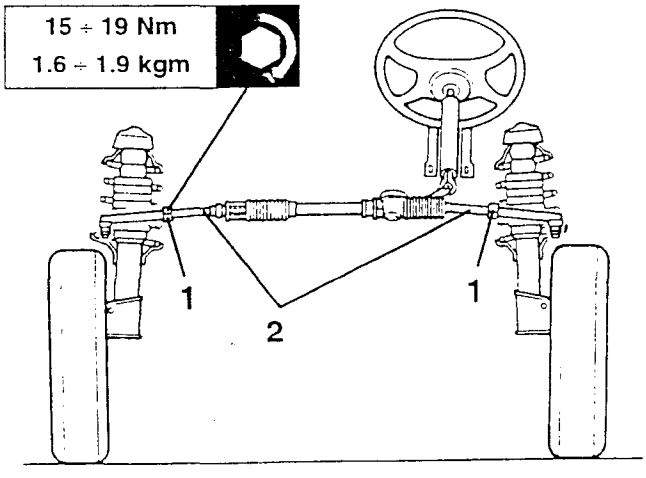
If the toe-in values differ from those specified, proceed as follows:
1. Loosen the attachments for the adjustment of the steering rods.

WARNING:Each time the front wheel toe-in is checked the bellows should also be checked to ensure that they rotate freely on the rod. If necessary pull them off and lubricate them with the specified grease.

2. Rotate the rods until the specified value is reached without altering the position of the steering wheel.
NOTE: This adjustment must be carried out by operating on the rods of both wheels.
- Tighten the steering rod adjustment attachments to the specified torque.

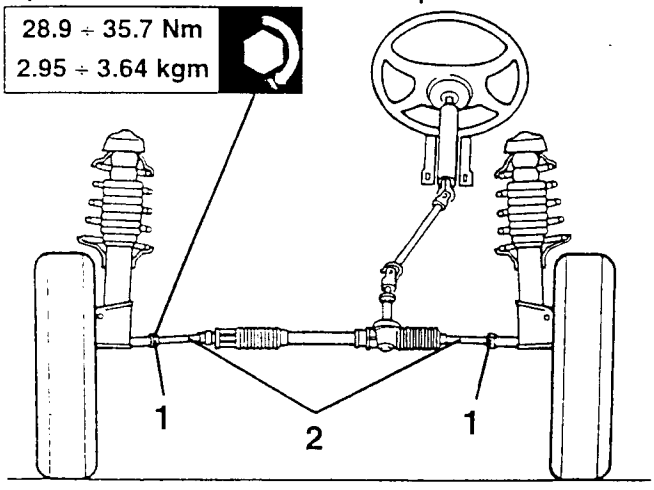
Specific for Boxer versions

15 ÷ 19 Nm 1.6 ÷ 1.9 kgm



Specific for Turbodiesel and T. Spark 16V versions

28.9 ÷ 35.7 Nm
2.95 ÷ 3.64 kgm



CHECKING FRONT WHEEL CAMBER AND CASTER

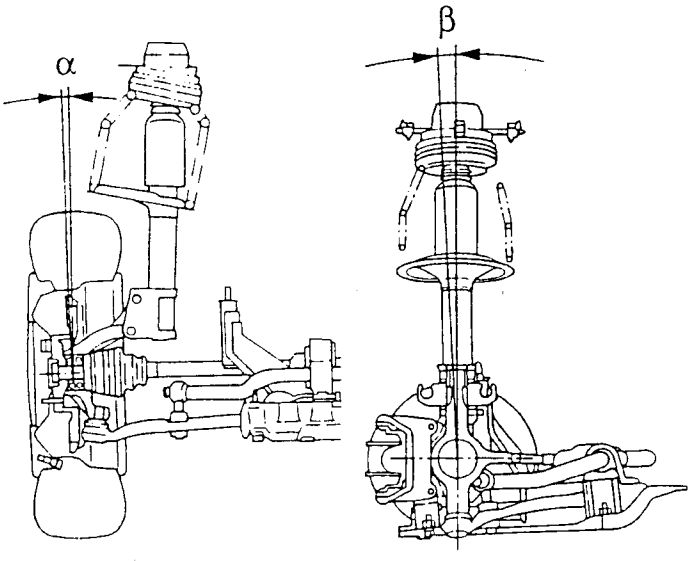
- Check that the camber and caster angles (not adjustable) are within the specified limits.

Front wheel camber "α" (*)	
Boxer	0°10' ± 20'
Turbodiesel 1.4 T. Spark 16V 1.6 T. Spark 16V	-1°10' ± 20'
1.8 T. Spark 16V 2.0 T. Spark 16V	-1°30' ± 20'

(*): Values measured unladen in running order (with specified fluids)

Caster angle "β" (*)
3°20' ± 30'

(*): Values measured unladen in running order (with specified fluids)



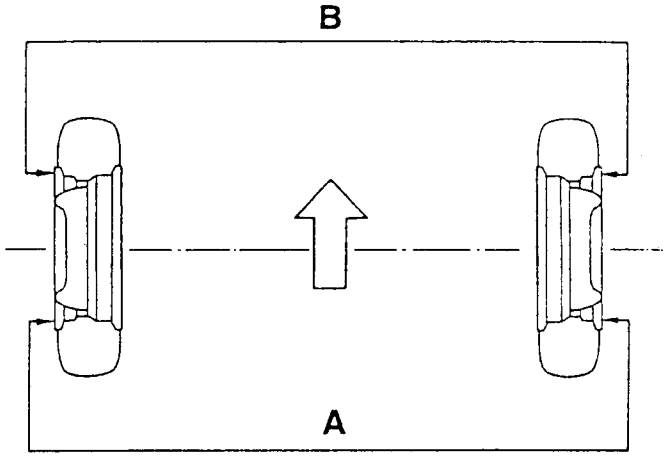
NOTE: If the values measured differ from the specified values body squaring should be checked (see GROUP 70).

CHECKING REAR WHEEL TOE-IN

- Using a suitable tools check that the toe-in value (not adjustable) is within the specified limits.

Rear wheel toe-in A - B (*)	
Boxer	4 ± 2 mm
Turbodiesel 1.4 T. Spark 16V 1.6 T. Spark 16V	1 ± 1 mm
1.8 T. Spark 16V 2.0 T. Spark 16V	1.5 ± 1 mm

(*): Values measured unladen in running order (with specified fluids)

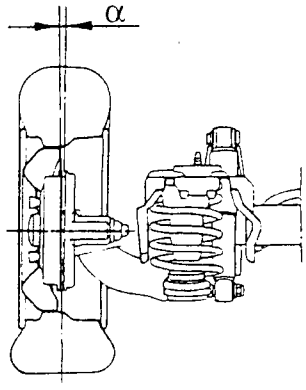


CHECKING REAR WHEEL CAMBER

- Check that the camber angle (not adjustable) is within the specified limits.

Rear wheel camber "α" (*)
-1° ± 15' (▲) -45' ± 15'

(*): Values measured unladen in running order (with specified fluids)
(▲): Specific for Boxer versions





SERVICE

DIREZIONE POST-VENDITA
SERVIZI ASSISTENZIALI
Viale Alfa Romeo 20020 Arese (MI)
Fiat Auto S.p.A.

Publication PA493000000000 - 3/94
Printed in Italy
no. 60494360

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Printed in Italy by Tip. Bogliani - Torino

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BODY AND TRIM

9 documents - 440 factory pages

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MANUALLY CONTROLLED HEATING
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(*): For items not mentioned see Turbodiesel engine

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- Washing the system..... (*)

Removing/Refitting - Turbodiesel engine
NOT AVAILABLE AT TIME OF GOING TO PRESS

MANUAL HEATING AND VENTILATION
NOT AVAILABLE AT TIME OF GOING TO PRESS

MANUALLY CONTROLLED HEATING
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(*): See Turbodiesel engine

(**): See T. Spark 16V engine

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Alfa Romeo

PA493000000002

9-1994

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INSTRUCTIONS

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WARNING:
The "145-146 - INSTRUCTIONS FOR REPAIR" manual refers to both models according to the following logic:

for the parts in common, the information refers to model 145, while for the parts specific to model 146 special pages, or, where necessary, whole groups, have been added.

For further details refer to the indexes (blue cards) at the beginning of each group.

INTRODUCTION

The "145-146 - Repair Instructions" Manual is composed of three volumes as follows:

Volume I
- Technical Data;
- Engines;
- Mechanical Groups.

Volume II
- Heating-Ventilation;
- Bodywork.

Volume III
- Electric system;
- Electrical system diagnosis.

For overhauling engines and mechanical groups refere to the following manuals:

- PA493600000000 REPAIR INSTRUCTIONS - ENGINE OVERHAUL.
- PA494200000000 REPAIR INSTRUCTIONS - OVERHAULING MECHANICAL GROUPS.

In order to facilitate consultation, the structure of the manual mirrors the functional groups already defined for the "Repair Flat-rate Manual" in use by Alfa Romeo Authorized Service Network.

The characteristic data and the tables for vehicles identification are contained in the "Technical Data" at the beginning of Volume I.

The "Model identification" tables should be consulted before carrying out repair work in order to identify the model of the vehicle, the engine size and the groups which form the vehicle.

How to use this manual

The aim of this manual is to supply the Alfa Romeo Service Personnel with a tool enabling them to rapidly identify faults and to render the corrective interventions precise and efficient.

The manual shows the procedures relative to the removal and refitting and dismontling operations and the checks relative to the various groups forming the vehicle.

The procedures are illustrated in detail as are the procedures for using the tools. An appropriate symbology and explanatory texts next to the fundamental technical drawings make a complete and rapid consultation of the manual possible.

The procedures illustrate complete component disassembly procedures and should only be carried out in their entirety when absolutely unavoidable. The procedures for "assembly" and "refitting" are normally obtained by reversing the procedure followed for disassembly or removal in reverse and only the reassembly procedures which are significantly different are illustrated.

For information relative to the electrical systems onboard the vehicle refer to section 55 "ELECTRIC SYSTEM" and to the successive 55 "ELECTRIC SYSTEM DIAGNOSIS" which gives the wiring diagrams and the description of each function, the connector tables, the location of the components, the tables for fault diagnosis and the technical data for checking the components.

All the information contained in this manual is updaded at the time of publication.

Alfa Romeo reserves the right to make any modifications to its products that it deems necessary without warning. However the technical information and updates to this manual will be supplied as soon as possible.

Symbology

A specific symbology has been used in this manual to permit a rapid identification of the main technical information supplied.

The list of symbols is given below.


removal/disassembly




refitting/re-assembly



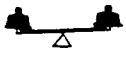

tighten to the torque


caulk nut


adjustment/regulation


visual check


lubricate


weight difference


angular value


pressure


temperature


brake system air purge


surfaces to be treated


interference


play


intake


exhaust


Lubricate only with engine oil


left-hand thread


torque for tightening in oil


engine r.p.m.


ovalization


taper


eccentricity


flatness


diameter


linear dimension


parallelism


service with grease


heating temperature


seal


service with engine oil


grease


CAUTION!


WARNING!

Warnings for the operator

All the operations must be carried out with the greatest care to prevent damage occurring to the vehicle or persons.

- The use of Alfa Romeo specific tools are indicated for some procedures. These tools must be used to ensure safety and to avoid damaging parts involved in the procedure.
- To free parts which are solidly stuck together, tap with an aluminium or lead mallet if the parts are of metal. Use a wooden or resin mallet for light alloy parts.
- When dismantling ensure parts are marked correctly if required.
- When refitting lubricate the parts, if necessary, to prevent seizing and binding during the initial period of operation.
- Using adhesive paper or clean rags cover those parts of the engine which, following disassembly, present openings which may allow dust or foreign material to enter.
- When refitting, the tightening torques and adjustment data must be respected.
- When substituting the main component(s) the seal rings, oil seals, flexible washers, safety plates, self-locking nuts and all worn parts must also be replaced.
- Avoid marking the internal coverings in the passenger compartment.

Substitution of groups or disconnected parts must be carried out using original spare parts only. Only in this way can the suitability and perfect operation of each organ be guaranteed.

- The words **CAUTION** and **WARNING** accompany those procedures where particular care should be taken to prevent damage occurring to people or vehicle parts.

CAUTION:
used when insufficient care could cause damage to people

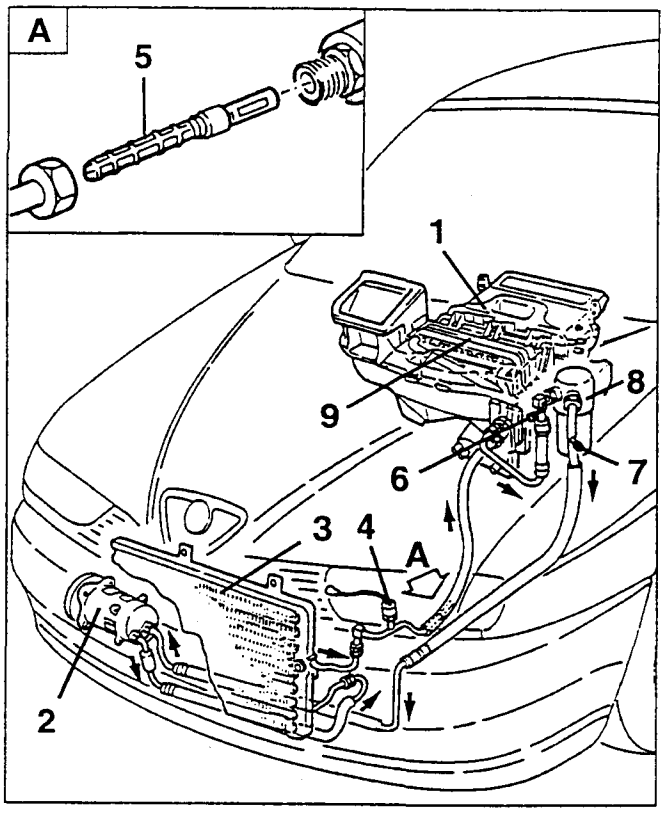
WARNING:
used when insufficient care could cause damage to the vehicle or its component parts.

- The safety regulations applied to workshops should be respected. Where necessary the manual also lists the specific precautions to be taken to prevent dangerous situations from arising.

When using chemical products follow the safety indications given on the safety cards which the supplier is obliged to deliver to the user (in Italy in compliance with D.M. n.46/1992).

NOTE:
It is possible that for certain subjects were not completed in time for printing.
However these subjects are given and highlighted in the indices of the single groups.
It is the duty of the Technical Services to supply documentation regarding these subjects as soon as possible through updates or "Technical Bulletins".

SYSTEM



1. *Heating and ventilation unit*
2. *Compressor*
3. *Condenser*
4. *Three-level pressure switch (trinary)*
5. *Expansion valve*
6. *Needle valve for charging/draining R134a on the low pressure pipe*
7. *Needle valve for charging/draining R134a on the low pressure pipe*
8. *Drier filter*
9. *Evaporator*

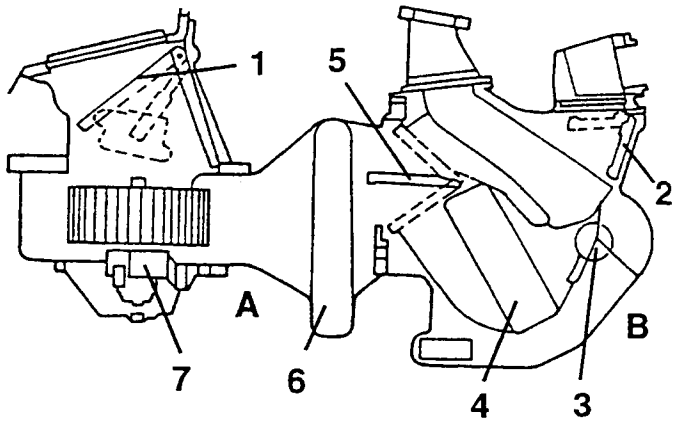
DESCRIPTION

The heating and ventilation system is of the manual type with air conditioner.
The system can be represented by three sections:
- a unit comprising the air ducting system and the heater - distributor unit.
- a closed circuit that generates cold (air conditioner).
- a control unit for certain functions of the system.

DUCTING SYSTEM AND HEATER - DISTRIBUTOR UNIT

Two types have been adopted, one described and illustraded in the various procedures with the words **"two bowden"** and in the other **"three bowden"**. The variations in relation to the proceding type are given in a specific paragraph.

The assembly comprising the ducting system (A) and the heater- distributor unit (B) is shown in diagram form in cross-section in the figure below.
The ducting system (A) can in turn be divided into two parts, a lower and an upper section; one end of the latter is suitably shaped to be connected with the *opening in the services box.*



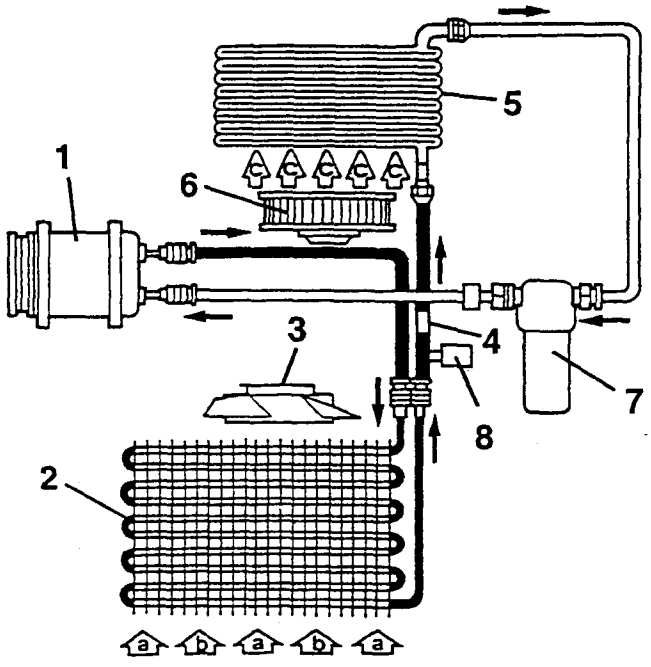
1. *Outside air/recirculation vent*
2. *Upper distribution vent*
3. *Lower distribution vent*
4. *Heater radiator*
5. *Mixing vent*
6. *Evaporator*
7. *Fan*

In the upper front section, in line with the outside air inlet, there is a second opening that communicates with the passenger compartment (air inlet for the recirculation function).
Between the two air inlet openings, inside the ducting system, there is a motorised flap which is duly directed to shut off one of the two openings. The flap is controlled through a leverage by an electric actuator (motor) fastened on the outside of the system.
Inside, opposite the air inlets there is the evaporator which represents the cooler.
The fan is fitted in the lower section in correspondence of the air inlets and it operates at different speeds.
Two bowdens are connected on the lefthand side of the heating- distributor unit which are operated by the controls and suitably direct the lower, upper and air mixing and distribution flaps and they also control the position of the tap fitted on the heater radiator inlet.

AIR CONDITIONING CIRCUIT

The circuit shown in diagram form in the figure below mainly comprises the following parts:
- a compressor fitted on the engine, which draws in the cooling liquid from the evaporator;
- a condenser, fitted in front of the engine cooling radiator (high pressure circuit);
- an evaporator in the ducting system;
- a drier filter.

The above parts are connected to one another by suitable hoses. On the hose connecting the condenser to the evaporator a three- level pressure switch has been fitted and this is the only part of the system with control and safety functions.
An expansion valve has also been inserted in the same hose.



High pressure circuit

Low pressure circuit

a. Flow of air to cool the condensor leading from the front grille when the vehicle is on the move.

b. Flow of air to cool the condenser generated by the corresponding fan when the car is at a standstill or travelling slowly (queues).

c. Flow of air for the evaporator generated by the corresponding fan installed in the heater - distributor unit.

1. *Compressor*
2. *Condenser*
3. *Condenser fan*
4. *Expansion valve*
5. *Evaporator*
6. *Evaporator fan*
7. *Drier filter*
8. *Three-level pressure switch (trinary)*

The air conditioner unit cools and dehumidifies the air before it reaches the passenger compartment. It operates according to a common refrigeration cycle containing R134a fluid exploiting the change from liquid to gas and viceversa to absorb and release a considerable amount of heat.
During operation, two pressure levels are created which are maintained on one side by the compressor and on the opposite side by the expansion valve at the evaporator inlet. Two needle valves are fitted on the hoses for charging and draining the system.
The refrigerating fluid leaves the compressor as a gas at high temperature and high pressure. It then enters the condenser where it is cooled and comes out as a liquid.
The expansion valve located on the evaporator inlet atomizes the fluid and lowers its pressure which leads to a decrease in its temperature.
The fluid which is still in a liquid state enters the evaporator where it is vapourized absorbing heat from the air directed onto the fins of the fan.
The air in contact with the cold walls of the evaporator loses a high percentage of its humidity which, when condensed is drained outside the car through a special drainage tube.
The fluid in a gaseous state leaves the evaporator and passes into the drier filter which absorbs any particles of water which, if allowed to continue around the circuit would freeze and block the expansion valve reducing or eliminating the efficiency of the cycle.
A three-level pressure switch is inserted in thehigh pressure circuit of the refrigerating fluid near the drier and controls the turning on and off of the compressor.

Refrigerating fluid

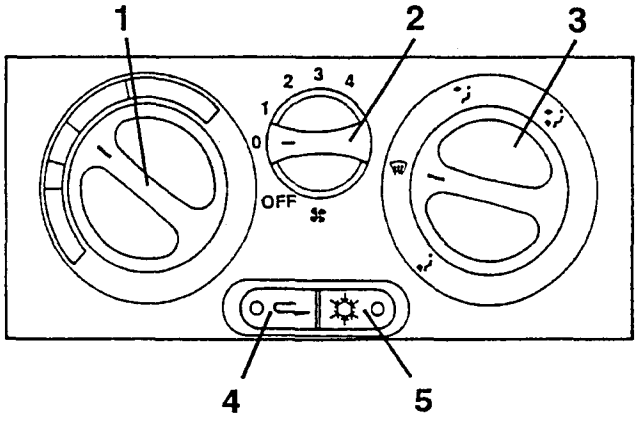
For the above air conditioning system the new **ecological fluid R134a** is used which does not contain chlorofluorocarbon (CFC), one of the chemical agents that causes the reduction of the ozone layer of the atmosphere.
The systems working with R134a are readily distinguished by the wording "R134a" printed on its main components.

Refrigerating fluid R134a cannot be mixed with the Freon 12 used in the conditioning systems of the previous cars; therefore, NEVER USE FREON 12 FOR ANY REASON WHATSOEVER for the conditioners with R134a.
All the components of the system are specifically for the use of R134a and ARE NOT INTERCHANGEABLE with those of the cars using R12.
The draining/recovery station is specifically for R134a fluid.
(Refer to the specific Tool Bulletins for further details).

CONTROL UNIT

Positioned on the right-hand side of the upper cross-member this momentarily deactivates the air conditioning system under some conditions of engine operation where the engine is required to deliver maximum power to the wheels thus eliminating the absorption of power by the compressor (for example, during overtaking, rapid acceleration etc.).
The control unit activates the following operating logic, or rather, two different operating logics at low and at high rpm.
- below 2000 rpm, as soon as the full load contact closes, the compressor electromagnetic joint is de-energized and it is re-connected as soon as the switch opens;
- above 2000 rpm the compressor supply is cut off for only 8 sec. after which it is restored.
a thermal contact is fitted on the thermostatic cup which cuts off the compressor if the engine temperature reaches over 111°C.

CONTROL PANEL



1. **Air temperature adjstment knob**
The heating is shut off when the knob is turned completely to the left; the temperature of the air is gradually increased turning the knob rightwards: maximum heating is obtained when the kknob is turned completely to the right.

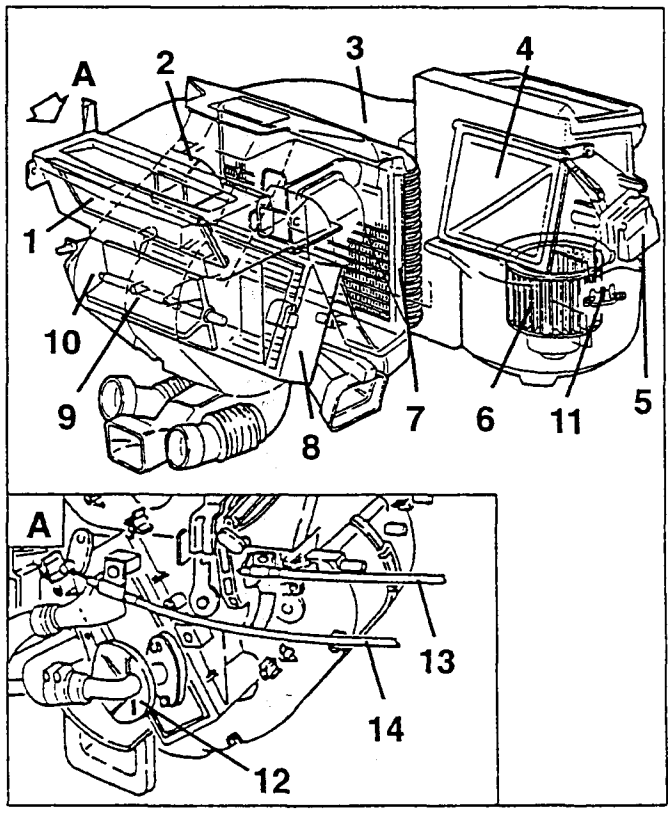
2. **Fan control knob**
When this is on **0** the fan is shut off; to switch it on, turn it clockwise and set it on the speed required.
The flow of air to the passenger compartment can be shut off setting the above knob to the **OFF** position.

3. **Air flow distribution control knob**
This distributes the air flow among the different vents.

4. **Outside air or recriculation control button**
When this is pressed it shuts off the outside air inlet and admits recirculation air.

5. **Air conditioning control button**
This is pressed to turn on the manual air conditioner.

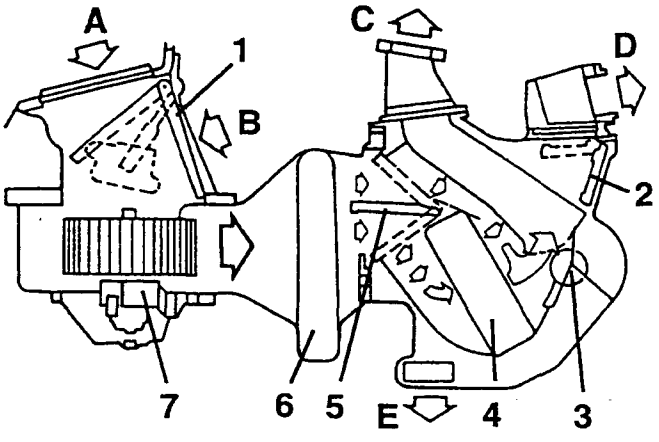
IDENTIFICATION AND LOCATION OF THE COMPONENTS IN THE DUCTING SYSTEM AND HEATER - DISTRIBUTOR UNIT



1. *Upper distribution vent*
2. *Mixing vent*
3. *Ducting system*
4. *Outside air/recirculation flow adjustment vent*
5. *Electric actuator for outside air/recirculation flow adjustment vent*
6. *Electrice fan*
7. *Evaporator*
8. *Heater radiator*
9. *Lower distribution vent*
10. *Heater-distributor unit*
11. *Fan speed resistance*
12. *Heater readiator coolant inlet tap*
13. *Distribution vents control cable*
14. *Mixing vent and heater radiator inlet tap control cable*

PATH OF THE AIT IN THE DUCTING SYSTEM AND HEATER-DISTRIBUTOR UNIT

The flow of outside air (A), see diagram below, is ducted to the heater-distributor unit passing through the motorized adjustment flap (1), the fan (7) and the evaporator (6) where, if the conditioner is operating, it is cooled and dehumidified. When the recirculation function is activated the flow of air (B) leads directly from the passenger compartment.



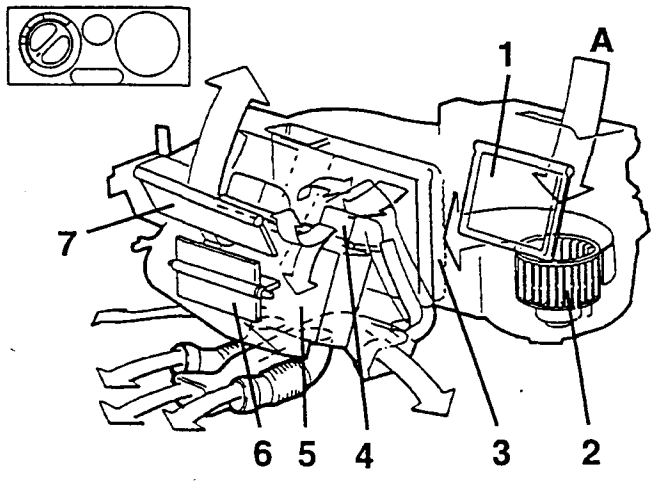
A. Outside air flow
B. Recirculation air flow
C. Air flow from windscreen vents
D. Air flow from front, centre and side vents
E. Air flow from vents front and rear seat foot level
1. Outside air and recirculation air flow adjustment flap
2. Upper distribution vent
3. Lower distribution vent
4. Heater radiator
5. Mixing vent
6. Evaporator
7. Electric fan

Depending on the position of the mixing vent (5), the flow of air leading from the evaporator (6) is all sent to the distribution vents (2 and 3) or it passes either partially or totally through the heater radiator (4) and then to the distribution ports (2 and 3).
Depending on the position of the upper (2) and lower (3) distribution vents, the flow of air is directed to the various outlets and vents.
Generally, the fan is used with recirculation air under the following two conditions:
- when the environment outside the car is polluted (queues, tunnels, etc.);
- when it is necessary to lower the temperature in the passenger compartment quickly (prolonged parking in direct sunlight during the summer months).

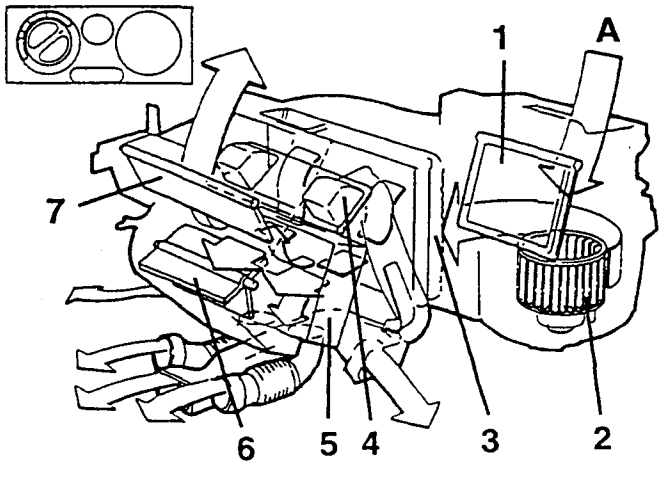
VIEWS OF THE AIR DISTRIBUTION FLOWS IN THE AIR DUCTING SYSTEM AND HEATER-DISTRIBUTOR UNIT

In the following diagrams the outside air/recirculation adjustment vent is shown in the position for admitting outside air (A).

Coldest position: the flow of outside air (A). passes through the fan (2), reaches the evaporator (3), finds the mixing vent (4) in the position that shuts off the heater radiator (5), so it wholly by-passes it and reaches the lower distribution vent (6) and the upper one (7) from where it is directed to the various vents and outlets depending on the position of the distribution knob.



Warmest position: the flow of outside air (A), passes through the fan (2), reaches the evaporator (3), and finds the mixing flap (4) which directs it wholly onto the heater radiator (5), it reaches the lower distribution vent (6) and the upper one (7) from where it is directed to the various vents and outlets in the passenger compartment depending on the position of the distribution knob.

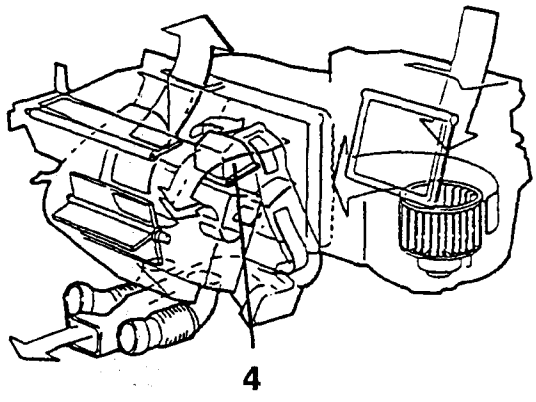


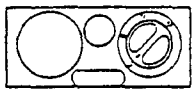
Distribution of the air flow in relation to the positions of the air distribution control knob

In the following diagrams the mixing vent (4) is shown in an intermediate position between warmest and coldest extremes (mixed air).

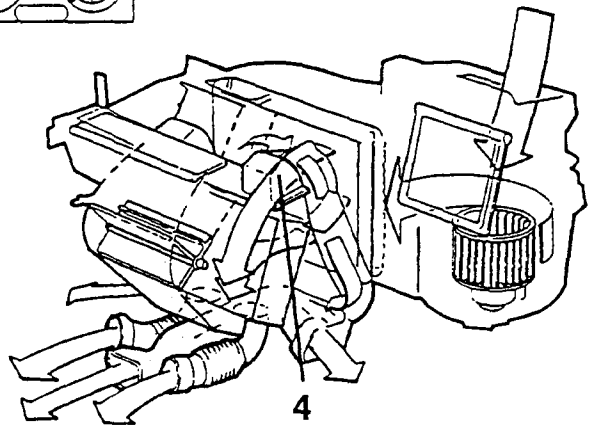


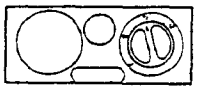
Defrost



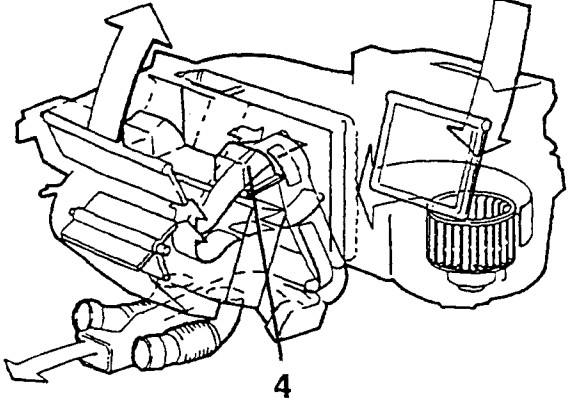


Feet level



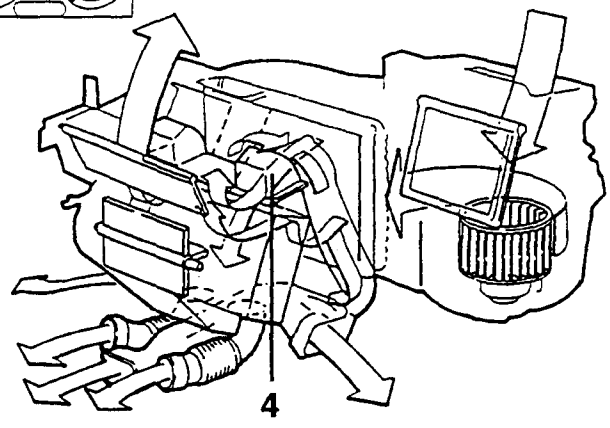


Front

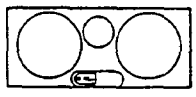




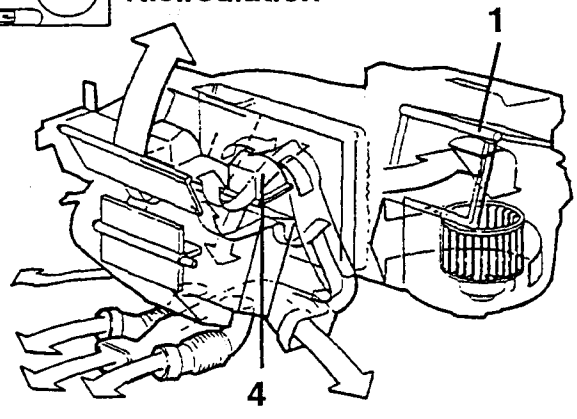
Half front, half to the feet



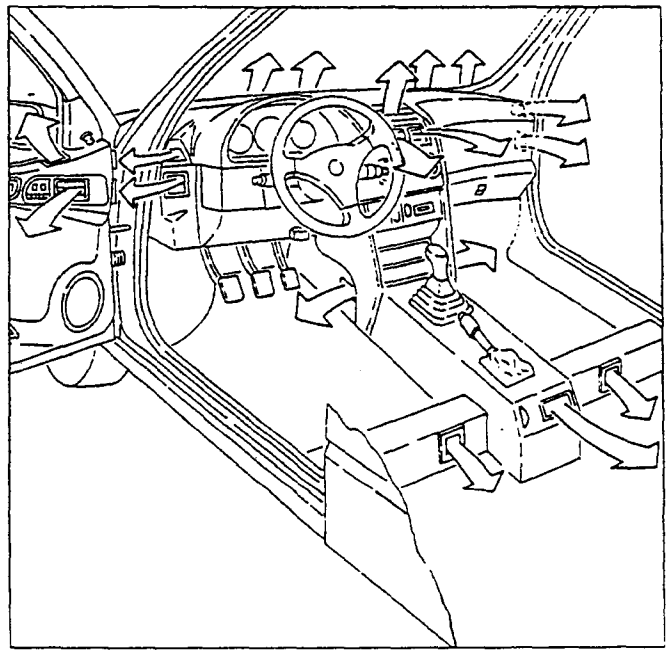
In the following diagram the mixing vent (4) is still shown in the mixed air condition and the recirculation flap (1) completely shutting off the outside air (recirculation air inlet (B)).



Ricirculation



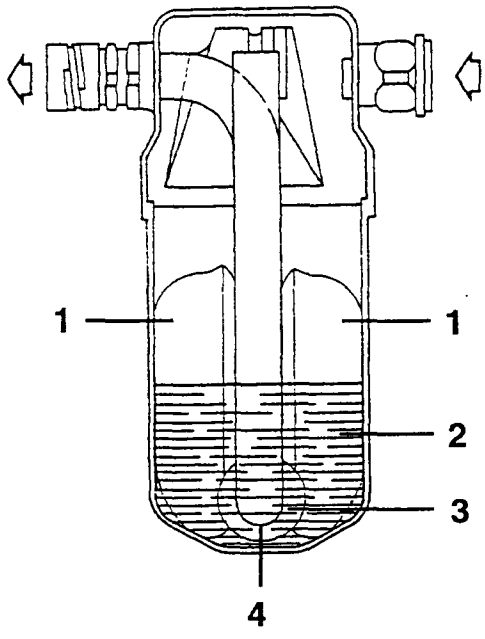
AIR FLOW DISTRIBUTION IN THE PASSENGER COMPARTMENT



DESCRIPTION OF THE MAIN COMPONENTS OF THE AIR CONDITIONING SYSTEM

EVAPORATOR

The evaporator is the second heat exchanger of the system and it is formed of aluminium pipes with aluminium fins which increase the heat exchange surface. The evaporator inlet and outlet ducts are welded to the assembly of pipes which forms it. The evaporator is chemically treated to protect it from corrosion.
It is the cooling element of the system and it can be crossed by either air leading from the passenger compartment (recirculated) which is always colder and dehumidified, or by outside air to change the air inside the passenger compartment.
As the temperature of the outside or recirculated air that crosses the evaporator is always higher than that of the R134a at low pressure and temperature inside it, this causes evaporation and the change to gas (still at low pressure).
At the same time, the air around the fins of the evaporator is cooled and dehumidified. The humidity that condenses on the evaporator fins is collected and drained off the car.



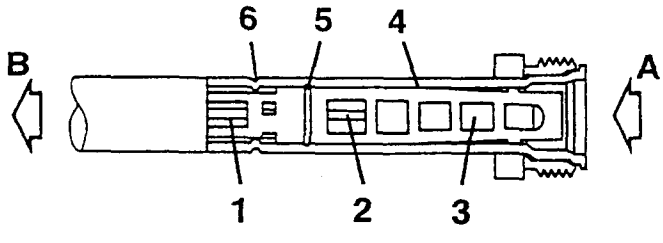
1. *SILICAGEL sachets*
2. *R134a refrigerant in the liquid state*
3. *Filter*
4. *Hole for oil return to the compressor*

DRIER FILTER

The drier filter shown schematically in cross-section, is connected by a pipe to the evaporator outlet from which it receives the R134a (mostly in the gaseous state with a minimal quantity of liquid) and the antifreeze oil.
The drier filter carries out different tasks, foremostly that of a separator between the refrigerant in gas state and that in liquid form.
It also acts as a reserve reservoir in which a large amount of the R134a is stored (in the liquid state) in the circuit.
It also serves as a drier through two sachets of SILICAGEL located in the lower section of the filter, which dry any particles of humidity in the system.
For this reason, these accumulators should be carefully stored in a dry place and kept completely sealed until the time of installation.
In the lower section of the shaped pipe which is located inside the accumulator and communicates with its outlet union, there is a hole which serves to ensure that the antifreeze oil returns to the compressor. On this shaped pipe near the oil hole, there is a metal mesh filtering ring.

EXPANSION VALVE

The expansion valve, which may be more aptly called an expansion tube, is inserted in the evaporator inlet duct.
This valve, shown in the diagram below, is cylindrical in shape and made from plastic except for the inside of the tube which is metal.
The initial and final sections of the valve are made of very fine metal netting with very small meshes which serve as filters, while the tube has a determinate inside diameter, calibrated to admit the necessary volume of refrigerant fluid when the compressor is operating.
On the outside of the valve there is a rubber ring which seals the inner surface of the evaporator inlet duct.

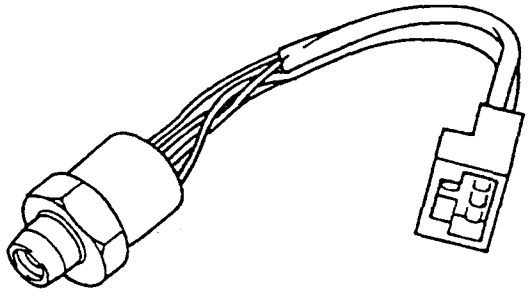


1. *Outlet net filter*
2. *Expansion tube*
3. *Inlet filter net*
4. *Evaporator inlet duct*
5. *Seal ring (O-Ring)*
6. *Expansion valve retainment rolling*

The expansion tube separates the high pressure side of the system from the low pressure side and after it the high pressure R134a in the liquid state leading from the condenser expands, lowering the pressure and temperature without changing its state. When the compressor is turned off, the refrigerant on the high pressure side flows through the expansion tube to the low pressure side until the two pressures are levelled; this reduces the amount of torque required to re-start the compressor.

THREE-LEVEL PRESSURE SWITCH (TRINARY)

The purpose of the three-level pressure switch is to operate the condenser and radiator fan when the car is at a standstill or moving slowly in a queue and the R134a needs to be condensed by forced ventilation as the flow of air caused when the car is travelling at speed fails to be generated.
It also has the task of de-energizing the electromagnetic joint of the compressor pulley when the pressure (high pressure side), reaches dangerous limits despite the action of the condenser and radiator fan or due to a failure, or when, due to a leak or because the outside temperature is below 10°C (and the thermal load is not enough to evaporate the R134a), the pressure is below 2,5 bar.

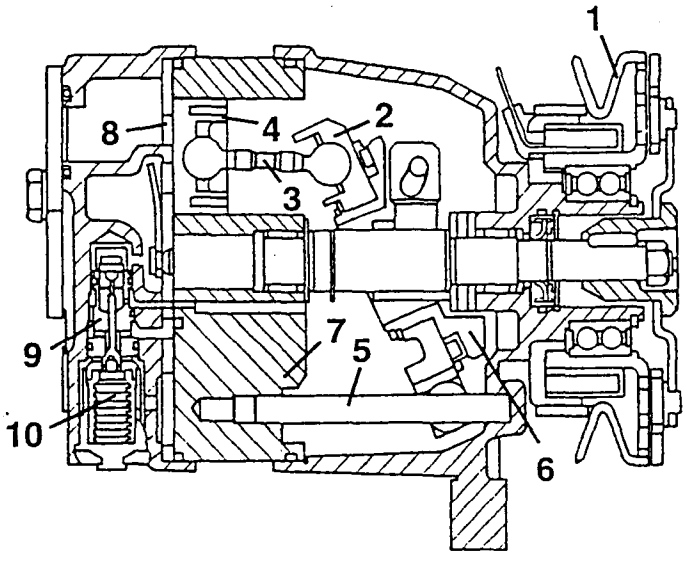


CONDENSER

The condenser is a heat exchanger formed of copper or aluminium pipes with aluminium fins which increase the thermal exchange surface.
The R134a in gaseous state crossing the coils of the condenser changes to the liquid state (on average at a temperature of 60°C). Insufficient thermal exchange in the system increases the pressure in the system and prevents the complete condensation of the R134a: thus the expansion valve would still receive gassy fluid that would considerably reduce the cooling capability of the system.
The condenser is lapped by the air produced as the car travels forward or by the air produced by the special fan when the car is at a standstill or moving slowly in a queue.

COMPRESSOR

The variable-displacement HARRISON V5 compressor shown in diagram form below comprises:
- a block (7) in which the liners on which the pistons (4) run are machined.
- a unit formed of a shaft on which a tilting plate (6) is fitted, on which, by the interposition of roller bearings, a disk (2) rotates guided by a pin (5) integral with the five connecting rods (3) which operate the pistons (4)
- a cylinder head in which the intake and delivery manifolds and the adjustment valve seat (9) are machined
- a plate (8), interposed between the block and the cylinder head on which the intake and delivery valves are machined
- a pulley assembly with electromagnetic joint (1).

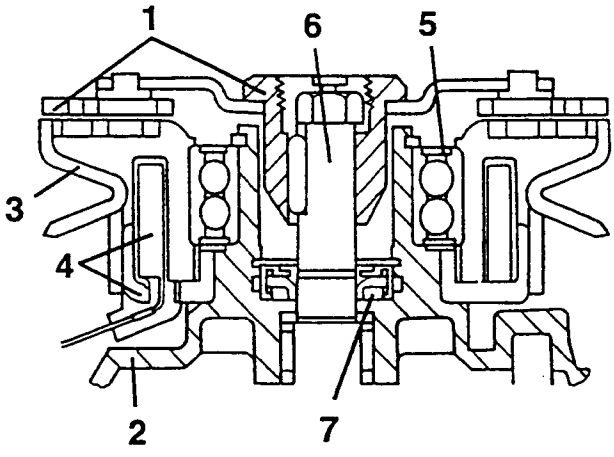


1. *Pulley with electromagnetic joint*
2. *Disk*
3. *Connecting rod*
4. *Pistons*
5. *Disk guide pin*
6. *Sloping plate*
7. *Block*
8. *Plate with intake and delivery valves*
9. *Adjustment valve*
10. *Adjustment valve control bellows*

The reciprocating motion needed to make the pistons run in their liners is obtained through the rotary motion of the tilting plate (6) while the changed displacement depends on the stroke of the pistons and is obtained by the changing of the angle of inclination of the control disk (2) of the connecting rods (3).
The inclination of this plate depends on the pressure difference between the intake duct and the inside of the compressor. This difference is detected by the bellows (10) and causes the actuation of the adjustment valve (9) and the consequent movement of the disk (2)
When the need for conditioned air is high, the adjustment valve (9) sets itself to disclose a gap that connects the intake side with the inside of the compressor; since in this case there is no pressure difference, the compressor works at the highest displacement corresponding to the positioning of the disk as described in the previous section.
When the need for air is lower, the valve sets itself to connect the delivery section with the block and it simultaneously annuls the passage between the latter and the intake side activated previously.
The angle of inclination of the disk carrying the connecting rods is determined by the balance of the two pressures.
A slight difference between the intake pressure and the pressure in the compressor creates a resulting force on the pistons which causes the disk to tilt on its fulcrum pin.
The vertical position of the disk corresponds to displacement of almost nil, thus R134a compression close to zero.
In the compressor when the piston moves away from the head during its stroke it generates a vacuum in the space above.
The difference in pressure causes the R134a in gas state to open the intake valve and fill the cylinder. As soon as the piston begins its stroke towards the head, the intake valve closes and the R134a is compressed until its pressure opens the exhaust valve (delivery).
The R134a is at pressure of between 9,81 ÷ 19,6 bar (10 ÷ 20 kg/cm^2) and a temperature of 80° ÷ 100°C can therefore be sent to the condenser.

TRANMISSION OF MOTION TO THE COMPRESSOR

The rotary motion required to operate the compressor is developed thanks to the presence of the pulley/electromagnetic joint assembly shown in the diagram which is formed of the following:
- a plate (1) keyed onto the compressor shaft (6)
- a rotor unit with pulley (3) turning on ball bearings (5)
- an electromagnet (4) controlled by the activation of the air conditioning system.



1. *Disk keyed onto the compressor shaft*
2. *Front compressor support*
3. *Rotor unit with pulley*
4. *Electromagnet*
5. *Ball bearings*
6. *Compressor shaft*
7. *Seal*

When the air conditioning system is not operating, the pulley (3) operated by the connection belt with the crankshaft idles on the bearing (5) keyed onto the front compressor support (2).
When the air conditioning system is turned on, an electric signal energizes the electromagnet which attracts the disk (1) against the pulley (3) which which causes the compressor shaft to turn.
The result is the special feature of this system compared with conventional rotary types, which is the possibility of not requiring the continual engagement/disengagement of the electromagnetic joint, resulting in excessive stresses on same, to activate the compressor.
In fact, the latter, always rotating, alters its operating condition by changing, as described previously, the displacement according to the amount of conditioned air required.

CAUTIONS FOR REMOVAL AND REFITTING

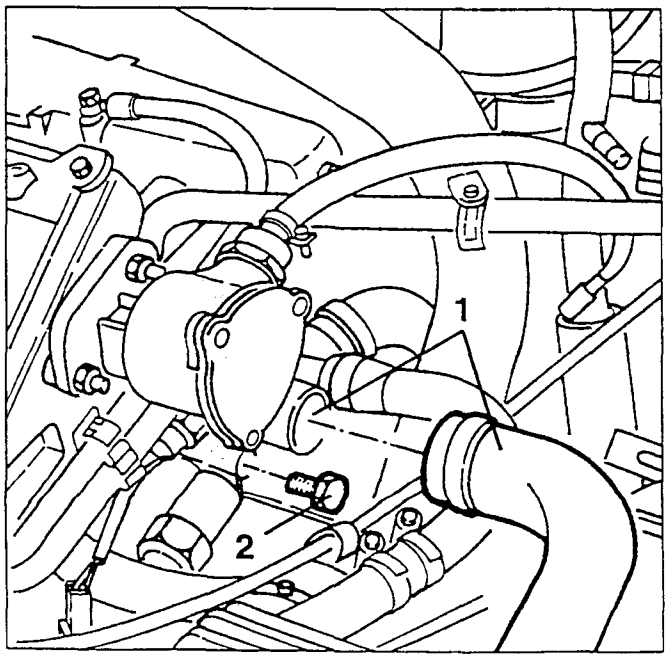
During servicing operations, when the components of the air conditioning system are disconnected, suitably plug the disconnected unions to prevent any damp and dirt from getting into the system.
When refitting the pipe unions always change their O-rings.
Lubrificate the threads of the pipe unions with the specified antifreeze oil and tighten them to the specified torque.
In the event of oil leaks from the system during servicing operations top up the system taking account of the estimated amount lost due to leaks.

DUCTING ASSEMBLY AND HEATER - DISTRIBUTOR UNIT (TWO BOWDEN)

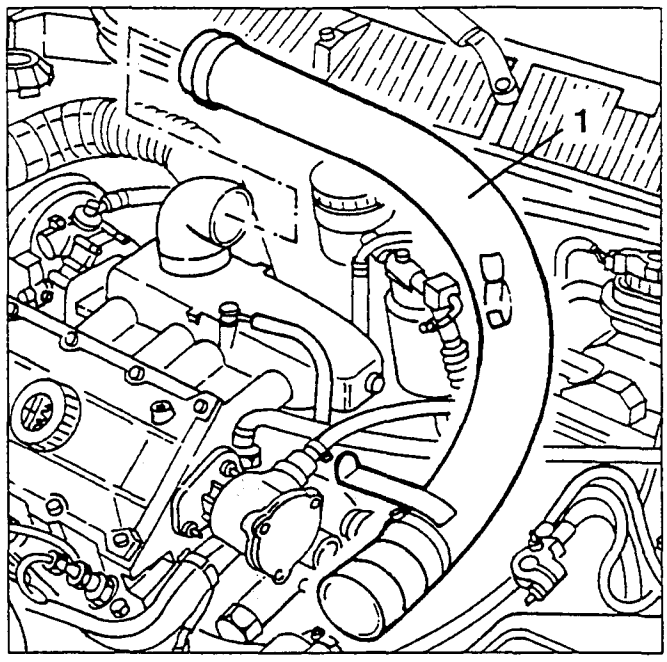
REMOVAL/REFITTING

- Drain the fluid from the air conditioning system (see the specific paragraph).
- Remove the battery (see GROUP 55).

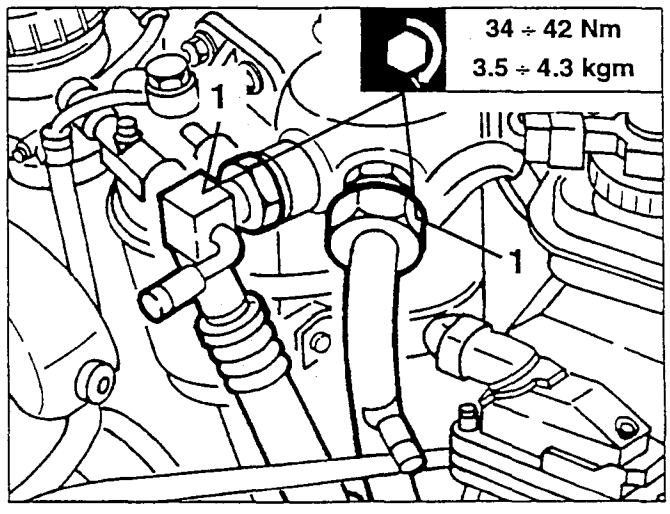
1. Disconnect the radiator delivery sleeve from the thermostatic cup and recover the coolant that flows out.
2. Slacken the screw fastening the stiff air inlet pipe.



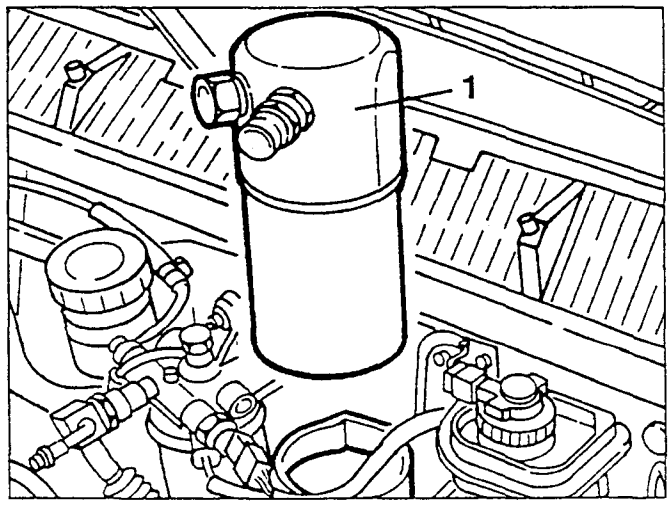
1. Slacken the fastening clamp and remove the stiff air inlet pipe.



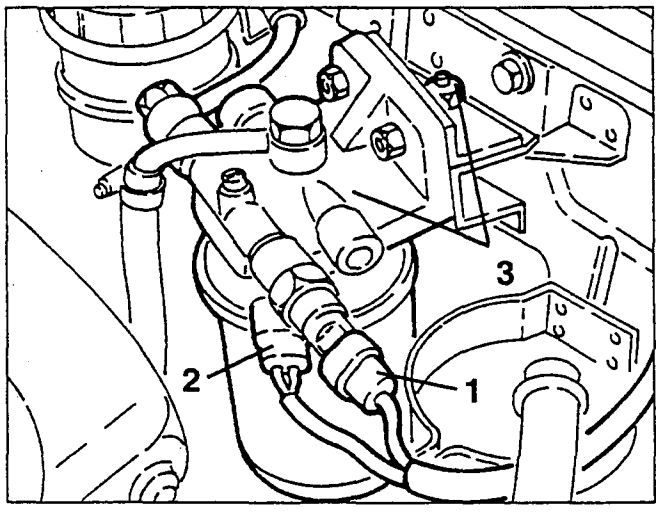
1. Disconnect the refrigerant fluid inlet and outlet pipes from the drier filter.



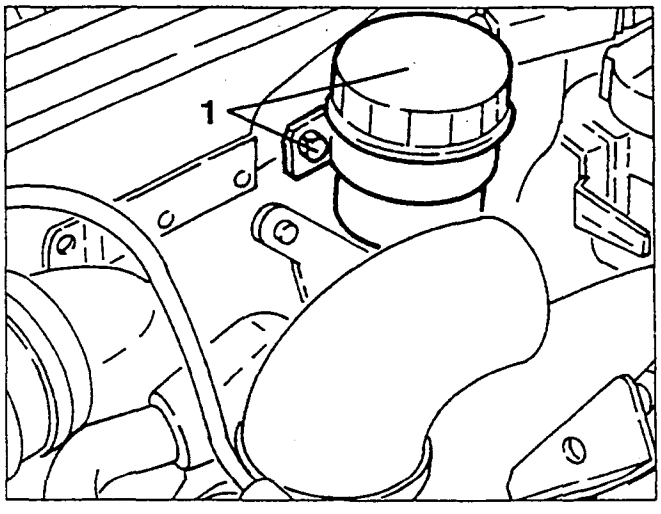
1. Slacken the support clamp and remove it slipping it off upwards.



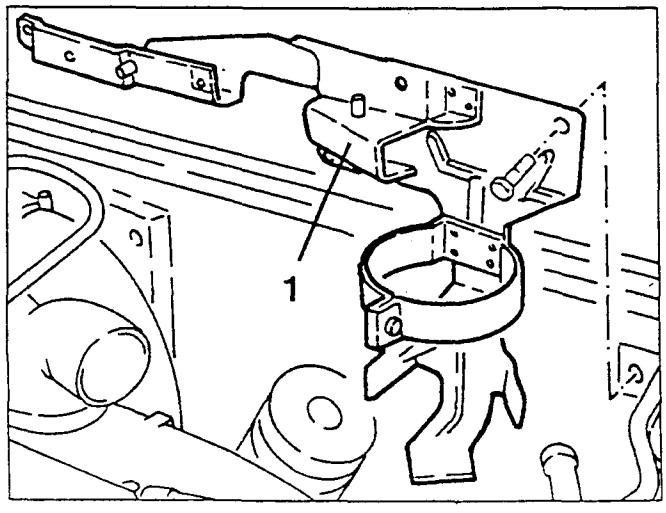
1. Disconnect the electrical connection of the fuel pre-heating device control sensor.
2. Disconnect the electrical connection of the supply to the fuel pre-heating device.
3. Slacken the fuel filter fastening nut, then move it to one side without disconnecting the pipes.



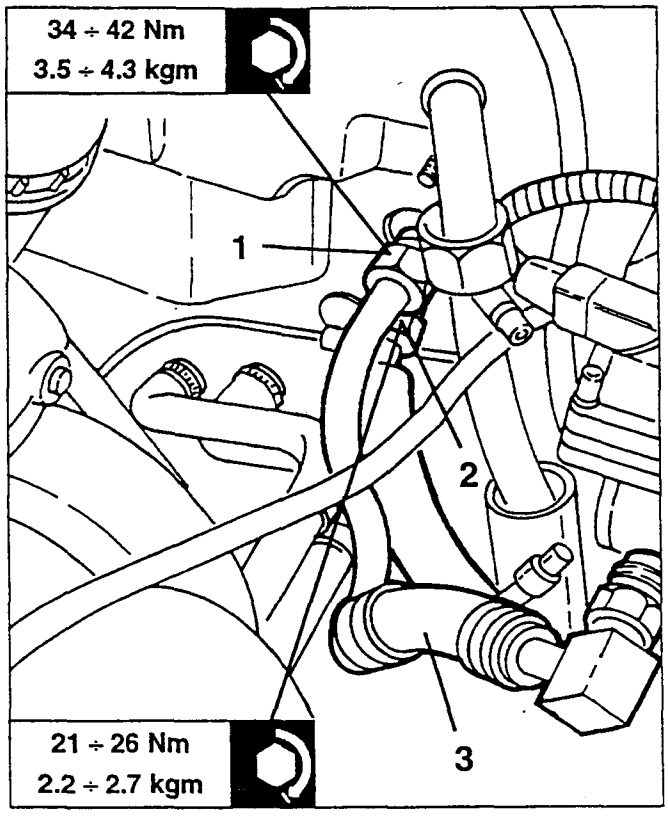
1. Slacken the power steering reservoir nut, then move it to one side without disconnecting the pipes.



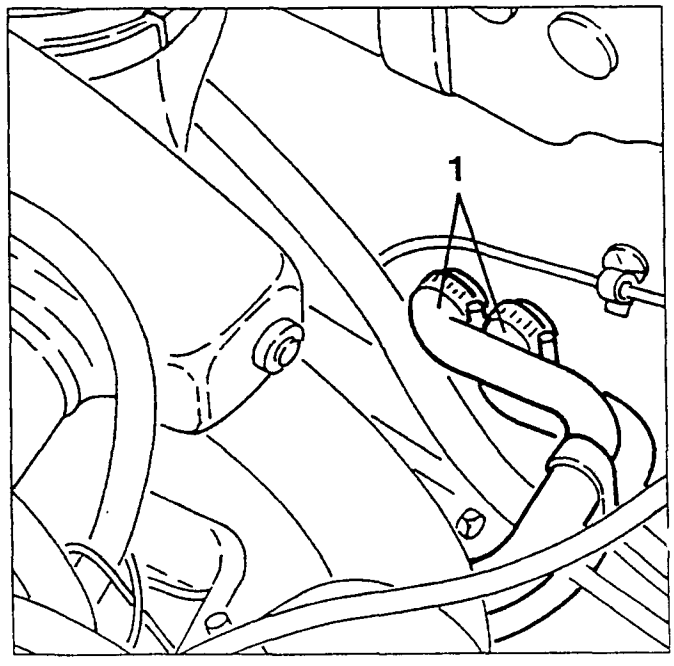
1. Slacken the four fastening screws and remove the support bracket.



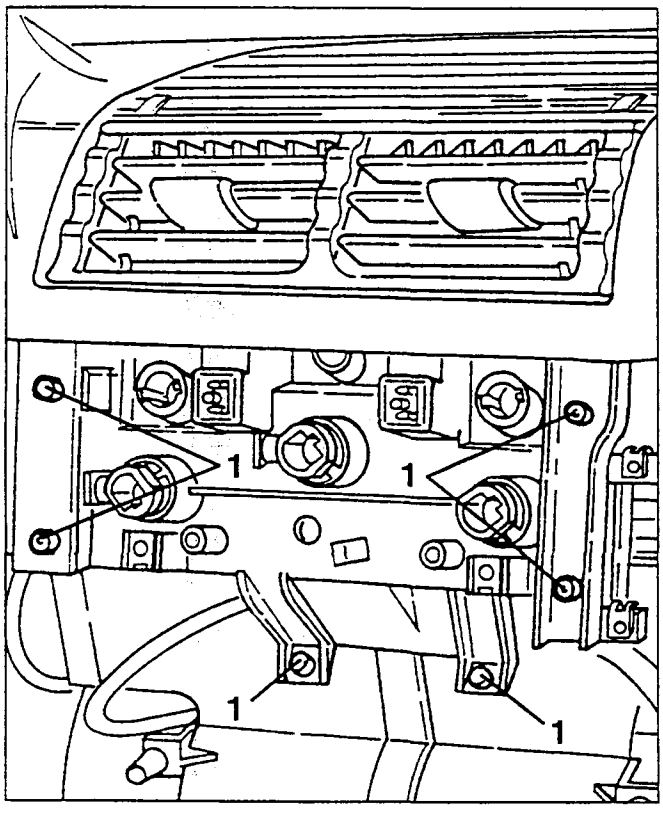
1. Using wrenches N° 1.822.112.000 and N° 1.822.115.000 disconnect the fluid outlet pipe from the evaporator.
2. Using wrenches N° 1.822.111.000 and N° 1.822.113.000 disconnect the fluid inlet pipe from the evaporator.
3. Retrieve the evaporator connection pipe to the drier filter.



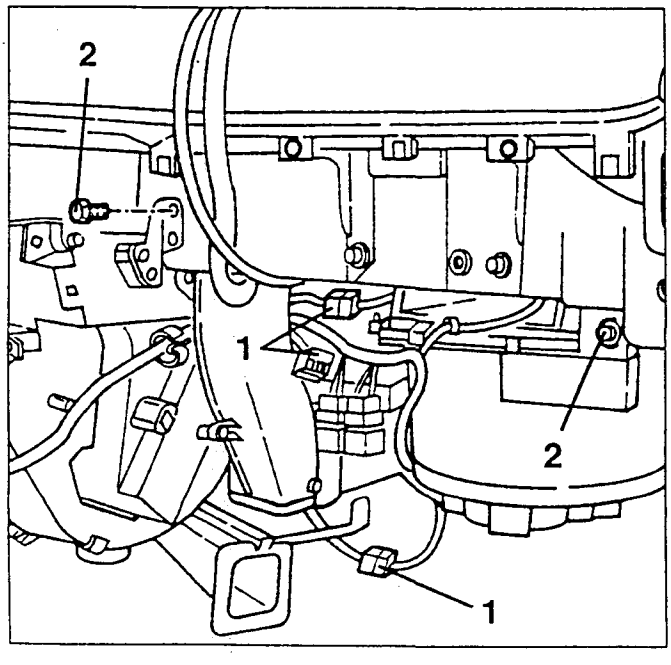
1. Disconnect the two engine coolant radiator delivery and return pipes.



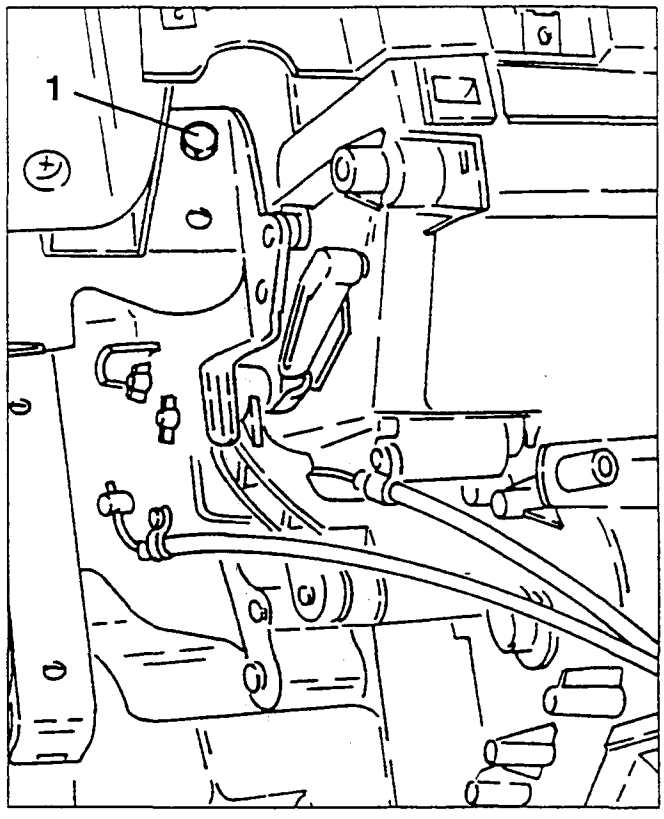
- Remove the lower part of the dashboard and the centre console (see GROUP 70).
1. Slacken the fastening screws and lower the heating and ventilation controls.



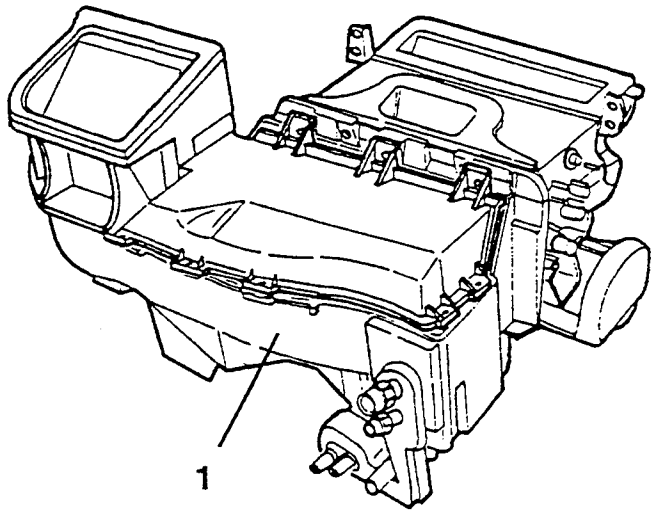
- Remove the two sections of the air flow duct to the rear passenger face level (see GROUP 70).
1. Disconnect the electrical connections of the heating and ventilation unit.
2. Slacken the three screws fastening the heating and ventilation unit on the righthand side.



1. Slacken the screw fastening the heating and ventilation unit on the lefthand side.



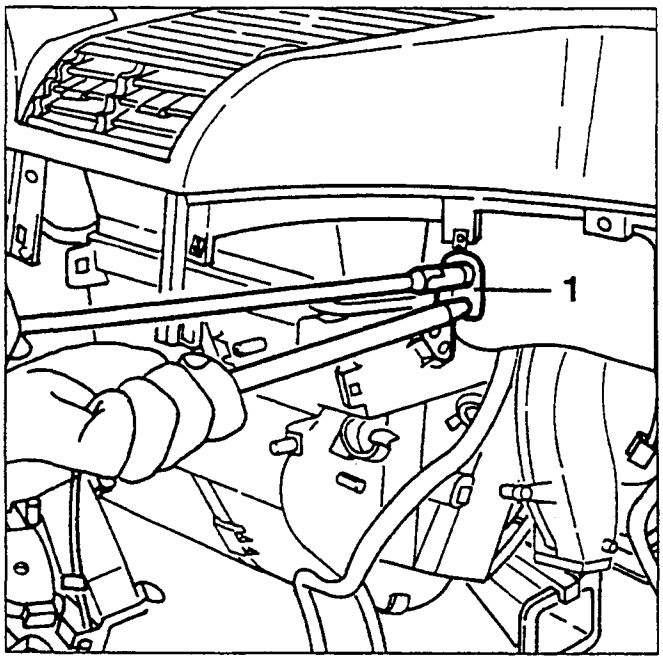
1. Remove the heating and ventilation unit.



To refit the heating and ventilation unit, reverse the sequence followed for removal, adhering to the following instructions:

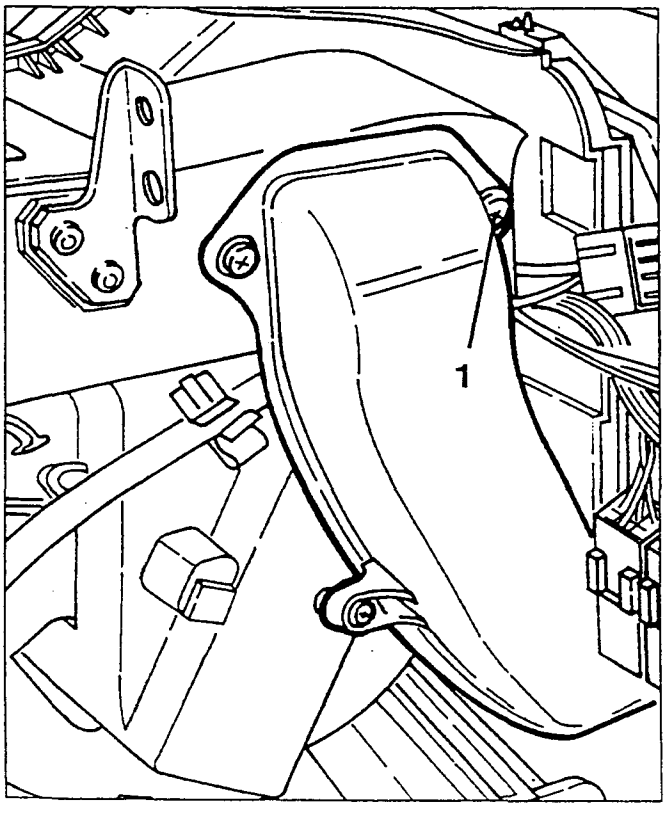
- Coat the mouth of the heater, water drain pipes and conditioning pipes with vaseline.
- Assemble the unit taking care to insert the above pipes correctly in the passage holes.

1. Use a centering pin positioned as shown, and centre the group before fixing it.

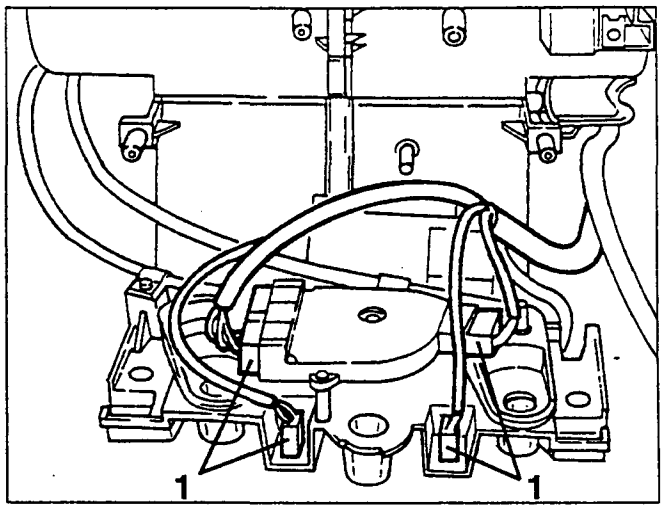


DIS-ASSEMBLY

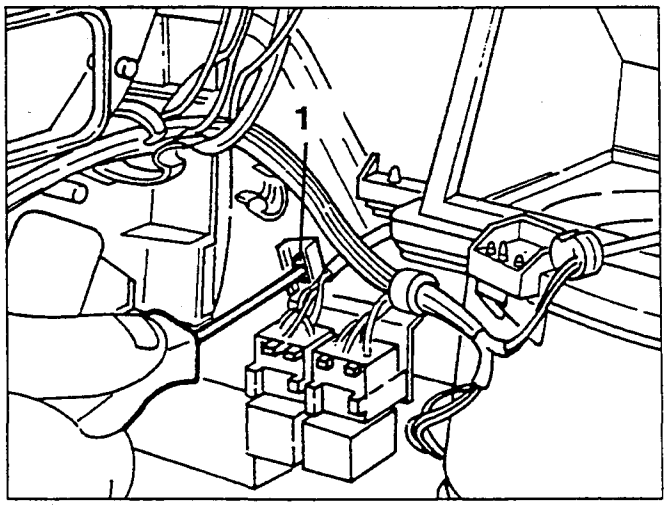
1. Slacken the three fastening screws and remove the air delivery duct to the rear passenger area.



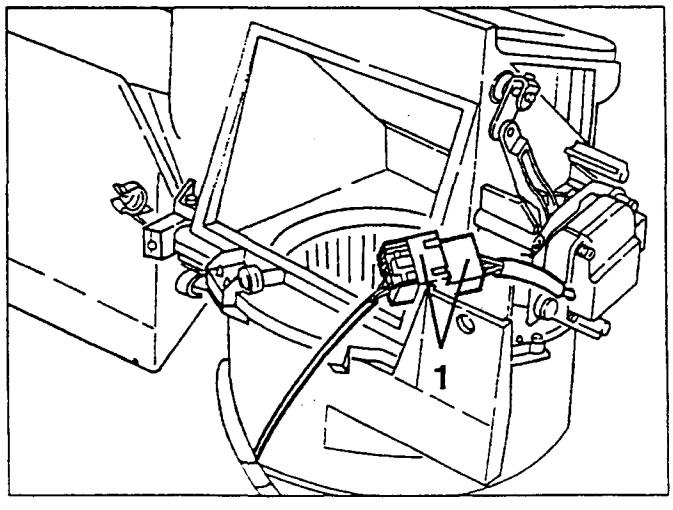
1. Disconnect the four electrical connections from the heating and ventilation controls.



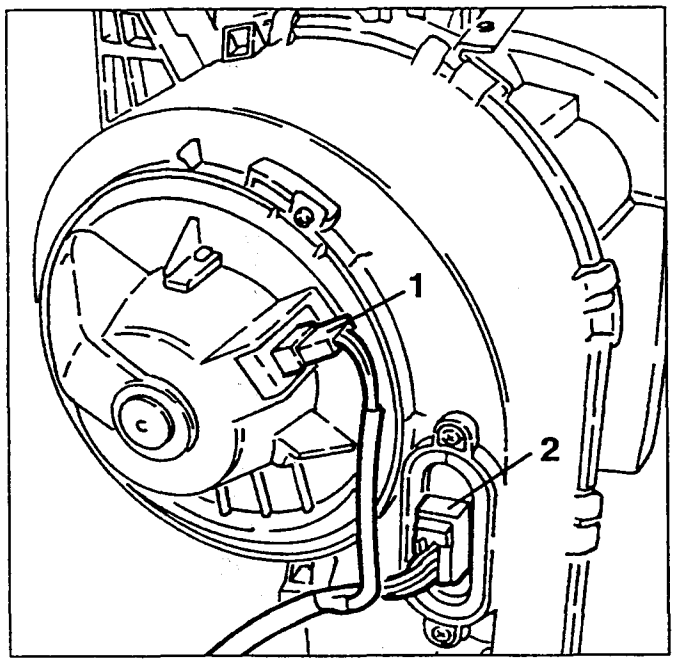
1. Slacken the screw fastening the relay switch support bracket.



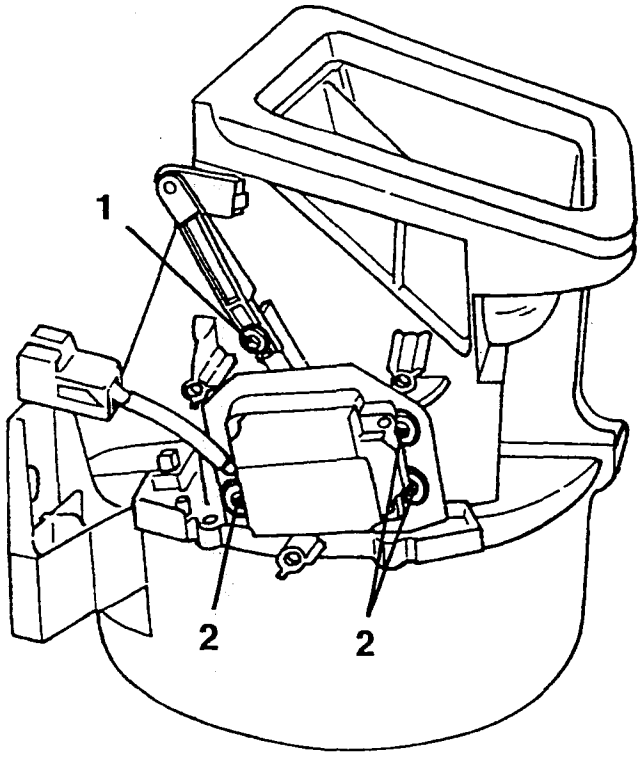
1. Disconnect the electrical connection of the outside air/recirculation mixing vent control motor.



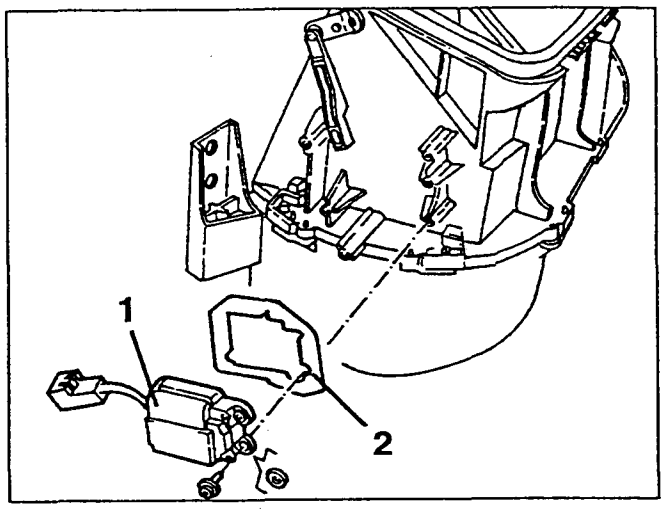
1. Disconnect the electrical connection from the fan.
2. Disconnect the electrical connection from the fan resistance, then remove the cable loom freeing it of the cable clamps.



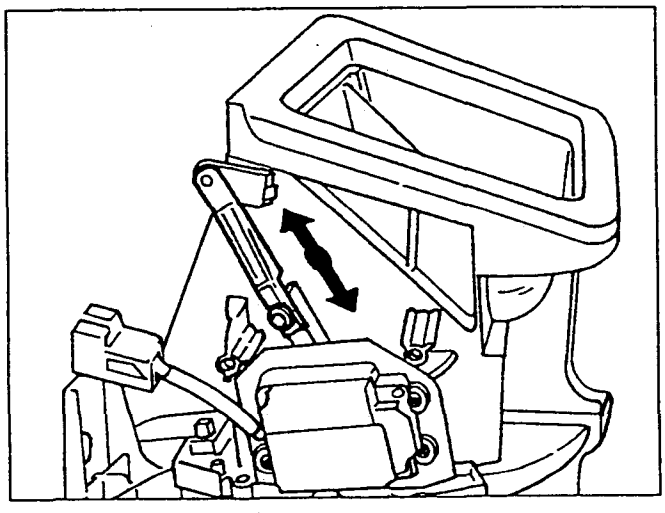
1. Slacken the screw fastening the outside air/recirculation mixing vent control motor tie-rod.
2. Slacken the three screws fastening the outside air/recirculation mixing vent motor.



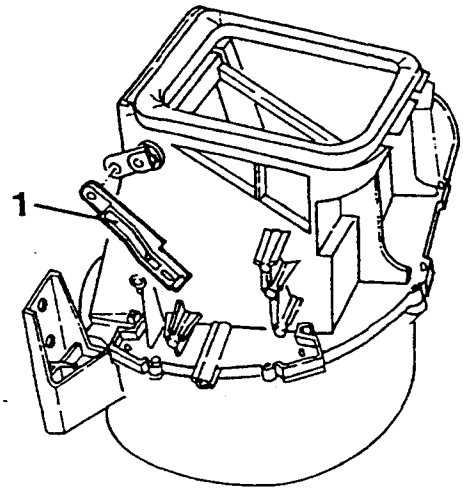
1. Remove the outside air/recirculation mixing vent motor complete with the grommets on the fastening hole.
2. Retrieve the rear plate.



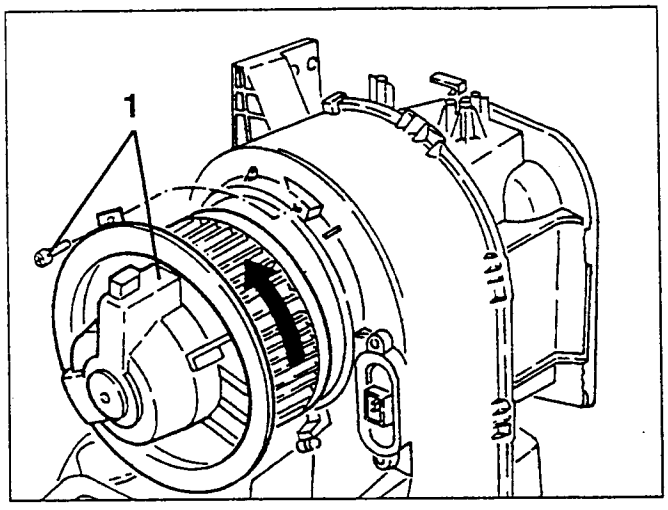
When refitting, adjust opening and closing of the outside air/recirculation mixing vent acting on the control tie-rod as shown in the figure.



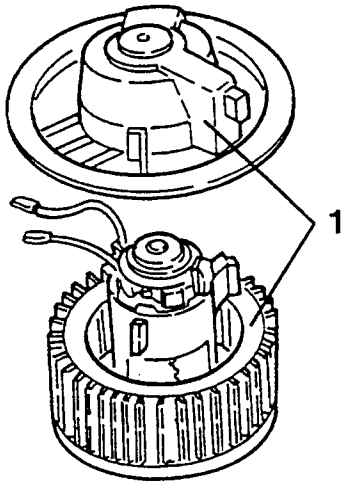
1. Remove the outside air/recirculation mixing vent control tie-rod.



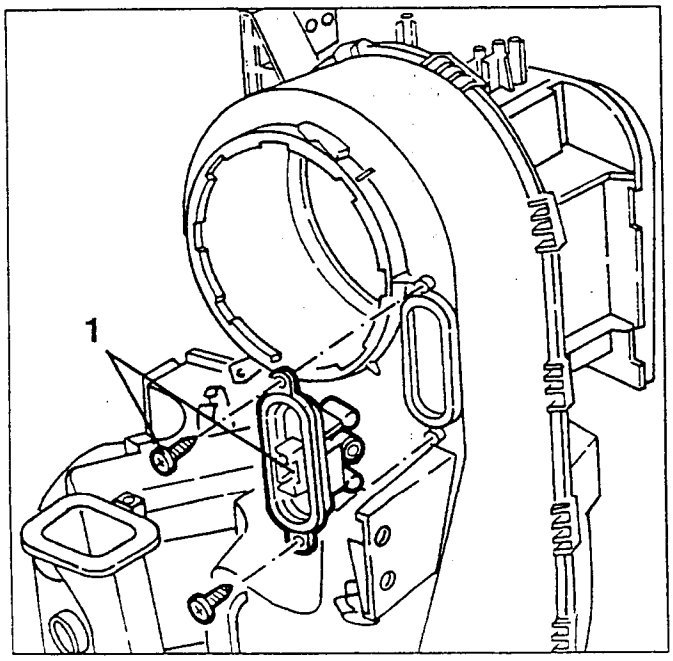
1. Slacken the screw fastening the electric fan, turn it as shown in the figure, then remove it.



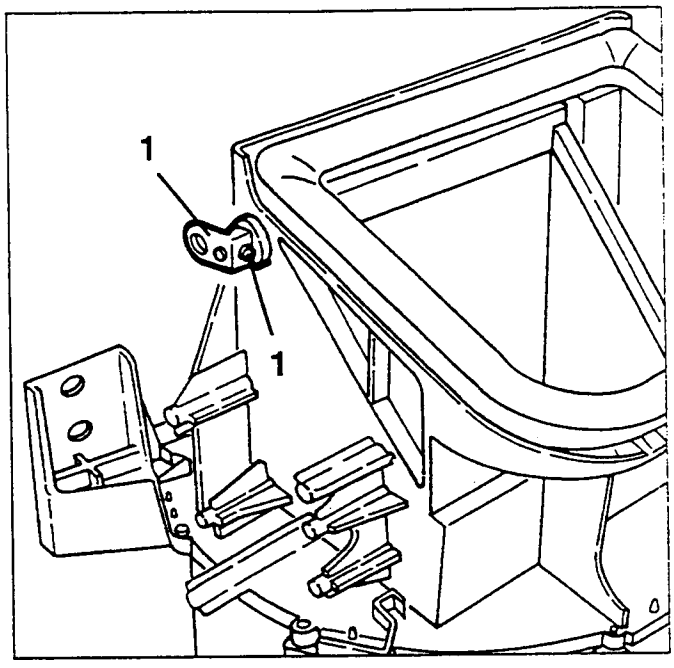
1. Separate the fan from the cover releasing the three rubber catches and removing the two electric cables.



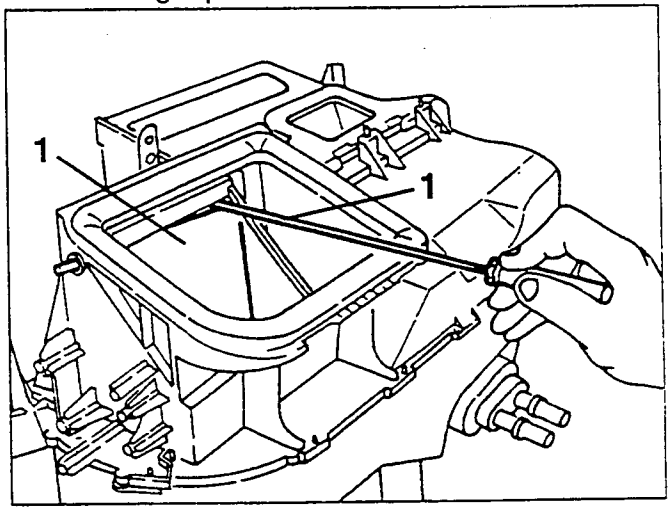
1. Slacken the two fastening screws and remove the fan resistance.



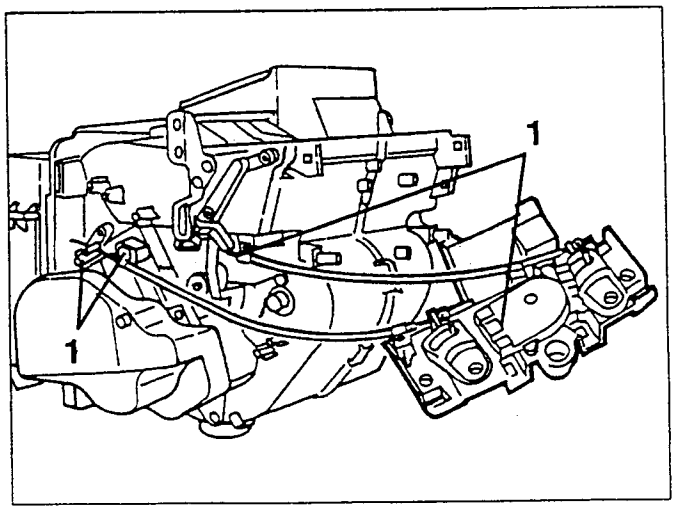
1. Slacken the fastening screw and remove the hook connecting the outside air/recirculation vent control tie- rod.



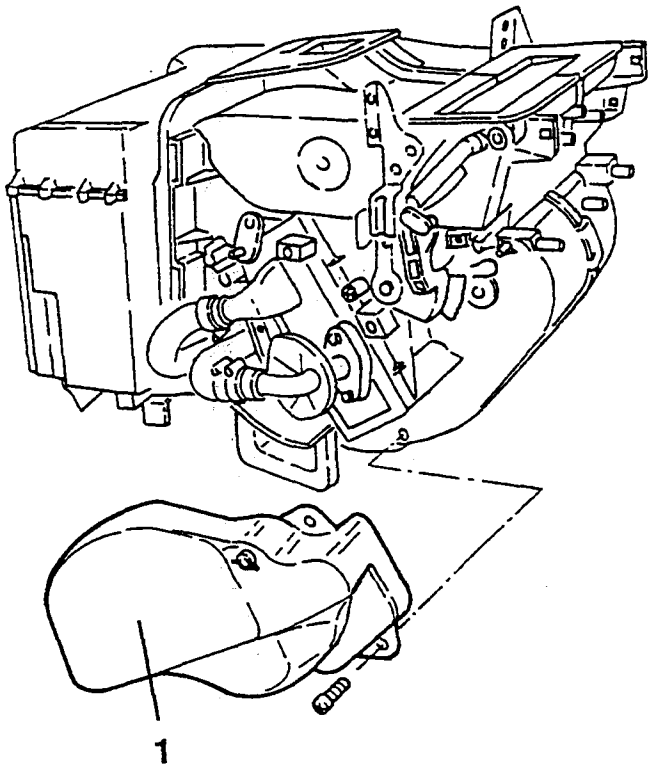
1. Release the outside air/recirculation vent from the two fastening clips and remove it.



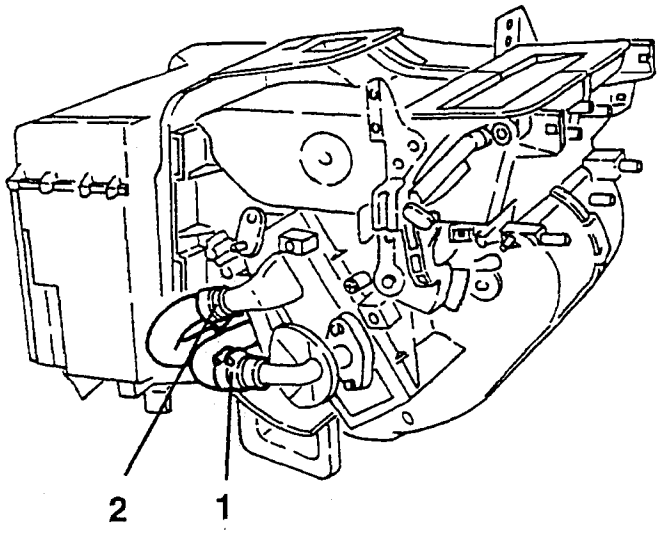
1. Disconnect the two control cables from the heating and ventilation unit and remove them complete with the control units.



1. Slacken the two fastening screws and remove the protection of the coolant fluid pipes at the heater radiator.

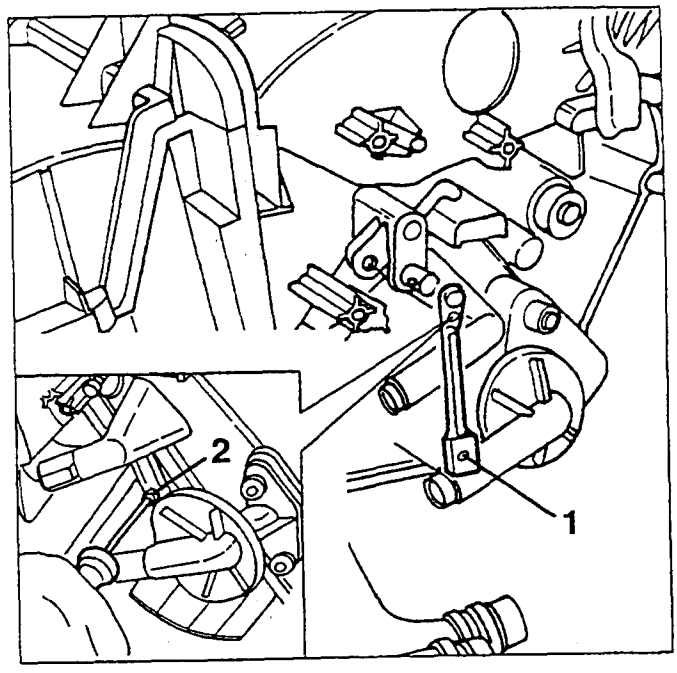


1. Disconnect the coolant fluid inlet pipe from the tap on the radiator.
2. Disconnect the coolant fluid outlet pipe from the tap on the radiator.

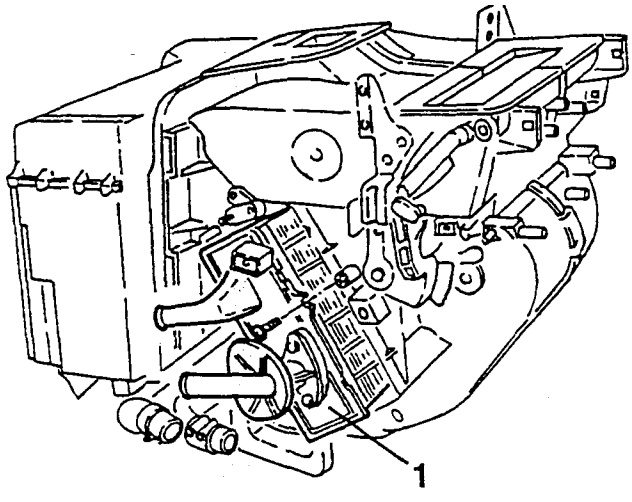


1. Slacken the screw fastening the control tie-rod for the coolant radiator inlet tap.

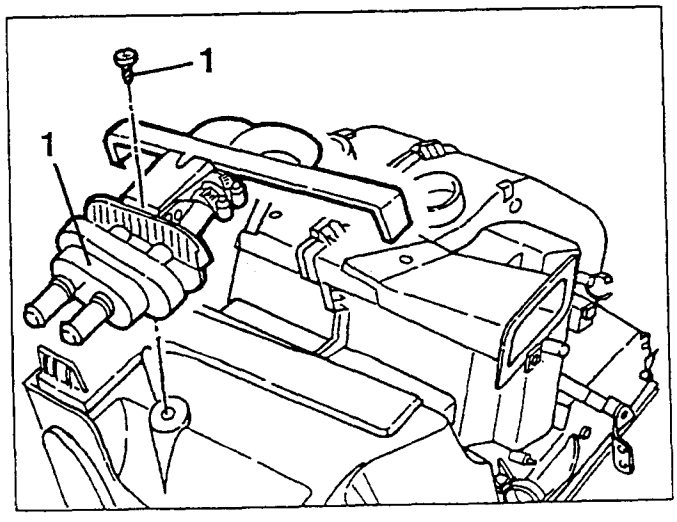
2. Disconnect the tie-rod and remove it.



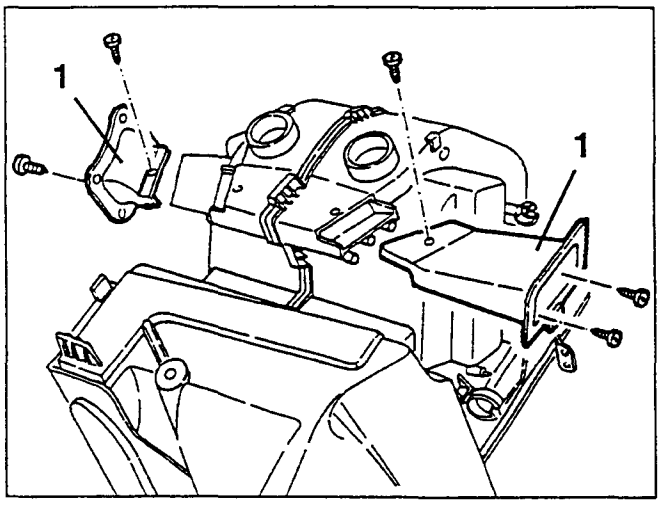
1. Slacken the two fastening screws and take out the heater radiator.



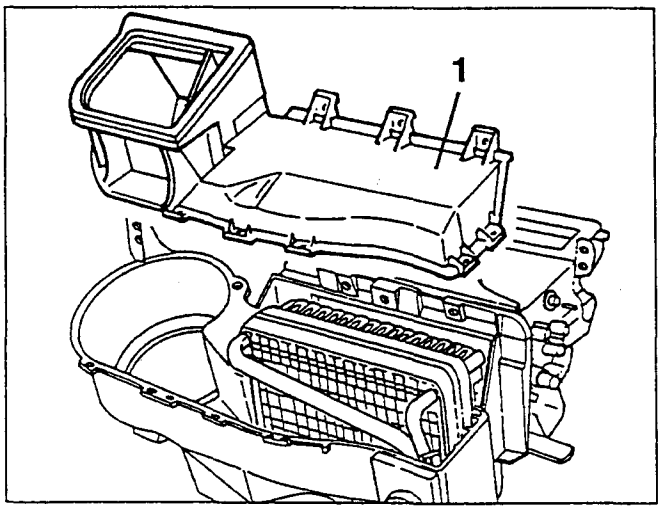
1. Slacken the fastening screw and remove the heater cooland delivery and return pipes.



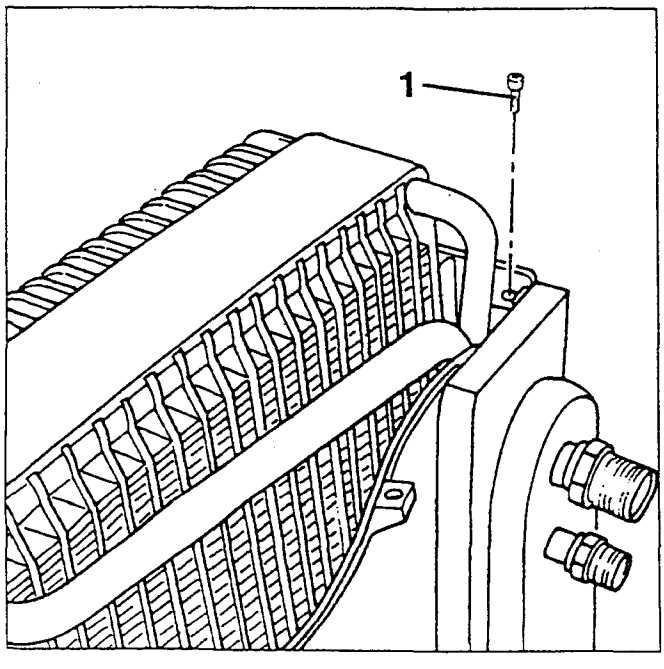
1. Slacken the fastening screws and remove the air delivery ducts to the feet.



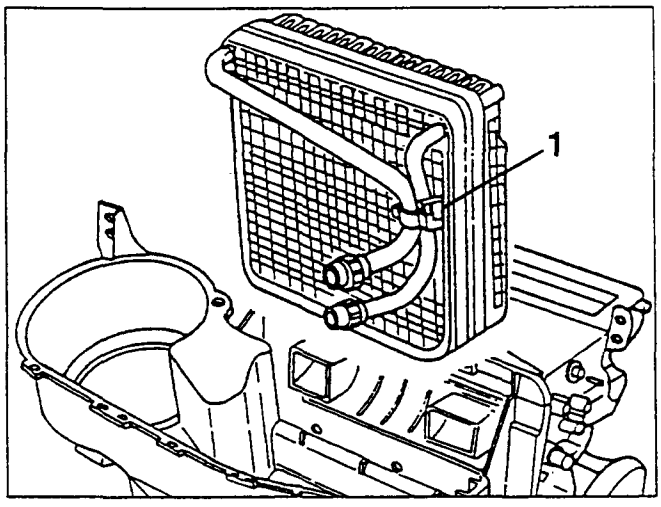
1. Slacken the fastening screws and remove the heater upper half box releasing it from its catches.



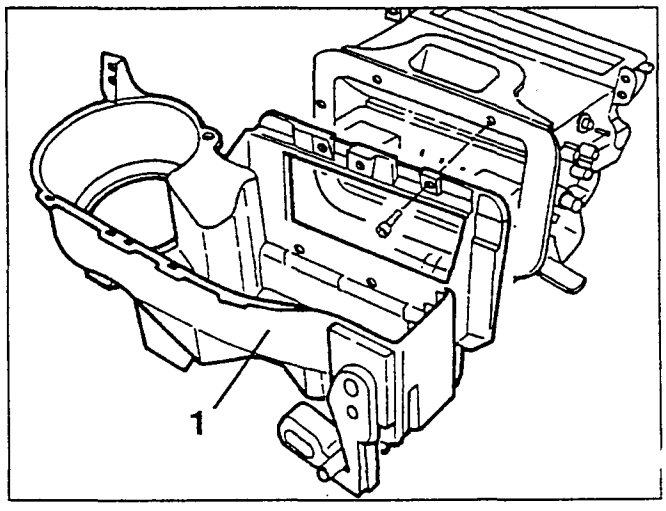
1. Slacken the evaporator fastening screw.



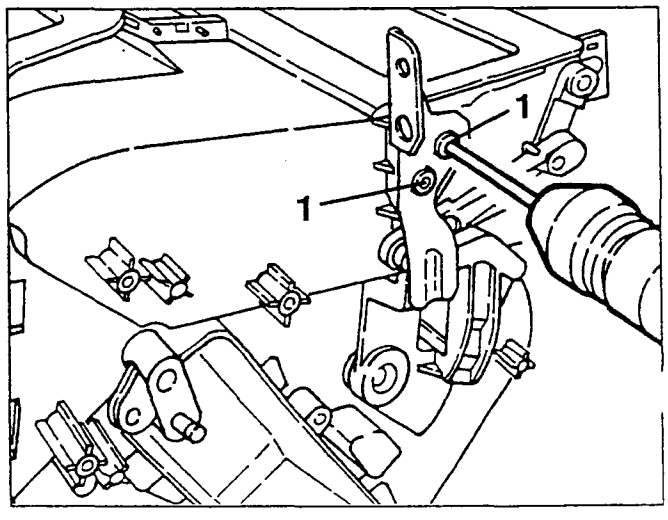
1. Remove the evaporator slipping the pipes out of their seals.



1. Slacken the fastening screws and remove the heater lower half box releasing it from its catches.

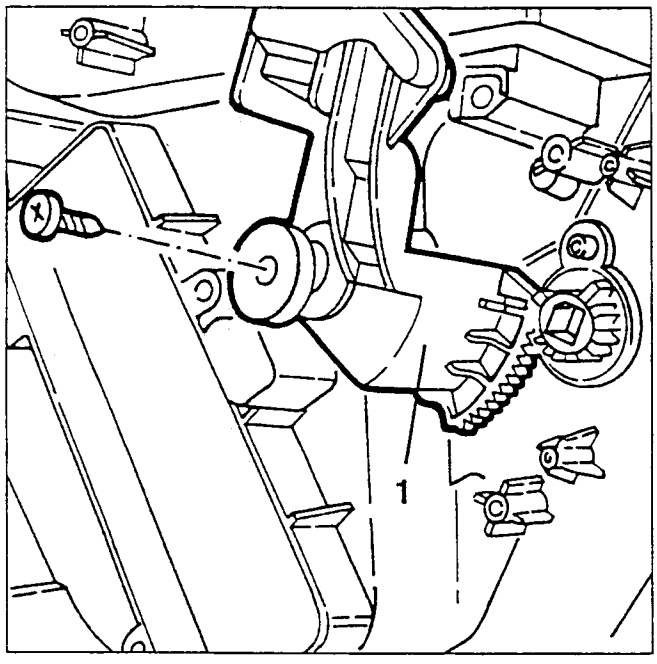


1. Using a drill knock off the two rivets fastening the heating and ventilation unit support bracket.

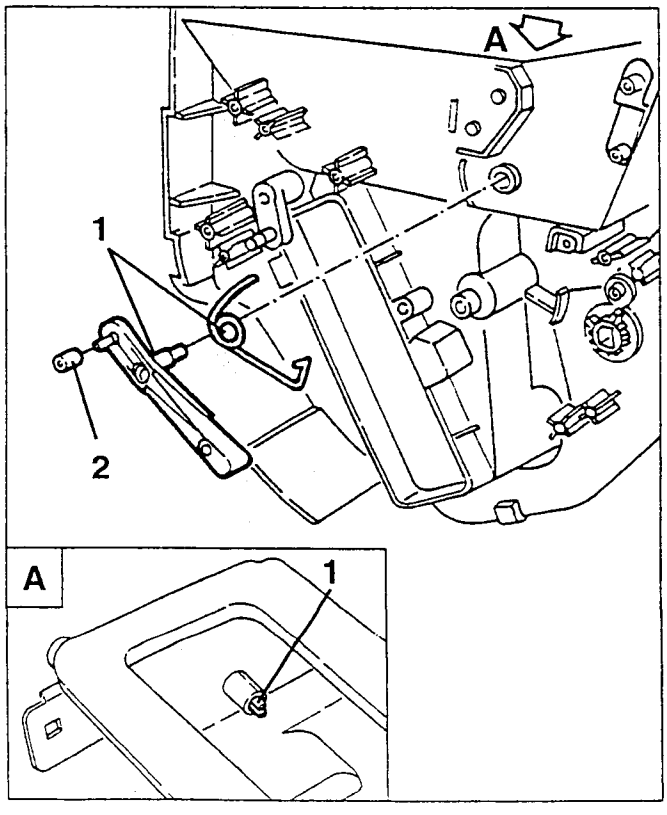


1. Slacken the fastening screw and remove the air distribution vent control leverage.

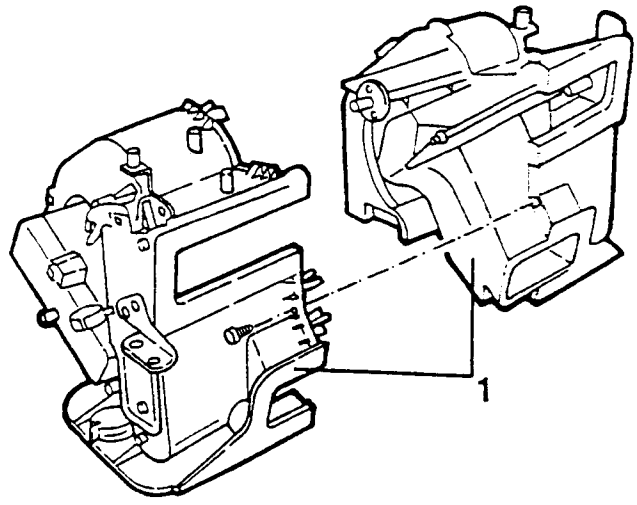
When refitting the leverage make sure that the two notches stamped on the gears coincide.



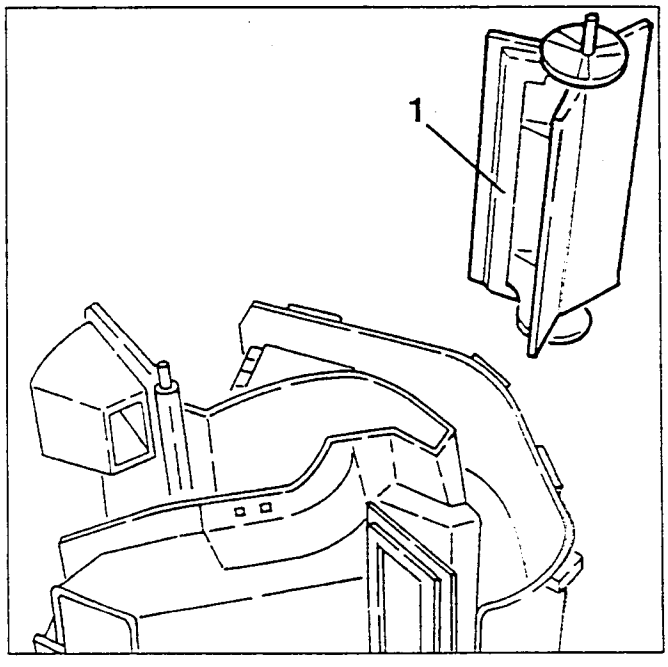
1. Release the clamps of the fastening pin and remove the tie-rod complete with air distribution vent control spring.
2. Retrieve the spacer.



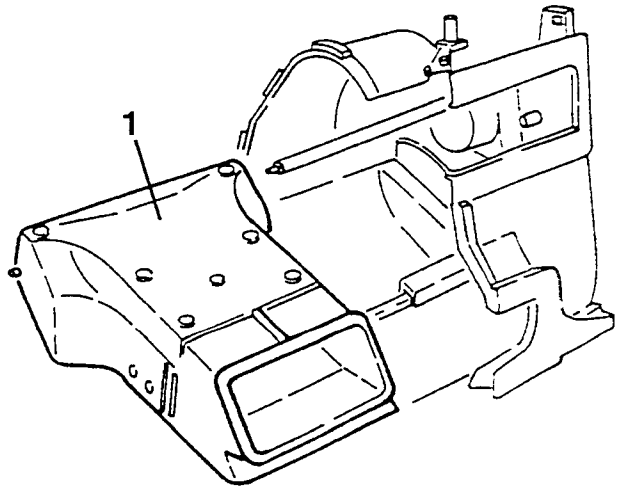
1. Slacken the fastening screws and dis-assemble the half boxes releasing the fastening clamps.



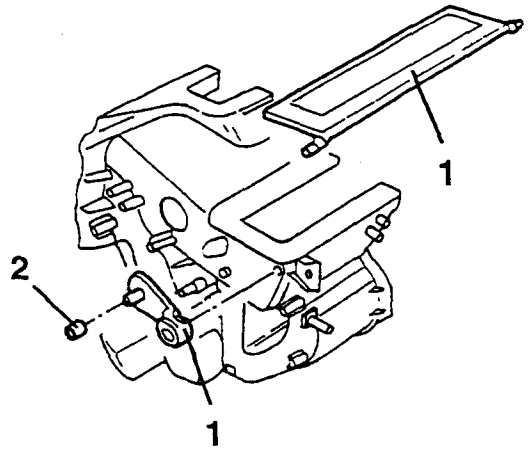
1. Remove the lower distribution vent.



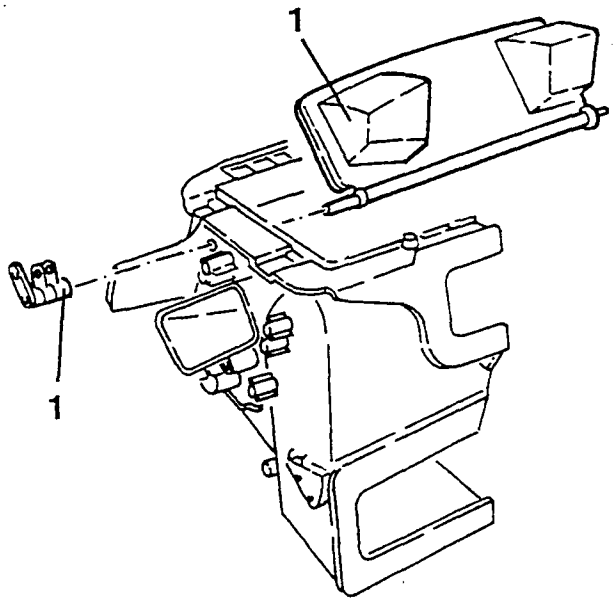
1. Remove the air duct.



1. Remove the fastening leverage and retrieve the upper distribution vent.
2. Retrieve the spacer.



1. Remove the fastening leverage and retrieve the air mixing vent.

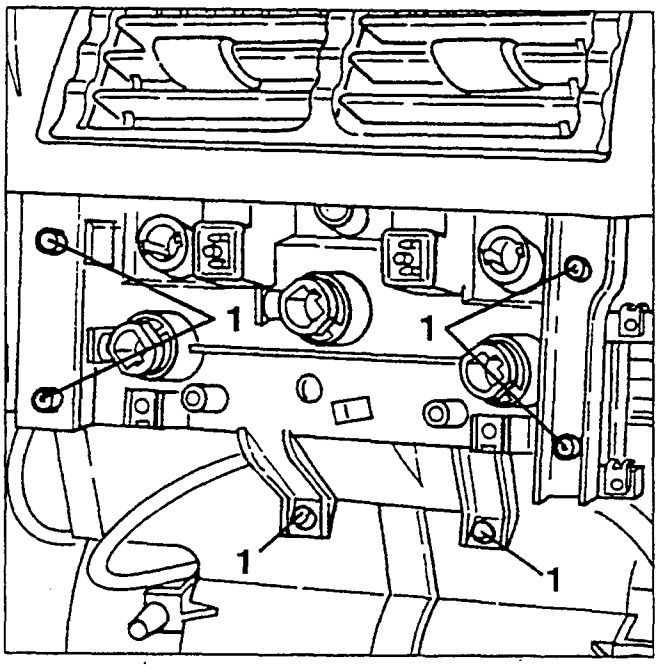


HEATING AND VENTILATION UNIT CONTROLS (TWO BOWDEN)

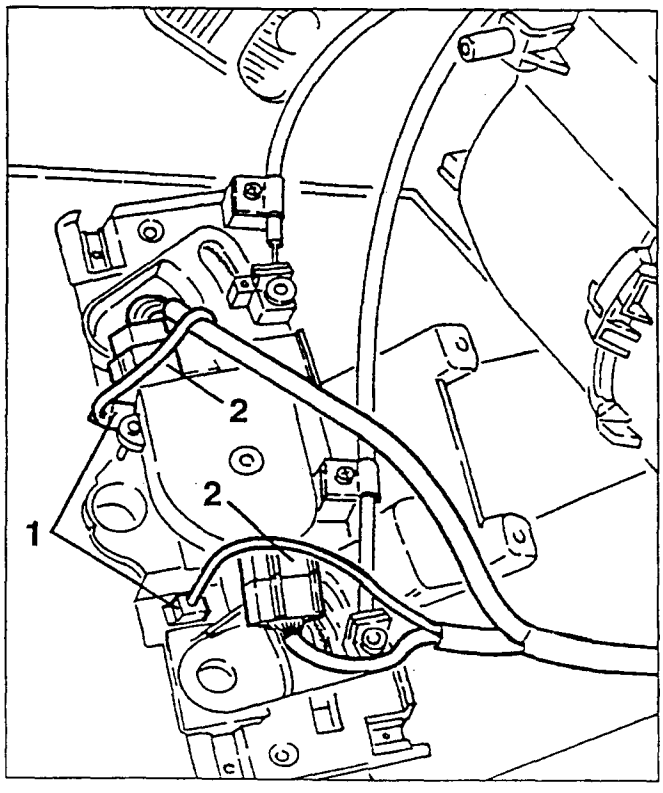
REMOVAL/REFITTING

- Remove the lower part of the dashboard (see GROUP 70).

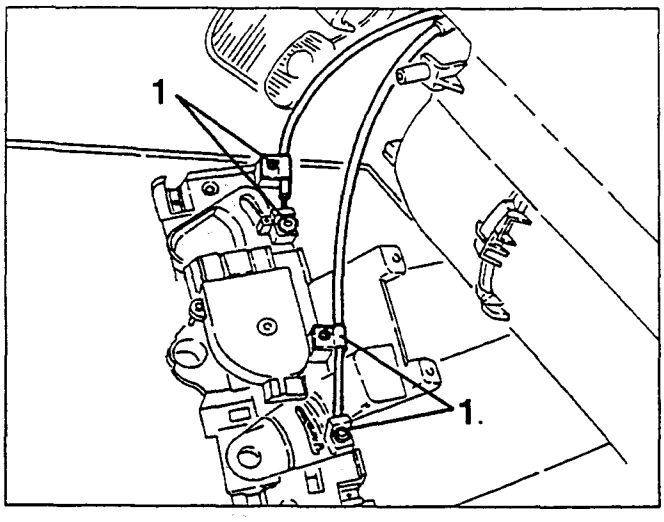
1. Slacken the screws fastening the heater control unit and take it out of its housing.



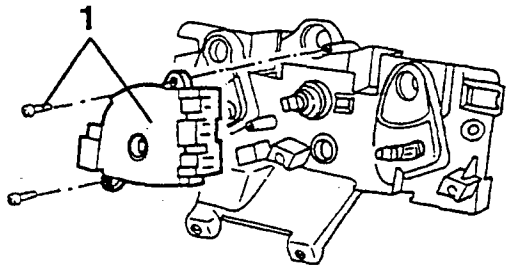
1. Disconnect the two electrical connections for the heater control unit lighting.
2. Disconnect the two electrical connections from the fan speed switch.



1. Remove the fastening washers, slacken the clamp screws and remove the two vent control cables.



1. Slacken the fastening screws and remove the fan speed switch.

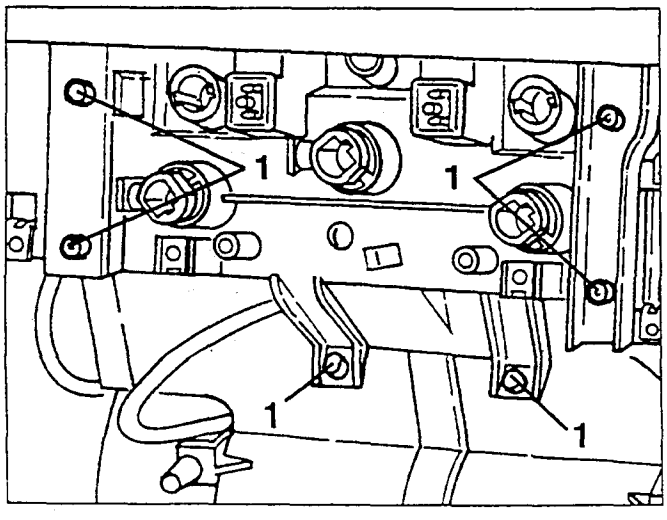


HEATING AND VENTILATION UNIT VENT CONTROL CABLES (TWO BOWDEN)

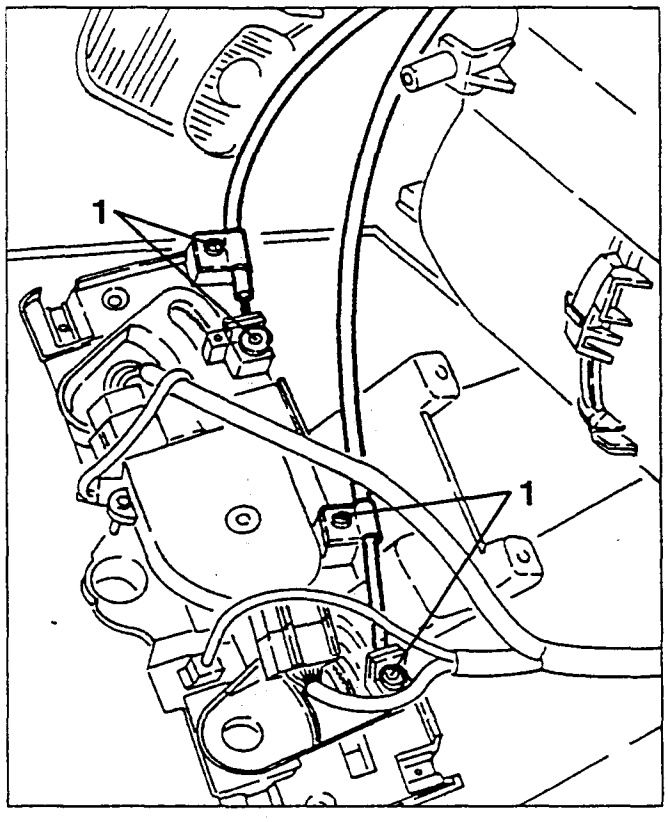
REMOVAL/REFITTING

- Remove the lower part of the dashboard (see GROUP 70).

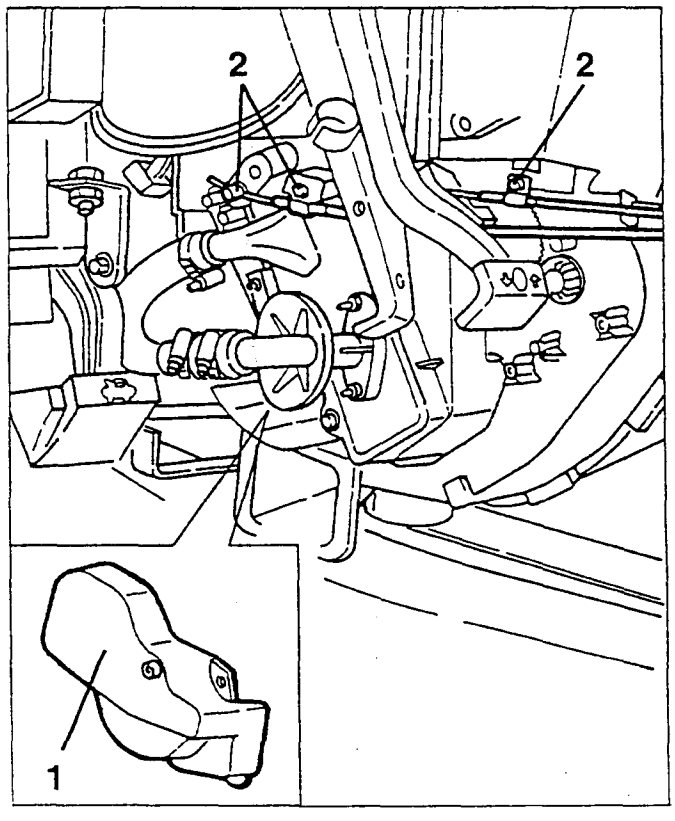
1. Slacken heater control unit fastening screws and remove it from its housing.



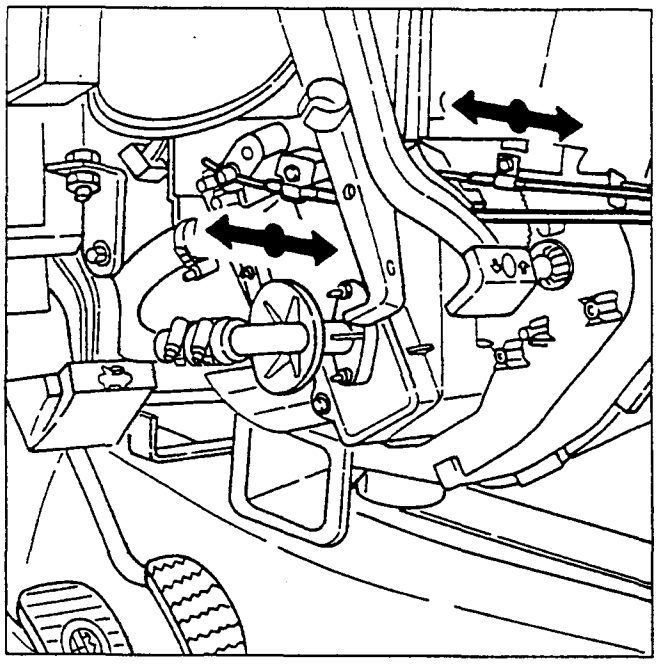
1. Remove the fastening washers, slacken the clamp screws and disconnect the two vent control cables from the control unit.



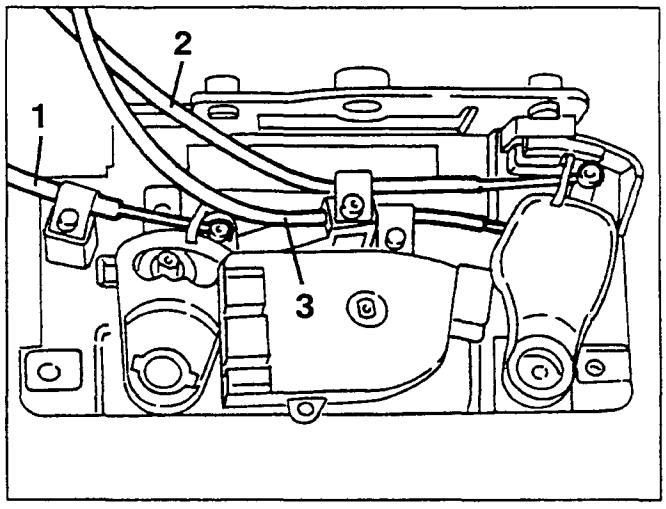
1. Slacken the two fastening screws and remove the coolant hose guard.
2. Slacken the screws fastening the sheaths to the heating and ventilation unit and remove the vent control cables.



Refit the control cables adjusting them as shown in the illustration before fastening them from the radiator side.



b) For the above variation the command group is also varied, three bowdens being connected instead of two.

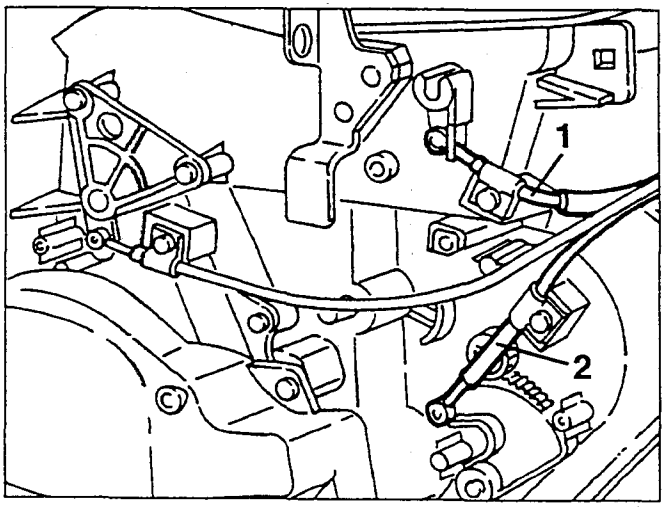


1. *Mixing gate command bowden*
2. *Upper distribution gate command bowden*
3. *Lower distribution gate command bowden*

DUCTING ASSEMBLY AND HEATER - DISTRIBUTOR UNIT (THREE BOWDEN)

This varies from the "two bowden" versions regarding in relation to the following:

a) The adoption of two front bowden rather than one for the movement of the two air distribution gates and consequent elimination of the transmission levers.

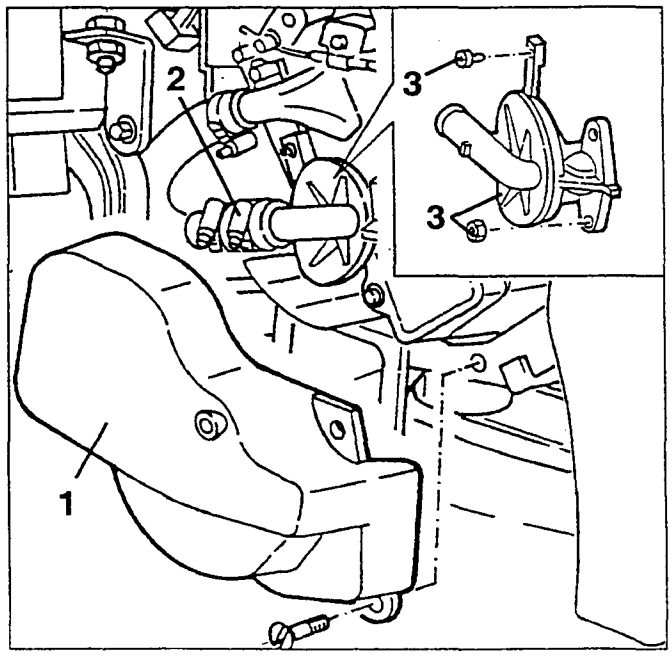


1. *Upper distribution gate command bowden*
2. *Lower distribution gate command bowden*

RADIATOR COOLANT INLET TAP

REMOVAL/REFITTING

- Remove the valve unit cover (see GROUP 70).
1. Slacken the two fastening screws and remove the protection for the coolant pipes at the radiator.
2. Disconnect the coolant inlet pipe from the tap and recover the fluid.
3. Slacken the tie-rod fastening screw, the two tap fastening nuts and remove it.

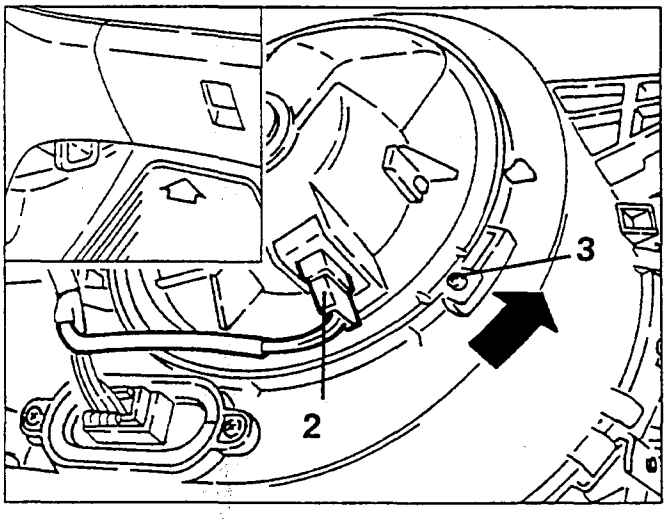


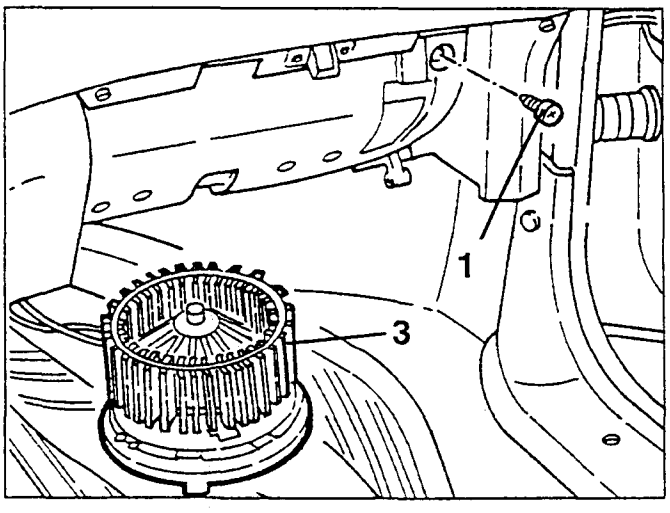
ELECTRIC FAN

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the glove box (SEE GROUP 70).

1. Slacken the lower screw fastening the dashboard to be able to remove the fan.
2. Disconnect the electrical connection of the fan.
3. Slacken the fan fastening screw, turn it as shown in the figure, then remove it raising the mat.



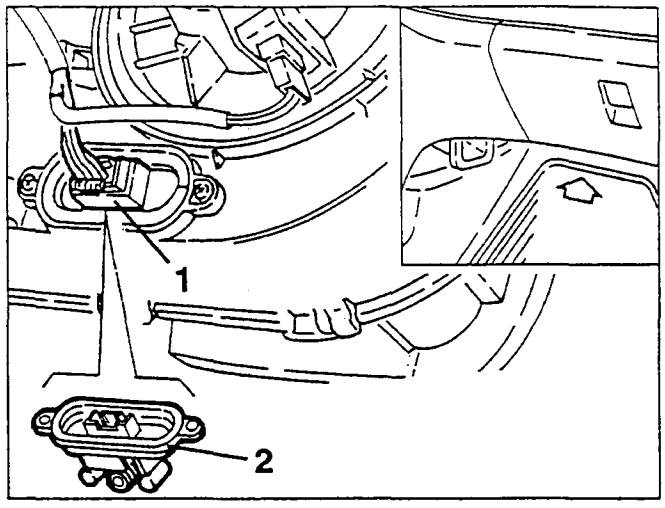


FAN RESISTANCE

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

1. Disconnect the electrical resistance from the fan.
2. Slacken the two fastening screws and remove the fan resistance.

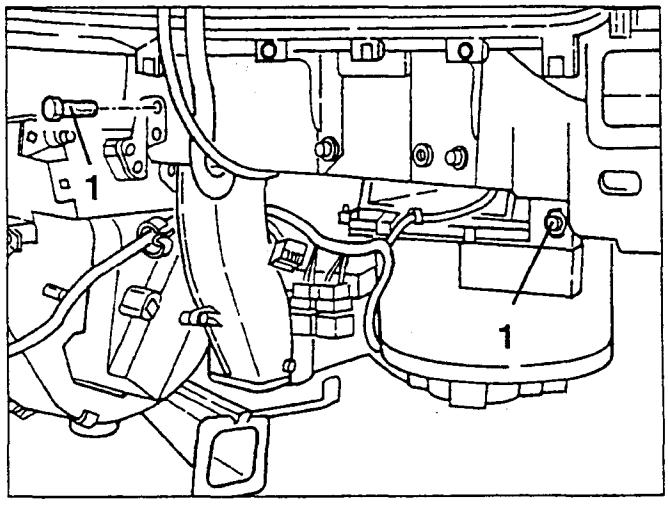


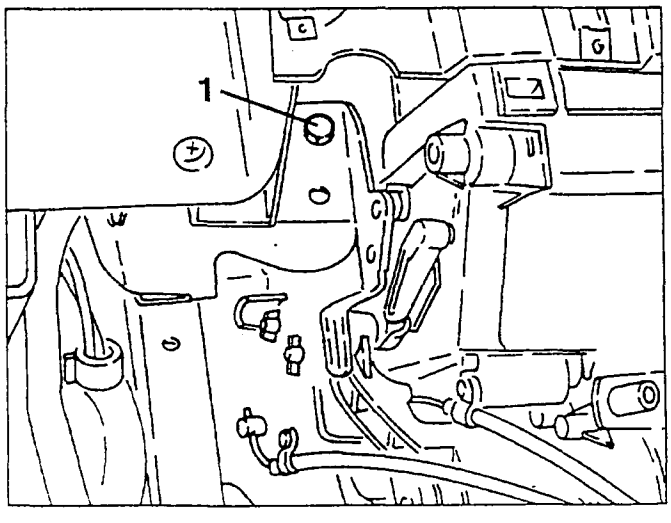
OUTSIDE AIR/RECIRCULATION VENT CONTROL MOTOR

REMOVAL/REFITTING

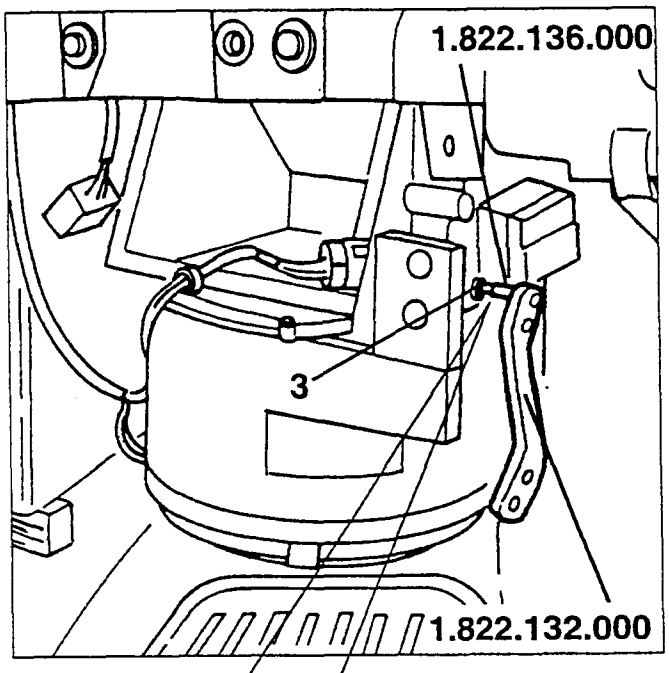
- Remove the lower part of the dashboard (SEE GROUP 70).

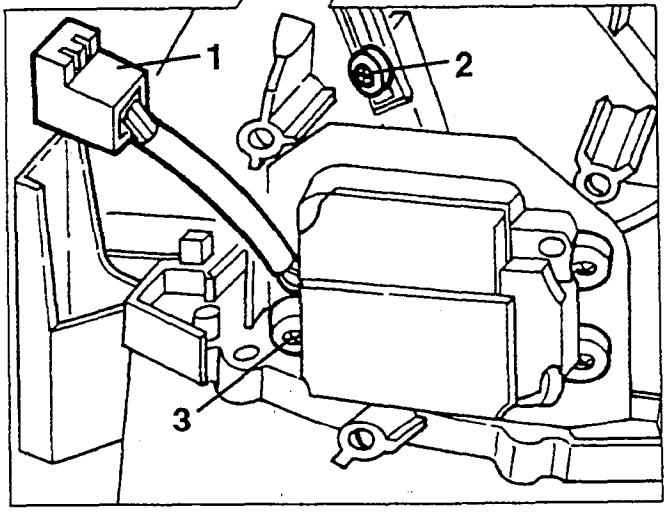
1. Slacken the four screws fastening the heating and ventilation unit to gain access to the motor.



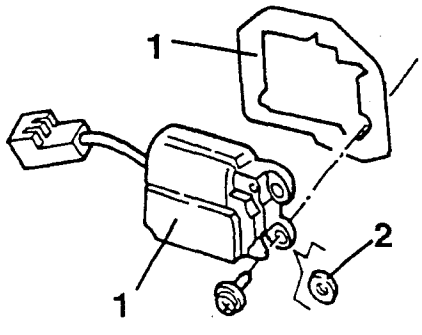


1. Disconnect the electrical connection of the outside air/recirculation vent control motor.
2. Slacken the screw fastening the outside air/recirculation vent control motor.
3. Slacken the three cross-slotted screws fastening the motor using wrench N° 1.822.132.000 with bit N° 1.822.136.000



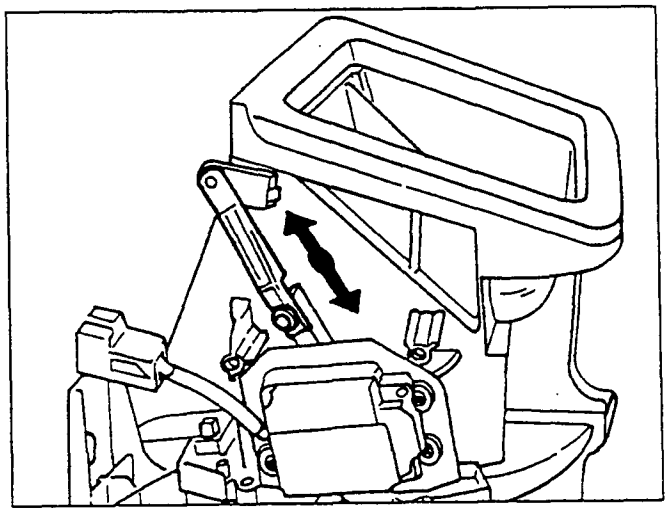


1. Remove the outside air/recirculation vent control motor complete with grommets on the fastening holes.
2. Retrieve the rear plate.



- When refitting replace the cross-slotted screws for fastening the motor with Allen screws to be tightened with wrench N° 1.822.132.000 and bit N° 1.822.136.000

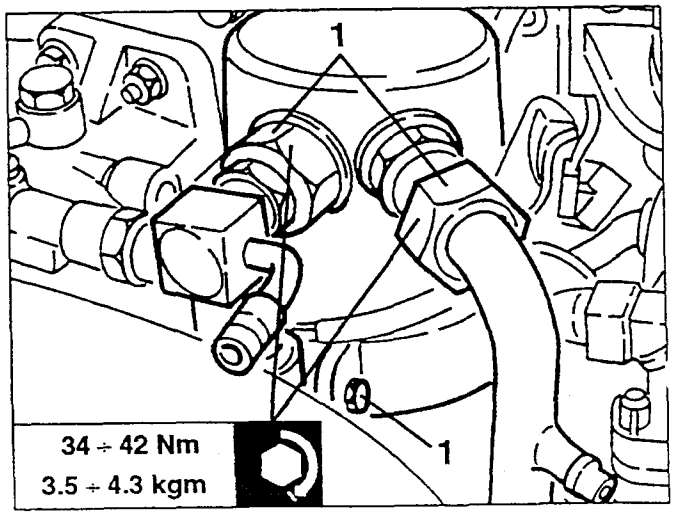
When refitting check:
- the correct positioning of the grommets in the motor fastening holes;
- the correct closing of the outside air/recirculation vent through the corresponding control button, if necessary adjust the position of the vent acting on the control tie- rod as illustrated.



DRIER FILTER

REMOVAL/REFITTING

- Drain the freon from the conditioning system (see the specific paragraph).
1. From the drier filter disconnect the fluid inlet and outlet pipes.
2. Slacken the bolt fastening the clamp and remove the drier filter.

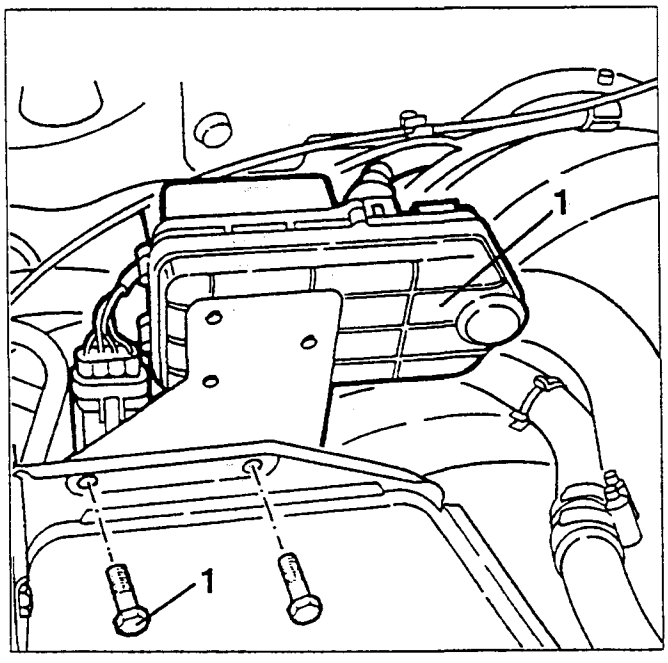


EXPANSION VALVE

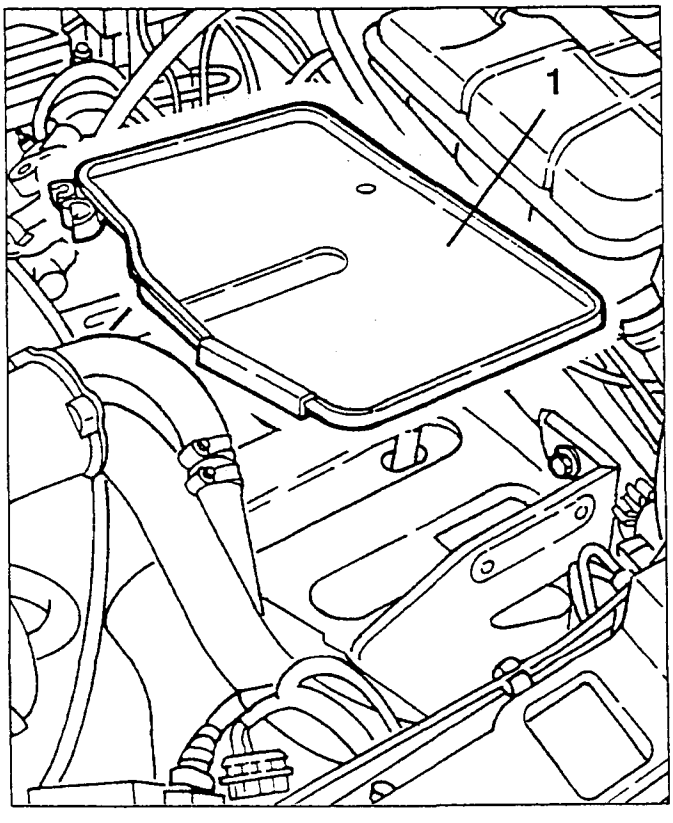
REMOVAL/REFITTING

- Drain the fluid from the conditioning system (see the specific paragraph).
- Remove the battery (see GROUP 70).

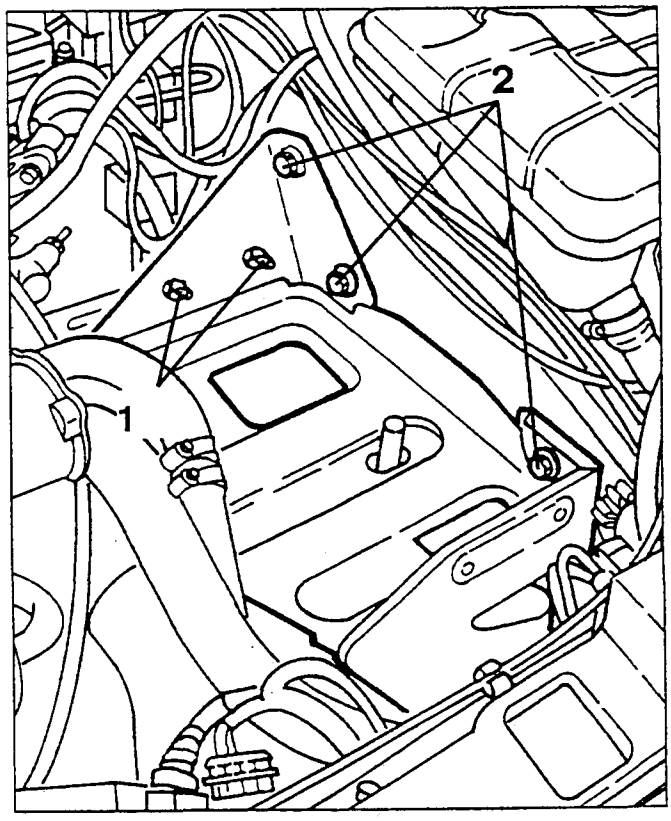
1. Slacken the two screws fastening the support for the relays and connections to the battery, then move it sidewards.



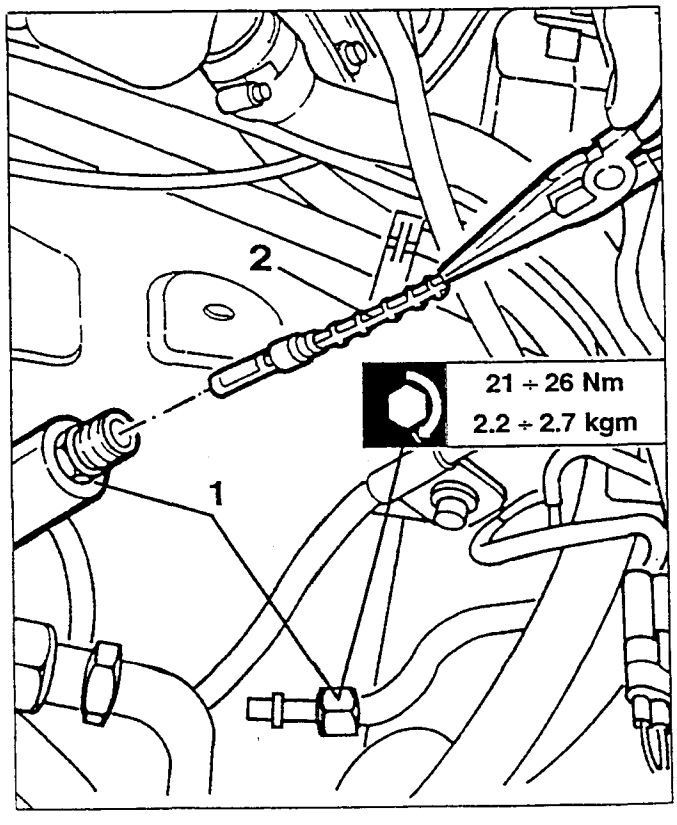
1. Remove the battery acid drain tray.



1. Slacken the two nuts fastening the support bracket for the glow plug control unit to the battery support.
2. Slacken the four fastening screws and remove the battery support.



1. Slacken the intermediate union of the fluid delivery pipe from the condenser to the evaporator.
2. Remove the expansion valve.

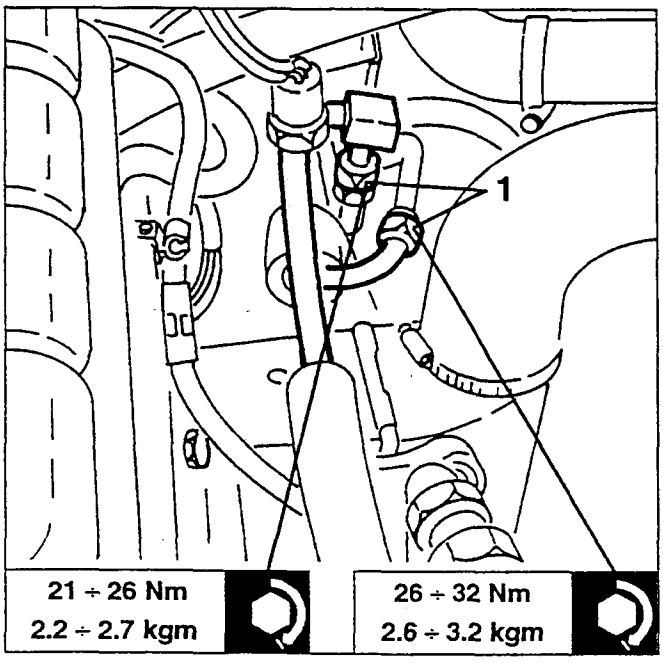


CONDENSER

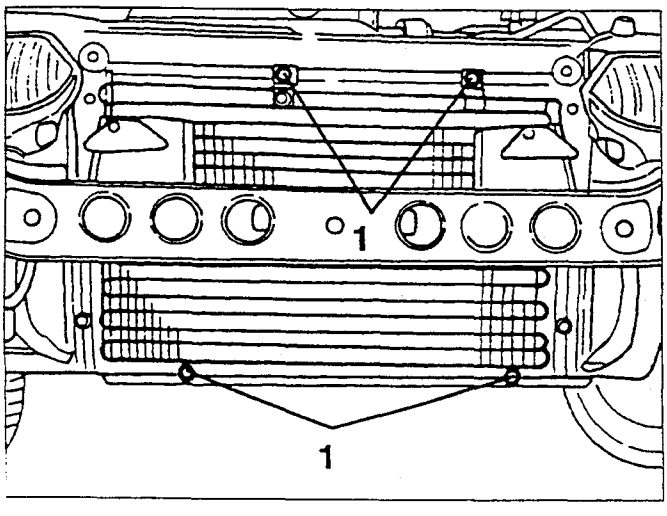
REMOVAL/REFITTING

- Set the car on a lift.
- Drain the fluid from the conditioning system (see the specific paragraph).
- Remove the radiator grille and the front bumper (see GROUP 70).
- Remove the battery (see GROUP 55).
- **Follow the first three steps described in the "EXPANSION VALVE" paragraph.**

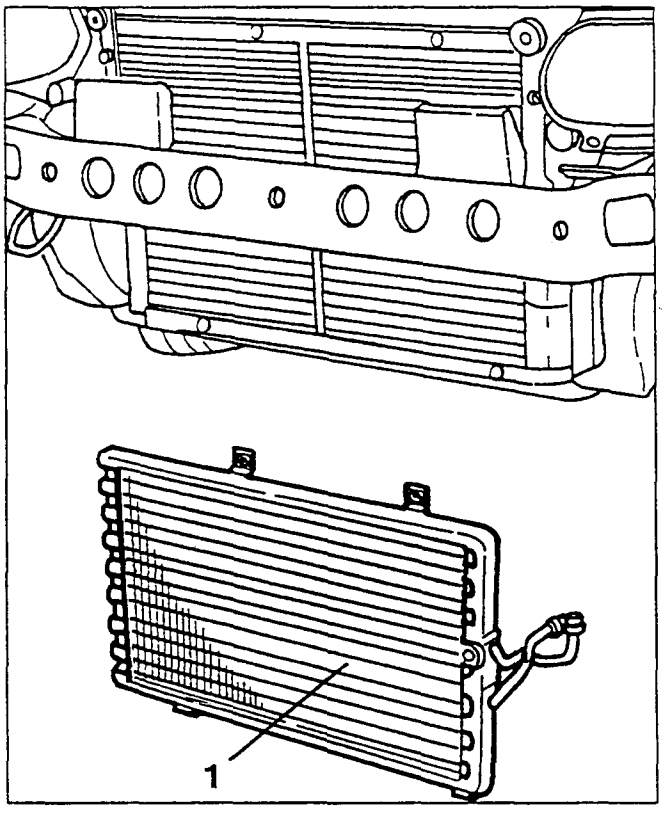
1. From the condenser disconnect the freon inlet and outlet pipe unions.



- Raise the car.
1. Slacken the four screws fastening the condenser to the radiator.



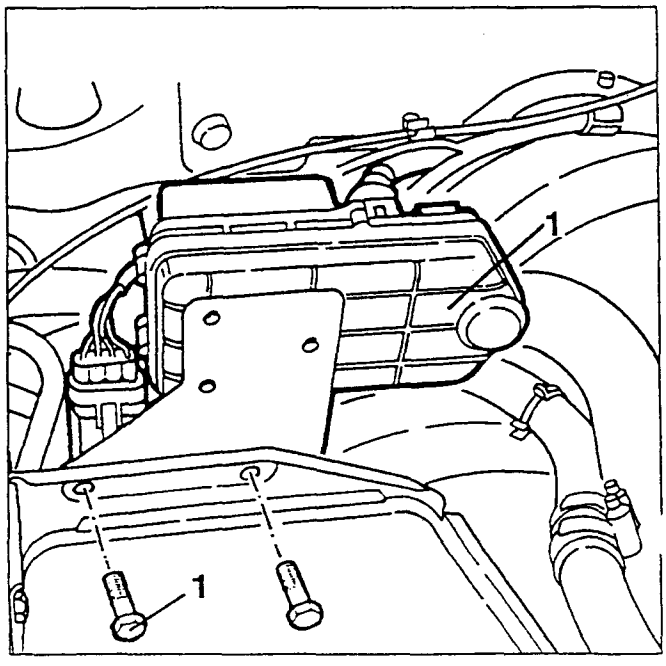
1. Remove the condenser pulling it downwards.



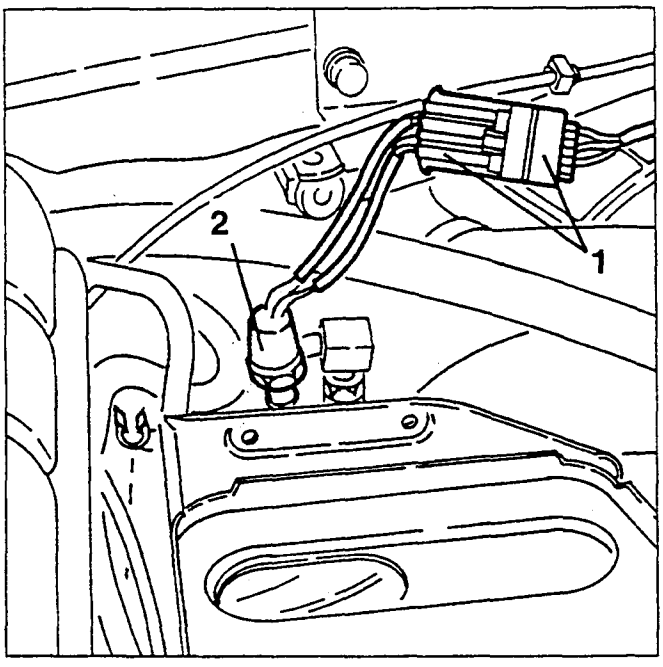
THREE-LEVEL PRESSURE SWITCH (TRINARY)

REMOVAL/REFITTING

- Remove the battery (see the specific group).
1. Slacken the two screws fastening the support for the relays and connections to the battery, then move it sidewards.



1. Disconnect the electrical connection of the three-level pressure switch.
2. Slacken and remove the three-level pressure switch.

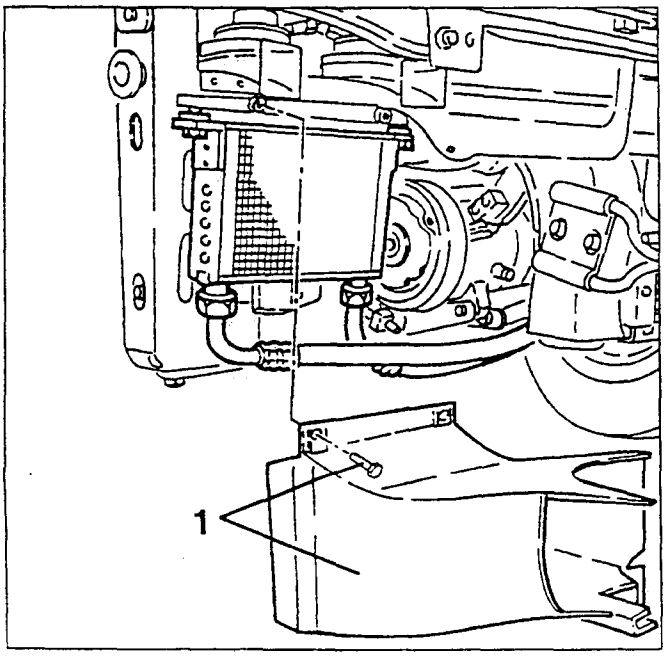


COMPRESSOR

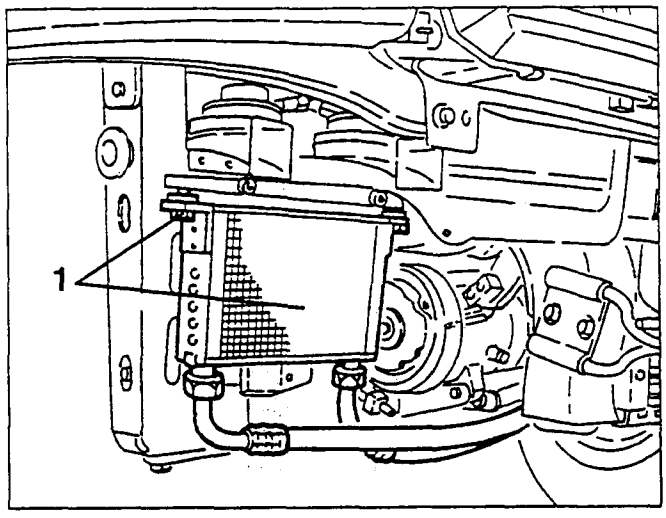
REMOVAL/REFITTING

- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
- Raise the car.

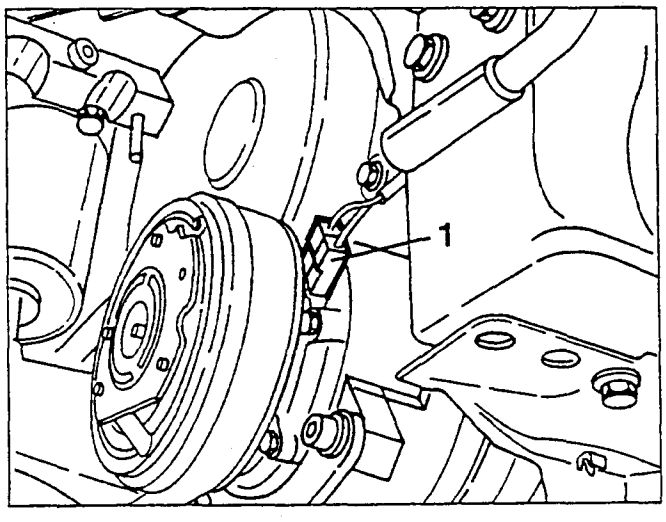
1. Slacken the fastening screws and remove the oir ducting system to the engine oil radiator.



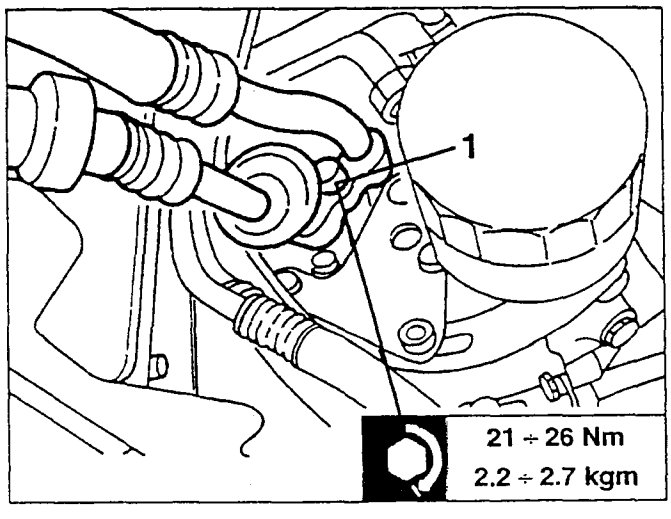
1. Slacken the two fastening nuts and move the engine oil radiator sidewards without disconnecting the pipes.



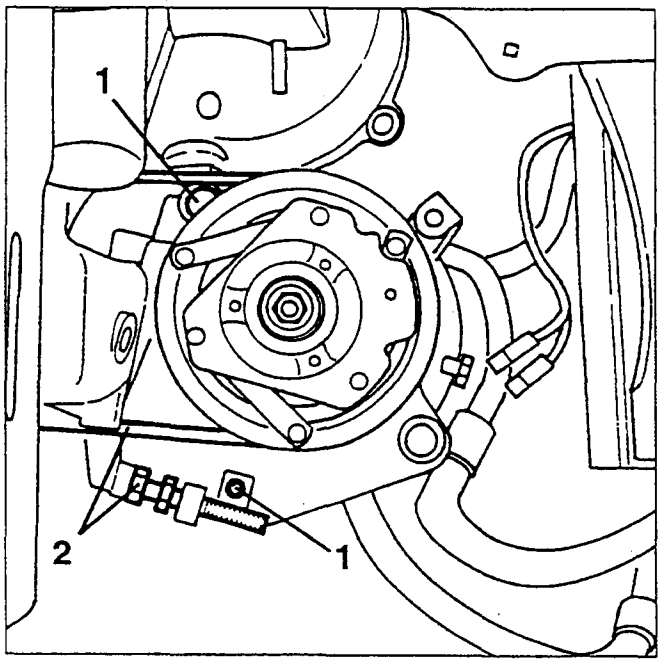
1. Disconnect the two electrical connections from the conditioner compressor.



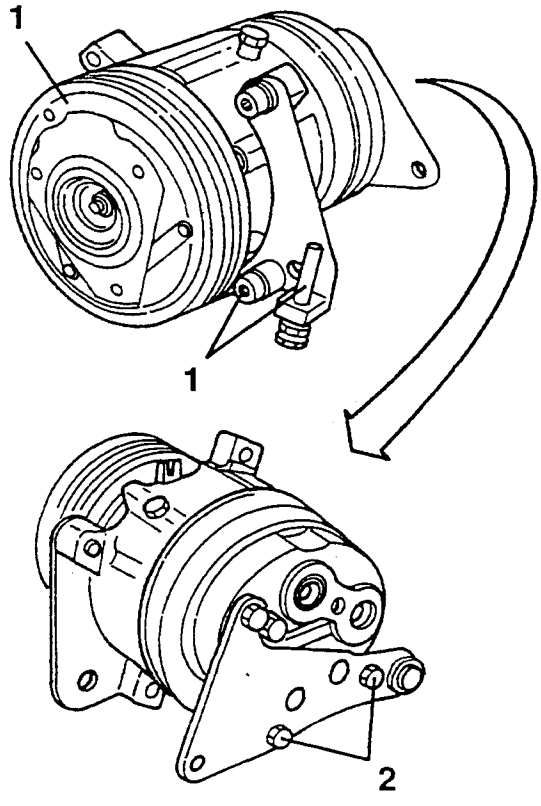
1. Slacken the fastening screw and disconnect the two freon pipes fluid the compressor.



1. Slacken the compressor fastening bolts.
2. Working on the micrometric screw for tensiong the drive belt, after loosening the locknut, relieve the belt tension and take it off the compressor.



1. Completely unscrew the bolts loosened previously and remove the compressor complete with bracket.
2. On the bench slacken the fastening screws and separate the brackets from the compressor.



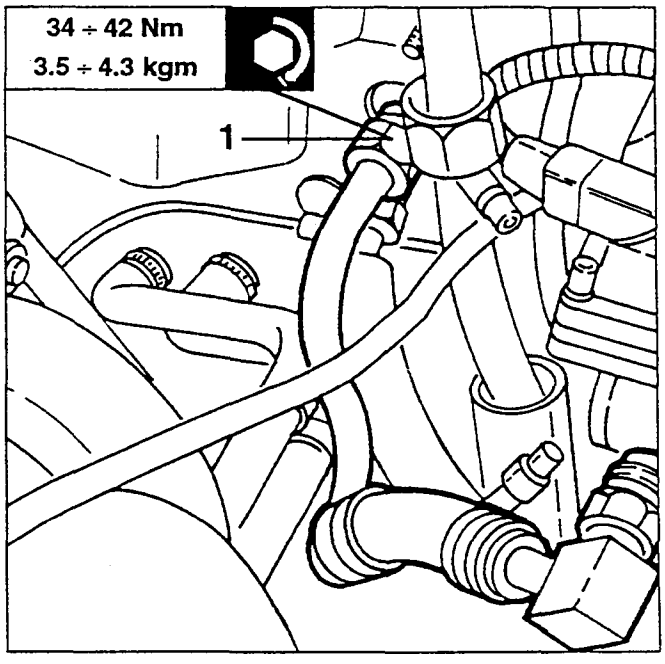
- When refitting, tension the conditioner compressor drive belt (see GROUP 00).

PIPING FROM EVAPORATOR TO DRIER FILTER

REMOVAL/REFITTING

- Drain the fluid from the conditioning system (see specific paragraph)
- Remove the battery (see GROUP 55).
- **Follow the first seven steps described in the "DUCTING ASSEMBLY AND HEATER - DISTRIBUTOR UNIT" paragraph.**

1. Using wrenches N° 1.822.112.000 and N° 1.822.115.000 disconnect the pipe in question from the evaporator and remove it.

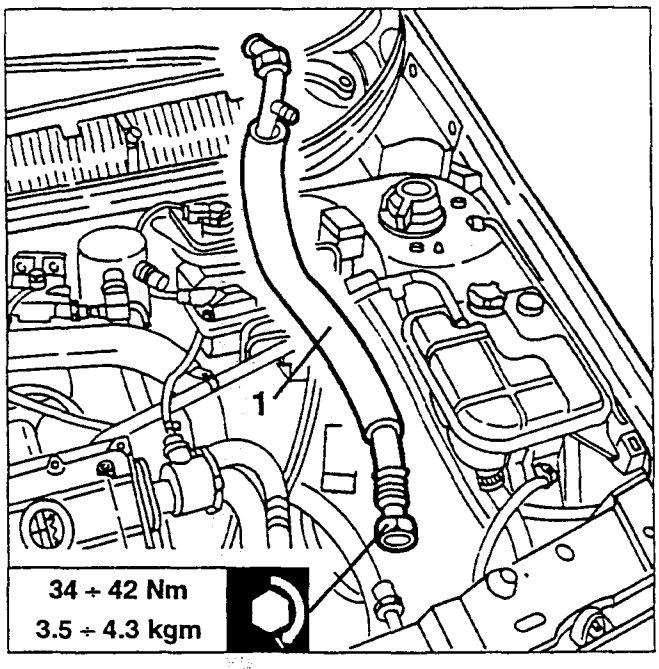


PIPE FROM DRIER FILTER TO COMPRESSOR

REMOVAL/REFITTING FIRST SECTION

- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the battery (see GROUP 55).
- **Follow the first three steps described in the "EXPANSION VALVE" paragraph.**

1. Disconnect the two unions of the section of pipe in question and remove it.

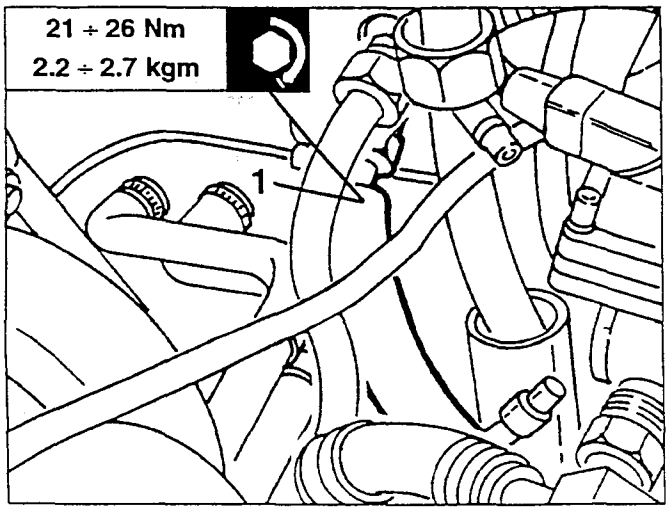


PIPE FROM CONDENSER TO EVAPORATOR

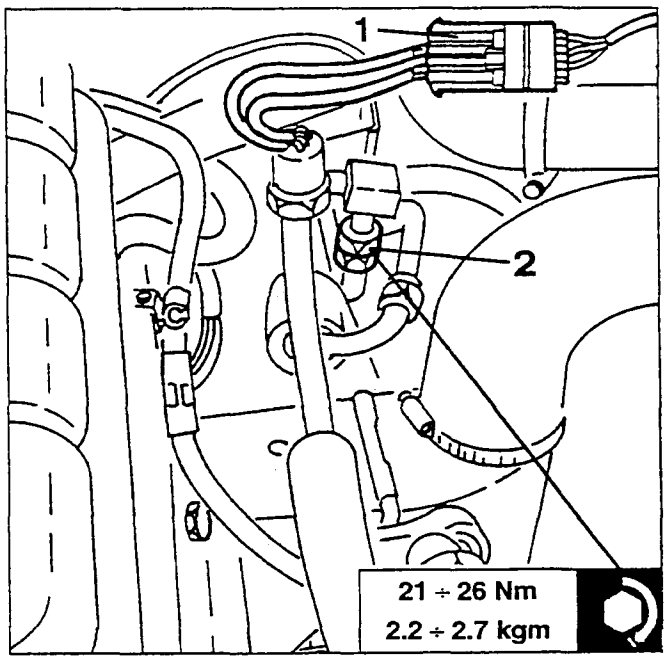
REMOVAL/REFITTING

- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the battery (see GROUP 55).
- **Follow the first seven steps described in the "DUCTING ASSEMBLY AND HEATER - DISTRIBUTOR UNIT" paragraph.**
- **Follow the first three steps described in the "EXPANSION VALVE" paragraph.**

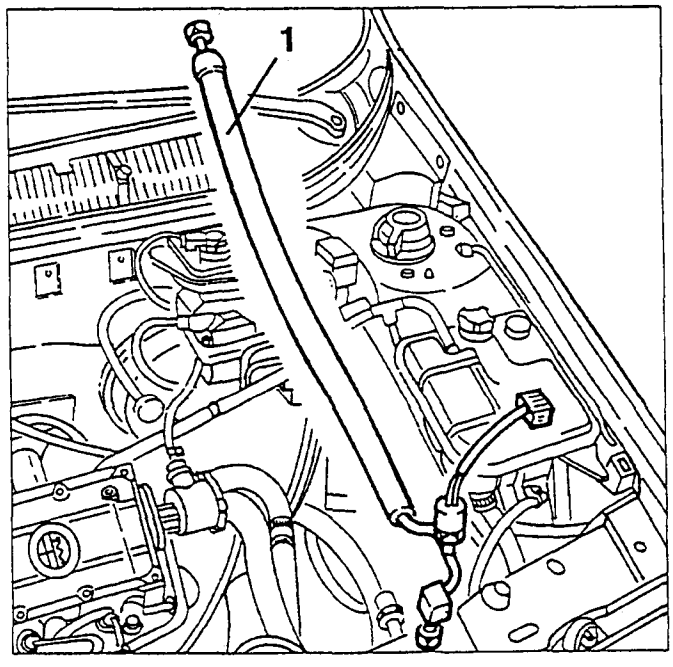
1. Using wrenches N° 1.822.111.000 and N° 1.822.113.000 disconnect the union of the pipe in question from the evaporator



1. Disconnect the electrical connection of the three-level pressure switch.
2. Disconnect the union of the pipe in question from the condenser.



1. Remove the pipe in question complete with three-level pressure switch and expansion valve.



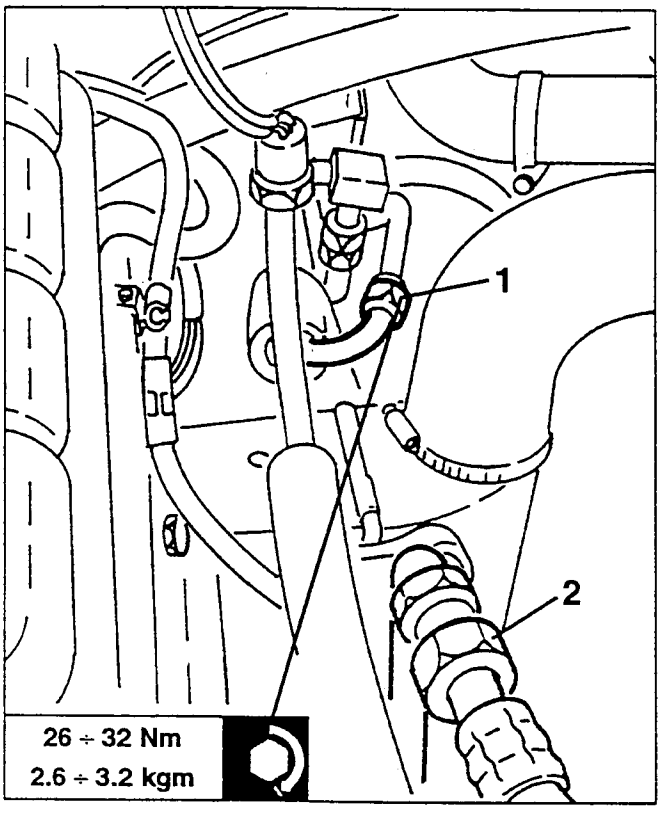
COMPRESSOR SIDE PIPES

REMOVAL/REFITTING

- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).

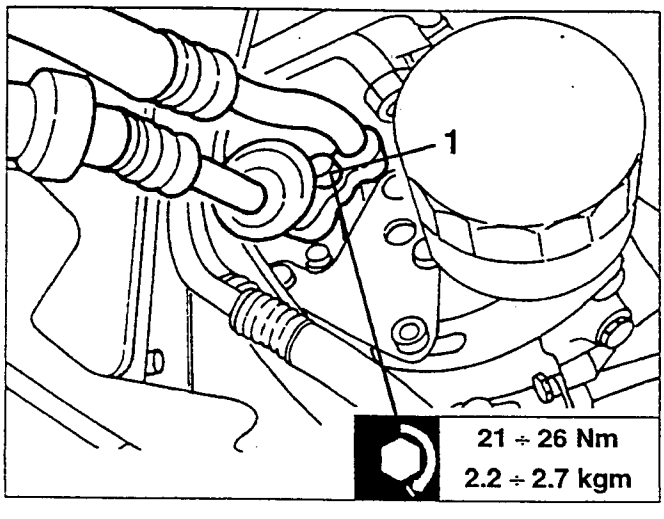
- Remove the radiator grille and front bumper (see GROUP 70).
- **Follow the first three steps described in the "EXPANSION VALVE" paragraph.**

1. Disconnect the union of the pipes in question from the condenser.
2. Disconnect the intermediate union of the pipes in question.

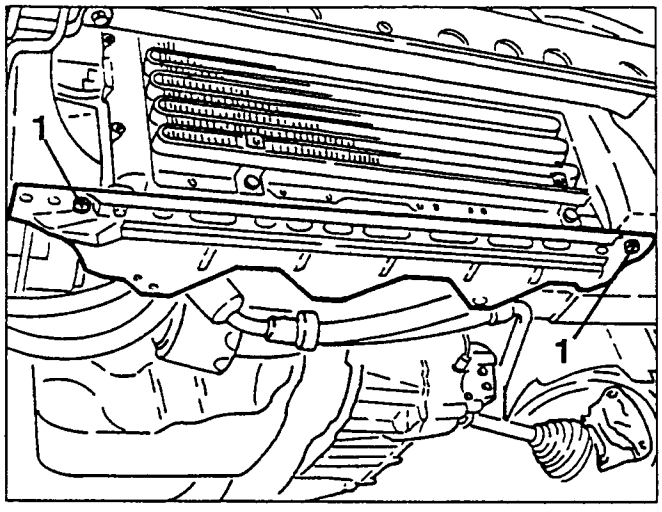


- Raise the car.

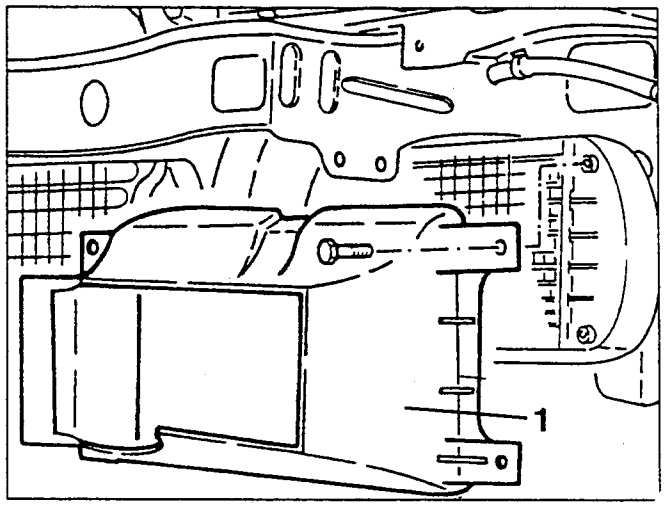
1. Slacken the fastening screw and disconnect the pipes in question from the compressor.



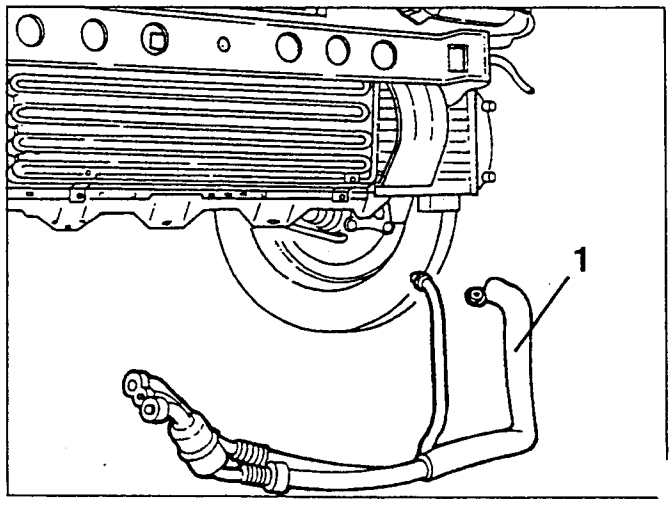
1. Slacken the fastening nuts and remove the lower radiator cross rail.



1. Slacken the fastening screws and remove the air ducting system from the intercooler.



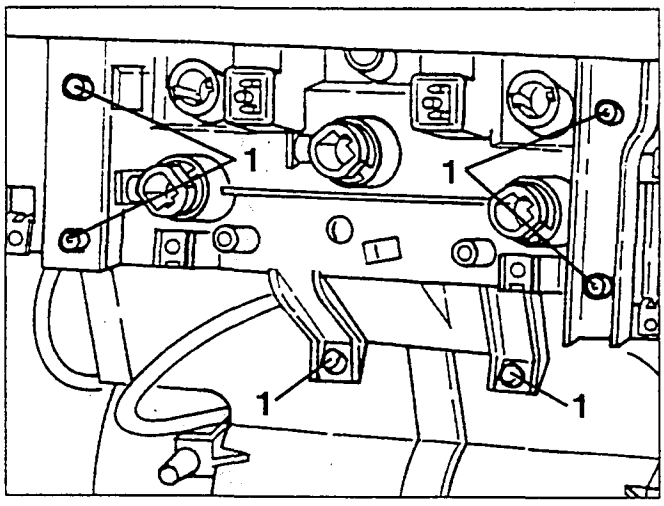
1. Remove the pipes in question.



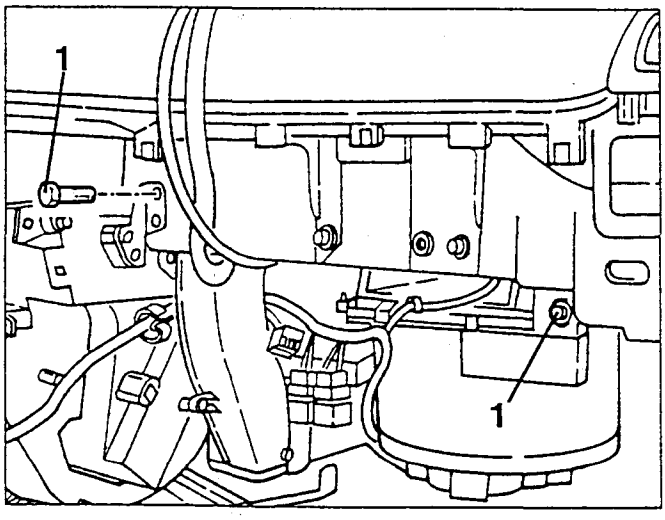
HEATER RADIATOR

REMOVING/REFITTING

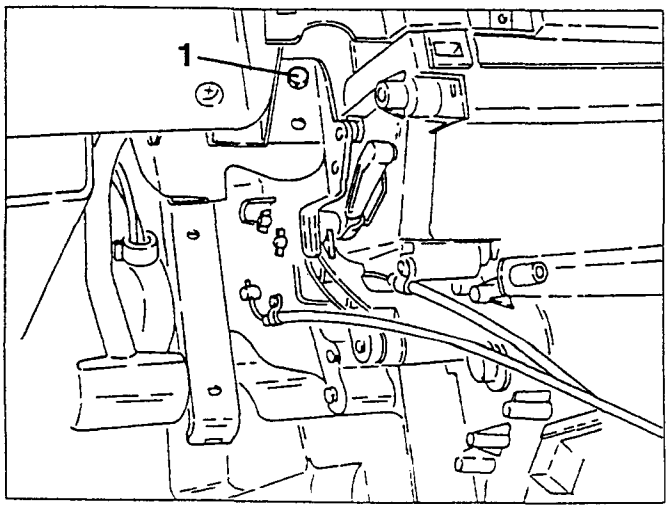
- Remove the lower part of the dashboard and the centre console (see GROUP 70).
1. Slacken the fastening screws and lower the controls.



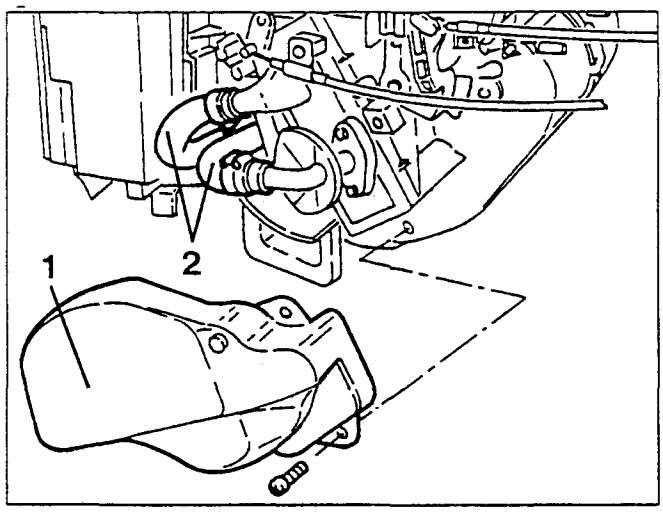
1. Slacken the three screws fastening the heating and ventilation unit on the righthand side.



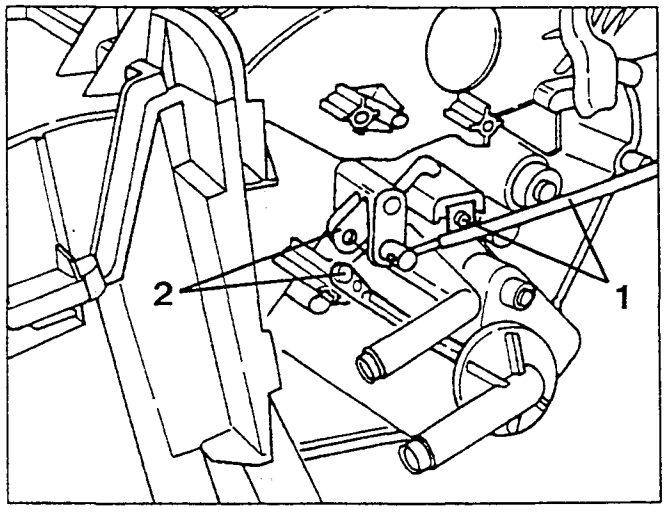
1. Slacken the screw fastening the heating and ventilation unit on the lefthand side.



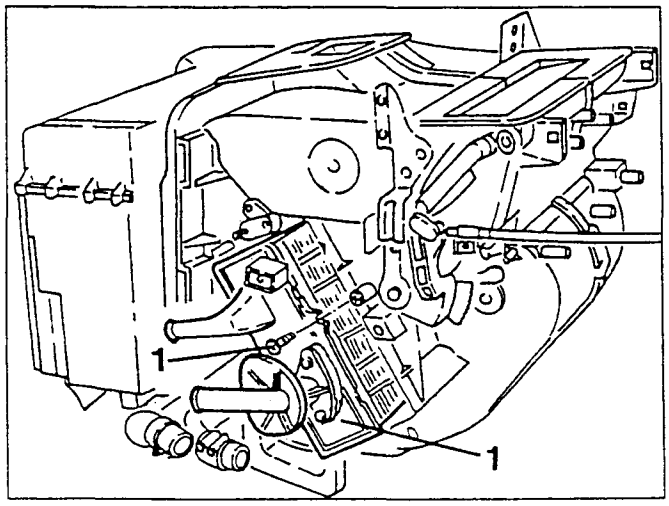
1. Slacken the fastening screws and remove the coolant pipe guard.
2. Disconnect the coolant fluid inlet and outlet pipes.



1. Remove the mixing port-coolant fluid inlet cock control cable.
2. Disconnect the fluid inlet cock control rod at the top.

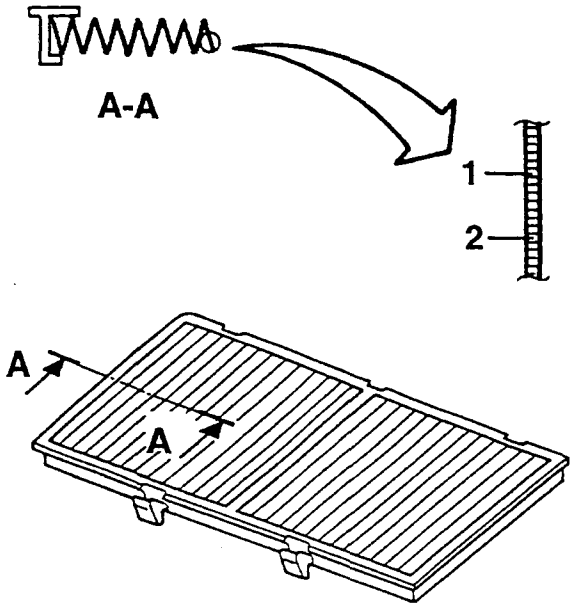


1. Move the unit enough to slacken the two fastening screws and take out the heater radiator.



POLLEN FILTER (upon request for the Versions /Markets for which it is foreseen)

The heating and ventilation unit may be fitted with a special dust/pollen filter formed of polyester fibres outside and electrostatically charged polycarbonate fibres inside (see figure).
This filter combines the mechanical filtering action of the air with an electrostatic effect so that the outside air admitted to the passenger compartment is cleaned and free of contaminants such as dust, pollen, etc., on condition of course, that the door windows are shut.



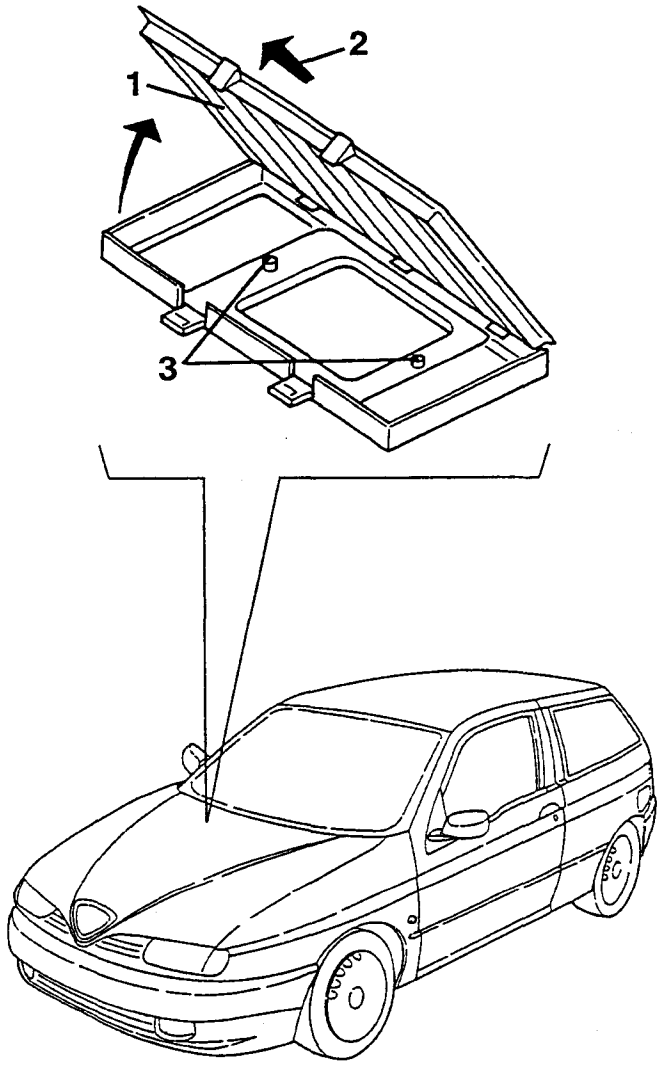
1. *Polycarbonate fibres*
2. *Polyester fibres (non woven fabric)*

NOTE:
The conditions of the filtering element should be checked once a year, preferably at the beginning of the warm season. It should be checked more frequently when the car is usually used in town or dusty areas.

REMOVAL/REFITTING

WARNING:
The failure to replace the filter or its incorrect installation can considerably reduce the effectiveness of the heating and ventilation system.

- Remove the air intake grille (see GROUP 70).
1. Raise the filtering element that is snap fastened by two hooks.
2. Remove the filtering element complete with frame; remove the element from the frame and replace it with a new one.
3. If necessary, remove the filtering element housing, slackening the two screws fastening it to the panel beneath.



LOCATING LEAKS IN THE SYSTEM

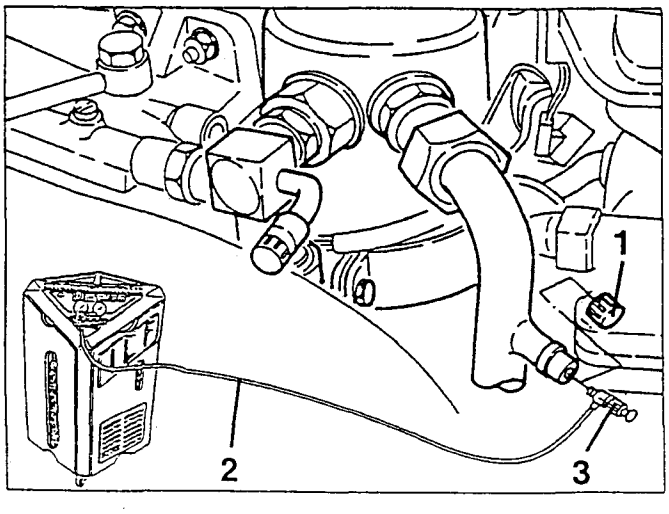
Check that all the unions are tightened. If leaking persists, check the presence of the O-rings on the unions, then add a certain amount of R134a to the system (appr. 200 gr.), find the leak using a leak detector, then drain the fluid and mend the leak.
Use one of the leak detectors described in the special Tool Bulletins.

EMPTYING THE SYSTEM-RECOVERING THE REFRIGERANT FLUID

The safety rules given in the introduction must be adhered to. It is especially important to bear in mind the following:

Any refrigerant fluid R134a spilt accidentally from the system or from the draining and recovery equipment can become toxic if very close to flames or in the presence of certain metals (magnesium and aluminium for example) in the form of fine particles or dust. It is thereofre wise to work without free flames and in well-aired environments with the extractor system operating.
Avoid prolonged contact of the skin with refrigerant fluid R134a during evaporation as the low temperature (appr. -30°C) it reaches at the end of expansion can cause cold "burns". It is therefore wise to use leather or thick fabric gloves.
The eyes must absolutely be protected from contact with the fluid as the very low temperature can cause serious harm to them.
Discharge of the refrigerant fluid to the atmosphere is an environmental hazard. Only use the specific equipment specified in the Tool Bulletins and described below for draining R143a from the system.

1. Slacken and remove the plug of the valve on the low pressure pipe.
2. Connect the drainage pipe to the drainage/recovery station.
3. Fit the special quick coupling pipe provided with the R143a recovery equipment on the valve and completely drain the fluid from the system, following the directions given in the instructions for the equipment.



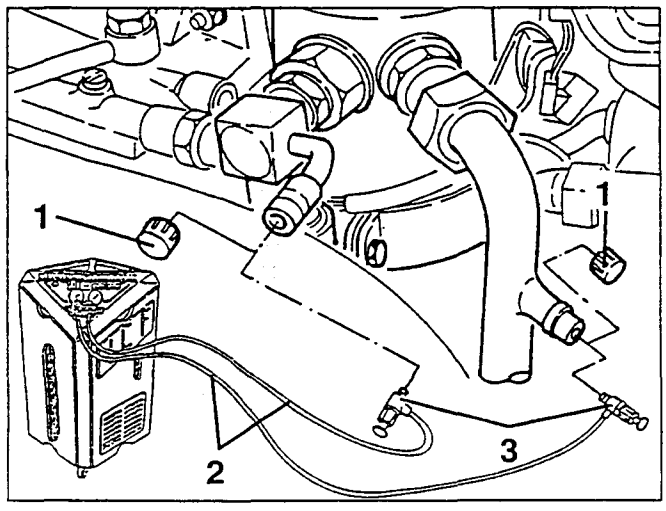
RECHARGING THE REFRIGERANT FLUID

1. Slacken and remove the caps from the rapid coupling valves located on the low pressure hoses.

2. Connect the drainage pipe to the refrigerant fluid drainage/recovery station.

WARNING:
Adhere to the technical specifications (see GROUP 00) for the quantity of R134a to be used for recharging.

3. Connect the high and low pressure union pipes to the corresponding quick coupling valves and begin the R134a recharging procedure following the directions in the instructions of the equipment.



R134a is a fluid which, if used with suitable care, is harmless for both persons and cars: however, as it is kept under pressure, it is subject to physical transformations which can make it harmful if it is not kept under perfect control. Therefore, the following warnings must be strictly adhered to.
The coolant is normally stored in metal cylinders: never expose the cylinders to sunlight for prolonged lengths of time, an increase in temperature increases the pressure that could exceed the safety limit.
During cold weather, difficulty is likely in transfer from the metal cylinder to the charging station due to the low pressure in the cylinder: in this case, before transferring, leave the cylinder for about twenty minutes in a heated place at temperatures not exceeding 35°C, and never using a free flame to warm the cylinder. Never leave the charging station cylinder completely full for long lengths of time.

Before recharging the system, top up the compressor with the oil removed during drainage (see the following paragraph).
To top up the lubricating oil in the conditioner compressors for R134a, only use the quantity and type of oil specified.
When recharging refrigerant fluid R134a only use the special equipment described in the specific Tool Bulletins.

TOPPING-UP THE OIL LEVEL IN THE COMPRESSOR

NOTE:
The compressor oil level should only be topped up when presumably a considerable amount has been leaked due to damage or disconnections of the conditioning unit components or when the system is drained/recharged.
In the event of operations in the engine compartment involving leaving the pipes of the system exposed to the air for more than six hours, topping up is insufficient and the compressor lubricating oil needs to be changed completely, proceeding as described in the following point C (after washing the system - see the specific paragraph).
To top up the oil level only use oil of the type specified in the specifications (see GROUP 00).

A) "SLOW" SYSTEM DRAINING -
In case of Routine Maintenance
When draining the system using the equipment described previously, the compressor oil removed is collected in a special graduated container.
- Before recharging the refrigerant fluid, top the system up with the quantity marked on the container, **plus 15 cm^3.**
- Use a syringe to send the oil through the special hole on the evaporator outlet pipe.

B) "QUICK" SYSTEM DRAINING
(In under 5 minutes)
In the case of Accidental Breakages
Under these circumstances it is not possible to determine the exact quantity of the oil lost. Replace it as described above, **in all cases with 50 cm^3 of oil.**

N.B.: if for some reason, the compressor is removed and refitted follow the description given in point C.

C) DRAINAGE FOLLOWED BY REMOVAL AND REFITTINGOF THE COMPRESSOR
- Drain the R134a fluid from the conditioning system.
- Remove the compressor (see the specific paragraph).
- Remove the plug from the oil drainage/charging hole and drain off all the oil contained in the compressor (N.B. turn the compressor a few times by hand to send all the oil out).
- Refill with oil of the specified type and quantity given in the specifications (see GROUP 00).
- Re-assemble the compressor on the car.
- Recharge the system.

N.B.:
When the compressor is replaced with a new one it is not necessary to top up the system because the compressor supplied as spare is already provided with the specified amount of oil.

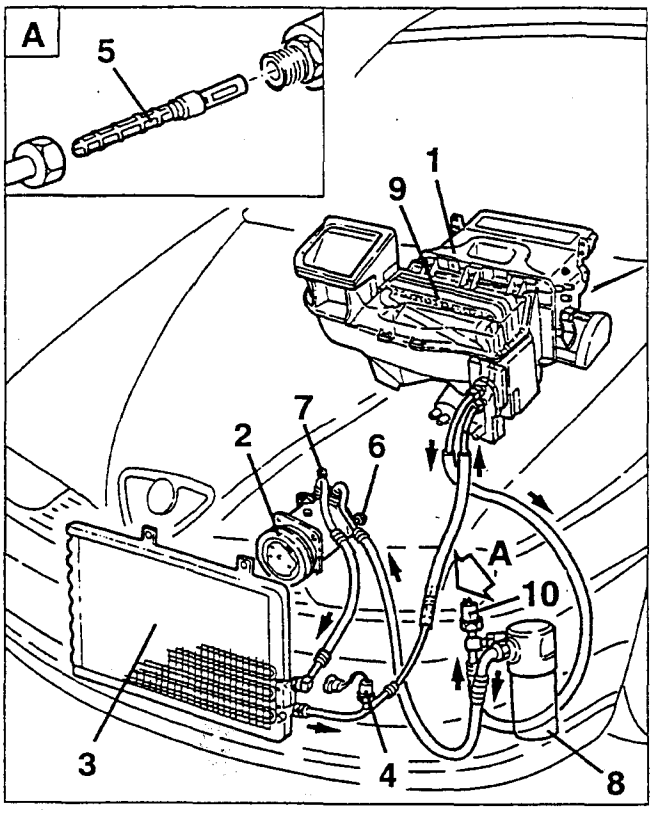
WASHING THE SYSTEM

In the event of damage or breakage of the compressor or of other components of the system, the system should be accurately washed.
Washing should also be carried out to remove any damp if the pipes are left open exposed to the atmosphere for over six hours during operations in the engine compartment.

Proceed as follows:

- If the compressor has suffered damage that might have caused the presence of metal in the pipes, the connection pipes (unions) to the compressor should be blown with compressed air.
- Fill with 1.5 ÷ 2 kg of R134a on the high pressure side - red tap.
- Carry out recovery operations from the low pressure side.
- Fill a second time with 1.5 ÷ 2 kg of R134a (use the same fluid).
- Connect the system with the special drainage/recovery system described previously.
- After washing, change the drier filter and clean the filter of the expansion valve (when fitted).
- Recharge the system as described previously.

SYSTEM



1. *Heating and ventilation Unit*
2. *Compressor*
3. *Condenser*
4. *Three-level pressure switch (trinary)*
5. *Expansion valve*
6. *Needle valve for draining/recharging R134a on the low pressure pipe*
7. *Needle valve for draining/recharging R134a on the high pressure pipe*
8. *Drier filter*
9. *Evaporator*
10. *Minimum pressure switch*

DESCRIPTION

The heating and ventilation system for the models with boxer engines is substantially the same as the one fitted on the model with turbodiesel engine.
The main differences from this system are the following:
- the adoption of a compressor with fixed rather than variable displacement;
- the adoption of a minimum pressure switch;
- different positioning of the system components in the engine compartment.

BELOW ARE GIVEN THE VARIANTS (FOR EXAMPLE THE MONOGRAPHIC PARTS AND PROCEDURES) TO THIS SYSTEM IN RELATION TO THE TURBODIESEL VERSION

STRATEGY FOR CONNECTING AND DISCONNECTING THE COMPRESSOR

The compressor is controlled by the engine electronic injection management system which adapts the idle speed when the compressor is connected, or it cuts off the connection.

IAW injection system management
In addition to adapting the idle speed each time the compressor is connected, this injection system temporaneously disables (appr. 10 sec) the compressor connection if high engine power is required.

MP3.1 injection system management
This injection system only adapts the engine idle speed each time the compressor is connected.

M2.10.3 injection system management
The injection system control unit carries out the following strategies:
- it adapts the engine idle speed each time the compressor is connected; if the engine speed falls below 700 rpm, the compressor is disconnected;
- in the need for high power (high speed - above 6000 rpm engine at full load - max throttle opening) it momentaneously cuts off the supply to the compressor;
- it does not allow the compressor to be connected when starting the engine until normal operating conditions have been reached.

DESCRIPTION OF THE MAIN COMPONENTS OF THE AIR CONDITIONING SYSTEM

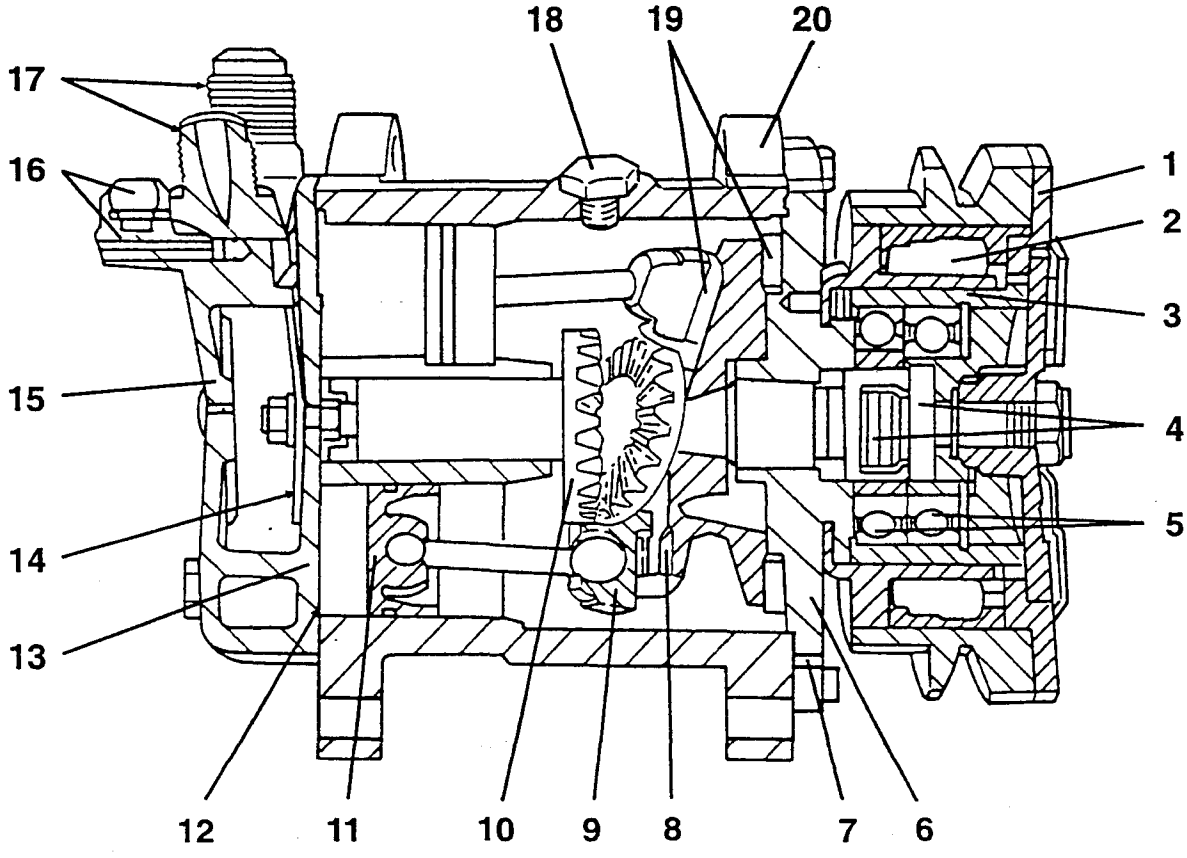
MINIMUM PRESSURE SWITCH

The purpose of the minimum pressure switch is to de-energize the electromegnetic joint of the compressor pulley when the pressure (in the accumulator) reaches a mean rating of 1.72 bar re-energizing it again when the pressure reaches the mean rating of 3.17 bar, in order to maintain the cold required and to prevent the evaporator from freezing.
It also protects the compressor disconnecting the electromagnetic joint from its pulley when the pressure of the refrigerant falls below 1.58 bar due to a leak or when the environment temperature falls below 2.7°C.

COMPRESSOR

The SANDEN compressor shown in diagram form in the cutaway view below comprises the following:
- a block (20);
- seven pistons (11) complete with corresponding connecting rod;
- a plate (13) with one-way blade type delivery and intake valve that operates automatically;
- a cylinder (15) head on which the intake and exhaust ducts are machined (17).

The reciprocating motion needed for the pistons to run in their liners is developed by the rotary motion of a tilted plate (rotor 8) on which, with the interposition of roller (18) a plate (9) rests to which the connecting rods of the pistons (11) are connected by ball joints. The plate (9) is unable to rotate and it articulates on two toothed gears (10).



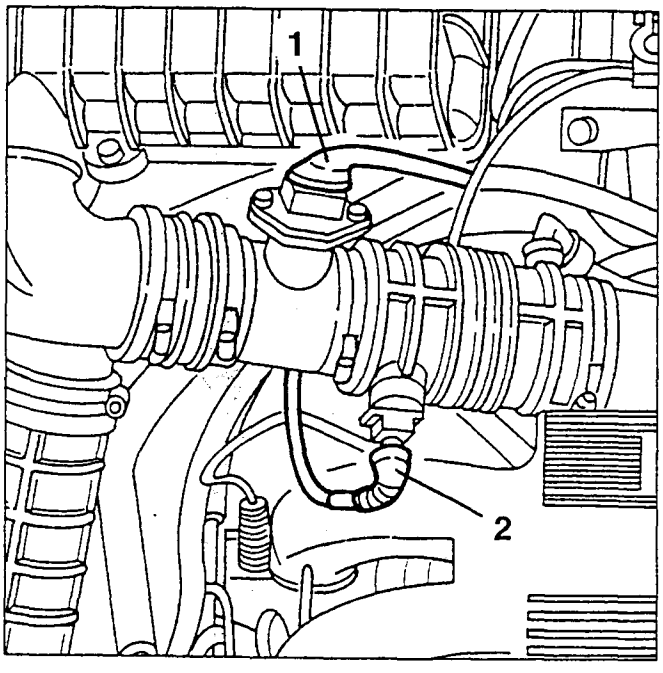
1. *Clutch plate*
2. *Electromagnet*
3. *Rotor with pulley*
4. *Set of seals*
5. *Ball bearings*
6. *Front plate*
7. *Seal ring*
8. *Rotor*
9. *Connecting rod carrier plate*
10. *Antirotation gear*
11. *Piston*
12. *Seal for valve plate*
13. *Valve plate*
14. *Cylinder head seal*
15. *Cylinder head*
16. *Service needle valve*
17. *Intake and delivery ducts*
18. *Oil filler plug*
19. *Roller thrust bearings*
20. *Compressor block*

DUCTING SYSTEM AND HEATER - DISTRIBUTOR UNIT (TWO BOWDEN)

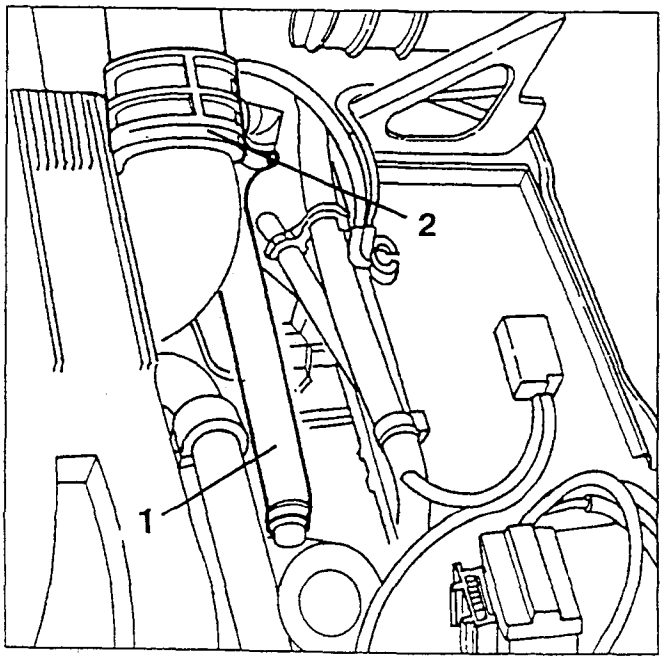
REMOVAL/REFITTING

- Drain the fluid from the conditioning system (see *specific paragraph*).
- Remove the battery with its acid drain tray (see GROUP 55).

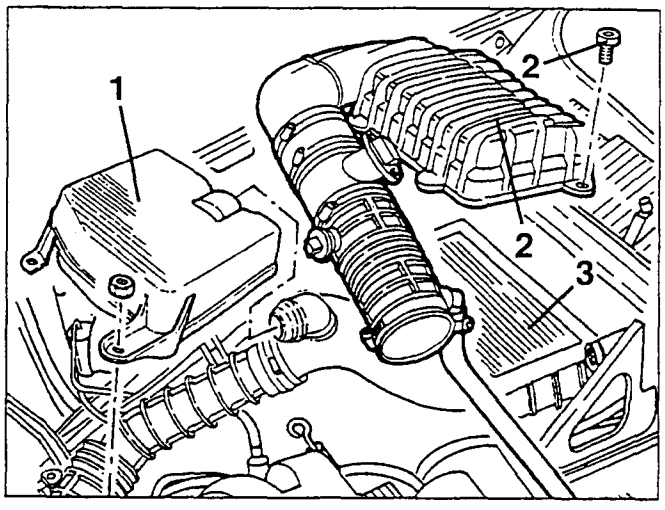
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the electrical connection from the intaken air temperature sensor.



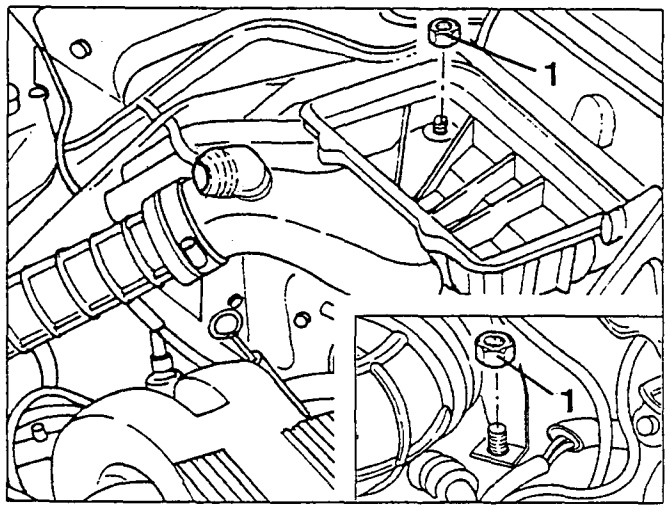
1. Disconnect the oil vapour recovery pipe from the engine oil filler.
2. Disconnect the corrugated sleeve from the intake box.



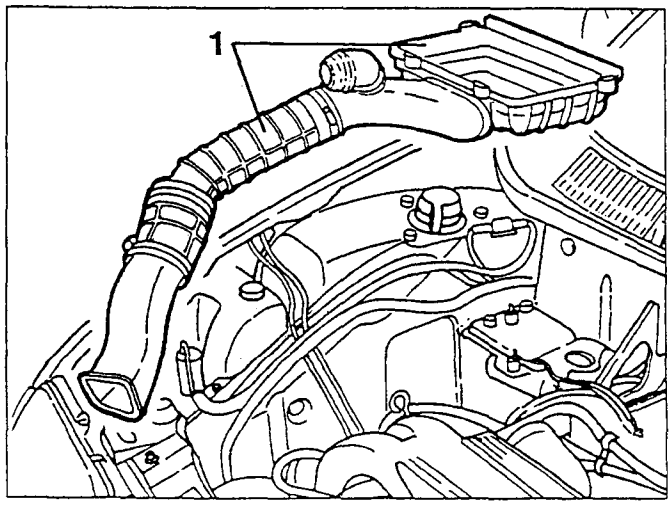
1. Remove the resonator
2. Slacken the four fastening screws and remove the air cleaner cover complete with sleeves.
3. Remove the filtering element.



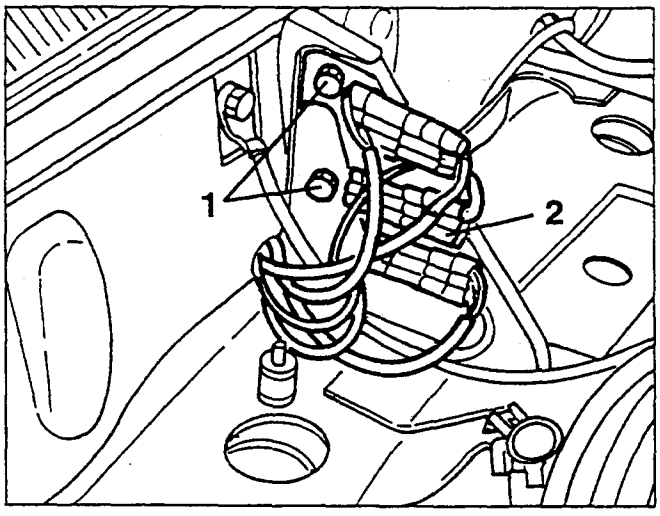
1. Slacken the three air cleaner fastening nuts and the front bolt fastening the air intake sleeve.



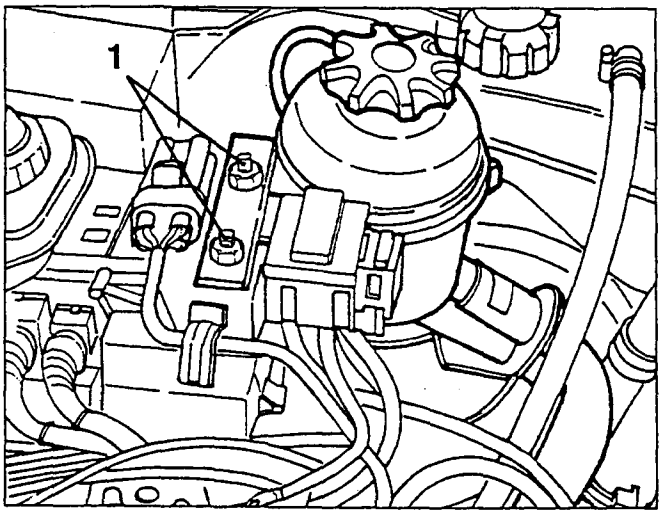
1. Remove the air cleaner box complete with air intake sleeve.



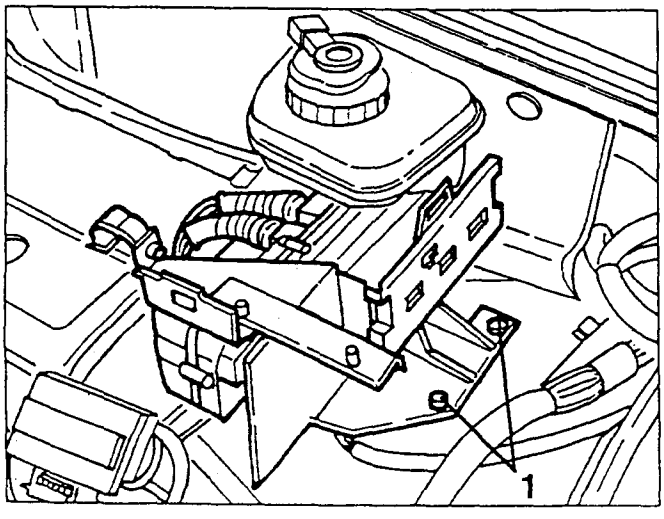
1. Slacken the two screws fastening the power steering crossrail support bracket.
2. Move the electrical connections away from the power steering crossrail support bracket.



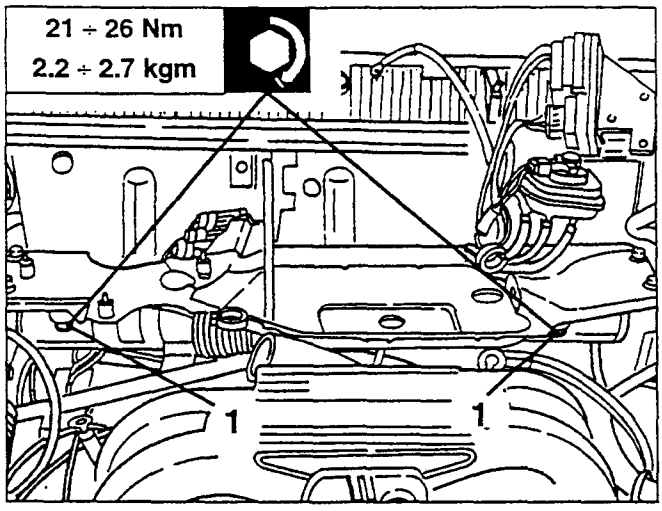
1. Slacken the two fastening screws and move the power steering reservoir sidways without disconnecting the pipes.



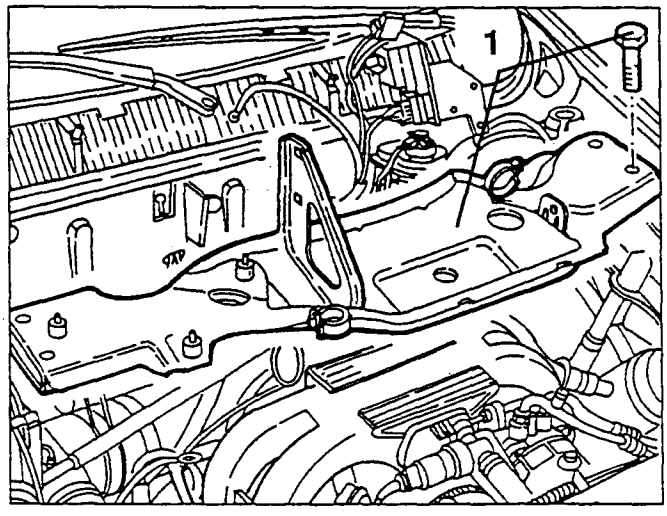
1. Free the support bracket of the relay switches from the electrical connections, then slacken the fastening screws and move it to one side.



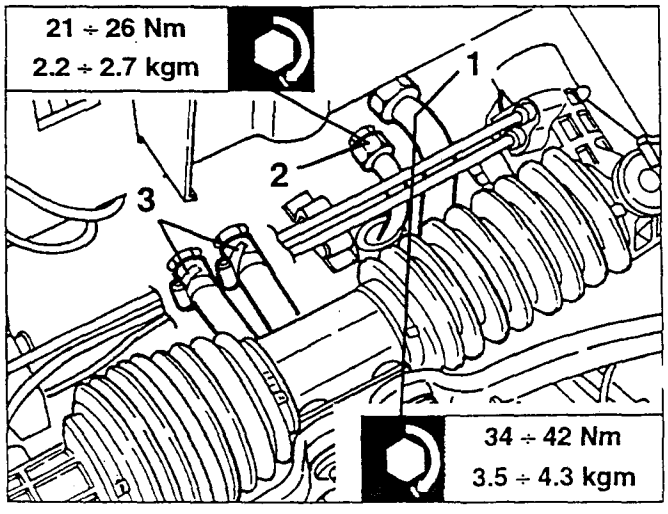
1. Slacken the four screws fastening the power steering box to the support crossrail.



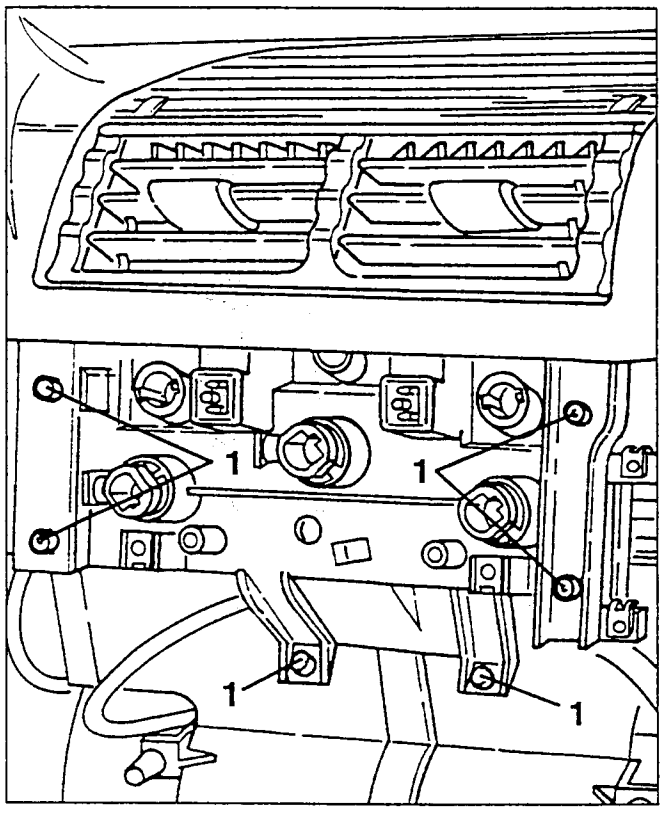
1. Slacken the four fastening screws and remove the power steering unit support crossrail.



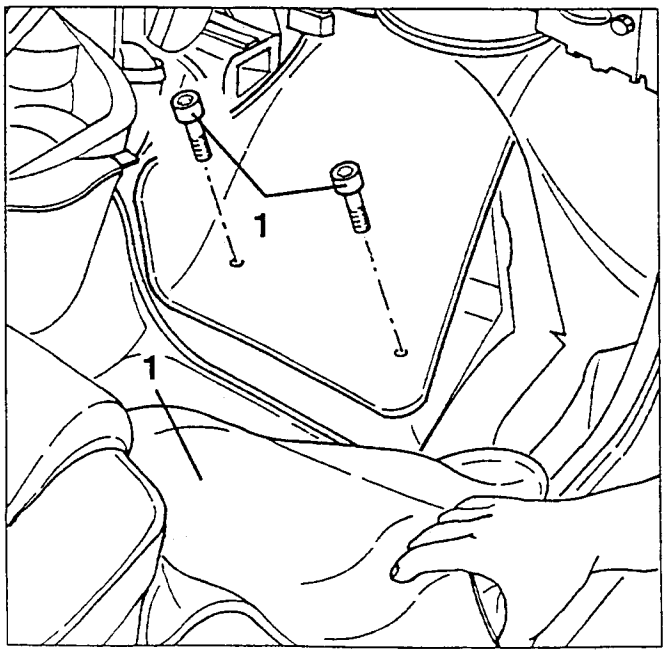
1. Using wrenches N° 1.822.112.000 and N° 1.822.115.000 disconnect the fluid outlet pipe union from the evaporator.
2. Using wrenches N° 1.822.111.000 and N° 1.822.113.000 the fluid inlet pipe union from the evaporator.
3.Disconnect the two coolant inlet and outlet pipes from the radiator and recover the coolant fluid.



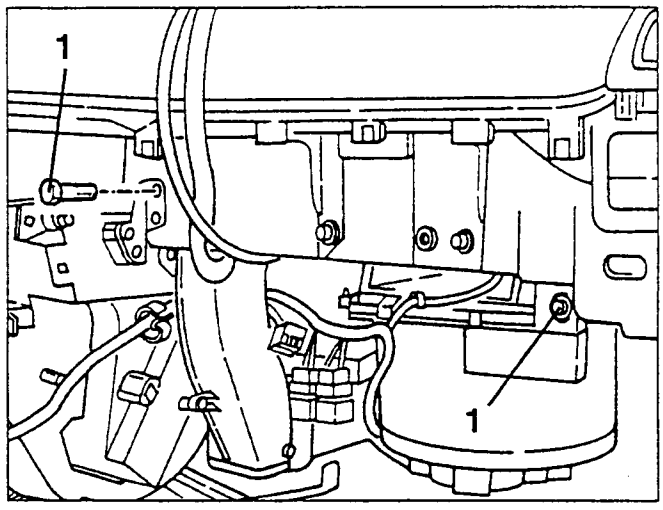
- Remove the lower part of the dashboard and the centre console (see GROUP 70).
1. Slacken the four fastening screws and lower the heating and ventilation unit controls.



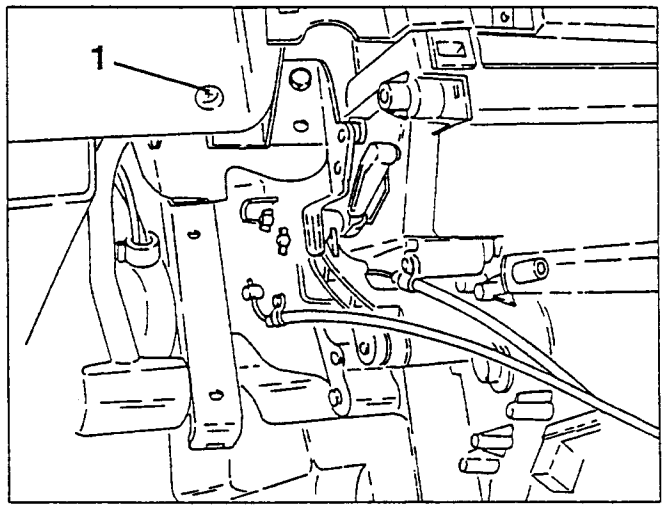
- Remove the two sections of air delivery pipe to the rear passenger face level (see GROUP 70).
- Disconnect the electrical connections of the heating and ventilation unit.
1. Move aside the floor mat, slacken the two fastening screws and remove the control unit cover.



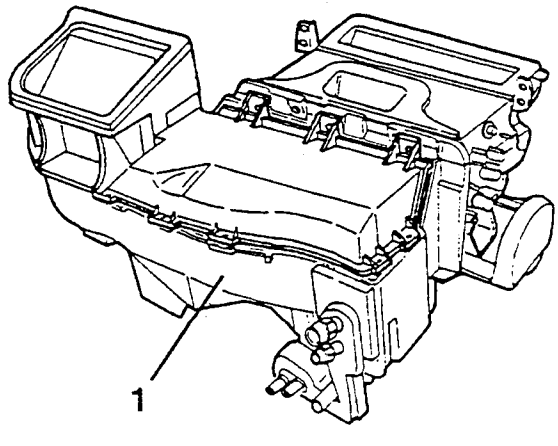
1. Slacken the three screws fastening the heating and ventilation unit on the righthand side.



1. Slacken the screw fastening the heating and ventilation unit on the lefthand side.

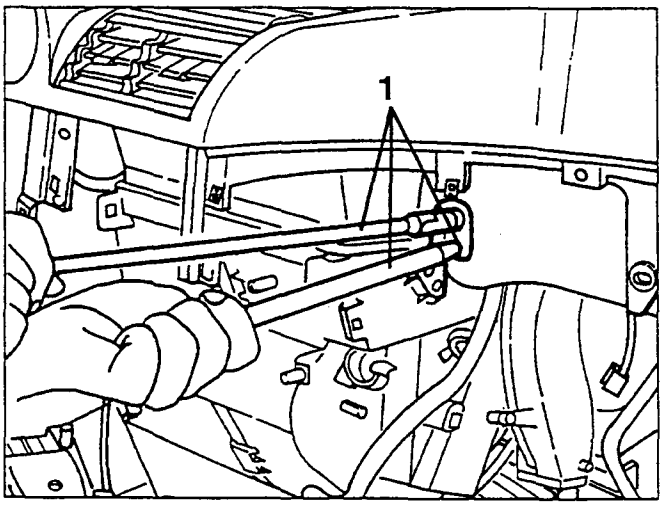


1. Remove the heating and ventilation unit.



Refit the unit reversing the sequence followed for its removal, adhering to the following instructions:

- Coat the mouth of the heater, water drain and R134a pipes with vaseline.
- Assemble the unit making sure that the above pipes are correctly inserted in the passage holes.
1. Use a centering pin positioned as shown, and centre the group before fixing it.



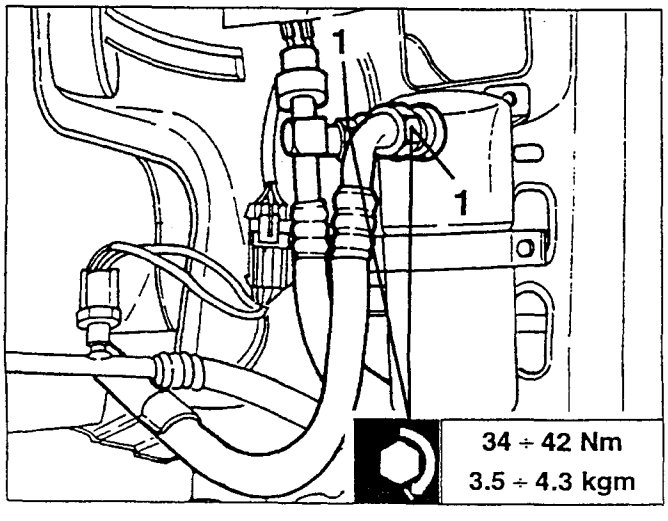
DIS-ASSEMBLY

- Proceed as described for the turbodiesel version.

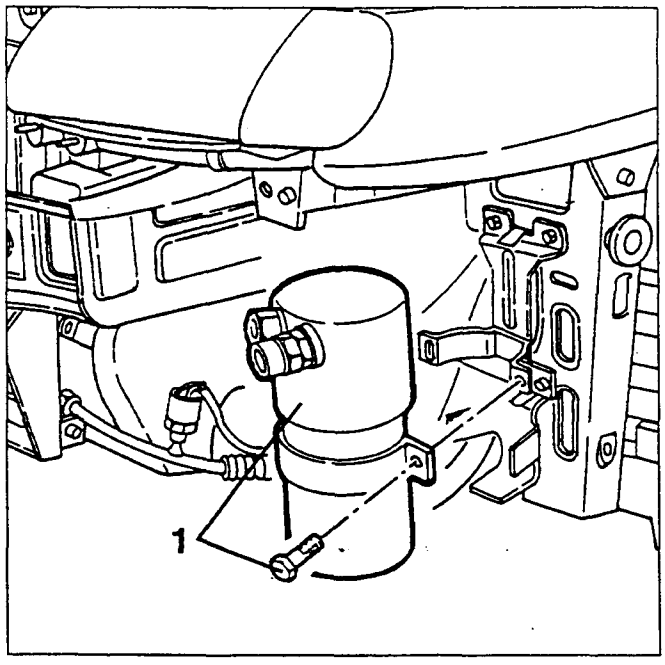
DRIER FILTER

REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) cable.
- Drain the fluid from the conditioning system (see specific paragraph).
-Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the two refrigerant fluid inlet and outlet pipe unions from the drier filter.



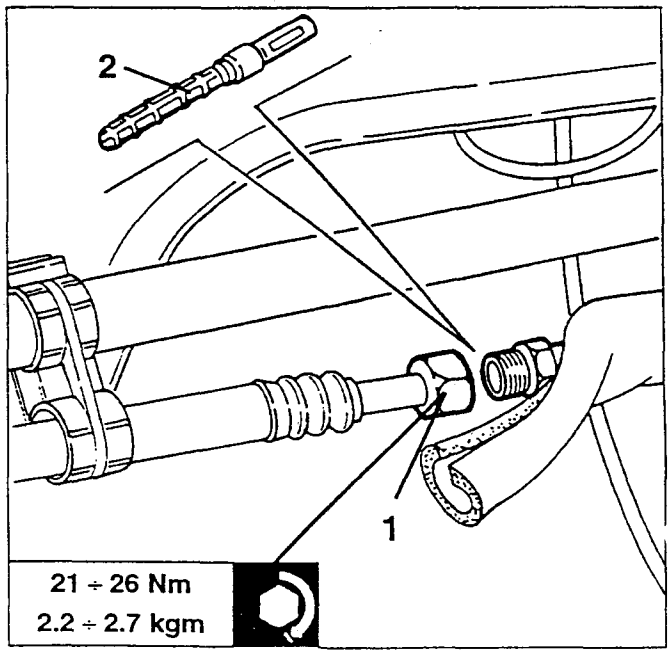
1. Slacken the clamp screw and remove the drier filter.



EXPANSION VALVE

REMOVAL/REFITTING

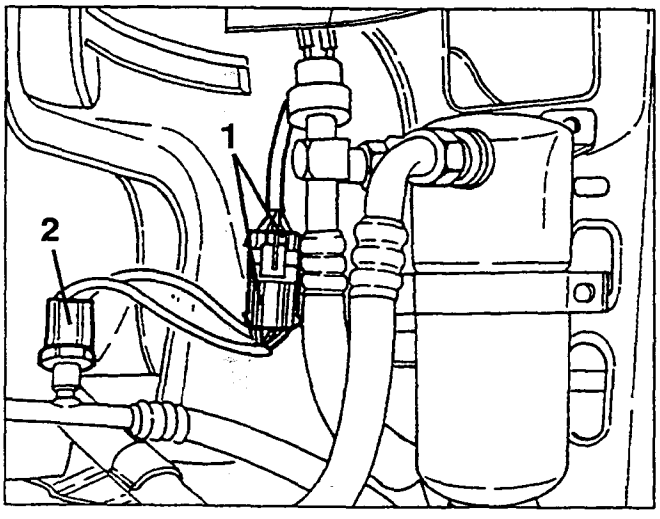
- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the left front wheel and wheel house.
1. Slacken the intermediate union of the freon delivery pipe from the condenser to the evaporator.
2. Pull out and remove the expansion valve.



THREE-LEVEL PRESSURE SWITCH (TRINARY)

REMOVAL/REFITTING

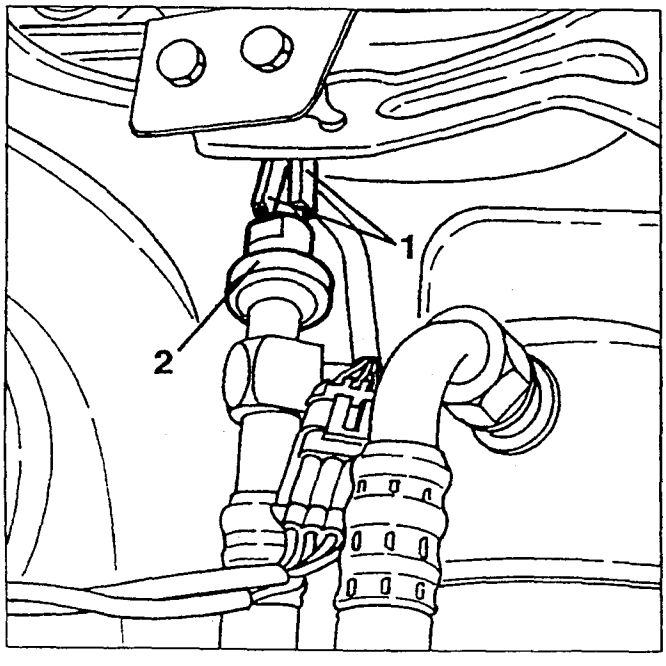
- Set the car on a lift.
- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the electrical connection of the three-level pressure switch.
2. Slacken and remove the three-level pressure switch.



MINIMUM PRESSURE SWITCH

REMOVAL/REFITTING

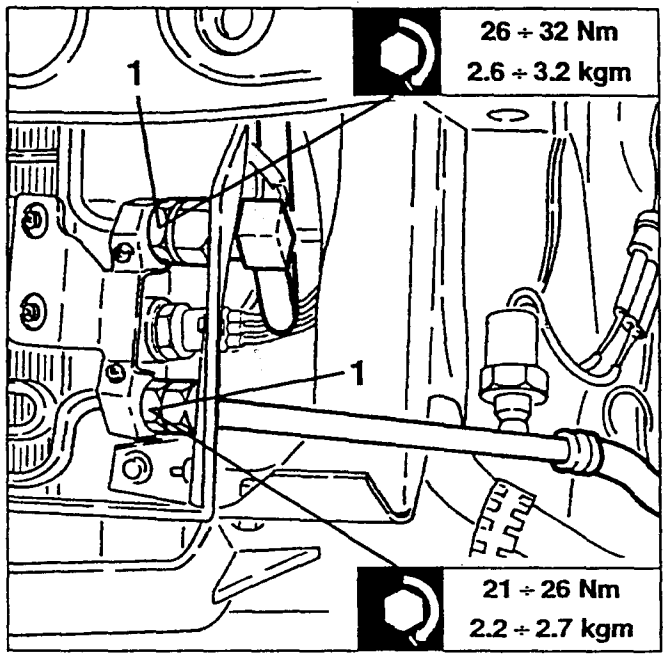
- Set the car on a lift.
- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the two electrical connections from the minimum pressure switch.
2. Slacken and remove the minimum pressure switch.



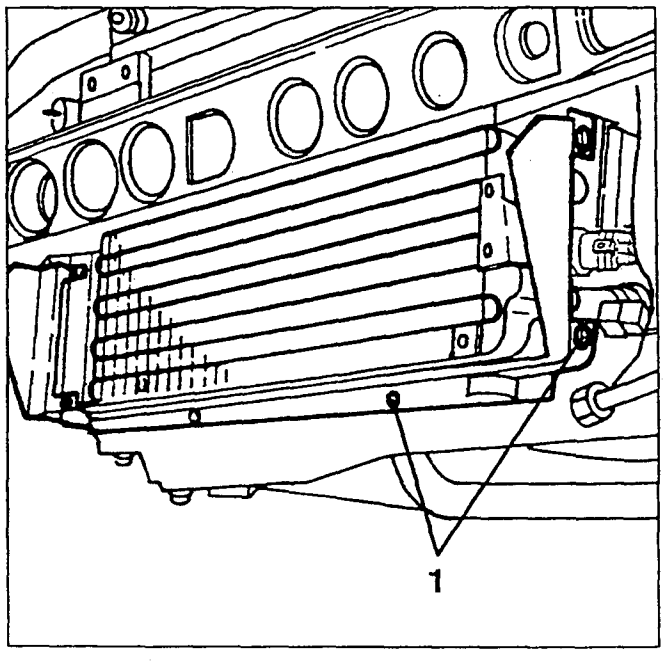
CONDENSER

REMOVAL/REFITTING

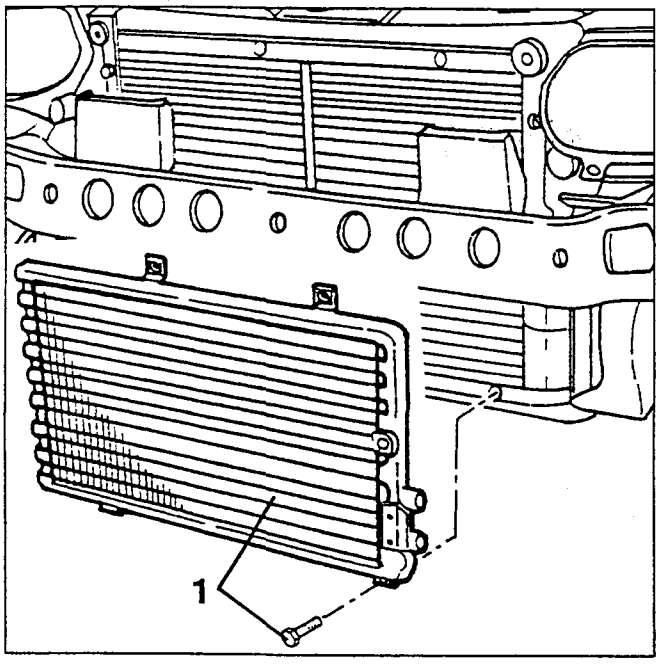
- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the refrigerant fluid inlet and outlet pipe unions from the condenser.



1. Slacken the fastening screws and remove the air ducting system.



1. Slacken the four fastening screws and remove the condenser.

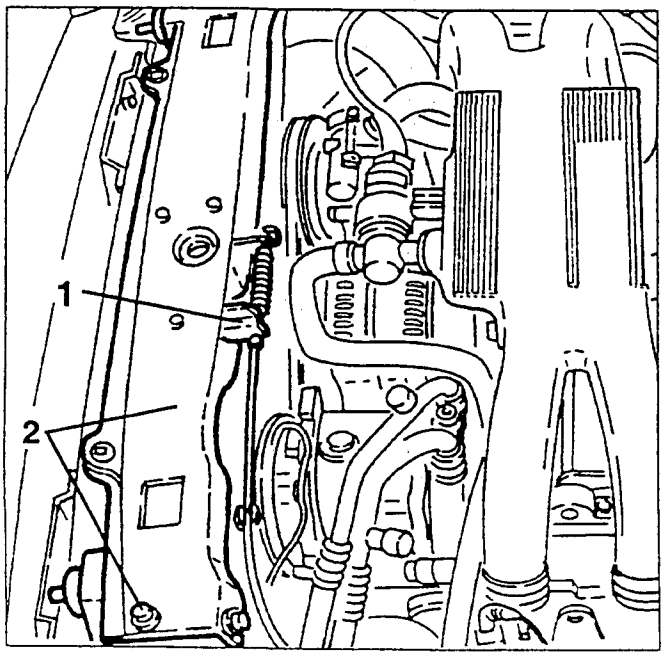


COMPRESSOR

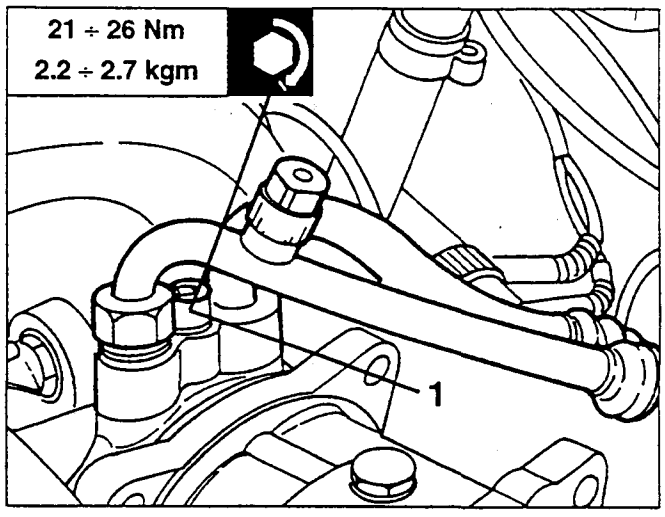
REMOVAL/REFITTING

- Drain the fluid from the conditioning system (see specific paragraph).
- Disconnect the battery (-) terminal.
- Remove the radiator grille (see GROUP 70).

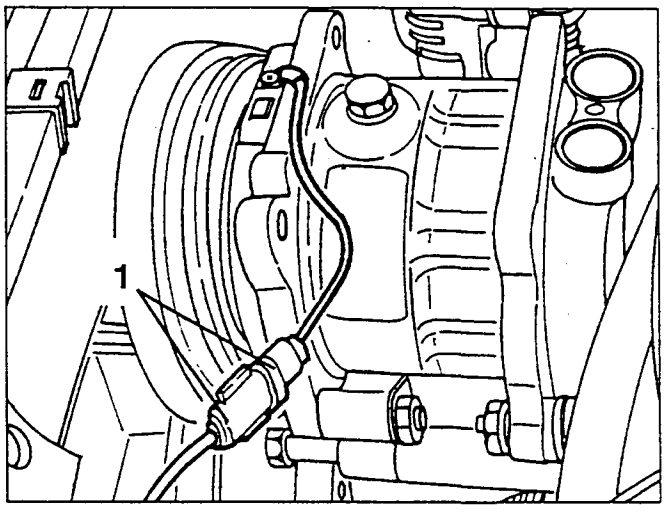
1. Disconnect the opening cable from the bonnet lock.
2. Slacken the fastening screws and remove the upper radiator crossrail.



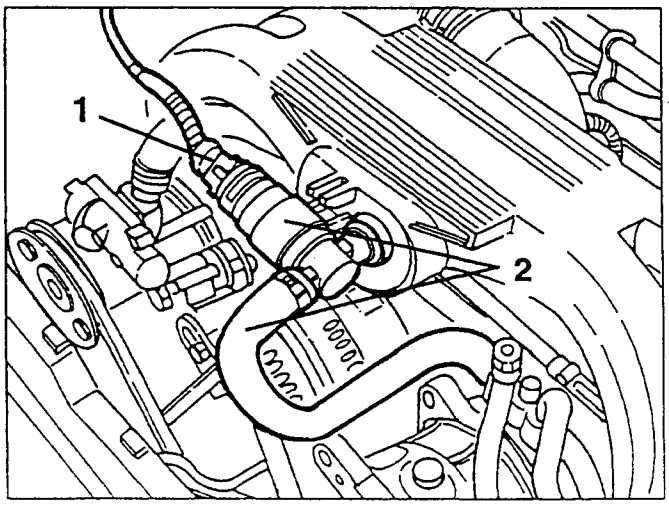
1. Disconnect the fluid inlet and outlet pipe unions from the compressor slackening the corresponding screw.



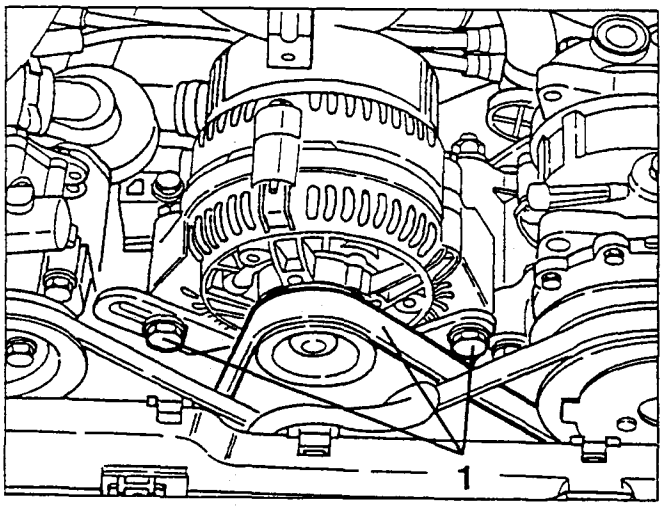
1. Disconnect the compressor electrical connection.



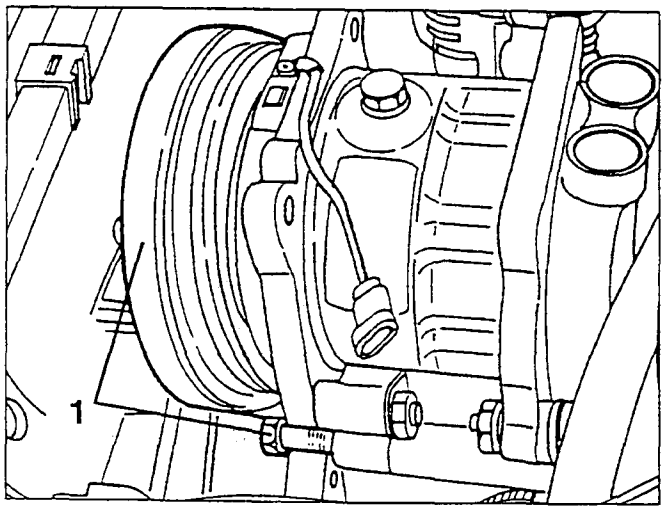
1. Disconnect the electrical connection from the idle speed actuator.
2. Slacken the clamp and disconnect the idle speed actuator from the intake box and move it to one side.



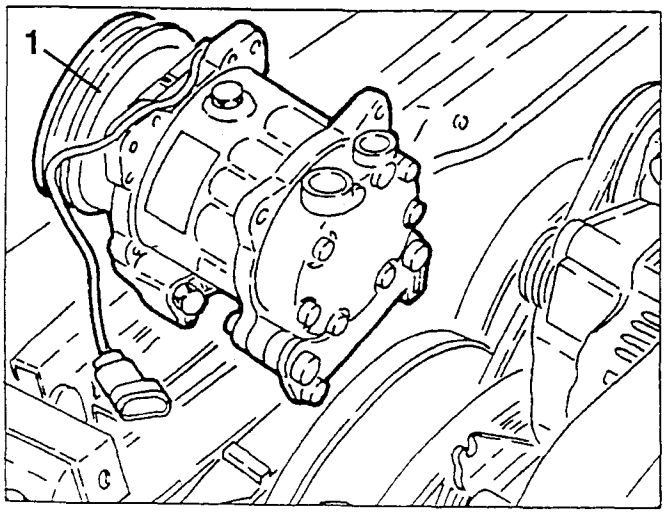
1. Slacken the two alternator fastening bolts and remove the drive belt.
- Completely unscrew the two bolts slackened previously and move the alternator just enough to disconnect the electrical connections.



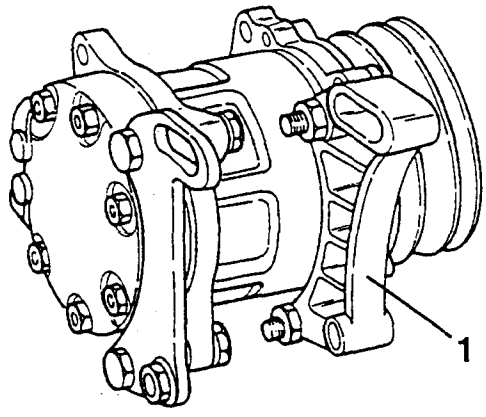
1. Slacken the right bolt and left screw fastening the compressor and remove the drive belt.



1. Completely unscrew the fastening bolt and screw and remove the compressor.



1. On the bench, slacken the fastening bolts and separate the brackets from the compressor.



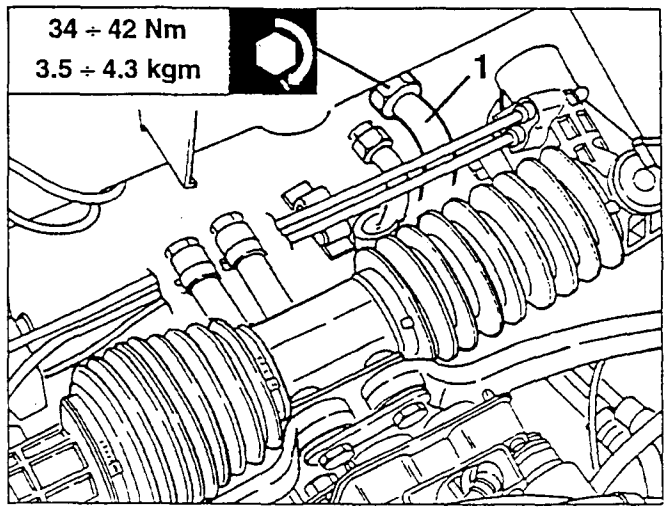
- When refitting, tension the compressor drive belt and the alternator - water pump drive belt (see GROUP 00).

PIPE FROM EVAPORATOR TO DRIER FILTER

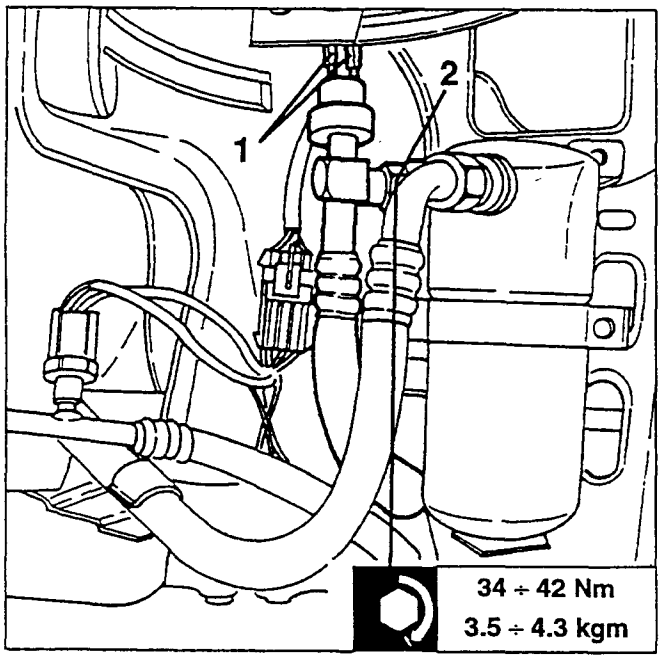
REMOVAL/REFITTING

- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
- Remove the left front wheel.
- Remove the battery with its acid drain tray (see GROUP 55).
- **Follow the first ten steps described in the "DUCTING ASSEMBLY AND HEATER - DISTRIBUTOR UNIT" paragraph.**

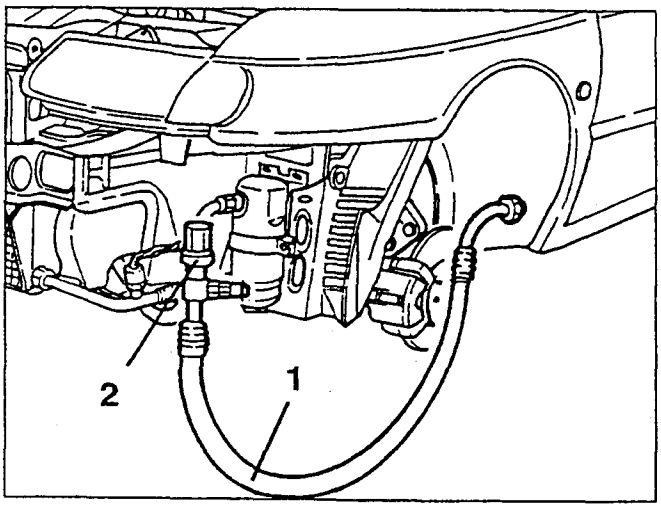
1. Using wrenches N° 1.822.112.000 and N° 1.822.115.000 disconnect the freon outlet pipe union from the evaporator.



- Raise the car.
1. Disconnect the two electrical connections from the minimum pressure switch.
2. Disconnect the union of the pipe in question from the drier filter.



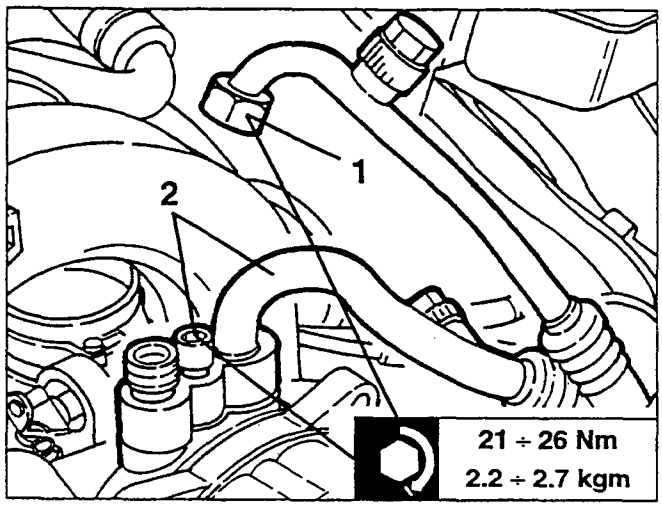
1. Remove the pipe in question disconnecting it from its clamps.
2. On the bench, slacken and remove the minimum pressure switch from the pipe.



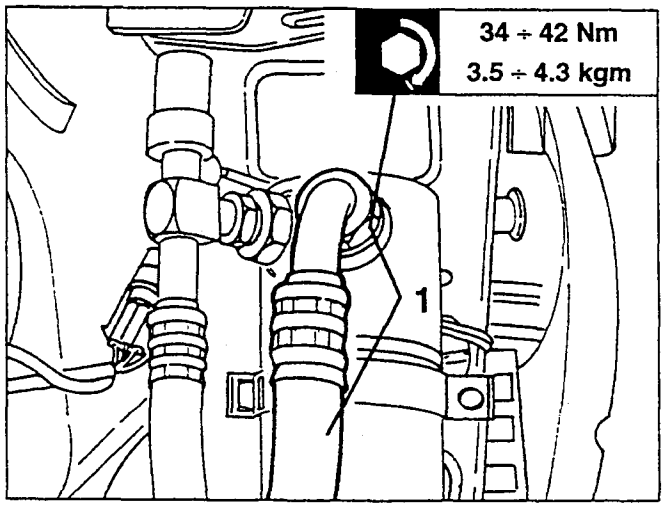
PIPE FROM THE DRIER FILTER TO THE COMPRESSOR

REMOVAL/REFITTING

- Set the car on a lift.
- Drain the fluid from the conditioner system (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect condenser connection pipe union from the compresor.
2. Slacken the fastening screw and disconnect the pipe in question from the compressor.



- Raise the car.
1. Disconnect the union of the pipe in question from the drier filter and release it from the hose clamps to remove it.



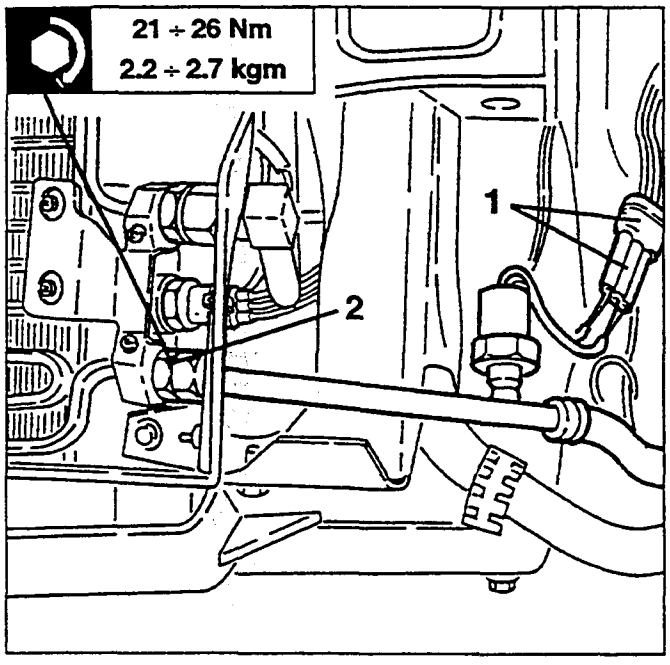
PIPE FROM THE CONDENSER TO THE EVAPORATOR

REMOVAL/REFITTING

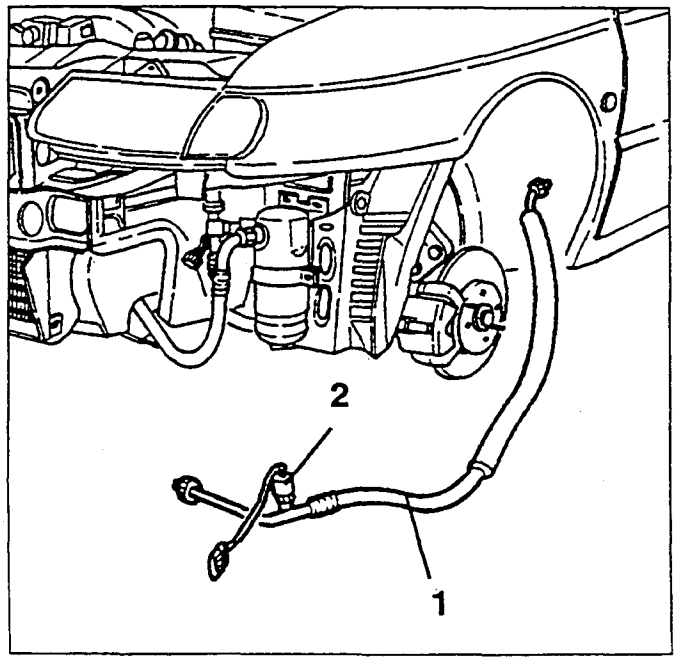
- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
- Remove the left front wheel.
- Remove the battery with its acid drain tray (see GROUP 55).

- Follow the first ten steps of the procedure described in the paragraph "DUCTING ASSEMBLY AND HEATER - DISTRIBUTOR UNIT" without disconnecting the two inlet and outlet hoses carryng the engine coolant to and from the heater.

- Raise the car.
1. Disconnect the electrical connection of the three-level pressure switch.
2. Disconnect union of the pipe in question from the condenser.



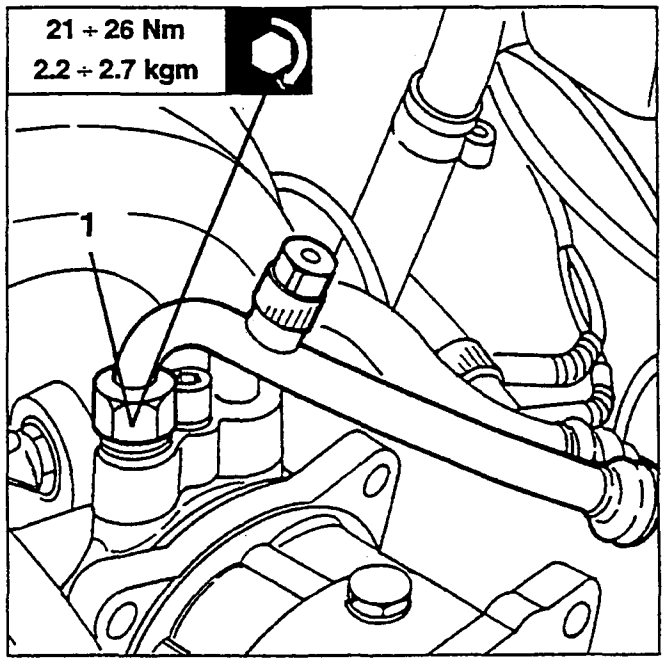
1. Remove the pipe in question freeing it of its clamps.
2. On the bench, slacken and remove the three-level pressure switch from the pipe.



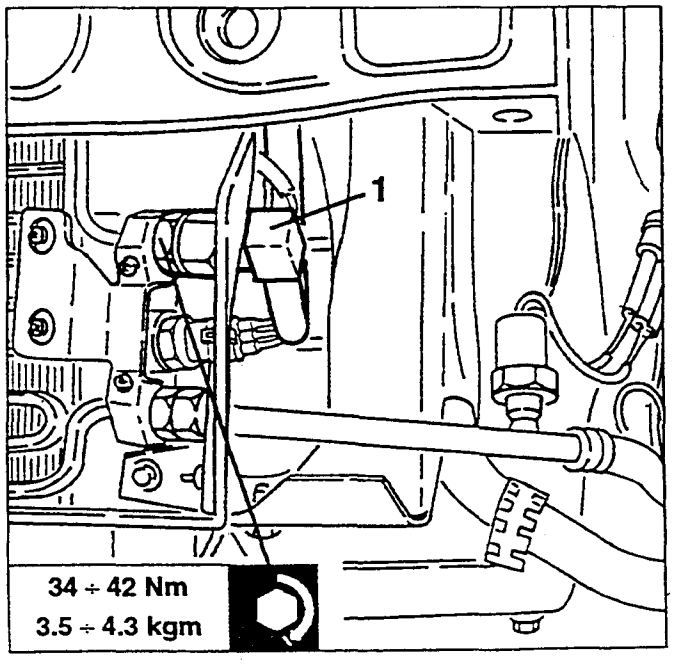
PIPING FROM THE CONDENSER TO THE COMPRESSOR

REMOVAL/REFITTING

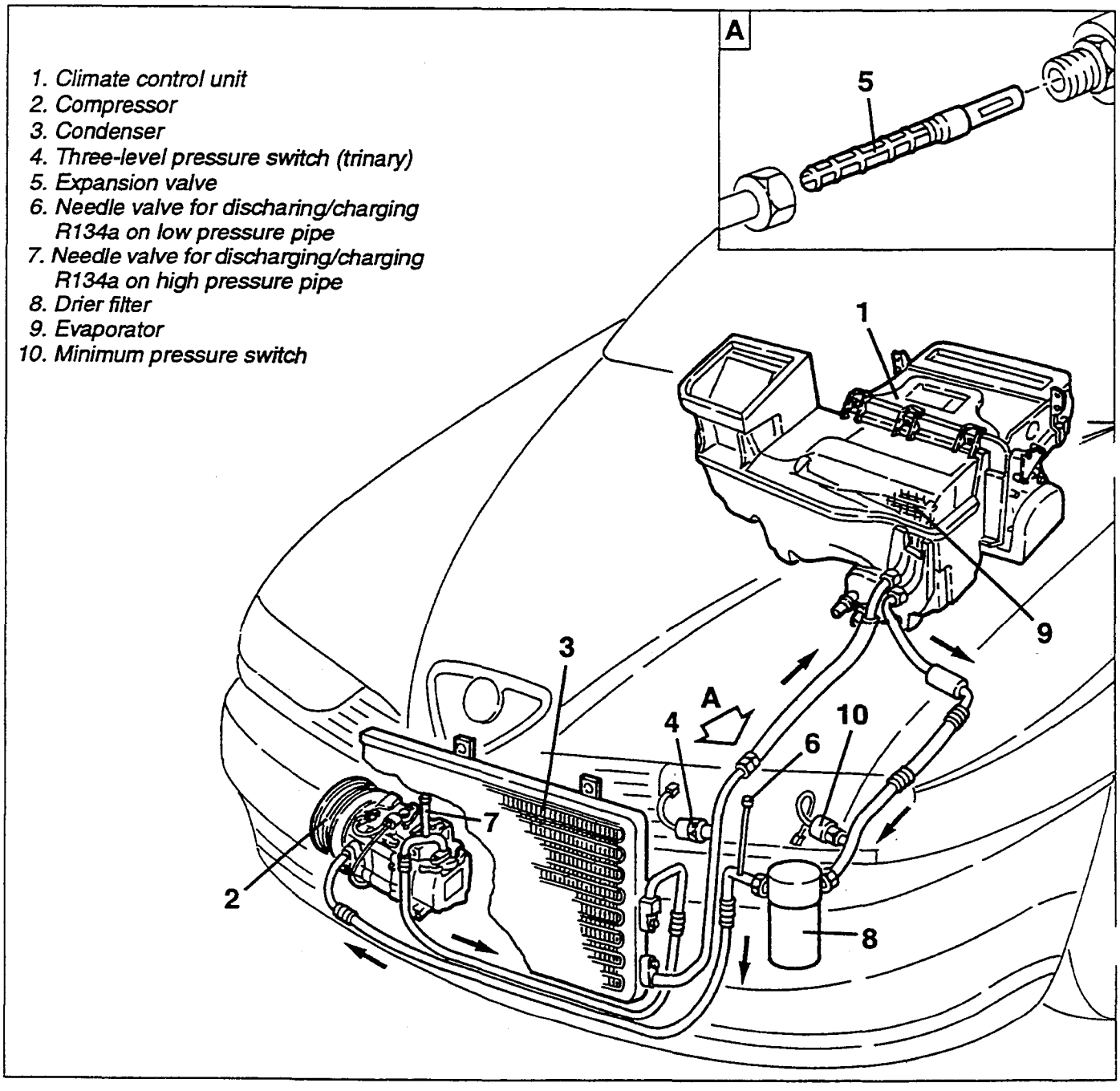
- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the union of the pipe in question from the compressor.



- Raise the car.
1. Disconnect the union of the pipe in question from the condenser then remove it.



SYSTEM



1. *Climate control unit*
2. *Compressor*
3. *Condenser*
4. *Three-level pressure switch (trinary)*
5. *Expansion valve*
6. *Needle valve for discharing/charging R134a on low pressure pipe*
7. *Needle valve for discharging/charging R134a on high pressure pipe*
8. *Drier filter*
9. *Evaporator*
10. *Minimum pressure switch*

DESCRIPTION

The climate control system for models with T. Spark 16V engine is substantially the same as the one installed on the model with turbodiesel engine.
The main differences of this system are:
• the adoption of a minimum pressure switch.
• the adoption of a compressor with variable displacement which makes it possible to "follow" the load required by the system without engagement/disengagement of the compressor joint. In fact, the change in the flow rate of the coolant fluid in relation to the pressures involved makes it possible to compensate the change in the number of revolutions of the compressor (connected with engine rpm) to adapt the amount of "cold" produced according to the requirements of the system.
• a different position of the system components in the engine compartment.

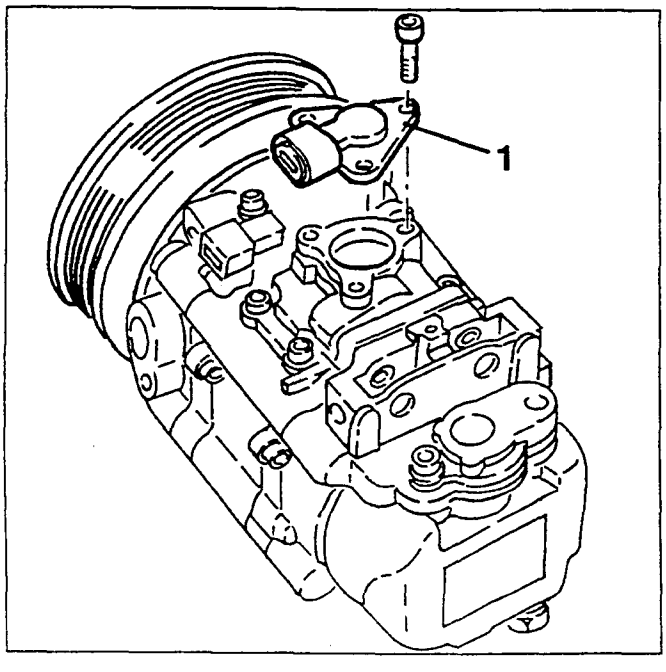
NOTE: BELOW WE ARE GIVING THE DIF FERENCES OF THIS SYSTEM CONCERNING THE DESCRIPTIONS AND PROCEDURES COMPARED WITH THE TURBODIESEL MODEL.

COMPRESSOR CUT-IN AND CUT-OUT STRATEGY

Compressor engagement is operated by the electromagnetic joint controlled by the electronic injection management system of the engine. Indeed the compressor absorbs a fair amount of power to the disadvantage of the overall output of the engine, and in certain instances, this must be avoided:
- at idle speed the engine must adapt its own speed taking account of this increase in absorbed power;
- when the engine is started or when high load is required, the compressor is cut off to leave all the available power for the engine.

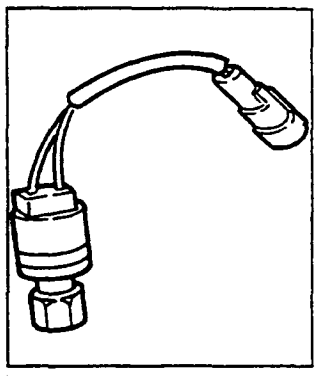
With the M 2.10.3 injection system, the control unit carries out the following strategies:
- it adapts the engine idle speed each time the compressor is engaged; if the speed falls below 700 rpm the compressor is disengaged;
- in the event of the need for high power (high speed, over 6000 rpm, full load, maximum throttle opening), it cuts off the compressor momentaneously;
- when the engine is started it prevents the compressor from being engaged until normal operating conditions are reached.

NOTE: You are reminded that the NIPPONDENSO TV14SC compressor with which this version is fitted, automatically cuts off the compressor through the safety thermal contact (1) if the temperature of the coolant fluid inside the compressor exceeds 160 °C.



DESCRIPTION OF THE MAIN COMPONENTS OF THE AIR CONDITIONING SYSTEM

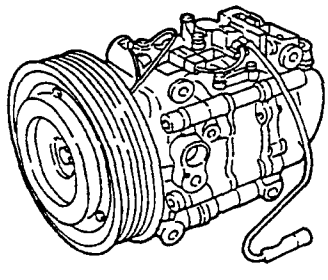
MINIMUM PRESSURE SWITCH



The purpose of the minimum pressure switch is to de-energise the electromagnetic joint of the compressor when the pressure (in the drier filter) reaches appr. 1.8 bar, in order to keep the cold required, but prevent the evaporator from freezing.
The minimum pressure switch also protects the compressor by disengaging the electromagnetic joint, from its pulley, when the pressure of the coolant fluid falls to very low levels owing to a leak.

COMPRESSOR

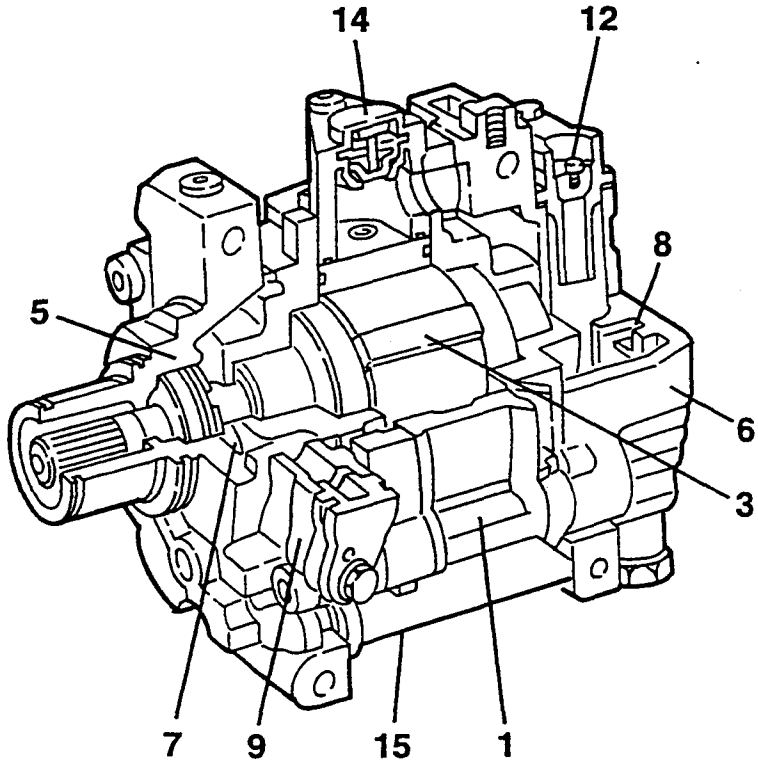
This is a NIPPONDENSO TV14SC with variable displacement: this parameter is automatically changed by the compressor itself according to the load (difference in pressure upstream and downstrem of it) : a special valve opens a by- pass which cuts off part of the fluid from the compression stage:
the displacement can be reduced to 17% of the maximum level.
Adjustment takes place on the intake pressure:
- **a low intake pressure** makes the system **reduce the displacement.** This takes place for example when the refrigerating cycle is working in the best conditions: high engine rpm (thus also of the compressor), high heat exchange at the condenser, etc; (without a compressor with this variable configuration the compressor would be engaged and disengaged continuously);
- on the other hand, **a high intake pressure increase the displacement** to its maximum level.
This takes place for example with low engine speeds and for high requirement for "cold".

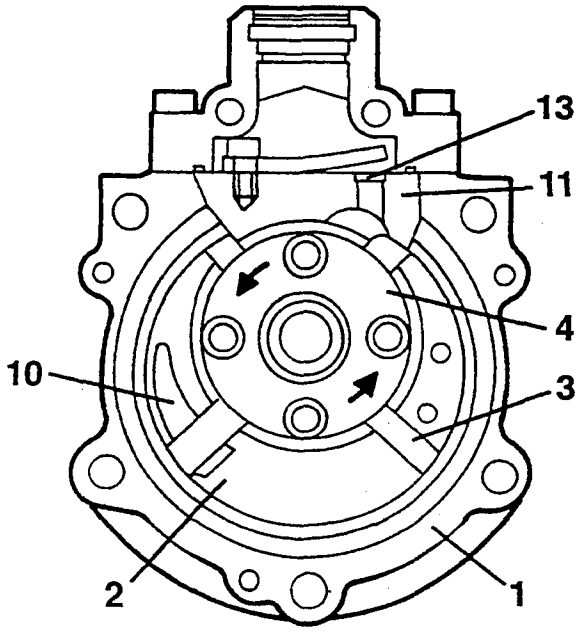


Cmposition and operation

It comprises a body (1) within which a chamber (2) has been made.
Four blades (3) turn in the chamber pulled by a hub (4) the axis of rotation of which does not coincide with the theoretical axis of the chamber.
Due to the particular geometry of the chamber, as the blades turn, they always stay in contact with the inner surface of the chamber: this way the volume in the compartments between one blade and the other changes during rotation.
Two covers are fastened to the body (1), a front one (5) and a rear one (6) containing respectively an intake or low pressure chamber (7) and a high pressure chamber (8). The gas, taken in by the union (9) on the cover (5), passes through the low pressure chamber (7) and the slit (10) machined on the body (1).
The gas is then compressed and sent out through the duct (11) in the high pressure chamber (8) and admitted to the system through the union (12).
The reed valve (13) prevents the high pressure gas from returning into the compressor.
On the upper part of the body there is a thermal contact (14) connected in series to the electromagnetic joint. When the temperature reaches dangerous levels (over 160 °C), the thermal contact (14) disengages the compressor: it engages it again if the temperature falls below 140 °C.
This prevents the compressor from operating in dangerous situations such as the lack of refrigerant fluid or oil.
The pressure regulator (15) in the lower section of the compressor adjusts the flow rate of the fluid in the compressor as described below.

1. Body
2. Chamber
3. Blades
4. Hub
5. Front cover
6. Rear cover
7. Intake or low pressure chamber
8. High pressure chamber
9. Union





10. Slit
11. Duct
12. Union
13. Reed valve
14. Thermal contact
15. Pressure regulator

Displacement control

Displacement control is obtained by a pneumatic device incorporated in the compressor, which by-passes part of the gas in the compression stage to the inlet, i.e. into the low pressure chamber.
When this system is activated it reduces the displacement in the compressor gradually and continuously to appr. 17% of the total.
The device comprises a piston (A) which can run in the cylinder (C) countered by the spring (B).
When the piston is positioned as in Fig A, it cuts off the holes (D) which put compartment (E), in which the gas starts being compressed, into communication with the low chamber (F).
Viceversa, when piston (A) is in the position of Fig. B, holes (D) put the two chambers into communication.
The piston is operated by a small amount of pressurised gas, withdrawn by the duct (J) which communicates with the calibrated hole (G).

The pressure regulator (H) is adjusted by the difference in pressure between the intake - chamber (F) - and the delivery: with a high intake pressure, the valve (I) is closed, and the pressure of the gas acts on the piston (A) taking it to the position of Fig.A.
Holes (D) are cut off and by-passing does not take place, and in chamber (E) compression of the gas begins as described later.
When the intake pressure falls, the regulator (H) opens the valve (I) allowing the pressurised gas in the duct (J) and cylinder (C), to discharge into the low pressure chamber (F).
Piston (A) is pushed by the spring (B) allowing the by-pass holes (D) to open.
This way, part of the gas in the chamber (E) - start of compression - can flow into the low pressure chamber (F), until the blade (K), has passed the holes (D); this reduces the amount of gas in the chamber (E) thereby reducing the displacement of the compressor.

Figure A

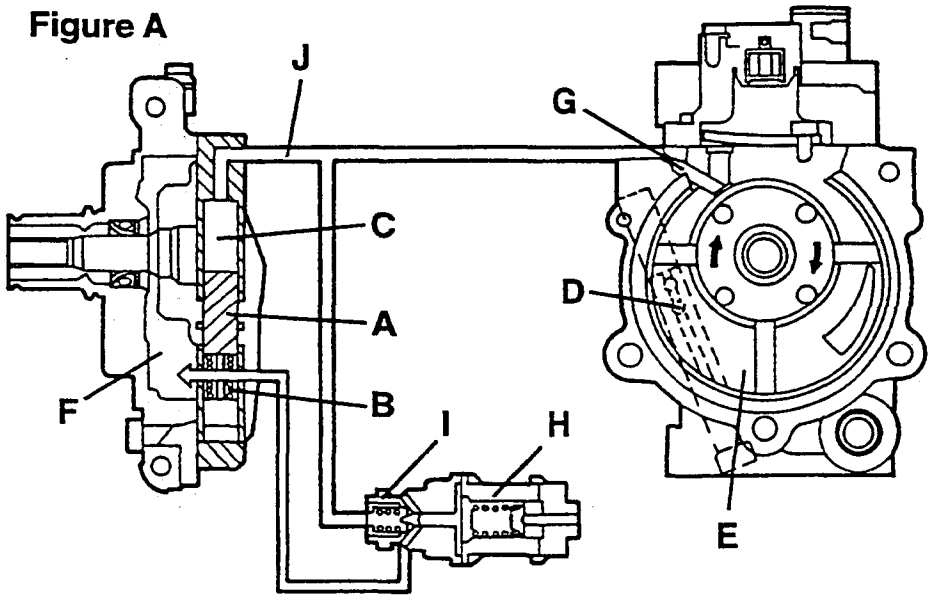
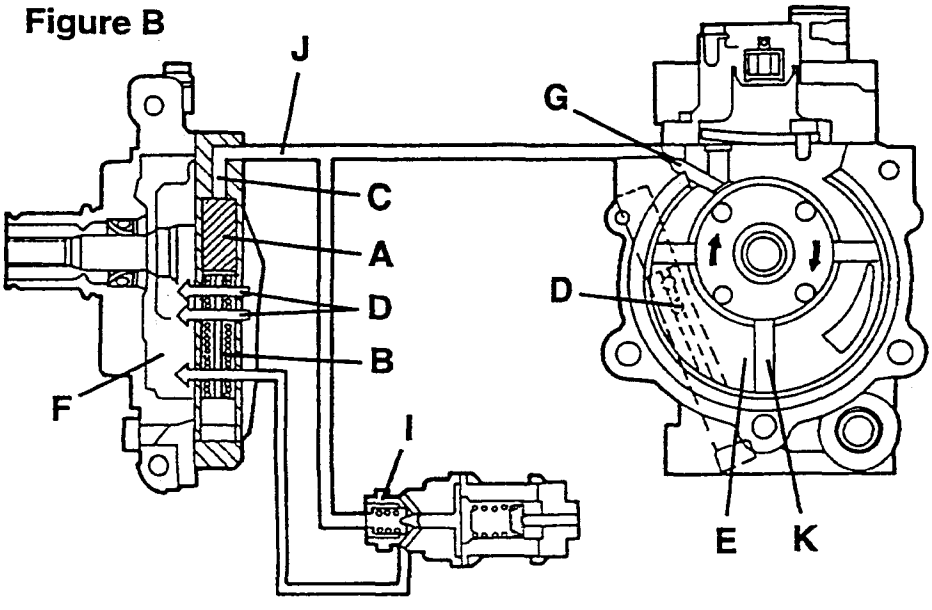


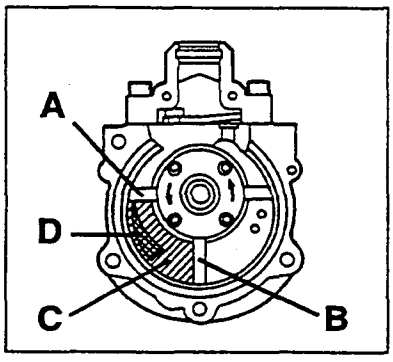
Figure B



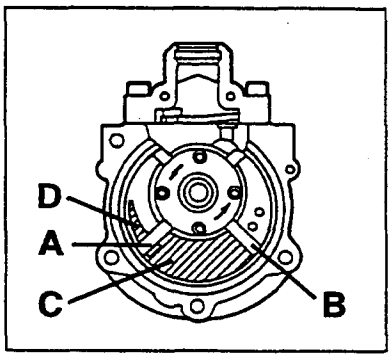
A. Piston
B. Spring
C. Cylinder
D. Holes
E. Compartment
F. Low pressure chamber
G. Calibrated hole
H. Pressure regulator
I. Valve
J. Duct
K. Blade

Normal operation
(100% displacement - by-pass closed)

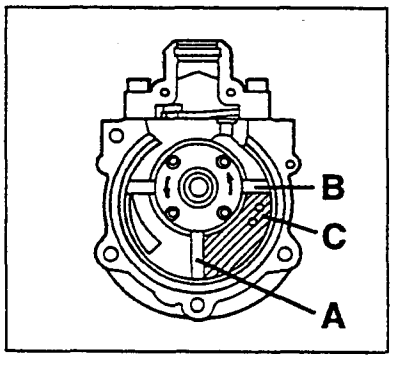
Intake
The gas is drawn in by the intake port (D) due to the gradual expansion of the compartment (C), delineated by blades (A) and (B). This is the start of the compression stage.



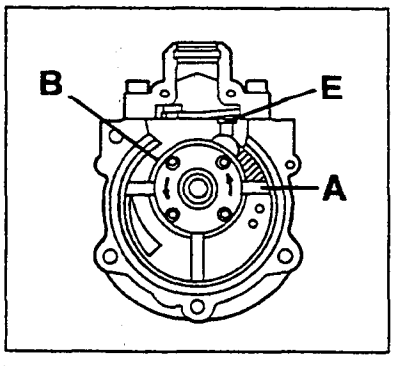
The new position of the blades (A) and (B) cause compartment (C) to be at its maximum volume. Blade (A) cuts off communication between compartment (C) and port (D) completing the intake stage.



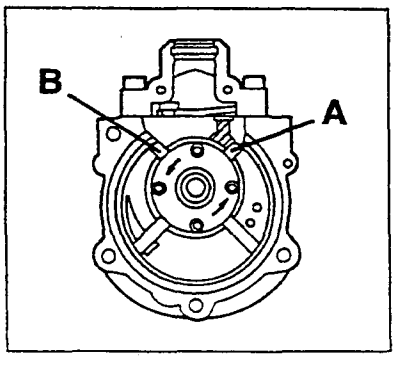
Compression
Compartment (C) reduces its volume thereby increasing the pressure of the gas: this is the start of the compression stage.



Exhaust
The pressure of the gas further increases until the reed (E) opens: in this precise moment the compression stage ends and exhaust begins.

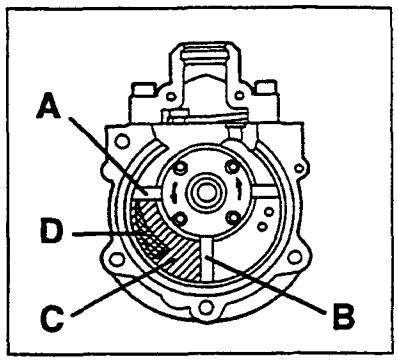


When blades (A) and (B) take the position shown in the diagram the exhaust stage ends.

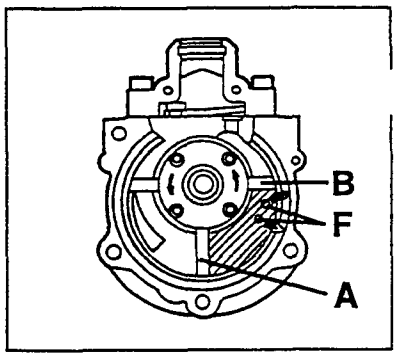


Operation with reduction of the displacement
(Down to 17% of the displacement - by-pass open)

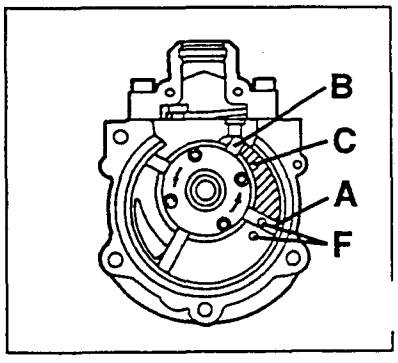
Intake
The gas is drawn in by the intake port (D) due to the gradual expansion of compartment (C), delineated by blades (A) and (B): this is the start of the compression stage.



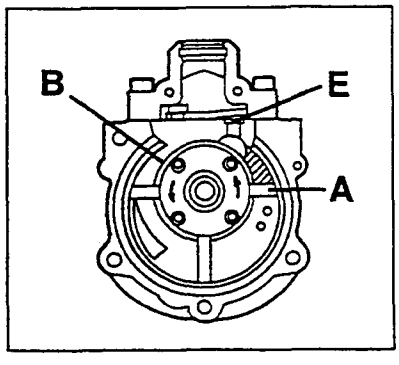
By - pass
If the holes (F) are open part of the gas flows out: the compression stage does not start yet.



Compression
Once past the holes (F), compartment (C) reduces in volume thereby increasing the pressure of the remaining gas (down to a minimum of 17% of the total): the compression stage starts.

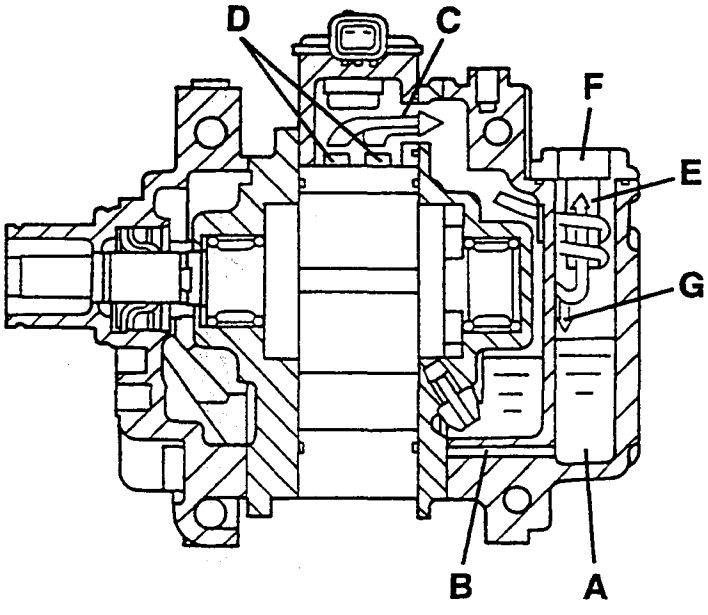


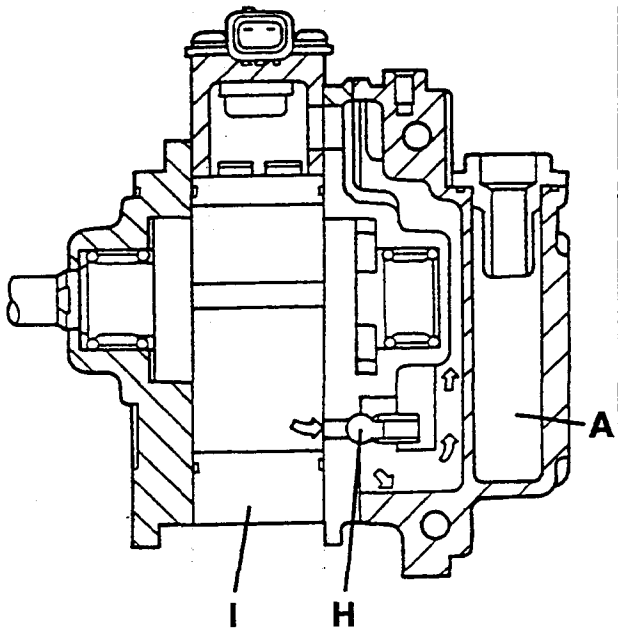
Exhaust
The pressure of the gas further increases until it opens the reed valve (E): in this precise moment the compression stage ends and exhaust begins.



Lubrication

The lubricating oil is contained in the high pressure chamber (A).
When the compressor is operating the high pressure in the chamber pushes the oil through the calibrated hole (B) into the inner moving components.
The oil mixed with gas (C) is sent out through the reed valves (D) in the high pressure chamber.
A separator device (E) installed in the gas outlet union separates it from the oil(G) which falls by gravity into the bottom of the chamber (A) while the gas flows out of the union (F).
This device makes it possible to minimise the quantity of oil admitted into the system piping thereby increasing the thermal yield.
The compressor is also fitted with two safety valves (H) which relieve any overpressure in the compression chamber (I).





A. High pressure chamber
B. Calibrated hole
C. Gas
D. Reed valves
E. Separator device
F. Union
G. Falling oil
H. Safety valves
I. Compression chamber

INSTRUCTIONS FOR REMOVING/REFITTING

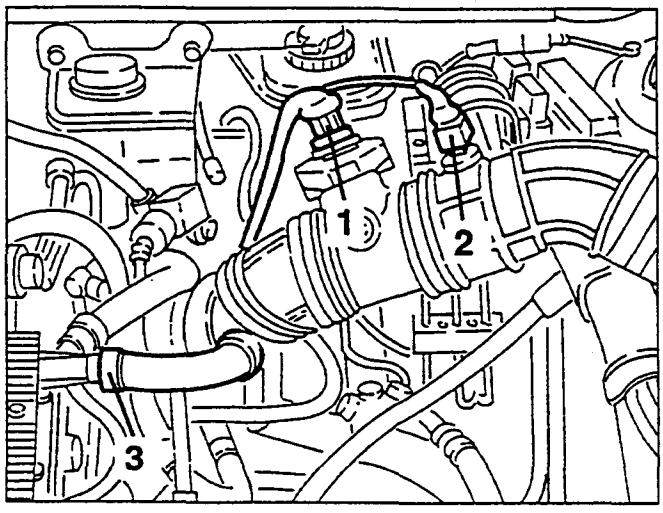
During servicing operations, when the components of the air conditioner system are disconnected, plug the unions suitably to prevent damp and dirt from getting into the system.

When refitting the pipe unions always replace the O-Rings on them.
Lubricate the threads of the pipe unions with the specified antifreeze oil and tighten the unions to the specified torque.
In the event of any losses of oil from the system during servicing operations, restore the amount of oil in the system calculating the losses.

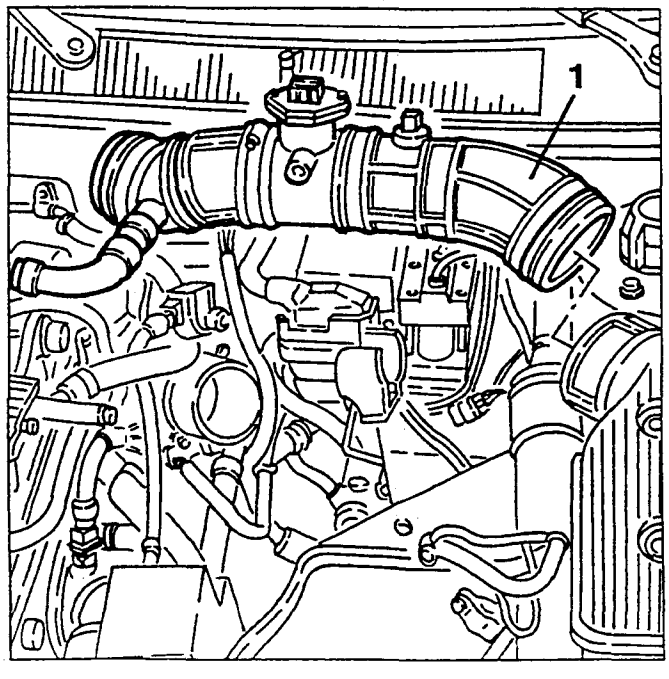
DUCTING UNIT AND HEATER - DISTRIBUTOR (TWO BOWDENS)

REMOVING/REFITTING

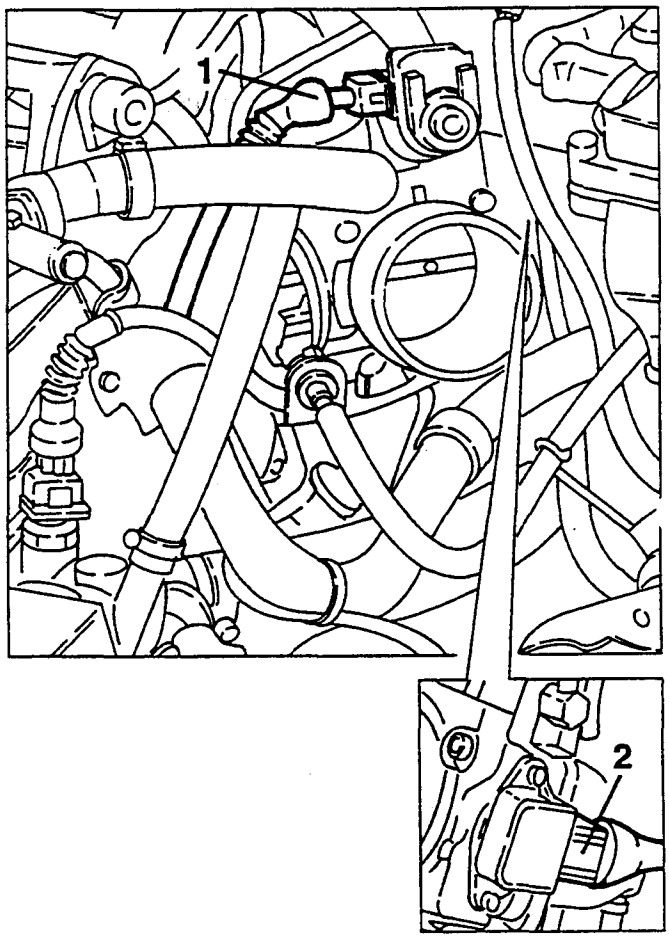
- Drain the fluid from the climate control system (see specific paragraph).
- Remove the battery (see specific paragraph).
1. Disconnect the electrical connection from the air-flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor.
3. Slacken the fastening clamp and disconnect the oil vapour recirculation pipe from the cylinder head cover.



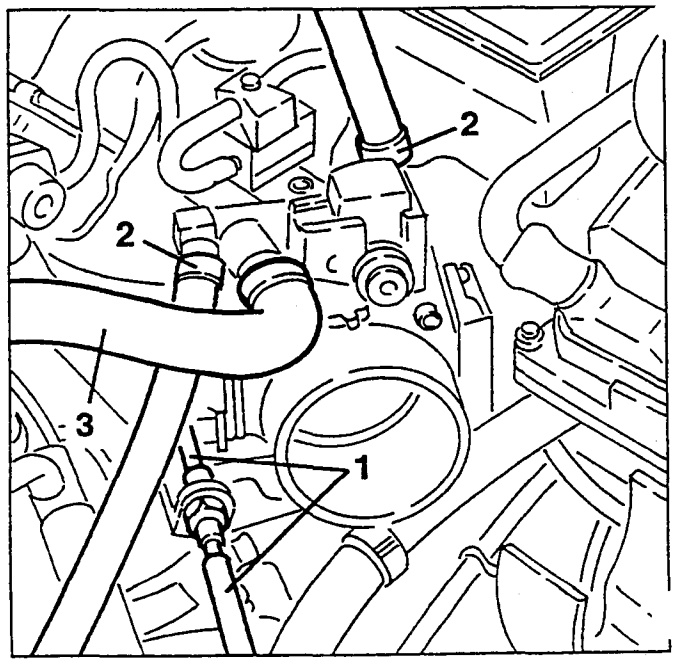
1. Slacken the fastening clamps and disconnect the corrugated sleeve complete.



1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection from the throttle potentiometer.

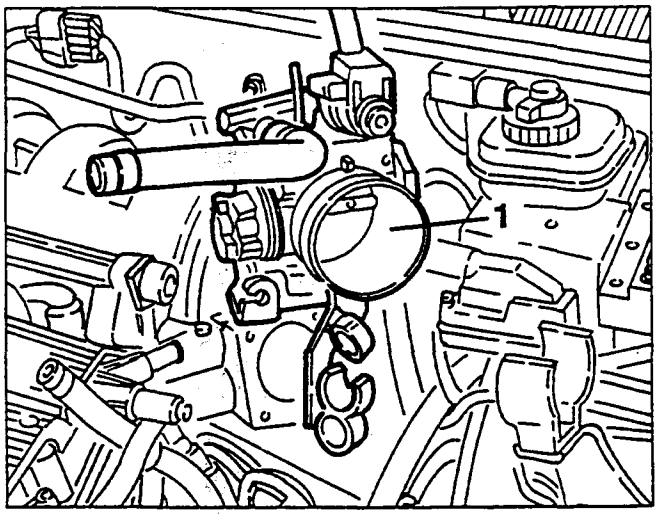


1. Disconnect the accelerator cable from the throttle body.
2. Disconnect the throttle body coolant inlet and outlet pipes.
3. Disconnect the idle speed oil vapour recirculation pipe.

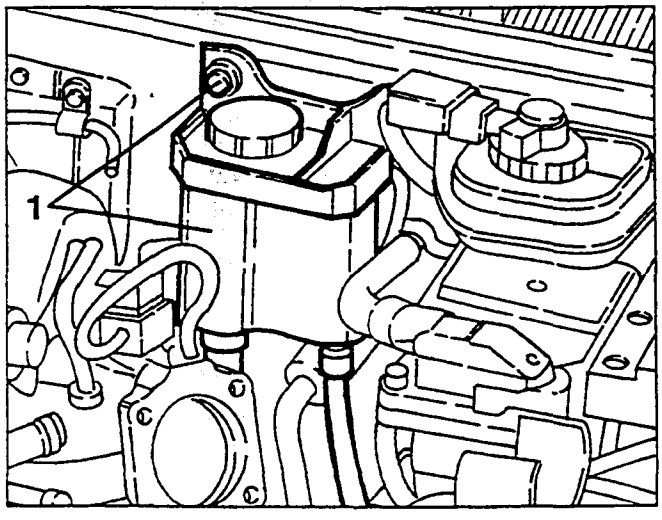


- Release the pipes from the fastenings on the bracket under the throttle body.

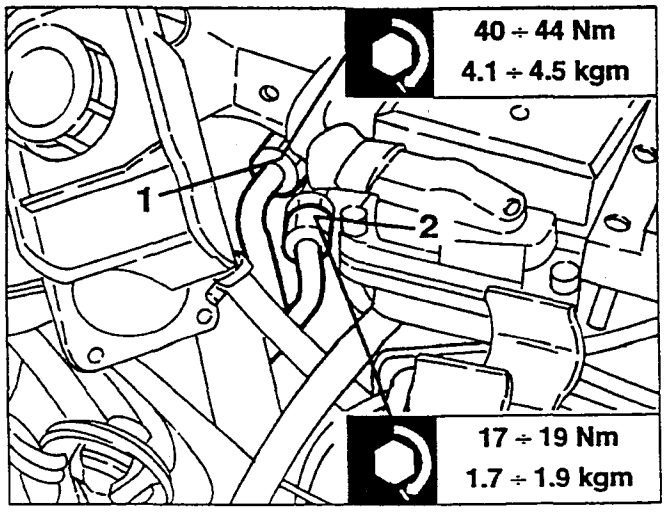
1. Slacken the four fastening screws and remove the throttle body complete.
- Remove the seal.



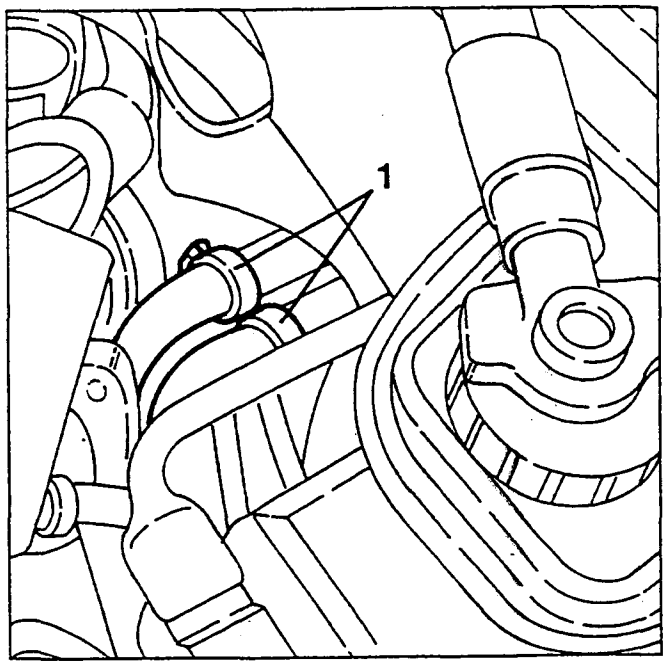
1. Using a suitable syringe partially empty the power steering oil reservoir, then slacken the screws fastening the power steering oil reservoir and move it aside without disconnecting the pipes.



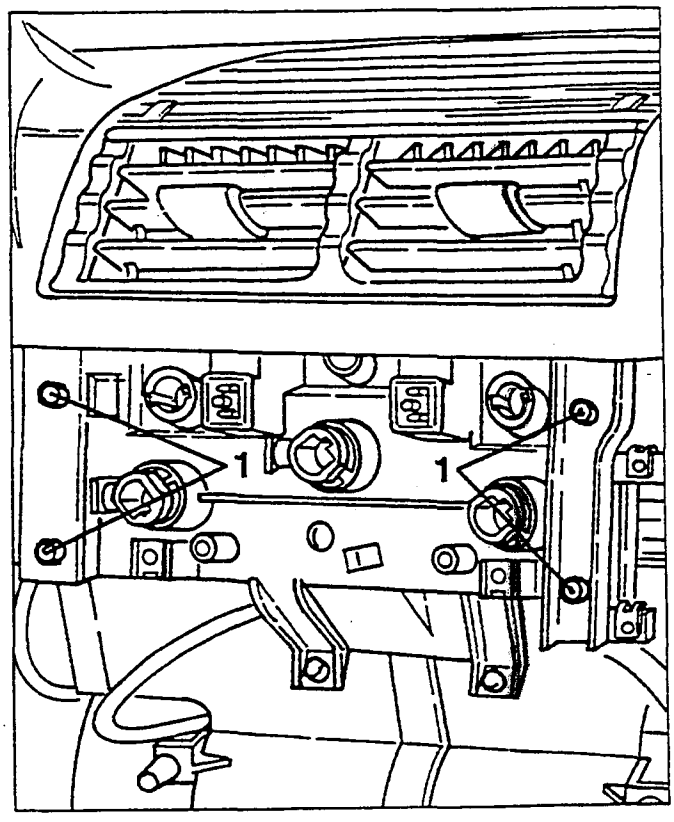
1. Using wrenches no. 1.822.112.000 and no. 1.822.115.000, disconnect the evaporator fluid outlet pipe.
2. Using wrenches no. 1.822.111.000 and no. 1.822.113.000,disconnect the fluid inlet pipe from the evaporator.



1. Disconnect the coolant fluid inlet and outlet pipes from the climate control system recovering it in a suitable recipient.

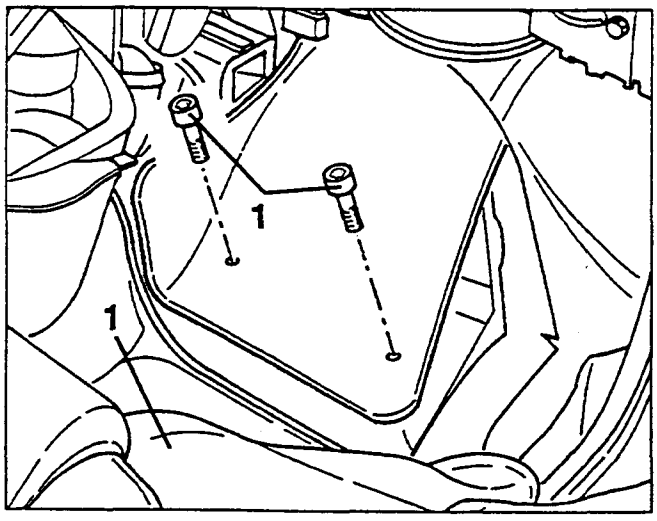


- Remove the lower part of the dashboard and the centre console (see GROUP 70).
1. Slacken the four fastening screws and lower the climate control unit controls.

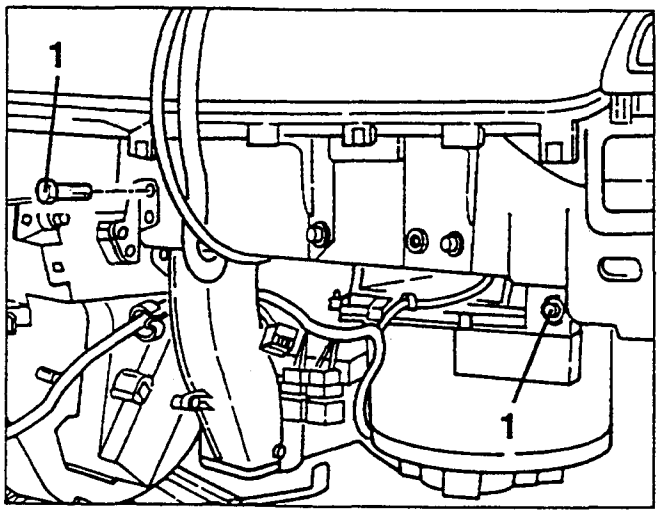


- Remove the two sections of air delivery duct to the rear seat (see GROUP 70).

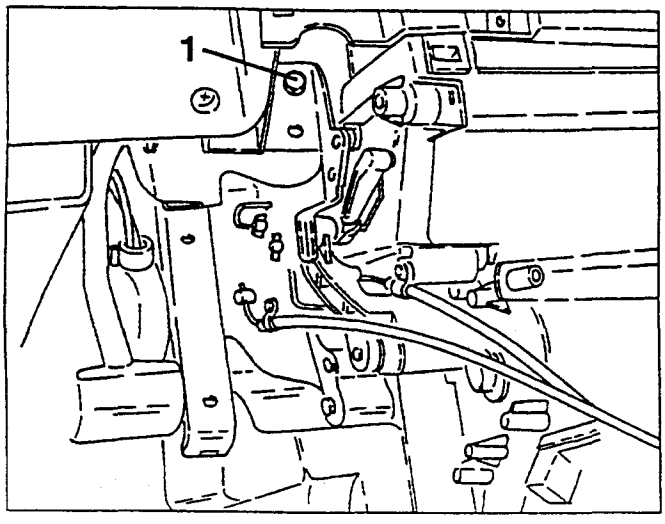
- Disconnect the electrical connections of the climate control unit.
1. Move aside the floor mat, slacken the two fastening screws and remove the control unit cover.



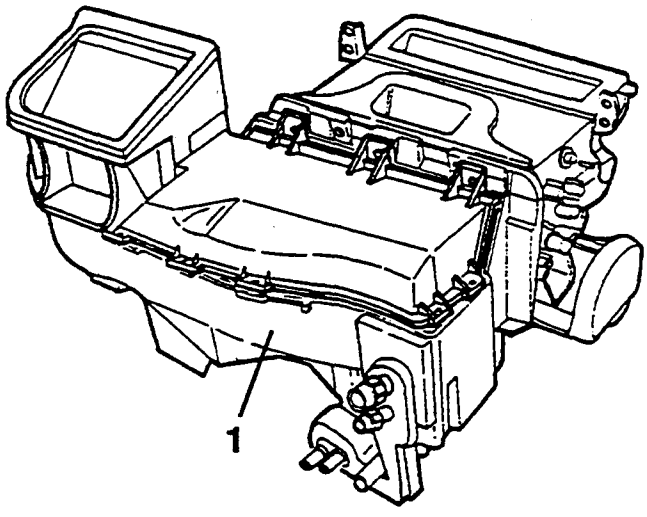
1. Slacken the three right-hand screws fastening the climate control unit.



1. Slacken the screw fastening the left-hand side of the climate control unit.

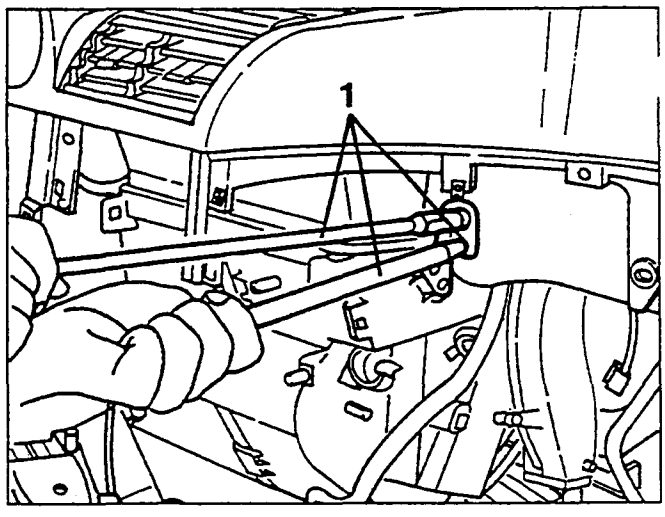


1. Remove the climate control unit.



Re-assemble the climate control unit reversing the sequence followed for removal and observing the instructions below.

- Coat the mouth of the heater, water drain and coolant fluid pipes with vaseline.
- Assemble the climate control unit taking care to correctly insert the above-mentioned pipes in their holes.
1. Using a dowel positioned as illustrated, centre the position of the unit before fastening it.



DIS-ASSEMBLY

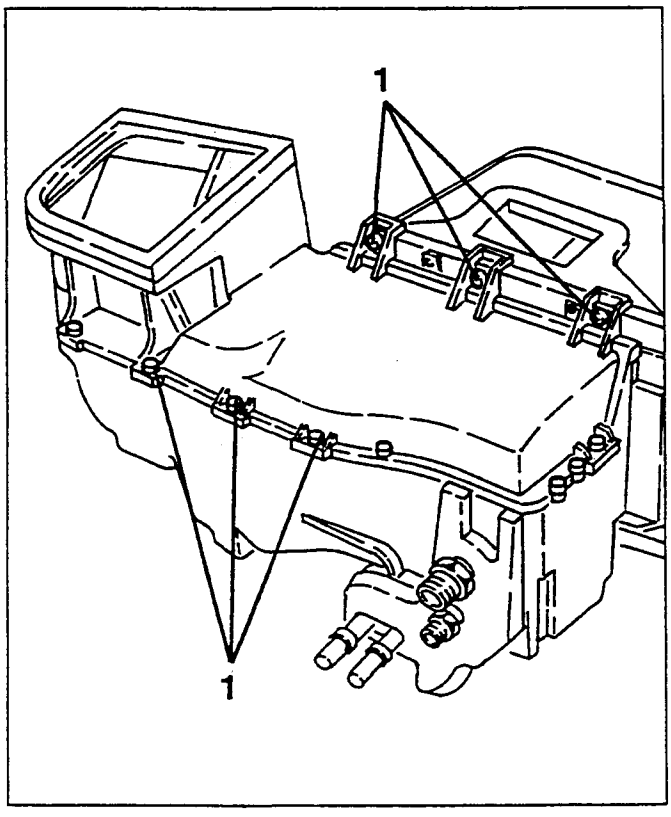
- Proceed as described for the Turbodiesel version.

EVAPORATOR

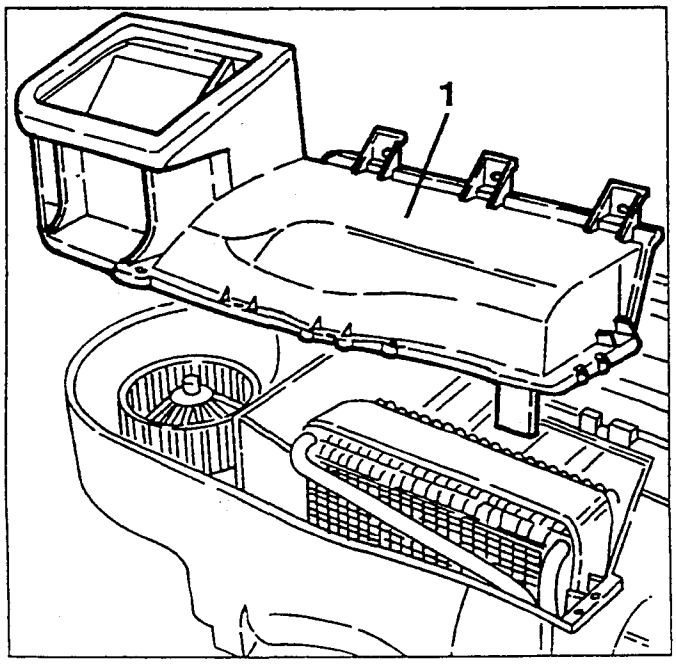
REMOVING/REFITTING

Remove the "Ducting unit and heater - distributor" as described in the corresponding procedure.

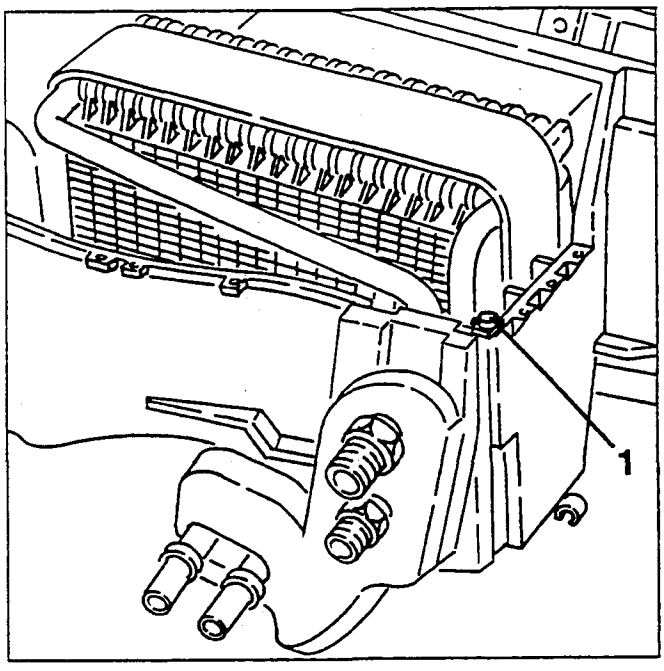
1. Slacken the screws fastening the upper half box to the ducting - distributor unit.



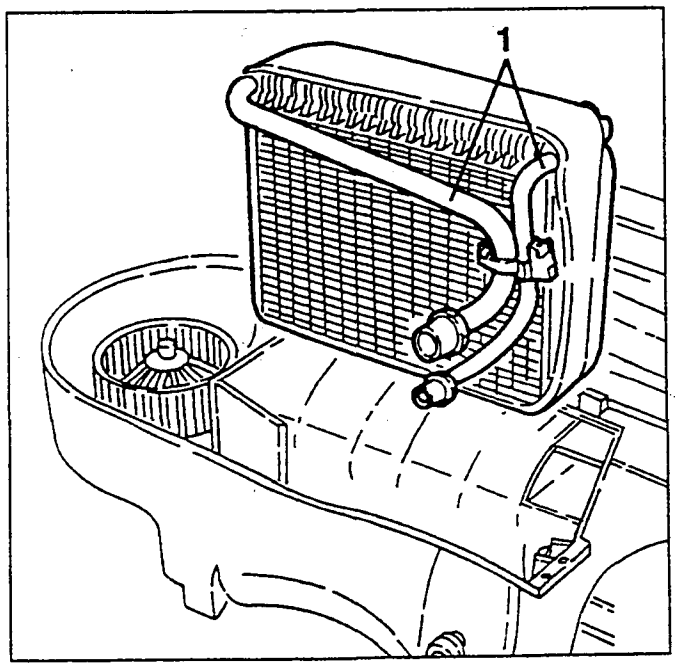
1. Remove the upper half box releasing it from the fastening clamps.



1. Slacken the screw fastening the evaporator to the ducting - distributor unit.



1. Remove the evaporator taking care to withdraw the pipes from the seals.

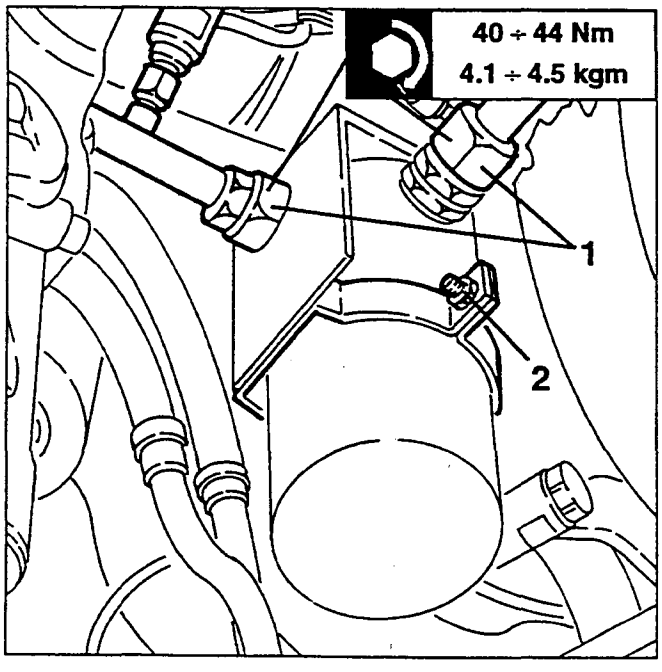


DRIER FILTER

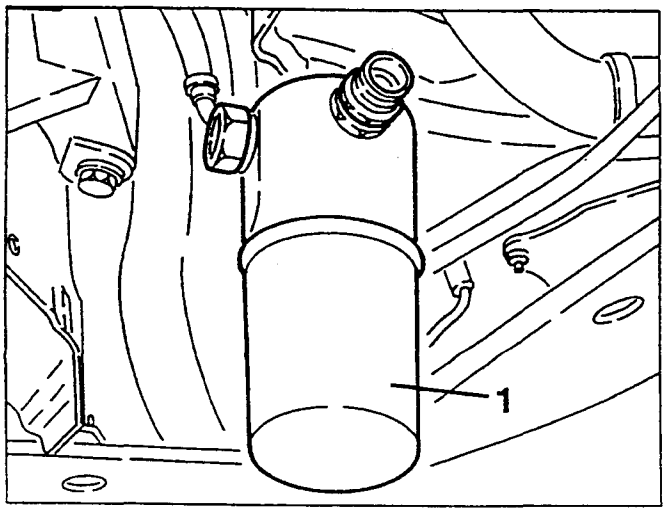
REMOVING/REFITTING

NOTE: In this system the spare drier filter is supplied with a certain amount of lubricating oil.
The filter should be changed only when the expansion valve is clogged or if the evaporator is faulty due to internal corrosion, or when the accumulator is leaking.
It is not necessary to replace the filter if it is distorted for some reason (eg. crash) unless it leaks.

- Set the car on a lift.
- Drain the fluid from the climate control unit (see specific paragraph).
1. Disconect the coolant fluid pipe fittings from the filter.
2. Slacken the drier filter support clamp.



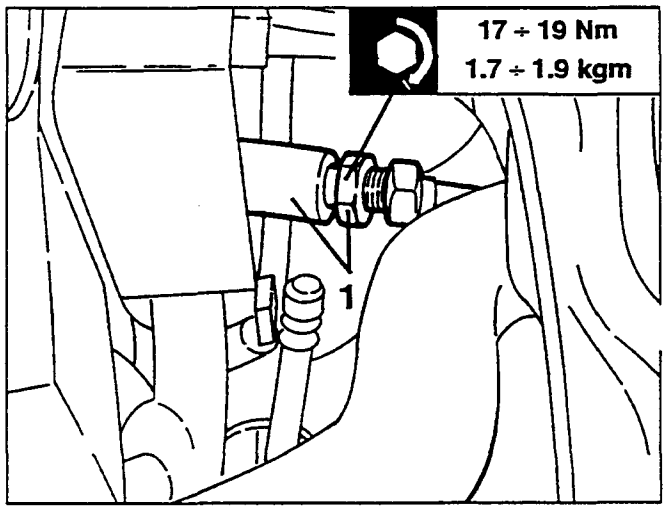
1. Remove the drier filter.



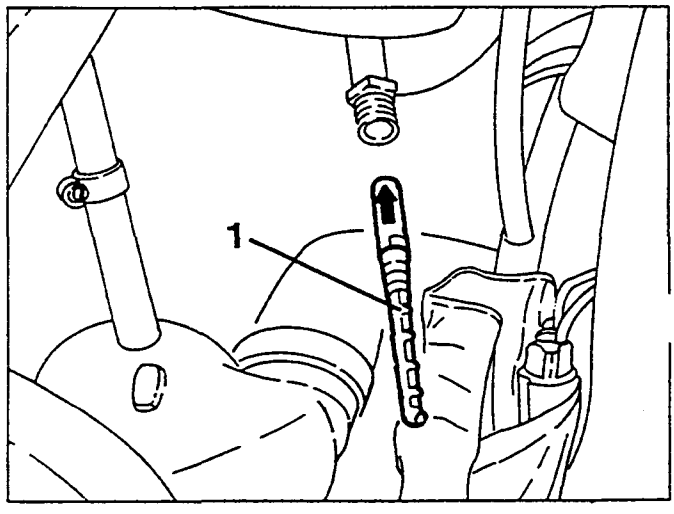
EXPANSION VALVE

REMOVING/REFITTING

- Drain the fluid from the climate control unit (see specific paragraph).
1. Withdraw the insulating cover as far as necessary, then disconnect the intermediate union on the pipe connecting the condenser to the evaporator.



1. Withdraw the valve using pliers taking care not to damage it.



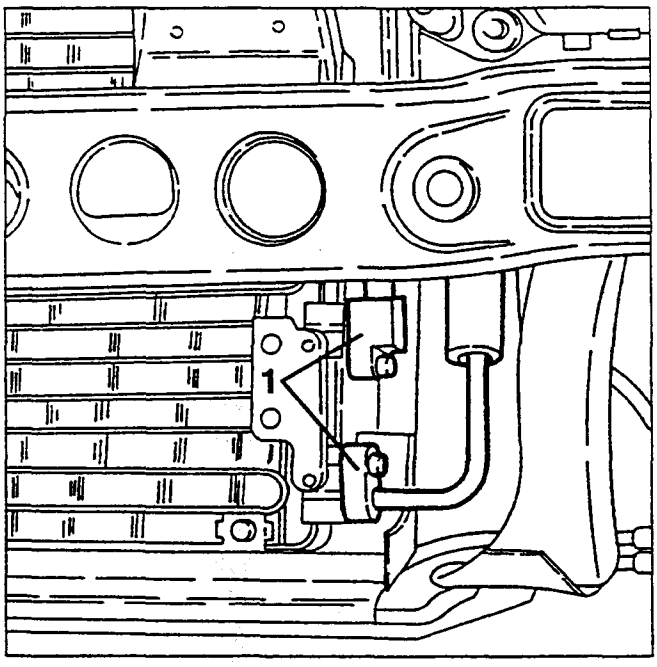
When refitting insert the expansion valve in the pipe with the arrow stamped on it pointing in the direction of the flow of the coolant.

CONDENSER

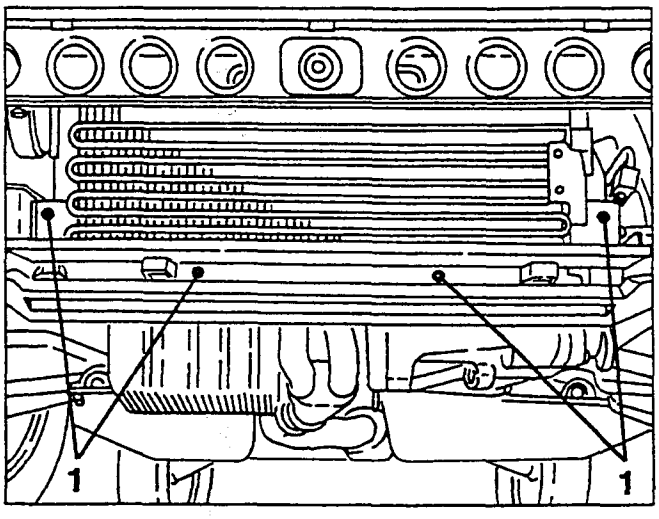
REMOVING/REFITTING

- Set the car on a lift.
- Drain the fluid from the climate control unit (see specific paragraph).
- Remove the front bumper (see specific paragraph).

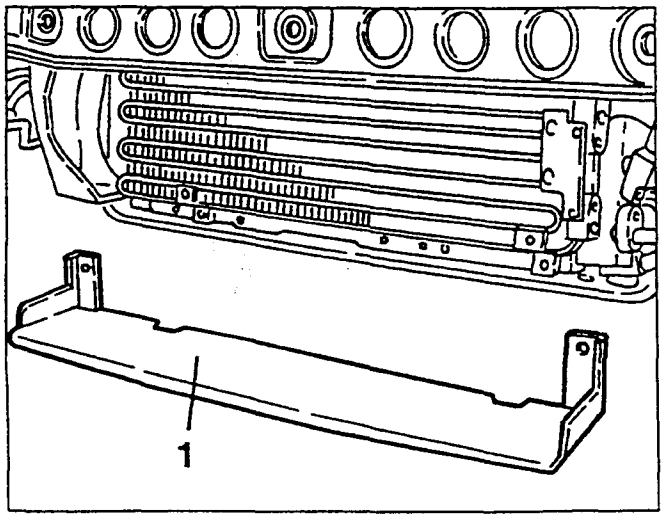
1. Slacken the two fastening screws and disconnect the two coolant inlet and outlet pipes from the condenser.



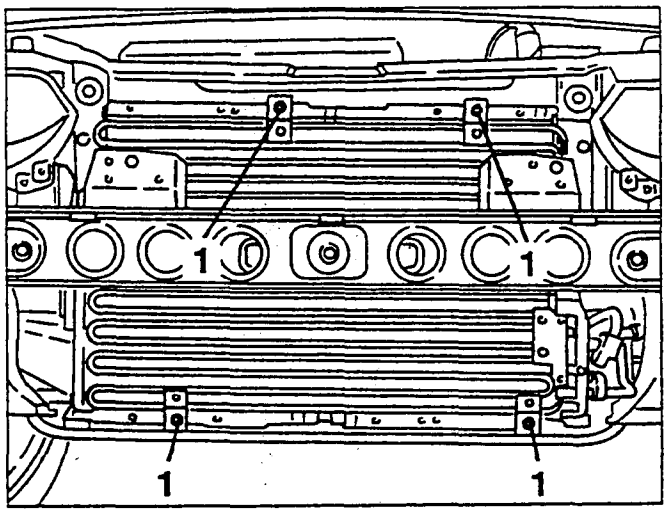
1. Slacken the fours screws fastening the air duct to the engine coolant fluid radiator.



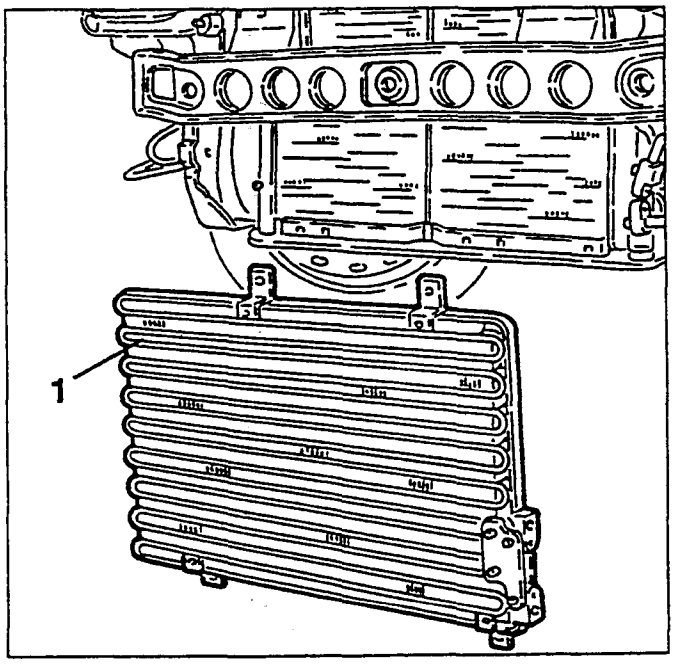
1. Remove the air duct.



1. Slacken the four screws fastening the condenser of the climate control system to the radiator of the engine cooling system.



1. Remove the condenser withdrawing it from below.



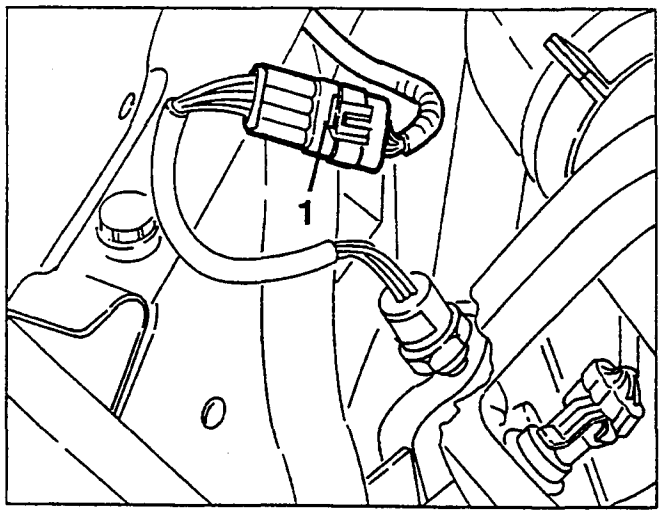
THREE - LEVEL PRESSUR SWITCH (TRINARY)

REMOVING/REFITTING

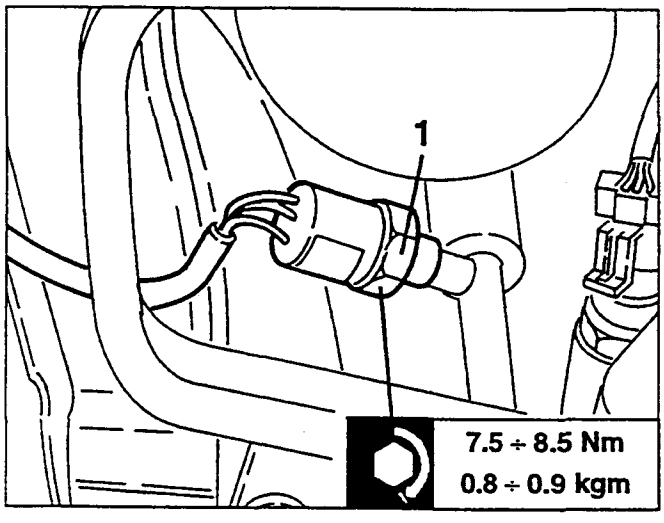
NOTE: Due to a non return valve on the pipe, the pressure switch can be removed without having to drain the coolant fluid.

- Set the car on a lift.
- Disconnect the battery (-) terminal.

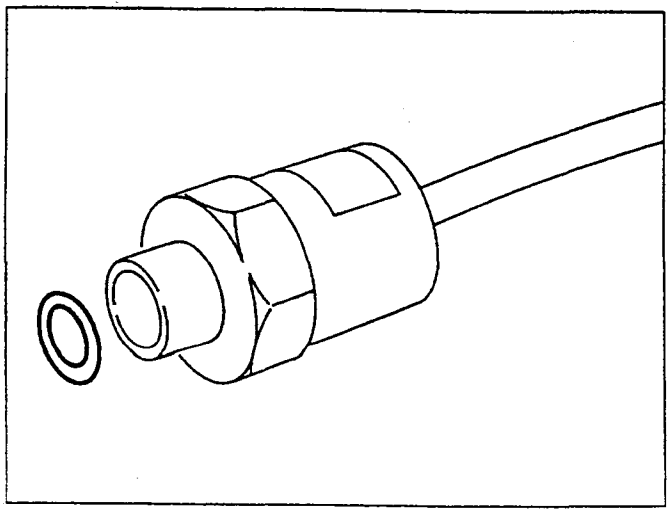
1. Disconnect the electrical connection of the three-level pressure switch.



1. Slacken and remove the three-level pressure switch.



Before refitting the pressure switch make sure of the presence of the seal ring on the pressure switch itself and that it is intact.

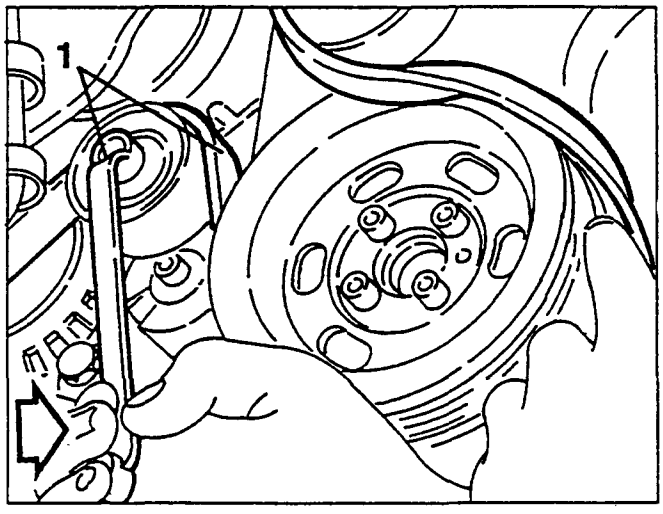


COMPRESSOR

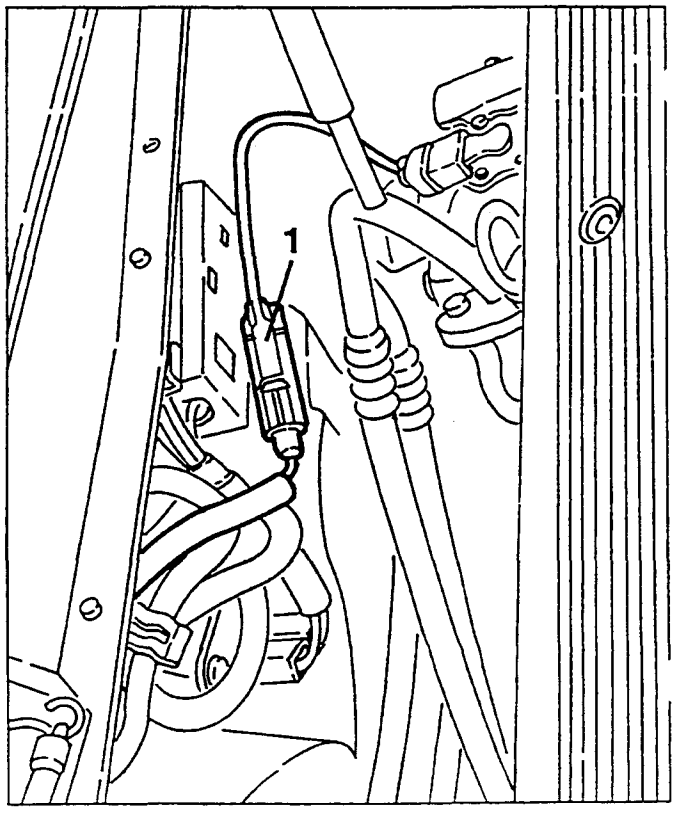
REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the right front wheel and mud flap.

1. Working as illustrated on the guide pulley, slacken the tension of the auxiliary components drive belt and remove it.

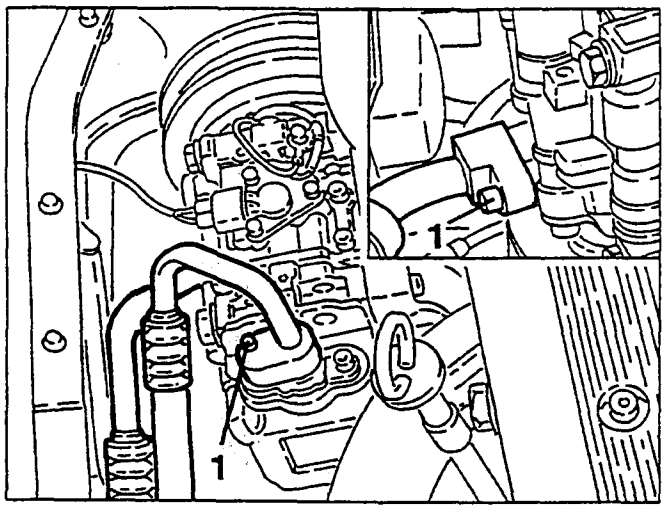


1. Disconnect the electrical connection of the compressor.

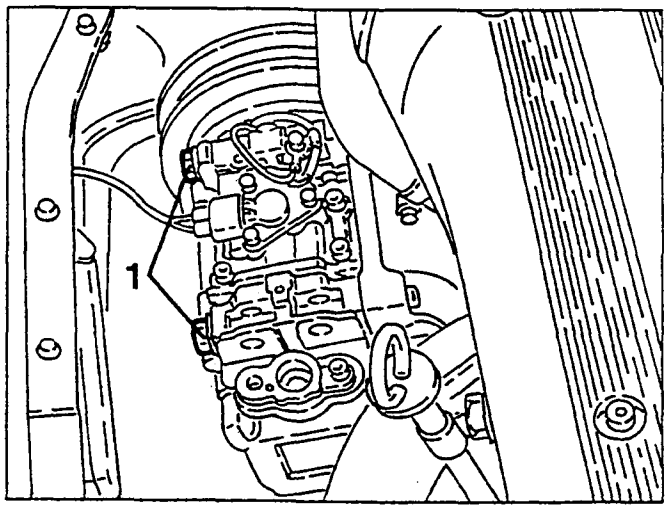


1. Slacken the fastening screws and remove the unions of the compressor coolant fluid inlet and outlet pipes.

NOTE: Suitably plug the compressor inlet and outlet holes to prevent dirt and humidity from getting in.



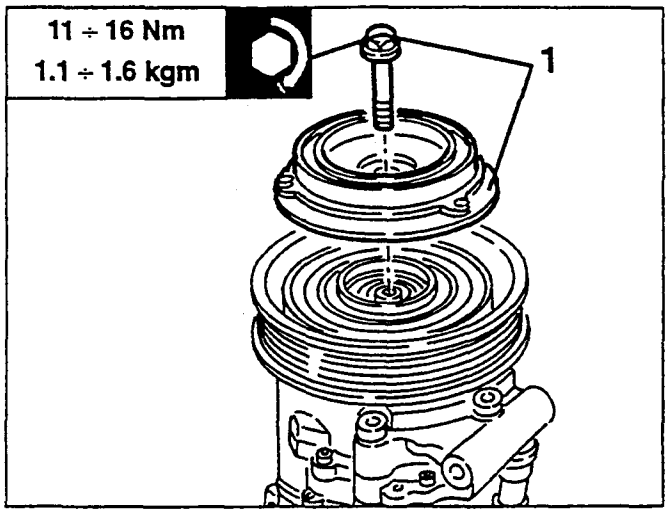
1. Slacken the four screws fastening the support bracket and remove the compressor.



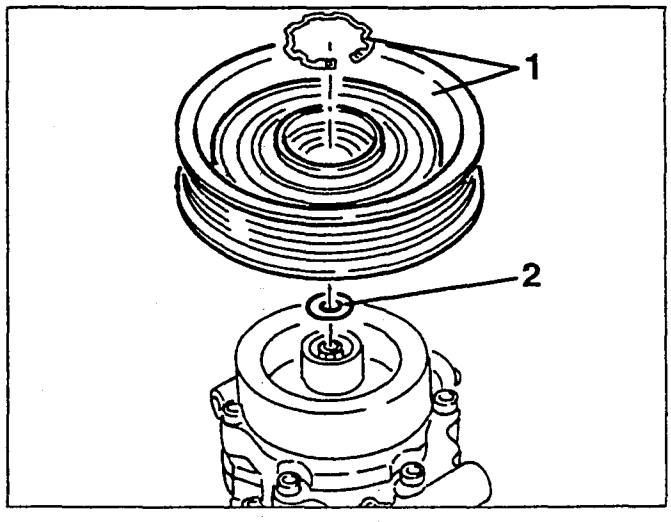
NOTE: The spare compressor is supplied pressurised with nitrogen to prvent the entrance of damp and dirt; during assembly it is therefore necessary to remove the plugs of the inlet and outlet unions slowly and with the compressor positioned absolutely as illustrated below (with the cover facing upwards).

REMOVING THE ELECTROMAGNETIC JOINT

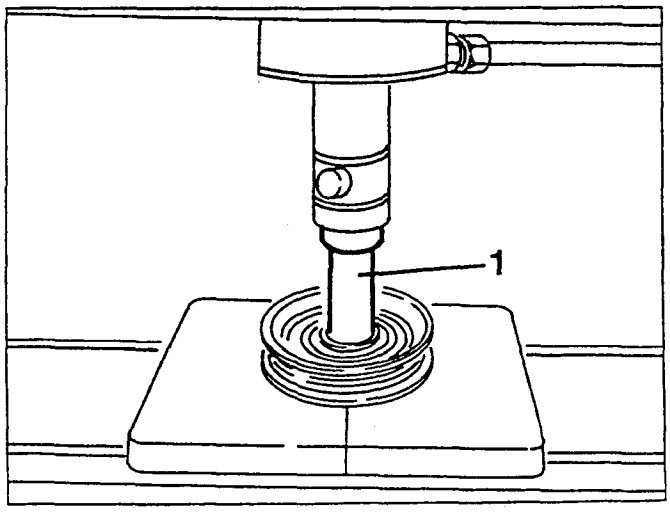
1. Slacken the fastening screw and remove the hub of the electromagnetic joint from the compressor.



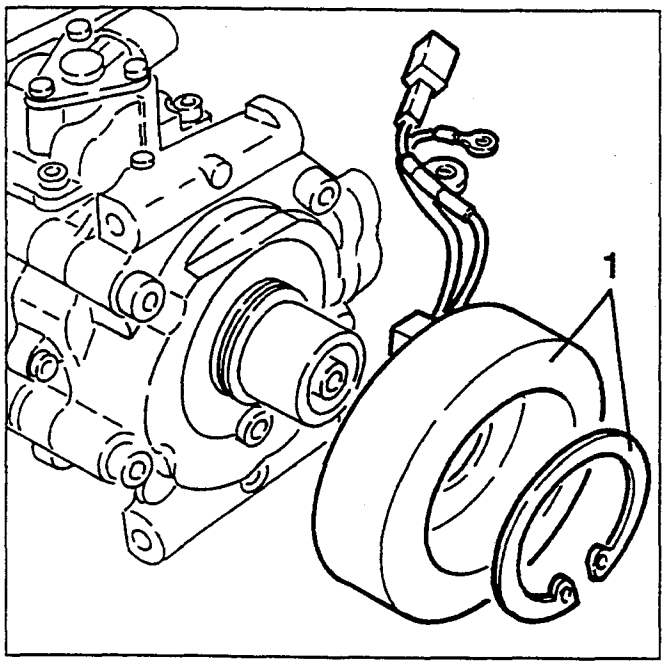
1. Remove the circlip and withdraw the pulley of the electromagnetic joint.
2. Retrieve the thrust ring.



1. Working under a press and using a suitable punch, remove the bearing from the pulley.

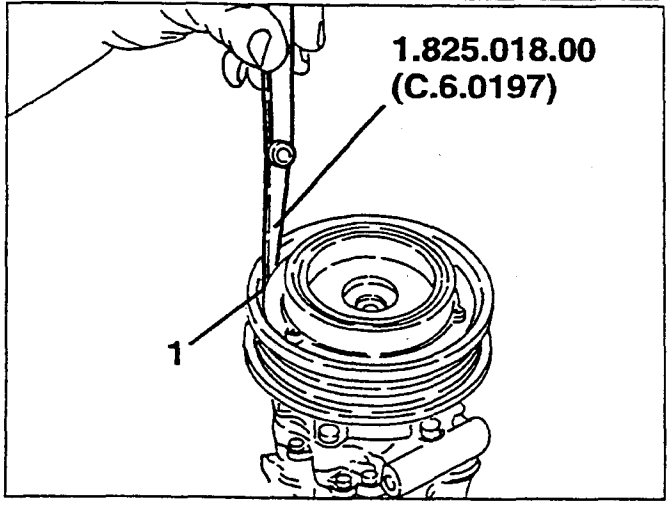


- Disconnect the earth cable and the electrical connection to the safety thermal contact.
1. Remove the circlip and remove the electromagnet complete with electrical cables.



When refitting it is necessary to check that the clearance between the hub and the pulley of the electromagnetic joint is within the specified limit, proceeding as follows.
1. Before assembling the hub, between the pulley and the hub insert the curved thickness gauge no. 1.825.018.000 (C.6.0197) and check that the clearance is within the specified limits.

Clearance between hub and pulley of the electromagnetic joint
0.5 ± 0.15 mm



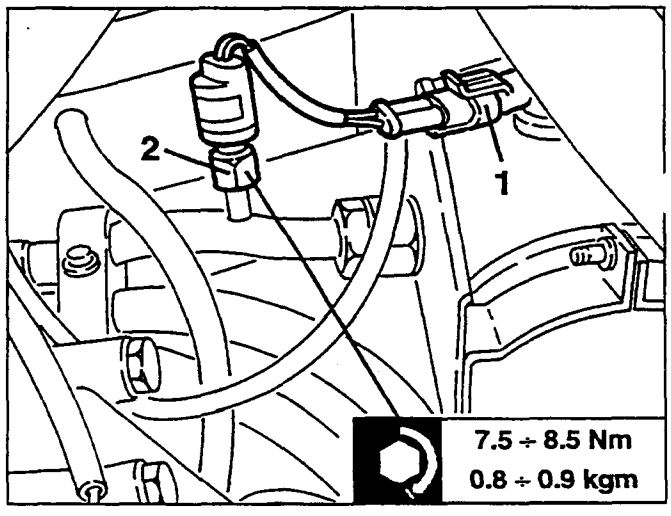
- If the measurement is not within the specified limits add or remove the special thrust rings between the hub and the compressor shaft.
- After adjustment tighten the electromagnetic joint fastening screw to the specified torque.

MINIMUM PRESSURE SWITCH

REMOVING/REFITTING

NOTE: Due to the presence of a non return valve on the pipe the minimum pressure switch can be removed without having to drain the coolant fluid.

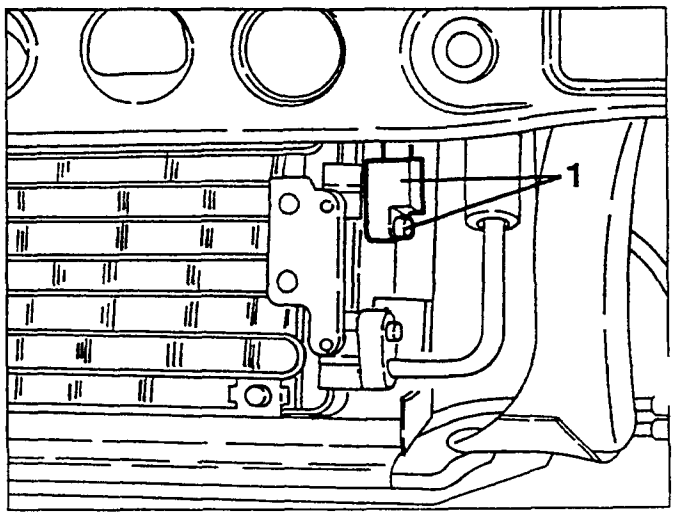
- Set the car on a lift.
- Disconnect the battery (-) terminal.
1. Raise the car, then disconnect the electrical connection of the minimum pressure switch.
2. Slacken and remove the minimum pressure switch.



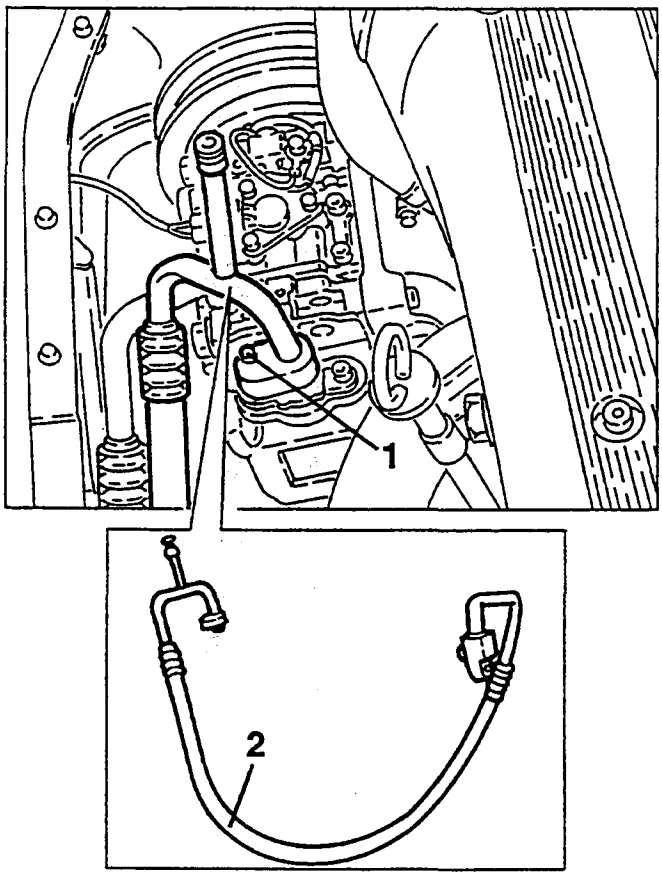
PIPE FROM COMPRESSOR TO CONDENSER

REMOVING/REFITTING

- Set the car on a lift.
- Drain the fluid from the conditioning system (se specific paragraph).
- Remove the il paraurti anteriore (see specific paragraph).
1. Slacken the fastening screw and disconnect from the condenser the fluid delivery pipe leading from the compressor.



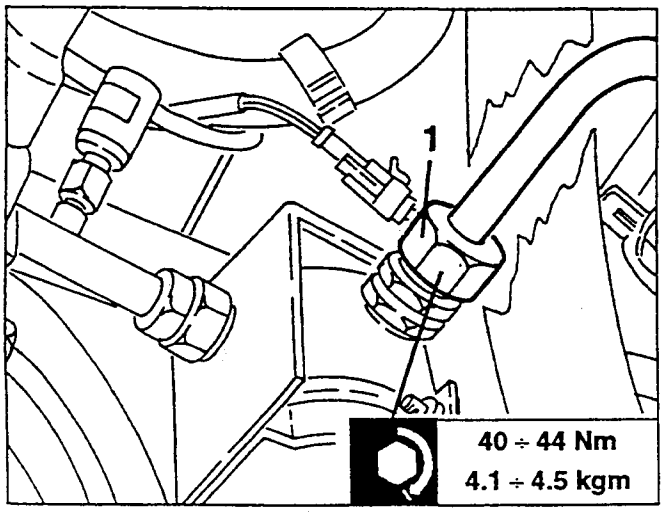
1. Slacken the fastening screw and disconnect the fluid delivery pipe to the condenser from the compressor.
2. Release the clamp fastening the pipe connecting the compressor to the condenser and remove it.



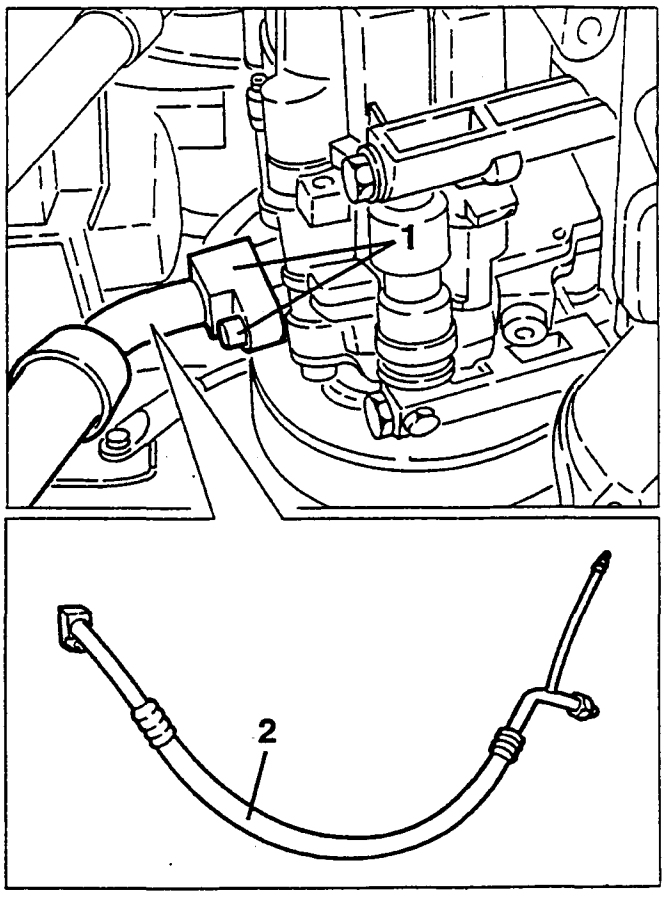
PIPE FROM DRIER FILTER TO COMPRESSOR

REMOVING/REFITTING

- Set the car on a lift.
- Drain the fluid from the climate control unit (see specific paragraph).
1. Disconnect the union of the delivery pipe to the compressor from the frier filter.



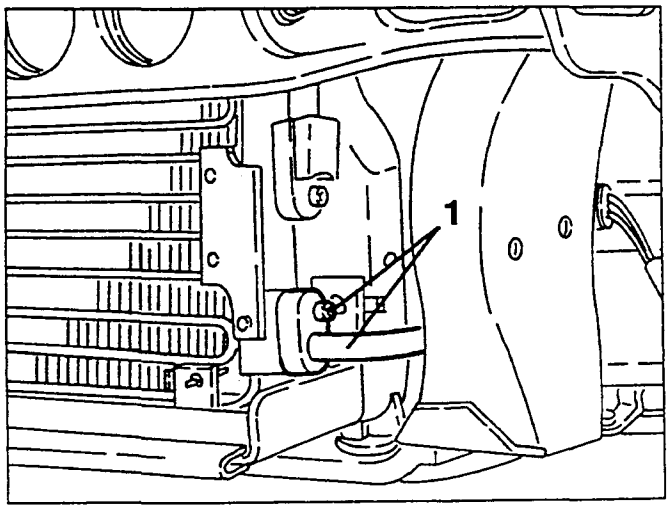
1. Slacken the fastening screw and disconnect the pipe leading from the compressor from the drier filter.
2. Release the clamp fastening the pipe connecting the drier filter to the compressor.



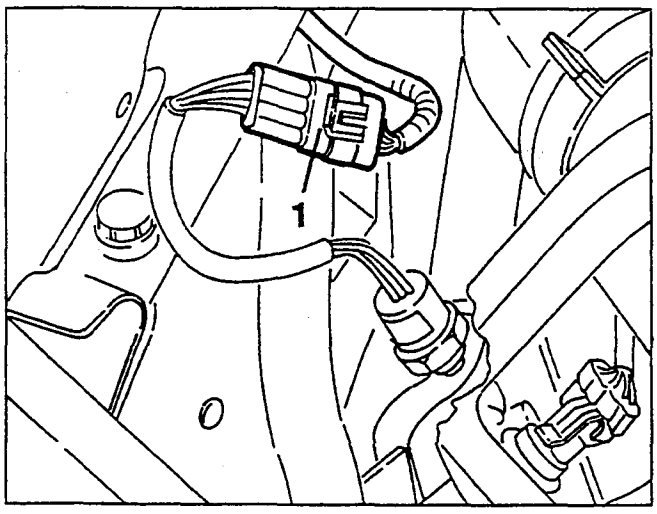
PIPE FROM CONDENSER TO EXPANSION VALVE

REMOVING/REFITTING

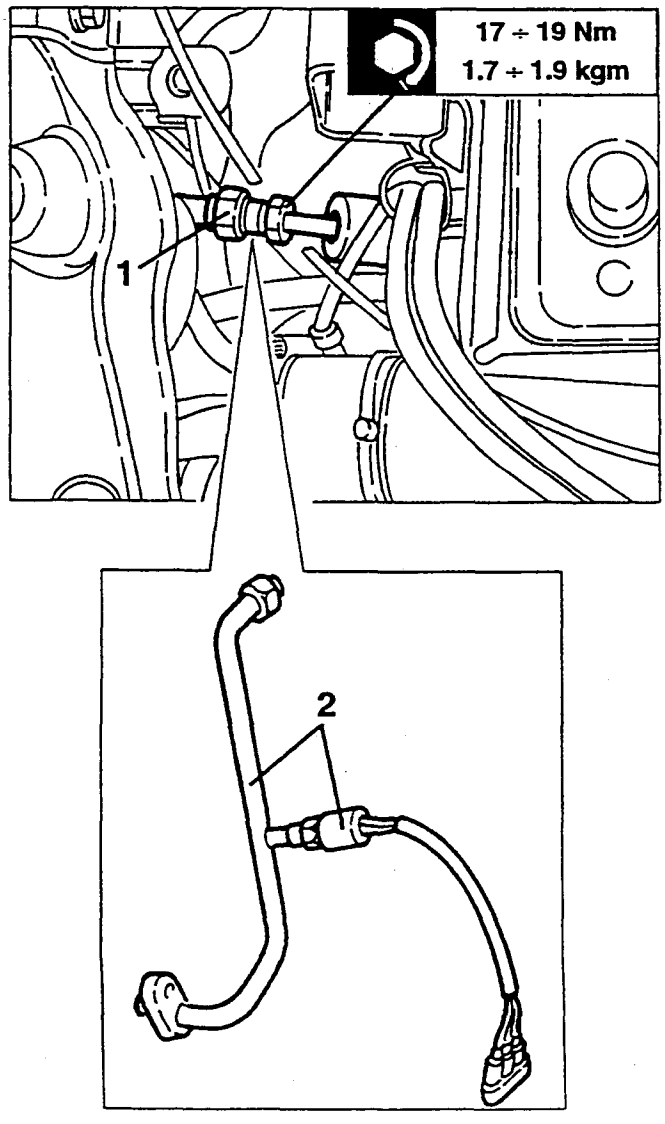
- Set the car on a lift.
- Drain the fluid from the conditioning system (see specific paragraph).
- Remove the il paraurti anteriore (see specific paragraph).
1. Slacken the fastening screw and disconnect the coolant fluid outlet pipe from the condenser.



1. Disconnect the electrical connection of the three-level pressure switch.



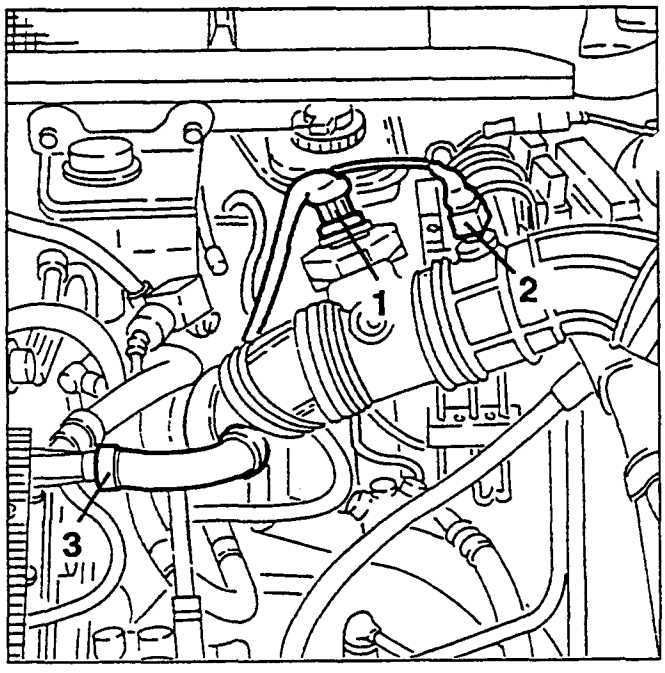
1. Withdraw the insulating cover, then disconnect the union on the expansion valve.
2. Remove the section of coolant fluid delivery pipe from the condenser to the expansion valve complete with three- level pressure switch and, if necessary, separate them on the bench.



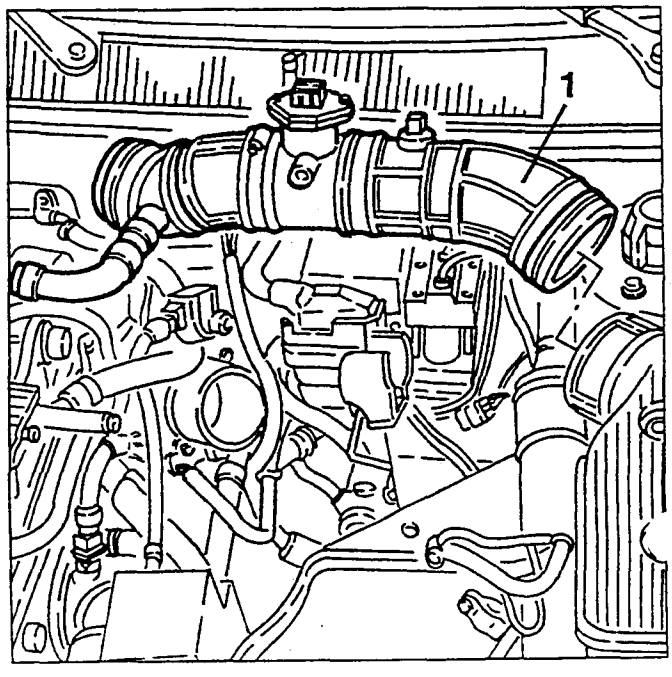
PIPE FROM EVAPORATOR TO DRIER FILTER

REMOVING/REFITTING

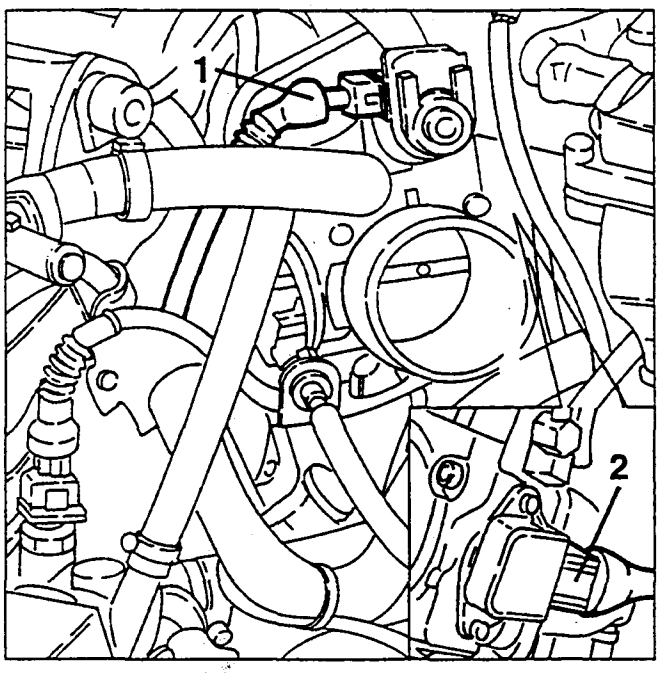
- Drain the fluid from the climate control unit (see specific paragraph).
- Remove the battery (see specific paragraph).
1. Disconnect the electrical connection from the air-flow meter.
2. Disconnect the electrical connection intake air temperature sensor.
3. Slacken the fastening clamp and disconnect the oil vapour recirculation pipe from the cylinder head cover.



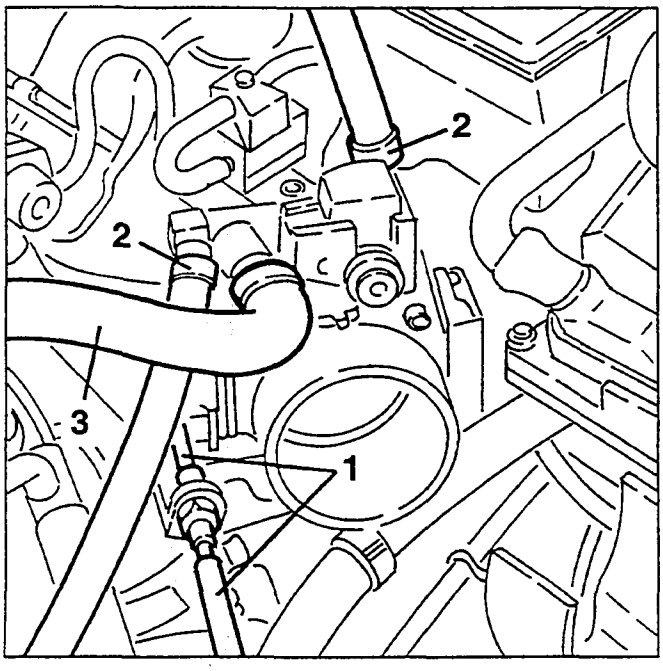
1. Slacken the fastening clamps and remove the th corrugated sleeve complete.



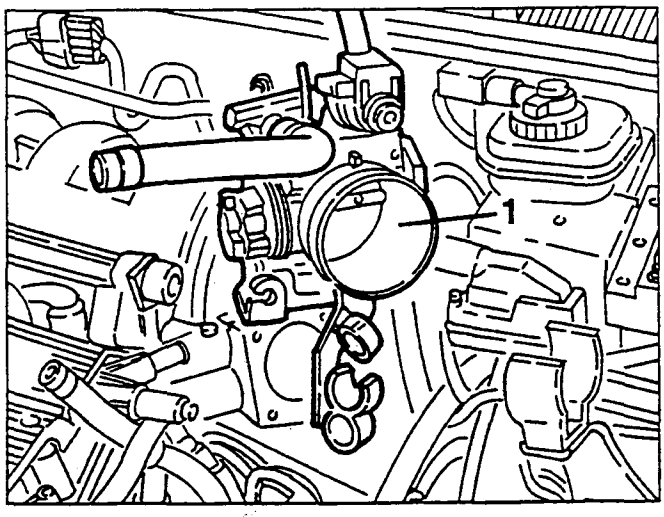
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection from the throttle potentiometer.



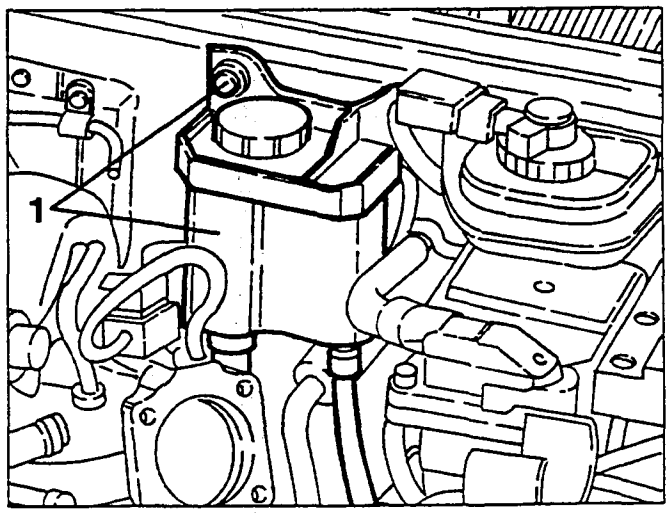
1. Disconnect the accelerator cable from the throttle body.
2. Disconnect the coolant fluid inlet and outlet pipes from the throttle body.
3. Disconnect the idle speed oil vapour recirculation pipe.



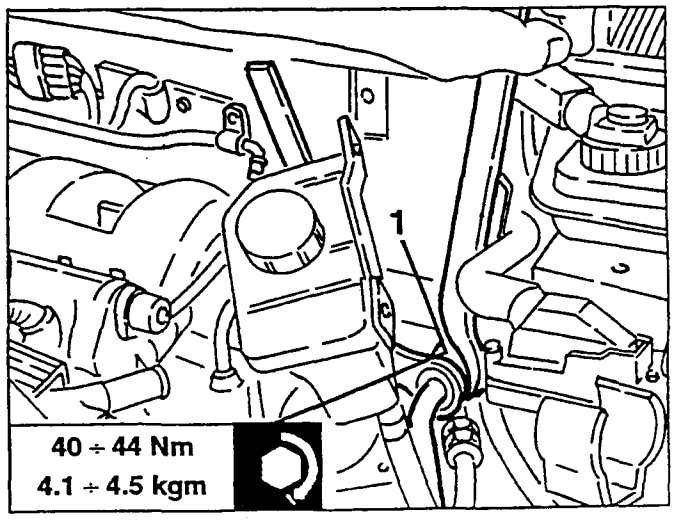
- Release the pipes from the fastenings on the bracket under the throttle body.
1. Slacken the four fastening screws and remove the throttle body complete.
- Remove the seal.



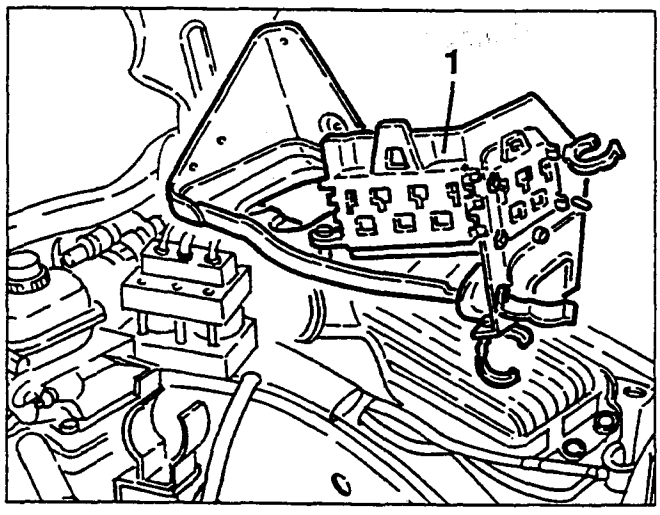
- Using a suitable syringe partially empty the power steering oil reservoir.
1. Slacken the screws fastening the power steering oil reservoir, then move it to one side without disconnecting the piping.



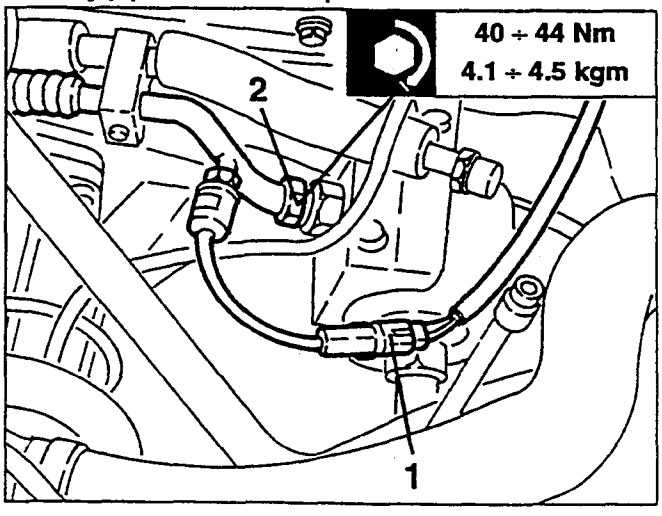
1. Using wrenches no. 1.822.112.000 and no. 1.822.115.000, disconnect the pipe in question from the evaporator.



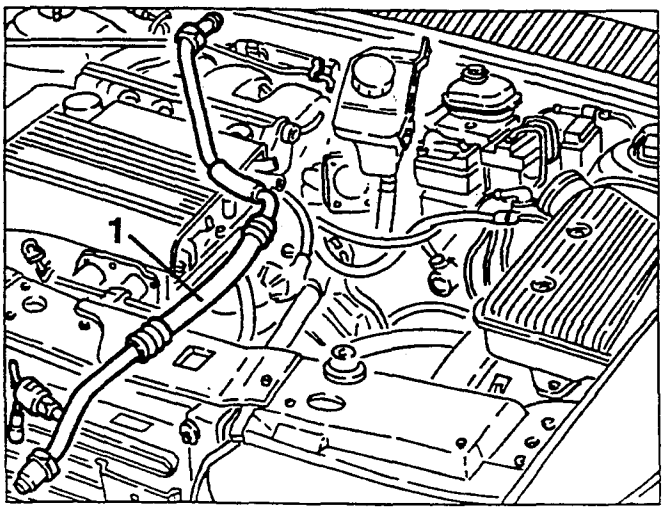
- Remove the relays from the battery support and set them to one side with their cablings so that they do not hinder the following operations.
1. Slacken the fastening screws, then remove the battery support after removing the rear cable support bracket from it.



1. Disconnect the electrical connection of the minimum pressure switch.
2. From the drier filter disconnect the coolant fluid delivery pipe from the evaporator.



1. Remove the pipe from the evaporator to the drier filter complete with minimum pressure switch and, if necessary, separate them on the bench.

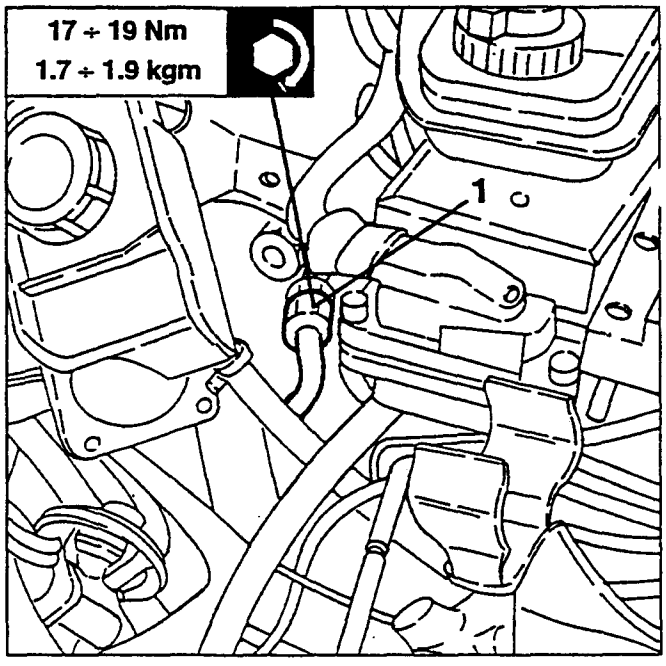


PIPE FROM EXPANSION VALVE TO EVAPORATOR

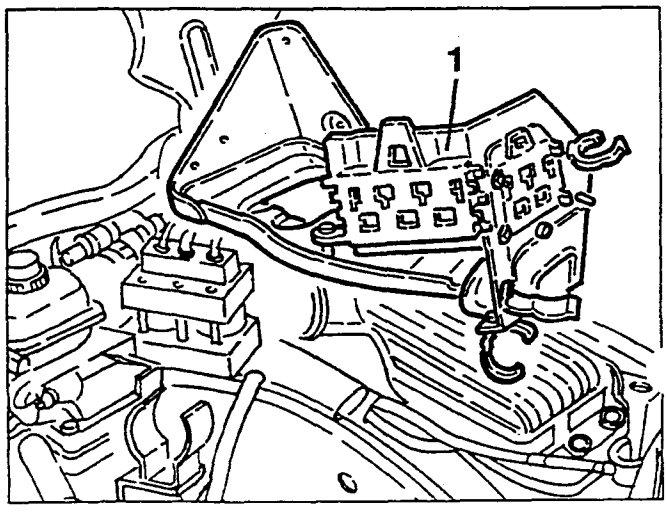
REMOVING/REFITTING

Proceed as described in the previous procedure up to disconnecting the coolant fluid outlet pipe from the evaporator.

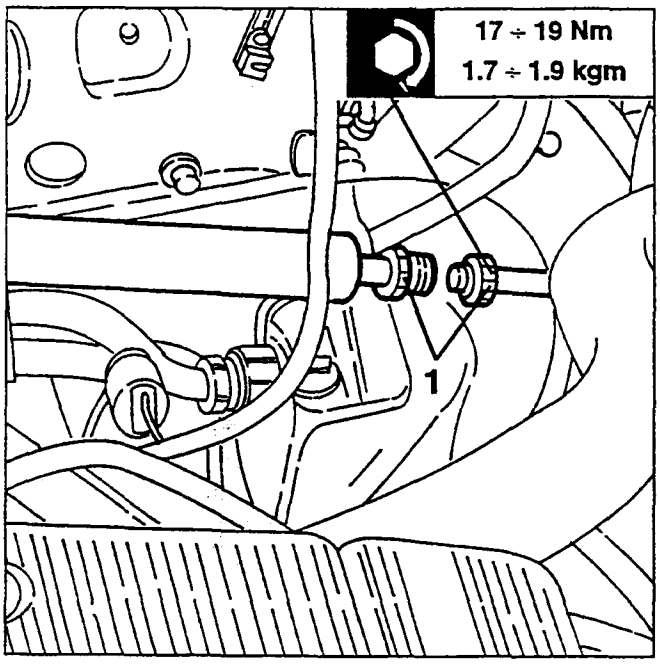
1. Using wrenches no. 1.822.111.000 and no. 1.822.113.000, disconnect the pipe in question from the evaporator.



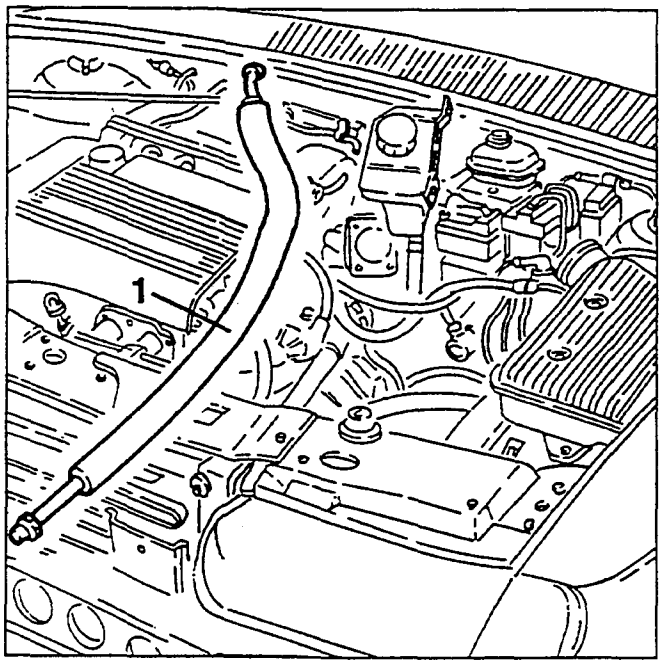
- Remove the relays from the battery support and set them to one side with their cablings so that they do not hinder the following operations.
1. Slacken the fastening screws, then remove the battery support after removing the rear cable support bracket from it.



1. Pull back the insulating cover, then disconnect the union on the expansion valve.



1. Remove the section of pipe from the expansion valve to the evaporator.



TOPPING UP THE OIL LEVEL OF THE CLIMATE CONTROL UNIT COMPRESSOR

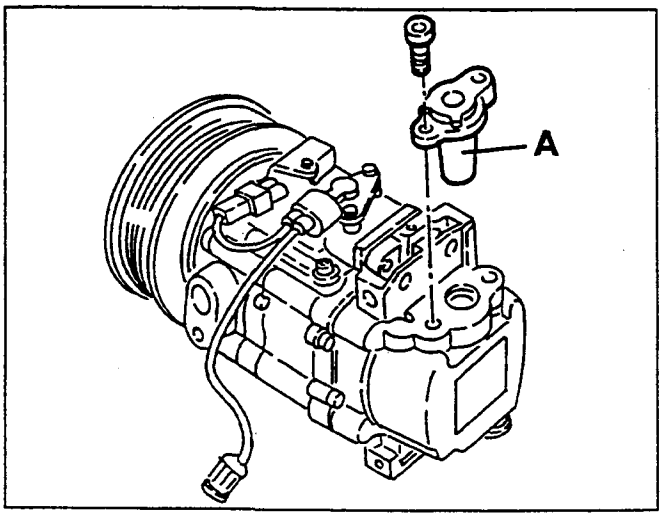
WARNING:
- The oil level in the compressor should only be carried out when presumably a considerable amount of lubricating oil has leaked due to damage or disconnection of components of the climate control system or if it has been emptied.
- The oil is hyghly hygroscopic: avoid leaving the cans open.
Avoid leaving the compressor and any other part disconnected from the system longer than the time necessary.
- In the event of operations or servicing in the engine compartment with pipes of the system exposed to the air for more than six hours, it is not sufficient to top up the level, the compressor lubricating oil must be replaced completely, proceeding as described in point C.
- To top up the oil level only use new oil of the type specified in the "TECHNICAL DATA".

N.B. The procedures differ according to the cases.
Five are described below (A, B, C, D, E).

A) "SLOW" SYSTEM DRAINING -
In case of Routine Maintenance (emptying and reacharging)
When draining the system using the special equipment, the compressor oil removed is collected in a special graduated container to be found on the equipment.
Before recharging the refrigerant fluid, top the system up with the quantity marked on the container, **plus 15 cm^3.**
If the plug on the compressor and the pipe fittings are not accessible, use a syringe to send the oil through one of the recharging valves (this valve can be removed with a suitable tool comprising a hollow pipe with special groove).

B) "QUICK" SYSTEM DRAINING
(In under 5 minutes) - In the case of accidental breakages
Under these circumstances it is not possible to determine the exact quantity of the oil lost.
Replace it as described above, **in all cases with 50 cm^3 of oil.**
N.B.: if for some reason, the compressor is removed and refitted follow the description given in point C.

C) COMPLETE OVERHAULING OF THE SYSTEM
In the event of washing or "important" operations on the system
- Drain the coolant fluid from the climate control system and flush the system.
- Remove the compressor.
- Remove the oil separator device (A) fastened next to the outlet union of the compressor and drain all the oil contained in the compressor.



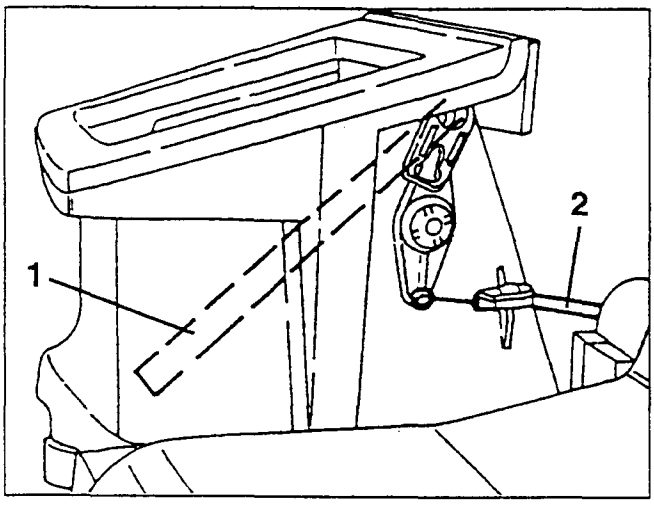
- Refill with new oil of the type and in the quantity specified in the "TECHNICAL DATA":
- Refit the compressor on the car and recharge the system.

D) CHANGING THE COMPRESSOR ONLY
- Drain the coolant fluid from the climate control system.
- Remove the compressor.
- Drain the oil from the compressor just removed, collecting it in a suitable recipient.
- Carry out the same operation for the new compressor.
- Fill the compressor with the same amount of oil removed from the old one.
- Refit the compressor on the car.
- Recharge the system, topping up with an additional 15 cm^3.

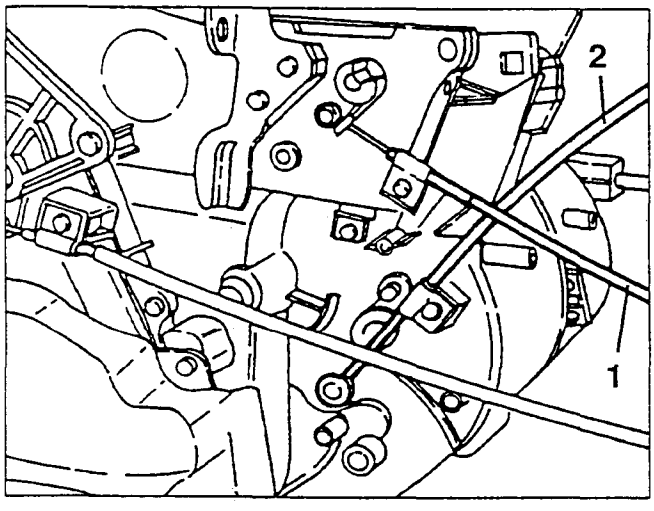
E) CHANGING ONLY THE DRIER FILTER
the drier filter is supplied in production (and also as spare) with a certain amount of oil.
NOTE: this filter is easily distinguished by a label wit' the writing "CONTAINS 130 C.C. OF NIPPONDENSO N.D.9 OIL".
- Drain the coolant fluid from the climate control system.
- Remove the filter.
- Drain the oil from the filter, collecting it in a suitable recipient.
- Carry out the same operation for the new filter.
- Fill the new filter with the same amount of oil drained from the old one (remove or add accordingly).
- Refit the filter on the car.
- Recharge the system. topping up with an additional 15 cm^3.

DESCRIPTION

The heater unit is substantially the same as the climate control unit.
The main differences are the following:
a) There is no evaporator;
b) The outside air/recirculation flap (1) is not operated electrically by an actuator but by a control cable (2).

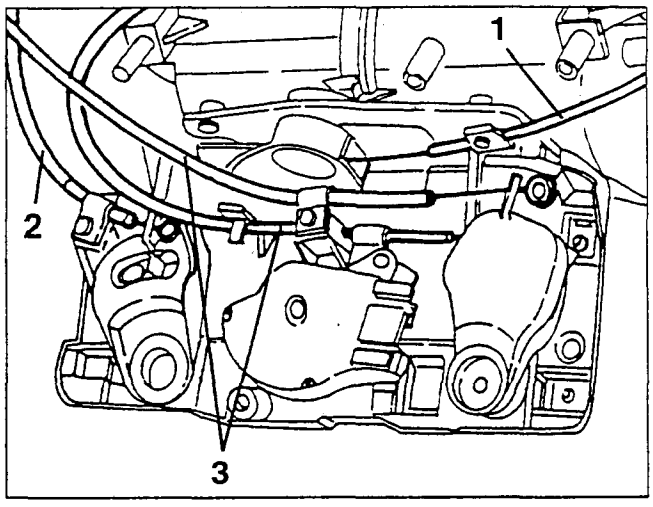


c) The adoption of two control cables instead of one for moving the two air flow flaps, thus the transmission linkages have been eliminated.



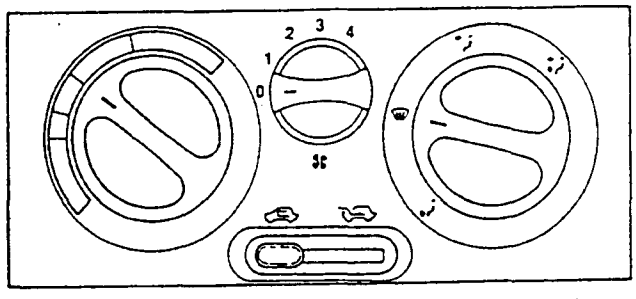
1. *Upper air flow flap control cable*
2. *Lower air flow flap control cable*

d) Due to the above-mentioned differences, also the control unit differs as it will have four control cables rather than two and an electrical connection less.



1. *Outside air/recirculation flap control cable*
2. *Air mixing flap control cable (unchanged)*
3. *Air flow flaps control cable*

- Therefore, the control panel is without the pushbutton for turning on the compressor and with a lever for manually controlling the outside air/recirculation flap. In addition, the fan control knob no longer has the OFF position for shutting off the inlet of outside air.

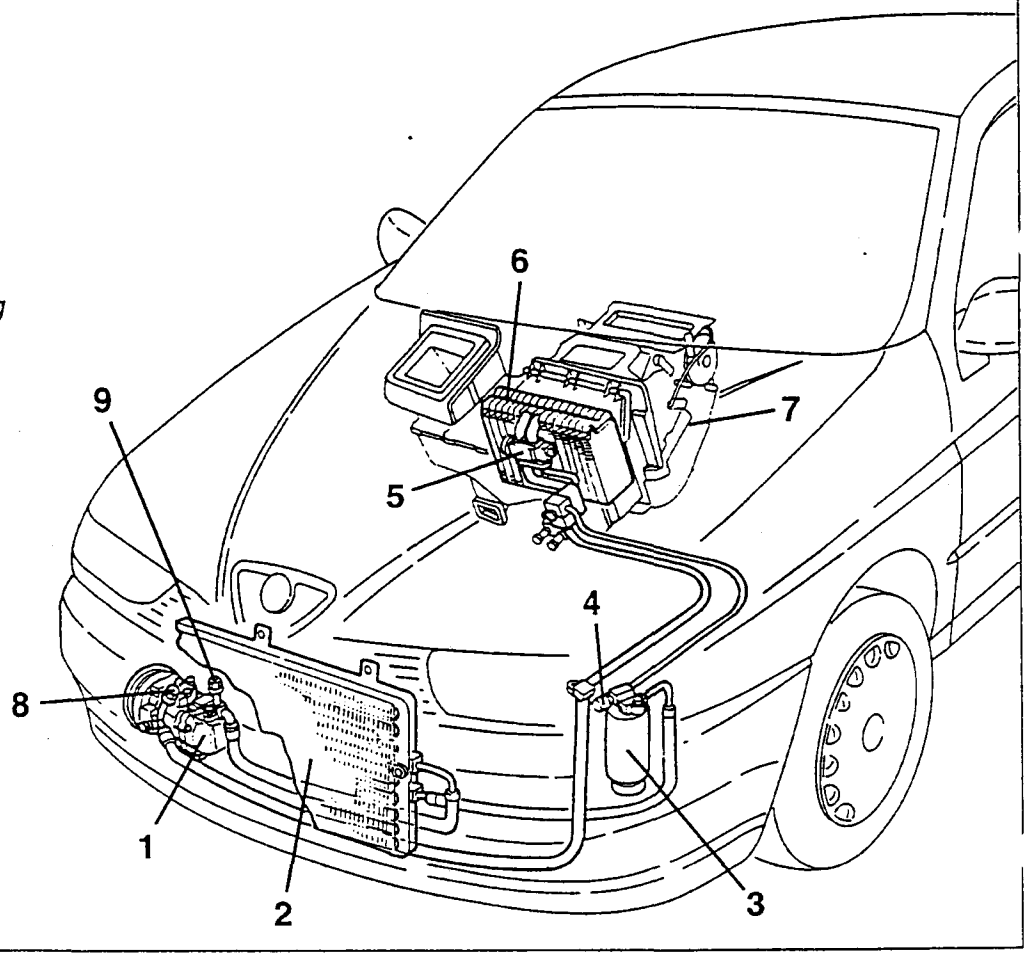


e) There is no air flow vent to the rear passengers.

DESCRIPTION OF THE SYSTEM

The air conditioning system comprises the following components:
- a variable displacement compressor fastened to the engine by brackets;
- a condenser which is a heat exchanger fitted in front of the engine coolant fluid radiator;
- a drier filter located to the left side of the condenser;
- an evaporator which is the second heat exchanger of the system to be found in the duct-distributor unit;
- an expansion valve fitted on the evaporator inlet duct;
- various pipes and hoses which connect the different components of the system;
- four-level pressure switch installed on the drier filter. Two tubes are welded on the high and low pressure pipes on which a needle valve is fitted which serves for discharging and charging the system.

1. *Compressor*
2. *Condenser*
3. *Drier filter*
4. *Four-level pressure switch*
5. *Expansion valve*
6. *Evaporator*
7. *Duct-distributor unit*
8. *Needle valve for discharging/charging the system (low pressure side)*
9. *Needle valve for discharging/recharging the system (high pressure side)*



The system with thermostatic adjustment SEMI-AUTOMATICALLY CONTROLS the climate control system of the car.

In fact, according to the temperature required in the passenger compartment, it manages the following automatically:
- air temperature at the vents;
- fan speed (with constant changing).

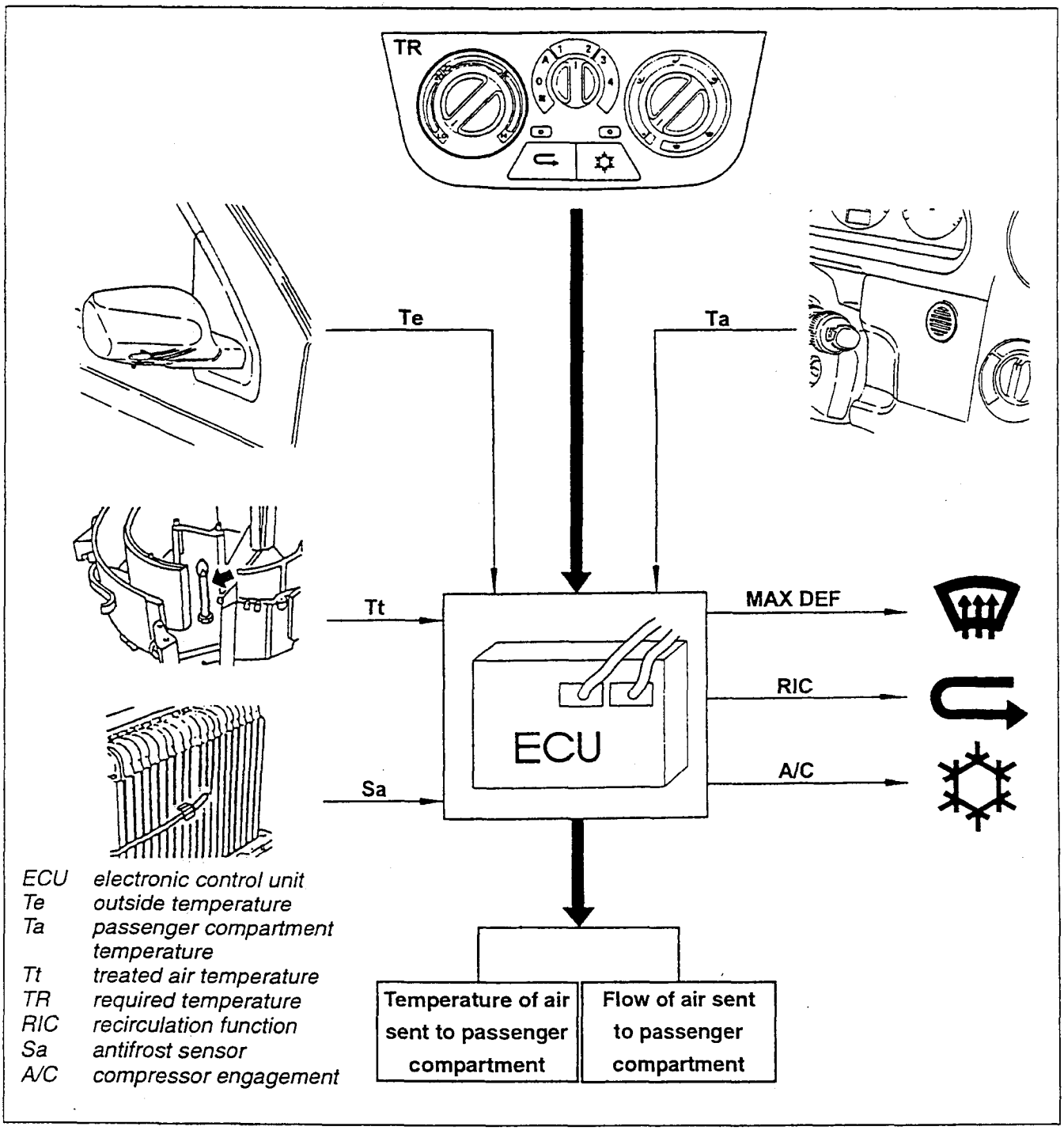
Upon manual operation it handles the following:
- fixed fan speed (4 speeds);
- compressor engagement (air cooling circuit);
- engagement of air recirculation;
- "MAX DEF" function.

Lastly the distribution of the flows of air to the different vents are adjusted completely manually (through bowden cable).

OPERATING LOGIC

A special control unit manages automatic operation of the system controlling the thermodynamic parameters in order to provide the climatic comfort (temperature and humidity) required by the occupants of the vehicle.

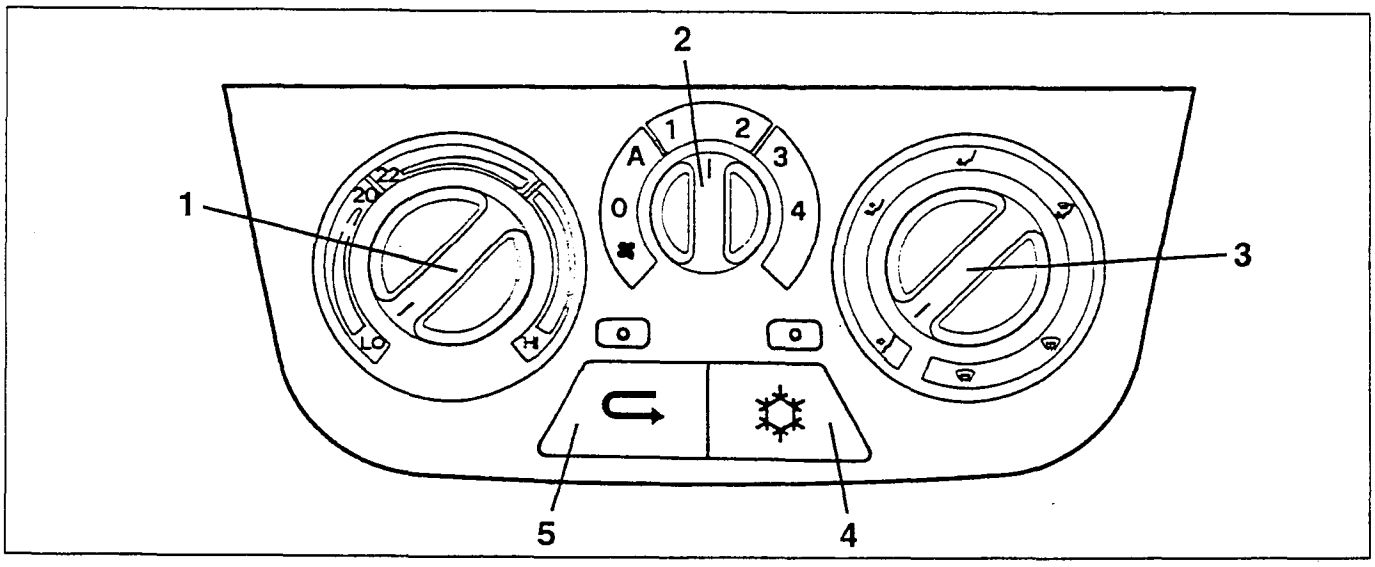
According to the requests received and the temperature conditions detected, the control unit sets certain functions to adapt the temperature of the passenger compartment to the one required.



ECU electronic control unit
Te outside temperature
Ta passenger compartment temperature
Tt treated air temperature
TR required temperature
RIC recirculation function
Sa antifrost sensor
A/C compressor engagement

Through suitable control logics of the sensors and adjustment with "self-teaching" of the actuators, the electronic control unit is capable of recording and memorising a series of faults and failures that may occur in the system.
If these faults occur, the control unit still continues to manage system operation replacing any abnormal values with suitable "recovery" values which ensure minimal operation though not perfect of the system.
For further information, see "ELECTRIC - ELECTRONIC DIAGNOSIS".

CONTROLS



The left knob (1) is used to select the TEMPERATURE REQUIRED (between 18 and 30°C): it is connected to a potentiometer which detects the different angular positions and transmits a signal to the electronic control unit for a total of 15 different positions (one per degree centigrade) of which the two extreme positions are "LO" and "HI" which correspond respectively to the request for the highest amount of cool air and the highest amount of warm air. The centre knob (2) adjusts AIR VENTILATION: this too, is connected to a potentiometer which detects the different angular positions and transmits a signal to the electronic control unit. There are four possible flow rates that can be set manually in a permanent manner (1, 2, 3 and 4), while in the 'AUTO" position it is the system itself that automatically selects the most suitable temperature for reaching or keeping the required temperature.

NOTE: Position "0" indicates minimum ventilation: the fan is off and only a light flow of air will go through the vents.

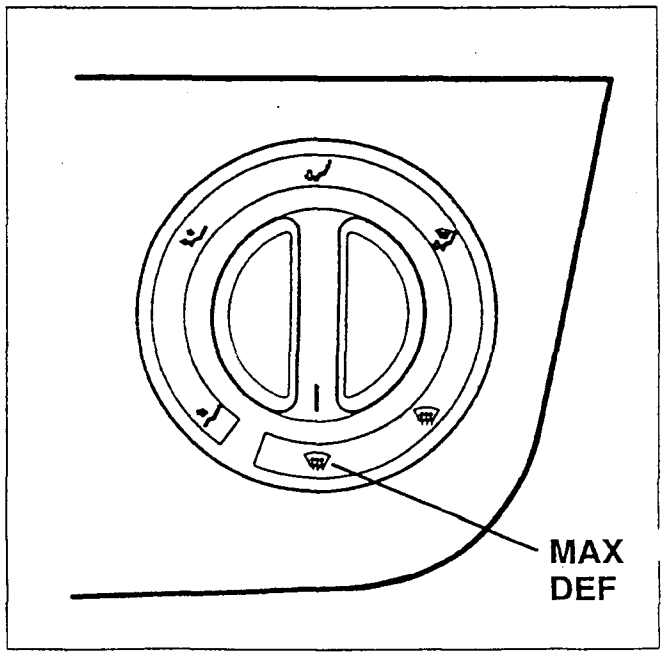
NOTE: There are two different maps inside the control unit which correlate the air flow rate and the fan speed: the presence of the pollen filter on the outside air inlet lowers the flow rate - at the same fan speed - in the "dynamic air" condition compared with "recirculation".

The right knob (3) selects FLOW DISTRIBUTION of air to the passenger compartment which can take place in five different ways:
selection takes place manually through a cable which controls the movement of the distribution ports.
When the button (4) is pressed, it enables operation of the COMPRESSOR (air cooling circuit); when the button is released operation is cut off.
Engagement takes place completely manually: only in the "MAX DEF" mode is the compressor still engaged with the button released.

When button (5) is pressed, it engages the AIR RECIRCULATION function from inside the passenger compartment; when the button is released it allows the inlet of "dynamic" air from outside.
Engagement takes place entirely manually: only in the "MAX DEF" mode is recirculation cut off also with the button pressed.

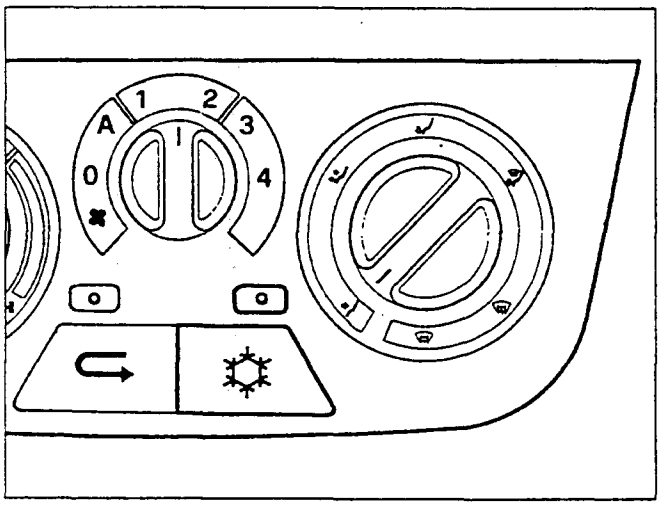
"MAX DEF" function

When the distribution knob is turned completely clockwise - it activates - through a special microswitch - the "MAX DEF" function for quick defrosting which involves:
- maximum air flow rate;
- mixing with the highest amount of heat available
- recirculation off, regardless of the position of button (5);
- compressor enabled, regardless of the position of button (4).



Compressor engagement

When pressed, the button illustrated enables COMPRESSOR OPERATION (air cooling circuit); when the button is released operation is disengaged.
However actual engagement of the compressor depends on the following conditions:
- outside temperature below 5°C: (disengagement below 4°C and re-engagement above 6°C);
- temperature detected by the antifrost sensor: (disengagement below 3.5°C and re-engagement above 5°C).

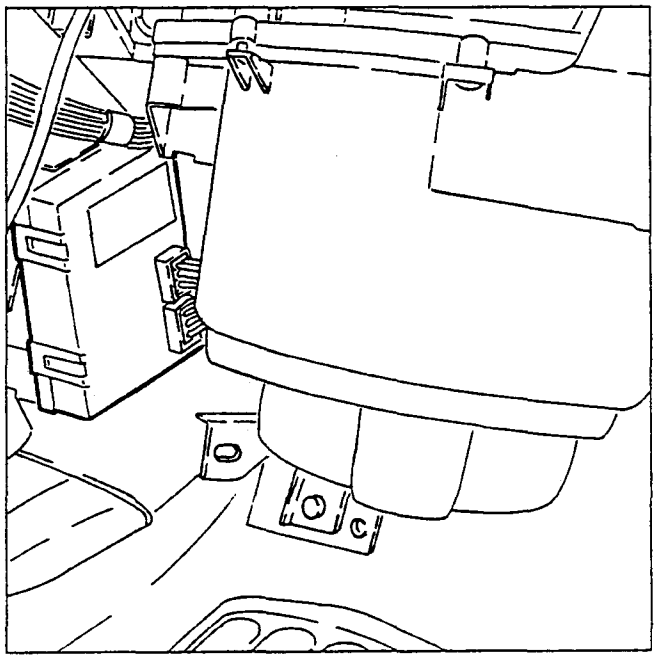


You are reminded that the compressor may also be disengaged by the four-level pressure switch or by the engine control unit. This logic depends on the different engine management control units (see ELECTRIC - ELECTRONIC DIAGNOSIS).

SYSTEM COMPONENTS

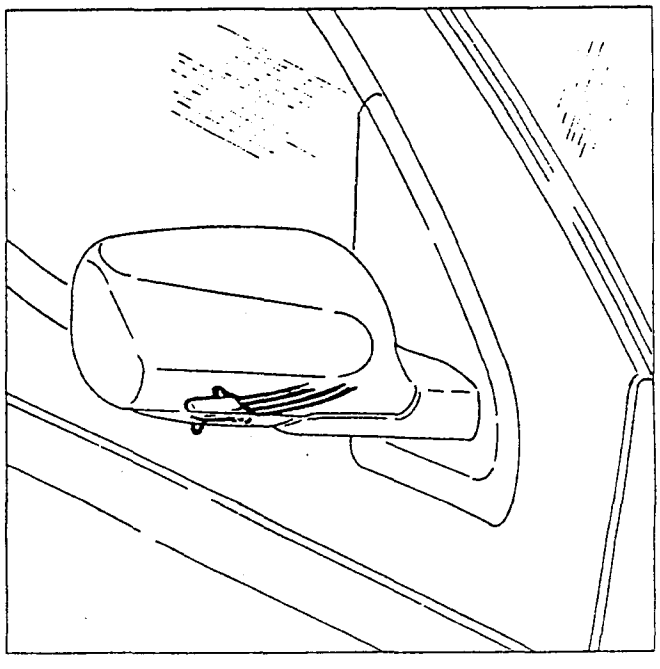
ELECTRONIC CONTROL UNIT

The electronic control unit manages automatic operation of the system controlling the thermodynamic parameters in order to provide the climatic comfort (temperature and humidity) required by the occupants of the car.
It is on the right side of the duct-distributor unit and access to it is easily gained from the passenger compartment.



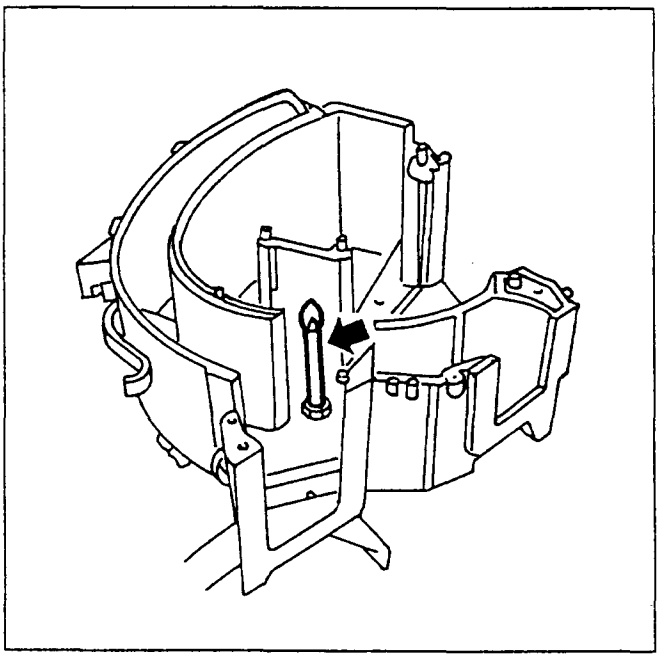
OUTSIDE AIR TEMPERATURE SENSOR

This is on the right wing mirror.
It is an NTC sensor - resistance that lowers with the temperature (R at 25°C = 10 kOhm), with operating range from -30°C to +50°C.



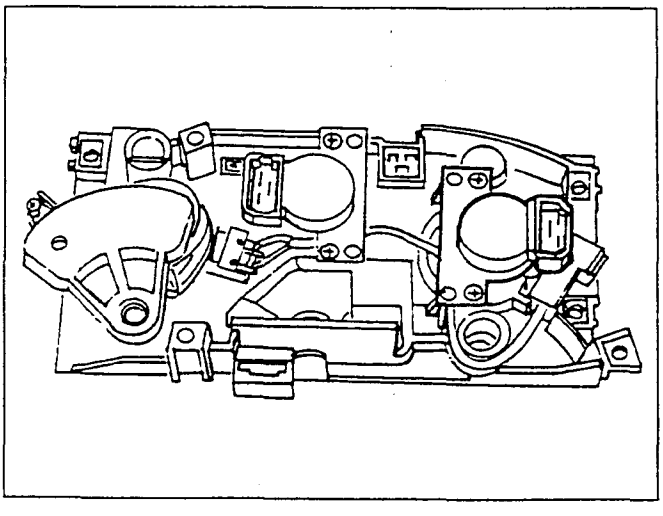
TREATED AIR TEMPERATURE SENSOR

This is inside the distributor unit immediately upstream of the air flow distribution ports to the different vents.
It is an NTC sensor (R at 25°C = 10 kOhm), with operating range from 0°C to +80°C.



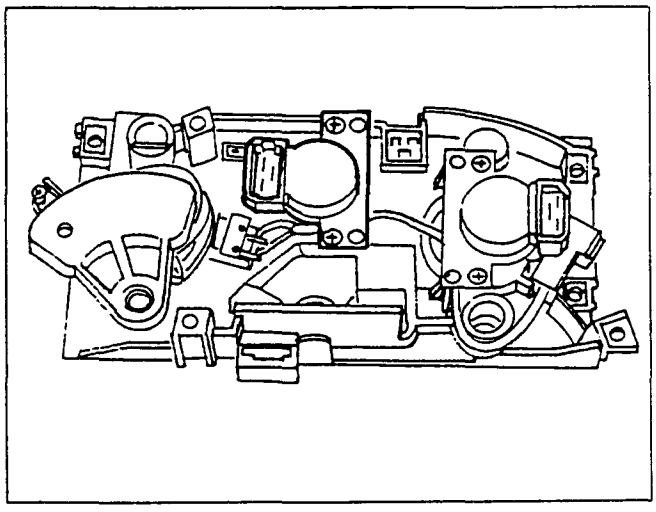
REQUIRED TEMPERATURE POTENTIOMETER

The potentiometer is connected to the temperature knob and detects the different angular positions, thereby transmitting a signal to the electronic control unit for a total of 15 different positions (one per degree centigrade) the two extreme positions of which are "LO" and "HI".



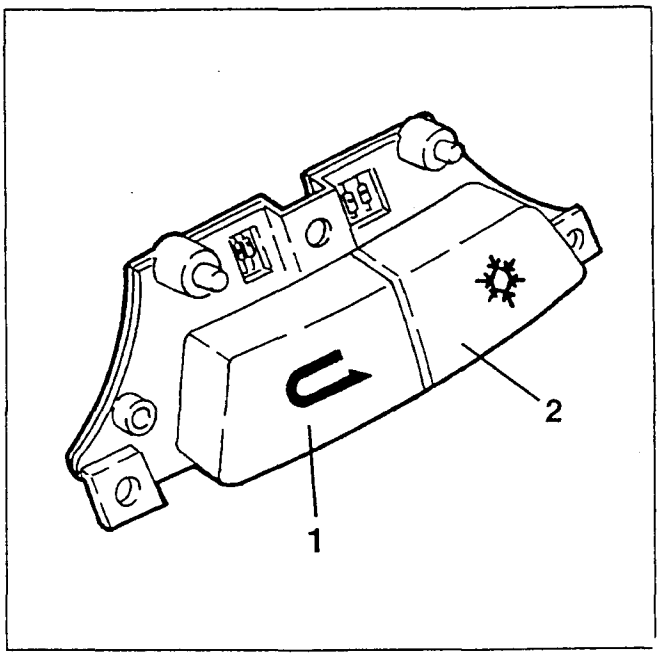
REQUIRED AIR FLOW POTENTIOMETER

The potentiometer is connected to the air ventilation knob and detects the different angular positions, thereby transmitting a signal to the electronic control unit: there are four possible air flow rates set manually permanently (1, 2, 3 e 4), plus the "AUTO" and "0" position.



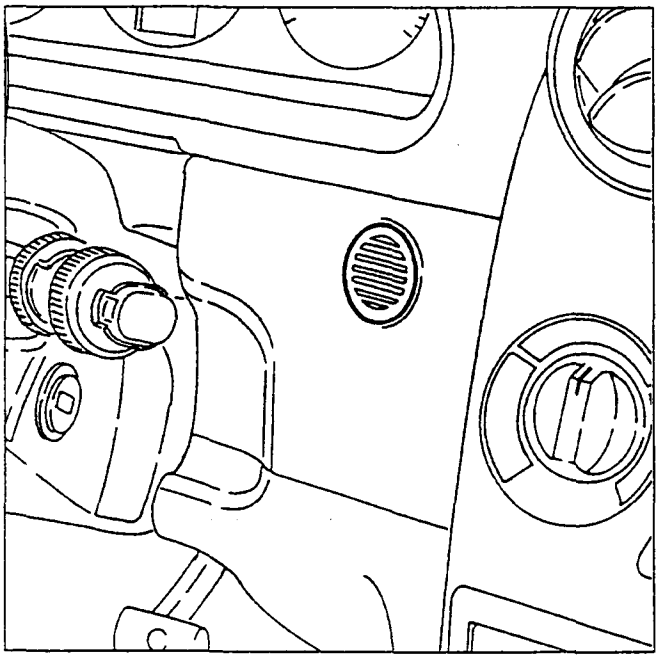
SET OF SWITCHES AND RECIRCULATION/COMPRESSOR ENGAGEMENT FUNCTION

When button (1) is pressed it engages the recirculation function managed entirely manually.
When button (2) is pressed, it enables operation of the compressor of the air conditioning system.



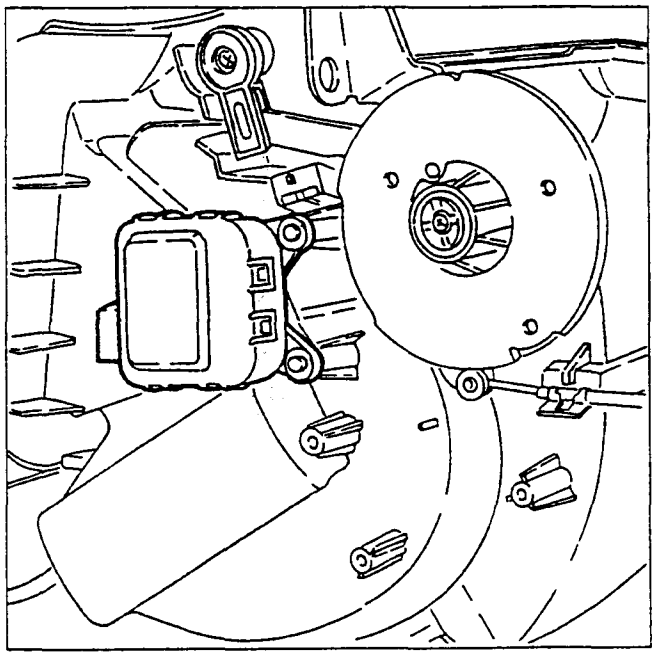
PASSENGER COMPARTMENT TEMPERATURE SENSOR

This is on the right hand trim on the driver's side of the dashboard.
It is an NTC sensor (R at 25°C = 2.2 kOhm), with operating range from +5°C to +45°C.
The sensor is "ventilated", i.e. inside it incorporates a small fan that is always supplied so that the temperature reading is not affected by the air stagnating inside the dashboard which would give an unrealistic result.



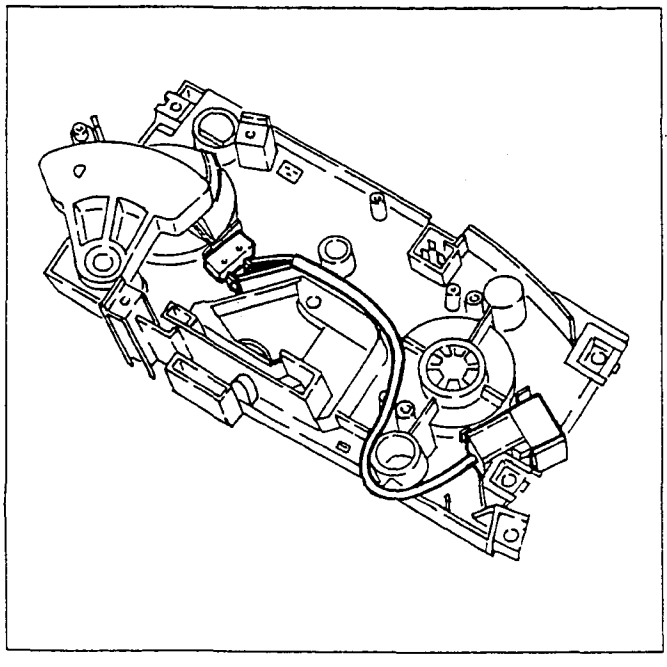
ELECTRIC MIXING ACTUATOR

The temperature of the treated air is adjusted by suitably controlling the mixing actuator between hot and cold air which acts on the port which sends or shuts off the flow of incoming air on the heater radiator, crossed by hot water leading from the engine. A motor supplied at 12V controls the rotary movement of a draw pin which acts directly on the mixing port. A potentiometer detects the actual position and acts as "feedback" to the control unit.



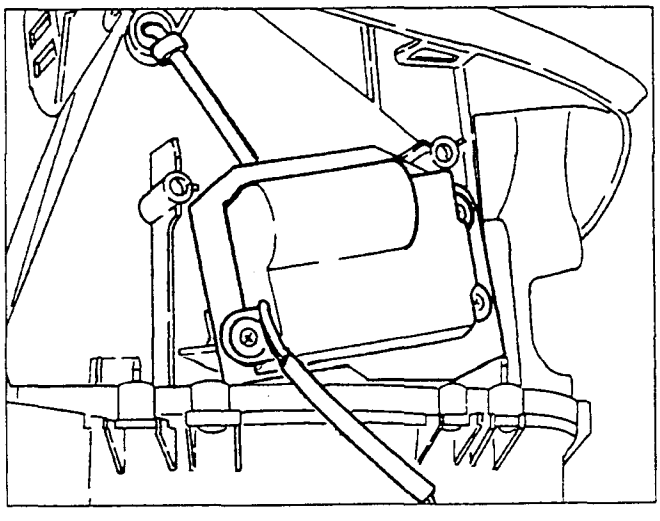
MAX DEF FUNCTION SWITCH

A special switch activates the MAX DEF function: this is located on the distribution knob; it is an N.O. contact which is closed with the knob turned completely clockwise.



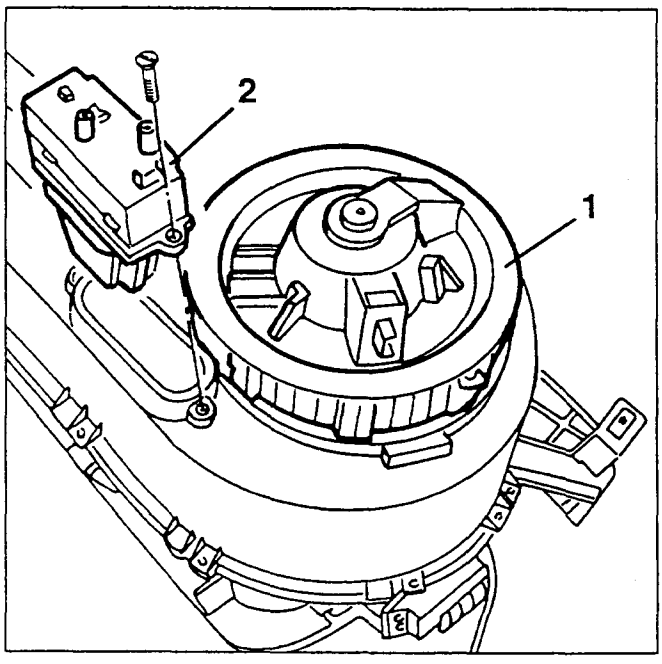
RECIRCULATION ELECTRIC ACTUATOR

Rotation of the outside air inlet port is obtained by suitably controlling the recirculation actuator which acts on the port itself passing from the "dynamic air" position to the "recirculation" position. There are NO intermediate positions. A motor supplied at 12V controls the rotary movement of a draw pin which acts directly on the port. Reversing the polarity, movement in the opposite direction is obtained.



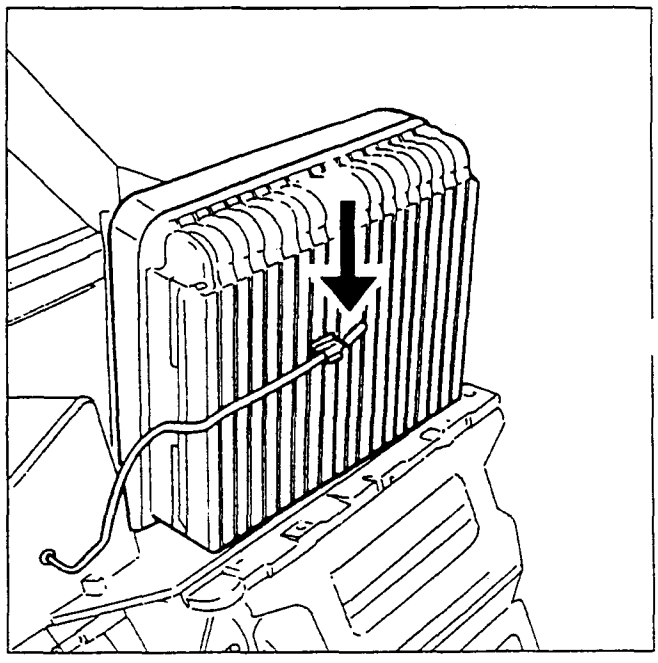
FAN WITH ELECTRONIC SPEED REGULATOR

The fan (1) that sends outside or recirculation air towards the duct-distributor unit is supplied at 12V and controlled continuously at different speeds by an electronic regulator (2) located next to it.



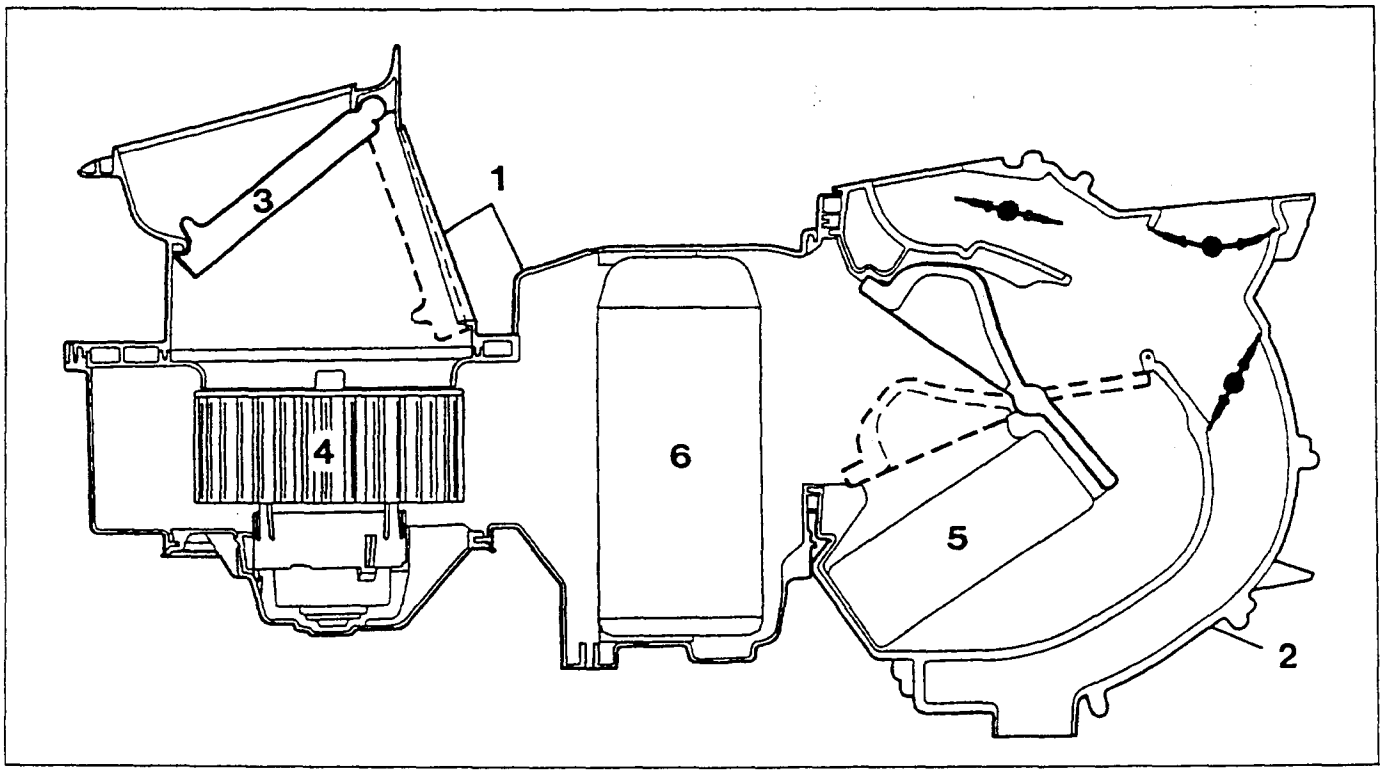
ANTIFROST SENSOR

The antifrost sensor is inside the duct-distributor unit, installed directly on the evaporator. It detects the temperature of the evaporator and informs the control unit which - if necessary - turns off the compressor to prevent freezing.
It is an NTC sensor (R at 25°C = 10 kOhm), with operating range from -5°C to +25°C.



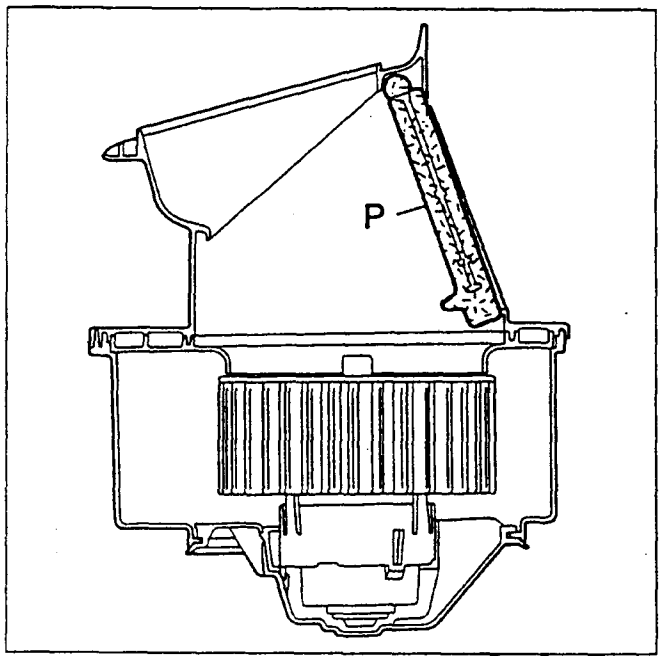
DUCT DISTRIBUTOR UNIT

This assembly, shown in cross section below, is the main component of the system and it comprises a duct (1) and a heater distributor unit (2).
The duct (1) is formed of two parts, a lower one and an upper one; the right part of the latter is suitably shaped so that it mates perfectly with the upper right part of the dashboard surface (area under the windscreen of the partition between the engine and passenger compartments) with which it is in contact.
On the upper part of the right hand side of the duct there are two rectangular openings; the first is in an almost horizontal position and coincides with the one on the dashboard thus it communicates with the outside enviroment, while the other faces the passenger in an almost vertical position and allows the inlet of the air to the passenger compartment.
In the upper inner part of the duct there is a flap (3) which, duly directed by the special actuator, can take a position between the limits for closing of one of the above-mentioned openings.
Inside the duct on the lower part in correspondence with the above-mentioned openings, there is a fan (4) which, duly supplied at different voltages can turn at different speeds.
Between the duct (1) and the distributor (2) there is the evaporator (6).
The heater - distributor unit is mainly composed of a box housing the following:
- in the central position, a mixing port which duly directed by a knob through a bowden cable allows or prevents the entire flow of air taken in by the fan (4) or part of it to flow on the finned surface of the heater radiator (5);
- at the bottom centre, the heater radiator (5) the inlet and outlet fittings of which jut from the right side surface of the above-mentioned unit;
- above and at the front, four flaps which duly directed by a knob through a bowden cable, a toothed sector, a disk with grooves acting as distributor, shutter or fully close the section of the inside ducts which send air respectively to the feet, front vents and to the windscreen demisting vents.

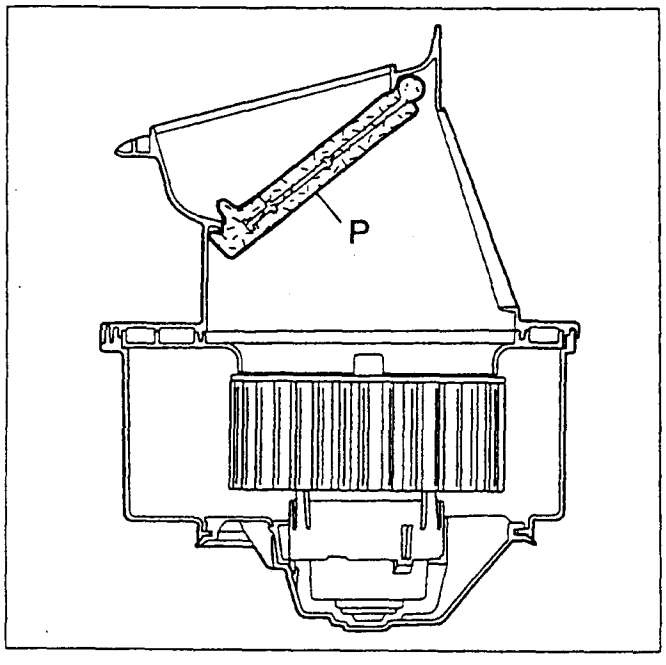


Dynamic/recirculation air

The special actuator turns the air inlet port (P) between two extreme positions.
- The position illustrated shuts inside air inlet, thus the fan withdraws only outside air.

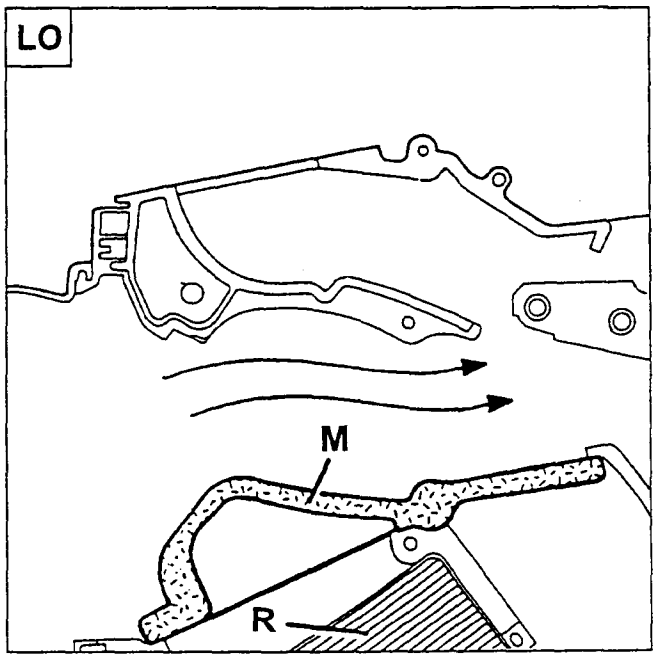


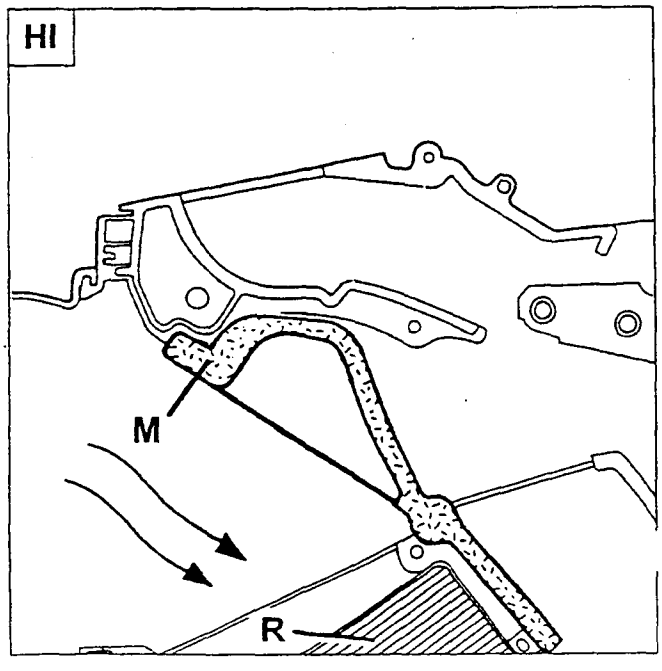
- If the port is turned as illustrated, the outside air is inhibited and recirculation air is withdrawn.



Hot/cold air mixing

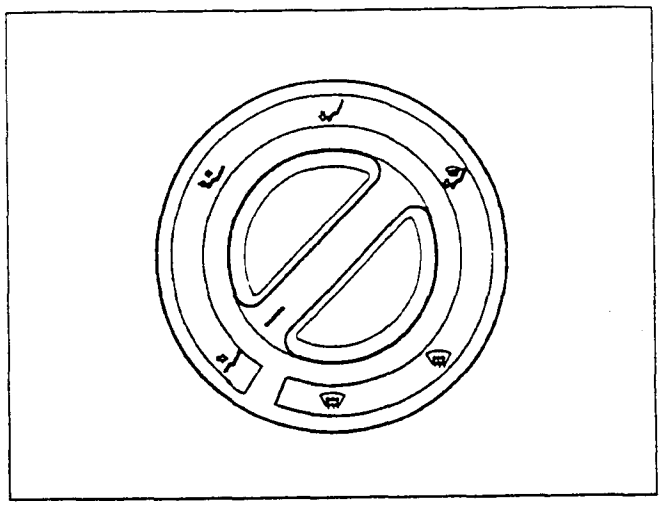
The special actuator turns the port (M) between the extreme (LO) and (HI) positions.
In the (LO) position the flow of air withdrawn by the fan is distributed to the different vents without undergoing any change in temperature as it is unable to flow against the finned surface of the heater radiator (R).
When the mixing port is at the limit position (HI) the entire flow of air withdrawn by the fan is compelled to flow against the fins of the heater radiator, therefore warm air at the highest temperature possible will be distributed to the different vents.
When the mixing port is at an intermediate position between the above-mentioned two, only part of the flow of air withdrawn by the fan touches the radiator fins.

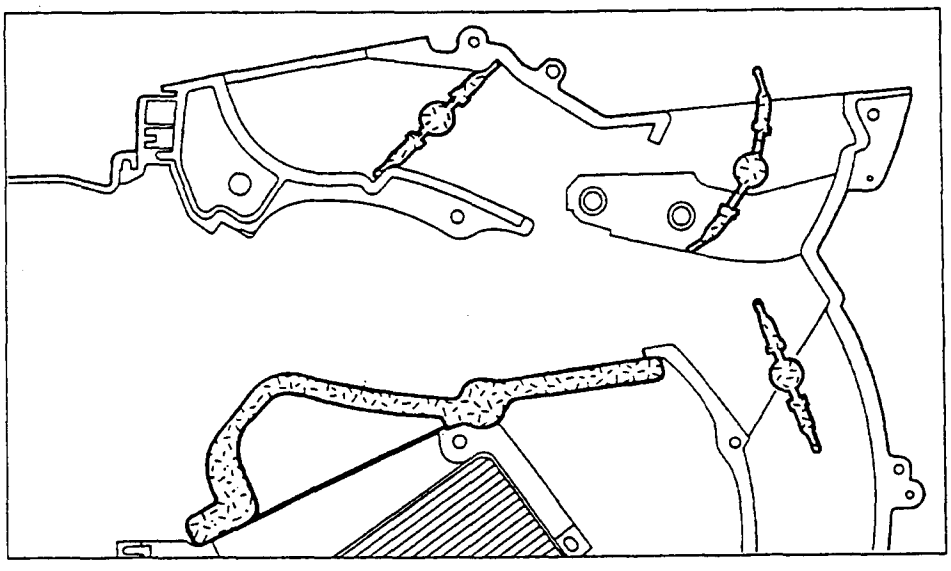




Air distribution

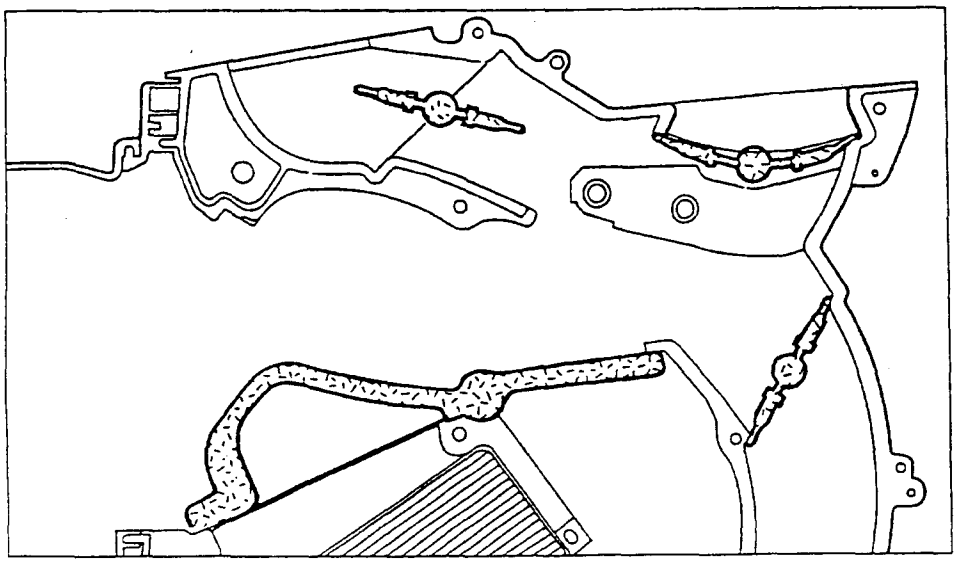
Turning the right knob clockwise suitably turns the four flaps to distribute the air as shown in the different pictograms, i.e. starting from only to the front vents up to only to the windscreen vents as illustrated below.







Detail of position of the different distribution flaps when the knob is turned completely counter-clockwise





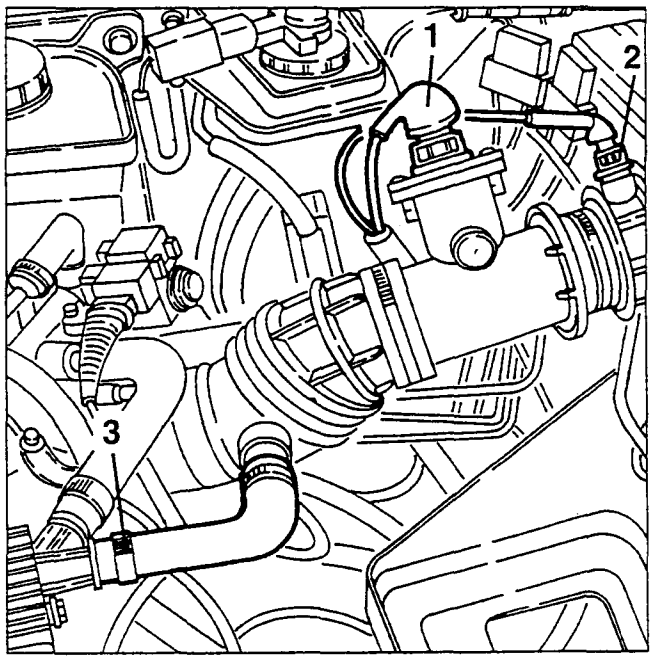
Detail of position of the different distribution flaps when the knob is turned completely clockwise

INSTRUCTIONS FOR REMOVING/REFITTING

During maintenance operations, when the components of the air conditioning system are disconnected, suitably plug the disconnected fittings to prevent damp and impurities from being admitted to the system.
When re-installing the pipe fittings always change the O- rings on the actual fittings.
Lubricate the threads of pipe fittings with the specified antifreeze oil and tighten them to the specified torque.
If oil is lost from the system during maintenance operations, restore the quantity of oil in the system calculating such losses.

Removing/refitting the following components:
- heater radiator
- expansion valve
- evaporator
- antifrost sensor
is only possible removing the "Duct assembly and heater- distributor unit" from the car and disassembling it up to where necessary.

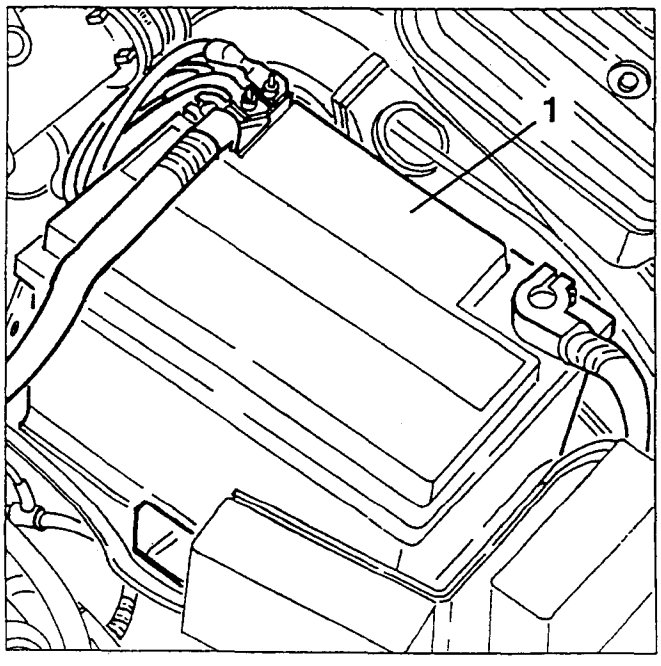
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor.
3. Slacken the fastening clamp and disconnect the oil vapour recirculation pipe from the cylinder head.



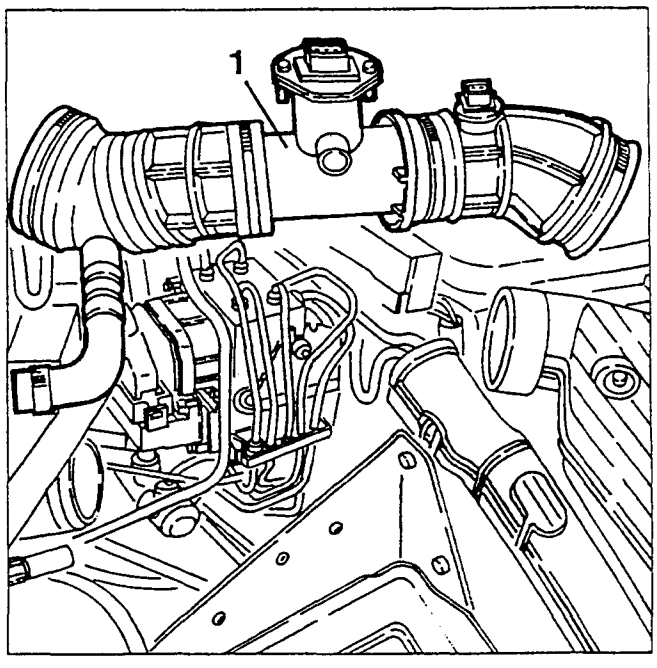
DUCT ASSEMBLY AND HEATER-DISTRIBUTOR UNIT

REMOVING/REFITTING

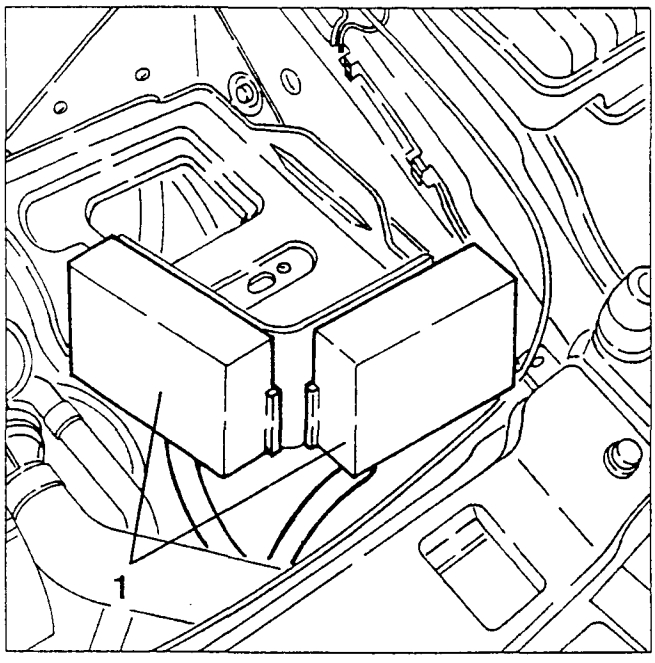
- Discharge the fluid of the climate control system (see specific paragraph).
1. Disconnect the terminals, then remove the battery.



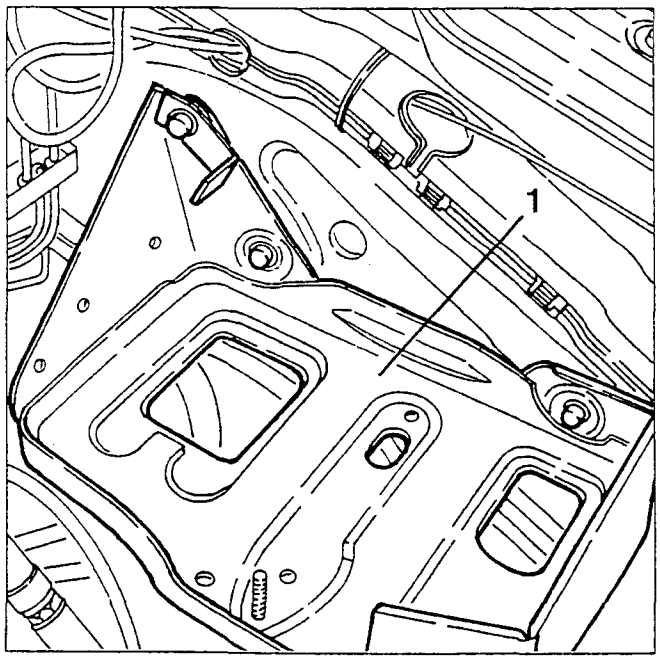
1. Slacken the two fastening clamps, then remove the corrugates sleeve complete.



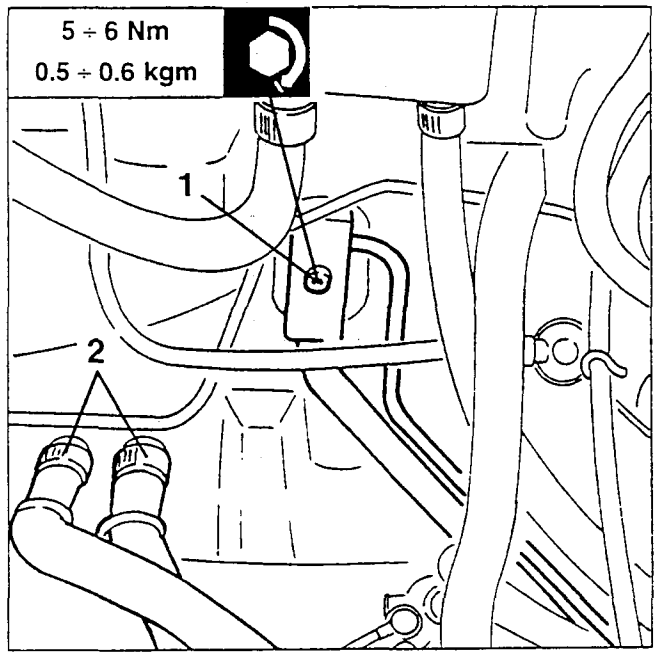
1. From the battery support release the two relay holder supports and set them to one side.



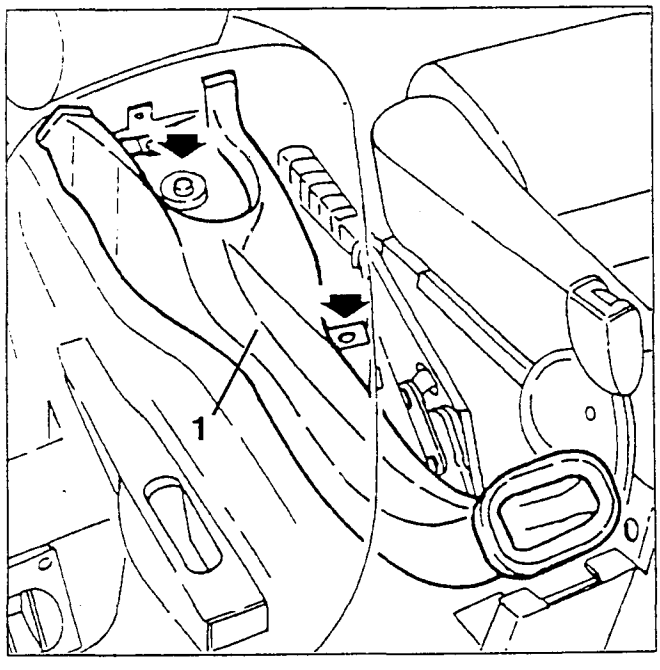
1. Slacken the fastening screws and remove the battery support complete with drain tube after freeing this from the wheel house.



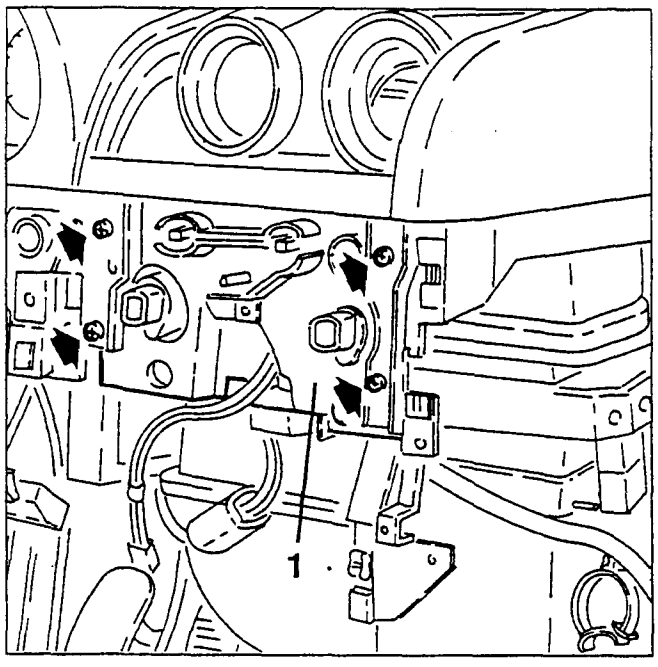
1. Slacken the fastening screw and disconnect the flange of the coolant fluid inlet and outlet pipes from the evaporator.
2. Disconnect the coolant fluid inlet and outlet pipes from the heater of the climate control system collecting the fluid in a suitable container.



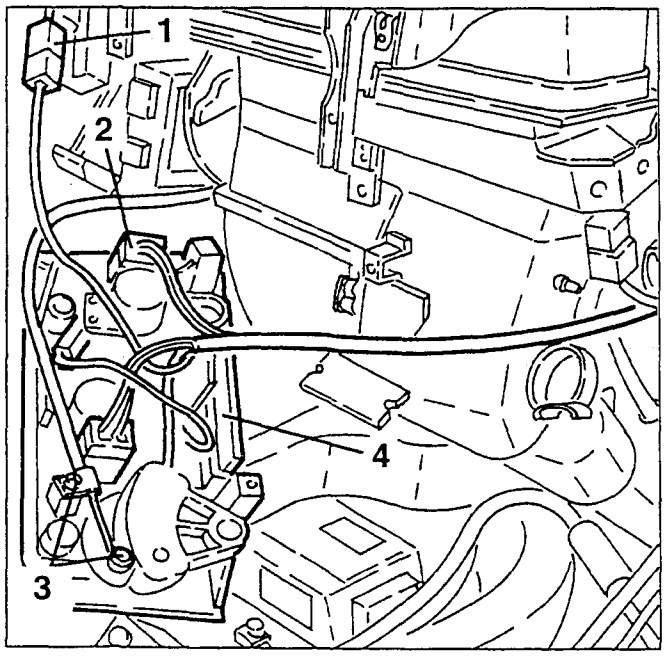
- Remove the lower part of the dashboard and the centre console (see GROUP 70).
1. Slacken the two fastening screws and remove the rear section of the air delivery duct to the rear passengers' face.



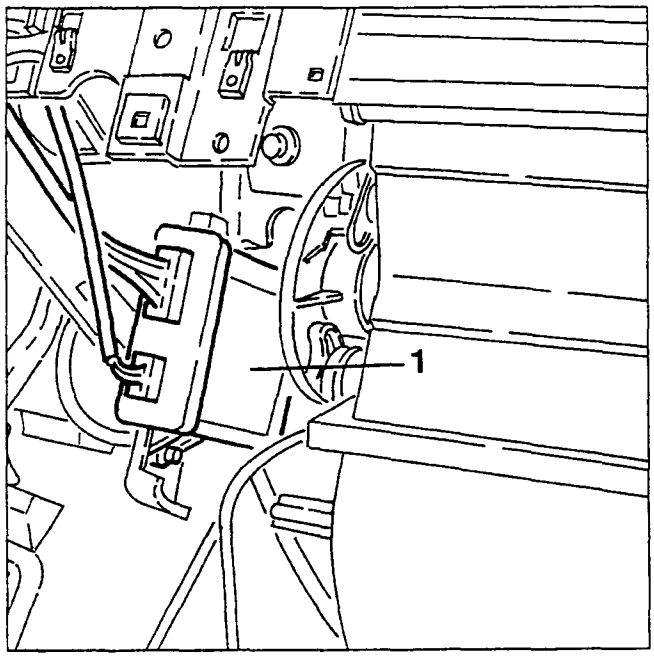
1. Slacken the four fastening screws and lower the controls of the climate control system.



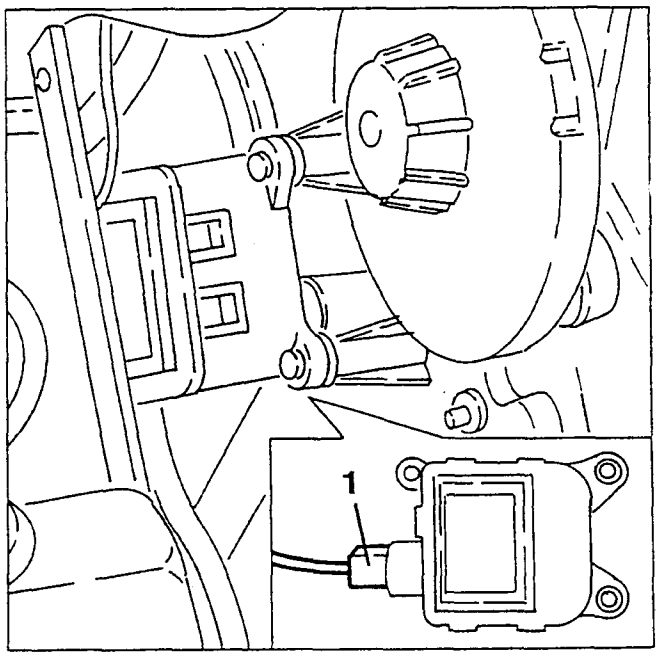
1. Disconnect the electrical connection of the inside air temperature sensor.
2. Disconnect the electrical connections from the climate control system controls.
3. Disconnect from the controls the bowden cable for moving the air distribution ports.
4. Remove the climate control system controls releasing them from the electrical wiring.



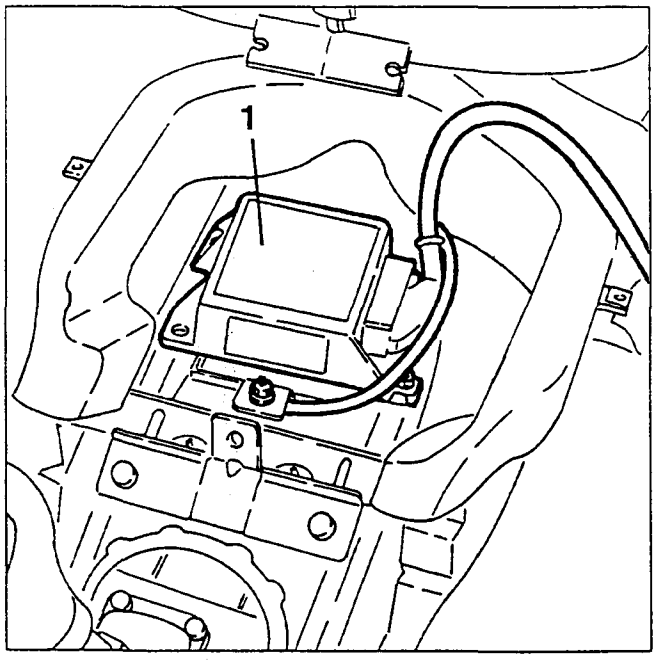
1. Slacken the fasteners, then set aside without disconnecting the electrical connections, the Alfa Romeo CODE control unit.



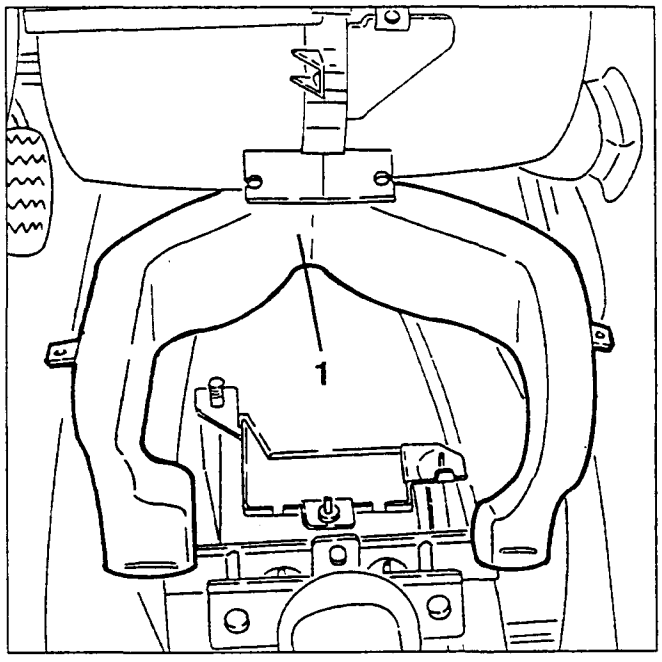
1. Disconnect the electrical connection from the air mixing port control motor.



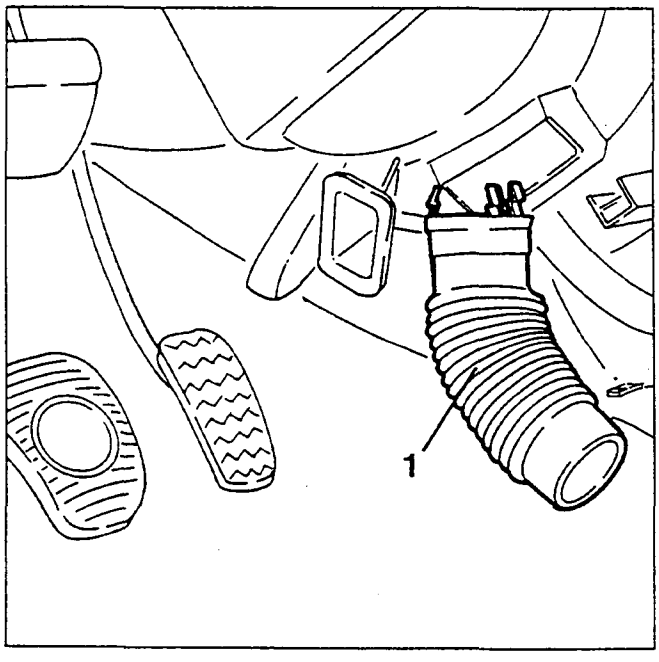
1. Slacken the fasteners, then set aside without disconnecting the electrical connections, the Air Bag control unit.



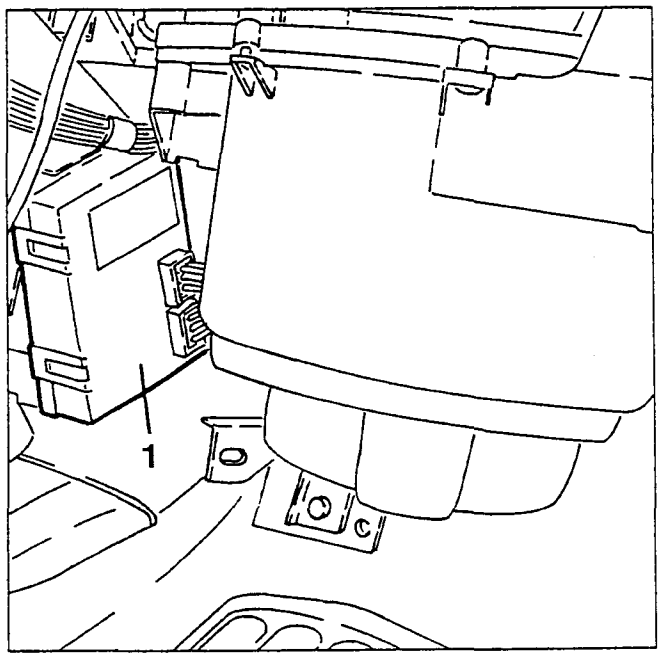
1. Slacken the fastenings and remove the front section of the air delivery duct to the rear passengers.



1. Remove the two elbows with bellows connecting the climate control system to the air delivery duct to the rear passngers' feet.

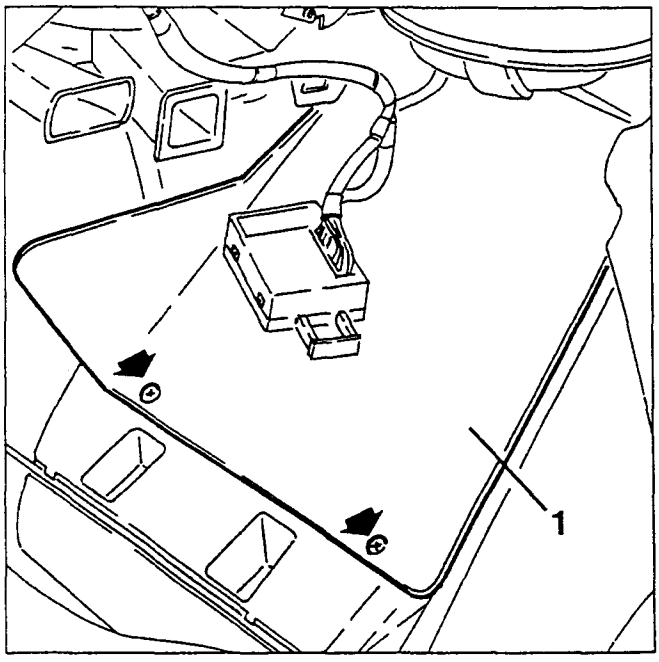


1. Release the climate control unit from the fastening clip, then set it to one side without disconnecting the corresponding electrical connections.

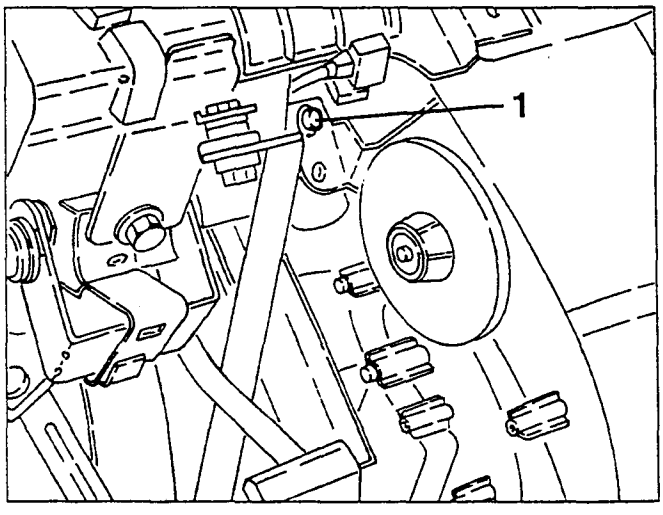


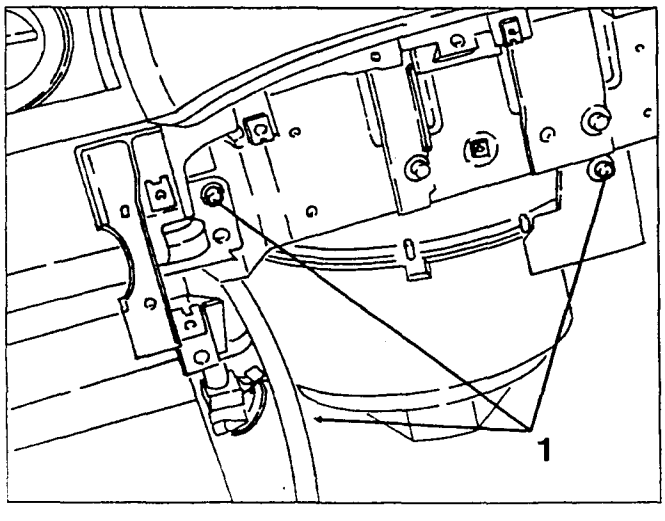
- Disconnect the following electrical connections:
- from the fan
- from the electronic fan speed regulator
- of the recirculation/outside air control motor
- of the treated air temperature sensor.

1. Move the floor mat, slacken the fastening screws and remove the injection control unit cover.

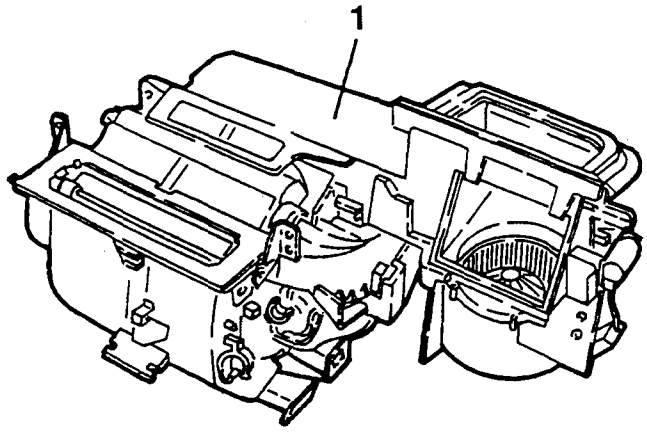


1. Slacken the screws fastening the climate control group to the body.



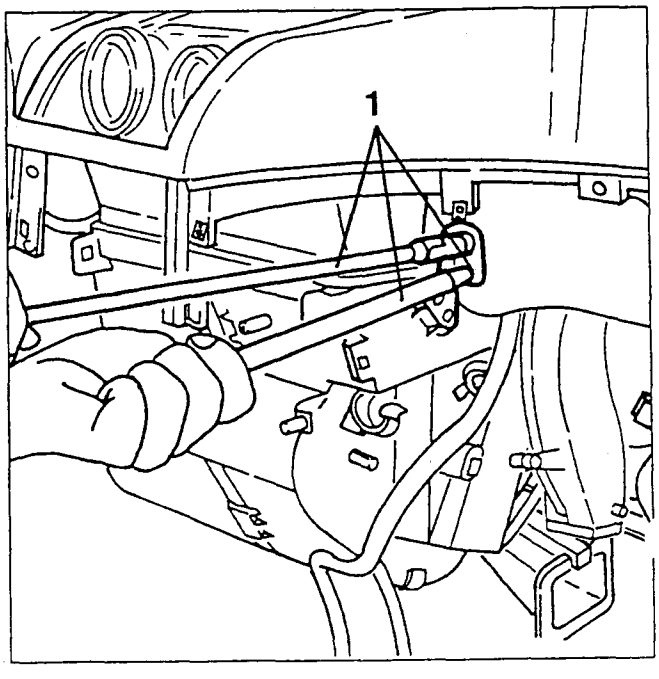


- Slacken the front screws fastening the air grooves to the feet and lower them just enough to remove the climate control group.
1. Withdraw and remove the climate control group.



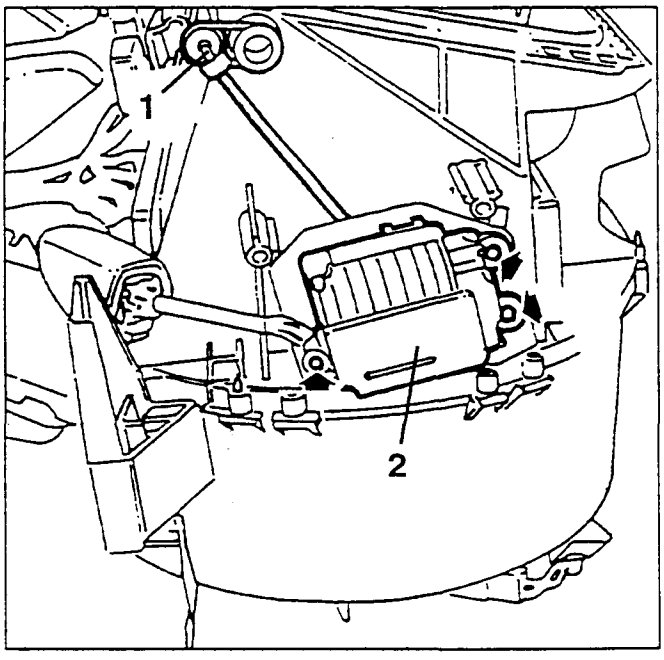
Refit the unit reversing the sequence followed for removal and adhering to the instructions given below.

- Coat the mouth of the heater and water drain pipes with vaseline, and when installing the climate control group make sure that these pipes are inserted correctly in the passage holes.
- Before reassembling the climate control group, remove the sponge under the upper part of the dashboard on the passenger's side and refit it after fastening the group itself.
1. Using a dowel, positioned as illustrated, centre the position of the group before fastening it.

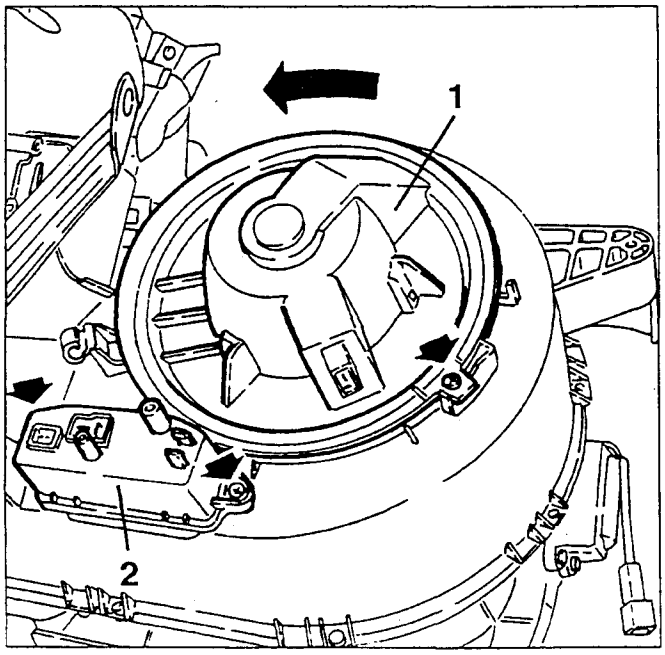


DISASSEMBLY

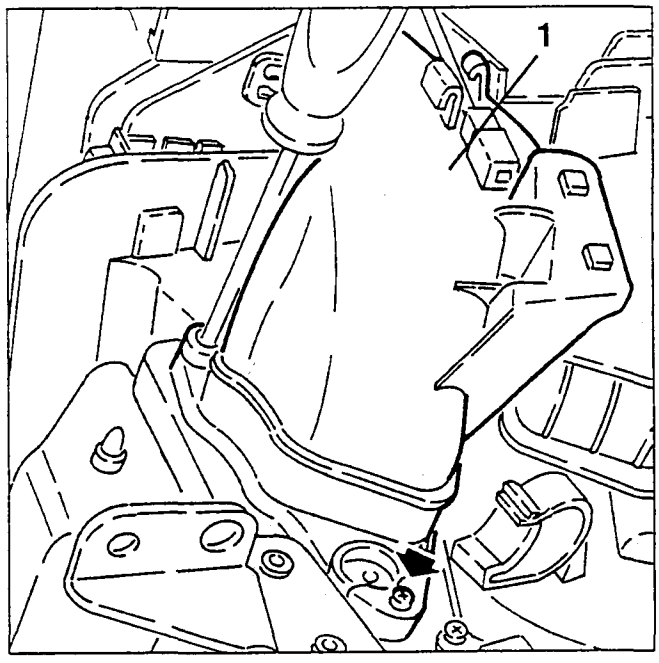
1. Disconnect the control rod from the coupling on the recirculation/outside air port.
2. Slacken the three fastening screws and remove the recirculation/outside air control motor complete with control rod.
- Retrieve the upper plate and grommets on the fastening holes.



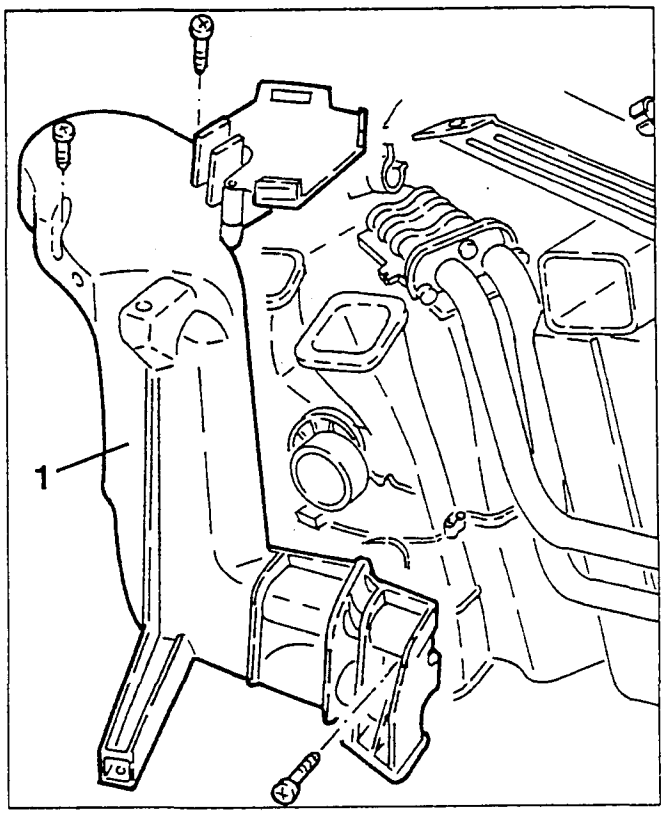
1. Slacken the fastening screw, raise the tab and turn the fan clockwise as far as its stop, then remove it from the climate control group.
2. Slacken the two fastening screws and remove the electronic fan speed regulator.



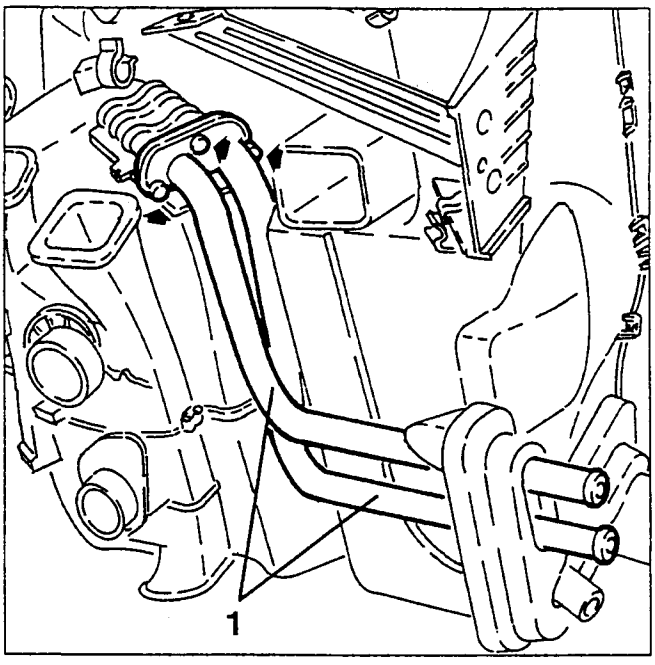
1. Slacken the fastening screws and remove the cover.



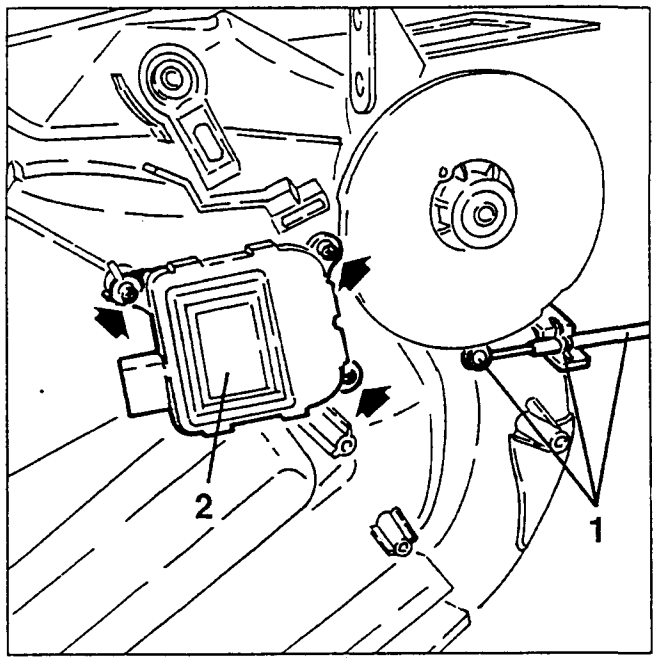
1. Slacken the three fastening screws and remove the heater cover and the corresponding pipes.



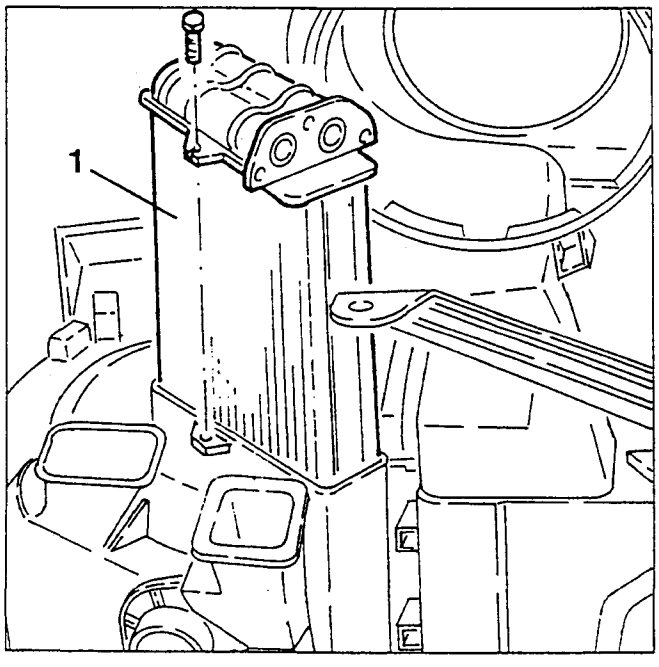
1. Slacken the three fastening bolts of the plate retaining the heater coolant fluid inlet and outlet pipes, then remove them.
- Remove the O-Rings and taper metal seal rings.



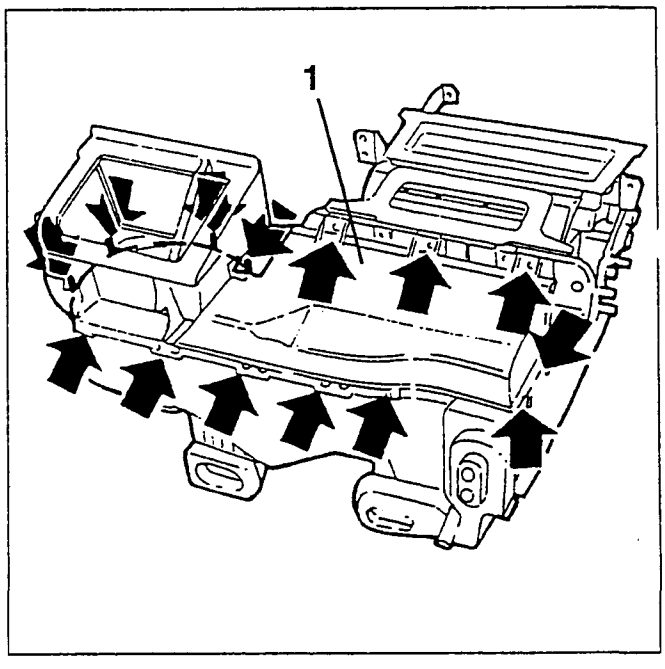
1. Free the air distribution port bowden control cable from its fasteners, then remove it.
2. Slacken the three fastening screws and remove the air mixing port control motor.



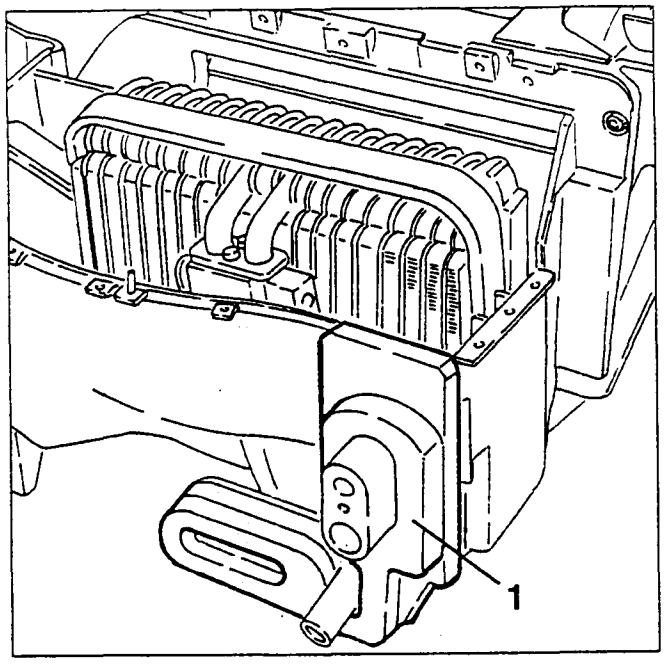
1. Slacken the two fastening screws and withdraw the heater.



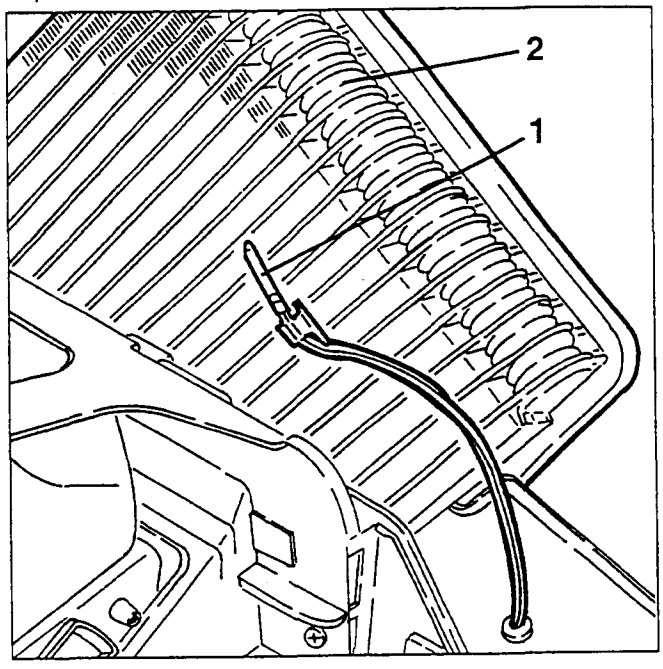
1. Slacken the fastening screws and separate the upper half box from the climate control group.



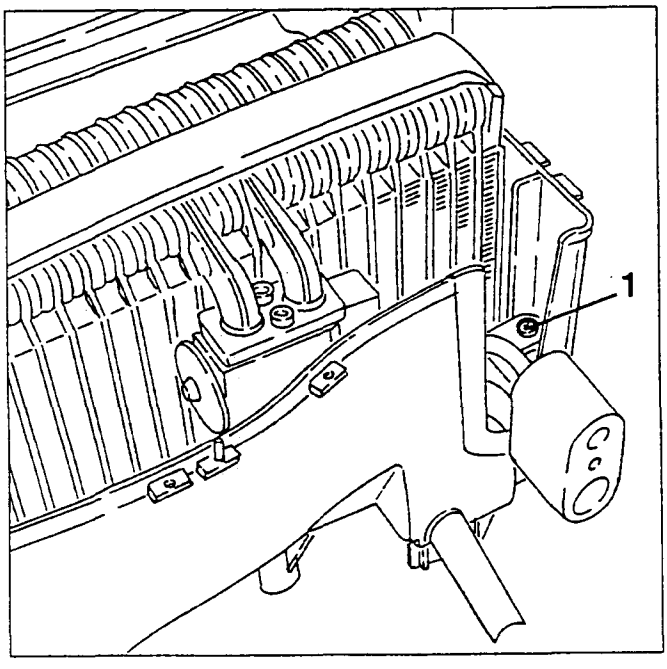
1. Remove the protective sponge.



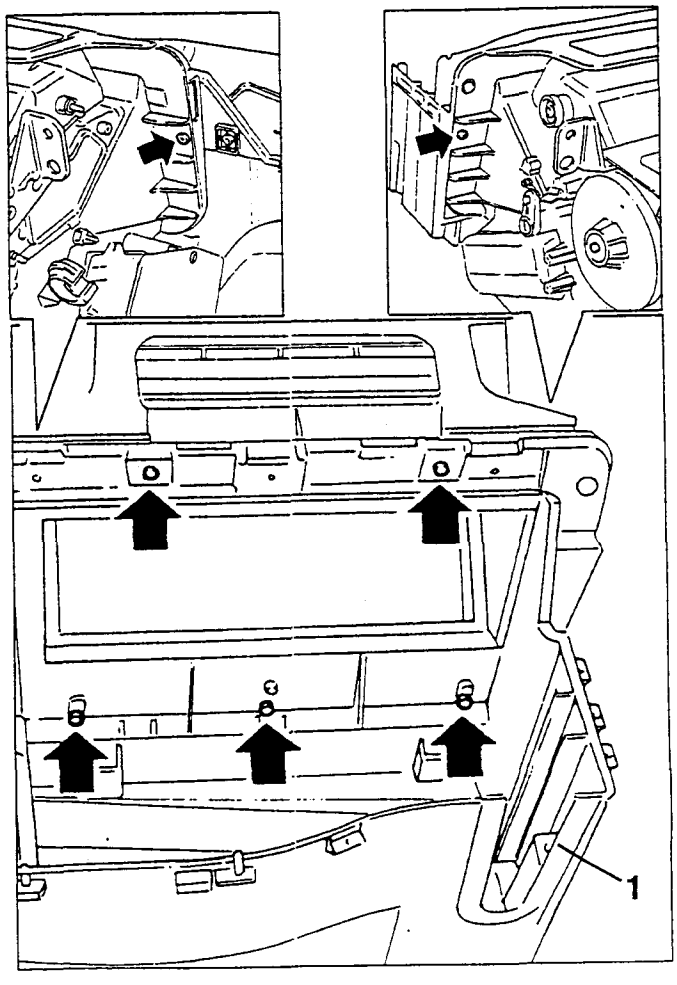
1. Withdraw the evaporator from its housing just enough to disconnect the antifrost sensor from the clamp on it.
2. Withdraw and remove the evaporator complete with expansion valve.



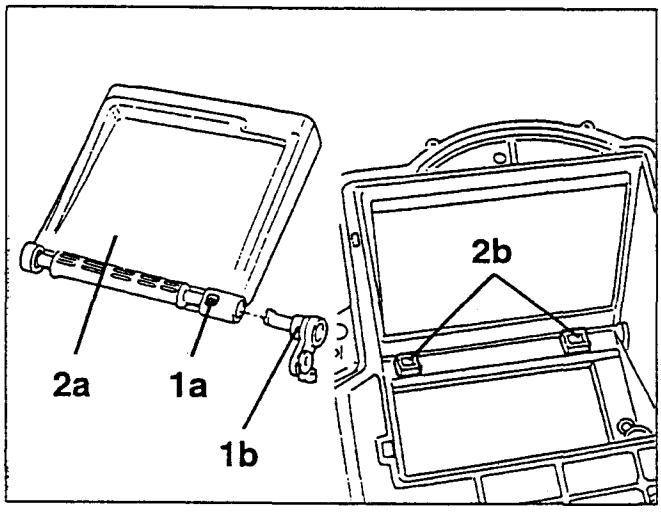
1. Slacken the screw fastening the evaporator.



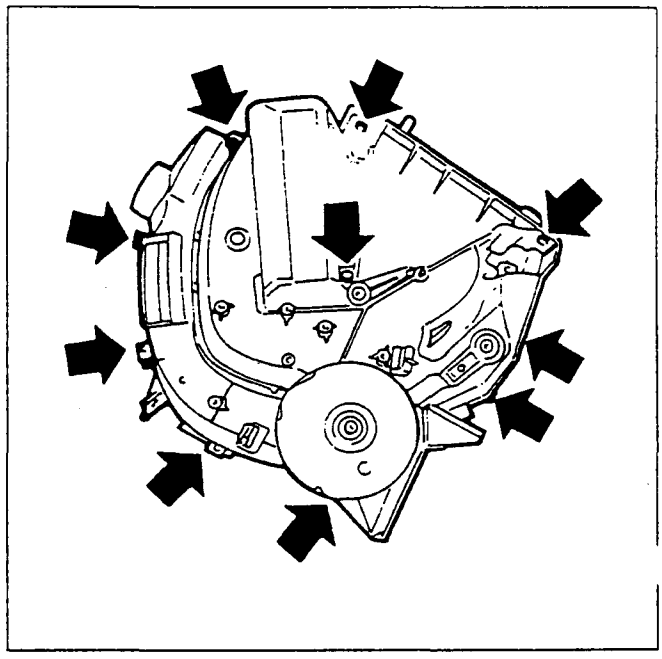
- If necessary, remove the expansion valve from its fittings slackening the fastening screws.
1. Slacken the fastening screws and remove the lower half box from the heater distributor unit.



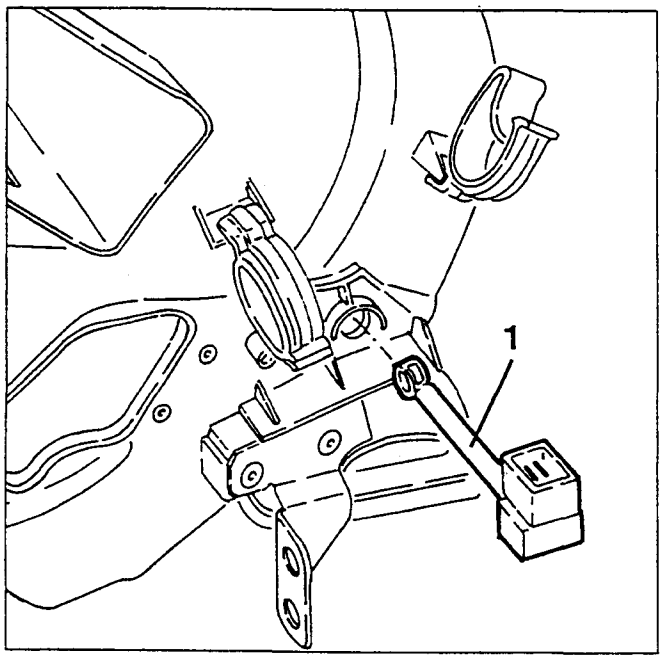
1. Work through the small slot (1a) machined on the air intake port spindle to release from it the tang of lever (1b) which may thus be withdrawn from the upper half box.
2. Release the air intake port (2a) from the upper half box bearing in mind that its spindle is dap fitted and articulates on the tabs (2b).



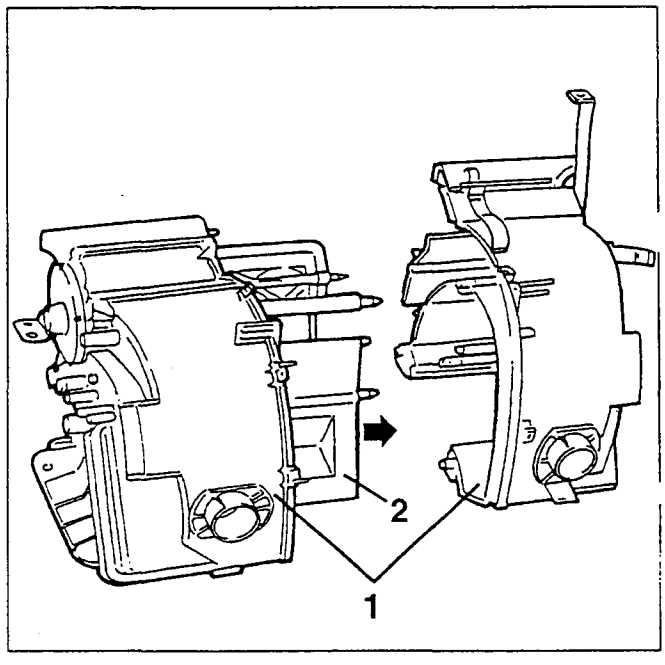
- Slacken the screws illustrated which join the two half boxes of the heater distributor unit.



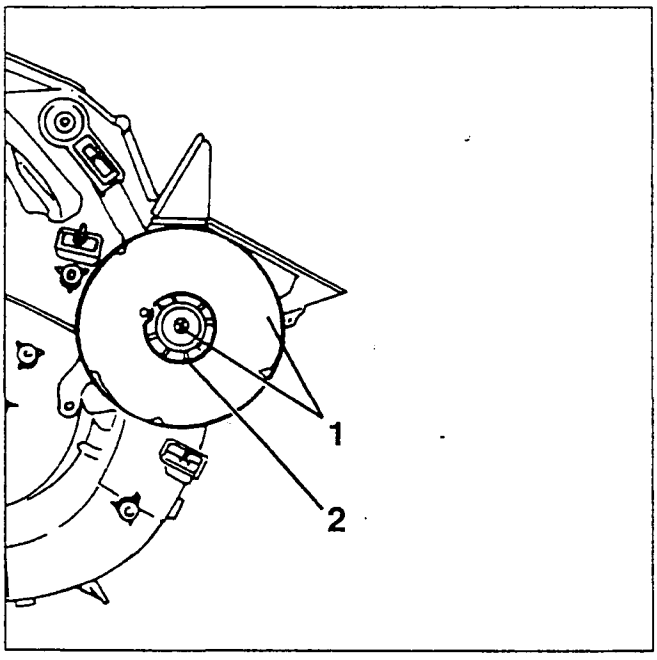
1. Remove the treated air temperature sensor.

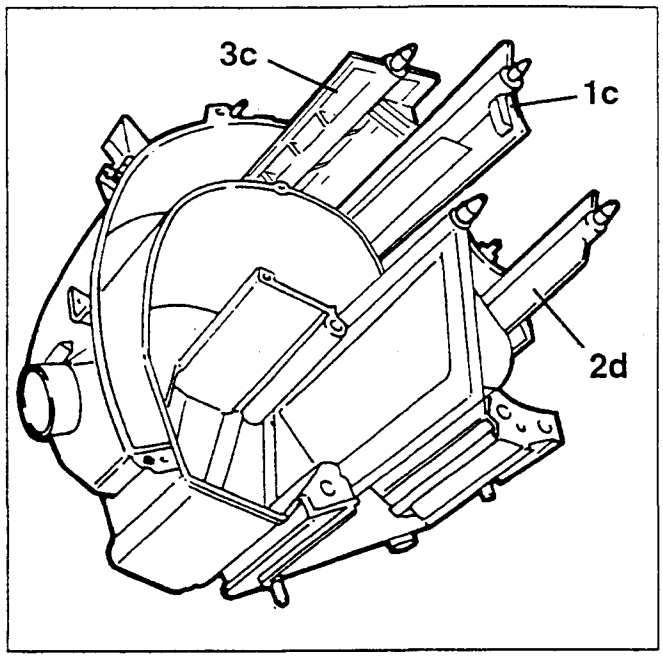


1. Release the right half box from the left one taking care not to damage the ports.
2. Withdraw the mixing port from the left half box.

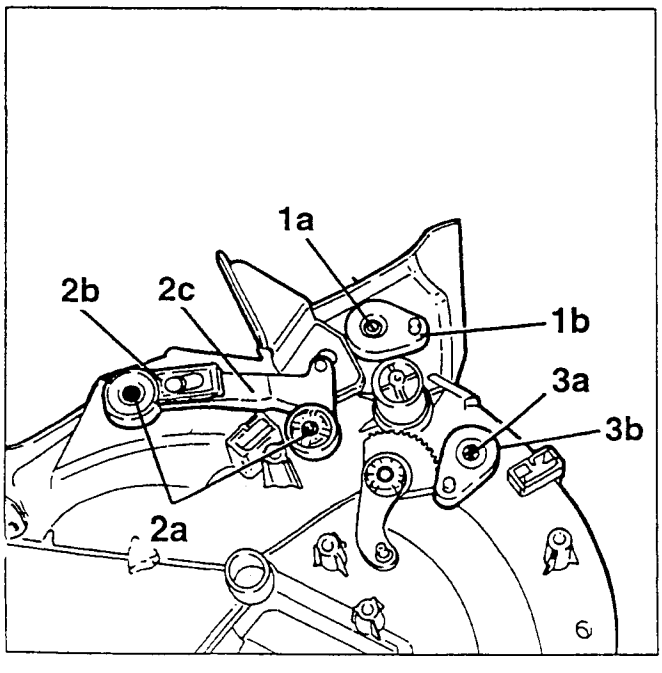


1. Slacken the fastening screw and remove the distributor disk from the left half box.
2. Retrieve the shaped plastic washer.





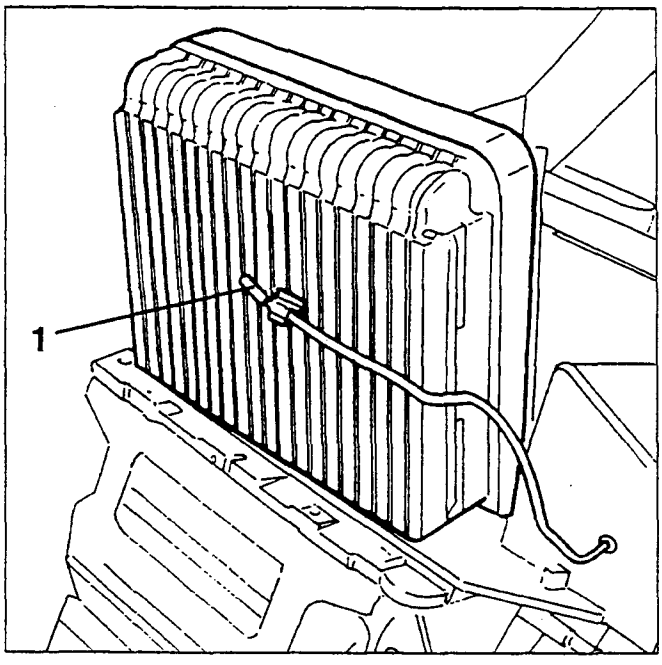
1. Slacken the fastening screw (1a) and release the lever (1b) inserted in a compulsory position on the spindle of rear upper distribution port (1c), then remove the latter from the left half box.
2. Slacken the fastening screws (2a) and release the lever (2b) with the control lever (2c) inserted in a compulsory position on the front upper distribution port sprindle (2d), then remove the latter from the left half box.
3. Slacken the fastening screw (3a) and release the lever (3b) from the lower distribution port spindle (3c).



REASSEMBLY

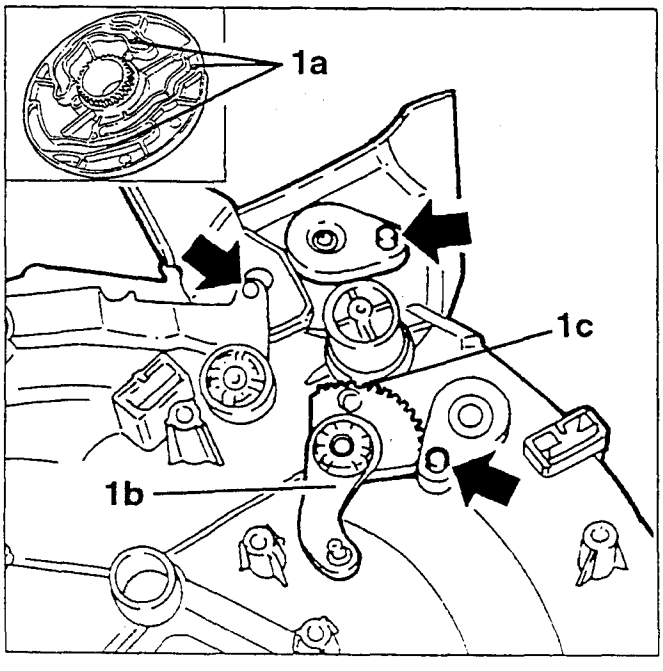
Reverse the sequence followed for disassembly adhering to the following instructions.

1. The sensitive element of the antifrost sensor must be set at the centre of the finned surface of the evaporator, therefore the catch must be inserted in a suitable position to obtain this position.

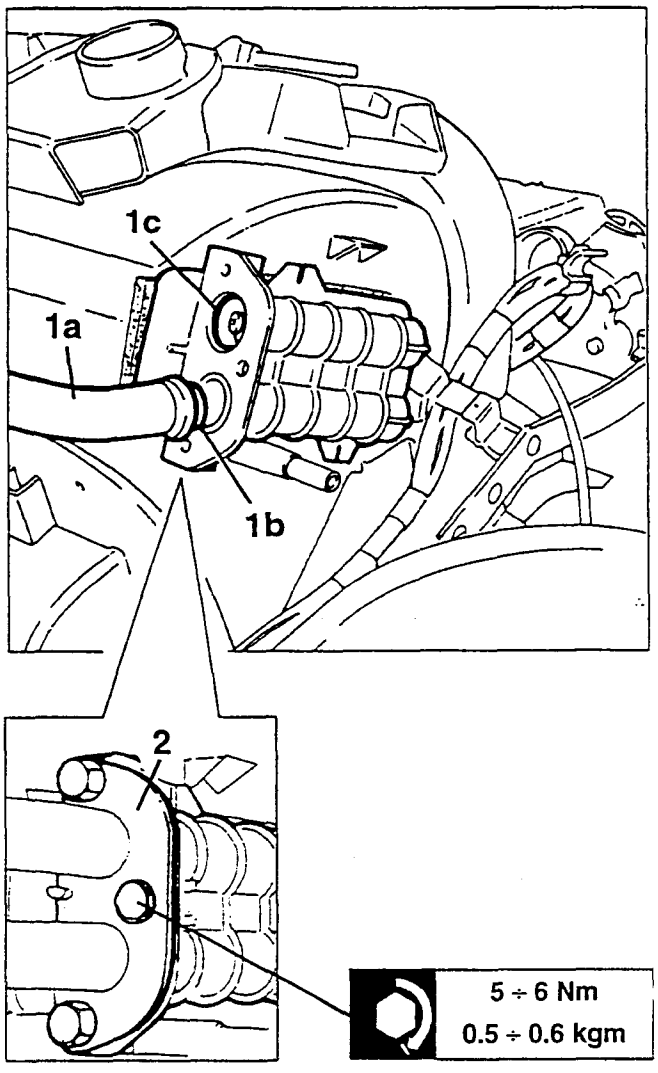


- Before reassembling the distributor disk, carefully lubricate the different grooves, for operating the levers, with TUTELA ZETA 2 grease.

1. Suitably direct the various levers so that their operating pins (indicated by the arrows) are aligned with the holes (1a) on the distributor disk when this is fitted correctly on the toothed sector (1b), i.e. when the relief (1c) of the toothed sector inserted in the special groove of the disk.



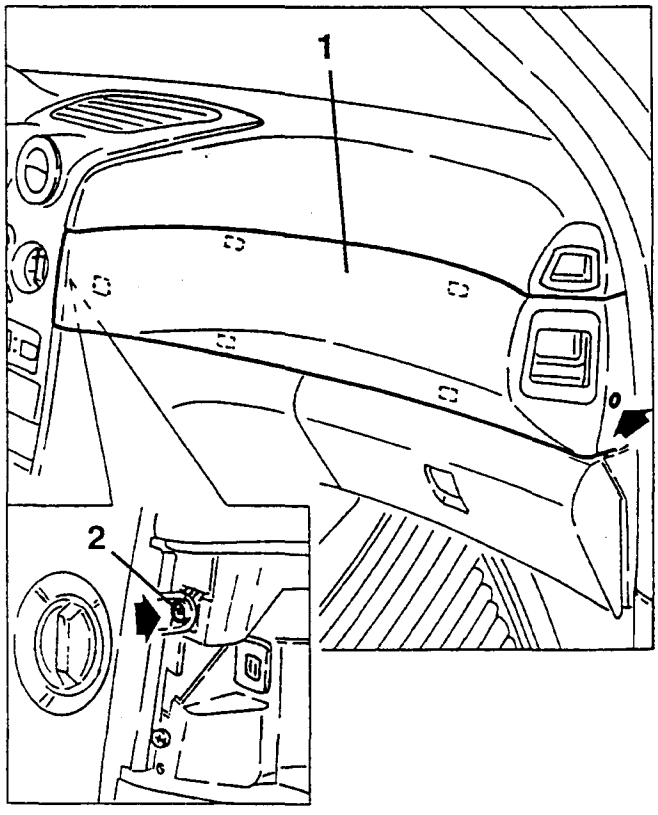
1. Before inserting the two metal pipes (1a) in the heater double fitting, check that the taper metal rings are inserted on their ends (1b) and that the O-Rings are inserted on the coupling holes (1c).
2. After inserting the above-mentioned pipes in the double fitting of the heater, fasten them using the plate directed as illustrated and the corresponding screws, taking care not to spoil the seal rings.



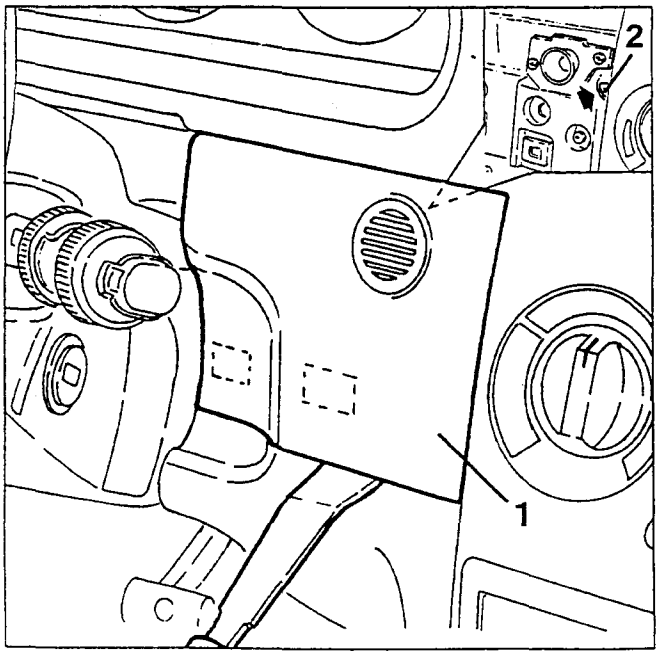
CLIMATE CONTROL SYSTEM CONTROLS

REMOVING/REFITTING

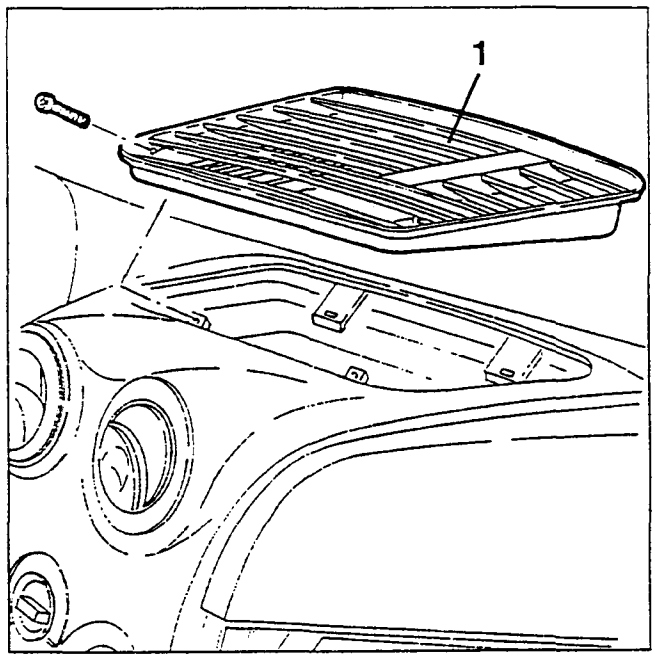
- Disconnect the battery (-) terminal.
1. Slacken the fastening screw, then prise and remove the passenger side dashboard trim.
2. Slacken the fastening screw illustrated of the climate control system controls module.



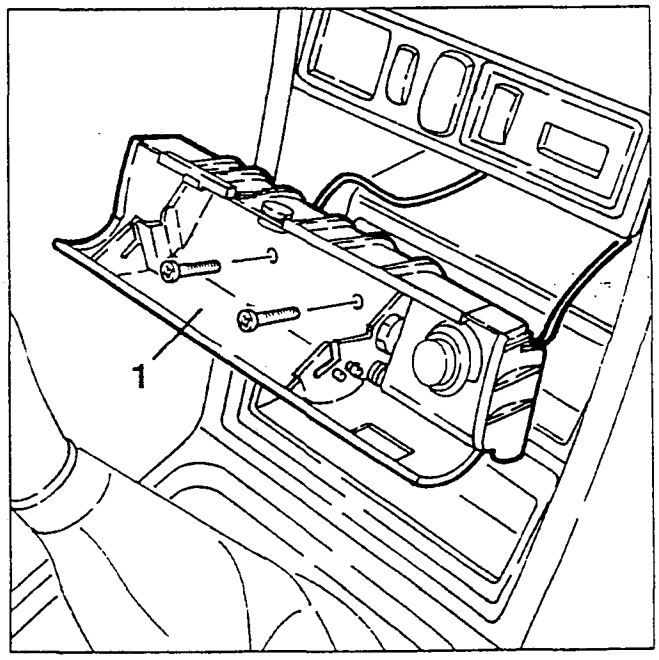
1. Remove the right hand driver's side dashboard trim prising it off the fastening clips.
2. Slacken the fastening screw illustrated of the climate control system controls module.



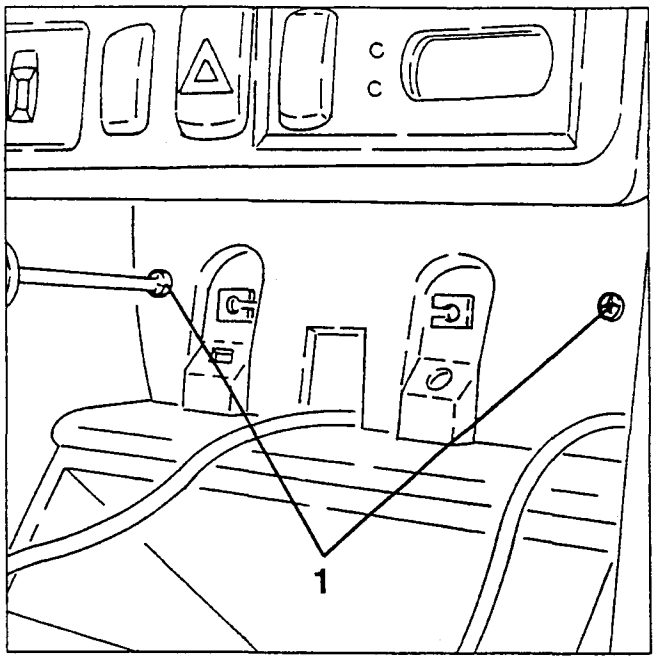
1. Slacken the two fastening screws and remove the upper dashboard air vent.



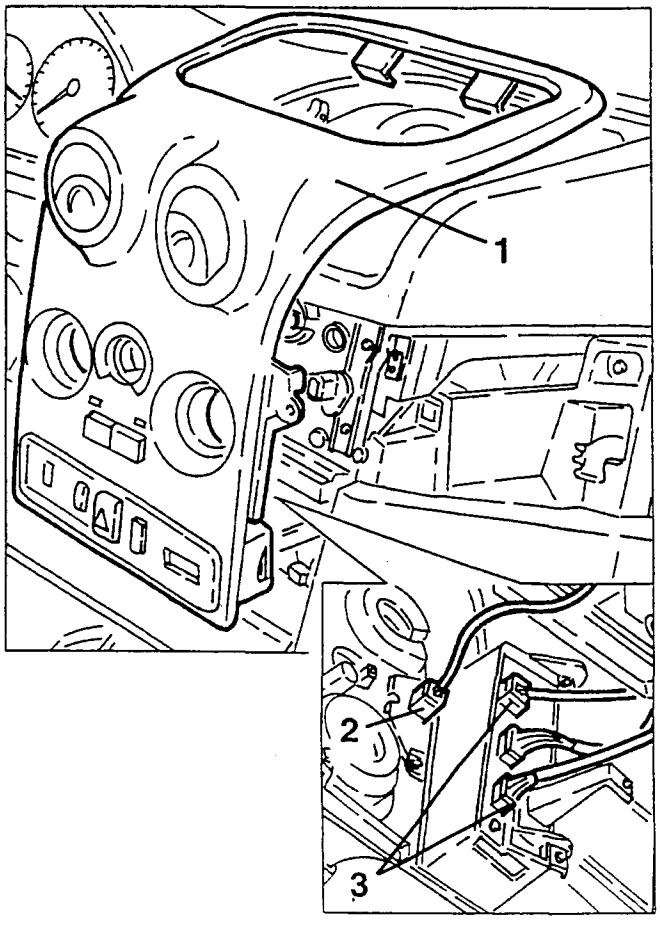
- Remove the ashtray.
1. Slacken the fasteners, then withdraw the ashtray support and set it aside without disconnecting the corresponding electrical connections.



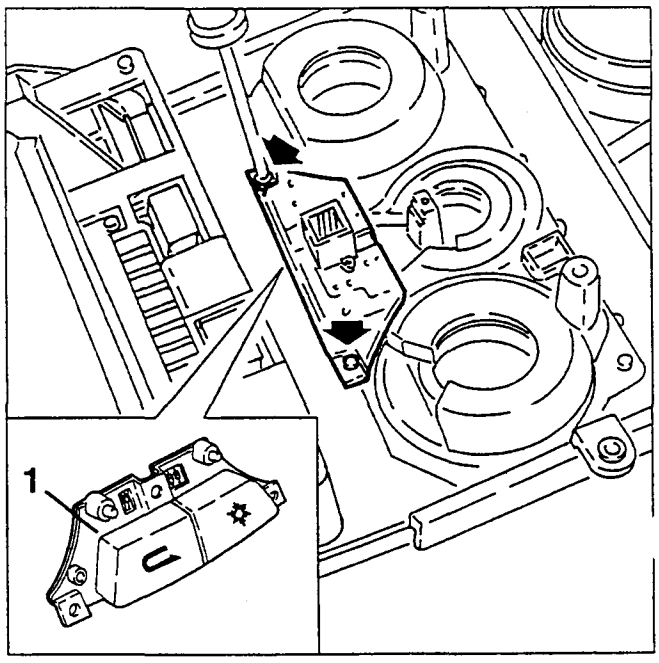
1. Slacken the two screws illustrated fastening the climate control system controls module.



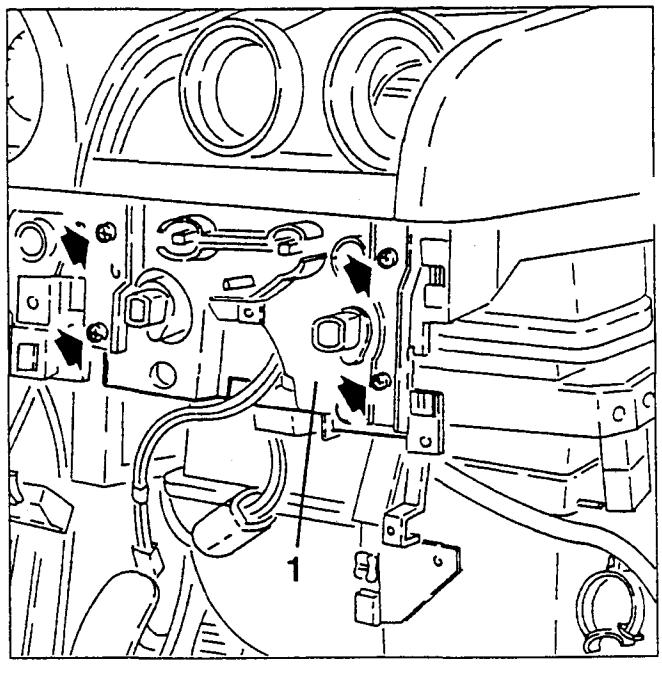
1. Withdraw the three control knobs and back away the module as necessary.
2. Disconnect the electrical connection from the set of air recirculation and compressor engagement switches.
3. Disconnect the electrical connections from the services controls, then remove the climate control system controls module.



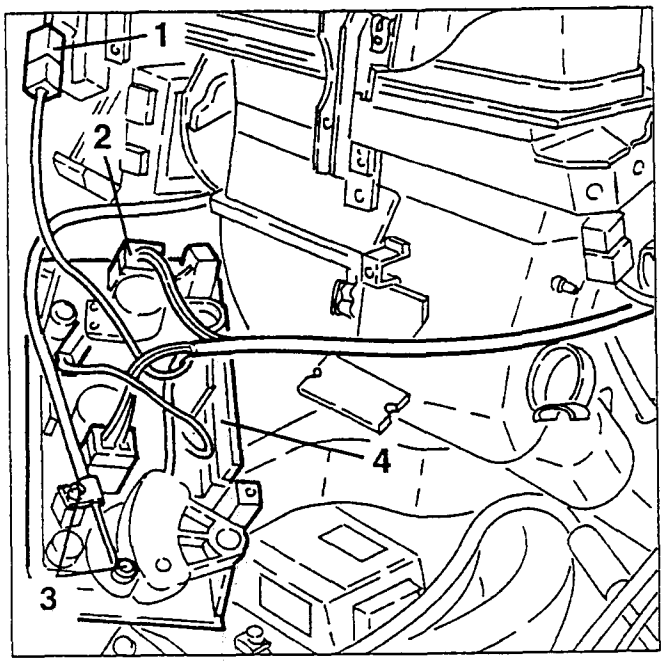
1. On the bench, if necessary, slacken the two fastening screws and remove the set of air recirculation and compressor engagement control switches.



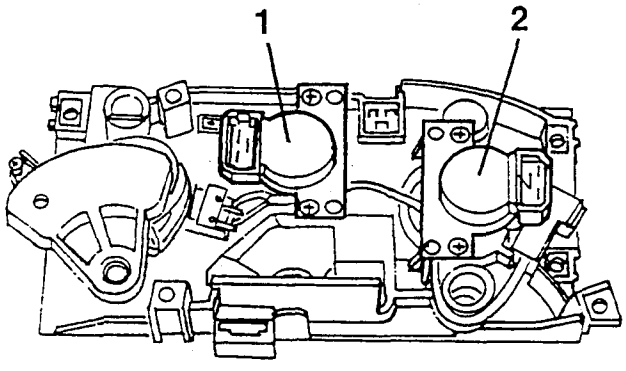
If necessary, also remove the controls group support, as described below.
- Remove the lower part of the dashboard (see GROUP 70).
1. Slacken the four fastening screws and lower the climate control system controls group.



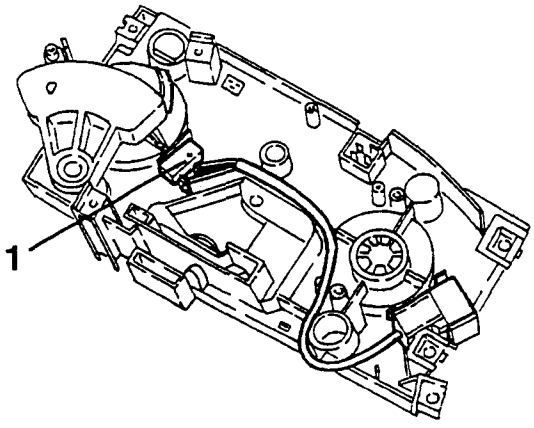
1. Disconnect the electrical connection of the inside air temperature sensor.
2. Disconnect the electrical connections from the climate control system controls support.
3. Disconnect the air distribution port bowden cable from the support.
4. Remove the support releasing it from the electrical wiring.



1. On the bench, if necessary, slacken the two fastening screws and remove the potentiometer for the air flow control knob.
2. Slacken the two fastening screws and remove the potentiometer for the required air temperature selection knob.



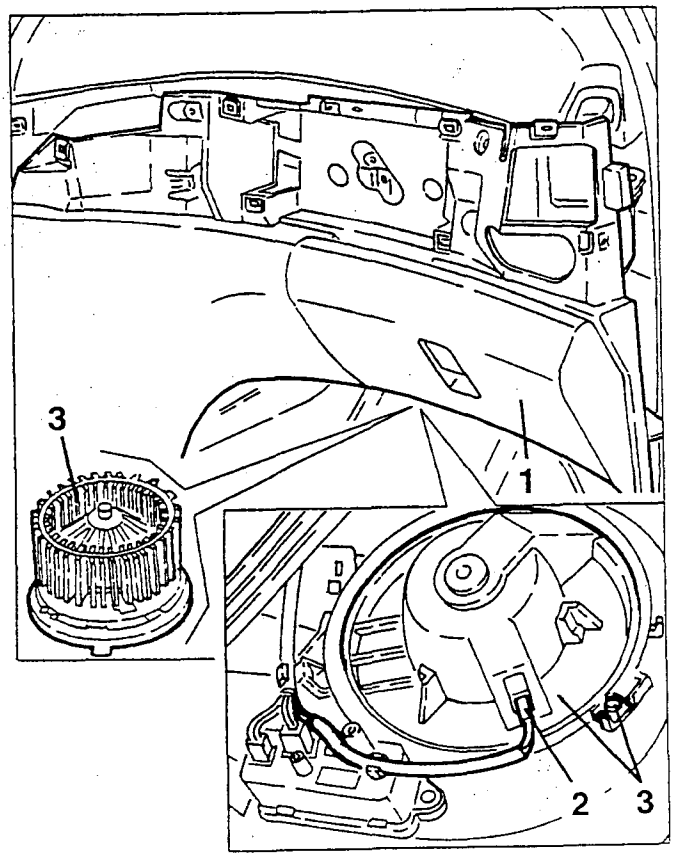
1. Remove the "MAX DEF" function control microswitch.



FAN

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Move away the lower part of the dashboard as illustrated (see GROUP 70).
2. Disconnect the electrical connection from the fan.
3. Slacken the fastening screw, raise the tab and turn the fan counter-clockwise as far as its stop, then withdraw it from the climate control group.



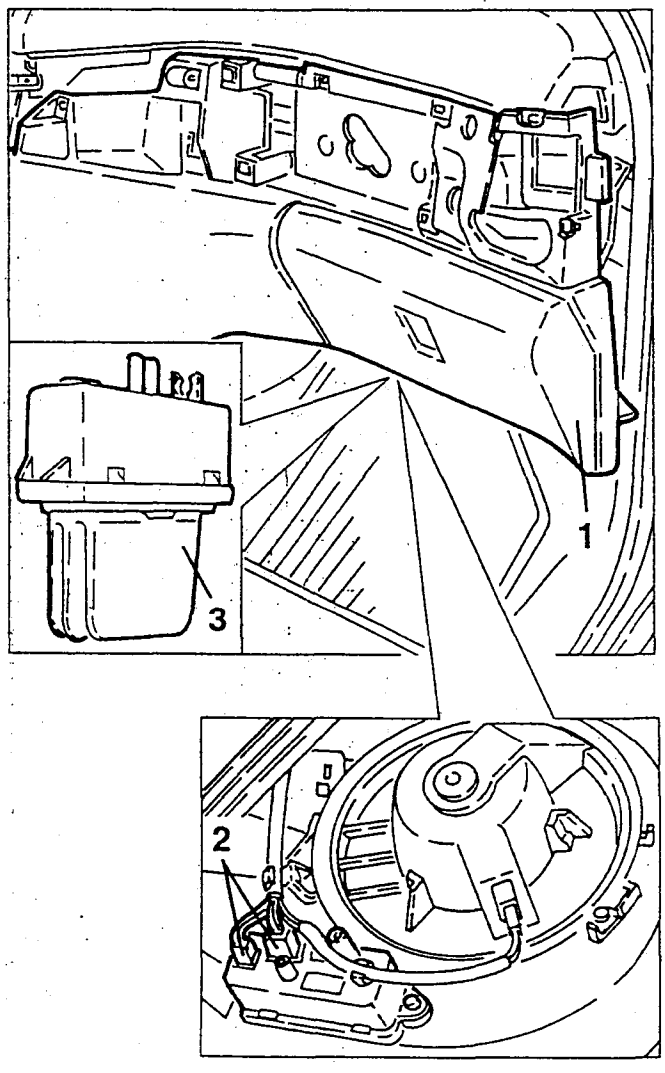
ELECTRONIC FAN SPEED REGULATOR

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Move aside the lower part of the dashboard as illustrated (see GROUP 70).

NOTE: To facilitate access to the electronic fan speed ragulator, it is advisable to move the floor mat and remove the injection control unit cover.

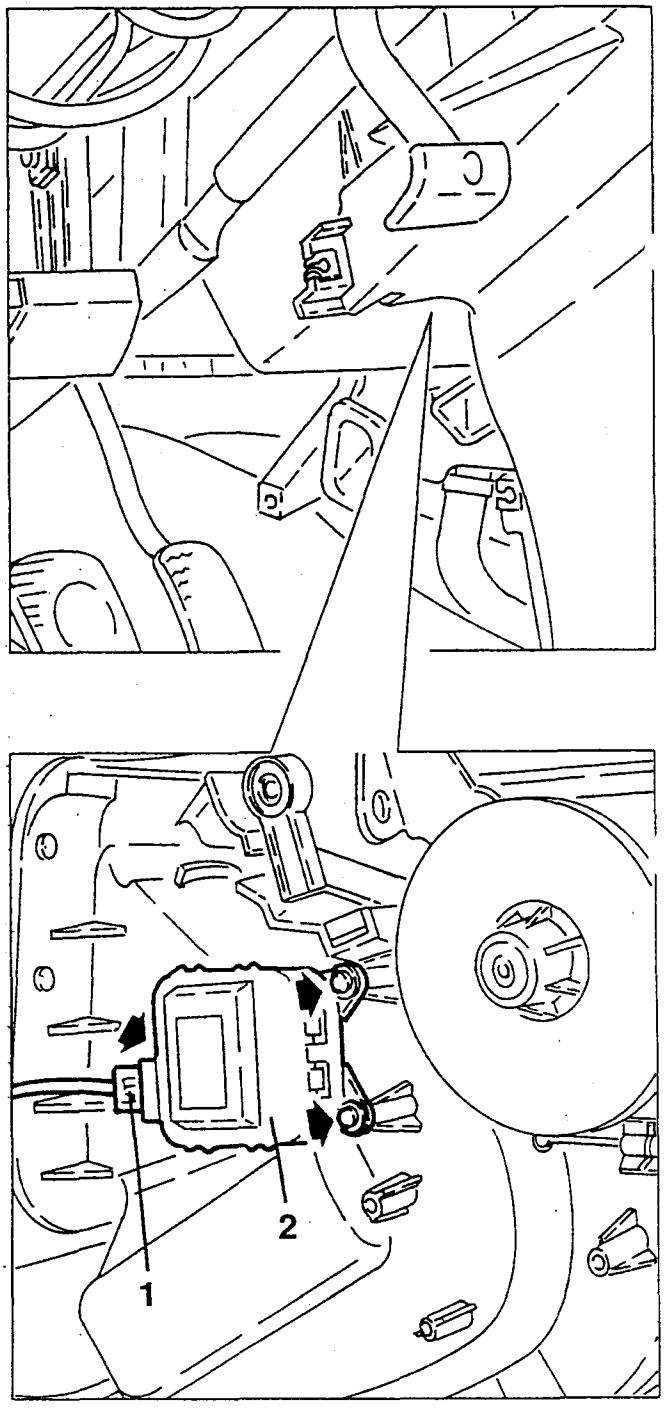
2. Disconnect the electrical connections from the electronic fan speed regulator.
3. Slacken the two fastening screws and remove the electronic fan speed regulator.



AIR MIXING PORT CONTROL MOTOR

REMOVING/REFITTING

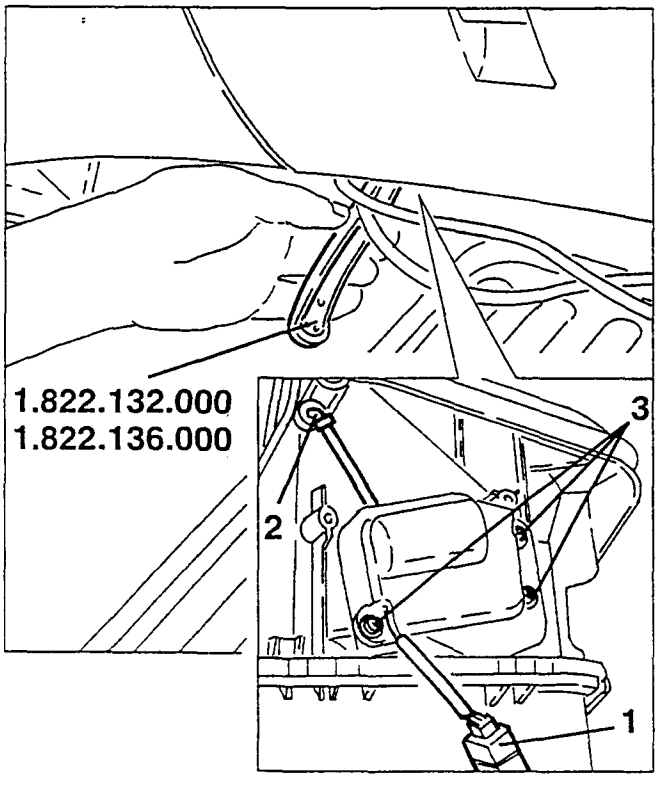
- Disconnect the battery (-) terminal.
- Remove the valve box trim (see GROUP 70).
1. Disconnect the electrical connection from the air mixing port control motor.
2. Slacken the three fastening screws and remove the air mixing port control motor.



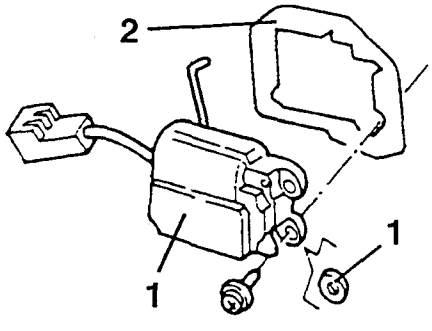
OUTSIDE/RECIRCULATION AIR PORT CONTROL MOTOR

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection of the outside/recirculation air port control motor.
2. Disconnect the control rod from the coupling on the outside/recirculation air port.
3. Slacken the three cross-slot screws fastening the motor using tool no. 1.822.132.000 with insert no. 1.822.136.000.



1. Remove the outside/recirculation air port control motor complete with control rod and grommets on the fastening holes.
2. Retrieve the rear plate.

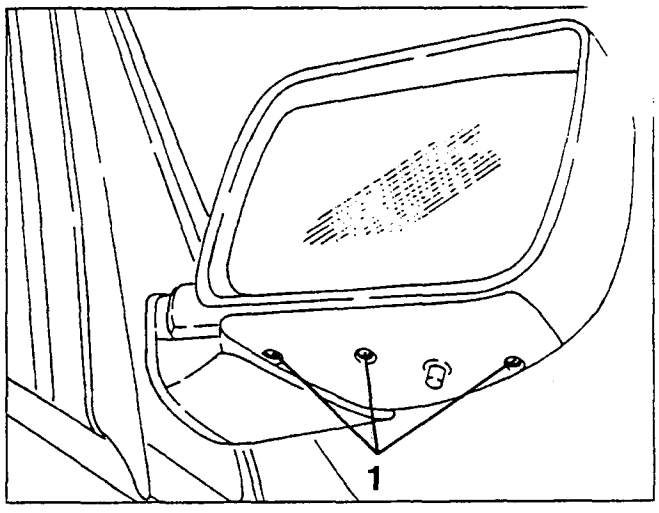


When refitting replace the cross-slot motor fastening screws with socket screws to be tightened with wrench no. 1.822.132.000 and insert of set no. 1.822.136.000.
Also check the correct position of the grommets in the motor fastening holes.

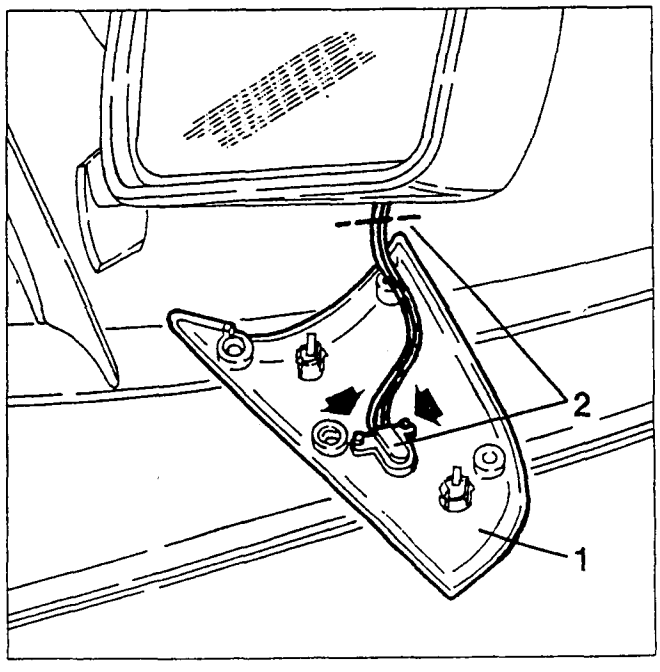
OUTSIDE AIR TEMPERATURE SENSOR

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Slacken the fastening screws of the right rear view mirror lower trim.



1. Lower the mirror trim as necessary, then remove it after slackening the two screws that fasten it to the outside temperature sensor.
2. Cut the two electrical cables connecting the outside air temperature sensor where illustrated, then remove it.
- Install a special connector on the electric cables cut previously and on the new outside air temperature sensor to be used.
- Install the new outside air temperature sensor connecting it with the cable cut previously through the connector fitted.
- Complete refitting reversing the sequence followed for removal.

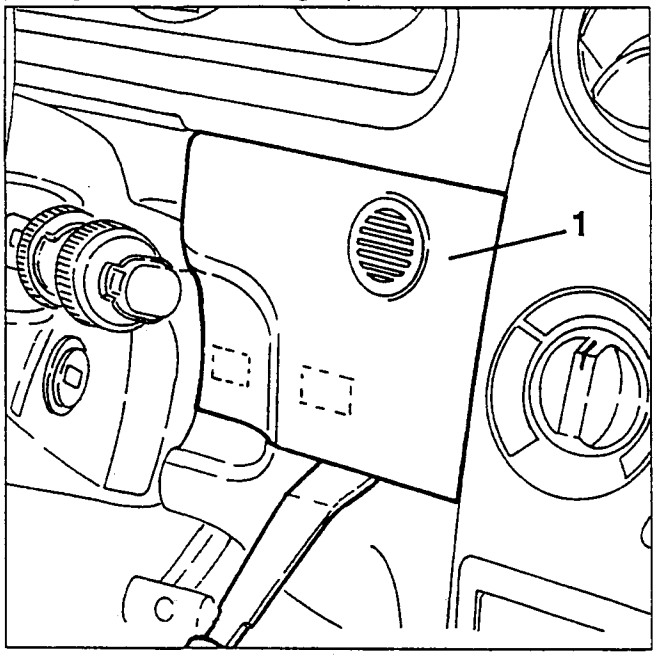


PASSENGER COMPARTMENT AIR TEMPERATURE SENSOR

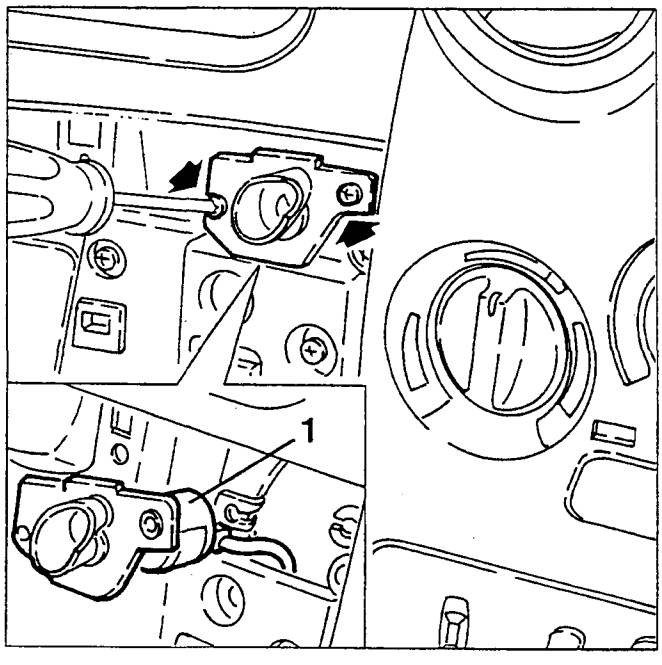
REMOVING/REFITTING

- Disconnect the battery (-) terminal.

1. Remove the right driver's side dashboard trim prising it off the fastening clips.



1. Slacken the two fastening screws, them withdraw the sensor just enough to disconnect the electrical connection and remove it.

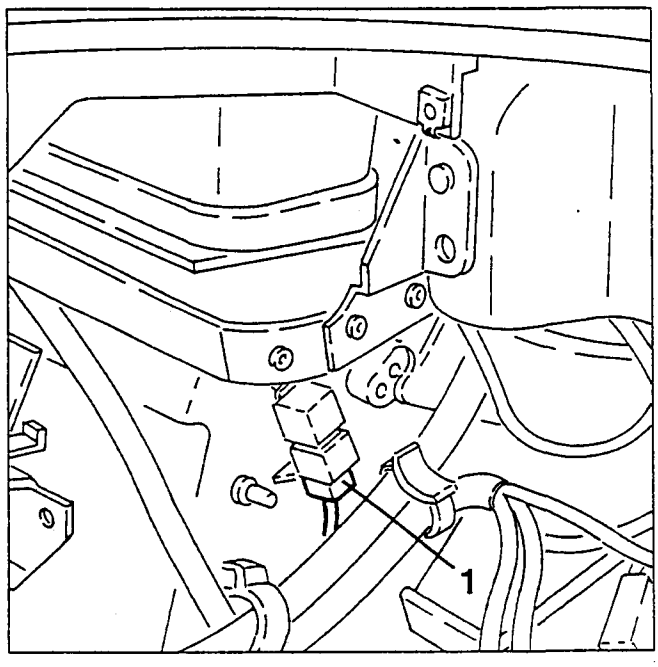


TREATED AIR TEMPERATURE SENSOR

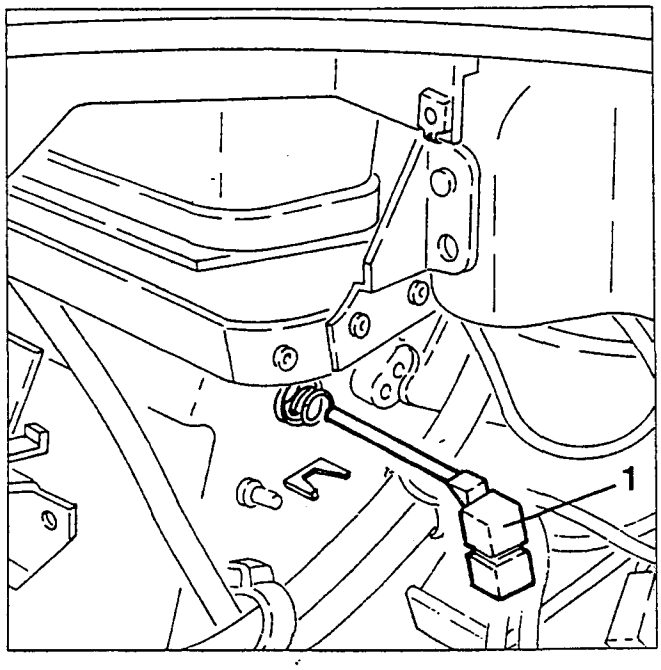
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Remove the lower part of the dashboard (see GROUP 70).

1. Disconnect the electrical connection from the treated air temperature sensor.



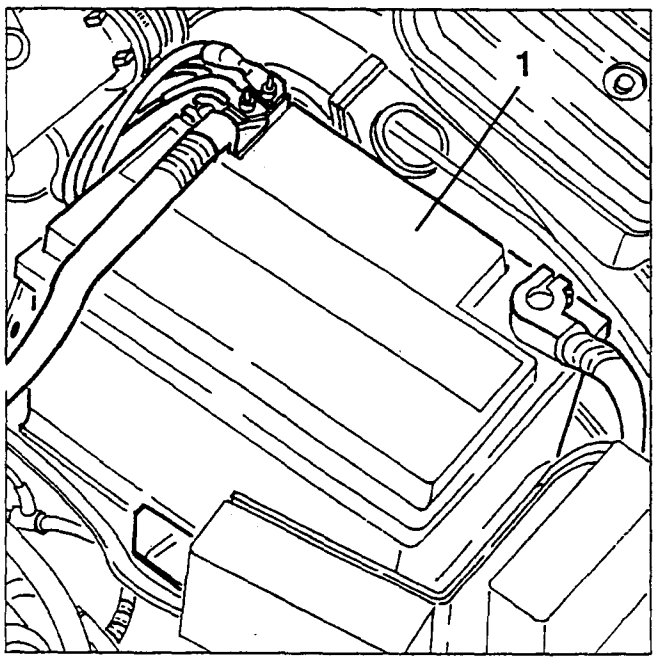
1. Withdraw and remove the treated air temperature sensor from its housing.



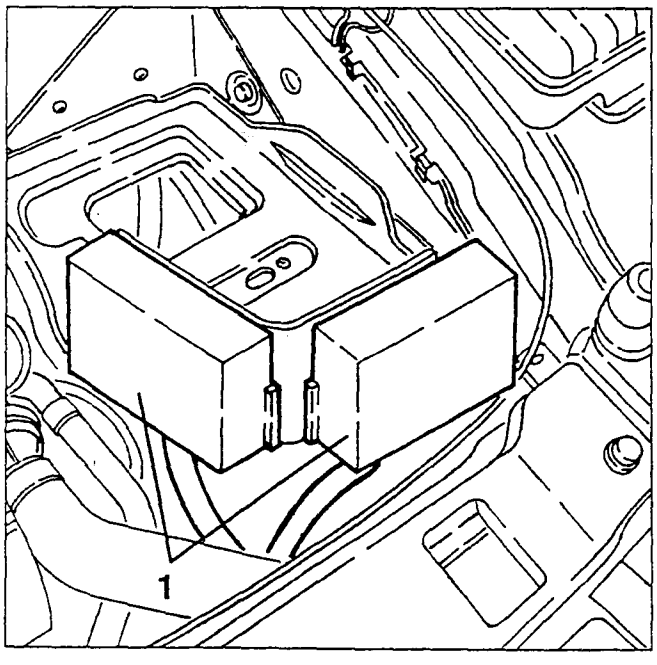
DRIER FILTER

REMOVING/REFITTING

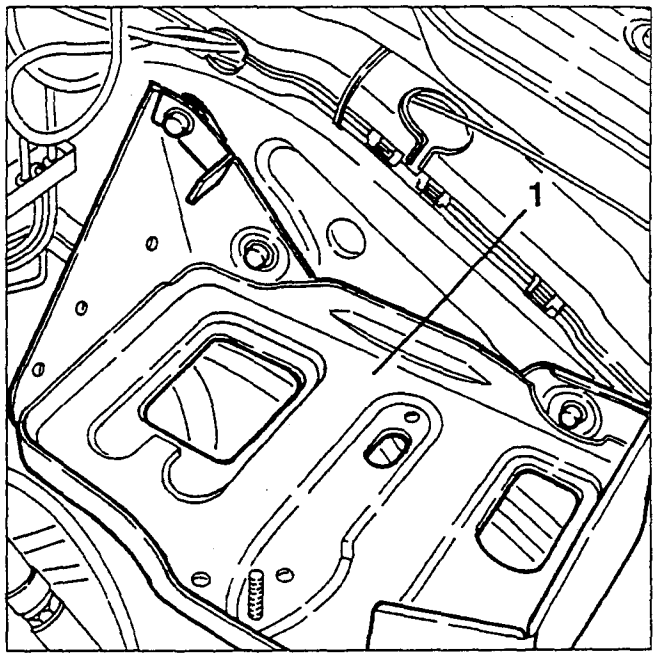
- Drain the fluid from the climate control system into a suitable container (see specific paragraph).
1. Disconnect te terminals and remove the battery.



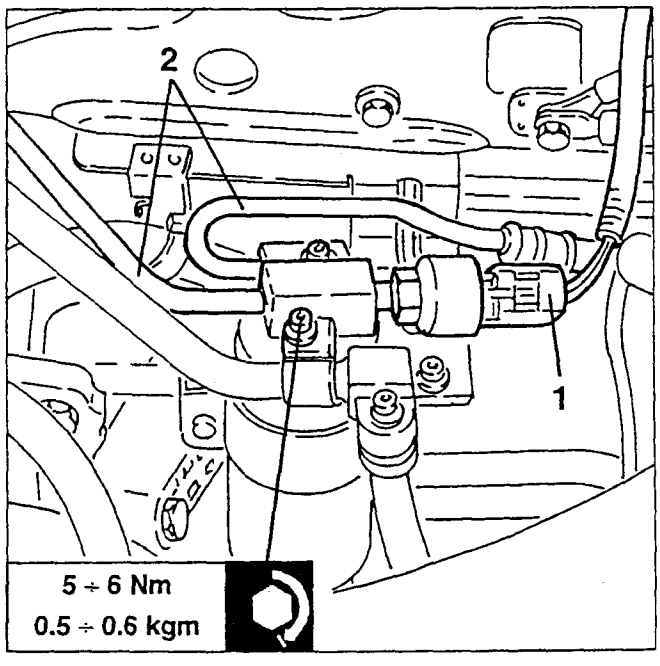
1. Release the two relay boxes from the battery support and set the aside.



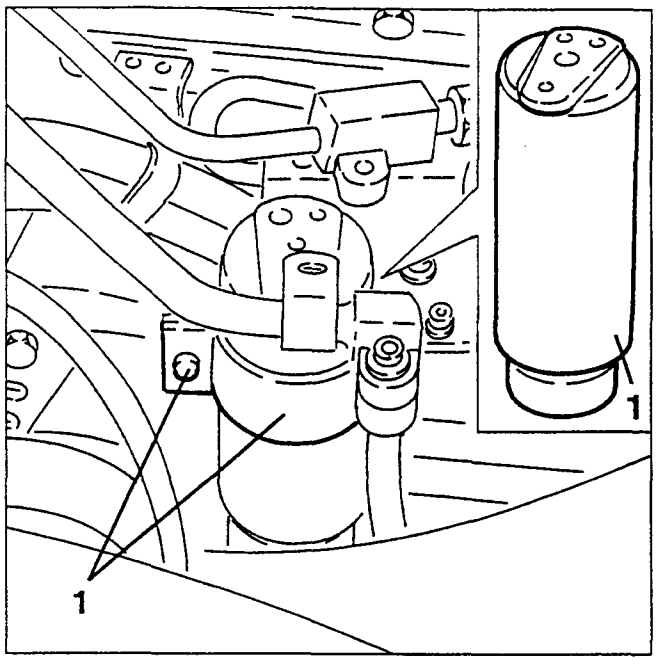
1. Slacken the fastening screws and remove the battery support complete with drain pipe after releasing this from the wheel house.



1. Disconnect the electrical connection from the four level pressure switch.
2. Slacken the two fastening screws and disconnect the coolant fluid stiff pipes from the drier filter.



1. Slacken the fastening clamp and remove the drier filter withdrawing it upwards.

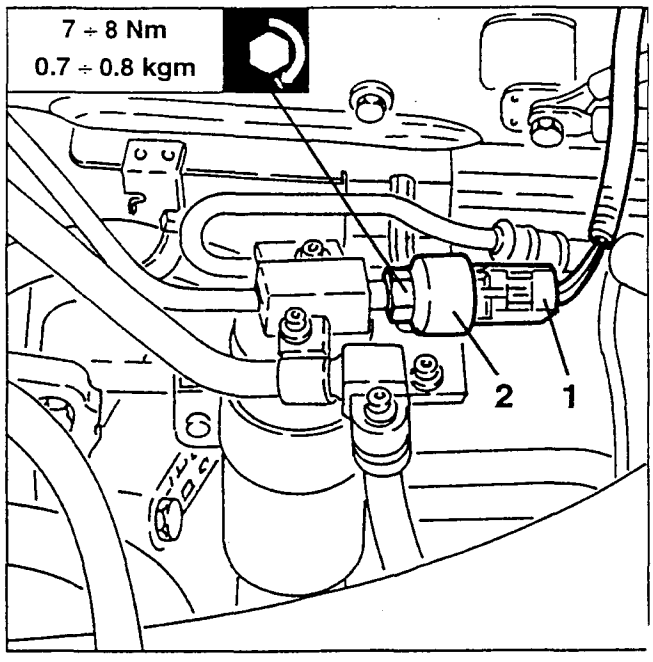


NOTE: To prevent the drier filter from absorbing too much humidity which would adversely affect the way it works, only 15 minutes at the most should lapse from the time it is connected to the system up to the end of assembly; if not, seal with seal plugs the filter inlet and outlet ducts or the free ends of the pipes connected to it.

FOUR-LEVEL PRESSURE SWITCH

REMOVING/REFITTING

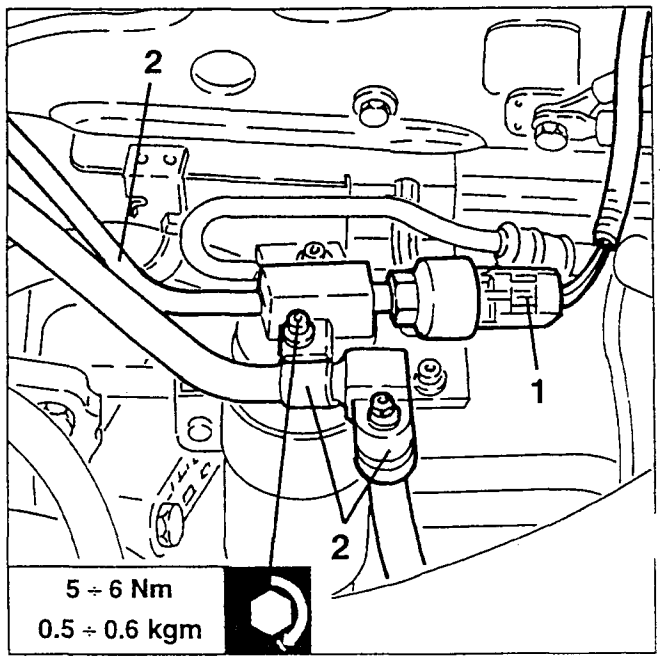
- Disconnect the battery (-) terminal.
- To gain access to the pressure switch, remove the battery and its support proceeding as described in the procedure "Drier Filter - Removing/Refitting".
1. Disconnect the electrical connection from the four-level pressure switch.
2. Slacken and remove the four-level pressure switch.



PIPES FROM EVAPORATOR TO DRIER FILTER

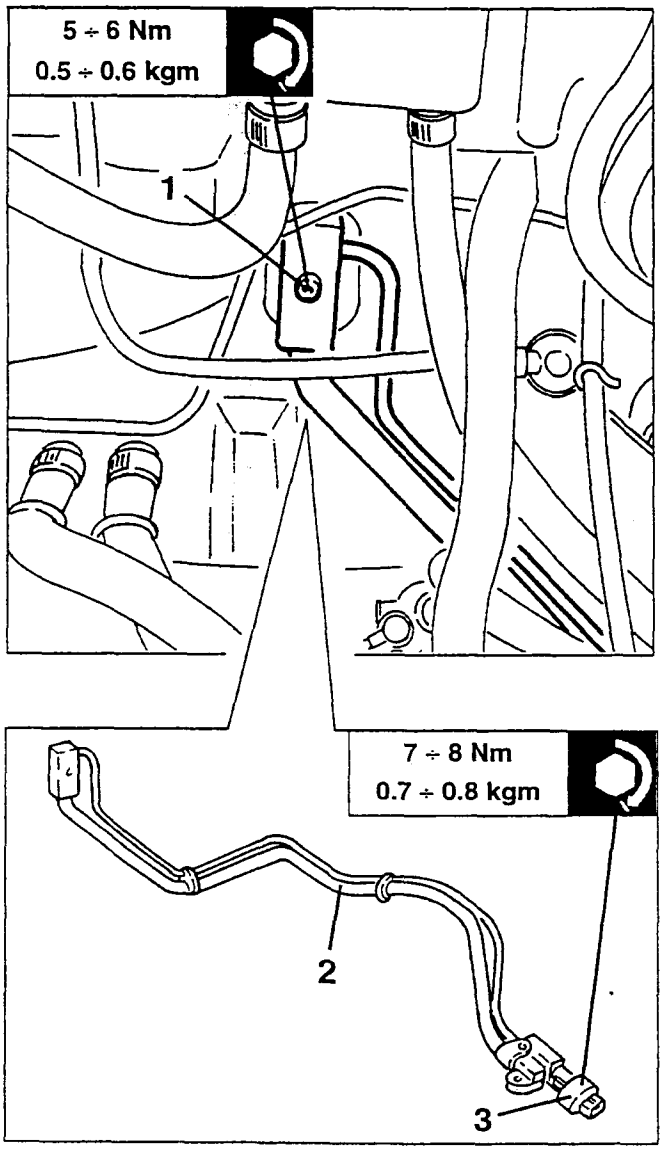
REMOVING/REFITTING

- Drain the fluid from the climate control system (see specific paragraph).
- Remove the battery, its support and the corrugated sleeve proceeding as described in the procedure "Duct assembly and heater-distributor unit - Removing/Refitting".
- Using a suitable syringe, empty the brake-clutch fluid reservoir.
1. Disconnect the electrical connection from the four-level pressure switch.
2. Slacken the fastening screw and nut, then disconnect the stiff pipe from the drier filter and the intermediate connector.



- Remove the power steering piping retainer bracket.
- Remove the damping mass from the gearshift bowden cable support bracket.
- Remove the clutch pump outlet pipe.

1. Slacken the screw fastening coolant fluid inlet and outlet pipes from the evaporator.
2. Remove the pipes connecting the evaporator to the drier filter and to the intermediate connector of the compressor intake pipe.
3. If necessary, on the bench, remove the four-level pressure switch from the pipe.

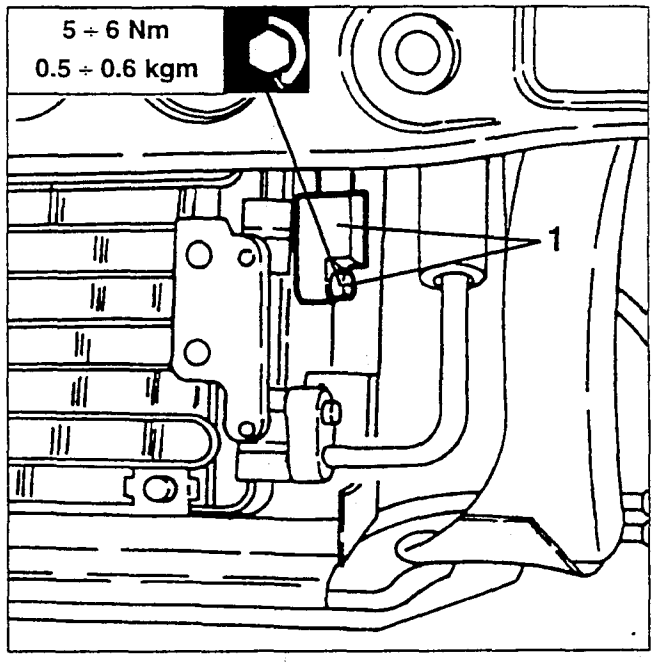


PIPE FROM COMPRESSOR TO CONDENSER

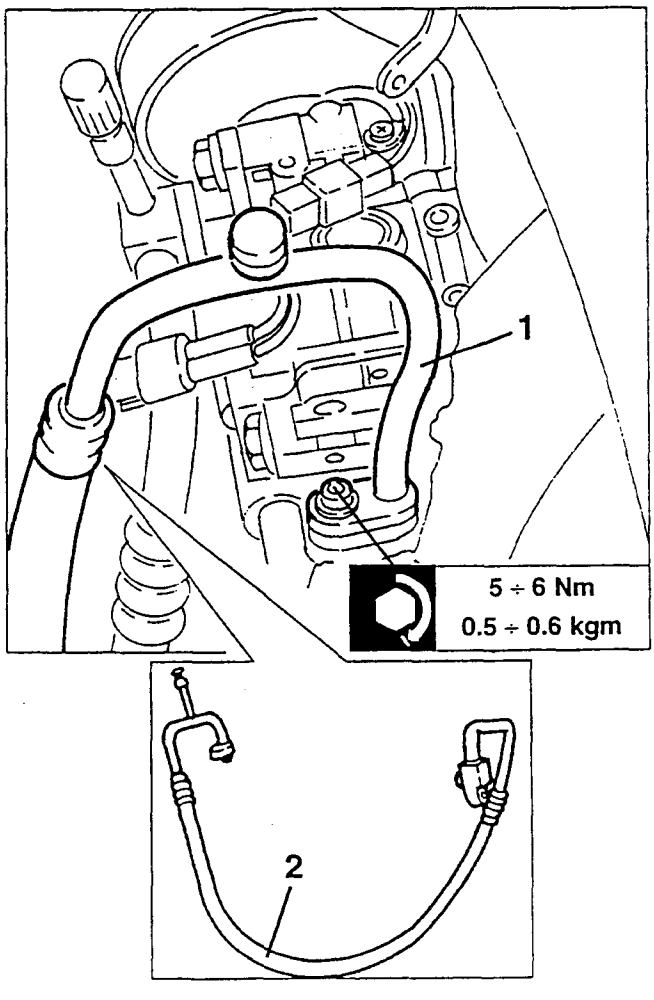
REMOVING/REFITTING

- Set the car on a lift.
- Drain the fluid from the climate control system (see specific paragraph).
- Remove the front bumper (see GROUP 70).

1. Slacken the fastening screw and disconnect from the condenser the coolant fluid delivery pipe leading from the compressor.



1. Slacken the fastening screw and disconnect from the compressor the coolant fluid delivery pipe to the condenser.
2. Free from the fastening clamps and remove the coolant delivery pipe from the compressor to the condenser.

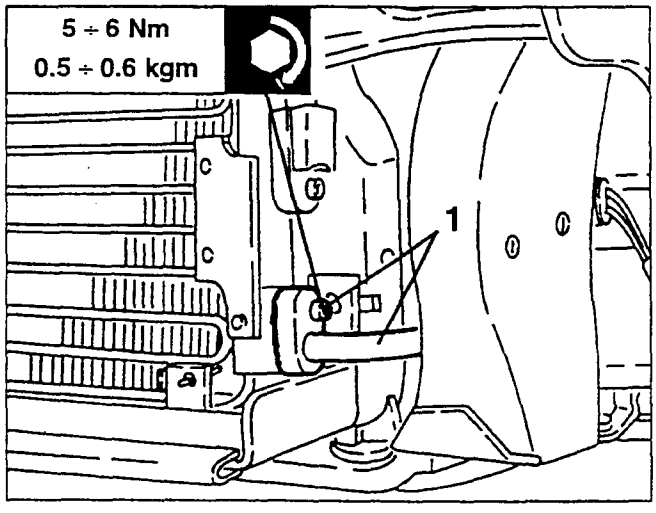


PIPE FROM DRIER FILTER TO CONDENSER

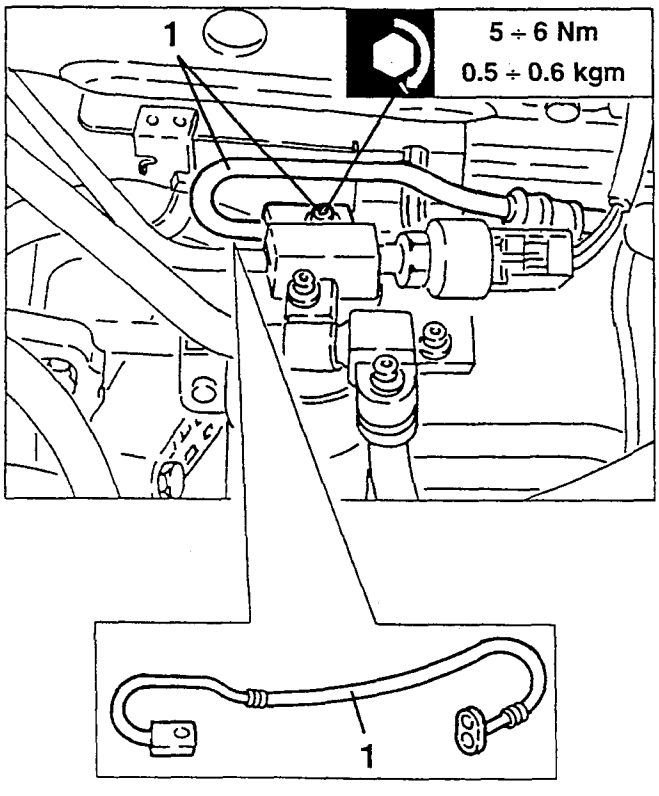
REMOVING/REFITTING

- Set the car on a lift.
- Drain the fluid from the climate control system (see specific paragraph).
- Remove the front bumper (see GROUP 70).

1. Slacken the fastening screw and disconnect the coolant outlet pipe from the condenser.



1. Working under the car slacken the fastening screw and disconnect the pipe leading from the condenser from the drier filter, then remove it.

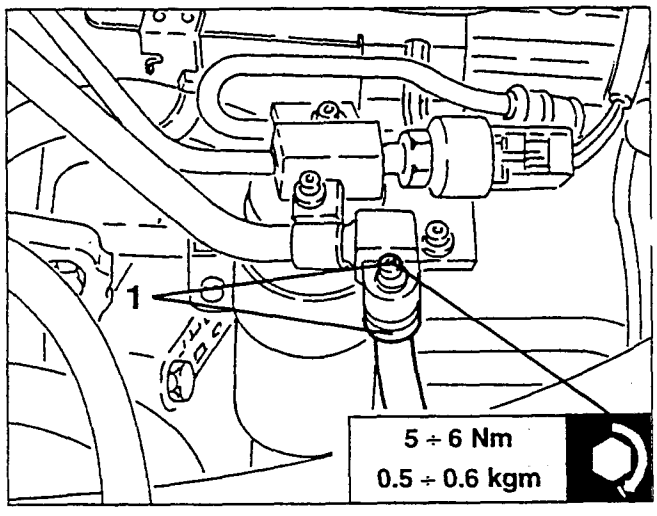


PIPE FROM THE COMPRESSOR TO THE INTERMEDIATE CONNECTOR

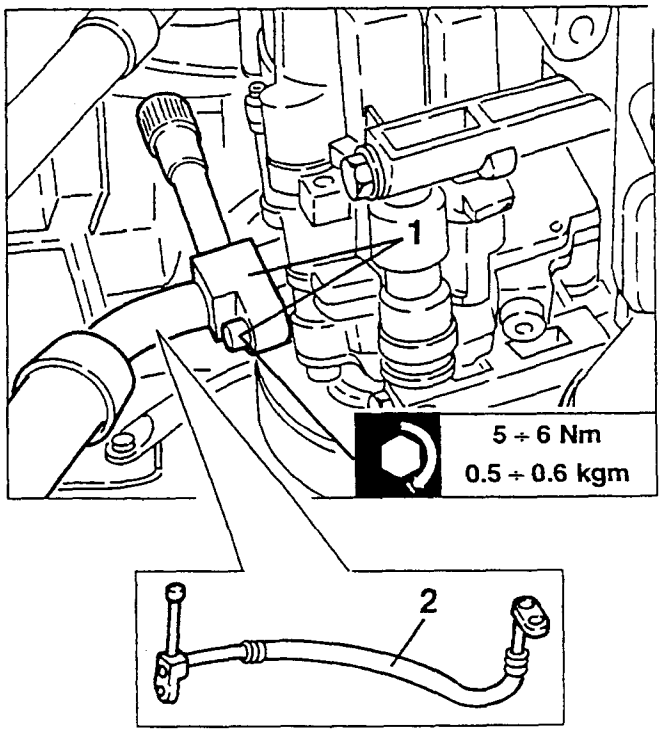
REMOVING/REFITTING

- Set the car on a lift.
- Drain the fluid from the climate control system (see specific paragraph).

1. Working under the car, slacken the fastening nut and disconnect the intermediate connector of the coolant delivery pipe from the compressor to the evaporator.

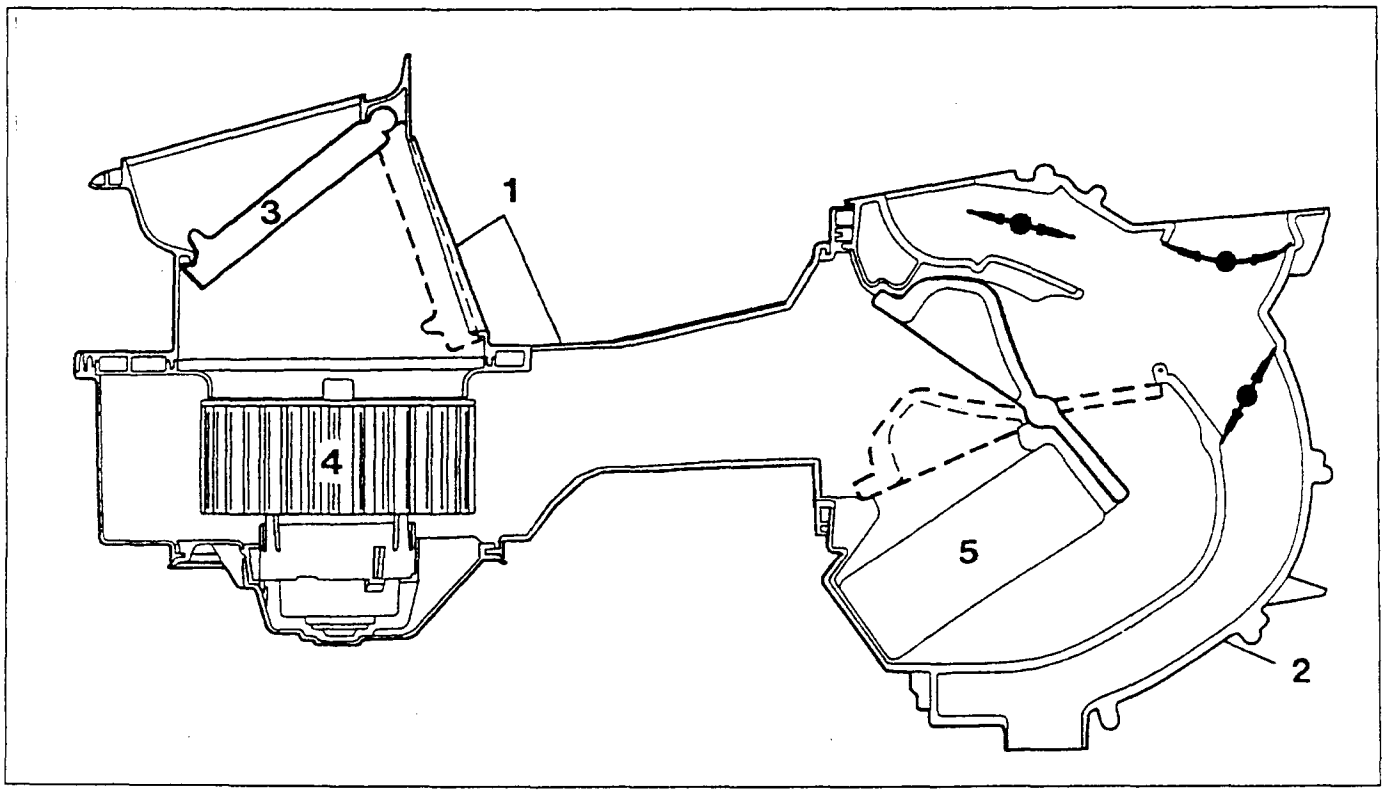


1. Slacken the fastening screw and disconnect from the from the compressor the coolant delivery pipe to the evaporator.
2. Release from the fastening clamps and remove the coolant delivery pipe from the compressor to the intermediate connector.



DESCRIPTION

The assembly represented below in cross-section is the main component of the system and it comprises a duct (1) and a heater distributor unit (2).
The duct (1) is formed of two sections, a lower one and an upper one; the right hand part of the latter is suitably shaped so that it mates perfectly with the right upper part of the dashboard surface (area under the windscreen of the partition between the engine and passenger compartment) with which it is in contact.
On the upper part of the right hand side of the duct there are two rectangular apertures; the first is in an almost horizontal position and mates with the one on the dashboard, thus communicating with the outside environment, while the other, facing the passenger in an almost vertical position, allows the inlet of the air present in the passenger compartment (recirculation).
In the upper inner part of the duct there is a flap (3) which, duly directed through a slider and hose and shaft, can take any intermediate position between the closing limits of the above-mentioned two apertures.
Inside the duct, dap fitted on the lower part in correspondence with the above-mentioned apertures there is a fan (4) which, duly supplied at different voltage ratings, can turn at four different speeds.
The heater - distributor unit mainly comprises a box housing the following:
- centrally a mixing flap which, duly directed by a knob through a bowden cable, allows or prevents the entire flow of air withdrawn by the fan (4), or part of it, to flow against the finned surface of the heater radiator (5);
- at bottom centre the heater radiator (5) the inlet and outlet fittings of which protrude from the right side surface of the above-mentioned unit;
- above and at the front four ports which, duly directed by a knob through a hose and shaft, a toothed sector, a disk with grooves acting as distributor, shutter or fully close the section of the inner ducts which send the air respectively to the feet, front vents and windscreen demisting vents.



FURTHER INFORMATION ON THE DESCRIPTION OF THE COMPONENTS FORMING THE SYSTEM REMOVING/REFITTING THE LATTER IS NOT AVAILABLE AT THE TIME OF GOING TO PRESS.

146

BODYWORK 70

THIS GROUP ONLY CONTAINS THE SPECIFIC SUBJECTS FOR THE 146 MODELS; FOR ITEMS NOT MENTIONED HEREIN REFER TO THE GROUP 70 FOR THE 145 MODELS.

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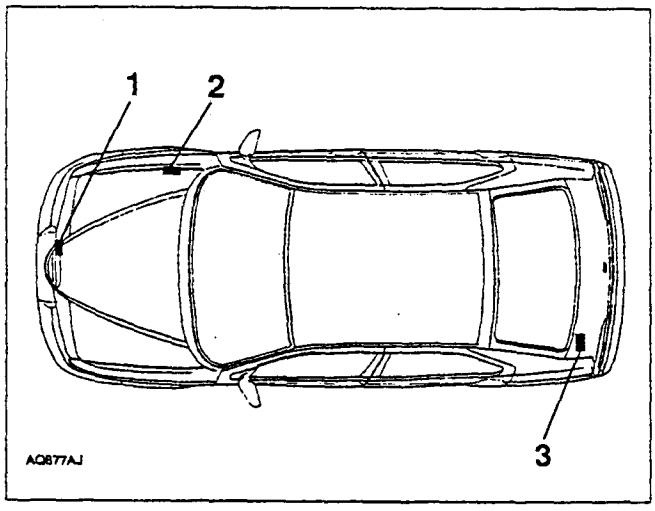
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IDENTIFICATION DATA



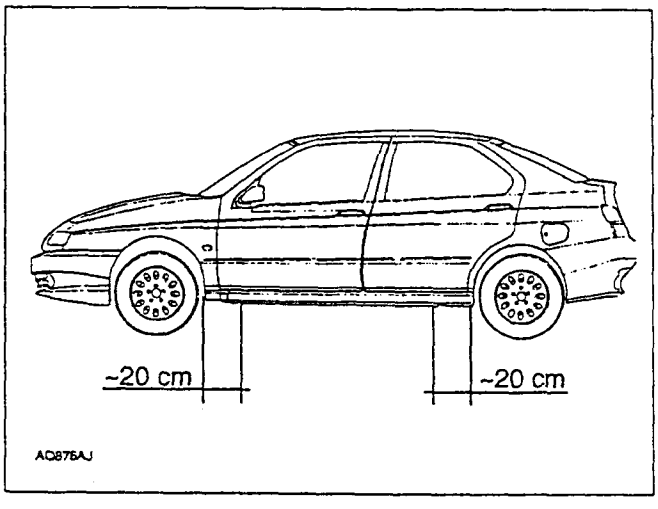
1. *Identification label*
2. *Body label*
3. *Bodywork paint label*

For the identification codes see: GROUP 00

CAR LIFTING POINTS

With arm lift or workshop jack

The car should be raised positioning the end of the arms or the jack in the areas shown in the diagram below.



CAR TOWING POINTS

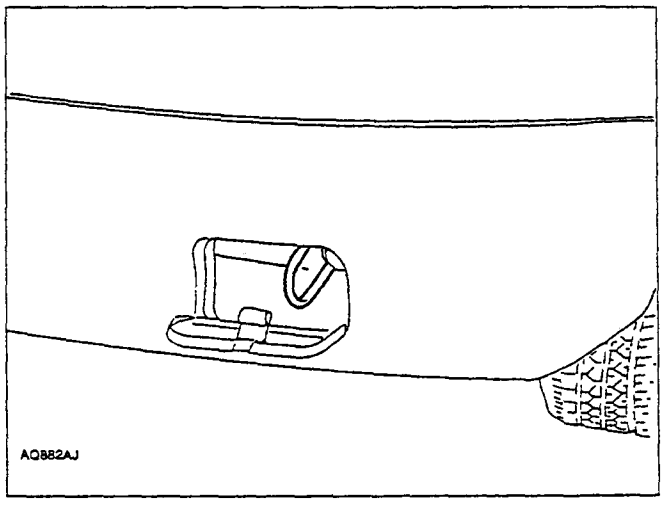
The car has two special towing rings, one at the front and one at the rear, located on the righthand side of the bumpers.

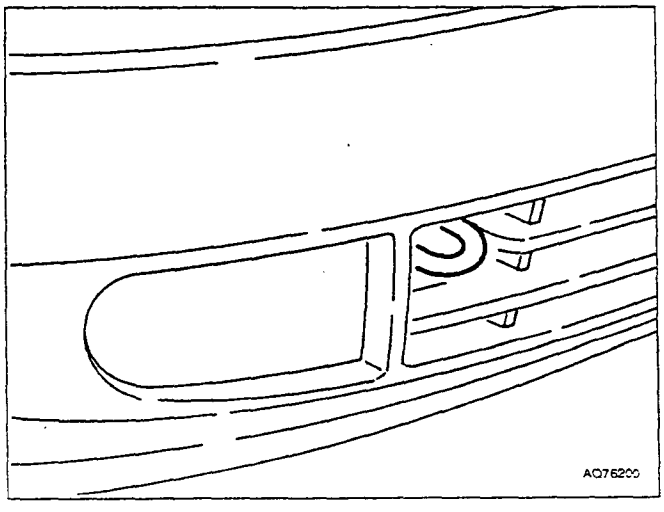
The rear ring is concealed by a lid which is opened pressing on the edge.

NOTA: always strictly adhere to the regulations in force on the subject of towing.

Before towing, the ignition switch of the towed car should be turned to MAR and then back to STOP without removing it; this is to prevent the steering from being locked.
Bear in mind that when the car is towed, the vacuum is not created in the servobrake thus considerably more braking effort is needed on the brake pedal.
Additionally, when the engine is off, the power steering circuit is not operational, thus more effort is required on the steering wheel.

WARNING: Absolutely never remove the ignition key from the lock; this will lock the steering

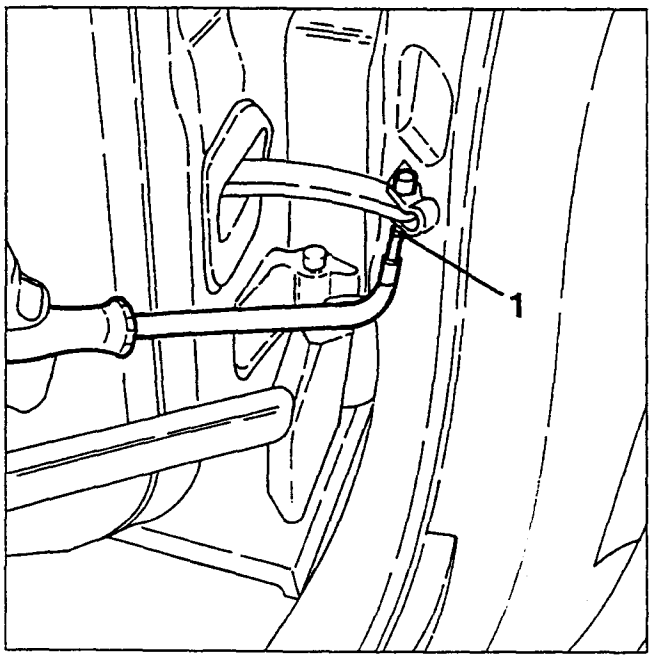




REAR DOORS

REMOVAL/REFITTING

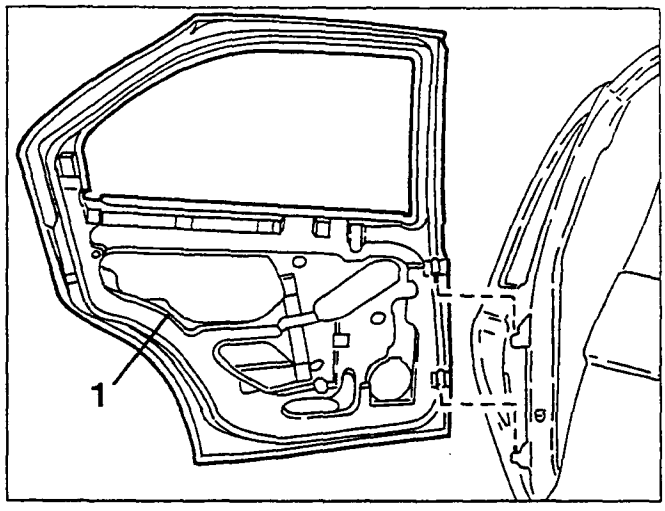
1. Using a suitable punch, remove the pin of the door check rod, half close the door to move the check rod inwards, then re-open the door.



1. Slacken the two screws fastening the door to the hinges.



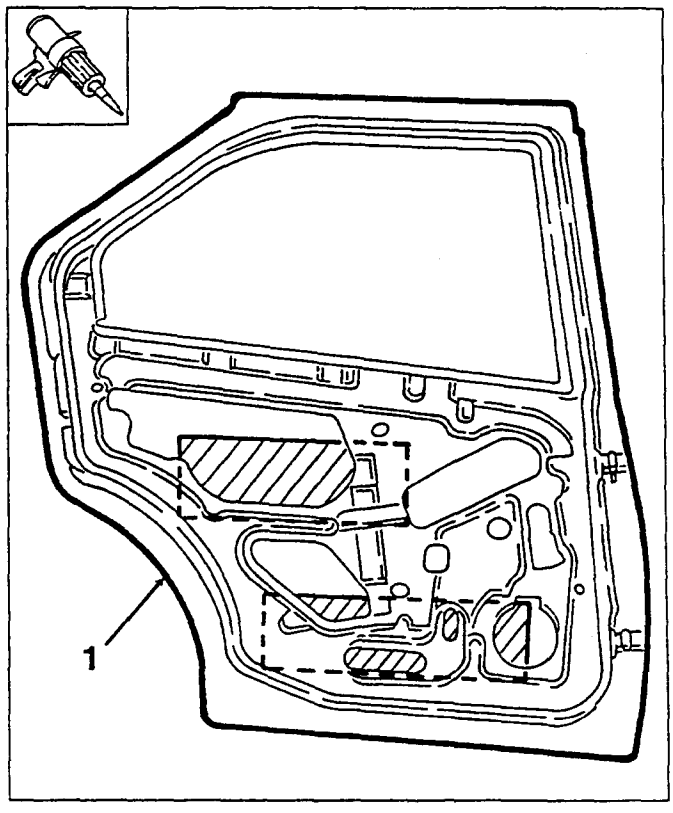
1. Raise the door to remove the hinge taper pins from their housings, then remove the door.



Refit the door reversing the sequence followed for removal and following the instructions given below.

1. When a new door is used, apply the specified sealant along the inner perimeter as illustrated.

NOTE:
Check that there are the sound-deadening panels inside the door.

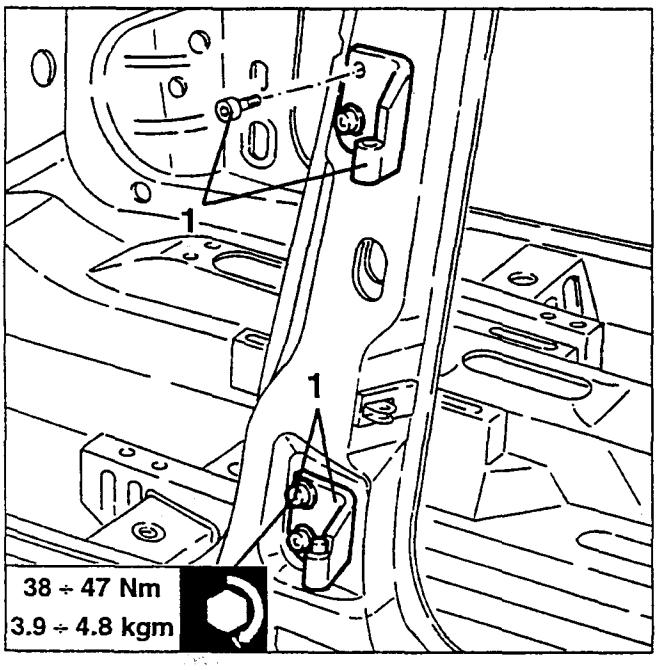


- If necessary adjust the rear door as described in the corresponding paragraph.

REAR DOOR HINGES

REMOVING/REFITTING

- Remove the la porta posteriore (vedere paragrafo specifico).
1. Remove the fastening screws and remove the hinges from the centre pillar.
- If present, remove the adjustment thicknesses under the hinges.



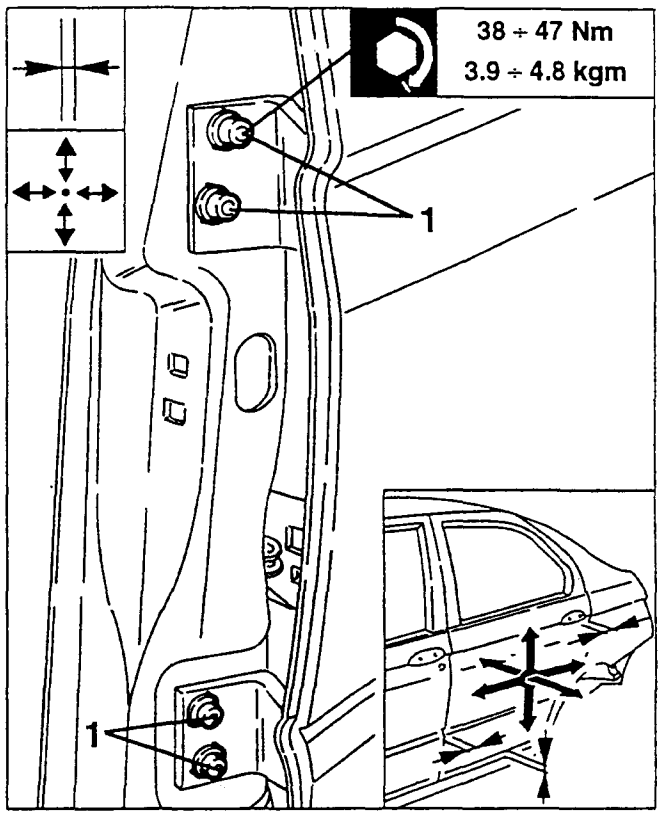
Refit the hinges reversing the sequence followed for removal and adjusting the door as described in the corresponding paragraph.

REAR DOOR AND HINGE ADJUSTMENT

- Working with the screws fastening the hinges to the centre pillar slackened and the door to hing fastening screws in pack, adjust the door longitudinally and in height checking for correct mating and lights.
- If necessary, place suitable adjustment thicknesses under the hinges and under the lock striker.

NOTE:
To adjust the door the mouldings, lock and striker must be assembled.

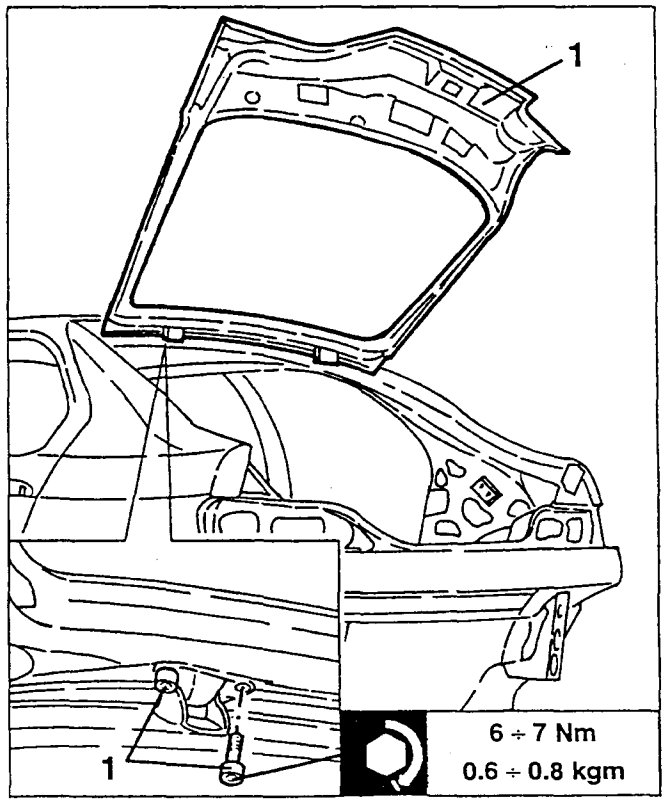
1. Tighten the screws fastening the hinges to the body to the specified torque.



BOOT LID

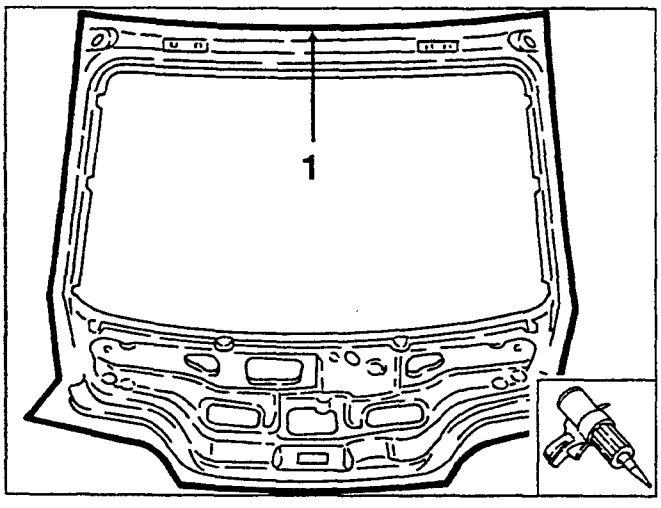
REMOVING/REFITTING

- Open the boot lid and support it suitably.
1. Slacken the two screws on each side fastening the boot lid to the hinges, then remove it.



Refit the boot lid reversing the sequence followed for removal following the instructions given below.

1. When a new boot lid is being used, apply the specified sealant along the inner perimeter as illustrated.

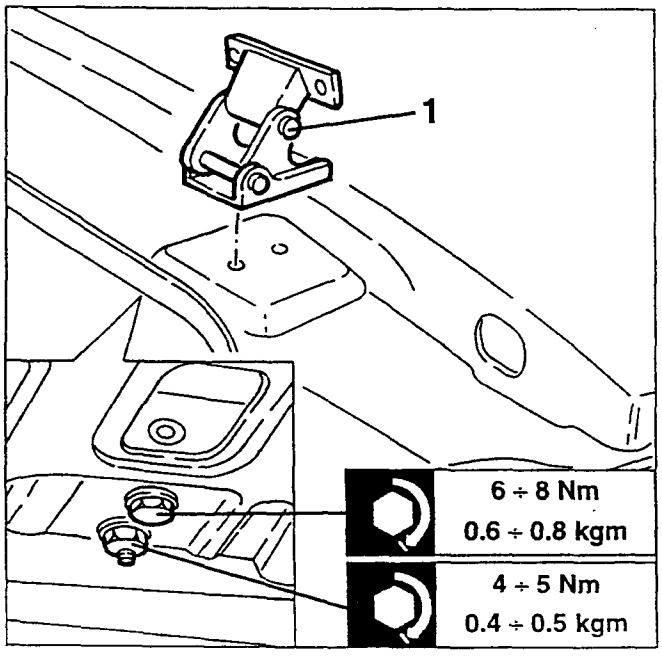


- If necessary, adjust the boot lid as described in the corresponding paragraph.

BOOT LID HINGES

REMOVING/REFITTING

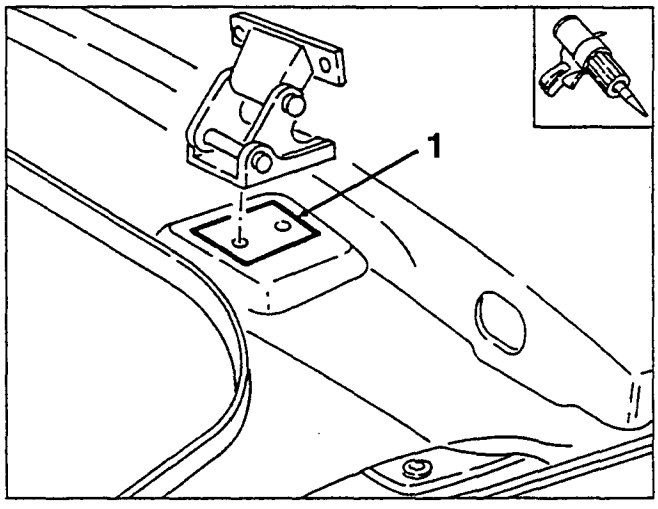
- Remove the boot lid (see specific paragraph).
1. Slacken the fastening screws and nuts and remove the complete hinges from the body.



- If necessary, separate the two hinge halves on the bench, removing the stop ring and withdrawing the fastening pins.

Refit the hinges rversing the sequence followed for removal and observing the following instructions.

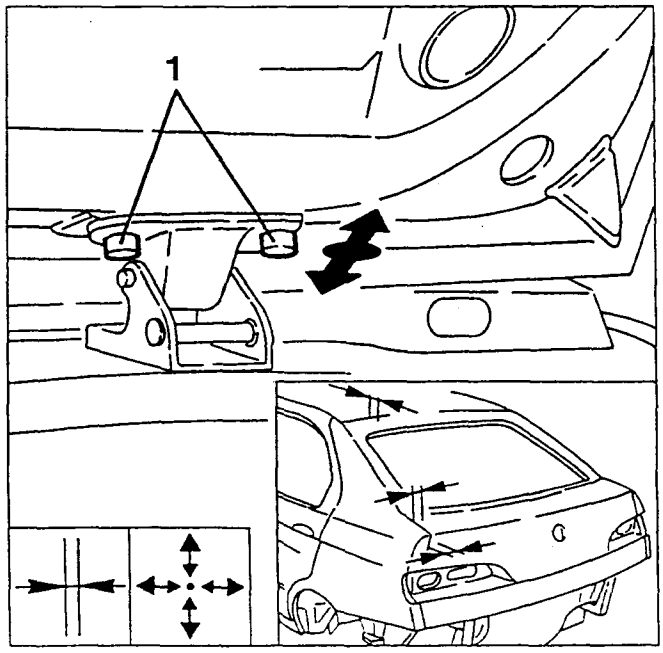
1. When assembling, apply the specified sealant between the hinges and the body as illustrated.



BONNECT ADJUSTMENT

1. Adjust the bonnet lid longitudinally, working on the screws fastening it to the hinges and checking the alignment and lights.

NOTE:
For bonnet adjustment the seal, lock and telescopic props should be assembled.

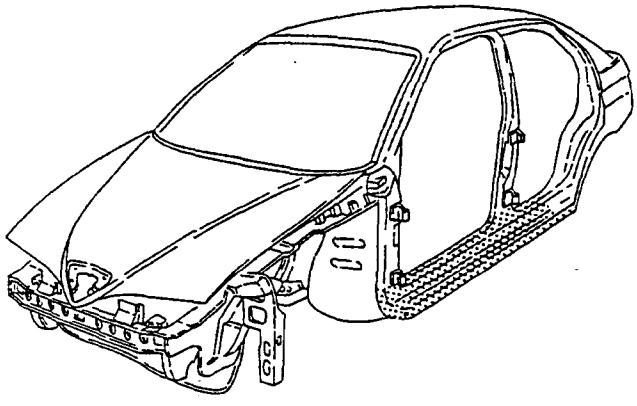


UNDER DOOR TRIM

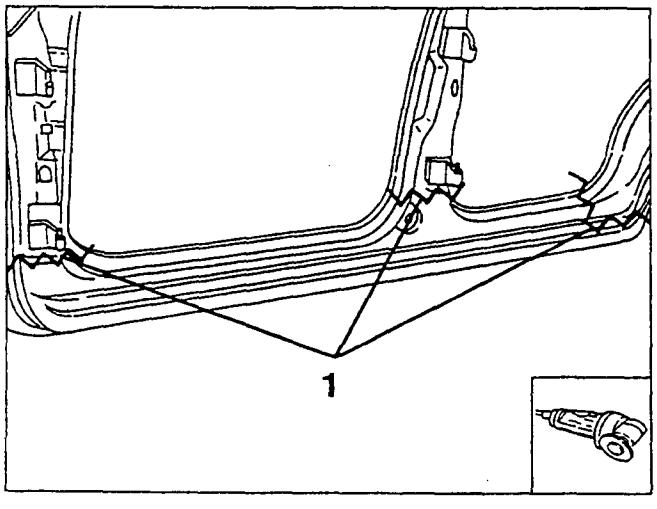
PRELIMINARY OPERATIONS

- Disconnect the battery (-) terminal and remove the electronic control units.
- Remove the trim components, electric and mechanical systems that might hinder the repair operation or suffer damage during work (see specific paragraphs).
- Remove the following sheet metal parts:
• doors on the side concerned (see specific paragraphs).
• front mudguard on the side concerned (see specific paragraph).

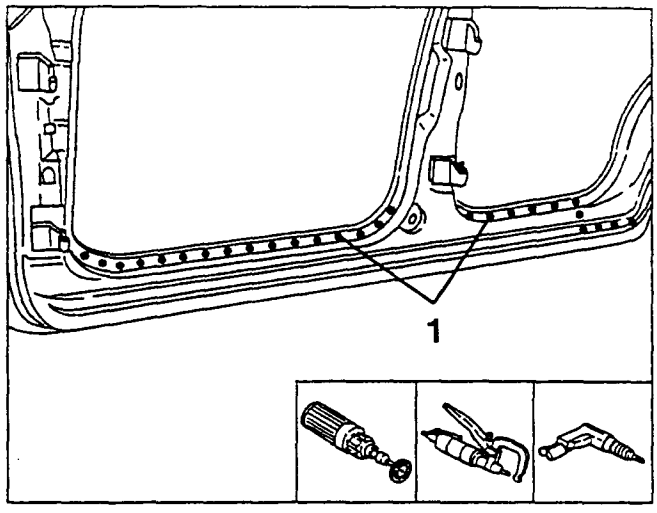
REMOVAL

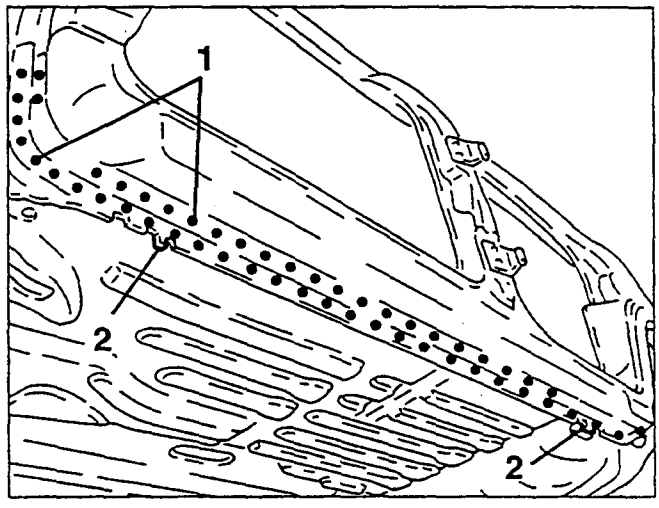


1. Using a circular blade saw, cut along the line illustrated, without damaging the parts below.



- Using a rotary brush, clean the areas to be de-welded to reveal the welding spots.
1. Using a snipping machine, remove the accessible welding spots; remove the remaining welding spots using a drill.
2. Open the clinching tabs.

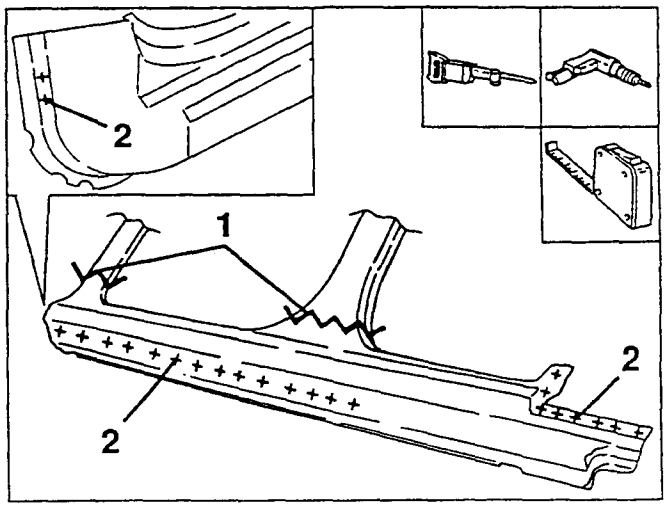




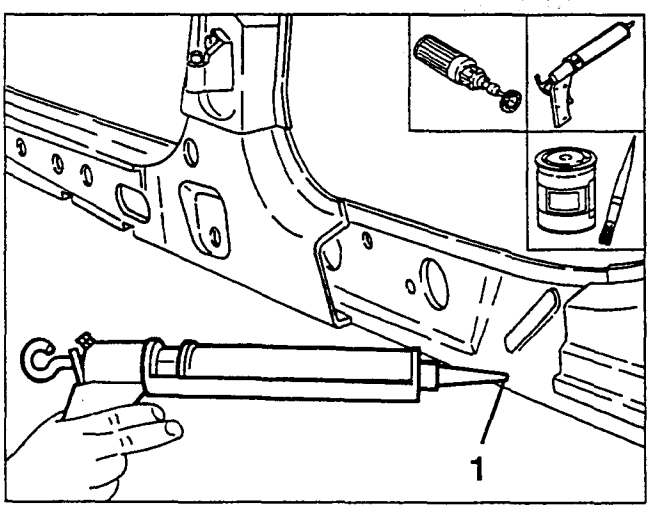
- Remove the underdoor trim, cutting the sealant if necessary.

PREPARATION

1. Working on the bench, with a reciprocating saw cut the new underdoor trim, keeping the same overlapping area.
2. Trace the trim and drill (bit Ø 5 mm), as illustrated.

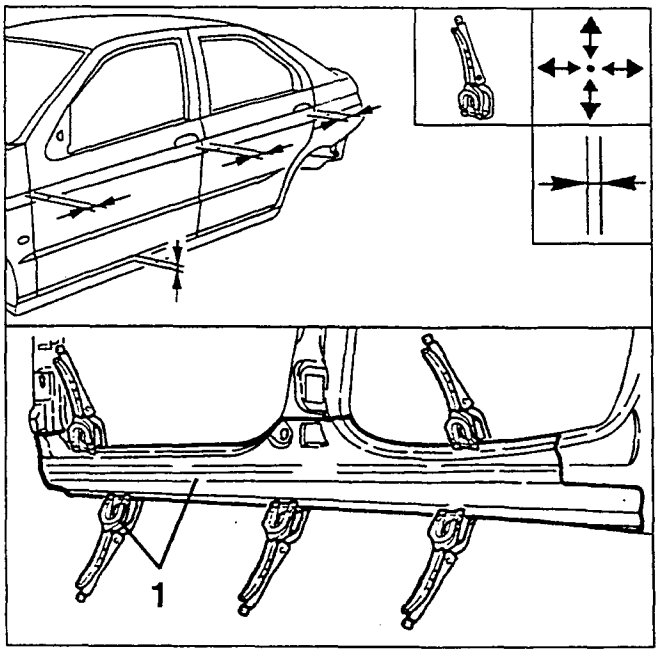


- Using a rotary brush, clean the areas concerned by welding.
1. Apply the high thickness electric welding protection on the lower section of the door frame.
- Apply the electric welding protection to be brushed on the remaining areas involved by spot welding.



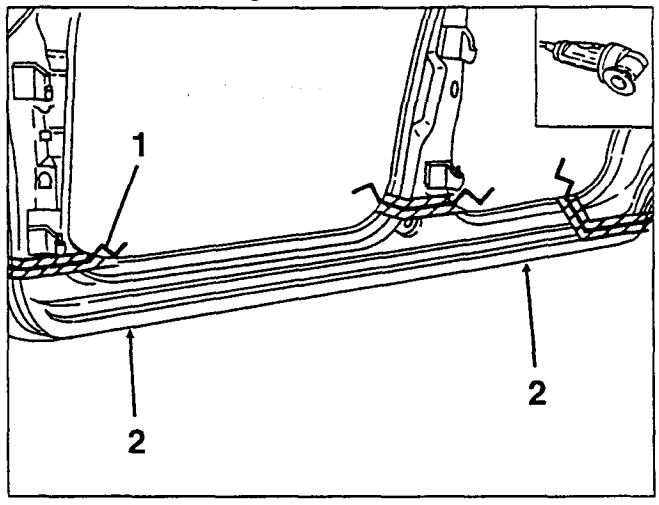
POSITIONING AND CHECKING

1. Position the underdoor trim joining the edges to be welded and fasten using clamps.
- Using screws temporarily fasten the underdoor trim, then remove the clamps fastened previously.
- Check the squareness, lights and angles refitting the components removed previously with the associated seals and parts which, once assembled make it possible to check that the operations have been carried out to perfection.



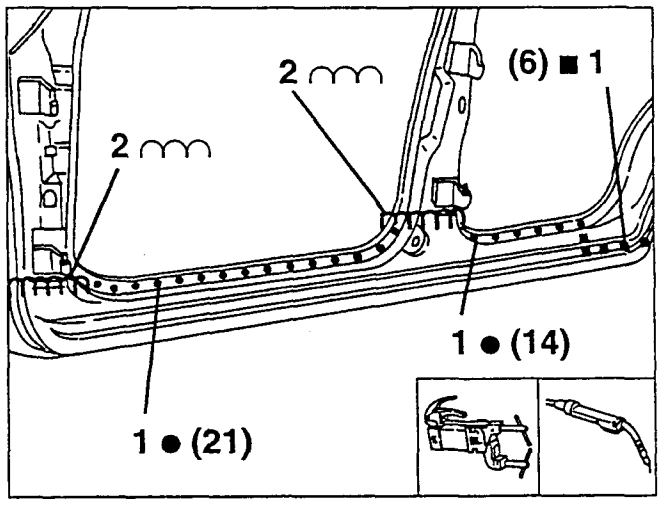
- Remove the assembled components to check for correct positioning of the underdoor trim.

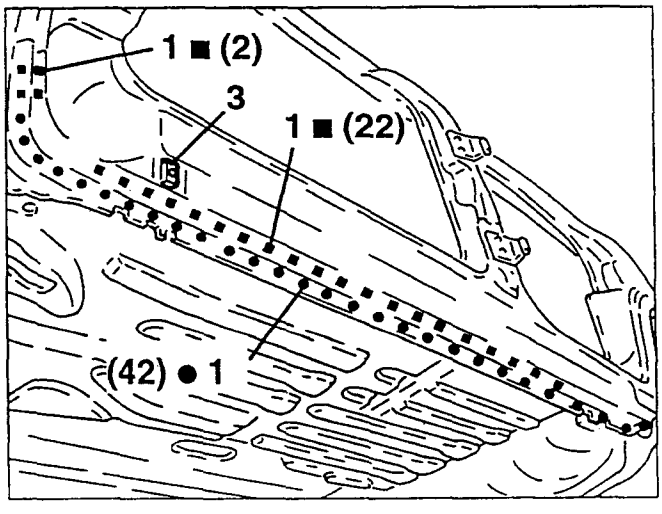
1. Using a circular blade saw, trim the sheet metal eliminating the excess, without damaging the sheet metal below.
2. Bend the clinching tabs.



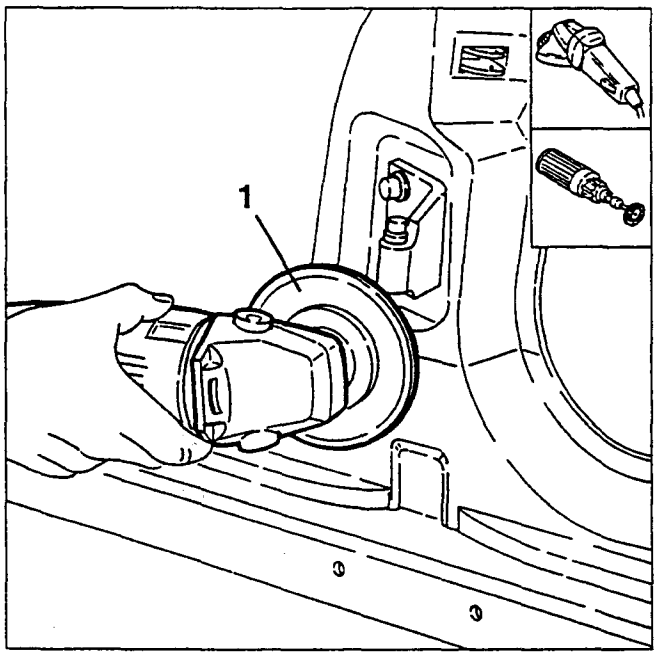
WELDING AND FINISHING OF SHEET METAL PIECE

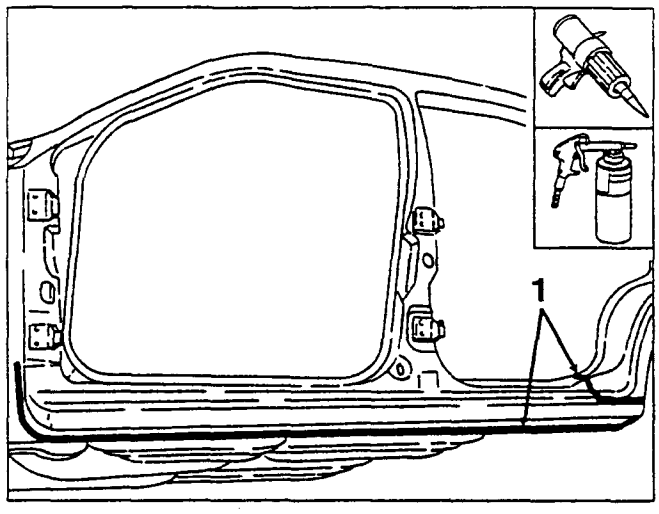
1. Using a spot welder or, where necessary, an MIG welder, proceed as illustrated.
2. Using an MIG welder, seam weld as illustrated.
3. Fit the mudguard fastening block.



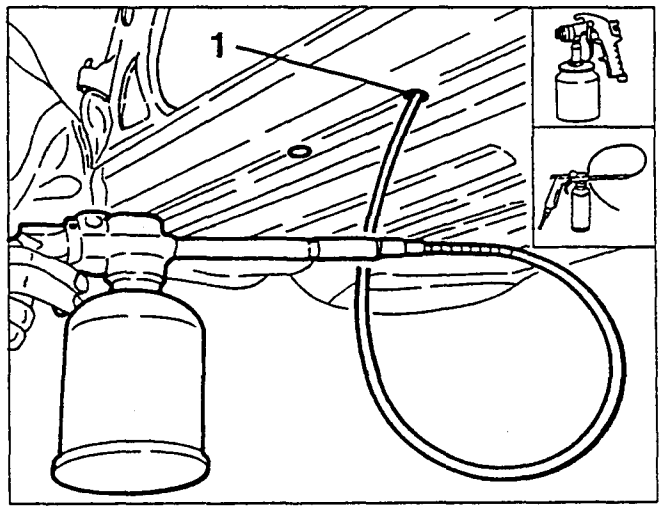


1. Using an abrasive grinder remove and level remains of welding.
- Using a rotary brush clean the welded areas.



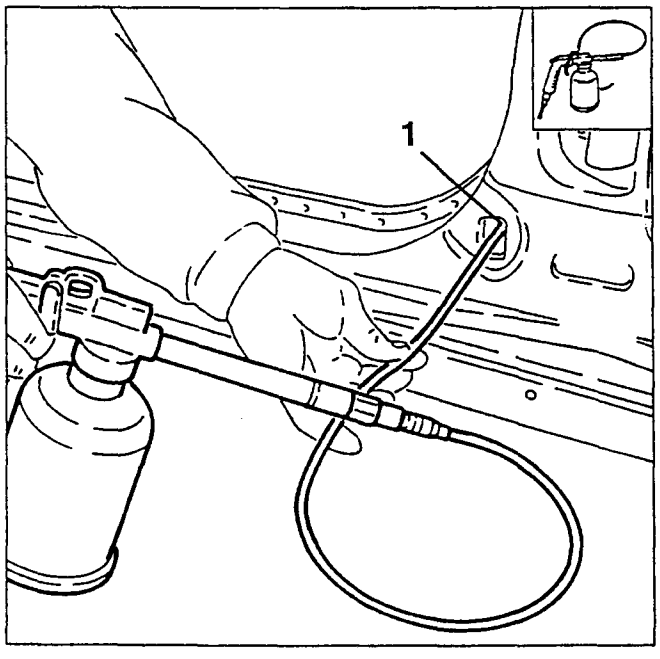


- Proceed with painting.
1. Proceed with waxing of the boxed sections through the holes shown.



PROTECTIONS

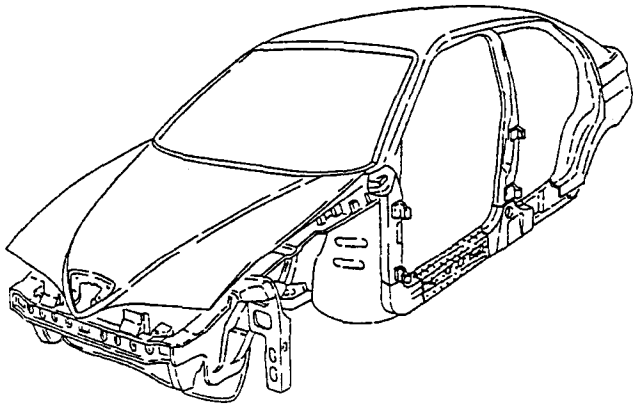
1. Apply the specified antirust on the areas involved by MIG welding.



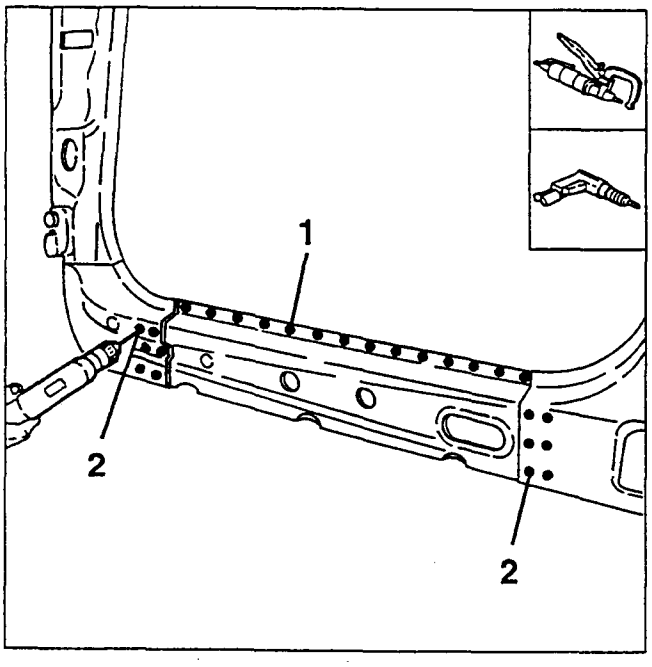
1. Apply the specified sealant along the lines illustrated.
- Apply the underbody protection specified in the areas involved in the replacement.

UNDERDOOR FRAME (WITH UNDERDOOR TRIM REMOVED)

REMOVAL

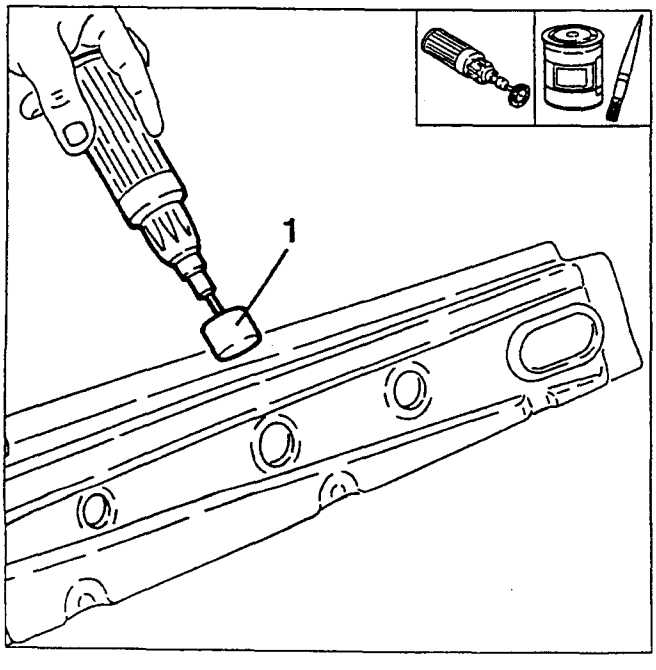


1. Using a snipping machine, remove the welding spots illustrated.
2. Using a drill, remove the welding spots illustrated, then remove the underdoor frame.



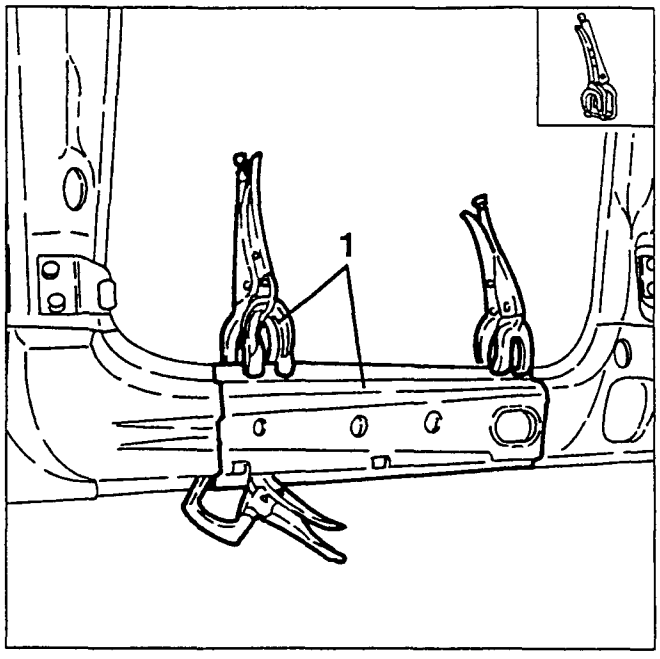
PREPARATION

1. Using a rotary brush, clean the areas concerned by welding.
- Apply the specified electric welding protection on the areas involved by spot welding.



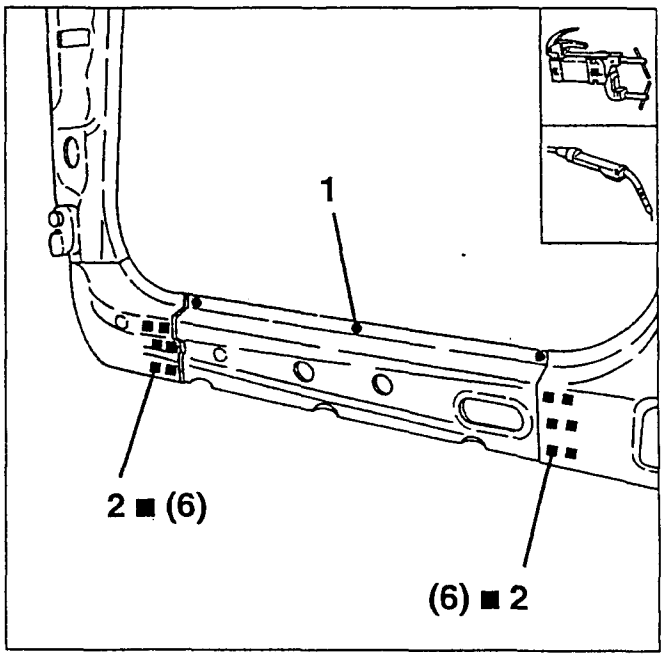
POSITIONING

1. Position the the underdoor frame joining the edges to be welded and fasten using clamps.



WELDING AND FINISHING OF SHEET METAL PIECE

1. Using a spot welder, tack the underdoor frame working as illustrated.
2. Using an MIG welder, proceed as illustrated.



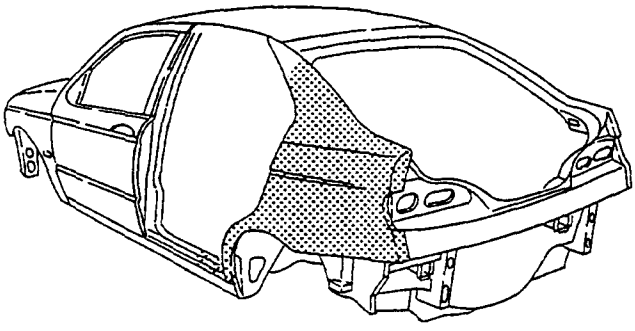
- Refit the underdoor trim working as described in the corresponding paragraph.

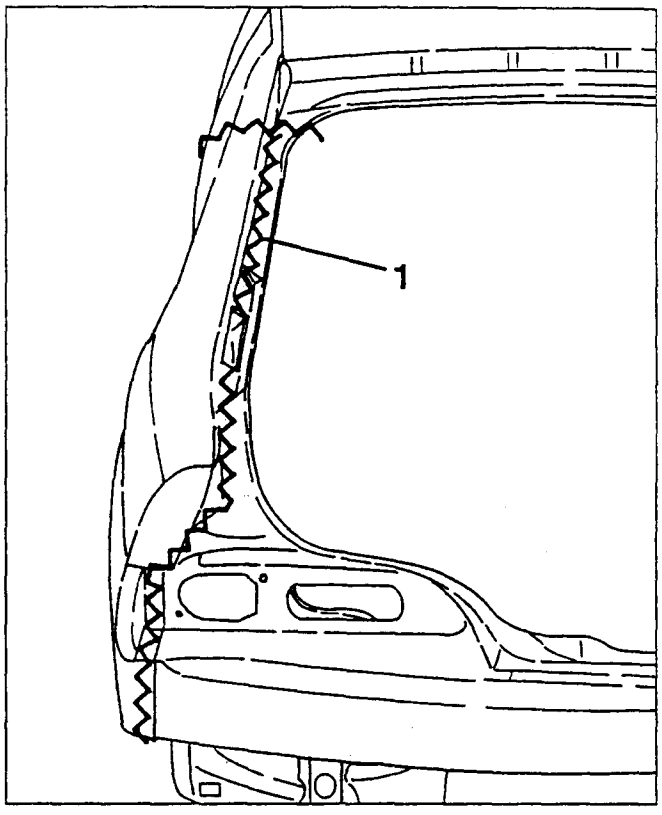
REAR MUDGUARD

PRELIMINARY OPERATIONS

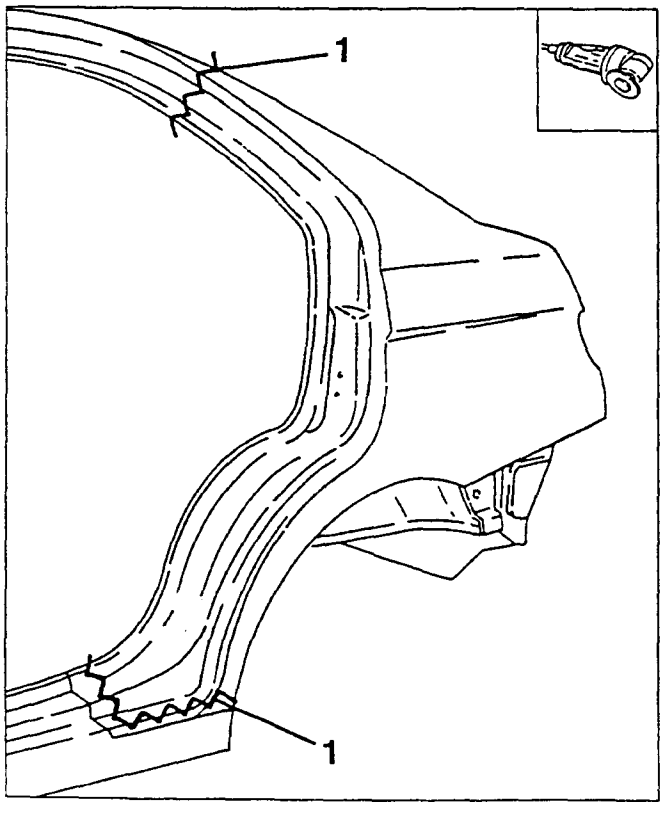
- Disconnect the battery (-) terminal and remove the electronic control units.
- Remove the trim components, electric and mechanical systems that might hinder the repair operation or suffer damage during work (see specific paragraphs).
- Remove the following sheet metal parts:
• rear door on the side concerned (see specific paragraph)
• deck lid (see specific paragraph).

REMOVAL

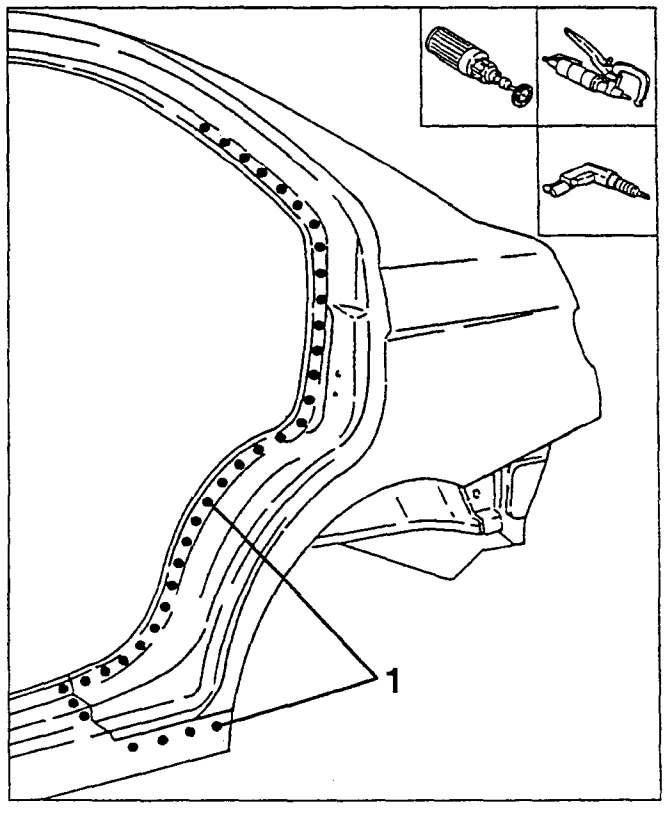




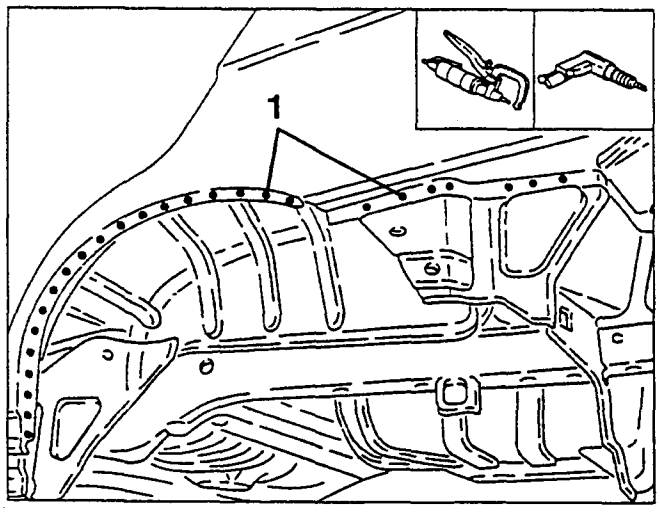
1. Using a circular blade saw, cut along the line illustrated, without damaging the sheet metal below.



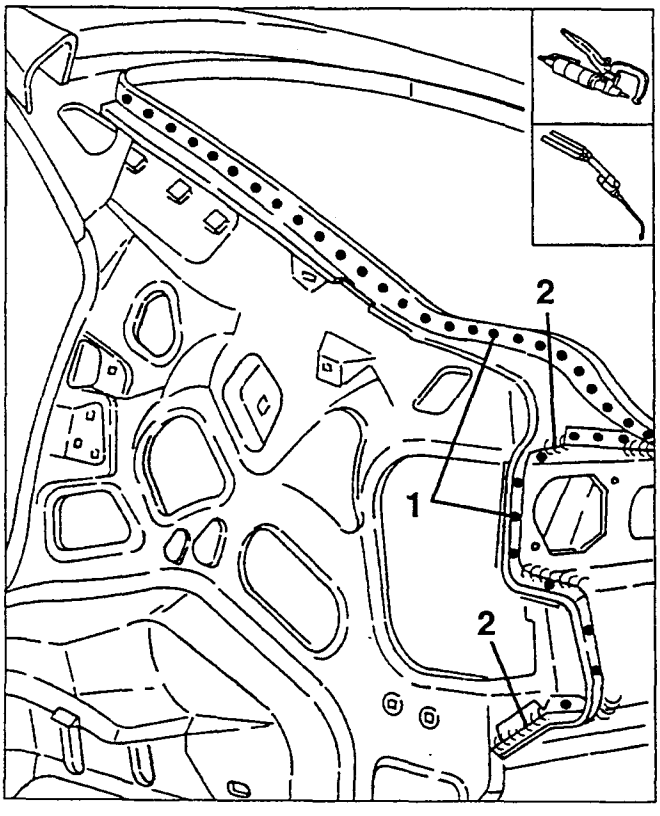
- Using a rotary brush, clean the areas to be de-welded to reveal the welding spots.
1. Using a snipping machine, remove the accessible welding spots; remove the remaining welding spots using a drill.



1. Using a snipping machine, remove the accessible welding spots; remove the remaining welding spots using a drill.

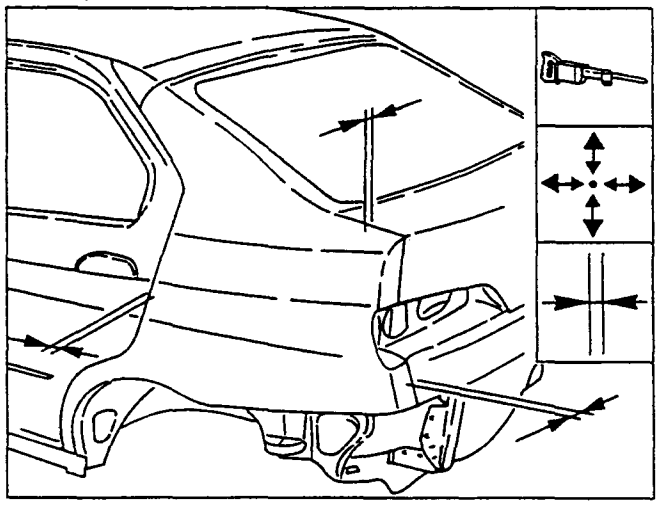


- Remove the rear mudguard.
1. Using a snipping machine, remove welding spots on the edges of the rear mudguard remaining on the body.
2. Using an oxyacetylene blower, de-weld the rear area of the mudguard edges, then remove them.

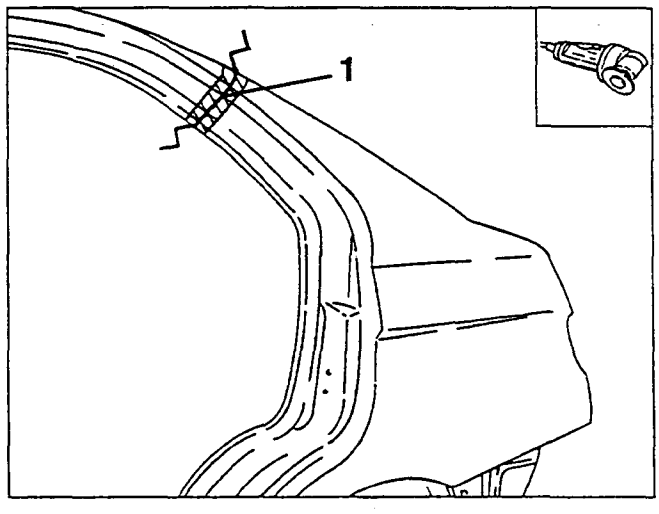


PREPARATION AND CHECKING

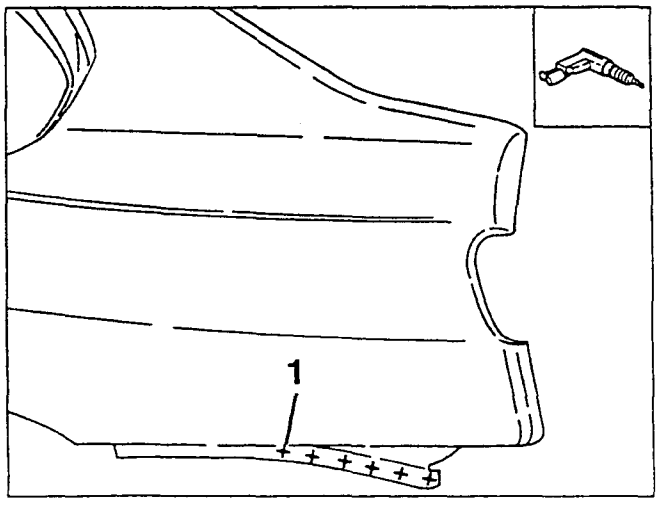
- On the bench with a reciprocating saw cut the new rear mudguard, keeping the same overlapping area.
- Temporarily assemble the rear mudguard.
- Check the squareness, lights and angles refitting the components removed previously with the associated seals and parts which, once assembled make it possible to check that the operations have been carried out to perfection.



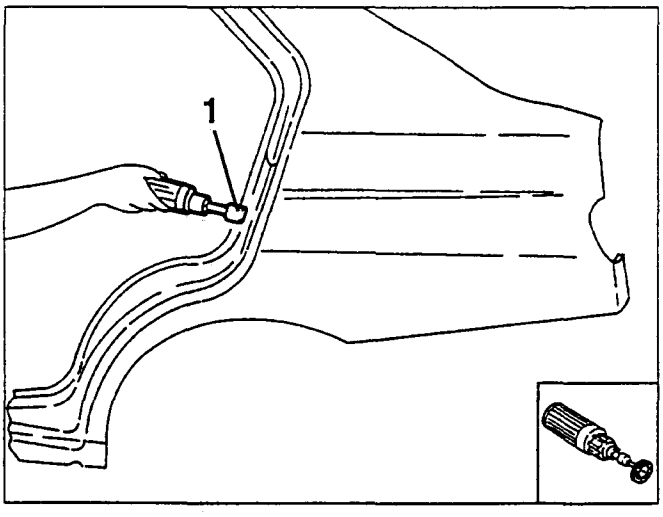
- Remove the assembled components to check for correct positioning the rear mudguard.
1. Using a circular blade saw, trim the sheet metal eliminating the excess, without damaging the sheet metal below.



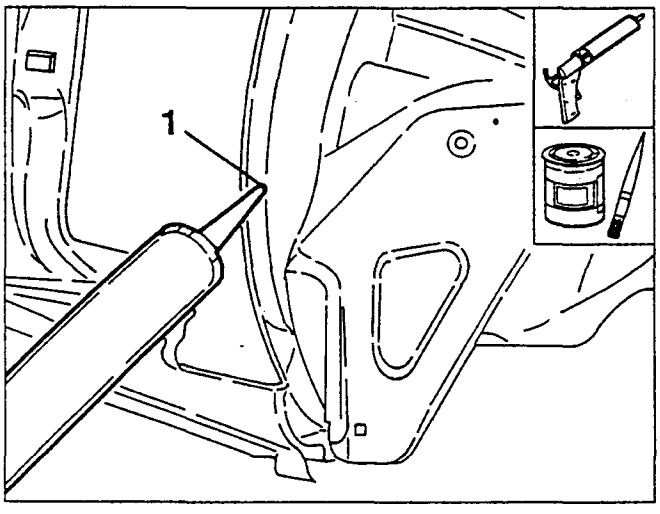
1. Remove the mudguard, then working on the bench, trace it and drill (bit Ø 5 mm), as illustrated.



1. Using a rotary brush, clean the areas concerned by welding.

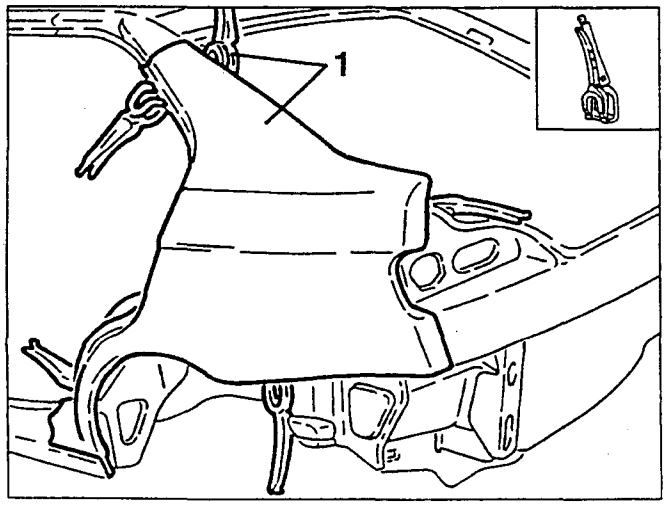


1. Apply the high thickness electric welding protection in the wheelhouse area concerned by spot welding and the electrically weldable protection to be coated on the remaining areas involved by spot welding.



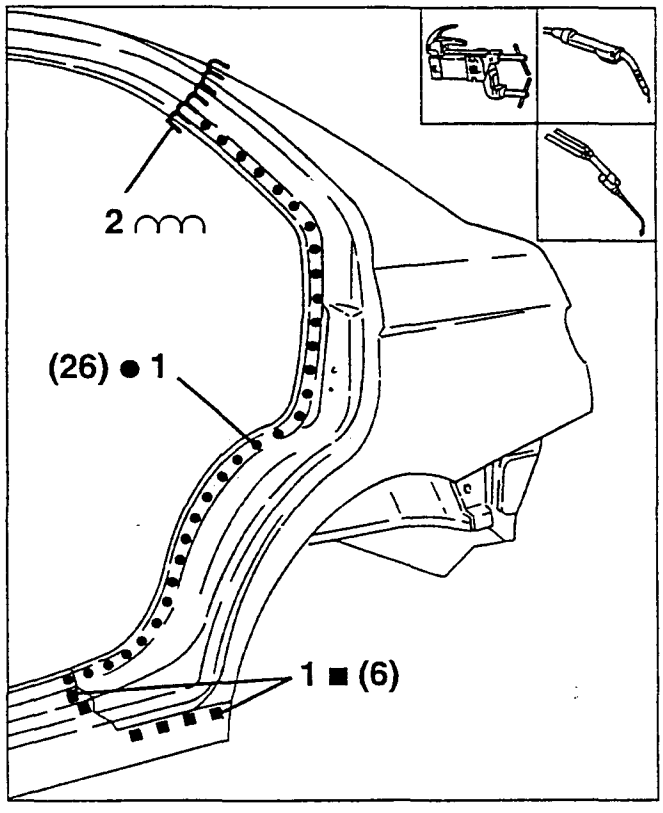
POSITIONING

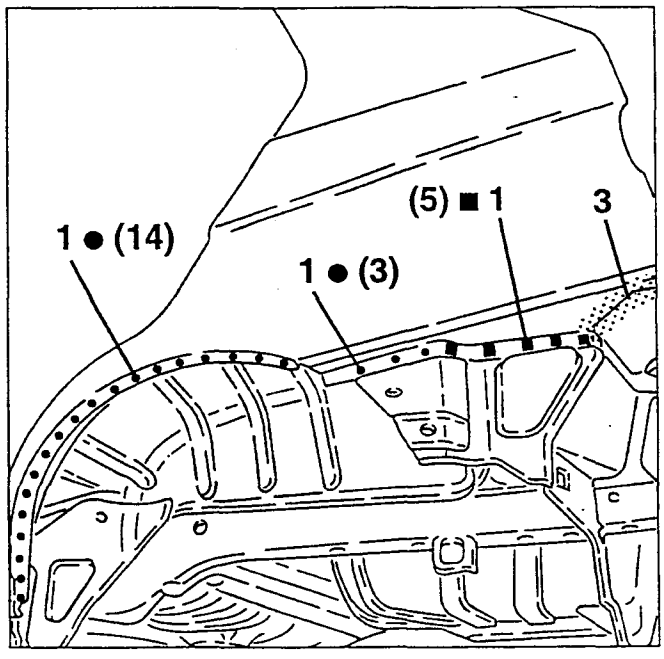
1. Position the rear mudguard joining the edges to be welded and fasten using clamps.



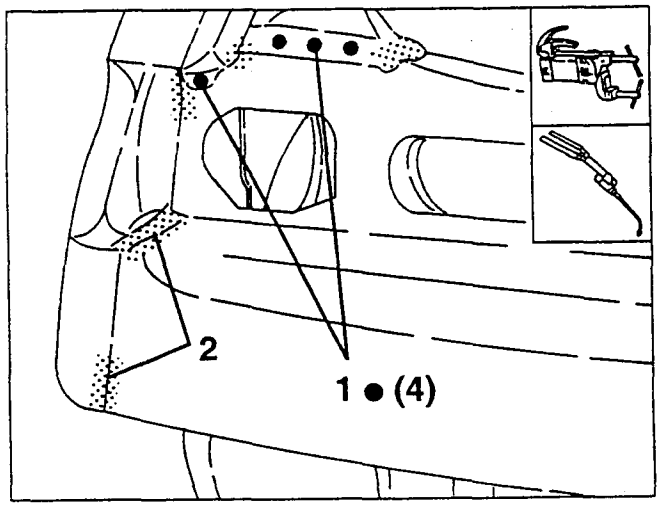
WELDING AND FINISHING OF SHEET METAL PIECE

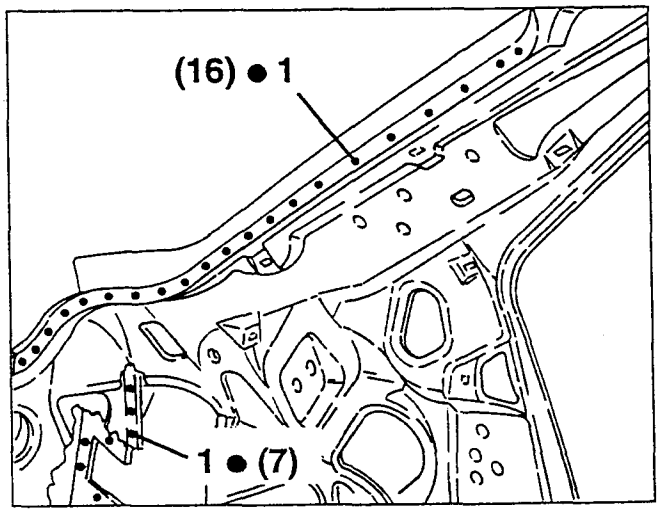
1. Using a spot welder or, where necessary, an MIG welder, proceed as illustrated.
2. Using an MIG welder, seam weld as illustrated.
3. Using an oxyacetylene blower, brass braze weld as illustrated.



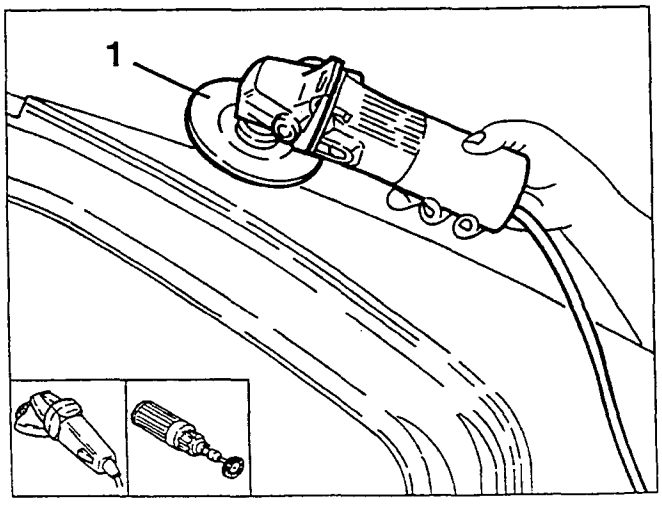


1. Using a spot welder, proceed as illustrated.
2. Using an oxyacetylene blower, brass braze weld as illustrated.



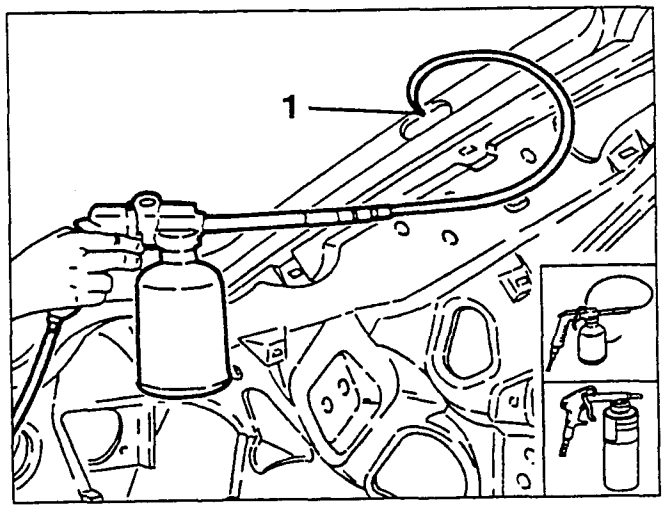


1. Using an abrasive grinder,remove and level remains of welding.
- Using a rotary brush, clean the welded areas.

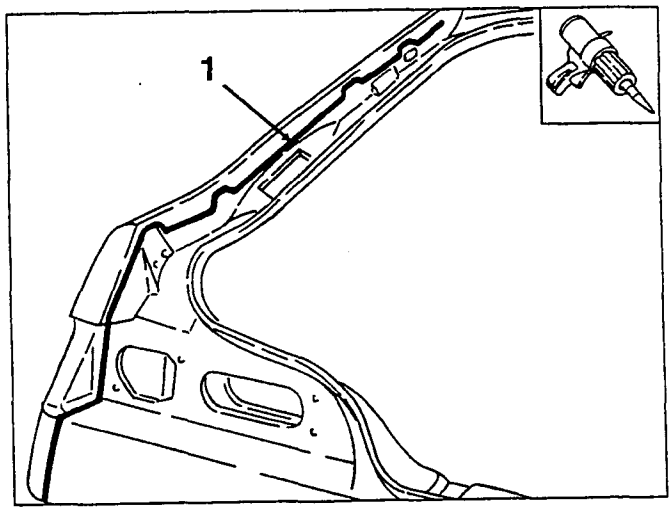


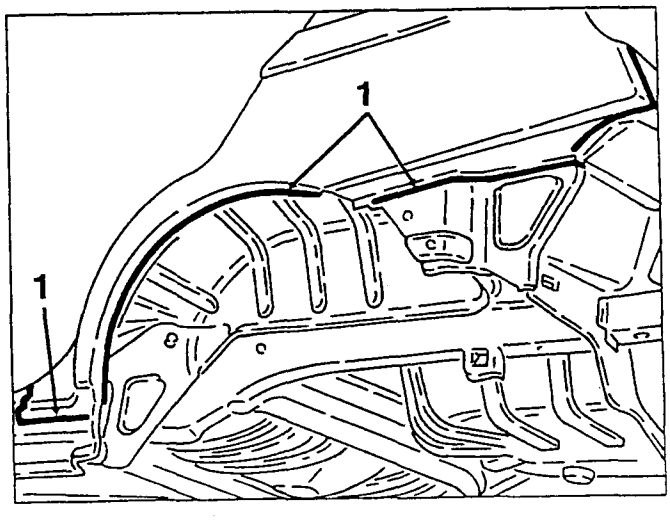
PROTECTIONS

1. Apply the specified antirust on the areas involved by MIG welding and braze welding.
- Apply underbody protective coating in the area of the wheelhouse concerned by the replacement.

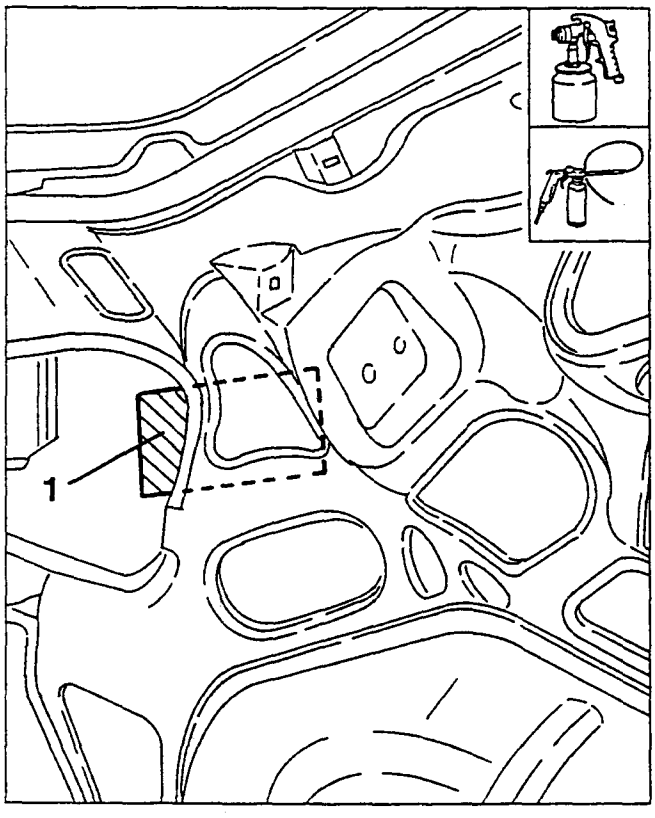


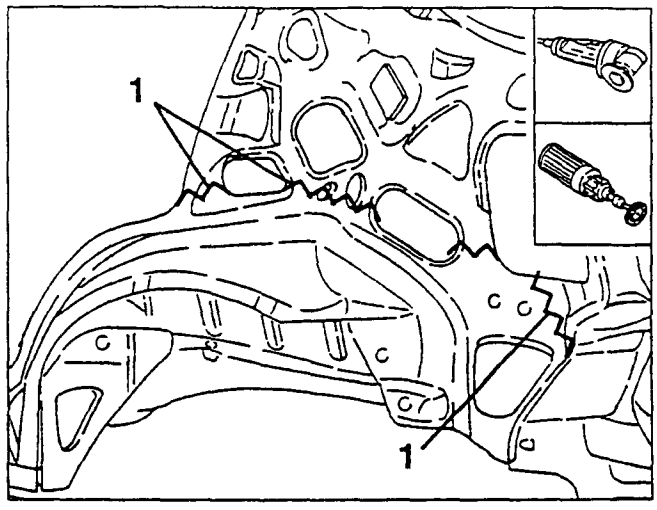
1. Apply the specified sealant on the joints of the mudguard panels.



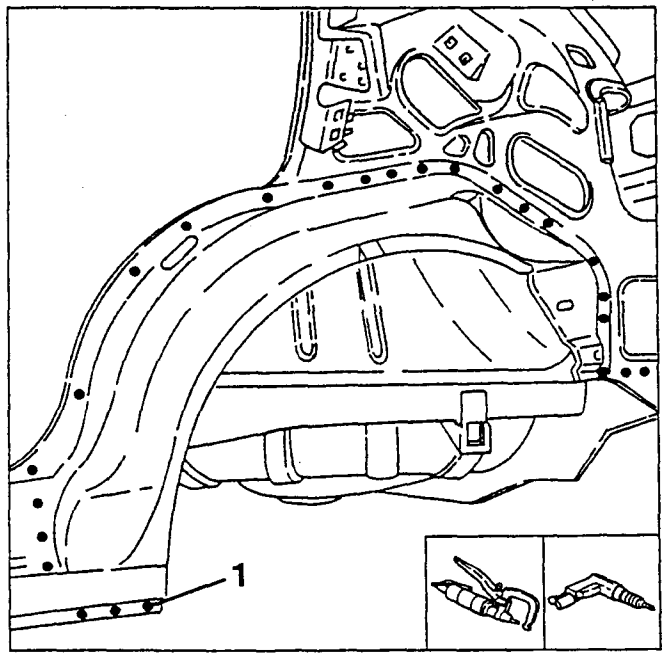


1. Apply the sound-deadening panel on the rear mudguard as illustrated.
- Proceed with painting.
- Proceed with waxing.



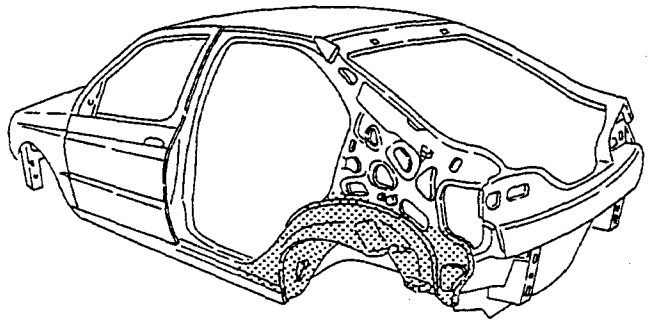


1. Using a snipping machine, remove the accessible welding spots; remove the remaining welding spots using a drill.
2. Open the clinching tab and remove the partial inner side frame.

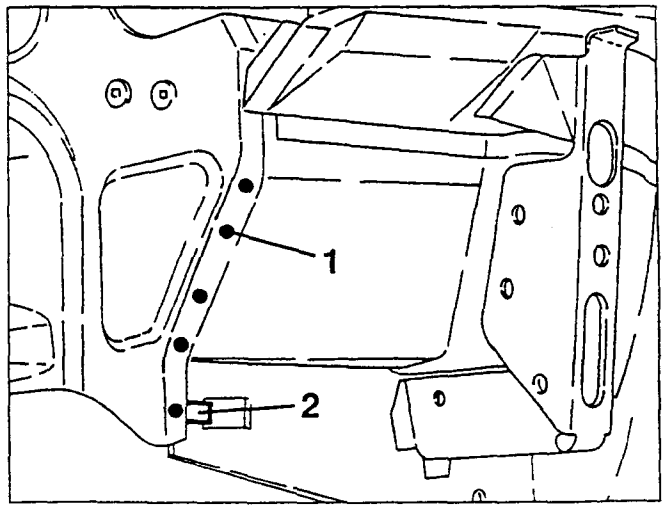


PARTIAL INNER SIDE FRAME (WITH REAR MUDGUARD REMOVED)

REMOVAL

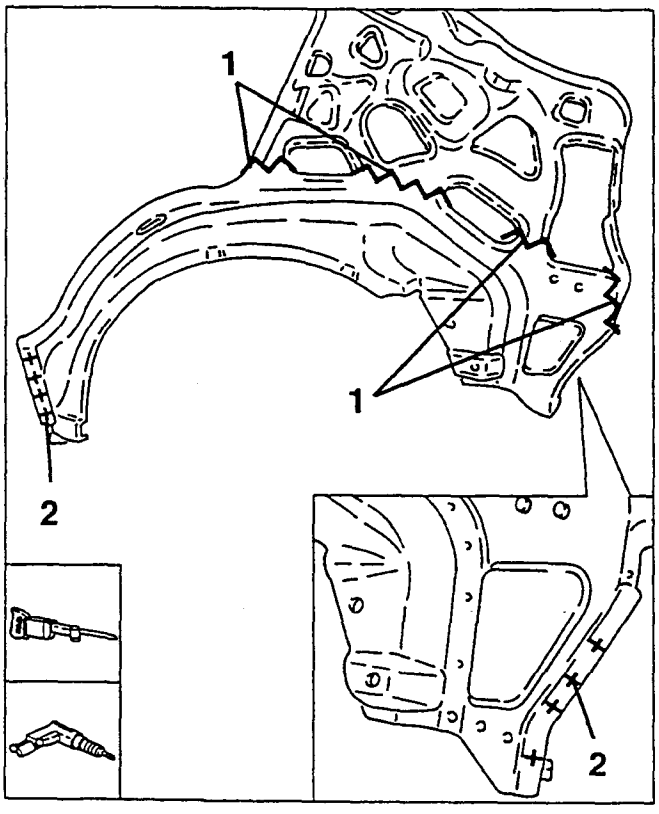


1. Using a circular blade saw, cut along the line illustrated without damaging the sheet metal below.
- Using a rotary brush, clean the areas to be de-welded to reveal the welding spots.

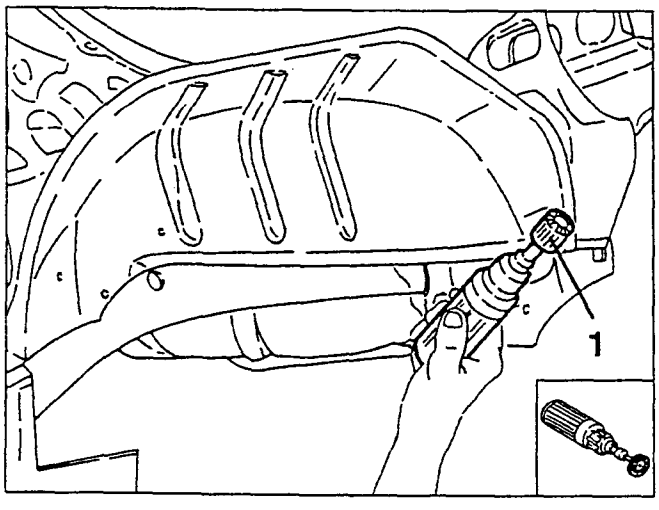


PREPARATION

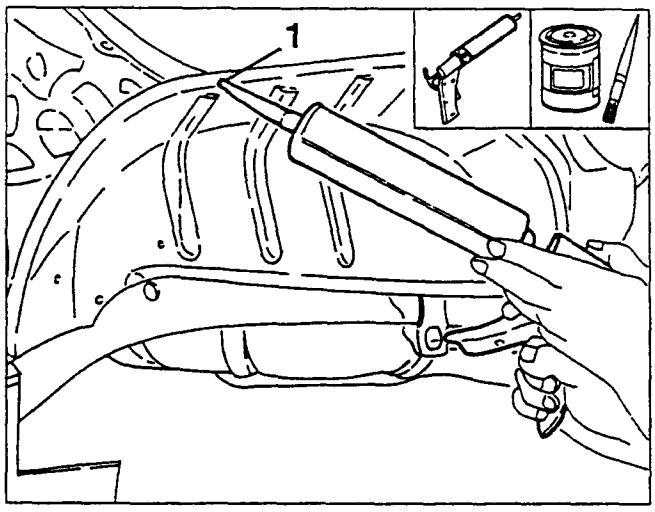
1. Working on the bench, with a reciprocating saw cut the new inner frame, keeping the same overlapping area.
2. Trace the inner side frame and drill (bit Ø 5 mm), as illustrated.



1. Using a rotary brush, clean the areas concerned by welding.

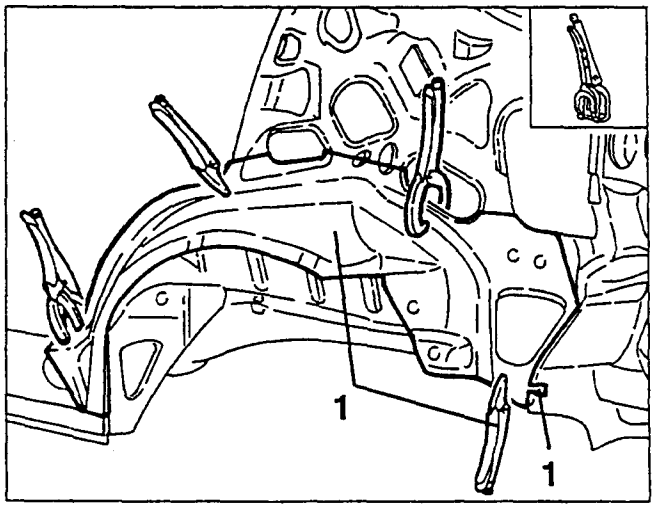


1. Apply the high thickness electric welding protective material on the parts coupling with the wheelhouse concerned by spot welding.
- Apply the electric welding protection to be brushed on the remaining areas involved by spot welding.

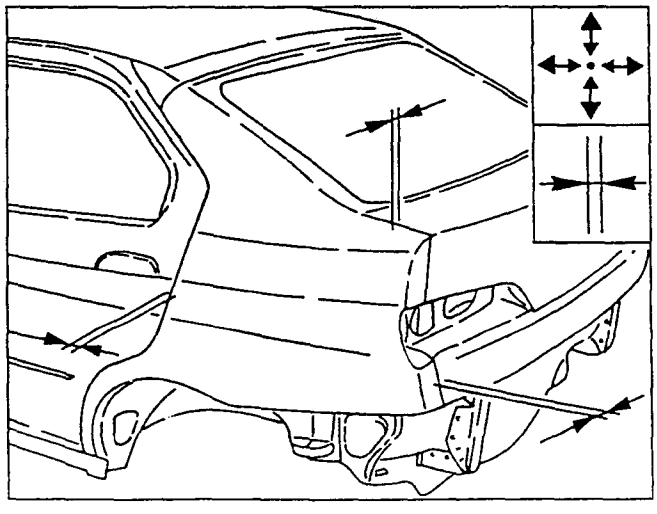


POSITIONING AND CHECKING

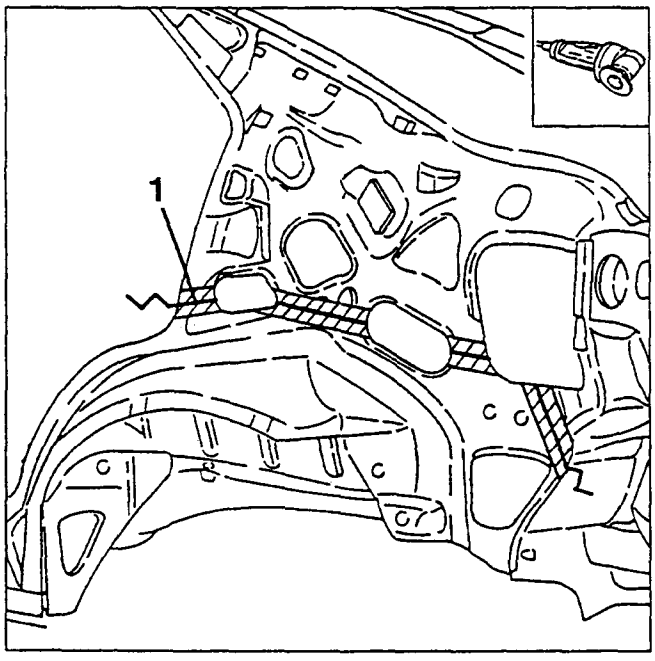
1. Position the partial inner side frame joining the edges to be welded and fasten using clamps and the clinching tab.



- Check the squareness, lights and angles refitting the components removed previously with the associated seals and parts which, once assembled make it possible to check that the operations have been carried out to perfection.

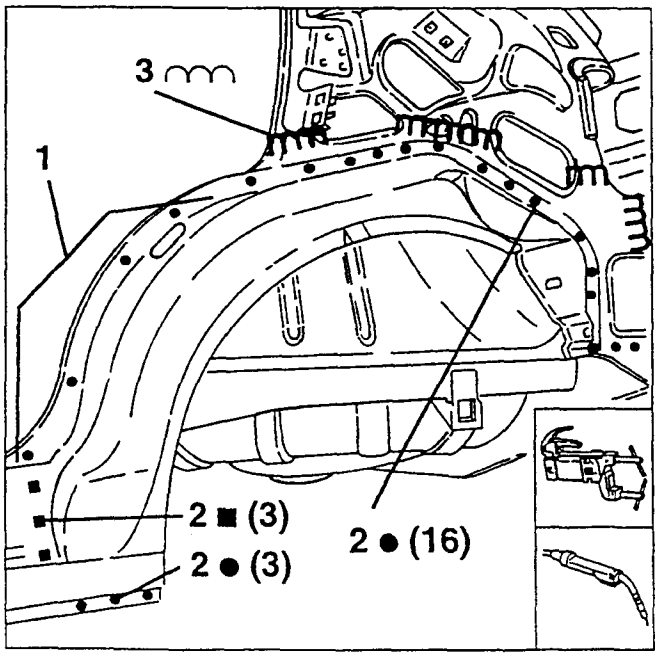


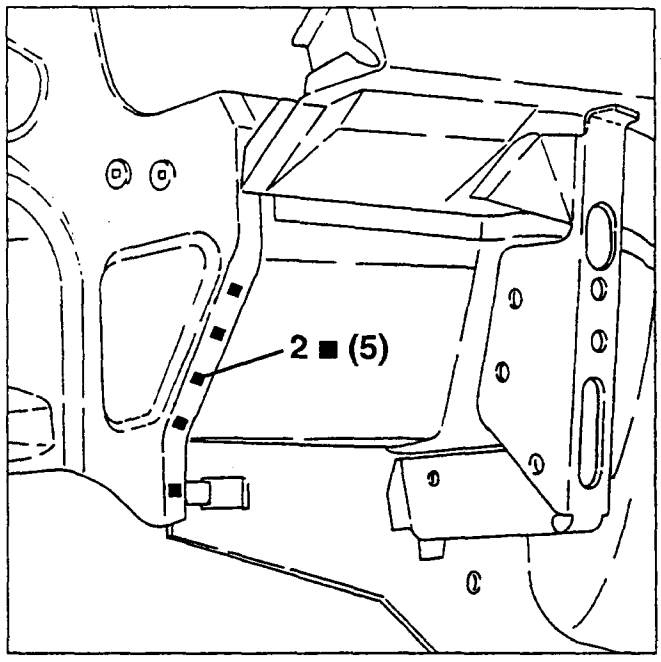
- Remove the assembled components to check for correct positioning of the inner side frame.
1. Using a circular blade saw, trim the sheet metal eliminating the excess, without damaging the sheet metal below.



WELDING AND FINISHING OF SHEET METAL PIECE

1. Using a spot welder, proceed with tacking.
2. Using a spot welder or where necessary, an MIG welder, proceed as illustrated.
3. Using an MIG welder, seam weld as illustrated.

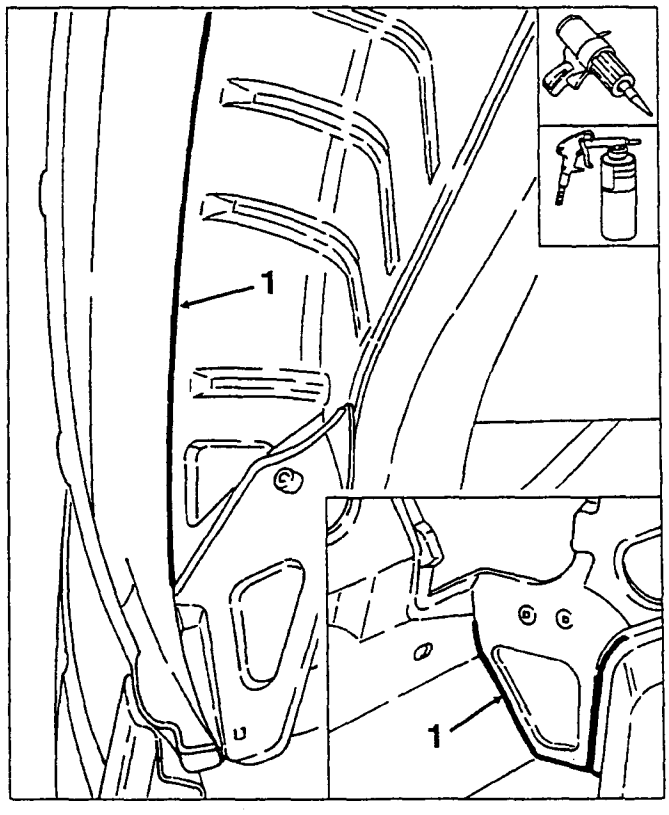




- Using an abrasive grinder remove and level remains of welding.

PROTECTIONS

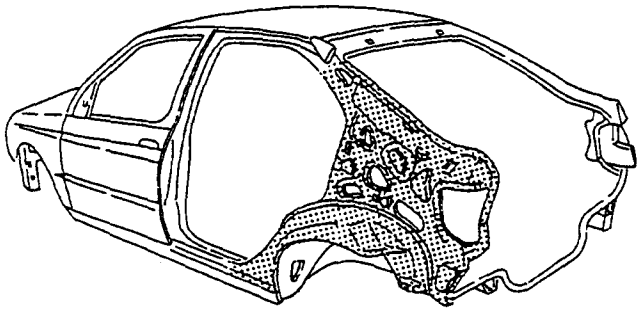
1. Apply the specified sealant along the lines illustrated.
- Apply the specified underbody protection in the area of the wheelhouse involved by the replacement.



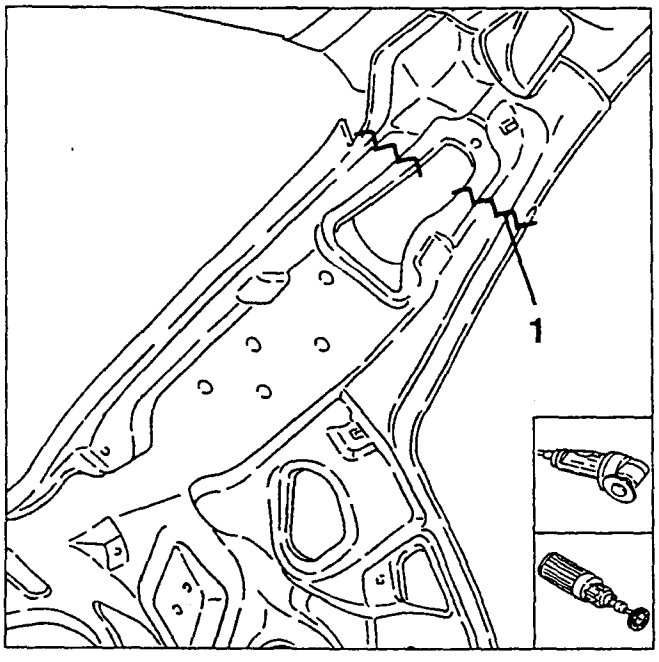
- Refit the rear mudguard working as described in the corresponding paragraph.

COMPLETE INNER SIDE FRAME (WITH REAR MUDGUARD AND REAR PANEL REMOVED)

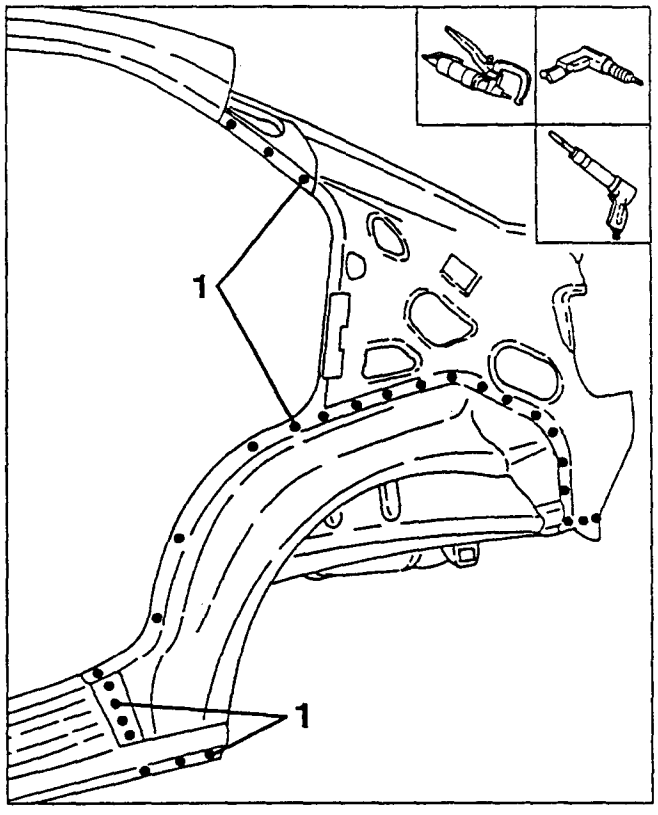
REMOVAL



1. Using a circular blade saw, cut along the line illustrated, without damaging the sheet metal below.
- Using a rotary brush, clean the areas to be de-welded to reveal the welding spots.

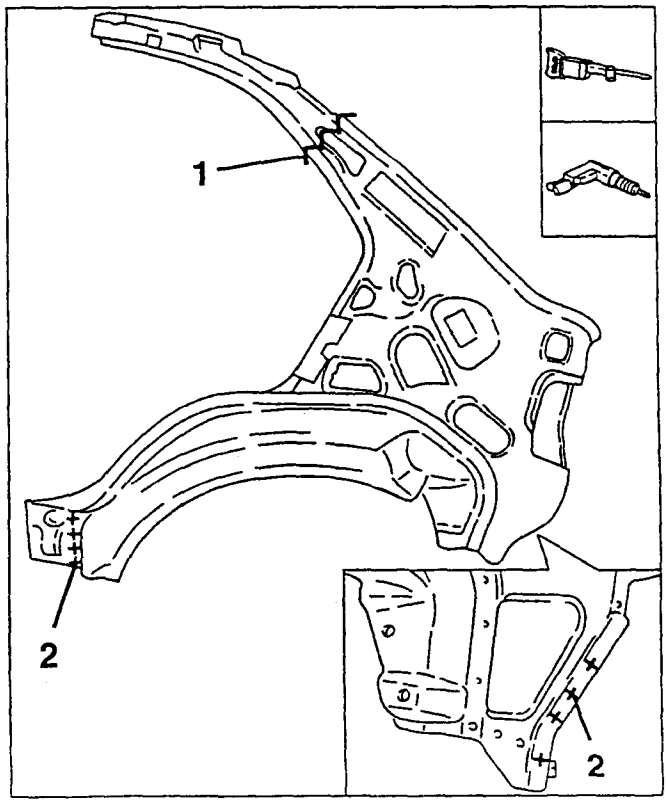


1. Using a snipping machine, remove the accessible welding spots; remove the remaining welding spots using a drill or chisel.
- Remove the complete inner side frame.

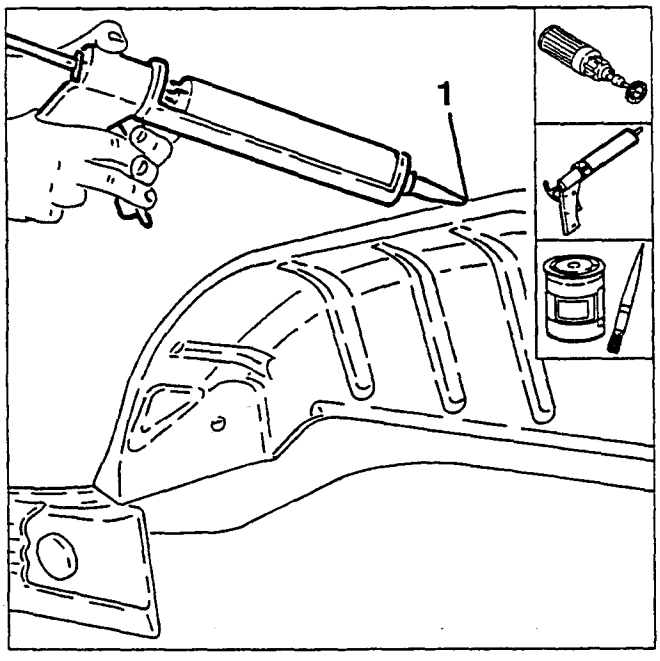


PREPARATION

1. Working on the bench, with a reciprocating saw cut the new inner side frame, keeping the same overlapping area.
2. Trace the inner side frameand drill (bit Ø 5 mm), as illustrated.

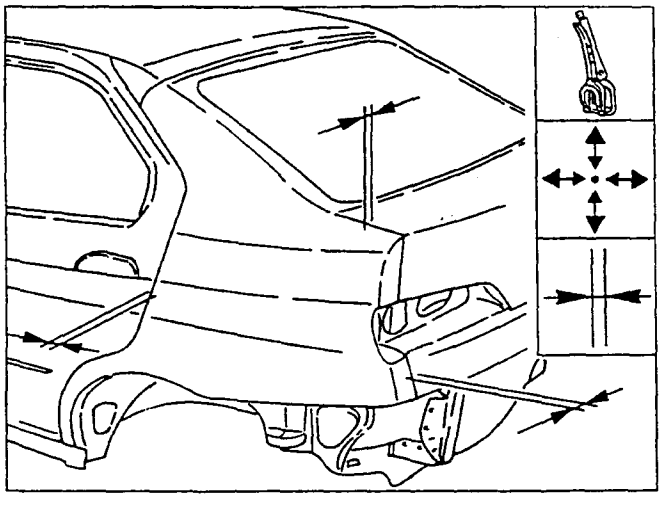


- Using a rotary brush, clean the areas concerned by welding.
1. Apply the high thickness electric welding protection on the coupling parts with the wheelhouse involved by spot welding.
- Apply the electric welding protection to be brushed on the remaining areas involved by spot welding.



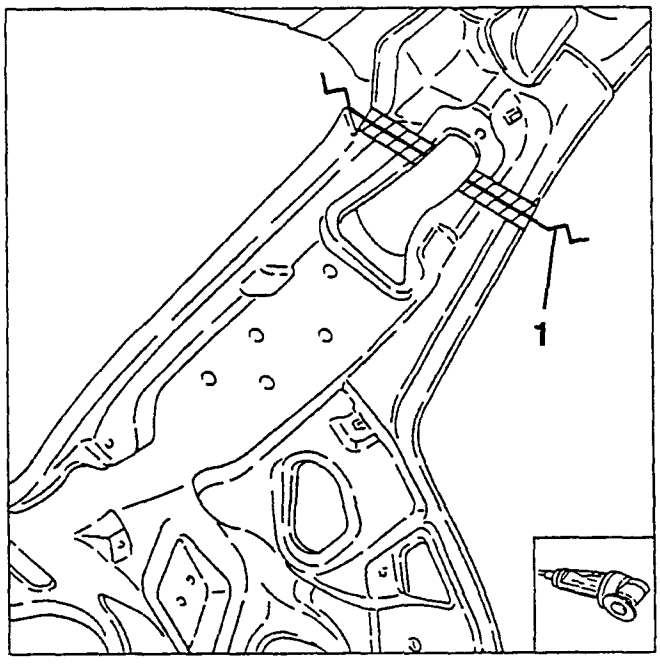
POSITIONING AND CHECKING

- Position the inner side frame joining the edges to be welded and fasten using clamps.
- Check the squareness, lights and angles refitting the components removed previously with the associated seals and parts which, once assembled make it possible to check that the operations have been carried out to perfection.



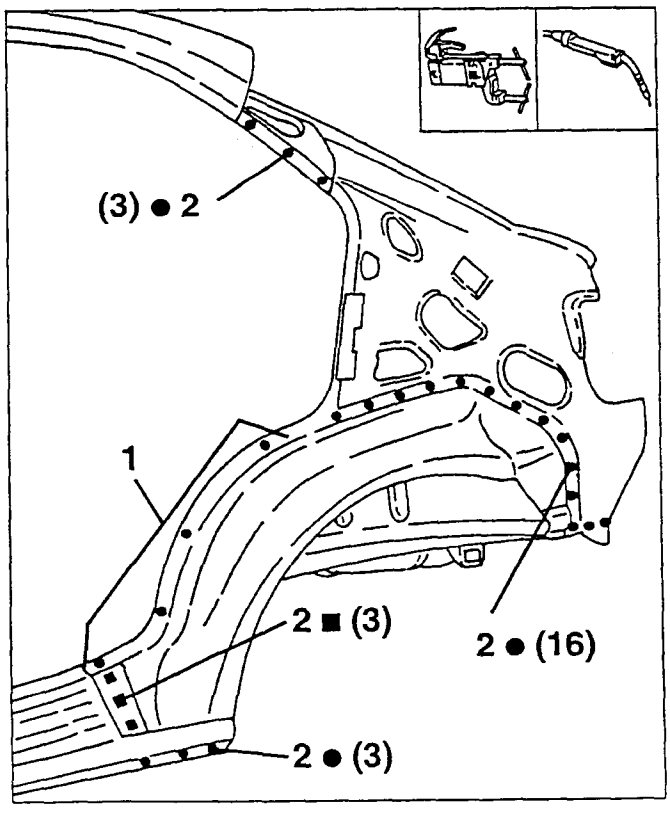
- Remove the assembled components to check for correct positioning of the inner side frame.

1. Using a circular blade saw, trim the sheet metal eliminating the excess, without damaging the sheet metal below.

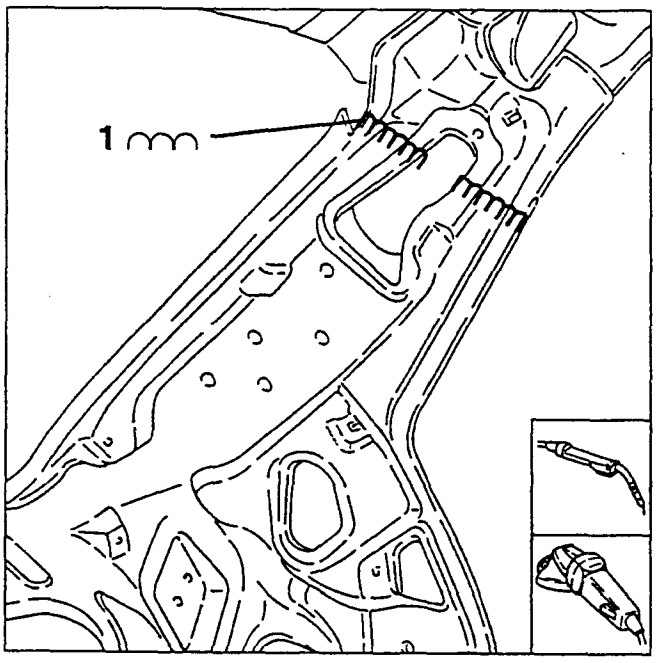


WELDING AND FINISHING OF SHEET METAL PIECE

1. Using a spot welder, proceed with tacking.
2. Using a spot welder or where necessary, an MIG welder, proceed as illustrated.

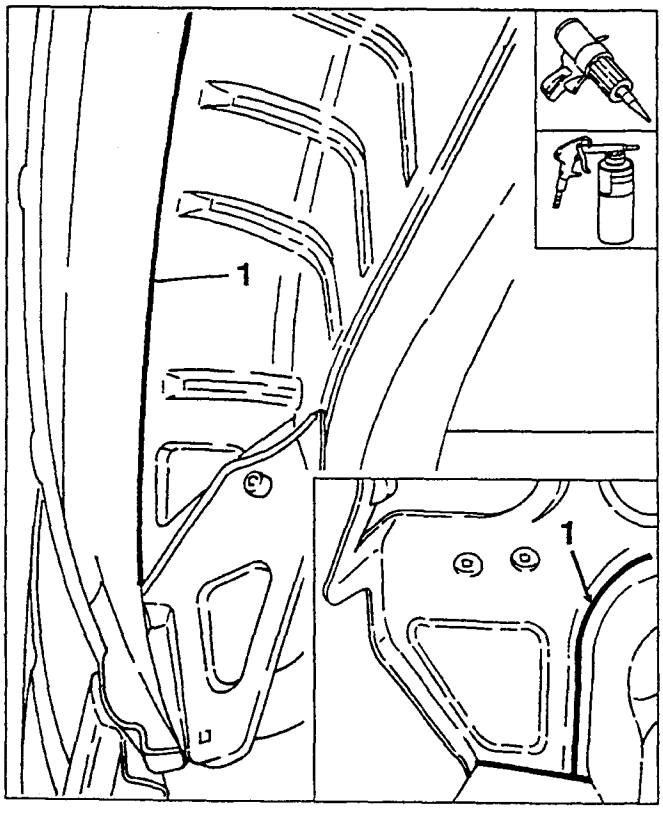


1. Using an MIG welder, seam weld as illustrated.
- Using an abrasive grinder, remove and level remains of welding.



PROTECTIONS

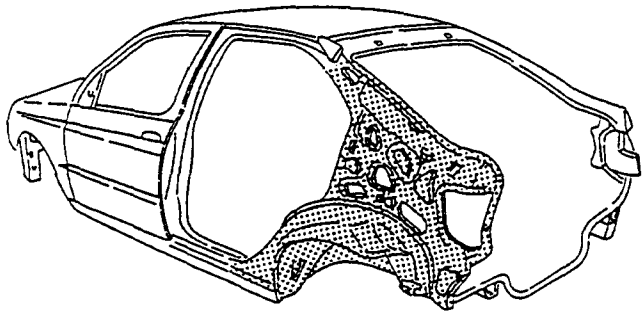
1. Apply the specified sealant along the lines illustrated.
- Apply the specified underbody protective coating in the area of the wheelhouse involved by the replacement.



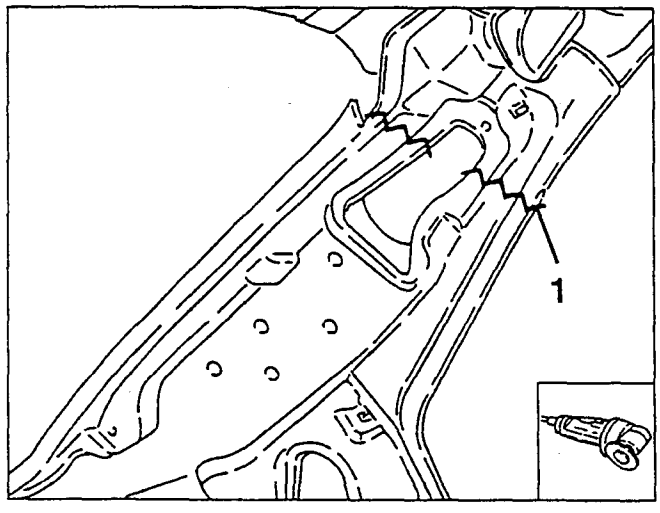
- Refit del rear mudguard and rear panel working in the corresponding paragraphs.

INNER SIDE FRAME WITH WHEELHOUSE (WITH REAR MUDGUARD AND REAR PANEL REMOVED)

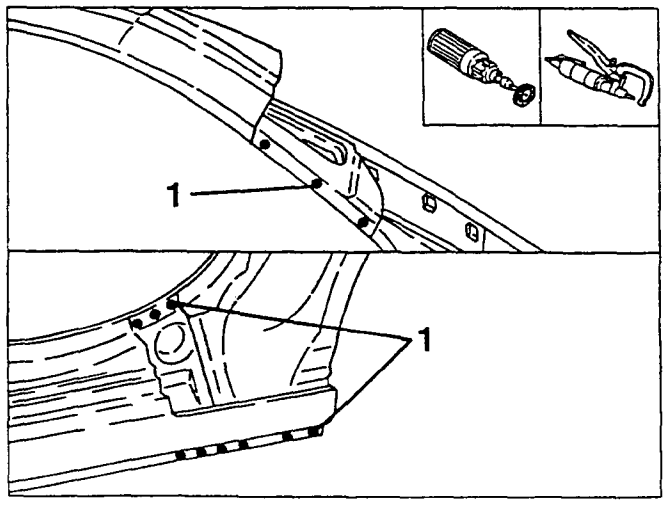
REMOVAL



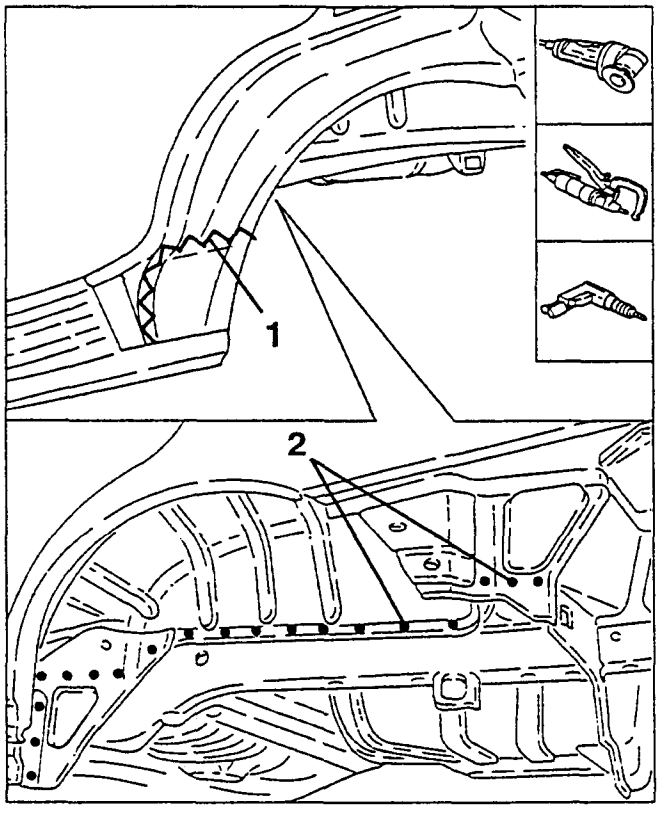
1. Using a circular blade saw, cut along the line illustrated, without damaging the sheet metal below.



- Using a rotary brush, clean the areas to be de-welded to reveal the welding spots.
1. Using a snipping machine, remove the welding spots.



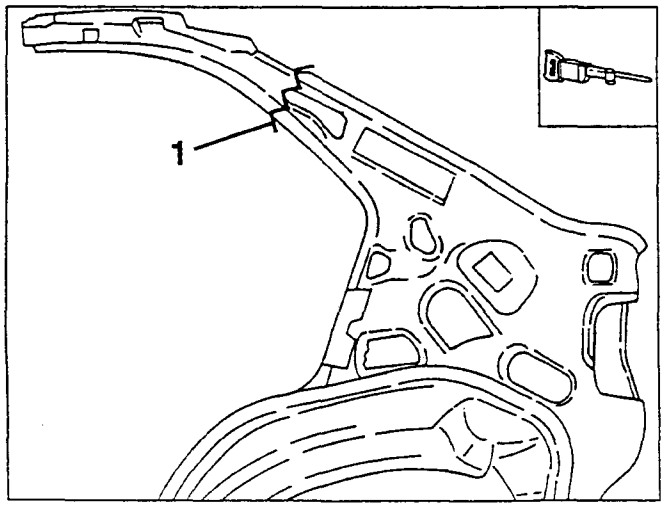
1. Using a circular blade saw, cut the sheet metal following the trace illustrated to gain access to the welding spots below.
2. Using a snipping machine, remove the accessible welding spots; remove the remaining welding spots using a drill.



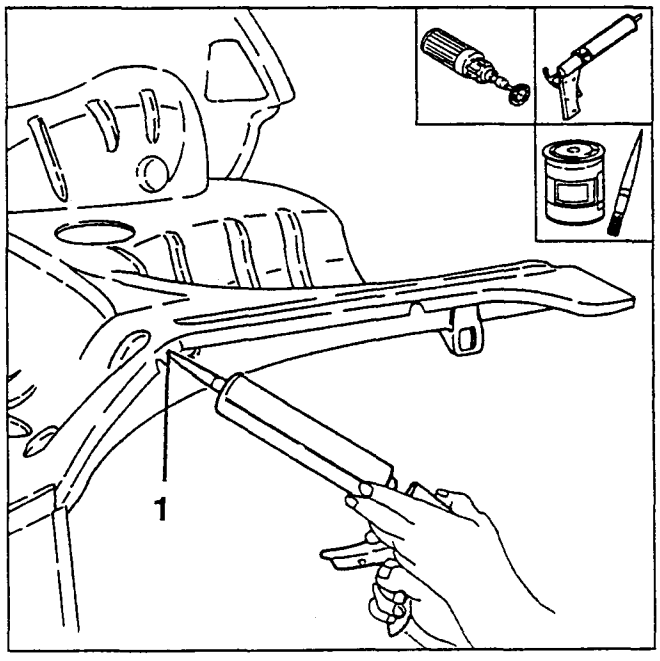
- Remove the inner side frame complete with wheelhouse.

PREPARATION

1. Working on the bench, with a reciprocating saw cut the new inner side frame complete with wheelhouse, keeping the same overlapping area.

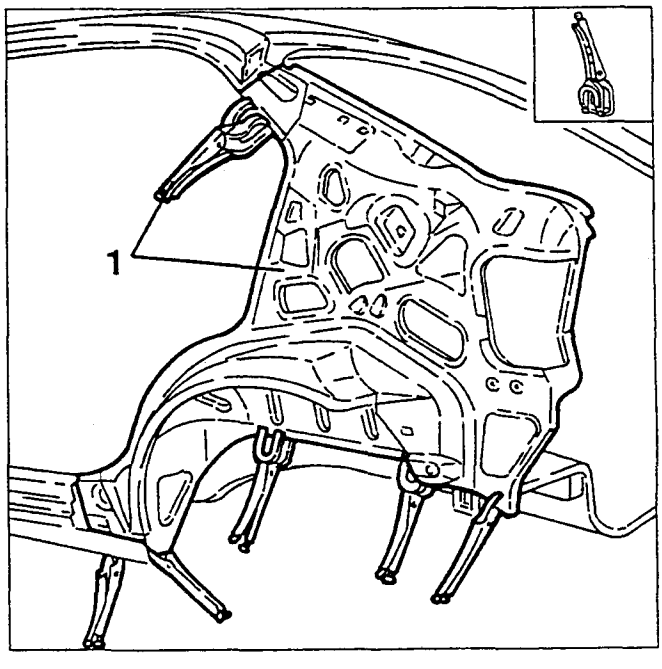


- Using a rotary brush, clean the areas concerned by welding.
1. Apply the high thickness electric welding protection on all the wheelhouse and floor coupling parts.
- Apply the electric welding protection to be brushed on the remaining areas involved by spot welding.

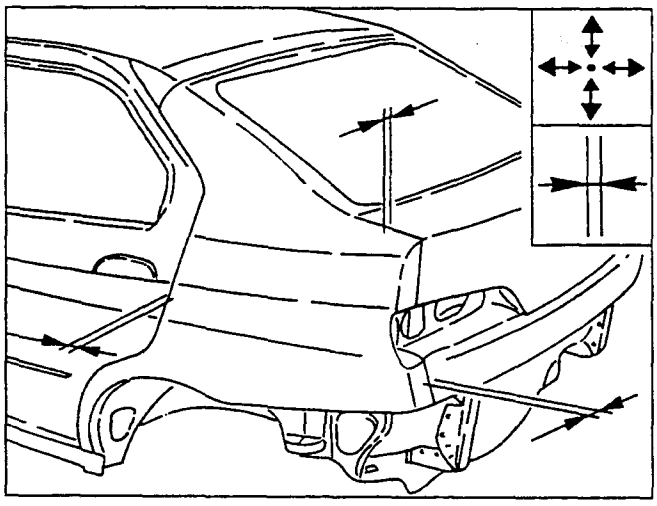


POSITIONING AND CHECKING

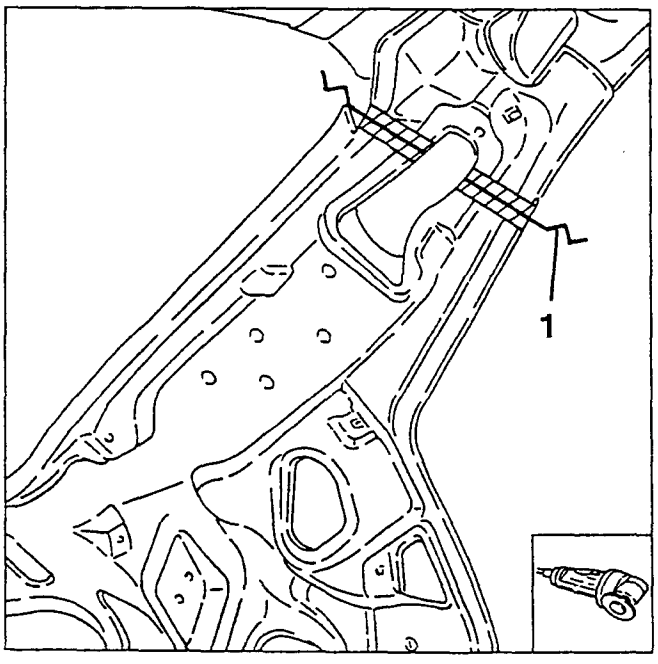
1. Position the inner side frame complete with wheelhouse joining the edges to be welded and fasten using clamps.

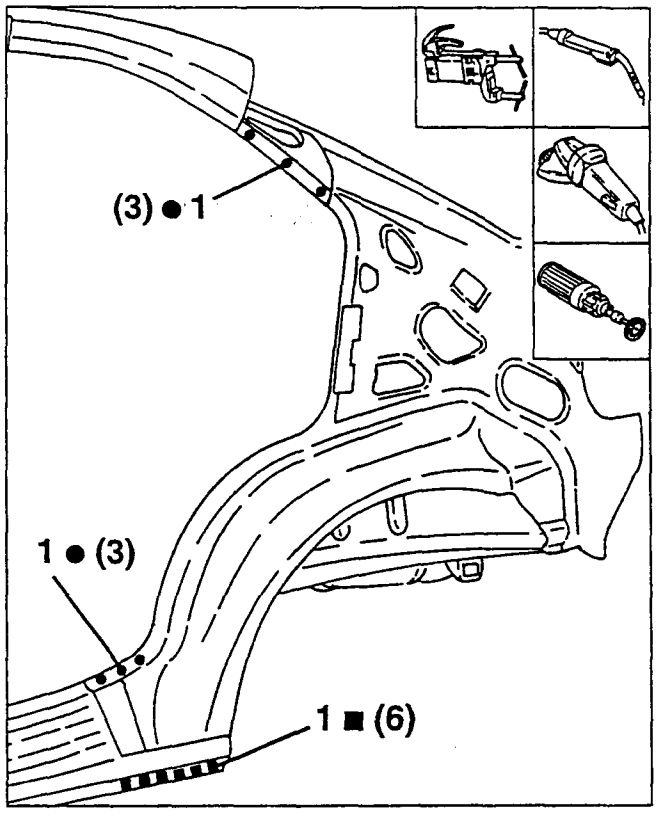


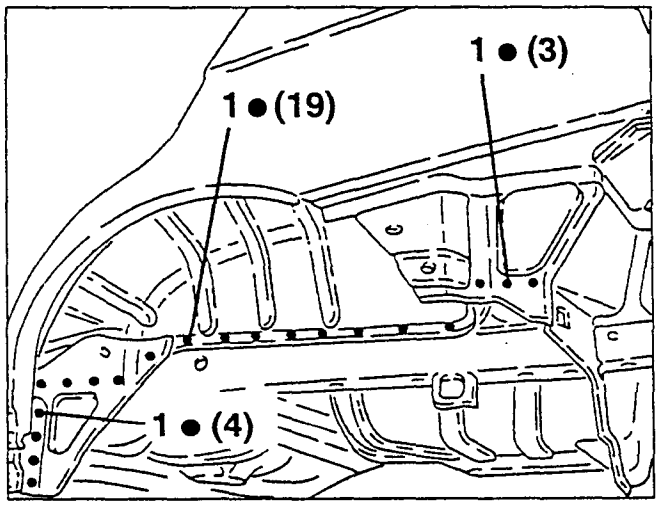
- Check the squareness, lights and angles refitting the components removed previously with the associated seals and parts which, once assembled make it possible to check that the operations have been carried out to perfection.

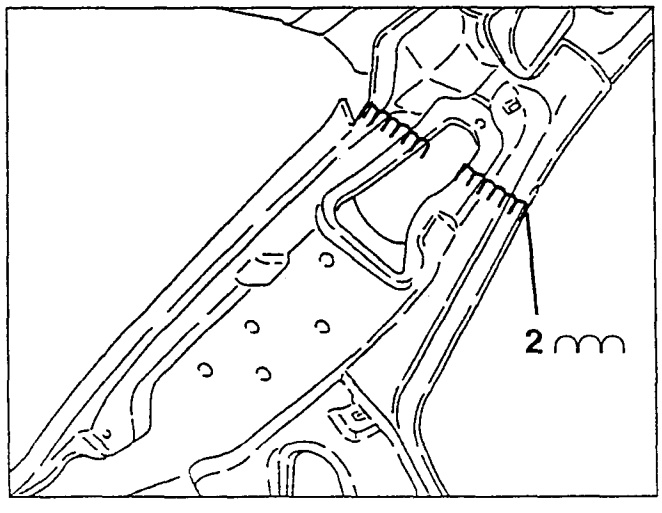


- Remove the components assembled for correct positioning of the inner side frame complete with wheelhouse.
1.Using a circular blade saw, trim the sheet metal eliminating the excess, without damaging the sheet metal below.







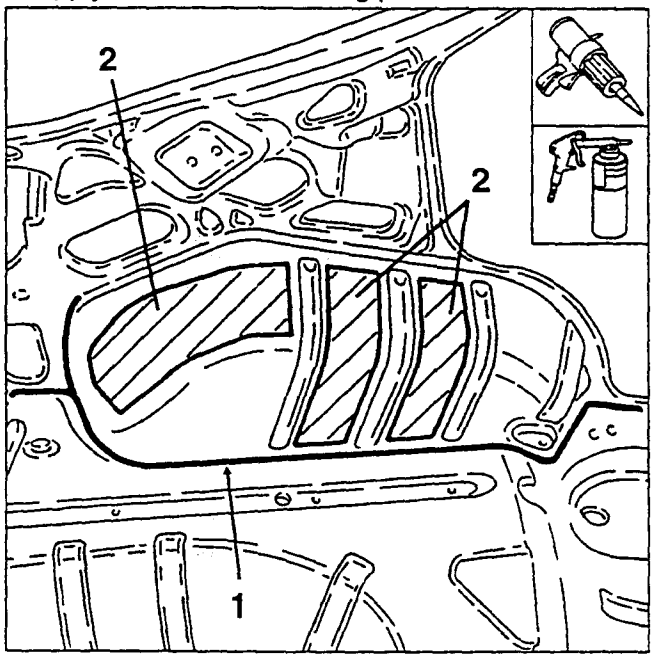


WELDING AND FINISHING OF SHEET METAL PIECE

1. Using a spot welder or, where necessary, an MIG welder, proceed as illustrated.
2. Using an MIG welder, seam weld as illustrated.
- Using an abrasive grinder, remove and level remains of welding.
- Using a rotary brush clean the welded areas

PROTECTIONS

1. Apply the specified sealant along the lines illustrated.
- Apply the specified underbody protective coating in the area of the wheelhouse involved by the replacement.
2. Apply the sound-deadening panels as illustrated.



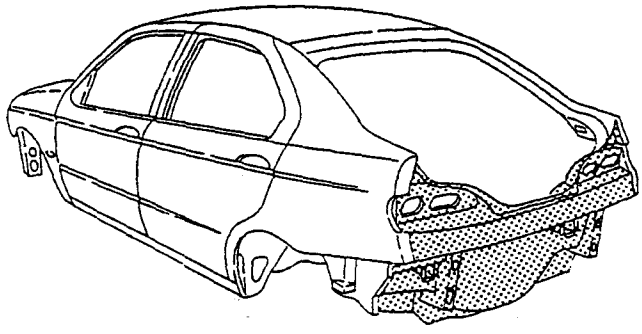
- Refit the rear mudguard and rear panel working as described in the corresponding paragraphs.

COMPLETE REAR PANEL

PRELIMINARY OPERATIONS

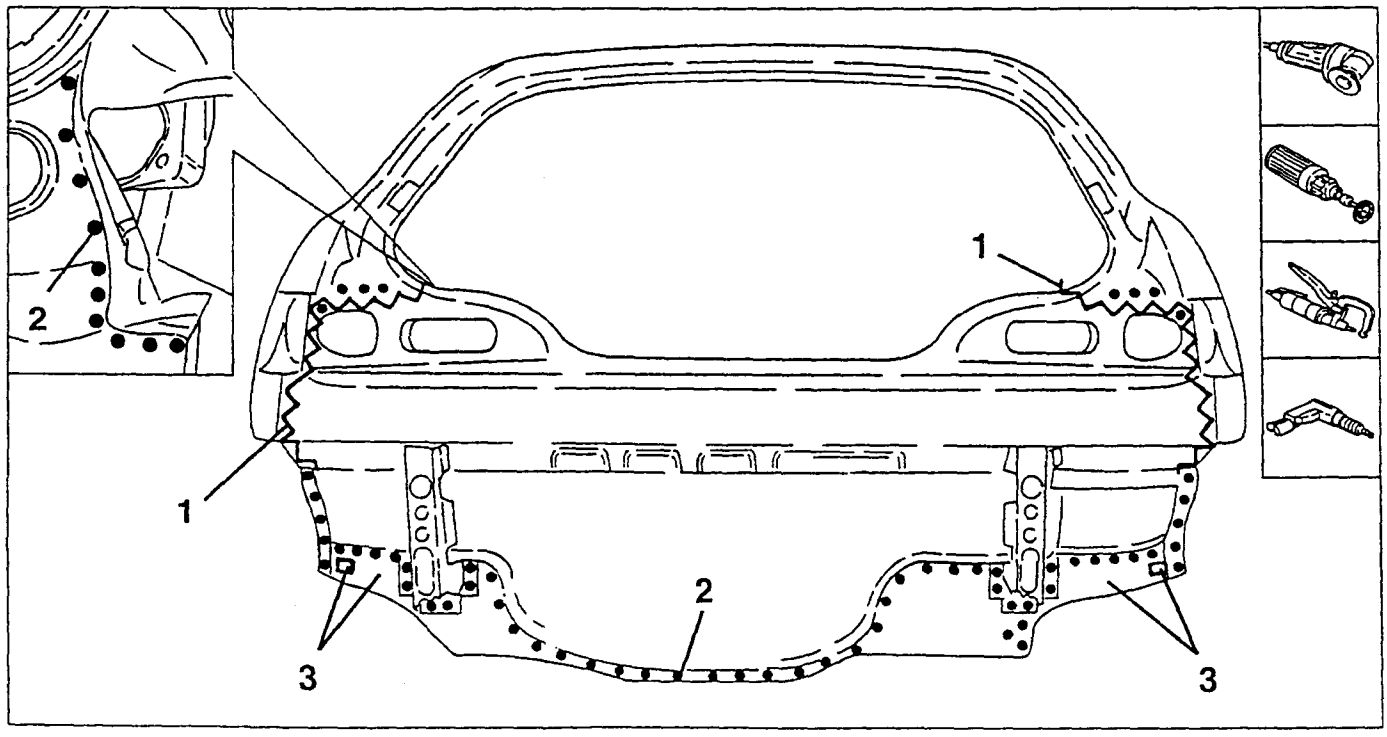
- Disconnect the battery (-) terminal and remove the electronic control units.
- Remove the trim components, electric and mechanical systems that might hinder the repair operation or suffer damage during work (see specific paragraphs).
- Remove the following sheet metal parts:
• boot lid (see specific paragraph).

REMOVAL

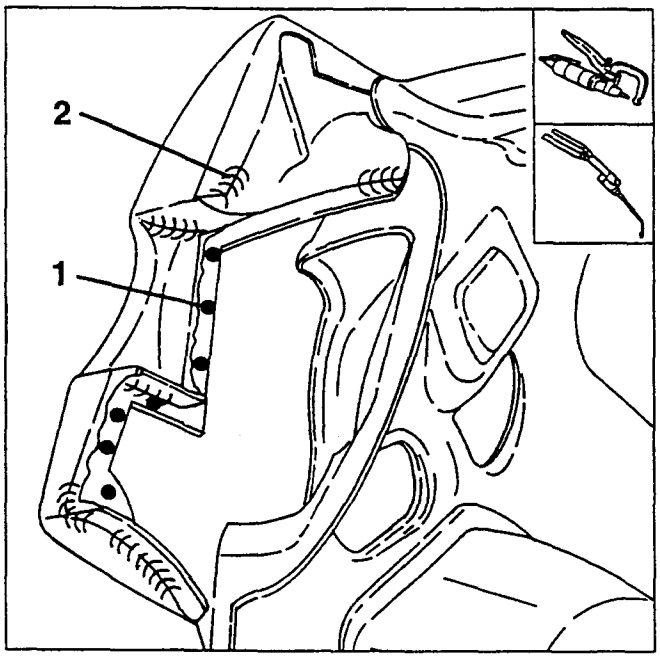


1. Using a circular blade saw, cut along the line illustrated, without damaging the sheet metal below.

- Using a rotary brush, clean the area to be welded to reveal the welding spots.
2. Using a snipping machine, remove the accessible welding spots; remove the remaining welding spots using a drill.
3. Open the clinching tabs and remove rear panel cutting the sealant if necessary.

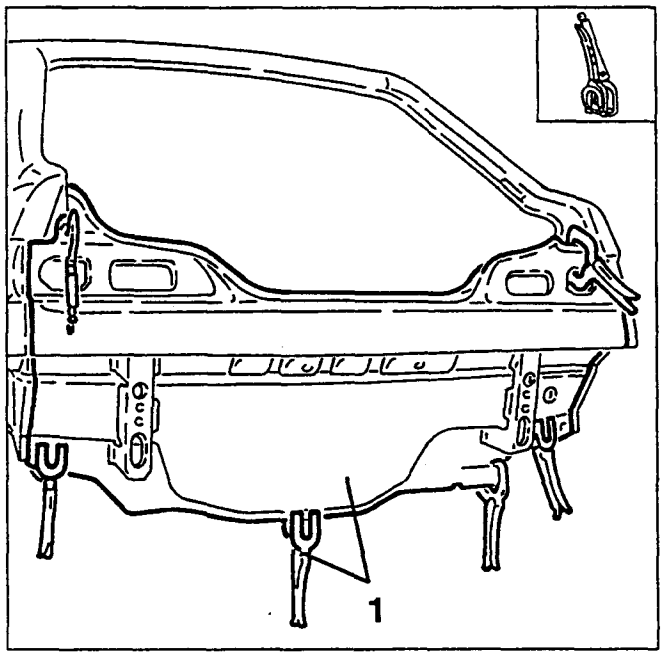


1. Using a snipping machine, remove the welding spots illustrated.
2. Using an oxyacetylene blower, de-weld the edges of the rear panel from the mudguard, then remove them.



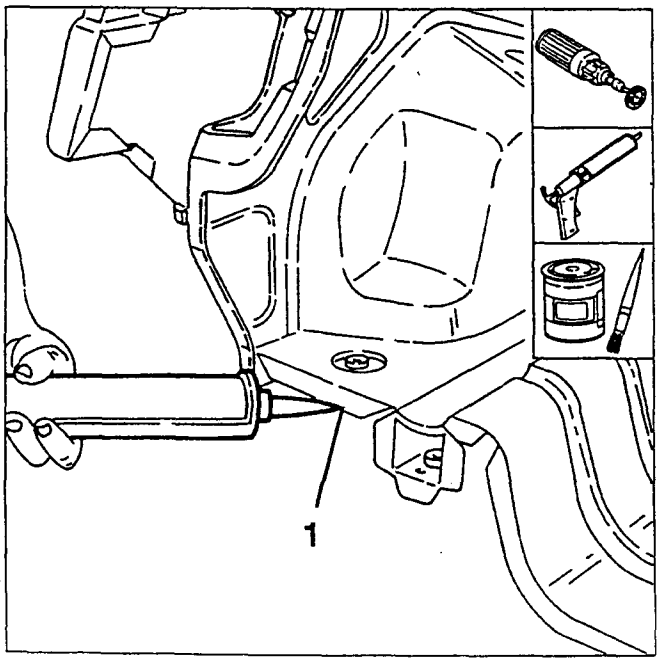
POSITIONING AND CHECKING

1. Position the rear panel joining the edges to be welded and fasten using clamps and two clinching tabs.

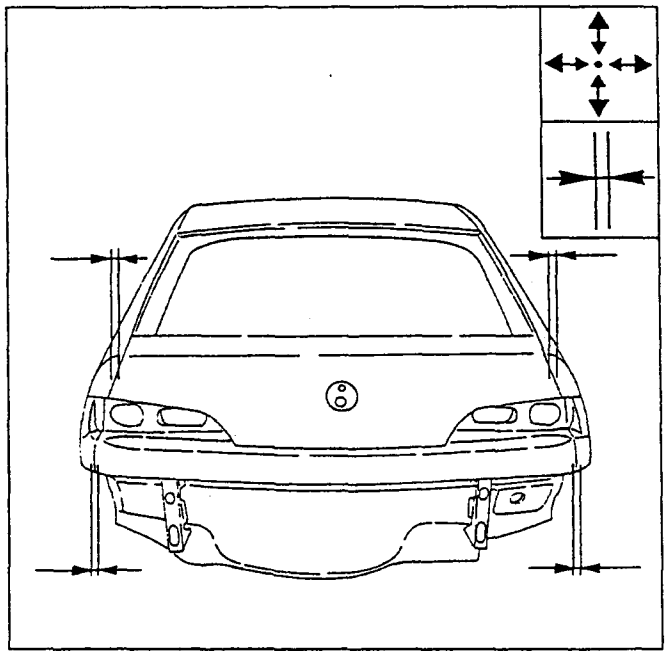


PREPARATION

- Using a rotary brush, clean the areas concerned by welding.
1. Apply the high thickness electric welding protection on the whole coupling area of the rear panel with the floor.
- Apply the electric welding protection to be brushed on the remaining areas involved by spot welding.



- Check the squareness, lights and angles refitting the components removed previously with the associated seals and parts which, once assembled make it possible to check that the operations have been carried out to perfection.

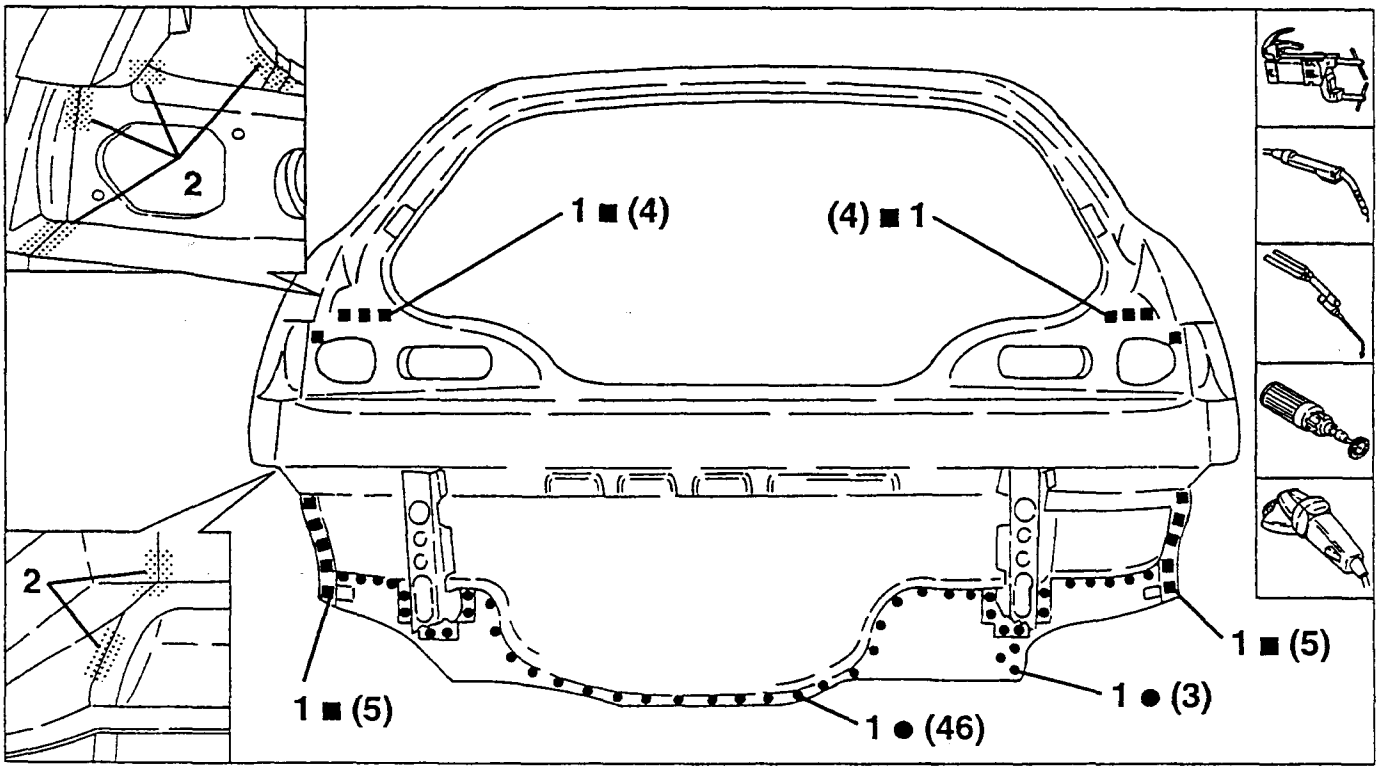


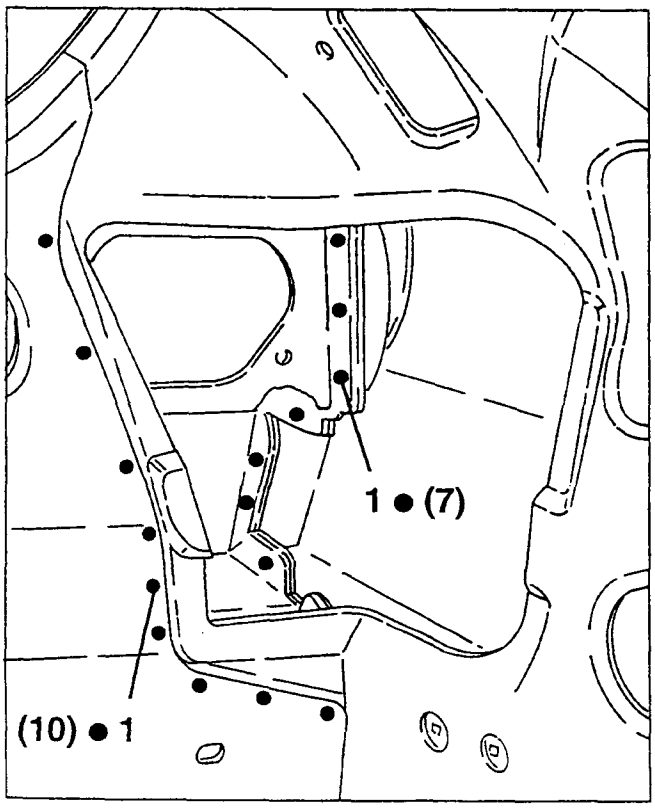
- Remove the assembled components to check for correct positioning of the rear panel.

WELDING AND FINISHING THE PANEL

1. Using a spot welder or, where necessary, an MIG welder, work as illustrated.
2. Using an oxyacetylene torch. brass braze weld as illustrated.

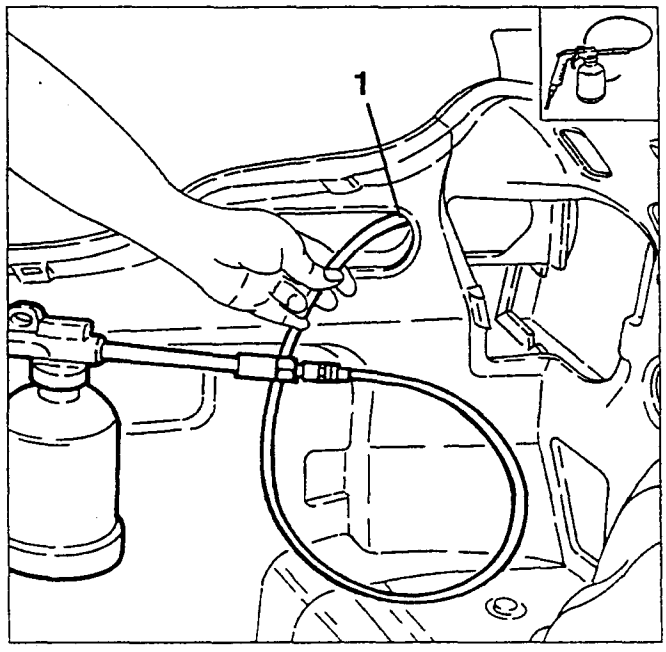
- Using a rotary brush, clean the welded areas.
- Using an abrasive grinding wheel remove and level the welding remains.



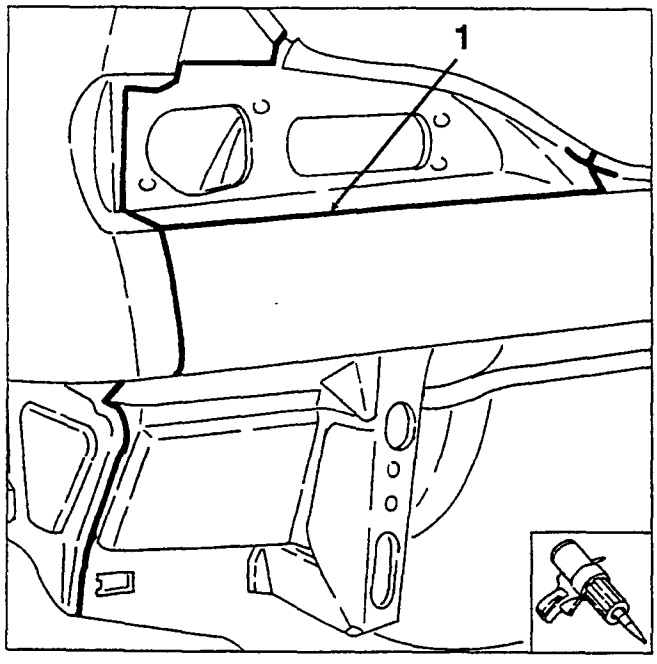


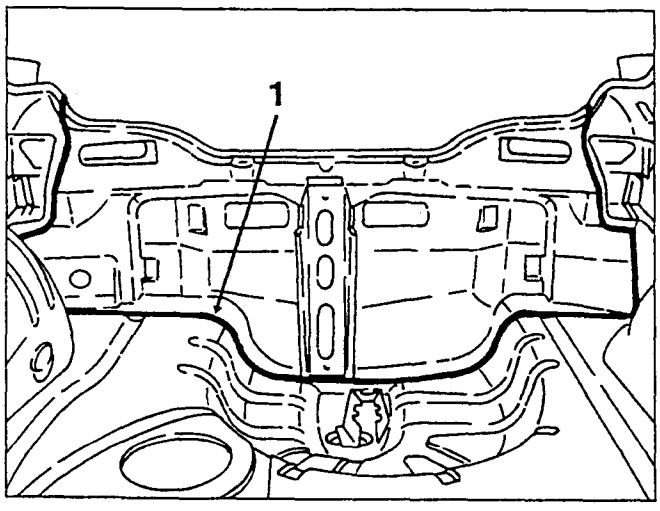
PROTECTIONS

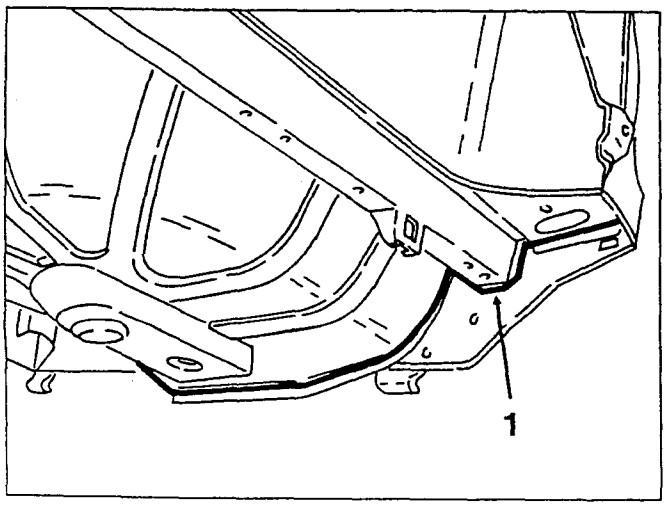
1. Apply the specified antirust in the areas involved by MIG welding and braze welding.



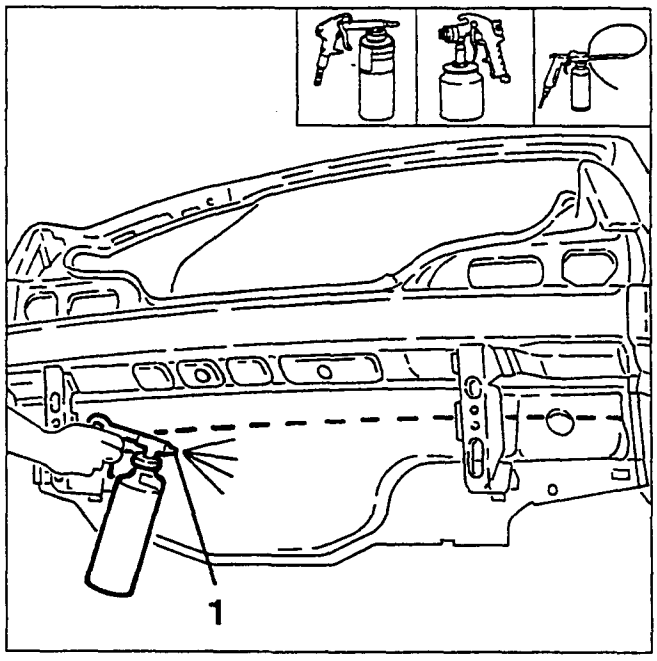
1. Apply the specified sealant along the lines shown in the figure.







1. Apply the specified underbody protection in the area of the floor involved in the replacement and on the rear panel up to the dotted line illustrated.
- Paint and wax coat.

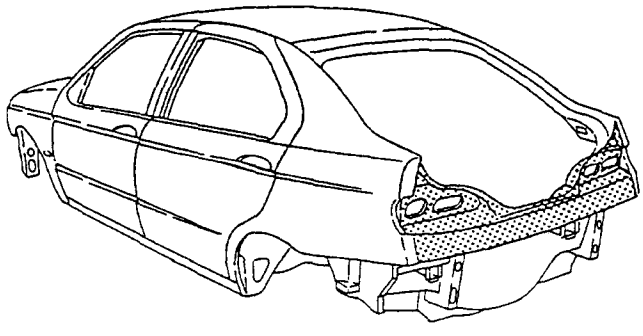


PARTIAL OUTER REAR PANEL

PRELIMINARY OPERATIONS

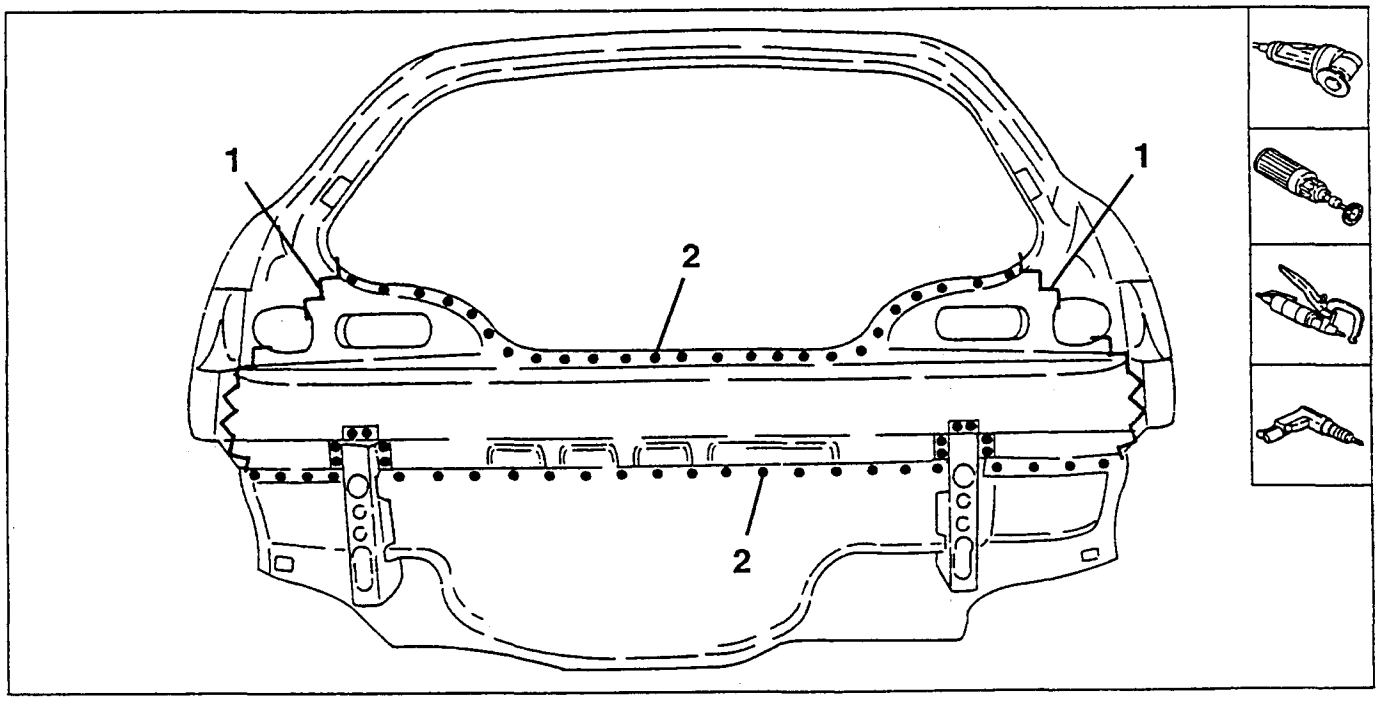
- Disconnect the battery (-) terminal and remove the electronic control units.
- Remove the trim components, and electric and mechanical components that could hinder the repair operation or suffer damage (see specific paragraphs).
- Remove the following parts:
• bonnet lid (see specific paragraph).

REMOVAL

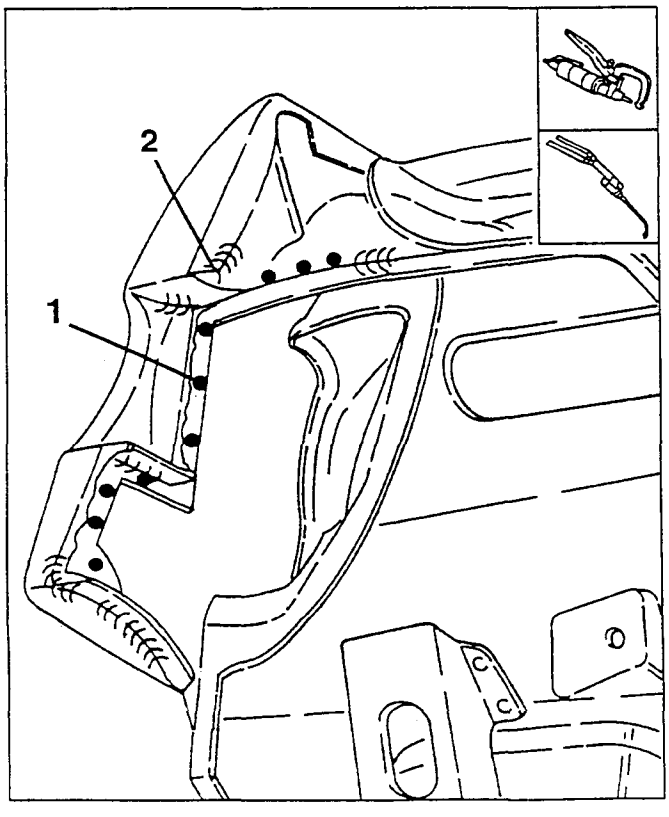


1. Using a saw with circular blade, cut following the trace illustrated, without damaging the panels below.
- Using a rotary brush, clean the areas to be de-welded to reveal the welding spots.

2. Using a de-welder remove the accessible welding spots; remove the remaining welding spots using a drill.
- Remove the partial rear panel opening the edges of the rear reinforcements.

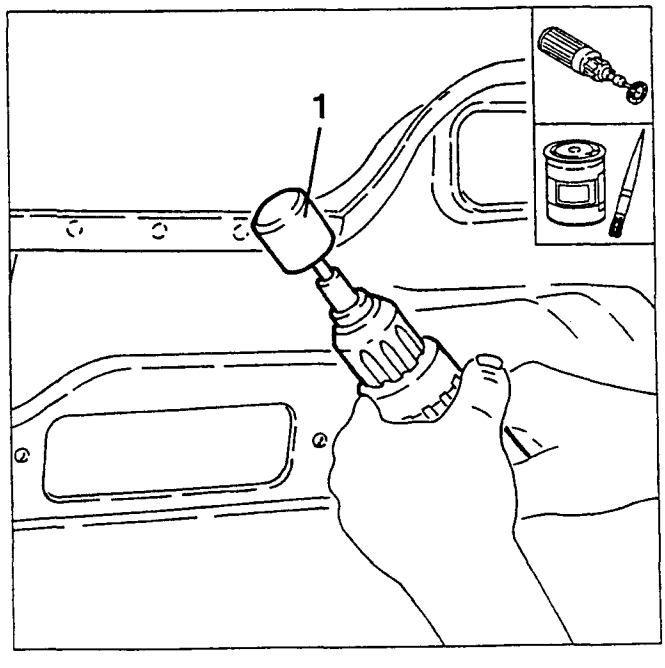


1. Using a de-welder, remove the welding spots illustrated.
2. Using an oxyacetylene torch, de-weld the edges of the partial rear outer panel from the mudguard, then remove them.



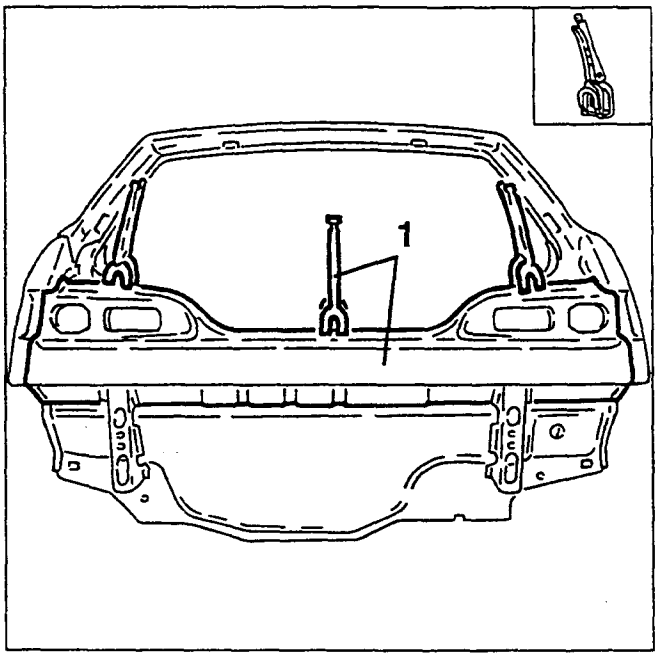
PREPARATION

1. Using a rotary brush clean the areas involved by welding.
- Apply the electric welding protection to be brushed on, on the areas involved by spot welding.

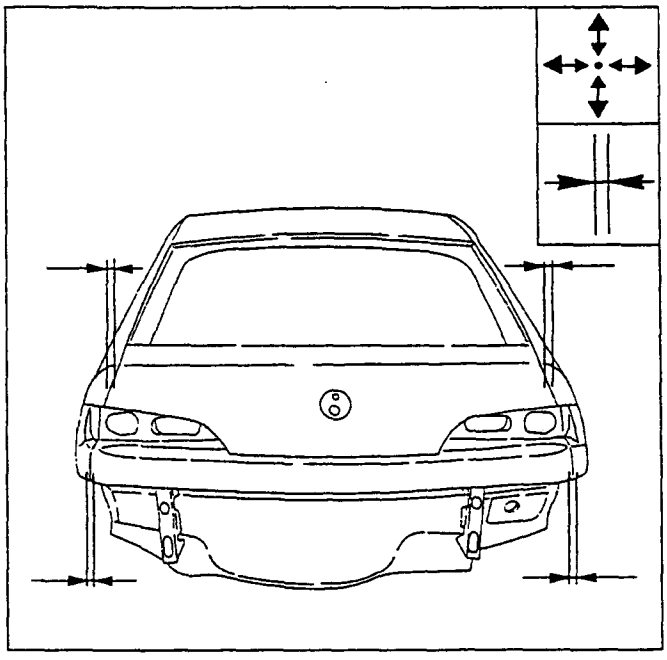


POSITIONING AND CHECKING

1. Position the partial outer rear panel joining the edges to be welded and fasten using clamps.



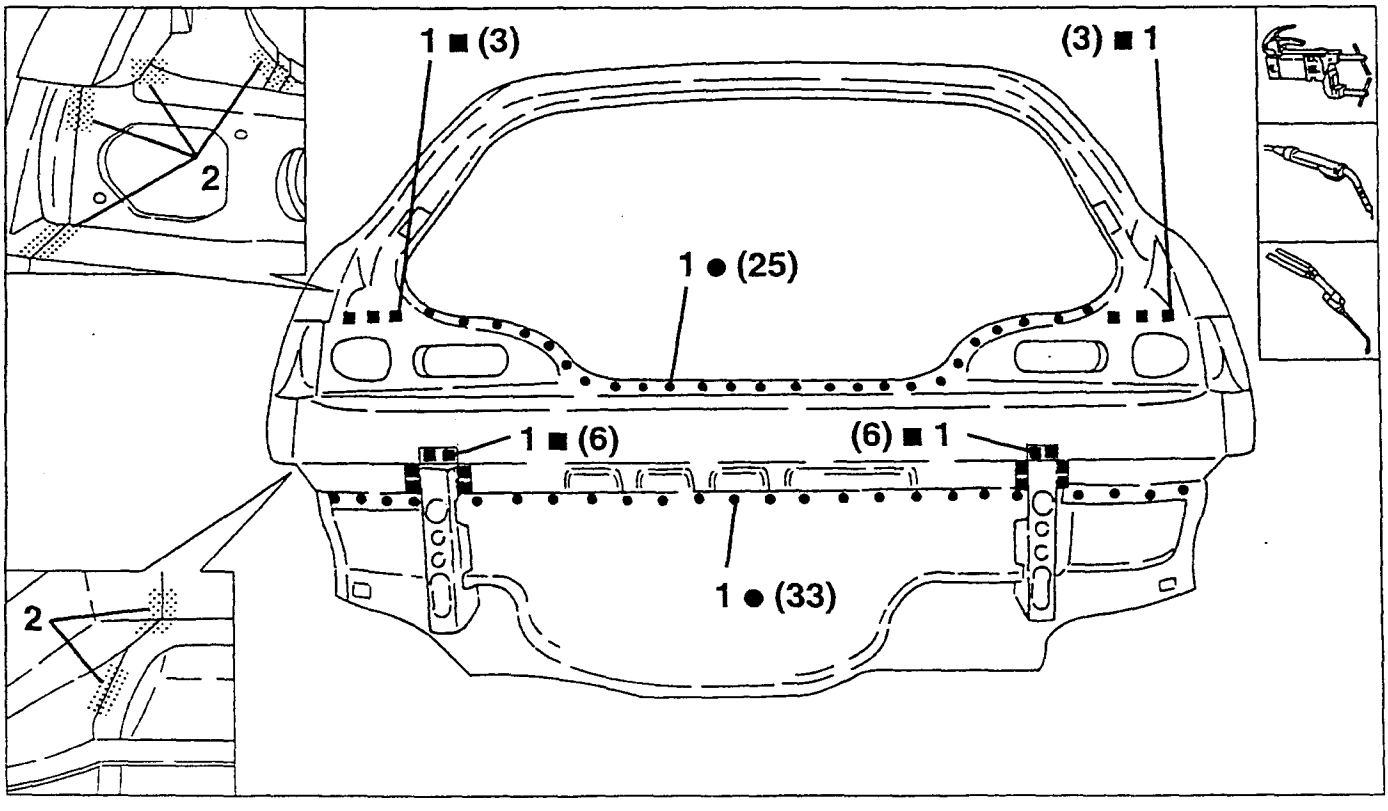
- Check the squareness, lights and angles refitting the components removed previously with the seals and parts, which, when assembled, make it possible to check that the result of the operation is perfect.



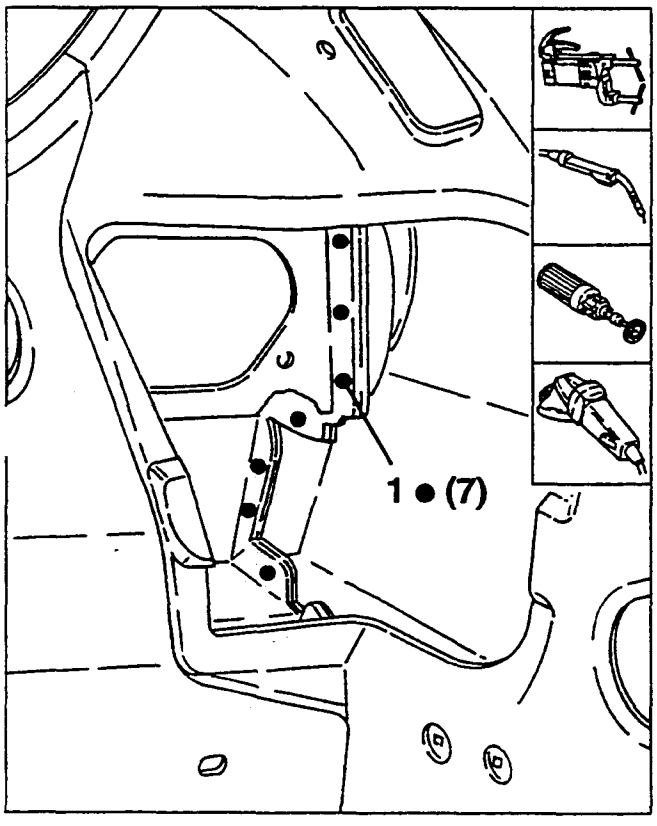
- Remove the components assembled for checking the correct positioning of the panel.
- Bend the edges of the rear reinforcements opened for removing the partial outer rear panel.

WELDING AND FINISHING THE PANEL

1. Using a spot welder or, where necessary, an MIG welder, proceed as illustrated.
2. Using an oxyacetylene torch, brass braze weld as illustrated.

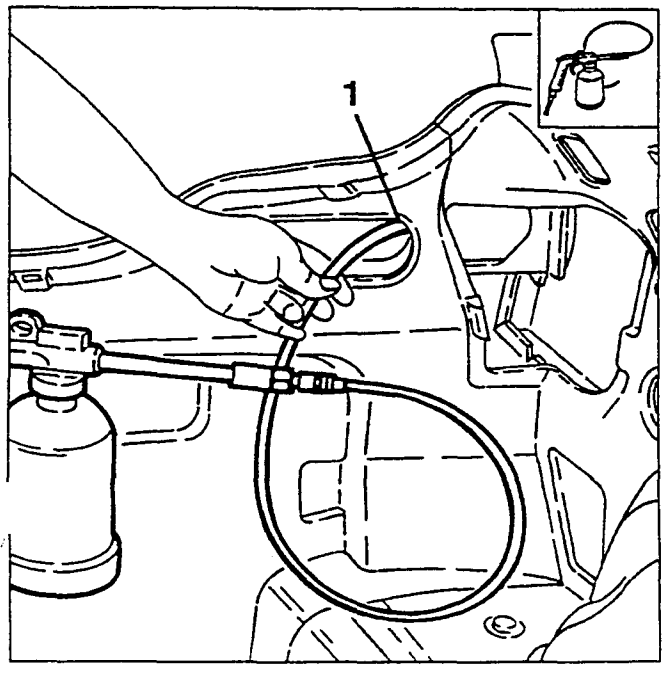


. Using a spot welder or, where necessary an MIG welder, proceed as illustrated.
- Using a rotary brush, clean the welded areas.
- Using an abrasive grinding wheel, remove and level the remains of welding.

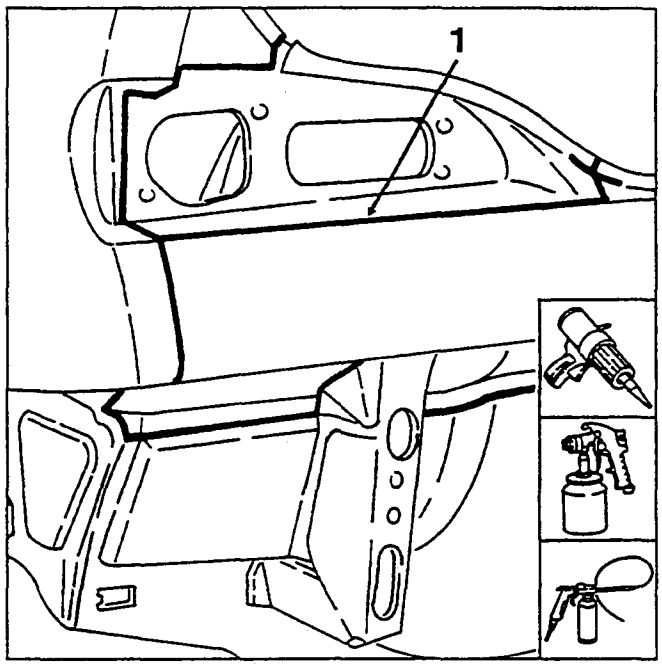


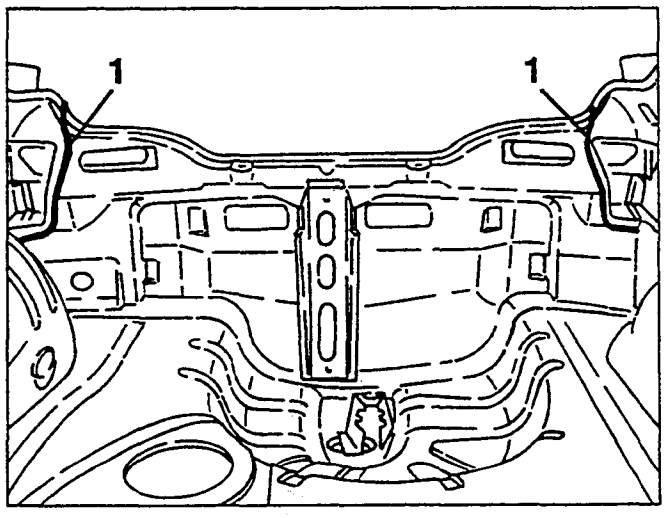
PROTECTIONS

1. Apply the specified antirust on the areas involved by MIG welding and braze welding.



1. Apply the specified sealant along the lines illustrated.
- Paint and wax coat.



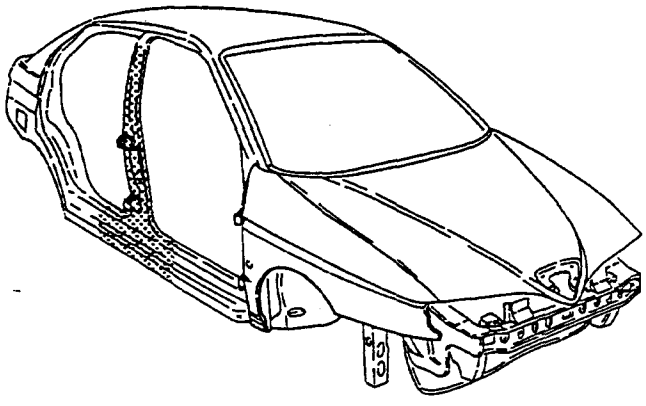


CENTRE PILLAR

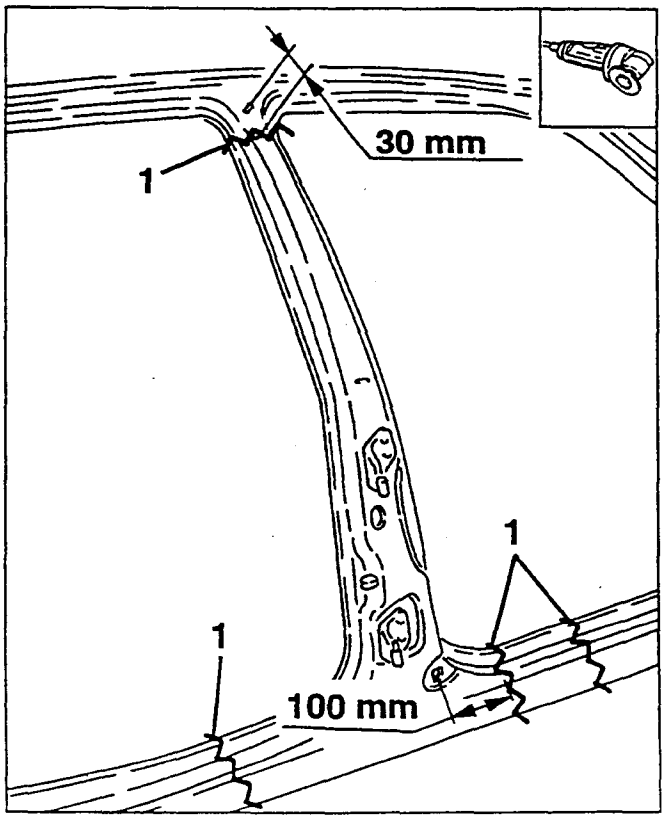
PRELIMINARY OPERATIONS

- Disconnect the battery (-) terminal and remove the electronic control units.
- Remove the trim, electrical and mechanical components that might hinder the repair operation or undergo damage during the operation itself (see specific paragraphs).
- Remove the following parts:
• doors on the side concerned (see specific paragraphs).

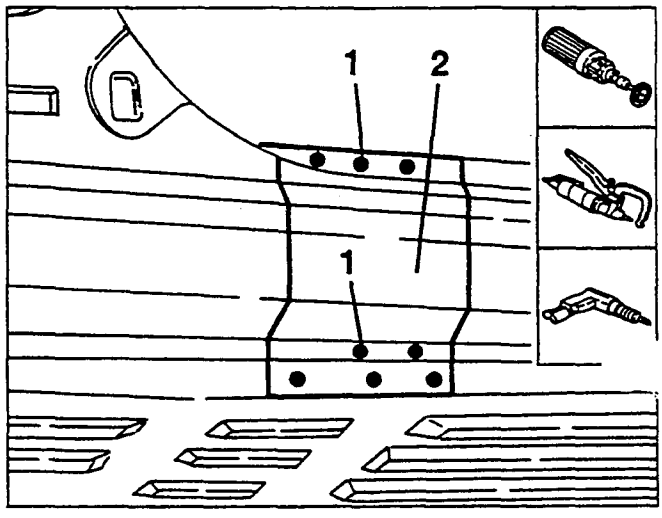
REMOVAL



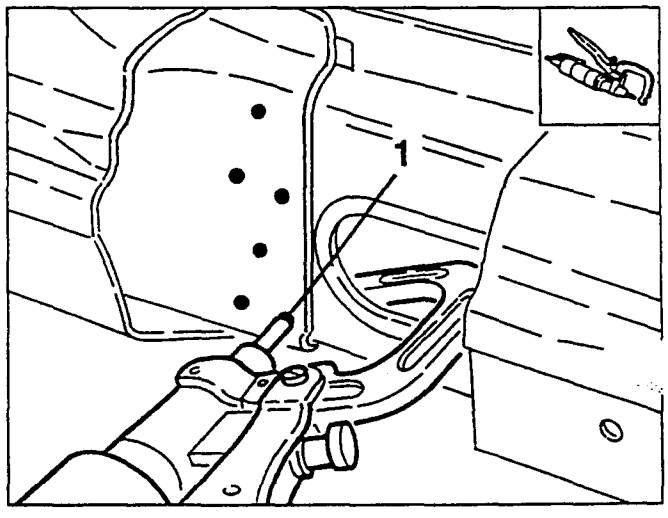
1. Using a saw with circular blade, cut following the trace illustrated without damaging the panels below.



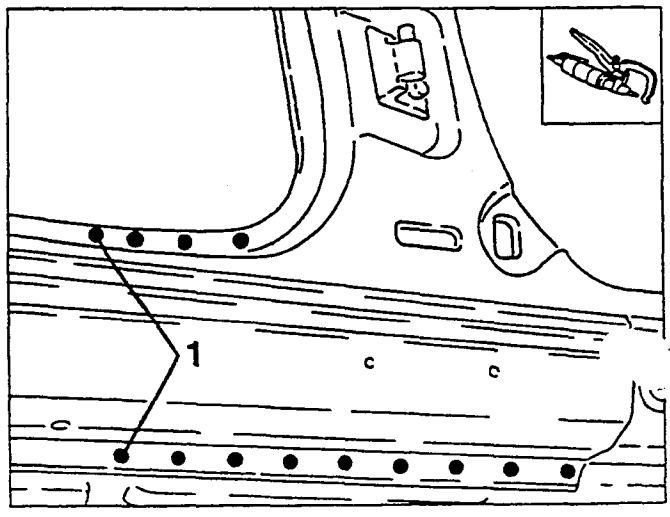
- Using a rotary brush, clean the areas to be welded to reveal the welding spots.
1. Using a de-welder, remove the accessible welding spots; remove the remaining welding spots using a drill.
2. Rimuovere plug created on the underdoor trim to gain access to the welding spots below.



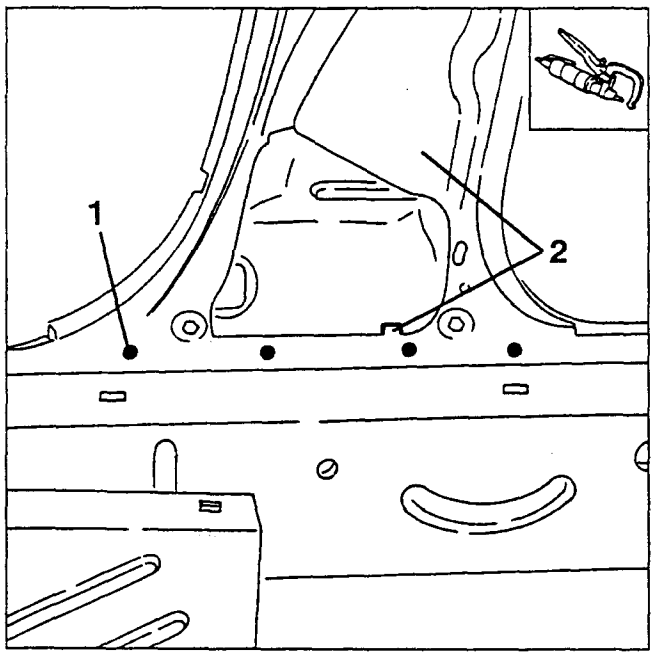
1. Using a de-welder remove the welding spots of the centre pillar frame and underdoor frame.



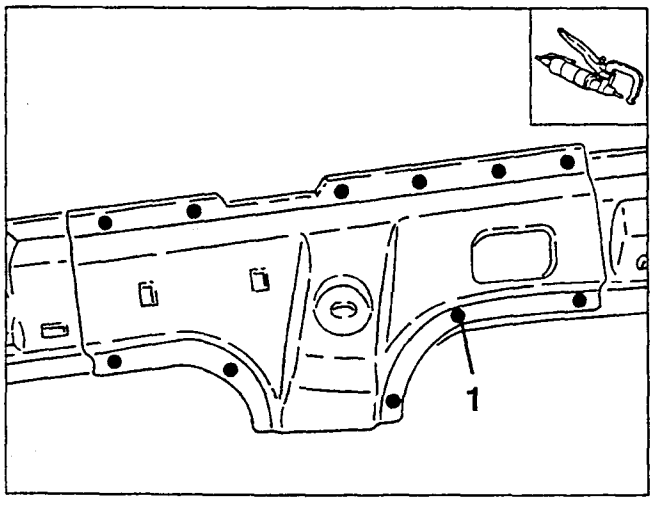
1. Using a de-welder, remove the welding spots illustrated.



1. Using a de-welder, remove the welding spots illustrated.
2. Open the clinching tab and remove the centre pillar.

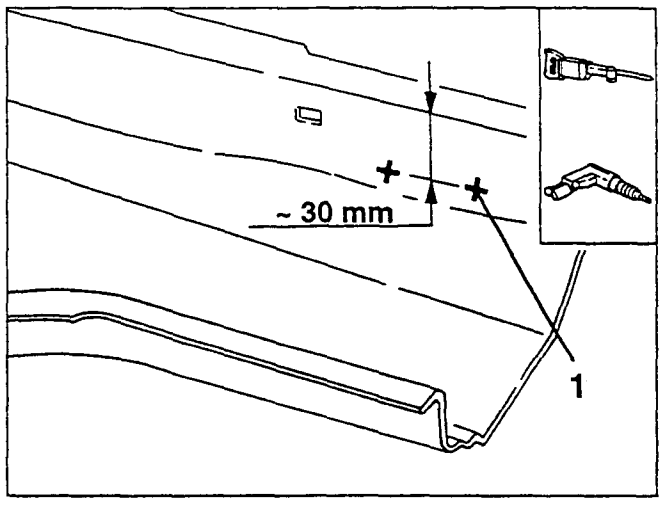


1. Using a de-welder remove the welding spots illustrated and remove the upper part of the inner centre pillar trim.

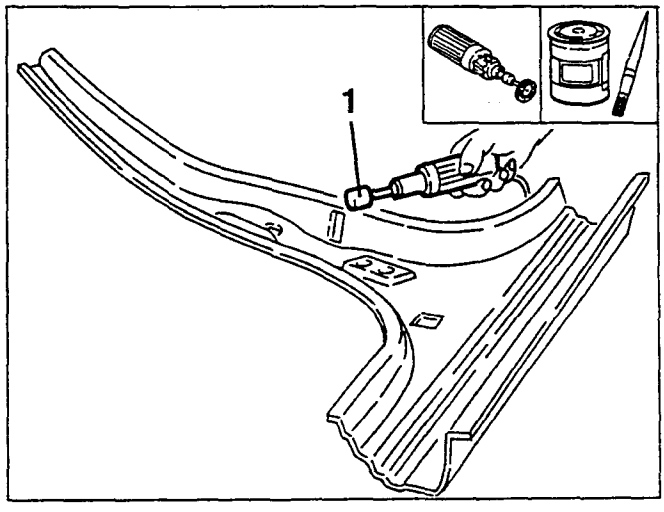


PREPARATION

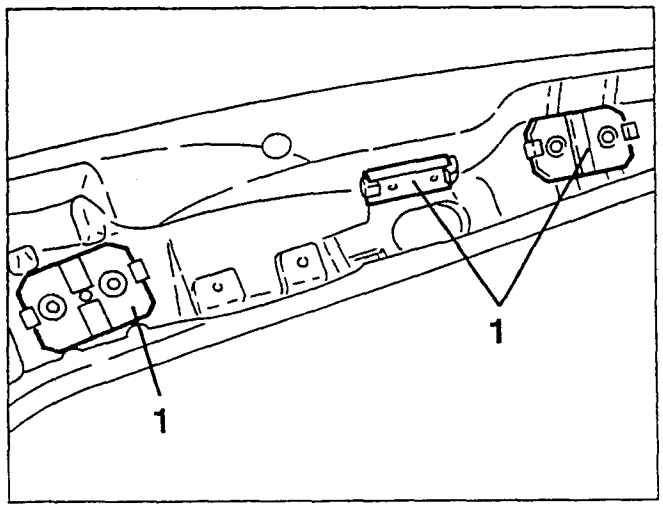
- Working on the bench and using a reciprocating saw, cut the outer pillar trim taking care to maintain the correct overlaying area.
1. Trace the outer pillar trim and drill (bit Ø 5 mm) as illustrated.



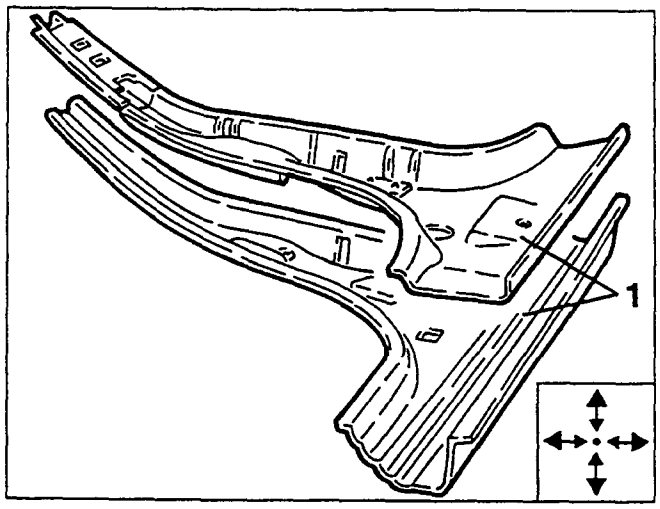
1. Using a rotary brush, clean the areas of the trim and of the centre pillar frame involved by welding.
- Apply the specified electric welding protection on the areas involved by spot welding.



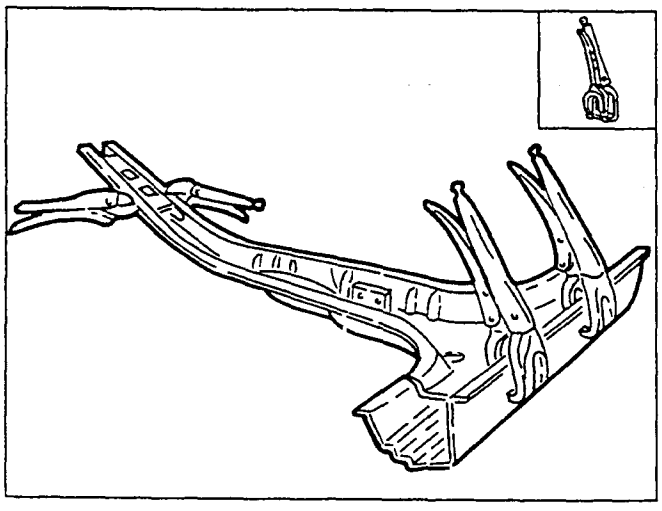
1. Fit the pads for fastening the door hinges and the lock striker on the centre pillar frame.



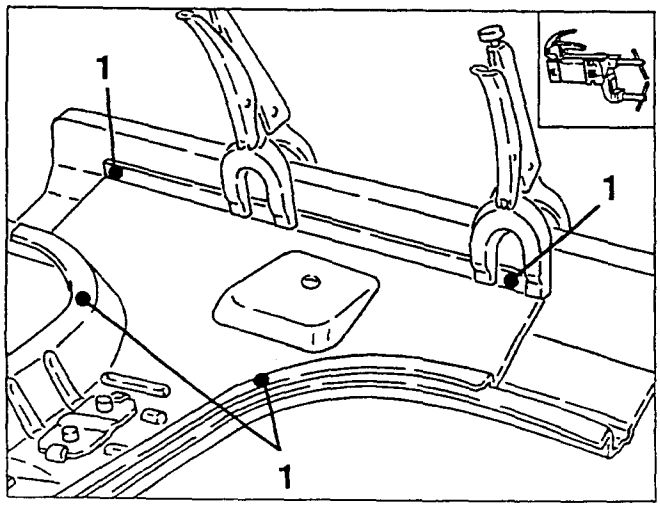
1. Assemble the frame on the centre pillar outer trim checking its correct coupling by the correspondence of the shared holes (hinge fastening pad holes, etc.)

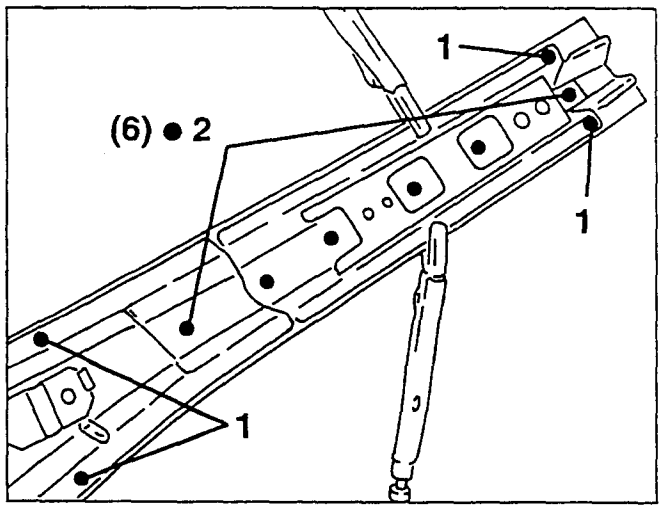


1. Join the edges of the parts to be welded and fasten them with clamps.

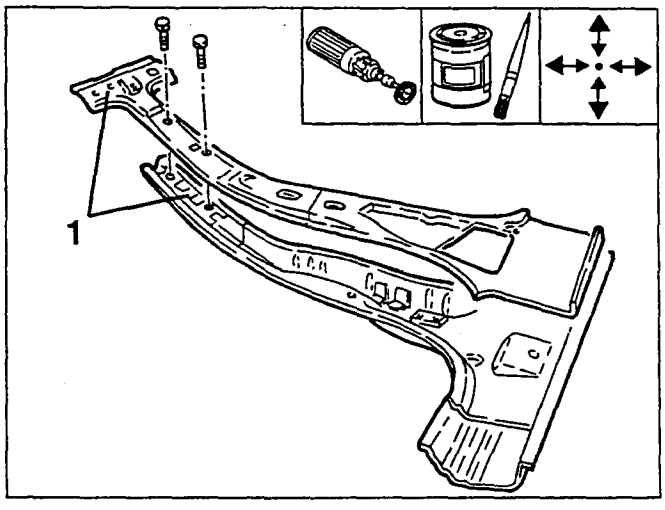


1. Using a spot welder, tack the frame on the outer trim as illustrated.
2. Using a spot welder, operate as illustrated.

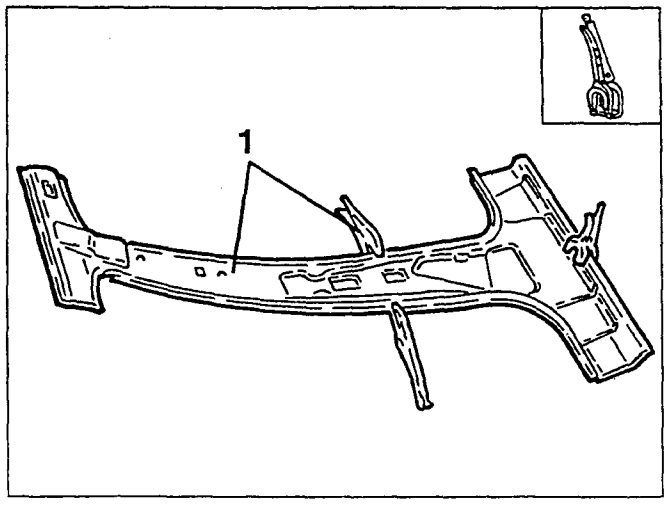




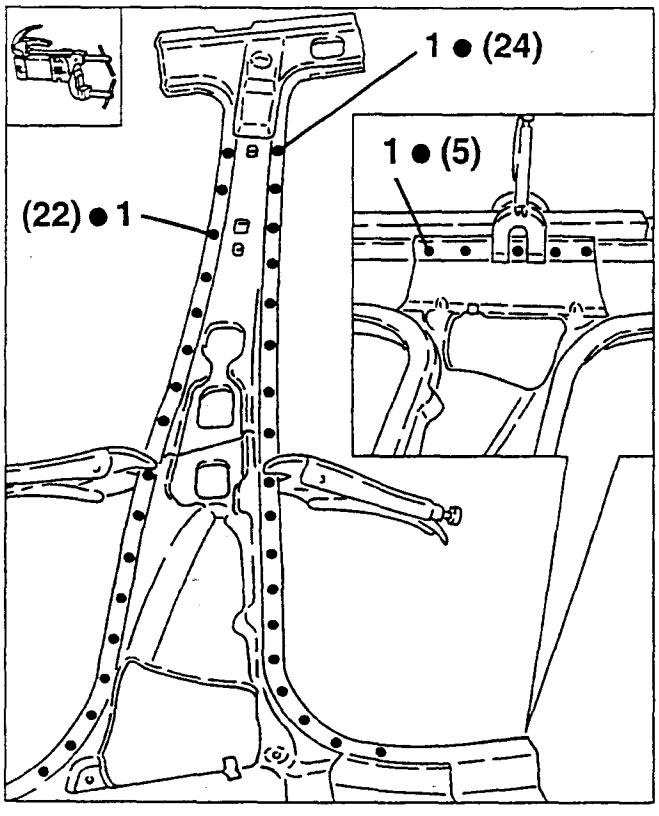
- Using a rotary brush clean the centre pillar inner trim and apply the electric welding protection on the areas involved by spot welding.
1. Assemble the centre pillar inner trim on the frame and on the outer trim esterno checking its correct coupling through the seat belt connection screws.



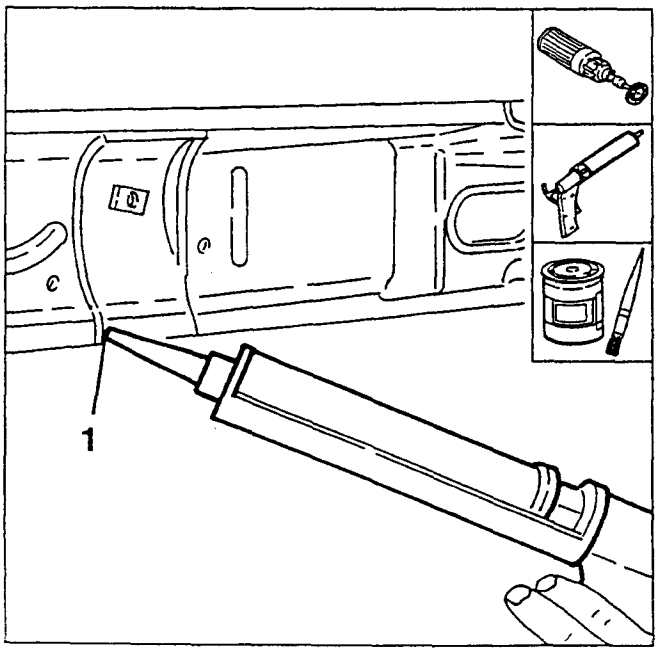
1. Join the parts to be welded and fasten them with clamps.



1. Using a spot welder operate as illustrated.

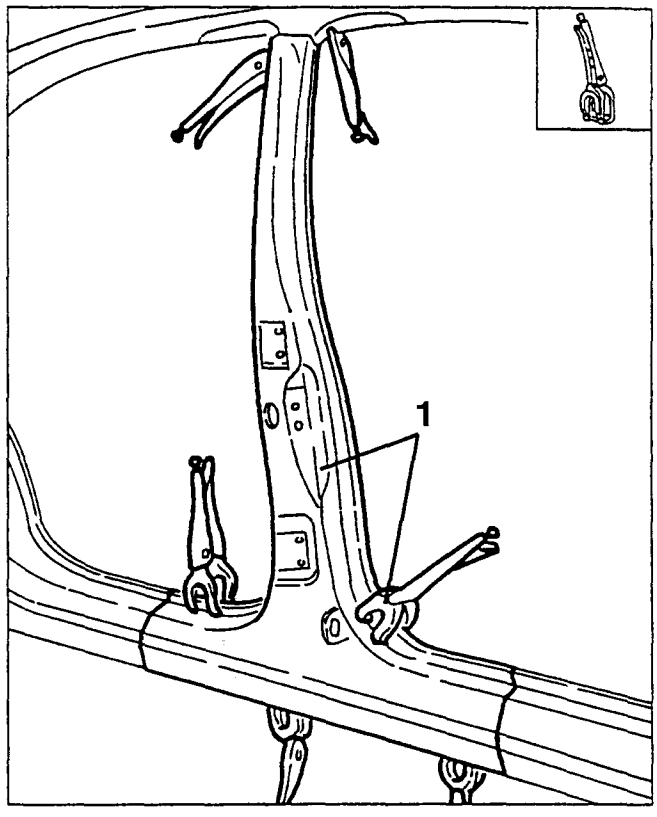


- Using a rotary brush, clean the areas of the body involved by spot welding.
1. Apply the high thickness electric welding protection on the lower part of the underdoor.
- Apply the electric welding protection to be brushed on the remaining areas involved by spot welding.

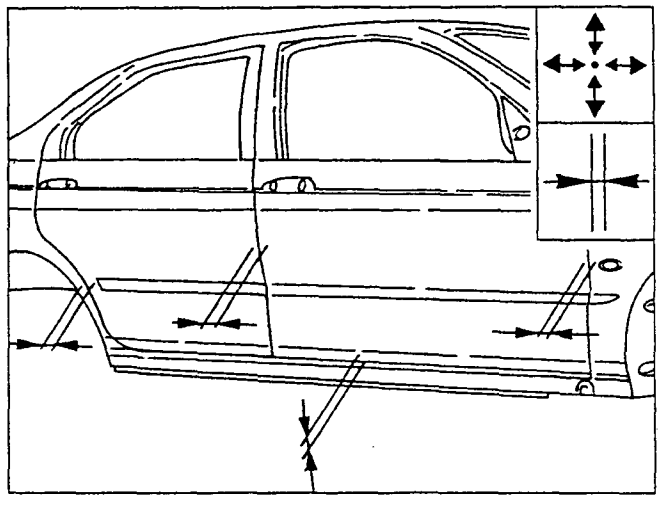


POSITIONING AND CHECKING

1. Position the centre pillar complete joining the edges to be welded and fastening it with clamps.

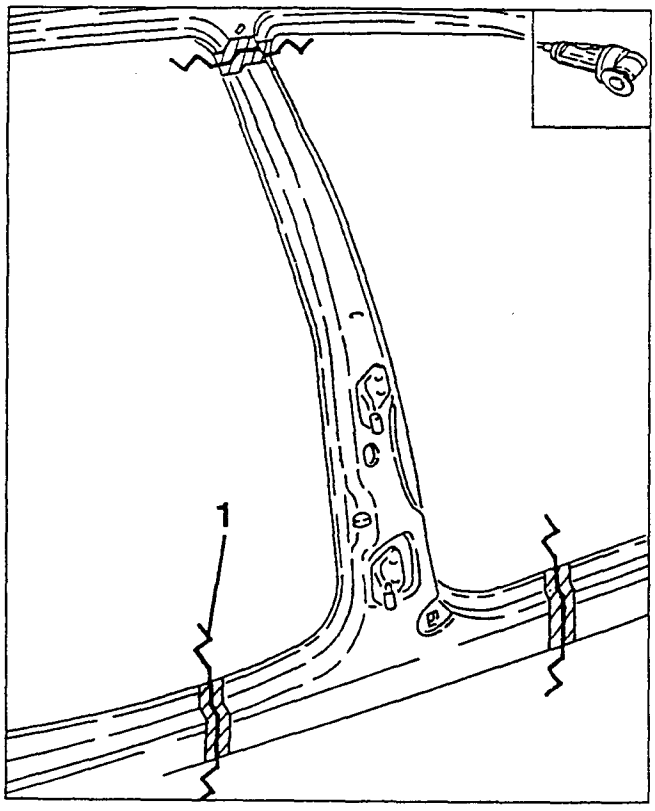


- Check the squareness, lights and angles re-assembling the components removed previously with their seals and the parts which, once assembled, make it possible to check that the operation is perfectly successful



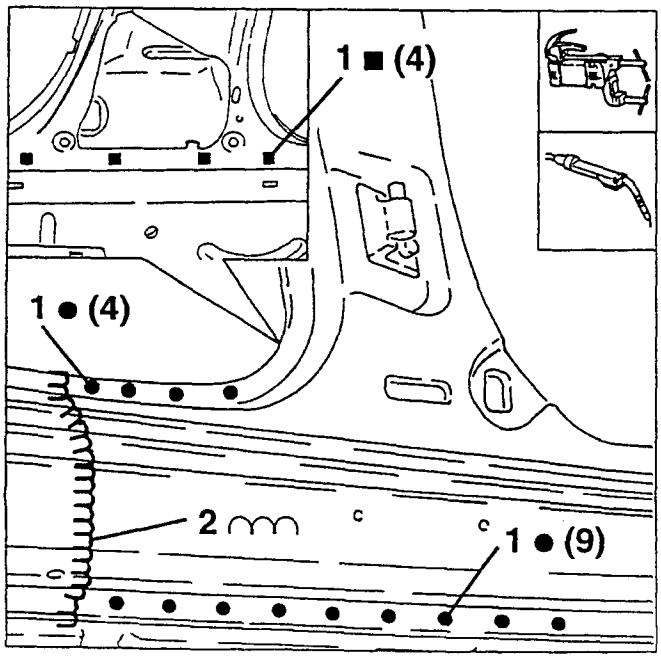
- Remove the components fitted for checking correct positioning of the centre pillar.

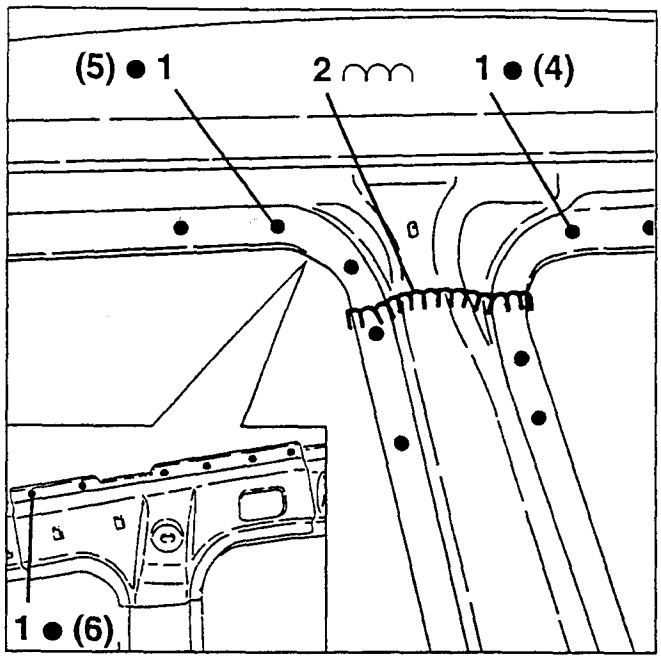
1. Using a saw with circular blade, trim the panels eliminating the excess without damaging the panels below.



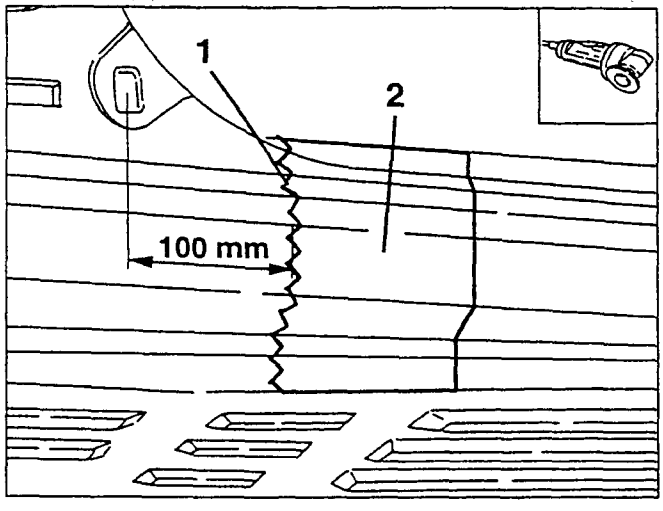
WELDING AND FINISHING THE PANEL

1. Using a spot welder, operate as illustrated.
2. Using an MIG welder, seam weld as illustrated.

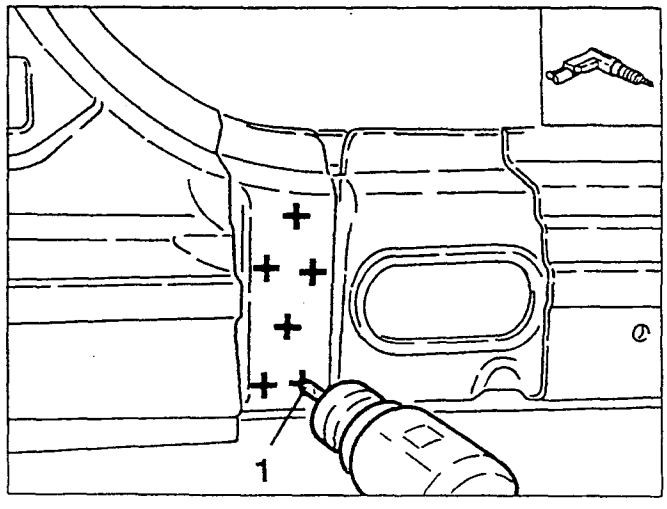




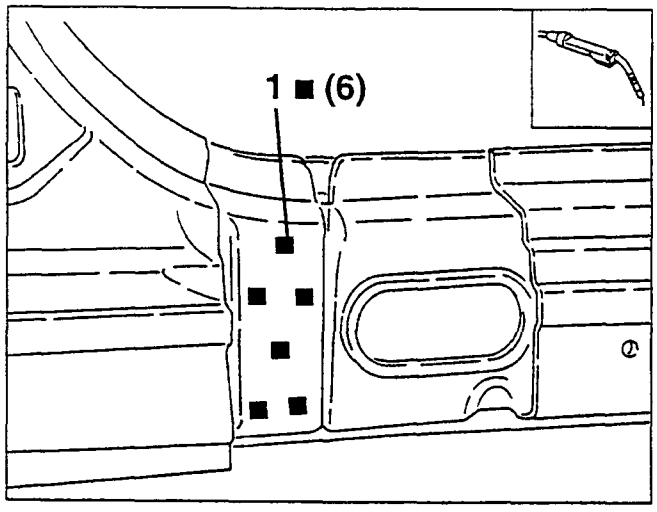
1. Using a saw with circular blade cut the underdoor trim following the trace illustrated.
2. Remove the plug created on the underdoor trim to be able to weld the centre pillar frame to the underdoor frame.



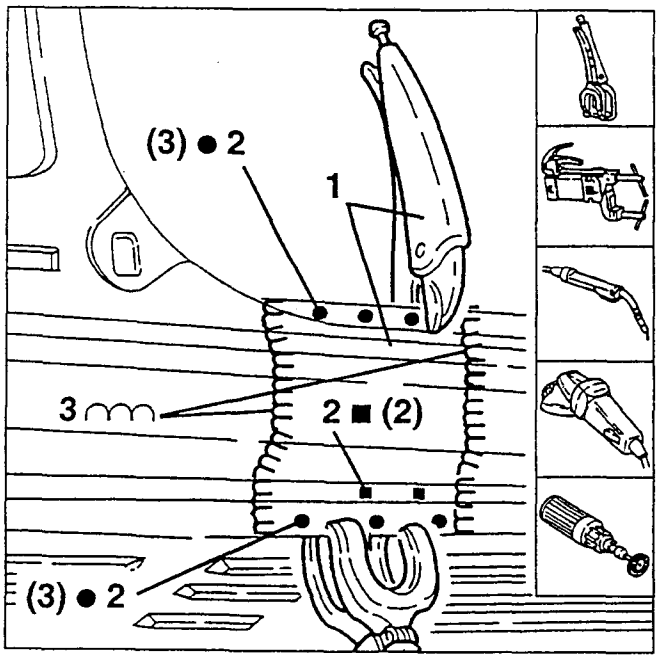
1. Using a drill with Ø 5 mm bit, drill the centre pillar frame.



1. Using a MIG welder operate as illustrated.

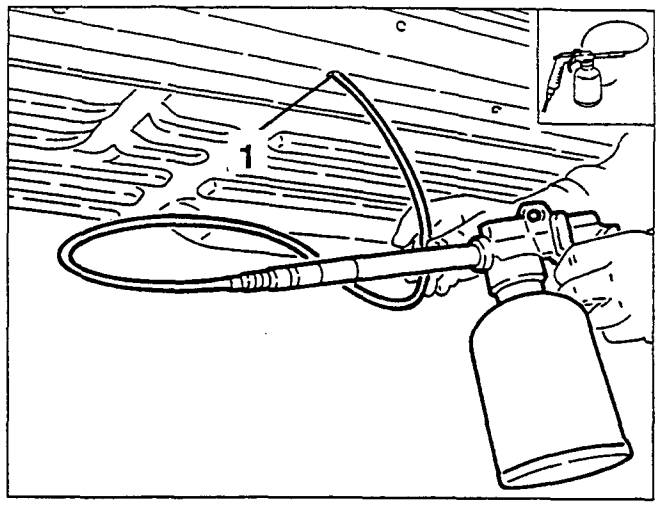


1. Position the plug removed previously fastening it with clamps.
2. Using a spot welder or, where necessary an MIG welder, operate as illustrated.
3. Using an MIG welder, seam weld as illustrated.
- Using an abrasive grinding wheel, remove and level welding remains.
- Using a rotary brush, clean the welded areas.

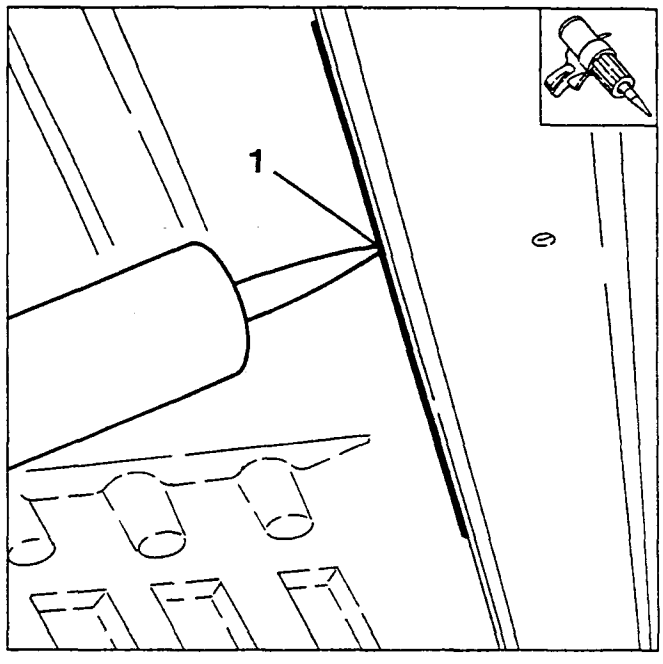


PROTECTIONS

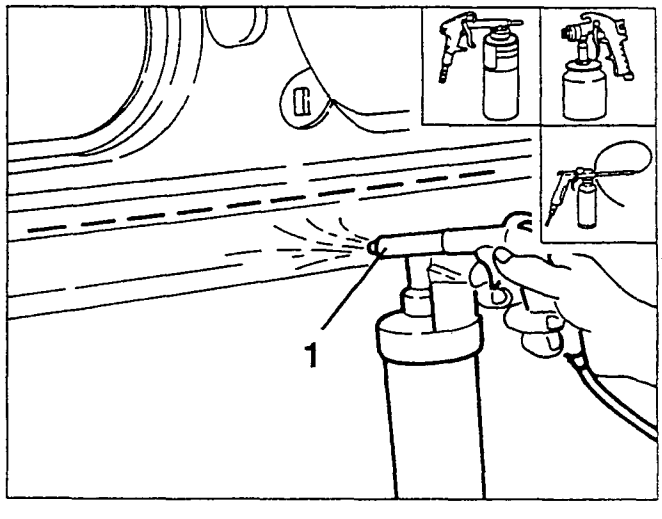
1. Apply the specified antirust on the areas involved MIG welding through the holes illustrated.



1. Apply the specified sealant along the joint of the underdoor trim with the floor as illustrated.



1. Apply the underbody protection in the area of the underbody involved by the replacement.
- Proceed with painting.
- Wax the boxed sections.



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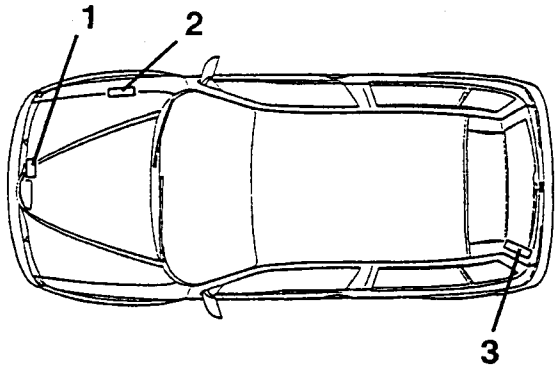
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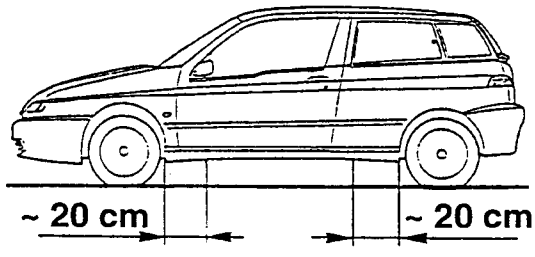
1. *Identification label*
2. *Body label*
3. *Bodywork paint label*

- For the identification codes see: GROUP 00.

CAR LIFTING POINTS

With arm lift or workshop jack.

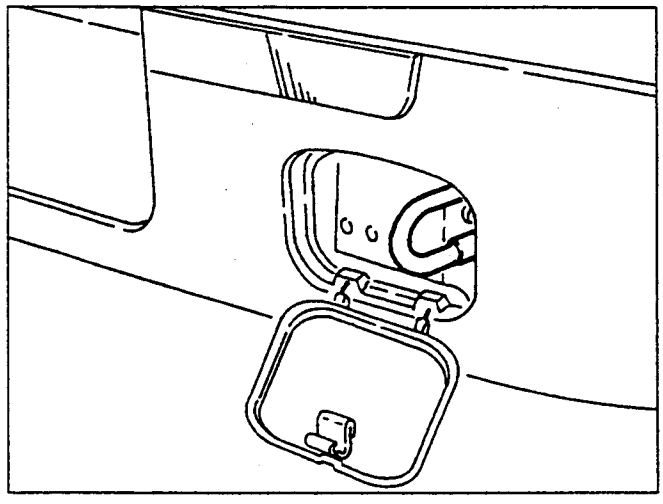
- The car should be raised setting the ends of the arms or the jack in the areas illustrated.

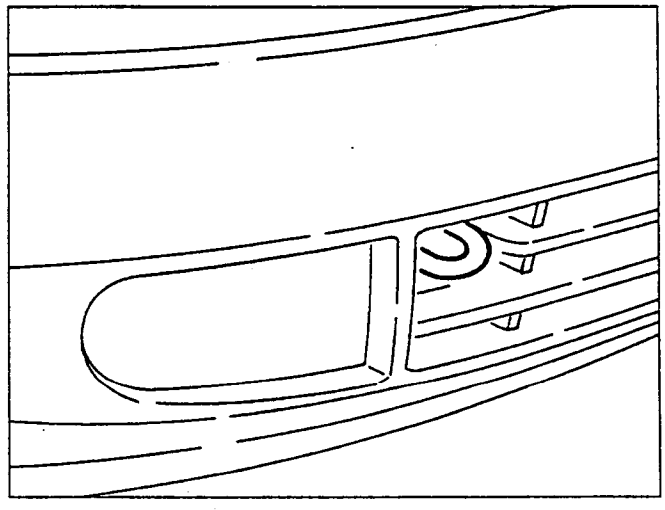


CAR TOW POINTS

The car has two rings, one at the front and one at the rear, on the right-hand side of the bumpers.
The rear ring is covered by a lid that is opened by pushing on the edge.
Always strictly adhere to local regulations on the subject of towing.
Before towing, the ignition switch of the towed car should be turned to MAR and then to STOP without removing it; this will prevent the steering from locking.
Remember that when the car is towed, the vacuum is not created in the servobrake system, therefore, considerably greater pressure on the brake pedal is required.
Additionally, when the engine is off, the power steering circuit is not operational, thus more effort is required on the steering wheel.

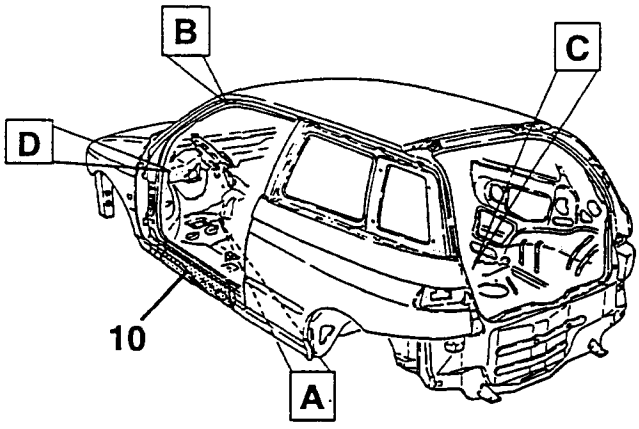
WARNING:
Absolutely never remove the ignition key from the lock; this will lock the steering.



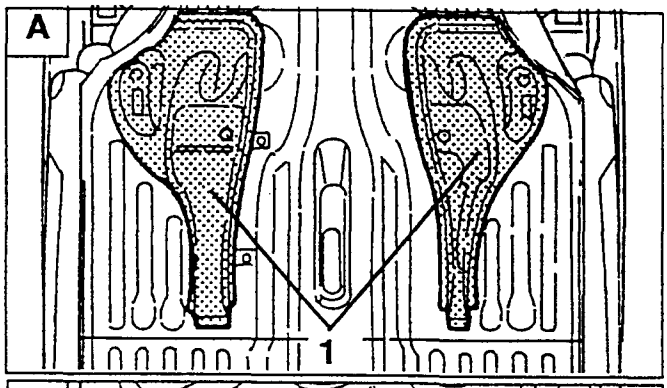


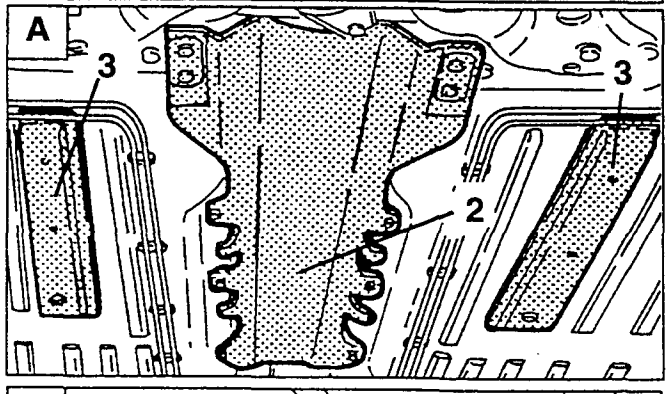
DESCRIPTION OF BODY

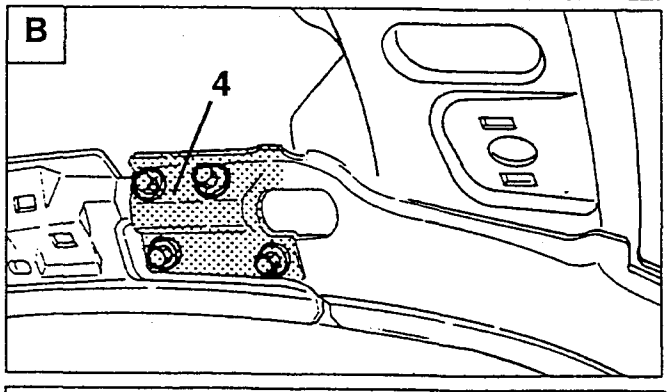
The body has been specifically studied to crumple in a controlled fashion during a collision whether from the front or from the side, absorbing the energy produced by the impact without compromising the spaces within the passenger compartment which are vital to the survival of its occupants.
To protect the passengers the floor, door sill rails, doors and front and central uprights have been reinforced in order to conform to future safety regulations.

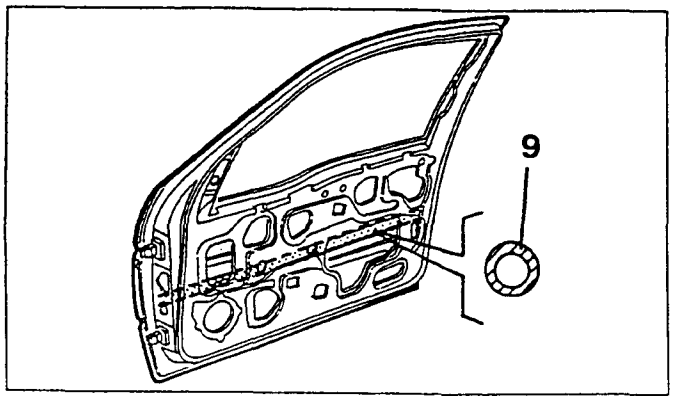


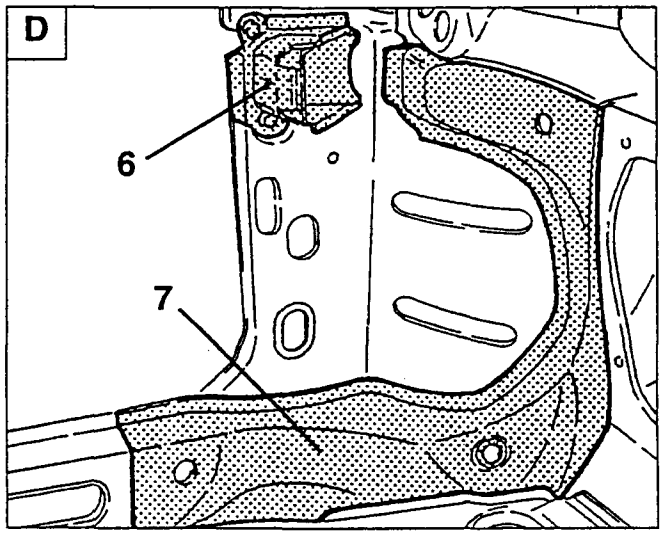
1. *Boxed parts under floor panel (Boxer engines)*
2. *Gear lever support (Turbodiesel engines)*
3. *Boxed parts under floor panel (Turbodiesel engines)*
4. *Front pillar reinforcing*
5. *Rear seat cushion retaining hook*
6. *Dashboard crossmember support*
7. *Strut (Boxer engines)*
8. *Strut (Turbodiesel engines)*
9. *Door reinforcing bar*
10. *Reinforcing under door*

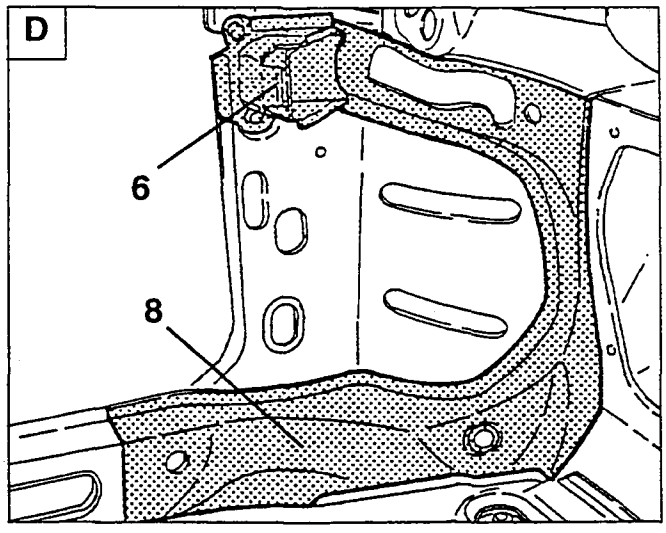


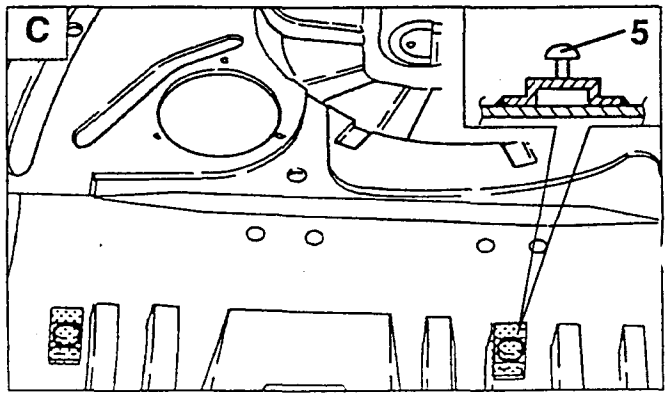










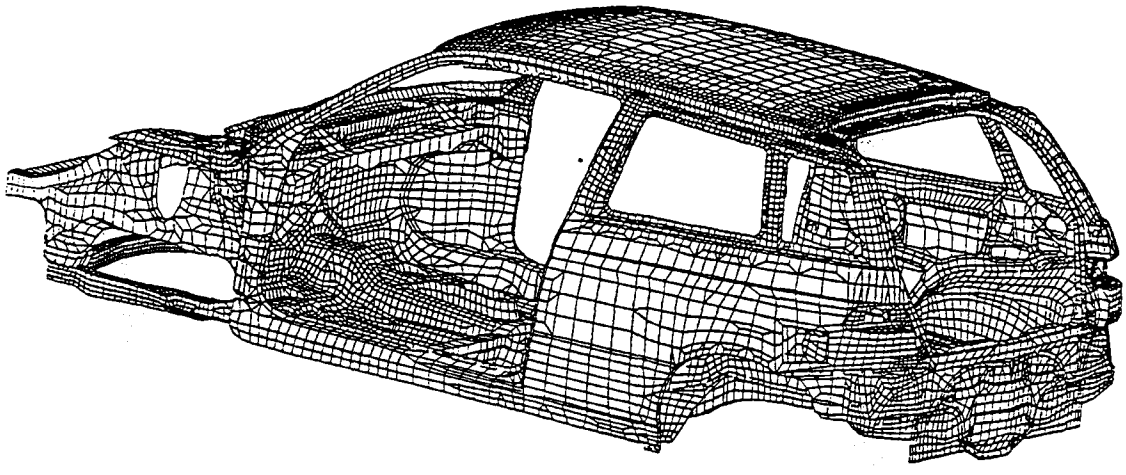


In this way the model not only conforms to the EEC regulations in force at present but also with the severer ECE norms which are already in force in some states and which have been recently introduced in Italy but not as yet implemented.
To give an example, regulation ECE12 specifies that during a collision with a barrier at a speed of 48.3 kph, the steering wheel must not move towards the driver more than 12.7 cm. This vehicle offers a higher level of performance than that specified by the law with a horizontal, vertical and lateral movement of the steering wheel limited to less than 10 cm.
During a 55 kph frontal crash tests against a barrier with a 15° slope, special biomechanical crash-test dummies simulating the human body were used. These dummies are able to detect the shocks to which the organs of the human body are subject during collision in order to accurately establish the consequences of an impact.
The tests carried out on this model have made it possible to establish that under these impact conditions the survival of the driver and any passengers is guaranteed.
Also during lateral impact at 50 kph the crumple values and those relative to the deceleration of the dummy are within the limits proposed by the EEVC regulation (collision with a 950 kg barrier which hits the vehicle at a speed of 50 kph exactly where the driver is sitting).
The table below gives the torsional and flectional rigidity values.

Torsional rigidity (kgm/mm)	Flectional rigidity (kgm/mm)
1200 (1) 1400 (2)	580

(1) Turbodiesel engines
(2) Boxer engines

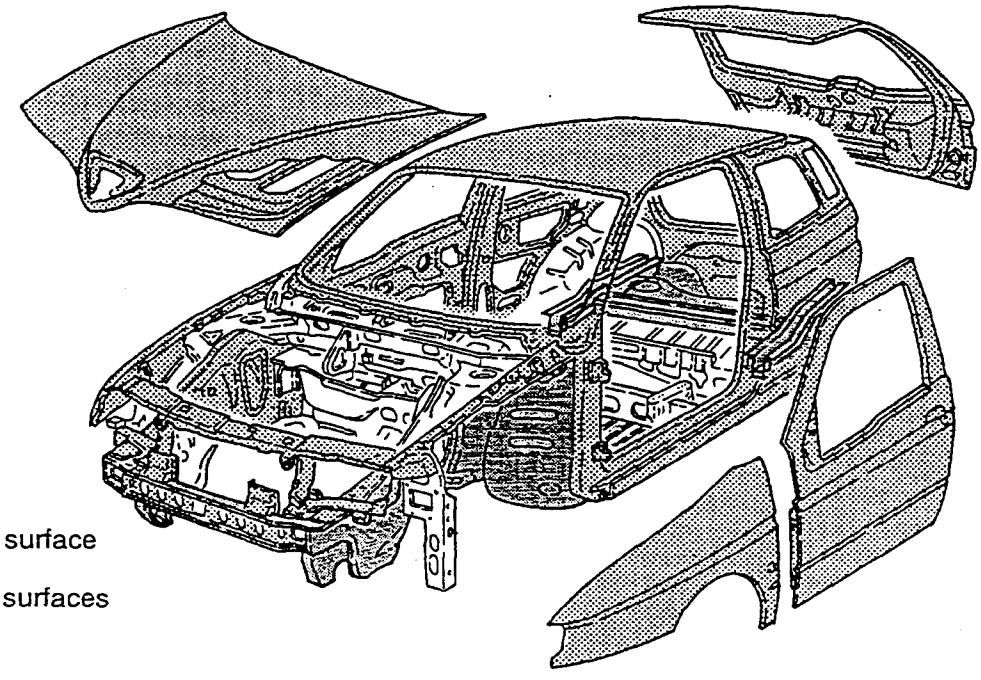
These higher rigidity values can be translated into advantages, for example:
- lesser vibration;
- lower noise levels;
- improved handling;
- greater resistance to breakage caused by uneven road surfaces;
- sensation of compactness of the vehicle;
- longer life of the vehicle in terms of overall quality.



TYPES OF SHEET METAL

The zinc treatment of the body panels guarantees a much higher degree of protection against attack by atmospheric agents in comparison to panels which are not treated.
The protective action of the zinc stems from the high reactivity of this metal with the chemical agents which form the atmosphere, combined with an equally high inertia levels of the compound which derives from it (zinc oxide).
The film of zinc oxide which forms on the parts of the sheet metal which come into contact with the atmosphere thus forms an efficient protective barrier against oxidation.

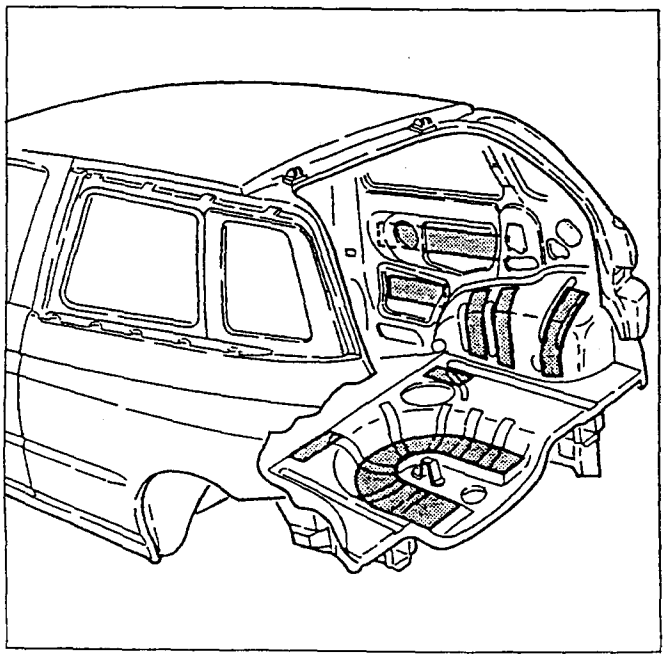
The film of protective zinc may be deposited:
- on two sides of the sheet metal when both surfaces are exposed to the atmosphere
- on only one side of the sheet metal. In this case the treated side faces outwards.



Zinc-plated on one surface

Zinc-plated on two surfaces

CHART SHOWING APPLICATION OF DAMPING PANELS



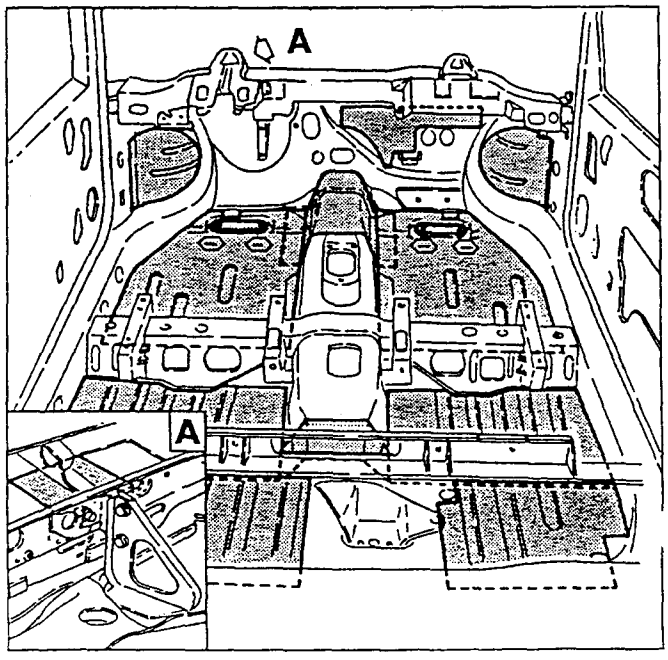


CHART SHOWING UNDERBODY PROTECTIVE COATING (PVC)

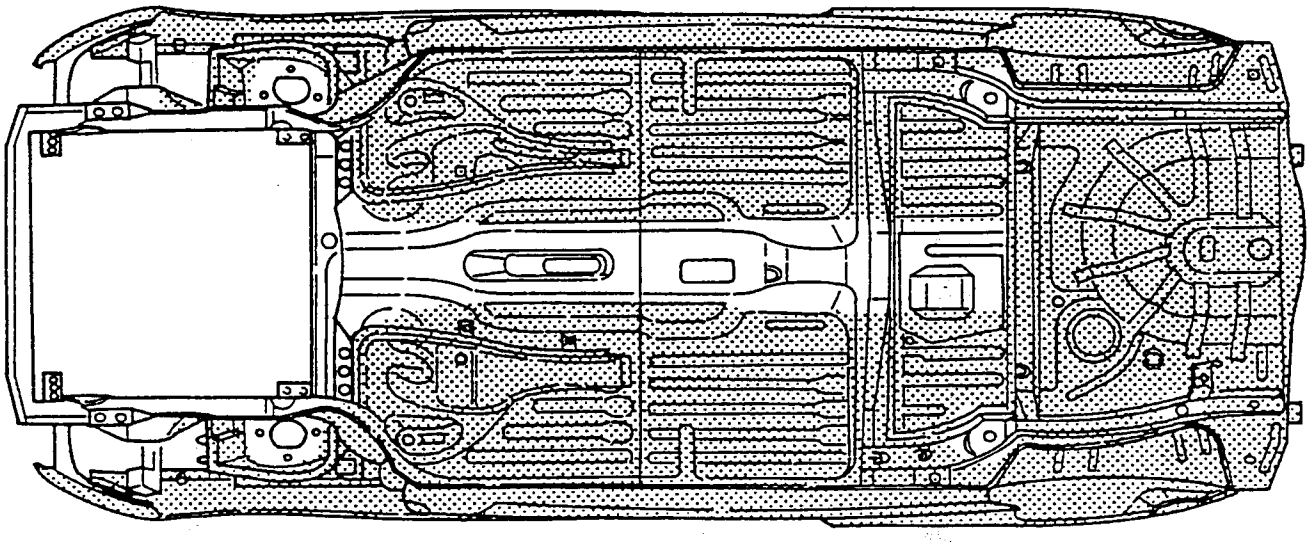
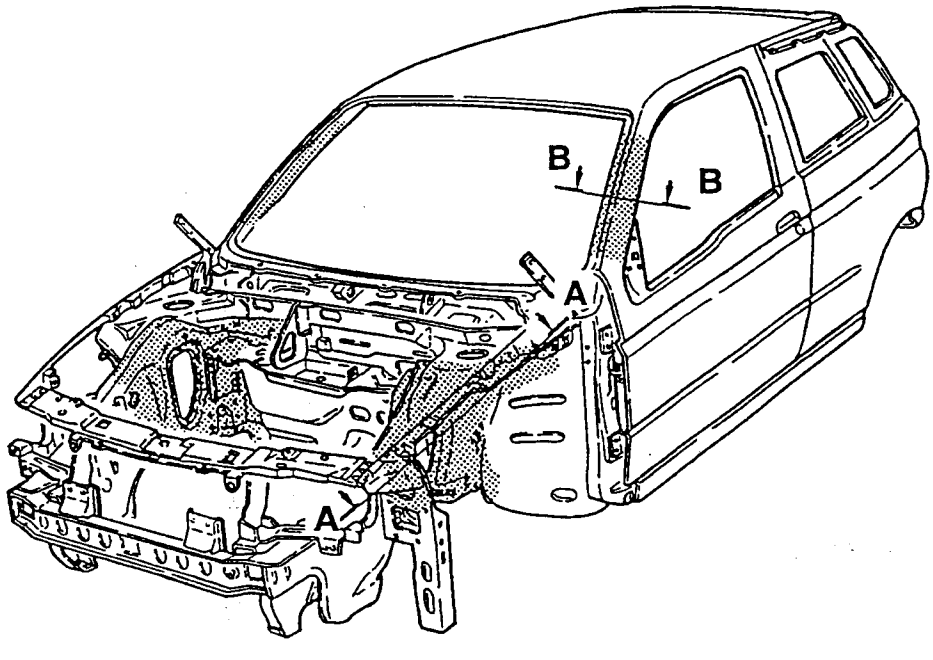
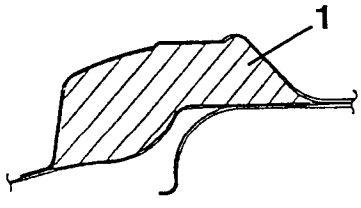


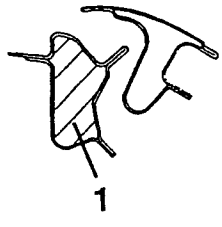
CHART SHOWING APPLICATION OF FOAM TREATMENT



A - A



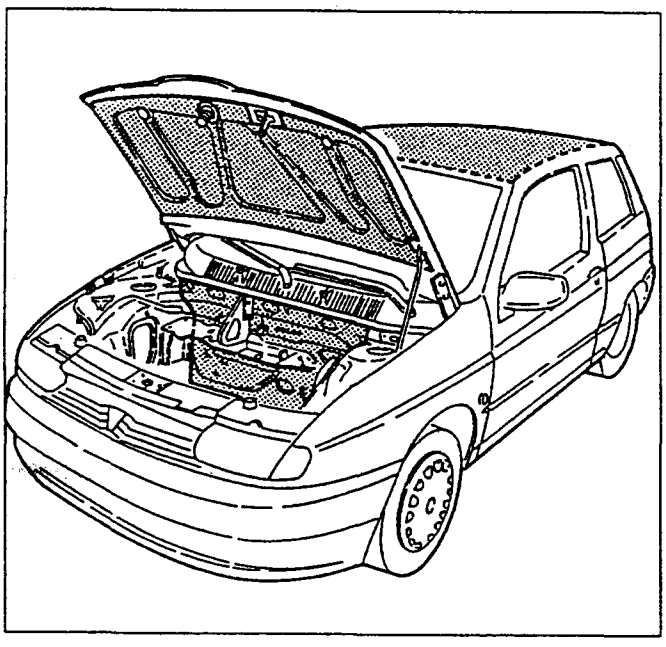
B - B



1. Rigid polyurethan foam treatment

CHART SHOWING APPLICATION OF SOUND-PROOFING PANELS

Sound-absorbing



Sound-proofing

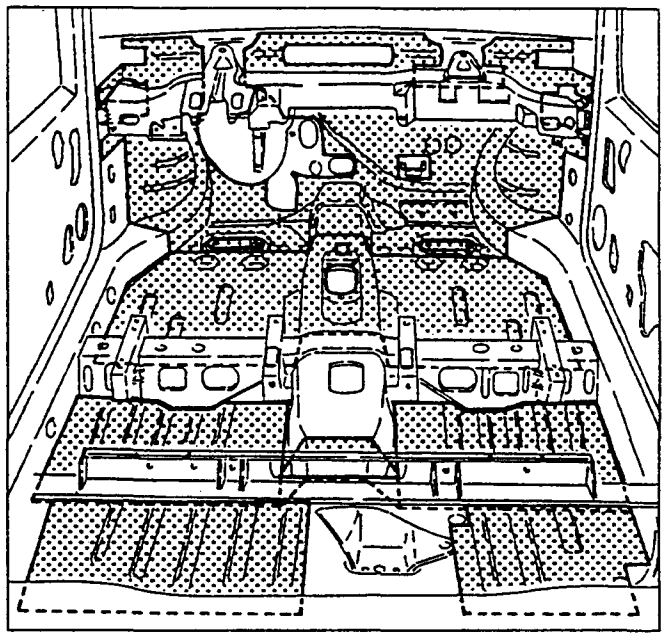
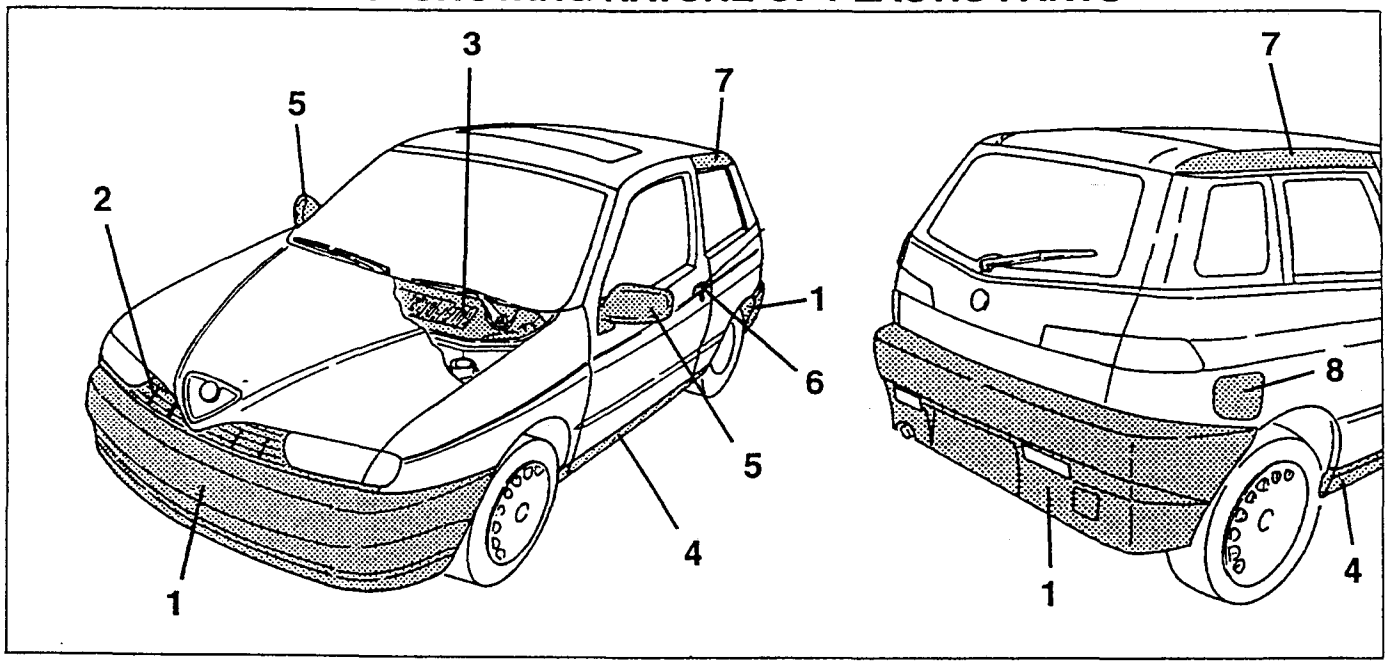


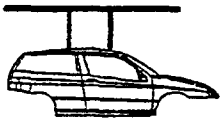
CHART SHOWING NATURE OF PLASTIC PARTS



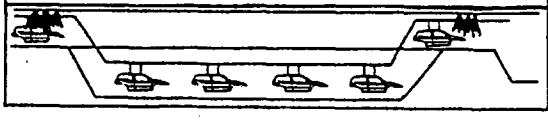
1. *Front and rear bumbers - polypropylene*
2. *Radiator grille - thermohardened polyester*
3. *Grille under windscreen (Noryl)*
4. *Shaft cover - polypropylene*
5. *Door mirror - polycarbonate - ABS*
6. *Door handles - polyethylene - thermoplastic polyester*
7. *Roof rail cover - thermohardened polyester*
8. *Fuel flap - thermohardened polyester*

BODY SHELL PAINTING CYCLE DURING PRODUCTION

Rough body shell



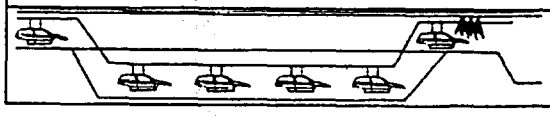
Bonderizing



Preparation with dip and spray systems
Stages: - Activation - Phosphating
Passivation - Intermediate washes

Drying oven

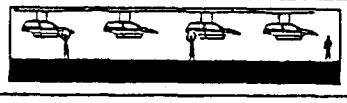
Cataphoresis



Application of the first protective coat by electroplating system

Baking oven

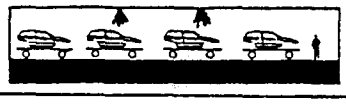
Sealant and PVC



Application of sealants for sheet metal jointings and PVC on underbody and wheel house by Robot

Baking oven

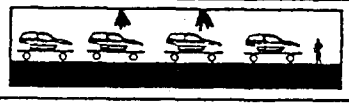
Primer



Application of the second protective coat
Automatic operations with rotary cups

Baking oven

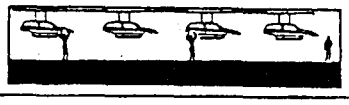
Enamel



Application of:
2 coats of base paint
1 coat of transparent warnish

Baking oven

Waxing of boxed sections

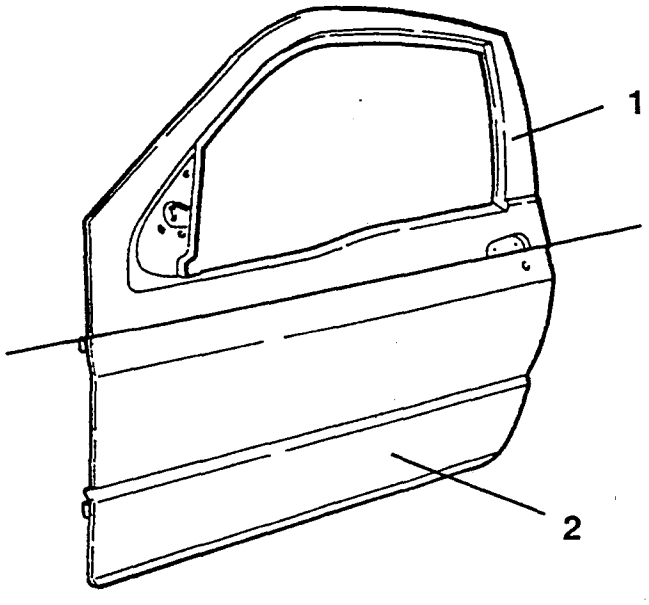


Painted body to assembly

BODYWORK RESTORATION AND PAINTING CYCLES SPECIFIED BY THE ASSISTANCE NETWORK AND INCLUDED IN THE FLAT-RATE MANUAL

The word "painting" means the operation of restoration carried out on a painted surface.
When a surface is only partially affected the operation is called "repainting cycle". Depending on the type of repair work to be carried out the following repainting cycles have been defined:
- Painting of replaced fixed metal sheet;
- Painting of replaced mobile metal sheet;
- Repainting of flawed metal sheet;
- Repainting of metal sheet with surface defect;
- Restoration of metal sheet without painting: dent removal.

For painting purposes it is important to define the term "panel".
To clarify this concept the door depicted in the diagram has been taken as an example.
The entire door is a panel but for reasons of convenience it can be divided into two areas: the upper area and the lower area. Area then, means a surface included between two borders.



1. Upper area *2. Lower Area*

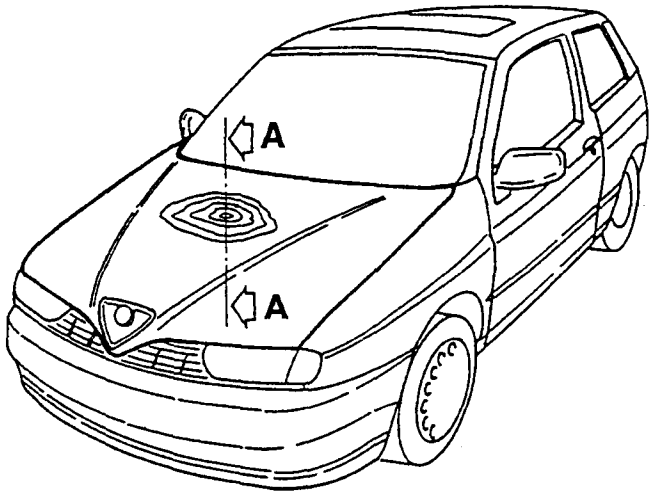
INTRODUCTION

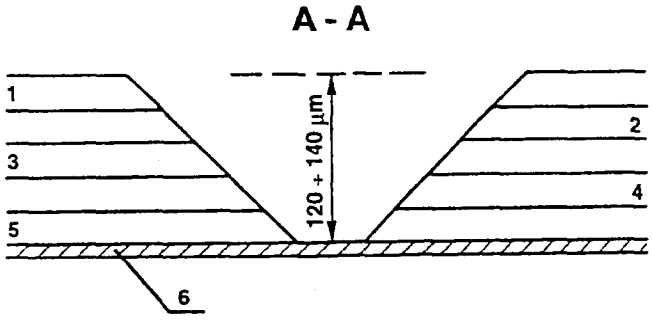
The procedures necessary for the repair and painting operations carried out on metal sheet supplied as a spare part are listed below.

NOTE:
Metal sheeting supplied as a spare part is treated by cataphoresis.

Preparation

Wash the affected part and asses the degree of damage. Sand the affected part with the grade of sandpaper most suited to the operation in hand.





1. Varnish
2. Paint
3. Undercoat
4. Cataphoresis (Primer)
5. Galvanization
6. Sheet metal

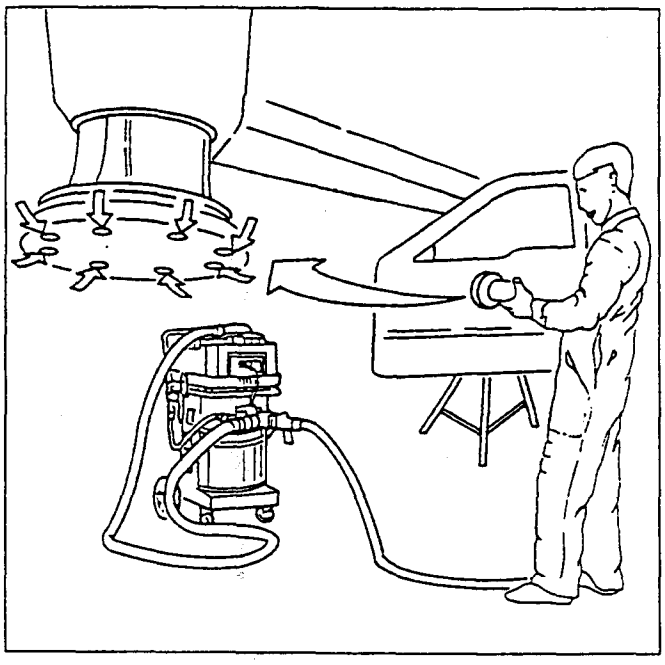
Thoroughly clean the affected areas with silicone-proof products.

Correction or Surfacing

Repair operations carried out on sheet metal usually involve a correction and/or surfacing phase.
It is vitally important that the products are mixed before application. A coating which is sufficiently thick to cover the irregularities should be applied without exceeding the specified thickness.

Sanding

Dry sanding may be carried out by hand or using an electric or pneumatic sander fitted with the specified abrasive paper.



Masking

The areas surrounding the parts to be repaired should be asked with sheets of paper fixed to the surface with adhesive tape.
The importance of this operation should not be underestimated and should be carried out, as with all other operations, by taking all the necessary precautions to prevent repainting parts which are not affected.
Masking should be applied:
- before applying the primer;
- before applying the undercoat;
- before applying the layers of paint.

Application of Primer

The primer is applied to the bare metal surfaces as a protection against corrosion.

Sealing

Sealing is required in order to avoid penetration of water or humidity and is carried out by the application of different products.
Sealants are products that fill, insulate and protect and are applied to the joints between the metal panels.
Sealant should be applied with a brush or suitable spray gun.

Application of Undercoat

The undercoat due to its thickness ensures that the underlying layers are isolated. This intervention eliminates any imperfections of the layer beneath.

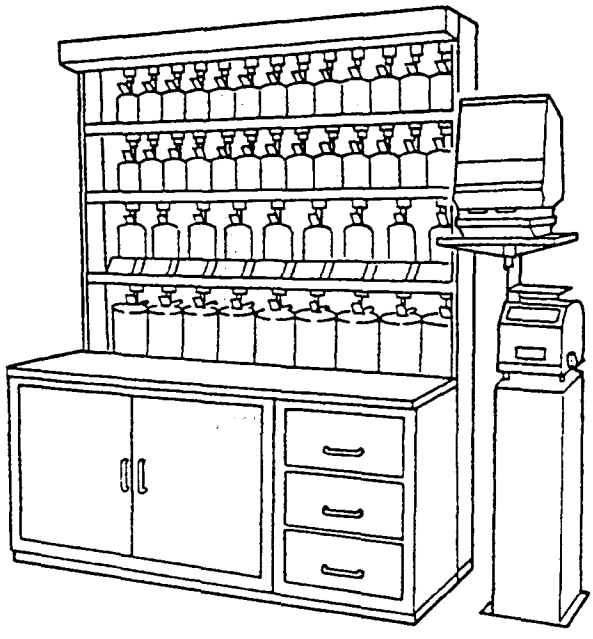
The undercoat must be prepared and applied following the indications given in the appropriate painting cycle.

Sanding of Undercoat

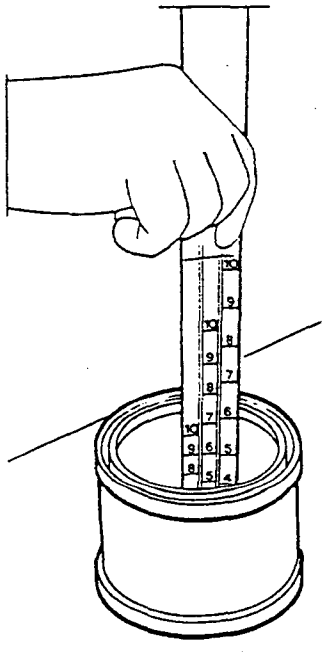
Sanding is necessary, given the thickness of the undercoat, in order to eliminate any imperfections or irregularities in the sheet metal.
A spy coat should be applied in order to facilitate identification of any imperfections.

Preparation of the Paints

Consult the manufacturer's technical specifications before mixing the catalyst and thinner in the proportions relative to the preparation of the paint products.



Application of Paints



The required colour may be prepared by mixing the basic colours in the ratio indicated by the applicable colour formula. The enamels obtained in this way do not have the same viscosity values suitable for application and should therefore be mixed with a catalyst and thinned to the proportions indicated by the manufacturer using a rod-scale.
It is extremely important that the enamel is thinned correctly in order to avoid defects (running, pin-holing etc).

Before application check that the colour or the prepared paint corresponds exactly to the colour of the vehicle.

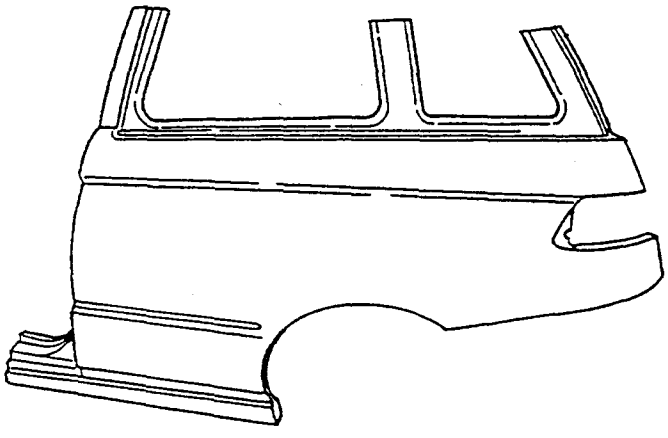
Waxing

Waxing is a supplementary protection for the boxed parts and serves to extend the protection against corrosion. It is applied through appropriate holes in the body.

Foam Treatment

Treatment with foam prevents the passage of air turbulence and sound- proofs the components treated in this way.

PAINTING OF REPLACED FIXED METAL SHEET (complete cycle)



The successive phases relative to the painting of replaced fixed metal sheet are as follows:

1. **Preparation (washing, sanding and cleaning)**
2. **Surfacing**
3. **Sanding**
4. **Masking**
5. **Application of Primer (on bare metal)**
6. **Sealing**
7. **Application of undercoat**
8. **Sanding**
9. **Masking**
10. **Application of paints (paint and varnish)**

- Wash the affected area, dry sand the cataphoresis, blow-off with compressed air, clean with a cloth soaked in a silicone-proof product and dry carefully.
- Surface any imperfections and leave to dry out.
- Sand, level the filler and carefully clean the treated areas.
- Mask the affected area, apply primer to the bare metal and allow to dry naturally.
- Apply the specified sealant to the mating surfaces and dry.
- Apply the undercoat and spy-coat (paint).
- Dry sand, remove the masking and blow-off with compressed air and clean with a silicone-proof product.
- Mask the area surrounding the sanded surfaces and adequately cover the remaining parts of the vehicle.
- Blow-off with compressed air and clean the surfaces with a tack-rag.
- Prepare and apply the paints (paint and varnish). For the flash-period between coats consult the manufacturers chart.

PAINTING OF REPLACED MOBILE METAL SHEET (complete cycle)

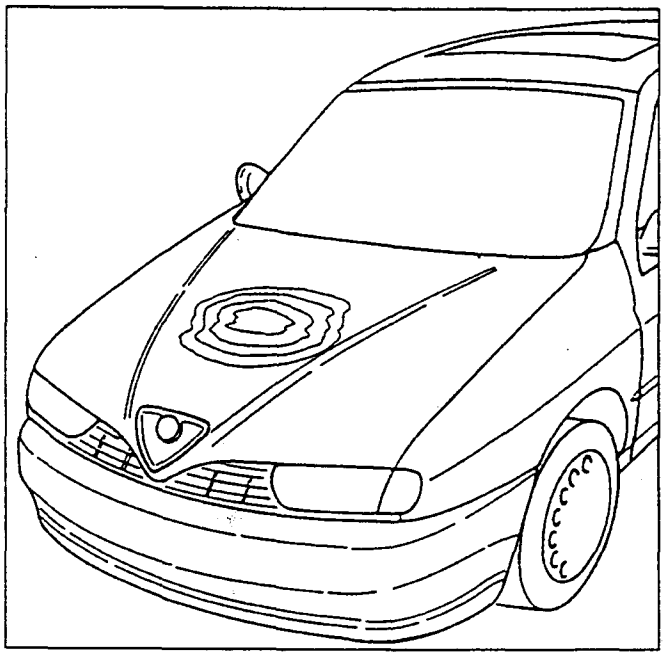
The successive phases relative to the painting of replaced mobile metal sheets are as follows:

1. **Preparation (washing, sanding and cleaning)**
2. **Correction and/or surfacing if necessary**
3. **Sanding**
4. **Application of Primer (on bare metal)**
5. **Sealing**
6. **Application of undercoat**
7. **Sanding**
8. **Application of paints (paint and varnish)**

- On a bench wash and dry sand the cataphoresis, blow-off with compressed air and clean with a cloth soaked in silicone-proof product, and allow to dry.
- Surface any imperfections and allow to dry completely.
- Sand, level the filler and carefully clean the treated surfaces.
- Apply the primer to the bare metal and allow to air-dry.
- Apply the specified sealant to the mating surfaces and dry.
- Apply the undercoat and spy-coat (paint)
- Dry sand, blow-off with compressed air and then clean with a silicone-proof product.
- Prepare and apply the paints (paint and varnish). (For the flash-period between coats consult the manufacturer's technical charts).

REPAINTING DAMAGED METAL SHEET

In the event of repairs being carried out on fixed or mobile parts, repair the defect in the metal and then proceed as described in PAINTING OF REPLACED FIXED METAL SHEET (complet cycle).



REPAINTING METAL SHEET WITH A SURFACE DEFECT

This cycle should be used in cases where the following anomalies occur:

- Water blistering
- Sagging
- Dulling
- Orange peel
- Dirt
- Transparency
- Roping
- Colour change
- Obvious touching-up
- Stripping
- Cissing
- Staining
- Roughness
- Chalking

The successive intervention phases relative to the surface painting operation of sheet metal are given below:

1. **Preparation**
2. **Sanding (elimination of anomalies)**
3. **Dulling with scotch brite across the entire surface**
4. **Masking**
5. **Application of paints (paint and varnish)**

- Wash the affected areas, dry sand, clean with a cloth soaked in a silicone-proof product and dry carefully.
- Sand to eliminate the anomalies in the sheet metal.
- Dull the entire panel with brite.
- Mask the areas surrounding the sanded surfaces and suitably cover the remaining part of the vehicle.
- Blow-off with compressed air and clean the surfaces with a tack-rag.
- Prepare and apply the paints (paint and varnish). For the appropriate flash-period between coats consult the manufacturer's technical charts.

RESTORATION OF METAL SHEET WITHOUT REPAINTING (DENT REMOVAL)

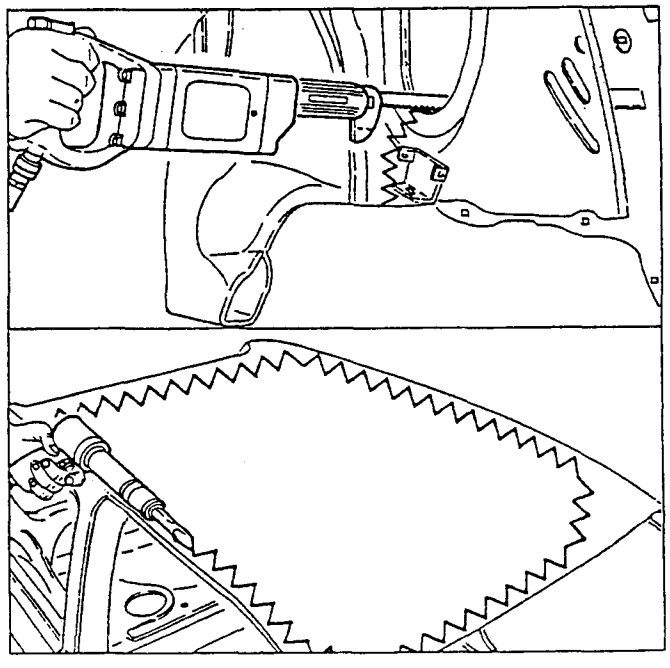
This procedure enables small dents to be removed from the bodywork using suitable tools and avoids surfacing and painting therefore maintaining the initial characteristics of the metal sheet.

GENERAL INFORMATION REGARDING REMOVAL AND INSTALLATION

SYMBOLS

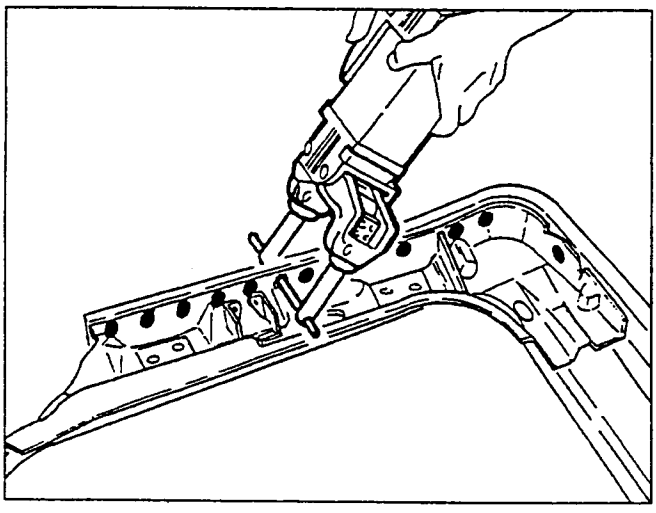
The symbols regarding operations of cutting, welding/brazing, chamfering, the use of protective products, sealants, corrosion inhibitors etc. used in this manual are shown in the following diagrams:

VVVVVVV	**Cut made with saw or pneumatic chisel**

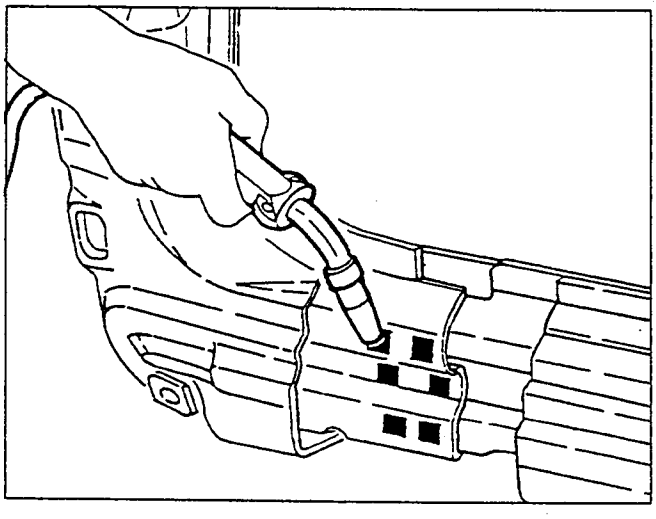


● ● ● ● Spot welding

NOTE:
To make the diagrams clearer no symbols are used to make a distinction between welding of two sheets and that applied to three sheets.



■ ■ ■ ■ ■ MIG welding for filling

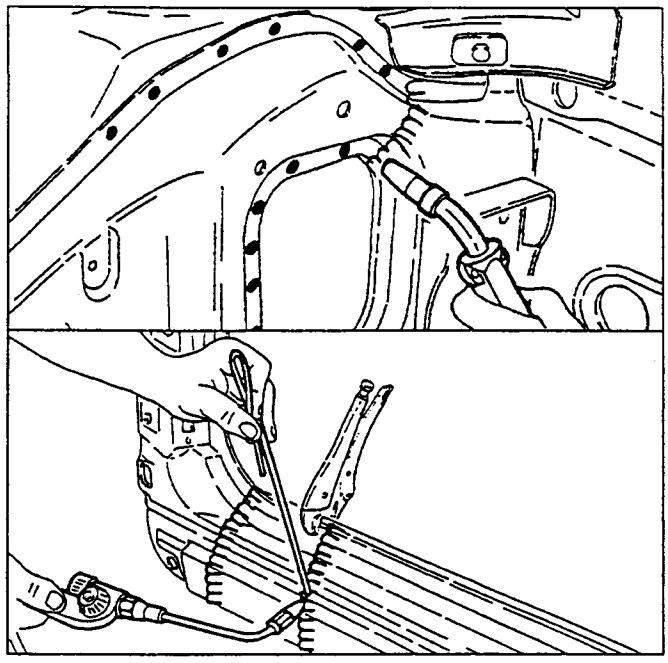


In order to condense the information relative to the operations described in the procedure for replacing components the following technique is used:

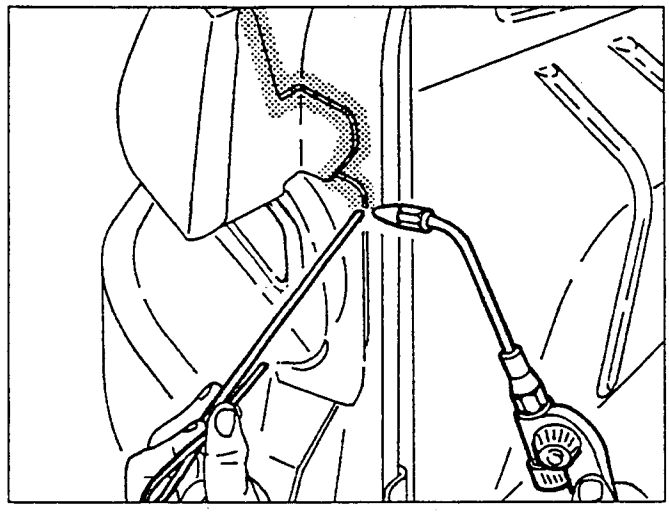
2 ● (6)

- number of welding points
- type of welding to be carried out
- progressive number of steps

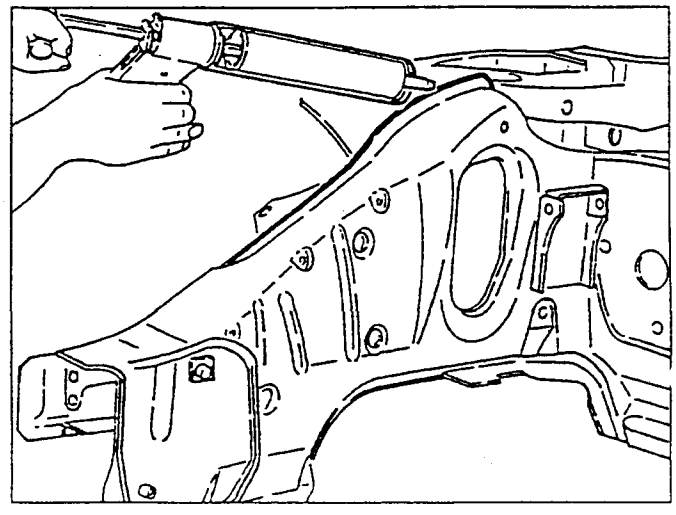
∩∩∩∩∩ Continuous MIG welding/for seams

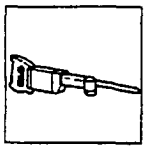
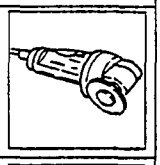
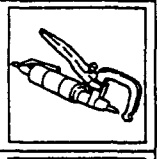
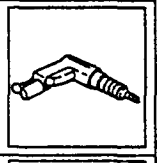
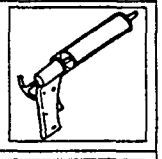
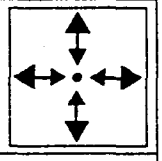
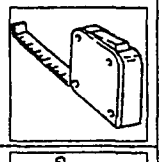
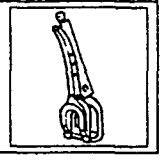


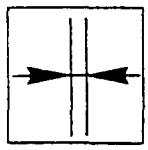
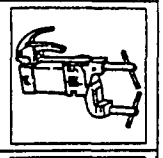
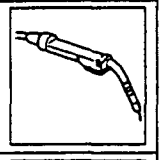
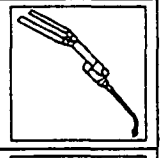
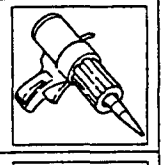
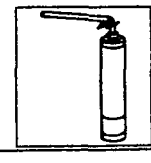
Braze-welding



Sealing



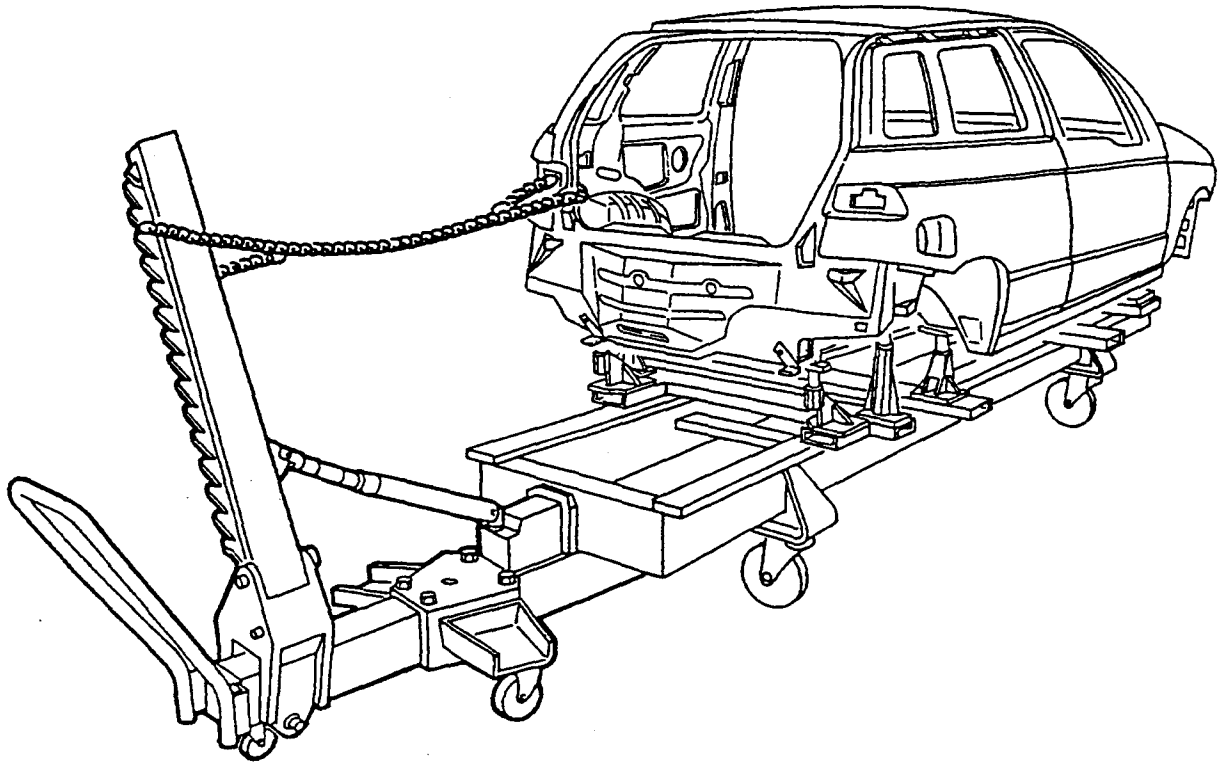
CUT WITH JIG SAW	
CUT WITH CIRCULAR SAW	
CLEAN WITH ROTATING BRUSH	
REMOVAL OF WELDING POINTS WITH CHAMFERING MACHINE	
REMOVAL OF WELDING POINTS WITH DRILL DRILLING FOR MIG WELDING	
RELEASE OF SHEET METAL WITH CHISEL REMOVAL OF WELDING POINTS WITH CHISEL	
APPLICATION OF ELECTROWELDABLE PROTECTION	
APPLICATION OF HIGH-THICK-NESS ELECTROWELDABLE PROTECTION	
CENTERING OF COMPONENTS	
MEASUREMENT	
ATTACHMENT OF COMPONENTS	

CHECKING OF GAPS	
SPOT WELDING	
MIG WELDING	
WELDING WITH OXYACELYLENE • TORCH	
GRIND	
APPLICATION OF RUST INHIBITORS	
APPLICATION OF SEALANTS	
APPLICATION OF UNDERBODY PROTECTION	
APPLICATION OF PAINTS	
APPLICATION OF WAX PROTECTION	
APPLICATION OF FOAM PROTECTION	

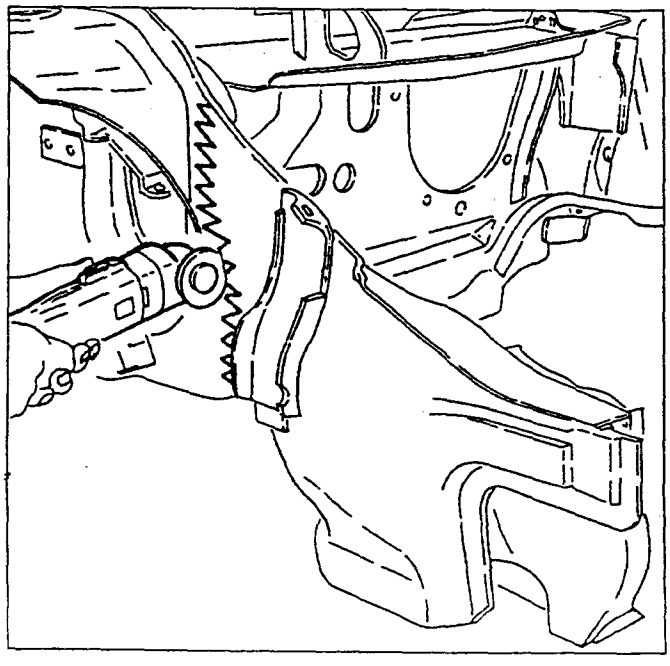
REMOVAL OF COMPONENTS

a. Ensure that all the damaged parts have been identified by measuring the main squaring values. See "Body Squaring".
b. Pull the body using a tool which is suitable to the extent of the damage and apply traction in the direction opposite to the impact. Removed parts can be re-used providing they meet the requirements listed in "Body Squaring".

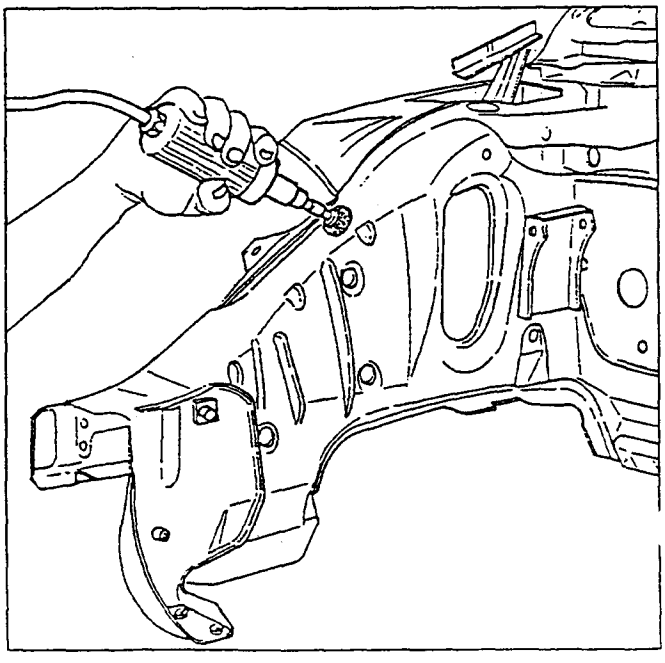
WARNING:
Pay special attention when securing tension chains to the body in order to avoid accidental release during the operations.



c. Cut away the damaged parts
Tools required:
- Pneumatic saw
- Pneumatic chisel



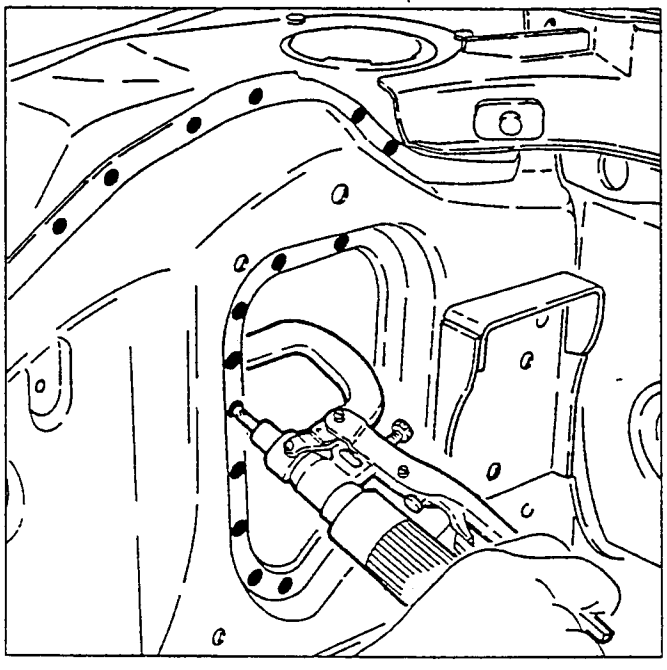
d. If the spot welds are not visible remove the paint with a wire brush.
Tools required:
- Rotating brush.



e. Punch each welding point where necessary to make a centering point for the drill bit.
Tools required:
- Hammer
- Graver.

WARNING:
Centre punching of each welding point should be deep and exactly centered. An off-centre punch will not permit the welding point to be completely removed while a weak punch will not allow the drill bit to be securely guided.

f. Remove the spot welds using a chamfering machine or pneumatic drill.
Tools required:
- Spot-cutter
- Drill



NOTE:
Where it is not possible to use a spot-cutter or drill, use a chisel.
The chisel is particularly useful for spot-cutting thin sheet metal from thick sheet metal.

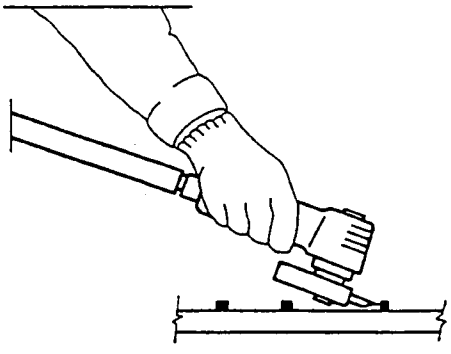
WARNING:
Use gloves and protective glasses.

WARNING:
- **Position the chamfering machine over the centre of the spot to be removed.**
- **To facilitate the operation a cutting speed of approximately 1000 r.p.m. should be used.**
- **Adjust the milling depth by acting on the screw.**
- **Care should be taken to avoid drilling mating components. Plug any holes by welding.**
- **Holes can reduce component rigidity and give rise to water seepage.**

g. Remove the traces of welding using a chisel.
Tools required:
- Chisel
- Hammer.

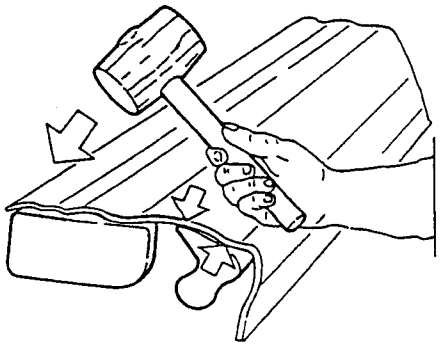
PREPARATION

a. Grind the metal sheet at the welding points using a sander.
Tools required:
- Grinding machine with brush
- Disk- sander.



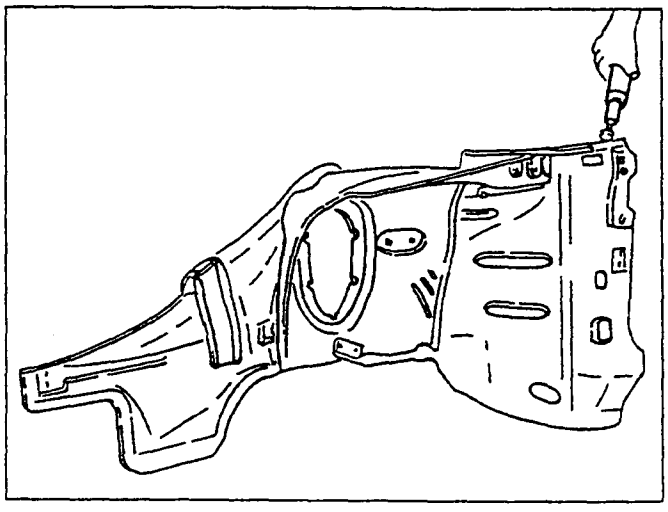
WARNING
- **When using the sander care should be taken to avoid excessively reducing the thickness of the metal sheet as this may adversely affect welding strength.**
- **Thoroughly clean the metal dust from the ground surfaces and surrounding areas.**
- **Metal dust reduces welding stetal dust from the ground surfaces and surrounding areas.**
- **Metal dust reduces welding strength and can lead to corrosion.**

b. Straighten the buckled areas with a hammer and dolly block.
Tools required:
- Hammer
- Dolly block.

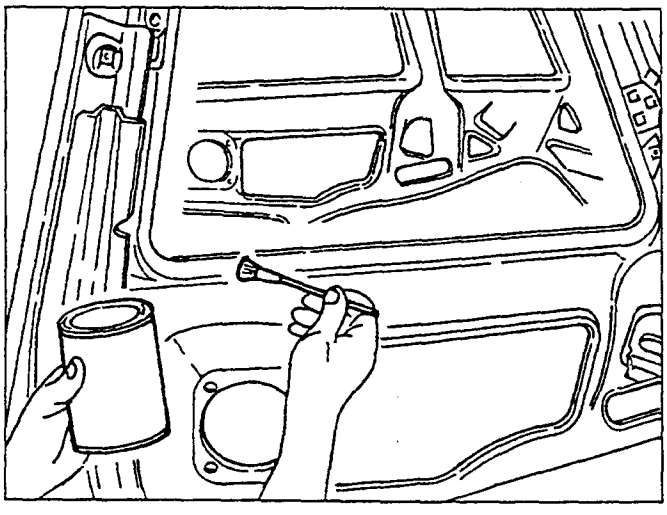


WARNING:
• Ensure that even the slightest buckling is removed, particularly on the inner panels or in hidden positions.
• If all buckling is not removed problems may arise during installation in addition to a reduction in strength due to the concentration of stresses.
• Carefully inspect the joint areas of each pillar.

c. Remove all traces of paint from the welding surfaces.
Tools required:
- Belt sander
- Disk sander
- Rotating brush.

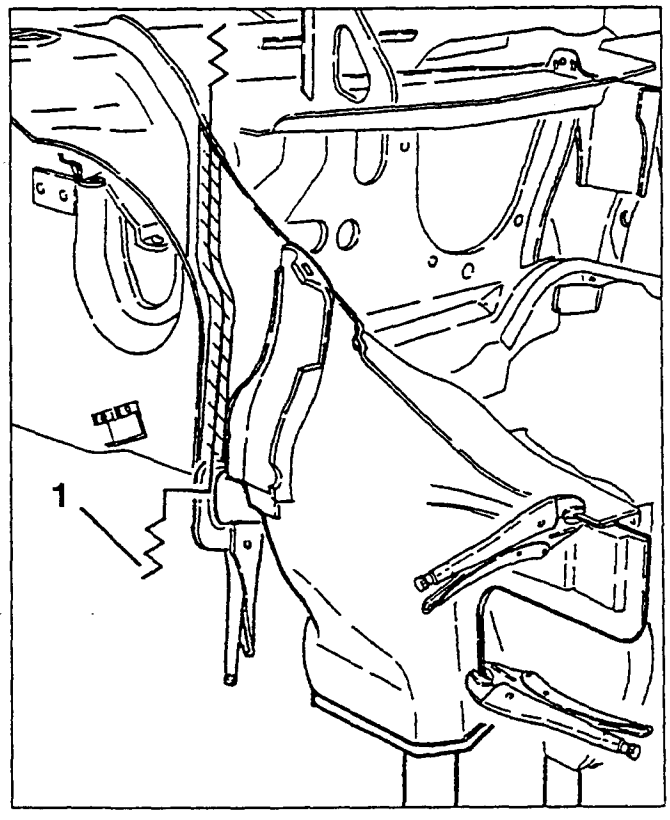


d. Apply electroweldable protection products to the edges of all the sheets that are to be spot welded.



NOTE:
In some areas it may be necessary to apply very thick electroweldable protection to seal between the joints as well as acting as a protective coating.

e. When partially replacing a damaged sheet an overlap of approx. 50 mm should be maintained when cutting away the unusable metal sheet in order to leave a wide enough area to permit bonding.
Tools required:
- Pneumatic saw
- Hand saw
- Scribe
- Shears.



1. Overlap

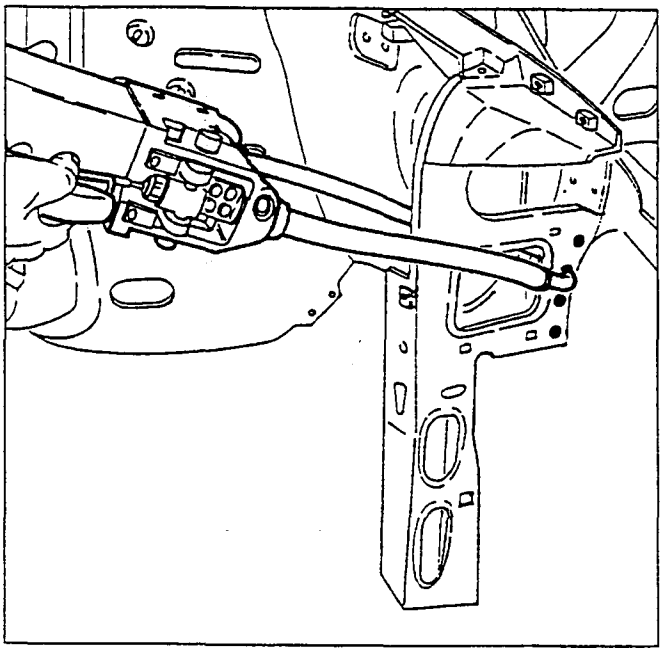
POSITIONING AND INSPECTION

a. Temporary installation of new components.
Tools required:
- Adjustable clamps
- Squaring tool (sighted)
- Chassis dimensional control system (Dime).

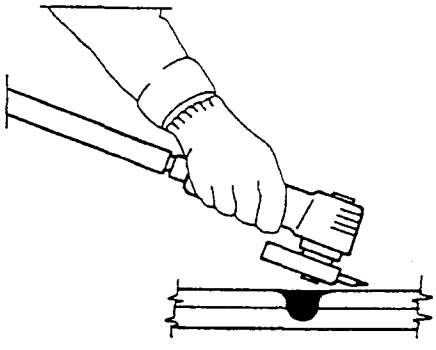
WARNING:
• Position the components as indicated in the diagrams in the "BODY SQUARING" paragraph.
• Draw together the edges of the sheets to be welded until they are in the correct position.
• Position mobile parts (doors, bonnet and boot lids) and check for proper installation by verifying gaps, parallelism and squaring.
• Secure the parts to be welded with clamps or a few spot welds.

WELDING AND FINISHING OF THE SHEET METAL

a. All welding should be carried out in strict accordance with the indications in "WELDING PRECAUTIONS".
Tools required:
- Spot welder
- MIG welder
- Oxyacetylene torch.



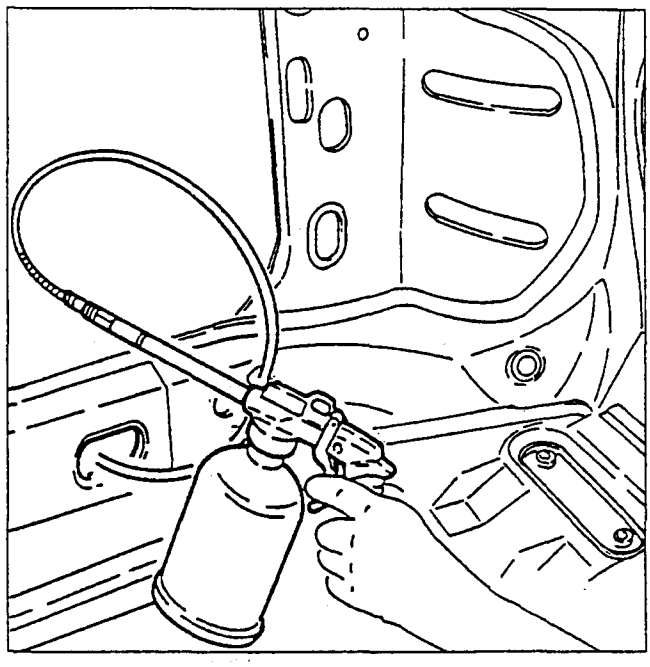
b. After welding remove the clamps used to hold the edges in place and remove the dents which may have been caused.
c. Sand the welds with a sander.
Tools required:
- Pneumatic sander
- Disk sander
- Grinding machine with milling cutter.



WARNING:
• When using the sander care should be taken to avoid excessively reducing the thickness of the metal sheet as this may adversely affect welding strength.
• Remove metal dust from the surfaces that have been smoothed and from the surrounding areas.
• Metal dust may cause corrosion.

PROTECTION

a. Apply a rust inhibitor to the components subject to MIG welding and oxyacetylene torch.

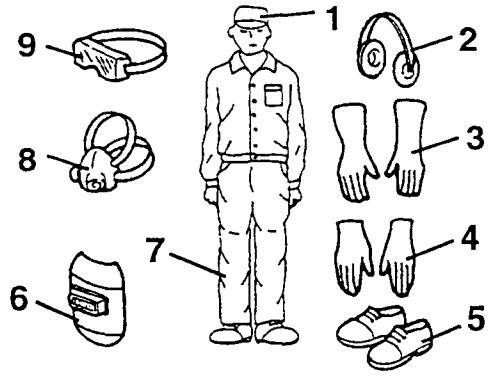


b. Apply the specified sealant to the joints in the metal.
c. Carry out the paint, wax and foam treat procedures (see specific paragraph).

INDICATIONS FOR OPERATORS

PREVENTION OF WORK ACCIDENTS

a. Protective clothing.
- Depending on the nature of the work to be carried out ensure that adequate protective glasses, ear protectors and dust masks are worn. As a general rule work clothes, safety shoes and cap should always be worn while working.



1. Cap
2. Ear protectors
3. Welding gloves
4. Gloves
5. Safety shoes
6. Protective shield
7. Work clothes
8. Dust-mask
9. Protective glasses

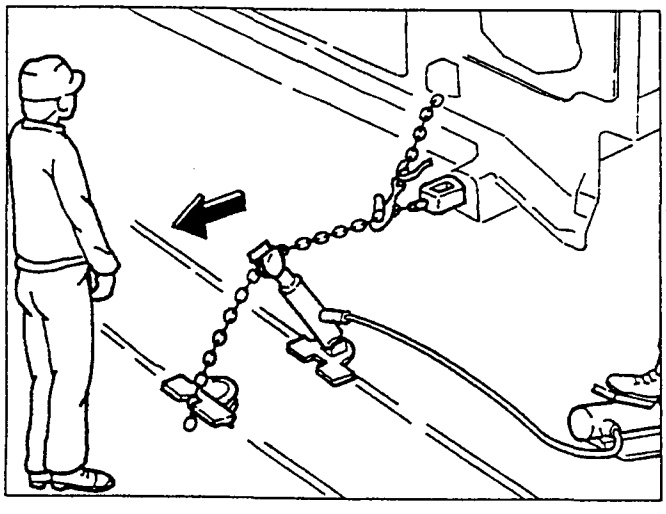
b. Safety supports.
- After the vehicle has been raised ensure that safety supports are adequately positioned. Refer to "LIFTING POINTS" for the location of bearing points.

c. Inflammable materials.

- Ensure that the negative lead is disconnected from the battery before undertaking repairs.
- In the event of needing to do any welding near the fuel tank, fuel vapour separator or fuel vapour filter, they must be removed from their housing.
- Plug the open ends of the fuel, brake fluid and fuel vapours hoses when they are disconnected.
- Remove the electronic control units before carrying out electric welding on the vehicle.

d. Work environment.
- To guarantee the safety of the operators the work environment should be well ventilated and lighted.
- As paints and sealants produce toxic gasses when heated it is advisable to use pneumatic chisels or saws instead of oxyhydrogen flame to cut and remove the damaged metal sheets.
- To remove the paint from the metal sheet a belt sander or rotating brush should be used.
- To contain the dust produced use a suction hood.

e. Vehicle bodywork straightener
- Ensure that the straightener is used in strict accordance with the procedures given in the Manufacturer's Instruction Manual.



WARNING:
During straightening of the damaged part never stand in front of the straightener in the direction of the tension load.

PROTECTION OF EXTERNAL COMPONENTS AND FURNISHINGS

a. Protection of furnishings
- Remove or cover the interior furnishings in the vehicle (upholstery, instruments, carpets).
- Cover glass, instruments, upholstery and carpets with heat resistant materials before attempting welding operations.

b. Protection of external components.
- When external components (bonnet, boot, mouldings, trimmings) are removed they must be adequately protected from scratching by using rags, protective tape or other materials.

WARNING
Painted surfaces which are even minimally scratched must be repaired as any scratching may lead to successive corrosion.

INDICATIONS FOR REPLACEMENT

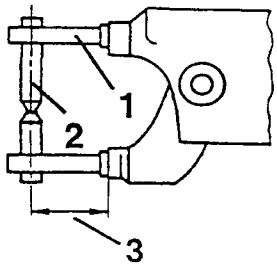
The use of Alfa Romeo spare parts is recommended as these ensure the best results with regard to repairs and maintenance of vehicle serviceability.

INDICATIONS FRO WELDING

Before electric welding remove the electronic control units from the vehicle to avoid damaging them.

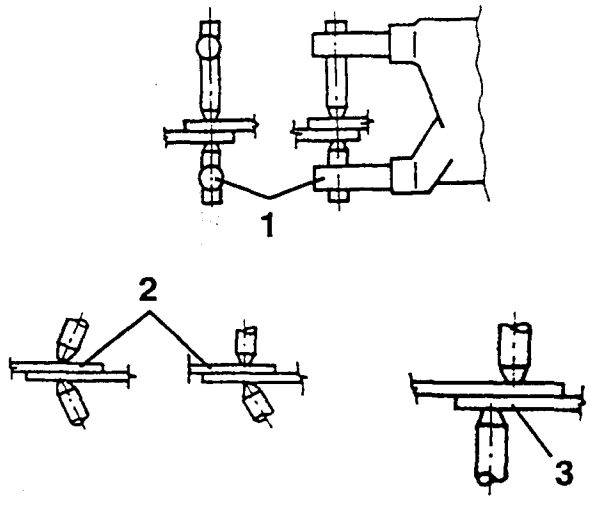
SPOT WELDING

The strength of spot-welds depends on the execution of the following inspections before welding operations begin:
a. Adjustment of the welding arm.
- Keep the arm as short as possible in order to maintain maximum loading between electrodes.
- Fully tighten the arm and electrodes so that they do not work loose during welding.



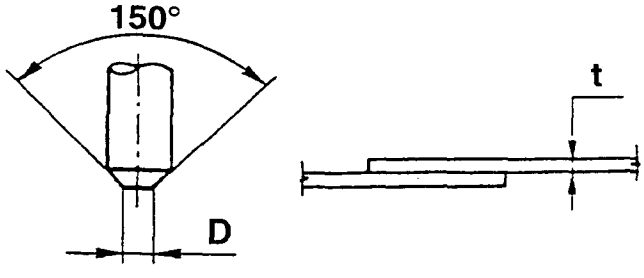
1. *Welding arm*
2. *Tip of electrode*
3. *Minimum arm length*

b. Alignment of electrodes.
- Align the tips of the upper and lower electrodes. Any misalignment of the electrodes causes low pressure on the welding points resulting in a reduction in strength.



1. *Correct alignment of arms*
2. *Incorrect position of arms*
3. *Incorrect length of arms*

c. Diameter of electrode tip
- It is necessary to check the diameter of the electrode in order to obtain the necessary welding strength. Before beginning work ensure that the diameter of the tip (D) is adequate for the thickness of the metal sheet following the formula given. Remove ll traces of burns or foreign bodies from the tips of the electrodes.



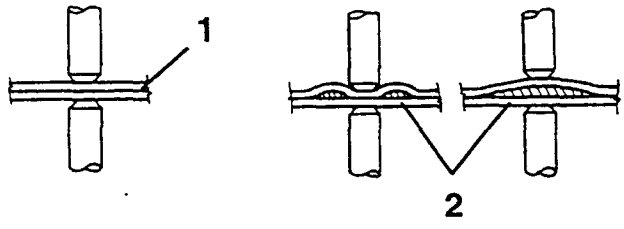
D = t + 3 (mm)

D = Diameter of the electrode tip
t = Thickness of sheet metal

Condition and preparation of the panels to be welded.

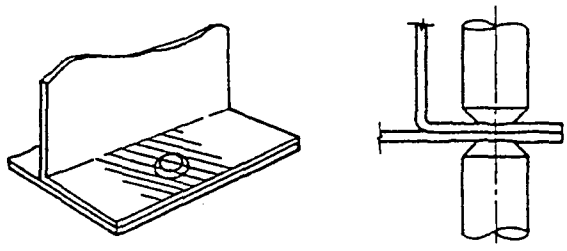
The presence of discontinuity, paint, rust or dust on panel edges prevents the flow of electricity and thus reduces welding strength. Before beginning welding check the condition of the mating surfaces and make any adjustments necessary.

a. Gaps between mating surfaces
- Even a slight gap between the surfaces to be welded reduces the intensity of the flow of electricity resulting in welds which will be too small or weak. Before welding join the surfaces and when necessary, secure them with a clamp.



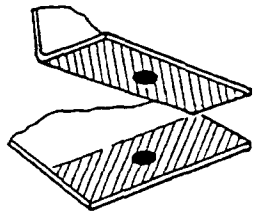
1. *Correct mating of the surfaces to be welded*
2. *Incorrect mating - gap between the surfaces to be welded*

b. Welding of metal surfaces.
- To obtain the best results prepare the surfaces to be welded by removing all traces of impurities and foreign bodies (paint, dust, rust).

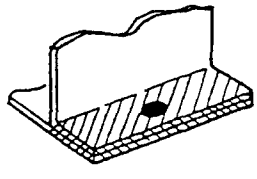


c. Corrosion prevention on metal surfaces.
- Coat the area to be welded with a high conductive corrosion inhibitor. The edges should also be coated with this product.

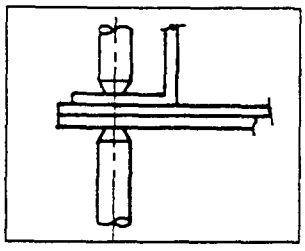
PRELIMINARY OPERATIONS



APPLY THE CORROSION INHIBITOR TO ALL THE SURFACES AND AROUND THE EDGES



Indications to be followed when spot welding.

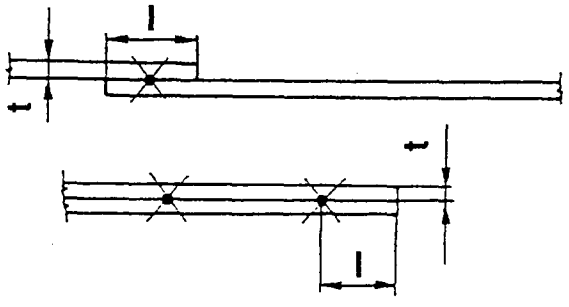


a. Welding of three of more over lapping metal sheets.
- When three or more overlapping sheets are to be welded, welding should be repeated a second time.

b. Number of spot-welds.
- Weld in accordance with the number of spots indicated in this manual.

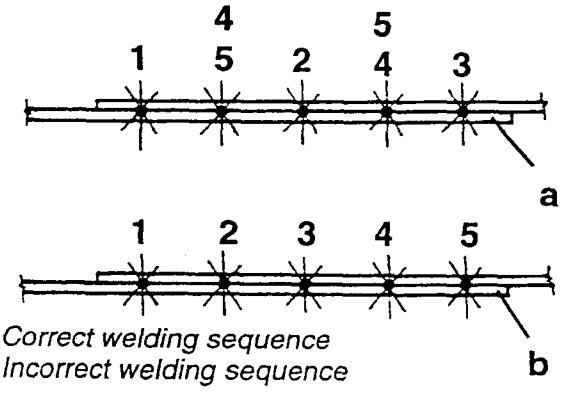
c. Minimum distance between spot welds and the edge of the sheet metal.
- When welding near the edges of the metal sheet the values given in the following table should be used.

Thickness of sheet metal (t) mm	Minimum distance from the edge of the metal sheet (l) mm
0.6	11
0.8	11
1.0	12
1.2	14
1.6	16
1.8	17



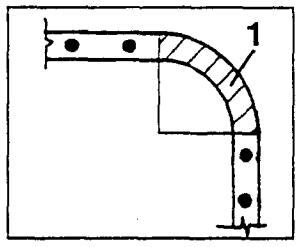
Welding carried out too close to the edge will not be strong enough and sheets may warp.

d. Welding sequence.
- Do not weld in one direction only as this results in weak welds due to electricity shunting. If the electrodes overheat and change colour interrupt the operation, leave them to cool and reshape the tips.



a. Correct welding sequence
b. Incorrect welding sequence

e. Welding on angled surfaces.
- Do not weld on angled surfaces as a concentration of voltage is created which can cause breakage.

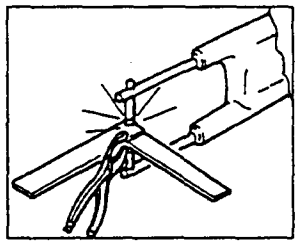


1. Angular surfaces exempt from welding.

Examples:
- Front pillar upper corner.
- Front part of rear wing.
- Front and rear window corners.

Inspecting the welding areas.

The spot-welding areas can be inspected either visually or by using a destructive method. This last method should be applied before and after welding. Spot-welds should be equally spaced and positioned at the centre of the flange.

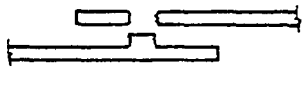


a. Sample test to be carried out before welding.
- Prepare the samples using metal sheet of the same thickness as the parts to be welded and secure them so that they do not move during welding.

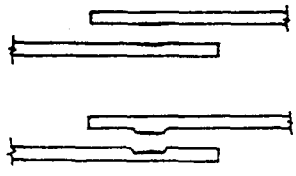
Carry out welding.
- Rotate the samples around the spot-weld until they detach and then inspect the break.
- The entire spot-weld should remain on one of the two samples and a circular hole should be on the other.

If this condition is not met welding conditions are incorrect.
Adjust the pressure, electricity and electricity flow time and other welding parameters and repeat the test until better results are obtained.

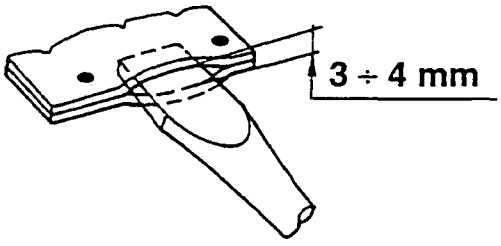
CORRECT WELDING PARAMETERS



INCORRECT WELDING PARAMETERS



b. Test to be carried out after welding using a hammer and chisel.
- Insert the point of a chisel between the welded sheets and lightly tap the chisel until a gap of 3-4 mm is obtained. If no warping is found then the welding is acceptable.



- If the gauge of the sheets in not equal the gap should be restricted to 1.5 - 2 mm.
- It should be remembered that the above values are for reference only.
- The gap can vary depending on the position of the spot-welds, length of the flange, thickness of the sheet, welding angle and other factors. To avoid breaking the spot-welds do not exceed these limits.
- Ensure that the damaged parts are repaired after testing.

MIG WELDING

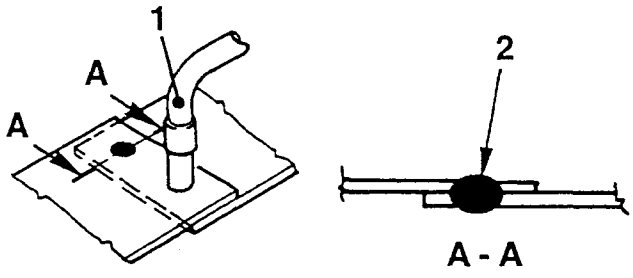
- Use MIG welding for parts where spot-welding cannot be used.

Conditions of the panel to be welded.

Remove all traces of foreign materials by sanding or brushing. Paint, rust or oil on the surface of the sheet may reduce the welding strength and cause blistering.

Welding indications.

a. Filler welding (of prepared holes).
- Drill a hole 5 to 6 mm in diameter on one of the sheets to be welded and secure the sheets together.
- Position the blowpipe at right-angles to the sheet and fill the hole. At each interruption in the welding process an oxide coating is formed on the surface which causes blistering. If this occurs remove the oxide with a brush.
- Ensure that the welding of the upper and lower sheets is perfect.



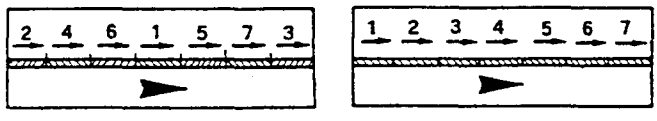
1. Blowtorch *2. Welding point*

b. Head-welding.
- Tack the two surfaces by welding intermittently in order to align correctly and prevent buckling. Fill the empty spaces with small welding seams.

NOTE:
The correct gap is approx. 1 mm.

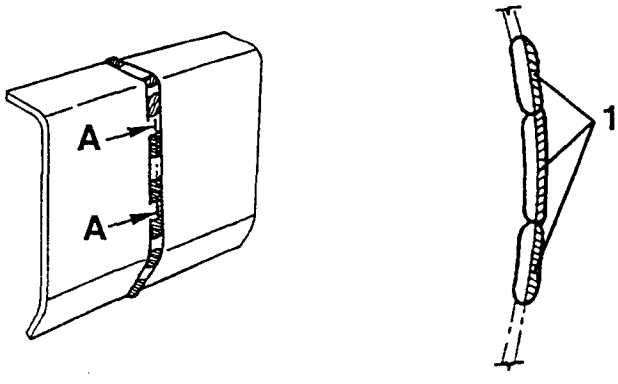
NOTE:
If welding is intermittent deformation is less. If welding is continuous deformation is greater.

- Do not weld a continuous seam as buckling may occur. In order to reduce buckling proceed as shown in the diagram.



CORRECT *INCORRECT*

- After welding sand the weld following the shape of the part. If any holes are left in the weld fill them and then sand.



1. Part of the seam-weld to be flushed.

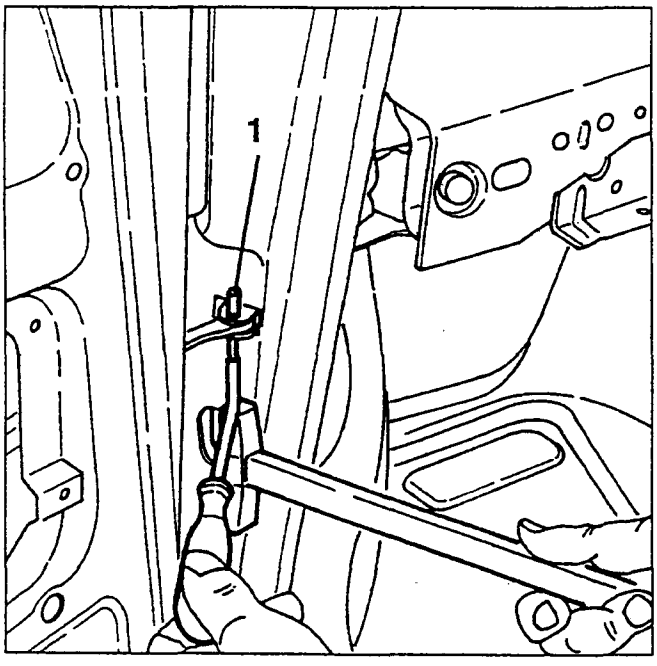
Inspecting filler-welds

This procedure is similar to that previusly described for spot-welding.

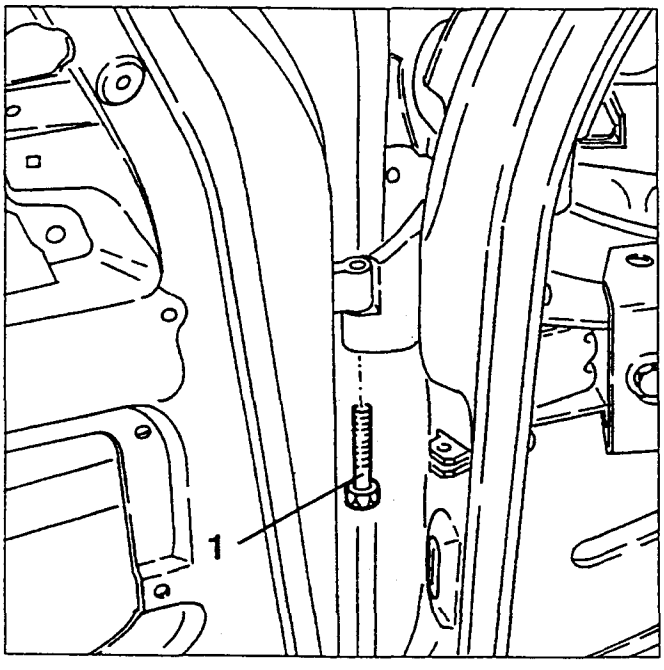
DOORS

REMOVAL AND REFITTING

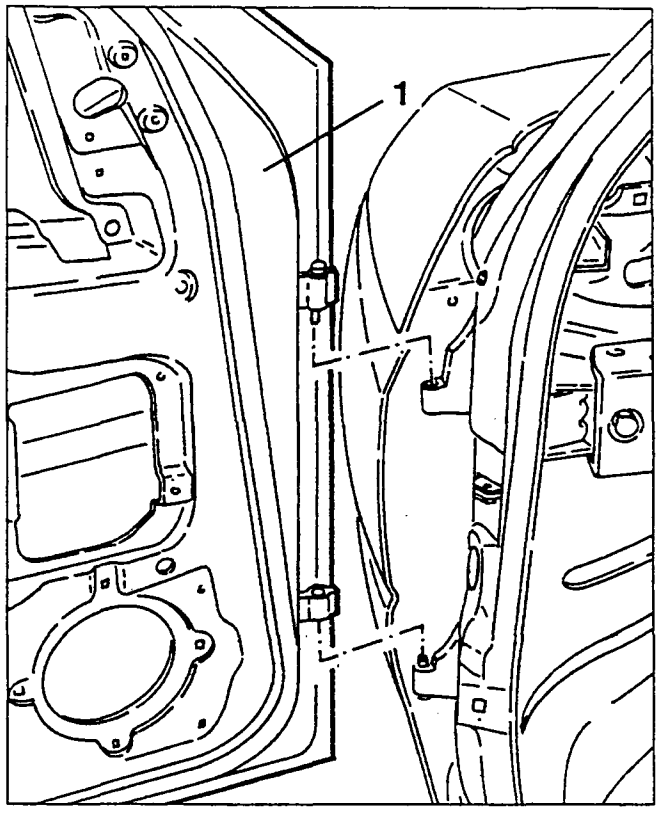
1. Remove the pin from the door check strap, half-close the door to back off the pin and then re-open the door.



1. Loosen the two screws securing the door to the hinge.



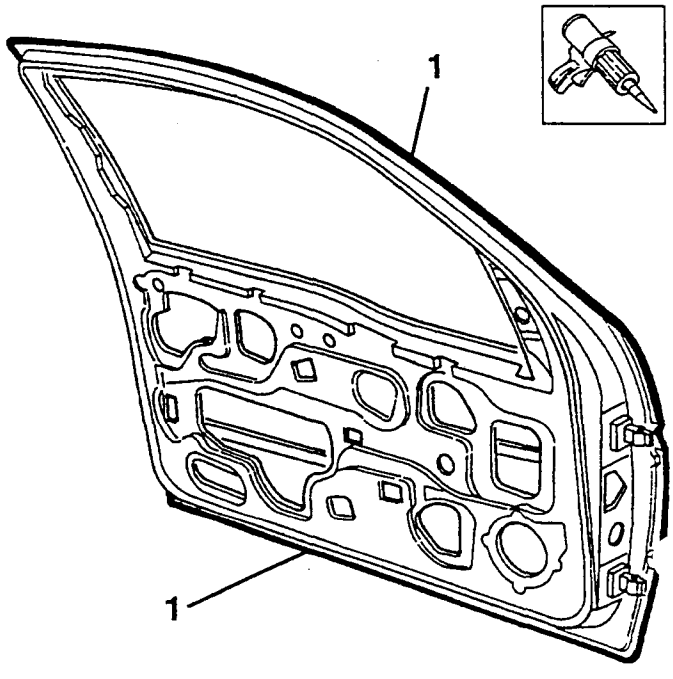
1. Lift the door unit the tapered pins of the hinges can be lifted from their seatings. Remove the door.



Refit the door by reversing the procedure followed for removal and note the following.

1. If a new door is being used apply the specified sealant along the inside edge of the door.

NOTE:
Check that the sound-proof panels are present inside the door panels.

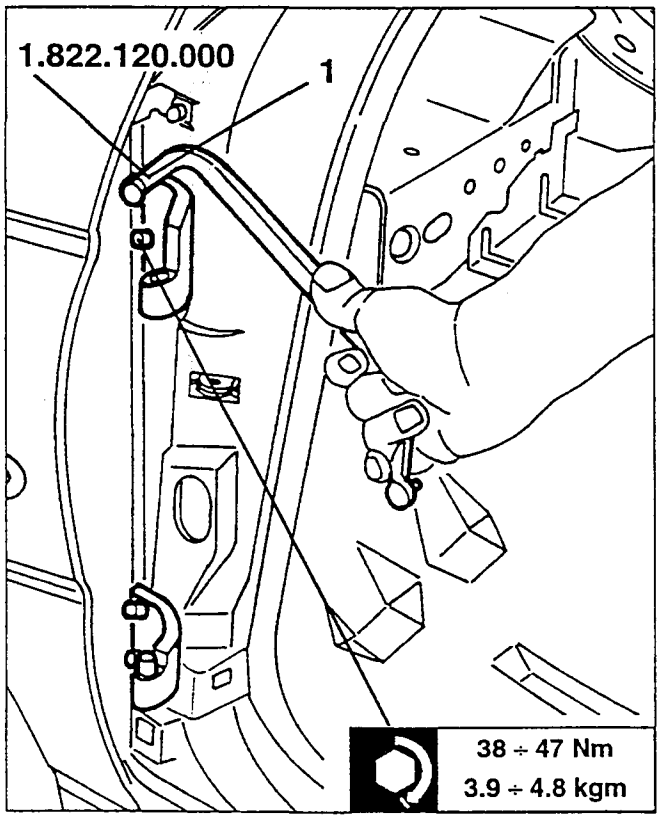


- If necessary adjust the door following the indications given in the relative paragraph.

HINGES

REMOVAL/REFITTING

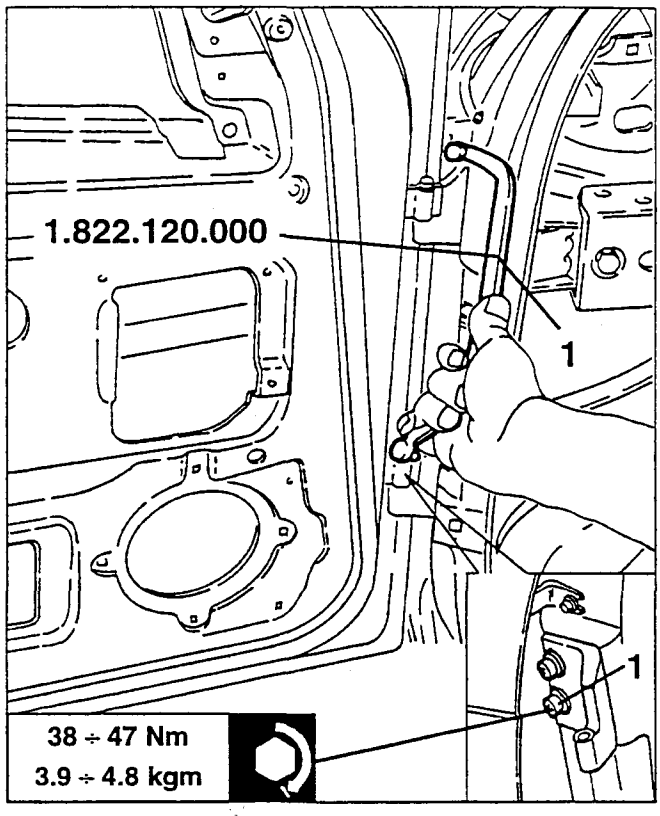
- Remove the door (see specific paragraph)
1. Using tool N° 1.822.120.000, loosen the two screws and remove the hinge.



Refit the hinges by reversing the procedure followed for removal and adjust the door as described in the relative paragraph.

ADJUSTING DOORS AND HINGES

1. Using tool no. 1.822.120.000, slacken the screws fastening the hinges to the pillar.

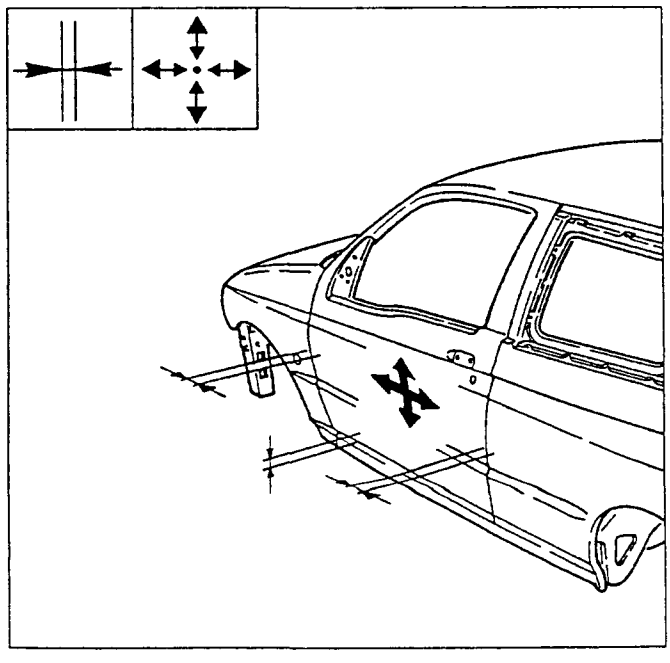


- Adjust the door longitudinally and in height checking that it mates correctly and the lights.

NOTE: Adjust the door maintaining the screws fastening the hinges to the door tightened in package.

- If necessary position shims under the hinges and under the door catch.

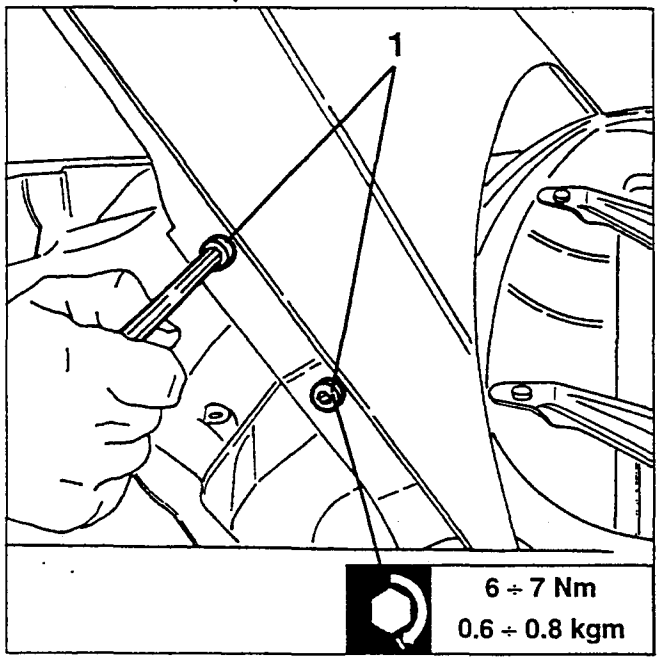
NOTE: To adjust the door the relative gaskets, lock and catch must be fitted.



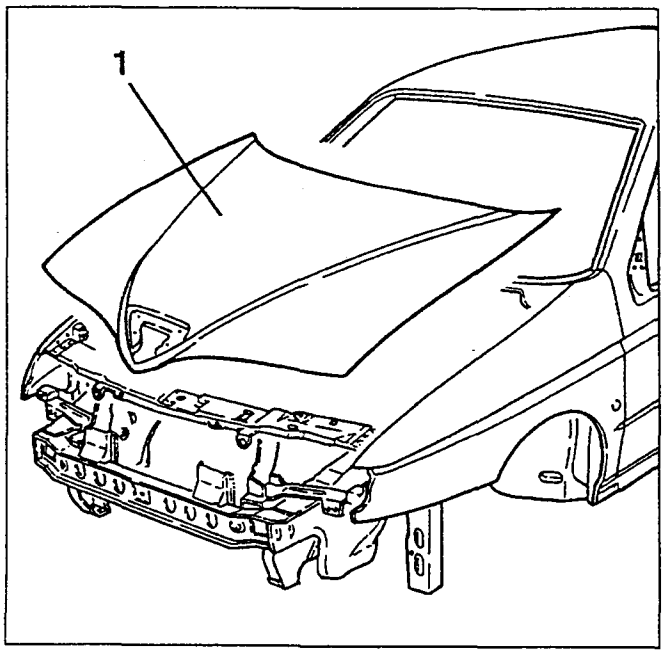
BONNET

REMOVAL/REFITTING

- Open and suitably support the bonnet.
1. Loosen the two screws, on each side, securing the bonnet to the hinges.

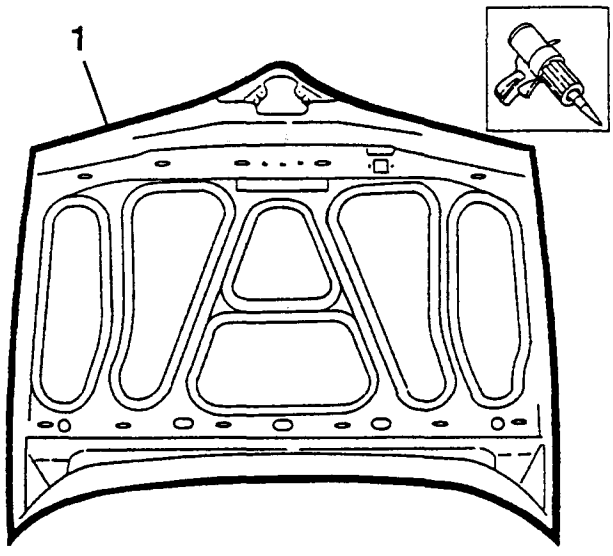


1. Remove the bonnet.



Refit the bonnet by reversing the procedure followed for removal and note the following.

1. If a new bonnet is being used apply the specified sealant around the inner edges of the bonnet.

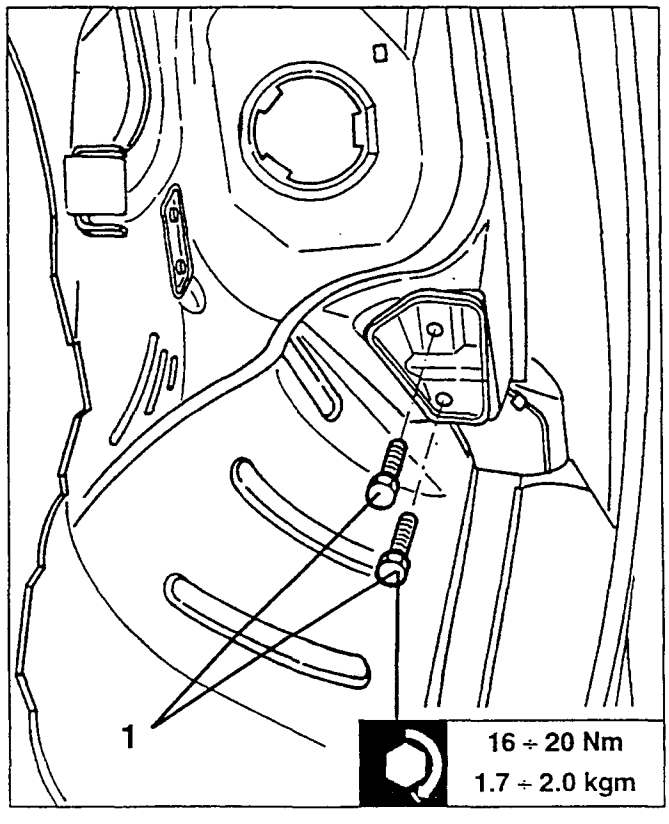


- If necessary adjust the bonnet as described in the relative paragraph.

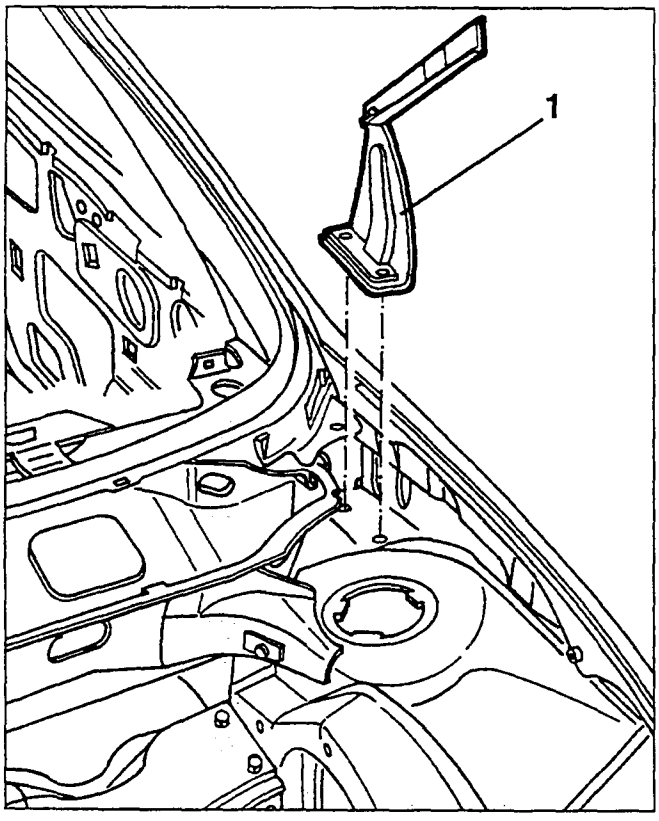
BONNET HINGES

REMOVAL/REFITTING

- Remove the bonnet (see specific paragraph).
1. Working from the wheel housing, loosen the screws securing the hinge to the body.



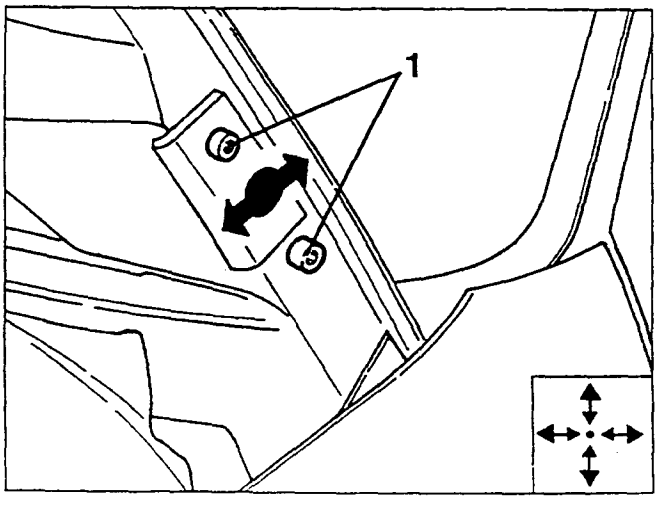
1. Remove the hinge.



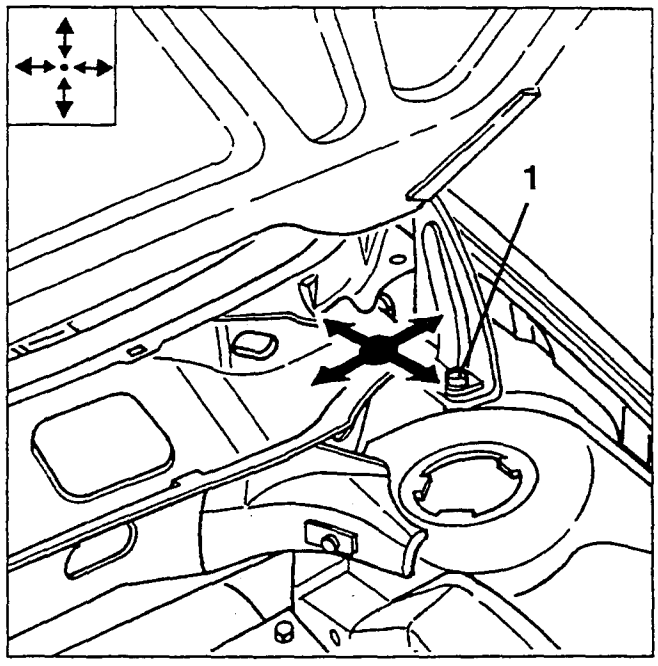
Refit the hinge by reversing the procedure followed for removal and adjust the bonnet as described in the relative paragraph.

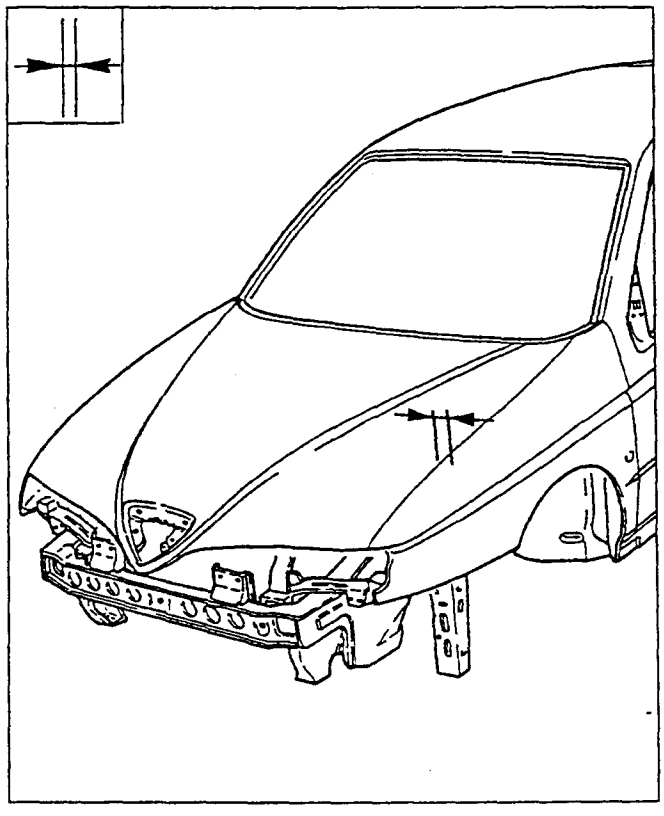
ADJUSTING BONNET AND HINGES

1. Adjust the bonnet for height by acting on the screws securing it to the hinge.



1. Adjust the bonnet longitudinally and laterally by adjusting the screws securing the hinges to the body checking the alignment of the gaps.



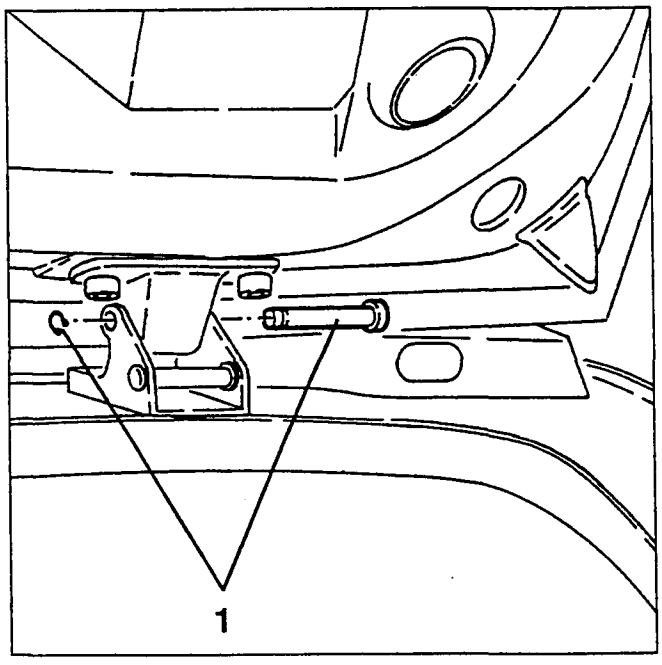


NOTE:
To adjust the bonnet the closure adjustment pin and the anti-vibration buffers must be installed.

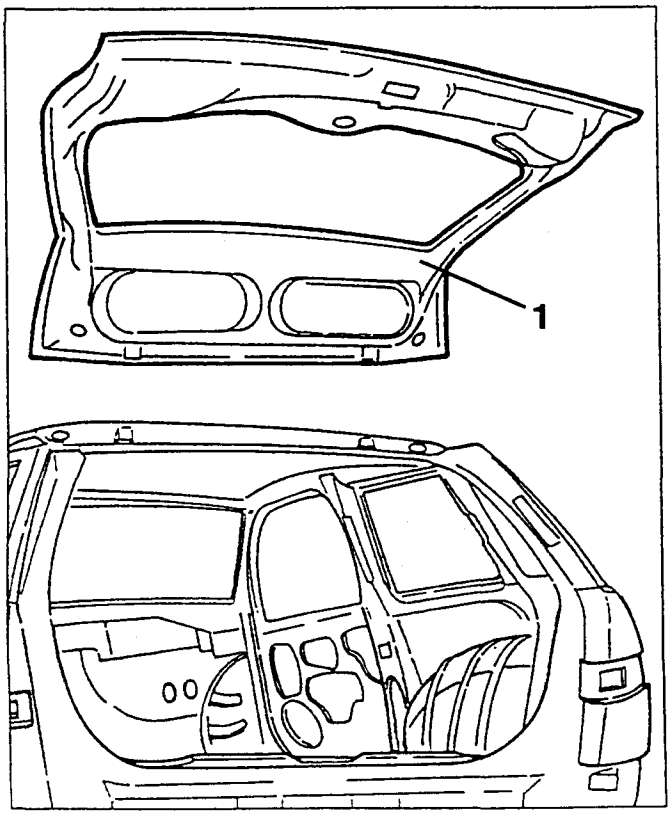
BOOT AND HINGES

REMOVAL/REFITTING

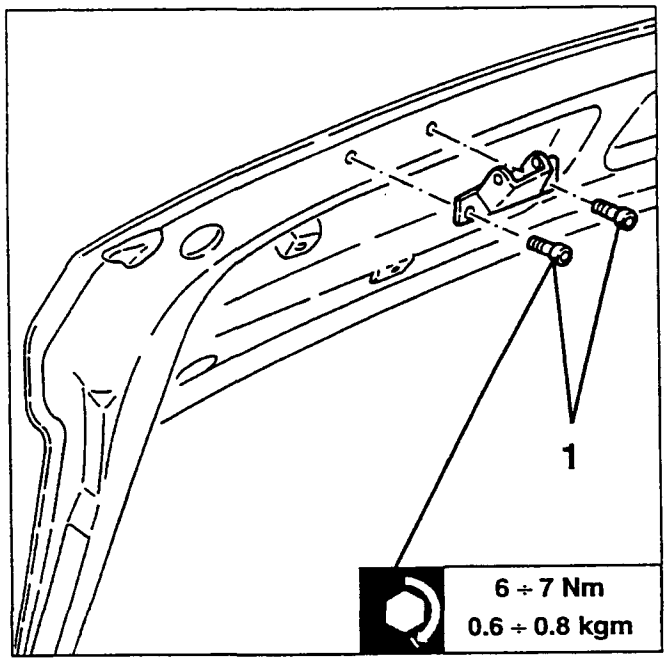
- Open and suitably support the boot.
1. Remove the locking pin and withdraw the pins securing the hinge.



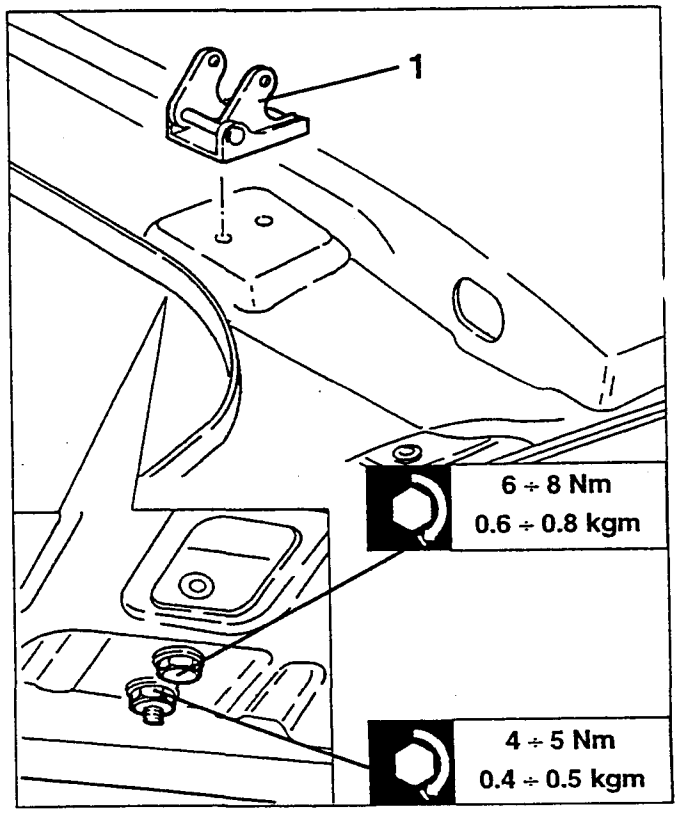
1. Remove the boot.



1. If necessary loosen the screws and remove the half-hinge from the boot.

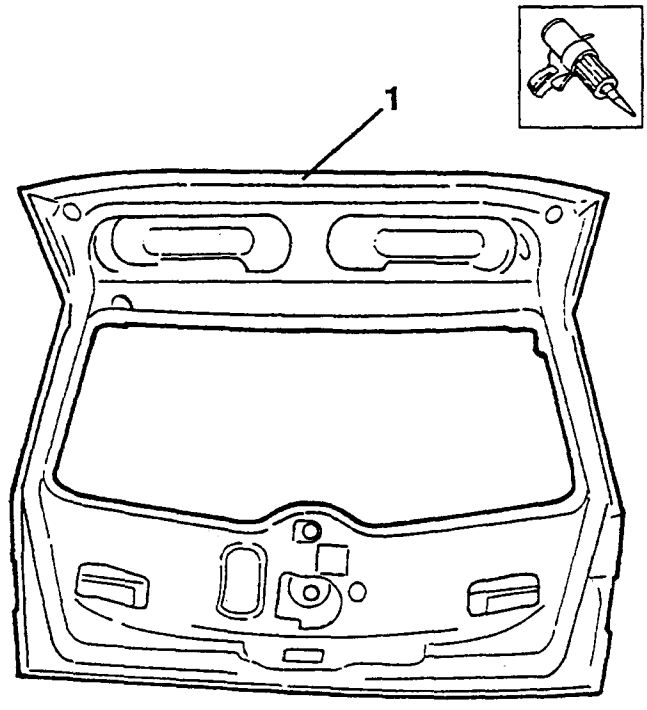


1.If necessary loosen the screws and nuts and remove the half- hinge from the body.

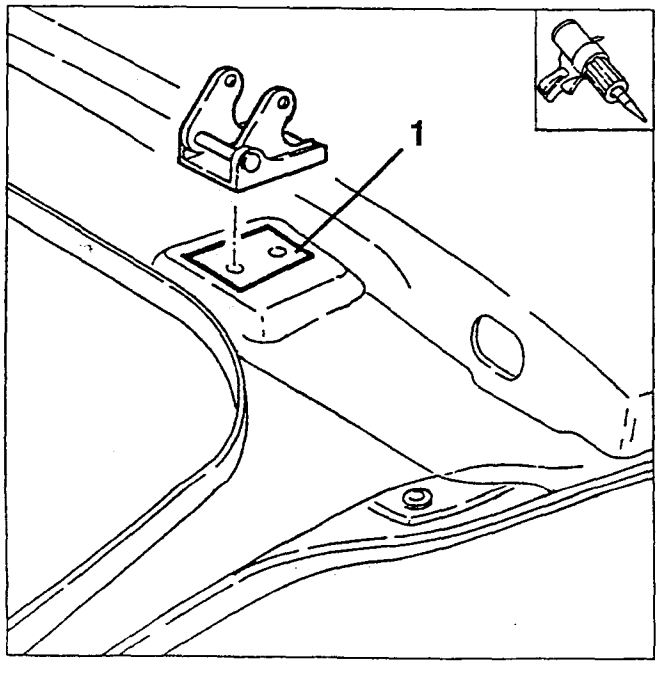


Refit the boot by reversing the procedure followed for removal and carry out the following:

1. If a new boot is being used apply the specified sealant along the internal edge of the boot before painting it.

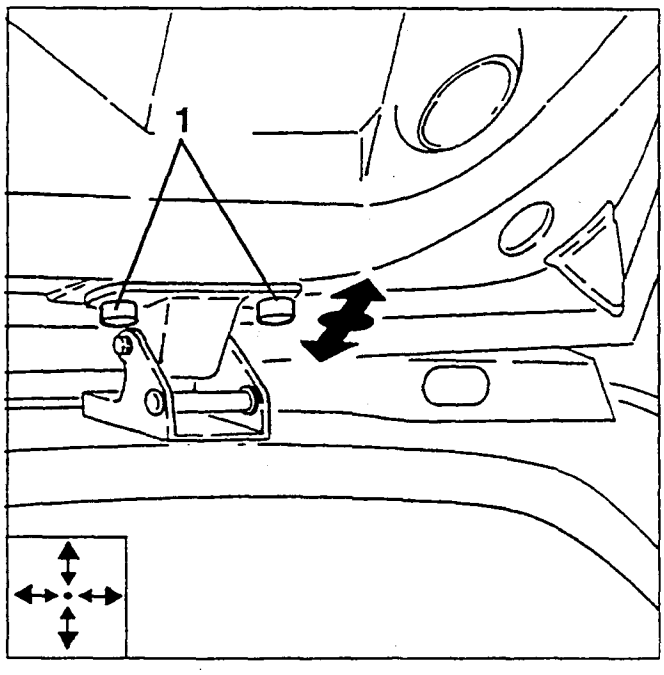


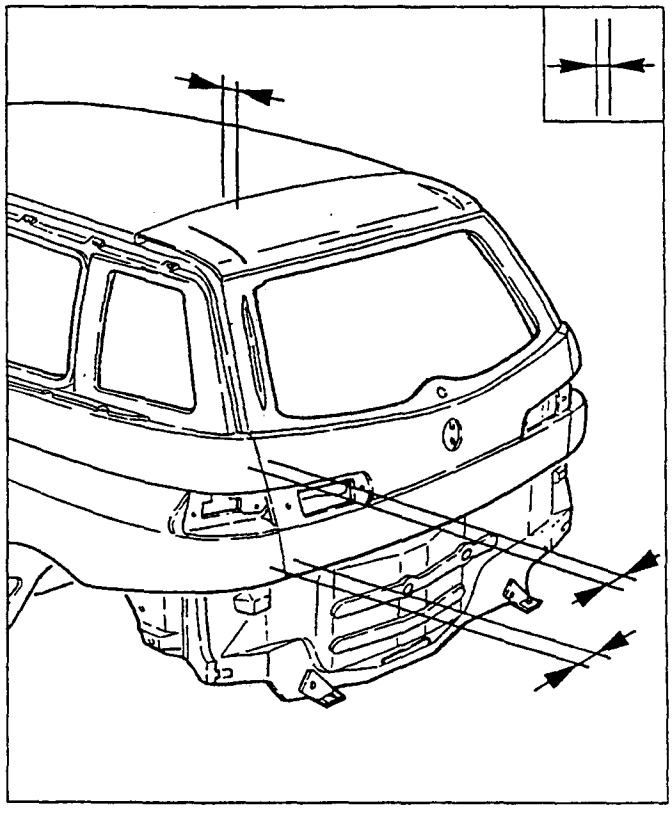
1. Apply the specified sealant when installing between the boot hinge and the body.



ADJUSTING THE BOOT

1. Adjust the boot longitudinally by acting on the screws securing it to the hinge and check the alignment of the gaps.



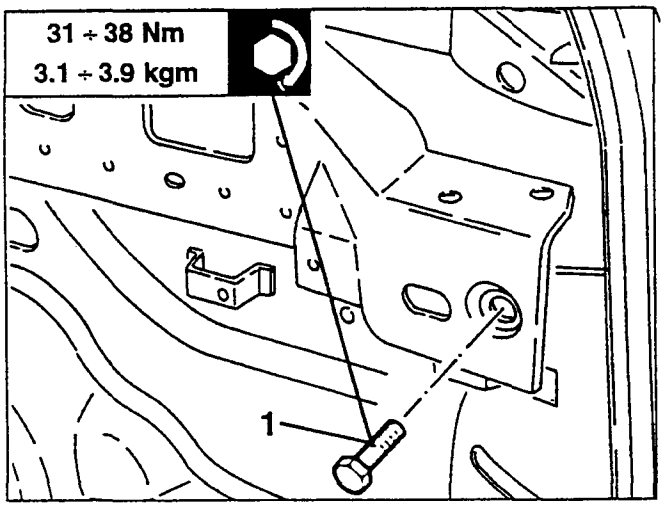


NOTE:
To adjust the boot correctly the gaskets, locks and telescopic support must be fitted.

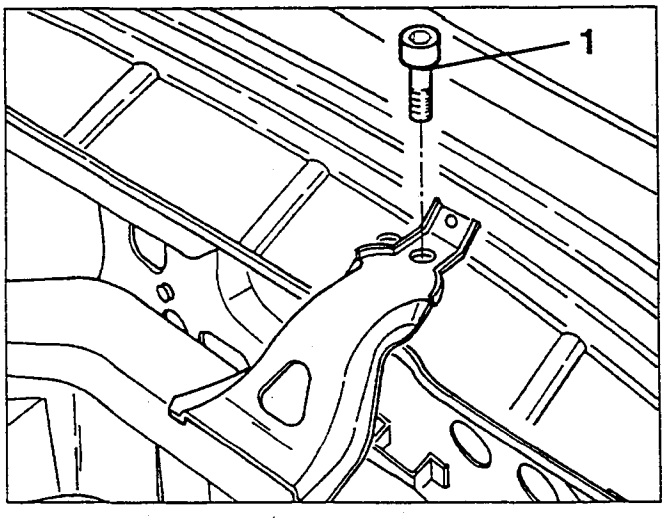
DASHBOARD SUPPORT CROSSMEMBER

REMOVAL/REFITTING

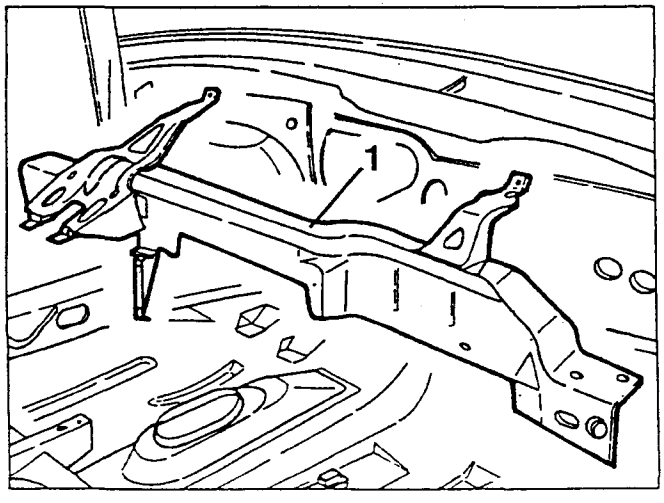
1. Loosen the two side screws securing the dashboard support crossmember.



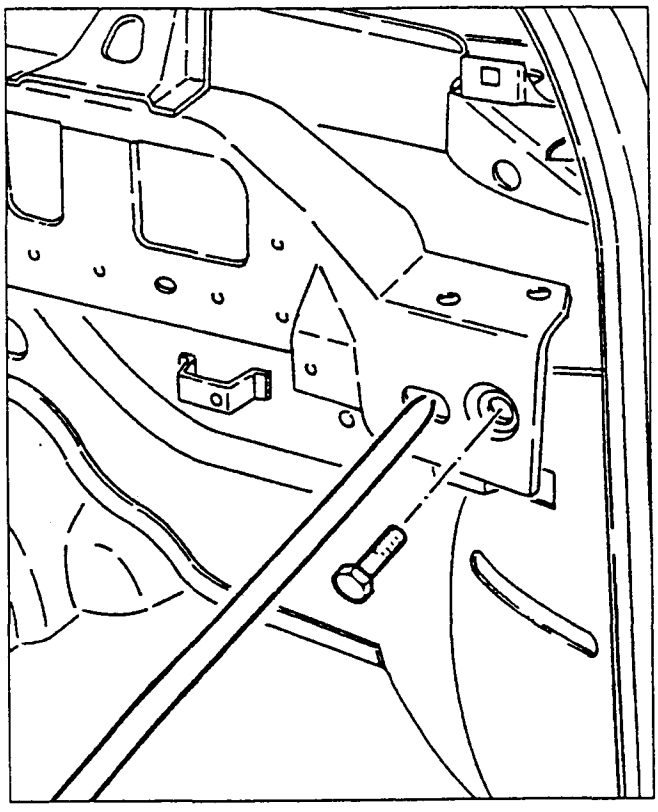
1. Loosen the two upper screws securing the dashboard support crossmember.



1. Remove the dashboard support crossmember.



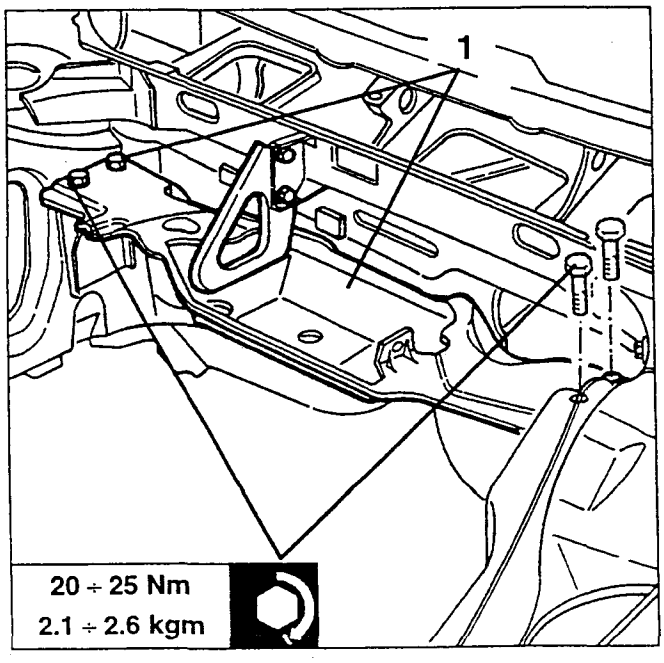
When refitting, before tightening the screws securing the crossmember, position the centering pin it its slot.



BATTERY SUPPORT CROSSMEMBER (Only for Boxer versions)

REMOVAL/REFITTING

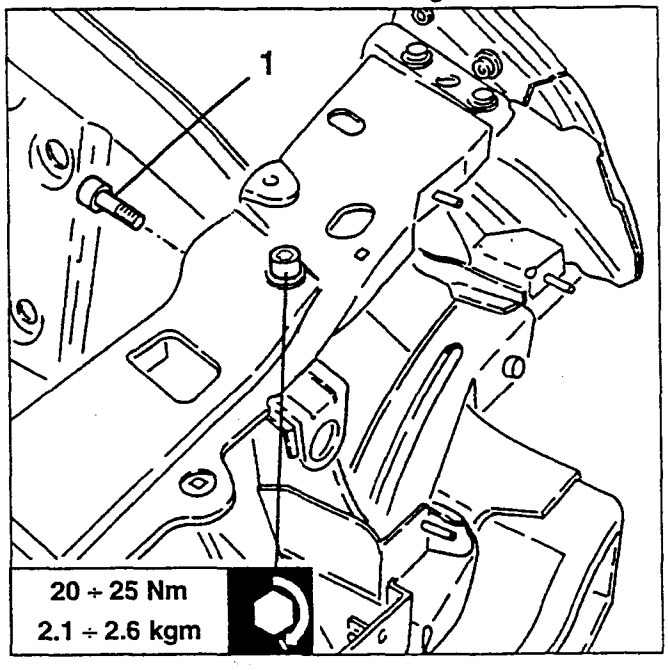
1. Loosen the six screws and remove the battery support crossmember.



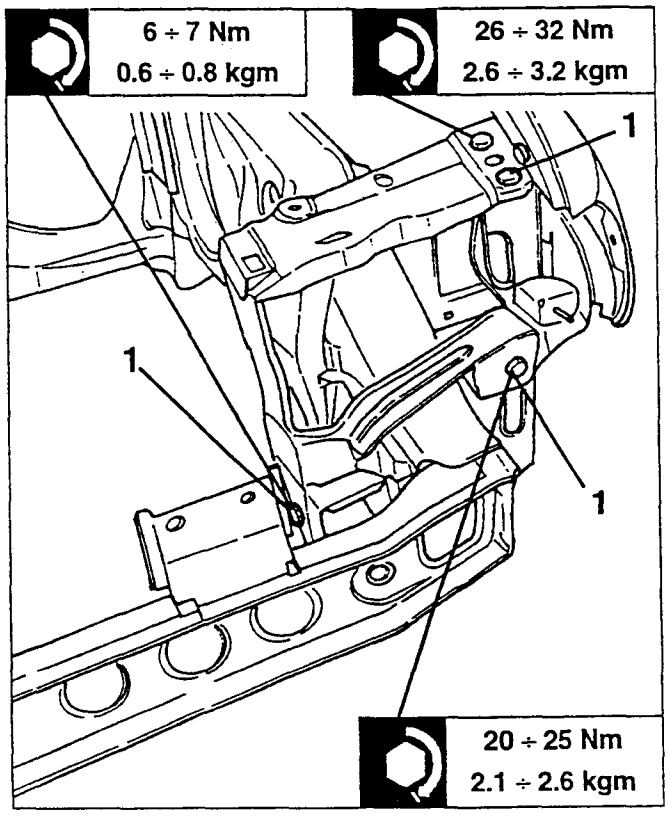
HEADLIGHT CROSSRAIL AND FRAME

REMOVAL/REFITTING

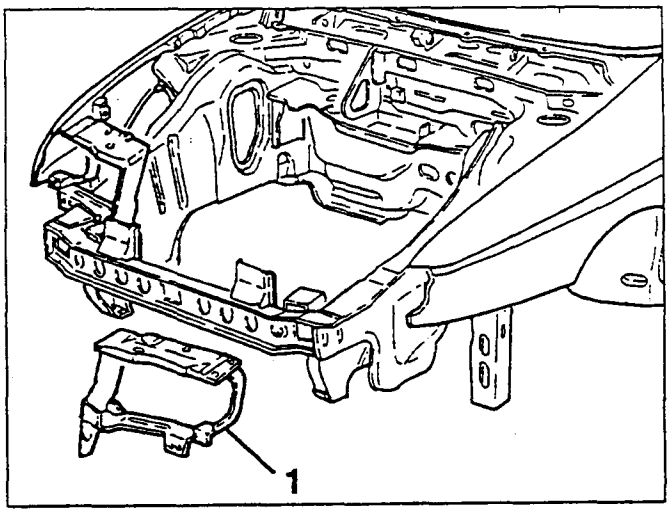
1. Loosen the side screws securing the crossrail.



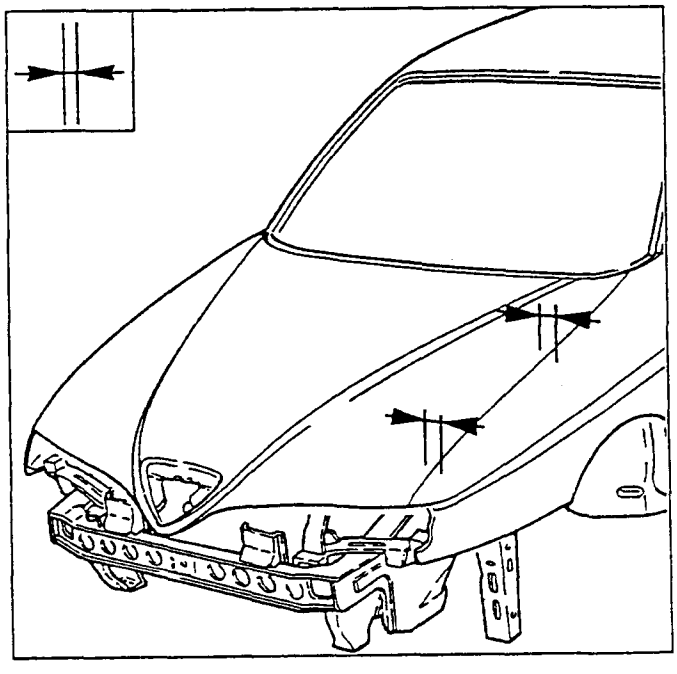
1. Loosen the screws securing the headlight frame.

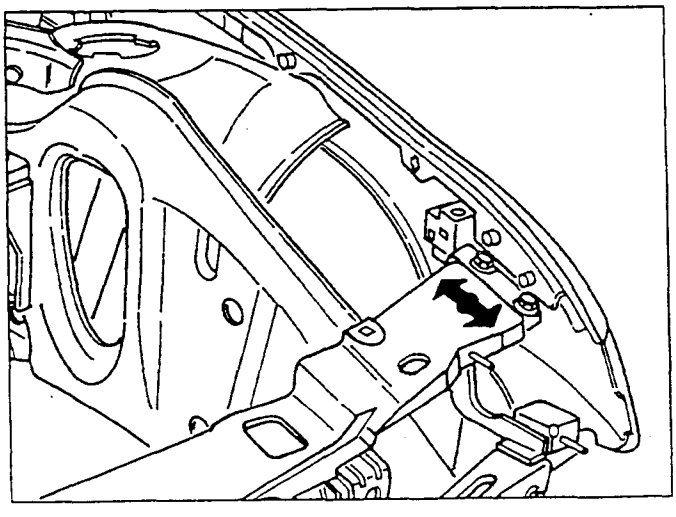


1. Remove the headlight frame.



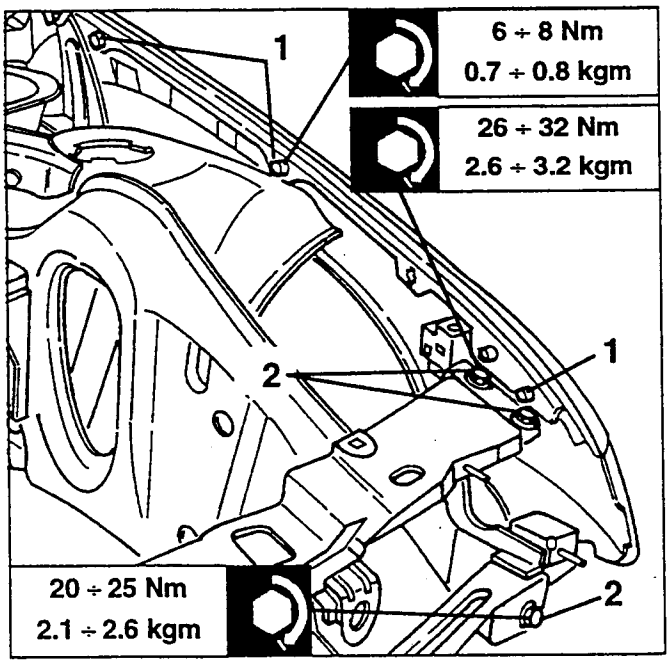
When refitting position the headlight frame and check the alignment and gaps between the bonnet and wing and adjusting the screws indicated in the diagram if necessary.



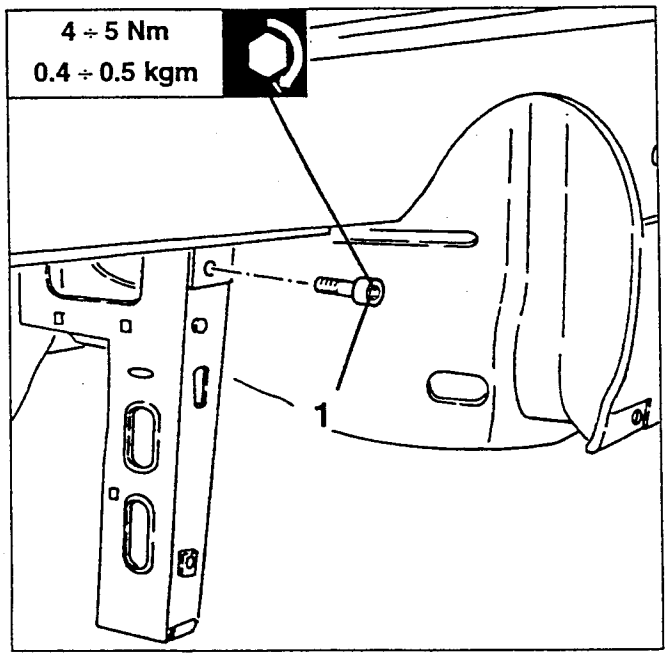


FRONT WING

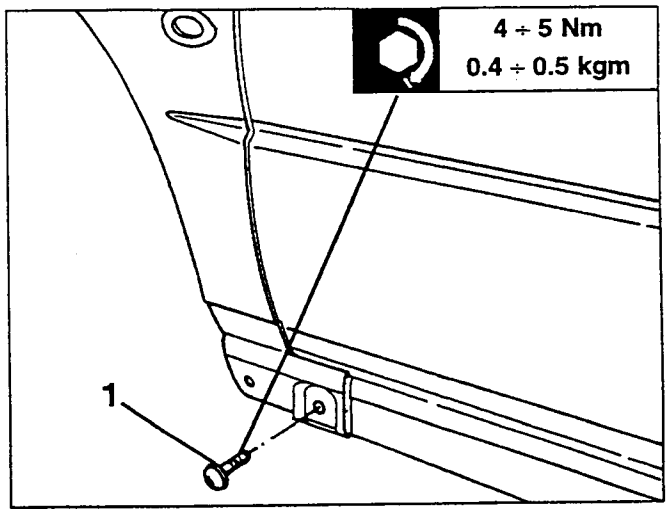
1. Loosen the four screws securing the wing to the upper panel.
2. Loosen the three screws securing the wing to the headlight frame.



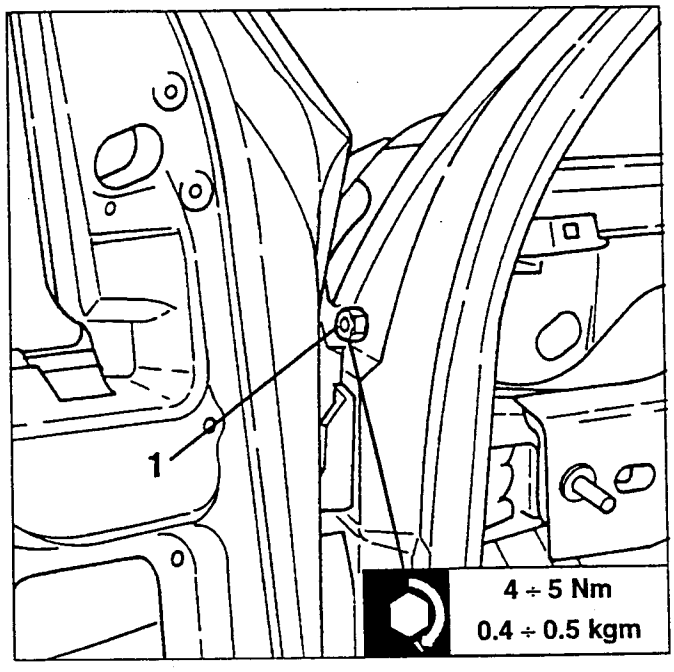
1. Loosen the screw securing the wing to the lateral shelf.



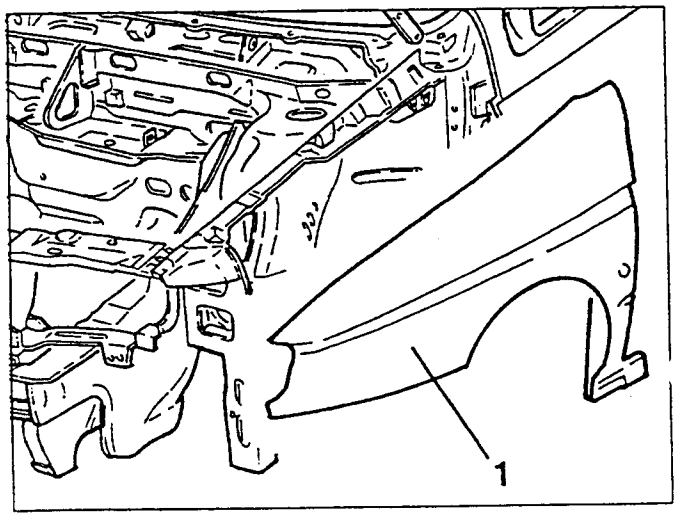
1. Loosen the screw securing the wing to the door sill.



1. Loosen the nut securing the wing to the side panel.

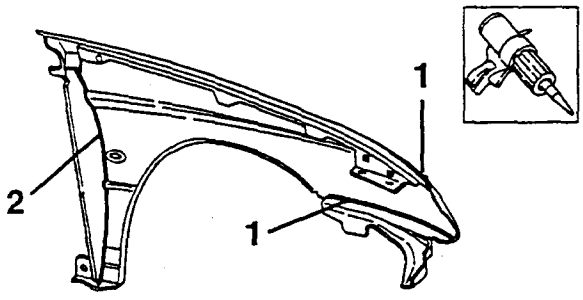


1. Cut the sealant and remove the front wing.

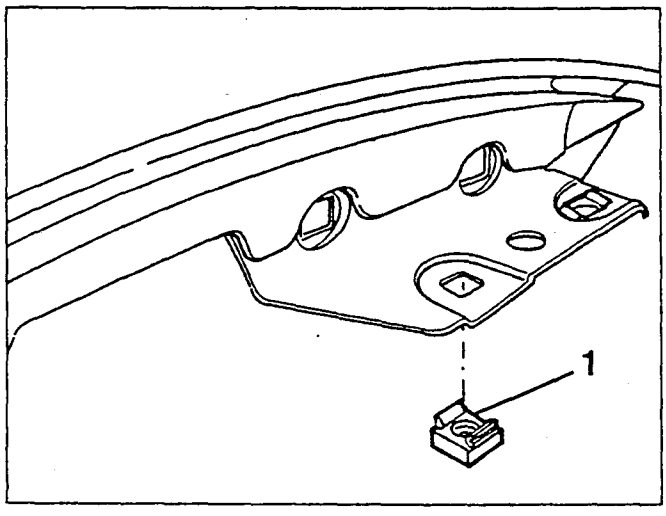


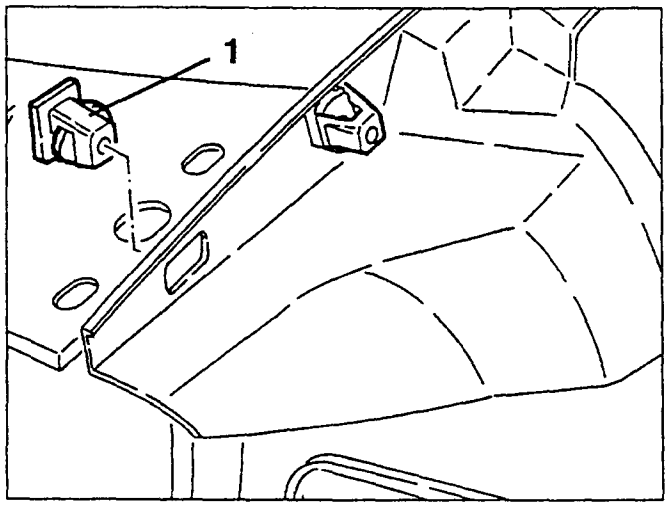
Refit the front wing by reversing the procedure followed for removal and note the following.

1. If a new front wing is being used, apply the specified sealant along the lines shown in the diagram before fitting.
2. Once the wing has been fitted apply the specified sealant along the lines indicated in the diagram.

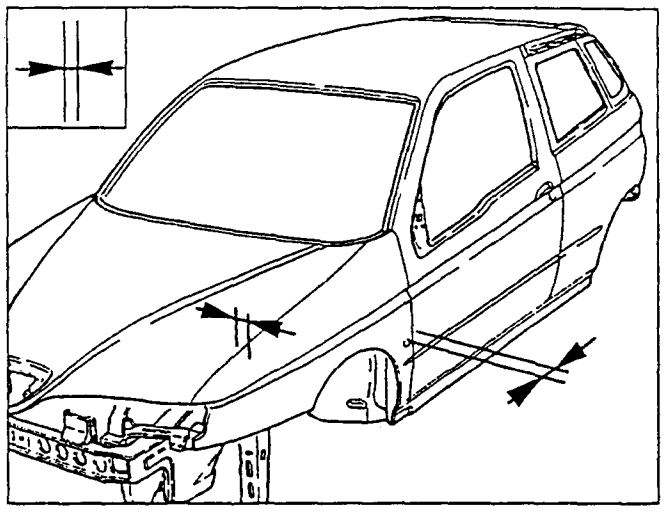


1. Inspect the blocks and nuts for damage and replace if necessary.





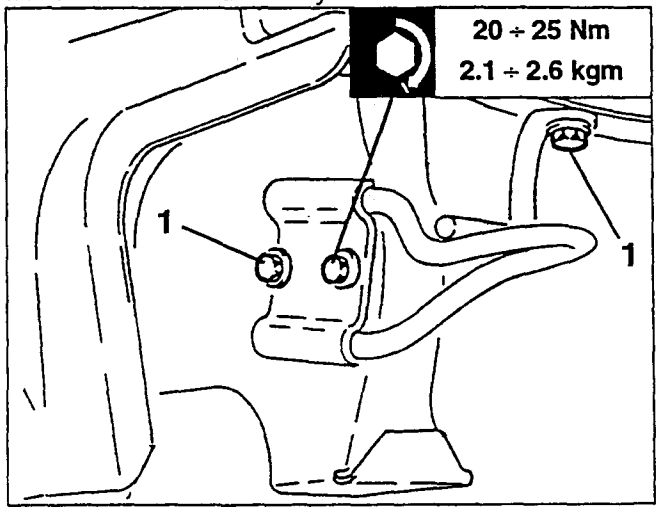
- Check the alignment and gaps between the front wing and the bonnet and door.



FRONT TOW HOOK

REMOVAL/REFITTING

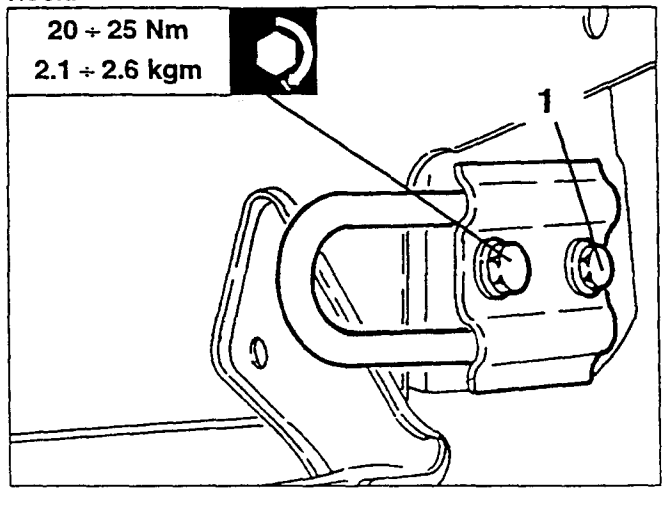
1. Loosen the three screws securing and remove the front tow hook to the body.



REAR TOW HOOK

REMOVAL/REFITTING

1. Loosen the two screws and remove the rear tow hook.

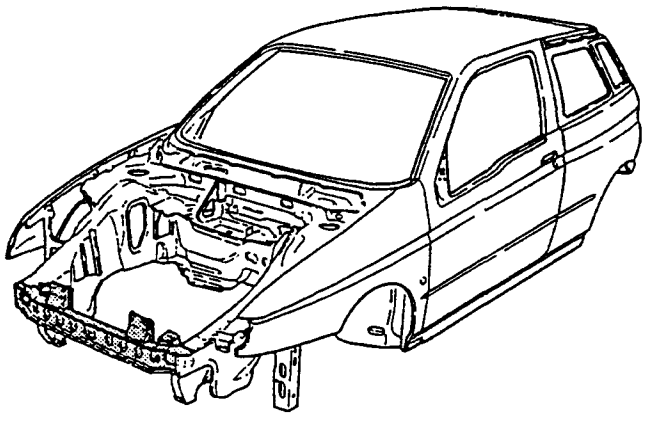


FRONT CROSSMEMBER

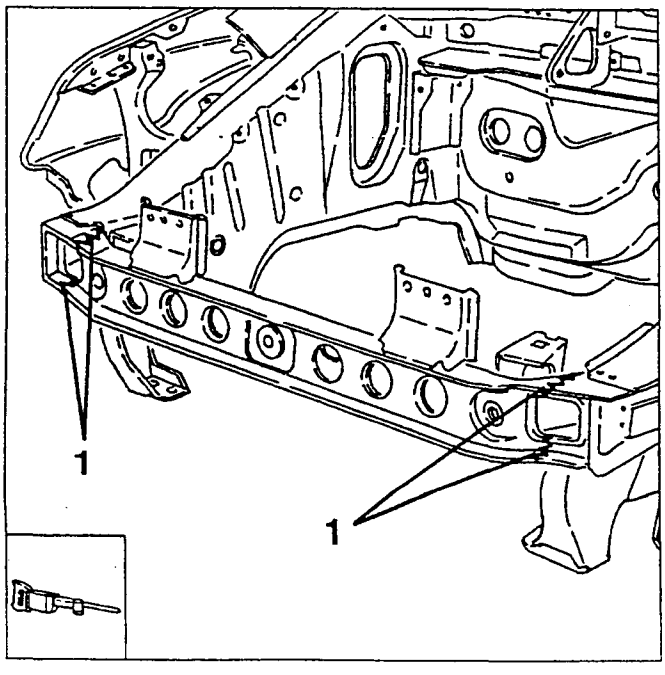
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• radiator upper crossmember (see specific paragraph).
• headlight housing frame (see specific paragraph).

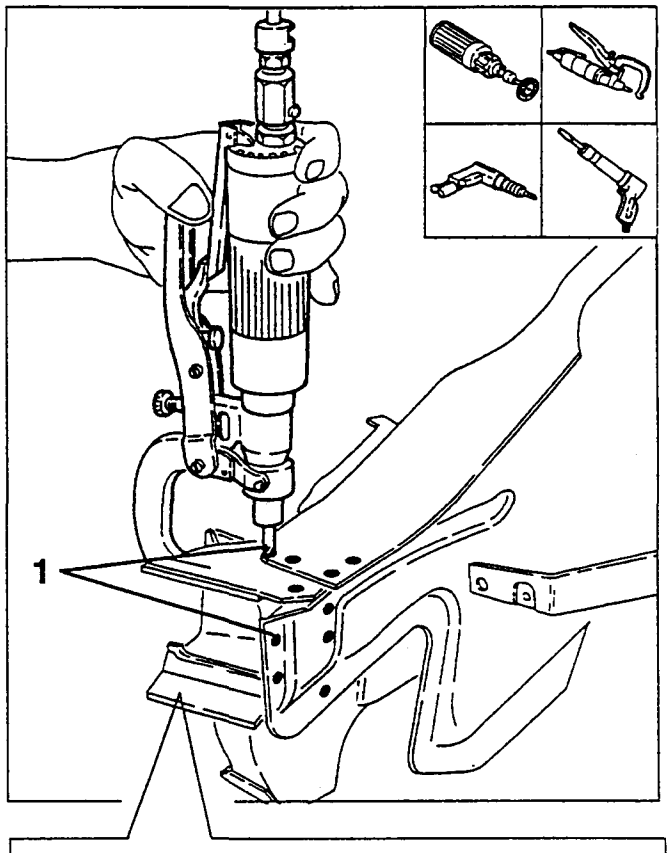
REMOVAL

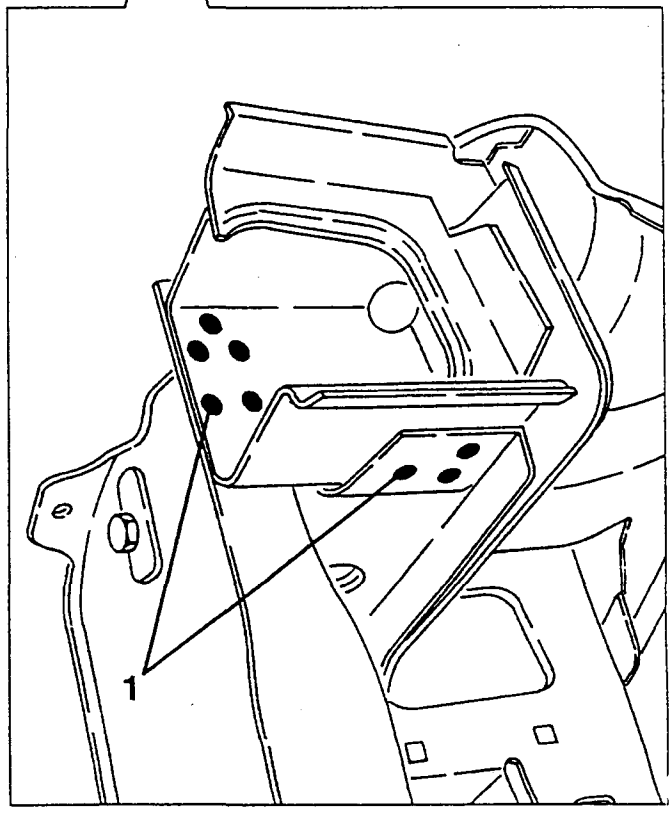


1. Using a jig saw, cut following the lines shown in the diagram and remove the front crossmember.



- Using a rotating brush, clean the areas to be spot-cut to show up the welding points.
1. Using a chamfering machine, remove the accessible welding points, remove the remaining welding points using a drill or a chisel.

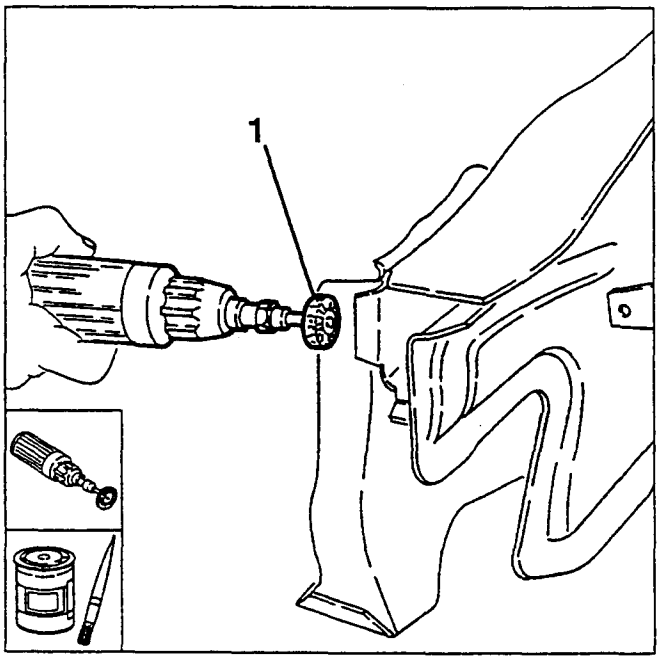




- Remove the side pieces from the front crossmember.

PREPARATION

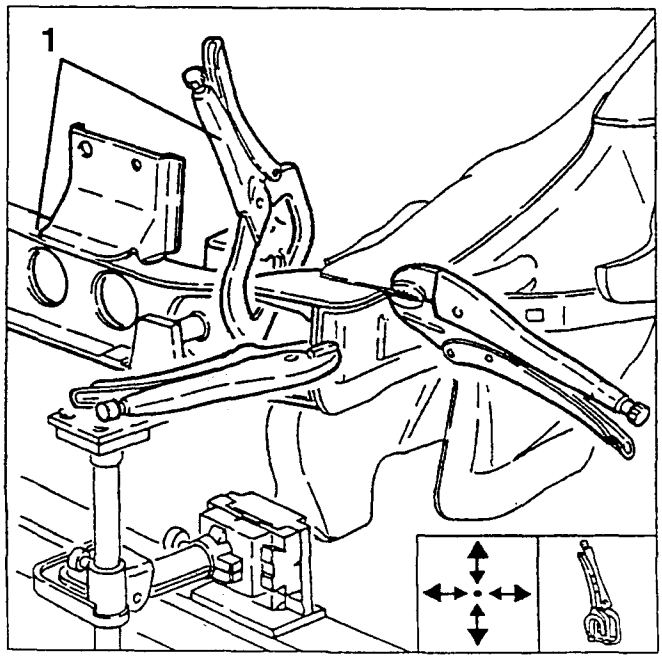
1. Using a rotating brush, clean the areas which are to be spot welded .
- Apply the specified electroweldable protection product to the areas to be welded.



POSITIONING

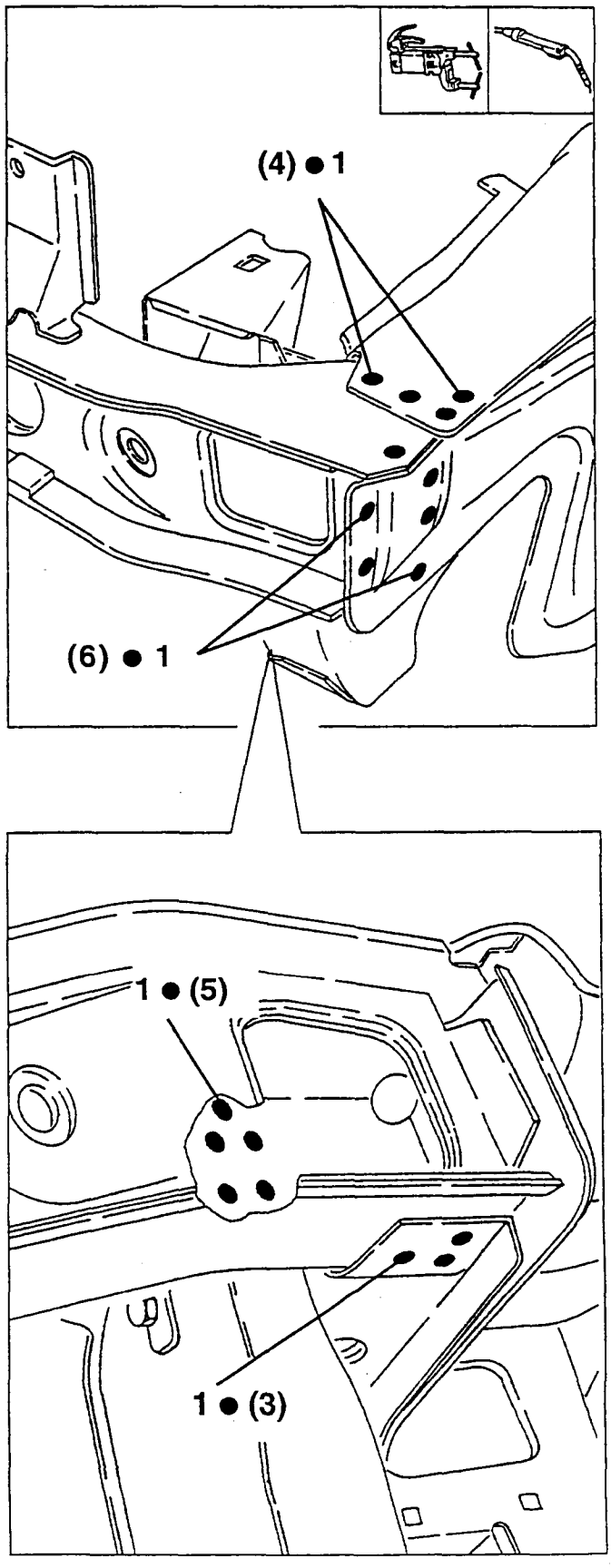
1. Position the new crossmember by mating the edges to be welded and securing them with clamps.

NOTE:
Use a jig if necessary.

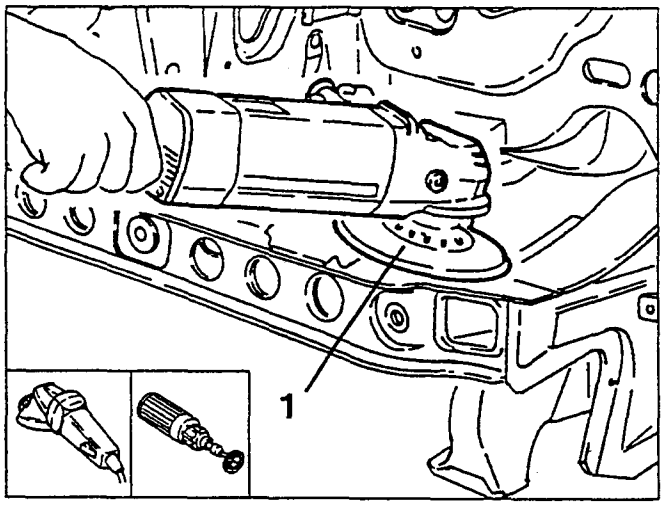


WELDING AND FINISHING OF THE SHEET METAL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.



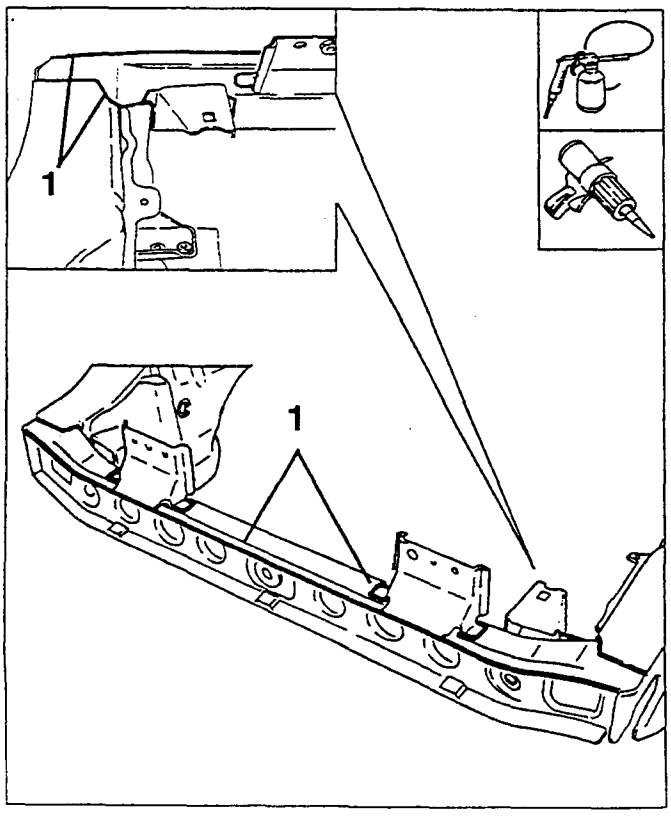
1. Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.



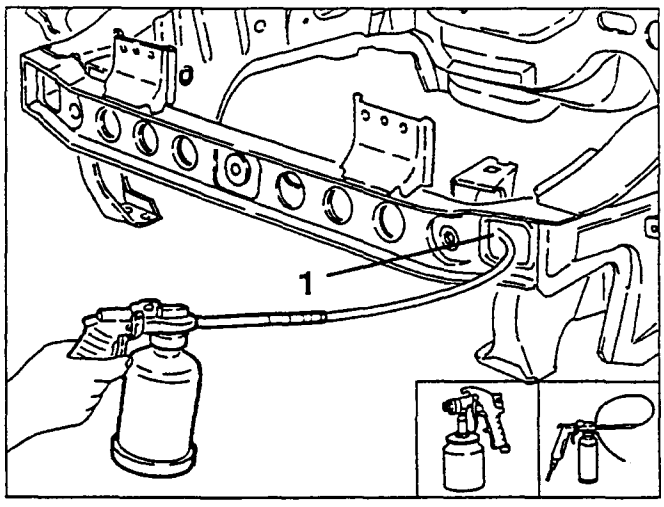
- Check that the components are correctly positioned after welding.

PROTECTION

- Apply the specified corrosion inhibitor to the areas which have been MIG welded.
1. Apply the specified sealant along the lines highlighted in the diagram.



- Proceed to the painting phase.
1. Wax-treat the boxed parts.



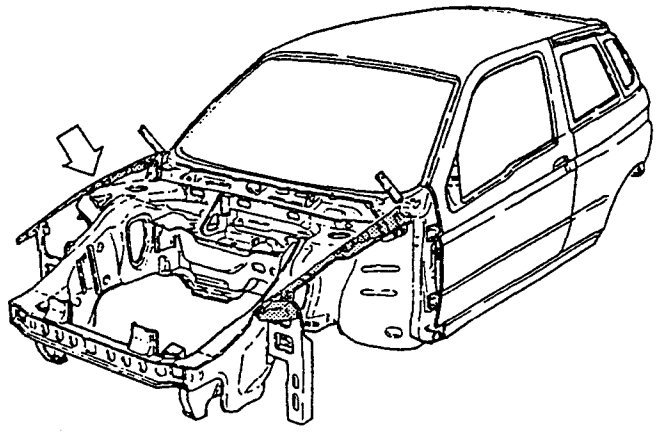
- Refit the components removed by reversing the procedure followed for removal.

UPPER PANEL

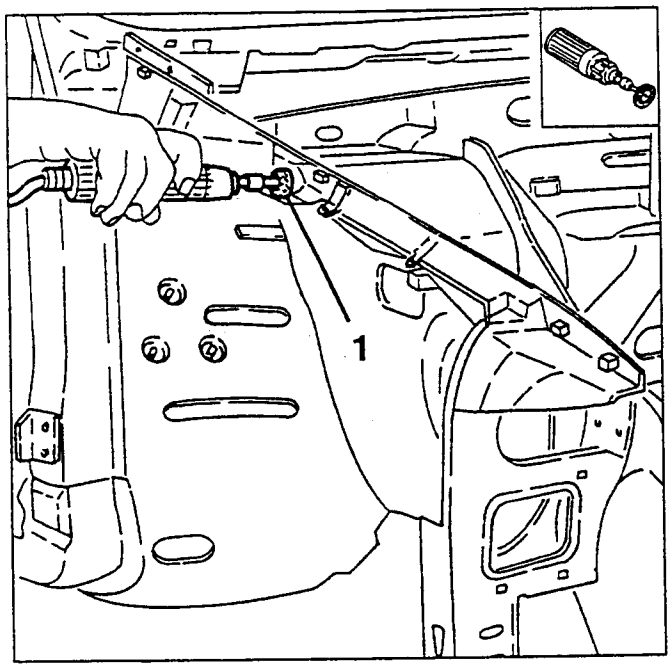
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• upper radiator crossmember (see specific paragraph).
• headlight housing frame on affected side (see specific paragraph).
• front wing on affected side (see specific paragraph).

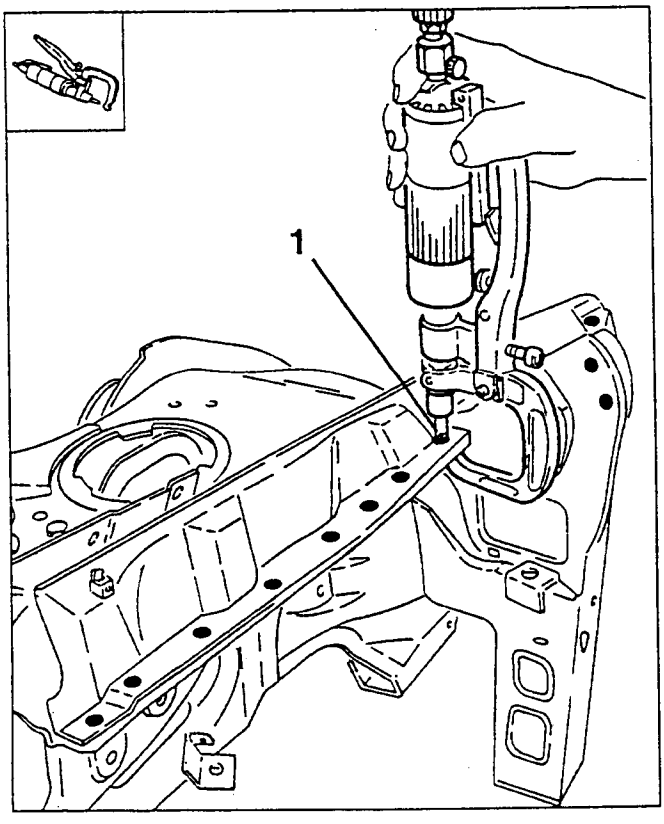
REMOVAL



1. Using a rotating brush, clean the areas to be spot-cut to show up the welding points.



1. Using a chamfering machine, remove the welding points.

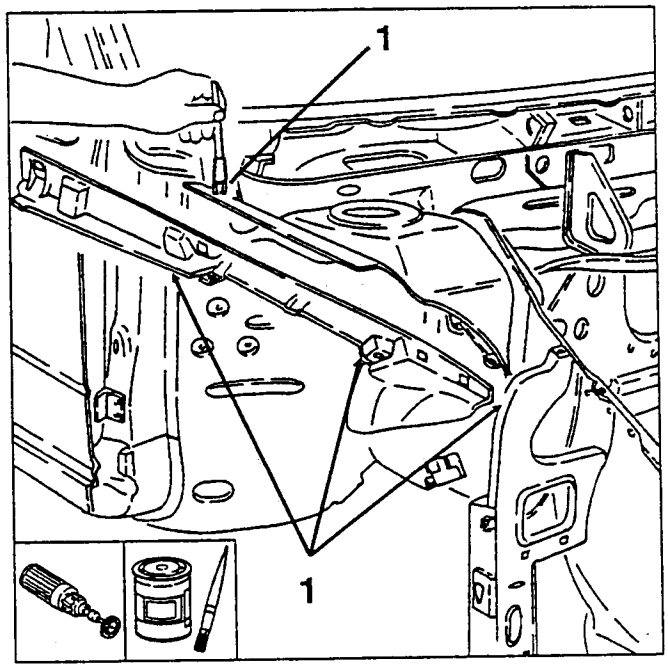


- Remove the upper panel and if necessary cut away the sealant.

PREPARATION

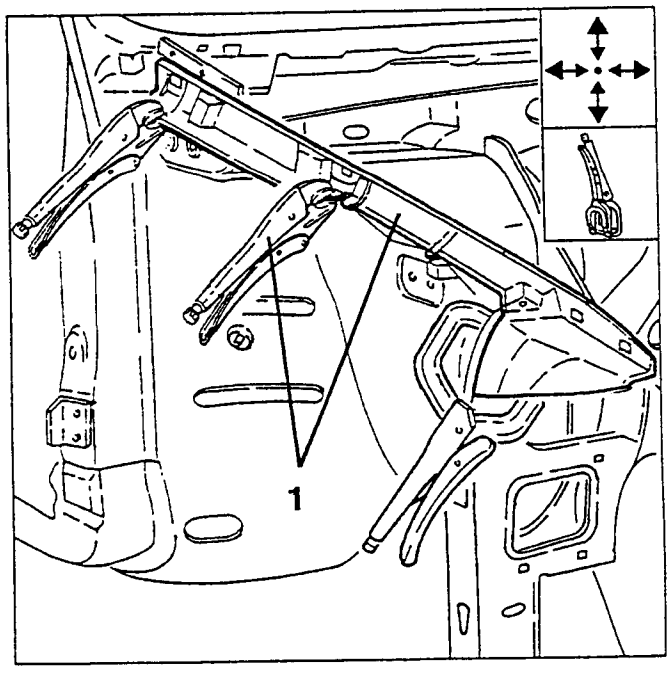
- Using a rotating brush, clean the areas which are to be welded .

1. Apply the specified electroweldable protection product to the areas to be spot-welded.



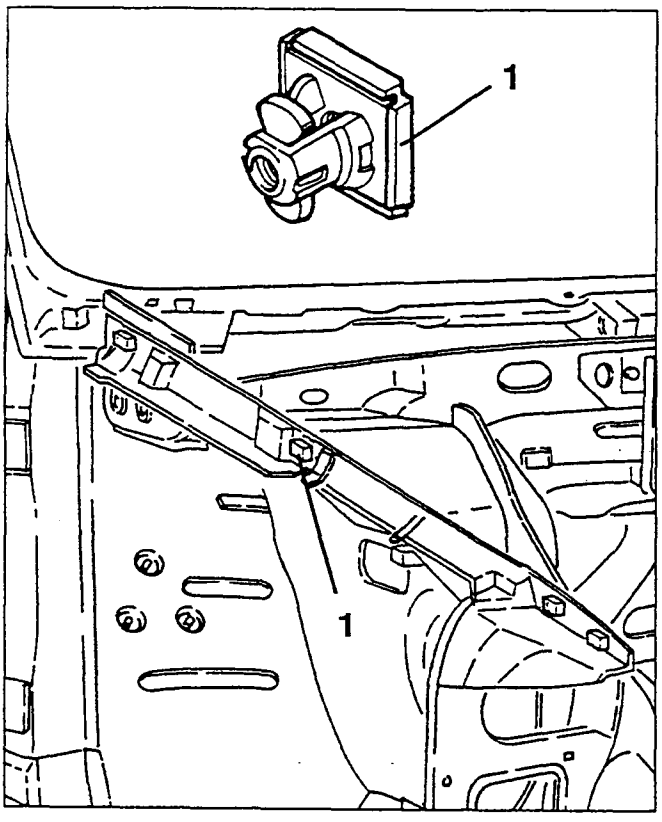
POSITIONING AND INSPECTION

1. Position the new upper panel joining together the edges to be welded and securing them with clamps.

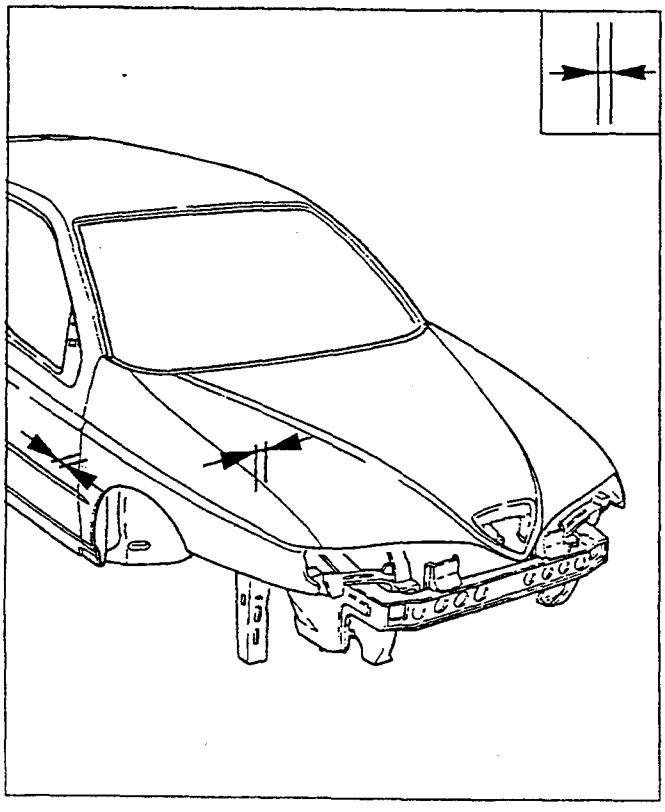


- Using screws temporarily fix the upper panel to the body.

1. Install the four blocks securing the front wing.

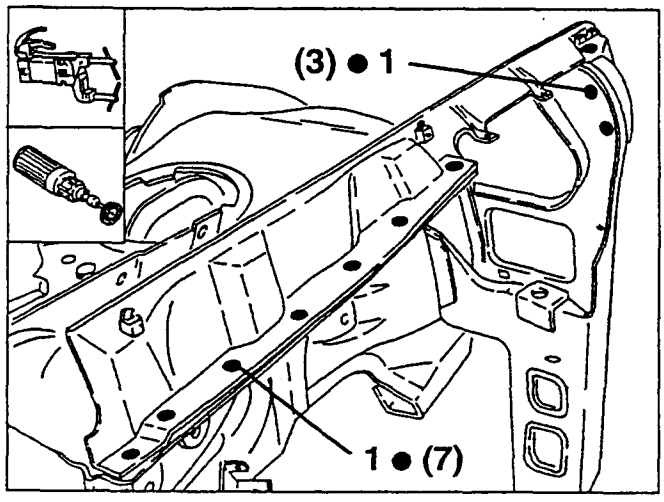


- Check parallelism, gaps and angles and refit the previously removed mobile components with their gaskets together with any parts which, once installed, make it possible to check the successful outcome of the operations.



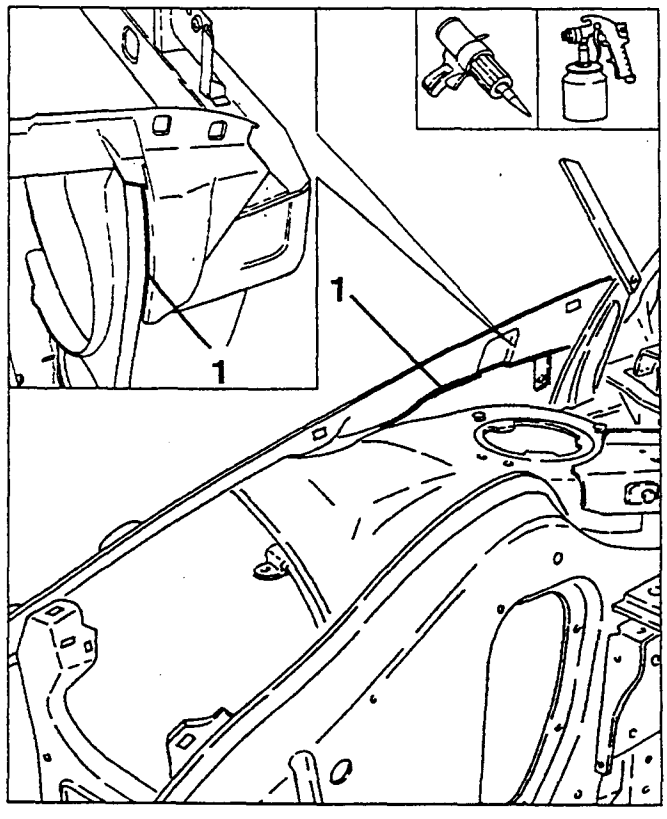
WELDING AND FINISHING OF THE SHEET METAL

1. Using a spot-welder, proceed as shown in the diagram.
- Using a rotating brush, clean the welded areas.



PROTECTION

1. Apply the specified sealant along the lines highlighted in the diagram.
- Proceed to the painting phase.



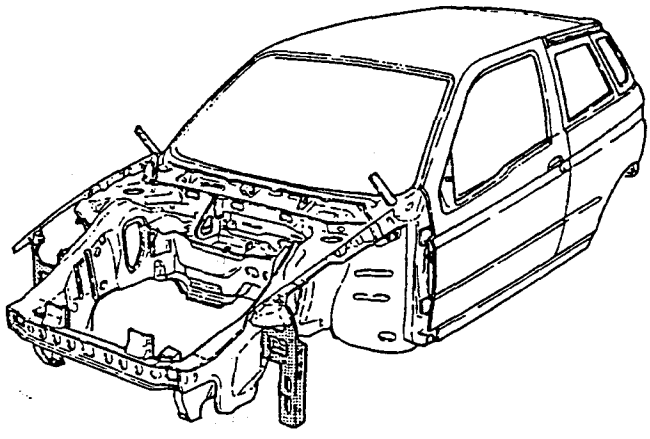
- Complete the refitting operation by reversing the procedure followed for removal and ensure that the gaps between the wing and the bonnet and the wing and the door are correctly adjusted.

SIDE PANEL

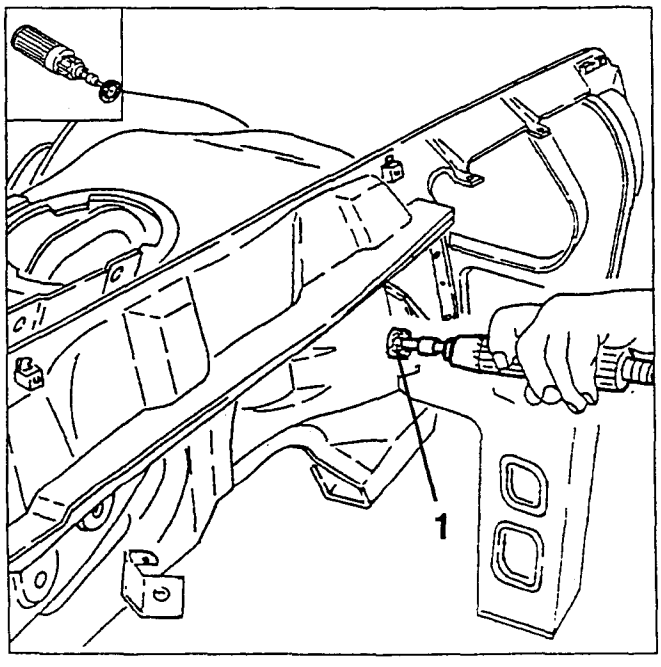
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• upper radiator crossmember (see specific paragraph).
• headlight housing frame on affected side (see specific paragraph).
• front wing on affected side (see specific paragraph).

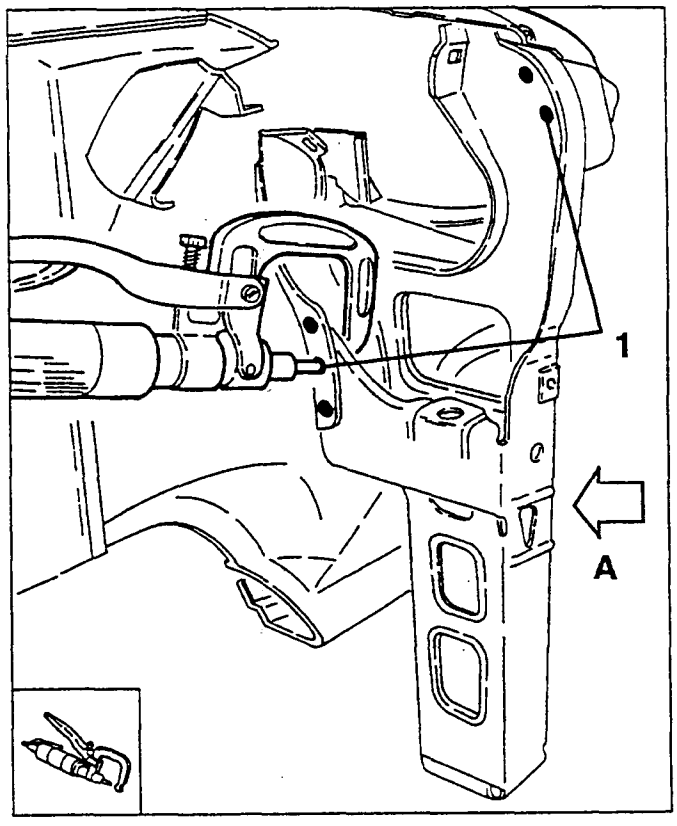
REMOVAL

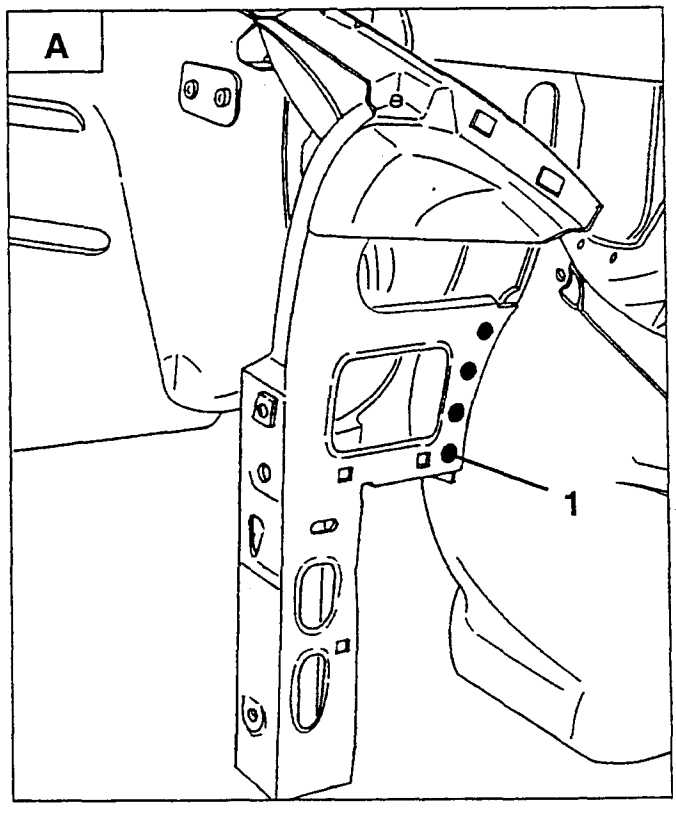


1. Using a rotating brush, clean the areas to be spot-cut to show up the welding points.



1. Using a chamfering machine, remove the welding points.

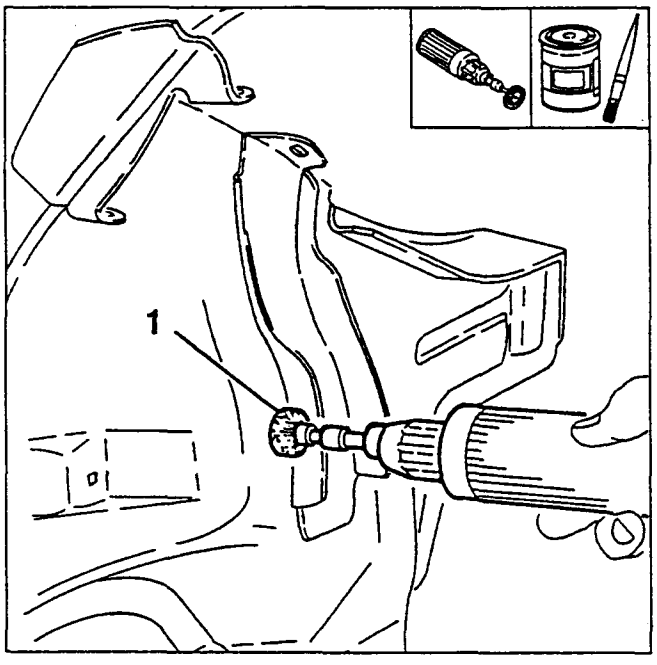




- Remove the side panel and where necessary cut away the sealant.

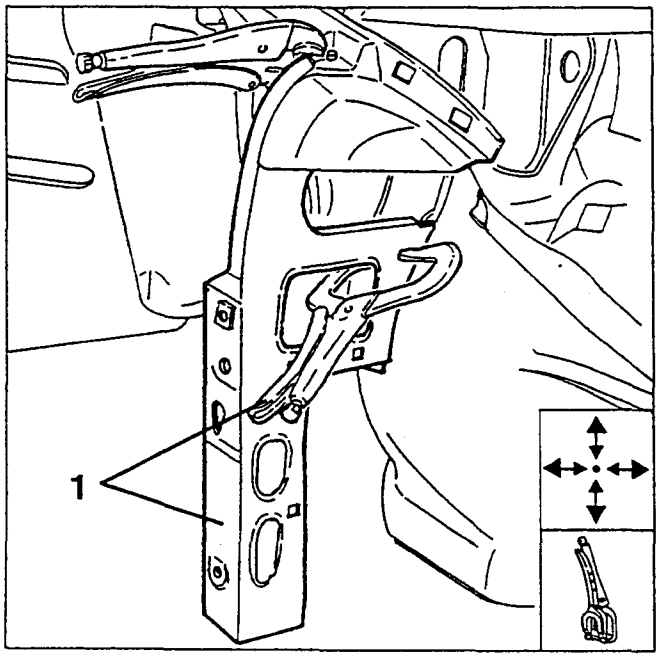
PREPARATION

1. Using a rotating brush, clean the areas which are to be welded .
- Apply the specified electroweldable protection product to the areas to be spot-welded.

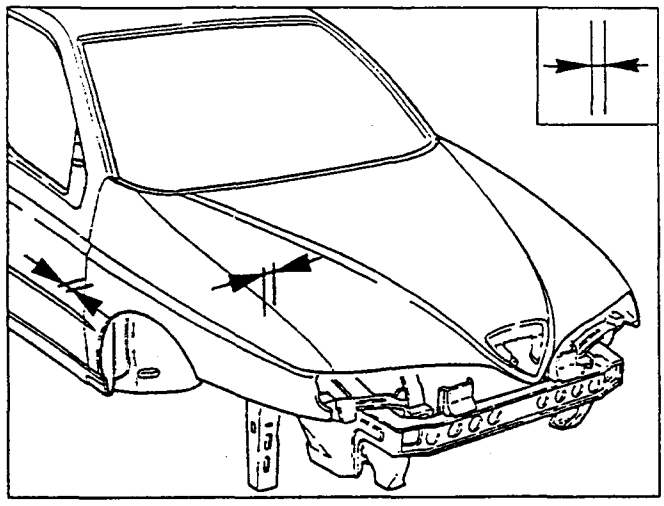


POSITIONING AND INSPECTION

1. Position the new side panel joining together the edges to be welded and secure it with clamps.

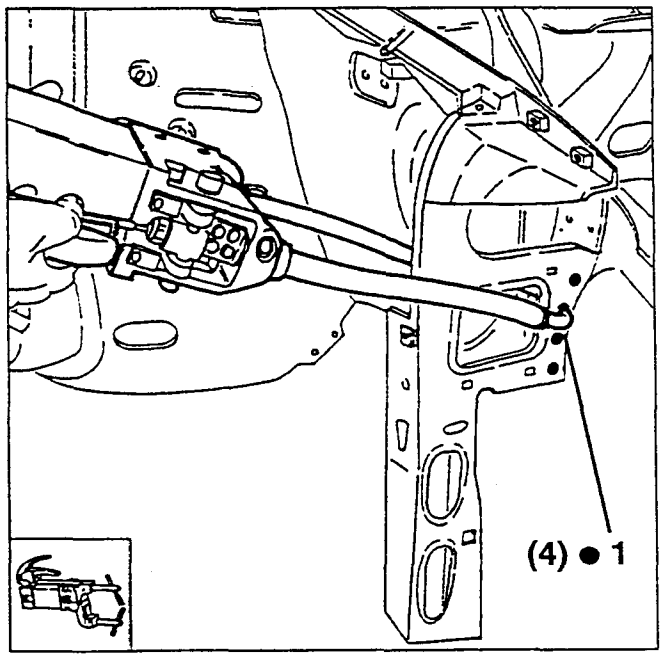


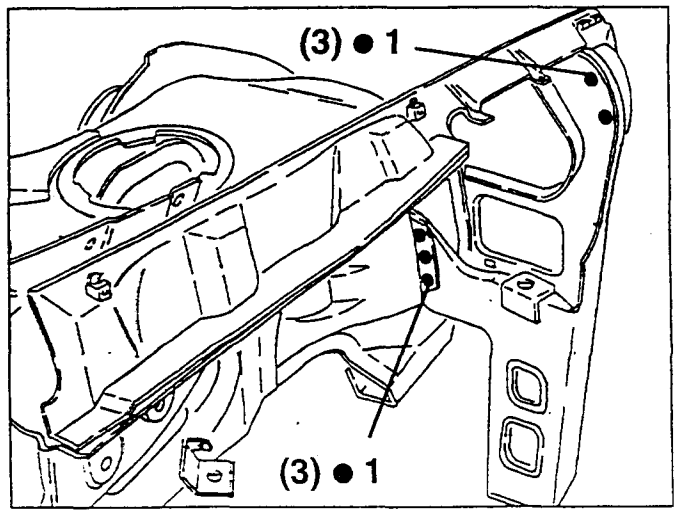
- Check parallelism, gaps and angles and refit the previously removed mobile components with their gaskets together with any parts which, once installed, make it possible to check the successful outcome of the operations.



WELDING AND FINISHING OF THE SHEET METAL

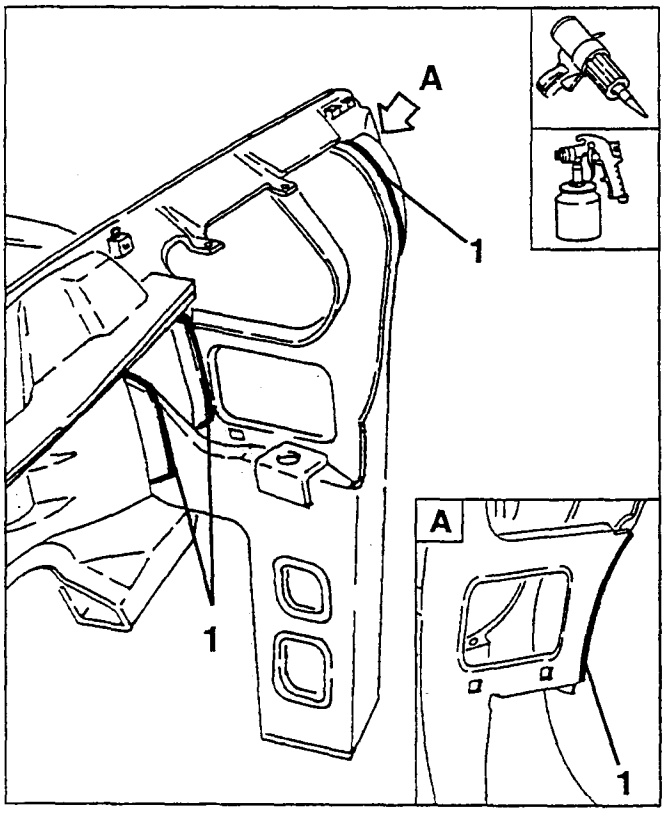
1. Using a spot-welder, proceed as shown in the diagram.





PROTECTION

1. Apply the specified sealant along the lines highlighted in the diagram.
- Proceed to the painting phase.



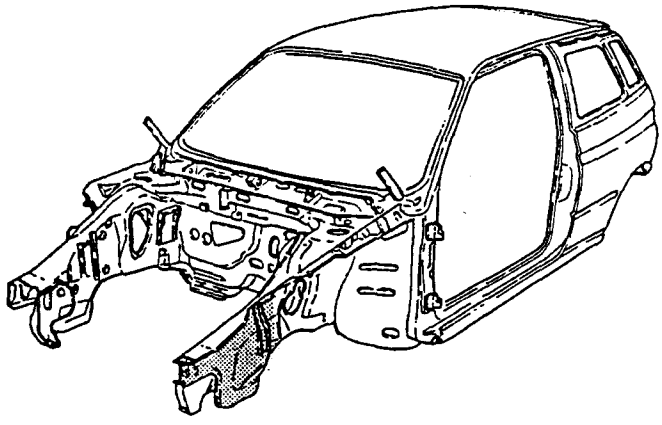
- Refit the components removed by reversing the procedure followed for removal.

FRONT SIDE PANEL - EXTERNAL PART (Boxer versions)

PRELIMINARY OPERATIONS

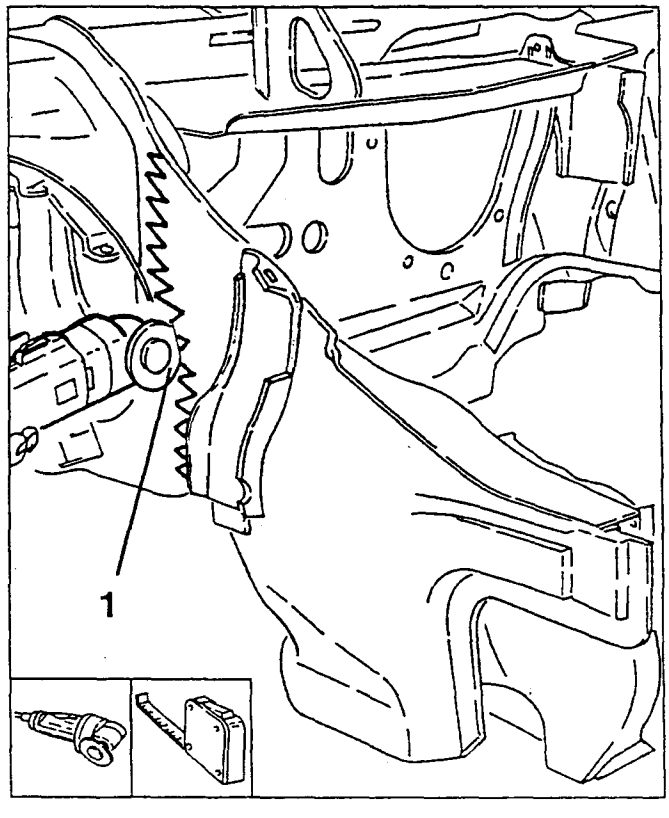
- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• upper radiator crossmember (see specific paragraph).
• headlight housing frame (see specific paragraph).
• front wing on affected side (see specific paragraph).
• front crossmember, if necessary (see specific paragraph).
• upper panel on affected side (see specific paragraph).
• side panel on affected side (see specific paragraph).

REMOVAL

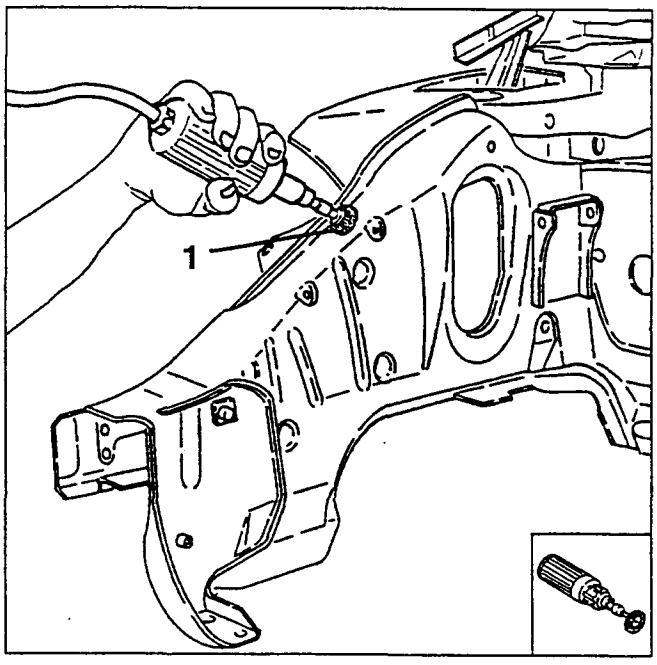


1. Using a circular saw, cut the external front side panel along the lines indicated in the diagram without damaging the underlying parts.

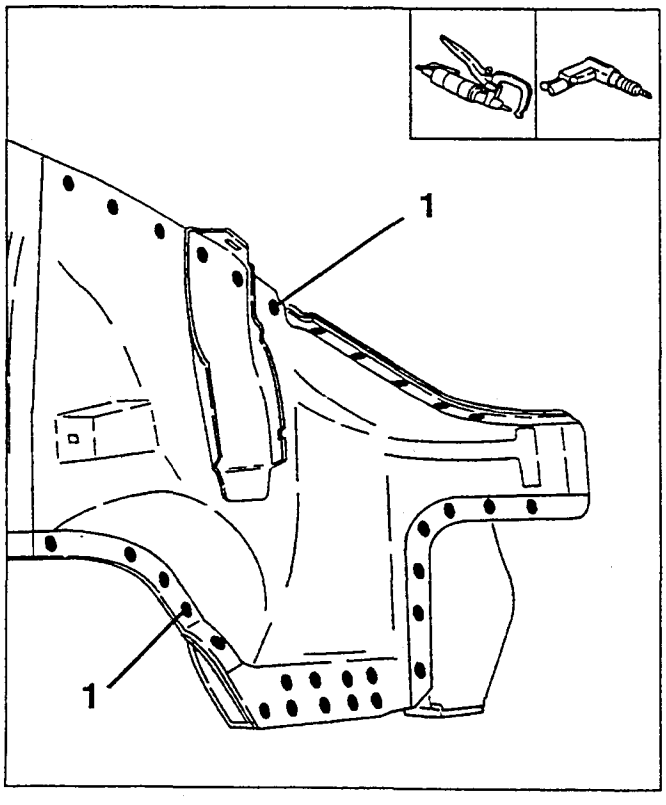
NOTE:
The cut on the side panel must be about 50 mm from the front suspension attachment pillar.



1. Using a rotating brush, clean the areas to be spot-cut to show up the welding points.



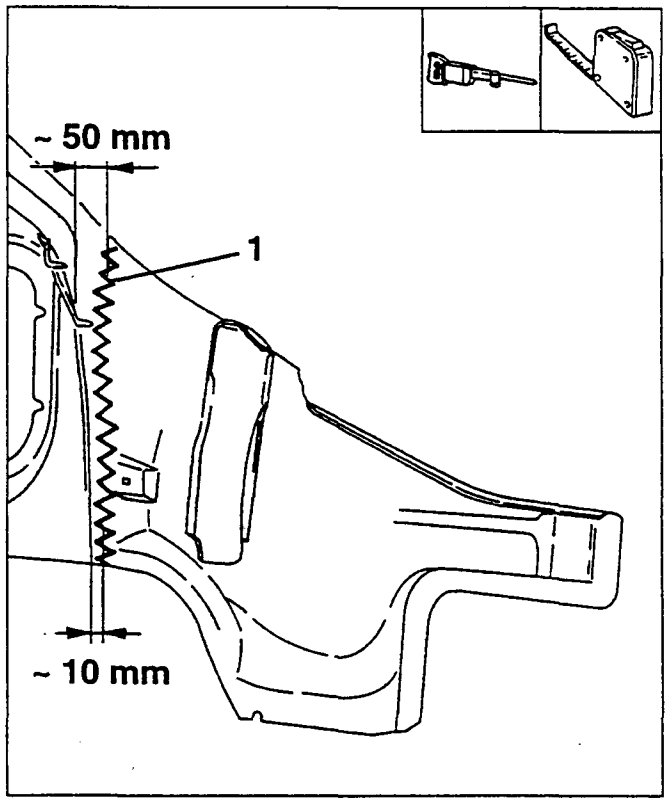
1. Using a chamfering machine, remove the accessible welding points; remove the remaining welding points using a drill.



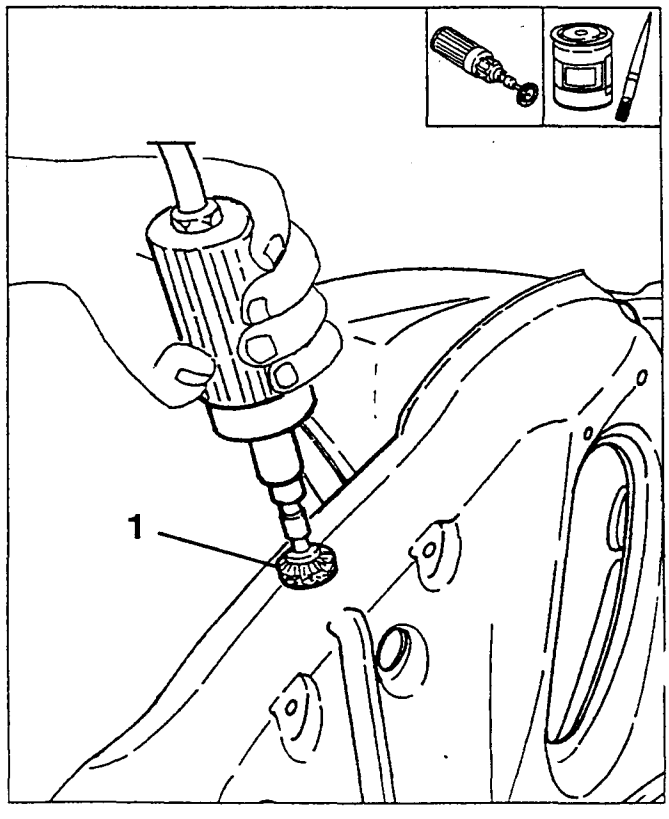
- Remove the partial front outer side panel, if necessary cutting away the sealant.

PREPARATION

1. Working on a bench and using a jig saw cut the new outer side panel to the dimensions indicated in the diagram in order to maintain the correct overlapping tolerances.

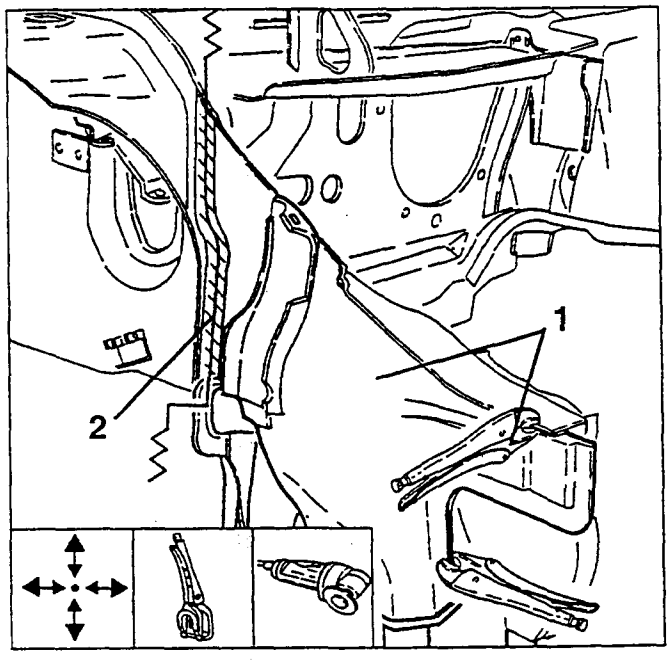


1. Using a rotating brush, clean the outer edge of the inner and outer side panels on both sides of the sheet metal.
- Apply the specified electroweldable protection product to the areas to be spot-welded.



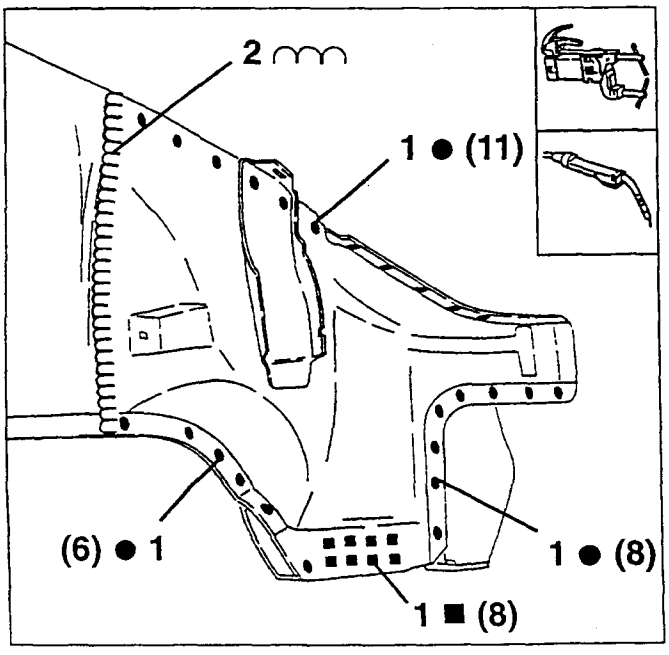
POSITIONING

1. Using a jig, position the outer side panel and overlap as shown. Fix the panel with clamps and join together the edges to be welded.
2. Using a circular saw, trim the sheet metal and remove the excess.

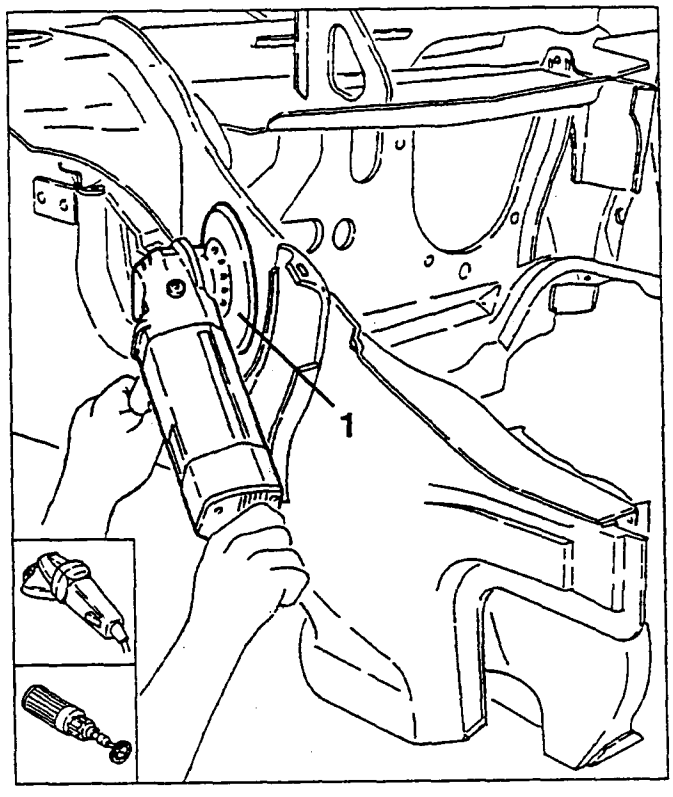


WELDING AND FINISHING OF THE SHEET METAL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, carry out seam welding.

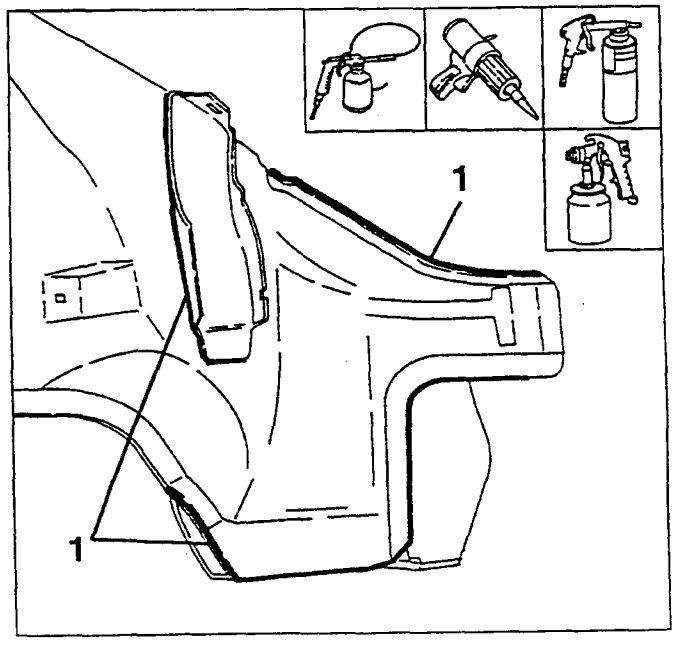


1. Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.

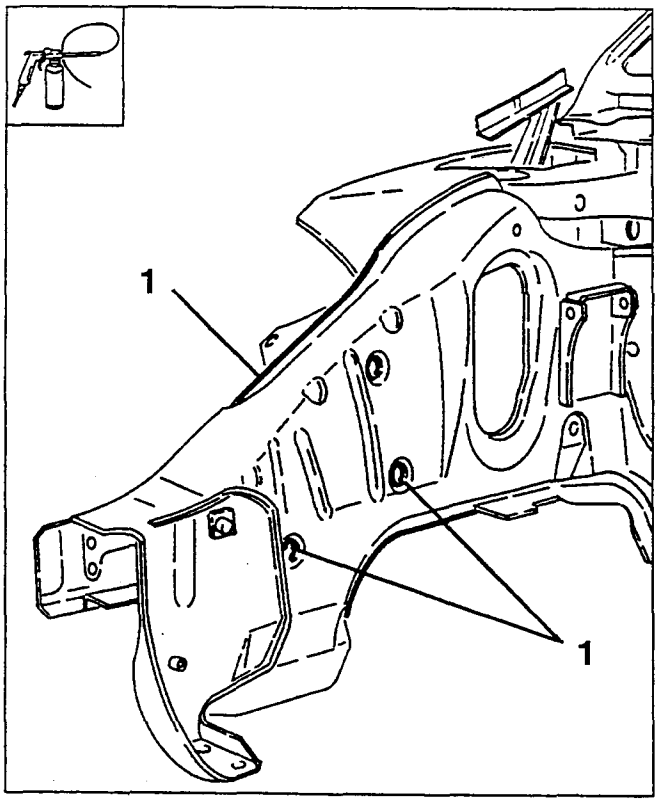


PROTECTION

- Apply the specified corrosion inhibitor to the areas which have been MIG welded.
1. Apply the specified sealant around the edges of the joints of the side panel.
- Apply the specified underbody protection to the replaced areas.
- Proceed to the painting phase.



1. Wax-treat the boxed parts through the holes shown in the diagram.



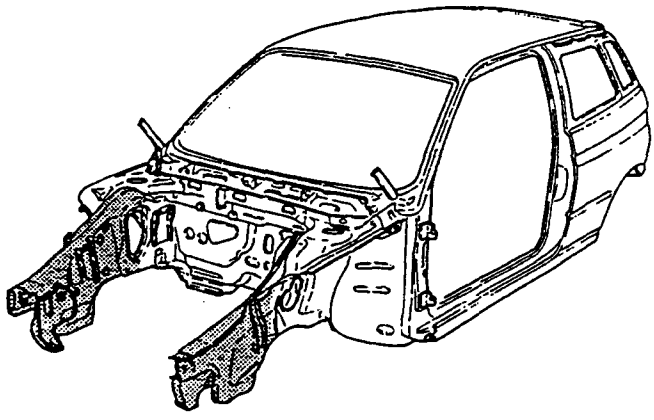
- Refit the components removed by reversing the procedure followed for removal.

FRONT SIDE PANEL - INTERNAL AND EXTERNAL PARTS (Boxer versions)

PRELIMINARY OPERATIONS

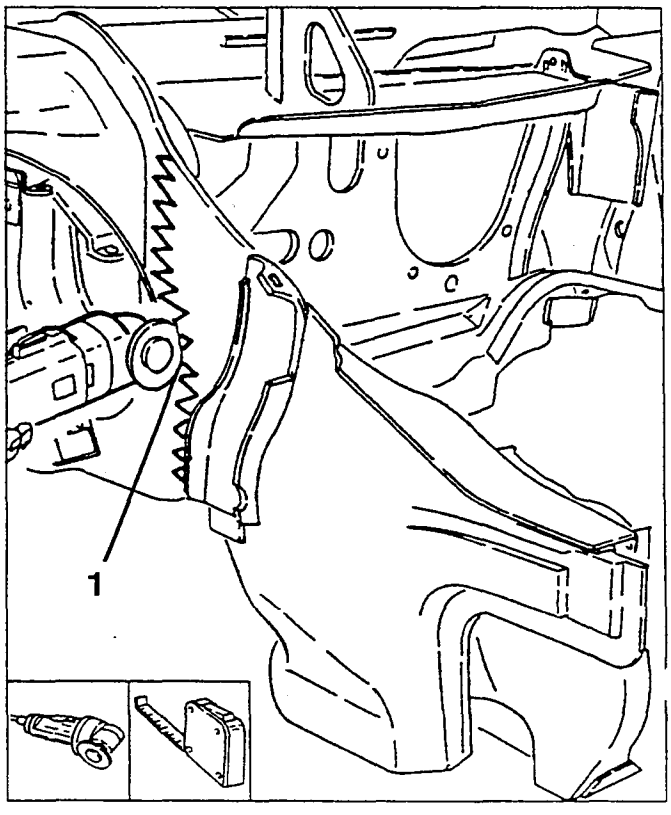
- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• upper radiator crossmember (see specific paragraph).
• headlight housing frame (see specific paragraph).
• front wing on affected side (see specific paragraph)
• front crossmember, if necessary (see specific paragraph).
• upper panel on affected side (see specific paragraph).
• side panel on affected side (see specific paragraph).
• battery support crossmember (see specific paragraph).

REMOVAL

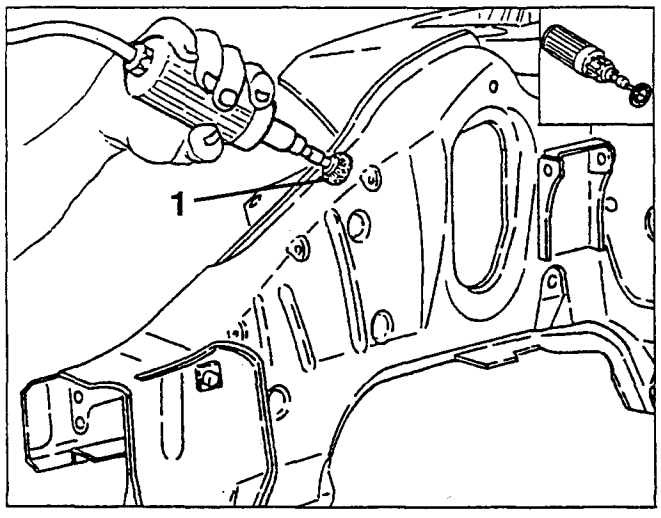


1. Using a circular saw, cut the outer front side panel along the lines shown in the diagram.

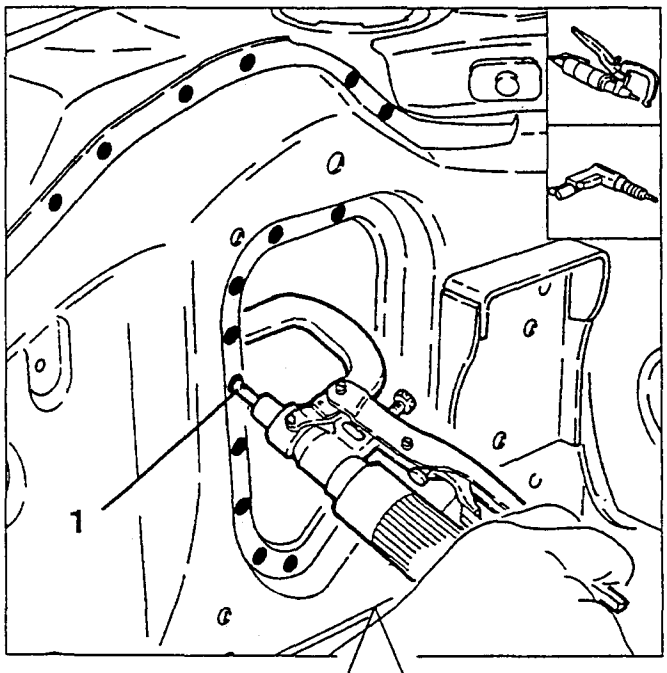
NOTE:
The cut on the side panel must be approx. 50mm fron the front suspension attachment pillar.

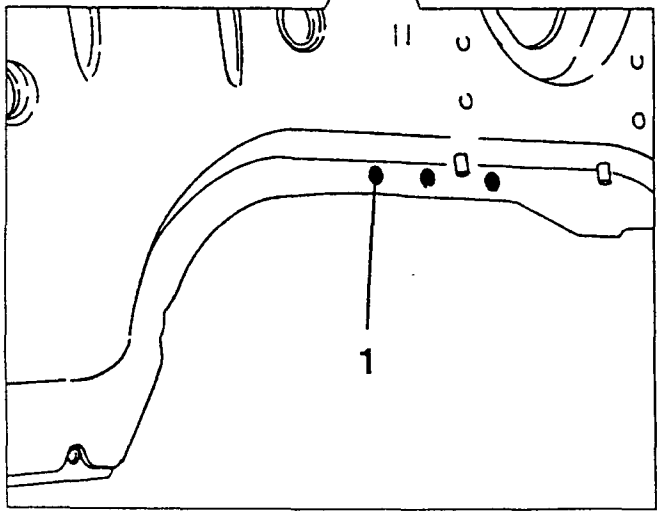


1. Using a rotating brush, clean the areas to be spot-cut to show up the welding points.

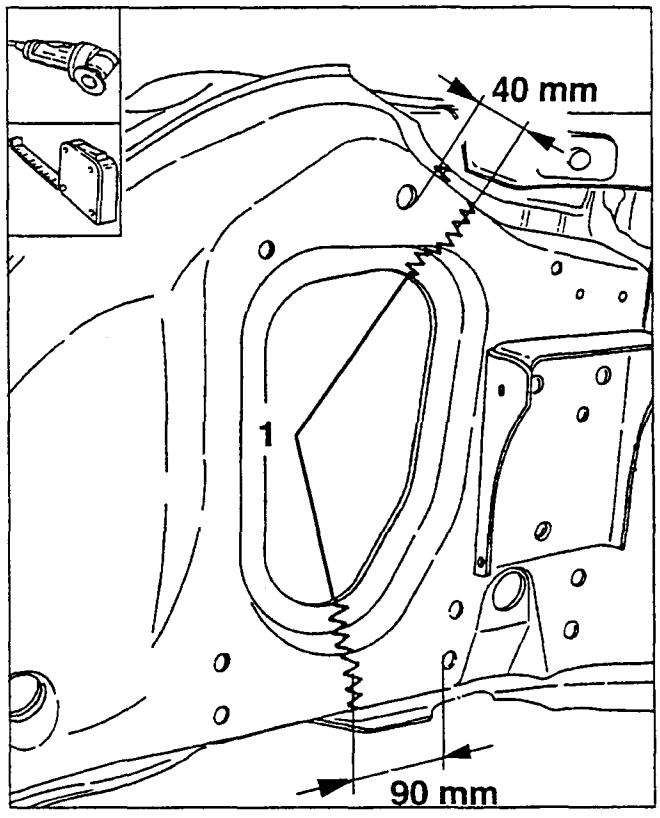


1. Using a chamfering machine, remove the accessible welding points; remove the remaining points using a drill.





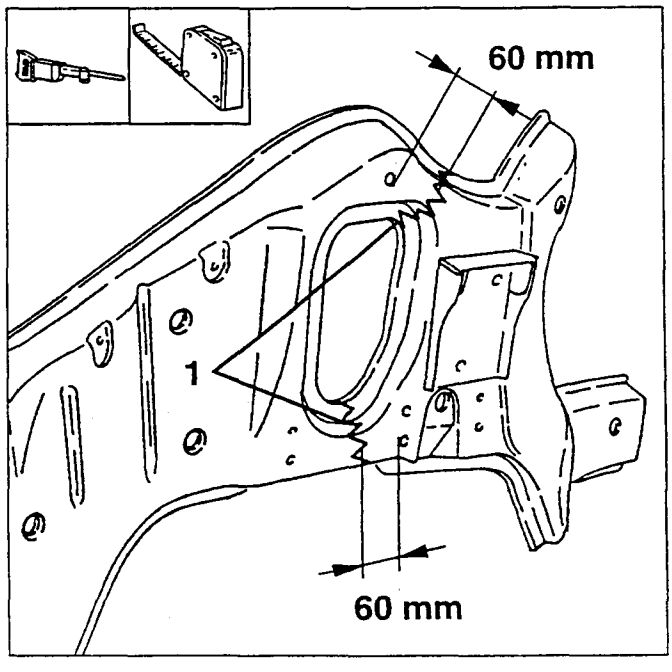
1. Using a circular saw, cut the inner part of the side panel to the dimensions indicated following the lines shown in the diagram taking care not to damage the external part of the side panel.



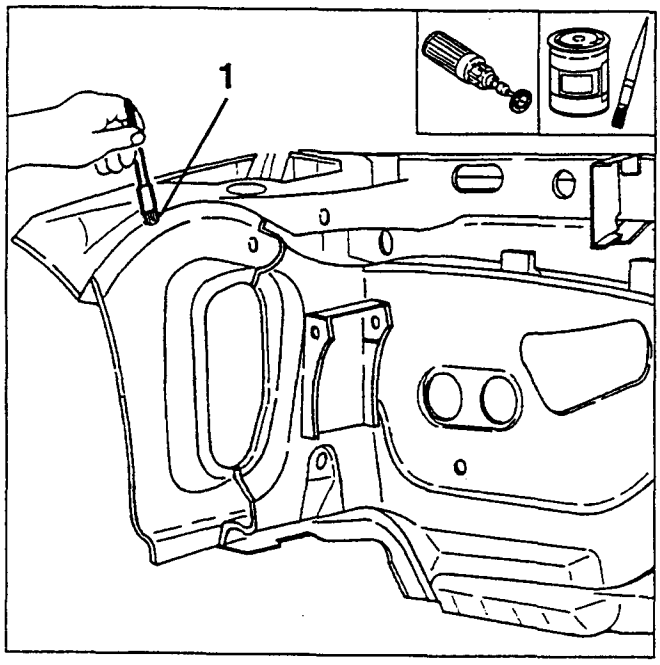
- If necessary cut away the sealant to remove the front partial side panel (internal and external).

PREPARATION

1. Working on a bench using a jig saw, cut the new inner side panel to the dimensions given in the diagram to maintain the correct overlapping tolerances.

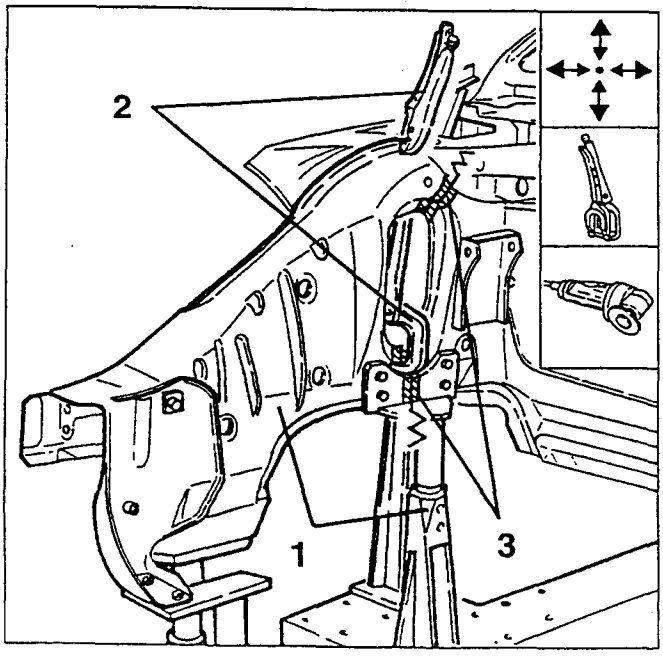


- Using a rotating brush, clean the areas which are to be welded and remove the foam treatment product from the area to be cut along approximately 30 mm to prevent burning during welding.
1. Apply the specified electroweldable protection product to the areas to be spot-welded.



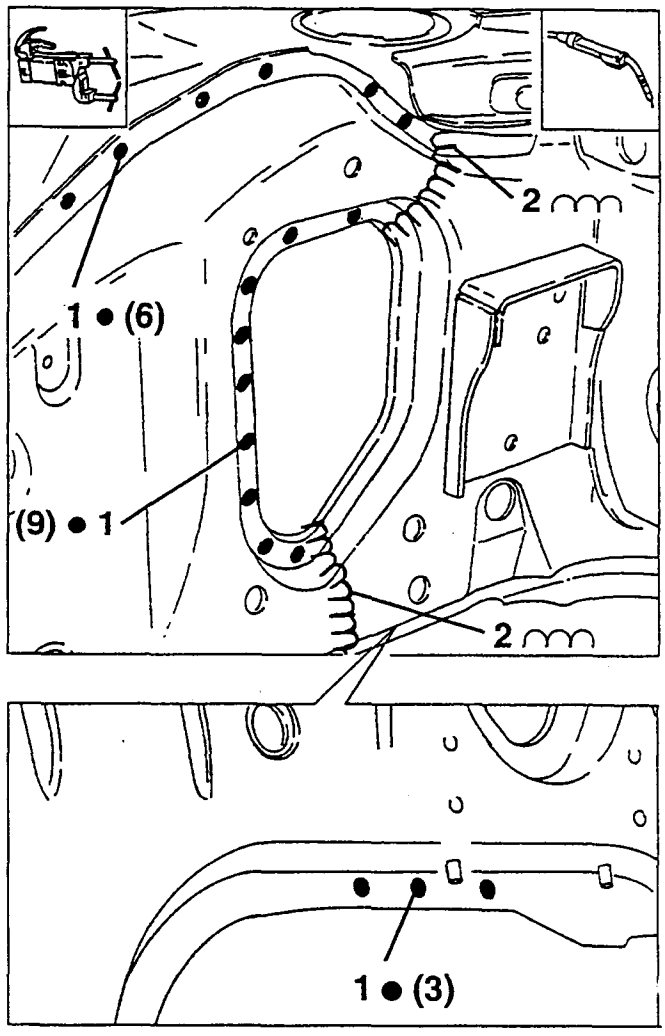
POSITIONING

1. Using a jig, correctly position the front inner partial side panel.
2. Overlap and secure the components to be welded in position using clamps, join together the edges and check alignment.
3. Using a circular saw, trim the sheet metal to eliminate the excess parts.

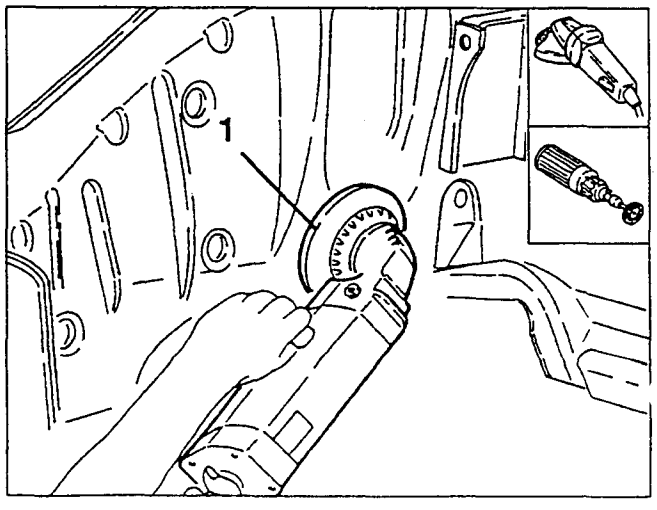


WELDING AND FINISHING THE SHEET METAL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, weld to seams.



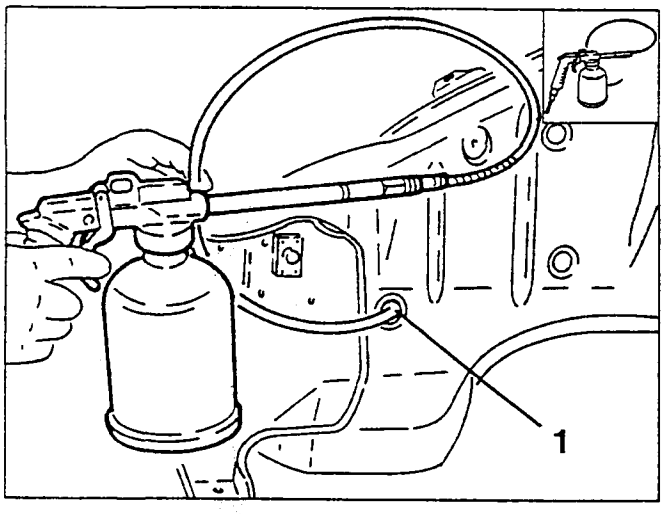
1. Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.



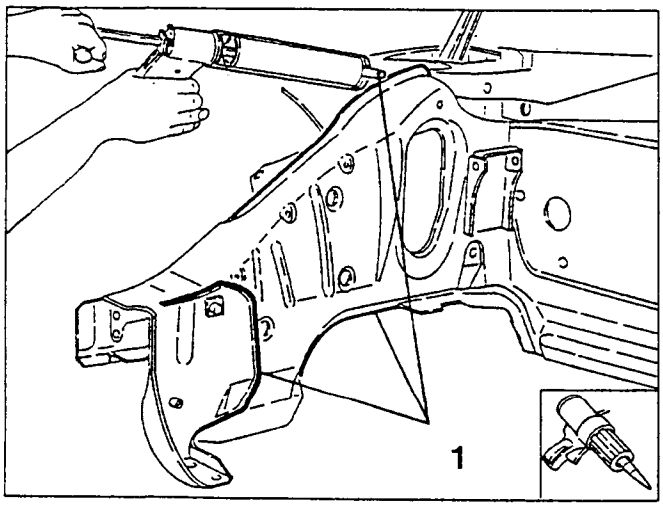
- Refit the partial outer side panel (see specific paragraph).

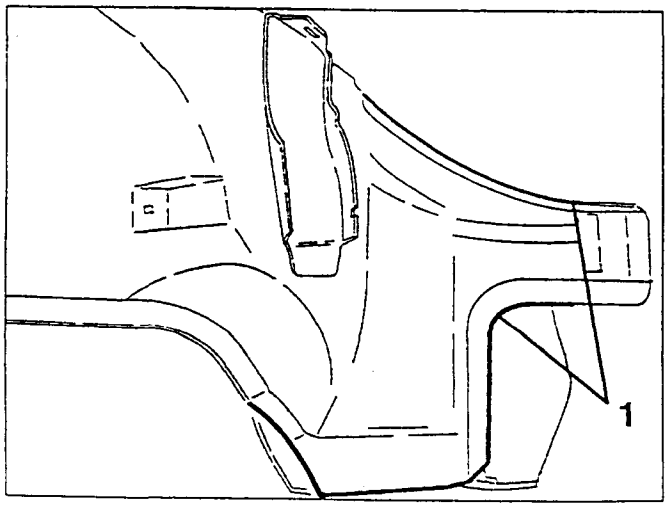
PROTECTION

1. Apply the specified corrosion inhibitor to the areas which have been MIG welded.

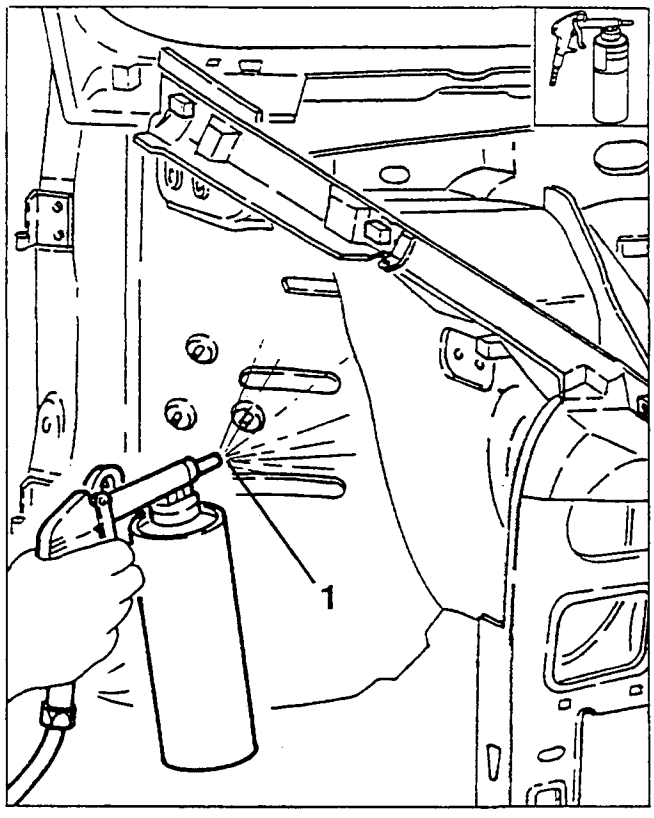


1. Apply the specified sealant around the edges of the panel.

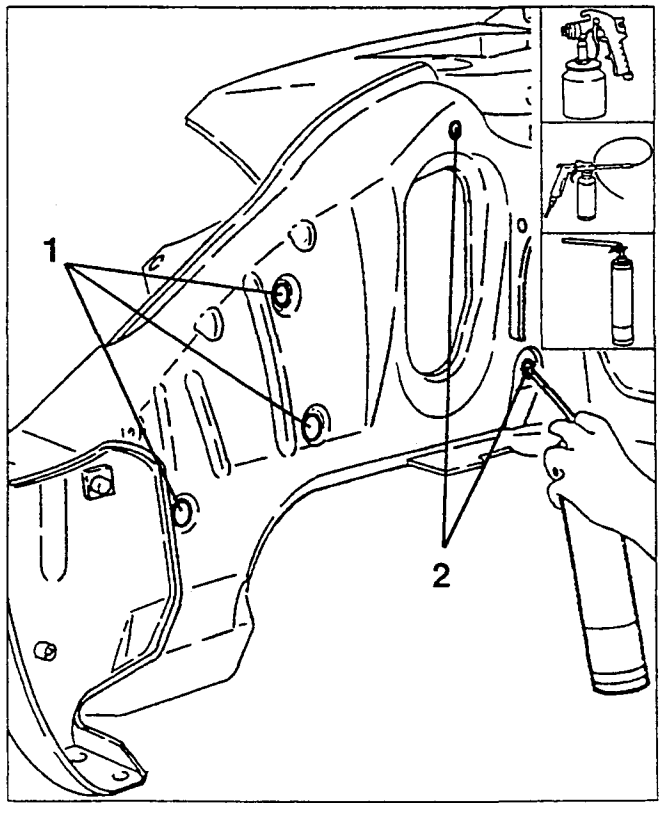




1. Apply the specified underbody protection to the replaced areas.



- Proceed to the painting phase.
1. Wax-treat the boxed parts through the holes shown in the diagram.
2. Foam-treat the boxed parts through the holes shown in the diagram.

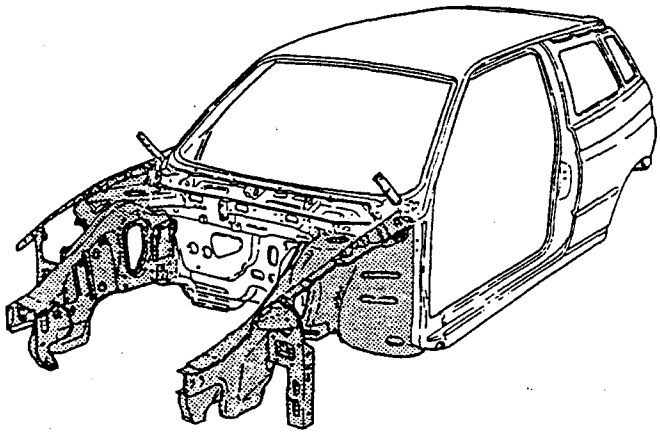


COMPLETE FRONT SIDE PANEL WITH FRONT PILLAR REMOVED (Boxer versions)

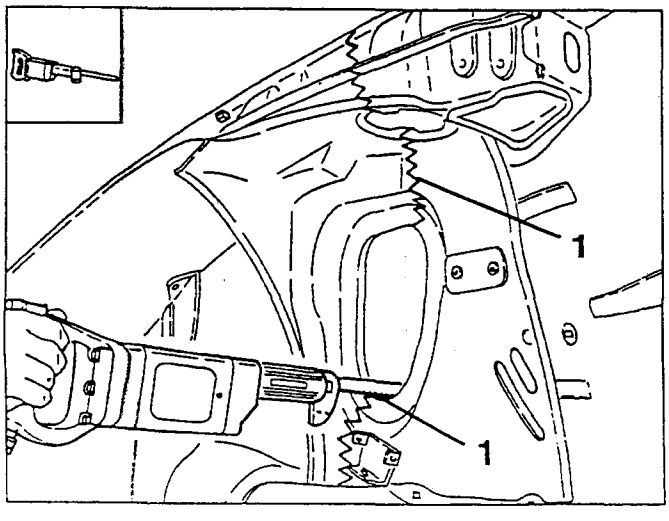
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• upper radiator crossmember (see specific paragraph).
• headlight housing frame (see specific paragraph).
• front crossmember (see specific paragraph).
• battery support crossmember (see specific paragraph).
• front bonnet hinge on affected side (see specific paragraph).
• dashboard support crossmember (see specific paragraph).

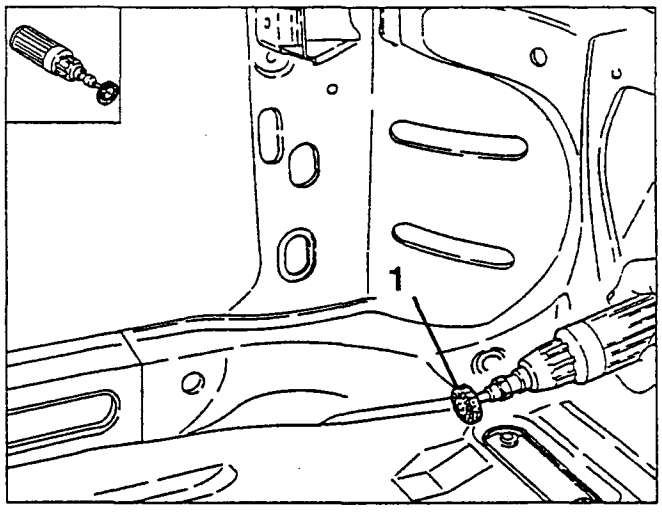
REMOVAL



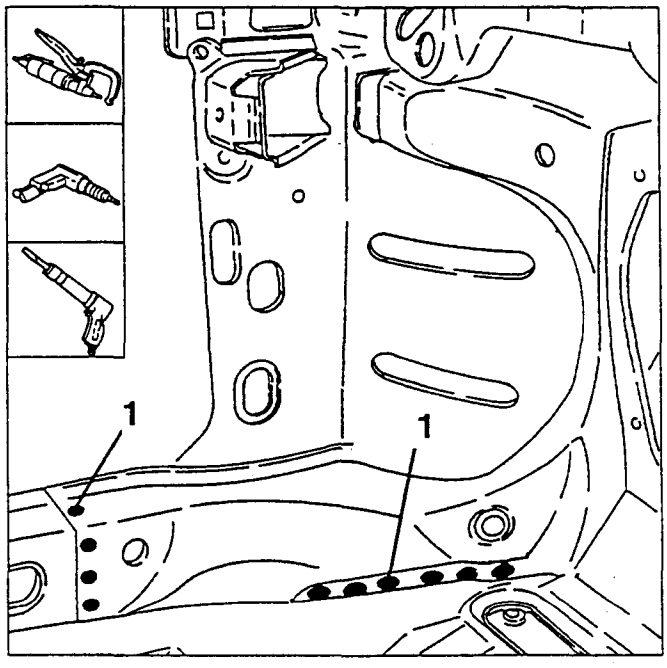
1. Using a jig saw, cut away the side panel as shown in the diagram.

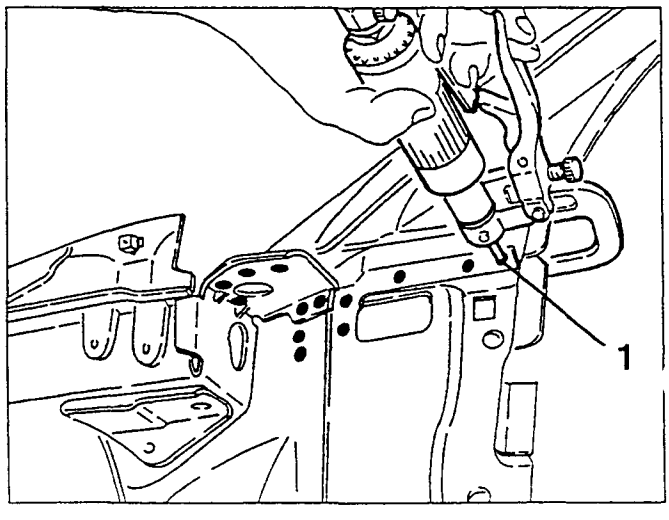


1. Using a rotating brush, clean the areas to be spot-cut to show up the welding points.

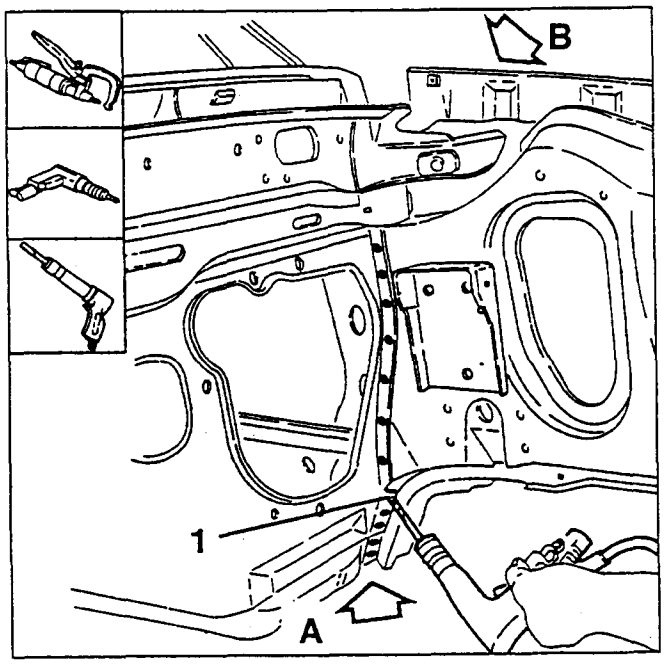


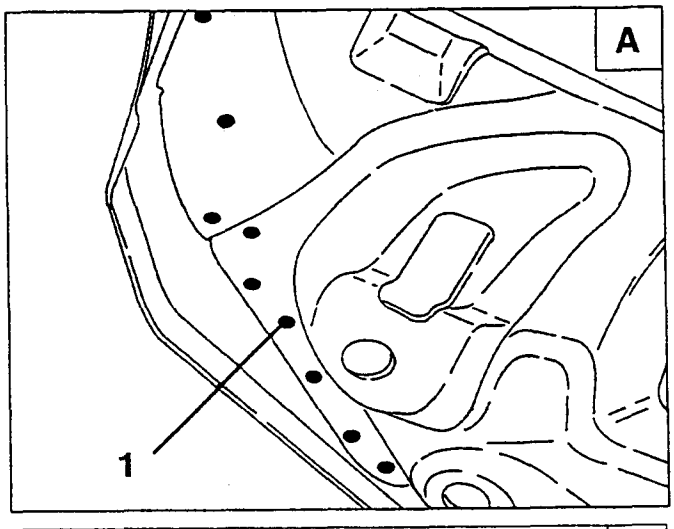
1. Using a chamfering machine, remove the accessible welding points; remove the remaining welding points using a drill or a chisel.

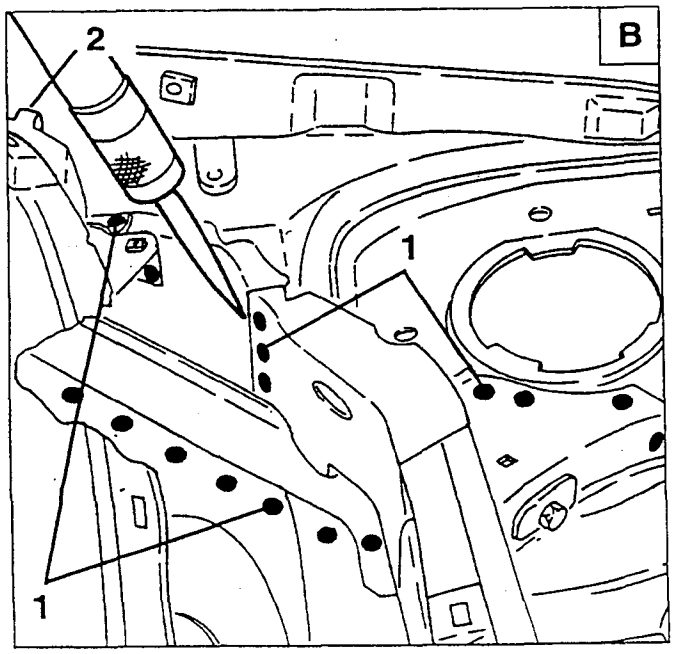




1. Using a chamfering machine remove the accessible welding points; remove the remaining welding points using a drill or a chisel.
2. Open the clinch tabs.



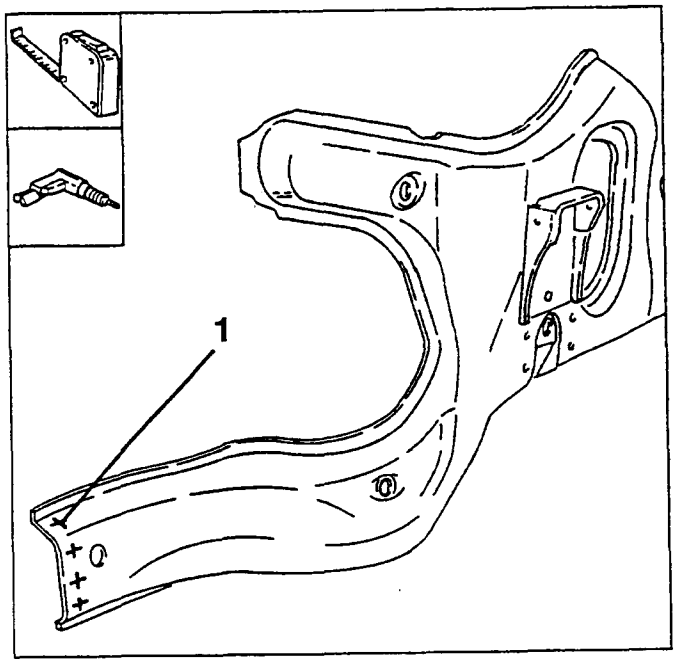




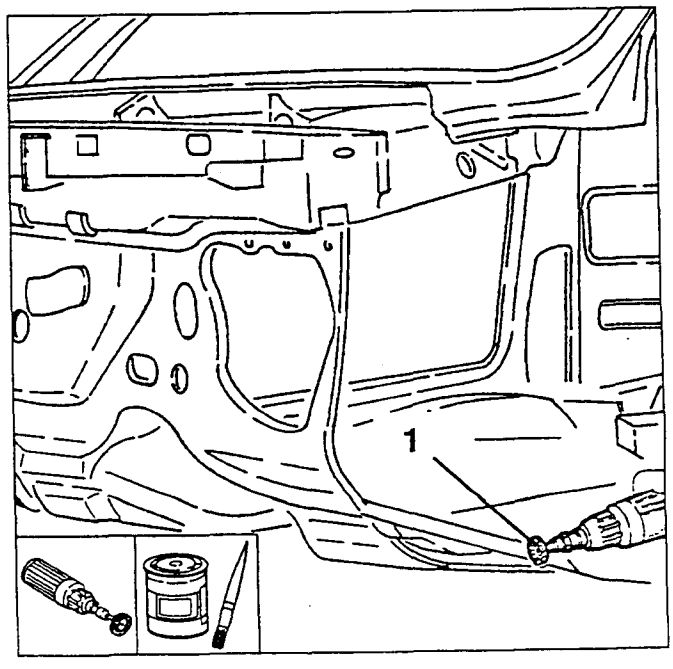
- Remove the complete front side panel cutting away the sealant if necessary.

PREPARATION OF THE INNER FRONT SIDE PANEL

1. Working on a bench, mark out and perforate the inner side panel with a 5 mm bit as shown in the diagram.

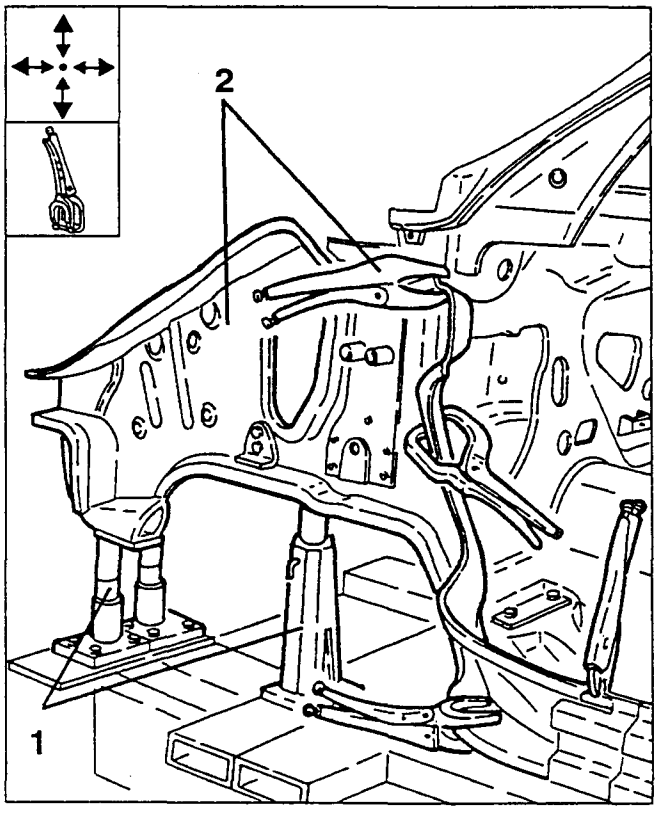


1. Using a rotating brush, clean the edge of the inner side panel and the areas to be welded.
- Apply the specified electroweldable protection product to the areas to be spot-welded.



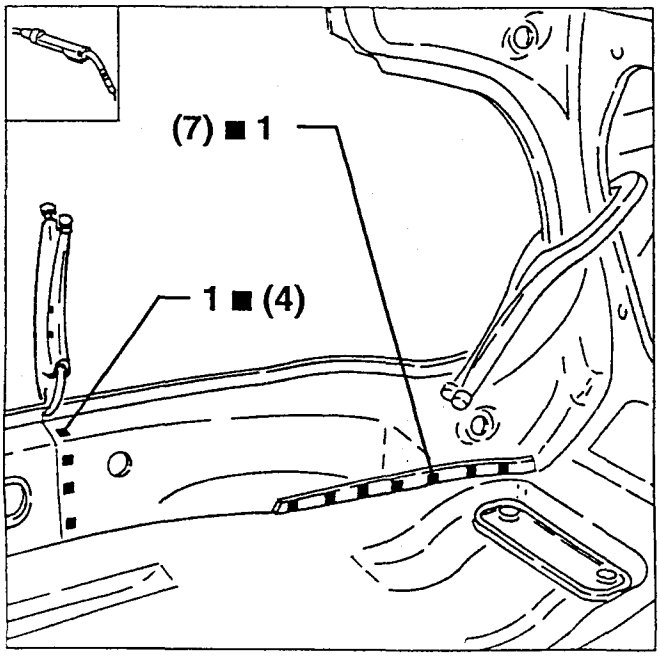
POSITIONING OF THE INNER FRONT SIDE PANEL

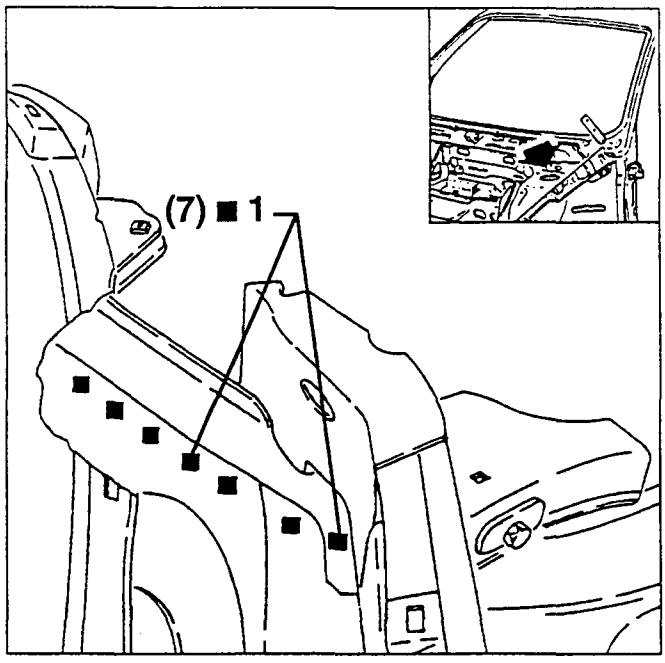
1. Using a jig, correctly position the inner side panel.
2. Lock the components to be welded into position using clamps, join together the edges and check alignment.



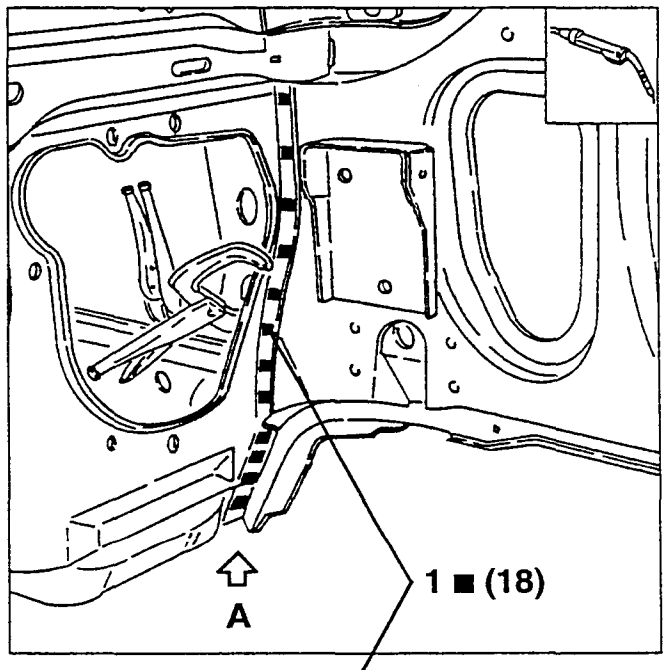
WELDING AND FINISHING OF THE INNER FRONT SIDE PANEL

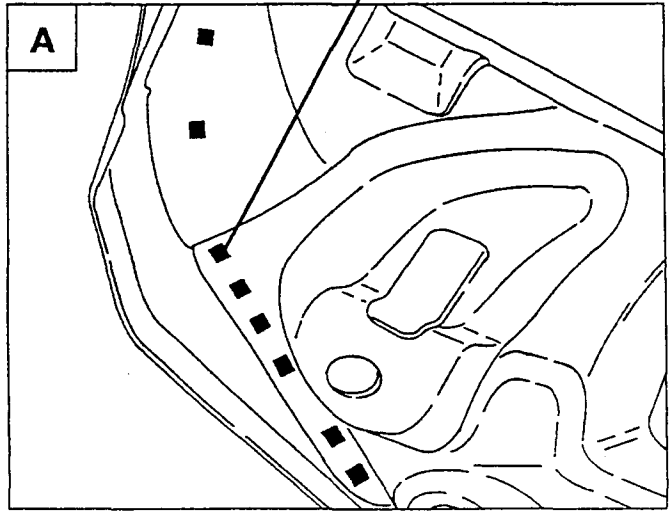
1.Using a MIG welder, proceed as shown in the diagram.



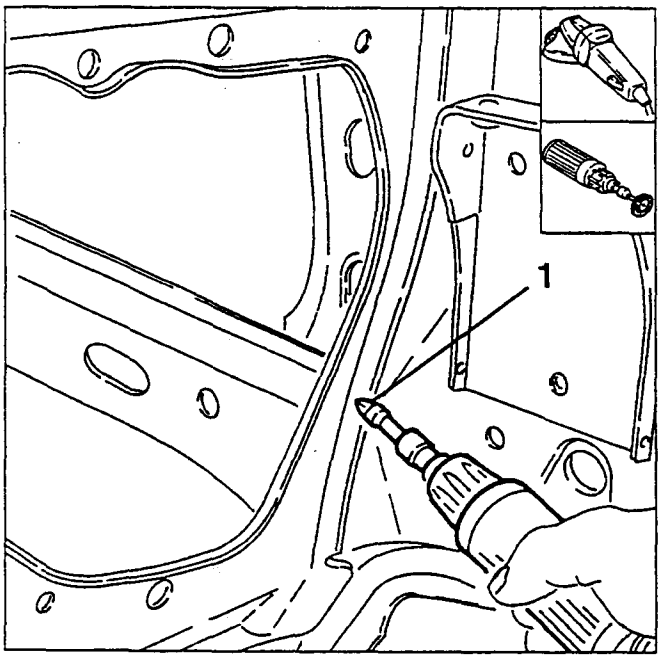


1. Using a MIG welder, proceed as shown in the diagram.



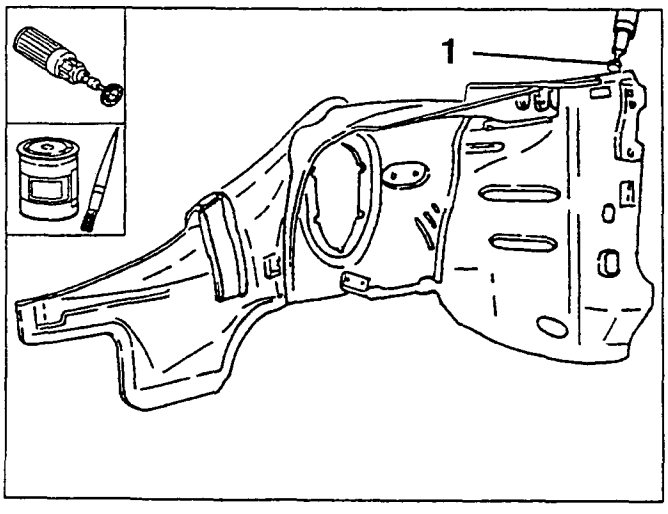


1. Using an abrasive grinding machine or a grinding machine with milling cutter on the which cannot be reached with the grind wheel, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.



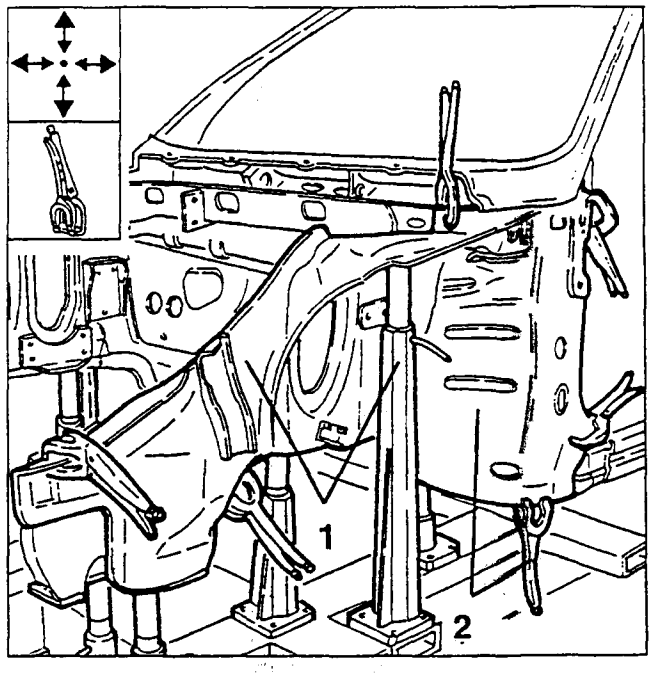
PREPARATION OF THE OUTER FRONT SIDE PANEL

1. Using a rotating brush, clean the edges of the outer side panel and the areas to be welded.
- Apply the specified electroweldable protection product to the areas to be spot-welded.



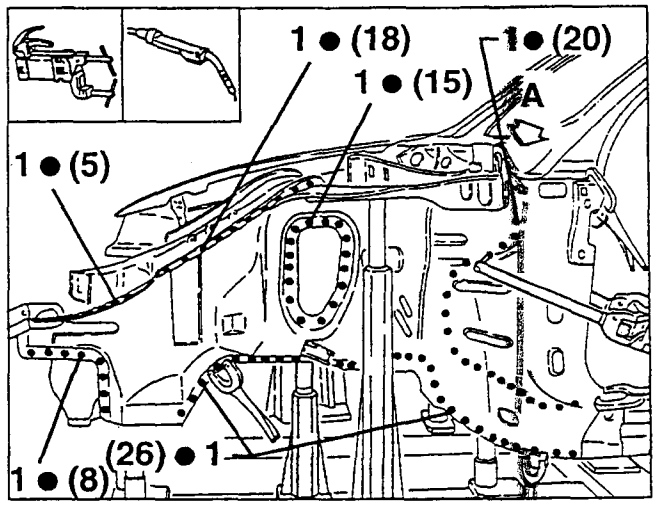
POSITIONING OF THE OUTER FRONT SIDE PANEL

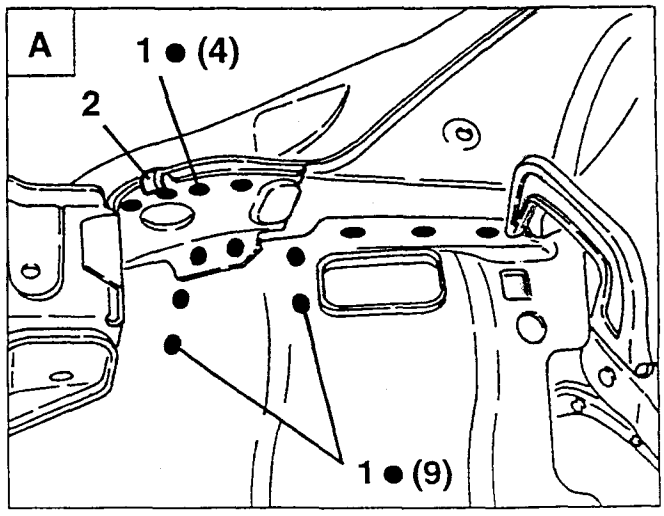
1. Using a jig correctly position the outer side panel.
2. Clamp the components to be welded into position, joint the edges together and check alignment.



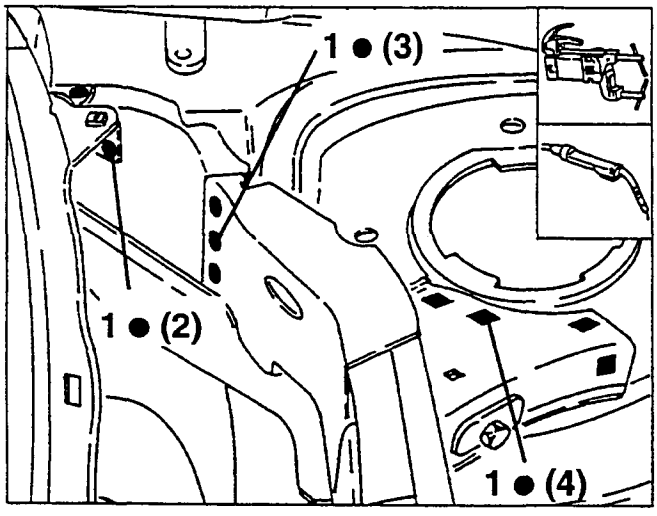
WELDING AND FINISHING OF THE OUTER FRONT SIDE PANEL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Bend the tabs over.



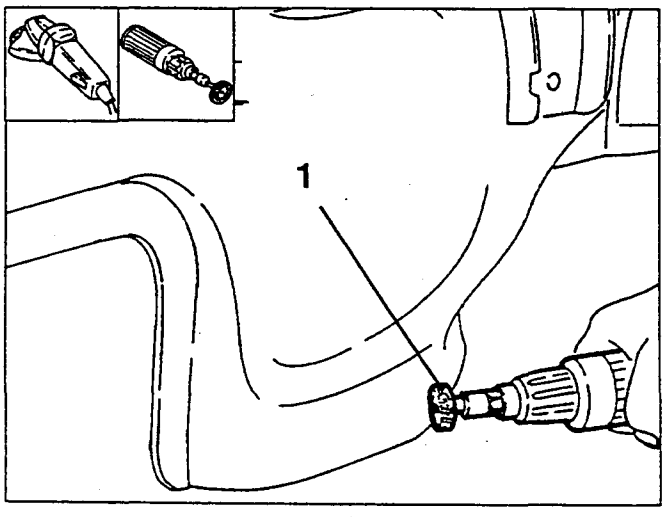


1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.



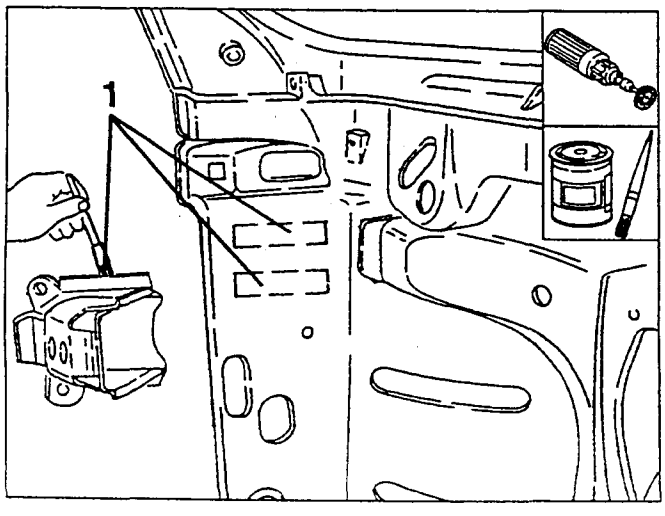
- Using an abrasive grinding machine remove and flush the residues left after welding.

1. Using a rotating brush, clean the welded areas.



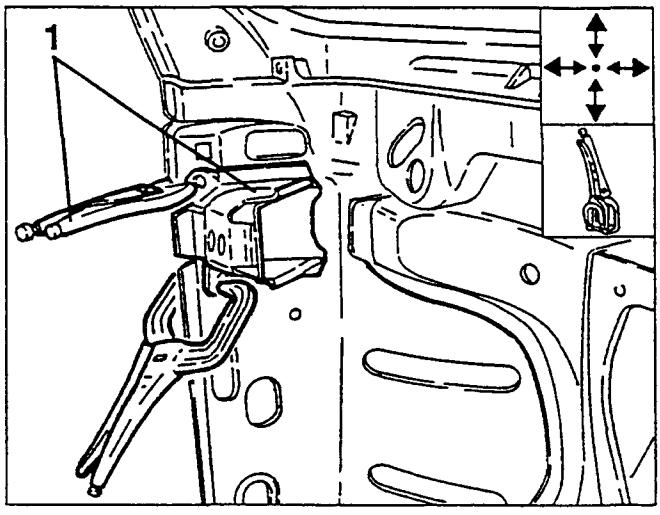
- Using a rotating brush, clean the areas which are to be welded on the dashboard support crossmember bracket.

1. Apply the specified electroweldable protection product to the areas to be spot-welded.

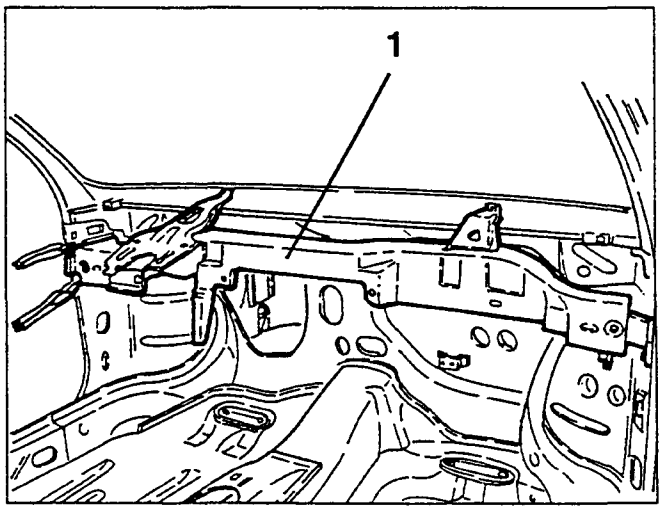


1. Position the dashboard crossmember support bracket and clamp it into position.

NOTE:
For the correct position of the bracket use the two special pins as shown in the diagram.

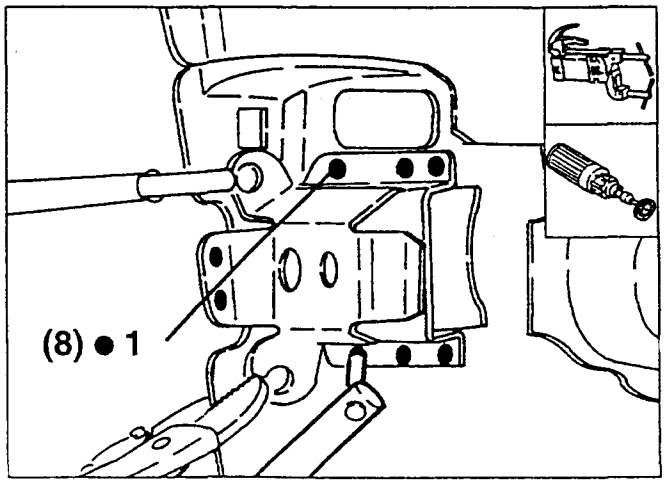


1. Temporarily install the dashboard crossmember to check the correct positioning of the support bracket and then remove it again.



1. Using a spot-welder, proceed as shown in the diagram.

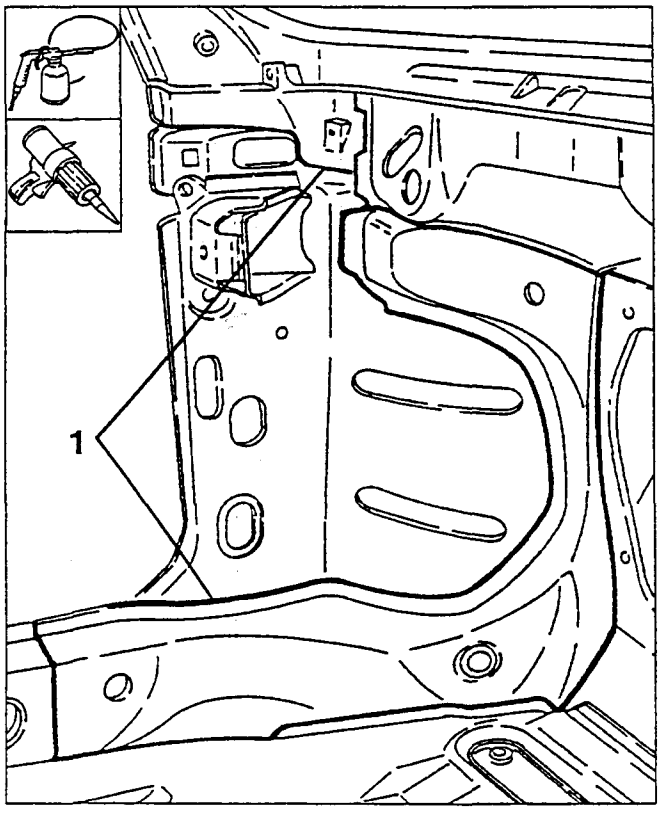
- Using a rotating brush, clean the welded areas.

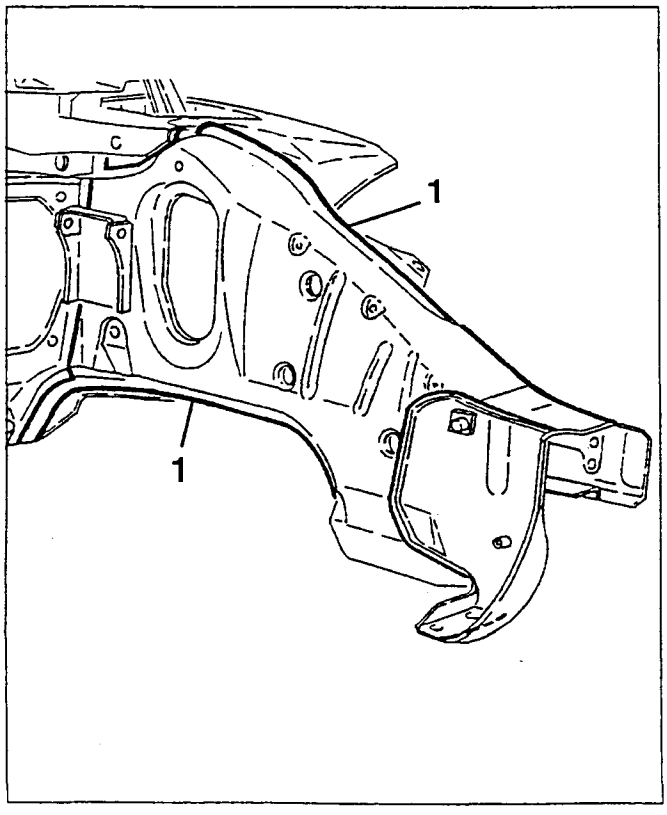


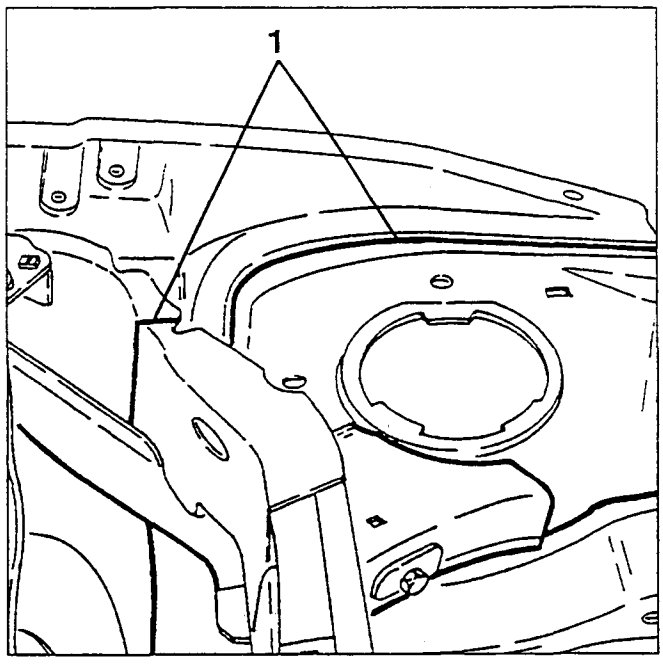
PROTECTION

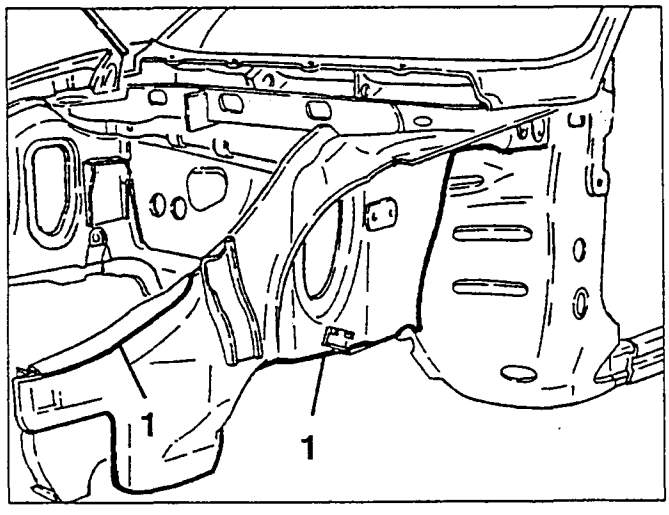
- Apply the specified corrosion inhibitor to the areas to be welded MIG.

1. Apply the specified sealant to all the joints of the side panel.

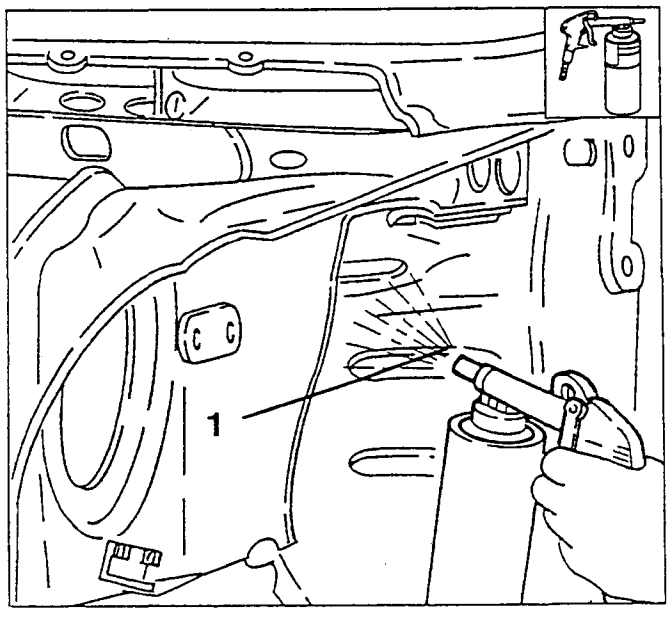






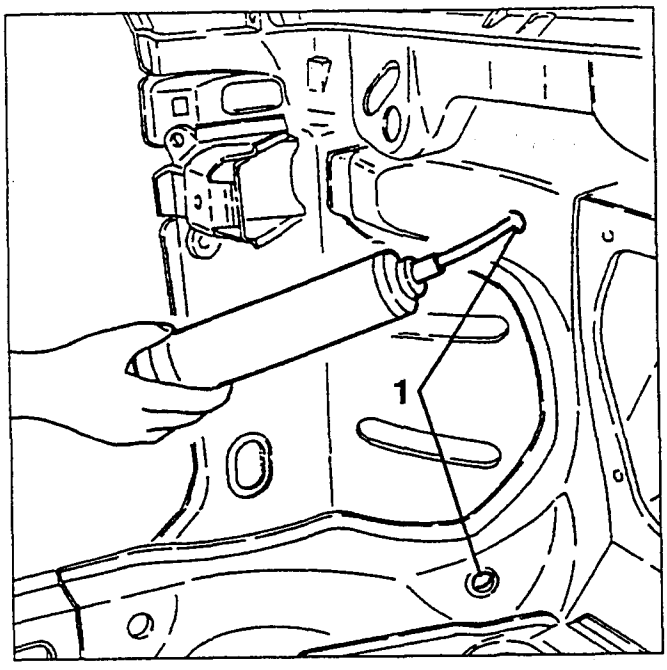


1. Apply the specified underbody protection to the replaced areas in the wheel housing.

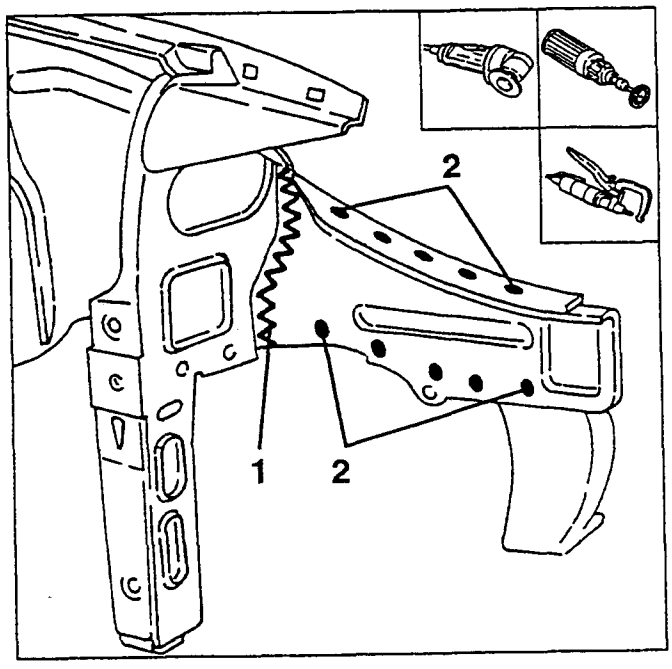


- Proceed to the painting phase.
- Wax-treat the boxed parts.

1. Foam treat the boxed parts through the hole shown in the diagram.



1. Using a circular saw, cut the external panel along the lines indicated in the diagram without damaging the underlying parts.
- Using a rotating brush, clean the areas to be spot-cut to show up the welding points.
2. Using a chamfering machine, remove the welding points.

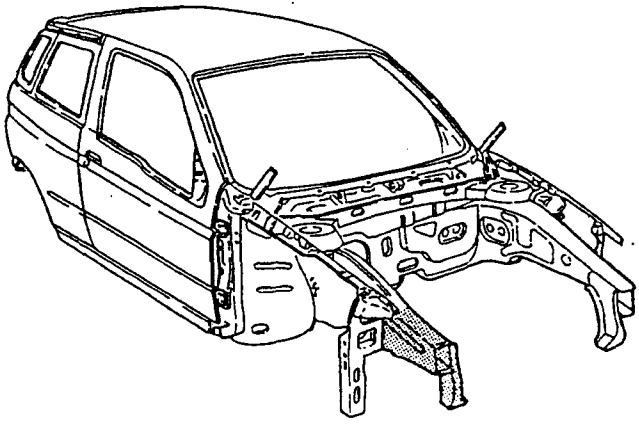


FRONT SIDE PANEL - PARTIAL (Turbodiesel version)

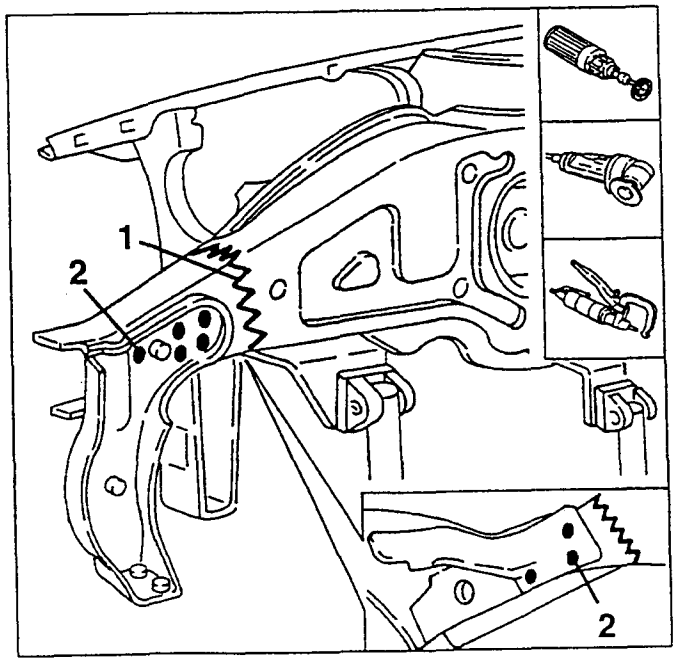
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• headlight housing frame (see specific paragraph).
• front crossmember, (see specific paragraph).

REMOVAL

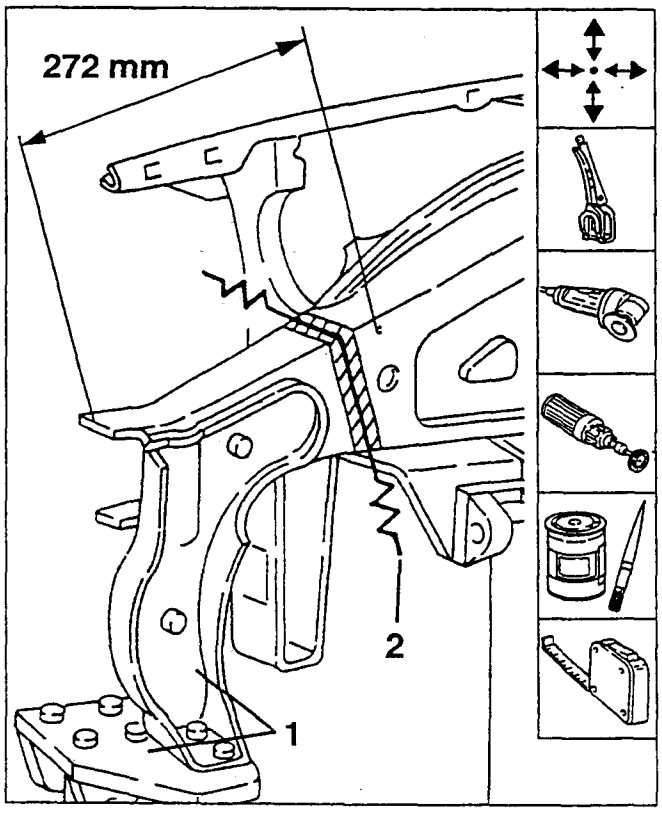


1. Using a circular saw, cut the internal panel along the lines indicated in the diagram without damaging the underlying parts.
- Using a rotating brush, clean the areas to be spot-cut to show up the welding points.
2. Using a chamfering machine, remove the welding points.



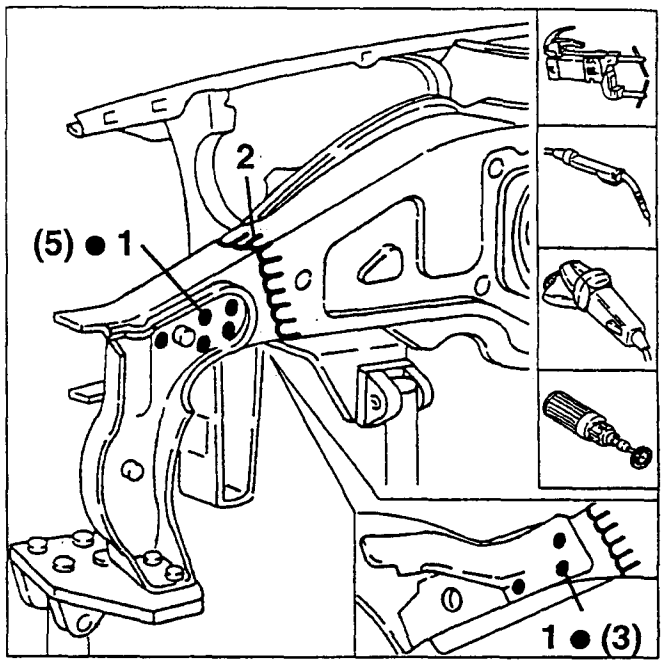
PREPARING AND POSITIONING THE INNER SIDE PANEL

1. Using s jig to secure the radiator attachment bracket correctly position the partial inner side panel and check the value given in the figure below.
- Fix the side panel to the strut and check alignment and overlapping of the components.
2. Using a circular saw, trim the sheet metal to eliminate the excess parts.
- Remove the inner side panel.
- Using a rotating brush, clean the areas which are to be welded.
- Apply the specified electroweldable protection product to the areas to be spot-welded.
- Position the inner side panel and check alignment.



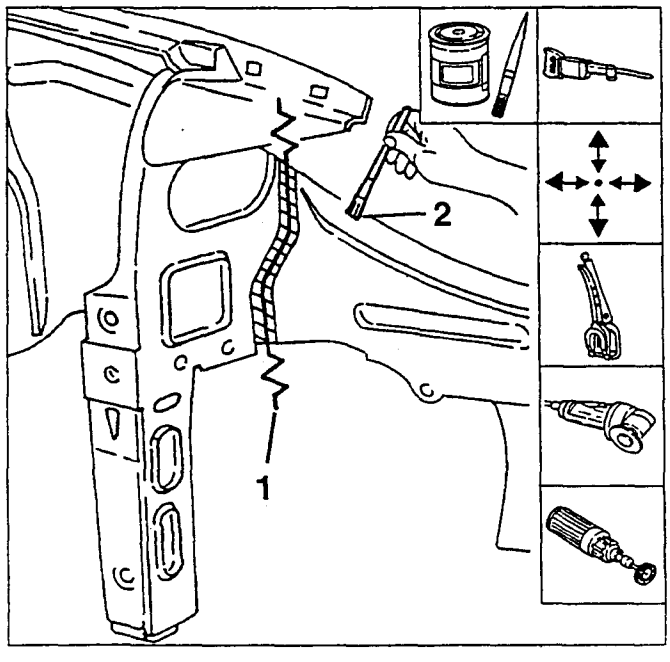
WELDING AND FINISHING OF THE INNER SIDE PANEL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, carry out seam welding.
- Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.



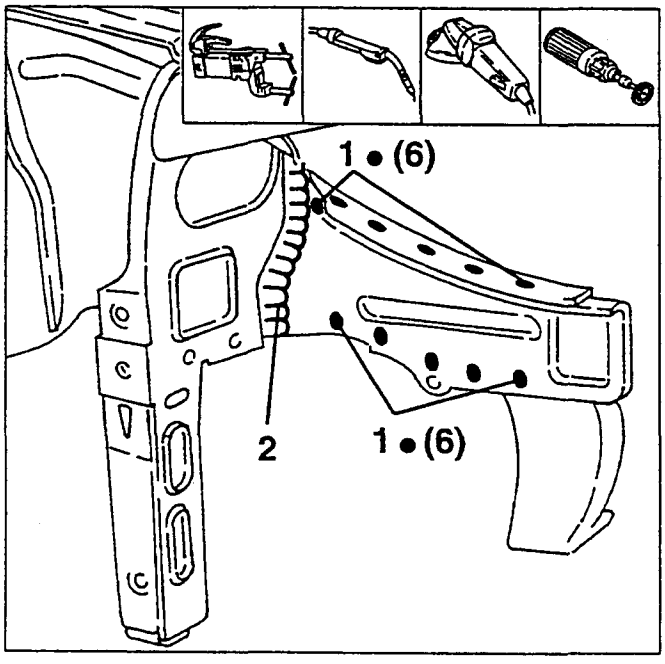
PREPARING AND POSITIONING THE OUTER SIDE PANEL

- Working on a bench use a jig saw to cut the new outer side panel leaving enough material to allow for overlapping.
- Secure the outer side panel to the strut and to the inner side panel.
1. Using a circular saw, trim the sheet metal to eliminate the excess parts.
- Remove the outer side panel.
- Using a rotating brush, clean the areas which are to be welded.
2. Apply the specified electroweldable protection product to the areas to be spot-welded.
- Position the outer side panel and check alignment.



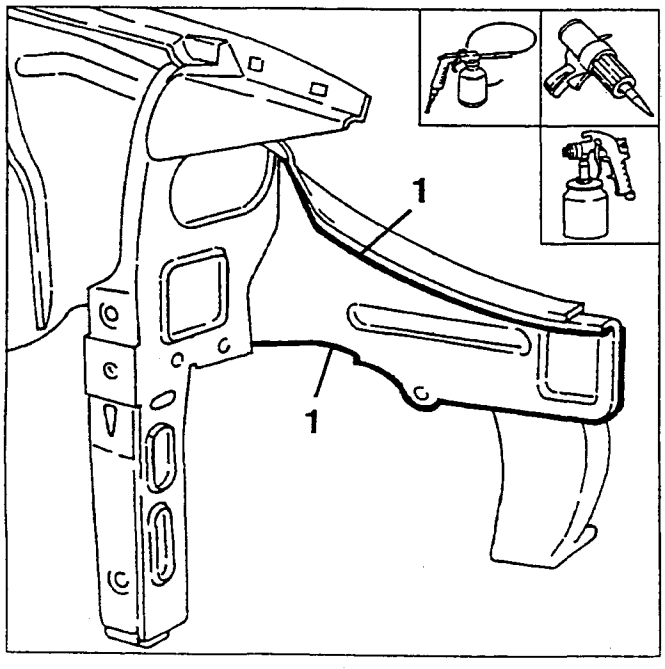
WELDING AND FINISHING OF THE OUTER SIDE PANEL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, carry out seam welding.
- Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.

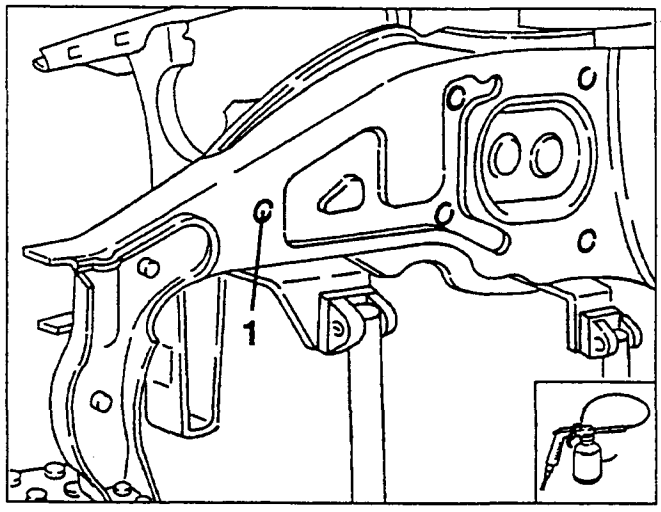


PROTECTION

- Apply the specified corrosion inhibitor to the areas to be welded MIG.
1. Apply the specified sealant along the lines highlighted in the diagram.
- Proceed to the painting phase.



- Centre the boxed parts through the hole shown in the diagram.

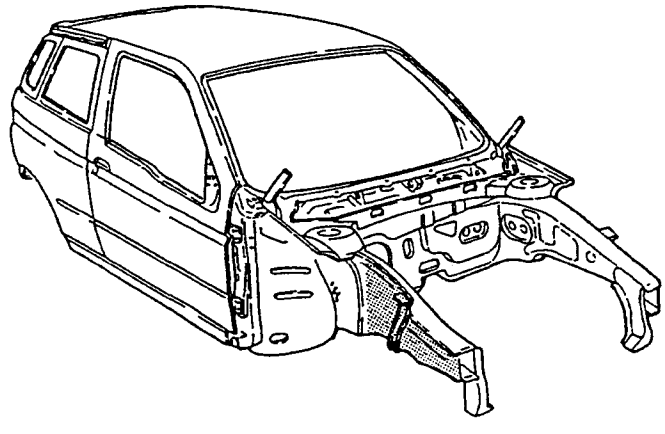


FRONT SIDE PANEL - EXTERNAL PARTIAL (Turbodiesel version)

PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• front wing of relative side (see specific paragraph).
• front cross-member if necessary (see specific paragraph).
• upper panel on relative side (see specific paragraph).
• side shelf on relative side (see specific paragraph).

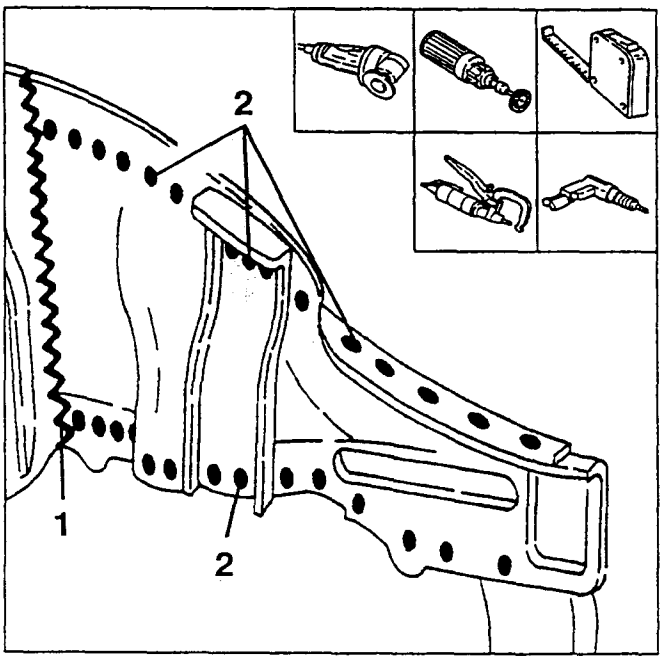
REMOVAL



1. Using a circular saw, cut the outer front side panel along the line shown in the diagram without damaging the underlying parts.

NOTE:
The cut on the side panel must be approx. 50mm fron the front suspension attachment pillar.

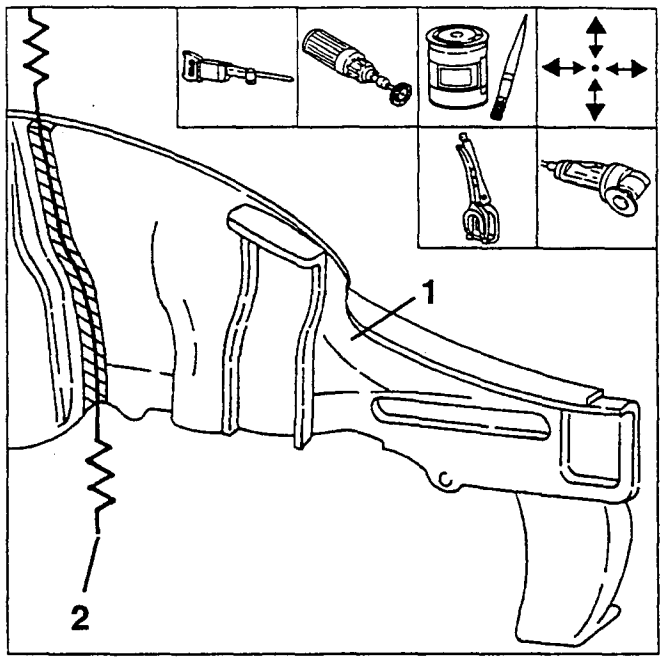
- Using a rotating brush, clean the areas to be spot-cut to show up the welding points.
2. Using a spot cutter remove the accessible welds. Remove the remaining welds using a drill.



- Remove the outer partial front side panel and if necessary cut the sealant.

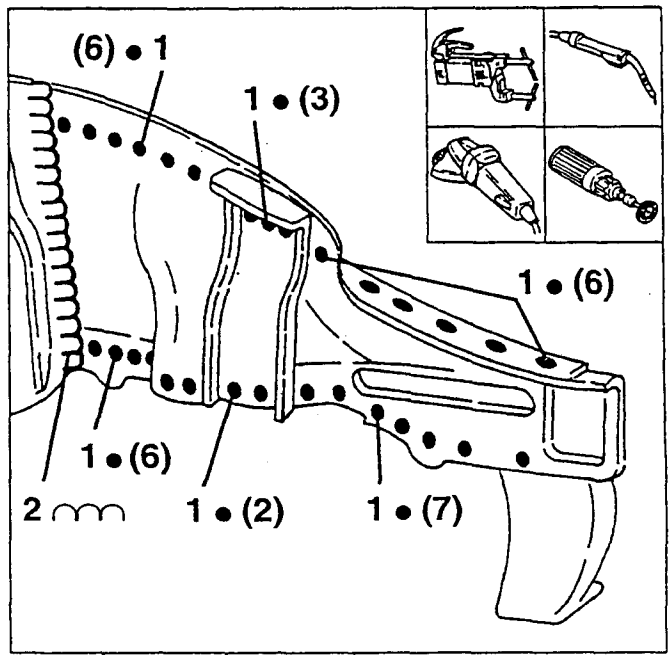
PREPARING AND POSITIONING

- Working on a bench use a jig saw to cut the new outer side panel allowing enough material for overlapping.
- Using a rotating brush clean around the edges of the inner and outer side panels on both sides of the sheet metal.
- Apply the specified electroweldable protection product to the areas to be spot-welded.
1. Position the outer side panel and overlap as shown in the diagram. Secure it using clamps and mate the edges to be welded.
2. Using a circular saw, trim the sheet metal to eliminate the excess parts.



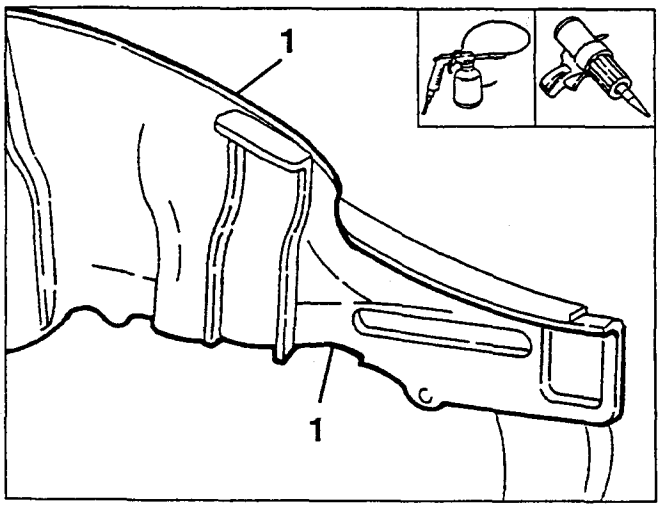
WELDING AND FINISHING OF THE SHEET METAL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, carry out seam welding.
- Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.

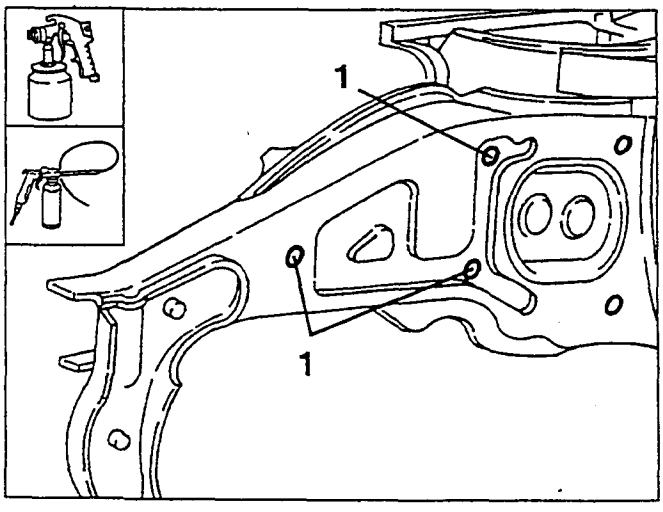


PROTECTION

- Apply the specified corrosion inhibitor to the areas to be welded MIG.
1. Apply the specified sealant along the lines highlighted in the diagram.



- Proceed to the painting phase.
1. Centre the boxed parts through the holes shown in the diagram.

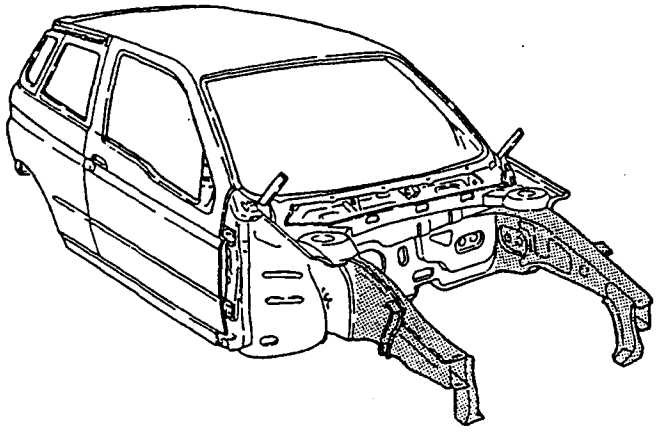


FRONT SIDE PANEL - INTERNAL AND EXTERNAL PARTIAL (Turbodiesel version)

PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• front wing of relative side (see specific paragraph).
• front cross-member if necessary (see specific paragraph).
• upper panel on relative side (see specific paragraph).
• side shelf on relative side (see specific paragraph).

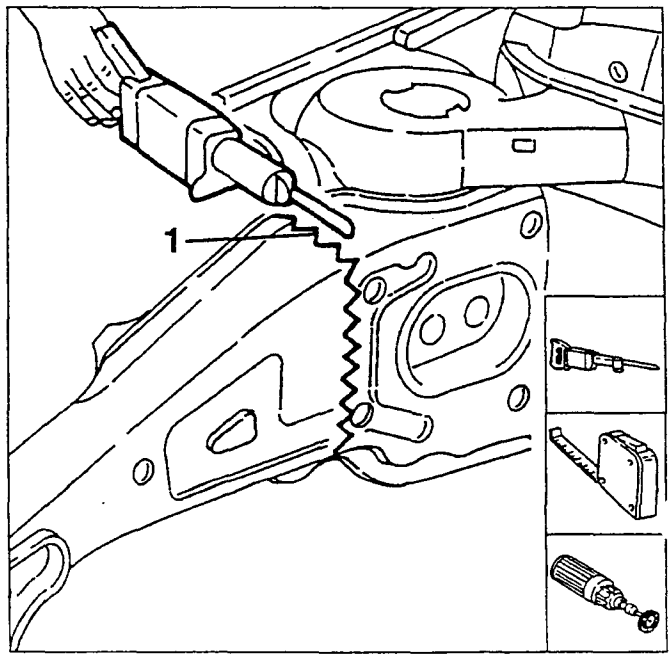
REMOVAL



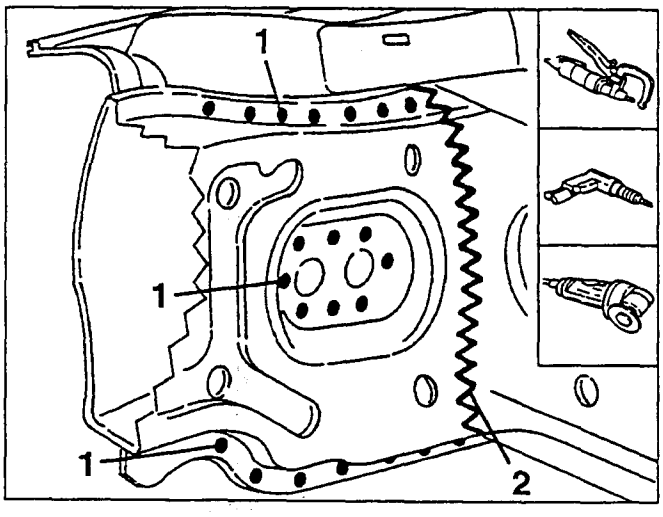
1. Using a jig saw cut the inner and outer front side panels along the line shown in the diagram.

NOTE:
The cut on the side panel must be approx. 50mm fron the front suspension attachment pillar.

- Using a rotating brush, clean the areas to be spot-cut to show up the welding points.

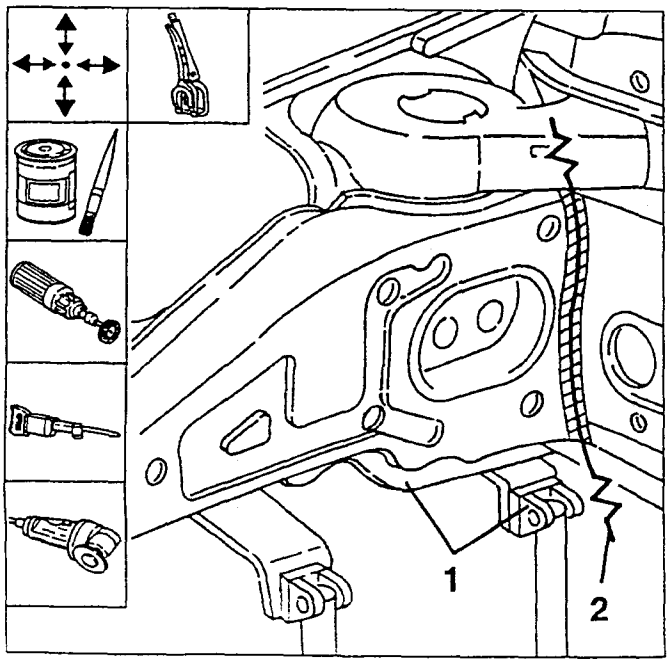


1. Using a spot cutter remove the accessible welds. Remove the remaining welds using a drill.
2. Using a circular saw, cut the inner side panel along the line shown in the diagram without damaging the underlying parts.



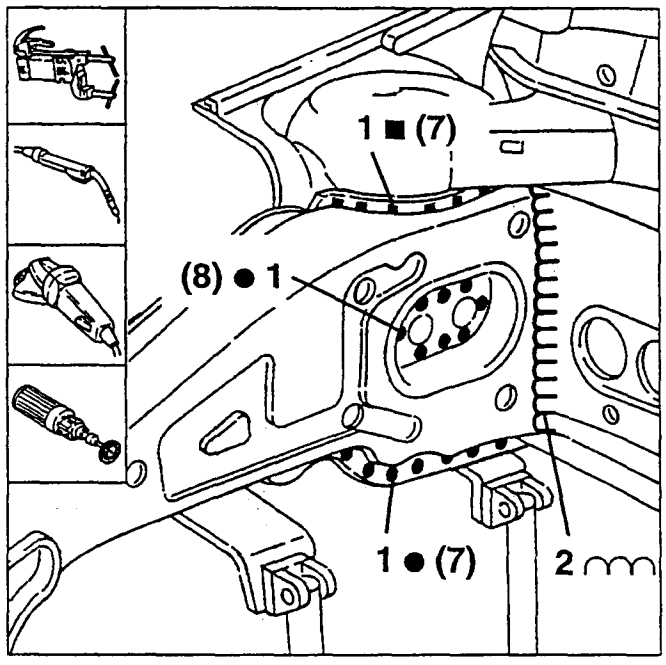
PREPARING AND POSITIONING

- Working on a bench use a jig saw to cut the new inner side panel allowing enough material for overlapping.
- Using a rotating brush clean around the edges of the inner and outer side panels on both sides of the sheet metal.
- Apply the specified electroweldable protection product to the areas to be spot-welded.
1. Using a jig correctly position the partial inner side panel and overlap as shown in the diagram; secure it with clamps and mate the edges to be welded.
2. Using a circular saw, trim the sheet metal to eliminate the excess parts.



WELDING AND FINISHING OF THE SHEET METAL

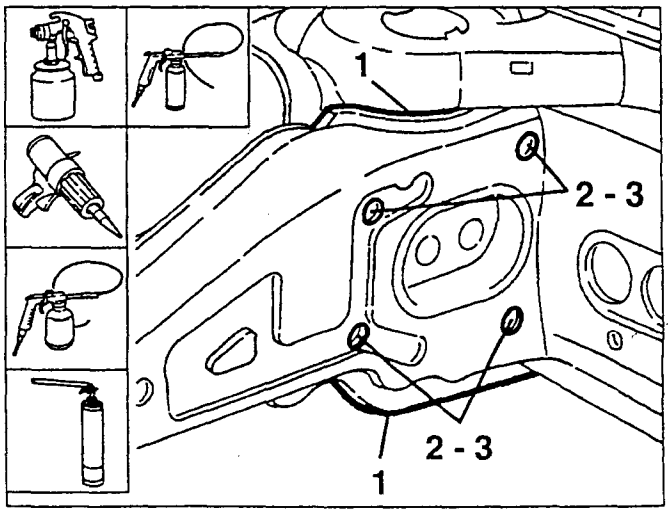
1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, carry out seam welding.
- Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.



- Mount the partial outer side panel (see specific paragraph)

PROTECTION

- Apply the specified corrosion inhibitor to the areas to be welded MIG.
1. Apply the specified sealant along the join with the side panel.
- Proceed to the painting phase.
2. Centre the boxed parts through the holes shown in the diagram.
3. Foam treat the boxed parts through the holes shown in the diagram.

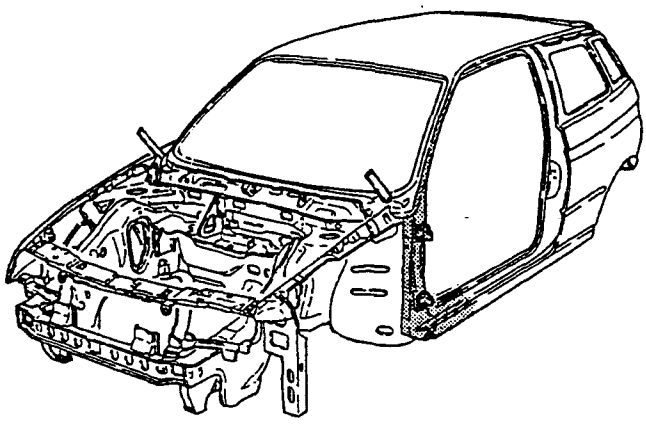


FRONT PILLAR

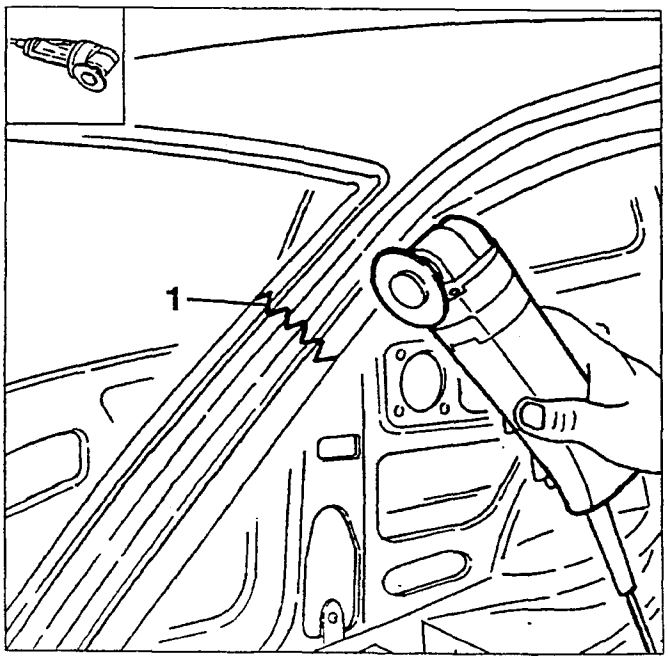
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• bonnet (see specific paragraph).
• door on affected side (see specific paragraph).
• front wing on affected side (see specific paragraph).

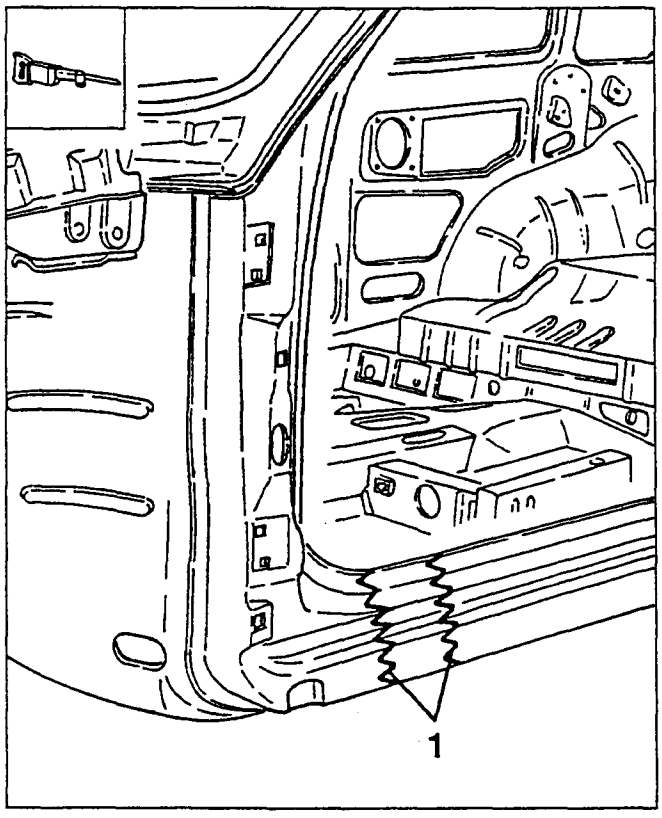
REMOVAL



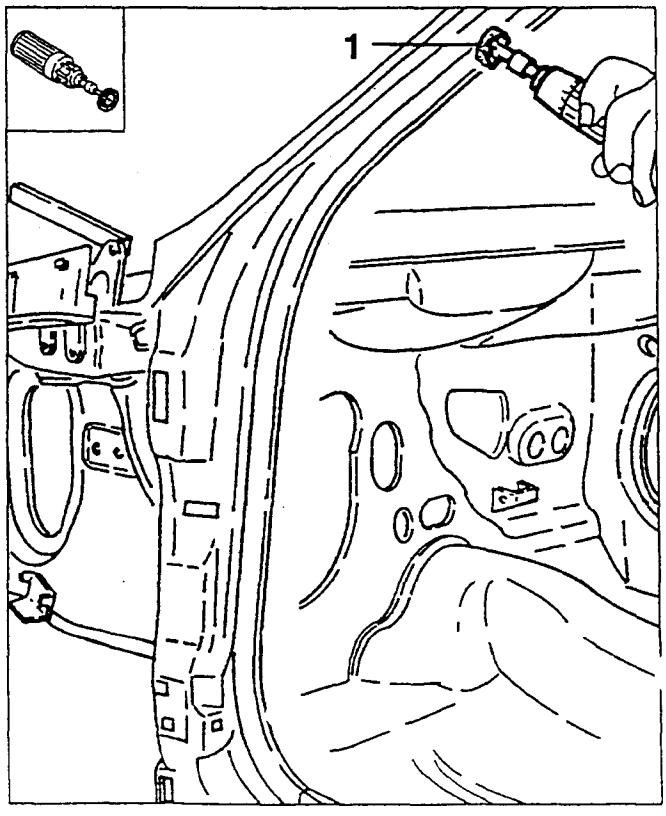
1. Using a circular saw, cut following the lines shown in the diagram, without damaging the underlying parts.



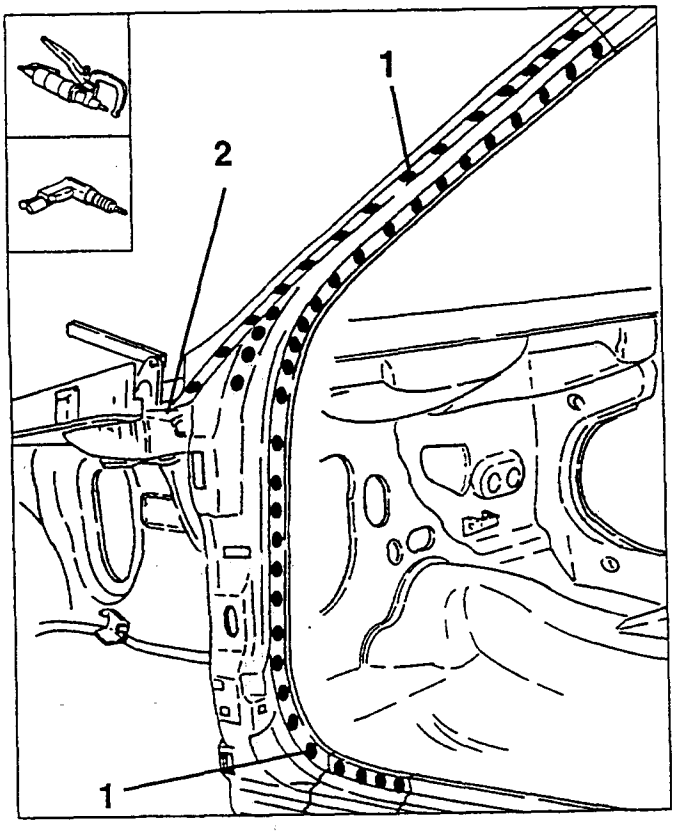
1. Using a jig saw, cut following the lines shown in the diagram, without damaging the underlying parts.

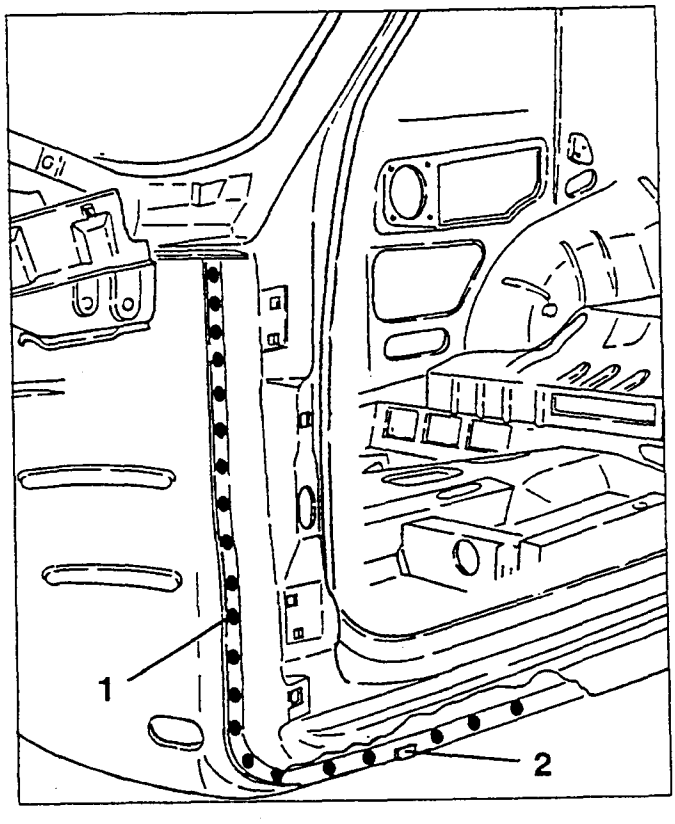


1. Using a rotating brush, clean the areas to be spot-cut to show up the welding points.



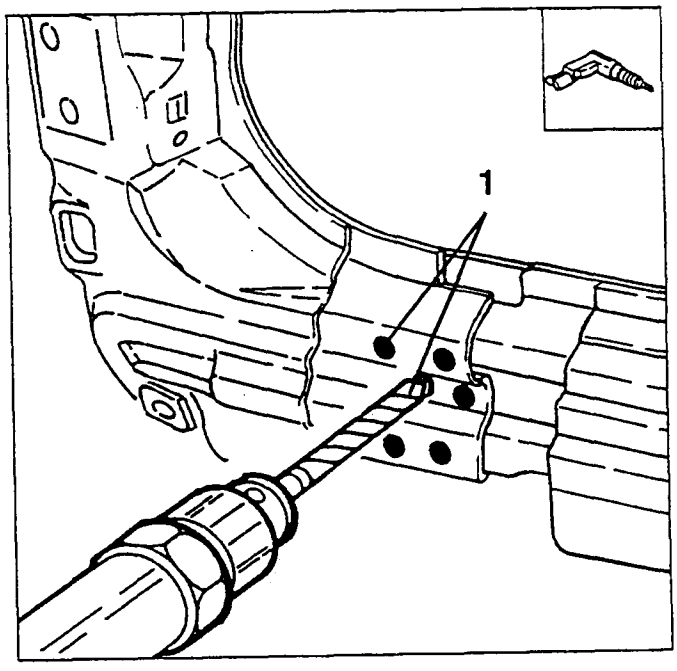
1. Using a chamfering machine, remove the accessible welding points, remove the remaining welding points using a drill.
2. Open the clinch tabs.





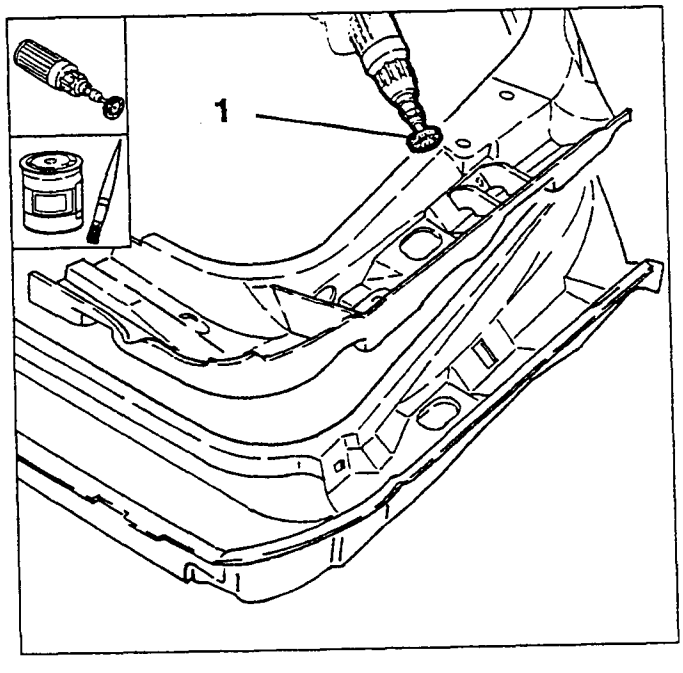
- Remove the plug from the door sill to gain access to the welding points on the front pillar frame.

1. Using a drill, remove the welding points.
- Remove the front pillar complete with frame cutting the sealant if necessary.



PREPARATION

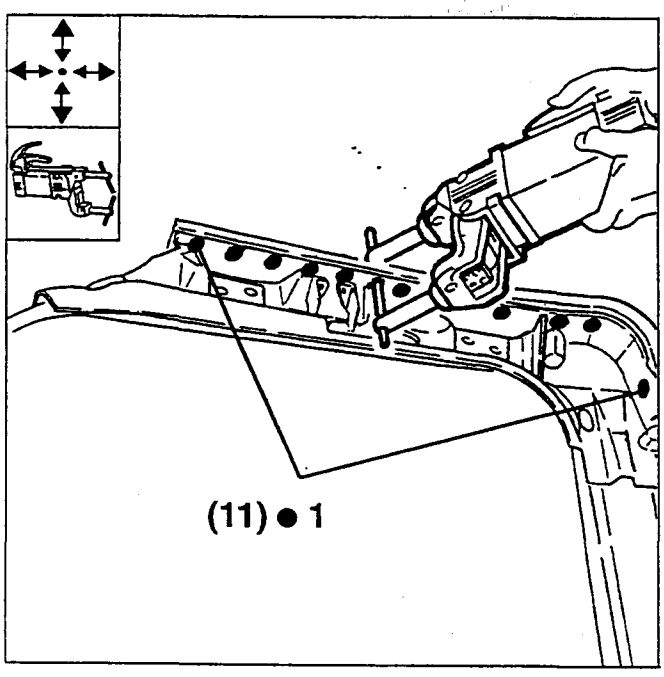
- Working on a bench prepare for the installation of the front pillar and frame as follows:
1. Using a rotating brush, clean the areas which are to be welded .
- Apply the specified electroweldable protection product to the areas to be spot-welded.



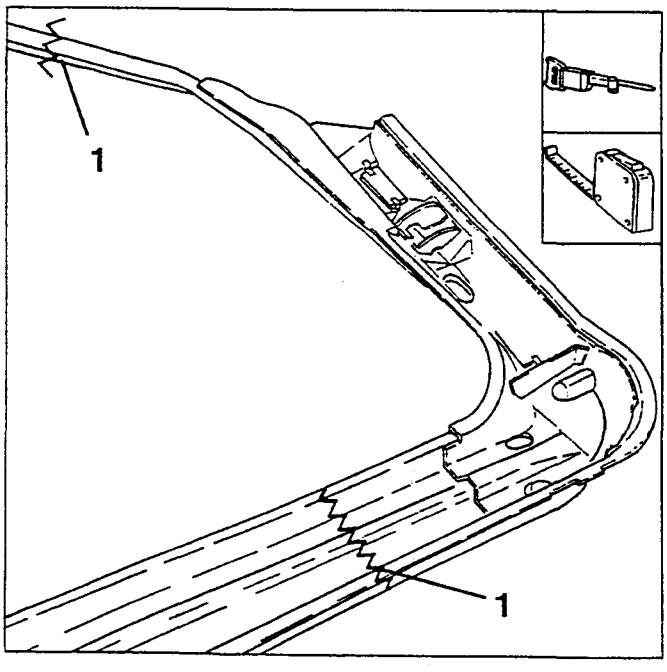
- Position the frame in on the pillar and lock the components in place.

NOTE:
Check centering of the hinge attachment hole to check the position.

1. Using a spot-welder, proceed as shown in the diagram.

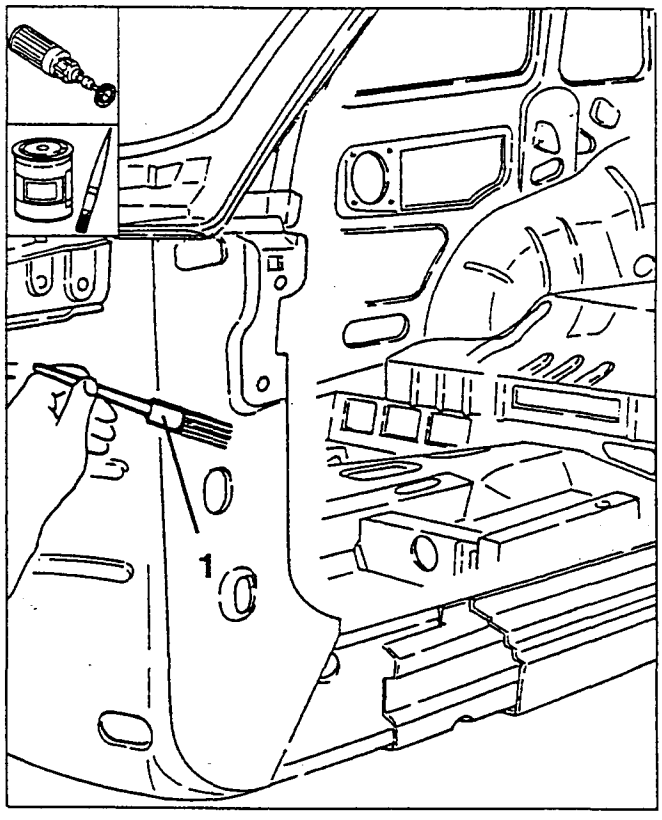


1. Working on a bench cut the new front pillar with a jig saw ensuring that enough margin is left for overlapping.



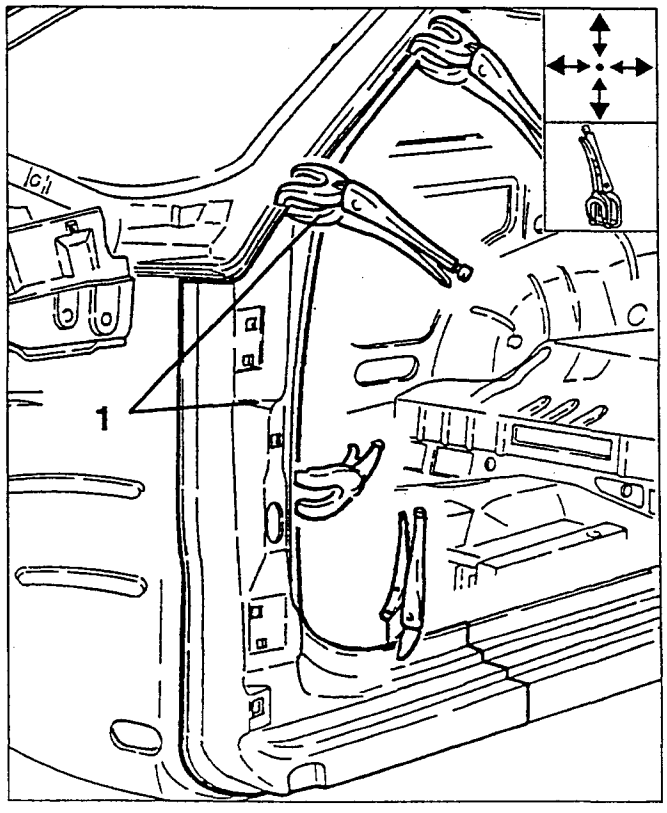
- Using a rotating brush, clean the areas which are to be welded on the vehicle and on the pillar.

1. Apply the specified electroweldable protection product to the areas to be spot-welded.

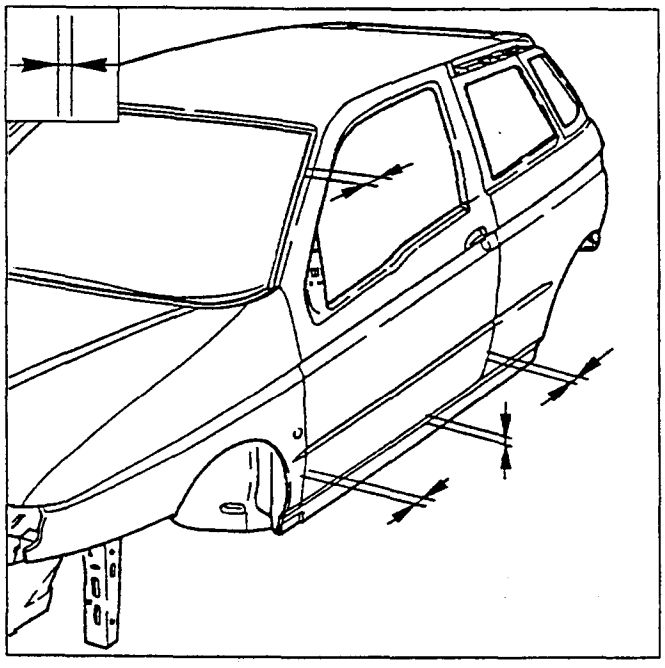


POSITIONING AND INSPECTION

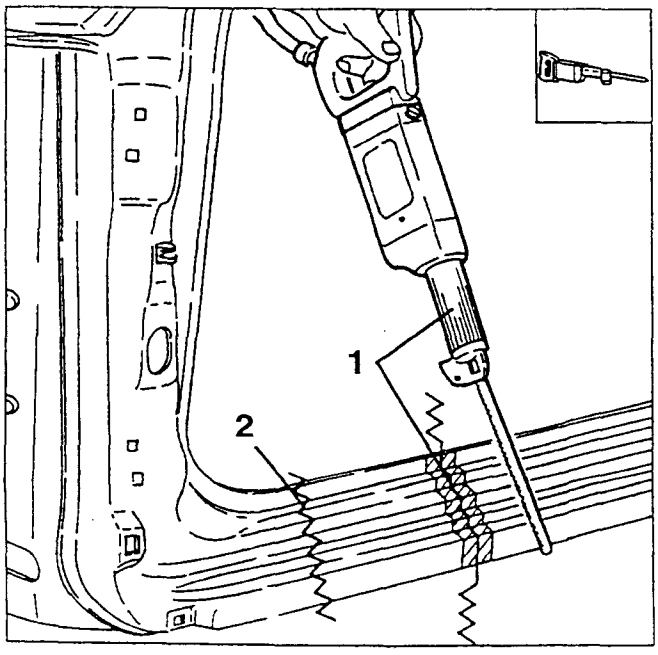
1. Position the front pillar complete with frame joining together the edges to be welded and securing them with clamps.



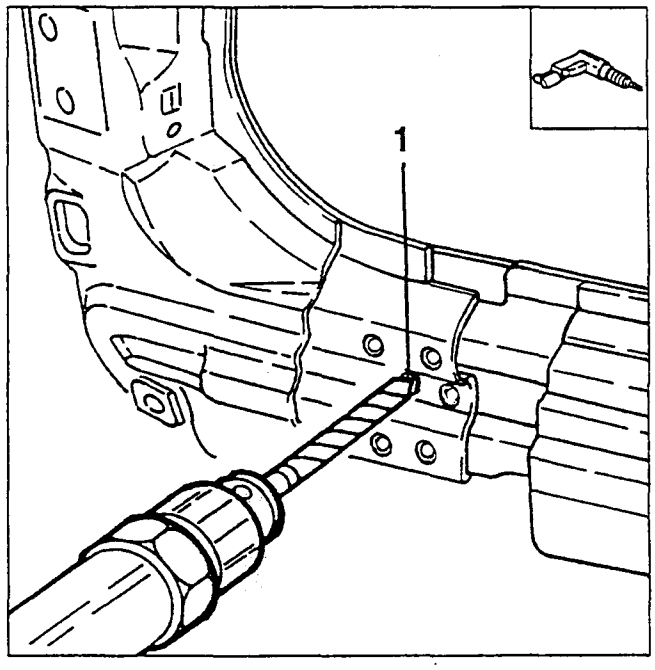
- Temporarily fix the front pillar with screws and remove the previously installed clamps.
- Check parallelism, gaps and angles and refit the previously removed mobile components with their gaskets together with any parts which, once installed, make it possible to check the successful outcome of the operations.



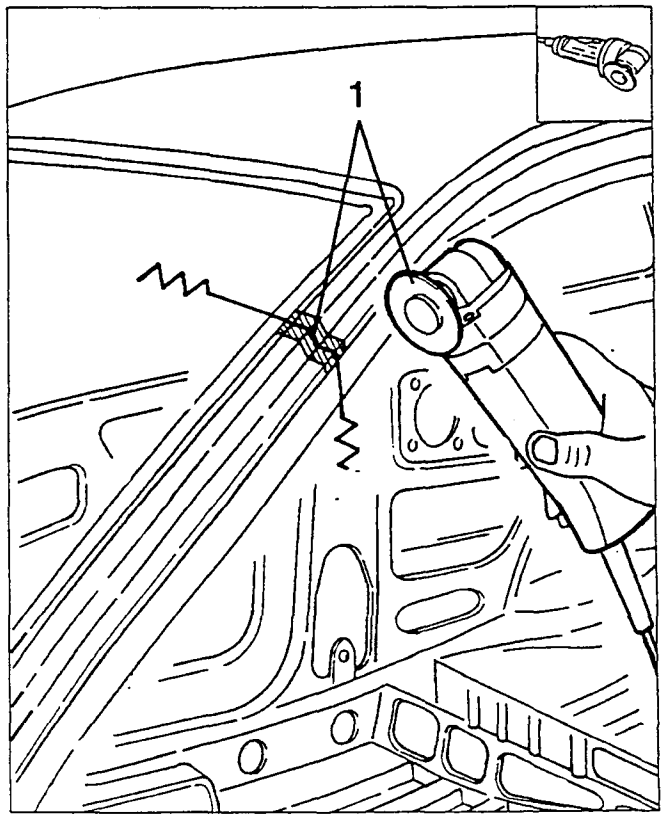
- Remove the components installed previously to check the correct position of the pillar.
1. Using a jig saw, trim the lower sheet metal panels removing the excess parts without damaging the underlying sheeting.
2. Using a jig saw, make another cut as shown in the diagram to create a plug to allow access to the welding on the pillar.



1. Using a drill, perforate with a 5 mm bit on the front pillar frame in order to permit welding.

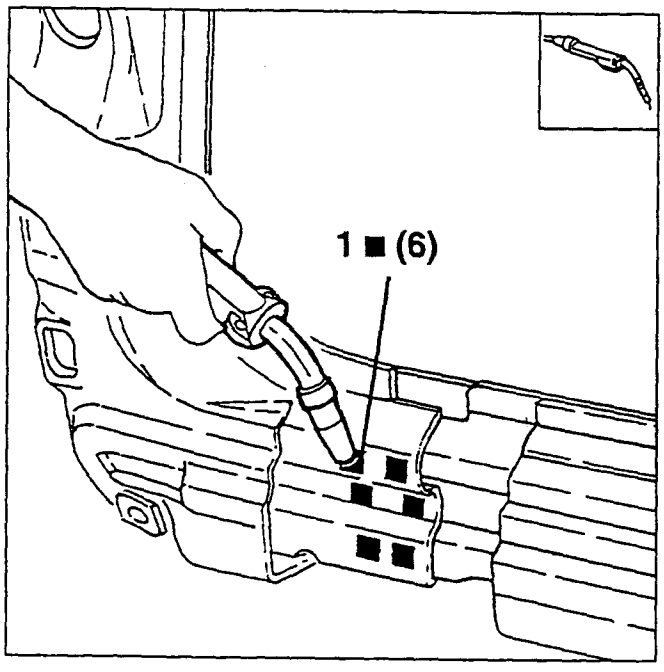


1. Using a circular saw, trim the upper sheet metal panels removing the excess parts without damaging the underlying sheeting.

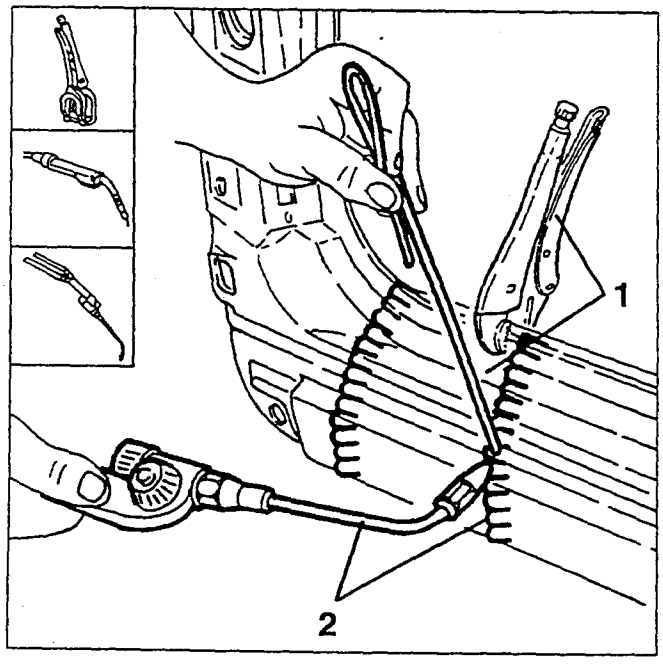


WELDING AND FINISHING OF THE SHEET METAL

1. Using a MIG welder, proceed as shown in the diagram.

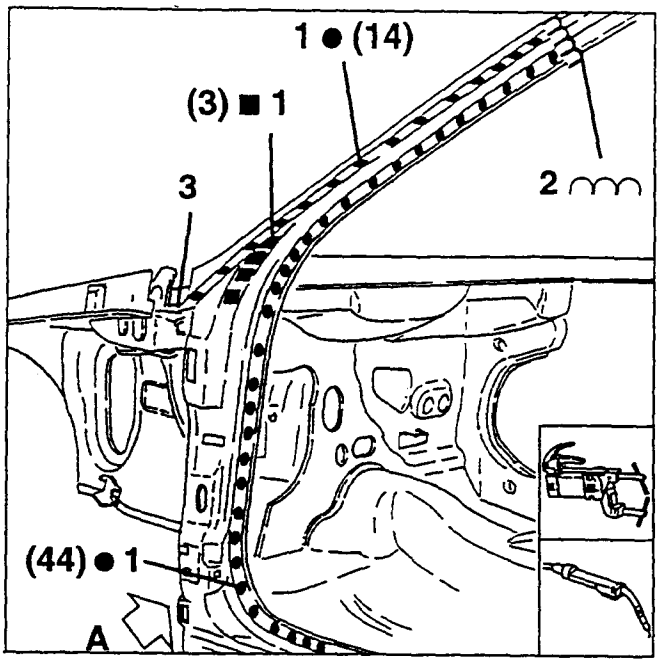


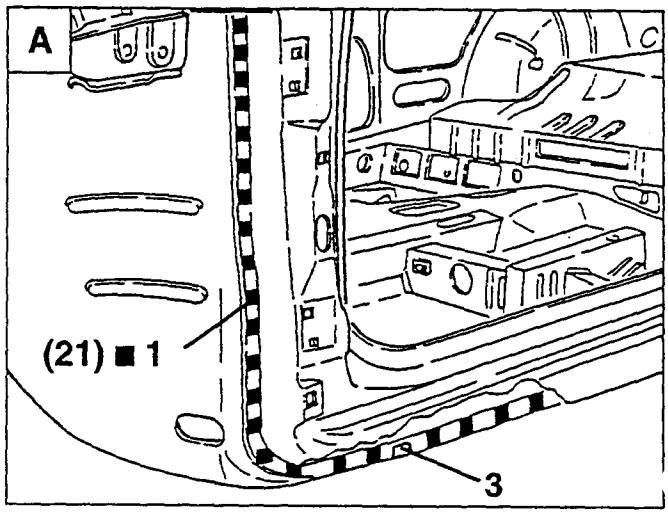
1. Install the previously created plug and fix it in position with clamps.
2. Using a MIG welder or an oxyacetylene torch weld as shown in the diagram.



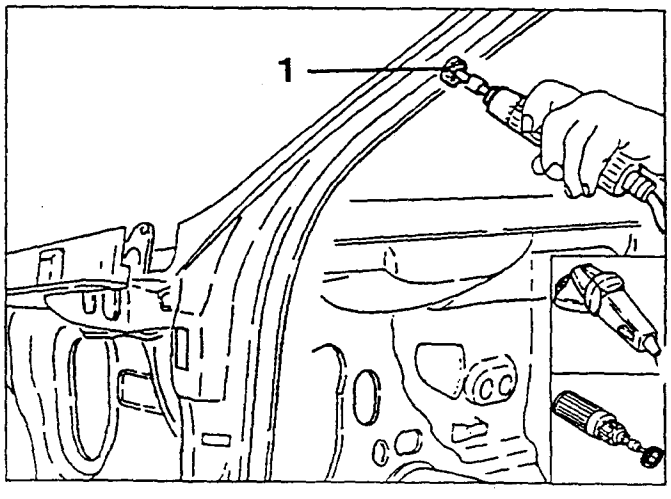
1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, weld a seam.

3. Bend the clinch tabs.



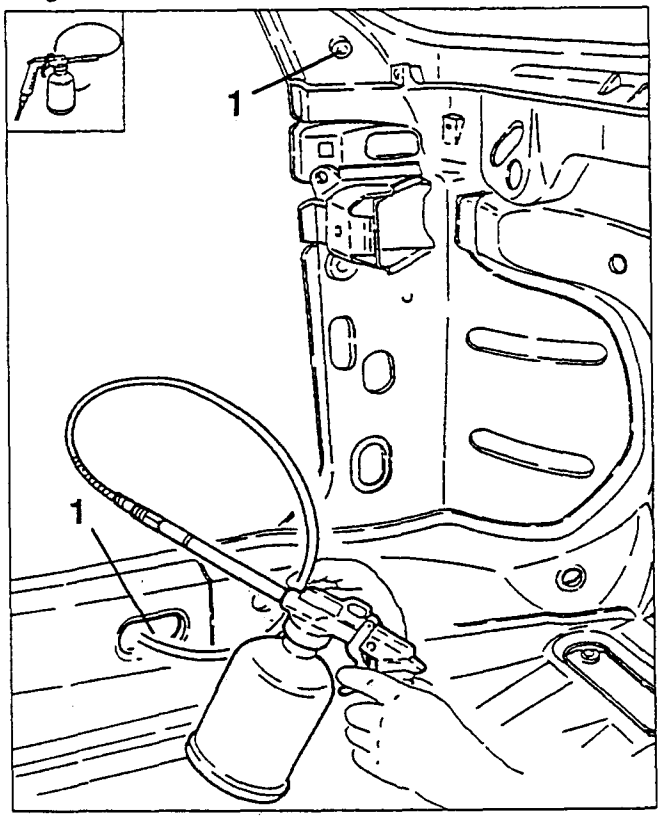


- Using an abrasive grinding machine, remove and flush the residues left after welding.
1. Using a rotating brush, clean the welded areas.

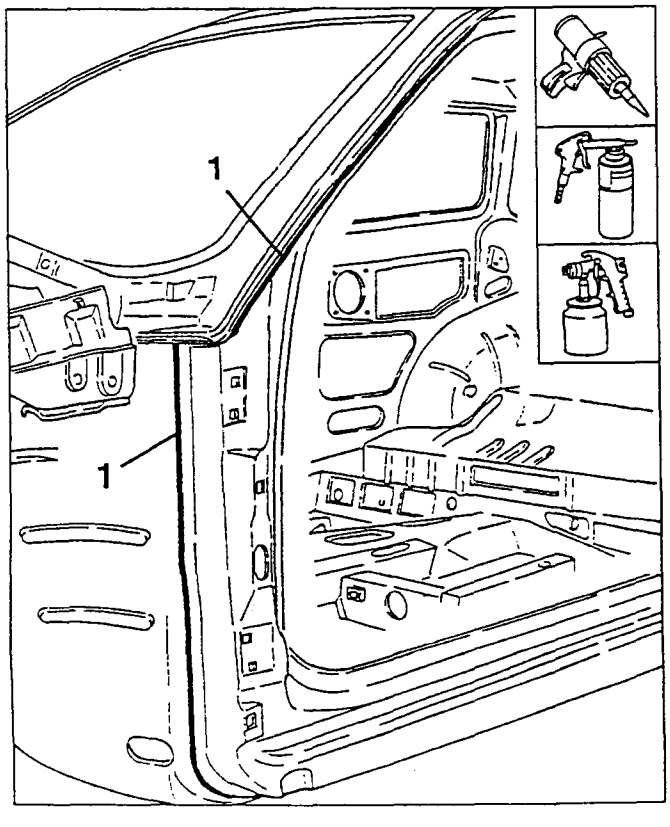


PROTECTION

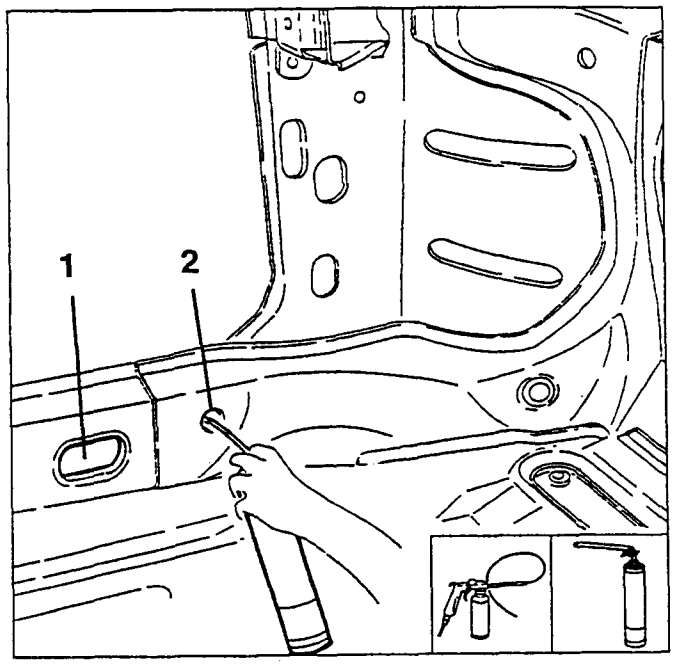
1. Apply the specified corrosion inhibitor to the areas to be welded MIG, through the holes shown in the diagram.



1. Apply the specified sealant along the lines highlighted in the diagram.
- Apply the specified underbody protection to the replaced areas.
- Proceed to the painting phase.



1. Wax treat the boxed parts through the hole shown in the diagram.
2. Foam treat the boxed parts through the hole shown in the diagram.

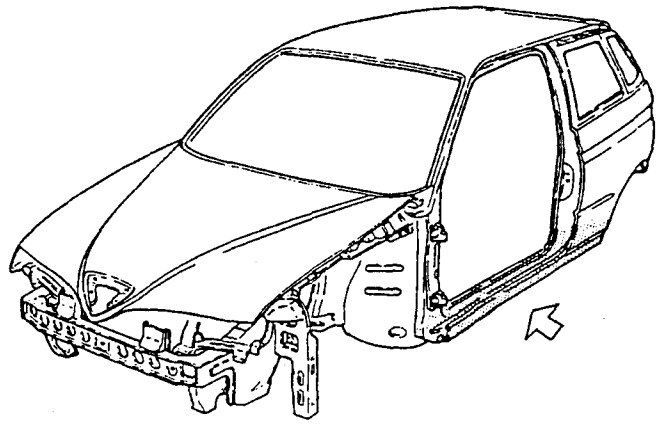


DOOR SILL RAIL

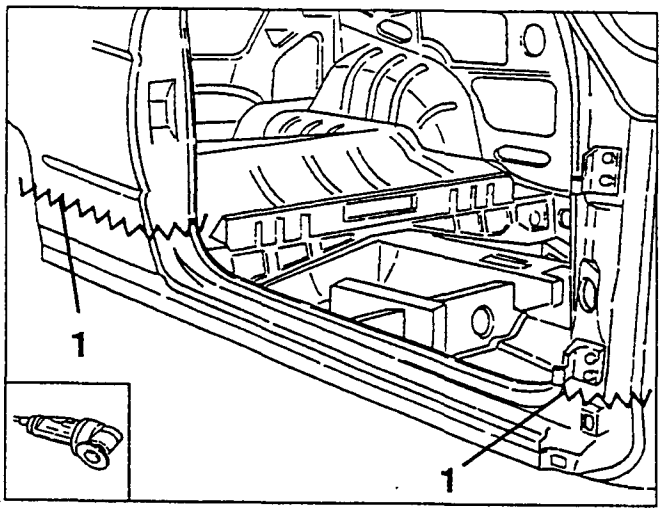
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the control units.
- Remove the trim components, electrical and mechanical systems which could hinder the repair operations or get damaged during work (see specific paragraph).
- Remove the following sheet metal parts:
  - door on affected side (see specific paragraph).
  - front wing on affected side (see specific paragraph).

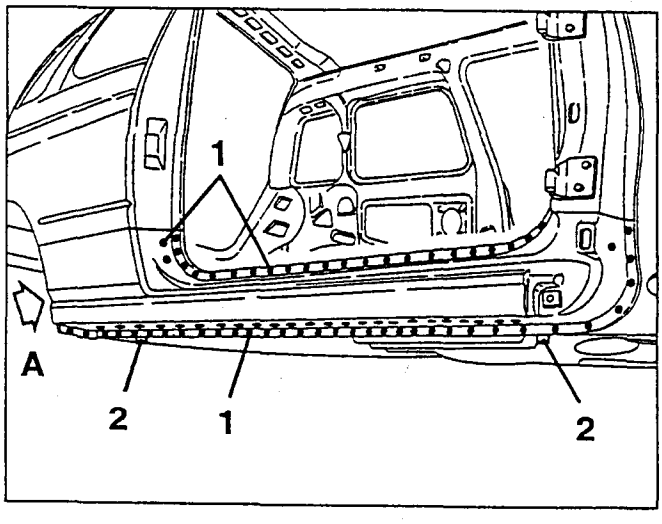
REMOVAL

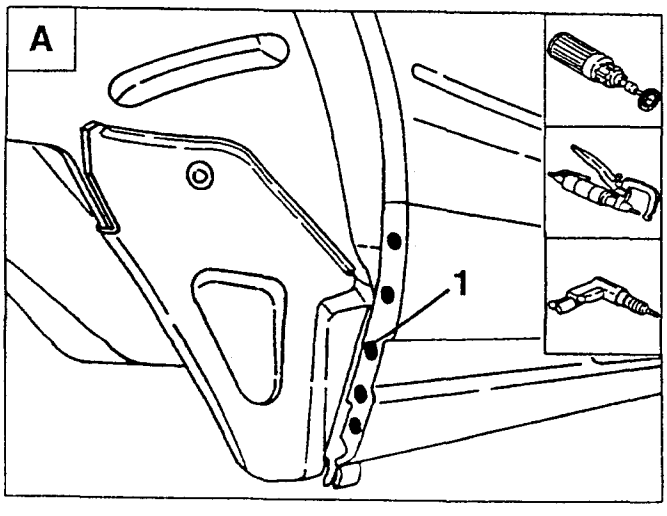


1. Using a circular saw, cut following the lines shown in the diagram, without damaging the underlying areas.



- Using a rotating brush, clean the areas to be spot-cut to show up the welding points.
1. Using a chamfering machine, remove the accessible welding points; remove the remaining welding points using a drill.
2. Open the clinch tabs.

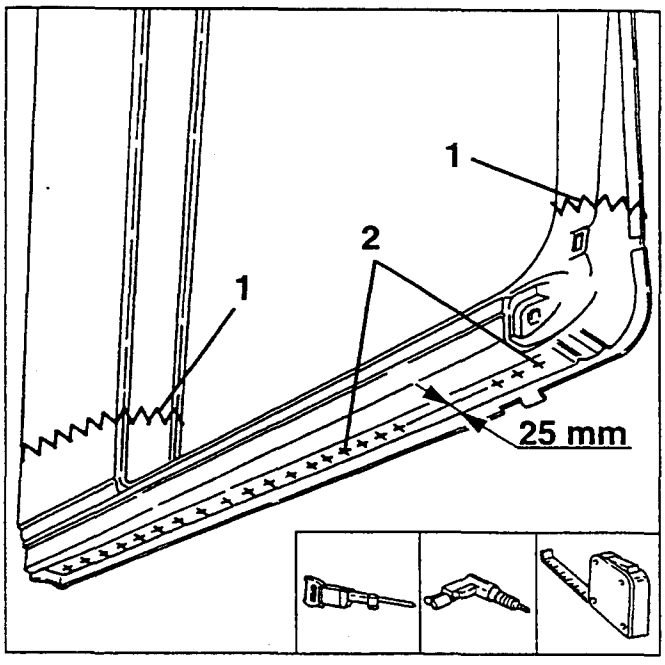




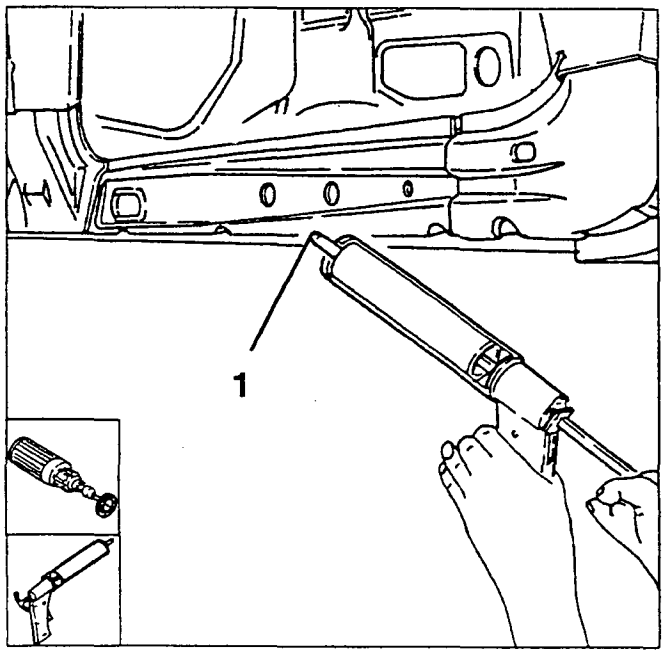
- Remove the door sill rail cutting away the sealant if necessary.

PREPARATION

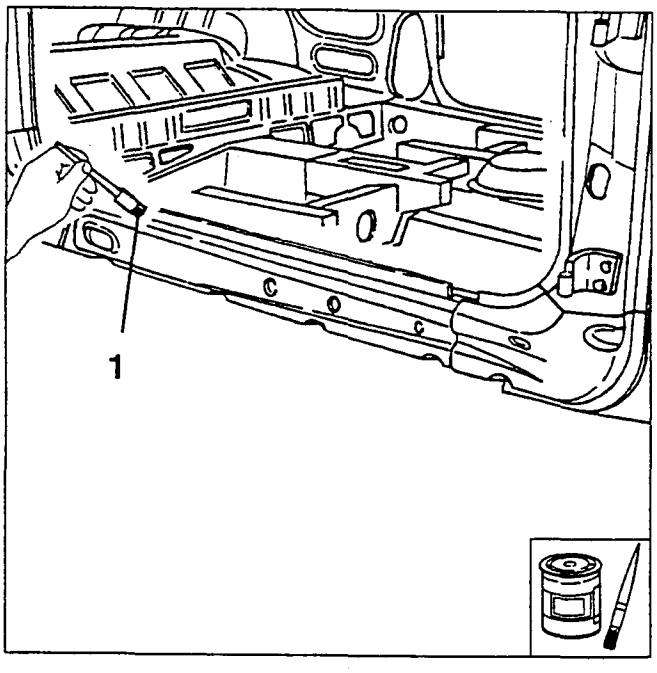
1. Working on a bench with a jig saw cut the new door sill rail allowing enough or overlapping.
2. Trace out the rail and drill with a 5 mm bit as shown in the diagram.



- Using a rotating brush, clean the areas which are to be welded .
1. Apply a thick layer of electroweldable protection to the lower part of the door sill rail and in the rear wheel housing.

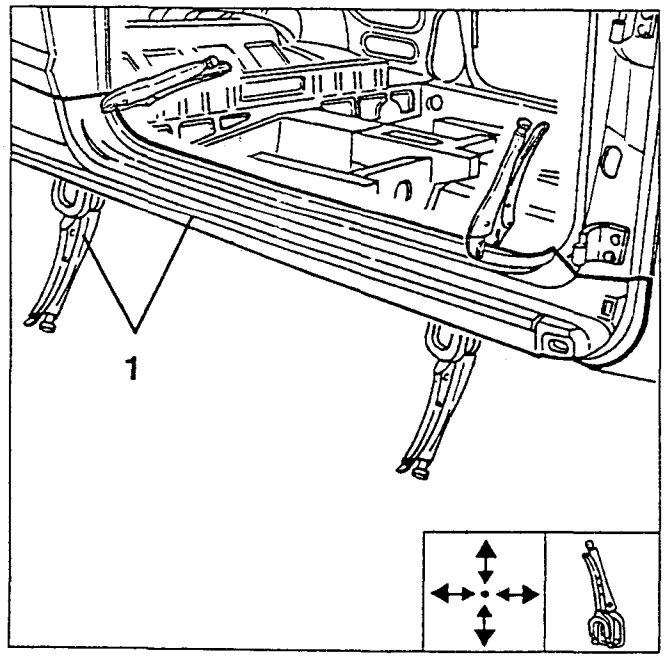


1. Apply electroweldable protection with a brush to the remaining areas to be spot welded.



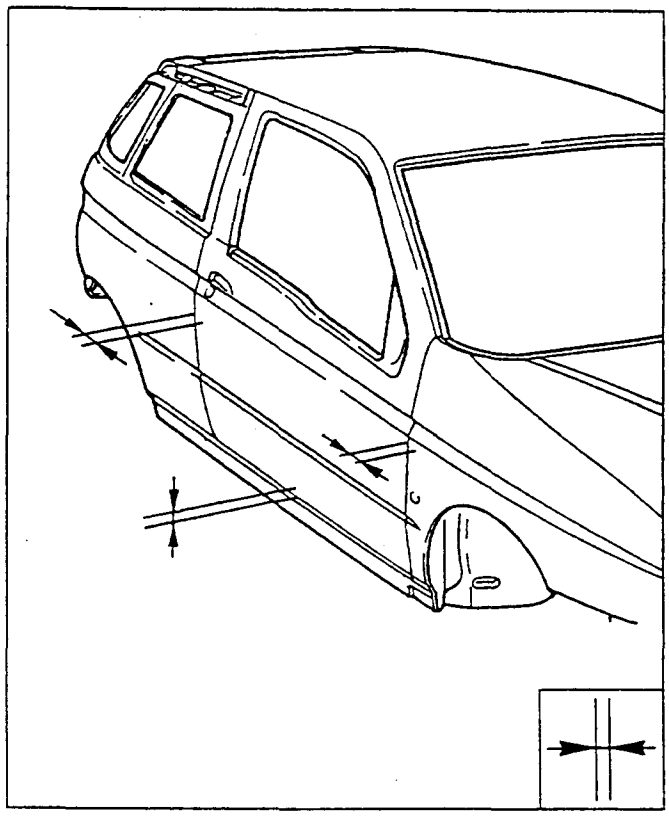
POSITIONING AND INSPECTION

1. Position the door sill rail joining together the edges to be welded and securing them with clamps.

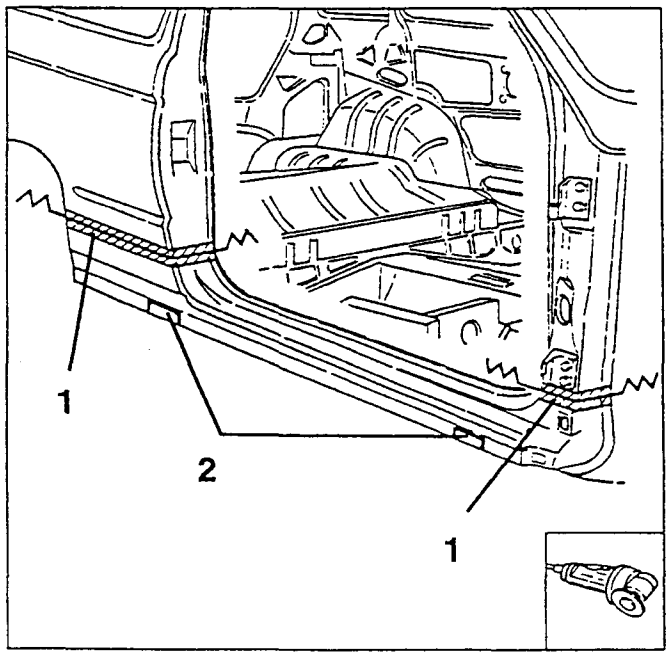


- Temporarily fix the door sill rail with screws and then remove the previously fitted clamps.

- Check parallelism, gaps and angles and refit the previously removed mobile components with their gaskets together with any parts which, once installed, make it possible to check the successful outcome of the operations.

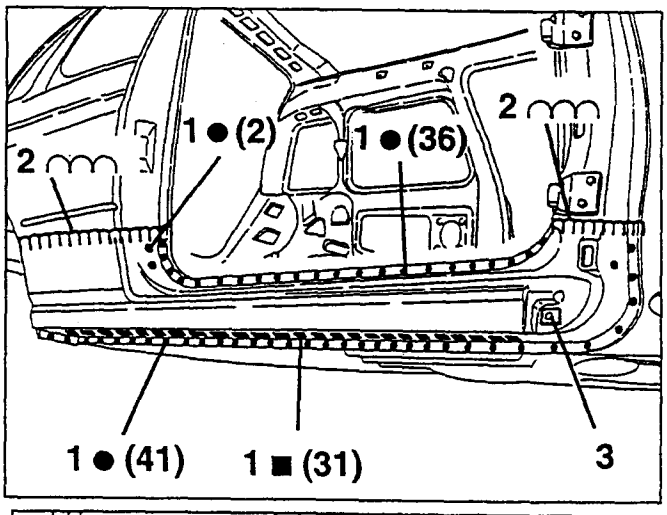


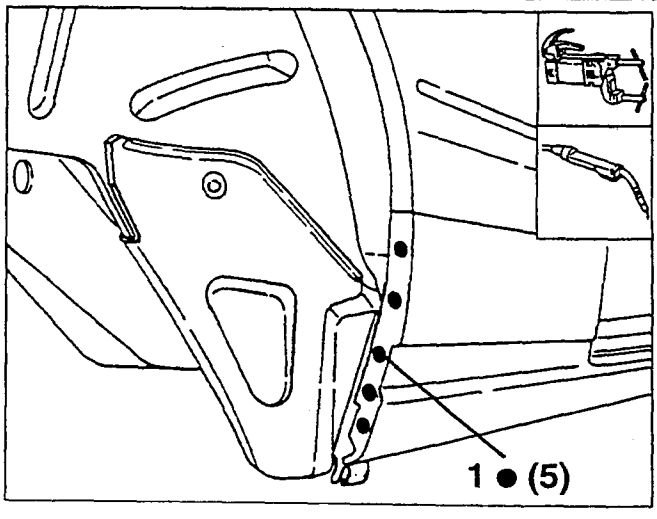
- Remove the components installed to check the correct position of the door sill rail.
1. Using a circular saw, trim the sheet metal and remove the excess parts without damaging the underlying parts.
2. Bend the clinch tabs.



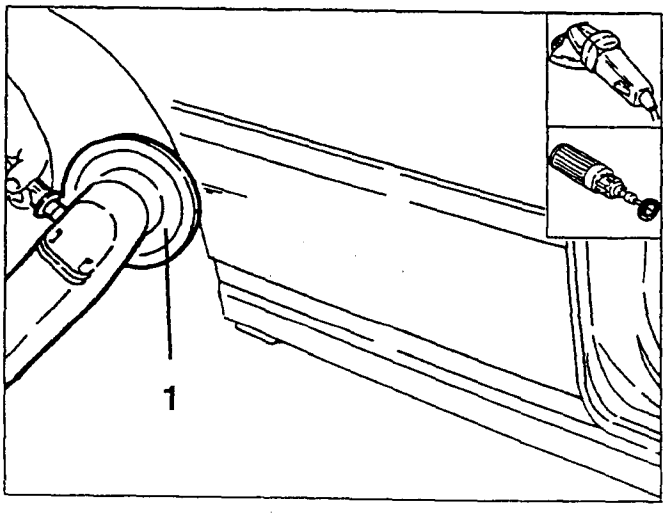
WELDING AND FINISHING OF THE SHEET METAL

1. Using a spot-welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, seam weld as shown in the diagram
3. Install the block securing the wing.



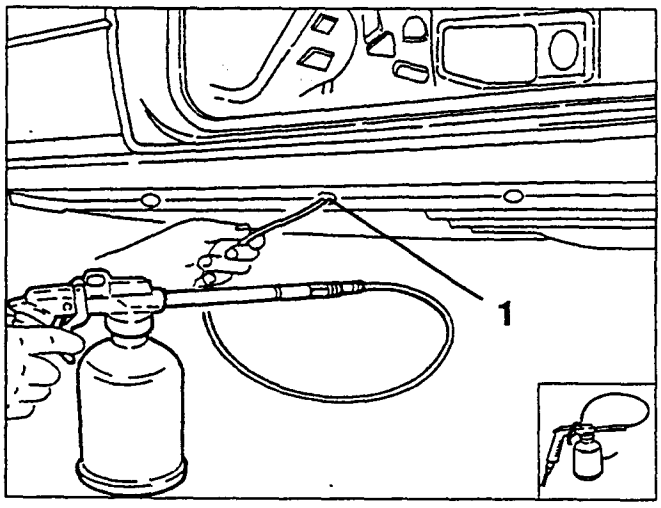


1. Using an abrasive grinding machine, remove and flush the residues left after welding.
- Using a rotating brush, clean the welded areas.

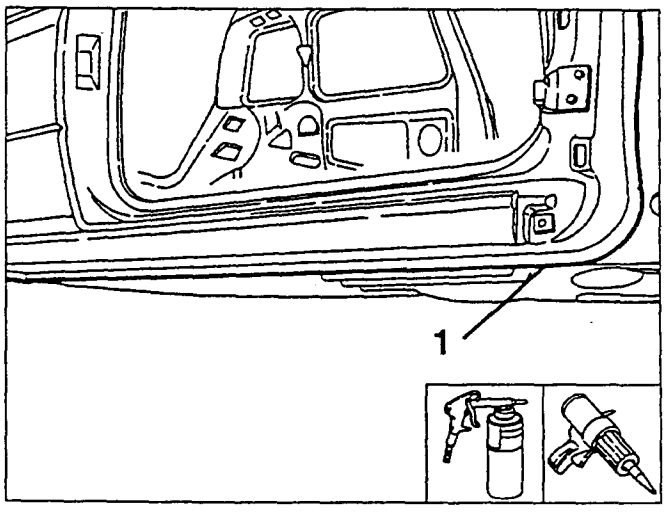


PROTECTION

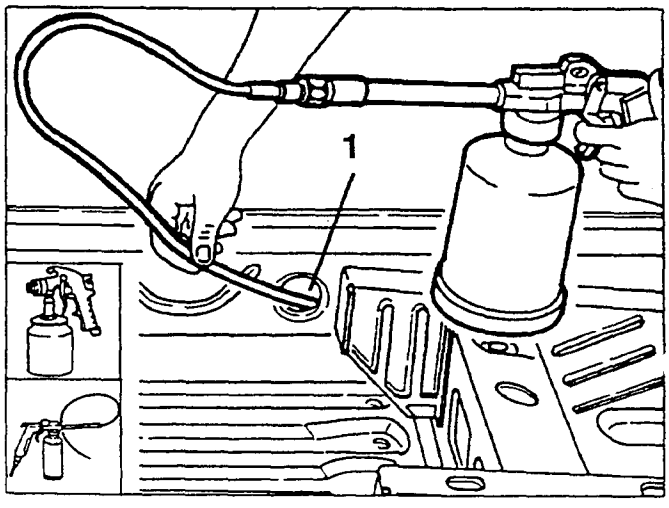
1. Apply the specified corrosion inhibitor to the areas to be welded MIG.



1. Apply the specified sealant along the lines highlighted in the diagram.
- Apply the specified underbody protection to the replaced areas.

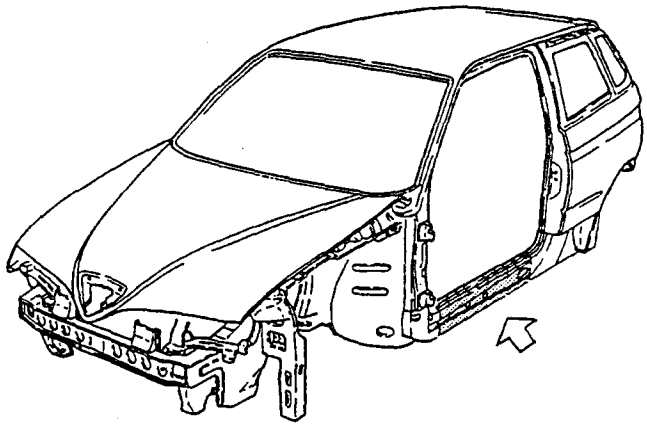


- Proceed to the painting phase.
1. Wax treat the boxed parts through the hole shown in the diagram.

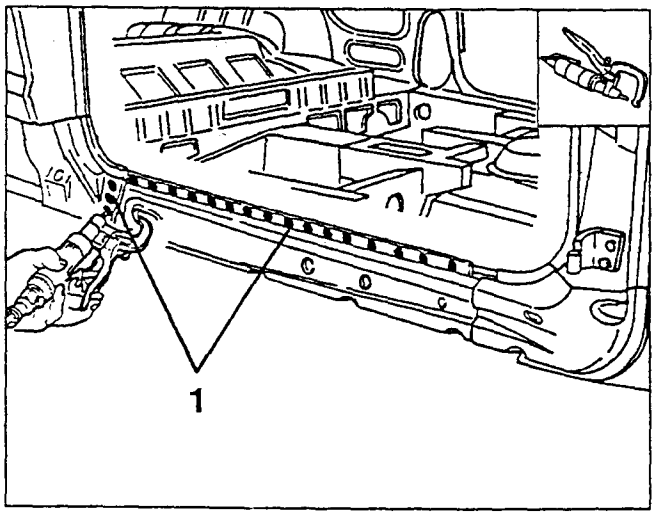


DOOR SILL FRAME (WITH DOOR SILL REINFORCING REMOVED)

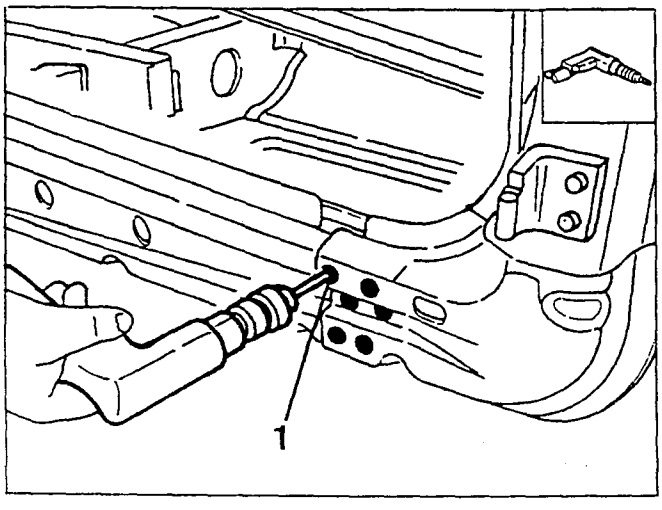
REMOVAL



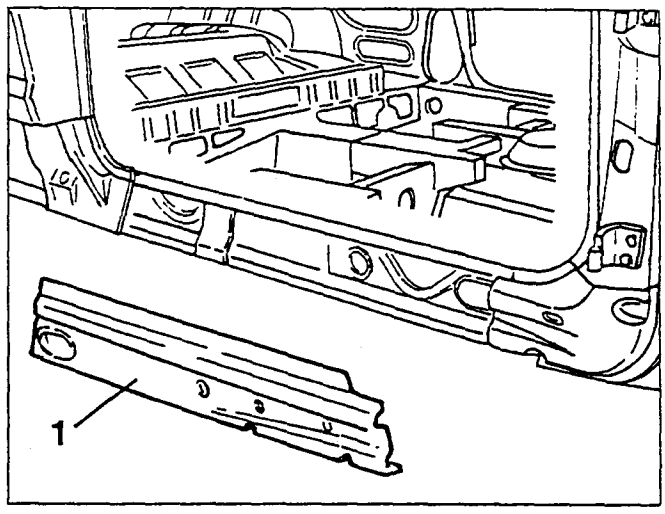
1. Using a spot cutter, remove the welding points shown in the diagram.



1. Using a drill, remove the welding points shown in the diagram.

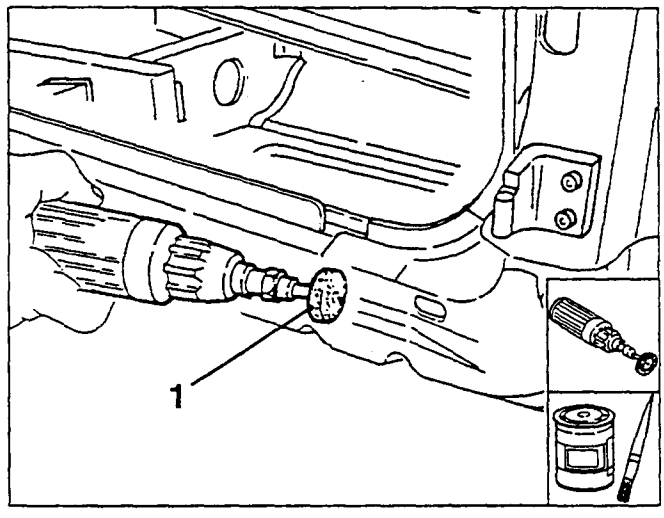


1. Remove the door sill frame.



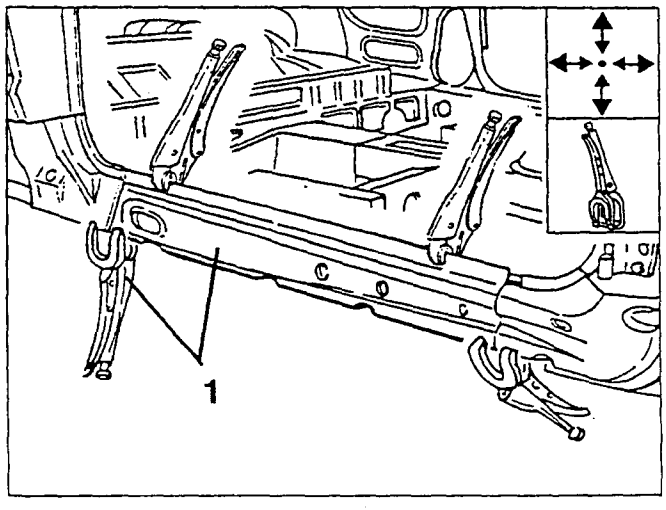
PREPARATION

1. Using a rotating brush, clean the area to be welded.
- Apply the specified electroweldable protection to the areas to be spot welded.



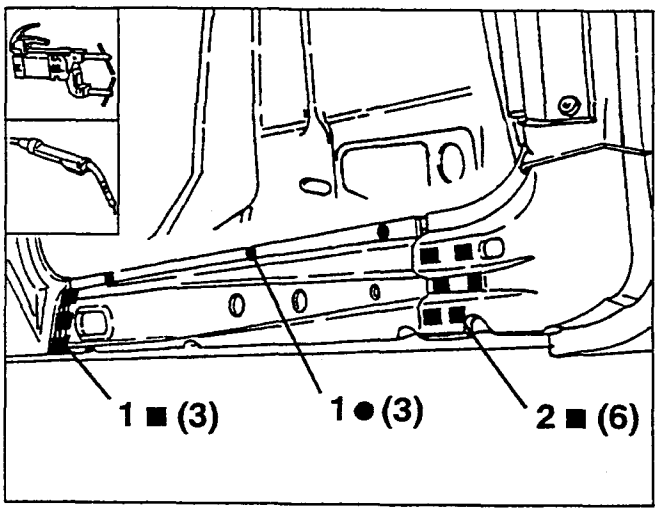
POSITIONING

1. Position the door sill frame and join the edges together and secure with clamps.



WELDING AND FINISHING THE SHEET METAL

1. Using a spot welder, tack the door sill frame as shown in the diagram.
2. Using a MIG welder, proceed as shown in the diagram.



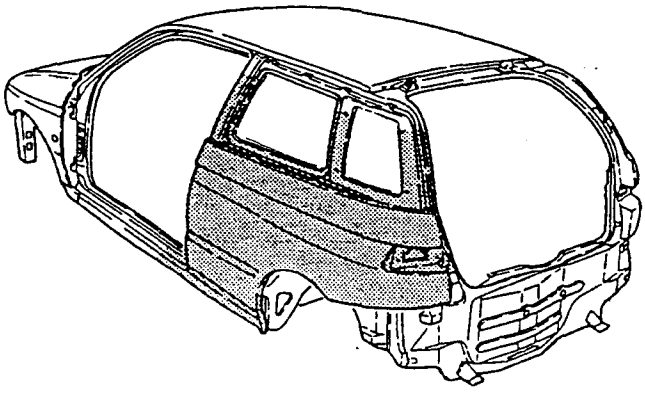
- Refit the reinforcing of the door sill proceeding as described in the relative paragraph.

REAR WING

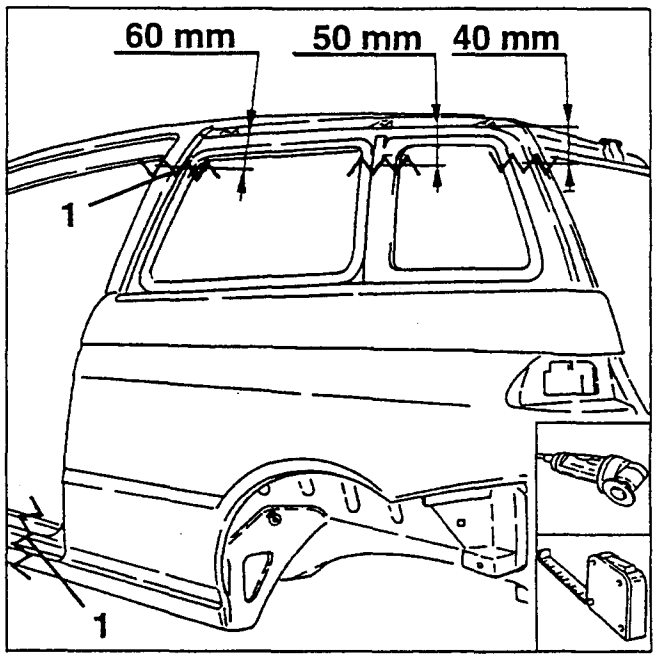
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the electronic control units.
- Remove the trim components, electrical and mechanical system which could hinder the repair operations or get damaged during work (see specific paragraphs)
– Remove the following sheet metal parts:
• door on affected side (see specific paragraph).
• front wing on affected side (see specific paragraph).

REMOVAL

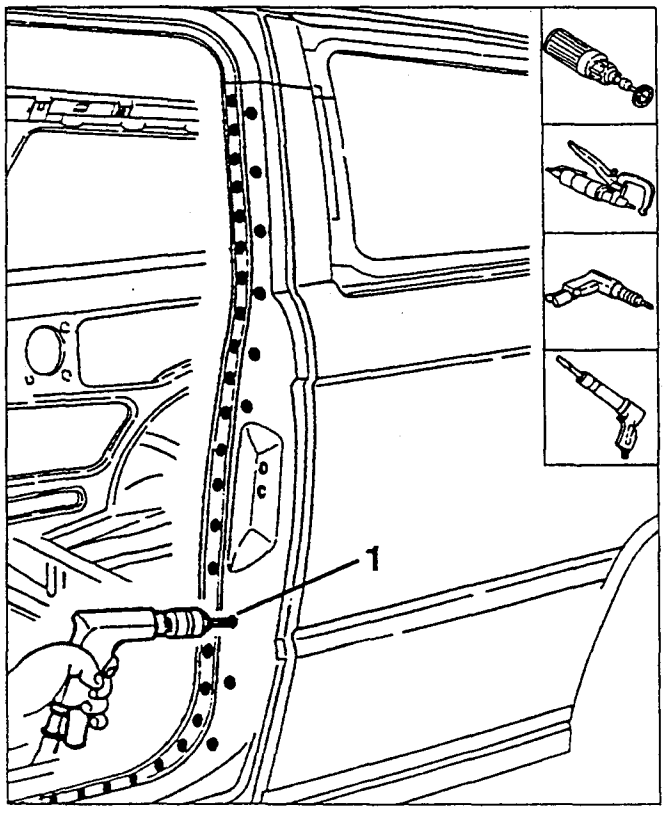


1. Using a circular saw, cut following the lines indicated in the diagram, without damaging the underlying components.

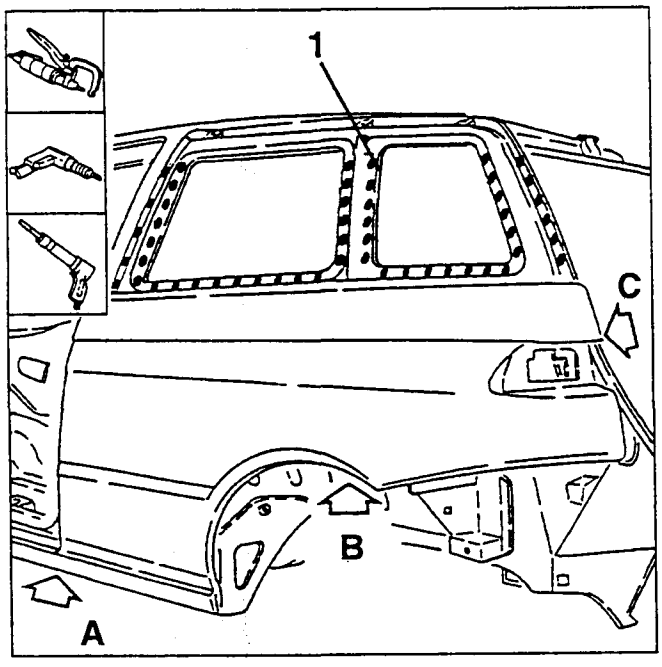


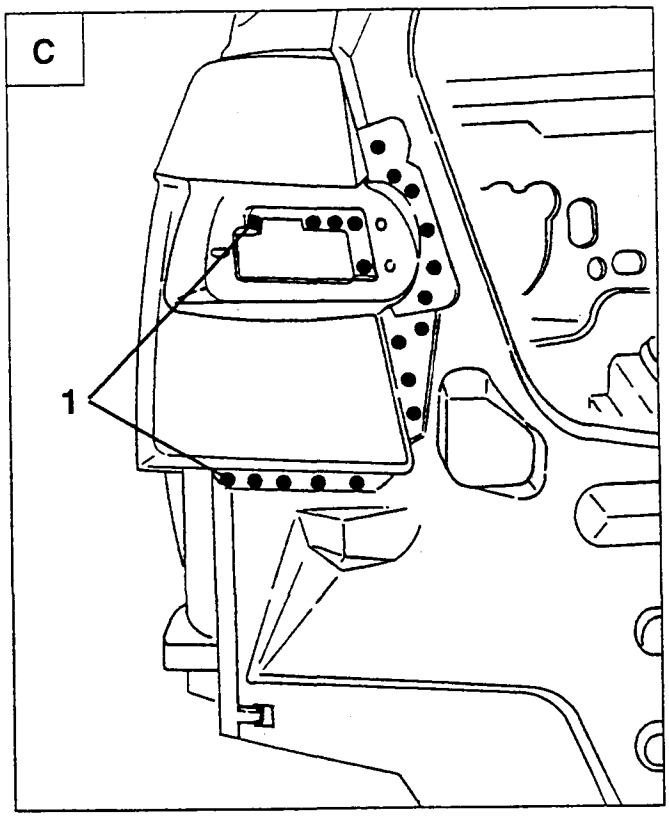
- Using a rotating brush, clean the areas to be spot-cut to highlight the welding points.
1. Using a spot cutter, remove the accessible welding points; remove the remaining welding points using a drill or a chisel.

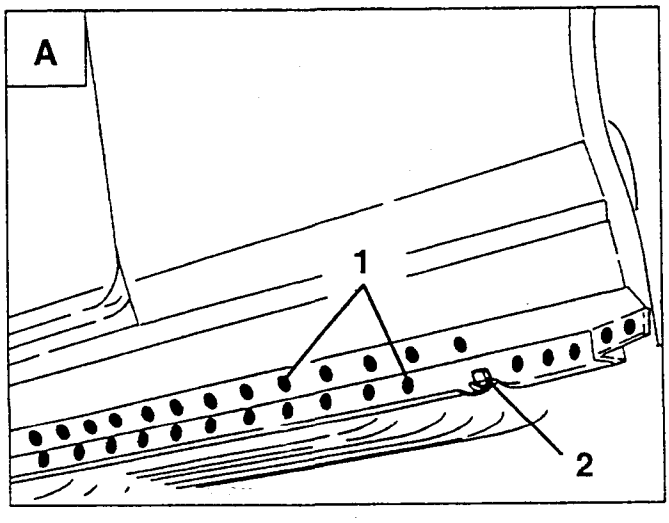
NOTE:
If necessary free the sheet metal to facilitate the spot cutting operations



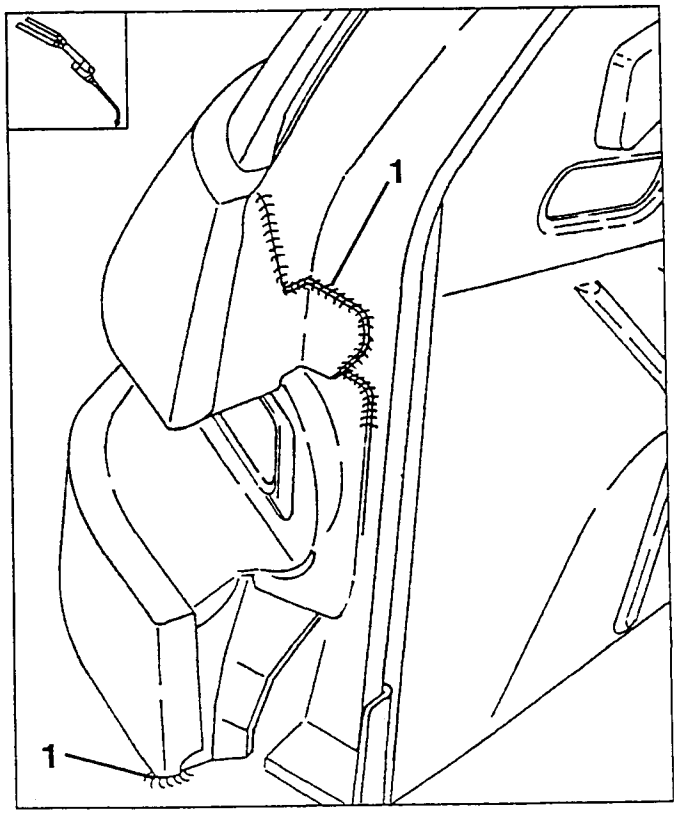
1. Using a spot cutter, remove the accessible welding points; remove the remaining points using a drill or a chisel.
2. Open the clinch tabs.

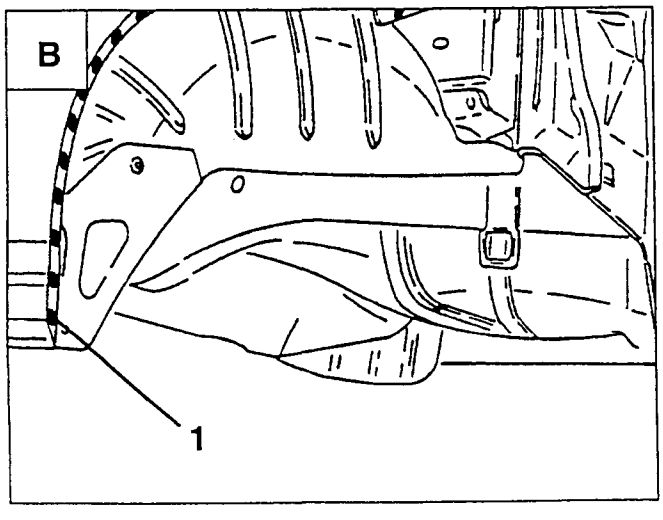






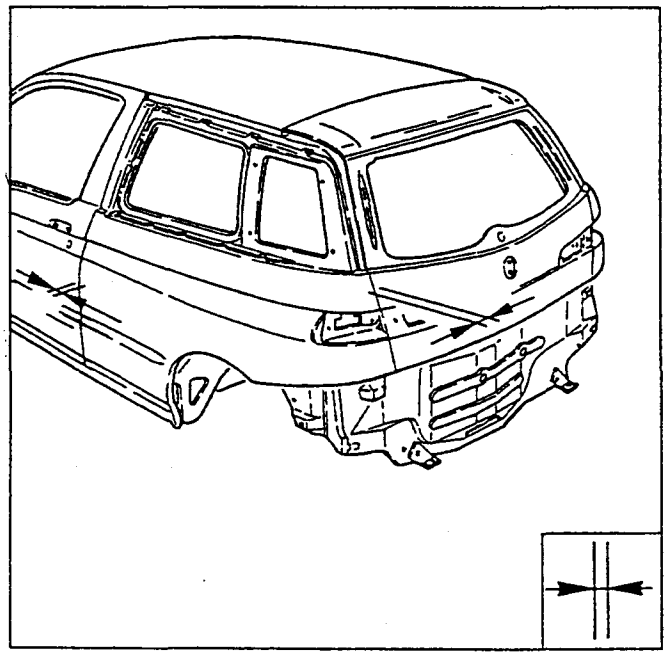
1. Using an oxyacetylene torch, unweld and remove the rear areas of the wing.





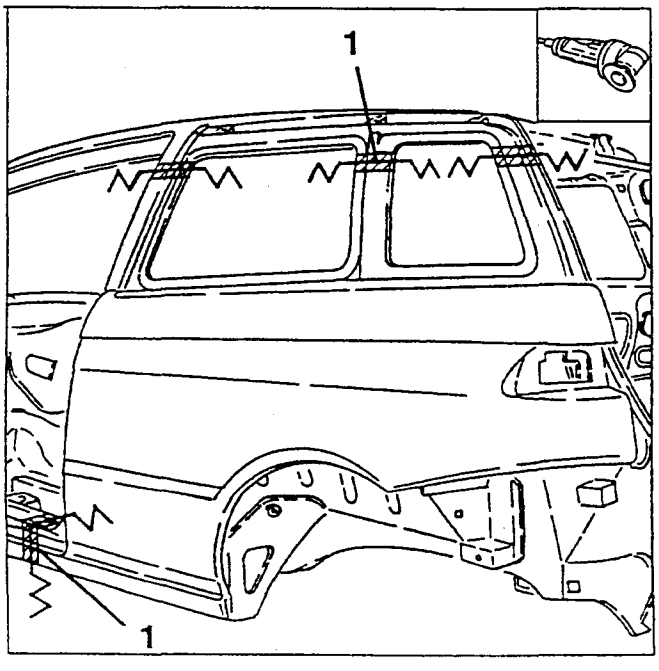
PREPARATION AND INSPECTION

- Working on a bench with a jig saw cut the new rear wing, remembering to leave enough margin for overlapping.
- Temporarily install the rear wing.
- Check parallelism, gaps and angles and refit the mobile components removed previously with their gaskets and the parts which, when fitted, permit verification of the success of the operations.

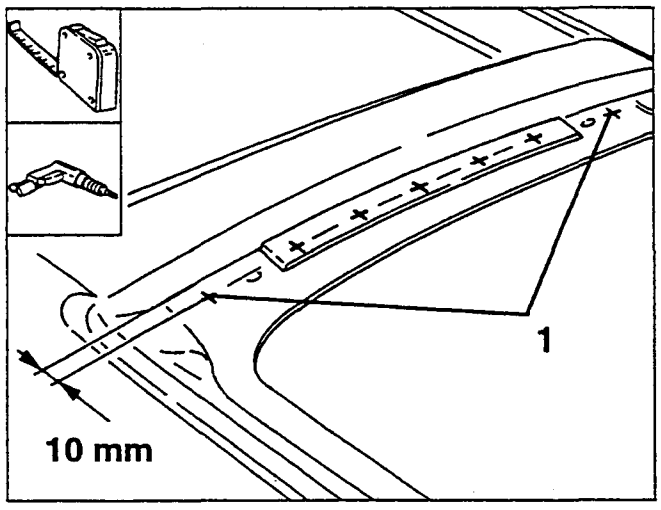


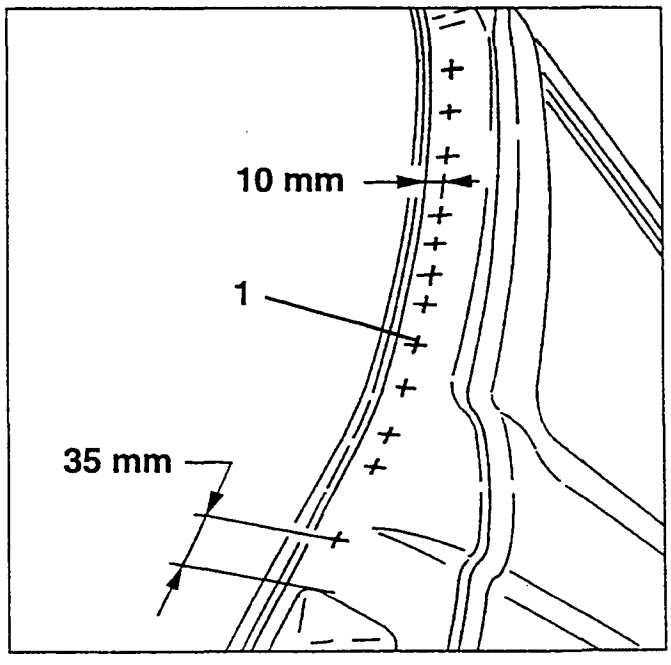
- Remove the components installed to check the correct positioning of the rear wing.

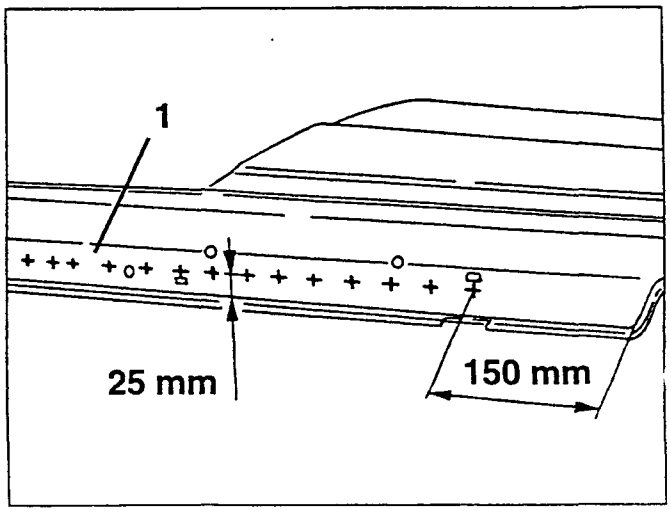
1. Using a circular saw, trim the excess sheet metal parts without damaging the underlying components.



1. Remove the wing and, working on a bench trace out and perforate using a drill and Ø 5 mm bit, as shown in the diagram.

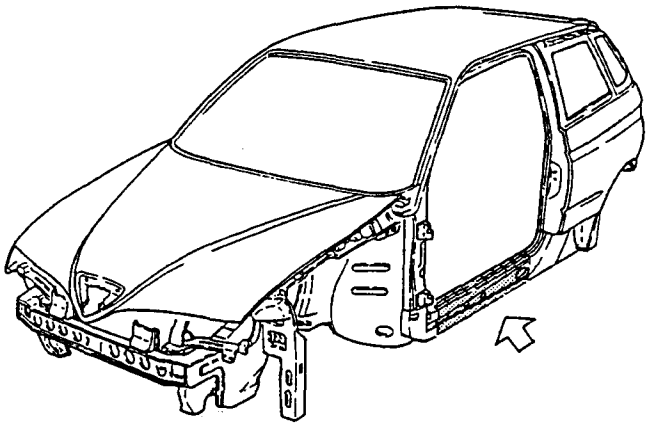




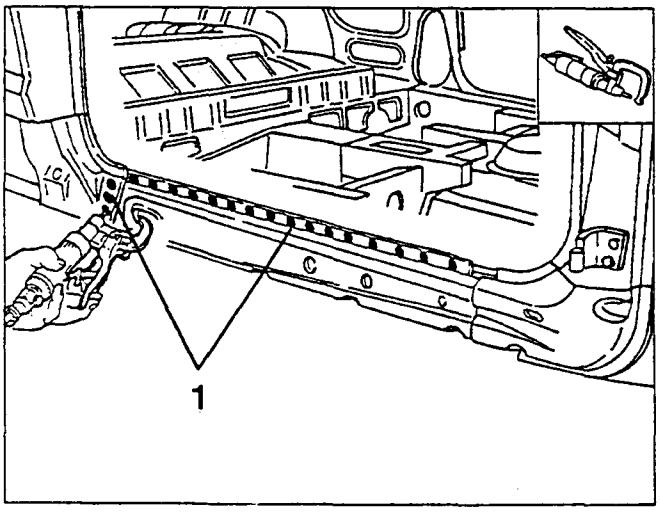


DOOR SILL FRAME (WITH DOOR SILL REINFORCING REMOVED)

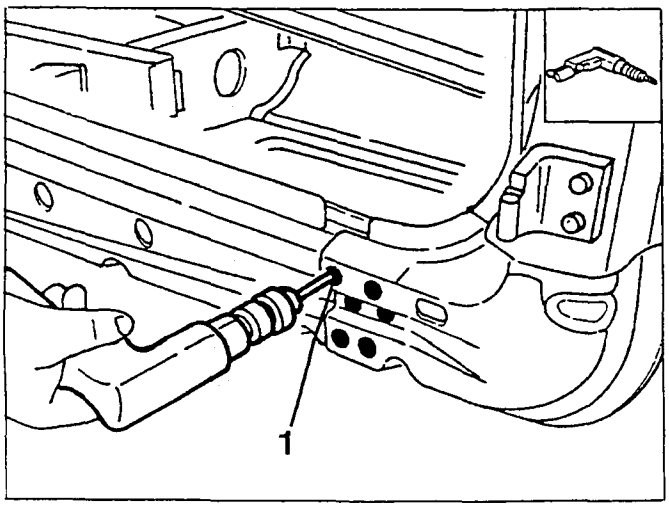
REMOVAL



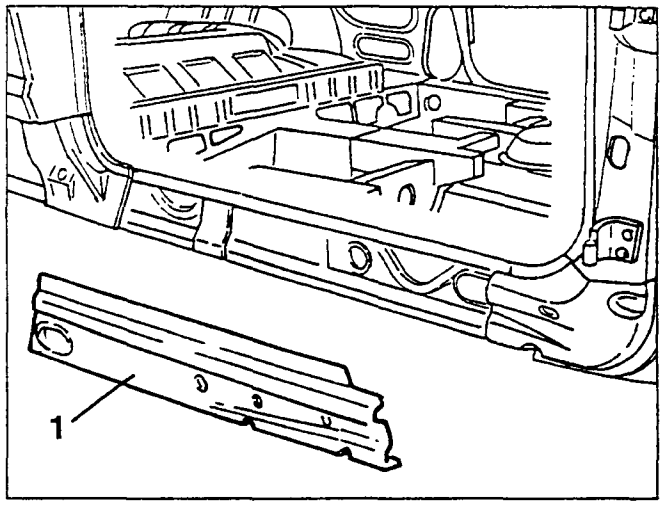
1. Using a spot cutter, remove the welding points shown in the diagram.



1. Using a drill, remove the welding points shown in the diagram.

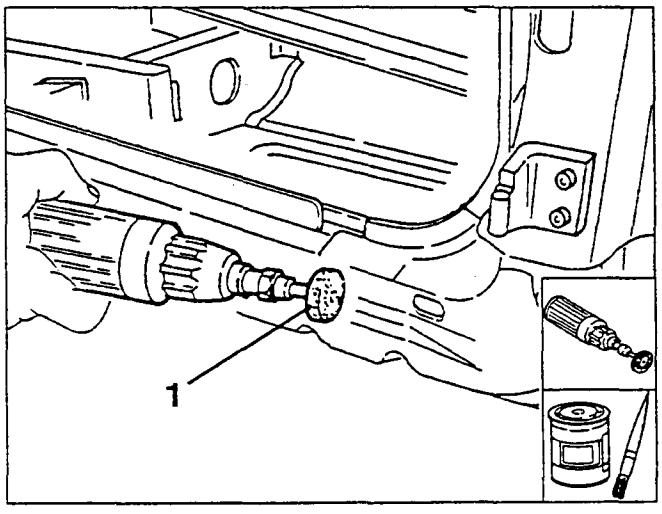


1. Remove the door sill frame.



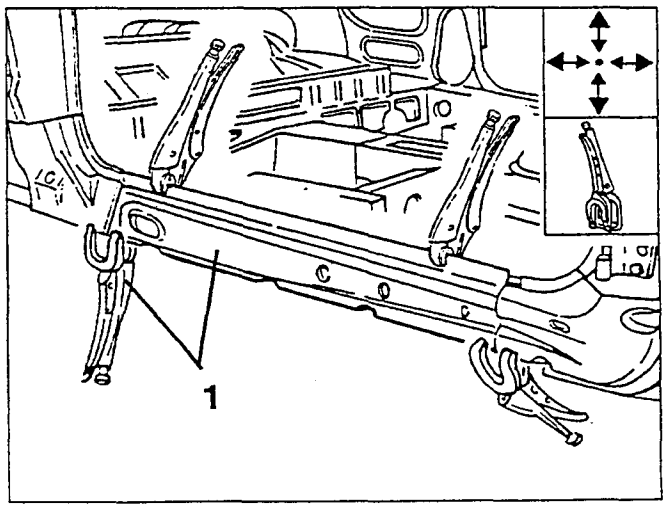
PREPARATION

1. Using a rotating brush, clean the area to be welded.
- Apply the specified electroweldable protection to the areas to be spot welded.

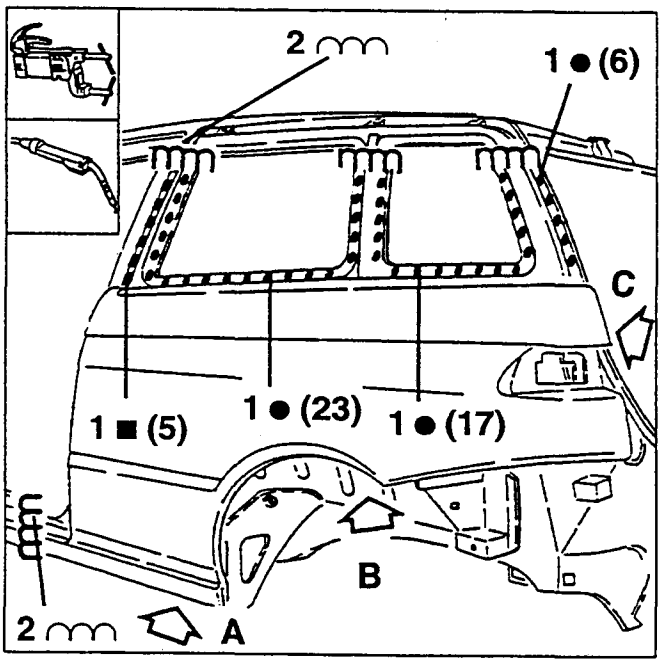


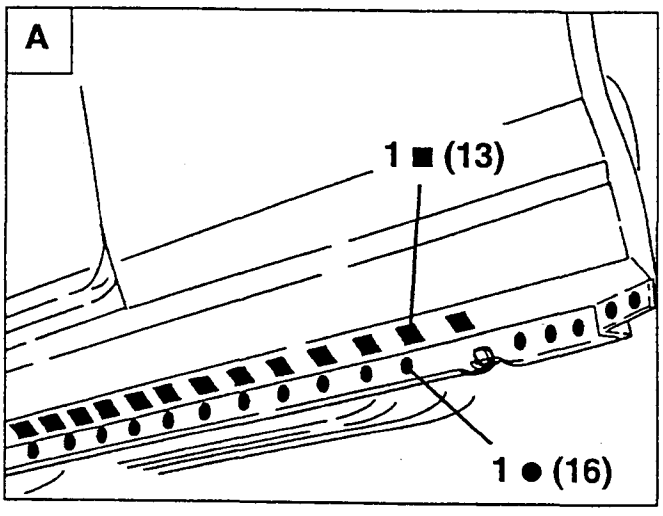
POSITIONING

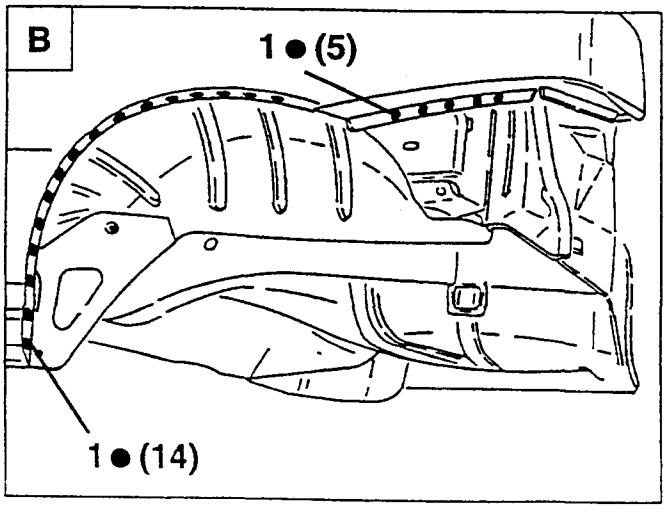
1. Position the door sill frame and join the edges together and secure with clamps.

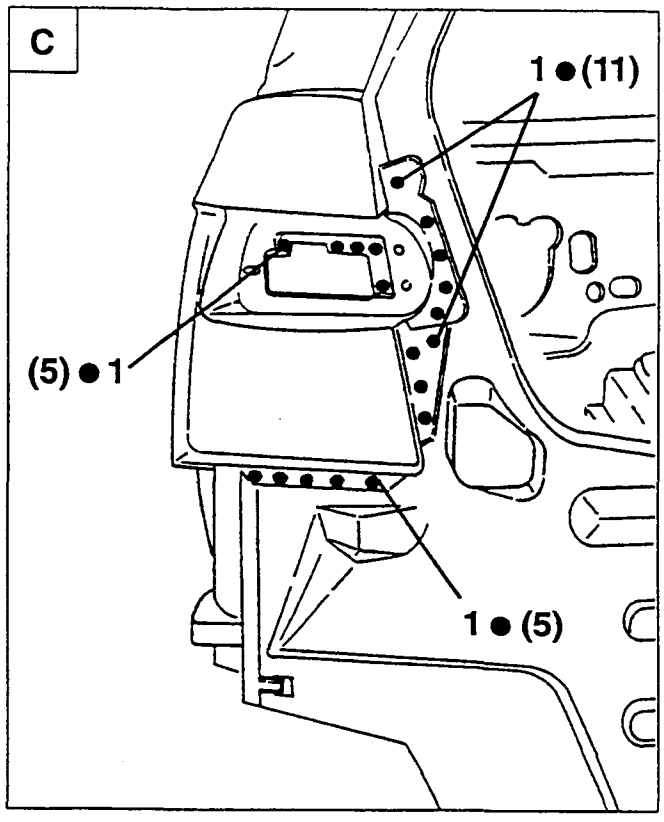


1. Using a spot welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, weld a seam as shown in the diagram.

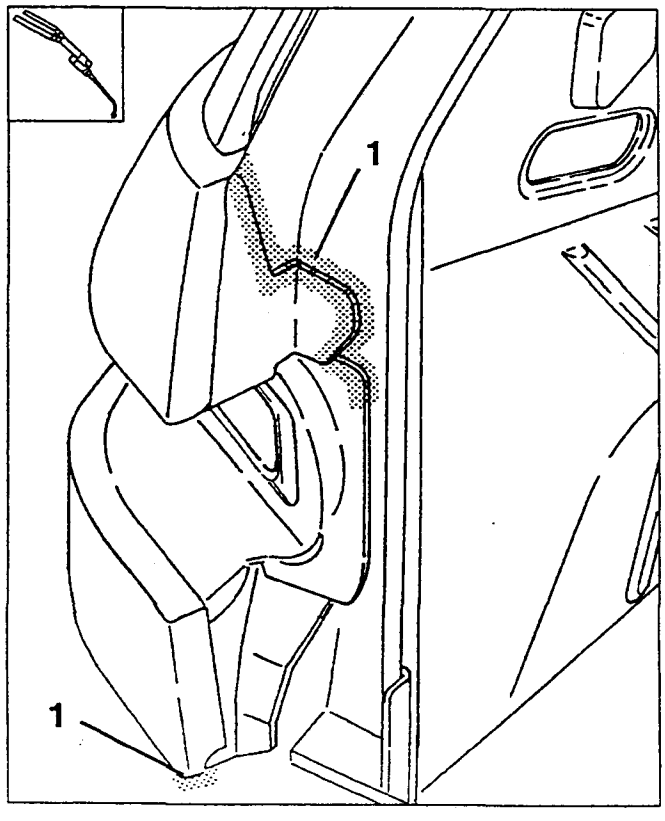




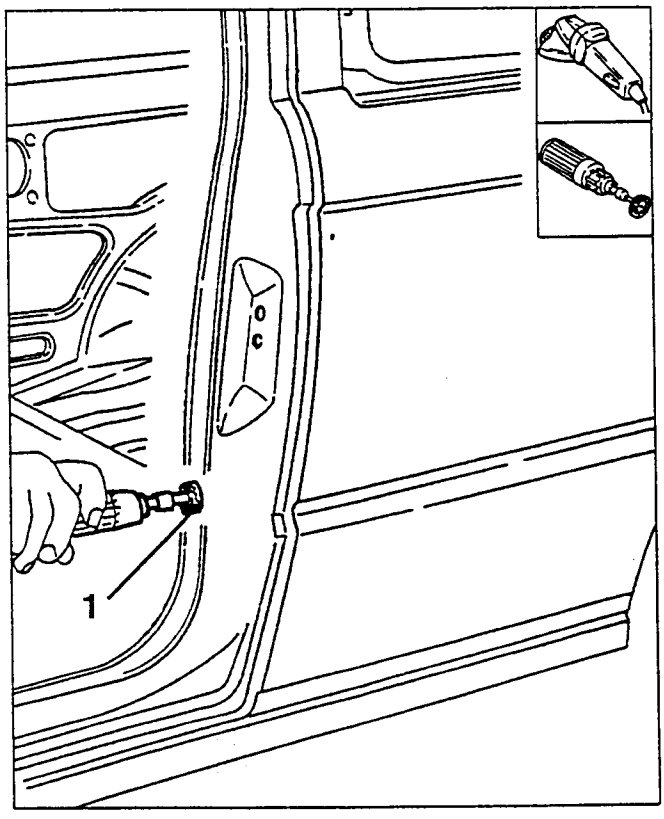




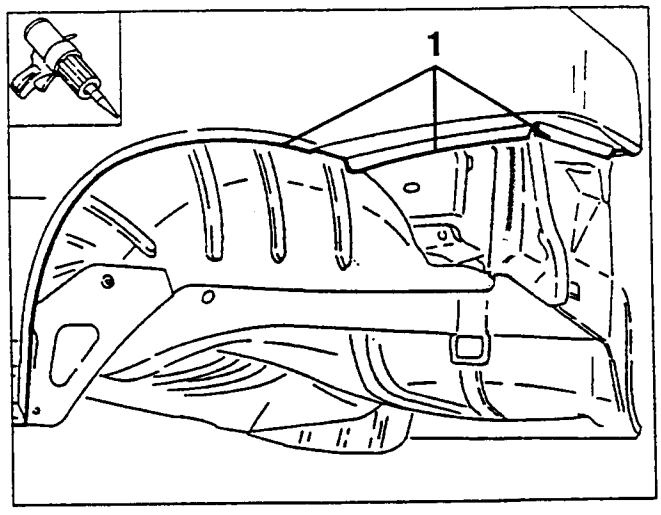
1. Using an oxyacetylene torch, brass braze-weld as shown in the diagram.

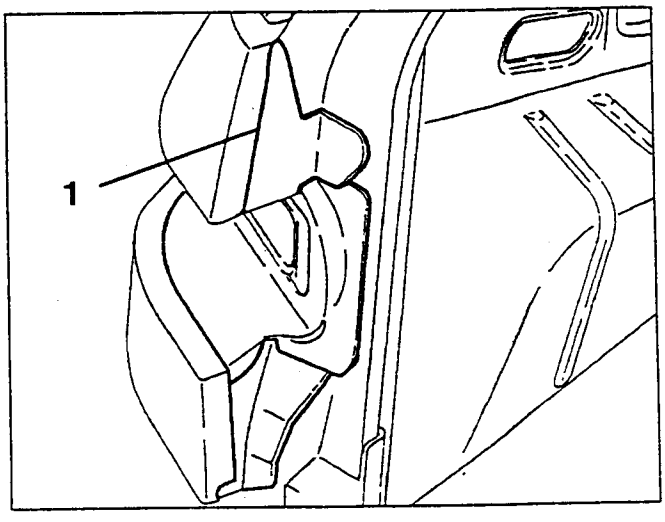


- Using an abrasive grinding wheel, remove and flush the residues left by welding.
1. Using a rotating brush, clean the welded areas.



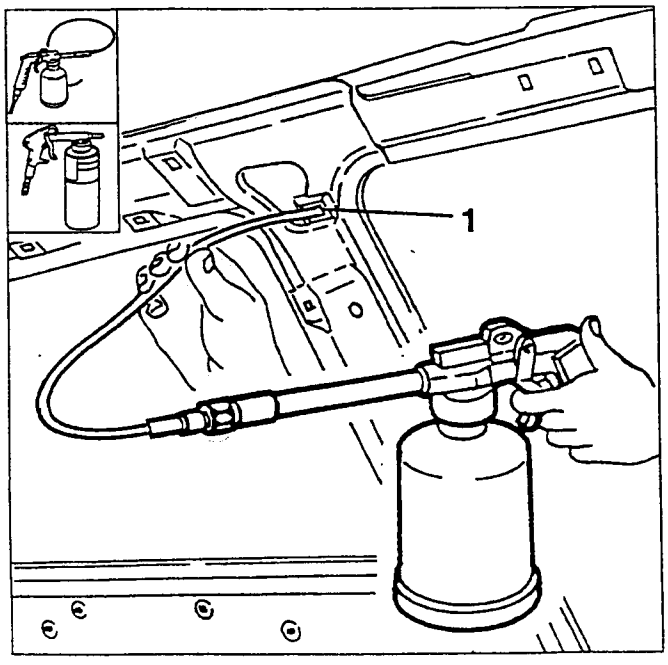
1. Apply the specified sealant to the joints in the metal sheet of the rear wing.



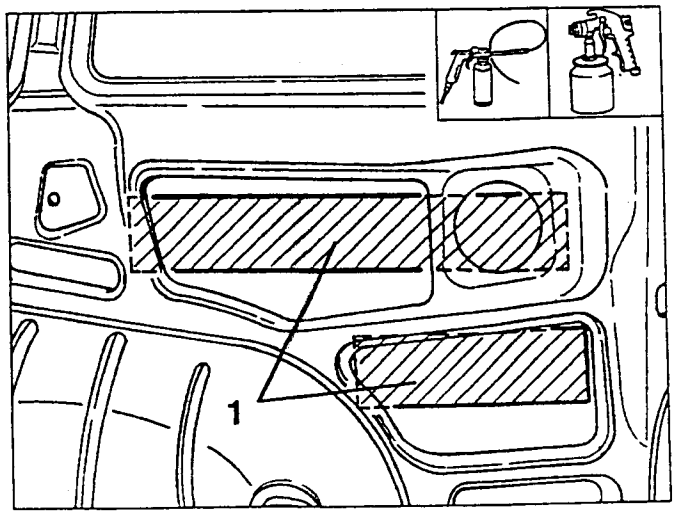


PROTECTION

1. Apply the specified corrosion inhibitor to the areas to be MIG welded and braze-welded.
- Apply the underbody protection in the new areas of the wheel housing.

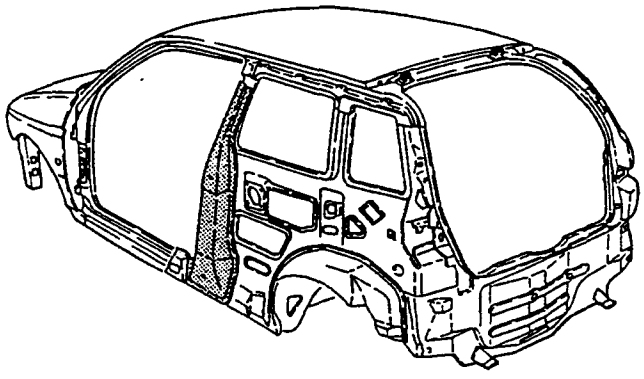


1. Apply the sound-proof panels to the rear wing as shown in the diagram.
- Proceed to the painting phase.
- Proceed to the wax-treatment phase.

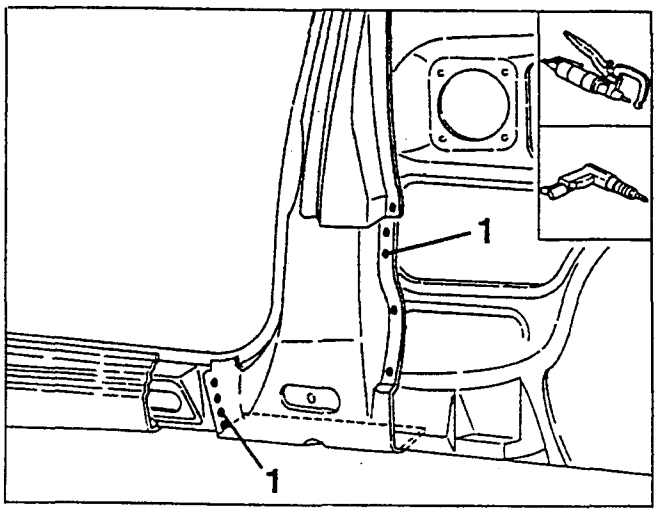


CENTRAL PILLAR (WITH REAR WING REMOVED)

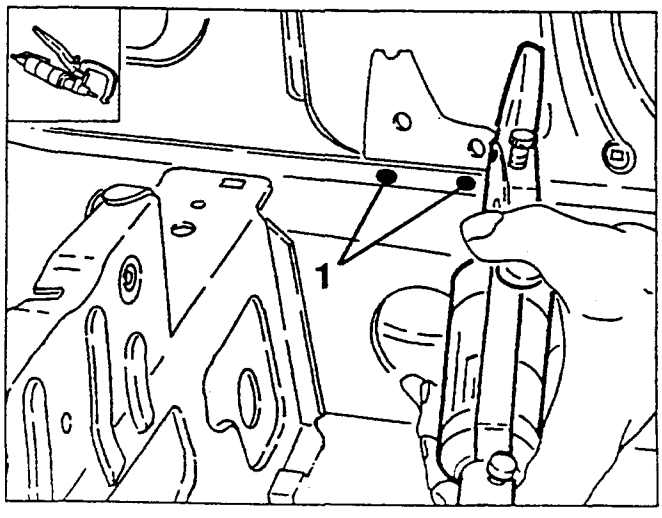
REMOVAL



1. Using a spot cutter, remove the accessible welding points; remove the remaining welding points using a drill.



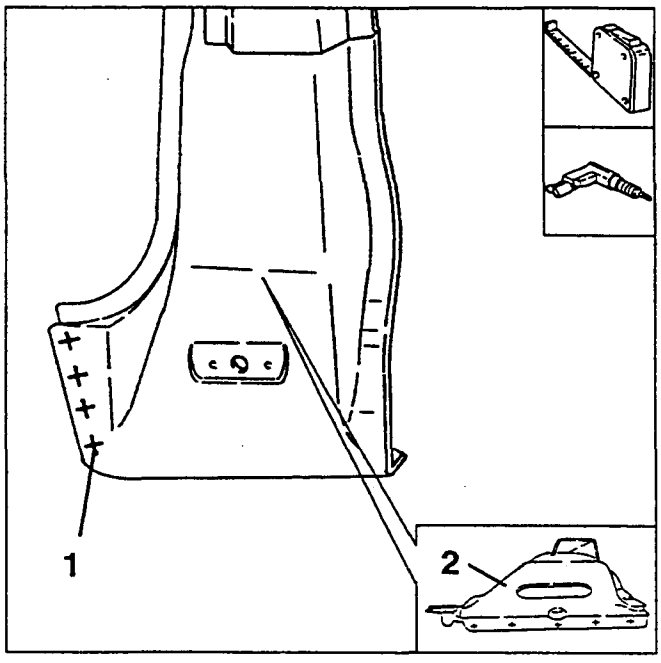
1. Using a spot cutter, remove the welding points shown in the diagram.



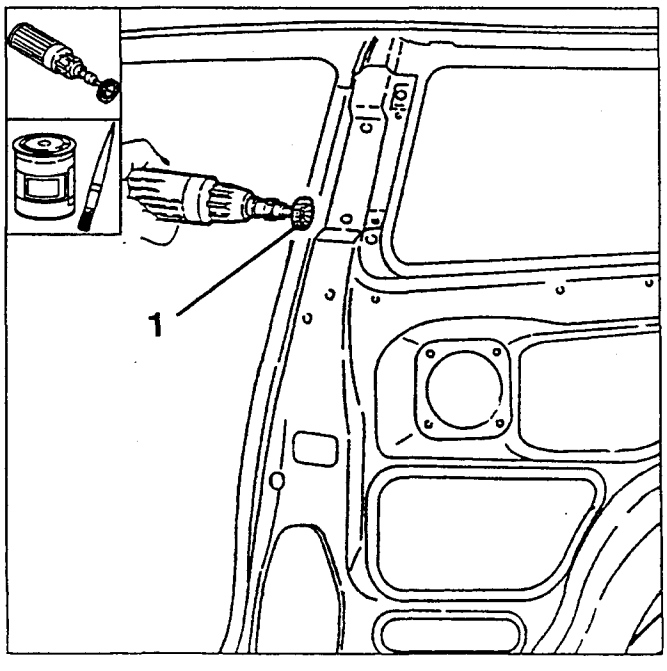
- Remove central pillar.

PREPARATION

1. Working on a bench trace out and perforate the new pillar with a drill and Ø 5 mm bit, as shown in the diagram.
2. Trace as shown in the figure for subsequent assembly with the wheel arch.

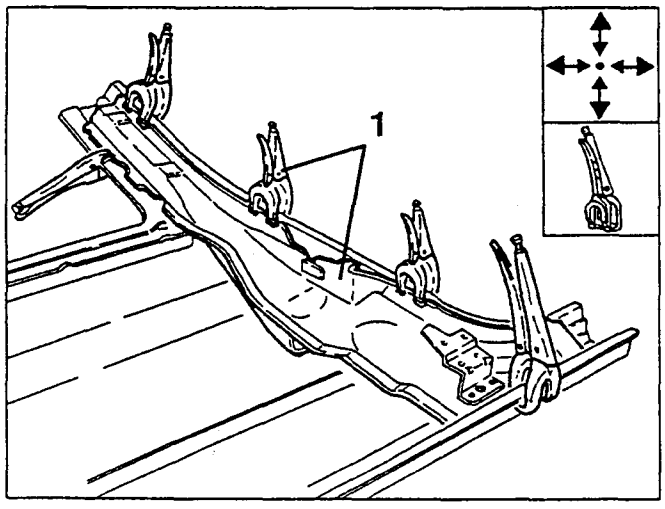


1. Using a rotating brush, clean the area to be welded.
- Apply the specified electroweldable protection to the areas to be spot welded.



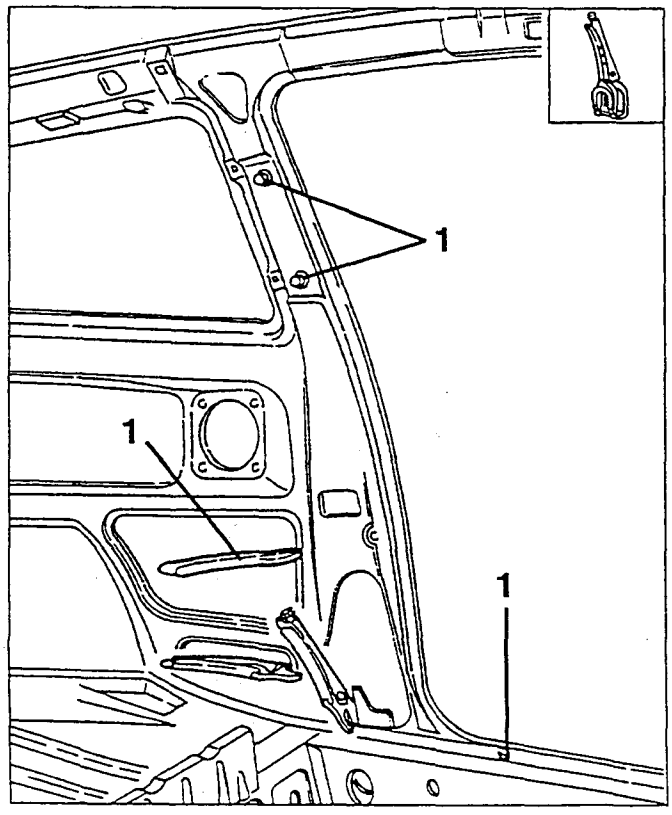
1. Position the new pillar on the rear wing and fix it with clamps.
- Fix the pillar to the wing using screws and the remove the clamps.

NOTE:
Take the centering of the plate for attaching the door catch as a reference point for the installation of the pillar on the rear wing.



POSITIONING

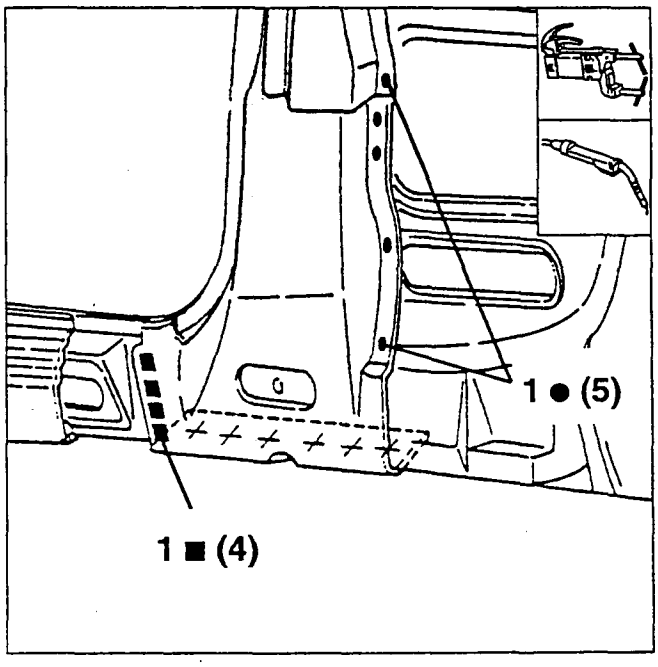
1. Install the assembled rear wing and pillar and secure it with clamps from the inside and with the two screws attaching the upper seatbelt attachment and a self-tapping screw.

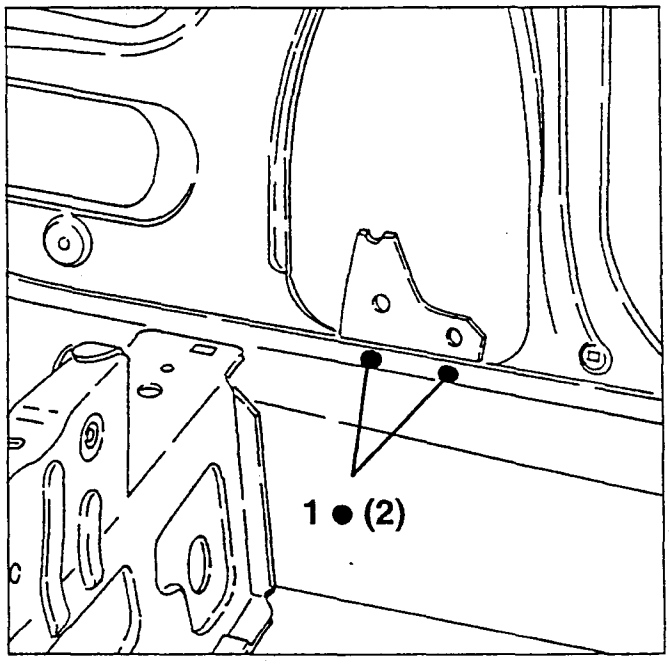


- Check alignment of the door with its seals and parts which when installed make it possible to check the outcome of the operations.
- Remove the rear wing leaving the pillar in its correct position.

WELDING AND FINISHING THE SHEET METAL

1. Using a spot welder or, where necessary, a MIG welder, proceed as shown in the diagram.

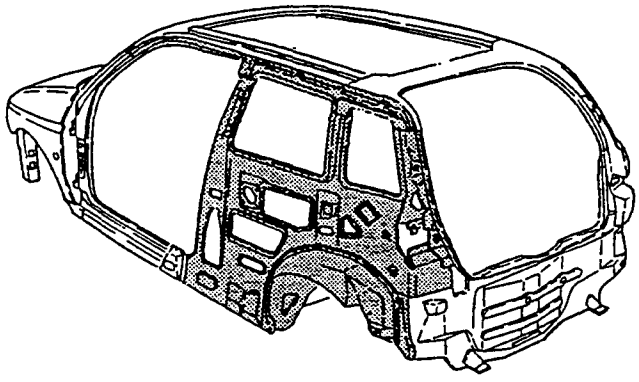




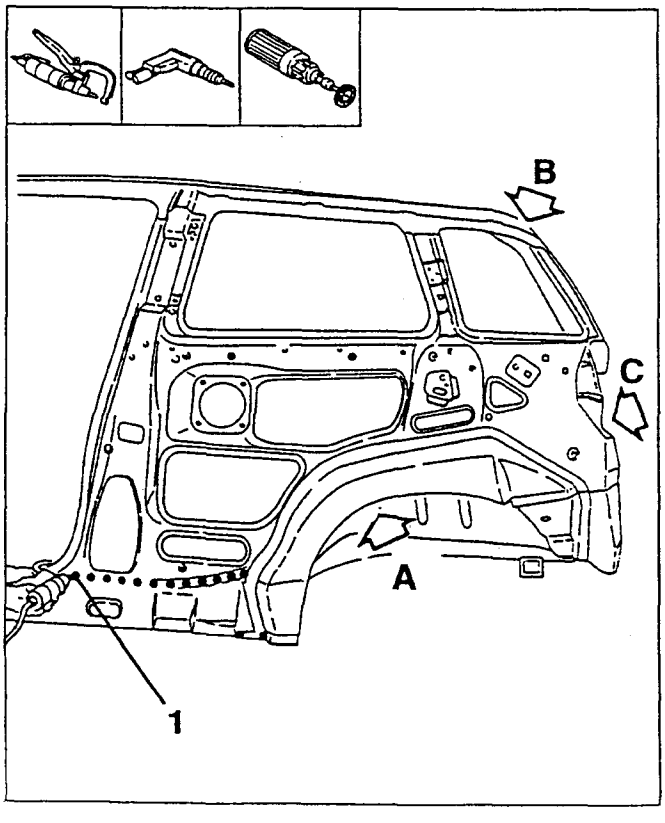
- Using an abrasive grinding wheel, remove and flush the residues left by welding.
- Using a rotating brush, clean the welded areas.

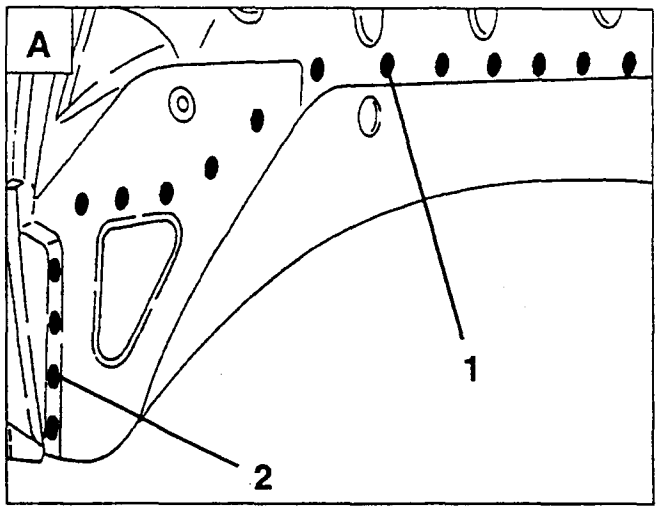
INNER SIDE PANEL FRAME (WITH REAR WING, CENTRAL PILLAR AND ROOF PANEL REMOVED)

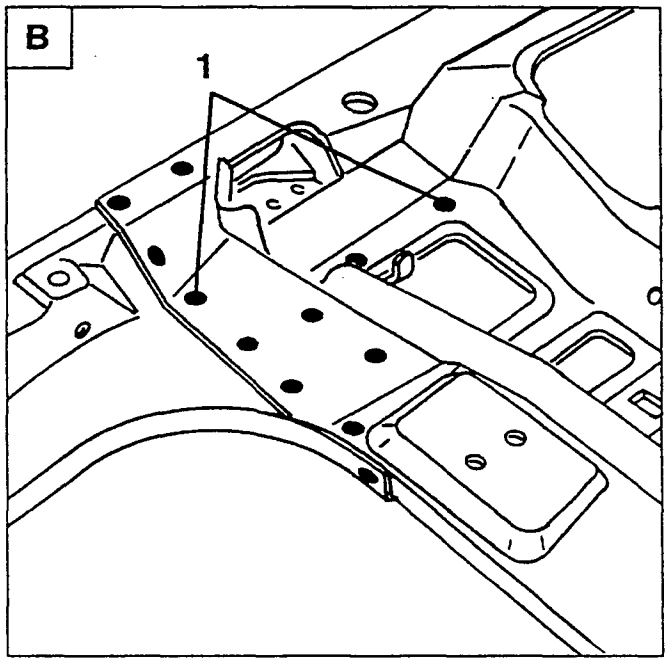
REMOVAL

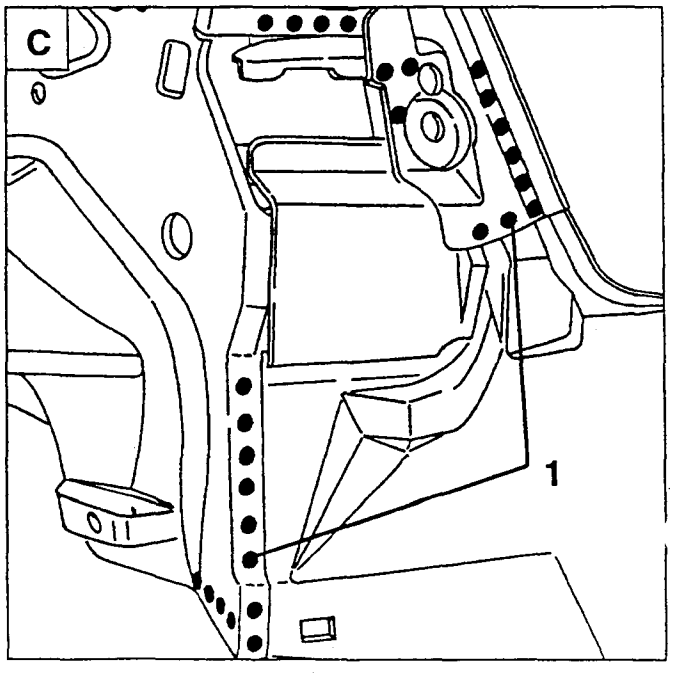


- Using a rotating brush, clean the areas to be spot-cut to highlight the welding points.
1. Using a spot cutter, remove the accessible welding points; remove the remaining welding points using a drill.
2. Using a drill, remove the welding points indicated after freeing the sheet metal to permit access.

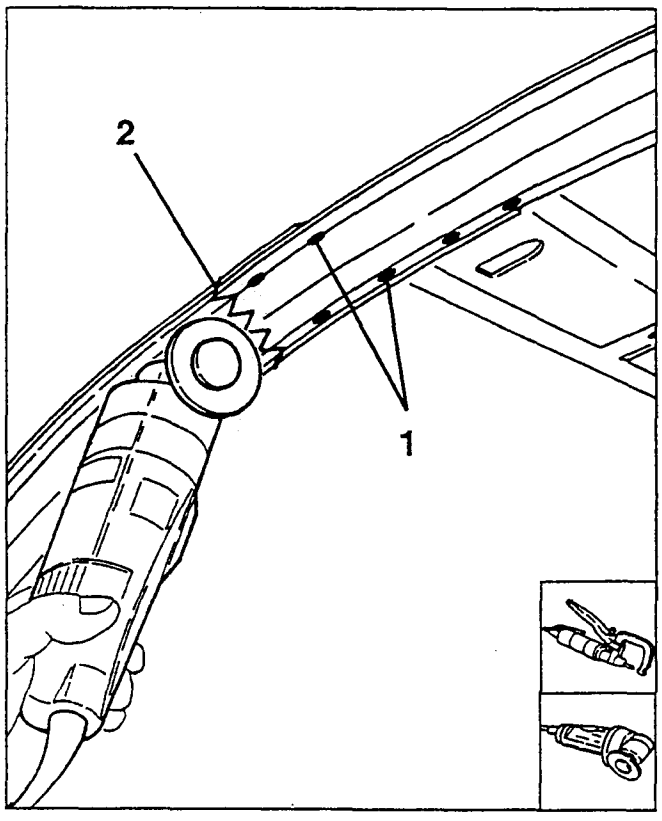




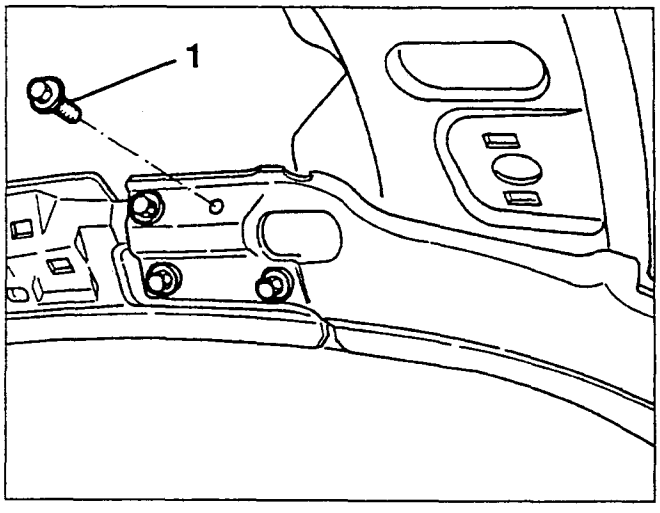




1. Using a spot cutter, remove the welding points shown in the diagram.
2. Using a circular saw, cut following the lines indicated in the diagram without damaging the underlying components.



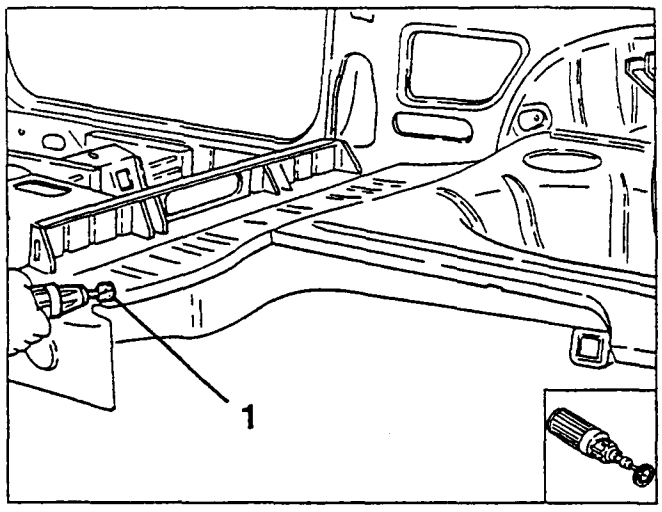
1. Loosen the four screws securing the inner frame of the side panel and the front windscreen frame.



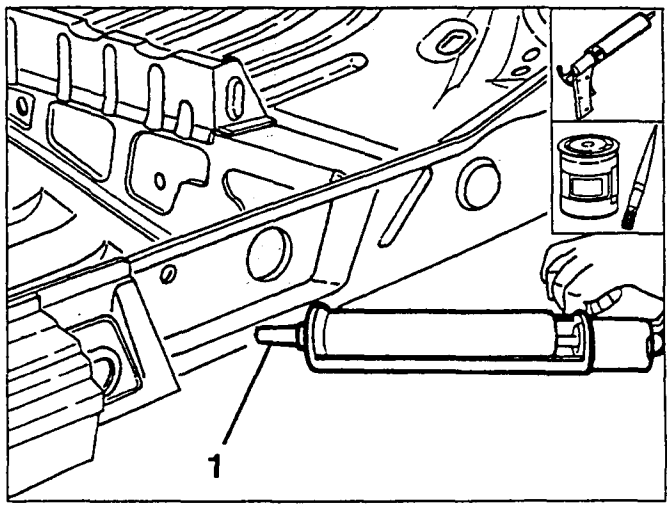
- Remove the complete inner side panel frame after opening the clinch tabs.

PREPARATION

1. Using a rotating brush, clean the area to be welded.

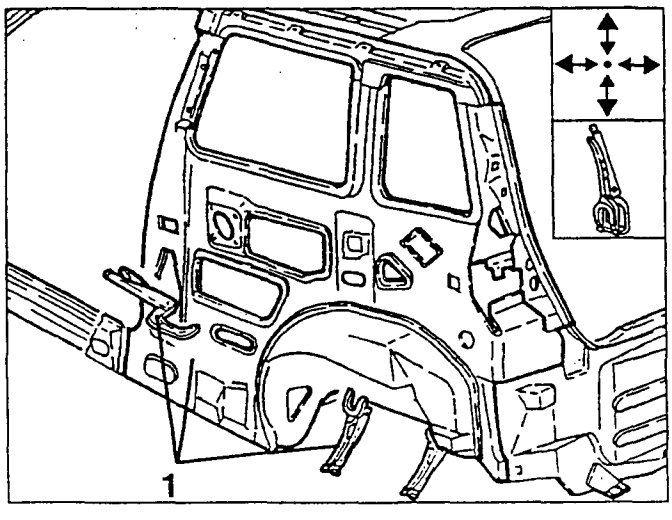


1. Apply a thick layer of electroweldable protection to the entire lover part of the side panel inner frame mating surfaces and with a brush to the remaining areas to the spot welded.

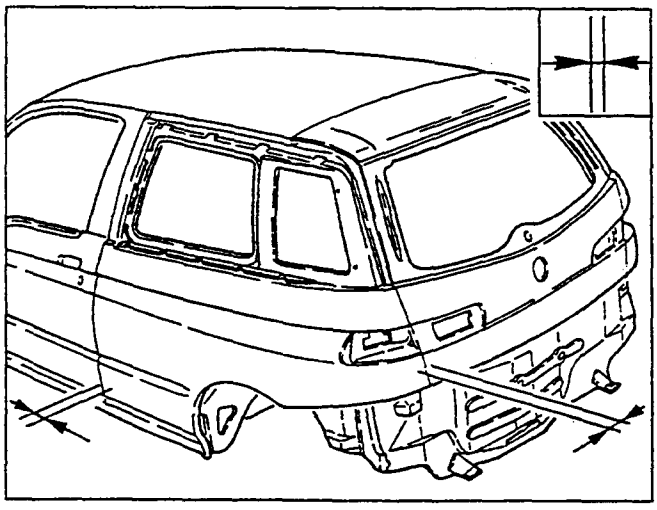


POSITIONING AND INSPECTION

1. Position the side panel inner frame and join the edges together and secure with clamps and the four front screws connecting the front windscreen frame and the clinch tabs.

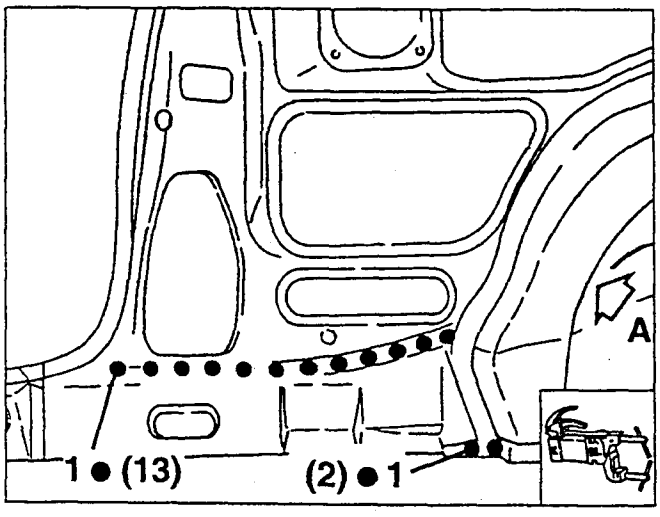


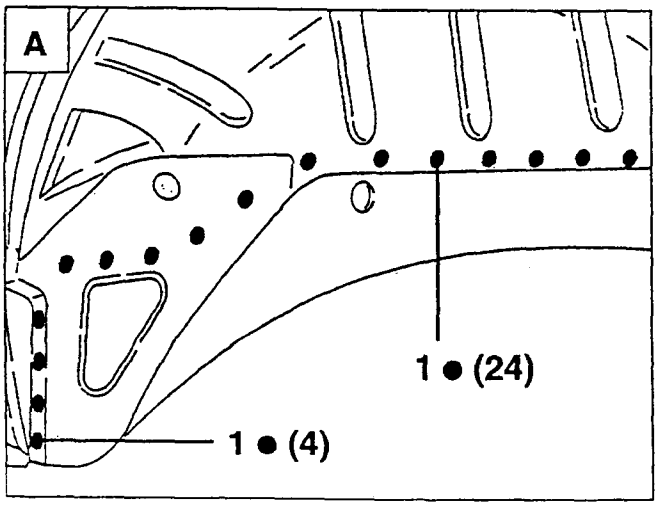
- Check parallelism, gaps and angles and refit the mobile components removed previously with their gaskets and the parts which, when fitted, permit verification of the success of the operations.



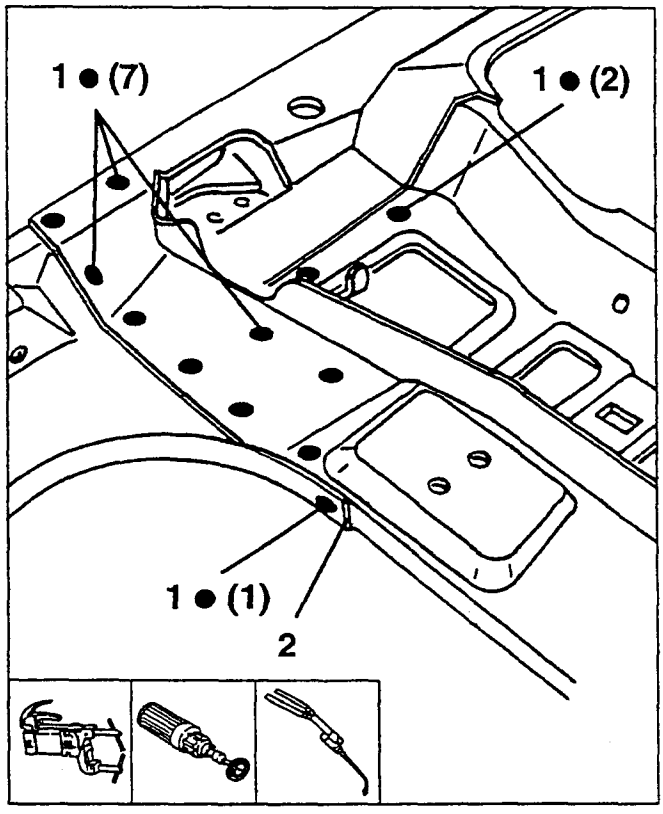
WELDING AND FINISHING THE SHEET METAL

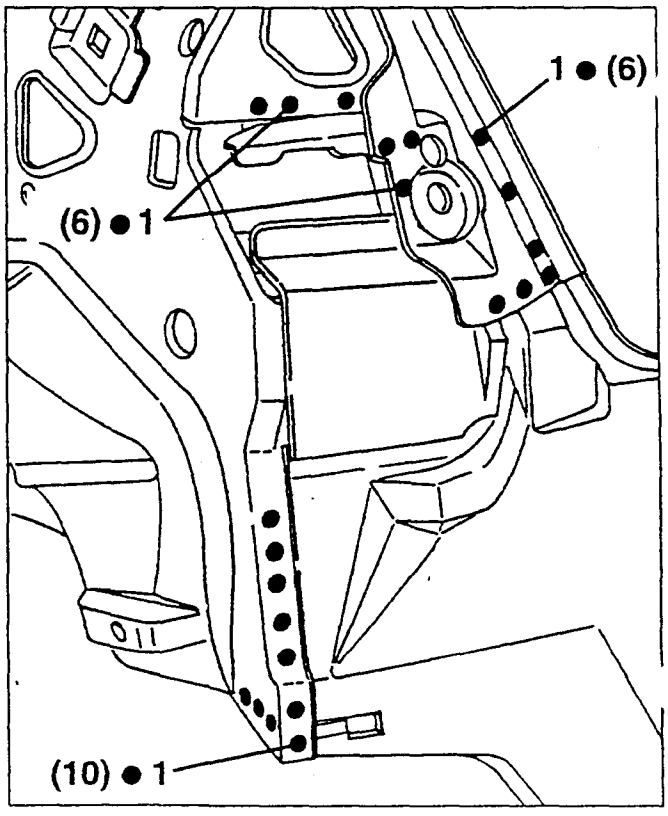
1. Using a spot welder, proceed as shown in the diagram.



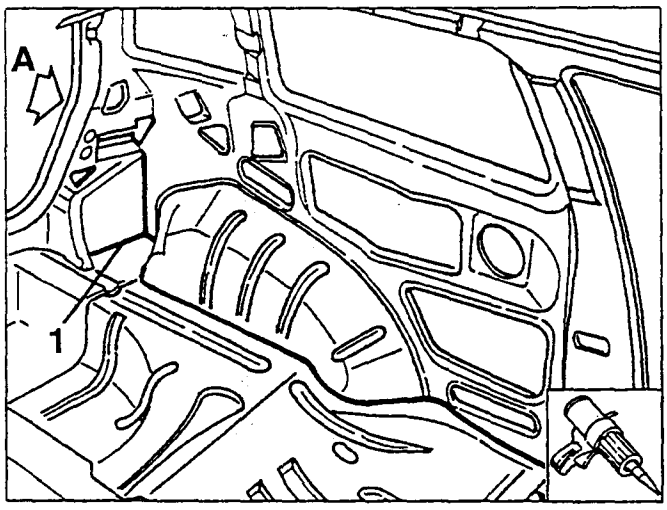


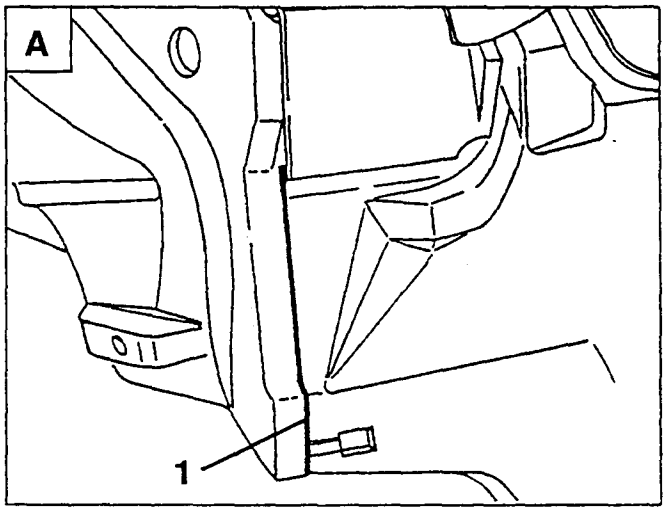
1. Using a spot welder, proceed as shown in the diagram.
- Using a rotating brush, clean the welded areas.
2. Using an oxyacetylene torch, brass braze-weld as shown in the diagram.



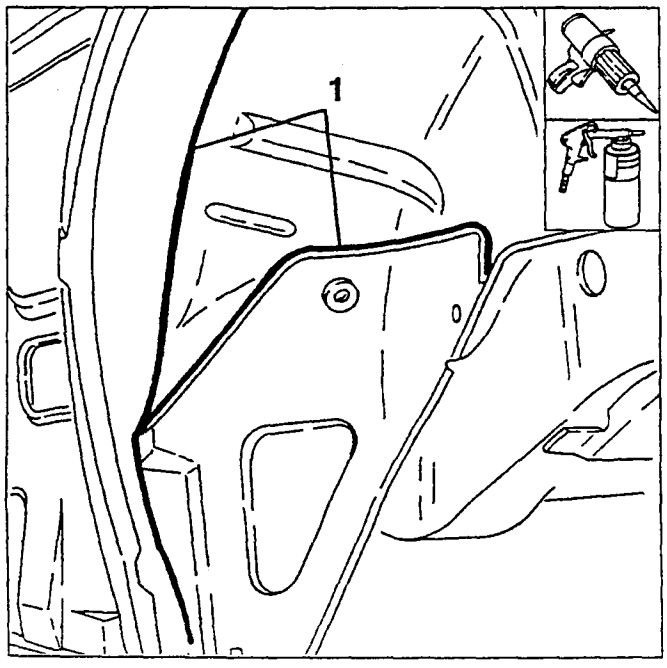


1. Apply the specified sealant along the lines shown in the diagram.

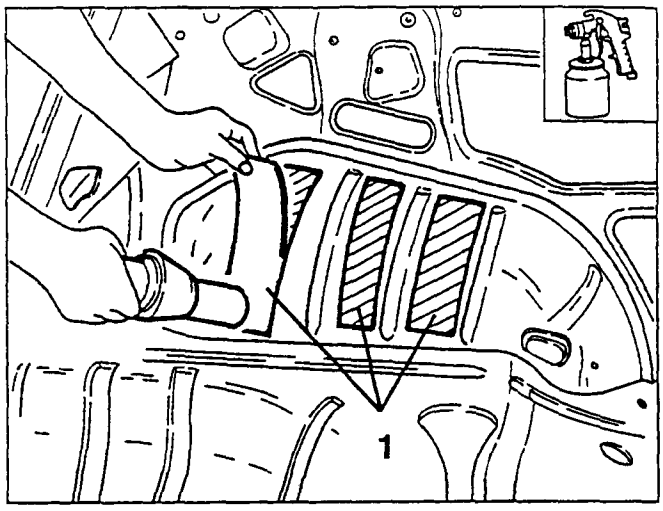




1. Apply the specified sealant along the lines shown in the diagram.
- Apply the specified underbody protection in the new areas of the wheel housing.

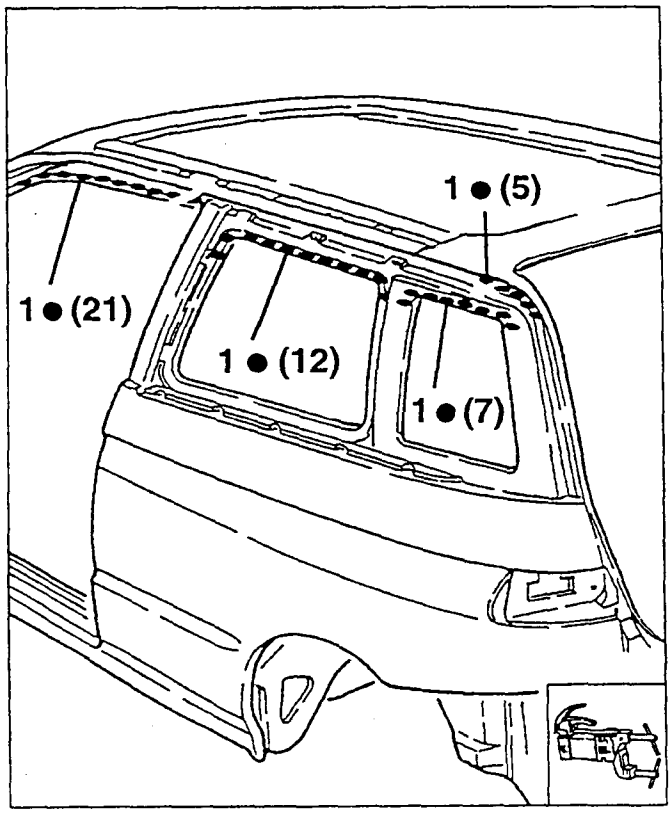


1. Apply the sound-proof panels as shown in the diagram.
- Proceed to the painting phase.



- Complete the refitting operations as described in the procedures for "central pillar" and Rear wing" ensuring that the following steps are added as this is a complete replacement of the rear wing and not a partial replacement.
1. Using a spot welder, proceed as shown in the diagram.

NOTE:
Due to the above it is not necessary to seam weld the lower to the upper parts of the wing.

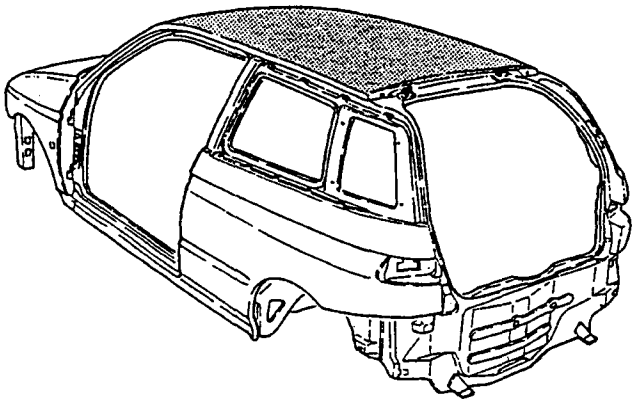


ROOF PANEL

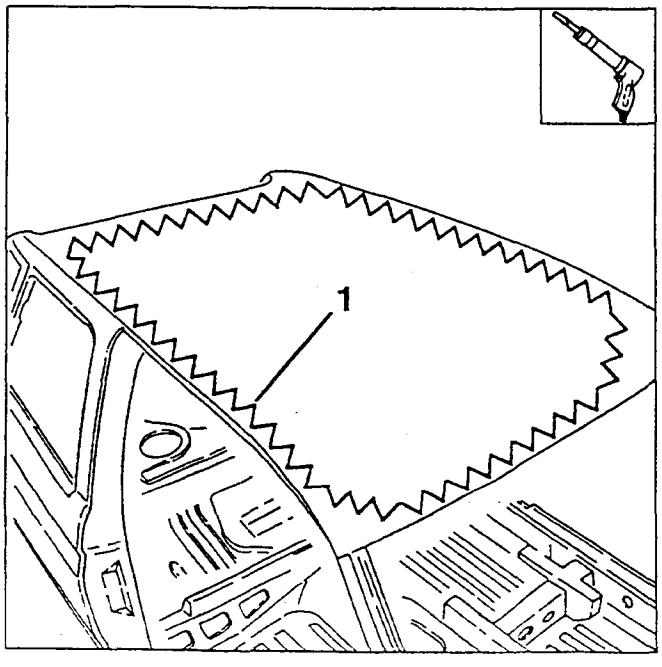
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the electronic control units.
- Remove the trim components, electrical and mechanical system which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• windscreen (see specific paragraph).
• boot (see specific paragraph).
• doors (see specific paragraph).

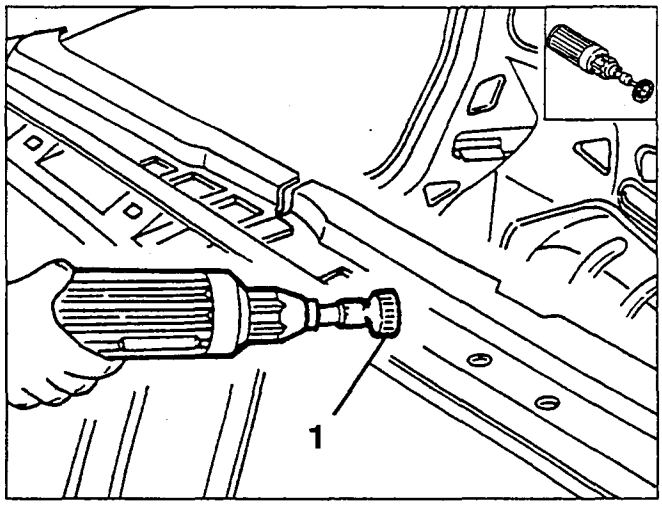
REMOVAL



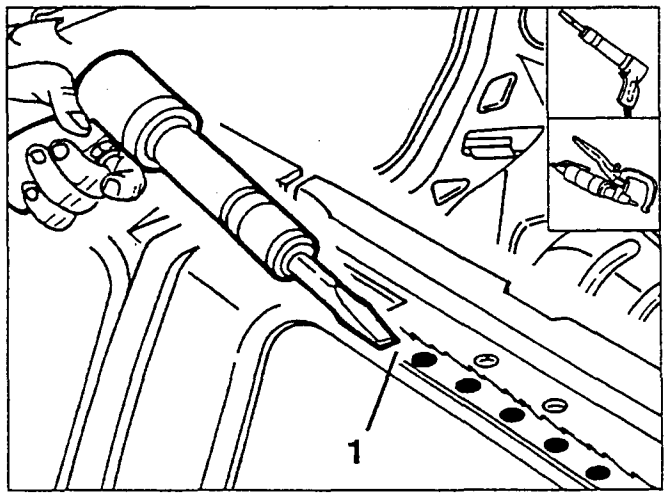
1. Using a chisel free the roof panel as shown in the diagram.



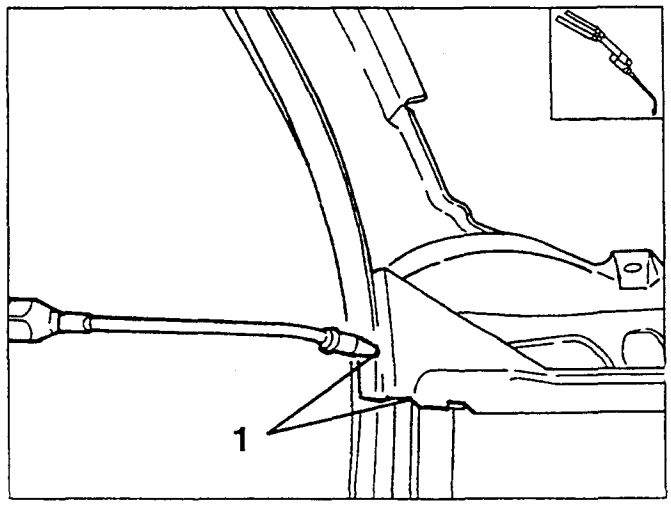
1. Using a rotating brush, clean the edge of the roof panel to highlight the welding points.



1. Using a chisel or spot cutter, remove the welding points from the edges of the roof panel remaining on the body.



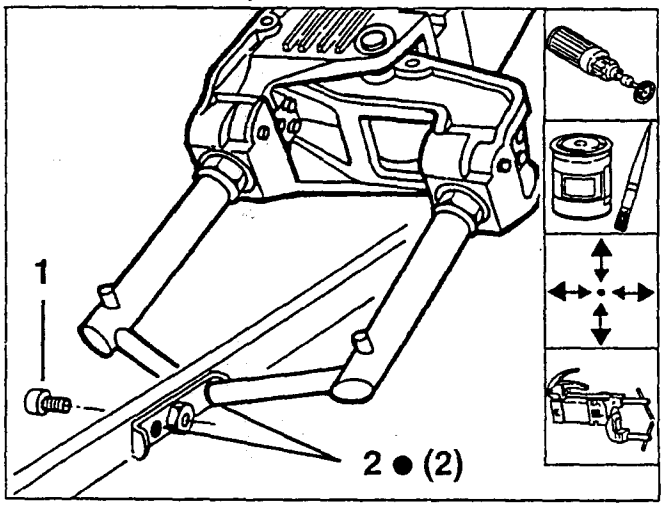
1. Using an oxyacetylene torch, unweld the roof panel from the pillars and remove the edges of the panel.



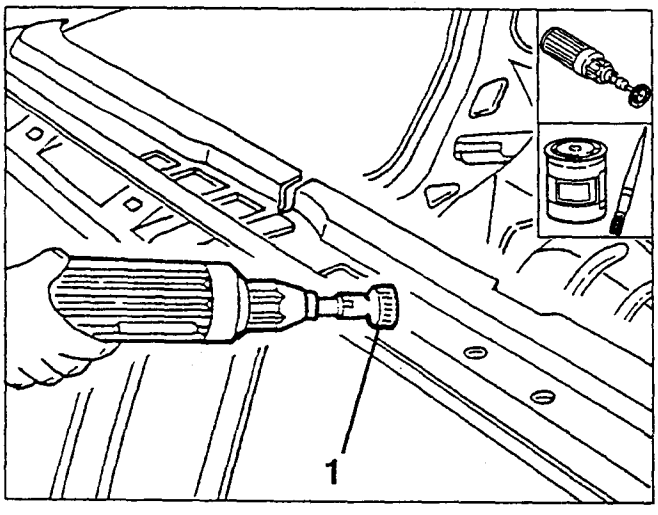
PREPARATION

Install the four brackets securing the roof-rack to the new panel as follows:
- Using a rotating brush, clean the area to be welded.
- Apply the specified electroweldable protection to the areas to be spot welded.

1. Position the bracket using the attachment pin as a centering device.
2. Using a spot welder, proceed as shown in the diagram.

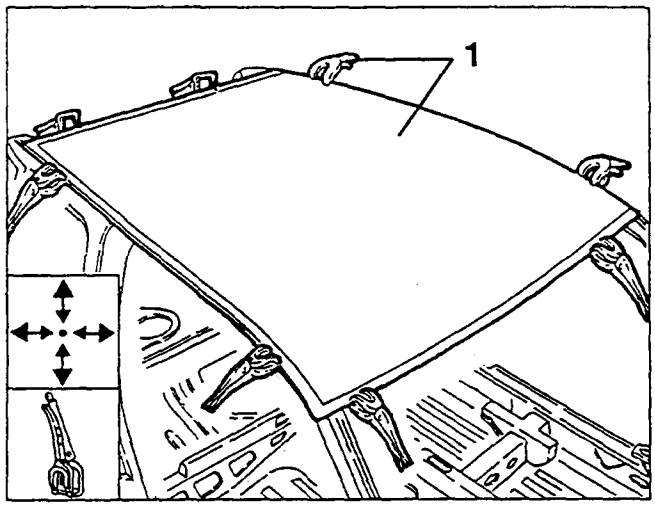


1. Using a rotating brush, clean the area to be welded along the edge of the new roof panel and the body.
- Apply the electroweldable protection to the areas to be spot welded.

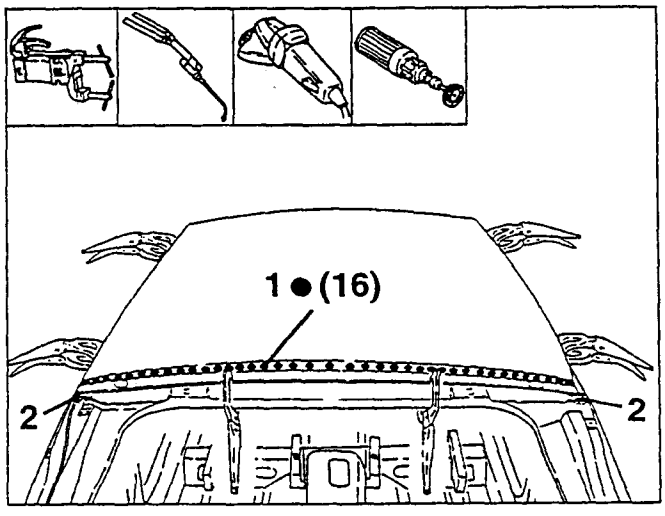


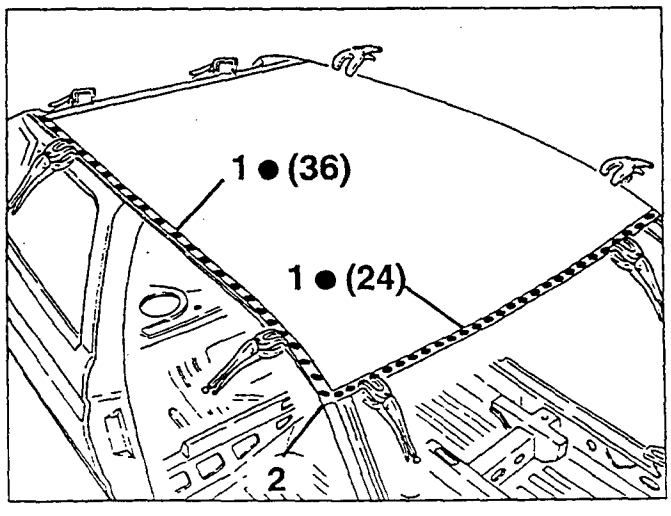
POSITIONING AND INSPECTION

1. Position the roof panel and join the edges to be welded together and fix using clamps.
- Check parallelism, gaps and angles and refit the mobile components removed previously with their gaskets and the parts which, when fitted, permit verification of the success of the operations.



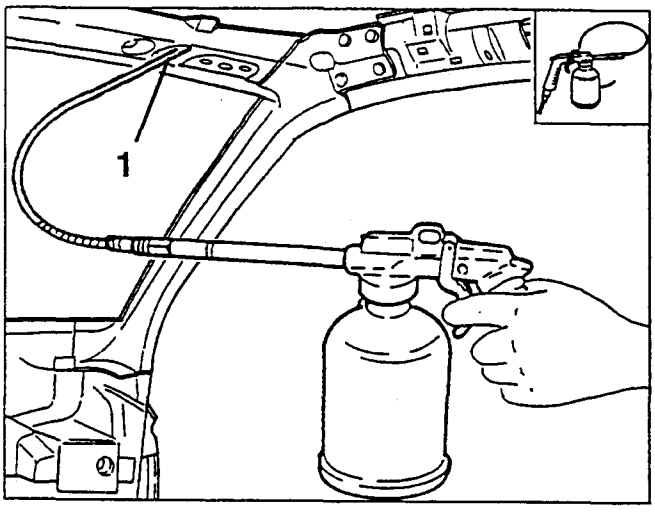
1. Using a spot welder, proceed as shown in the diagram.
2. Using an oxyacetylene torch, brass braze-weld the four corners of the roof panel to the pillars.
- Using an abrasive grinding wheel, remove and flush the residues left by welding.
- Using a rotating brush, clean the welded areas.



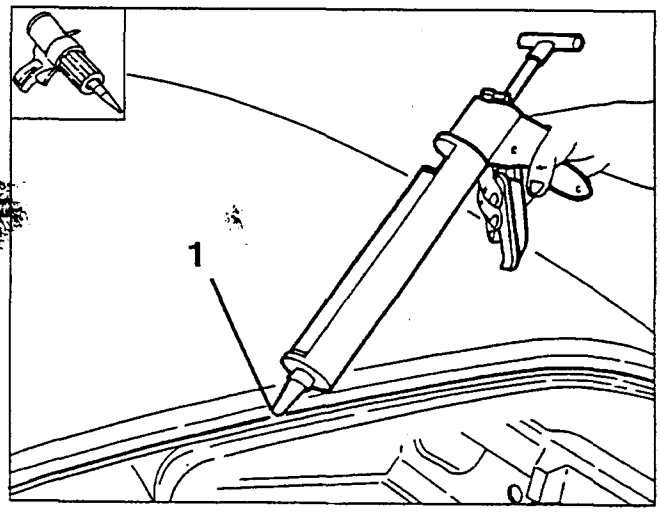


PROTECTION

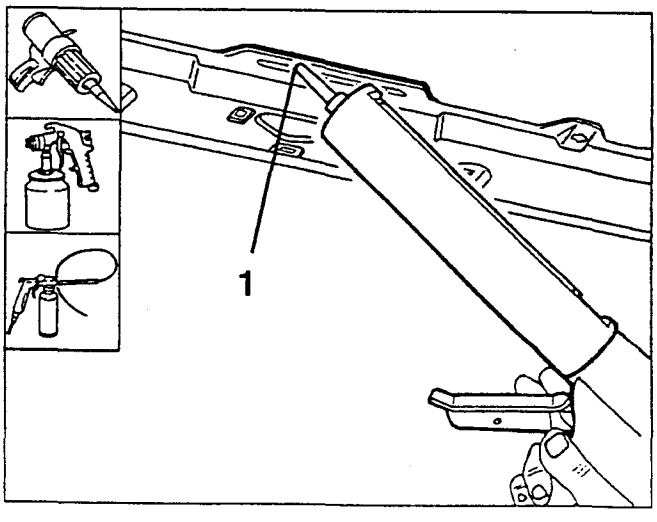
1. Apply the specified corrosion inhibitor to the areas to be braze welded.



1. Apply the specified sealant along the side edge of the roof panel.



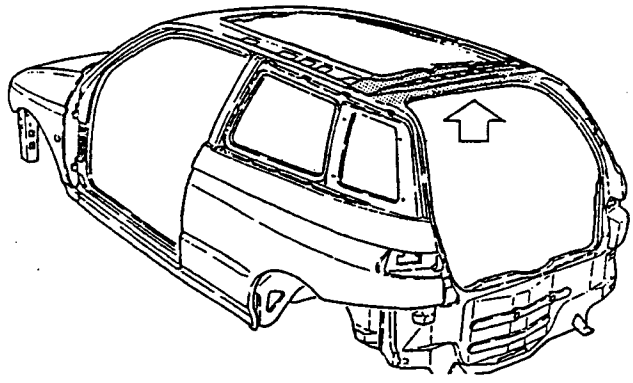
1. Apply the specified sealant to the front inner part of the roof panel along the lines shown in the diagram.



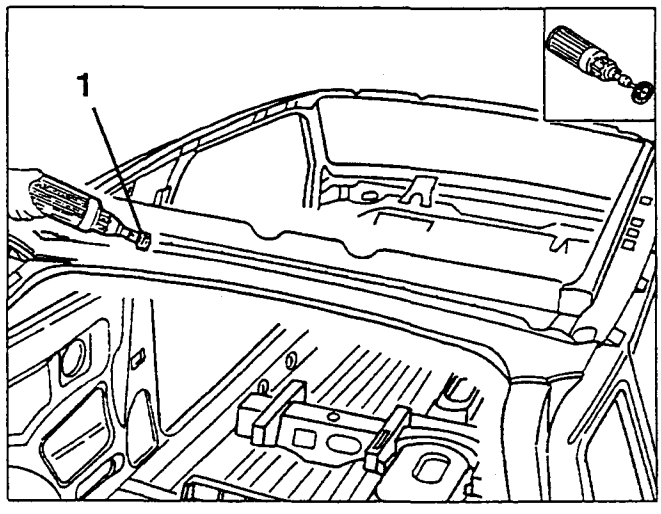
- Proceed to the painting phase.
- Proceed to the wax-treatment phase for the areas to which have been braze welded.

REAR HOOPS (WITH ROOF PANEL REMOVED)

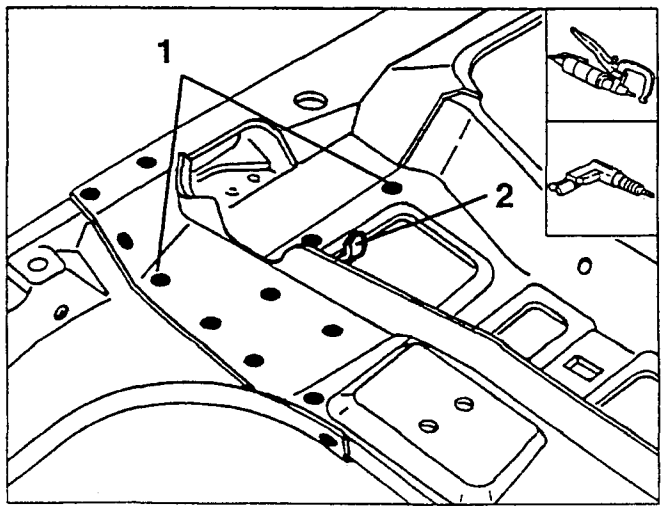
REMOVAL



1. Using a rotating brush, clean the areas to be spot-cut to highlight the welding points.



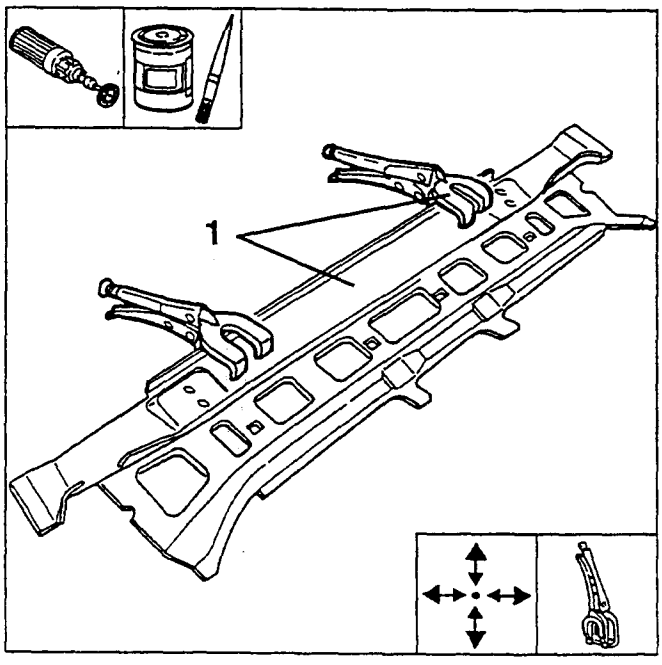
1. Using a spot cutter, remove the accessible welding points, remove the remaining welding points using a drill.
2. Open the clinch tabs.



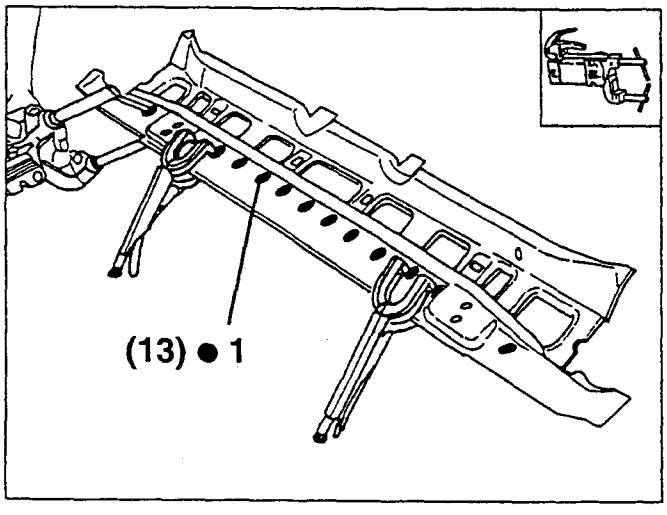
- Remove the rear hoops cutting away the sealant if necessary

PREPARATION

Assemble the rear hoops as follows:
- Using a rotating brush clean the area to be welded.
- Apply the specified electroweldable protection to the areas to be spot welded.
1. Assemble the two hoops joining together the edges to be welded and fix them with clamps and using the matching of the attachment holes for the boot with the appropriate pins as a reference.

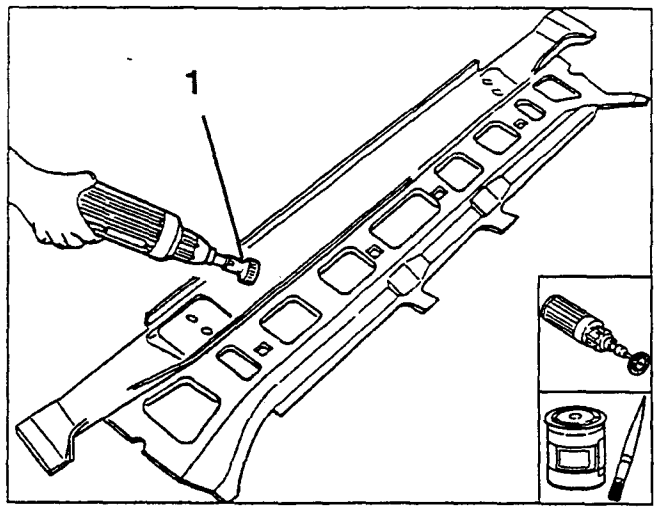


1. Using a spot welder, proceed as shown in the diagram.



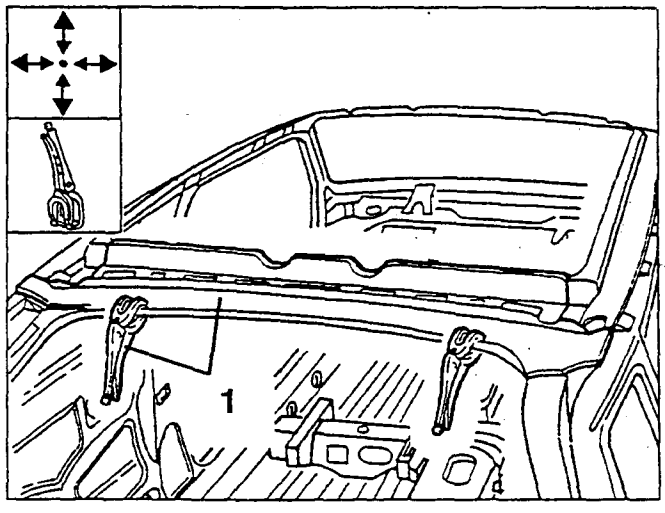
1. Using a rotating brush, clean the area to be welded.

- Apply the electroweldable protection to the areas to be spot welded.

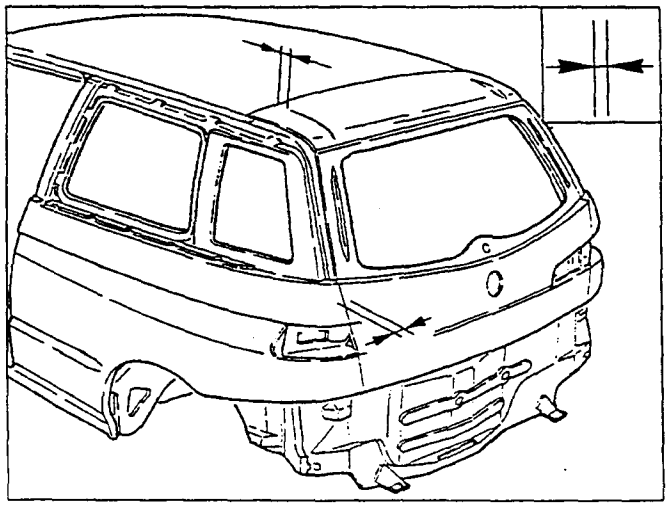


POSITIONING AND INSPECTION

1. Position the assembled hoops bringing the edges together and secure them with clamps.

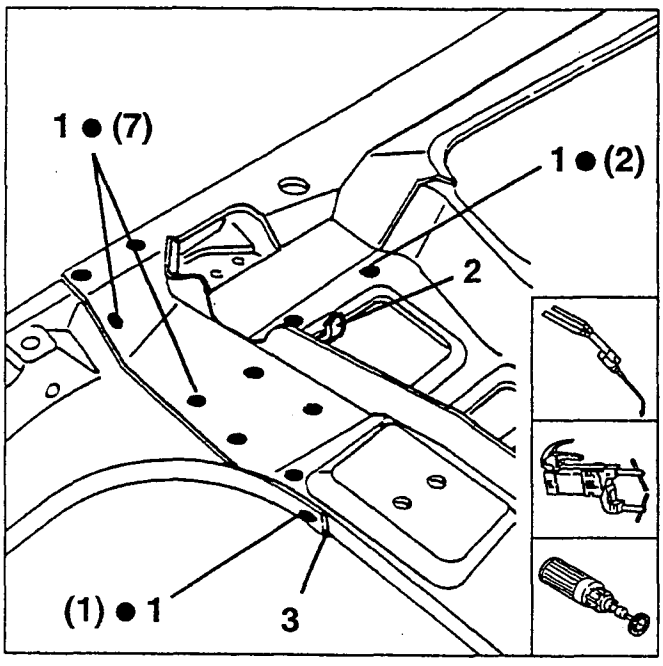


- Check parallelism, gaps and angles and refit the mobile components removed previously with their gaskets and the parts which, when fitted, permit verification of the success of the operations.



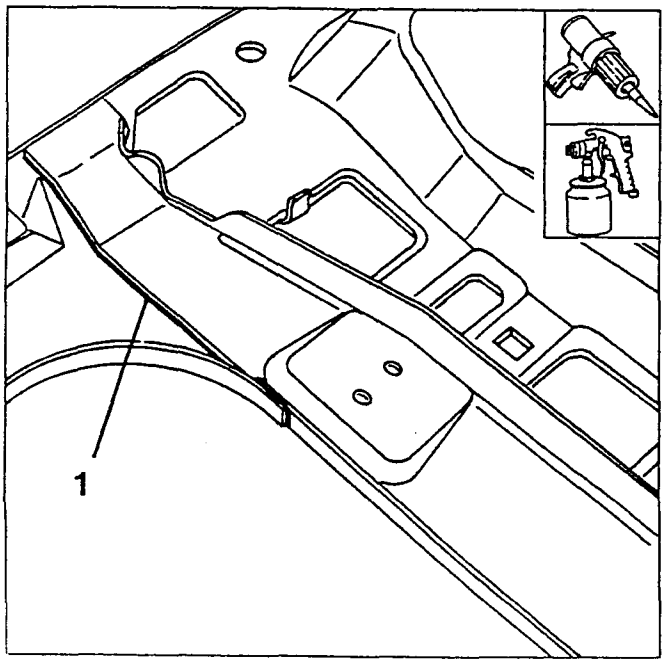
WELDING AND FINISHING THE SHEET METAL

1. Using a spot welder, proceed as shown in the diagram.
2. Bend the clinch tabs.
3. Using an oxyacetylene torch, brass braze-weld as shown in the diagram.
- Using a rotating brush, clean the welded areas.



PROTECTION

1. Apply the specified sealant along the lines shown in the diagram.
- Proceed to the painting phase.

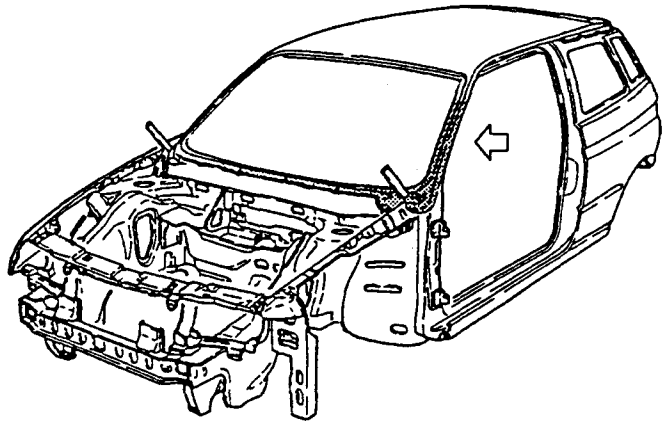


FRONT WINDSCREEN FRAME (PARTIAL)

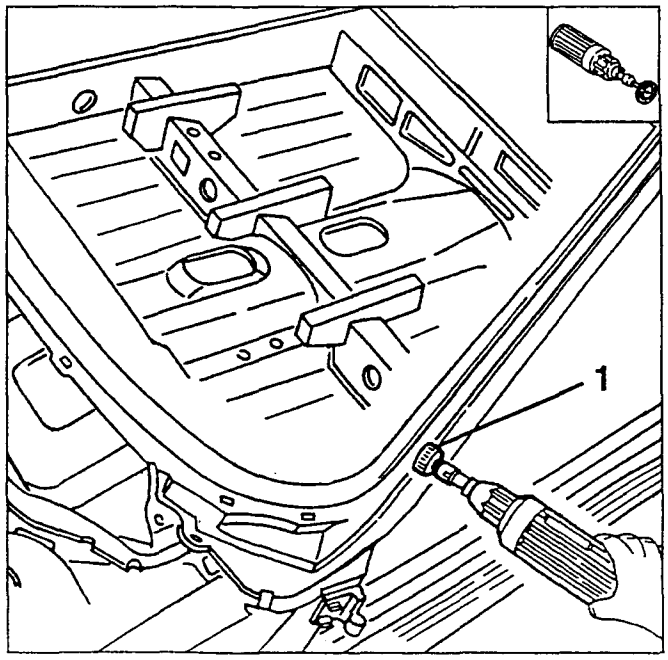
PRELIMINARY OPERATIONS

- Disconnect the negative (-) cable from the battery and remove the electronic control units.
- Remove the trim components, electrical and mechanical system which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• bonnet (see specific paragraph).
• door on affected side (see specific paragraph).
• front wing (see specific paragraph).
• dashboard support crossmember (see specific paragraph).

REMOVAL

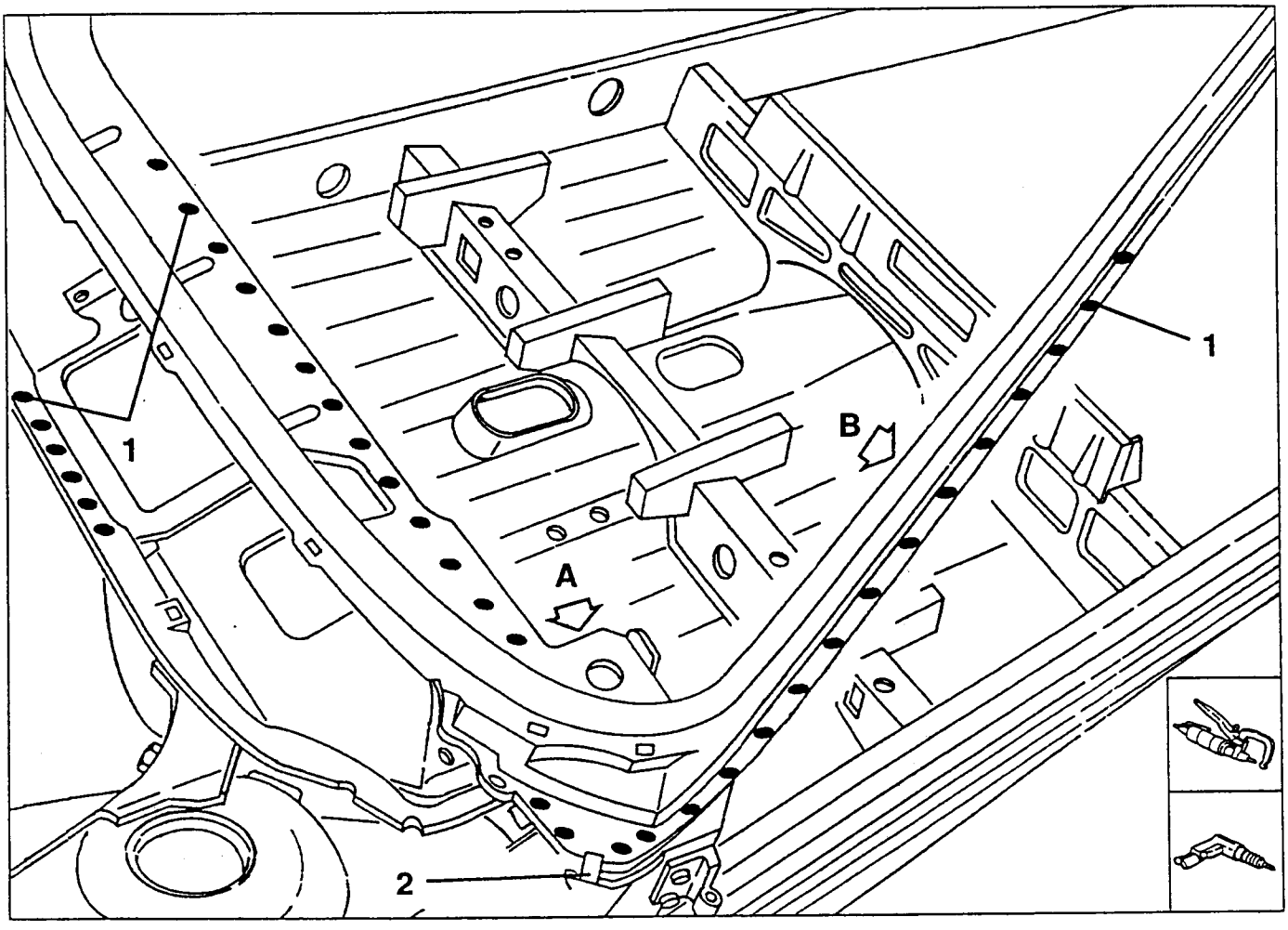


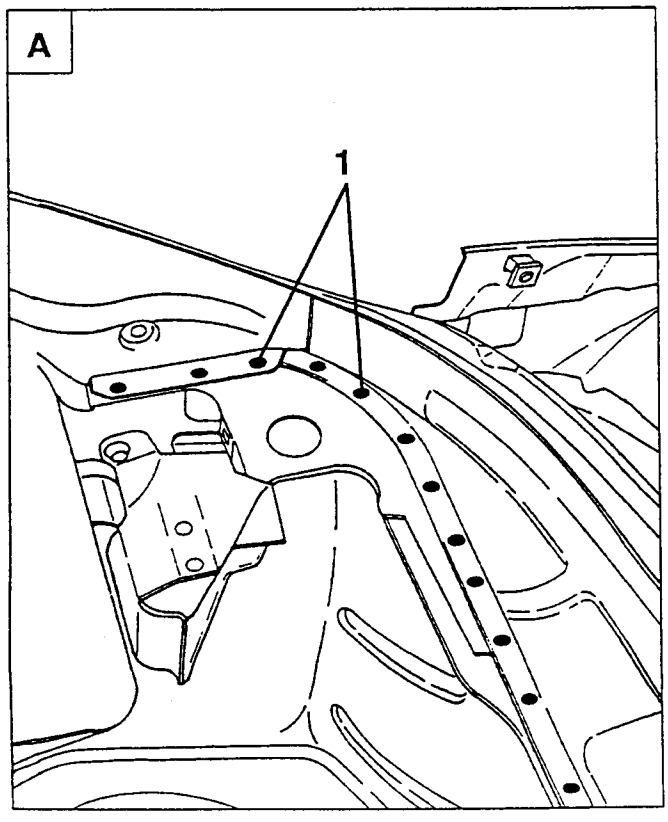
1. Using a rotating brush, clean the areas to be spot-cut to highlight the welding points.

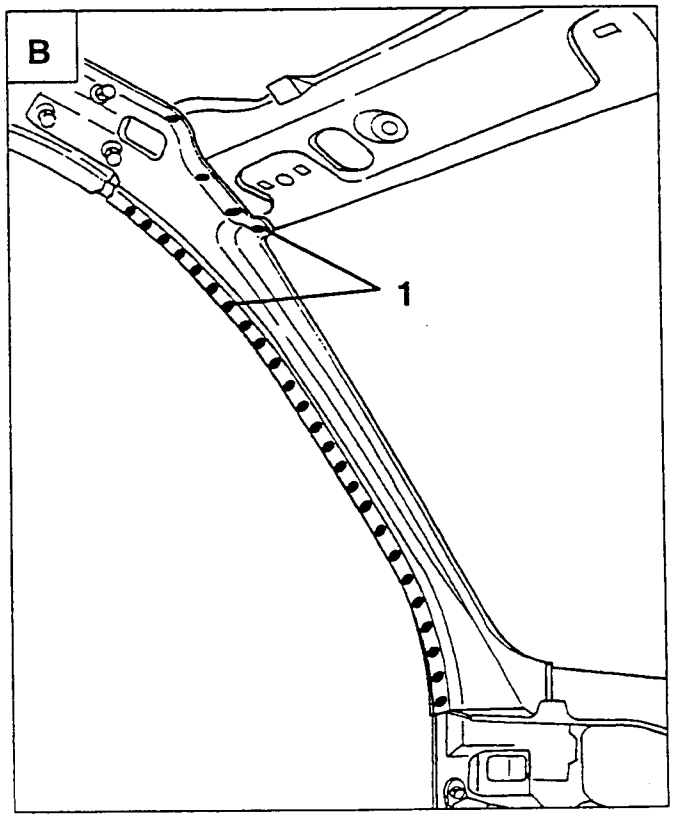


1. Using a spot cutter, remove the accessible welding points; remove the remaining welding points using a drill.

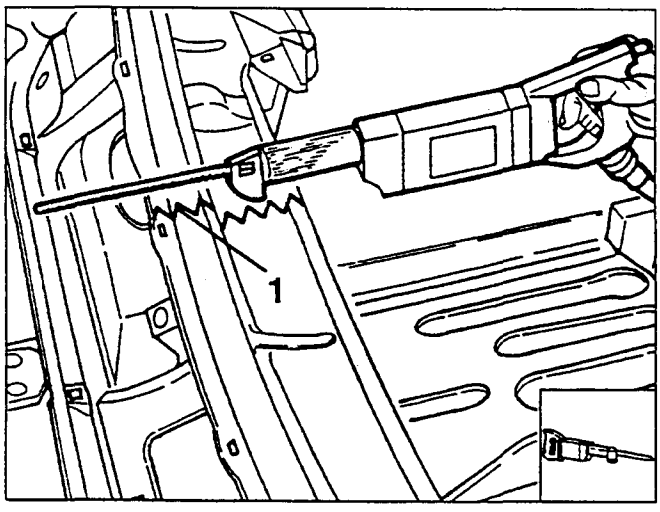
2. Open the clinch tab .



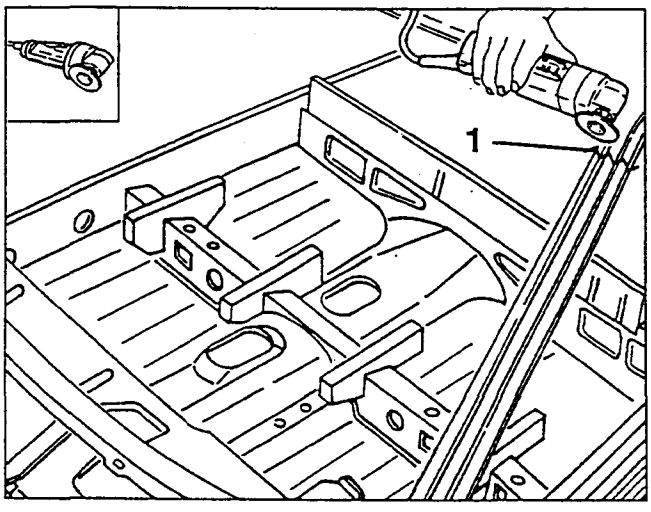




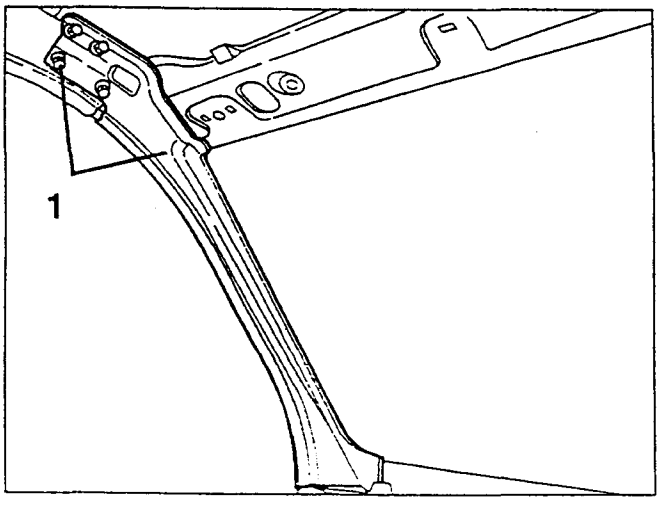
1. Using a jig saw, cut the windscreen frame following the indications given in the diagram without damaging the underlying components.



1. Using a circular saw, cut the front windscreen frame following the lines indicated in the diagram without damaging the underlying components.

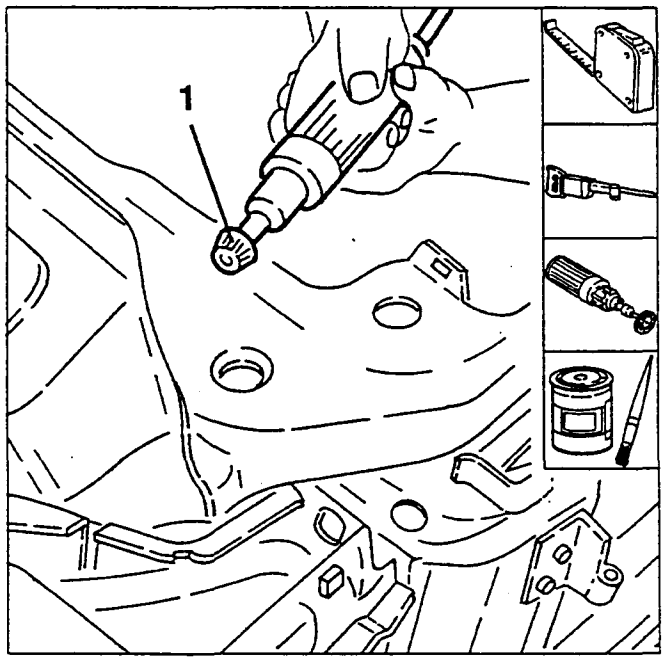


1. Loosen the four screws securing the inner side panel frame to the front windscreen frame and remove the windscreen frame removing the sealant if necessary.



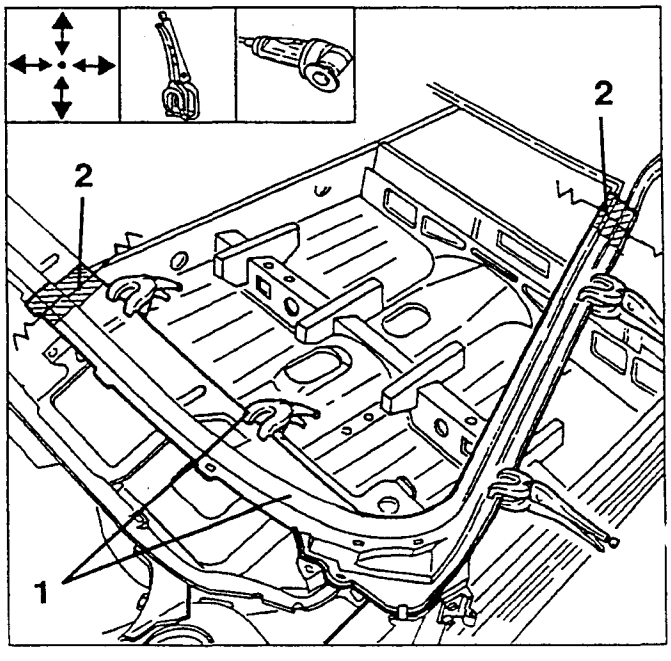
PREPARATION

- Working on a bench cut the new front windscreen frame ensuring that enough material is left for overlapping.
1. Using a wire brush, clean the area to be welded.
- Apply the specified electroweldable protection to the areas to be spot welded.



POSITIONING

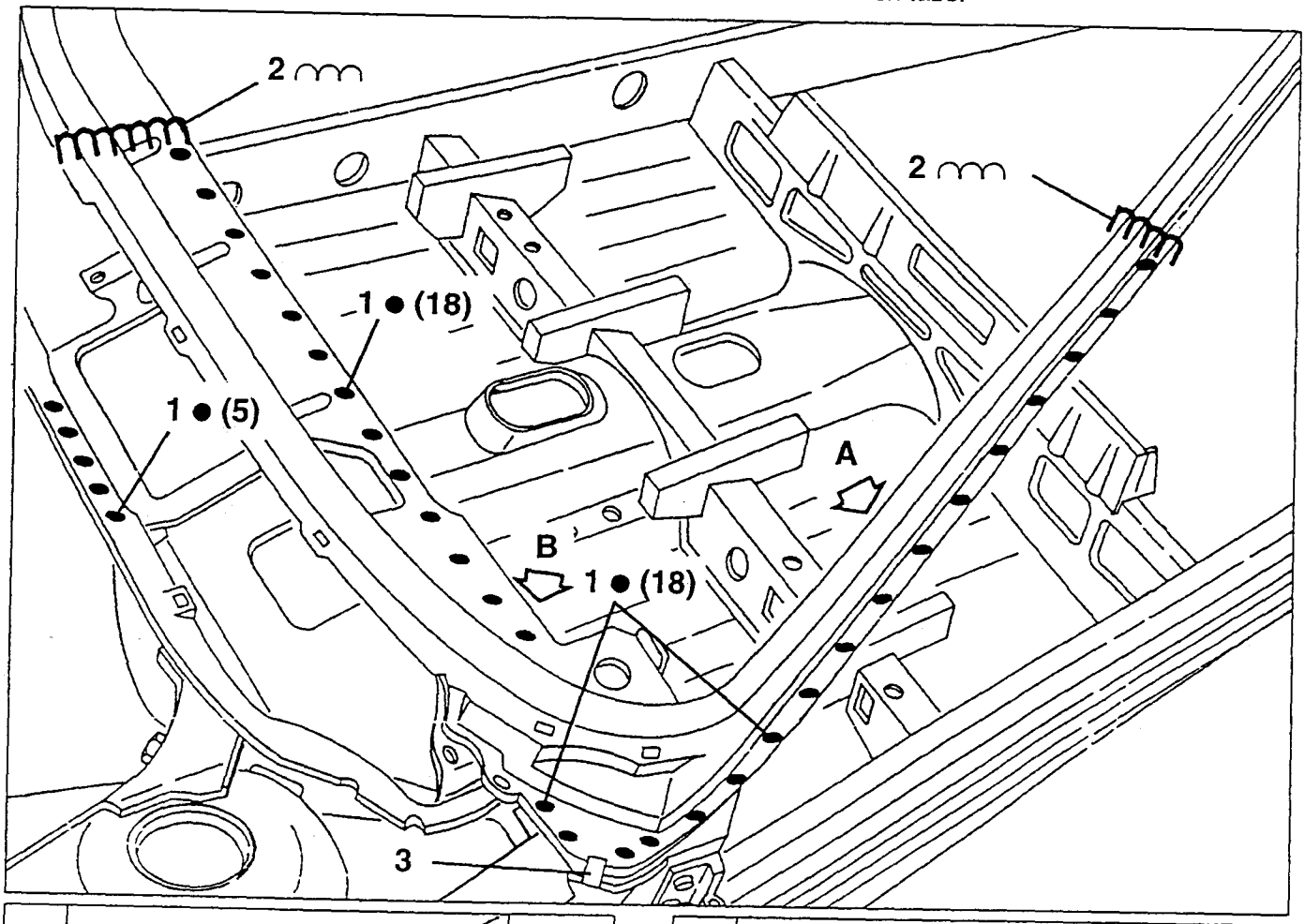
1. Position the front windscreen frame and join the edges together and secure with clamps and the four screws securing the inner side panel frame.
- Using the windscreen, check positioning the front windscreen frame
2. Using a circular saw, trim the excess sheet metal parts.

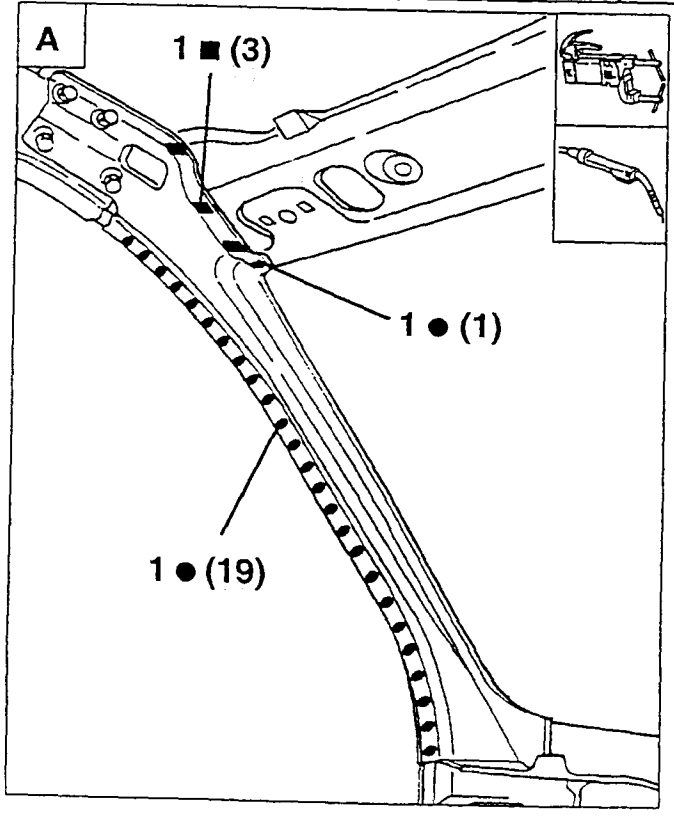


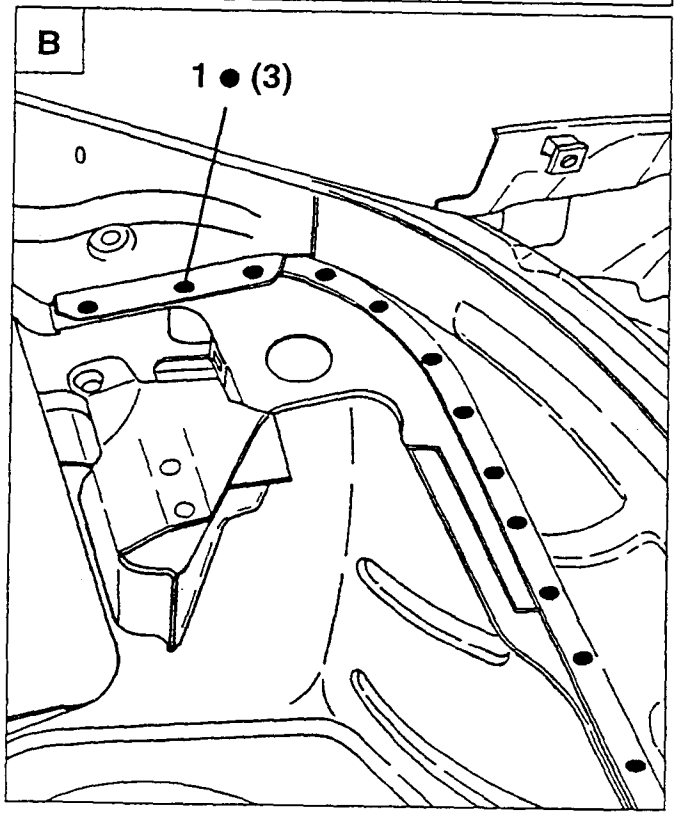
WELDING AND FINISHING THE SHEET METAL

1. Using a spot welder or, where necessary, a MIG welder, proceed as shown in the diagram.

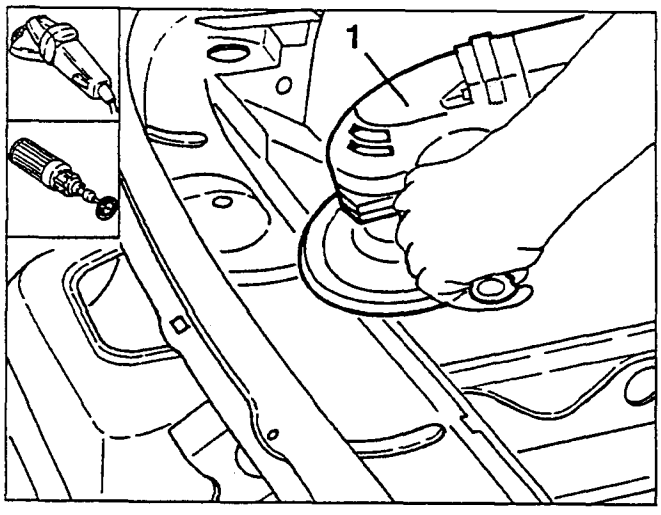
2. Using a MIG welder, weld a seam as shown in the diagram.
3. Bend the clinch tabs.





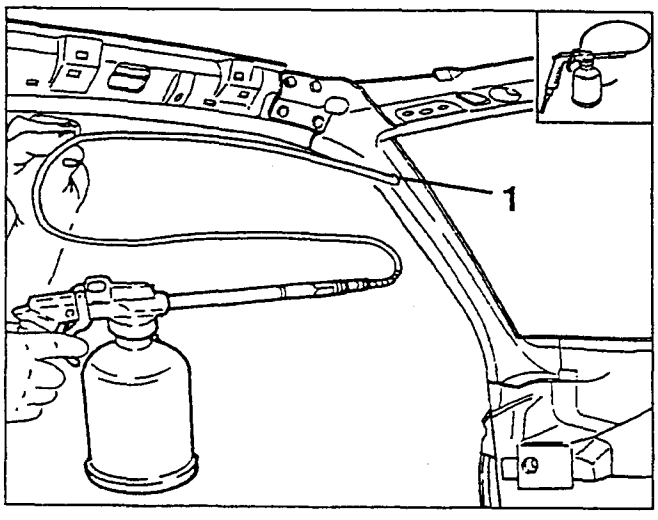


1. Using an abrasive grinding wheel, remove and flush the residues left by welding.
- Using a rotating brush clean the welded areas.

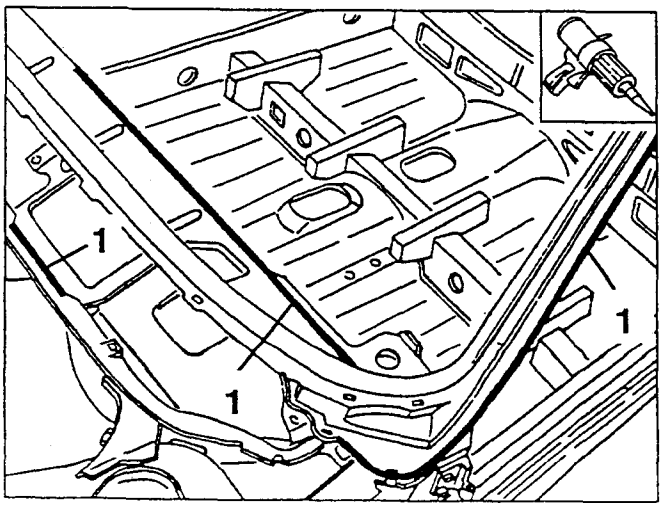


PROTECTION

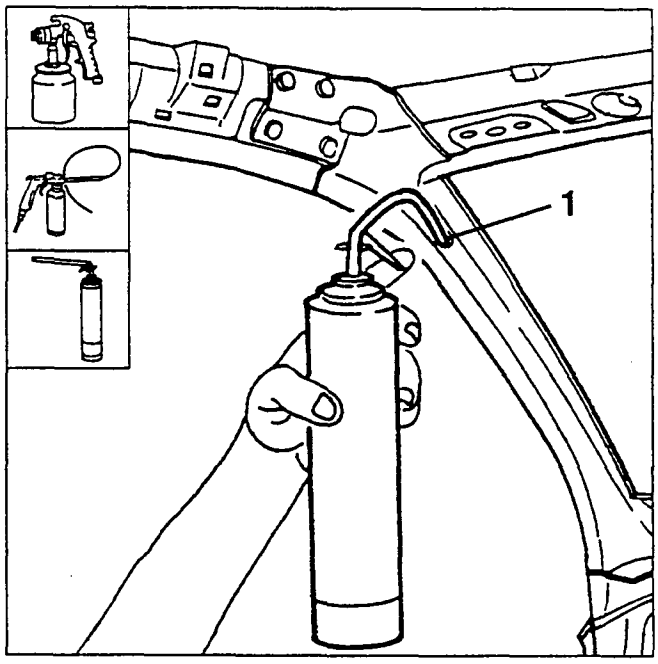
1. Apply the specified corrosion inhibitor to the areas to be MIG welded.



1. Apply the specified sealant along the lines shown in the diagram.



- Proceed to the painting phase.
- Proceed to the wax-treatment phase for the boxed parts.
1. Proceed to the foam treatment phase for the front pillar as shown in the diagram.

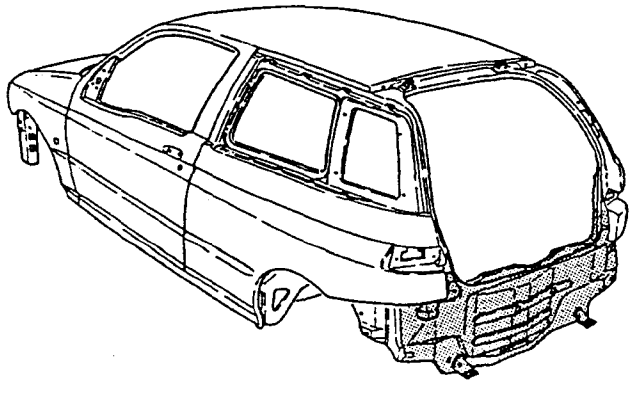


RIB

PRELIMINARY OPERATIONS

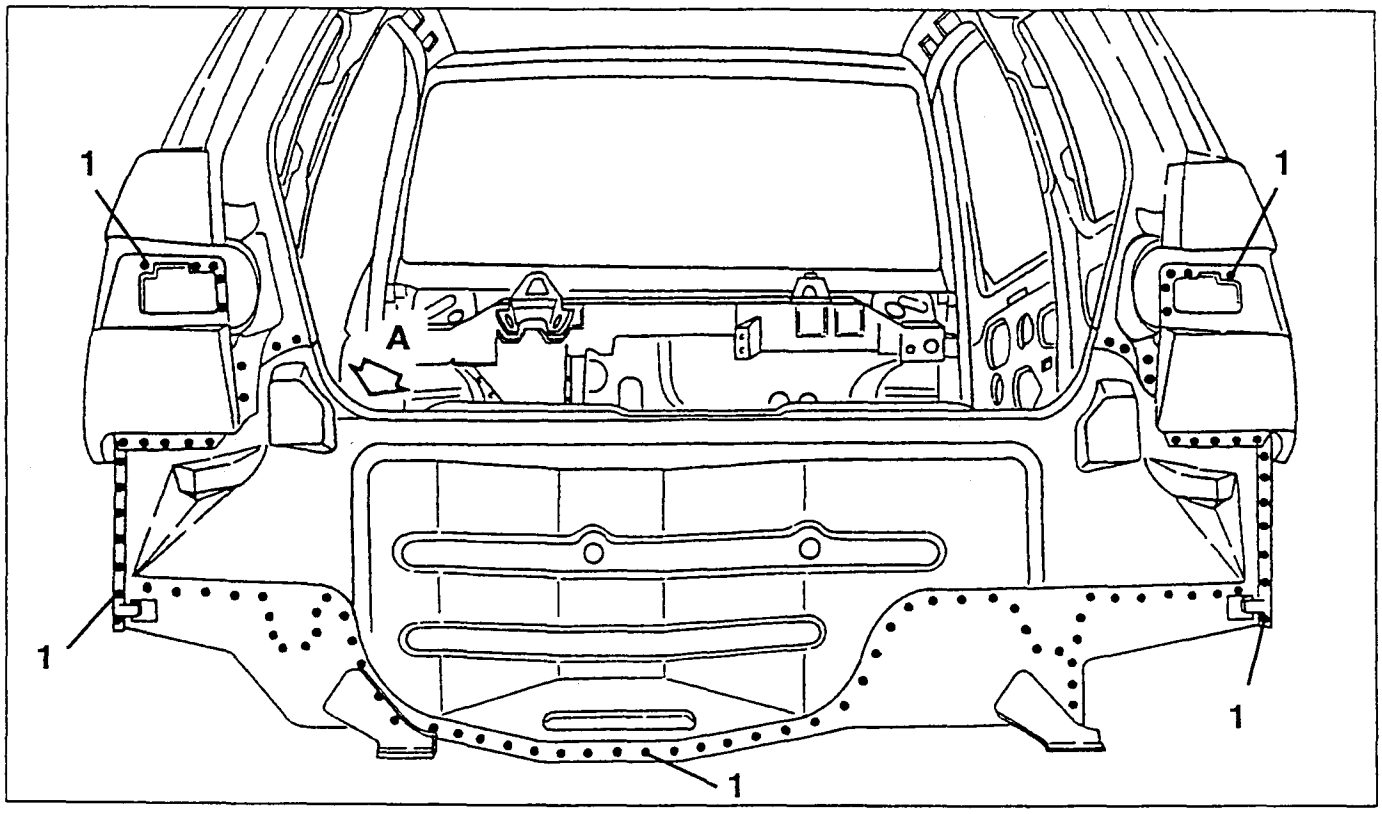
- Disconnect the negative (-) cable from the battery and remove the electronic control units.
- Remove the trim components, electrical and mechanical system which could hinder the repair operations or get damaged during work (see specific paragraphs).
- Remove the following sheet metal parts:
• boot (see specific paragraph).

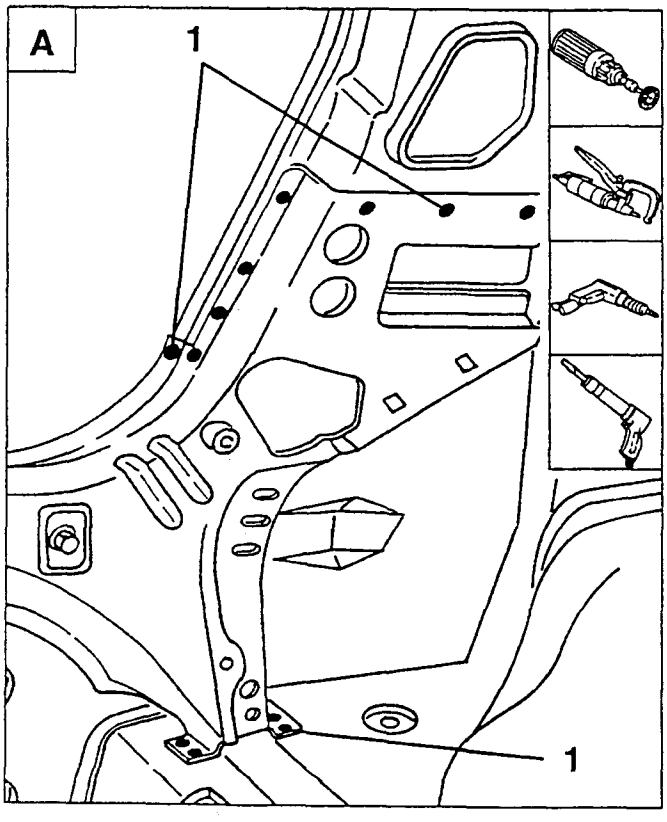
REMOVAL



- Using a rotating brush clean the areas to be spot-cut to highlight the welding points.
1. Using a spot cutter, remove the accessible welding points; remove the remaining points using a drill or a chisel.

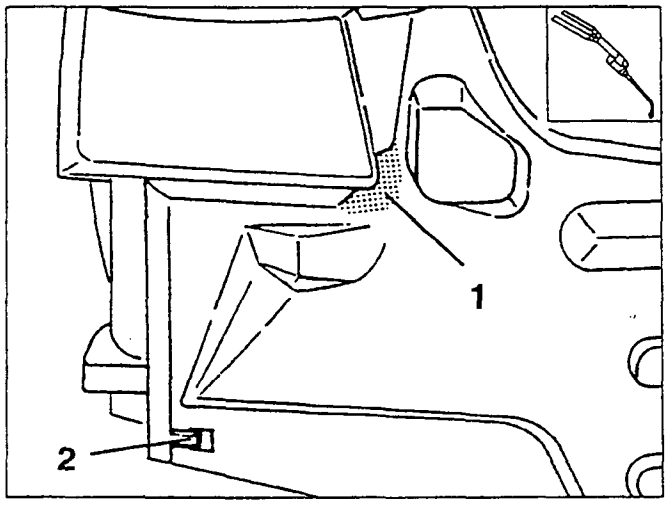
NOTE:
If necessary free the sheet metal.





1. Using an oxyacetylene torch, unweld the braze welds shown in the diagram.

2. Open the clinch tabs and remove the rib cutting the sealant if necessary.



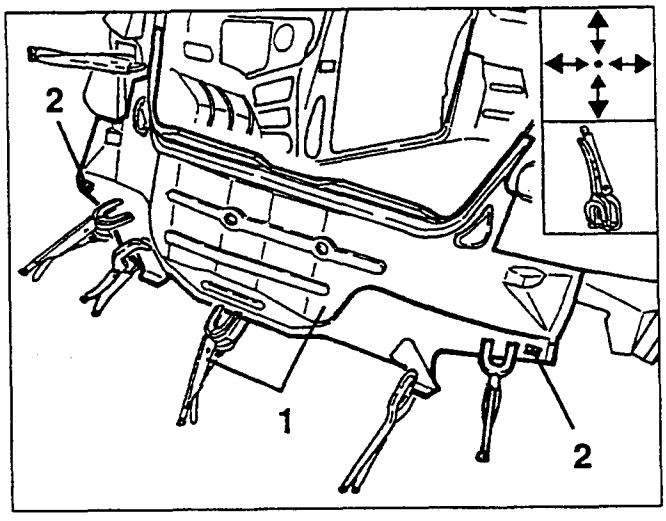
PREPARATION

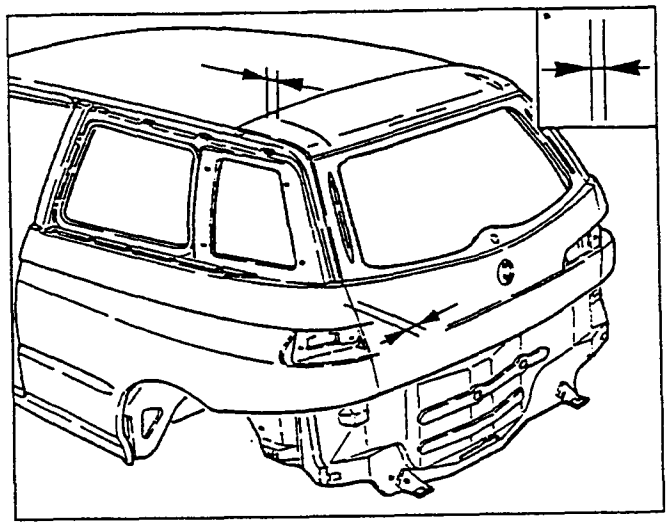
- Using a rotating brush, clean the area to be welded.
- Apply a thick layer of electroweldable protection to the entire lower part of the floor-rib mating surfaces.
- Apply the electroweldable protection with a brush to the remaining areas to the spot welded.

POSITIONING AND INSPECTION

1. Install the rib ensuring that the upper tabs are bent just enough to facilitate positioning. Join the edges to be welded and fix with clamps.
2. Bend the clinch tabs.

- Check parallelism, gaps and angles and refit the mobile components removed previously with their gaskets and the parts which, when fitted, permit verification of the success of the operations.

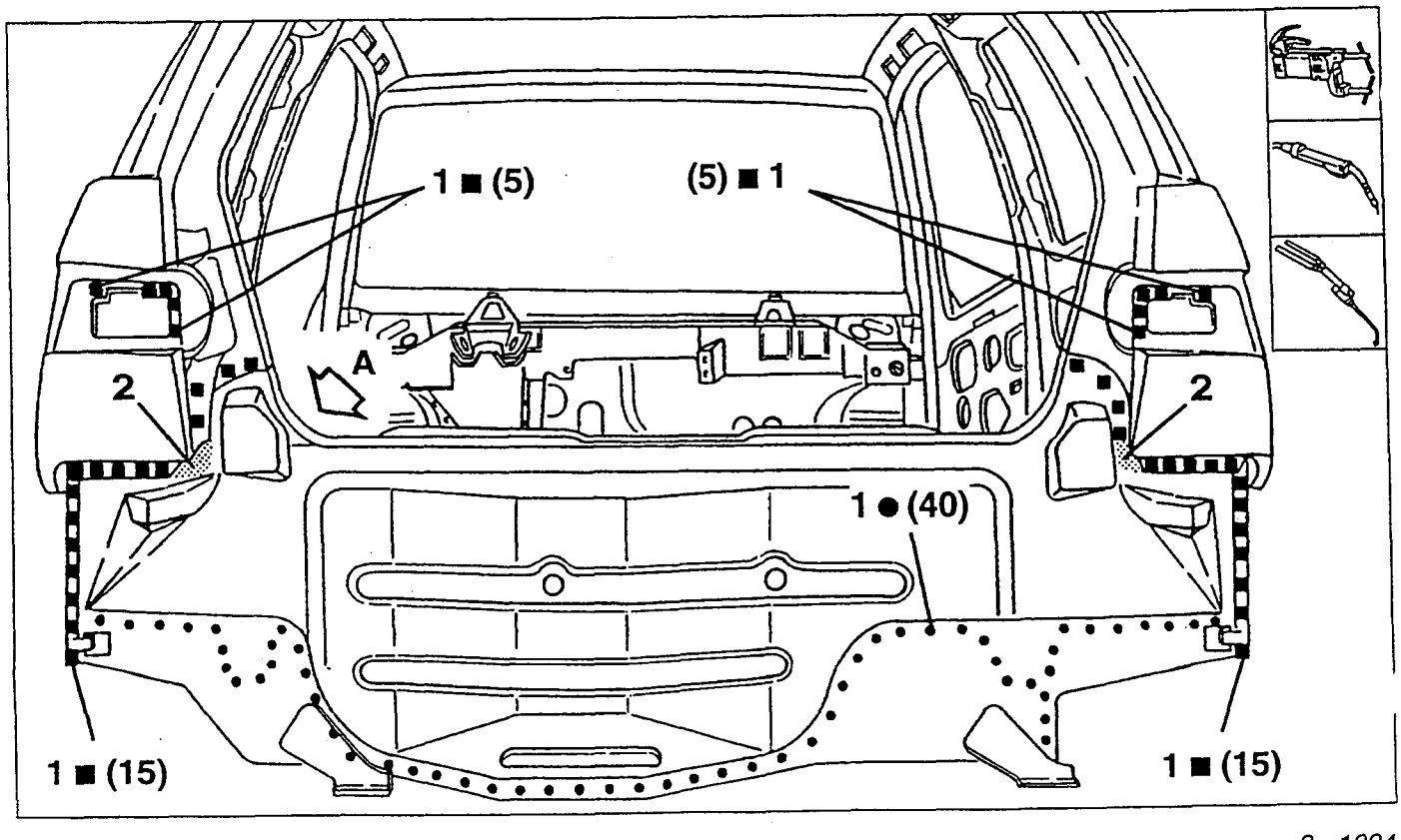




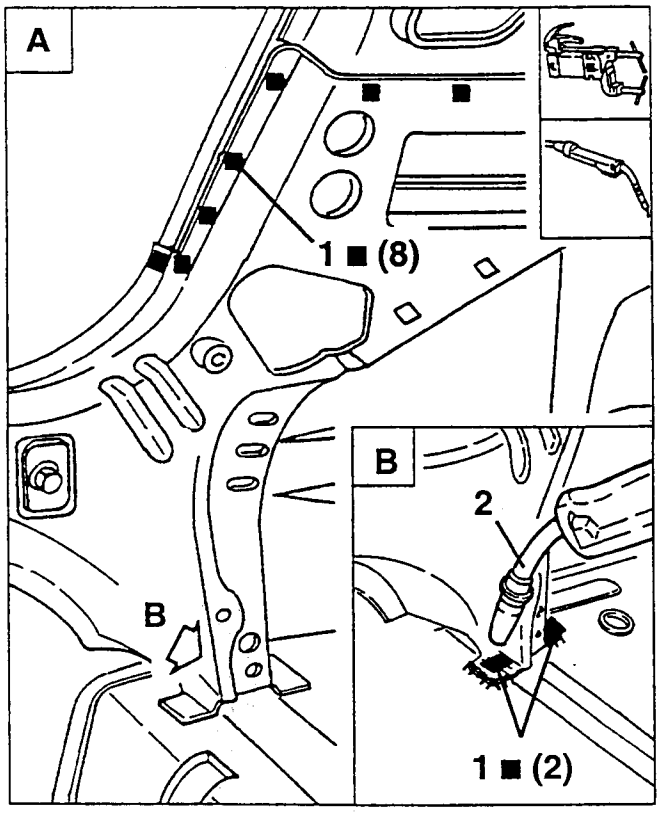
WELDING AND FINISHING THE SHEET METAL

1. Using a spot welder or, where necessary, a MIG welder, proceed as shown in the diagram.

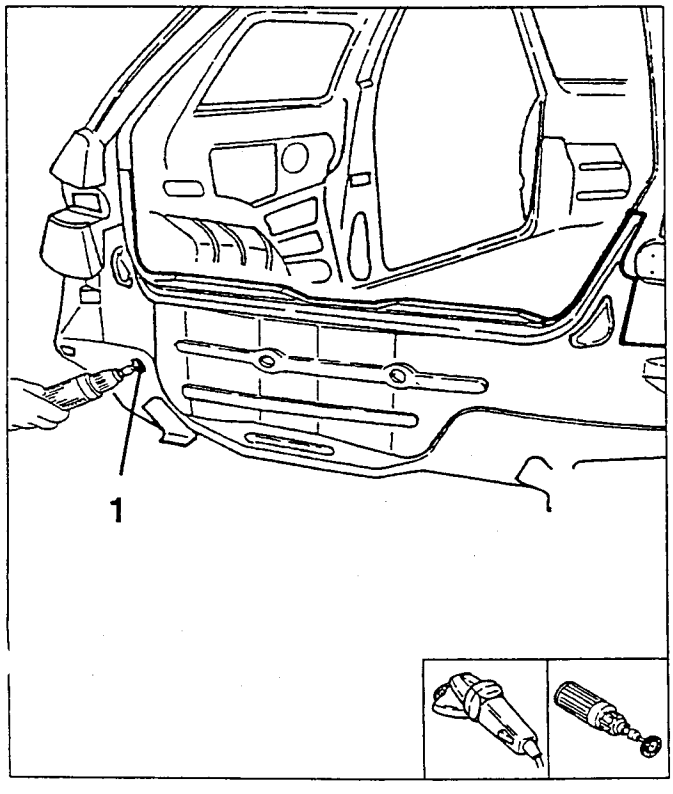
2. Using an oxyacetylene torch brass braze-weld as shown in the diagram.



1. Using a spot welder or, where necessary, a MIG welder, proceed as shown in the diagram.
2. Using a MIG welder, weld a seam as shown in the diagram.

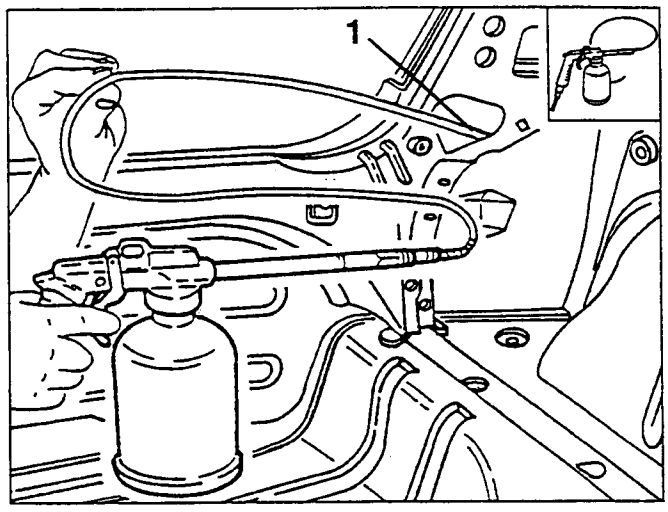


- Using an abrasive grinding wheel, remove and flush the residues left by welding.
1. Using a rotating brush, clean the welded areas.

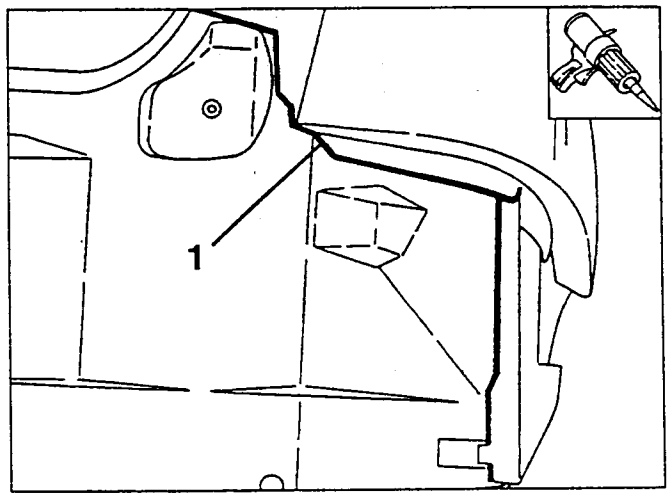


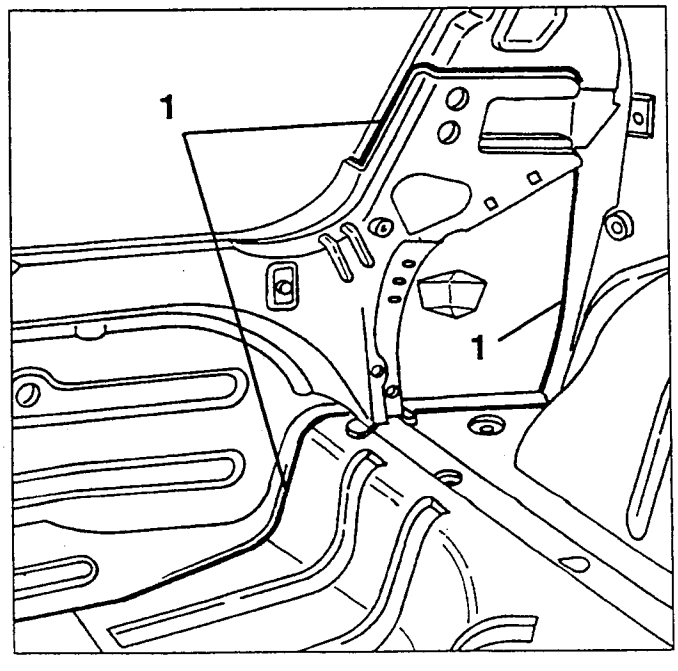
PROTECTION

1. Apply the specified corrosion inhibitor to the areas which have been MIG welded.

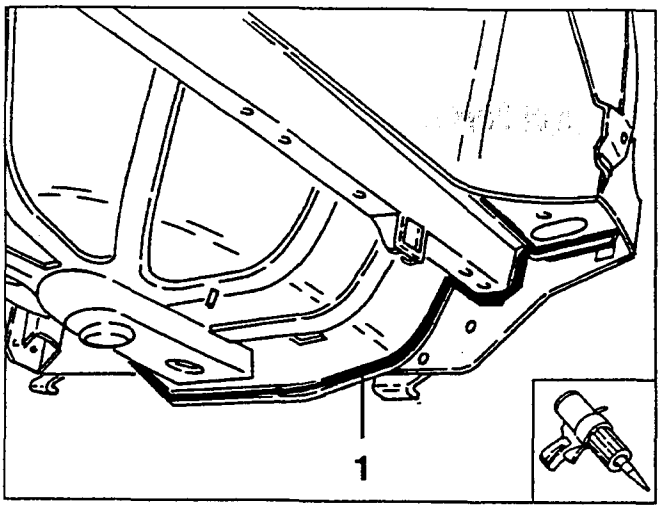


1. Apply the specified sealant along the lines shown in the diagram.

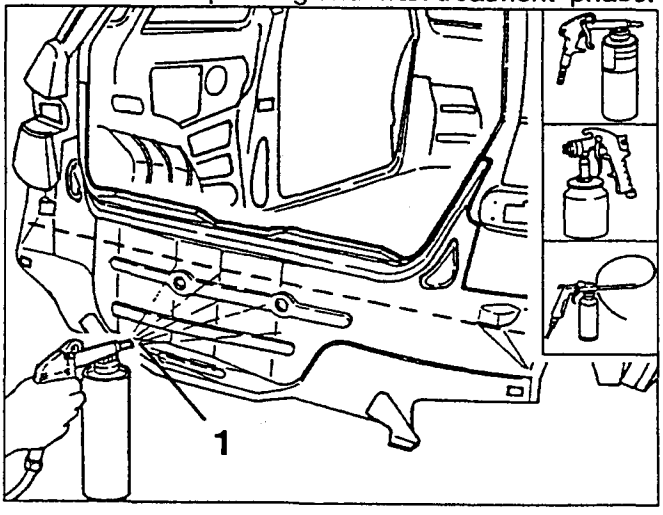




1. Working from under the car, apply the specified sealant along the lines shown in the diagram.

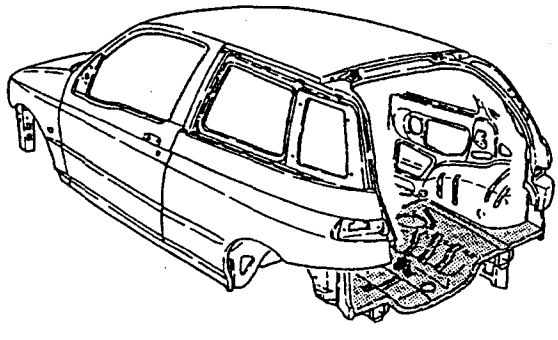


1. Apply the specified underbody sealant to the new areas and on the rib spreading it up to the line shown in the diagram.
- Proceed to the painting and wax-treatment phase.

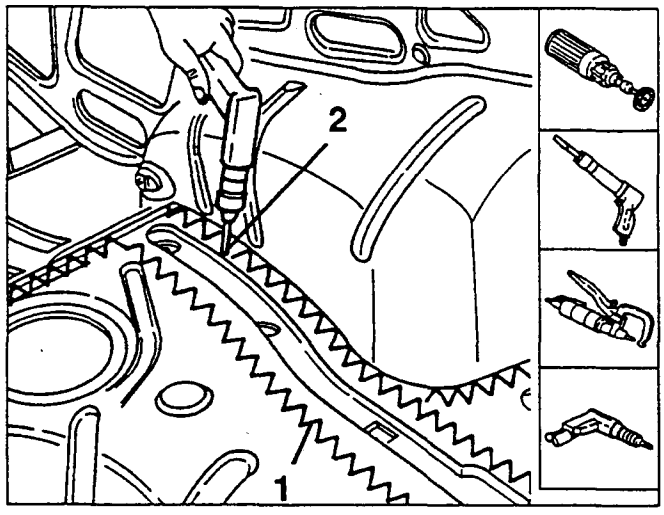


REAR PARTIAL FLOOR PANEL (WITH RIB REMOVED)

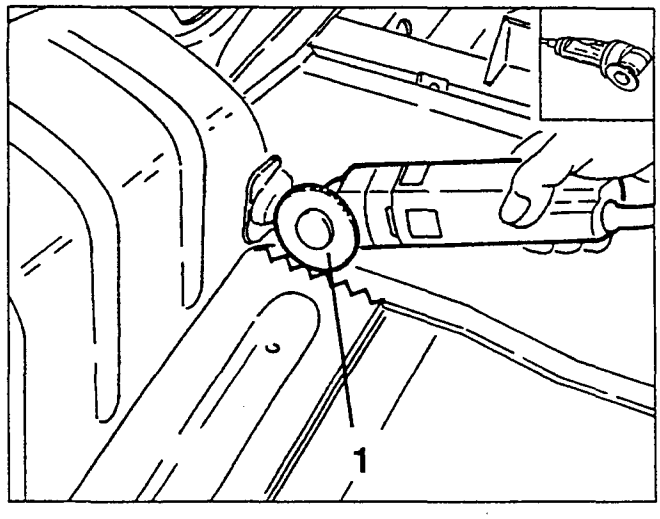
REMOVAL



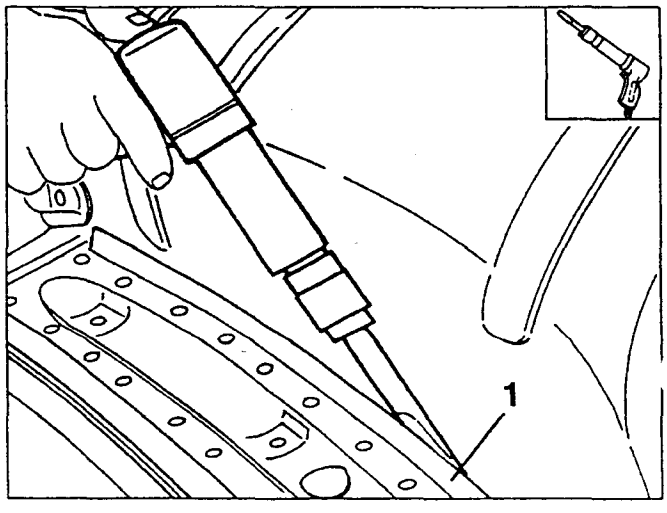
1. Using a chisel free the floor panel as shown in the diagram and remove the sheet metal.
- Using a rotating brush, clean the areas to be spot-cut to highlight the welding points.
2. Using a spot cutter, remove the accessible welding points, remove the remaining welding points using a drill or a chisel.



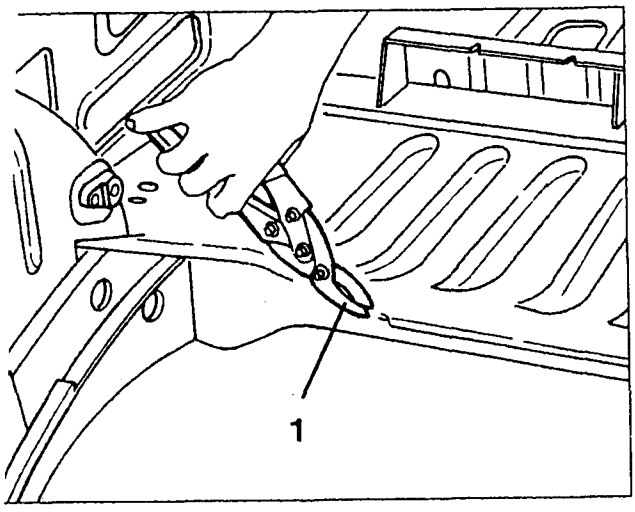
1. Using a circular saw, cut the side edges of the floor panel to be removed as shown in the diagram.



1. Using a chisel remove the side edges of the rear partial floor panel.

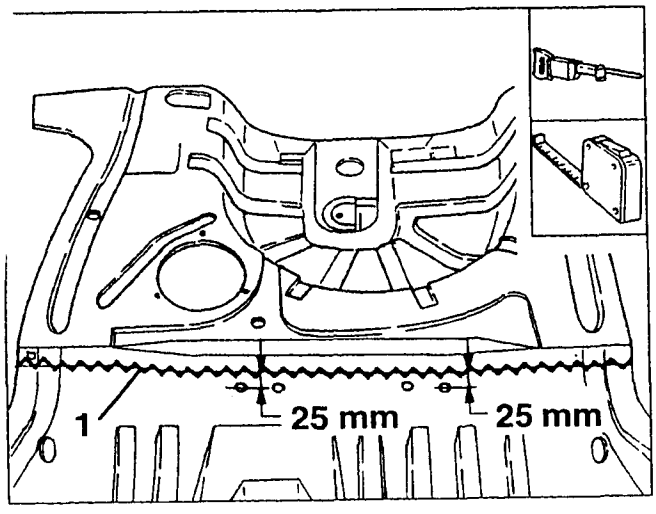


Jsing shears trim the floor panel so that it is flush ı the frame.

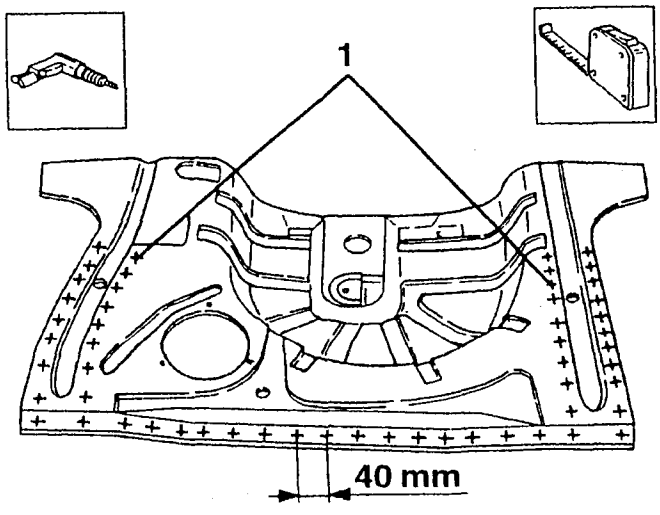


'REPARATION

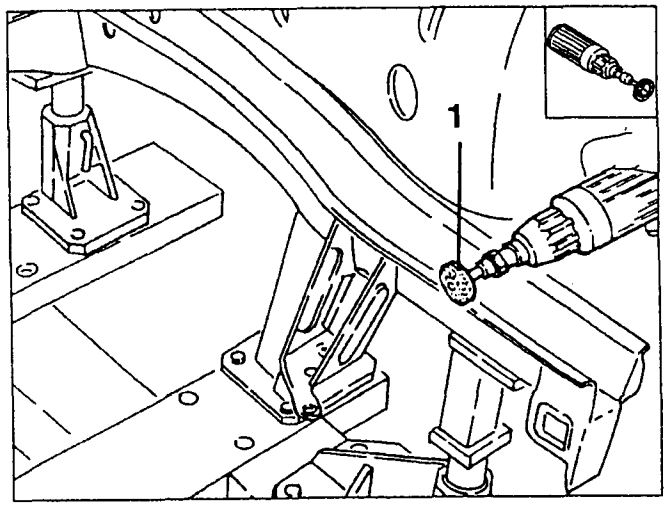
. Working on a bench trace out and cut the new floor ıanel to the dimensions given in the diagram.



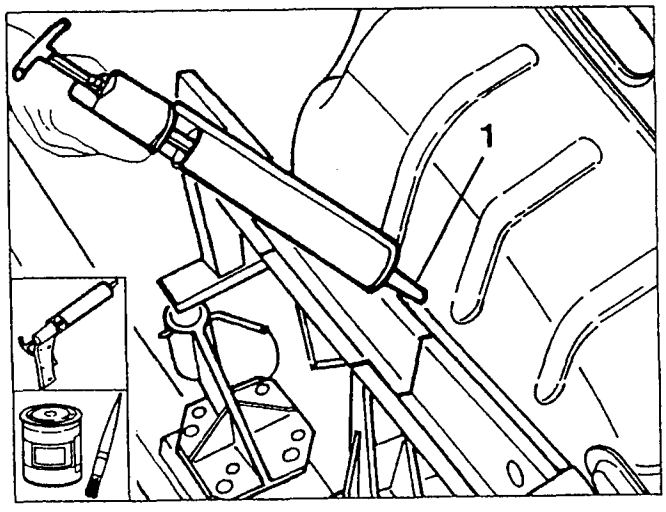
- Using shears trim the cut on the partial rear floor panel.
1. Trace out and drill the partial rear floor using a drill and a Ø 5 mm bit and leaving space between the holes as shown in the diagram.



1. Using a rotating brush, clean the area to be welded.

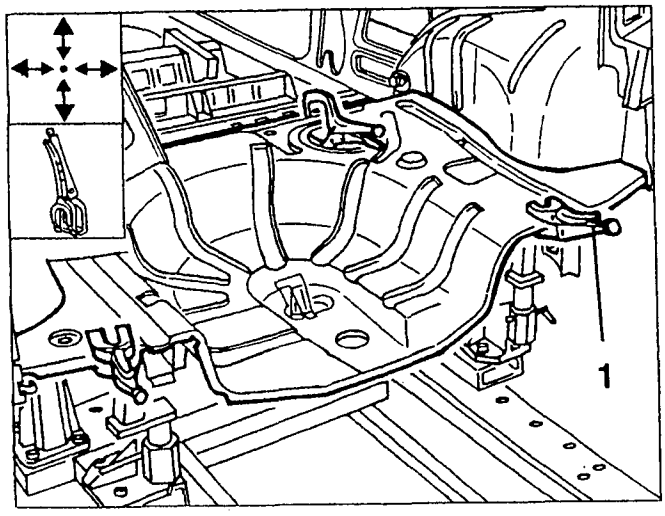


1. Apply a thick layer of electroweldable protection to the area indicated in the diagram.
- Apply the electroweldable protection with a brush to the remaining areas to the spot welded.



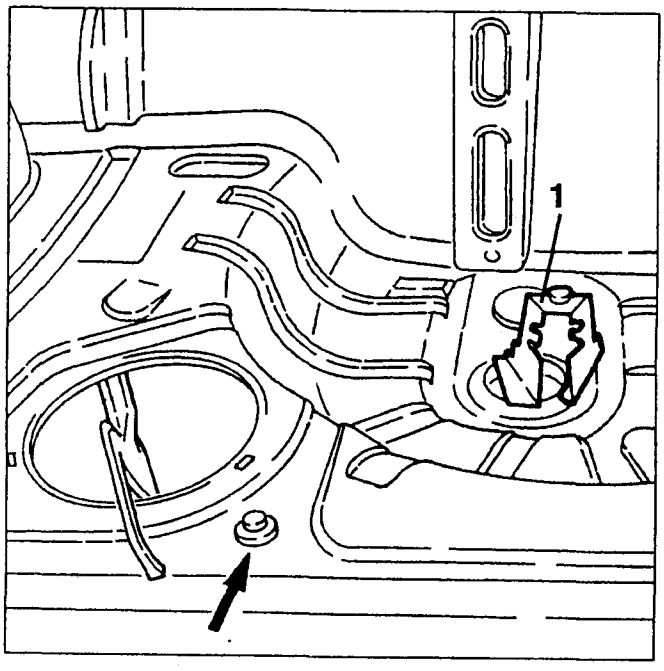
POSITIONING

1. Position the partial rear floor panel and join the edges to be welded together and fix using clamps.



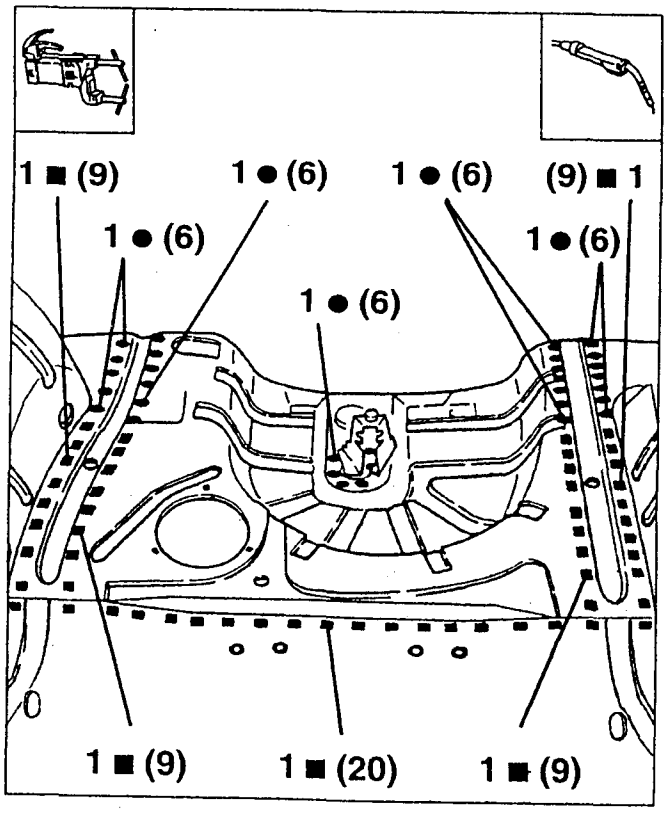
1. Position the well support as indicated in the diagram.

NOTE:
Check the correct position of the partial rear floor panel using a screw in the hole indicated in the diagram as a reference point.

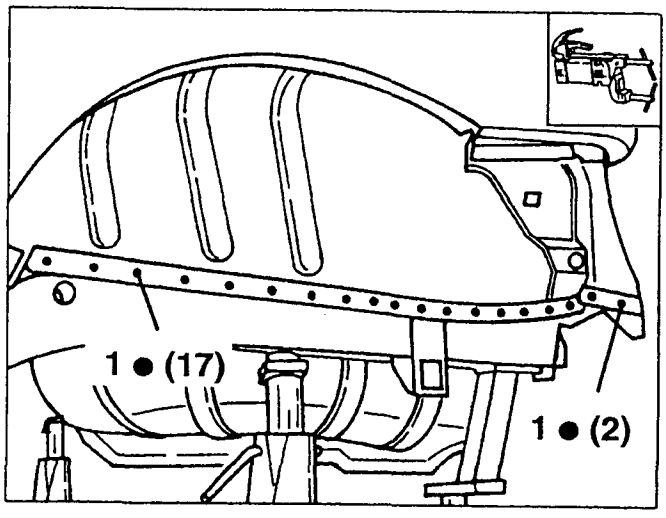


WELDING AND FINISHING THE SHEET METAL

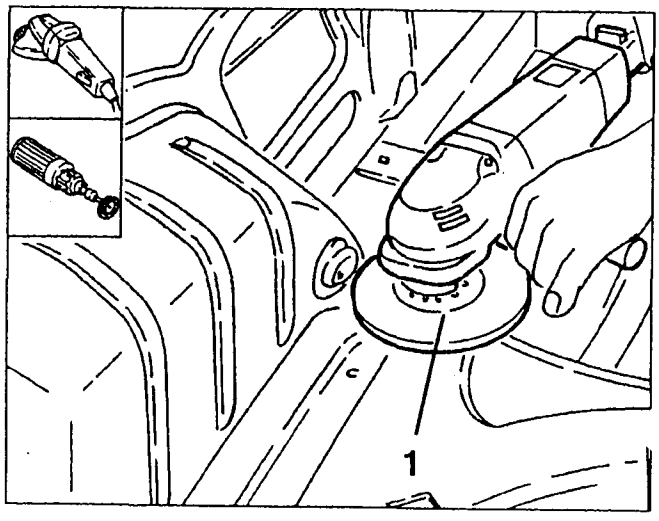
1. Using a spot welder or, where necessary, a MIG welder, proceed as shown in the diagram.



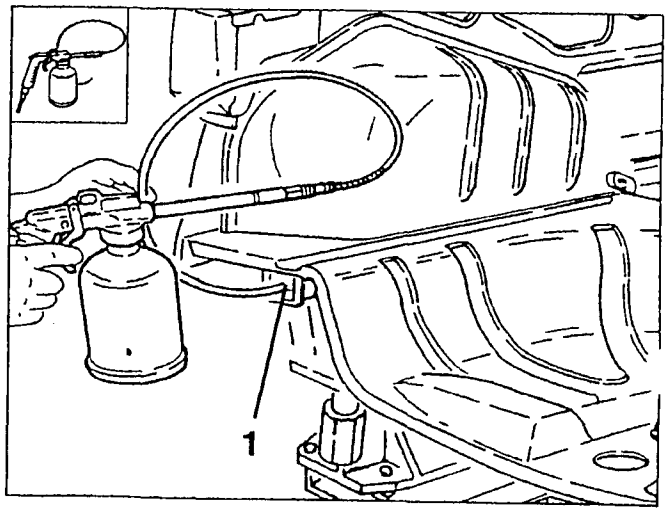
1. Using a spot welder, proceed as shown in the diagram.



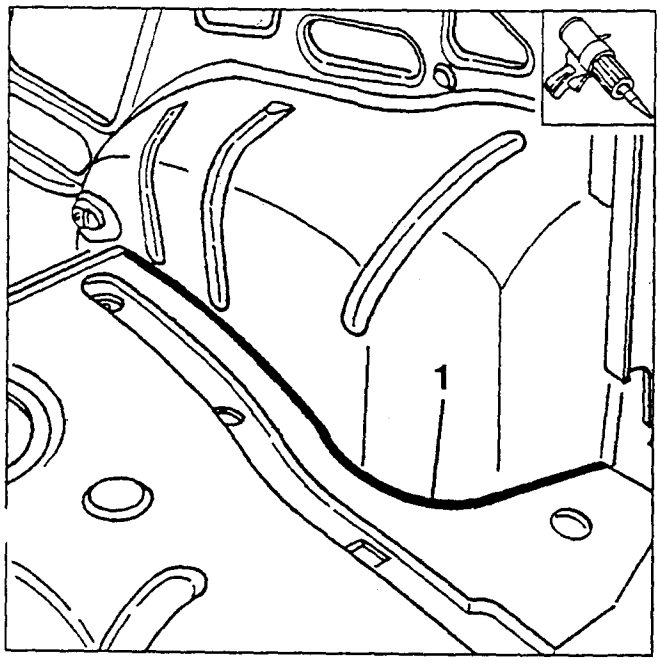
1. Using an abrasive grinding wheel, remove and flush the residues left by welding.
- Using a rotating brush, clean the welded areas.

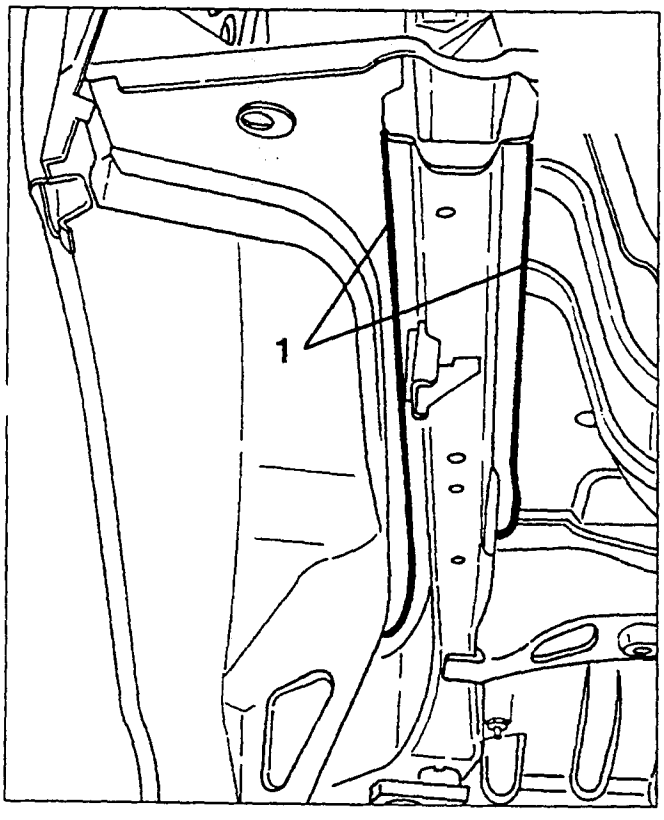


1. Apply the specified corrosion inhibitor to the areas to be MIG welded.



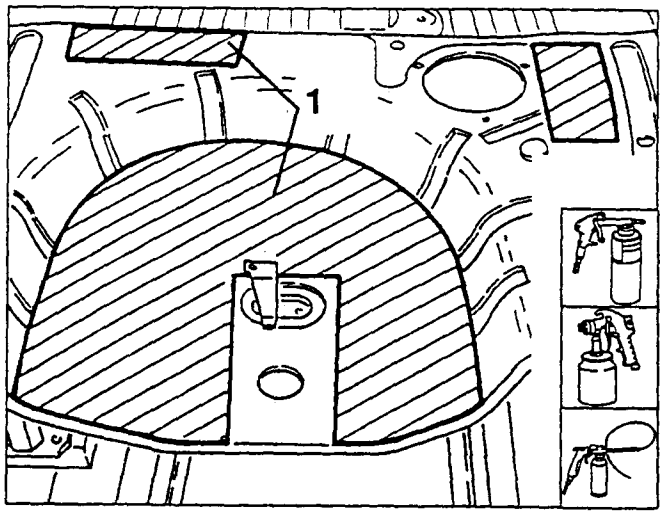
. Apply the specified sealant along the lines shown in the diagram.





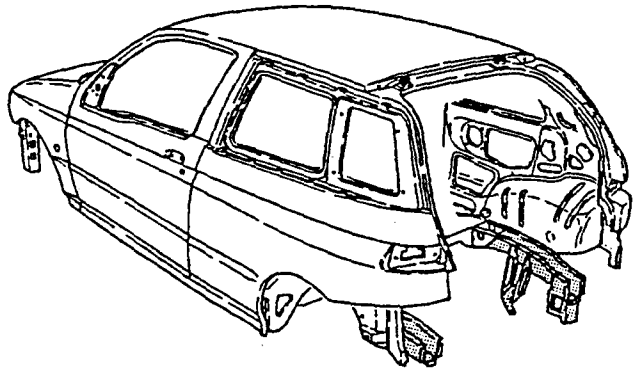
1. Apply the sound-proof panels as shown in the diagram.
- Apply the specified underbody protection to the under-floor areas.
- Proceed to the painting phase.

- Proceed to the wax-treatment phase.

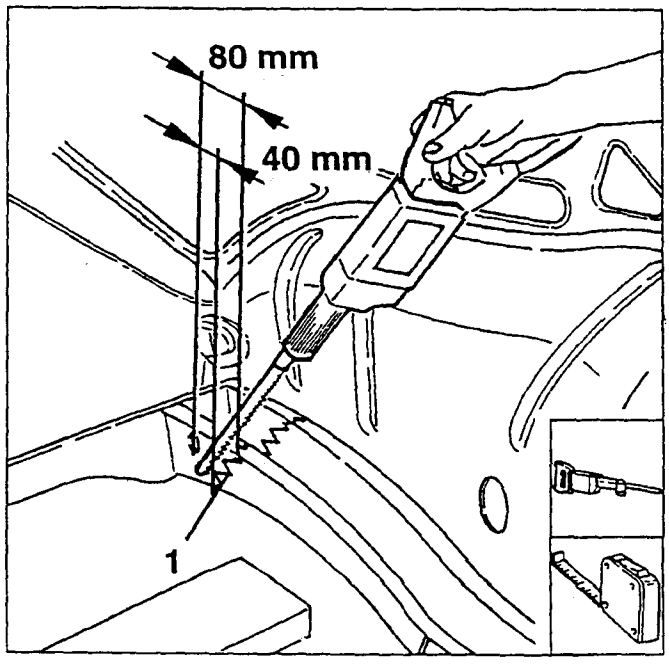


PARTIAL REAR CROSS-MEMBERS (WITH FLOOR REMOVED)

REMOVAL



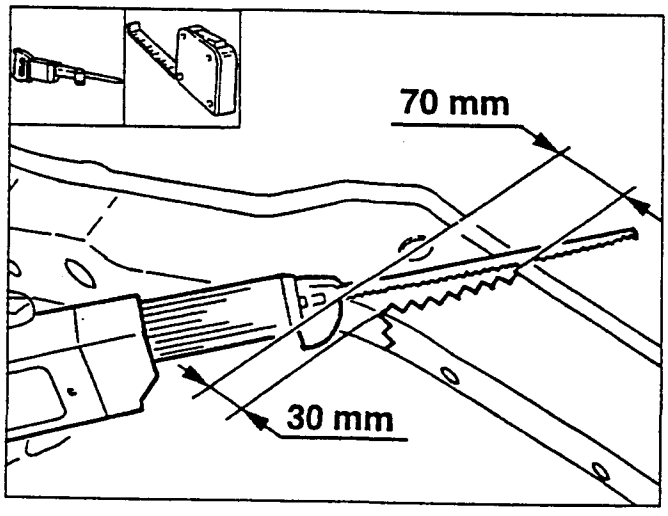
1. Using a jig saw, cut the cross-member to the dimensions shown in the diagram



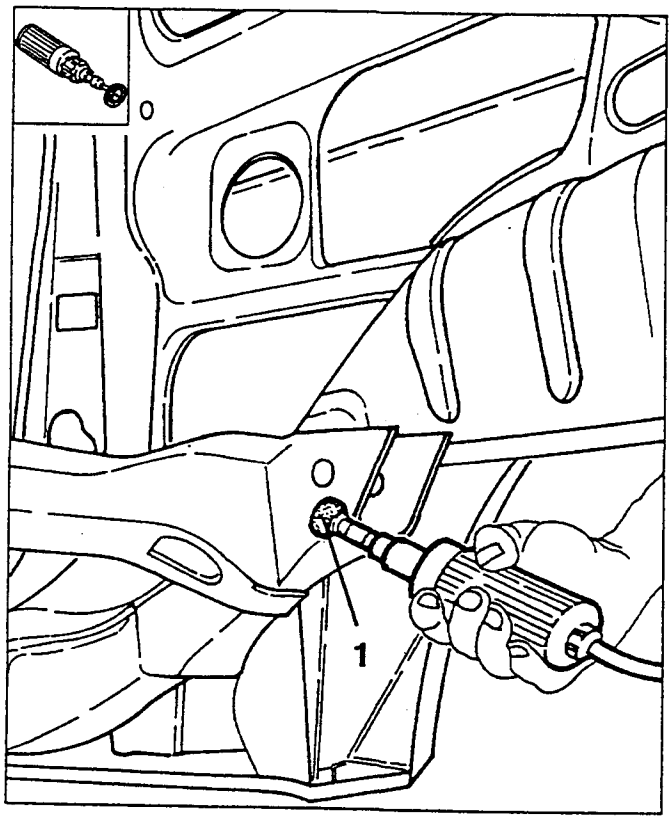
- Remove the partial rear cross-member.

PREPARATION

1. Working on a bench and using a jig saw cut the new cross- member to the dimensions shown in the diagram.



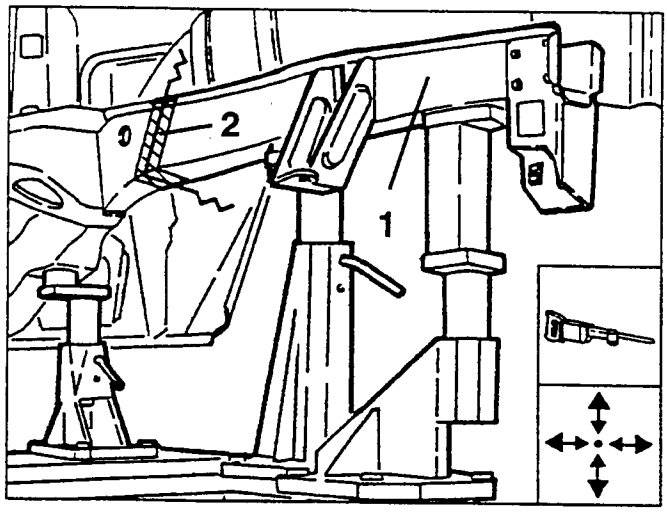
1. Using a rotating brush, clean the area to be welded.



POSITIONING

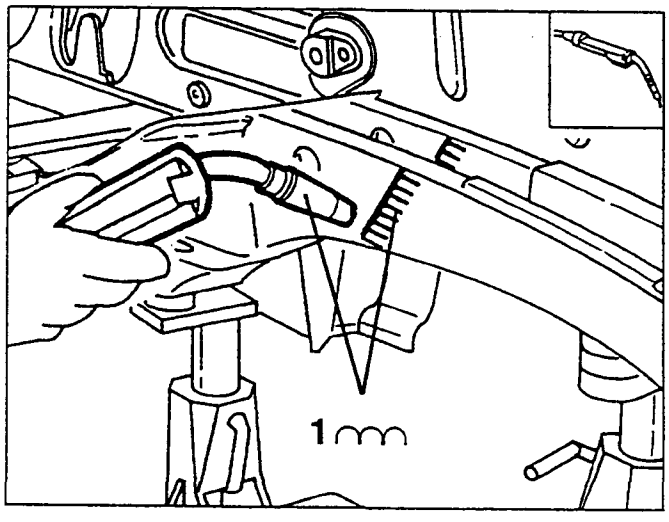
1. Using a jig, correctly position the partial rear cross-member remembering to allow for overlapping.

2. Using a jig saw, trim the excess sheet metal parts.

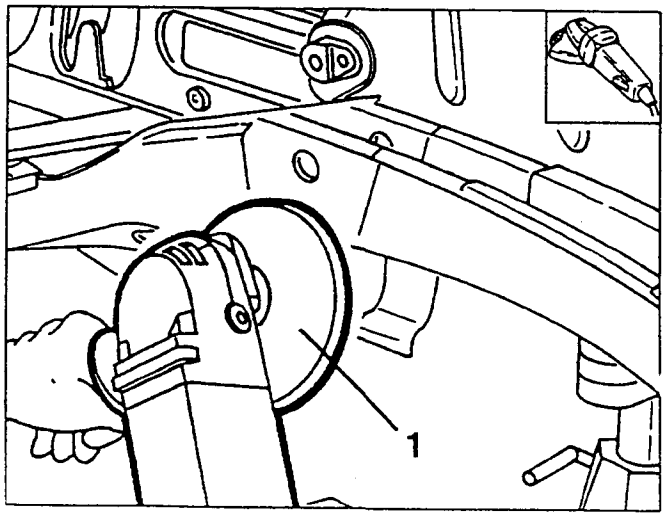


WELDING AND FINISHING THE SHEET METAL

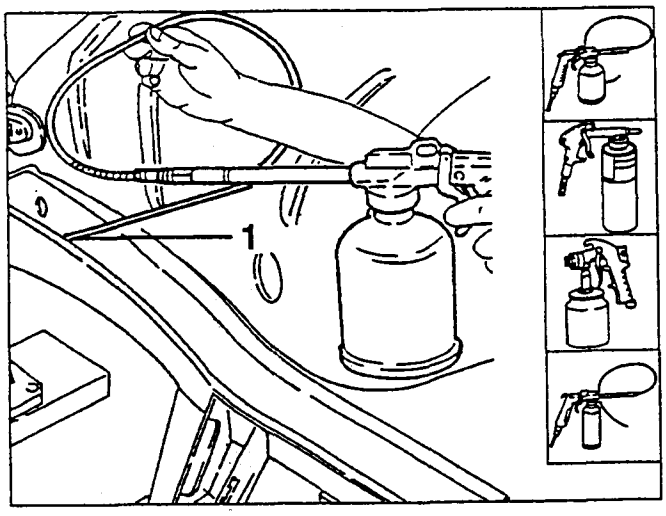
1. Using a MIG welder, proceed as shown in the diagram.



1. Using an abrasive grinding wheel, remove and flush the residues left by welding.

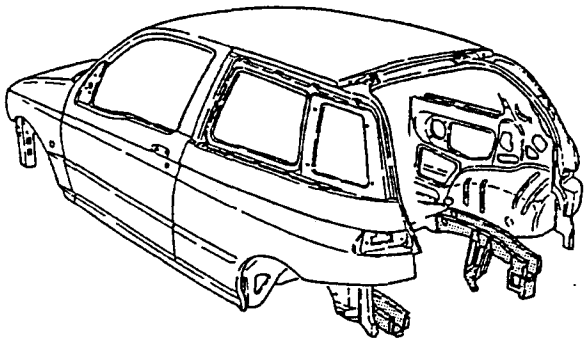


1. Apply the specified corrosion inhibitor to the areas to be welded.
- Apply the underbody protection to the new areas.
- Proceed to the painting phase.
- Proceed to the wax-treatment phase.

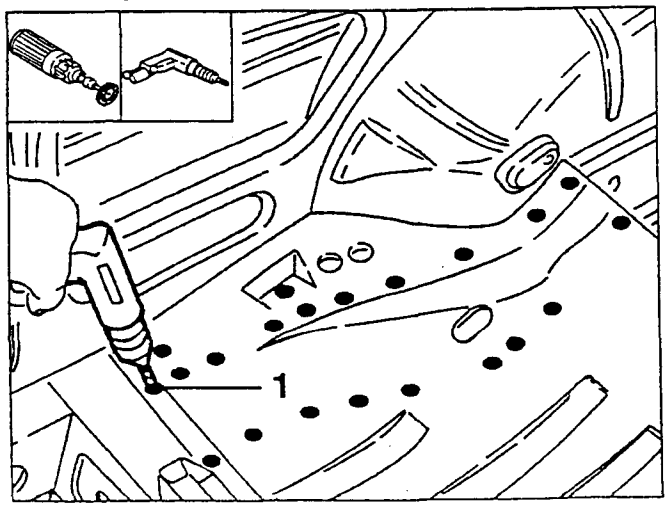


COMPLETE REAR CROSS-MEMBERS (WITH FLOOR REMOVED)

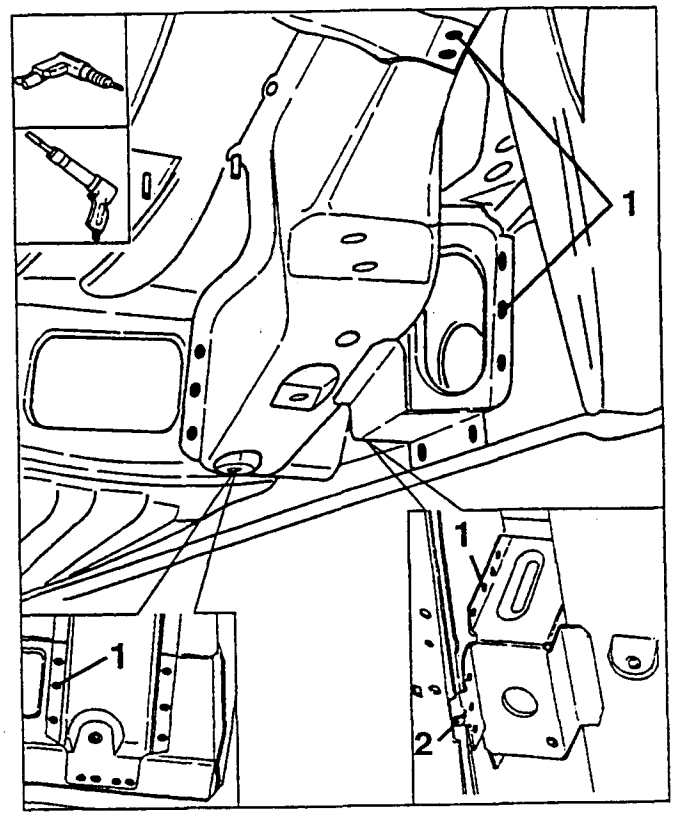
REMOVAL



- Using a rotating brush, clean the areas to be spot-cut to highlight the welding points.
- Remove the sound-proofing carpets from the floor.
1. Using a drill, spot cut the welding points as shown in the diagram.

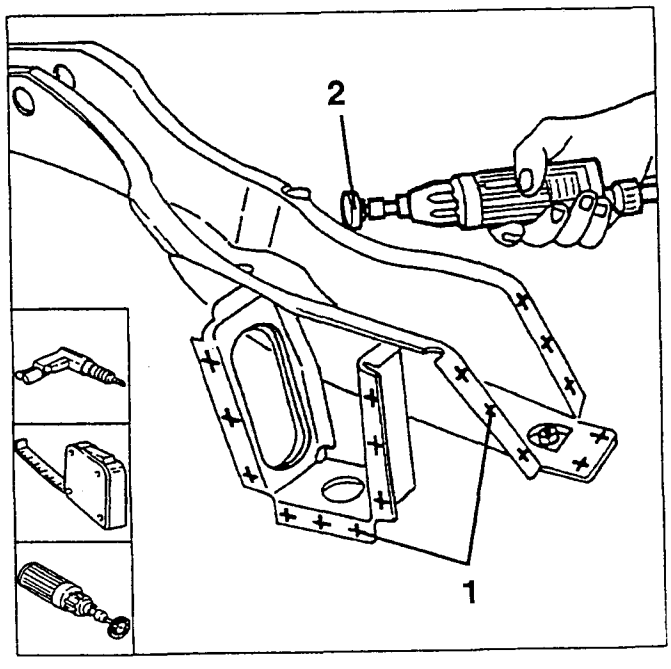


1. Using a drill or, where necessary, a chisel, spot cut as shown in the diagram.
2. Remove cross-member after opening the clinch tab.



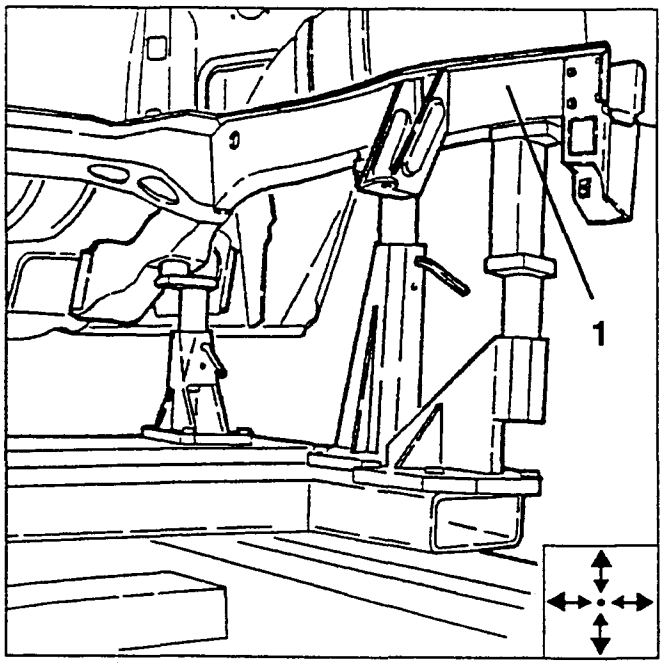
PREPARATION

1. Working on a bench trace out and perforate the cross-member with a drill and Ø 5 mm bit, as shown in the diagram.
2. Using a rotating brush, clean the area to be welded.



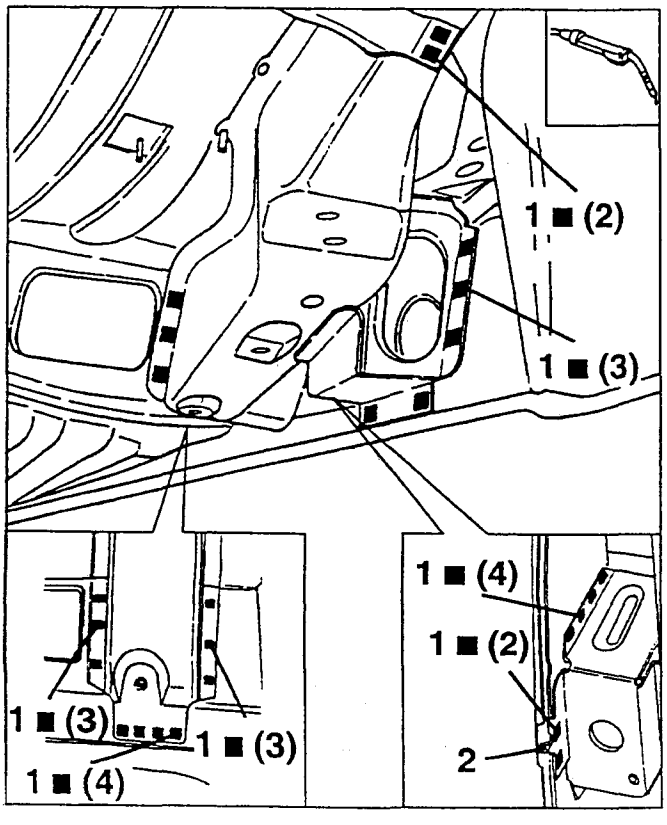
POSITIONING

1. Install the cross-member using a jig to position it. Join the edges to be welded.

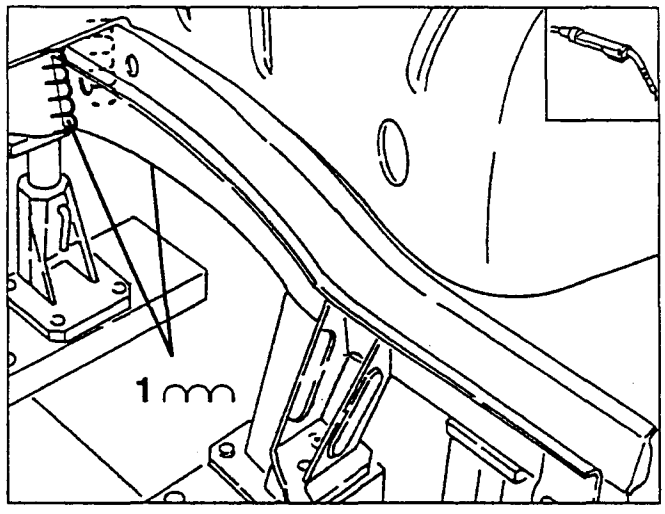


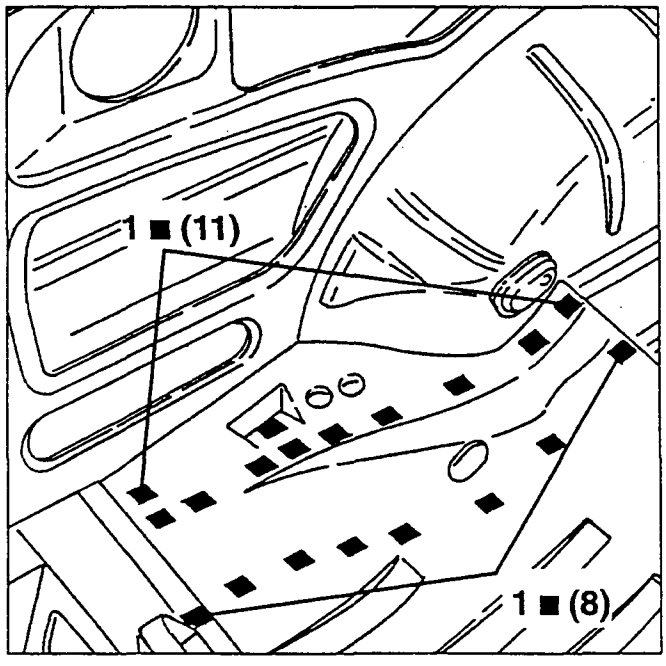
WELDING AND FINISHING THE SHEET METAL

1. Using a MIG welder, proceed as shown in the diagram.
2. Bend the clinch tabs.

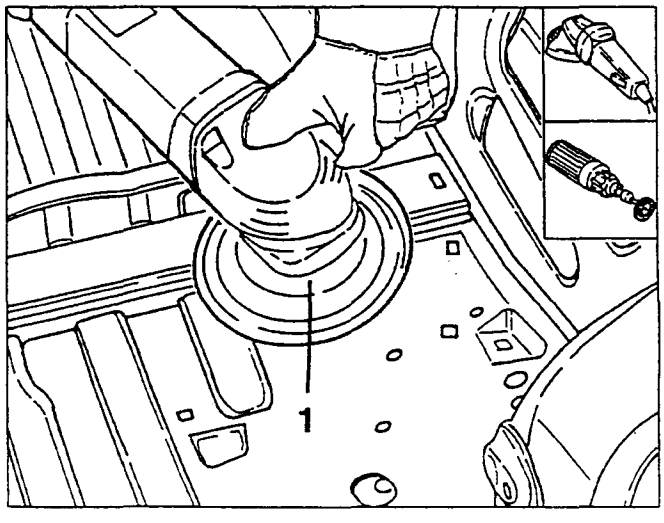


1. Using a MIG welder, proceed as shown in the diagram.



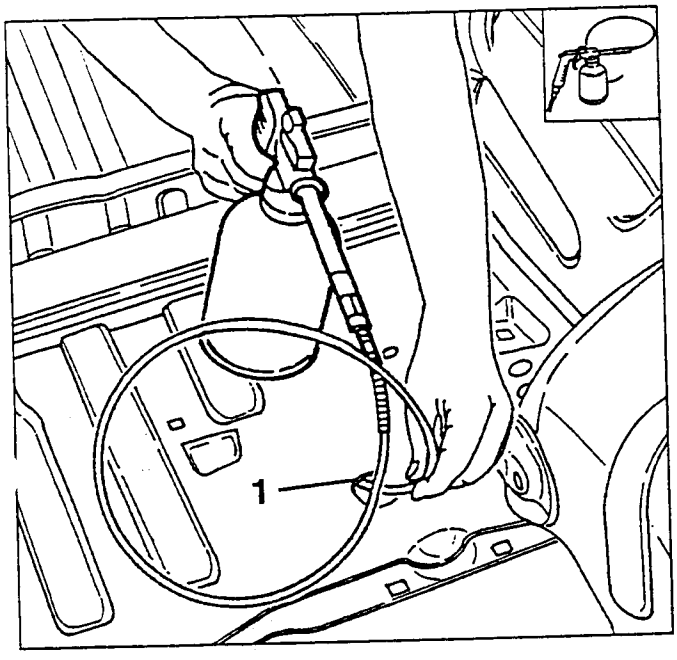


1. Using an abrasive grinding wheel, remove and flush the residues left by welding.
- Using a rotating brush, clean the welded areas.



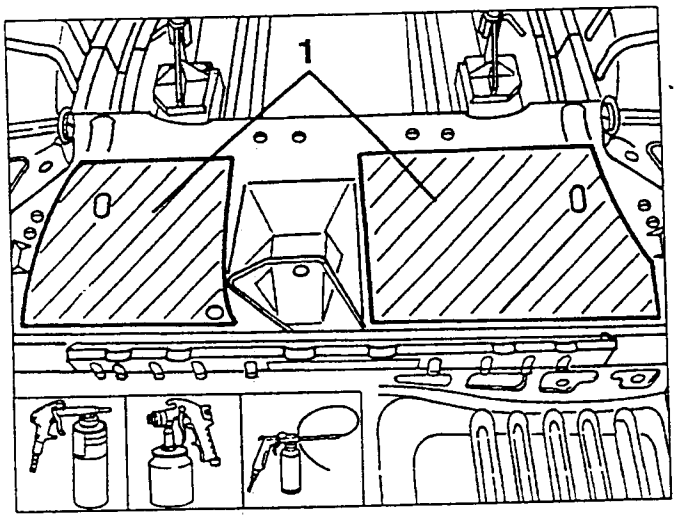
PROTECTION

1. Apply the specified corrosion inhibitor to the areas which have been MIG welded.



- Apply underbody protection to the new areas.
- Proceed to the painting phase.
- Proceed to the wax-treatment phase.

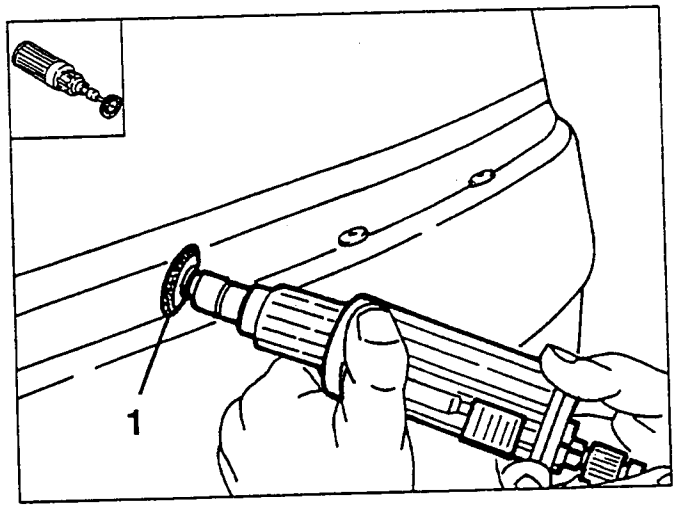
1. Refit the sound-proofing carpets as shown in the diagram.



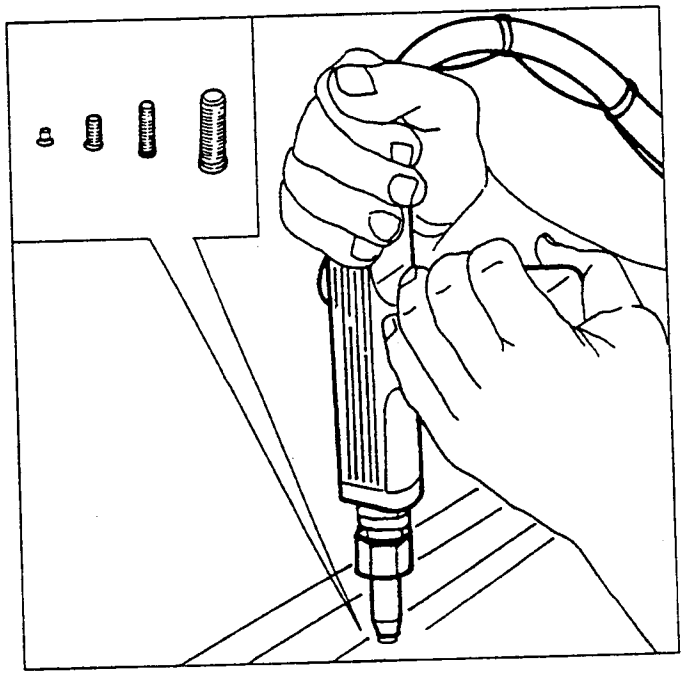
REPLACING NAILS

- Suitably protect the surrounding areas or the area to be replaced.

1. Using a rotating brush clean the affected areas.



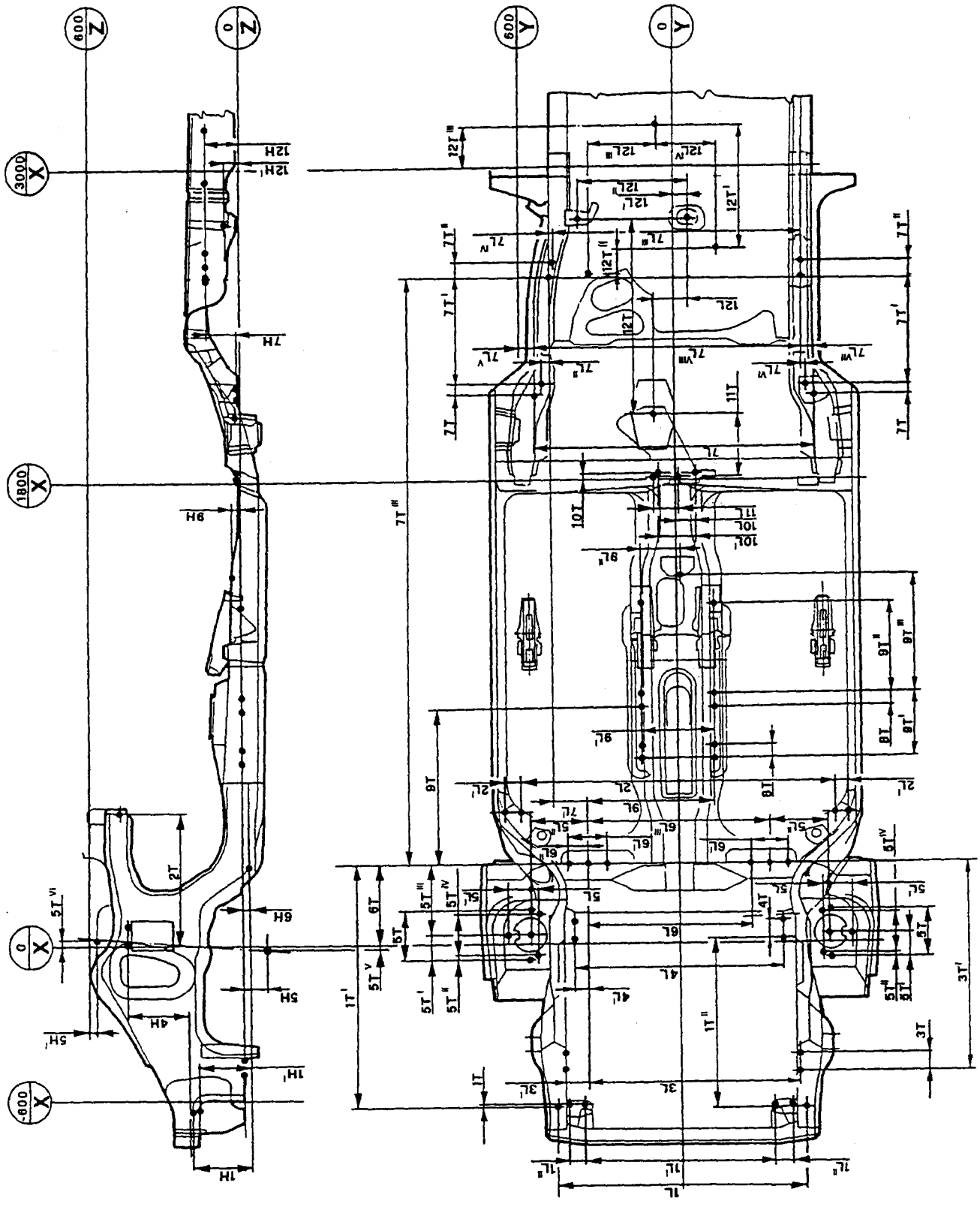
- Insert a nail of the correct size in the gun.
- Install the nail in place of the one removed.



- Sand and respray the new areas.

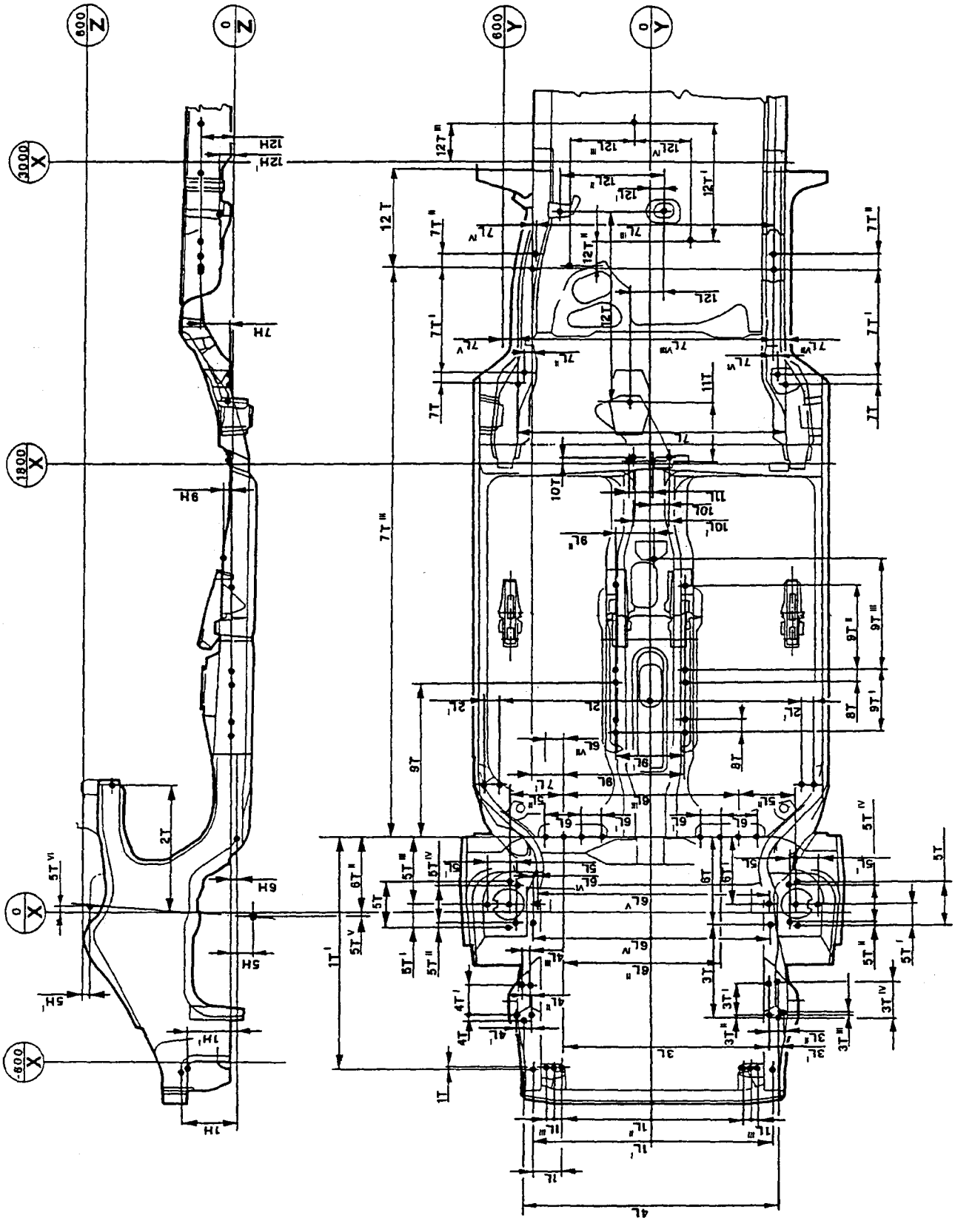
Specific for Boxer versions

		L	L^{I}	L^{II}	L^{III}	L^{IV}	L^{V}	L^{VI}	L^{VII}	L^{VIII}	T	T^{I}	T^{II}	T^{III}	T^{IV}	T^{V}	T^{VI}	H	H^{I}
Lower radiator attachments	1	940 æ 1	740 ± 1	60							9	948 ± 1.5	651 ± 1					216	195
Dashboard cross-member and steering column attachments	2	1200	40								520 ±1								
Front suspension frame side attachment	3	835 ± 1	125 ± 0.5								70	808 ± 1							
Front suspension frame front attachment	4	818 ± 1	53.5								70							234	
Front suspension attachments	5	28.4	79	206.35 ± 1							178 ± 0.5	89	11	279.4 ± 1	156	4.54	28.58	74	42
Front suspension frame rear attachment	6	625 ± 1.2	145 ± 0.2	60.5	710 ± 1						308							24 ± 0.5	
Rear suspension attachments	7	1084	132.25 ± 1	25	976	11	55 ± 0.5	12	42 ± 0.5	987 ± 0.5	43	422 ± 1	58	2269 ± 2				118	
Gearbox centering holes	8										50								
Holes for exhaust pipe support bracket	9	495 ± 1	280 ± 1	150							612 ± 1	250	345	455				49.2	
Holes for flexible support	10	84.5	147								19								
Hand brake attachments	11	90									233								
Fuel tank attachments	12	140	55	420	260	228					750	472	96	152				141 ± 1.5	116



Specific for Turbodiesel versions

		L	L^{I}	L^{II}	L^{III}	L^{IV}	L^{V}	L^{VI}	L^{VII}	L^{VIII}	T	T^{I}	T^{II}	T^{III}	T^{IV}	T^{V}	T^{VI}	H	H^{I}
Lower radiator attachments	1	115 ± 0.5	940 ± 1	740 ± 1	60						9	948 ± 1.5						216	195
Dashboard cross-member and steering column attachments	2	1200	40								520 ±1								
Gearbox attachments	3	830	28	60							372 ± 1	128	2	9	132				
Engine attachments	4	1013.5	55	35.5	30						5	131							
Front suspension attachments	5	28.4	79	206.35 ± 1							178 ± 0.5	89	11	279.4 ± 1	156	4.54	28.58	74	42
Suspension crossmember attachment	6	145 ± 0.2	83	625 ± 1.2	710 ± 1	948 ± 1	938	5	60.5		358 ± 1	270 ± 1	308					24 ± 0.5	
Rear suspension attachments	7	1084	132.25 ± 1	25	976	11	55 ± 0.5	12	42 ± 0.5	987 ± 0.5	43	422 ± 1	58	2269 ± 2				118	
Gearbox centering holes	8										50								
Holes for exhaust pipe support bracket	9	495 ± 1	280 ± 1	150							612 ± 1	250	345	455				49.2	
Holes for flexible support	10	84.5	147								19								
Hand brake attachments	11	90									233								
Fuel tank attachments	12	140	55	420	260	228					750	472	96	152				141 ± 1.5	116

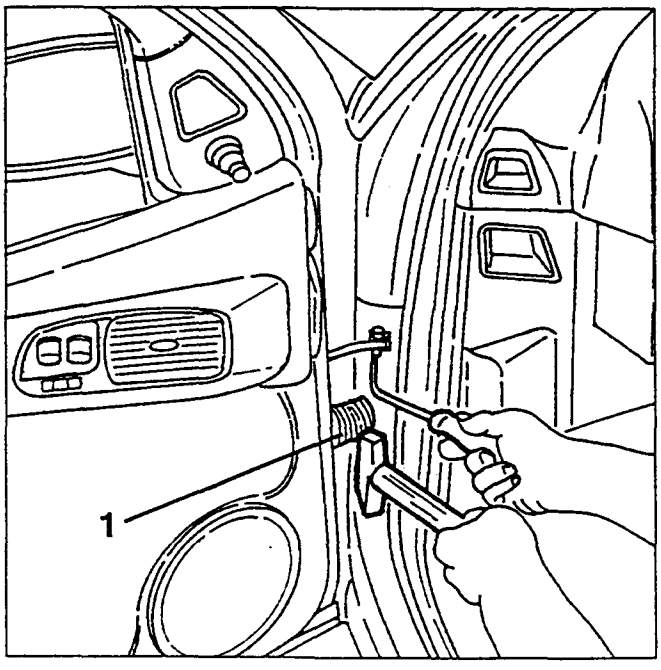


FRONT DOORS

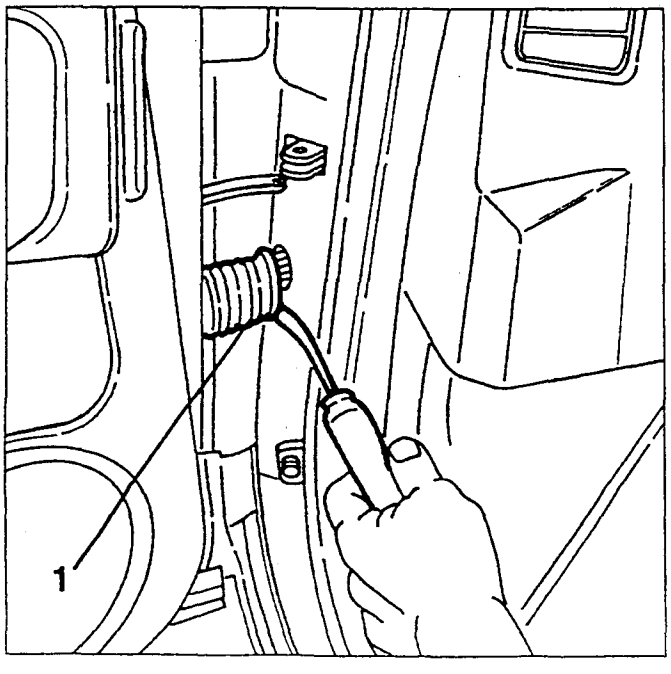
REMOVAL AND REFITTING

NOTE:
When removing or refitting avoid damaging the paintwork.

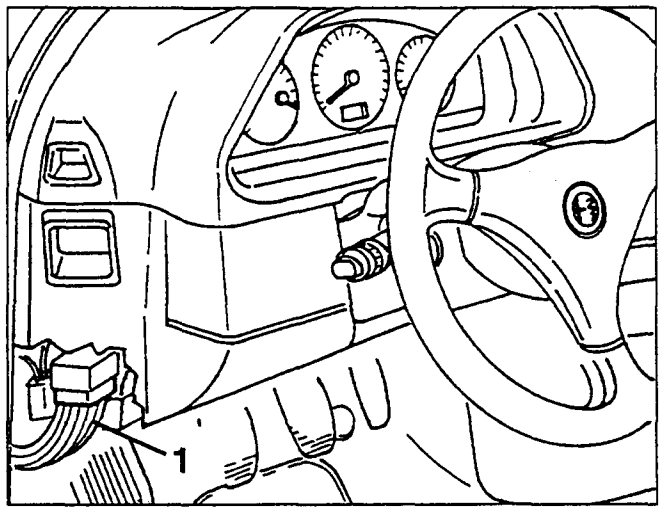
- Disconnect the negative (-) lead from the battery.
1. Using a suitable tool withdraw and remove the pin from the door check strap, half-close the door to back-off the rod and then open the door again.



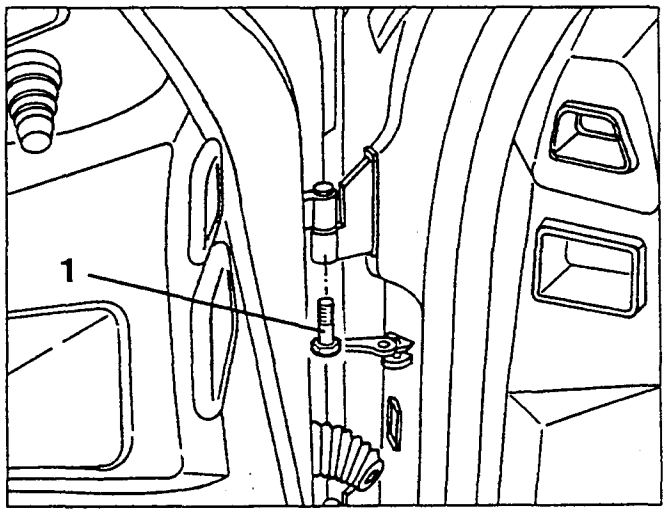
1. Disconnect the cable runner from the front pillar.



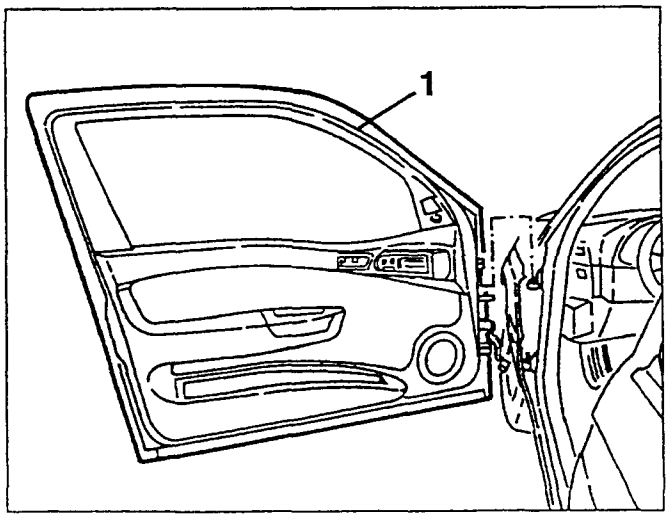
1. Working under the dashboard trim, disconnect the electrical connection from the door wiring and withdraw the pillar.



1. Loosen the two screws securing the door to the hinge.

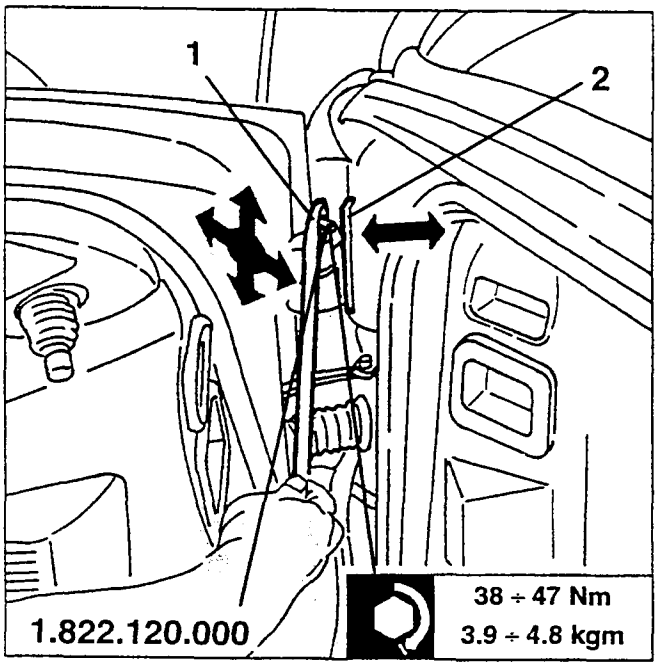


1. Raise the door until the tapered pins of the hinges can be removed from their seatings and then remove the door.



ADJUSTMENT

1. Using tool N° 1.822.120.000, loosen the screws securing the hinge to the body and make adjustments for the height and width of the door.
2. If necessary position suitable shims under the hinges to adjust the position of the door.

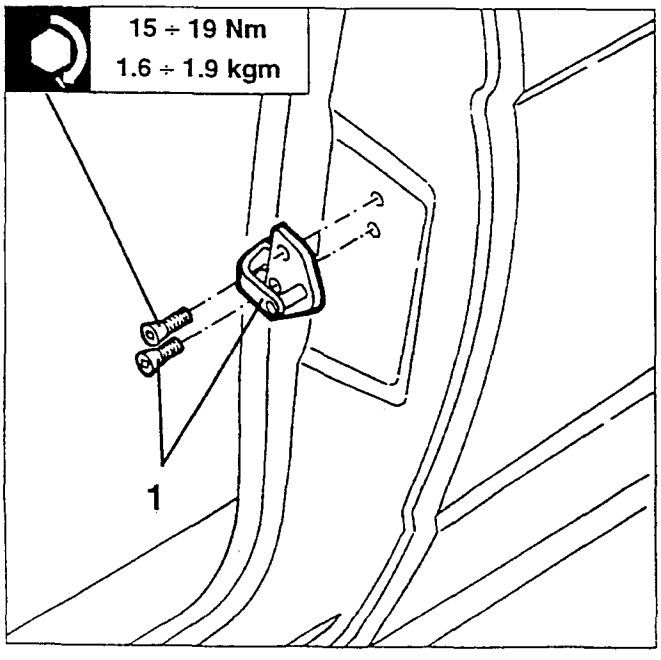


NOTE:
To gain access to the screws of the upper hinge, disconnect the door check strap.

DOOR CATCH

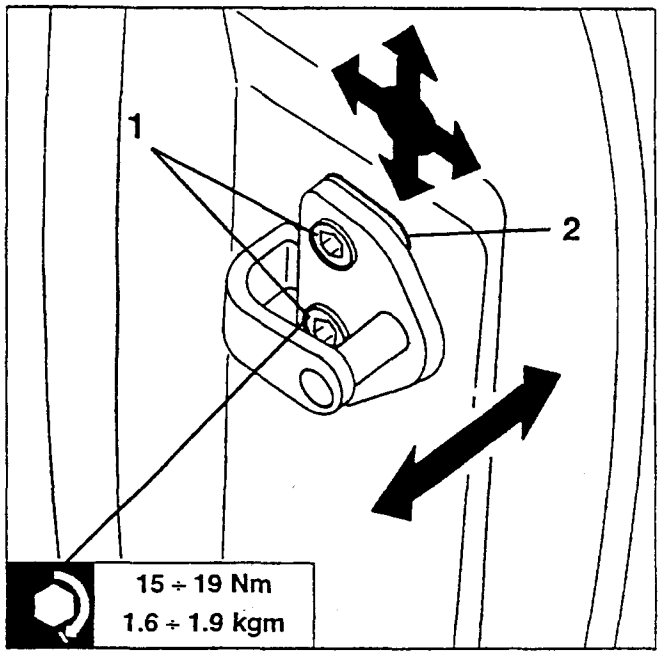
REMOVAL AND REFITTING

1. Loosen the two screws and remove the catch.



ADJUSTMENT

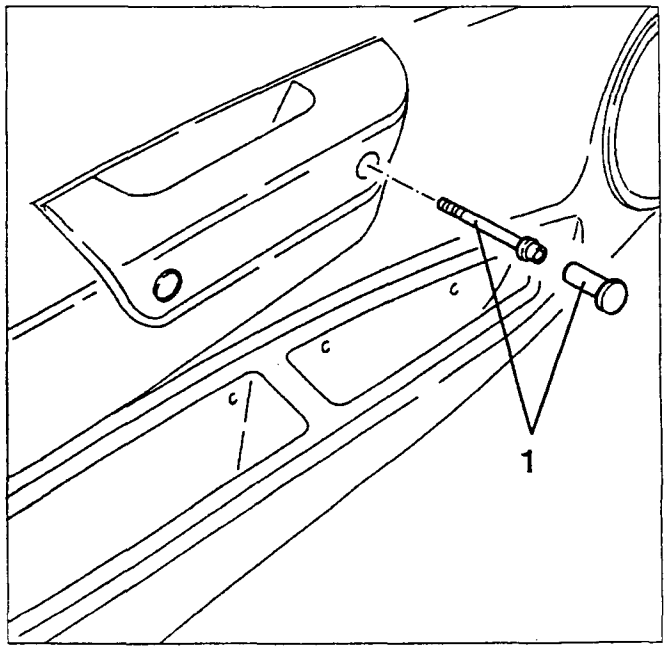
1. Loosen the screws securing the catch and adjust the catch until the door closes correctly. Tighten the screws.
2. If necessary position suitable shims under the catch to adjust the closure of the door.



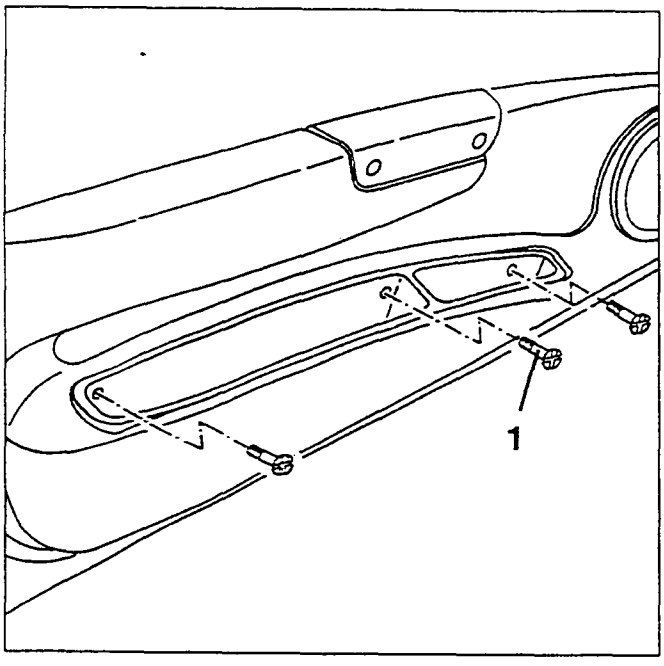
PANEL

REMOVAL AND REFITTING

- Disconnect the negative (-) lead from the battery.
1. Pull off the plastic caps from the armrest grip and unscrew the underlying screws.

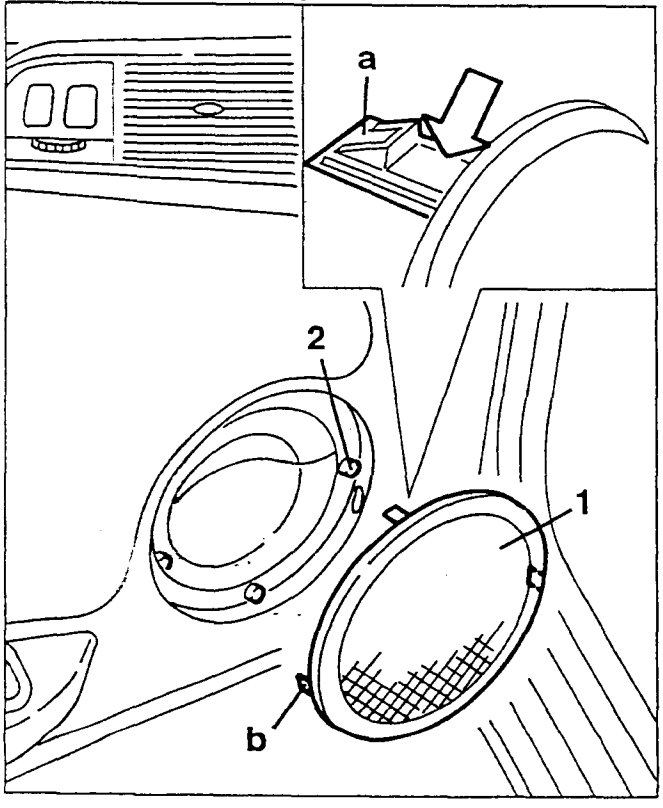


1. Slacken the three upper screws fastening the utility pocket.

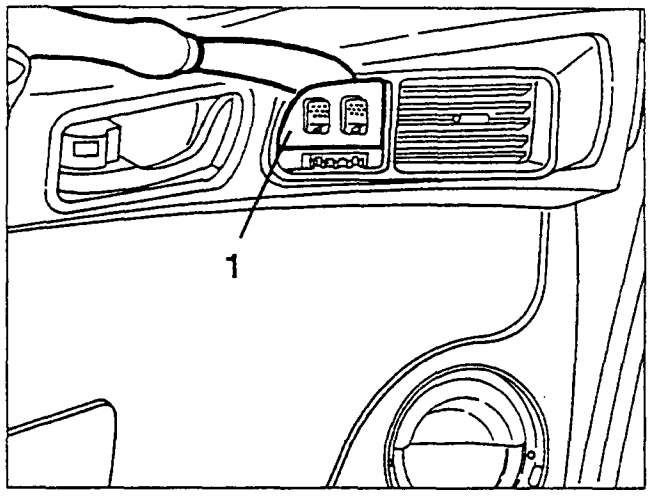


1. Remove the speaker protection grille proceeding as follows:
- using a suitable tool (eg. small, flat screwdriver) press on the upper catch (a) hooking the grille to the door panel;
- proceed as described for the previous step on the rear catch (b);
- remove the grille.

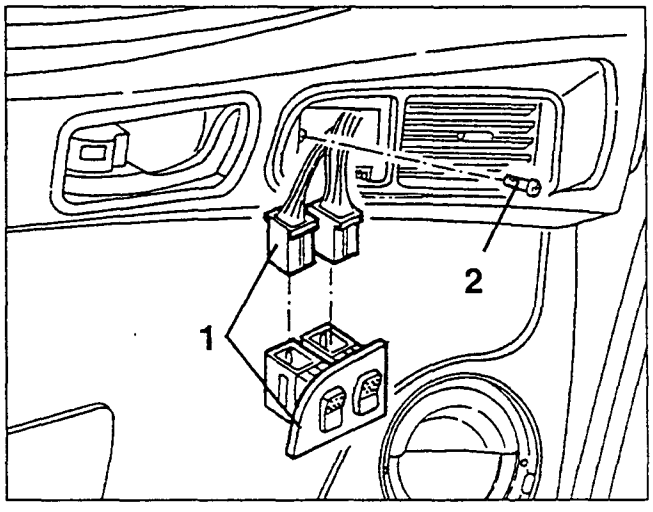
2. Slacken the three screws fastening the speaker compartment to the body.



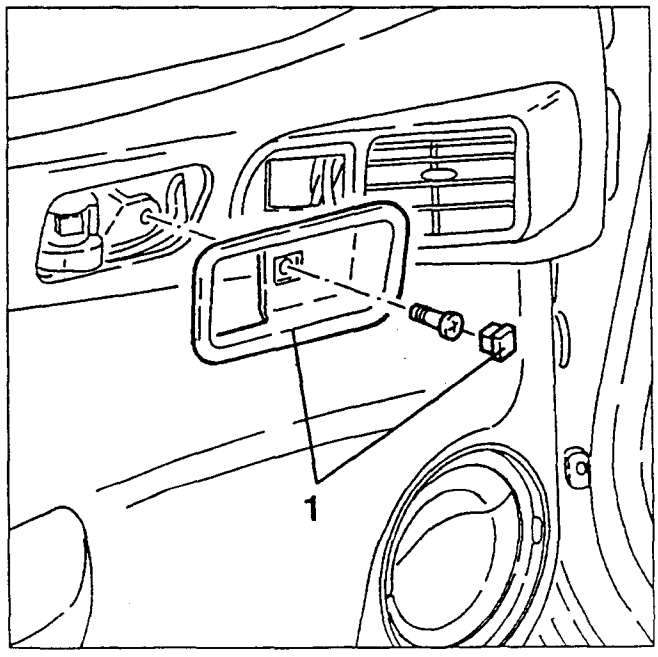
1. Remove the power window switches complete with plate from their housing.



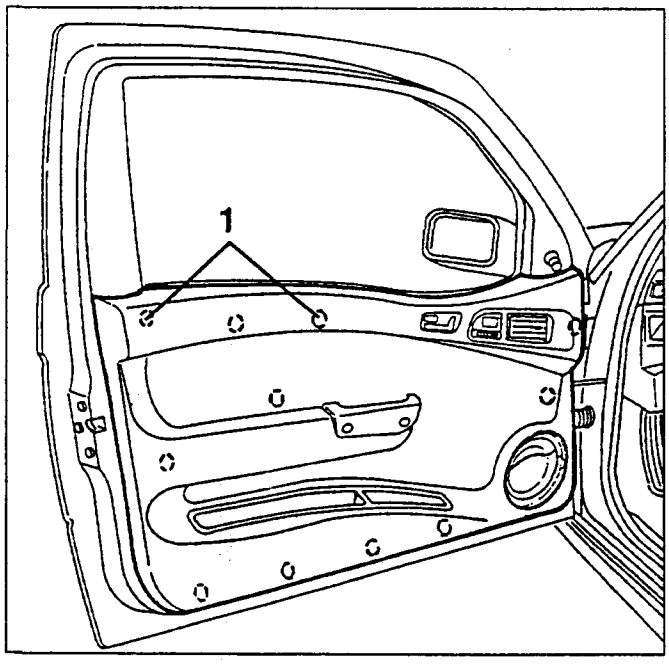
1. Disconnect the electrical connections from the power window switches and remove the switches.
2. Slacken the fastening screw in the switch compartment.



1. Remove the plastic cap, slacken the fastening screw and remove the door opening handle plate.

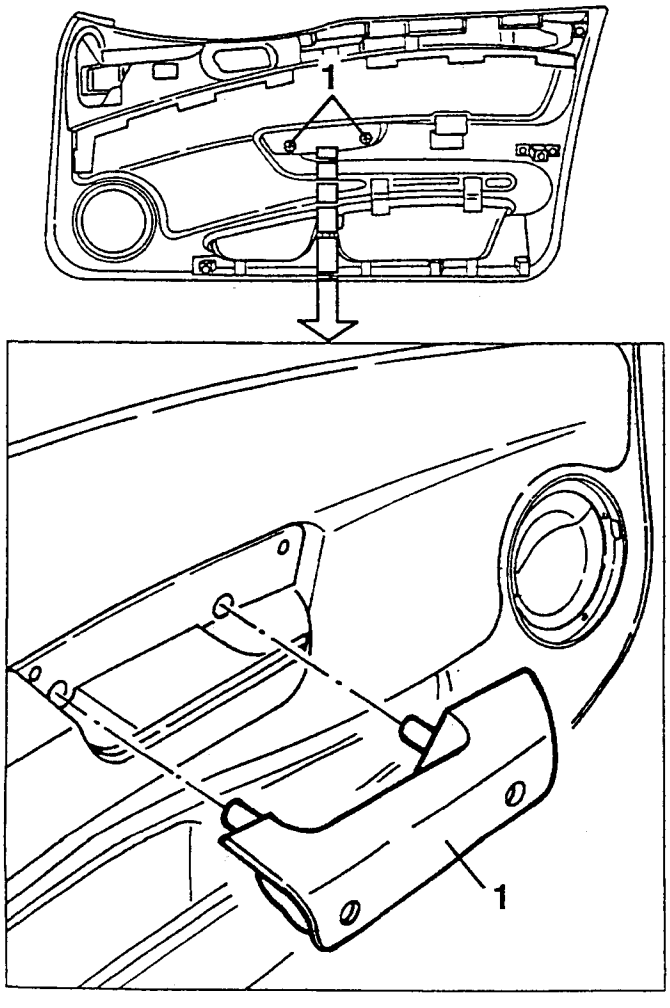


1. Pull the panel away from the plastic buttons positioned as shown in the diagram and remove the panel.

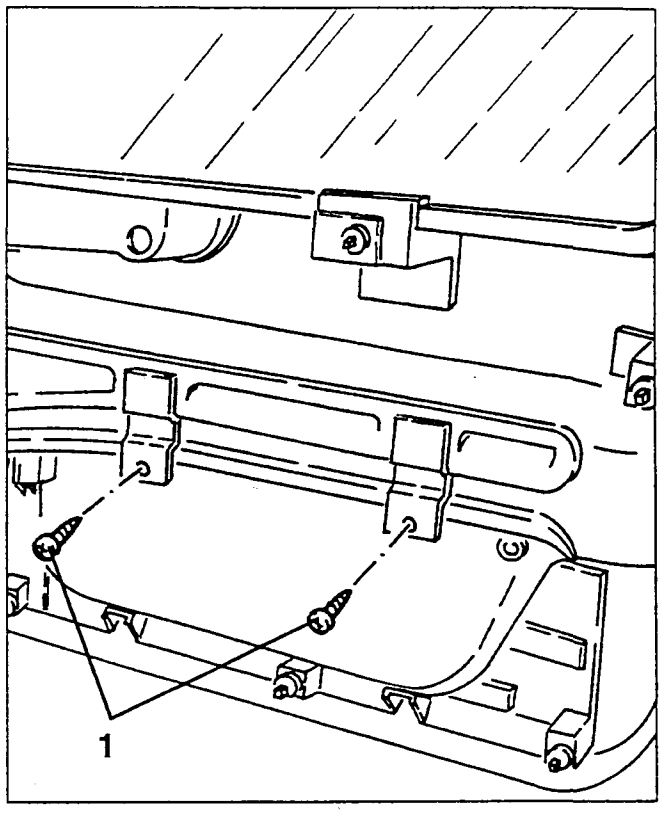


DISASSEMBLY

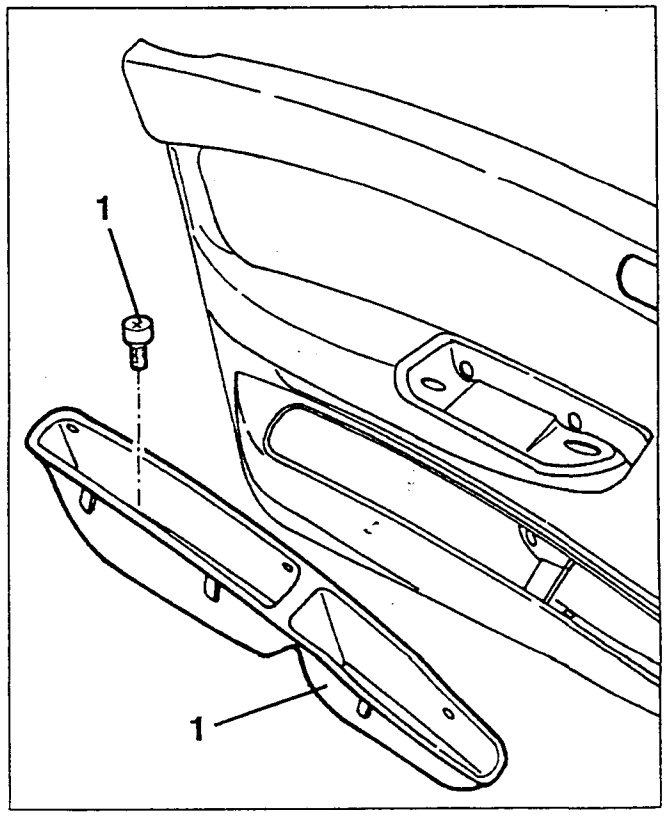
1. Loosen the two screws and remove the armrest handle.



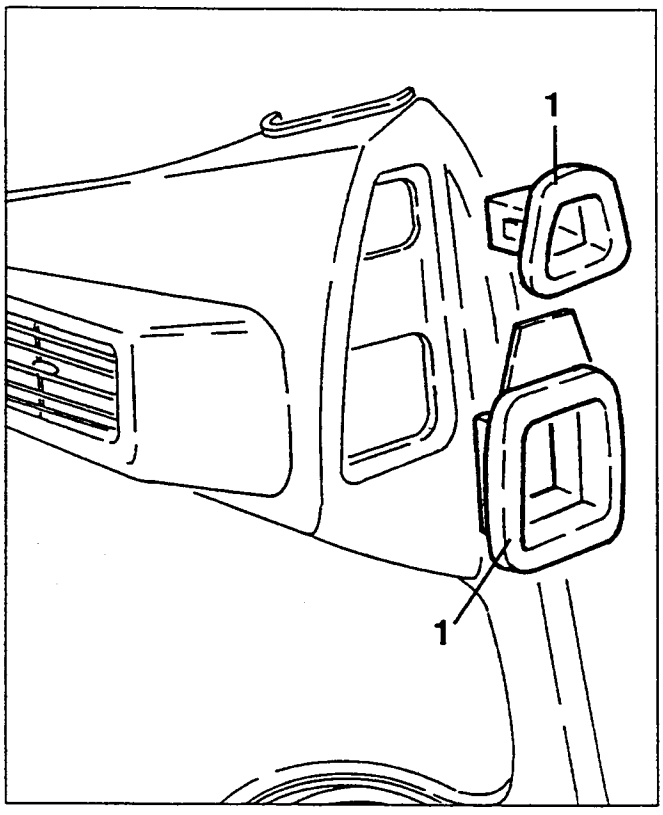
1. Loosen the two rear screws securing the object pouch.



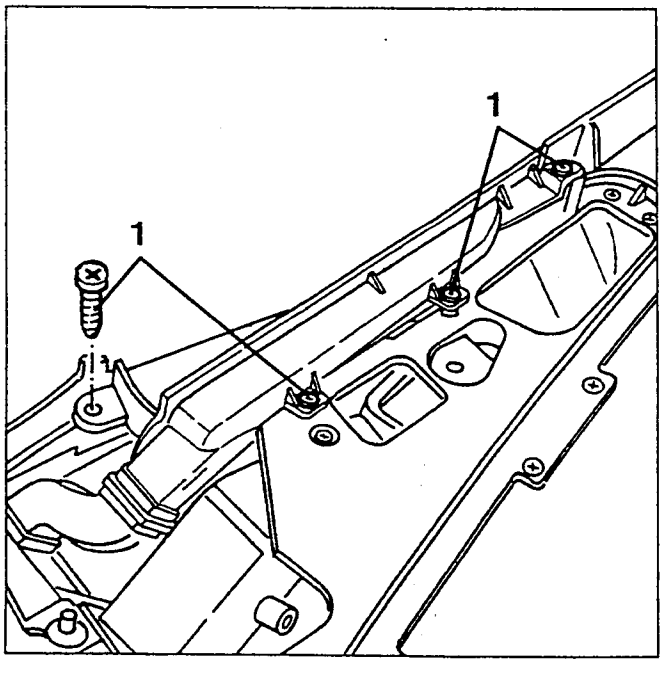
1. Loosen the three rear screws securing the object pouch and remove it.



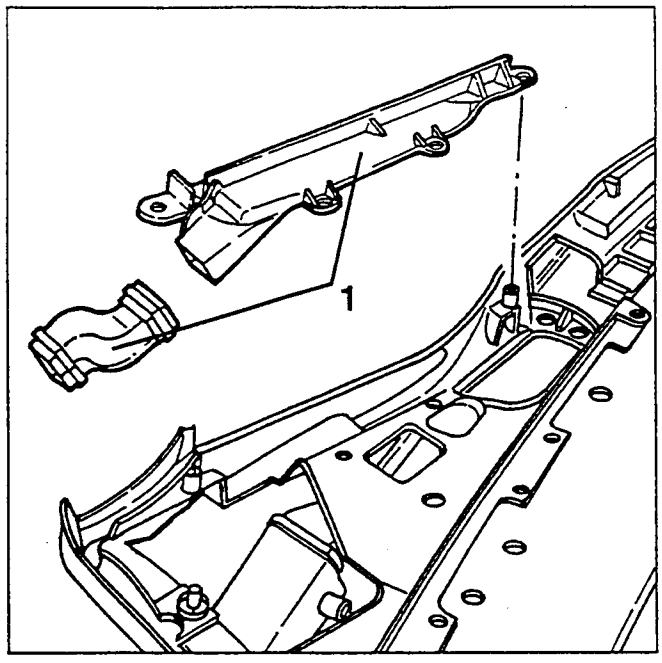
1. Remove the two gaskets from the air vents (these can be removed even if the panel is still installed).



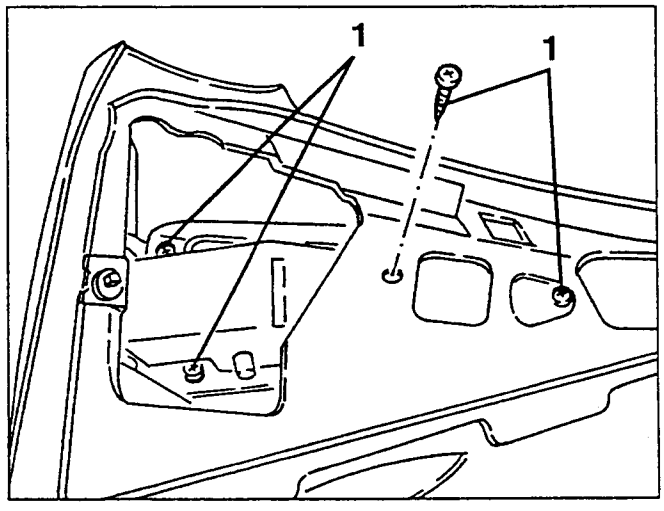
1. Loosen the four screws securing the door window defrosting vent.



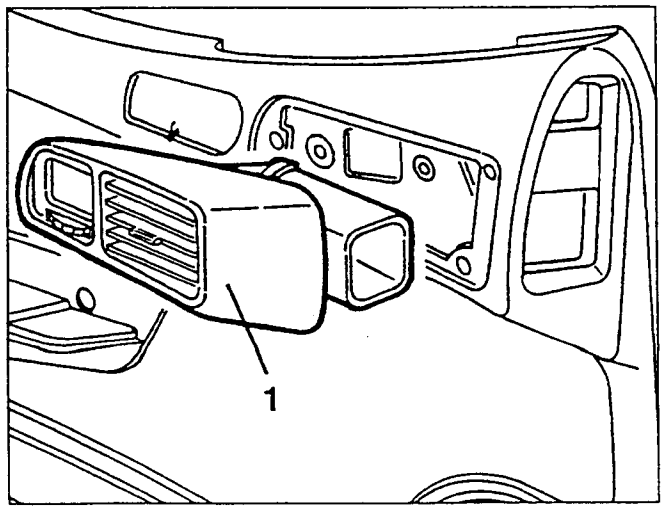
1. Remove the door window defrosting vent.
- If necessary disassemble the door window defrosting vent.



1. Loosen the four screws securing driver's air delivery vent.



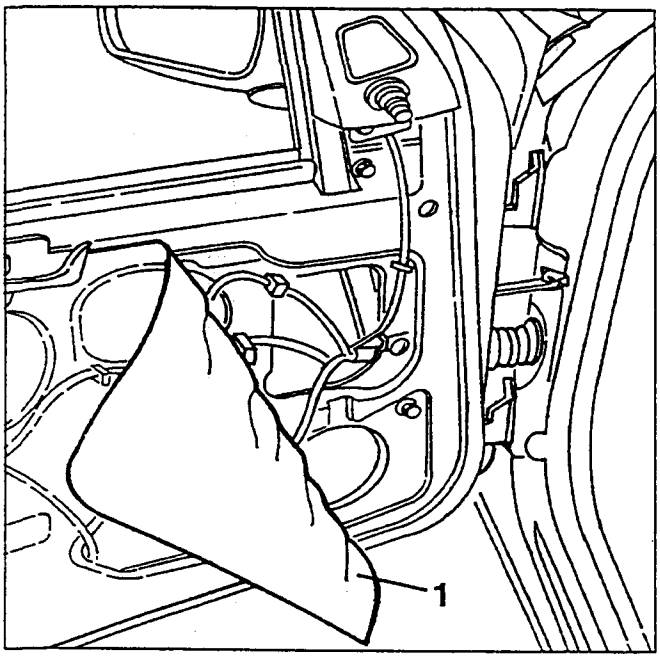
1. Remove the driver's air delivery vent.



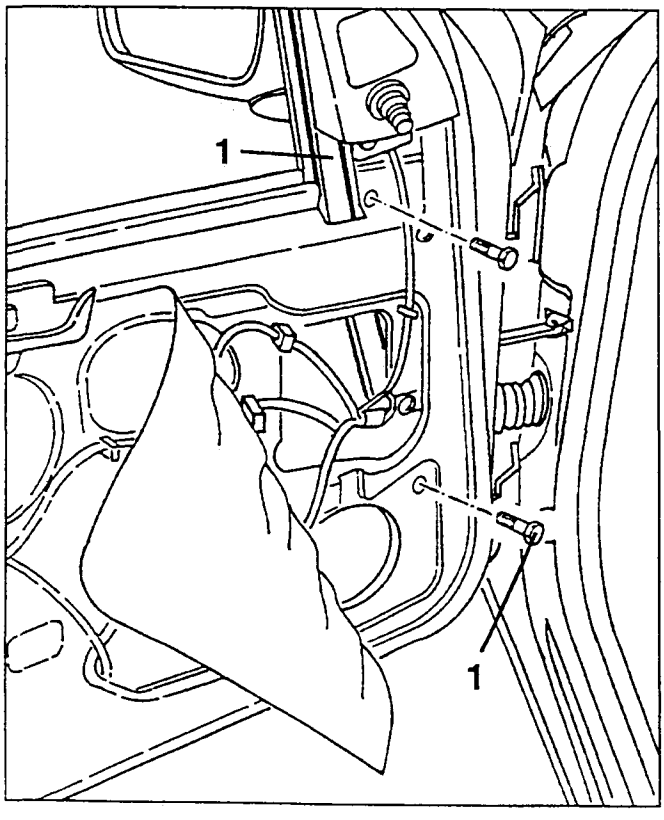
DOOR CHECK-STRAP

REMOVAL AND REFITTING

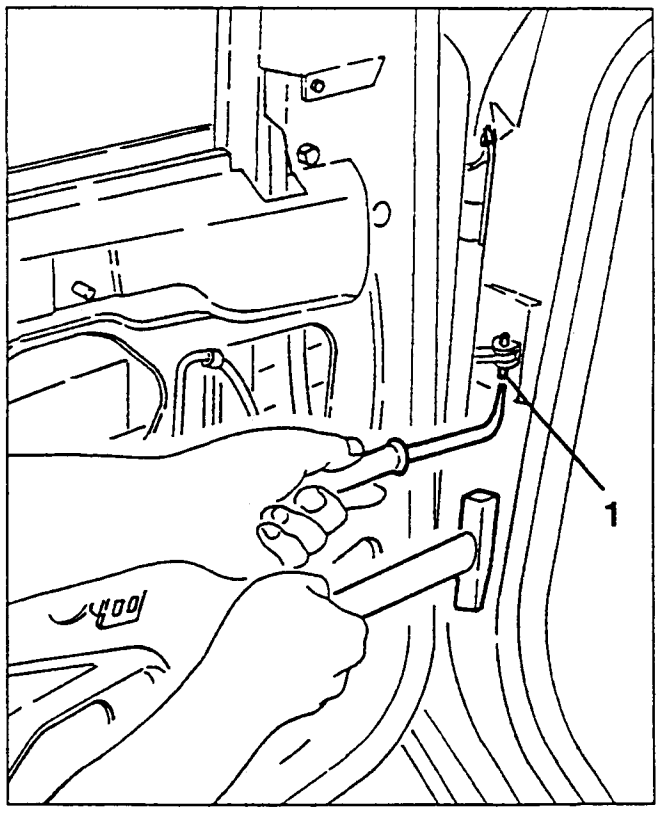
- Remove the panel (see specific paragraph).
1. Partially detach the opaline without damaging it.



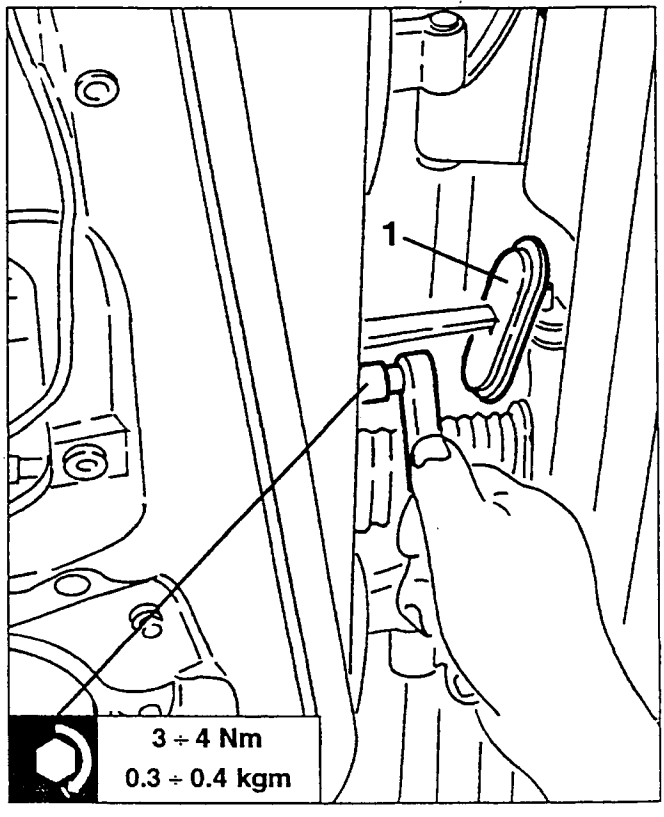
1. Loosen the two screws securing the door window runner and move it as required.



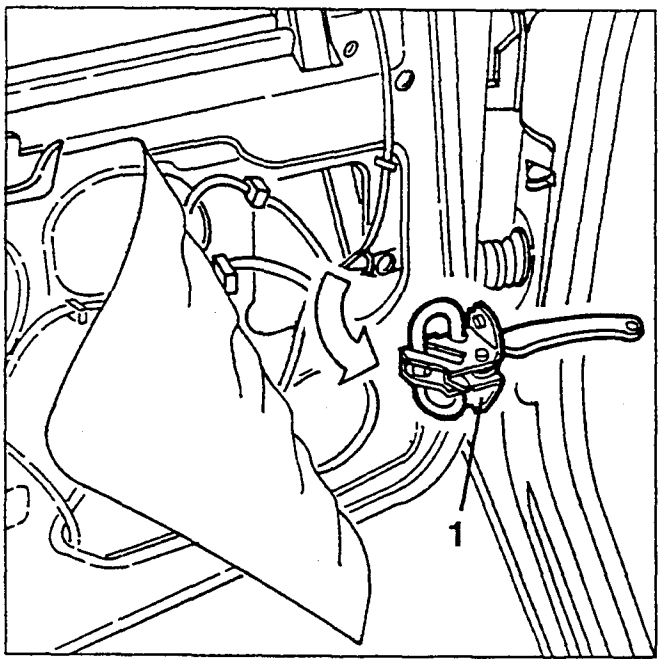
1. Using a suitable tool, withdraw and remove the pin from the door check strap, half-close the door to back-off the rod and then open the door once again.



1. Pull off the rubber protection and loosen the two screws securing the tie-rod.



1. Withdraw the check strap from inside the door.

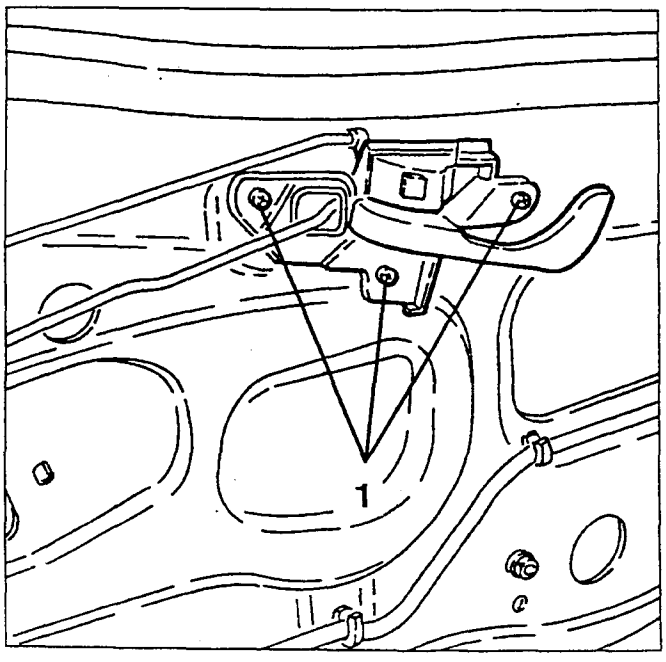


When refitting reverse the procedure followed for removal and note the following:
- Before refitting the door check-strap, treat the mating areas of the check strap with primer.
- If the glue of the opaline is no longer able to guarantee perfect bonding, replace it.

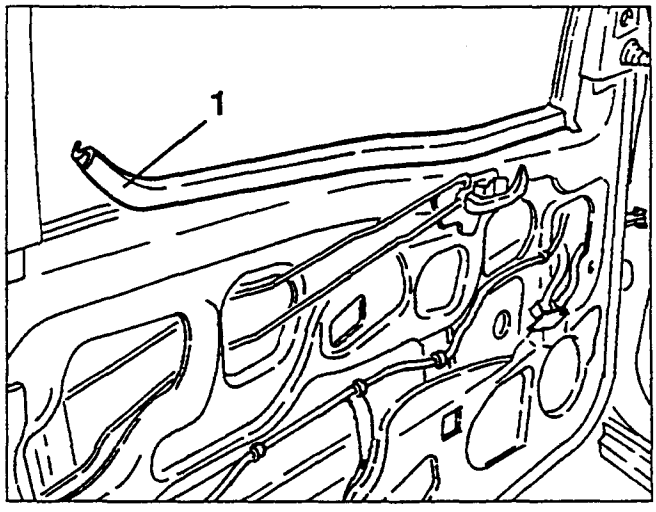
WINDOW

REMOVAL AND REFITTING

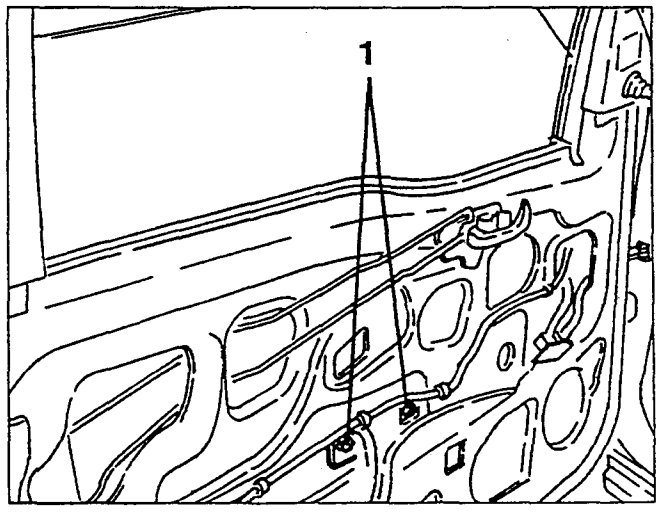
- Remove the panel (see specific paragraph).
1. Loosen the three screws securing the internal handle and free it from the retaining device.



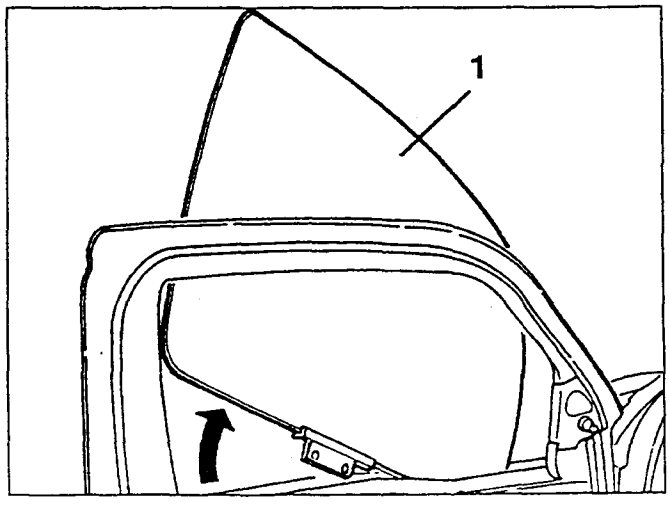
- Detach the opaline ensuring that it does not get damaged.
1. Remove the door window weatherstrip.



1. Momentarily connect the battery and the power window buttons and position the window so that access can be gained to the retaining screws as shown in the diagram.



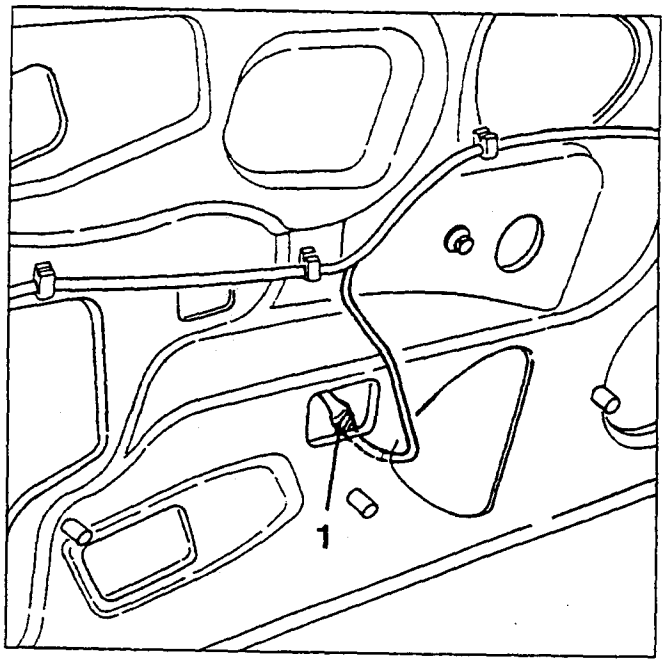
1. Remove the glass by pulling it upwards and mount it to facilitate removal.



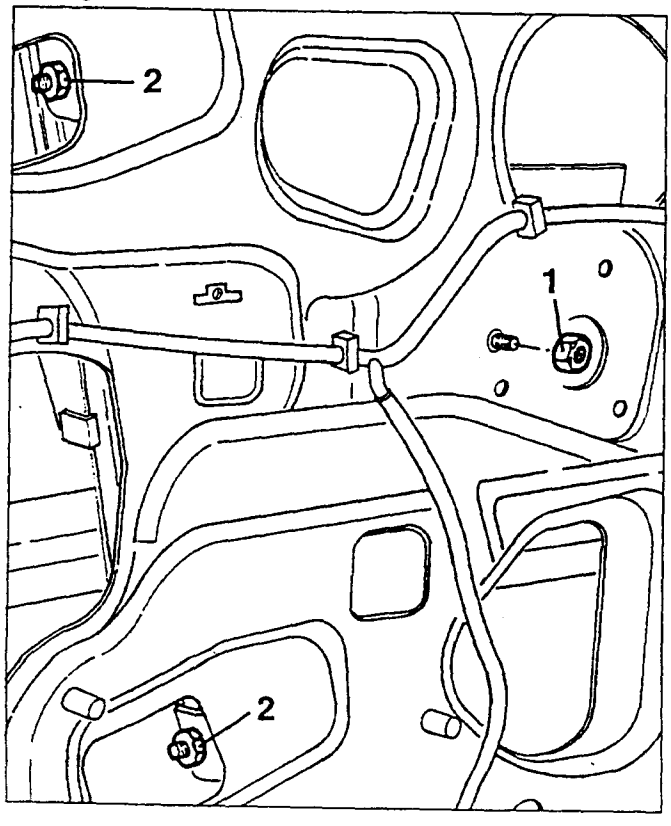
WINDOW RAISING DEVICE

REMOVAL AND REFITTING

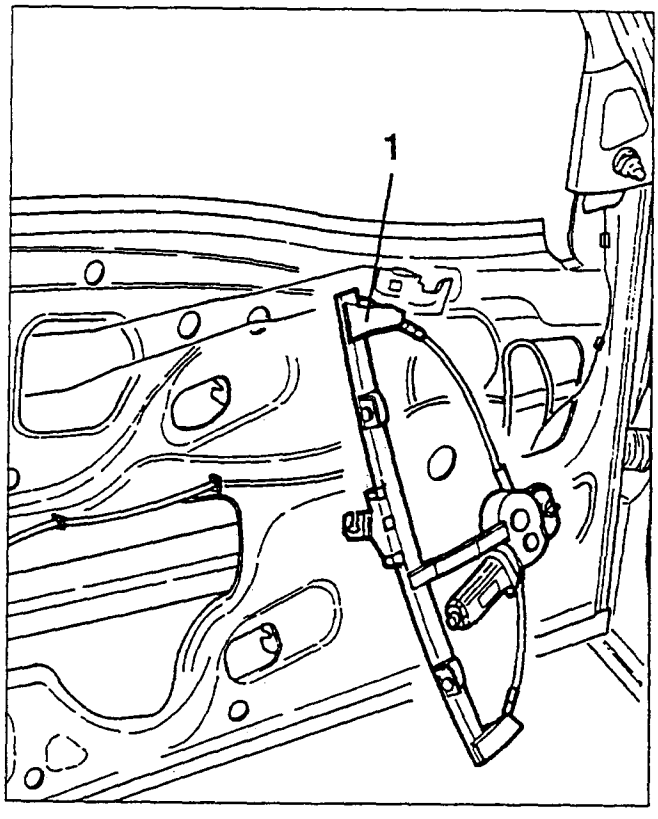
- Remove the window (see specific paragraph).
1. Disconnect the electrical connection from the window raising device.



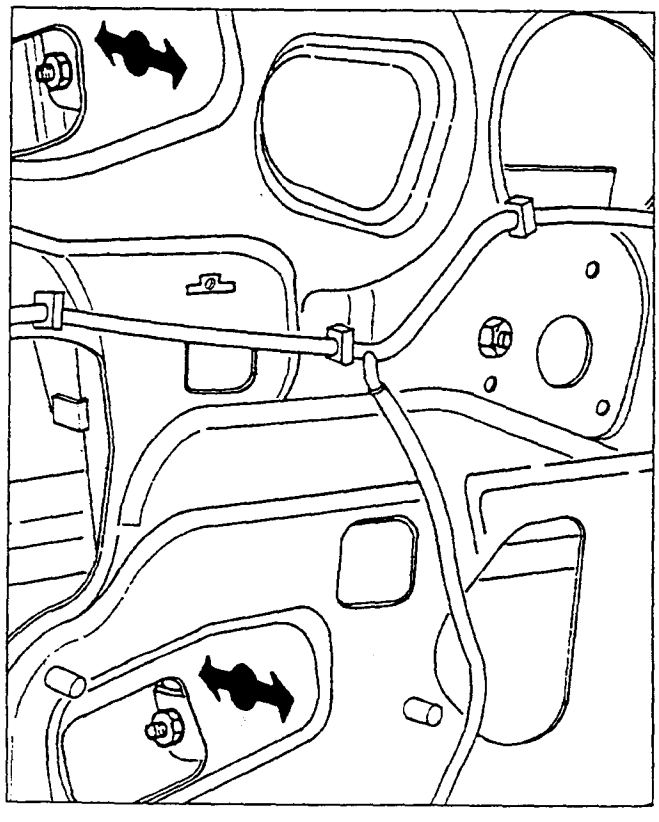
1. Loosen the front nut securing the window raising device.
2. Loosen the two rear nuts securing the window raising device.



1. Withdraw and remove the window raising device from inside the door.



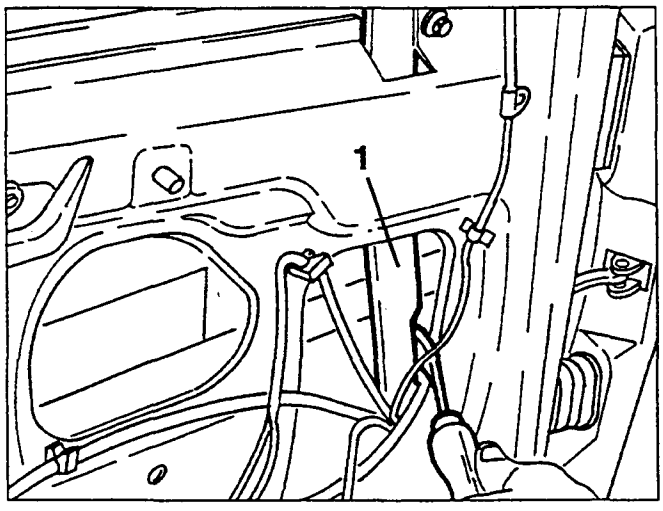
Refit the window raising device by reversing the procedure followed for removal ensuring that its position is adjusted as shown in the diagram.



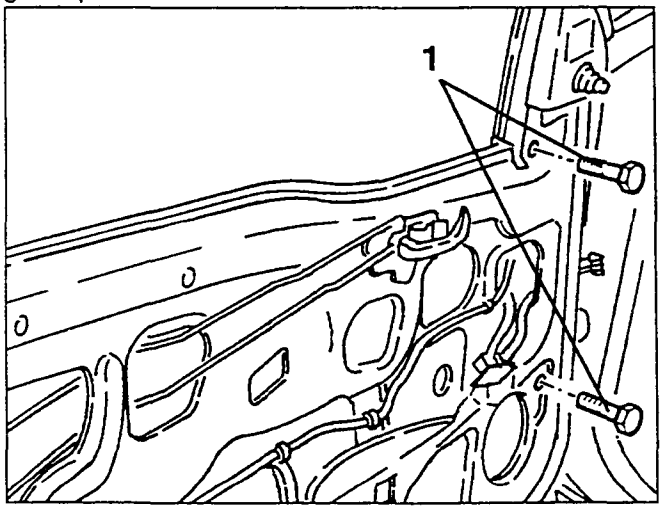
FRONT GUIDE PAD

REMOVAL AND REFITTING

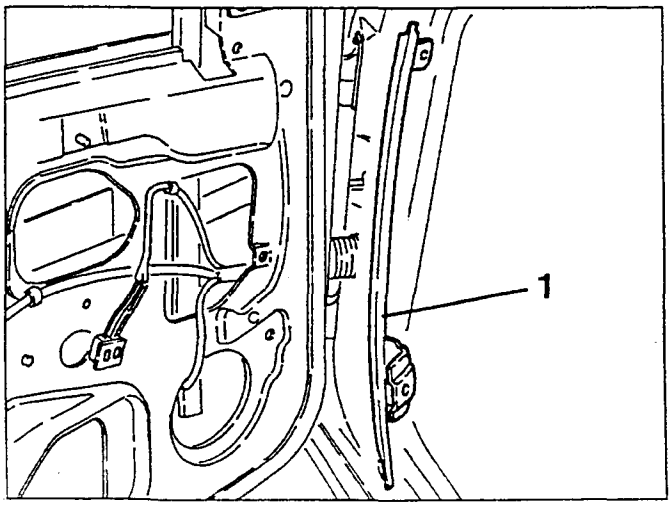
- Remove the window (see specific paragraph).
1. Pull off the gasket from the front window guide pad.



1. Loosen the two screws securing the front window guide pad.



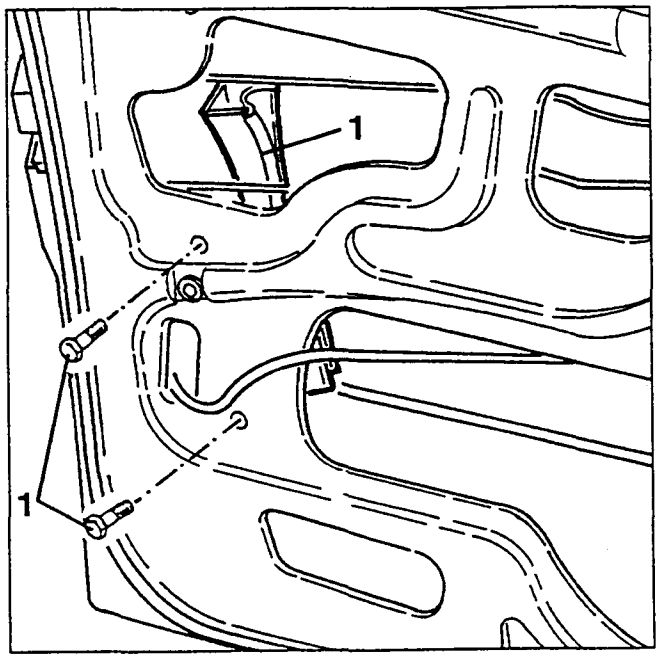
1. Remove the front window guide pad by withdrawing it from inside the door.



REAR GUIDE PAD

REMOVAL AND REFITTING

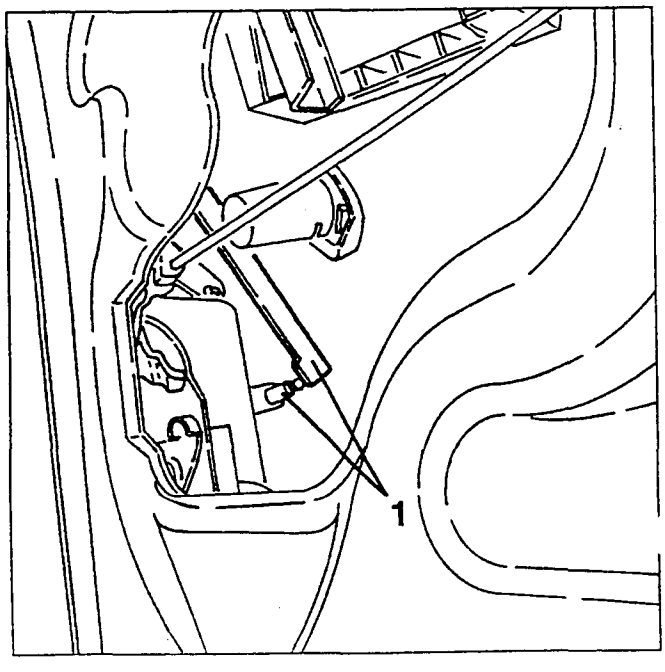
- Remove the panel (see specific paragraph).
- Partially detach the opaline from the upper rear part of the door.
1. Loosen the two screws securing the rear window guide pad and remove it.



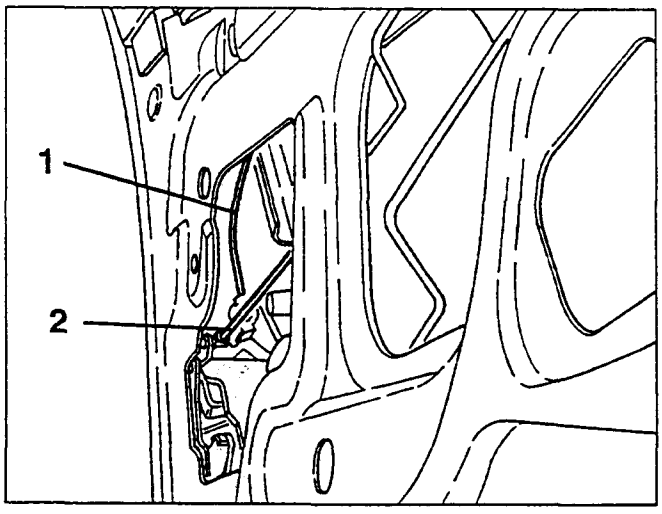
LOCK DEVICE

REMOVAL AND REFITTING

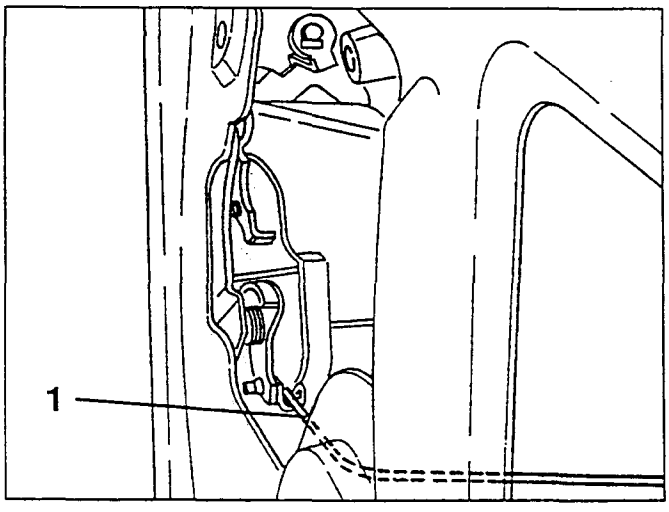
- Remove the rear window guide pad (see specific paragraph).
1. Disconnect the check strap from the lock block from the lock device.



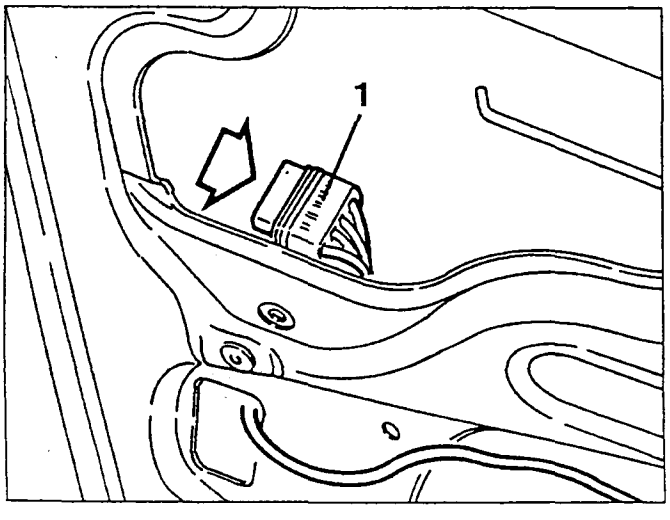
1. Disconnect the lock device from the external handle tie-rod.
2. Disconnect the opening block tie-rod from the lock device.



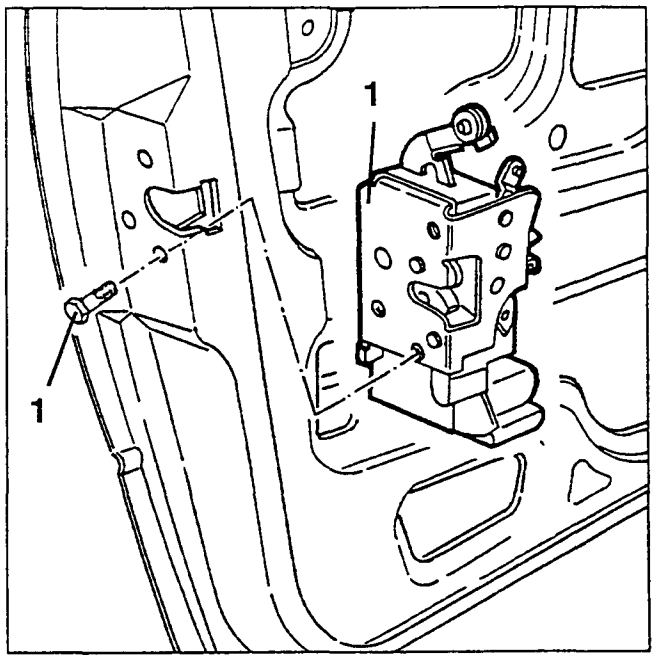
1. Disconnect the tie-rod of the inner handle from the lock device and back- off the lock device to free the tie-rods.



1. Disconnect the electrical connection from the lock device.



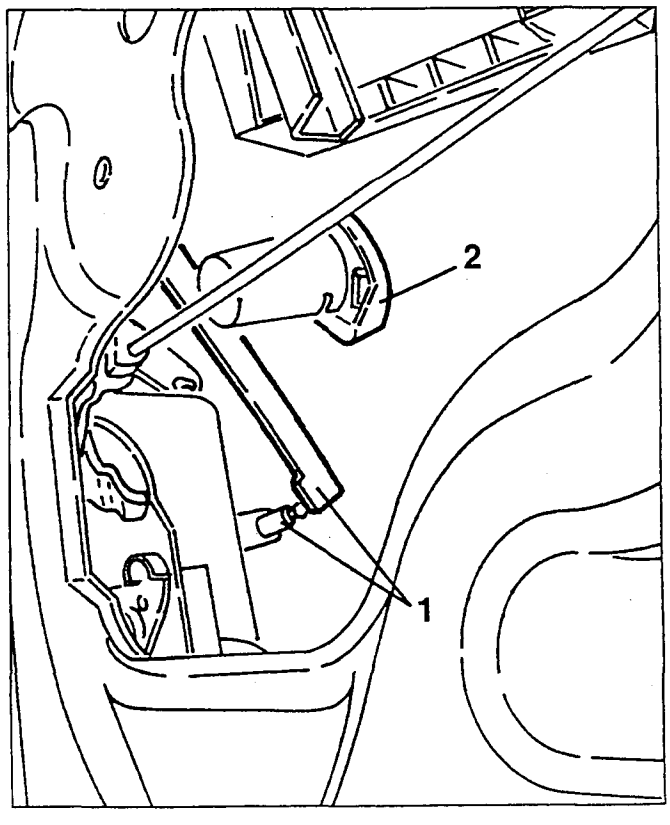
1. Loosen the three screws securing the lock device and remove it by withdrawing it from inside the door.



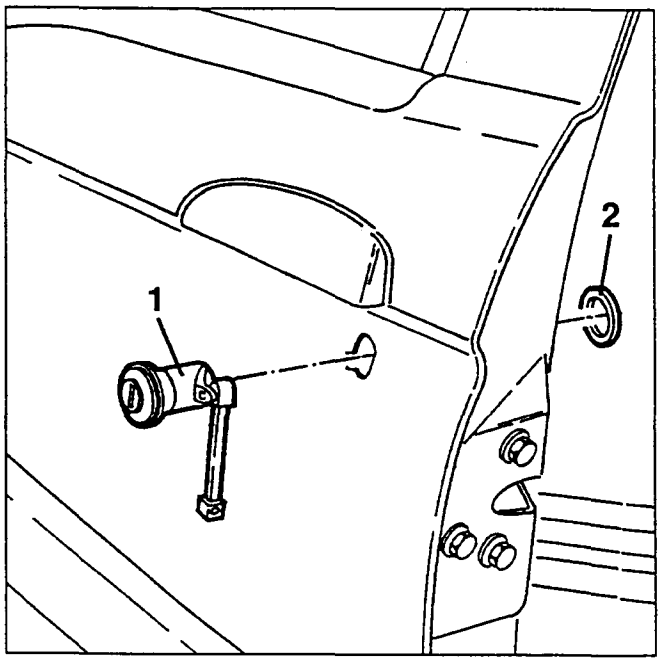
LOCK UNIT

REMOVAL AND REFITTING

- Remove the rear window guide pad (see specific paragraph).
1. Disconnect the tie-rod connecting the lock unit to the lock device.
2. Using a screwdriver as a lever withdraw the clip securing the lock unit.



1. Remove the lock unit from the outside of the door.
2. Remove the spring abutting ring from inside the door.

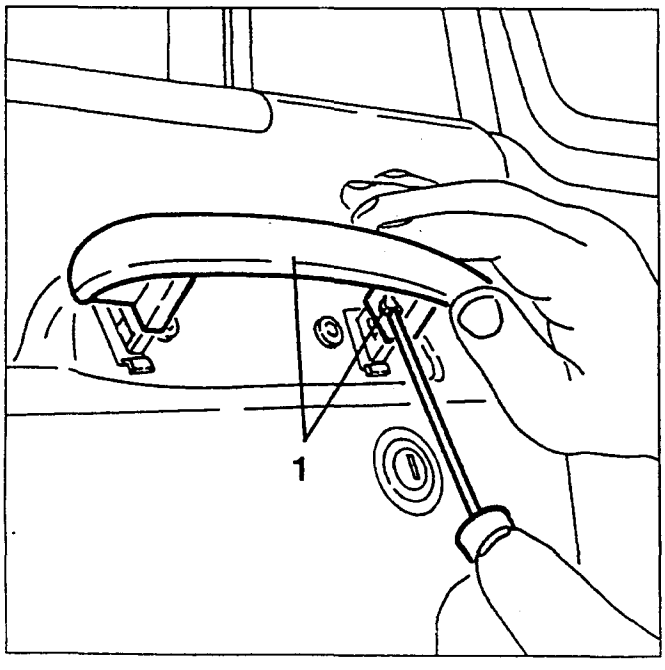


- Working on a bench, of necessary disconnect the tie-rod from the lock unit.

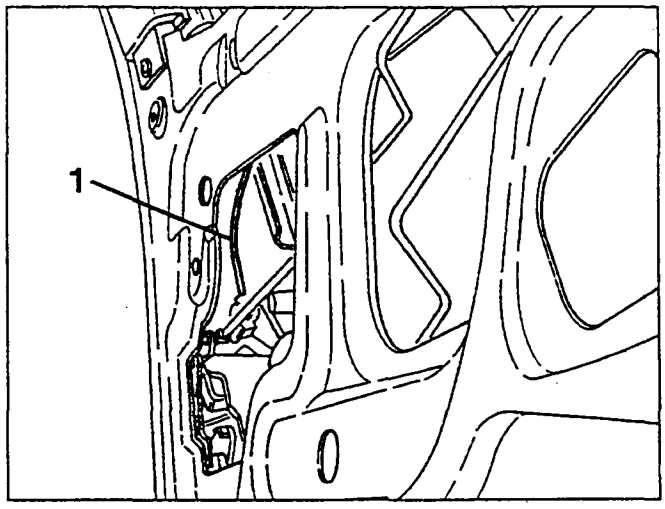
OUTSIDE DOOR HANDLE

REMOVAL AND REFITTING

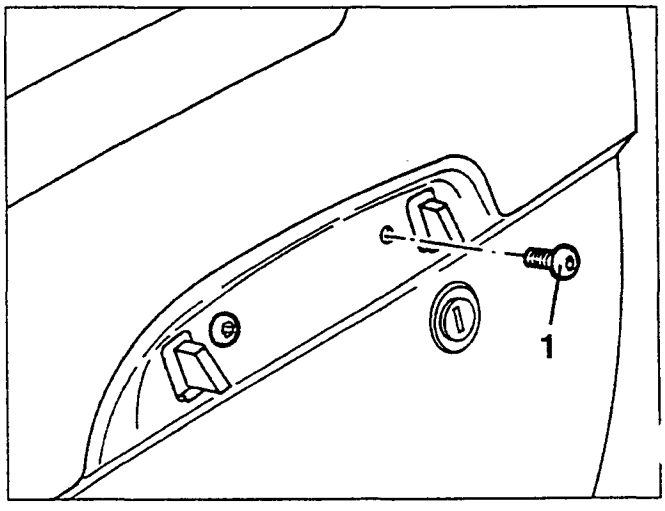
1. Using a screwdriver, free the two clips and remove the outer handle.



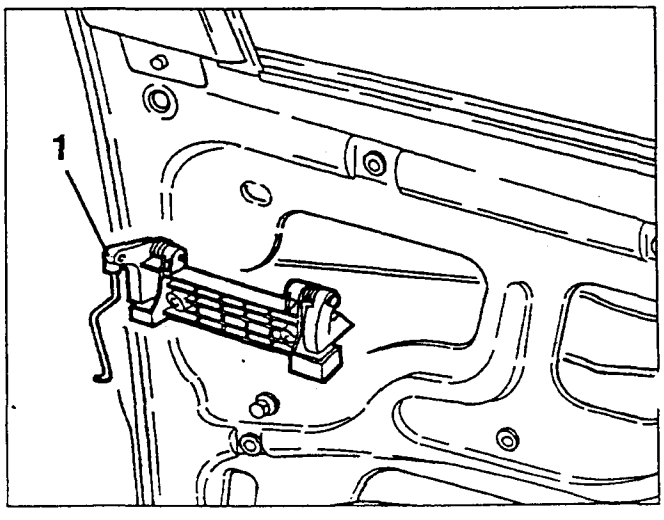
- Remove the rear window guide pad (see specific paragraph).
1. Disconnect the outside door handle tie-rod fro the lock device.



1. Loosen the two outer screws securing the outside door handle device.



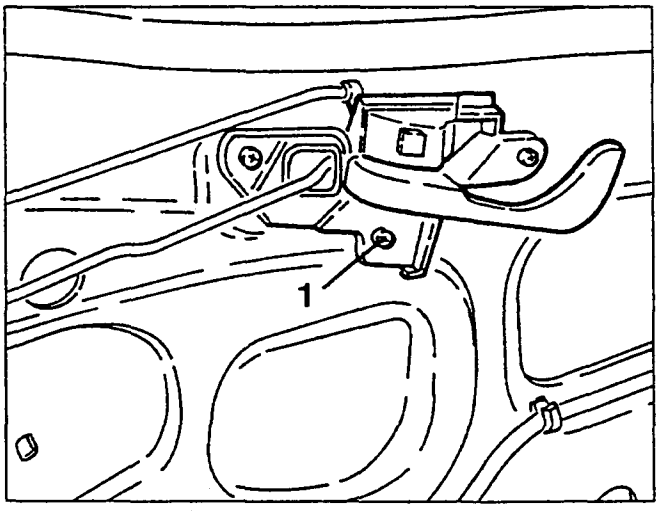
1. Remove the outside door handle device by withdrawing it from inside the door.



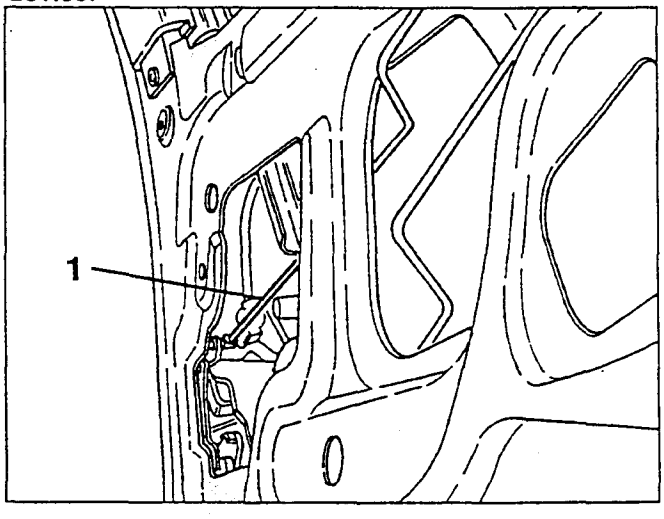
INSIDE DOOR HANDLE

REMOVAL AND REFITTING

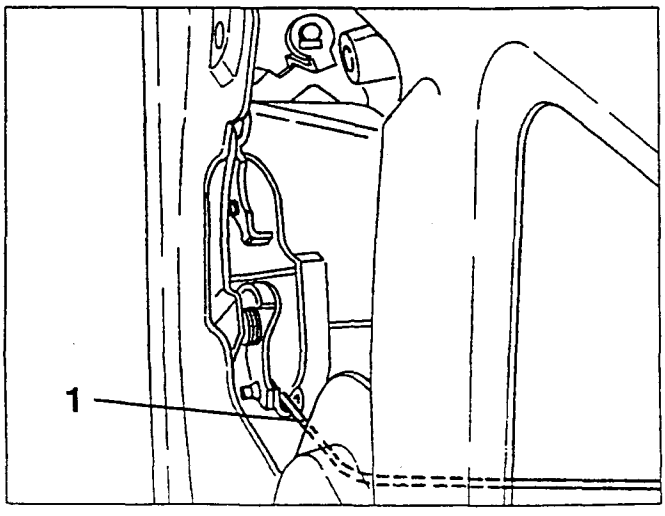
- Remove the panel (see specific paragraph).
1. Loosen the three screws securing the inside door handle.



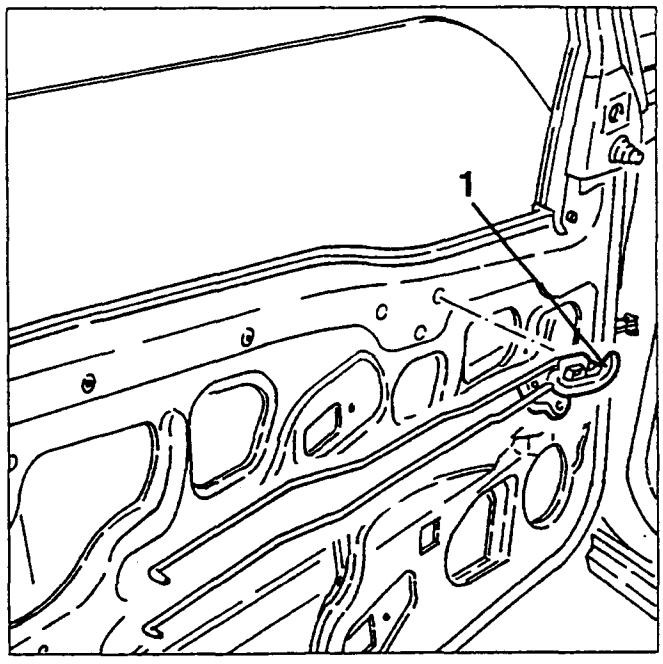
- Pull off the plastic buttons and partially detach the opaline.
1. Disconnect the opening unit tie-rod from the lock device.



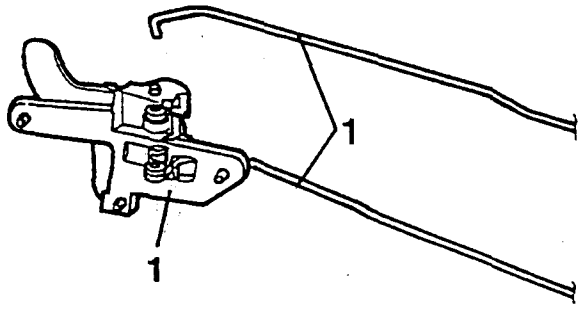
1. Disconnect the inside door handle tie-rod from the lock device.



1. Free the tie-rods from the two clamps and remove the inside handle.



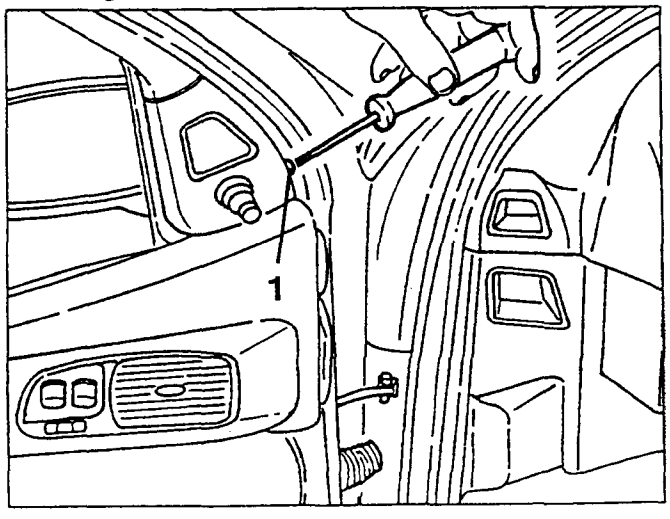
1. If necessary, working on a bench, separate the inside handle from the tie-rods.



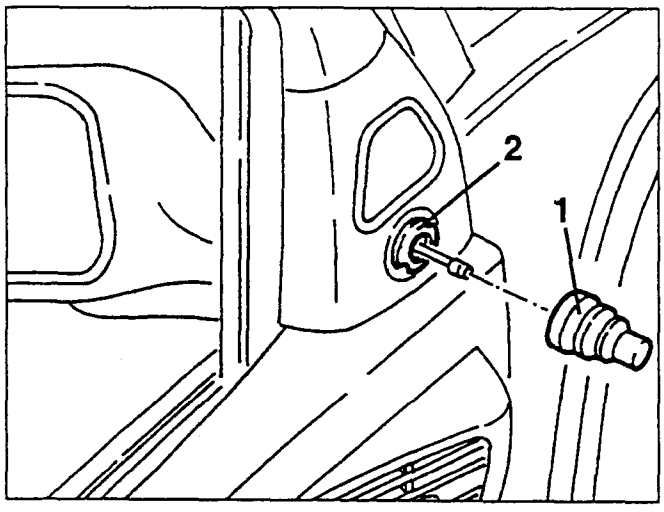
DOOR MIRROR (manually operated)

REMOVAL AND REFITTING

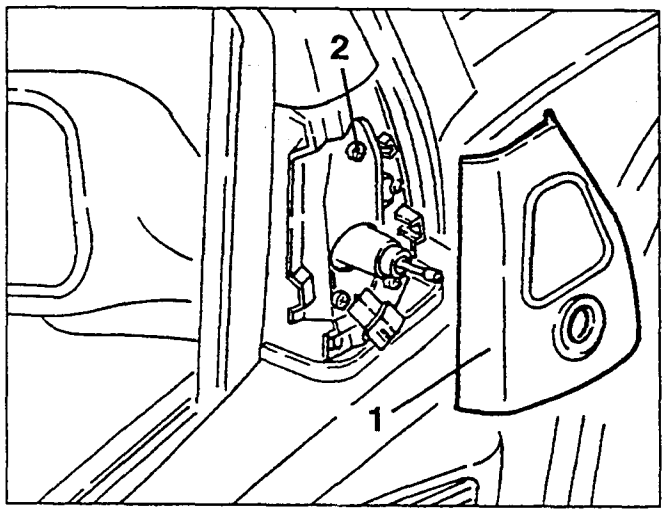
1. Loosen the screw securing the door mirror internal moulding.



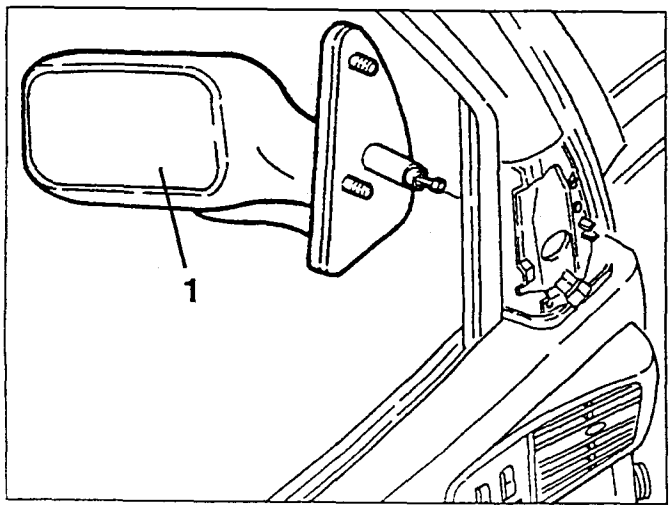
1. Remove the protective bellows.
2. Loosen the ring nut securing the moulding.



1. Remove the door mirror inner moulding.
2. Loosen the three screws securing the door mirror.



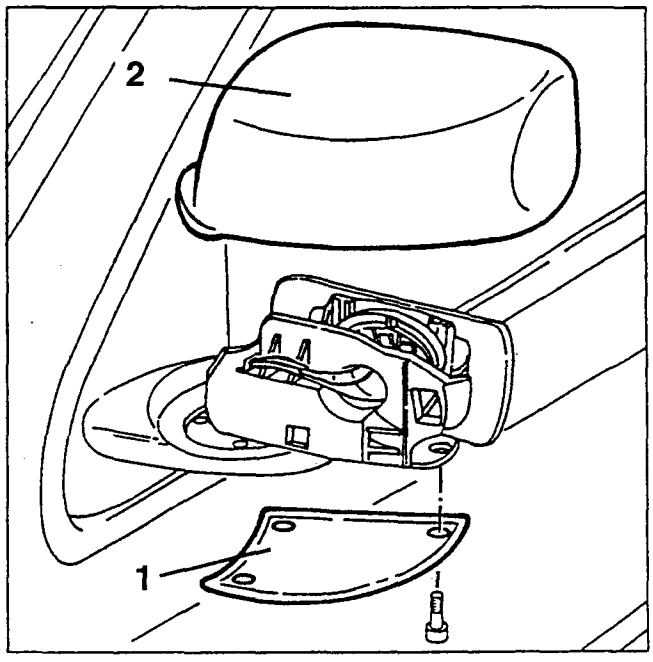
1. Remove the door mirror and relative gasket.



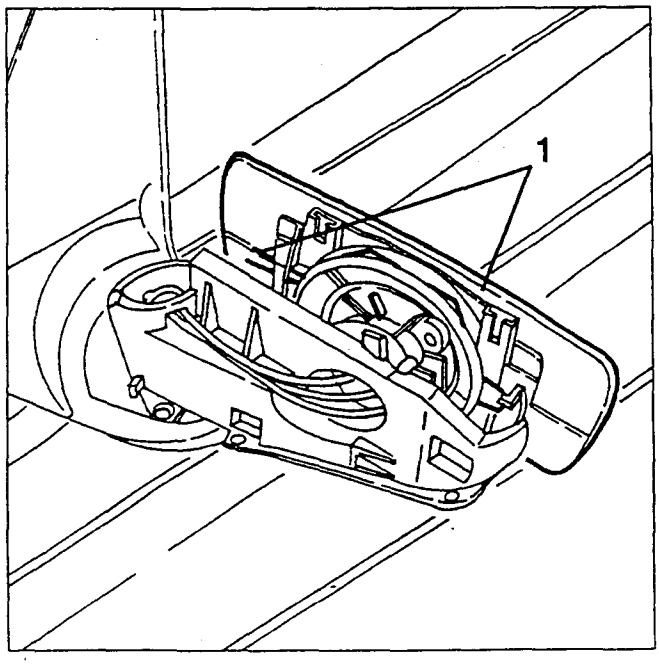
WING MIRROR (manually-operated)

REMOVAL/REFITTING

1. Slacken the fastening screws and remove the lower trim.
2. With the mirror facing downwards, remove the outer casing.



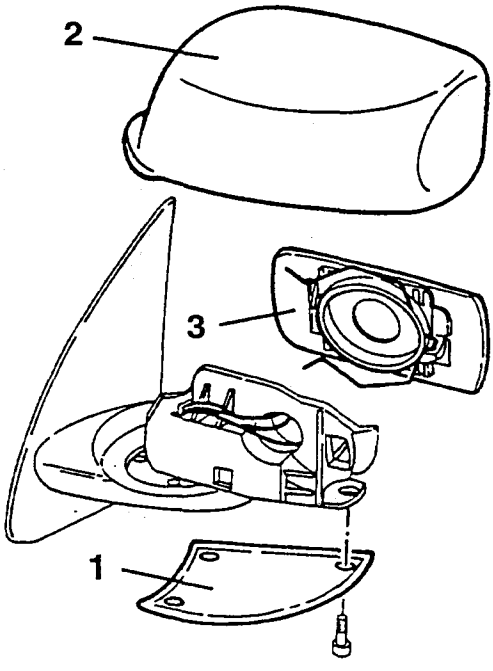
1. Release the fastening clip and remove the wing mirror glass.



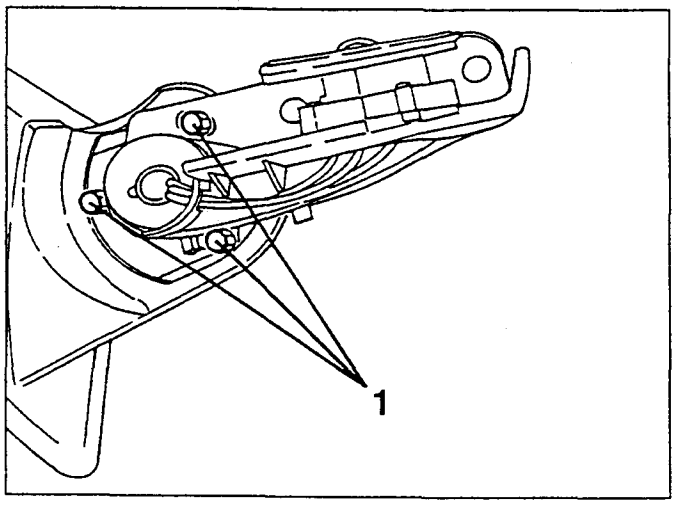
WING MIRROR TRIM (manually-operated mirror)

REMOVAL/REFITTING

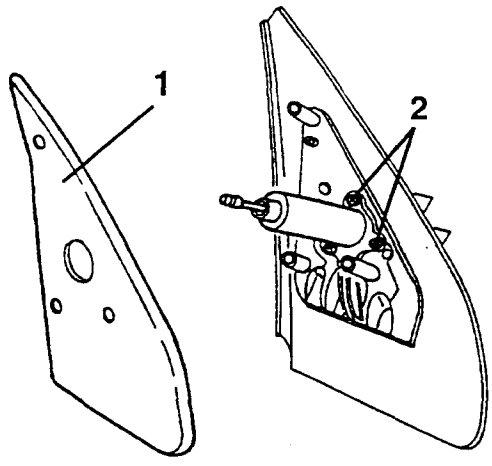
- Remove thye complete wing mirror (see specific paragraph).
1. On the bench, slacken the fastening screws and remove the lower trim.
2. With the mirror facing downwards, remove the outer casing.
3. Release the fastening clip and remove the wing mirror glass.



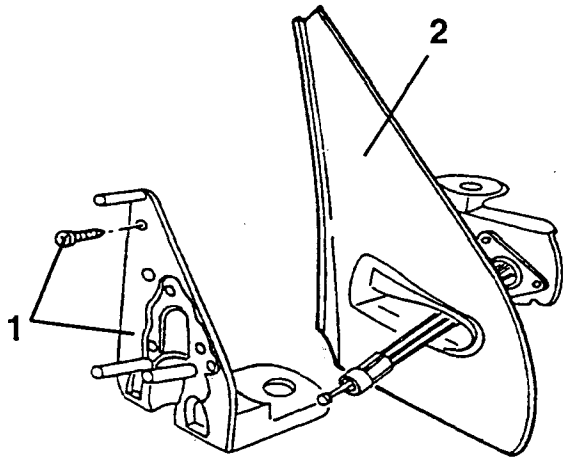
1. Working as shown in the figure, slacken the three screws fastening the wing mirror support.



1. Remove the seal.
2. Slacken the three fastening screws and remove the wing mirror adjustment device support.



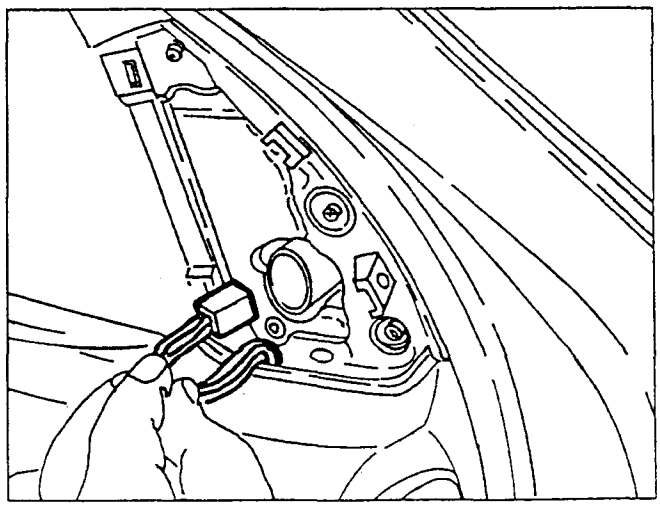
1. Slacken the remianing fastening screws and remove the wing mirror support.
2. Retrieve the wing mirror outer trim.



WING MIRROR (electrically-operated)

REMOVAL/REFITTING

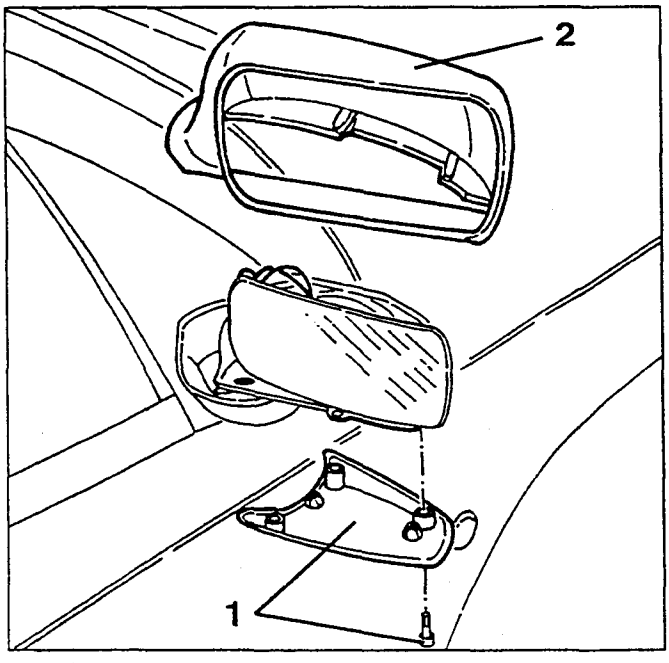
- Proceed as described for removal/refitting the manually-operated wing mirror remembering that instead of removing the vellows and ringnut the electrical connection shown in the figure below needs to be removed.



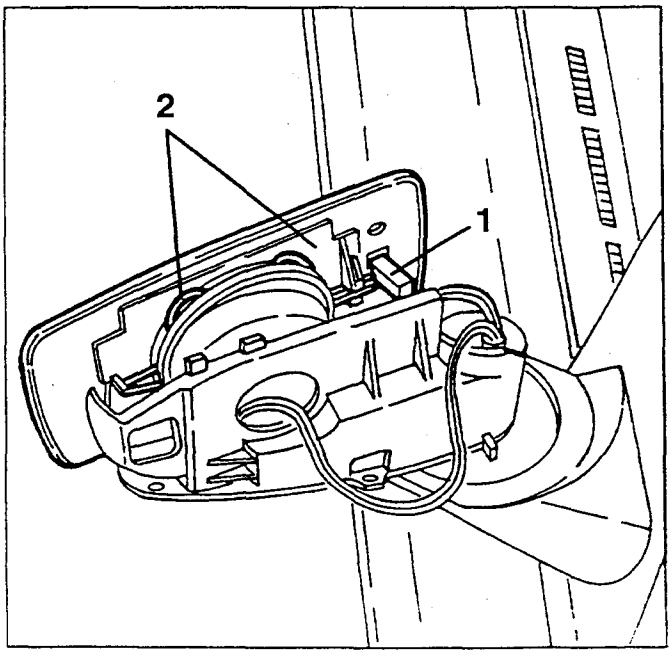
WING MIRROR (electrically-operated)

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. slacken the fastening screws and remove the lower trim.
2. With the mirror facing downwards, remove the outer casing.



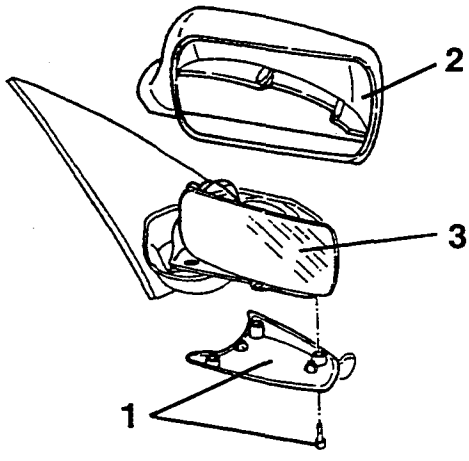
1. Disconnect the electrical connection for the mirror defrosting coil.
2. Release the fastening clip and remove the wing mirror glass.



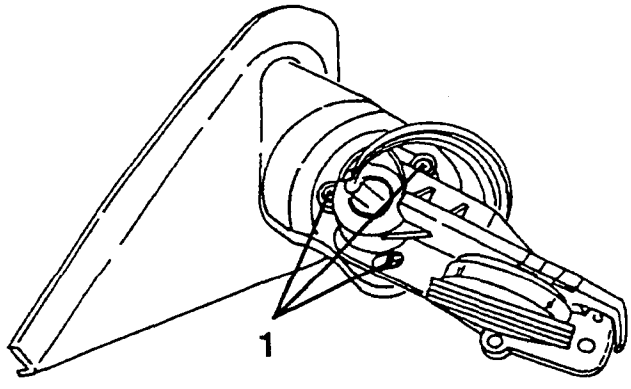
WING MIRROR TRIM (electrically-operated)

REMOVAL/REFITTING

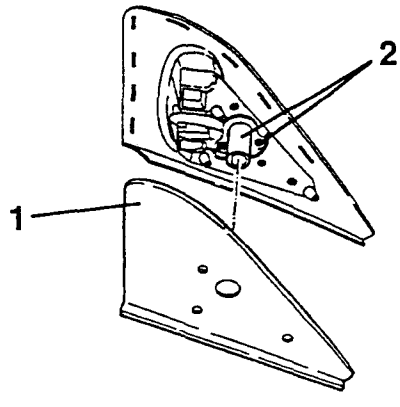
- Remove the complete wing mirror (see specific paragraph).
1. On the bench, slacken the fastening screws and remove the lower trim.
2. With the mirror facing downwards, remove the couter casing.
3. Release the fastening clip and remove the wing mirror glass after disconnecting the electric connection.



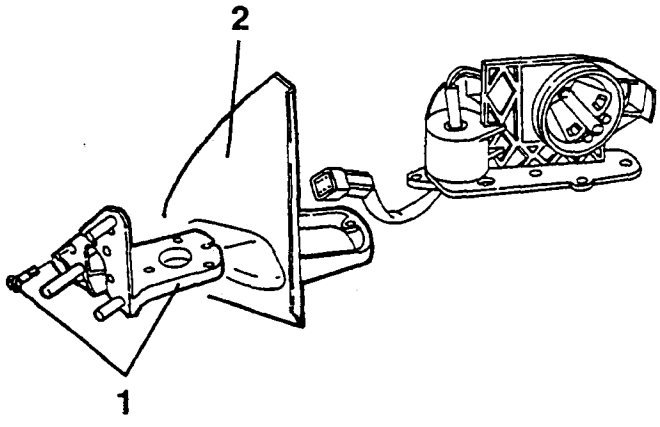
1. Working as shown in the figure, slacken the three screws fastening the wing mirror support.



1. Remove the seal.
2. Slacken the two fastening screws and remove the tube housing the electrical connection.



1. Slacken the remaining fastening screws and remove the wing mirror support.
2. Retrieve the wing mirror outer trim.

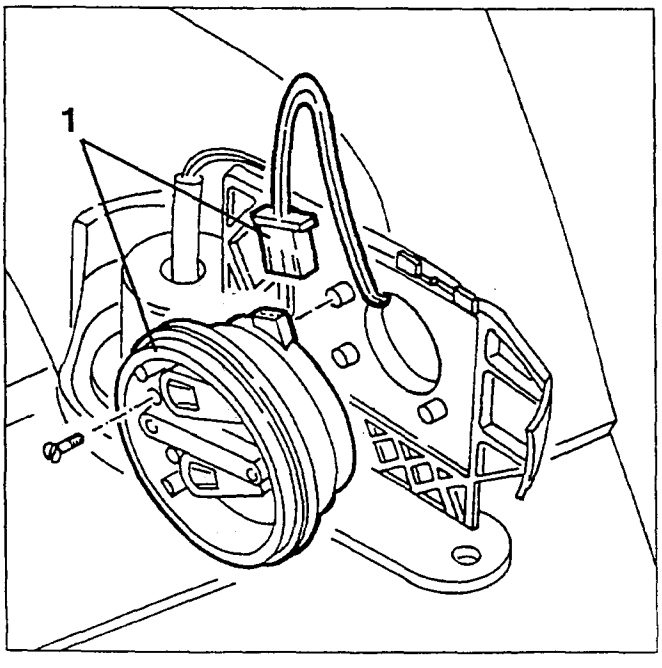


WING MIRROR MOTOR (electrically-operated)

REMOVAL/REFITTING

- Proceed as described in the first two steps described in the "WING MIRROR (electrically.operated) paragraph.

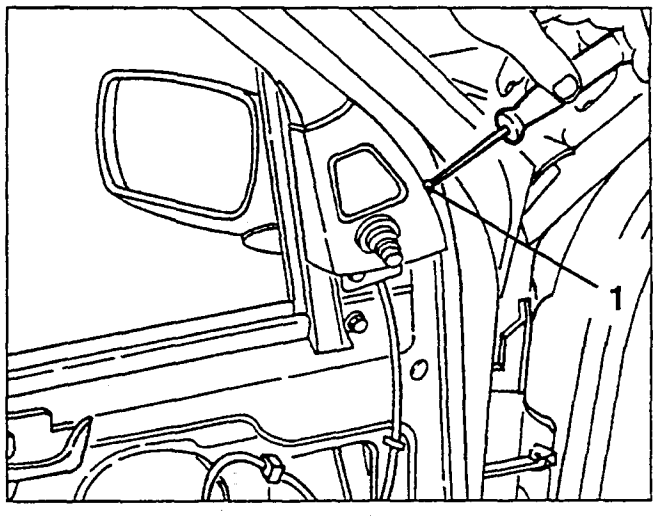
1. Slacken the fastening screws and remove the electric motors, after disconnecting the electrical connection.



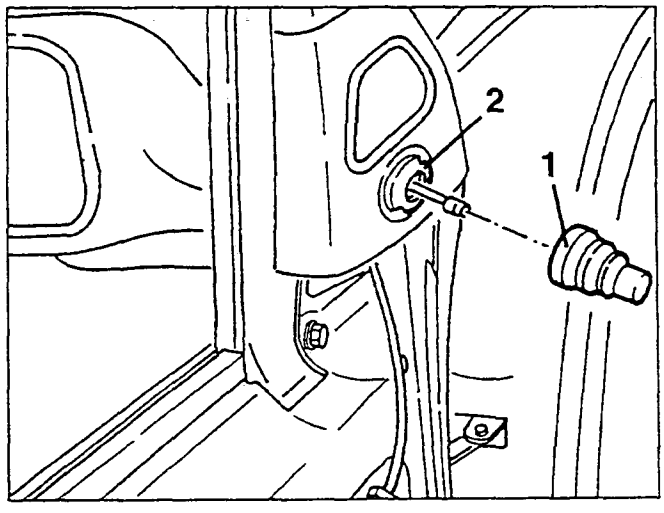
TRIM MOULDINGS

REMOVAL AND REFITTING

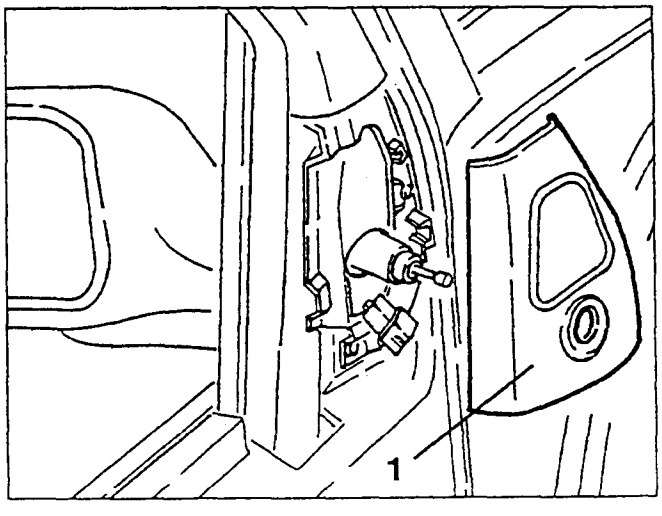
- Remove the panel (see specific paragraph).
1. Loosen the screw securing the door mirror inner moulding.



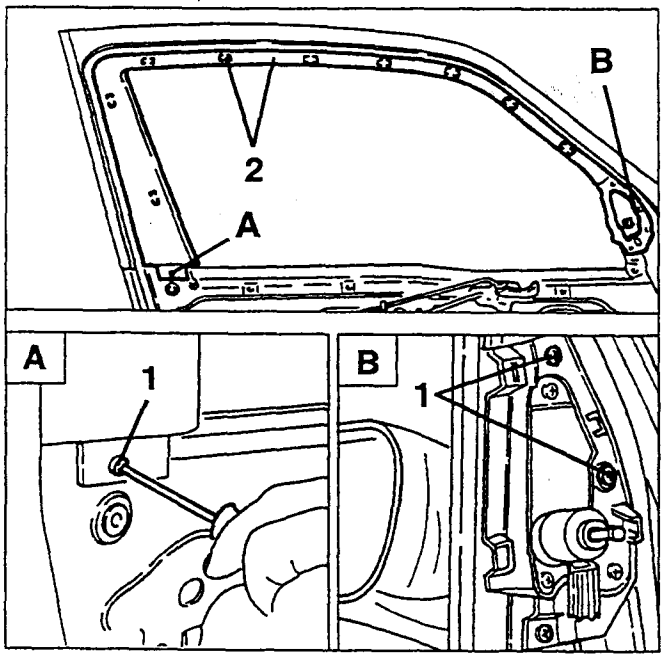
1. Remove the protective bellows.
2. Loosen the ring nut securing the moulding.



1. Remove the door mirror internal moulding.



1. Loosen the screws securing the moulding.
2. Pull off the moulding from the plastic buttons positioned as shown in the diagram and remove the moulding.

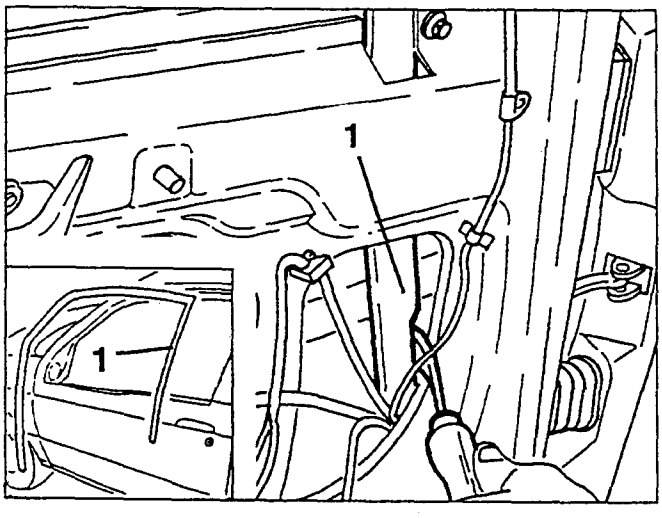


WINDOW RUNNER SEAL STRIPS

REMOVAL AND REFITTING

- Remove the trim moulding and the door mirror (see specific paragraphs).
- Remove the weather strip and window (see specific paragraphs).

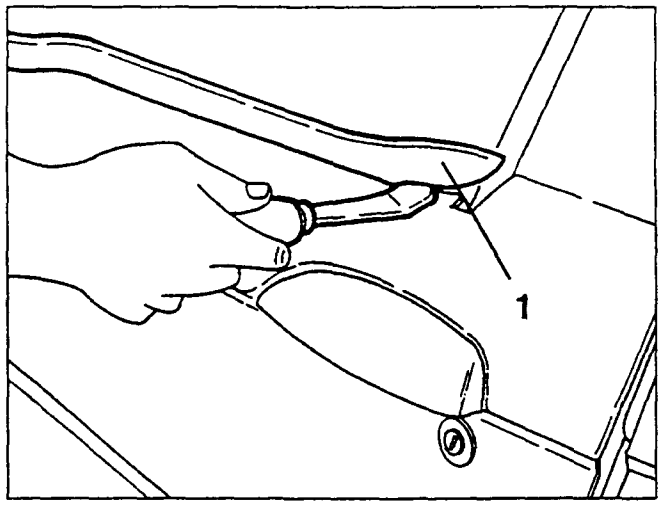
1. Pull off the window runner strips beginning from the front part.



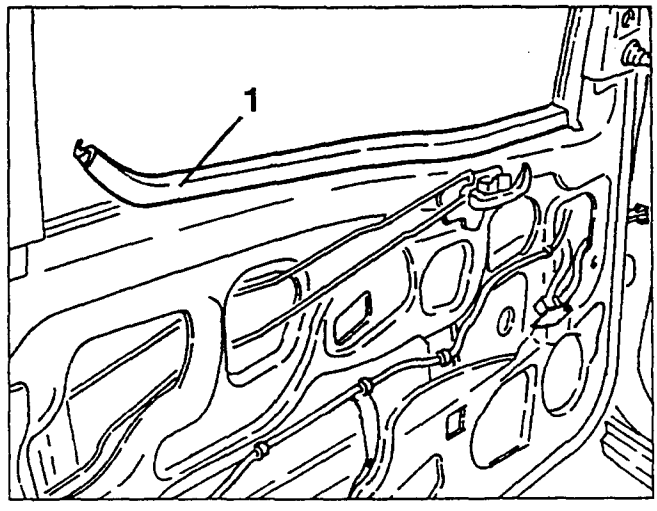
WEATHER STRIPS

REMOVAL AND REFITTING

1. Remove the external weather strip by pulling it out from it seating.



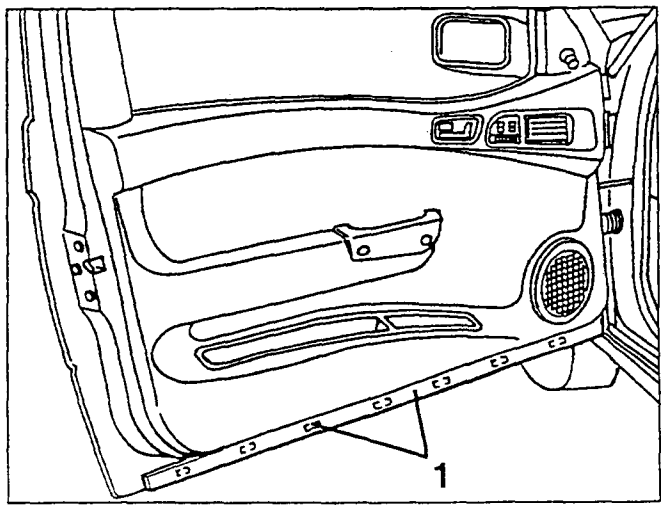
1. Remove the panel and pull off the internal weather strip.



NOISE REDUCING SEAL STRIP

REMOVAL AND REFITTING

1. Pull off the plastic buttons and remove the noise reducing seal strip.

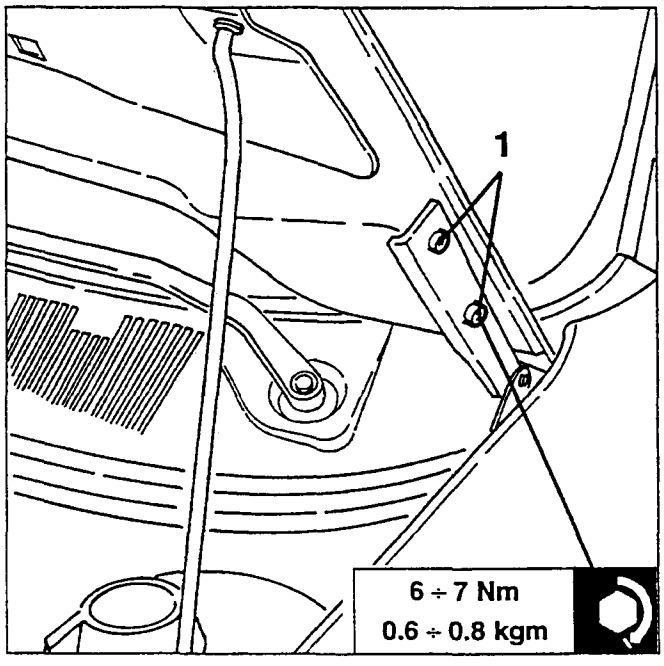


BONNET

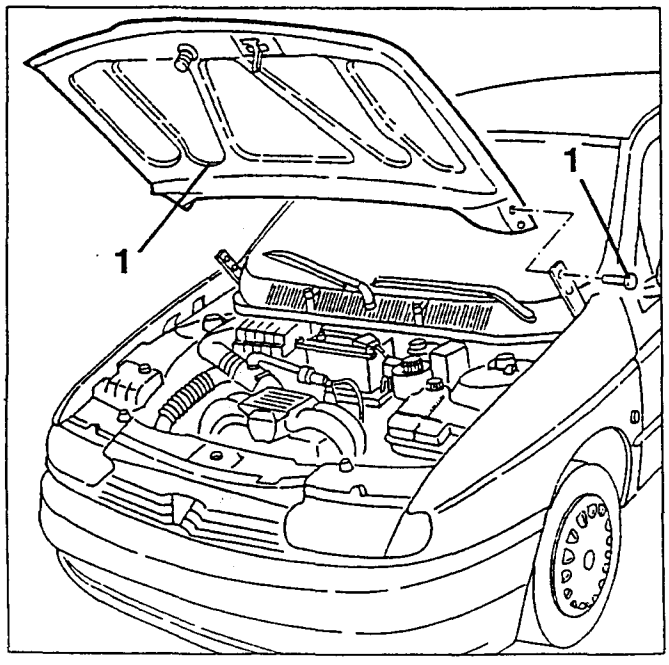
REMOVAL/REFITTING

NOTE:
Avoid damaging the paintwork during removal or installation of the bonnet.

- Open the bonnet and support it properly with the appropriate rod.
- Disconnect the negative cable (-) from the battery.
1. Loosen the screws securing the hinges to the bonnet.

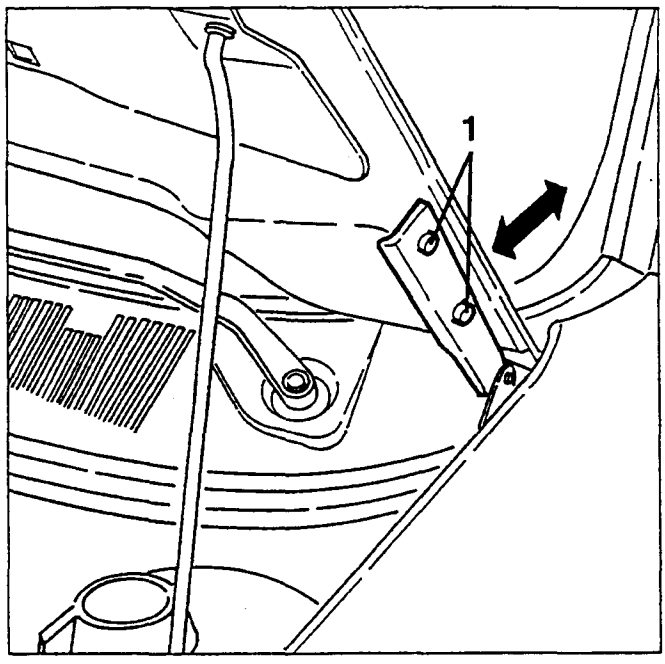


1. Remove the bonnet support rod after completely unscrewing the screws securing the hinges.



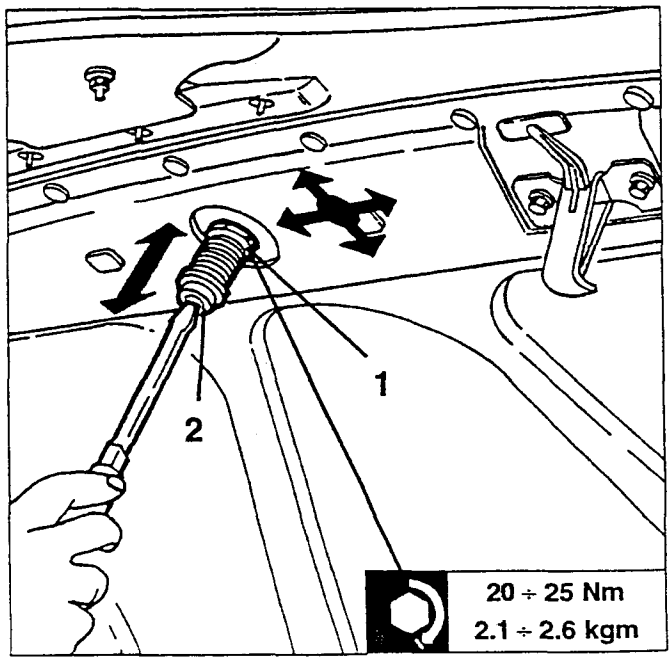
ADJUSTMENT

1. Loosen the screws securing the bonnet to the hinges and adjust for height.

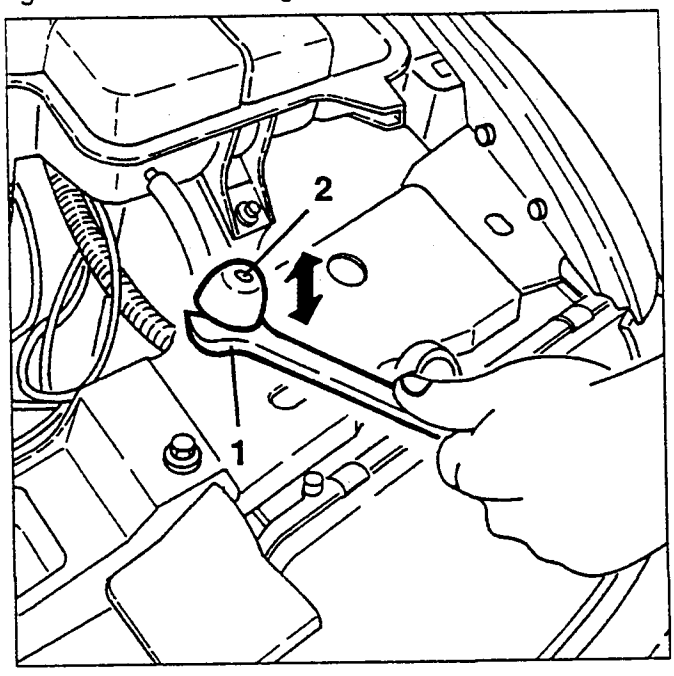


NOTE:
If the above adjustment is not sufficient further adjustment can be made following the procedure described in the specific paragraph.

1. Loosen the nut securing the adjustment pin.
2. Tighten or loosen the adjustment rod as required.
- Tighten the locking nut on the adjustment pin after checking that it is in the correct position.



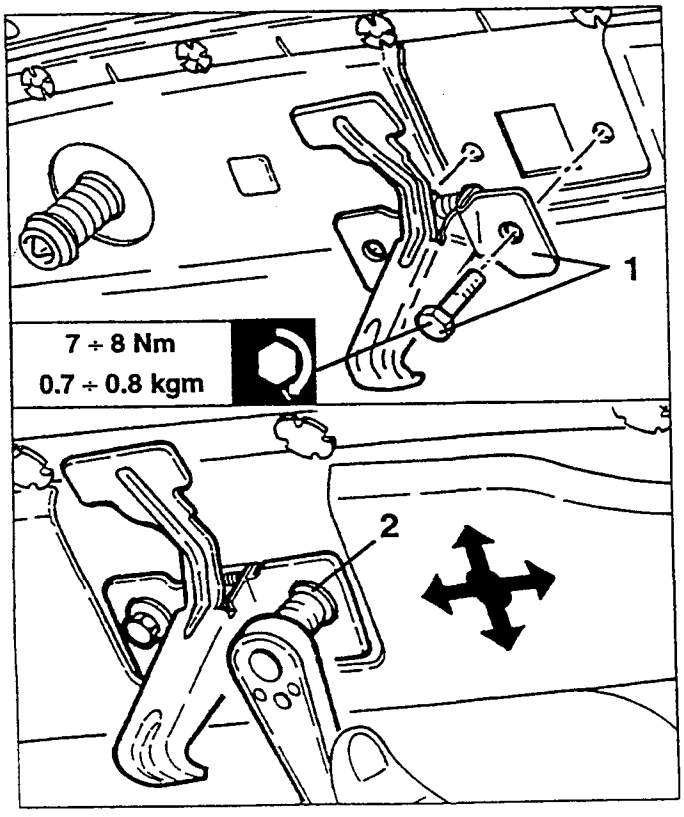
1. Loosen the nut securing the buffer.
2. Manually tighten or loosen the buffer as required; tighten the nut securing.



BONNET CLOSURE SAFETY DEVICE

REMOVAL/REFITTING

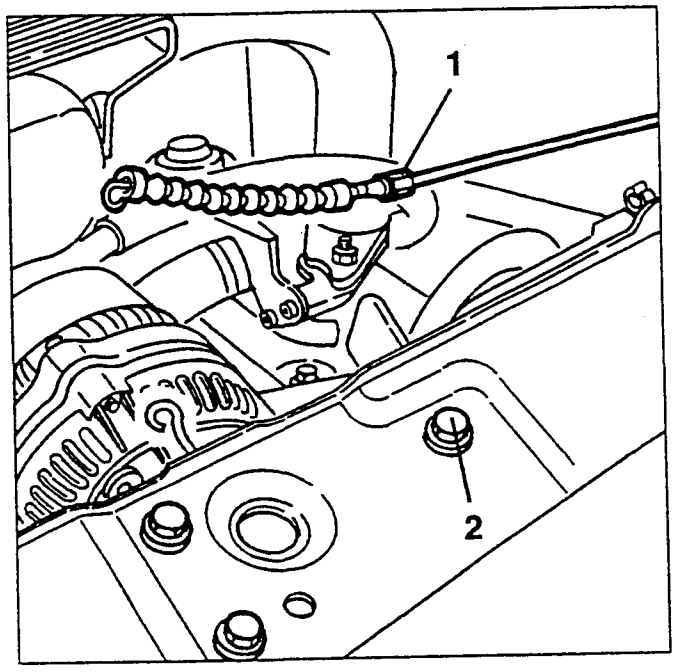
1. Loosen the two screws securing the safety device.
- Remove the bonnet closure safety device.
2. For adjustment loosen the screws securing the safety device and adjust longitudinally and transversally.



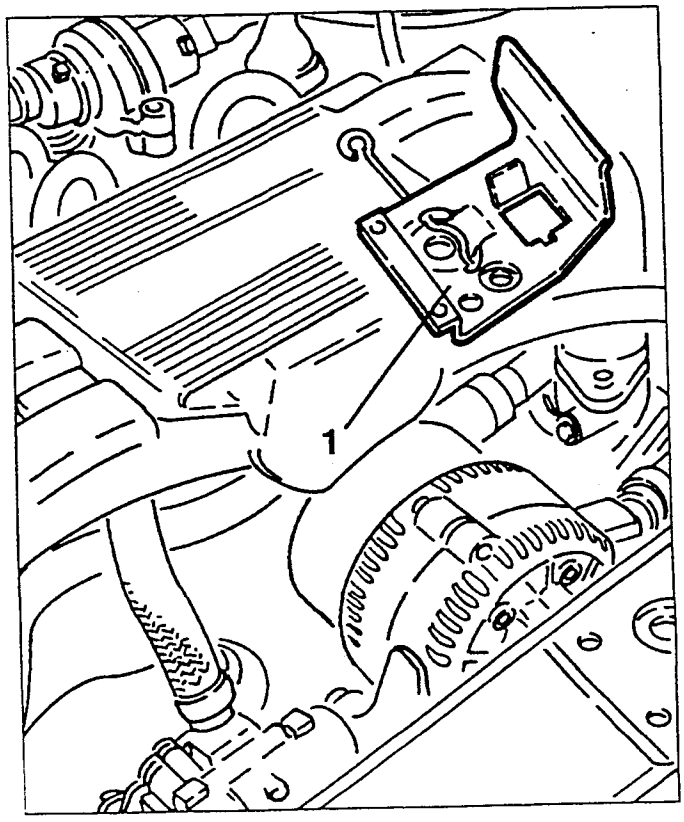
BONNET CATCH

REMOVAL/REFITTING

1. Disconnect the bonnet release cable from the catch.
2. Loosen the three screws securing the catch.



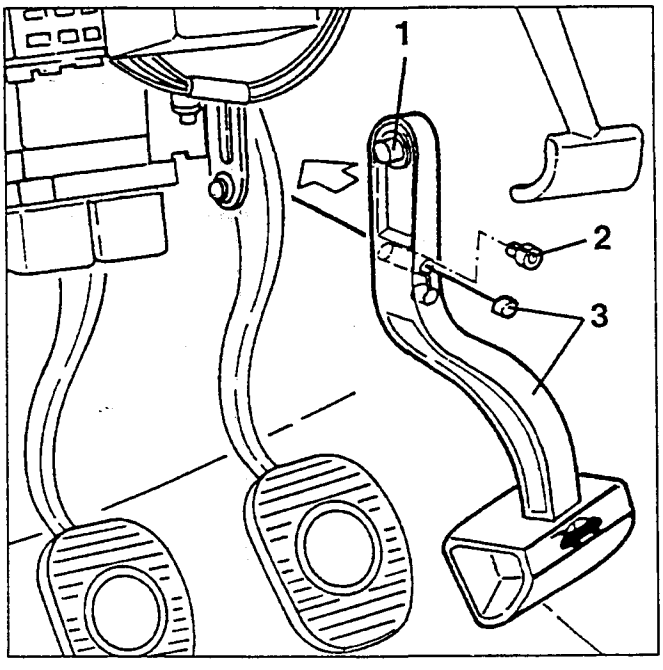
1. Remove the bonnet catch.



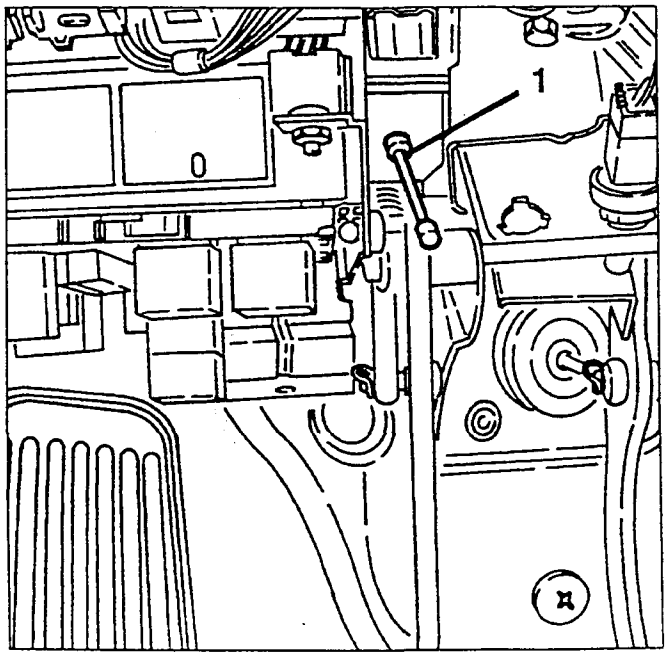
BONNET RELEASE CABLE

REPLACING

- Disconnect the bonnet release cable from the catch.
- Remove all the components in the engine bay which may prevent successive access to the bonnet release cable.
- Remove the trim from under the dashboard on the driver's side of the vehicle (see specific paragraph).
1. Free the bonnet release handle from its pivot.
2. Remove the cap.
3. Remove the pawl from the handle of the bonnet release cable and remove the handle.



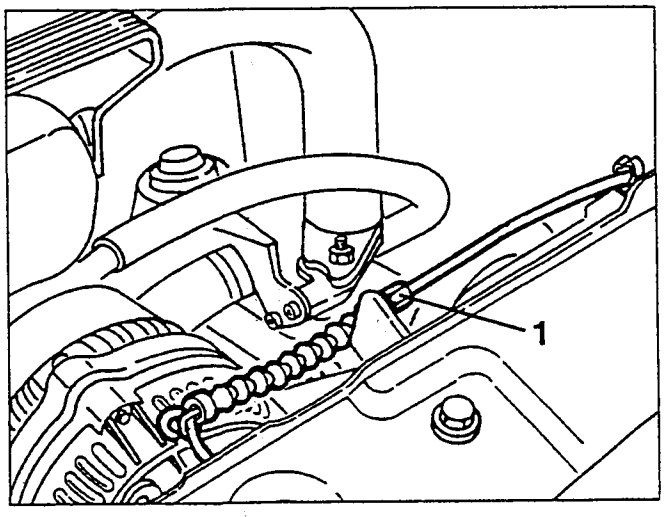
1. Using a pair of pliers free the cable from its attachment bracket.



- Free the cable from the clamps inside the engine bay.
- Tie a wire to the end of the cable on the passenger compartment side in order to permit subsequent recovery of the cable.
- Refit a new cable by reversing the procedure followed for removal ensuring that it is adjusted as described in the following paragraph.

ADJUSTMENT

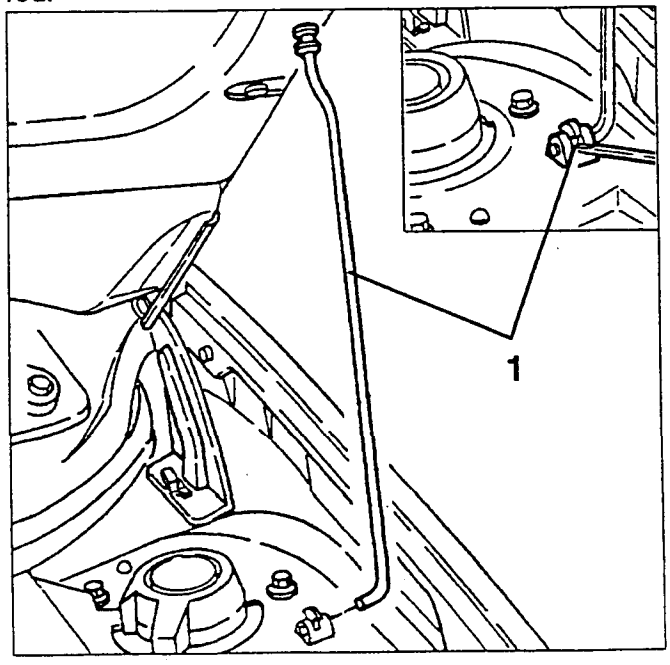
1. Working in the engine bay, adjust the tension on the cable by manually acting on the appropriate nut.



BONNET SUPPORT ROD

REMOVAL/REFITTING

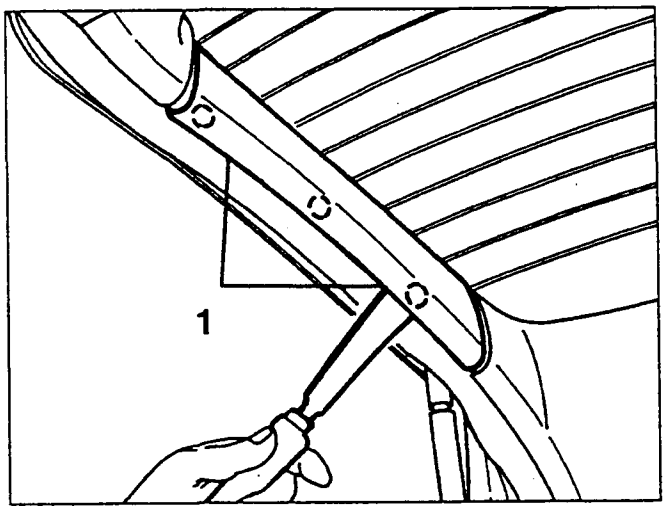
- Open and suitably support the bonnet.
1. Using a screwdriver, open the bonnet support rod; withdraw the rod from its support and then remove the rod.



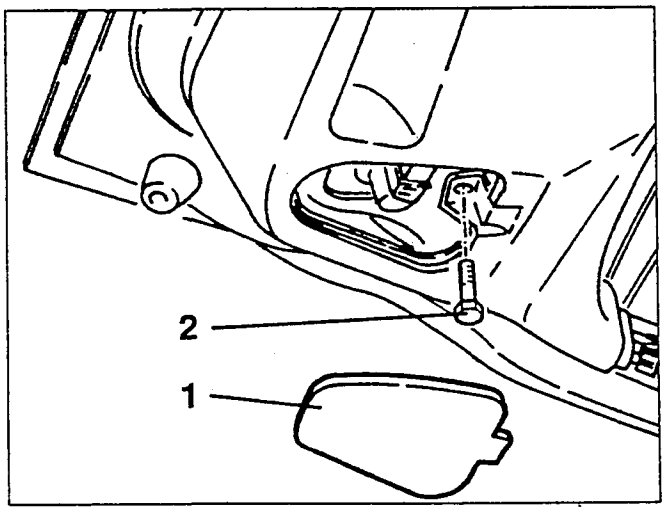
BOOT

REMOVAL/REFITTING

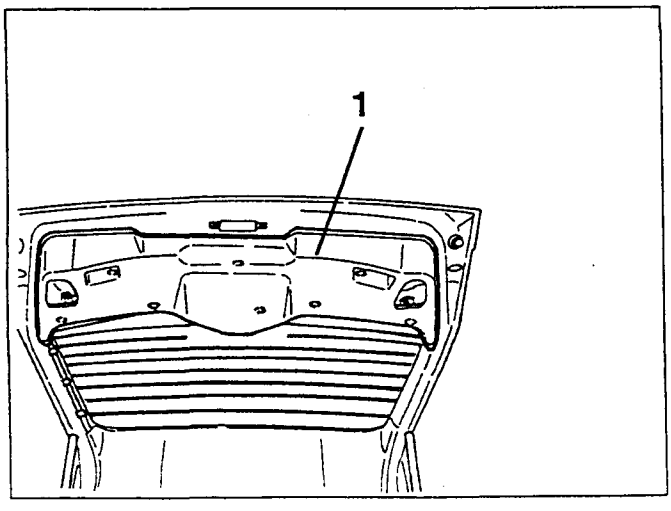
- Disconnect the negative cable (-) from the battery.
1. Open the boot. Pull off and remove the two side trim panels from the plastic buttons.



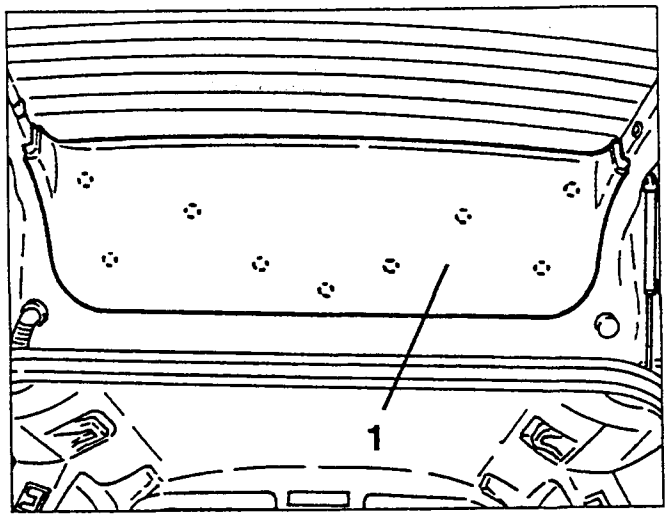
1. Remove the two bulb access panels.
2. Loosen the two screws securing the boot's interior trim.



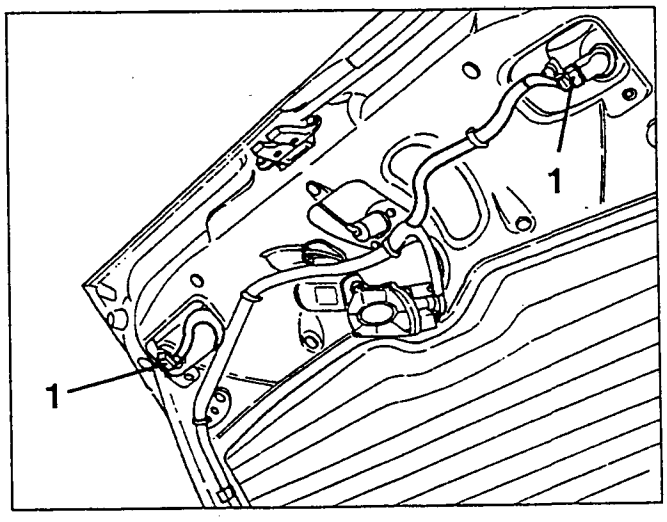
1. Pull the trim away from the plastic buttons in the lower part of the boot and remove.



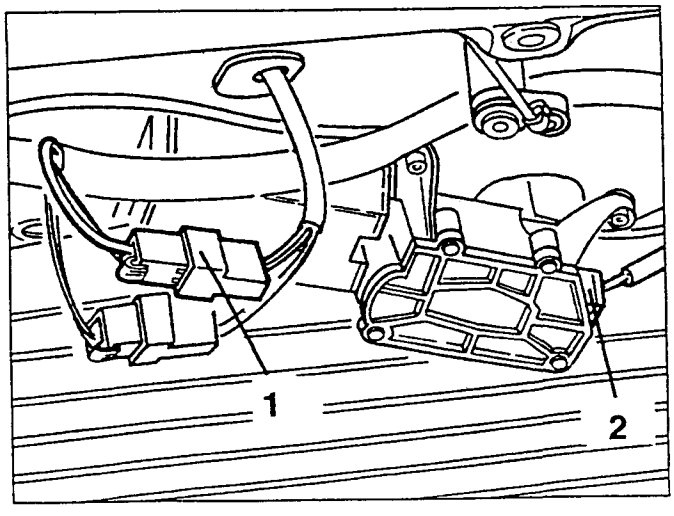
1. Pull the trim away from the plastic buttons (positioned as shown in the diagram) in the upper part of the boot and remove.



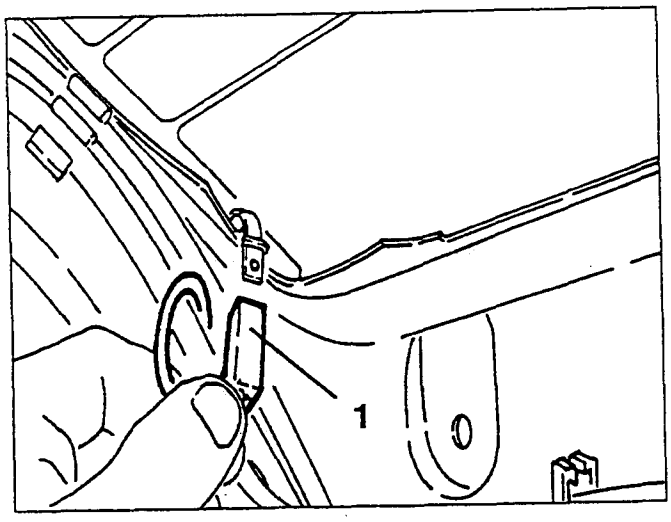
1. Disconnect the electrical connections from the reversing lights and the rear fog lights.



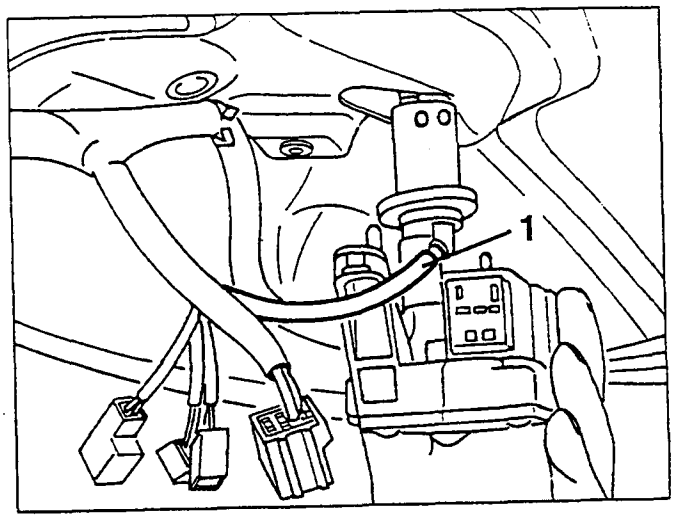
1. Disconnect the electrical connection from the centralized locking.
2. Disconnect the electrical connection from the rear windscreen wiper.



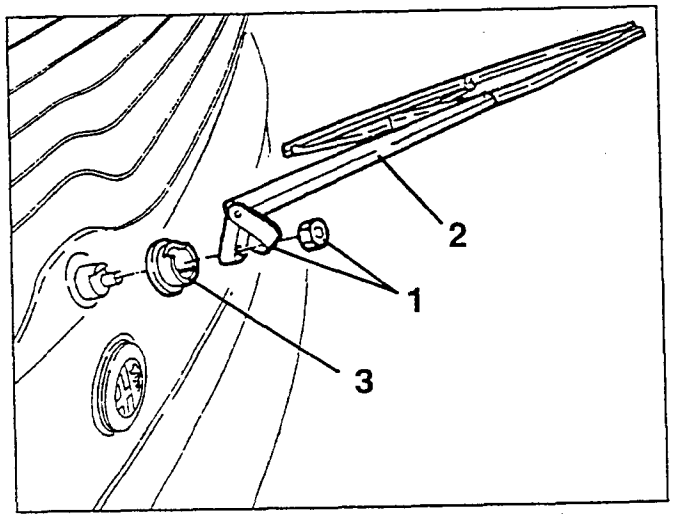
1. Disconnect the two electrical connections from the heated rear windscreen.



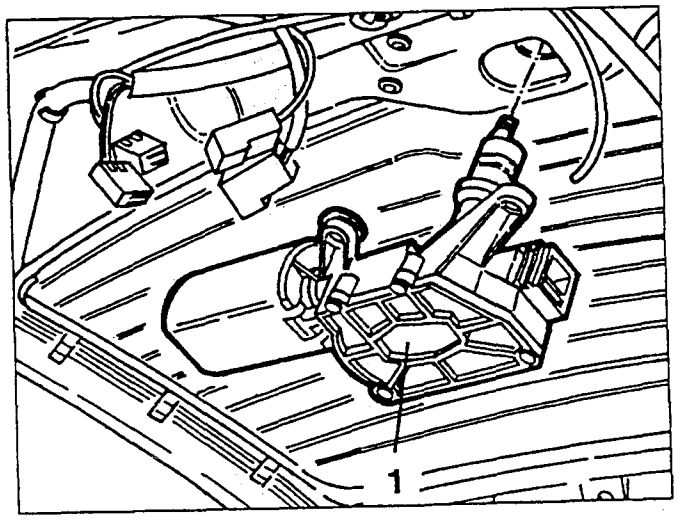
1. Withdraw the rear windscreen wiper motor from the boot just enough to enable the detergent abduction hose to be disconnected.



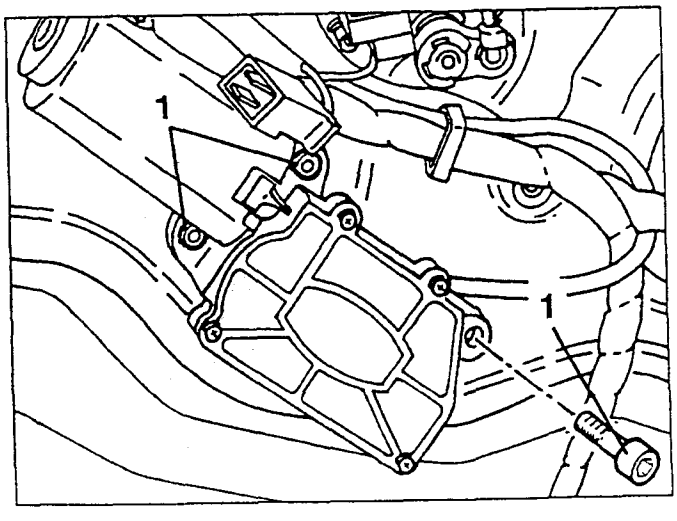
1. Lower the boot, raise the protective cap and unscrew the nut securing the rear windscreen wiper arm.
2. Remove the rear windscreen wiper arm.
3. Pull off and remove the rubber protection from the windscreen wiper.



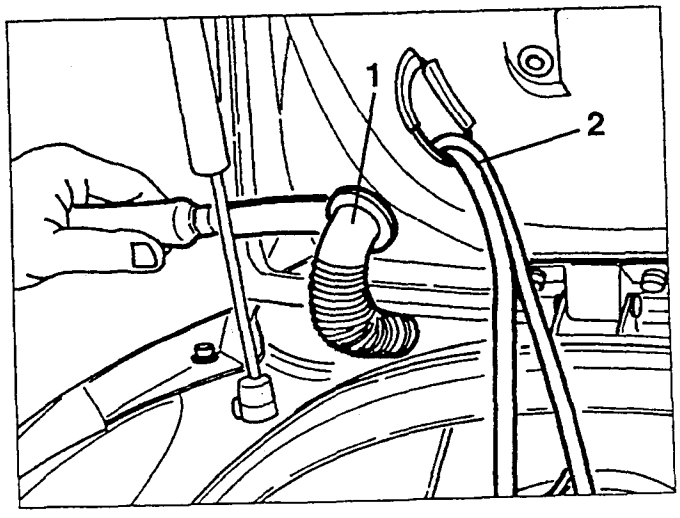
1. Remove the rear windscreen wiper motor.



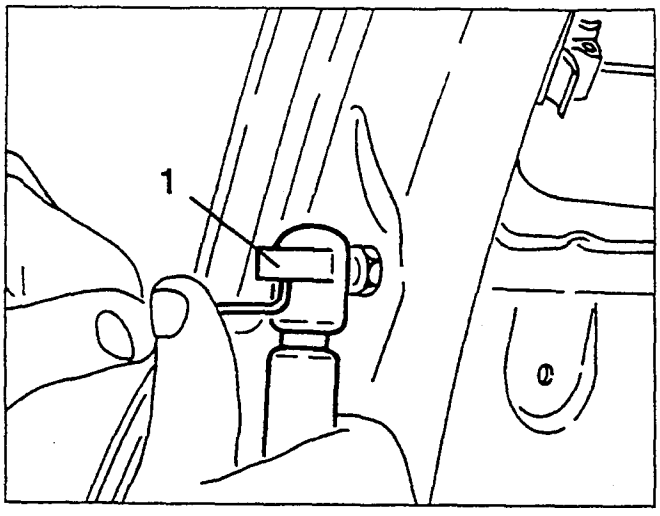
1. Raise the flap and loosen the three screws securing the rear windscreen wiper motor.



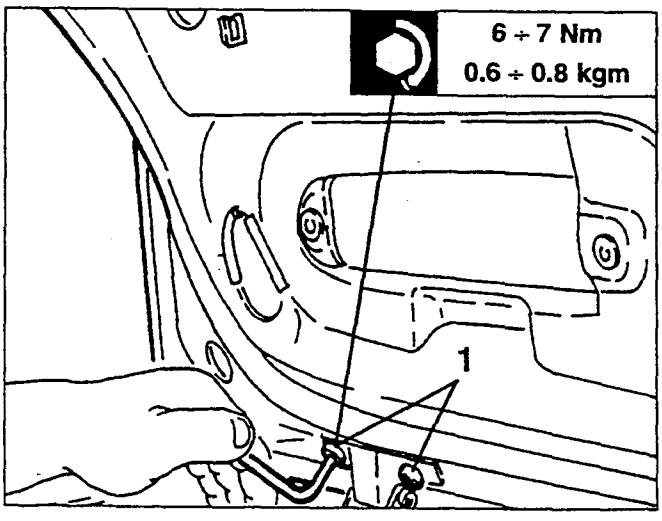
- Free the electrical wiring from the clamps securing it to the boot.
1. Disconnect the cable runner sleeve from the boot.
2. Withdraw the electrical wiring from its hole.



1. Suitably support the boot and disconnect it from the telescopic supports.

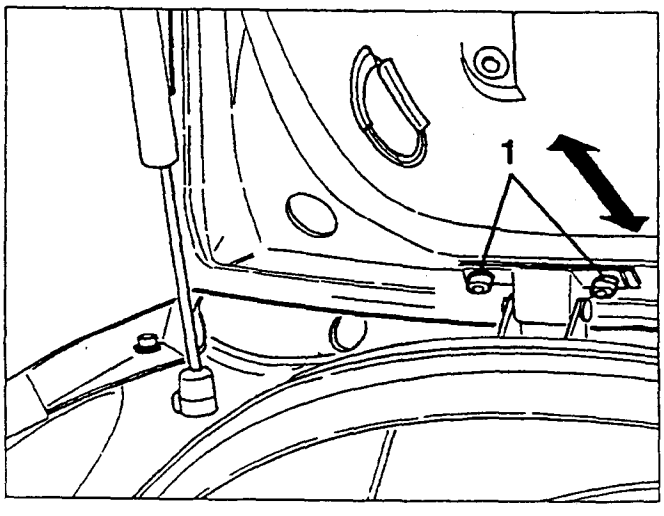


1. Loosen the two screws per hinge securing the boot and remove the boot lid.



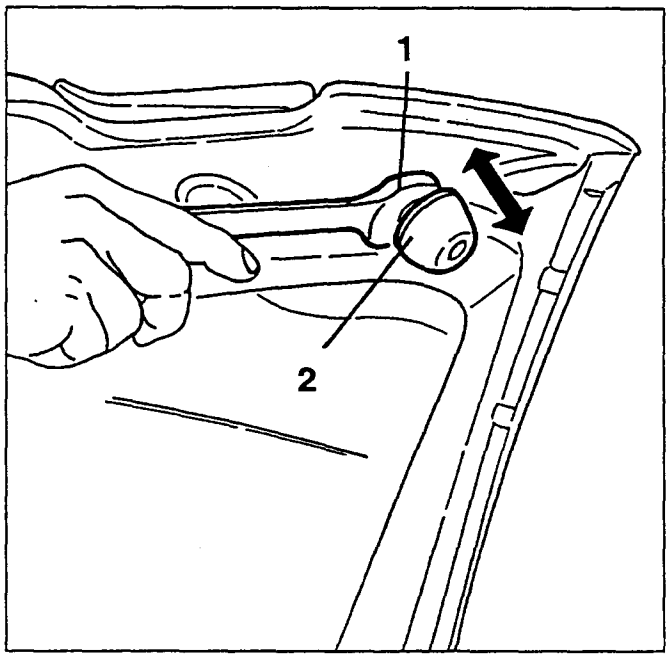
ADJUSTMENT

1. Loosen the screws securing the boot to the hinge and adjust longitudinally.



NOTE:
If the above adjustment is not sufficient adjust the hinge as described in the specific paragraph.

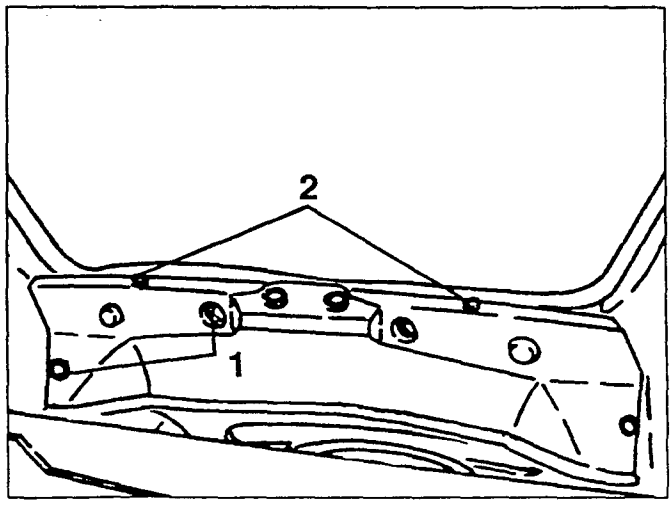
1. Loosen the nut securing the buffer.
2. Loosen or tighten the buffer as required.



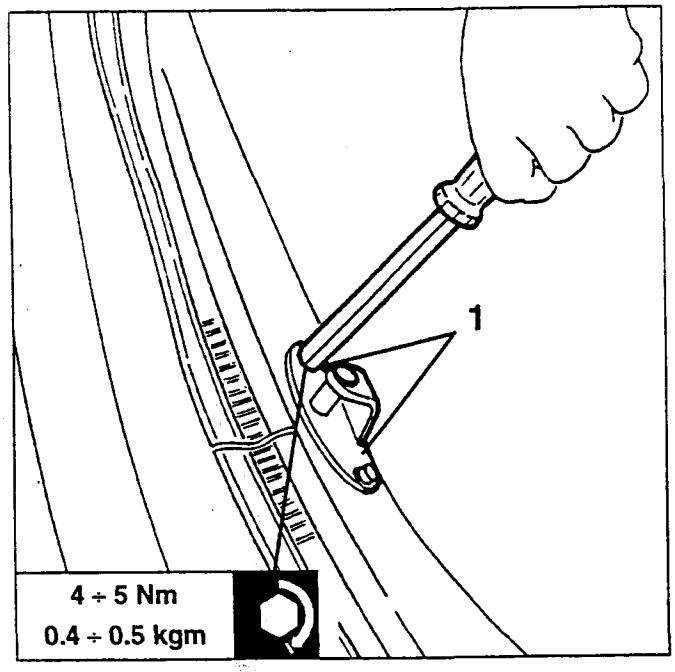
BOOT CATCH

REMOVAL/REFITTING

1. Working in the boot, pull off the four plastic buttons securing the protective trim.
2. Loosen the two screws securing the protective trim and remove the protective trim.

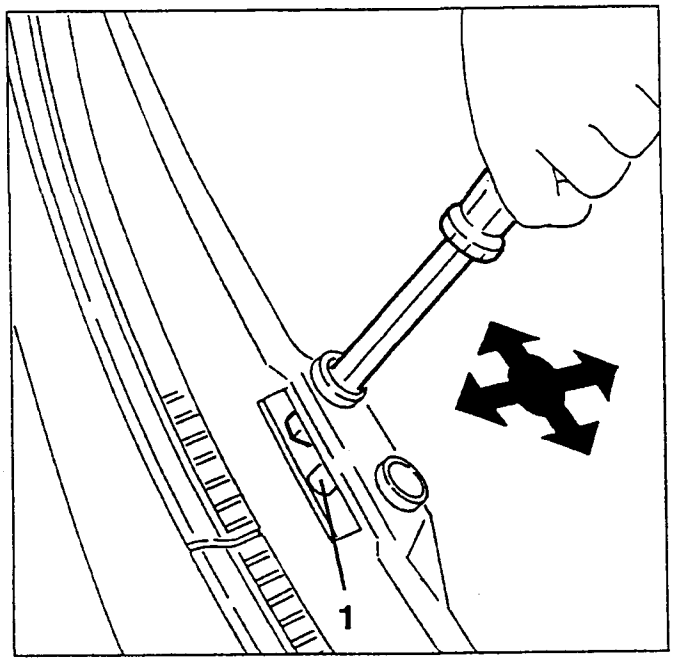


1. Loosen the two screws and remove the boot catch.



ADJUSTMENT

1. Loosen the two screws securing the boot catch and adjust it until the correct position is reached and then tighten the screws once again.

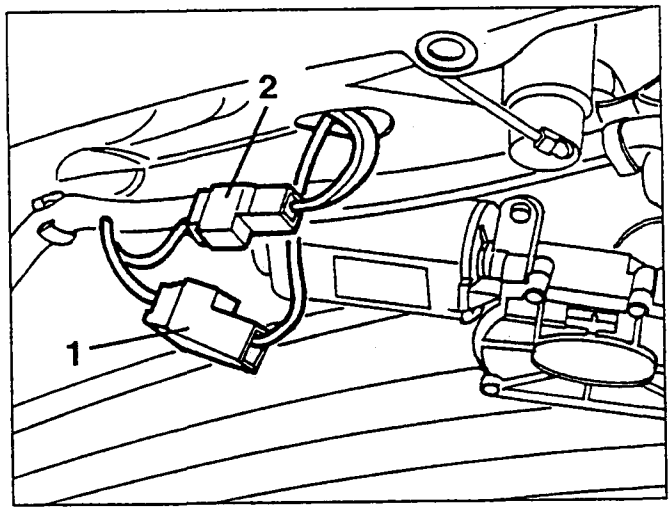


BOOT LOCK

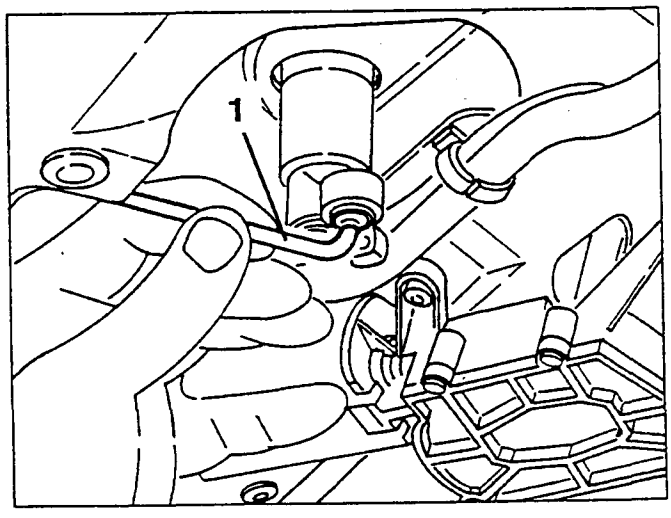
REMOVAL/REFITTING

- Follow the first three steps described in the "BOOT" paragraph.

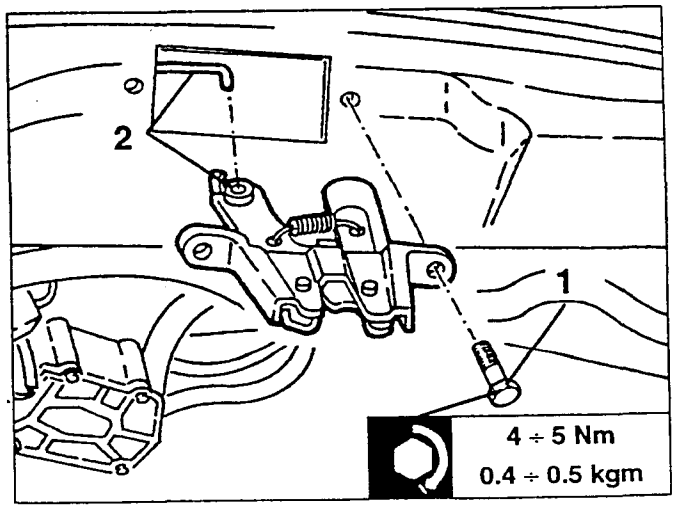
1. Disconnect the electrical connection from the boot open warning light.
2. Disconnect the electrical connection from the rear windscreen wiper.



1. Disconnect the lock unit from the rod connecting it to the lock device.



1. Loosen the two screws securing the lock.
2. Lower the lock just enough to permit the tie-rod connected to the actuator to be disconnected and removed.

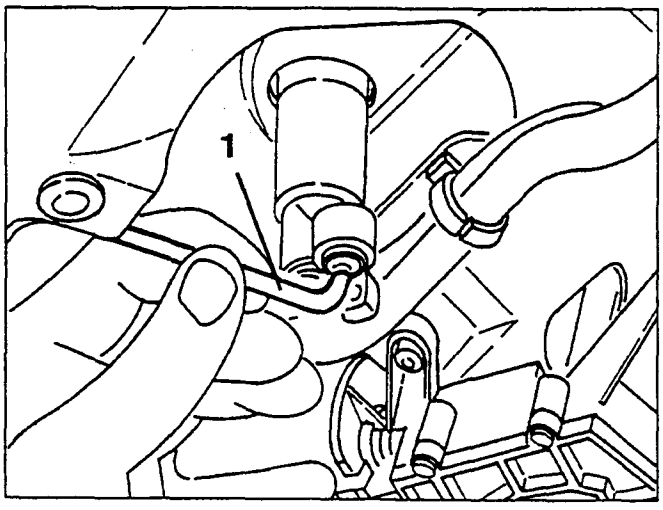


LOCK UNIT

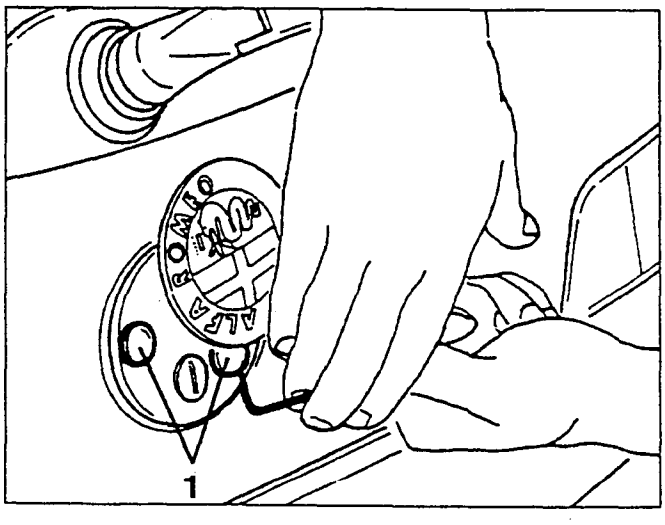
REMOVAL/REFITTING

- Follow the first three steps described in the "BOOT" paragraph.

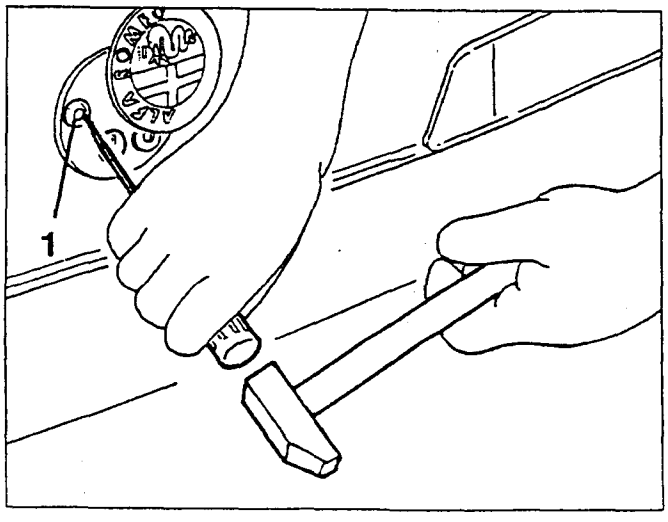
1. Disconnect the tie-rod connecting the lock to the unit.



1. Lower the boot, turn the logo and pull the two protective caps from the attachment screws.



1. Using a suitable punch, loosen the two self-cutting screws securing the lock unit to the boot and remove the lock unit.

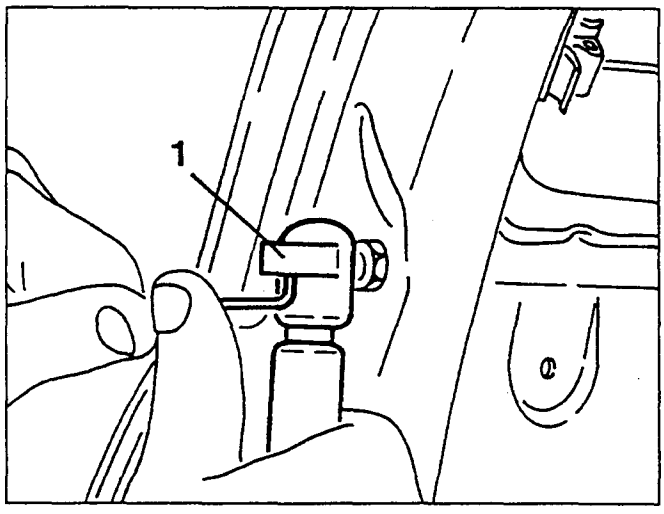


Refit by reversing the procedure followed for removal ensuring that two self-cutting screws are used for the lock unit attachment.

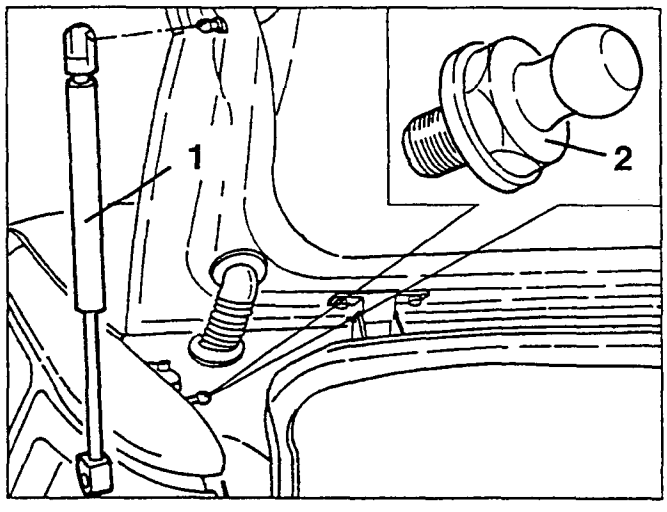
TELESCOPIC SUPPORTS

REMOVAL/REFITTING

1. Open the boot, support it adequately and then open the clips securing the supports to the relative balls.



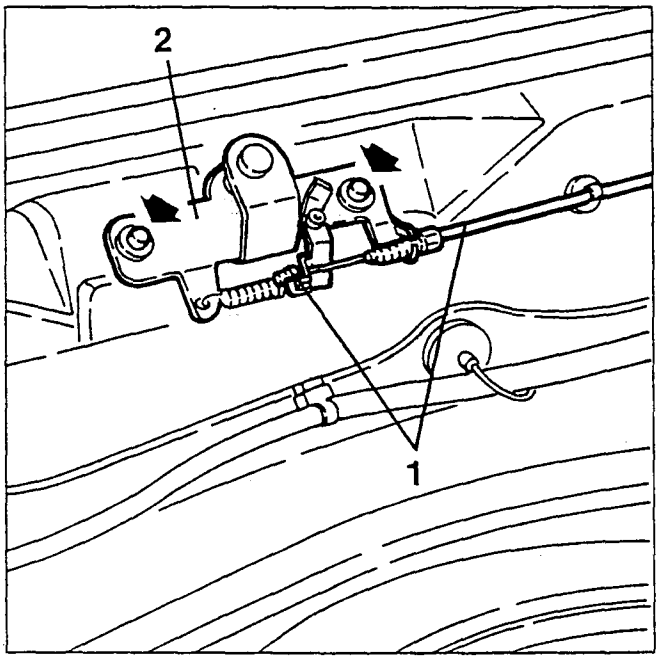
1. Remove the support by freeing it from the two retaining balls.
2. If necessary loosen and remove the two retaining balls.



LOCK STRIKER

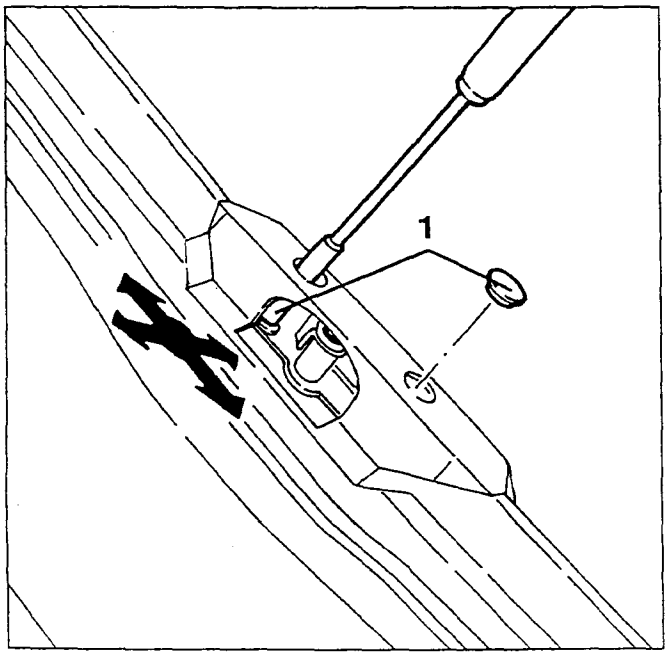
REMOVING/REFITTING

- Remove the suitcase guard (see specific paragraph).
1. Disconnect the boot opening cable from the lock striker.
2. Slacken the two fastening screws and remove the lock striker.



ADJUSTMENT

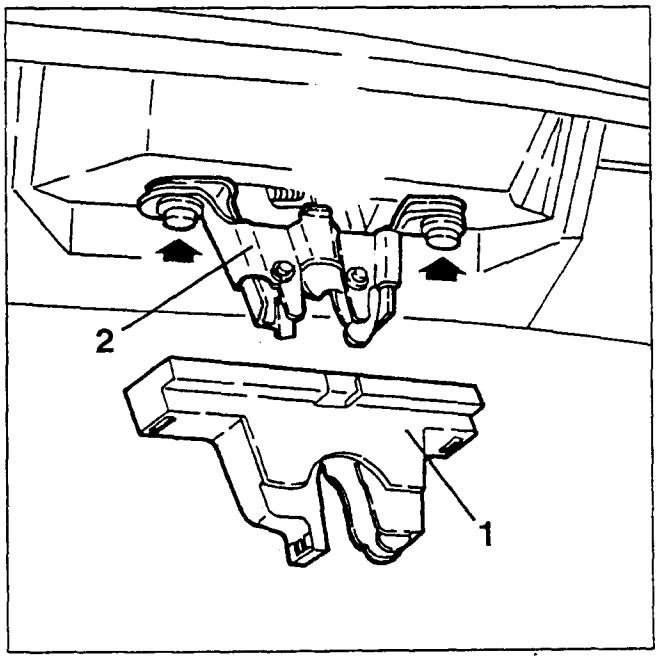
1. Remove the two caps from the suitcase guard, then slacken the screws fastening the boot lock striker until the bonnet closes correctly, then tighten the screws.



BOOT LOCK

REMOVING/REFITTING

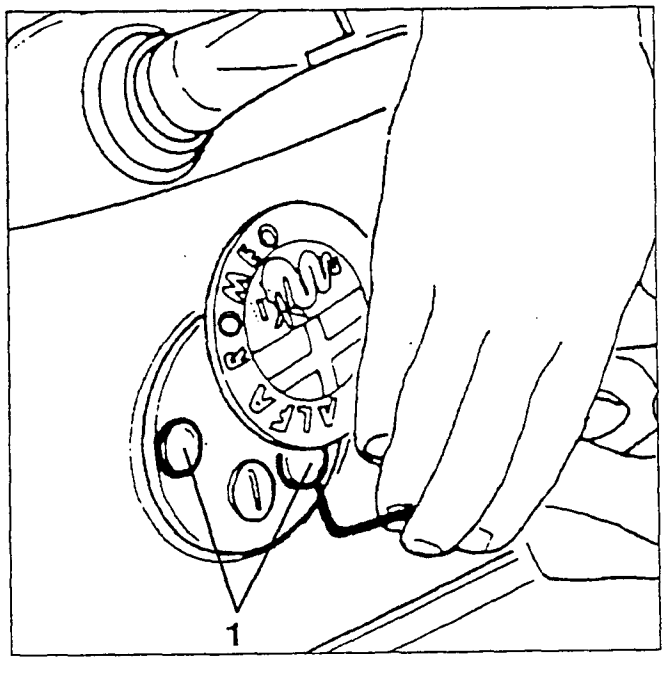
1. Prise and remove the plastic cover from the boot lock.
2. Slacken the two fastening screws and remove the boot lock.



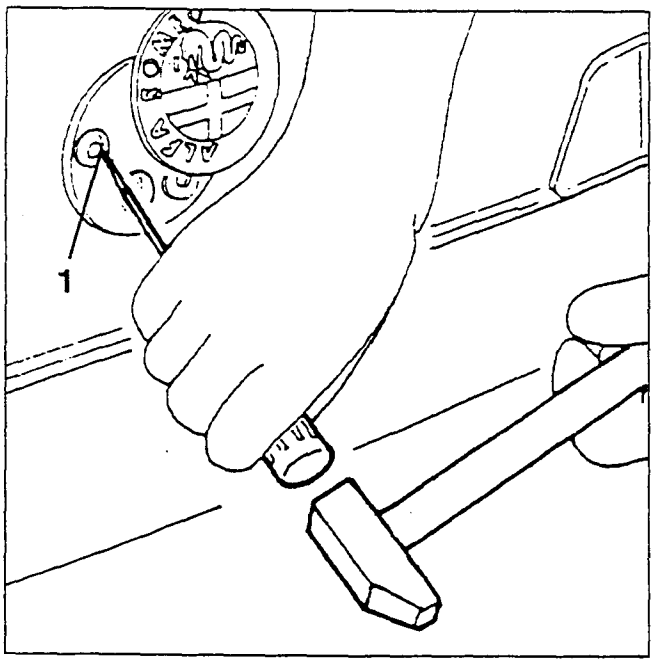
LOCK BLOCK

REMOVING/REFITTING

1. Turn the badge and remove the two caps protecting the fastening screws.



1. Using a punch, slacken the two self-shearing screws fastening the lock block to the boot and remove it.

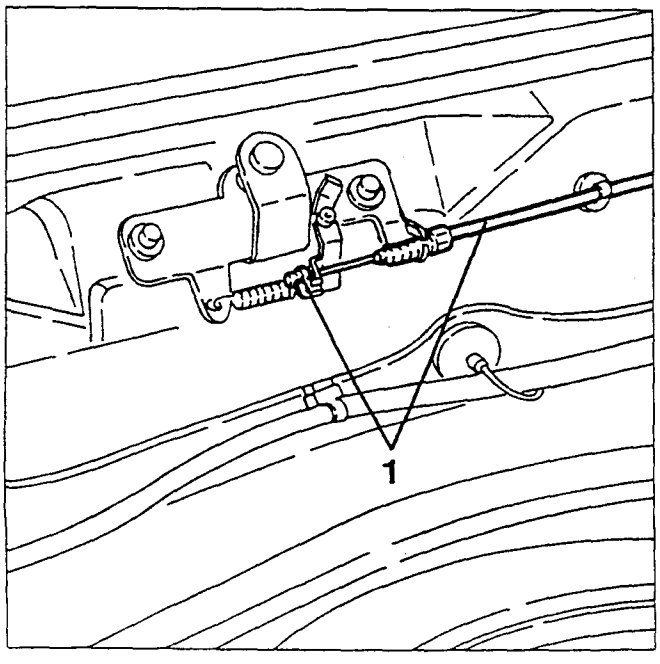


Refit reversing the sequence used for removal taking care to use new self-shearing screws for fastening the lock block.

REPLACING THE BOOT OPENING CONTROL CABLE

- Remove the suitcase guard (see specific paragraph).

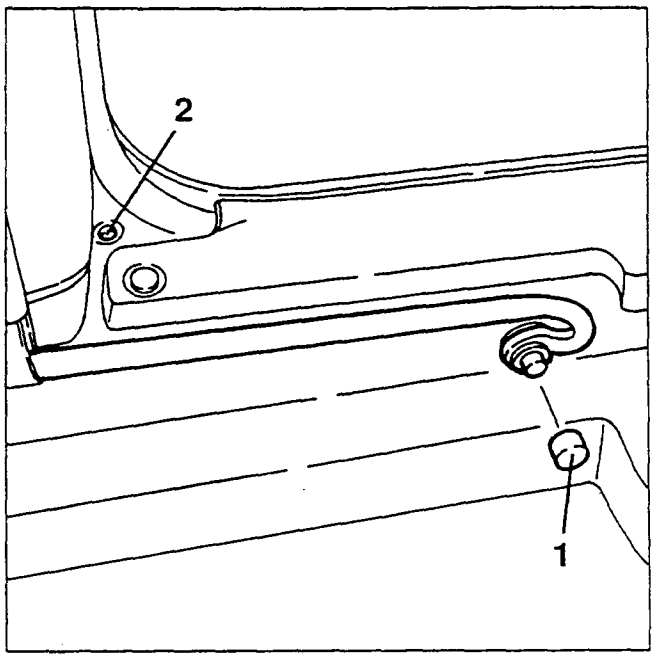
1. Disconnect the boot opening cable from the lock striker and release it from the fastening clamps in the luggage compartment.



- Remove the rear seat cushion (see specific paragraph).

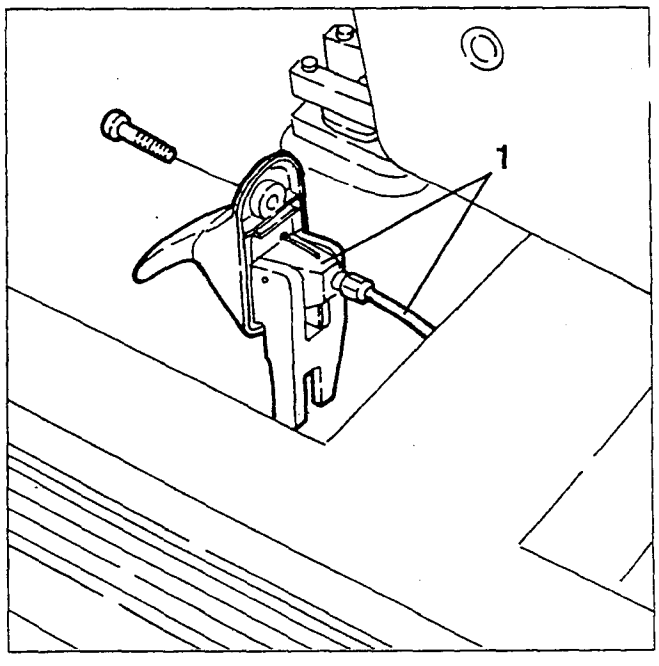
1. Remove the cap and slacken the screw fastening the left front seat belt sliding connection, without withdrawing the belt itself.

2. Slacken the screw illustrated fastening the side panel to facilitate moving the floor mat.



- Remove the left hand sill board (see specific paragraph).
- Pull away the floor mat and release the cable from the fastening clamps.

1. Slacken the two fastening screws and pull out the boot opening control lever just enough to remove the control cable.



- Remove the boot opening control cable and install a new one reversing the sequence followed for removal.

INDEX

BONNET

- Bonnet opening control cable.....1

INTERNAL TRIM

- Dashboard.....3

BONNET

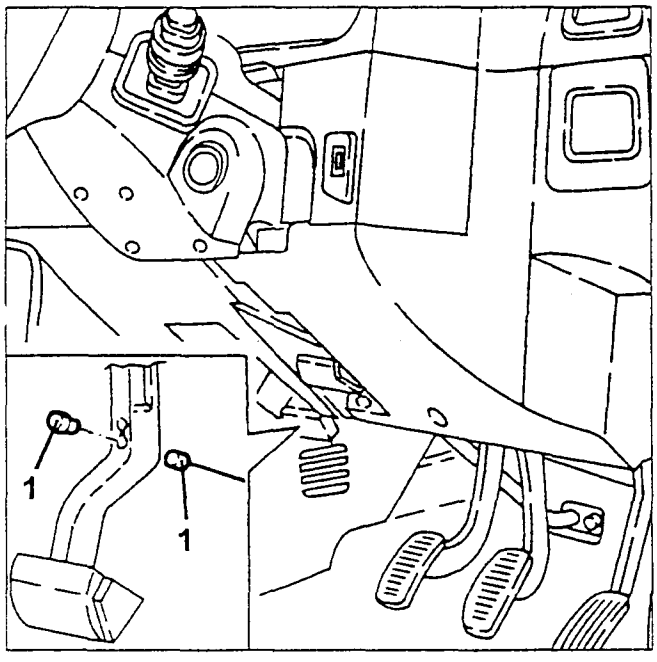
- Bonnet opening wire ('98 models).....7

For the information not given here, see the corresponding groups of "145 - 146 - Base Manual".

BONNET OPENING WIRE ('98 MODELS)

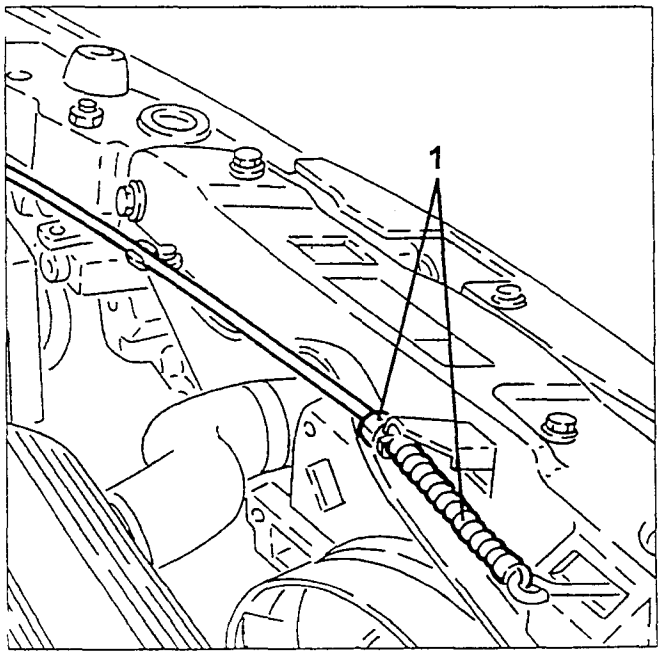
REPLACEMENT

1. From inside the passenger compartment, remove the cap and remove the pawl from the bonnet opening wire.

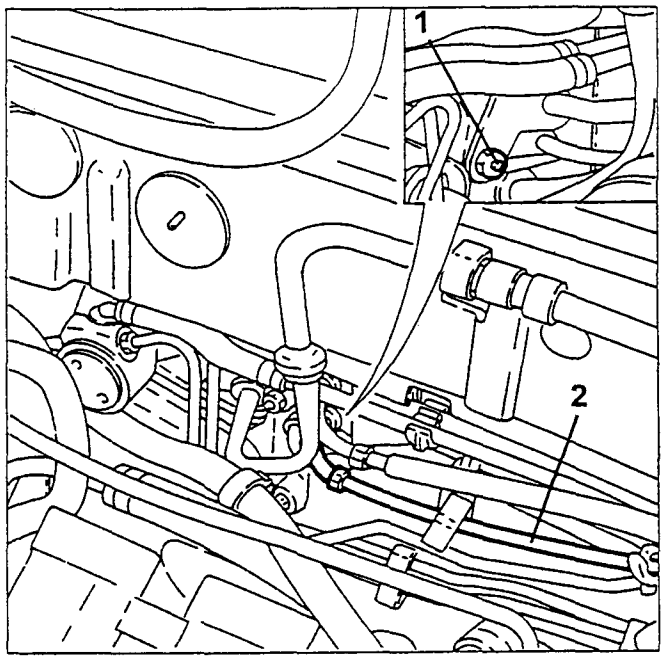


- Remove the intake manifold (see ASSEMBLY 10).

1. Disconnect the bonnet opening wire from the respective lock.

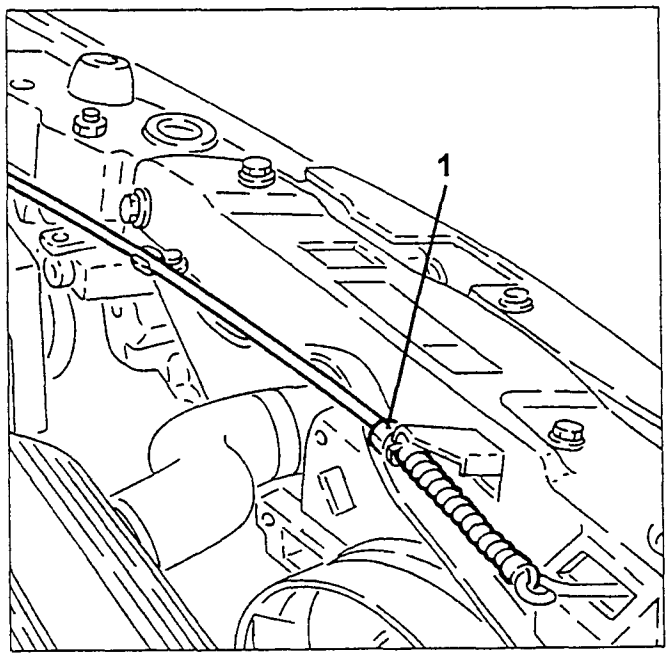


1. Loosen the accelerator wire and bonnet opening wire nut from the engine compartment partition.
2. Remove the bonnet opening wire from the engine compartment partition.



- Refit a new bonnet opening wire by reversing the removal sequence.

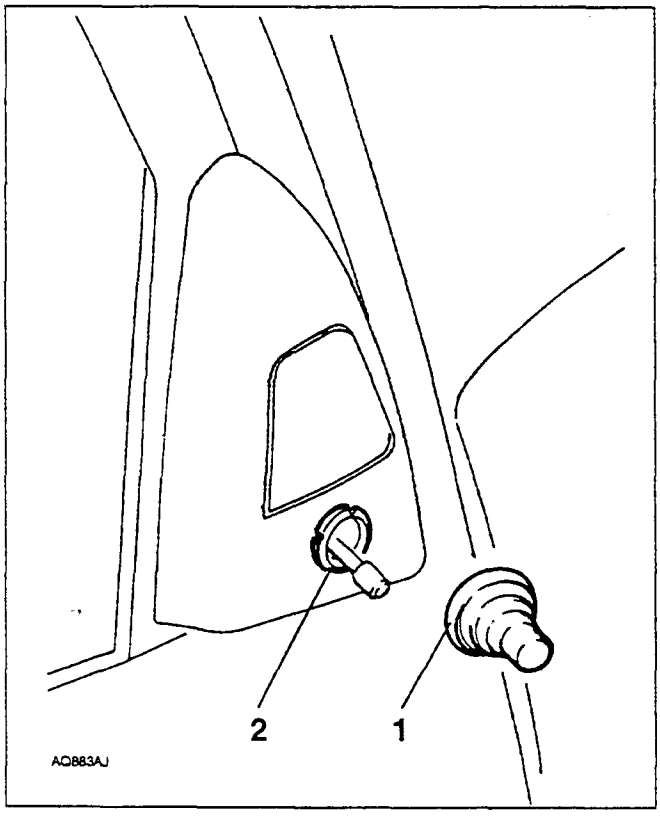
1. Calibrate bonnet opening wire tension by means of the specific nut.



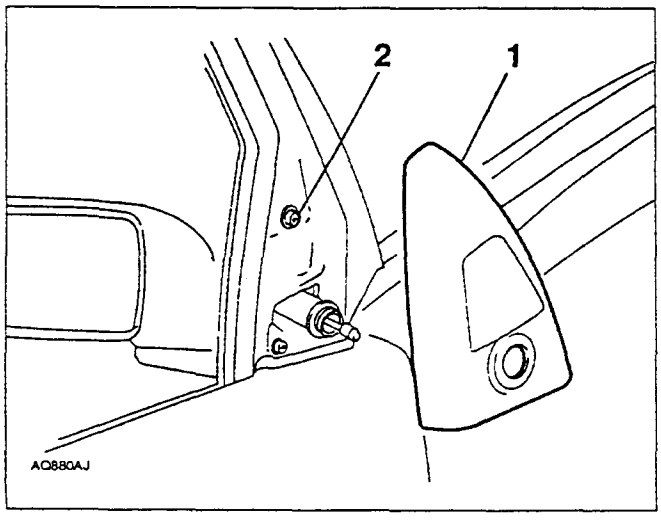
WING MIRROR (manually - operated)

REMOVAL/REFITTING

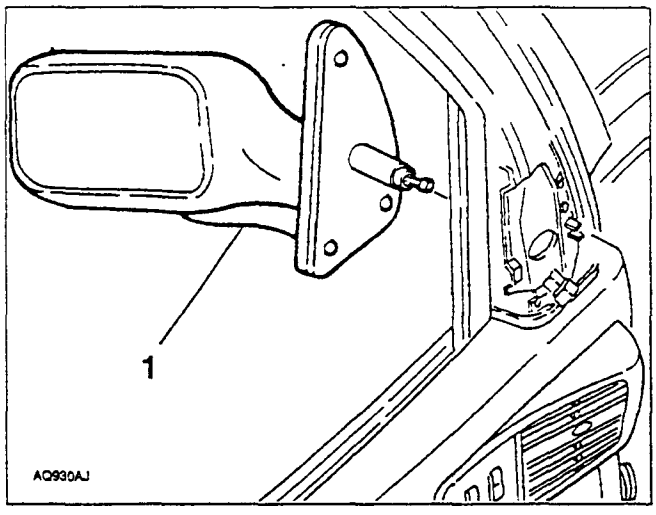
1. Remove the bellow.
2. Slacken and remove the plate locknut



1. Using knife **1.823.014.000**, remove the rearview mirror inner plate.
2. Slacken the three screws fastening the wing mirror



1. Remove the mirror and seal.

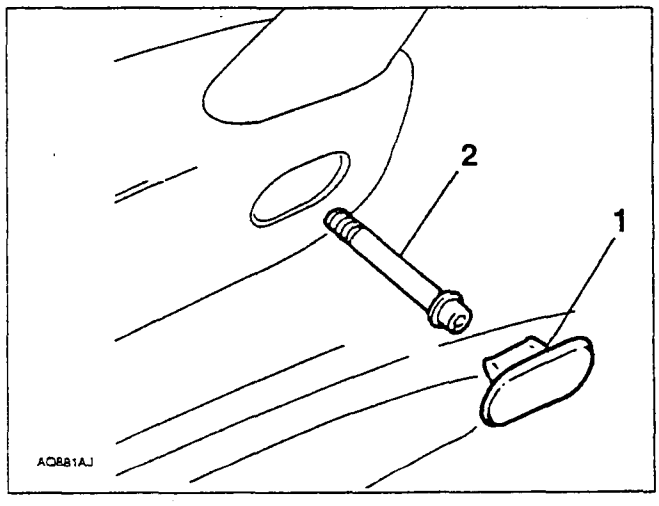


FRONT DOOR PANEL

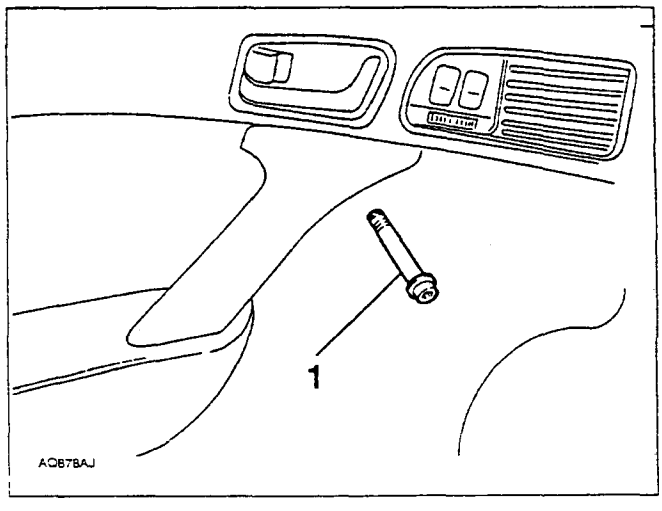
REMOVAL/REFITTING

- Disconnect the battery negative terminal (-).
- Remove the rearview mirror plate (see specific paragraph).

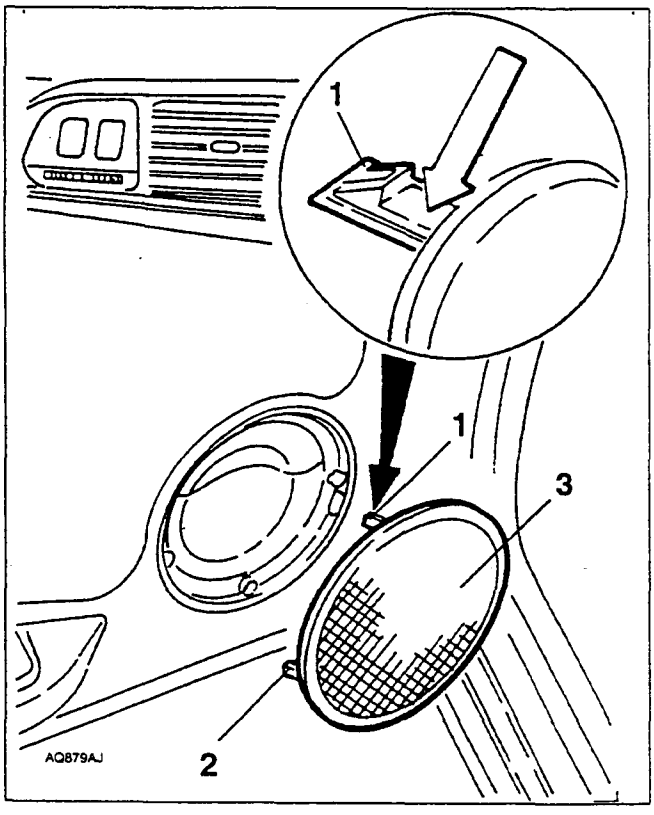
1. Remove the plastic cap of the armrest grip.
2. Slacken the fastening screw below.



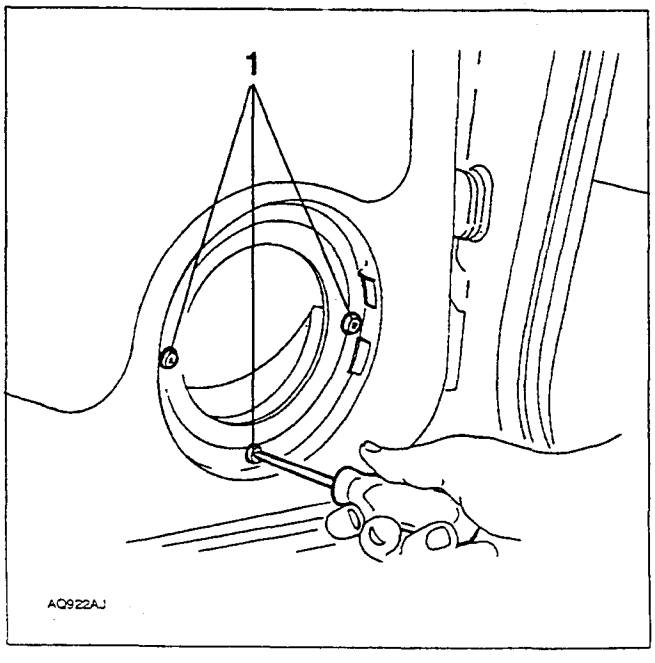
1. Slacken the upper fastening screw.



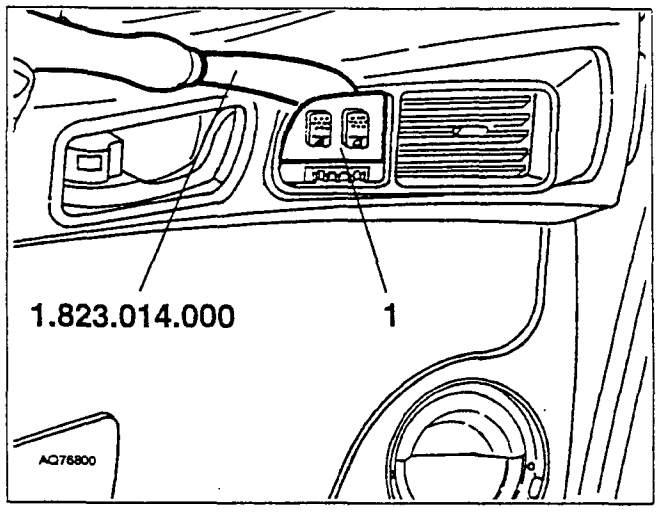
- Using a suitable screwdriver, prise off the speaker cover plate as described below:
1. Press and release the upper catch tooth.
2. Press and release the left side catch tooth.
3. Remove the plate.



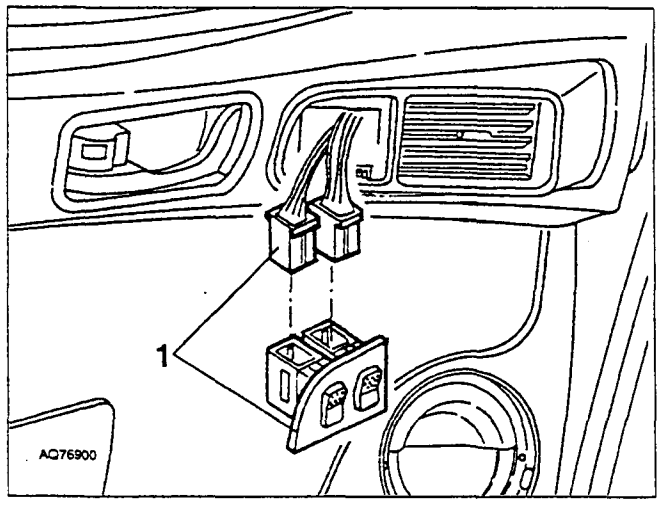
1. Slacken the three screws fastening the speaker compartment to the body and remove them.



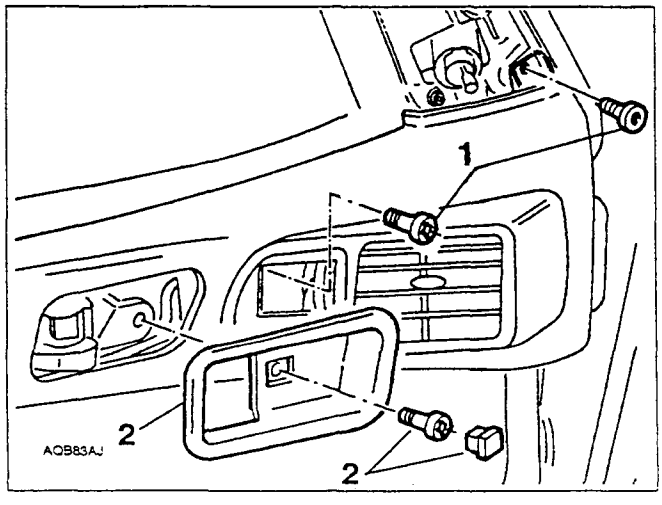
1. Using tool no. **1.823.014.000**, remove the power window switches complete with plate from the housing.



1. Disconnect the electrical connections from the power window switches and remove them.

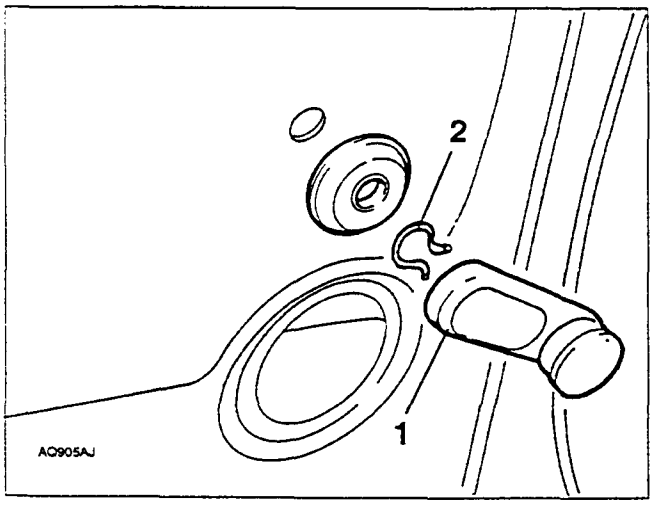


1. Slacken and remove the fastening screws to be found under the rearview mirror plate and in the switch compartment.
2. Remove the plastic cap, slacken the fastening screw and using knife **1.823.014.000** remove the door opening hanndle plate.

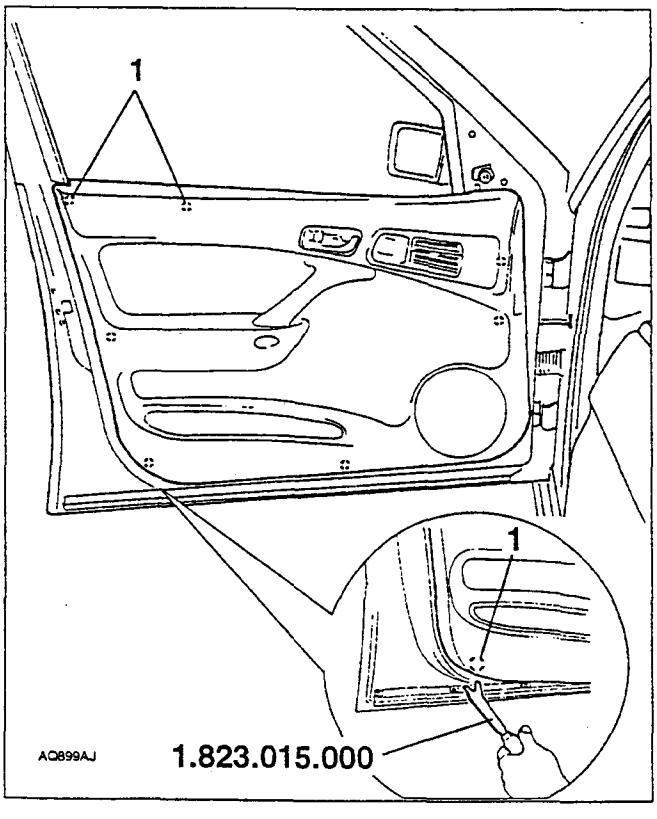


NOTE: only on cars fitted with manually-operated window winder:

1. Remove the catch clip.
2. Remove the window winder handle.

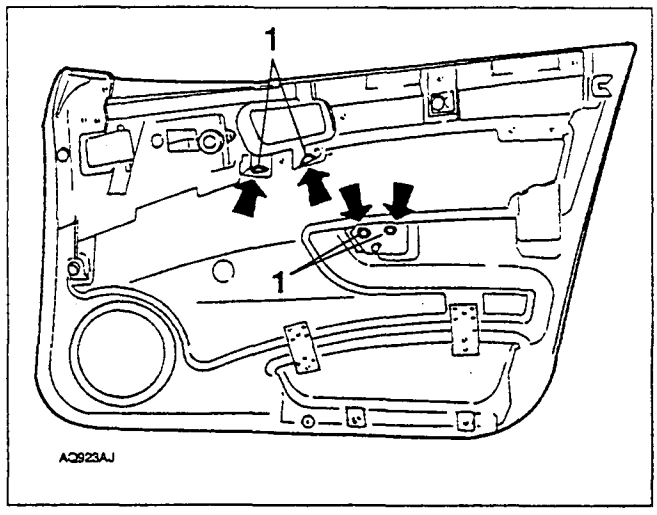


1. Using tool no. **1.823.015.000** detach the panel from the plastic nails illustrated and remove it.

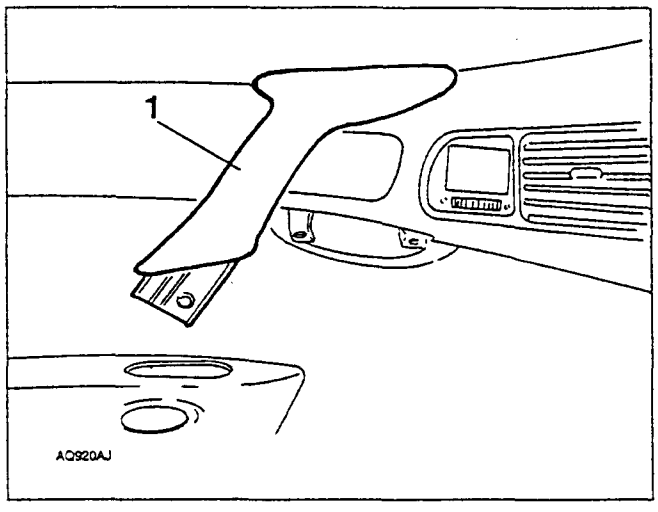


DISASSEMBLY

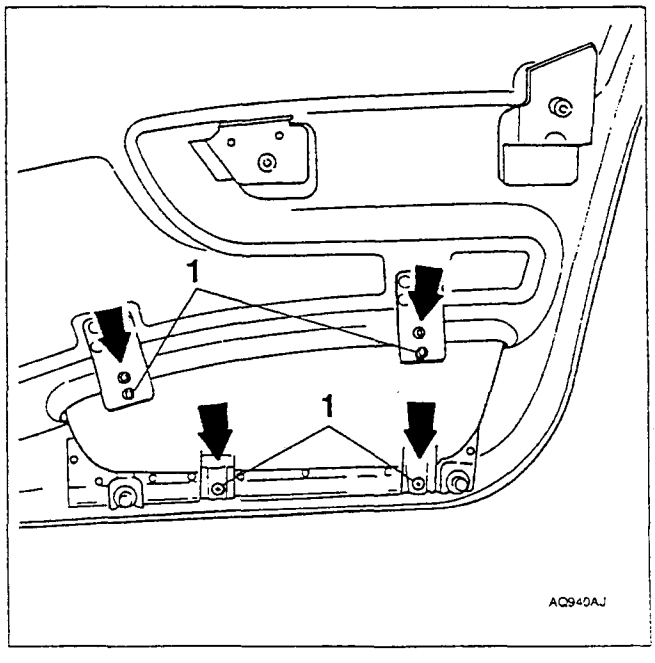
1. Slacken the four fastening screws.



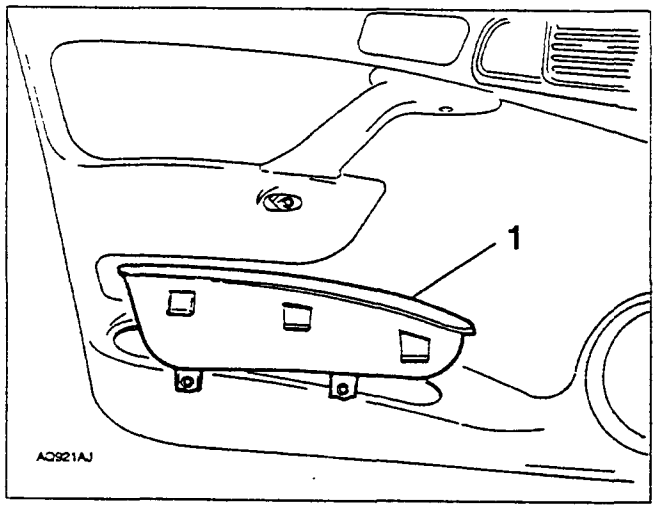
1. Remove the armrest handle pulling it upwards.



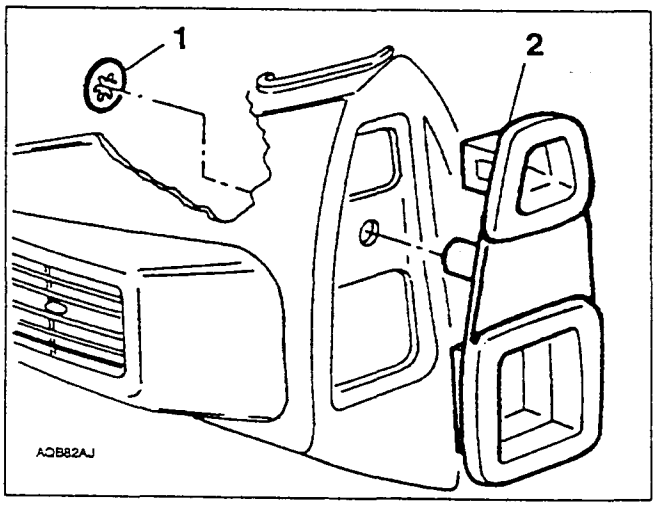
1. Slacken the four rear screws fastening the utility compartment.



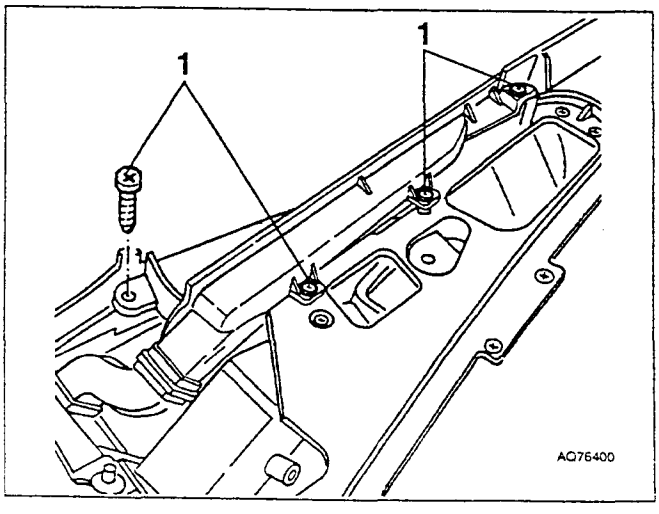
1. Remove the utility compartment pulling it upwards.



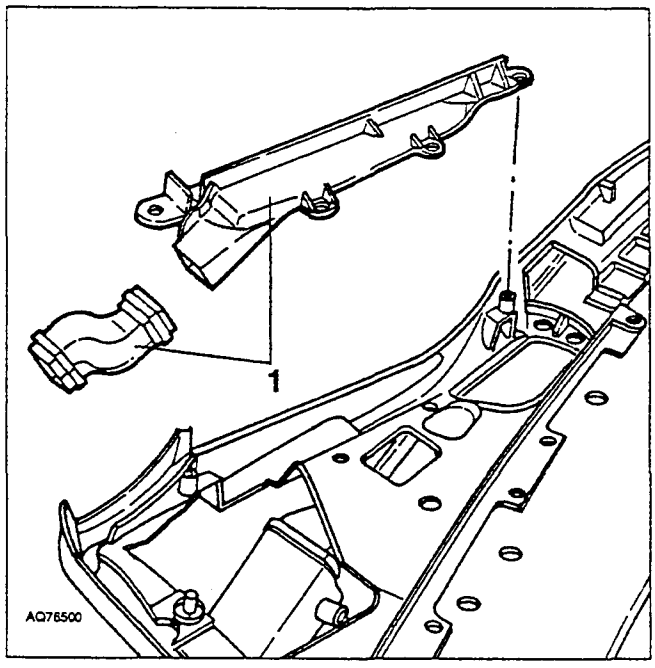
1. Working from inside the panel, remove the stay clip.
2. Remove the air vent.



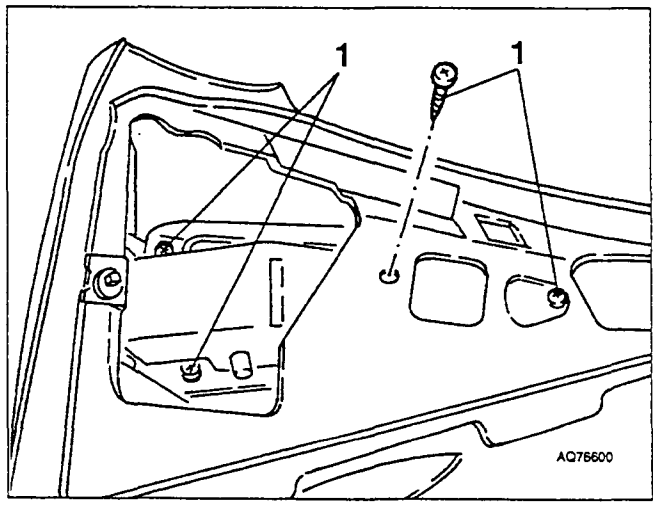
1. Slacken the four screws fastening the door window demisting vent.



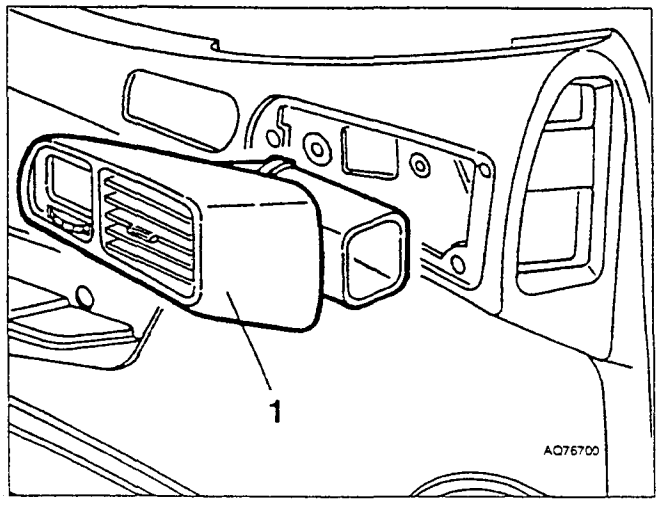
1. Remove the door window demisting vent.
- If necessary disassembly the door window demisting vent.



1. Slacken the four screws fastening the air flow vent to the driver's seat.



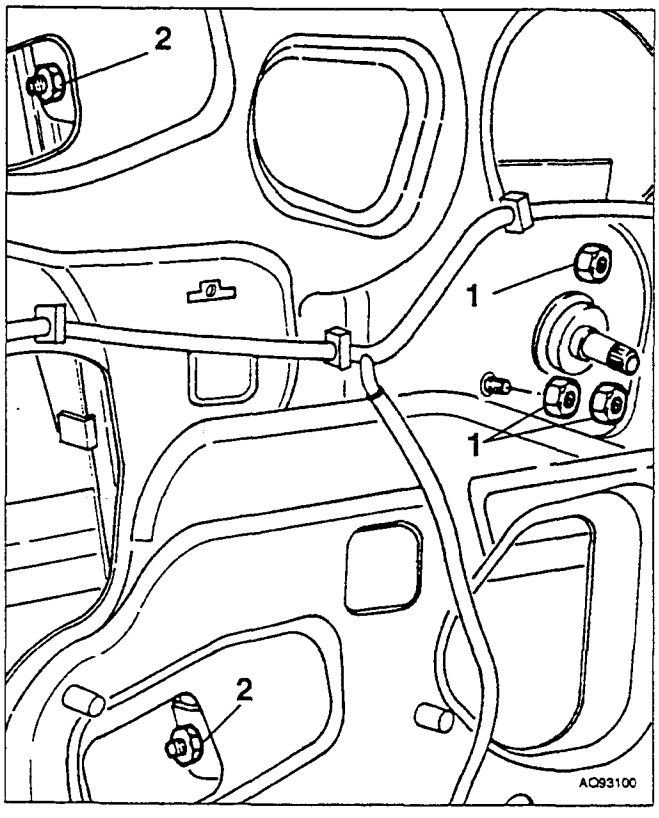
1. Remove the air flow vent.



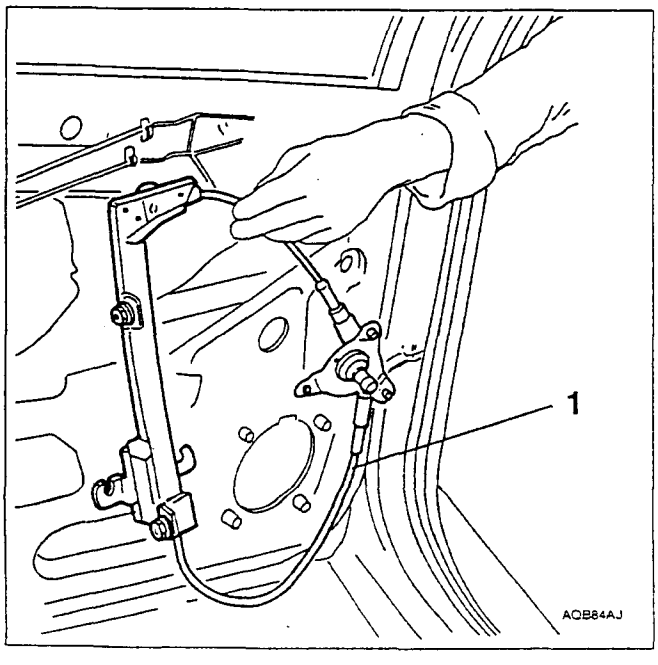
FRONT DOOR WINDOW WINDER (Manual)

REMOVAL/REFITTING

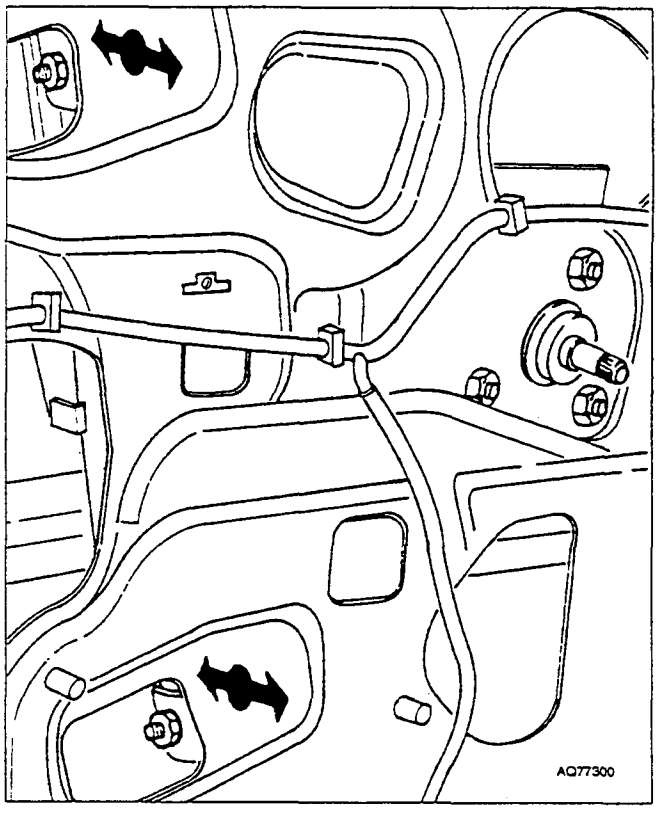
- Remove the glass (see specific paragraph).
1. Slacken and remove the three fastening nuts.
2. Slacken the two rear nuts fastening the window winding device.



1. Pull and remove the window winder from inside the door.



Refit the window winder reversing the sequence followed for removal taking care to adjust its position as shown below.

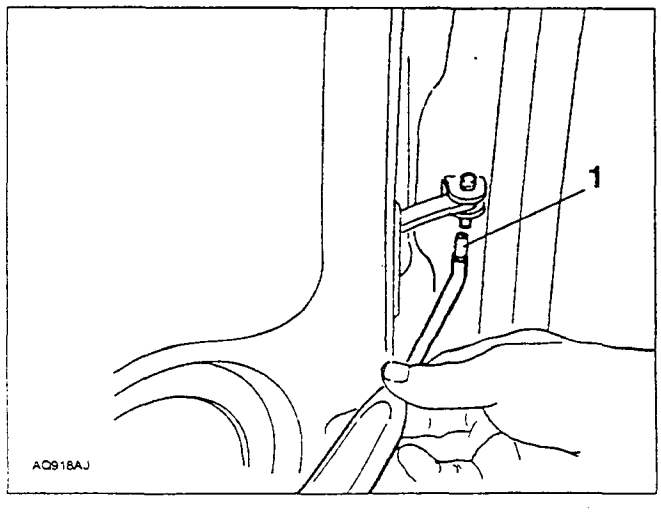


REAR DOORS

REMOVAL/REFITTING

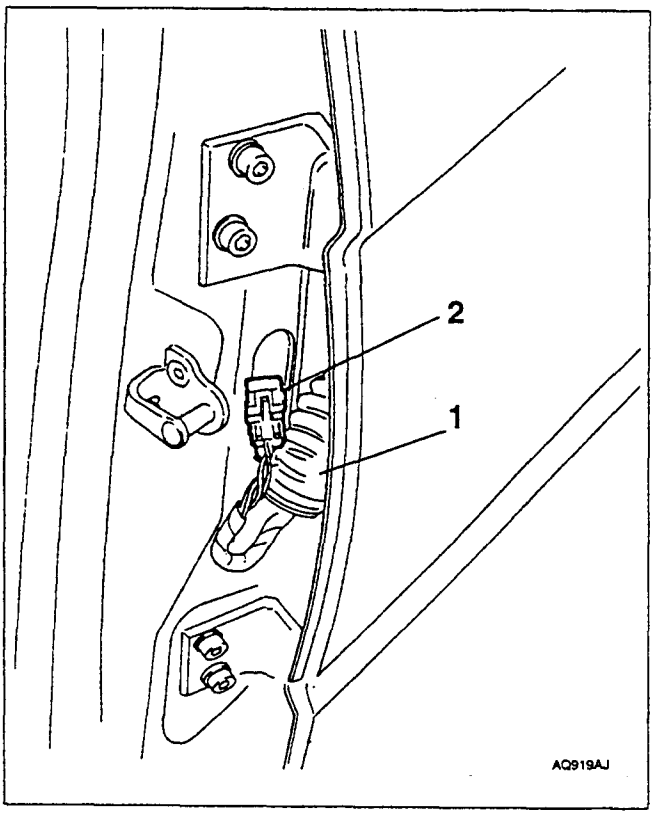
NOTA: during removal and refitting operations avoid damaging the paintwork.

- Disconnect the battery negative (-) terminal.
1. Using a suitable tool, withdraw and remove the door check rod pin, half close the door to make the check rod go in, then open it.

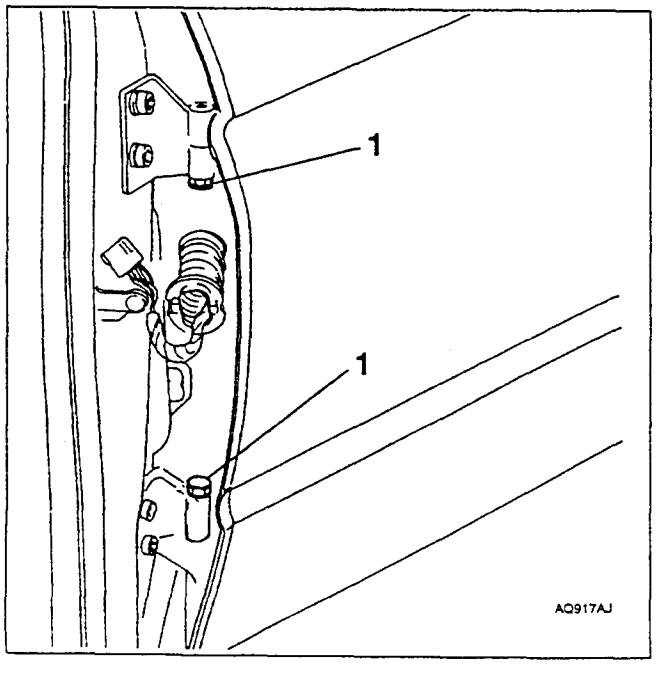


1. Using tool no. **1.823.014.000** disconnect the cable sleeve from the centre pillar.

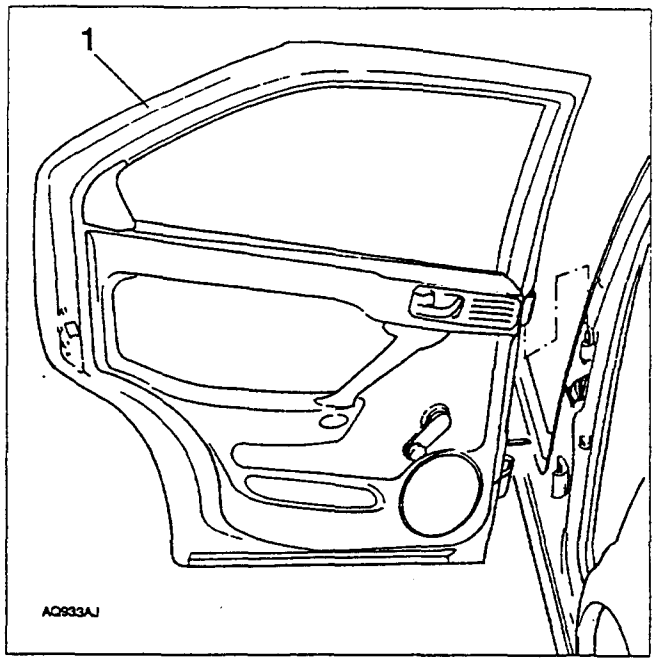
2. Disconnect the electrical connection.



1. Slacken the two screws fastening the door to the hinges.

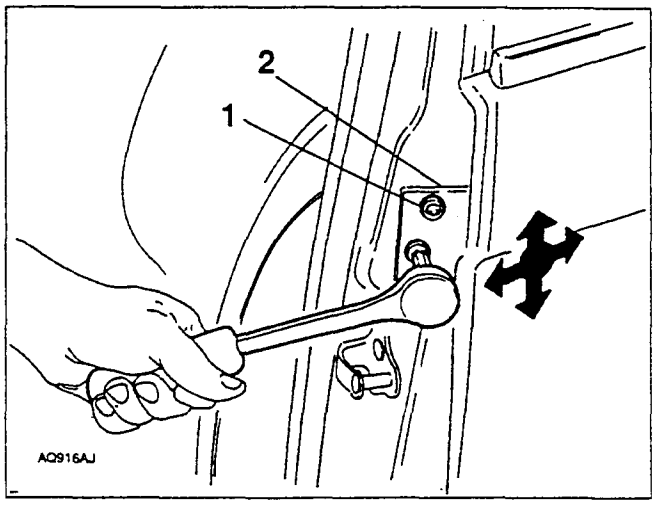


1. Raise the door until the taper pins of the hinges are removed from their housings, then remove the door.



ADJUSTMENT

1. Slacken the screws fastening the hinges to the body and adjust the height and longitudinal alignment.
2. If necessary place suitable shims under the hinges to adjust the position of the door.



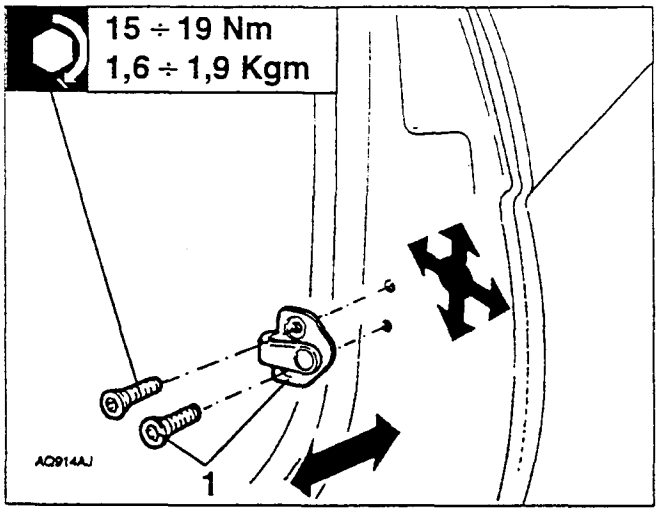
REAR DOOR LOCK STRIKER

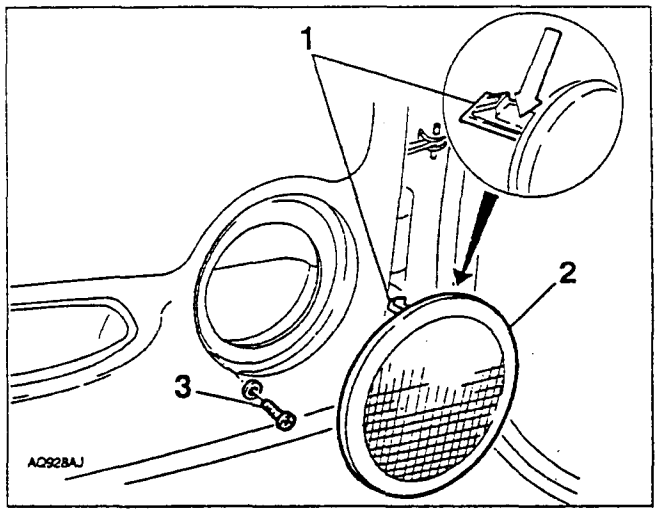
REMOVAL/REFITTING

1. Slacken the two fastening screws and remove the striker.

ADJUSTMENT

- Slacken the door striker fastening screws and adjust the striker until the door closes correctly, then tighten the screws.
- If necessary place suitable shims under the striker to adjust door closing.

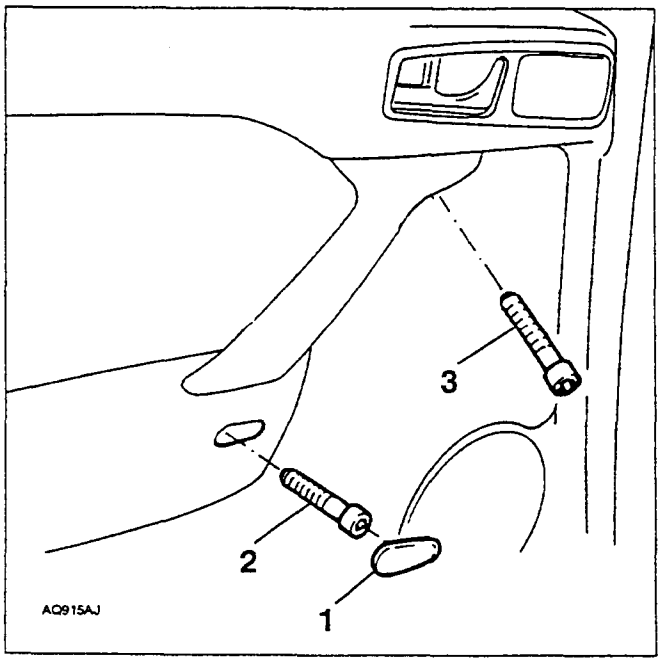




REAR DOOR PANEL

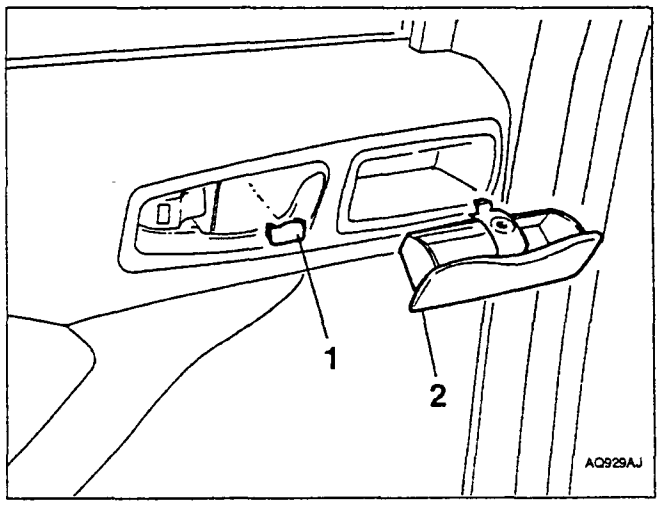
REMOVAL/REFITTING

- Disconnect the battery negative cable (-).
1. Remove the plastic cap of the armrest grip.
2. Slacken the armrest lower fastening screw below.
3. Slacken the upper armrest fastening screw.

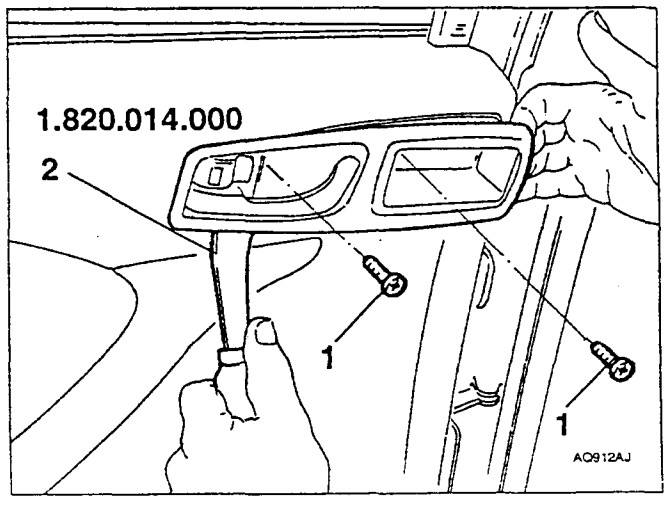


- Using a suitable screwdriver, prise off the speaker cover plate as described below:
1. Press and release the upper catch tooth.
2. Press and release the left side catch tooth.
3. Remove the plate.

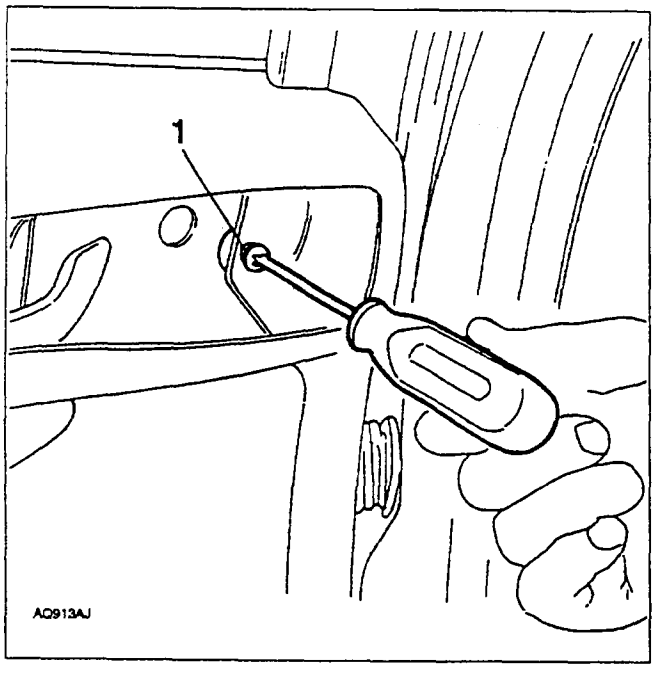
1. Prise and remove the plastic cap.
2. Remove the ashtray.



1. Slacken and remove the two screws fastening the door handle plate.
2. Using tool no. **1.823.014.000**, remove the door opening handle plate.

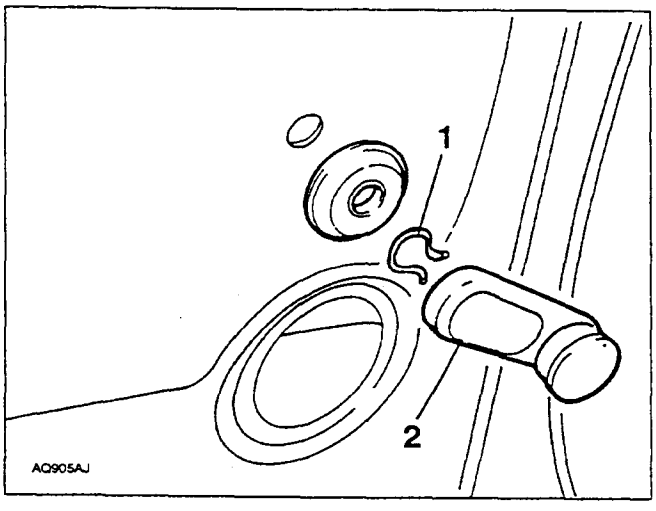


1. Slacken and remove the fastening screw in the door handle plate housing.

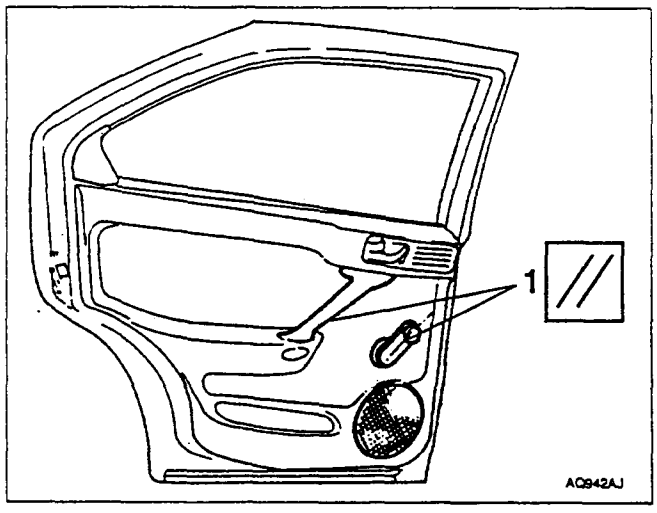


NOTA: only on cars fitted with manual window winding device:

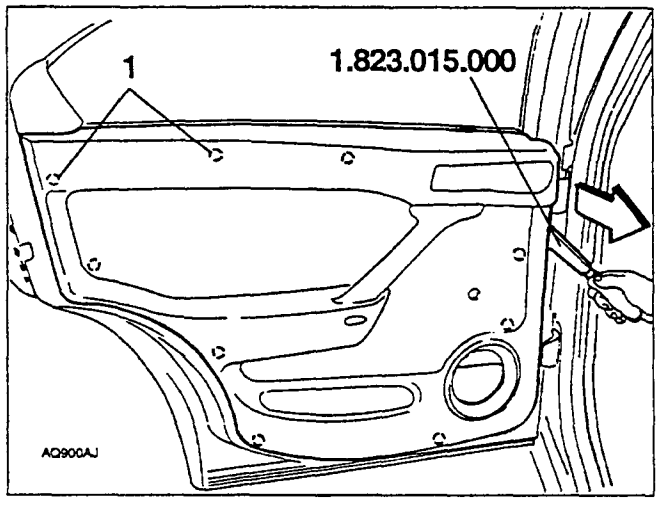
2. Remove the catch clip.
1. Remove the window winder handle.



When refitting:
1. Insert the handle and move the glass to the closed position.
2. Remove the handle.
3. Insert the stay clip on the handle engagement spindle, then definitively insert the handle in its housing, until it catches, aligning it with the armrest.

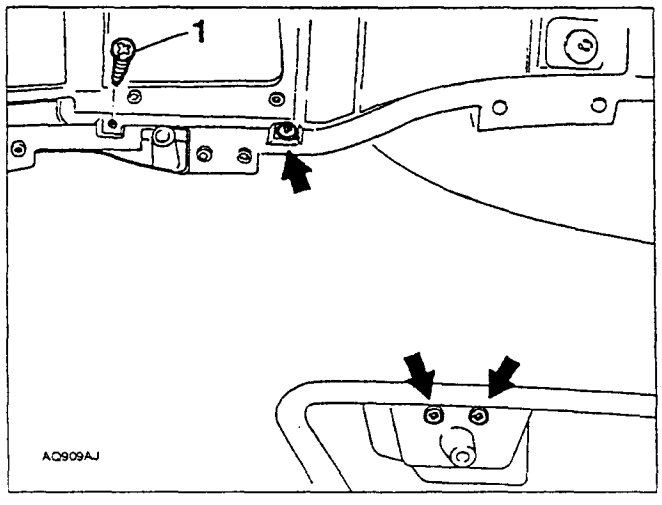


1. Using tool no. **1.823.015.000**, detach the panel from the plastic nails illustrated and remove it.

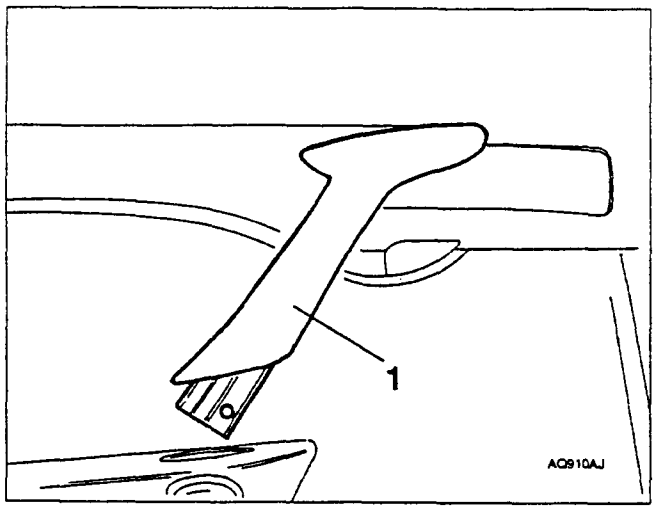


DISASSEMBLY

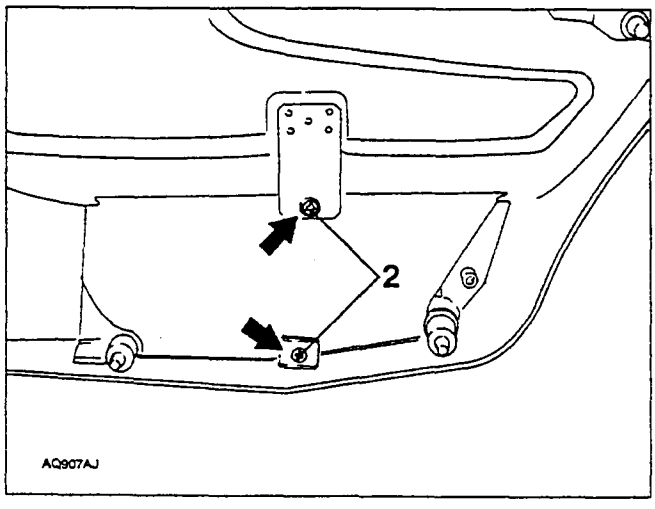
1. Slacken the four rear screws fastening the armrest handle.



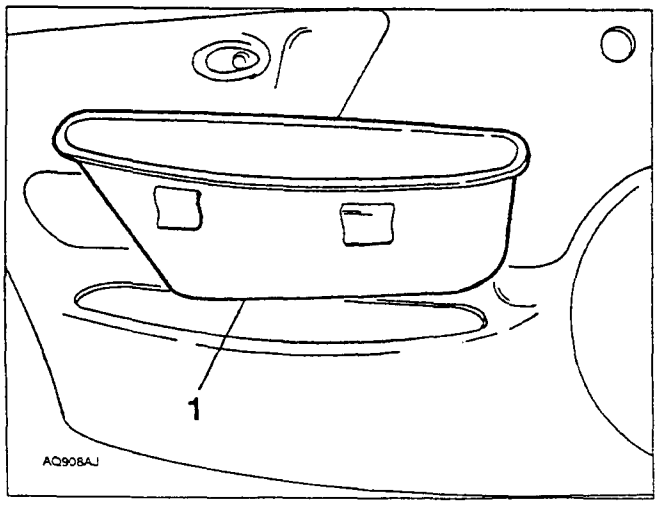
1. Remove the armrest handle pulling it upwards.



1. Slacken the two rear screws fastening the utility compartment.



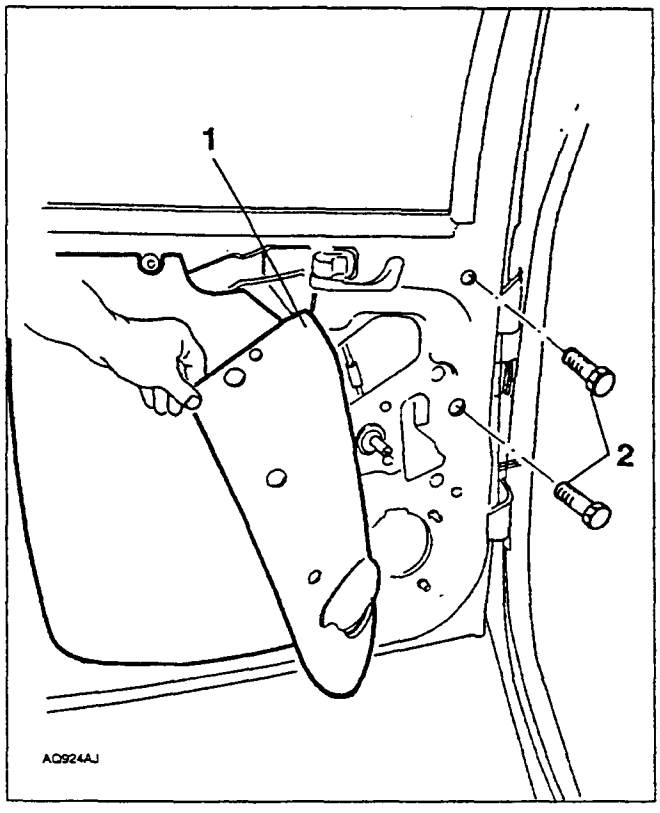
1. Remove the utility compartment pulling it upwards.



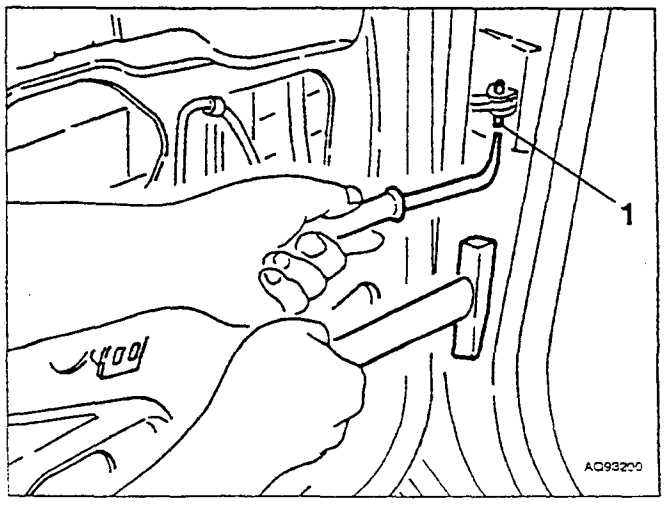
REAR DOOR CHECK ROD

REMOVAL/REFITTING

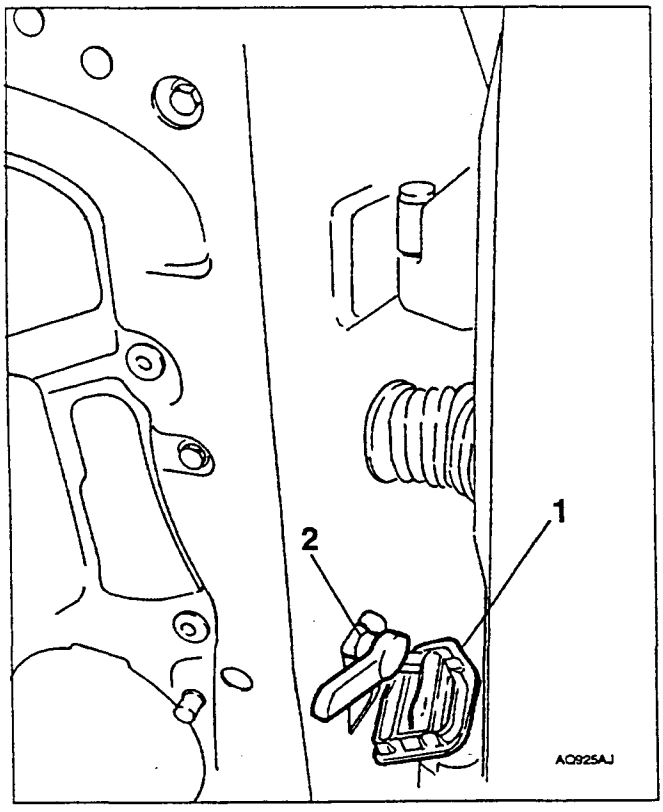
- Remove the door panel (see specific paragraph)
1. Partially detach the opaline from the door taking care not to damage it.
2. Slacken and remove the two screws fastening the door window front guide and move it aside as necessary.



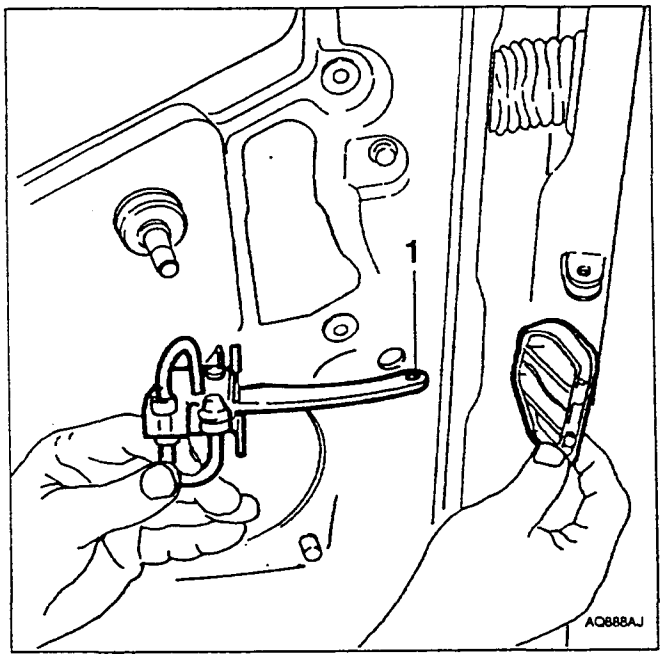
1. Using a suitable tool, pull and remove the door check rod, half close the door to push it back in, then open the door again.



1. Remove the protective rubber.
2. Slacken the two check rod fastening screws.



1. Remove the check rod from the inner side of the door.

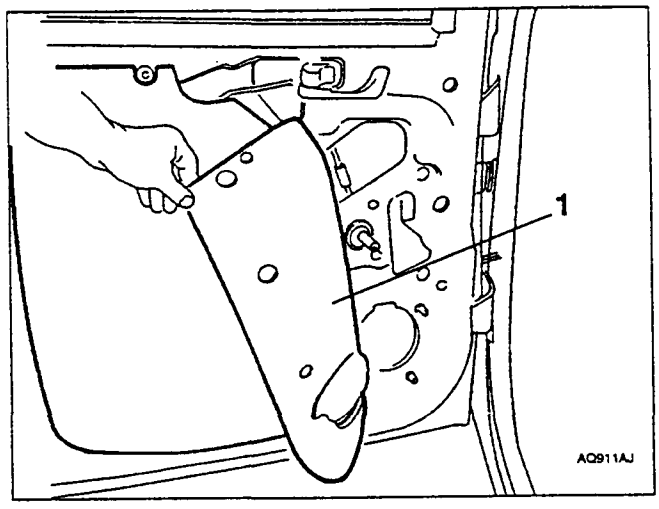


When refitting, reverse the procedure followed for removal, observing the following:
- Before refitting the door check rod, treat the area on which it rests with Primer.
- If the glue of the opaline is no longer able to warrant perfect adhesion, change it.

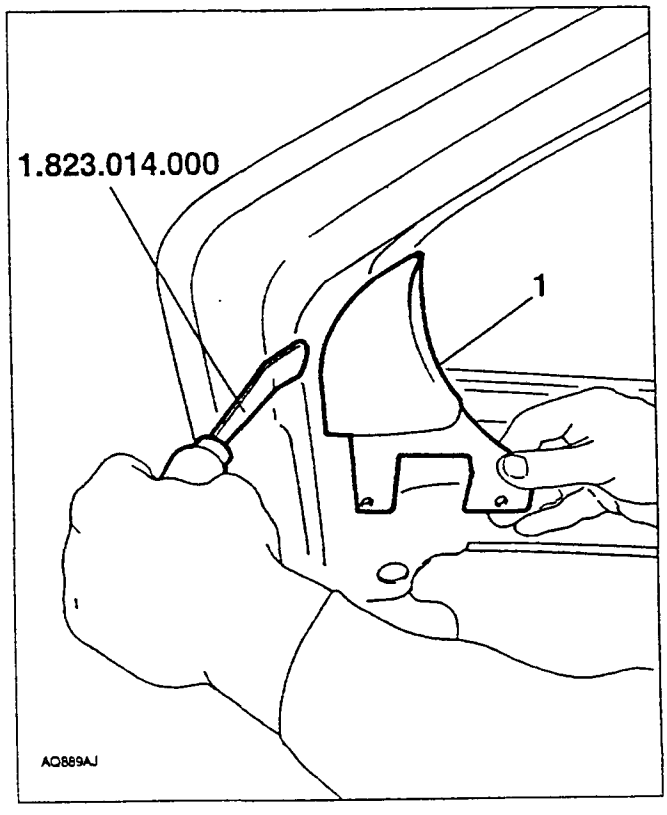
REAR DOOR WINDOW

REMOVAL/REFITTING

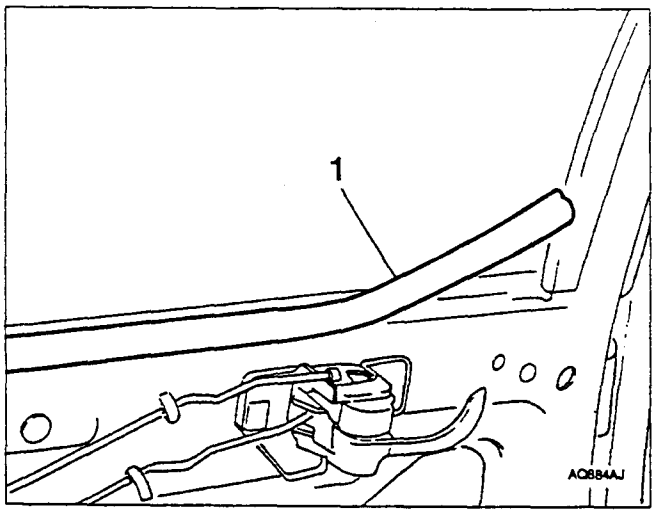
- Remove the door panel (see specific paragraph)
1. Completely remove the opaline from the door taking care not to damage it.



1. Slacken the two screws and remove the corner frame of the rear door, if necessary with the help of tool **1.823.014.000.**

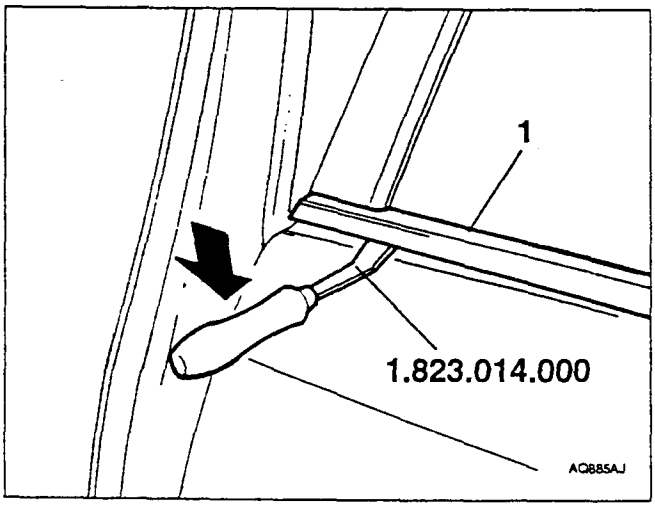


1. Remove the inner glass moulding.

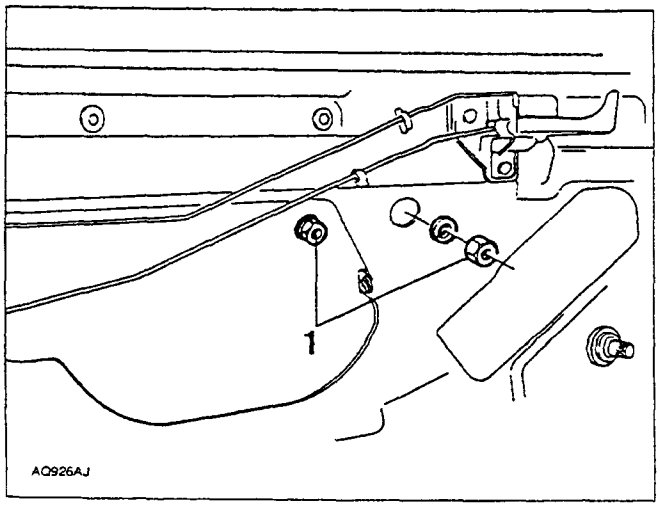


1. Using tool **1.823.014.000** remove the outer glass moulding.

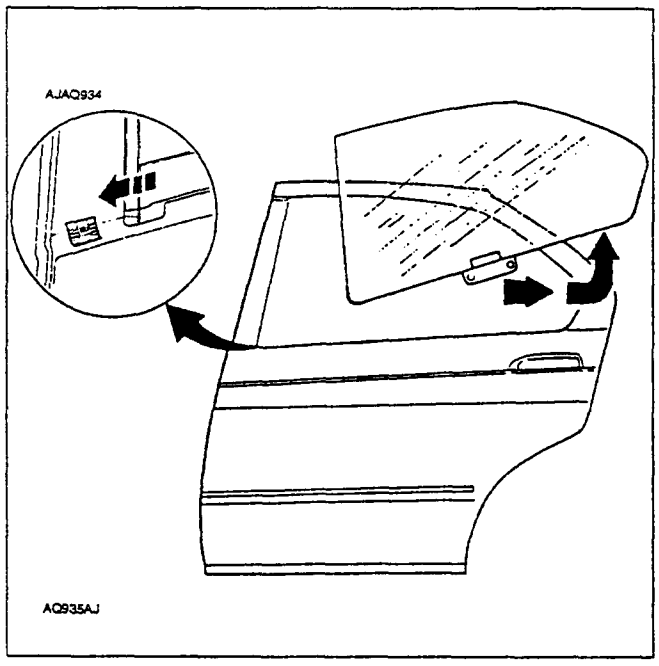
When removing the outer glass moulding take care not to damage the paintwork.



1. Take the window to the "completely raised" position to gain access to the fastening nuts as shown below.



1. Partially lower the window, move it towards the front of the door making use of the space left by the outer moulding and turn it to facilitate its removal from the rear.

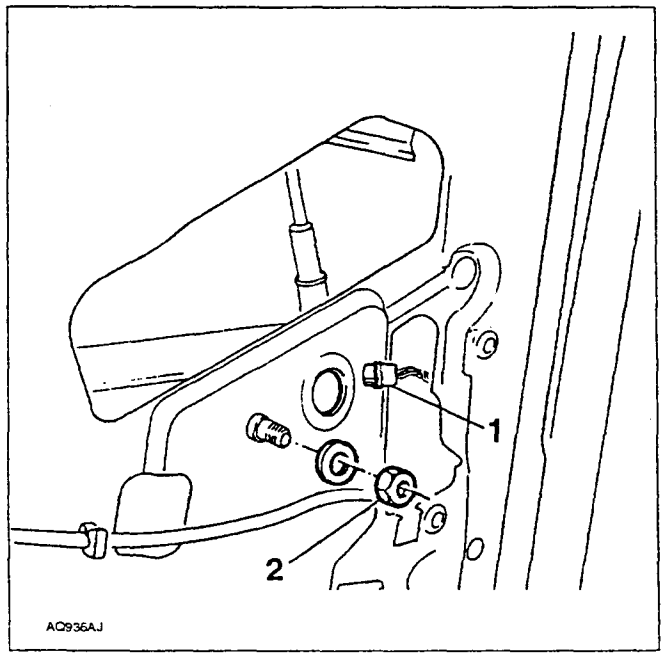


REAR DOOR WINDOW WINDING DEVICE (Electric)

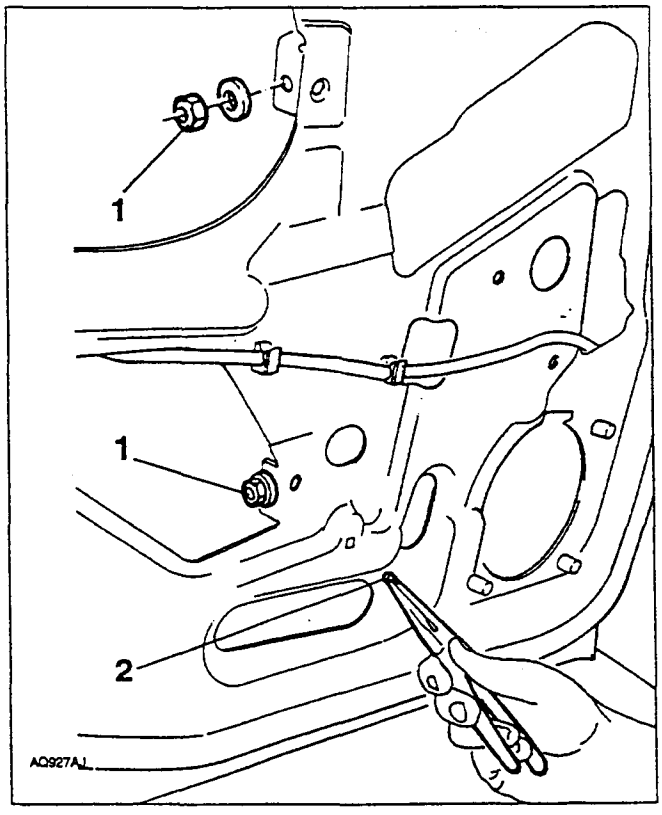
REMOVAL/REFITTING

- Remove the window (see specific paragraph)

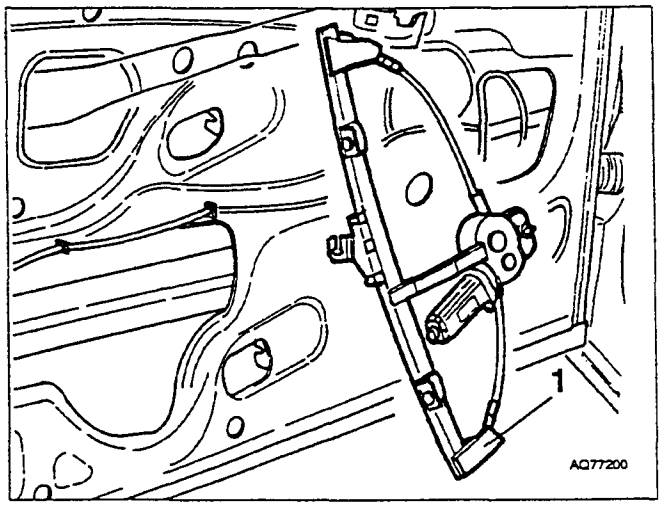
1. Disconnect the electrical connection of the window winding device.
2. Slacken and remove the front nut fastening the window winding device.



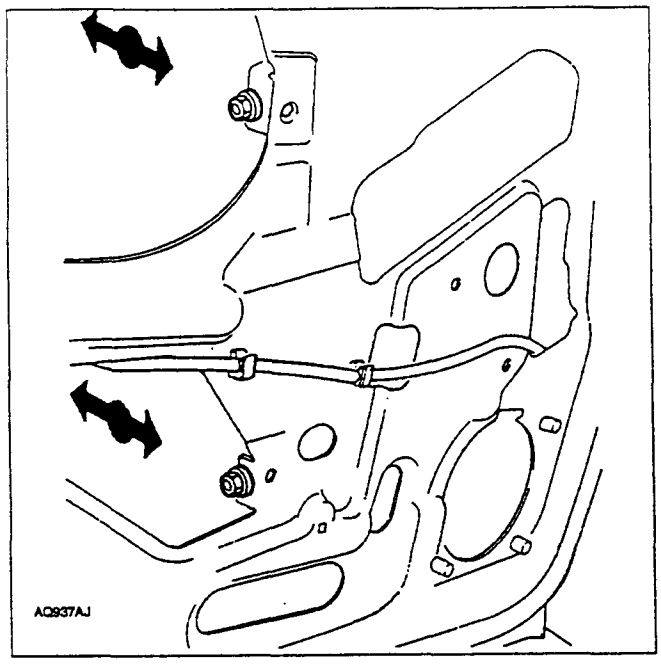
1. Slacken the two rear nuts fastening the device to the glass.
2. Release the catch clip of the window control cable.



1. From inside the door panel, remove the window winding device, pulling from the large hole towards the rear of the door.



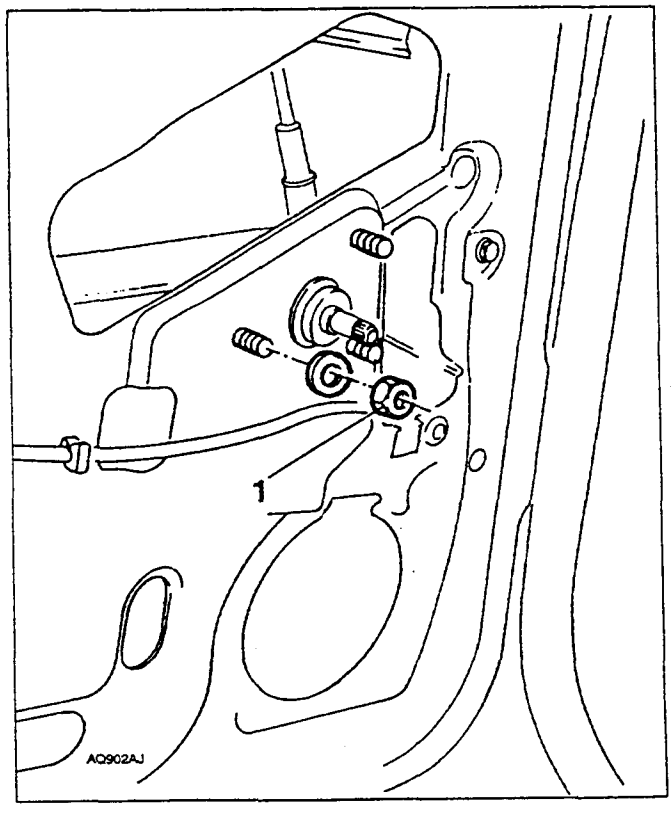
When refitting the window winding device, reverse the procedure described for removal and adjust the position as illustrated.



REAR DOOR WINDOW WINDING DEVICE (Manual)

REMOVAL/REFITTING

- Remove the window (see specific paragraph).
1. Slacken and remove the three nuts fastening the window winding device.



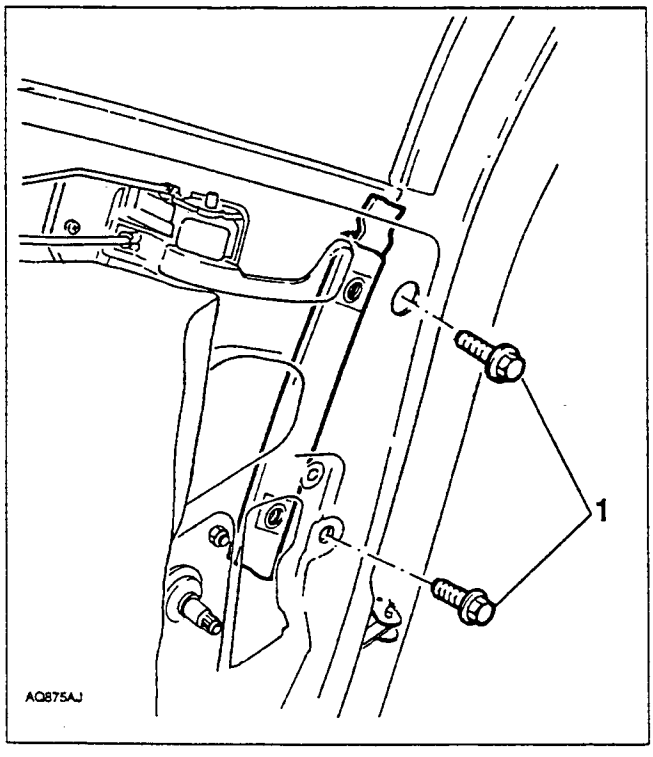
- Continue removal, and subsequent refitting following the procedures described previously for the electric window winding device (see specific paragraph).

REAR DOOR FRONT WINDOW GUIDE

REMOVAL/REFITTING

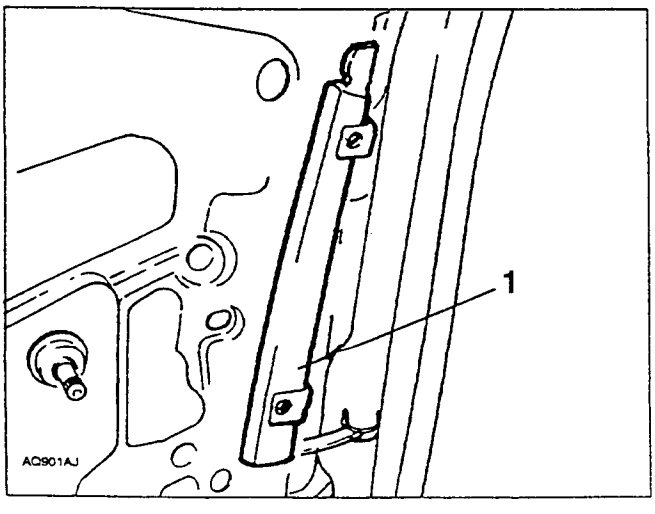
- Remove the inner door panel (see specific paragraph).
- Partially move aside the opaline taking care not to damage it.
- Raise the glass completely.

1. Slacken the two front glass guide fastening screws.

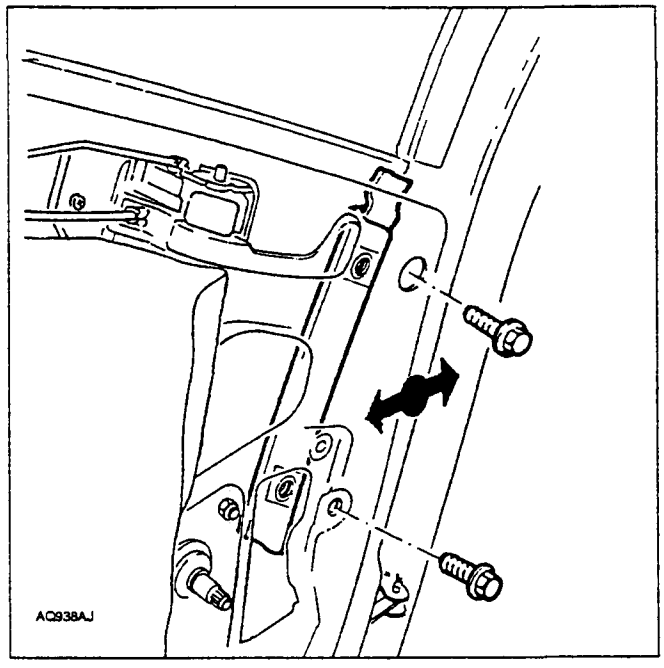


1. Remove the door window front guide.

If necessary separate the moulding from the door window front guide.



When assembling, lower the window completely and adjust the position of the guide so that it is perfectly in contact with the glass, then lock the fastening screws (see figure).

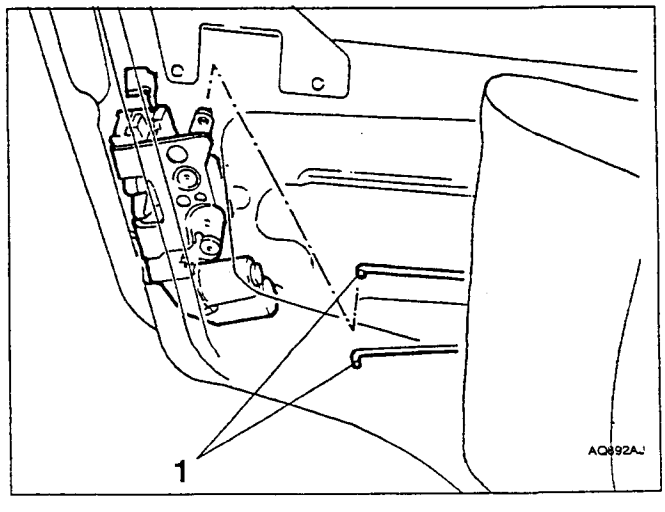


REAR DOOR LOCK DEVICE

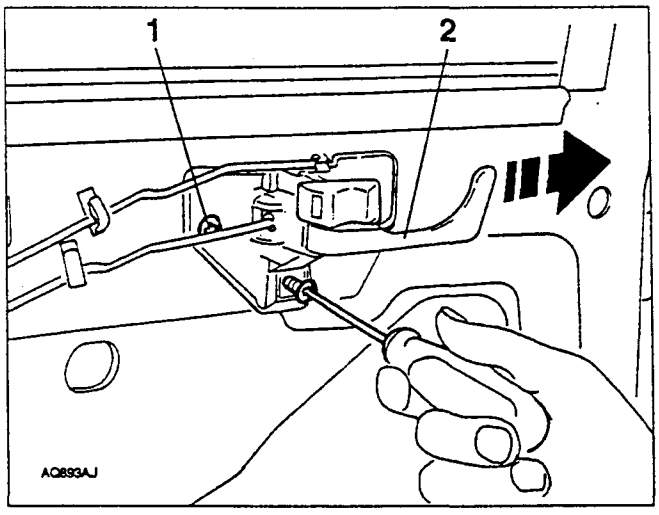
REMOVAL/REFITTING

- Remove the door inner panel (see specific paragraph).
- Partially set aside the opaline taking care not to damage it.

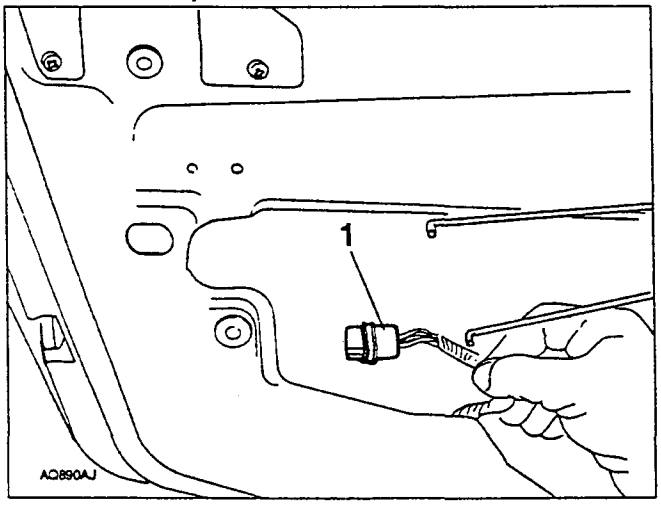
1. Disconnect the lock opening and locking rods.



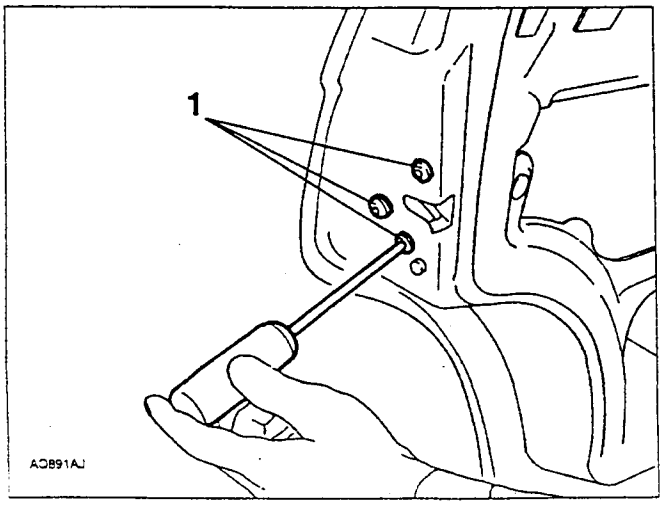
1. Slacken and remove the remaining 2 screws fastening the inner door opening handle.
2. Slide the handle towards the front of the car to free the rods.



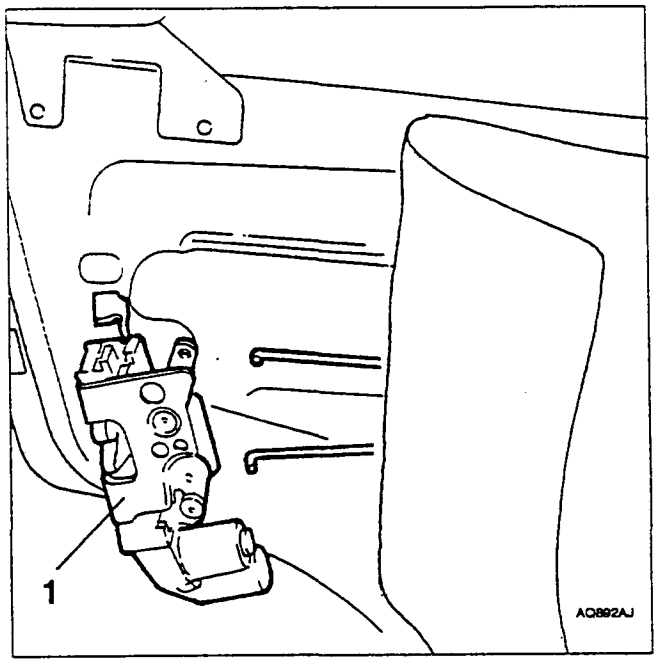
1. Disconnect the electrical connections from the lock device.



1. Slacken the three lock fastening screws.



1. Turn the lock to facilitate freeing, release the outer handle rod and remove the lock from the inner door.

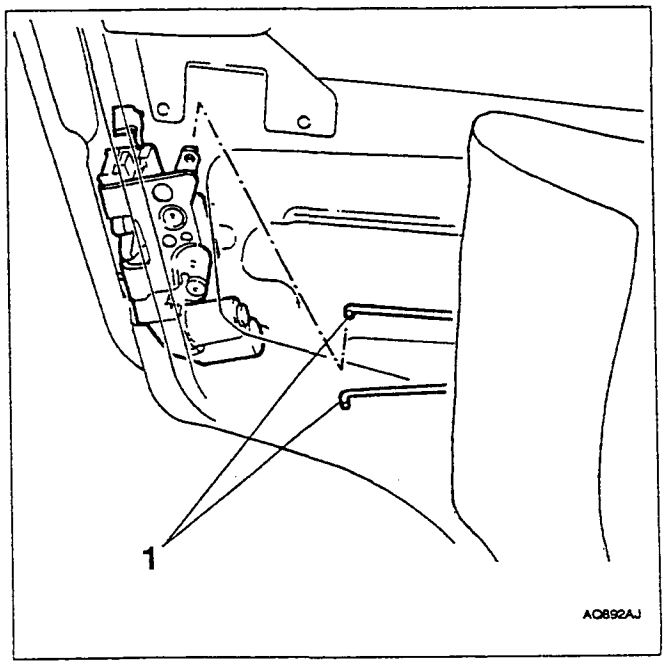


REAR DOOR INNER HANDLE

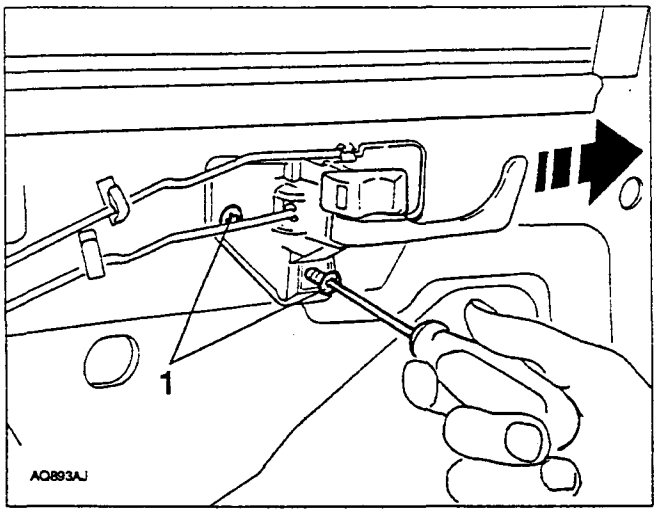
REMOVAL/REFITTING

- Remove the door inner panel (see specific paragraph).
- Partially set aside the opaline taking care not to damage it.

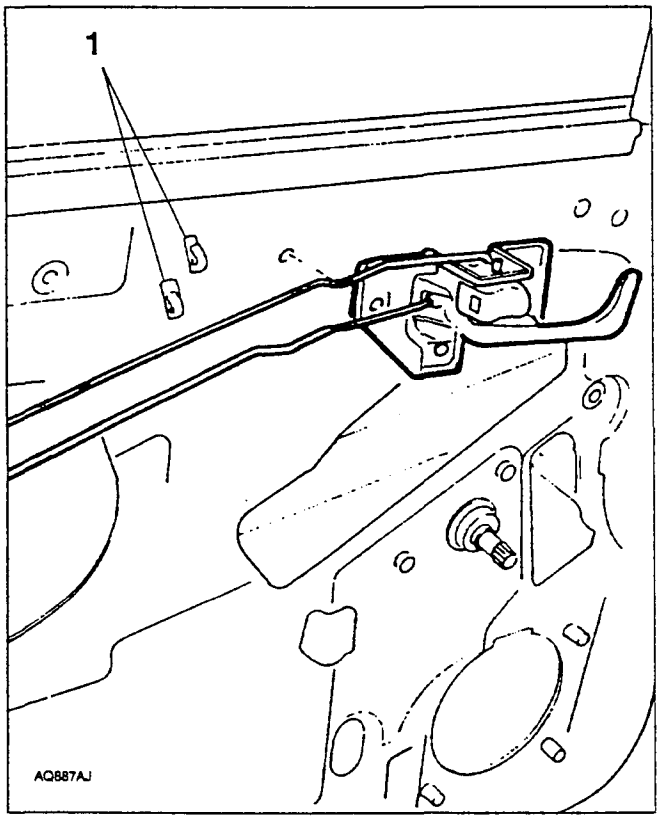
1. Disconnect the lock opening and locking rods.

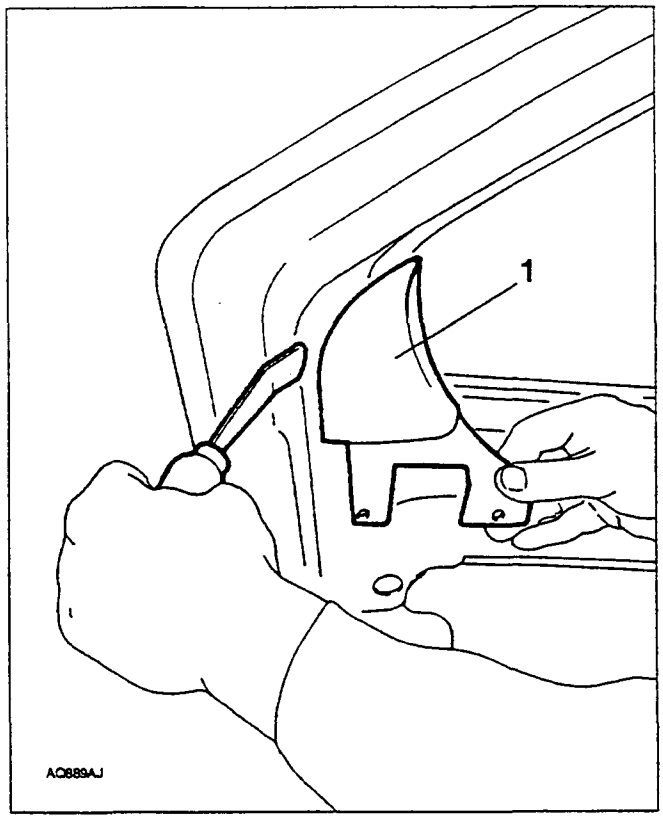


1. Slacken and remove the remaining two screws fastening the inner door opening handle.

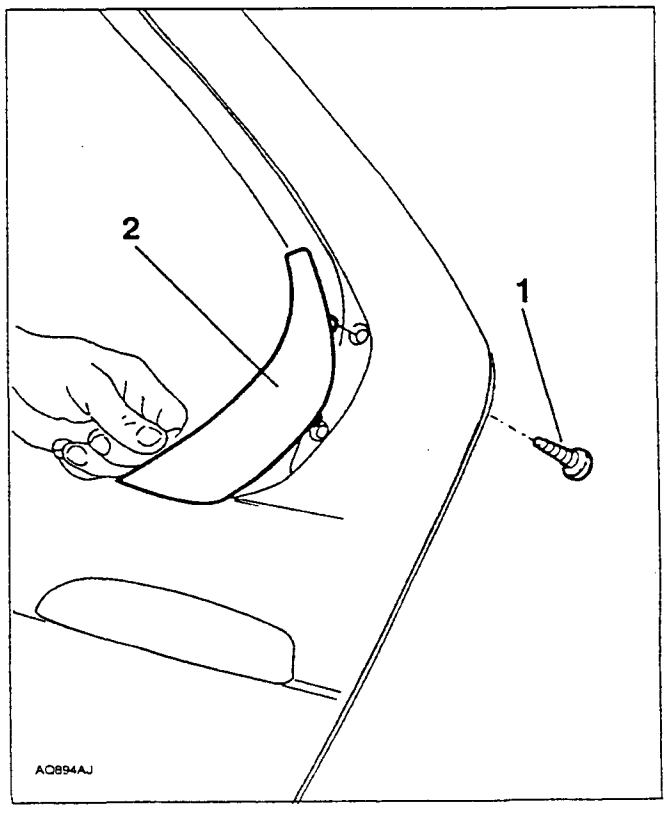


1. Free the rods from the two fastening clamps and remove the inner handle.





1. Slacken and remove the three screws locking the outer plate.
2. Remove the outer plate.



REAR DOOR OUTER ANGLE PLATE

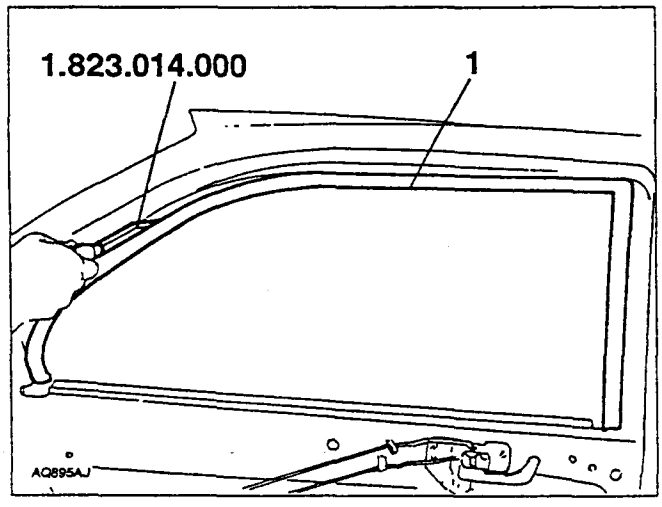
REMOVAL/REFITTING

- Remove the inner door panel (see specific paragraph)
1. Slacken the two screws and remove the rear door angle plate if necessary with the help of tool no. **1.823.014.000.**

REAR DOOR TRIM MOULDING

REMOVAL/REFITTING

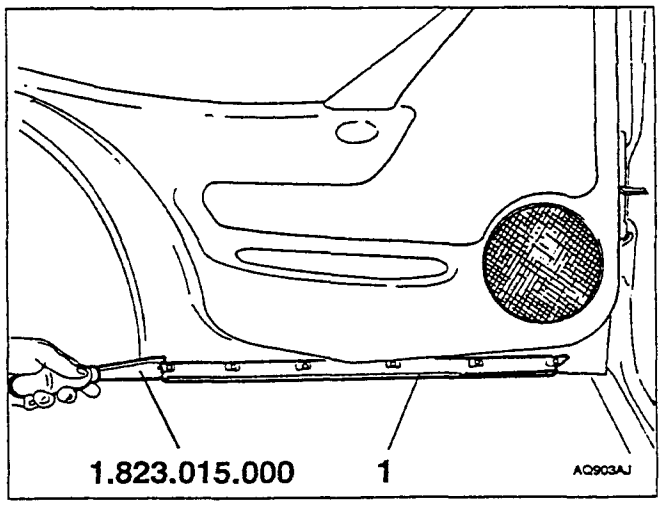
- Remove the door window (see specific paragraph).
1. Using knife **1.823.014.000**, remove the door trim mouldings starting from the rear part.



REAR DOOR LOWER STRIP

REMOVAL/REFITTING

1. Using tool **1.823.015.000**, remove the six plastic buttons and remove the strip.

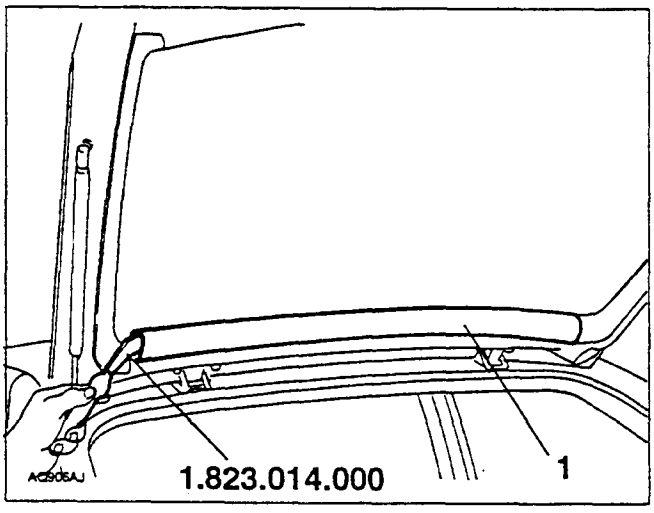


TAILGATE

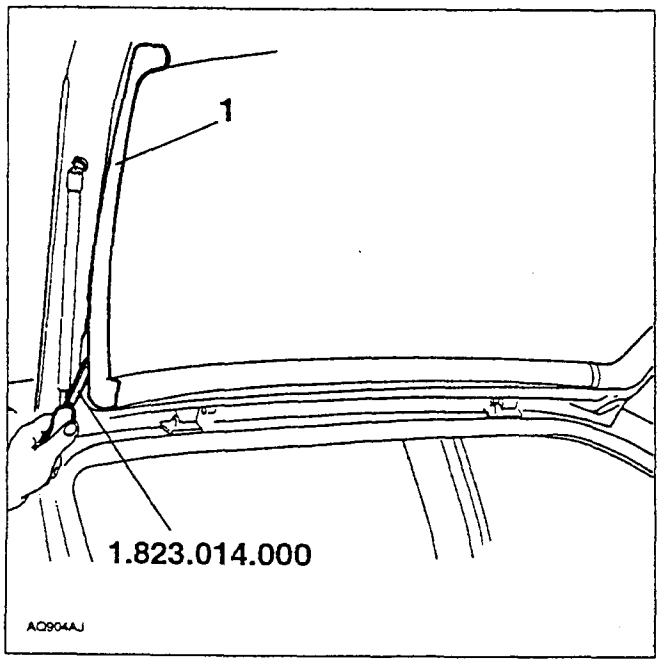
REMOVAL/REFITTING

- Disconnect the battery negative terminal (-).
- Open the boot and release the parcel shelf support cables.

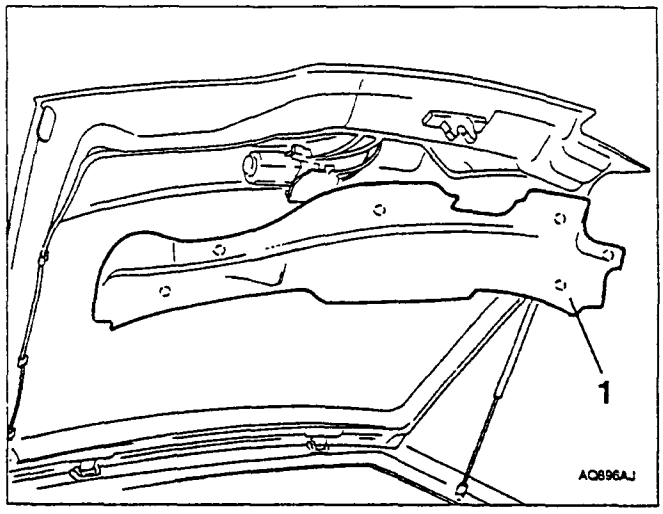
1. Using tool **1.823.014.000**, remove the upper tailgate trim from the plastic nails (five) and remove it.



1. Using tool **1.823.014.000**, remove the left side trim.

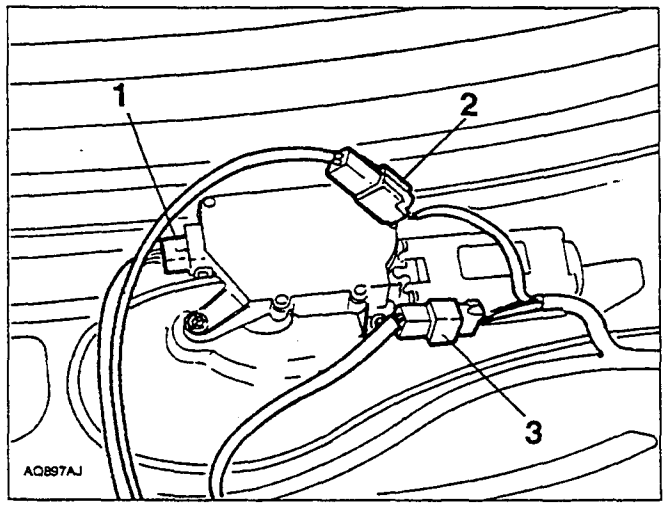


1. Using tool **1.823.014.000**, remove the lower tailgate trim from the plastic nails (eight) and remove it.

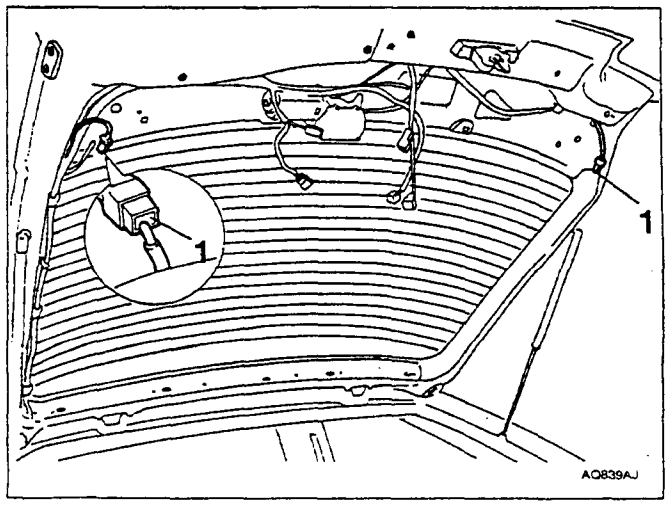


- Disconnect the electrical connections of:

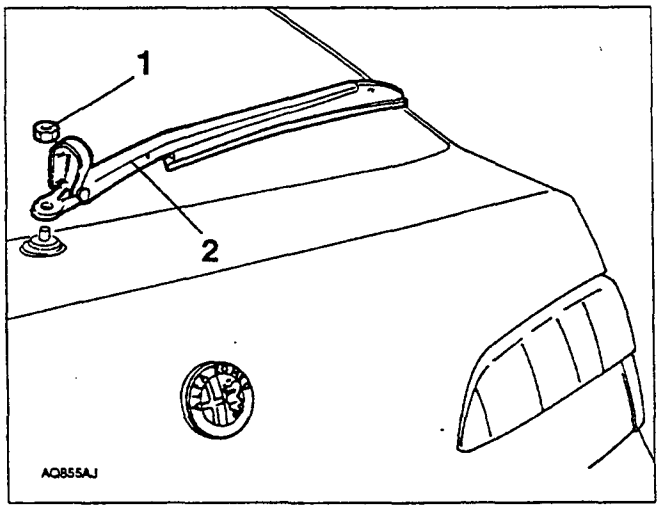
1. Rearscreen motor
2. Tailgate open warning light
3. Tailgate control opening actuator.



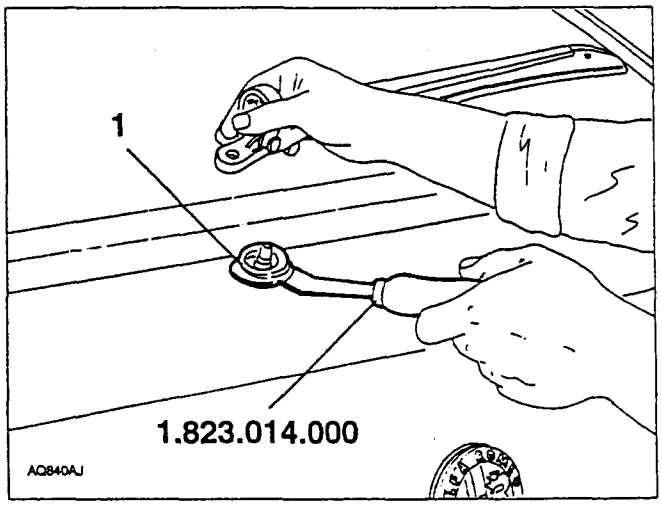
1. Disconnect the two, right and left rearscreen heating connectors.



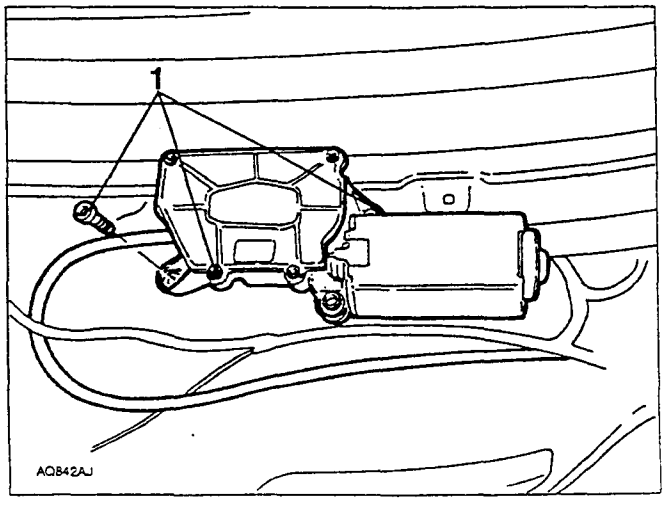
1. Lower the tailgate, raise the protection cap and slacken the nut fastening the rearscreen wiper arm.
2. Remove the wiper arm.



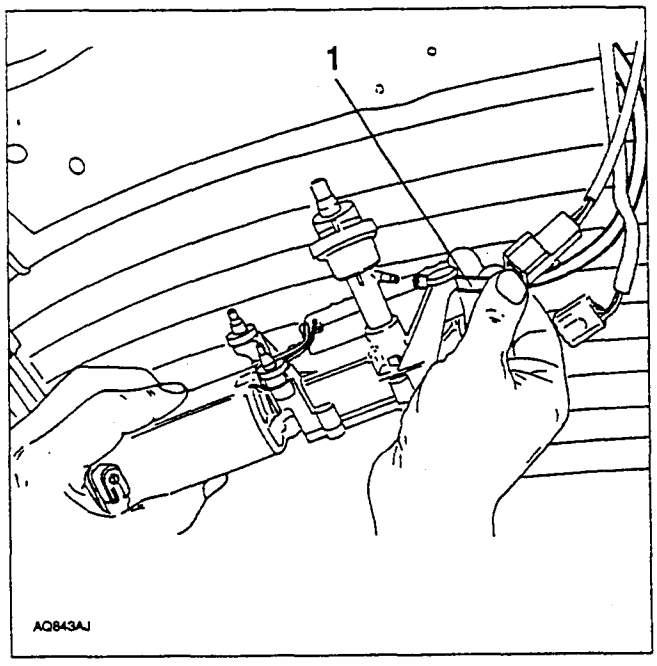
1. Using tool no. **1.823.014.000**, remove the rearscreen wiper rubber cap.



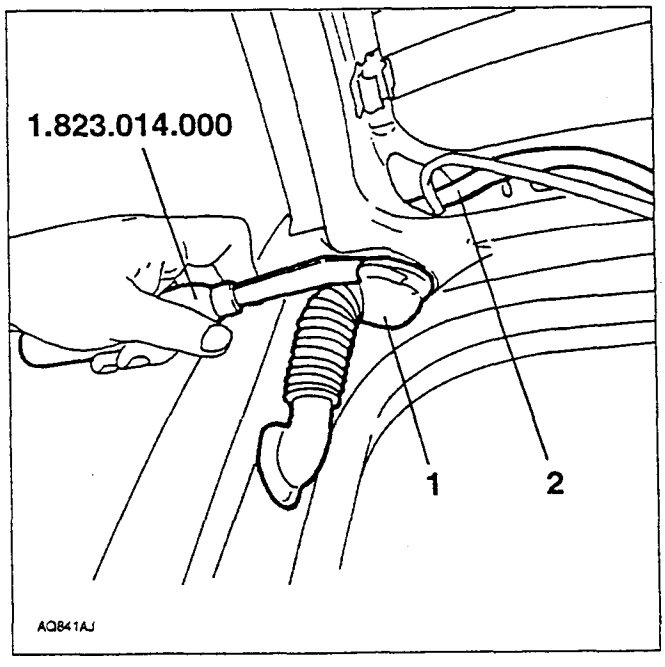
1. Raise the tailgate and slacken the three screws fastening the rearscreen wiper motor.



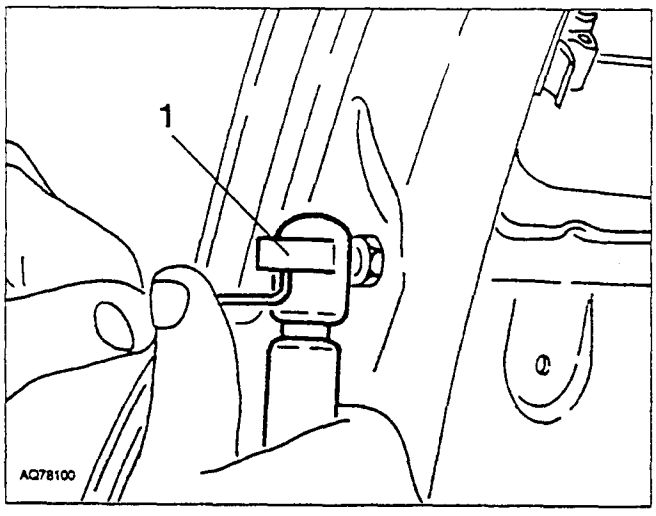
1. Pull the wiper motor off the tailgate just enough to disconnect the detergent fluid tube and then remove the motor.



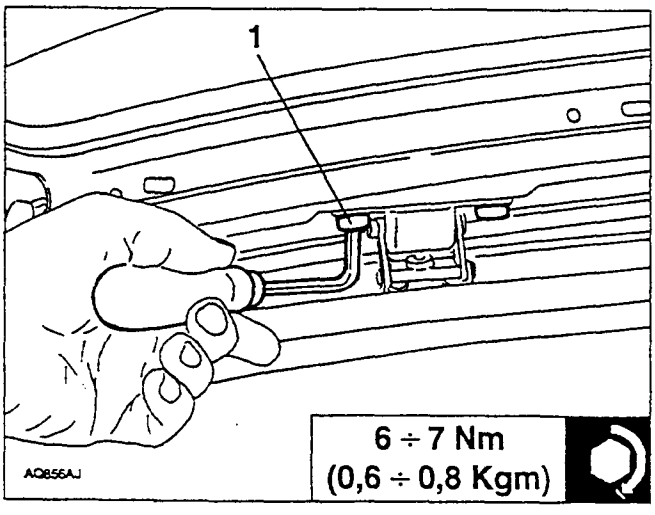
- Release the wiring from the fastening clamps.
1. Using tool no. **1.823.014.000**, remove the cable sleeve from the tailgate.
2. Withdraw the cables.



1. Suitably prop the tailgate, then disconnect the two telescopic shock absorbers.

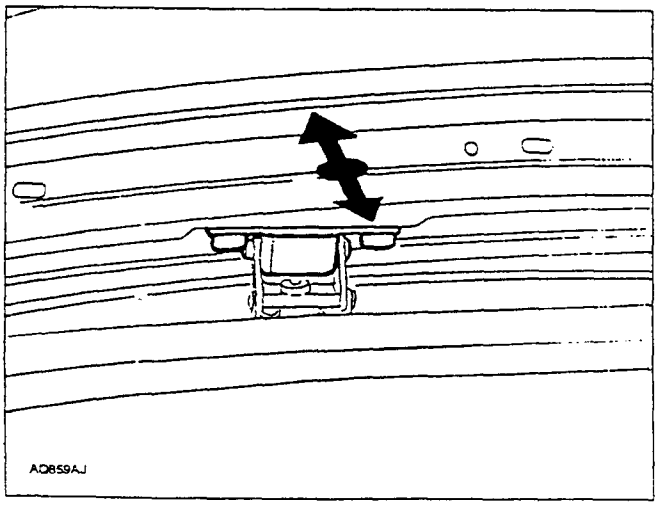


1. Slacken the two screws per hinge fastening the tailgate, then remove it.



ADJUSTMENT

1. Slacken the screws fastening the tailgate to the hinges and adjust longitudinally.

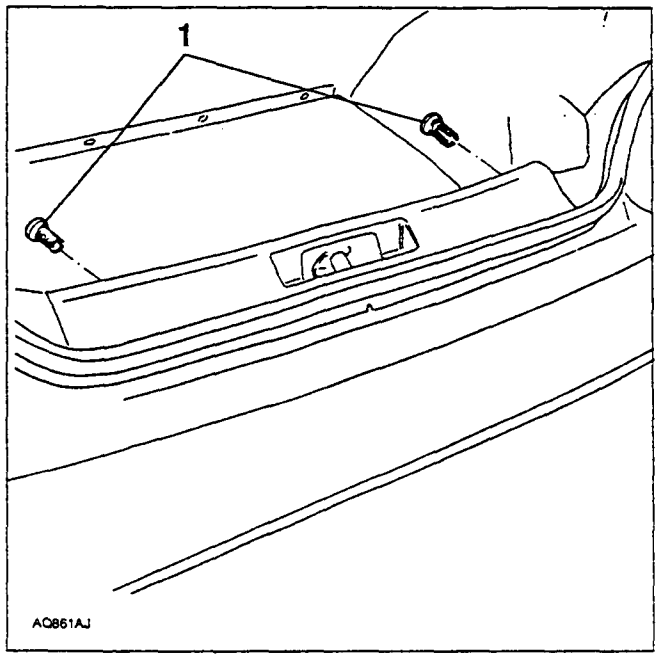


NOTE: if adjustment of the position of the tailgate hinges is not sufficient to obtain the effect required, adjust the position of the lock striker as described in the specific paragraph.

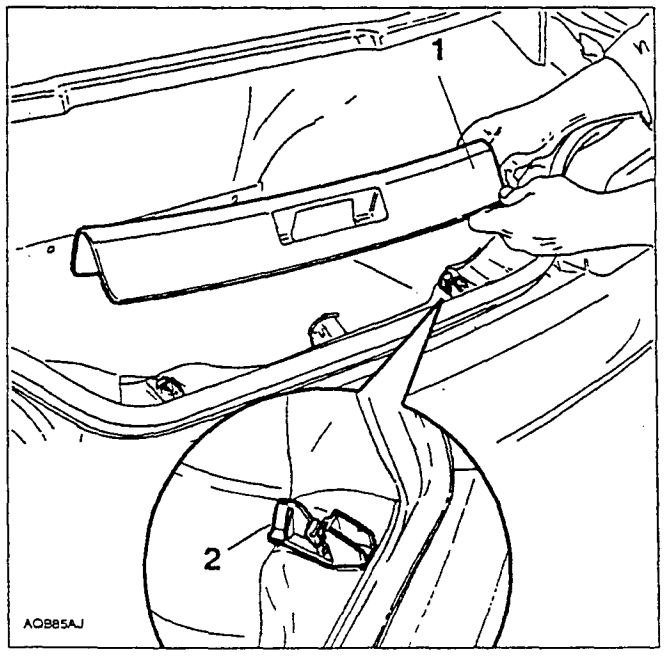
TAILGATE LOCK STRIKER

REMOVAL/REFITTING

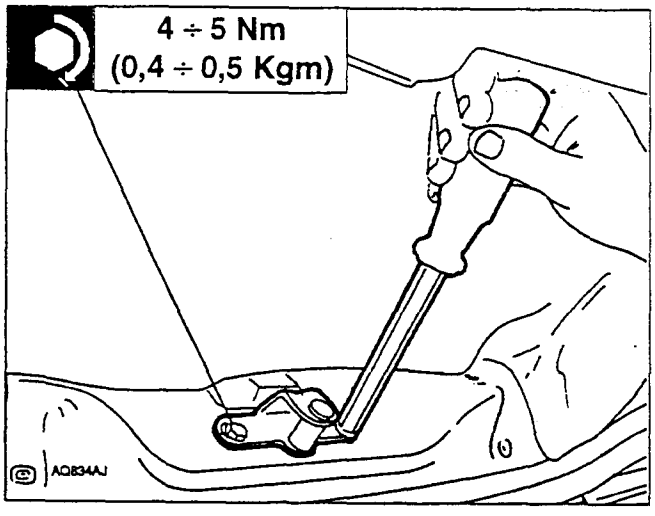
1. Working from the luggage compartment, slacken and remove the two screws fastening the protective trim.



1. Remove the protective trim, pulling it upwards.
2. If necessary, remove the two protective trim stay clamps.

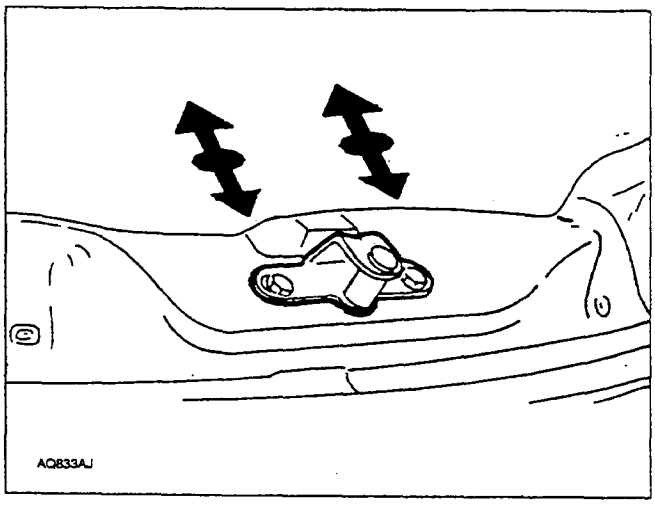


1. Slacken the two fastening screws and remove the lock striker.



ADJUSTMENT

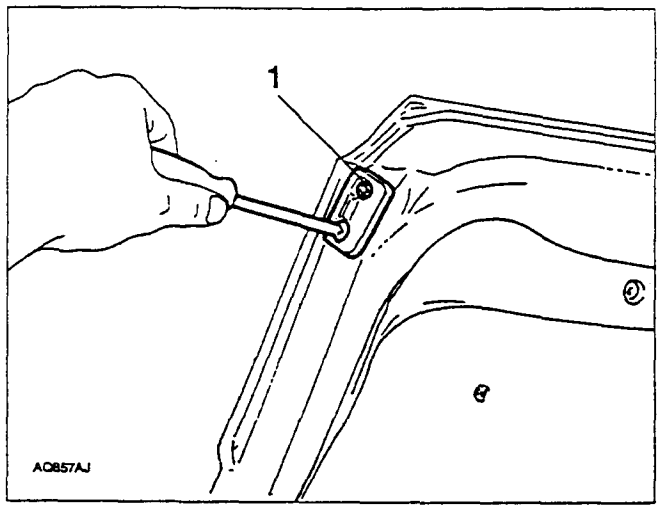
1. Remove the luggage compartment seal caps and slacken the tailgate lock striker, then adjust its position until correct tailgate closing is obtained; then tighten the screws.



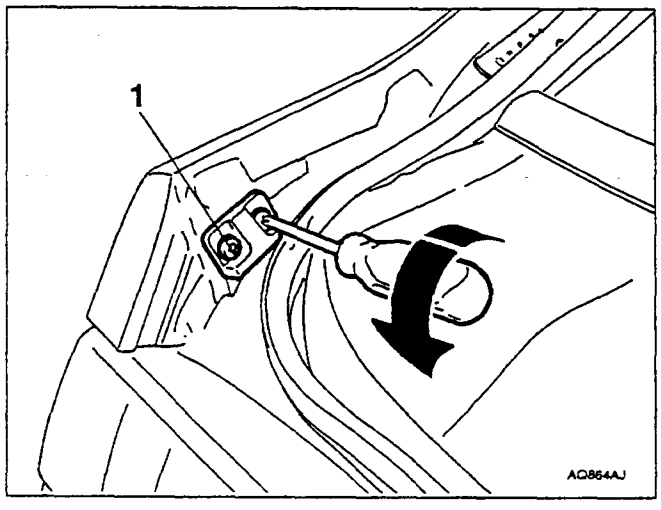
TAILGATE BUFFERS

REMOVAL/REFITTING

1. Slacken the two screws for each buffer and remove the right and left upper buffers of the tailgate.

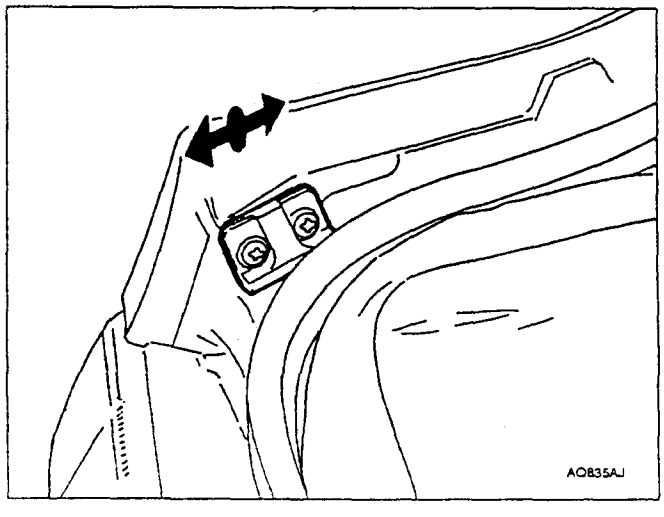


1. Slacken the two screws, for each buffer, and remove the two right and left lower tailgate buffers.



ADJUSTMENT

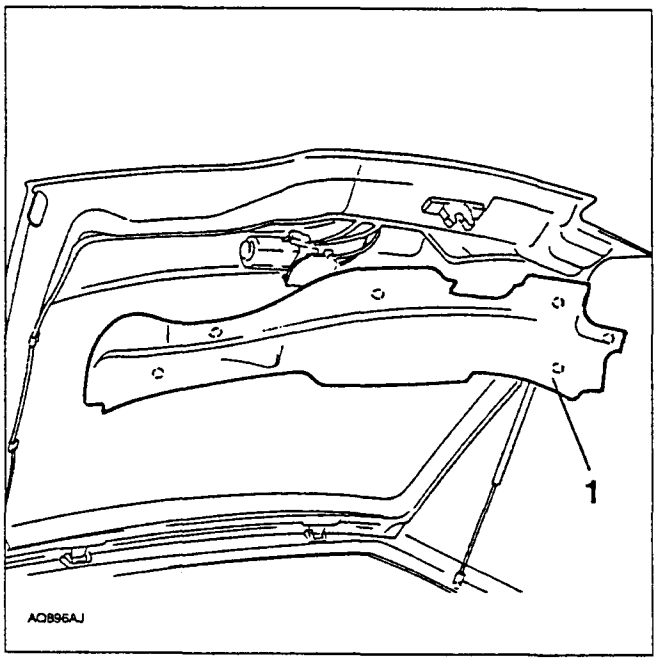
1. Slacken the right and left tailgate buffer fastening screws and adjust the position until the tailgate closes correctly.



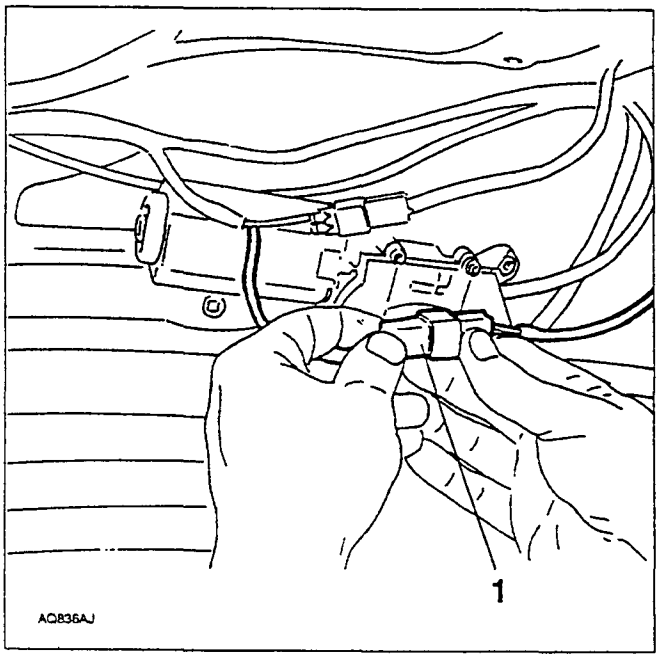
TAILGATE LOCK

REMOVAL/REFITTING

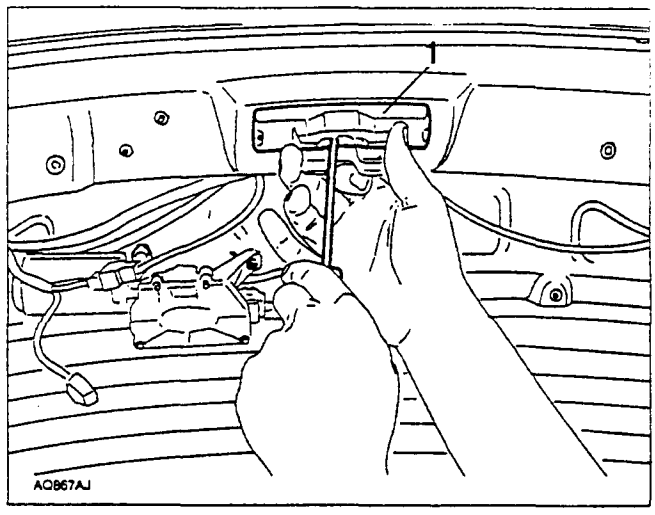
1. Using tool no. **1.823.015.000**, release the tailgate lower trim from the plastic nails and remove it.



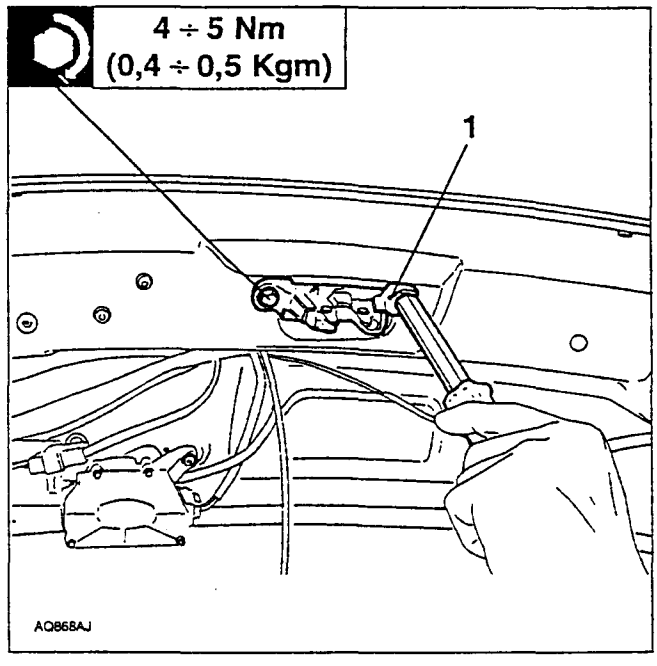
1. Disconnect the electrical connection from the boot open warning sensor (if fitted).



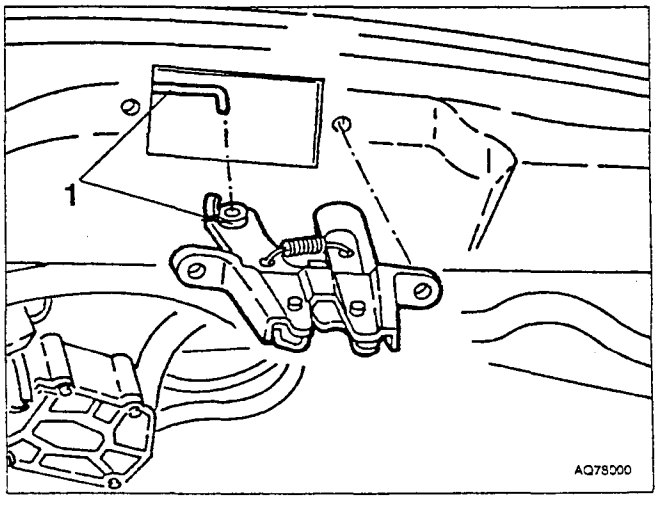
1. Remove the lock trim.



1. Slacken the two screws fastening the tailgate lock.



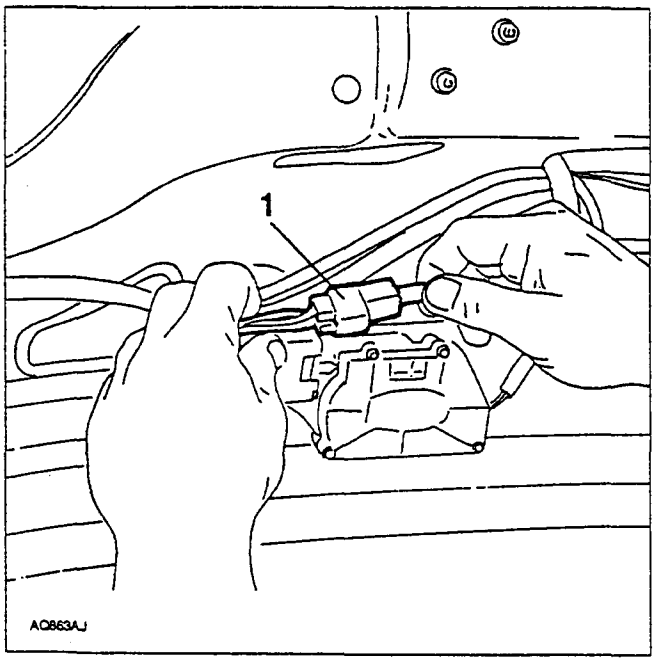
1. Remove the lock taking care to release the opening control rod from the actuator (electrically-operated locks).



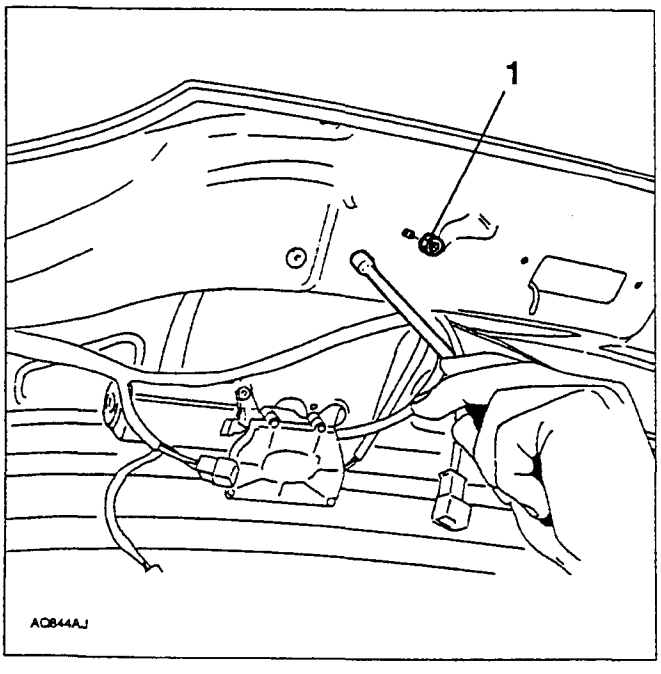
TAILGATE OPENING CONTROL ACTUATOR

REMOVAL/REFITTING

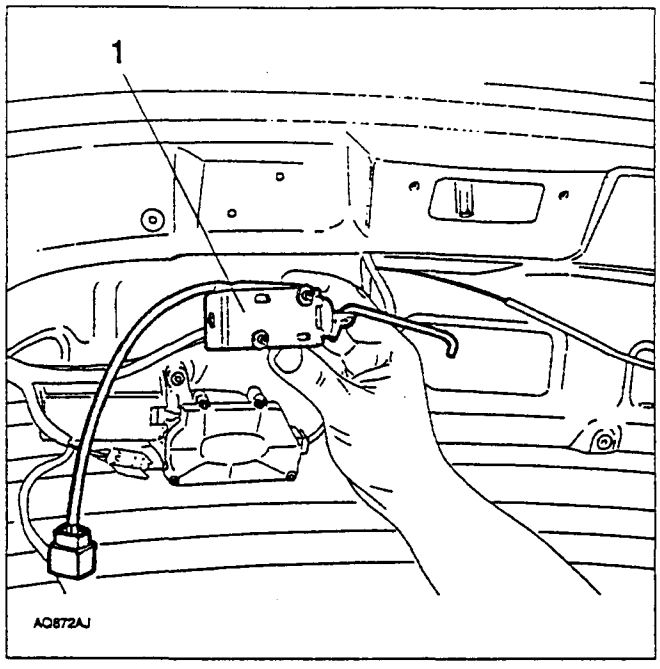
- Remove the tailgate lock (see specific paragraph)
1. Disconnect the electrical connector of the tailgate opening control actuator.



1. Slacken the two actuator fastening nuts.



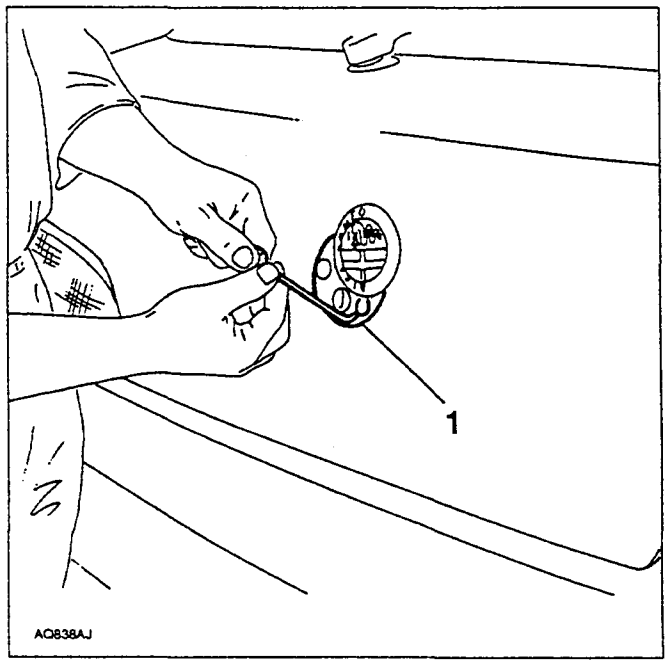
1. Remove the tailgate opening control actuator withdrawing it from inside the tailgate



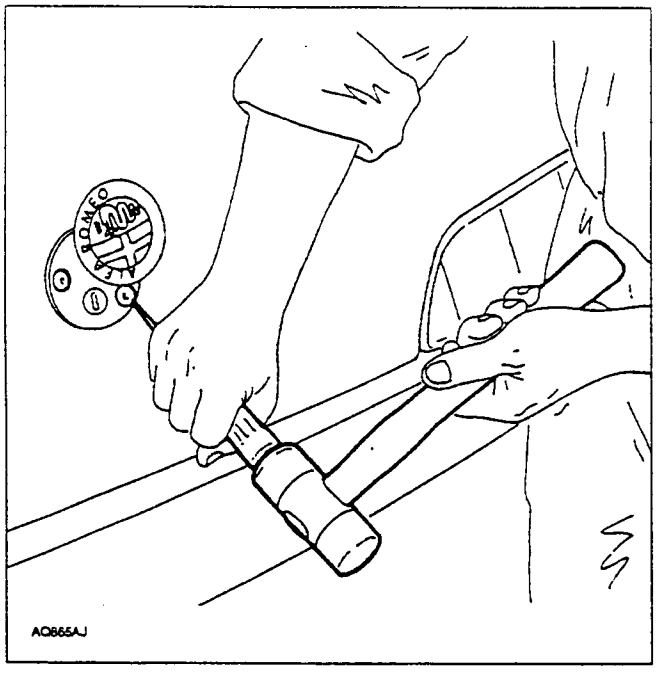
TAILGATE LOCK UNIT

REMOVAL/REFITTING

1. Lower the tailgate, turn the badge and remove the two caps protecting the fastening screws



1. Using a punch, slacken the two screws fastening the lock unit and remove it.

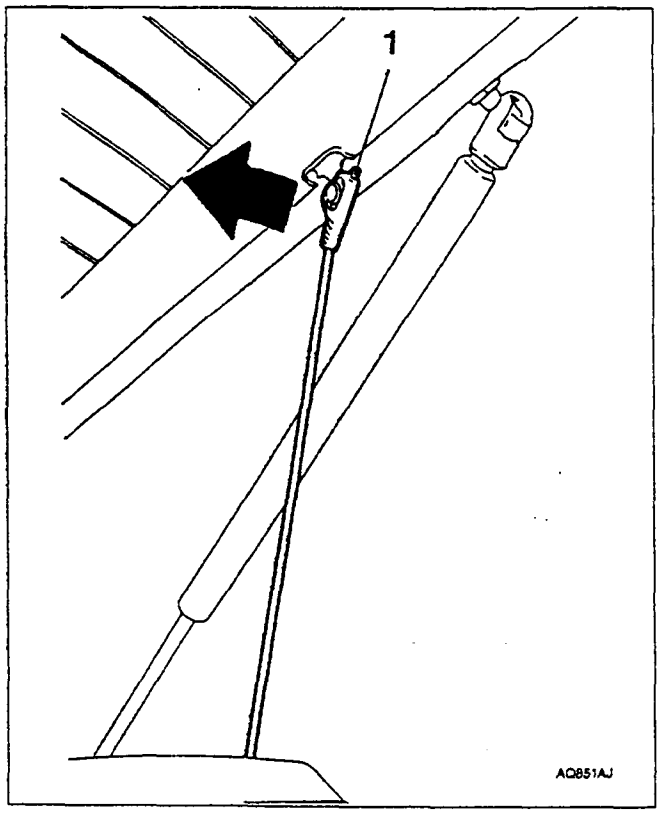


When refitting, reverse the sequence described for removal using two new screws for fastening the lock unit.

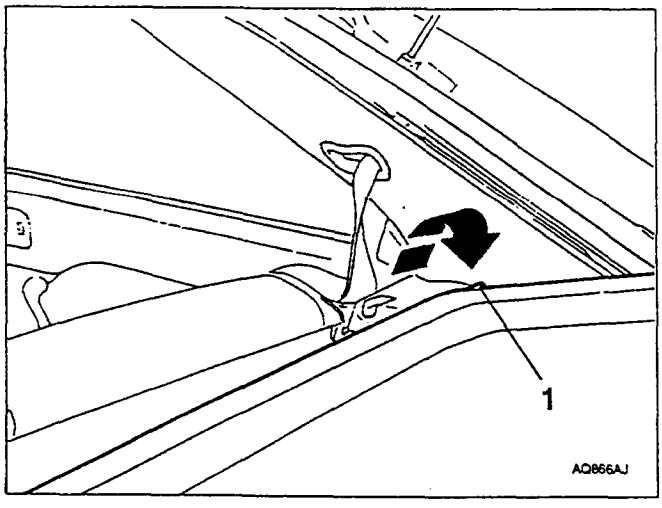
PARCEL SHELF

REMOVAL/REFITTING

1. Release the parcel shelf lifting cords.



1. Release the parcel shelf side fasteners, then remove it.

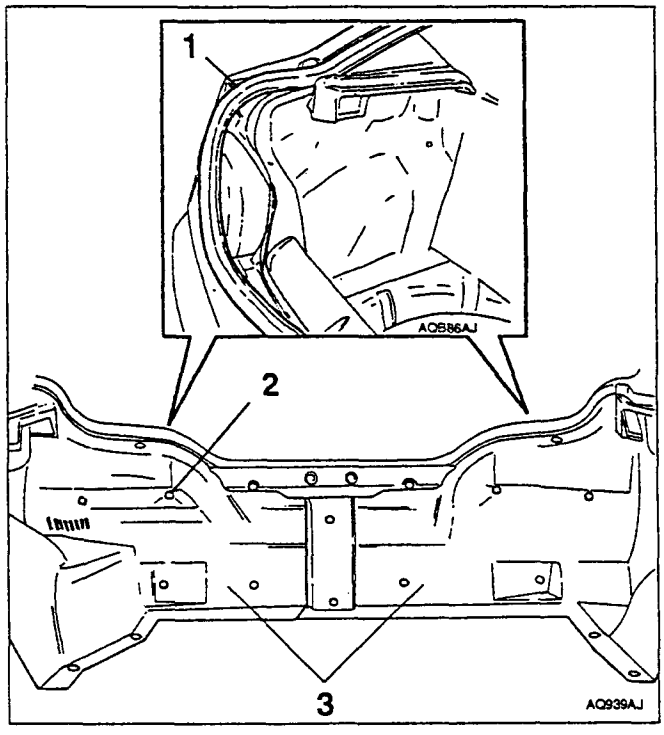


INNER LUGGAGE COMPARTMENT TRIM

REMOVAL/REFITTING

- Remove the lower luggage compartment trim (see specific paragraph).
- Remove the lower fastenings of the pillar cover side brackets (see specific paragraph).
- Remove the protective trim (see specific paragraph).

1. Partially remove the luggage compartment seal.
2. Using tool 1.**823.014.000**, release the plastic caps fastening the inner luggage compartment trim.
3. Remove the luggage compartment inner trim, in tho parts.

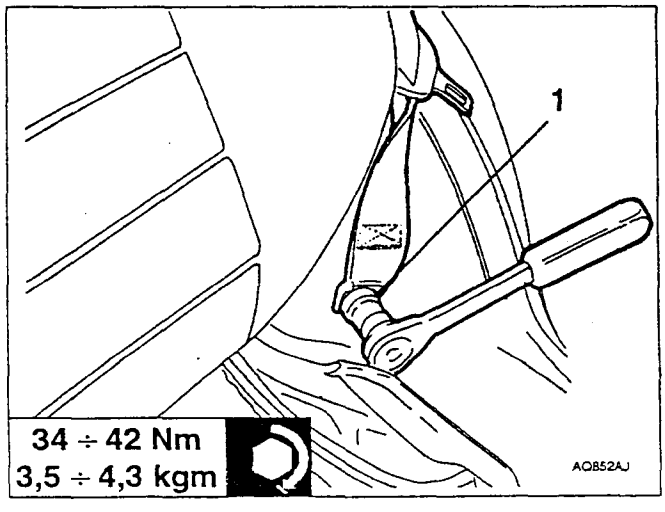


SIDE PILLAR COVER BRACKETS

REMOVAL/REFITTING

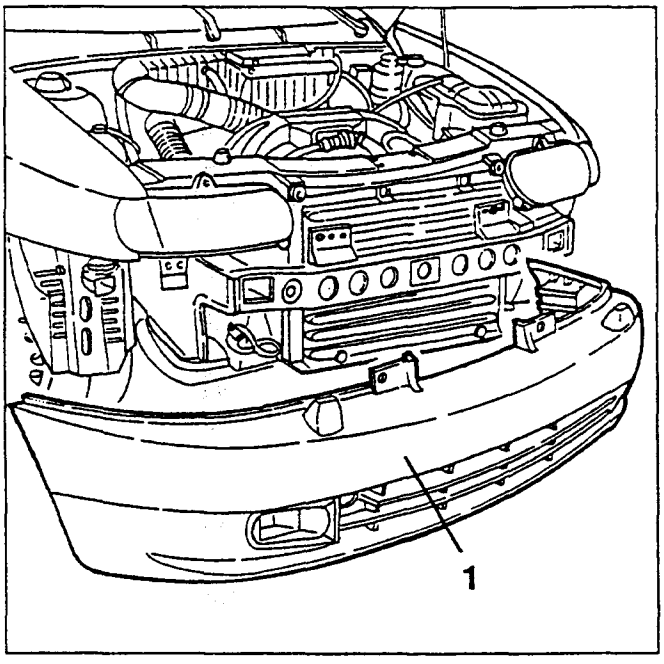
- Removal the parcel shelf (see specific paragraph).
- Move the rear seat cushion forwards.

1. Slacken and remove the lower screw fastening the rear seat belt and release the belt itself.

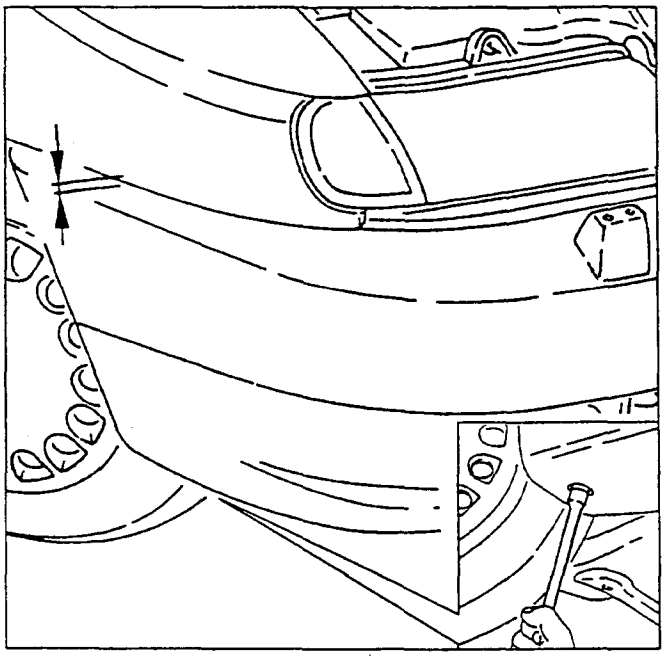


1. Remove the front bumper.

When refitting check that the two upper gaskets are present on the bumper.



Refit by reversing the procedure followed for removal adjusting the position of the bumper using the screws shown in the diagram.

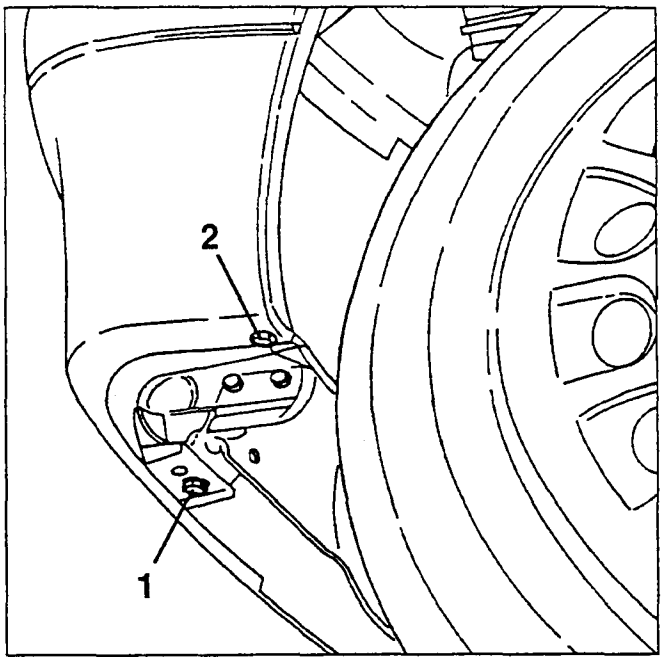


REAR BUMPER

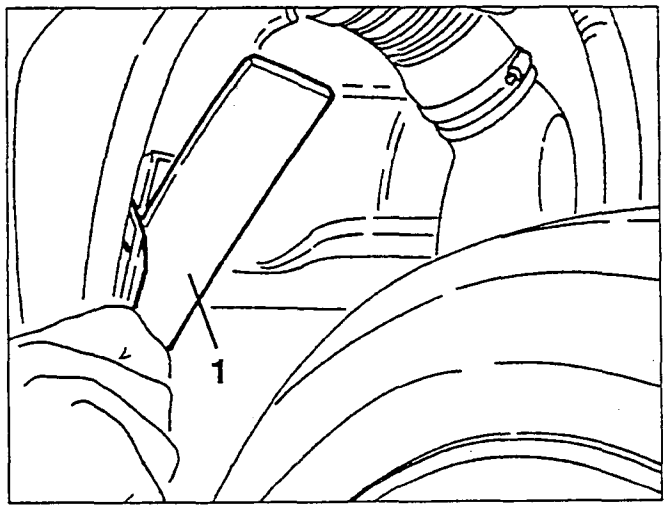
REMOVAL/REFITTING

1. Loosen the two lower screws securing the bumper.

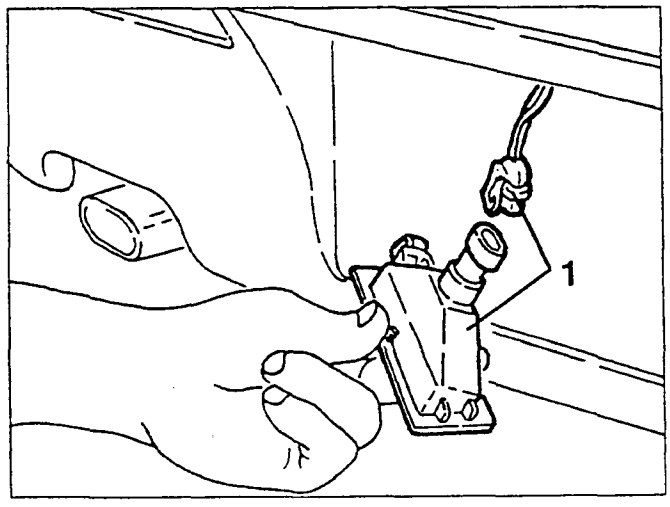
2. Loosen the two screws securing the rear wheel housing to the bumper.



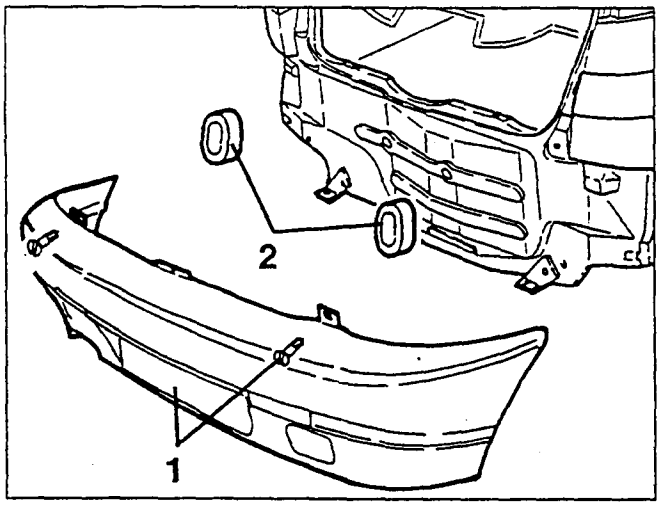
1. Pull the wheel housing from the bumper.



1. Pull off the numberplate light and remove them after disconnecting the relative electrical connections.



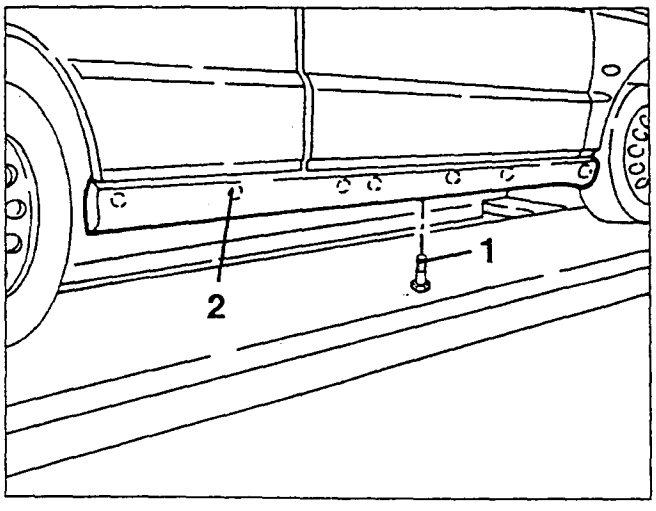
1. Working with the boot lid raised, loosen the two upper screws and remove the bumper.
2. Remove the two rubber energy absorbing buffers.



DOOR SILL COVERING

REMOVAL\REFITTING

- Position the vehicle on a four-column bridge.
1. Loosen the screws securing the door sill covering.
2. Pull off the plastic buttons located in the positions shown in the diagram and remove the door sill covering.

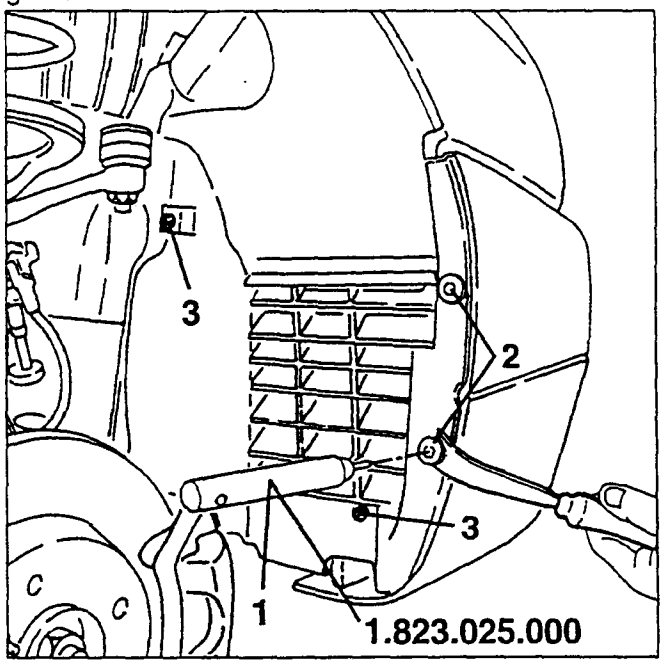


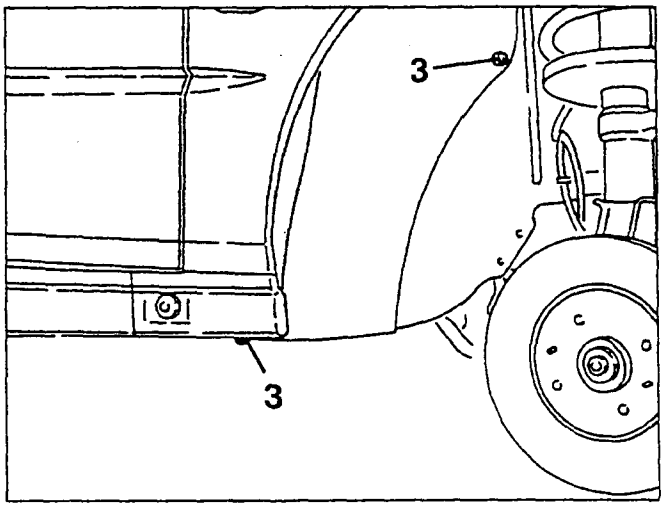
FRONT GRAVEL GUARD

REMOVAL/REFITTING

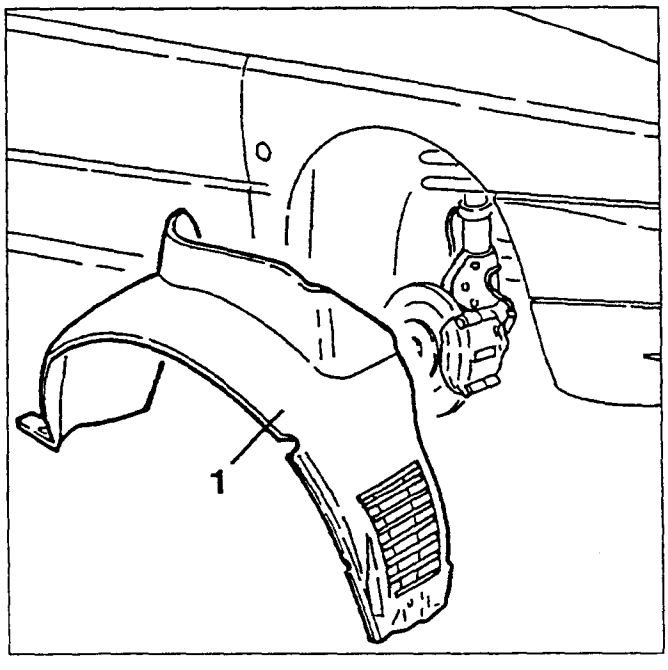
1. Using tool No. 1.823.025.000 release the clips of the centre part of the plastic nails fastening the side bumpers to the gravel guard.
2. Remove the above-mentioned nails using the special tool.

3. Loosen the four screws securing the front gravel guard.

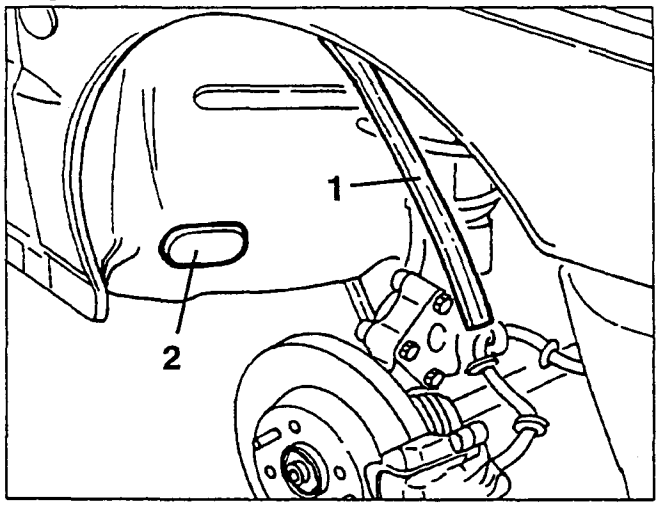




1. Remove the front gravel guard.



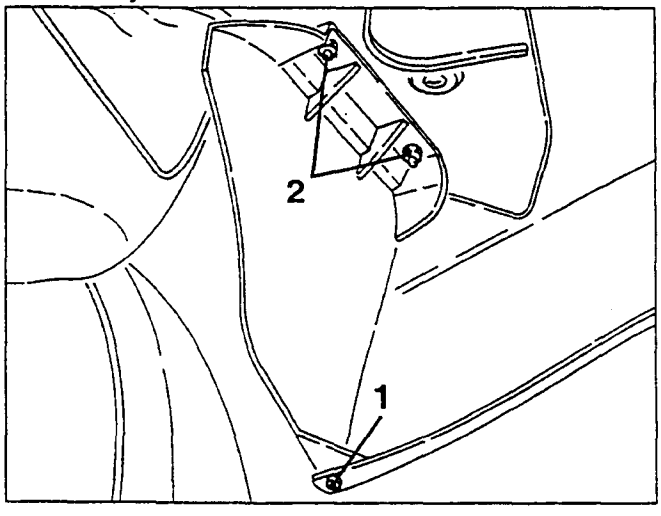
1. Remove the seal from the front wheel housing.
2. Check for presence and damage of the cap on the wing.



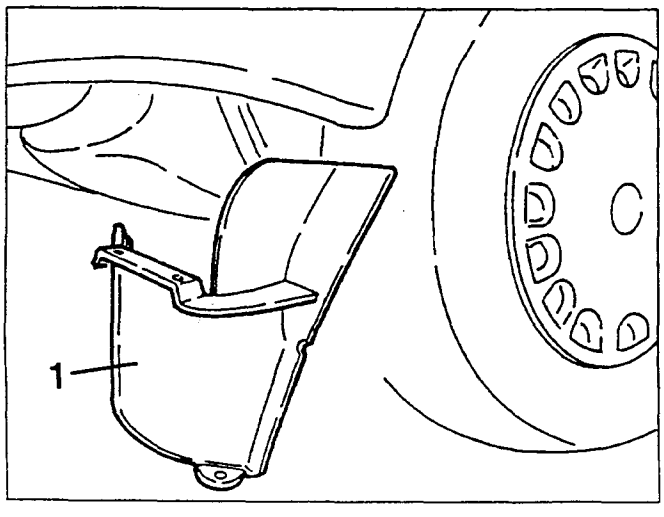
REAR RIGHT-HAND GRAVEL GUARD

REMOVAL/REFITTING

1. Loosen the screw securing the rear gravel guard to the bumper.
2. Loosen the two buts securing the rear gravel guard to the body.



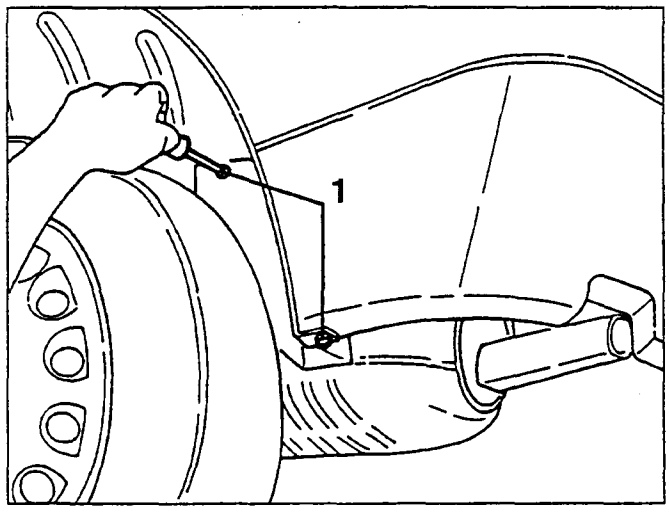
1. Remove the rear right-hand gravel guard.



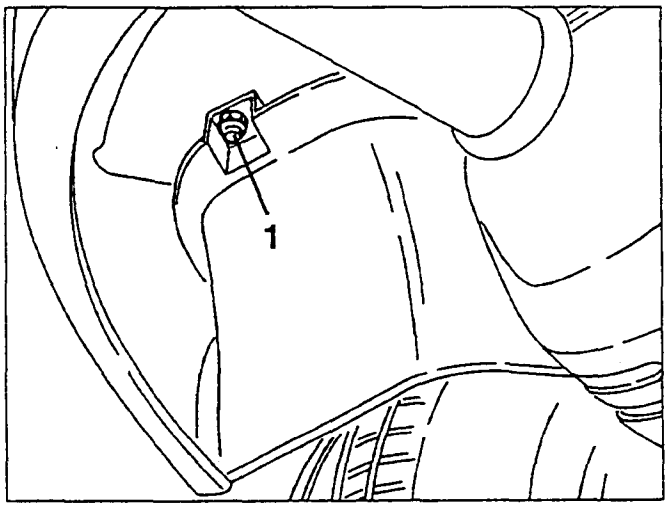
REAR LEFT-HAND GRAVEL GUARD

REMOVAL/REFITTING

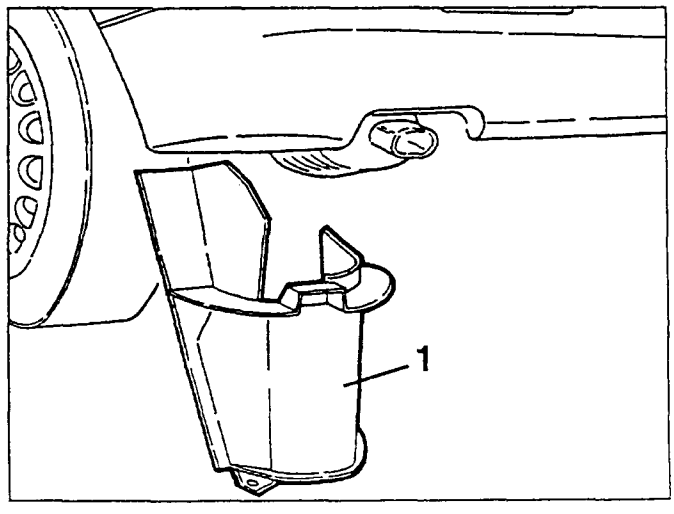
1. Loosen the two screws securing the rear gravel guard as shown in the diagram.



1. Loosen the nut securing the rear gravel guard to the body.



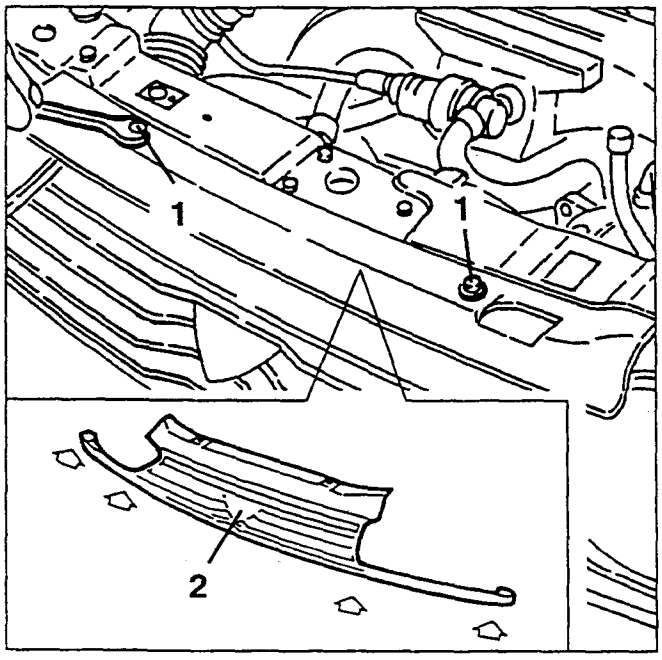
1. Remove the rear left-hand gravel guard.



RADIATOR GRILLE

REMOVAL/REFITTING

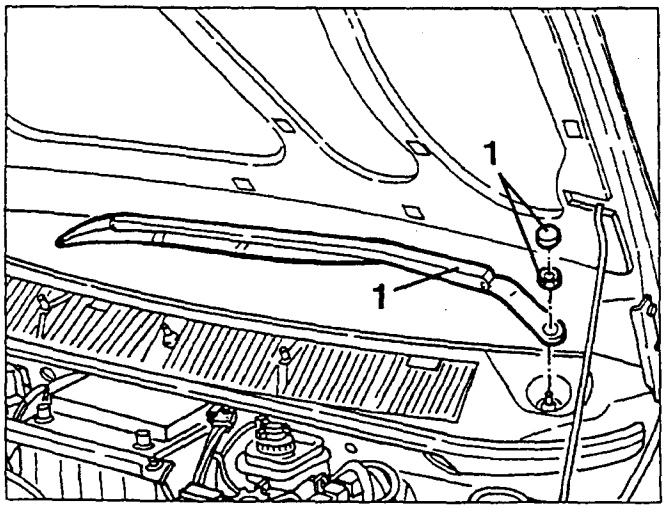
1. Working with the bonnet raised, loosen the two screws securing the radiator grille.
2. Pull the radiator grille away from the clips positioned as shown in the diagram and remove the grille.



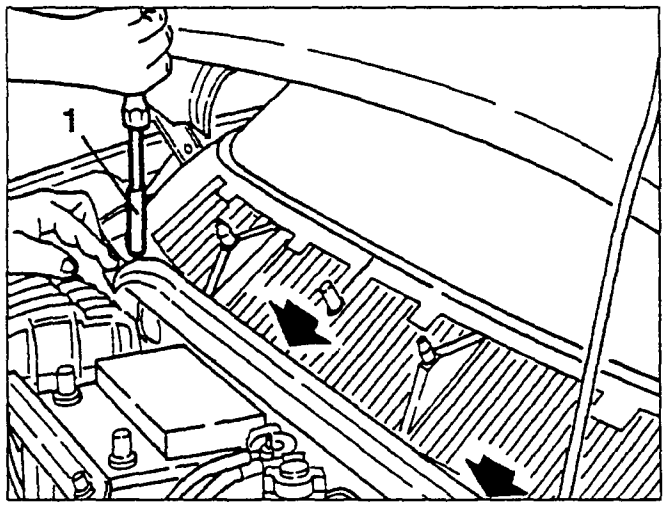
AIR INTAKE GRILLE

REMOVAL/REFITTING

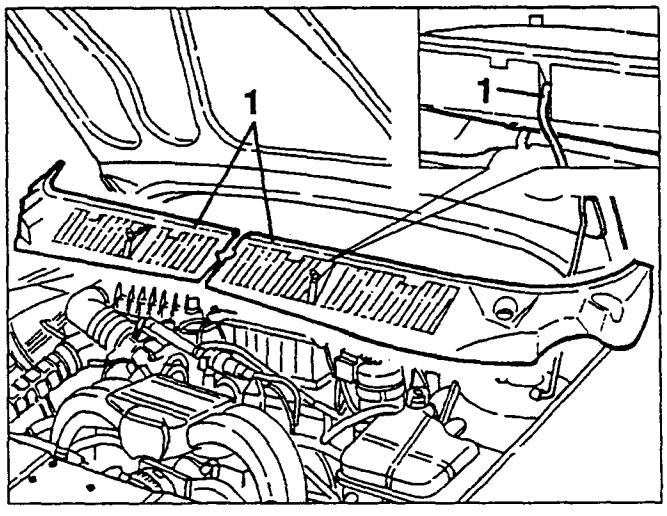
1. Working with the bonnet open, pull off the protective caps and loosen the nuts securing the windscreen wiper arms and then remove the windscreen wiper arms.



1. Loosen the three screws securing the air intake grille.



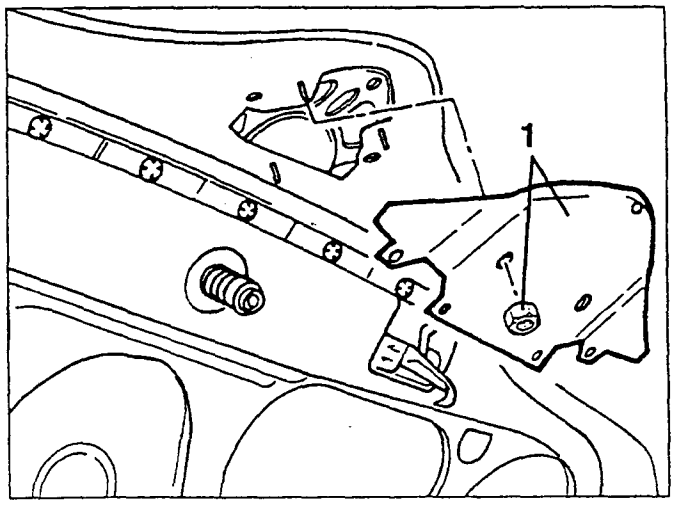
1. Pull off the two parts of the air intake grille and remove them after disconnecting the spray hoses.



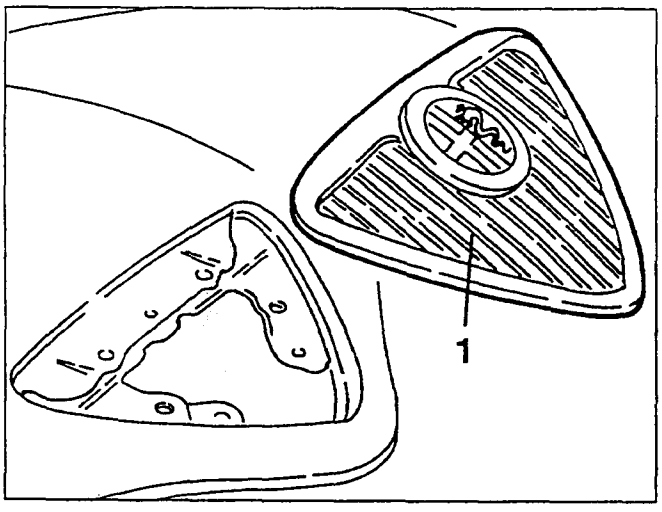
BONNET GRILLE

REMOVAL/REFITTING

1. Working with the bonnet in the upright position loosen the three nuts securing the grille and pull off the internal plastic covering.



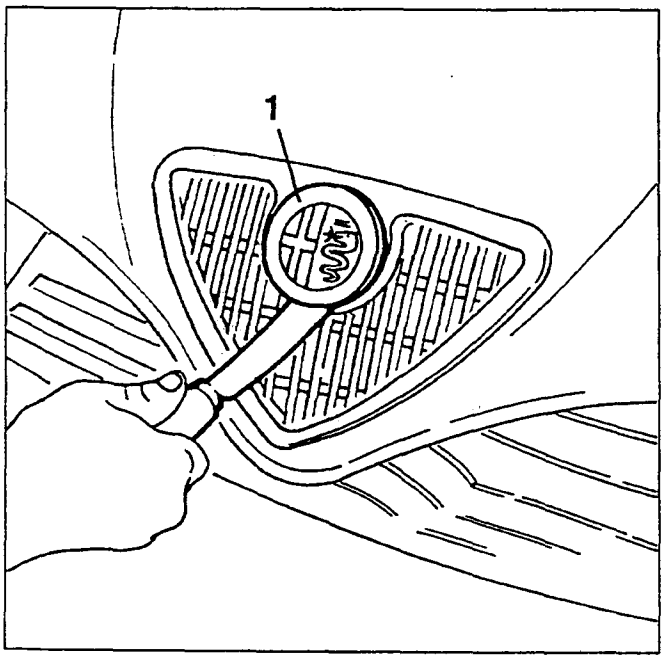
1. Remove the bonnet grille by pulling it away from the two glips.



BONNET GRILLE LOGO

REMOVAL/REFITTING

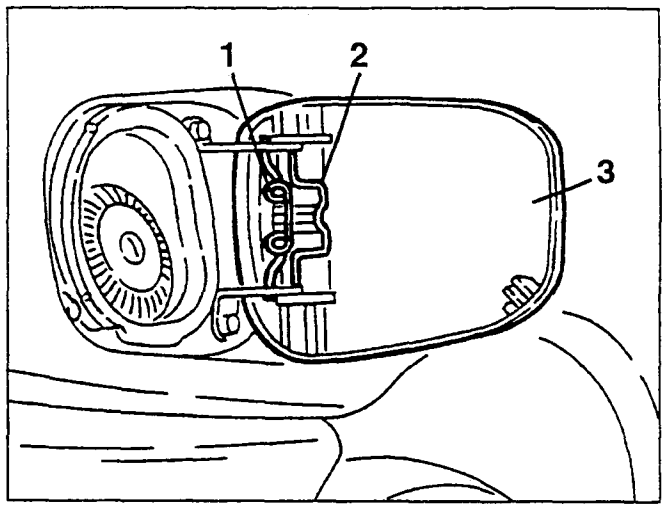
1. Pull off and remove the logo from the grille on the bonnet.



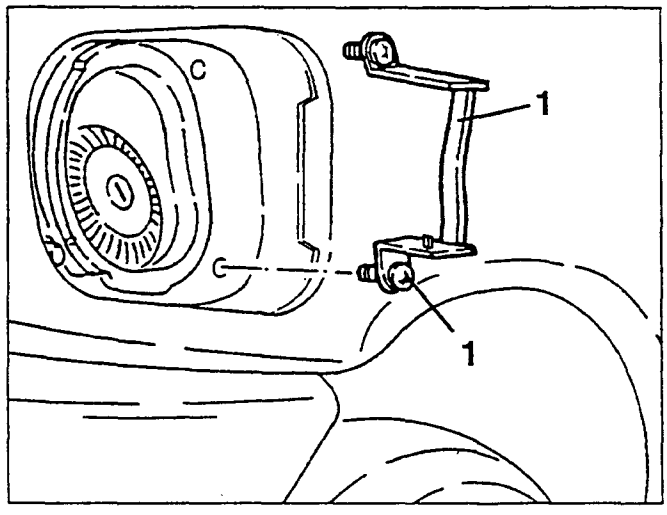
FUEL CAP COVER

REMOVAL/REFITTING

1. Open the flap and free the return spring.
2. Unhook and remove the flap attachment device.
3. Remove the fuel flap.

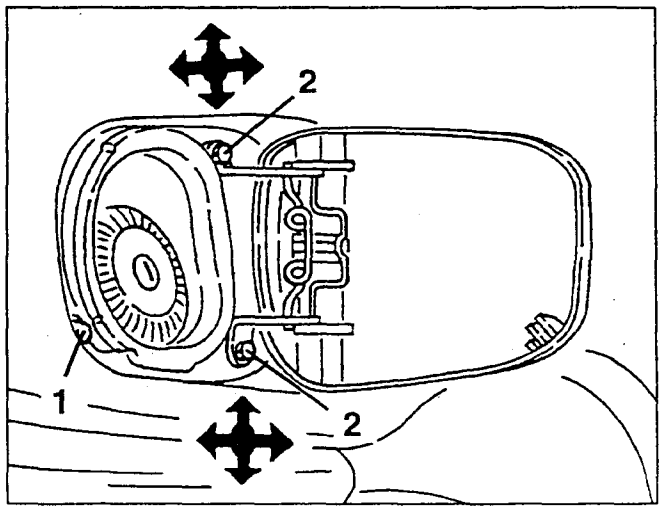


1. Working through the wheel housing loosen the two nuts and remove the fuel flap support bracket.



Refit by reversing the procedure followed for removal and note the following:

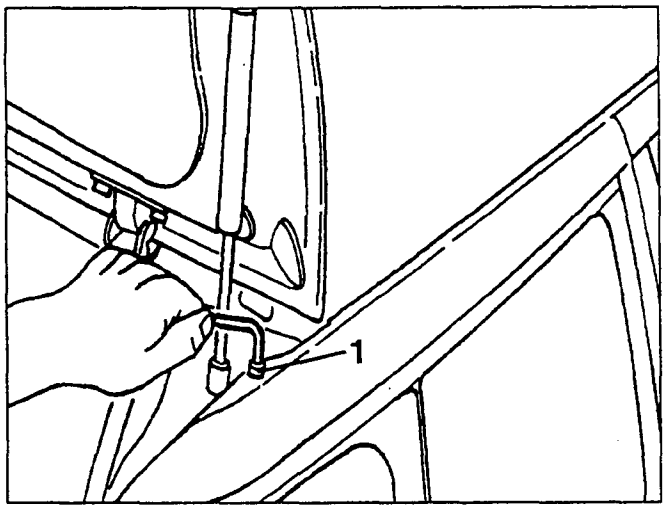
1. Ensure that the flap is fitted with its gasket.
2. Adjust the position of the flap by turning the nuts securing the support bracket.



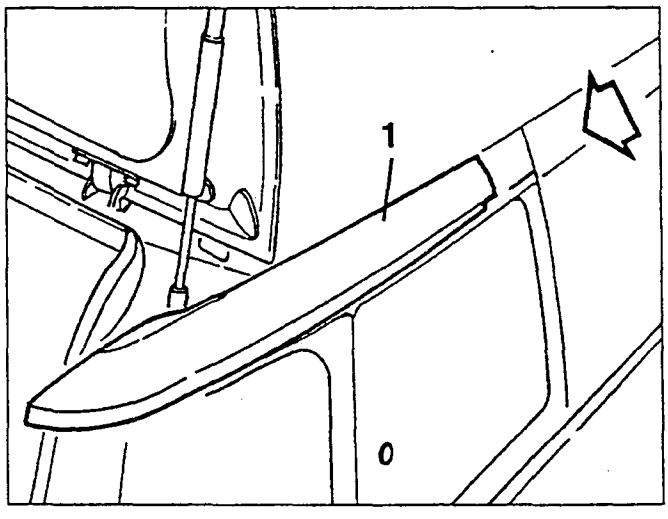
UPPER WINDOW TRIM

REMOVAL/REFITTING

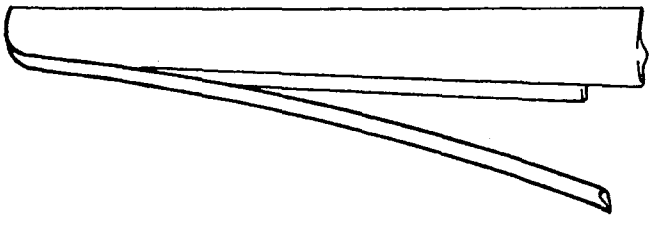
1. Working with the boot lid open loosen the screw securing the upper window trim.



1. Remove the upper window trim by pushing the rear part of the vehicle.



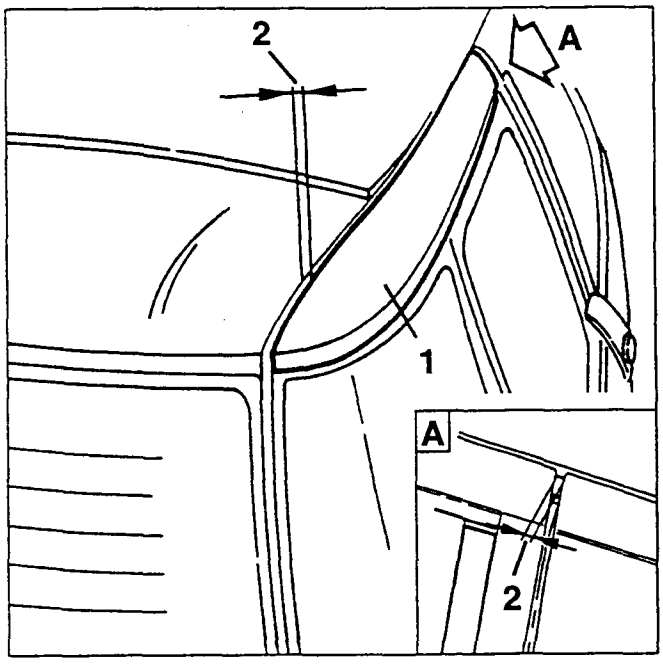
– Working on a bench remove the seal from the upper window trim.



Refit by reversing the procedure followed for removal and note the following.

1. Refit the upper window trim by pressing it onto the clips.

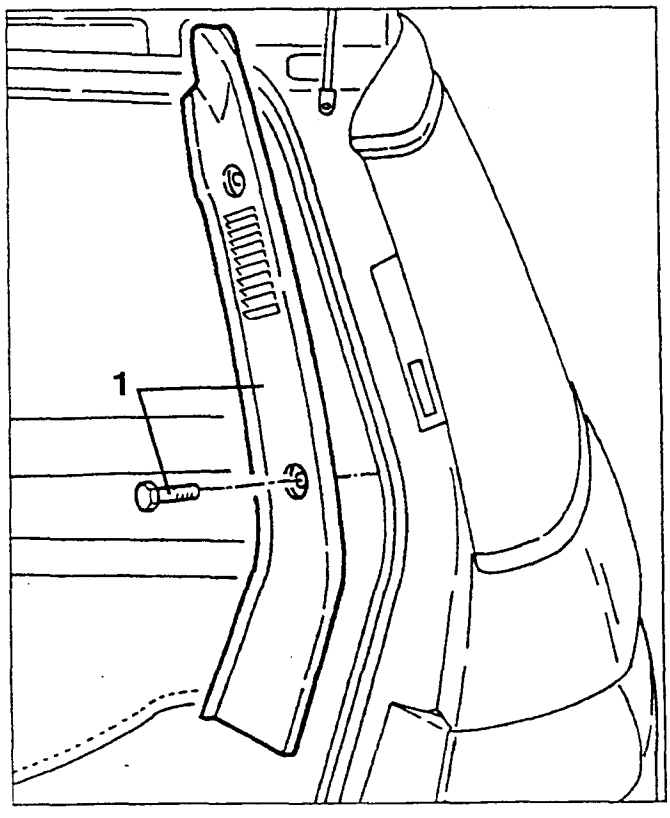
2. Adjust the trim longitudinally using the screw and check the gaps with the boot and door.



AIR OUTLET GRILLE FROM PASSENGER COMPARTMENT

REMOVAL/REFITTING

1. Working with the boot lid raised loosen the two screws and remove the passenger compartment air outlet grille.

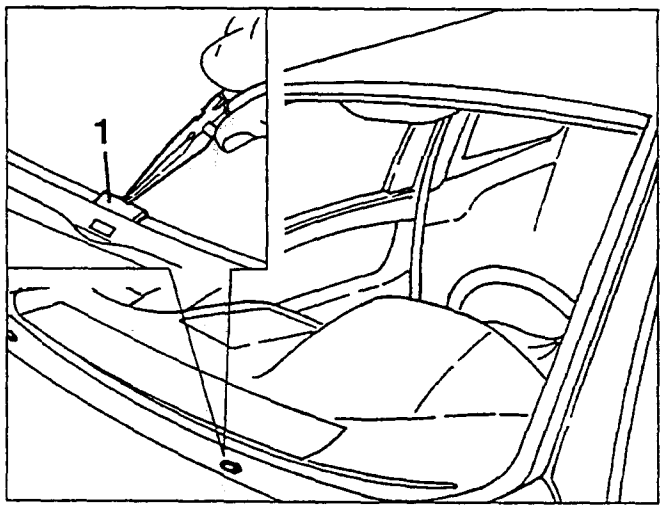


WINDSCREEN

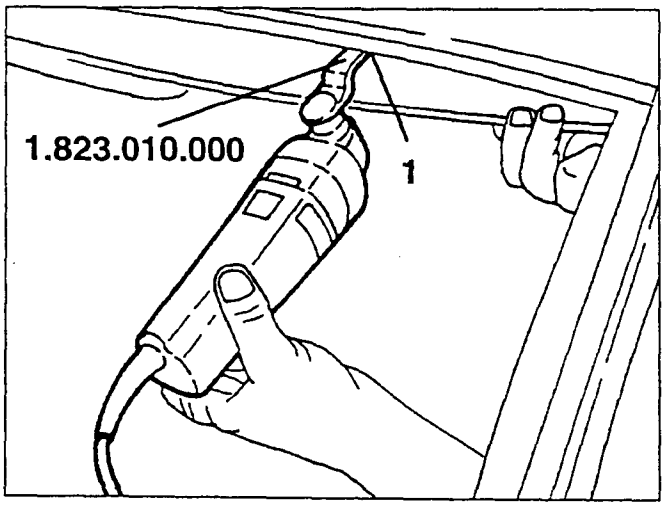
REMOVAL

- Remove the air intake grille (see specific paragraph).
- Remove the trim from the front pillars (see specific procedure).
- Remove the front roof light (see GROUP 55).
- Remove the sun visors (see specific procedure).
- Remove the passenger compartment rear-view mirror (see specific procedure).
- Loosen the two screws securing the front of the roof panel and lower this in order to avoid hindering the successive operations.

1. Remove the two lower windscreen shims.

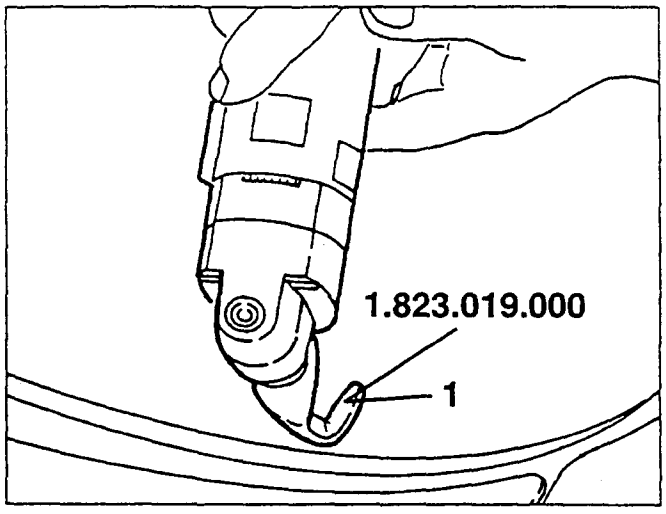


1. Working in the passenger compartment, using a pair of electric shears with blade N° 1.823.010.000, cut the sealant on the upper and side edges.

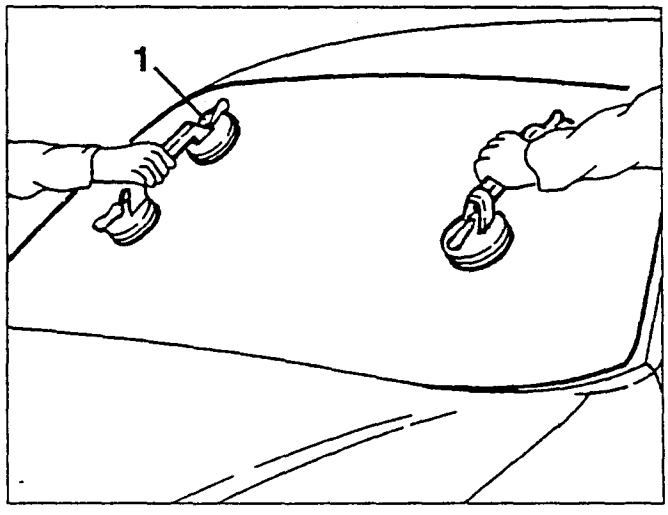


NOTE:
Adjust the cutting depth of the blade to avoid damaging the bodywork.

1. Working from outside the vehicle, using a pair of electric shears with blade N° 1.823.019.000, cut the sealant on the lower edge.



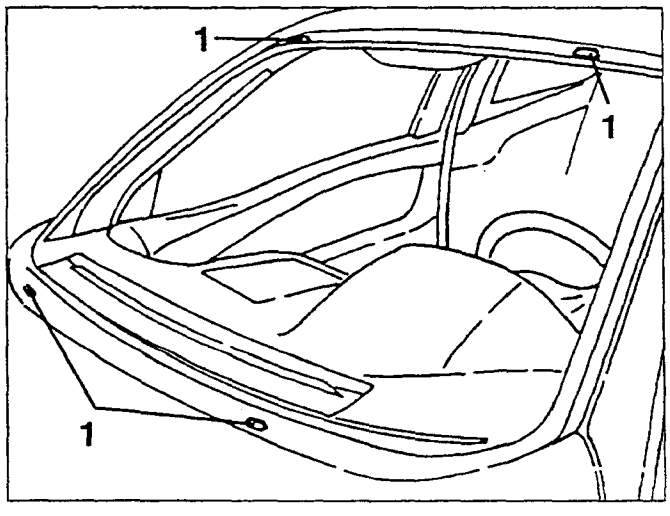
1. Using the appropriate sucker remove the windscreen and remove the upper windscreen shims.



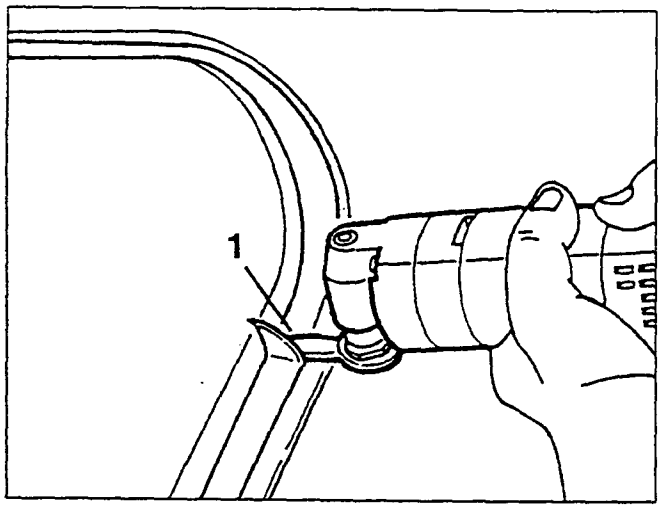
REFITTING

- Clean residues of sealant from the edge of the windscreen mating surfaces.
- Restore any damaged paintwork caused when cutting the sealant with the shears.

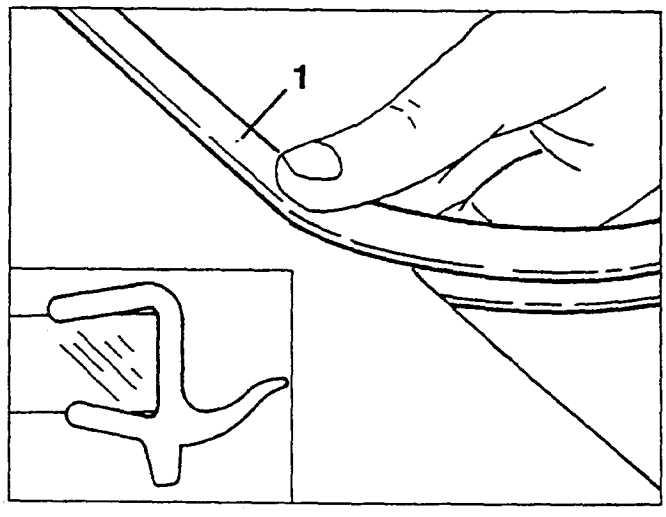
1. Position the supports/spacers on the windscreen.



1. If the removed windscreen is to be re-used, remove the profile and the residual sealant from the edge of the windscreen.

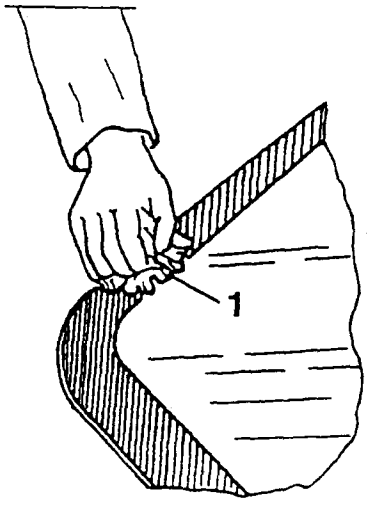


1. Fit the new profile on the windscreen.



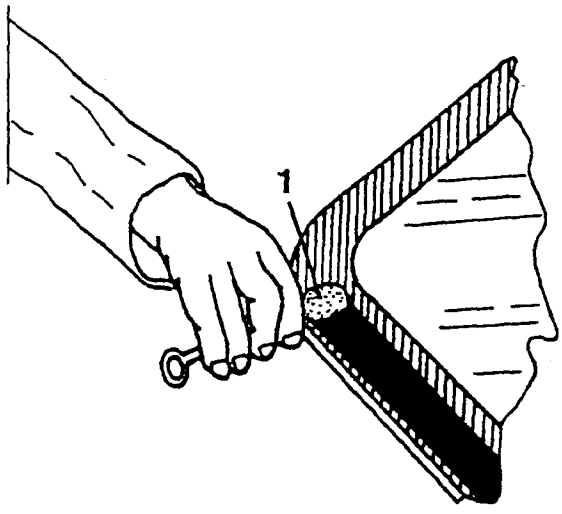
Proceed with the glueing cycle using the special KIT supplied by Spares checking the date of expiry.

1. Carefully clean the edge of the windscreen with the special cloth moistened with degreasing agent.

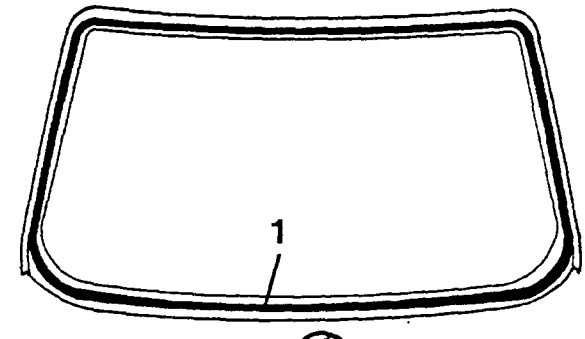


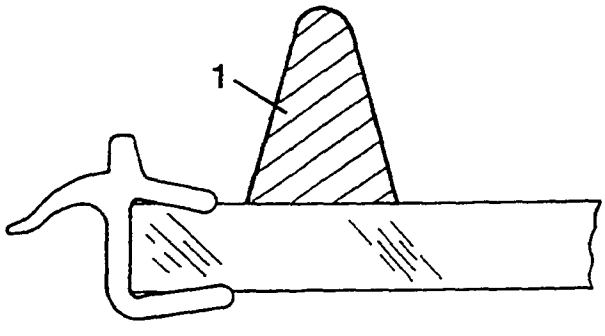
1. Apply the primer evenly and without interruption on the black printing using the applicator as shown in the diagram.

NOTE:
After applying the primer allow to dry for at least 10 minutes ensuring that the surfaces are kept clean.



1. Apply sealant along the line shown in the diagram using the nozzle (from which the guide must be removed) contained in the kit.





NOTE:
Using the short or long sealant cartridge (or both if necessary) depending on the edge of the windscreen in question.

- Using the appropriate suction cups install the windscreen positioning it on the lower spacers and centering it in its frame.
- Exert a light, uniform pressure around the edges of the windscreen.

- Before installing the windscreen ensure that when its is cleaned that there are no signs of chipping around the edges.
- Ensure that the windscreen housing frame is not bent.

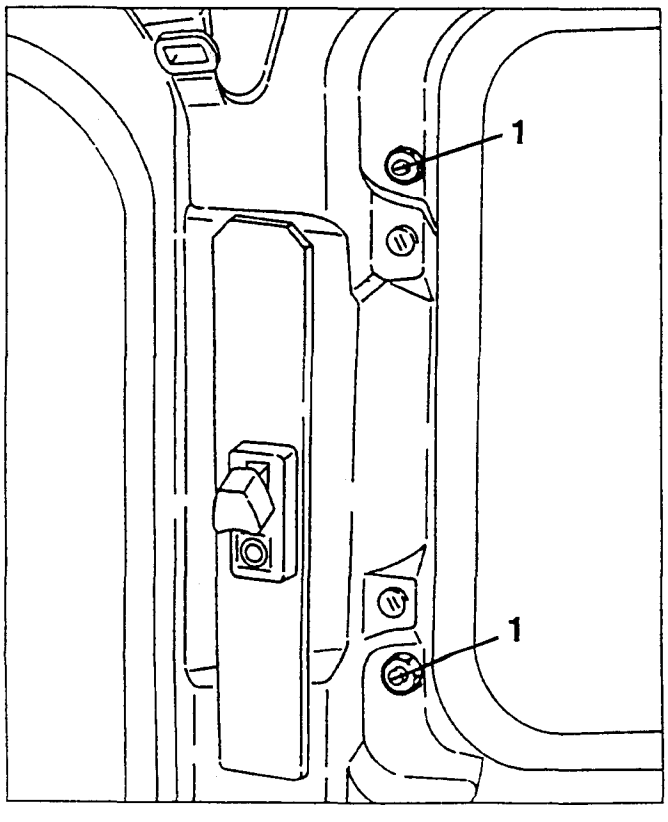
Complete with refitting operations by reversing the procedure followed for removal ensuring that the rear-view mirror is not installed when the sealant is still fresh.

NOTE:
Do not use the vehicle until the sealant is completely dry.

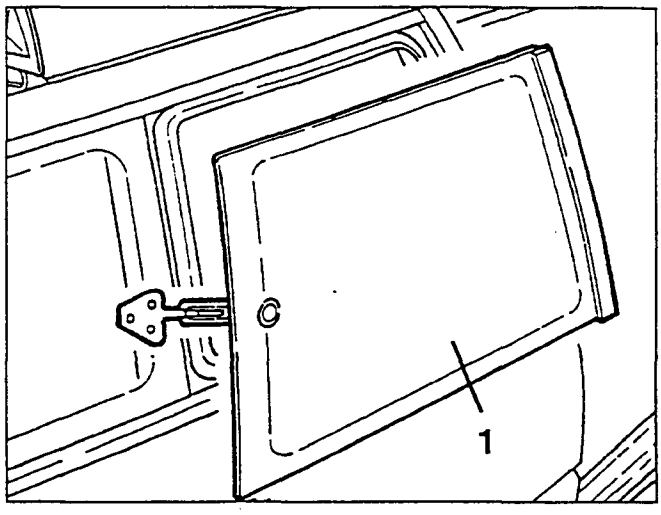
QUARTERLIGHT WINDOW

REMOVAL/REFITTING

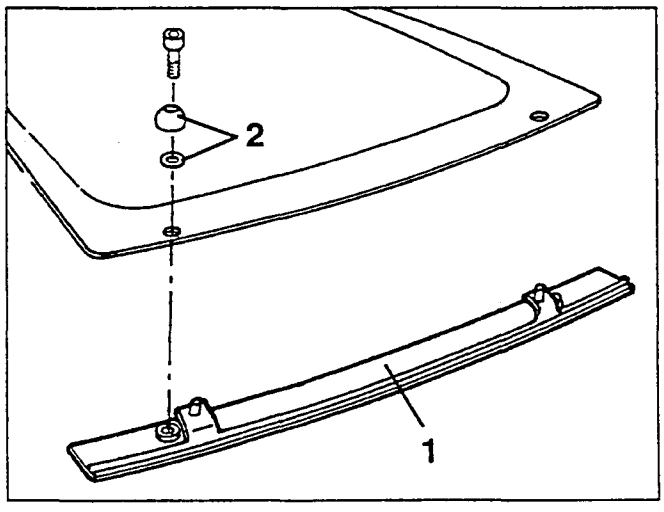
- Remove the window surround (see specific paragraph).
1. Loosen the two nuts securing the glass.



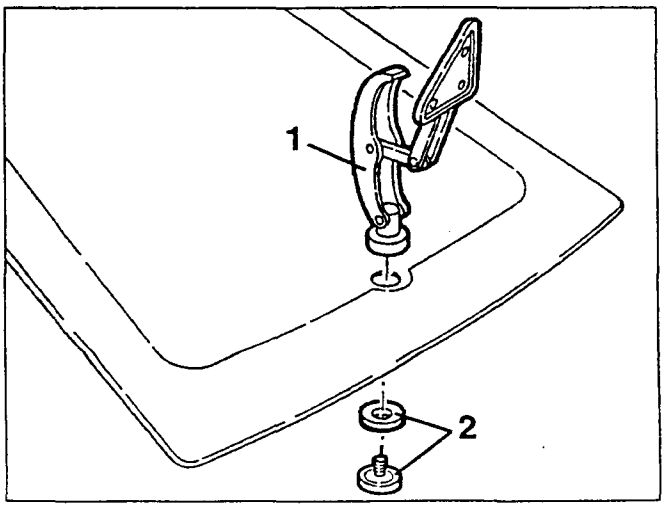
1. Remove the complete window.



1. Working on a bench loosen the two retaining screws and remove the glass from the front part of the frame.
2. Remove the spacers and seal strips.

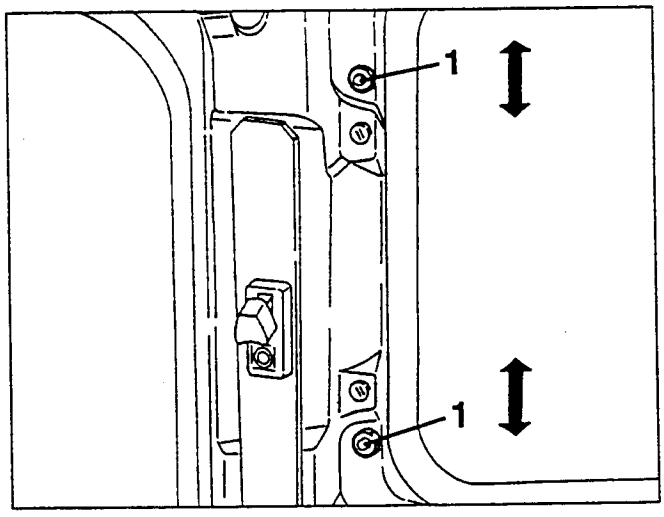


1. Loosen and remove the opening device from the window.
2. Remove the pin and the seal.

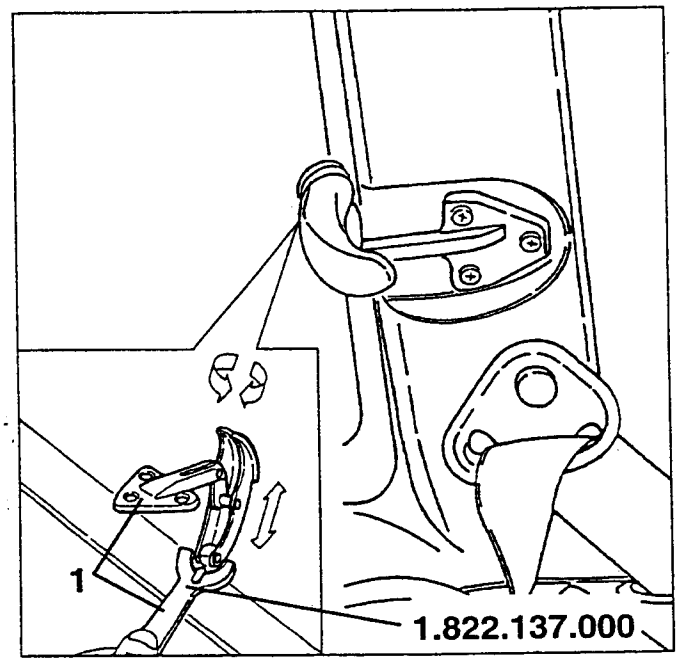


Refit by reversing the procedure followed for removal and adjust the position of the quarterlight as described below.

1. Adjust the height of the quarterlight by altering the two front attachment nuts.



1. Adjust the closing device by loosening the ring nut with tool N° 1.822.137.000 and turning the handle of the opening device.

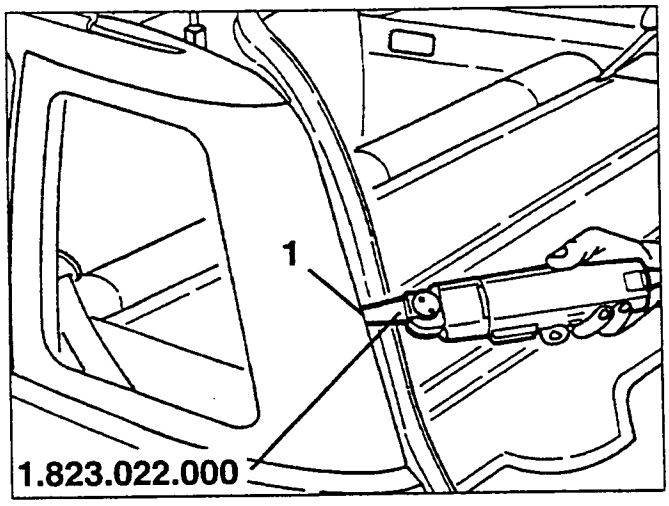


REAR FIXED WINDOW

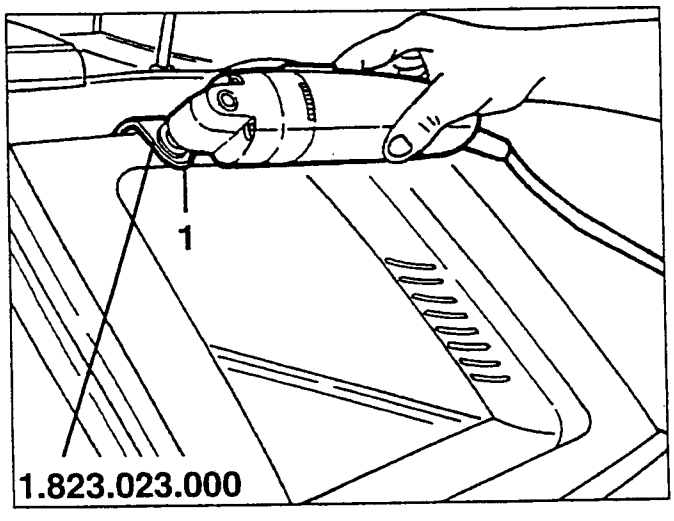
REMOVAL

- Remove the upper window strip (see specific paragraph).
- Remove the quarterlight (see specific paragraph).
- Remove the lower window strip (see specific procedure).
- Remove the passenger compartment air outlet grille (see specific paragraph).

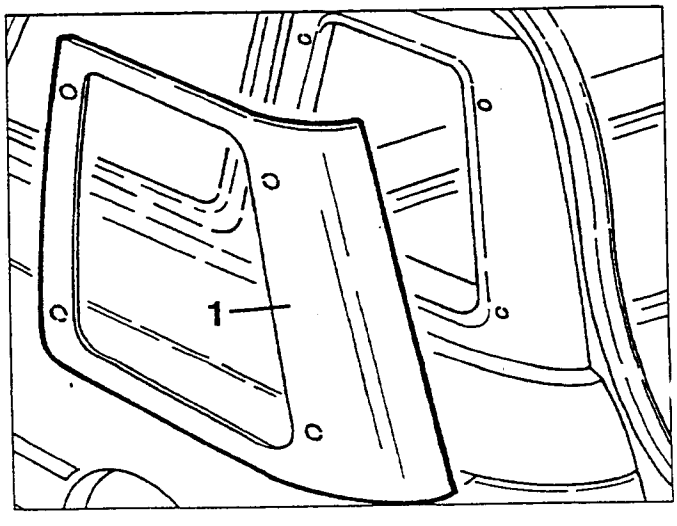
1. Using a pair of electric shears with blade N° 1.823.023.000, cut the sealant on the rear edge.



1. Using a pair of electric shears with blade N° 1.823.023.000, cut the remaining stretches of sealant.



1. Remove the window pulling it away from the plastic positioning nails.

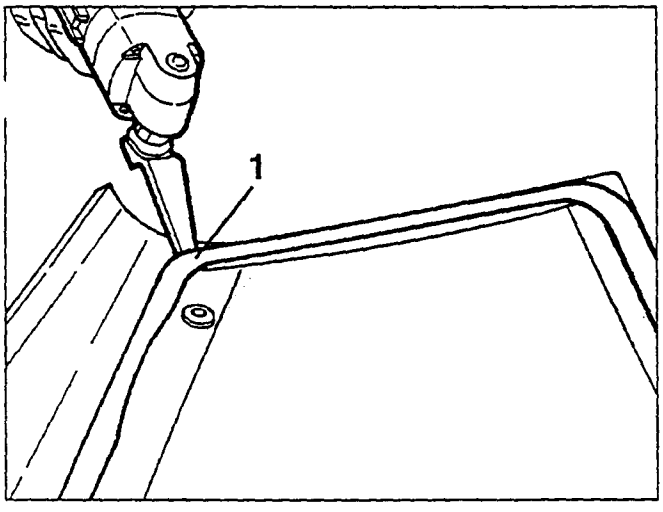


NOTE:
It is therefore possible to re-use the windscreen even if one or more supports of the centering pins are broken or cut.

REFITTING

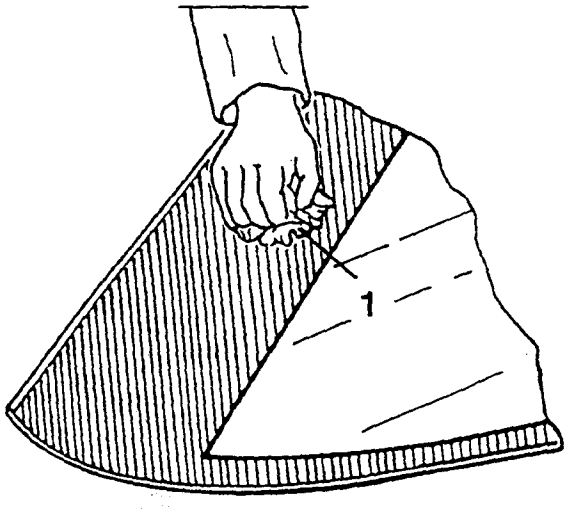
- Clean residues of sealant from the edge of the windscreen mating surfaces then clean with a dry cloth and blow-off with compressed air.
- Restore any damaged paintwork caused when cutting the sealant with the shears.

1. If re-using the old windscreen remove the three lateral and upper strips and remove the residual sealant from the edge of the windscreen.



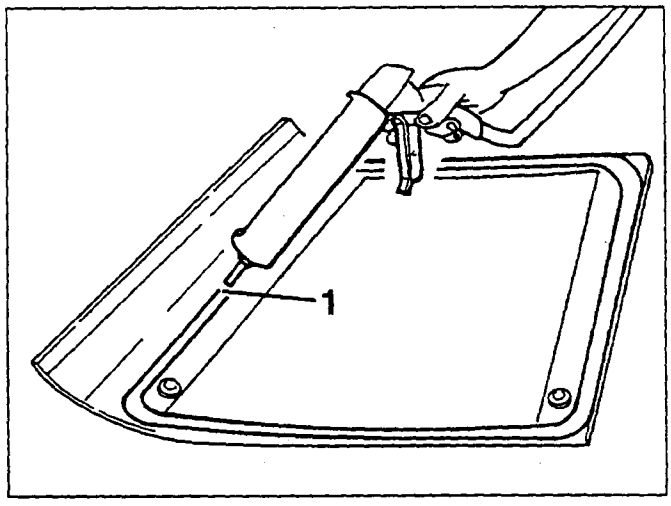
Proceed with the glueing cycle using the special KIT supplied by Spares checking the date of expiry.

1. Carefully clean the edge of the windscreen with the special cloth moistened with degreasing agent.



1. Apply sealant along the seal strip on the window using the nozzle from which the guide has been removed.

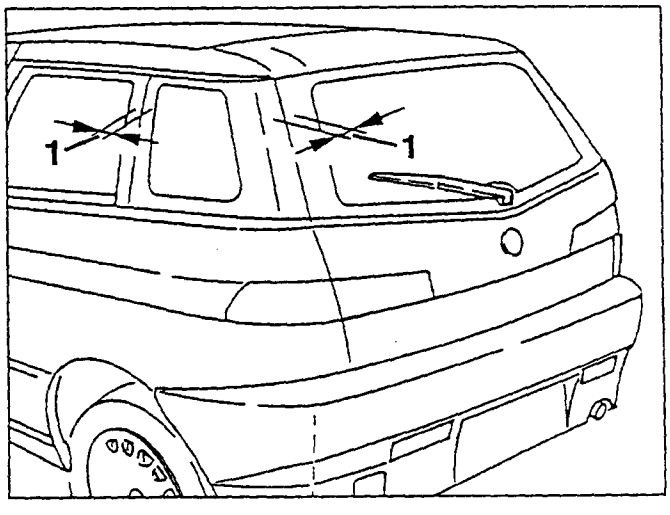
NOTE:
Use the short or long sealant cartridge depending on the edge of the window in question.



- Install the lower rear window seal strip.
- Install the rear fixed window centering the plastic nails and then pressing so that they are fixed in position.

- Before installing the window ensure that when its is cleaned that there are no signs of chipping around the edges.
- Ensure that the window housing frame is not bent.

1. Check alignment with the quarterlight and the rear windscreen.



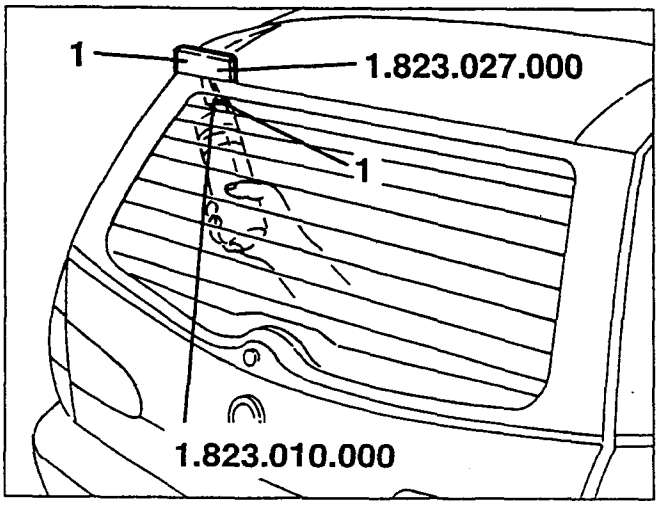
- Complete the refitting operations by reversing the procedures followed for removal.

NOTE:
Do not use the vehicle until the sealant is completely dry.

REAR WINDSCREEN

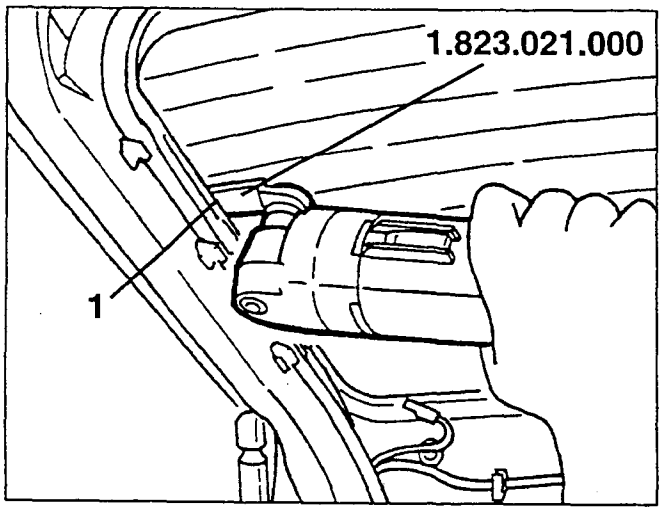
REMOVAL

- Remove the internal finishing trim and the wiper arm from the rear windscreen (see specific paragraph).
- Disconnect the electrical connections from the heating element in the rear windscreen.
1. Using a pair of electric shears with blade N° 1.823.010.000 and tool N° 1.823.027.000, cut the sealant from the upper and lower edges.



NOTE:
Adjust the cutting depth of the shears to avoid damaging the bodywork.

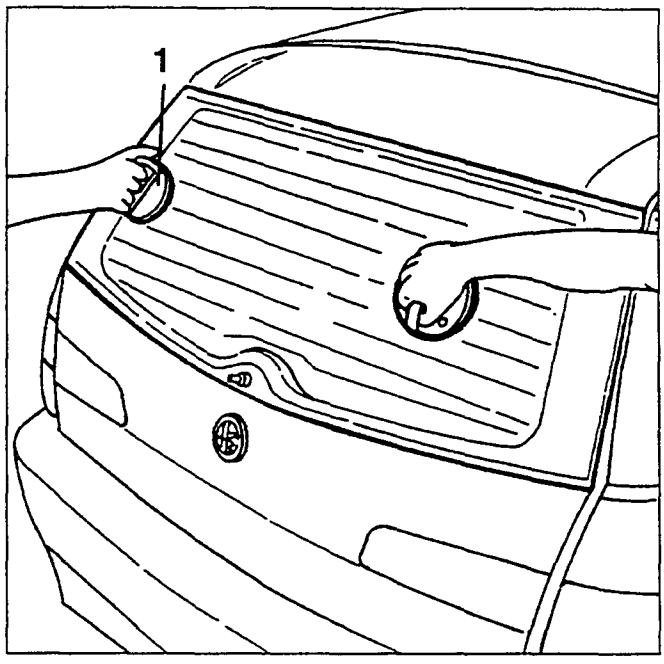
1. Using a pair of electric shears with blade N° 1.823.021.000, cut the sealant on the side edges.



NOTE:
The correct use of the specified tools facilitates the removal of the heated rear windscreen without damaging the window seal strip.

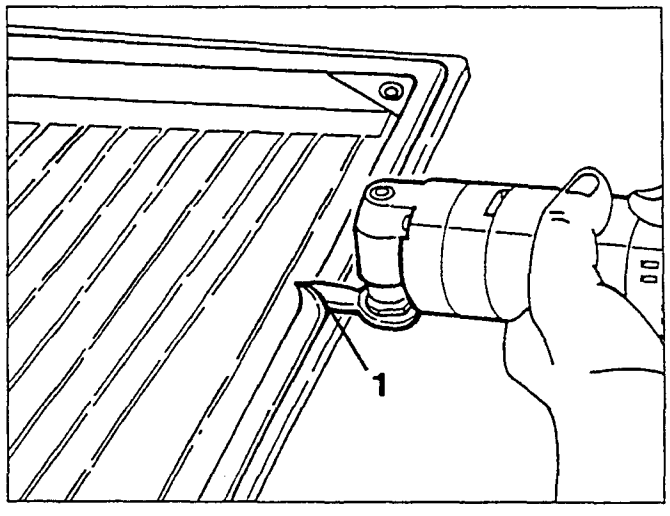
1. Using the appropriate suction cups, remove the rear windscreen.

NOTE:
It is therefore possible to re-use the windscreen even if one or more supports of the centering pins are broken or cut.



REFITTING

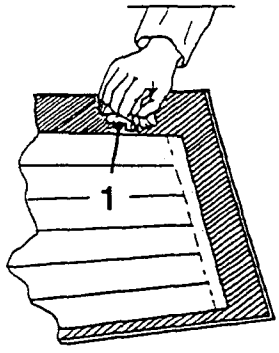
- Clean the edges of the mating surfaces of residues of sealant using a clean cloth or compressed air.
- Restore any damaged to the paintwork caused by the sealant cutting operations.
1. When re-using the original rear windscreen remove the residual sealant from the edges.



- When using a new windscreen install the four plastic centering pins.

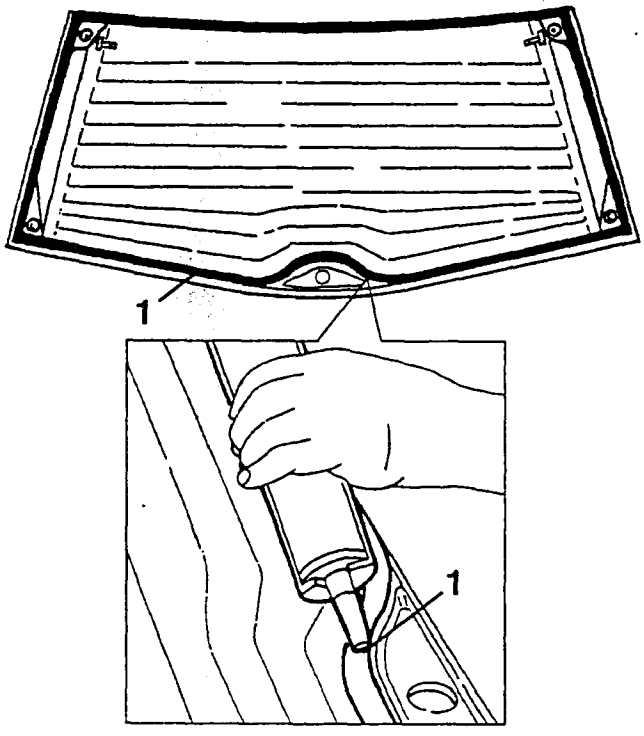
Proceed with the glueing cycle using the special KIT supplied by Spares checking the date of expiry.

RICAMBI ORIGINALI

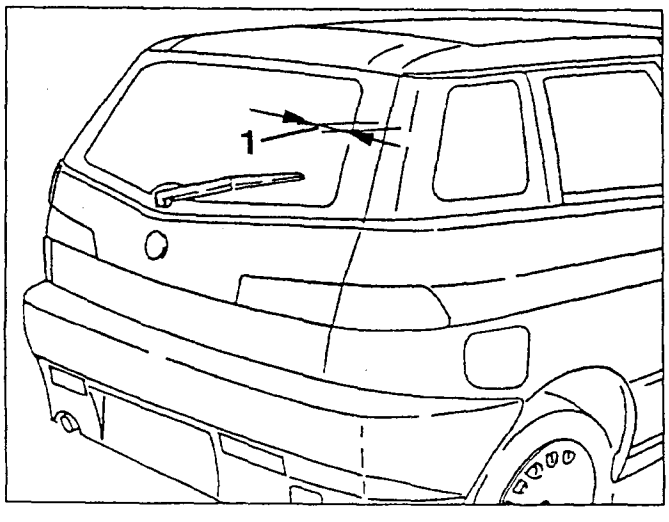


1. Carefully clean the edge of the windscreen with a special cloth moistened with degreasing agent.

1. Apply the sealant along the lines shown in the diagram using the nozzle (from which the guide has been removed) contained in the kit.



- Using the suction cups install the rear windscreen centering it in its housing frame.
- Exert a light, even pressure around the edges of the rear windscreen.
1. Check the gaps and alignment of the rear windscreen with the fixed windows.



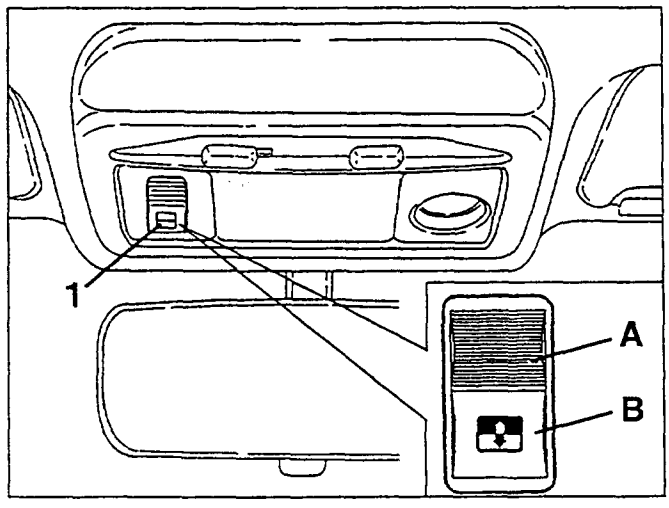
- Complete the refitting operations by reversing the procedure followed for removal.

NOTE:
Do not use the vehicle until the sealant is completely dry.

SUNROOF

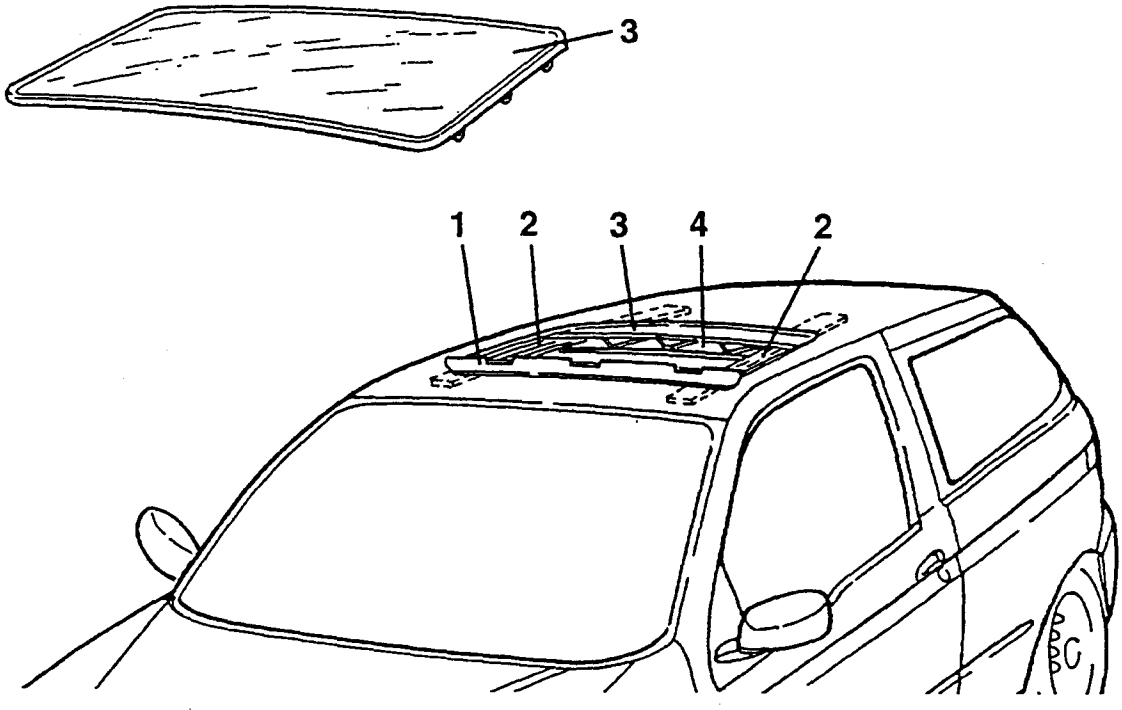
GENERAL DESCRIPTION

The sunroof is of the glass type with sunshade blind. The sunroof is operated by an electric motor.
The sliding mechanisms permit two different types of positioning:
- a "hidden" position which allows the roof to be opened partially or fully. The glass panel slides backwards into the space between the inner and outer roof panels.
- the sunroof can also adopt a quarterlight position which makes it possible to raise the rear part of the roof so that a limited air flow enters the passenger compartment.
The blind is also housed in the space between the inner and outer roof panels when the sunroof is open.
The sunroof is controlled using the button (1) located on the front roof light. The type of movement (closing/opening to the hidden or quarterlight positions) results from the shape of the control used to operated the sunroof cams on the runners and from the sliding of the runners on the rails.



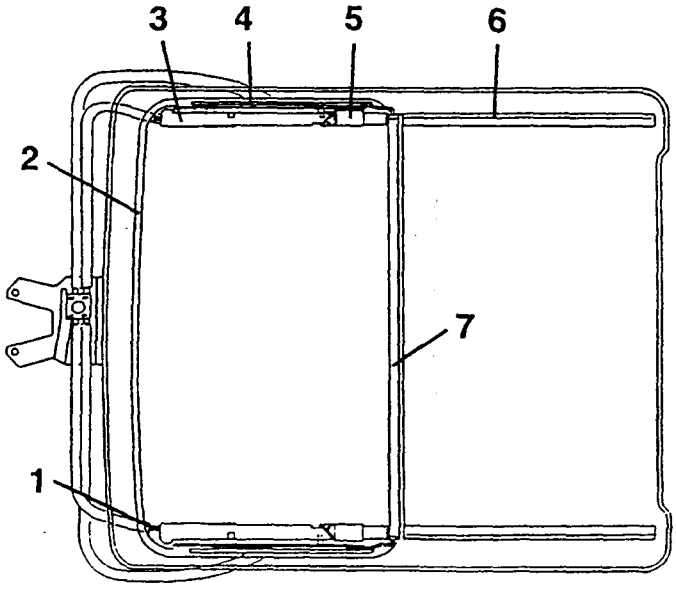
Initial position	Operation	Resulting position
Open to hidden position	Press "B"	Closed
Closed	Press "B"	Open to quarterlight position
Open to quarterlight position	Press "A"	Closed
Closed	Press "A"	Open to hidden position

The sunroof is composed of an external glass panel (3) which slides on rails (2), by an internal blind (4), by an external spoiler (1) and by the device used to move the glass panel.



1. Spoiler *2. Rail* *3. Glass panel* *4. Blind*

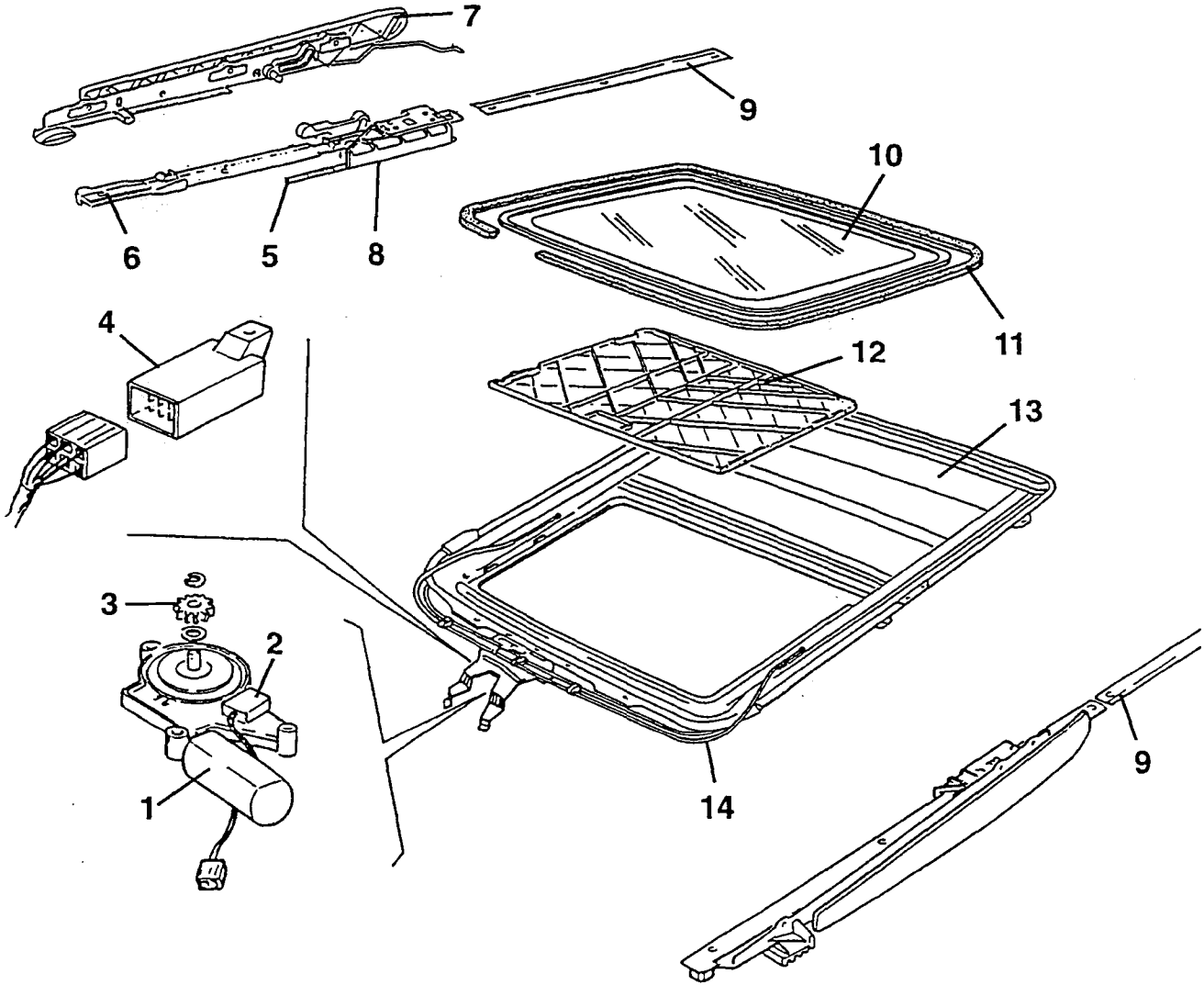
The frame holding the glass panel (2) is fixed to the positioning brackets (4) commanded by the movement of the runners (5) along the rails (3 e 6). The flexible racks (1), commanded by the electric motor form a single unit with the runners (5) and establish the movement. The coupling between the runners (5) and the brackets (4) permits both opening and closing actions through the sliding of the glass panel and the opening to the quarterlight position.
The bracket (4) is also connected to the mobile water run-off channel (7) which follows the movement of the roof when opening or closing.
The sunroof is fitted with an inner blind which can be moved manually to screen the occupants of the vehicle from direct sunlight.



1. *Flexible rack*
2. *Frame for glass panel*
3. *Front rail*
4. *Sliding brackets*
5. *Runner*
6. *Rear rail*
7. *Water collection channel*

Structure of the sunroof

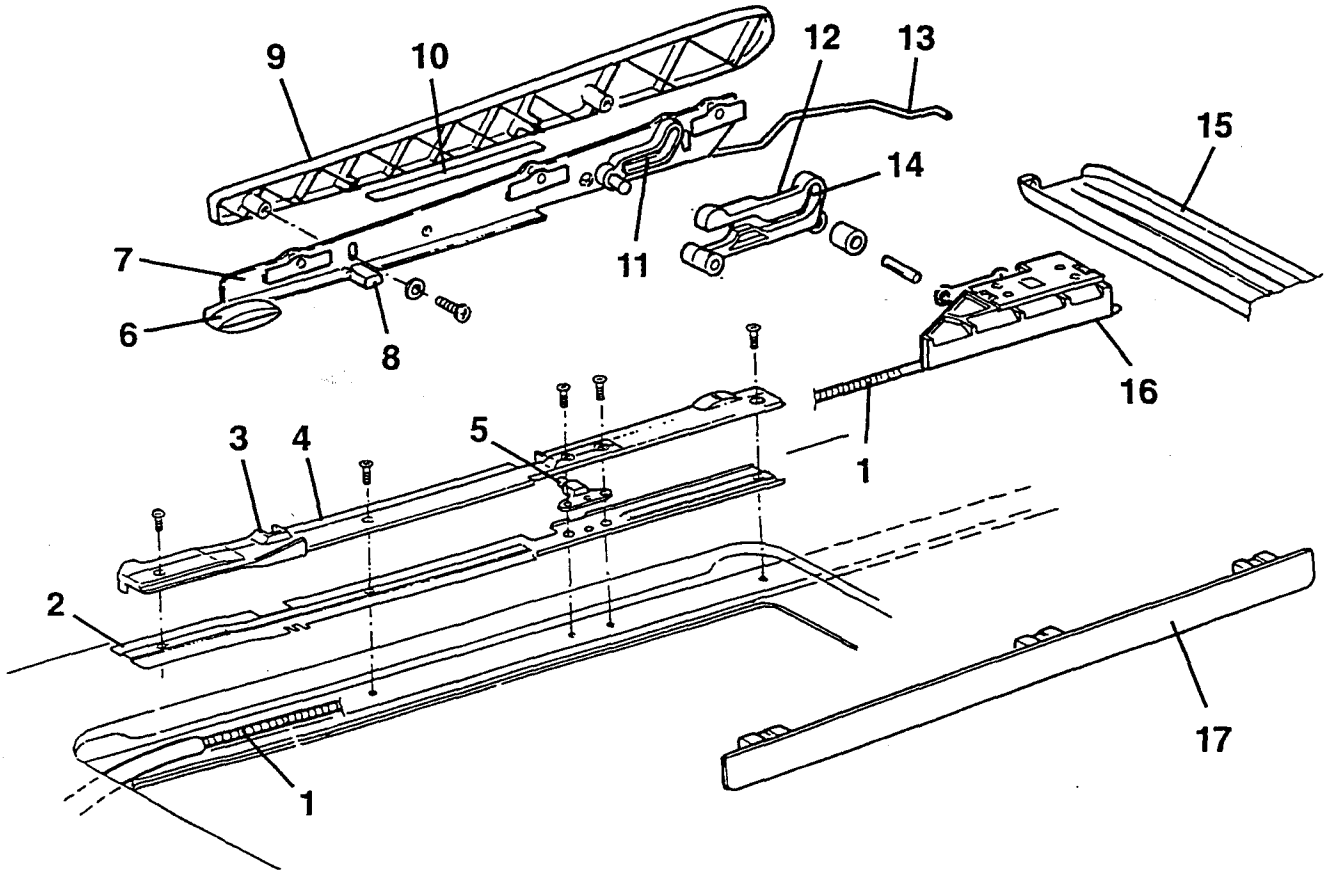
All the components of the sunroof are housed on a frame **(13)** secured to the body of the vehicle between the outer and inner roof panels.
The electric motor **(1)** is fixed frontally to this frame together with the controlling relay **(4)**.
A microswitch **(2)** is fixed to the motor and this determines the position of the sunroof by the position of the runners through a cam on the spindle.
A toothed wheel **(3)** is positioned on the end of the spindle coming out of the electric motor and this engages with the flexible racks **(5)** controlling the sliding action along the inside of the guides **(14)**.
The runner **(8)** which slides along the rails **(6 and 9)** is fixed to the frame at the end of each rack and this determines the various positions of the sunroof.
The coupling between the pins and cams and the longitudinal movement of the runners determines the type of movement of the brackets **(7)** to which the glass panel is fixed **(10)**. The position of the runner determines the opening/closing sliding action and that of the opening to the quarterlight position.
The metal frame housing the glass panel is fixed to the brackets **(7)** with six screws. The holes which are occupied by these screws are slotted to allow the horizontal and vertical position of the roof to be adjusted.



1. *Electric motor*
2. *Microswitch*
3. *Toothed wheel*
4. *Relay*
5. *Flexible rack*
6. *Front rail*
7. *Sliding bracket*
8. *Runner*
9. *Rear rail*
10. *Glass panel*
11. *Seal*
12. *Sliding blind*
13. *Sunroof frame*
14. *Guiding channel*

Opening/closing mechanism

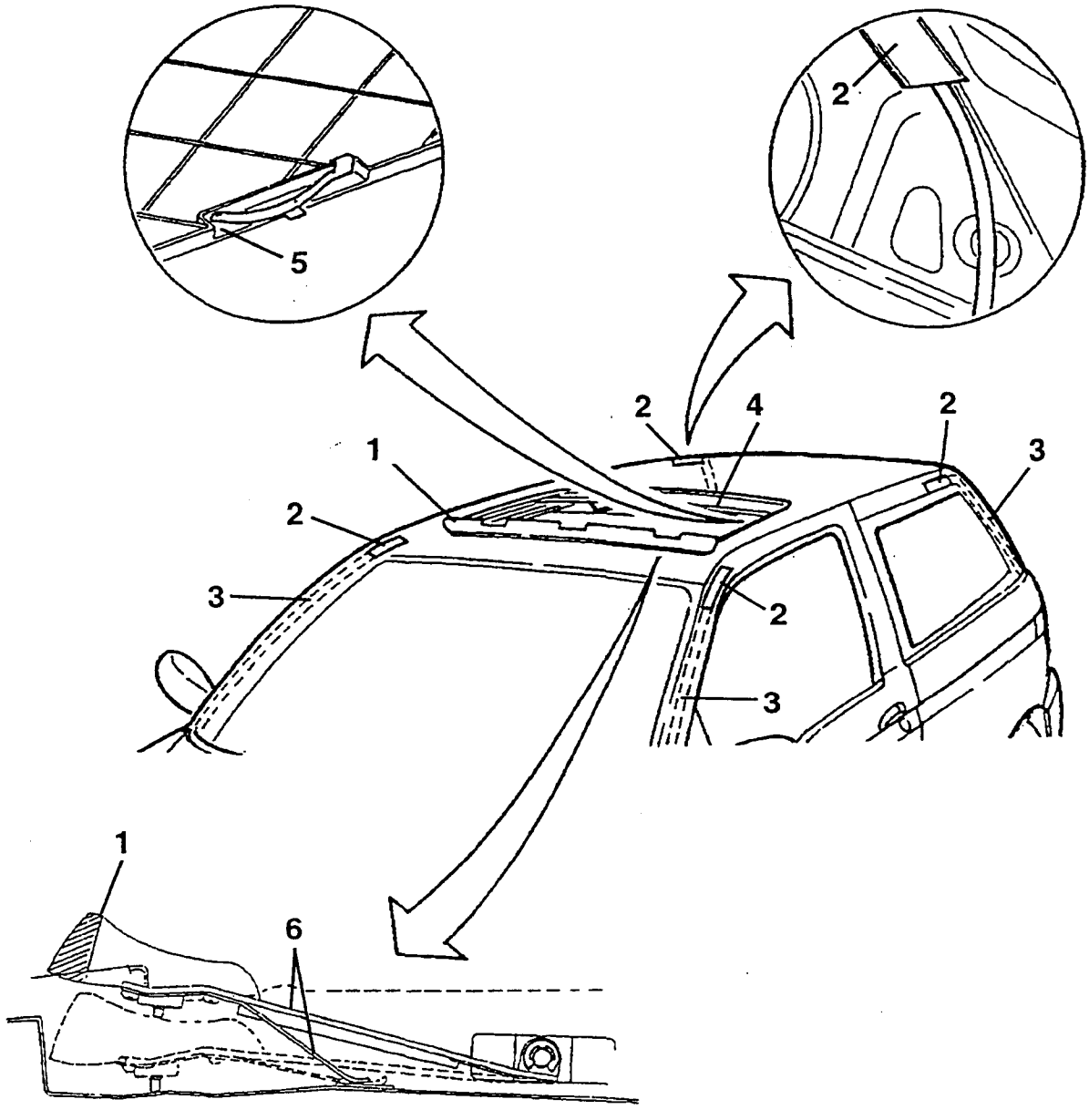
The runner **(16)** slides along the guide rail **(4)** and is moved by the flexible rack **(1)**.
The pantograph device **(12)** is hinged to the runner and the coupling with the pins and relative cams ensures the sliding of the bracket **(7)** when opening or closing and the raising of the rear part to open it to the quarterlight position. The raising to the quarterlight position is caused by the pin **(5)**, fixed to the guide, engaging in the cam groove **(14)** while the groove **(11)** makes it possible to lower the inner part of the frame when the horizontal opening movement begins.
The hook **(13)** is hinged to the bracket which moves the channel **(15)** so that it always shadows the movements of the glass panel.
The rail **(6)** guides the horizontal movements of the roof and, when it touches the opposite surface of the guide acts as a fulcrum to open to the quarterlight position.
The pin **(8)** engaging the slot **(3)** in the guide makes it possible to slightly back-off the roof during the opening to the quarterlight position so that it does not get in the way of the front edge of the sunroof housing frame.
The external finishing trim **(9)** is loosely fixed to the bracket **(7)** so that it remains in contact with the roof.



1. *Flexible rack*
2. *Lower rail*
3. *Slot*
4. *Upper rail*
5. *Fixed pin*
6. *Runner*
7. *Sliding bracket*
8. *Pin*
9. *Outer moulding*
10. *Clip*
11. *Cam groove*
12. *Pantograph device*
13. *Channel two hook*
14. *Cam groove*
15. *Channel*
16. *Runner*
17. *Outer moulding*

Spoiler, Sliding blind, Draining

The opening of the panel to the hidden position allows the spoiler to lift up **(1)** thus deviating the flow of air.
The spoiler is attached to the body by two brackets fitted with flexible arms **(6)**. When the panel is closed or open in the quarterlight position it presses on the flexible arms holding the spoiler in the lowered position. When the roof panel is opened to the hidden position the roof panel frees the two flexible arms which thus raise the spoiler.
Water which infiltrates between the seal of the glass is drained off by a channel in three fixed sides of the frame and on the mobile hoop.The channels are connected by a hose **(3)** and suitable connections **(2)** located in the four corners of the frame. The hoses drain the water off through outlets in the engine compartment and in the luggage compartment.
The inner sun blind **(4)** is connected to the frame by four spring attachments **(5)**. These attachments also act as runners sliding in the guides on the frame. When the roof panel is closed the blind can be operated manually. When the sunroof is opened in the hidden position the blind is towed by the panel until, when the roof is fully open, it it is completely hidden inside the space between the inner and outer roof panels. When the sunroof is closed the blind partially protrudes from the space between the two roof panels so that it can then be moved manually.



1. *Spoiler*
2. *Connection*
3. *Hose*
4. *Blind*
5. *Blind attachment*
6. *Flexible arms*

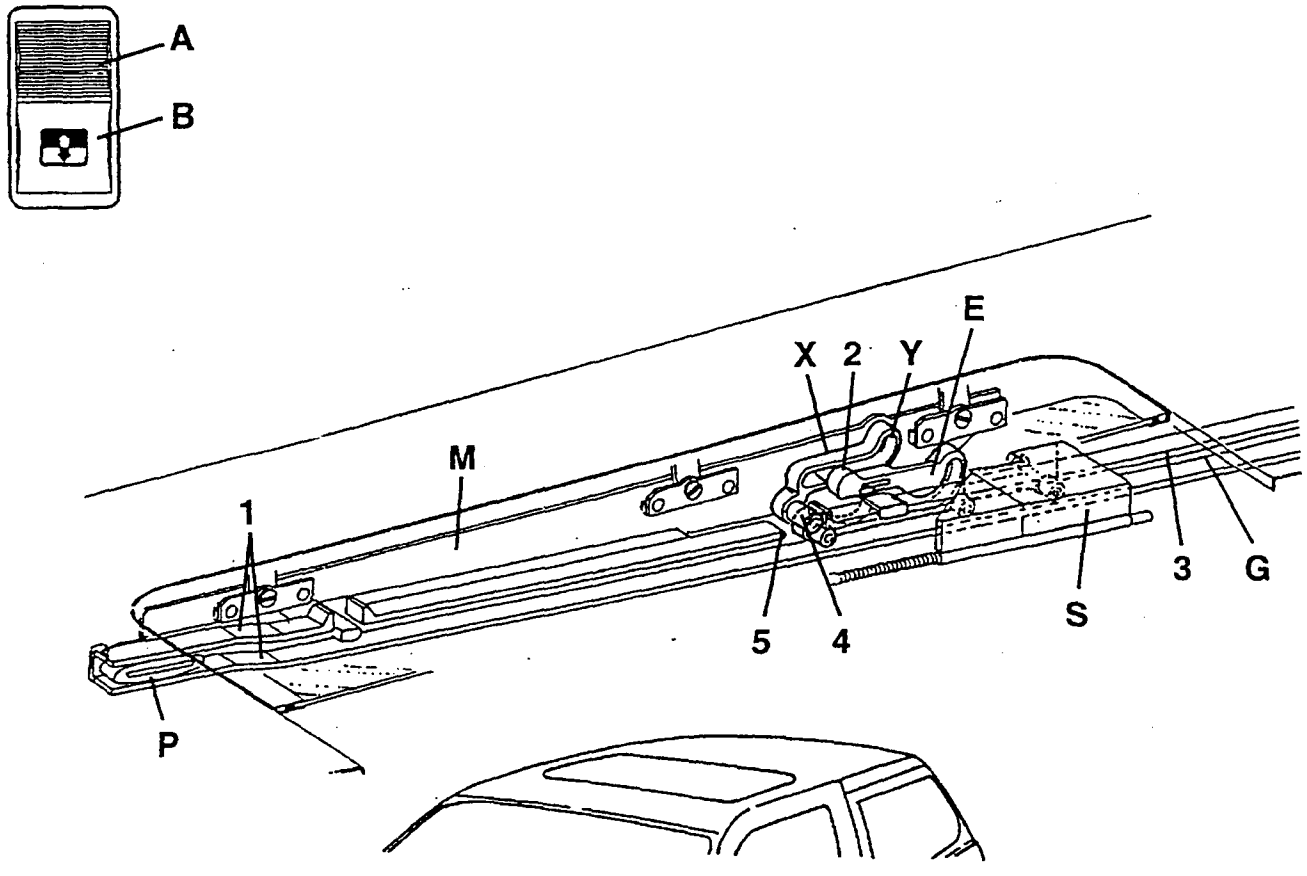
OPERATION

This paragraph describes the movements of the sunroof command mechanism in detail for opening/closing to both the hidden and quarterlight positions.
The flexible racks, moved by the electric motor, command the sliding of the runners **S** one on each side along the longitudinal rails **G**.
The pantograph element **E** is hinged to each runner and by the pin connected to the cam grooves, determines the movements of the bracket **M** to which the sunroof if fixed.
The front of the bracket is fitted with a runner **P** which runs in a groove.

Opening the roof

If, when the sunroof is closed, and side **A** of the control switch is pressed, the roof will begin to open.
From the closed position (position a) the runner **S** is pushed backwards by the flexible rack. The pin **(2)** of the pantograph **E** is moved from the **"X"** position to the **"Y"** position along the groove in the bracket **M** thus causing the rear part of the panel to be lowered so that it can slide into the compartment between the inner and outer roof panels.
At the same time pin **(4)** enters space **(5)** of guide **G** and is engaged under the groove **(3)**.
After the glass panel has begun to back off the runner **P** follows the curve **(1)** of the guiding groove and cause the front part of the panel to be lowered (position b).
The opening action is continued in this configuration until the runner **S** reaches the stop limit **(6)** in the guide **G** and the motor is deactivated (position c).

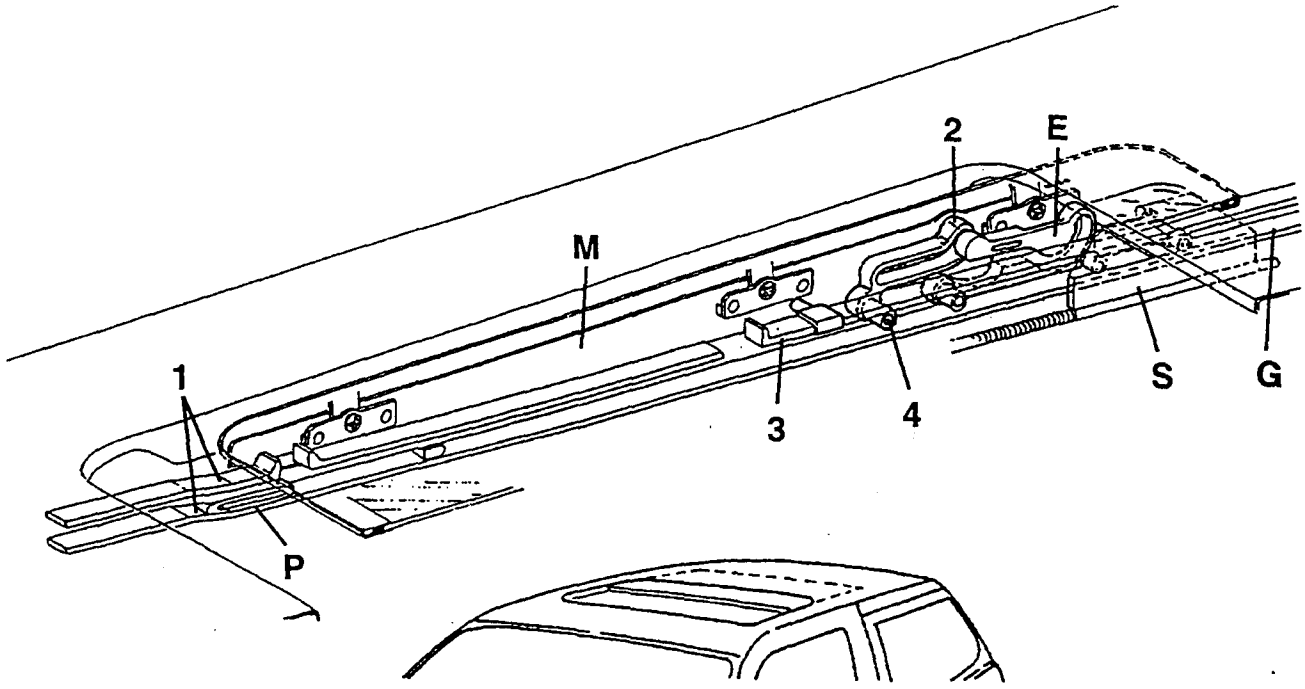
Position "a" - Roof closed



P. Runner
M. Sliding bracket
E. Pantograph element
G. Rail
S. Runner

1. Bend in guiding groove
2. Pantograph pin
3. Guiding groove
4. Pin
5. Guide space

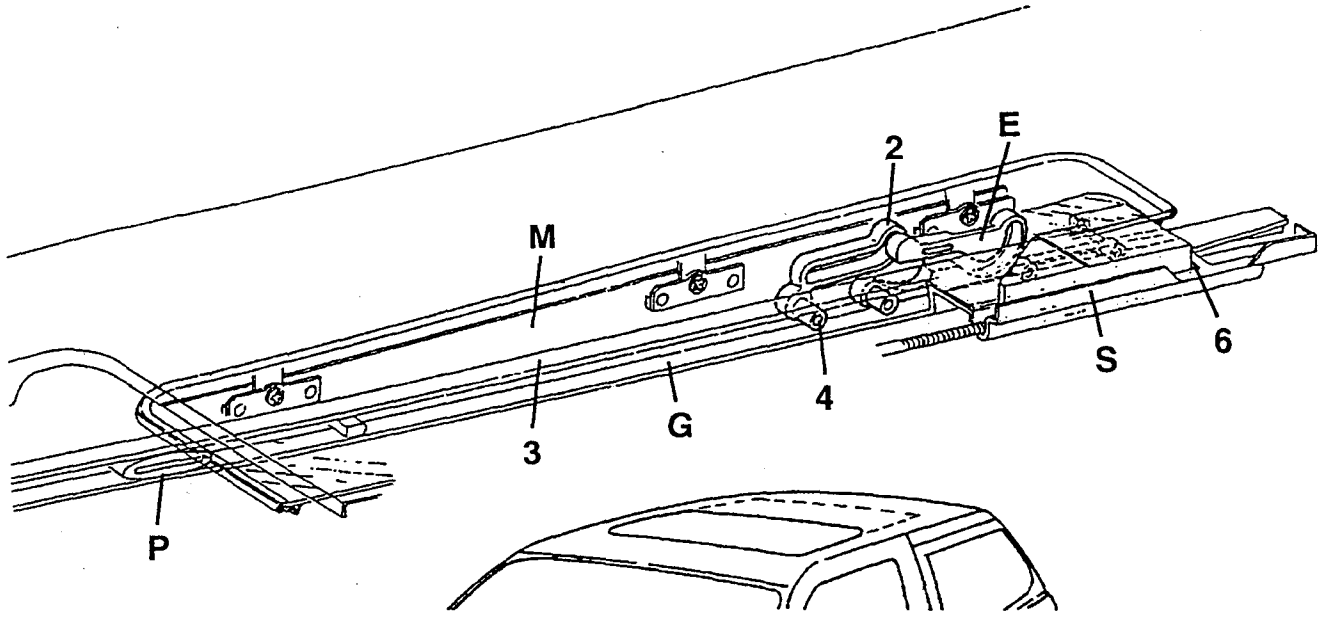
Position "b" - Roof during opening



P. Runner
M. Sliding bracket
E. Pantograph element
G. Rail
S. Runner

1. Bend in the guiding groove
2. Pantograph pin
3. Guiding groove
4. Pin

Position "c" - Roof completely open



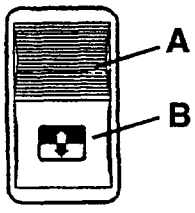
P. Runner
M. Sliding bracket
E. Pantograph element
G. Rail
S. Runner

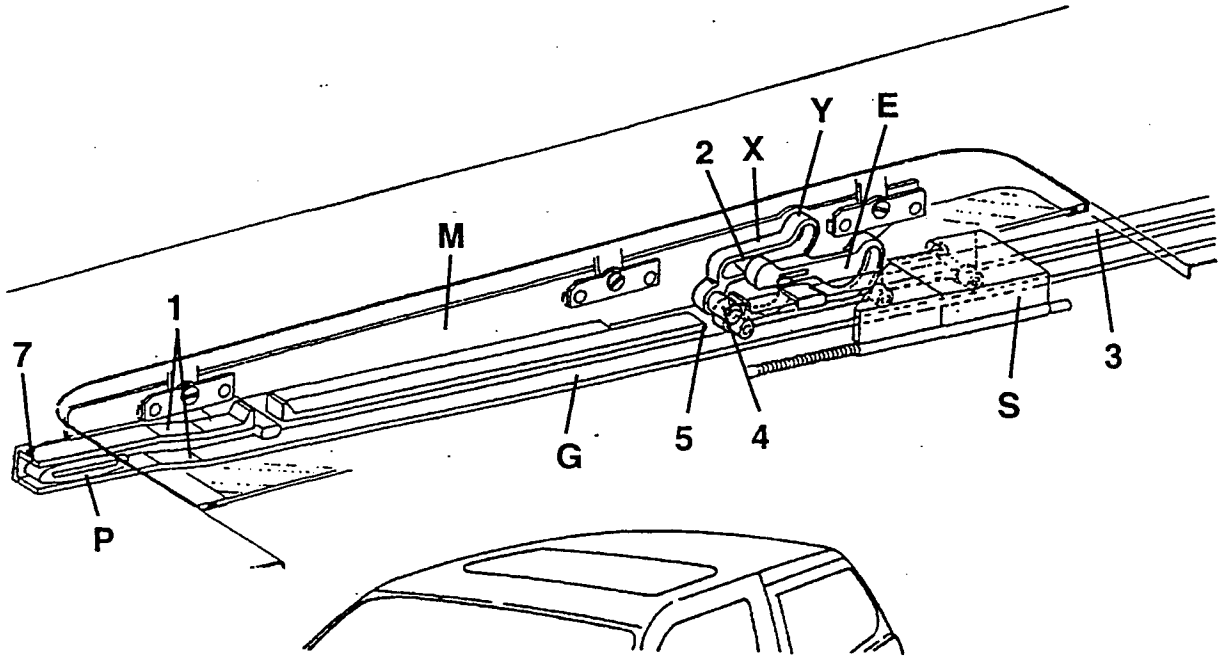
2. Pantograph pin
3. Guiding groove
4. Pin
6. Stop limit

Closing the roof

The roof is closed by the forward motion of the runner **S** maintaining the position illustrated in positions c and b until the runner support **P** reaches the stop limit **(7)** in the guide **G**. At this point the front part of the bracket **M** is locked but the runner **S** continues its movement allowing the pin **(4)** to come out of the groove **(3)** through space **(5)**. Pin **(2)** is forced to move along the groove in the bracket **M** from position **"Y"** to position **"X"** thus raising the glass panel so that it is flush with the outer roof panel. At this point the microswitch disengages the electric motor as the closed position has now been reached (position d).

Position "d" - Roof closed



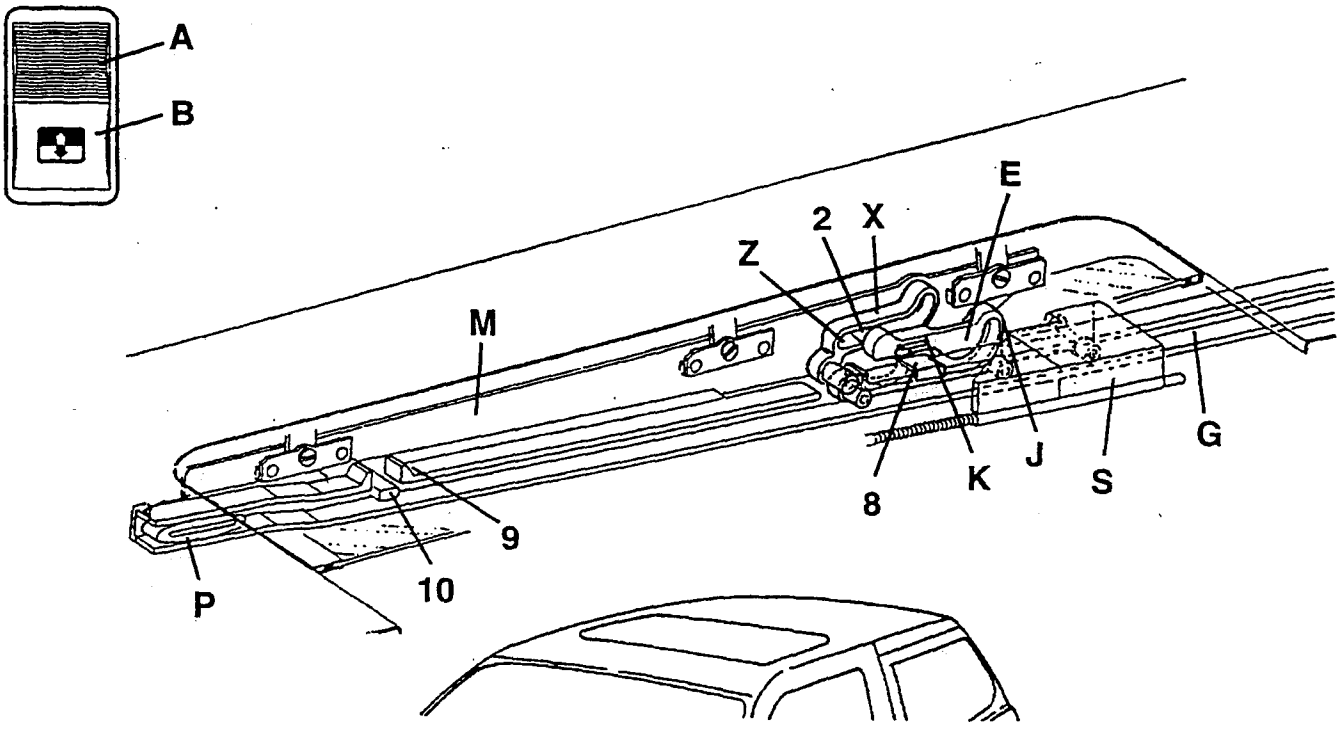


P. Runner
M. Sliding bracket
E. Pantograph element
G. Rail
S. Runner
1. Bend in guiding groove
2. Pantograph pin
3. Guiding groove
4. Pin
5. Guiding space
7. Stop limit

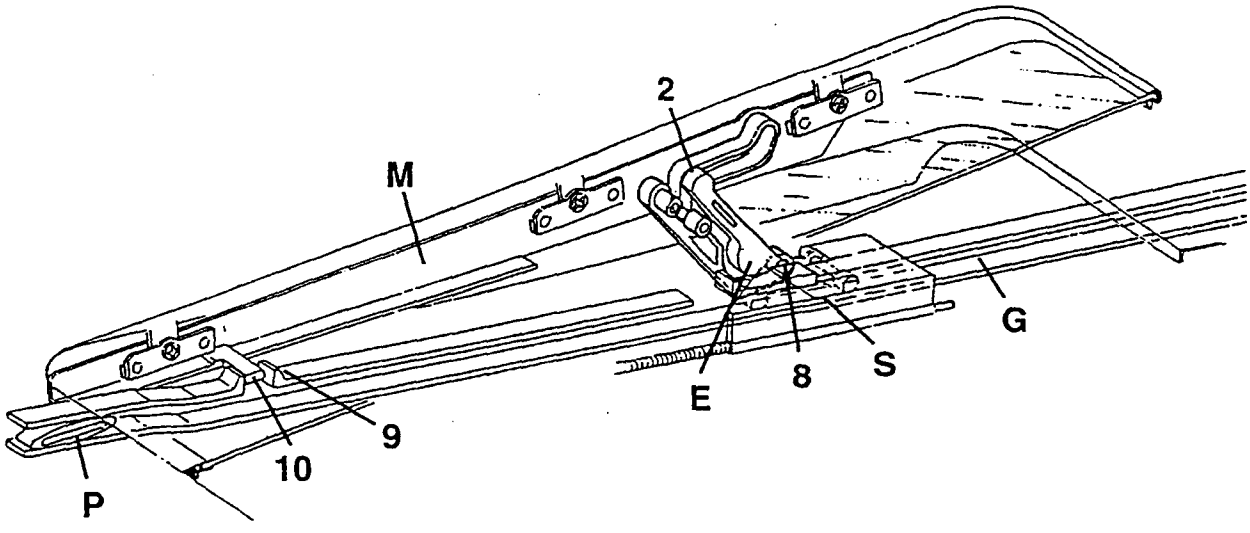
Opening to quarterlight position

If the control button is pressed again (press side **B**) runner **S** moves forwards.
The pin **(2)** passes from position **"X"** to the end **"Z"** of the groove in the bracket **M** (position a).
Pin **(8)**, fixed to the guide, slots into the groove in the pantograph **E** passing from position **"K"** to position **"J"** (positions a and b).
The forward movement of the runner thus causes the pantograph device to lift up in turn causing the rear part of the roof to also lift up.
Towards the front the pin **(10)** is forced to enter the slot **(9)** causing the front end of the panel to back off a few millimeters so that it does not get in the way of the front edge of the sunroof housing frame.
The sunroof is closed (position a) by pressing side **A** of the button again.

Position "a" - Roof closed



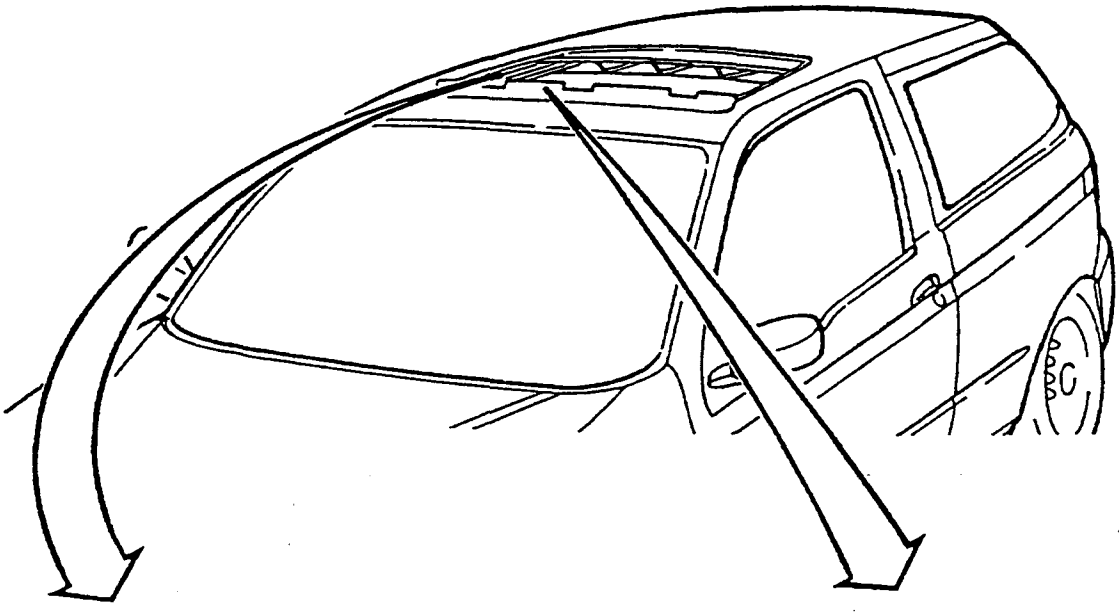
Position "b" - Roof opened to the quarterlight position

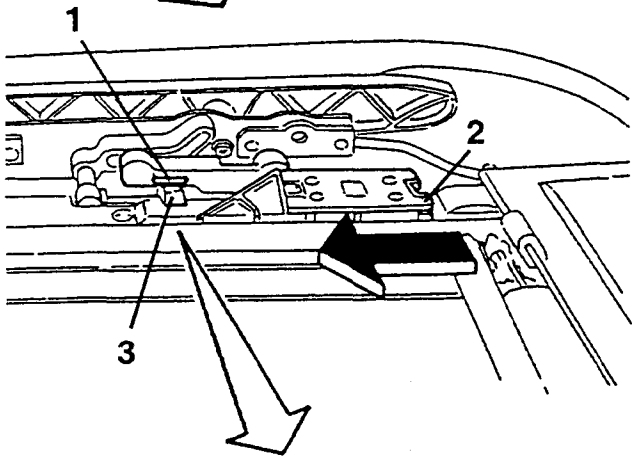


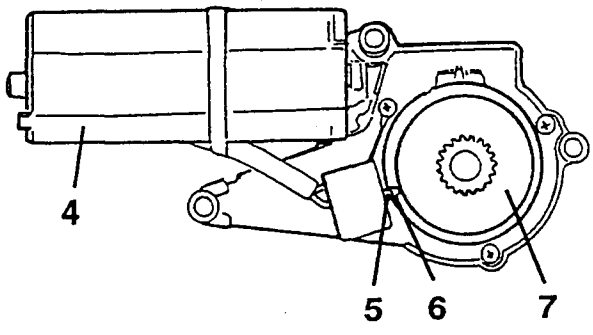
P. Runner
M. Sliding bracket
E. Pantograph element
G. Rail
S. Runner
2. Pantograph pin
8. Guide pin
9. Guiding slot
10. Pin

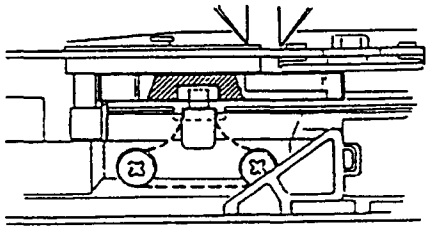
Alignment of Runners and Motor

If, following maintenance interventions, the coupling must be restored between the rack and the motor the system must be first set in a certain position.
After disconnecting the glass roof and the motor, though maintaining the electrical connection, the runners **(2)** must be manually moved to the rear part and then returned to the front part until the slot **(1)** and the abutting surface **(3)** of the guide pin are perfectly aligned.
Activate the electric motor **(4)** until the pin **(5)** of the microswitch is engaged in the hollow **(6)** of the plastic wheel **(7)**.
Starting from this position the electric motor and sunroof can be refitted.





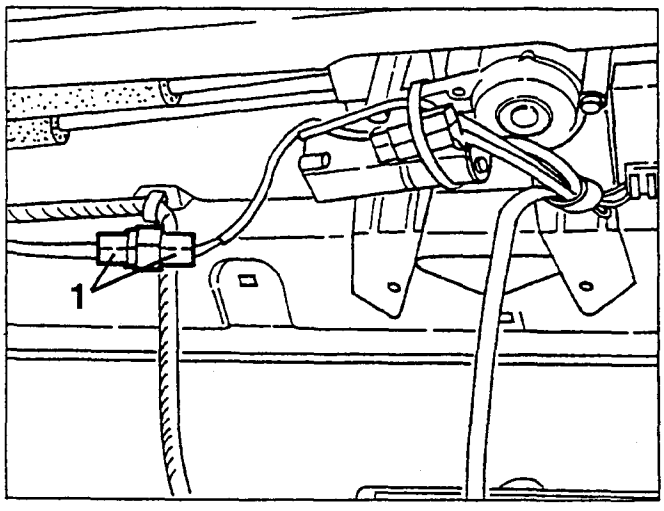




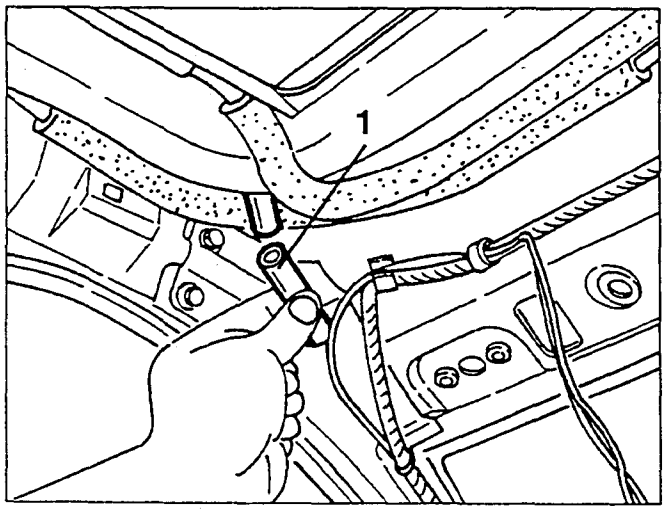
1. *Slot*
2. *Runner*
3. *Abutting surface*
4. *Electric motor*
5. *Pin*
6. *Hollow*
7. *Wheel*

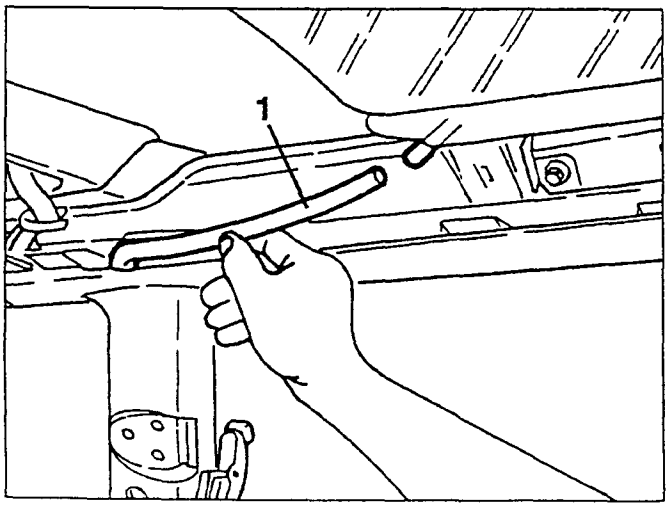
REMOVAL/REFITTING

- Remove the roof panel (see specific paragraph).
1. Disconnect the electrical connection from the sunroof motor.

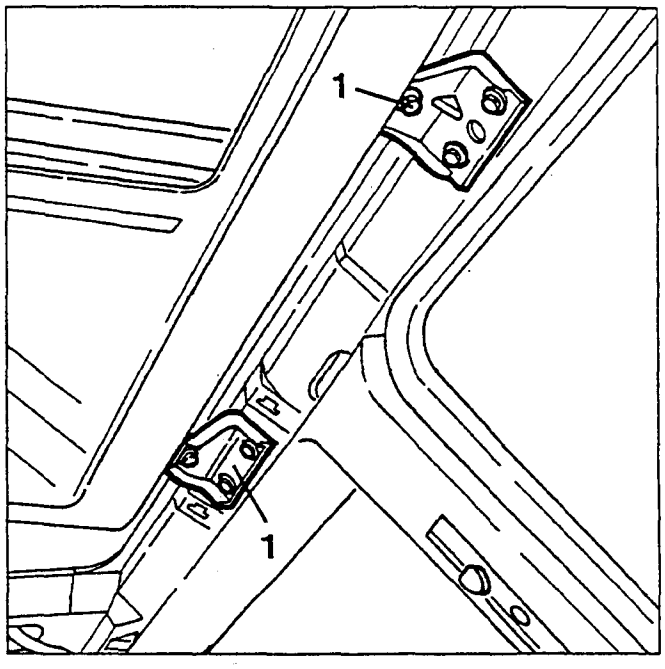


1. Disconnect the front and rear drainage hoses.

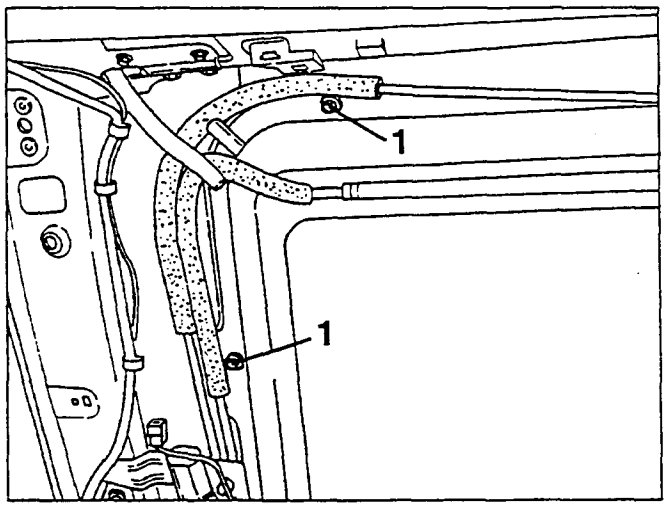


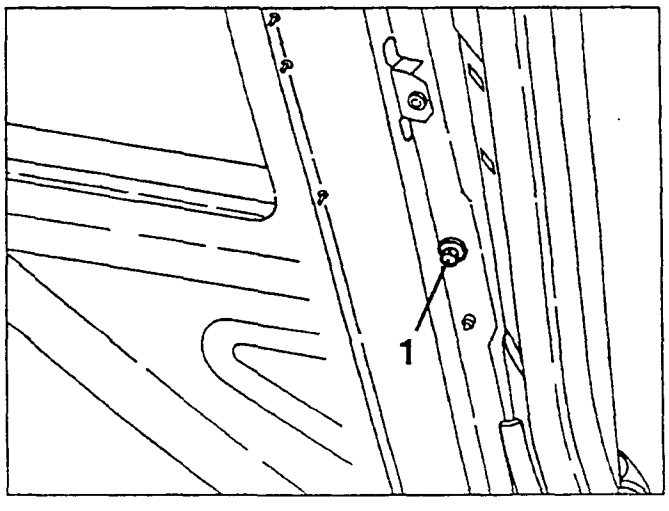


1. Loosen the screws securing the side brackets supporting the sunroof and remove the screws.



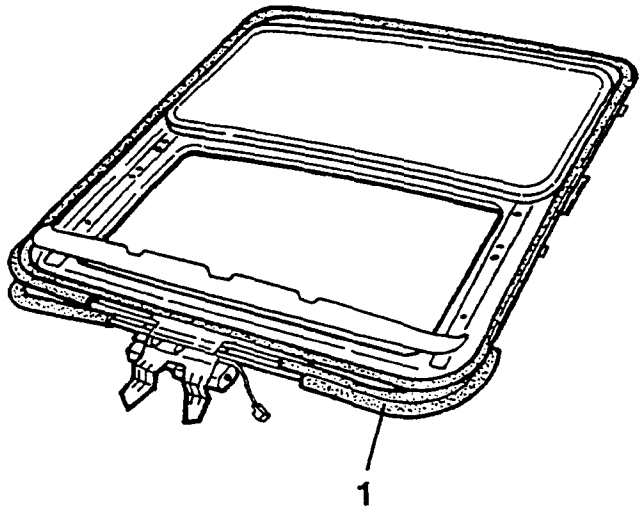
1. Loosen the four side screws and the two front screws securing the sunroof.



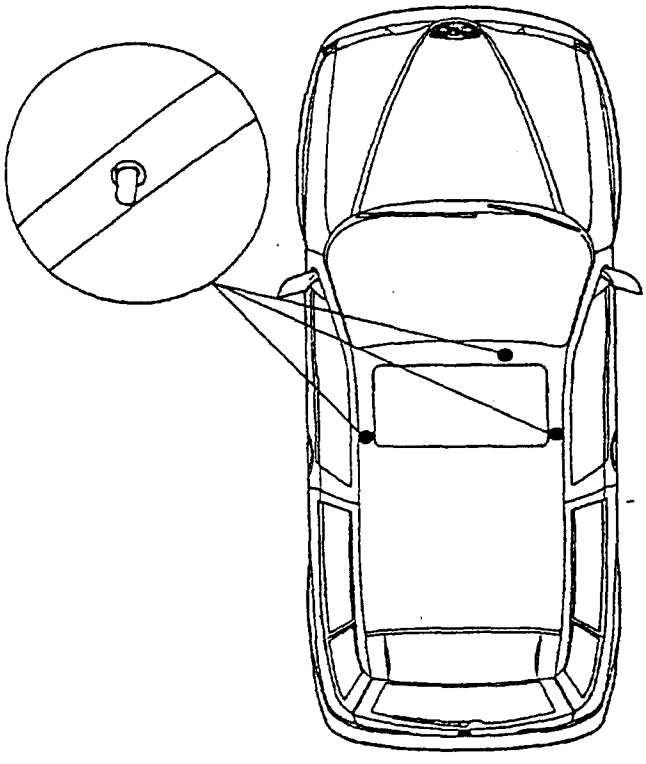


1. Remove the sunroof through the right-hand door.

NOTE:
When refitting the sunroof check that the seals are present around the edge, that the tubular seals are present on the rack guides and the vibration buffers are on the centering pins.

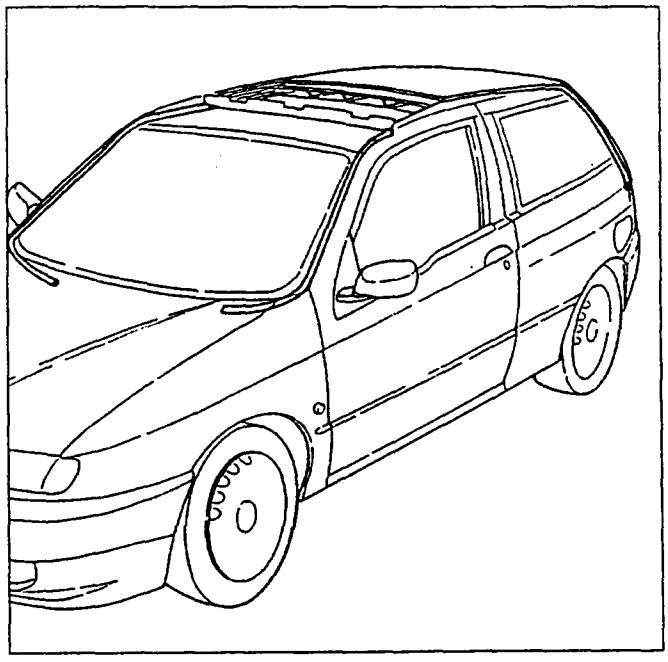


When refitting position the sunroof in the vehicle using the three centering pins as reference marks.



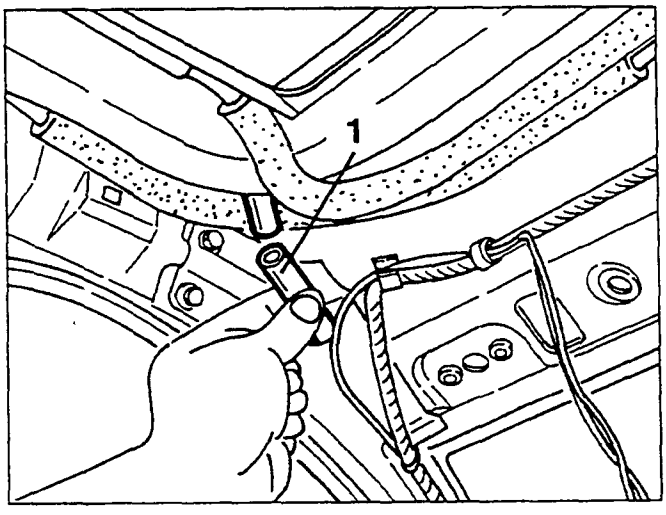
- After refitting check the alignment of the sunroof and that it works correctly.

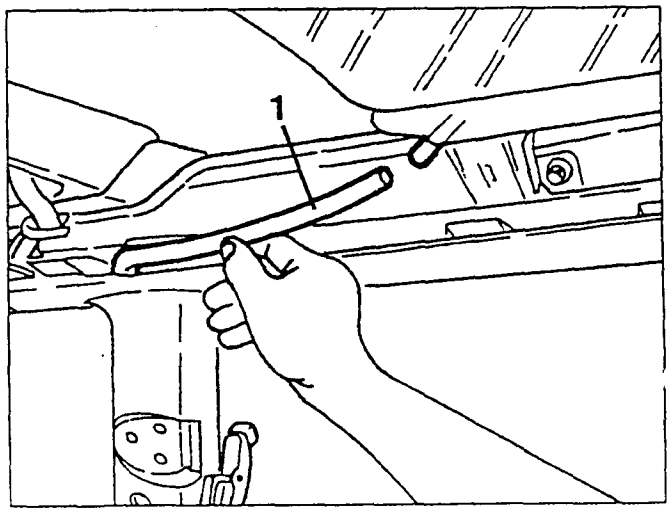
WATER DRAINAGE HOSES



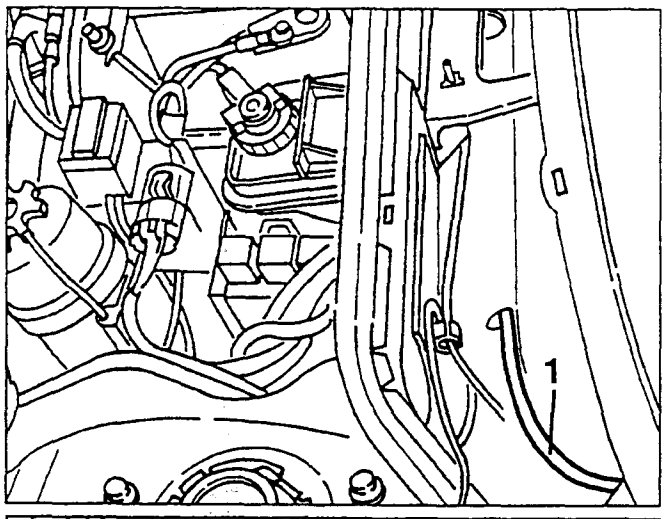
Removal/Refitting

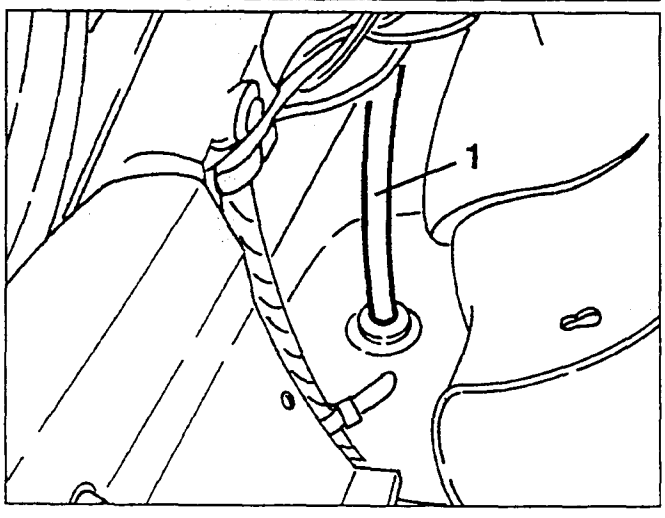
- Remove the roof panel (see specific paragraph).
1. Disconnect the front and rear drainage hoses from the sunroof and withdraw them.





1. Refit the front and the rear drainage hoses as shown in the diagram.

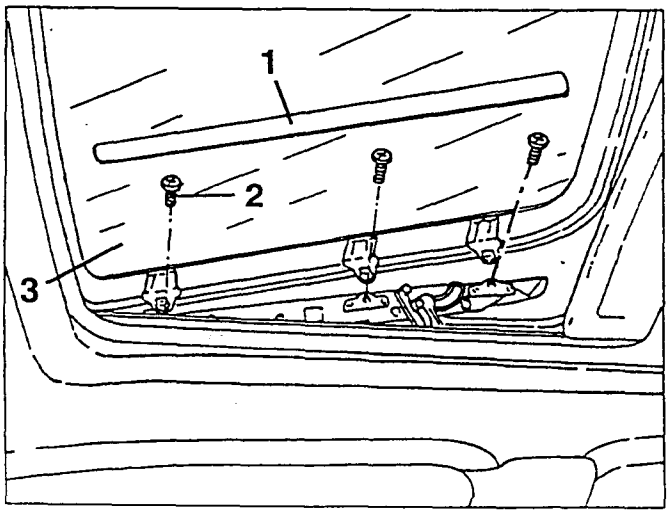




SUNROOF GLASS PANEL

Removal/Refitting

- Open the sunroof to the quarterlight position.
1. Open the sliding blind and remove the two protective strips.
2. Loosen the three screws securing each side of the glass to the sliding mechanisms.
3. Lift up the glass and remove it from the outside.



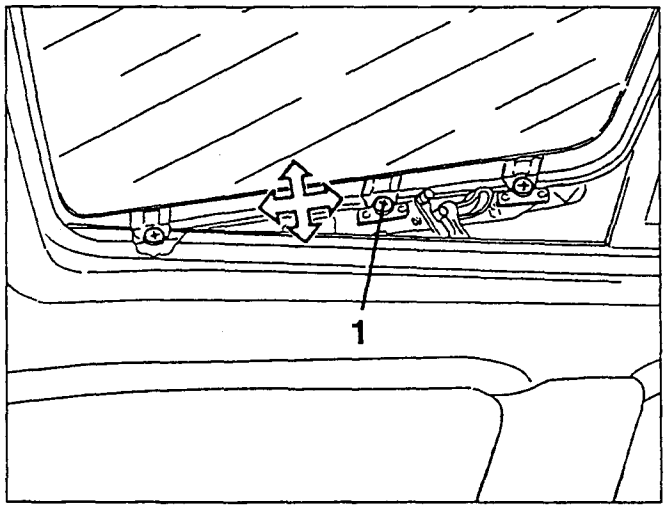
- If necessary replace the sunroof seal (the joint in the seal is towards the front).

NOTE:
After refitting adjust the position of the sunroof glass as described in the following paragraph.

ADJUSTING THE POSITION OF THE SUNROOF GLASS

NOTE:
To adjust the position of the sunroof glass two operators are needed, one working from the inside and one from the outside.

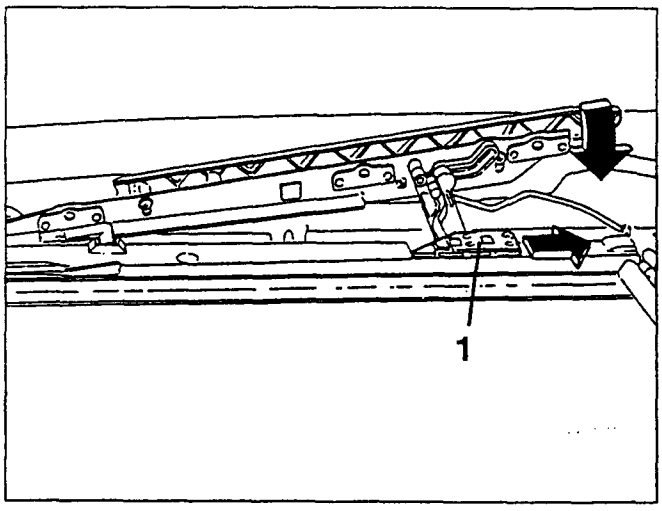
The operator working outside the vehicle centres the glass in its seating in the roof of the vehicle and level with the surface of the roof. The operator working on the inside tightens the adjustment screws.
- Open the sunroof the quarterlight position.
- Remove the internal protective strips from the sliding mechanisms.
- Close the roof.
1. Loosen the six adjustment screws (three screws on each side).
- Correctly position the glass longitudinally and vertically.
- Tighten the six screws.



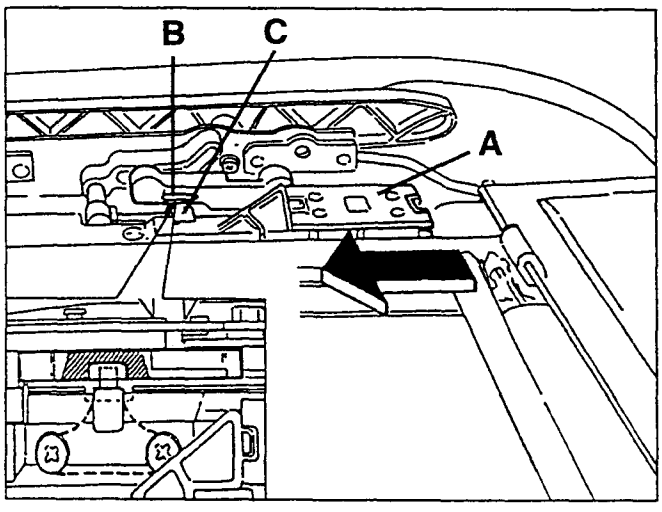
ALIGNING THE RUNNERS

If the parts of the sunroof command system are malfunctioning and/or being replaced it is also necessary to realign the runners which carry the roof and the relative coupling with the motor, as follows:
- Remove the glass from the sunroof (see specific paragraph)
- Disconnect the electric motor without however disconnecting the electrical connections (see specific paragraph).

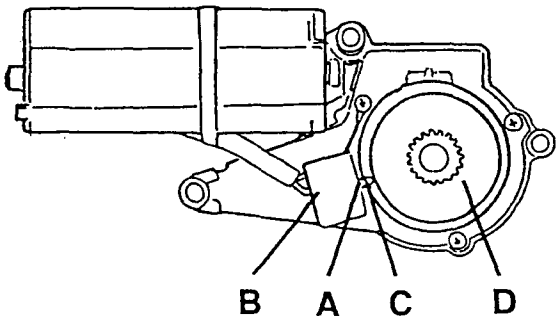
1. Manually push the runners to the rear part of the roof compartment.



- Manually return the runners (A) to the front area until the slot (B) and the abutting face (C) of the guide pin are perfectly aligned.



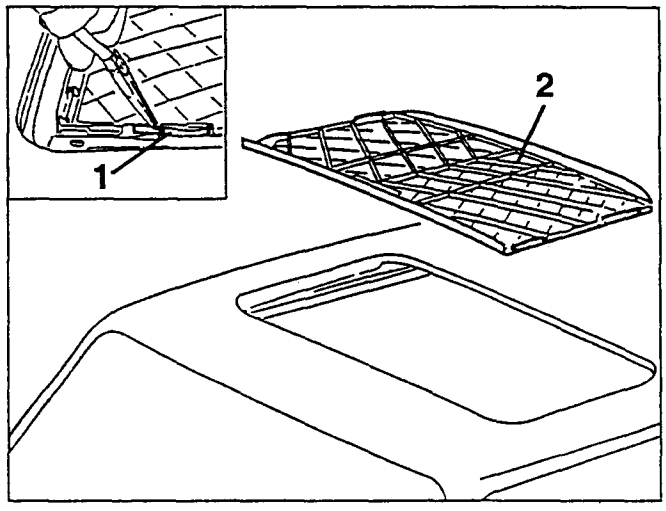
- Insert the sunroof command switch into its connector.
- Work the electric motor until pin (A) of microswitch (B) is engaged in the hollow (C) in the plastic wheel (D).
- Without adjusting the position of the runners refit the motor and tighten the three screws.
- Refit the glass panel and the front roof light operating as shown in the relative paragraphs.



SLIDING BLIND

Removal/Refitting

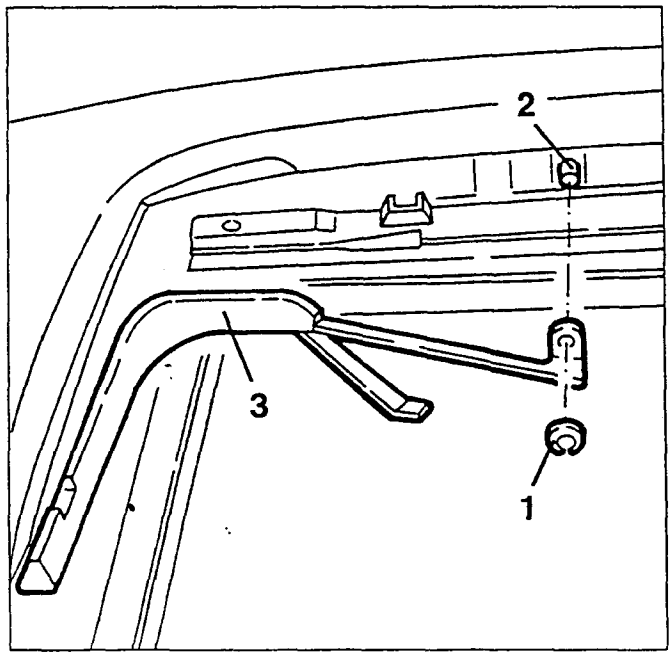
- Remove the glass panel (see specific paragraph).
- Move the blind to the closed position.
1. Using a suitable tool release the springs on one side of the blind from the guide.
2. Free the sliding blind and remove it from the front end.



MOBILE SPOILER

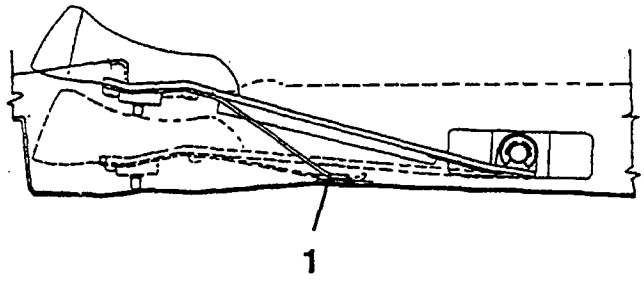
Removal/Refitting

- Open the sunroof .
1. Remove the seeger from each side.
2. Remove the bracket from the pin.
3. Remove the deflector.



When refitting reverse the procedure followed for removal and note the following:

1. Grease the mating surfaces between the flexible spring and frame.

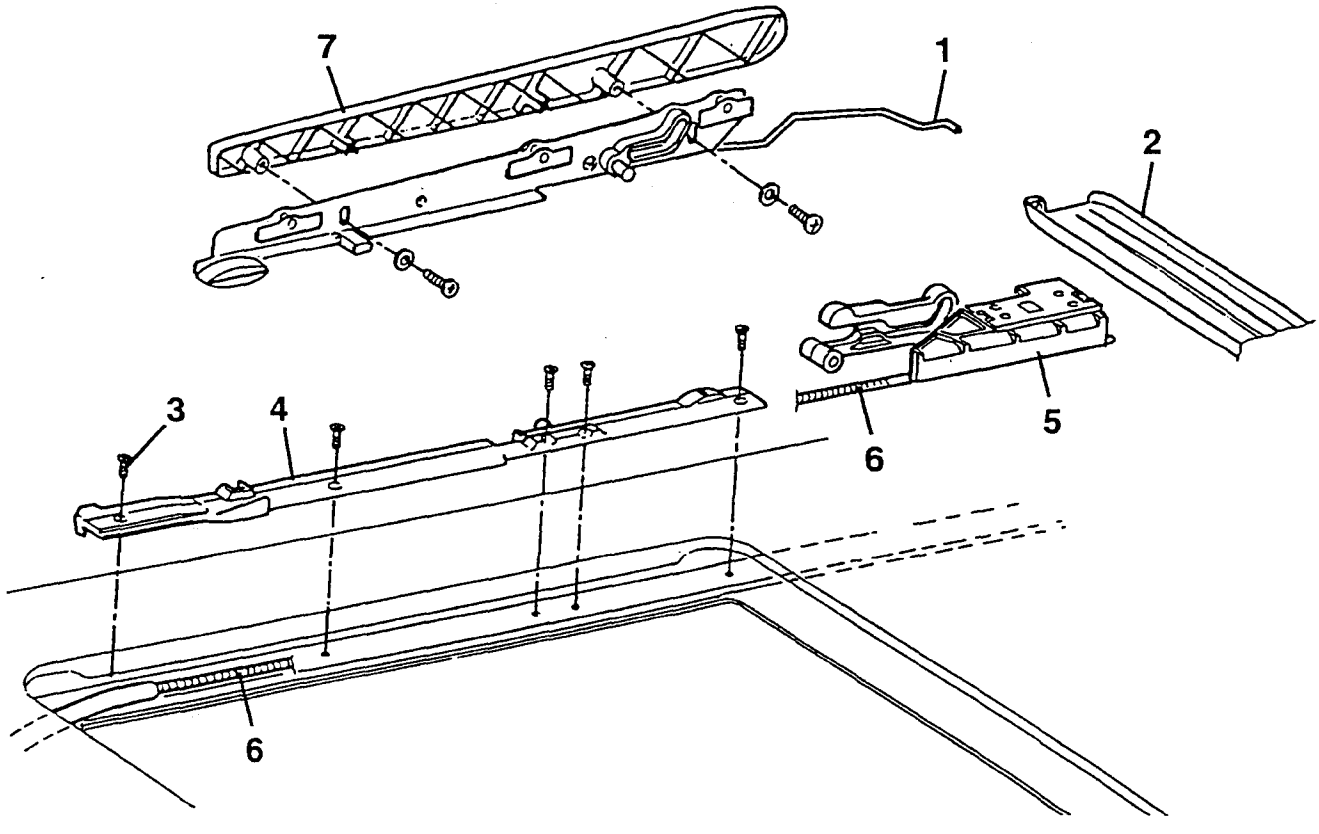


RUNNERS AND RACKS

Removal/Refitting

- Remove the glass panel (see specific paragraph).
- Remove the sliding blind (see specific paragraph).
- Remove the electric motor (see specific paragraph).

1. Free the water connection channel from the two connecting pins holding it to the runners.
2. Back-off the channel.
3. Loosen the five screws moving the runners bit by bit to enable them to be removed.
4. Remove the guides.
5. Remove the entire runner.
6. Withdraw the flexible rack from the guide track.
7. If necessary loosen the two screws and separate the external moulding.



When refitting reverse the procedure followed for removal and note the following:
- When inserting the flexible rack in the guiding tracks check that the second section of track slides correctly in the gear seating.
- Align the runners (see specific paragraph) and refit the electric motor.
- Refit the various parts by following the procedures given the the relative paragraphs.

MOBILE WATER CHANNEL

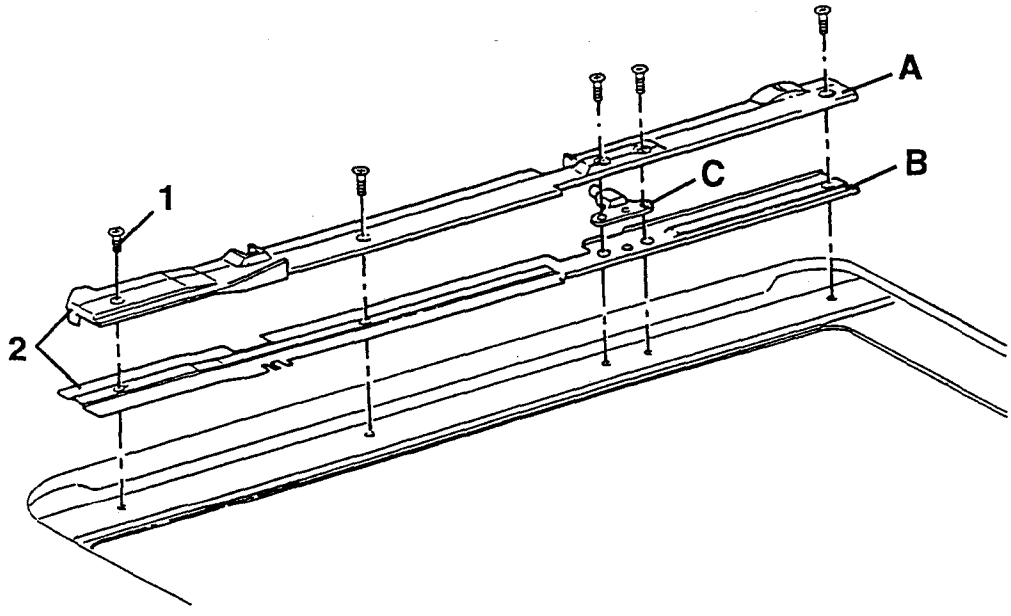
Removal/Refitting

NOTE:
The procedure for disassembling the channel is similar to that for dismantling the runners (see specific paragraph).
It is only necessary to remove one runner to free and remove the channel.

GUIDES

Disassembly and Reassembly.

- Fully open the sunroof.
1. Loosen the five screws securing each guide.
2. Remove the complete guide.
3. Separate the plastic upper part (A) from the lower part (B) and remove the guide pin (C).



SUNROOF ELECTRIC MOTOR/RELAY

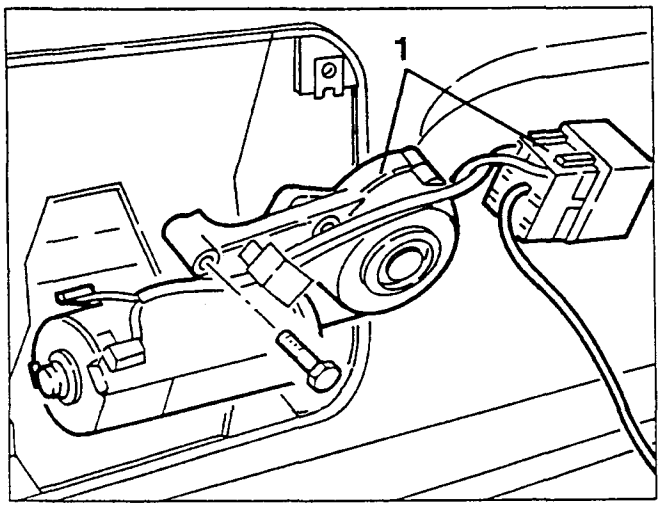
Removal/Refitting

NOTE: In the event of a failure of the electric motor, it is possible to move the roof to the required position operating the motor manually (see "EMERGENCY MANUAL OPERATION OF THE SUNROOF").

- Move the sunroof to the closed position flush with the roof.
- Remove the front passenger compartment ceiling light (see GROUP 55).

1. Slacken the three fastening screws and withdraw the motor- control relay assembly just enough to disconnect the electrical connection, then remove it.

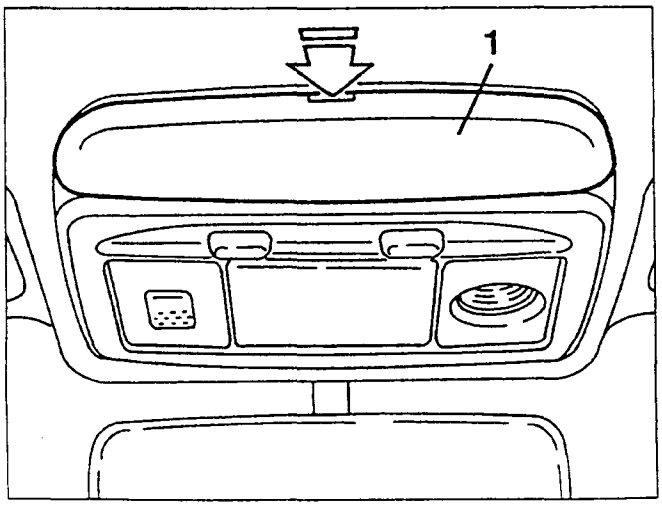
- On the bench, remove the relay from its base.



EMERGENCY MANUAL OPERATION OF THE SUNROOF

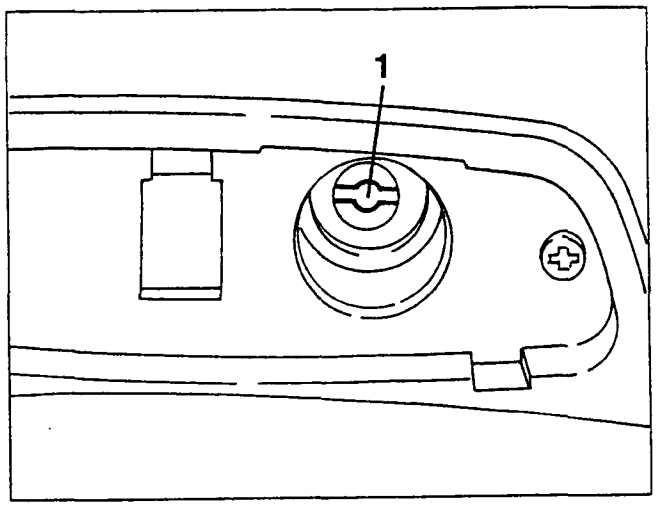
If the electric control device fails to work, the sunroof can be operated manually as follows:

1. Levering in the point shown by the arrow, remove the cover.



1. Using the special wrench provided in the car tool bag, turn the bush of the sunroof gear motor until the roof is brought to the required position.

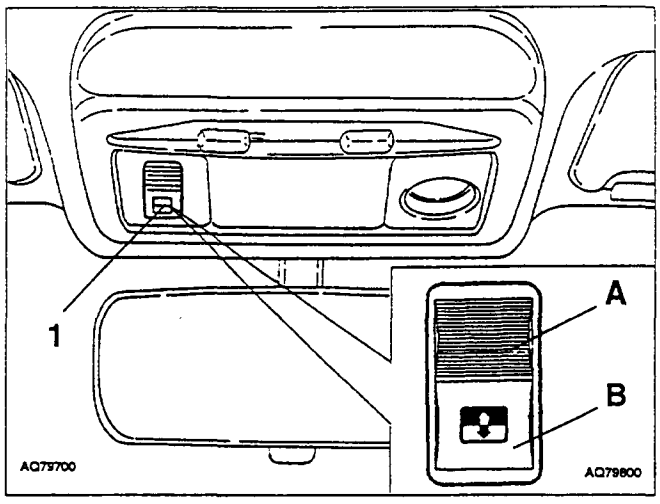
NOTE: When this operation has been completed, before removing the wrench, it must be turned half a turn in the opposite direction to before until a click is heard.



SUNROOF

GENERAL DESCRIPTION

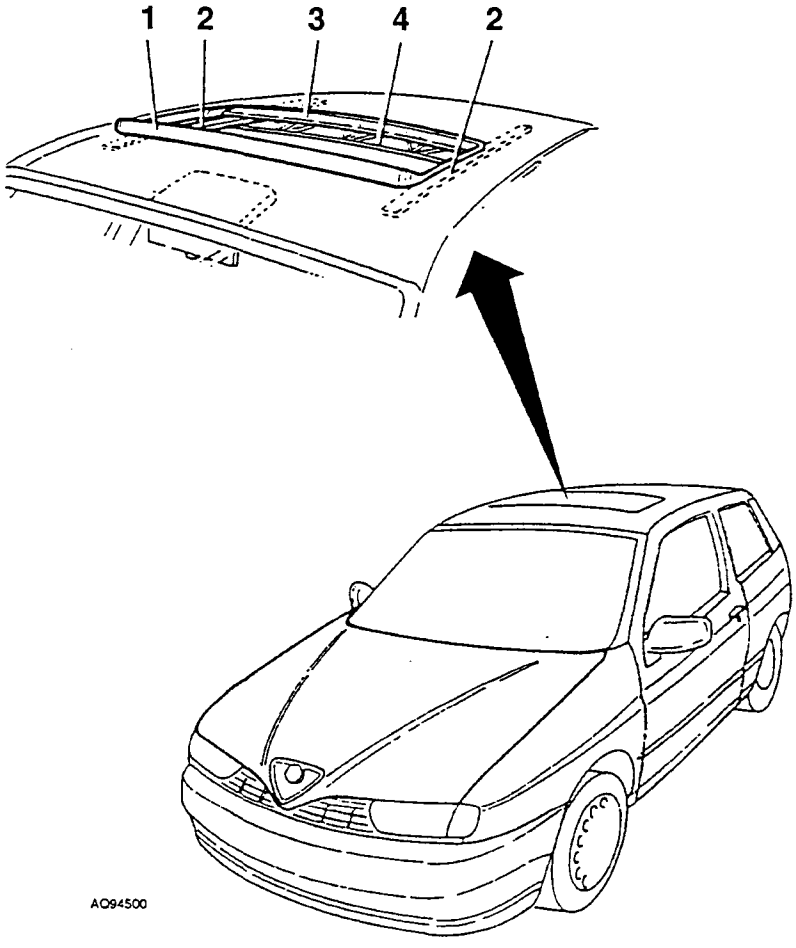
The sunroof (INALFA) is of the glass type with sunshade curtain and it can be distinguished from the previous one (WEBASTO) by the completely smooth outer deflector (rather than having three grooves).
The sliding mechanisms of the sunroof enable two different types of positioning:
a "concealed" position, by which it can be partially or completely opened, making it slide completely into the gap between the roof panel trim and the roof panel.
a "quarter-light" position, by which the roof is raised to allow air to escape from the passenger compartment but limits ventilation.
The sunshade is also housed, in the opening position, in the space between the roof panel trim and the roof panel.
The sunroof is operated by a pushbutton (1) located on the front roof light; the type of resulting movement (closing/"quarter-light" opening or "concealed" opening) is caused by the profile of the cams machined on the runners and by the sliding of the runners inside the guides.



The sunroof operating sequence is described in the following table:

Initial position	Operation	Position obtained
Completely open	Press «A»	Closed
Closed	Press «A»	Quarter-light
Quarter light	Press «B»	Closed
Closed	Press «B»	Completely open

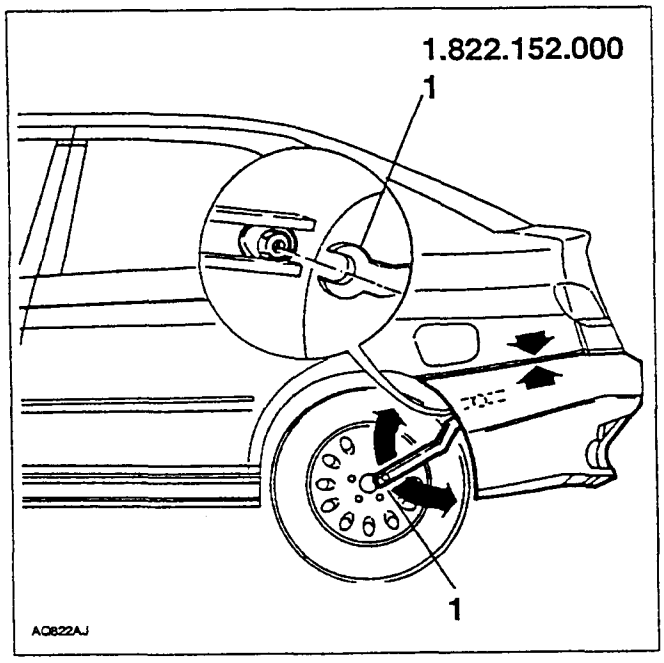
The sunroof (see Figure) consists of an external glass (3), sliding on guides (2), an outside deflector (1) and the glass moving device.



REFITTING

- When refitting, reverse the sequence described for removal.

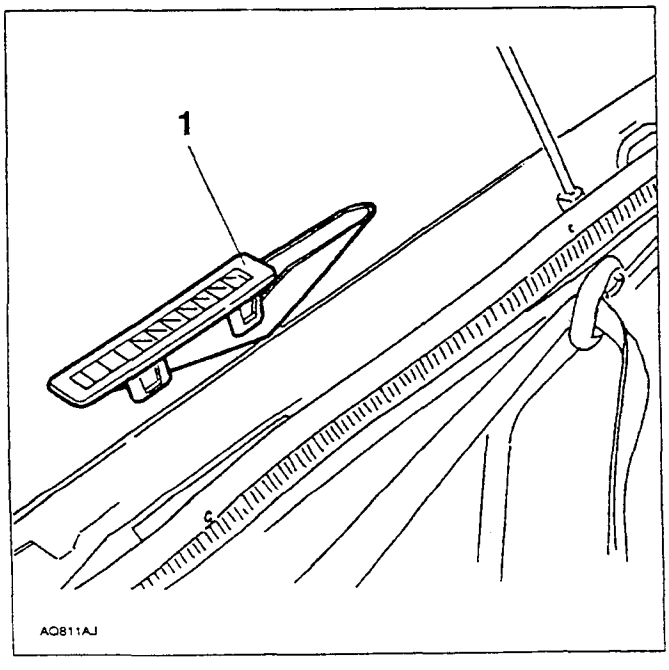
1. Adjust the position of the bumper acting on the eccentric side guides, always remembering to turn them clockwise to avoid loosening them.



PASSENGER COMPARTMENT AIR VENT GRILLE

REMOVAL/REFITTING

- Open the tailgate.
- Using tool **1.823.014.000**, prise the grille and remove it.

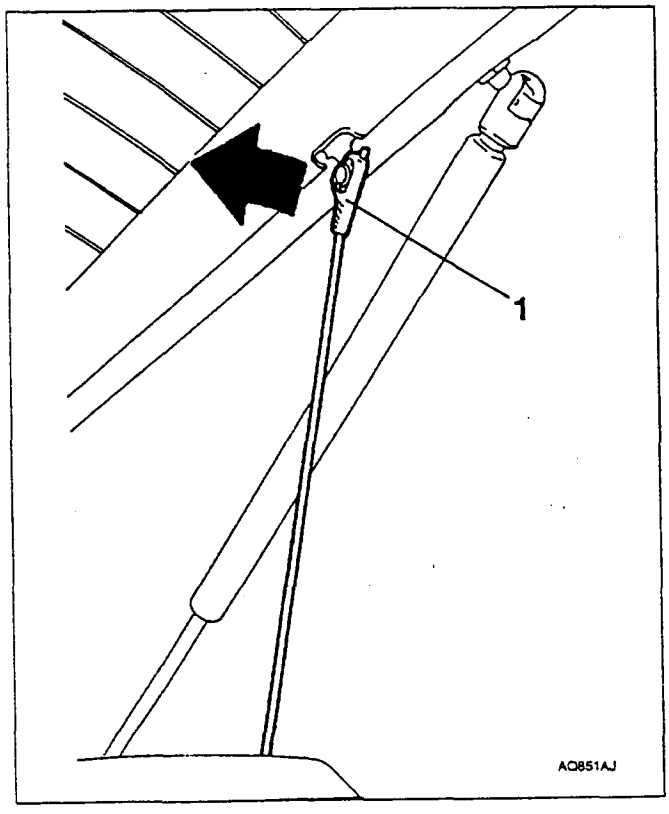


REARSCREEN

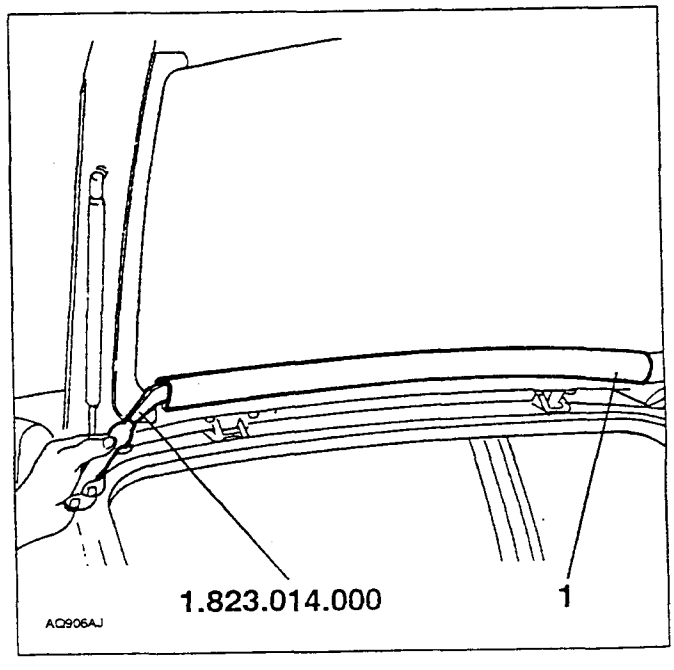
REMOVAL

- Disconnect the battery negative pole (-).

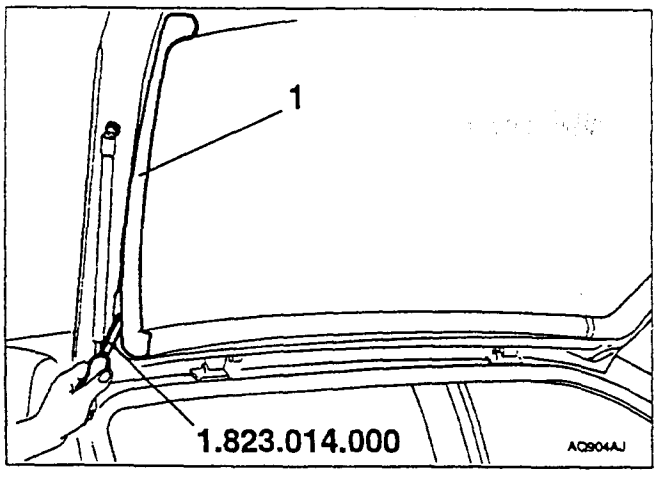
1. Open the tailgate and release the supports of rear shelf.



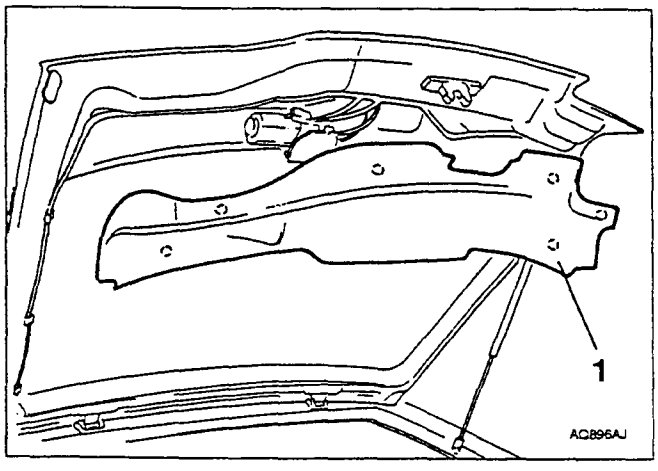
1. Using tool **1.823.014.000**, release the upper tailgate trim and remove it.



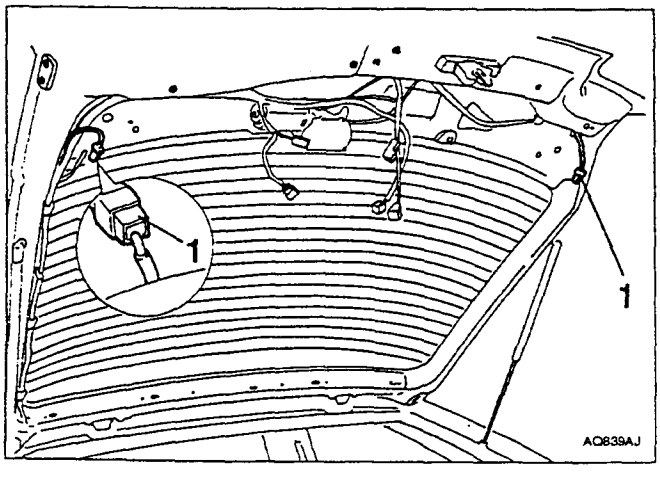
1. Using tool **1.823.014.000** release the right and left side trims.



1. Using tool **1.823.015.000** release the lower tailgate trim from the plastic nails (eight) and remove it.

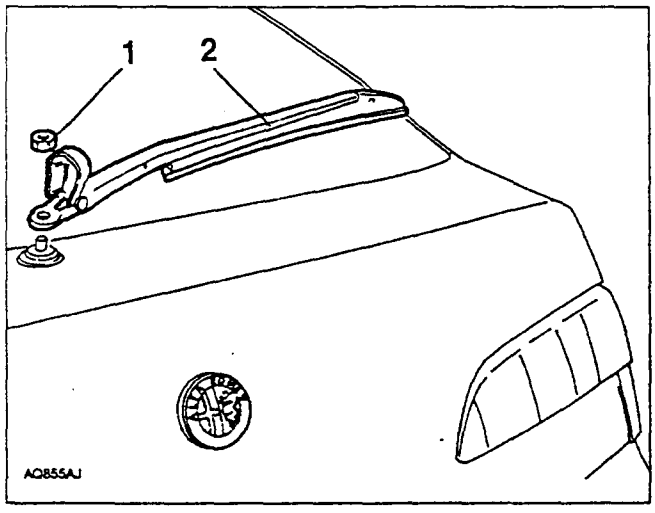


1. Disconnect the right and left rearscreen heating connectors.



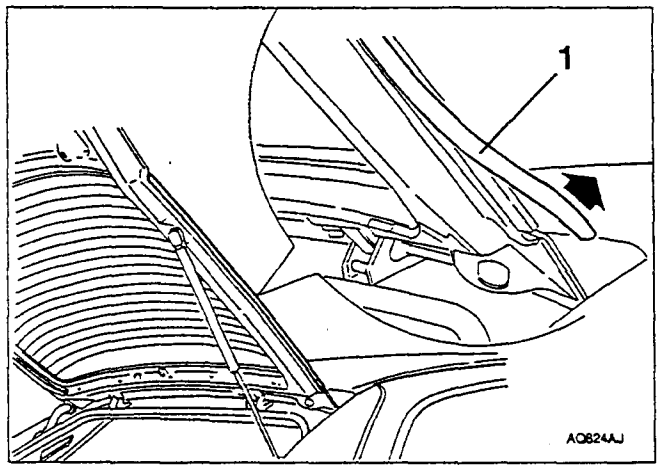
1. Lower the tailgate, lift the protection cap and slacken the nut fastening the rearscreen wiper arm.

2. Remove the rearscreen wiper arm.

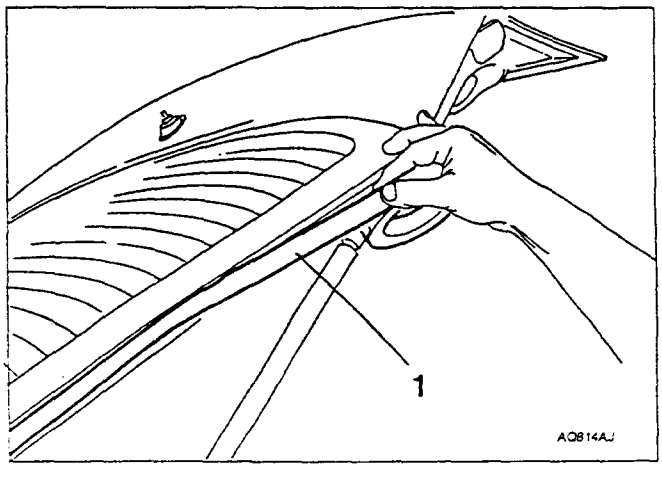


1. Remove the 2 side seals.

Always replace the side seals with new ones when refitting.

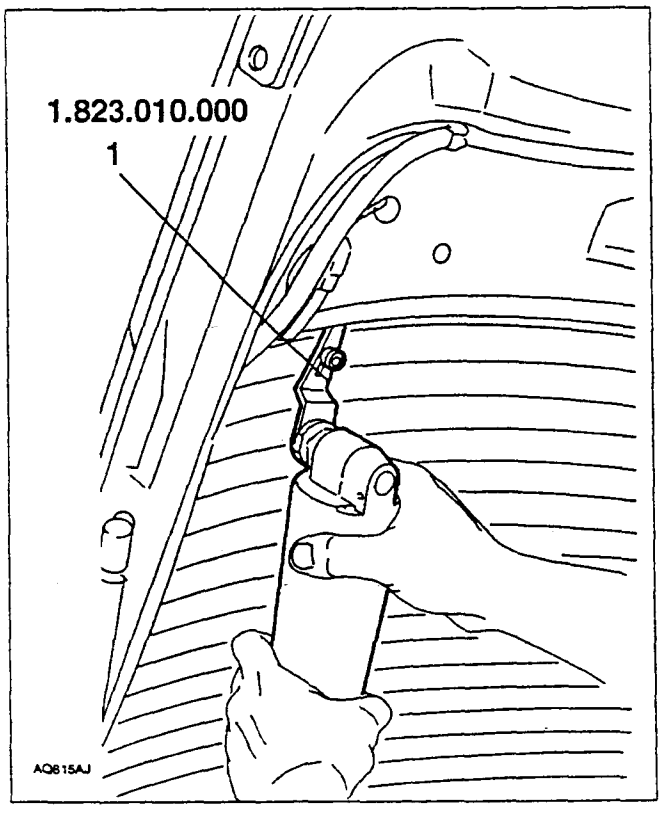


1. Protect the side edge of the tailgate on which the pin of the electric cutter blade will rest with adhesive tape.

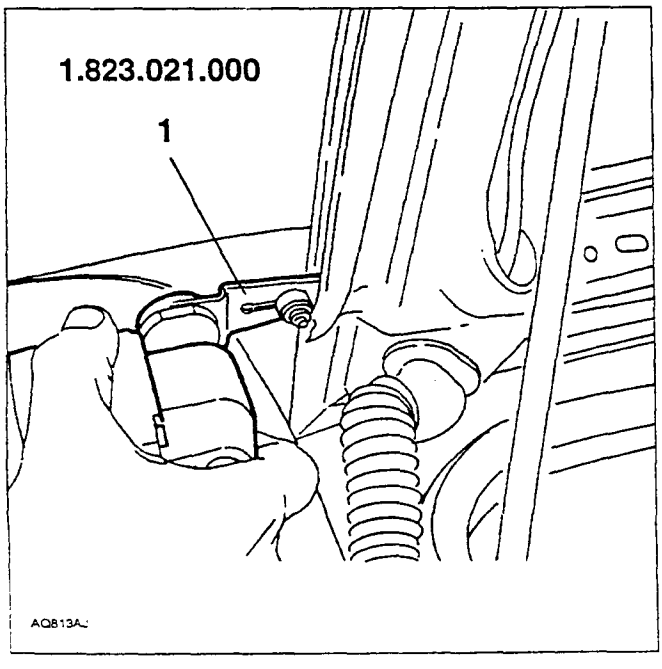


1. Using an electric cutter with blade **1.823.010.000** and working from inside the tailgate, cut the sealant on the upper and lower ends.

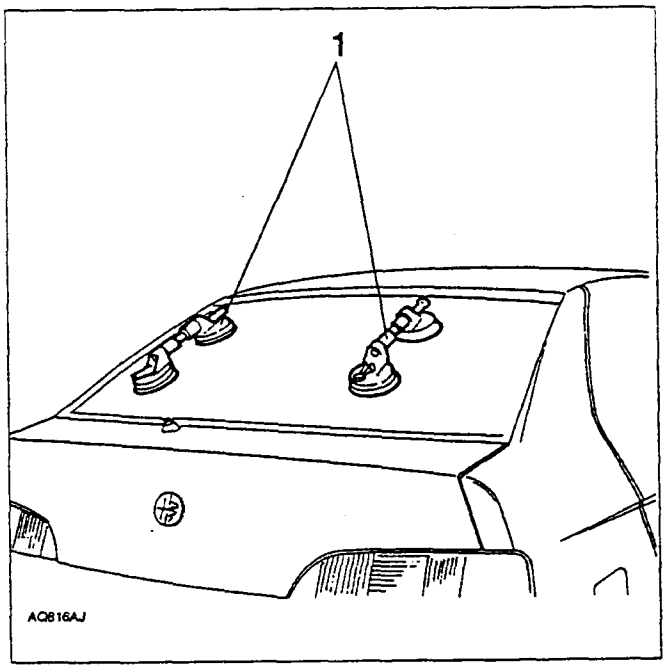
Adjust the blade thickness to avoid damaging the bodywork.



1. Using an electric cutter, fitted with blade **1.823.021.000** and working from the outside of the tailgate, cut the sealant on the sides.



1. Remove the rearscreen using the special suction grips.

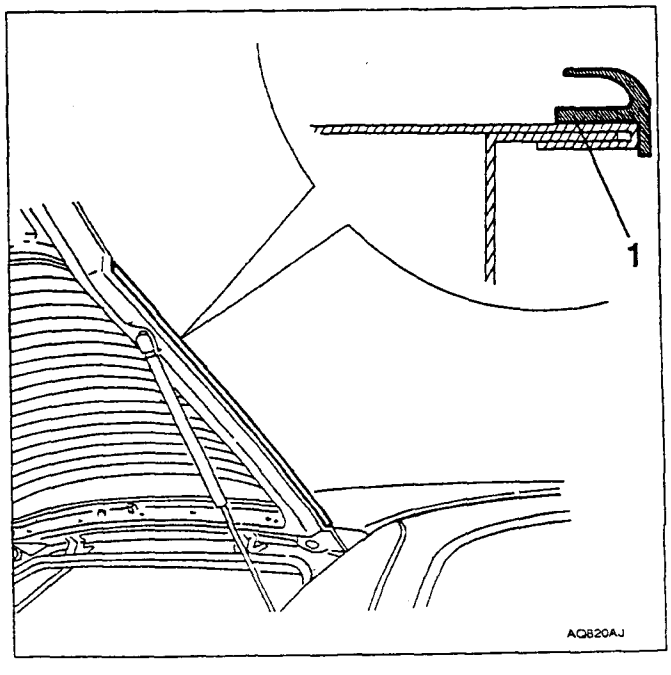


NOTE: the rearscreen may be re-used also in the event of breakage/shearing of one or more of the centering peg supports.

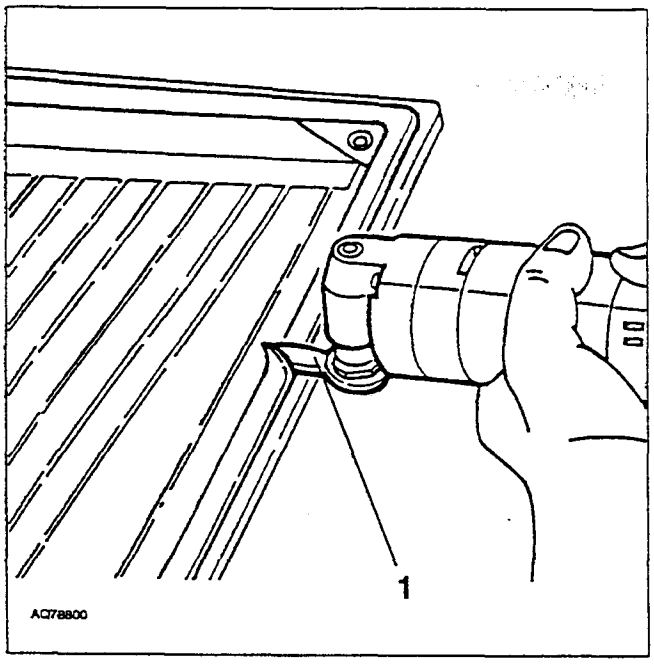
REFITTING

- Clean the perimeter of the rearscreen rest area of the remaining sealant and eliminate using a dry cloth or compressed air.
- Restore any damaged paintwork caused when cutting the sealant.

1. Install two new side seals on the tailgate.



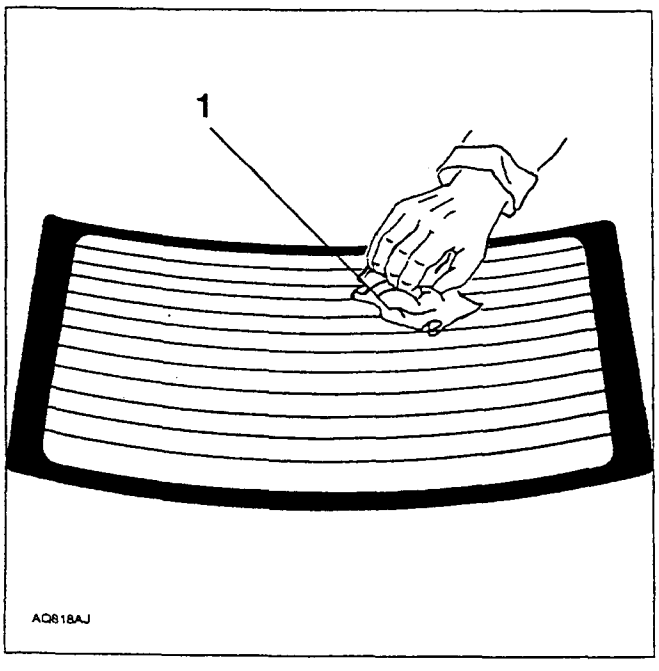
1. *If the original rearscreen is to be re-used*, remove the residual sealant from the edges of it.



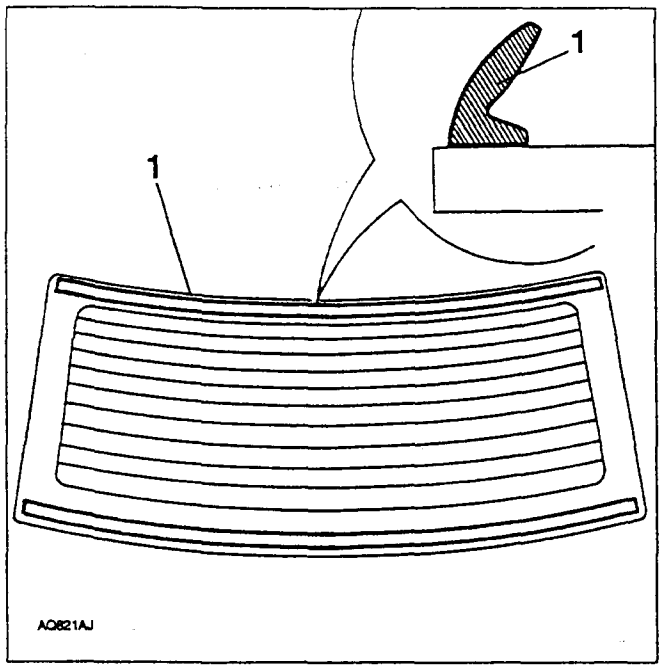
Proceed with the glueing cycle using the special KIT supplied by Spares checking the date of expiry.

- If a new rearscreen is to be fitted install the four plastic centering nails.

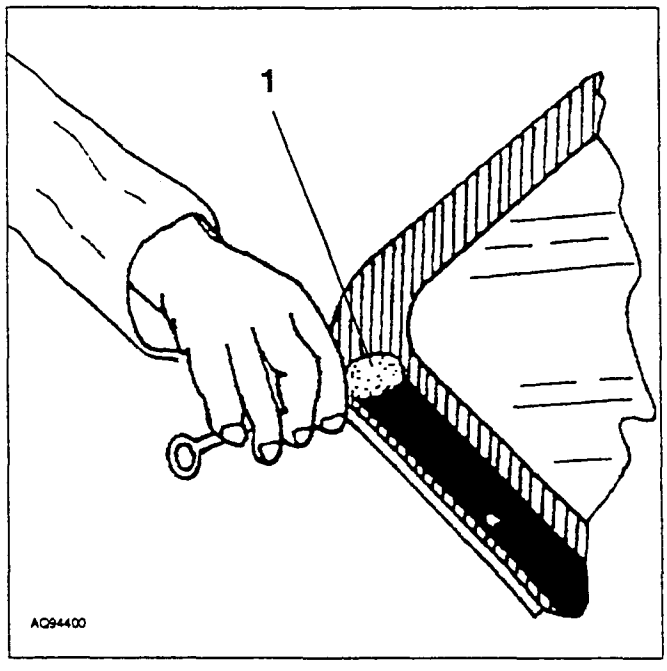
1. Carefully remove any dust and grease from the edge of the glass using the special cloth moistened with degreasing agent.



1. Fit the upper and lower seals on the rearscreen glass using tool **1.823.008.001** for positioning.

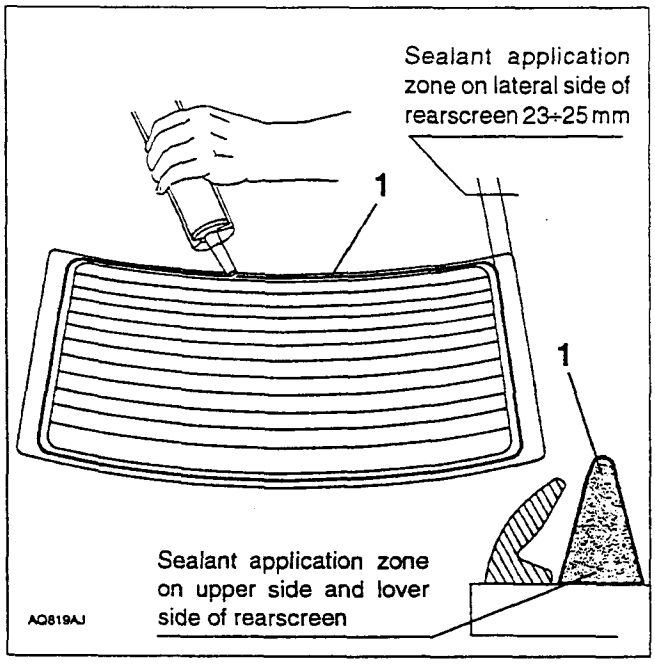


1. Apply the primer continuously and seamlessly on the black serigraph using the pad provided in the kit as illustrated.



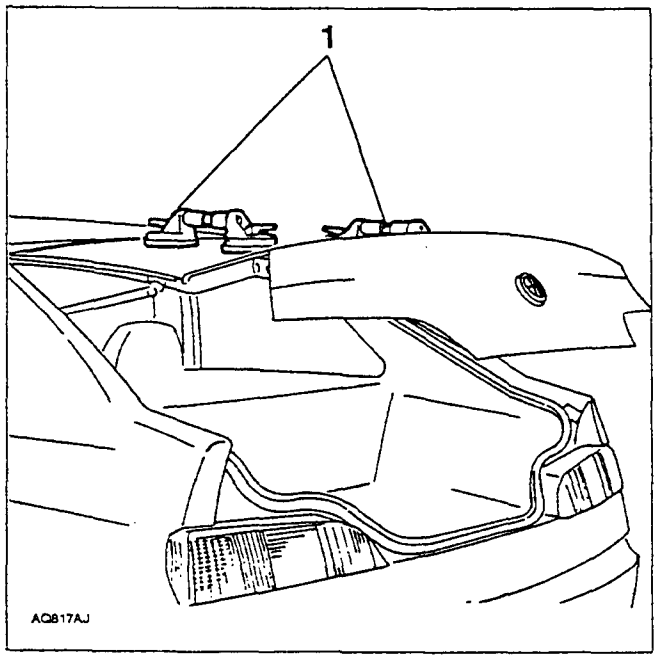
NOTE: allow the primer to dry for at least 10 minutes keeping the surface clean.

1. Apply the sealant along the line shown in the figure using the nozzle provided after removing the guide.



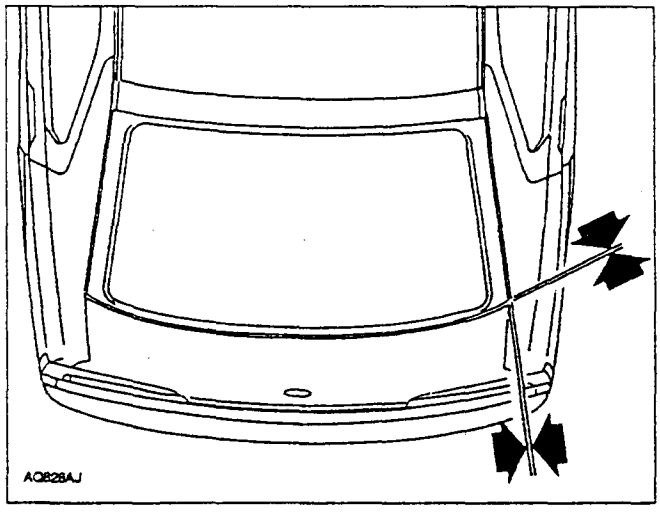
NOTE: use the short or long sealant cartridge (or both) according to necessity.

- Using the special suction cups, install the rearscreen, centering it in its housing.



Keep the tailgate horizontal to enable correct positioning of the glass even without the guide pegs.

1. Check that the rearscreen gap and alignments are correct.



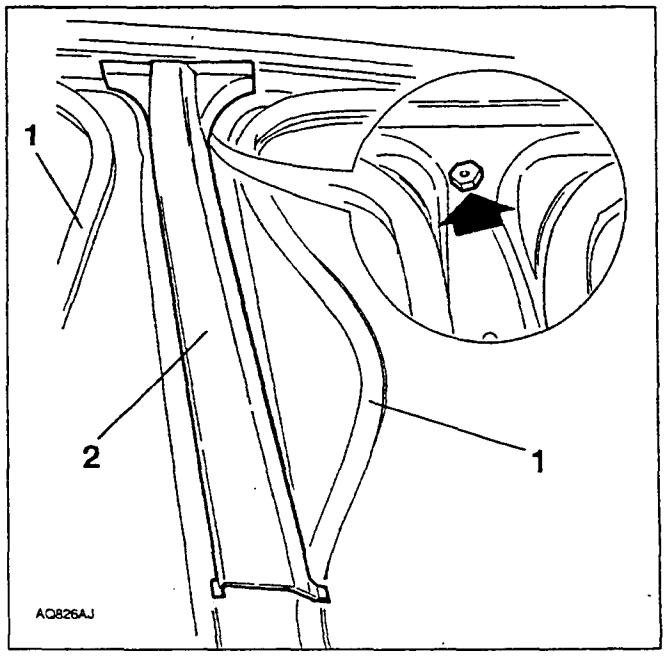
- Exert a light, even pressure along the edge of the rearscreen.
- Complete refitting operations reversing the sequence followed for removal.

Do not use the car until the sealant has dried completely.

OUTER PILLAR COVER

REMOVAL/REFITTING

1. Carefully partially move aside the door seals.
2. Draw the outer pillar cover downwards.



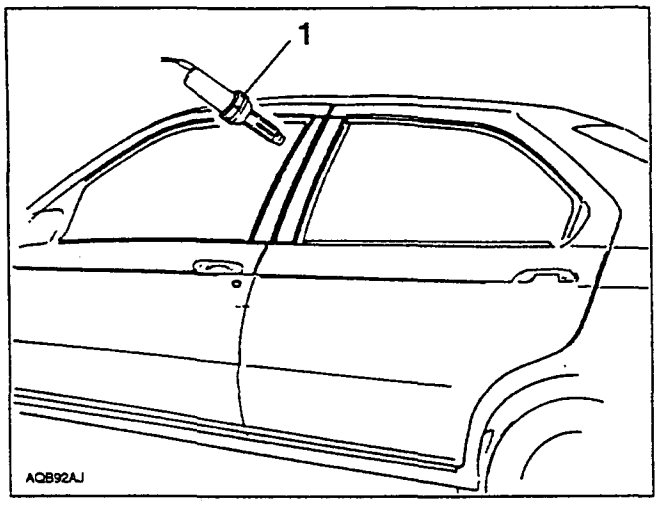
When refitting make sure that the pillar cover guide pin is correctly inserted.

DOOR CENTRE PILLAR COVER OUTER TRIM (FRONT AND REAR)

REMOVAL

- Remove the front door outer glass scraper seal (see specific paragraph).
- Remove the front door trim moulding.

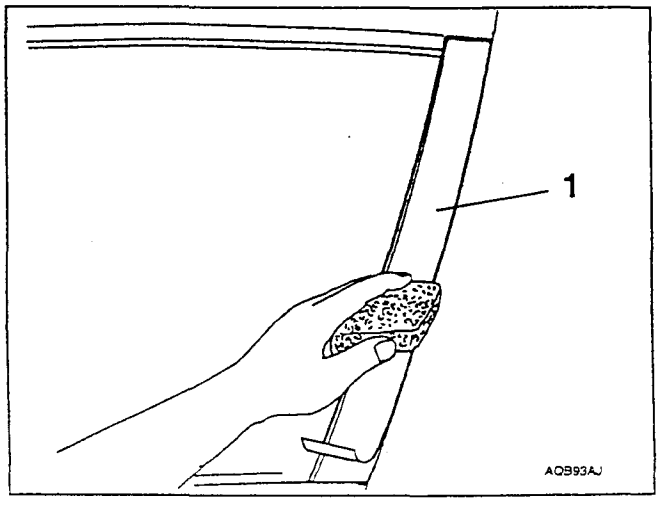
1. Using a hot air gun remove the door centre pillar cover outer trim (front and rear)



REFITTING

- Thoroughly clean the application area of residual adhesive using a de-greasing agent.
- Dampen the application area with soapy water.

1. Apply the new centre door pillar outer trim starting from the upper edge and pressing lightly into position; take care to correctly position the trim and eliminate any air bubbles.





SERVICE

DIREZIONE POST-VENDITA
SERVIZI ASSISTENZIALI
Viale Alfa Romeo 20020 Arese (MI)
Fiat Auto S.p.A.

Publication PA493000000000 - 3/94
Printed in Italy
no. 60494360

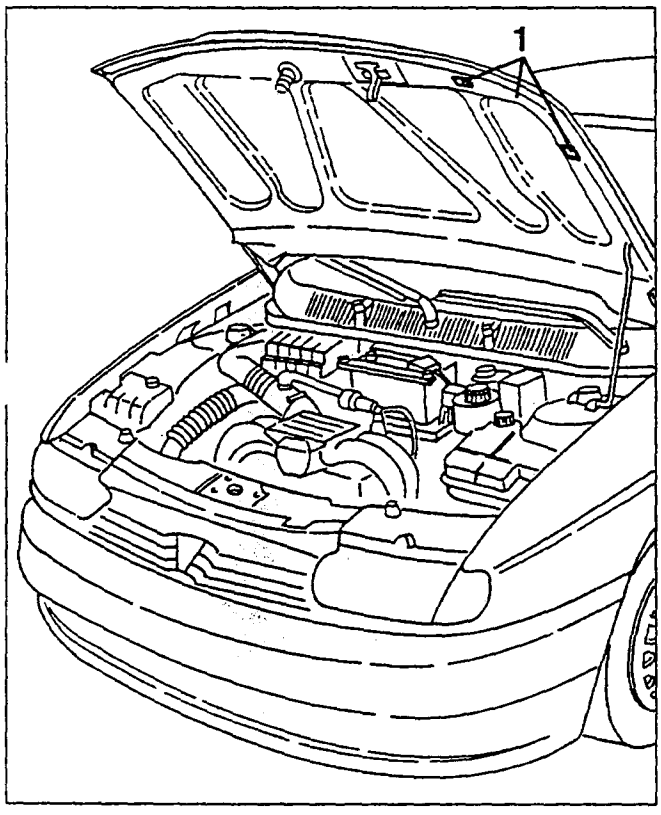
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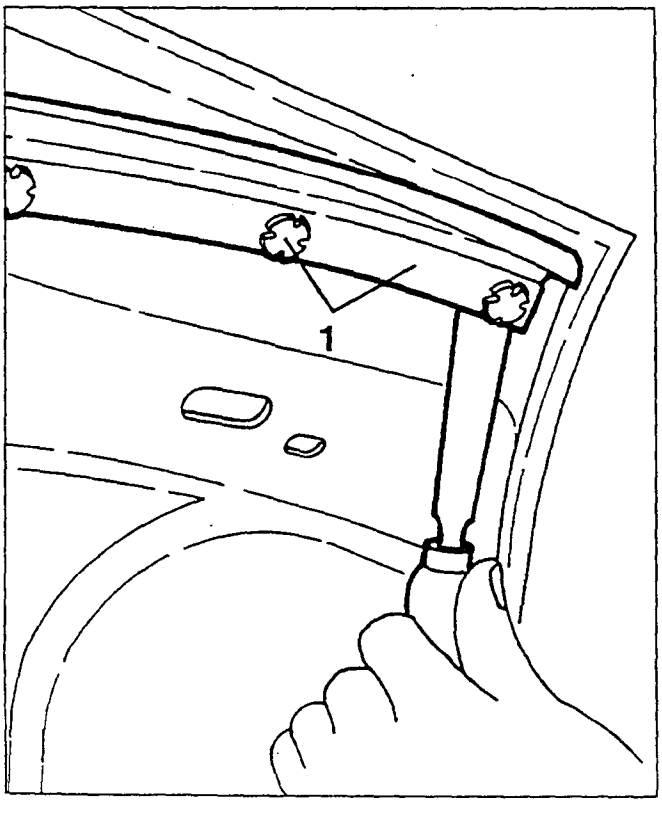
BONNET TRIM

REMOVAL/REFITTING

1. Working from the engine bay, pull off the plastic buttons and remove the bonnet trim.



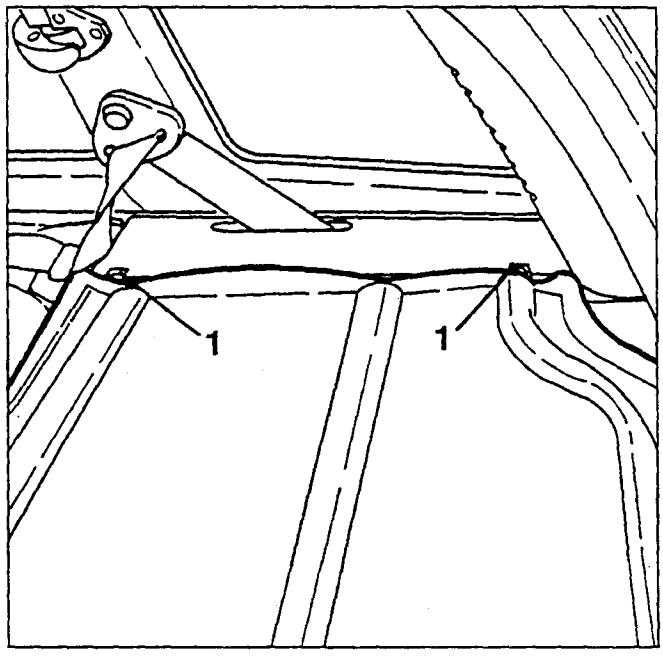
1. If necessary, pull off the plastic buttons and remove the front seal strip.



HATSHELF

REMOVAL/REFITTING

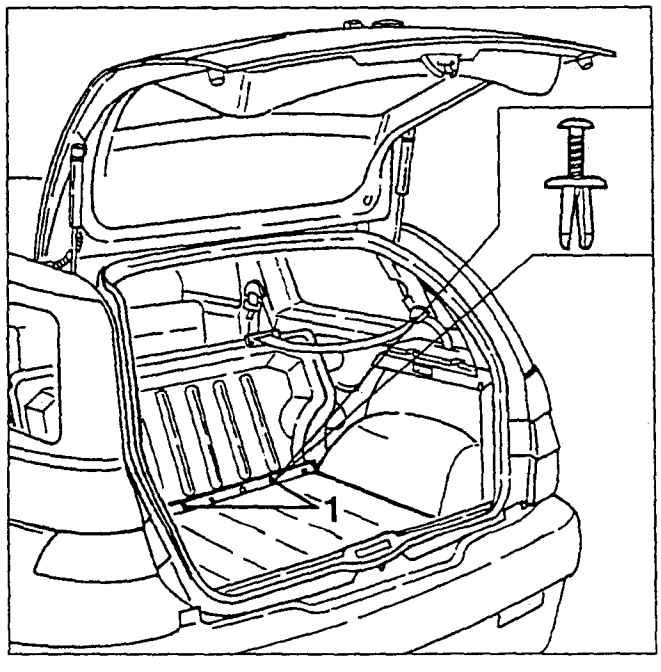
1. Working from the luggage compartment, free the two side hatshelf attachments, wind it up and remove it.



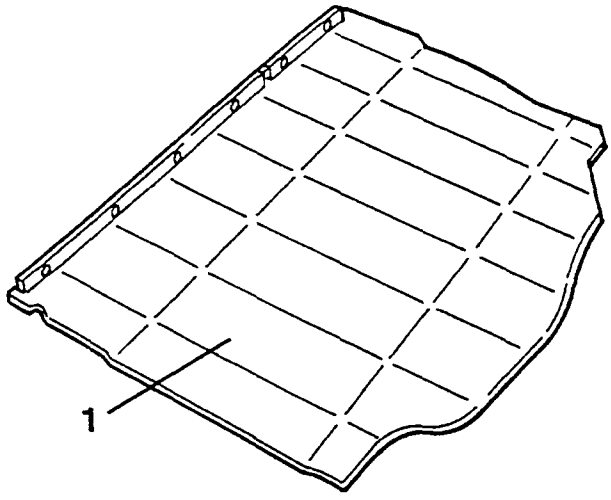
LUGGAGE COMPARTMENT LOWER TRIM

REMOVAL/REFITTING

- Tip the rear seat back-rest forward.
1. Loosen the plastic screws and pull off the buttons the luggage compartment lower trim.



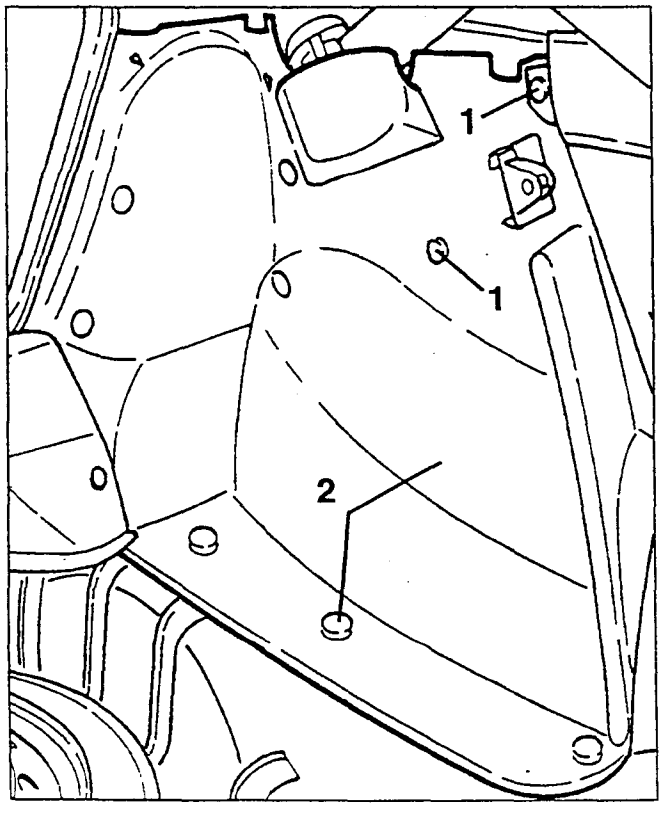
1. Remove the luggage compartment lower trim.



LUGGAGE COMPARTMENT SIDE TRIM

REMOVAL/REFITTING

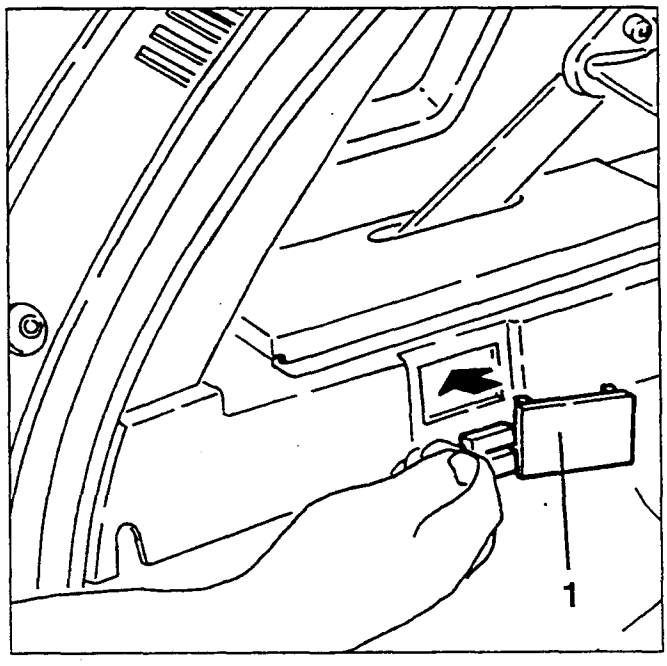
- Remove the side shelves supporting the hatshelf (see specific paragraph).
- Tip the luggage compartment lower trim forward.
1. Loosen the two screws securing the luggage compartment side trim.
2. Pull off the plastic buttons and remove the luggage compartment side trim.



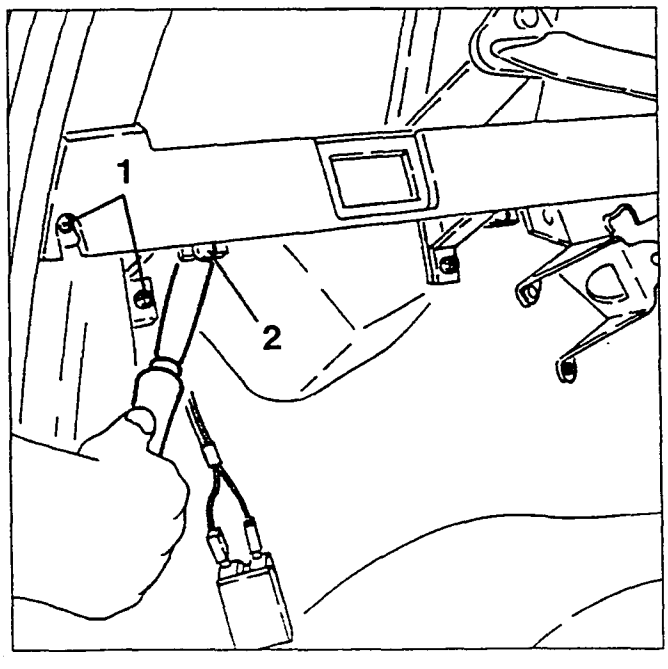
SIDE SHELVES SUPPORTING THE HATSHELF

REMOVAL/REFITTING

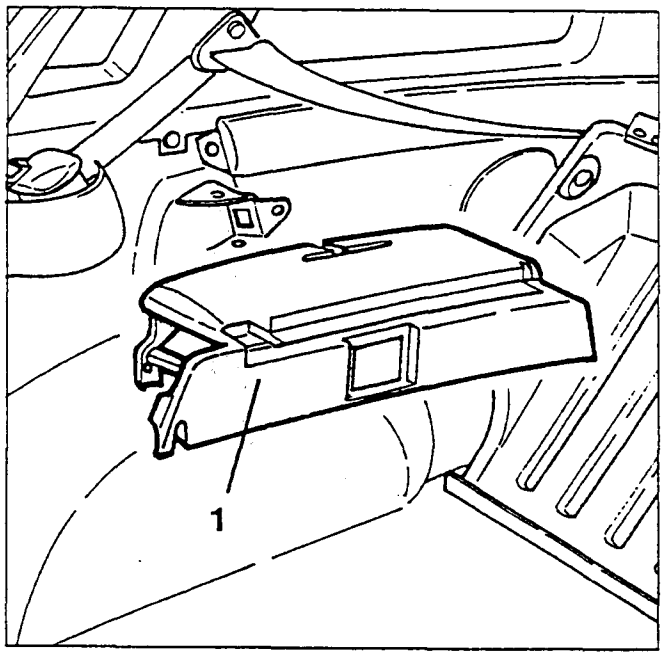
- Remove the hatshelf (see specific paragraph).
- Tip the rear seat back-rest forward.
1. Pull the roof light from its seating and without disconnecting the electrical connections, replace it in the attachment hole freeing it from the shelf.



1. Loosen the three screws securing the shelf.
2. Pull off the two plastic buttons securing the shelf.



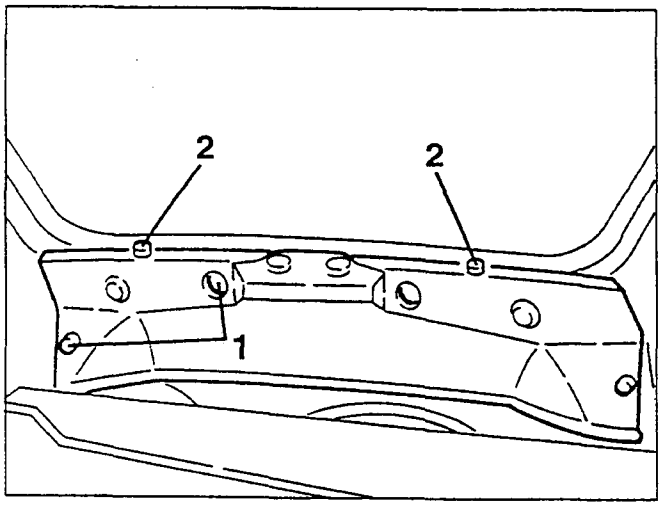
1. Remove the side parcel shelf support bracket withdrawing the safety belt from its housing.



LUGGAGE COMPARTMENT PROTECTIVE TRIM

REMOVAL/REFITTING

1. Working from the luggage compartment, remove the four plastic nails fastening the protective trim.
2. Slacken the two screws fastening the luggage compartment protective trim and remove it.

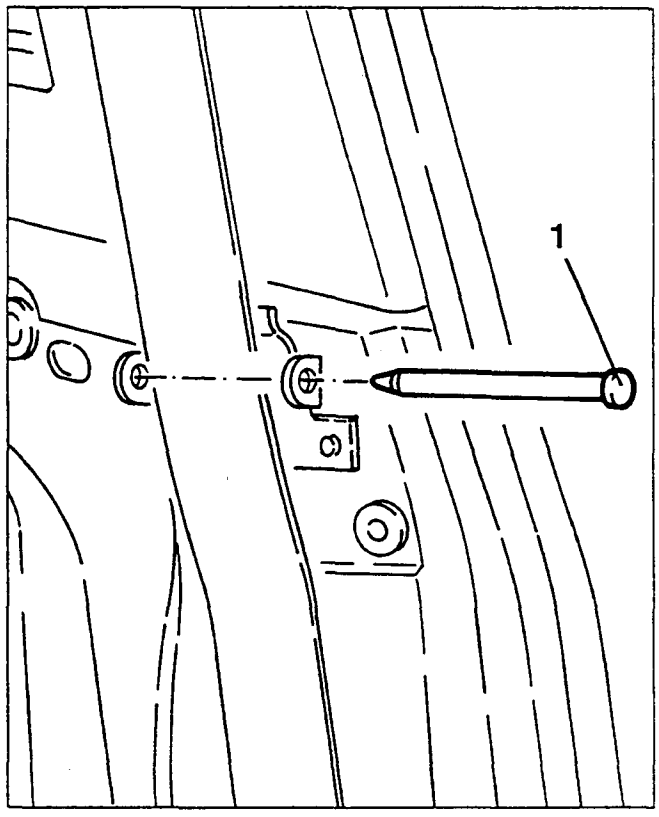


FRONT SEAT BELTS

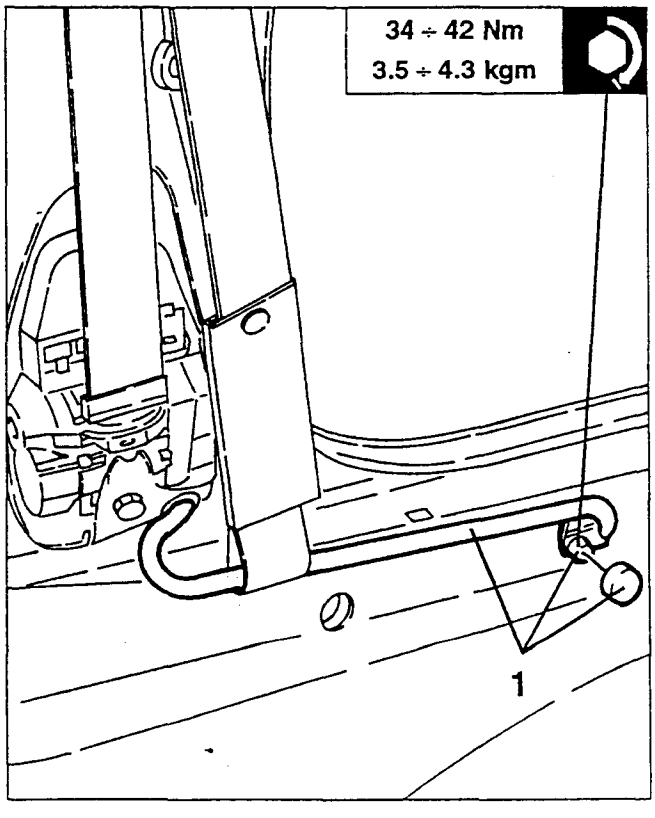
REMOVAL/REFITTING

- Unarm the pre-tensioning device as described in "Removing/Refitting the arming rod".

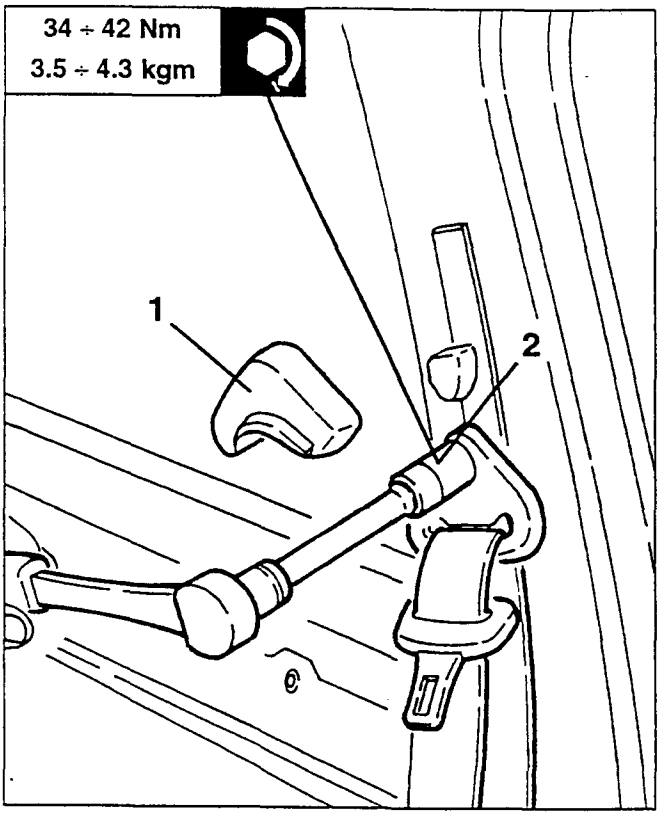
1. Withdraw the belt holder bracket guide pin.



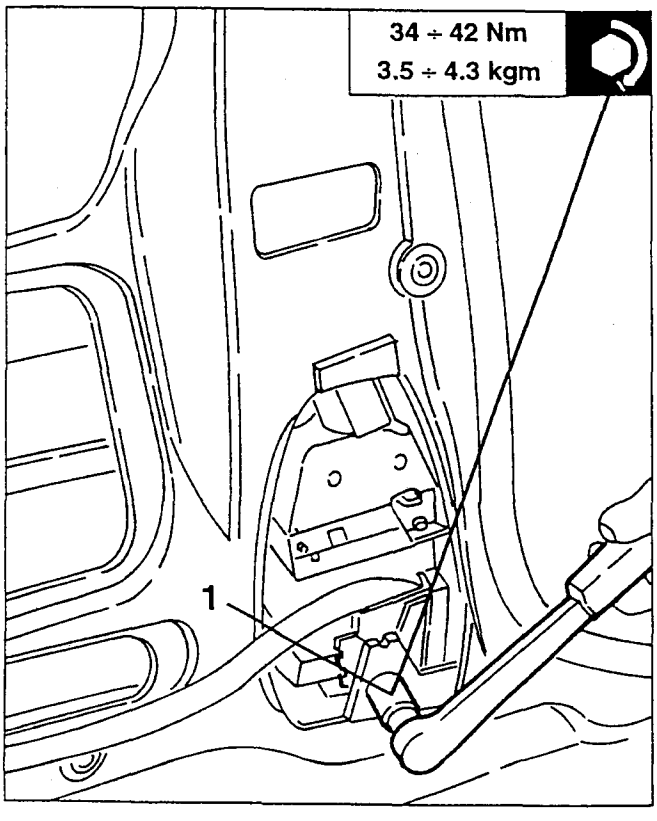
1. Remove the cap, slacken the fastening screw, then remove the lower seat belt slider connection.



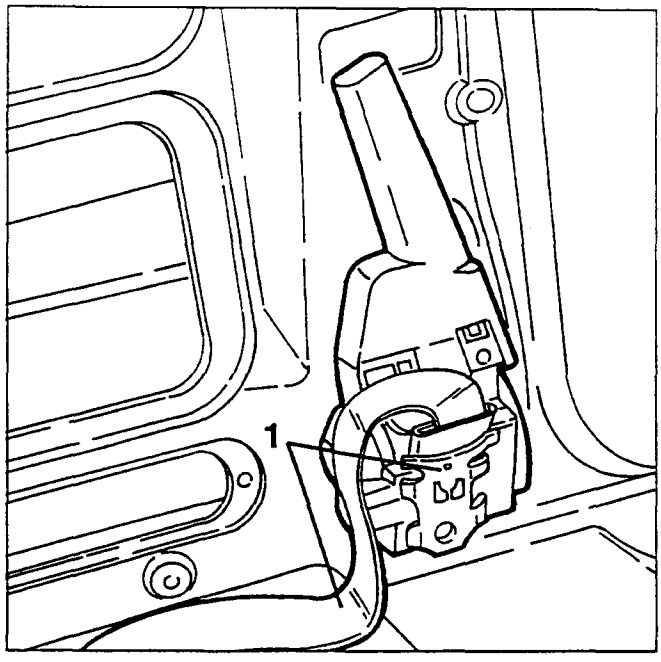
1. Remove the seat belt runner cover.
2. Slacken the seat belt runner screw.



1. Slacken the seat belt pre-tensioner fastening screw.



1. Remove the seat belt pre-tensioner withdrawing it from its housing.



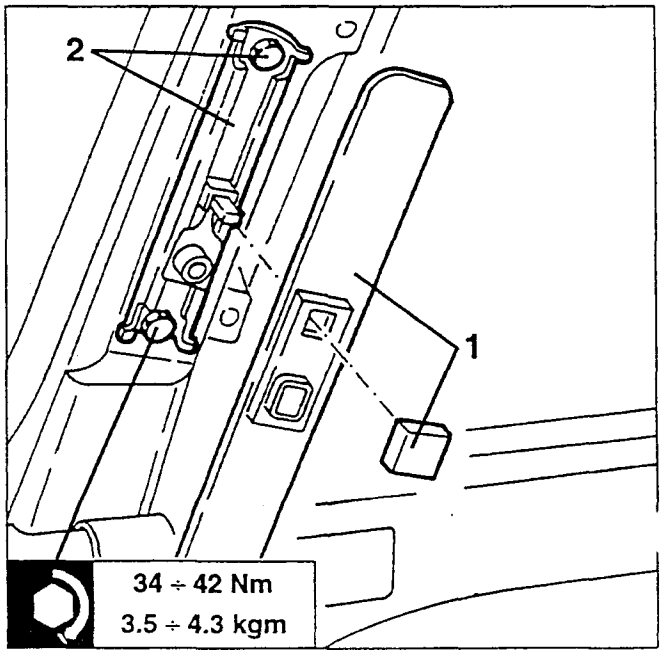
For refitting, reverse the sequence described for removal taking care to install the arming rod. For this operation follow the cautions given in "Removing/refitting the arming rod".

FRONT SEAT BELTS HEIGHT ADJUSTMENT DEVICE

REMOVAL/REFITTING

- Remove the window winder moulding (see specific paragraph).

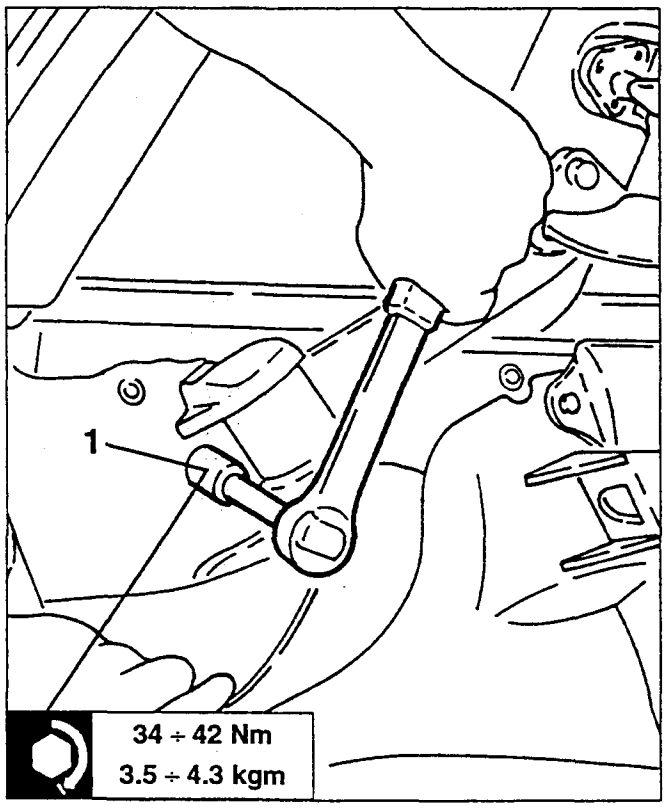
1. Remove the seat belt height adjustment device knob and retrieve the corresponding plate.
2. Slacken the two fastening screws and remove the front seat belt height adjustment device.



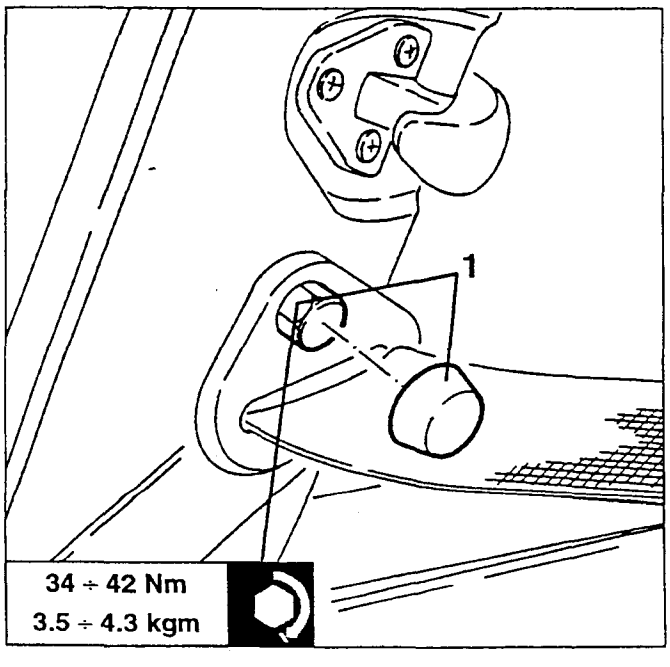
REAR SEAT BELTS

REMOVAL/REFITTING

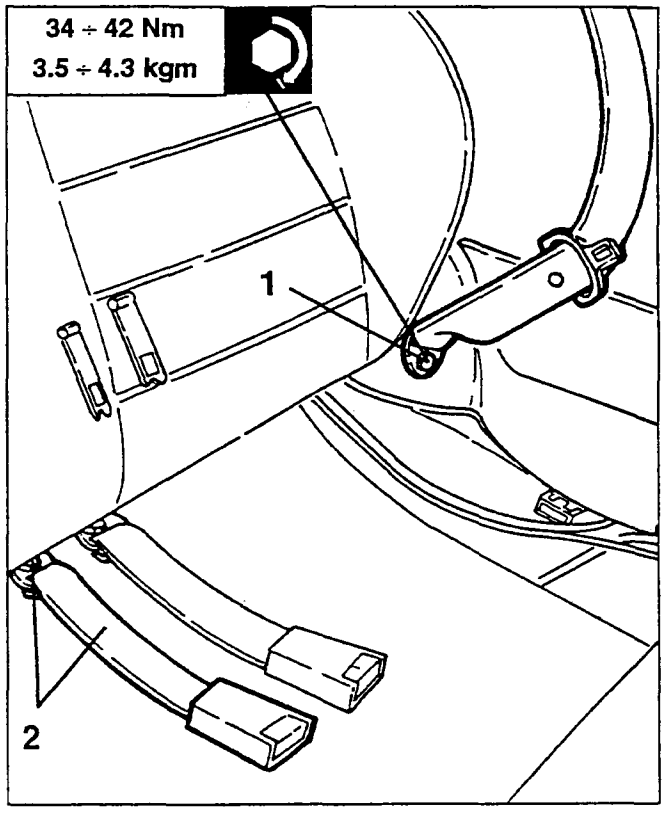
- Remove the side shelves supporting the haltshelf (see specific paragraph).
1. Lower the covering and loosen the re-winding mechanism attachment screw.



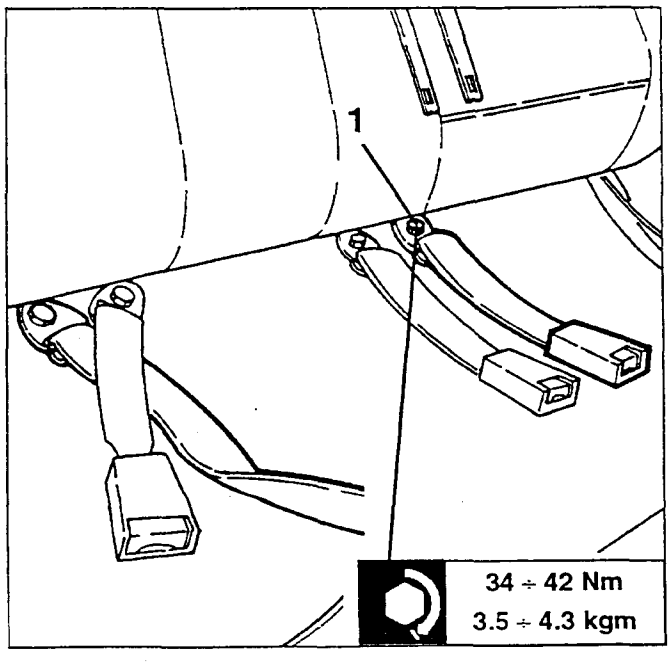
1. Pull off the cover from the rear seat belt runner attachment screw and then loosen the screw.



- Return the rear seat backrest to the vertical position.
- Tip the rear seat cushion forwards.
1. Loosen the screw on the seat belt lower attachment and remove the screw.
2. Loosen the screw and remove the seat belt stalk.



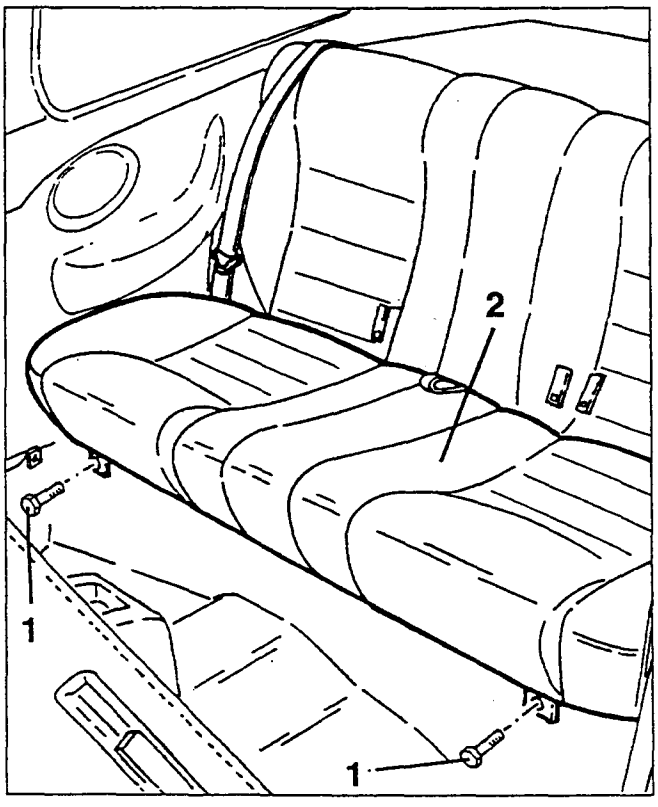
1. Loosen the screws and remove the lap-belt from the central rear seat position.



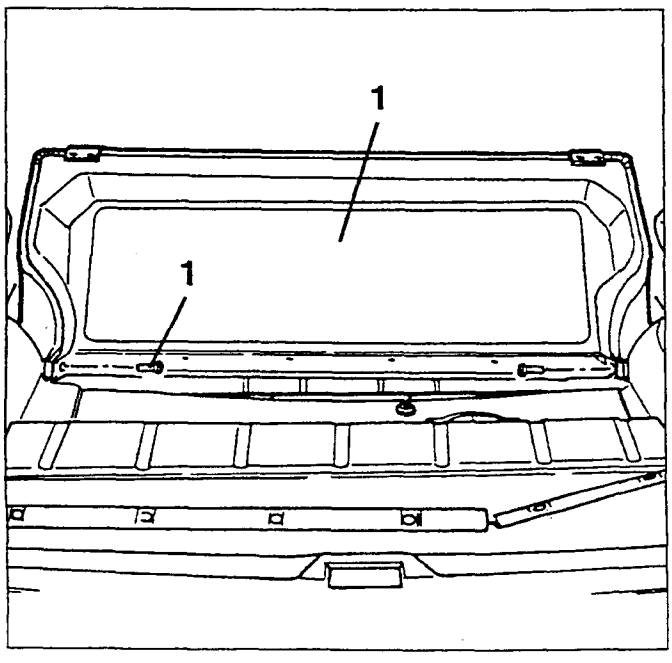
REAR SEAT (bench type)

REMOVAL/REFITTING

1. Loosen the two screws securing the seat to the floor of the vehicle.
2. Lift up and remove the rear seat.

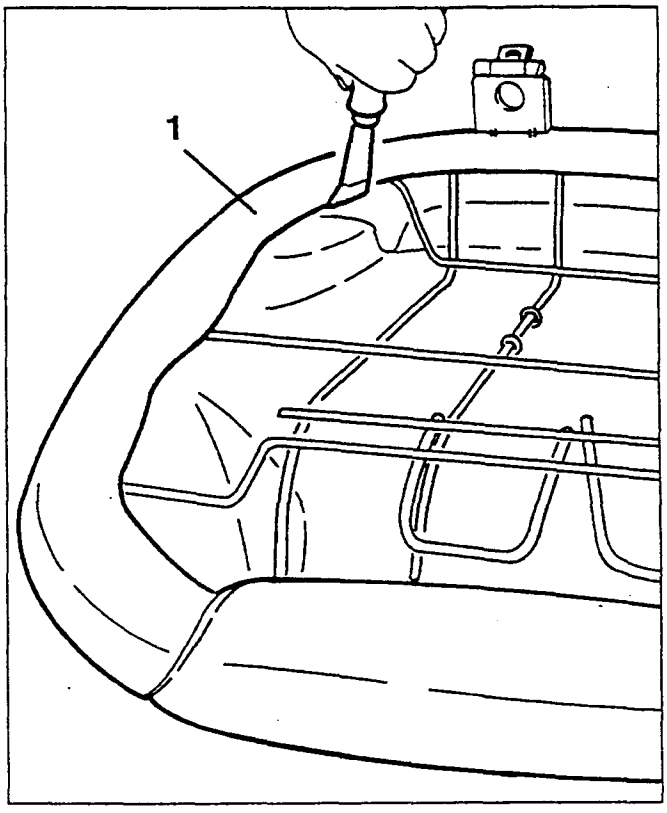


- Remove the lower trim from the luggage compartment (see specific paragraph).
1. Tip the backrest forwards, loosen the two screws and remove the backrest freeing it from the seat belts.

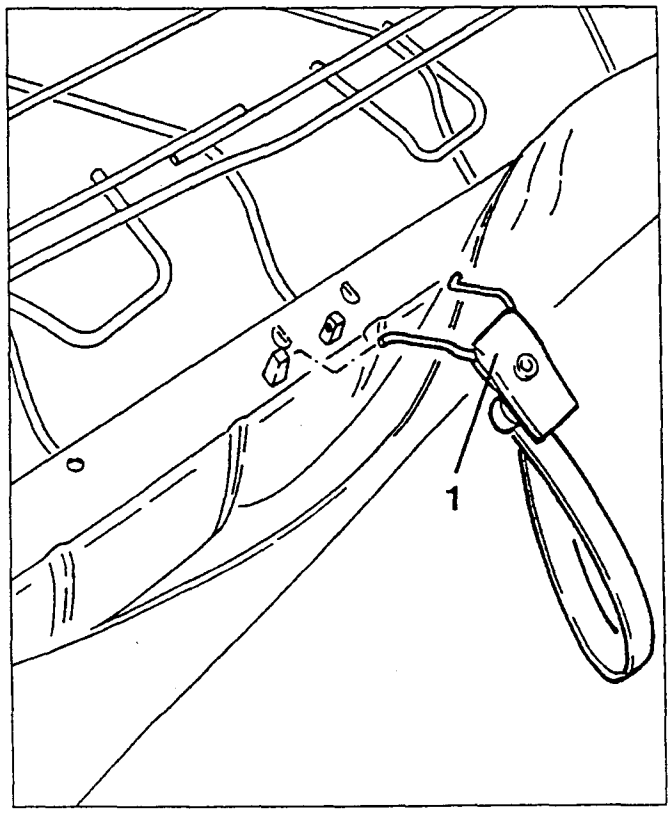


DISASSEMBLING/REFITTING THE SEAT

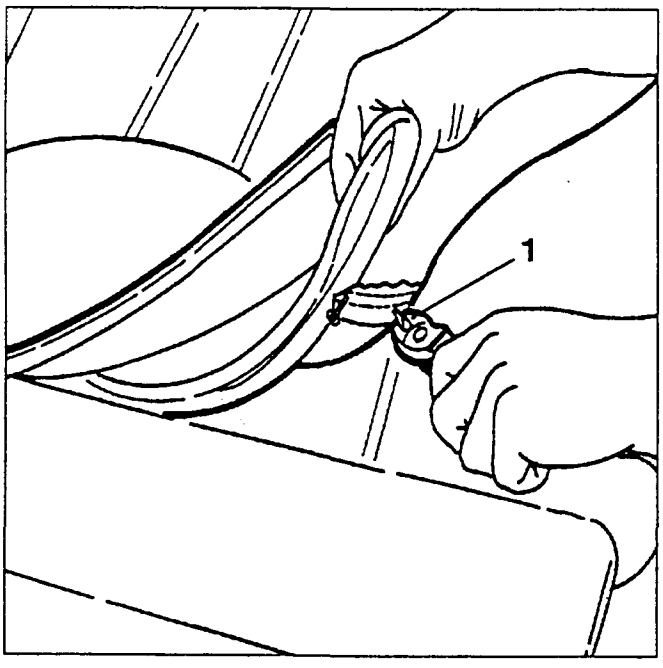
- Pull off the plastic buttons and remove the rear sealt covering.
1. Pull the covering from the seat.



1. When pulling off the trim in the area around the handle used for tipping the seat forward, this handle must be removed by freeing the retaining clip.

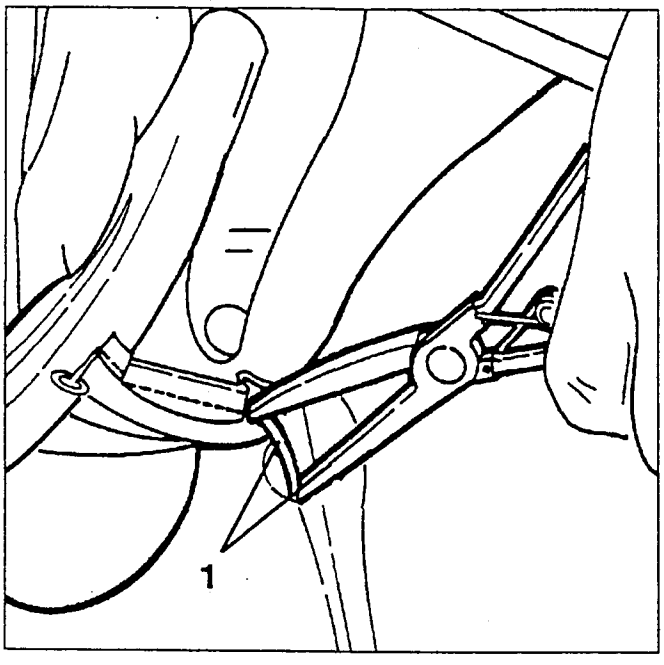


1. Using a pair of shears cut the clips securing the cover to the seat and remove the cover.



Refit by reversing the procedure followed for removal and note the following:

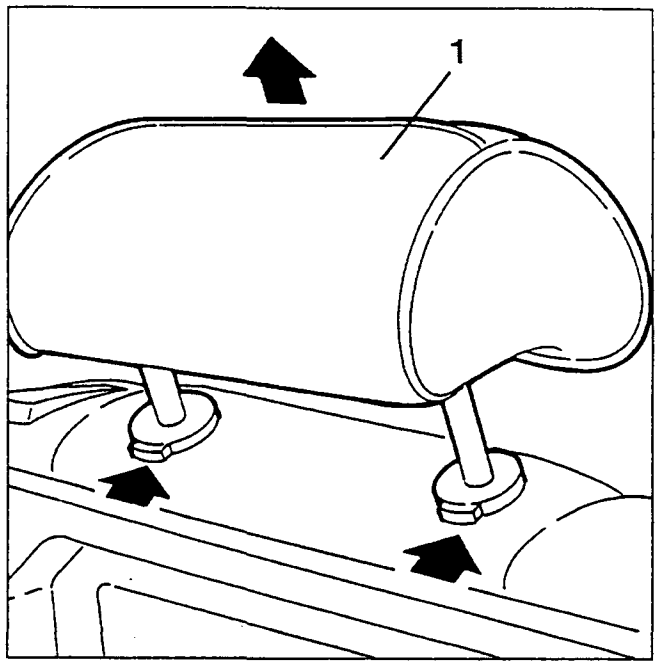
1. Secure the covering with the clips using the appropriate pliers supplied as a spare part.



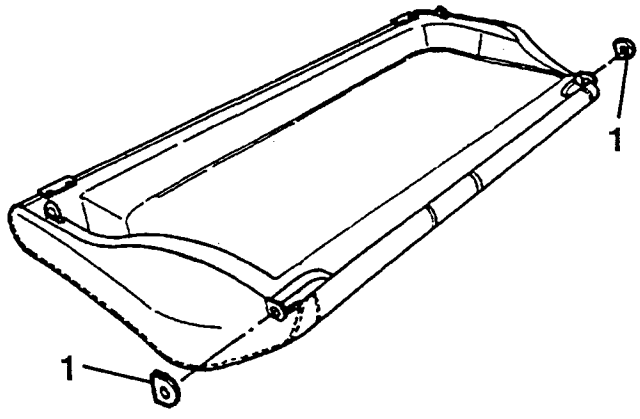
- Using a plastic mallet clinch the edge of the covering attachment.

DISASSEMBLING/REASSEMBLING THE BACKREST

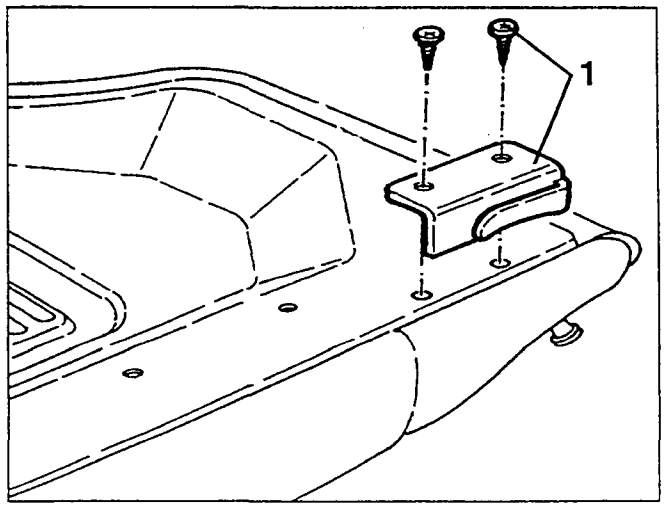
1. Remove the headrest by pressing the clips and at the same time pulling the headrest upwards.



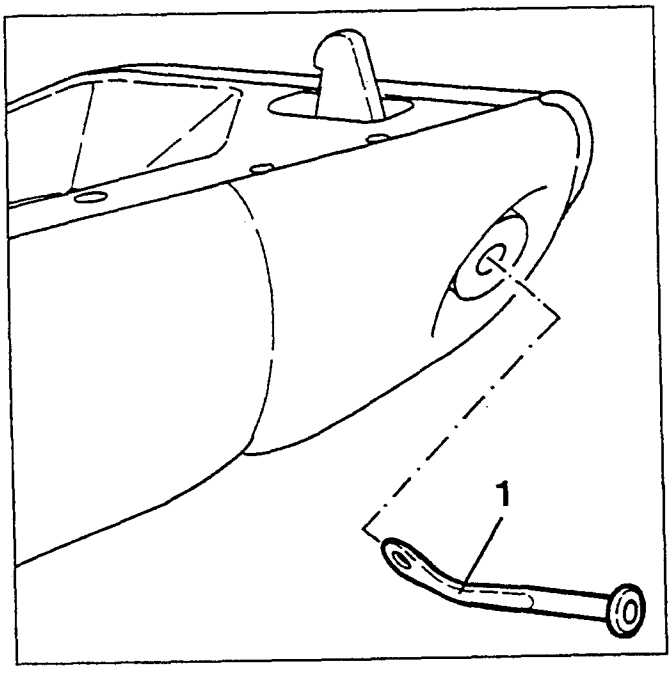
1. Remove the two plastic trim pieces from the backrest hinge.



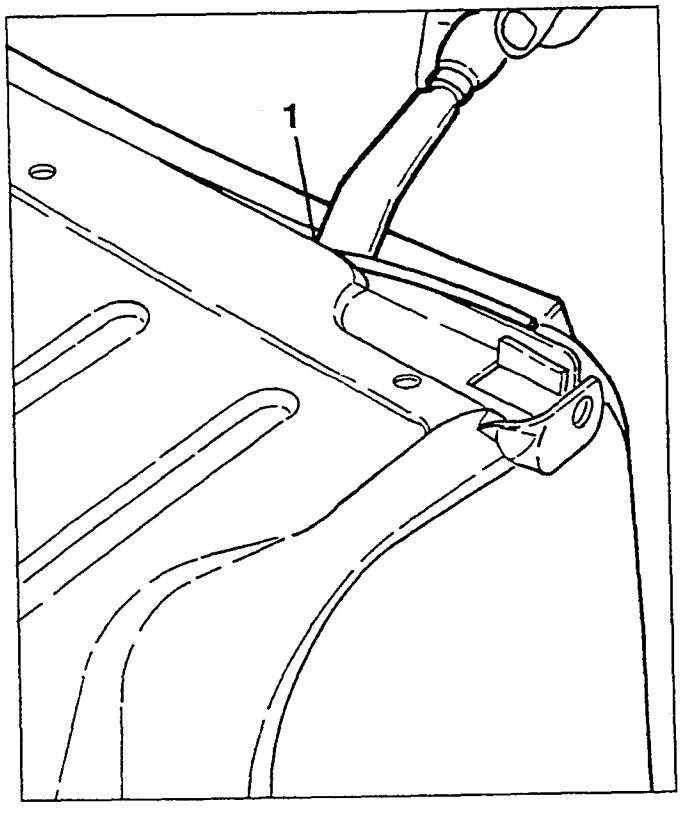
1. Loosen the two screws and remove the seat belt runners.



1. Remove the pins releasing the backrest catch.

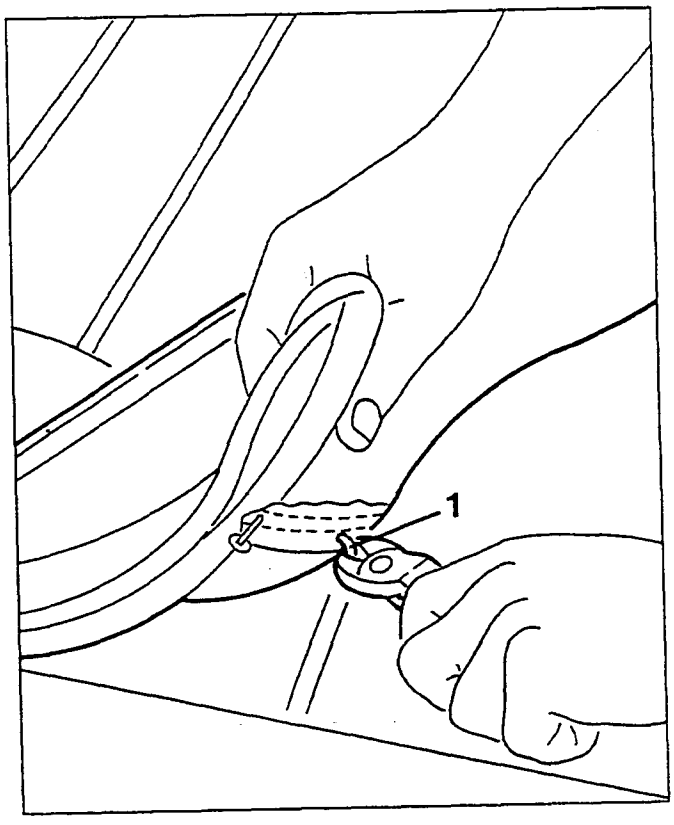


1. Working as shown in the diagram, pull the covering from the backrest.

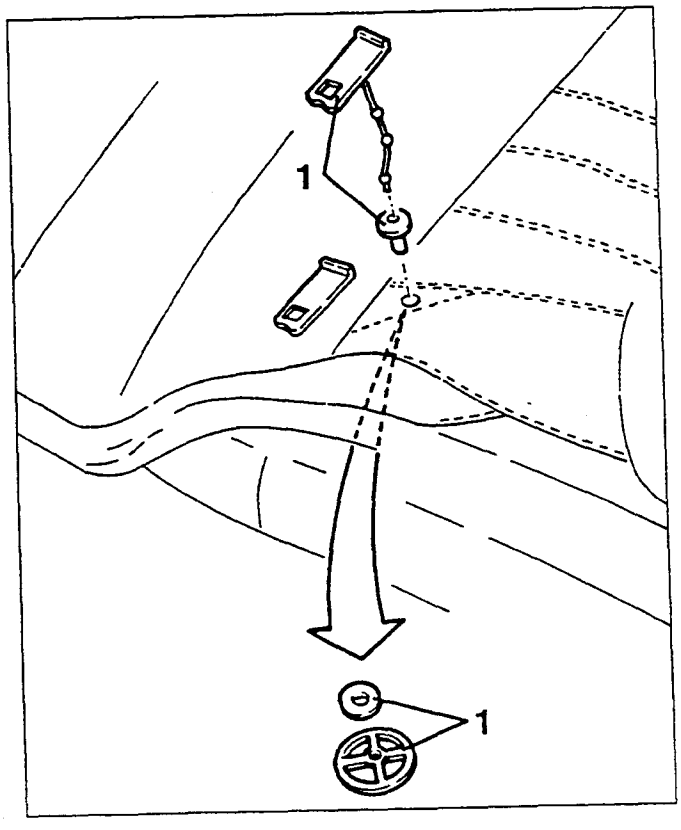


NOTE:
Care should be taken when removing the covering from the backrest release pins trim.

1. Using a pair of shears, cut the clips securing the backrest covering.

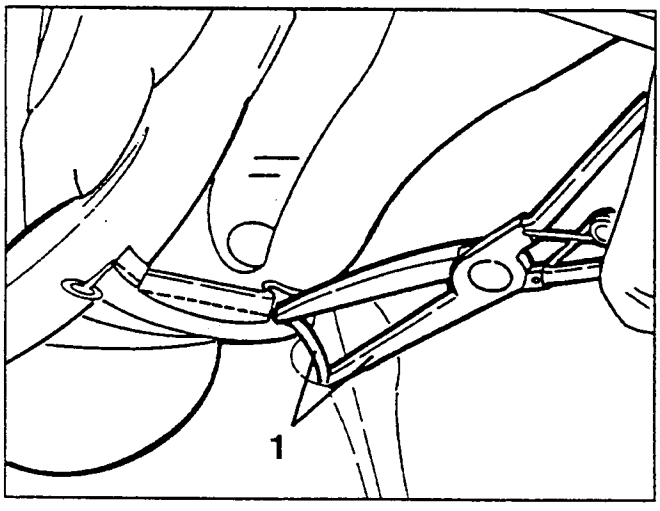


1. Remove the seat belt support attachments from the backrest and remove the covering.



Refit by reversing the procedure followed for disassembly and note the following:

1. Fix the covering with the clips using the appropriate pliers supplied as a spare part.

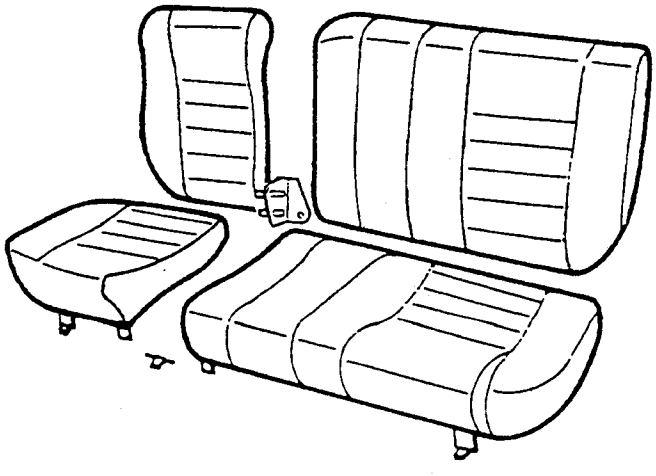


- Using a plastic mallet, clinch the edge of the covering.

REAR SEATS (split version)

REMOVAL/REFITTING

- Remove the seats as described in the section relative to the bench-type seats ensuring that the screws securing the central hinges are loosened and that the backrests and cushions are withdrawn from their pins.



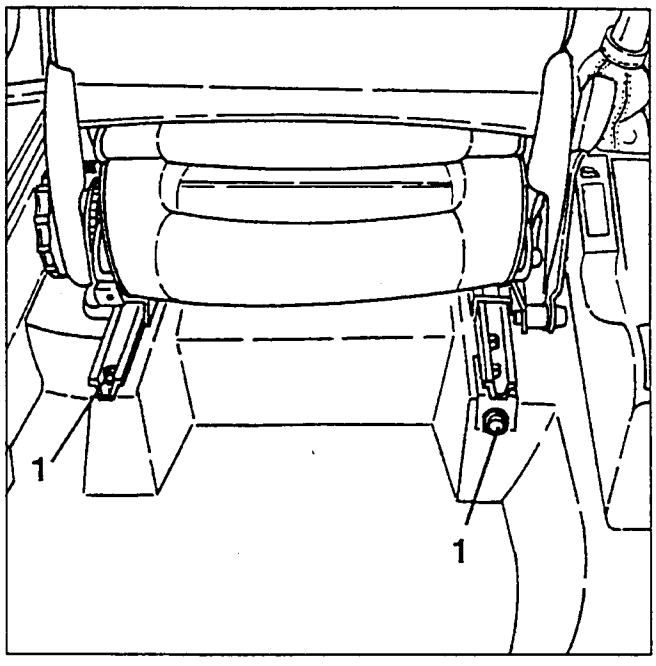
DISASSEMBLY/REASSEMBLY

- Proceed as described for the bench-type seat and make the modifications required by the shape of the seat.

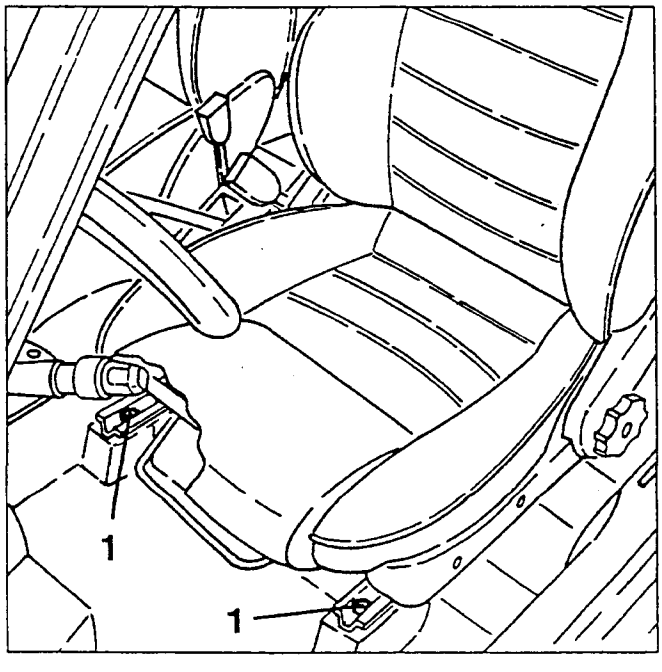
FRONT SEATS

REMOVAL/REFITTING

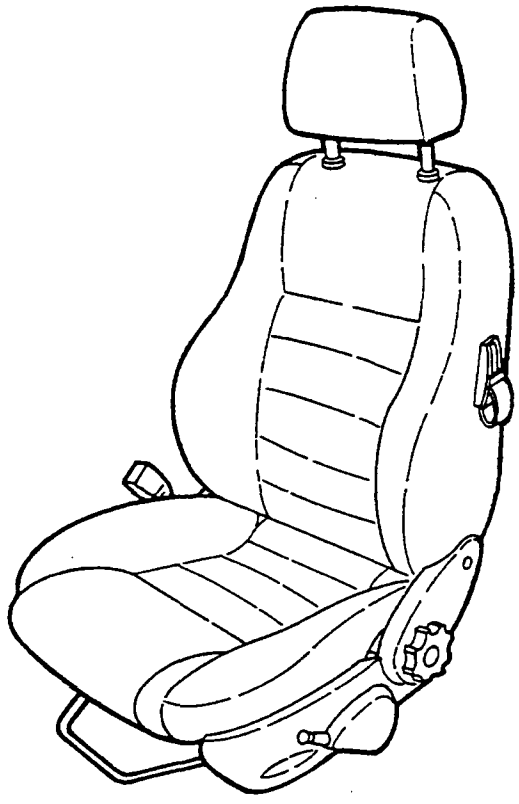
- Slide the seat fully forwards.
1. Loosen the two rear screws securing the runner to the floor.



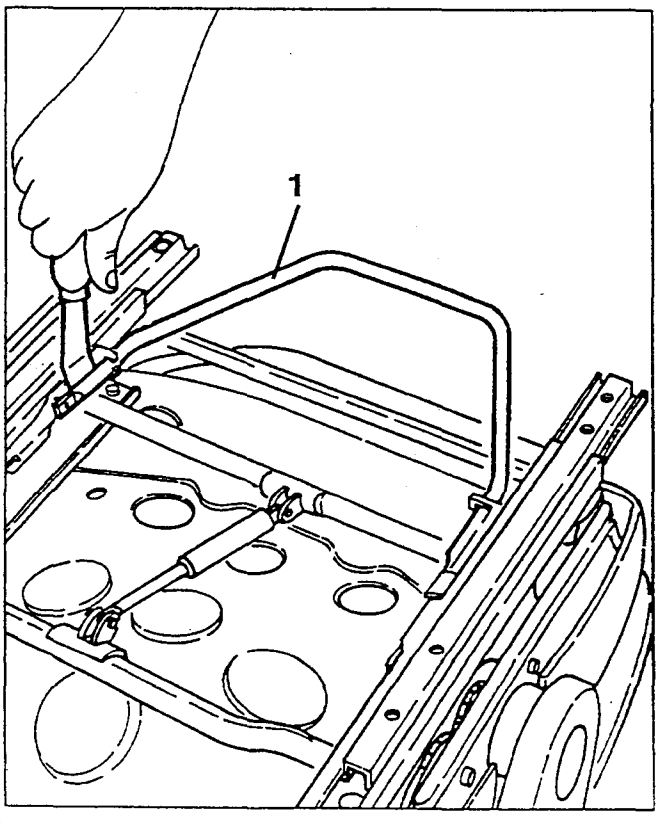
1. Slide the seat fully backwards, loosen the two front screws securing the runners to the floor and remove the seat.



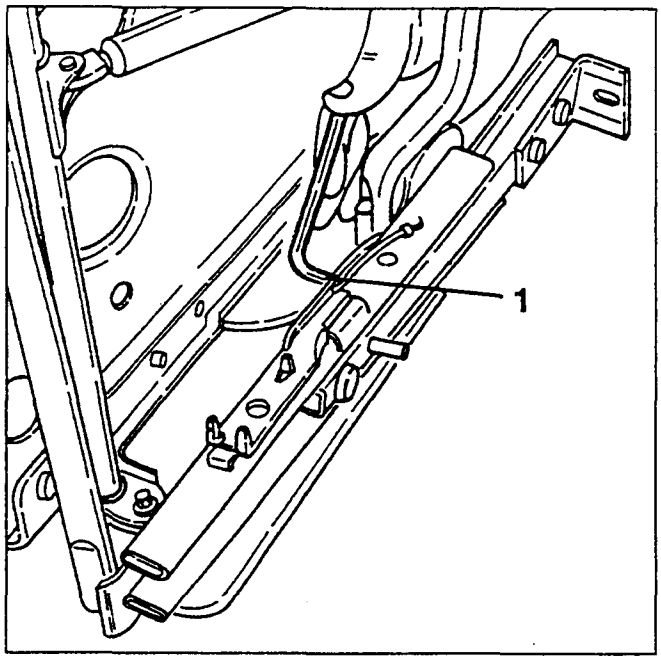
DISASSEMBLING/REASSEMBLING THE DRIVER'S SEAT (WITH HEIGHT ADJUSTMENT)



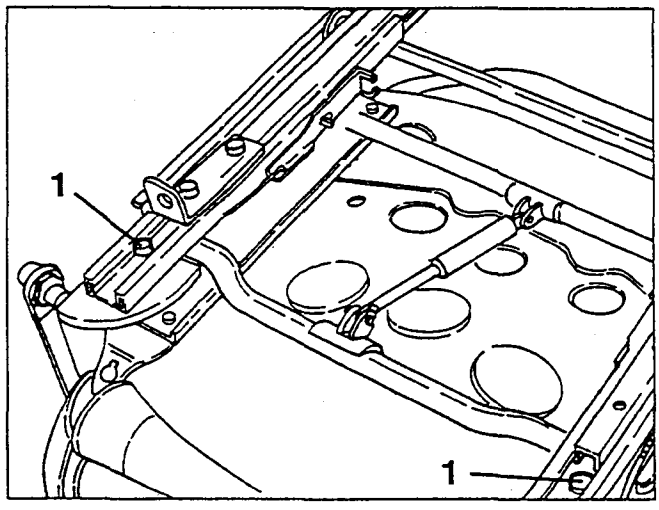
1. Remove the seat sliding control lever as shown in the diagram.



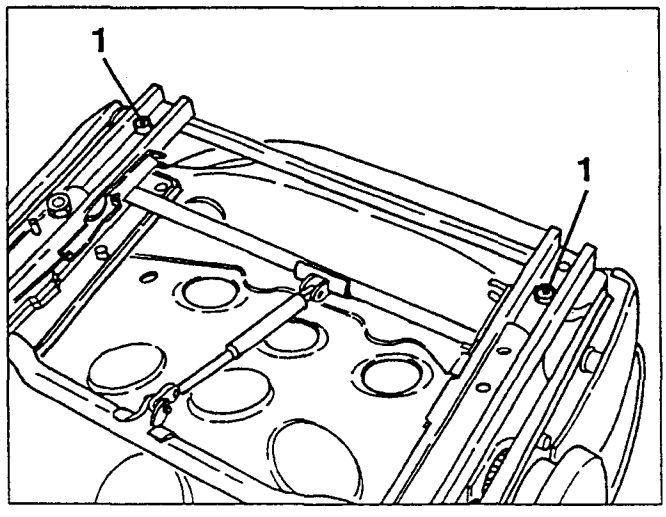
1. Loosen the upper screw securing the right-hand runner.



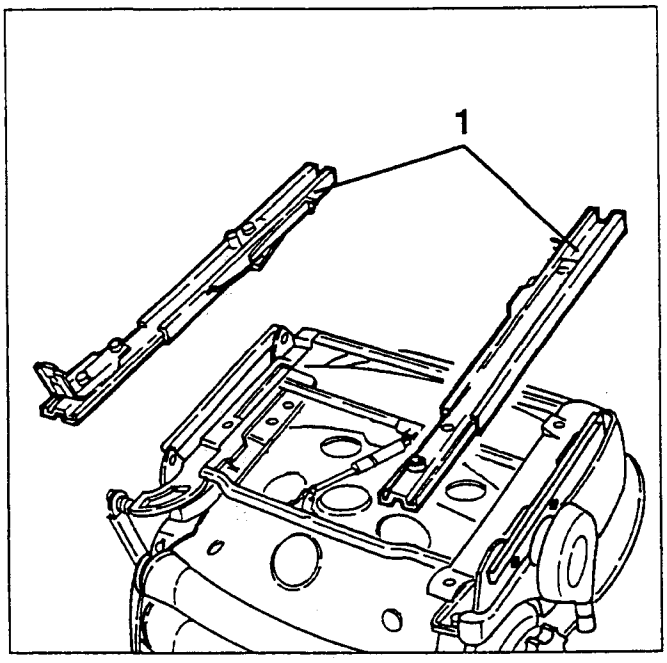
1. Move the guides forward and loosen the rear retaining screws.



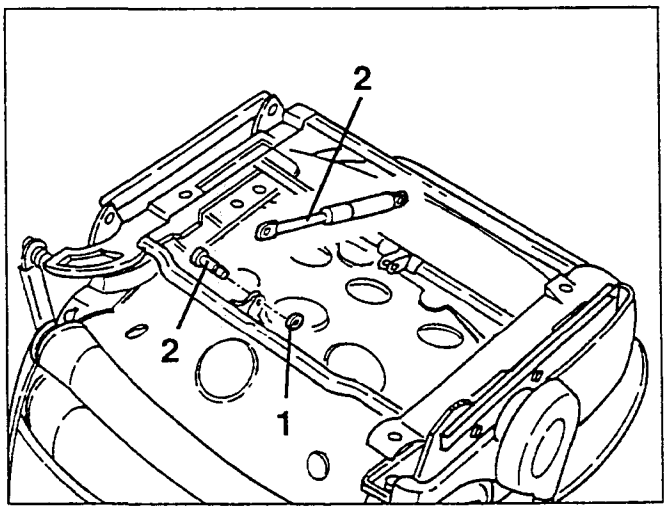
1. Move the guides backwards and loosen the front retaining screws.



1. Remove the seat runners.

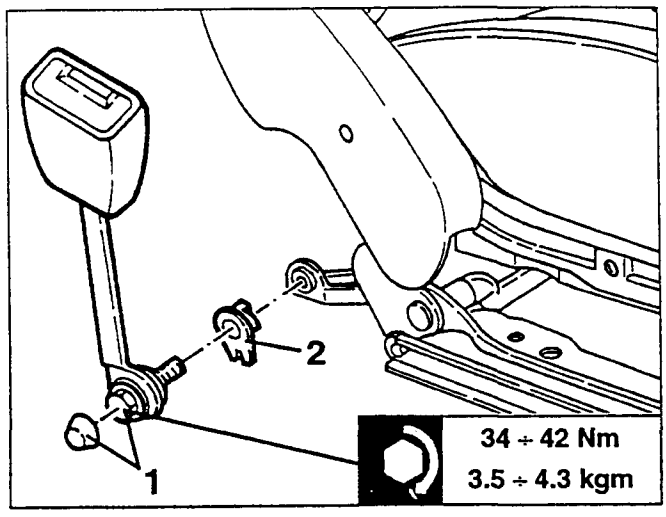


1. Remove the two clips securing the seat height adjustment device shock absorber.
2. Withdraw the pins and remove the seat height adjustment device telescopic support.

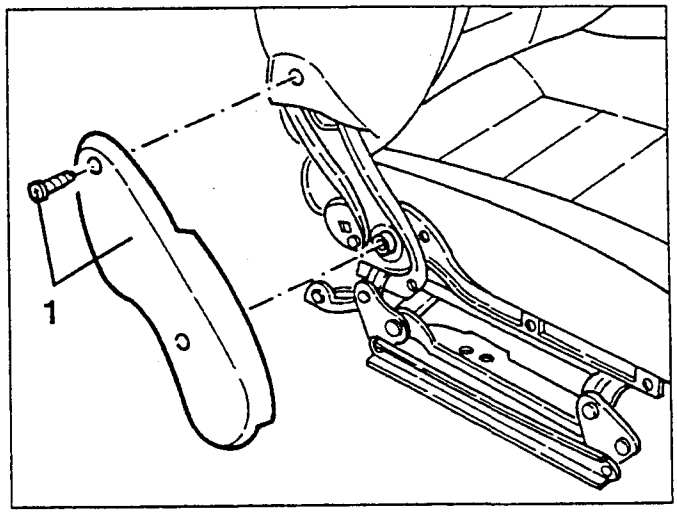


NOTE:
Before removing the telescopic support, fully raise the seat regulation device to prevent the telescopic support from leaping free during removal.

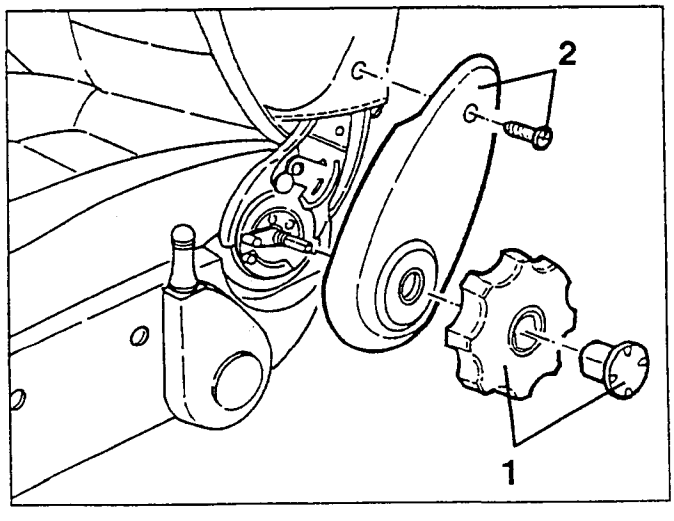
1. Remove the protective cover, loosen the screw and remove the seat belt attachment.
2. Remove the spacer.



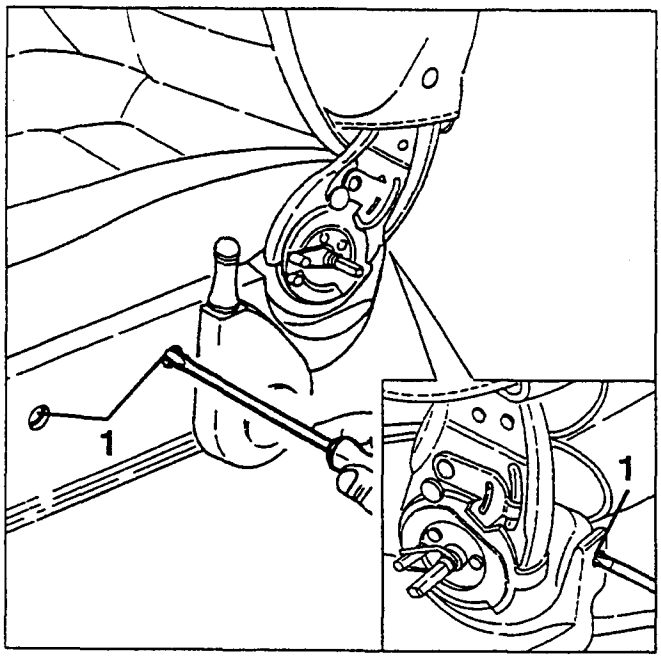
1. Loosen the two screws and remove the right-hand hinge moulding by pulling it away from the clips.



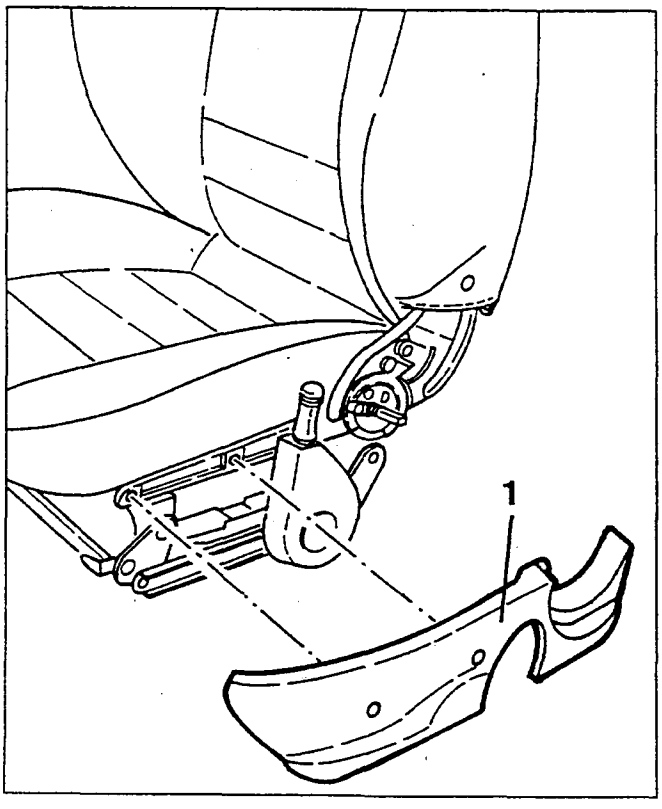
1. Pull off the cap and remove the backrest tilt handle.
2. Loosen the screw and remove the left-hand hinge moulding by pulling it away from the clips.



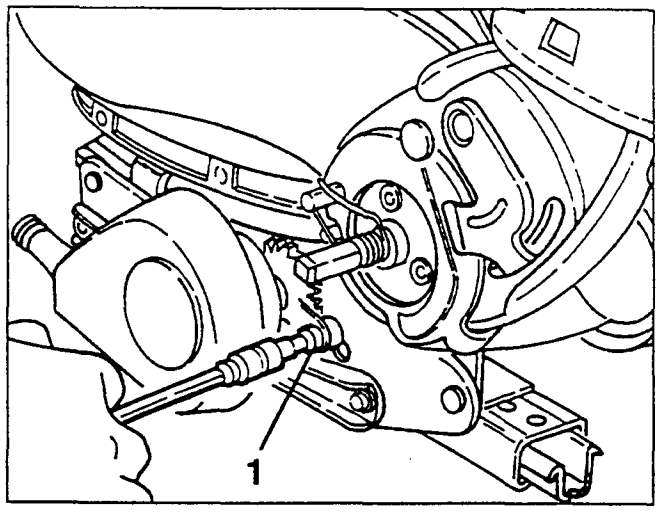
1. Loosen the three screws securing the cushion lower moulding.

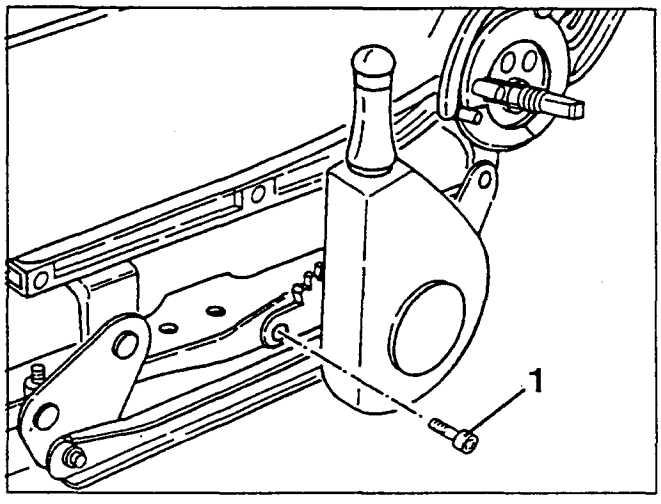


1. Remove the lower cushion moulding.

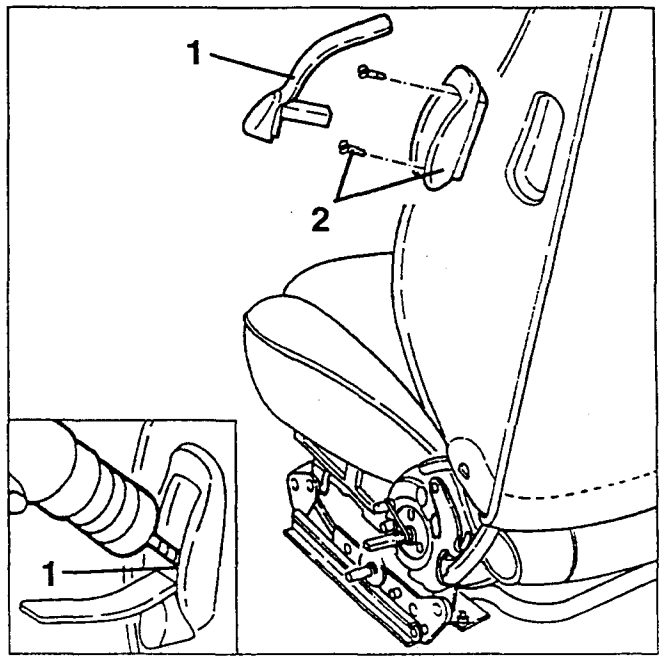


1. Suitably rotating the height regulation device of the seat, loosen the two screws and remove the device.

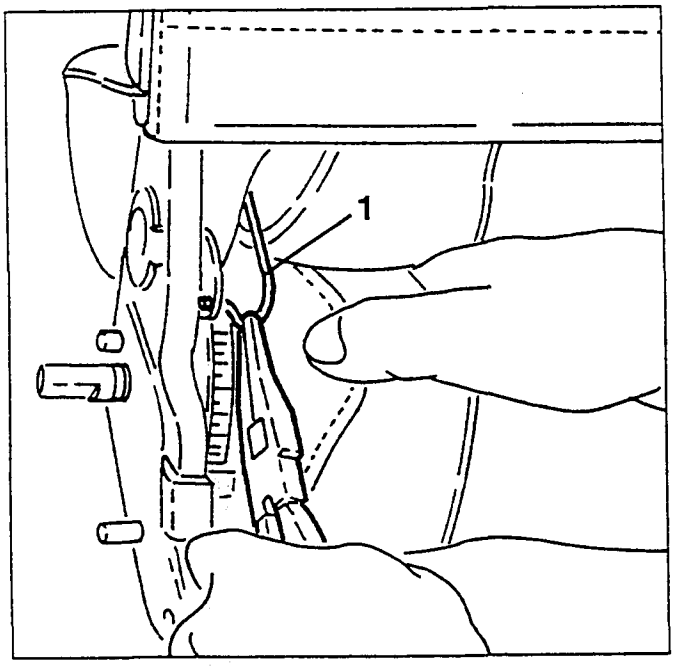


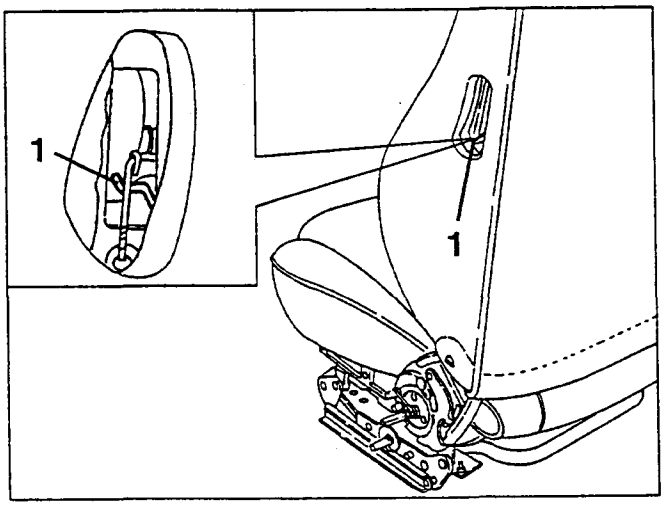


1. Remove the moulding and using a drill remove the rivet securing the handle used for tipping the backrest. Remove the handle.
2. Loosen the two screws and pull off the trim moulding.

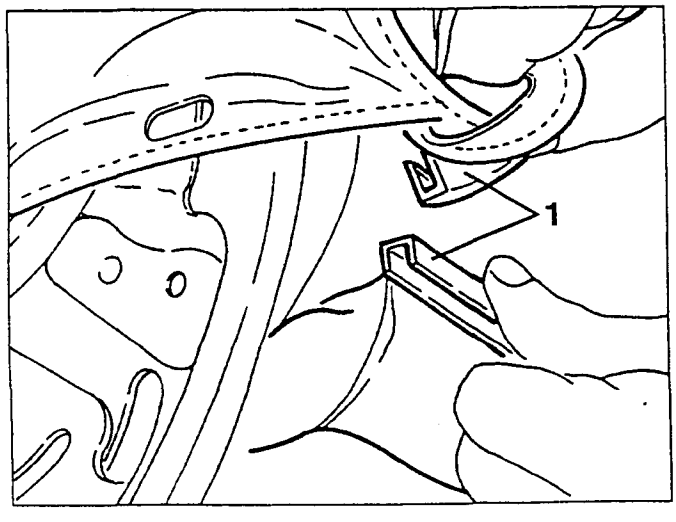


- Tip the backrest forwards to expose the recess.
1. Disconnect the the backrest tilt recess from the relative attachments.

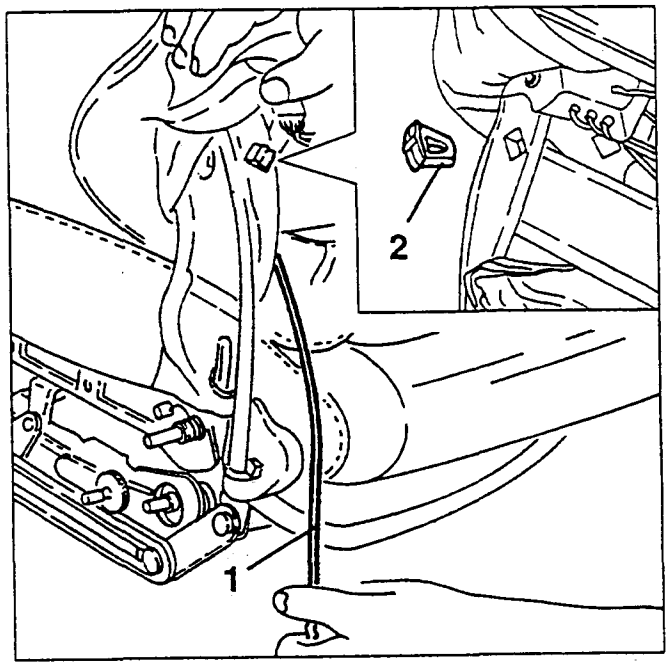




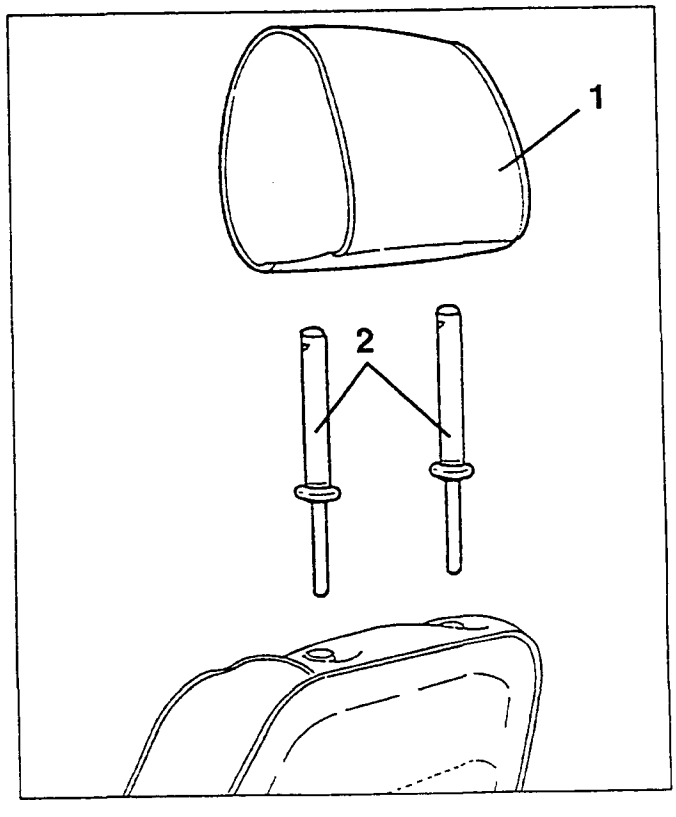
1. Open the backrest covering as shown in the diagram.



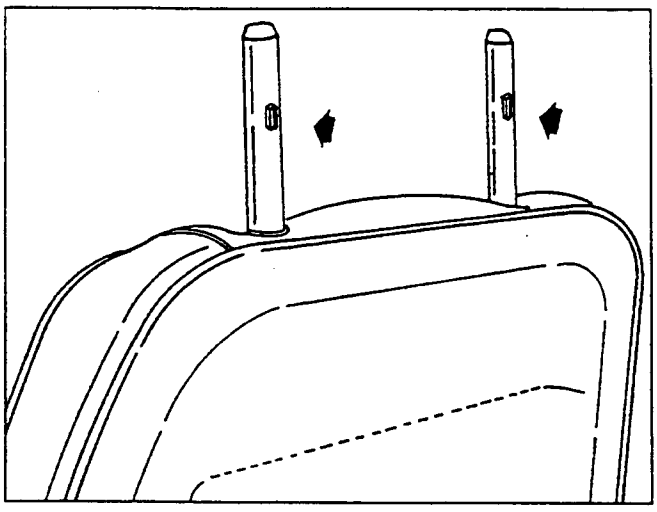
1. Remove the backrest tilt recess withdrawing it from the retaining clip.
2. Remove the backrest tilt recess passage clip.



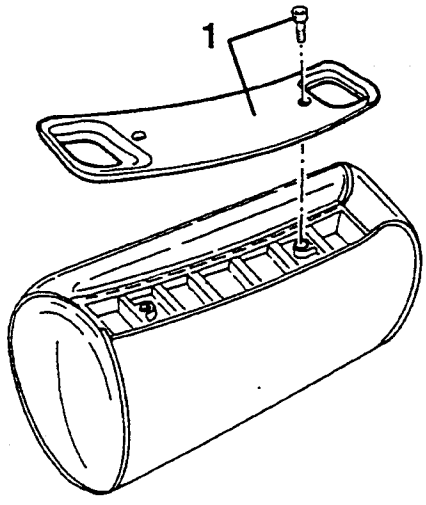
- Fully raise the headrest.
1. Rotate the support pins 90° anticlockwise and remove the headrest.
2. Withdraw the two headrest support pins.



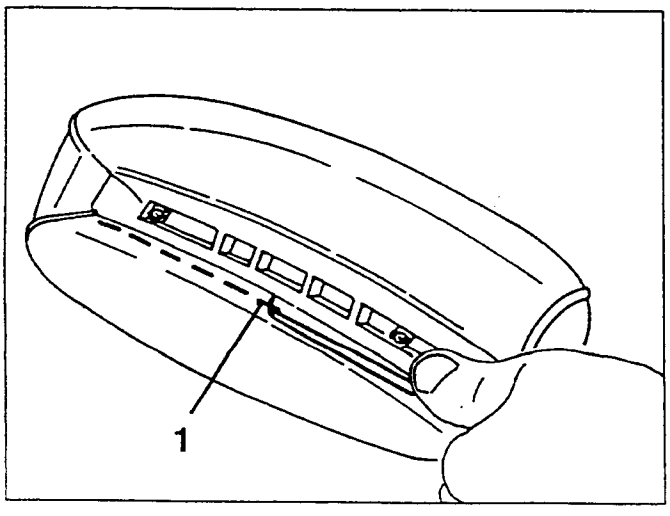
When refitting the headrest ensure that the two teeth on the pins of the headrest support face the rear of the seat.



1. Loosen the two screws and remove the headrest lower trim.

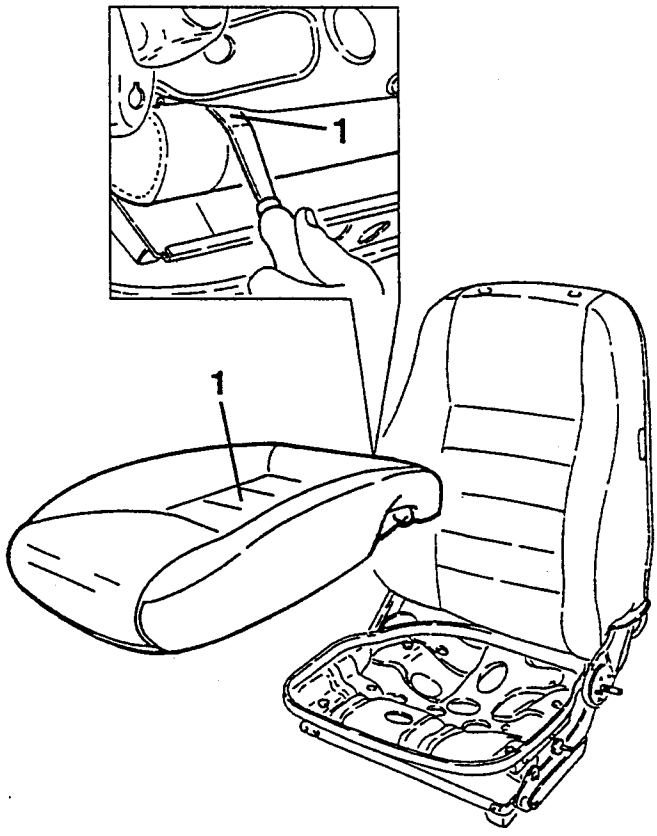


1. Remove the clips and pull off the headrest trim.

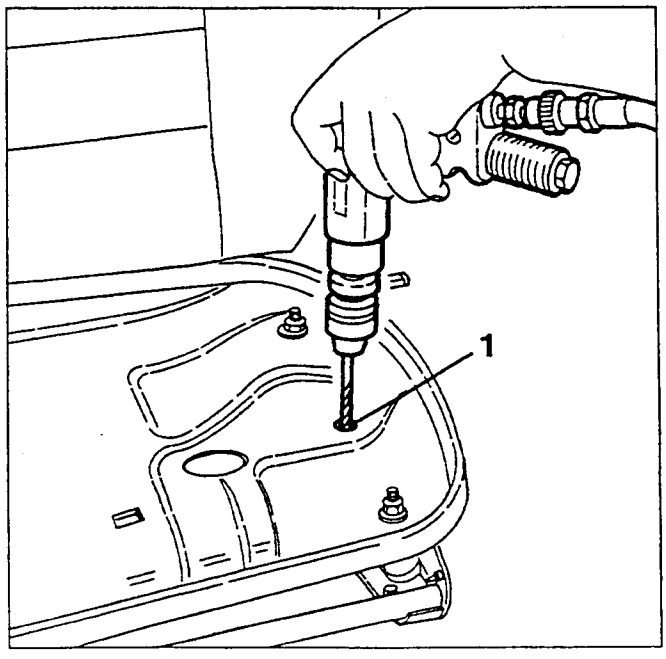


To make it easier to refit the trim onto the headrest use the appropriate material (non-woven fabric) which facilitates the sliding action and correct positioning of the covering itself.

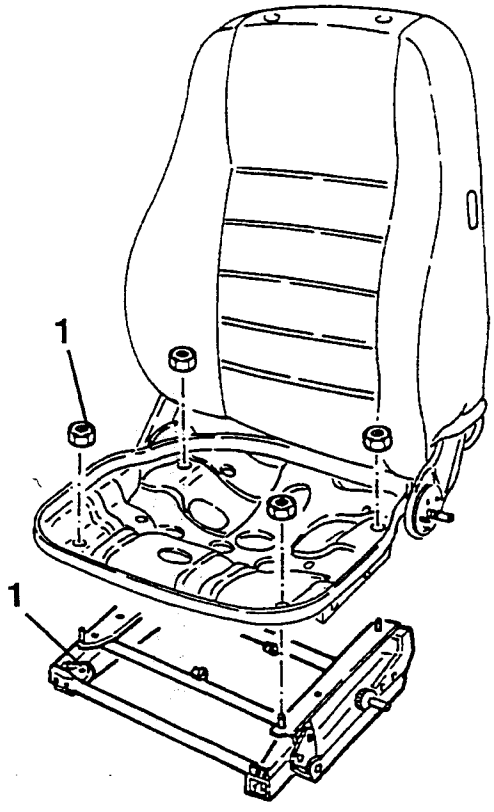
1. Pull off the cushion covering and remove the cushion complete with covering.



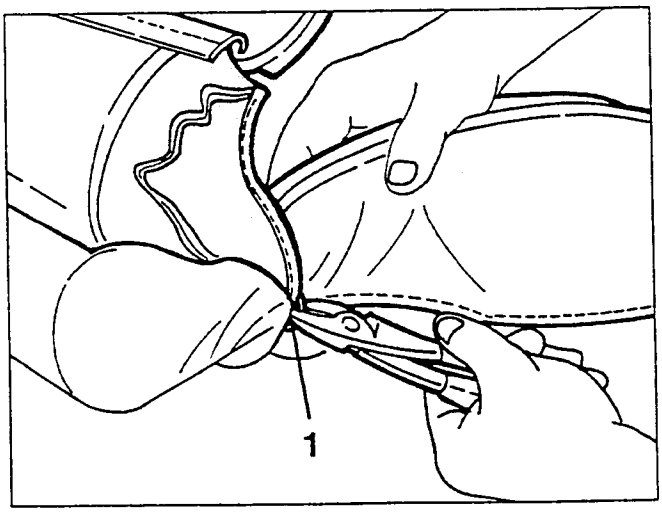
1. Using a drill, remove the two rivets securing the seat raising device.



1. Loosen the four nuts and remove the seat raising device.

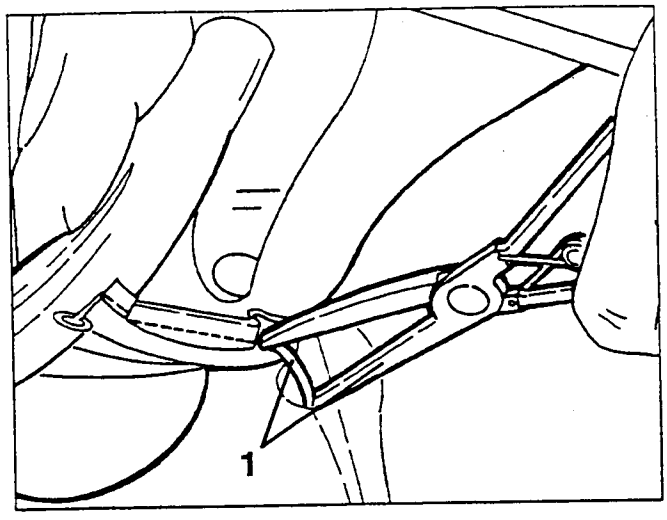


1. Using a pair of shears, cut the clips securing the cushion covering and remove the covering.

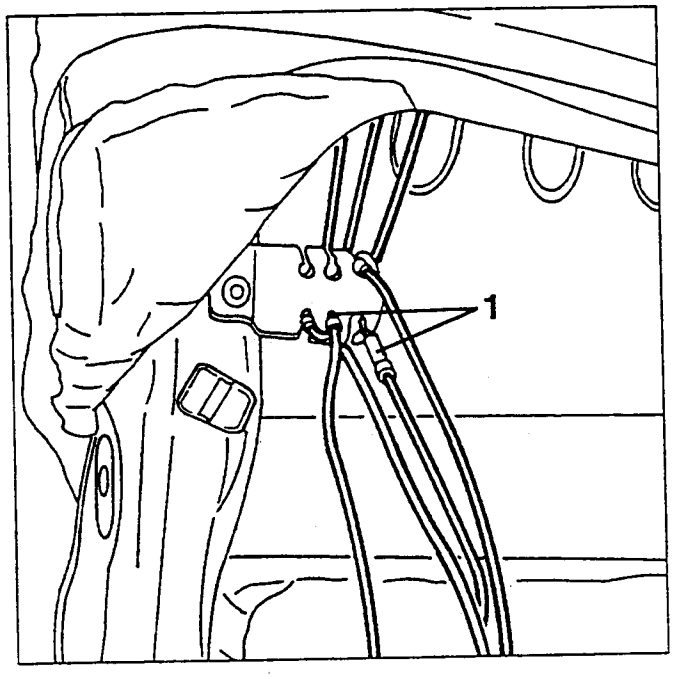


Refit by reversing the procedure followed for disassembly and note the following:

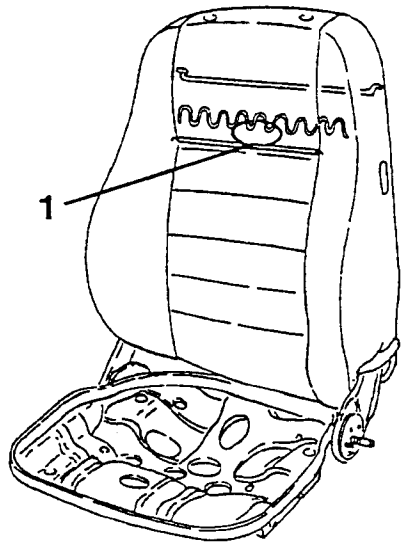
1. Fix the covering with the clips using the appropriate pliers supplied as a spare part.
- Clinch the edge of the covering using a plastic mallet.



1. Unhook the tensioning/adaptation wires of the backrest covering from the brackets.



1. Remove the covering from the backrest after freeing the rear frame tensioning tie-rod and the front rubber ring.

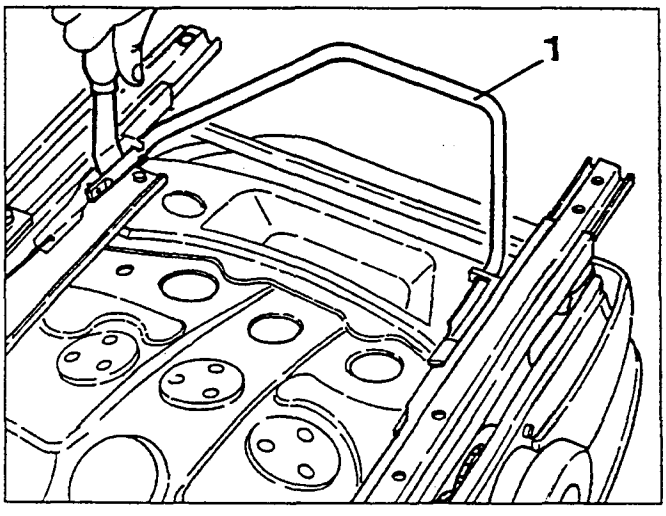


NOTE:
The following components can be removed/refitted from/to the seat whilst it is in the vehicle by following the operations described in the section relative to the bench disassembly of the seat and extrapolating the relative operations:
- **Headrest**
- **Height adjustment device**
- **Backrest tilt handle.**

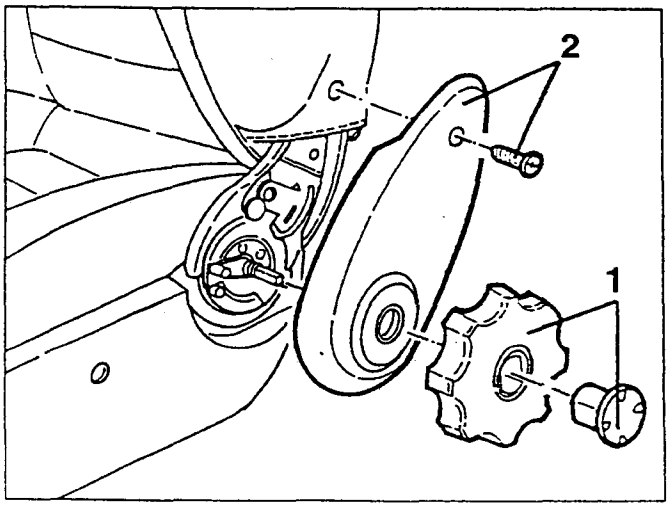
DISASSEMBLING/REASSEMBLING DRIVER'S SEAT (WITHOUT HEIGHT ADJUSTMENT)

Disassemble as described for the seat with height adjustment except for the procedure relative to the removal of the guide runners which is described below.

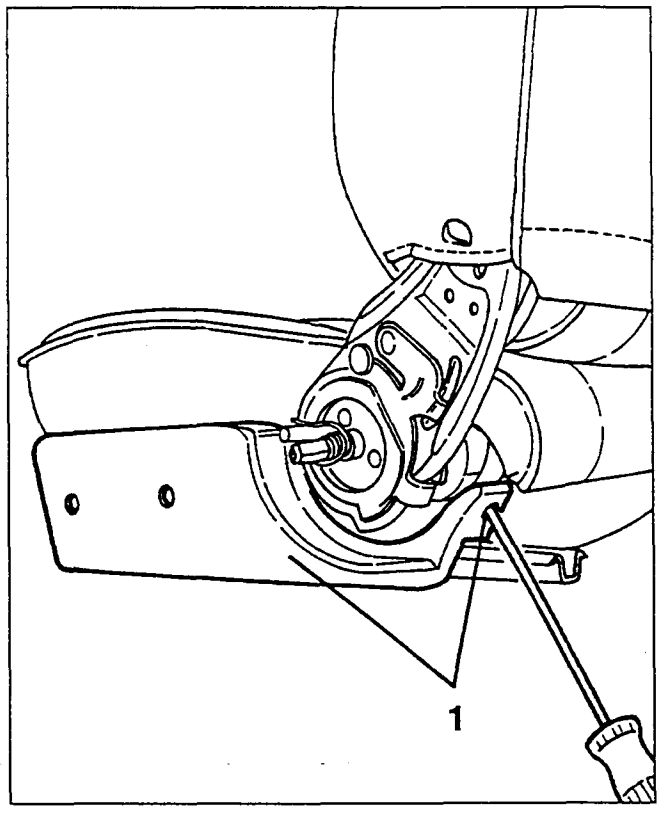
1. Remove the seat runner lever and pull it away from its attachments.



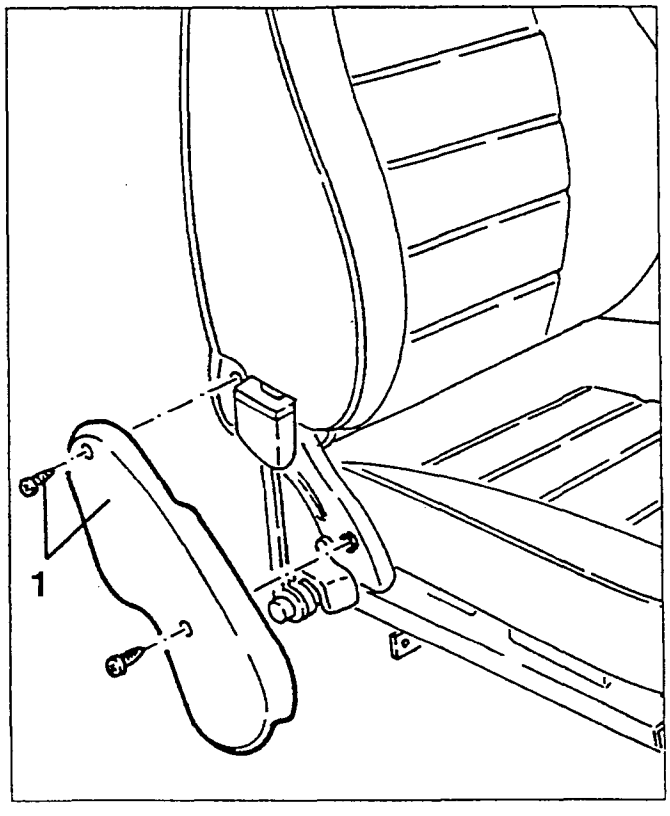
1. Pull off the cap and remove the backrest tilt handle.
2. Loosen the screw and remove the left-hand hinge moulding pulling it away from the clips.



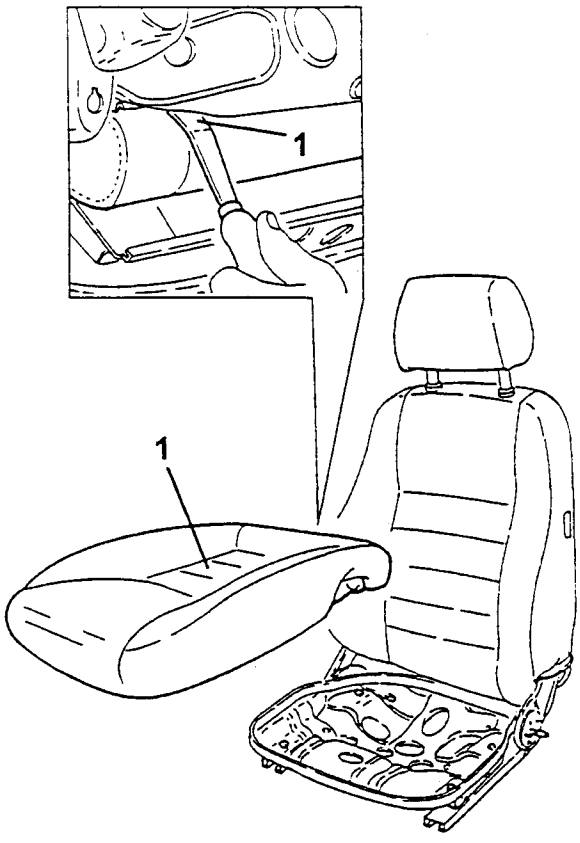
1. Loosen the three screws and remove the lower moulding from the cushion.



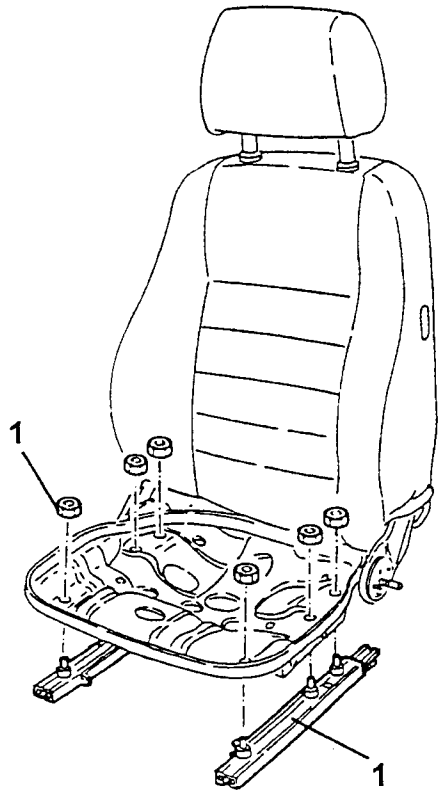
1. Loosen the two screws and remove the right-hand hinge moulding pulling it away from the clips.



.. Remove the cushion cover, then remove the cushion complete with cover.



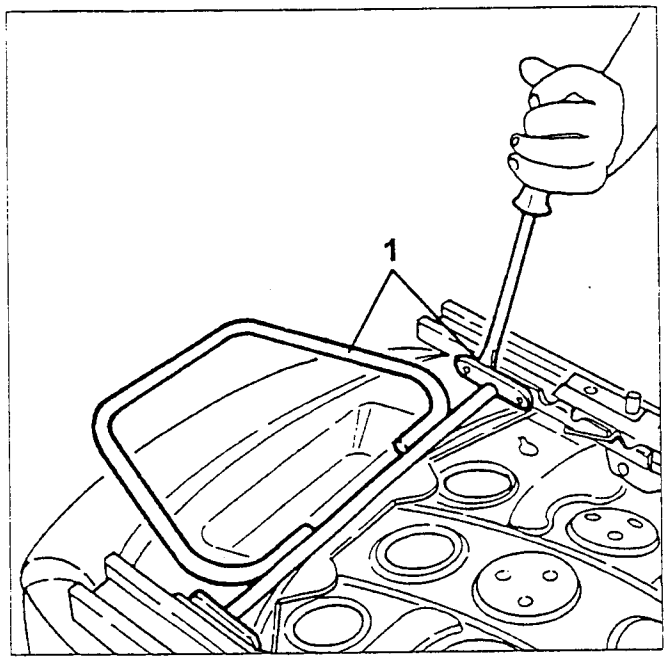
1. Undo the six fixing bolts and remove the seat runners.



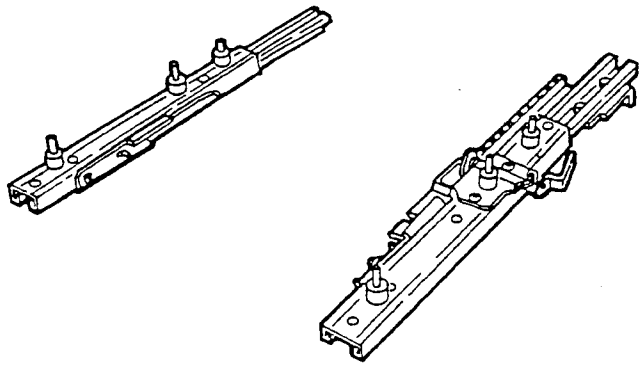
DISMANTLING/REASSEMBLING PASSENGER SEAT

Proceed with the dismantling, working in the same way as described for the driver's seat without height adjustment, making the following changes.

1. Fully retract the runners, then remove the seat sliding lever, releasing it from the side fastenings.



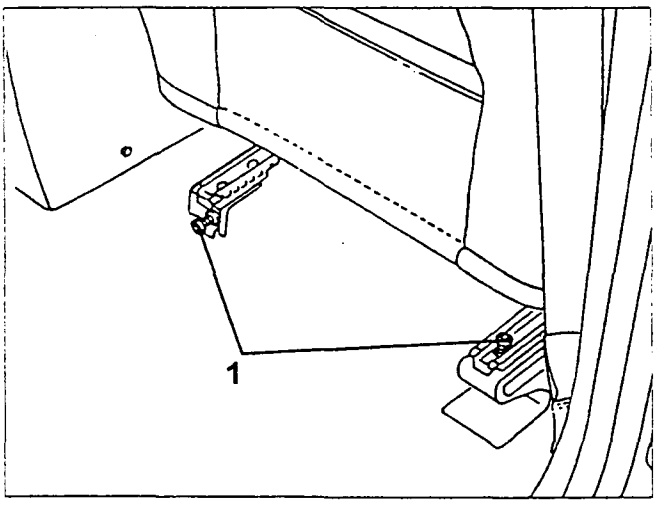
- The seat guides in question do not have a seat height adjustment device, but another device which allows the side to slide forwards and then return to its original position.
- For the removing-refitting, follow the instructions for the driver's seat.



FRONT SEATS
(for versions with Side Bag)

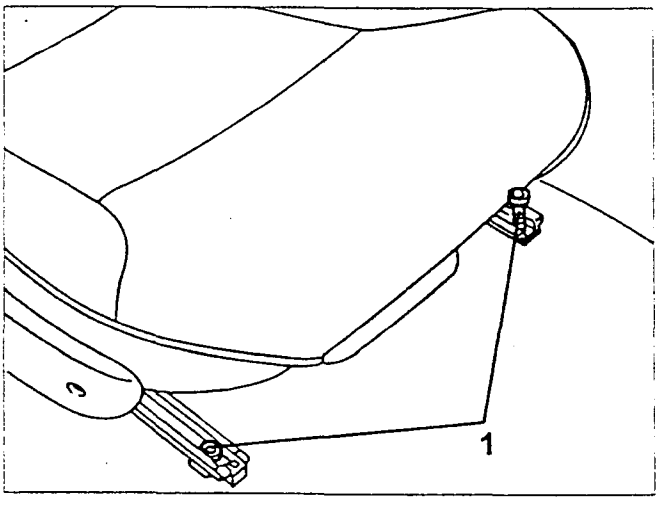
REMOVING

1. Place the seats in the end of travel forwards position and undo the bolts fixing the guides to the floor.

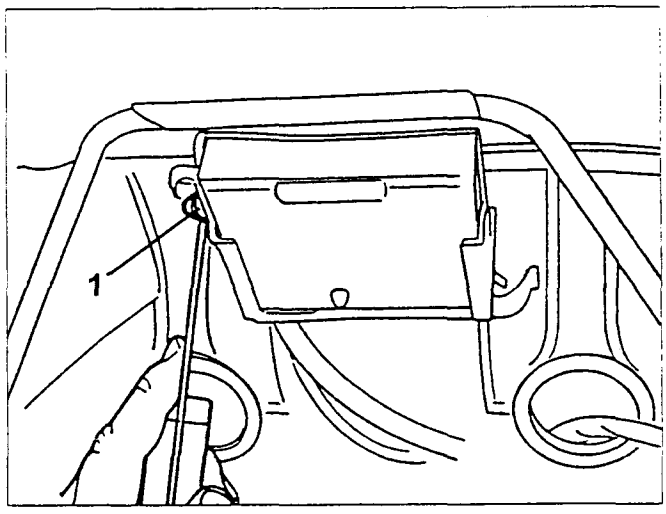


1. Place the seat in the end of travel backwards position and undo the bolts fixing the guides to the floor.

NOTE: Before removing the seat:
- disconnect the battery terminals;
- wait for at least 10 minutes before disconnecting the electrical connection for the passenger presence sensor (for vehicles up to June '99) and for the Side Bag, then proceed as described below.

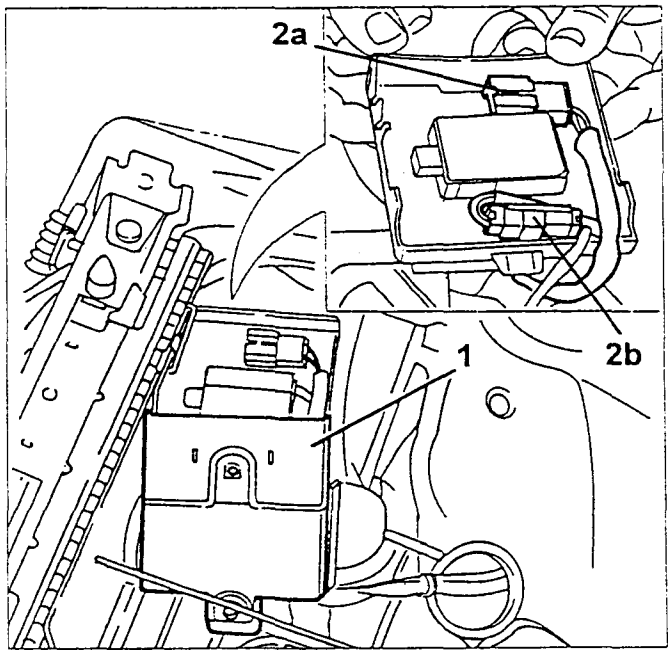


1. Fold the seat backwards and remove the connector box safety plug.



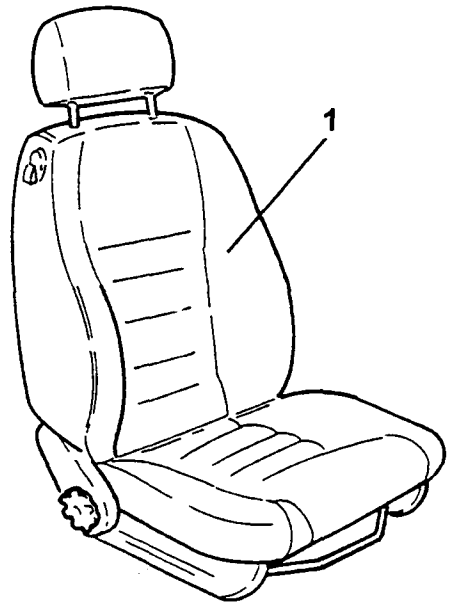
1. Extract the connector box flap.
2. Disconnect the electrical connection (2a) for the Side Bag and the electrical connection (2b) for the passenger presence sensor (for vehicles up to June '99).

NOTE: There are two connections on the passenger seat, one for the Side Bag and one for the passenger presence sensor (for vehicles up to June '99), whilst on the driver's seat there is only the connection for the Side Bag.



1. Remove the seat from the vehicle.

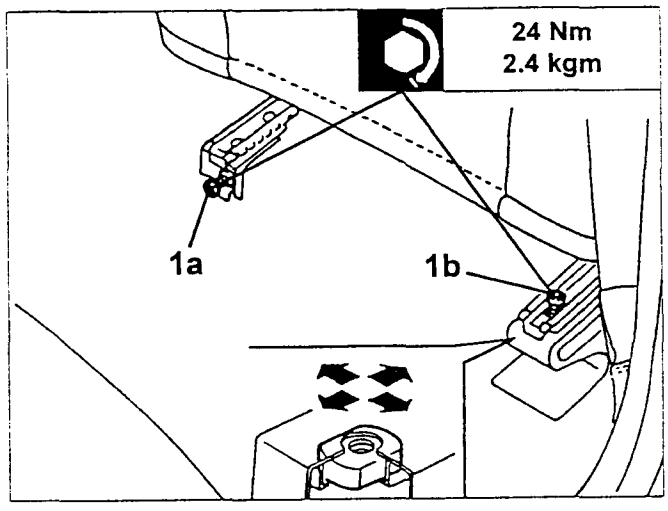
NOTE: Do not extract the seat from its housing using the seat lever shown by the arrow in the diagram or else the guides will not be aligned.



1. Tighten the rear fixing bolts starting from the one on the inside (1a) and continuing with the one on the outside (1b).

The seat should be fixed to the floor without the guides being distorted; if necessary, adjust the nuts shown in the diagram making sure that they are free.

NOTE: During this stage do not lift up the seat to fit the fixing bolts.

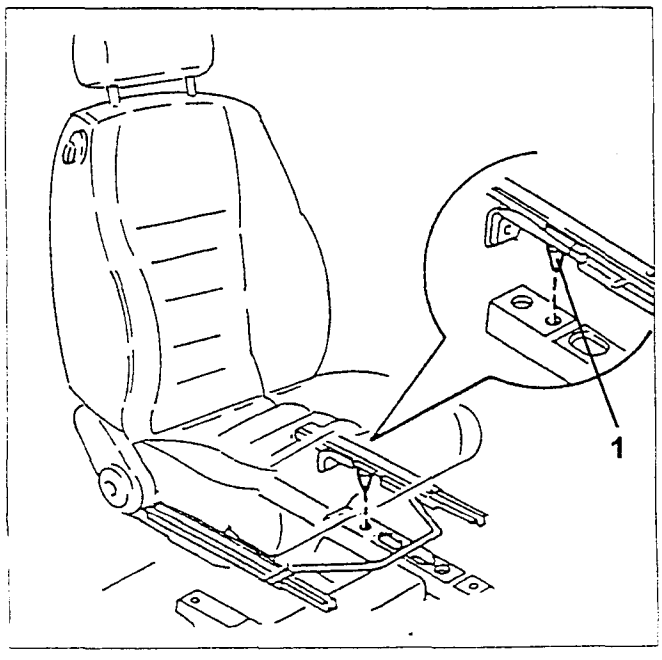


REFITTING

- Place the seat in its housing in the vehicle.
- Connect the electrical connections.

1. Check that the centering pin on the seat guide is correctly positioned.

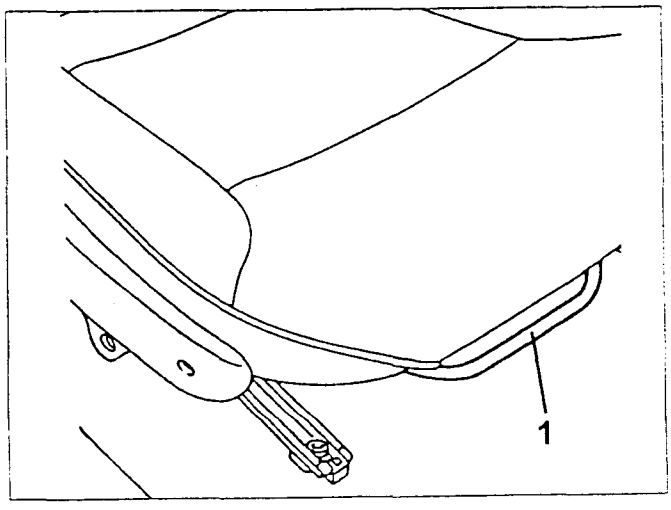
NOTE: Check that the carpet does not interfere with the seat guide support areas.



1. Place the seat in the fully retracted end of travel position using the guide control lever.

Always make sure that the guide control lever is correctly attached.

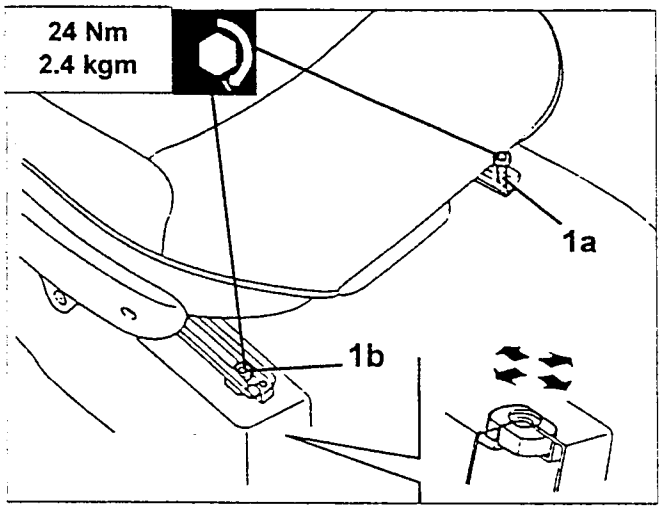
NOTE: For 145 version avoid folding the backrest when sliding the seat in order not to free the guides and prevent them from being out of alignment.



1. Tighten the front fixing bolts, starting from the one on the inside (1a) and continuing with the one on the outside (1b).

The seat should be fixed to the floor without distorting the sliding guides; if necessary, adjust the nuts shown in the diagram making sure that they are free.

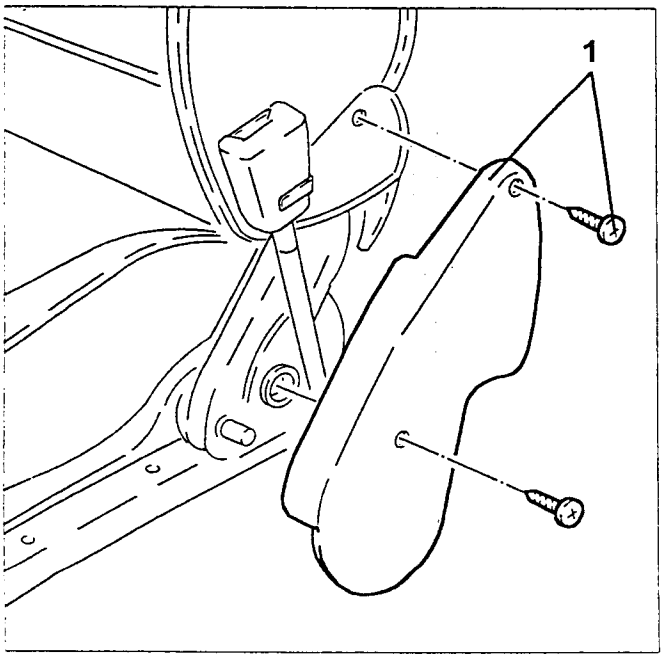
NOTE: Each time operations are carried out on the Air Bag system the operation of the system MUST be checked using the diagnostic equipment.



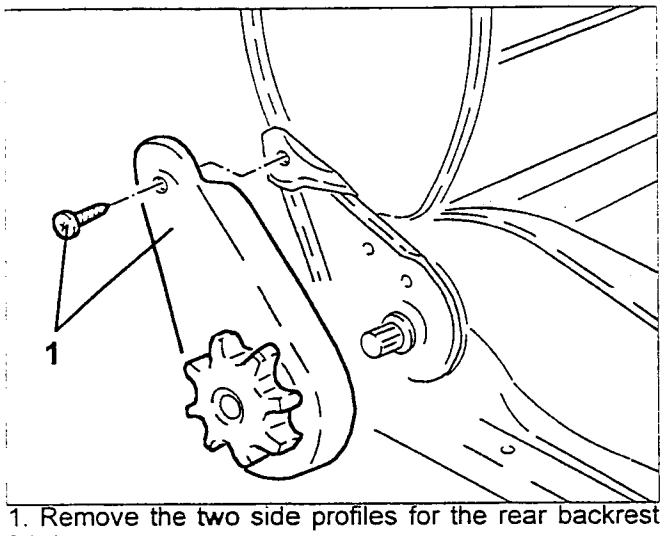
DISMANTLING-REASSEMBLING FRONT SEAT BACKREST UPHOLSTERY

- Remove the front seat (see specific procedure).

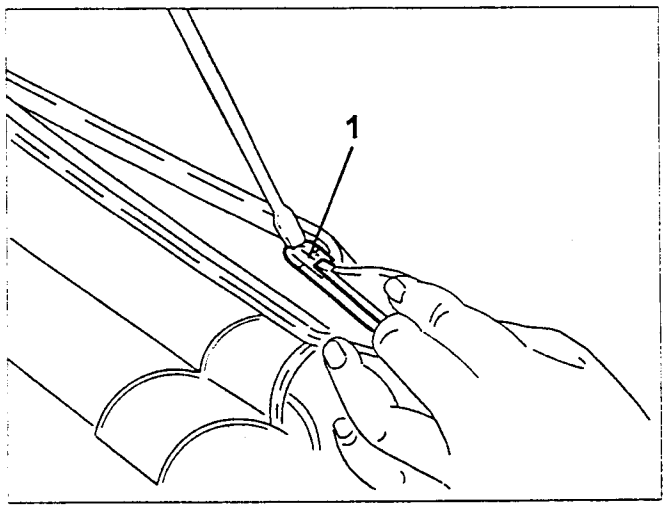
1. Undo the two fixing bolts and remove the hinge trim releasing it from the fastening springs.



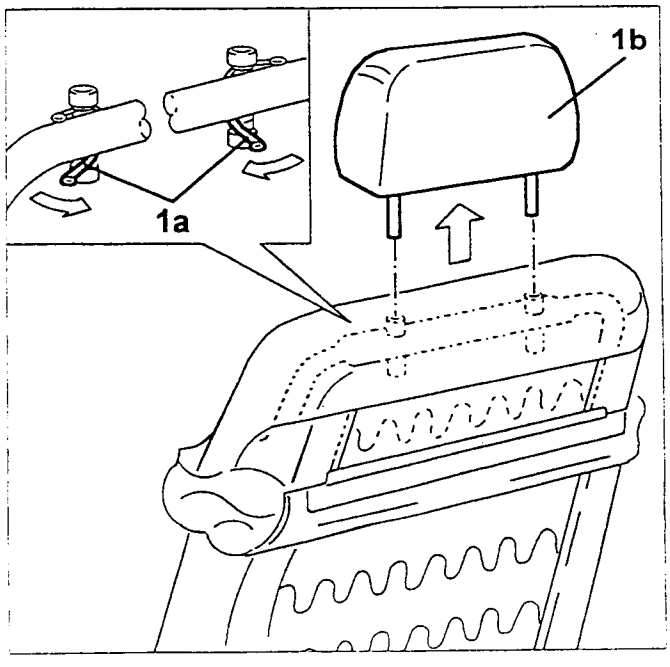
1. Undo the fixing bolt and remove the hinge trim complete with knob releasing it from the fastening springs.



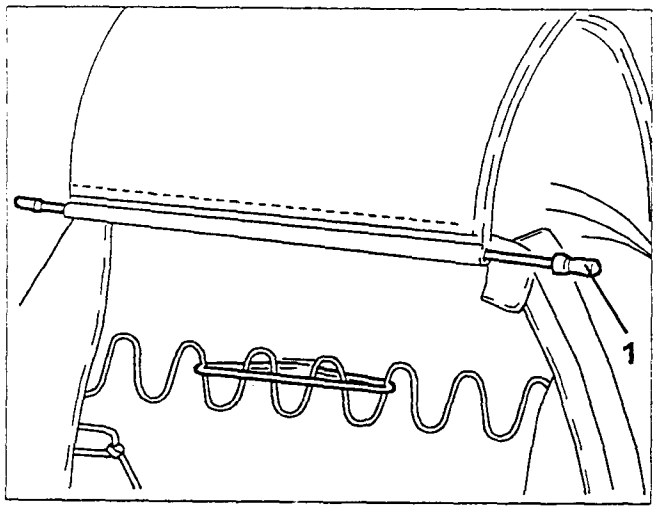
1. Remove the two side profiles for the rear backrest fabric.



1. Rotate the springs (1a) and remove the head restraint (1b).

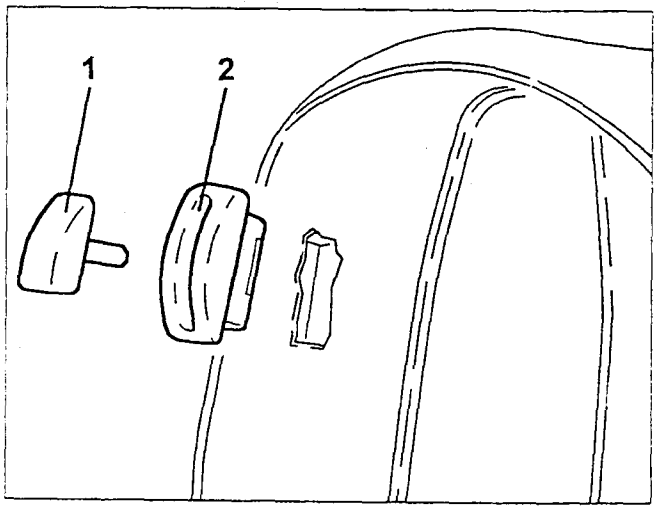


1. Remove the upper backrest cover retaining rod.

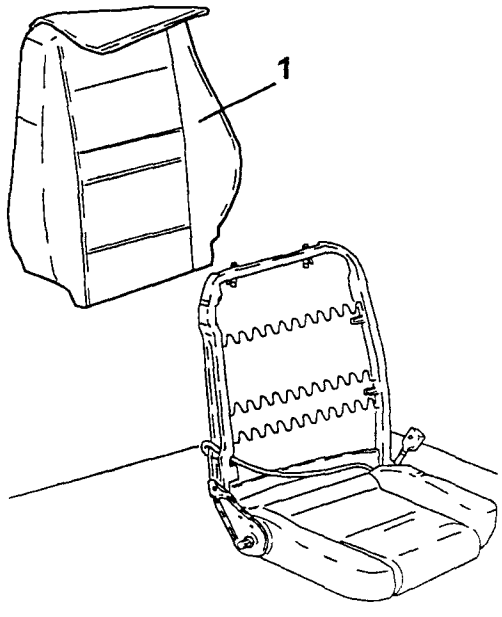


1. Remove the seat folding lever.
2. Remove the trim.

NOTE: When refitting, replace the trim.

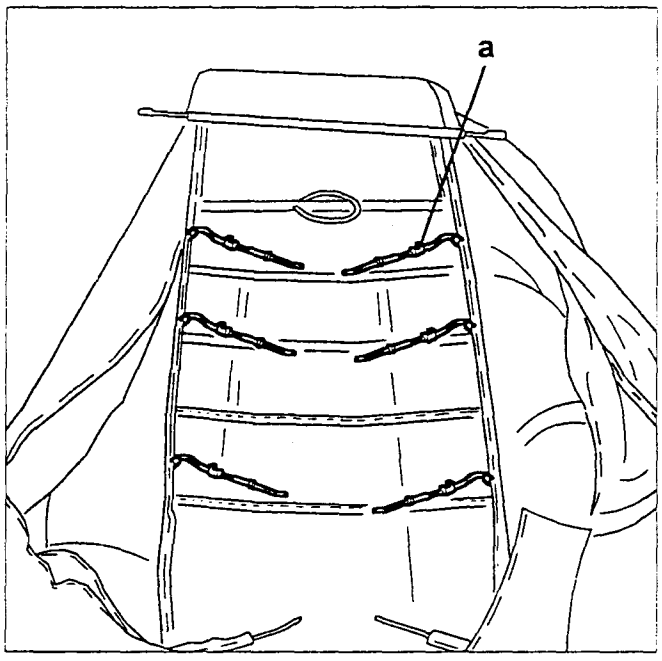


1: Remove the front seat backrest cover complete with upholstery.



NOTE: When refitting, check that the seat rods are correctly positioned.

If the rods (a) are incorrectly fitted this will adversely affect the operation of the Side Bag.

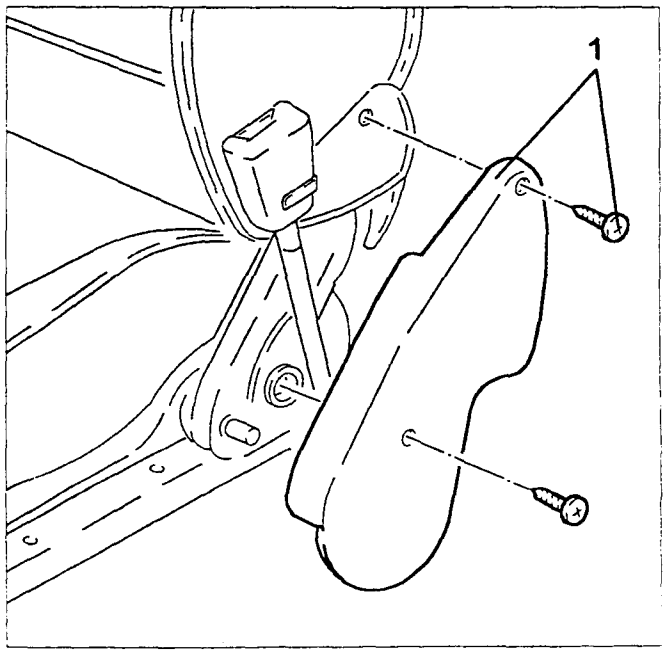


NOTE: Before fitting a new backrest cover on the seat, make the openings for the head restraint pins and the folding lever.

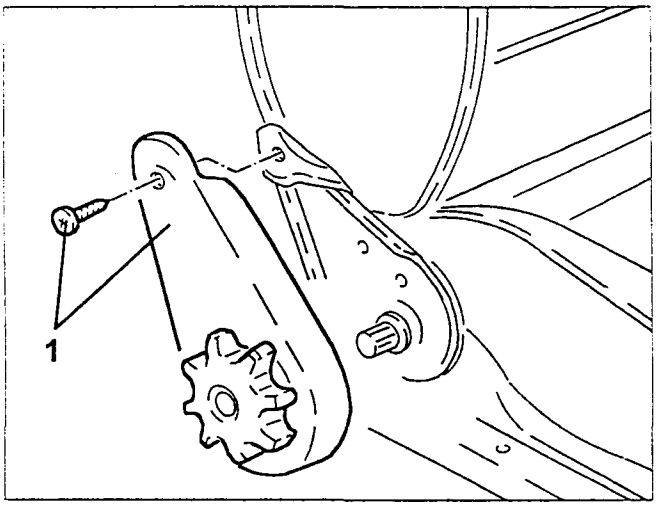
DISMANTLING/REASSEMBLING FRONT SEAT CUSHION COVER

- Remove the front seat (refer to the specific procedure).

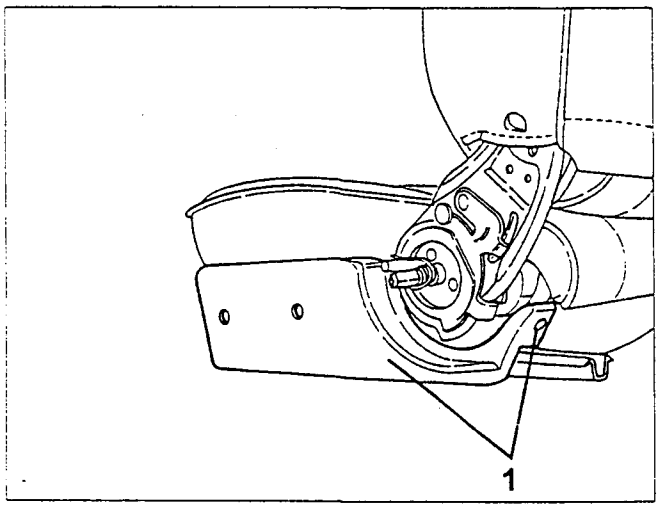
1. Undo the two fixing bolts and remove the hinge trim releasing it from the fastening springs.



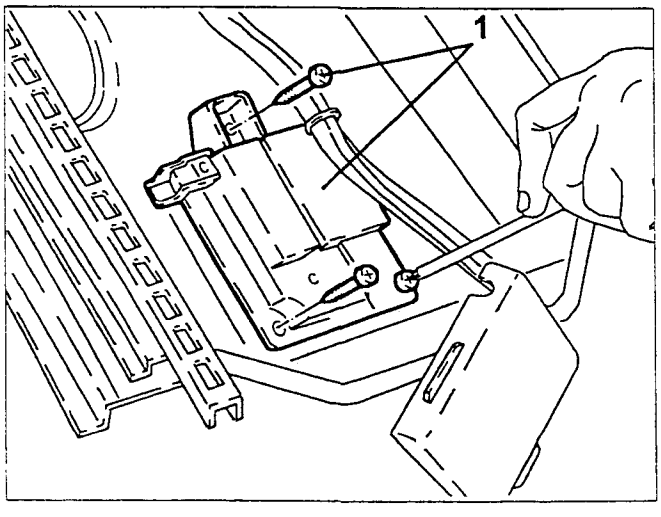
1. Undo the fixing bolt and remove the hinge trim complete with knob releasing it from the fastening springs.



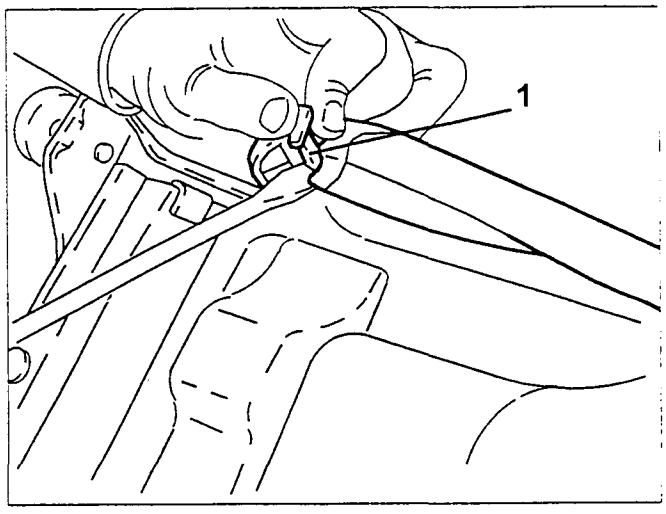
1. Undo the fixing bolts and remove the right and left hinge trim.



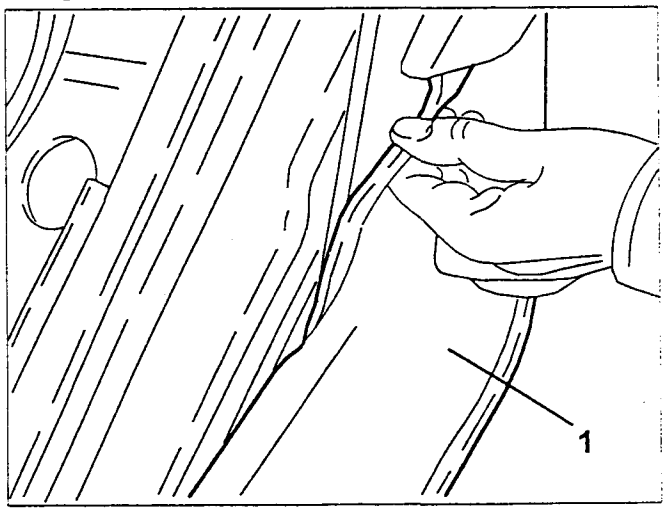
1. Remove the connector box fastened to the base of the seat.



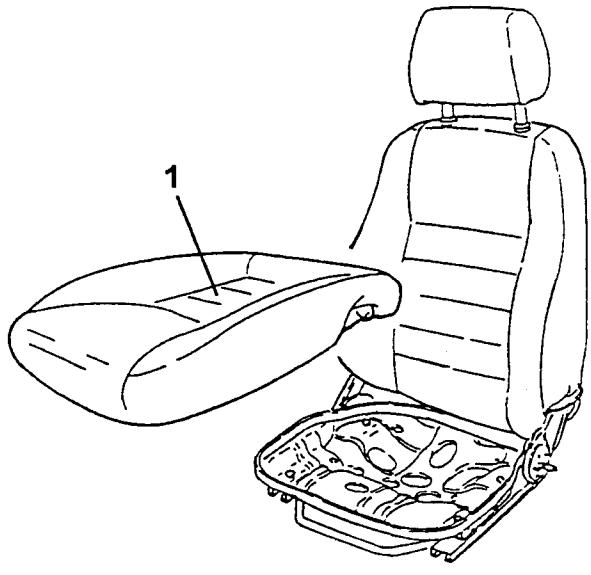
1. Release the seat cover from the base of the rear of the seat.



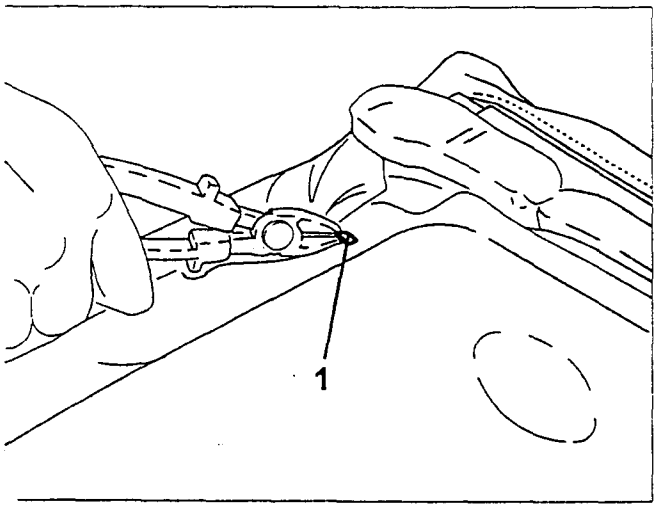
1. Release the seat cover from the base of the seat on the right and left sides.



1. Remove the cushion.



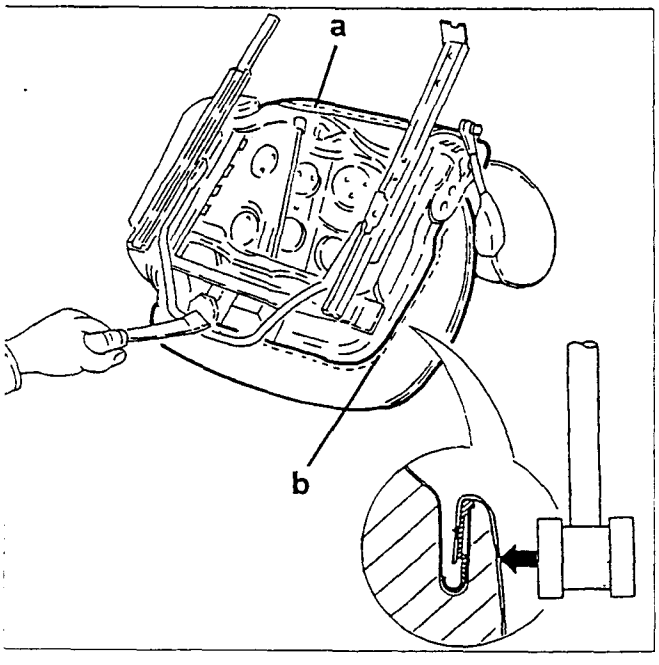
. Cut the metal points fixing the seat cover to the seat upholstery.



Remove the remaining metal points connected to the upholstery to avoid damaging the cover.

- Proceed with the refitting, reversing the order of the operations carried out for the removal, taking care to observe the following.
- Fit the cushion on the seat frame, attaching the profiles (a) and (b) using a spatula, starting at the centre front area.
- Stake the drip channel using a rubber hammer as illustrated in the diagram.

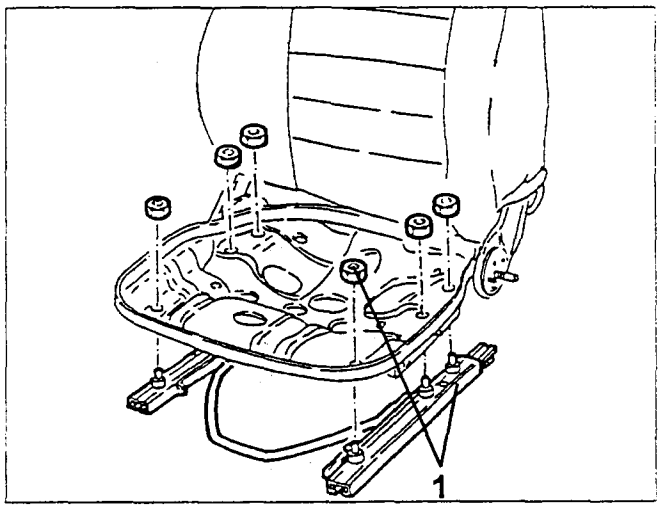
The use of other tools could damage the cover.



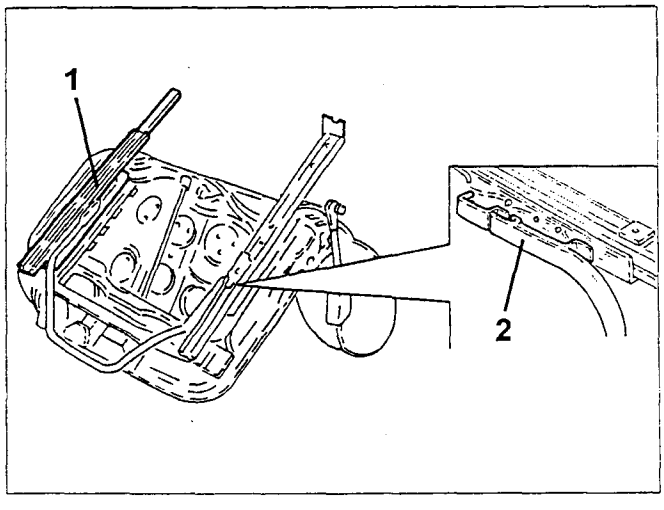
DISMANTLING/REASSEMBLING PASSENGER SEAT GUIDES

- Remove the cushion from the seat (see "Dismantling/Reassembling front seat cushion cover" procedure).
1. Undo the fixing nuts and remove the guides complete with runner.

The runner should not be removed before dismantling the guides in order to prevent distortions which could adversely affect operation.



- Proceed with the refitting, reversing the order of the operations carried out for the removal, taking care to observe the following.
1. Position the guide with the memory on the base and fasten it without tightening the two nuts.
2. Position the runner on the remaining guide taking care to centre the ratchet gears.
- Fit the guide complete with runner and fasten it without tightening the two nuts.



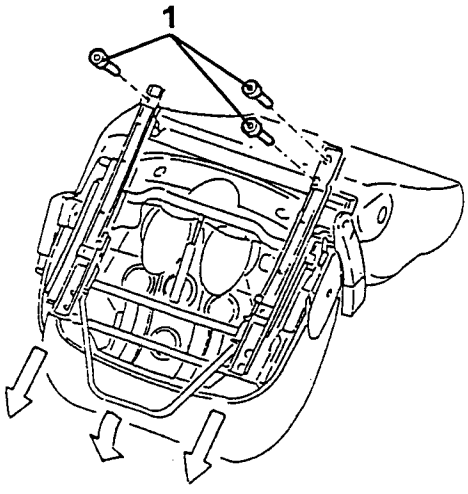
- Place the guides forwards until they are heard to lock.
- Tighten the nuts fixing the guides to the recommended torque.

24 Nm 2.4 Kgm

DISMANTLING/REASSEMBLING DRIVER'S SEAT GUIDES

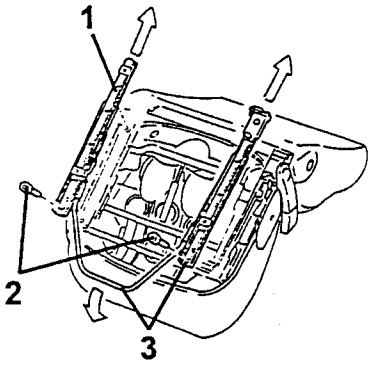
- Remove the front seat (see specific procedure).
- At the bench, move the guides forwards with the runner.

1. Undo the rear guide fixing bolts.

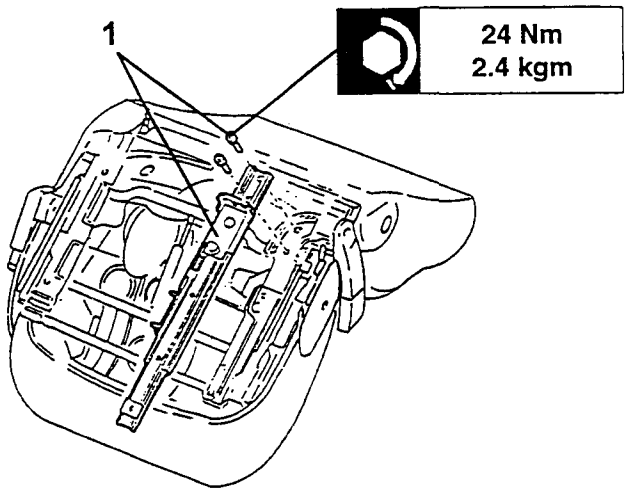


1. Retract the guides with the runner.
2. Undo the front guide fixing bolts.
3. Remove the guides complete with runner.

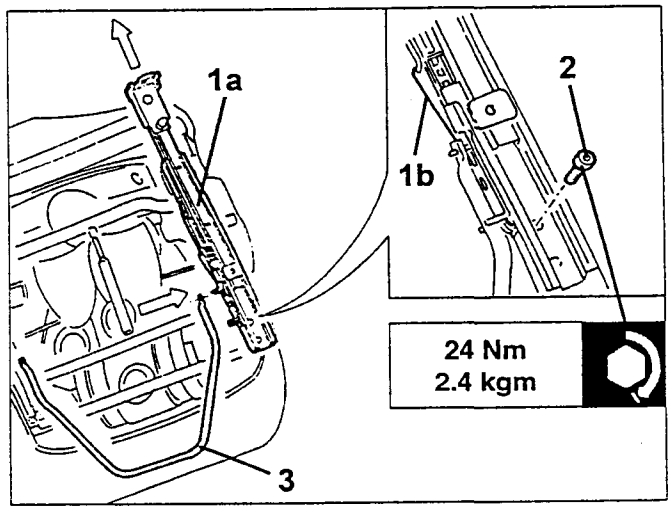
The runner should not be removed before dismantling the guides to prevent distortions which could adversely affect operation.



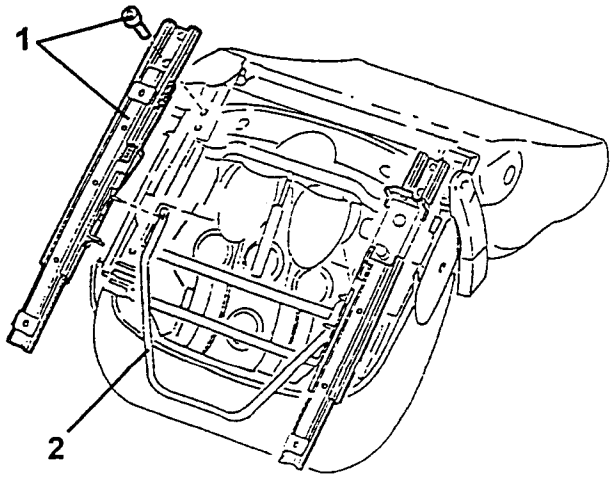
1. Position the inner guide and secure it tightening the rear bolts to the recommended torque.



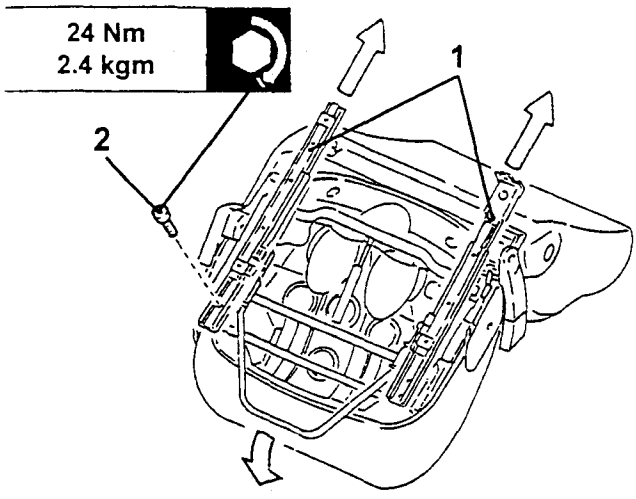
1. Retract the inner guide (1a) manually using the bolt (1b).
2. Tighten the front bolt fixing the guide to the recommended torque.
3. Place the runner back in its housing, taking care to centre the ratchet gears on the guide.



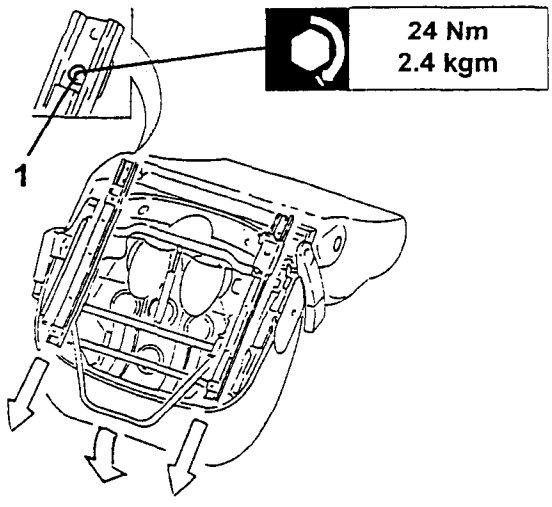
1. Fit the outer guide and secure it without tightening the rear bolt.
2. Attach the runner.



. Retract the guides using the runner.
2. Tighten the front bolt fixing the outer guide to the recommended torque.



- Move the guides forwards using the runner.
1. Tighten the rear bolt fixing the outer guide to the recommended torque.

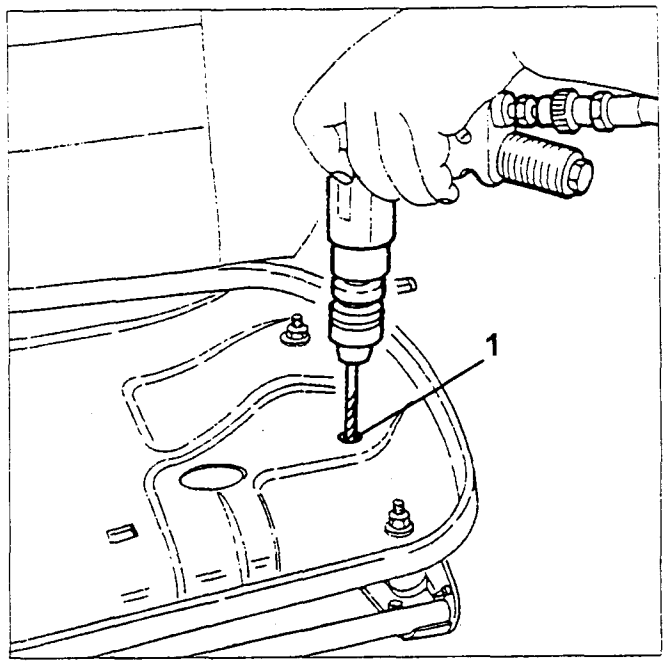


- Fit the front seat (refer to the specific procedure).

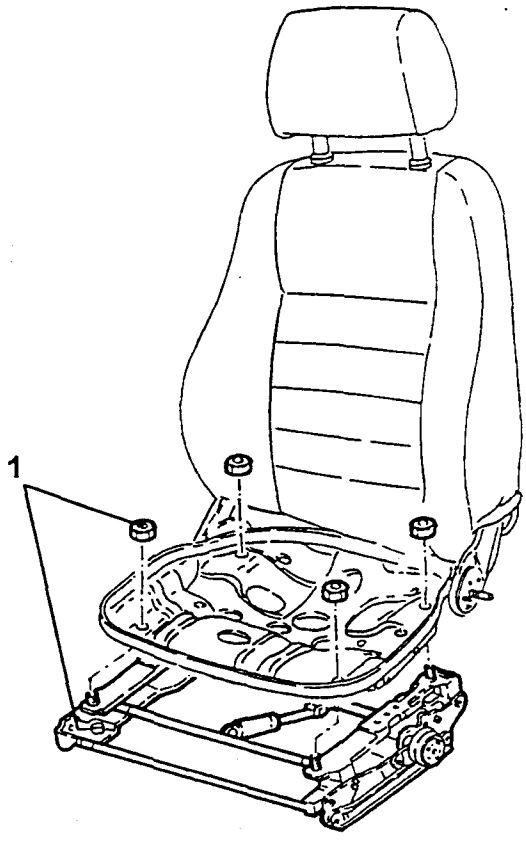
DISMANTLING/REASSEMBLING SEAT LIFTING DEVICE

- Remove the seat guides after having place the seat in the highest position (see "Dismantling/Reassembling driver's seat guides").

1. Using a drill, remove the two rivets fixing the seat lifting device.



1. Undo the four fixing nuts and remove the seat lifting device.
- Recover the seat lifting lever.



DISMANTLING/REASSEMBLING DRIVER'S SEAT LIFTING DEVICE GAS SPRING

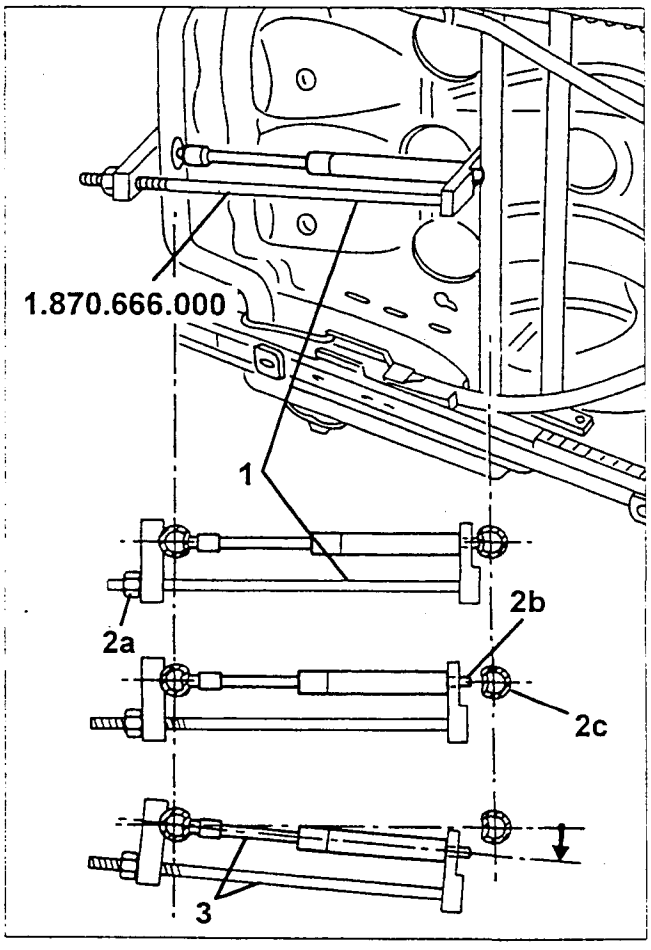
- Remove the front seat (see specific procedure).
- Place the seat in the completely raised position.

1. Fit tool N° 1.870.666.000 on the gas spring as shown in the diagram.
2. Tighten the nut for the tool (2a) to compress the gas spring until the gas spring pin (2b) is released from the housing (2c).

Whilst tightening the nut, keep the tool in position and carry out the operation very carefully.

3. Rotate the tool assembly with the gas spring, as necessary, then undo the nut for the tool until the gas spring is completely removed.

Whilst undoing the nut, keep the tool in position.



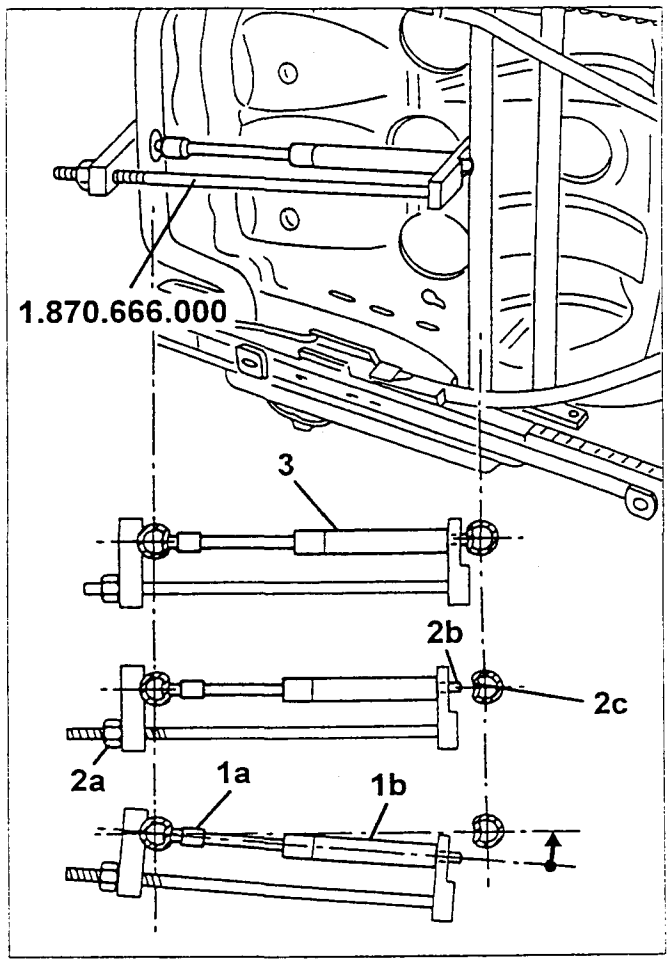
- Check that the gas spring is not damaged and provides a suitable load.

1. Rest the head (1a) of the gas spring (1b) in its housing in the tube, then fit tool No. 1.870.666.000 as illustrated in the diagram.
2. Tighten the nut (2a) for the tool to compress the gas spring in order to be able to align the device pin (2b) with the housing (2c) in the tube.

Whilst tightening the nut, keep the tool in position and carry out the operation very carefully.

3. Undo the nut for the tool until the gas spring is completely inserted in the housing.

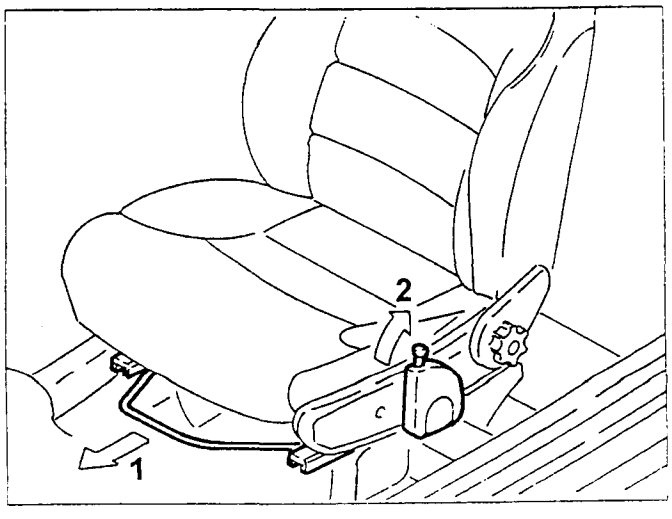
Whilst undoing the nut, keep the tool in position.



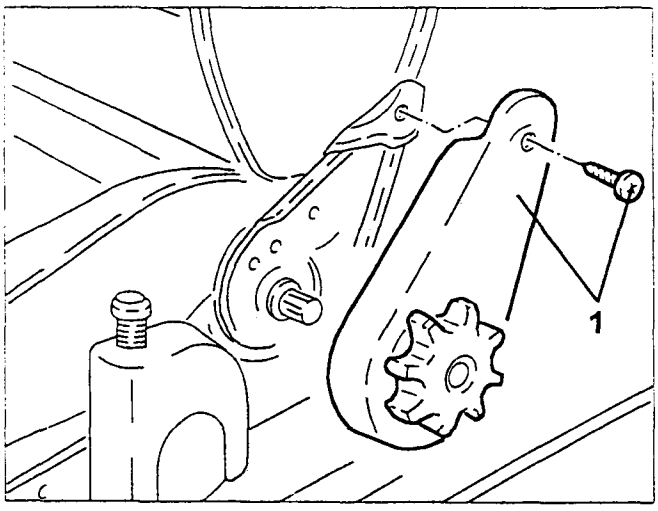
- Fit the front seat (see specific procedure) and check the operation of the device.

REMOVING/REFITTING SEAT LIFTING CLUTCH IN VEHICLE

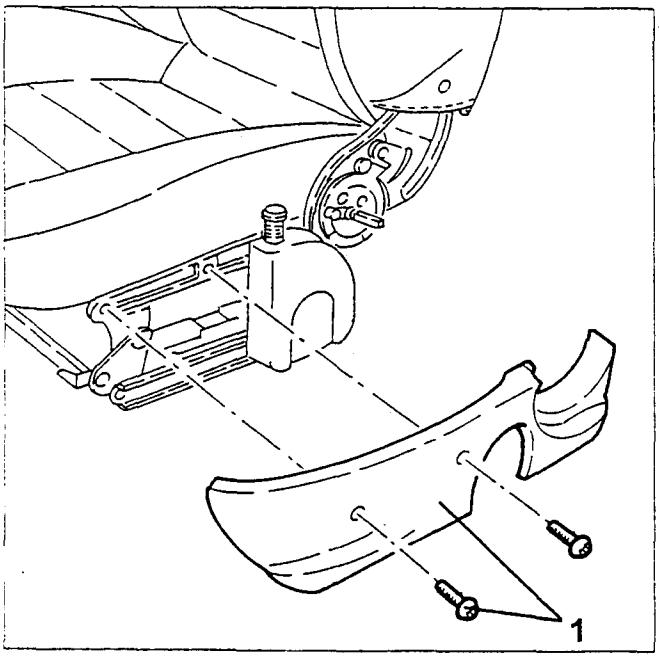
1. Position the seat completely forwards.
2. Position the seat lifting device completely upwards.



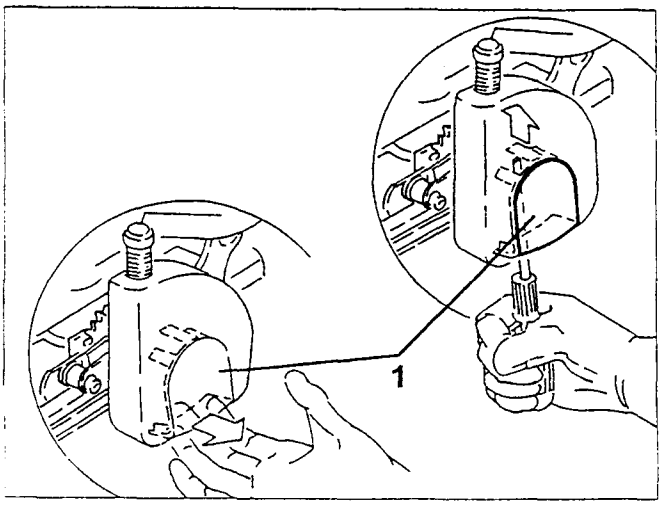
.. Undo the bolt and remove the hinge trim, complete with knob, releasing it from the fastening springs.



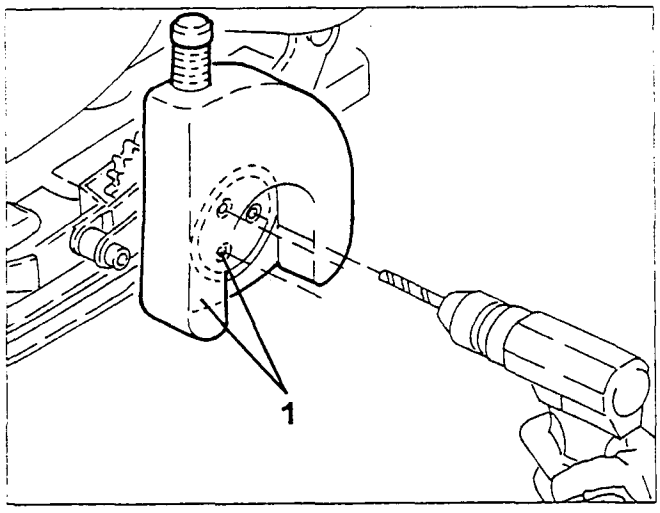
'. Undo the fixing bolts and remove the right hinge trim.



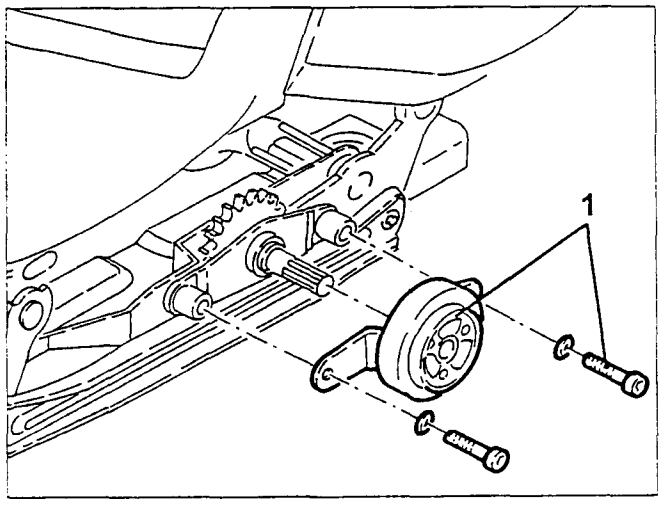
1. Remove the seat lifting lever trim, firstly detaching the lower part by hand and then using a screwdriver on the upper tab.



1. Remove the head of the rivets using a drill with a 4 mm bit and remove the lifting device.

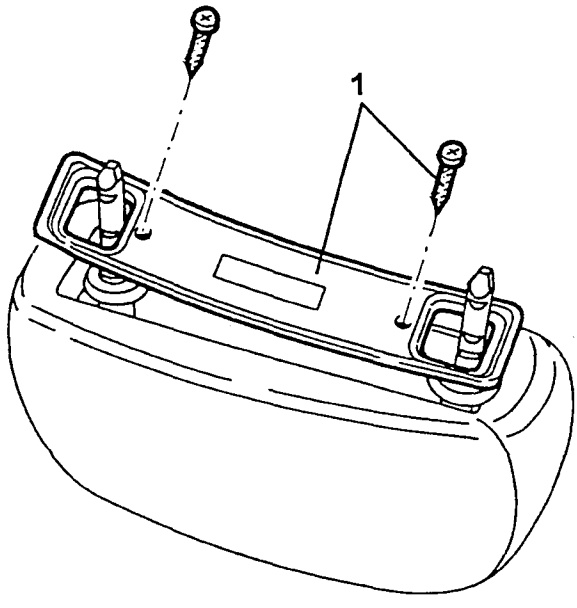


1. Undo the fixing bolts and remove the seat lifting clutch.

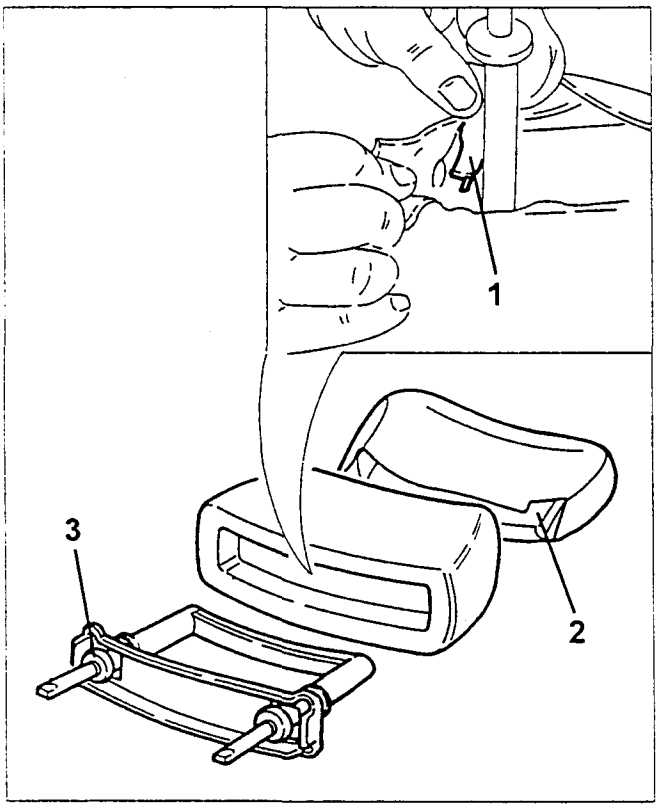


DISMANTLING/REASSEMBLING HEAD RESTRAINT

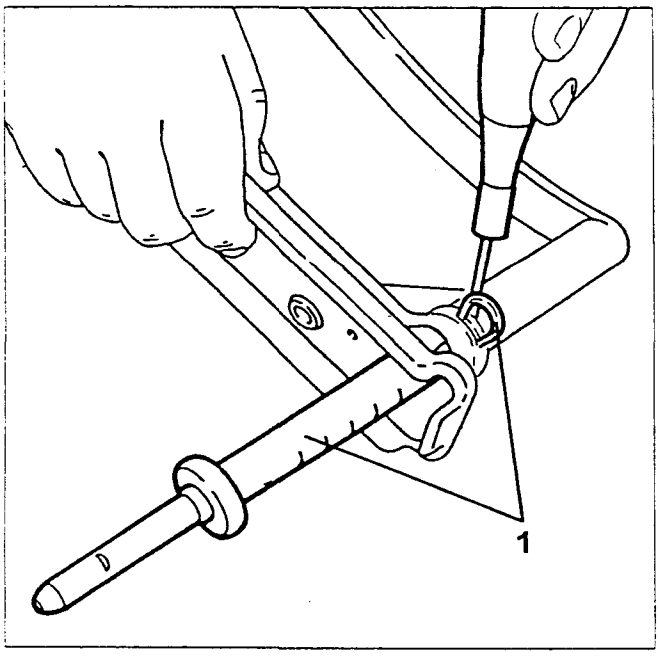
1. Undo the bolts and remove the trim.



- Remove the metal points fixing the fabric to the structure.
1. Remove the ends of the strengthening wire from the upholstery.
2. Remove the fabric from the head restraint upholstery.
3. Remove the structure from the head restraint upholstery.

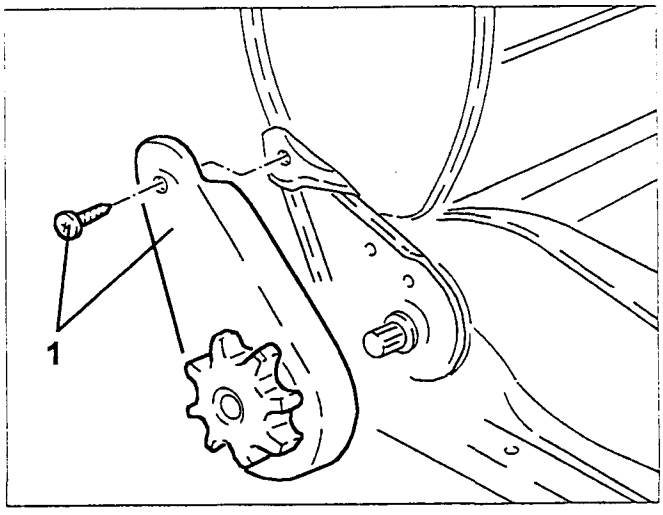


1. Remove the retaining springs and remove the pins from the structure.

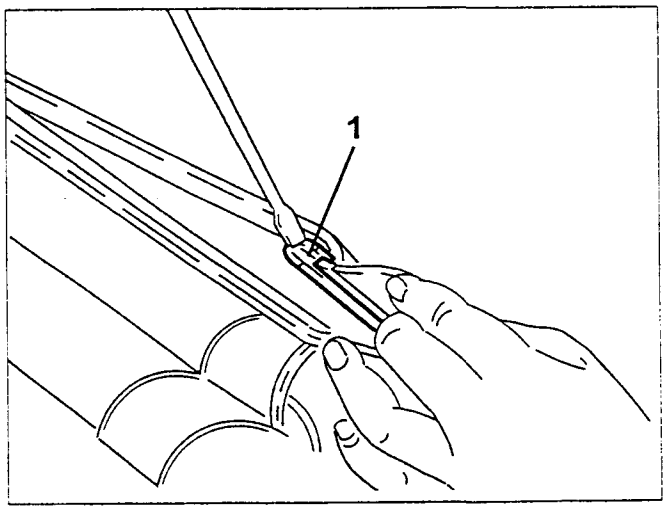


REMOVING/REFITTING BACKREST FOLDING CABLE ON VEHICLE

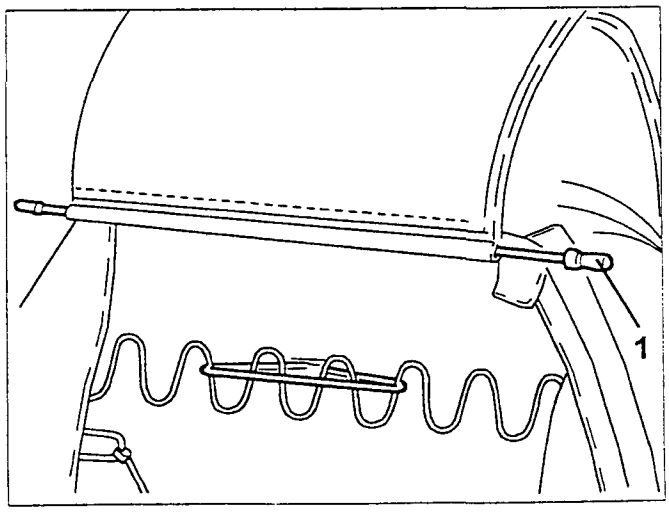
1. Undo the fixing bolt and remove the hinge trim, complete with knob, releasing it from the fastening springs.



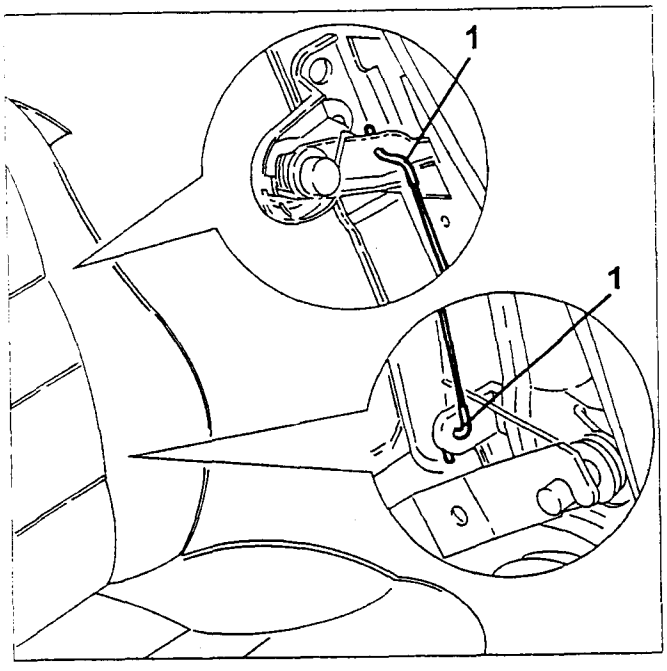
1. Remove the two side profiles for the backrest rear fabric.



1. Remove the upper backrest cover retaining rod.



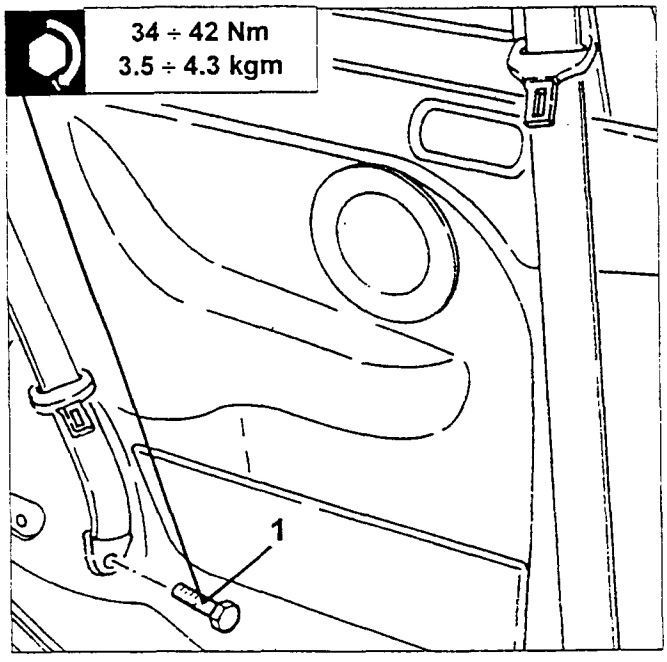
- Fold the backrest forwards.
1. Release the two ends of the backrest folding cable and remove it.



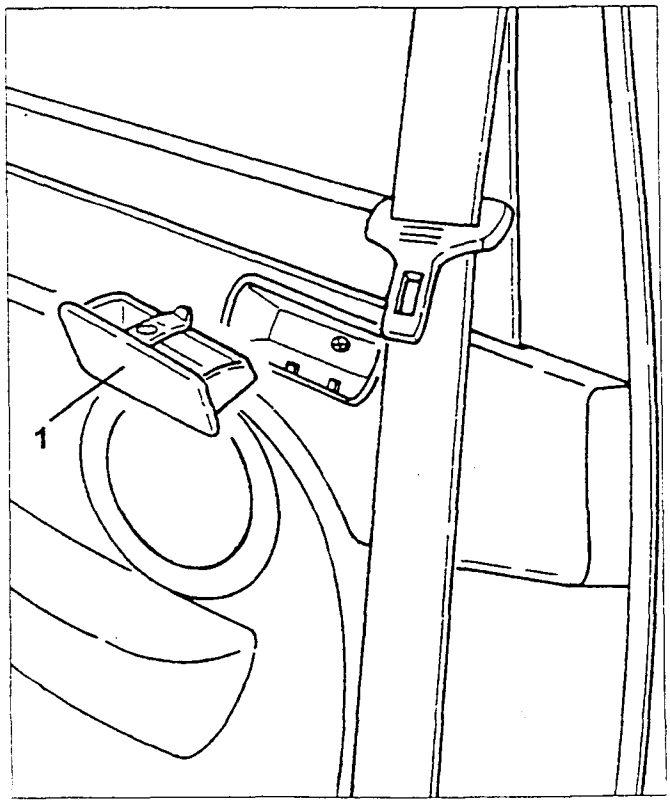
SIDE PANELS

REMOVING/REFITTING

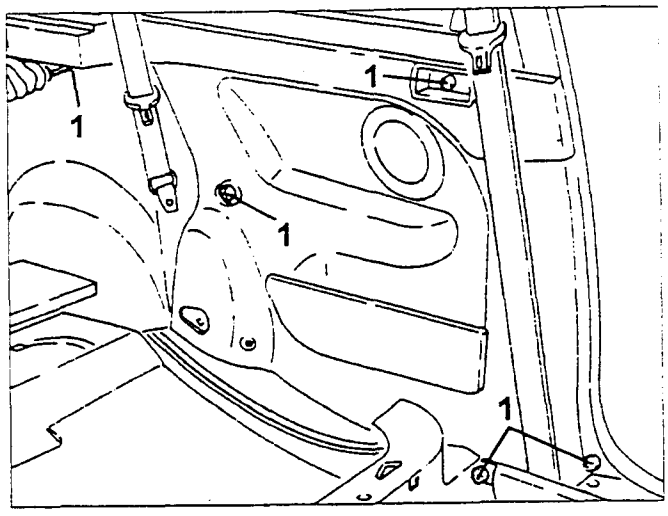
- Remove the rear seats (see specific paragraph).
1. Undo the bolt fixing the rear seat belt lower mounting.



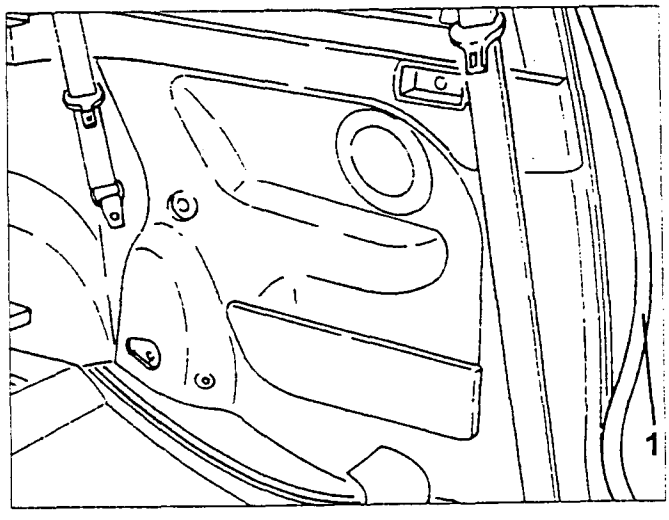
1. Release and remove the ashtray from the housing.



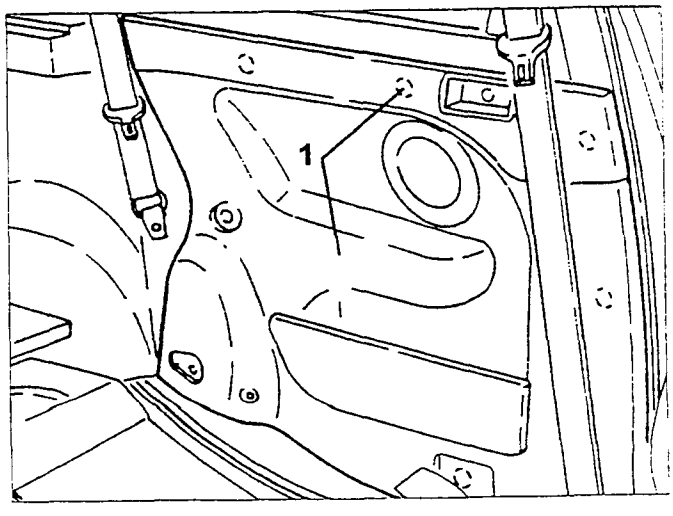
1. Undo the five bolts fixing the panel to the bodyshell.



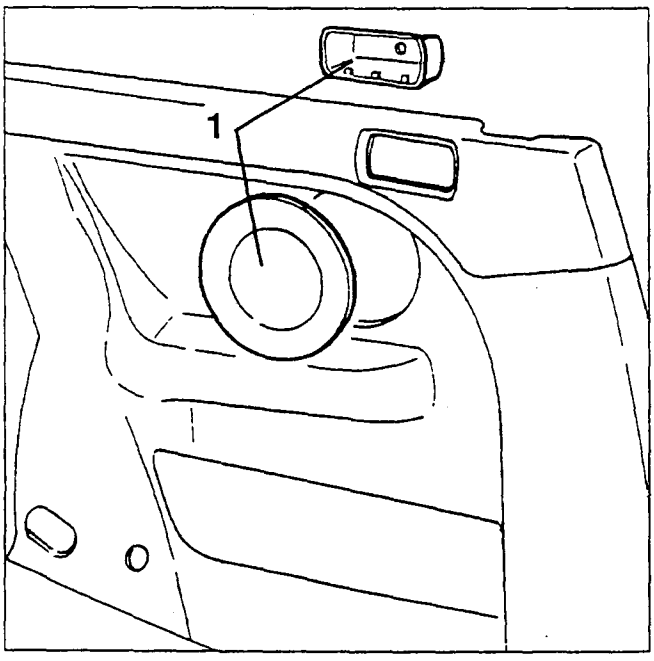
1. Remove the door trim, as necessary.



1. Remove the five plastic nails positioned as illustrated in the diagram and remove the side panel.



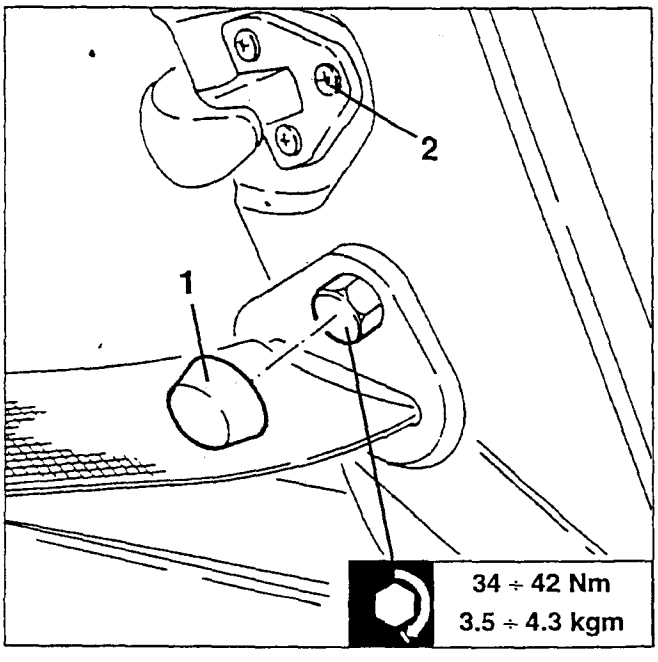
1. On the bench, if necessary, remove the ashtray support and speaker grille.



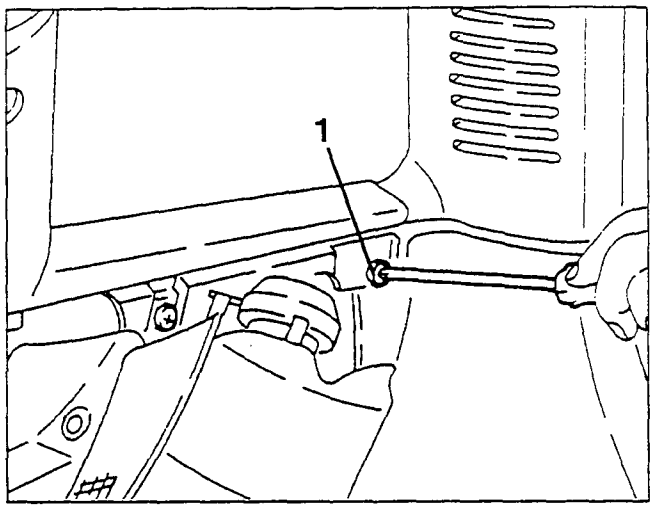
WINDOW MOULDING

REMOVING/REFITTING

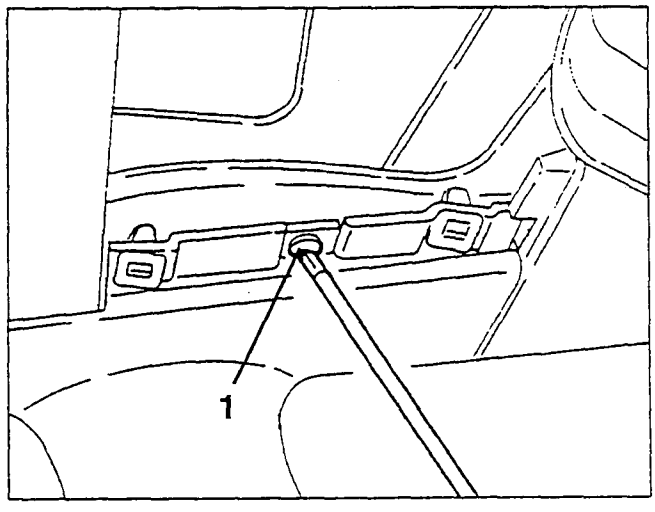
- Remove the parcel shelf side support (see specific paragraph).
1. Remove the cap and slacken the screw fastening the rear seat belt runner.
2. Slacken the three screws fastening the quarter light opening device.



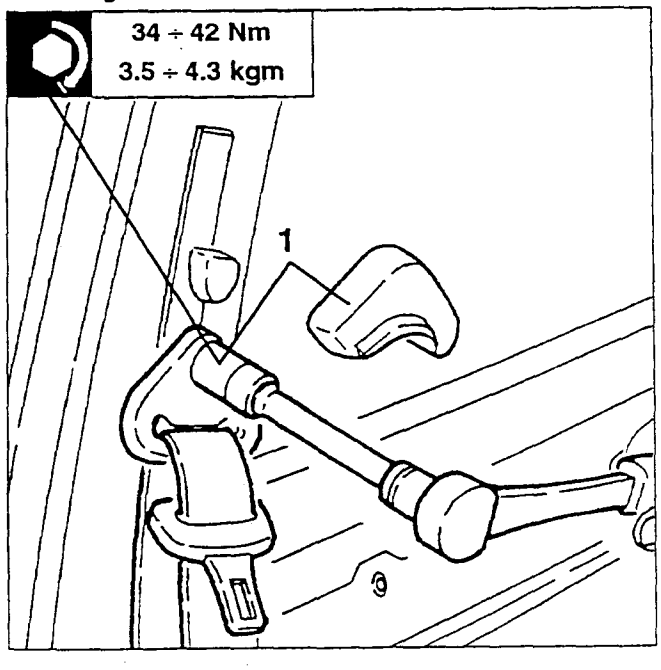
1. Slacken the three lower screws fastening the window moulding.



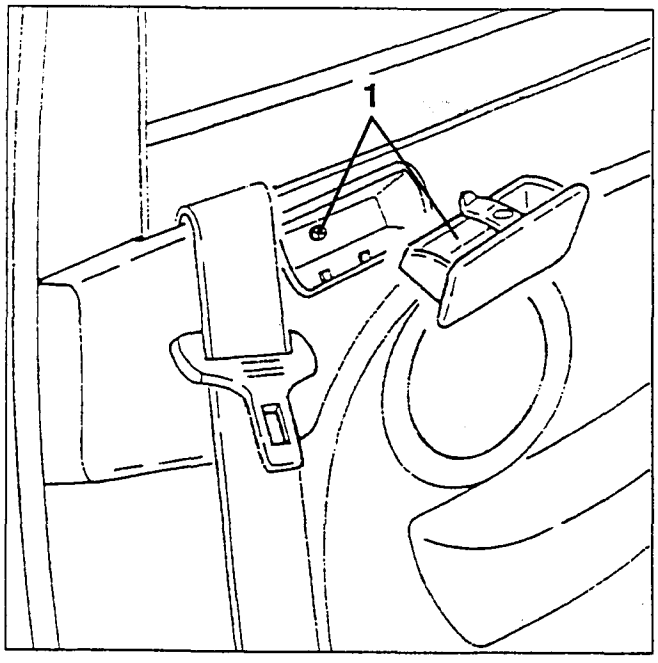
- Remove the rear roof lining (see specific paragraph).
1. Slacken the upper screw fastening the window moulding.



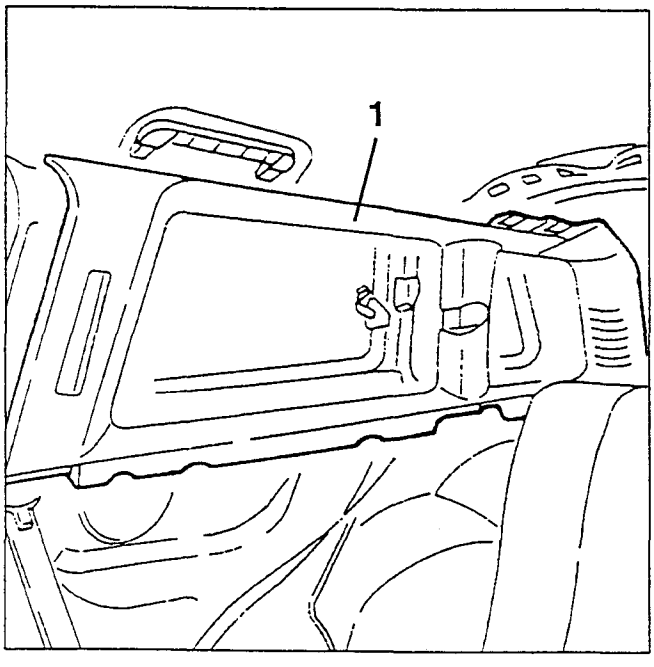
1. Remove the trim plate and slacken the screw fastening the front seat belt runner.

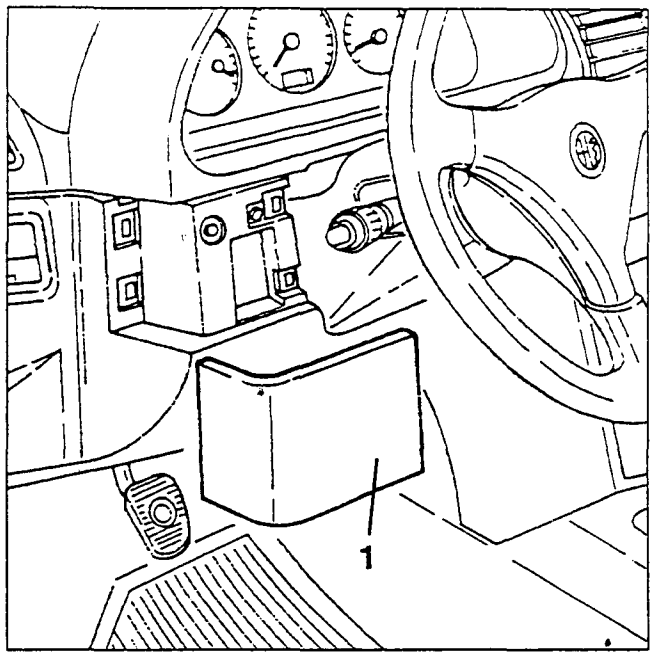


- Prise off the door surround moulding as necessary.
1. Prise and remove the ashtray from its housing, then slacken the screw below fastening the window moulding.

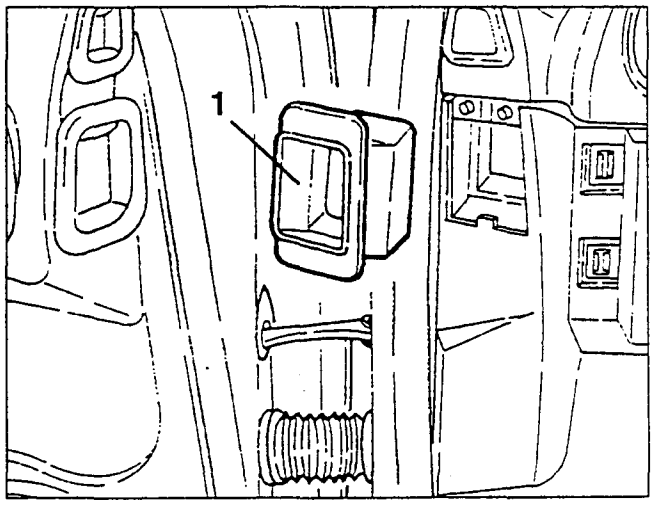


1. Prise the upper part of the side panel, then remove the window moulding prising it off the plastic rivets.

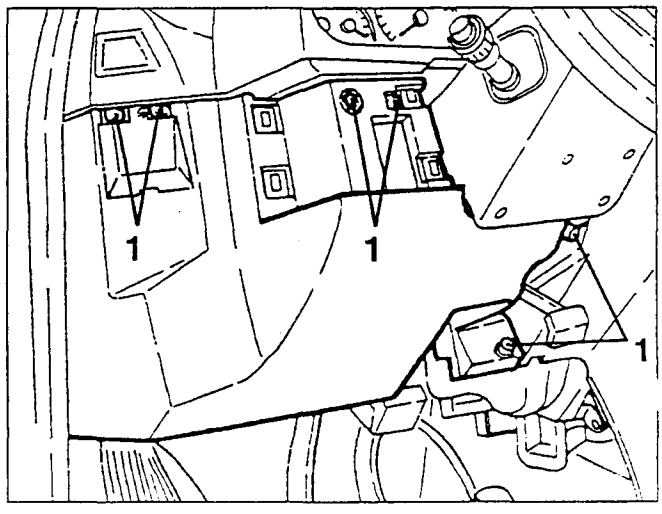




1. Remove the driver's air vent from the dashboard.



1. Slacken the six fastening screws and remove the fusebox trim.

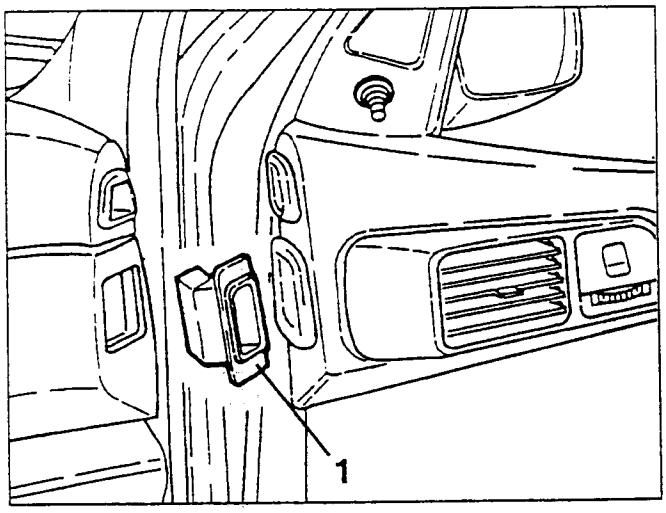


DASHBOARD

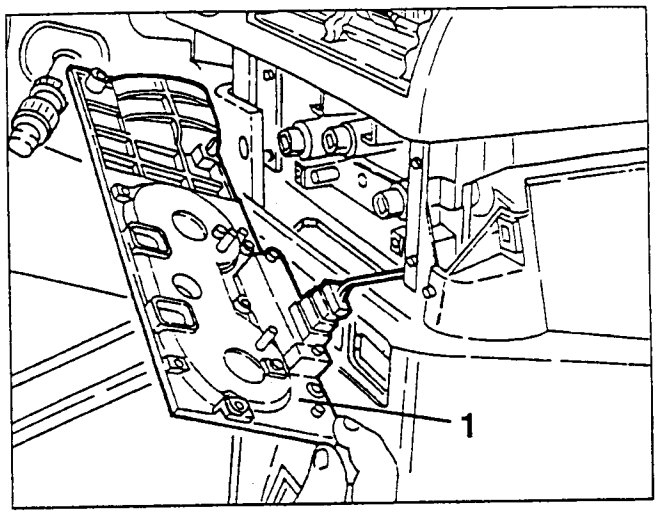
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Remove the centre console (see specific paragraph).
1. Prise and remove the lefthand side dashboard trim.

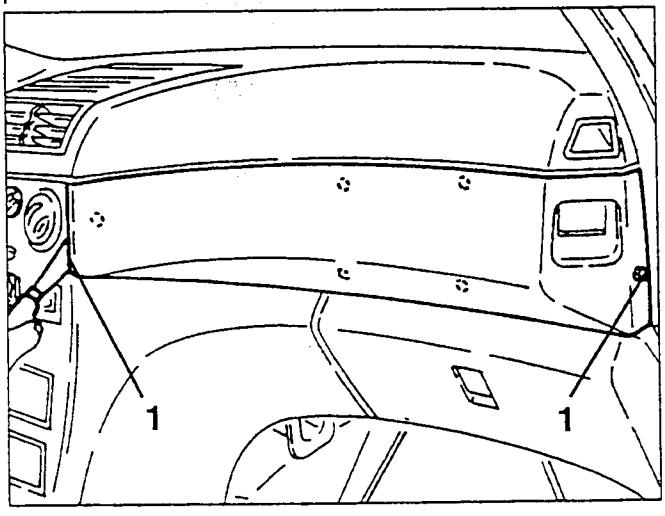
1. Remove the passenger air vent from the dashboard.



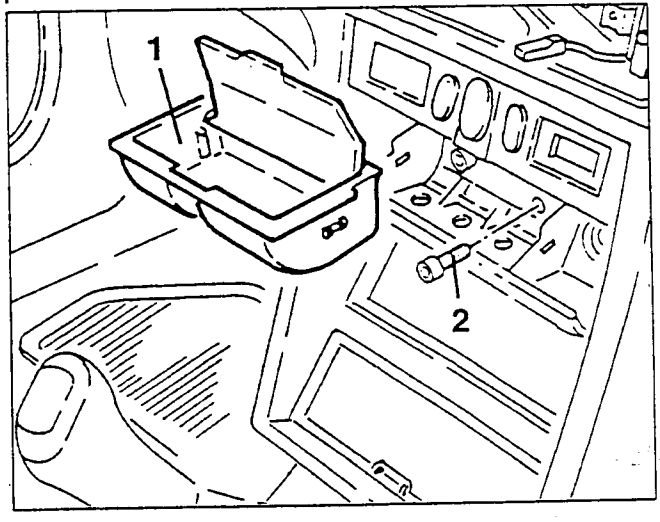
1. Prise the climate control system controls trim from the plastic rivet, then remove it after disconnecting the electrical connection for recirculation control.



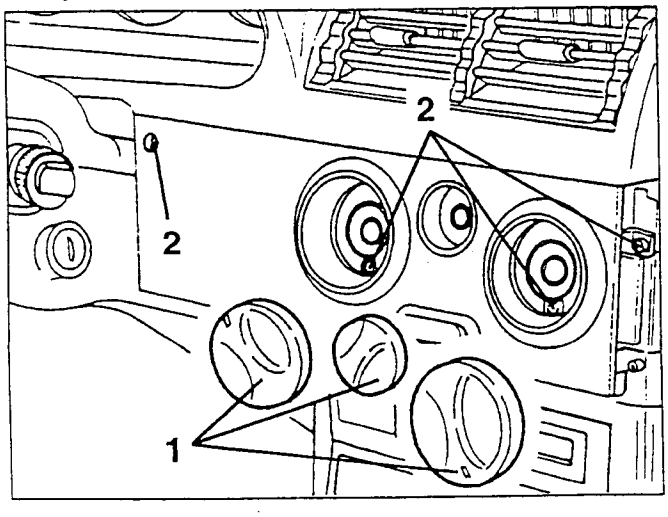
1. Slacken the fastening screw then remove the right hand dashboard trim prising it off the plastic rivets positioned as illustrated.



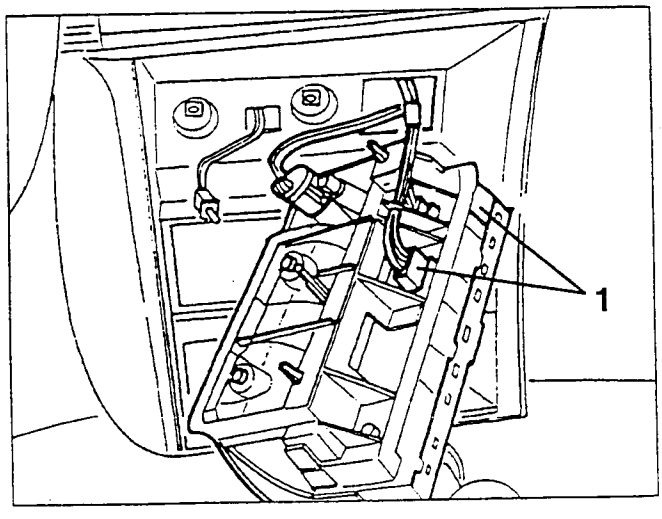
1. Remove the ashtray.
2. Slacken the two screws fastening the ashtray support.



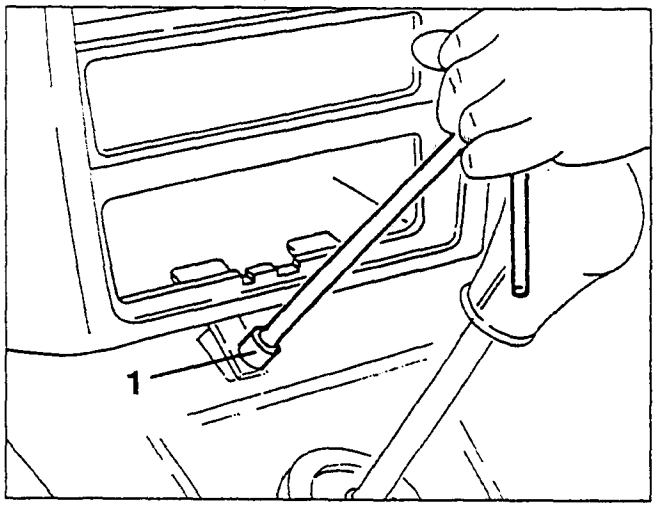
1. Prise and remove the climate control knobs.
2. Slacken the four screws fastening the climate control system controls.



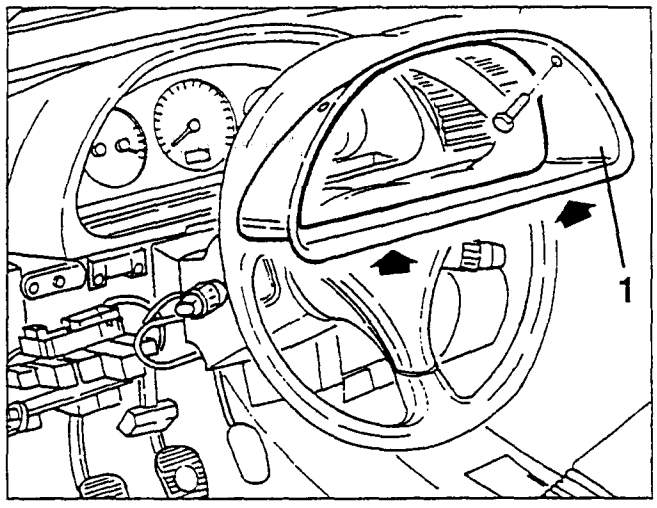
1. Remove the ashtray support complete with the services control unit and remove it after disconnecting the electrical connections.



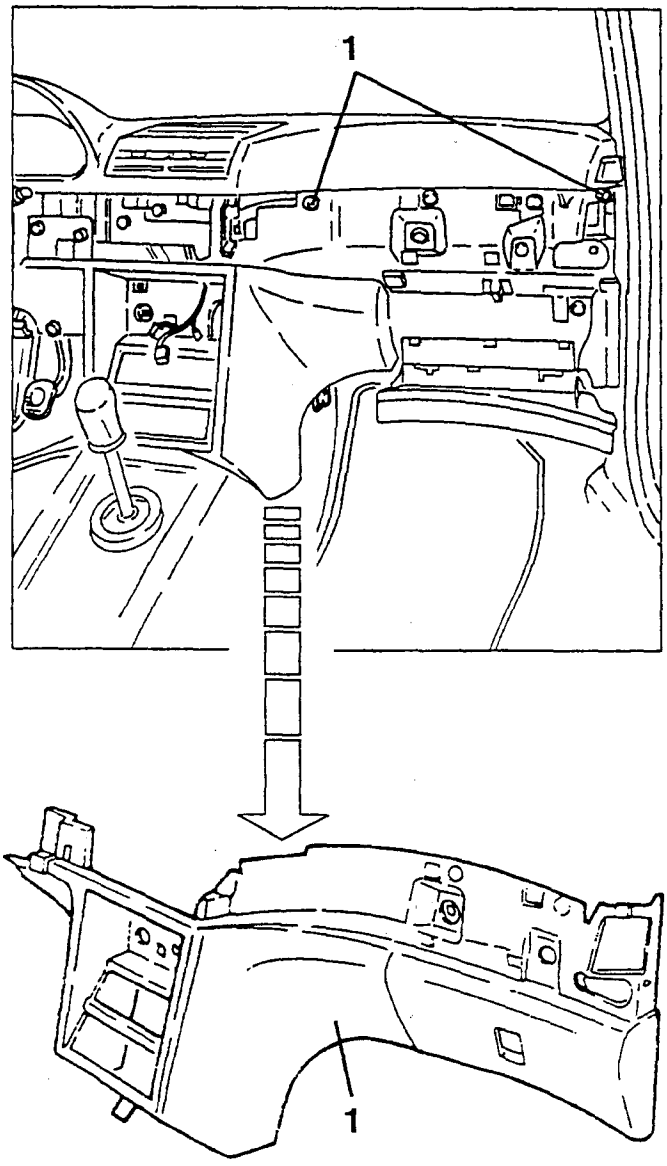
1. Slacken the lower screw fastening the centre console.



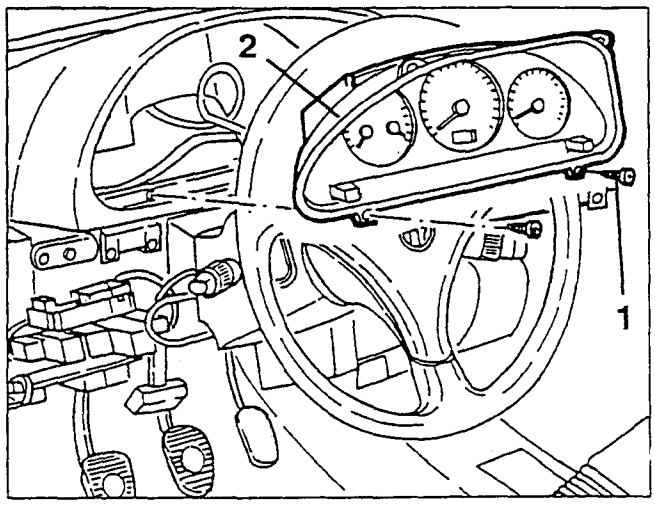
1. Slacken the two fastening screws and remove the plate prising in the points shown by the arrows.



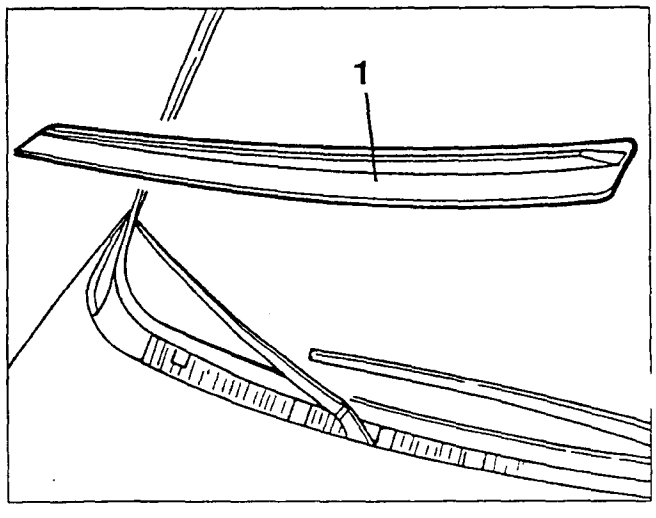
1. Slacken the screws fastening the lower part of the dashboard and remove it.



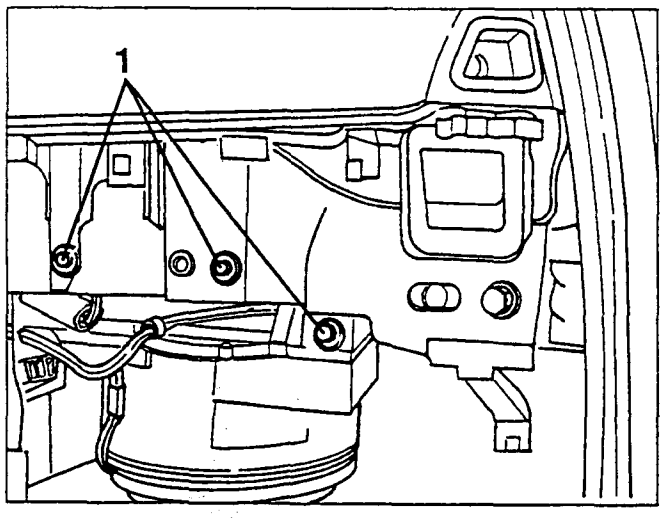
1. Slacken the four screws fastening the instrument cluster.
2. Disconnect the two side electrical connections and remove the instrument cluster.



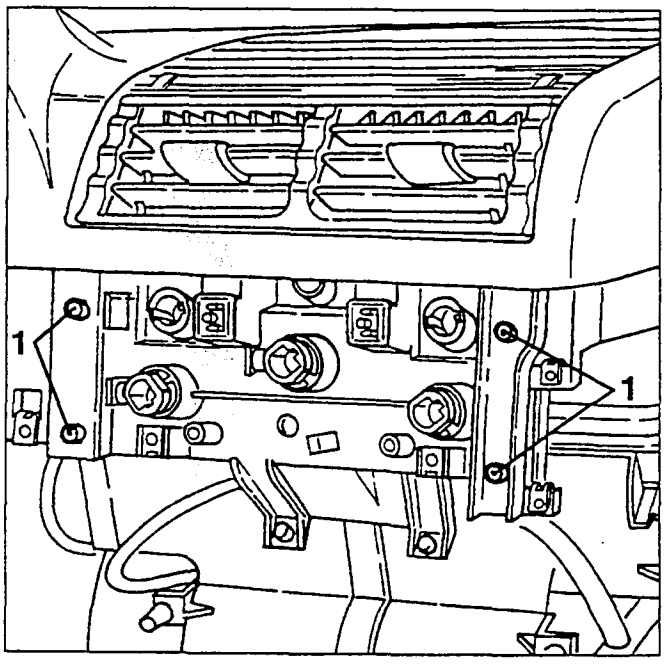
1. Prise and remove the windscreen air grille.



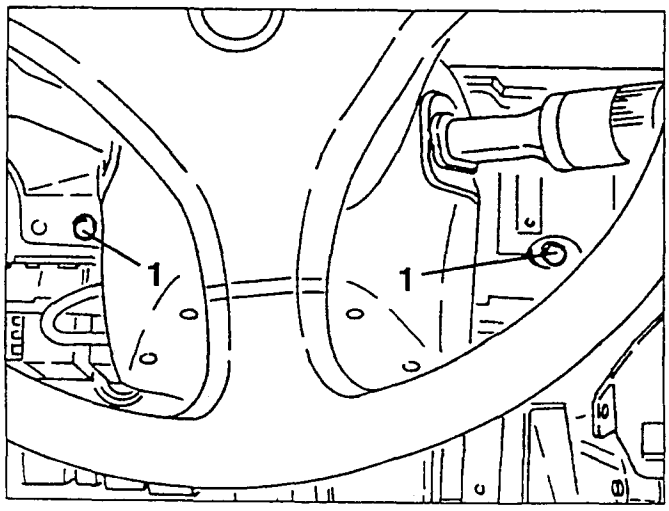
1. Loosen the screws on the passenger side securing the dashboard.



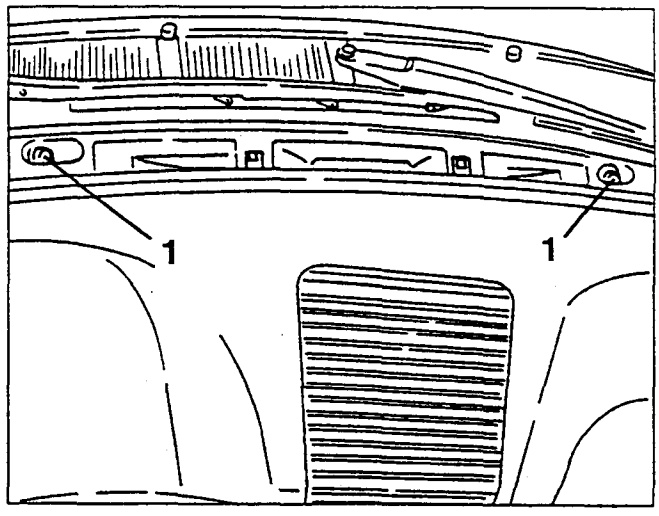
1. Loosen the four central screws securing the heating- ventilation controls.

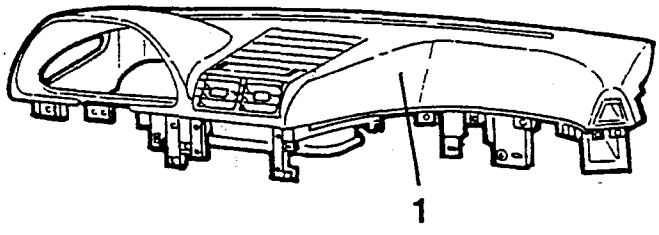


1. Loosen the two screws on the driver's side securing the dashboard.



1. Loosen the two screws securing the dashboard shown in the diagram and remove the upper part of the dashboard.

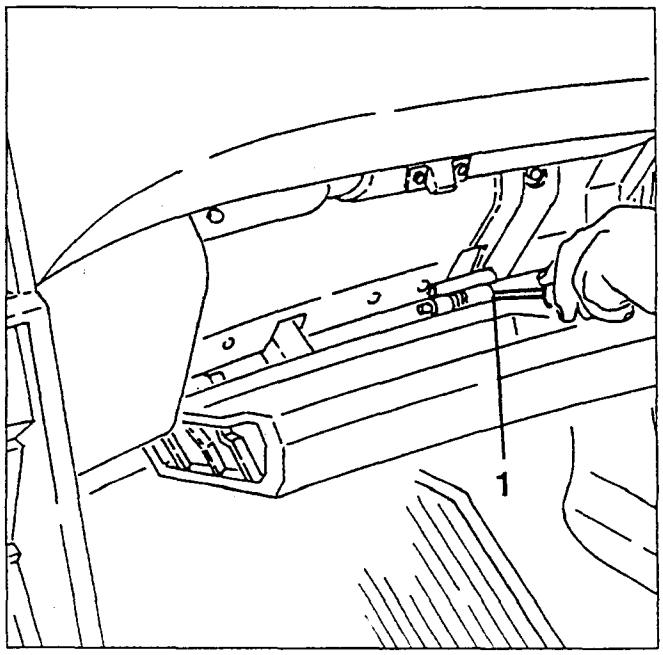




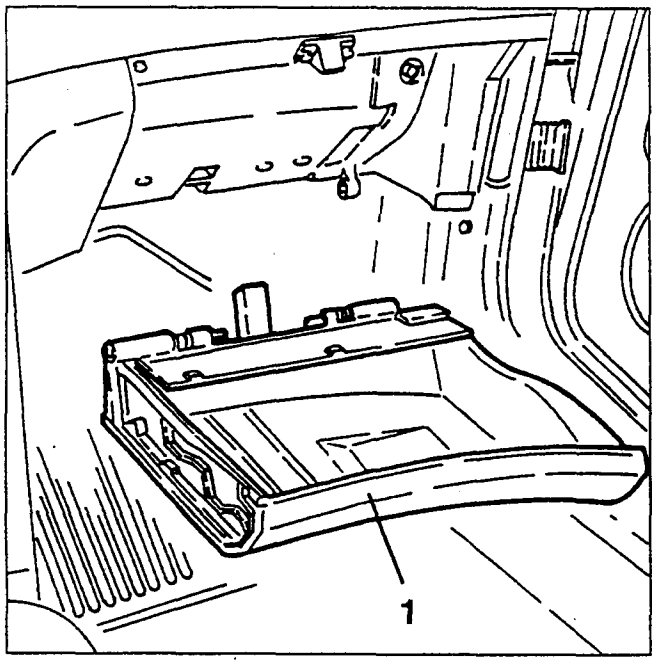
GLOVE COMPARTMENT

REMOVAL/REFITTING

1. Open the glove compartment and holding the spring flap downwards use a screwdriver as a lever to free it from the attachments.



1. Remove the glove compartment.

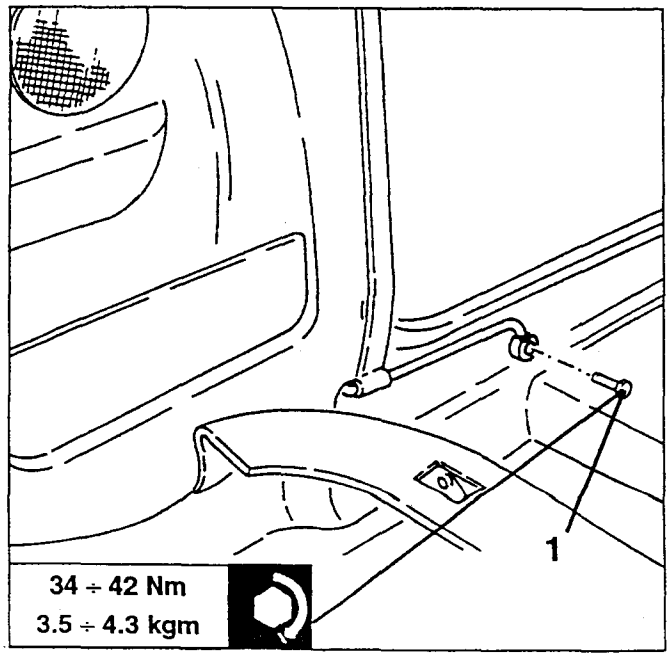


FLOOR TRIM

REMOVAL/REFITTING

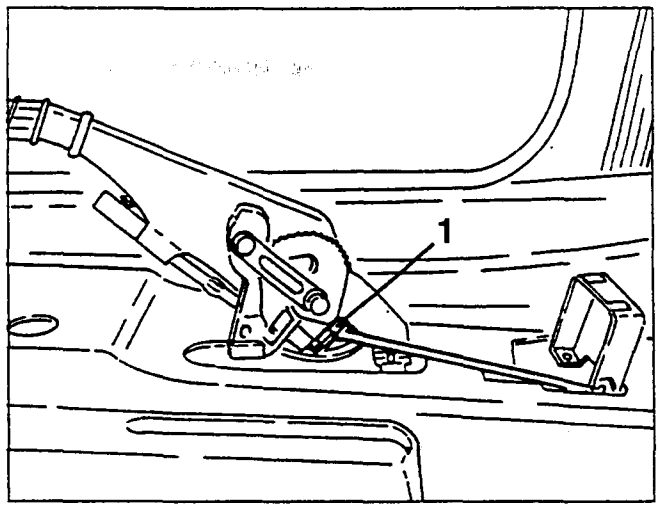
- Remove the front seats (see specific paragraph).
- Remove the rear seat cushion (see specific paragraph).
- Remove the heel pads (see specific paragraph).
- Remove the lower part of the dashboard (see specific paragraph).

1. Loosen the front screws securing the front seat belt sliding attachments.

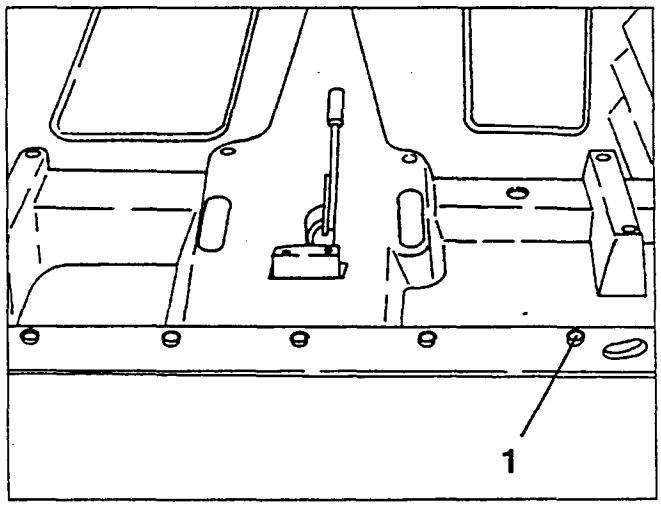


- Remove the gear lever cover and the central console (see specific paragraphs).

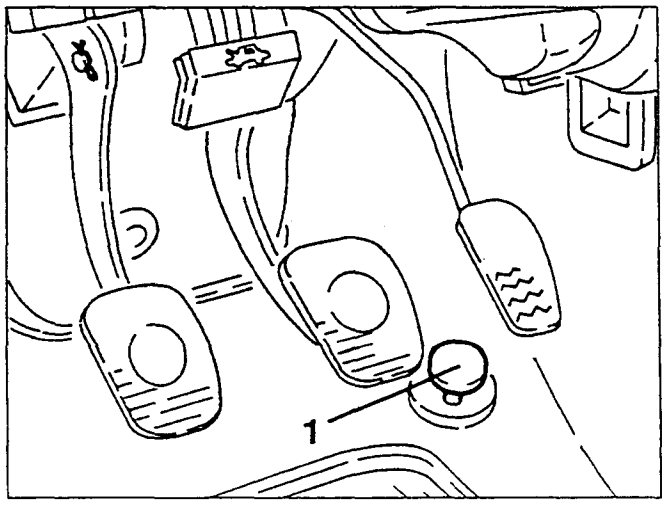
1. Disconnect the electrical connections from the handbrake switch.



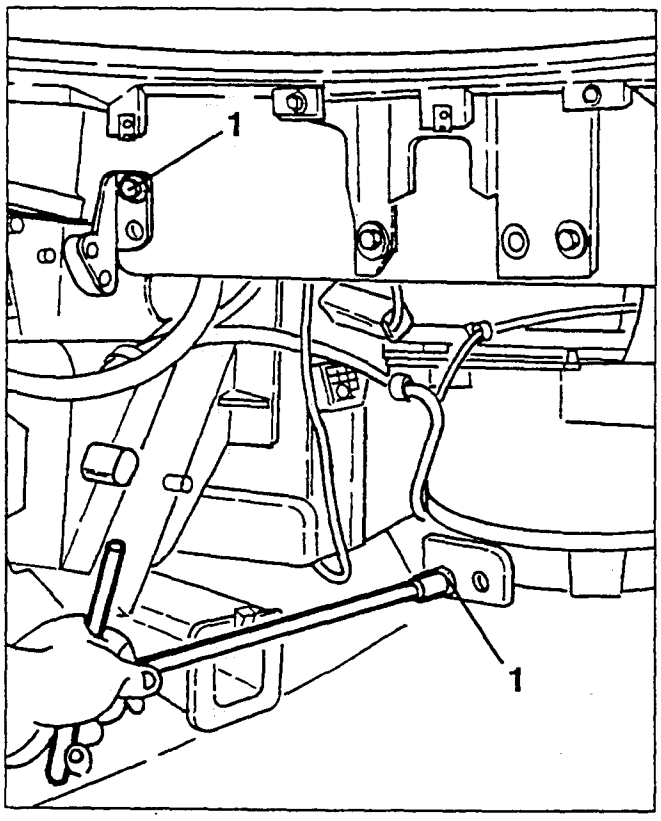
1. Pull off the five plastic nails securing the rear floor trim.



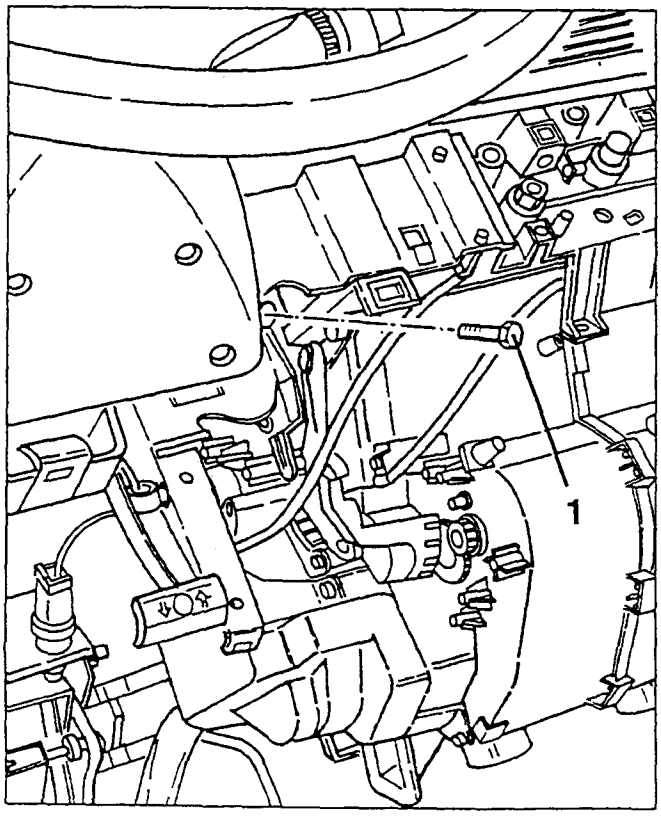
1. Unscrew and remove the accelerator pedal stop limit.



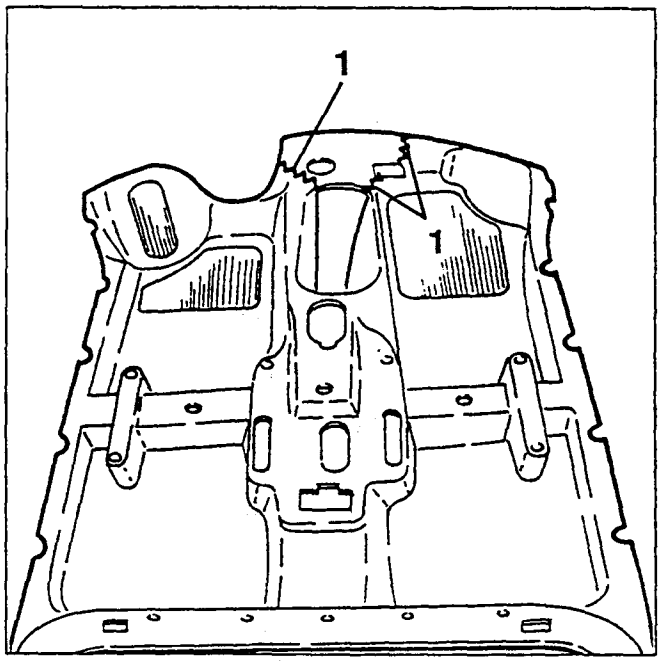
- For vehicles with air conditioning remove the vents delivering air to the floor of the rear part of the passenger compartment (see specific paragraph).
1. Loosen of the four screws securing the heating-ventilation group right side.



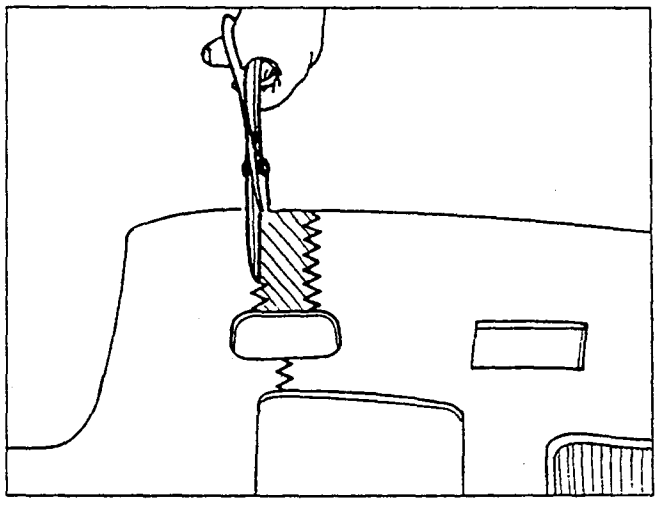
1. Loosen the screw securing the heating-ventilation group left side.



1. Cut the front part of the floor trim as shown in the diagram and then remove it together with the cut part from behind the heating- ventilation group.



Cut the new floor trim as shown in the diagram and fit it on behind the heating-ventilation group and then refit by reversing the procedure followed for removal.

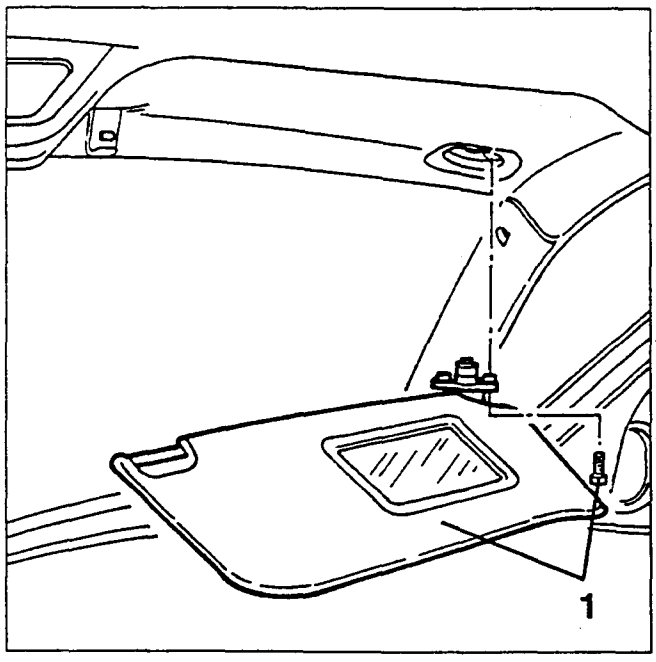


SUN VISORS

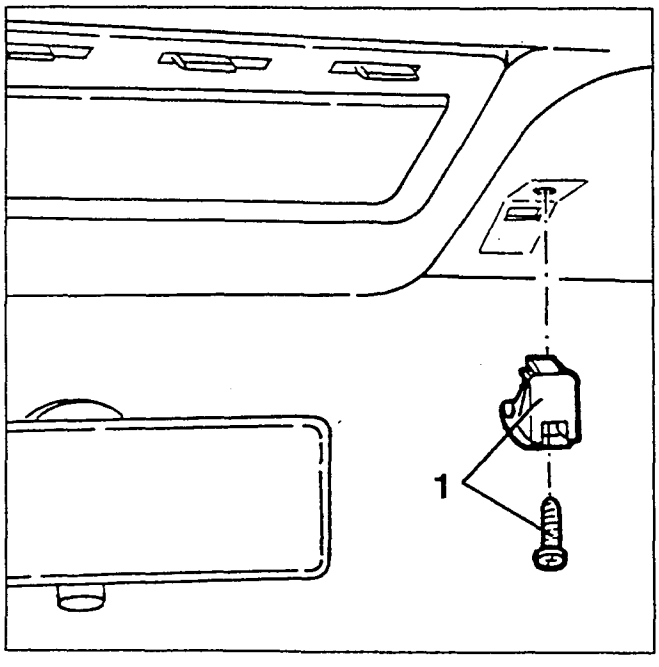
REMOVAL/REFITTING

- Tip the sun visor down to gain access to the relative screws.

1. Loosen the two screws and remove the sun visor.



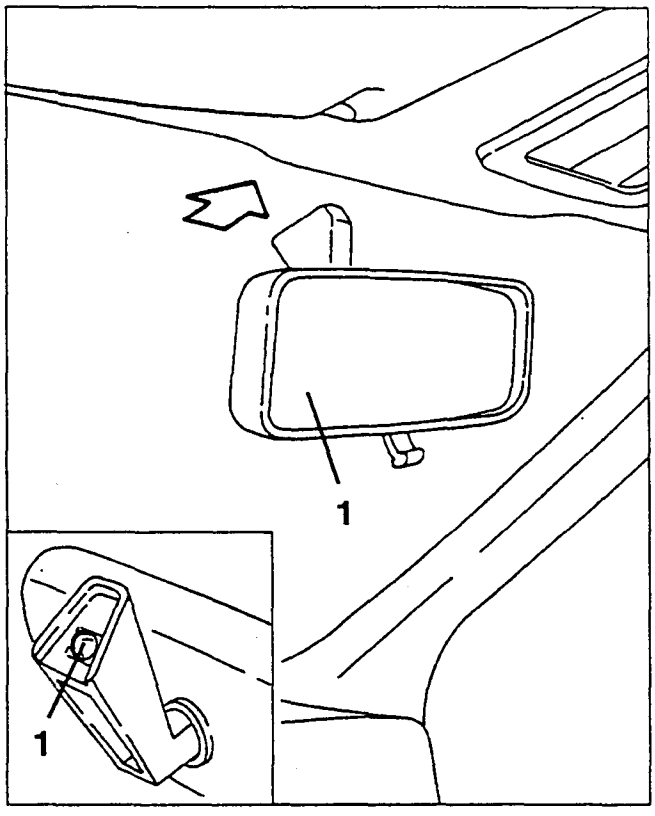
1. Pull off the cover, loosen the screw and remove the sun visor support.



REAR-VIEW MIRROR

REMOVAL/REFITTING

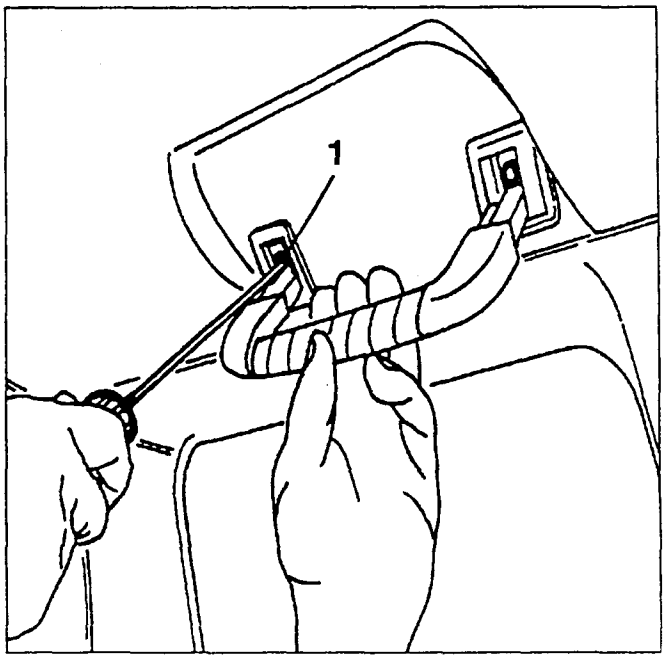
1. Remove the rear-view mirror by pushing it upwards overcoming the force exerted by the locking ball.



PASSENGER GRAB HANDLES

REMOVAL/REFITTING

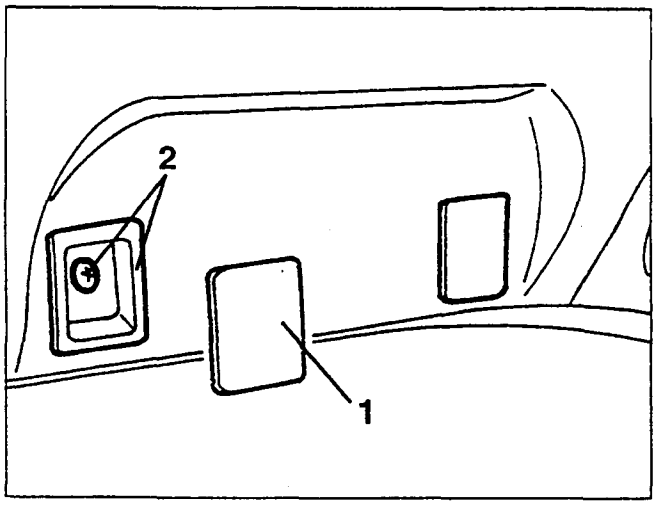
1. Lower the passenger grab handle, loosen the two screws and remove it.



CAPS ON DRIVER'S SIDE

REMOVAL/REFITTING

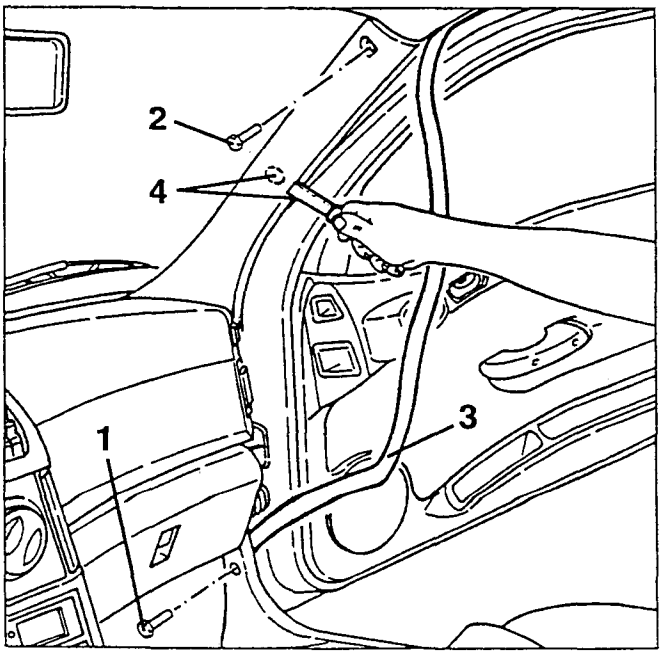
1. Pull off the protective cap.
2. Loosen the screw and remove the cap for the handle on the driver's side.



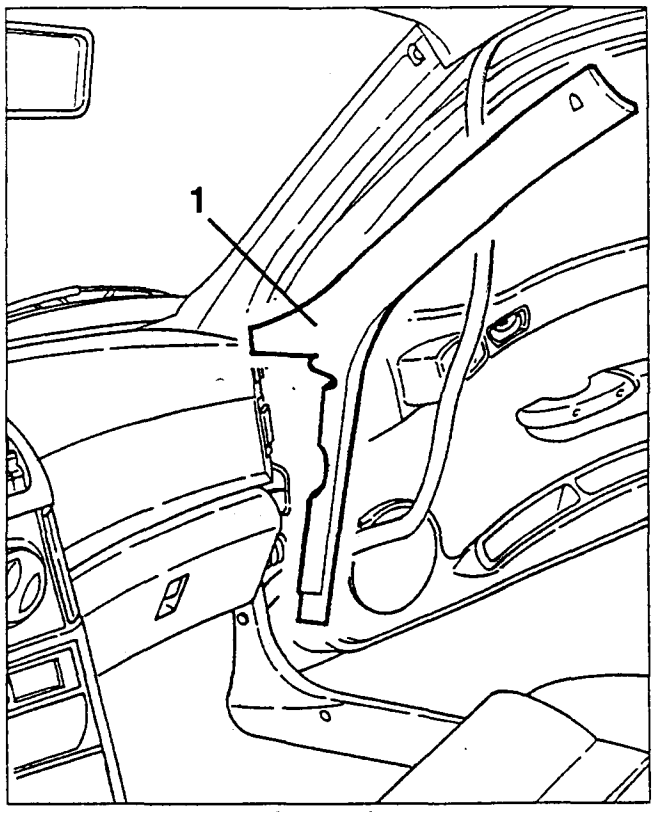
TRIM ON FRONT PILLARS

REMOVAL/REFITTING

1. Loosen the screw securing the heel rest as shown in the diagram.
2. Loosen the screw securing the trim to the front pillar.
3. Pull the door seal from its seating as required.
4. Pull the on the front pillar away from the plastic nail.



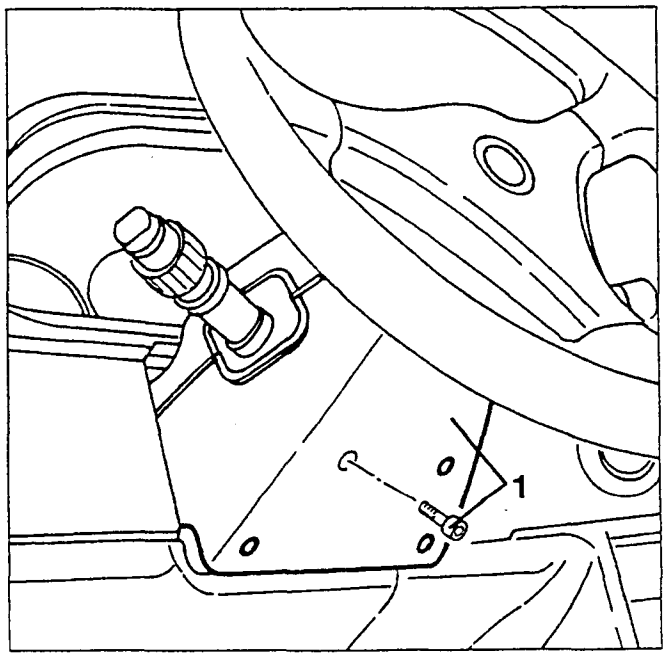
1. Remove the trim from the front pillar.



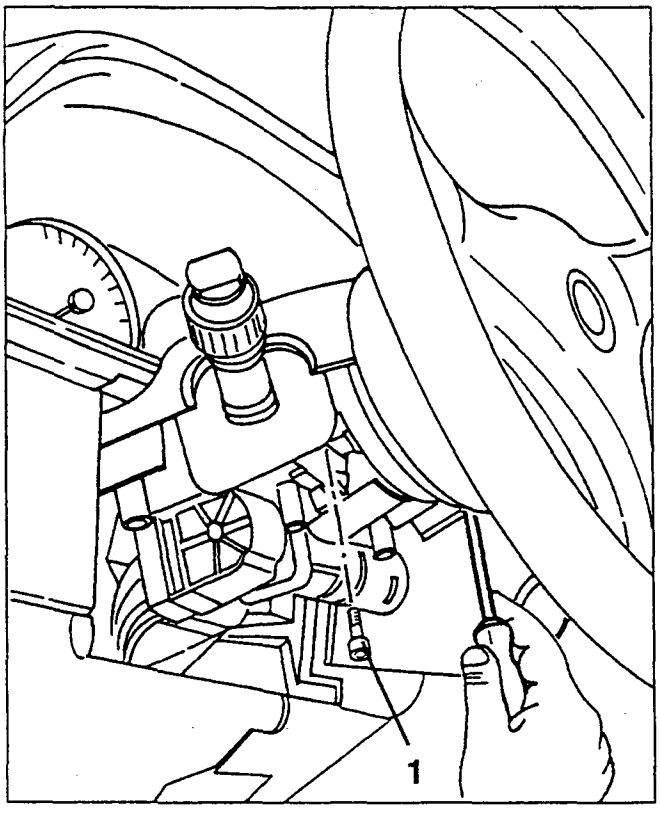
STEERING COLUMN CASING HALF

REMOVAL/REFITTING

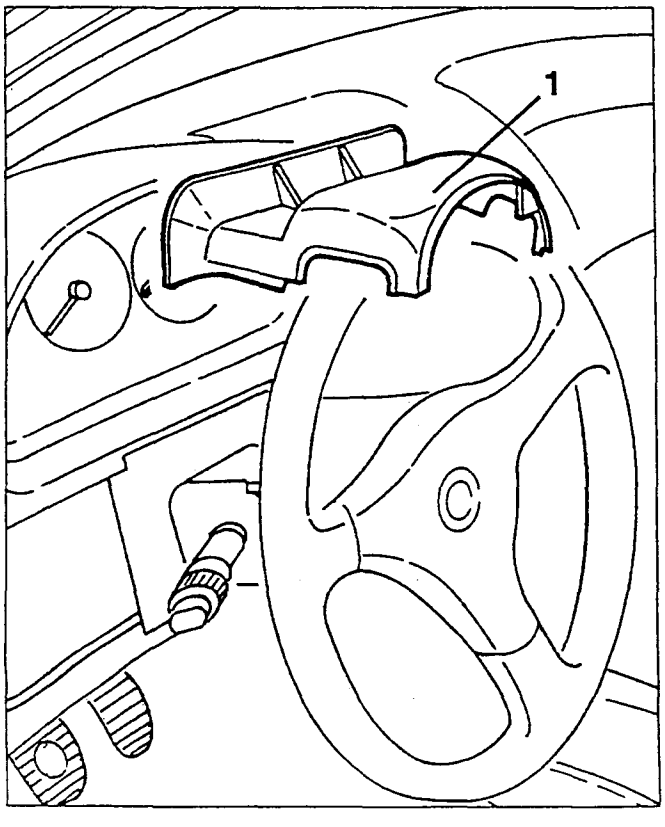
1. Loosen the four screws and remove the steering column lower casing half.



1. Loosen the two screws securing the steering column upper casing half.



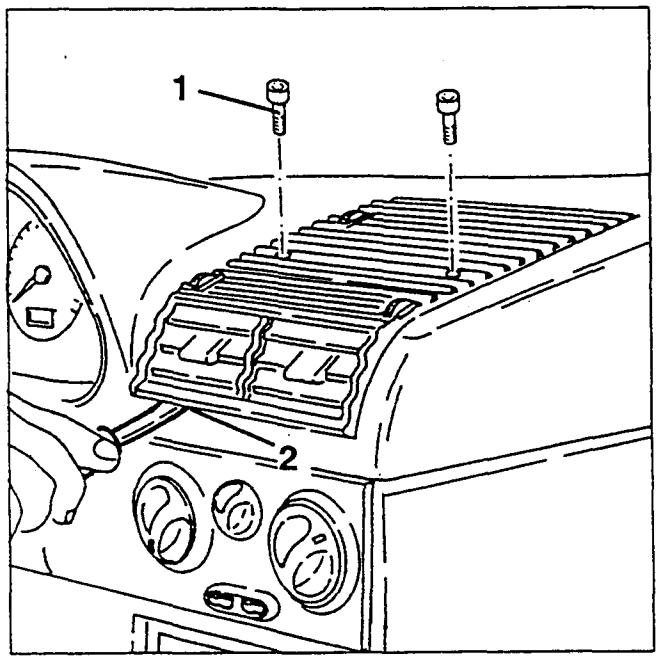
1. Remove the steering columns upper casing half.



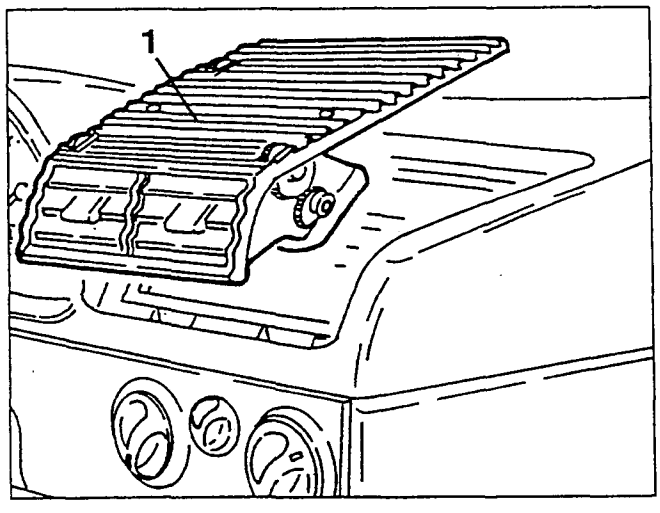
AIR VENT ON DASHBOARD

REMOVAL/REFITTING

1. Loosen the two screws securing the air vent to the dashboard.
2. Pull the air vent from the dashboard as shown in the diagram.



1. Remove the air vent from the dashboard.

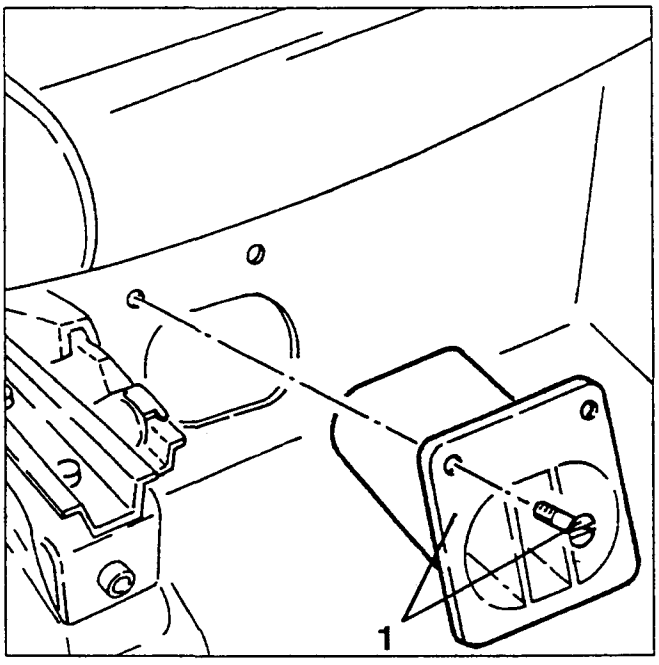


REAR FLOOR AIR VENTS

REMOVAL/REFITTING

- Slide the front seat forwards on the relative side.

1. Loosen the two screws securing the air vent and remove it.

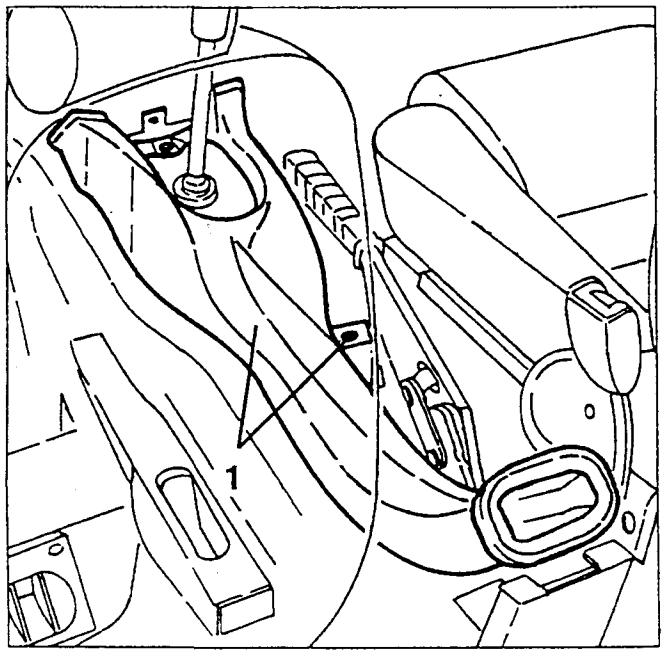


AIR DELIVERY DUCTS

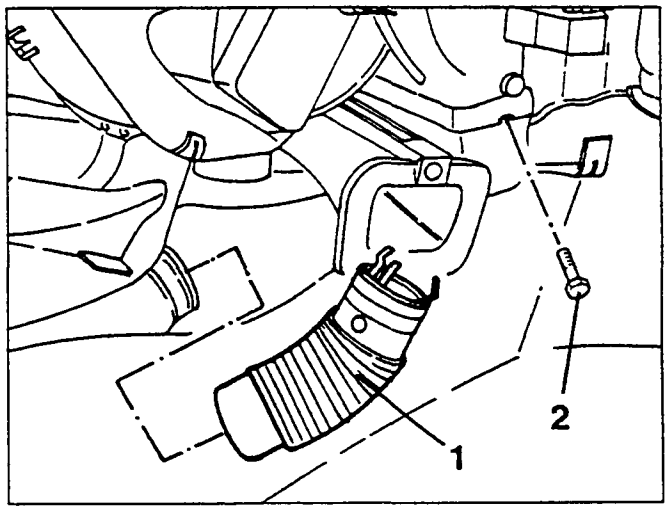
REMOVAL/REFITTING

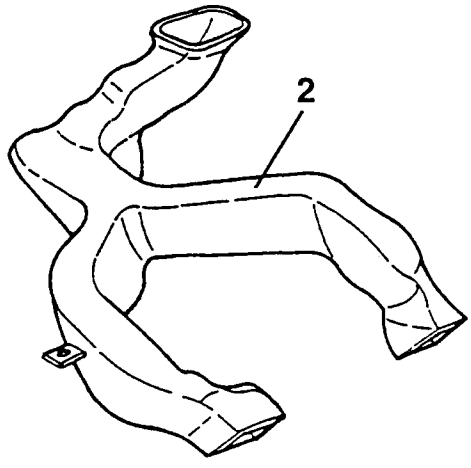
- Remove the centre console (see specific paragraph).
- Remove the lower dashboard (see specific paragraph).

1. Slacken the fastening screws and remove the air delivery duct to rear passenger face level.

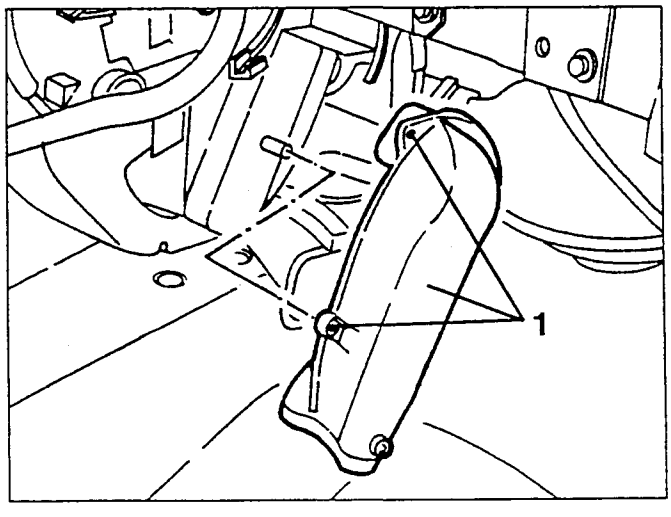


1. Remove the right air delivery elbow to the rear passenger feet from the climate control unit.
2. Slacken the fastening screw and remove the front section of the air delivery duct to rear passenger face level.

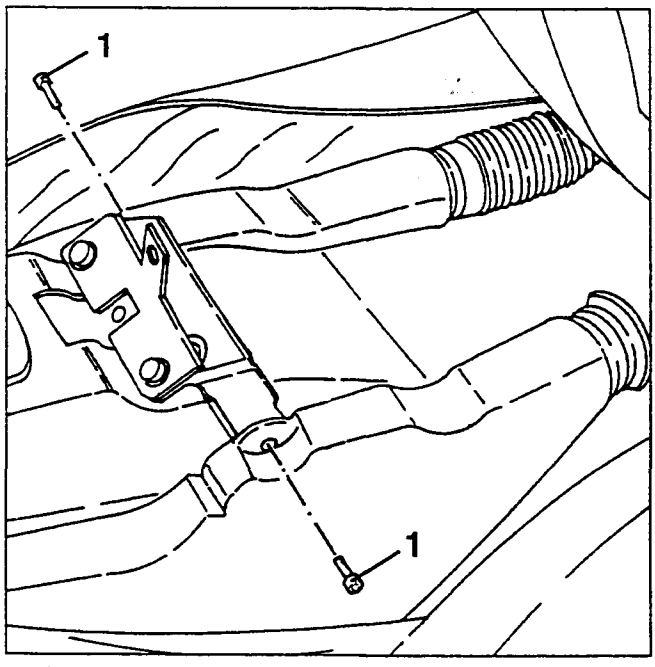


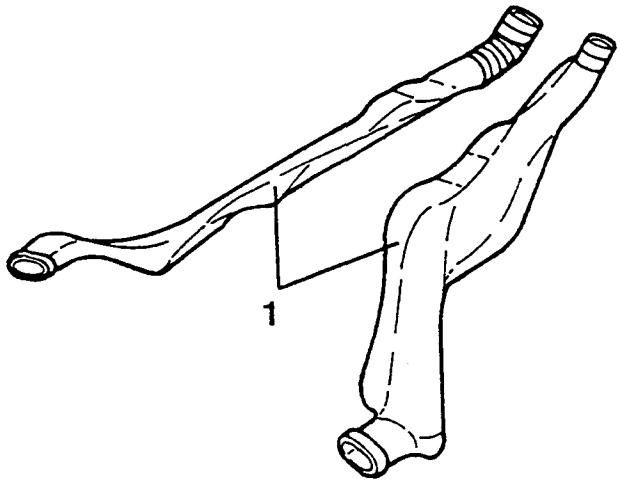


1. Slacken the remaining fastening screw and remove the air delivery duct to rear passenger face level from the climate control unit.

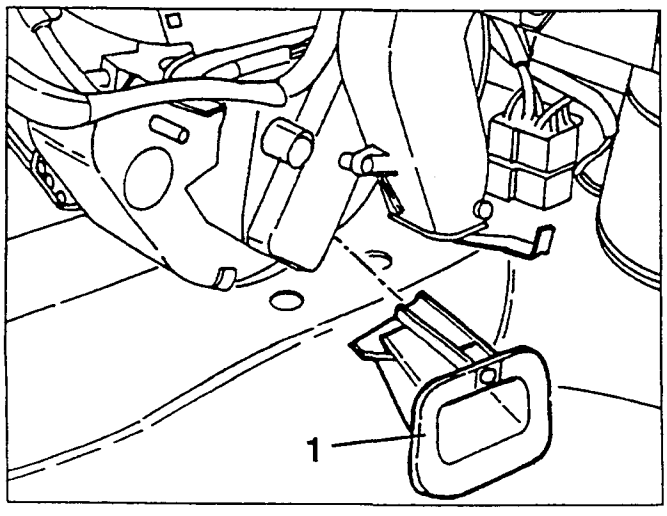


1. Slacken the screw at eatch side and remove the two air delivery ducts to the rear passenger feet area.





1. Slacken the fastening screws and remove the air flow vents driver and front passenger feet area .

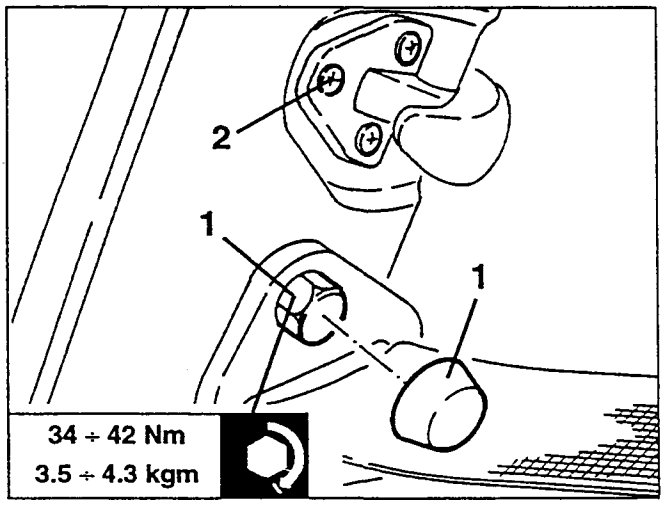


ROOF PANEL (FOR VERSIONS WITH SUNROOF)

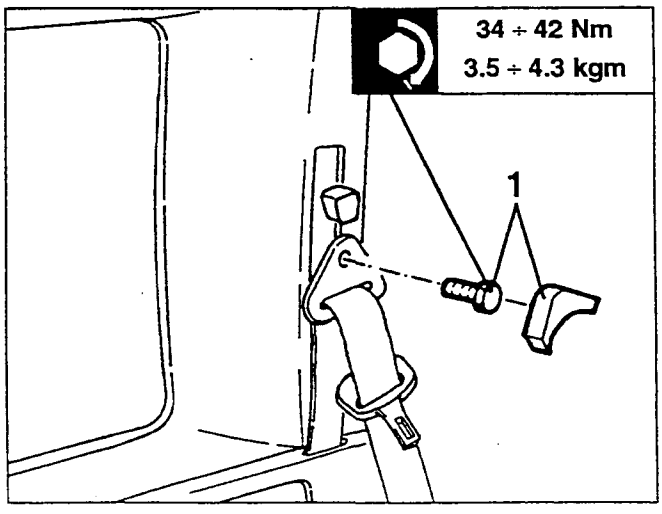
REMOVAL/REFITTING

- Disconnect the negative cable from the battery.
- Remove the passenger grab handles and the caps on the driver's side (see specific paragraphs).
- Remove the rear trim from the roof panel (see specific paragraph).
- Remove the sun visors (see specific paragraph).
- Remove the front roof light (see GROUP 55).
- Remove the trim from the front pillars (see specific paragraph).

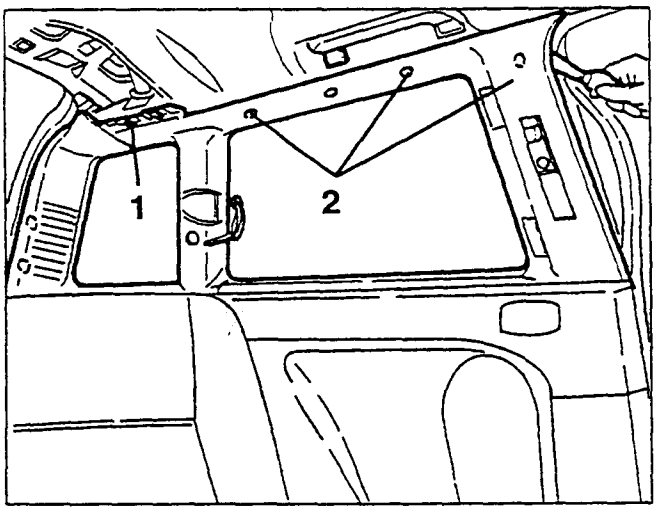
1. Pull off the covers and unscrew the screws securing the rear seat belt runners.
2. Loosen the screws securing the quarterlight opening catches on the rear windows.



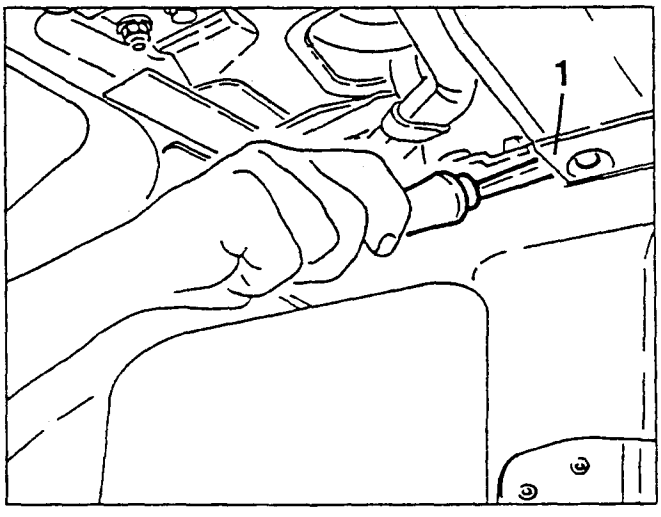
1. Remove the trim and loosen the screws securing the front seat belt runners.



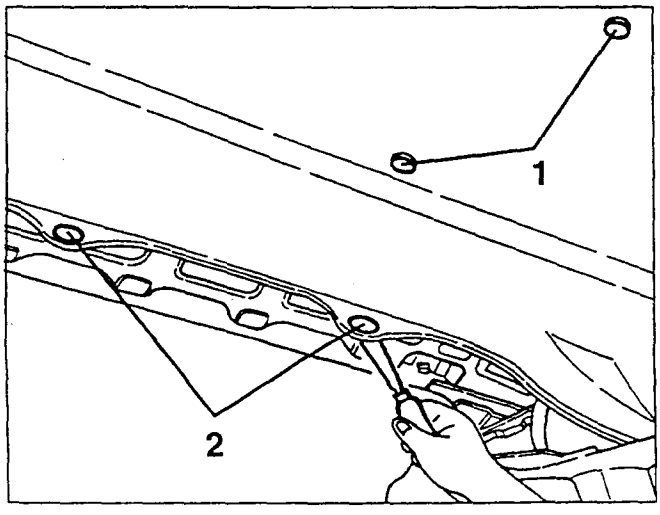
- Pull the door and boot seals away from their seatings as required.
1. Loosen the screw securing the window surround.
2. Pull the window mouldings away from the plastic nails positioned as shown in the diagram.



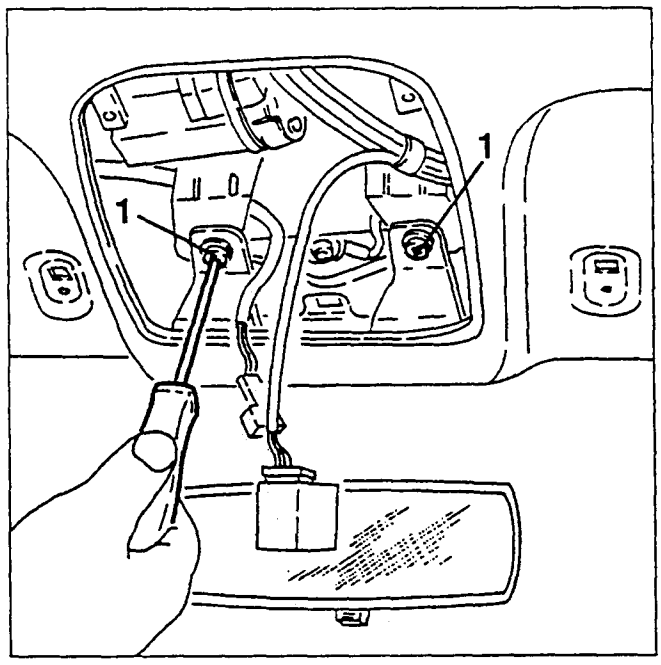
1. Pull off the button on the roof panel rear attachment.



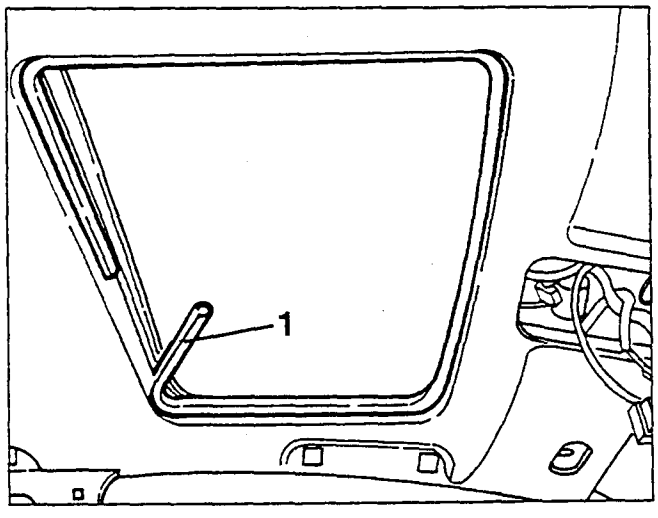
1. Loosen and remove the two central buttons.
2. Pull off and remove the two rear buttons.



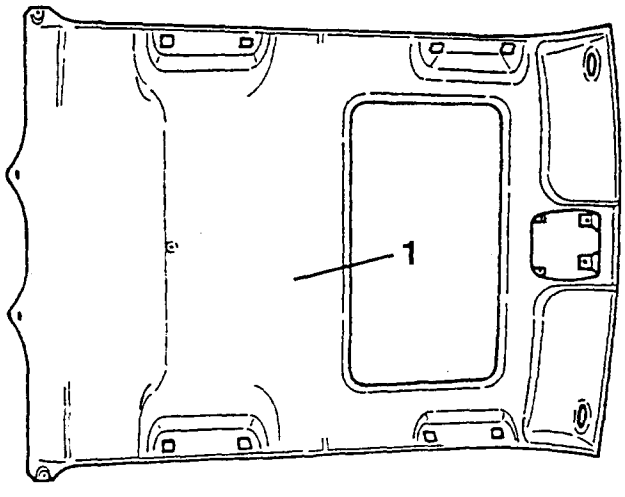
1. Loosen the two front screws securing the roof panel.



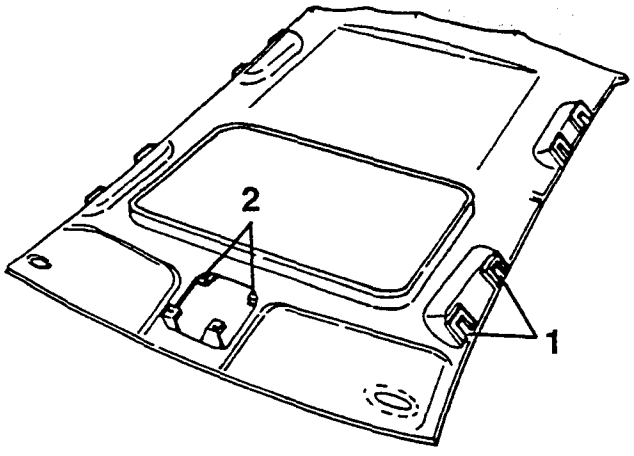
1. Pull off and remove the sun roof seal strip.



1. Remove the roof panel moving it first to one side to free it and then to the other and remove from the vehicle through the right- hand door.



When refitting check that the gaskets (1) and the clip (2)s for the front screws, indicated in the diagram, are present on the roof panel.

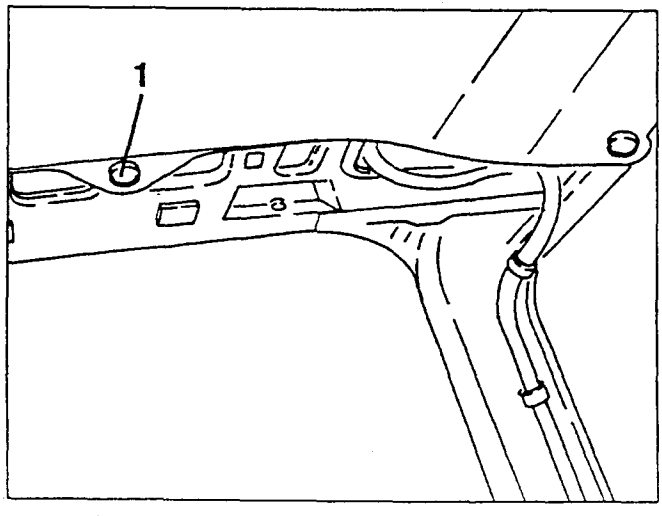


GLUED ROOF PANEL (FOR VERSIONS WITHOUT SUNROOF)

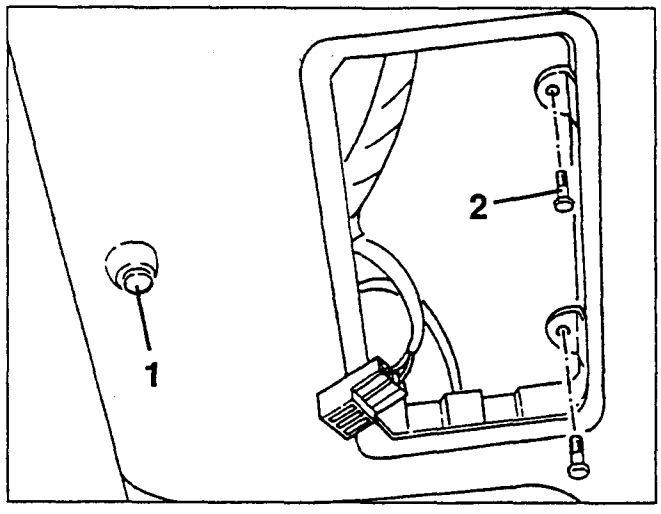
REMOVAL/REFITTING

- Disconnect the negative cable from the battery.
- Remove the front and rear seats (see specific paragraphs).
- Remove the rear window mouldings (see specific paragraph).
- Remove the front roof light (see GROUP 55).
- Remove the passenger grab handles and the caps on the driver's side (see specific paragraphs).
- Remove the sun visors (see specific paragraph).
- Remove the trim from the front pillars (see specific paragraph).

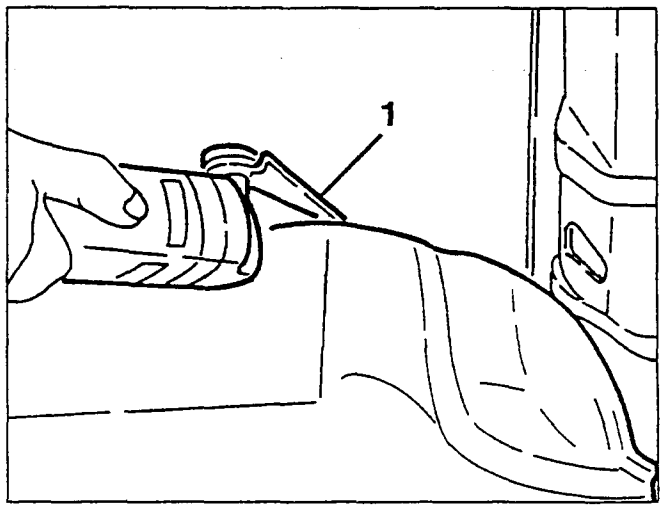
1. Remove the four plastic nails securing the rear part of the roof panel.



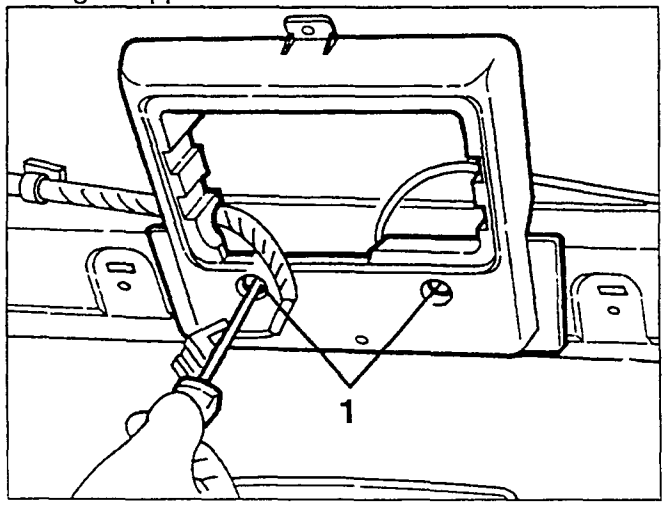
1. Remove the plastic nail securing the front part of the roof panel.
2. Loosen the two screws securing the front of the roof panel.



1. Lower the rear part of the roof panel just enough to permit the glue to be cut as shown in the diagram.

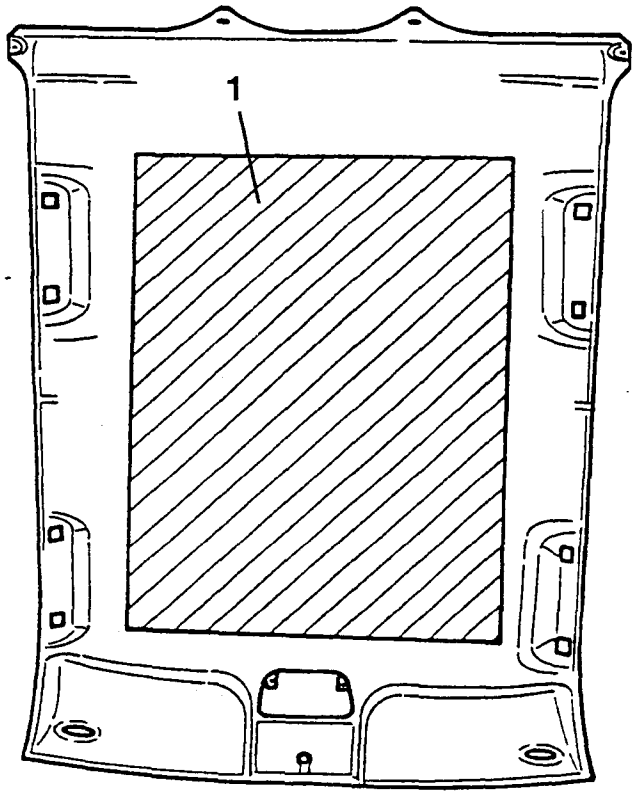


1. If necessary loosen the two screws and remove the roof light support.

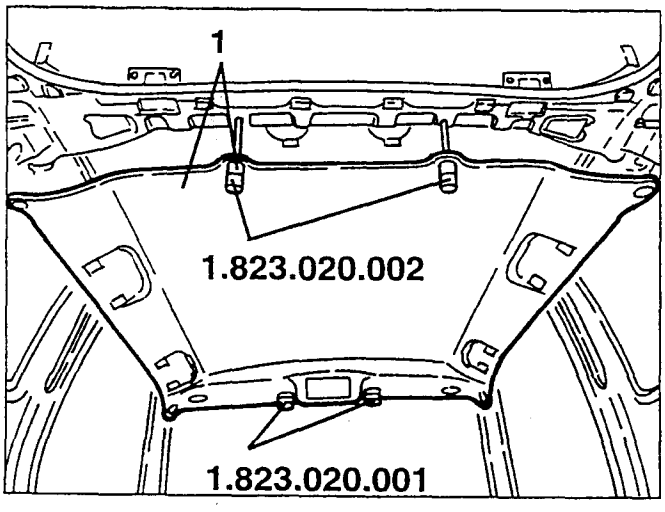


Refit the roof panel by reversing the procedure followed for removal and note the following:

1. Apply the specified glue to the new inner and outer roof panels as shown in the diagram.



1. Position the roof panel using guide pins 1.823.020.002 and 1.823.020.001 as shown in the diagram and press it using your hand around the glued parts.

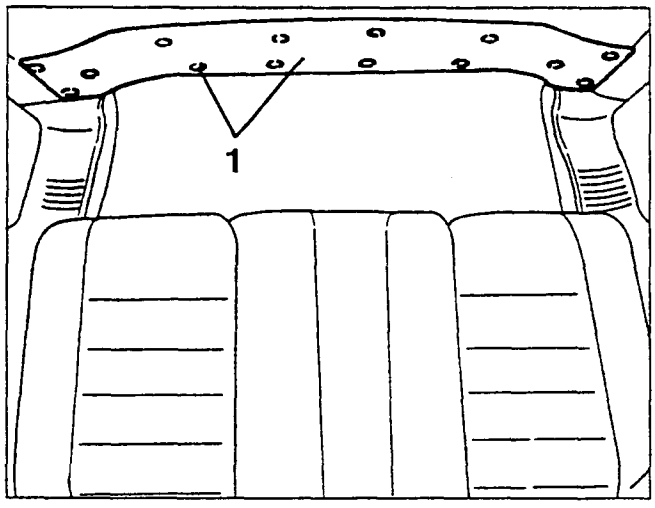


- Remove the centering pins and install the plastic nails in their place to secure the roof panel.

ROOF PANEL REAR TRIM

REMOVAL/REFITTING

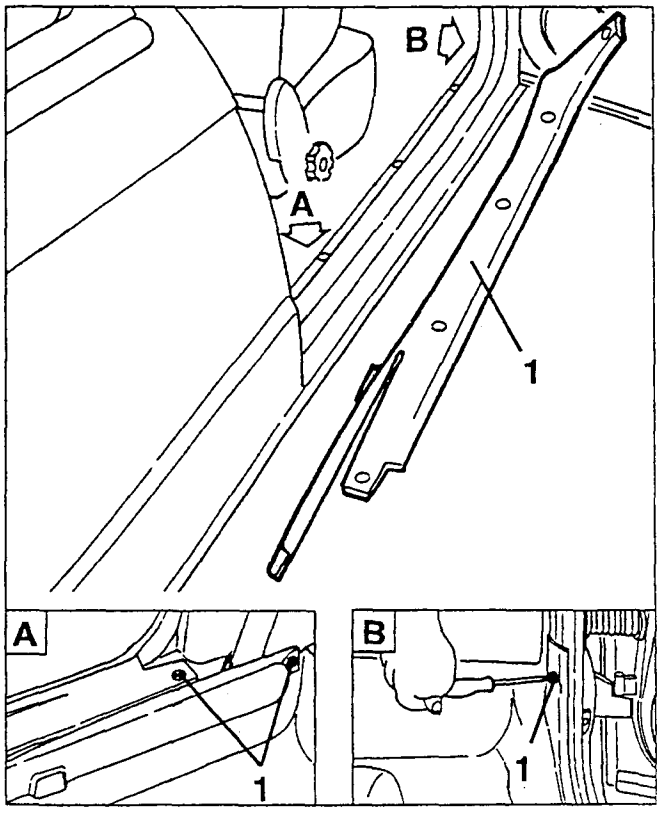
1. Pull the rear trim on the roof panel away from the plastic nails positioned as shown in the diagram and remove .



HEEL REST

REMOVAL/REFITTING

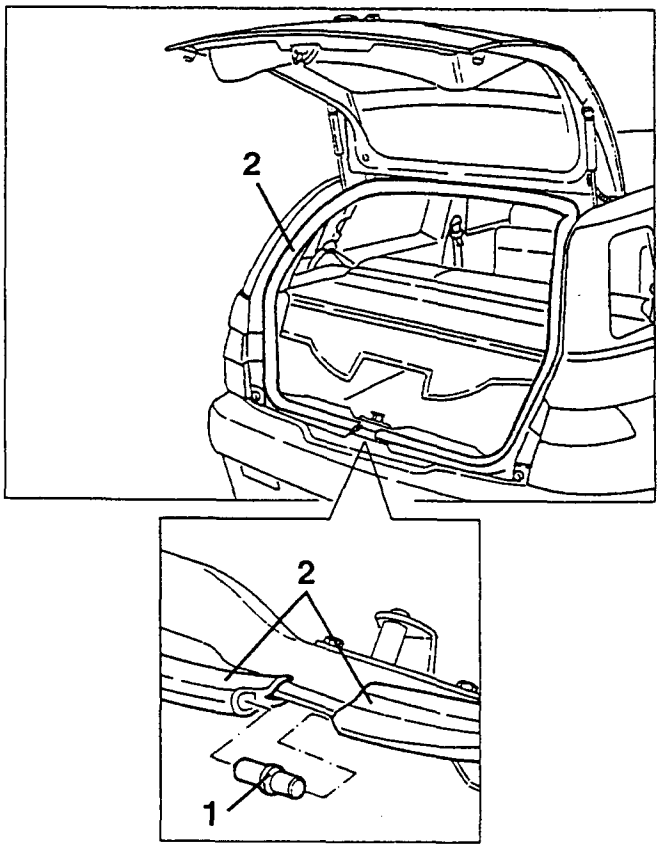
1. Loosen the six screws securing the heel rest and remove .



LUGGAGE COMPARTMENT SEAL

REMOVAL/REFITTING

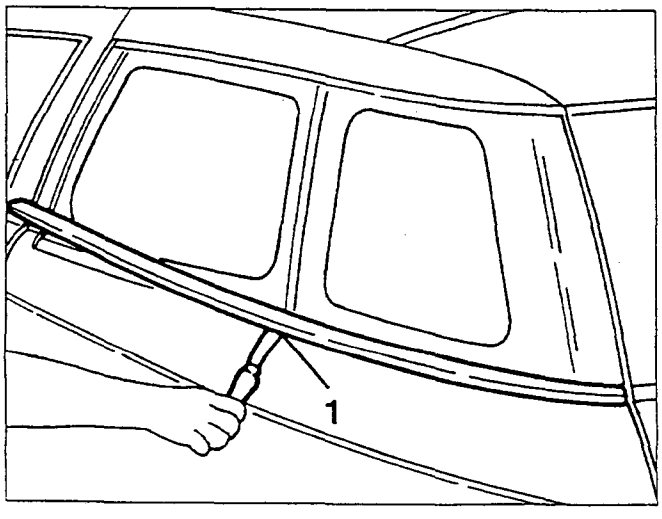
- Remove the protective covering (see specific paragraph).
1. Remove the joins from the ends of the seal.
2. Pull away the seal beginning from the join.



SIDE WINDOW LOWER SEAL

REMOVAL/REFITTING

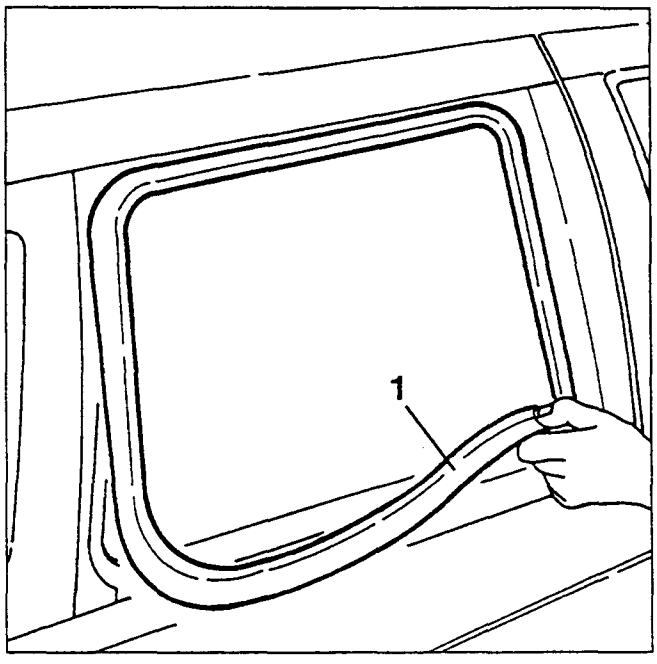
1. Pull off and remove the side window lower seal.



SEAL ON QUARTERLIGHT WINDOW

REMOVAL/REFITTING

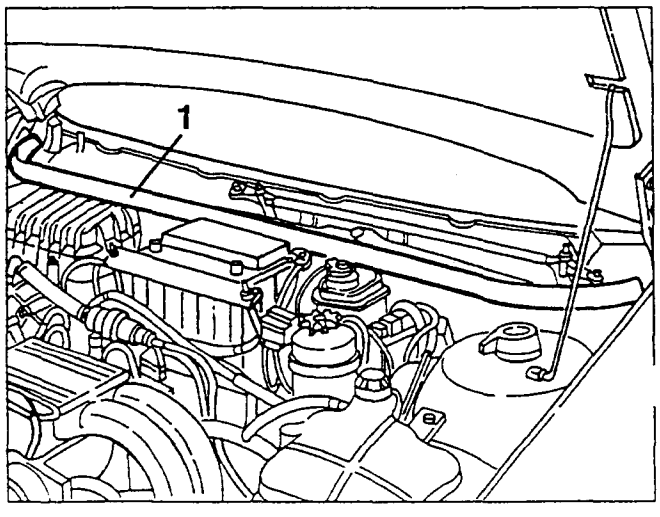
- Remove the window mouldings (see specific paragraph).
- Remove the quarterlight window (see specific procedure).
1. Pull off and remove the quarterlight seal.



SERVICES TANK SEAL

REMOVAL/REFITTING

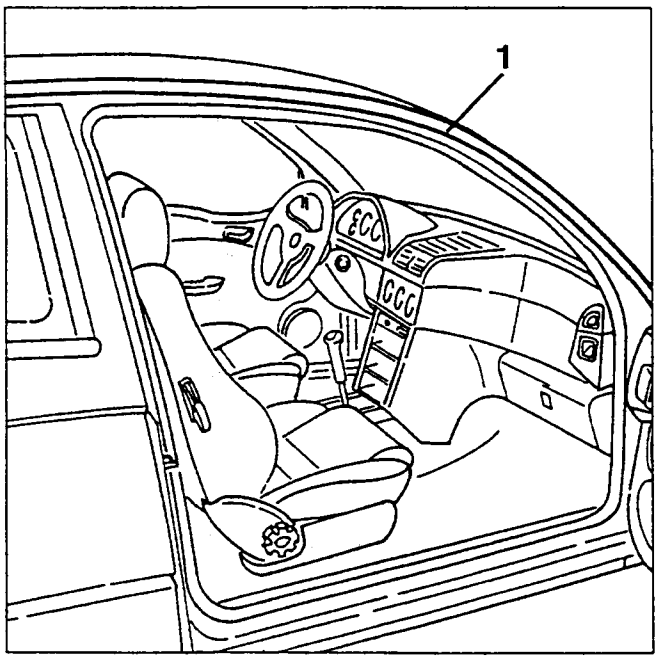
- Remove the air intake grille (see specific procedure).
1. Pull off and remove the services tank seal.



ROOF PANEL SIDE SEALS

REMOVAL/REFITTING

- Remove the upper window strip (see specific procedure).
1. Pull off and remove roof panel side seal.

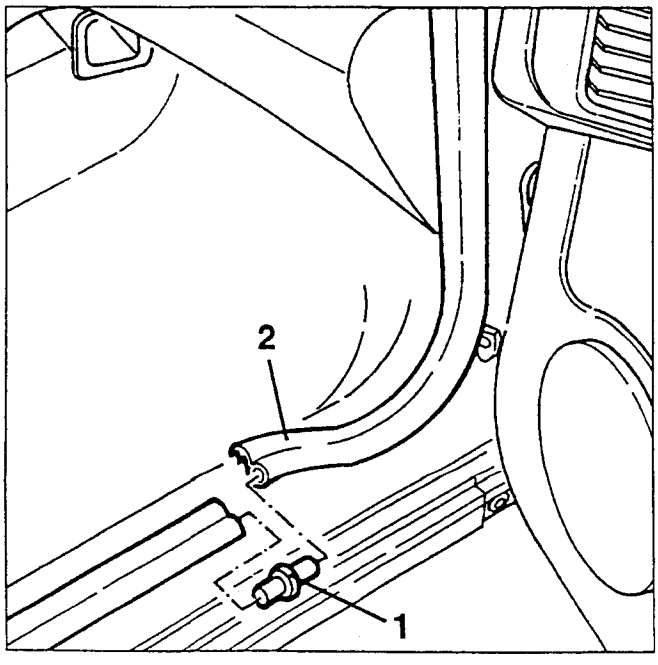


Refit by reversing the procedure followed for removal ensuring that the inner edge of the seal covers the internal trim.

DOOR SEALS

REMOVAL/REFITTING

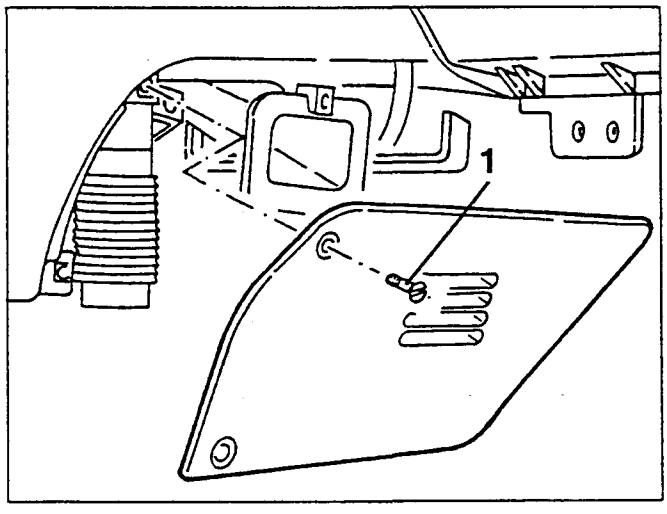
- Remove the heel rest (see specific paragraph).
1. Remove the join from the ends of the seal.
2. Pull off the seal starting from the join.



FRONT FLOOR VENT MOULDINGS

REMOVAL / REFITTING

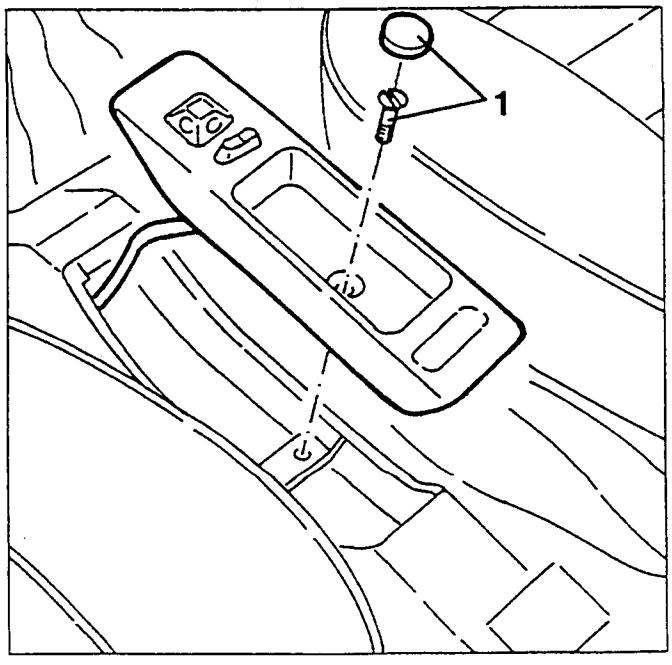
1. Loosen the two screw and remove the floor vent moulding by backing it off from the retaining bracket.



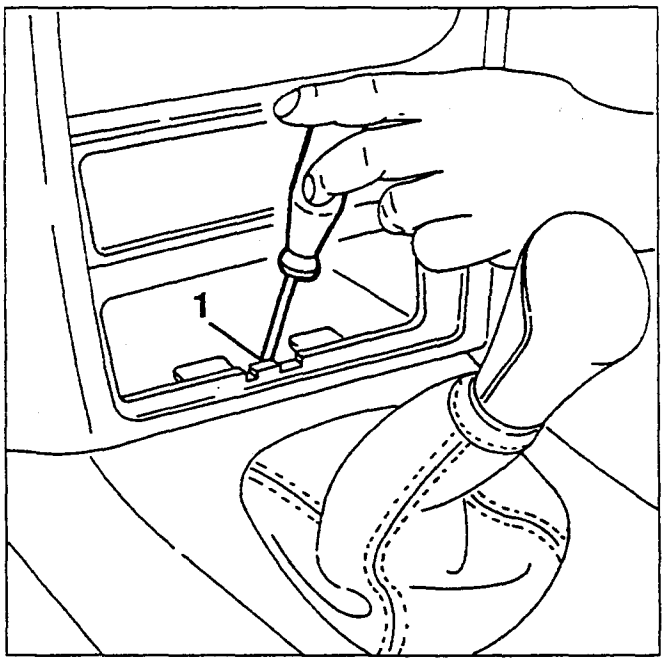
CENTRAL CONSOLE

REMOVAL / REFITTING

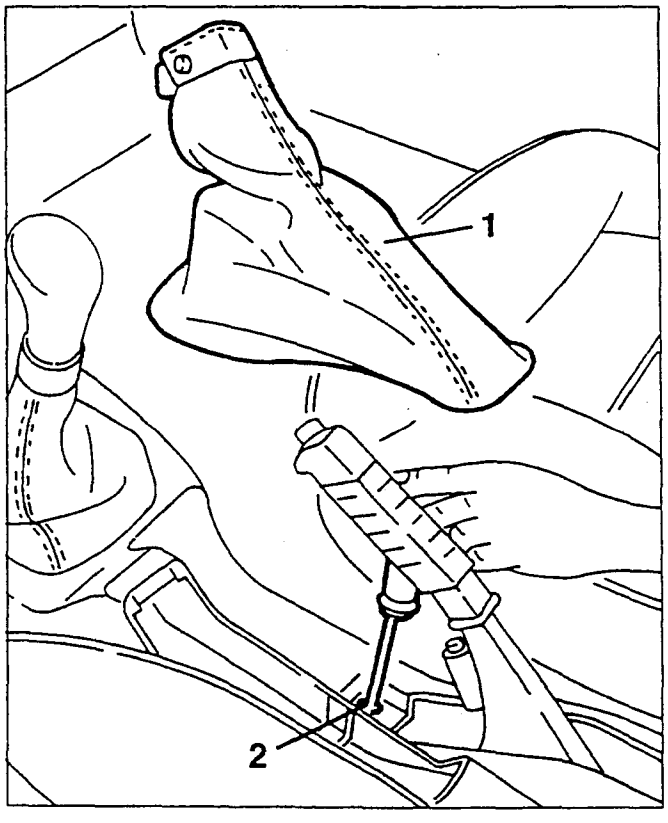
- Disconnect the negative (-) cable from the battery .
1. Pull off the plastic cap, loosen the screws and lift the moulding just enough to allow the electrical connection of the electric mirrors to be removal .



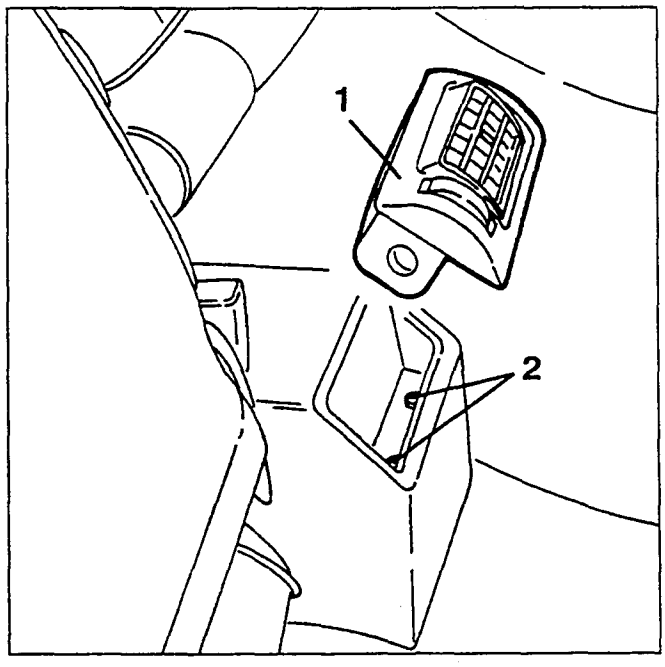
1. Remove the object tray and loosen the front screw securing the central console .



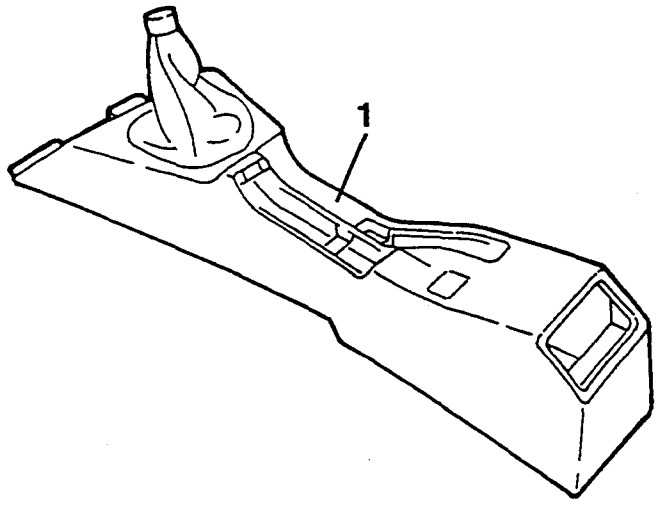
1. Pull off and remove the covering from the hand brake .
2. Loosen the central screw securing the central console .



1. Pull and remove the rear air distribution vent from the console .
2. Loosen the two rear screws securing the central console .



1. Withdraw and remove the central console .



AIR BAG

DESCRIPTION

The AIR BAG is a passive safety device consisting of:
- twin front Air Bags, driver and passenger (where fitted) for front protection;
- side bags (where fitted).

The system operates:
- the driver and passenger Air Bags in the case of a frontal impact of a certain severity.
- on the other hand, in the case of a side impact of a certain severity, the corresponding side bag is operated (only on the side where the impact occured).

The system consists of the following components:
- electronic control unit (1);
- driver's Air Bag (2);
- passenger Air Bag (3);
- passenger side automatic disabling sensor (only up to June '99) (4);
- side impact sensors in the left door pillar (5);
- side impact sensors in the right door pillar (6);
- right Side Bag (7);
- left Side Bag (8);
- diagnostic sockect for checking the system using the Examiner or other diagnostic equipment (9).

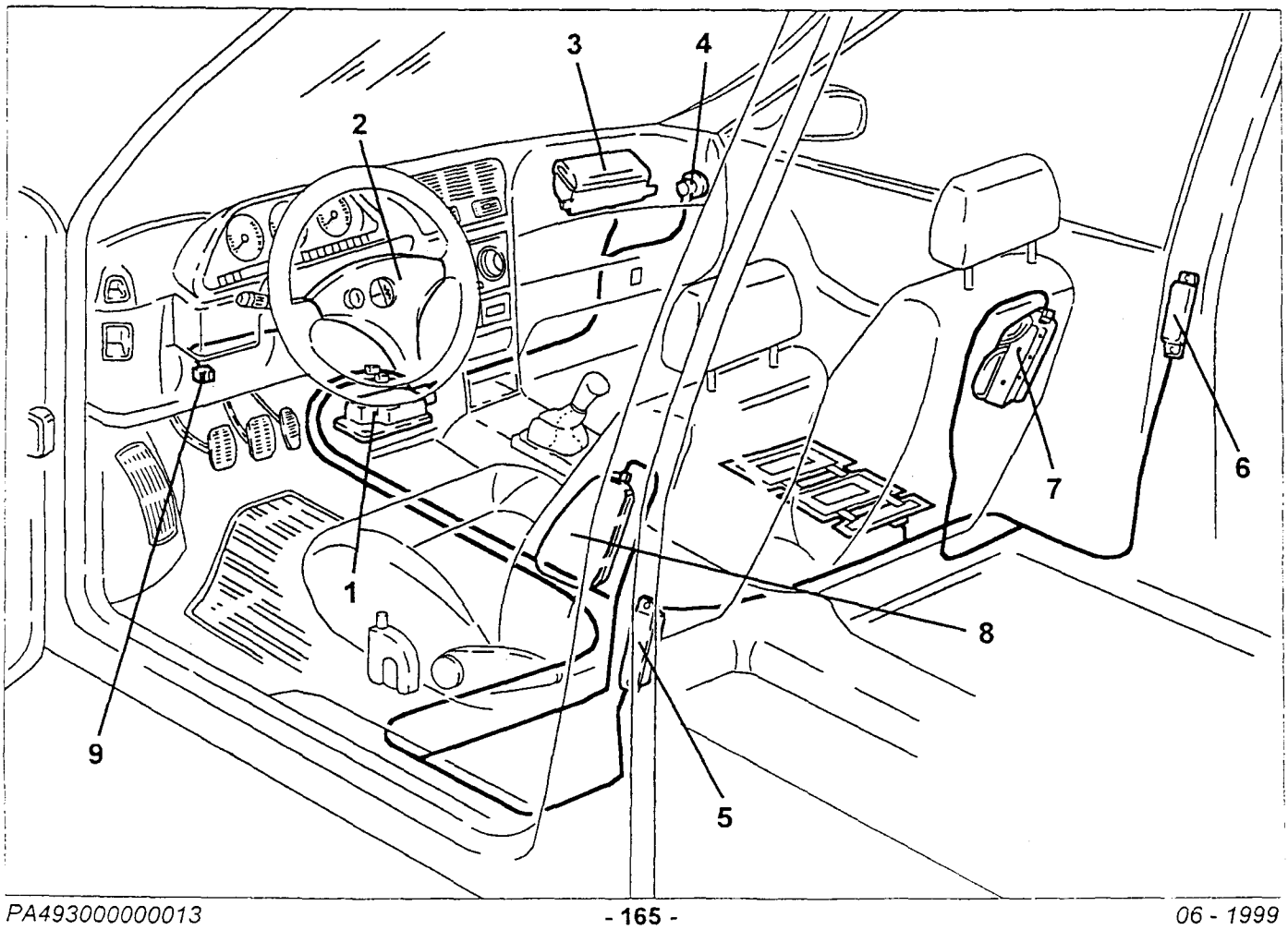
An electronic control unit manages the entire system checking all the components and activating the appropriate systems (pretensioners and Air Bags) when necessary.

Operation in the case of a frontal impact
Inside the control unit there is an accelerometric sensor whose signal, appropriate processed by a microprocessor, allows the severity of an impact to be assessed and, as a result, the operation of the Air Bags to be decided upon.
A second sensor with safety functions gives the go ahead to activate the Air Bags. The control unit only detects frontal impacts. No intervention takes place in the case of side impacts, shunts or if the vehicle overturns.

Operation in the case of a side impact
There is an accelerometric sensor in the two front door pillars which detects side impacts and transmits a signal to the control unit.
This signal, suitably processed by a microprocessor inside the control unit, makes it possible to assess the severity of a side impact and, as a result, decide upon the operation of the Side Bag on the side where the impact has taken place, but only if the safety sensor gives the go ahead.

NOTE: The Side Bags are activated independently of one another and the front Air Bags.

WARNING: On vehicles with Side Bags:
- do not wash the seat backrest with water or pressurized steam in automatic car washes for seats;
- do not cover the front seat backrests with loose covers.



SAFETY REGULATIONS TO BE OBSERVED DURING OPERATIONS ON VEHICLES EQUIPPED WITH AIR BAG SYSTEMS

Below are several rules which SHOULD, UNDER ALL CIRCUMSTANCES, BE OBVERVED when carrying out an operation on vehicles equipped with Air Bags.

PRELIMINARY INSTRUCTIONS

It should be remembered that Air Bag modules are devices which should be handled with caution. Their use, transportation and storage are governed by the procedures for handling these components illustrated below.

Before starting to carry out:
- bodywork repairs;
- welding operations;
- work for which the Air Bag modules or the control unit have to be removed.

Remove the ignition key.
Always disconnect the battery, i.e. disconnect the two terminals from the poles and insulate them by taping them carefully.
Disconnect the control unit connector waiting at least **10 minutes** after having disconnected the battery.
If one of the Air Bag modules is being removed, observe the following procedure scrupulously:

1. Wait at least **10 minutes** after having disconnected the battery before starting to remove the module.

2. Undo the fixing bolts.

3. Disconnect the connector for the inflation devices.

4. Place the devices, with the cover facing upwards, in a locked metal cupboard. This cupboard, designed exclusively for this purpose, should not, under any circumstances, be used to store other types of material, especially if they are inflammable. The cupboard should meet the specifications for storing pyrotechnic charges (metal, impact-resistant cupboard with grilles to allow natural ventilation inside) and should have notices as laid down by the laws in force (DANGER EXPLOSIVES - NO NAKED FLAMES - NOT TO BE OPENED BY UNAUTHORIZED PERSONNEL).

All the connectors used in Air Bag modules contain a shortcircuit clip: until the Air Bag modules are connecetd to a suitable energy source via a suitable connector there is no possibility of their accidental activation.

A system component which has not been activated in the case of an accident should be considered as still "active" therefore components which are unexploded because they are defective or have reached the end of their warranty period or for other reasons have to be replaced and returned to the special centre following the procedure described below.

The assembly and dismantling of safety system components should ONLY be carried out by suitably trained and authorized personnel.
The failure to respect the above instructions could lead to the undesired activation of the system resulting in personal injury or unnecessary repairs to the system.

THE AIR BAG MODULES MUST NOT BE DISMANTLED, UNDER ANY CIRCUMSTANCES, INTO THEIR COMPONENTS.

All the system components have been specifically designed to work on a particular marque and type of vehicle, therefore Air Bags should not be adapted, reused or fitted on other vehicles, but only on these for which they were designed and produced. Any attempt to reuse, adapt or fit one on a different type of vehicle could result in serious injury or even be fatal for the occupants of the vehicle in the case of an accident.

Replacing an Air Bag (because of defects or the expiry of the warranty)
If an Air Bag module is being replaced because it is defective or the warranty period has expired it is necessary to:

1. Remove the new adhesive label from the module, placing it in a special file with the vehicle data (chassis no., registration date, model, etc.) and add the serial number of the old module. The file with the recorded data should be kept for future checks.
2. Before being stuck on top of the existing plate, the plate should be perforated by the month and ten years after the date when the module is being fitted (e.g. 2007 for 1997).
3. Connect the module to the appropriate connector.
4. Fit the Air Bag module in the appropriate housing checking that the connecting cable is correctly routed and tighten the bolts to the recommended torque.

Replacing the control unit
The electronic control unit should ALWAYS be replaced in the case of an impact involving the activation of the system.
Do not, under any circumstances, attempt to reuse the electronic control unit.
If the control unit is being replaced the adhesive label must be replaced and stuck in the above mentioned file.

For the withdrawal from and depositing in the storage area an incoming and outgoing register must be kept.

Fragile. Handle with extreme caution. Do not drop.

If the Air Bag control unit is accidentally dropped it must be checked over with the ALFA TESTER cancelling the error messages where necessary. If the unit has been dropped from a height above 75 cm it must be replaced.

The loaded AIRBAG module, after disassembly must immediately be placed in the appropriate cabinet.

2) ASSISTANCE INTERVENTION

Do not use tools like hammers or percussion screw-drivers which could transmit shock waves to the inflation device. Do not cut or puncture the AIRBAG module.

Do not tamper with any part of the AIRBAG. Any attempt at tampering with the module could provoke the activation of the system and result in personal injury.

Handle the AIRBAG module with extreme caution. If the inflation device is broken materials which are extremely dangerous may be projected from the device:
The surface of an AIRBAG which has detonated inside the vehicle may be covered with a dust residue. This dust contains some sodium compounds which are a by-product of the reaction which generated the gas used to inflate the cushion. The sodium compounds are, for the most part composed of sodium carbonate and trace quantities of sodium hydroxide.
This dust is slightly alkaline but is not held to be toxic. In addition to the dust there may be a small quantity of unused sodium azide and potassium nitrate inside the gas generator. These components are dangerous. In the even of contact with these substances, refer to the "FIRST AID" section.

Never use naked flame near the AIRBAG module.

Do not allow the module to come into contact with acids, water, other liquids or sprays as this could cause the chemical elements within the module to react dangerously.

First aid

In the event of contamination by one of the components involved in the production of the gas, the following first aid procedures should be applied:

INGESTION:
Induce vomiting if the subject is conscious. Do not provoke vomiting in an unconscious patient. Consult a doctor.

CONTACT WITH SKIN:
Immediately wash the area with neutral soap and running water. Remove contaminated items of clothing and wash them before putting them on again. Seek the advice of a doctor.

CONTACT WITH THE EYES:
Immediately rinse with copious quantities of running water for at least 15 minutes. Remove contact lenses to ensure complete washing. Seek the advice of a doctor.

INHALATION:
Help the accidented patient into the fresh air. Treat any irritation on the basis of the symptoms. Seek the advice of a doctor.

A DOCTOR SHOULD ALWAYS BE CONSULTED AFTER EXPOSURE TO THE COMPONENTS USED IN THE PRODUCTION OF THE GAS.

3) AFTER THE ASSISTANCE INTERVENTION

Following each service operation concerning the Air bag the operation of the entire system should be checked using the ALFA TESTER.

If the intervention did not require the substitution of the AIRBAG module, check that the specific labels are present and restore them if necessary.

If the intervention required the substitution of the AIRBAG module, a new label showing the new date of expiry (month and year) written in indelible ink should be applied.

4) TRANSFER OF OWNERSHIP, DEMOLITION

The vehicle must not be demolished when the AIRBAG module is still intact or when the module is out of its seating. If the vehicle is to be demolished the personnel charged with this operation must be informed of the presence of the AIRBAG so that the appropriate measures and precautions can be taken (see also relative paragraph below). The detonated modules must be destroyed in accordance with the regulations in force in the each country.

The detonated modules should be kept in sealed plastic bags ready for disposal.

If the vehicle is to be sold, the new owner must be informed of the presence of the AIRBAG module.

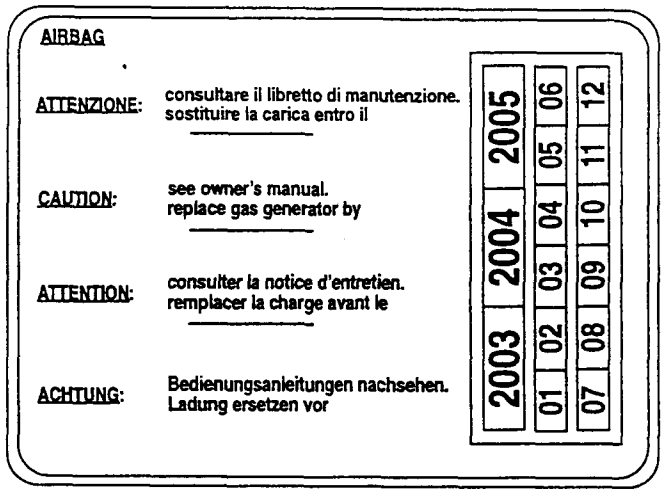
Check the labels and if necessary have them replaced.

5) DURATION OF THE AIRBAG SYSTEM

The AIRBAG module should last for 10 years (see expiry date on specific label). It must be replaced when this period expires and a new label showing the new date of expiry (month and year) written in indelible ink should be applied.

6) IDENTIFICATION LABELS

On vehicles fitted with an AIRBAG two adhesive labels are present which warn the owner of the presence of the device and its date of expiry.

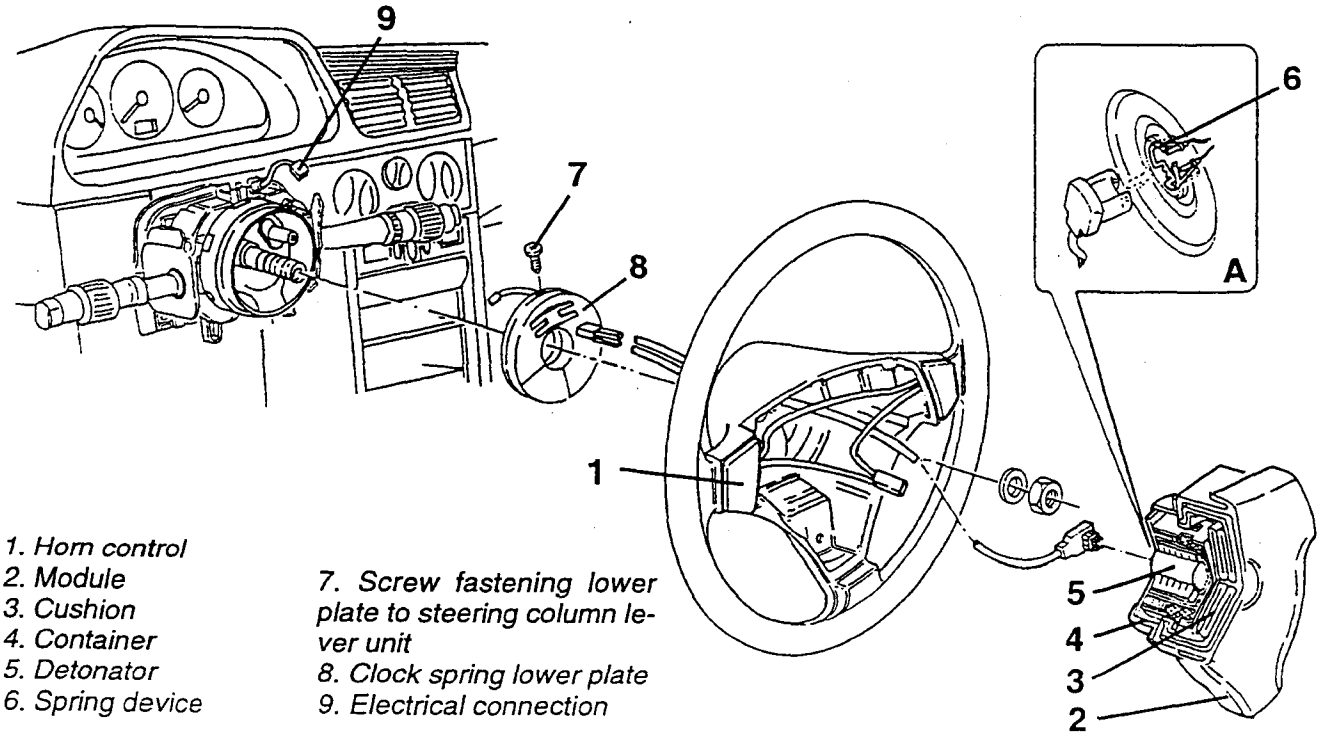


WARNING !
The operators authorized to handle the AIRBAG modules, in addition to scrupulously respecting the indications given above, must be extremely attentive and informed regarding the potential danger resulting from the involuntary intervention of the module.

AIR MBAG MODULE ON DRIVERS'S SIDE

The new type of steering wheel is fitted with lateral commands for the homs. The centre of the steering wheel houses the AIR BAG module. It is fixed with three screws to the rear part of the steering wheel. The module is composed of a steel plate covered with a plastic container which forms the hub of the steering wheel.

The container holds a folded cushon and the inflation device. The inflation device contains a detonator which is activated electrically producing a chemical copound (sodium azide) forming nitrogen gas.
The rear part of the cushon has holes of a suitable size to allow the cuschon to deflate immediately after inflation.

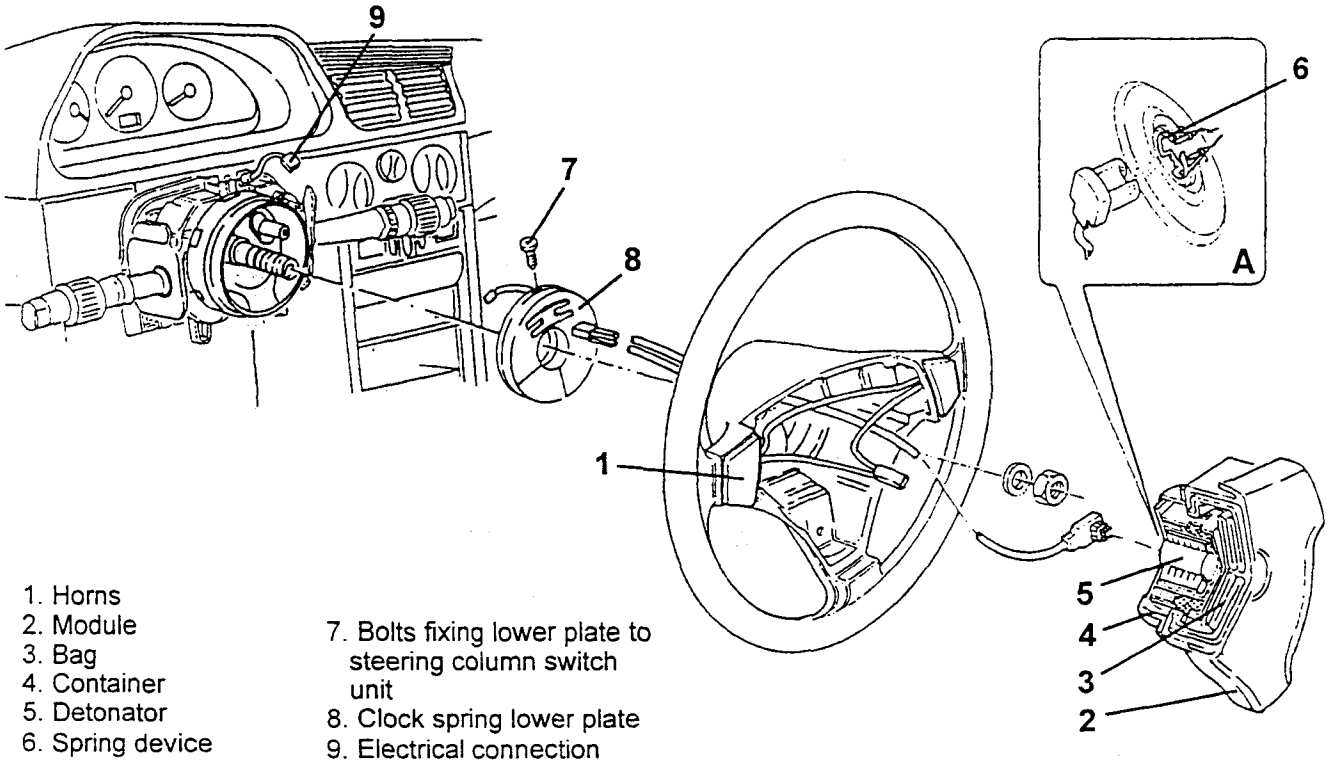


1. Horn control
2. Module
3. Cushion
4. Container
5. Detonator
6. Spring device
7. Screw fastening lower plate to steering column lever unit
8. Clock spring lower plate
9. Electrical connection

DRIVER'S AIR BAG MODULE

The new type steering wheel has side controls for the horns and the centre section contains the housing for fitting the module.
It is secured by three bolts to the rear of the steering wheel.
The module is made up of a steel plate covered by a plastic container which constitutes the centre of the steering wheel.

The container houses the suitably folded bag and the inflation device. The inflation device contains a detonator which can be electrically activated and a chemical compound (sodium nitride) for the formation of the gas (nitrogen).
The rear of the bag houses suitable sized openings for deflating the bag immediately after it has been inflated.

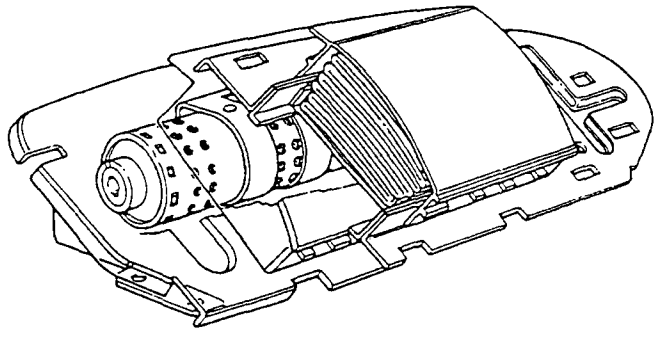


1. Horns
2. Module
3. Bag
4. Container
5. Detonator
6. Spring device
7. Bolts fixing lower plate to steering column switch unit
8. Clock spring lower plate
9. Electrical connection

AIR BAG MODULE PASSENGER SIDE

The passenger AIR BAG module is also enclosed in a container which is fixed to a metal fram. The composition and operating principle is the same as for the one on the driver's side.
When the connector is disconnected from the Air Bag modules, they are shortcircuited: a special spring device incorporated in the module connectors joins the two terminals. In this way they cannot be activated by means of a direct supply.

NOTE: Air Bag modules should be replaced 10 years after fitting, the date is given on the label.

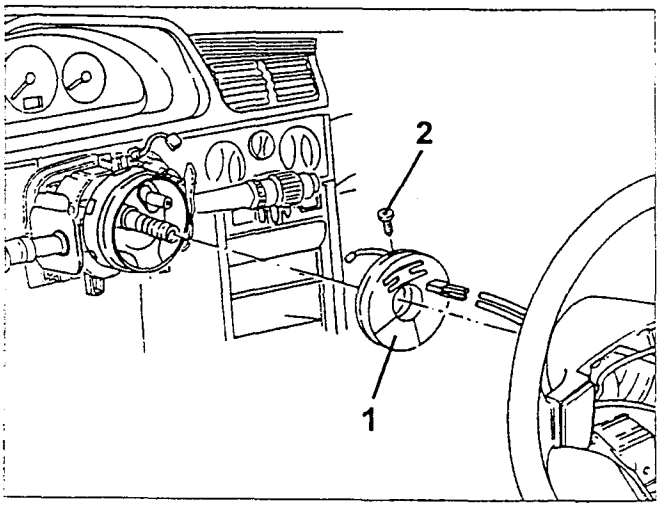


CLOCK SPRING

The clock spring (1) is a device which is fitted on the steering column switch unit and is designed to allow the Air Bag module cables fitted on the steering wheel to follow the rotation of the latter without danger of breaking.
The device consists of two plates, the lower one fixed to the steering column switch unit by means of bolts (2), the upper one attached by means of two elements on the upper section.
Inside the two plates, the connecting cables for the module and the horn buttons are wound around to allow the movements of the steering wheel to be followed.
The clock spring is fitted with a device which automatically stops it from rotating when the steering wheel is removed.
This operation is designed to prevent the upper plate, no longer attached to the steering wheel, from rotating freely causing the cables to be unwound or wound, with the possibility of them breaking.
When fitting the steering wheel the device is automatically locked.

NOTE: When removing-refitting the clock spring, make sure that it is refitted on the steering column switch unit in the same position in which it was removed.

If, for any reason, the upper clock spring plate should rotate in relation to the lower one so that its position during removal is not known, the CLOCK SPRING MUST BE REPLACED.
When replacing, if the clock spring is supplied as spares separately from the steering column switch unit, it should be fitted with the wheels straight because this is the corresponding position for the new device.
The new device is fitted with a safety tab which keeps it locked.
This tab should be removed when fitting the steering wheel to allow the system to rotate correctly.



SIDE BAGS

Impact sensors
There is an accelerometric sensor on the two front doors which, in the case of a side impact, transmits a signal to the control unit.
This side is also processed inside the control unit which, as a result, decides to operate the Side Bag on the side the impact has occurred on.
In effect, the control unit is equipped with a second safety sensor, which detects side impacts, in exactly the same way as the sensor which detects frontal impacts, and gives the go ahead for the activation of the Side Bag on the side where the impact has occurred.
This sensor is positioned so that it only detects impacts on the side on which it is located: e.g. the sensor in the driver's pillar only detects impacts which occur on the left and does not detect impacts on the right side.

NOTE: The sensor should be fitted with the arrow pointing in the direction of travel.

Side Bag module
The Side Bag is housed in the outer part of the front seats towards the window.
It consists of a container, incorporated in the seat backrest, which houses the gas generator and the folded bag.
The container is fixed to the backrest frame by means of a special bracket.
The gas generator can be electrically activated by means of a signal coming from the electronic control unit.
In this way a propellant charge is triggered which releases a compressed gas (argon) which expands in the bag, which is smaller than the front bags.
The bag deflates immediately after inflation thanks to an opening in the rear.
The seat cover stitching has predetermined rupture lines which allow the bag to come out completely.

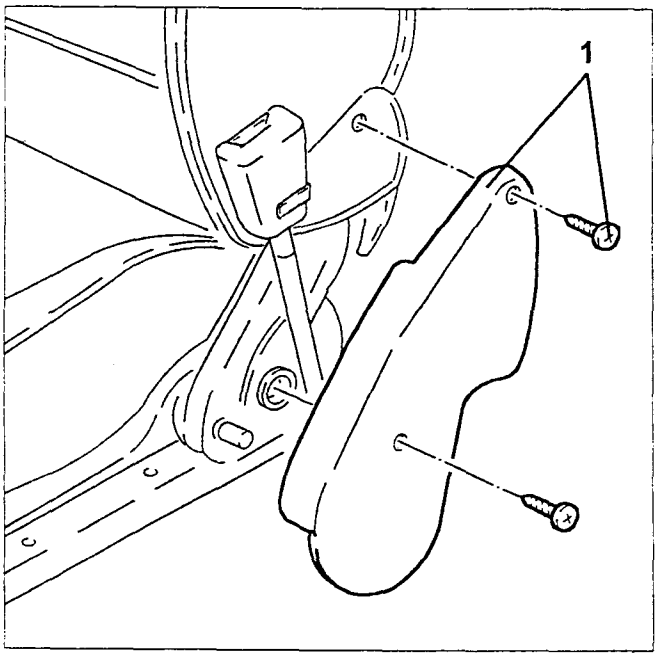
Disabling passenger Side Bag (device fitted up to June '99)
When the "no passenger" condition is detected, constantly for at least thirty seconds, the control unit excludes the activation of the passenger Air Bag and the Side Bag.
If the sensor then detects the "passgner present" condition, the control unit immediately reactivates the passenger Air Bag and the Side Bag.

REMOVING-REFITTING AIR BAG MODULE SIDE

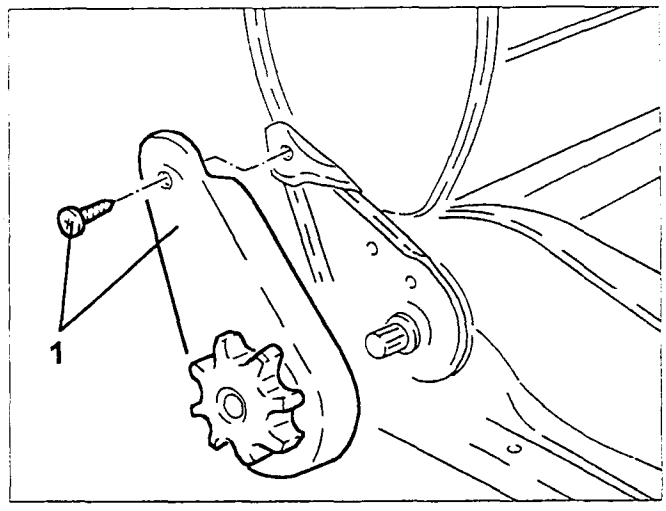
Operations on Air Bag components should be carried out by suitably trained personnel SCRUPULOUSLY following the safety measures listed below.

- **During removal or replacement operations, polythene gloves and protective goggles must be worn.**
- **Before removing the Air Bag, disconnect the battery terminals, insulate them and wait for 10 minutes.**
- **Do not use naked flames in the vicinity of Air Bags or system components.**
- **Damaged or defective individual components should not be repaired or tampered with, but replaced in their entirety.**
- **For further clarifications on the safety instructions, see "Safey Measures" at the beginning of this chapter.**

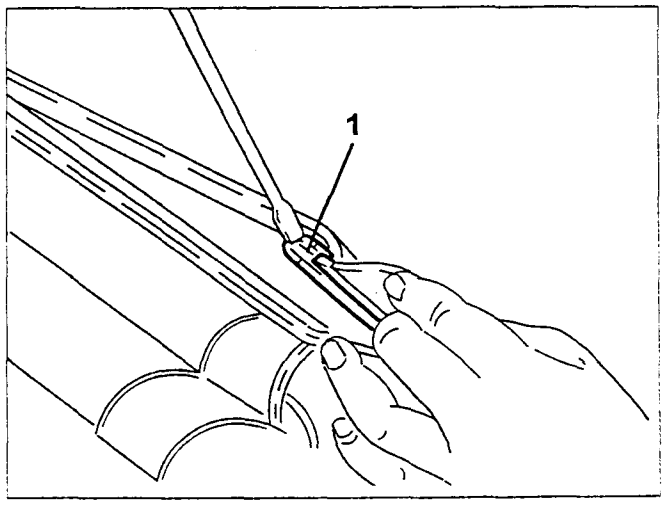
- Remove the front seat (see specific procedure).
1. Undo the fixing bolts and remove the hinge trim, releasing it from the fastening springs.



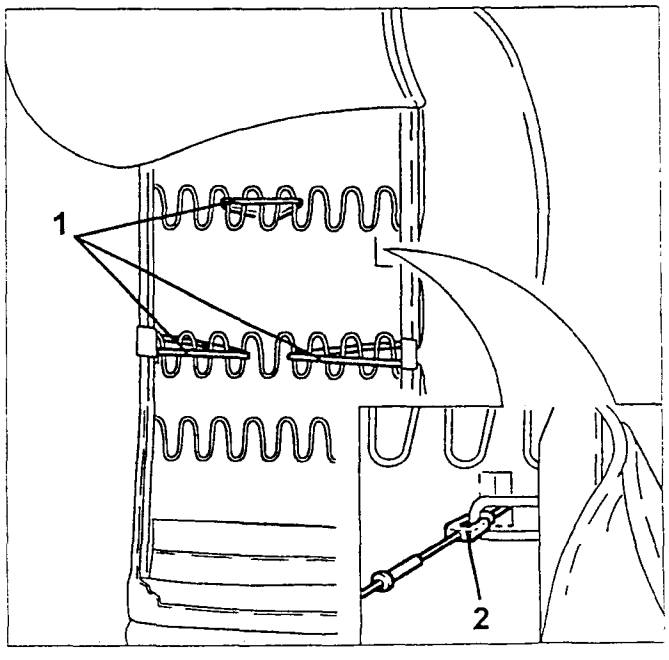
1. Undo the fixing bolts and remove the hinge trim complete with knob, releasing it from the fastening springs.



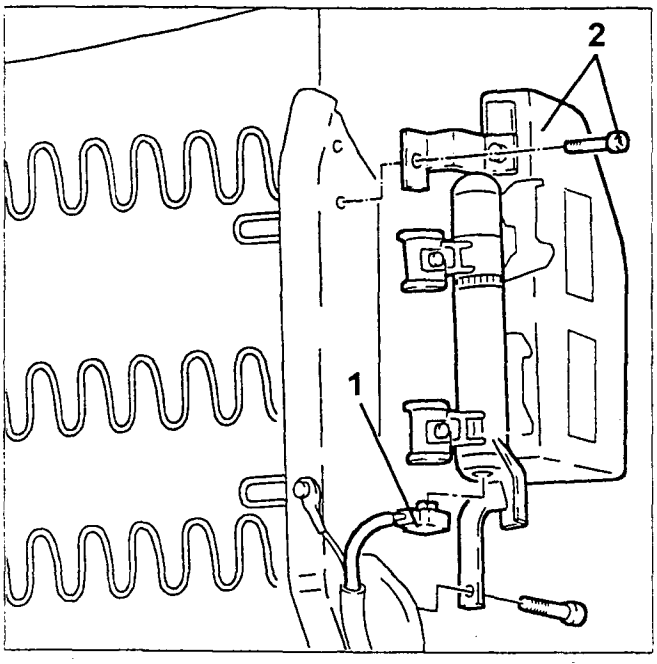
1. Remove the two side profiles for the backrest rear cloth.



1. Release the three upholstery flexible bands.
2. Release the three right and left upholstery rods.

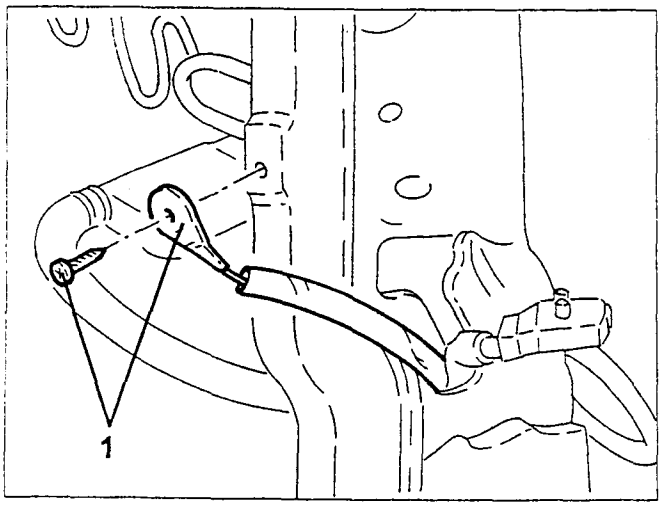


- Lift up the backrest fabric and remove the upholstery in the area of the Side Bag module.
1. Disconnect the electrical connection from the Side Bag module.
2. Undo the fixing bolts and remove the Side Bag module.

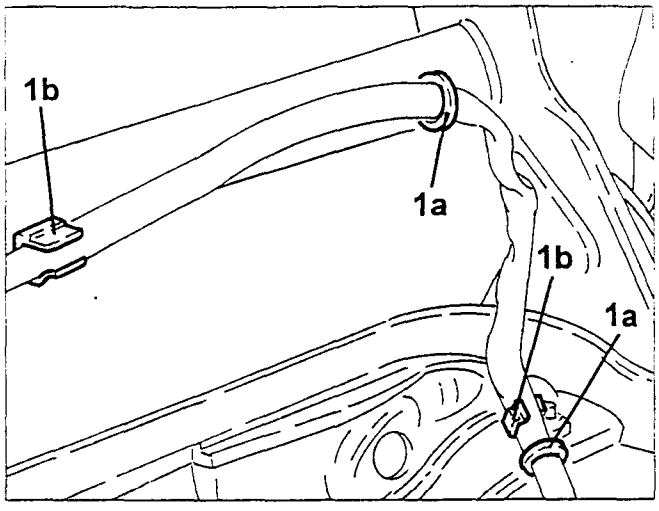


DISMANTLING/REASSEMBLY SIDE BAG SUPPLY CABLE

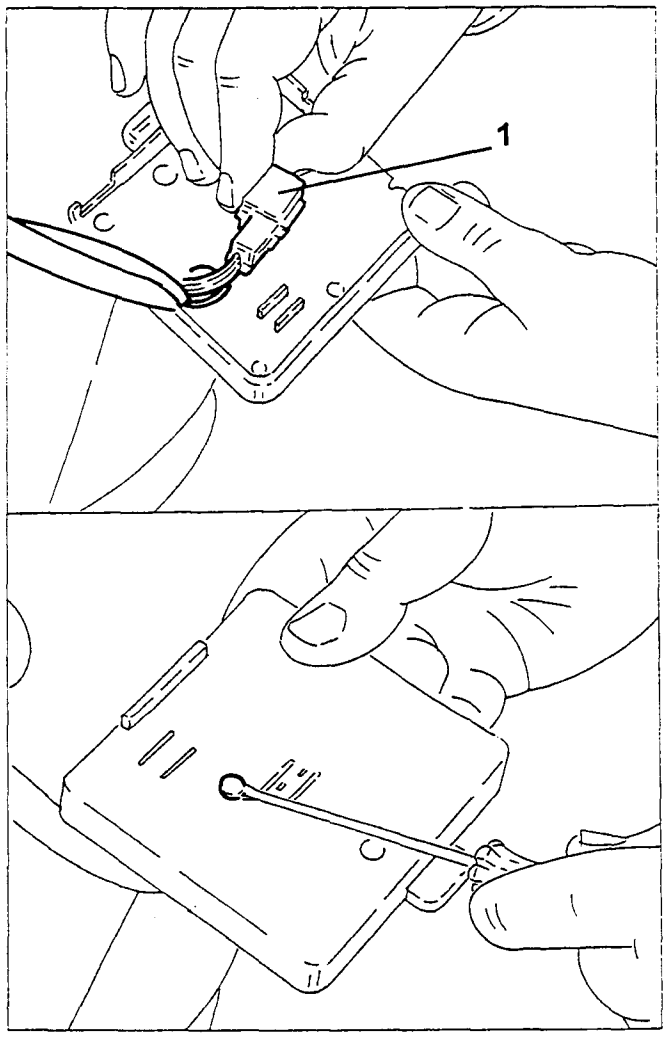
- Remove the front seat (see specific procedure).
- Remove the Side Bag module (see specific procedure).
- Remove the cushion from the seat (see "Dismantling-Reassembling front seat cushion" procedure).
1. Disconnect the earth lead from the backrest frame.



1. Remove the bands (1a) and the springs (1b) fixing the Side Bag supply cable.



1. Release the electrical connections from the connector box.

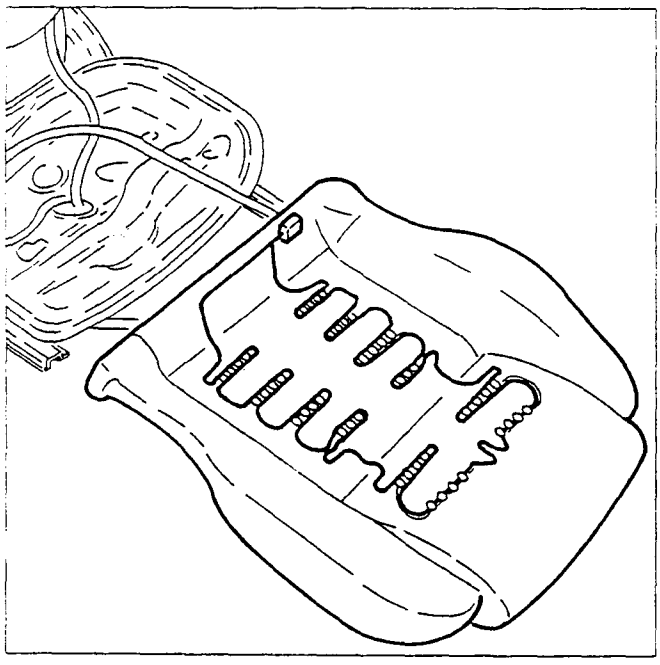


- Remove the Side Bag supply cable, releasing it.

DISMANTLING/REASSEMBLING PASSENGER PRESENCE SENSOR (Device present until June '99)

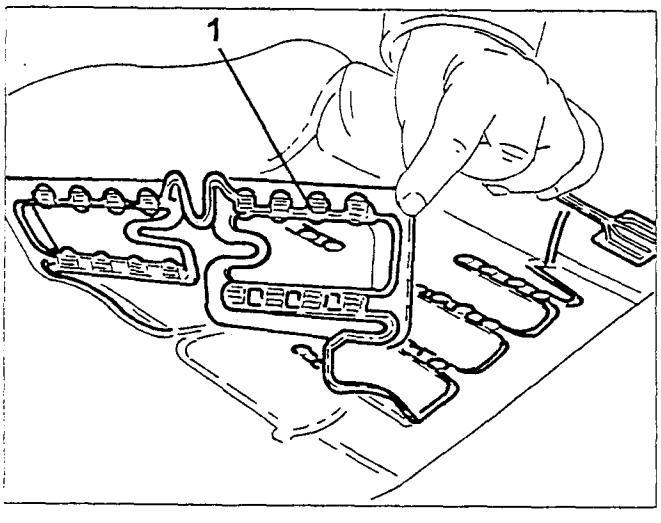
- Remove the front seat (see specific procedure).

Remove the frotn seat cushion upholstery (see specific procedure).

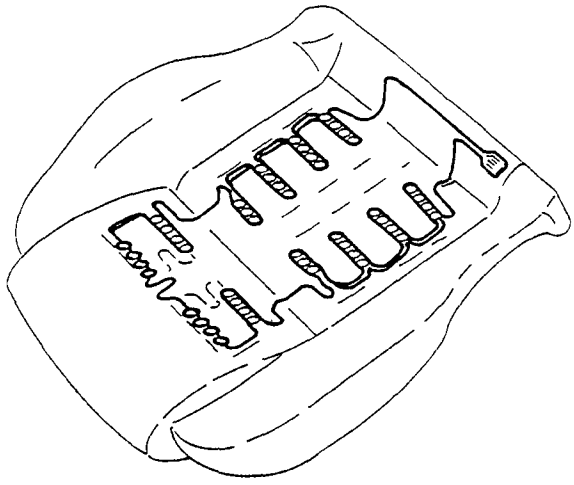


- Disconnect the electrical connection for the passenger presence sensor fixed to the connector box under the base.
1. Remove the passenger presence sensor from the cushion upholstery.

Work carefully so as not to damage the connections and the structure of the sensor.



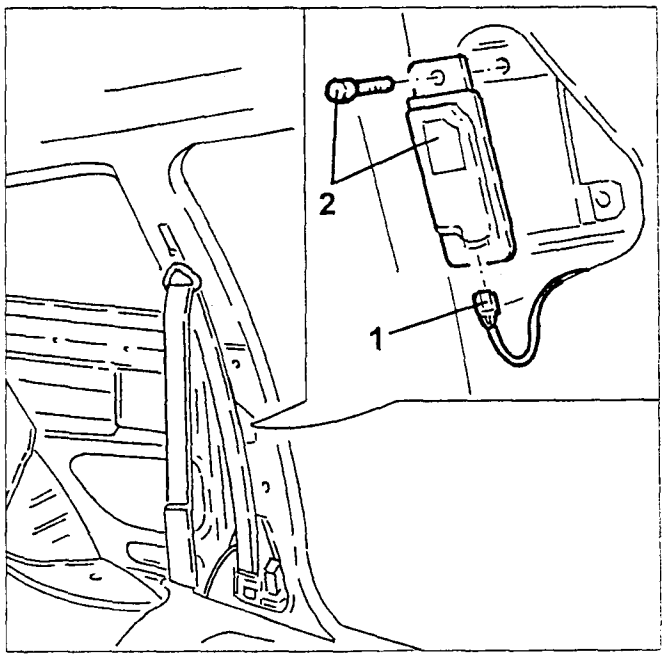
- When refitting, position the passenger presence sensor with the adhesive part facing the upholstery.



REMOVING-REFITTING IMPACT SENSORS FOR SIDE BAGS

- Remove the side panel (see specific procedure).
1. Move the seat belt and disconnect the electrical connection from the Side Bag impact sensor.
2. Undo the two bolts and remove the Side Bag impact sensor.

NOTE: The sensor should be fitted with the arrow pointing in the direction of travel.



WHITE

.EMOVING THE DRIVER'S SIDE AIR BAG MODULE - CLOCK SPRING DEVICE

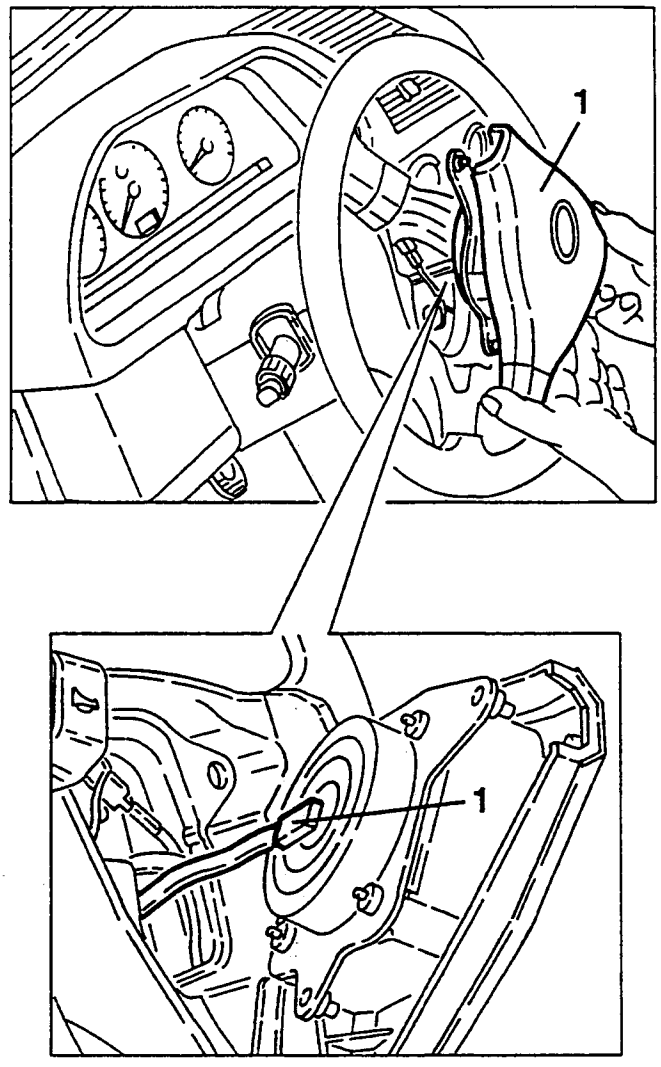
Operations on Air Bag components must be carried out by suitably trained personnel, CLOSELY adhesring to the safety instructions given below.

• For removal or replacement operations it is always necessary to use polyethylene goves and protective goggles.

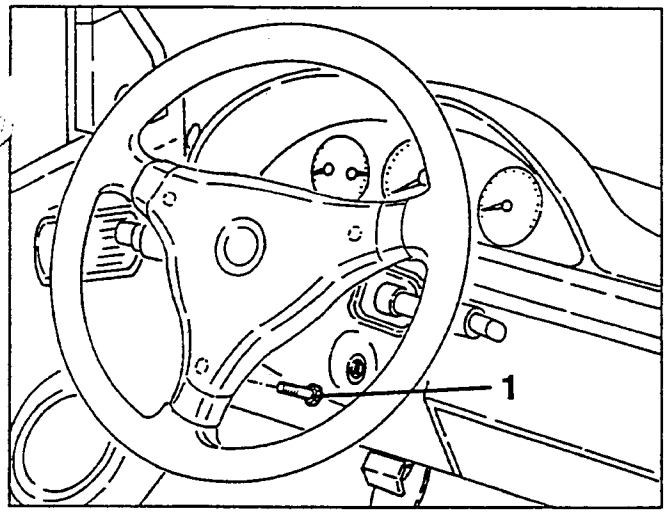
• Before disconnecting the Air Bag, disconnect the battery terminals, isolate them suitably and wait for 10 minutes.

• Non usare fiamme libere nelle vicinanze del dispositivo Air Bag e dei relativi componenti del sistema.

• The single damaged or faulty components must not be repaired or tampered with in any way, they must be wholly replaced.
For further explanations on the safety instructions, see "Safety Measures" at the beginning of this chapter.

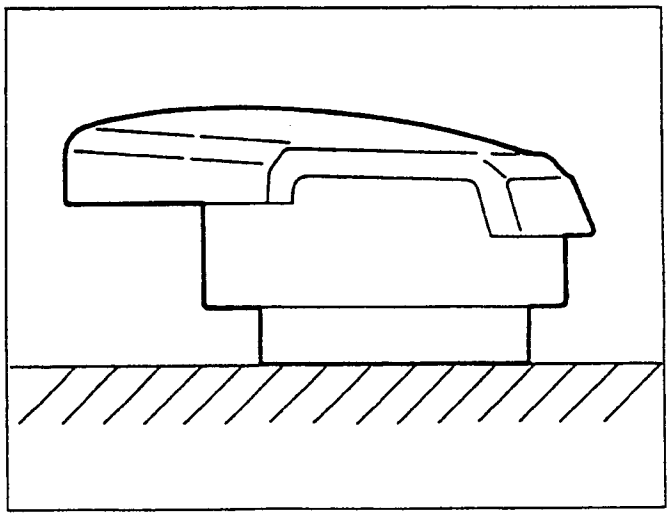


1. Slacken the the 5mm hexagon socket screws a 5 mm in the rear of the steering wheel.



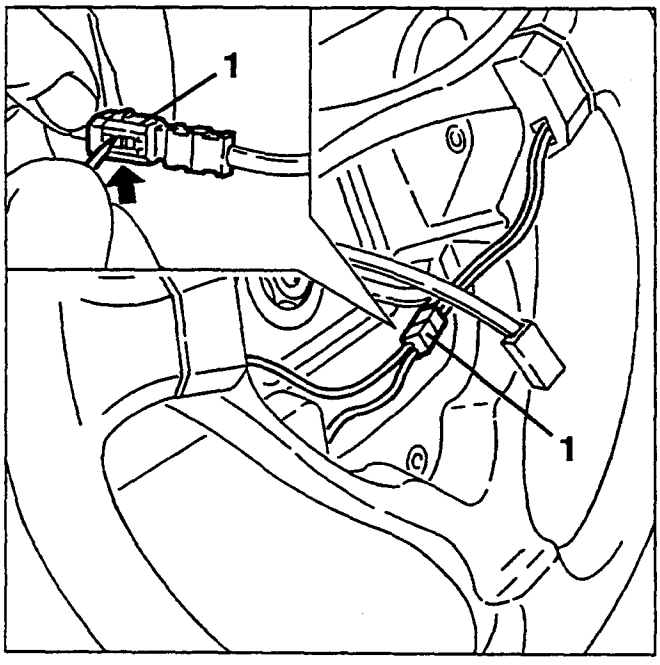
1. Withdraw the Air Bag module just enough to disconnect white, two-way electrical connection, then nove it.

WARNING:
Air Bags not deployed after removal, should be immediately placed in a special cabinet, suitably identified and key-locked.
The figure below shows how to place the module with the metal part resting on the shelf.



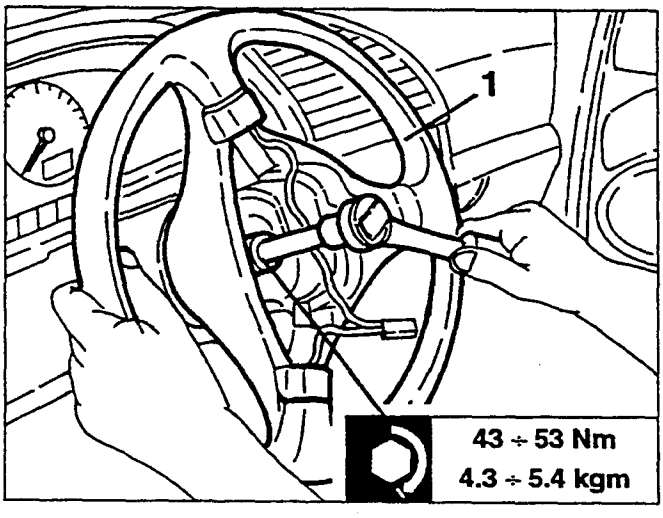
Remove the clock spring device after removing the driver's side Air Bag module proceeding as follows.

1. Disconnect the two-way black electrical connection for supplying the horns working on the tab as illustrated.

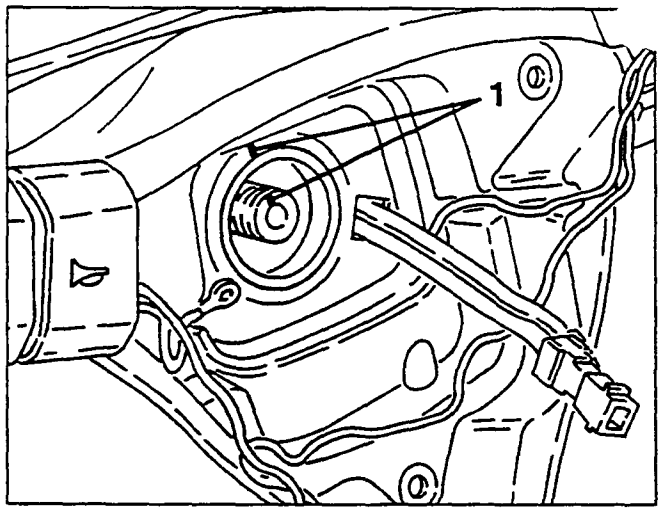


WARNING:
Set the car with the wheels STRAIGHT and check that, during the whole operation they remain in this position.

1. Completely back off the nut fastening the steering wheel to the steering column.

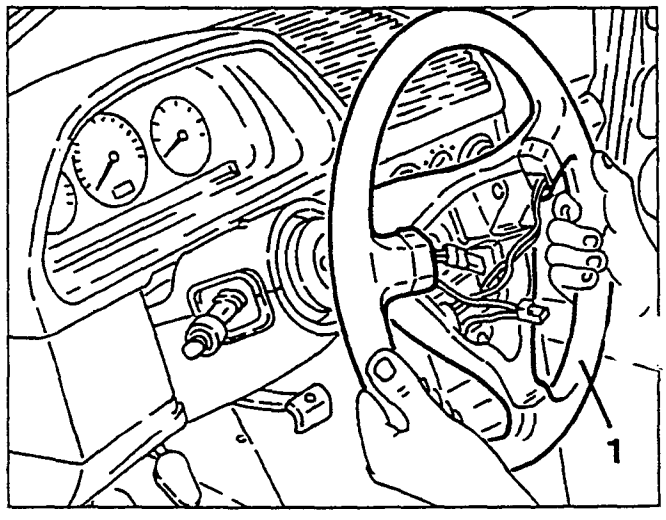


1. Still with the car with the sheels STRAIGHT, mark the recirpocal position between the steering wheel hub and the steering column.

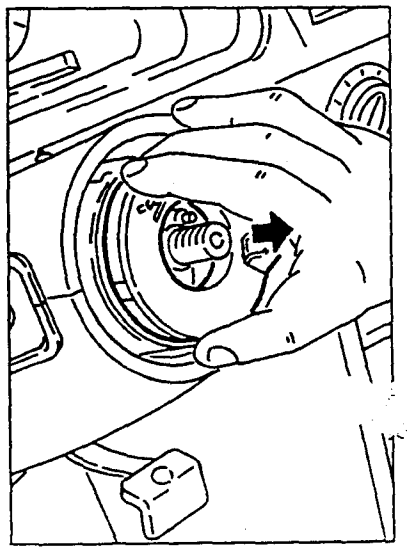


1. Completely remove the steering wheel with withdrawing the Air Bag module and horn su cables.

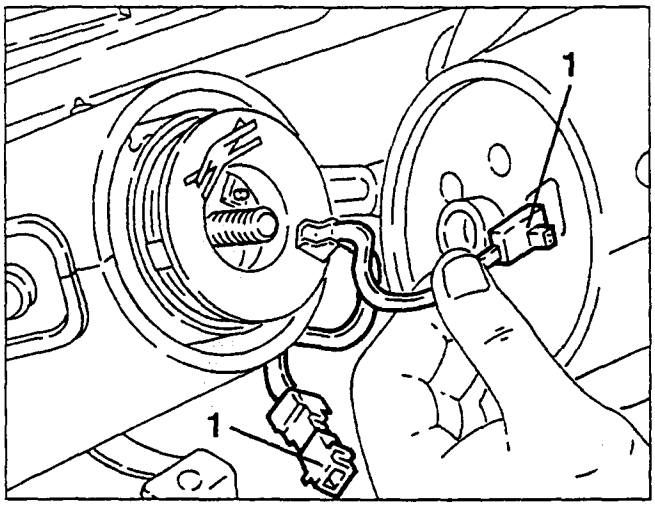
WARNING:
During removal operations take care not to knock the steering wheel violently.



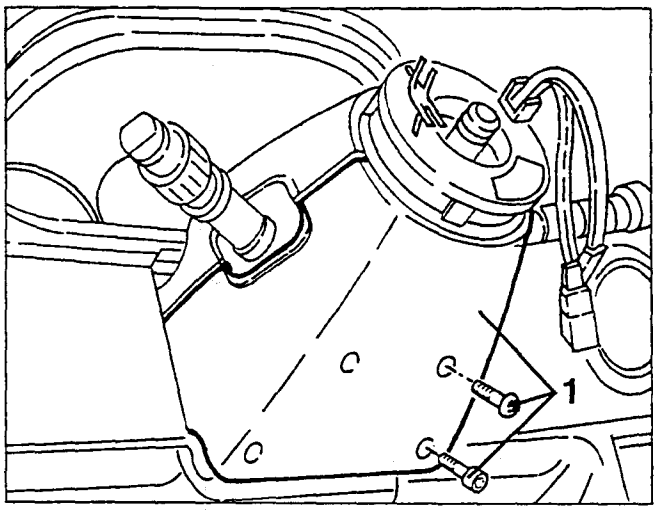
- Make sure that the removal of the steering wheel has raised the upper ring of the clock spring device. If the clock spring device upper spring turns, it is necessary to grasp it diametrally and pull it upwards as illustrated: a click will be heard upon locking.



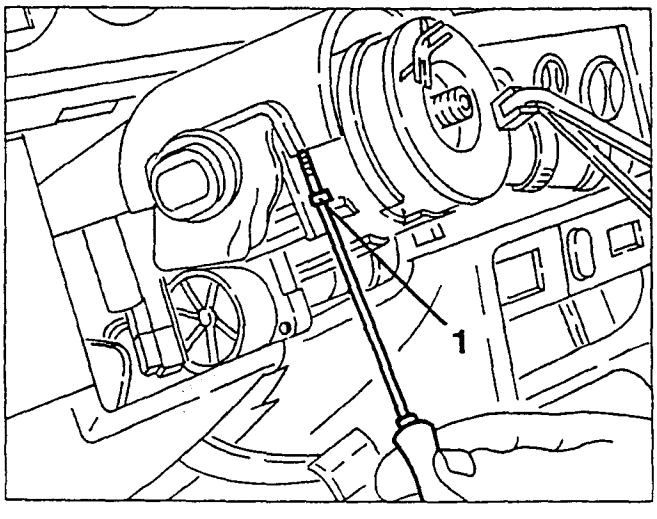
1. From the slot on the steering wheel hub, carefully remove the horn and Air Bag module supply cables.



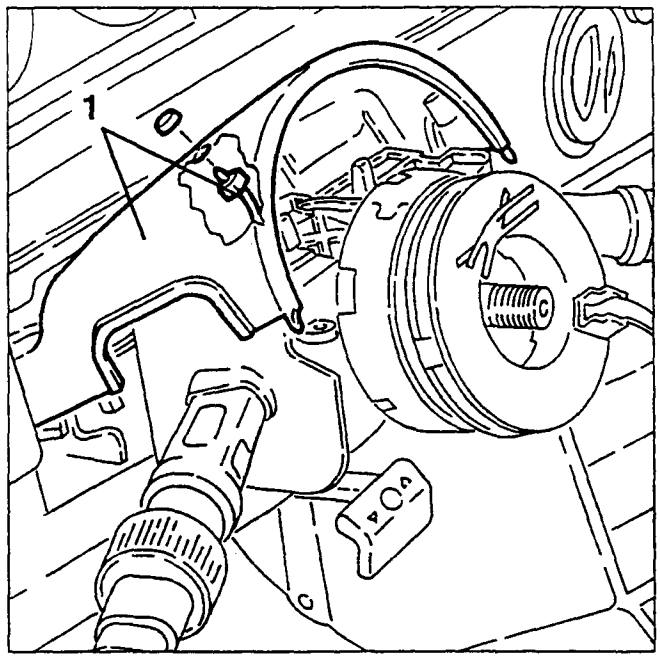
1. Raise the steering column as far as possible, slacken the four fastening screws (the two at the front of the car are 3mm hexagon socket screws, the two at the rear are cross- slotted) and remove the lower half cover.



1. Lower the steering column as far as possible and slacken the two upper half cover fastening screws.

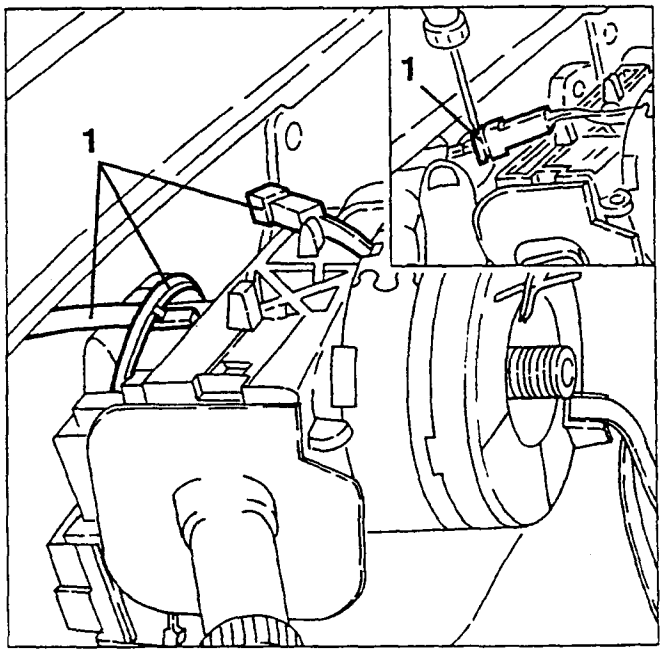


1. Disconnect the upper half cover just engough to slacken the locknut fastening the alarm system led, then remove the upper half cover.

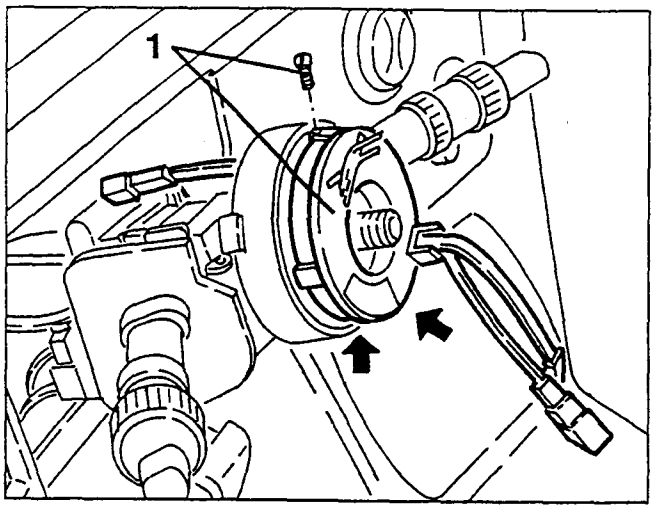


1. Cut the fastening clamp and disconnect the electrical connection of the cable with yellow sheath connecting the Air Bag control unit to the clock spring device.

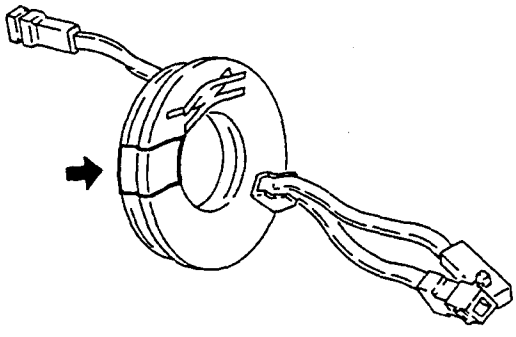
WARNING:
To disconnect the electrical connection always work on the tab and never on the electric cable.



1. Slacken the three screws fastening the clock spring device to the steering column lever unit then remove it.



WARNING:
The clock spring device is fitted with a device which automatically prevents it from turning when the steering wheel is removed.
It is necessary to remove the clock spring device without turning the upper ring and, for further safety, holding it in place, with a clamp or adhesive tape.



REFITTING THE DRIVER'S SIDE MODULE - CLOCK SPRING DEVICE

NOTE: For the illustrations not given here, refer to those given in the removal procedure.

WARNING:
Make sure that the wheels are STRAIGHT.

- If it is not necessary to change the clock spring device, assemble it, after removing the adhesive tape or clamp used previously, without turning the upper ring, then tighten the three fastening screws.

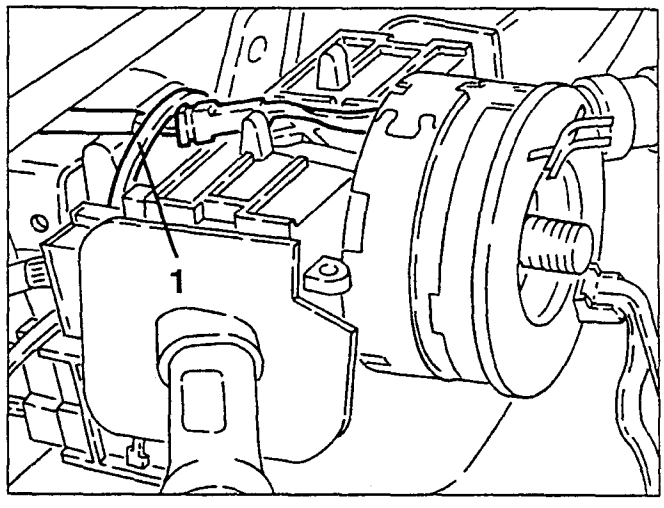
WARNING:
Should the upper ring of the clock spring device release during assembly, it is sufficient to pull it upwards until it clicks meaning that it has locked.

- When fitting a new clock spring device, after fastening it to the steering column lever unit, tear the plastic tab to lock the upper ring and check that it does not turn; if it does turn, pull the ring upwards until it clicks.

- Completely remove the red guarantee adhesive tape.

WARNING:
The failure to or incomplete removal of this tape may cause noise due to interference with the upper section of the steering column lever unit when the steering wheel is turned.

- Connect the electrical connection of the cable with the yellow sheath for connecting the Air Bag control unit to the clock spring device and check that it has coupled.
1. Fasten the above cable to the steering column using a suitable clamp.

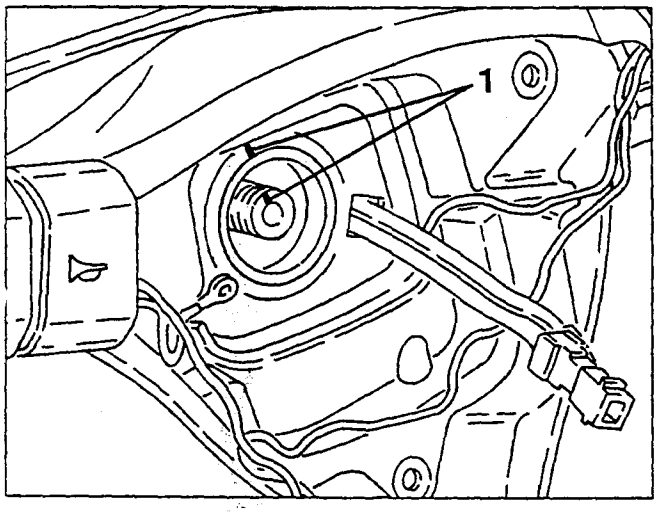


- Assemble the steering column half covers and fasten them with the special screws..

- Through the special slot on the steering wheel hub, carefully insert first the cable with the white connection for supplying the Air Bag module and then the cable with the black connection for supplying the horns.

Engage the ignition key and turn it to prevent the steering lock from engaging.
1. Turn the steering wheel to make the references marked previously coincide.

NOTE: Before assembling the steering wheel, position the direction indicator return bushes so that the tooth on it corresponds to the special notch on the steering wheel.



- Push the steering wheel in the taper housing; it will automatically lock the upper ring of the clock spring device.
- Tighten the steering wheel fastening nut to the specified torque.
- Connect the electrical connection for supplying the horns.

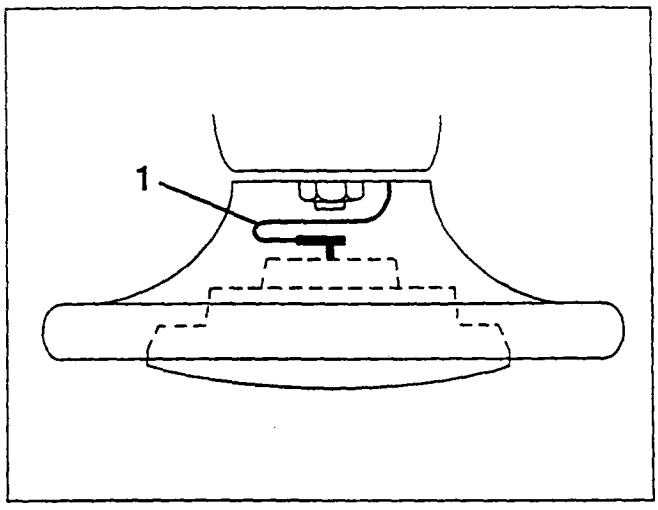
NOTE: Pass horn cable in the special notches on the edges of the steering wheel to avoid any interferences.

- Reconnect the battery terminals, on the white Air Bag module supply connector, assemble the electrical resistance (2 Ohm), supplied with the Alfa Tester, then using the Tester check that the system is working properly.
- After testing, disconnect the electrical resistance, remove the battery terminals and wait for 10 minutes.

1. Connect the electrical connection to the Air Bag module, then assemble it in its housing checking that the cable follows the routing illustrated.

WARNING:
Before making the electrical connection of the Air Bag the ignition keey must be in the OFF position.

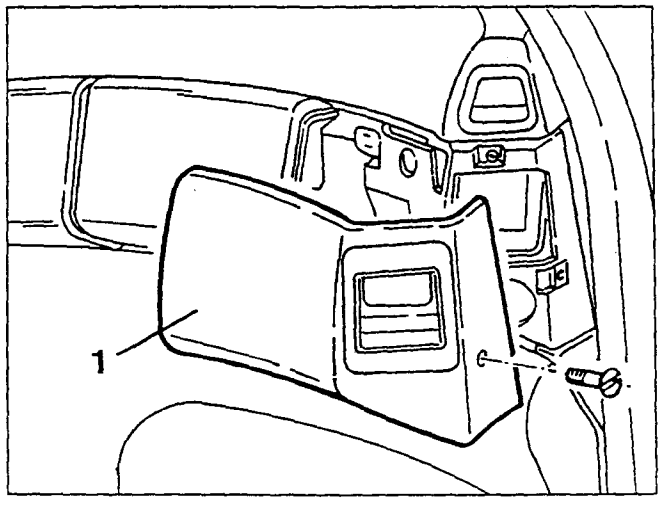
- Fasten the Air Bag module tightening the three fastening screws



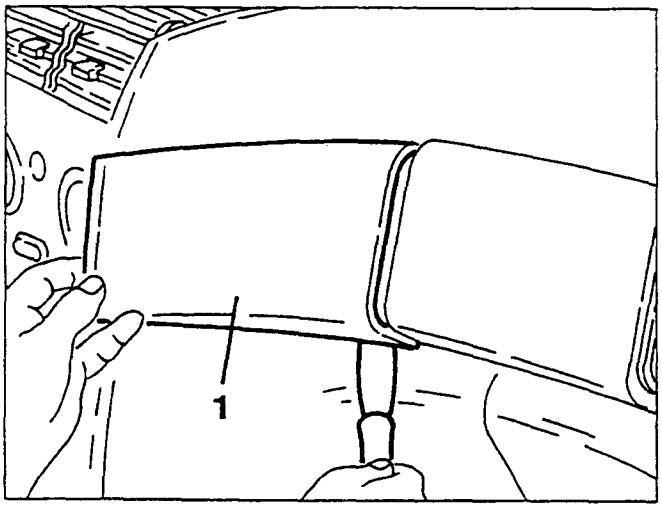
REMOVING/REFITTING THE PASSENGER'S SIDE MODULE

Work on components of the Air Bag must be carried out by suitably trained personnel, CLOSELY adhering to the safety instructions given below.
• For removal or replacement operations polyethylene gloves and protective goggles must be used.
• Before removing the Air Bag device, disconnect the battery terminals, suitably isolate them and wait for 10 minutes.
• Do not use naked flames in the vicinity of the Air Bag and other components of the system.
• Single damaged or faulty components must not be repaired or tampered with, they must be changed wholly.
For further explanations on the safety instructions see "Safety Measures" at the beginning of this chapter

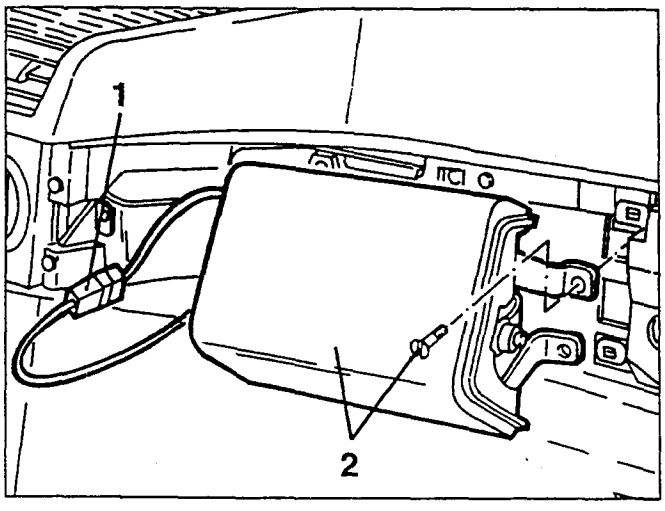
1. Slacken the fastening screw, then remove the right-hand trim.



1. Prise and remove the left-hand trim.



1. Disconnect the electrical connection of the passenger side Air Bag module.
2. Slacken the fastening screws and remove the passenger side Air Bag module.



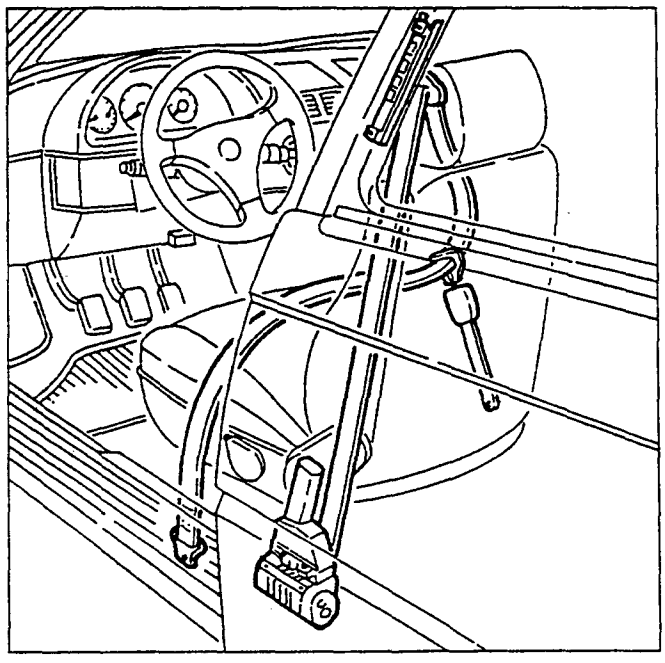
FRONT SEAT BELT PRE-TENSIONING DEVICES

DESCRIPTION

The seat belt pre-tensioners are devices which are integrated in the rewinding mechanisms and which, during an impact, take up the slack caused by the weight of the wearer so that he or she is pressed firmly against the back of the seat. A second device makes it possible to activate the pretensioner only when the seat belt is fastened. Knocks (other than those caused by irregularities in the road surface of bumping over kerb stones etc.), vibration or heat applied to the pre-tensioners may cause their activation.
Seat belt pre-tensioners are pyrotechnical devices which are commanded mechanically to intervene during impact, to take up the slack in the seat belt caused by the pressure of the wearer's body.

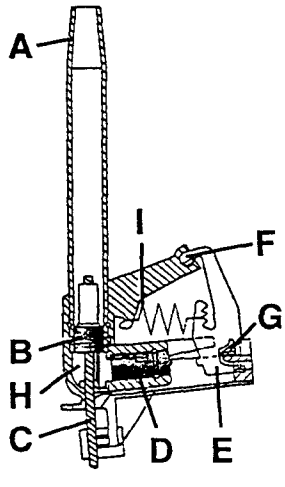
The seat belts must adhere as closely as possible to the wearer in roder to gradually absorb the kinetic energy to which he is subject during impact.
The main reasons for which the seat belts may not always press the wearer towards the seat back during an impact are mainly due to:
- a delay in the intervention of the inertial locking device;
- stretching of the fibers in the seat belt;
- spooling effect;
- clothes of a certain thickness which create an excessive space between the belt and the thorax.

Combining all these causes it can easily be seen that the seat belt may only become effective as a restraining device after the wearer has moved some distance forwards.

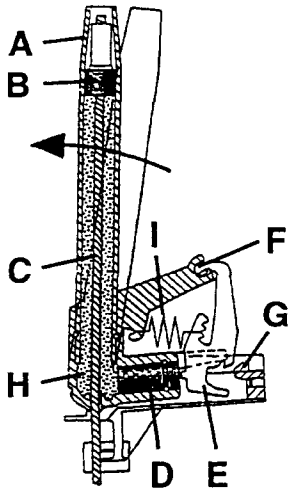


PRINCIPLES OF OPERATION

The operation of these devices is based on the inertia force which arises during deceleration on the vehicle in relation to the mass of the cylinder-piston assembly.
Lever A is hinged onto the piston-cylinder assembly on pin F. When in the rest position this lever is subject to the tension exercised by spring I and locked by tooth G.
When, following impact, the force of inertial acting on the mass of the assembly A overcomes force I, the assembly rotates slightly and frees the lever E from tooth G.

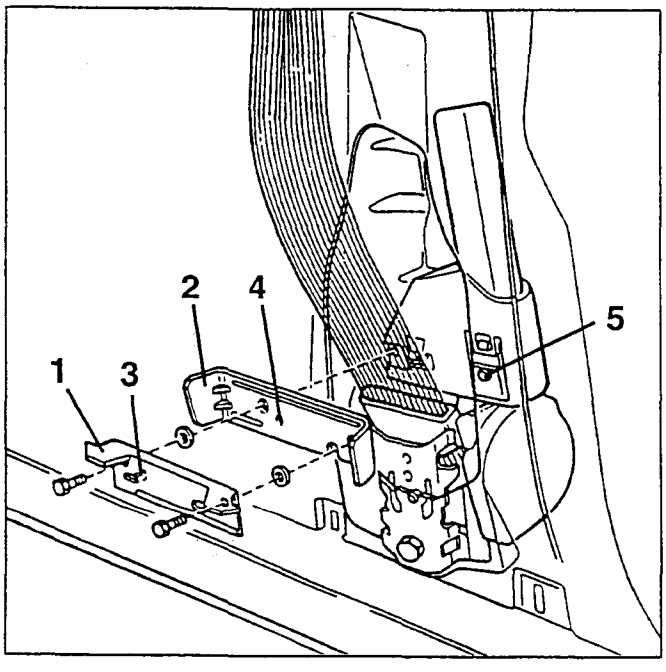


The lever, pulled by spring I acts as a percussion head to trigger charge D.
The gas freed by combustion, which is for the most part harmless nitrogen, pushes piston B along tube A. The psiton tows the steel cable C behind it shich is fixed to the other end of the seat belt rewinding device, causing it to rewind to a degree suited to the variable factors of vehicle type and speed of impact.
Following its intervention the seat belt is locked thus signalling that the device has in fact intervened.



WARNING:
The removal of the arming bracket is the only way to prevent the pyrotechnic device from being triggered accidentally.
This procedure must therefore be carried out every time mechanical or body servicing operations on the car might cause the device to be operated by accident; the arming rod must absolutely be removed to obtain the necessary security conditions *before proceeding with removal* of the inertia reel - belt pretensioner unit, and also when handling and refitting.
The arming bracket must ALWAYS be refitted ONLY WITH THE INERTIA REEL - PRETENSIONER UNIT FITTED ON THE CAR, in order to prevent any harm to personnel.

To prevent the device from being triggered if an inerti reel is removed, it is fitted with a security or aming system which locks the deceleration sensor/trigger mechanism.

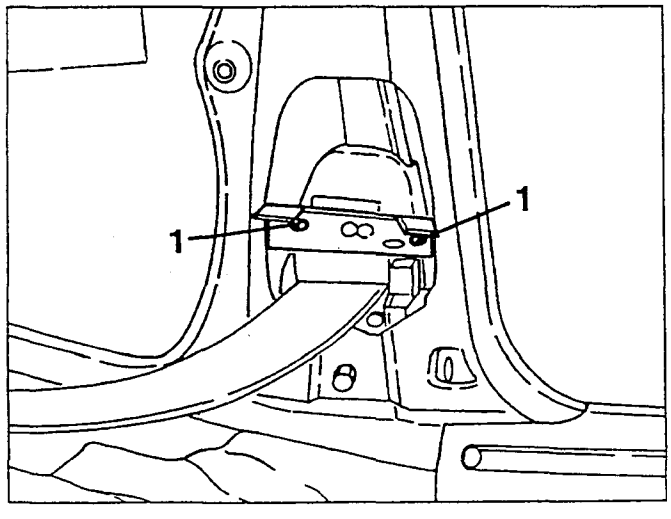


1. *Outer arming bracket*
2. *Inner bracket*
3. *Centering pin*
4. *Centering hole*
5. *Inner bracket retainer pin*

NOTE: The arming bracket comprises an inner bracket and an outer arming bracket which improve fastening the inertia real - *pretensioner unit to the pillar.*

- Remove the sill (see specific paragraph).
- Remove the side panel (see specific paragraph).
- check that the paint applied to the inertia real/pretensioner unit is instact meaning that the components have been installed correctly; check the way this paint is applied to restore the same conditions after assembly of the arming bracket.

1. Slacken the two fastening screws and remove the outer arming bracket.

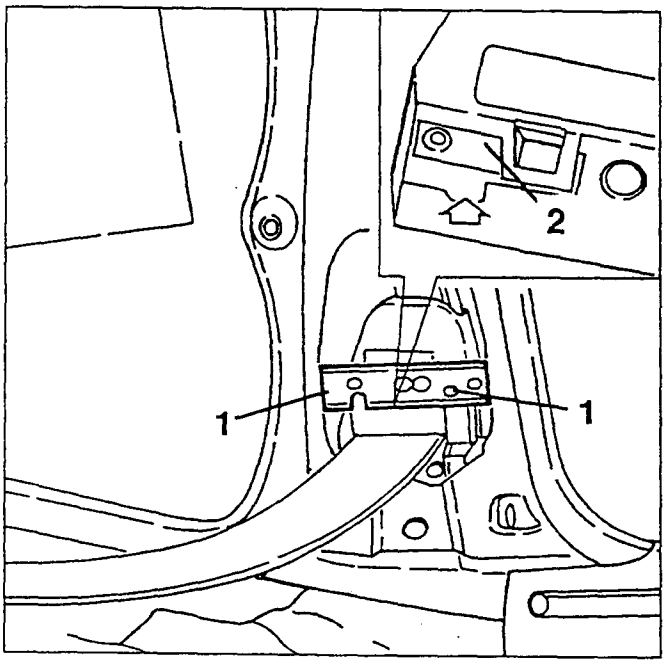


REMOVING/REFITTING ARMING BRACKET

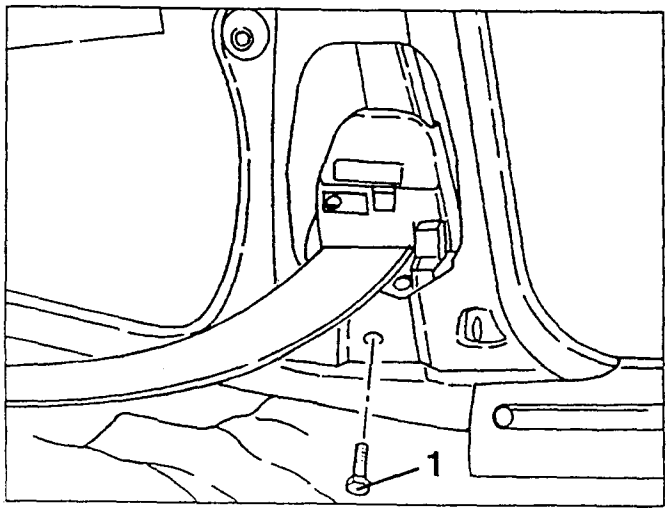
When remoing/refitting the arming bracket, the sequence given below must be strictly adhered to.

1. Separate the inner bracket from the retainer pin on the reel, then take it off the pillar.
2. Through the special window, make sure that the safety device has been engaged, checking that the spring indicated by the arrow has returned to the rest position against the pretensioner cover; if not, suspend the procedure and be very carefuyl because the device might be triggered.

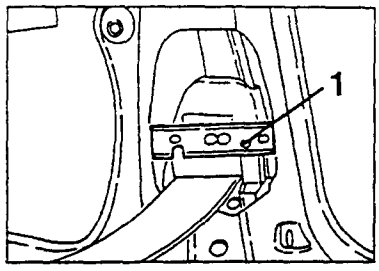
WARNING:
The operator must be suitably protected (polyethylene gloves, safety goggles and ear muffs), never go close to the device with the face and he must keep as far away as possible when carrying out the operation.

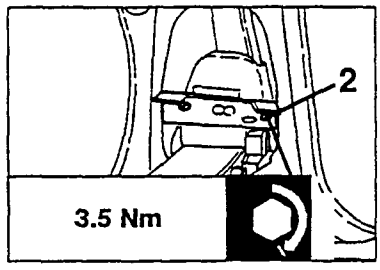


1. Slacken the screw fastening the inertial reel - pretensioner unit to the pillar.



1. Position the inner bracket in its housing in the pillar, inserting it in the retainer pin.
2. Working from outside the pillar, couple the arming bracket on the inner bracket, so that the centering pin is correctly inserted on the corresponding hole, then tighten the outer arming bracket fastening screws to the specified torque.





WARNING:
Never use percussion screwdrivers.

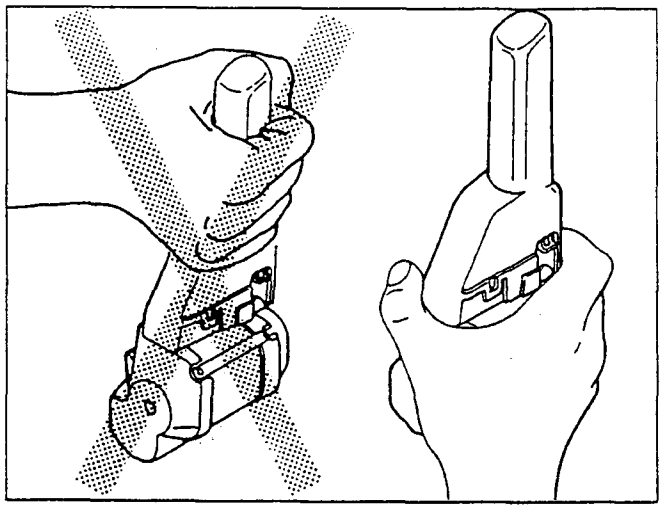
- Tighten the screw fastening the inertia reel - pretensioner unit slackened previously to the specified torque of 34 to 42 Nm (3.5 to 4.3 kgm).
- Restore the original seal conditions of the inertia reel - pretensioner unit, suitably painting the areas concerned to warrant that the device is intact and correctly assembled.
- Complete refitting operations reversing the sequence followed for removal.

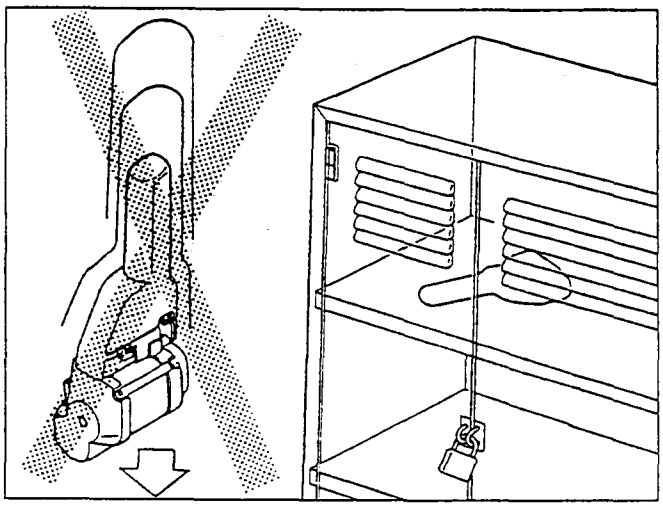
SAFETY RULES TO BE FOLLOWED FOR SAFETY BELTS WITH PRETENSIONERS

WARNING:
The following rules must ABSOLUTELY be adhered to for the safety of operators, the integrity of the belt unit with pretensioner and in observance of the law explosives.

- When handling a safety belt unit with pretensioner, hold it as shown in the figure.
- NEVER hold the unit by the lever.
- ALWAYS remove the arming lever before dis-assembly.
- Never drop the unit or subject it to shocks.
- When operations on the car require its temporary removal, the unit should be stored in a key-lockable metal cabinet as required by law.

- Do not carry out repairs on the pretensioner, apply only to the Service Network for its replacement.

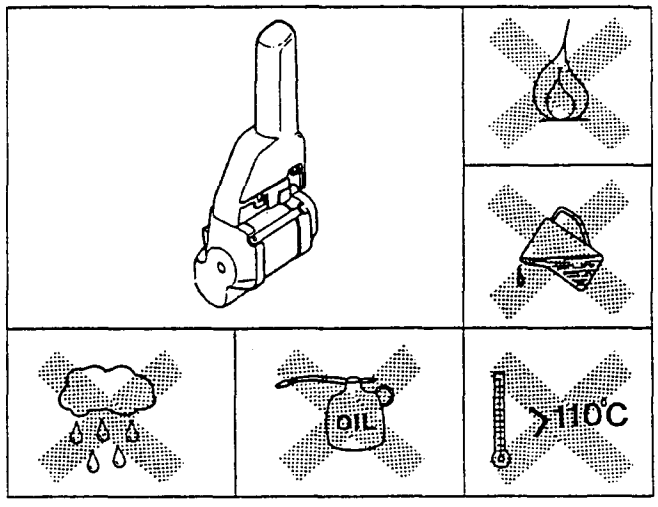




WARNING:
The pretensioner requires no maintenance whatsoever and must absolutely never be lubricated.
Any attempt to change its original conditions will invalidate its efficiency.

- Never allow naked flames, fluids, solvents or lubricants near the device.
- Do not expose it to temperatures above 110°C.
- When needing to handle a device that has been triggered, use polyethylene gloves and protective goggles.
- If the device has been triggered, ALWAYS wait for at least 30 minutes from activation before doing any type of work on it.
- Wash your hands with soap and water after handling the device.

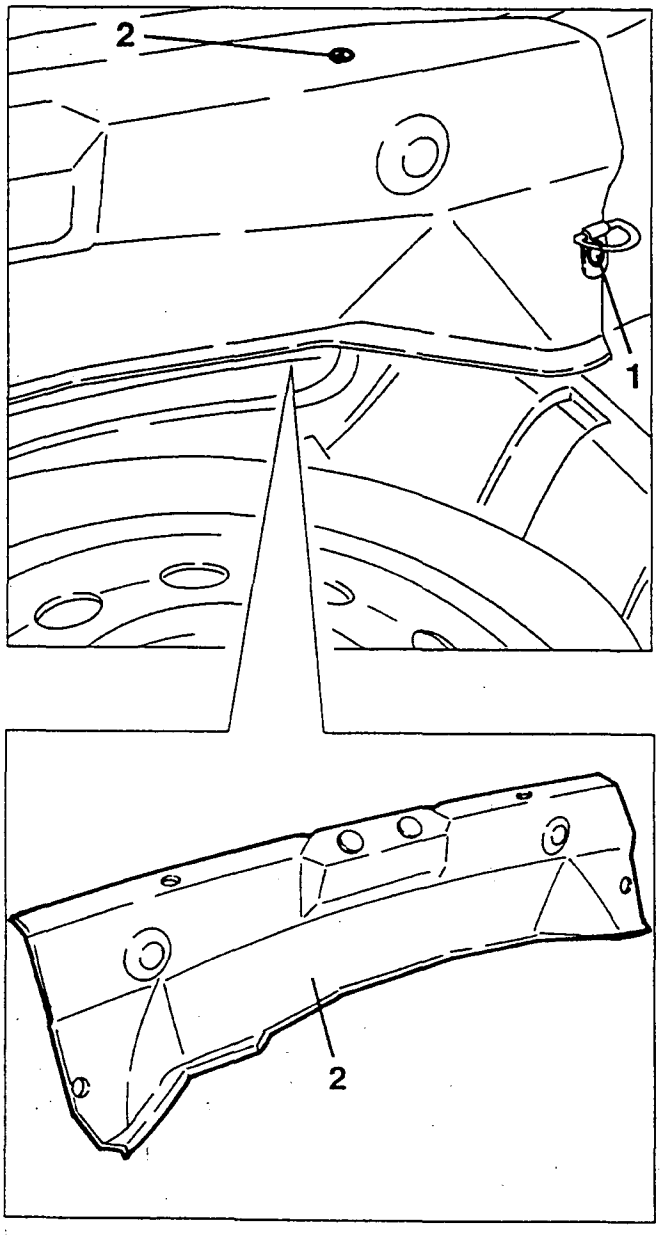
WARNING:
If due to exceptional events (floods, sea storms, etc.) water and mud reach such a level as to involve the components of the device, it must absolutely be replaced.



LUGGAGE GUARD

REMOVING/REFITTING

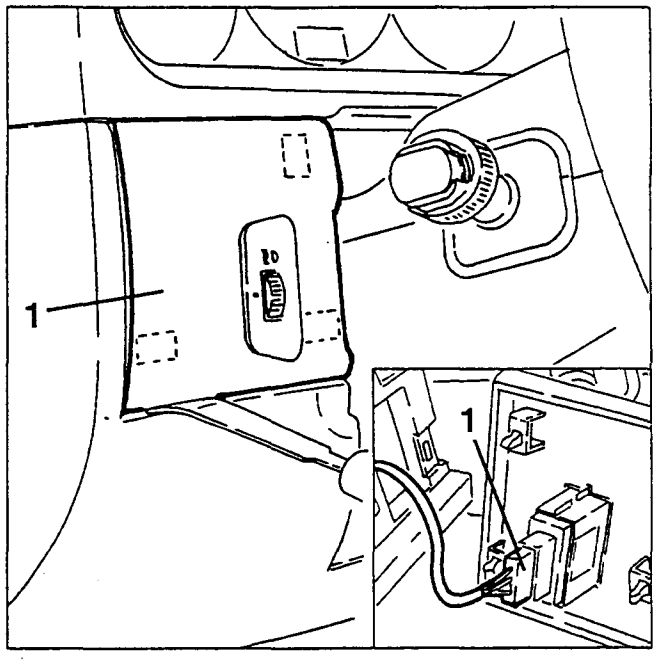
1. Working from the luggage compartment, prise the two plastic rivets fastening the lugggage check strap.
2. Slacken the two fastening screws and remove the luggage guard.



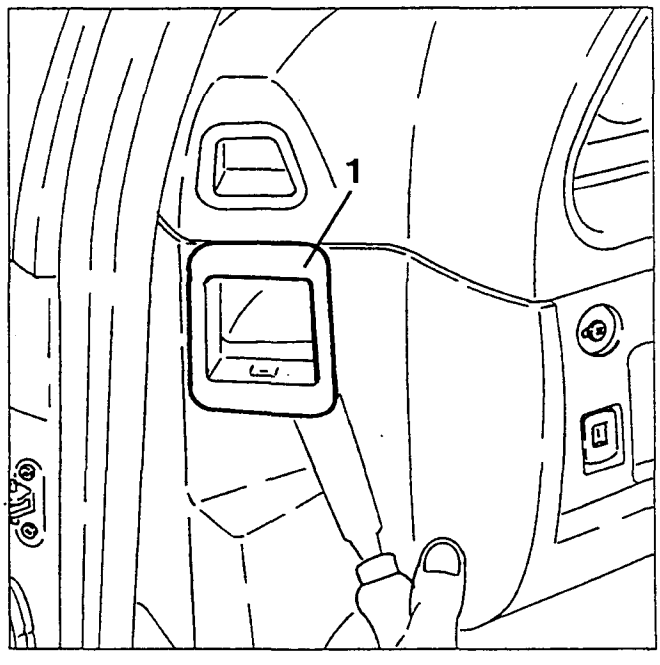
FUSEBOX COVER TRIM

REMOVING/REFITTING

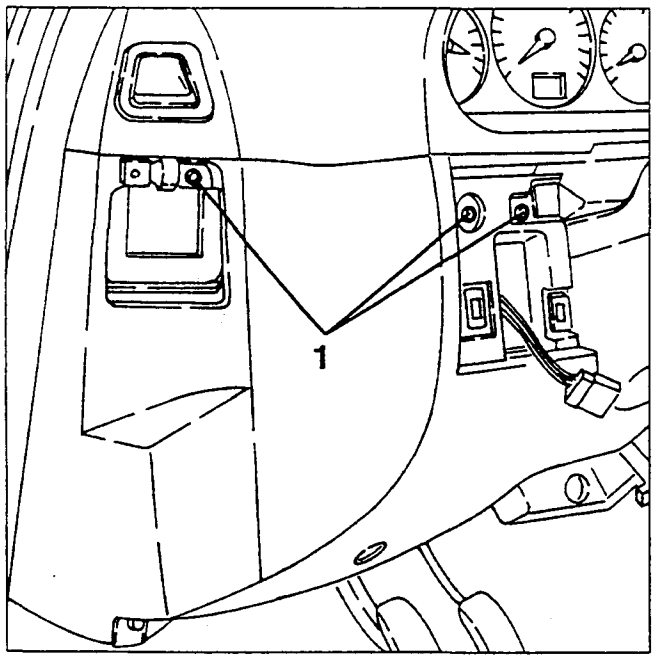
- Disconnect the battery (-) terminal.
1. Prise the dashboard left hand trim and move it back just enough to disconnect the electrical connection from the headlamp aiming device switch, then remove it.



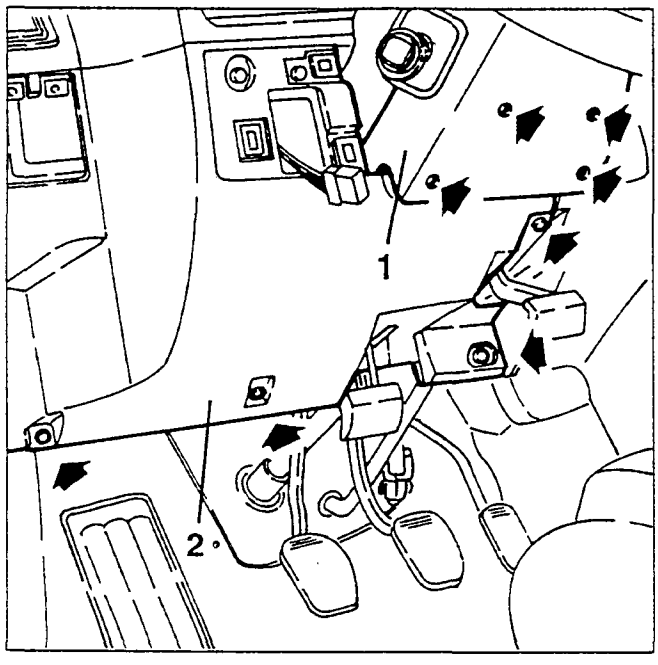
1. Remove the air delivery vent to the driver's door from the dashboard.



1. Slacken the three upper screws fastening the fuse-box cover trim.



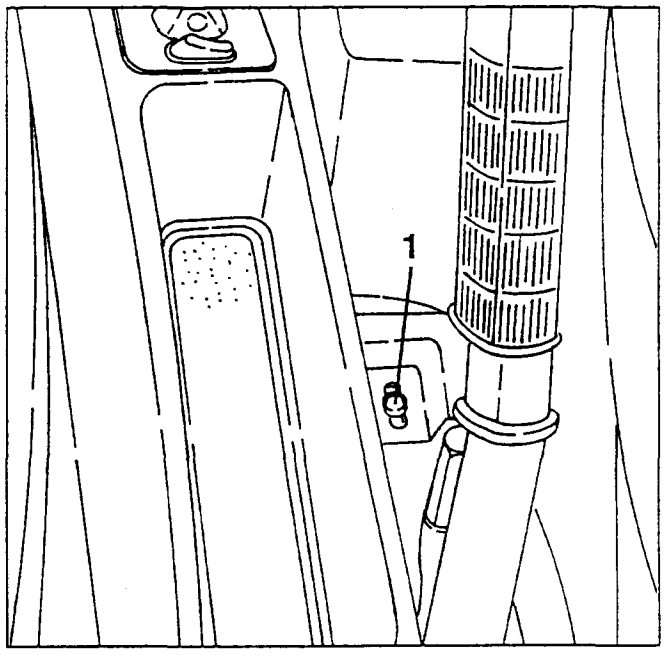
1. Slacken the four fastening screws and remove the steering column lower half box.
2. Slacken the four lower screws fastening the fuse-box cover trim and remove it.



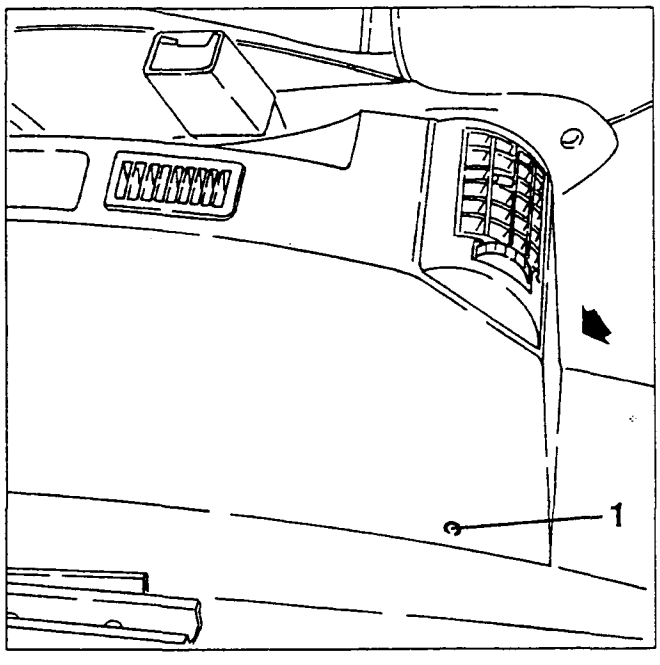
CENTRE CONSOLE

REMOVING/REFITTING

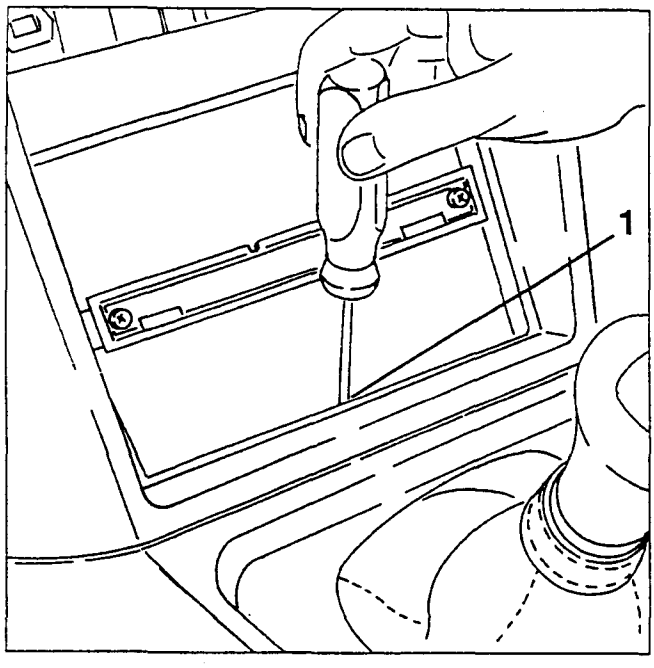
- Disconnect the battery (-) terminal.
1. Remove the protective cover from the handbrake lever, then slacken the screw below fastening the centre console.



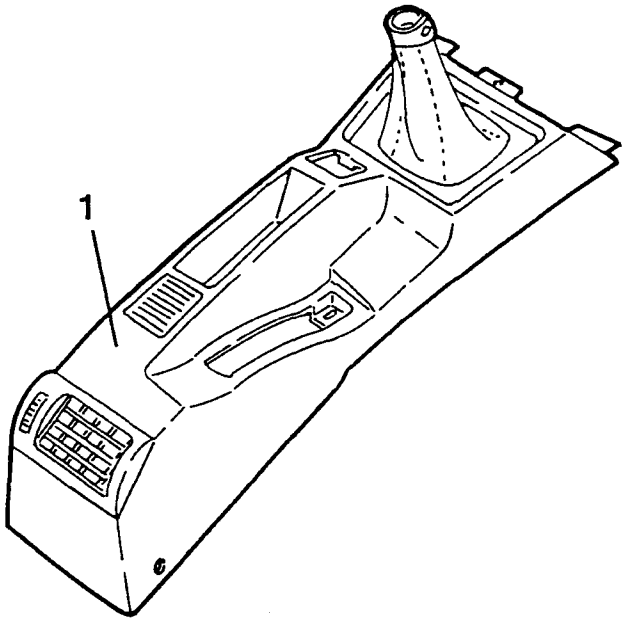
1. Slacken the two rear screws fastening the centre console.



1. Remove the glovebox from the lower part of the dashboard and slacken the centre console front screw.



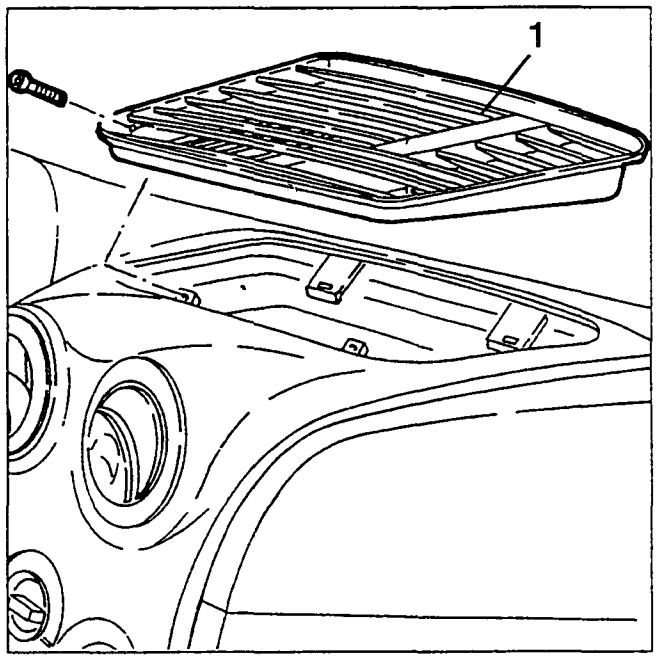
- Remove the wing mirror adjustment switch from the centre console, then remove it after disconnecting the associated electrical connection.
1. Release the gearshift lever from its protective cover and remove the centre console.



AIR VENT ON DASHBOARD

REMOVING/REFITTING

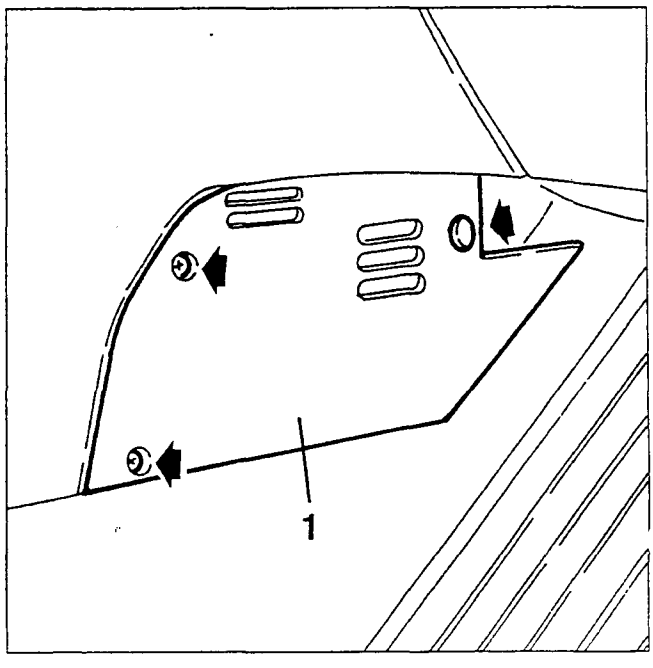
1. Slacken the two fastening screws, then prise and remove the air vent from the dashboard.



FOOT LEVEL AIR VENT TRIMS

REMOVING/REFITTING

1. Slacken the two fastening screws, prise the plastic rivet, then remove the foot level air vent trims.

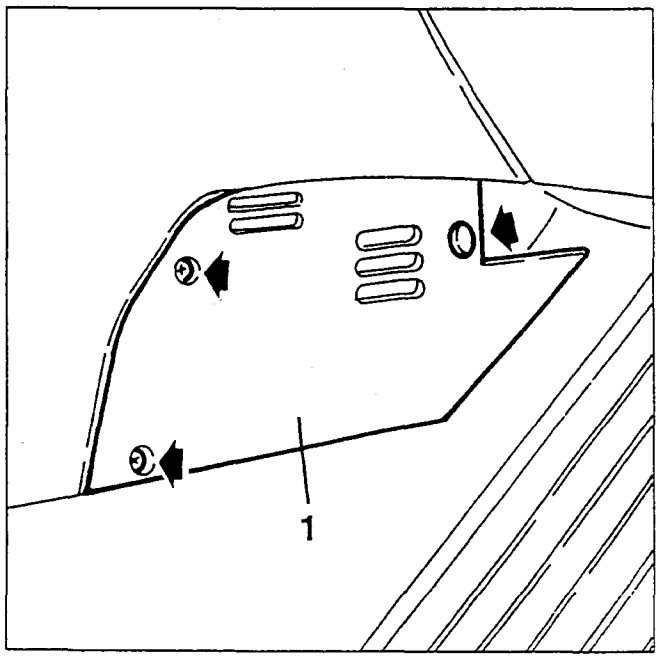


DASHBOARD

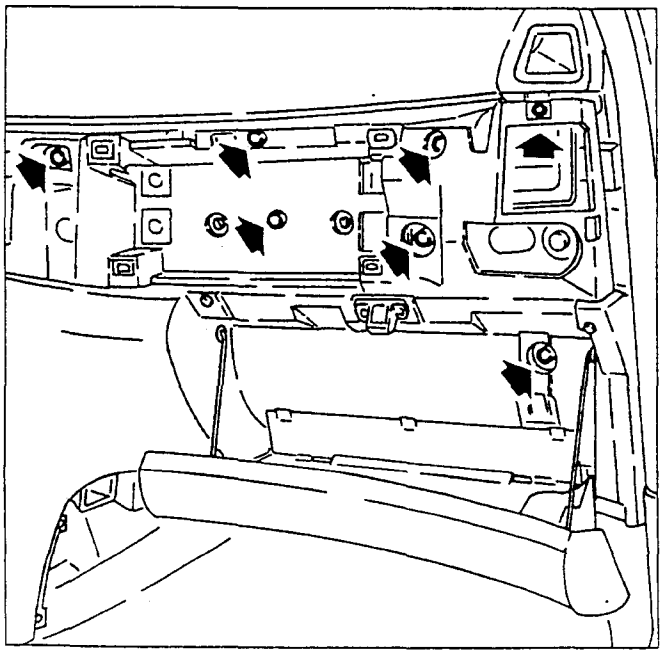
REMOVING/REFITTING

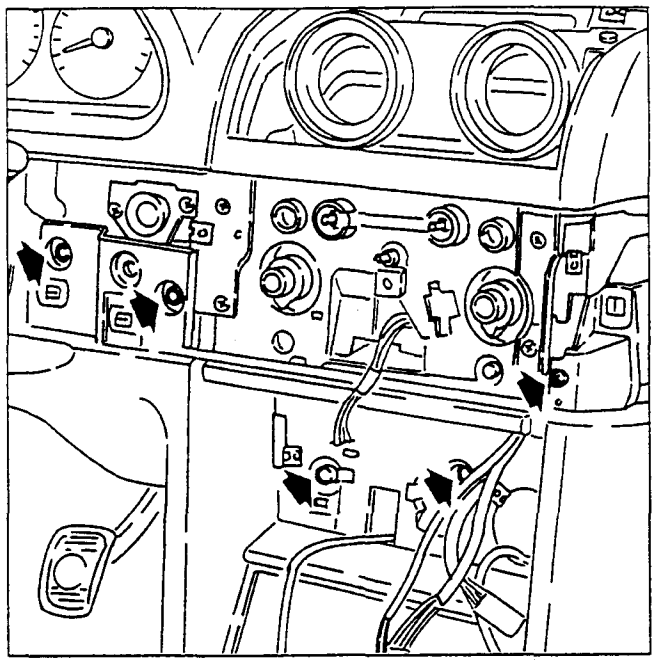
- Disconnect the battery (-) terminal.
- Remove the centre console (see specific paragraph).
- Remove the fusebox cover trim (see specific paragraph).
- Remove the climate control system controls module (see GROUP 50).

1. Slacken the two fastening screws, prise the plastic rivet, then remove the foot level air vent trims.

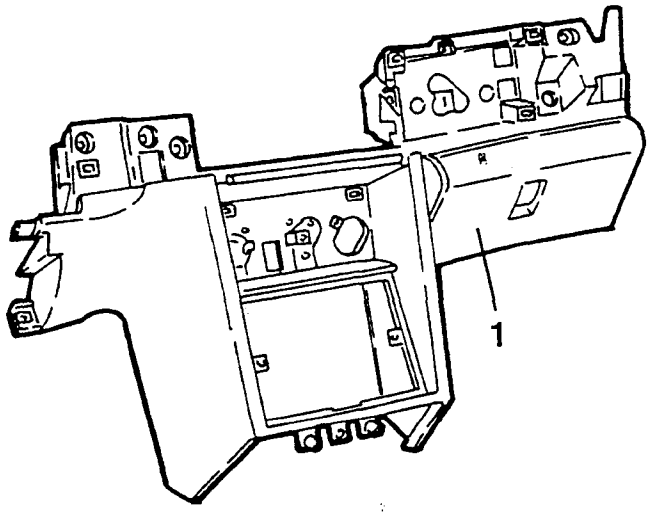


- Slacken the screws fastening the lower part of the dashboard.





1. Remove the lower part of the dashboard.



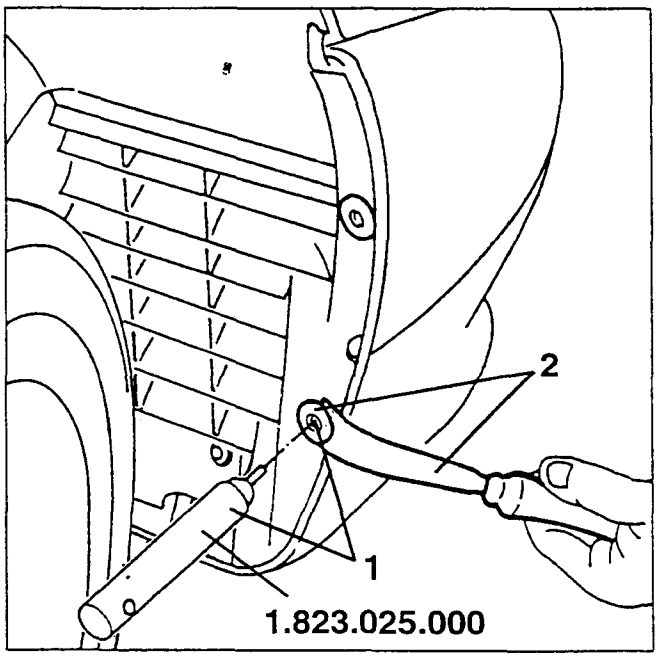
Complete removal of the dashboard (upper part), proceeding as described in the procedure "DASHBOARD - Removing/Refitting" for the previous versions.

FRONT BUMPER

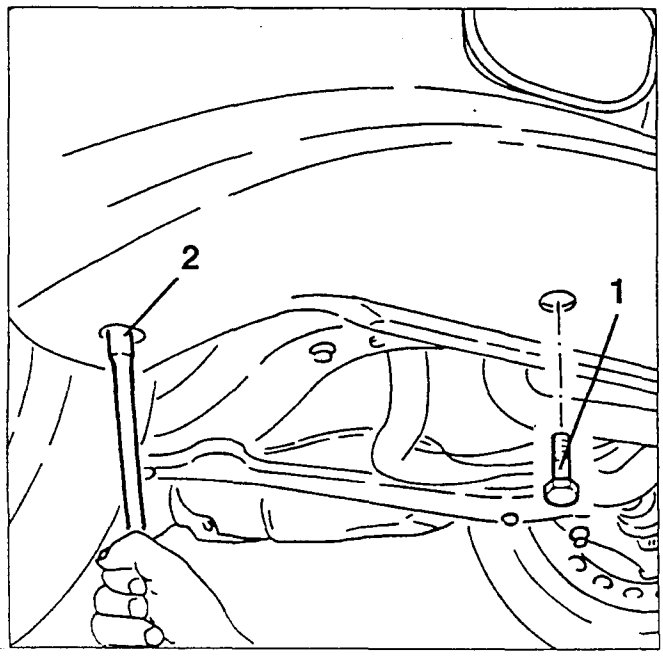
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Remove the radiator grille (see specific paragraph).

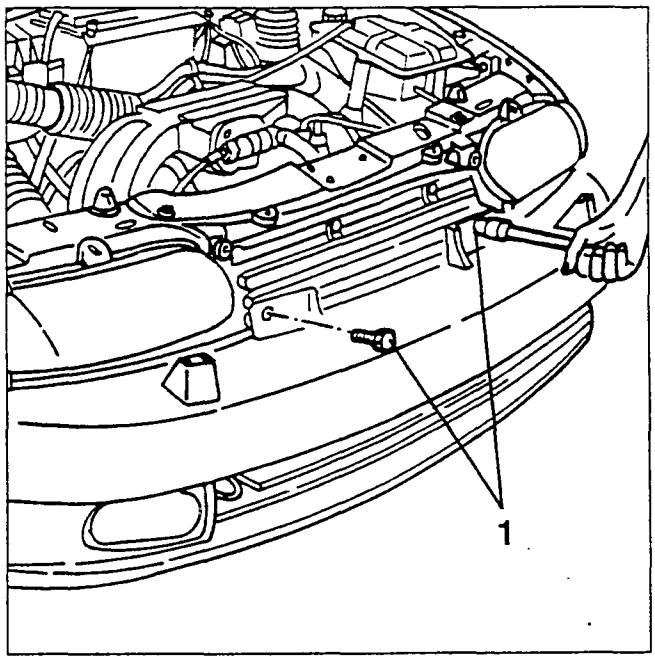
1. Using tool no. 1.823.025.000 release the catches of the centre part from the plastic rivets fastening the side bumper to the gravel guard.
2. Remove the above-mentioned rivets using the special tool.



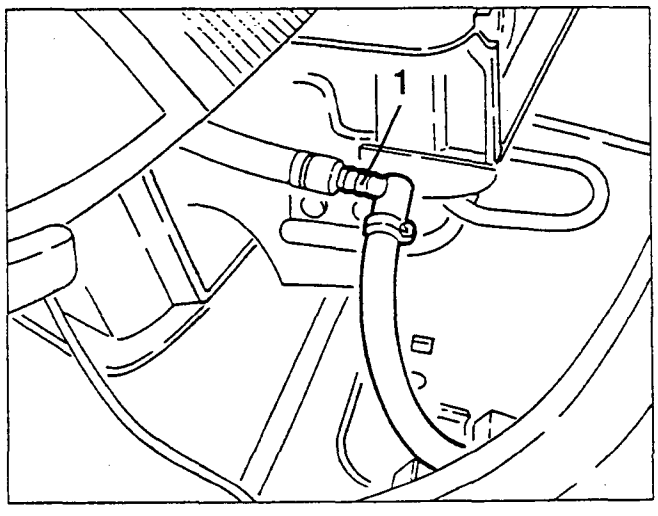
1. Slacken the two lower fastening screws illustrated.
2. Slacken the two lower bumper fastening screws illustrated.



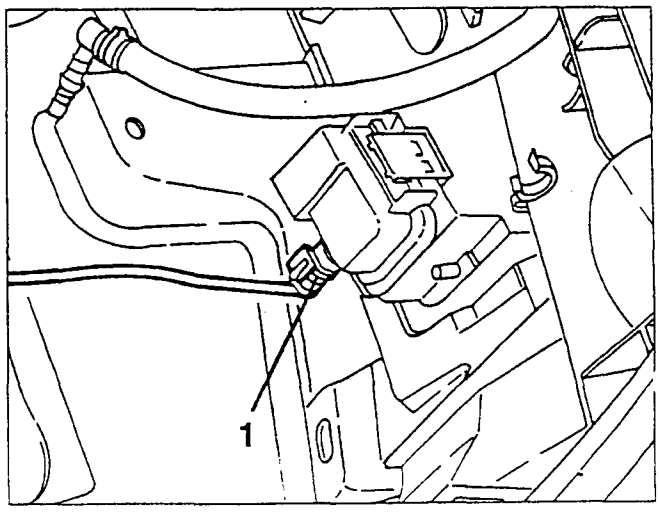
1. Slacken the two upper bumper fastening screws.



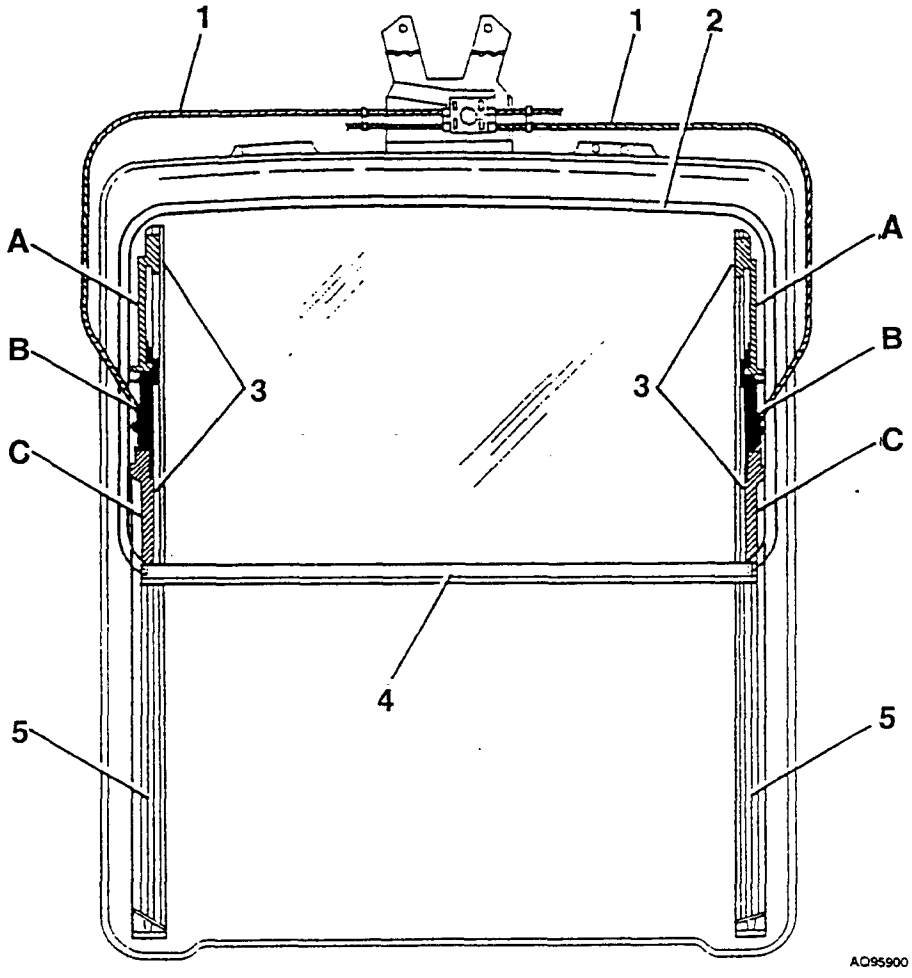
1. Move away the bumper just enough to disconnect the headlamp washer pipe connection.



1. Disconnect the electrical connections from the fog lamps.



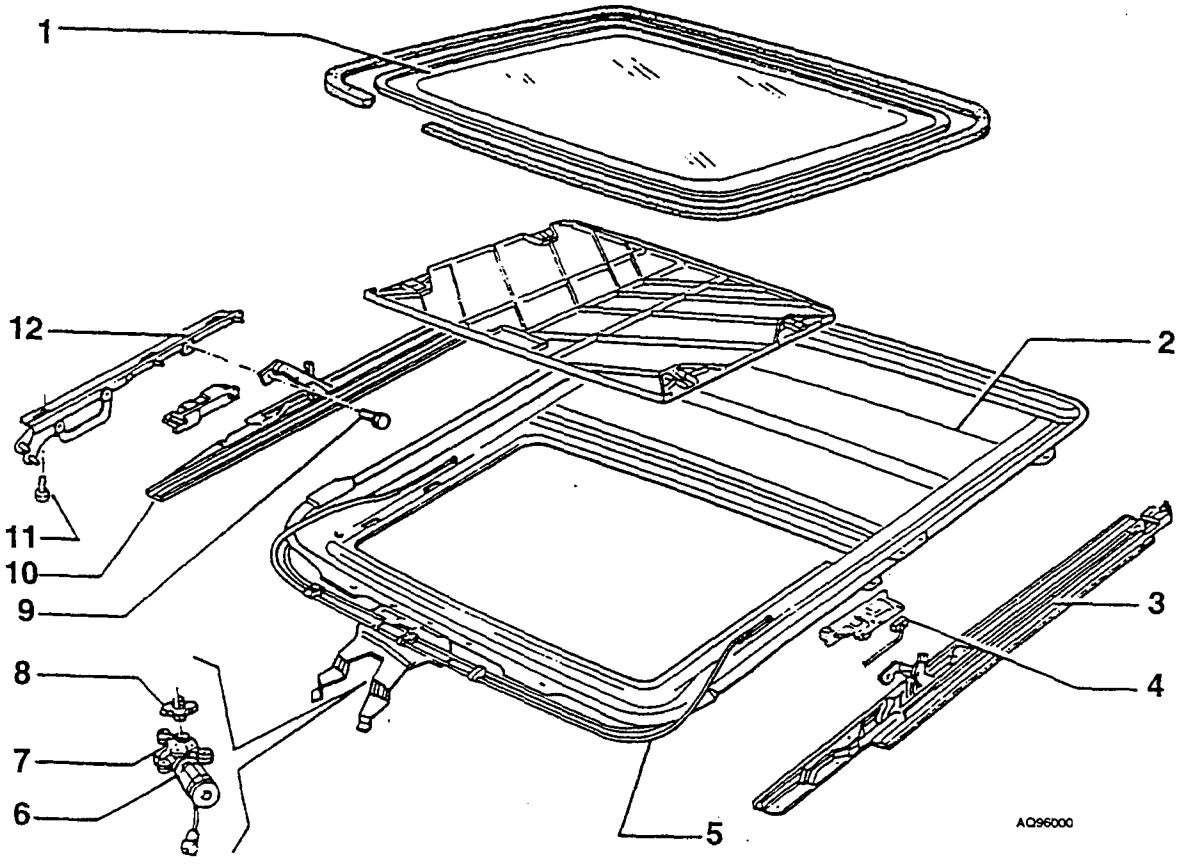
The sliding guides (5) are fastened at the two sides of the glass holder frame. Three runners are inserted in each guide: a front one (A), an intermediate one (B) and a rear one (C). The intermediate runners are connected to the flexible racks (1) and their purpose is to draw the entire kynematism; the brackets (3) carrying the sunroof are fastened to the front and rear runners; therefore, the brackets are the interconnection between runners A and C.
The rear runners cause "quarterlight" opening of the sunroof and move the mobile rib (4) during complete opening and closing.
During the latter the rib opens the sunshade, if this has been closed.



A. *Front runner*
B. *Intermediate runner*
C. *Rear runner*
1. *Flexible rack*
2. *Glass holder frame*
3. *Bracket fastening points*
4. *Mobile rib*
5. *Guide*

Location of main components

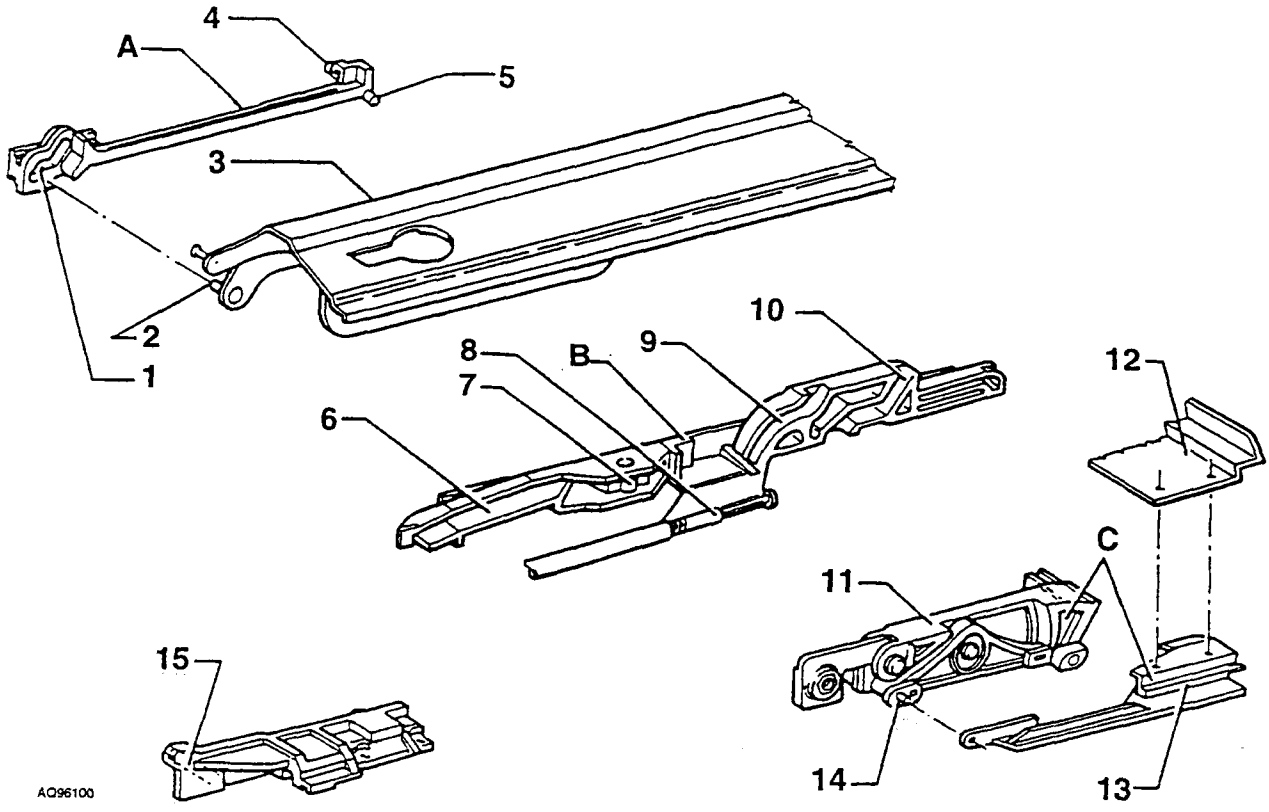
Fastened to the glass holder frame (1) there are two carrier brackets (12) which enable connection with the front and rear runners; the screws (11) fastening the brackets to the glass holder frame are those for lengthwise adjustment of the sunroof position, while the screws (9) fastening the brackets to the runners enable height adjustment.
Under the roof lining, concealed from view, we find the support frame (2) for guides (3 and 10).
The movement device mainly comprises two flexible racks (5) which pull the runners; the motion is transmitted by the motor (6) to the racks through a driving gear (7) and a gear (8) keyed onto the motion output shaft.
On the left-hand guide (3) there is the stroke limit microswitch (4) which determines the roof closed position by stopping the motor.



1. *Glass holder frame*
2. *Guides support frame*
3. *Left-hand guide*
4. *Microswitch*
5. *Flexible rack*
6. *Motor*
7. *Driving gear*
8. *Gear*
9. *Bracket/runner fastening screw*
10. *Right-hand guide*
11. *Frame bracket fastening screw*
12. *Carrier bracket*

Sunroof components

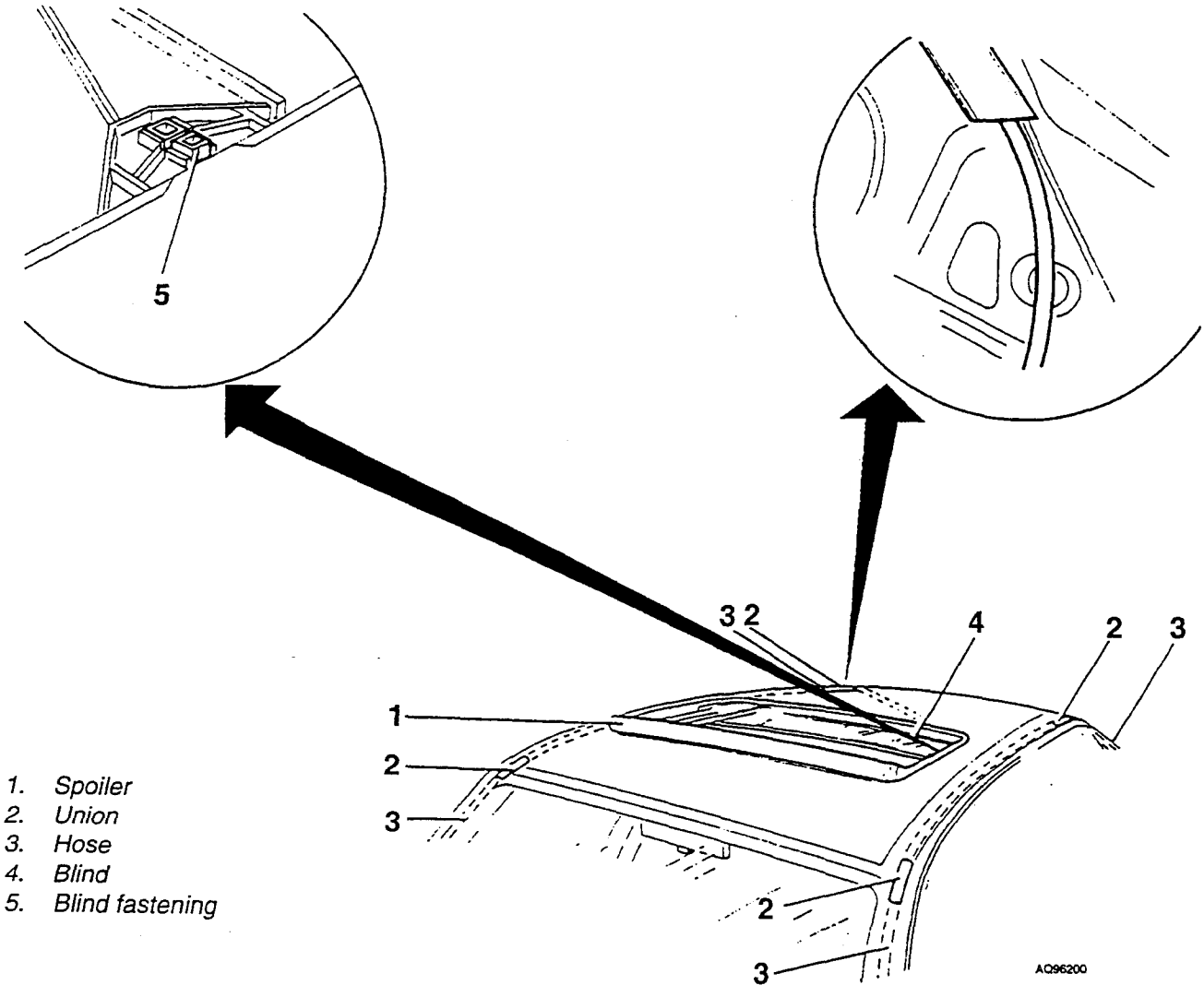
The cam (1) for connecting the carrier bracket (3) is machined on the front of the runner (A), and the puller pins (4 and 5) which run respectively in cams (6 and 15) are located on the rear.
The runner is connected to the bracket (3) by pin (2) and its movements are determined through this connection.
The end of the flexible rack (8) engages on the intermediate runner (B) which draws the complete kynematism.
The element (7) for operating the microswitch is positioned on the left centre runner.
Cams (9 and 10) are machined on the rear section of the runner. These cams determine the movement of the pantograph device (11) located on the rear runner.
The rear runner (C) comprises two components (11 and 13) which are strictly inter-connected by pin (14).
The front section (11) consists of the pantograph device which enables "quarterlight" opening of the sunroof, the rear section (13) is the support for the mobile rib (12) and it is the piece which counters the rear stroke limit.



A. Front runner
B. Intermediate runner
C. Rear runner
1. Cam on runner "A"
2. Pin connecting bracket to runner "A"
3. Carrier bracket
4. Runner "A" inner pin
5. Runner "A" outer pin
6. Runner "B" front cam
7. Reference for microswitch
8. Flexible rack
9. Pantograph front cam
10. Pantograph rear cam
11. Pantograph (Runner "C")
12. Mobile rib
13. Mobile rib support (Runner "C")
14. Connection pin
15. Microswitch support cam

Runners

The opening of the roof to the completely open position makes it possible to raise the spoiler (1) which in this position suitably diverts the flow of air.
The spoiler is kept in the lowered position by the sunroof itself when it is closed or in the "quarterlight position, while it is raised by two reaction springs coupled with two shock dampers.
Any water that drips through the glass seal is suitably drained by gutters obtained on the three fixed sides of the frame and on the mobile rib; the gutters are connected to hoses (3) bu unions (2) set at the four corners of the frame.
The hoses drain at the front and rear through the engine compartment and boot drains respectively.
The inner sun blind (4) is connected to the frame by four spring fasteners (5); these fasteners act as pads for the running in the guide formed on the frame.
When the sunroof is closed the blind can be drawn by hand.
When the sunroof is opened to the "quarterlight" position, the blind is pulled by the mobile rib into the space between the body and the roof lining.



1. *Spoiler*
2. *Union*
3. *Hose*
4. *Blind*
5. *Blind fastening*

Drenaggio

OPERATION

As mentioned previously, the possible movements of the sunroof are two closing strokes and two opening strokes, for the two "quarterlight" and completely open "concealed" conditions the device makes possible.
The following paragraphs illustrate and describe the positions of the system during the complete operating cycle, starting from the sunroof completely open position up to return to the same position through the sunroof closed and "quarterlight" open positions.

NOTA: because of the complexity of the device it is advisable to follow the description of how it works observing it directly on the car.

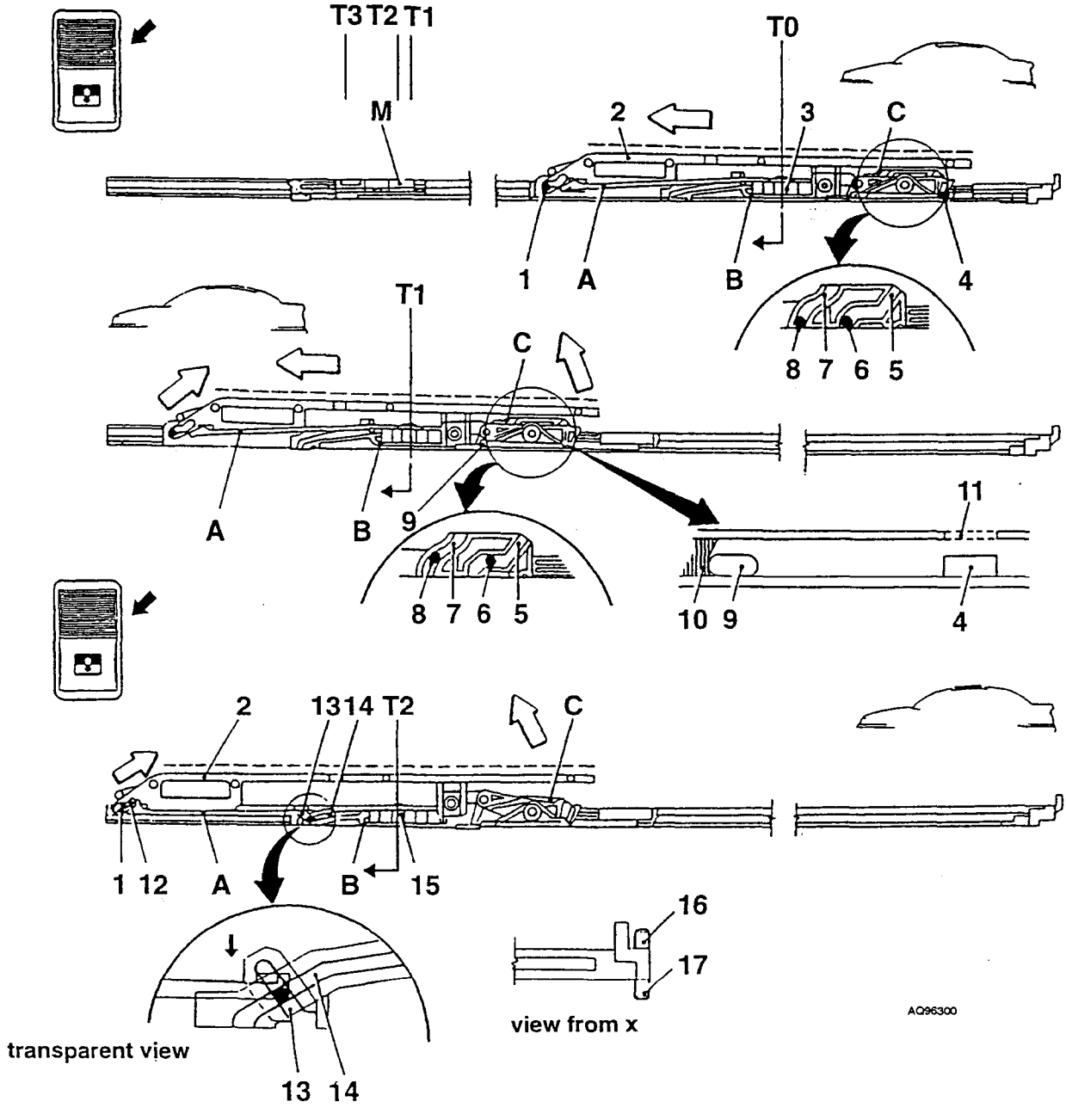
Pressing the pushbutton, the sunroof moves from the completely open "concealed" position to the closed position.

Section T0 - T1

During this phase the intermediate runner (B) moved by the rack fastened in (3) pulls the rear runner (C) via pins (6 and 8); the rear runner in turn pushes the front runner (A) by pin (1) of the carrier bracket (2).
Pins (6 and 8) do not run along the profiles of cams (5 and 7) as the counter piece (4), inserted in the guide only allows longitudinal translation of the kynematism.

Section T1 - T2

In position T1 the reference (9) of the rear runner (C) reaches its front stroke limit stopping against the stopper (10) on the guide and the counter piece (4) is in correspondence of slott (11); this way the pantograph device is released, allowing pins (6 and 8) to run respectively along the profile of cams (5 and 7).
The intermediate runner (B) moves along the guide until piece (15) sets itself on the microswitch (M), position T2, causing the motor to stop.
During this section the intermediate runner (B) which pushes the front runner (A) through the combined action of the two cams (14 and 15) on pins (16 and 17).
The motion of the front runner causes the movement of the connection pin (1) of the carrier bracket (2), along the profile of the front cam (12); the action of the pantograph device and the running along the front cam enable the raising of the sunroof which reaches the position flush with the body (roof closed).



Pressing the pushbutton again, the sunroof passes from the closed position to the "quarterlight" open position.

Section T2 - T3

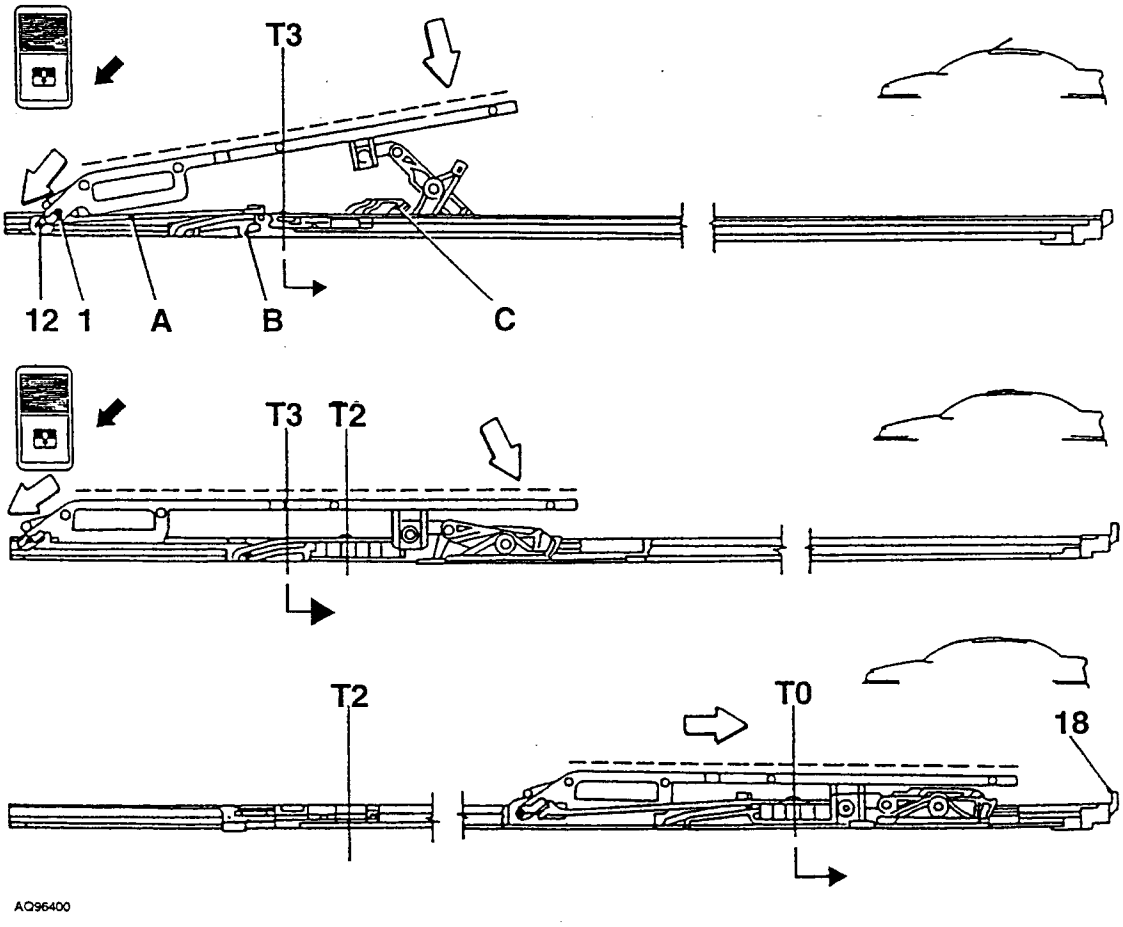
The intermediate runner (B) goes through the last section of its movement completing the raising of the pantograph.
At the front, pin (1) reaches the upper stroke limit in cam (12) of the front runner (A).
Once the pantograph stroke limite has been reached, an overcurrent relay stops the motor.
At this point, to complete the cycle it is necessary to press the pushbutton again to invert the direction of rotation of the motor.

Section T3 - T2

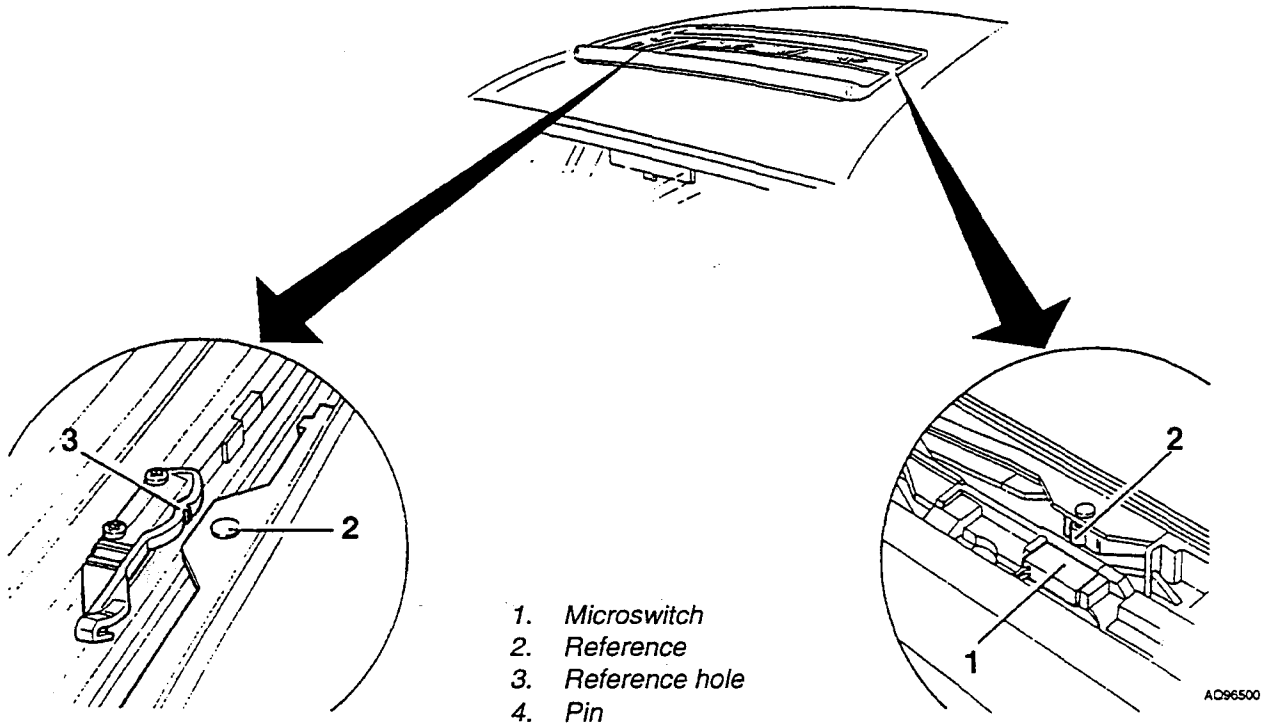
The sunroof goes back along the closing section from the "quarterlight" open position until the microswitch stops it.

Section T2 - T0

After lowering to make access possible in the space between the roof panel and the roof lining (section T2 - T1), it runs along the guides until it reaches the rear stroke limit (18), where the overcurrent relay stops the motor (sunroof completely open in the "concealed" position).



NOTA: if after servicing operations, it is necessary to adjust the coupling of the racks, the system must be positioned in a determinate point of the cycle.
The position is shown in the diagram by the correspondence of the microswitch (1) with the reference (2) for the left-hand guide, and the reference pin (4) placed on the rack locking cover with the hole (3) on the intermediate runner for the right-hand guide.
Refitting of the electric motor may begin starting from this position.



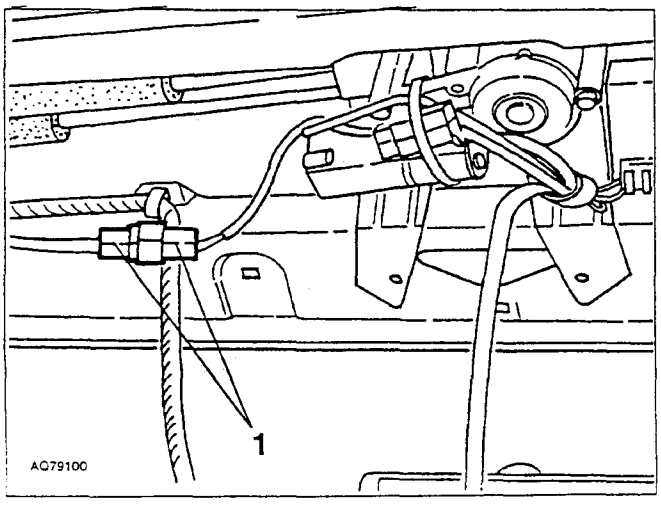
1. *Microswitch*
2. *Reference*
3. *Reference hole*
4. *Pin*

Positioning of runners

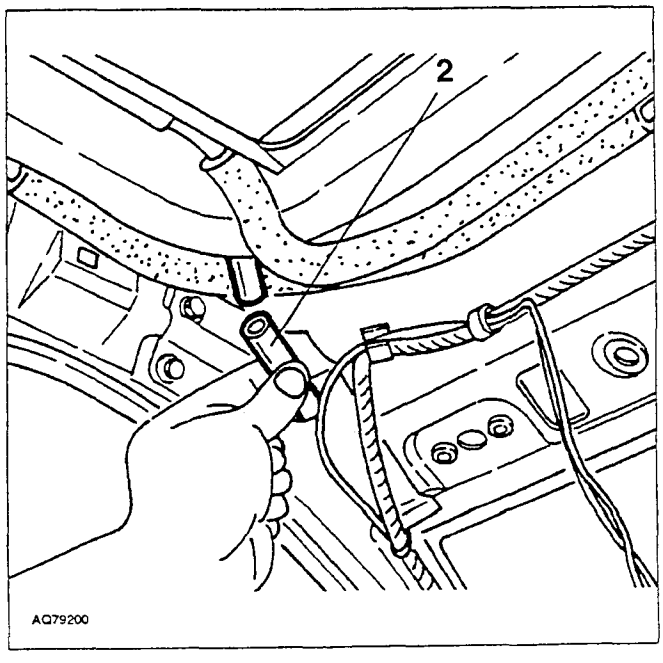
REMOVAL/REFITTING

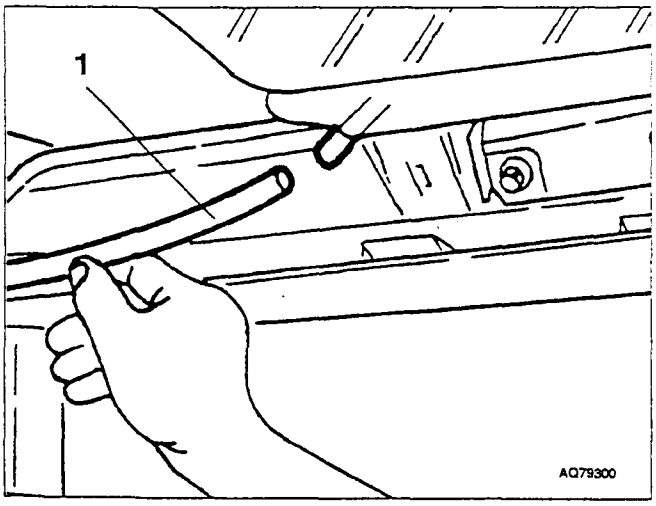
- Disconnect the battery negative pole (-).
- Remove the roof lining (see specific paragraph).

1. Disconnect the sunroof motor electrical connection.

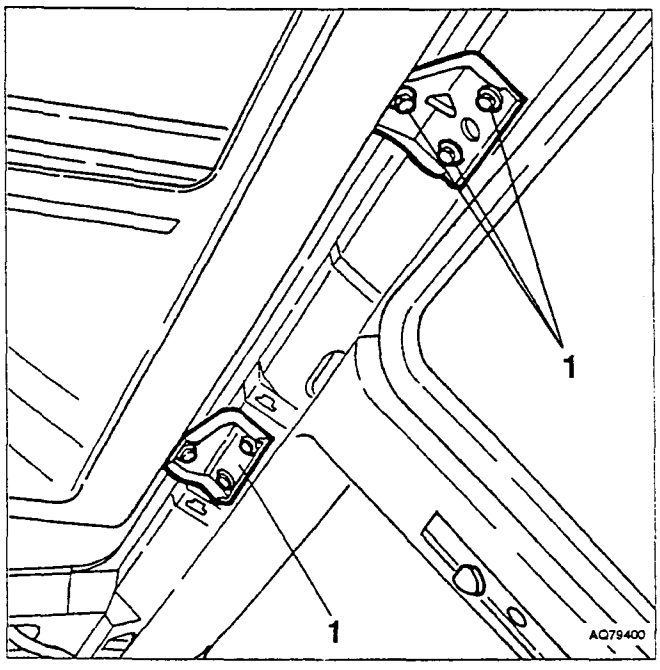


1. Disconnect the front and rear water drain pipes.

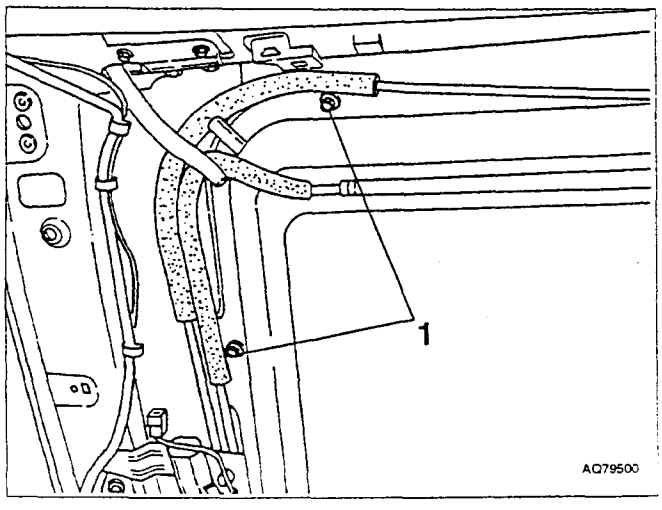


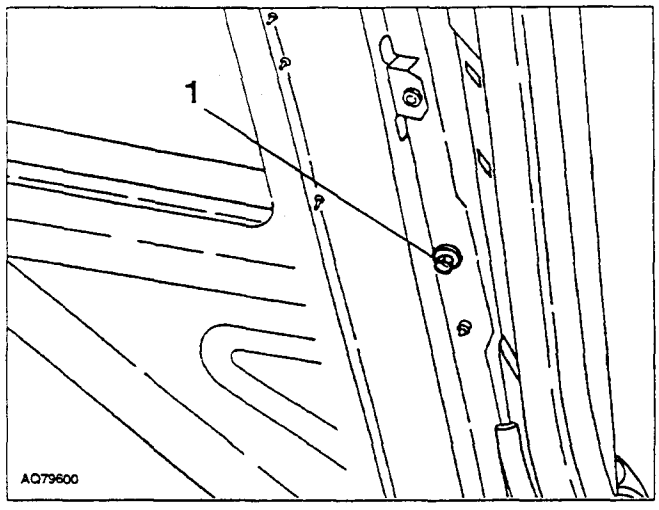


1. Slacken and remove the screws fastening the brackets to the sunroof and then remove the brackets.

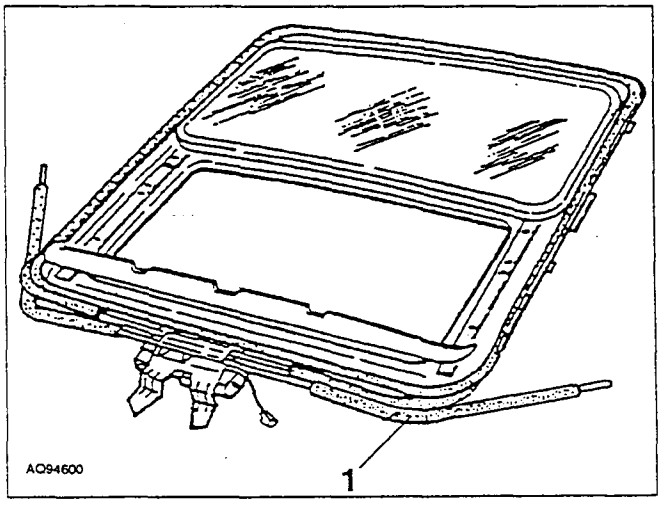


1. Slacken the six screws fastening the sunroof to the roof panel.





1. Remove the sunroof complete, withdrawing it through the front door.



When refitting the sunroof check the presence of the perimeter seals, the tubular ones on the rack guide pipes and the vibration damper caps on the centering pins; for refitting, reverse the sequence followed for removal.
After refitting, check the alignment of the roof and that it works properly.

SUNROOF ELECTRIC MOTOR

REMOVAL/REFITTING

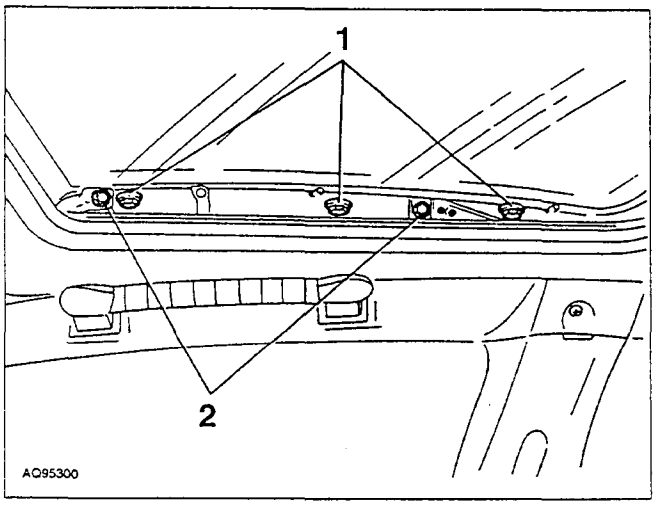
NOTA: in the event of a failure to the electric motor, the sunroof can be moved to the position required, operating the motor by hand (see: EMERGENCY MANUAL OPERATION OF THE ELECTRIC SUNROOF)

After refitting adjust the vertical and crosswise position.

ADJUSTING THE POSITION THE SUNROOF GLASS

NOTA: To adjust the position of the sunroof glass two operators are required, one operating inside the vehicle and one outside.

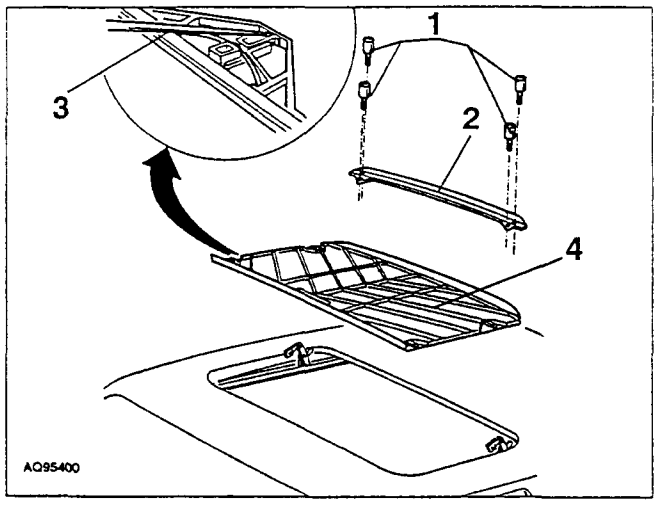
The operator on the outside centres the glass in relation to its housing on the car roof and flush with the roof surface; the operator on the inside tightens the adjustment screws.
- Open the roof to the "quarterlight" position.
- Remove the plates protecting the sliding mechanism.
- Close the roof.
1. Slacken the six crosswise adjustment nuts.
- Position the glass correctly.
- Tighten the six nuts.
2. Slacken the four vertical roof adjustment screws.
- Position the glass so that it is flush with the car roof surface.
- Tighten the four screws.



SLIDING BLIND

REMOVAL/REFITTING

- Remove the sunroof (see specific paragraph).
- Set the blind to the closed position.
1. Slacken the four rear screws fastening the rib.
2. Remove the rib.
3. Using a screwdriver release two of the four clips fastening the blind to the sunroof guides (on the same side of the vehicle).
4. Remove the sliding blind.

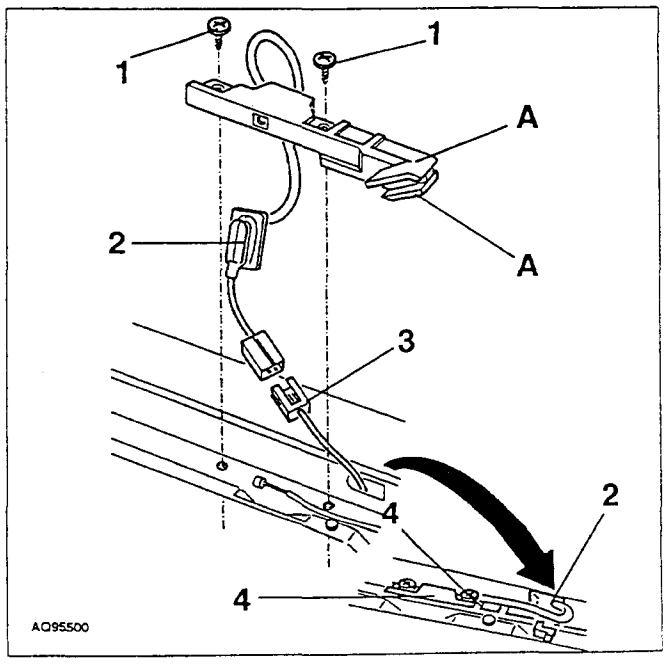


STROKE LIMIT MICROSWITCH

REMOVAL/REFITTING

- Completely open the sunroof to the "concealed" position.
- Disconnect the battery negative pole (-).
1. Slacken the two screws fastening the microswitch to the left-hand guide.
2. Remove the rubber protection from the cable fastened to the guide.
3. Withdraw the cable and disconnect the microswitch connector.
4. Remove the microswitch.

When refitting correctly position the cable so that it fits in the housing without hindering the movement of the flexible rack drawing the sunroof. Correctly couple the guide (A) on the microswitch to the pin of the sliding guide.

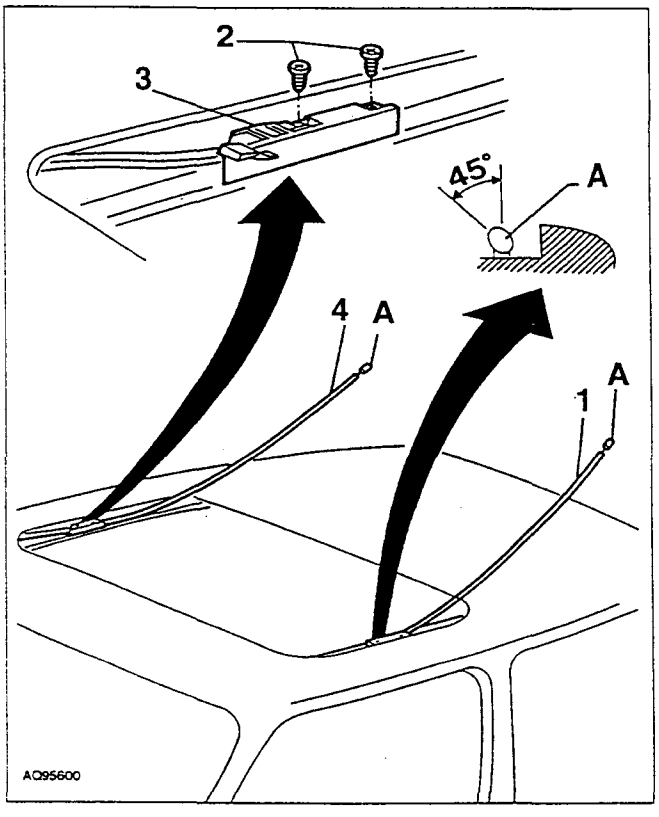


FLEXIBLE RECKS DRAWING THE SUNROOF

REMOVAL

- Remove the sunroof motor (see specific paragraph).
- Remove the sunroof (see specific paragraph).
- Remove the sliding blind (see specific paragraph).
- Remove the stroke limit microswitch (see specific paragraph).

1. Withdraw the left rack from the guide sheath.
2. Slacken the two screws fastening the rack stop plate.
3. Remove the rack stop plate from the right guide.
4. Withdraw the right rack from the guide sheath.



REFITTING

-Insert the right rack in the guide sheath.

NOTA: When the end of the rack is level with the drawing gear housing, check that it centres the second section of the guide.
Once it is completely inserted, check that the eliptical head (A) is positioned in its housing sloping 45° towards the inside of the car.

- Position the rack stop plate and fasten it with the two screws.
- Repeat the operation for the left rack, then complete refitting reversing the sequence described for removal.
- Position the control system (see specific paragraph).

POSITIONING THE SUNROOF CONTROL SYSTEM

- Move the front runner to the foremost position.
- Position the rear runner so that the pin of the safety microswitch (left guide) or the hole (right guide) coincide respectively with the switch or reference pin; this way the two guides will correspond perfectly.

GUIDES

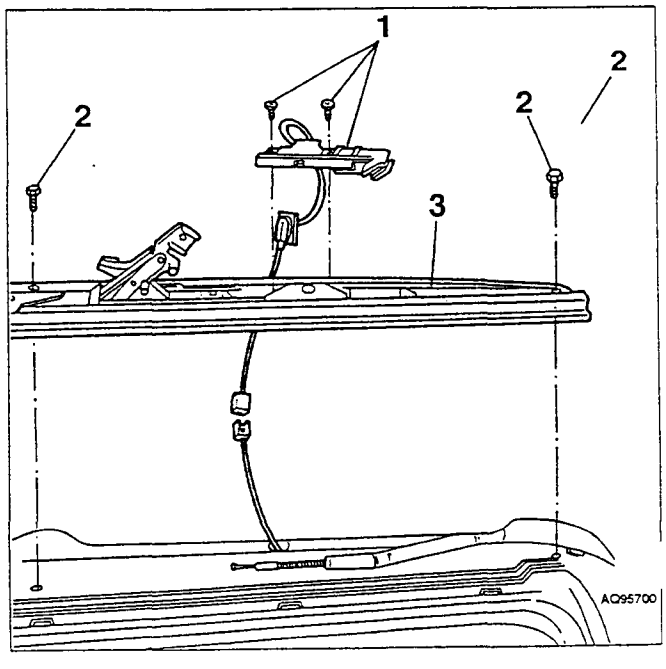
REMOVAL/REFITTING

- Disconnect the battery negative pole (-).
- Remove the sunroof glass (see specific paragraph).
- Remove the sliding blind (see specific paragraph).

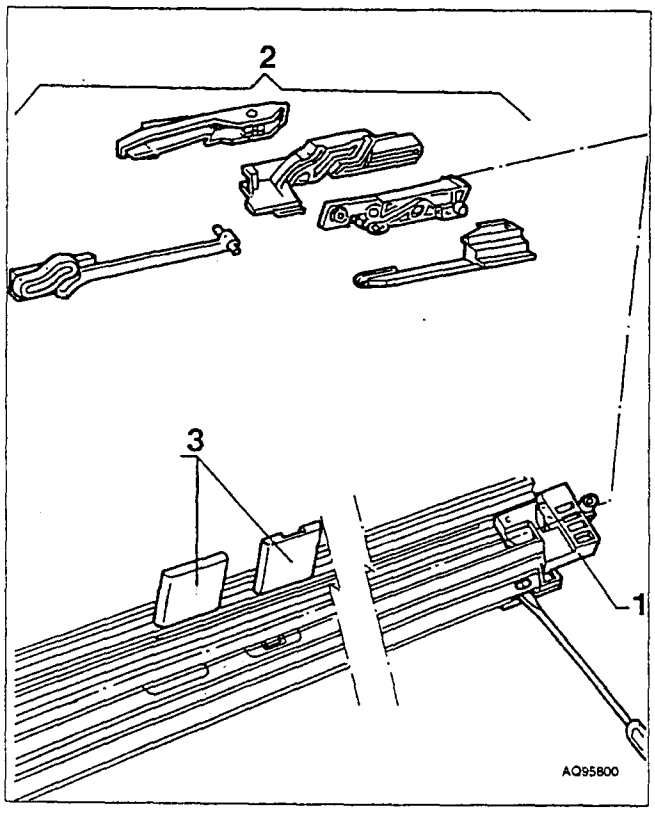
1. Slacken the two screws fastening the microswitch to the guide and remove it releasing the left rack.

- Slacken the two screws fastening the cable clamp plate.

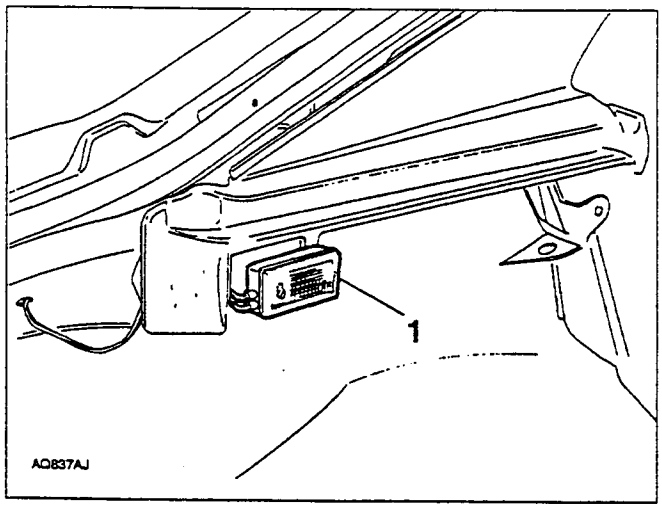
2. Slacken the four screws fastening the guide to the frame..
3. Remove the guides releasing them from the retainer clips of the centering device fastened behind the frame.



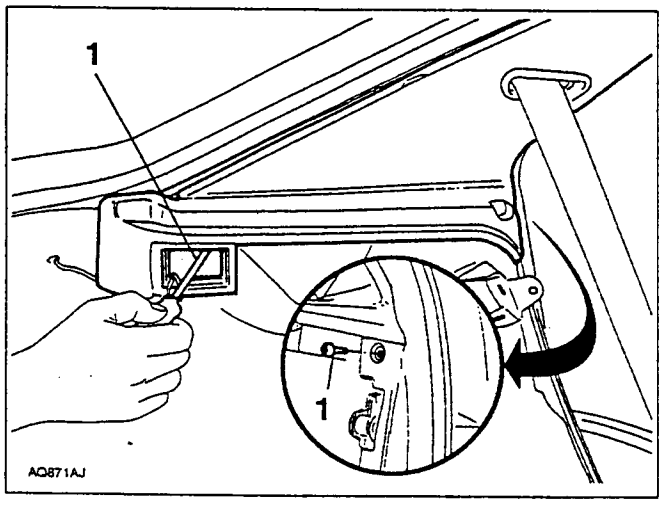
1. Using a screwdriver, lever on the rail and release the mechanical stop limit blocking the runner located on the end part of the guide.
2. Withdraw the entire quarterlight lever unit from the guide and dis-assemble it.
3. Withdraw the mechanical quarterlight references.



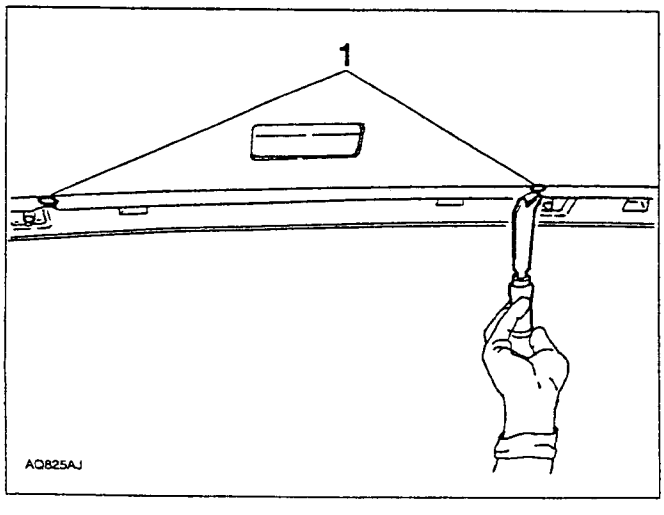
- Move the rear seat cushion forwards
1. Take the courtesy light out of its housing, then disconnect the electrical coonnections and remove it.



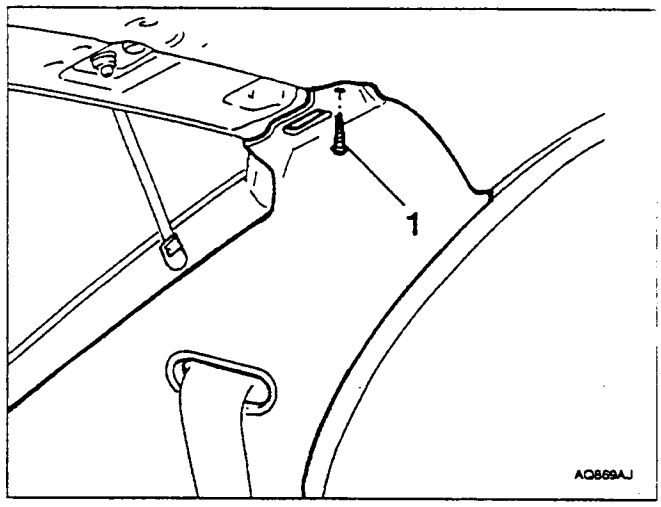
1. Slacken and remove the two lower screws and the third side screw fastening the pillar cover side bracket.



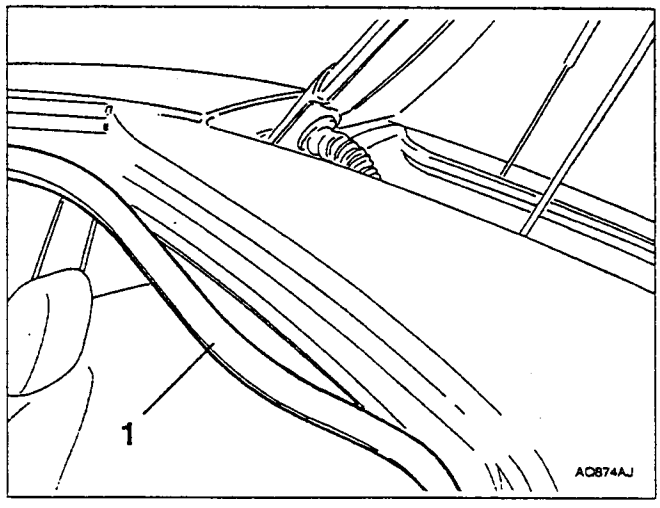
1. Using tool **1.823.014.000**, release the rear roof panel trim from the plastic nails and remove it.



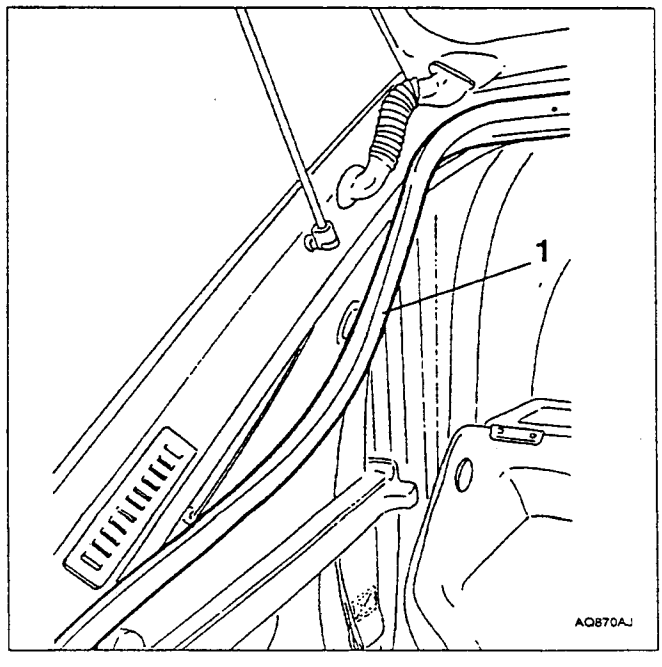
1. Slacken and remove the upper screws fastening the pillar cover bracket.



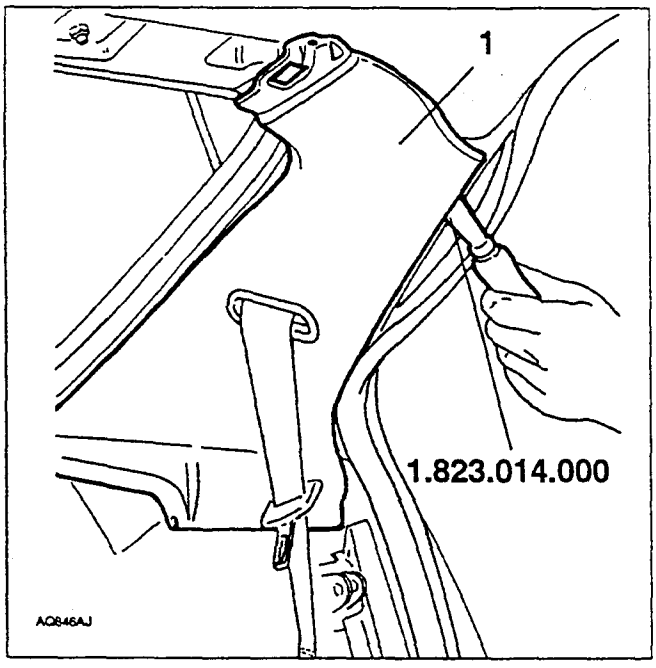
1. Partially remove the door seal.



1. Partially remove the tailgate seal.



1. Using tool **1.823.014.000** release the pillar cover bracket and remove it withdrawing the safety belt.

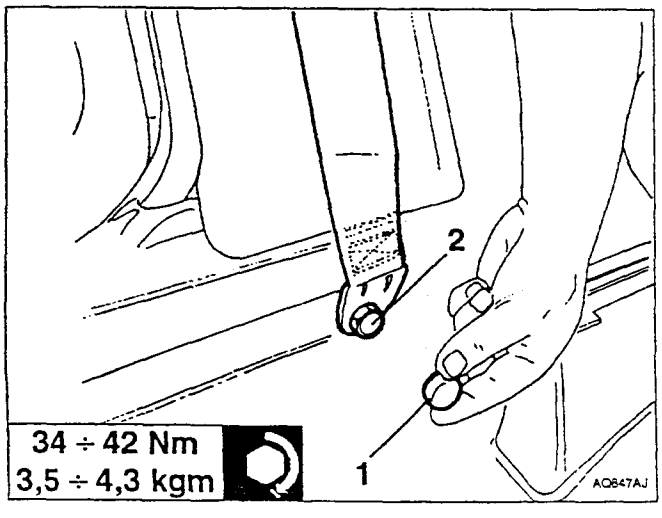


FRONT SAFETY BELTS

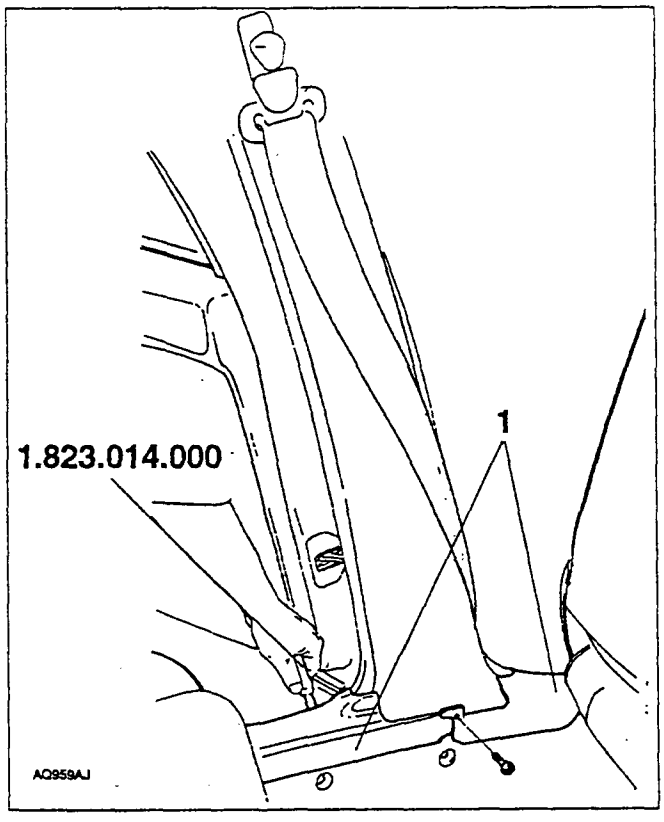
REMOVAL/REFITTING

The vehicle is fitted with safety belts with pretensioner: ALWAYS take extreme care and CLOSELY adhere to safety regulations when working on the belts or near to them (see specific paragraph).

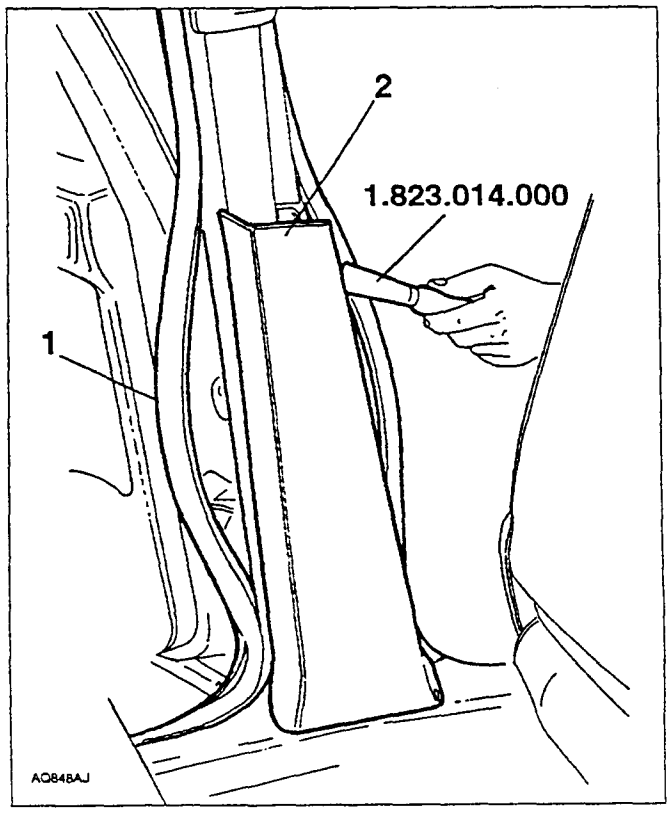
1. Remove the plastic cap.
2. Remove the lower safety belt lockscrew and free the belt.



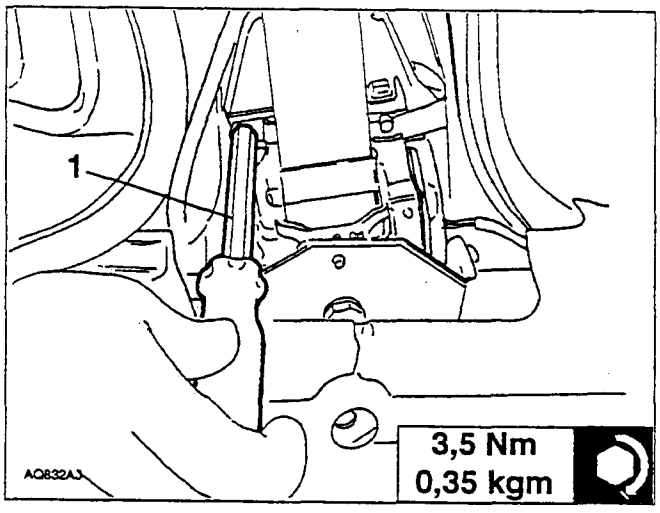
1. Remove the two "heel boards" (see specific paragraph).



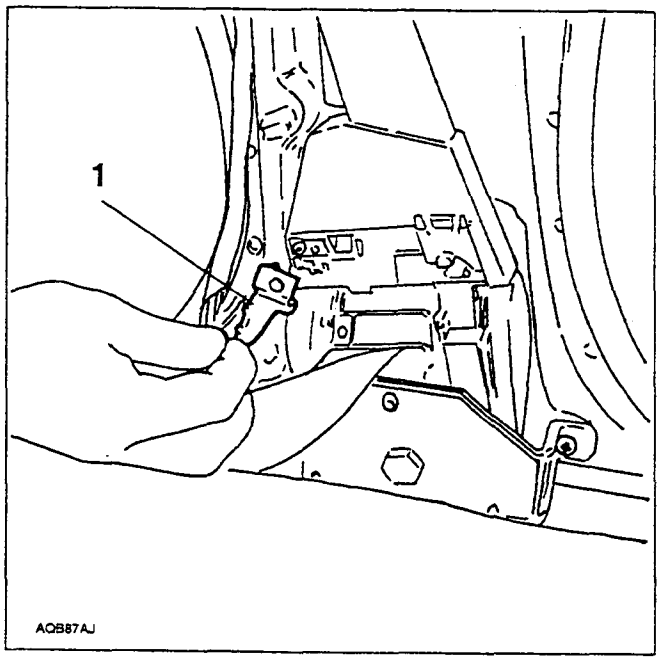
1. Carefully remove part of the door seal.
2. Using tool **1.823.014.000** prise the pillar cover towards the inside of the car and remove it.



1. Slacken and remove the screw fastening the pretensioning device "safety" bracket.

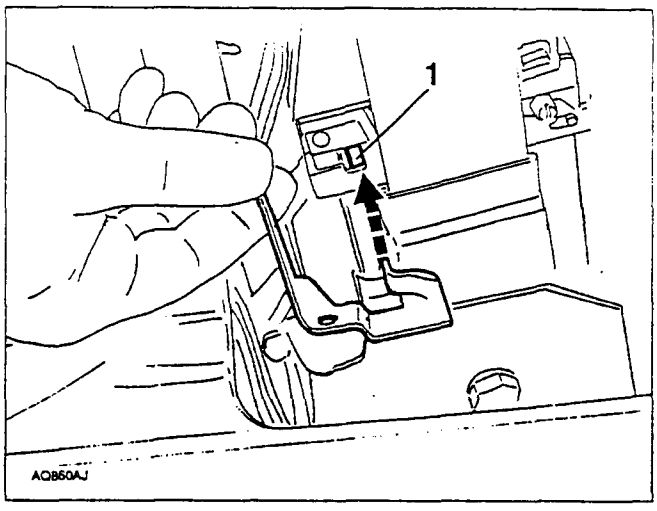


1. Separate the inner bracket from the retainer pin on the innertia reel to "disable" the pretensioner, then remove it from the pillar.



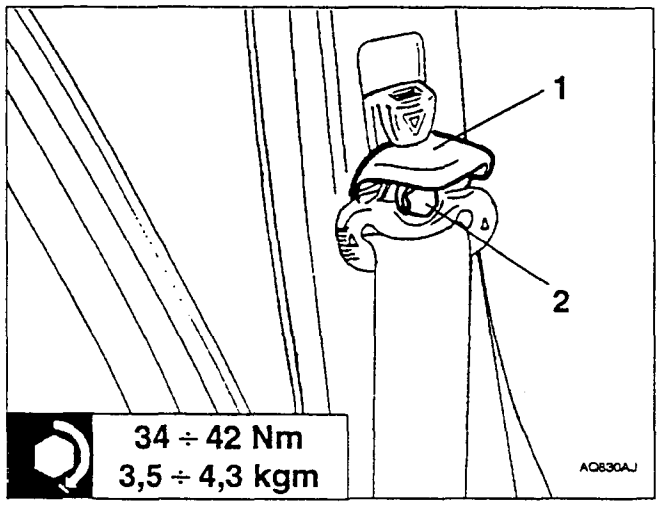
1. Through the special window make sure that the security device has been engaged checking that the spring shown by the arrow has returned to the rest position (towards the inside of the car); if not, suspend the procedure and be very careful because the device may be triggered.

NOTE: when the inner bracket is in position its tooth presses on the spring causing the release of the security device.

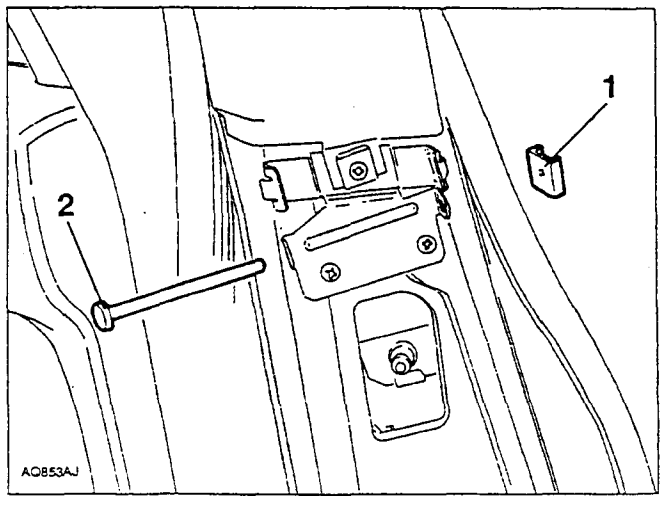


The operator must wear protective items (polyethylene gloves, safety goggles, ear muffs), never go near with the face and keep as far away as possible when carrying out the operation.

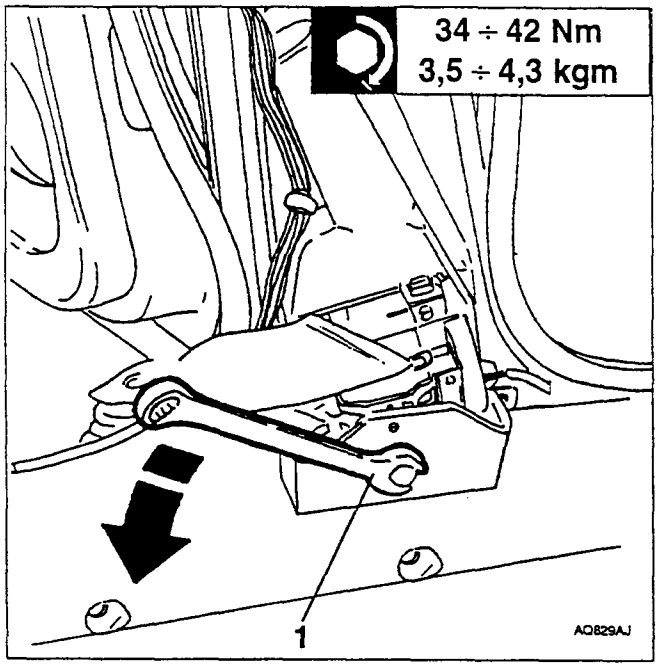
1. Remove the upper trim cap fastened to the height adjustment device.
2. Slacken the nut, then remove it.



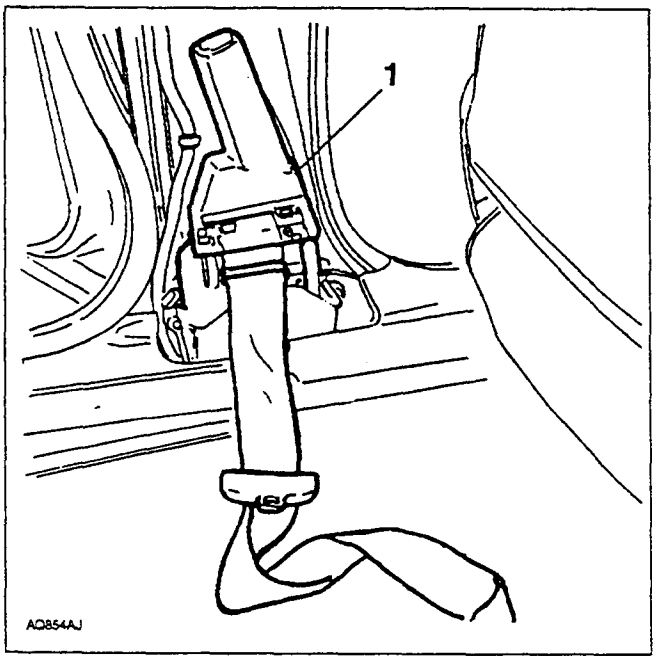
1. Release and withdraw the belt guide pin.



1. Slacken the pretensioner anchor screw.



1. Remove the pretensioner.

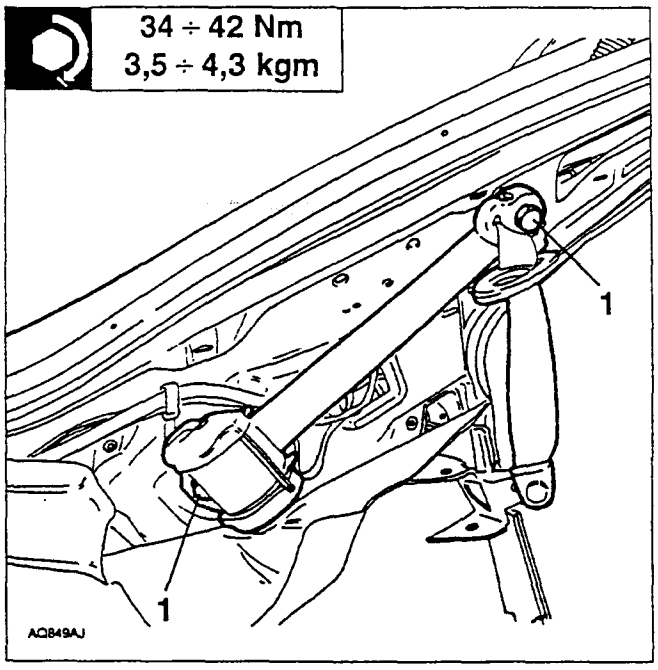


REAR SIDE SAFETY BELTS

REMOVAL/REFITTING

- Remove the pillar cover side bracket (see specific paragraph)

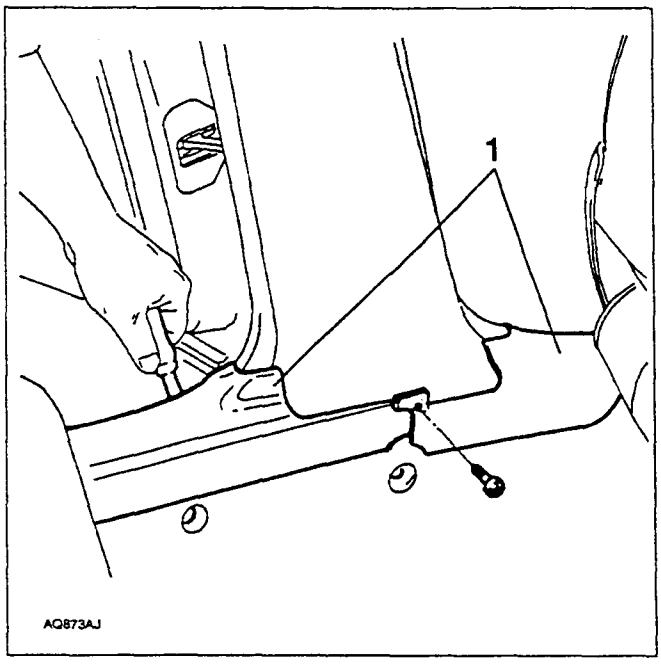
1. Slacken and remove the two screws fastening the safety belt and remove it.



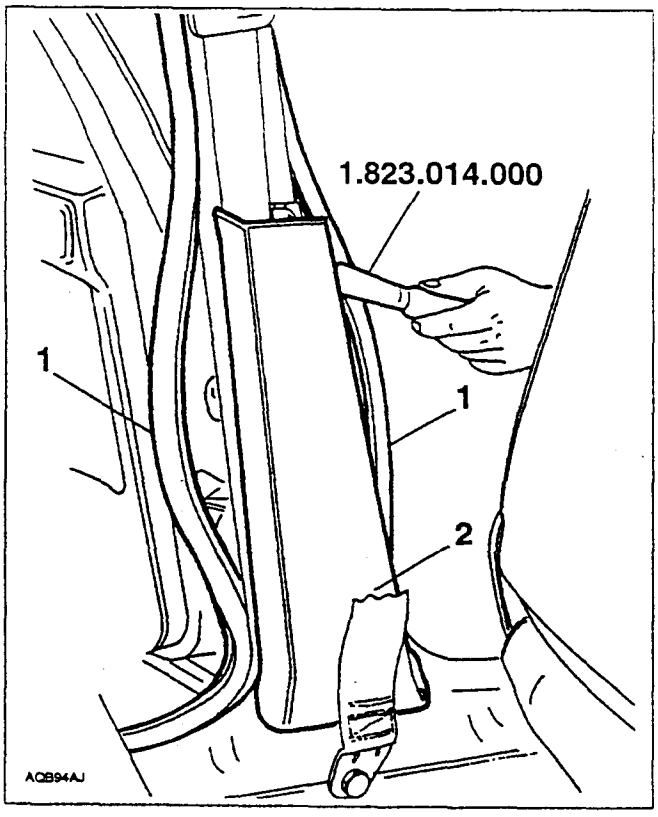
LOWER PILLAR COVER

REMOVAL/REFITTING

1. Prise and remove the two "heel boards" (see specific paragraph).



1. Carefully partially remove the door seals.
2. Using tool **1.823.014.000**, prise the pillar cover towards the inside of the car and remove it.



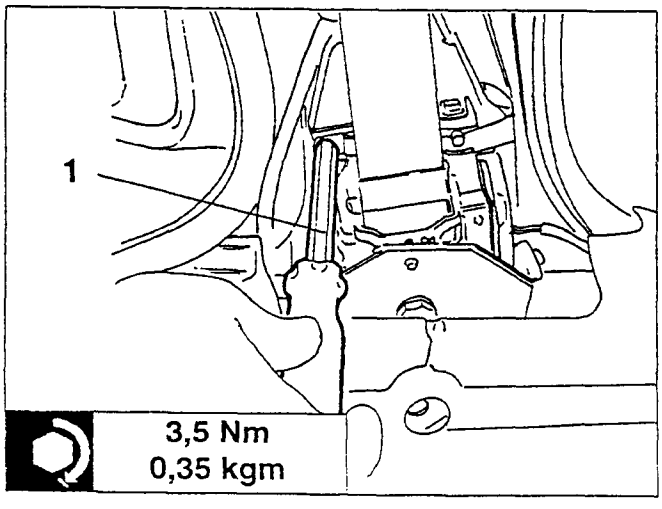
UPPER PILLAR COVER

REMOVAL/REFITTING

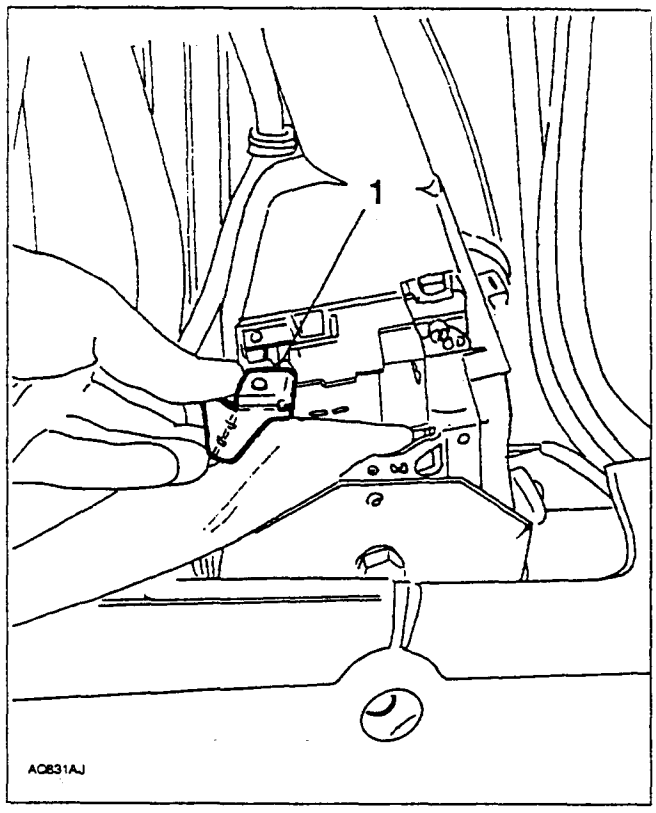
- Remove the lower pillar cover (see specific paragraph)

The vehicle is fitted with safety belts with pretensioner: ALWAYS take extreme care and CLOSELY adhere to safety regulations when working on the belts or near to them (see specific paragraph).

1. Slacken and remove the screw fastening the pretensioning device "safety" bracket.

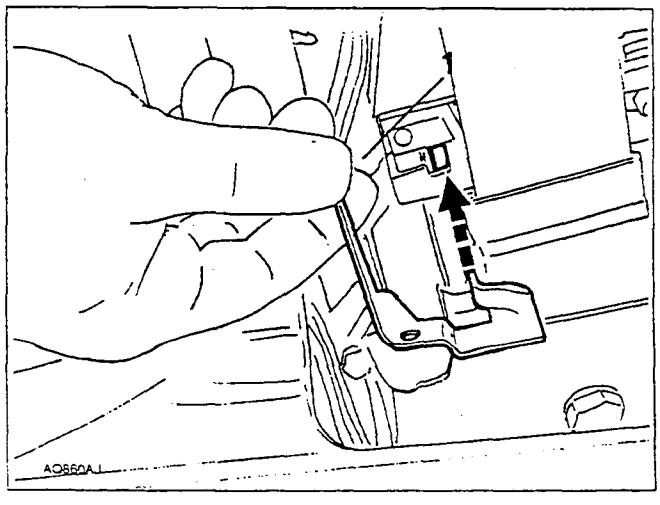


1. Separate the inner bracket from the retainer pin on the innertia reel to "disable" the pretensioner, then remove it from the pillar.



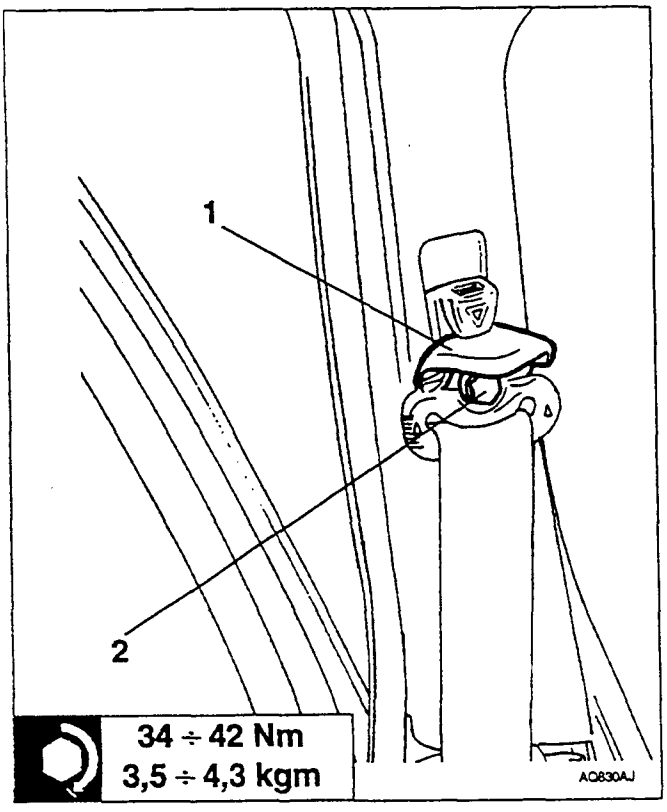
1. Through the special window make sure that the security device has been engaged checking that the spring shown by the arrow has returned to the rest position (towards the inside of the car); if not, suspend the procedure and be very careful because the device may be triggered.

NOTE: when the inner bracket is in position its tooth presses on the spring causing the release of the security device.

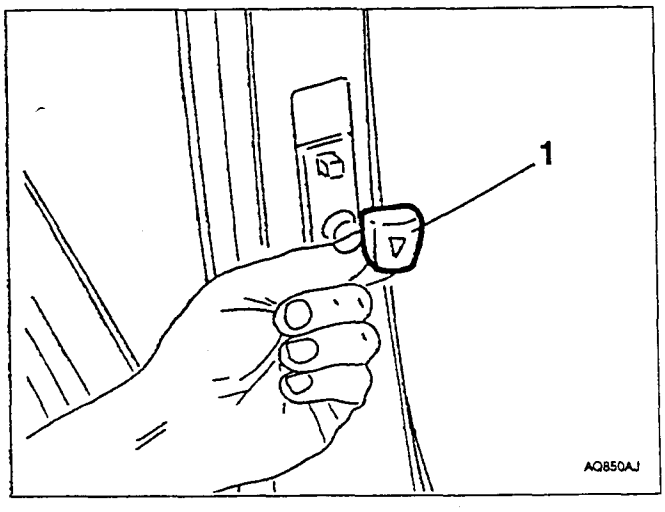


The operator must wear protective items (polyethylene gloves, safety goggles, ear muffs), never go near with the face and keep as far away as possible when carrying out the operation.

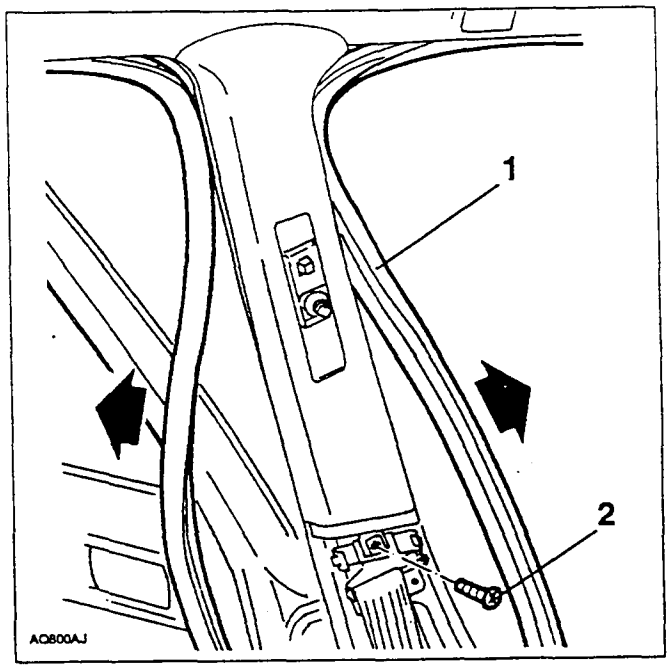
1. Remove the upper trim cap fastened to the height adjustment device.
2. Slacken the nut, then remove it.



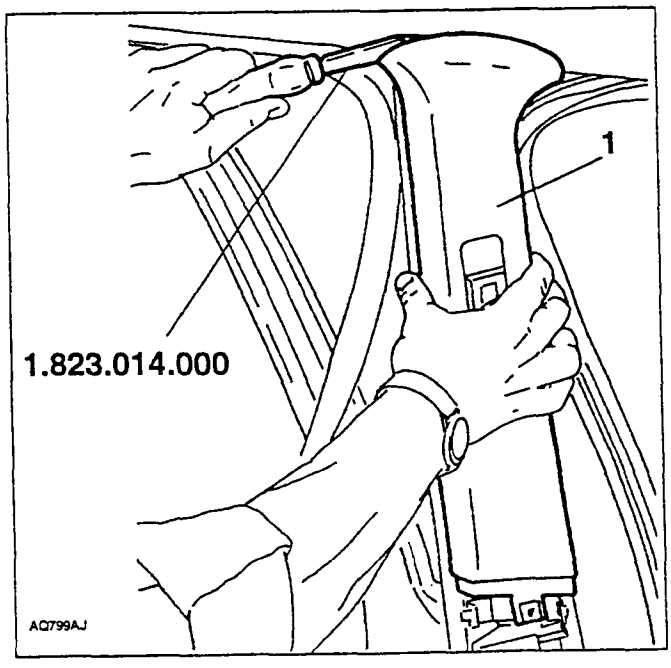
1. Remove the plastic trim cap.



1. Carefully partially remove the door seals.
2. Slacken and remove the lower screw fastening the pillar cover.



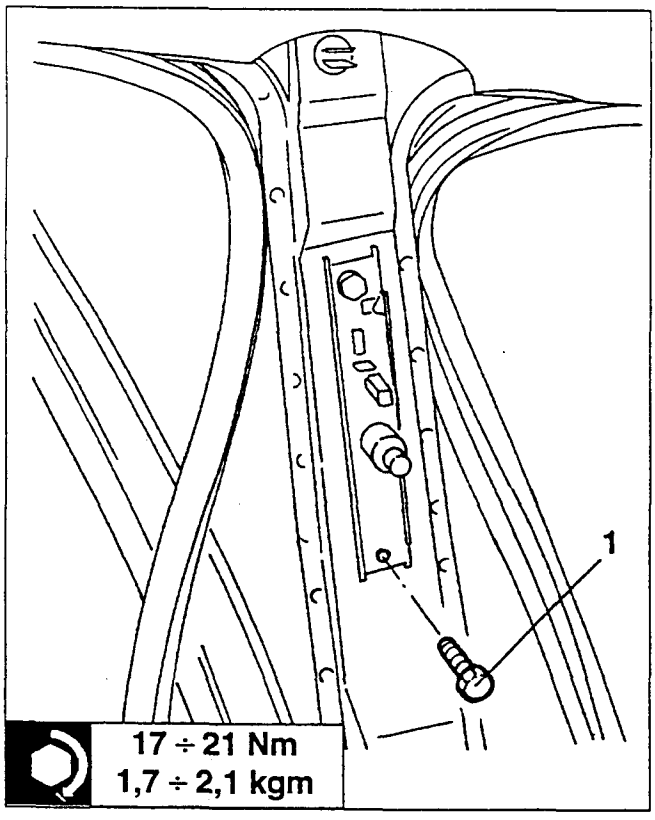
1. Using tool **1.823.014.000**, prise the upper pillar cover and remove it complete with the sliding plate.



FRONT SEAT BEL HEIGHT ADJUSTMENT DEVICE

REMOVAL/REFITTING

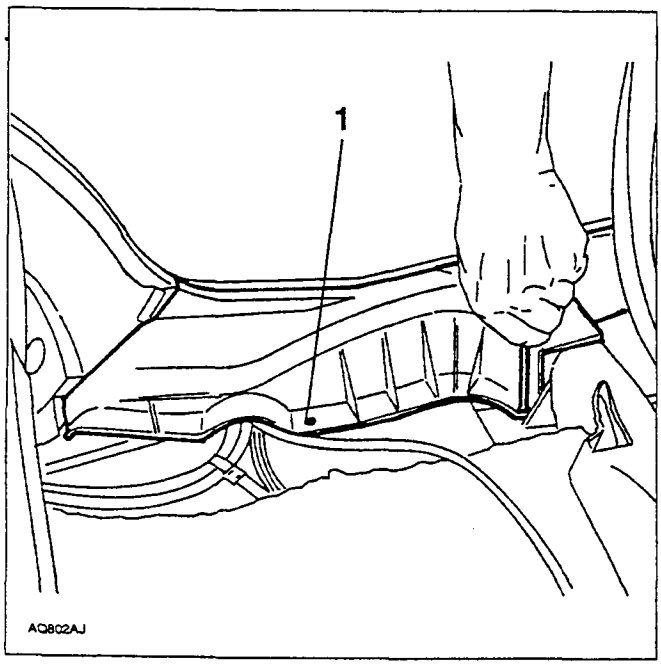
- Remove the upper pillar cover (see spec. par.)
1. Slacken the two fastening screws and remove the safety belt height adjustment device.



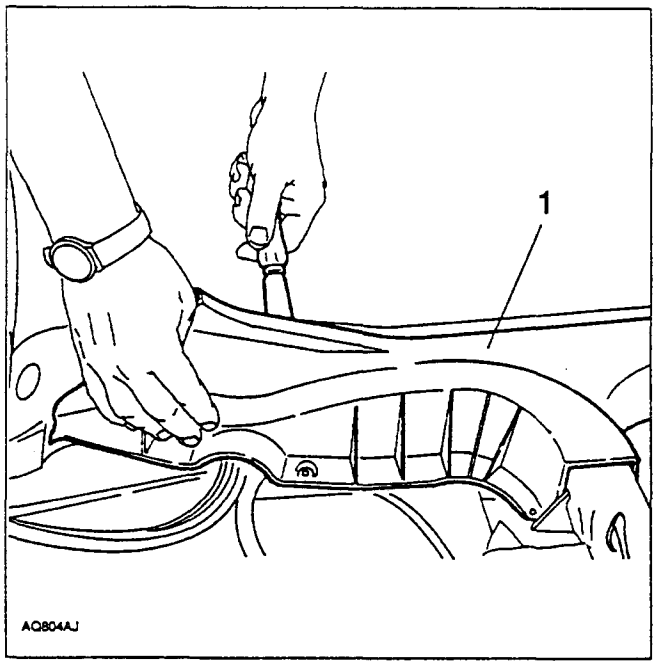
REAR HEELBOARD

REMOVAL/REFITTING

- Fold the rear seat.
1. Slacken and remove the three heelboard fastening screws.



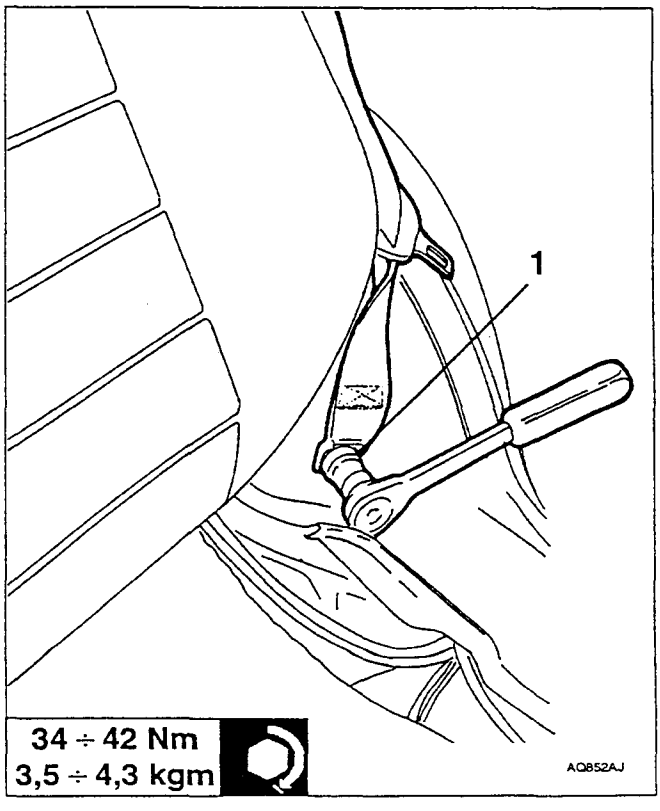
1. Using tool **1.823.014.000**, prise the rear heelboard and remove it.



WHEELHOUSE TRIM

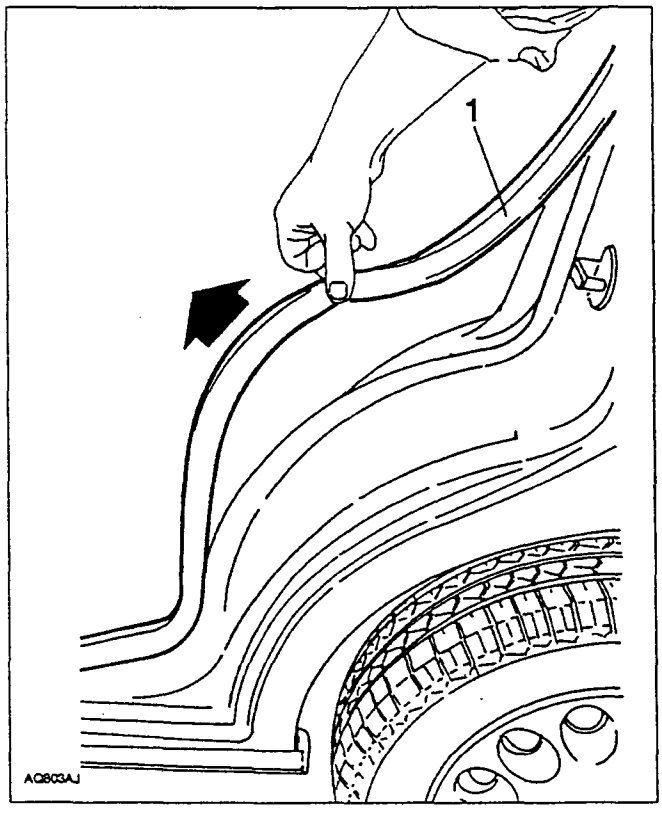
REMOVAL/REFITTING

- Remove the rear heelboard (see specific paragraph)
1. Remove the plastic cap.
2. Remove the seat belt lower lockscrew and free the belt.

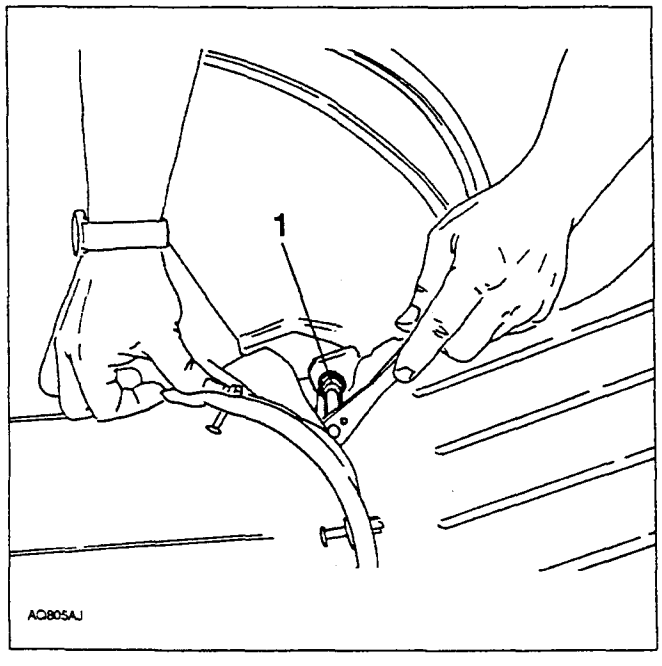


- Fold the rear seat back.
- Partially remove the luggage compartment floor trim.

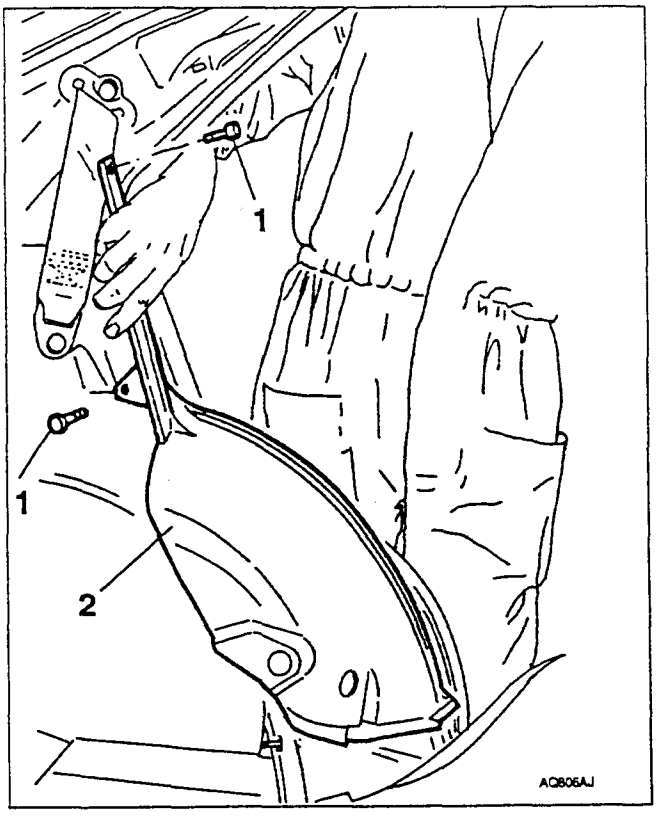
1. Partially remove the door seal.



1. Remove the seat back fastening screw.



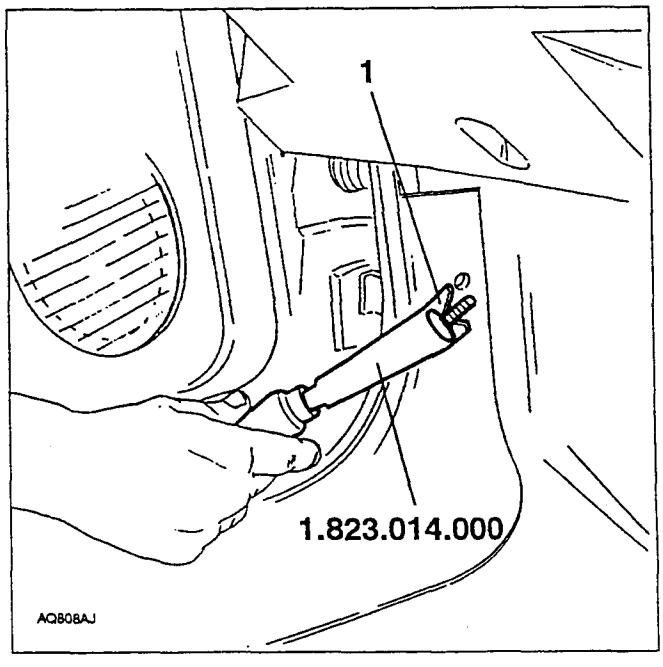
1. Slacken and remove the upper and side screws fastening the wheel arch liner.
2. Remove the wheel arch liner.



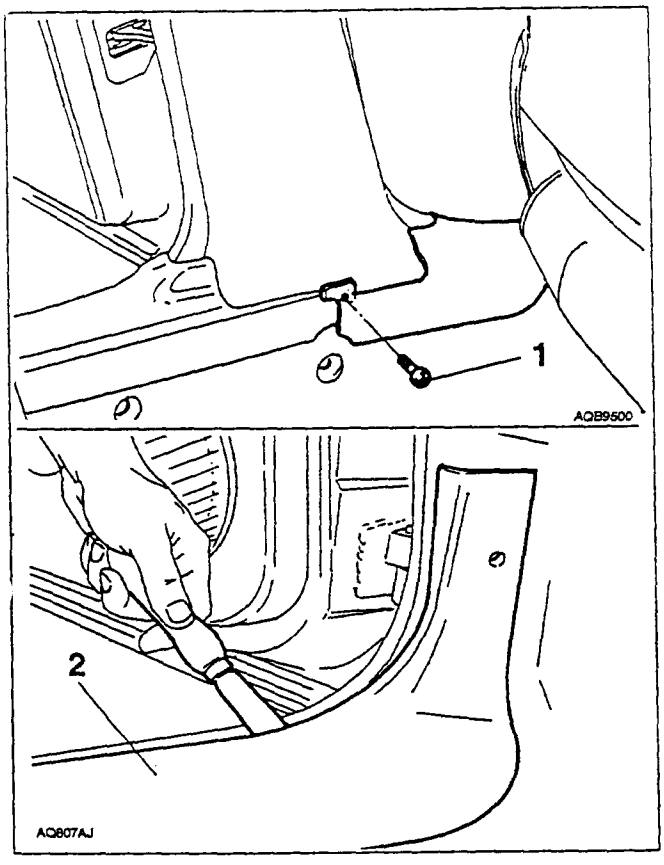
FRONT HEELBOARD

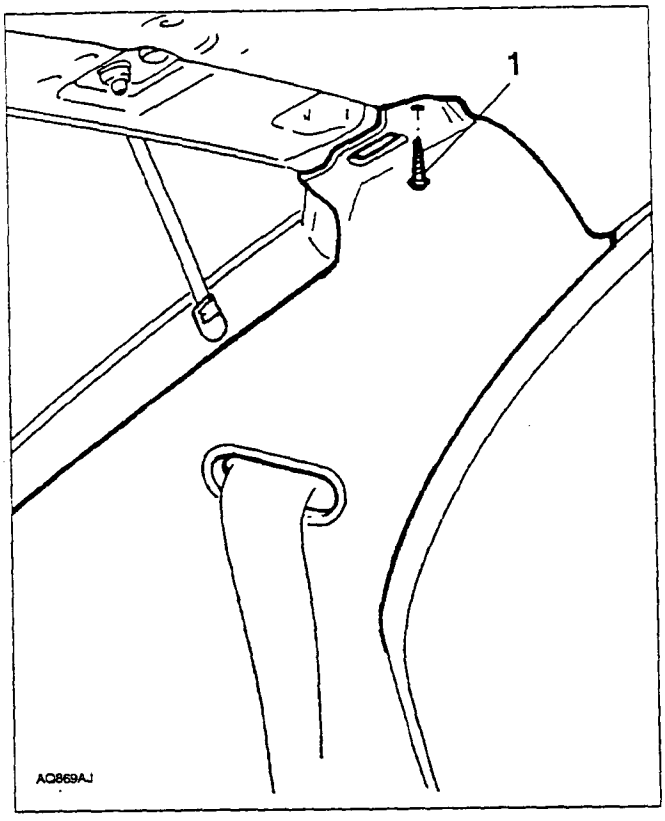
REMOVAL/REFITTING

1. Using tool **1.823.014.000**, remove the front fastening cap.



1. Slacken the front heelboard rear fastening screw.
2. Using tool **1.823.013.000**, remove the front heelboard.



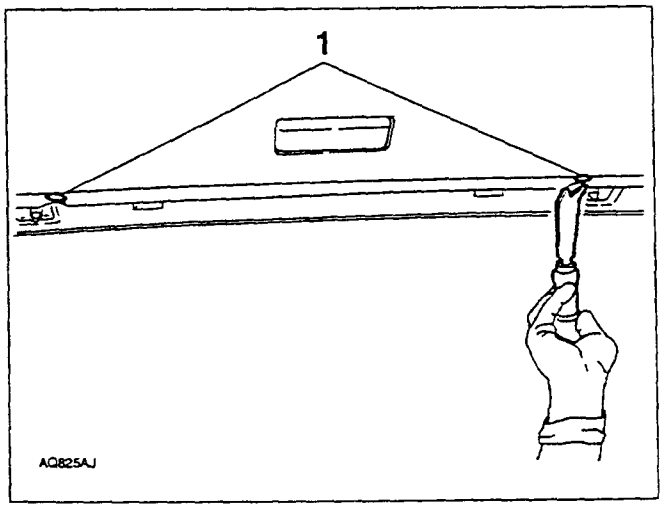


ROOF PANEL TRIM (for versions without Sunroof)

REMOVAL/REFITTING

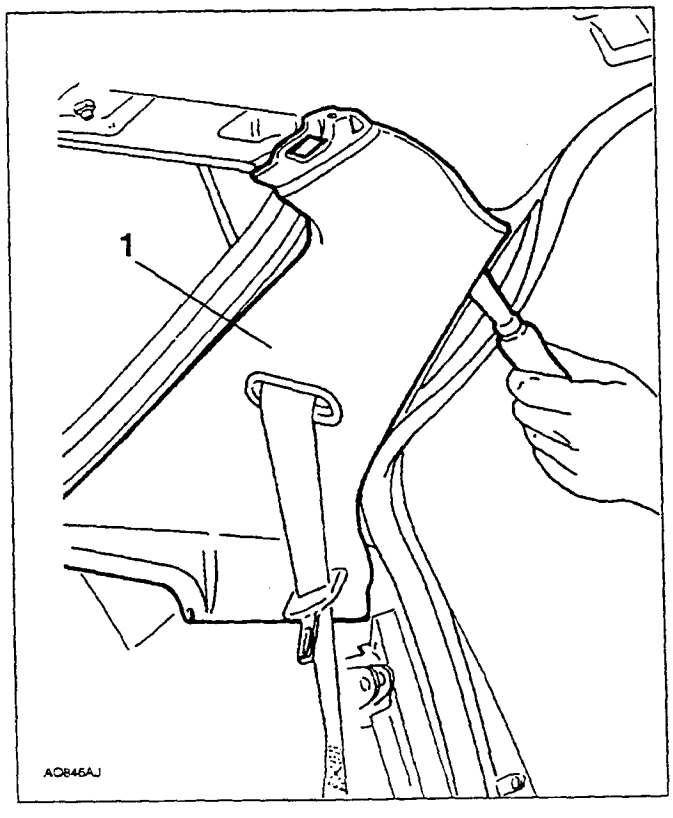
- Disconnect the battery negative pole (-).
- Remove the front seats (see specific paragraph).

1. Using tool **1.823.014.000**, release the rear roof panel trim from the plastic nails and remove it.



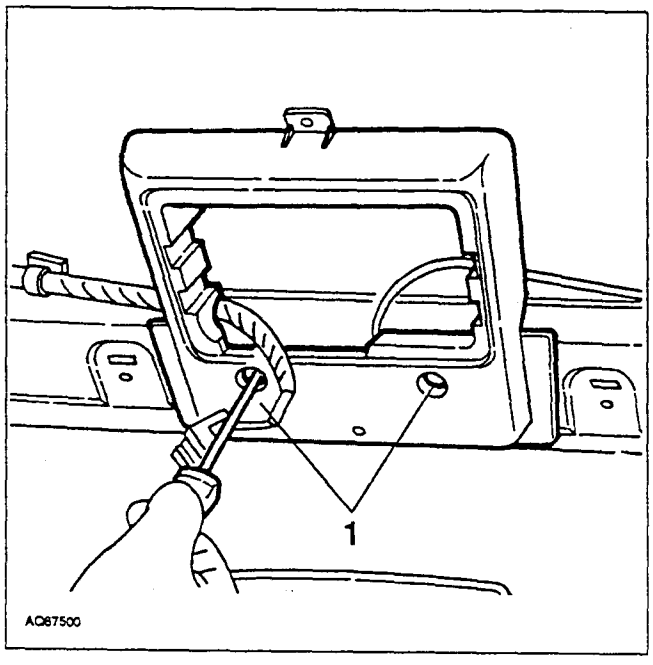
1. Slacken and remove the upper screw fastening the pillar cover side brackets.

1. Using tool **1.823.014.000**, release the pillar cover bracket and remove it withdrawing the safety belt.

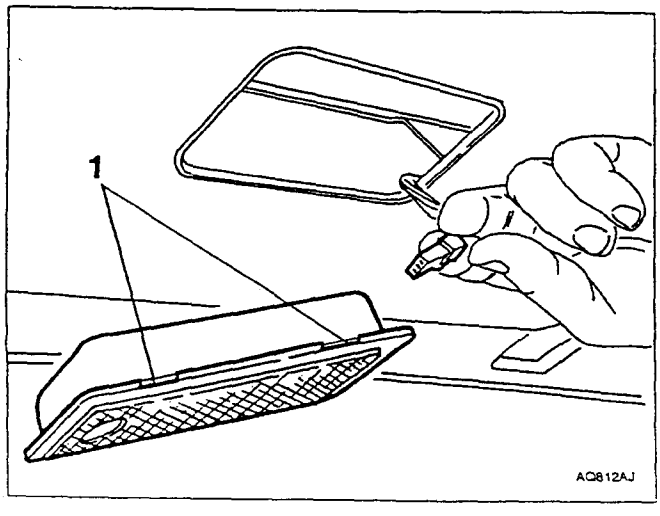


- Remove the upper centre pillar covers (see specific paragraph).
- Remove the front pillar covers (see specific paragraph).
- Remove the sun visors (see specific paragraph).
- Remove the inner rearview mirror (see specific paragraph).
- Remove the passenger grab handles (see specific paragraph).
- Remove the caps on the driver's side (see specific paragraph).
- Remove the front courtesy light (see specific paragraph).

1. Slacken the two screws fastening the courtesy light support.

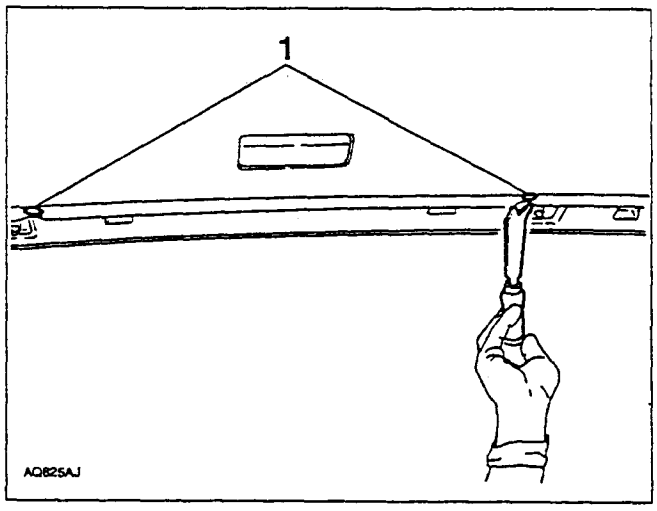


1. Release the courtesy light using a screwdriver in the two notches on the frame to free the catches, disconnect the electrical connector and remove the light.

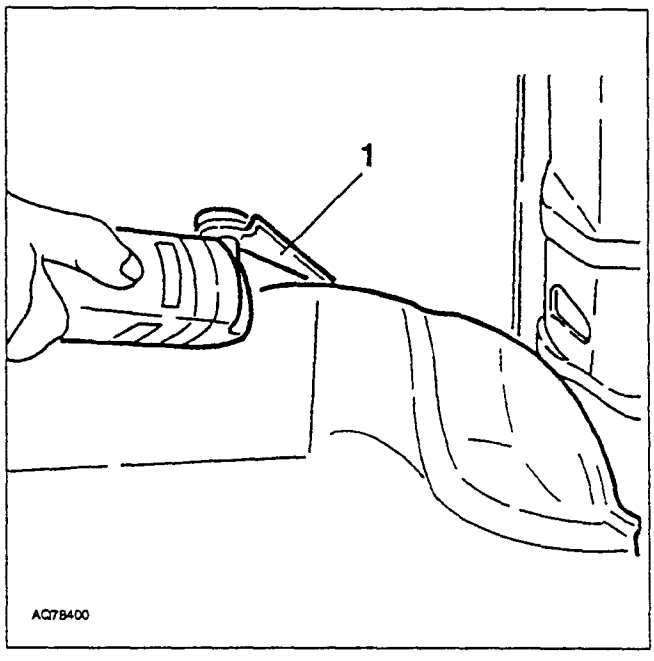


- Carefully partially move aside the front and rear door seals.

1. Remove the two rear plastic nails.



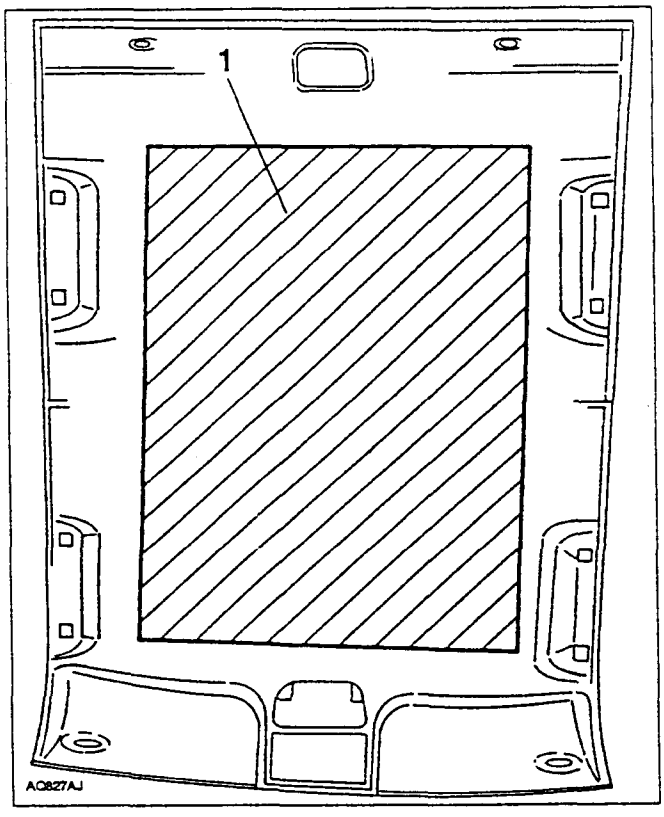
1. Lower the rear section of the roof panel trim enough to cut the glue as illustrated.



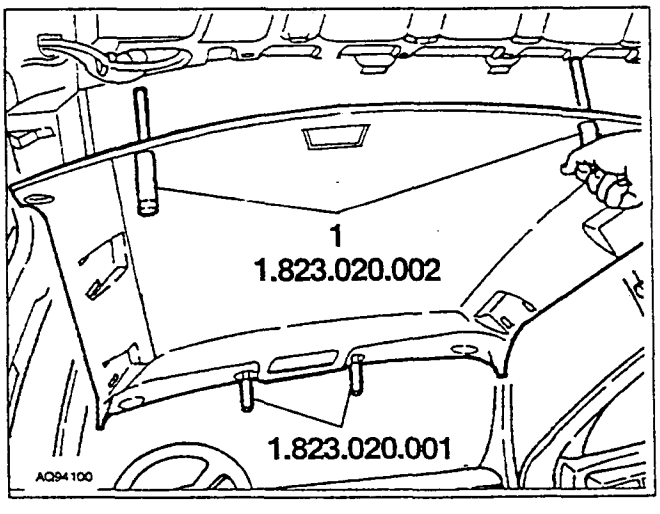
- Remove the roof panel trim.

When refitting the roof panel trim, reverse the sequence followed for removal and observing the instructions below.

1. Coat the roof panel trim and the roof panel with the specified glue in the area illustrated below.



1. Position the roof panel trim using guide pins **1.823.020.002** and **1.823.020.001**, as illustrated and press it with the hands in the areas coated with glue.

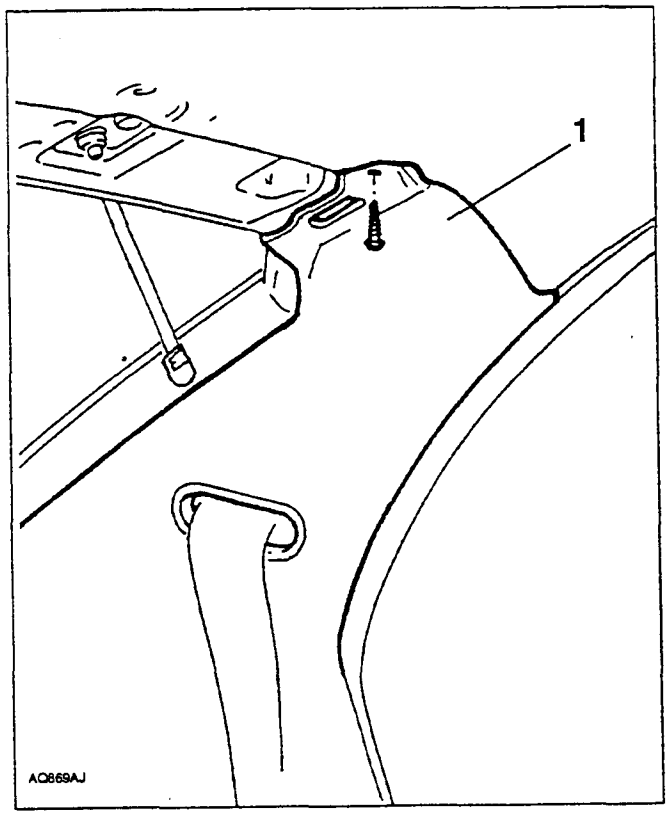


ROOF PANEL TRIM (for versions with sunroof)

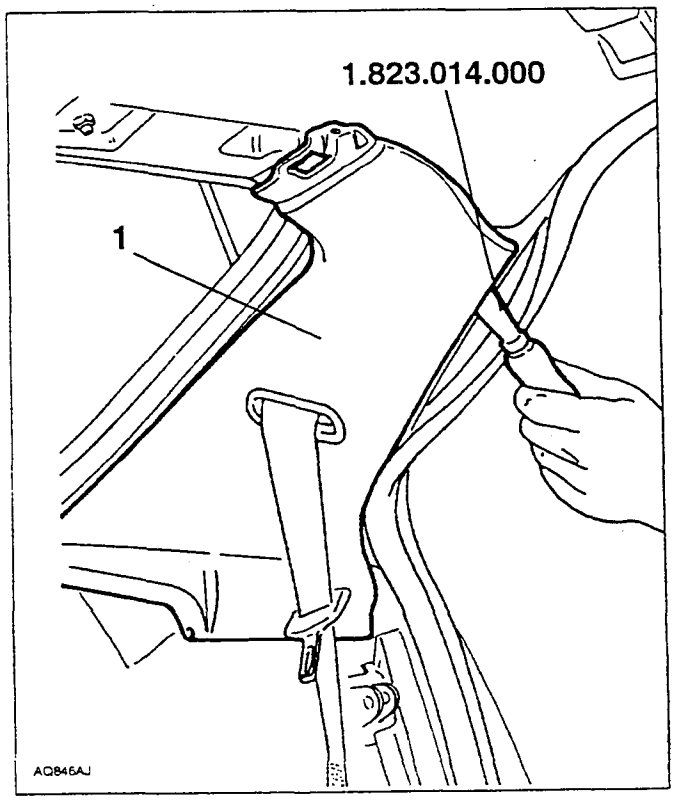
REMOVAL/REFITTING

- Disconnect the battery negative pole (-).
- Remove the front seats (see specific paragraph).
- Using tool **1.823.014.000**, release the rear roof panel trim from the plastic nails and remove it.

1. Slacken and remove the upper screw fastening the pillar cover side brackets.

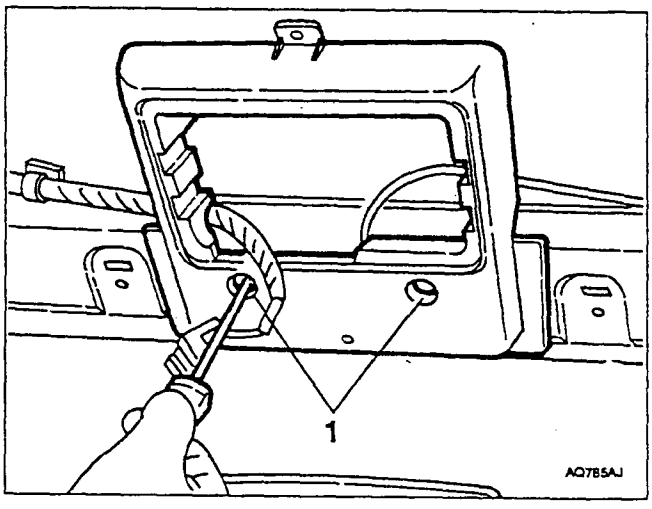


1. Using tool **1.823.014.000**, release the pillar cover bracket and remove it withdrawing the safety belt.

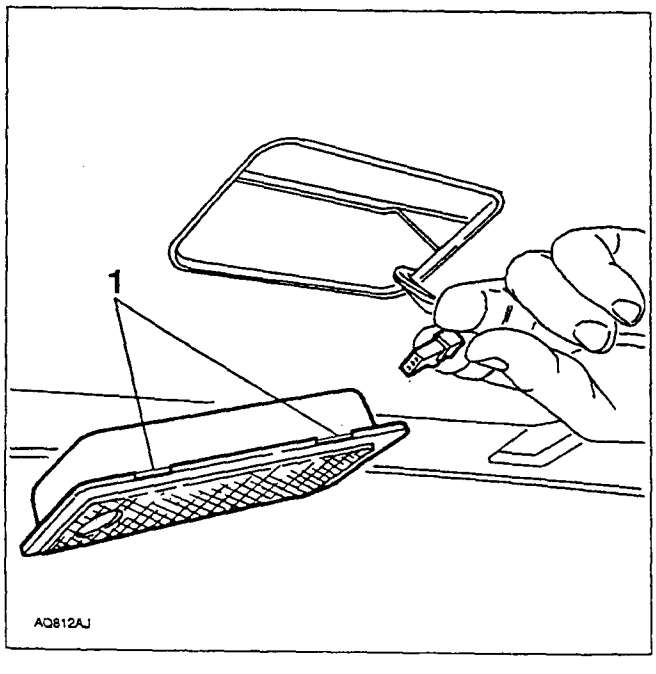


- Remove the upper centre pillar covers (see specific paragraph).
- Remove the front pillar covers (see specific paragraph).
- Remove the sun visors (see specific paragraph).
- Remove the inner rearview mirror (see specific paragraph).
- Remove the passenger grab handles (see specific paragraph).
- Remove the caps on the driver's side (see specific paragraph).
- Remove the front courtesy light (see specific paragraph).

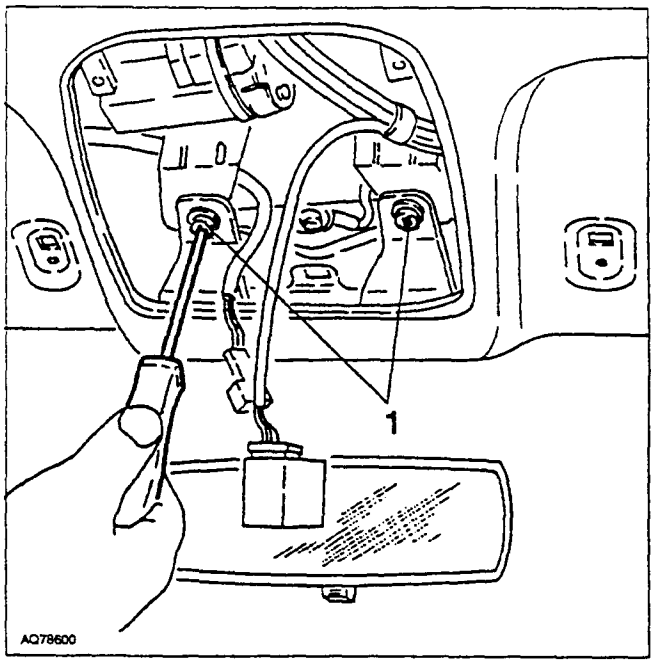
1. Slacken the two fastening screws and remove the courtesy light support.



1. Release the rear courtesy light with a screwdriver, disconnect the electrical connection and remove it.

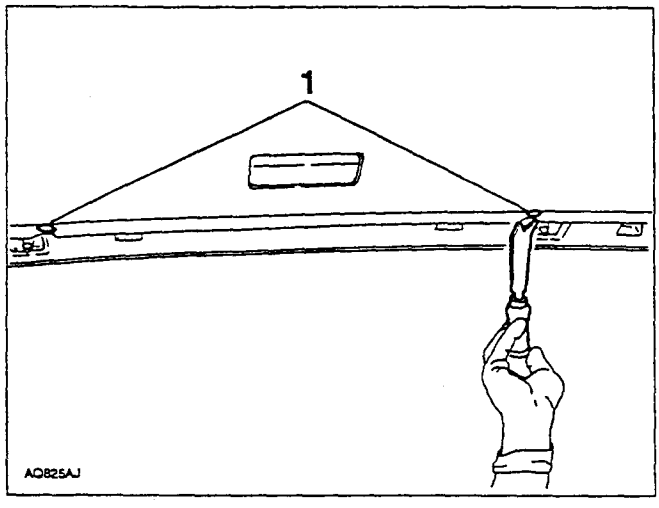


1. Slacken the two roof panel trim front fastening screws.

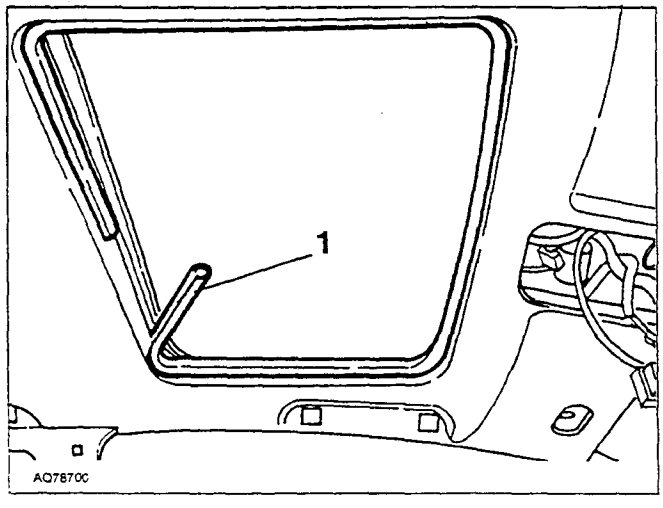


- Carefully partially move aside the front and rear door seals.

1. Remove the two rear plastic nails
2. Remove the two rear buttons.

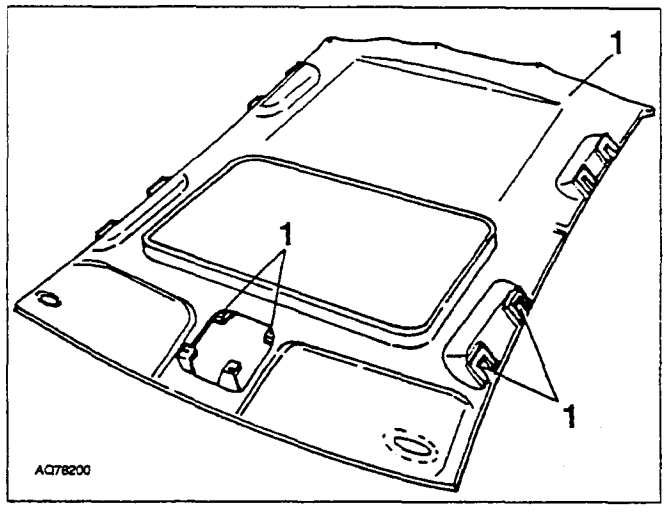


1. Release and remove the sunroof seal.



- Remove the roof panel trim firstly moving it towards one side in order to release it from the other and retrieve it drawing it out through the front door.

When refitting make sure that on the roof panel trim there are all the seals illustrated and the clamps for the front fastening screws.

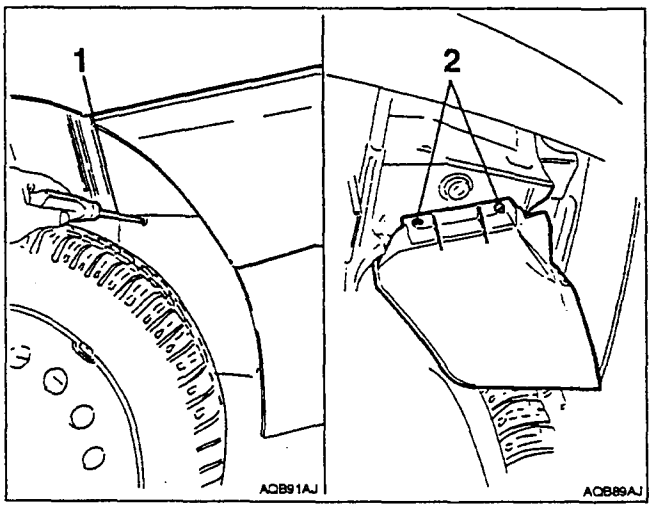


REAR BUMPER

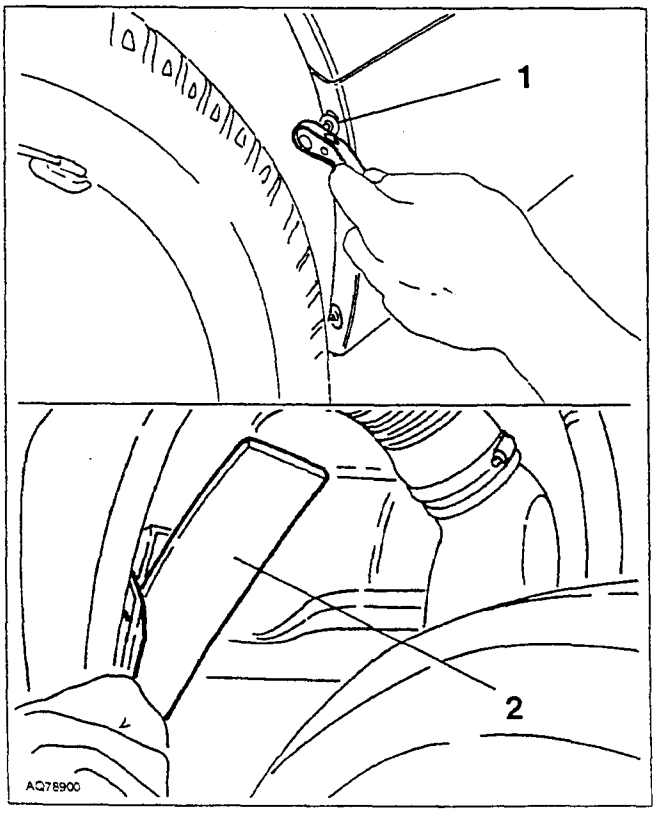
REMOVAL

- Raise the car just enough to gain access to the side screw fastening the left-hand wheelhouse.

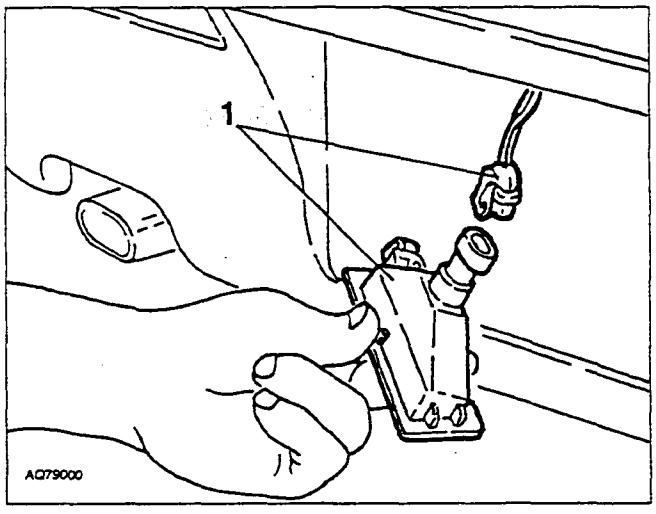
1. Slacken and remove the side screw fastening the left-hand wheelhouse.
2. Slacken and remove the upper wheelhouse fastening nuts (one for the left-hand wheelhouse and one for the right-hand wheelhouse).



1. Using ratchet wrench **1.822.132.000**, slacken and remove the four screws fastening the left-hand and right-hand wheelhouse to the bumper.
2. Prise and remove the wheelhouse; lower the car.

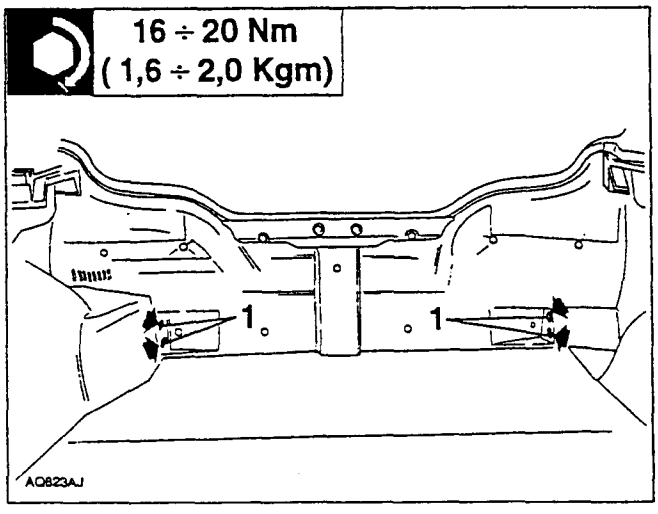


1. Prise the number plate lights and remove them after disconnecting the electrical connections.

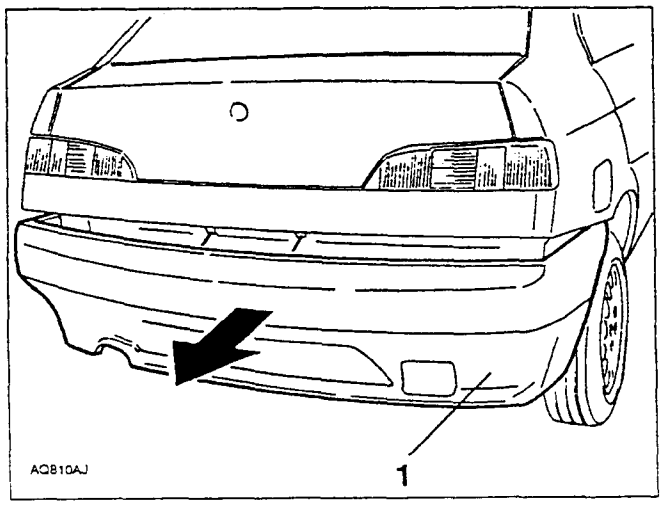


- Remove the two rear luggage stay hooks.

1. Move aside the trim and slacken the four bumper fastening screws, two for each side.



1. Remove the bumper, pulling from the rear of the car.



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HEATING, VENTILATION AND AIR CONDITIONING

6 documents - 204 factory pages

increase of pressure at the condenser (cut in at appr. 15 bar);

- it stops the compressor, de-energizing the electromagnetic joint, if the pressure reaches very high, thus dangerous, values (above appr. 28 bar), or very low values to ensure correct operating conditions (below appr. 2.45 bar);

minimum pressure switch (defroster) - Boxer and T.SPARK versions only - : this disconnects the compressor when the pressure is too low (<1.7 bar) to prevent the danger of the evaporator "frosting". It also protects the compressor from sharp pressure falls, caused for example by leaks in the circuit.

compressor cutoff thermal contact: - TD version only - : this cuts off the compressor if the engine temperature reaches dangerously high levels (it is a contact to be found on the thermostatic cup, which cuts in opening the circuit above 111°C.

full load switch - TD version only - : this is a mechanical microswitch on the injection pump which, through the special compressor cutout control unit, cuts in to shut off the compressor temporarily when the accelerator pedal is completed depressed (full load).

compressor cutout control unit - TD version only -: this momentaneously cuts out the cooling system under particular circumstances in which the engine needs to be able to deliver the maximum power to the wheels, eliminating the absorption of power by the compressor (for example when overtaking, rapid accelerations, uphill driving, etc..).
The control unit activates the following **operating logic**, or rather two different logics at low and high rpms: below 2000 rpm as soon as the full load switch closes, the compressor electromagnetic joint is de-energised, and vice versa it is engaged as soon as the switch opens again; above 2000 rpm the supply is cut off only for 8 seconds, then it is restored.

Engine fan control

When the car is travelling at low speed the cooling action of the dynamic air on the condenser is reduced and it is necessary to turn on the two fans which cool the engine radiator and the actual condenser. This is done by the trinary pressure switch which cuts in preventing an increase of the pressure at the condenser (over 15.2 bar).

The engine fans are firstly turned on at first speed, then through a timer - not fitted on the T.SPARK version - they gradually pass to second speed avoiding sudden actuations and overloads at the relay contacts.

The delay device works according to the following logic:

- The first speed is turned on with a signal from the pressure switch on the cooling fluid circuit: after appr. 8-12 seconds, if this signal persists, the delaying device operates the second speed.
- When the signal from the pressure switch ceases, the second speed is turned off immediately and the delaying device operates the first speed for appr. 0.5 second more.

Fuses and relays:

There is a box (**Q41**) in the engine compartment which contains the relays and fuses associated with the air conditioning system:

- cooling fan delaying device (**Q42**);
- compressor electromagnetic joint relay (**Q22**);
- additional compressor relay (**Q32**); - Boxer versions only
- 1st fan speed relay (**I99b**);
- 2nd fan speed relay (**I100**); - Boxer versions only
- 7.5A wander fuse (**Q65**);
- 3A wander fuse (**Q66**) - Boxer versions only

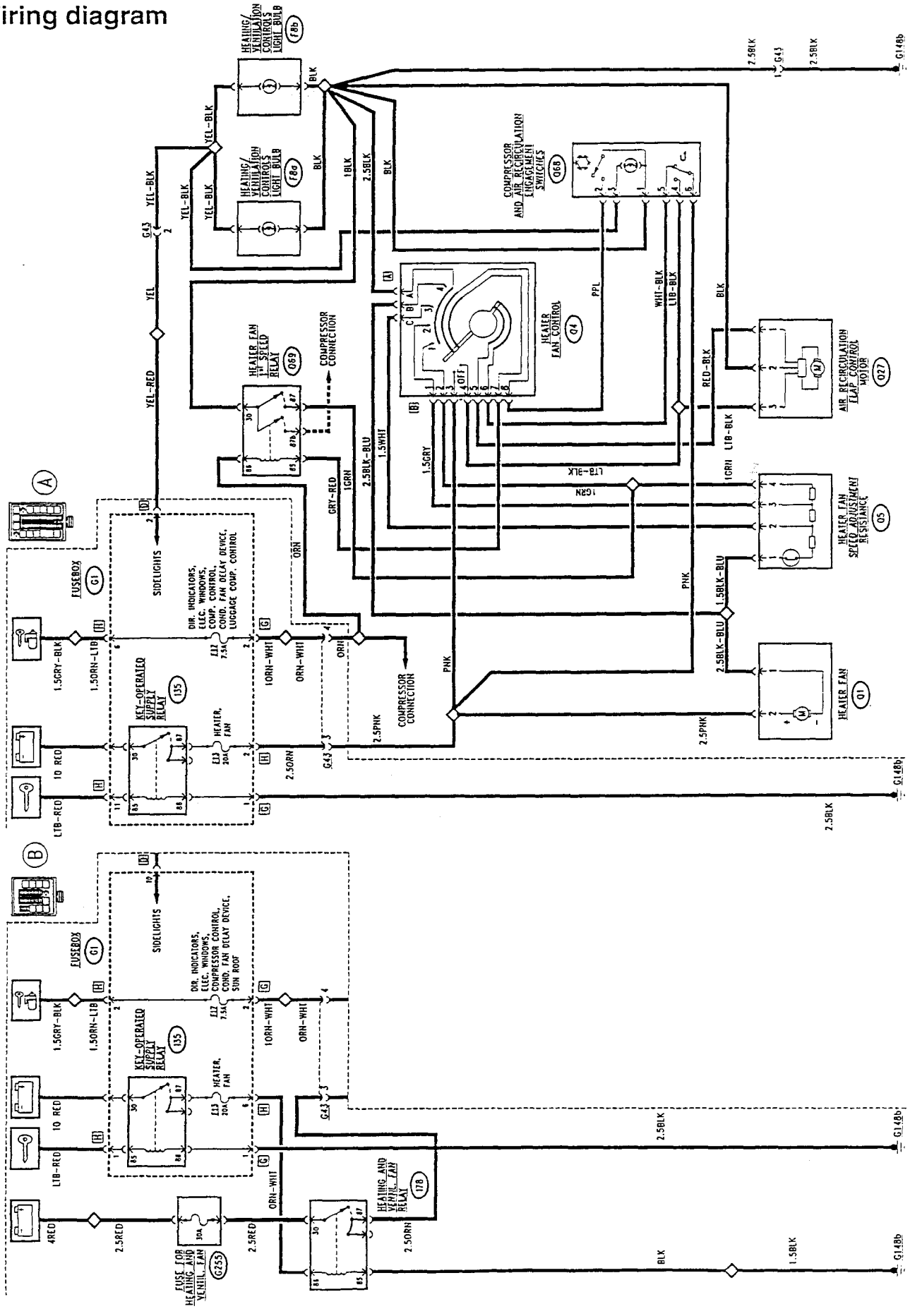
There is also the relay unit supply wander fuse and the 30A conditioning fuses (**Q39**), located next to the branch terminal box (Boxer versions only).

N.B.: For T.SPARK and boxer versions from chassis no. 4065018, and from chassis no. ... for the TD version, box Q41 is no longer present, and the fuses and relays are located on the bracket next to the fusebox

For further details concerning this system, refer to Group 50 "CLIMATE CONTROL".

FAN AND RECIRCULATION CONTROL

Wiring diagram



Functional description

Fan:

The heater and ventilation fan **Q1** is supplied with battery voltage through the key-operated services relay **I35** - located in fusebox **G1** -; in addition to the supply line relay also through fuse **F13** of fusebox **G1**.

In the versions with fusebox "B" downstream of fuse **F13**, there is also a special relay **I78** which controls fan **Q1** with a supply protected by fuse **G255** (30A).

The motor of fan **Q1** is operated with an earth signal leading from the control knob **Q4**. This signal crosses the speed regulator **Q5**, which is formed of three resistances in series and which determine the four different speeds depending on the signal from knob **Q4**: from pin 2 of connector B (1st speed), from pin 1 of connector B (2nd speed), from pin C of connector A (3rd speed) and lastly from pin B of connector A (4th speed) with a direct signal that does not cross the regulator **Q5**.

NOTE : the regulator **Q5** has a built-in thermometric safety switch which de-activates the circuit if a temperature of 90±5°C is exceeded due to excess voltage (it closes again when the temperature falls by appr. 10°C).

First fan speed with the compressor operating:

With control **Q4** in the "0" position the fan **Q1** is stopped but it is is operated at first speed if the compressor is turned on: in this case a special relay **Q69** controls the fan supply at first speed. In fact, this switch is supplied from the ignition switch via fuse **F17** of **G1** - it is energized by the same earth signal that turns the compressor on (from switch **Q68** through pins 7 and 8 of connector B of knob **Q4**) and sends a signal to the regulator **Q5** in correspondence of the 1st speed.

Recirculation:

The recirculation function is achieved by actuating motor **Q27**, according to the following supply logic:

- pin 2 of **Q27** always earthed;
- 12 V at pin 3 of **Q27**: the motor turns operating recirculation;
- 12 V at pin 1 of **Q27**: the motor turns shutting off recirculation.

Turning on takes place through switch **Q68** but with switch **Q4** on "0", "1", etc...:

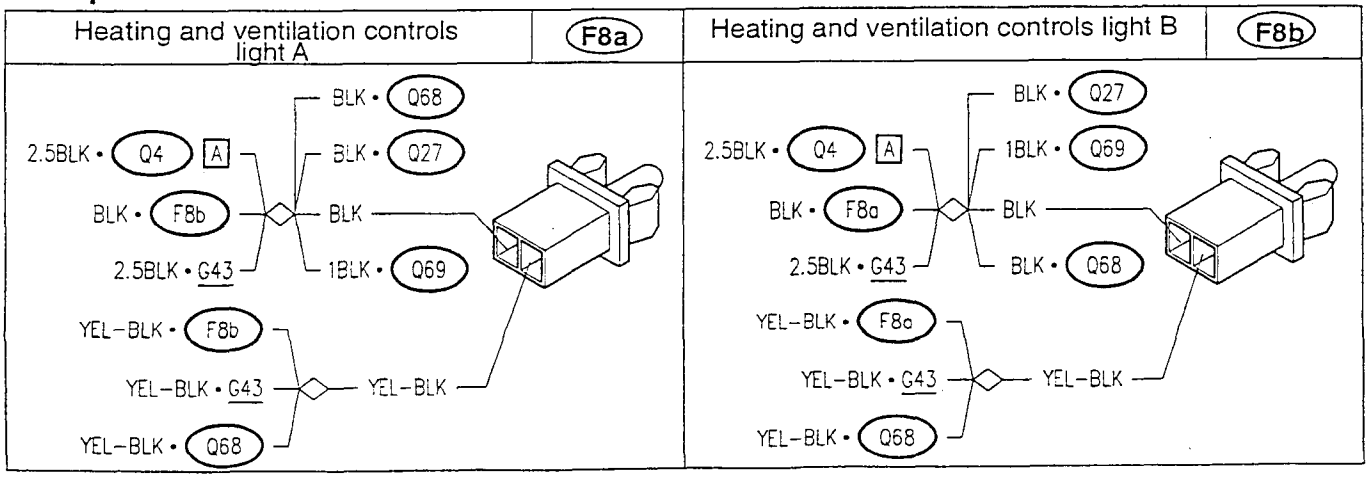
- switch **Q68** not pressed: recirculation not turned on;
- switch **Q68** pressed: recirculation turned on.

N.B.: With switch **Q4** at "OFF" recirculation is operational regardless of the position of switch **Q68**.

Controls lighting:

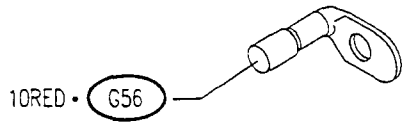
Lights **F8a** and **F8b**, located inside the control panel, together with the led next to switch **Q68** are supplied by the side lights circuit - connector D of fusebox **G1**.

Components and connectors

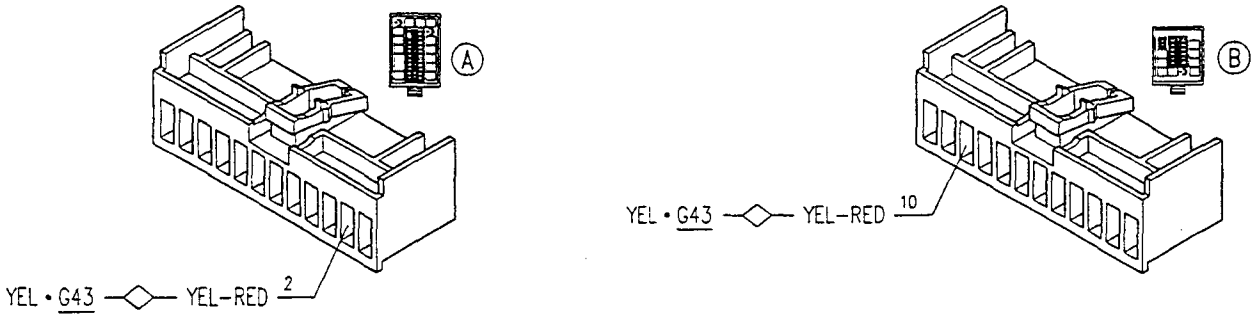


Components and connectors (cont.d)

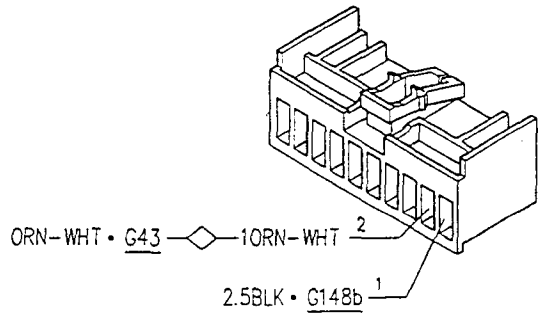
Fusebox	G1



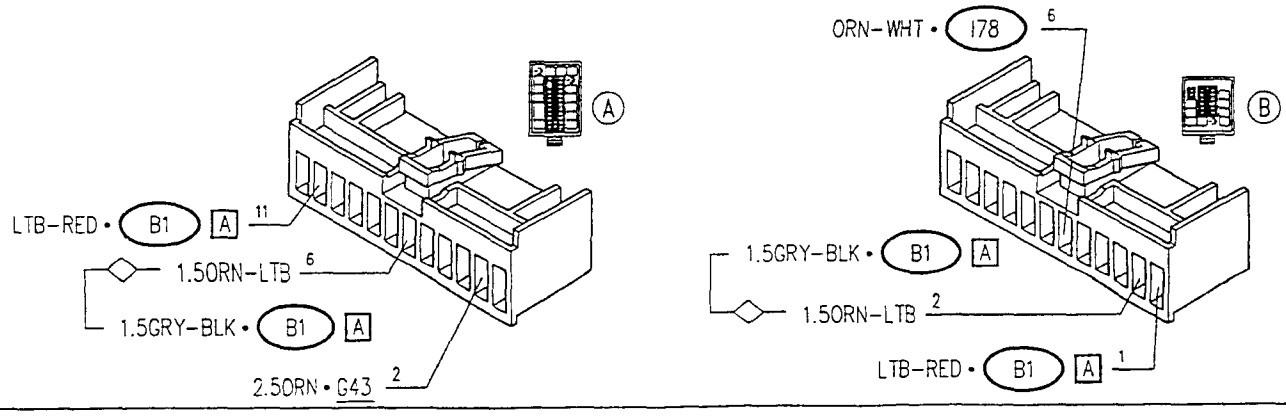
Fusebox	G1 D



Fusebox	G1 G

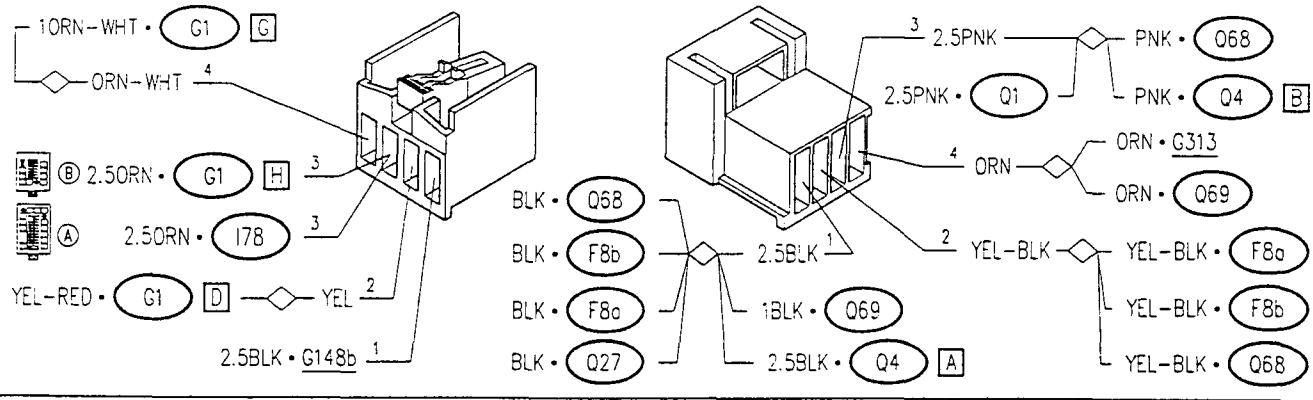


Fusebox	G1 H

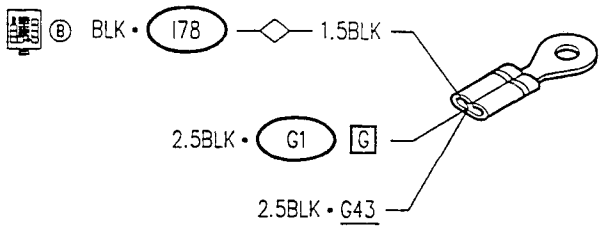


Components and connectors (cont.d)

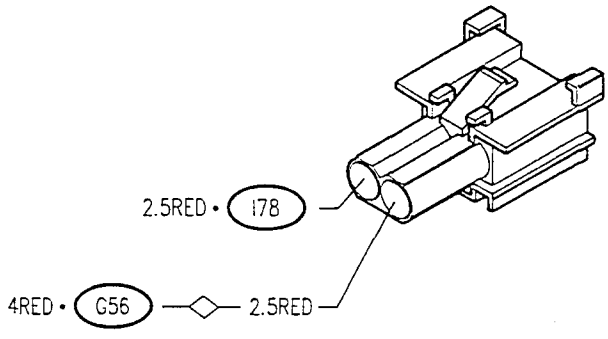
Heating & ventilation control wiring connector — G43



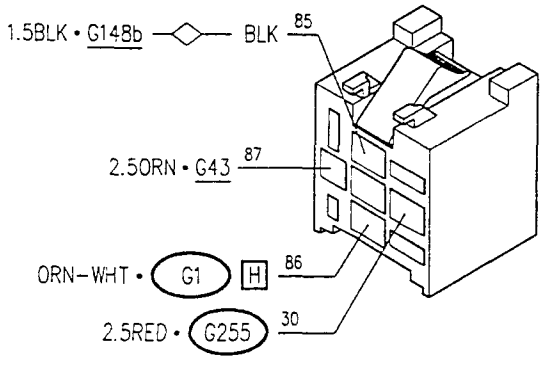
Earth under LH dashboard. — G148b



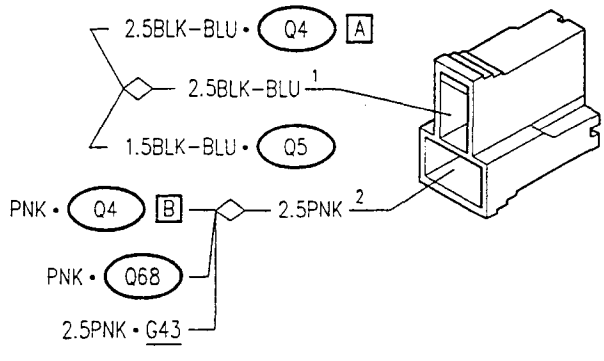
Heating and ventilation fan fuse — G255



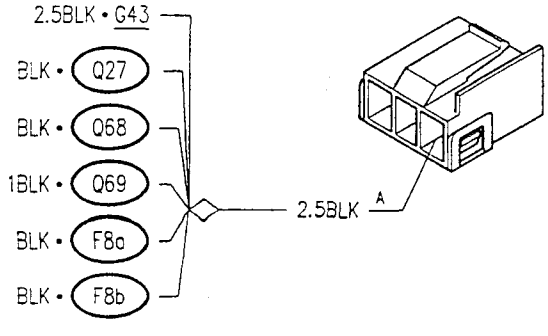
Heating & ventilation fan relay — I78



Heating & ventilation fan — Q1

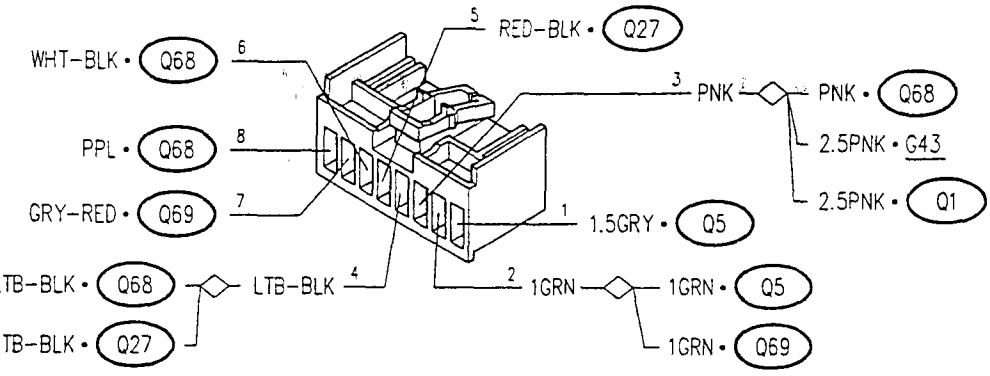


Heating and ventilation fan control — Q4 A

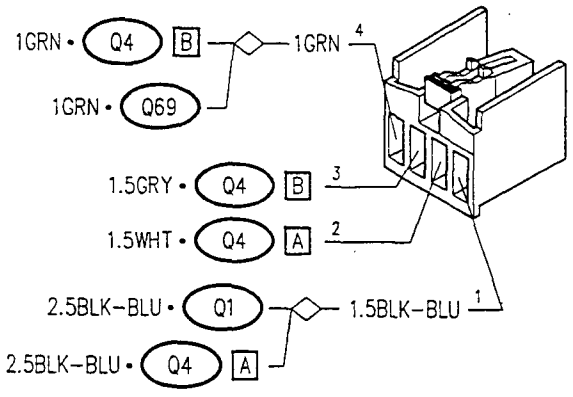


Components and connectors (cont.d)

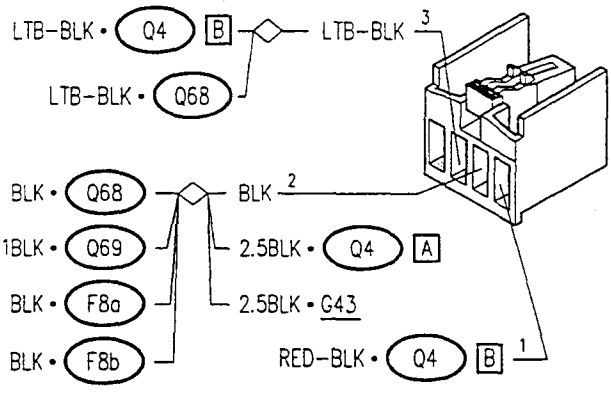
Heating and ventilation fan control — Q4 B



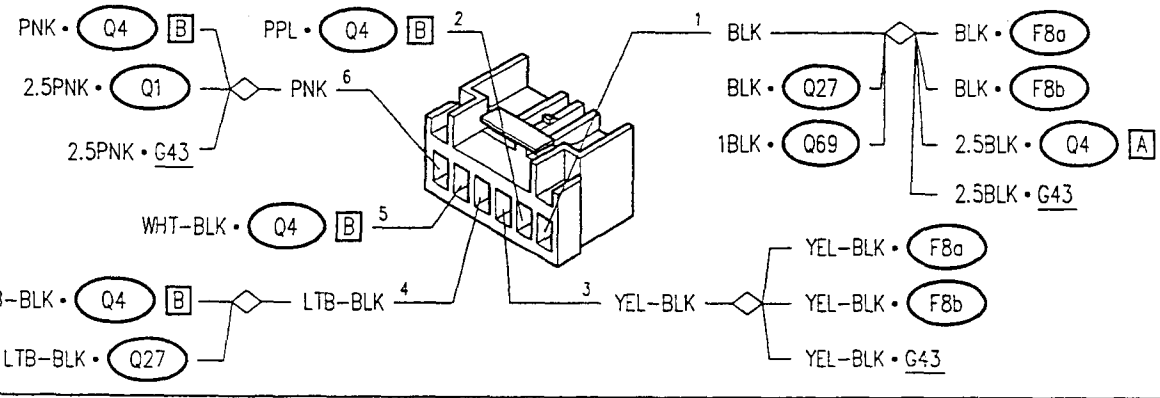
Heating & ventilation fan speed adjustment resistance — Q5



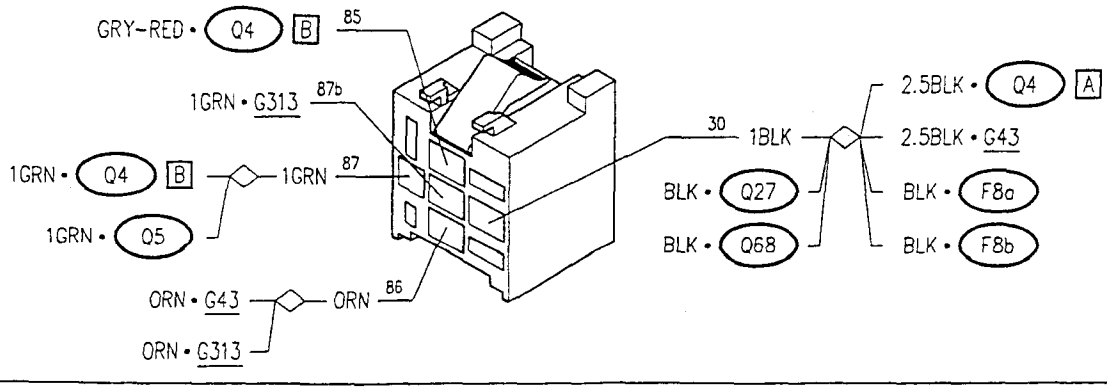
Air recirculation port control motor — Q27



Compressor and air recirculation control switches — Q68

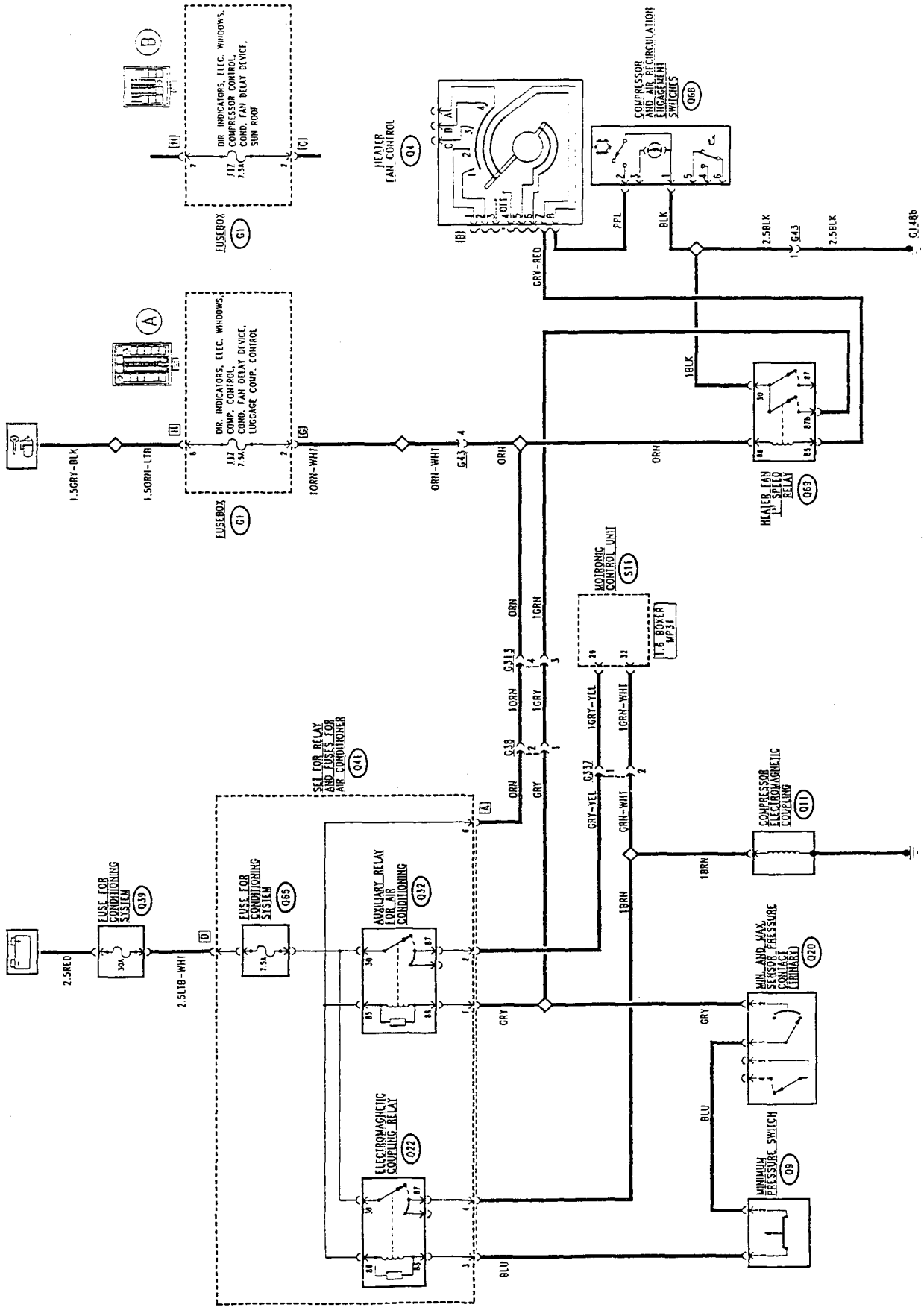


Heating & ventilation 1st speed relay — Q69

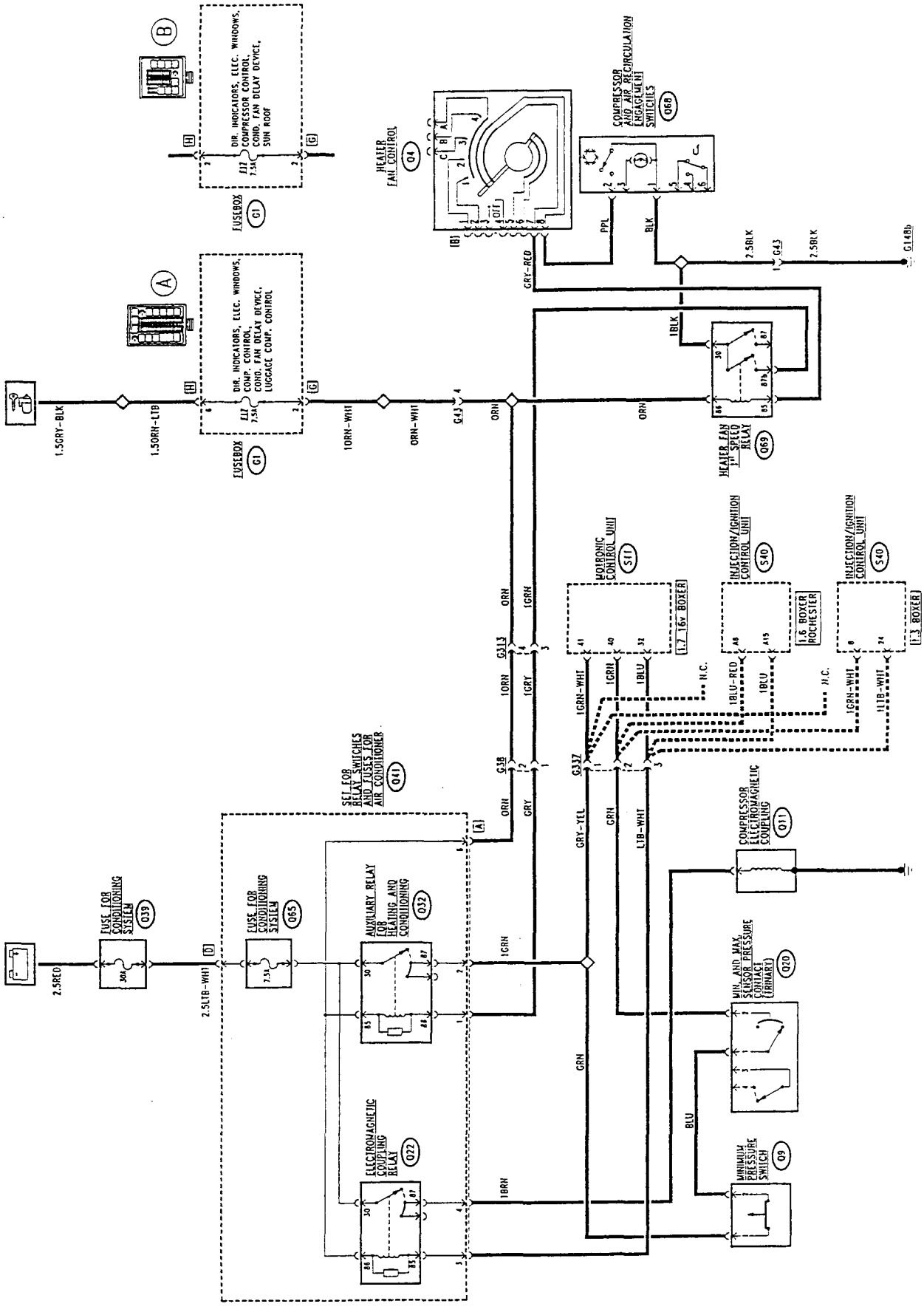


COMPRESSOR CONNECTION

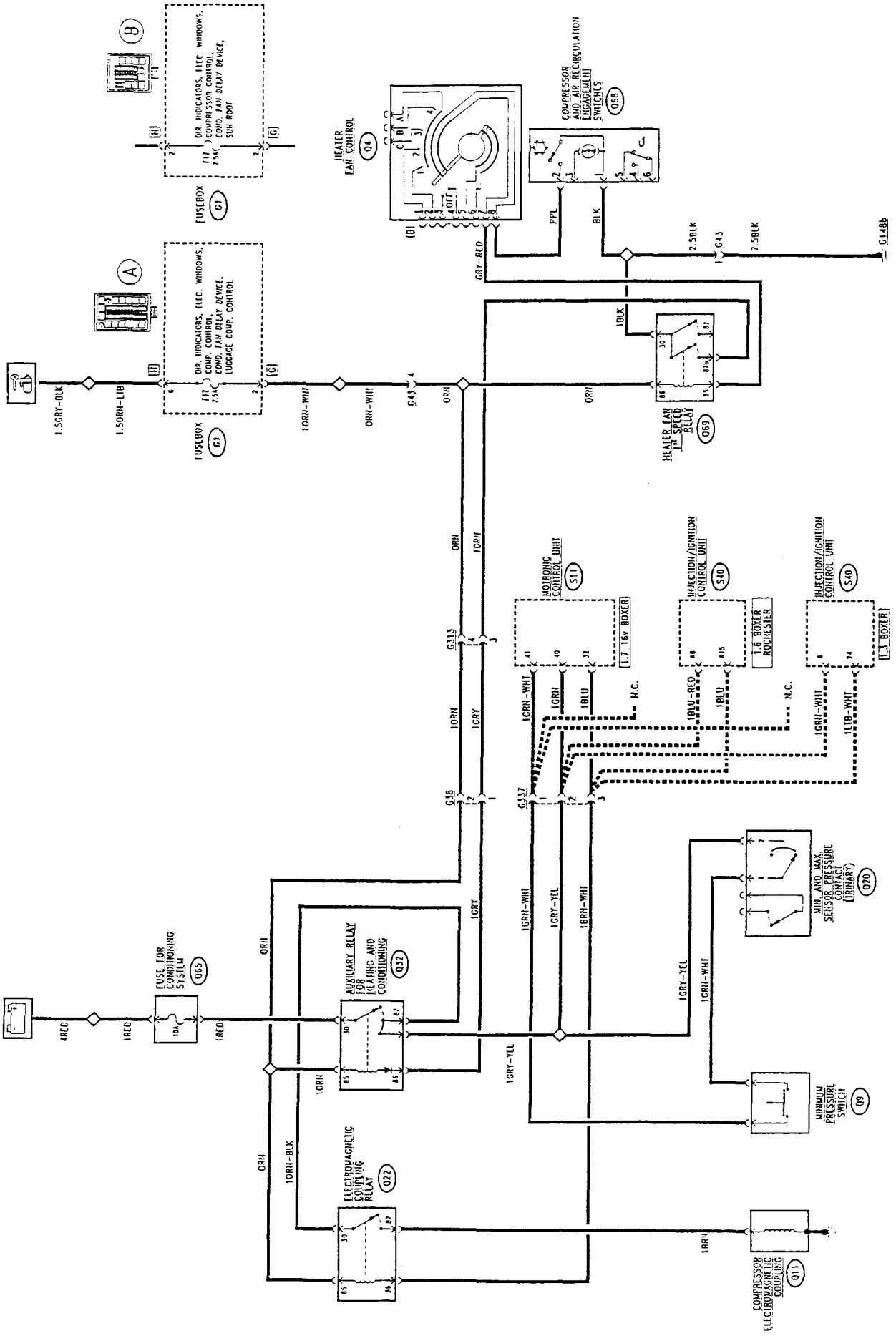
Wiring Diagram (Boxer version 1.6- MOTRONIC MP3.1)



Wiring Diagram (other Boxer versions - up to chassis no 4065017)



Wiring Diagram (Boxer versions - from chassis no 4065018)



Functional Description

- up to chassis no. 4065017

The electromagnetic joint which operates the compressor **Q11** is controlled by relays **Q22 and Q32**, to be found in the set of relays and fuses **Q41**.

Relays **Q22** and **Q32**, have the coil supplied from the ignition switch (line protected by fuse **F17** of **G1**); their power line is supplied by battery voltage through fuse **Q65** (7.5A), also located in group **Q41**, as well as through floating fuse **Q39** (30A) which protects the entire system.

Relay **Q22** is energized and consequently supplies 12V to the electromagnetic joint **Q11**, according to the following logic:

BOXER Version 1.6 (MOTRONIC MP3.1) :

- Relay **Q32** is energized by a signal leading from **Q69**, which is in turn energized with a signal leading from the compressor operating switch **Q68**; this signal crosses the control knob **Q4** which interrupts it when the knob itself is in the "OFF" position, In this condition, the compressor cannot be turned on. It should be remembered that the same signal controls the first speed of the fan contemporaneously ("Fan and Recirculation Control").
- the same control signal is also sent to the other relay **Q22**: this signal crosses the minimum pressure switch (antifrost) **Q9** and the minimum and maximum pressure switch (trinary) **Q20** which intervene if the pressure in the cooling system is too high or too low: in this case the control signal does not reach **Q22** which operates the compressor.
- relay **Q32** sends a signal to the Motronic control unit MP3.1 (pin 29) which informs this system about the "request" to turn on the compressor.
- the other signal sent to the control unit (pin 32 of the Motronic MP3.1 control unit) is the one which supplies joint **Q11**, and thereby informs that the compressor has actually been turned on.

BOXER Version 1.7 16v:

- relay **Q32** is energized by a signal leading from relay **Q69**, which is in turn energized with a signal leading from the compressor switch **Q68**; This signal crosses the control knob **Q4** which interrupts it when the knob itself is in the "OFF" position. In fact in this condition, the compressor cannot be turned on. It should be remembered that the same signal controls the first speed of the fan contemporaneously ("Fan and Recirculation Control").
- relay **Q32** consequently sends two signals to the Motronic M2.10 control unit **S11**,: a direct "request" signal to turn the compressor on to pin 41, and a second signal which crosses the minimum pressure switch (antifrost) **Q9** and the minimum and maximum pressure switch (trinary) **Q20** which intervene if the pressure in the cooling system is too high or too low: in this case the signal does not reach the control unit at pin 40, and the control unit does not command the turning on of the compressor
- the control unit "refers" the command signal - pin 32 of **S11** - to relay **Q22** which is energized and supplies joint **Q11** which turns on the compressor, but only when the internal logic has ascertained determinate conditions (for example the compressor does not turn on in the event of the engine requiring full power, etc...)

BOXER Version 1.3 and BOXER 1.6 (ROCHESTER):

- relay **Q32** is energized by a signal leading from relay **Q69**, which is in turn energized with a signal from the compressor operating switch **Q68**; this signal crosses the control knob **Q4** which interrupts it when the knob is at the "OFF" position: indeed in this condition the compressor cannot be turned on. It should be remembered that the same signal controls the first speed of the fan contemporaneously ("Fan and Recirculation Control").
- relay **Q32** consequently sends a signal to the IAW control unit **S40**, to pin 8 (IAW) or pin A8 (Rochester), which crosses the minimum pressure switch (antifrost) **Q9** and the minimum and maximum pressure switch (trinary) **Q20** which intervene if the pressure in the cooling system is too high or too low: in this case the signal does not reach the control unit **S40** which does not command the turning on of the compressor
- the control unit "refers" the command signal - pin 24 (IAW) or pin A15 (Rochester) of **S40** - to relay **Q22** which is energized and supplies joint **Q11** which turns on the compressor, but only when the internal logic has ascertained determinate conditions (for example the compressor does not turn on in the event of the engine requiring full power, etc...)

Functional description

- from chassis no. 4065018

The electromagnetic joint which operates the compressor **Q11** is controlled by relays **Q22 and Q32**, located on the auxiliary bracket for relays and fuses.

Relays **Q22** and **Q32**, have the coil supplied from the ignition switch (line protected by fuse **F17** of **G1**); conversely the power line is supplied by battery voltage via fuse **Q65** (7.5A).

The relay **Q22** is energised, and thus supplies 12 V current to the electromagnetic joint **Q11**, according to the following logic:

BOXER 1.7 16v version:

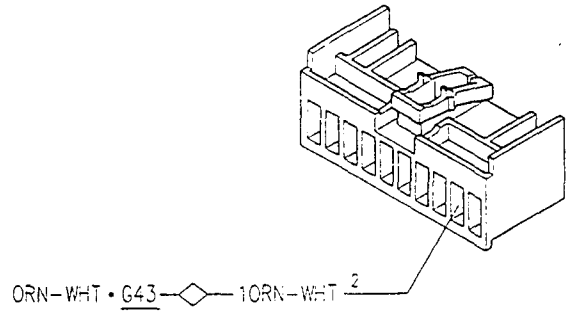
- the relay **Q32** is energised by a signal leading from relay **Q69**, which is in turn energised with a signal leading from the compressor engagement switch **Q68**; this signal crosses the control knob **Q4** which cuts it off when the knob is at "OFF": in this condition, in fact, the compressor can not be engaged. You are reminded that the same signal simultaneously controls engagement of the fan at first speed ("Fan and Recirculation control")
- the relay **Q32** consequently sends two signals to the Motronic M2.10 control unit **S11**,: a direct signal to "request compressor engagement" at pin 41, and a second signal which crosses the pinimum pressure switch (antifrost) **Q9** and the minimum and maximum pressure switch (trinary) **Q20** which cut n in the event of high or low pressure in the cooling system: in this case the signal does not reach the control unit at pin 40, and this does not command engagement of the compressor
- the control unit "relays" the command signal - pin 32 of **S11** - to relay **Q22** which is energised and supplies the joint **Q11** which thereby engages the compressor, but only when the internal logic has checked determinate conditions (e.g. the compressor does not engage in the case of the need for full power at the engine, etc..)

BOXER 1.3 and BOXER 1.6 (ROCHESTER) version

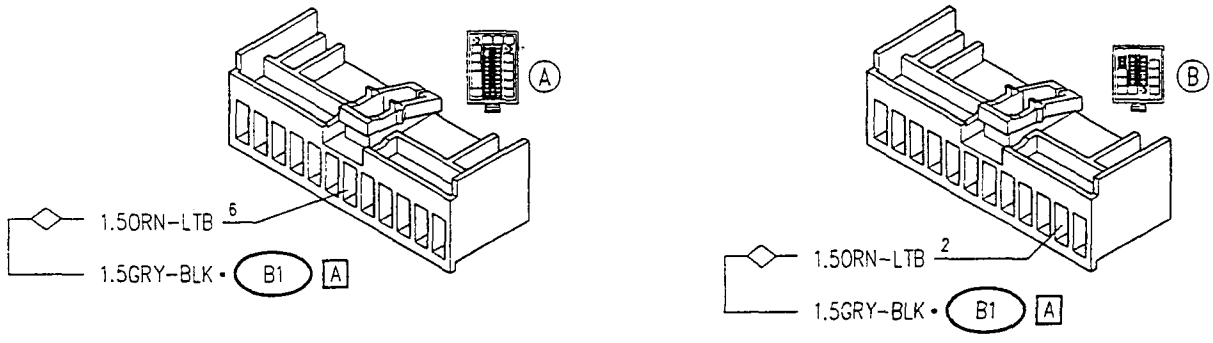
- the relay **Q32** is energised by a signal leading from relay **Q69**, which is in turn energised with a signal leading from the compressor engagement switch **Q68**; this signal crosses the control knob **Q4** which cuts it off when the knob is at "OFF": in this condition, in fact, the compressor can not be engaged. You are reminded that this signal simultaneously controls engagement of the fan at 1st speed ("Fan and Recirculation control")
- the relay **Q32** consequently sends a signal to the control unit **S40**, at pin 8 (IAW) or pin A8 (Rochester), which crosses the minimum pressure switch (antifrost) **Q9** and the minimum and maximum pressure switch (trinary) **Q20** which cut in if the event of high or low pressure in the cooling system: in this case the signal does not reach the control unit **S40** and this does not engage the compressor
- the control unit "relays" the command signal - pin 24 (IAW) or pin A15 (Rochester) di **S40** - to relay **Q22** which is energised and supplies the joint **Q11** which thereby engages the compressor, but only when the internal logic has checked determinate conditions (e.g. the compressor is not engaged if the engine needs full power, etc..)

Components and Connectors

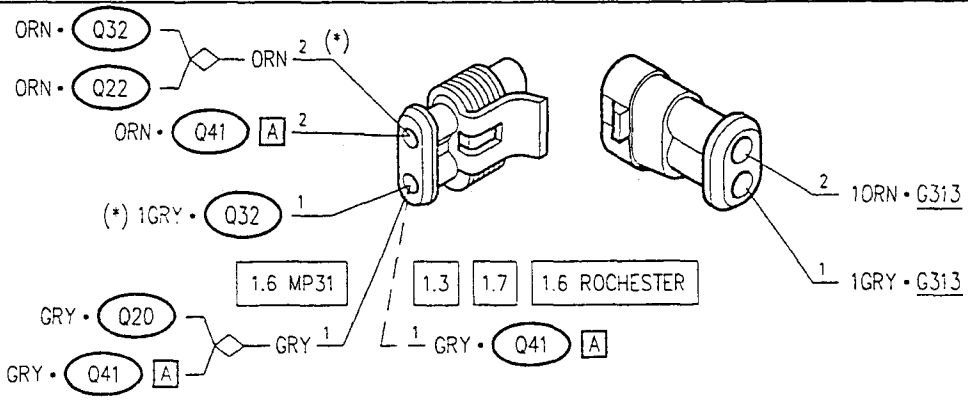
Fusebox	G1 G



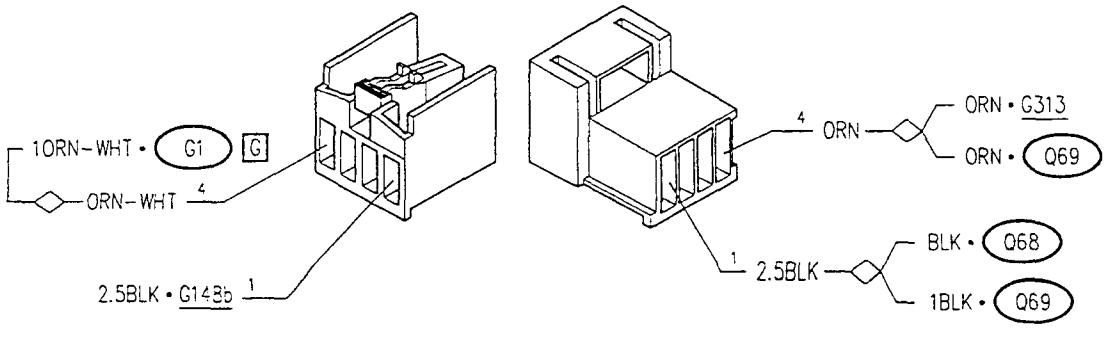
Fusebox	G1 H



Air conditioner wiring connector	G38



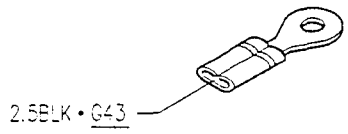
Heating & ventilation wiring connector	G43



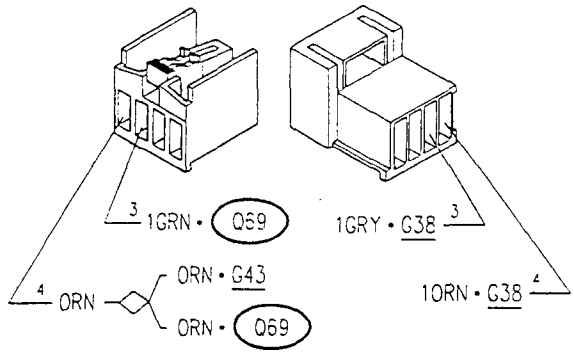
(*) from chassis no. 4065018

Components and connectors (cont.d)

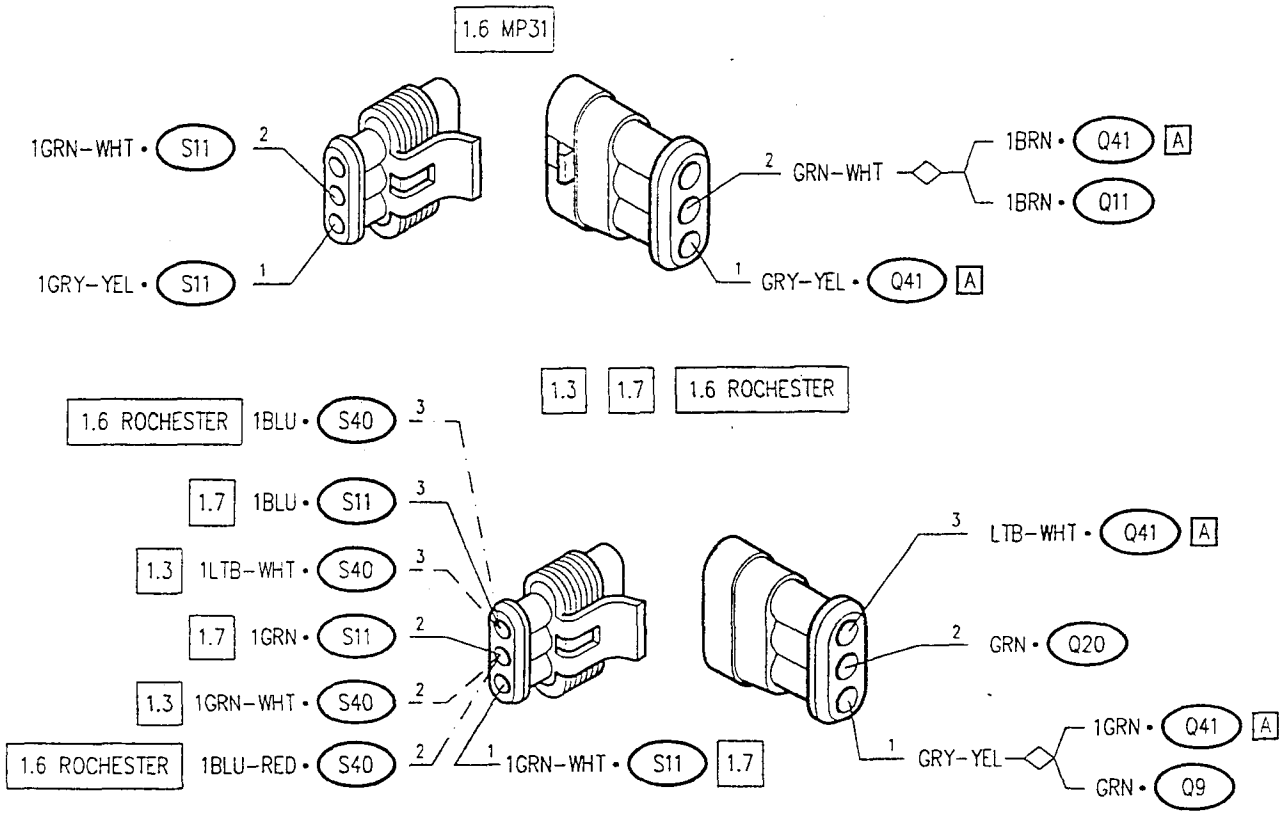
Earth under LH dashboard.	G148b



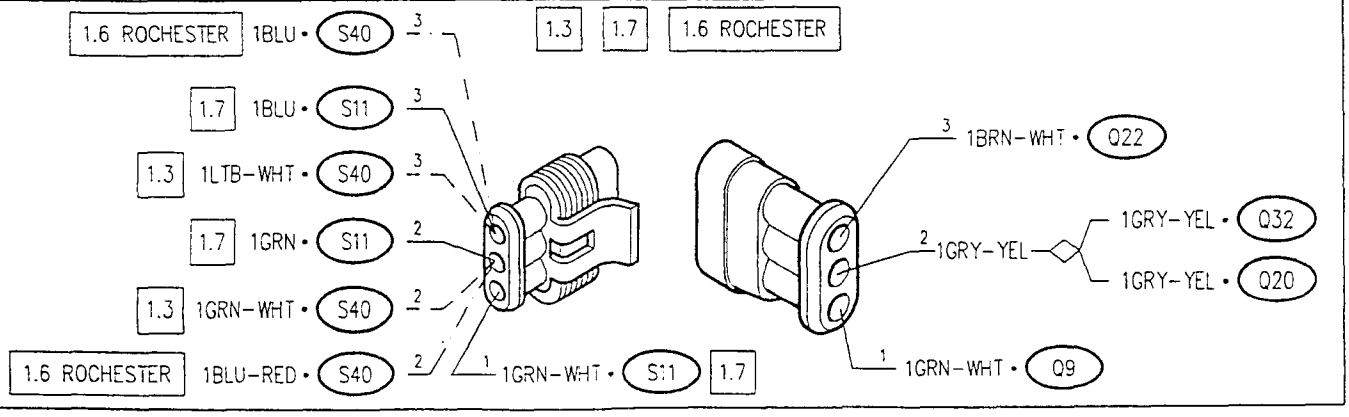
Additional conditioner wiring connector	G313



Conditioner system/injection system connector	G337



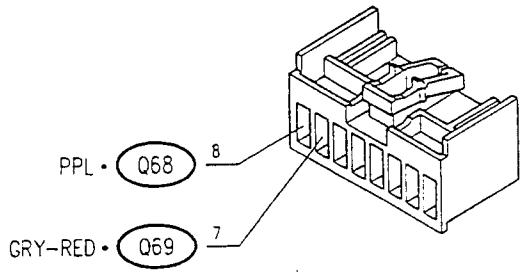
Conditioner system/injection system connector	G337



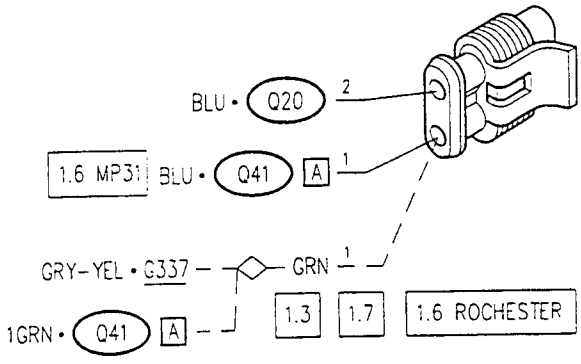
(*) from chassis no. 4065018

Components and connectors (cont.d)

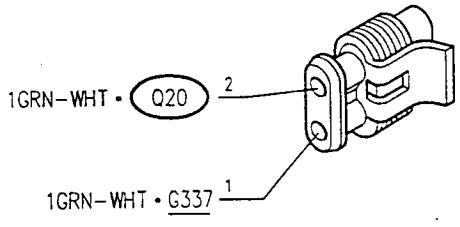
Heating and ventilation fan control — Q4 B



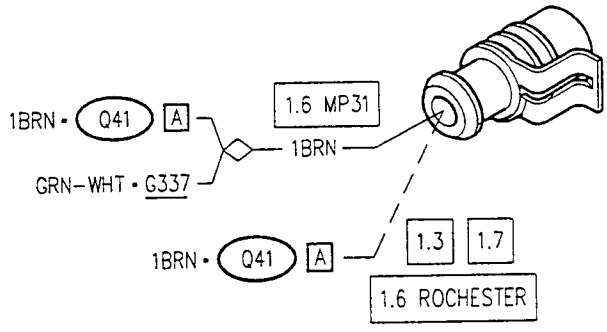
Minimum pressure switch — Q9



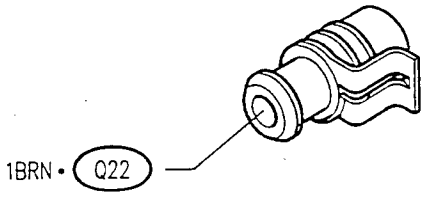
Minimum pressure switch (*) — Q9



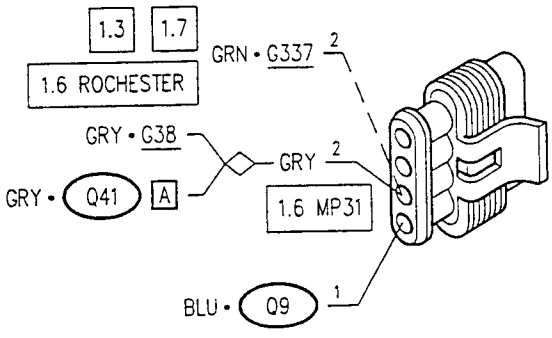
Compressor electromagnetic joint — Q11



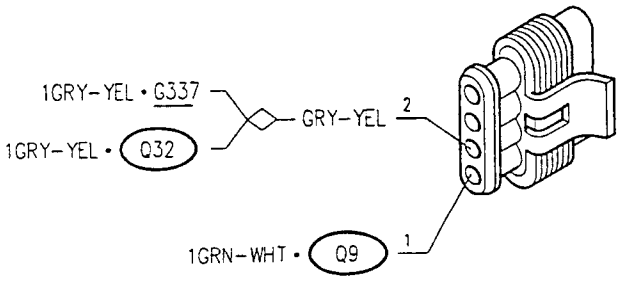
Compressor electromagnetic joint (*) — Q11



Min. & max. sensor pressure contact (Trinary) — Q20



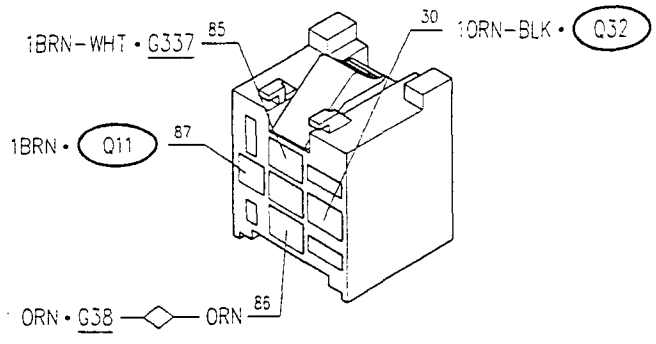
Min. & max. sensor pressure contact (Trinary) (*) — Q20



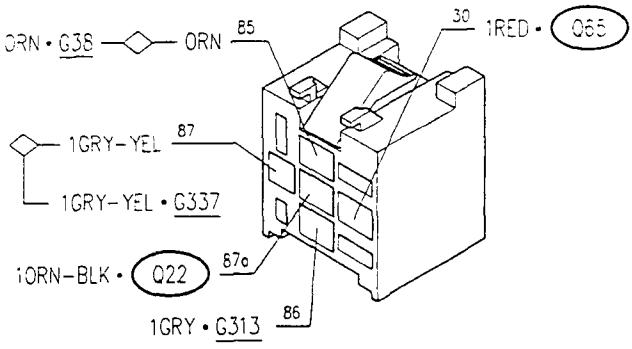
(*) from chassis no. 4065018

Components and connectors (cont.d)

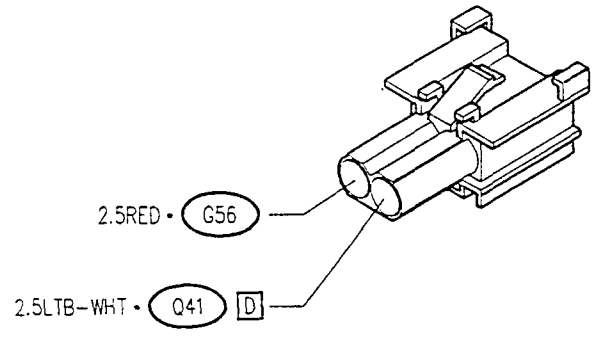
Electromagnetic coupling relay — Q22



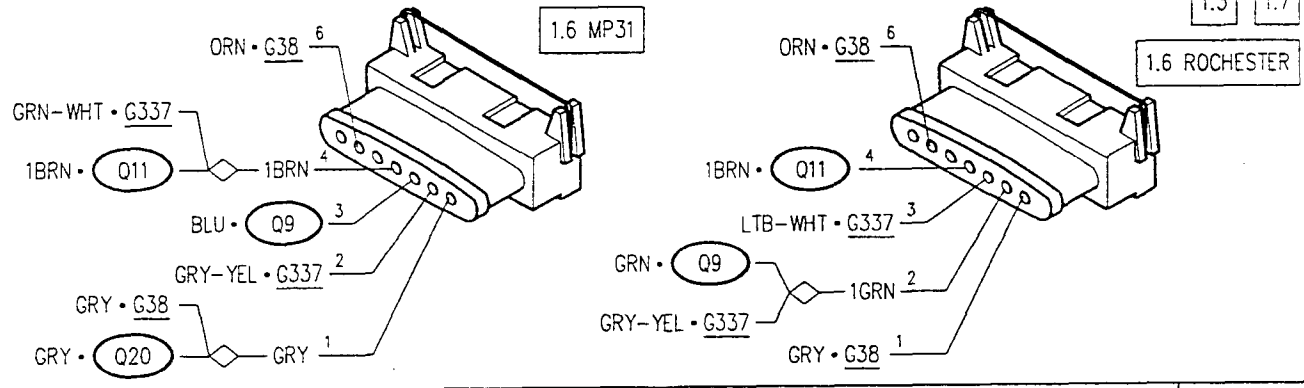
Auxiliary relay for heating and ventilation — Q32



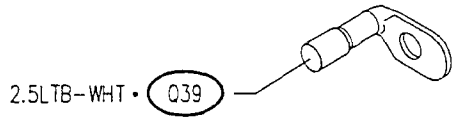
Conditioner system floating fuse-30A (•) — Q39



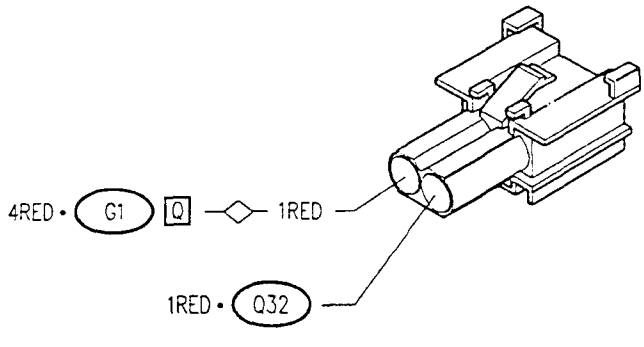
Set of conditioner relays and fuses (•) — Q41 A



Set of conditioner relays and fuses (•) — Q41 D



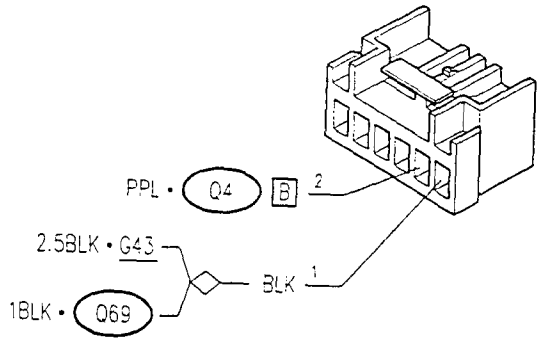
Fuse for conditioning system-7.5 A — Q65



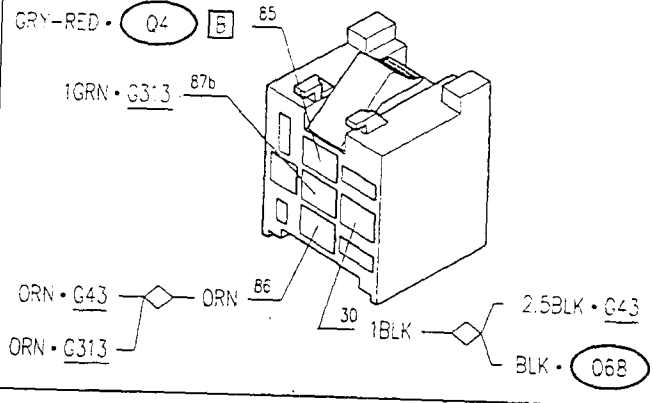
(•) only up to chassis no. 4065017

Components and connectors (cont.d)

Compressor and air recirculation switches — Q68

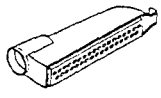


Heater fan 1st speed relay — Q69

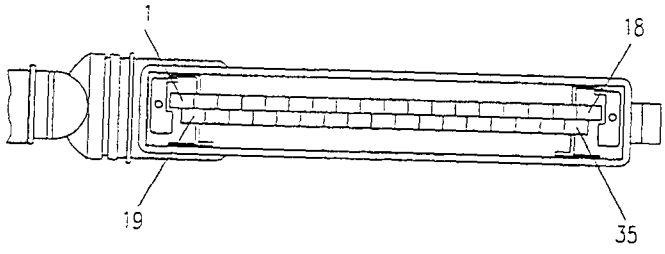


Motronic control unit — S11

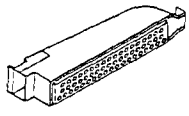
1.6



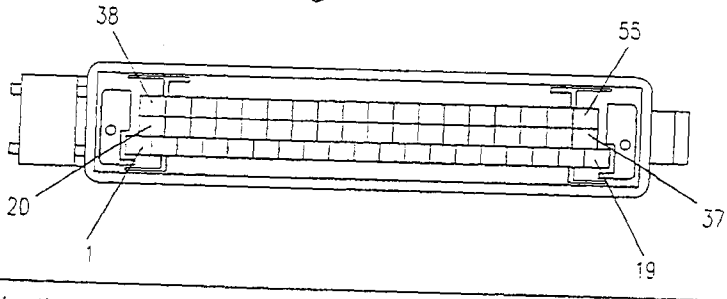
29 1GRY-YEL • G337
32 1GRN-WHT • G337



1.7

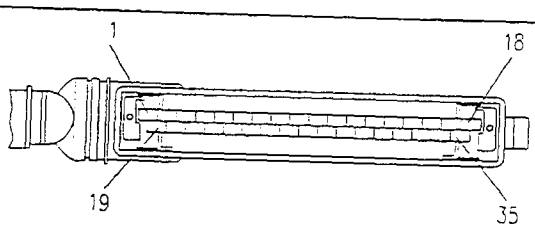


32 1BLU • G337
40 1GRN • G337
41 1GRN-WHT • G337



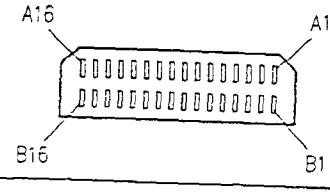
Injection/ignition control unit — S40

6 1GRN-WHT • G337
32 1LTB-WHT • G337



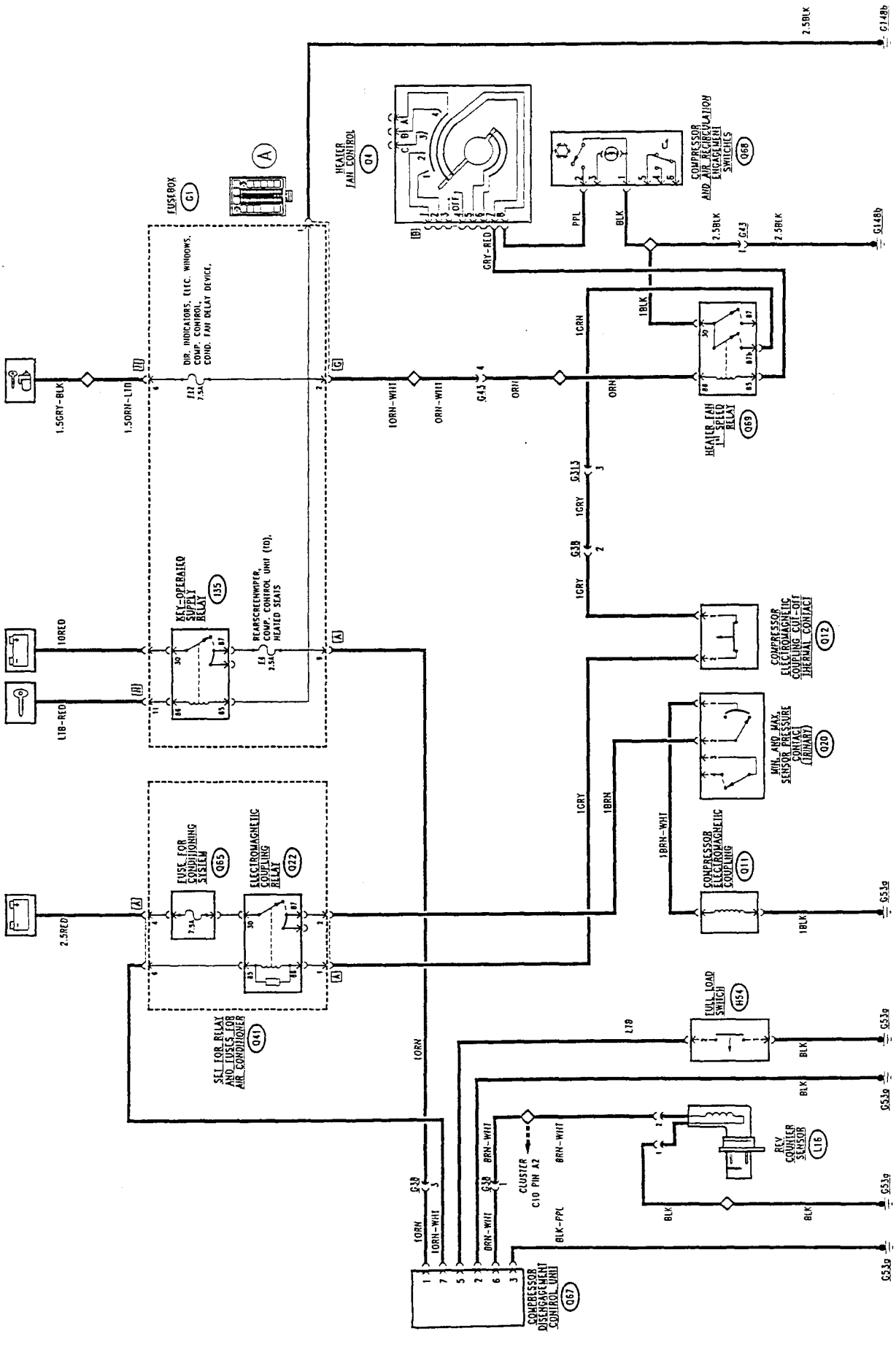
1.3

A8 1BLU-RED • G337
A15 1BLU • G337

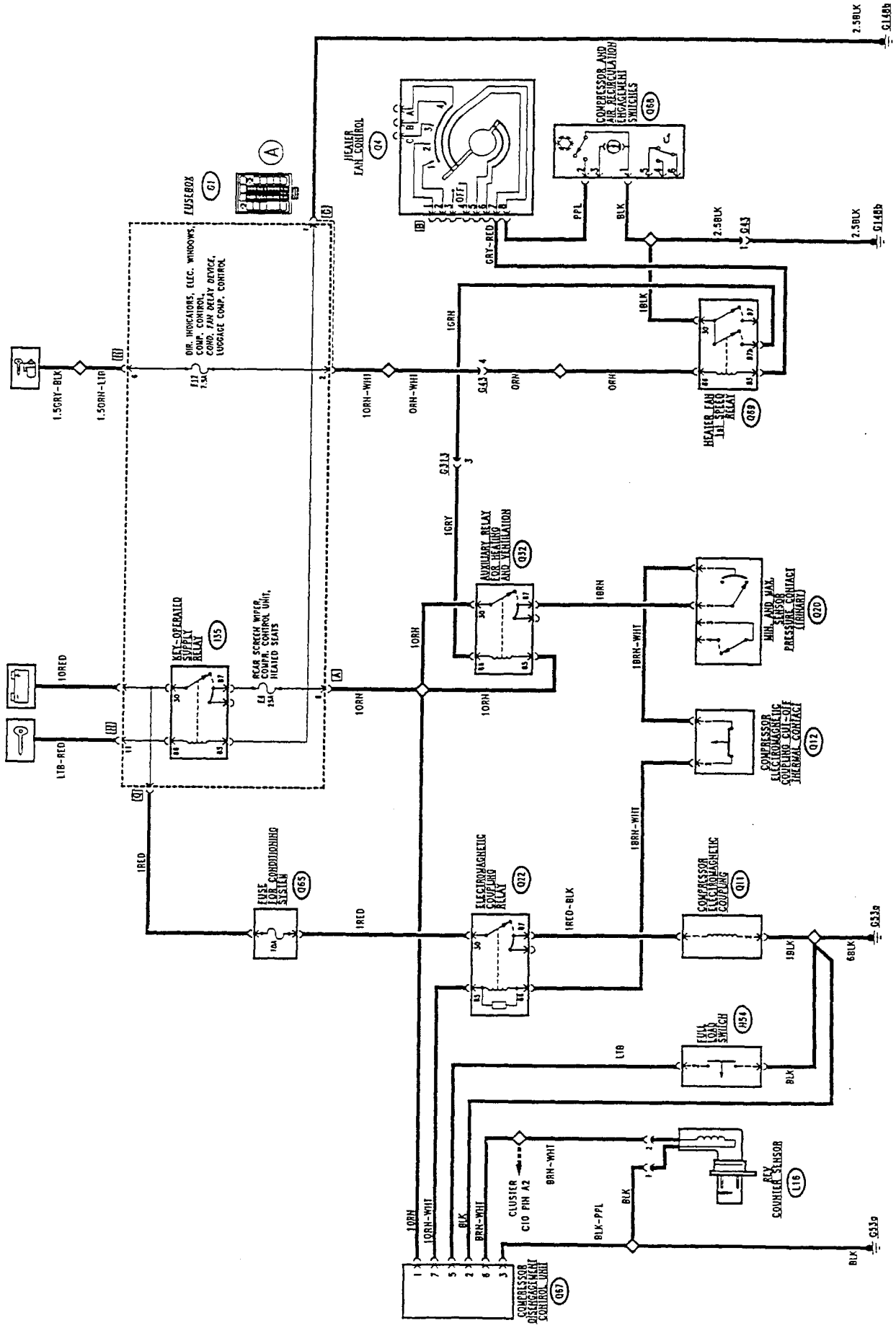


1.6 ROCHESTER

Wiring Diagram (TD version - up to chassis no. ....)



Wiring Diagram (TD version - from chassis no. ....)



Functional Description

The electromagnetic joint which operates the compressor **Q11** is operated by the corresponding relay **Q22**.

Relay **Q22** is supplied directly by the battery, via fuse **Q65**.
The two energising signals (12 V and earth) reach the relay **Q22** from the compressor cutout control unit **Q67**, and from the control switch **Q68**:

- the earth signal leads from relay **Q69**, which is energised with a signal leading from the compressor cutout switch **Q68**; this signal crosses the control knob **Q4** which cuts it off when the actual knob is in the "OFF" position: in this condition, in fact, the compressor cannot be engaged. In addition, before reaching relay **Q22** crosses the compressor cutout thermal contact Q12 - which disengages the compressor if the engine is very hot, and - from chassis no. .... - pressure switch **Q20**. In this version there is also an auxiliary relay **Q32** which is energised by the earth signal leading from relay **Q69** and controls relay **Q21**.
- the signal from the control unit **Q67** is either 12 V or 0 V (earth), according to the following logic, in relation to engine rpm (information picked up directly from the rev counter sensor **L16**:
  - up to 2000 rpm: when the full load switch **H54** closes, an earth signal leaves the control unit - pin 7- therefore the compressor electromagnetic joint is not energised; vice versa as soon as the switch opens again, the signal from pin 7 becomes 12 V, energising the joint;
  - above 2000 rpm: the earth signal is timed and lasts only for 8 seconds, then it becomes 12 V, therefore the joint is energised and engages the compressor, provided that the pushbutton **Q68** has been pressed.

The control unit **Q67** is connected, as mentioned previously, to the rev counter sensor **L16** at pins 3 and 6, to switch **H54** at pin 5; pin 2 is earthed, while pin 1 receives the "key- operated" supply via relay **I35** and fuse **F4** of the fusebox **G1**: the signal for engaging the compressor leaves pin 7 as described above.

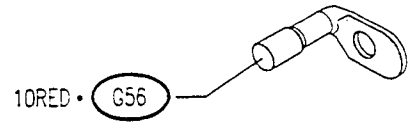
When it is energised, relay **Q22** operates the compressor electromagnetic joint **Q11** which engages the compressor.

This control signal - up to chassis no. .... - must not however be cut off by the minimum and maximum pressure switch (trinary) **Q20** - located between relay **Q22** and the compressor joint **Q11** - which cuts in if the pressure of the cooling system is too high or too low.

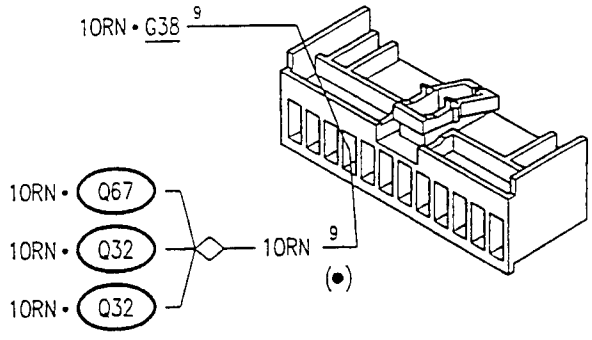
Relay Q22 and fuse Q65 are to be found - up to chassis no. .... - in the set of fuses and relays Q41.

Components and Connectors

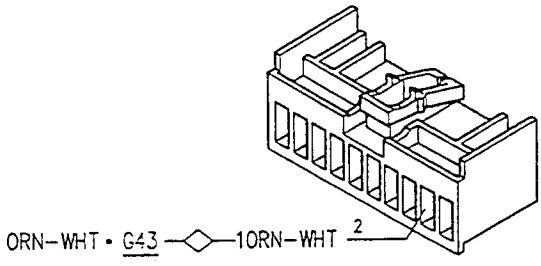
Fusebox	G1



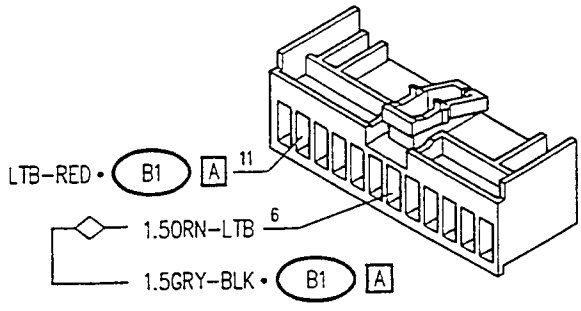
Fusebox	G1 A



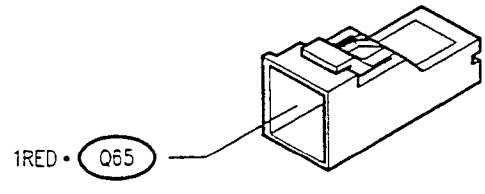
Fusebox	G1 G



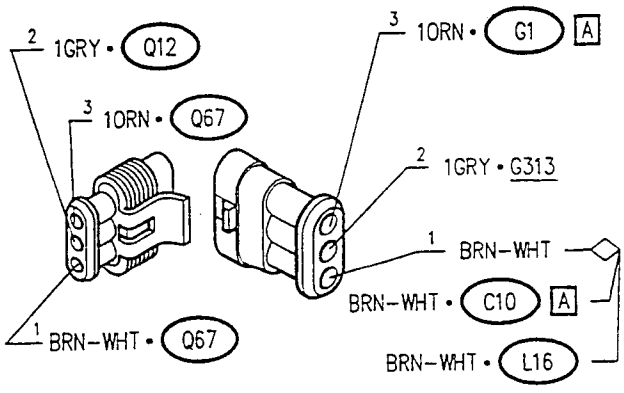
Fusebox	G1 H



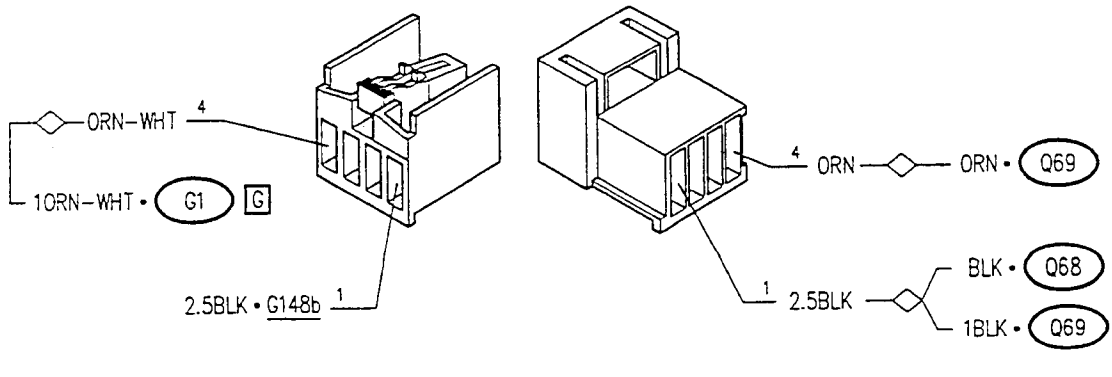
Fusebox (•)	G1 Q



Conditioner wiring connector	G38



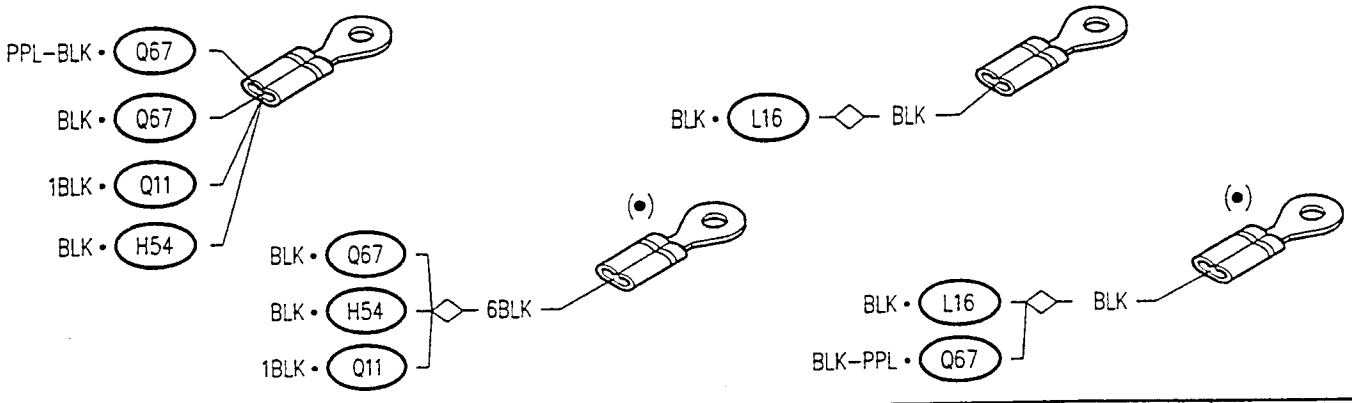
Climate control wiring connector	G43



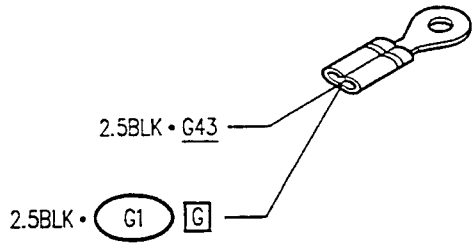
(•) Variant from chassis no....

Components and Connectors (contd.)

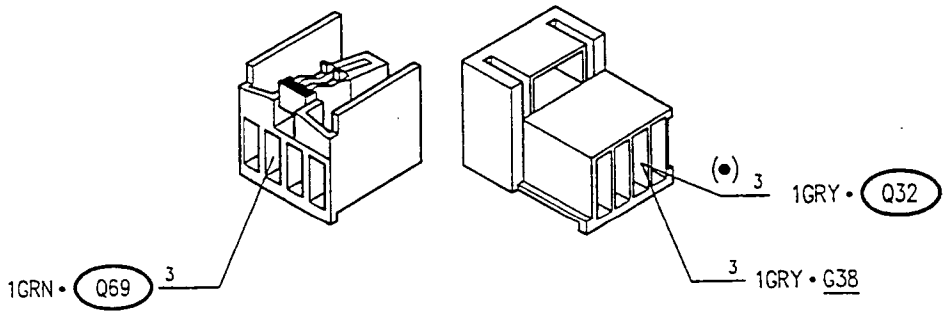
RH engine compt. earth	G53a



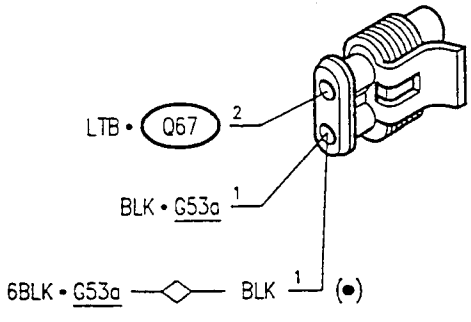
LH earth under dashboard	G148b

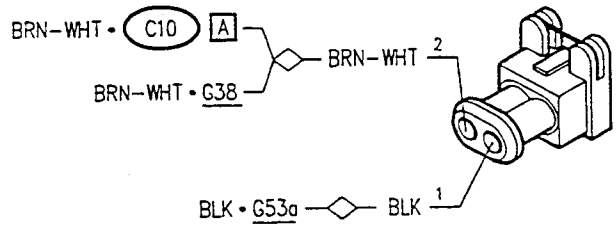


Additional conditioner wiring connector	G313



Full load switch	H54	Rev counter sensor	L16

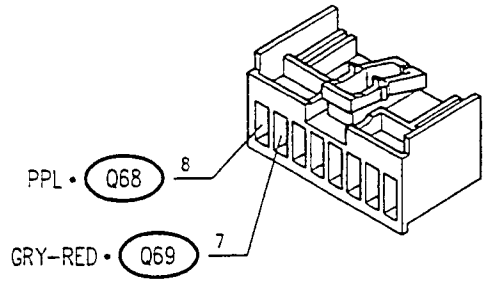




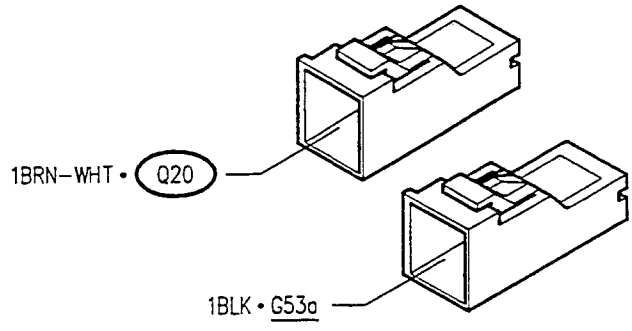
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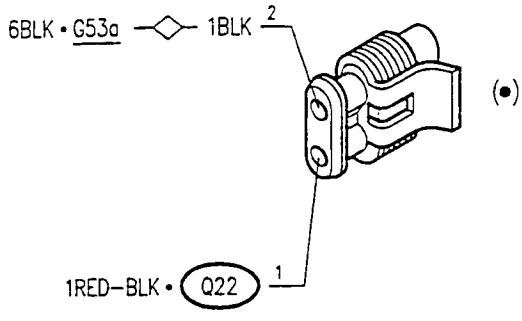
Components and Connectors (contd.)

Climate control fan command — Q4 B

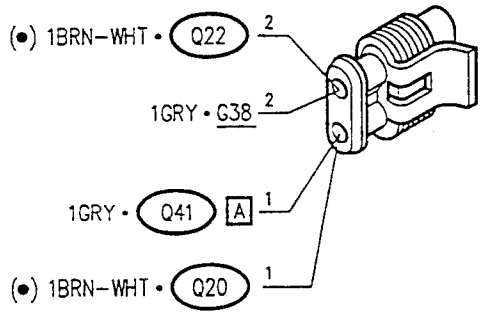


Compressor electromagnetic joint — Q11

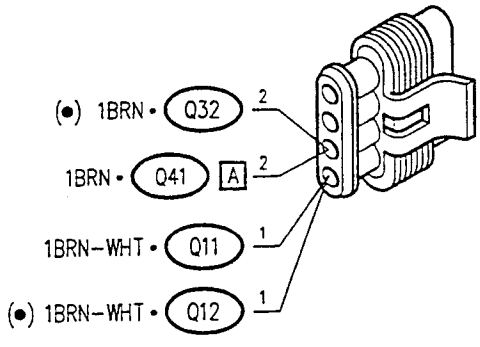




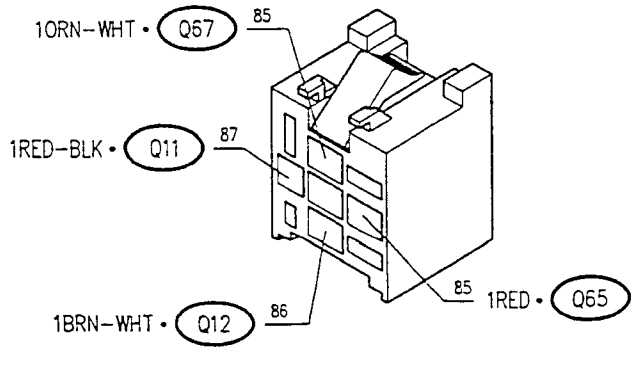
Compressor electromagnetic joint connector — Q12



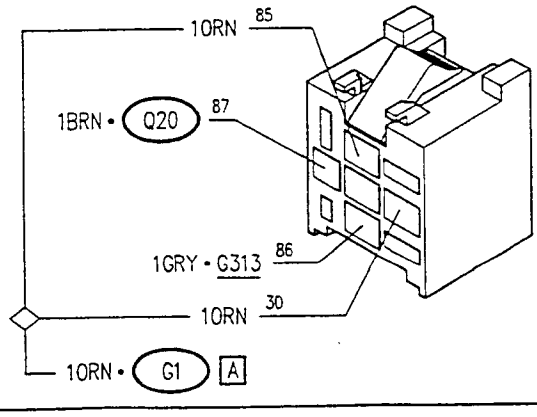
Min. and max. sensor pressure contact (Trinary) — Q20



Electromagnetic joint control relay (•) — Q22



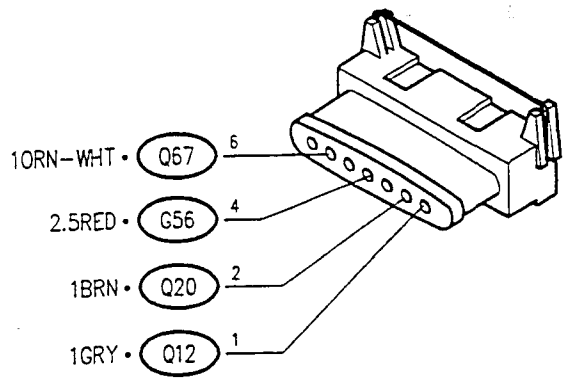
Auxiliary climate control relay(•) — Q32



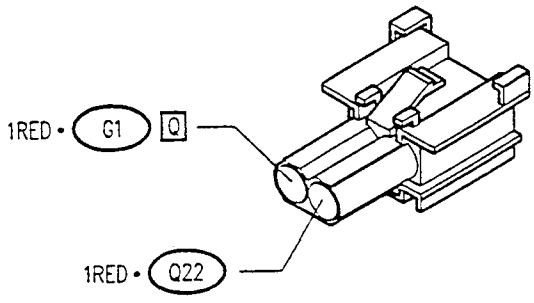
(•) Variant from chassis no....

Components and Connectors (contd.)

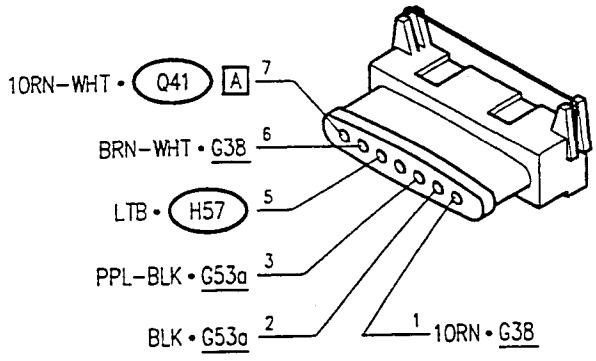
Set of conditioner relays and fuses — Q41 A

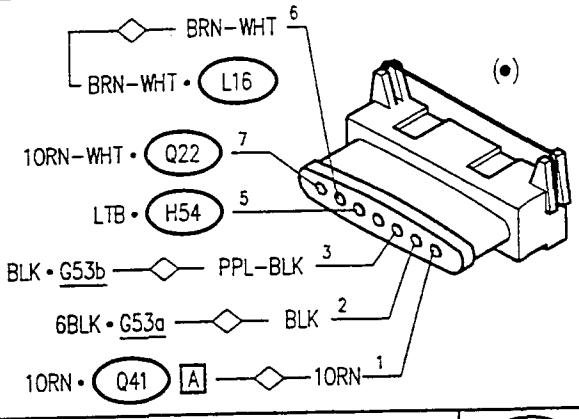


Conditioning system wanderfuse (•) — Q65

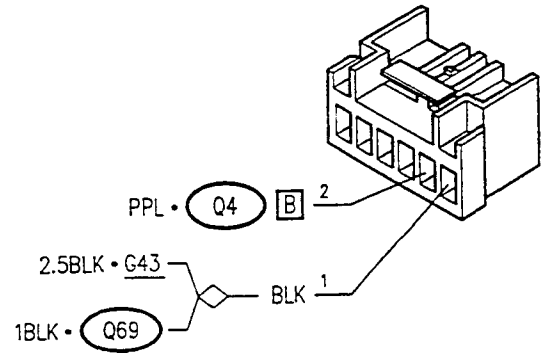


Compressor cutout control unit — Q67

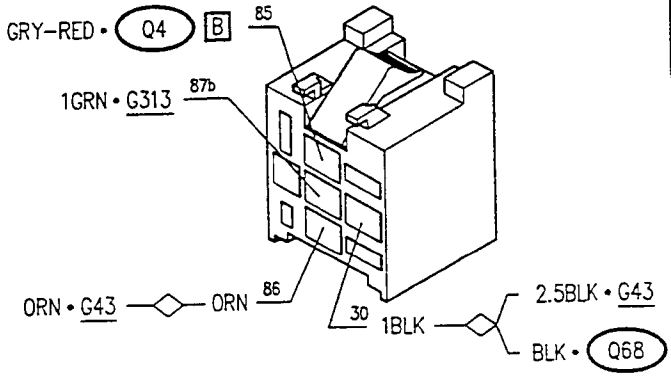




Compressor engagement and air recirculation switches — Q68

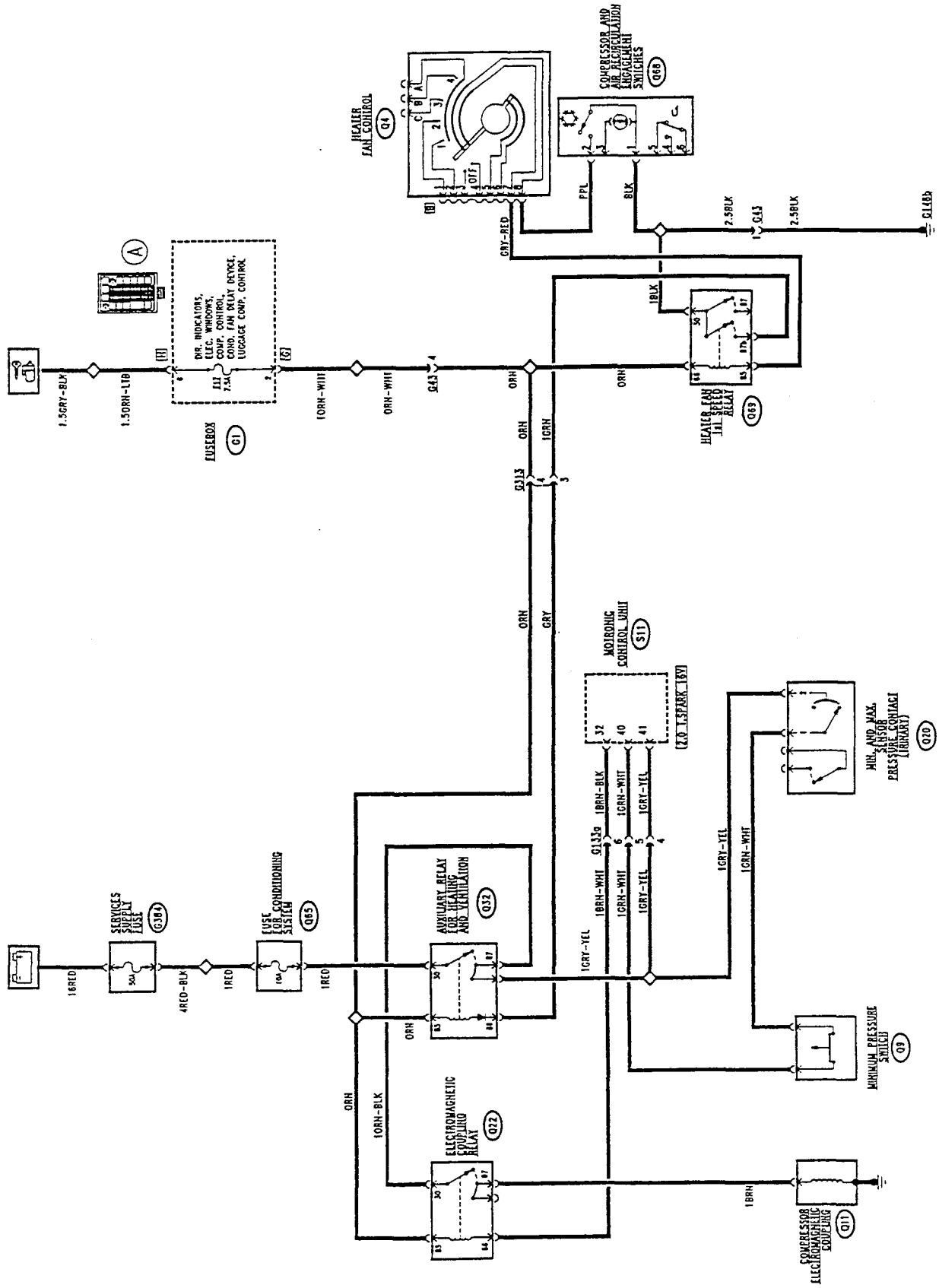


Climate control fan 1st speed relay — Q69



(•) Variant from chassis no....

Wiring Diagram (T.SPARK)



Functional Description

The electromagnetic joint which operates the compressor **Q11** is controlled by relays **Q22** e **Q32**.

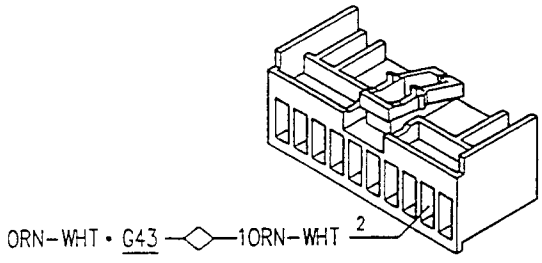
Relays **Q22** and **Q32**, have the coil supplied by the "key- operated" line (protected by fuse **F17** of **G1**); the power line is supplied by battery voltage via fuse **Q65** (10A) and the general fuse **G384** (50A).

Relay **Q22** is energised, therefore it supplies the 12 V signal to the electromagnetic joint **Q11**, according to the following logic:

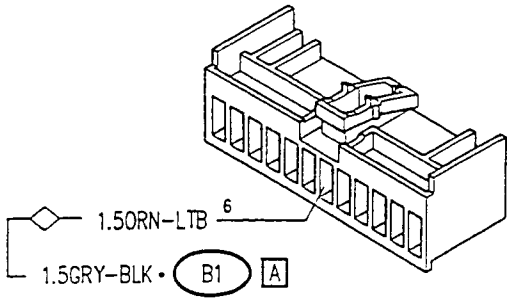
- relay **Q32** is energised by a signal leading from relay **Q69**, which in tum energised with a signal leading from the compressor engagement switch **Q68**; this signal crosses the control knob **Q4** which cuts it off when the knob itself is at "OFF": in fact, in this condition, the compressor cannot be engaged. You are reminded that the same signal simultaneously controls the engagement of the fan at first speed ("Fan and Recirculation Control")
- relay **Q32** consequently sends two signais to the Motronic control unit **S11**,: a direct signal to "request engagement of the compressor" to pin 41, and a second signal which crosses the minimum pressure switch (antifrost) **Q9** and the minimum and maximum pressure switch (trinary) **Q20** which cut in if the pressure in the cooling system is too high or too low: in this case the signal does not reach the control unit at pin 40, and the compressor is not engaged
- the control unit "relays" the control signal - pin 32 of **S11** - to relay **Q22** which is energised and supplies connector **Q11** which engages the compressor, but only when the internal logic has checked determinate conditions (e.g. the compressor is not engaged in the event of the need for full power at the engine, etc..)

Components and Connectors

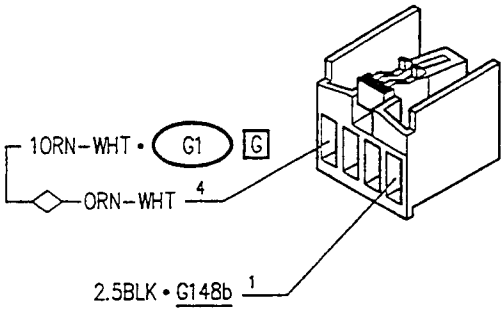
Fusebox	G1 G

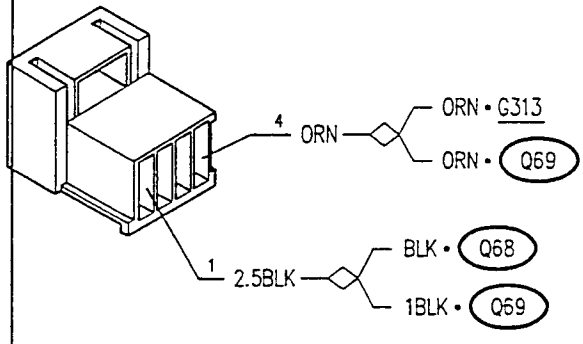


Fusebox	G1 H

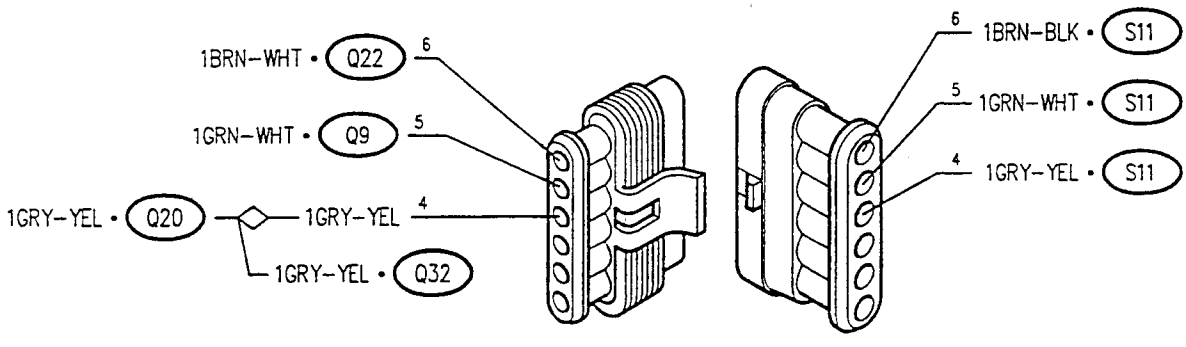


Climate control wiring connector	G43

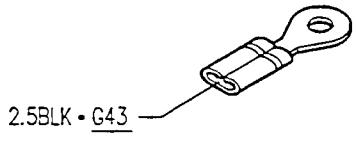




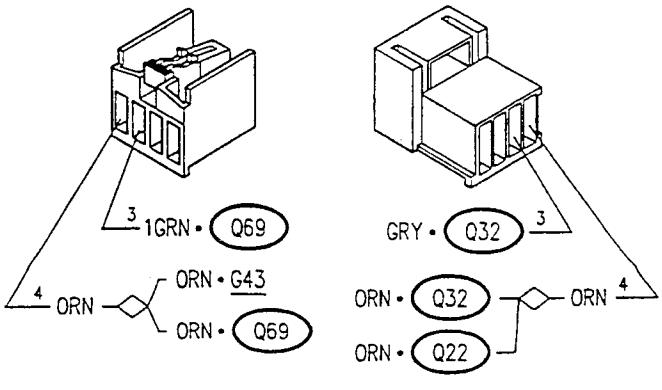
Connector for electronic injection wiring A	G133a



Earth under dashboard LH	G148b

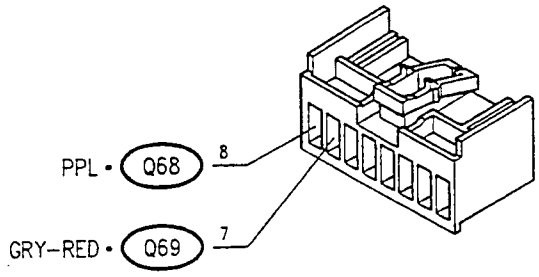


Connector for conditioner syst./ijection syst.	G313

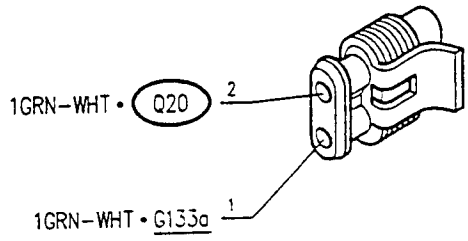


Components and Connectors (contd.)

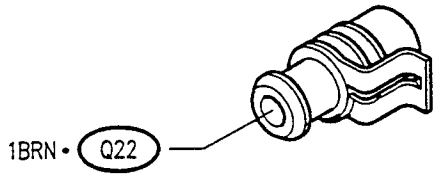
Climate control fan comand	Q4 B



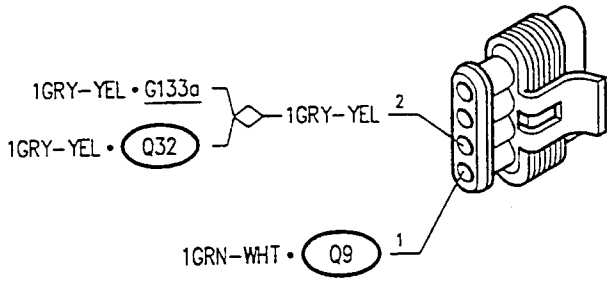
Minimum pressure switch	Q9



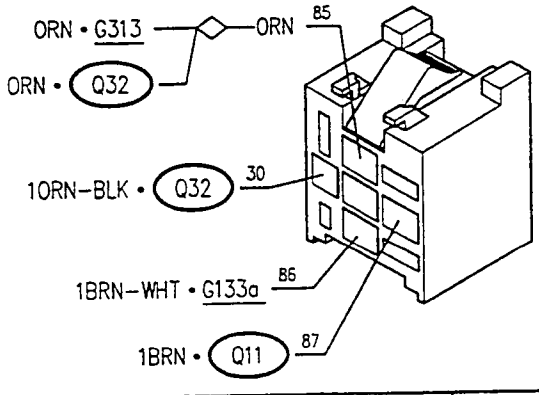
Compressor electromagnetic joint	Q11



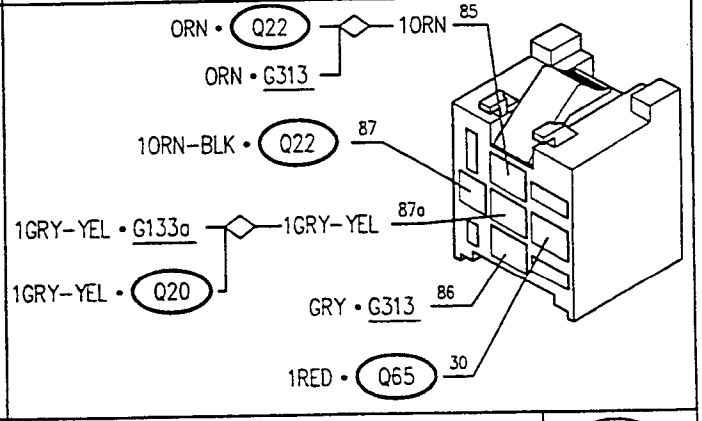
Min. and max. sensor pressure contact (Trinary)	Q20



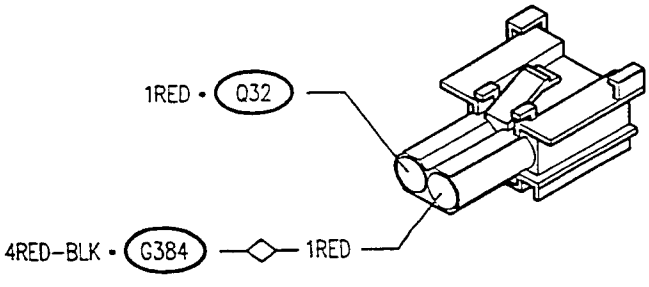
Electromagnetic joint control relay	Q22



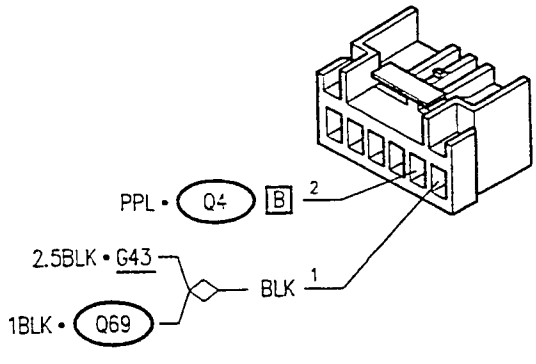
Climate control auxiliary relay	Q32



Conditioning system wander fuse	Q65

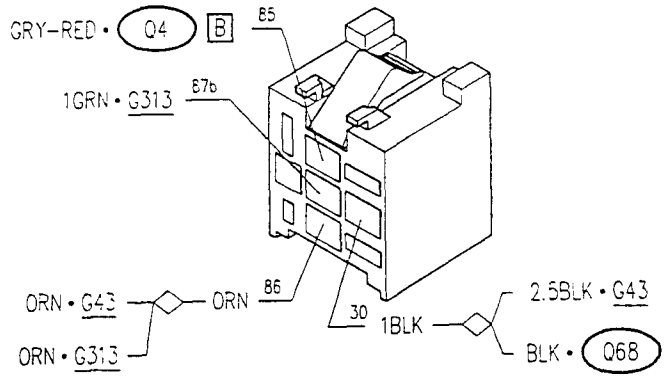


Compressor and air recirculation engagement switches	G68

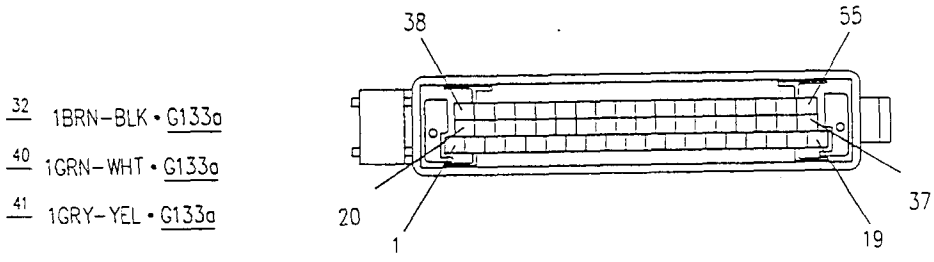


Components and Connectors (contd.)

Climate control fan 1st speed relay	Q69

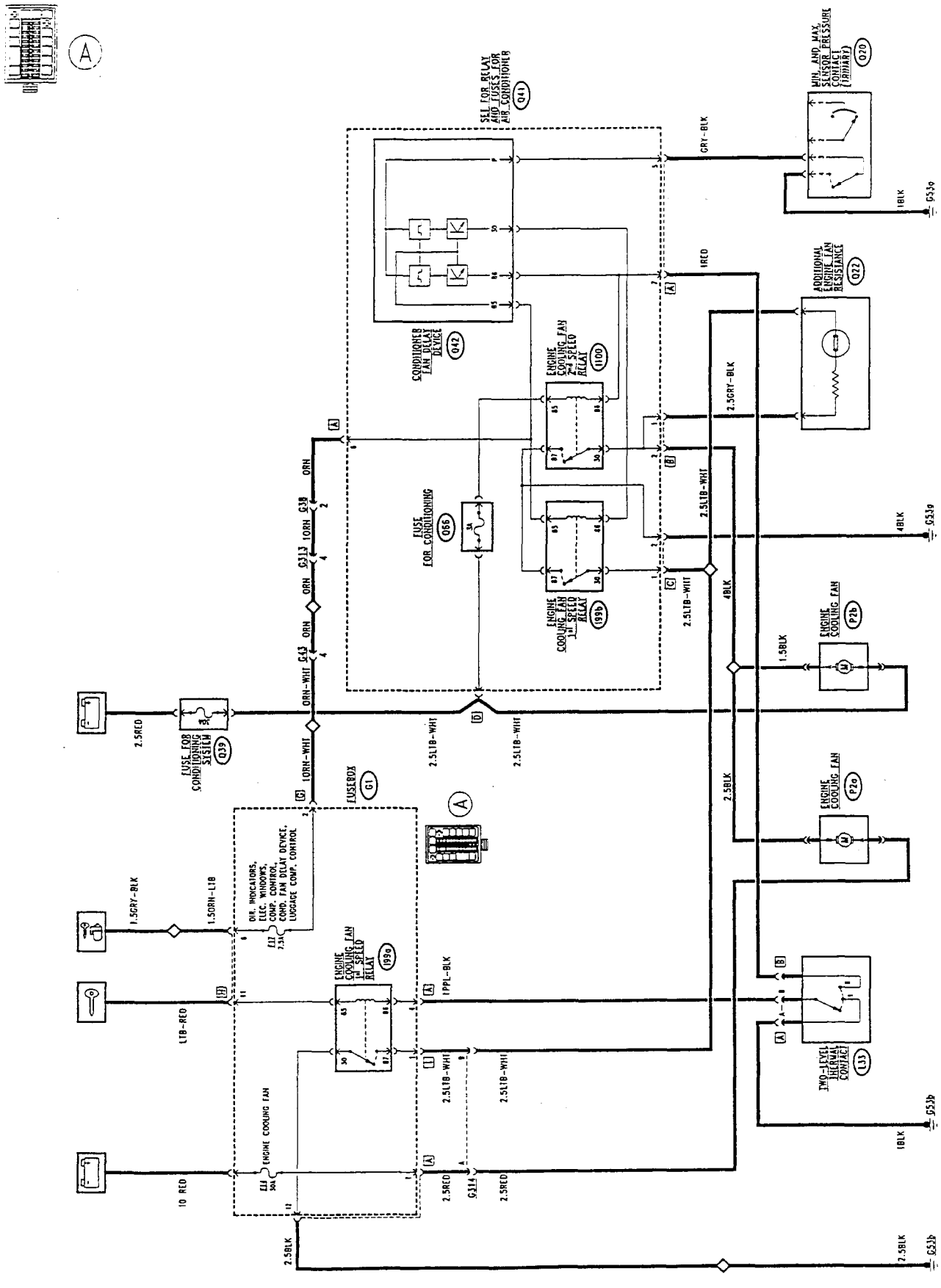


Motronic control unit	S11



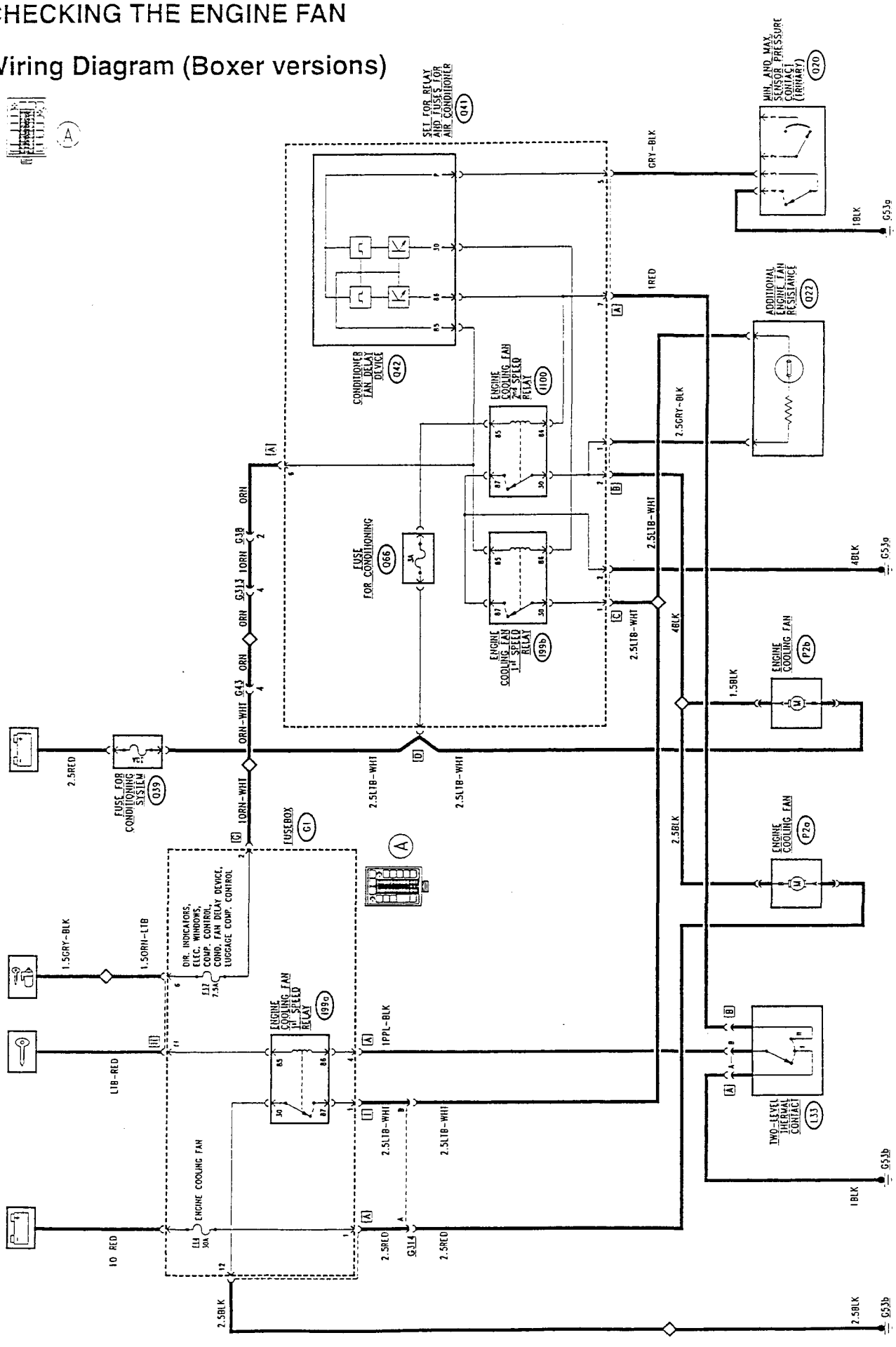
CHECKING THE ENGINE FAN

Wiring Diagram (Boxer versions - up to chassis no. 4065017)

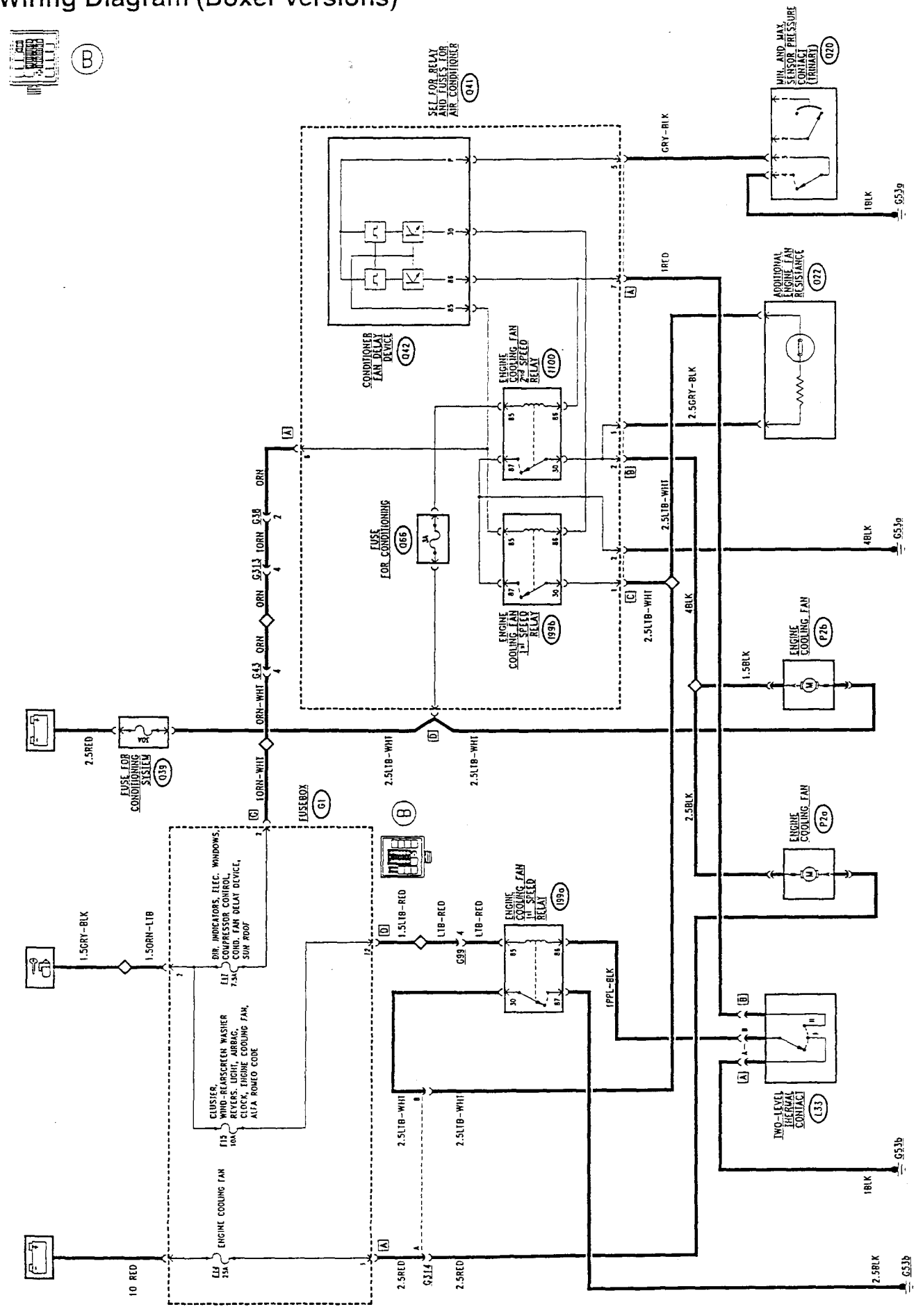


CHECKING THE ENGINE FAN

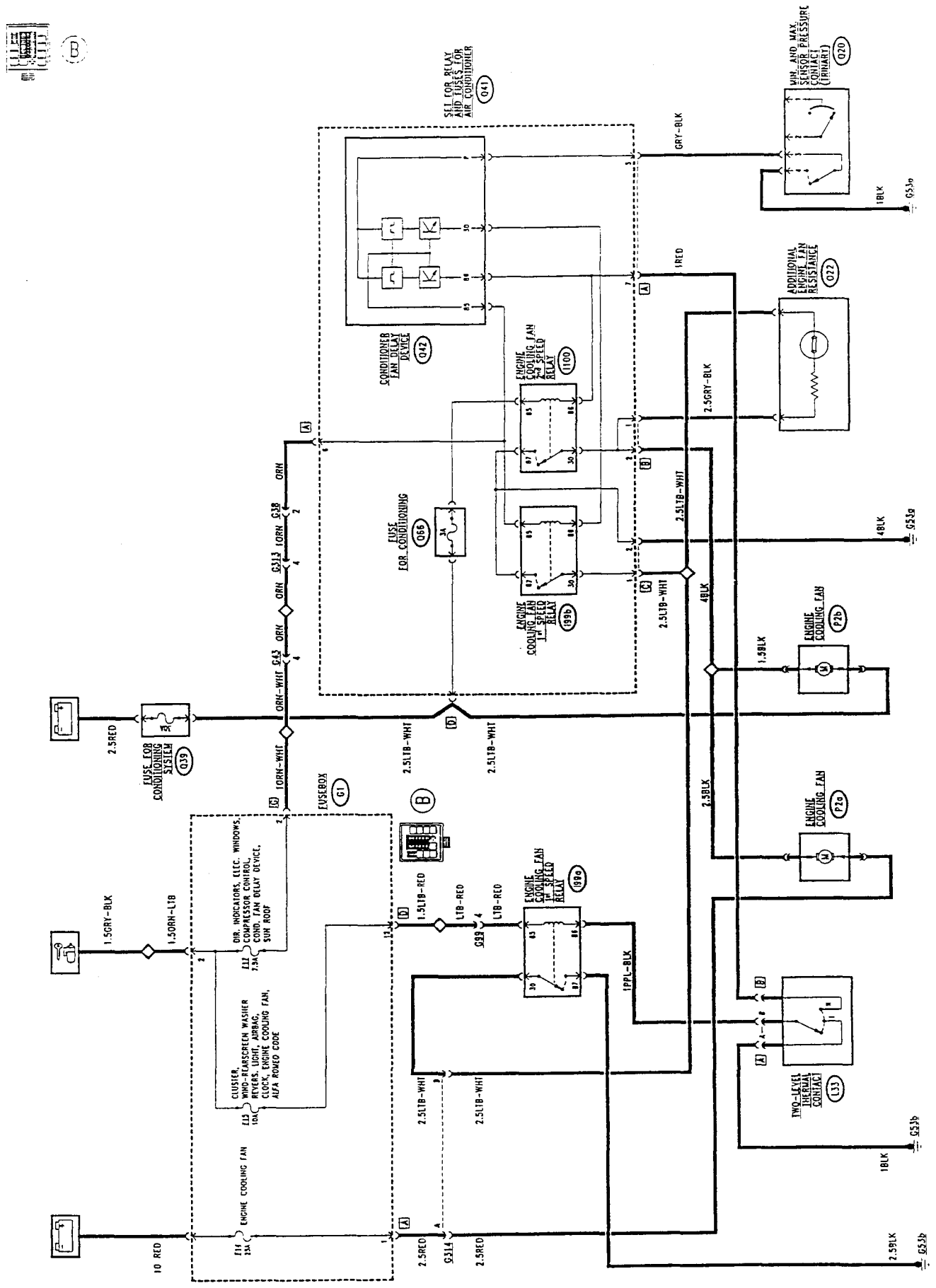
Wiring Diagram (Boxer versions)



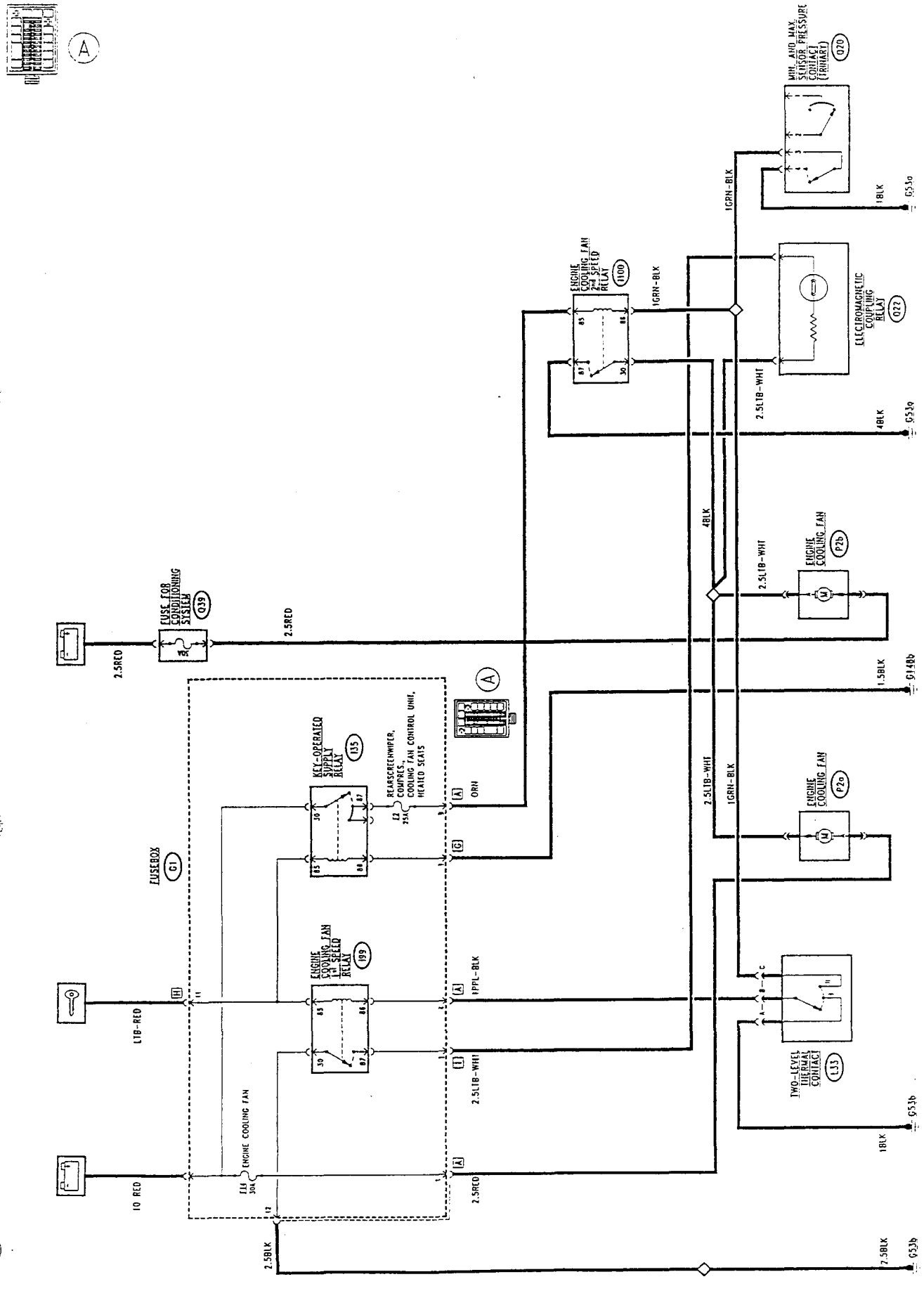
Wiring Diagram (Boxer versions)



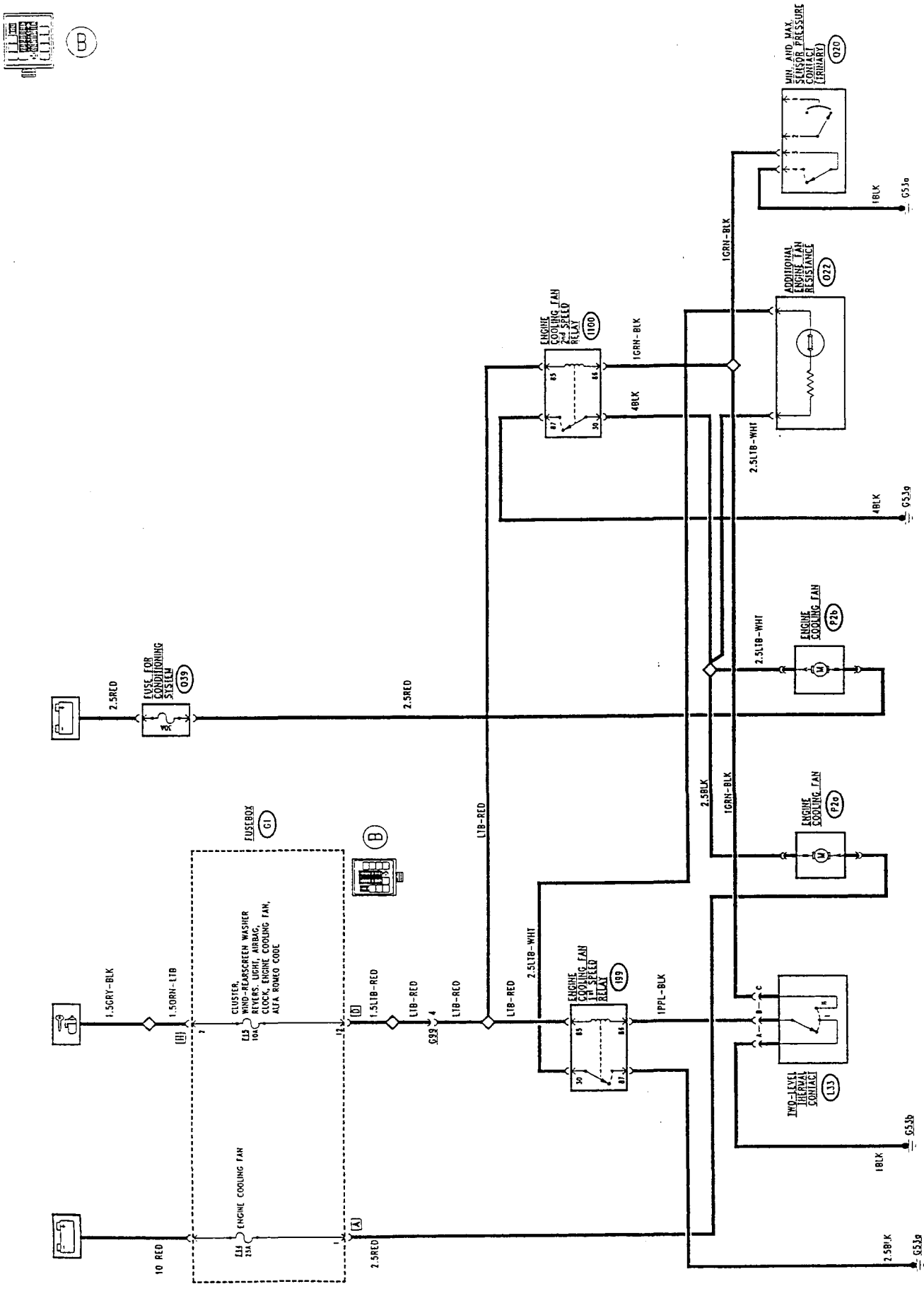
Wiring Diagram (Boxer versions - up to chassis no. 4065017)



Wiring Diagram (Boxer versions - from chassis no. 4065018)



Wiring Diagram (Boxer versions - from chassis no. 4065018)



Functional Description
- up to chassis no. 406517

Two fans **P2a** and **P2b** warrant the necessary ventilation of the cooling air for the engine and air conditioning system condenser radiator.

N.B.: the two fans are set in parallel and they are always operated together, following the same logic.

The two fans are always supplied by battery voltage: the first one (**P2a**) has the line protected by fuse **F14** of fusebox **G1**; the second one (**P2b**) is protected by floating fuse **Q39** (30A) which protects the whole system; they are therefore operated by an earth signal: this signal arrives directly (2nd speed) or through the additional resistance **O22** (1st speed) fitted with a thermal safety fuse.

The delaying device **Q42**, in group **Q41**, controls the gradual turning on of the fans which are operated at two different speeds also via two relay **I99b** and **I100**, also part of group **Q41**.

The delaying device works according to the following logic:

The "key-operated" voltage (line protected by fuse **F17** of **G1**) supplies the coil and electronic devices of the delaying device **Q42** -pin 85, and relay **I99b**, while relay **I100** is supplied by the battery voltage through floating fuse **Q39** (30 A) and fuse **Q66** (3 A) in group **Q41**. The coil of delaying device **Q42** is energized by an earth signal -pin P- which leads from the trinary pressure switch **Q20**: this causes an earth signal to be sent immediately - pin 30 - to energize relay **I99b** which sends the earth to the two engine cooling fans **P2a e P2b** through the additional resistance **O22**: 1st speed)

After appr. 8-12 seconds, if the signal from the trinary persists, the delaying device operates the second speed with an earth signal from: pin 86, which energises relay **I100** which sends the earth command directly to the two engine cooling fans **P2a e P2b:** 2nd speed.
When the signal from the pressure switch ceases the fan turns off immediately.

The two fans are operated at the two different speeds also by the two-level thermal contact **L33** which controls the temperature of the coolant in the engine radiator: when a first level is reached, relay **I99a** is energized, which is located inside fusebox **G1** in version "A" and outside it in version "B" - which sends the earth signal to the two engine cooling fans **P2a** and **P2b** through resistance O22: 1st speed.

If the second temperature level is reached, relay **I100**, is energized, which is located in group **Q41**, and this sends the earth signal directly to the two engine cooling fans **P2a and P2b**: 2nd speed.

Functional Description
- from chassis no. 406518

Two fans **P2a** and **P2b** ensure the necessary ventilation of the air for cooling the engine radiator and the conditioner system condenser.

N.B.: the two fans are in parallel, and are therefore operated together, always following the same logic.

The two fans are always supplied by battery voltage: the first (**P2a**) has the line protected by fuse **F14** of fusebox **G1**; the second (**P2b**) is protected by wander fuse **Q39** (30A) which protects the entire system; they are thus operated by an earth control signal: this signal arrives directly (2nd speed) or through the additional resistance **O22** (1st speed), fitted with a safety fuse.

Engagement of the fans, operated at two different speeds through two relays **I99** and **I100** takes place according to the following logic:

The fans **P2** are operated at two different speeds by the two-level thermal contact **L33** which controls the temperature of the coolant in the engine radiator: when a first level is reached relay **I99** is energised which sends the earth control signal to the fans **P2** via resistance **O22**: 1st speed

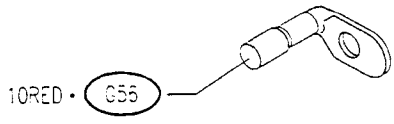
If the second temperature level is reached, relay **I100** is energised which sends the earth control signal directly to the fans **P2**: 2nd speed.

The two relays receive the key-operated supply; **I100** is supplied by the line of fuse **F4** of **G1** (fusebox A) or fuse **F15** (fusebox B).

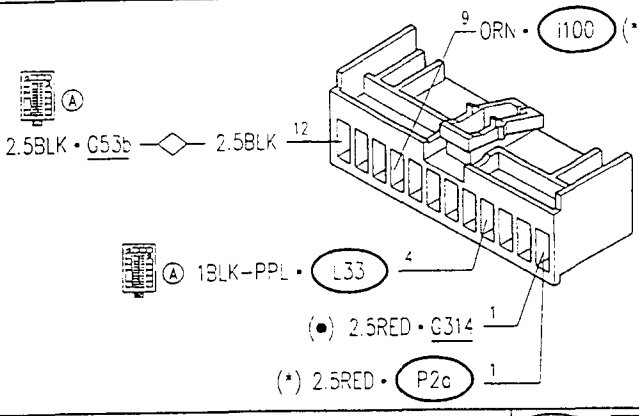
Similarly the fans **P2** are controlled at first speed by an earth signal leading from the trinary pressure switch **Q20**.

Components and Connectors

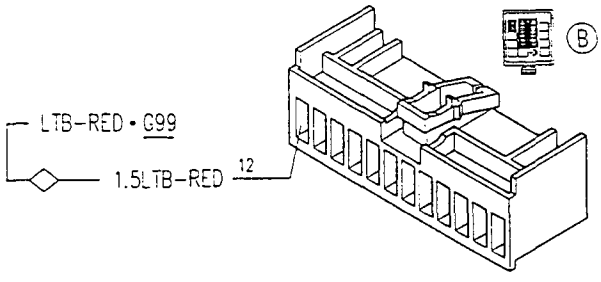
Fusebox G1



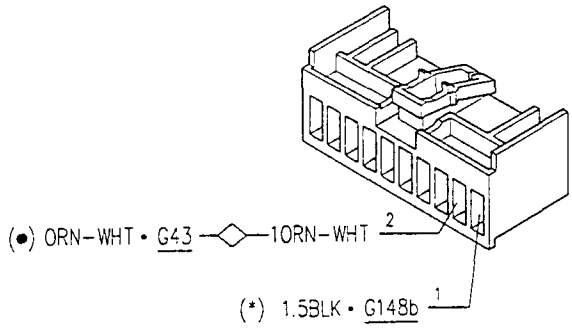
Fusebox G1 A



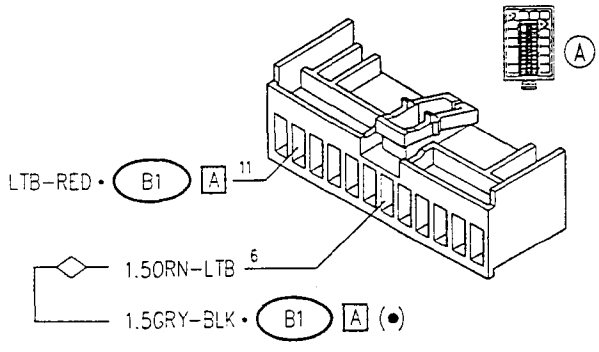
Fusebox G1 D

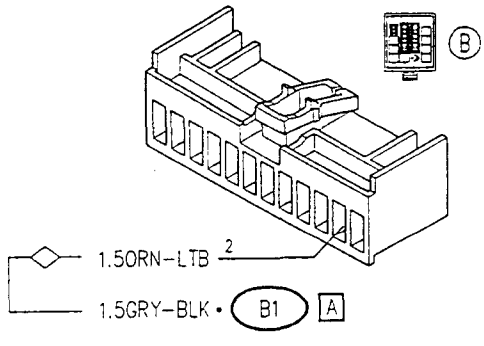


Fusebox G1 G

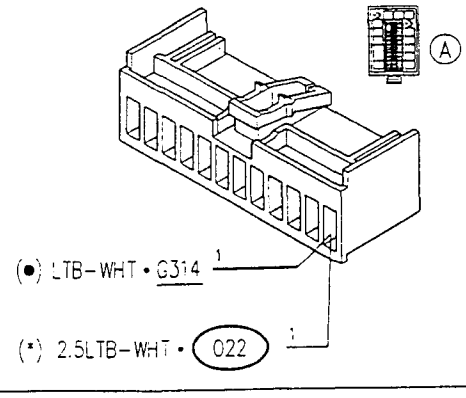


Fusebox G1 H





Fusebox G1 I

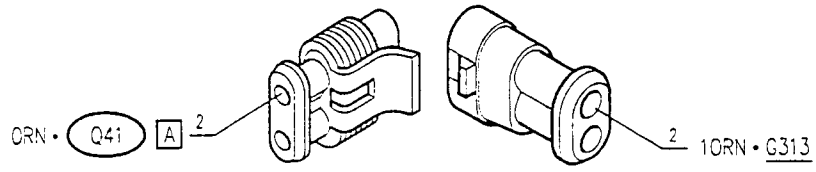


(*) from no. 4065018

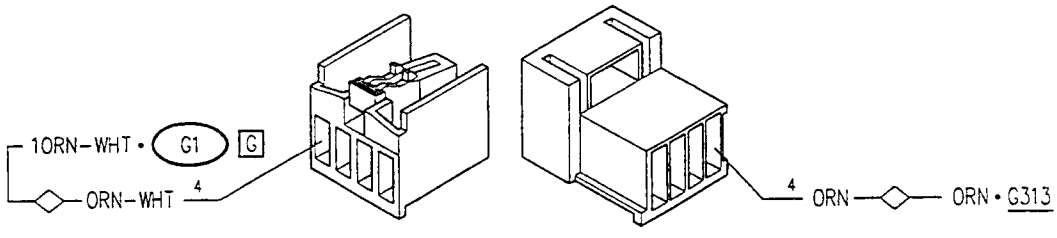
(•) up to no. 4065017

Components and connectors (cont.d)

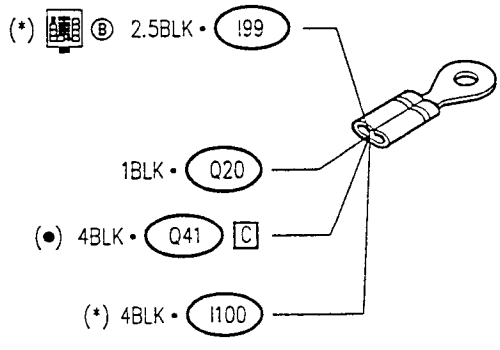
Conditioner wiring connector	G38

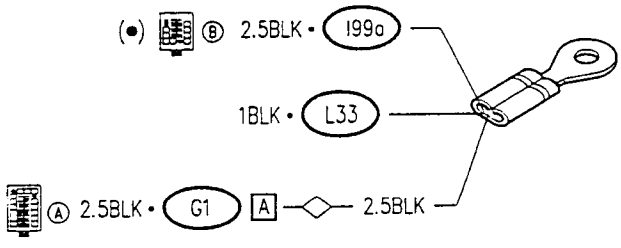


Heating & ventilation control wiring connector	G43

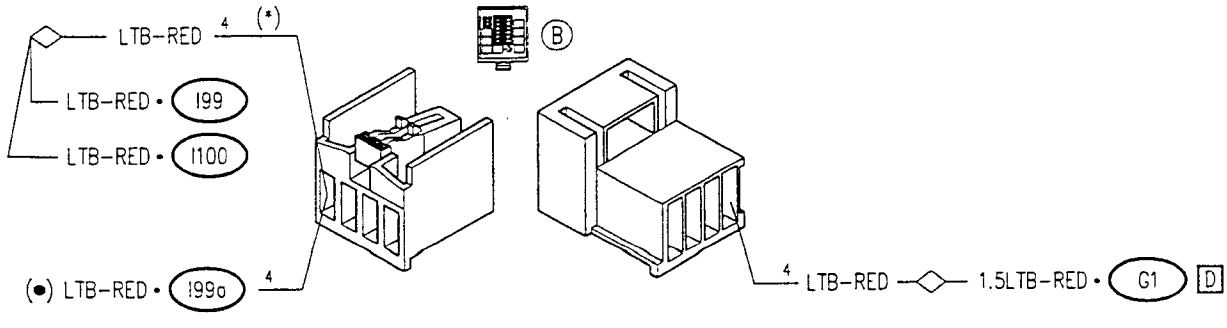


RH engine compartment earth	G53a	LH engine compartment earth	G53b





Dashboard/engine wiring connector	G99

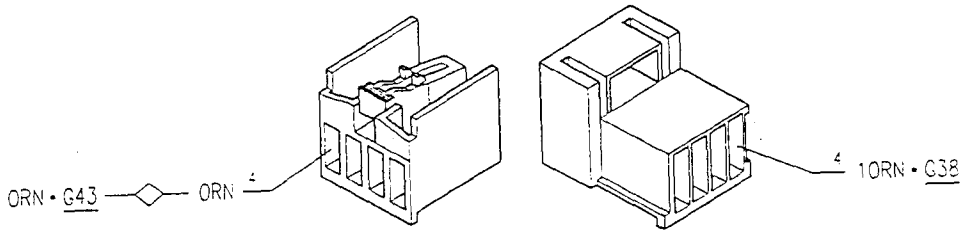


(*) from no. 4065018

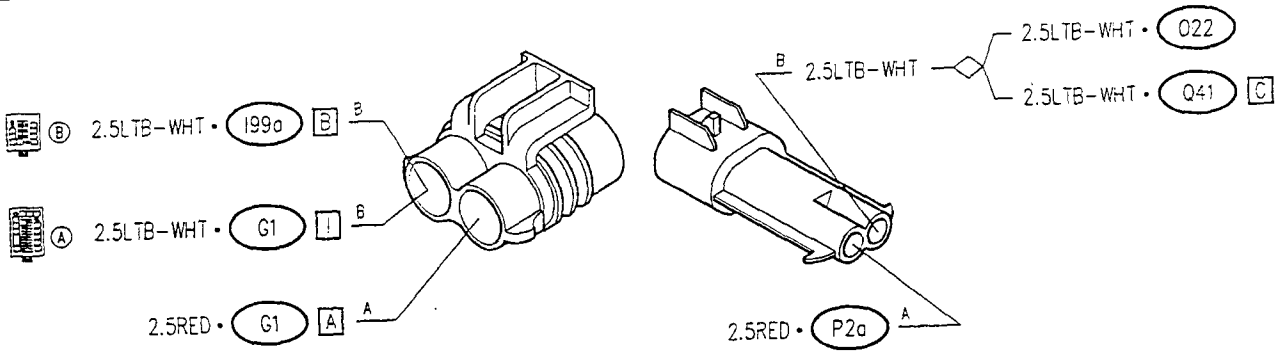
(•) up to no. 4065017

Components and connectors (cont.d)

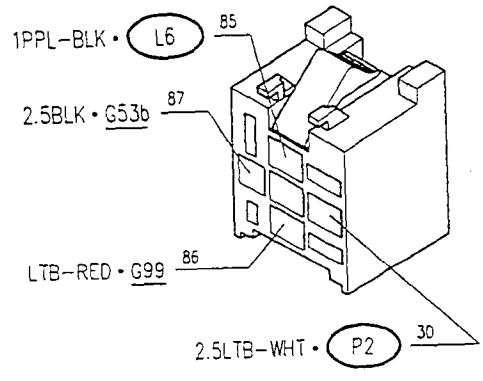
Conditioner additional wiring connector (•) — G313



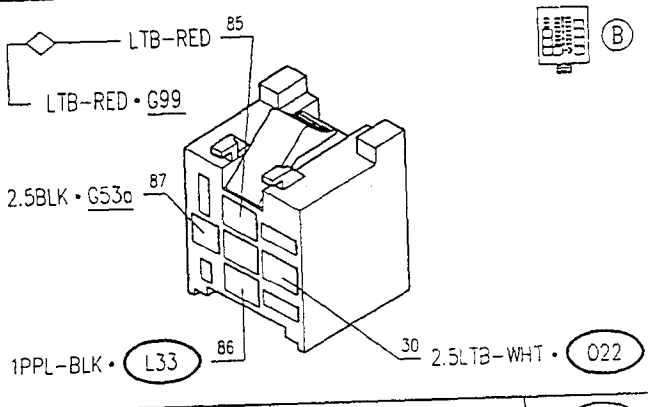
Engine/conditioner wiring connector (•) — G314



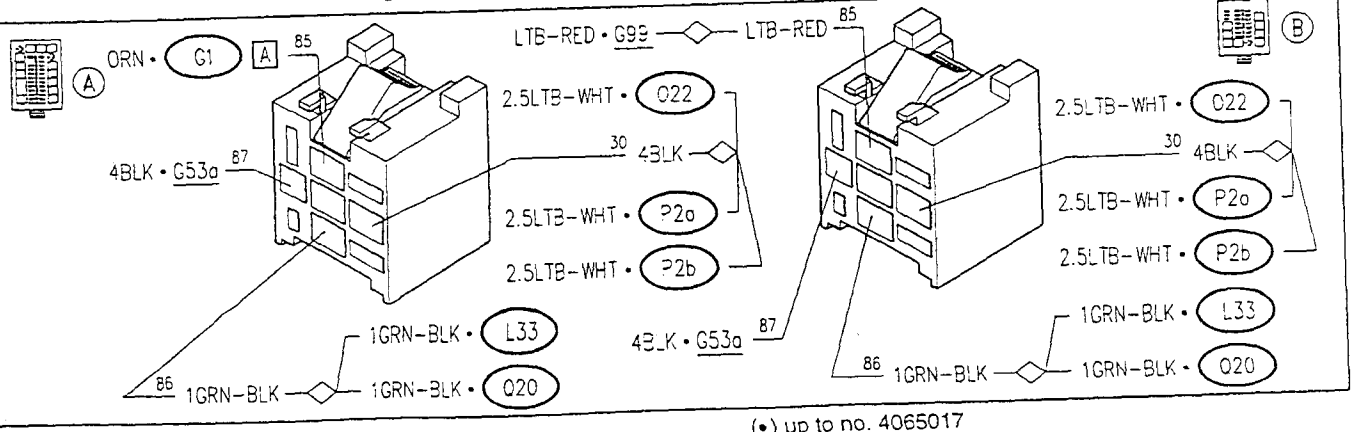
Engine cooling fan 1st speed relay (•) — I99a



Engine cooling fan 1st speed relay (*) — I99b



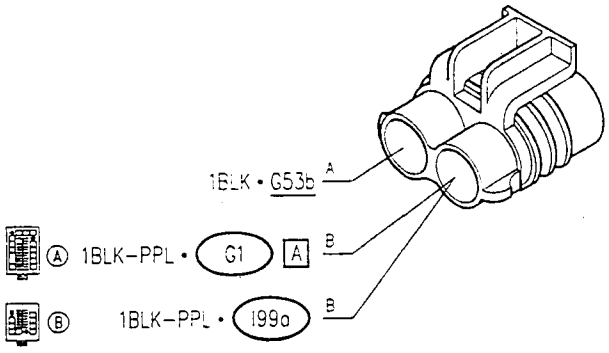
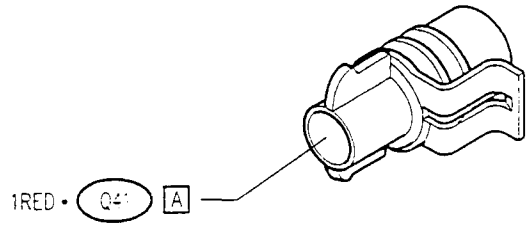
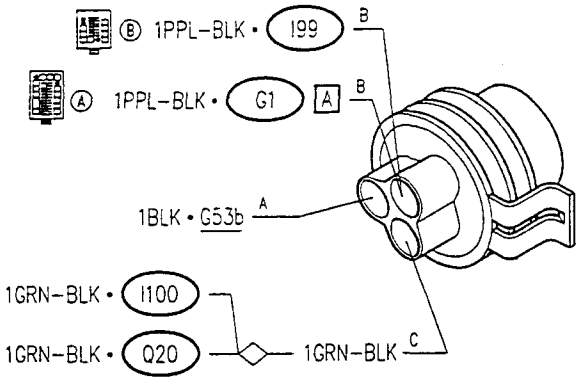
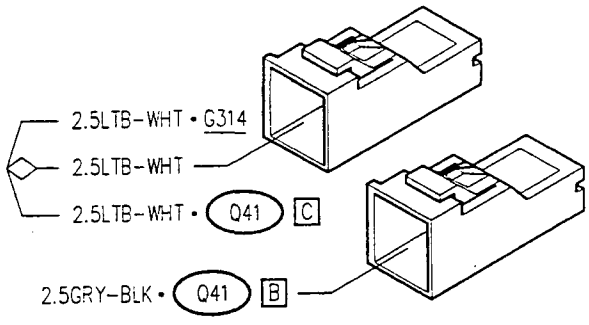
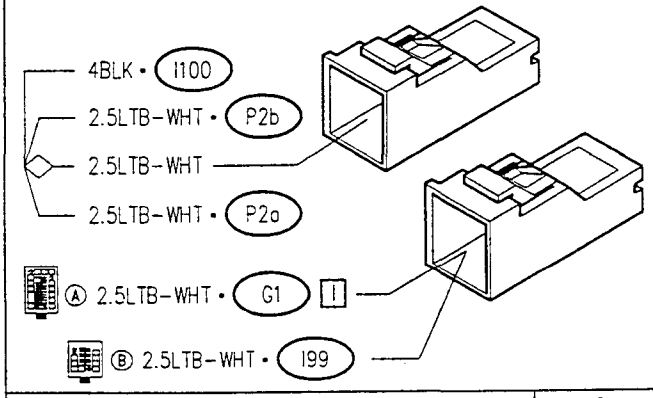
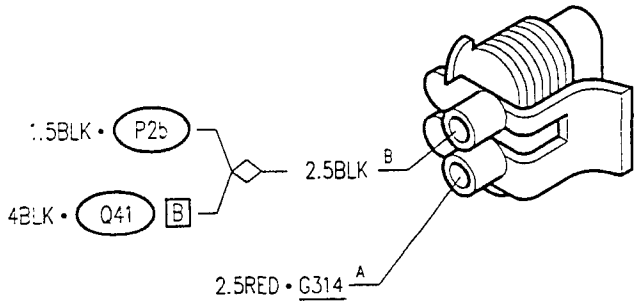
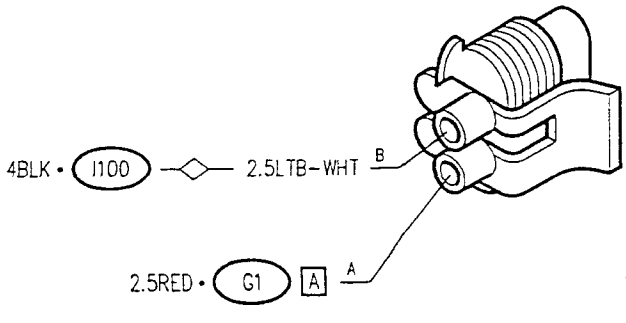
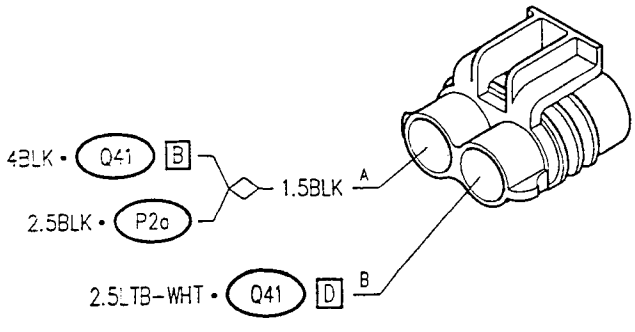
Engine cooling fan 2nd speed relay (*) — I100



(*) from no. 4065018

(•) up to no. 4065017

Components and connectors (cont.d)

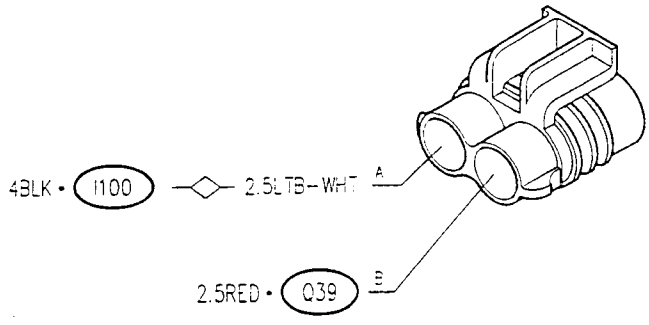
Two-level thermal contact (•) L33 A	Two-level thermal contact (•) L33 B
	
Two-level thermal contact (*) L33	**Engine fan additional resistance (•) O22**
	
Engine fan additional resistance (*) O22	**Engine water cooling fan (•) P2a**
	
Engine water cooling fan (*) P2a	**Engine water cooling fan (•) P2b**
	

(*) from no. 4065018

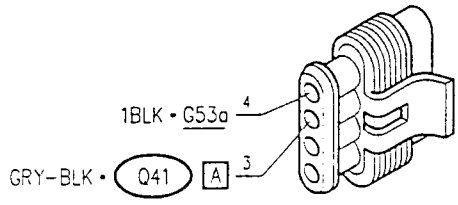
(•) up to no. 4065017

Components and connectors (cont.d)

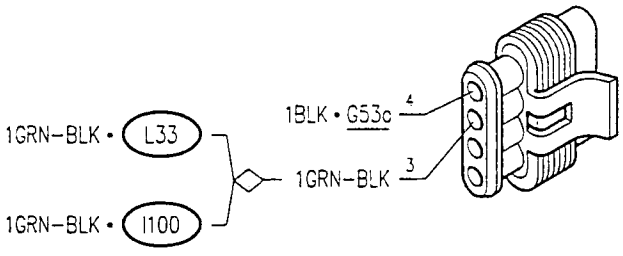
Engine water cooling fan (*)	P2b



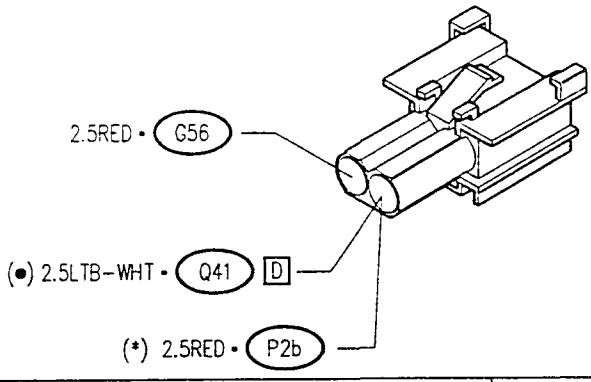
Min. and max. sensor pressure contact (Trinary) (•)	Q20



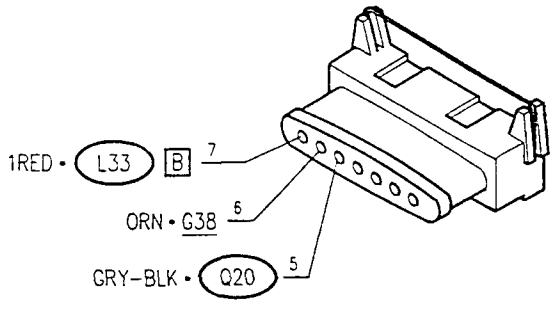
Min. and max. sensor pressure contact (Trinary) (*)	Q20



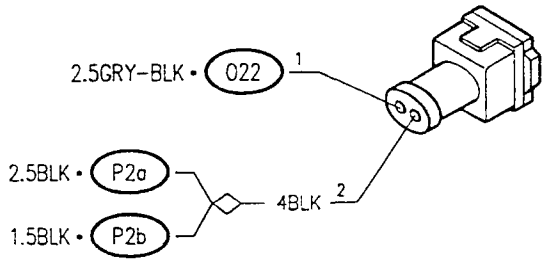
Conditioner system floating fuse-30A	Q39



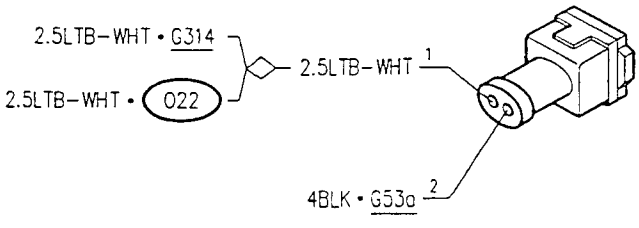
Set of conditioner relays and fuses (•)	Q41 A



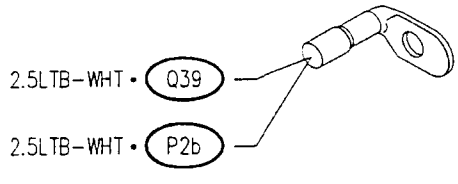
Set of conditioner relays and fuses (•)	Q41 B



Set of conditioner relays and fuses (•)	Q41 C



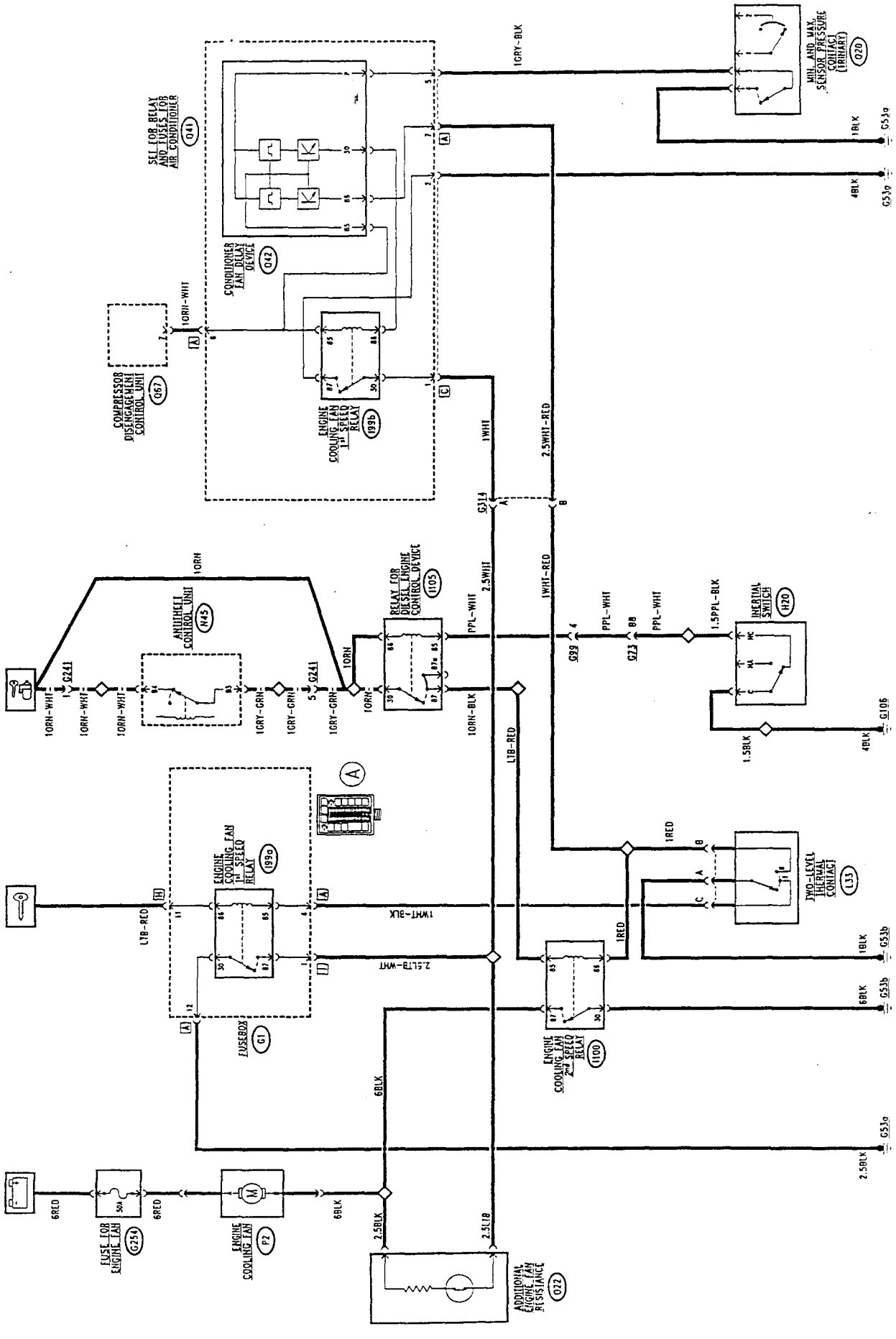
Set of conditioner relays and fuses (•)	Q41 D



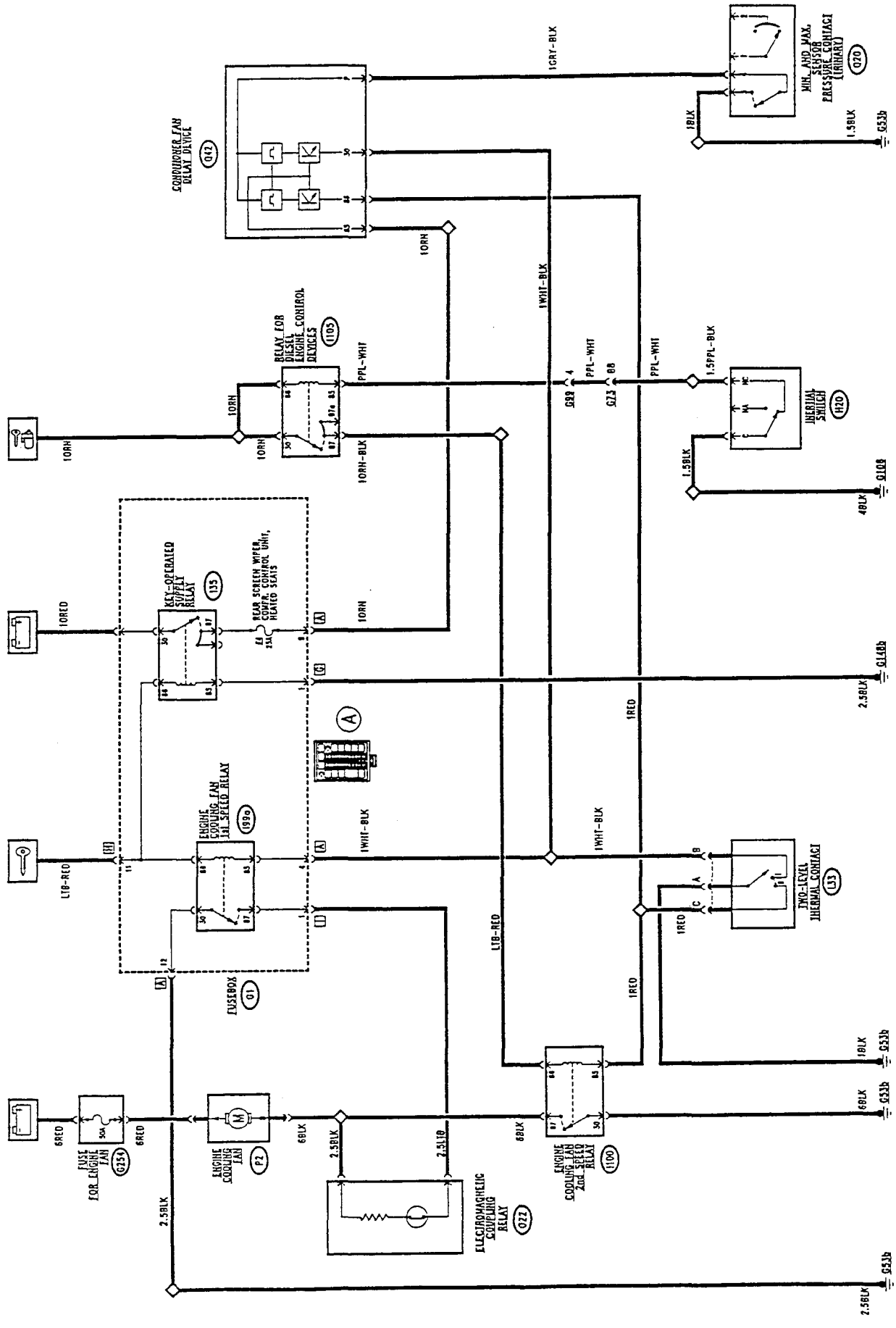
(*) from no. 4065018

(•) up to no. 4065017

Wiring diagram (TD version - up to chassis no.....)



Wiring diagram (TD version - from chassis no.....)



Functional Description

The fan **P2** provides the necessary ventilation of the cooling air for the radiator and engine and for the air conditioning system condenser.

This fan is always supplied by battery voltage through the line protected by the specific wander fuse **G254**, to be found next to the branch terminal box: it is therefore operated by an earth signal: this signal arrives directly (2nd speed) or through the additional resistance **O22** (1st speed), fitted with a thermal safety contact.

The delaying device **Q42**, together with relay **I99b** - present only up to chassis no..... - , controls the gradual engagement of the fan **P2**, operating according to the following logic:

The voltage leading - up to chassis no..... - from the compressor disengagement control unit **Q67** (12V with compressor engaged) and - from chassis no..... - directly from the ignition switch - supplies the coil and the electronic devices of the delaying device **Q42** -pin 85 and relay **I99b** - where fitted - ; the coil of **Q42** is energised by an earth signal -pin P- which leads from the trinary pressure switch **Q20**: this causes the immediate sending of a signal - pin 30- to energise relay **I99a** or **I99b**, which sends the earth signal for the fan **P2** through the additional ressitance **O22**: 1st speed.

After appr. 8-12 seconds, if the signal leading from the trinary persists, the delaying device operates the second speed with an earth signal from pin 86, which energises relay **I100** that sends the earth signal directly to the fan **P2:** 2nd speed.
When the pressure switch signal ceases, the fan is immediately disengaged.

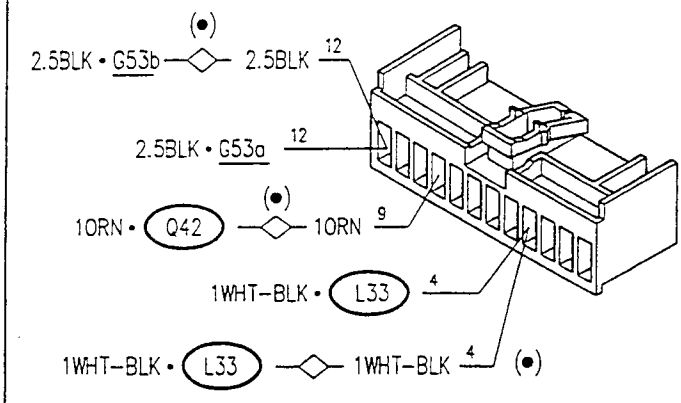
The fan is operated at the two different speeds also by the two- level thermal contact **L33** which controls the temperature of the coolant in the engine radiator: when a first level is reached, relay **I99a** is energised, located in the fuxebox **G1**, which sends the earth signal to the fan **P2** through resistance **O22**: 1st speed.

If the second temperature level is reached, relay **I100** is energised, located on the fan duct, which sends the earth signal directly to the fan **P2**: 2nd speed.

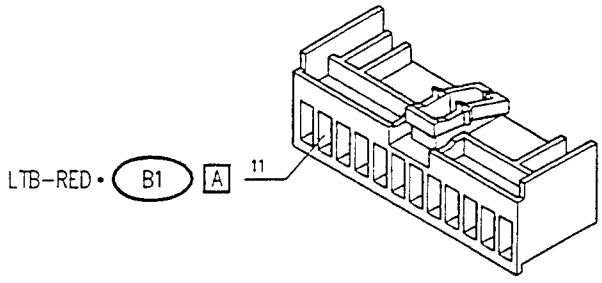
The delaying device Q42 and relay I99b are located - up to chassis no..... - in the set of relays and fuses Q41.

Components and Connectors

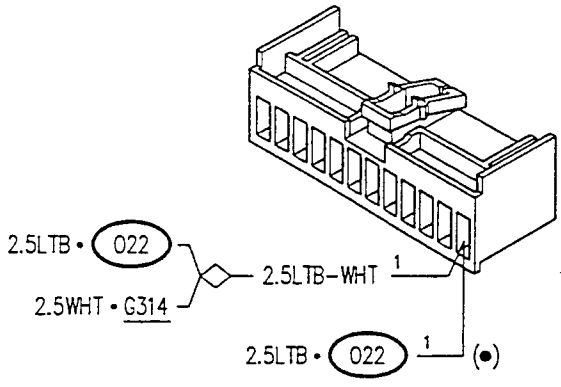
Fusebox	G1 A



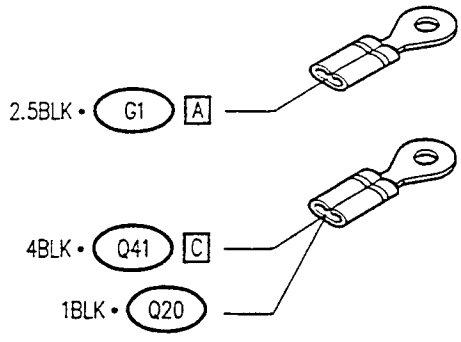
Fusebox	G1 H



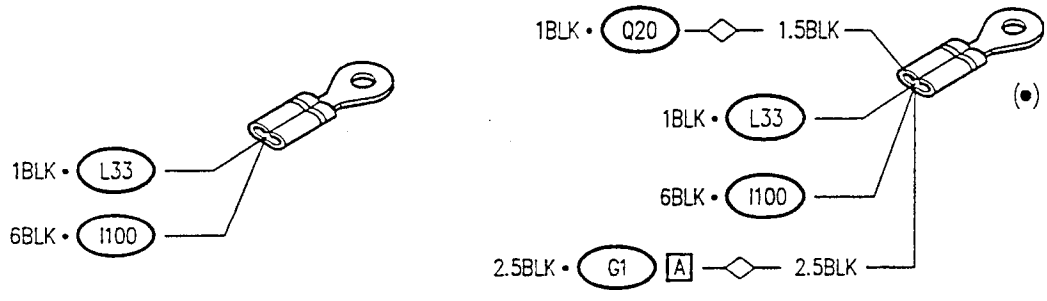
Fusebox	G1 I



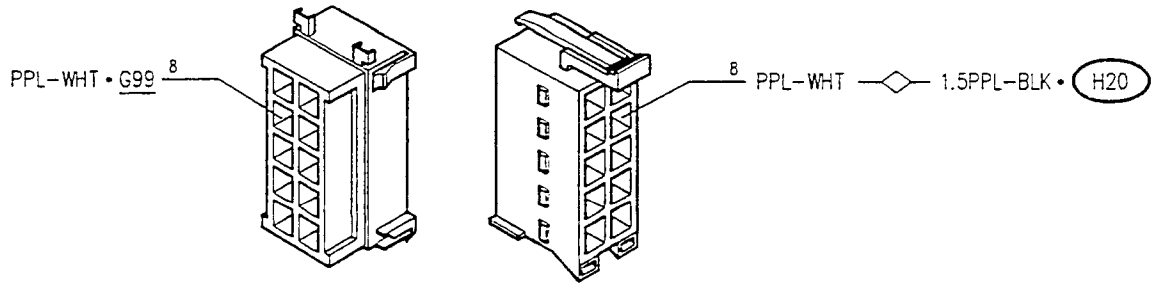
RH engine compartment earth	G53a



LH engine compartment earth	G53b



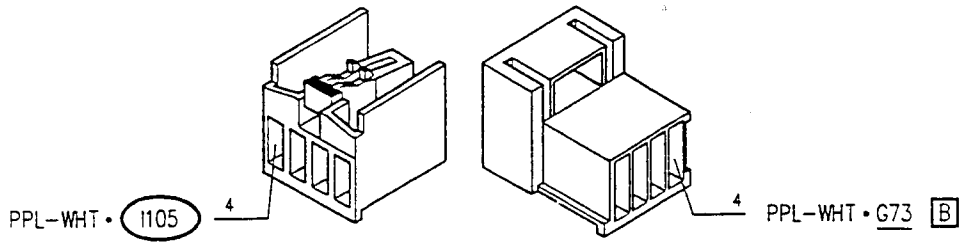
Rear services connector	G73 B



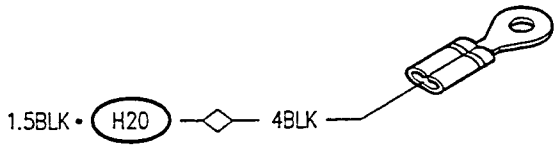
(•) Variant from chassis no....

Components and Connectors (contd.)

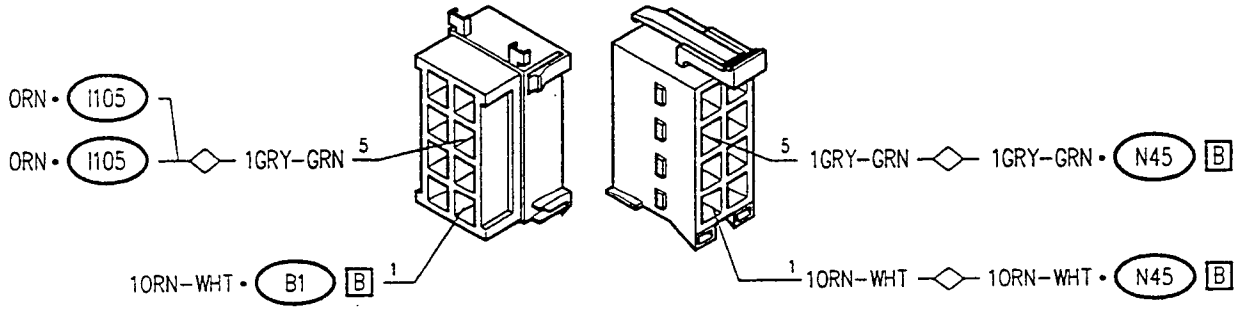
Engine/dashboard wiring connectors	G99



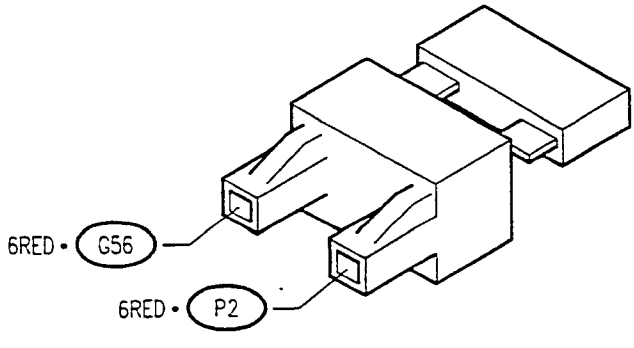
Seat crossmember earth	G106



Alarm wiring connector (*)	G241



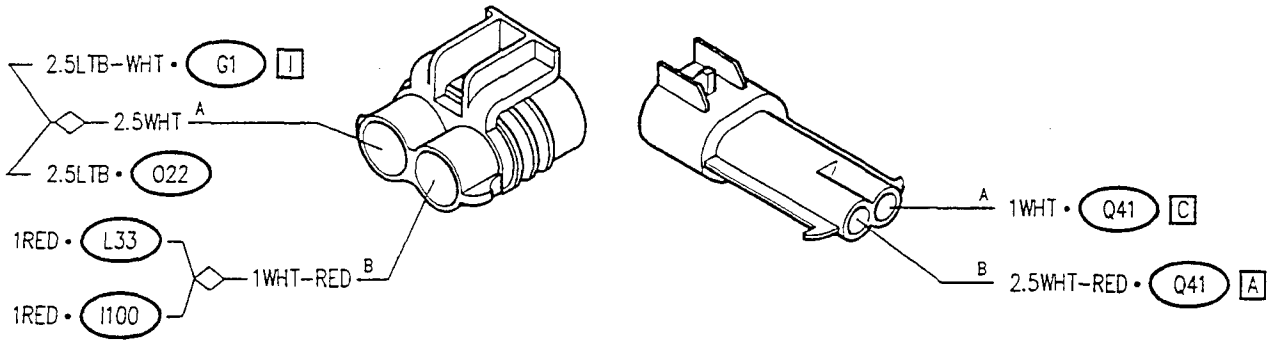
Engine fan fuse	G254



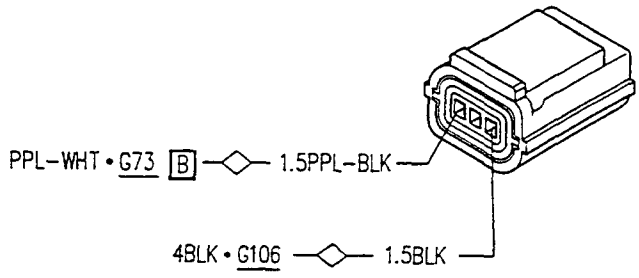
(*) Versions without ALFA ROMEO CODE, but with anti-theft system

Components and Connectors (contd.)

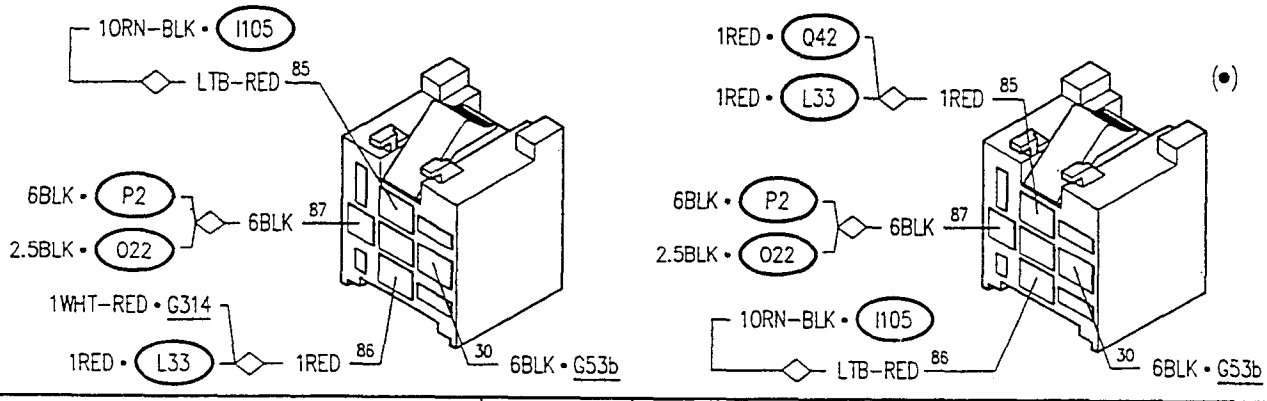
Engine/conditioner wiring connector — G314



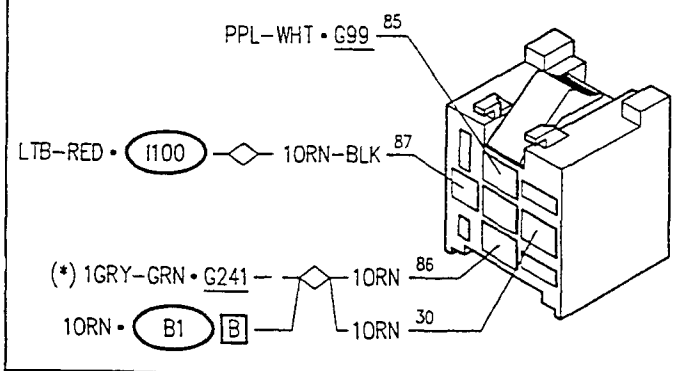
Inertial switch — H20



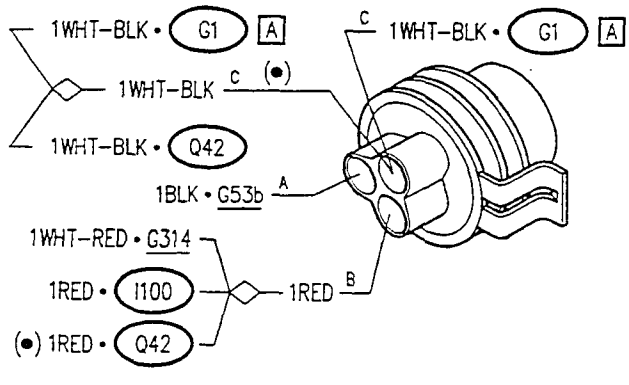
Engine cooling fan 2nd speed relay — I100



Diesel engine control devices relay — I105



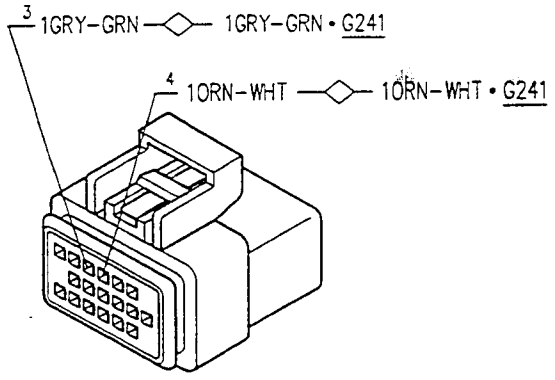
Two-level thermal switch — L33



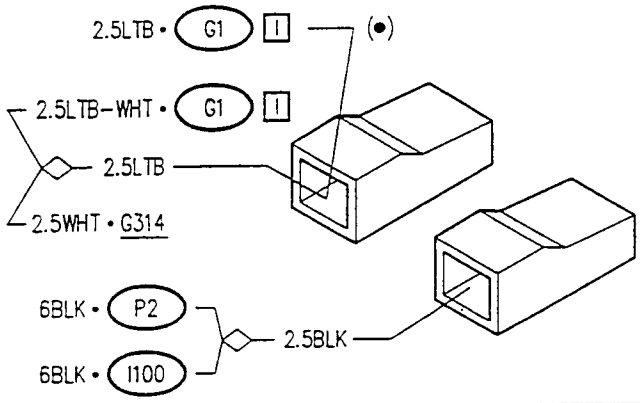
(*) Versions without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

Components and Connectors (contd.)

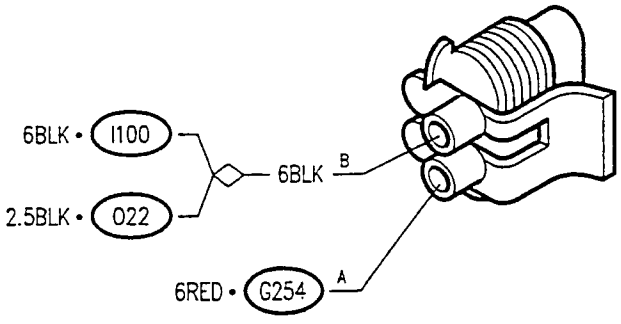
Alarm control unit (*) — N45 B



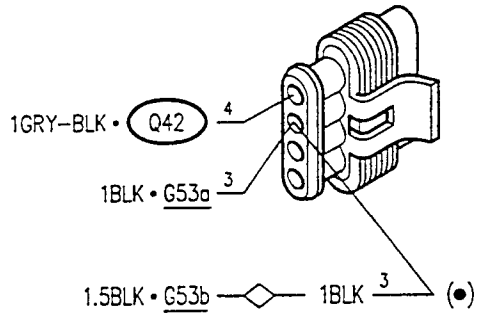
Engine fan additional resistance — O22



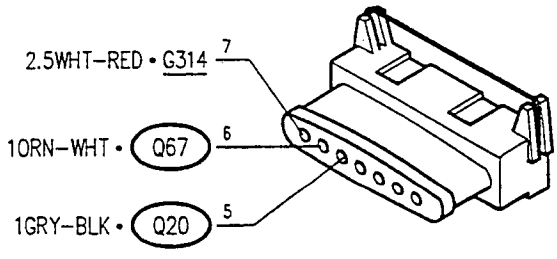
Engine water cooling fan — P2



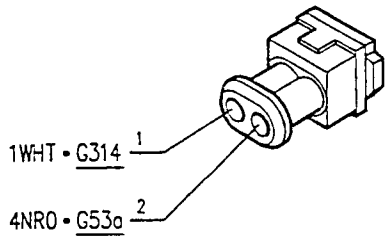
Min. and max. sensor pressure contact (Trinary) — Q20



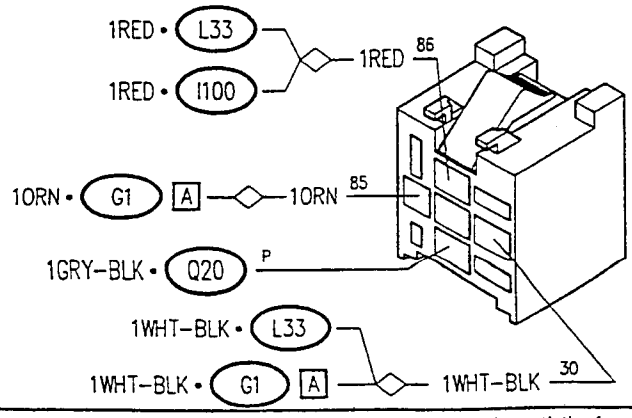
Set of conditioner relays and fuses — Q41 A



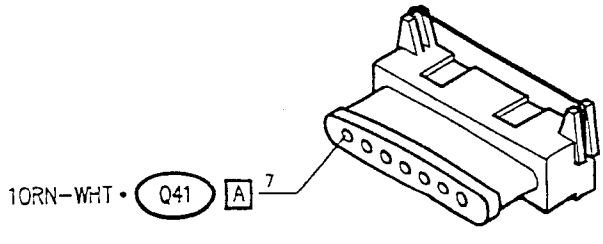
Set of conditioner relays and fuses — Q41 C



Conditioner solenoid delaying device (•) — Q42

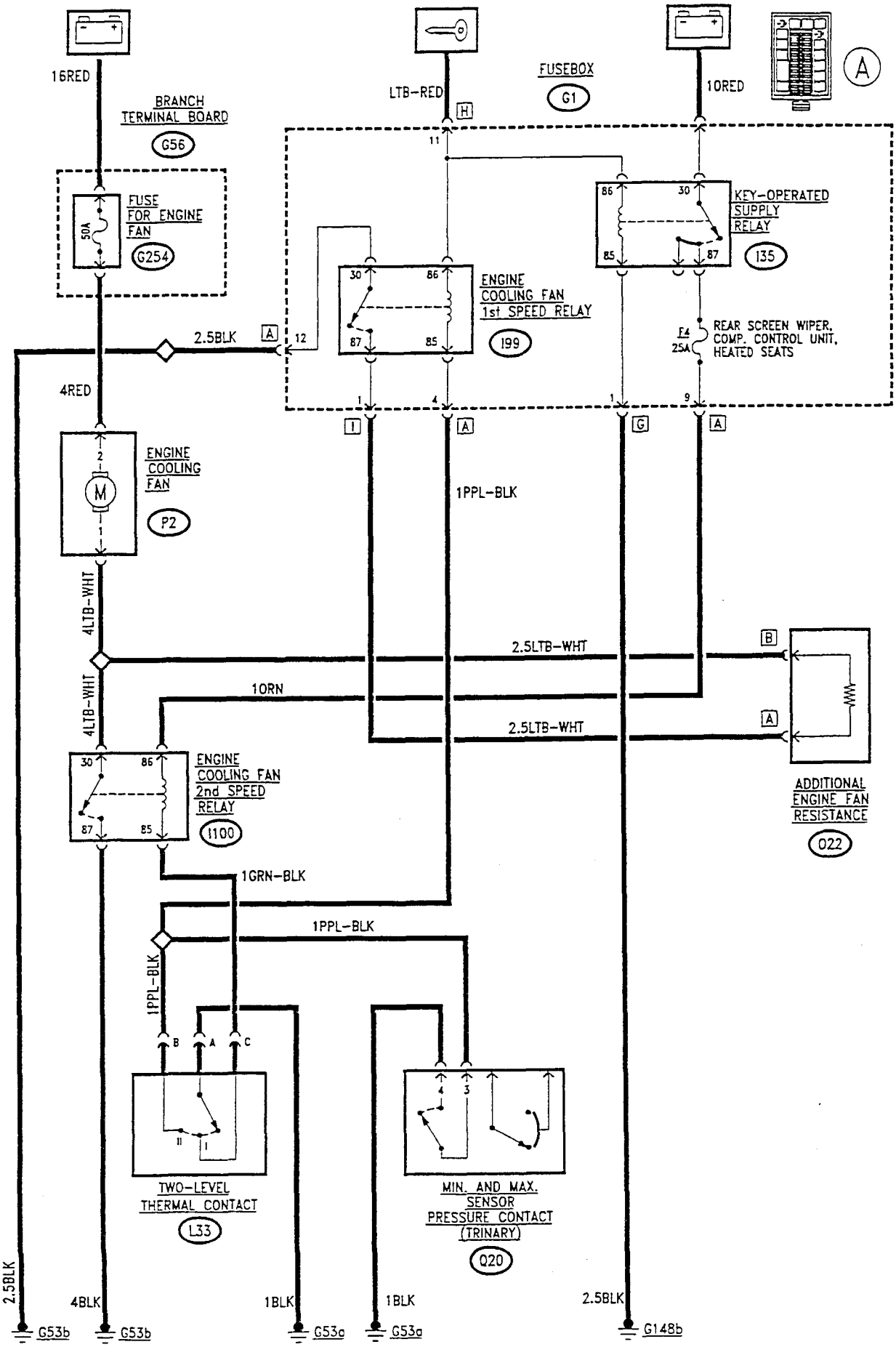


Compressor disengagement control unit — Q67



(*) Versions without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

Wiring diagram (T.SPARK version)



Functional Description

The fan **P2** provides the necessary ventilation of the cooling air for the radiator and engine and for the air conditioning system condenser.

This fan is always supplied by battery voltage through the line protected by the specific wander fuse **G254**, to be found next to the branch terminal box: it is therefore operated by an earth signal: this signal arrives directly (2nd speed) or through the additional resistance **O22** (1st speed).

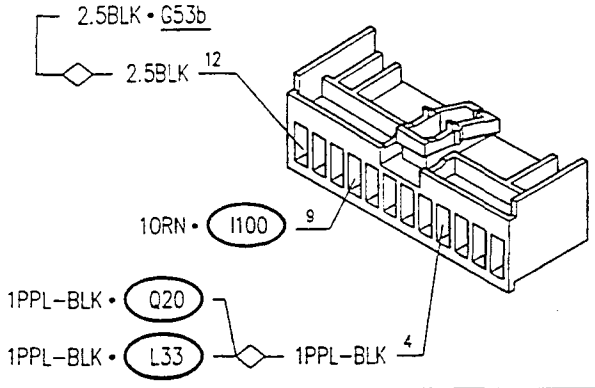
The fan **P2** is operated at the two different speeds by the two- level thermal contact **L33** which controls the temperature of the coolant in the engine radiator: when a first level is reached, relay **I99a** is energised, located in the fuxebox **G1**, which sends the earth signal to the fan **P2** through resistance **O22**: 1st speed.

If the second temperature level is reached, relay **I100** is energised, located on the fan duct, which sends the earth signal directly to the fan **P2**: 2nd speed.

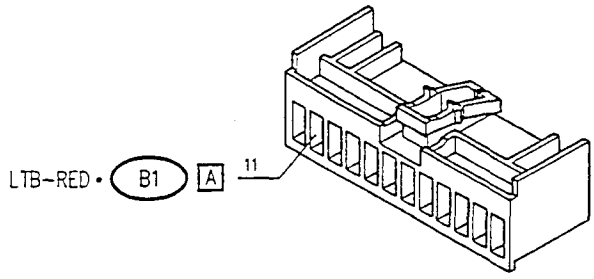
The two relays receive the key-operated supply; **I100** is supplied by the line of fuse **F4** of **G1**.
Similarly, the fan **P2** is controlled at the first speed by an earth signal leading from the trinary pressure switch **Q20**.
When the pressure switch signal ceases, the fan is immediately disengaged.

Components and Connectors

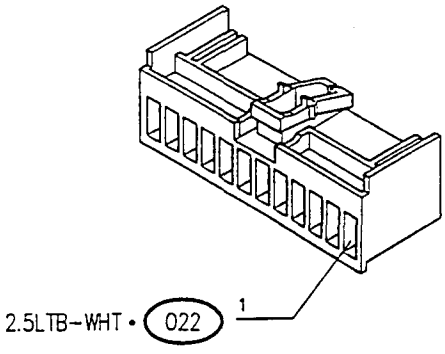
Fusebox G1 A



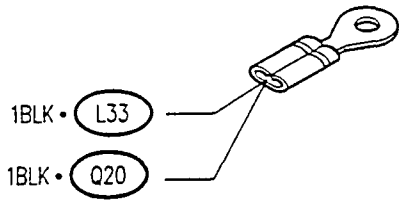
Fusebox G1 H



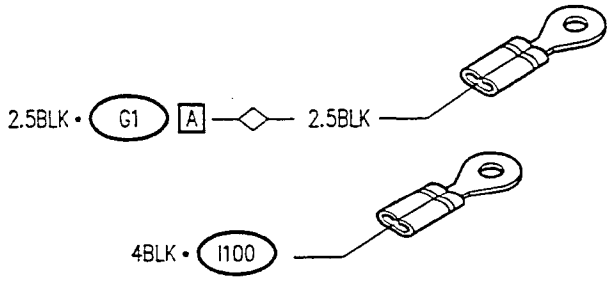
Fusebox G1 I



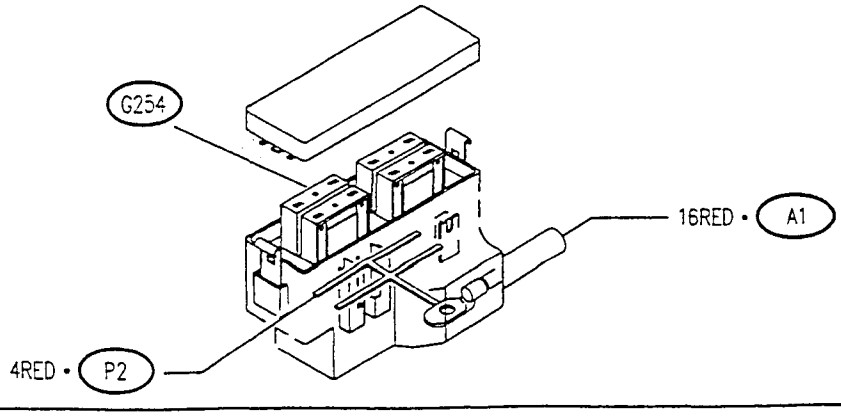
RH engine compartment earth G53a



LH engine compartment earth G53b

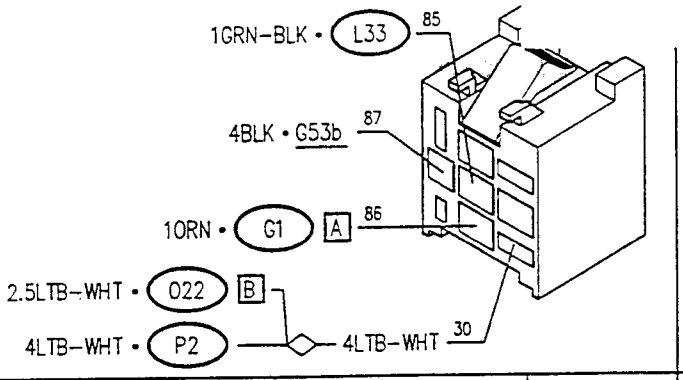


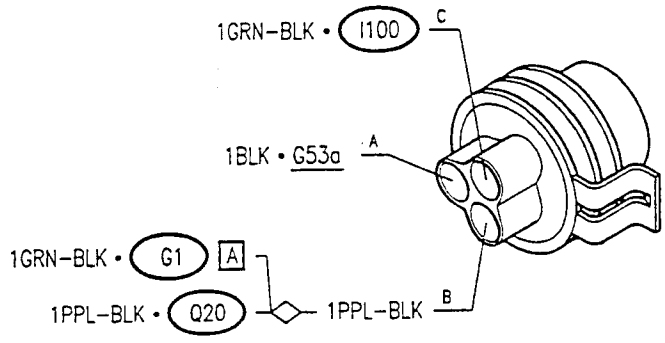
Branch terminal board G56



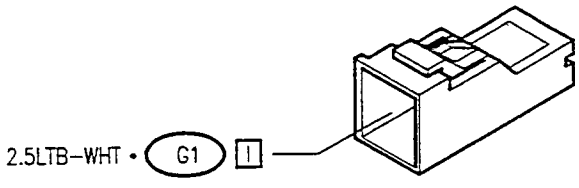
Components and Connectors (contd.)

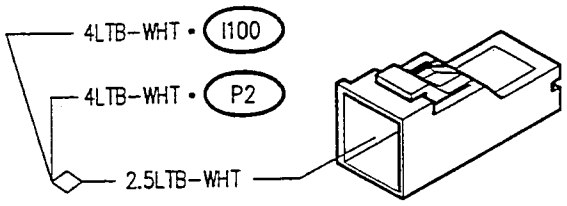
Engine cooling fan 2nd speed relay	I100	Two level thermal contact	L33



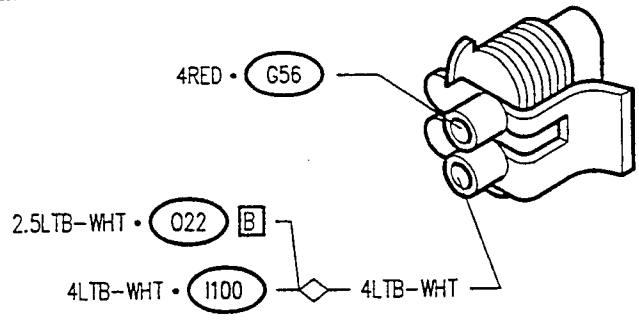


Engine fan additional resistance	O22 A	Engine fan additional resistance	O22 B

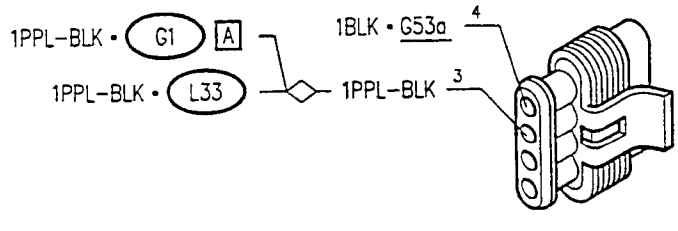




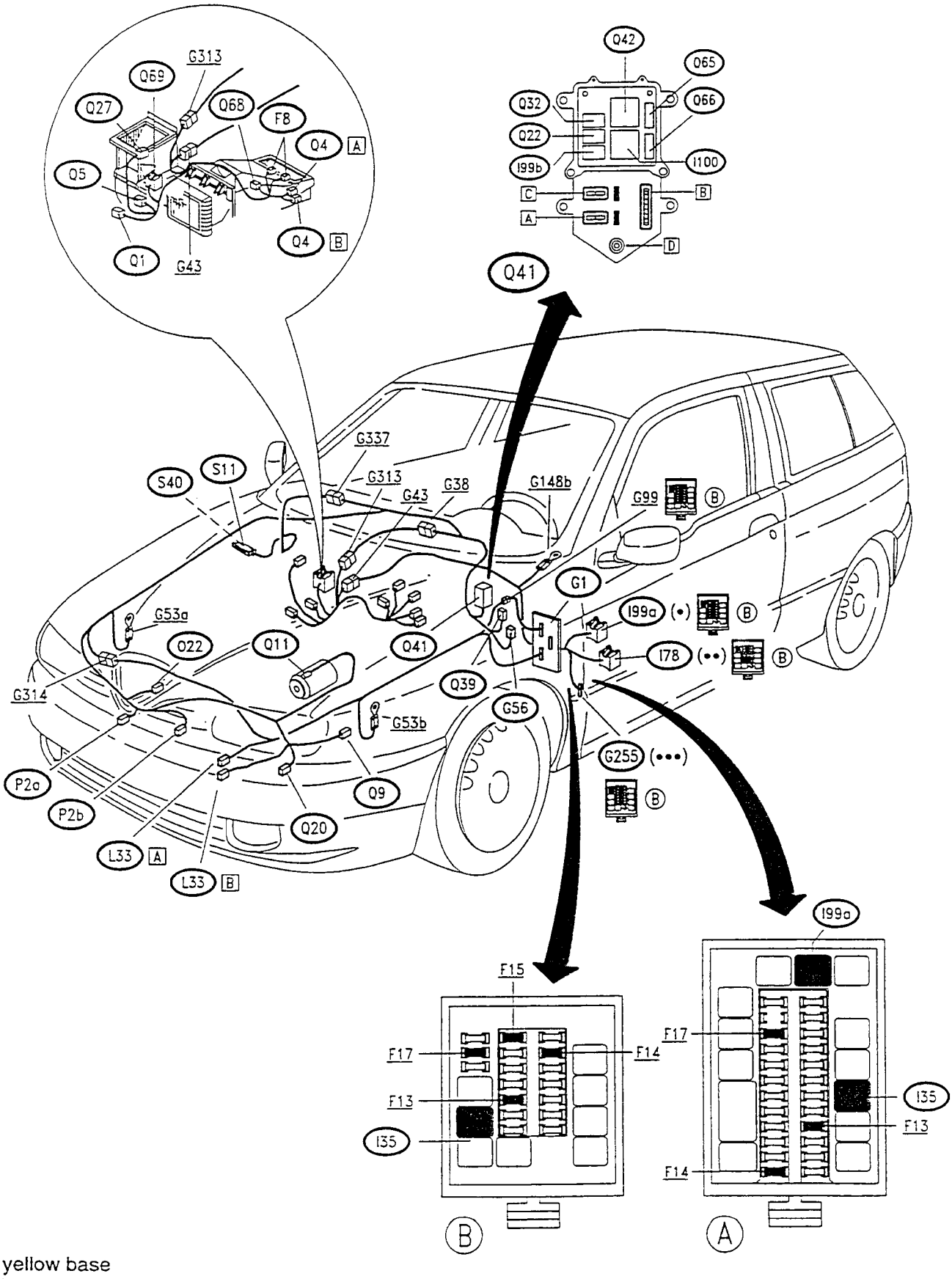
Engine water cooling fan	P2



Min. and max. sensor pressure contact	Q20

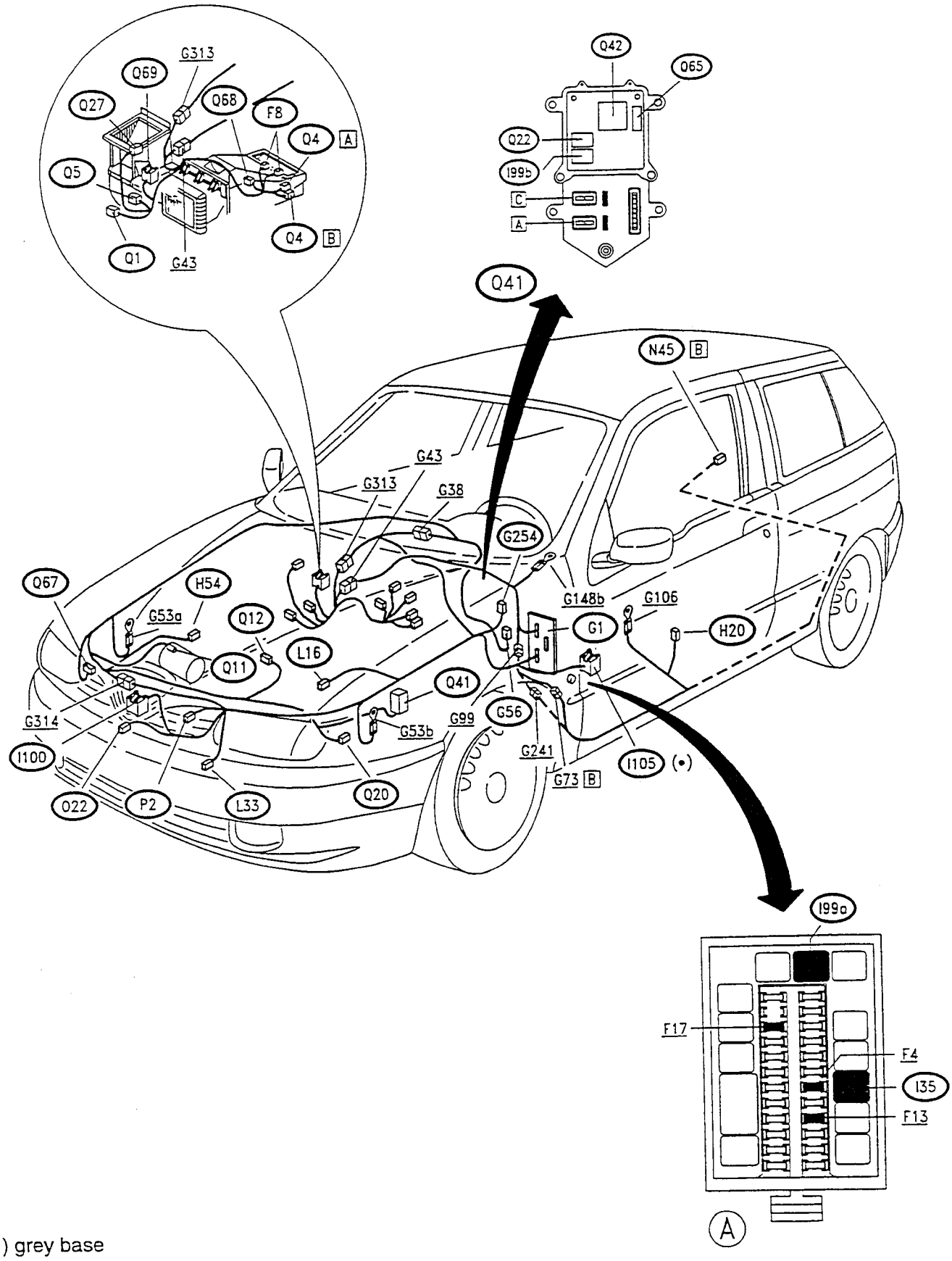


LOCATION OF COMPONENTS (Boxer Versions)



(•) yellow base
(••) yellow base
(•••) green fuseholder

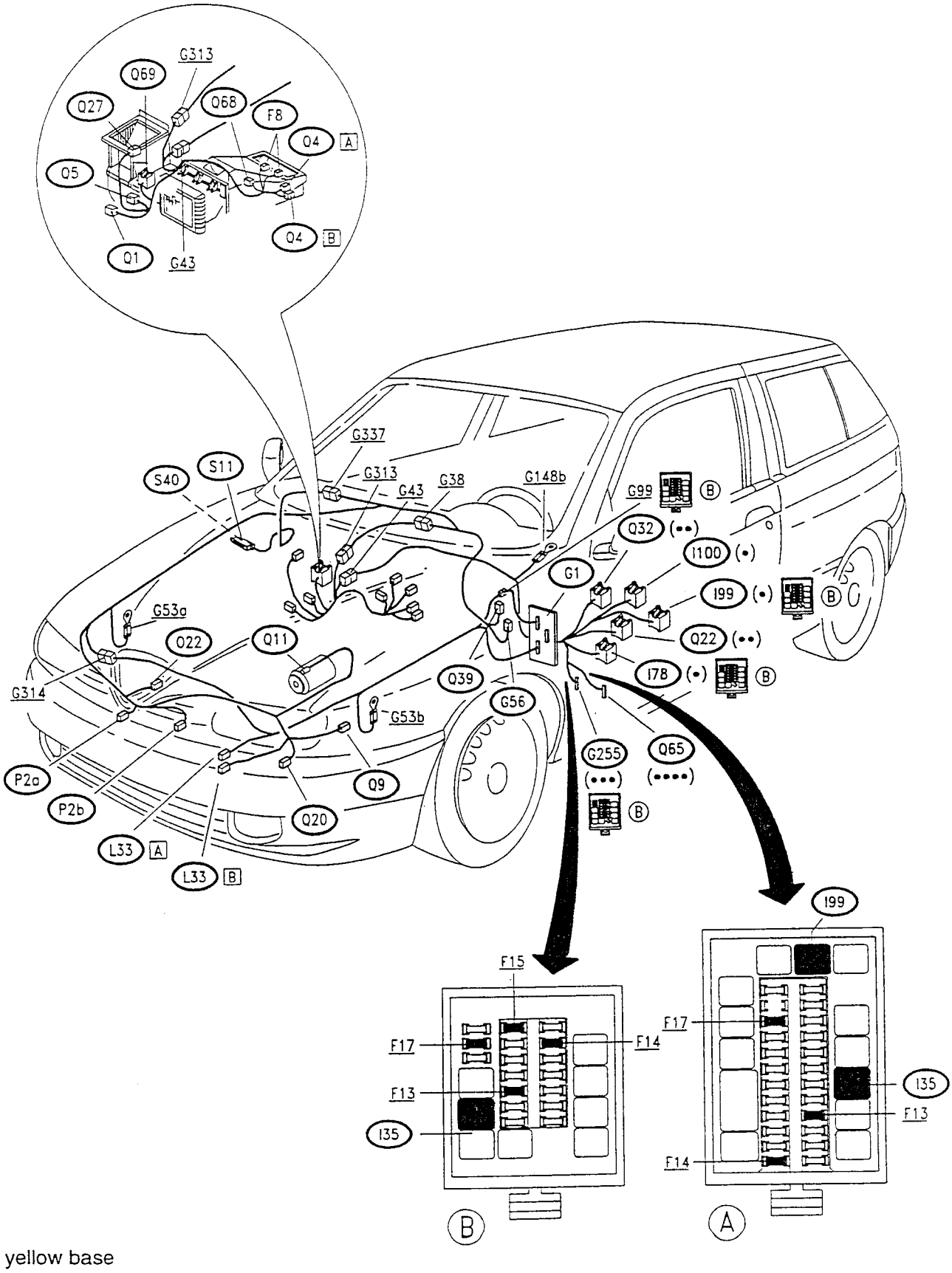
LOCATION OF COMPONENTS (TD Version - up to chassis no.....)



(•) grey base

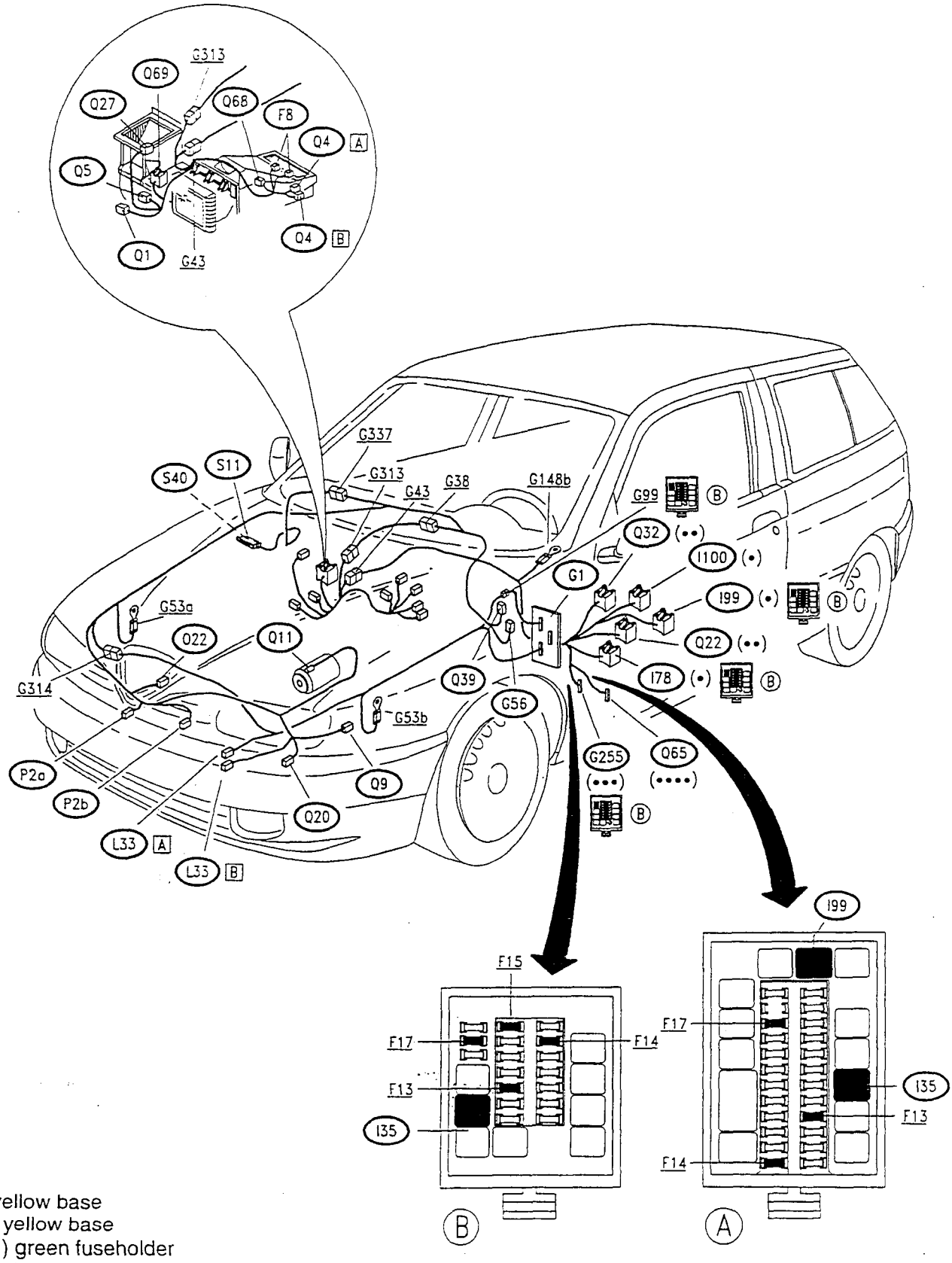
— — — — only versions without ALFA ROMEO CODE, but with theft alarm

LOCATION OF COMPONENTS (Boxer Versions - up to chassis no. 4065017)



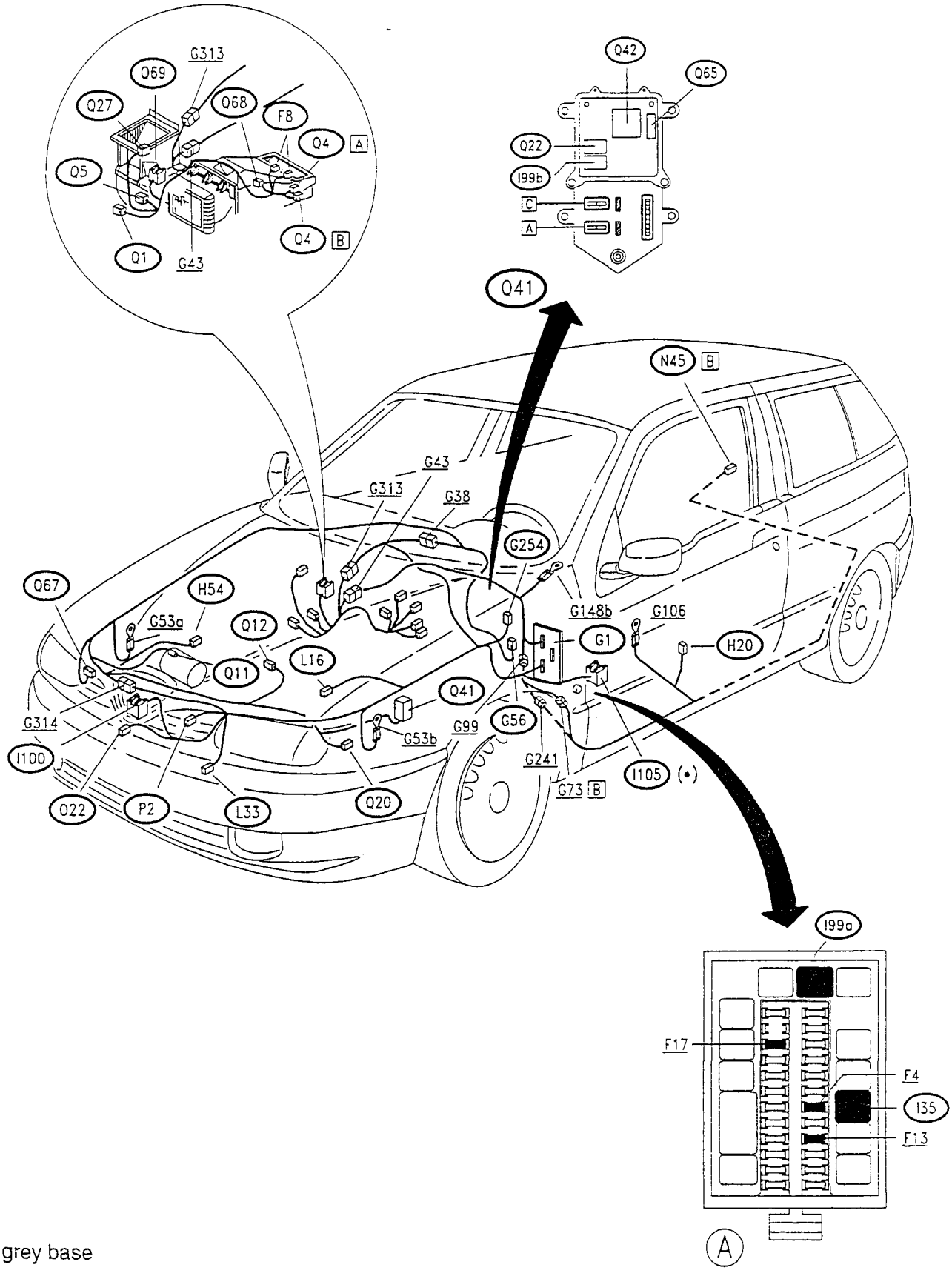
(•) yellow base
(••) yellow base
(•••) green fuseholder

LOCATION OF COMPONENTS (Boxer Versions - from chassis no. 4065018)



(•) yellow base
(••) yellow base
(•••) green fuseholder
(••••) red fuseholder

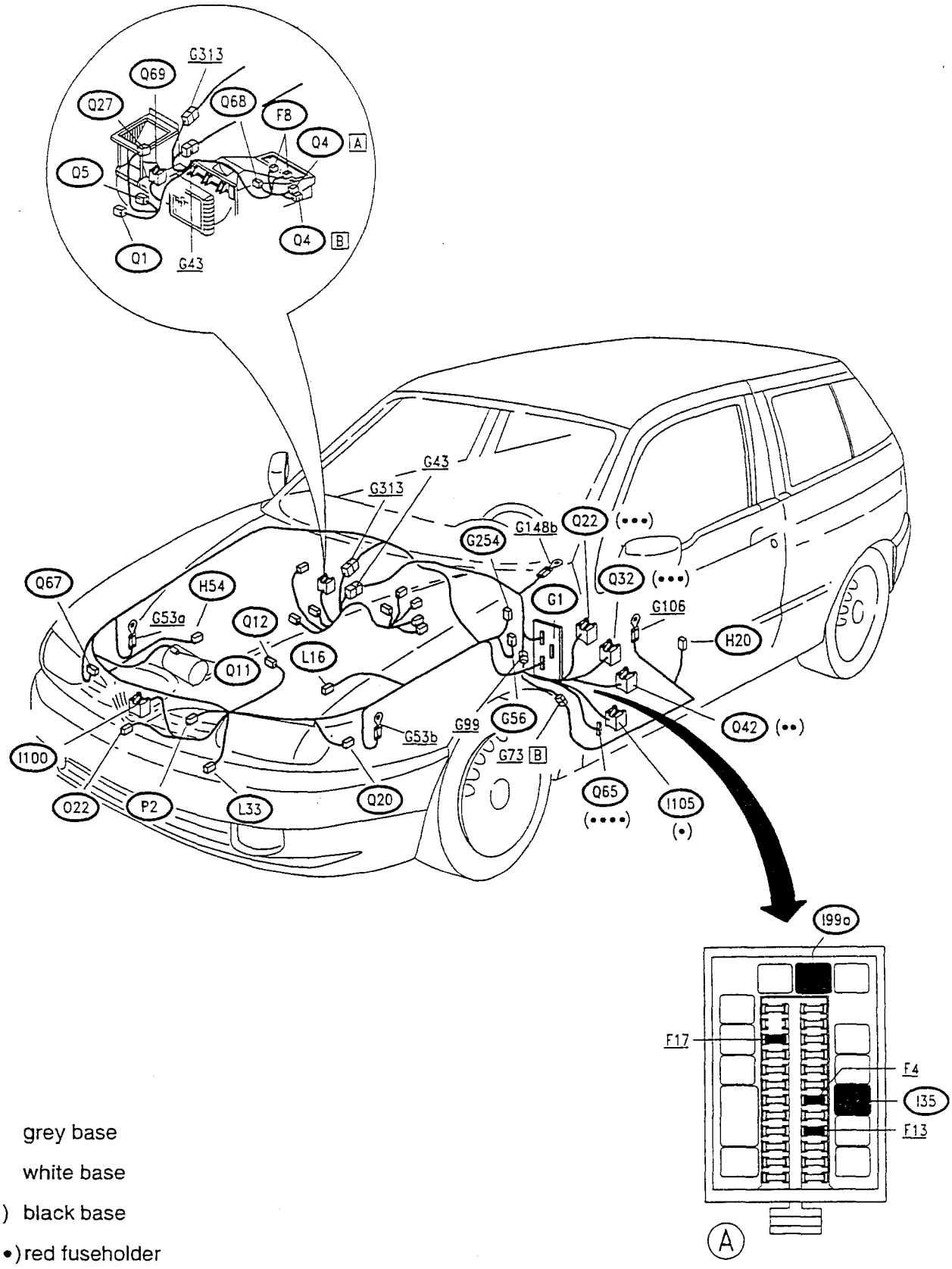
LOCATION OF COMPONENTS (TD Version - up to chassis no.....)



(•) grey base

— — — — only versions without ALFA ROMEO CODE, but with theft alarm

LOCATION OF COMPONENTS (TD version - from chassis no.....)



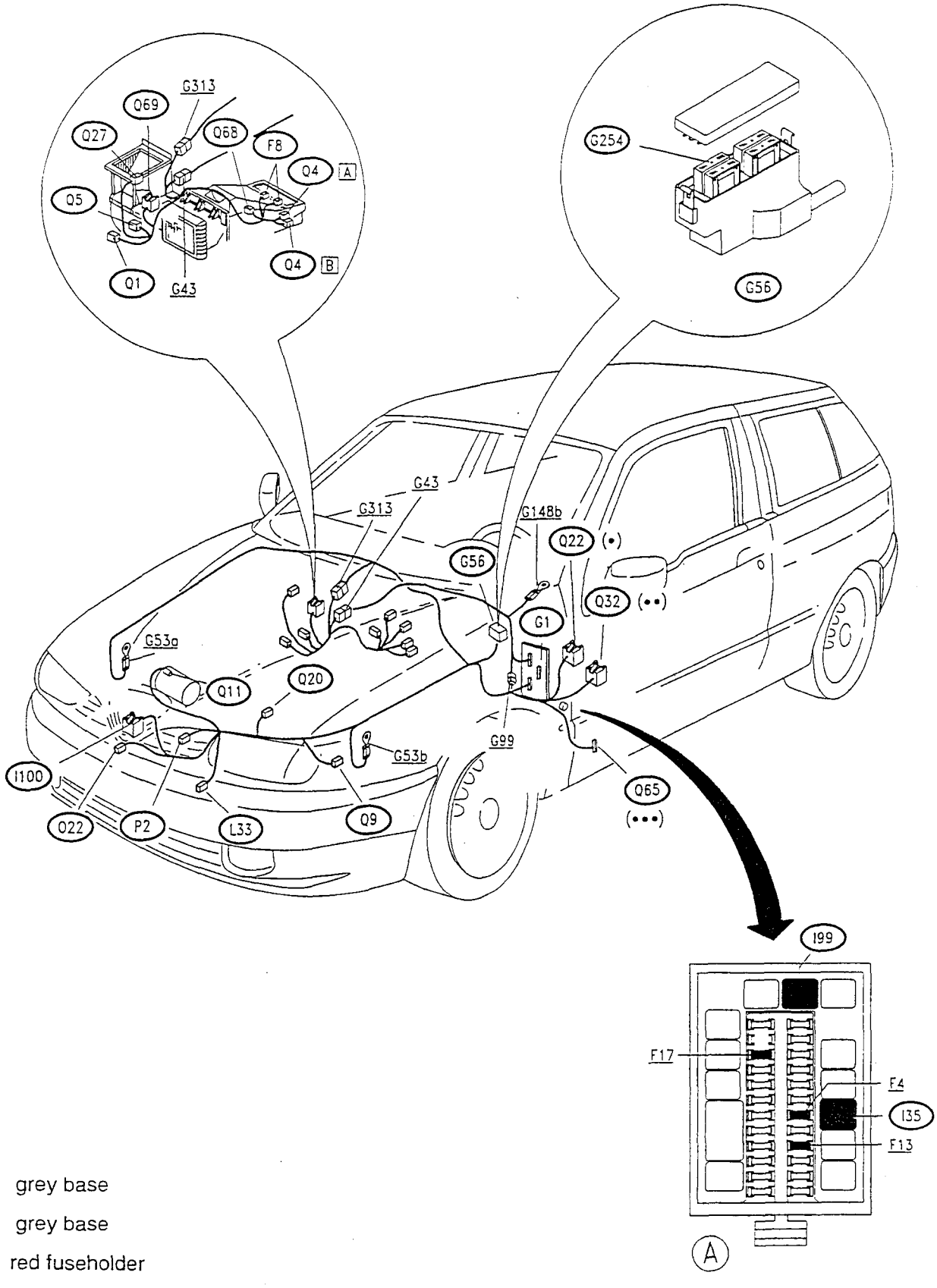
(•) grey base

(••) white base

(•••) black base

(••••) red fuseholder

LOCATION OF COMPONENTS (T.SPARK version)



(•) grey base

(••) grey base

(•••) red fuseholder

FAULT-FINDING TABLE

NOTE:
To make it easier to understand, the fault-finding table has been subdivided into three section which concern the three functions also described separately in the wiring diagrams:

Climate control fan and recirculation

Compressor control

Engine fan control

Climate control fan and recirculation

Fault	Component to be checked										
	F13	G255 (B)	Q1	I78 (B)	Q5	Q4	Q27	Q68	F8a (1)	F8b (1)	Q69
Fan engagement	•	•	•	•		•					
Fan engagement at the different speeds					•	•					
Fan engagement at 1st speed with compressor engaged						•					•
Recirculation function						•	•	•			
Climate control panel lighting									•	•	

(1) It is possible to replace the bulbs with their bulb holder

(B) Only for fusebox "B"

Compressor control

Fault		Component to be checked																
		Q39 (•)	Q65	F17	F4	Q11	Q20	Q9	Q12	H54	Q67	Q22	Q32	Q69	Q4	Q68	S11 (1)	S40 (2)
Compressor engagement (under all circumstances)	petrol	•	•	•		•						•	•	•	•	•		
	TD		•	•	•	•						•		•	•	•		
Compressor engagement (only under certain circumstances) (*)	petrol						•	•									•	
	TD						•		•	•	•							

(•) only up to chassis no. 4065017

(1) Boxer 1.6 e 1.7 16 v, T.SPARK - (2) Boxer 1.3

(*) You are reminded that compressor operation is cut off by the system logic under the following conditions:

coolant fluid pressure > 28 bar appr.;

coolant fluid pressure < 2.5 bar appr. (circuit drained);

engine temperature > 111°C (only TD);

full load (temporary cutoff for appr. 8 sec. with engine rpm over 2000 rpm). (only TD).

This operation is also determined by the logic of the ignition/injection control unit (only petrol) (refer to the corresponding sections).

Engine fan control

Fault		Component to be checked																
		Q39	G254	Q66 (•)	F14	F4 (A) (*)	F15 (B)	F17 (•)	P2 P2a/b	O22	L33	Q20	Q42	Q67 (•)	I99a I99b (•)	I99 (*)	I100	I105
Fan engagement (underall circum-stances)	Boxer	•			•				•									
	TD		•						•									
	T.SPARK		•						•									
Fan engagement for high engine temperature (2nd speed)	Boxer			•		•	•	•		•	•				•	•	•	
	TD		•							•	•			•	•	•	•	•
	T.SPARK					•				•	•				•	•	•	
Fan engagement for highcoolant pressure	Boxer											•	•					
	TD											•	•					
	T.SPARK											•						

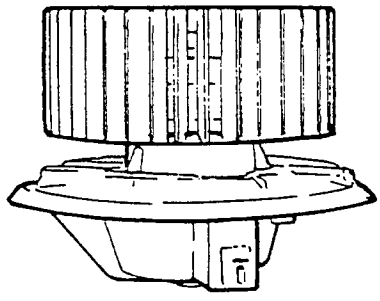
(B) Only for fusebox "B"

(•) only up to chassis no. 4065017

(*) from chassis no. 4065018

CHECKING COMPONENTS

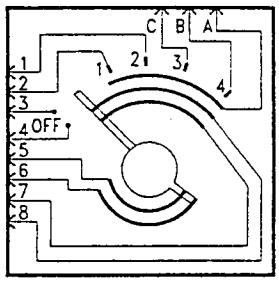
Heating and ventilation fan (Q1)



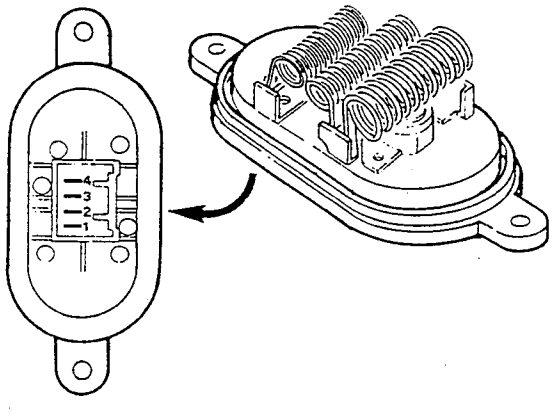
SPECIFICATIONS	
Nominal voltage	12V
Speed at 12V/25°C in free air with impeller and support	3700 ± 100 rpm
Direction of motor rotation	leftwards impeller side

Heating and ventilation fan control (Q4)

Check the contacts corresponding to the different positions of the knob.

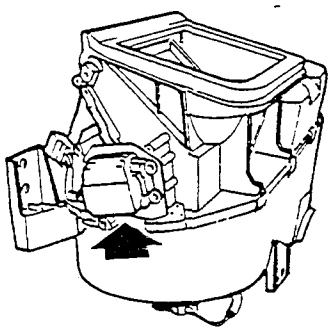


Heating & ventilation fan speed adjustment coil (Q5)



SPECIFICATIONS		
Section crossed	Total resistance	fan speed
4-1 3-1 2-1 none	2.9 Ω 0.8 Ω 0.3 Ω -	1st 2nd 3rd 4th
Thermal contact cut-in temperature		90 ± 5°C

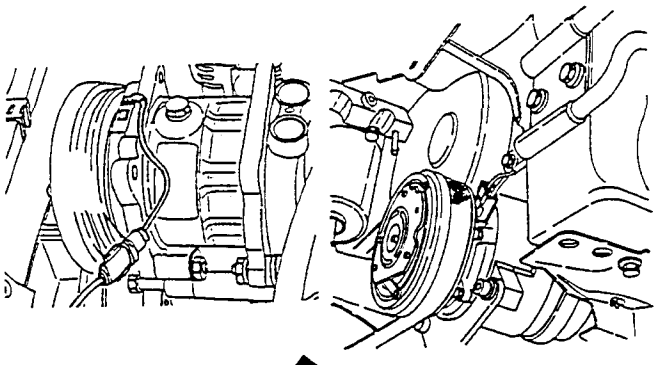
Recirculation port control motor (Q27)



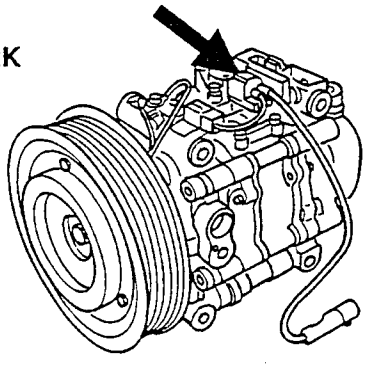
SPECIFICATIONS
12 V at pin 1 and 0 V at pin 2 = output shaft **counter-clockwise** rotation
12 V at pin 3 and 0 V at pin 2 = output shaft **clockwise** rotation

Compressor electromagnetic joint (Q11)

Boxer TD



T.SPARK

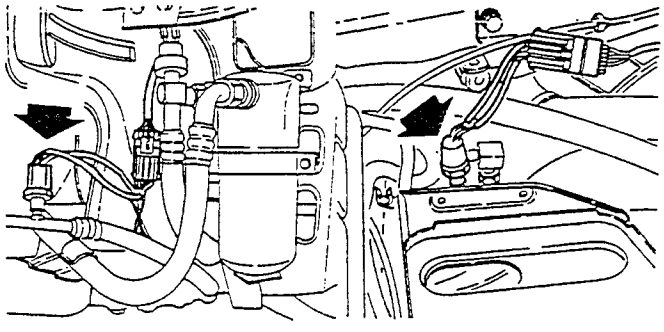


SPECIFICATIONS	
supply voltage	12 V
absorbed current	4 A (Boxer) 4.2 A (TD) 2.2 (T.SPARK)

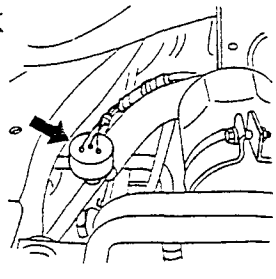
Only T.SPARK:	Compressor disengagement thermal contact (T)	
	contact opens	>160 °C
	contact closes	<140 °C

Minimum and maximum pressure switch (trinary) (Q20)

Boxer TD



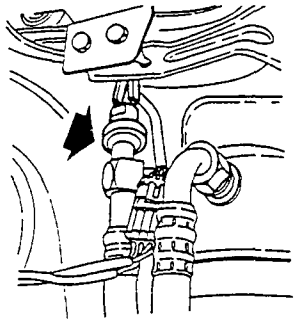
T.SPARK



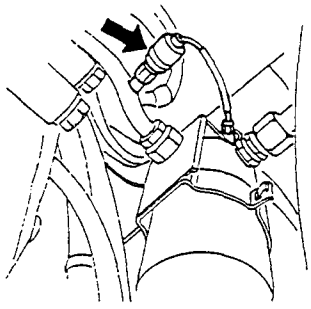
SPECIFICATIONS	
1st level: contact opens contact closes	 2.45 ± 0.25 bar 2.85 ± 0.50 bar
2nd level: contact closes contact opens	 15.2 ± 0.98 bar 11.28 ± 1.99 bar
3rd level: contact opens contact closes	 28 $^{+2}_{-3}$ bar 22 $^{+4}_{-5}$ bar

Minimum pressure switch (antifros) (Q9)

Boxer



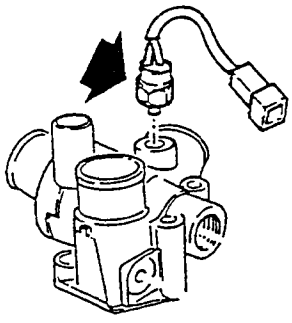
T.SPARK



SPECIFICATIONS	
Contact opening pressure	1.7 ± 0.2 bar
Contact closing pressure	3.4 ± 0.65 bar

Compressor cutoff thermal contact (Q12)

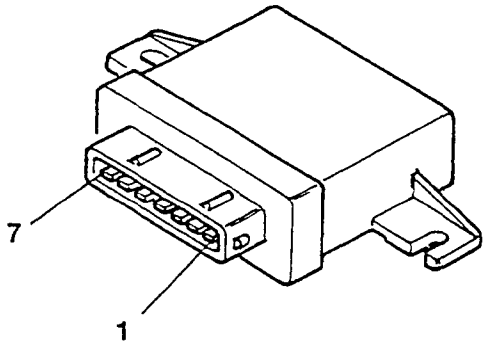
(for TD version only)



SPECIFICATIONS	
contact opens	111 ± 2 °C
contact closes	106 ± 2 °C

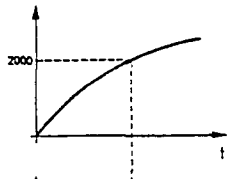
Compressor disengagement control unit (Q67)

(for TD version only)



SPECIFICATIONS
Operating diagram:

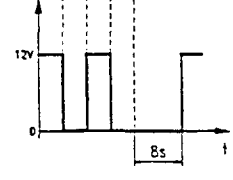
Engine rpm (pin 6)



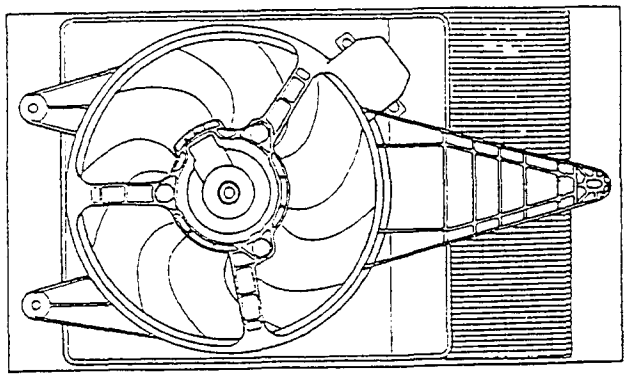
Full load switch (pin 5)



Output voltage (pin 7)



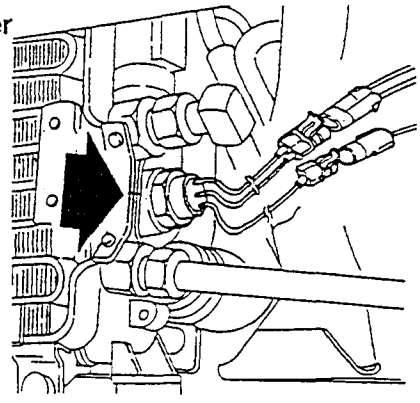
Cooling fan (P2)



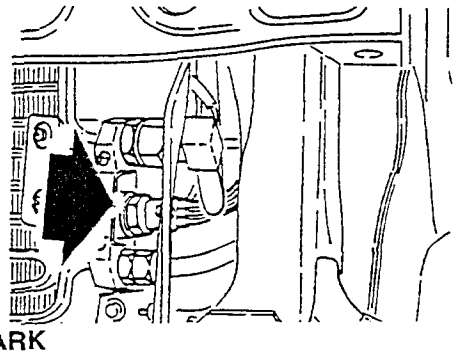
SPECIFICATIONS	
Nominal voltage	12V
Speed at 12V in free air in duct	2350 +150 rpm (minimum)
Motor direction of rotation (marked on duct)	right-hand (impeller side)

Fan two-level thermal contact (L33)

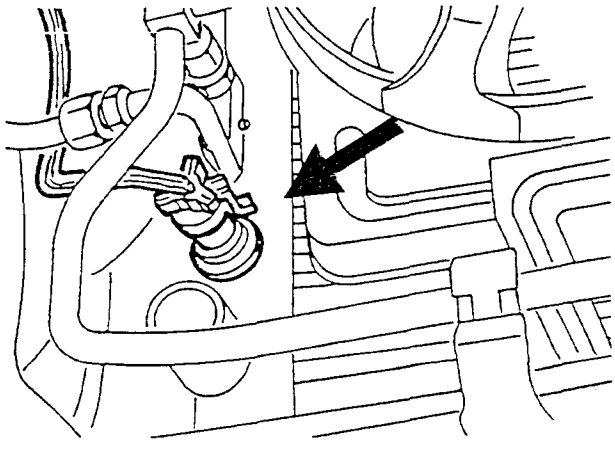
Boxer



TD



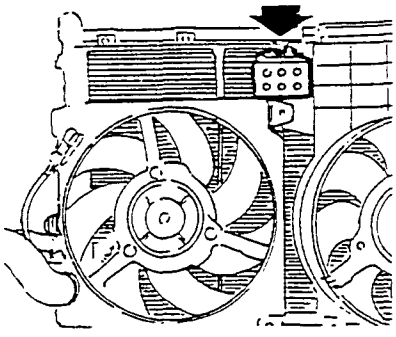
T.SPARK



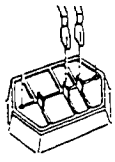
SPECIFICATIONS	
Boxer and T.SPARK versions	
1st level: contact closes contact opens	 92 ± 2 °C 87 ± 2 °C
2nd level: contact closes contact opens	 97 ± 2 °C 92 ± 2 °C
TD version	
1st level: contact closes contact opens	 88 ± 2 °C 83 ± 2 °C
2nd level: contact closes contact opens	 92 ± 2 °C 87 ± 2 °C

Fan resistance (O22)

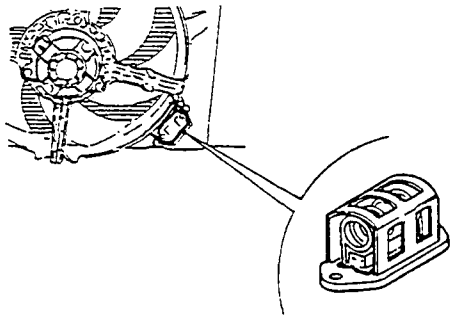
Boxer



T.SPARK

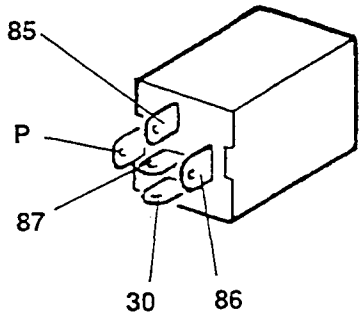


TD



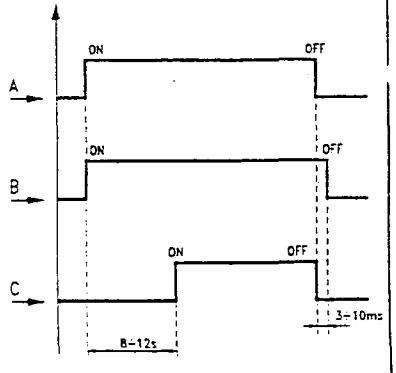
SPECIFICATIONS	
Boxer versions	
resistance	0.18 ± 10%
thermal fuse cut in	216 °C
TD versions	
resistance	0.23 ± 0.02Ω
thermal contact opening temperature thermal contact closing temperature	130 ± 10°C 60 ± 10°C
T.SPARK version	
resistance	0.18 Ω ± 10%
thermal fuse cut in	< 100 °C

Engine fan delaying device (Q42) (escluding T.SPARK)



SPECIFICATIONS

A pin P: earth signal
B = output pin 30: 1st speed
C = output pin 86: 2nd speed



Operating diagram

CLIMATE CONTROL: AUTOMATIC AIR CONDITIONER

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(*) **The engine cooling fan control system is quite the same as the one for cars with MANUAL CONDITIONER - See section 32A.**

GENERAL DESCRIPTION

The system with thermostatic adjustment controls the climate control system semi-automatically:

In fact it automatically controls the following - on the basis of the temperature required in the passenger compartment - :

– air temperature at the vents

– fan speed (continuously changing);

On manual intervention it controls:

– fixed fan speed (4th speed)

– compressor engagement (air cooling circuit)

– air recirculation engagement

– "fast defrosting" function

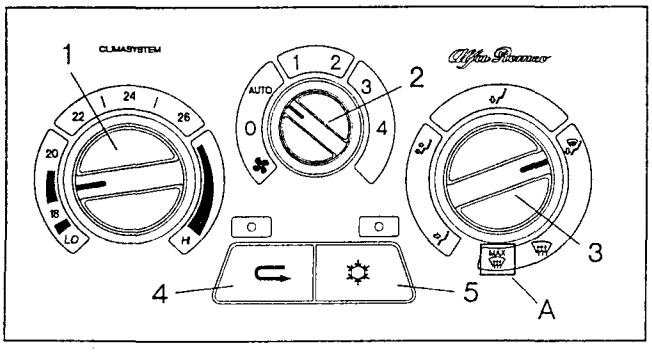
The distribution of the air flow to the various vents is adjusted completely by hand (through bowden cables).

Operating logic

A special electronic control unit manages automatic operation of the system controlling the thermodynamic parameters in order to provide the climatic comfort (temperature and humidity) required by the occupants of the vehicle.

According to the requests received and the temperature conditions detected, the control unit sets certain functions to adapt the temperature of the passenger compartment to the one required (for further details see Group 50).

Controls:



The left knob (1) selects the temperature required: it is connected to a potentiometer which detects the various angular positions and transmits a signal to the electronic control unit for a total of 15 different positions (one step corresponds to one degree centigrade); the two extreme positions "LO" and "HI" correspond to the request respectively for the coldest and warmest level.

The centre knob (2) adjusts air ventilation : this too, is connected to a potentiometer which detects the different angular positions and transmits a signal to the electronic control unit. There are four possible types of air flow with fixed manual settings (1, 2, 3 and 4), while in the "AUTO" position, the system itself automatically selects the most suitable flow rate for reaching or keeping the required temperature.

NOTE: Position "0" indicates minimum ventilation: the fan is off and only a light flow of dynamic air will go through the vents.
With the compressor engaged, the fan is always "forced at first speed, also with the knob at "0".

The right knob (3) selects air flow distribution to the passenger compartment which can take place in five different ways: this selection takes place manually through a cable that controls the movement of the distribution ports.

When the distributor knob is turned completely clockwise it activates - through a special microswitch - the "fast defrosting" function - yellow serigraph "A" - fast defrosting involves:

– maximum air flow rate

– mixing with the highest amount of warm air available

– dynamic air, regardless of the position of the button (5)

– compressor enabled, regardless of the position of the button (4)

When button (4) is pressed it enables operation of the compressor (air cooling circuit); when the button is released it cuts off the compressor. Engagement is fully manual: only in the "fast defrosting" mode is the compressor still enabled also when the button is released.

Actual compressor engagement however, also depends on other conditions:

– outside temperature below 5°C: (disengagement below 4°C and re-engagement above 6°C)

– temperature detected by the antifrost sensor: (disengagement below 3.5°C, re-engagement above 5°C).

The compressor may also be disengaged by the 4 level pressure switch or by the engine control unit. This logic depends on the different engine control units, as described in the specific "Engine Control" sections.

When button (5) is pressed it engages the air recirculation function; when the button is released it allows "dynamic" air from outside into the passenger compartment.

Engagement takes place only manually: recirculation is cut off even if the button is pressed only in the "fast defrosting" mode.

Air cooling system:

This is a closed loop system in which a fluid condenses and evaporates withdrawing heat from the air in the evaporator.

It mainly comprises:

compressor, operated by the crankshaft through a belt: it is turned on and off through an electromagnetic joint controlled by the air conditioning system:

- Petrol version: the compressor is controlled by the electronic engine management system which adapts the idle speed when the compressor is engaged, or cuts it off under power absorption conditions which adversely affect the performance levels of the car;
- TD version: compressor engagement is controlled by a special control unit which takes account of a series of operating conditions of the system and of the engine, as described below.

NOTE:in both cases a **variable displacement compressor** is used: this configuration is made through a suitable adjustment valve and sloping plate which changes the inside geometry. This makes it possible to meet the different requirements of cold air without continuously energising and energising the electromagnetic joint: in fact the compressor will set itself to the maximum displacement position for high requirements and vice versa for low requirements.

condenser, fitted in front of the engine coolant fluid radiator: when the car is stationary it stops the air needed for heat exchange, it is supplied operating the engine radiator fan;

evaporator, exchanger that cools the air, located in the duct-distributor;

accumulator/drier, which separates the fluid in liquid state from gas and also acts as a storage lung and filter for any foreign matter;

four-level pressure switch (trinary): controls the safety and correct operation of the fluid circuit.

The 4 levels cut in at:

- 1st level = minimum pressure for compressor engagement.
- 2nd level = pressure requiring engagement of the first speed of the fans.
- 3rd level = pressure requiring engagement of the second speed of the fans (level not present in the previous 3-level pressure switches).
- 4th level = maximum pressure for compressor engagement.

compressor cut out thermal contact: - only TD version - : this cuts off the compressor if the engine temperature reaches dangerously high values (it is a contact on the thermostatic cup which opens the circuit above 111°C.

full load switch - only TD version - : this is a mechanical microswitch on the injection pump which, through the special compressor cut out control unit, cuts off the compressor, only temporarily, when the accelerator pedal is completely depressed (full load).

compressor cut out control unit - only TD version - : this momentaneously disengages the cooling system under certain particular conditions in which the engine needs to deliver maximum power to the wheels, eliminating the power absorption of the compressor (e.g. when overtaking, fast acceleration, up hills, etc.).
The control unit brings about the following **operating logic**, or rather two different logics at low and high engine speed: below 2000 rpm as soon as the full load switch closes, the compressor electromagnetic joint is de- energised, and it is engaged as soon as the switch opens again; above 2000 rpm the supply cut off to the compressor only lasts 8 seconds, after which it is restored.

Engine fan control:

When the car is travelling at low speed, dynamic air cooling on the condenser lowers and it is necessary to engage the fan that cools the engine radiator and the condenser. This takes place through the 4-level pressure switch which prevents an increase of the pressure at the condenser: the engine fan is initially engaged at first speed (level of appr. 15 bar) then, at second speed (level of appr. 20 bar).

Fuses and relays:

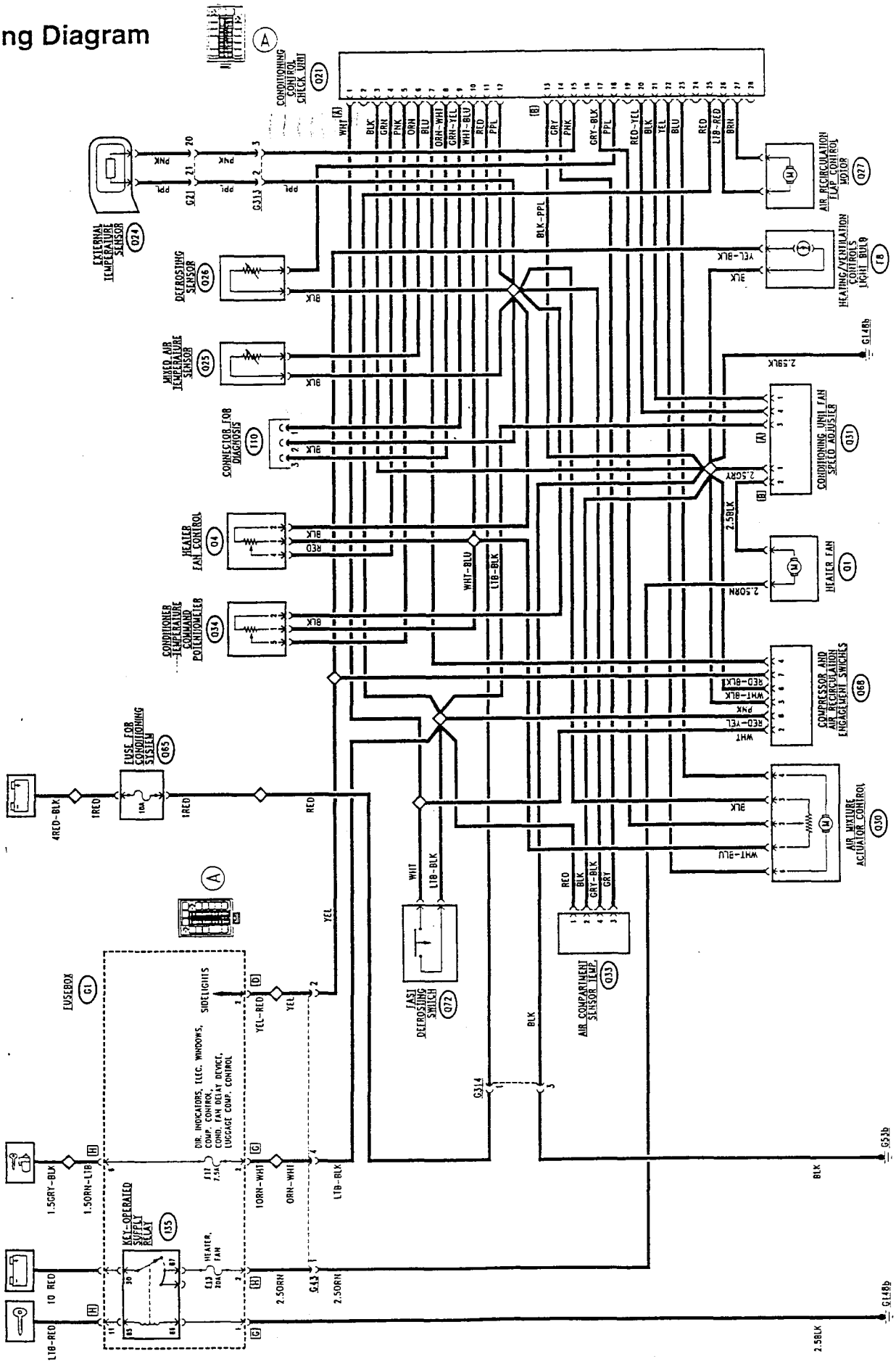
The system fuses and relays are grouped as follows:

- next to the fusebox **G1**: 30A fuse **G255** (only **G1**, B), 10A fuse **Q65**, relay **I78** (only **G1**, B), relay **I99** (only **G1**, B), relay **Q22** (only TD);
- in the "maxi fuse" box **G56**: 50A fuse **G254**;
- on the fan duct: relay **I100** (only TD);
- next to the i.e. fuses and relays i.e. (only petrol version): relays **Q22** and **I100**;

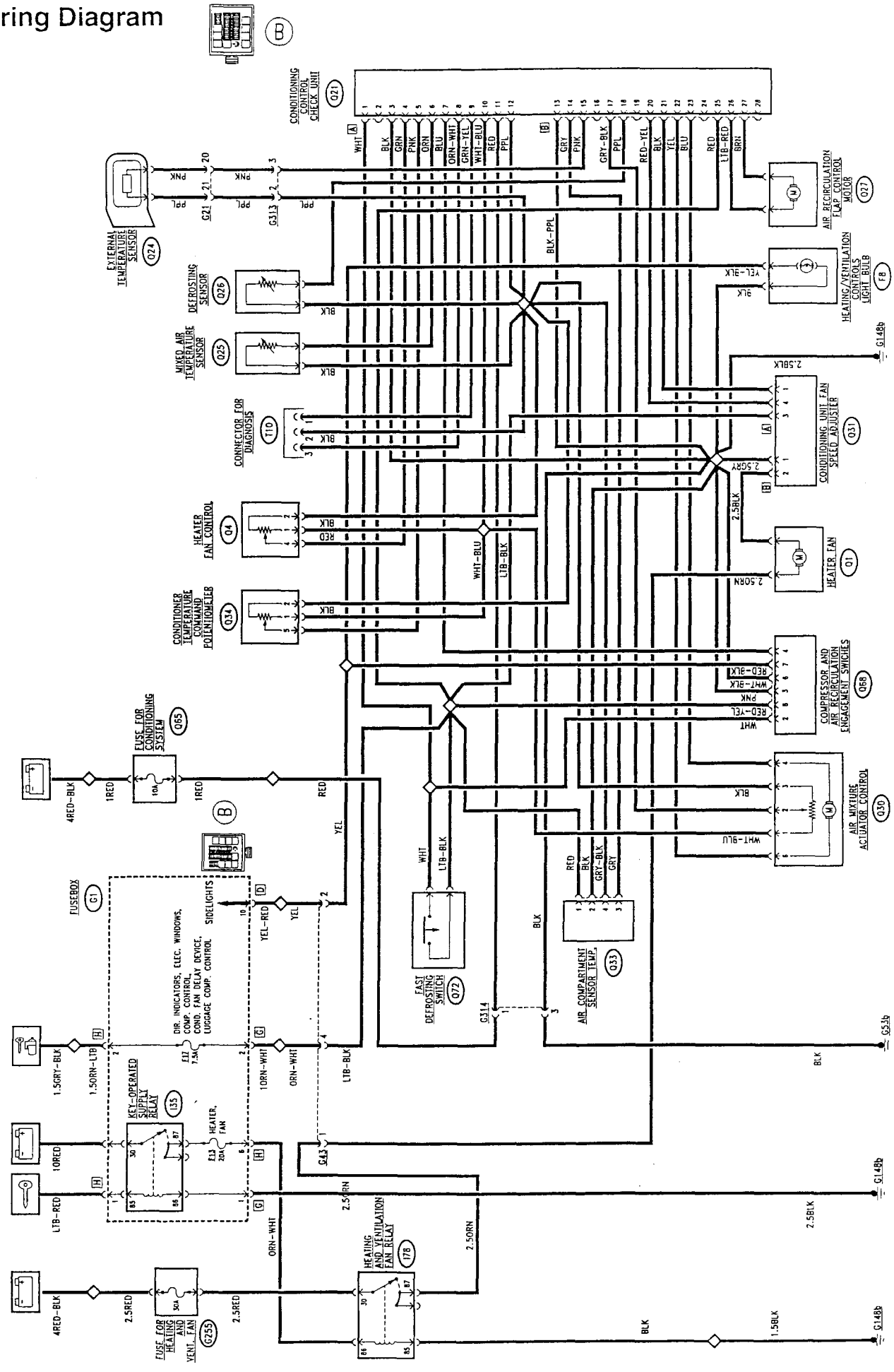
For further details concerning this system, refer to Group 50 "CLIMATE CONTROL".

RECIRCULATION AND AIR TEMPERATURE FAN CONTROL

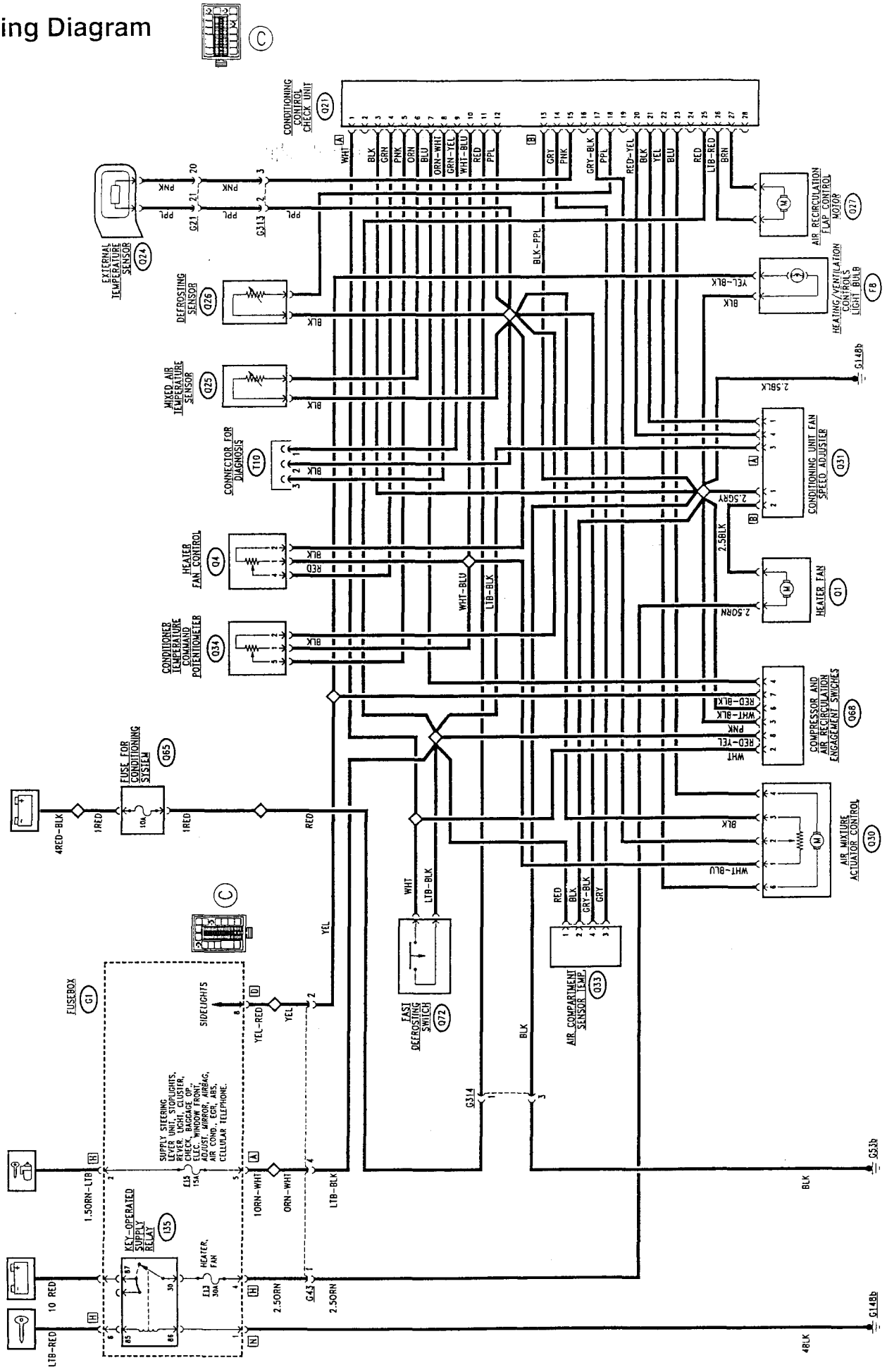
Wiring Diagram



Wiring Diagram



Wiring Diagram



Functional Description

The electronic control unit automatically operates the system controlling the thermodynamic parameters in order to provide the climatic comfort (temperature and humidity) required by the occupants of the car.

The control unit **Q21** is supplied directly at pin 11 by the line of wander fuse **Q65**; the key-operated supply reaches pin 25 by the line of fuse **F17** of **G1** (box "A") or fuse **F15** (box "C"). Pin 3 and 13 are at earth (**G148b**).

The outside temperature sensor **Q24** is on the right wing mirror: it is an NTC sensor connected to pin 15 of **Q21** and connected to the reference earth at pin 12 of **Q21**.

The antifrost sensor **Q26** is inside the duct/distributor unit near the evaporator: it is an NTC sensor connected to pin 18 of **Q21** (reference earth at pin 12).

The treated air temperature sensor **Q25** is inside the duct/distributor unit upstream of the distribution ports: this is an NTC sensor connected to pin 6 of **Q21** (reference earth at pin 12).

The fan control potentiometer **Q4** is connected with the corresponding knob : it is supplied by the control unit with 5V (pin 10) and reference earth (pin 12) and returns a signal corresponding to the different positions of the knob (pin 4).

The required temperature control potentiometer **Q34** is connected with the corresponding knob: it is supplied by the control unit with 5V (pin 10) and the reference earth (pin 12) and returns a signal corresponding to the position of the knob (pin 5).

The "fast defrosting" switch **Q72** is on the distribution knob: this is an N.O. contact which sends a voltage signal (12V) to pin 1 of **Q21** and to the compressor switch **Q68**.

The pasenger compartment air temperature sensor **Q33** is on the dashboard, on the right of the steering wheel. This is an NTC sensor connected to pin 14 of **Q21**.

The sensor is "ventilated", i.e. it contains a small fan that is always supplied (line of **F17** box **G1** "A" - or **F15** for box **G1** "C" - and earth **G148b** and earth **G148b**) so that the temperature reading remains unaffected by the air stagnating inside the dashboard.

The mixing control actuator **Q30** is driven by the control unit of pin 22 and 23.
A motor supplied at 12V controls the rotary movement of a draw pin which acts directly on the mixing port. A potentiometer detects the position and acts as "feedback" to the control unit (pin 17).

The recirculation control actuator **Q27** is a motor supplied at 12V by pin 26 and 27 of **Q21** which turns the outside air inlet port in the two directions to the end of its stroke, without intermediate positions.

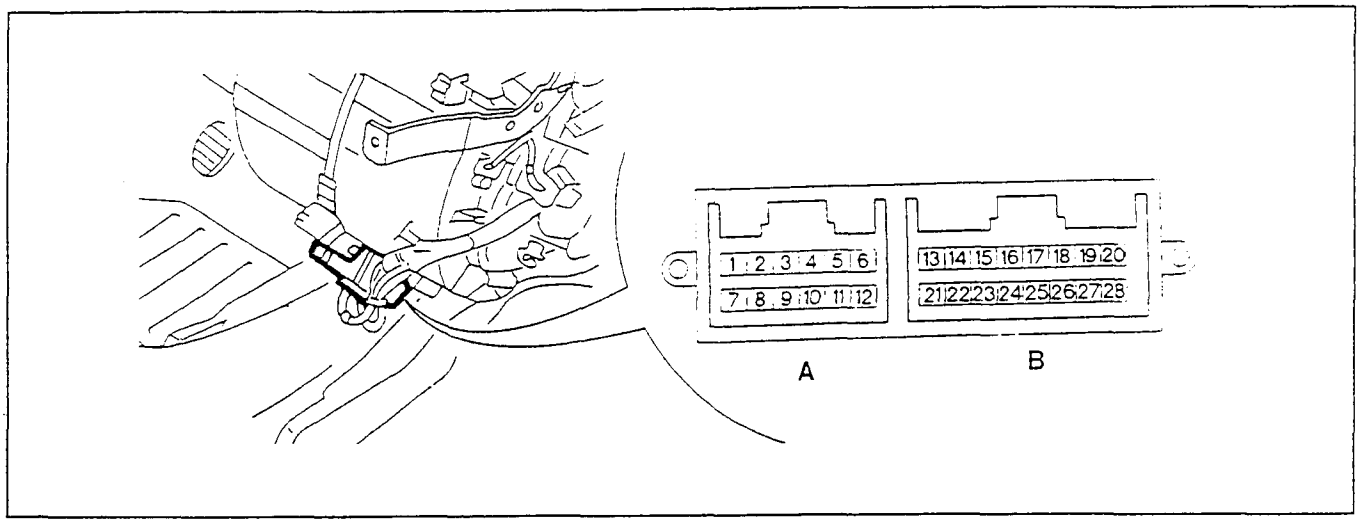
The fan **Q1** that sends outside or recirculation air to the duct-distributor is supplied at 12V by the special line of fuse **F13** of **G1** and it is controlled at different speeds continuouslt by an electronic regulator **Q31** near to it.

At the input, the electronic regulator **Q31** receives a control signal from the control unit - pin 20 and 21 - and converts it into an earth signal of variable power continuously so as to operate the fan accordingly.

Switches **Q68** enable engagement of the compressor and recirculation connecting to pin 25 and 7 of **Q21**; inside the set of switches the leds are lit when the sidelights are on, and also the whole control panel, through lights **F8** and the line of connector D of **G1**.

Lastly the diagnosis connector **T10**, near the control unit; connects to pin 8 and 9 of **Q21**.

PIN OUT Control unit



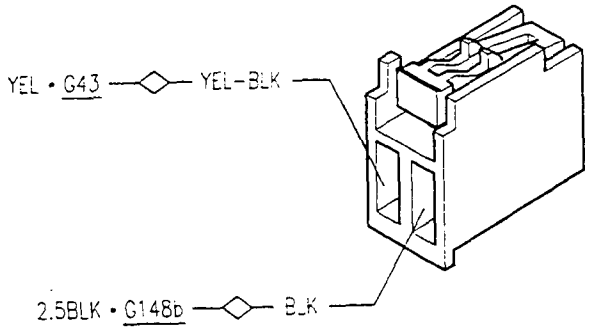
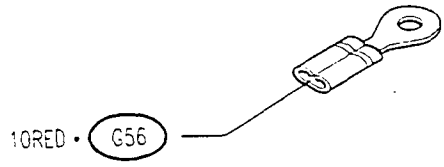
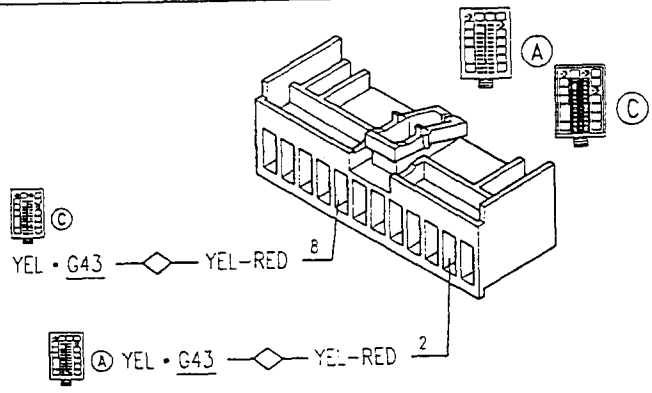
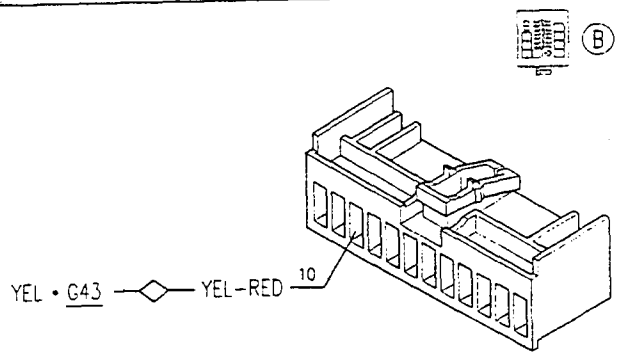
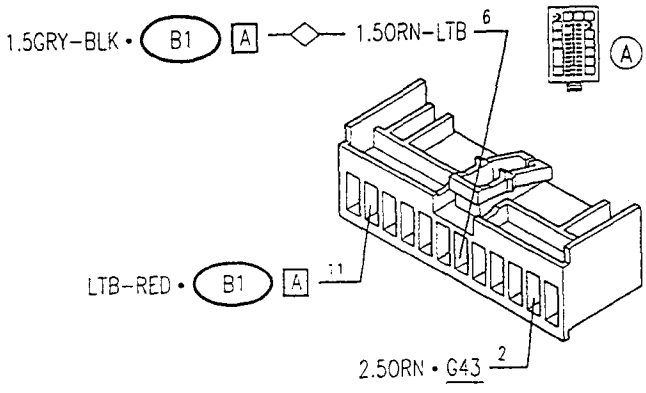
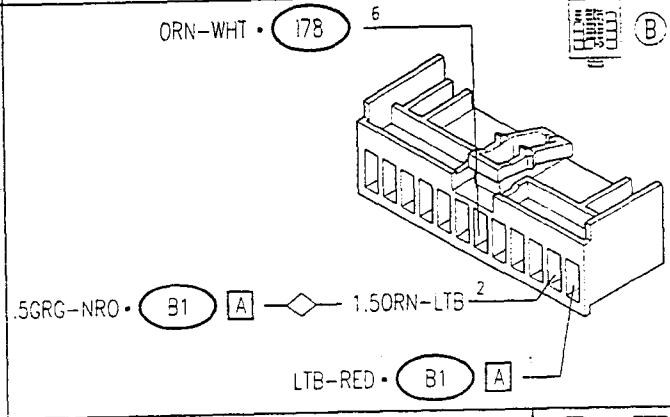
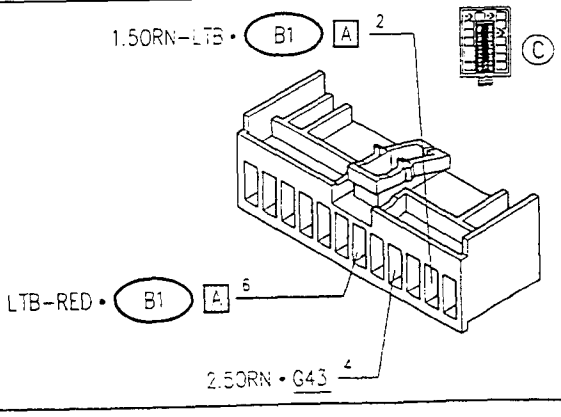
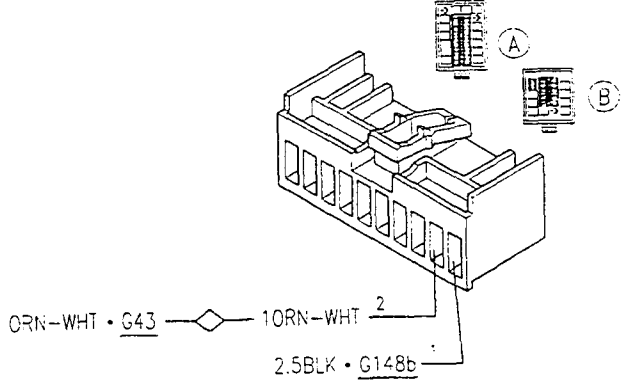
CONNECTOR A

PIN	FUNCTION
1	"Fast defrosting" function
2	Compressor engagement
3	Earth
4	Fan control potentiometer
5	Required temperature adjustment potentiometer
6	Treated air temp. sensor
7	Recirculation engagement
8	Diagnosis line K
9	Diagnosis line L
10	Supply for potentiometers - 5V
11	Direct supply from battery
12	Earth for sensors

CONNECTOR B

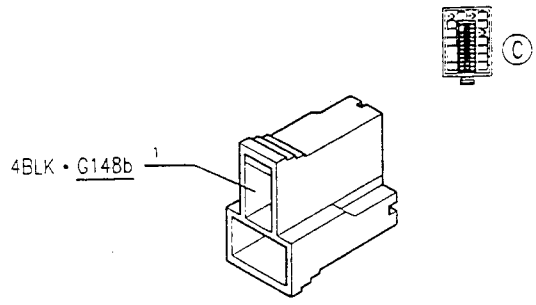
PIN	FUNCTION
13	Earth
14	Passenger compartment temperature sensor
15	Outside temperature sensor
16	N.C.
17	Mixing actuator feed-back
18	Antifrost sensor
19	N.C.
20	Fan control
21	Earth for fan
22	Mixer control - 5V
23	Mixer control - 5V
24	Compressor control
25	Key supply
26	Recirculation engagement control- 5V
27	Recirculation shut off control - 5V
28	N.C.

Components and Connectors

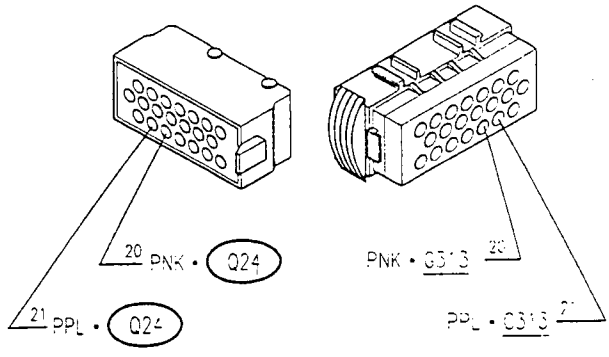
Climate control system controls lighting (F8)	Fusebox (G1)
	
Fusebox (G1 D)	**Fusebox (G1 D)**
	
Fusebox (G1 H)	**Fusebox (G1 H)**
	
Fusebox (G1 H)	**Fusebox (G1 G)**
	

Components and Connectors (continued)

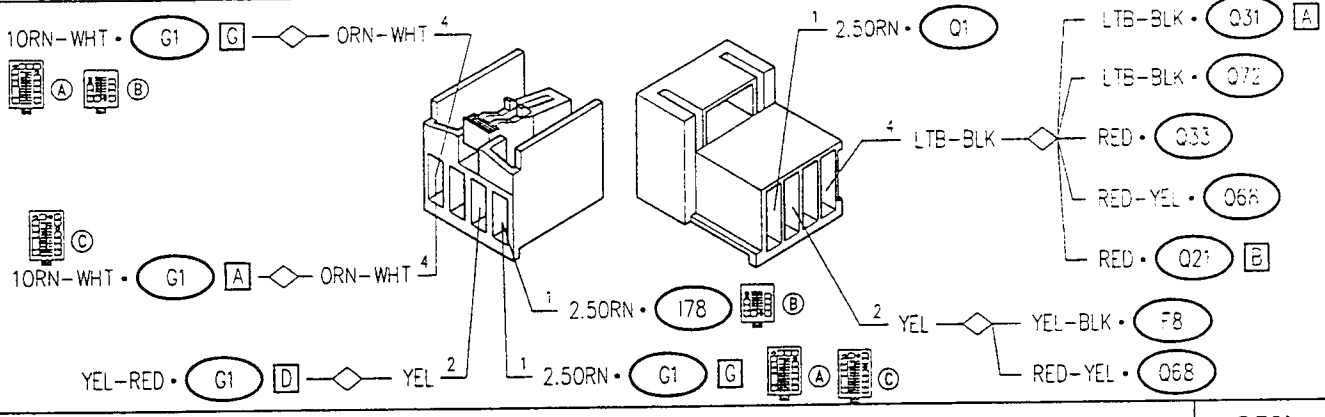
Fusebox	G1 N



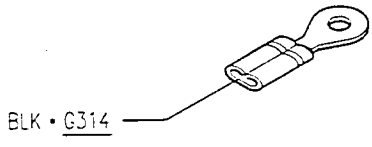
RH front door wiring connector	G21



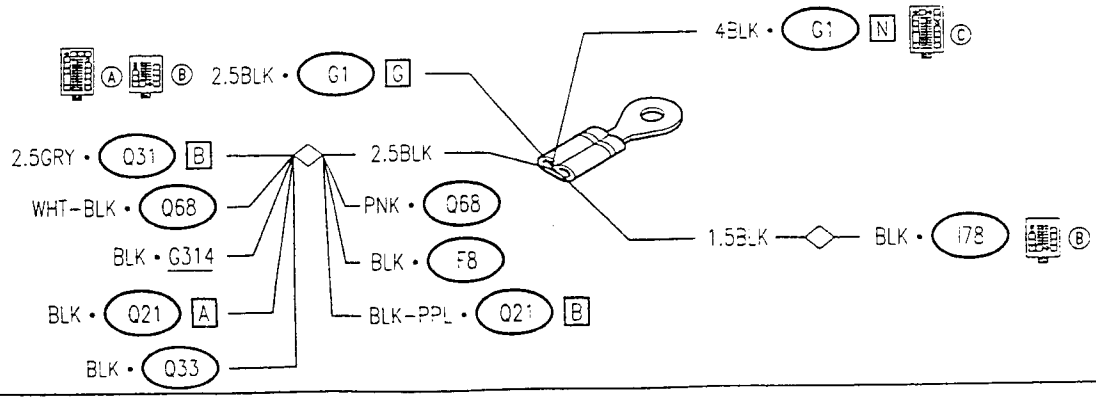
Climate control system wiring connector	G43



LH engine compartment earth.	G53b

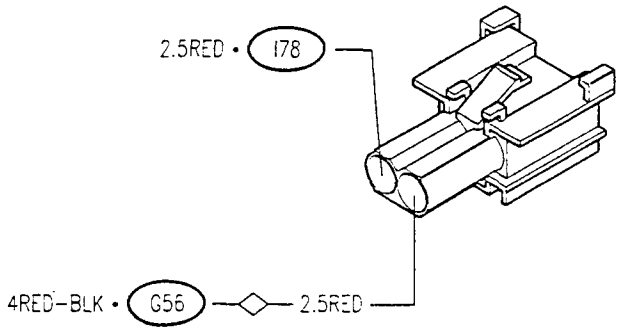


Earth under LH dashboard	G148b

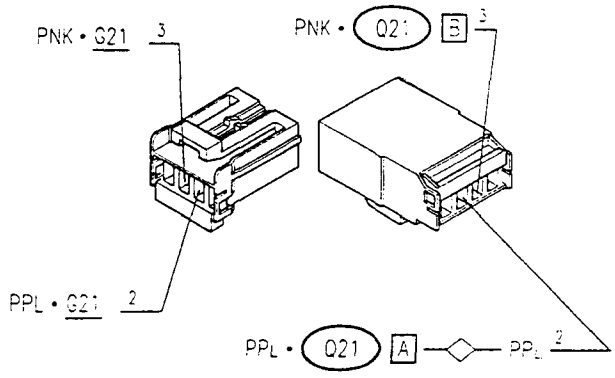


Components and Connectors (continued)

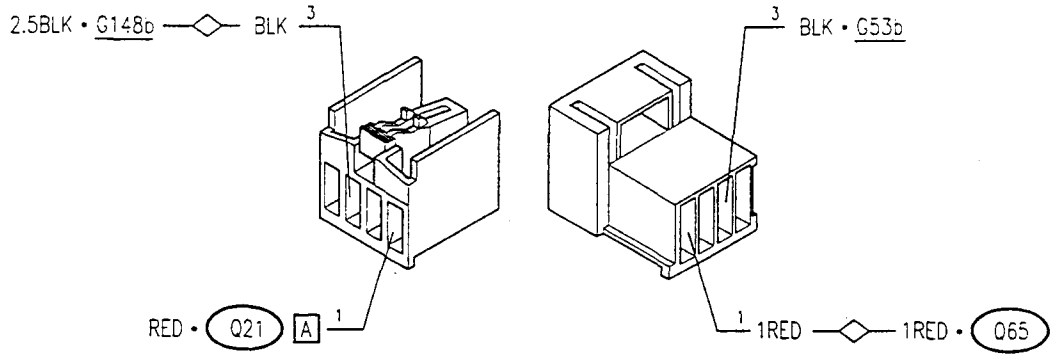
Climate control fan fuse	G255



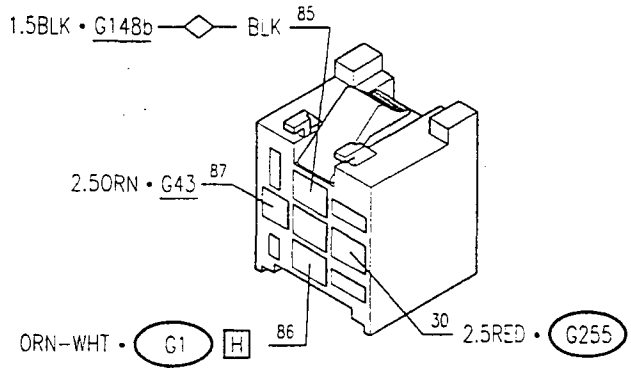
Conditioner additional wiring connector	G313



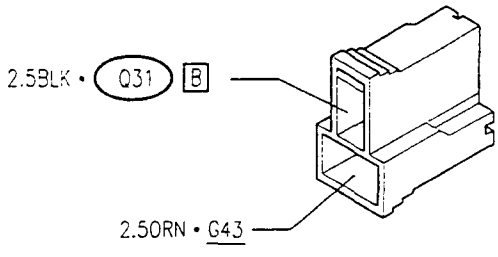
Engine wiring/conditioner wiring connector	G314



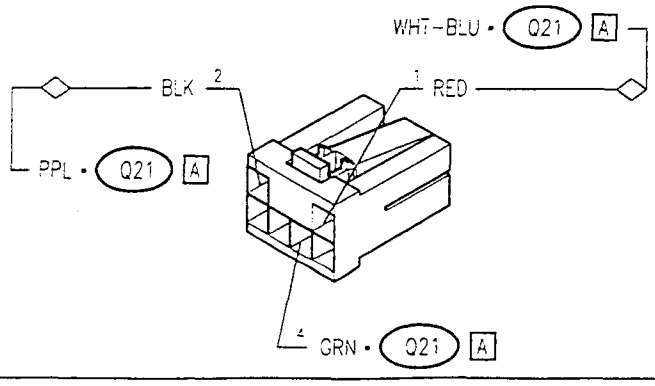
Climate control fan relay	I78



Climate control fan	Q1

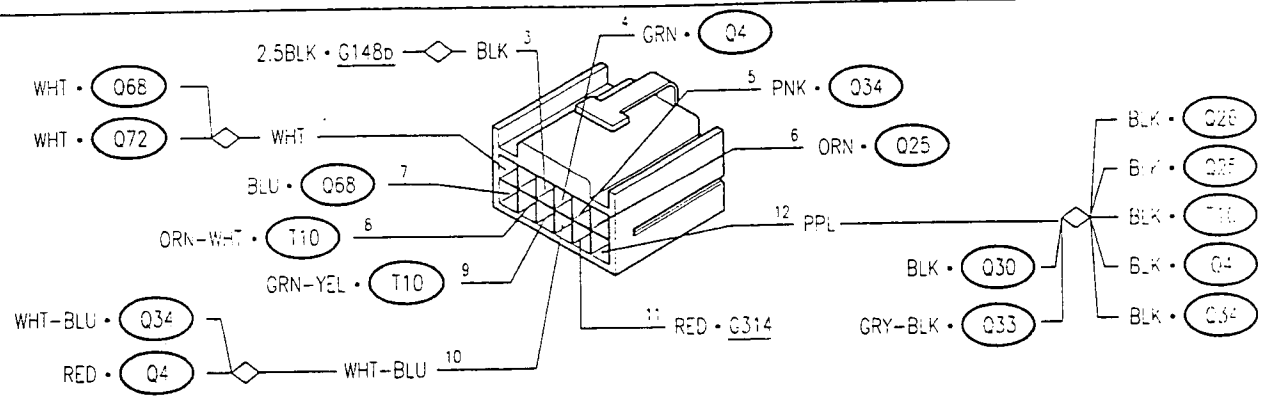


Climate control fan control	Q4

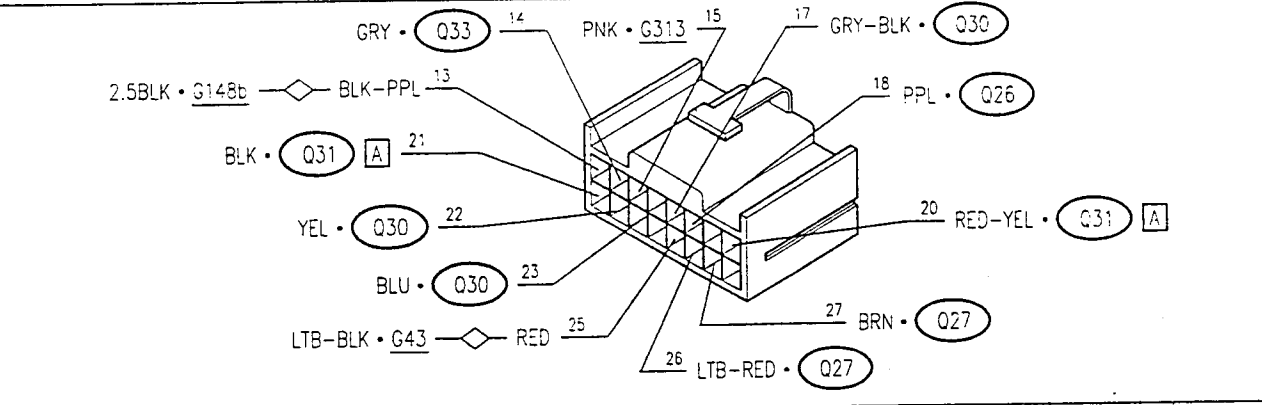


Components and Connectors (continued)

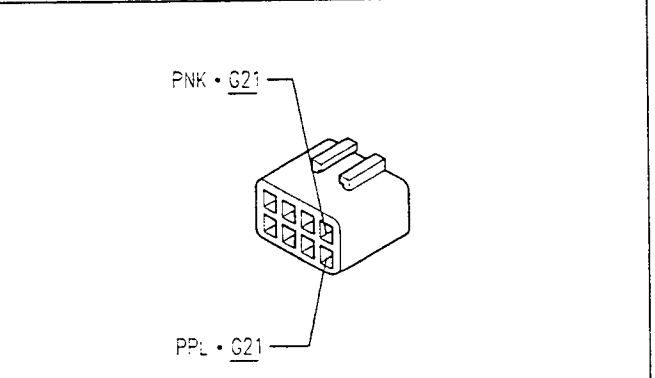
Climate control system control unit — Q21 A



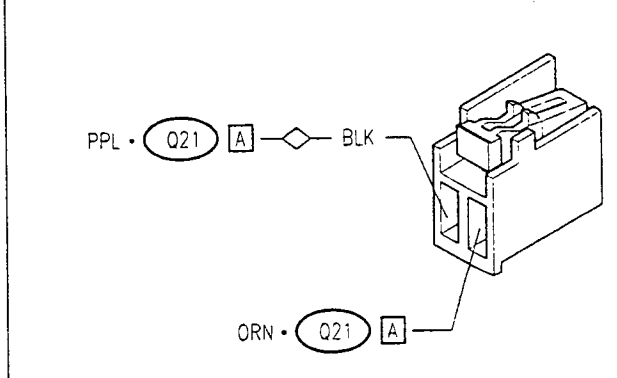
Climate control system control unit — Q21 B



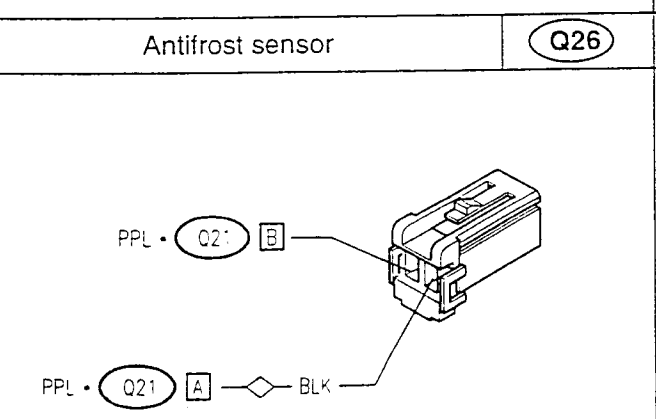
Outside temperature sensor — Q24



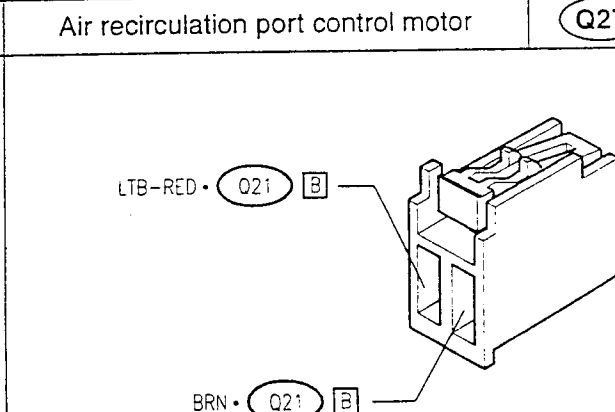
Treated air temperature sensor — Q25



Antifrost sensor — Q26

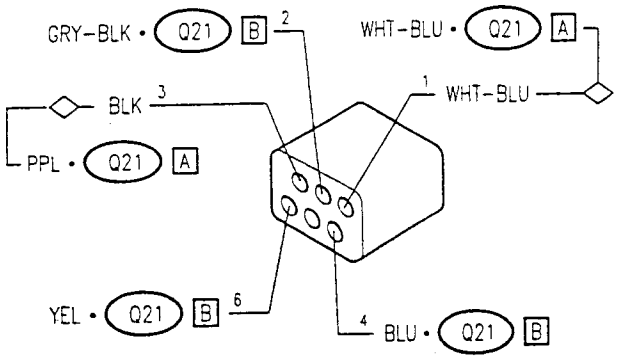


Air recirculation port control motor — Q27

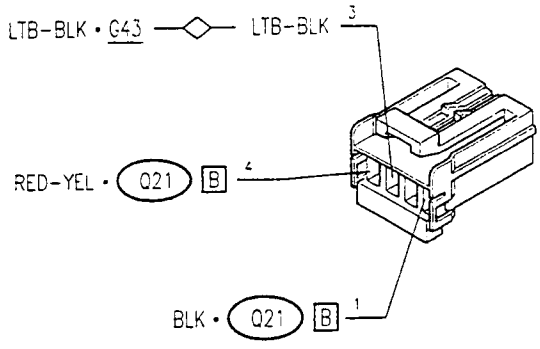


Components and Connectors (continued)

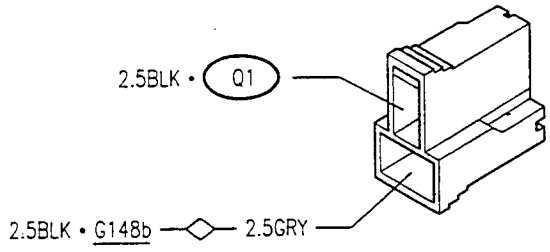
Air mixing control motor — Q30



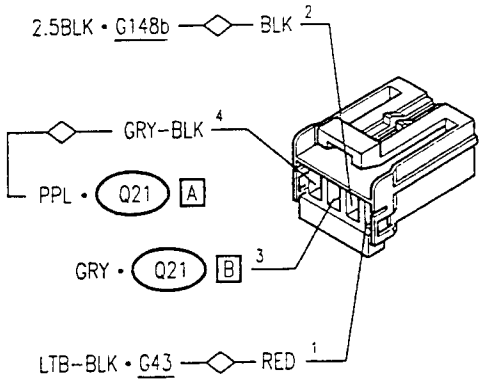
Climate control system fan electronic regulator — Q31 A



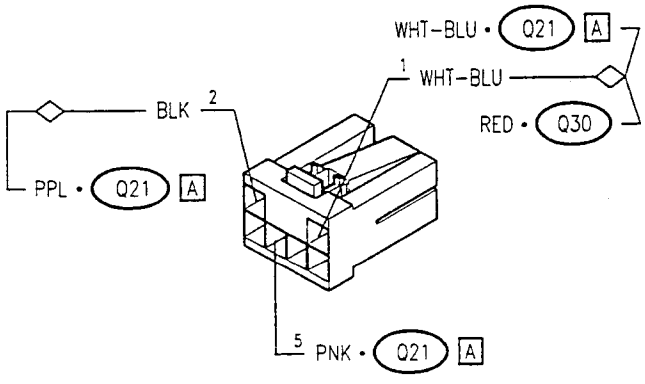
Climate control system fan electronic regulator — Q31 B



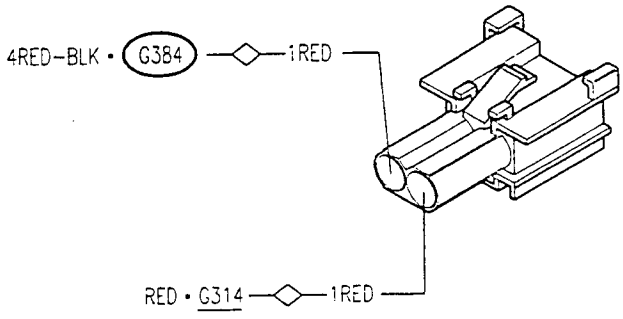
Passenger compartment air temperature sensor — Q33



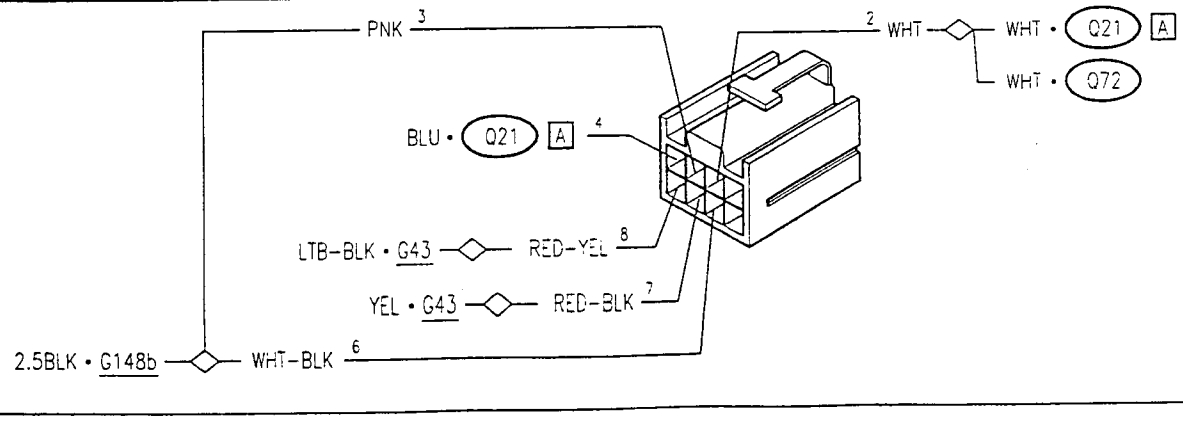
Required air adjustment control — Q34



Air conditioning system wander fuse — Q65

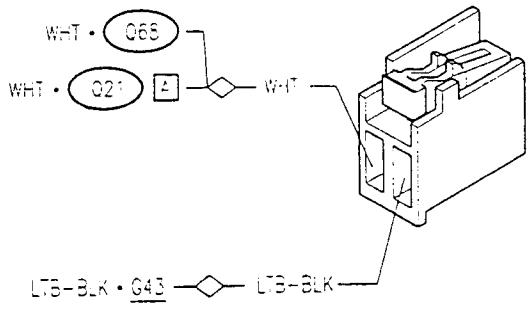


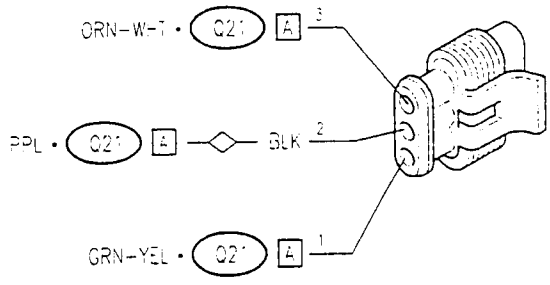
Compressor and air recirculation switches — Q68



Components and Connectors (continued)

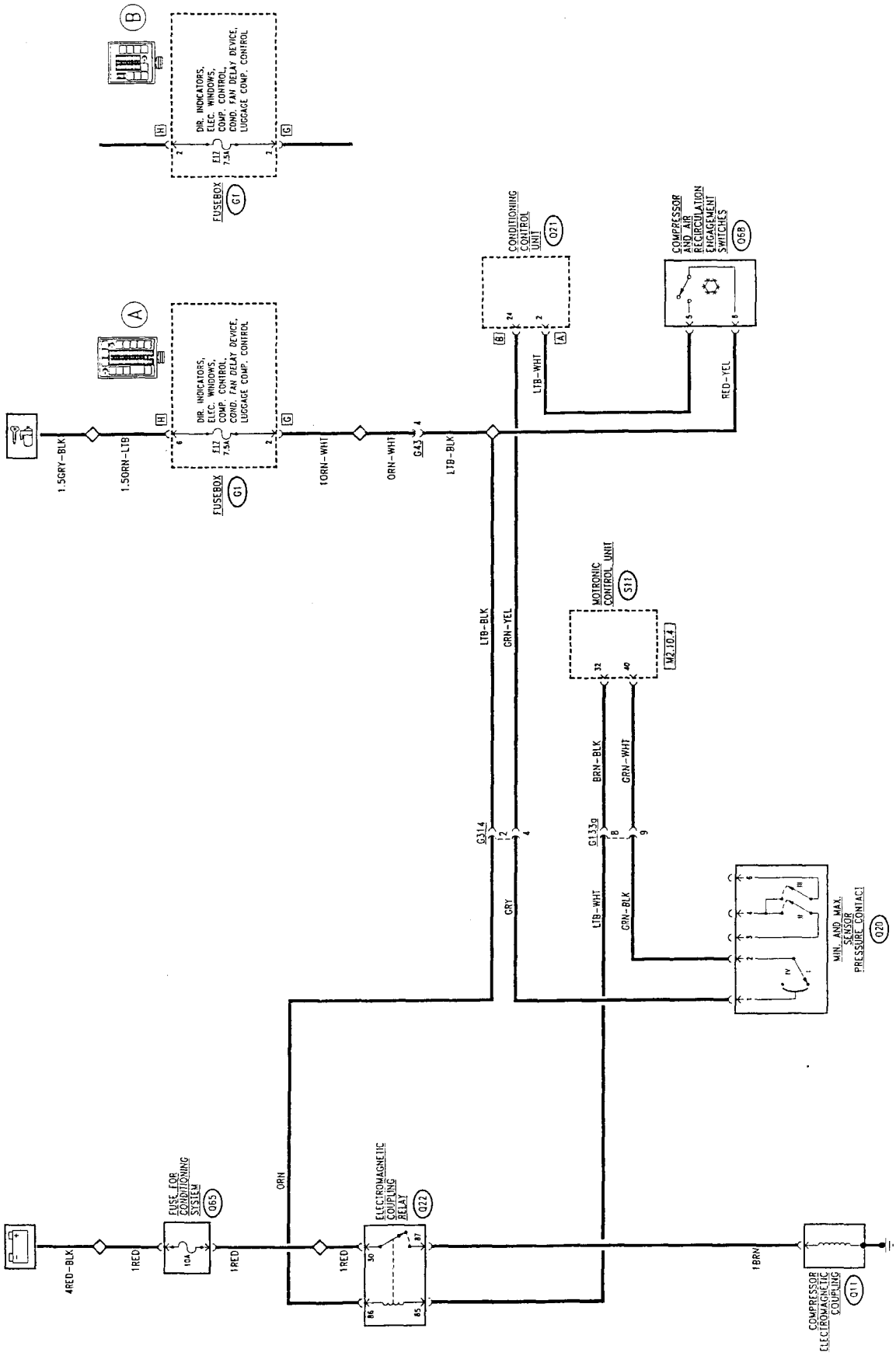
Fast defrosting switch	Q72	Connector for ALFA TESTER (air conditioner)	T10



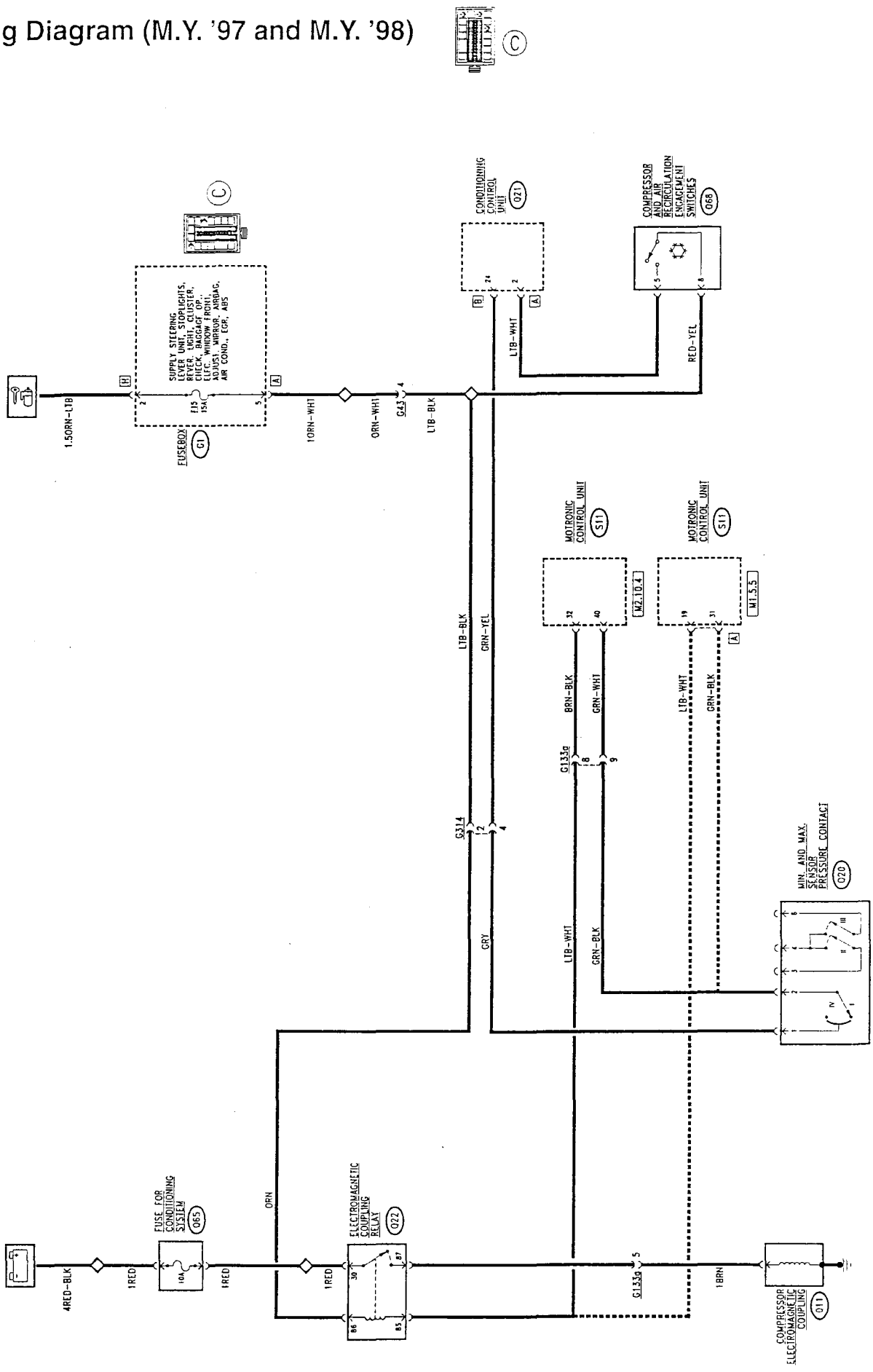


COMPRESSOR ENGAGEMENT (Petrol version)

Wiring Diagram



Wiring Diagram (M.Y. '97 and M.Y. '98)



Functional Description

The electromagnetic joint that operates the compressor **Q11** is controlled by relay **Q22** next to the relays and fuses of the injection/ignition system.

The coil of relay **Q22** receives the key-operated supply (line protected by fuse **F17** of **G1** (box "A") or fuse **F15** (box "C"); conversely the power line is supplied by battery current via wander fuse **G65**.

Relay **Q22** is energised, and consequently supplies to 12V current to the electromagnetic joint **Q11**, according to the following logic managed by the M2.10.4 injection - ignition control unit, which is connected with the air conditioning system through:

- pin 40 which receives the request signal to turn the system on from the air conditioning system;
- pin 32 from which a "low" (earth) signal leads which controls the relay **Q22** for engaging the conditioner compressor **Q11**.

A special logic enables this engagement, as follows:

- it adapts idle speed to compensate the increase in absorbed power due to compressor engagement;
- if the engine needs high power (high throttle opening speed), full load, or high engine temperature, it momentaneously cuts off compressor engagement.

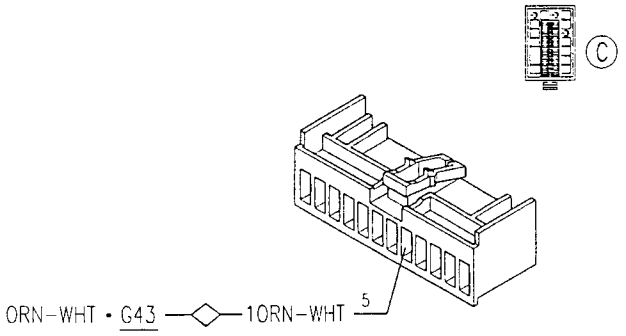
The positive signal leading from the compressor engagement switch **Q68** crosses the control unit **Q21** which comes into action in the following conditions:

- low outside temperature: (disengagement below 4°C and re-engagement above 6°C);
- low mixed air temperature (disengagement below 3.5°C and re-engagement above 5°C).

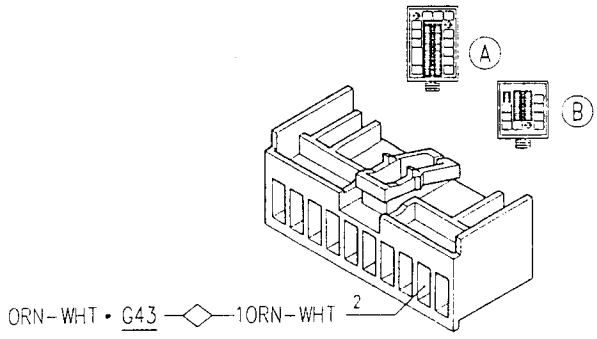
The same signal also crosses the pressure switch **Q20** which cuts in if the pressure of the cooling system is too high or too low: in this case the signal does not reach the control unit which does not command compressor engagement.

Components and Connectors

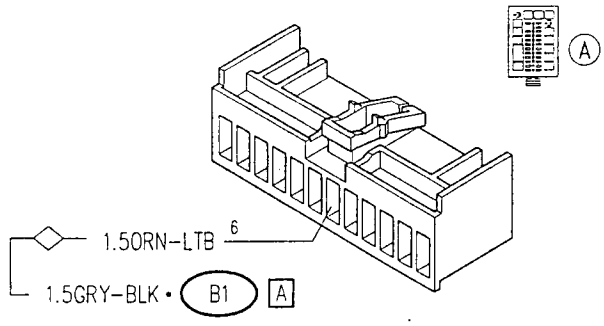
Fusebox G1 A



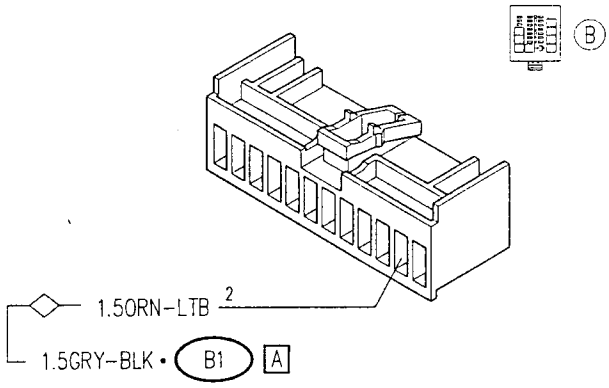
Fusebox G1 G



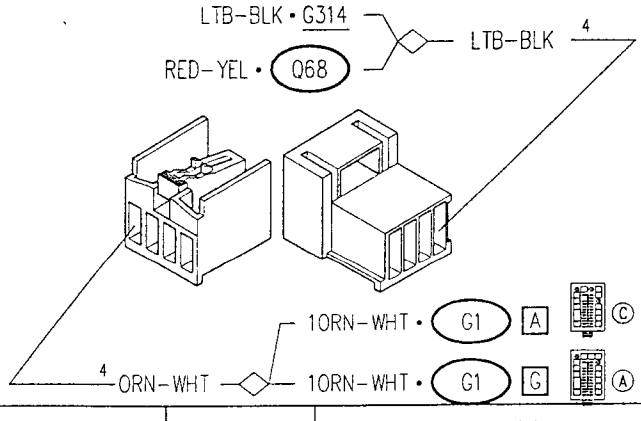
Fusebox G1 H



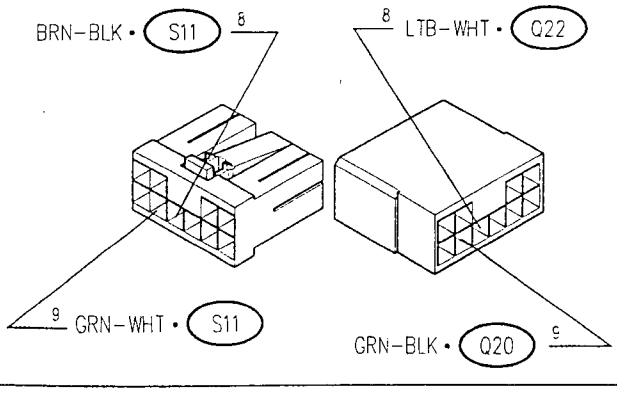
Fusebox G1 H



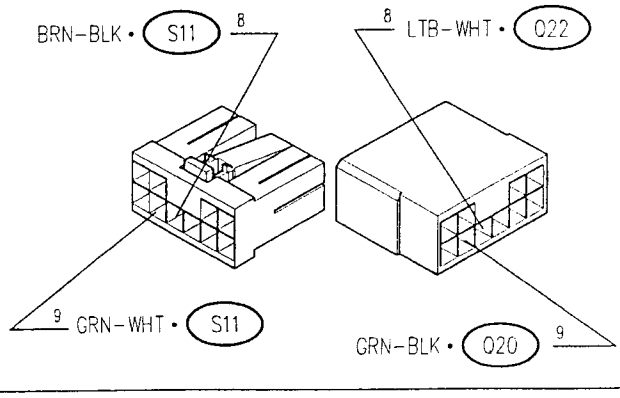
Climate control system controls connector G43



Injection wiring connector A (*) G133a



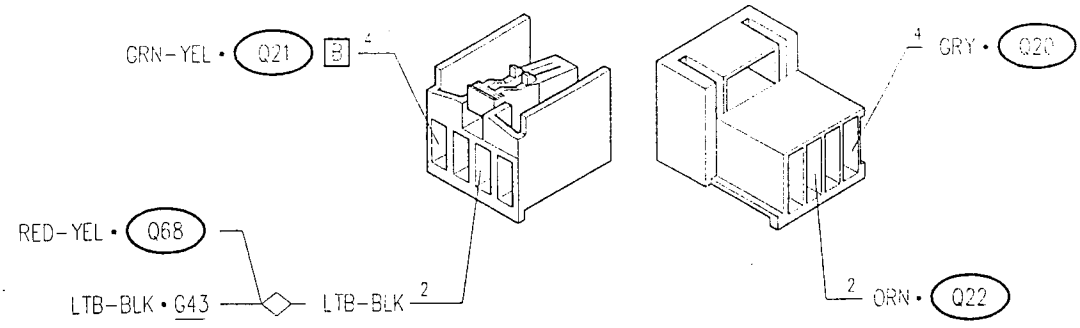
Injection wiring connector A (•) G133a



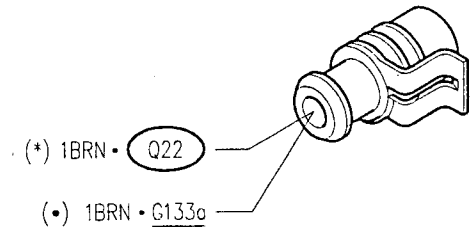
(*) only M2.10.4
(•) M1.5.5.

Components and Connectors (continued)

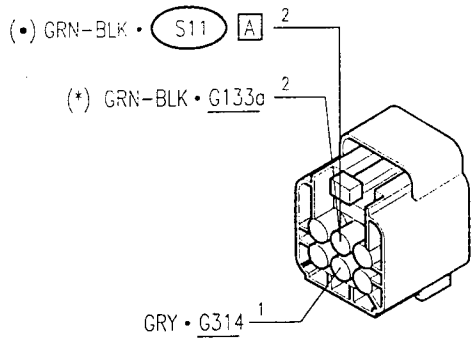
Engine wiring/conditioner wiring connector	G314



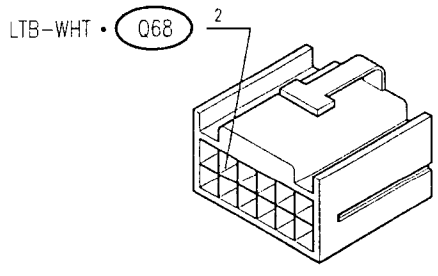
Compressor electromagnetic joint	Q11



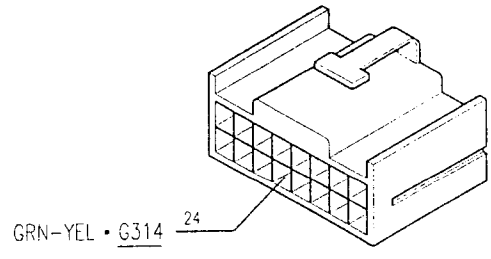
Min. and max. sensor pressure contact	Q20



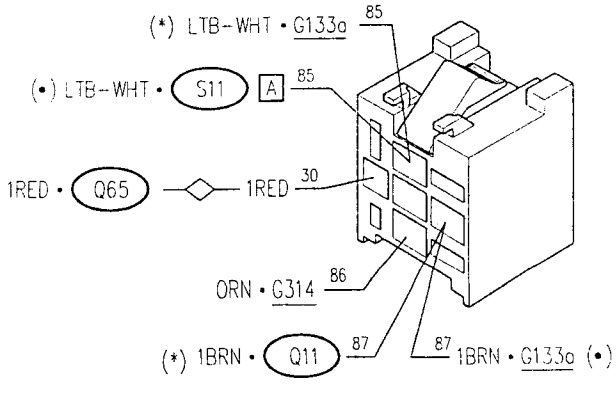
Climate control unit	Q21 A



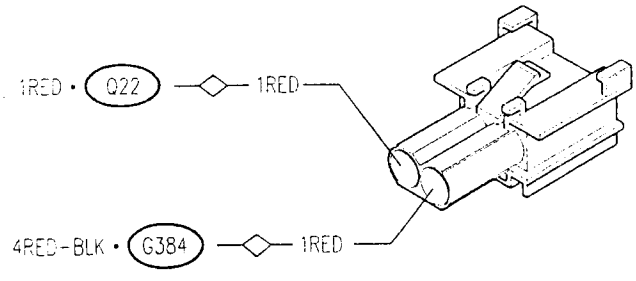
Climate control unit	Q21 B



Electromagnetic joint control relay	Q22



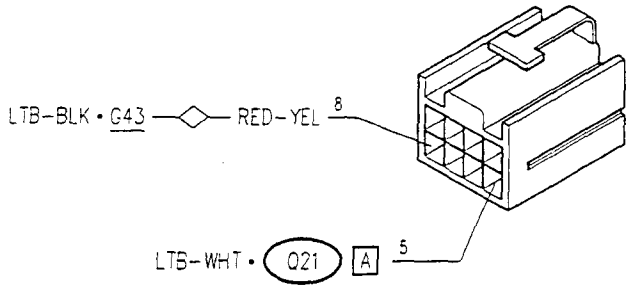
Air conditioning system wander fuse	Q65



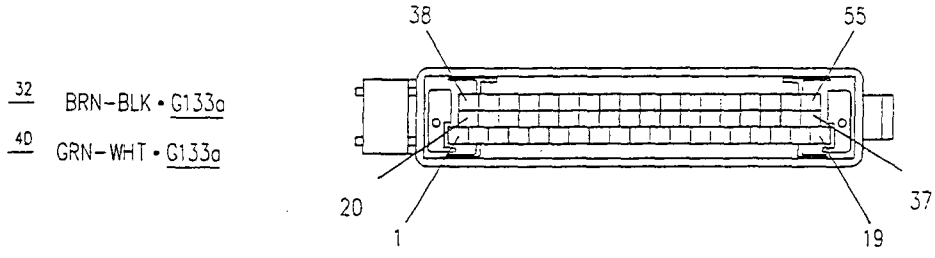
(*) only M2.10.4
(•) M1.5.5

Components and Connectors (continued)

Compressor and air recirculation switches	Q68

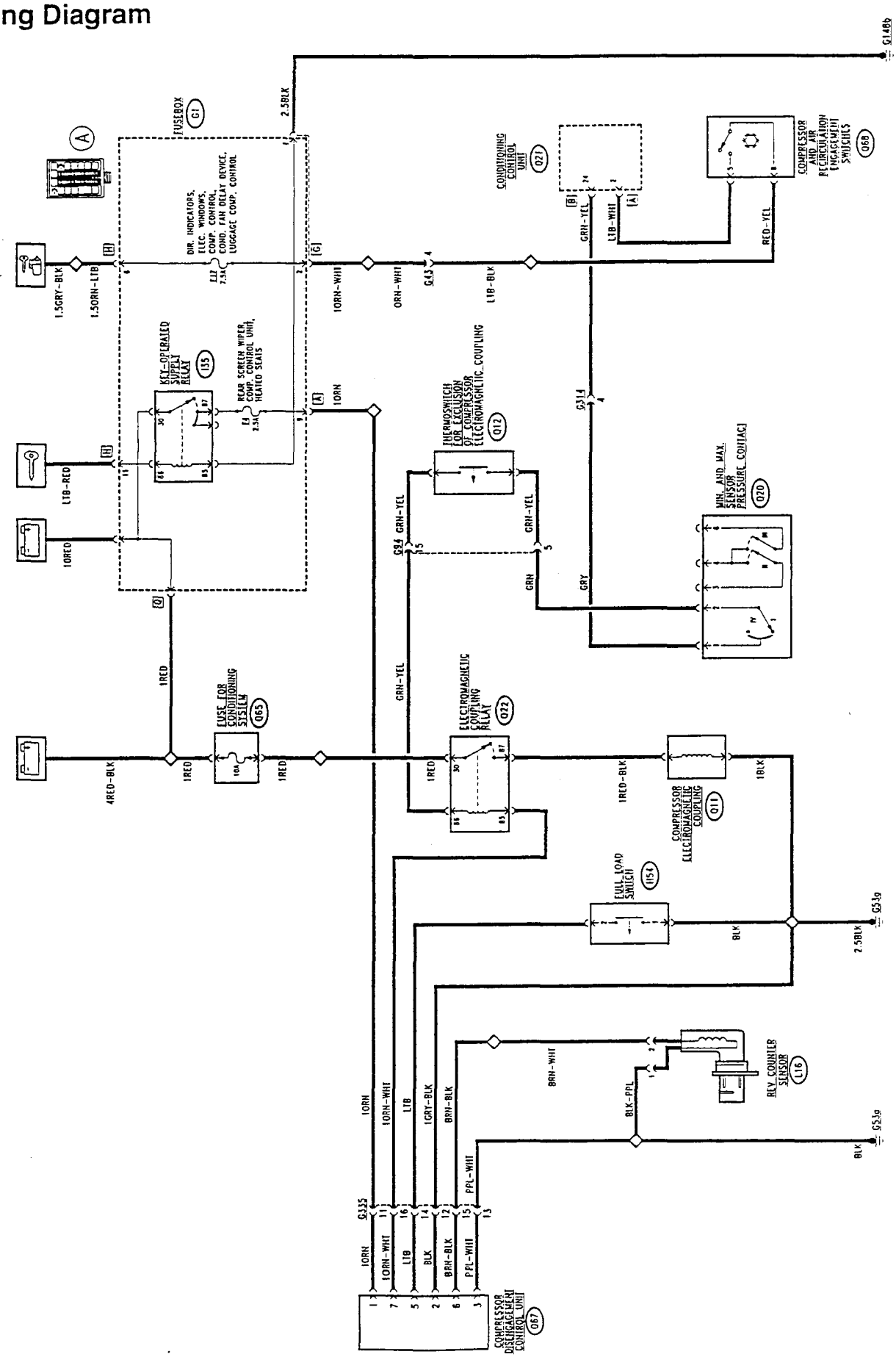


Motronic control unit	S11

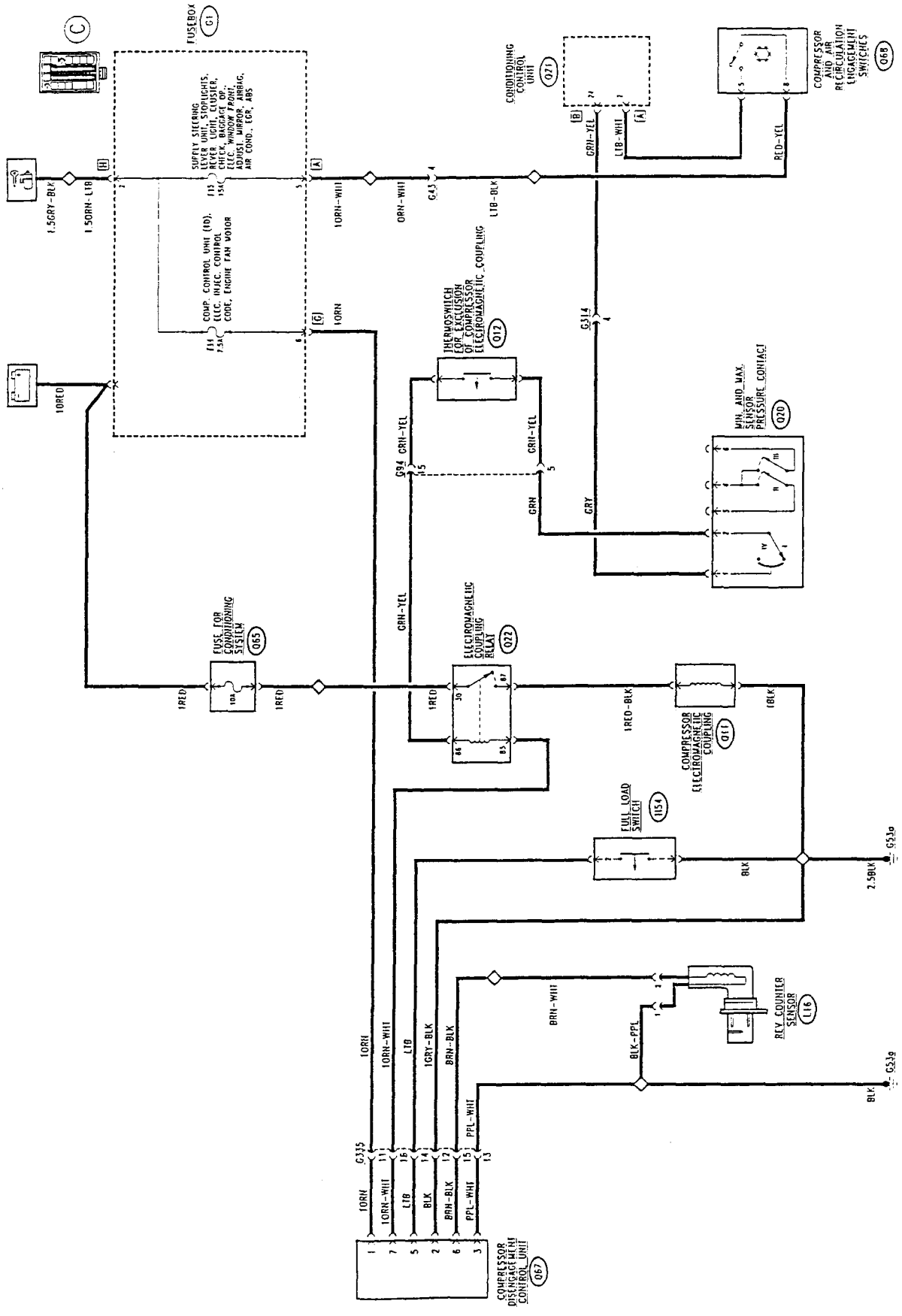


COMPRESSOR ENGAGEMENT (TD version)

Wiring Diagram



Wiring Diagram (TD-CAT version)



Functional Description

The electromagnetic joint that operates the compressor **Q11** is actuated by the corresponding relay **Q22**.

Relay **Q22** is supplied directly by the battery, through fuse **Q65**.
The two energising signals (12 V and earth) reach relay **Q22** from the compressor cut out control unit **Q67**, and from the control switch **Q68**:

– the positive signal leading from the switch in **Q68**, before reaching relay **Q22** it crosses the compressor cut out thermal contact **Q12** (which cuts off the compressor if the engine is very hot) and the pressure switch **Q20**.
The signal also crosses control unit **Q21** which comes into operation in the following conditions:

- low outside temperature: (disengagement below 4°C and re-engagement above 6°C);
- low mixed air temperature (disengagement below 3.5°C and re-engagement above 5°C);

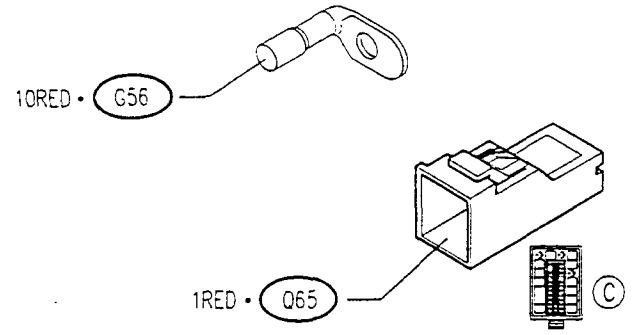
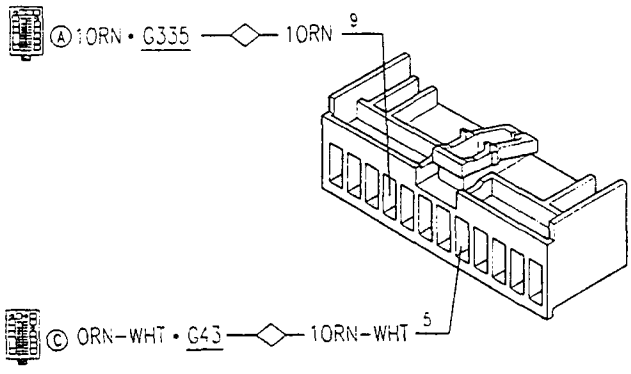
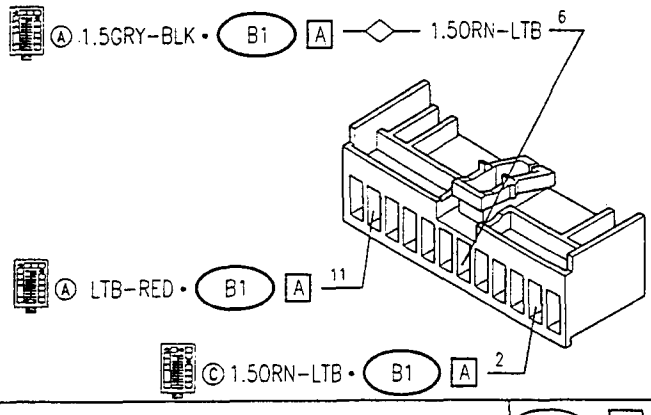
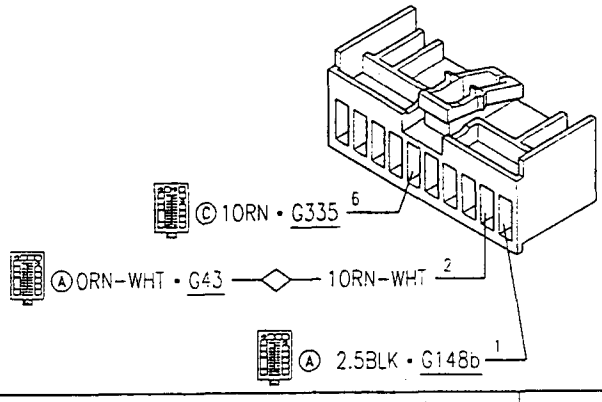
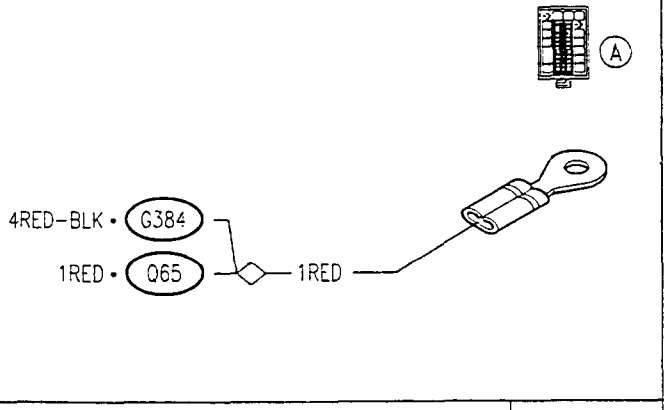
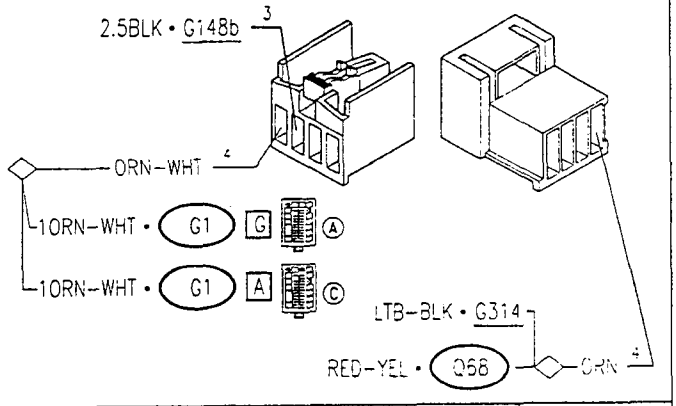
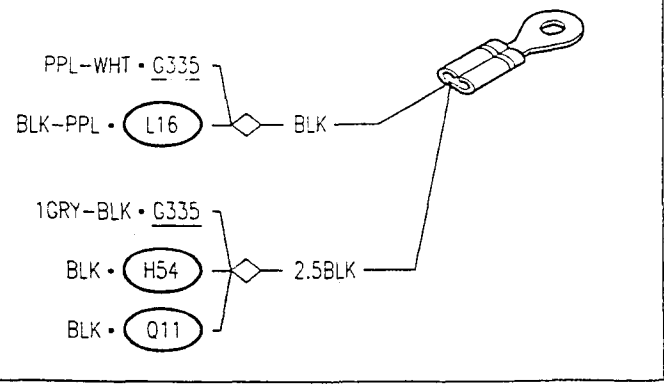
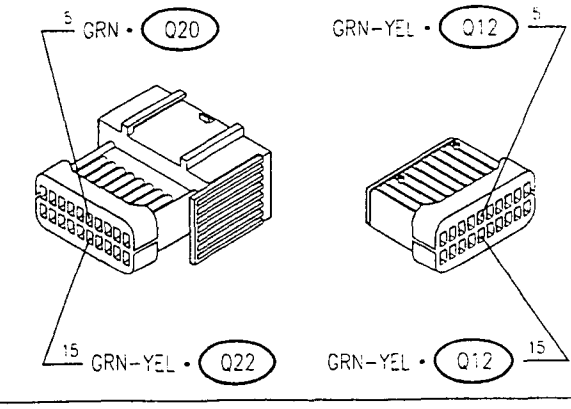
– the signal leading from the control unit **Q67** is either 12 V or 0 V (earth), according to the following logic, depending on the rpm (information picked up directly by the rev counter sensor **L16**:

- up to 2000 rpm: when the full load switch **H54** closes, an earth signal leaves the control unit -pin 7-, and therefore the compressor electromagnetic joint is not energised; conversely, as soon as the switch opens again the signal from pin 7 becomes 12 V, energising the joint;
- over 2000 rpm: the earth signal is timed and lasts only 8 seconds, then it becomes 12 V, and therefore the joint is energised, thereby engaging the compressor, if still required by the special button **Q68**.

The control unit **Q67** is connected, as mentioned previously, with the rev counter **L16** at pin 3 and 6, at switch **H54** - pin 5; pin 2 is earthed, while pin 1 receives the key-operated supply via relay **I35** and fuse **F4** of box **G1** (box "A" or fuse **F14** (box "C" the compressor engagement signal leaves pin 7 as described above.

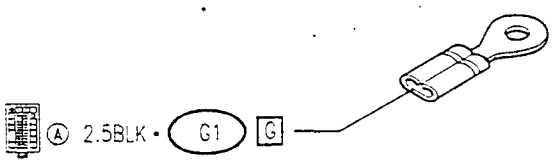
When energised, relay **Q22** operates the electromagnetic joint **Q11** which turns on the compressor.

Components and Connectors

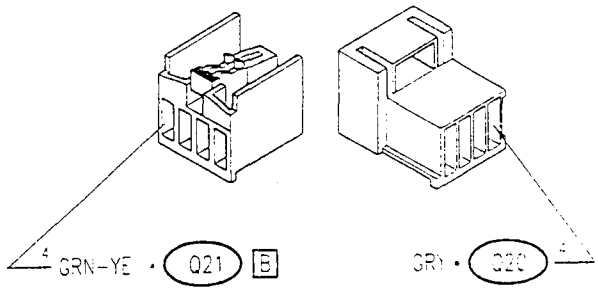
Fusebox G1	Fusebox G1 A
	
Fusebox G1 H	**Fusebox G1 G**
	
Fusebox G1 Q	**Climate control system controls wiring connector G43**
	
RH engine compartment earth G53a	**Engine compartment connector G94**
	

Components and Connectors (continued)

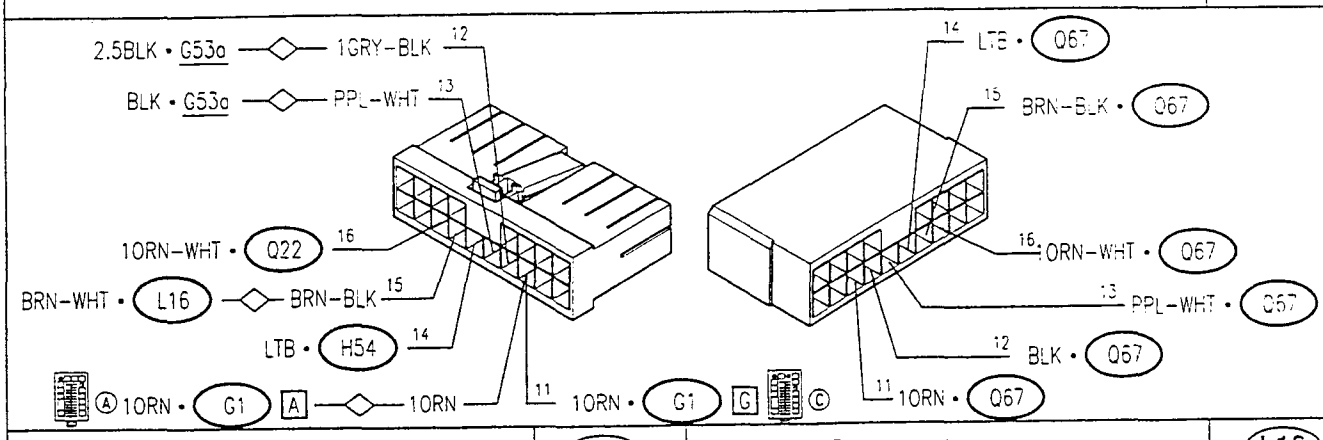
Earth under LH dashboard	G148b



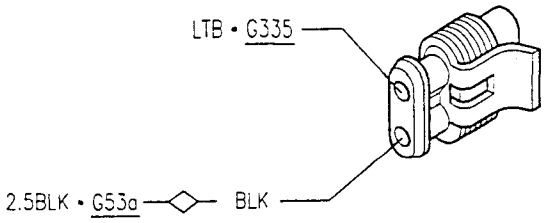
Engine wiring/conditioner wiring connector	G314



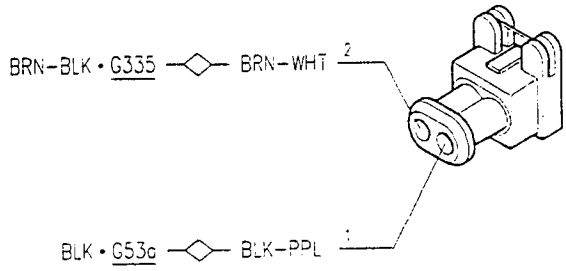
Connector for E.G.R.	G335



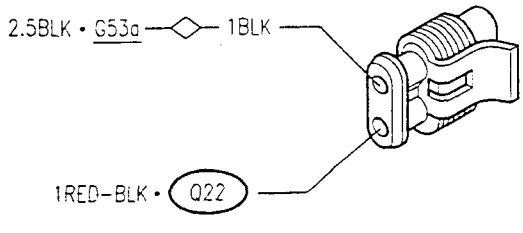
Full load switch	H54



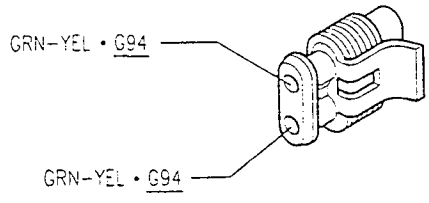
Rev counter sensor	L16



Compressor electromagnetic joint	Q11

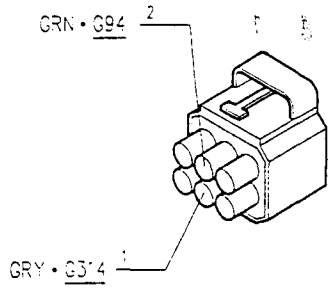


Compressor electromagnetic joint cut out thermal contact	Q12

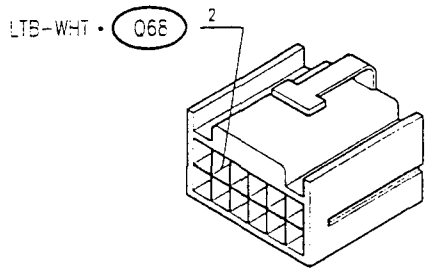


Components and Connectors (continued)

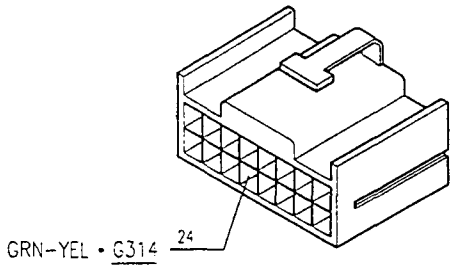
Min. and max. sensor pressure contact	Q20



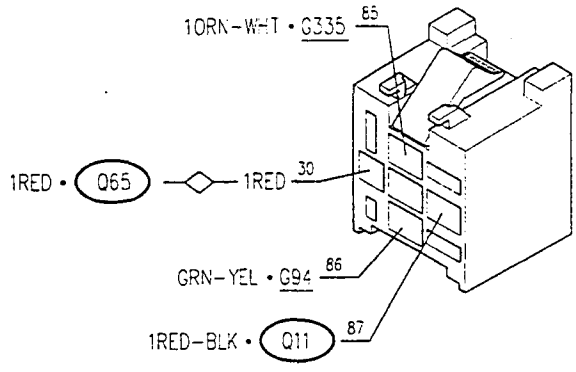
Climate control unit	Q21 A



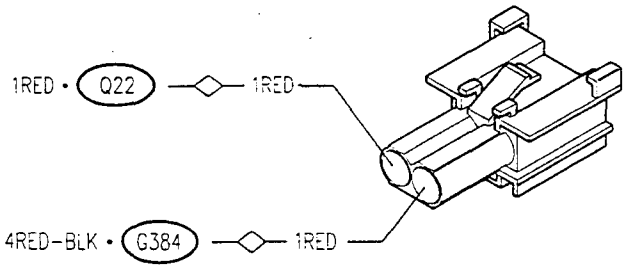
Climate control unit	Q21 B



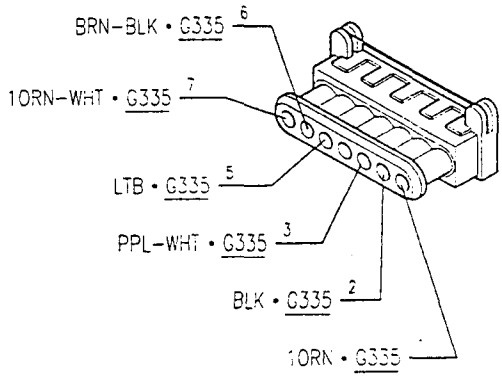
Electromagnetic joint control relay	Q22



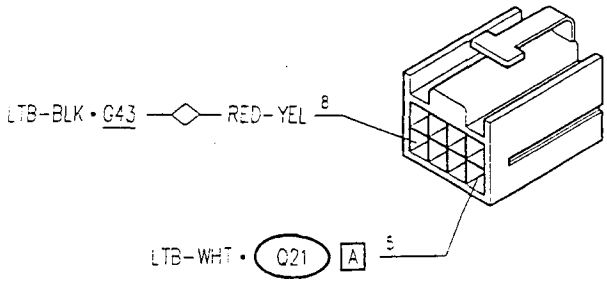
Conditioning system wander fuse	Q65



Compressor disengagement control unit	Q67

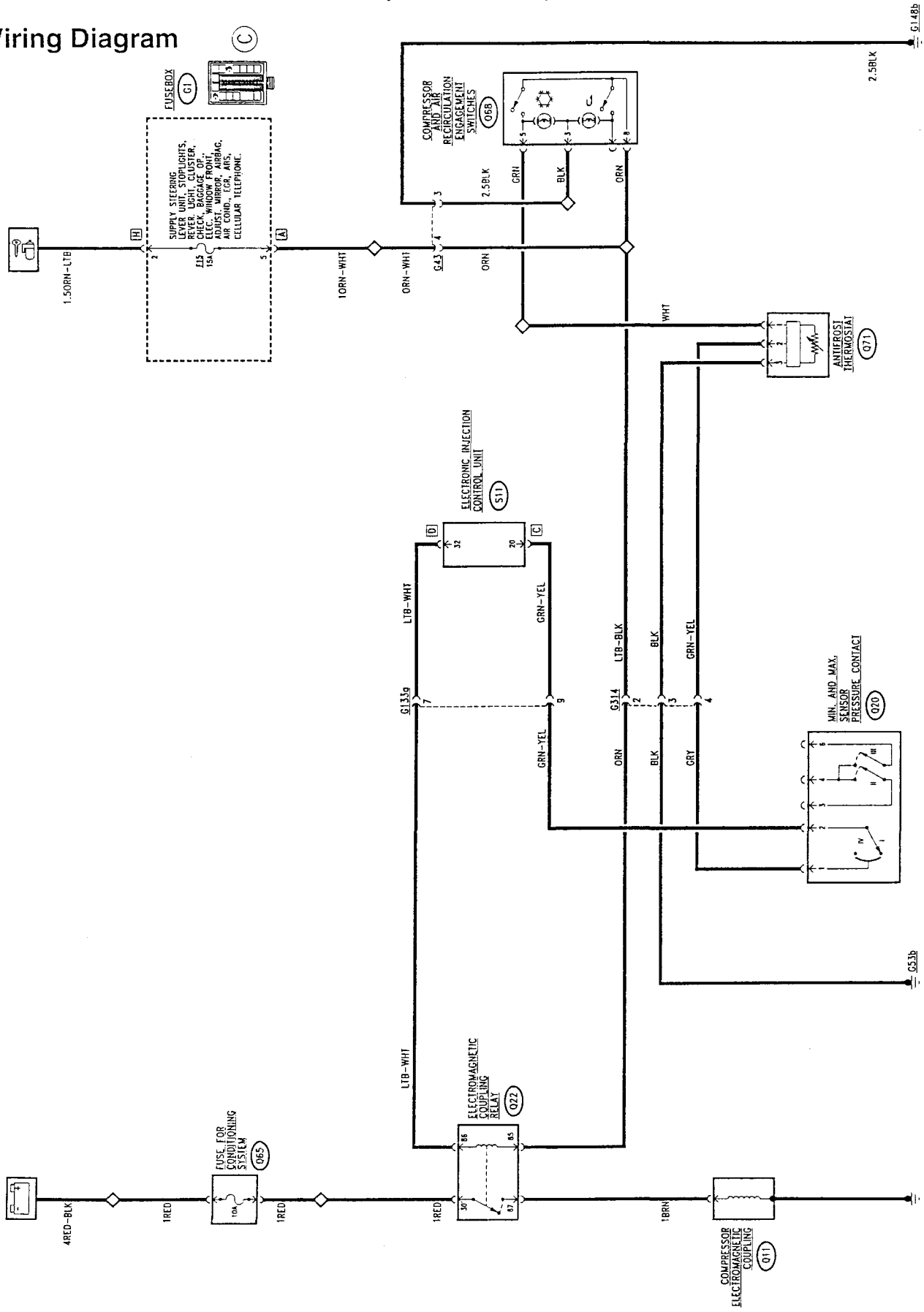


Compressor and air recirculation switches	Q68



COMPRESSOR ENGAGEMENT (JTD version)

Wiring Diagram



Functional Description

The electromagnetic joint which operates the compressor **Q11** is controlled by relay **Q22** located next to terminal strip **G56** which contains the MAXI FUSES.

The coil of relay **Q22** receives the key-operated supply (line protected by fuse **F15** of fusebox **G1**; while the power line is supplied by battery voltage through wander fuse **Q65**.

Relay **Q22** is energised and consequently supplies 12 V to the electromagnetic joint **Q11**, according to the following logic, controlled by the injection electronic control unit which is connected with the air conditioning system through:

- pin 20 of connector C, which receives the signal requesting engagement of the system from the air conditioning system circuit;
- pin 32 of connector D, from which a ©low" (earth) signal leads that controls relay Q22 for engaging the air conditioner compressor Q11.

A special logic enables this engagement, as follows:

- it adapts idle speed to compensate the increase in absorbed power due to compressor engagement;
- if the engine needs high power (high throttle opening speed), full load, or high engine temperature, it momentaneously cuts off compressor engagement.

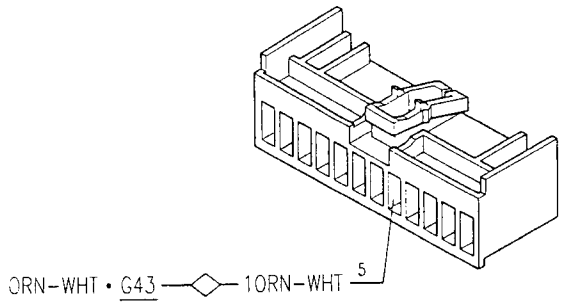
The positive signal leading from the compressor engagement switch **Q68** crosses the control unit **Q21** which comes into action in the following conditions:

- low outside temperature: (disengagement below 4°C and re-engagement above 6°C);
- low mixed air temperature (disengagement below 3.5°C and re-engagement above 5°C).

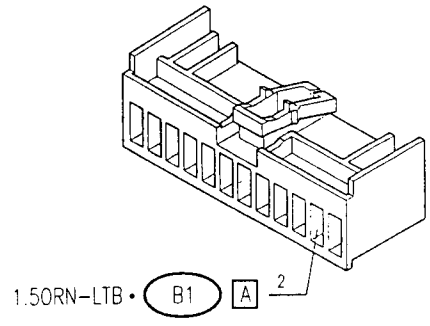
The same signal also crosses the pressure switch **Q20** which cuts in if the pressure of the cooling system is too high or too low: in this case the signal does not reach the control unit which does not command compressor engagement.

Components and Connectors

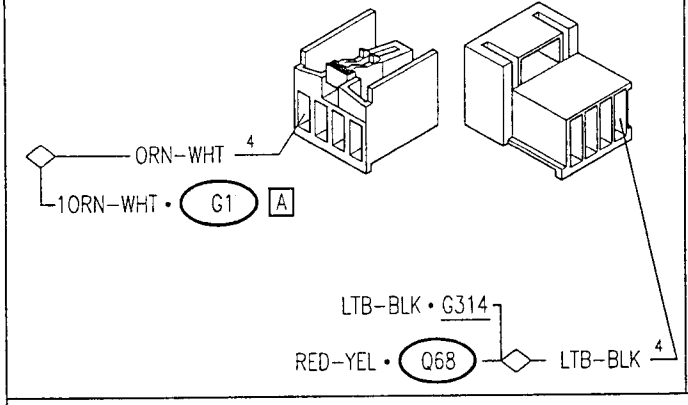
Fusebox	G1 A



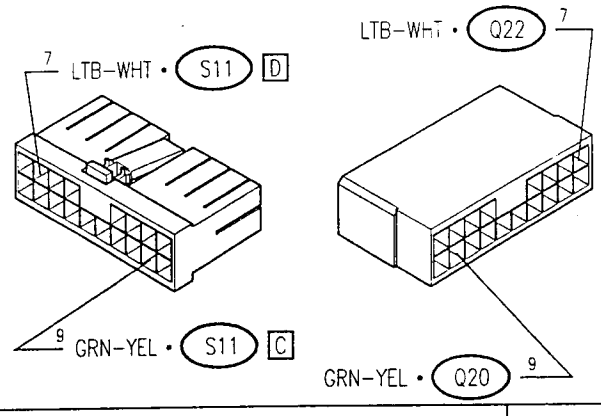
Fusebox	G1 H



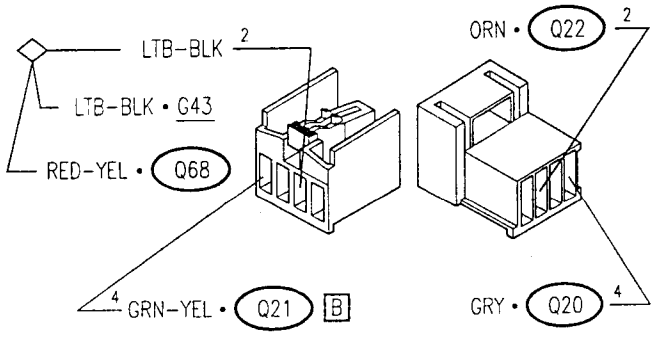
Climate control system controls wiring connector	G43



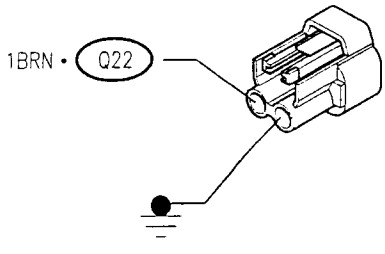
Connector for electronic injection wiring A	G133a



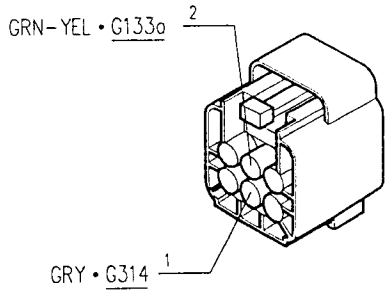
Connector for engine wiring/conditioner wiring	G314



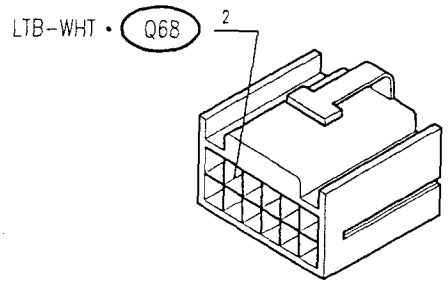
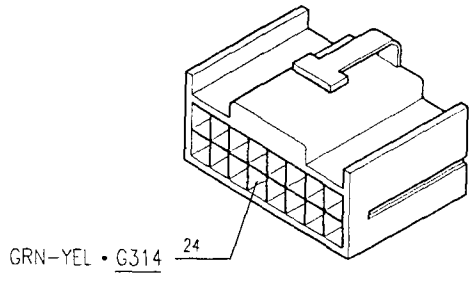
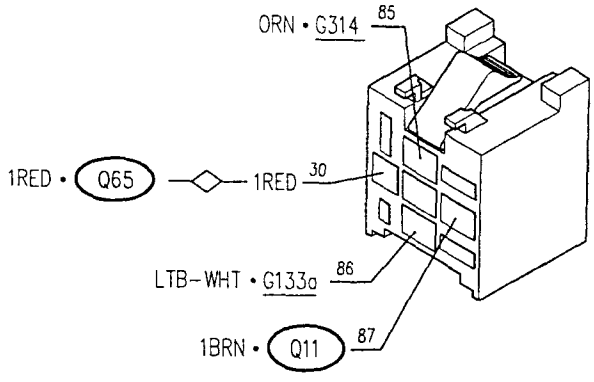
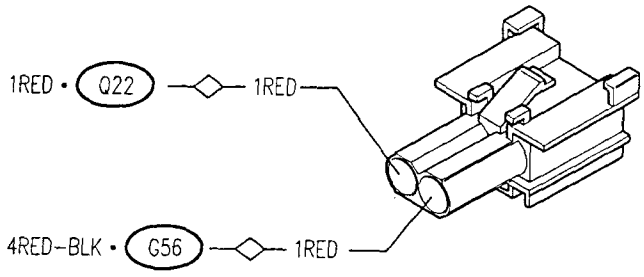
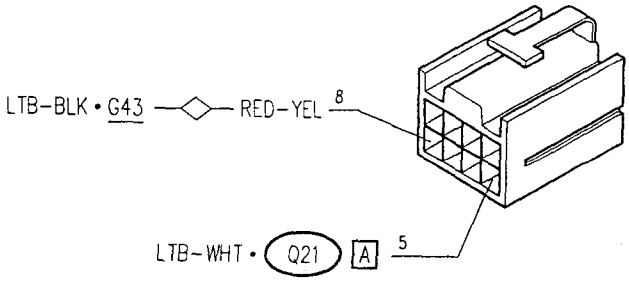
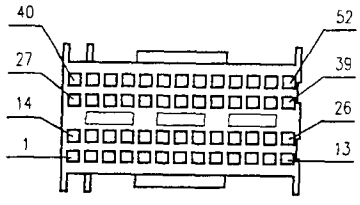
Compressor electromagnetic coupling	Q11



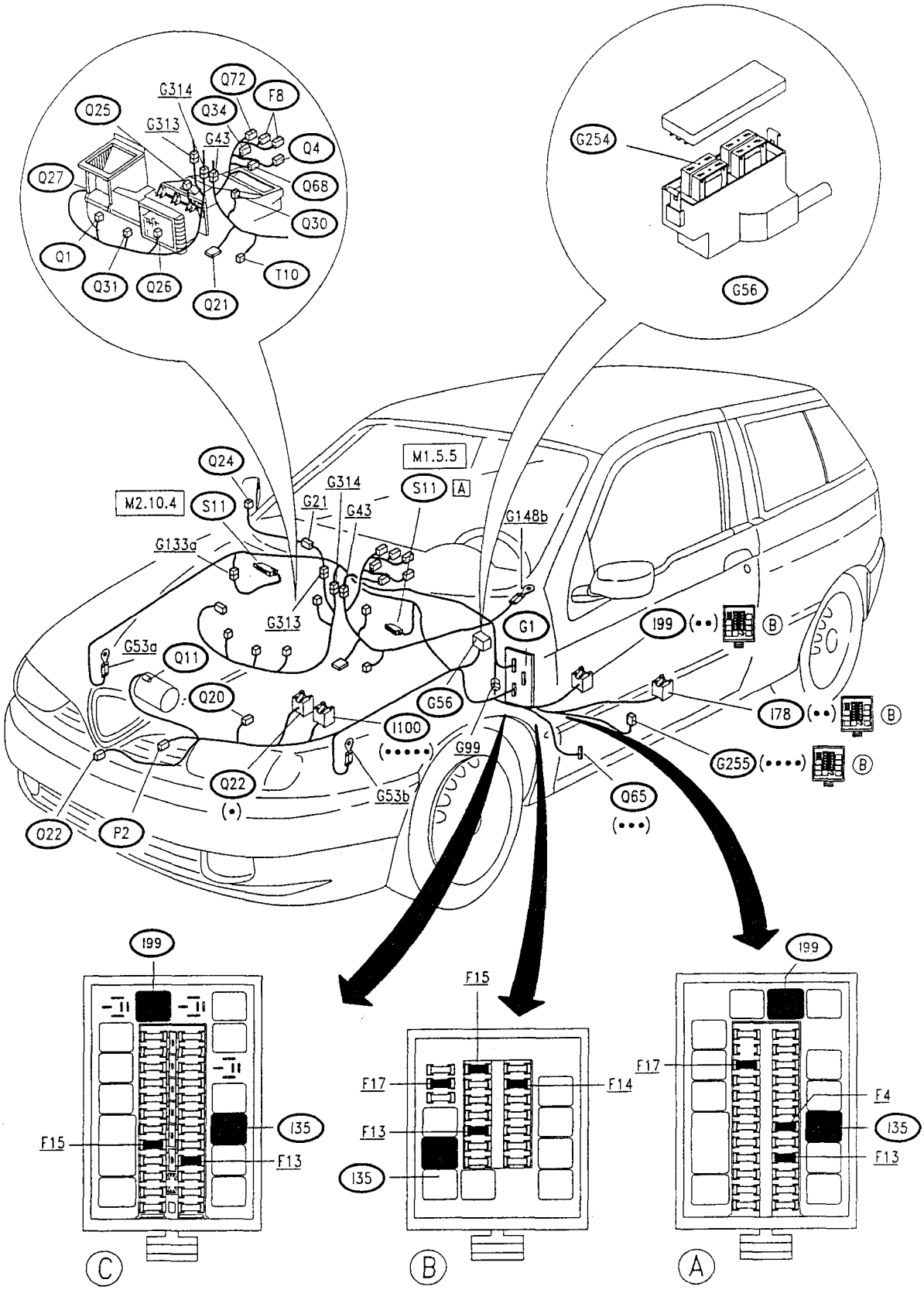
Min. and max. sensor pressure contact	Q20



Components and Connectors (continued)

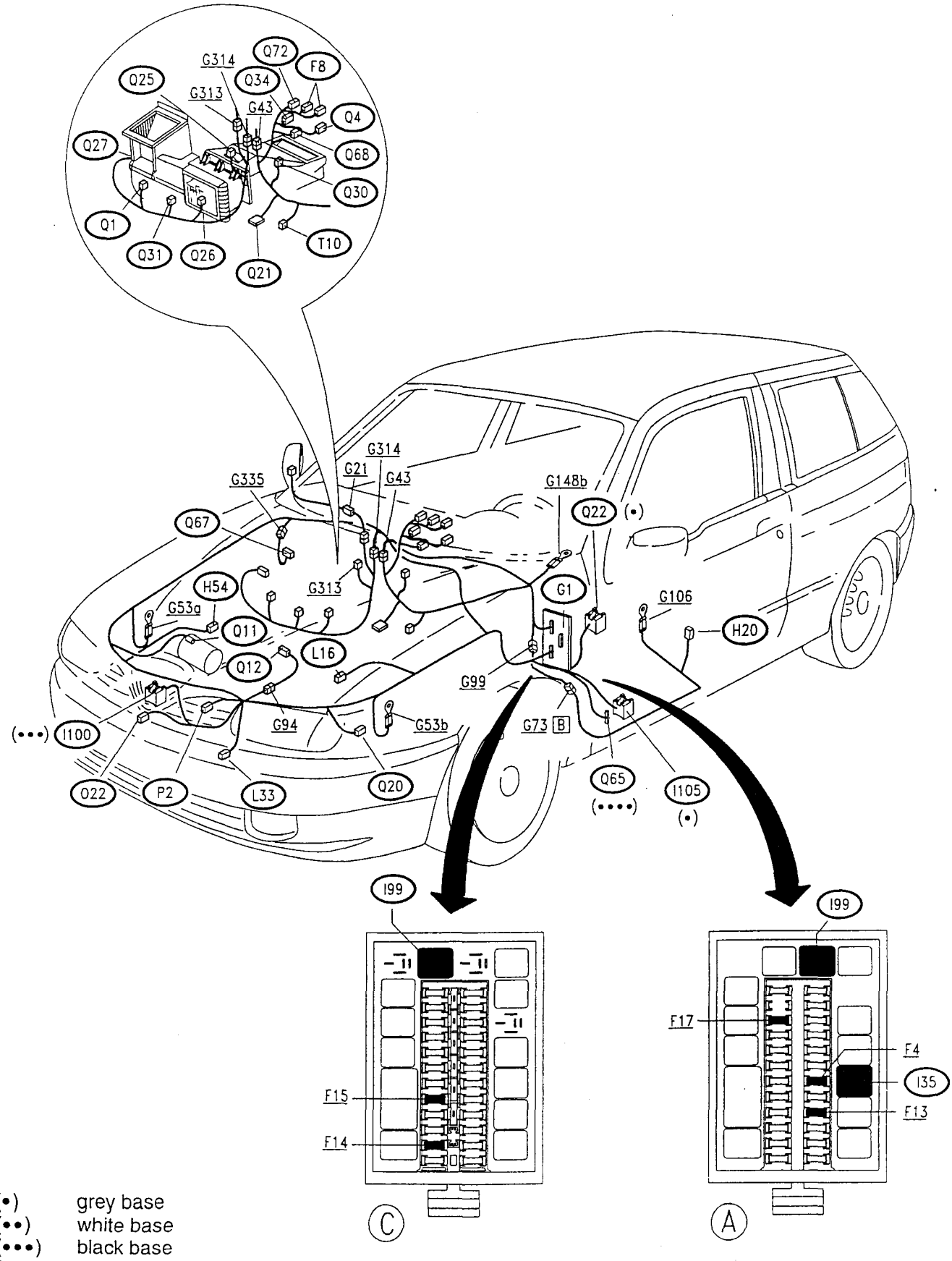
Climate control system control unit (Q21 A)	Climate control system control unit (Q21 B)
	
Electromagnetic coupling relay (Q22)	**Fuse for conditioning system-7.5 A (Q65)**
	
Compressor and air recirculation engagement switches (Q68)	**Electronic injection control unit (S11 C)**
	
Electronic injection control unit (S11 D)	
	

LOCATION OF COMPONENTS (petrol versions)



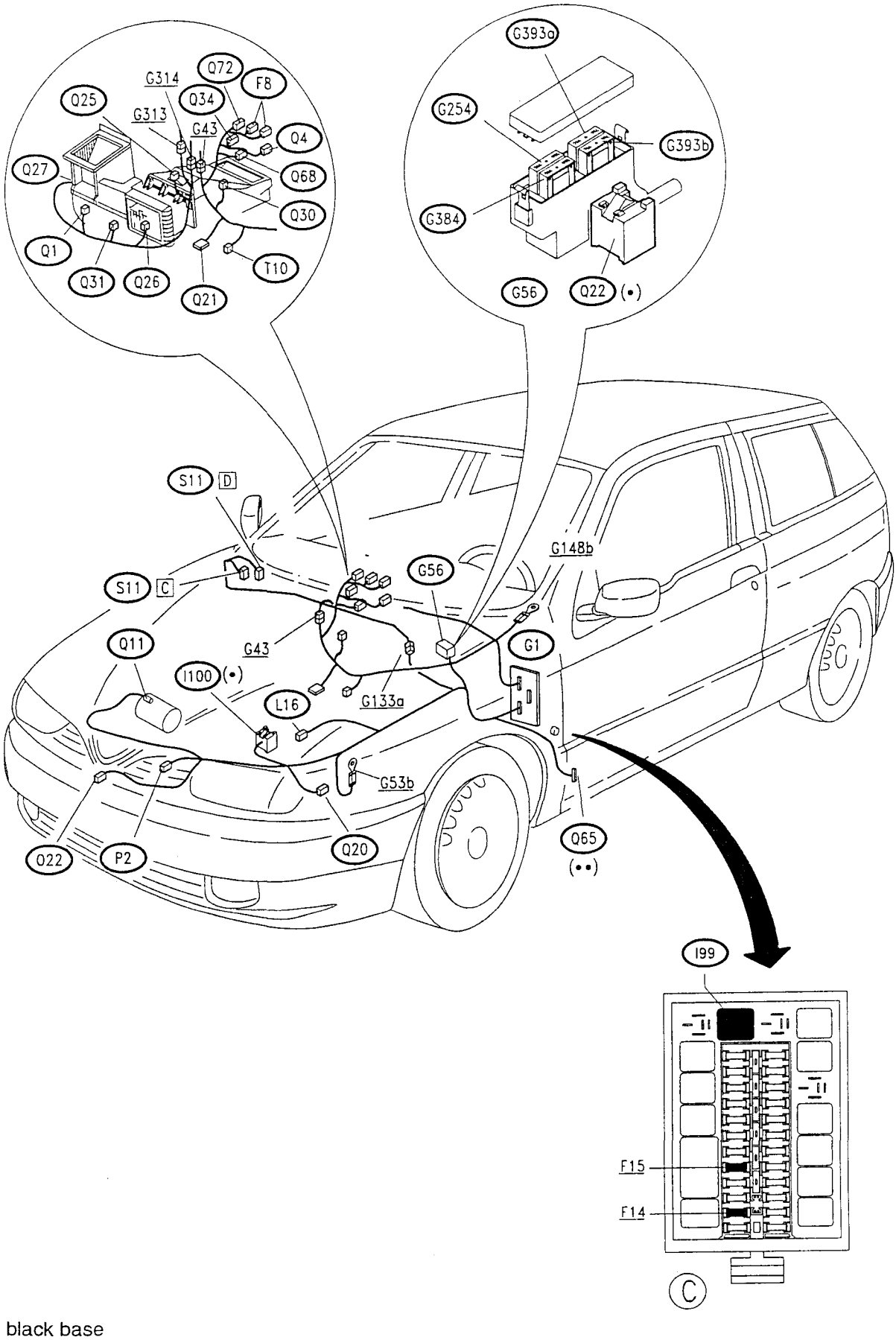
(•) grey base
(••) yellow base
(•••) red fuseholder
(••••) green fuseholder
(•••••) black base

LOCATION OF COMPONENTS (TD versions)



(•) grey base
(••) white base
(•••) black base
(••••) red fuseholder

LOCATION OF COMPONENTS (JTD versions)



(•) black base
(••) red fuseholder

Self-diagnosis

Through suitable control logics of the sensors and adjustment with "self-learning" of the actuators, the electronic control unit is capable of recording and storing a series of faults and failures which may occur in the system.

In the event of such faults the control unit still continues to manage the system replacing any abnormal values with suitable "**recovery**" values which ensure minimal operation, even if not perfect, of the system.

The errors stored can be read by the ALFA ROMEO TESTER, and there are two types:

- "**occasional" errors**, which are reset with the ignition key at STOP
- "**permanent" errors**: if an error occurs more than 5 times in a determinate time it is considered as permanent and memorised in the control unit; these errors are NOT reset with the key at STOP, but only after a specific outside command (Tester).

A preliminary system check is possible through **TEST A**.

FAULT-FINDING TABLE

NOTE:
The fault-finding table for the air conditioner has been subdivided into three sections to simplify interpretation, which contain the three functions shown separately also in the wiring diagrams:

- Climate control fan, air temperature and recirculation control (see SELF-DIAGNOSIS)
- Compressor control
- Engine fan control (see Sect. 32A) (B)

Compressor control

Fault		Component to be checked												
		Q65	F17	F4	F15 (C)	Q11	Q20	Q21	Q12	H54	Q67	Q22	Q68	S11
Compressor engagement (in all circumstances)	petrol	•	•		•	•						•	•	
	TD	•	•	•		•						•	•	
	JTD				•	•						•	•	
Compressor engagement (only in certain circumstances) (*)	petrol						•	•						•
	TD						•	•	•	•	•			
	JTD						•	•						•

(C) Only for fusebox "C"
(*) Operation of the compressor is cut off by the system logic in the following conditions:

- coolant fluid pressure > 28 bar appr.;
- coolant fluid pressure < 2.5 bar appr. (circuit discharged);
- outside temperature < 5°C;
- mixed air temperature < 3.5 °C;
- engine temperature > 111°C (only TD);
- full load (temporary cut off for appr. 8 sec. with engine speed over 2000 rpm.) (only TD).

Moreover, this operation is also determined by the logic of the ignition/injection control unit (only petrol) (see corresponding section).

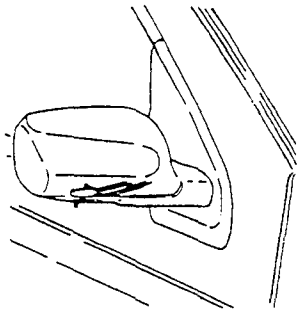
PRELIMINARY CHECKS ON THE AUTOMATIC AIR CONDITIONING SYSTEM	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check the intactness of fuses **F13** and **F17** of fusebox **G1**, and wander fuses **Q65** and **G255** (only for fusebox B)	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Replace any faulty fuse/s
A2 CHECK RELAY – Check the intactness of relay **I78** (only for fusebox B)	OK ▶	Carry out **step A3**
	~~OK~~ ▶	Replace the faulty relay
A3 CHECK CONTINUITY – Check continuity of the cable between the control unit **Q21** (pin 25) and connector G, fusebox **G1**	OK ▶	Carry out **step A4**
	~~OK~~ ▶	Restore the continuity of the wiring
A4 CHECK CONTINUITY – Check continuity of the cable between the control unit **Q21** (pin 3 and 13) and earth **G148b**	OK ▶	CONNECT TO THE DIAGNOSIS SOCKET **T10** AND CONTINUE OPERATIONS WITH THE ALFA TESTER
	~~OK~~ ▶	Restore continuity of the wiring

CHECK COMPONENTS

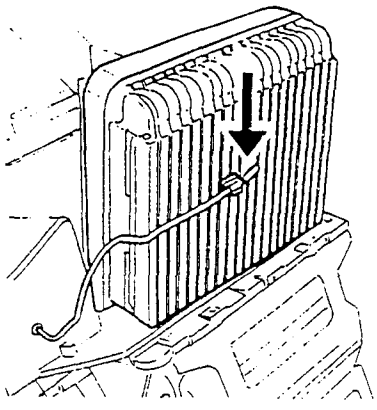
N.B.:
Here, only the specific components for the AUTOMATIC CONDITIONER are mentioned: those shared with the MANUAL CONDITIONER are to be found in Section 32A.

Outside air temperature sensor (Q24)



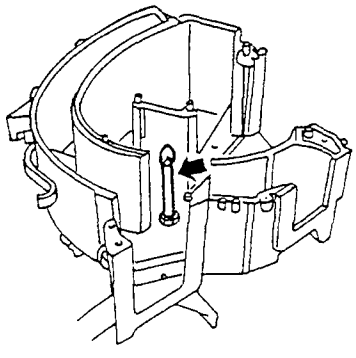
SPECIFICATIONS	
Resistance at 25°C (with operating range from -30°C to +50°C)	10 kOhm

Antifrost sensor (Q26)



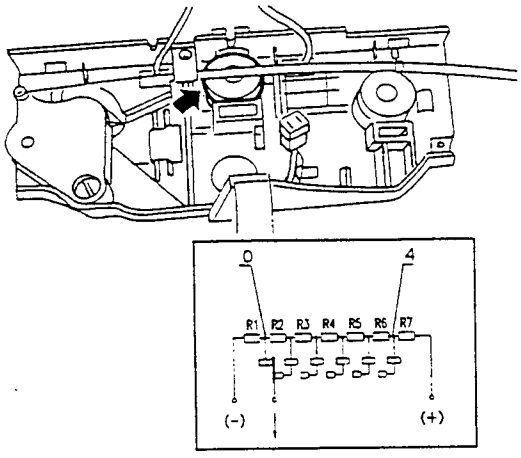
SPECIFICATIONS	
Resistance at 25°C (with operating range from -5°C to +25°C)	10 kOhm

Treated air temperature sensor (Q25)



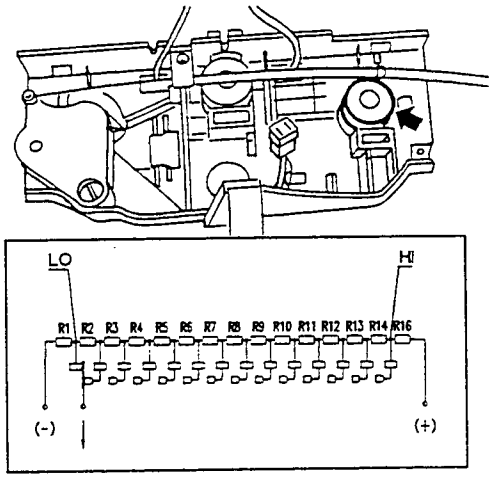
SPECIFICATIONS	
Resistance at 25°C (with operating range from 0°C to +80°C)	10 kOhm

Climate control system fan control (Q4)



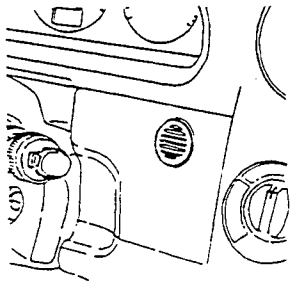
SPECIFICATIONS	
Resistences R1 ÷ R7	1500 Ohm ± 1%

Required temperature regulator control (Q34)



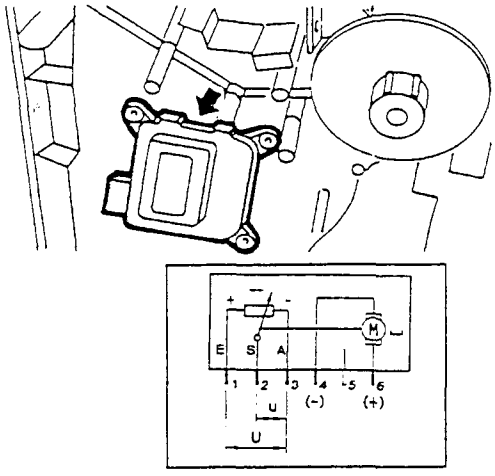
SPECIFICATIONS	
Resistances R1 ÷ R16	681 Ohm ± 1%

Passenger compartment temperature sensor (Q33)



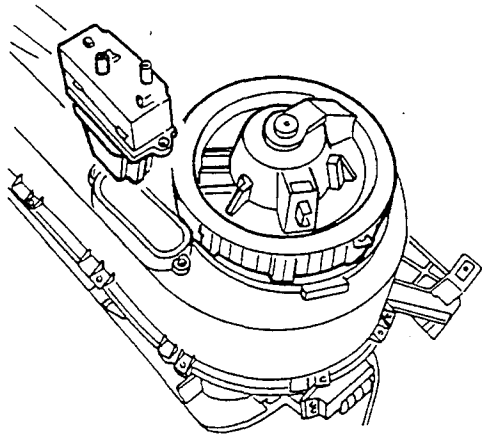
SPECIFICATIONS	
Resistance at 25°C (with operating range from +5°C to +45°C)	2.2 kOhm

Mixing control actuator (Q30)



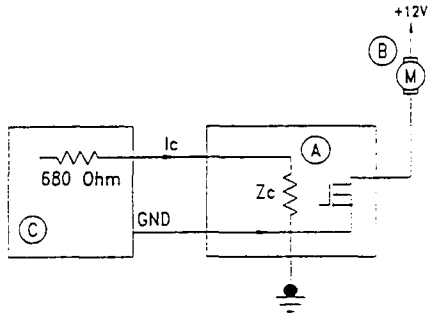
SPECIFICATIONS	
Total angle of rotation between max. heat and max. cool	62°
Ratio u/U for max. heat	0.707
Ratio u/U for max. cool	0.26

Mixing control actuator (Q31)



SPECIFICATIONS

Wiring diagram



Delivery current Ic = 1 mA max.
Max. current I = 5A
Adjustment impedance Zc = 80 kOhm

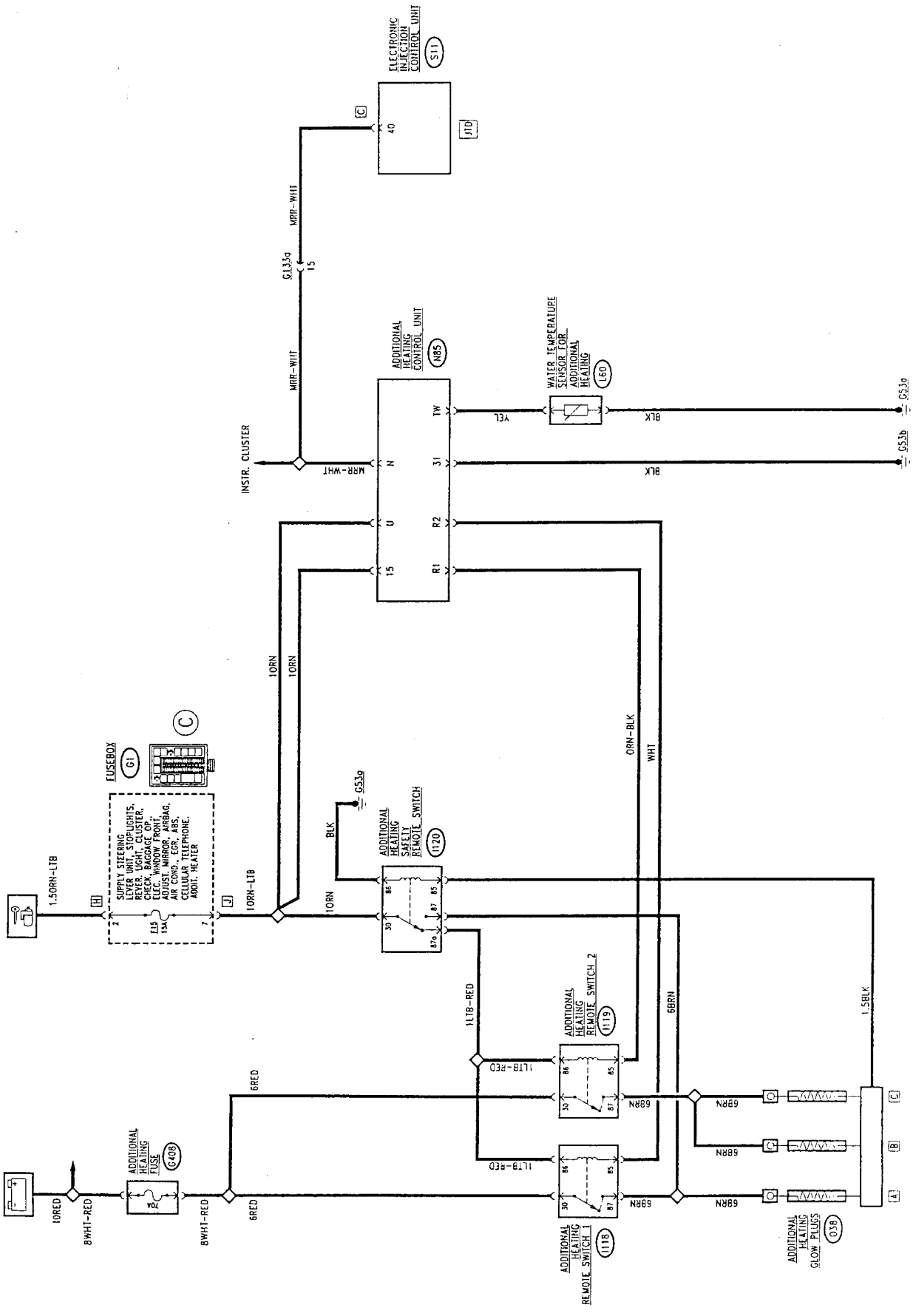
A = fan
B = electric regulator
C = electronic control unit

CLIMATE CONTROL: ADDITIONAL HEATER

INDEX

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OPERATIONAL DESCRIPTION 31B-3
COMPONENTS AND CONNECTORS 31B-4
LOCATION OF COMPONENTS 31B-6

WIRING DIAGRAM



GENERAL DESCRIPTION

Climate control of the car through heater unit is insufficient when the engine is cold, especially in the case of Diesel engines, which reach the proper temperature more slowly.

An additional heating system is therefore provided for these engines and is activated during the initial seconds of engine operation, until a certain temperature is reached.

The system consists of an additional heating device, located on the engine coolant delivery pipe that leads to the engine heating unit.

There are three glow plugs on this device (similar to those used for preheating the combustion chamber).

Glow plug operation is controlled by an ECU that pilots one, two or three plugs to provide a heating of 200 W, 400W or 600W.

This control logic depends on:

- the temperature reached by the engine coolant;
- the amount of available electrical power (the battery voltage is controlled)
- engine rpm (which must exceed a pre-established value)

The power supply of one, two or three glow plugs is piloted by two remote switches:

- level 1: activated by the first remote switch;
- level 2: activated by the second remote switch;
- level 3: activated by both remote switches.

There is also a third remote switch/ safety switch that interrupts power supply to the glow plugs if their contact to earth is incorrect: the metal device containing the glow plugs is in fact connected to the engine earth by means of a special braid.

OPERATIONAL DESCRIPTION

The additional heater control unit **N85** is protection-powered at pins 15 and U by the line protected by fuse **F15** of the fuse box **G1.**

The engine rpm signal comes from the engine management control unit **S11**and enters pin N of **M75.**

Pin TW is connected to the special temperature sensor **L60** which detects the coolant temperature in the vicinity of the additional heater.

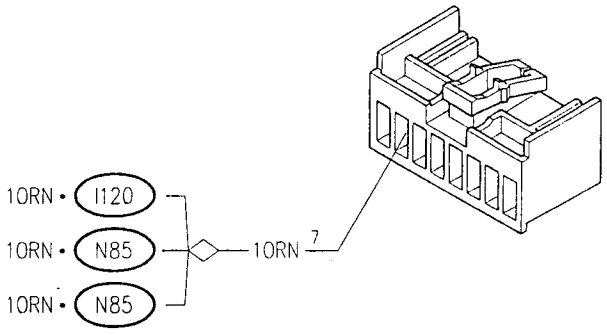
The remote switches **I118** and **I119** control connection of the three resistances **O38.**

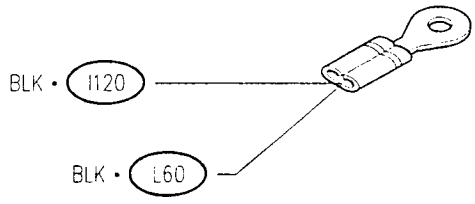
Direct power reaches the battery through maxifuse **G408,** while the coils are energized by control unit **N85,** which controls only remote switch **I118** to enable glow plug **O38 A,** only remote switch **I119** to enable glow plugs **O38 B** and **C,** and both remote switches for all three glow plugs **O38.**

The safety remote switch **I120** interrupts the power supply of the above-mentioned glow plugs if they are incorrectly earthed: the coil of **I120** is connected on one side to earth and on the other side to the metal frame of the device containing the glow plugs: the device is connected to earth **G53a** through a special earthing braid: if this connection is interrupted, remote switch **I120** is energized and immediately blocks the distribution of electricity to the glow plugs.

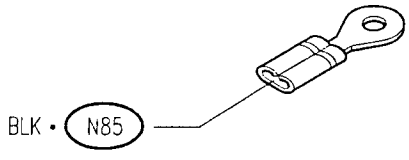
COMPONENTS AND CONNECTORS

Fusebox	G1 J	RH engine compartment earth	G53a

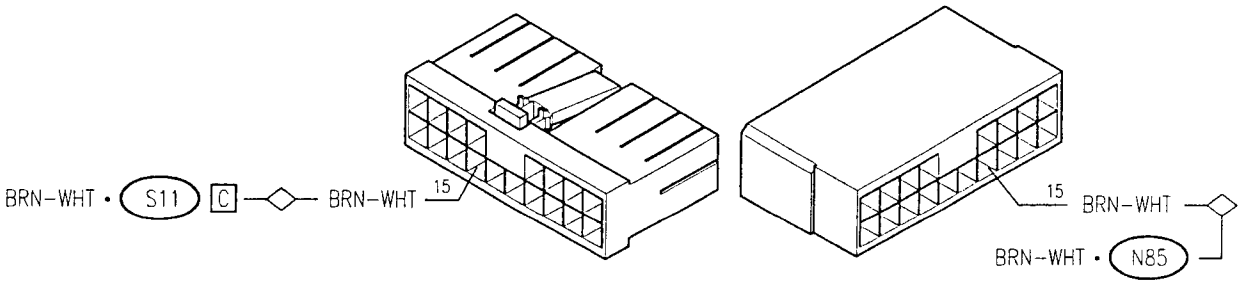




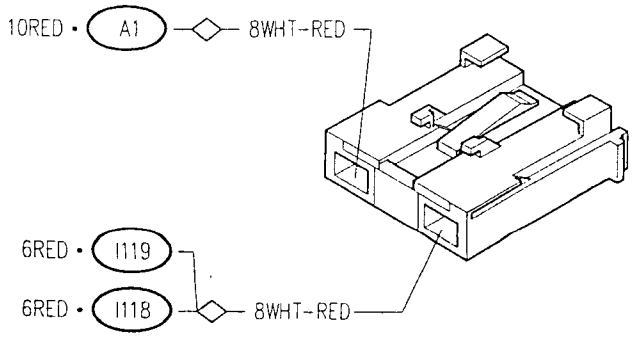
LH engine compartment earth	G53b

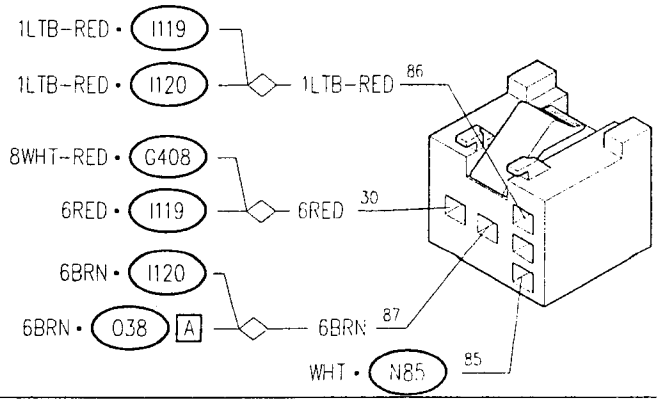


Connector for electronic injection wiring A	G133a



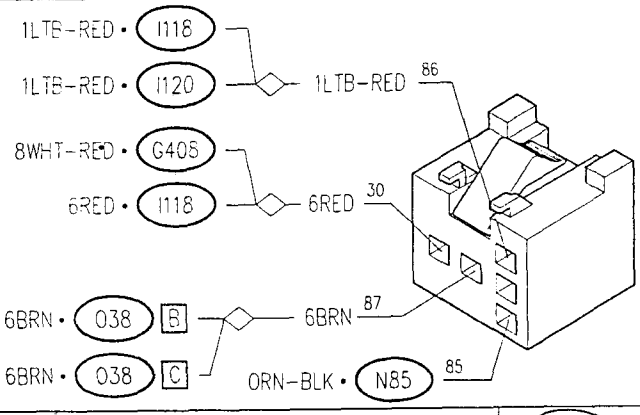
Additional heating fuse	G408	Additional heater remote switch -1	I118



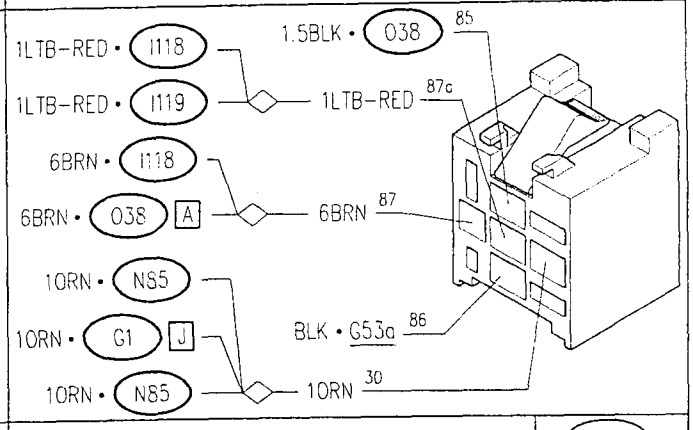


COMPONENTS AND CONNECTORS (cont'd)

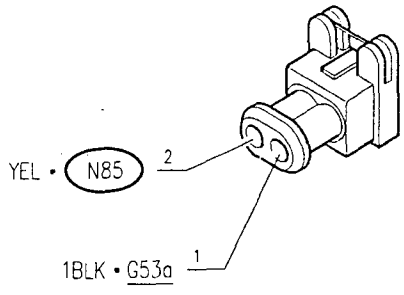
Additional heater remote switch -2 — I119



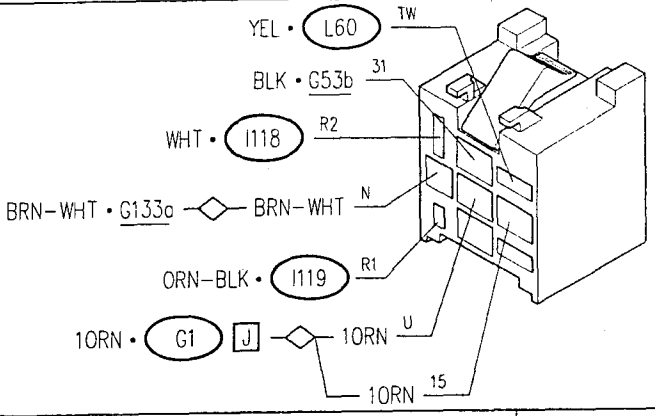
Additional heater safety remote switch — I120



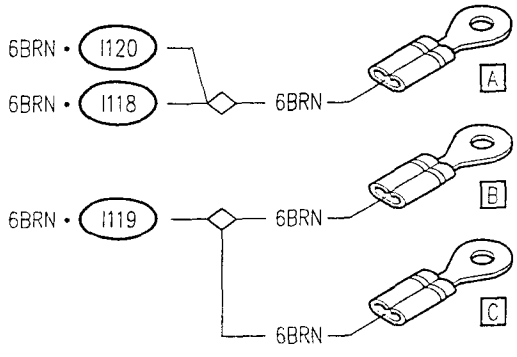
Water temperature sensor for additional heater — L60



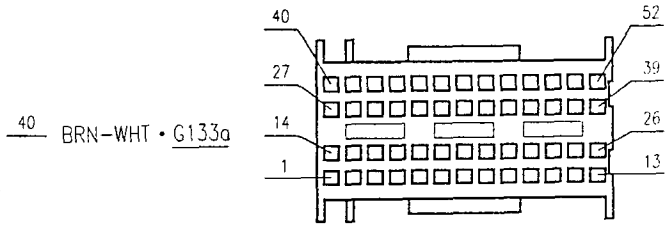
Additional heater control unit — N85



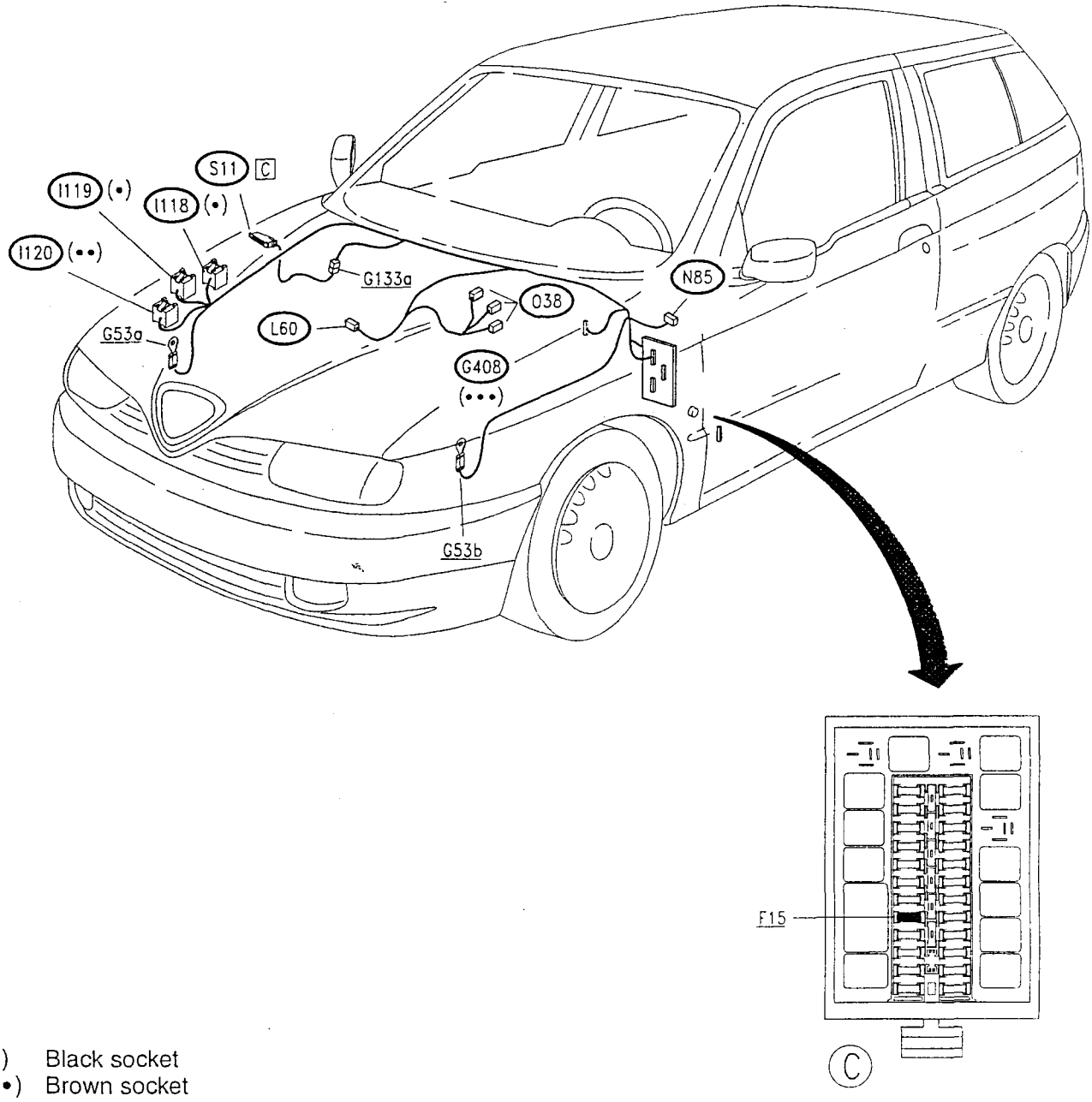
Additional heater glow plugs — O38



Electronic injection control unit — S11 C



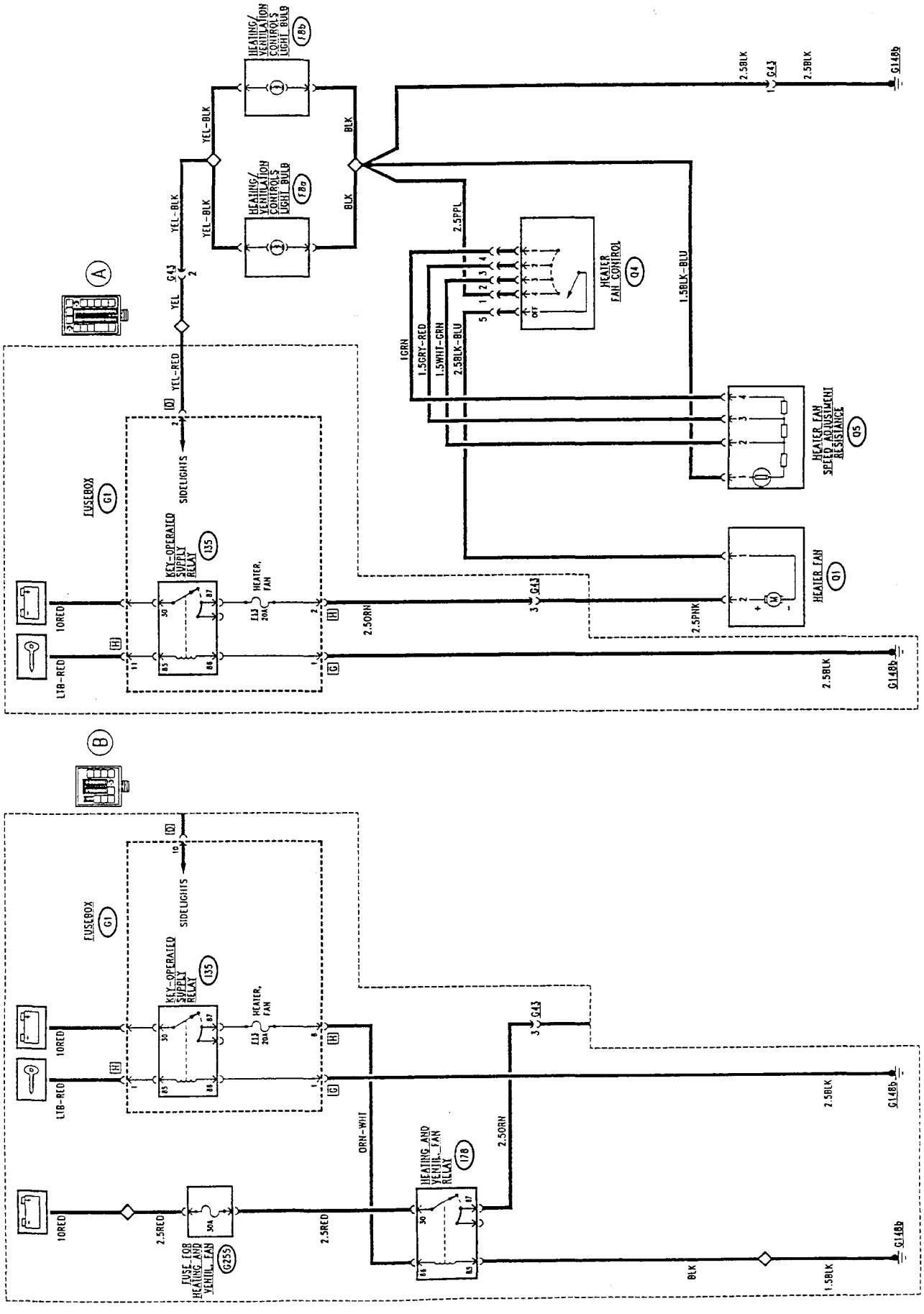
LOCATION OF COMPONENTS



(•) Black socket
(••) Brown socket
(•••) Black fuse box

MANUALLY OPERATED RECIRCULATION

Wiring Diagram



Functional Description

Fan:

The heating and ventilation fan **Q1** is supplied with battery voltage via the key-operated services relay **I35** - located in fusebox **G1** -; in addition to the relay, the supply line also crosses fuse **F13** of fusebox **G1**.

In the versions with fusebox "B" there is a specific relay **I78** which exploits the previous line in terms of energization and supplies the fan as a direct line protected by fuse **G255** (30A).

The fan motor **Q1** is operated with an earth signal from the control knob **Q4**. This signal crosses the speed regulator **Q5**, comprising three resistances in series, the crossing of which determines the four different speeds, depending on the signal from the knob **Q4**: from pin 1 (1st speed) , from pin 2 (2nd speed), from pin 3 (3rd speed) and lastly from pin 4 (4th speed) with a direct signal that does not cross the regulator **Q5**.

The regulator **Q5** has a built-in thermal safety fuse which deactivates the circuit if the temperature exceeds 98°C.

Recirculation:

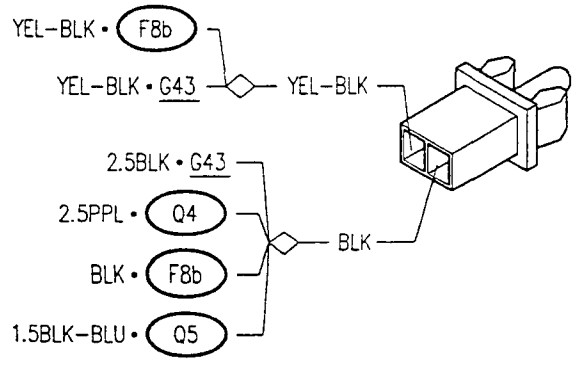
N.B. recirculation is operated mechanically through a special cable.

Controls lighting:

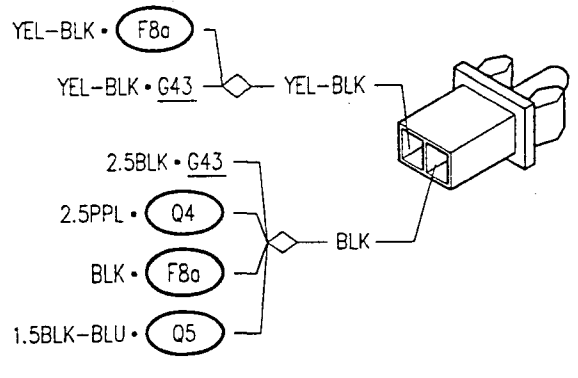
Lights **F8a** and **F8b**, inside the control panel are supplied by the sidelights circuit - connector D of fusebox **G1** (also see "Lighting of controls and Indicators").

Components and Connectors

Heating/ventilation controls light bulb	F8a

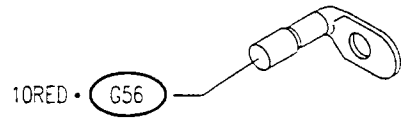


Heating ventilation controls light bulb	F8b

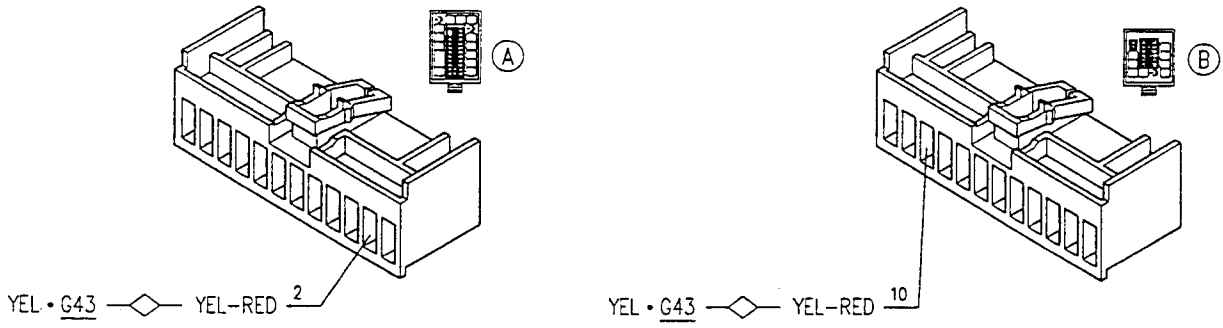


Components and Connectors (cont.d)

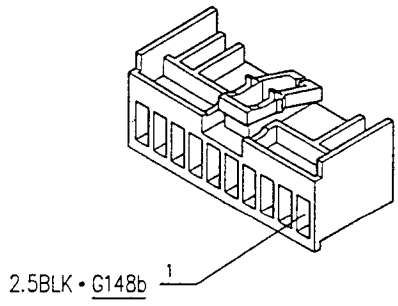
Fusebox	G1



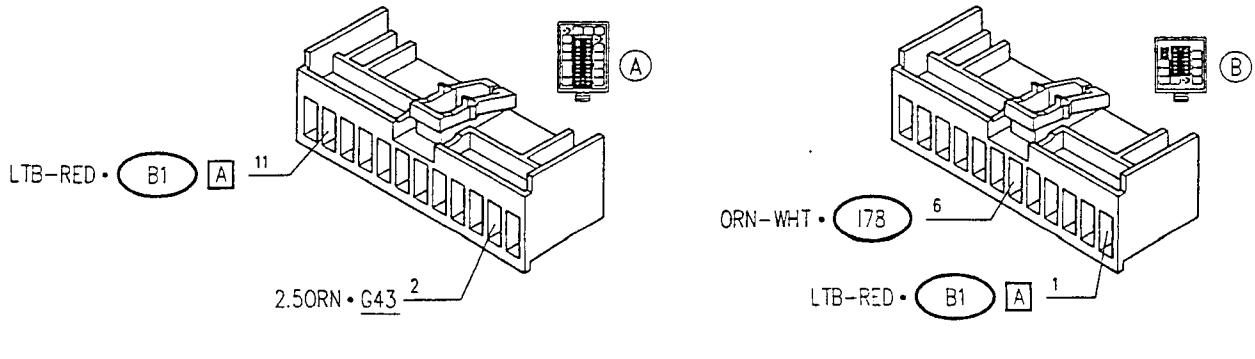
Fusebox	G1 D



Fusebox	G1 G

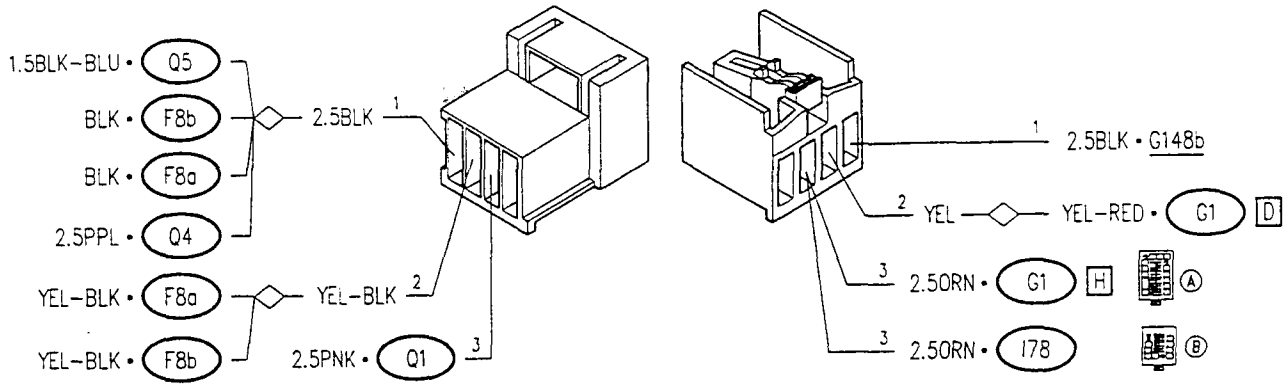


Fusebox	G1 H

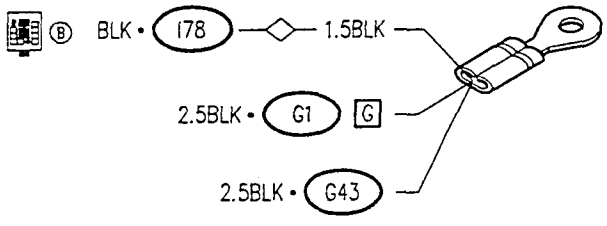


Components and Connectors (cont.d)

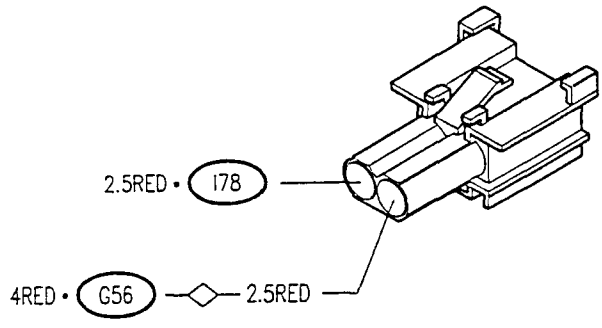
Connector for heating and ventilation control wiring	G43



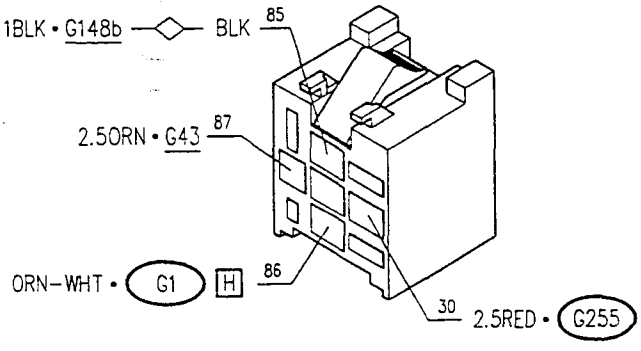
Earth under LH dashboard	G148b



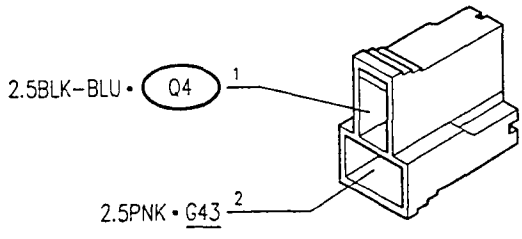
Heater fan fuse	G255



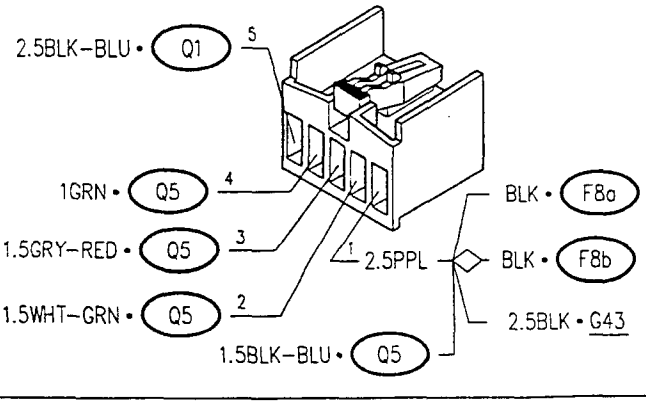
Heater fan relay	I78



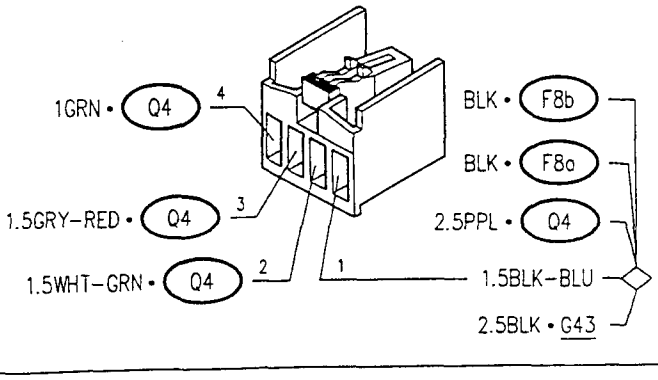
Heater fan	Q1



Heater fan control	Q4

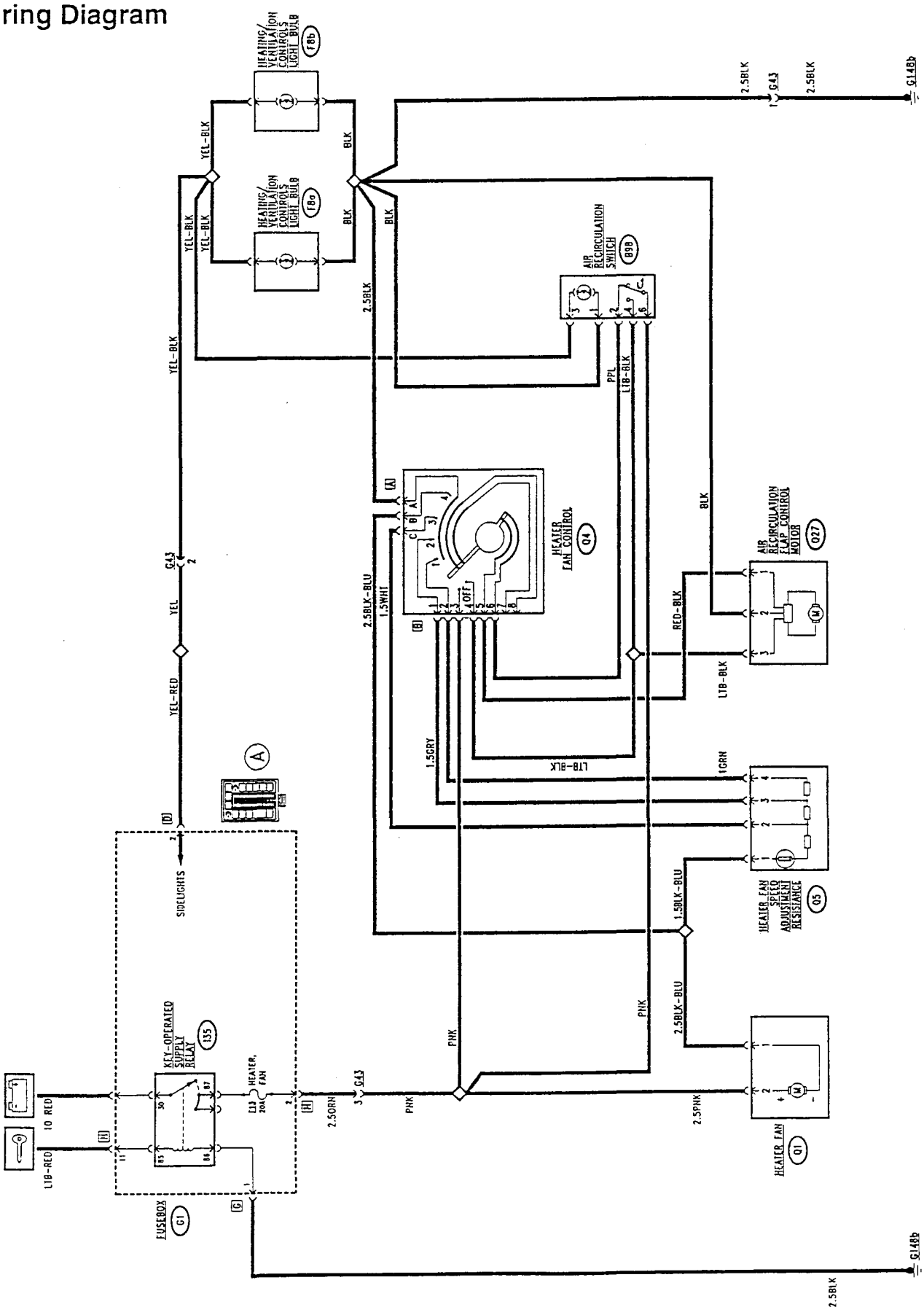


Heater fan speed adjustment resistance	Q5



ELECTRICALLY OPERATED RECIRCULATION (only for certain Markets)

Wiring Diagram



Functional Description

Heater fan:

The heater fan **Q1** is supplied with battery voltage through the key-operated services relay **I35** - located in fusebox **G1** -; in addition to the relay, the supply line also crosses fuse **F13** of fusebox **G1**.

The fan motor **Q1** is operated with an earth signal from the control knob **Q4**. This signal crosses the speed regulator **Q5**, comprising three resistances in series, the crossing of which determines the four different speeds, depending on the signal from the knob **Q4**: from pin 2 of connector B (1st speed), from pin 1 of connector B (2nd speed), from pin C of connector A (3rd speed) and lastly from pin B of connector A (4th speed) with a direct signal that does not cross the regulator **Q5**.

The regulator **Q5** has a built-in thermal safety fuse that deactivates the circuit for temperatures above 98°C.

Recirculation:

The recirculation function is operated by the motor **Q27**, according to the following logic:

- pin 2 of **Q27** always earthed;
- 12 V at pin 3 of **Q27**: the motor turns cutting in recirculation;
- 12 V at pin 1 of **Q27**: the motor turns cutting out recirculation;

Cutting in takes place via switch **B98**, but with switch **Q4** on "0", "1", etc...:

- switch **B98** not pressed: recirculation not operational;
- switch **B98** pressed: recirculation operational.

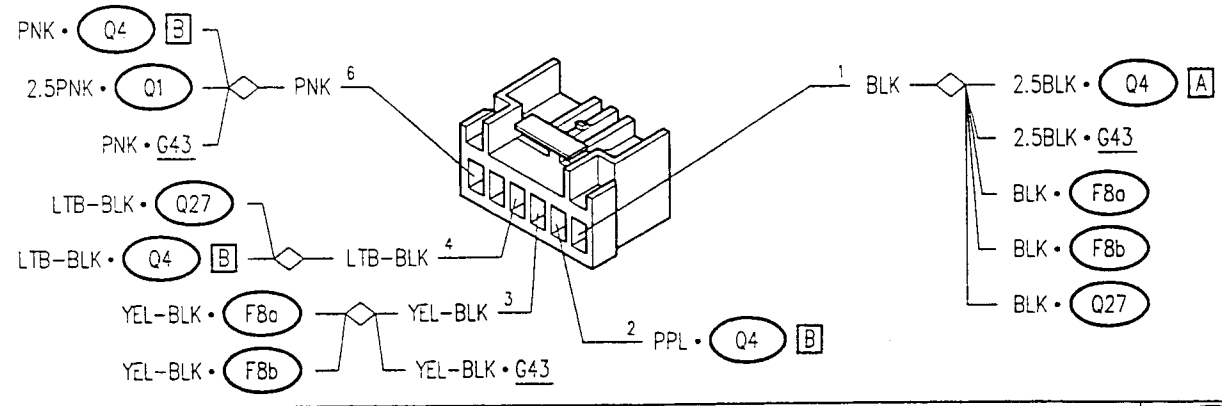
N.B. : With switch **Q4** at "OFF" recirculation is still engaged regardless of the position of switch **B98**

Controls lighting:

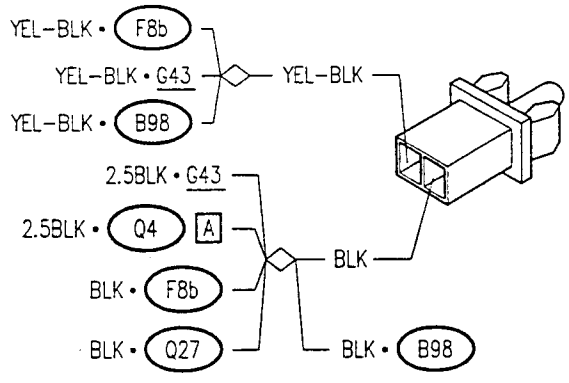
Lights **F8a** and **F8b**, inside the control panel, together with the leds next to switch **B98** are supplied by the sidelights circuit - connector D of fusebox **G1** (also see "Lighting of controls and indicators").

Components and Connectors

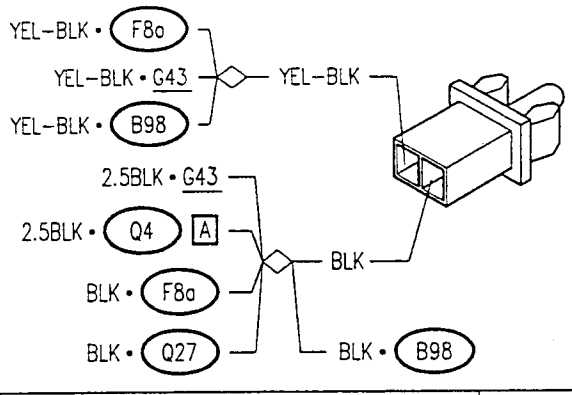
Air recirculation switch — B98



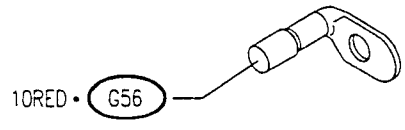
Heating/ventilation controls light bulb — F8a



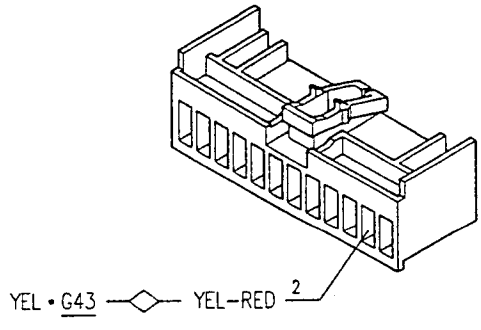
Heating ventilation controls light bulb — F8b



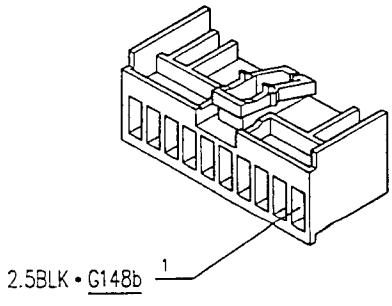
Fusebox — G1



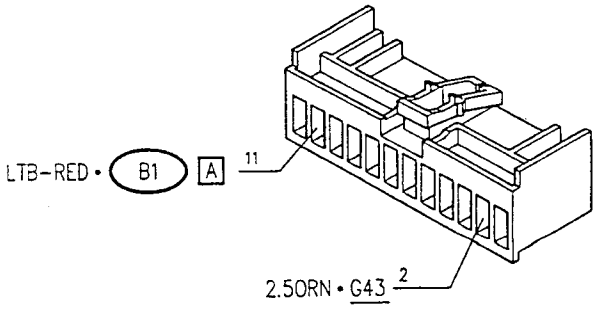
Fusebox — G1 D



Fusebox — G1 G

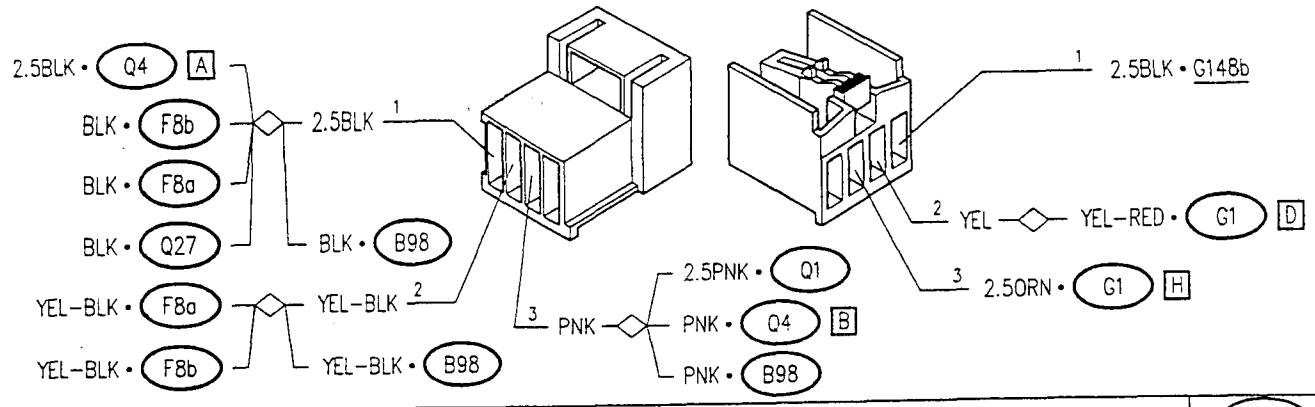


Fusebox — G1 H

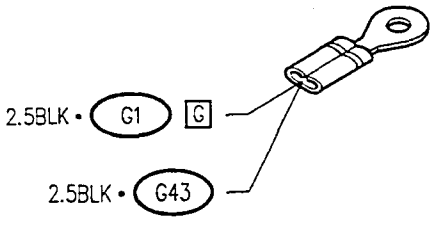


Components and Connectors (cont.d)

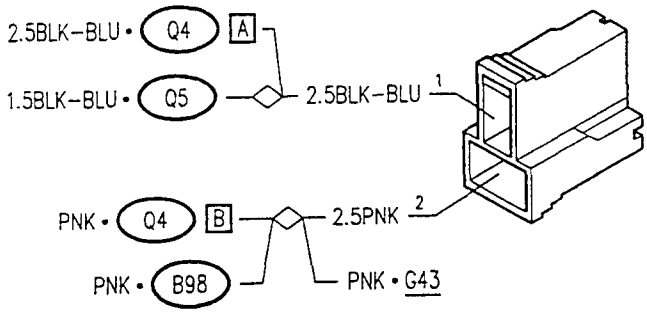
Connector for heating and ventilation control wiring — G43



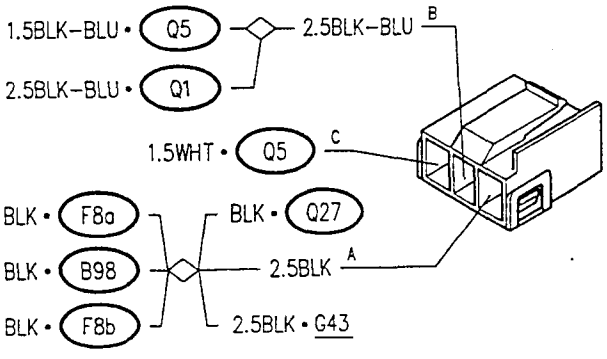
Earth under LH dashboard — G148b



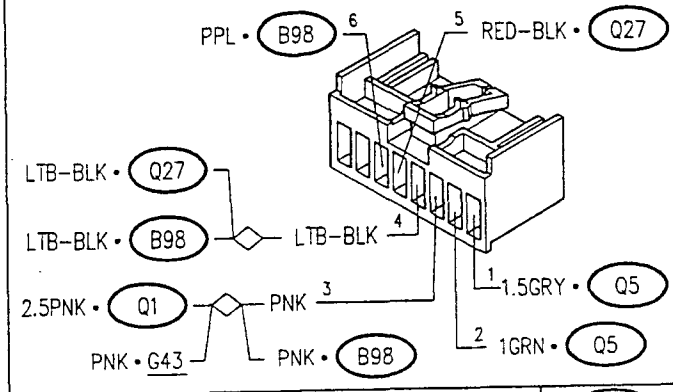
Heater fan — Q1



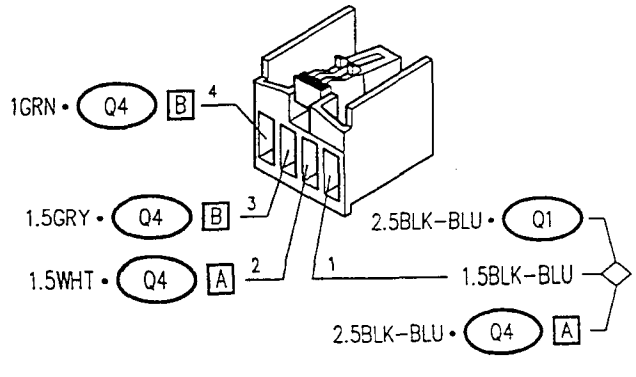
Heater fan control — Q4 A



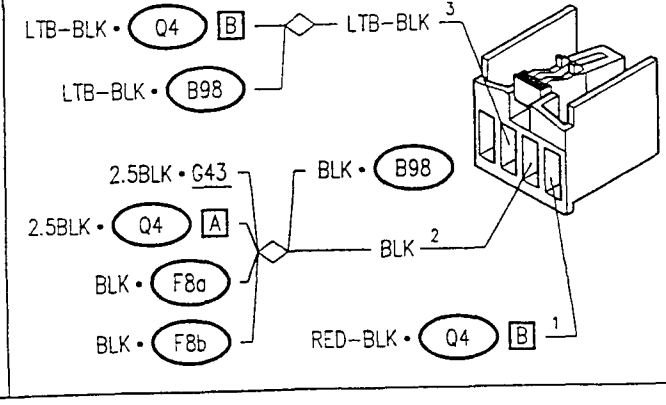
2Heater fan control — Q4 B



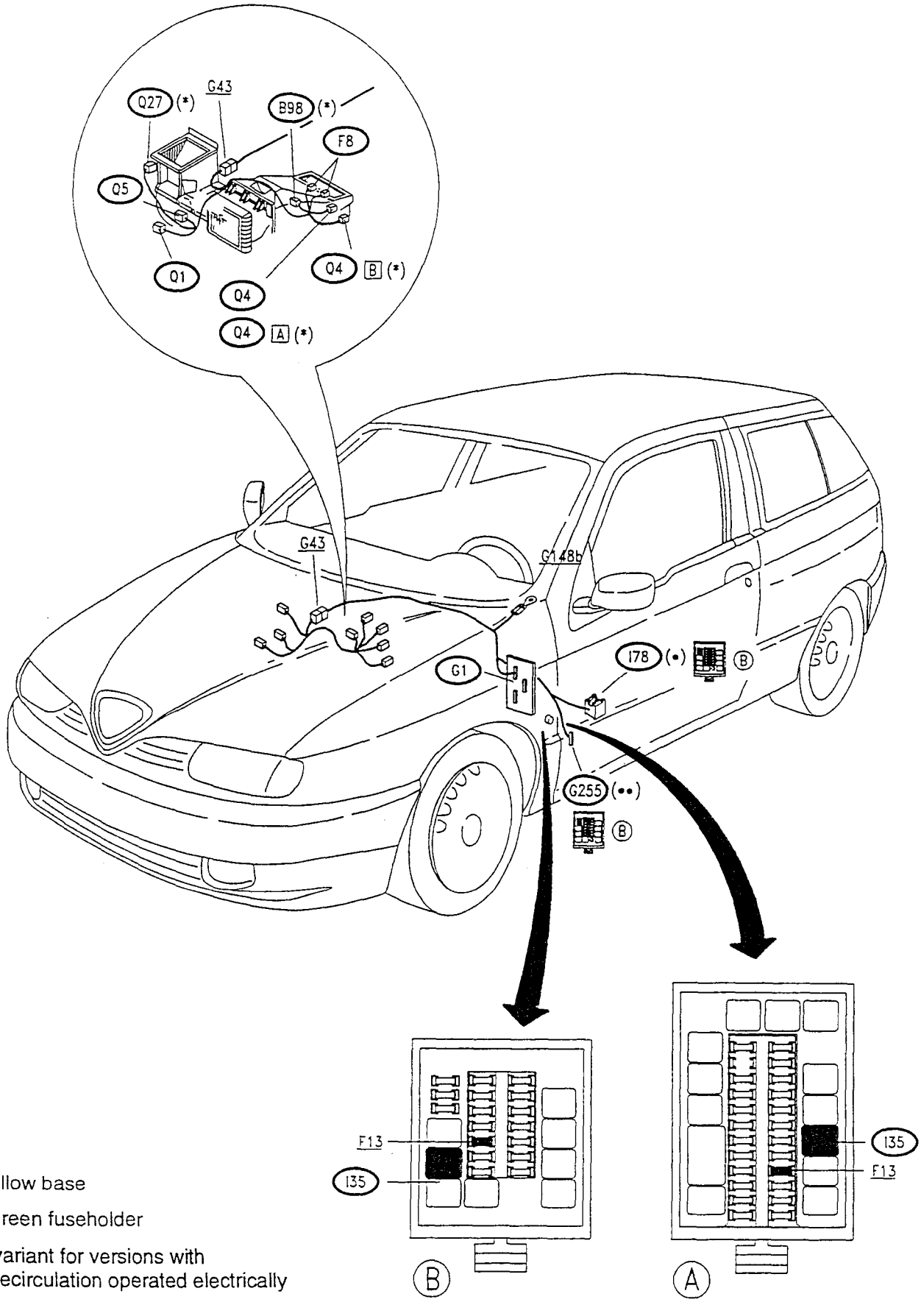
Heater fan speed adjustment resistance — Q5



Air recirculation port control motor — Q27



LOCATION OF COMPONENTS



(•) yellow base

(••) green fuseholder

(*) variant for versions with recirculation operated electrically

FAULT-FINDING TABLE

NOTE: air distribution to the passenger compartment and air heating/cooling are controlled mechanically. Therefore for failures such as the lack of heating/ventilation, incorrect air distribution, etc...., see Group 50 "HEATING AND VENTILATION"

Fault	Component to be checked									
	F13	G255 (B)	Q1	I78 (B)	Q5	Q4	Q27	B98	F8a (2)	F8b (2)
Fan engagement	•	•	•	•		•				
Fan engagement at different speeds					•	•				
Recirculation function (1)						•	•	•		
Control panel lighting									•	•

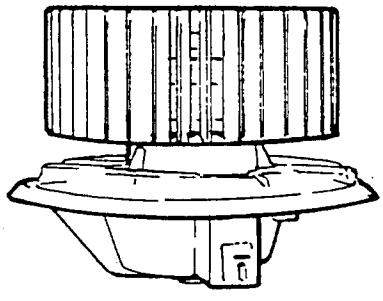
(1) only for certain Markets: in other versions this function is controlled mechanically.

(2) it is possible to change individual bulbs with their bulb holder.

(B) only for fusebox "B"

CHECKING COMPONENTS

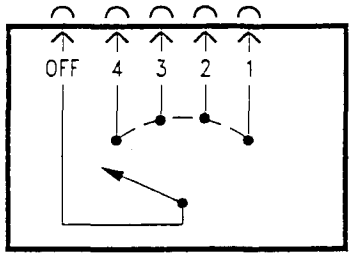
Heater fan (Q1)

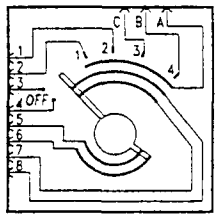


SPECIFICATIONS	
Nominal voltage	12V
Speed at 12V/25°C in free air with impeller and support	3400 $^{+200}_{-100}$ rpm
Power yielded at 12V/25°C at above-mentioned speed	110 W
Motor direction of rotation	leftwards impeller side

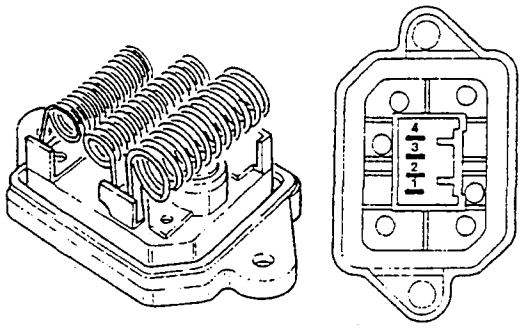
Heating/ventilation fan control (Q4)

Check the contacts corresponding to the different positions of the knob.





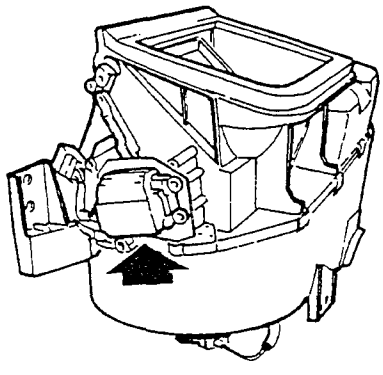
Heating/ventilation fan speed adjustment resistance (Q5)



SPECIFICATIONS		
Piece crossed	Total resistance	Fan speed
4-1 3-1 2-1 none	3.55 Ω 1.35 Ω 0.35 Ω -	1st 2nd 3rd 4th
Thermal fuse cut in temperature		98°C

Recirculation flap control motor (Q27)

(only for certain versions)



SPECIFICATIONS
12 V at pin 1 and 0 V at pin 2 = **counterclockwise** rotation of output shaft
12 V at pin 3 and 0 V at pin 2 = **clockwise** rotation of output shaft

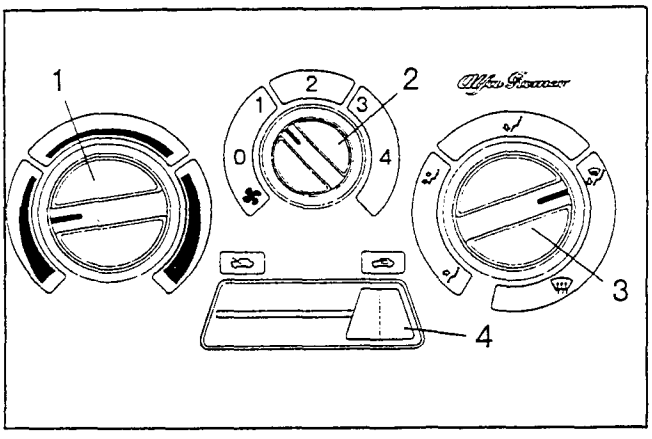
HEATING AND VENTILATION SYSTEM: HEATER - Model Year '97

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COMPONENTS AND CONNECTORS 31A-5
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CHECKING COMPONENTS 31A-8

GENERAL DESCRIPTION

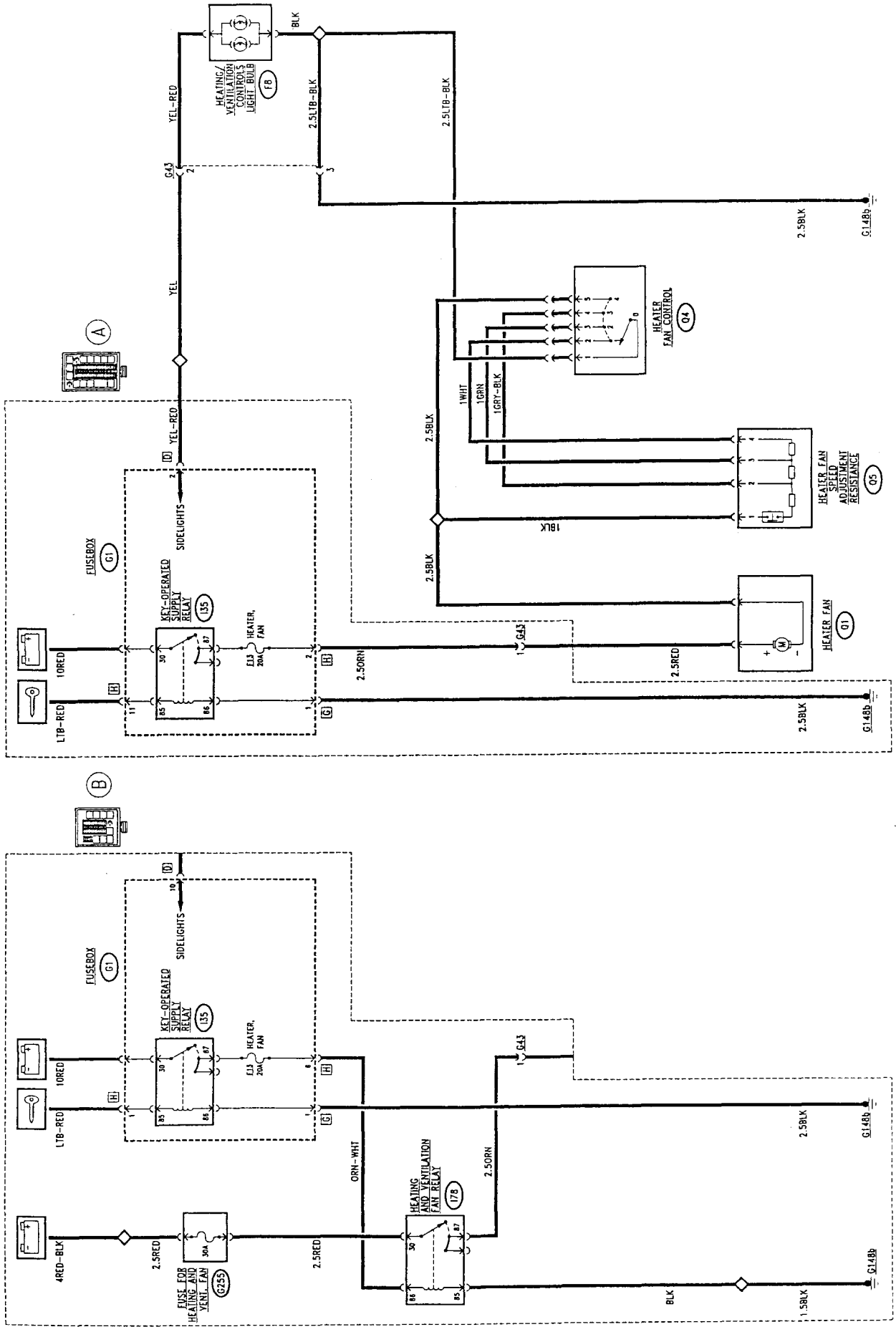
Climate control through the heater is controlled by three knobs of the control unit located on the panel: these controls act on the heater- distributor -air flow unit as follows:



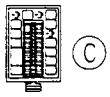
- the left-hand knob (1) mechanically operates the mixing port for hot (red) and cold (blue) air; when it is turned completely counter-clockwise it shuts off the heater closing a special tap.
  NOTE:the heater comprises a heat exchanger which exploits the engine coolant to give off heat to the air sent to the passenger compartment: in fact it is supplied by a special pipe of the engine cooling circuit.
- the centre knob (2) - mechanically operates a flexible transmission - firstly for opening the flaps that adjust the flow of air;
  - 0: inlet of outside air without fan (dynamic air)
  - from 1 to 4: a switch is controlled which turns on the fan through a four-speed regulator. The regulator and its resistor are fitted on the duct near the fan.
    NOTE: the fan can only be turned on with ignition key engaged.
- the right-hand knob (3) adjusts the distribution of the flow acting, still by a mechanical transmission,on the distribution ports, sending air into the passenger compartment in the directions shown schematically on the ideograms.
- the recirculation function (4), is engaged through the lever (4) which operates a special port. This acts by closing the outside air duct and simultaneously opening the one for recirculating air from inside the passenger compartment (lever (4) completely to the right).
  The recirculation function makes it possible to withdraw the air to be treated from inside the passenger compartment, shutting off the flow of outside air which under certain circumstances might be unwanted: bad smells, smoke, unventilated tunnels, etc.

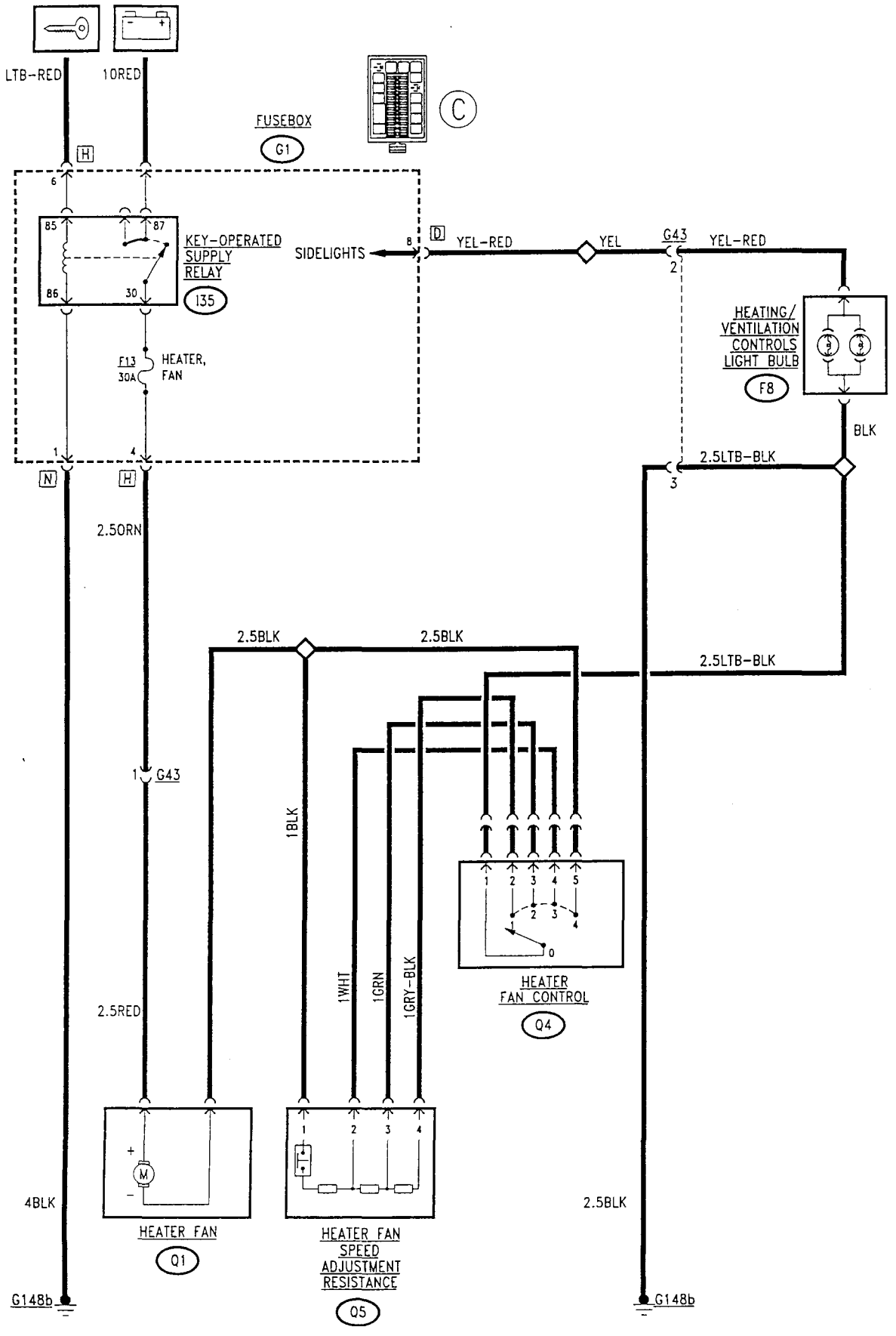
NOTE: If the lever (4) is left in an intermediate position it may adversely affect operation of the system.

WIRING DIAGRAM



WIRING DIAGRAM





FUNCTIONAL DESCRIPTION

Fan:

The heating and ventilation fan **Q1** is supplied with battery voltage via the key-operated services relay **I35** - located in fusebox **G1** -; in addition to the relay, the supply line also crosses fuse **F13** of fusebox **G1**.

In the versions with fusebox "B" there is a specific relay **I78** which exploits the previous line in terms of energization and supplies the fan as a direct line protected by fuse **G255** (30A).

The fan motor **Q1** is operated with an earth signal from the control knob **Q4**. This signal crosses the speed regulator **Q5**, comprising three resistances in series, the crossing of which determines the four different speeds, depending on the signal from the knob **Q4**: from pin 1 (1st speed) , from pin 2 (2nd speed), from pin 3 (3rd speed) and lastly from pin 4 (4th speed) with a direct signal that does not cross the regulator **Q5**.

Recirculation:

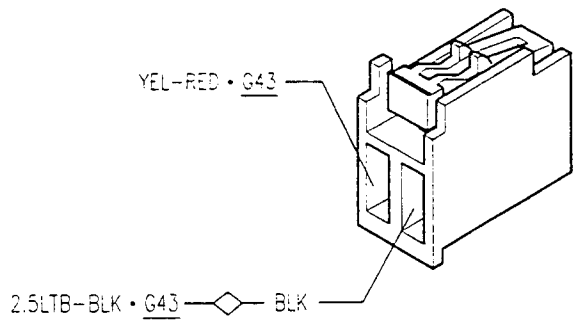
N.B. recirculation is operated mechanically through a special cable.

Controls lighting:

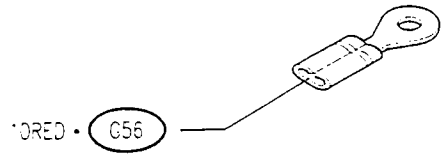
Lights **F8**, inside the control panel are supplied by the sidelights circuit - connector D of fusebox **G1** (also see "Lighting of controls and Indicators").

COMPONENTS AND CONNECTORS

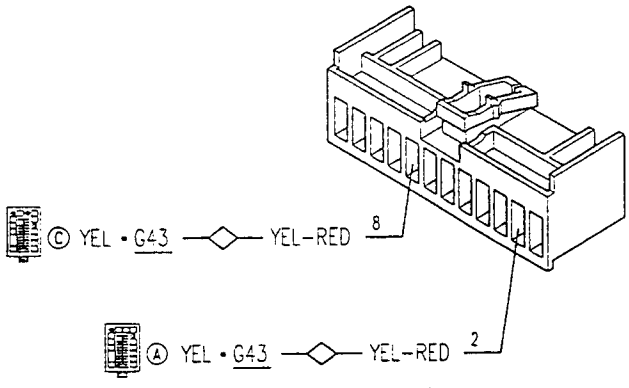
Heating/ventilation controls light bulb	F8



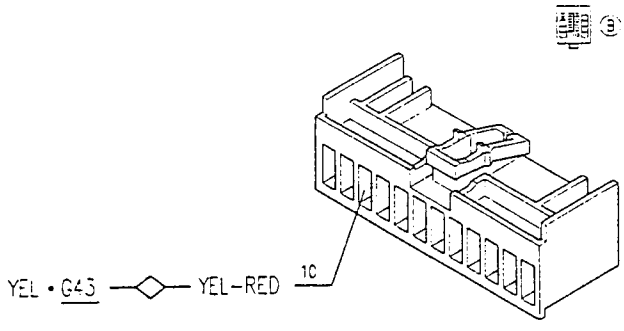
Fusebox	G1



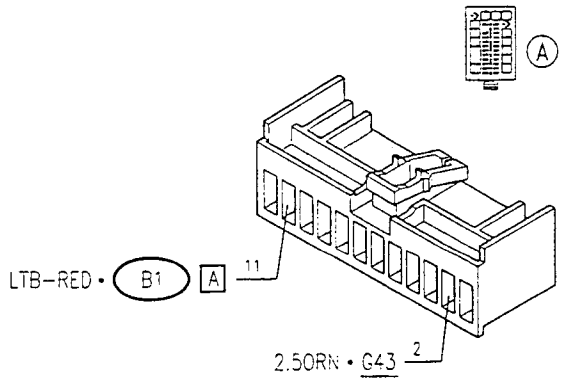
Fusebox	G1 D



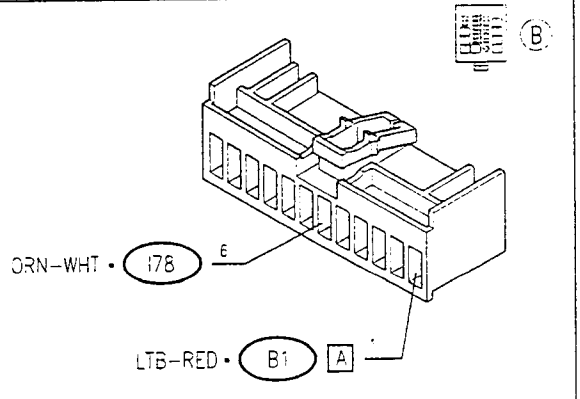
Fusebox	G1 D



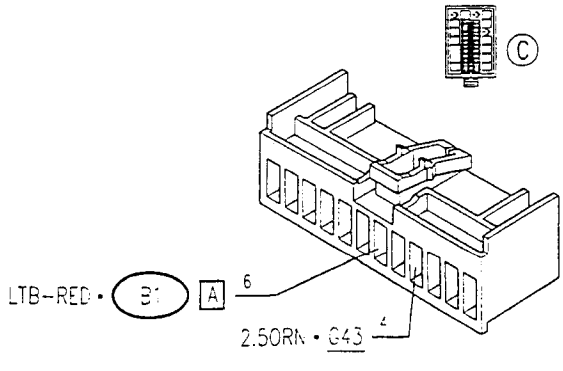
Fusebox	G1 H



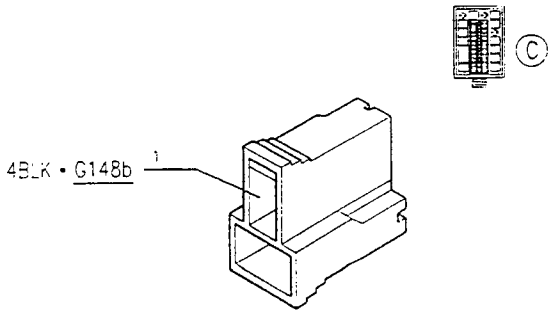
Fusebox	G1 H



Fusebox	G1 H

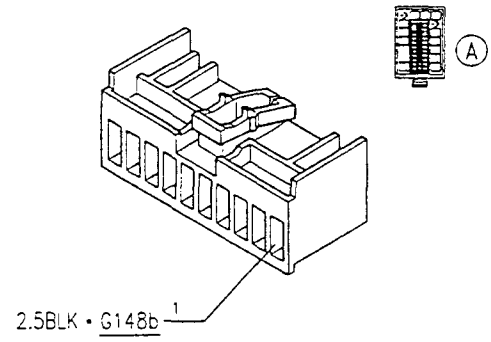


Fusebox	G1 N

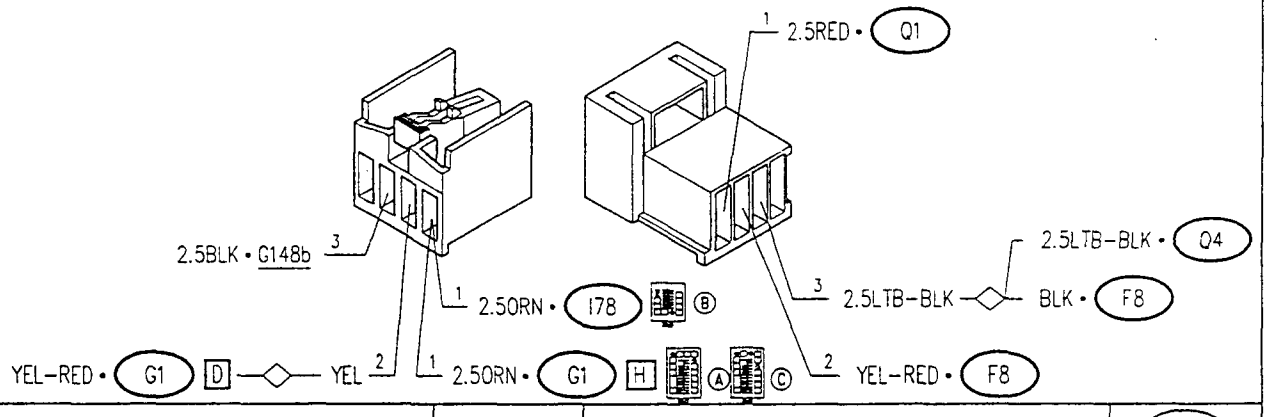


COMPONENTS AND CONNECTORS (cont.d)

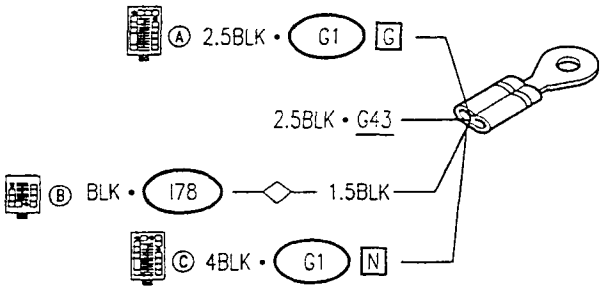
Fusebox	G1 G



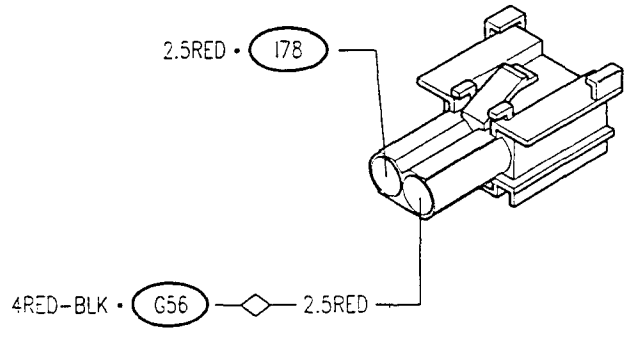
Connector for heating and ventilation control wiring	G43



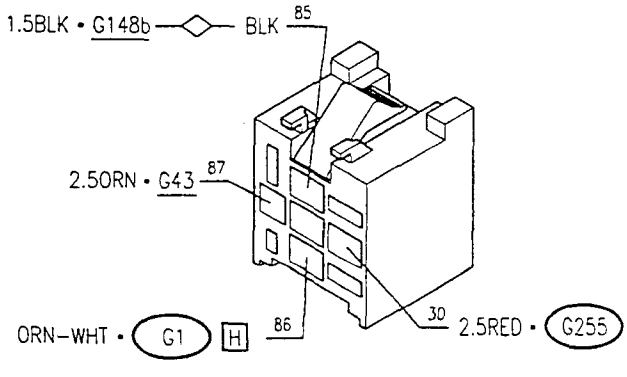
Earth under LH dashboard	G148b



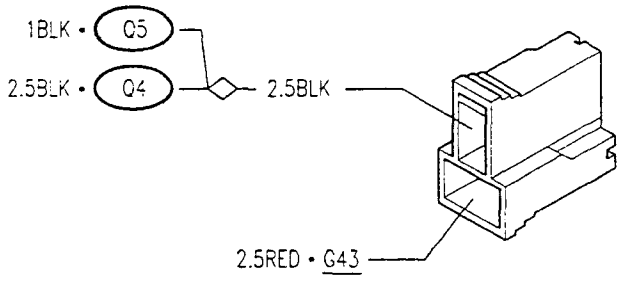
Heater fan fuse	G255



Heater fan relay	I78

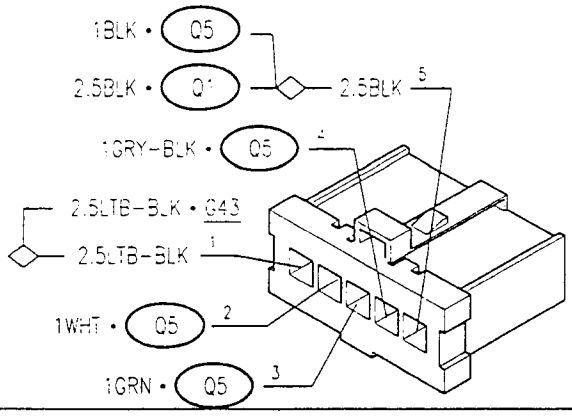


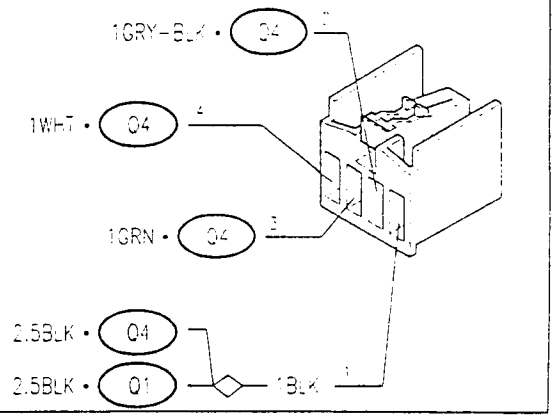
Heater fan	Q1



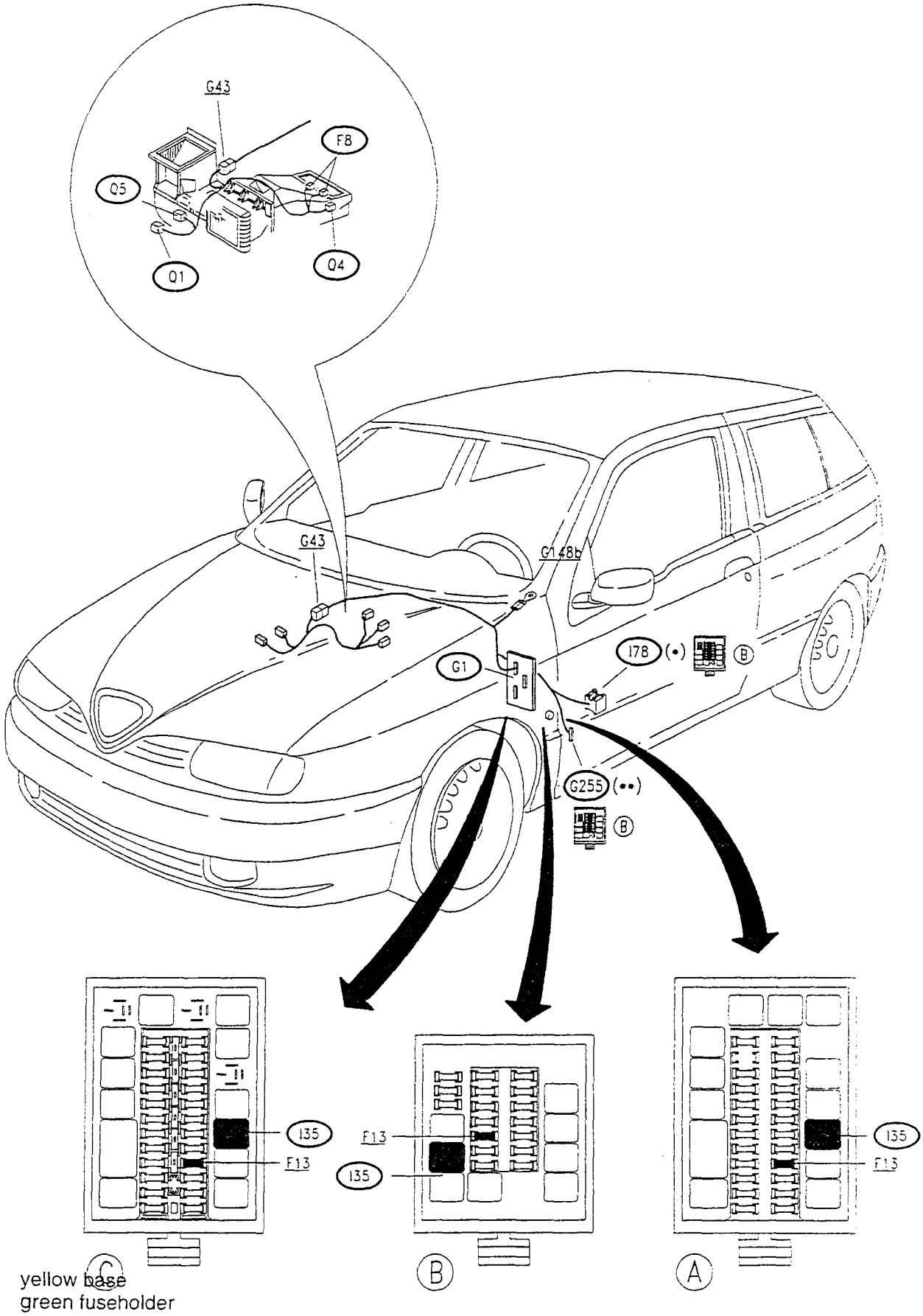
COMPONENTS AND CONNECTORS (cont.d)

Heater fan control	Q4	Heater fan speed adjustment resistance	Q5





LOCATION OF COMPONENTS



(•) yellow base
(••) green fuseholder

FAULT-FINDING TABLE

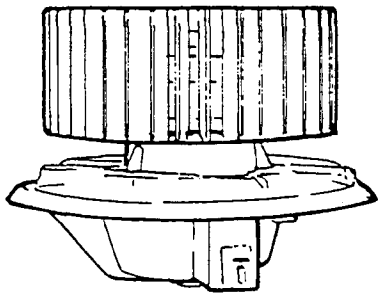
NOTE: air distribution to the passenger compartment and air heating/cooling are controlled mechanically. Therefore for failures such as the lack of heating/ventilation, incorrect air distribution, etc...., see Group 50 "HEATING AND VENTILATION"

Fault	Component to be checked						
	F13	G255 (B)	Q1	I78 (B)	Q5	Q4	F8
Fan engagement	•	•	•	•		•	
Fan engagement at different speeds					•	•	
Control panel lighting							•

(B) only for fusebox "B"

CHECKING COMPONENTS

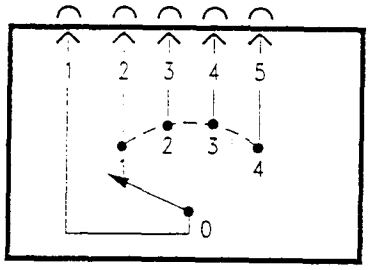
Heater fan (Q1)



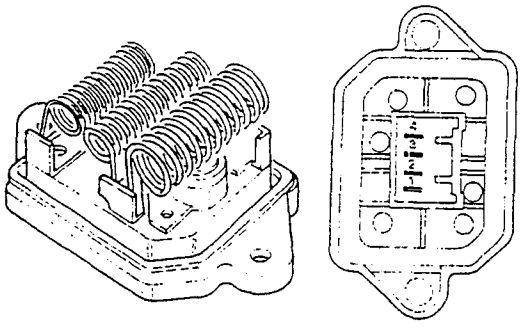
SPECIFICATIONS	
Nominal voltage	12V
Maximum current	16.5 A
Speed at 12V/25°C in free air with impeller and support	3230 ÷ 3570 rpm
Motor direction of rotation	leftwards impeller side

Heating/ventilation fan control (Q4)

Check the contacts corresponding to the different positions of the knob.



Heating/ventilation fan speed adjustment resistance (Q5)



SPECIFICATIONS		
Piece crossed	Total resistance	Fan speed
4-1 3-1 2-1 none	3.55 Ω 1.35 Ω 0.35 Ω -	1.ª 2.ª 3.ª 4.ª
Thermal fuse cut in temperature		98°C

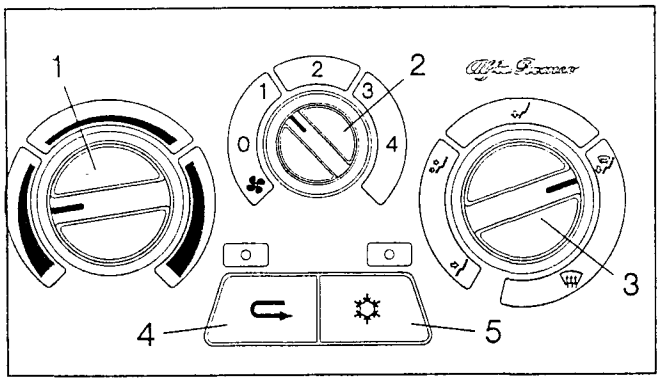
CLIMATE CONTROL: MANUAL AIR CONDITIONER - Model Year '97

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GENERAL DESCRIPTION

The system with manually operated air conditioner integrates the simple but functional heater with the function of producing cold, dehumidified air obtained by engaging the compressor and the cooling system.



Controls

The control unit on the dashboard comprises three knobs and two push-buttons:

- the left hand knob (1) mechanically operates the mixing port between warm air (red) and cold (blue); when turned completely counter-clockwise, it cuts off the radiator closing a special tap.
  NOTE: the heater comprises a heat exchanger which exploits the engine coolant fluid to release heat to the air that is sent to the passenger compartment: in fact it is supplied by a special pipe of the engine cooling circuit.
- the centre knob (2) mechanically controls the opening of the ports that adjust the flow of air:
  - 0: inlet of outside air without fan (dynamic air)
  - from 1 to 4: a switch is controlled which turns on the fan through a regulator with four speeds. The regulator and its resistor are fitted on the duct near the fan.
    NOTE: the fan can only be turned on with the ignition key turned.
- the right knob (3), acting on the distribution ports, still by mechanical transmission, sending the air into the passenger compartment in the directions shown on the pictograms.
- the button (4) controls the engagement of the "recirculation" function, by operating a motor which closes the outside air duct port and at the same time opens the air duct for recirculation from inside the passenger compartment. The driver is alerted that the recirculation function is operating by the lighting up of a special led.
  (The recirculation function makes it possible to withdraw the air to be treated from inside the passenger compartment, shutting off the flow of air from outside which in certain instances may be undesirable: bad smells, smoke, unventilated tunnels, etc...)
- button (5) controls engagement of the cooling system which produces cold, dehumidified air. A special led lights up to warn that it is operating.

Air cooling system:

This is a closed loop system in which a fluid condenses and evaporates withdrawing heat from the air in the evaporator.

It mainly comprises the following:

compressor, operated by the crankshaft through a belt: it is turned on and off through an electromagneic joint operated by the air conditioning system.

- Petrol version: the compressor is controlled by the engine electronic management system which adapts idle speed when the compressor is engaged, or prevents it from engaging under power absorption conditions that would adversely affect vehicle performance levels.
- TD version: engagement of the compressor is controlled by a special control unit which takes account of a series of operating conditions of the system itself and of the engine which are described below.

NOTE:
In both cases a **variable displacement compressor** is used: this configuration is made through a suitable adjustment valve and a sloping plate. This makes it possible to meet the different requirements of cold air without the electromagnetic joint being energised and de-energised continuously: when the requirement is high, the compressor moves to the maximum load configuration and vice versa for low requirements.

condenser, fitted in front of the engine coolant radiator: if the car is stationary, the air needed for thermal exchange is supplied operating the engine radiator fan;

evaporator, exchanger which cools the air, located in the duct-distributor;

accumulator/drier, which separates the fluid in liquid state from gas and also acts as accumulator and filter for any foreign matter

minimum thermostat (antifrost): - this disconnects the compressor when the temperature is too low as it would risk "freezing" the evaporator.

four-level pressure switch (trinary): this controls the safety and correct operation of the fluid circuit.

The 4 levels cut in as follows:

- 1. level = minimum pressure for engaging the compressor.
- 2. level = pressure requiring engagement of the of first speed of the fan.
- 3. level = pressure requiring engagement of the second speed of the fan.

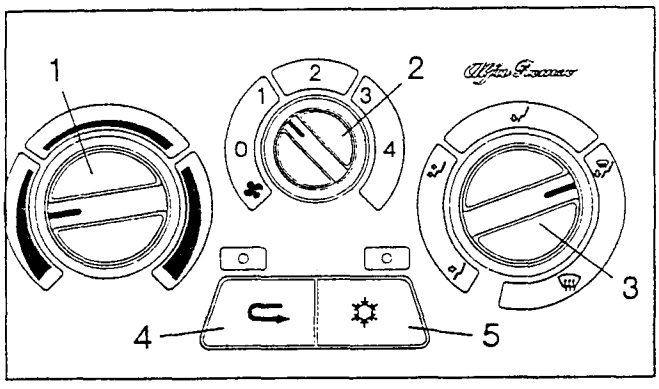
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GENERAL DESCRIPTION

The system with manually operated air conditioner integrates the simple but functional heater with the function of producing cold, dehumidified air obtained by engaging the compressor and the cooling system.



Controls

The control unit on the dashboard comprises three knobs and two push-buttons:

- the left hand knob (1) mechanically operates the mixing port between warm air (red) and cold (blue); when turned completely counter-clockwise, it cuts off the radiator closing a special tap.
  NOTE: the heater comprises a heat exchanger which exploits the engine coolant fluid to release heat to the air that is sent to the passenger compartment: in fact it is supplied by a special pipe of the engine cooling circuit.
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  - from 1 to 4: a switch is controlled which turns on the fan through a regulator with four speeds. The regulator and its resistor are fitted on the duct near the fan.
    NOTE: the fan can only be turned on with the ignition key turned.
- the right knob (3), acting on the distribution ports, still by mechanical transmission, sending the air into the passenger compartment in the directions shown on the pictograms.
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  (The recirculation function makes it possible to withdraw the air to be treated from inside the passenger compartment, shutting off the flow of air from outside which in certain instances may be undesirable: bad smells, smoke, unventilated tunnels, etc...)
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It mainly comprises the following:

compressor, operated by the crankshaft through a belt: it is turned on and off through an electromagneic joint operated by the air conditioning system.

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- TD version: engagement of the compressor is controlled by a special control unit which takes account of a series of operating conditions of the system itself and of the engine which are described below.

NOTE:
In both cases a **variable displacement compressor** is used: this configuration is made through a suitable adjustment valve and a sloping plate. This makes it possible to meet the different requirements of cold air without the electromagnetic joint being energised and de-energised continuously: when the requirement is high, the compressor moves to the maximum load configuration and vice versa for low requirements.

condenser, fitted in front of the engine coolant radiator: if the car is stationary, the air needed for thermal exchange is supplied operating the engine radiator fan;

evaporator, exchanger which cools the air, located in the duct-distributor;

accumulator/drier, which separates the fluid in liquid state from gas and also acts as accumulator and filter for any foreign matter

minimum thermostat (antifrost): - this disconnects the compressor when the temperature is too low as it would risk "freezing" the evaporator.

four-level pressure switch (trinary): this controls the safety and correct operation of the fluid circuit.

The 4 levels cut in as follows:

- 1. level = minimum pressure for engaging the compressor.
- 2. level = pressure requiring engagement of the of first speed of the fan.
- 3. level = pressure requiring engagement of the second speed of the fan.

– 4. level = maximum pressure for engaging the compressor.

compressor cut out thermal contact: - TD version only - : this cuts off the compressor if the engine temperature reaches dangerously high levels (it is a contact on the thermostatic cup, which operates opening the circuit over 111°C.

full load switch - TD version only - : this is a mechanical microswitch on the injection pump, which, through the special compressor cut out control unit, cuts off, even if only temporarily, the compressor when the accelerator pedal is depressed completely (full load).

compressor cut out control unit - TD version only - : this momentaneously turns off the cooling system under certain particular conditions in which the engine needs to deliver the maximum power to the wheels, eliminating the absorption of power by the compressor (e.g. when overtaking, fast acceleration, up hills etc.). The control unit carries out the following **operating logic**, or rather two different operating logics at low and high speeds: below 2000 rpm as soon as the full load switch closes, the compressor electromagnetic joint is de-energised, and energised as soon as the switch opens again; over 2000 rpm the compressor supply cut off lasts only 8 seconds and then it is restored.

Engine fan control:

At low car speed the cooling by dynamic air on the condenser lowers and it is necessary to engage the fan that cools the engine radiator and the condenser itself. This takes place through the 4-level pressure switch which cuts in preventing an increase of the pressure at the condenser: engaging the engine fan takes place initially at first speed (level of appr. 15 bar) then, at second speed (level of appr. 20 bar).

Fuses and relays:

The system fuses and relays are grouped as follows:

– next to the fusebox **G1**: 30A fusebox **G255** (only **G1**, B), 10A fuse **Q65**, relay **I78** (only **G1**, B), relay **I99** (only **G1**, B), relay **Q22** (only TD);

– in the "maxi fuse" bos **G56**: 50A fuse **G254**;

– on the fan duct: relay **I100** (only TD);

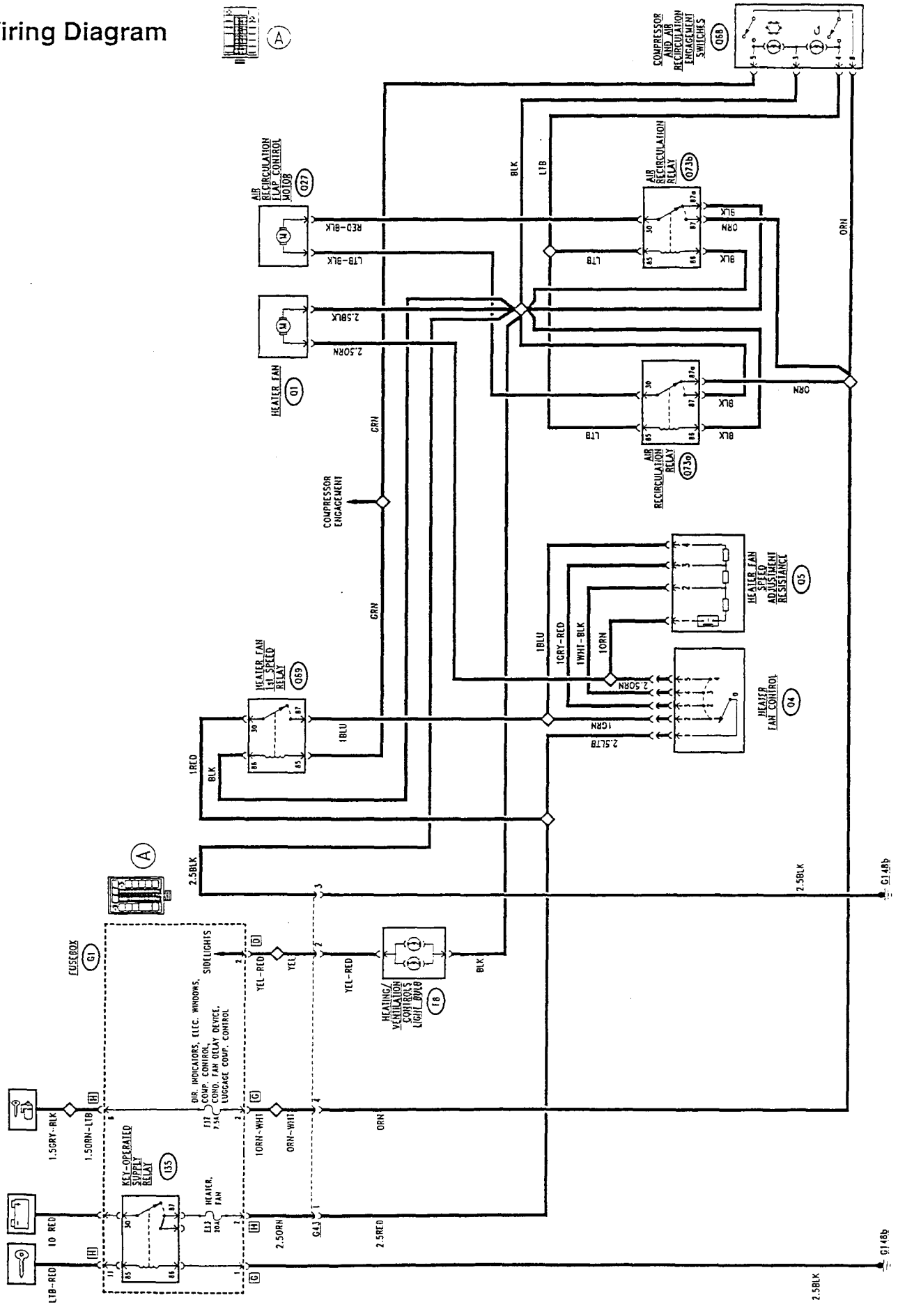
– next to the i.e. fuses and relays (only petrol version): relays **Q22** and **I100**;

– on the duct/distributor unit: relays **Q69**, **Q73a** and **Q73b**.

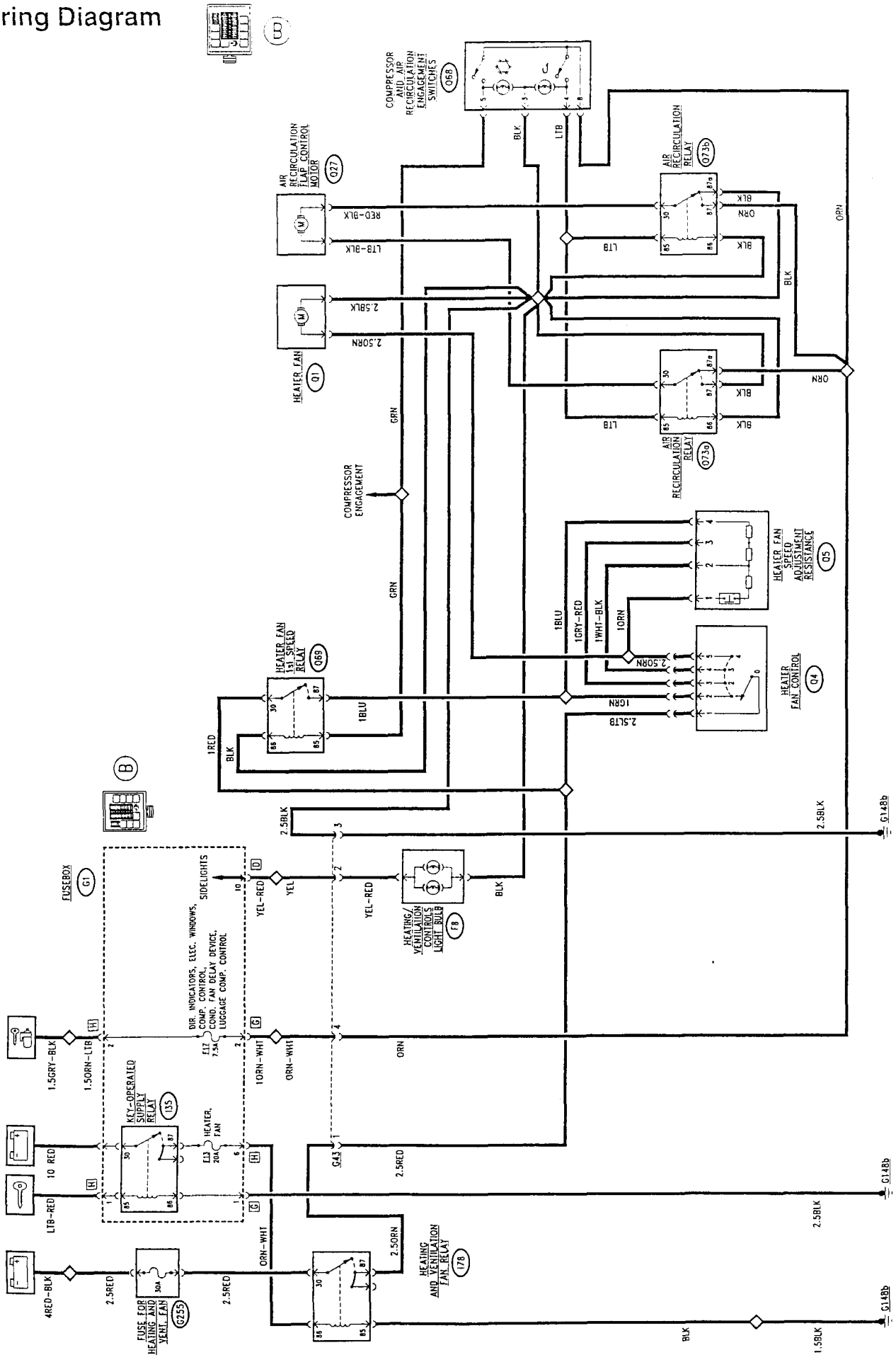
For further details concerning this system, refer to Group 50 "CLIMATE CONTROL".

FAN AND RECIRCULATION CONTROL

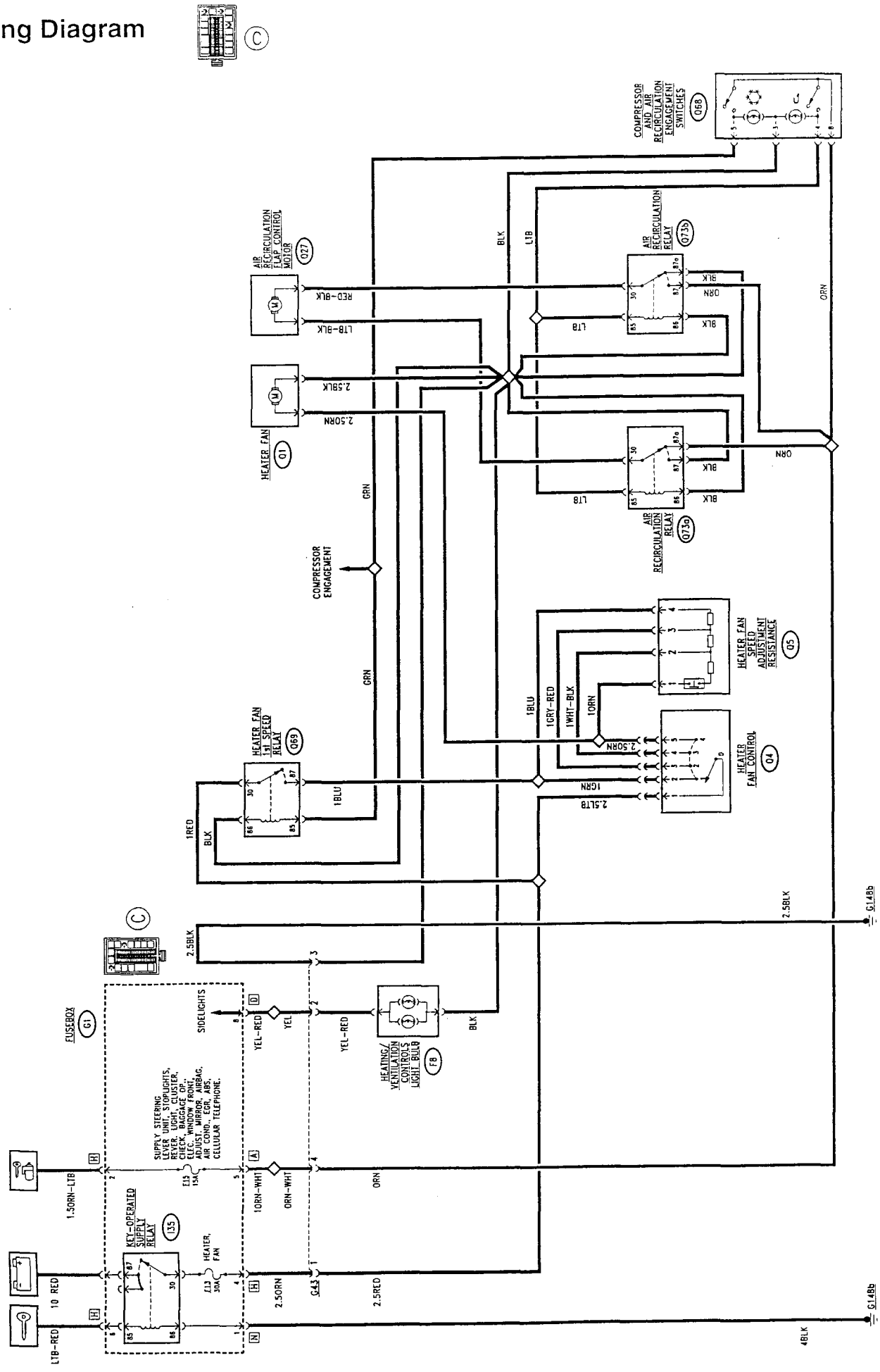
Wiring Diagram



Wiring Diagram



Wiring Diagram



Functional Description

Fan:

The climate control fan **Q1** is supplied with battery voltage through the key-operated services relay **I35** - located in fusebox **G1** -; in addition to the relay the supply line also crosses fuse **F13** of fusebox **G1**.

In the versions with fusebox "B" downstream of fuse **F13**, there is also a special relay **I78** which controls the fan **Q1** with a supply protected by fuse **G255** (30A).

The fan motor **Q1** is operated with an earth signal leading from the control knob **Q4**. This signal crosses the speed regulator **Q5**, formed of three resistances in series and the crossing of them determines the four different speeds, depending on the signal leading from the knob **Q4**.

First fan speed, with the compressor engaged:

With control **Q4** in position "0" the fan **Q1** is stationary but it is operated at first speed if the compressor is enagged: in this case a special relay **Q69** controls the fan supply at first speed.

In fact this relay receives the "key-operated" supply - via fuse **F17** of **G1** box "A" (F15 for box "C") is energised by the same earth signal that controls engagement of the compressor (switch **Q68**) and sends a signal to the regulator **Q5** in correspondence of the 1st speed.

Recirculation

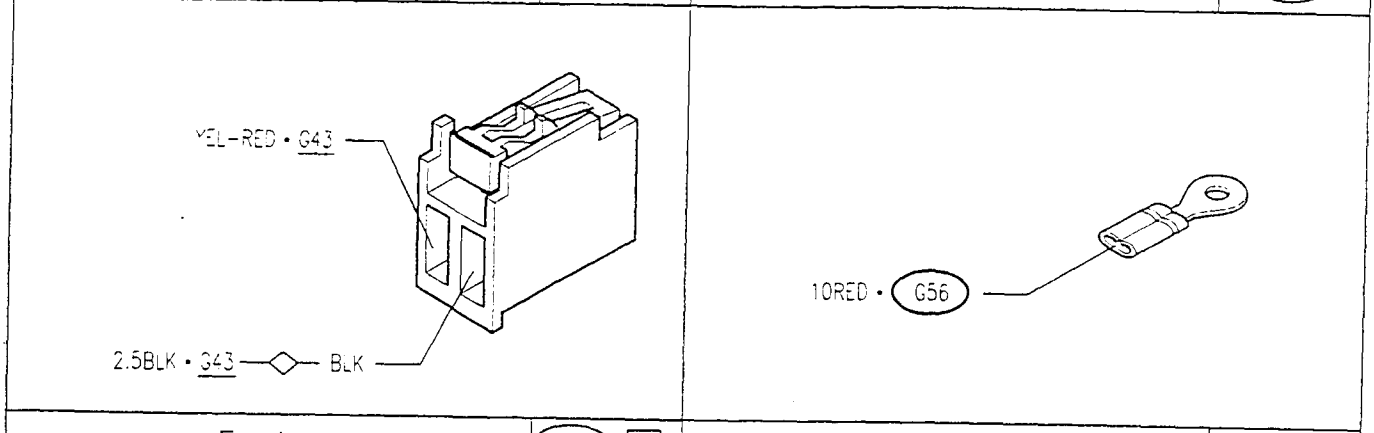
The recirculation function is made by operating the motor **Q27**, controlled by two switches **Q73a** and **Q73b** according to the following logic: through the switch on Q68 the two switches **Q73a** and **Q73b** are energised which switch respectivel positive and earth to the motor making it turn in one direction: if they are de-energised they switch the opposite positive and earth making the port turn in the opposite direction.

Lighting controls:

The lights **F8**, inside the control panel are supplied by the sidelights circuit - connector D of fusebox **G1**.

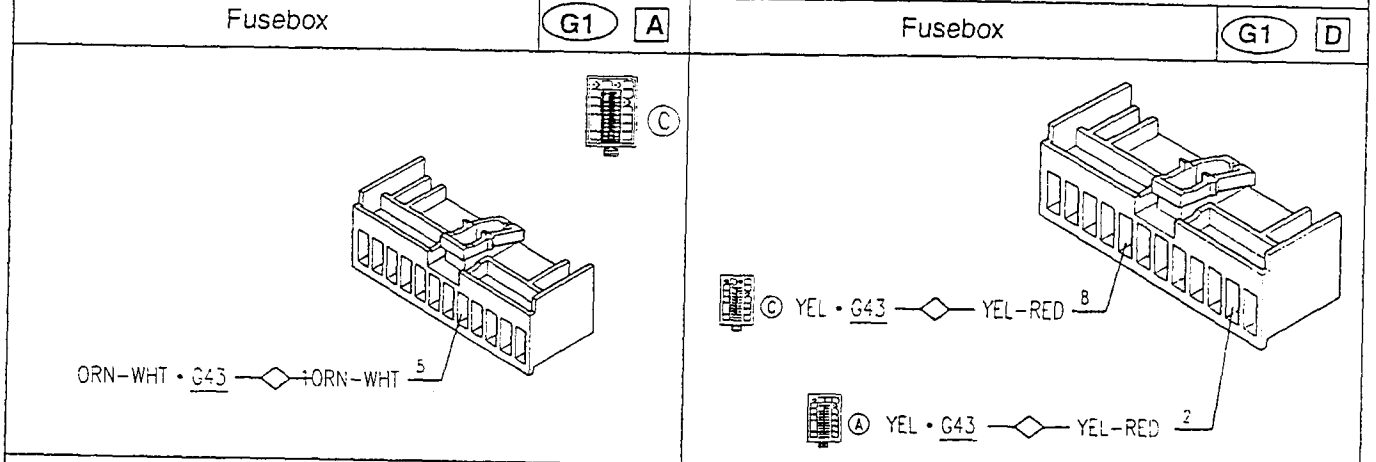
Components and Connectors

Light bulb for control system controls	F8



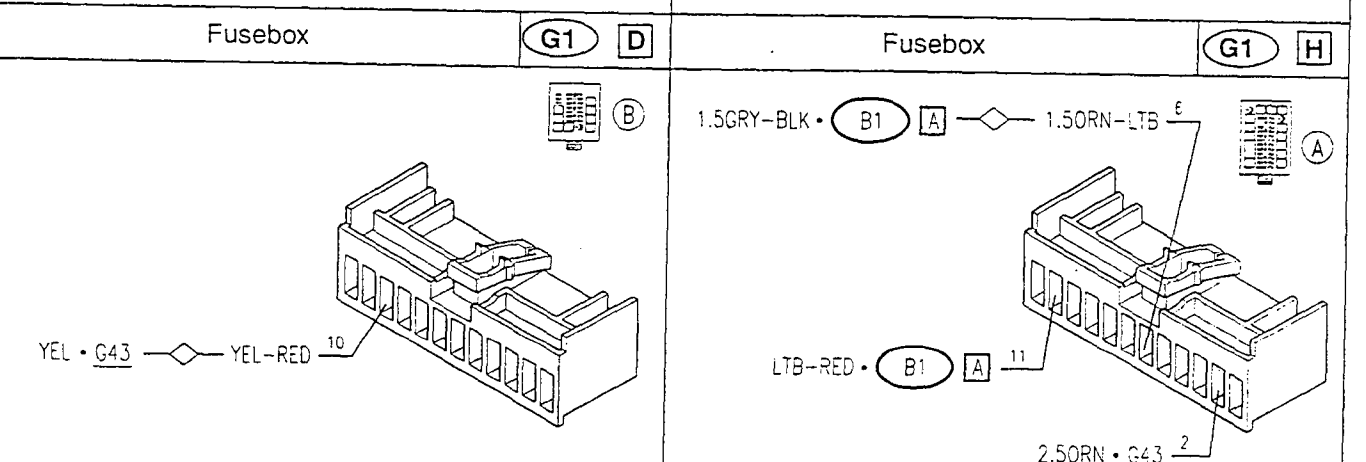
Fusebox	G1

Fusebox	G1 A



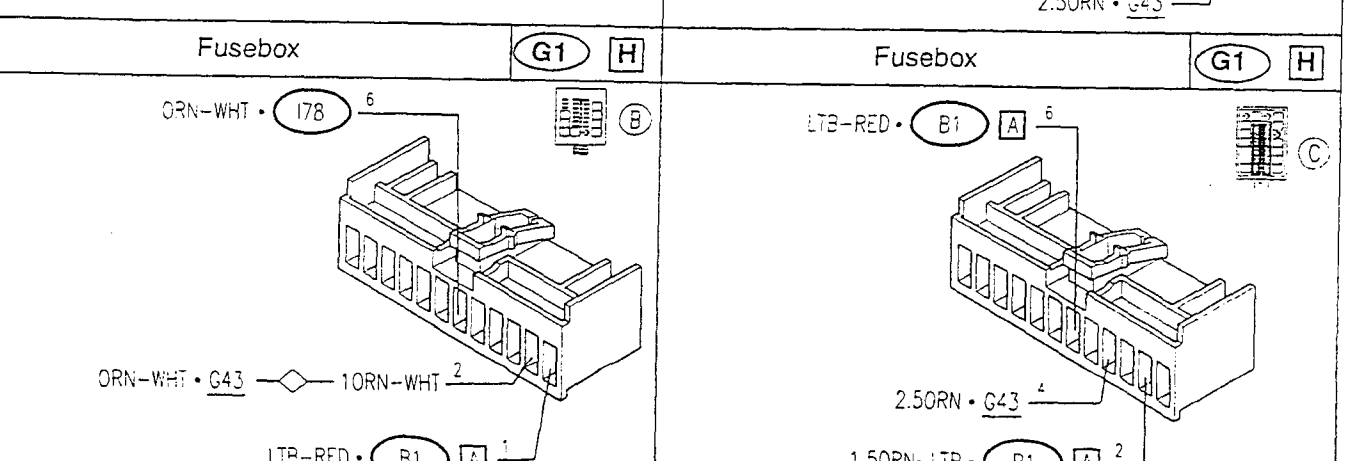
Fusebox	G1 D

Fusebox	G1 D



Fusebox	G1 H

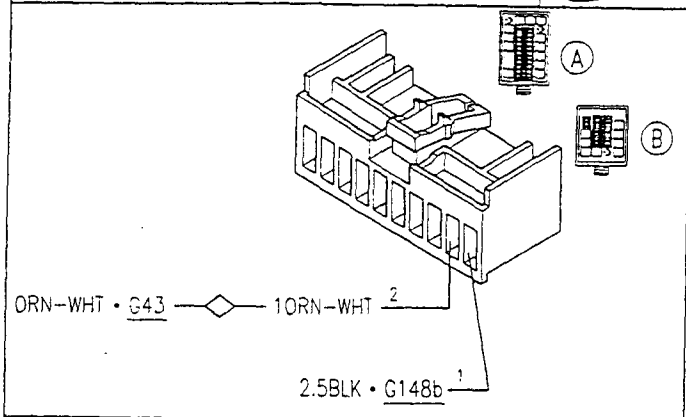
Fusebox	G1 H



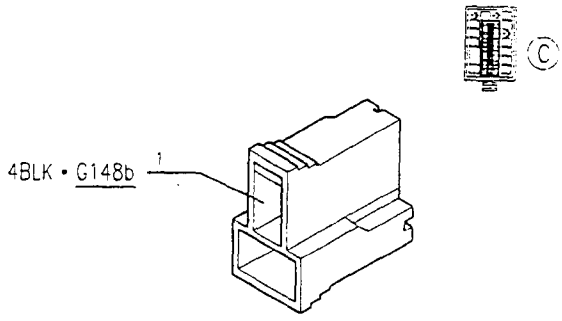
Fusebox	G1 H

Components and Connectors (continued)

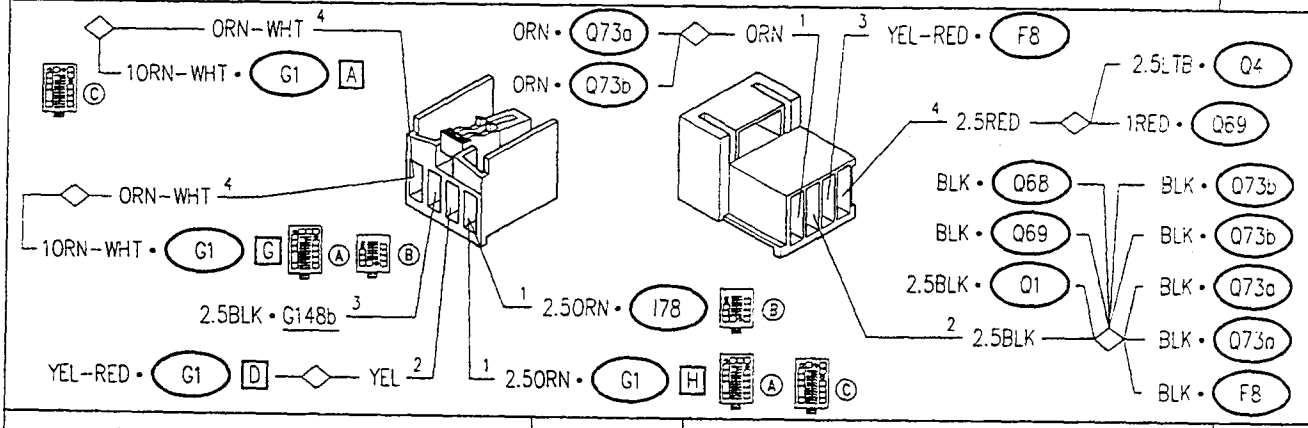
Fusebox	G1 G



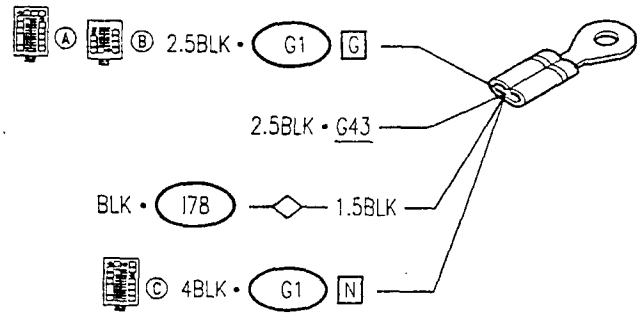
Fusebox	G1 N



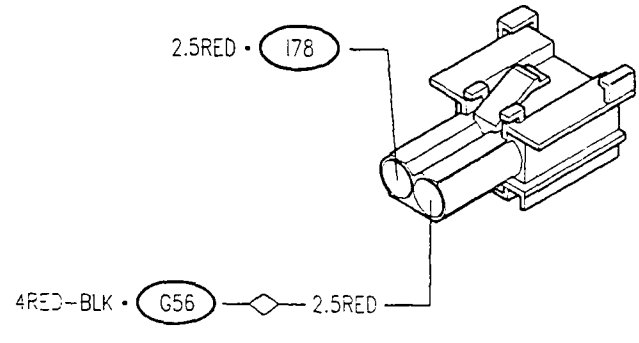
Climate control system controls wiring connector	G43



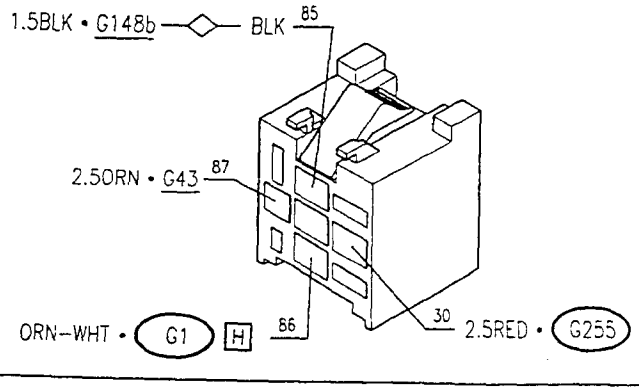
Earth under LH dashboard	G148b



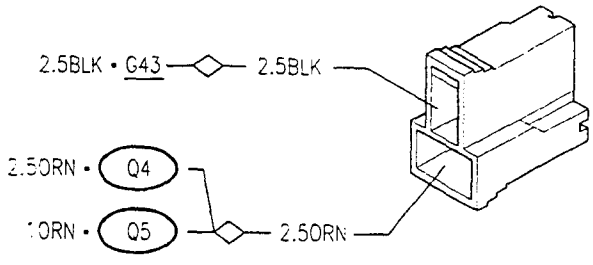
Climate control fan fuse	G255



Climate control fan relay	I78

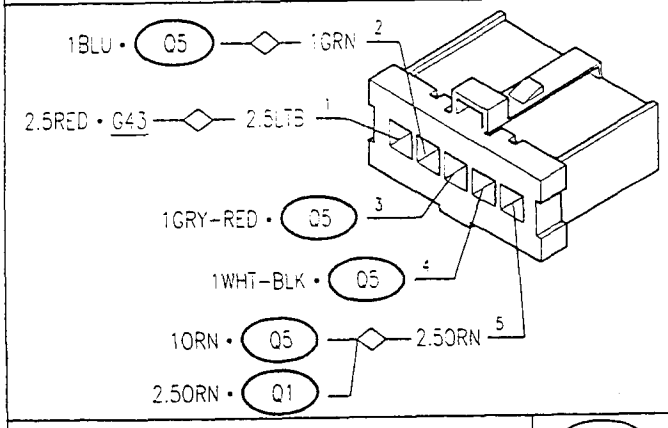


Climate control fan	Q1

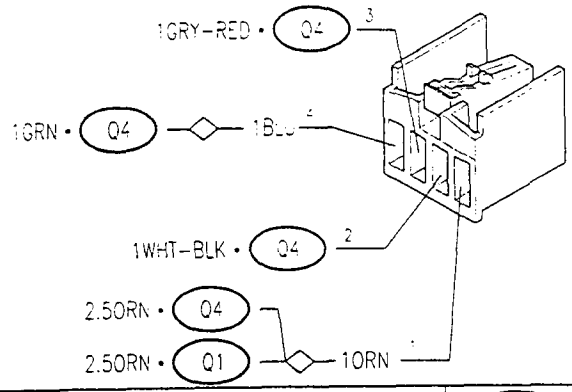


Components and Connectors (continued)

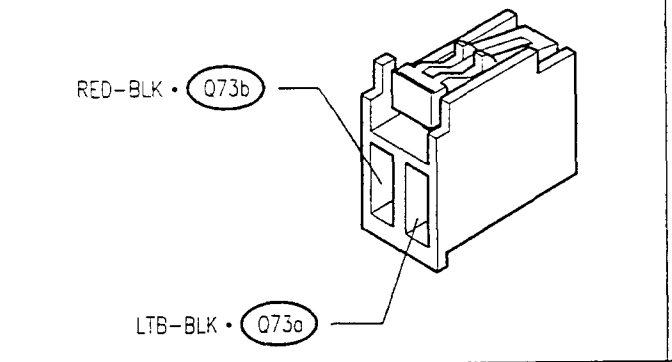
Climate control fan control — Q4



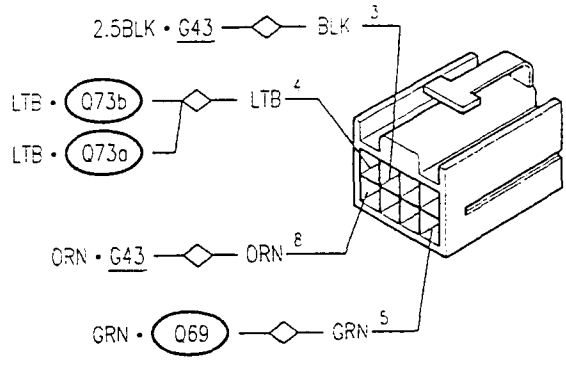
Climate control fan speed adjustment resistance — Q5



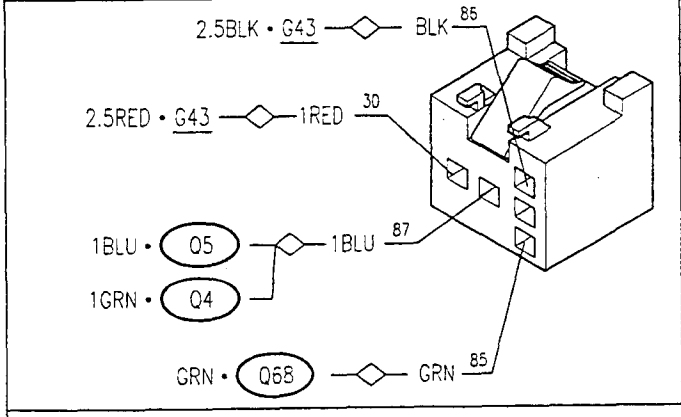
Air recirculation port control motor — Q27



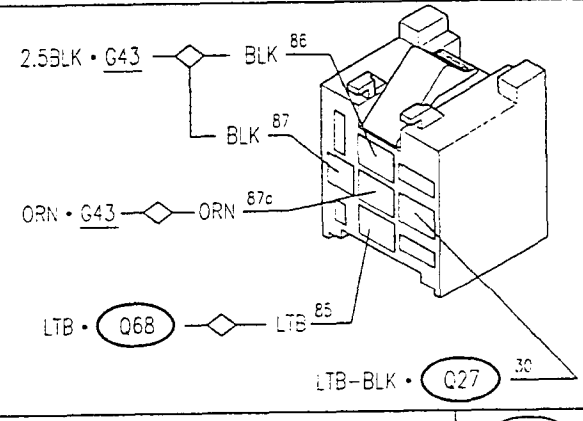
Compressor and air recirculation ON switches — Q68



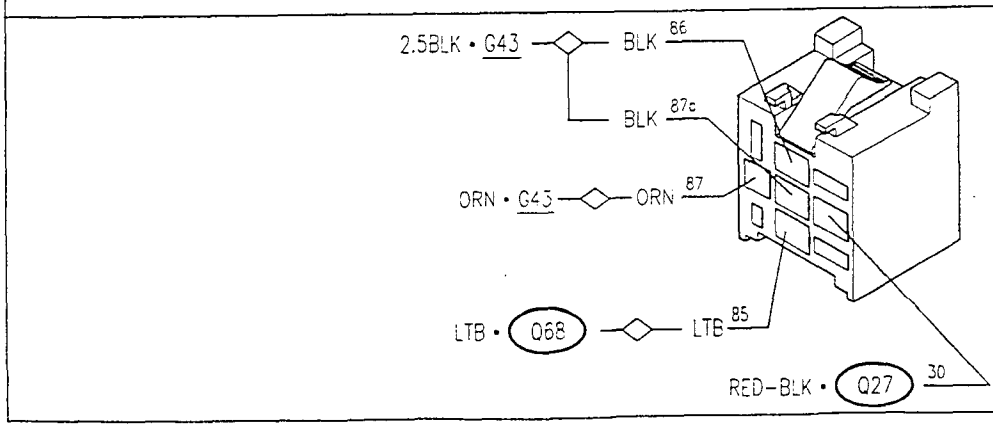
Relay for climate control fan 1st speed — Q69



Air recirculation relay A — Q73a

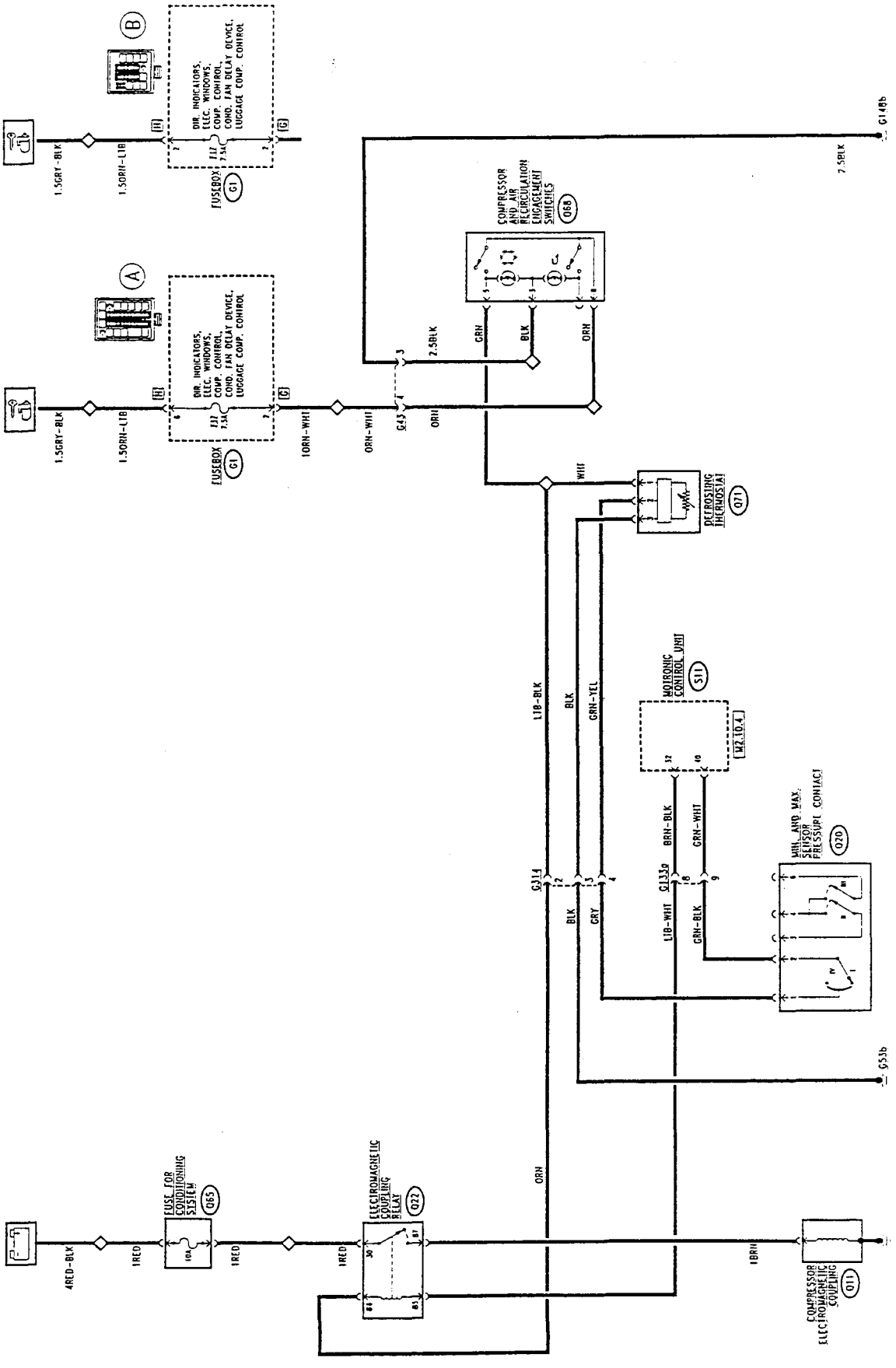


Air recirculation relay B — Q73b

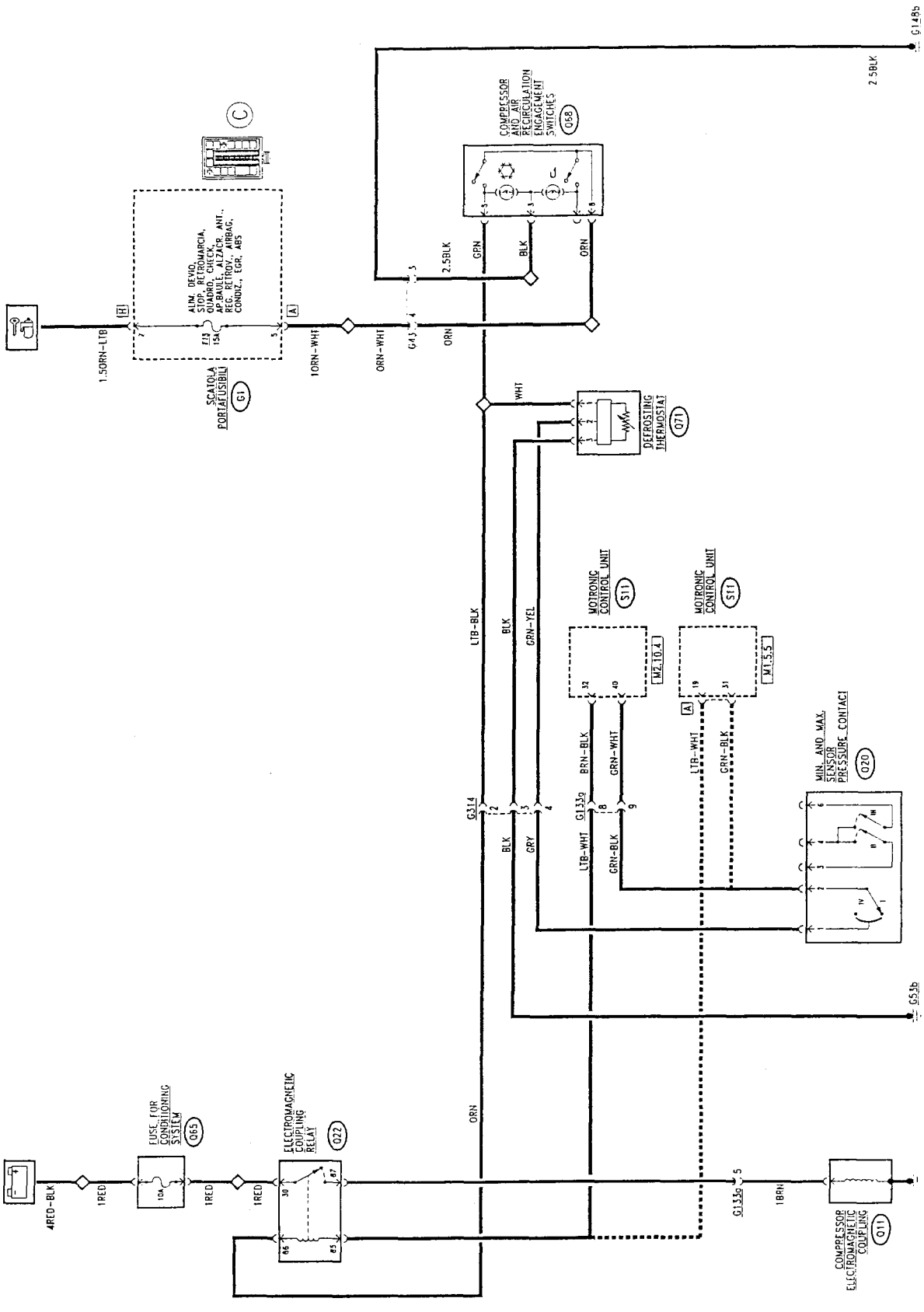


COMPRESSOR ENGAGEMENT (Petrol Version)

Wiring Diagram



Wiring Diagram



Functional Description

The electromagnetic joint that operates the compressor **Q11** is controlled by relay **Q22** located next to the relays and fuses for injection/ignition.

The coil of relay **Q22** receives the key-operated supply (line protected by fuse **F17** of **G1** (box "A" and "B") or by fuse **F15** box "C"; conversely the power line is supplied by battery current through wander fuse **Q65**.

The relay **Q22** is energised, thus it supplies 12V current to the electromagnetic joint **Q11**, according to the following logic, managed by the injection - ignition control unit, which is connected with the air conditioning system through:

- pin 40 (M2.10.4) or pin A31 (M1.5.5) which receives the request signal for engaging the system from the air conditioning system circuit;
- pin 32 (M2.10.4) or pin A19 (M1.5.5) from which a Elow[a] signal (earth) leads that controls relay **Q22** for engaging the conditioner compressor **Q11**.

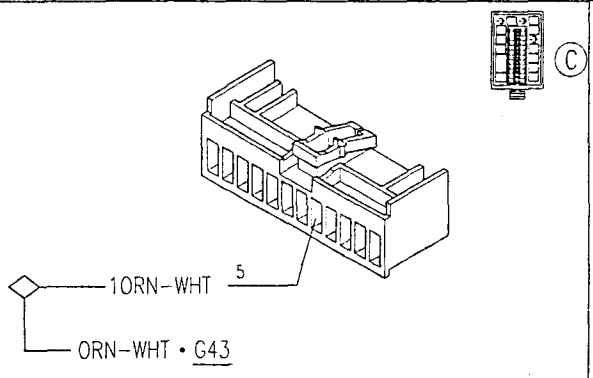
A special logic enables this engagement. In particular:

- it adapts idle speed to compensate the increased power absorption caused by engaging the compressor;
- if the engine needs power (high throttle opening speed), full load, or high engine temperature, it momentaneously stops engaging the compressor.

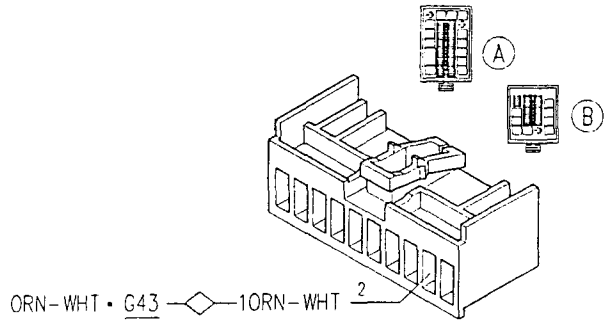
The positive signal leading from the compressor engagement switch **Q68** crosses the antifrost thermostat **Q71** which cuts in if the temperature is too low and the pressure switch **Q20** which cuts in if the cooling system pressure is too high or too low: in this case the signal does not reach the control unit and it does not command engagement of the compressor.

Components and Connectors

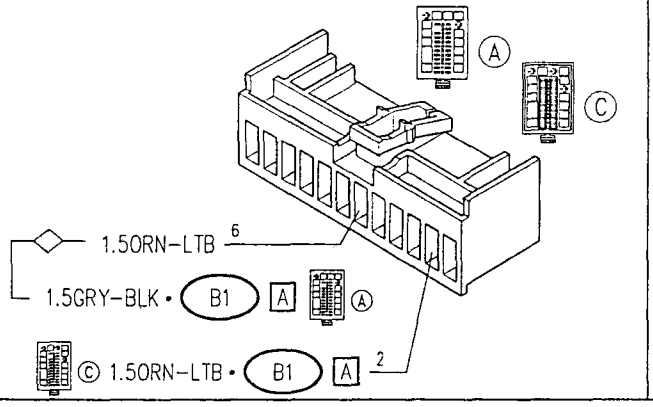
Fusebox	G1 A



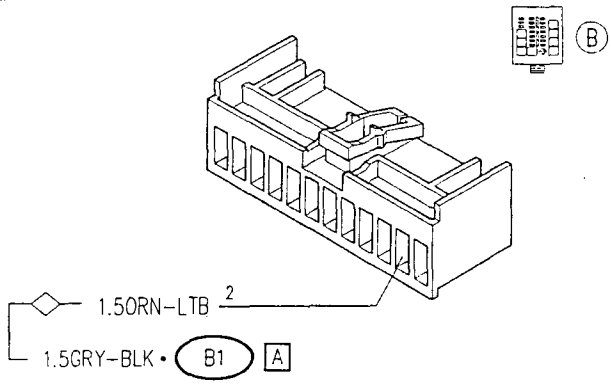
Fusebox	G1 G



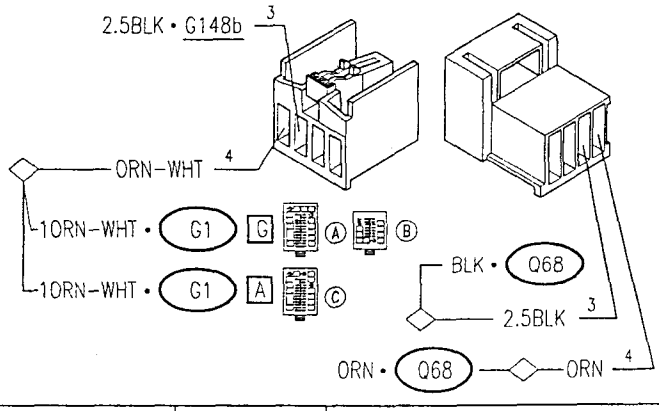
Fusebox	G1 H



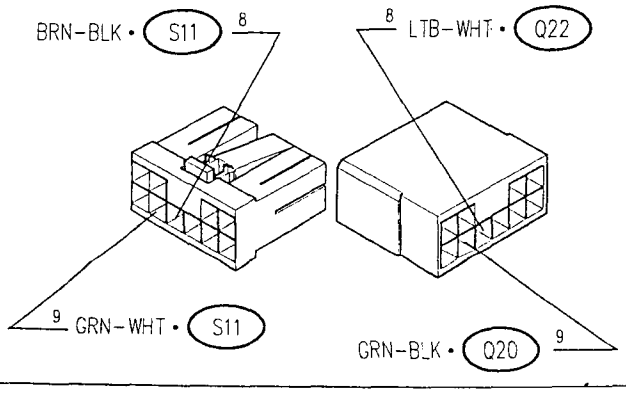
Fusebox	G1 H



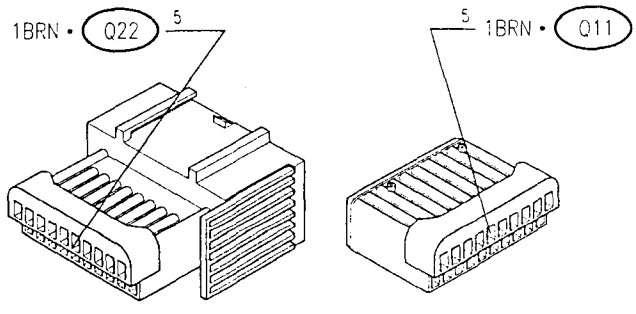
Climate control system controls wiring connector	G43



Electronic injection wiring connector A (*)	G133a



Electronic injection wiring connector A (•)	G133a

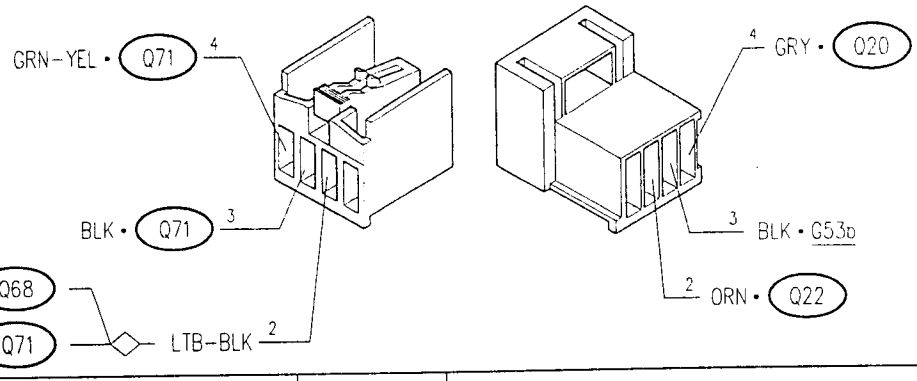


(*) only M2.10.4

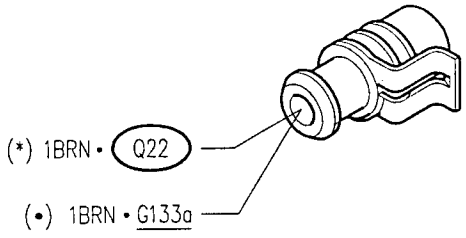
(•) M1.5.5.

Components and Connectors (continued)

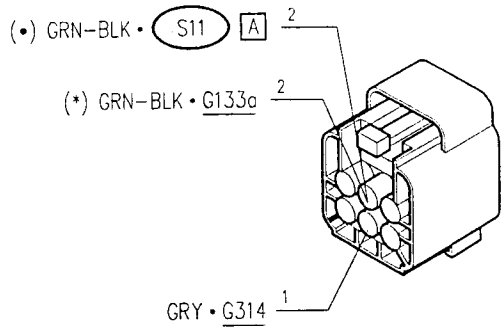
Engine wiring/conditioner wiring connector	G314



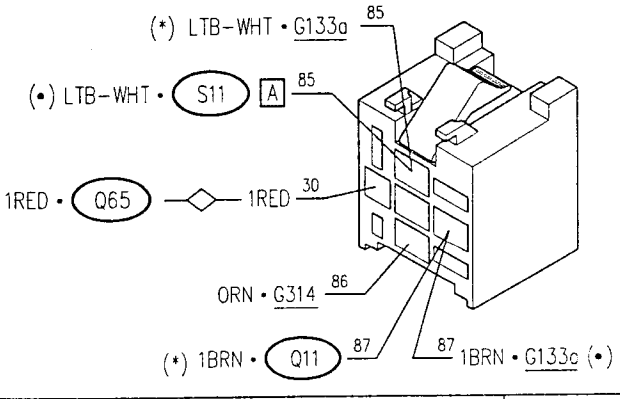
Compressor electromagnetic joint	Q11



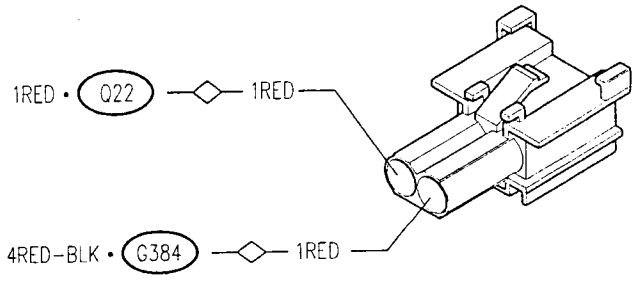
Min. and max. sensor pressure contact	Q20



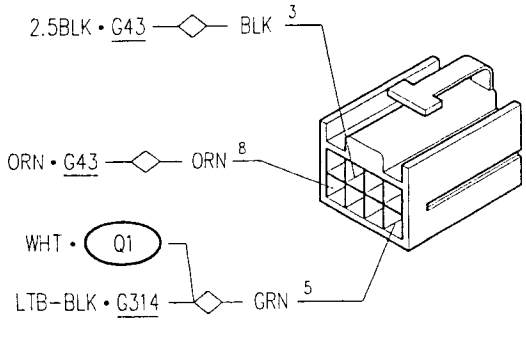
Electromagnetic joint control relay	Q22



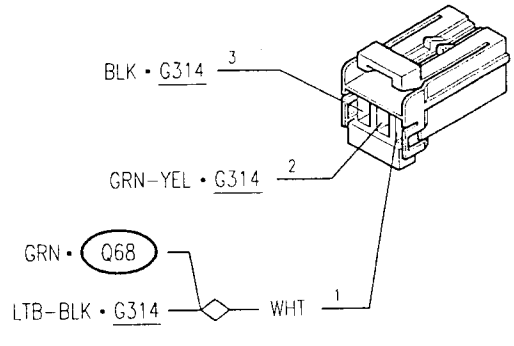
Conditioner system wander fuse	Q65



Switches for engaging compressor and air recirculation	Q68



Antifrost thermostat	Q71

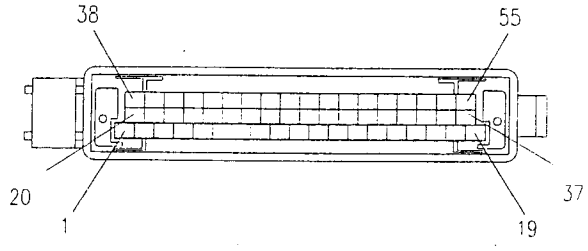


(*) only M2.10.4 (•) M1.5.5

Components and Connectors (continued)

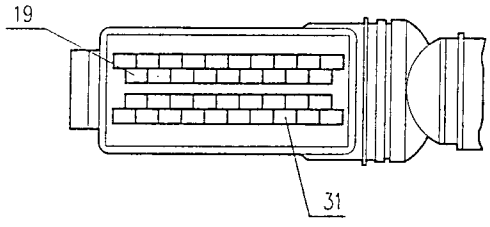
Motronic control unit (M2.10.4)	S11

32 BRN-BLK • G133a
40 GRN-WHT • G133a



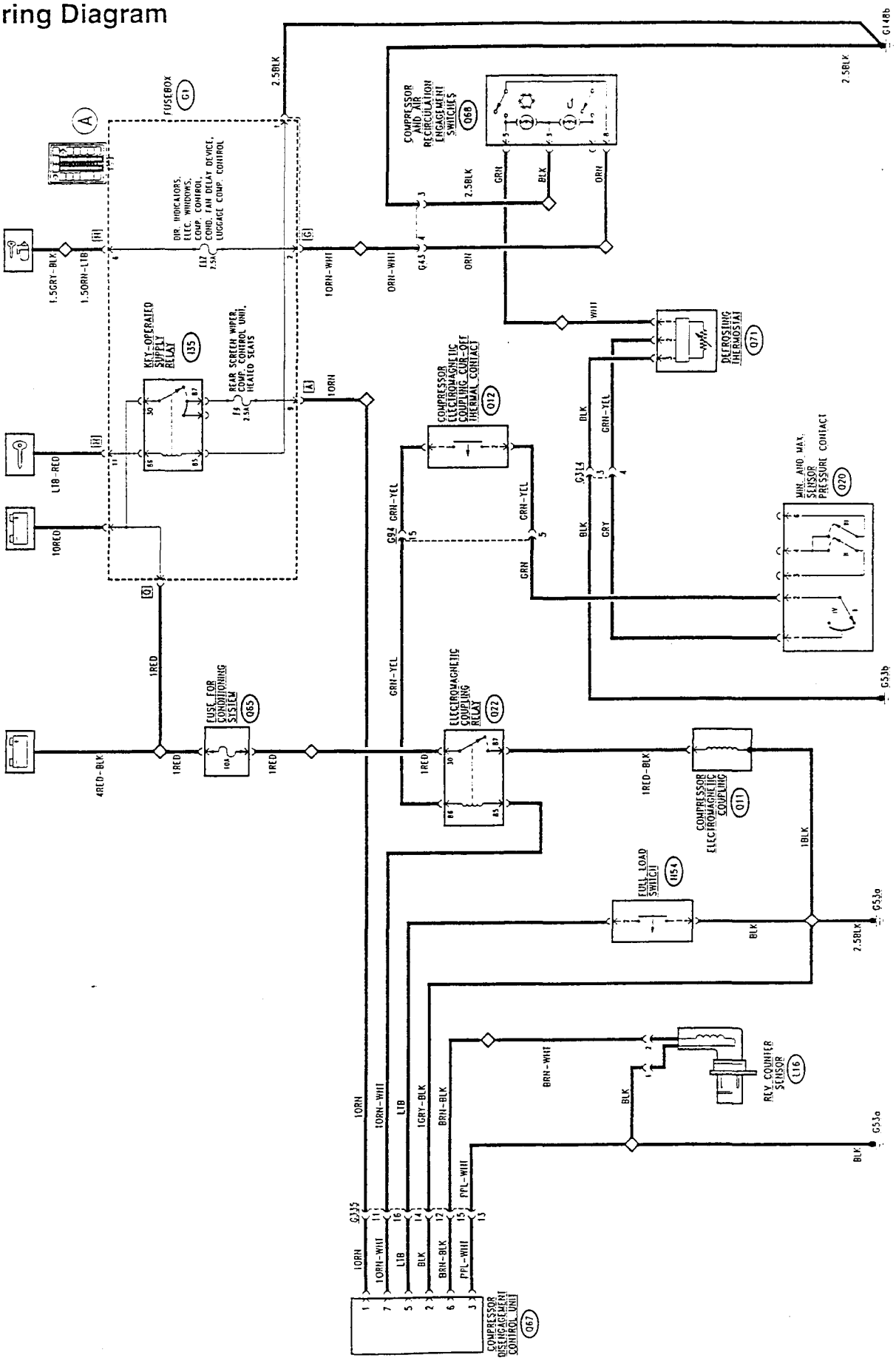
Motronic control unit (M1.5.5)	S11 A

19 LTB-WHT • Q22
31 GRN-BLK • Q20

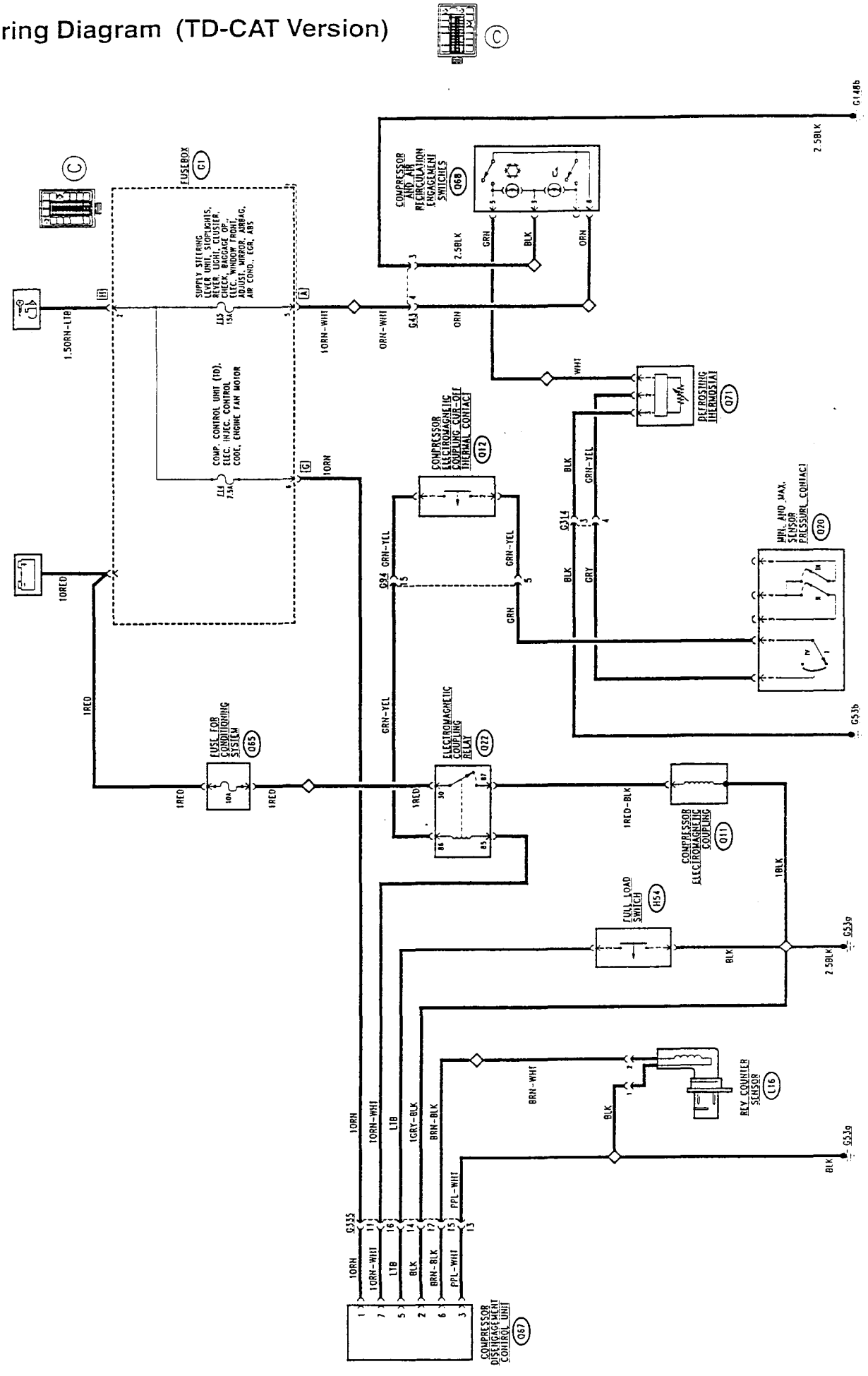


COMPRESSOR ENGAGEMENT (TD Version)

Wiring Diagram



Wiring Diagram (TD-CAT Version)



Functional Description

The electromagnetic joint which operates the compressor **Q11** is operated by the corresponding relay **Q22**.

Relay **Q22** is supplied directly by the battery, via fuse **Q65**.
The two energising signals (12 V and earth) reach relay **Q22** from the compressor disengagement control unit **Q67**, and from the control switch **Q68**:

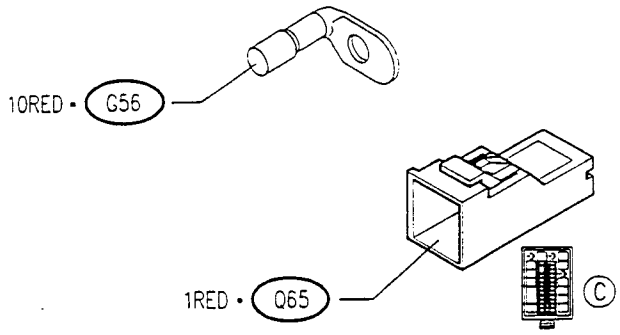
- the positive signal leading from the switch in **Q68**, before reaching relay **Q22** crosses the compressor cut out thermal contact **Q12** (which turns off the compressor if the engine is very hot), the pressure switch **Q20** and the thermostat **Q71** which cut off the signal respectively for high or low pressures and low temperatures;
- the signal leading from the control unit **Q67** is either 12 V or 0 V (earth), according to the following logic, depending on engine rpm (information picked up directly by the rev counter sensor **L16**:
  - up to 2000 rpm: when the full load switch **H54** closes, an earth signal leaves the control unit -pin 7-, therefore the electromagnetic joint of the compressor is not energised; vice versa as soon as the switch opens again, the signal from pin 7 becomes 12 V, energising the joint;
  - over 2000rpm: the earth signal is timed and lasts only 8 seconds, then it becomes 12 V, therefore the joint is energised, thereby engaging the compressor, if this is still requested through the special button **Q68**.

The control unit **Q67** is connected, as mentioned previously, with the rev counter sensor **L16** at pin 3 and 6, to switch **H54** at pin 5; pin 2 is at earth, while pin 1 receives the "key-operated" supply via relay **I35** and fuse **F4** of box **G1** (box "A") or only by fuse **F14** still in **G1** (box "C"): the compressor engagement signal leads from pin 7 as described above.

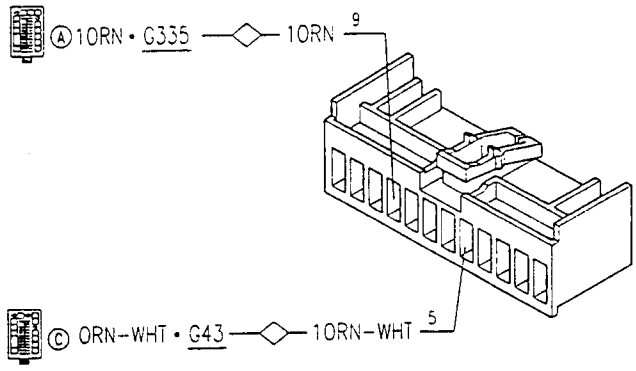
When it is energised, relay **Q22** operates the electromagnetic joint **Q11** which engages the compressor.

Components and Connectors

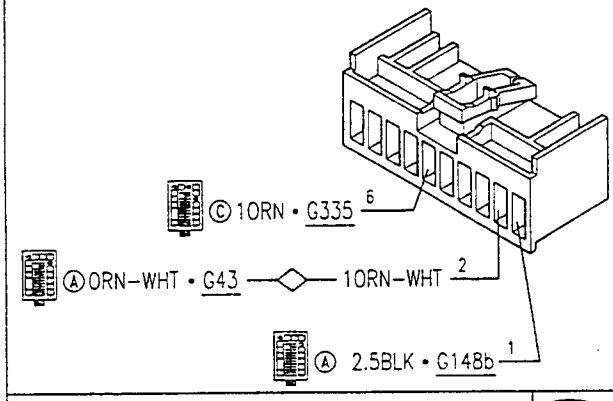
Fusebox	G1



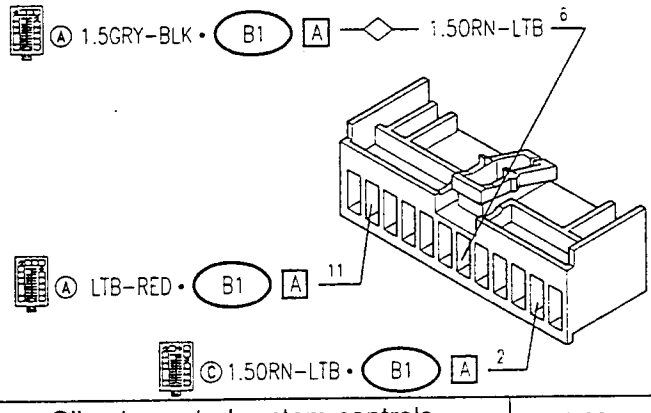
Fusebox	G1 A



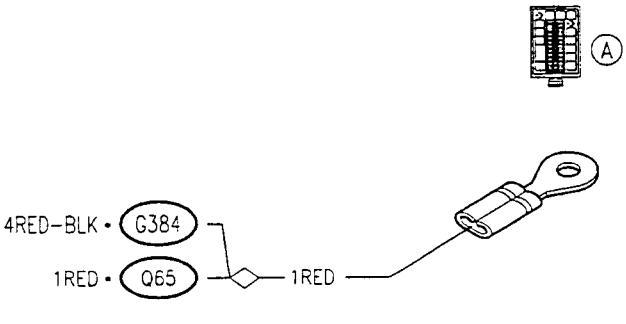
Fusebox	G1 G



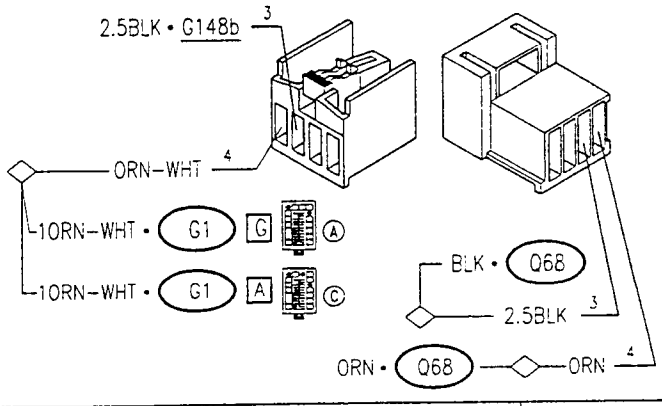
Fusebox	G1 H



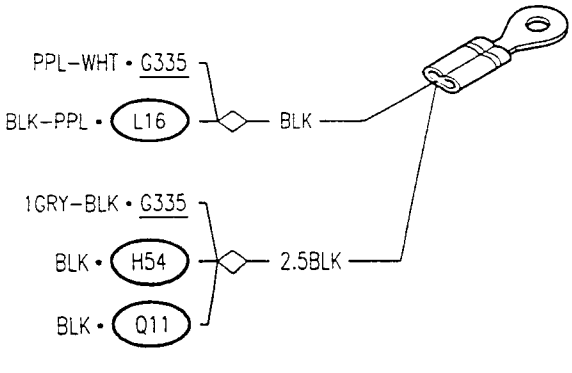
Fusebox	G1 Q



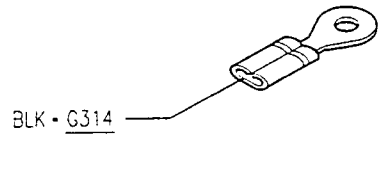
Climate control system controls wiring connector	G43



RH engine compartment earth	G53a

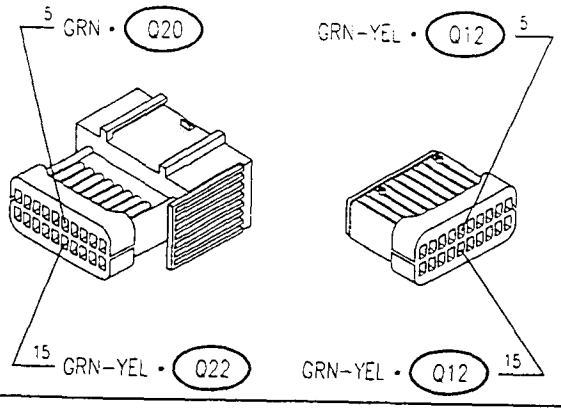


LH engine compartment earth	G53b

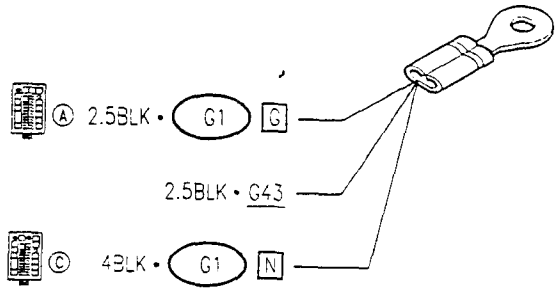


Components and Connectors (continued)

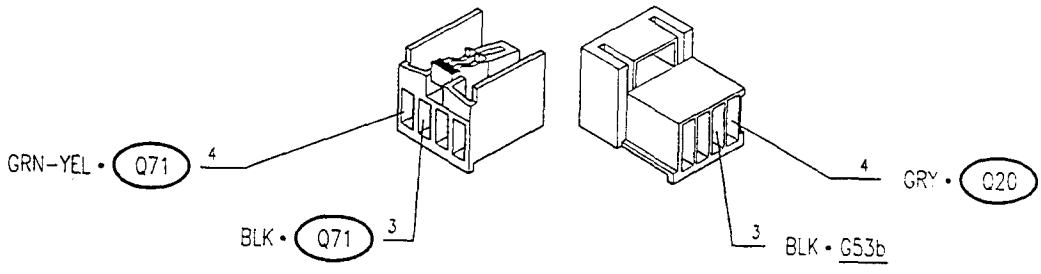
Engine compartment connector	G94



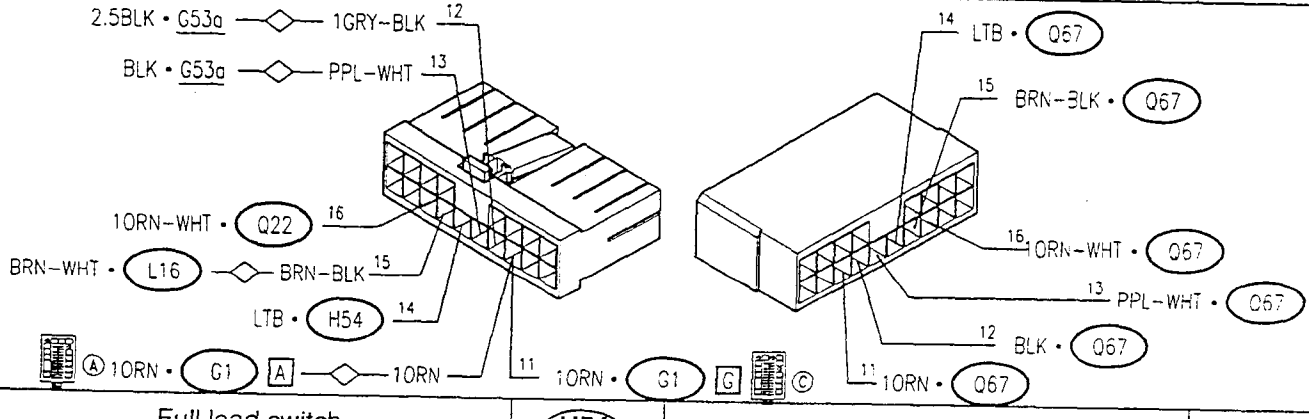
Earth under LH dashboard	G148b



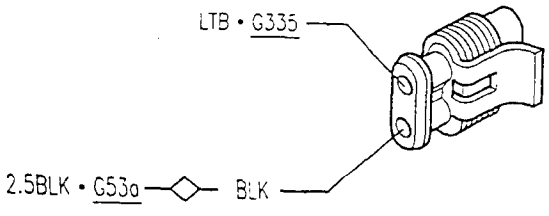
Eng. wiring/conditioner wiring connector	G314



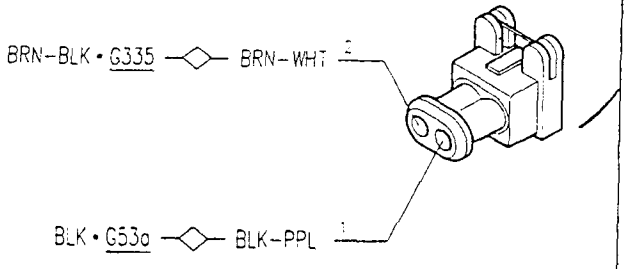
Connector for E.G.R.	G335



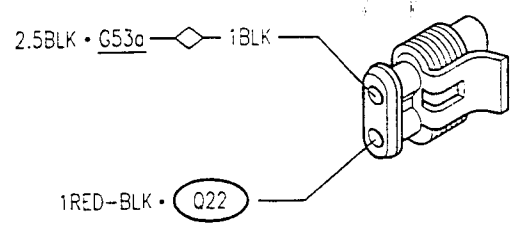
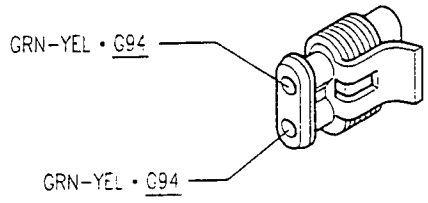
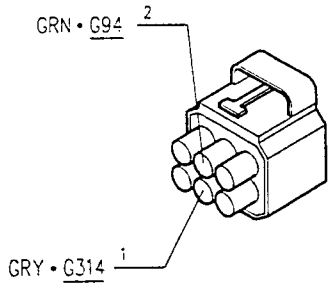
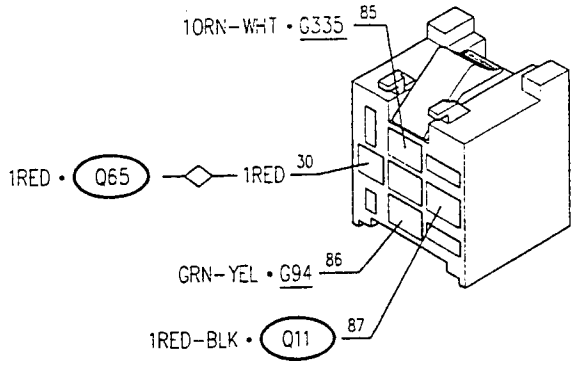
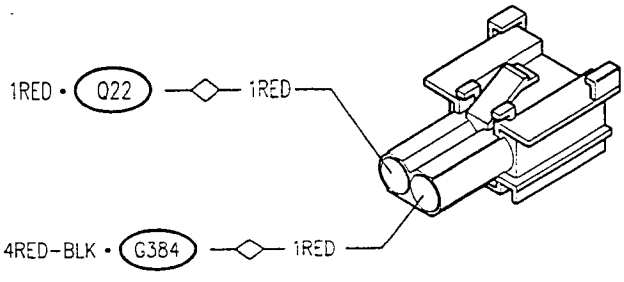
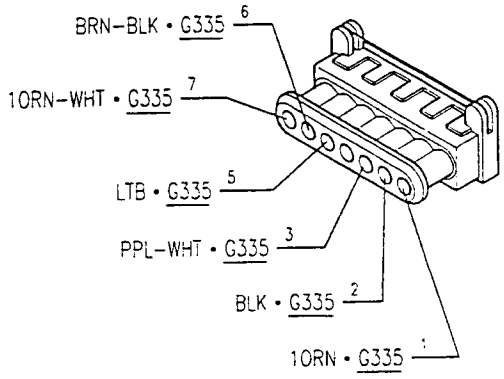
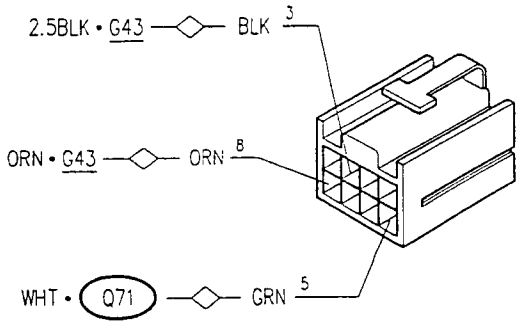
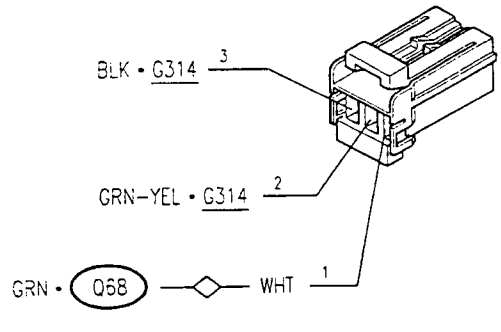
Full load switch	H54



Rev counter sensor	L16

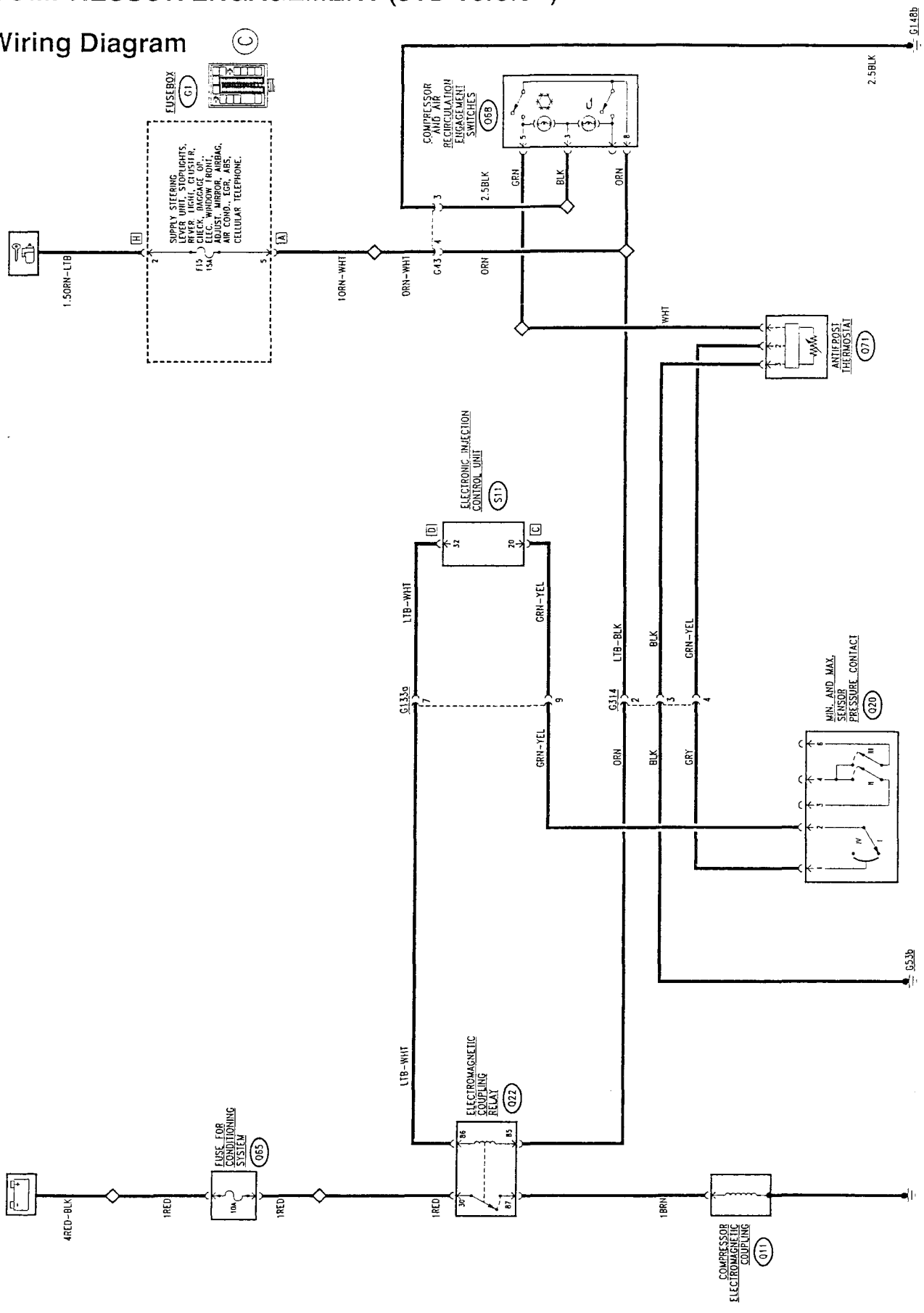


Components and Connectors (continued)

Compressor electromagnetic joint (Q11)	Thermal contact for cutting out electromagnetic joint compressor (Q12)
	
Min. & max. pressure sensor contact (Q20)	**Electromagnetic joint control relay (Q22)**
	
Conditioning system wander fuse (Q65)	**Compressor cut out control unit (Q67)**
	
Compressor and air recirculation ON switches (Q68)	**Antifrost thermostat (Q71)**
	

COMPRESSOR ENGAGEMENT (JTD Version)

Wiring Diagram



Functional Description

The electromagnetic joint which operates the compressor **Q11** is controlled by relay **Q22** located next to terminal strip **G56** which contains the MAXI FUSES.

The coil of relay **Q22** receives the key-operated supply (line protected by fuse **F15** of fusebox **G1**; while the power line is supplied by battery voltage through wander fuse **Q65**.

Relay **Q22** is energised and consequently supplies 12 V to the electromagnetic joint **Q11**, according to the following logic, controlled by the injection **S11** electronic control unit which is connected with the air conditioning system through:

- pin 20 of connector C, which receives the signal requesting engagement of the system from the air conditioning system circuit;
- pin 32 of connector D, from which a "low" (earth) signal leads that controls relay **Q22** for engaging the air conditioner compressor **Q11**.

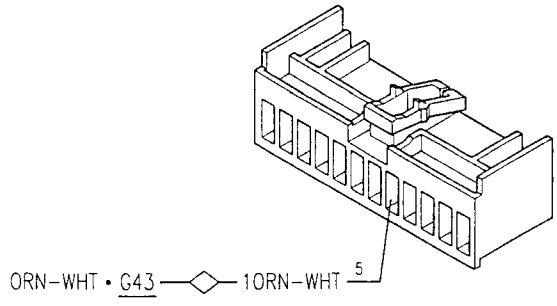
A special logic enables this engagement. In particular:

- it adapts idle speed to compensate the increased power absorption caused by engaging the compressor;
- if the engine needs power (high throttle opening speed), full load, or high engine temperature, it momentaneously stops engaging the compressor.

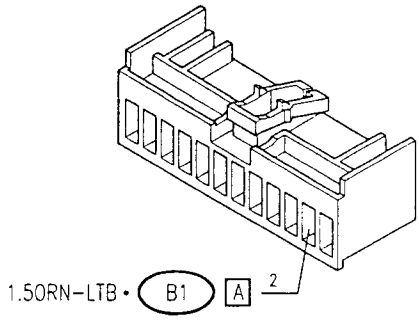
The positive signal leading from the compressor engagement switch **Q68** crosses the antifrost thermostat **Q71** which cuts in if the temperature is too low and the pressure switch **Q20** which cuts in if the cooling system pressure is too high or too low: in this case the signal does not reach the control unit and it does not command engagement of the compressor.

Components and Connectors

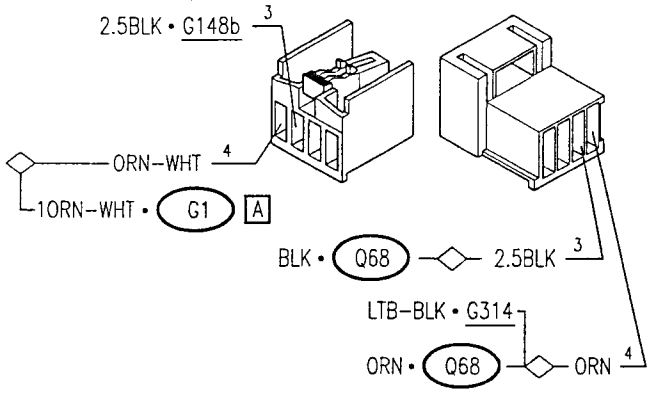
Fusebox	G1 A



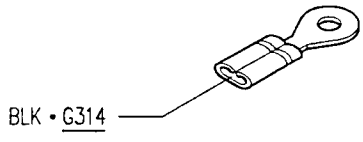
Fusebox	G1 H



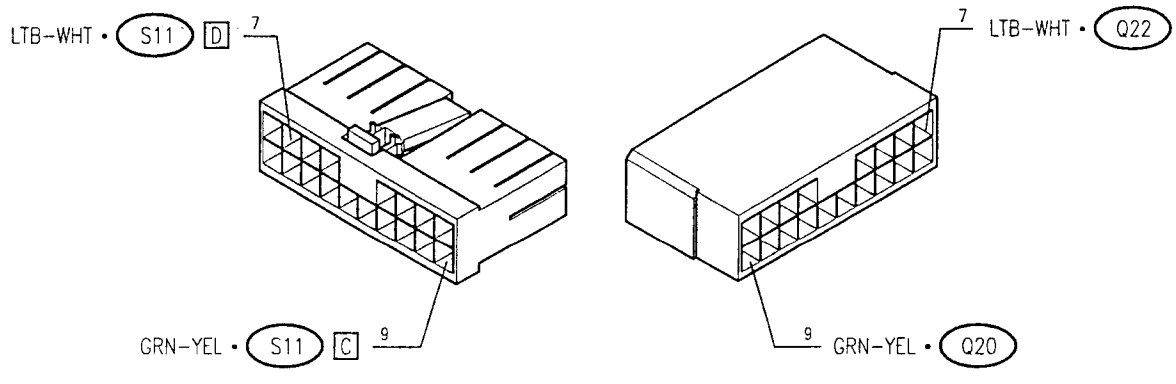
Climate control system controls wiring connector	G43



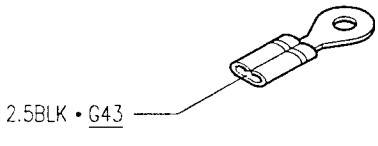
LH engine compartment earth	G53b



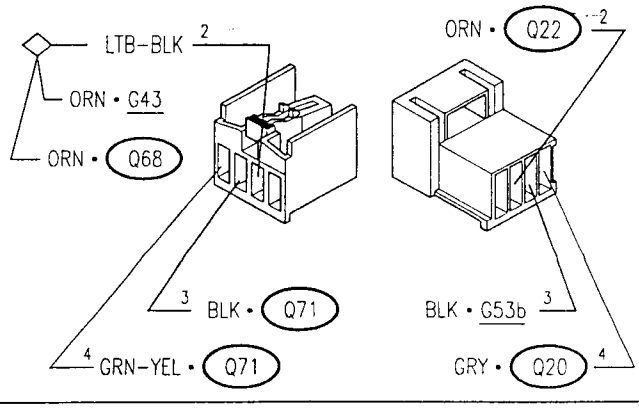
Connector for electronic injection wiring C	G133a



Earth under dashboard LH	G148b

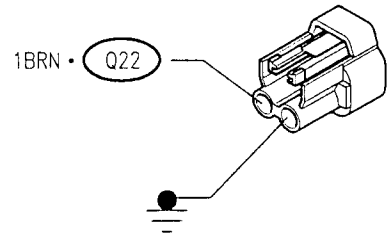


Connector for engine wiring/conditioner wiring	G314

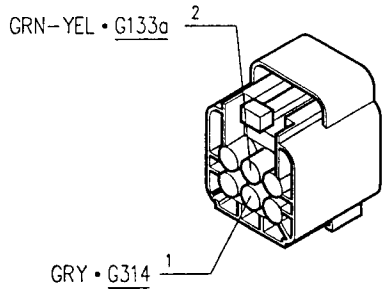


Components and Connectors (continued)

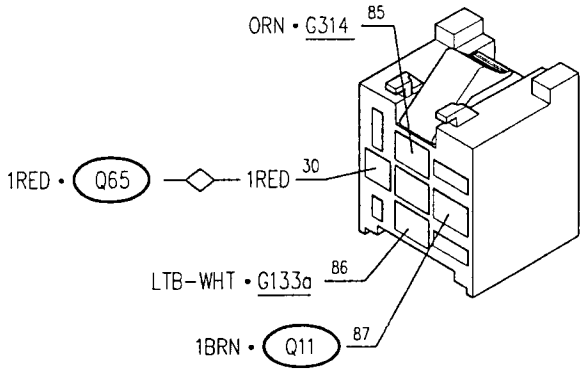
Compressor electromagnetic coupling	Q11



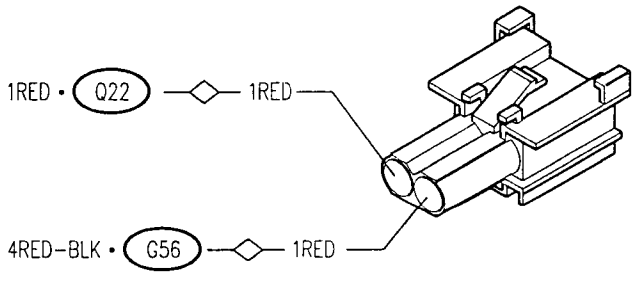
Min. and max. sensor pressure contact	Q20



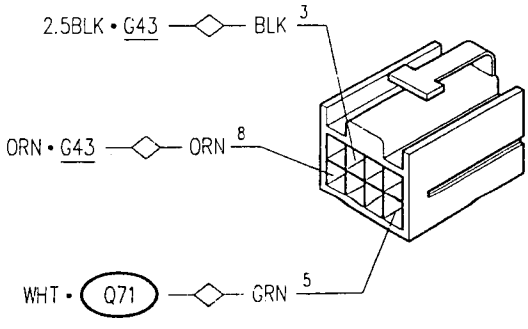
Electromagnetic coupling relay	Q22



Fuse for conditioning system	Q65

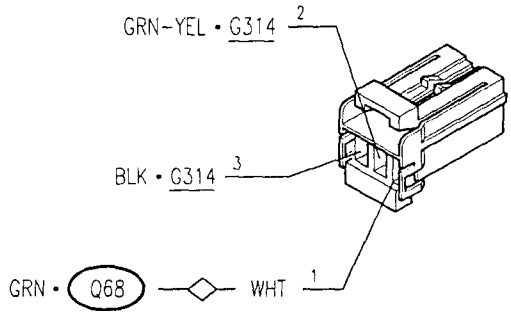


Compressor and air recirculation engagement switches	Q68



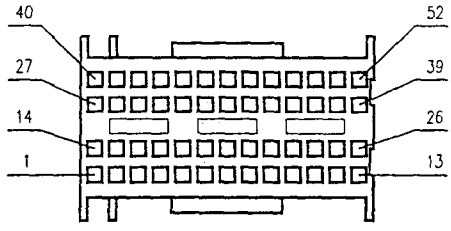
Components and Connectors (continued)

Antifrost thermostat — Q71



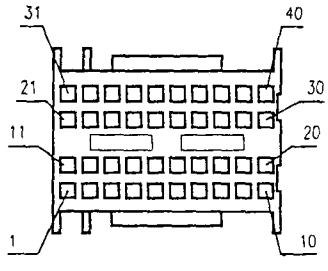
Electronic injection control unit — S11 C

20 GRN-YEL • G133a



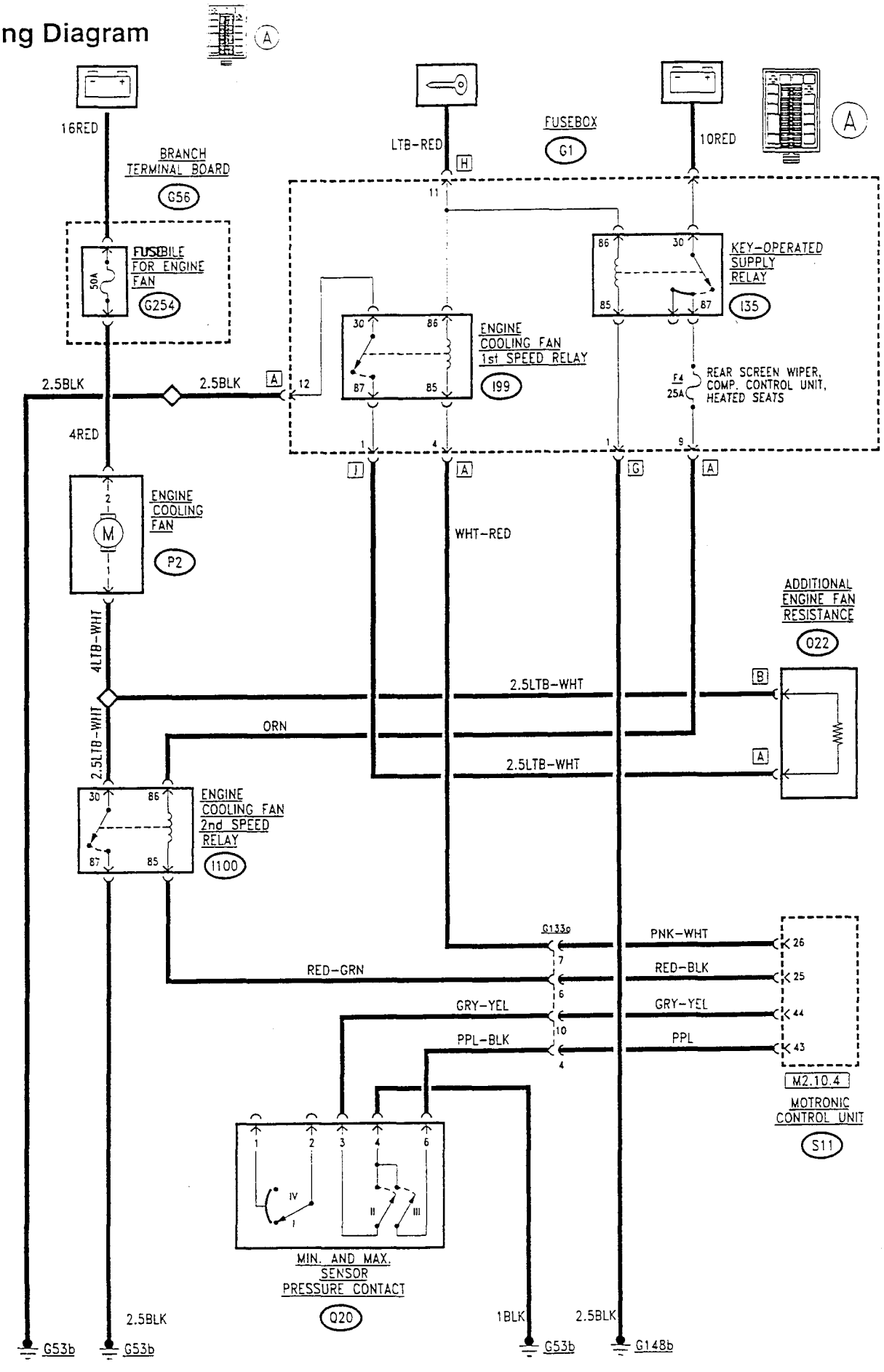
Electronic injection control unit — S11 D

32 LTB-WHT • G133a

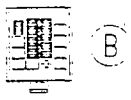


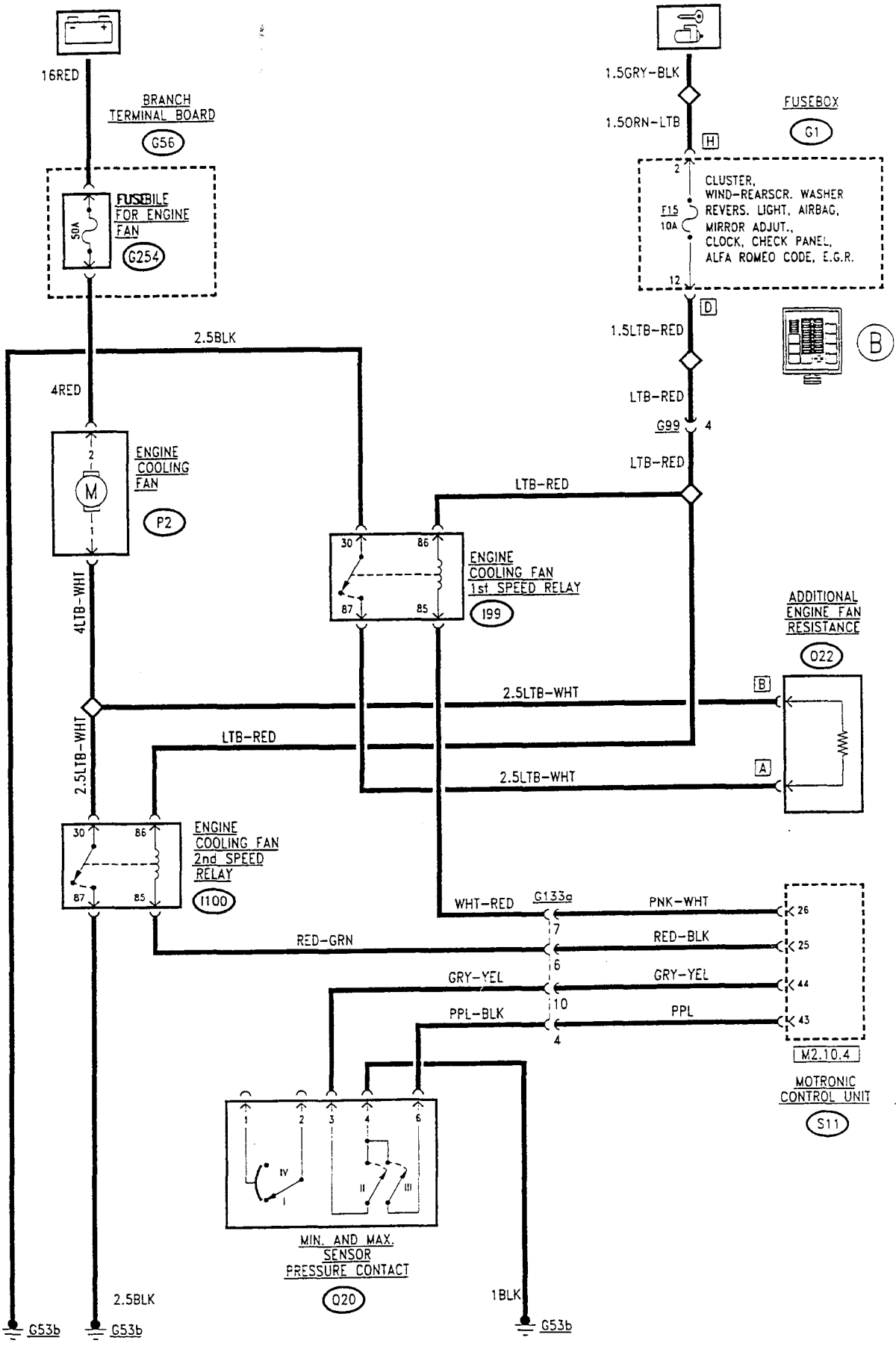
ENGINE FAN CONTROL (Petrol version)

Wiring Diagram

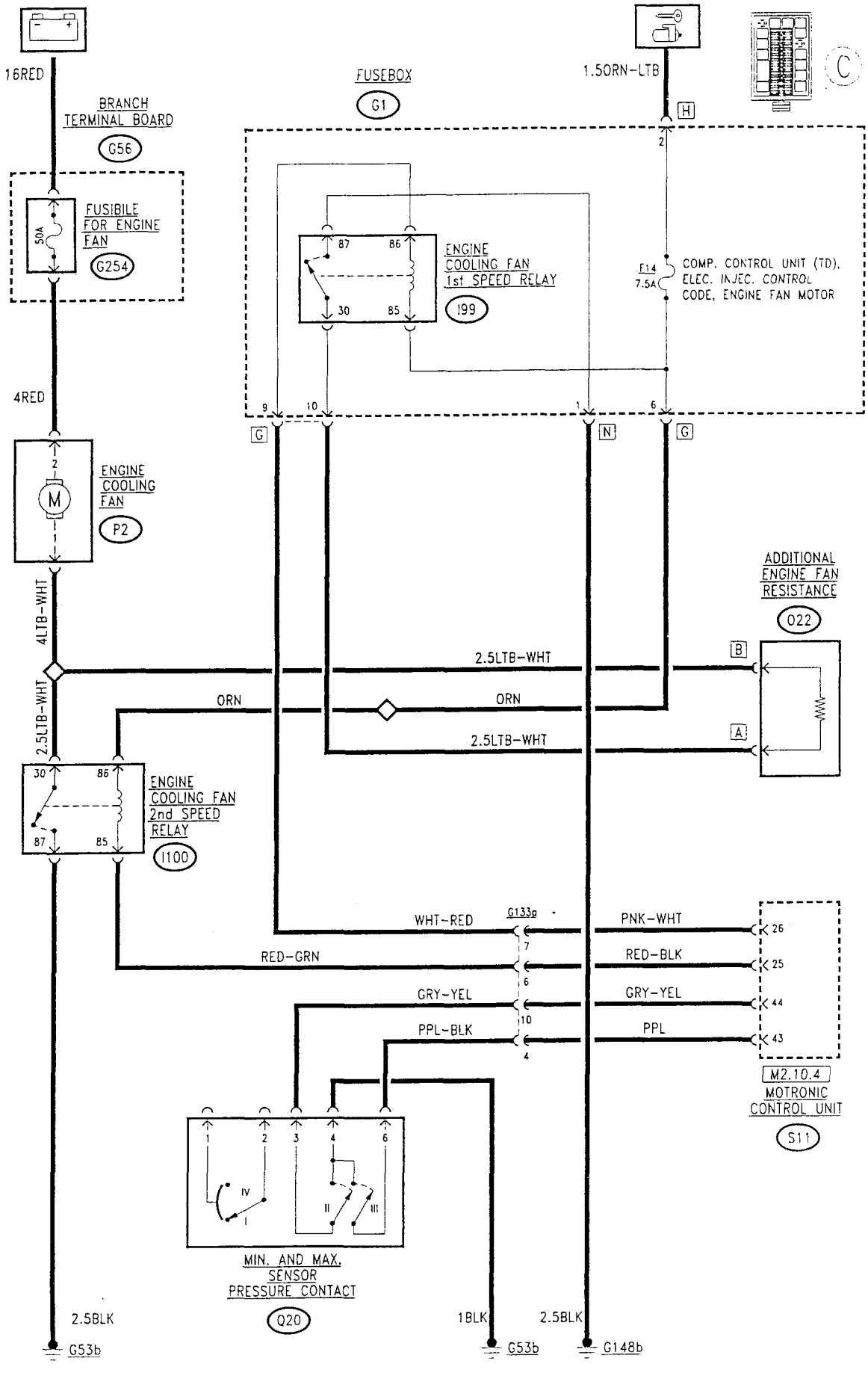


Wiring Diagram

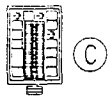


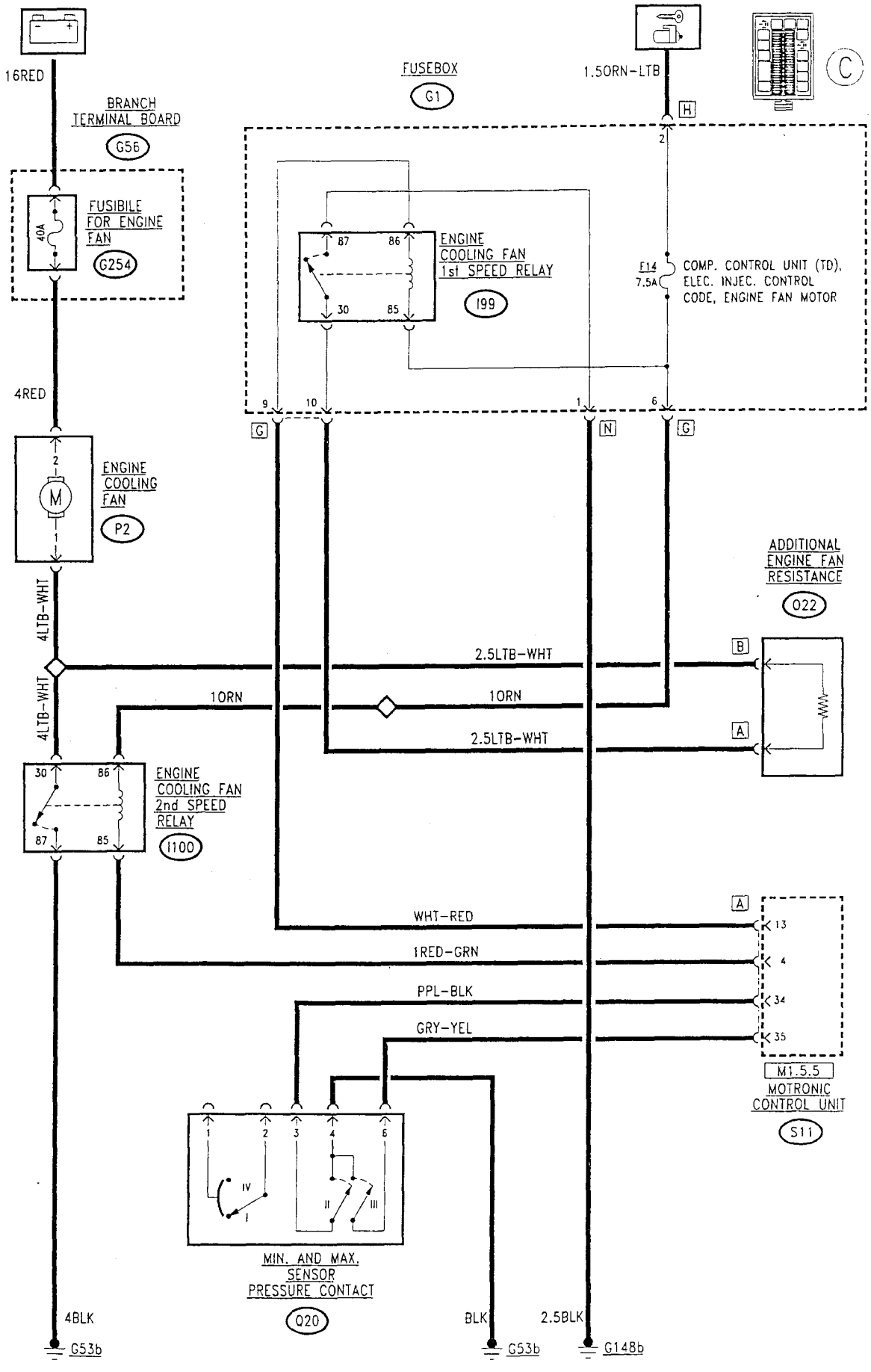


Wiring Diagram (Model Year '97)



Wiring Diagram (Model Year '98)





Functional Description

The fan **P2** provides the necessary ventilation for cooling the engine radiator and air conditioning system condenser.

This fan is always supplied by battery voltage through the line protected by the specific wander fuse **G254**, located in the branch terminal strip: it is operated by an earth signal: this signal arrives directly (2nd speed) or via the additional resistance **O22** (1st speed).

The M2.10.4 injection - ignition control unit controls the fan for cooling the engine coolant fluid and the conditioning system coolant fluid.

This has made it possible to eliminate the thermal contact usually to be found on the radiator. the two fan speeds are operated depending on the engine temperature, detected by the control unit through the special sensor: a "low" (earth) signal leaves pin 26 which controls the 1st speed relay **I99**, and a "low" (earth) signal leaves pin 25 which controls the second speed relay **I100**.

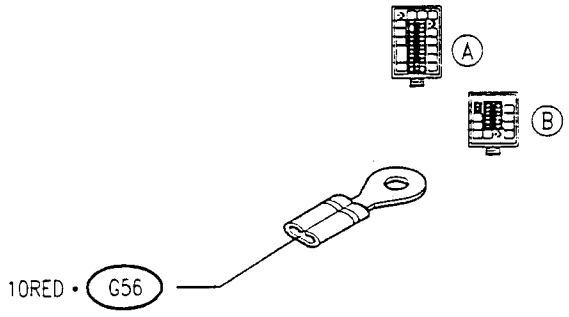
The pressure switch **Q20** also sends special signals to the control unit for engaging the fans if the pressure of the coolant fluid in the circuit exceeds certain ratings:

- over 15 bar appr. the signal is sent to pin 44 for engaging 1st speed;
- over 20 bar appr. to pin 43 for the 2nd speed.

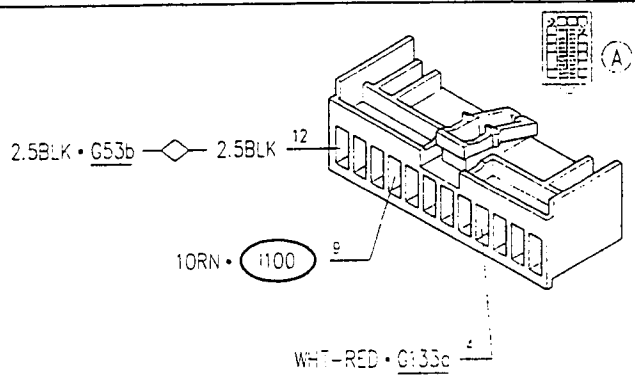
The "key-operated" voltage (line of relay **I35** protected by fuse **F4** of **G1** for box "A" or fuse **F17** for "B" or fuse **F14** for "C") supplies the coil of relays I99 and **I100**; which are operated by the above-mentioned earth signals.

Components and Connectors

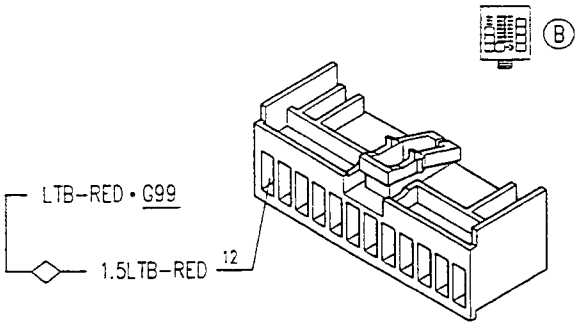
Fusebox G1



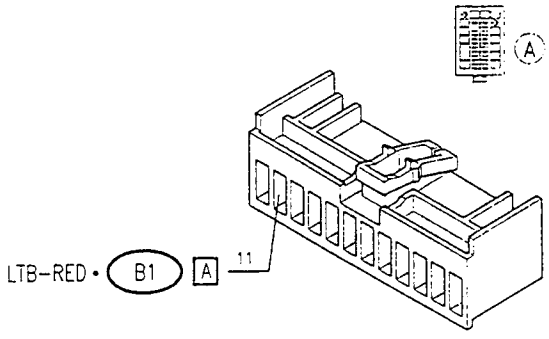
Fusebox G1 A



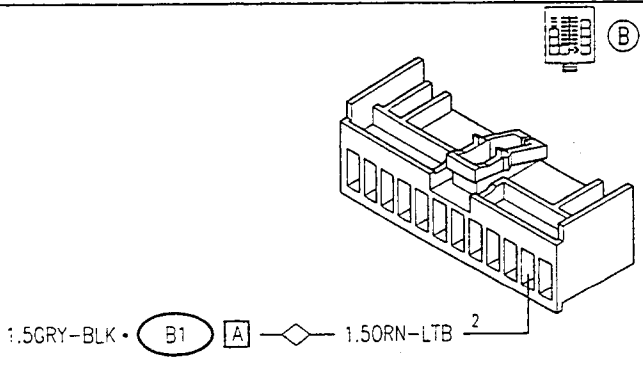
Fusebox G1 D



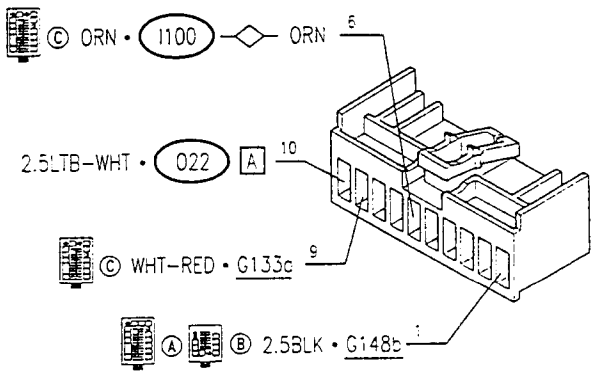
Fusebox G1 H



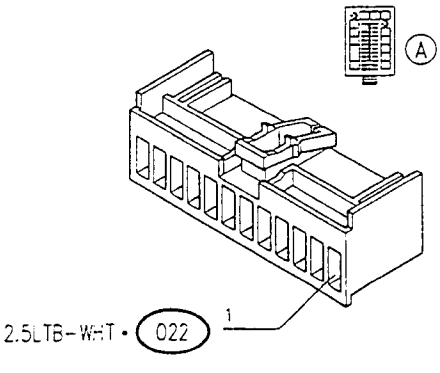
Fusebox G1 H



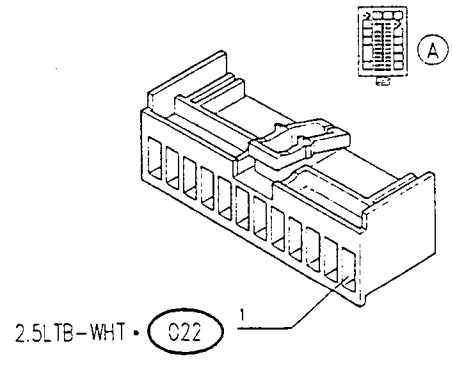
Fusebox G1 G



Fusebox G1 I

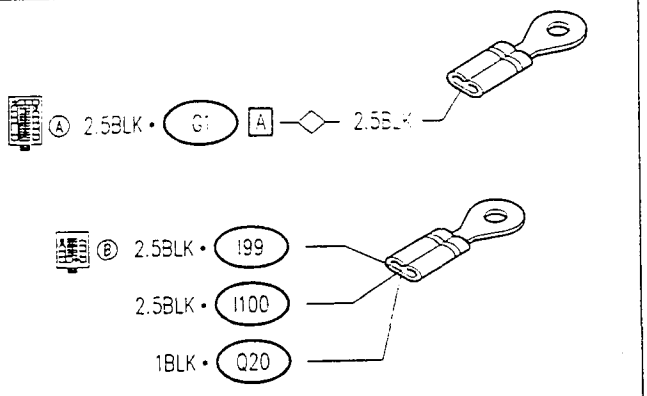


Fusebox G1 N

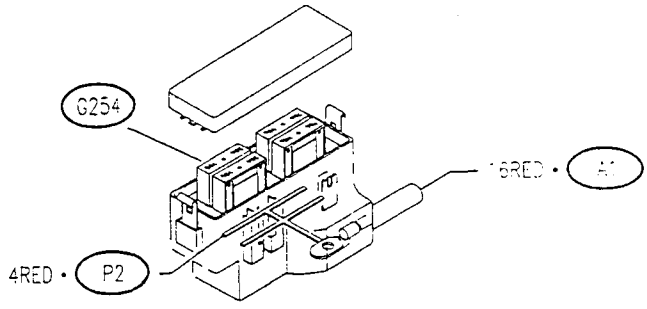


Components and Connectors (continued)

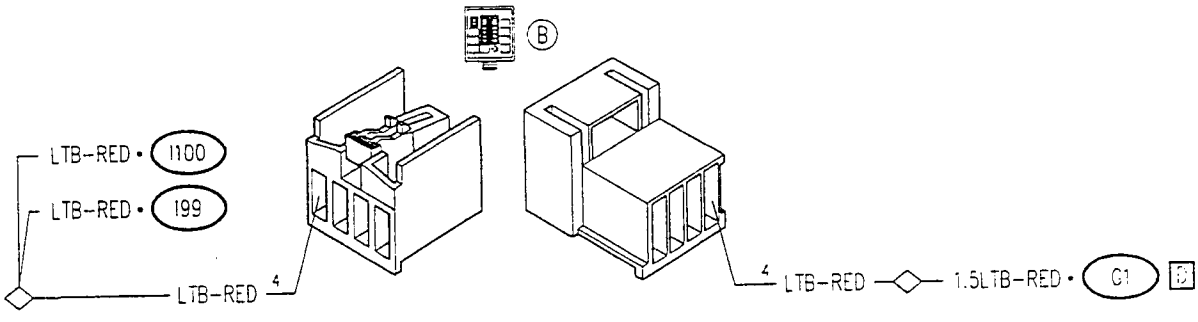
LH engine compartment earth	G53b



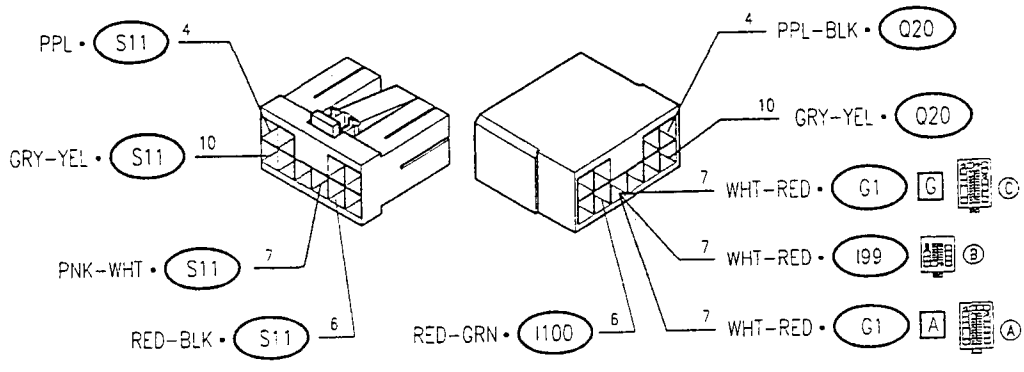
Branch terminal strip	G56



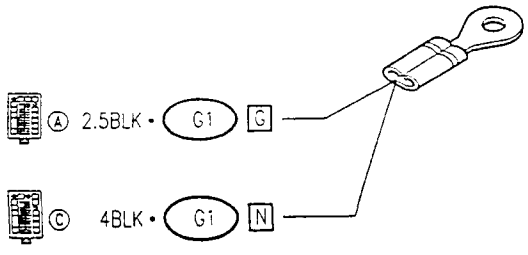
Dashboard wiring/engine wiring connector	G99



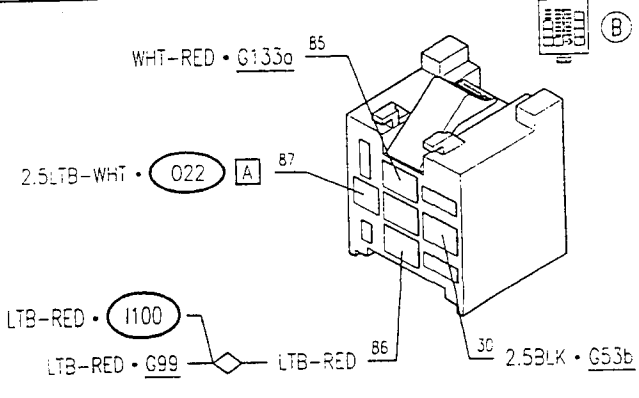
Electronic injection wiring connector A	G133a



Earth under LH dashboard	G148b

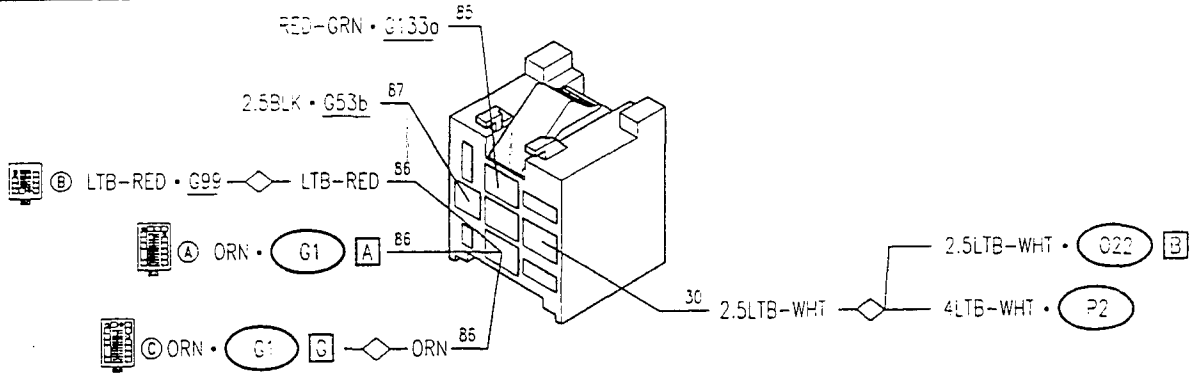


Engine cooling fan 1st speed relay	I99

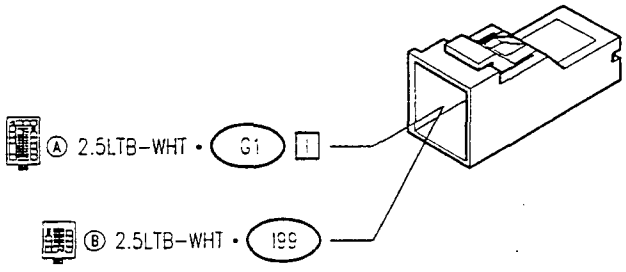


Components and Connectors (continued)

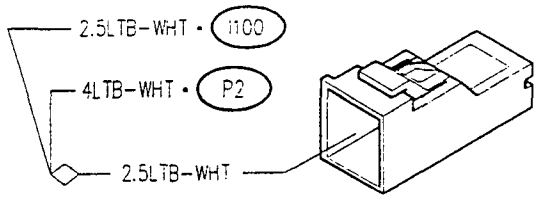
Engine cooling fan 2nd speed relay — I100



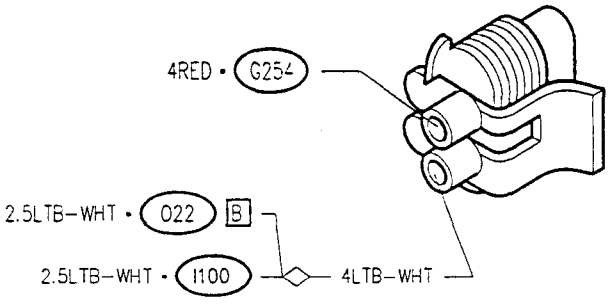
Engine fan additional resistance — O22 A



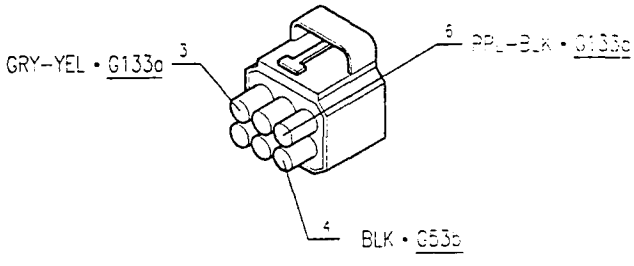
Engine fan additional resistance — O22 B



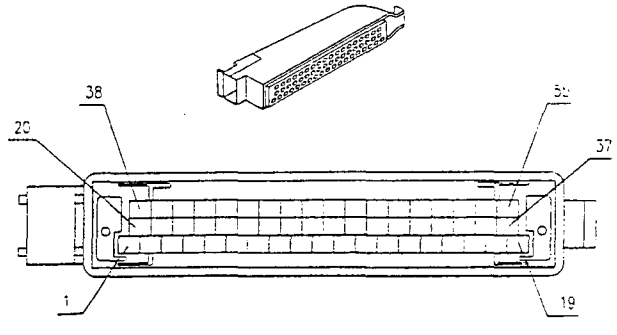
Engine water cooling fan — P2



Min. and max. sensor pressure contact — Q20



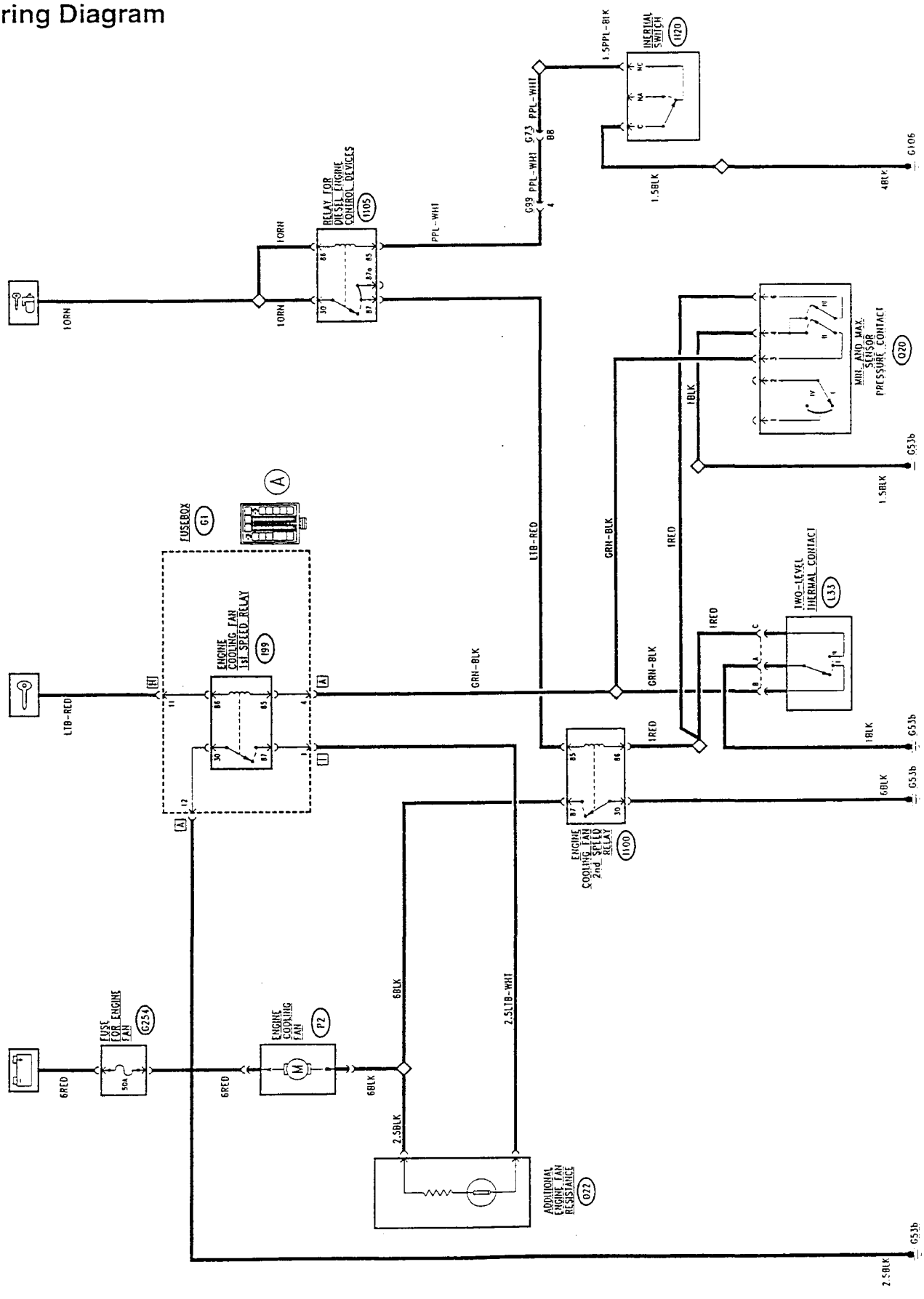
Motronic control unit — S11



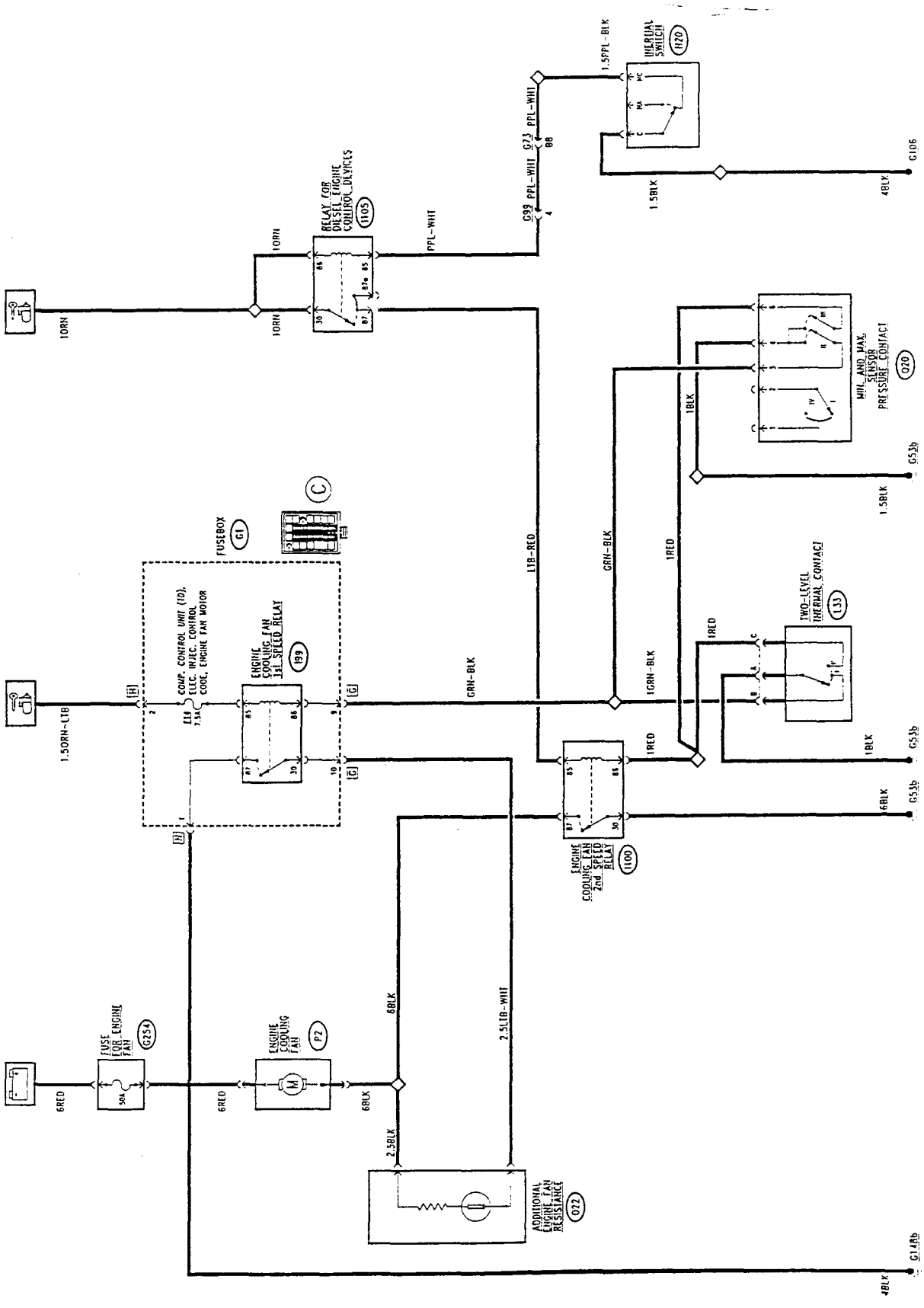
25 RED-BLK • G133a
26 PNK-WHT • G133a
43 PPL • G133a
44 GRY-YEL • G133a

ENGINE FAN CONTROL (TD version)

Wiring Diagram



Wiring Diagram (TD-CAT version) Ⓒ



Functional Description

The fan **P2** provides the necessary ventilation of the air for cooling the engine radiator and the conditioning system condenser.

This fan is always supplied by battery voltage through the line protected by the specific wander fuse **G254**, located next to the branch terminal strip: it is therefore operated by an earth control signal: this signal arrives directly (2nd speed) or via the additional resistance **O22** (1st speed), fitted with a safety thermal contact.

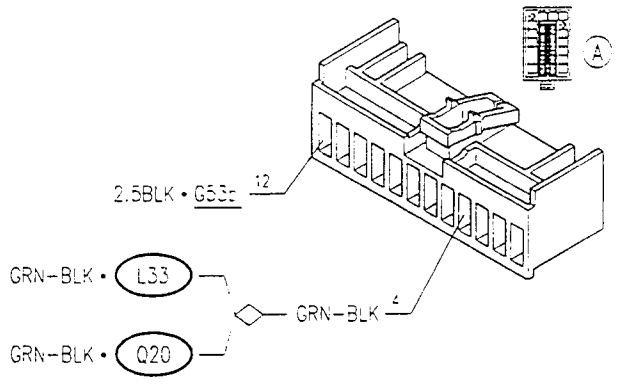
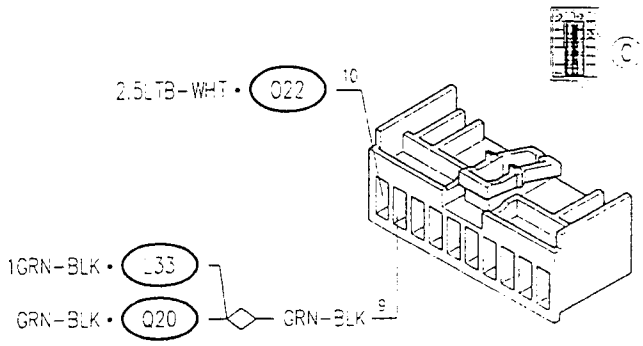
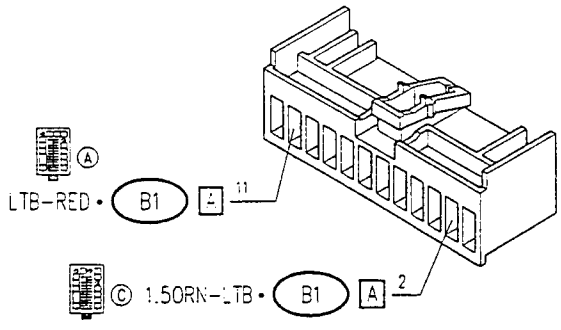
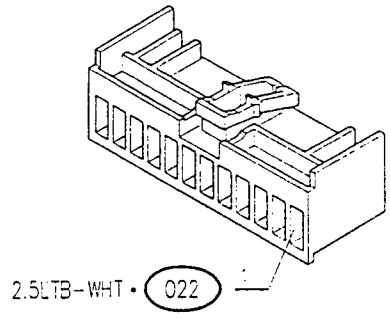
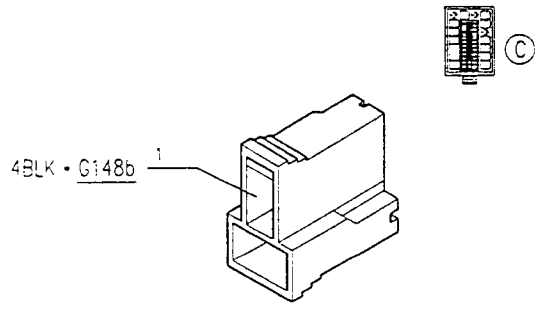
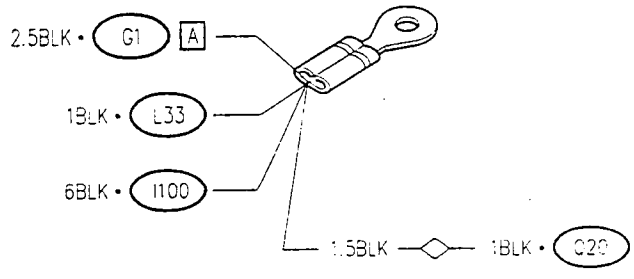
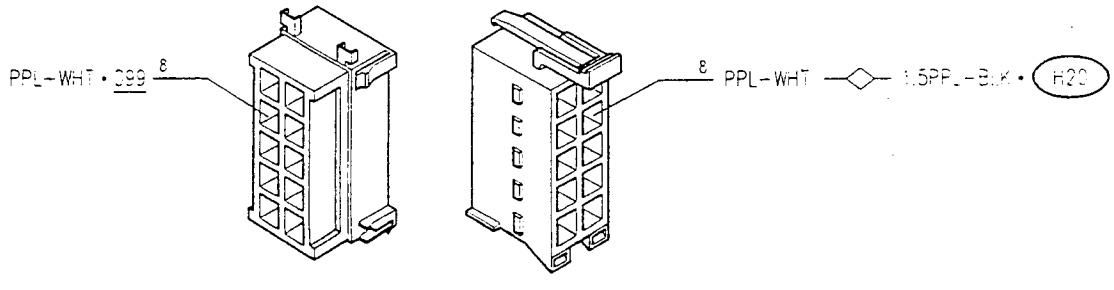
Two relays **I99** and **I100**, which receive the key-operated supply, the former (line of fuse **F14** for fusebox "C") and the latter from relay **I105** (supply controlled by the inertial switch **H20**), are energised by thermal contact **L33** or by pressure switch **Q20**.

The fan is operated at the two different speeds by the two- level thermal switch **L33** which controls the temperature of the coolant in the engine radiator: when a first level is reached, relay **I99**, in fusebox **G1** is energised, which sends the earth control signal to the fan **P2** via resistance **O22**: 1st speed.

If the second temperature level is reached, relay **I100** on the fan duct is energised, which sends the earth control signal directly to the fan **P2**: 2nd speed.

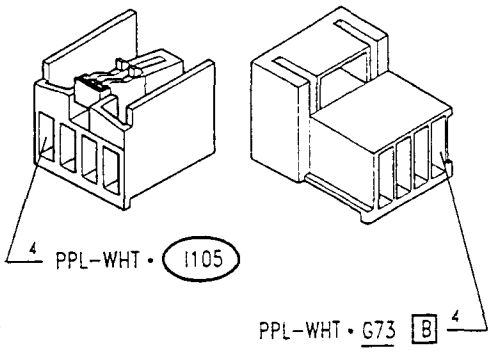
Similarly, the pressure switch **Q20** sends a signal from pin 3 for the 1st speed and from pin 6 for the 2nd speed.

Components and Connectors

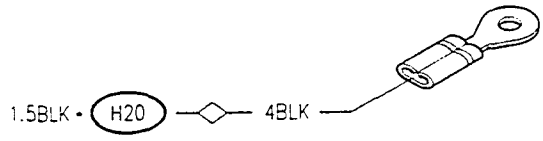
Fusebox G1 A	Fusebox G1 G
	
Fusebox G1 H	**Fusebox G1 I**
	
Fusebox G1 N	**LH engine compartment earth G53b**
	
Rear services connector G73 B	
	

Components and Connectors (continued)

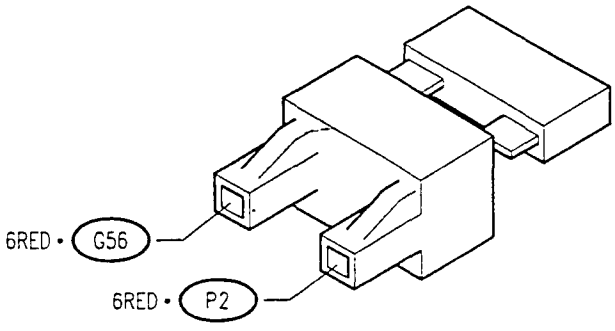
Dashboard wiring/engine wiring connector	G99



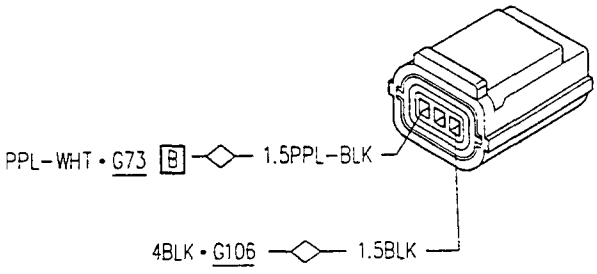
Seat crossmember earth	G106



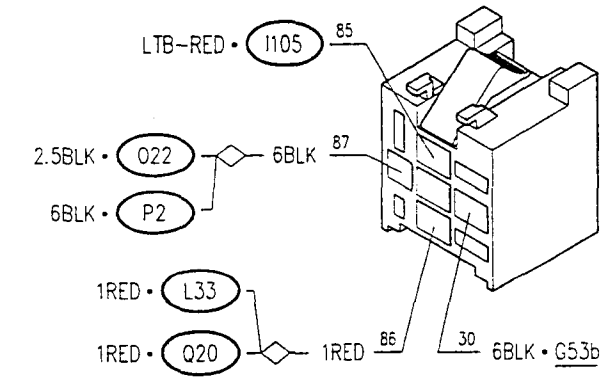
Engine cooling fan 2nd speed relay	I100



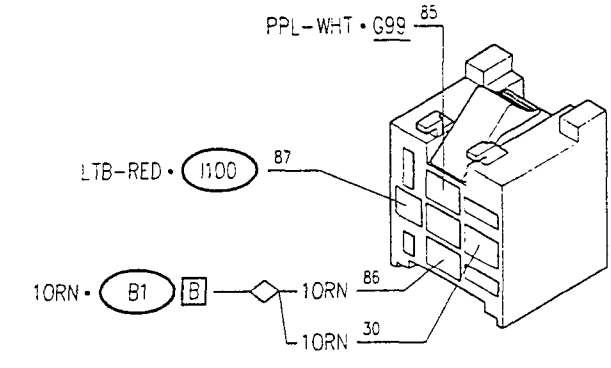
Diesel engine control devices relay	I105



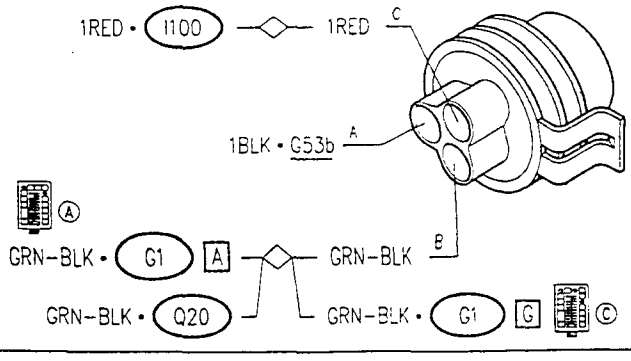
Engine cooling fan 2nd speed relay	I100



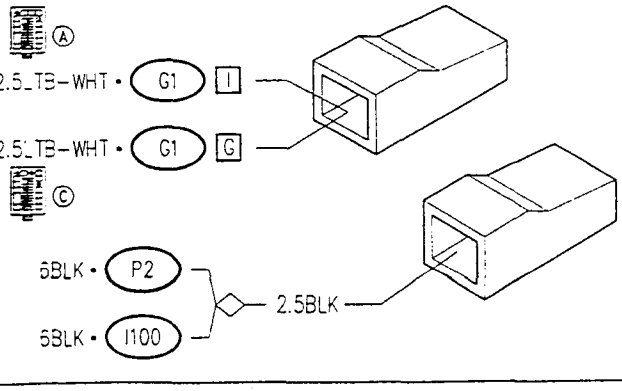
Diesel engine control devices relay	I105



Two-level thermal contact	L33

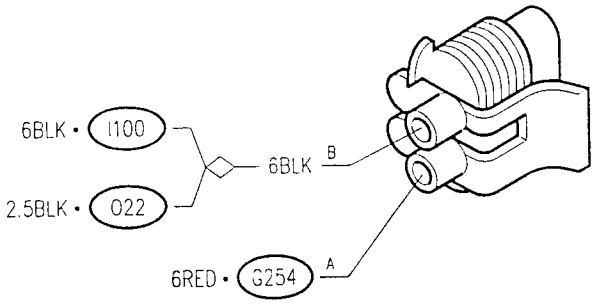


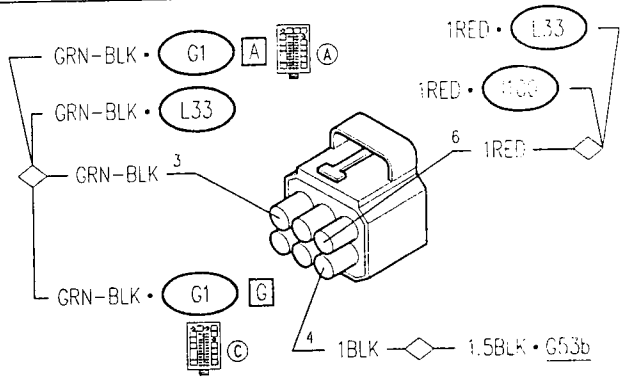
Engine fan additional resistance	O22



Components and Connectors (continued)

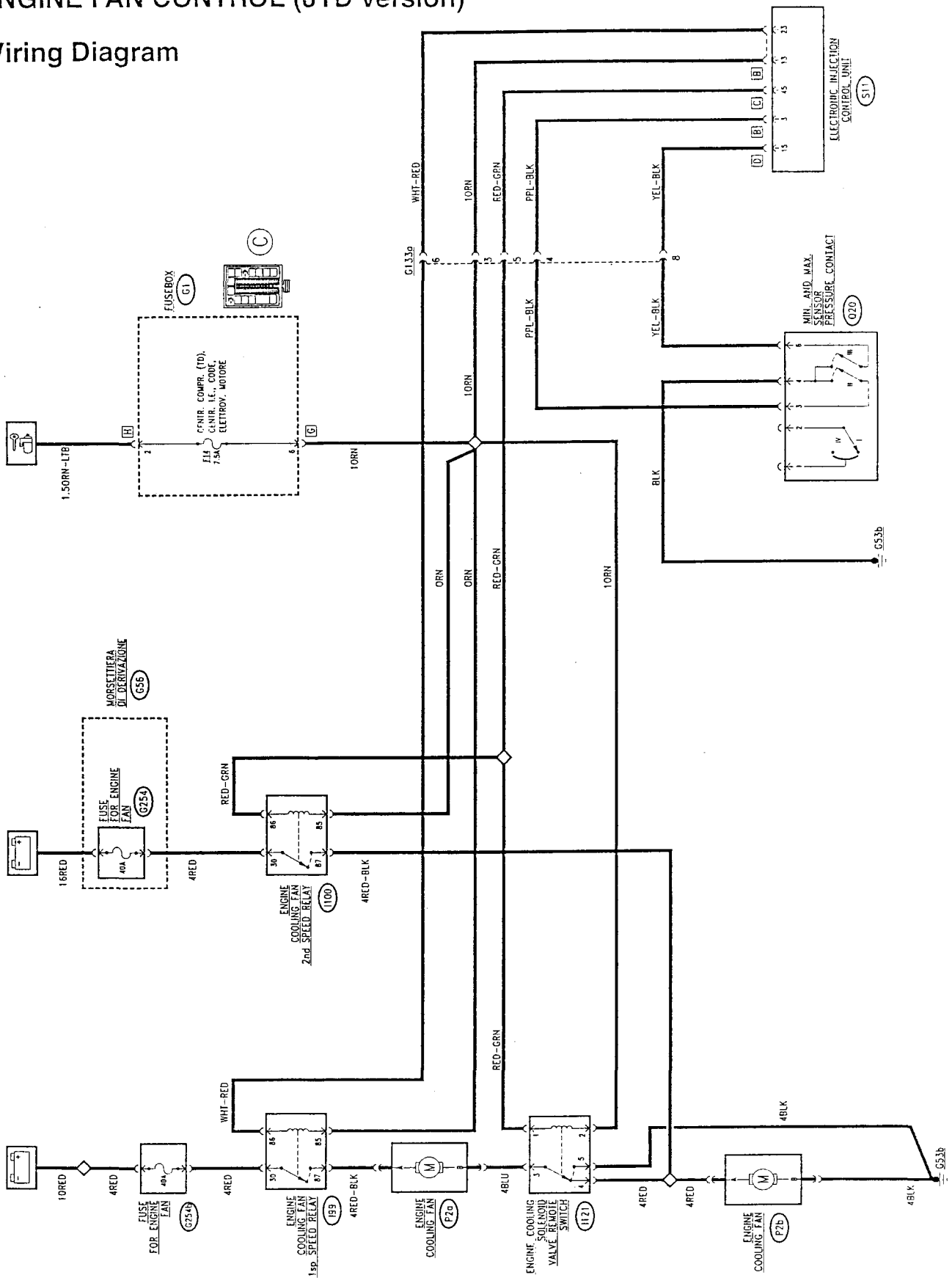
Engine water cooling fan	P2	Min. and nax. sensor pressure contact	Q20





ENGINE FAN CONTROL (JTD version)

Wiring Diagram



Functional Description

Two coolant fans **P2a** and **P2b** provide the required ventilation for cooling the engine radiator and air conditioning system condenser.

The injection control unit **S11** controls the fan for cooling the engine coolant fluid and the conditioning system coolant fluid.

This way, the thermal contact usually installed on the radio is dispensed with. The two speeds of the fan are controlled on the basis of the engine temperature, detected by the control unit through the special sensor: a "low" signal (earth) leaves pin 23 of connector B which controls the first speed relay **I99**, and a "low" (earth) signal leaves pin 45 of connector C which controls the second speed relay **I100**.

The "key-operated" voltage (line of fuse **F14** of control unit **G1**) supplies the coils of relays **I99**, **I100** and **I121**.

The first speed signal energizes remote switch **I99** which powers – with the **G254b** maxifuse line – electric fan **P2a**: the fan rotates at low speed because it receives a "damped" earth from fan **P2b**; through the non-energized switch **I121**, fan **P2b** also rotates at a low speed.

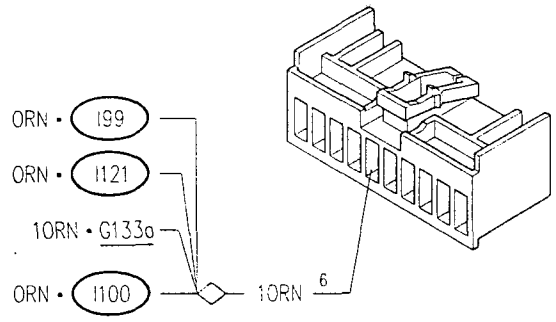
The second speed signal energizes remote switch **I100** which powers – with the **G254** maxifuse line of **G56** – the electric fan **P2b** at maximum speed; simultaneously the same signal energizes the switch **I121** which sends an earth to fan **P2a.** This fan also rotates at maximum speed.

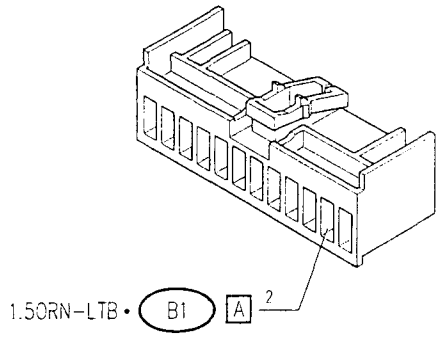
Pressure switch **Q20** also sends special signals to the control unit **S11** for engaging the fans if the pressure of the coolant fluid in the circuit exceeds determinate ratings:

- over approx. 15 bar the signal is sent to pin 3 of connector B for engaging the 1st speed;
- over approx. 20 bar to pin 15 of connector D for the 2nd speed.

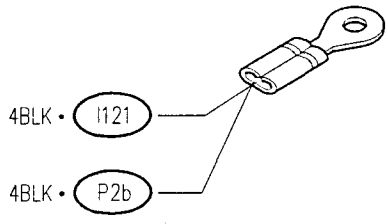
Components and Connectors

Fusebox	G1 G	Fusebox	G1 H

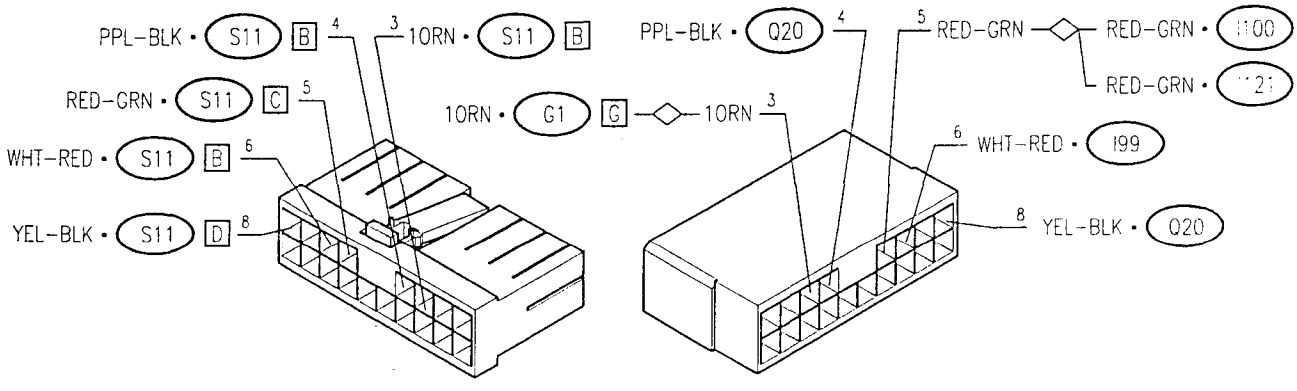




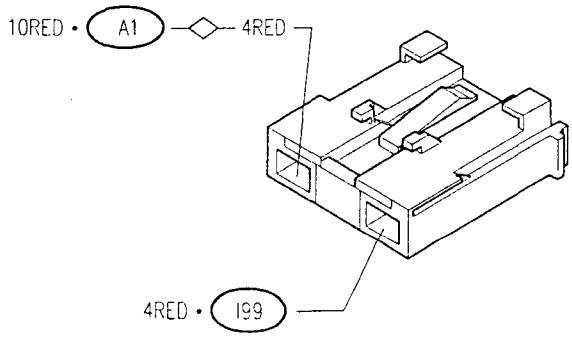
LH engine compartment earth	G53b

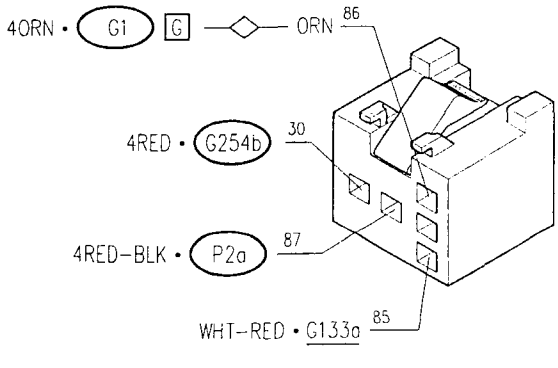


Connector for electronic injection wiring A	G133a



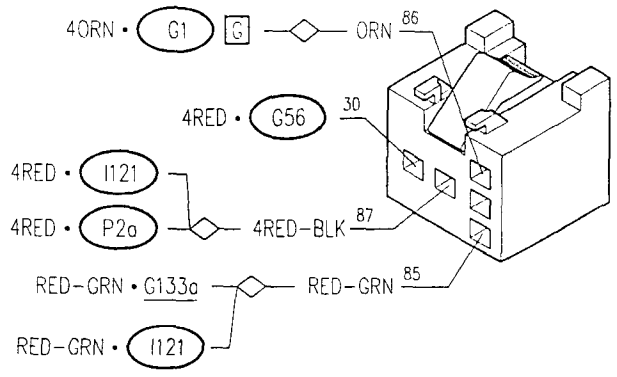
Fuse for engine fan	G254b	Engine cooling fan 1st speed relay	I99



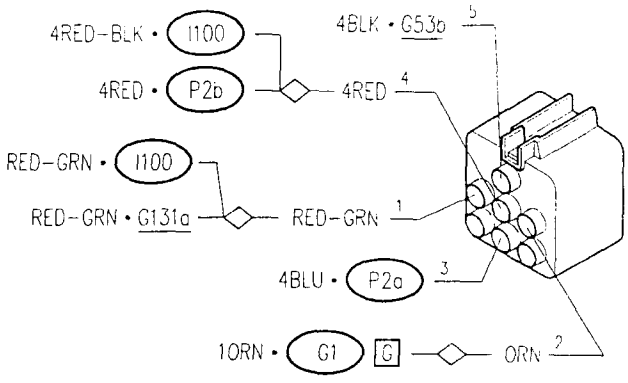


Components and Connectors (continued)

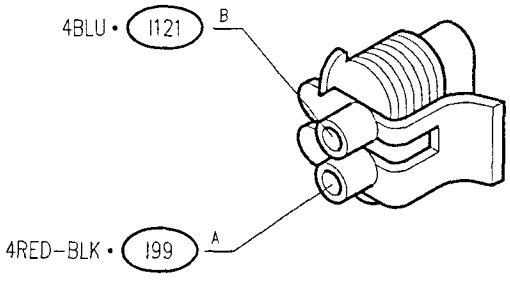
Engine cooling fan 2nd speed relay — I100



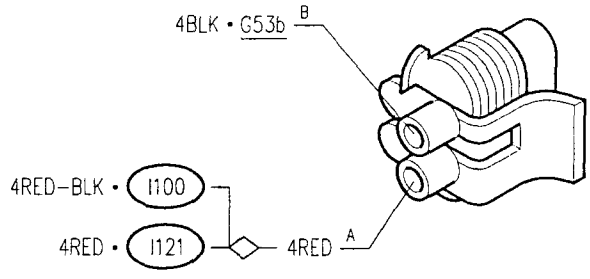
Engine cooling solenoid valve remote switch — I121



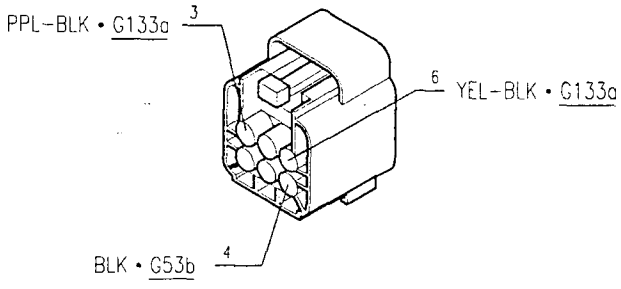
Engine cooling fan — P2a



Engine cooling fan — P2b

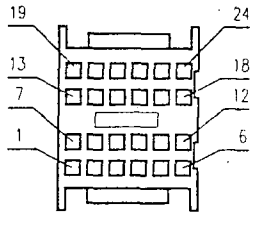


Min. and max. sensor pressure contact — Q20



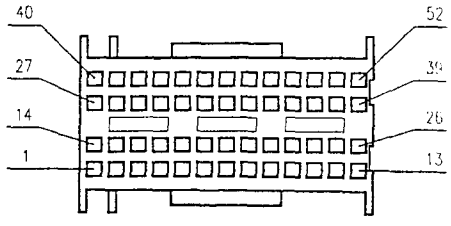
Electronic injection control unit — S11 B

3 PPL-BLK • G133a
13 1ORN • G133a
23 WHT-RED • G133a



Electronic injection control unit — S11 C

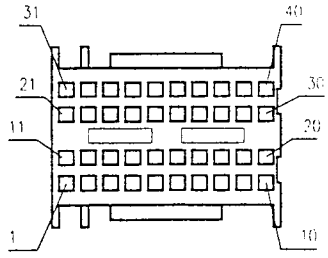
45 RED-GRN • G133a



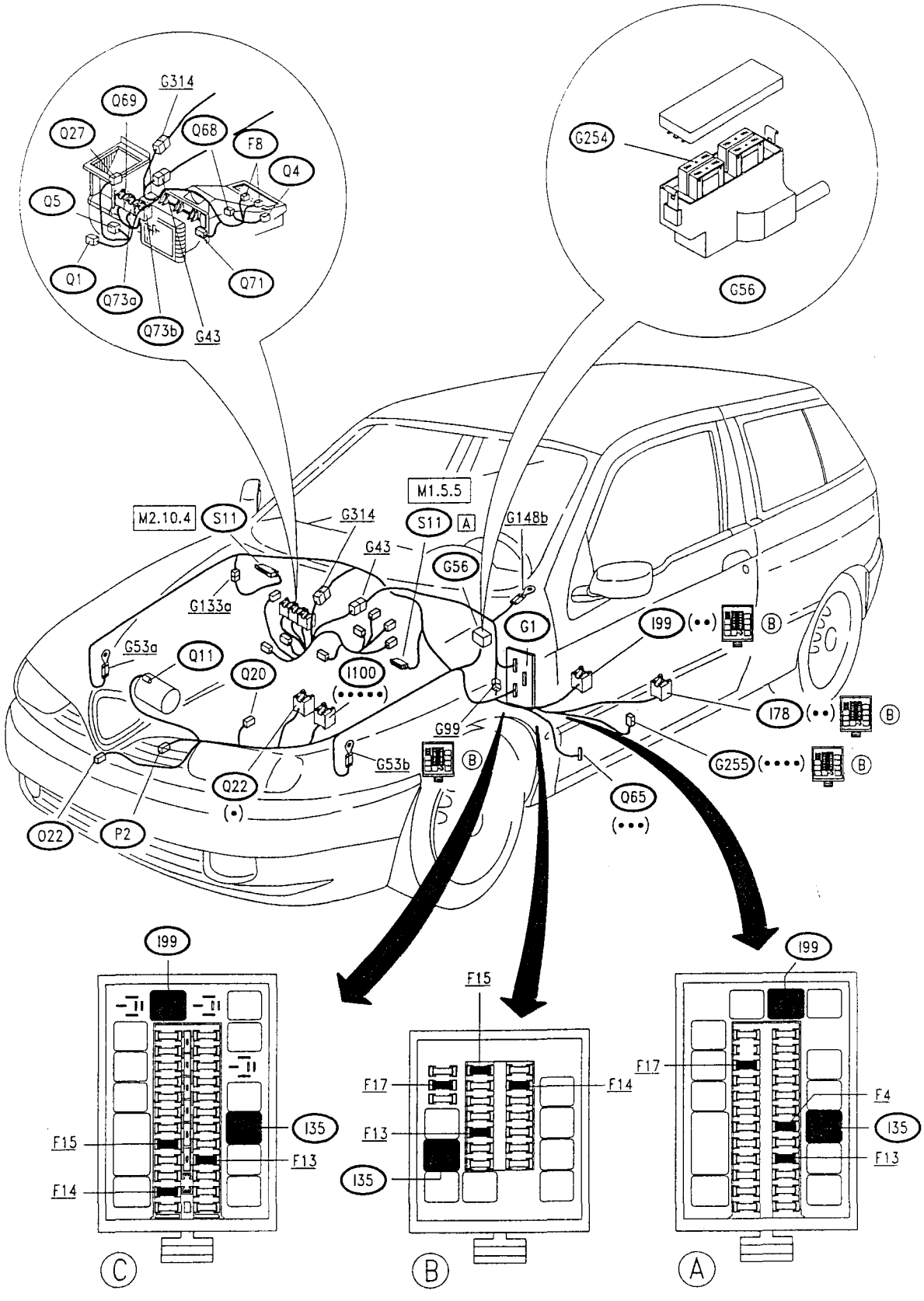
Components and Connectors (continued)

Electronic injection control unit	S11 D

15 YEL-BLK • G133a

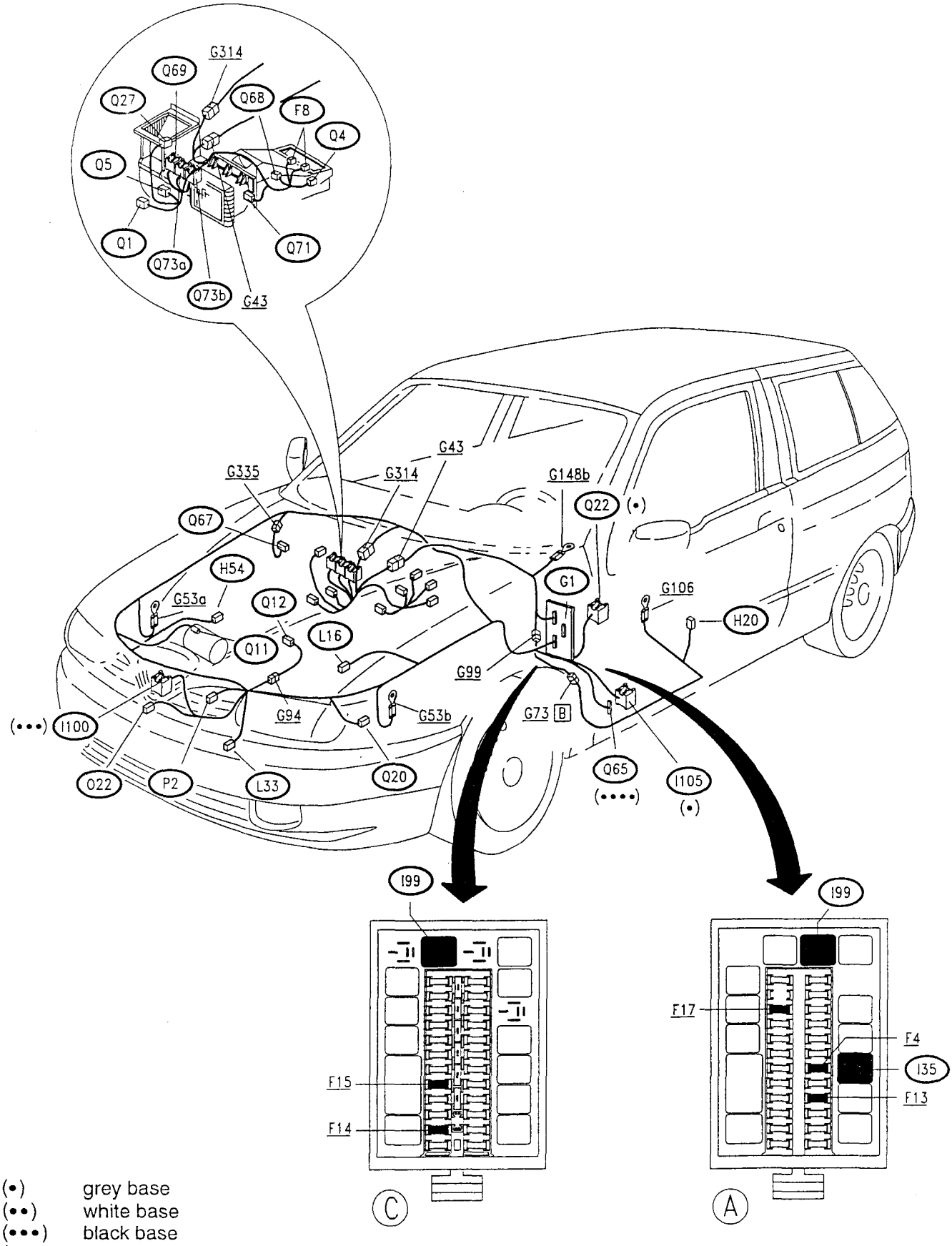


LOCATION OF COMPONENTS (petrol versions)



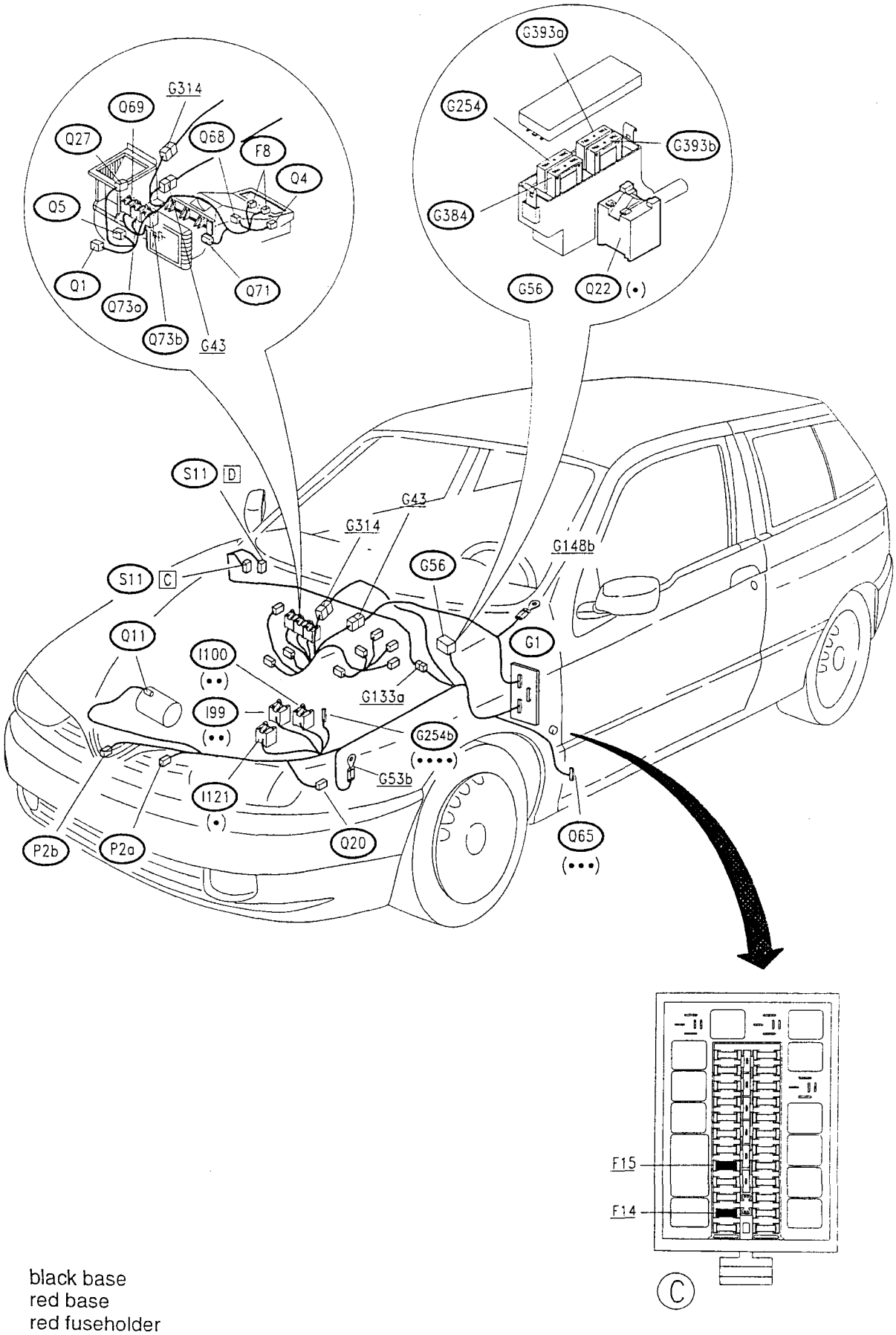
(•) white base
(••) yellow base
(•••) red fuseholder
(••••) green fuseholder
(•••••) black base

LOCATION OF COMPONENTS (TD versions)



(•) grey base
(••) white base
(•••) black base
(••••) red fuseholder

LOCATION OF COMPONENTS (JTD versions)



(•) black base
(••) red base
(•••) red fuseholder
(••••) black fuseholder

FAULT-FINDING TABLE

NOTE: To make its interpretation easier, the fault-finding table for the air conditioner has been subdivided into three section which comprise the three functions described separately also in the wiring diagrams:

– Climate control and recirculation fan

– Compressor control

– Engine fan control

Climate control and recirculation fan

Fault	Component to be checked											
	F17	F13	G255 (B)	Q1	I78 (B)	Q5	Q4	Q27	Q68	F8	Q69	Q73
Fan engagement		•	•	•	•		•					
Fan engagement at the different speeds						•	•					
Fan engagement at 1st speed with the compressor on							•				•	
Recirculation function	•							•	•			•
Climate control panel lighting										•		

(B) Only for fusebox "B"

Compressor control

Fault		Component to be checked												
		Q65	F17	F4	F15 (C)	Q11	Q20	Q71	Q12	H54	Q67	Q22	Q68	S11
Compressor engagement (under all circumstances)	petrol	•	•		•	•						•	•	
	TD	•	•	•		•						•	•	
	JTD				•	•						•	•	
Compressor engagement (only in certain circumstances) (*)	petrol						•	•						•
	TD						•		•	•	•			
	JTD						•	•						•

(C) Only for fusebox "C"

(*) Bear in mind that operation of the compressor is cut off by the system logic in the following conditions:

– coolant fluid pressure > 28 bar appr.;

– coolant fluid pressure < 2.5 bar appr. (circuit discharged);

– engine temperature > 111°C (only TD);

– full load (temporary cut out for appr. 8 sec. with engine speed over 2000 rpm) (only TD).

This operation is also determined by the logic of the injection-ignition control unit (only petrol) (see the corresponding section).

Engine fan control

Fault		Component to be checked													
		G254	G254	F4 (A)	F15 (B)	F14 (C)	P2a/b	O22	L33	Q20	S11	I99	I100	I105	I121
Fan engagement (under all circumstances)	TD	•					•								
	Petrol	•				•	•								
	JTD	•	•			•	•								
Fan engagement for high engine temp.(2nd speed)	TD	•						•	•			•	•	•	
	Petrol			•	•			•			•	•	•		
	JTD						•				•	•	•		•
Fan engagement for high coolant pressure	TD									•					
	Petrol									•	•				
	JTD									•	•	•	•		

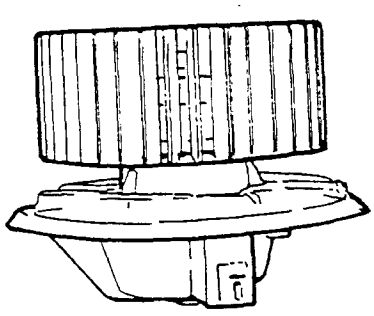
(A) Only for fusebox "A"

(B) Only for fusebox "B"

(C) Only for fusebox "C"

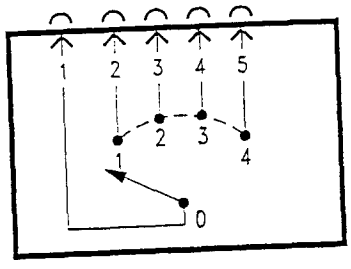
CHECKING COMPONENTS

Climate control fan (Q1)



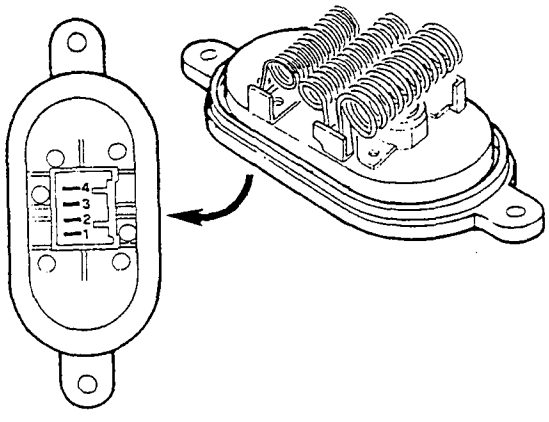
SPECIFICATIONS	
Rated voltage	12V
Maximum current	25.5 A
Speed at 12V/25°C in free air with impeller and support	3220 ÷ 3780 rpm
Motor direction of rotation	left

Climate control fan control (Q4)



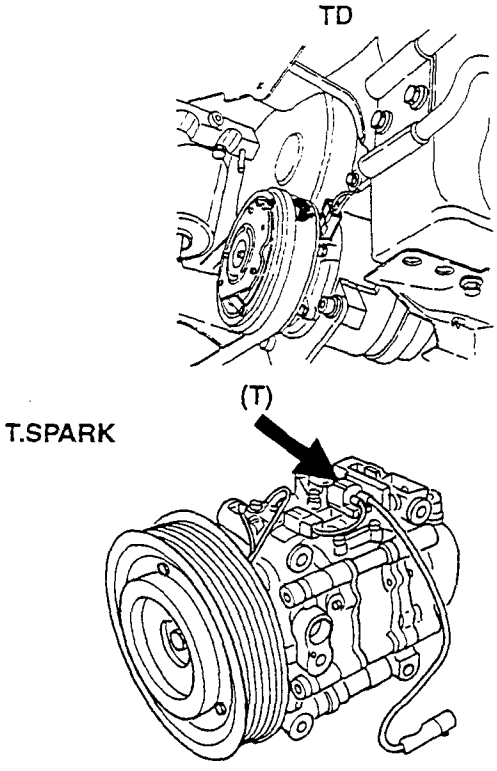
Check the contacts corresponding to the different knob positions.

Climate control fan speed adjustment resistance (Q5)



SPECIFICATIONS		
Section crossed	Total resistance	Fan speed
4-1 3-1 2-1 none	2.9 Ω 0.8 Ω 0.3 Ω -	1st 2nd 3rd 4th
Thermal contact cut in temperature		90 ± 5°C

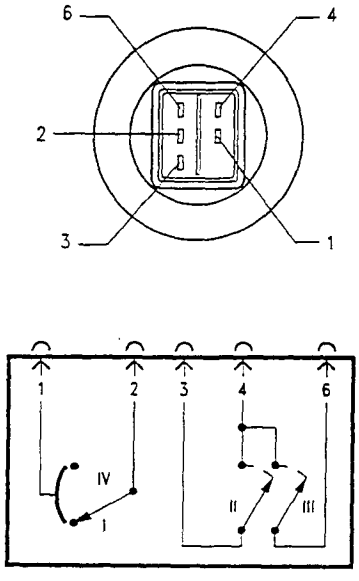
Compressor electromagnetic joint (Q11)



SPECIFICATIONS	
supply voltage	12 V
absorbed current	4.2 A (TD) 2.2 (T.SPARK)

	Compressor cut out thermal contact (T)	
Only T.SPARK:	contact opens	>160 °C
	contact closes	<140 °C

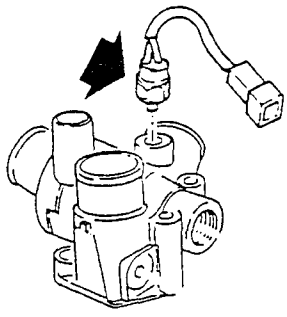
Minimum and maximum pressure switch (Q20)



SPECIFICATIONS	
1st level: contact opens contact closes	 2.45 ± 0.35 bar max 3.5 bar
2nd level: contact closes contact opens	 15 ± 1 bar 11 ± 2 bar
3rd level: contact closes contact opens	 20 ± 1.2 bar 16 ± 2.2 bar
4th level: contact opens contact closes	 28 ± 2 bar 22 ± 4 bar

Compressor cut out thermal contact (Q12)

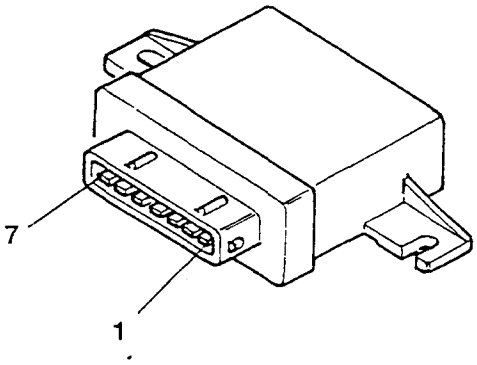
(only for TD version)

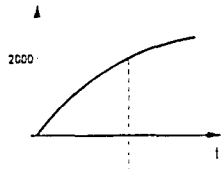
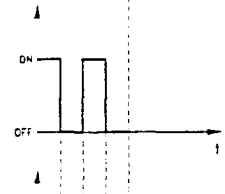
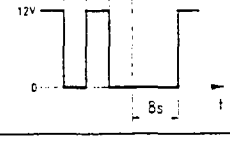


SPECIFICATIONS	
contact opens	111 ± 2 °C
contact closes	106 ± 2 °C

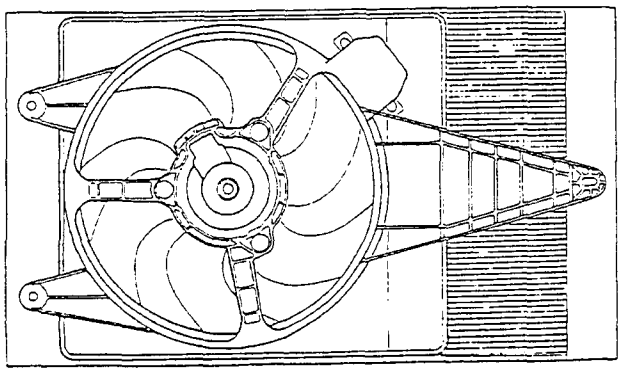
Compressor cut out control unit (Q67)

(only per TD version)



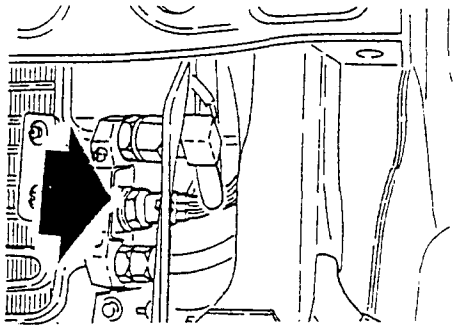
SPECIFICATIONS
Operating diagram:
Engine rpm (pin 6) 
Full load switch (pin 5) 
Output voltage (pin 7) 

Cooling fan (P2)



SPECIFICATIONS	
Rated voltage	12V
Speed at 12V in free air in duct	2350 +150 rpm (minimimum)
Motor direction of rotation (marked on duct)	right (impeller side)

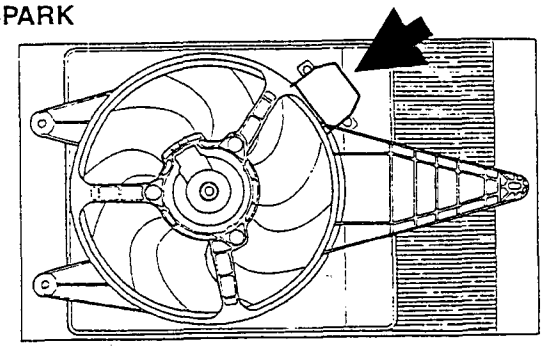
Fan two-level thermal contact (L33) (only TD)



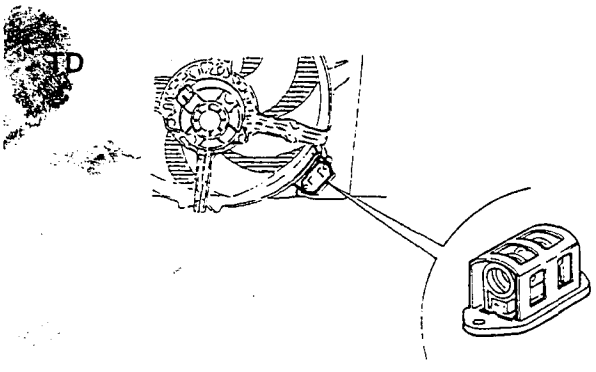
SPECIFICATIONS	
1st level:	
contact closes	88 ± 2 °C
contact opens	83 ± 2 °C
2nd level:	
contact closes	92 ± 2 °C
contact opens	87 ± 2 °C

Fan resistance (O22)

T.SPARK



TD



T.SPARK version	
resistance	0.18 Ω ± 10%
thermal fuse cut in	< 100 °C
TD version	
resistance	0.23 ± 0.02Ω
thermal contact opening temperature thermal contact closing temperature	130 ± 10°C 60 ± 10°C

70

SAFETY AND SECURITY

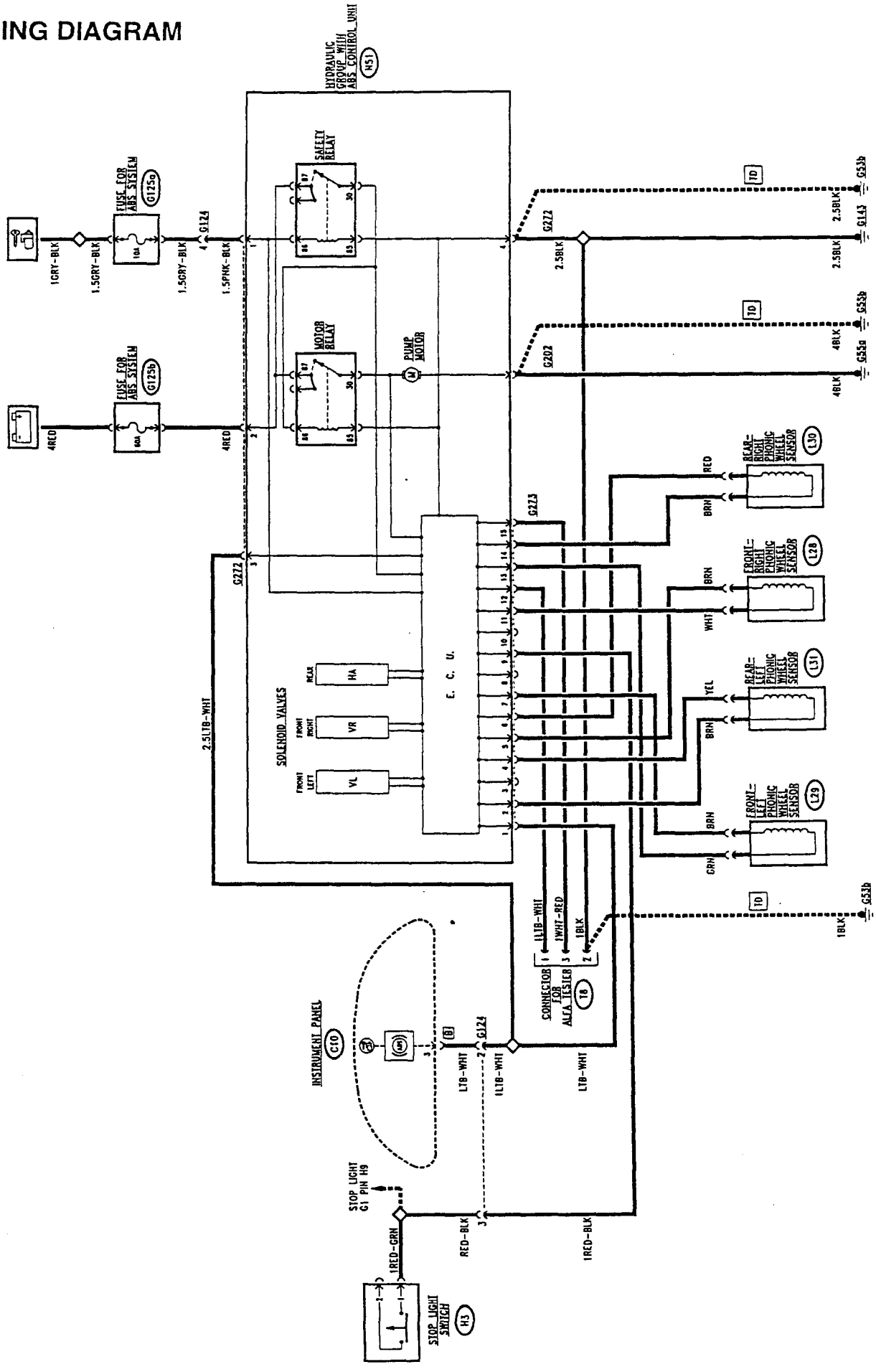
7 documents - 136 factory pages

ABS SYSTEM (BOSCH 2E ABS)

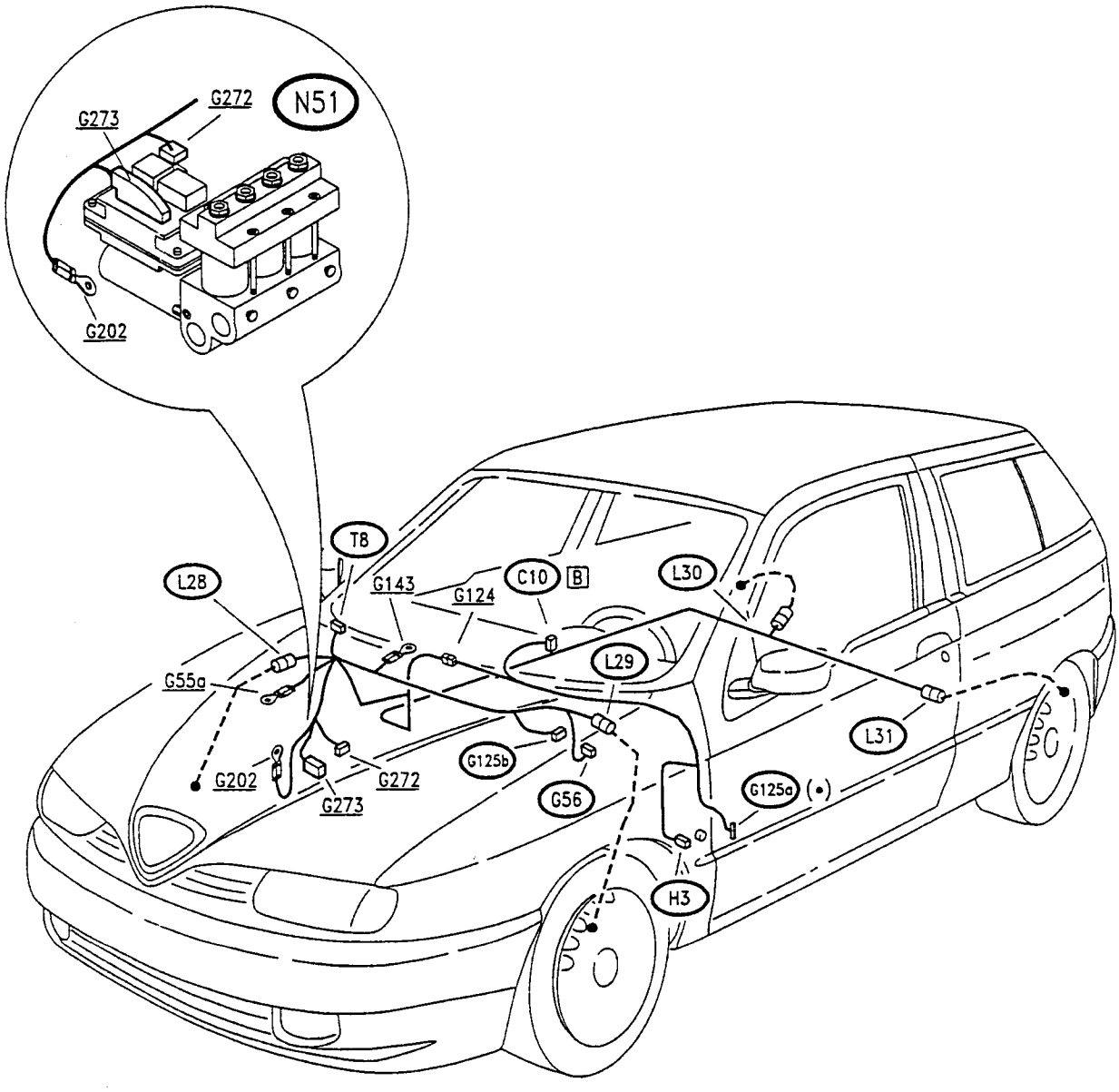
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GENERAL DESCRIPTION 39-3
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WIRING DIAGRAM

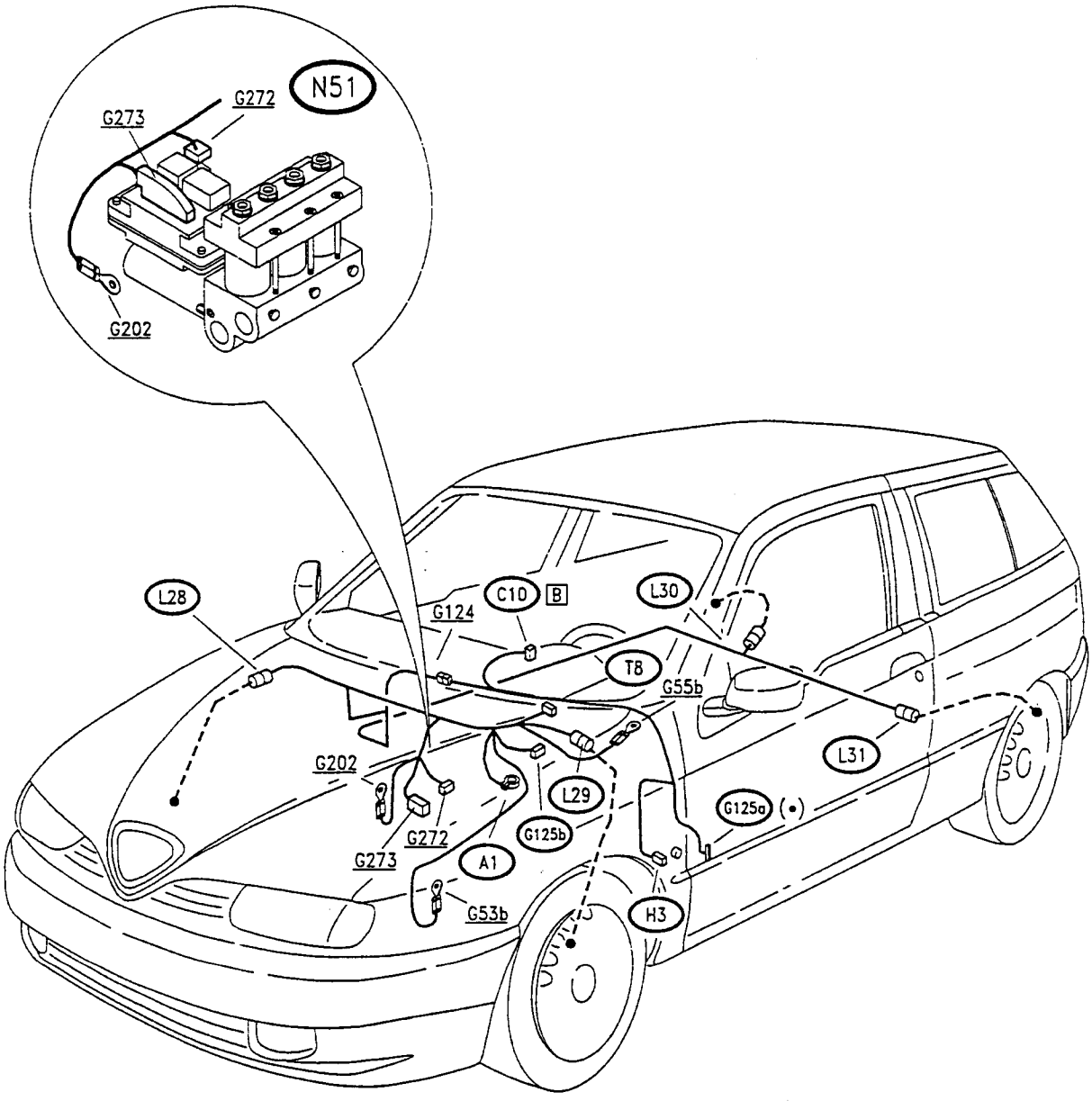


LOCATION OF COMPONENTS (Boxer version)



(•) red fuseholder

LOCATION OF COMPONENTS (TD version)



(•) red fuseholder

FAULT-FINDING

AUTOMATIC CHECK UPON IGNITION: when the car is started the "ABS warning light" on the instrument cluster turns on for appr. 2 secs., then it goes off meaning that the system is working properly. If the warning light stays on, carry out diagnosis using the flashing code, as mentioned previously.

If the warning light does not turn on, carry out **test J.**

Fault-Finding using the Flashing Code

The self-diagnosis system with which this system is fitted, makes it possible to quickly locate a faulty component following the instructions of a **FLASHING CODE**, which is activated as follows:

– earth the line of pin A of connector **T8**

– power the ABS control unit **N51** ("key-operated" supply")

Read the sequence of flashes on the "ABS warning light" on the instrument panel **C10**:

– for three times code "12" appears, meaning correct operation: if this does not occur, carry out **test J**

– the codes of the errors memorised appear (each repeated three times): carry out the test given in the following table

– code "12" appears for another three times, indicating the end of the sequence

NOTE: Resetting the memorised code is obtained by disconnecting the line of pin 1 of **T8** and engaging the ignition switch 20 times (or using the ALFA ROMEO Tester)

Error Codes Table

CODE	FAULT	CARRY OUT TEST
12	Start and end of diagnosis	—
No code (*)	Control unit and self-diagnosis fault	A
16	Faulty LH front solenoid valve (VL)	Check the impedance of the solenoid valve (1.5÷2.5 Ω) and the condition of the connections between the control unit and the solenoid valve; if necessary change the solenoid valve
17	Fault RH front solenoid valve (VR)	Check the impedance of the solenoid valve (1.5÷2.5 Ω) and the condition of the connections between the control unit and the solenoid valve; if necessary change the solenoid valve
18	Faulty rear solenoid valve (HA)	Check the impedance of the solenoid valve (1.5÷2.5 Ω) and the conditions of the connections between the control unit and the solenoid valve; if necessary change the solenoid valve
19	Faulty safety relay	B
25	Incorrect number of phonic wheel teeth	Change the phonic wheel concerned see Group 33 "BRAKES")
35	Faulty pump motor	C
37	Faulty brake switch (H3)	D
39	Faulty LH front sensor (**L29**)	Check the impedance of the sensor (appr.1 kΩ); change it if necessary. Then carry out the next **test E.**
41	LH front sensor (**L29**) not connected	E
42	Faulty RH sensor (L28)	Check the impedance of the sensor (appr. 1kΩ); change it if necessary. Then carry out the next **test F.**
43	RH front sensor (**L28**) not connected	F
44	Faulty LH rear sensor (	Check the impedance of the sensor (appr. 1kΩ); change it if necessary. Then carry out the next **test G.**
45	LH rear sensor (**L31**) not connected	G
46	Faulty RH rear sensor (**L30**)	Check the impedance of the sensor (appr. 1kΩ); change it if necessary. Then carry out the next **test H.**
47	RH rear sensor (**L30**) not connected	H
48	Insufficient supply voltage	I
55	Faulty electronic control unit	Change the control unit, contained in **N51**

(*) if the warning light is not working, see **test J**

Fault-finding using the Alfa Romeo Tester

N.B. Before carrying out diagnosis with the Tester, perform the preliminary check described later (TEST A); if the warning light is not working properly also carry out TEST J.

The connection between the TESTER and the control unit must be made as follows:

1. Supply the TESTER either through the cigar lighter socket or connecting directly to the battery using the special lead.
2. Connect the TESTER socket to the control unit (the socket is near the control unit).

The instrument can give the following information:

– parameter display;

– error display;

– active diagnosis.

ERROR STORAGE:

The control unit self-diagnosis system checks a series of components, checking the operating parameters and logging any faults permanently in the control unit; in this situation the control unit de-activates the system and turns on the warning light on the instrument panel.

N.B. the control unit can memorise up to three errors contemporaneously: if a failure is present when three more are memorised, the last one supersedes the "oldest" of the three previous ones.

ERROR CLEARING:

Stored errors may only be cleared SOLELY using the ALFA ROMEO TESTER.

ACTIVATING DIAGNOSIS:

Diagnosis begins with the engine stopped and the ignition key turned to MARCIA.

During diagnosis it will also be requested to set the car in motion.

WARNING: During connection with the Tester the A.B.S. system is disabled and the warning light on the instrument cluster stays on; therefore, the control unit is unable to memorise new errors. Great care is also necessary because in the event of emergency braking, the ABS system is not operational and only the conventional braking system is available.

N.B.:
The system is disabled when the supply voltage falls below 8.6 V, when the solenoid valves are not energized or 9.4 V, when the solenoid valves are energized.

PRELIMINARY SYSTEM CHECK	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSES – Check the intactness of wander fuses **G125a** and **G125b**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Change fuses - **G125a** (10A) - **G125b** (60A)
A2 CHECK RELAYS – Check the two relays in unit **N51**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Change the relays if faulty
A3 CHECK VOLTAGE – Check for 12 V at pin 2 of **G272**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between pin 2 of **G272** and branch terminal board **G56**
A4 CHECK VOLTAGE – Turn the key and check for 12 V at pin 1 of **G272**	OK ▶ ~~OK~~ ▶	Carry out **step A5** Restore the wiring between pin 1 of **G272** and the ignition block **B1**
A5 CHECK EARTH – Check that **G202** is earthed	OK ▶ ~~OK~~ ▶	Carry out **step A6** Restore the wiring between **G202** and earth **G55a** (Boxer) or **G55b** (TD)
A6 CHECK EARTH – Check that pin 4 of **G272** is earthed	OK ▶ ~~OK~~ ▶	CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER OR USING THE FLASHING CODE Restore the wiring between pin 4 of **G272** and earth **G143** (Boxer) or **G53b** (TD)

FAULTY SAFETY RELAY — TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK RELAY – Check that the safety relay is working properly (in group **N51**)	OK ▶	Carry out **step B2**
	~~OK~~ ▶	Change the relay
B2 CHECK VOLTAGE – Check for 12 V at pin 87 of the safety relay	OK ▶	Carry out **step B3**
	~~OK~~ ▶	In this case breaks of the connection between **G272** and the safety relay are likely. Change group **N51**
B3 CHECK VOLTAGE – Turn the key and check for 12 V at pin 86 of the safety relay	OK ▶	Carry out **step B4**
	~~OK~~ ▶	In this case breaks of the connection between **G272** and the safety relay are likely. Change group **N51**
B4 CHECK VOLTAGE – Turn the key and check for 12V at pin 86 of the motor relay	OK ▶	Change the motor relay (also see **test C**)
	~~OK~~ ▶	Change group **N51**

FAULTY PUMP MOTOR	TEST C

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
C1 CHECK RELAY – Check the correct operation of the motor relay (in group **N51**)	OK ▶ ~~OK~~ ▶	Carry out **step C2** Change the relay, contained in **N51**
C2 CHECK VOLTAGE – Check for 12 V at pin 87 of the motor relay	OK ▶ ~~OK~~ ▶	Carry out **step C3** In this case breaks are likely in the connection between **G272** and the motor relay. Change group **N51**
C3 CHECK VOLTAGE – Turn the key and check for 12 V at pin 86 of the motor relay	OK ▶ ~~OK~~ ▶	Carry out **step C4** Check the safety relay (see **test B**). If not, breaks are likely in the connection between the safety relay and the motor relay. Change group **N51**
C4 CHECK EARTH – Check for 0 V at pin (-) of the pump motor	OK ▶ ~~OK~~ ▶	Carry out **step C5** In this case breaks are likely in the connection between pin (-) of the pump motor and **G202**. Change group **N51**
C5 CHECK PUMP – Bridge pins 30 and 87 of the motor relay. Check that the pump motor is working properly	OK ▶ ~~OK~~ ▶	If necessary, check the brake hydraulic circuit. (see Group 33 "BRAKES") Change group **N51**, complete with pump motor

FAULTY BRAKE SWITCH — TEST D

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
D1 CHECK STOP LIGHTS – Check that the stop lights are working properly	OK ▶	Carry out **step D2**
	~~OK~~ ▶	Change the stop lights switch **H3**, or proceed as described in the "STOP LIGHTS" section
D2 CHECK VOLTAGE – With the pedal pressed, check for 12 V at pin 9 of **G273**	OK ▶	Check and if necessary change the electronic control unit contained in **N51**
	~~OK~~ ▶	Restore the wiring between pin 9 of **G273** and **H3**

LH FRONT SENSOR NOT CONNECTED — TEST E

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
E1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pins 7 and 13 of **G273**	OK ▶	Carry out **step E2**
	~~OK~~ ▶	Carry out **step E3**
E2 CHECK CONTINUITY – Disconnect the sensor **L29** and check for continuity between the sensor and pin 7 of **G273** , and between the sensor and pin 13 of **G273**	OK ▶	Check and if necessary change the sensor **L29**.
	~~OK~~ ▶	Restore the wiring between **L29** and **G273**
E3 CHECK OPEN CIRCUIT – Disconnect the sensor **L29** and check for an open circuit between pins 7 and 13 of **G273** (wiring side)	OK ▶	Check and if necessary change sensor **L29**.
	~~OK~~ ▶	Restore the wiring eliminating the short circuit between the cables connecting **L29** with **G273**

RH FRONT SENSOR NOT CONNECTED — TEST F

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
F1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pins 5 and 11 of **G273**	OK ▶	Carry out **step F2**
	~~OK~~ ▶	Carry out **step F3**
F2 CHECK CONTINUITY – Disconnect the sensor **L28** check for continuity between the sensor and pin 5 of **G273**, and between the sensor and pin 11 of **G273**	OK ▶	Check and if necessary change the sensor **L28**.
	~~OK~~ ▶	Restore the wiring between **L28** and **G273**
F3 CHECK OPEN CIRCUIT – Disconnect the sensor **L28** and check for an open circuit between pins 5 and 11 of **G273** (wiring side)	OK ▶	Check and if necessary change the sensor **L28**.
	~~OK~~ ▶	Restore the wiring eliminating the short circuit between the cables connecting **L28** with **G273**

LH REAR SENSOR NOT CONNECTED — TEST G

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
G1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pins 4 and 2 of **G273**	OK ▶	Carry out **step G2**
	~~OK~~ ▶	Carry out **step G3**
G2 CHECK CONTINUITY – Disconnect the sensor **L31** and check for continuity between the sensor and pin 4 of **G273**, and between the sensor and pin 2 of **G273**	OK ▶	Check and if necessary change the sensor **L31**.
	~~OK~~ ▶	Restore the wiring between **L31** and **G273**
G3 CHECK OPEN CIRCUIT – Disconnect the sensor **L31** and check for an open circuit between pins 4 and 2 of **G273** (wiring side)	OK ▶	Check and if necessary change the sensor **L31**.
	~~OK~~ ▶	Restore the wiring eliminating the short circuit between the cables connecting **L31** with **G273**

RH REAR SENSOR NOT CONNECTED — TEST H

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
H1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pins 6 and 14 of **G273**	OK ▶	Carry out **step H2**
	~~OK~~ ▶	Carry out **step H3**
H2 CHECK CONTINUITY – Disconnect the sensor **L30** and check for continuity between the sensor and pin 6 of **G273** , and between the sensor and pin 14 of **G273**	OK ▶	Check and if necessary change the sensor **L30.**
	~~OK~~ ▶	Restore the wiring between **L30** and **G273**
H3 CHECK OPEN CIRCUIT – Disconnect the sensor **L28** and check for an open circuit between pins 6 and 14 of **G273** (wiring side)	OK ▶	Check and if necessary change the sensor **L30.**
	~~OK~~ ▶	Restore the wiring eliminating the short circuit between the cables connecting **L30** with **G273**

INSUFFICIENT SUPPLY VOLTAGE — TEST I

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
I1 CHECK VOLTAGE – Check that the battery voltage is 12V	OK ▶	Carry out **step I2**
	~~OK~~ ▶	Restore the correct voltage recharging or changing the battery **A1**
I2 CHECK VOLTAGE – Check for a voltage of 12 V at pin 2 of **G272**	OK ▶	Carry out **step I3**
	~~OK~~ ▶	Restore the wiring between pin 2 of **G272** and the battery **A1** (TD) or the branch terminal board **G56** (Boxer), through fuse **G125b**
I3 CHECK VOLTAGE – With the key turned, check for a voltage of 12 V at pin 1 of **G272**	OK ▶	CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER
	~~OK~~ ▶	Restore the wiring between pin 1 of **G272** and the ignition switch **B1** through fuse **G125a**

"ABS" WARNING LIGHT NOT WORKING (fails to turn on for faults)	TEST J

TEST PROCEDURE	RESULT	AZIIONE CORRETTIVA
J1 CHECK CONTINUITY – Check the continuity between pin 12 of **G273** and pin 1 of connector **T8** and between pin 15 of **G273** and pin 3 of **T8**	OK ▶ ~~OK~~ ▶	Carry out **step J2** Restore the wiring between **G273** and connector **T8**
J2 CHECK EARTH SIGNAL – Turn the key and check for, 0V for a few seconds 0V at pin B3 of the instrument cluster **C10**	OK ▶ ~~OK~~ ▶	Change the instrument cluster **C10** Carry out **step J3**
J3 CHECK EARTH SIGNAL – Turn the key and check for, 0V for a few seconds 0V at pin 1 of **G273**	OK ▶ ~~OK~~ ▶	Restore the wiring between **G273** and **C10** Also check the wiring between pin 3 of **G272** and **C10** Change the control unit contained in **N51**

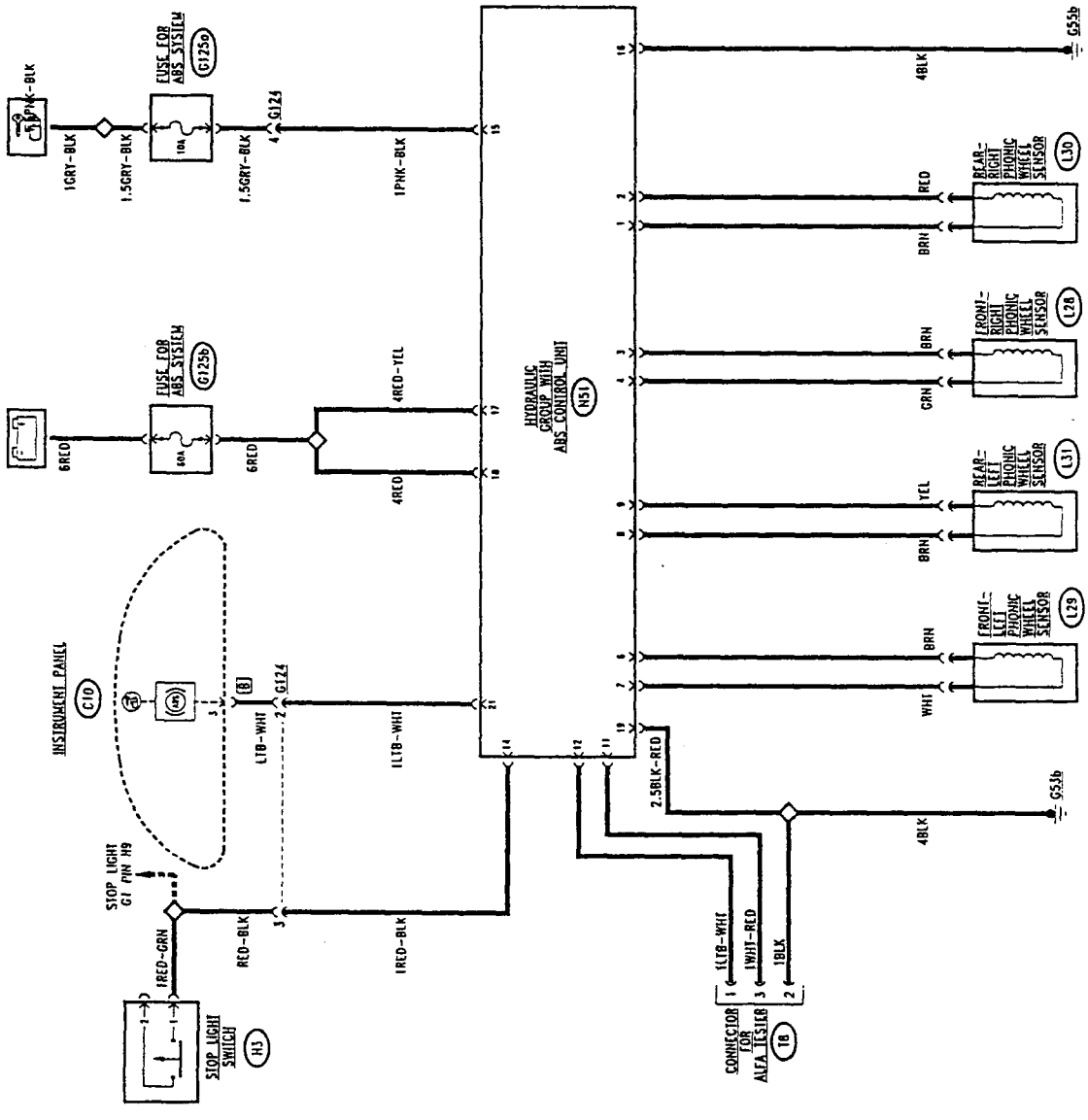
ABS SYSTEM (BOSCH ABS 5.3)

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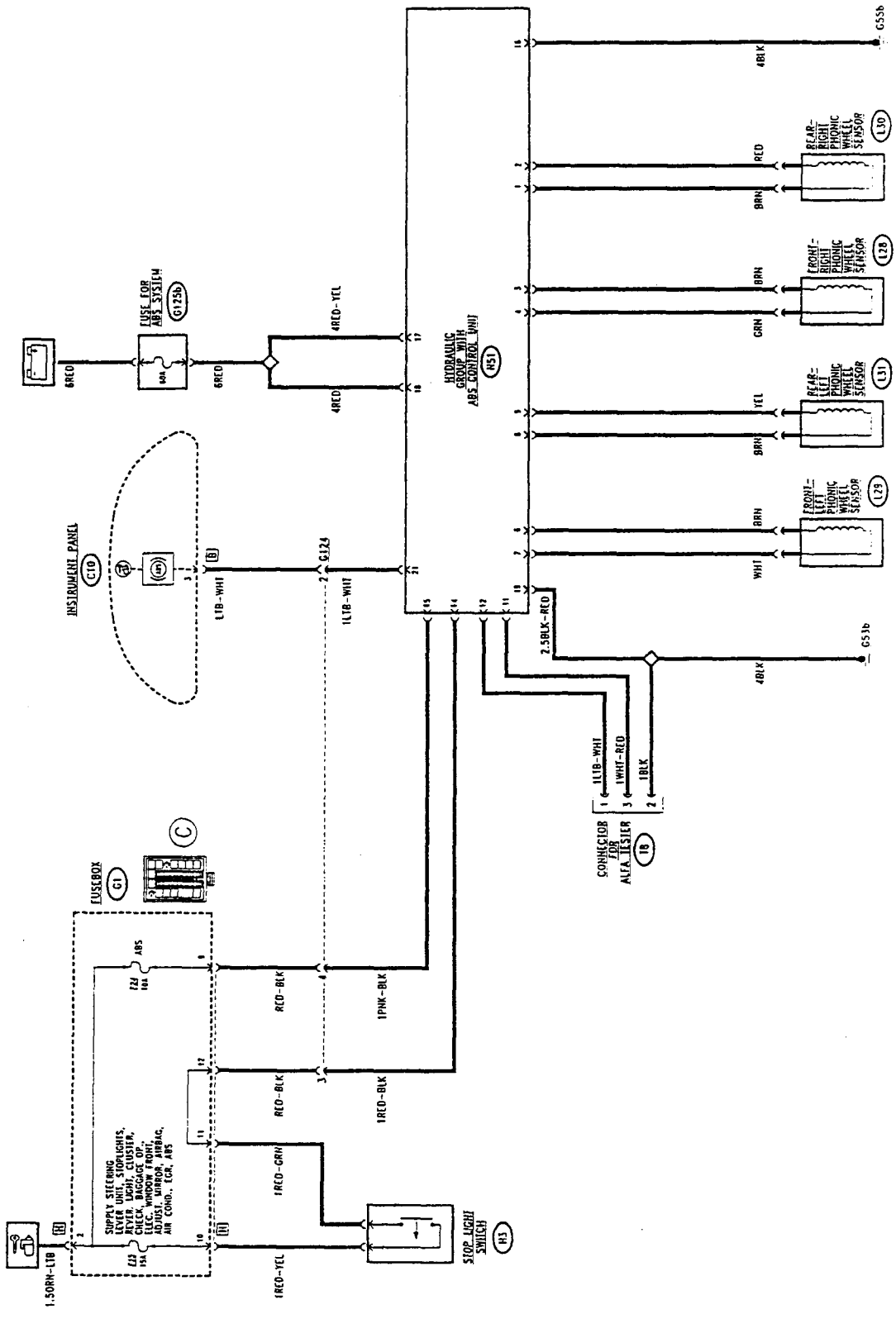
WIRING DIAGRAM 39A-2
GENERAL DESCRIPTION 39A-3
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COMPONENTS AND CONNECTORS 39A-4
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From chassis no. ... it replaces the previous BOSCH 2E ABS system

WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The electronic wheel anti-lock system (**BOSCH ABS 5.3**) adjusts the braking pressure transmitted to the wheels preventing loss of road-holding under all tyre and road conditions.

The system has been designed to integrate, and not replace, the normal mechanical braking system, guaranteeing a high degree of of safety in the event of a failure: in fact it operates on the same brake fluid as the conventional mechanical circuit.

Four sensors, located on the four wheels, inform the electronic control unit of the speed of each wheel continuously, thereby recording locking situations affecting the wheels, skidding and loss of grip.

In these situations, the control unit suitably operates the solenoid valves that modulate the pressure in the hydraulic circuit, eliminating wheel locking and bringing the car back to the limit of roadholding, which means that the braking distance is reduced to a minimum, without losing control of steering.

The **adjustment solenoid valves** are, in this version of the system, two (one for pressure charging and one for relief) for each wheel.

For further details on the hydraulic operation of the system see GROUP 33-BRAKES.

Components

The system comprises:

- four magnetic induction sensors which read the speed of the wheels: **L28**; **L29**; **L30**; **L31**.
- the integrated electronic and hydraulic control unit **N51**, which houses the following:
  - the electronic control module (CPU)
  - the eight solenoid valves
  - two brake fluid pumps with corresponding motor
  - two damping accumulators and two reservoirs
  - a safety valve
- the connector for self-diagnosis **T8**
- the brake switch **H3** (the same that turns on the stop lights) which signals the system the braking condition.

The ABS includes a self-diagnosis system which continually monitors all the system parameters and components: in the event of a failure or fault, the system cuts itself off automatically leaving the conventional servo-assisted mechanical braking system operational: the driver is alerted of this situation by a special warning light on the instrument cluster (**C10**).

Suitably connecting to the diagnosis connector (**T8**) located next to the control unit, it is possible to use the signals of the flashing code to quickly locate the faulty component (see "Fault-finding").

The connector **T8** can also be used to connect to the ALFA ROMEO Tester system.

FUNCTIONAL DESCRIPTION

System supply:

With a line protected by wander fuse **G125a** the "key-operated" voltage supplies, (10A) pin 15 of the ABS control unit **N51**, for box "C" the supply line is protected by fuse **F24** inside box **G1**.

The battery voltage reaches pin 17 and 18 of the same **N51** from the line protected by fuse **G125b** (60A).

The electronic control unit is connected to earth via pin 19 of N51, while the pump is via pin 16.

Sensors and solenoid valves:

Directly inside the control unit **N51**, the module is connected with the adjustment solenoid valves, which modulate the pressure on the brakes of the four wheels; outside, it is connected with the four sensors **L28 - L29 - L30 - L31** (pin 1-2, 3-4, 6-7 and 8-9) which signal the speed of the single wheels, and with the brake switch **H3** (pin 14), which sends a consent signal: in fact the ABS system cannot come into operation if the brake pedal is not pressed.

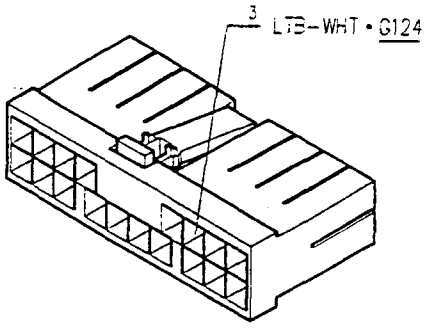
Self-diagnosis:

When the control unit detects problems through the self- diagnosis function, it sends a signal to the instrument cluster **C10** which turns on the ABS warning light: this signal is sent to pin 21.

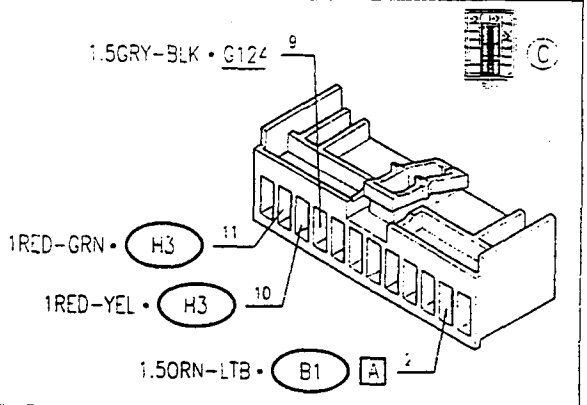
The diagnosis connector **T8** connected to pin 11, 12 and 19 allows connection of the control unit with the ALFA ROMEO Tester or "reading" of the flashing code (see "Fault- finding").

COMPONENTS AND CONNECTORS

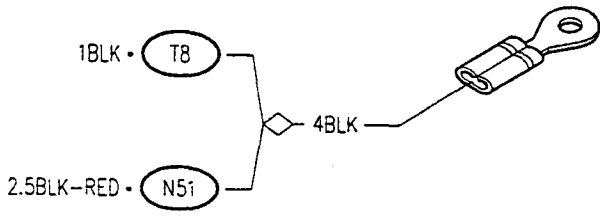
Instrument cluster	C10 B



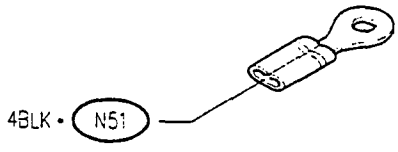
Fusebox	G1 H



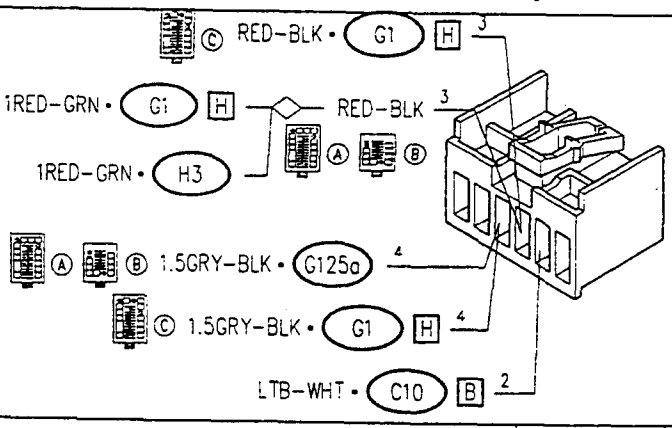
LH engine compartment earth	G53b

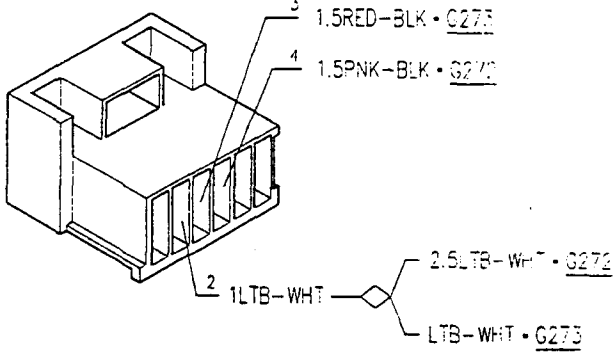


LH wing earth	G55b

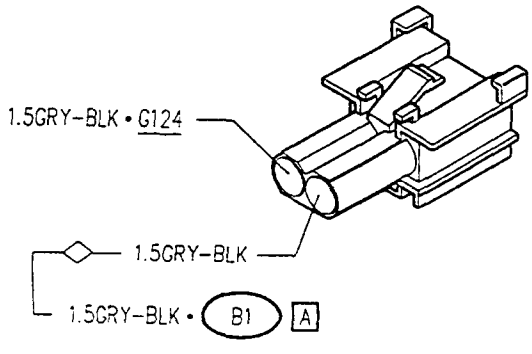


ABS system connector	G124

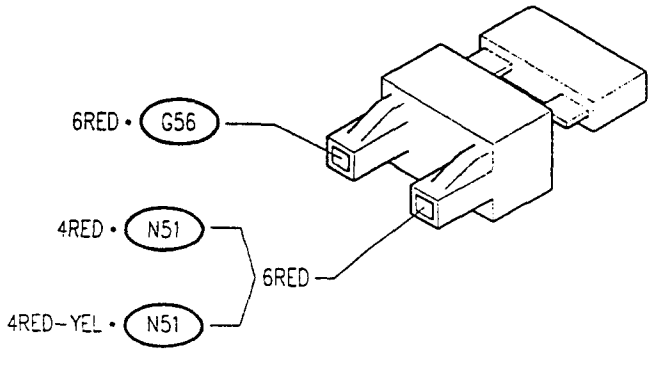




ABS system wander fuse	G125a

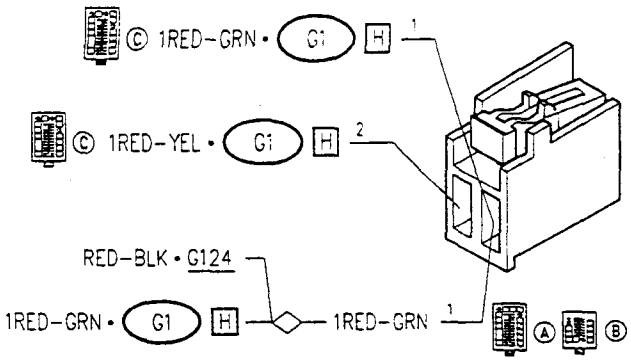


ABS system wander fuse	G125b

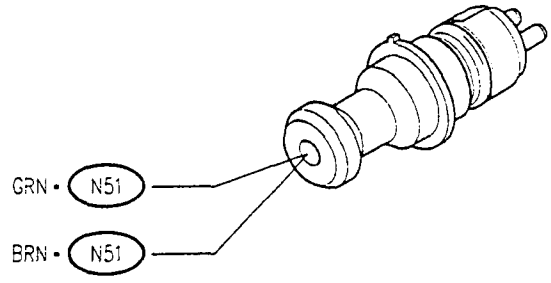


COMPONENTS AND CONNECTORS (continued)

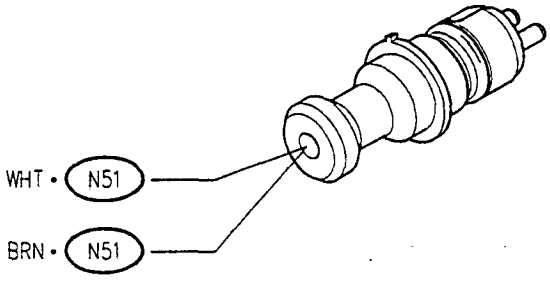
Stop lights switch	H3



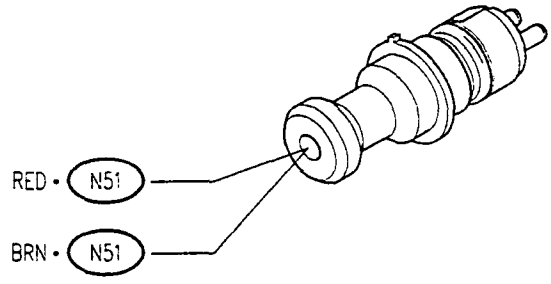
RH front phonic wheel inductive sensor	L28



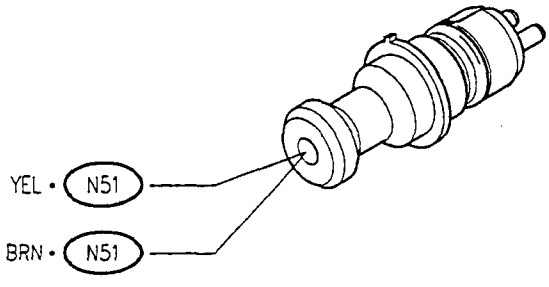
LH front phonic wheel inductive sensor	L29



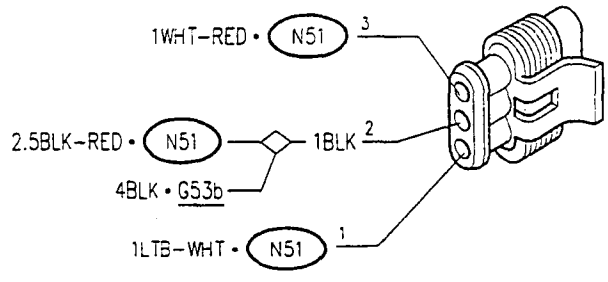
RH rear phonic wheel inductive sensor	L30



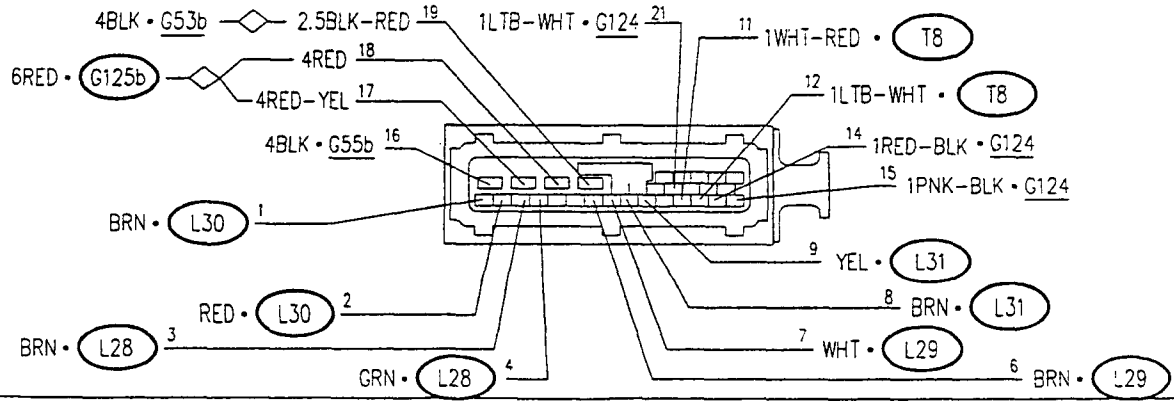
LH rear phonic wheel inductive sensor	L31



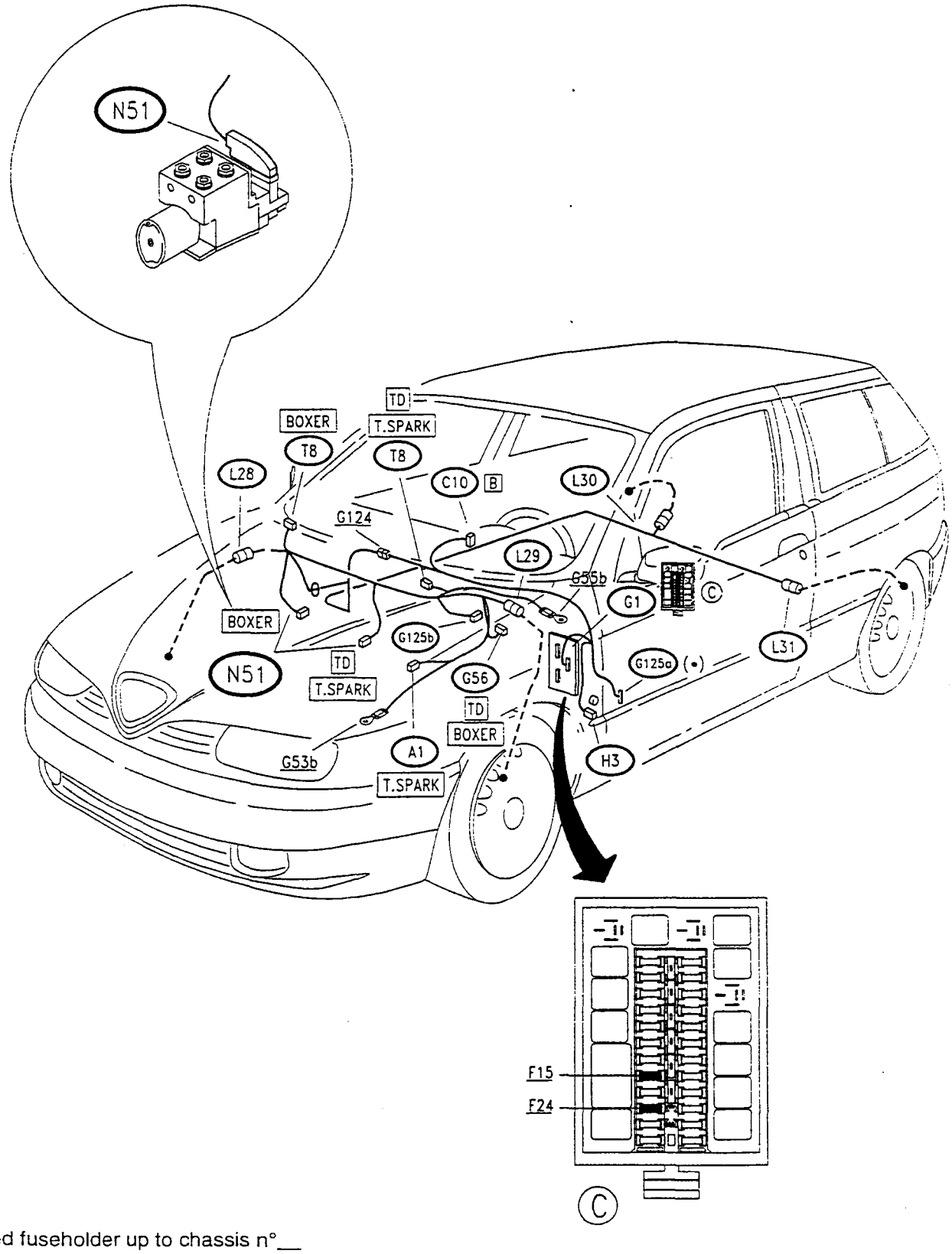
Connector for ALFA TESTER (ABS)	T8



ABS control unit	N51



LOCATION OF COMPONENTS



(•) red fuseholder up to chassis n°__

FAULT-FINDING

AUTOMATIC CHECK UPON IGNITION: when the car is started the "ABS warning light" on the instrument cluster turns on for appr. 2 secs., then it goes off meaning that the system is working properly. If the warning light stays on, carry out diagnosis using the flashing code, as mentioned previously.

If the warning light does not turn on, carry out **test H.**

Fault-Finding using the Flashing Code

The self-diagnosis system with which this system is fitted, makes it possible to quickly locate a faulty component following the instructions of a **FLASHING CODE**, which is activated as follows:

- earth the line of pin 1 of connector **T8** (LIGHT BLUE-WHITE cable)
- power the ABS control unit **N51** (turning the ignition key to MARCIA)

Read the sequence of flashes on the "ABS warning light" on the instrument cluster **C10**:

- after appr. 3 seconds for three times code "12" appears, meaning correct operation: if this does not occur, carry out **test H**
- after another 3 seconds appr. the codes of the errors memorised appear (each repeated three times) at appr. 3 sec. intervals (see table on following page)
- at the end, code "12" appears for another three times, indicating the end of the sequence
- of disconnecting pin 1 of T8, after 2 seconds the system resumes normal operation.

NOTE: Resetting the memorised code is obtained by of disconnecting the line of pin 1 of **T8** and engaging the ignition switch 20 times (or using the ALFA ROMEO Tester)

Fault-finding using the Alfa Romeo Tester

N.B. Before carrying out diagnosis with the Tester, perform the preliminary check described later (TEST A); if the warning light is not working properly also carry out TEST H.

The connection between the TESTER and the control unit must be made as follows:

1. Supply the TESTER either through the cigar lighter socket or connecting directly to the battery using the special lead.
2. Connect the TESTER socket to the control unit (the socket is near the control unit).

The instrument can give the following information:

- parameter display;
- error display;
- active diagnosis.

Activation of diagnosis

Diagnostic conversation is started with the engine stopped and the ignition key at MARCIA.

Flashing code table

NOTE: The error code is formed of two digits and is displayed by a number of flashes equalling the first digit followed by a 1 second pause and then a number of flashes equalling the second digit.

CODICE	DESCRIPTION	CORRECTIVE ACTION
12	Start and end of procedure	-
No code	Control unit or diagnosis function fault	Carry out **test A**
16	Faulty LH front load solenoid valve	Replace the electronic unit group
17	Faulty RH front load solenoid valve	Replace the electronic unit group
19	Faulty solenoid valve supply relay	Replace the electronic unit group
25	Damaged phonic wheel (regardless of which)	Replace the phonic wheel (see GROUP 33)
26	Faulty LH rear load solenoid valve	Replace the electronic unit group
27	Faulty RH rear load solenoid valve	Replace the electronic unit group
28	Faulty LH front relief solenoid valve	Replace the electronic unit group
29	Faulty RH front relief solenoid valve	Replace the electronic unit group
31	Faulty LH rear relief solenoid valve	Replace the electronic unit group
32	Faulty RH rear relief solenoid valve	Replace the electronic unit group
35	Faulty recovery pump	Replace the electronic unit group
37	Inefficient brake pedal switch	Carry out **test B**
39	LH front wheel speed sensor absent	Carry out **test C**
41	LH front wheel speed sensor discontinuous or irregular	Carry out **test C**
42	RH front wheel speed sensor absent	Carry out **test D**
43	RH front wheel speed sensor discontinuous or irregular	Carry out **test D**
44	LH rear wheel speed sensor absent	Carry out **test E**
45	LH rear wheel sensor signal discontinuous or irregular	Carry out **test E**
46	RH rear wheel speed sensor absent	Carry out **test F**
47	RH rear wheel sensor signal discontinuous or irregular	Carry out **test F**
48	Low battery voltage	Carry out **test G**
55	Faulty electronic control unit	Replace the electronic unit group
56	Flashing code activation procedure fault	Carry out **test A**
74	Inefficient warning light wiring on instrument cluster	Carry out **test M**

PRELINARY SYSTEM CHECK	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSES – Check the intactness of wander fuses **G125a** and **G125b**	OK ▶ ~~OK~~ ▶	Carry out step A2 Replace the fuses - **G125a** (10A) - **G125b** (60A)
A2 CHECK VOLTAGE – Check for 12 V at pin 17 and 18 of **N51**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore the wiring between pin 17 and 18 of **N51** and fuse **G125b**
A3 CHECK VOLTAGE – Turn the ignition key and check for 12 V at pin 15 of **N51**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between pin 15 of **N51** and fuse **G125a**
A4 CHECK EARTH – Check that pin 16 of **N51** is earthed	OK ▶ ~~OK~~ ▶	Carry out **step A5** Restore the wiring between pin 16 of **N51** and earth **G55b**
A5 CHECK EARTH – Check that pin 19 of **N51** is earthed	OK ▶ ~~OK~~ ▶	CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER OR FLASHING CODE Restore the wiring between pin 19 of **N51** and earth **G53b**

FAULTY BRAKE SWITCH	TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK STOP LIGHTS – Check that the stop lights are working properly	OK ➡	Carry out **step B2**
	~~OK~~ ➡	Replace the stop light switch **H3**, or proceed as described in the "STOP LIGHTS" section
B2 CHECK VOLTAGE – With the pedal pressed, check for 12 V at pin 14 of **N51**	OK ➡	Check and if necessary replace the electronic control unit **N51**
	~~OK~~ ➡	Restore the wiring between pin 14 of **N51** and **H3**

LH FRONT SENSOR NOT CONNECTED	TEST C

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
C1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pin 7 and 6 of **N51**	OK ➡	Carry out **step C2**
	~~OK~~ ➡	Carry out **step C3**
C2 CHECK CONTINUITY – Disconnect sensor **L29** and check continuity between the sensor and pin 7 of **N51** , and between the sensor and pin 6 of **N51**	OK ➡	Check and if necessary replace sensor **L29**.
	~~OK~~ ➡	Restore the wiring between **L29** and **N51**
C3 CHECK OPEN CIRCUIT – Disconnect sensor **L29** and check for an open circuit between pin 7 and 6 of **N51** (wiring side)	OK ➡	Check and if necessary replace sensor **L29**.
	~~OK~~ ➡	Restore the wiring eliminating the short circuit between the cables connecting **L29** with **N51**

RH FRONT SENSOR NOT CONNECTED	TEST D

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
D1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pin 4 and 3 of **N51**	OK ▶	Carry out **step D2**
	NO ▶	Carry out **step D3**
D2 CHECK CONTINUITY – Disconnect sensor **L28** and check for continuity between the sensor and pin 4 of **N51**, and between the sensor and pin 3 of **N51**	OK ▶	Check and if necessary replace sensor **L28**.
	NO ▶	Restore the wiring between **L28** and **N51**
D3 CHECK OPEN CIRCUIT – Disconnect sensor **L28** and check for an open circuit between pin 4 and 3 of **N51** (wiring side)	OK ▶	Check and if necessary replace sensor **L28**.
	NO ▶	Restore the wiring eliminating the short circuit between the cables connecting **L28** with **N51**

LH REAR SENSOR NOT CONNECTED	TEST E

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
E1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pin 8 and 9 of **N51**	OK ▶	Carry out **step E2**
	NO ▶	Carry out **step E3**
E2 CHECK CONTINUITY – Disconnect sensor **L31** and check continuity between the sensor and pin 8 of **N51**, and between the sensor and pin 9 of **N51**	OK ▶	Check and if necessary replace sensor **L31**.
	NO ▶	Restore the wiring between **L31** and **N51**
E3 CHECK OPEN CIRCUIT – Disconnect sensor **L31** and check for an open circuit between pin 8 and 9 of **N51** (wiring side)	OK ▶	Check and if necessary replace sensor **L31**.
	NO ▶	Restore the wiring eliminating the short circuit between the cables connecting **L31** with **N51**

RH REAR SENSOR NOT CONNECTED — TEST F

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
F1 CHECK OPEN CIRCUIT – Turn the key and check for an open circuit between pin 1 and 2 of **N51**	OK ▶	Carry out **step F2**
	~~OK~~ ▶	Carry out **step F3**
F2 CHECK CONTINUITY – Disconnect sensor **L30** and check continuity between the sensor and pin 1 of **N51** , and between the sensor and pin 2 of **N51**	OK ▶	Check and if necessary replace sensor **L30**.
	~~OK~~ ▶	Restore the wiring between **L30** and **N51**
F3 CHECK OPEN CIRCUIT – Disconnect sensor **L28** and check for an open circuit between pin 1 and 2 of **N51** (wiring side)	OK ▶	Check and if necessary replace sensor **L30.**
	~~OK~~ ▶	Restore the wiring eliminating the short circuit between the cables connecting **L30** con **N51**

INSUFFICIENT SUPPLY VOLTAGE — TEST G

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
G1 CHECK VOLTAGE – Check that the battery voltage is 12V	OK ▶	Carry out **step G2**
	~~OK~~ ▶	Restore the correct voltage charging or changing the battery **A1**
G2 CHECK VOLTAGE – Check for a voltage of 12 V at pin 17 and 18 of **N51**	OK ▶	Carry out **step G3**
	~~OK~~ ▶	Restore the wiring between pin 17 and 18 of **N51** and the battery **A1**, via fuse **G125b**
G3 CHECK VOLTAGE – With the ignition key turned, check for 12 V at pin 15 of **N51** –	OK ▶	CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER
	~~OK~~ ▶	Restore the wiring between pin 15 of **N51** and the ignition switch **B1** via fuse **G125a**

"ABS" WARNING LIGHT NOT WORKING	TEST H

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
H1 CHECK CONTINUITY – Check continuity between pin 12 of **N51** and pin 1 of connector **T8** and between pin 11 of **N51** and pin 3 of **T8**	OK ▶ OK ▶	Carry out **step H2** Restore the wiring between **N51** and connector **T8**
H2 CHECK EARTH SIGNAL – Turn the ignition key and for a few seconds, check for 0V at pin B3 of the instrument cluster **C10**	OK ▶ OK ▶	Replace the ABS warning light bulb on the instrument cluster **C10** Carry out **step H3**
H3 CHECK EARTH SIGNAL – Turn the key and for a few seconds, check for 0V at pin 21 of **N51**	OK ▶ OK ▶	Restore the wiring between **N51** and **C10** Replace the electronic control unit **N51**

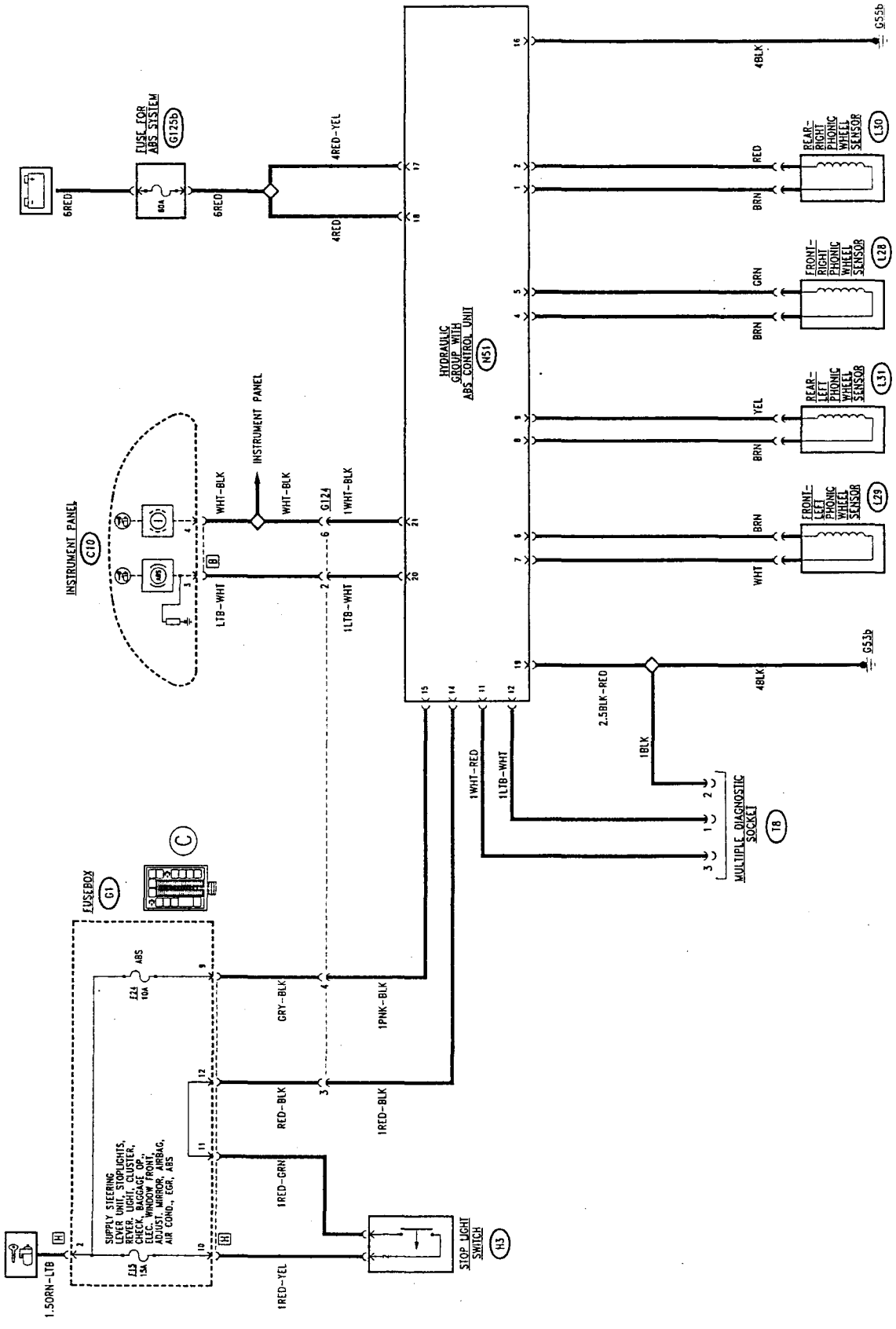
ABS SYSTEM (BOSCH 5.3 ABS with "EBD")

INHALTSVERZEICHNIS

ELEKTRISCHES SCHALTBILD 39B-2
ALLGEMEINE BESCHREIBUNG 39B-3
FUNKTIONSBESCHREIBUNG 39B-3
KOMPONENTEN UND VERBINDER 39B-4
ANORDNUNG DER KOMPONENTEN 39B-6
DEFEKTSUCHE 39B-7

From Model Year '98 replaces the previous 5.3 system.

WIRING DIAGRAM



GENERAL DESCRIPTION

The electronic anti wheel locking systen (BOSCH 5.3 ABS) adjusts the braking pressure transmitted to the wheels preventing lack of grip under all conditions of the tyres and road surfaces.

In this version, the control unit also controls distribution of the braking load also on the rear axle, replacing the mechanical braking distributor used previously ("EBD" function: Electronic Brake Distribution").

The system has been designed to integrate and not replace the normal mechanical braking system, thereby ensuring effective safety in the event of faults: the device works on the same brake fluid as the conventional, mechanical circuit.

Four sensors, on the four wheels, constantly signal to the electronic control unit the speed of each wheel, thus recording wheel locking, skidding and loss of grip conditions.

In these situations the control unit suitably controls the solenoid valves which modulate the pressure in the hydraulic circuit, eliminating locking and bringing the vehicle back to the grip limit, which makes it possible to obtain the shortest braking distance possible, without losing control over steering.
In this version of the system there are two **adjustment solenoid valves** (one for pressure load and one for pressure relief) for each wheel.

For further details on how the hydraulic system works, see GROUP 33-BRAKES.

Components

The system comprises:

- four magnetic induction sensors which read the speed of the wheels: **L28**; **L29**; **L30**; **L31**.
  The sensors are of the "active" type, i.e. they contain a Hall-effect pick-up device which faces a magnetic coder integrated in the hub bearing: in these conditions, the signal is less affected by electromagnetic interferences and by temperature.
- the integrated electronic and hydraulic control unit **N51**, which houses the following:
  - the electronic control module (CPU)
  - eight solenoid valves
  - two brake fluid pumps with associated motor
  - two damping accumulators and two reservoirs
  - a safety valve
- the standardised connector for self-diagnosis **T20**
- the brake switch **H3** (the same one that turns on the braking lights) which signals the braking condition to the system.

The ABS includes a self-diagnosis system which continuously keeps all the system components and parameters under control: in the event of faults or failures, the system cuts itself off automatically, while however leaving the conventional mechanical power-assisted system operational: the driver is alerted of this situation by the special "ABS" warning light on the instrument cluster (**C10**).
This telltale light is the so-called "intelligent" type: : it turns on not only if the system detects an anomaly, but also in cases of lack of contact or short circuit to earth of the circuit that connects the telltale light to the relative control unit thanks to a special internal pilot circuit which checks proper connection.
A fault in the "EBD" function turns on the "handbrake on" warning light .

Connector **T8** also allows connection to the system with the Diagnosis tools available for the Service Network.

FUNCTIONAL DESCRIPTION

System supply:

With a line protected by fuse **F15** of the fusebox **G1**, the "key-operated" voltage supplies pin 15 of the AB control unit **N51**, the battery voltage reaches pin 17 and 18 of **N51** from the line protected by wander fuse **G125b** (60A).

The electronic control unit is connected to earth via pin 19 of **N51**, while the pump is earthed through pin 16.

Sensors and solenoid valves

The module is connected, directly inside the control unit **N51**, with the adjustment solenoid valves, which modulate the pressure on the brakes of the four wheels; outside it is connected with the four sensors **L28 - L29 - L30 - L31** (pin 3-4, 6-7, 1-2 and 8-9) which signal the speed of the single wheels, and with the brake switch **H3** (pin 14) which sends an enable signal: in fact, operation of the ABS system is cut off if the brake pedal is not pressed.

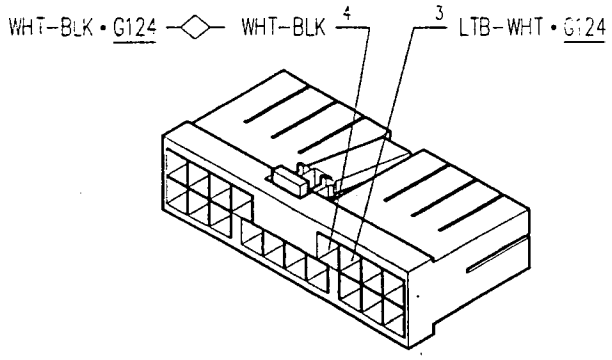
Self-diagnosis:

When the control unit detects problems through the self- diagnosis function associated with the "ABS" system, it sends a signal to the instrument cluster **C10** which turns on the "ABS failure" warning light: this signal is sent from pin 20.
If the problems involve the "EBD" function, the handbrake warning light is turned on, from pin 21.

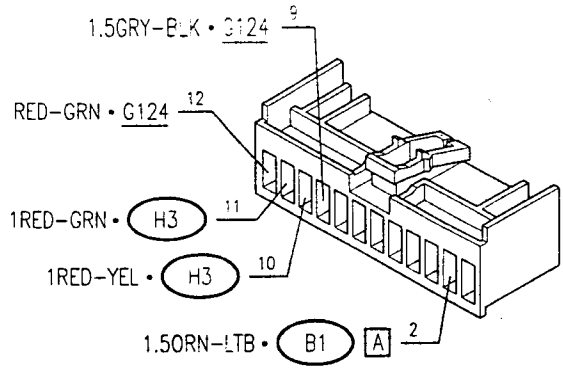
The diagnosis connector **T8** connected to pin 11 and 12 allows connection of the control unit with the diagnosis tools of the Service Network.

COMPONENTS AND CONNECTORS

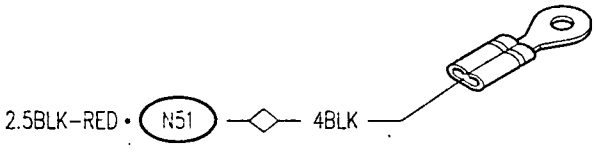
Instrument cluster	C10 B



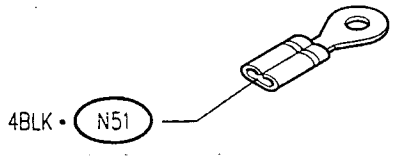
Fusebox	G1 H



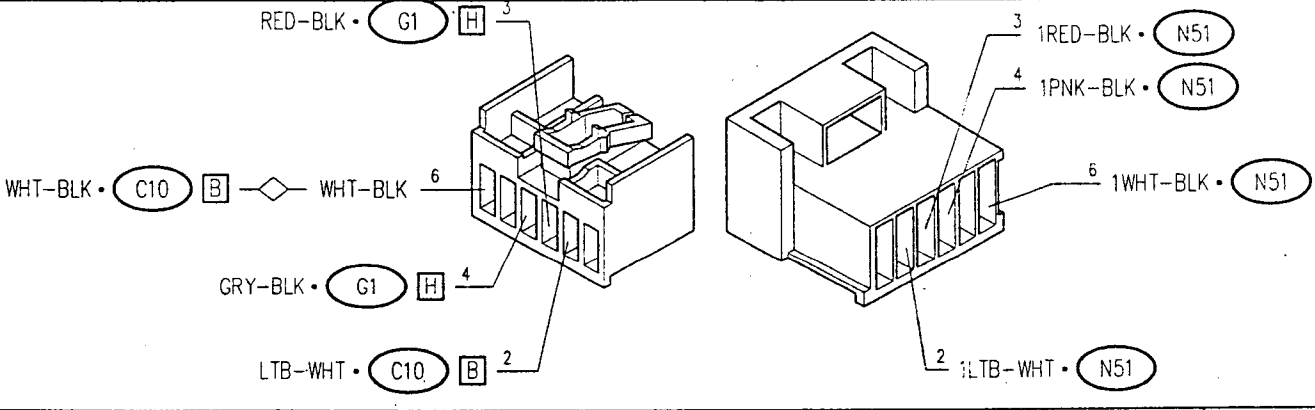
LH engine compartment earth	G53b



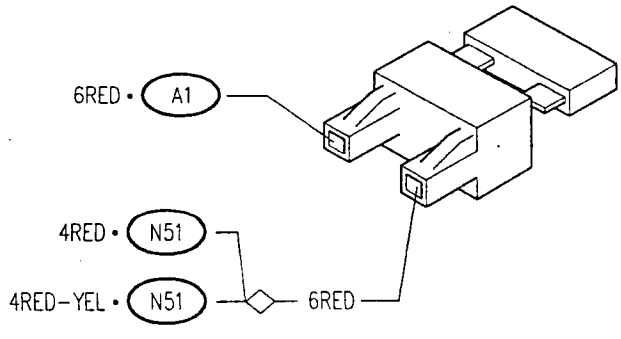
LH side panel earth	G55b



ABS system connector	G124



ABS system fuse	G125b



GENERAL DESCRIPTION

The electronic anti wheel locking systen (BOSCH 5.3 ABS) adjusts the braking pressure transmitted to the wheels preventing lack of grip under all conditions of the tyres and road surfaces.

In this version, the control unit also controls distribution of the braking load also on the rear axle, replacing the mechanical braking distributor used previously ("EBD" function: Electronic Brake Distribution").

The system has been designed to integrate and not replace the normal mechanical braking system, thereby ensuring effective safety in the event of faults: the device works on the same brake fluid as the conventional, mechanical circuit.

Four sensors, on the four wheels, constantly signal to the electronic control unit the speed of each wheel, thus recording wheel locking, skidding and loss of grip conditions.

In these situations the control unit suitably controls the solenoid valves which modulate the pressure in the hydraulic circuit, eliminating locking and bringing the vehicle back to the grip limit, which makes it possible to obtain the shortest braking distance possible, without losing control over steering.
In this version of the system there are two **adjustment solenoid valves** (one for pressure load and one for pressure relief) for each wheel.

For further details on how the hydraulic system works, see GROUP 33-BRAKES.

Components

The system comprises:

- four magnetic induction sensors which read the speed of the wheels: **L28**; **L29**; **L30**; **L31**.
  From chassis no.___ the sensors are of the "active" type, i.e. they contain a Hall-effect pick-up device which faces a magnetic coder integrated in the hub bearing: in these conditions, the signal is less affected by electromagnetic interferences and by temperature.
- the integrated electronic and hydraulic control unit **N51**, which houses the following:
  - the electronic control module (CPU)
  - eight solenoid valves
  - two brake fluid pumps with associated motor
  - two damping accumulators and two reservoirs
  - a safety valve
- the standardised connector for self-diagnosis **T20**
- the brake switch **H3** (the same one that turns on the braking lights) which signals the braking condition to the system.

The ABS includes a self-diagnosis system which continuously keeps all the system components and parameters under control: in the event of faults or failures, the system cuts itself off automatically, while however leaving the conventional mechanical power-assisted system operational: the driver is alerted of this situation by the special "ABS" warning light on the instrument cluster (**C10**).
A fault in the "EBD" function turns on the "handbrake on" warning light.

Connector **T20** also allows connection to the system with the Diagnosis tools available for the Service Network.

FUNCTIONAL DESCRIPTION

System supply:

With a line protected by fuse **F15** of the fusebox **G1**, the "key-operated" voltage supplies pin 15 of the AB control unit **N51**, the battery voltage reaches pin 17 and 18 of **N51** from the line protected by wander fuse **G125b** (60A).

The electronic control unit is connected to earth via pin 19 of **N51**, while the pump is earthed through pin 16.

Sensors and solenoid valves

The module is connected, directly inside the control unit **N51**, with the adjustment solenoid valves, which modulate the pressure on the brakes of the four wheels; outside it is connected with the four sensors **L28 - L29 - L30 - L31** (pin 3-4, 6-7, 1-2 and 8-9) which signal the speed of the single wheels, and with the brake switch **H3** (pin 14) which sends an enable signal: in fact, operation of the ABS system is cut off if the brake pedal is not pressed.

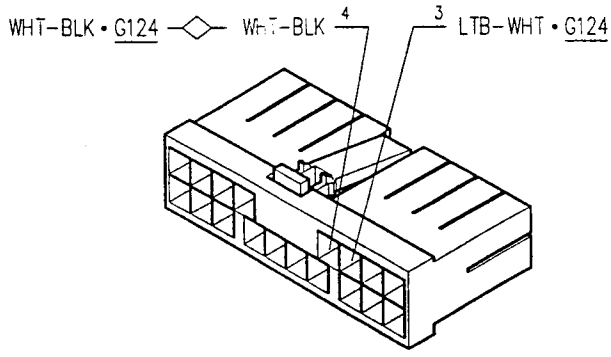
Self-diagnosis:

When the control unit detects problems through the self- diagnosis function associated with the "ABS" system, it sends a signal to the instrument cluster **C10** which turns on the "ABS failure" warning light: this signal is sent from pin 20.
If the problems involve the "EBD" function, the handbrake warning light is turned on, from pin 21.

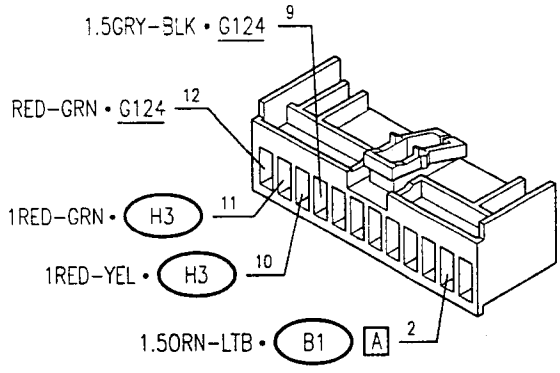
The diagnosis connector **T20** connected to pin 11 allows connection of the control unit with the diagnosis tools of the Service Network.

COMPONENTS AND CONNECTORS

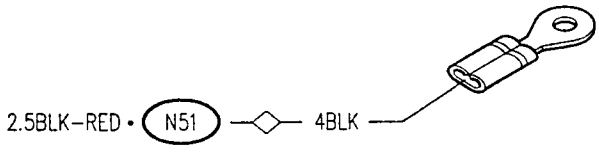
Instrument cluster	C10 B



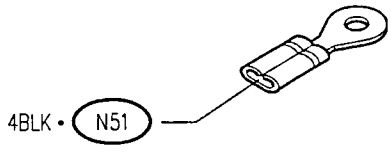
Fusebox	G1 H



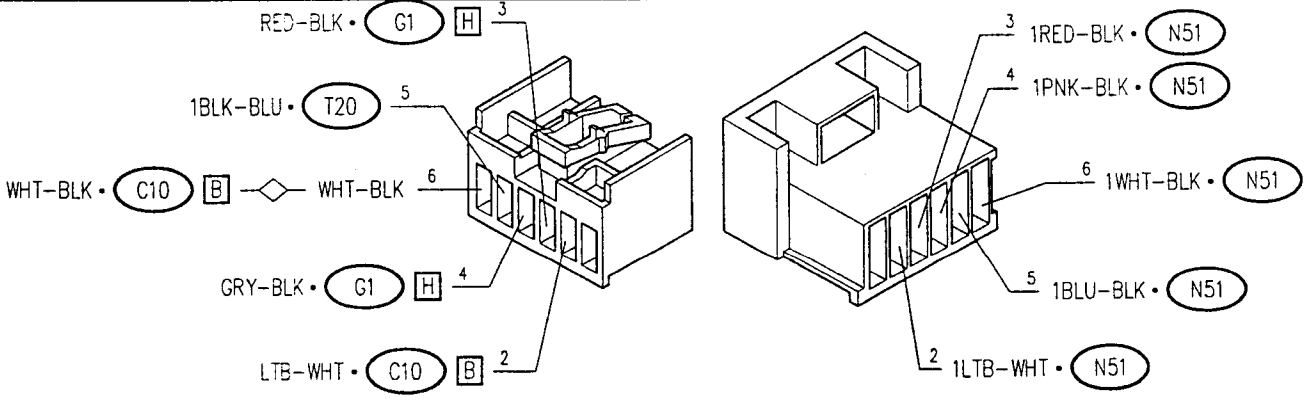
LH engine compartment earth	G53b



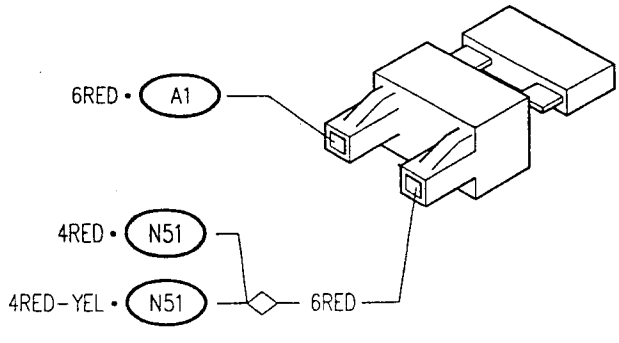
LH side panel earth	G55b



ABS system connector	G124

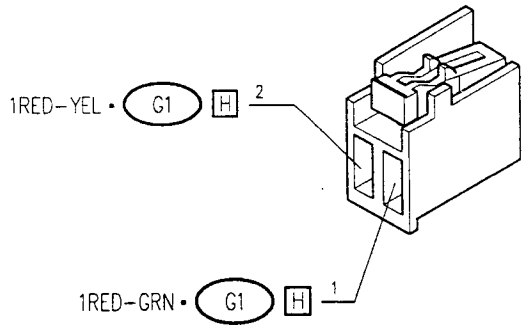


ABS system fuse	G125b

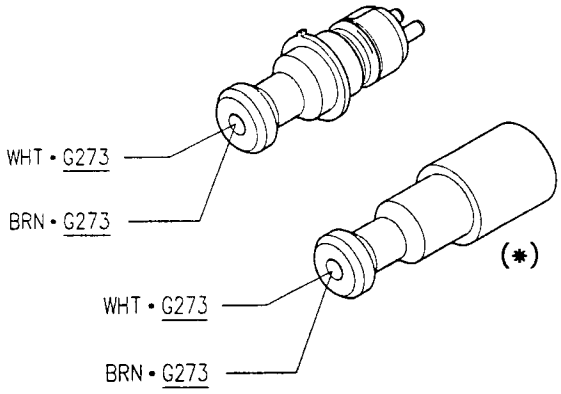


COMPONENTS AND CONNECTORS (cont.d)

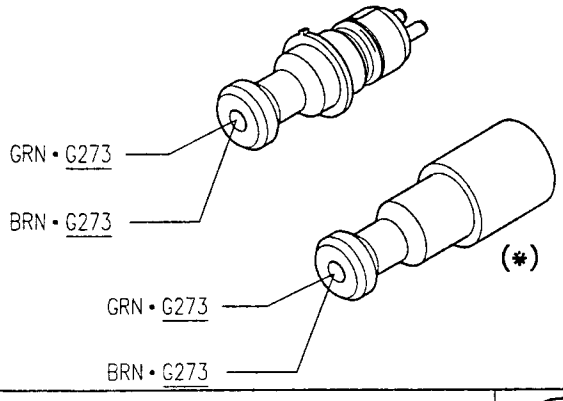
Brake light switch	H3



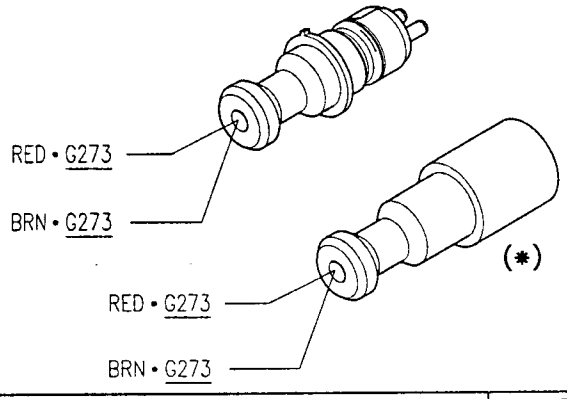
RH front phonic wheel inductive sensor	L28



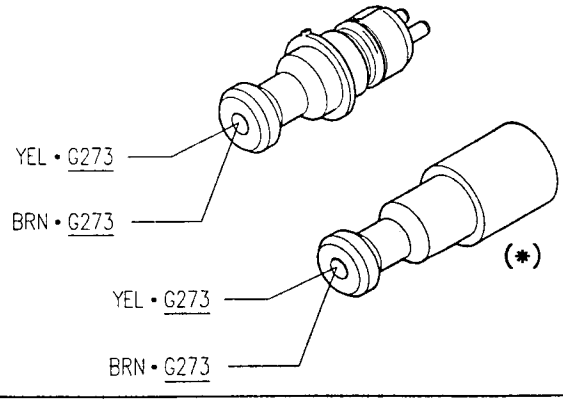
LH front phonic wheel inductive sensor	L29



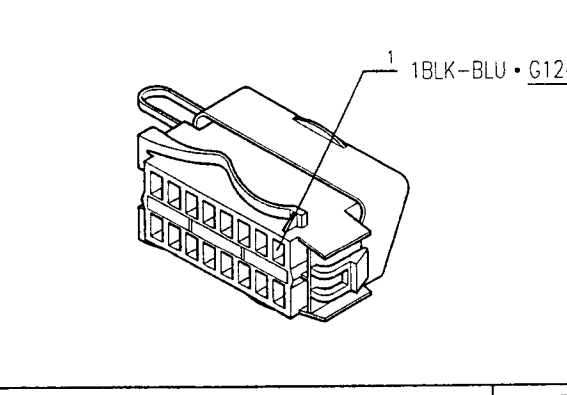
RH rear phonic wheel inductive sensor	L30



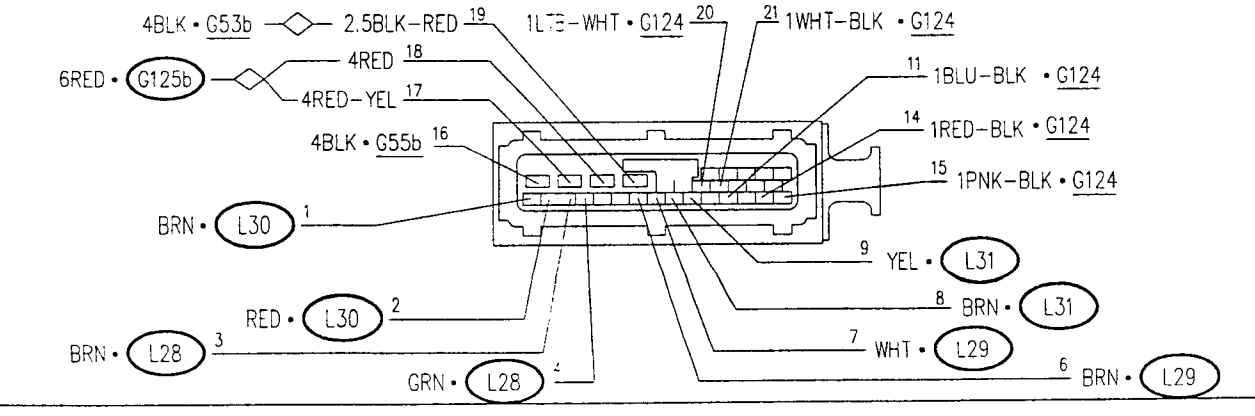
LH rear phonic wheel inductive sensor	L31



Standardised diagnosis connector	T20

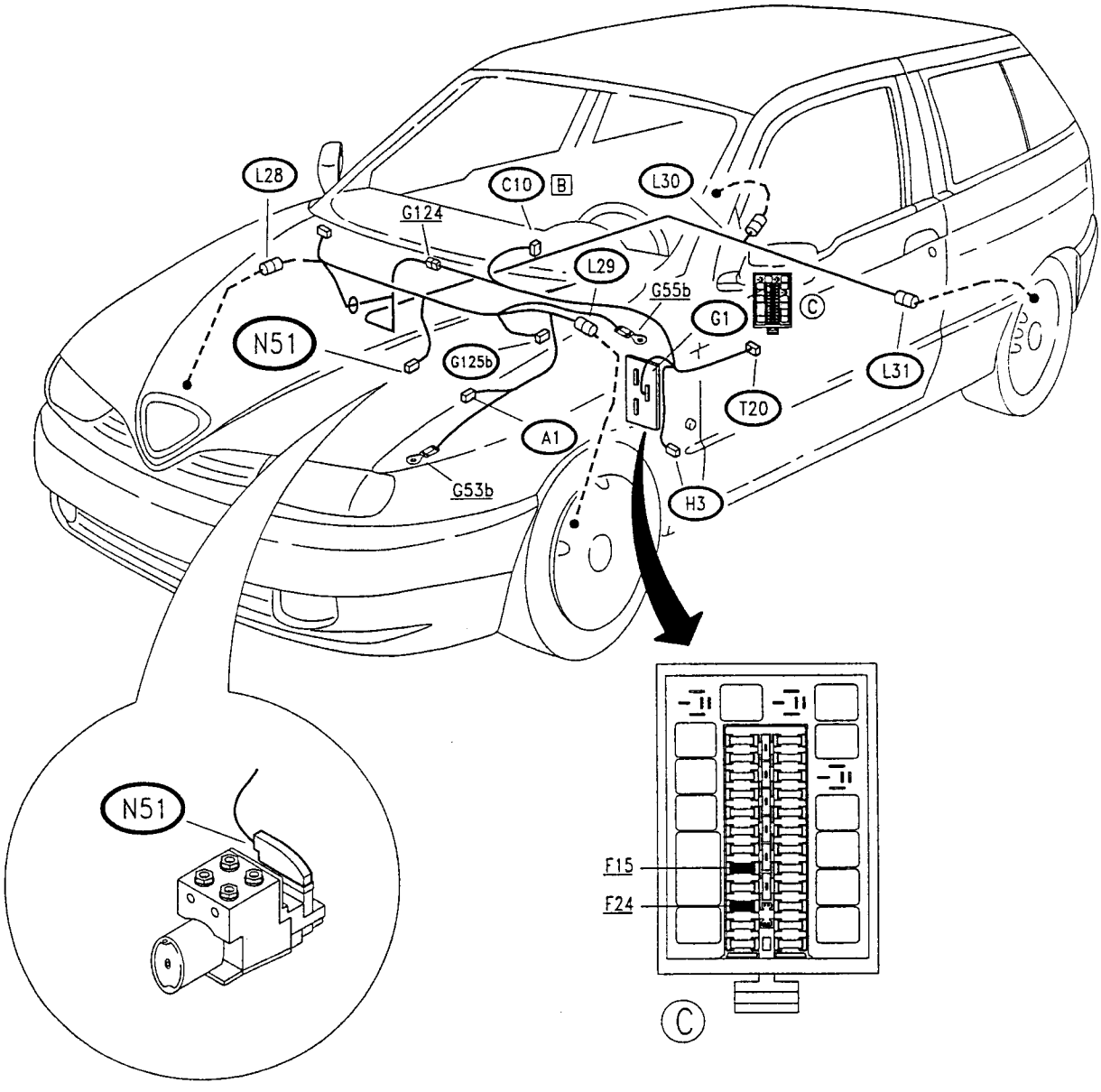


ABS control unit	N51



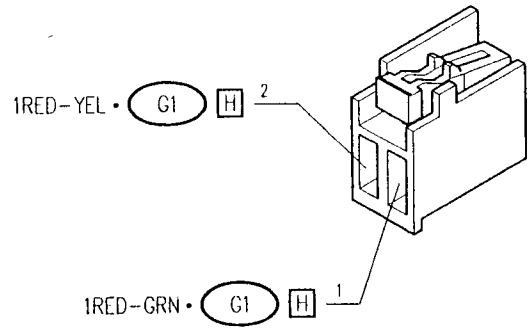
(*) Version with "ACTIVE SENSORS"

LOCATION OF COMPONENTS

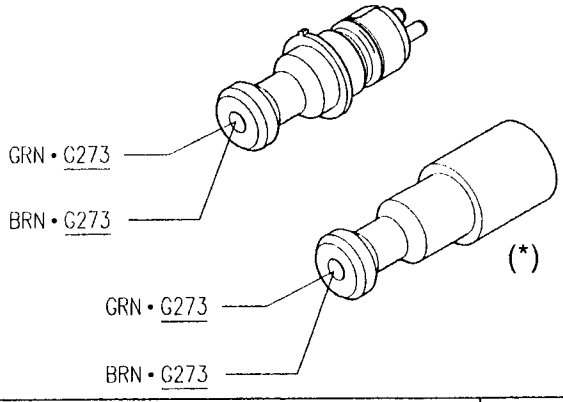


COMPONENTS AND CONNECTORS (cont.d)

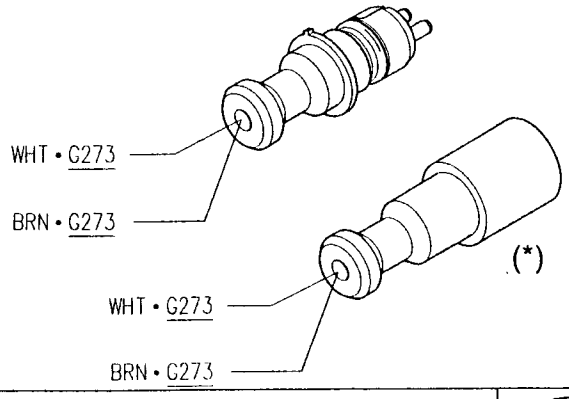
Brake light switch	H3



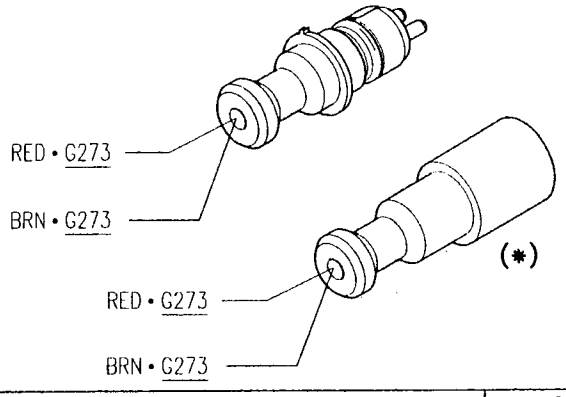
RH front phonic wheel inductive sensor	L28



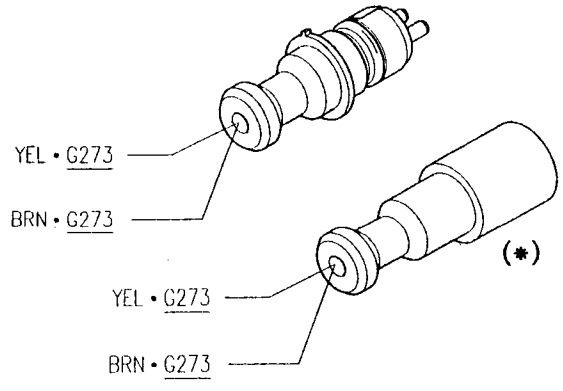
LH front phonic wheel inductive sensor	L29



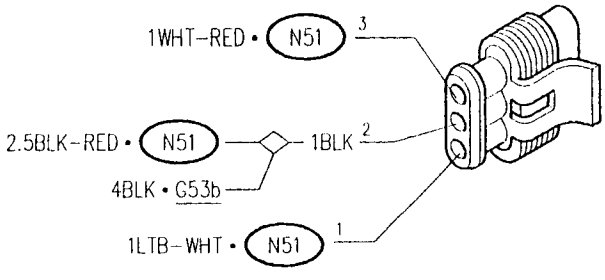
RH rear phonic wheel inductive sensor	L30



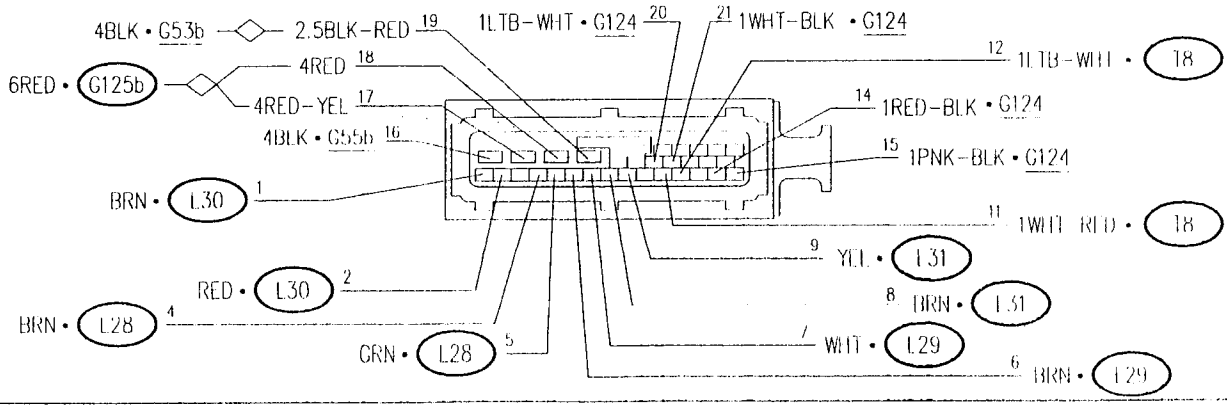
LH rear phonic wheel inductive sensor	L31



Connector for ALFA TESTER (ABS)	T8

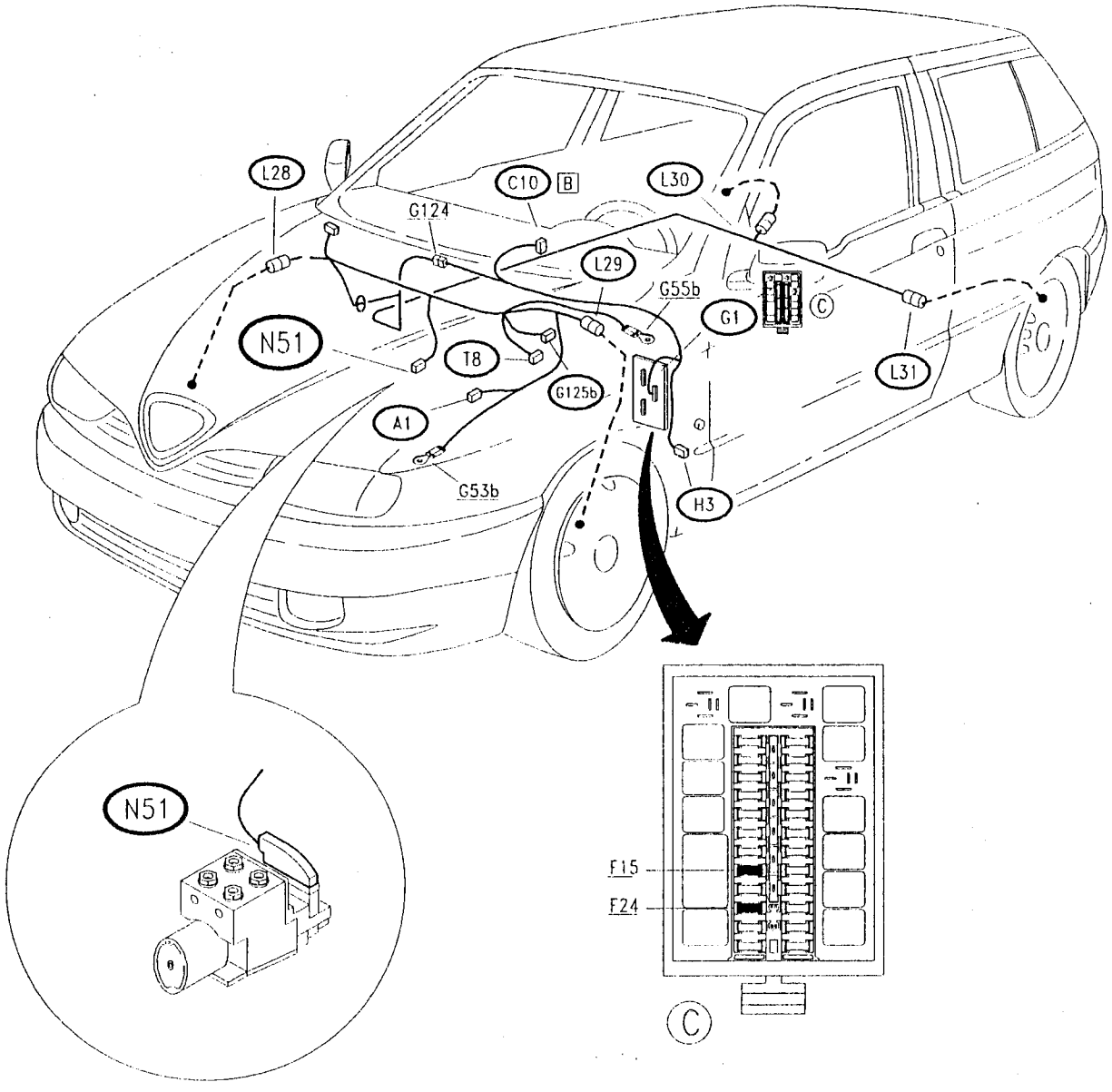


ABS control unit	N51



(*) Version with "ACTIVE SENSORS"

LOCATION OF COMPONENTS



FAULT-FINDING

AUTOMATIC CHECK AT SWITCH ON: when the car is started the "ABS failure" warning light on the instrument cluster turns on for approx. 2 sec., then it goes out to indicate correct operation of the system.
If the warning light stays on, carry out diagnosis connecting the Service Network diagnosis tool to connector **T20**.

If the light fails to turn on, carry out **test B.**

N.B.: When the control unit detects an error in the "ABS" function and turns on the warning light at the same time it deactivates the system, therefore the vehicle brakes with the conventional system only.
When the control unit also detects an error in the "EBD" function", it turns on both warning lights e . In these conditions rear braking distribution control is also deactivated and the car should be driven very carefully.

PRELIMINARY SYSTEM CHECK	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSES – Check that wander fuses **F15** and **G125b** are intact	OK ▶ OK ▶	Carry out **step A2** Replace the fuses - **F15** (15A) - **G125b** (60A)
A2 CHECK VOLTAGE – Check for 12 V at pin 17 and 18 of **N51**	OK ▶ OK ▶	Carry out **step A3** Restore the wiring between pin 17 and 18 of **N51** and fuse **G125b**
A3 CHECK VOLTAGE – Turn the key and check for 12 V at pin 15 of **N51**	OK ▶ OK ▶	Carry out **step A4** Restore the wiring between pin 15 of **N51** and the control box **G1**
A4 CHECK EARTH – Check that pin 16 of **N51** is earthed	OK ▶ OK ▶	Carry out **step A5** Restore the wiring between pin 16 of **N51** and earth **G55b**
A5 CHECK EARTH – Check that pin 19 of **N51** is earthed	OK ▶ OK ▶	CONTINUE DIAGNOSIS USING THE DIAGNOSIS TOOLS Restore the wiring between pin 19 of **N51** and earth **G53b**

"ABS" WARNING LIGHT NOT WORKING (*)	TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK CONTINUITY – Check for continuity between pin 12 of **N51** and pin 1 of connector **T8** and between pin 11 of **N51** and pin 3 of **T8**	OK ▶ ~~OK~~ ▶	Carry out **step B2** Restore the wiring between **N51** and connector **T8**
B2 CHECK EARTH SIGNAL – Turn the key and check for 0V, for a few seconds at pin B3 of the instrument cluster **C10**	OK ▶ ~~OK~~ ▶	Replace the ABS warning light on the instrument cluster **C10** Carry out **step B3**
B3 CHECK EARTH SIGNAL – Turn the key and check for 0V, for a few seconds at pin 20 of **N51**	OK ▶ ~~OK~~ ▶	Restore the wiring between **N51** and **C10** Replace the electronic control unit **N51**

(*) To check whether the "EBD" warning light is working, simply pull the handbrake! In the event of a fault, proceed as described in the "Instrument Cluster" section.

ALFA ROMEO CODE

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(•) For the T.SPARK 2.0 16V (with M2.10.3) version refer to the details given for the 1.7 16V, as the wiring diagram is the same

GENERAL DESCRIPTION

The car is fitted with an electronic code system (ALFA ROMEO CODE) which inhibits the control of the engine operated by the ignition keys.

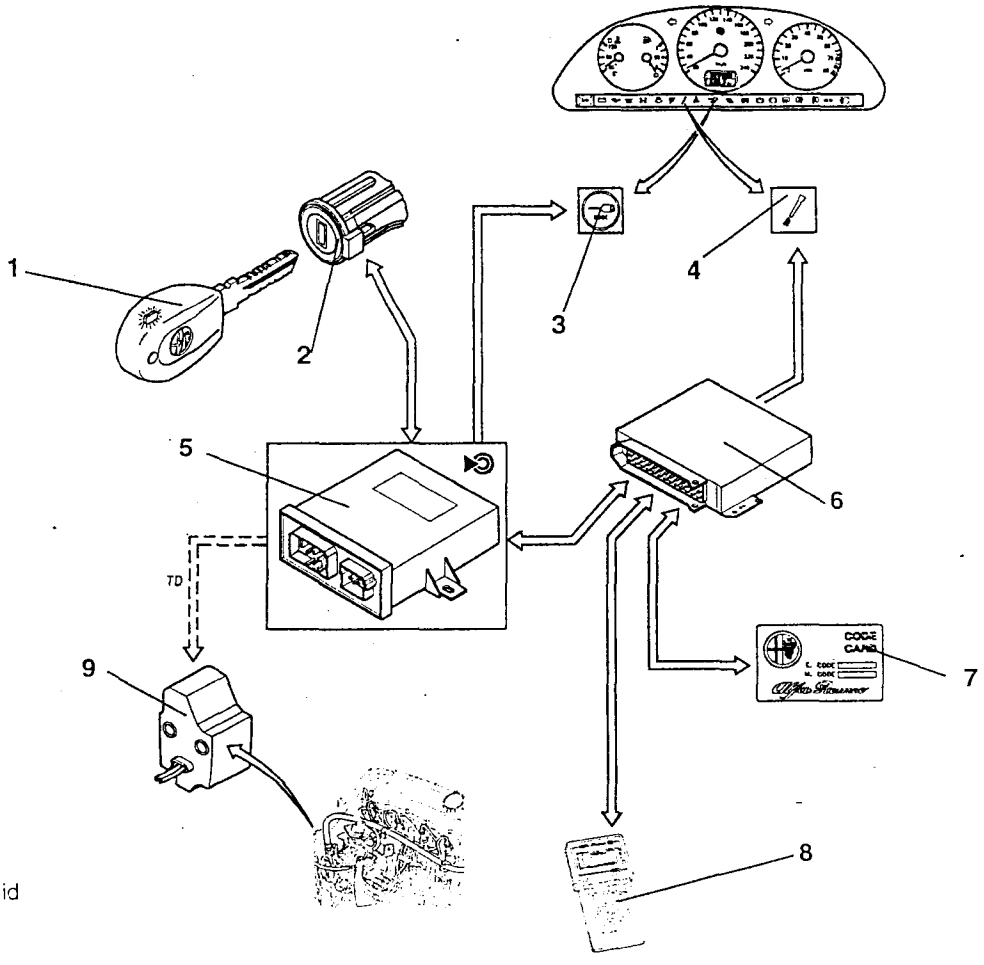
PETROL AND JTD VERSIONS:

Turning the key to the MARCIA position the Engine Control System Control unit (**C.C.M.**) requests the code from the Control unit of the ALFA ROMEO CODE system - Electronic Key Control Unit (**C.C.E.**). Once it has received the code, it compares it with the code in its memory (**MASTER CODE**).
It the comparison of the code received with the one memorised is positive the C.C.M proceeds with normal electronic engine management (starting, ignition, injection, etc.).
If not, (wrong code, various faults, etc.) the C.C.M. does not carry out engine management and the car will not start.
The C.C.M. offers the possibility to start the car without having received the MASTER CODE by the emergency procedures using the Code Card or the Alfa Tester (see recovery procedures).
The code transmitted to the engine control system control unit (allowing over 4 billion combinations) is computed by an algorithm which makes each transmission between C.C.M. and C.C.E. different from the previous one. (variable, crypted code).

If the code has not been recognised correctly the ALFA ROMEO CODE warning light stays on, together with the injection system failure warning light.

TD VERSION:

In the TD version a special Electronic Device integrated in the Engine Stop Solenoid valve (**D.E.S.M.**) communicates with the C.C.E..
Turning the key to the MARCIA position, the D.E.S.M. device asks the ALFA ROMEO CODE system control unit - Electronic Key Control Unit (**C.C.E.**) for a code. Once it has received the code, it compares it with the memorised code (**MASTER CODE**).
If the comparison of the code recieved with the one memorised is posiive, the D.E.S.M. device enables the normal opening of the engine stop solenoid valve.
If not, (wrong code, various faults, etc.) the solenoid valve will not open and the engine will not start.
The C.C.M. offers the possibility to start the car without having received the MASTER CODE by the emergency procedures using the Code Card or the Alfa Tester (see recovery procedures).
If the code has not been recognised correctly, the ALFA ROMEO CODE warning light stays on (in the TD version the injection system warning light is not present).
NOTE: in the following pages the D.E.S.M. device will be called C.C.M., for all the functions which remain unchanged with respect to the injection control unit of a petrol engine.



1. Electronic key
2. Ignition lock
3. "ALFA ROMEO CODE" warning light
4. Injection failure warning light
5. ALFA ROMEO CODE Electronic key control unit
6. Injection control unit (C.C.E.)
7. Code Card
8. Alfa Romeo Tester
9. Engine stop electronic solenoid valve device (D.E.S.M.)

DESCRIPTION OF COMPONENTS

The system comprises the following components:

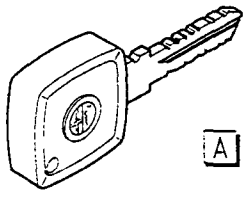
Keys

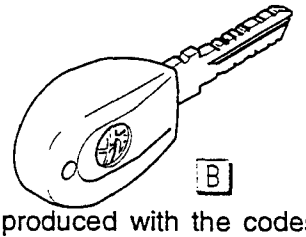
The following are supplied:

- An electronic key ***A:*** **"MASTER" key**
- Two **main electronic keys *B* (with Alfa Romeo badge)**

The keys contain an electronic circuit called Transponder, which contains the code which characterises them; this is transmitted to the Electronic key control unit (C.C.E.) when the key is turned to the MARCIA position.

Each electronic key possesses its own code, which must be memorised by the system's electronic control unit.





The cars are produced with the codes of the keys supplied with them already memorised, as described below:

- The C.C.E. contains the codes of the two main keys and the MASTER CODE (code of the master key)
- The C.C.M. only contains the MASTER CODE

It is very important to keep the MASTER key most carefully, since its code is memorised, through a special specific procedure (described later), in the electronic injection control unit, therefore the two control units are linked indissolubly.

If the MASTER key goes astray or is damaged, further memorising procedures of new keys will not be possible; without the MASTER key in the event of a failure to the C.C.E. it will be necessary to change the C.C.E. and the C.C.M.

The user is advised to keep the MASTER key in a safe place outside the car. In fact, it serves as an "access key" for memorising further codes (keys). The MASTER key should only be used when needing to memorise new keys.

The Transponder inside the key comprises a minute integrated circuit (which contains the code), and a coil (which supplies the integrated circuit and transmits the code).

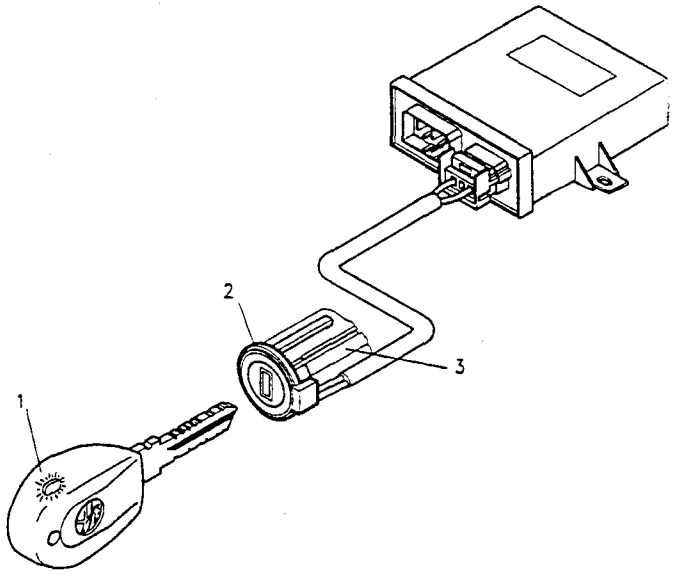
In the main keys, the Transponder is inserted in an accessible manner, while the MASTER key has the possibility to transfer the component to another MASTER key, if the need arises (for example if the ignition lock needs replacing).

The **MASTER** key is proof of the ownership of the car: it must therefore be present (together with the Code Card), when the car is sold.

Aerial

The aerial is a loop coil which is wound round the ignition lock and is connected to the C.C.E. by a specific connector (see figure).

The purpose of the aerial is firstly to supply the transponder so that it can send the code and secondly to receive the Transponder signal.

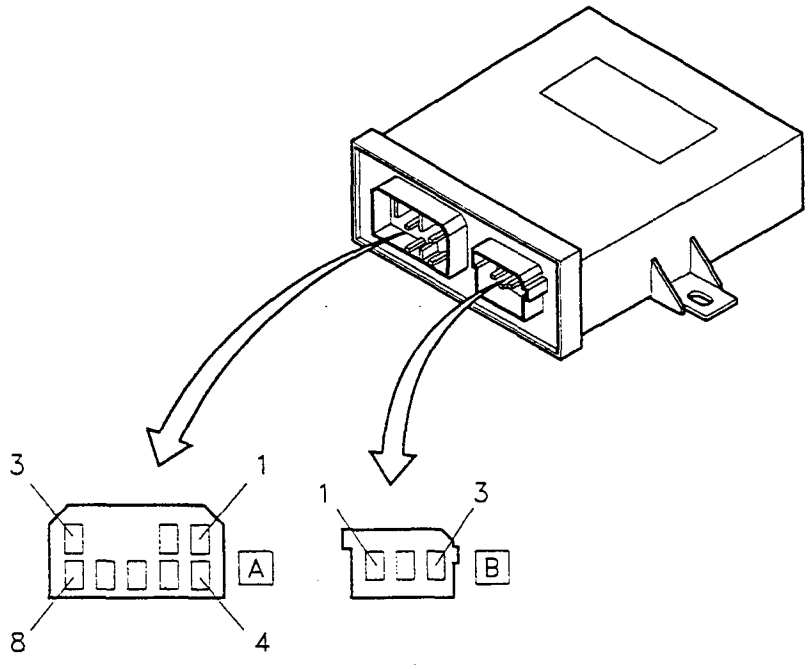


1. Transponder
2. aerial
3. ignition lock

Electronic Key Control unit (C.C.E.)

The C.C.E. is located under the dashboard at the right of the steering wheel ; it is interfaced with the car via two connectors: B (3-way) and A (8-way) and it has the following functions:

- It detects rotation of the key in the ignition switch to the MARCIA position
- It emits an electromagnetic field to give power and activate the Transponder of the key
- It receives and computes the secret code sent by the key
- It manages the serial line connecting with the C.C.M. control unit (petrol engines) or with the D.E.S.M. device (TD version)
- It manages the special diagnosis warning light on the instrument cluster
- It memorises up to 8 secret codes, one of which is the MASTER CODE
- It recognises connection with the Alfa Tester and allows the use of the serial line for diagnosis (only for Bosch Motronic injection - 1.7 16 v engine - and for TD engine)



CONNECTOR A

pin 1: N.C.
pin 2: warning light signal
pin 3: direct supply
pin 4: earth
pin 5: diagnosis line K
pin 6: serial line towards the C.C.M.
pin 7: signal for outside relay (N.C.)
pin 8: key-operated supply

CONNECTOR B

pin 1: aerial signal
pin 2: N.C.
pin 3: aerial earth

Engine Control System Control Unit (C.C.M.) with software (programme) for ALFA ROMEO CODE :

Thw engine control system control units adopted on these cars are provided with functions for management of the ALFA ROMEO CODE electronic key: these functions, which are activated when the key is turned, are the following:

- Permanent memorising of the MASTER key code (MASTER CODE) by a specific procedure carried out during production testing or when the C.C.M. is changed.
- Request of the MASTER key code to the C.C.E.
- Recognition of the MASTER CODE and engine control enabling (starting the car)
- Recognition of the message (transmitted by the C.C.E.) warning that an unauthorised key has been inserted (the car will not start).
- Recovery function via the Alfa Romeo Tester (it is necessary to know the ELECTRONIC CODE written on the Code Card)
- Recovery function by entering the ELECTRONIC CODE written on the Code Card using the accelerator pedal.
- Control of the diagnosis warning light (injection failure warning light)

Absolutely never exchange the injection control units between cars to check whether they are working properly.

Therefore, during fault-finding operations, avoid changing the injection control unit, if you are not sure that it is the cause of the problem on the car (firstly check the actuators and sensors and the wiring, etc.) bearing in mind that the installation of a new control unit (never used before) will involve the permanent memorising of the MASTER CODE inside it of the next key that is turned to MARCIA; therefore, from that moment onwards this control unit will only work in combination with the keys and C.C.E. of that car.

Electronic Engine Stop Solenoid Valve Device (D.E.S.M.) with software (programme) for ALFA ROMEO CODE:

In the TD version the special electronic device D.E.S.M. is provided with the functions for management of the ALFA ROMEO CODE:

These functions are the same as for the C.C.M. in a petrol engine, with the exception of the following differences:

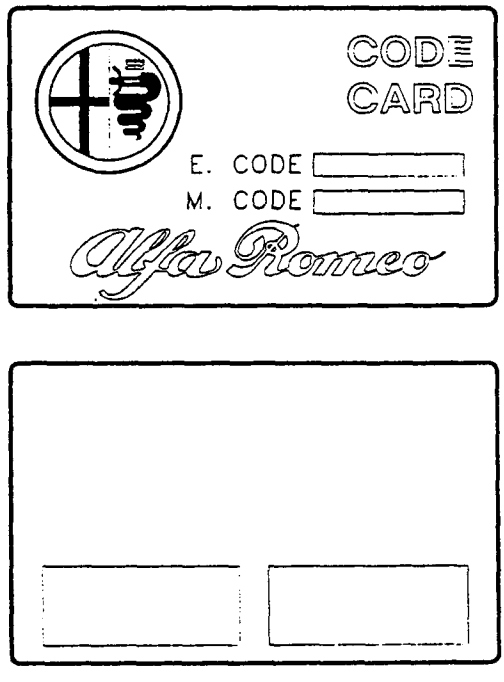
- There is the recovery system via Alfa Romeo Tester, but NOT via the accelerator pedal
- There is no specific diagnosis warning light (injection failure warning light)

Never exchange the D.E.S.M. devices between cars to check that they are working properly.

Code Card (card with secret code)

This is a memo card the size of a credit card which is supplied with the car. (see illustration).

It contains a five-digit code (**ELECTRONIC CODE**) which makes it possible to start the engine (recovery function) when the electronic keys have been lost or damaged.
Two cards are supplied.
NOTE: Clearly this emergency procedure only takes account of the electronic code associated with the keys, and not the mechanical parts shared with other cars.



The Code Card should not be kept in the car, but it should be kept at hand because through the code, it will be possible to start the car without the ALFA ROMEO CODE (see the specific recovery procedure).

The Code Card, as well as the ELECTRONIC CODE (**"E. CODE"**), contains the mechanical code of the keys (**"M. CODE"**): through this code it is possible to request other keys suited to the ignition switch and to be memorised in the C.C.E.

On the back there are two special spaces for applying the labels of the transmitters supplied with the optional alarm system (V.A.S. alarm).

OPERATION: Anti-theft strategy

Each time the ignition key is turned to MARCIA the following main operations are carried out in sequence: The injection control unit asks the C.C.E. for the MASTER CODE (the one of the MASTER key memorised previously).

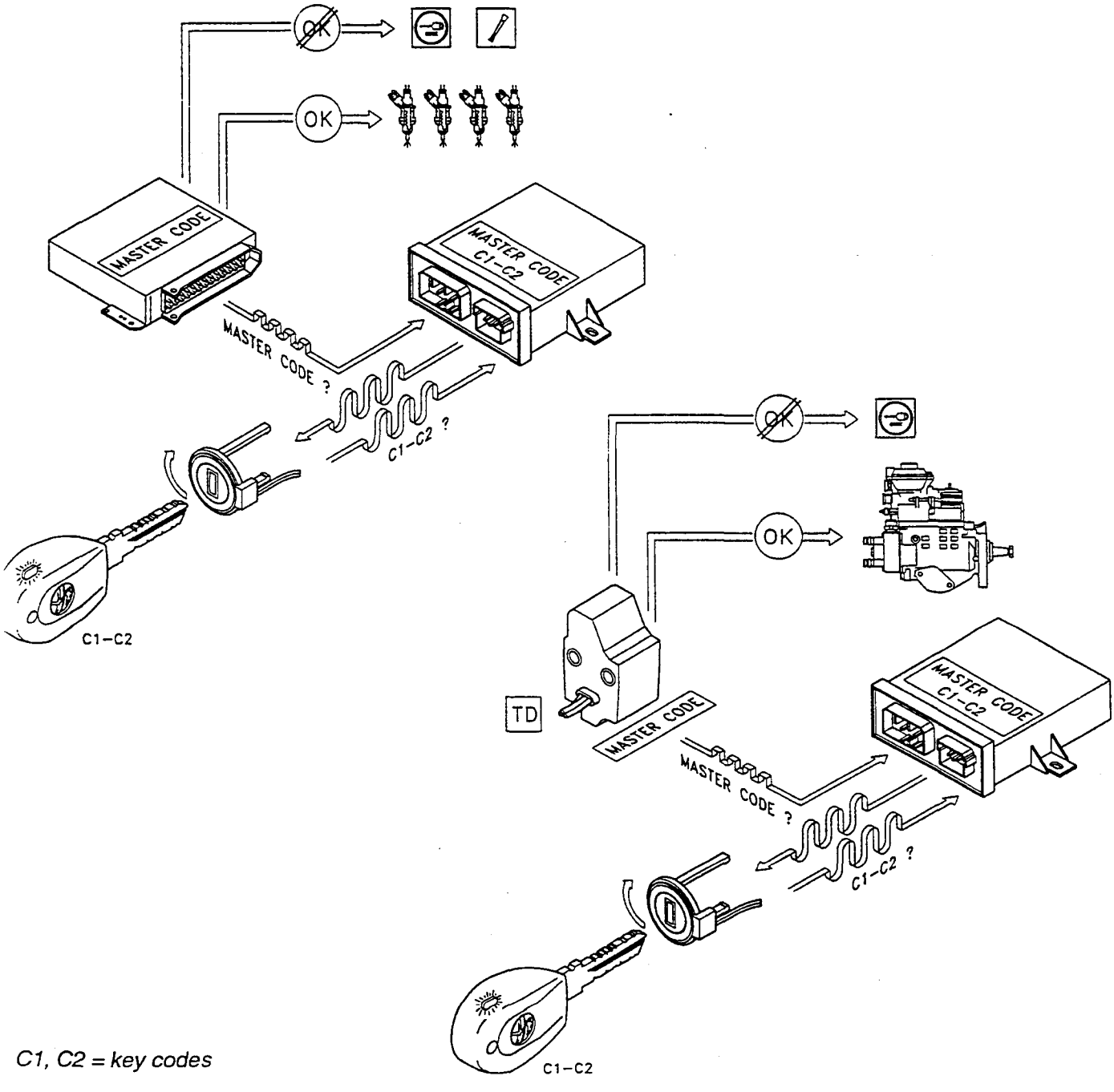
The C.C.E. checks that the code of the key engaged in the ignition lock corresponds to one of the codes contained in its memory.

If the key corresponds to one of the memorised codes:

the C.C.E. sending the MASTER CODE, to the injection control unit, **enables starting** (see illustration).

If the code of the key engaged in the ignition lock does not correspond to one of those memorised:

The C.C.E. informs the injection control unit that an extraneous key has been engaged and **starting will not be enabled** (see illustration) this situation will be indicated by the turning on of the electronic injection system failure warning light (only in petrol versions) and the ALFA ROMEO CODE warning light.



C1, C2 = key codes

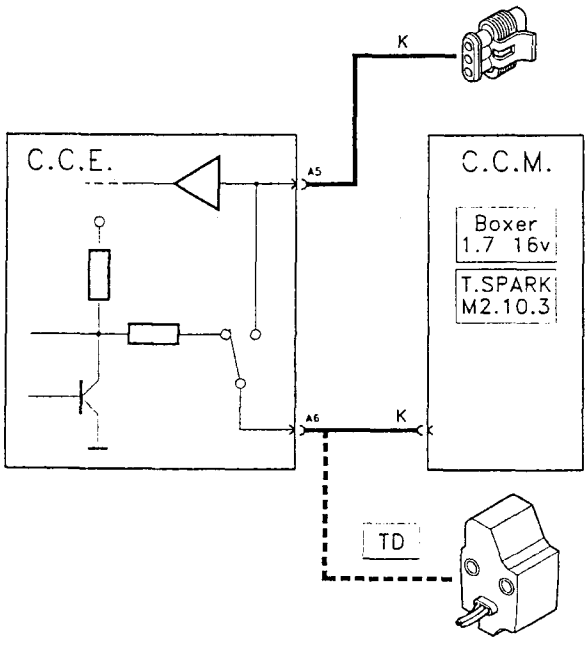
Interaction between key and C.C.E.

When the C.C.E. detects the engagement of the key it sends a signal to the ends of the aerial thereby generating an electromagnetic field.
This way the Transponder coil is inductively connected and it receives the energy to supply the integrated circuit to which it is connected.
At this point the integrated circuit transmits the code.

Sharing of the serial line of the diagnosis functions and the ALFA ROMEO CODE system (Bosch Motronic M2.10.3 versions - 1.7 16v, T.SPARK 2.0 16v- and TD engines)

Inside the C.C.E. there is a shunt relay which has the purpose of enabling dialogue between the C.C.M. and the Alfa Tester or the C.C.E. itself. Pin A6 is usually dedicated to dialogue between the C.C.E. and the C.C.M (see illustration).
Line K of the diagnosis socket is connected to the C.C.E. at pin A5.
The shunt relay is normally in such a position as to allow dialogue between the C.C.E. and the C.C.M (default position).

When diagnosis begins connecting with the Alfa Tester (turning the ignition key to MARCIA) the C.C.E., after ending dialogue with the C.C.M. recognises the request for diagnosis and pilots the relay to connect pin A5 and A6 to one another, thereby enabling dialogue between the tester and the C.C.M.



The C.C.E enables connection with the Alfa Tester only when the following conditions occur contemporaneously:

- There is not activity on the serial line between the C.C.E. and the C.C.M.
- A low level (of voltage) is present on pin A5 for a time of between 500ms and 5s (a low level for over 5s is considered as a short circuit towards earth)

The relay returns to the default position when there is no activity on pin A5 for over 30s.

When the control unit detects that the Alfa Tester has been engaged, it turns on the ALFA ROMEO CODE warning light to indicate correct switching of the relay.

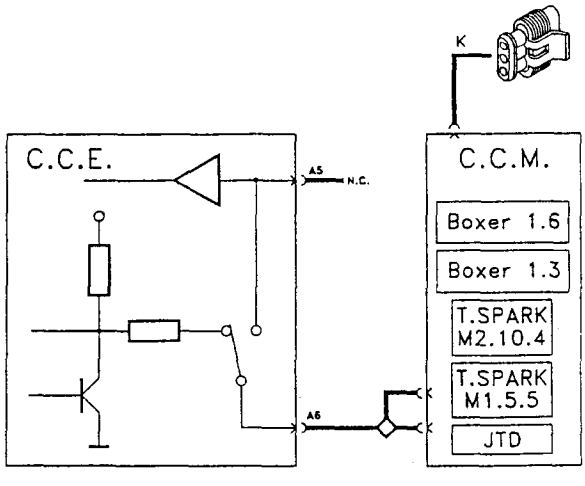
NOTE: in the TD version, the connection of the D.E.S.M. deice with the Alfa Tester only makes it possible to detect information concerning the status of the ALFA ROMEO CODE system (see Diagnosis), but no information is given as to the injection pump, which is mechanical!!!

Dedicated serial line between C.C.E. and C.C.M.- (IAW versions - 1.3 engine - G.M. Rochester - 1.6 engine and BOSCH Motronic M2.10.4 - T.SPARK 16v engine and JTD)

Certain injection control units are specially provided with a serial line for dialogue between the C.C.M. and the C.C.E, using pin A6 of the C.C.E. (see illustration).

Line Kof the diagnosis socket is NOT connected to pin A5, but goes directly from the C.C.M. - to the Tester.

The diagnosis line K is at all events enabled by the C.C.M. only at the end of dialogue between the C.C.M. itself and the C.C.E.



Dialogue between C.C.E. and C.C.M.

As mentioned previously, the C.C.E. and C.C.M. "dialogue" via a serial line formed of a single cable. The serial line is two-way, this means that the information travels sequentially from the C.C.M. to the C.C.E. and vice- versa. The information exchanged between the two control units may concern the following operating conditions:

A) Checking the code
C.C.E. memorised C.C.M. memorised:

Each time the key is turned to MARCIA (also during starting) the C.C.M., before starting engine management, asks the C.C.E. for the MASTER CODE. The C.C.E. can answer in one of the following three ways:

1. It sends the MASTER CODE (crypted), enabling the C.C.M. to start the car
2. It sends a code which inhibits starting the engine (if the key engaged has not been memorised, or it is a key without Transponder, aerial failure, etc.)
3. It does not answer (C.C.E. failure)

The function is governed by a programme which takes account of all the variables that might be present in the system.

B) Memorising the codes

These operations concern the system when at least one control unit (C.C.E. or C.C.M) is brand new.
The following instances may arise:

C.C.E brand new and C.C.M. brand new:

When both the control units are brand new (C.C.E. and C.C.M.) the C.C.E. answers the request of the injection control unit sending a universal code crypted by an algorithm. This condition is indicated by a characteristic flash.(1.6 Hz) of the warning light: this only takes place if the C.C.E. has detected the presence of a Transponder. Conversely, if the aerial is broken or disconnected or there is no Transponder in the key, the C.C.E. will not answer).
In this situation the system is not protected yet, and it is ready to start the key memorising procedure.

C.C.E. memorised and C.C.M. brand new:

When the ignition key has been turned to MARCIA the C.C.M. will ask the C.C.E. for the MASTER CODE to memorise it; the C.C.E. sends the MASTER CODE only if it has recognised a key among those memorised in the ignition lock: from this moment the MASTER CODE is memorised in the C.C.M. which is thus indissolubly linked with the car.

C.C.E. brand new and C.C.M. with MASTER CODE memorised:

When the ignition key has been turned to MARCIA the C.C.M. asks for the MASTER CODE to be enabled for starting. As the C.C.E. is brand new, it answers sending the universal code, only if it reads a code correctly in the Transponder. (It might be a key without Transponder or with a key with the Tramsponder not working or the aerial might be disconnected or damaged, etc.).

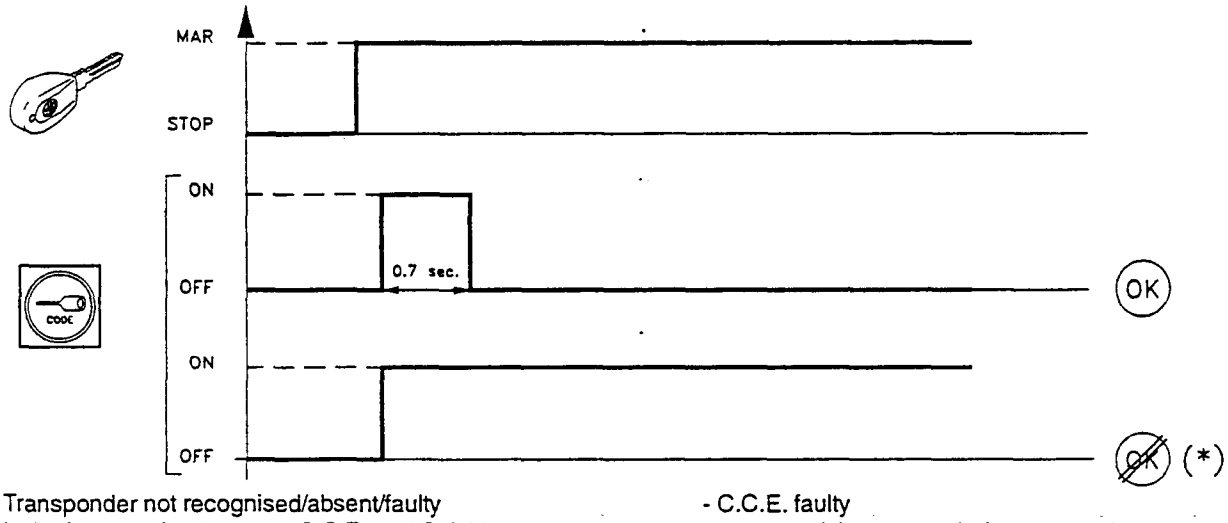
The C.C.M. prevents the engine from being started as it does not recognise the universal code: it is necessary to memorise the keys in the C.C.E., MAKING SURE THAT THE MASTER KEY IS THE ONE WHICH OPENS AND CLOSES THE PROCEDURE (see programming).

Piloting times of the ALFA ROMEO CODE warning light

The diagnosis warning light on the instrument panel is controlled by the C.C.E. to inform the user and workshops of the system status.

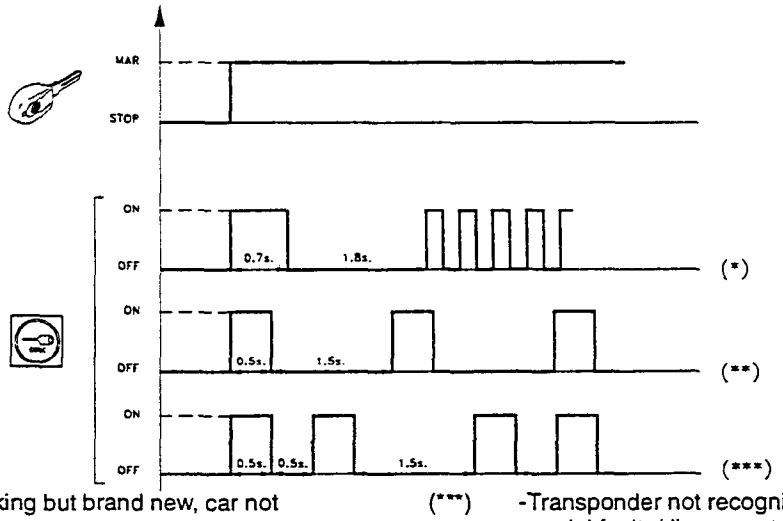
There are two types of characteristic flashing:

1. When the keys have already been memorised (see illustration) it indicates the correct operation of the system or a problem:
2. When the system is still brand new the flash (1.6 Hz after 2.5 seconds) means that the system is intact and working, the car is not protected until a key memorising procedure has been carried out, other faults detected are also indicated (see illustration)



(1)

(*) - Transponder not recognised/absent/faulty
- lack of connection between C.C.E. and C.C.M.
- aerial faulty/disconnected
- C.C.E. faulty
- re-memorising not carried out correctly



(2)

(*) system intact, working but brand new, car not protected

(**) lack of connection between CCE and CCM

(***) -Transponder not recognised/absent/faulty
- aerial faulty/disconnected

WARNING!
If the ALFA ROMEO CODE warning light turns on momentaneously or permanently while travelling or starting the car, this does not necessarily mean a system failure, but, in certain cases, it means a condition that can be interpreted as an attempt to manipulate the vehicle by a thief.

Should this occur, to correctly check the car, turn the engine off and move the key to STOP; then turn the key back to MARCIA: the warning light should turn on and off in less than one second.

If it stays on after this procedure, repeat the operation, leaving the key at STOP for more than 30 seconds. If the warning light still stays on when the key is in the MARCIA Position, carry out diagnosis on the ALFA ROMEO CODE system.

PROGRAMMING THE KEYS

The system is capable of memorising up to 7 keys plus the MASTER KEY. Correct memorising needs two keys plus the MASTER key.

During production testing the keys were memorised and the system is tested and working. If the need arises, for servicing reasons, to replace faulty components or there is the need for more keys than those supplied, the key memorising procedure must be carried out. There are two types of ways to memorise the keys :

- Memorising procedure, with a brand new system (C.C.E. and C.C.M. new).
- Re-memorising procedure, which is carried out under the following circumstances:
  - the addition of other keys besides those already memorised in the C.C.E.
  - if it is absolutely necessary to change the ignition lock. In this circumstance, in fact, it is possible to keep the only the Transponder of the MASTER key of the old set of keys, which, once inserted in the new key (see specific procedure) makes it possible to memorise the other keys provided with the new ignition lock.
  - changing the C.C.E.

MEMORISING

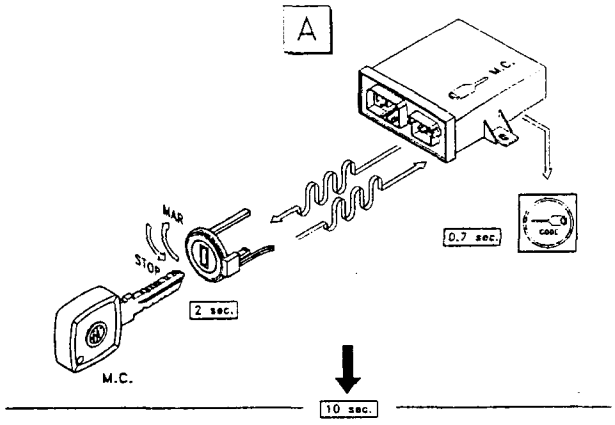
Before starting to programme the keys, it is necessary to check whether the system is brand new or if any keys have been memorised; this can be done by displaying the indications of the diagnosis warning light or connecting to the Alfa Tester. **The use of a faulty or already memorised C.C.E. would in fact involve the irreversible memorising of an incorrect code in the C.C.M. which it will no longer be possible to use in future on other cars.**

The memorising procedure is divided into two strictly consecutive phases:

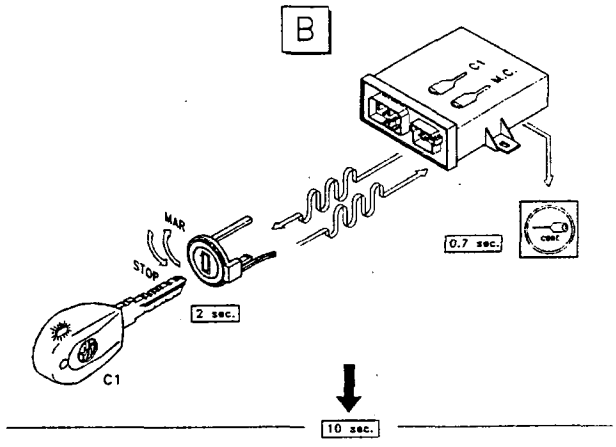
1. Memorising the keys inside the C.C.E.
2. Memorising the MASTER CODE in the engine control system control unit (if brand new)
   This is carried out only when the first one has been carried out with a positive result, turning the key to MARCIA.

MEMORISING PROCEDURE WITH BRAND NEW SYSTEM

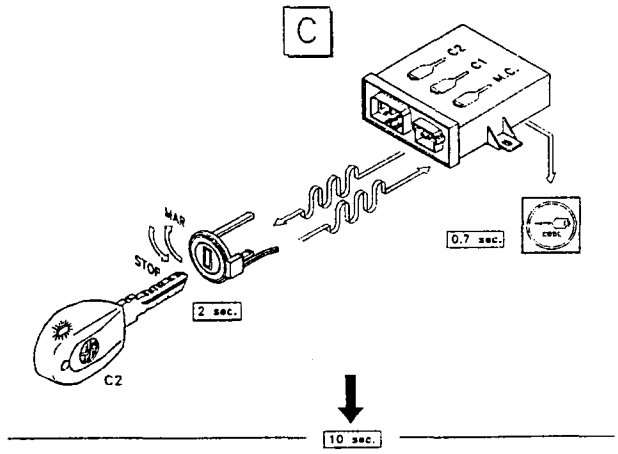
A Insert the **MASTER key** in the ignition lock
Turn the MASTER key to MARCIA and move it back to STOP as soon as the ALFA ROMEO CODE warning light goes off.



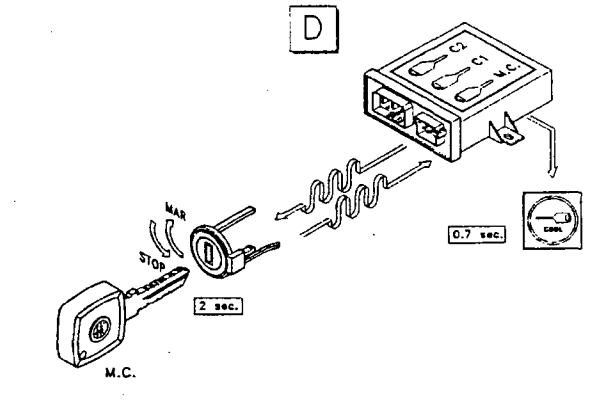
B Within 10 seconds:
Remove the MASTER key from the ignition lock, insert **a main key** in the lock
Turn the key to MARCIA. As soon as the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



C Within 10 seconds:
Remove the key from the ignition lock, insert **a second main key** in the lock.
Turn the key to MARCIA. As soon as the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



D Within 10 seconds:
Remove the key from the ignition lock, insert **the MASTER** key in the ignition lock **again**
Turn the key to MARCIA. As soon as the ALFA ROMEO CODE warning light goes out, move it back to the STOP position.



Keep the key in the STOP position for 4 - 9 seconds.

Do not leave the key in the STOP position for over 10 seconds: if you do, all the memorized codes are deleted.

M.C. = MASTER CODE C1, C2 = key codes

Variant only for JTD engines

– Keep the key in the STOP position for 4 - 9 seconds.

Do not leave the key in the STOP position for over 10 seconds: if you do, all the memorized codes are deleted.

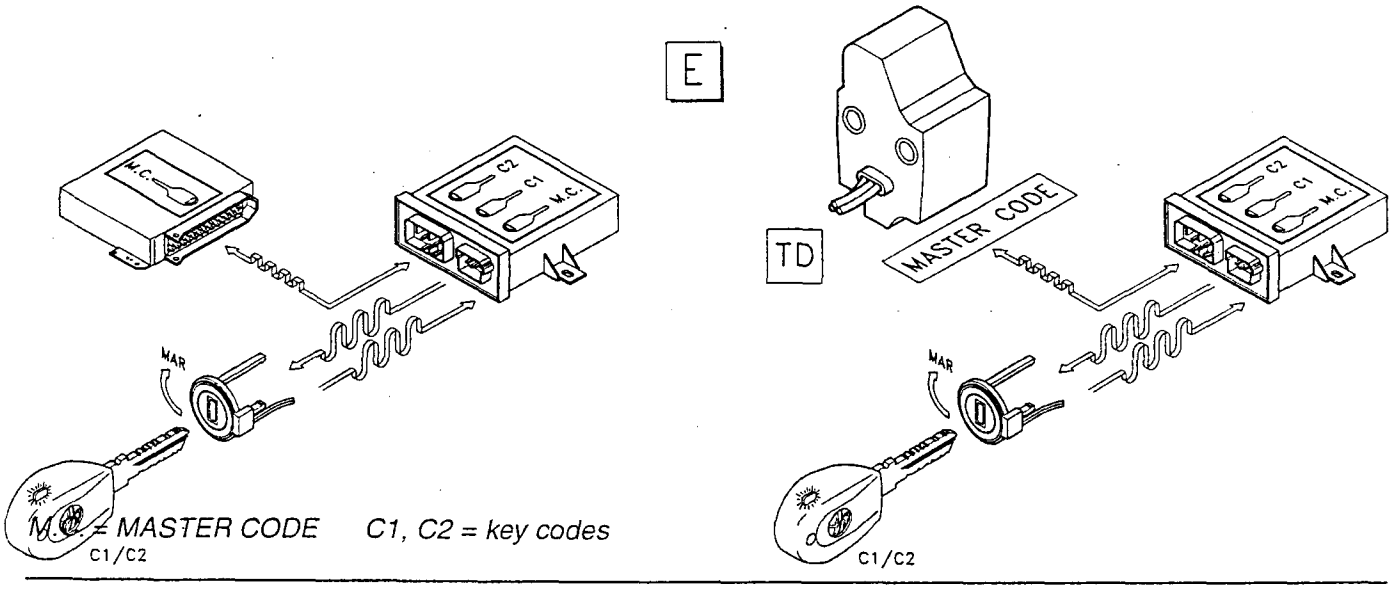
– Turn the MASTER key to MAR. As soon as the ALFA ROMEO CODE telltale light turns off, turn the key to the STOP position.

– Repeat this operation (key turned to MAR and then STOP when the telltale light turns off) UNTIL THE TELLTALE LIGHT STAYS ON.

– Turn the key to STOP and remove it.

At this point the keys are memorised in the C.C.E.

E Insert **any one of the memorised keys and turn it to MARCIA**: the ALFA ROMEO CODE warning light will turn off and go out after 0.7 seconds. Wait for 2 seconds: if the ALFA ROMEO CODE warning light stays off, that means that the key memorising procedure has been carried out correctly, and the MASTER key code has been memorised in the injection control unit. Conversely, if the warning light flashes again (1.6 Hz), it means that the memorising procedure has not been carried out correctly.



M.C. = MASTER CODE C1, C2 = key codes

If, for any reason and in any moment, you think you have mistaken the procedure:

– **Move the key to MARCIA for more than 2 seconds or move the key to STOP for more than 10 seconds.**

– **Repeat the procedure from the start inserting all the keys..**

As may be deduced, during the procedure the key should never be kept at MARCIA for over 2 seconds, while it should never be kept at STOP for over 10 seconds.

Each time the key is turned to MARCIA, the warning light turns on (0.7 s), indicating the correct sequence of the procedure.

The above-mentioned procedure includes three keys: the MASTER key and two main keys.
Up to seven main keys may be inserted, using more keys between two insertions of the MASTER key.The MASTER key must always be inserted for the first and last time during programming.

The procedure is interrupted if the following situations occur:

– The same key is inserted twice consecutively

– The same key is inserted twice or more times between two insertions of the MASTER key

– A key stays at MARCIA for more than 2 seconds

A key is kept at STOP (during the procedure) for more than 10 seconds

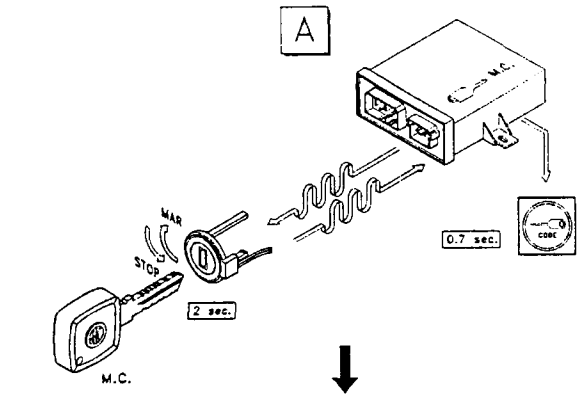
KEY RE-MEMORISING PROCEDURE

This procedure is similar to the previous one, and consists in inserting the main keys between two insertions of the MASTER Key.

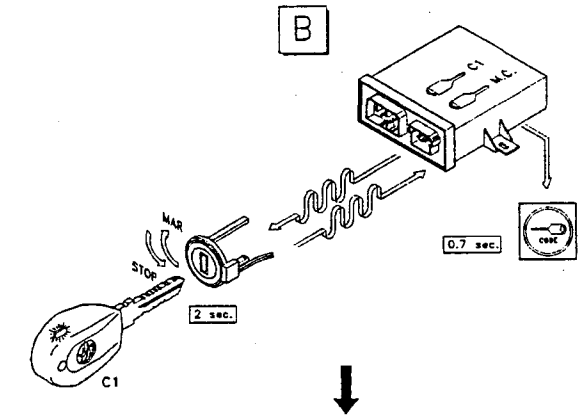
During the sequence the new main keys and the old ones are inserted.

If the main keys memorised previously are not inserted, their code will be erased from the memory of the control unit.

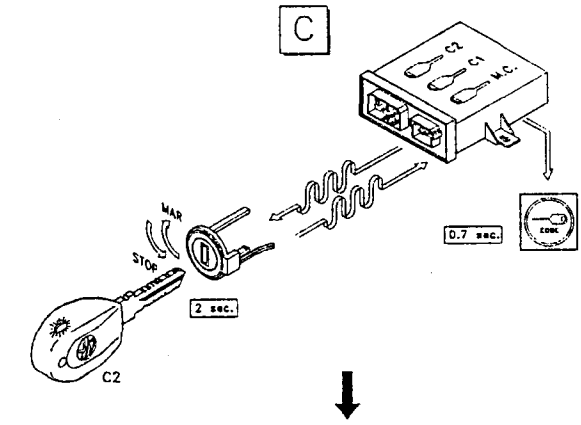
A Insert the **MASTER key** in the ignition lock
Turn the MASTER key to MARCIA and move it back to STOP as soon as the ALFA ROMEO CODE warning light goes out.



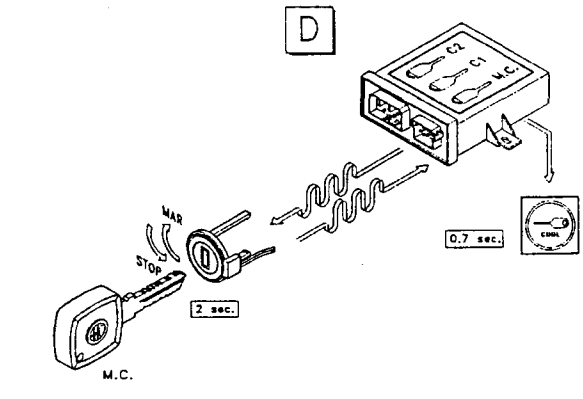
B Within 10 seconds:
Remove the MASTER key from the ignition lock, insert a **main key (known or new)** in the lock.
Turn the key to MARCIA : when the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



C Within 10 seconds:
Insert **a second main key (known or new)** in the ignition lock
Turn the key to MARCIA : when the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



D Within 10 seconds:
Remove the key from the ignition lock, insert the **MASTER key in the lock again**
Turn the key to MARCIA and when the ALFA ROMEO CODE warning light goes out, move it back to the STOP position.



Keep the key in the STOP position for 4 - 9 seconds.

Do not leave the key in the STOP position for over 10 seconds: if you do, all the memorized codes are deleted.

M.C. = MASTER CODE C1, C2 = key codes

If, for any reason and in any moment, you think you have mistaken the procedure:

- Move the key to MARCIA for more than 2 seconds or move the key to STOP for more than 10 seconds.
- Repeat the procedure from the start inserting all the keys..

As may be deduced, during the procedure the key should never be kept at MARCIA for over 2 seconds, while it should never be kept at STOP for over 10 seconds.

Each time the key is turned to MARCIA, the warning light turns on (0.7 s), indicating the correct sequence of the procedure.

The above-mentioned procedure includes three keys: the MASTER key and two main keys.
Up to seven main keys may be inserted, using more keys between two insertions of the MASTER key.The MASTER key must always be inserted for the first and last time during programming.

The procedure is interrupted if the following situations occur:

- The same key is inserted twice consecutively
- The same key is inserted twice or more times between two insertions of the MASTER key
- A key stays at MARCIA for more than 2 seconds
- A key is kept at STOP (during the procedure) for more than 10 seconds

Memorising the MASTER CODE in the C.C.M. (if the latter is changed:

This operation takes place turning the key to MARCIA after having memorised all the keys in the C.C.E.

Warning:

- Once the codes have been programmed, the C.C.E. is capable of transferring the MASTER CODE to the injection control unit (which stores it permanently), each time the key is turned to MARCIA.
- Do not use brand new C.C.M.s to check that the system is working properly.
- Do not swop C.C.M.s among cars.

Memorising with brand new C.C.E. and memorised C.C.M.:

This function is carried out following the normal memorising procedure, as if the whole system were brand new; the MASTER Key must be the same with which the injection control unit was memorised previously.

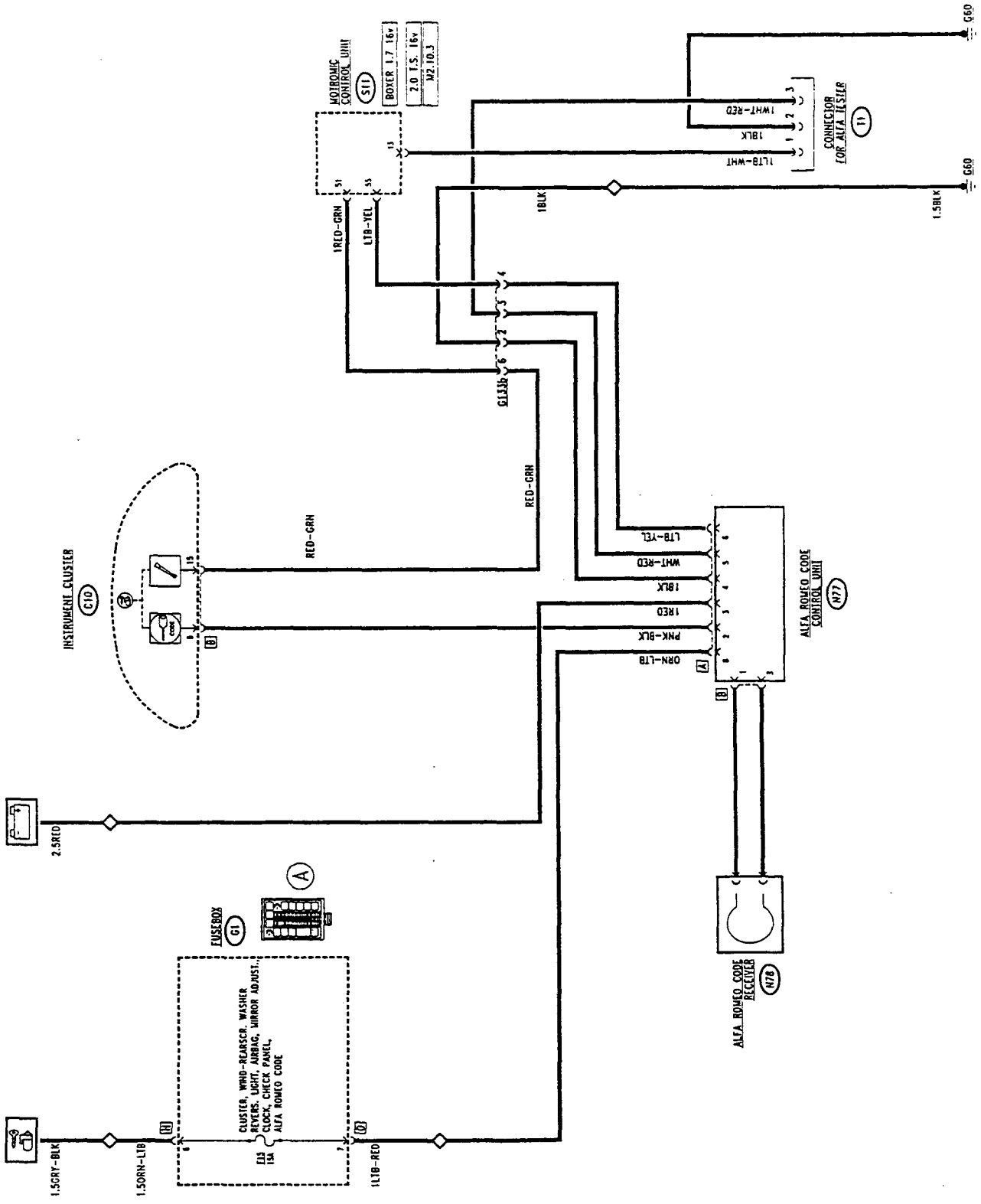
WARNINGS:

- Before starting the procedure make sure that the C.C.E. is truly brand new. The use of a faulty or already memorised C.C.E. will cause the irreversible memorisation of a wrong code in the C.C.M., which will no longer be able to be used in future on other cars.

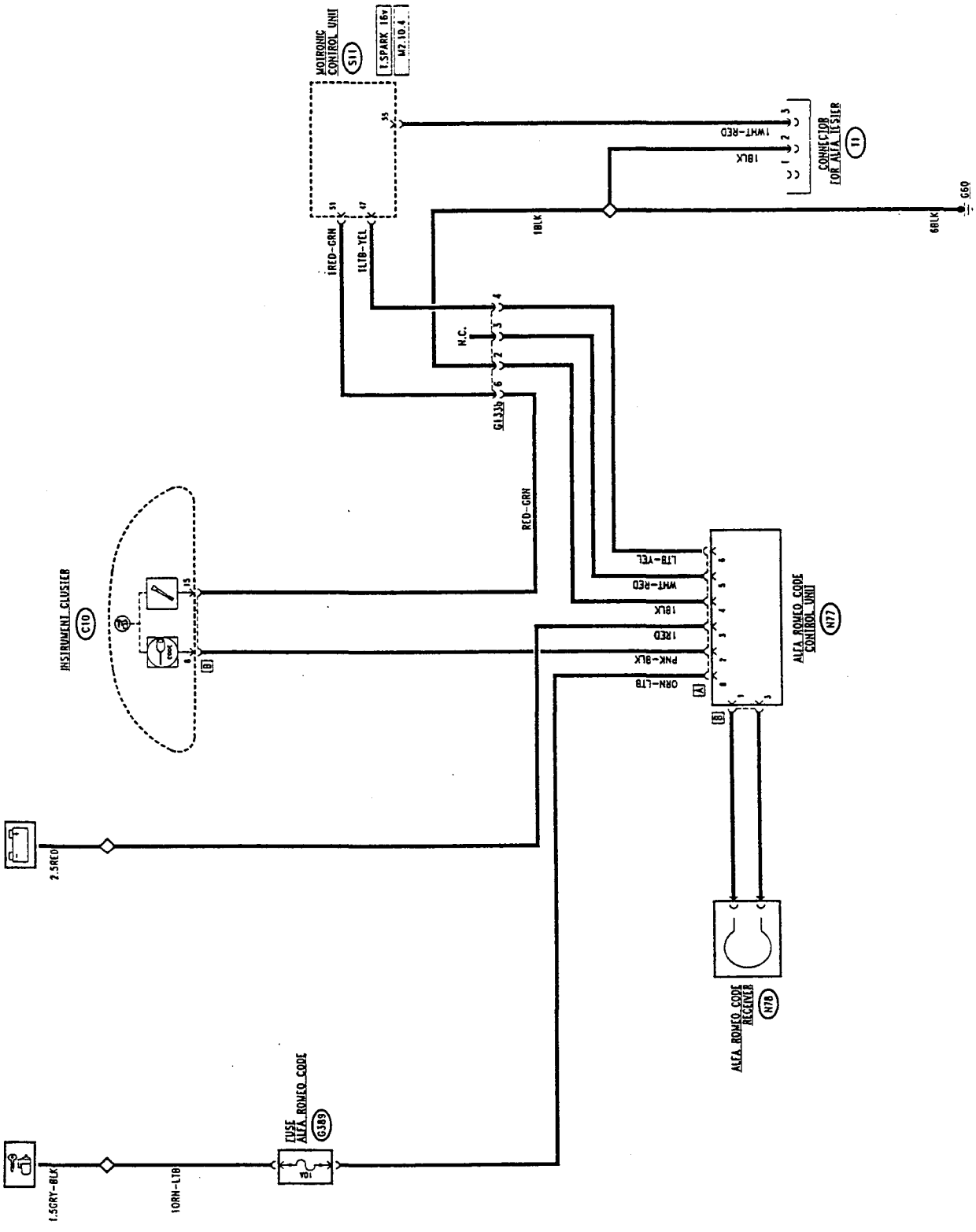
- WARNING:
  If the ALFA ROMEO CODE warning light stays on during re- memorisation, it means that the procedure has not been carried out correctly and it has been interrupted.
  Repeat the re-memorising procedure from the start.

- If the ALFA ROMEO CODE warning light stays on when the MASTER key has been inserted twice consecutively, this does not mean a malfunctioning, but that the re-memorising procedure has been opened (key at MARCIA) and interrupted (second key at MARCIA). To resume the correct operation of the warning light, move the key to STOP.

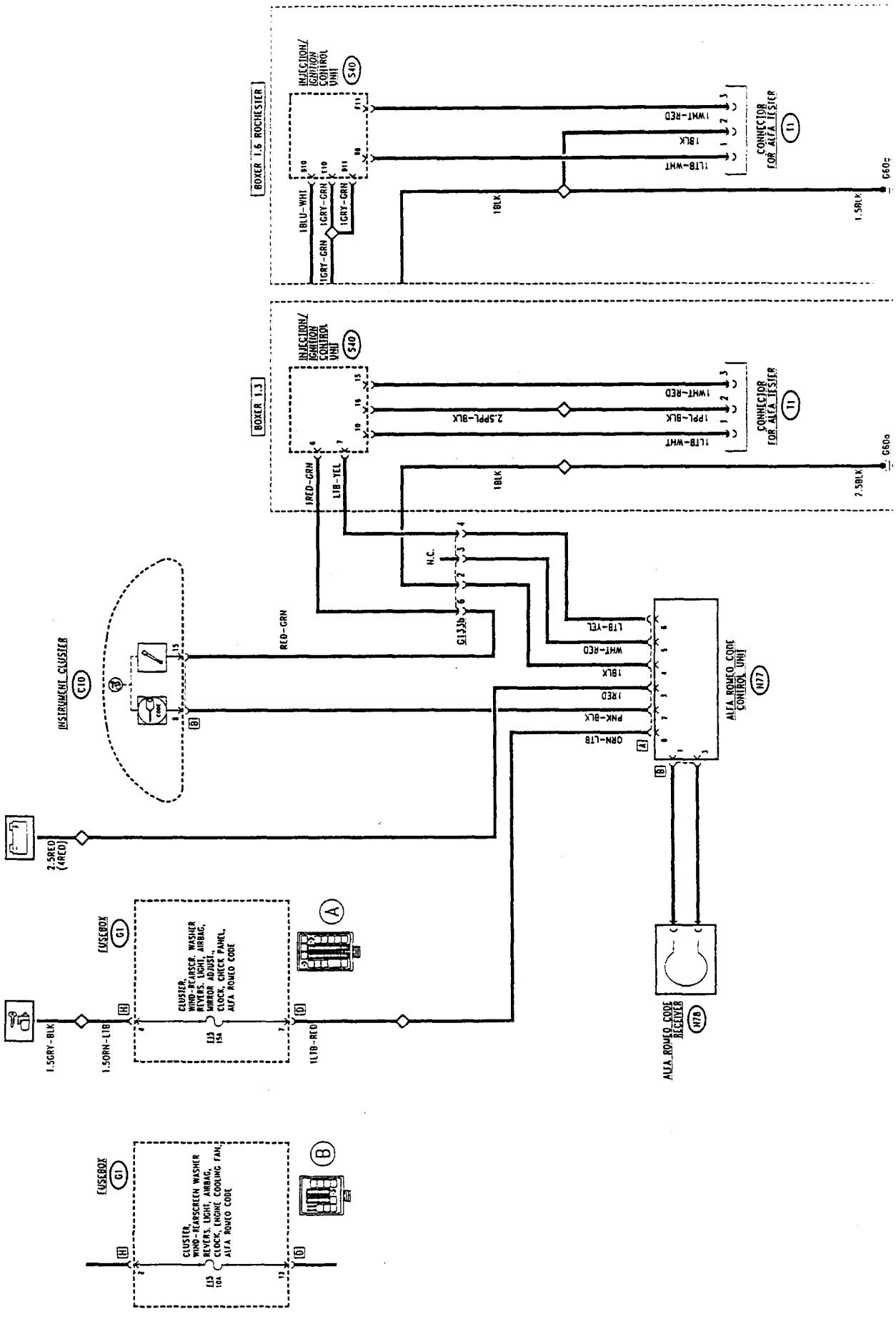
WIRING DIAGRAM - Boxer 1.7 engine, 2.0 T.SPARK 16v engine, up to chassis no. ...



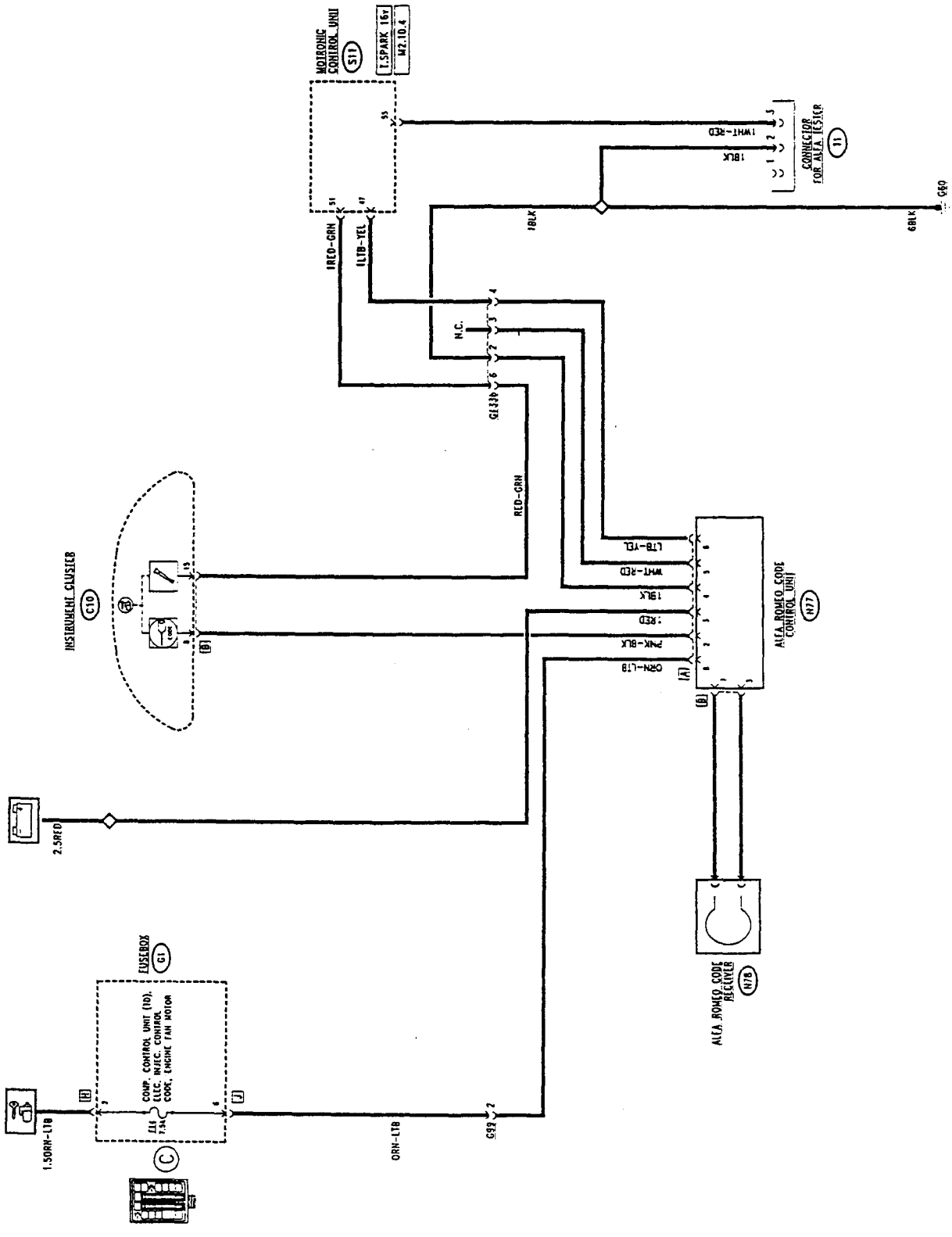
WIRING DIAGRAM - T.SPARK 16v engine



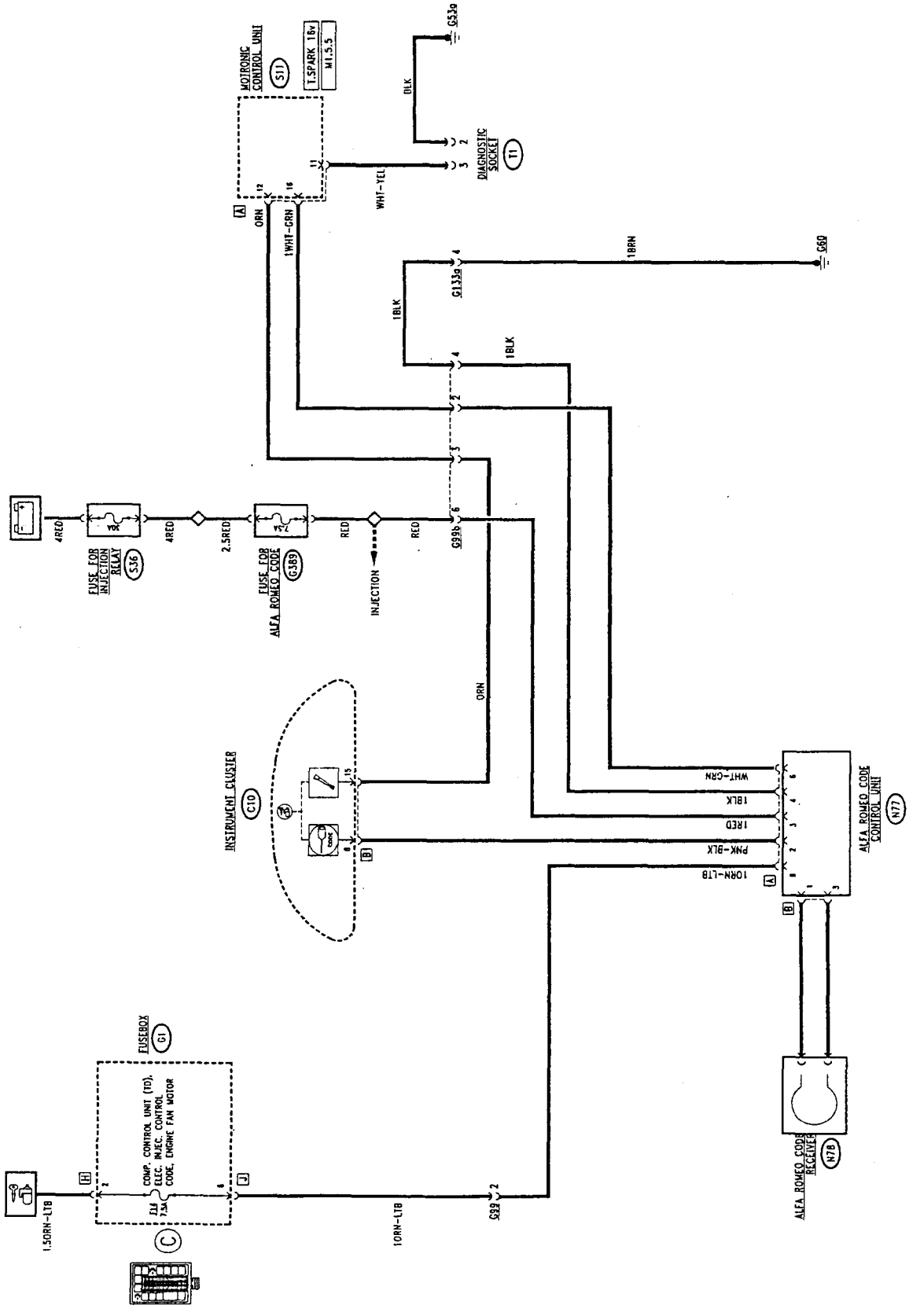
WIRING DIAGRAM - Boxer 1.3 and 1.6 engines -



WIRING DIAGRAM (T.SPARK engine)



WIRING DIAGRAM (T.SPARK engine - from M.Y. '98)



FUNCTIONAL DESCRIPTION (petrol engines)

The ALFA ROMEO CODE control unit **N77**, to be found under the righthand side of the steering wheel, is connected via connector B to a special pair of cables to the receiver **N78**, consisting in a coaxial aerial with the ignition switch.

Through connector A it is connected to the Motronic injection control unit **S11** or **S40** - IAW and G.M. Rochester and to the other systems: at pin 8 it receives the "key-operated" supply via the line of fuse **F15** of **G1**, - up to chassis no. ... - or the line of the specific wander fuse **G389**, or for box "C" from fuse **F14** of **G1**, while pin 3 receives the direct supply and pin 4 is earthed.

The connection line with the ALFA ROMEO CODE warning light on the instrument panel **C10** leaves from pin 2.

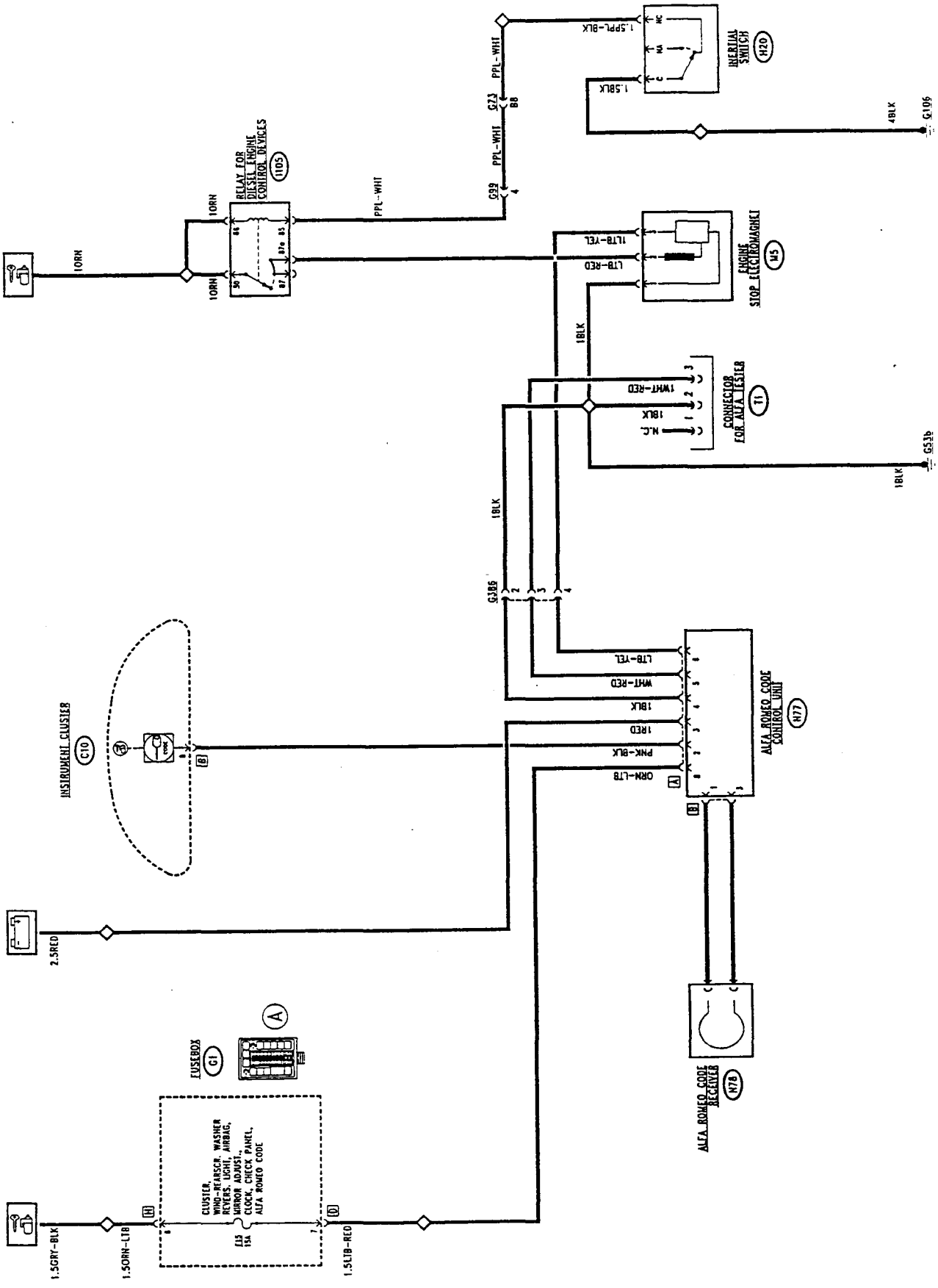
- Boxer 1.7 16v and 2.0 T.SPARK with M2.10.3: Pins 5 and 6 manage communication between the ALFA ROMEO CODE control unit **N77** and the Motronic control unit S11: this communication takes place "cutting off" the diagnosis line K which leads from **S11** to the diagnosis connector **T1**.

- Boxer 1.3 and 1.6: pin 6 manages communication between the ALFA ROMEO CODE control unit **N77** and the injection control unit **S40** via the special connection serial line (pin 7 of **S40** for the IAW control unit and pins E10 and B11 of **S40** for the G.M. Rochester control unit: in this case one pin serves for the input of the signal in the control unit and the other for the output).

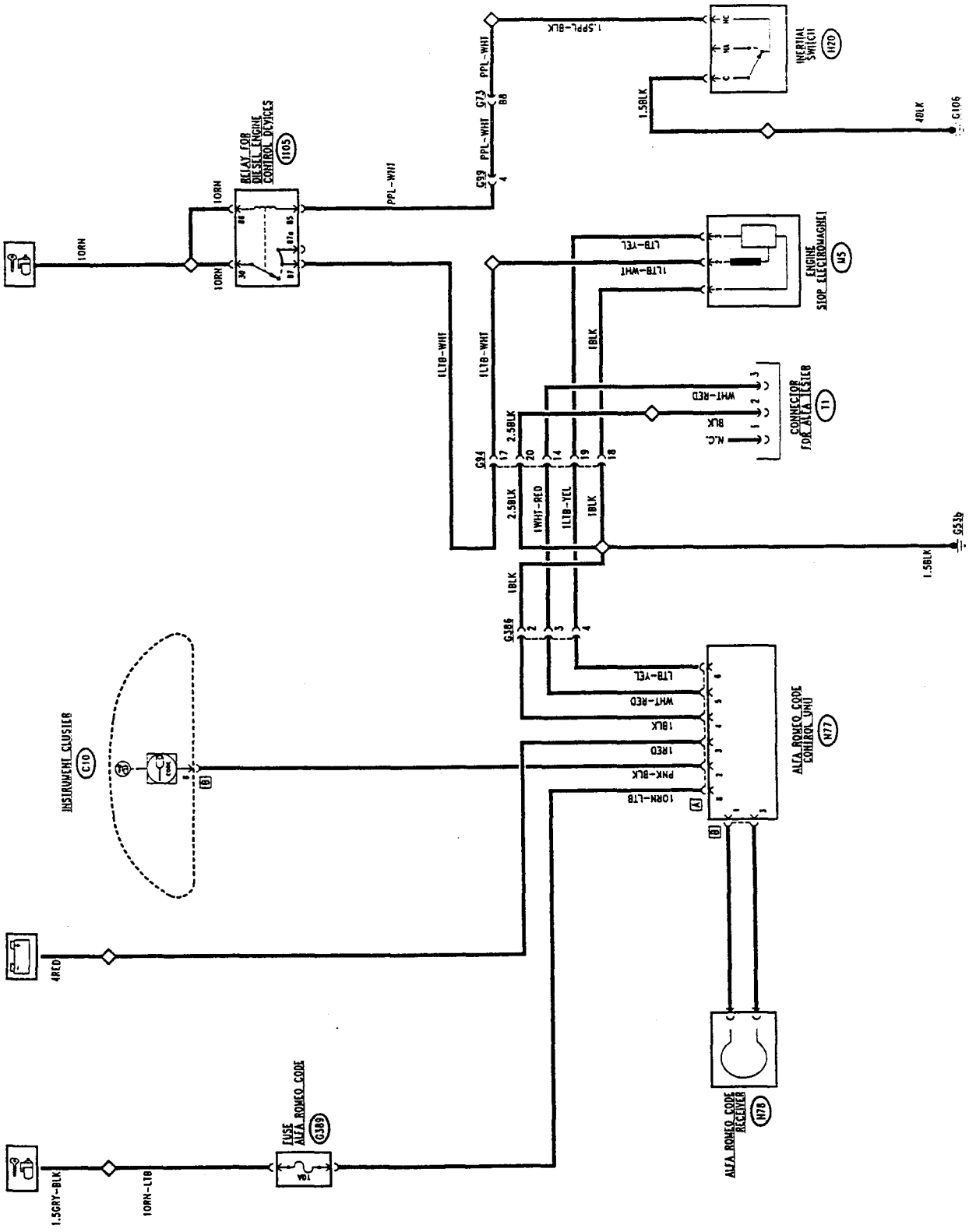
- T.SPARK 16v with Motronic M2.10.4: communication between the ALFA ROMEO CODE control unit **N77** - pin 6 - and control unit **S11** is managed by a special direct line: between pin 6 of **N77** and pin 47 of **S11**.

- T.SPARK 16v with Motronic M1.5.5.: communication between the ALFA ROMEO CODE control unit **N77** - pin 6 - and control unit **S11** is managed by a special direct line: pin A16 of **S11**.

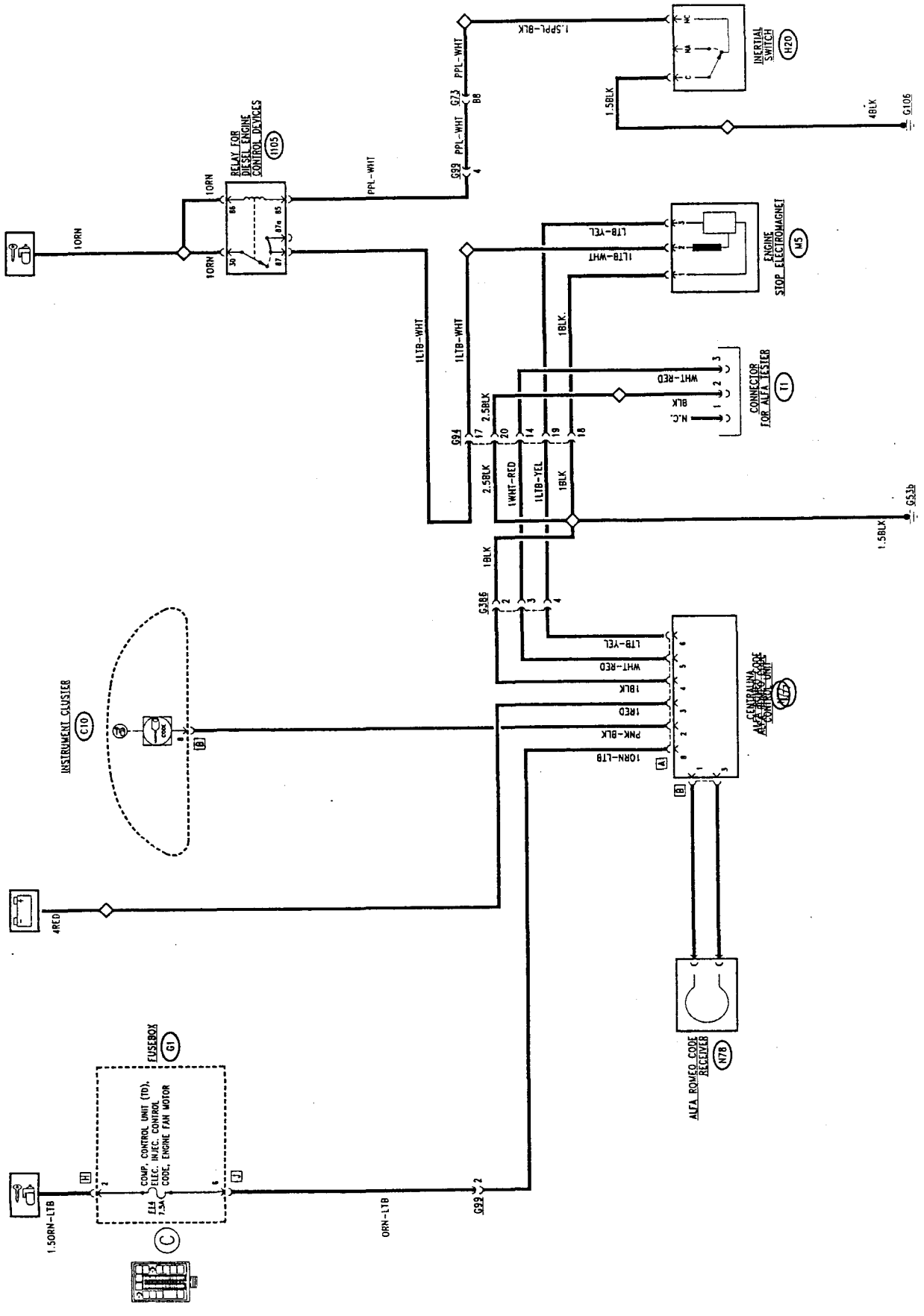
WIRING DIAGRAM - TD engine



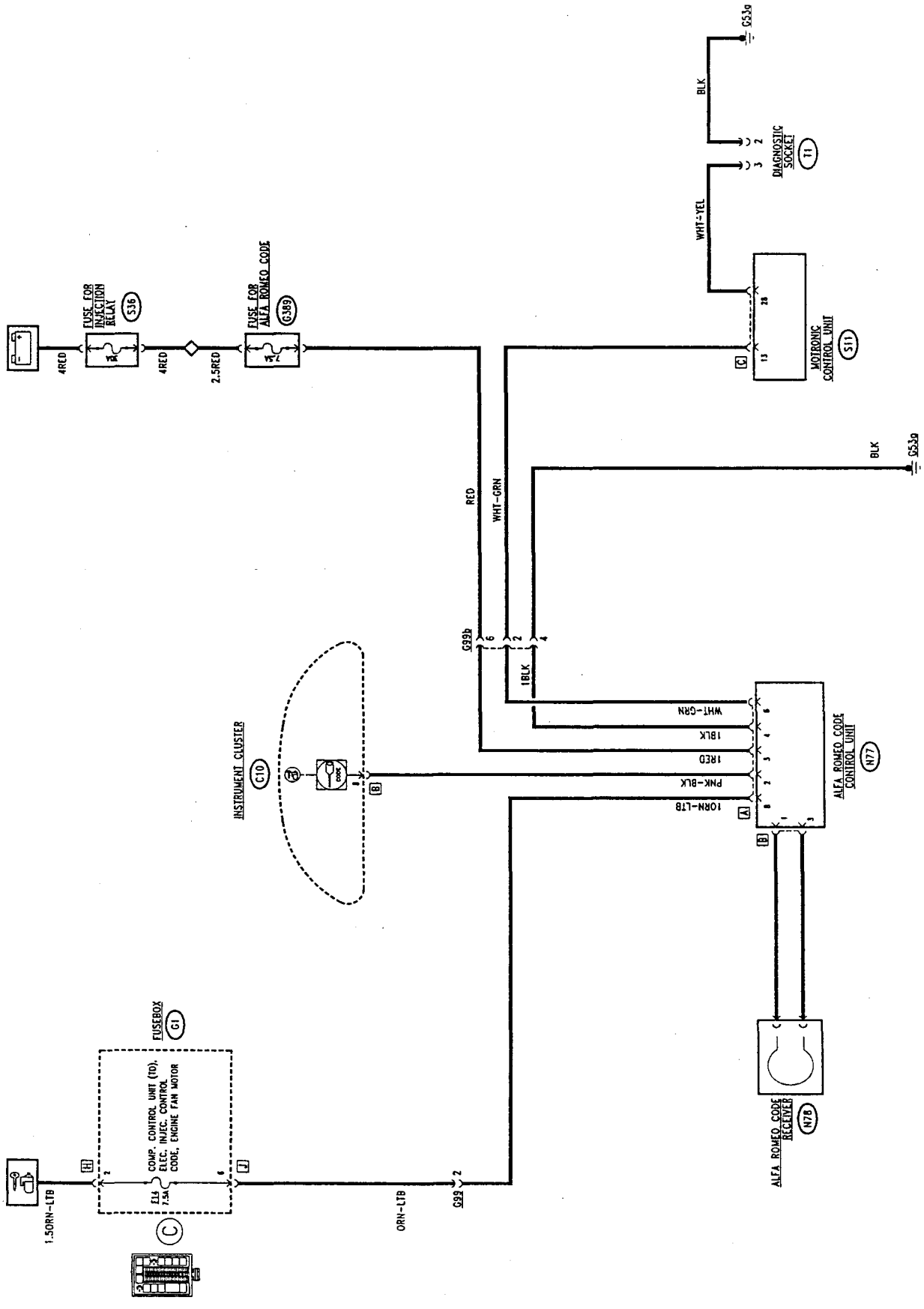
WIRING DIAGRAM - TD-CAT engine



WIRING DIAGRAM - TD-CAT engine



WIRING DIAGRAM - JTD engine



FUNCTIONAL DESCRIPTION (TD and TD-CAT engine)

The ALFA ROMEO CODE control unit **N77**, to be found under the righthand side of the steering wheel, is connected via connector B to a special pair of cables to the receiver **N78**, consisting in a coaxial aerial with the ignition switch.

Through connector A it is connected to the engine stop electromagnet device **M5** and to the other systems: at pin 8 it receives the "key-operated" supply via the line of fuse **F15** of **G1**, (TD) or the line of the specific wander fuse **G389** (for box "C" by fuse **F14** of **G1**); the direct supply is received at pin 3 and pin 4 is earthed.

The connection line with the ALFA ROMEO CODE warning light on the instrument panel **C10** leaves from pin 2.

Pin 6 manages communication between the ALFA ROMEO CODE control unit **N77** and the engine stop electromagnet **M5** via the special serial connection line. The line of pin 5 is used for connection with the Alfa Romeo Tester **T1** for checking the ALFA ROMEO CODE system.

The solenoid valve **M5** contains an electronic device which operates the opening of the flow of fuel towards the pump only after dialogue has been carried out correctly with the control unit **N77** (MASTER CODE recognition, etc.).

FUNCTIONAL DESCRIPTION (JTD engine)

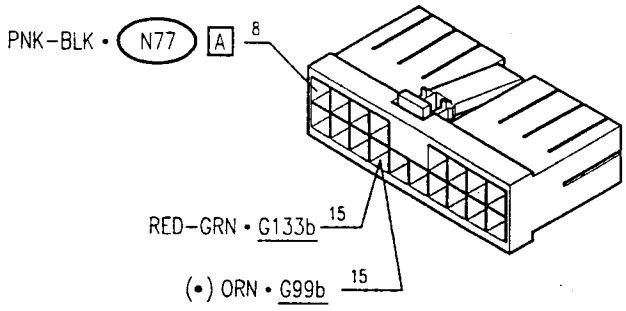
The ALFA ROMEO CODE control unit **N77**, to be found under the righthand side of the steering wheel, is connected via connector B to a special pair of cables to the receiver **N78**, consisting in a coaxial aerial with the ignition switch.

Through connector A it is connected to the injection control unit **S11** and to the other systems: at pin 8 it receives the "key-operated" supply through the line of fuse **F14** of **G1** -, while at pin 3 it receives the direct supply via the line of fuse **G389**, and pin 4 is earthed. The connection line with the ALFA ROMEO CODE warning light on the instrument cluster **C10** leads from pin 2.

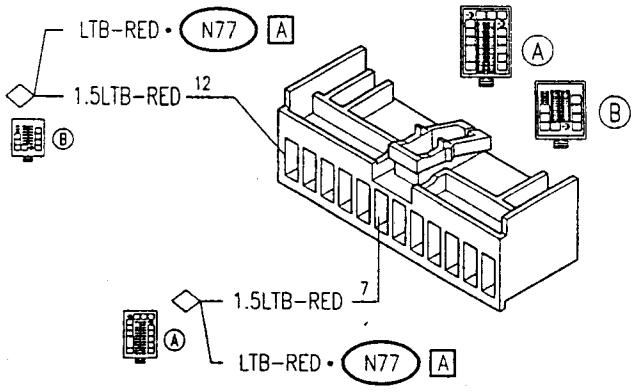
Communication between the ALFA ROMEO CODE control unit **N77** - pin 6 - and control unit **S11** is controlled by a special direct line: pin 13 of connector C of **S11**.

COMPONENTS AND CONNECTORS

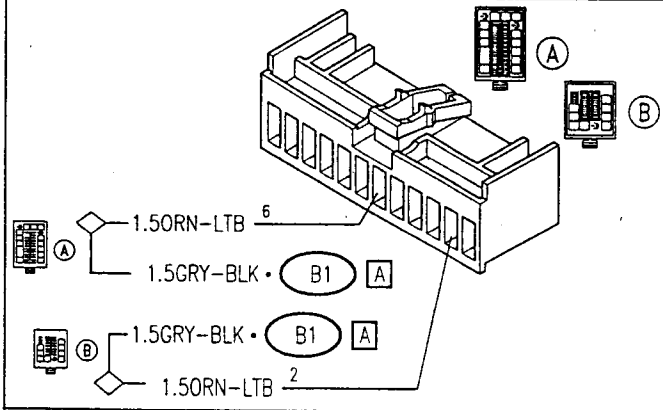
Instrument cluster	C10 B



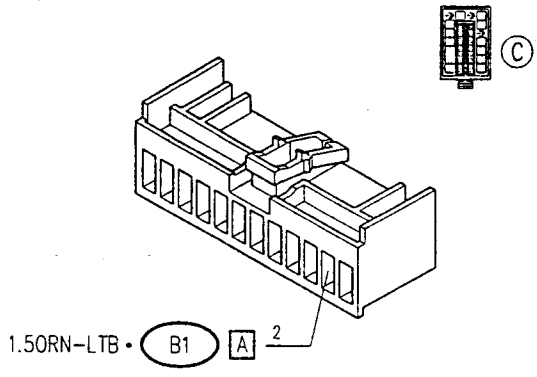
Fusebox (*)	G1 D



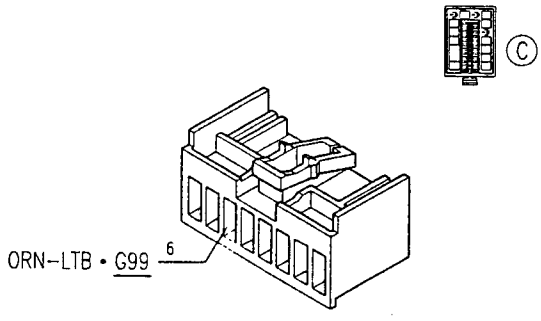
Fusebox (*)	G1 H



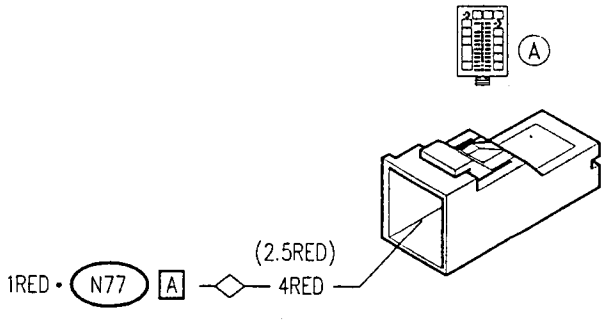
Fusebox	G1 H



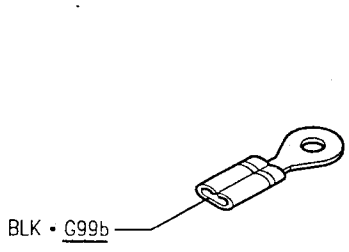
Fusebox	G1 J



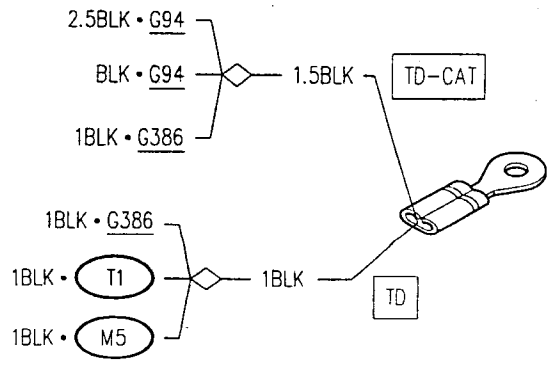
Fusebox	G1 Q



RH engine compartment earth	G53a



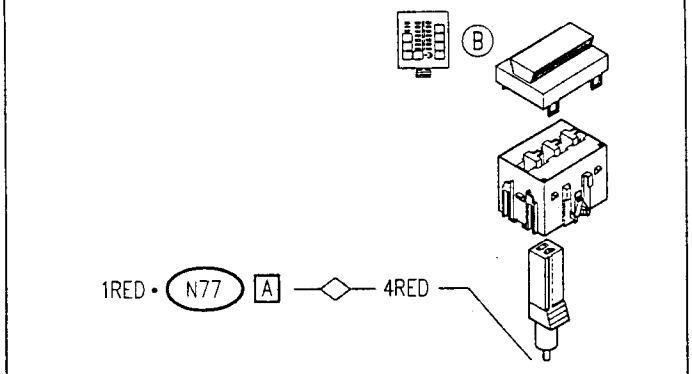
LH engine compartment earth	G53b



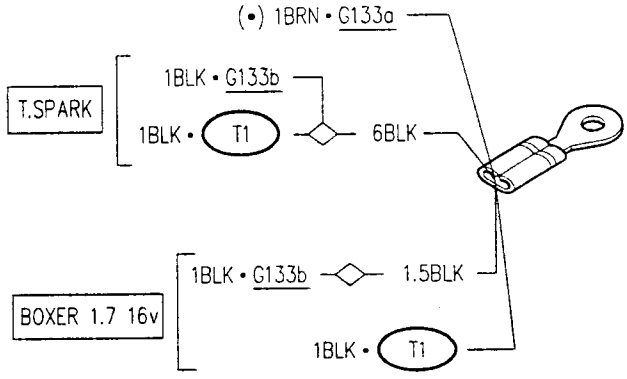
(*) only up to chassis no. ...
(•) only M1.5.5

COMPONENTS AND CONNECTORS (cont.d)

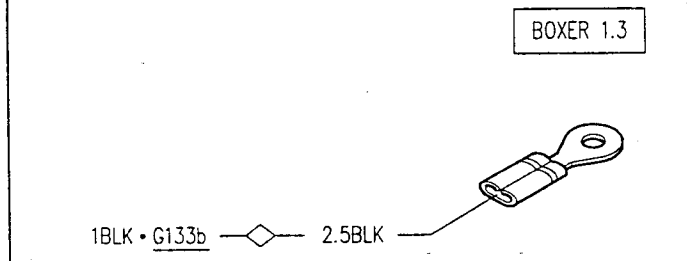
Branch terminal board — G56



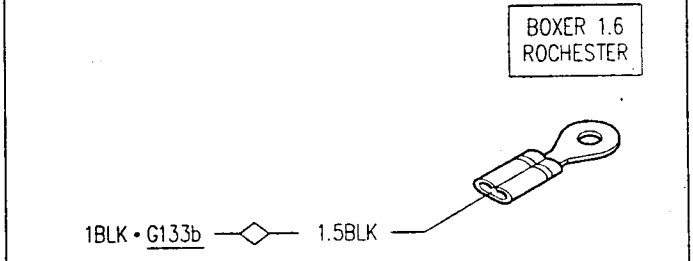
Injection wiring earth — G60



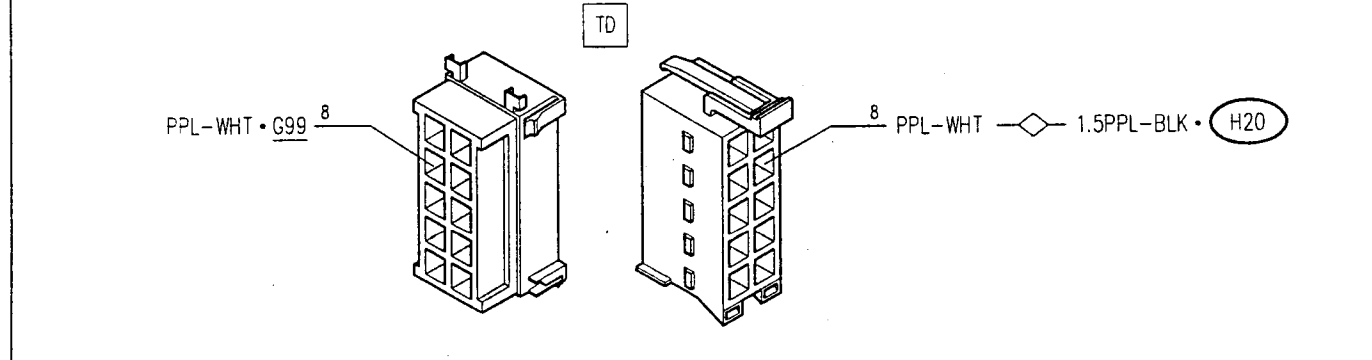
Injection wiring earth — G60a



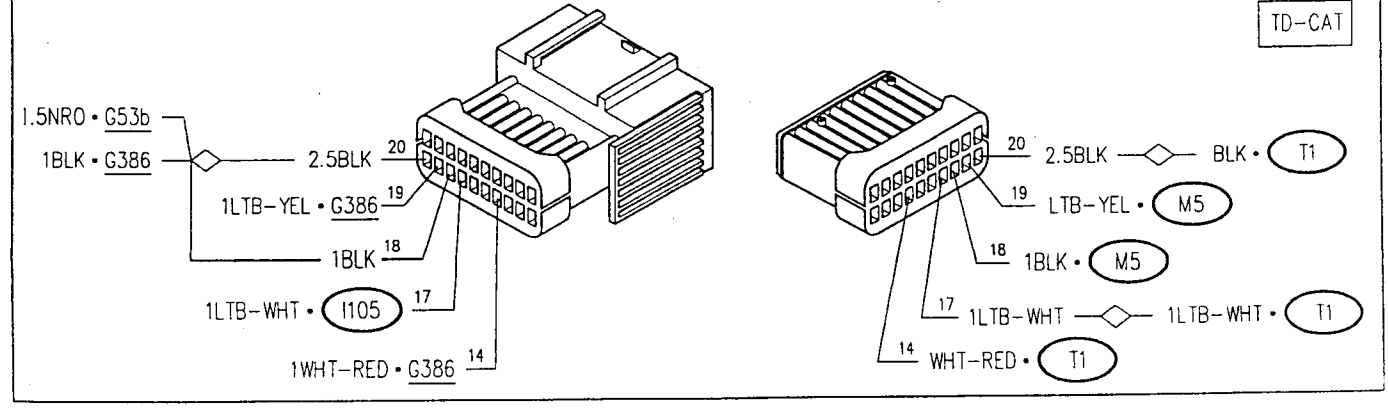
Injection wiring earth — G60a



Connector for rear services — G73 B



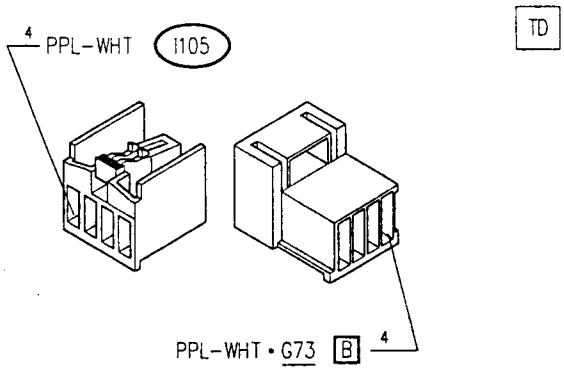
Engine compartment — G94



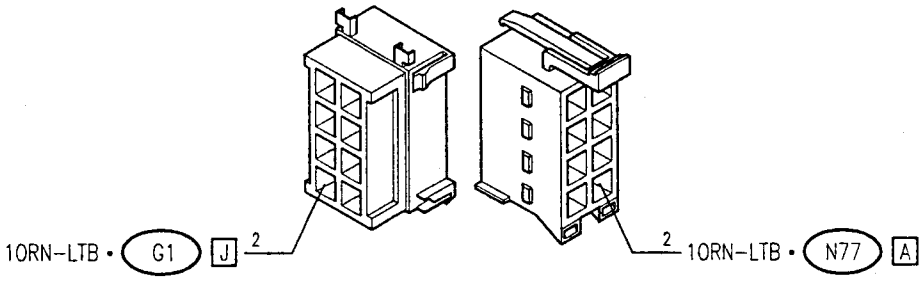
(*) only up to chassis no. ...
(•) from M.Y. '98

COMPONENTS AND CONNECTORS (cont.d)

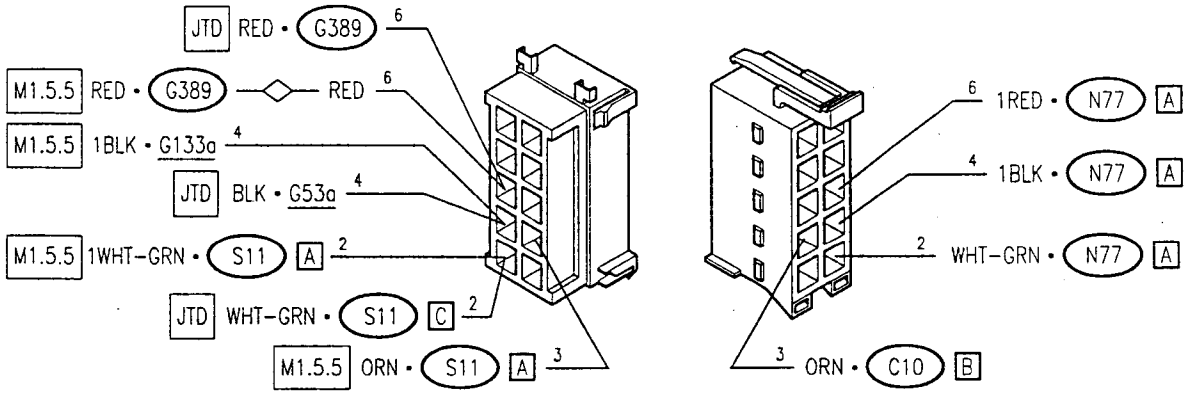
Connector for dashboard wiring/engine wiring	G99



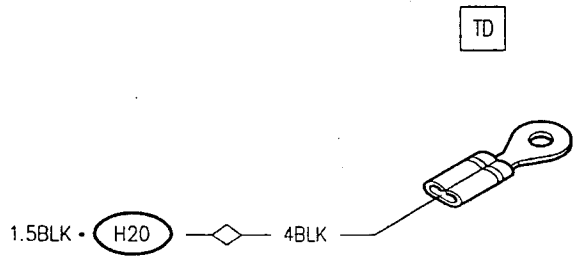
Connector for dashboard wiring/engine wiring	G99



Connector for dashboard wiring/engine wiring (•)	G99b



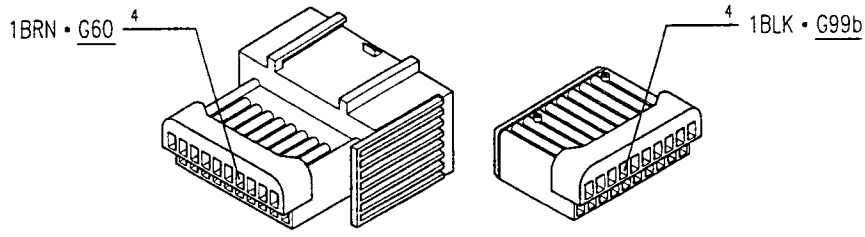
Seat cross rail earth	G106



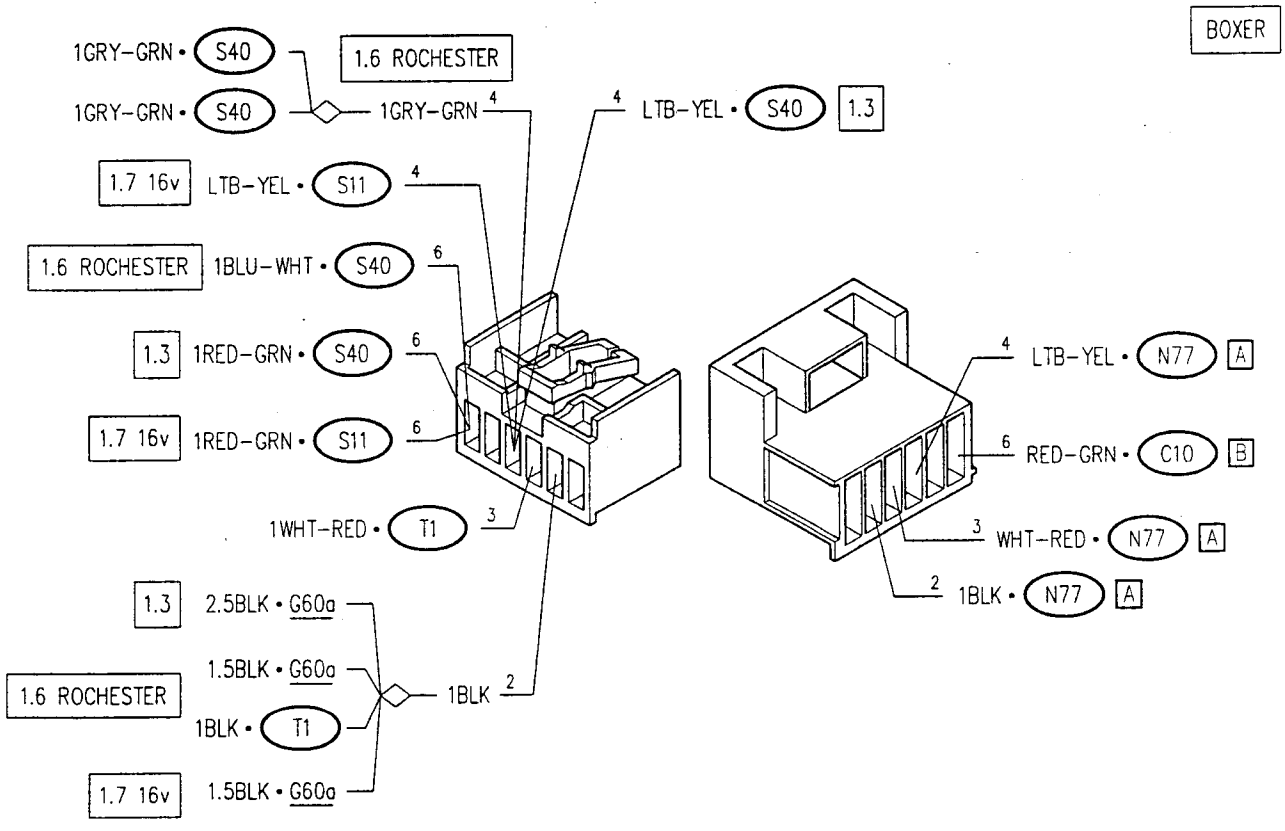
(*) only up to chassis no. ...
(•) from M.Y. '98

COMPONENTS AND CONNECTORS (cont.d)

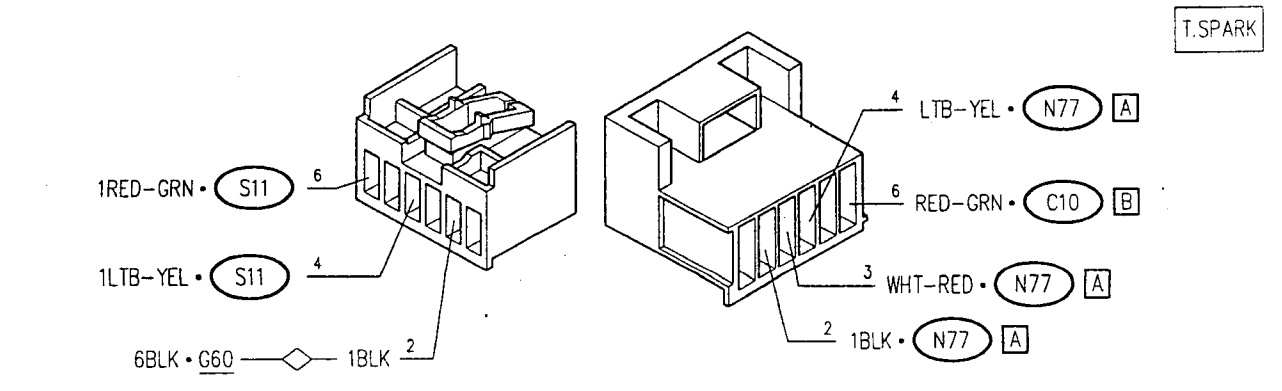
Connector for electronic injection wiring A (•)	G133a



Connector for electronic injection wiring B	G133b



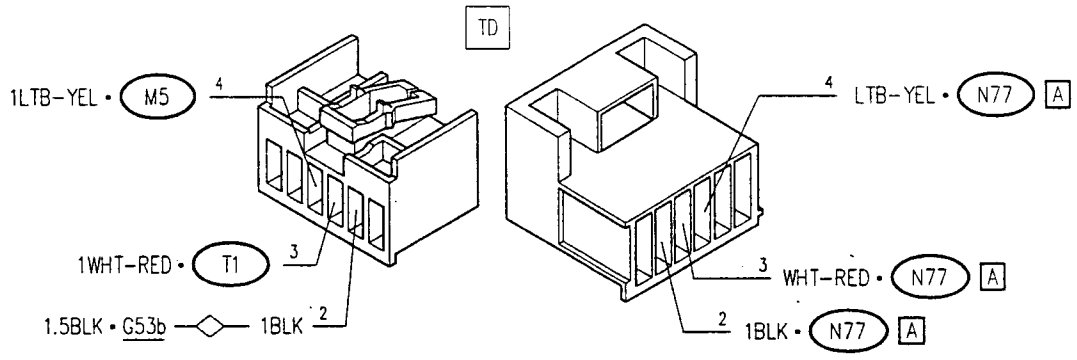
Connector for electronic injection wiring B (*)	G133b



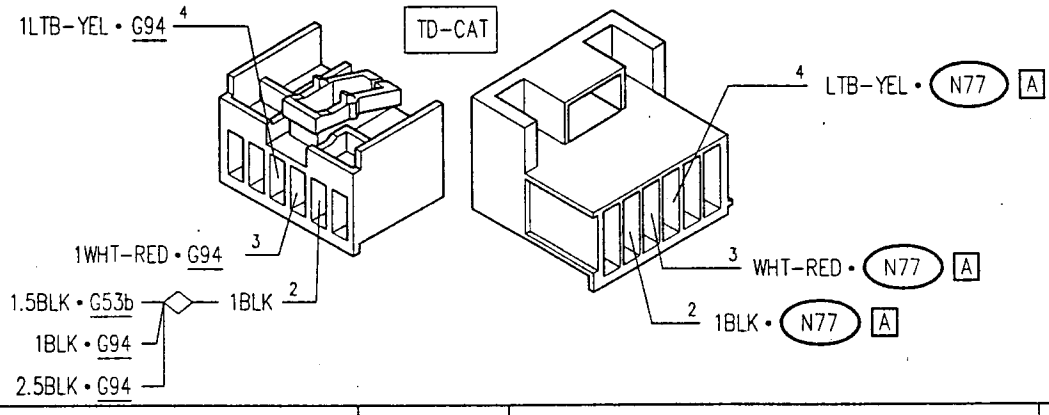
(•) from M.Y. '98
(*) up to M.Y. '97

COMPONENTS AND CONNECTORS (cont.d)

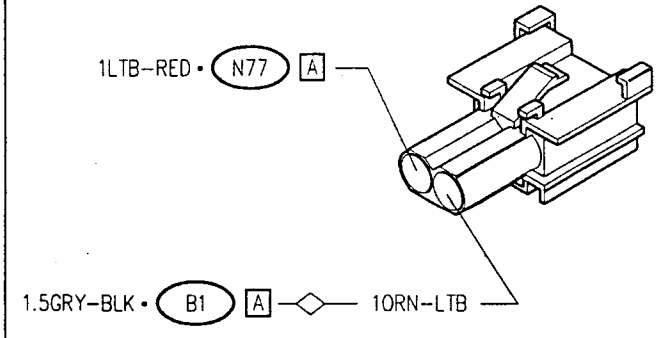
ALFA ROMEO CODE system connector	G386



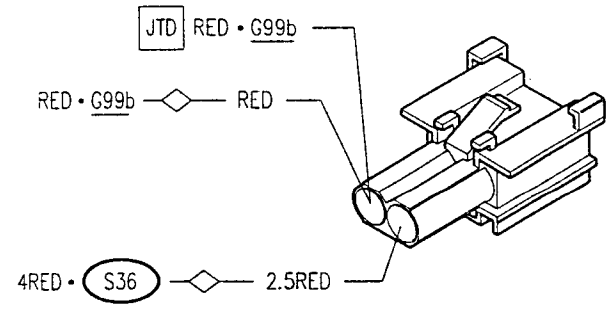
ALFA ROMEO CODE system connector	G386



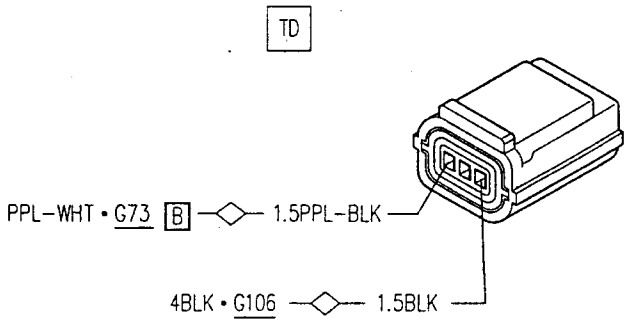
ALFA ROMEO CODE fuse (*)	G389



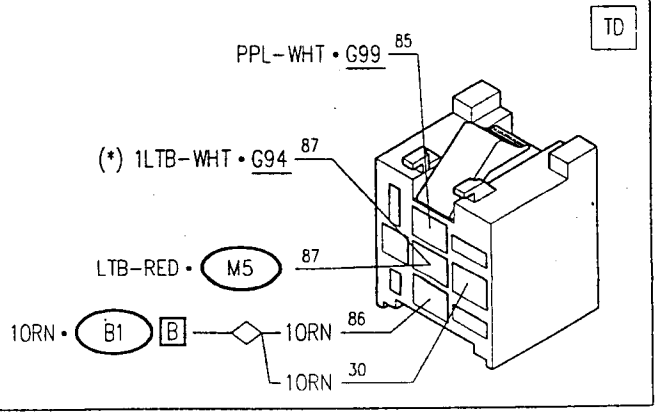
ALFA ROMEO CODE fuse (•)	G389



Inertial switch	H20



Relay for Diesel engine control devices	I105



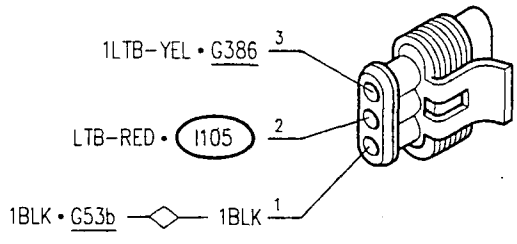
(*) up to chassis no. ...

(•) from M.Y. '98

COMPONENTS AND CONNECTORS (cont.d)

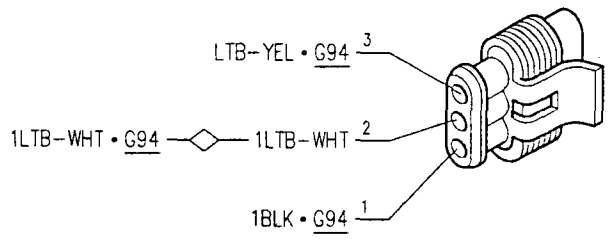
Engine stop electromagnet	M5

TD

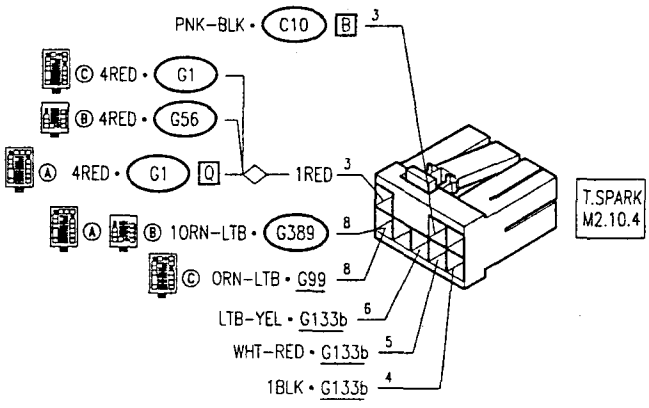


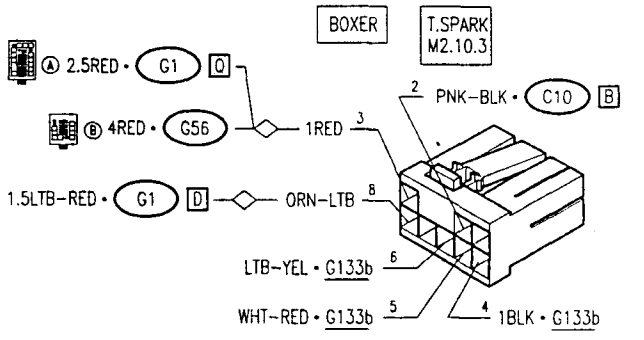
Engine stop electromagnet	M5

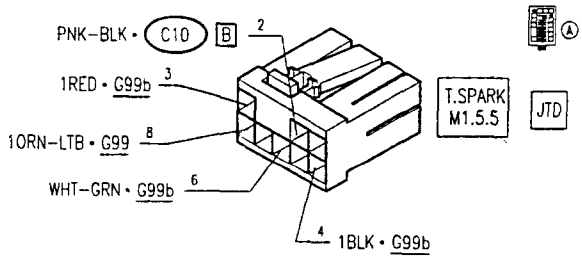
TD-CAT

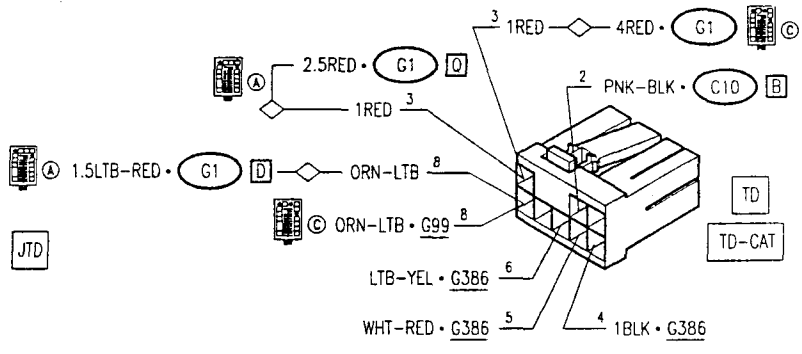


ALFA ROMEO CODE control unit	N77 A

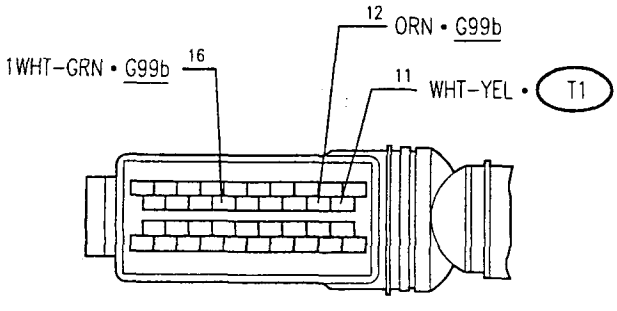




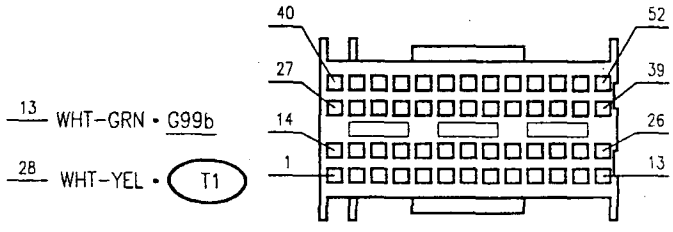




Electronic injection control unit (M1.5.5)	S11 A



Electronic injection control unit	S11 C



COMPONENTS AND CONNECTORS (cont.d)

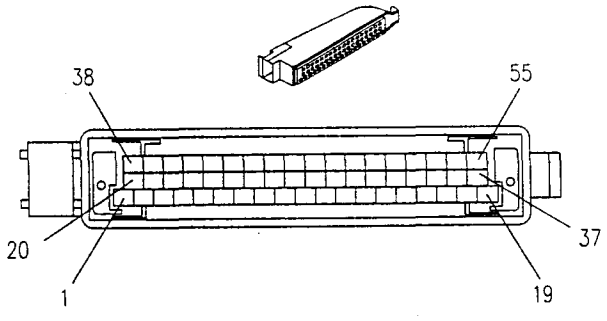
Motronic control unit — S11

1.7 / T.SPARK M2.10.3

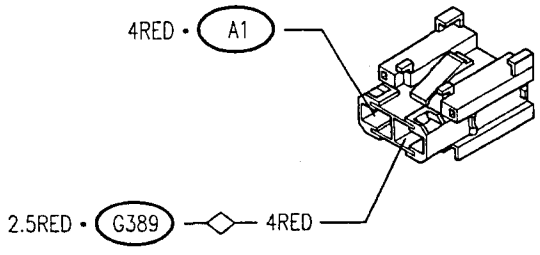
13 — 1LTB-WHT • T1
51 — 1RED-GRN • G133b
55 — LTB-YEL • G133b

T.SPARK M2.10.4

47 — 1LTB-YEL • G133b
51 — 1RED-GRN • G133b
55 — 1LTB-WHT • T1



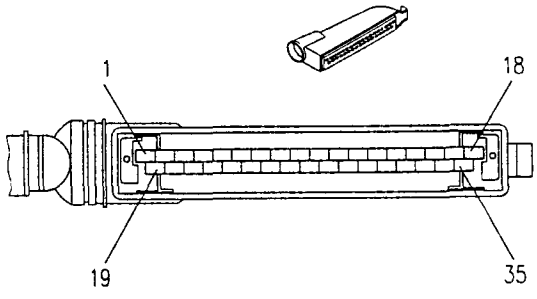
Fuse for injection relay — S36



Injection/ignition control unit — S40

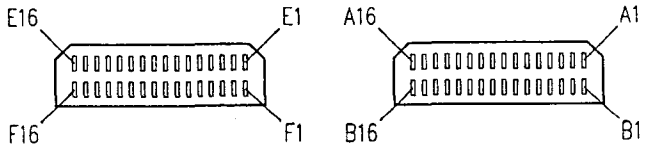
1.3

6 — 1RED-GRN • G133b
7 — LTB-YEL • G133b
10 — 1LTB-WHT • T1
15 — 1WHT-RED • T1
16 — 2.5PPL-BLK — 1PPL-BLK • T1



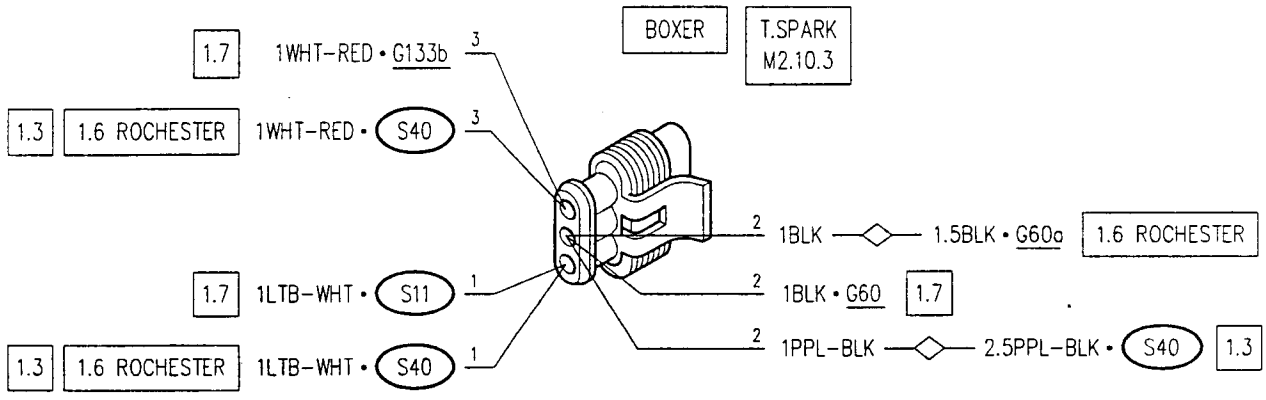
1.6 ROCHESTER

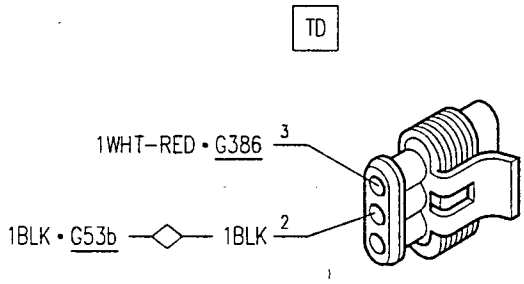
B8 — 1LTB-WHT • T1
B10 — 1BLU-WHT • G133b
B11 — 1GRY-GRN
E10 — 1GRY-GRN
1GRY-GRN • G133b
F11 — 1WHT-RED • T1

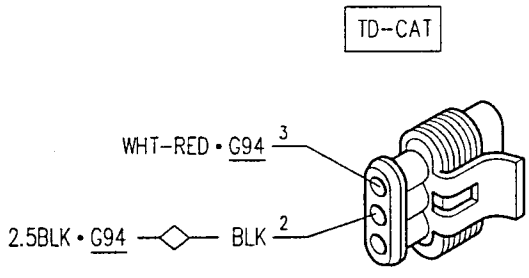


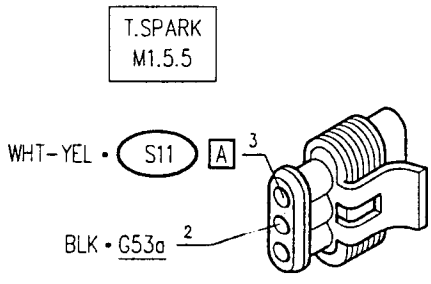
COMPONENTS AND CONNECTORS (cont.d)

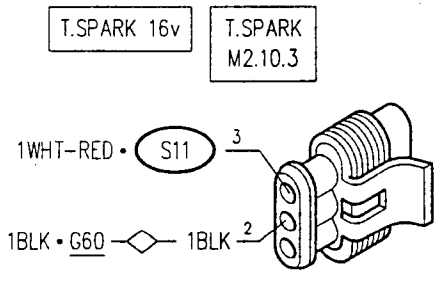
Connector for ALFA TESTER (engine and ALFA ROMEO CODE management) — T1

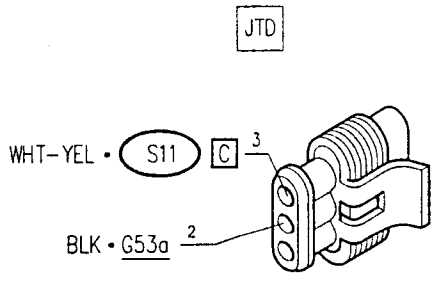




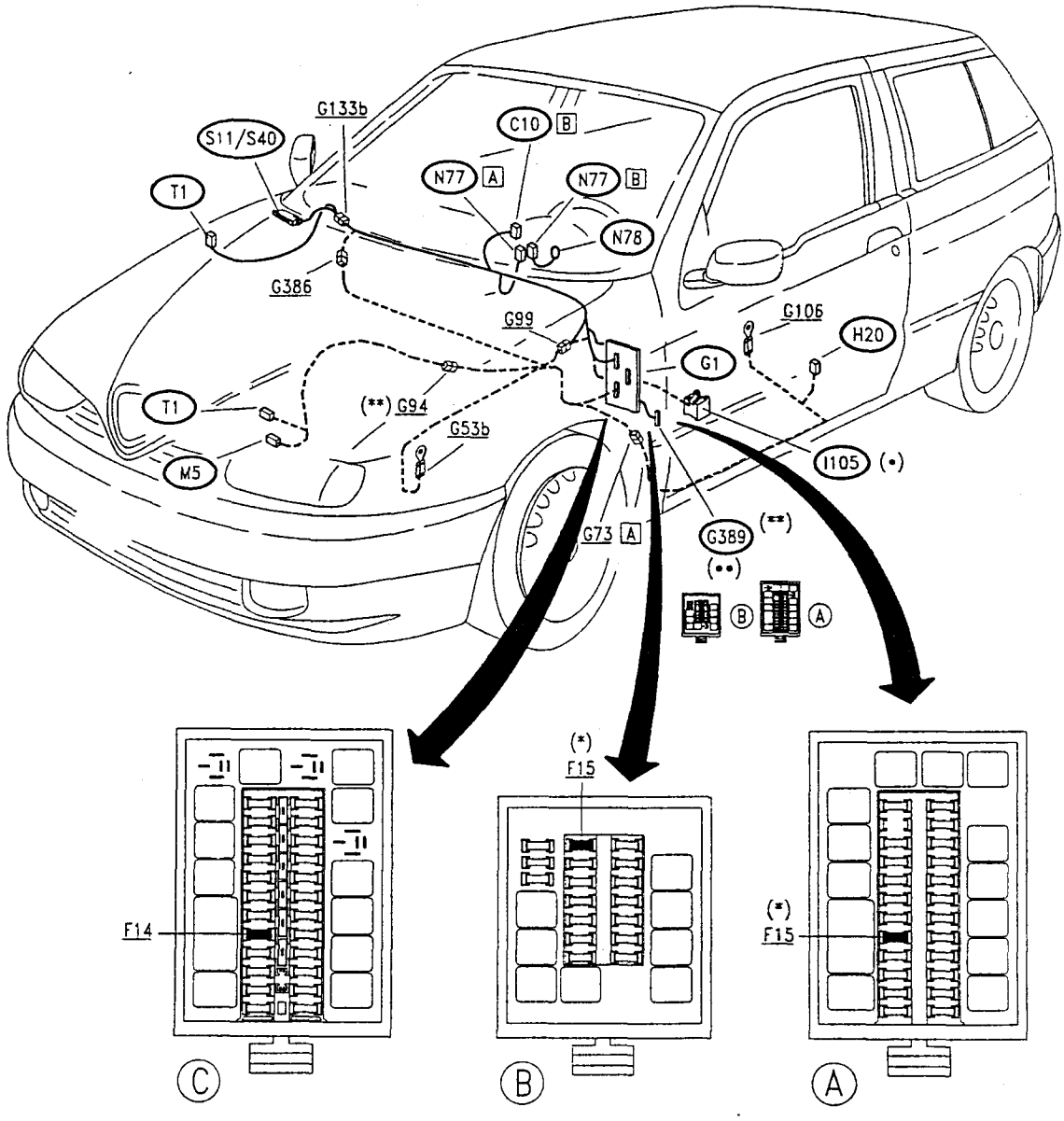






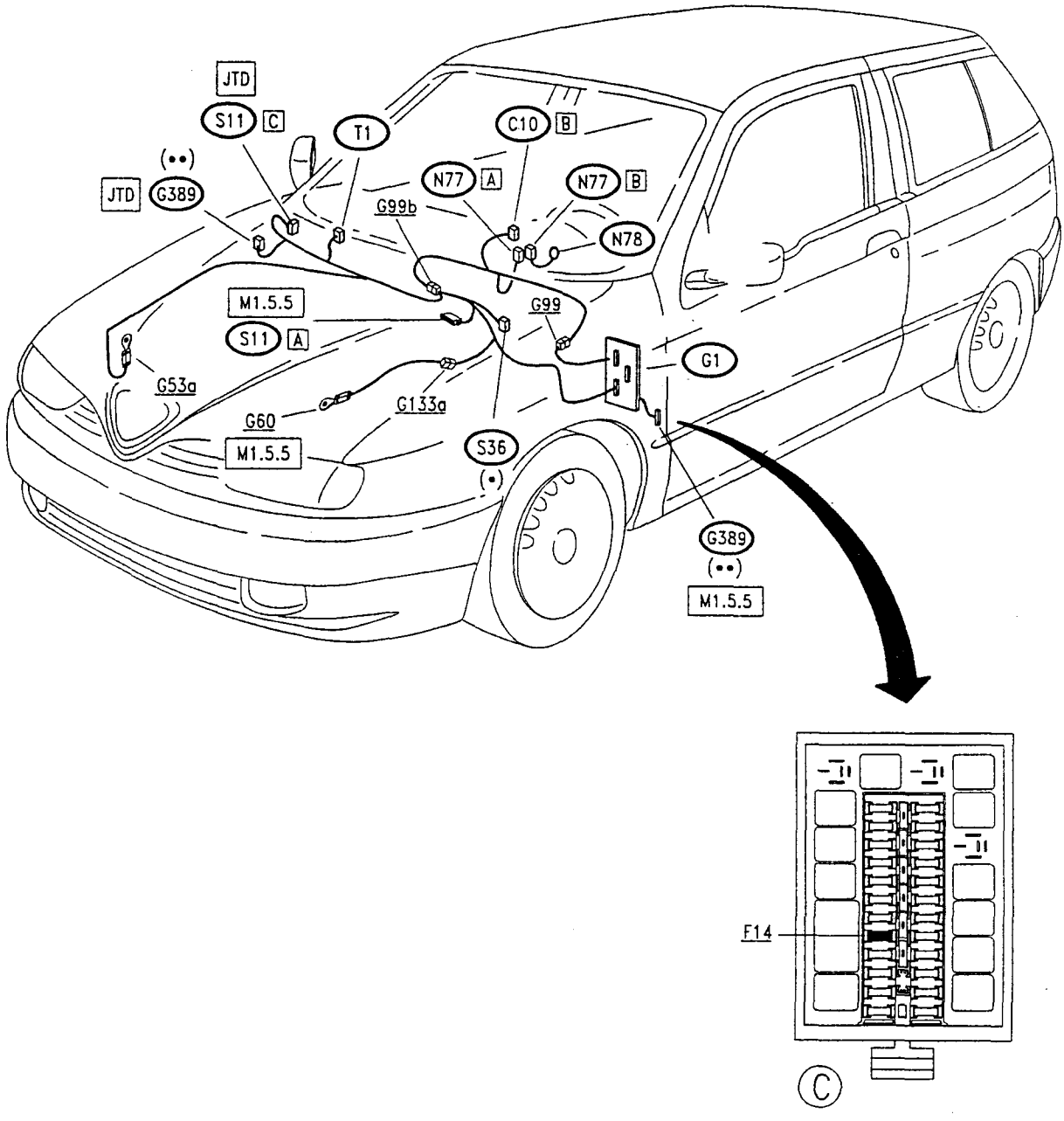


LOCATION OF COMPONENTS (up to M.Y. '97)



– – – – Variant for TD
(•) grey base
(••) red fusebox
(*) up to chassis no. ...
(**) from chassis no. ...

LOCATION OF COMPONENTS (M.Y. '98)



(•) green fusebox
(••) brown fusebox

DIAGNOSIS

The C.C.E. cannot be tested directly via the Alfa Tester.

To the injection control unit, which already possesses a sophisticated self-diagnosis, the possibility has been added to test and display the more important functions of the ALFA ROMEO CODE.

Dialogue between the C.C.M. and the Alfa Tester begins when the key has been turned to MARCIA and when communication between the C.C.M. and the C.C.E. has ended.

The information, concerning the ALFA ROMEO CODE, supplied to the Alfa Tester, may belong to two different environments:

Errors:
generally displayed by the tester with priority depending on the importance.

There is a counter inside the control unit, which is activated when an error is stored and it decreases each time the error is no longer present; when the counter reaches zero, the control unit erases the error from the memory.

Therefore, the error memorised can be distinguished as PRESENT or not PRESENT.

The errors memorised are:

- Serial line not active, code not received or time-out: this error indicates that the control units (C.C.E. and C.C.M.) have not succeeded in communicating and the probable causes can be line interrupted or short circuited or some problem on the actual control units (or - with brand new system - faulty or disconnected aerial or faulty or lacking Transponder).
- Received incorrect code: the injection control unit has received from the C.C.E. a code that does not correspond to its memorised MASTER CODE; the probable cause can be an exchange of the injection control unit or the use of another main key during re-memorisation.
- Incorrect code in the C.C.E.: this means that a key unknown to the control unit has been inserted and starting of the car has not been allowed.

Parameters:

This is the environment of the Tester after connection with the C.C.M. (if no errors are present).

This environment is used to display the engineering parameters which define the status of a system.

The parameters are the following:

- brand new C.C.M.
- Starting inhibition procedure; (an un-memorised key has been inserted, the C.C.M. has not been enabled to start by the C.C.E.)
- brand new C.C.E. connected correctly

RECOVERY PROCEDURES

The emergency procedures should be carried out, when it is not possible to start the engine with the keys available.

This procedure requires the possession of the Code Card; with the corresponding ELECTRONIC CODE (5-figure code written on the card. The procedure, (carried out either with the Alfa Tester or with the accelerator pedal) consists in entering the ELECTRONIC CODE directly in the inection control unit.
This procedure makes it possible to start the engine only once; the procedure must be repeated to start the engine again (or a "known" key must be inserted, i.e. already memorised in the control unit).

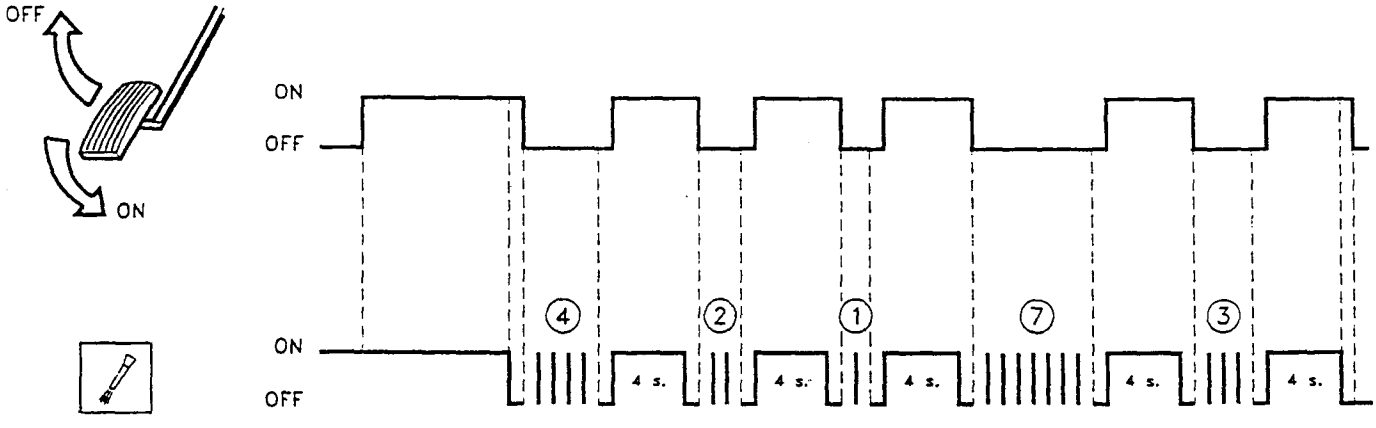
Emergency starting procedure (using the accelerator pedal): NOT foreseen for the TD version

This procedure should be carried out using the accelerator pedal and carefully watching the indications of the injection control unit warning light.

- Turn the key to MARCIA
- Press the accelerator pedal and keep it pressed until the warning light goes out.
- When the warning light goes out release the accelerator pedal.
- At this point the warning light begins to flash; after the number of flashes corresponding to the first number of the code on the Code Card (ELECTRONIC CODE) depress the accelerator pedal completely.
- The warning light turns on and stays on for 4 seconds then it goes out.
- When the warning light goes out, release the accelerator pedal
- The warning light starts to flash again; after the number of flashes corresponding to the second number of the ELECTRONIC CODE, press the accelerator fully home again.
- Proceed in the same way for the other numbers of the ELECTRONIC CODE.
- Also after the last number, keep the accelerator pressed until the warning light goes out (appr. 4 seconds)
- Release the accelerator pedal.

If the warning light flashes quickly, it means that the operation has been carried out correctly, thus the car can be started: if the warning light stays on, the code has not been entered correctly, move the key to STOP and back to MARCIA again, and repeat the procedure.

EXAMPLE: ELECTRONIC CODE = "42173"



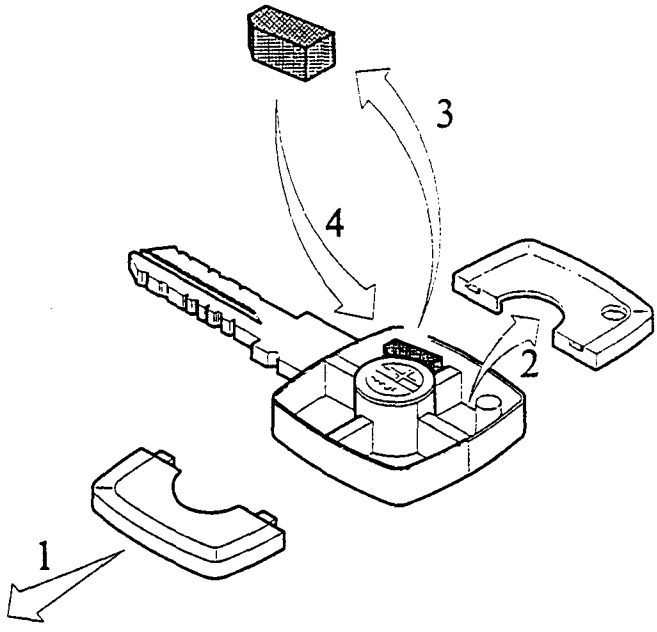
NOTE : If this procedure is not activated correctly, check the throttle potentiometer and the corresponding wiring, and also the throttle itself (throttle stroke without obstacles or sticking); also check the supply to the C.C.M..

TRANSPONDER TRANSFER PROCEDURE

When needing to change the ignition lock or a door lock, for example, **it is possible to transfer the Transponder from MASTER key to another:** this way the memory of the Electronic Key Control Unit (C.C.E.) can be "re-opened" to memorise the new main keys (with new locks). Otherwise it would be necessary to change both the C.C.E. and the Master Key Control Unit (C.C.M.) as it would be impossible to re-open the memory of the latter using another Transponder.

To transfer a Transponder, proceed as follows:

1. Open the MASTER key removing the mobile part.
2. Lift the other part, acting on the two notches. Procede carefully, in order to avoir damages to the key.
3. Remove the Transponder taking care not to damage it.
4. Insert the Transponder in another MASTER key. N.B.: The Transponder rests in place in the key and is not restrained.



AIRBAG + SIDEBAG

INDEX

GENERAL DESCRIPTION 27A-2
SAFETY REGULATIONS 27A-3
WIRING DIAGRAM 27A-4
FUNCTIONAL DESCRIPTION 27A-5
COMPONENTS AND CONNECTORS 27A-6
LOCATION OF COMPONENTS 27A-9
TROUBLESHOOTING 27A-10

GENERAL DESCRIPTION

The car has a safety system complete with:

- Airbag for frontal protection of driver and passenger.
- Side airbags

The system actuates:

- the airbags on the driver and passenger side in case of **frontal collision** of a certain severity.
- In the case of a **side collision** of a certain severity, the side airbag on the collision side alone is actuated.

The system is made up of the following components:

- ECU
- Driver's side airbag
- Passenger's side airbag
- Sensor for automatic disabling of passenger's side airbag (only present up to June '99)
- Side collision sensor on left doorjamb
- Side collision sensor on right doorjamb
- Right side airbag
- Left side airbag
- Diagnostics socket for checking the system with Examiner or other diagnostics instruments

ECU

An ECU manages the entire system by controlling all the components and activating, when necessary, all the retraint systems (pretensioners and airbags).

Operation in the case of frontal collisions

The ECU contains an accelerometric sensor whose signal, appropriately processed by a microprocessor, detects the severity of a collision, and consequently decides to activate the airbag.

The second sensor has safety functions and consents to activation of the airbags. **The ECU detects only front collisions. It does not intervene whatsoever in cases of side collisions, rear collisions or rollovers.**

Operation in the case of side collisions

On the doorjamb of the front doors there is an accelerometric sensor that detects side collisions and transmits a signal to the control unit.

This signal, appropriately processed by a microprocessor inside the ECU, detects the severity of the side collision and consequently decides whether or not to activate the side airbag on the collision side, but only if the safety sensor consents to activation.

Activations of the side airbags are independent from one another and from the frontal airbags.

SIDE AIRBAGS

Collision sensors

On the doorjamb of the two front doors is an accelerometric sensor which, in the case of side collisions, transmits a signal to the control unit.

This signal is appropriately processed inside the control unit, which consequently decides whether or not to activate the side airbag on the side collision where the impact was detected.

In fact, the control unit has a second safety sensor which detects side collisions (much like the sensor that detects frontal collisions) and consents to activation of the side airbag on the side of the collision.

This sensor is positioned so as to detect impacts only on the side on which it is located: *e.g.: the sensor on the driver's side doorjamb detects only collisions on the left and not from the upper right side.*

NOTE: The sensor must always be mounted with the arrow pointing towards the front of the vehicle.

Side airbag

The side airbag is housed on the external part – toward the window – of both front seats.

It consists of a container – built into the seat back – that houses the gas generator and the folded bag.

The container is fixed to the frame of the seat back by means of a bracket.

The gas generator can be activated electrically by means of a signal from the ECU, whereby a charge of propellant is fired and releases a compressed gas (Argon) which expands in the cushion. The side cushions are smaller than the front cushions.

Cushion deflation – after being inflated by the gas – is immediate, thanks to a hole located on the rear part of it.

The seat upholstery has seams with predetermined breakage lines which allow the complete release of the cushion.

Disabling the passenger's side airbag (only present up to June '99)

If a "passenger absent" condition is detected continuously for at least 30 seconds, the control unit cuts out the activation of both the frontal and side airbag on the passenger's side.

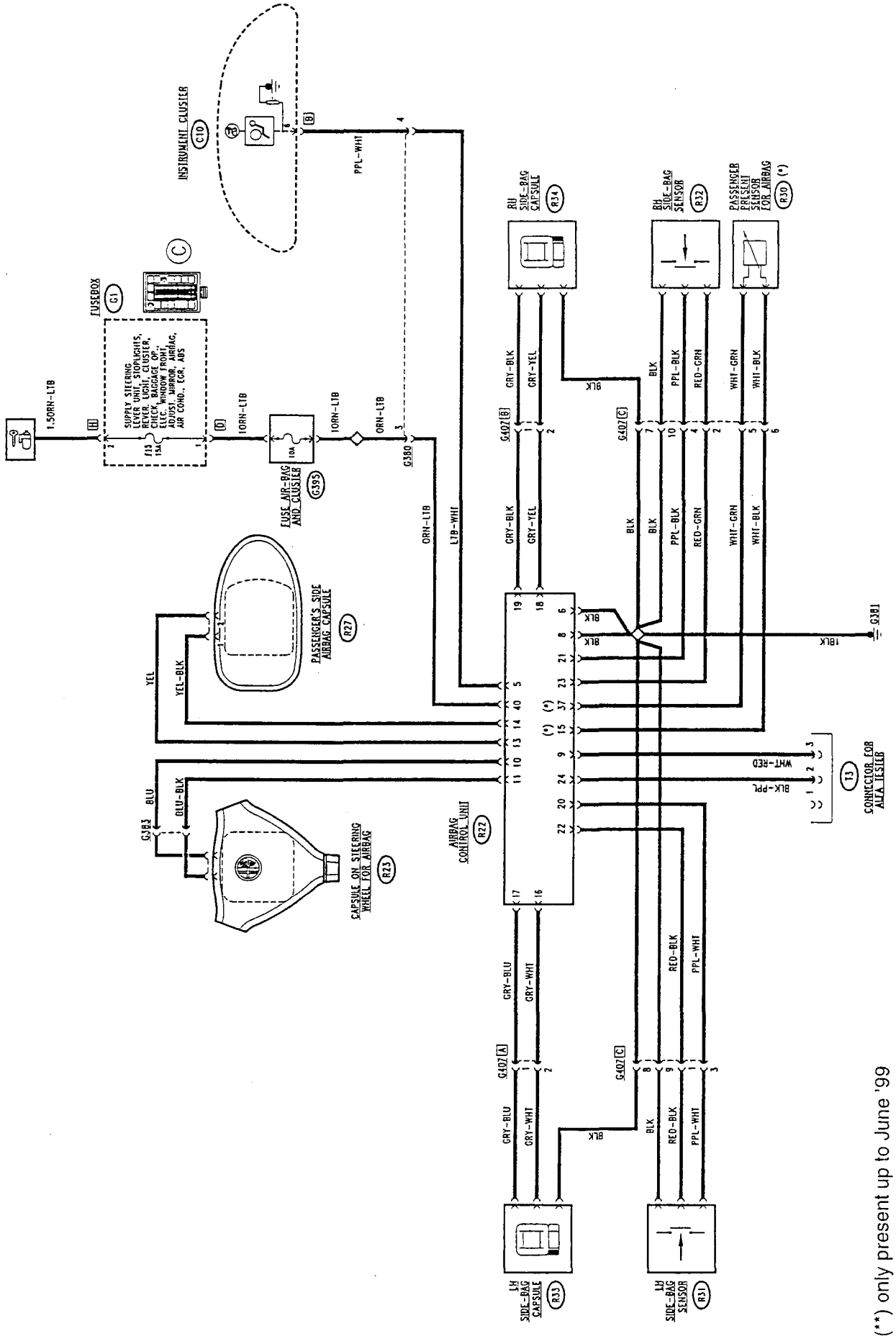
If the sensor later detects the "passenger present" condition, the control unit immediately re-enables the passenger airbags.

SAFETY REGULATIONS TO OBSERVE FOR INTERVENTIONS ON CARS FITTED WITH THE AIRBAG SYSTEM

Below is a list of regulations that MUST ABSOLUTELY BE OBEYED in case of any sort of intervention on cars equipped with the airbag safety system.

See description in section 55-27 above.

WIRING DIAGRAM



FUNCTIONAL DESCRIPTION

The **R22** control unit is protection-powered, (circuit protected by fuse **F15** located in fuse box **G1**) by pin 40.

The power supply of the **R22** control unit is protected by another fuse (**G395**) located in the vicinity of the same fuse box (**G1**).

The system contains two frontal cushions: one is positioned on the driver's side **R23** (in the center of the steering wheel) and one in the dashboard in front of the passenger **R27**. It contains two side cushions: **R32** e **R33**.
NOTE: The cushion on the steering wheel is connected electrically by means of a spiraled cable and the connector **G383**.

While the car is traveling, control unit **R22** continuously runs system diagnostics to check the continuity of system circuits and components.

In case of a frontal collision detected by the two internal sensors (one piezoelectric and the other mechanical), the control unit, activates both modules by sending a voltage by means of two signals at 12V: one earth signal and one power supply signal, pin 13 and 14 for the passenger module **R27** and pin 10 and 11 for the module on the steering wheel **R23**.

If the sensor **R30** (only present up to June '99) indicates (pin 15 and 37 of **R22**) the absence of the passenger on the seat, the relative airbag is not activated.

In the case of a side collision, the information is sent to the control unit by sensors **R31** (driver's side) and **R32** (passenger's side) on pins 20 and 22 and 21 and 23 of **R22** respectively.

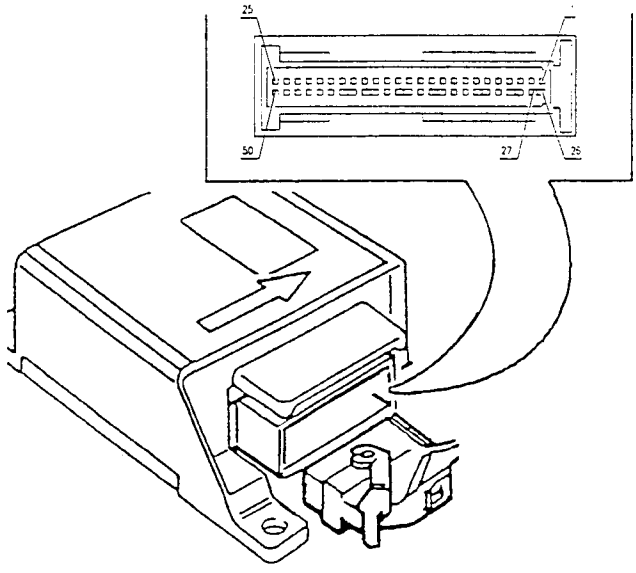
Consequently the control unit enables the side bag on the driver's side **R33** (from pins 16 and 17) and the side bag on the passenger's side **R34** (from pins 18 and19).

The telltale light in question is the so-called "intelligent" type: in fact it lights up not only when the system detects an anomaly, but also in cases of a lack of connection or short circuit to earth from the circuit that connects the telltale light to the relative control unit, thanks to a special internal pilot circuit which checks proper connection.

Upon detection of a failure or malfunction of the system, the type of failure is memorized and consequently the airbag telltale light on the instrument panel **C10** turns on to warn the user that there is a failure in the system.

Finally, connection **T3** allows connection to the ALFA TESTER (pin 24).

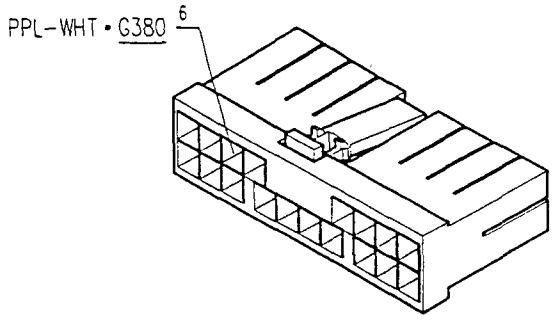
CONTROL UNIT PIN-OUT



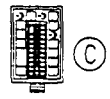
5. Airbag system failure warning light signal
6. Earth
8 Earth
9. K diagnostics line
10. Activation (+) driver's frontal airbag
11. Activation (-) driver's frontal airbag
13. Activation (+) passenger's frontal airbag
14. Activation (-) passenger's frontal airbag
15. Passenger presence sensor signal
16. Activation (+) driver's side airbag
17. Activation (-) driver's side airbag
18 Activation (+) passenger's side airbag
19. Activation (-) passenger's side airbag
20. Driver's seat side sensor
21. Passenger's seat side sensor
22. Driver's seat side sensor power supply
23. Passenger's seat side sensor power supply
24. Diagnostics K line earth
37. Passenger presence sensor signal
40. Protected power supply

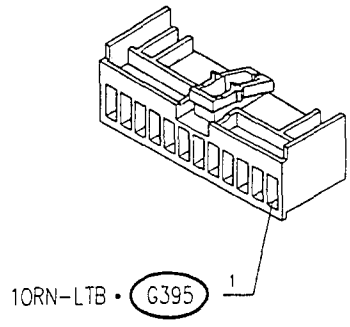
COMPONENTS AND CONNECTORS

Instrument cluster	C10 B

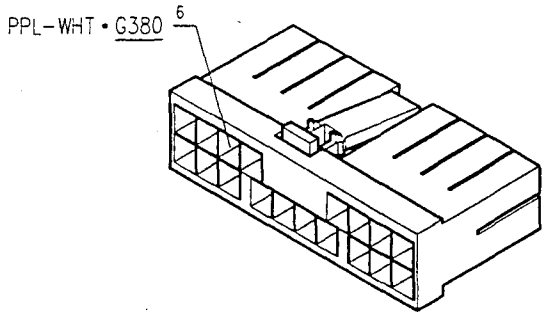


Fusebox	G1 D

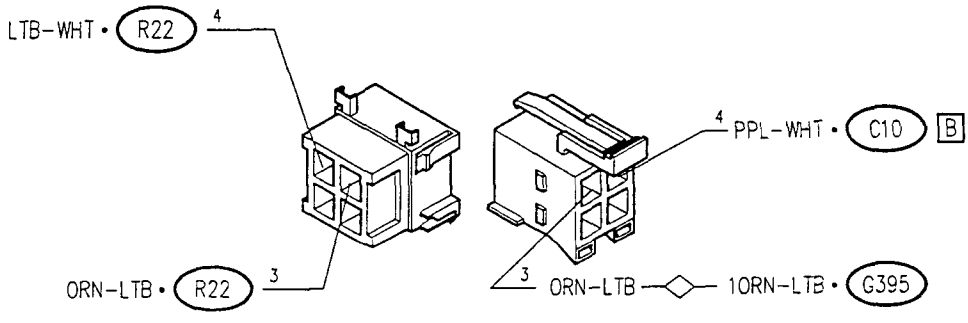




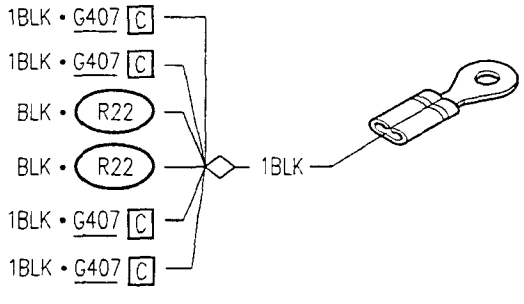
Fusebox	G1 H



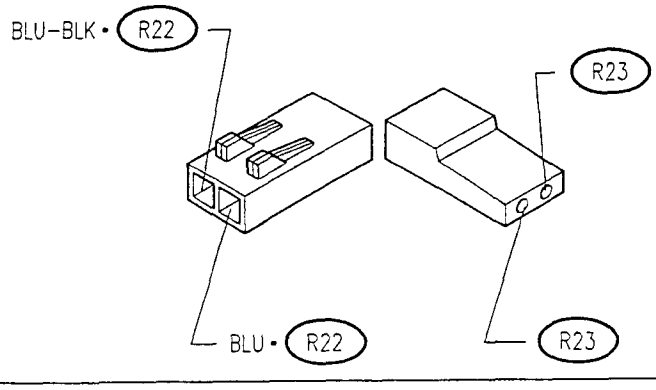
Airbag connector	G380



Earth for airbag	G381

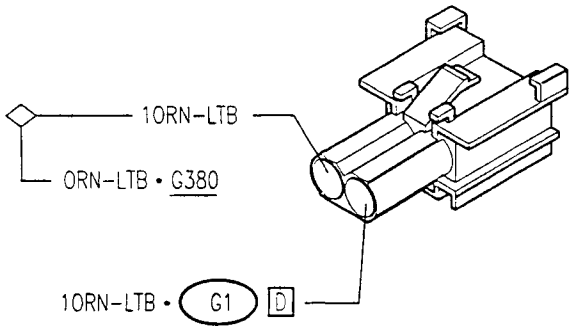


Connector for airbag capsule	G383

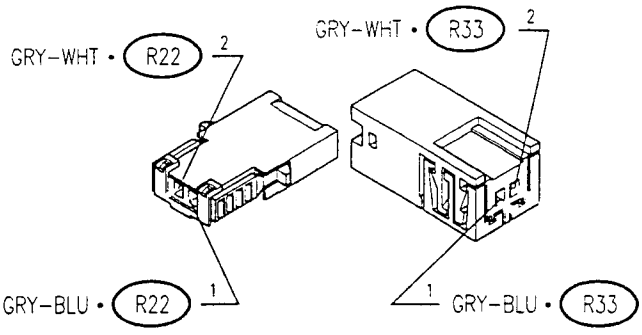


COMPONENTS AND CONNECTORS (cont.d)

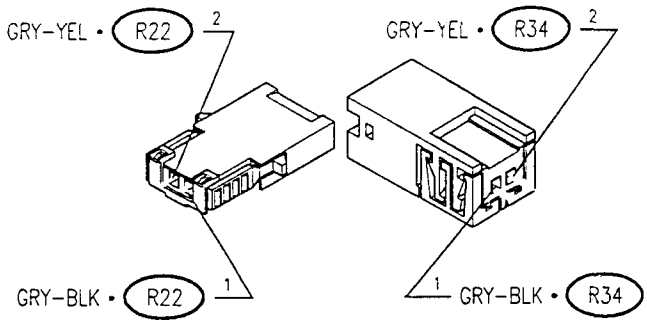
Air Bag and cluster fuse — G395



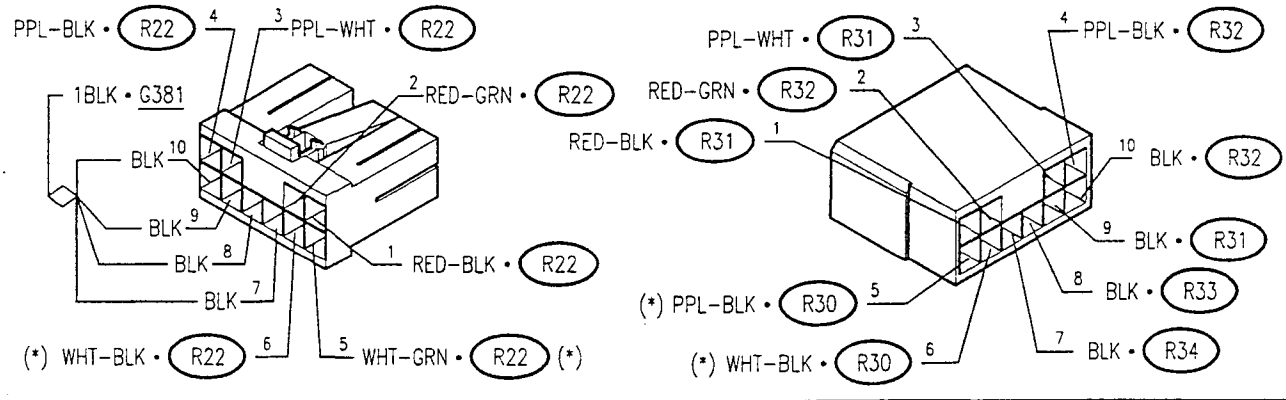
Seam for Side Bag — G407 A



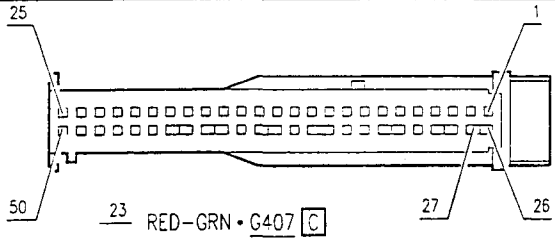
Seam for Side Bag — G407 B



Seam for Side Bag — G407 C



Airbag control unit — R22

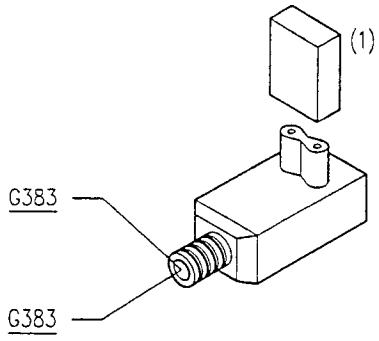


5 ORN-LTB • G380
6 BLK — 1BLK • G381
8 BLK — 1BLK • G381
9 WHT-RED • T3
10 BLU • G383
11 BLU-BLK • G383
13 YEL • R27
14 YEL-BLK • R27
15 WHT-BLK • G407 C (*)
16 GRY-WHT • G407 A
17 GRY-BLU • G407 A
18 GRY-YEL • G407 B
19 GRY-BLK • G407 B
20 PPL-WHT • G407 C
21 PPL-BLK • G407 C
22 RED-BLK • G407 C
23 RED-GRN • G407 C
24 BLK-PPL • T3
37 WHT-GRN • G407 C (*)
40 LTB-WHT • G380

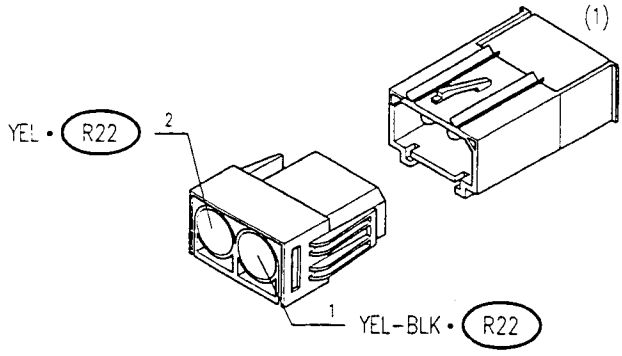
(*) only present up to June '99

COMPONENTS AND CONNECTORS (cont.d)

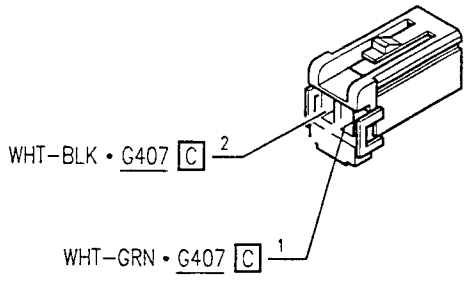
Capsule on steering wheel for airbag	R23



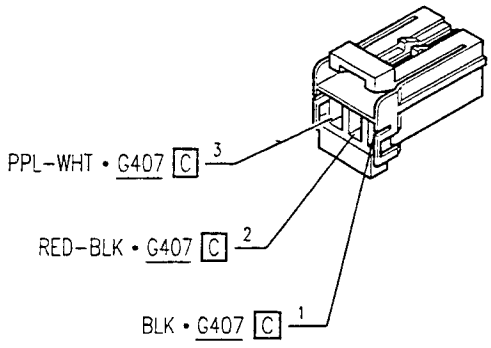
Passenger's side airbag capsule	R27



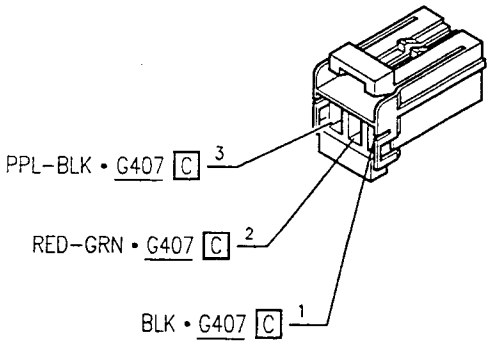
Passenger present sensor for Air Bag (*)	R30



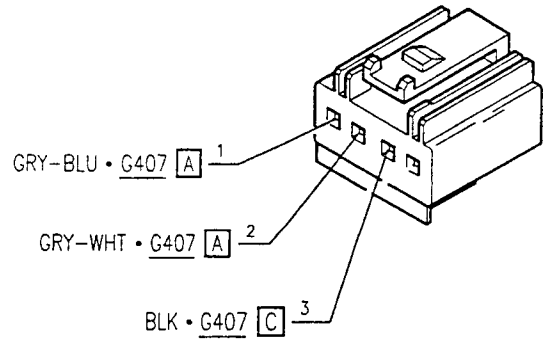
LH Side Bag sensor	R31



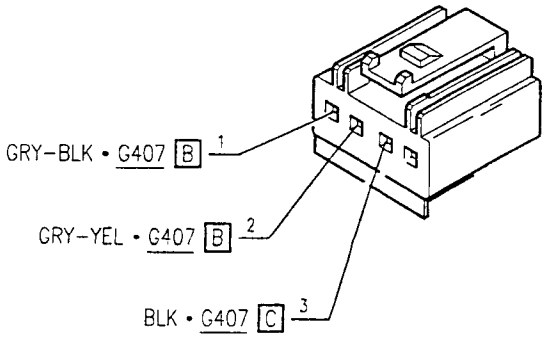
RH Side Bag sensor	R32



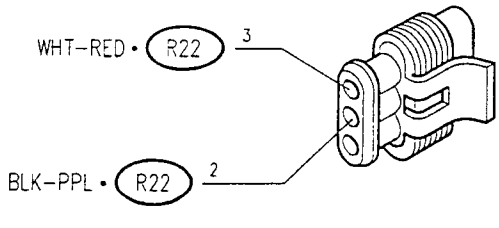
LH Side Bag capsule	R33



RH Side Bag capsule	R34

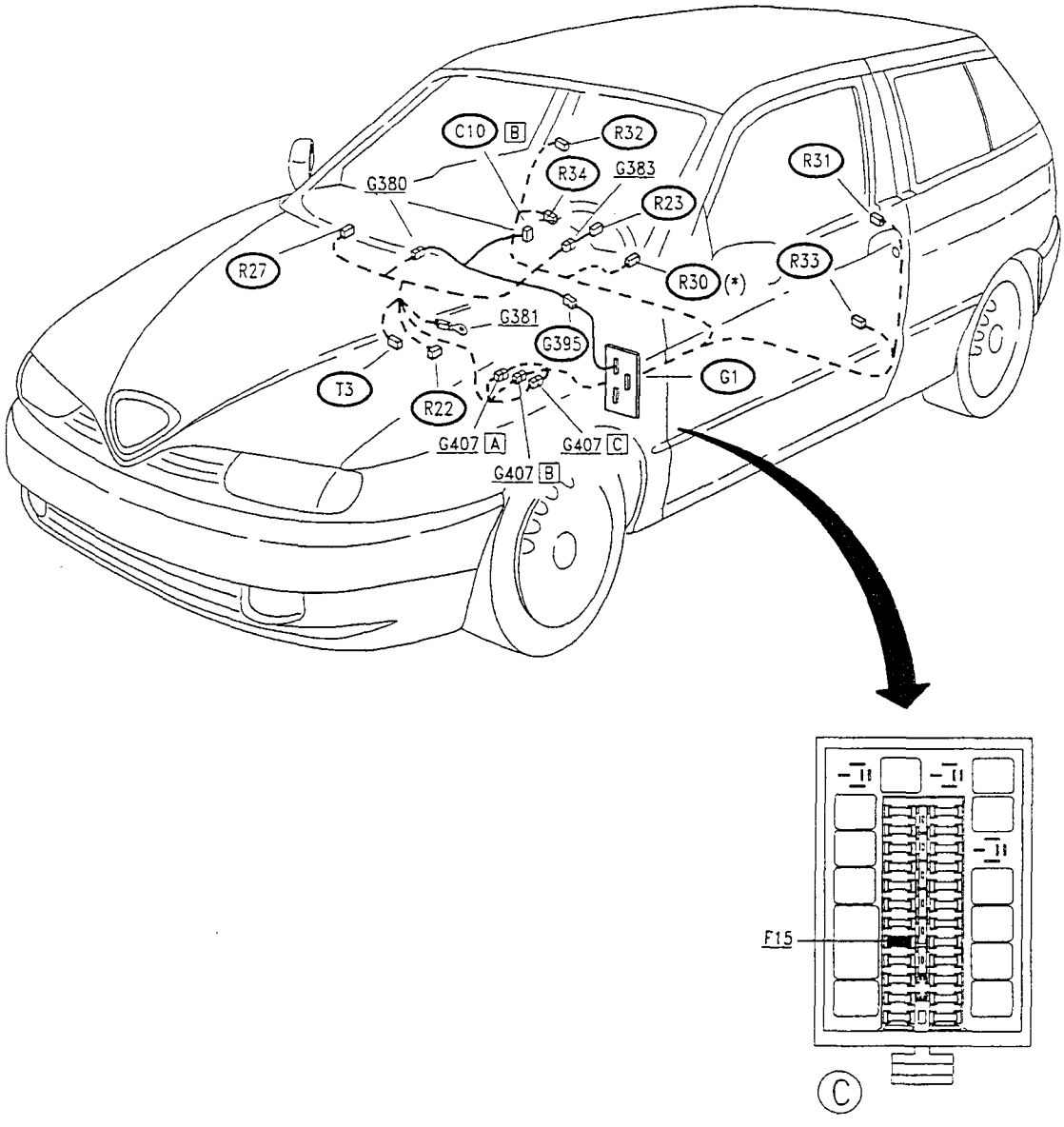


Connector for ALFA TESTER (airbag)	T3



(*) only present up to June '99

LOCATION OF COMPONENTS



(•) Red fuse box
NOTE:

— • — • —The airbag wiring harness is easy to recognize because the sheath is **YELLOW**
(*) only present up to June '99

TROUBLESHOOTING

WARNING:
Before any intervention on system components, carefully read the SAFETY REGULATIONS listed above and follow them scrupulously.

System self-diagnosis

During the entire traveling period of the car, the ECU runs a self-diagnostics test to check the airbag system and memorize any failures. When a failure is detected, it not only memorizes it but it turns on the airbag warning light.

Upon starting the car, the airbag warning light turns on for about 4 seconds (initial test phase) and then turns off.

If the light DOES NOT turn on or DOES NOT turn off after 4 seconds, there is a failure in the airbag system.

The anomalies memorized in the control unit can be cancelled, after the failure has been repaired by means of diagnostic instruments (e.g. Examiner).

The control unit also memorizes airbag activations caused by particularly severe collisions. **When a collision causes activation of the system, it is not possible to delete it from the memory of the control unit and therefore the control unit must always be replaced.**

System diagnostics

It is possible to analyze anomalies memorized in the control unit by means of diagnostic instruments (e.g. Examiner).

During diagnosis, in particular if it is necessary to take measurements of continuity on the module lines, it is **absolutely necessary to disconnect the modules from the wiring harness and replace them with the appropriate simulation resistances.**

IT IS PROHIBITED TO TAKE CONTINUITY MEASUREMENTS ON SYSTEM COMPONENTS UNLESS THE MODULES HAVE BEEN REPLACED WITH THE SIMULATION RESISTANCES.

AIRBAG
(driver's and passenger's side)

INDEX

GENERAL DESCRIPTION 27-2
SAFETY MEASURES 27-2
WIRING DIAGRAM (BECKER control unit) 27-2/4
WIRING DIAGRAM (TRW control unit) 27-3
WIRING DIAGRAM (from M.Y. '97) 27-4
FUNCTIONAL DESCRIPTION 27-4/1
COMPONENTS AND CONNECTORS 27-5
LOCATION OF COMPONENTS 27-8
FAULT-FINDING 27-9

GENERAL DESCRIPTION

The Air Bag is a passive safety device formed of one or two cushions which, in the event of a head-on crash, automatically inflate between the body of the occupants of the front seats of the vehicle and the front structures of the passenger compartment.

The system comprises the following components:

- an electronic control unit which contains an electronic circuit with two deceleration sensors; it evaluates the impact situation, implements the intervention strategy and checks and memorises any system faults;
- a driver's side Air Bag module;
- a passenger's side Air Bag module;
- a warning light that indicates any faults,
- a connector for the ALFA TESTER.
- An automatic passenger Air Bag disabling sensor (only up to June '99)

The electronic control, is located in the centre console, unit is equipped with suitably calibrated deceleration sensors, through which it detects a collision situation and triggers the reaction of a chemical compound which produces nitrogen through two electric detonators. The gas inflates the two synthetic fibre cushions respectively housed at the centre of the steering wheel and in a compartment of the dashboard in front of the passenger.

SAFETY RULES TO BE FOLLOWED FOR OPERATIONS ON CARS FITTED WITH AIR BAG SYSTEM

Below we are giving some rules which MUST BE STRICTLY ADHERED TO during any type of operation concerning vehicles fitted with Air Bag safety systems.

PRELIMINARY RULES

You are reminded that Air Bag modules should be handled with care. The use, transport and storage of them are ruled by the following procedures for handling these components.

- Before starting to carry out:

body repair work;

welding operations;

work requiring the removal of Air Bag modules or the control unit.

- Remove the key from the ignition switch
- Always disconnect the battery, i.e.: disconnect the two terminals from their posts and isolate them taping carefully.
- Disconnect the control unit connector waiting at least **10 minutes** after disconnecting the battery.
- When removing one of the inflating devices, closely follow the procedure given below:

1. Wait for at least **10 minutes** after disconnecting the battery before starting to disassemble the module.
2. Slacken the fastening screws.
3. Disconnect the coupling of the inflation devices
4. Store the devices with the cover upwards in a key-locked metal cabinet. This cabinet, to be used only for this purpose, must never be used for storing any other type of material, especially if inflammable. The cabinet must possess all the requisites foreseen for containing pyrotechnical charges (shockproof metal cabinet with air vents to allow natural ventilation inside) and it must be labelled according to the laws in force (DANGER EXPLOSIVES - USE OF NAKED FLAMES PROHIBITED - DO NOT OPEN UNLESS DULY AUTHORISED).

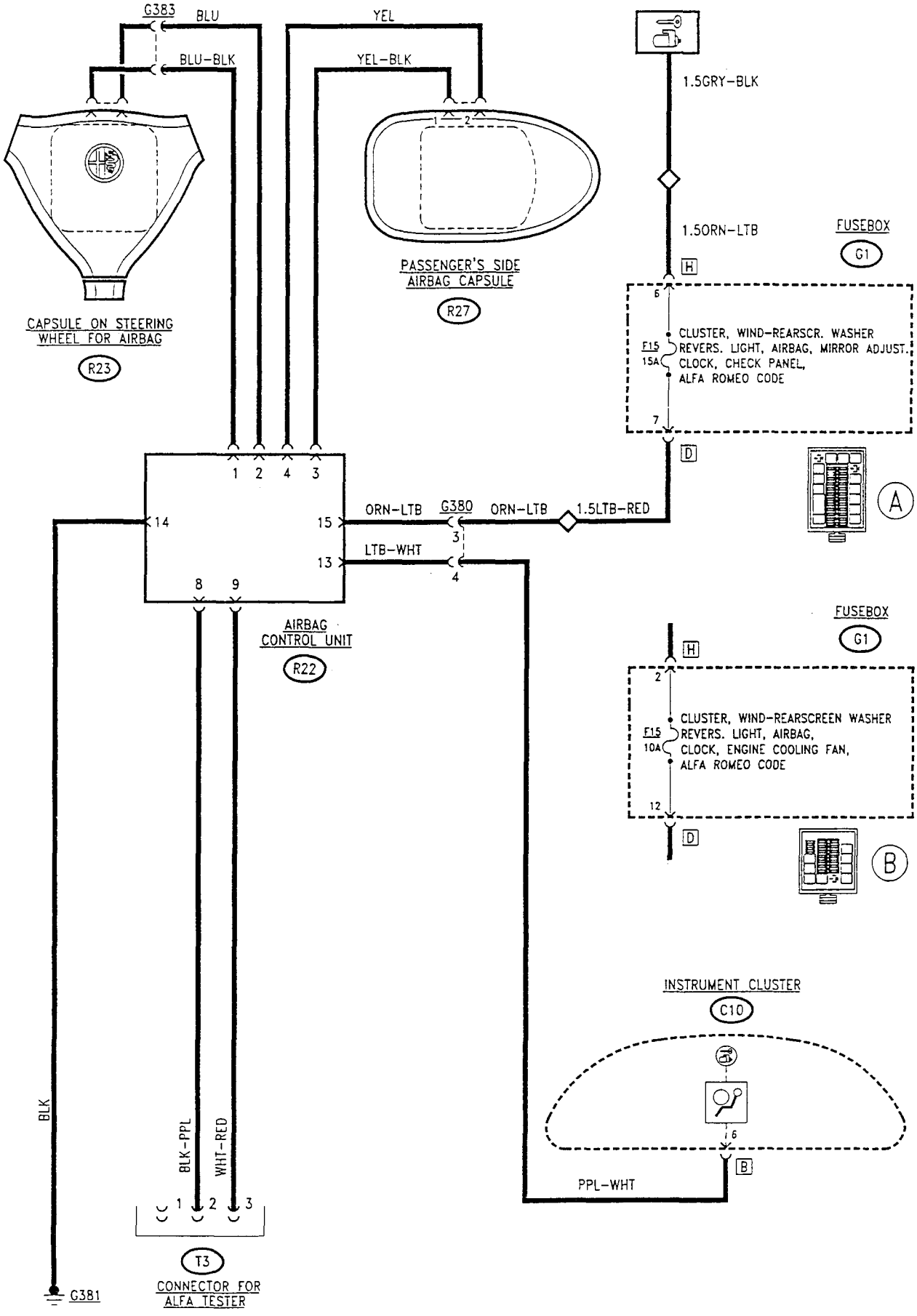
- All the connectors used and wired on Air Bag modules contain a short circuit clip, until the moment in which the Air Bag modules are connected to a suitable power source through the appropriate connector there is no possibility of unduly activating the units.

A component of the system that was not activated during an accident is to be considered still "active" therefore unexploded components due to faults or guarantee expiry or other causes which make their replacement necessary must be returned to the special centre following the procedure described below

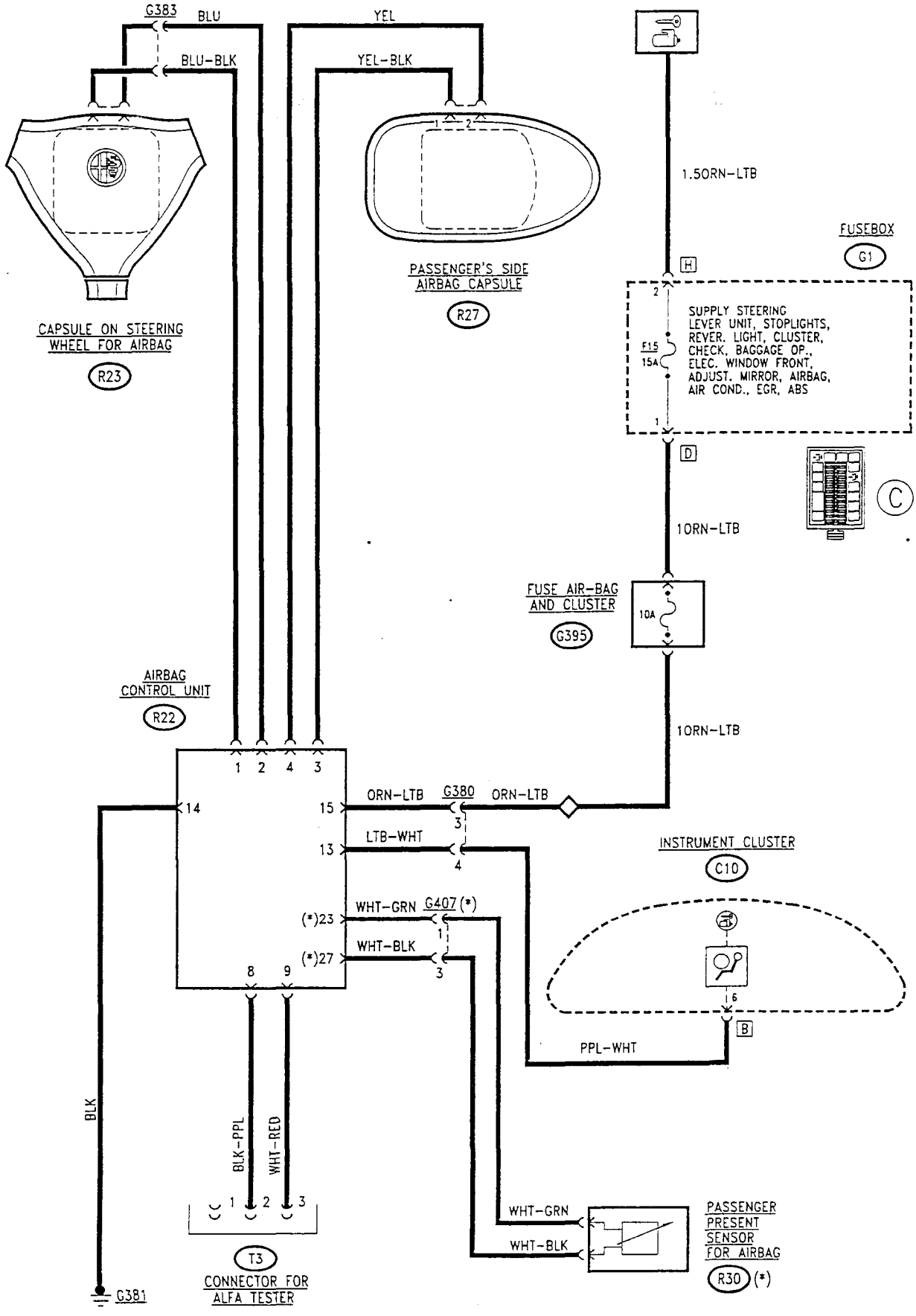
Assembly and disassembly of components of the safety system must be carried out SOLELY by competent, authorised technical staff.
The failure to abide by the instructions herein may involve undesired activation of the system, personal injury or unneccessary system repairs.
IT IS STRICTLY PROHIBITED TO DISASSEMBLE THE COMPONENTS OF AIR BAG MODULES.

All the system components have been designed specifically to work on a car of specific make and model, therefore Air Bags cannot be adapted, re-used or installed on other vehicles, but only on those for which they were designed and produced.
Any attempt to re-use, adapt or install an Air Bag on a different model may cause serious or lethal harm to the occupants of the vehicle in the event of an accident.

WIRING DIAGRAM (TRW control unit, from chassis no....)



WIRING DIAGRAM (from Model Year '97)



(*) only present up to June '99

FUNCTIONAL DESCRIPTION

The control unit **R22** receives the "key-operated" supply, (circuit protected by fuse **F15** in fusebox **G1**) at pin 9 - BECKER or at pin 15 - TRW.

For box "C" the supply of control unit **R22** is protected by a further fuse **G395** next to the box itself **G1** "C".

The system comprises two cushions, one in front of the driver **R23** (at the centre of the steering sheel) and one in the dashboard in front of the passenger **R27**.
NOTE: The cushion on the steering wheel is connected electrically through a clock spring and connector **G383**.

While the car travels, the control unit **R22**continuously diagnoses the system, thereby checking the continuity of the circuits and of the components.

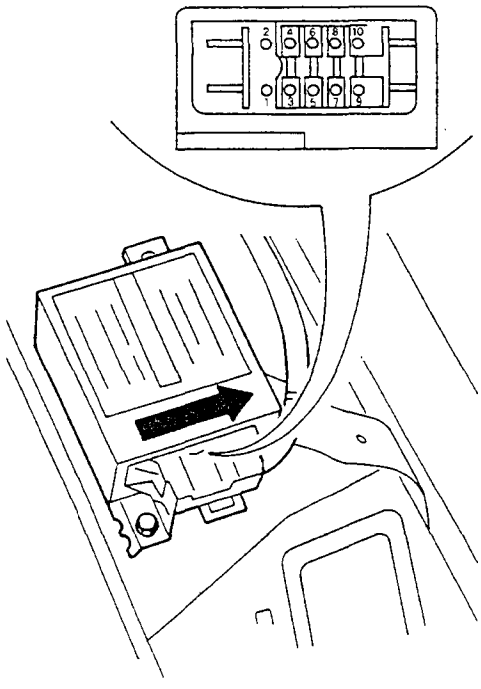
In the event of a crash, detected by the two internal sensors (one piezoelectric and one mechanical) commands activation of the two modules sending current through two signals: one earth and one 12V supply (from pins 6 and 2 - BECKER and 3 and 4 - TRW for the passnger's module and from pins 5 and 2 - BECKER or 1 and 2 - TRW for the module on the steering wheel).

If sensor **R30** (only present until June '99) signals (pins 15 and 37 of **R22**) that there is no passenger on the seat, the Air Bag is not activated.

When a fault or system malfunction is detected, the type of fault is logged and the warning light on the instrument panel **C10** is turned on to alert the driver of the presence of a fault in the system.

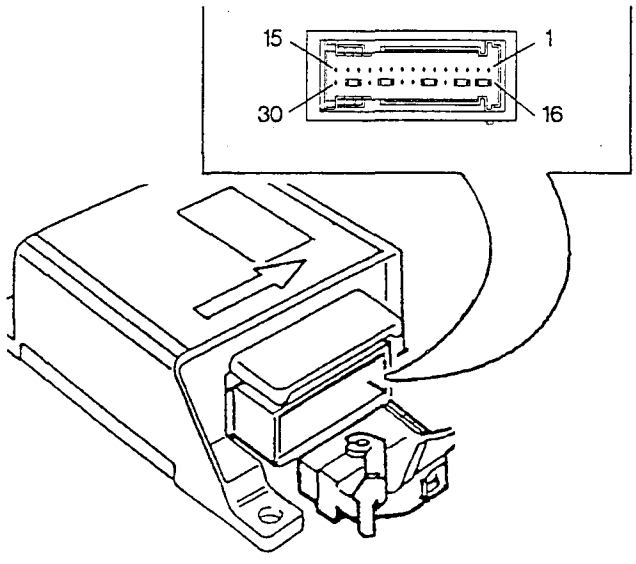
From M.Y. '99, the telltale light in question is the so-called "intelligent" type: it turns on not only if the system detects an anomaly, but also in cases of lack of contact or short circuit to earth of the circuit that connects the telltale light to the relative control unit thanks to a special internal pilot circuit which checks proper connection.

Lastly connector **T3** allows connection to the ALFA TESTER.



BECKER CONTROL UNIT PIN-OUT

1. N.C.
2. Module activation circuit (+)
3. Warning light signal (and diagnosis connector)
4. Diagnosis connector signal
5. Passenger module activation (-)
6. Steering wheel module activation (-)
7. N.C.
8. Earth
9. "Key-operated" supply
10. N.C.



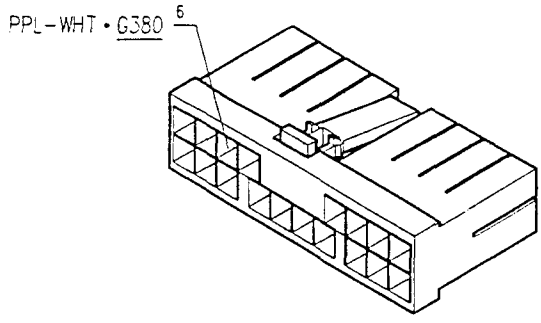
TRW CONTROL UNIT PIN-OUT

1. Driver's Air Bag (-)
2. Driver's side Air Bag (+)
3. Passenger's side Air Bag (-)
4. Passenger's side Air Bag (+
5. N.C.
6. N.C.
7. N.C.
8. Earth for diagnosis
9. Line K for diagnosis
10. N.C.
11. N.C.
12. N.C.
13. Warning light (failure and diagnosis)
14. Control unit earth
15. "Key-operated" supply
23. Passenger presence sensor
27. Passenger presence sensor

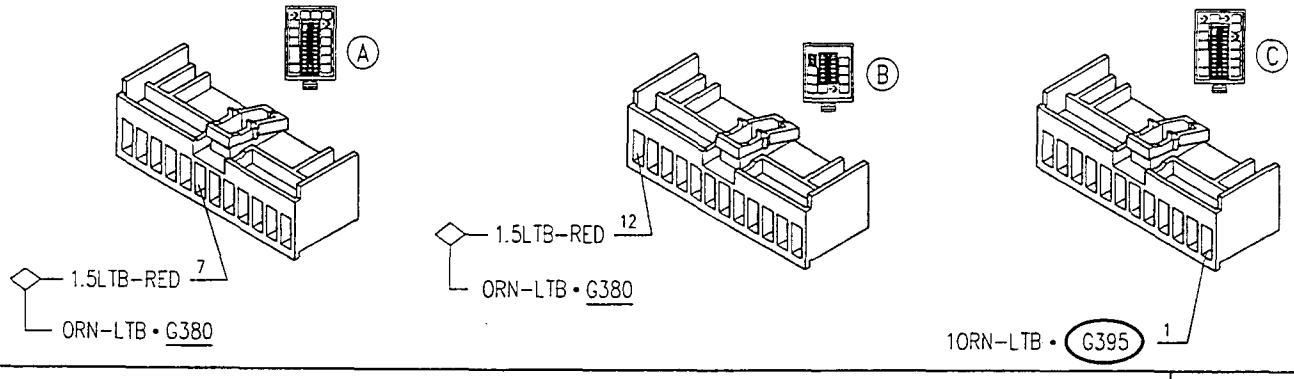
PAGES
4/3 and 4/4
TO BE ELIMINATED

COMPONENTS AND CONNECTORS (cont.d)

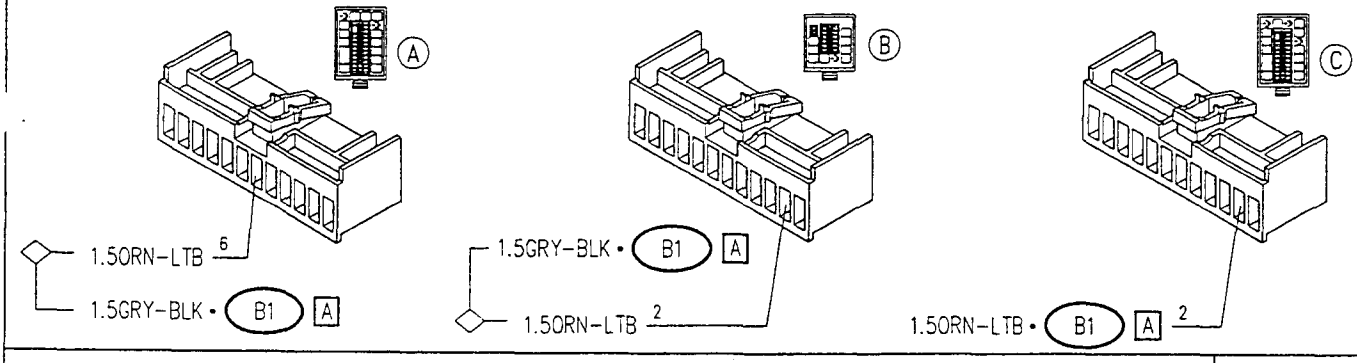
Instrument cluster — C10 B



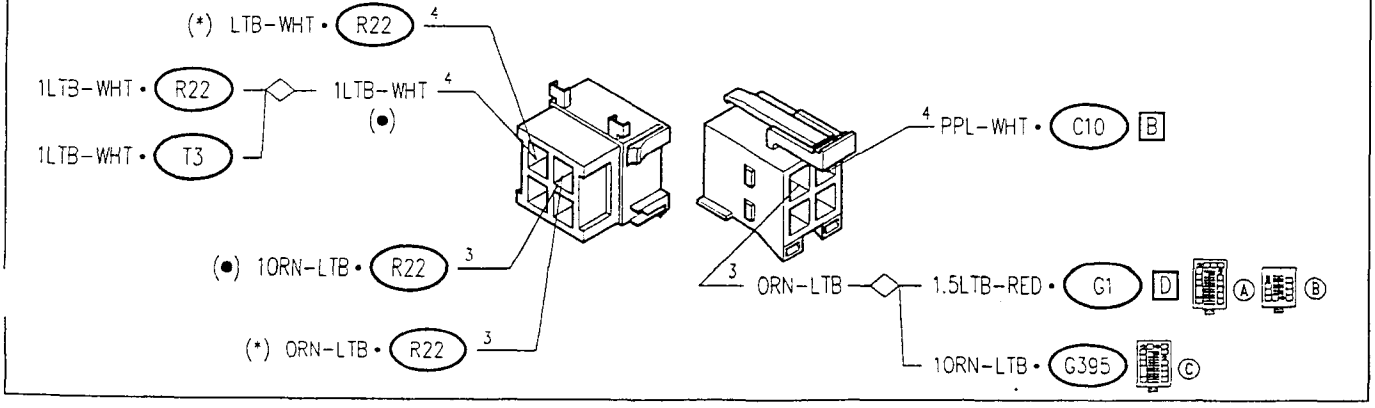
Fusebox — G1 D



Fusebox — G1 H



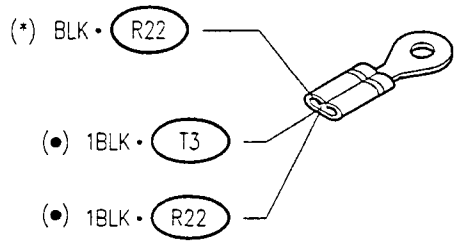
Air Bag wiring connector — G380



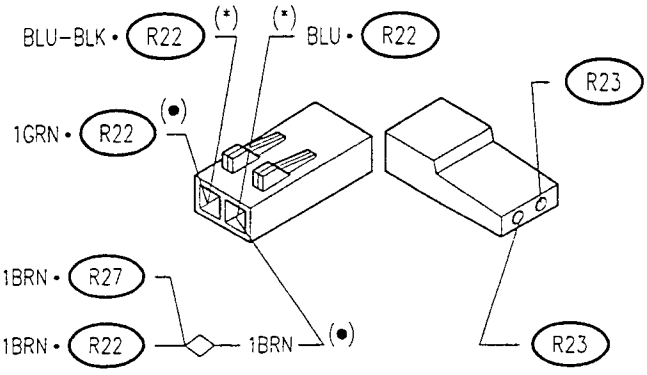
(•) BECKER
(*) TRW

COMPONENTS AND CONNECTORS (cont.d)

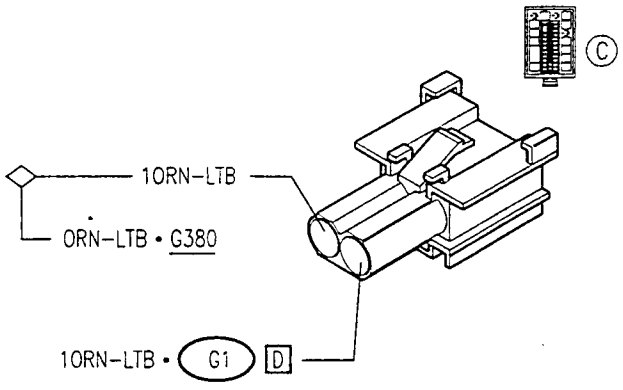
Air Bag earth — G381



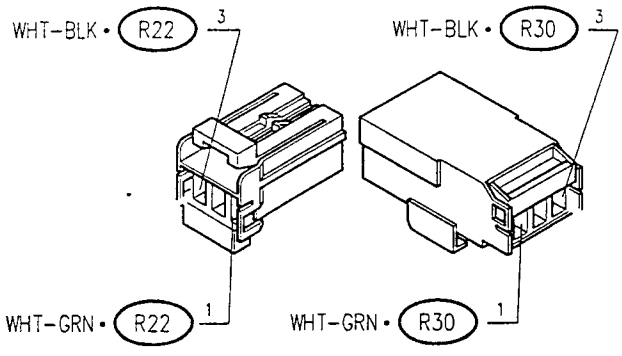
Air Bag capsule connector — G383



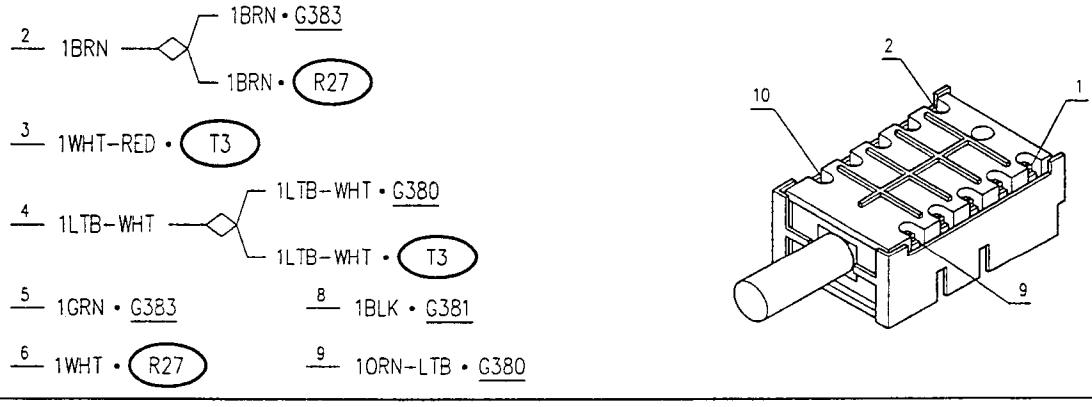
Air Bag and cluster fuse — G395



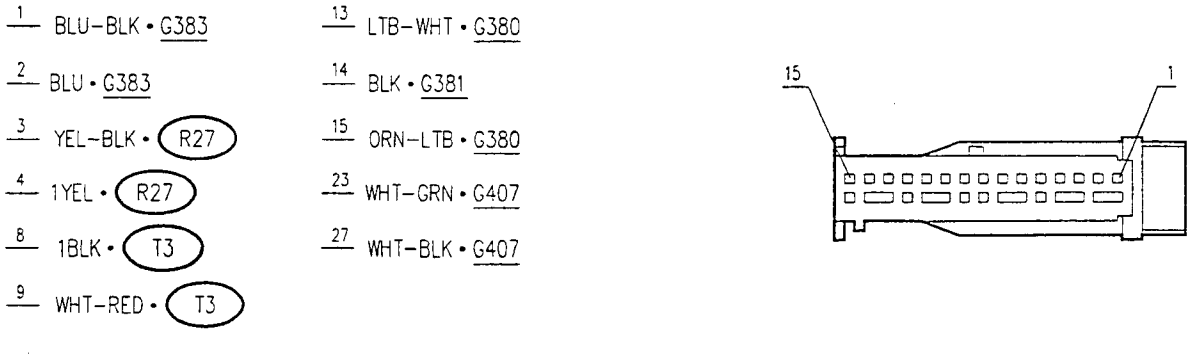
Passenger presence sensor connector (**) — G407



Air Bag control unit (BECKER) — R22



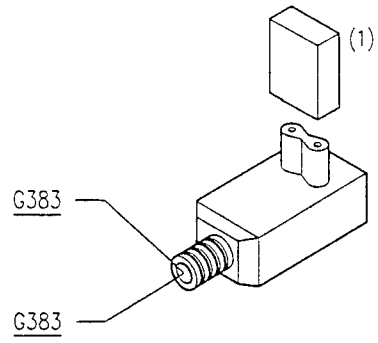
Air Bag control unit (TRW) — R22



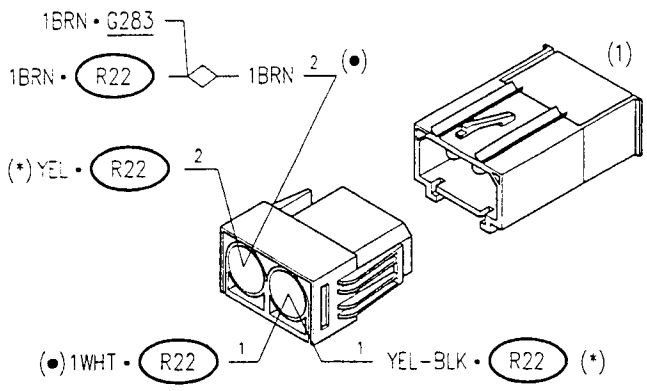
(•) BECKER (*) TRW (**) only present up to June '99

COMPONENTS AND CONNECTORS (cont.d)

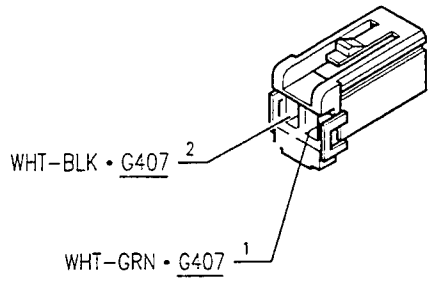
Capsule on stering wheel for Air Bag	R23



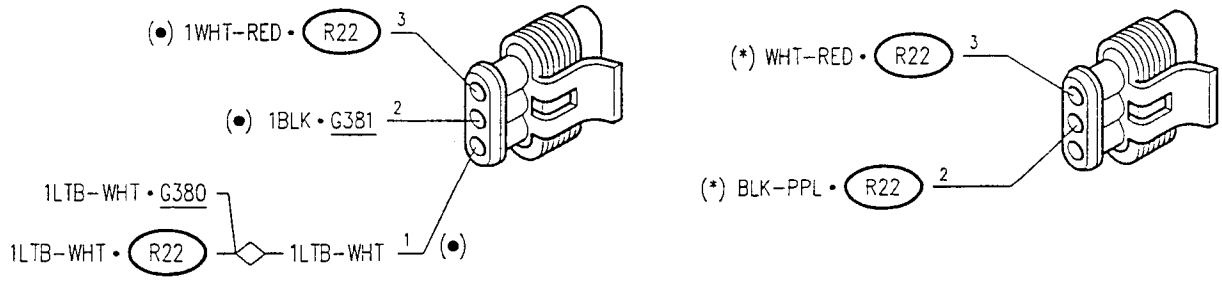
Passenger's side Air Bag capsule	R27



Passenger present sensor for Air Bag (**)	R30

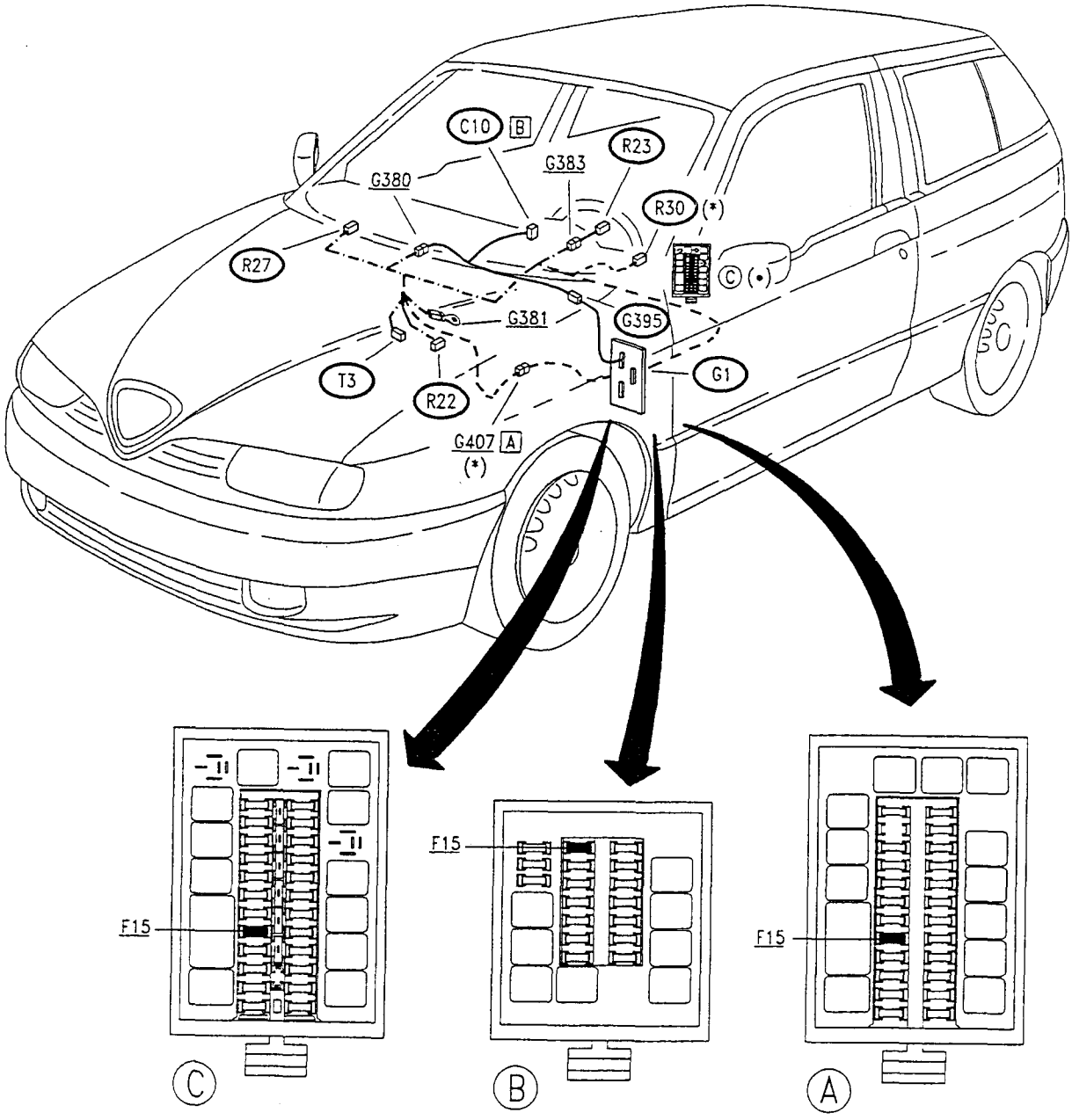


Connector for ALFA TESTER (Air Bag)	T3



(•) BECKER
(*) TRW
(1) dummy resistance
(**) only present up to June '99

LOCATION OF COMPONENTS



(•) red fuseholder
NOTA:
—·—· The Air Bag wiring is easily distinguished because the protective sheath is **YELLOW**
(*) only present up to June '99

FAULT-FINDING

WARNING:
Before doing any work whatsoever on system components, carefully read through the RULES OF SAFETY given previously and closely adhere to them.

System diagnosis

During the whole time the vehicle is travelling the electronic control unit performs a diagnosis cycle every 100 msec. checking the Air Bag system and memorising any faults in the FAULT-MEMORY whether they are momentaneous or continuous. The moment the fault is detected, besides memorising it, the control unit turns on the Air Bag warning light.

When the engine is turned on, this warning light turns on for 4 seconds (initial test) and then it turns off.

If the warning light does NOT turn on or does NOT turn off after 4 seconds it means that there is a fault in the Air Bag system.

The User must then take the vehicle **at the soonest** to the nearest Service Centre to have the fault repaired because the system is no longer capable of operating correctly.

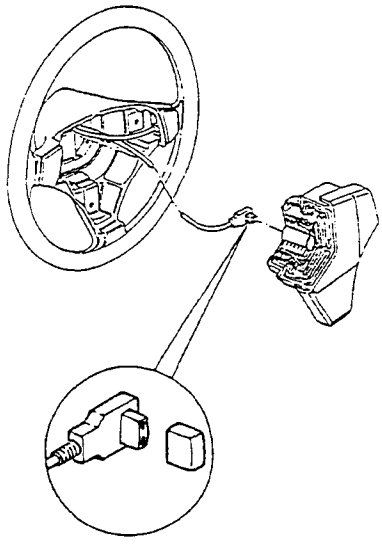
Once the fault has been signalled, the warning light stays on until the fault has been repaired and cancelled from the fault memory.

DIAGNOSIS USING THE ALFA TESTER

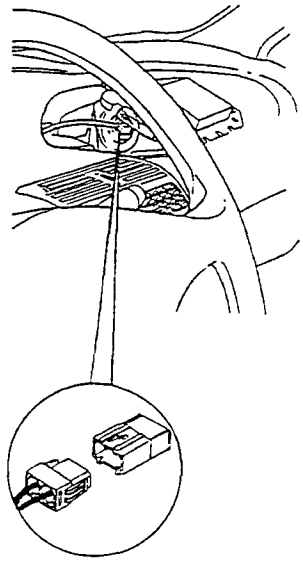
N.B. Before carrying out diagnosis using the tester, carry out the prelinary test described below (TEST A).

To prevent the Air Bags from being triggered accidentally during diagnosis - upon request of the Tester - it is necessary to disconnect them from the wiring and connect a dummy resistance to the connectors which is supplied with the ALFA TESTER cartridge.

Driver's side module (R23)



Passenger's side module (R27)



NOTA:
When the ignition key is removed, the time and type of fault or error code remain present in the FAULT-MEMORY. Once the fault has been repaired it will be cancelled by the TESTER. Intermittent faults are kept in the FAULT-MEMORY for 48 hours, counted from the time in which they occur (time calculated only with the ignition key at MARCIA).

DIAGNOSIS WITH FLASHING CODES (only with BECKER control unit)

As an alternative to the ALFA TESTER it is possible to diagnose the system by **reading the number of flashes of the Air Bag warning light.**

N.B. Before carrying out diagnosis using the flashing code, carry out the preliminary test described later (TEST A).

To perform diagnosis, with the ignition key engaged, earth pin 3 of the electronic control unit for between 1 and 5 seconds (pin 3 of the control unit connects the Air Bag failure warning light and pin 1 of connector **T3**).

Once the fault has been repaired, the test must be repeated to check that other faults are not present. Remember that the control unit signals one fault at a time, in decreasing order, until the system has been repaired completely. When the repairs have been completed, the FAULT MEMORY is cancelled by earthing pin 3 of the control unit for between 5 and 10 seconds. All the errors stored must be cancelled one by one, repeating the procedure each time, until the FAULT-MEMORY has been cancelled completely.

The following table shows the possible faults and the remedies to be adopted, according to the number of flashes of the warning light.

Flashing code table

NO. OF FLASHES	POSSIBLE FAULT	REMEDIES
1	No faults detected	-
2	Faulty control unit	Change the control unit **R22**
3	Module triggering circuit in contact with +12V	Check the wiring
4	Module triggering circuit in contact with earth	Check the wiring
5	Driver's side module triggering device resistance out of tolerance	Check the wiring or change the driver's side module **R23**
6	Passenger's side module triggering device resistance out of tolerance	Check the wiring or change the passenger's module **R27**
7	Supply voltage below 9.5 V	Check fuse **F15** of fusebox **G1** or recharge or change the battery **A1**
8	Warning light circuit fault	Check the wiring or change the instrument cluster **C10**

NOTE: Diagnosis with the blink code is NOT possible with the TRW control unit.

PRELIMINARY CHECKS ON THE AIR BAG SYSTEM	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check the intactness of fuse **F15** of fusebox **G1**	OK ▶	Carry out **step A2**
	OK ▶	Change the fuse
A2 CHECK CONTINUITY – Check continuity of the cable between fusebox **G1** connector D, and the Air Bag control unit **R22** (pin 9 BECKER - pin 15 TRW)	OK ▶	Carry out **step A3**
	OK ▶	Restore wiring continuity
A3 CHECK CONTINUITY – Check continuity of the cable between the control unit **R22** (pin 8 - BECKER - pin 14 TRW) and earth **G381**	OK ▶	Carry out **step A4**
	OK ▶	Restore wiring continuity
A4 WARNING LIGHT – Check that the warning light is intact in the instrument cluster **C10**	OK ▶	Carry out **step A5**
	OK ▶	Change the instrument cluster **C10**
A5 CHECK CONTINUITY – Check the continuity of the cables between module **R27** and the control unit **R22**	OK ▶	Carry out **step A6**
	OK ▶	Restore wiring continuity
A6 CHECK CONTINUITY – Check continuity of the cables between module **R23** and control unit **R22**	OK ▶	CONNECT TO THE DIAGNOSIS SOCKET **T3** AND CONTINUE OPERATIONS WITH THE ALFA TESTER OR WITH THE FLASHING CODE with control unit BECKER
	OK ▶	Restore wiring continuity

ANTI-THEFT DEVICE/ALARM

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This section deals with the INFRARED CONTROL alarm system.
For the version with RADIO FREQUENCY CONTROL, refer to the special publication "ALARM SYSTEM PA500300000000".

GENERAL DESCRIPTION

Upon request the car is pre-wired for the installation of an alarm system, combined with the door locking system with remote control.

The V.A.S.(Vehicle Alarm System) is a system which offers both both perimeter and interior protection: it is able to survey the state of the doors and note the presence of foreign bodies inside the passenger compartment; the system is controlled by a single compact unit which comprises the electronic control unit and siren.

The system is "universal" as it offers the possibility to configure the control unit according to the requirements of the different countries (alarm sound level and types of light flashing for activation/deactivation.

In addition, a sophisticated self-diagnosis system controls:

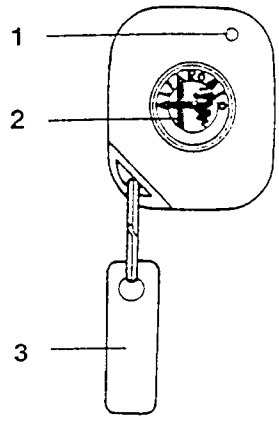
- intermittent and permanent errors or faults;
- number of activations of the anti-theft device and the number of alarms sounded;
- specific faults of the control unit;

WARNING:
For the 145 the alarm system is supplied in two different versions:

- **cars without ALFA ROMEO CODE: V.A.S. ALARM system with volumetric. perimetral protection and internal counter measures in the event of alrm (engine and starter motor lock);**
- **cars with ALFA ROMEO CODE: V.A.S. ALARM system with volumetricand perimetral protection: without engine control carried out by the above-mentioned system (see the corresponding section "ALFA ROMEO CODE").**

COMPONENTS

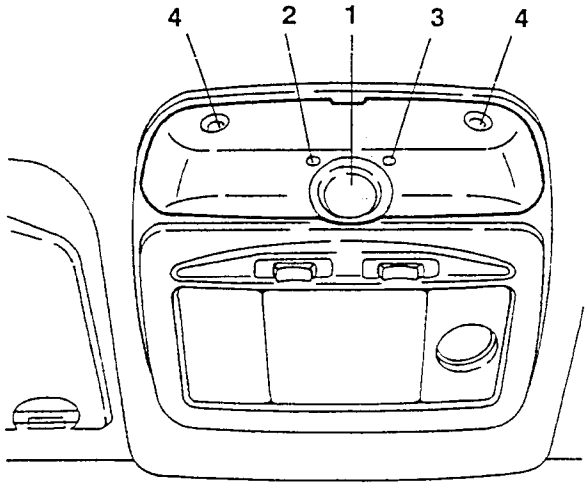
The **transmitter**, protected by a shockproof rubber cover, comprises a printed circuit and an infrared ray sender; it is battery-powered (2 3V lithium batteries) and, each time the control button is pressed, it sends a beam of rays in the direction in which it is pointed. This infrared ray device continuously transmits the code for the whole time in which the button is pressed. An indicator (led) turns on each time a signal is emitted.



Transmitter

1 - Luminous led
2 - Control button
3 - Transmitter code label

The **receiver**, incorporated in the front ceiling lamp, is an electronic device that picks up the infrared ray signal through a half-ball protruding from the receiver. There is also a led on the receiver which lights up when the signal is received, while a special button makes it possible to memorise the secret control code. The special half round shape makes it possible to capture the signal through 360 degrees, provided that the transmitter is no more than 5 metres away

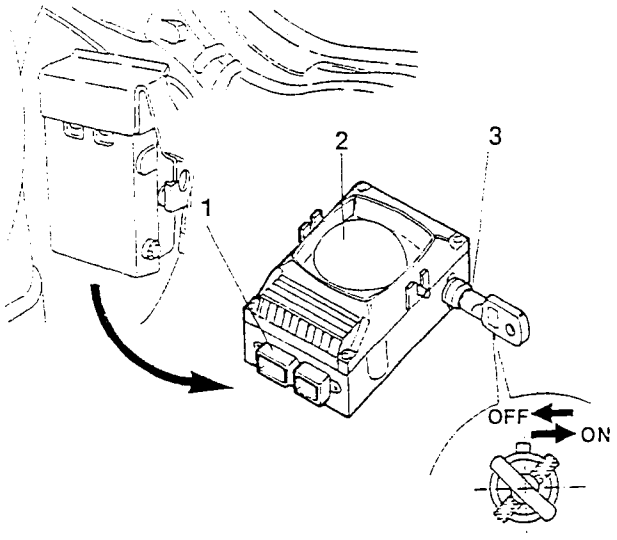


Receiver and volumetric sensors

1 - Half-ball receiver
2 - Luminous led
3 - Memorising button
4 - Volumetric sensors

.**The electronic control unit** also comprises the compact **siren** : it is to be found at the rear in the luggage compartment.
The siren operates at different intensity depending on the programming for the different countries (see description below).

The **emergency key** for deactivating the system is located on the actual control unit, thus access to it is quick and easy.



Control unit

1 - Electronic control unit
2 - Siren
3 - Emergency key

For the control of the doors and luggage compartment the same switches as for the door locking system are used (see sections "Door locking system" and "Luggage compartment opening control"): all the switches signal when the doors are "not closed" (door open = earth signal to the control unit.
There is a special **switch** on the bonnet which operates with the opposite logic: (bonnet closed = earth signal).

The two **volumetric sensors** enable extra surveillance controlling that there are no intrusions inside the car. They are incorporated in the front ceiling light; one acts as a transmitter and the other as receiver; the beam of ultrasounds emitted by the former (left) must be wholly picked up by the latter (right), after a number of "rebounds" inside the passenger compartment: if not, an alarm signal is sent to the control unit.

The system **signalling led** (red, of the high efficiency type), is located on the dashboard, on the upper half cover of the steering column behind the steering wheel, and it signals the state of the system and any faults (see following description).

OPERATION

ENABLING/DISABLING

It is only possible to enable the alarm when the ignition key is in the STOP position.

ENABLING is possible by pressing the button on the transmitter.

DISABLING is obtained by pressing the same button once again.

To obtain the most efficient switching. press the button until a visual and acoustic signal are noted (feedback).

N.B. The system is protected against unauthorised recording of the secret code.

Enabling

Press the button whilst pointing the transmitter towards the receiver dome. Acoustic and optical signals will be noted (for the markets/versions foreseen).

Disabling

Press the button pointing the transmitter towards the receiver dome.
Also for disabling acoustic and optical signals will be noted (for the markets/versions foreseen).

COMPLETE DEACTIVATION OF THE SYSTEM

If the batteries of the transmitter are flat or the system is not working properly. the alarm system can be deactivated using the emergency key on the control unit.
When the car is delivered this emergency key must be in the "ON" position.
Turning the key to "OFF" the system is deactivated completely. In the specific version for some markets, only the batteries inside the control unit/siren are deactivated, leaving the alarm system activated as it is still supplied by the car battery.
With the key at "OFF" the surveillance of the cable cutting/battery disconnection is no longer activated.

Set this key to "OFF" and disconnect the battery cable if the vehicle is left unused for long periods (over 1 month).

"SURVEILLANCE" MODE

During the "surveillance" mode (car closed and alarm activated) the dissuasion led flashes at 0.8 Hz, in this conditions, the system;

- checks the doors, bonnet and tailgate;
- checks that the battery is connected and that the leads are intact;

- checks that the ignition key is not being tampered with;
- checks movements inside the passenger compartment (volumetric sensors);
- only for versions without ALFA ROMEO CODE: cuts off the supply to the starter motor (provided that the key is turned to MARCIA)and deactivates the engine electronic control unit (Boxer 1.7 16 v version).

ALARM MODE

The system enters the alarm mode when one of the surveillance sensors detects an abnormal situation.

The alarm mode can trigger a warning system to the outside (activation of the siren and blinkers, with times varying according to the versions/markets). Only for versions without ALFA ROMEO CODE there are other countermeasures such as: cutting off the engine supply (Motronic control unit supply - Boxer 1.3 and 1.6 version - or stop solenoid valve supply and glow plug warming device - TD version).

The alarm ceases:

- with a command from the transmitter (deactivation);
- 25 min. after the last activation of the alarm mode;
- by turning the emergency key.
  (N.B.: in this case the alarm activated condition is stored in the control unit memory).

SELF-DIAGNOSIS

UPON ACTIVATION the system carries out self-diagnosis (indicated by the flashing of the LED at 4 Hz). If a fault is found, the LED will identify it through a special flashing code as shown in **table 1.**

Table 1: Selfdiagnosis signals

Type of flashing	Meaning
8 Hz, duration 2,5 sec.	Door/bonnet/tailgate left open or faulty switch
Fixed light, duration 2,5 sec.	Faulty volumetric sensors
16 Hz, duration 2,5 sec.	Fault in electronic control unit

When a door or bonnet/tailgate is found to be open/faulty or when a fault is detected on the volumetric sensors, the corresponding sensor is cut off by the surveillance mode and a beep signal is given one second after they are reactivated.

WHEN THE ALARM IS DISABLED the dissuasion LED flashes to indicate which of the sensors triggered an alarm during surveillance (see **table 2**).

N.B.: the signal is cancelled turning the ignition key to MARCIA

Table 2: Signals indicating alarms

N. Flashes*	Component with alarm
1 Flash	Right front door
2 Flashes	Left front door
3 Flashes	-
4 Flashes	-
5 Flashes	Volumetric sensors on ceiling light
6 Flashes	Bonnet
7 Flashes	Tailgate
8 Flashes	Key-operated supply cut off
9 Flashes	Battery supply cut off
10 Flashes	At least 3 causes of alarm contemporaneously

(*) If there is more than one, the alarm codes are presented in sequence.

The flashes last for 0.5 sec. with an interval of 1.5 sec. between them.

In addition to the automatic SELF-DIAGNOIS described here, it is also possible to check the system by MANUAL DIAGNOSIS (see "FAULT-FINDING").

INHIBITING THE INTERIOR SURVEILLANCE SYSTEM

It is possible to inhibit interior surveillance in one of the following ways:

a) in close sequence (prior to enabling the alarm system): starting from the MARCIA position, move the key to: STOP, MARCIA, STOP.

Confirmation of the inhibition of the interior surveillance system is given by the lighting up of the dissuasion LED for appr. 2 sec.

b) starting from the key in the MARCIA position, press the button on the receiver (for less than 0.5 sec.) no longer than 8 sec. before turning the key to STOP.

Confirmation that the interior surveillance system is deactivated is given by the lighting up of the LED on the ceiling light for appr. 2 sec.

The next time the key is turned to MARCIA the interior surveillance system is re-enabled.

WARNING: It will be possible to turn the key to MARCIA for a maximum of 30 sec. without re-enabling the interior surveillance system (for example to allow the closing of electric windows which may have been left open accidentally).

SELF-ENABLING (only for certain Markets and for versions without ALFA ROMEO CODE)

The self-enabling system ensures that the alarm system is partially enabled automatically after a certain period of time - 4 minutes - from when the car is left by the driver.

This takes place under the following two conditions:

- ignition key moved from MARCIA to STOP;
- opening followed by closing of the driver's door.

The surveillance system operates in the same way as when activated by the remote control with the exception of the following points:

- the doors are not locked;
- interior surveillance is not activated.

The opening of the driver's door before the delay time for self-enabling - 4 minutes - stops and resets the counter: the closing of the door will make the counter resume from the beginning.

In order to regain possession of the car, the owner must disable the system via the remote control, which must be pressed twice in two separate phases:

- **the first press activates the alarm system completely;**
- **the second one deactivates the alarm system and opens the doors.**

PROGRAMMING THE TRANSMITTER

Upon leaving the factory the receiver contains a **"UNIVERSAL" code** which can be controlled by a "UNIVERSAL" transmitter for inspection and moving the car in the factory. On delivery it is therefore necessary to reprogramme the receiver with the transmitter code so that only the owner will have authorised use of the vehicle.

There are two possible programming modes:

a) before entering the password: **SIMPLIFIED PROGRAMMING**;

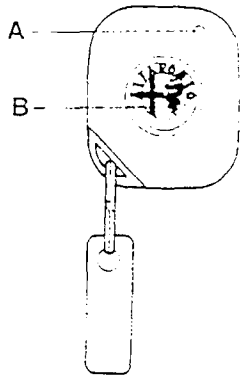
b) after entering the password: **PROTECTED PROGRAMMING**;

The memorising of a transmitter must be carried out with:

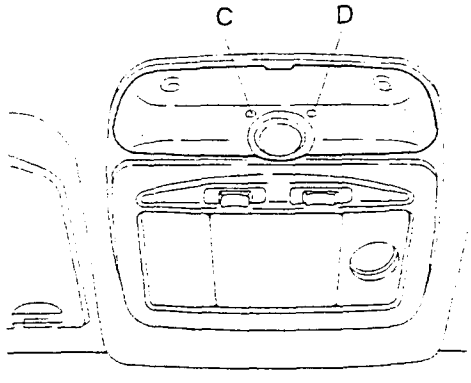
- the alarm system deactivated (by remote control); the warning led on the panel must be off;
- the emergency key at "ON";
- the ignition key at STOP.

Each transmitter has a label with a four-figure number to protect the system from unauthorised programming (protected programming) which must be removed by the customer on delivery of the vehicle and kept in a safe place.

Transmitter



A - Luminous led
B - Control button



Receiver

C - Luminous led
D - memorising button

SIMPLIFIED PROGRAMMING

Simplified programming is for use when no remote controller data has previously been entered in the memory and the system needs to accept all transmitters, i.e. when the memory has not yet been "locked" by protected programming.

In this programming mode as many codes as required are recognised, but only the last four are memorised.

Proceed as follows:

1. press button **D** on the ceiling light: LED **C** flashes; **NOTE:** if the led does NOT flash, check that the alarm system is de-activated or that the receiver on the ceiling lamp is correctly powered.

2. keeping the receiver button **D** pushed, press the transmitter button **B**, point it towards the receiver, but at least 20 cm. from it: the led of transmitter **A**, must flash no more than once;

3. LED **C** lights continuously indicating that the code has been memorised: at this point the operator can release button **D** to end programming.
In the 3 sec. following the release of the button, it is possible to programme the country code to suit the country in which the car will be used.

This is performed by pressing in quick succession the button of the receiver **D**, as shown in **table 3**.

If the button is not pressed, the country code defaults to E.E.C. In the event of further memory storage operations, the last one remains in the memory.

If the procedure has been carried out correctly, the LED on receiver **C** will flash 6 times, indicating that the code has been memorised on both the ceiling light receiver and in the control unit, if not, LED **C** will flash 18 times and it will be necessary to repeat the entire procedure starting from point 1 of simplified programming, after checking the correct connection between the control unit and the ceiling lamp

Table 3: Country Codes

No. of presses	Country
1	ITALY
2	GERMANY (*)
3	FRANCE
4	SWITZERLAND
5	UNITED KINGDOM
6	HOLLAND
7	USA
8	EEC
9 / 10	Others

(*) Not used in this country, for versions without ALFA ROMEO CODE, because in this country a specific control unit with a special operating logic is foreseen.

As it is not easy to carry out this procedure in such a short time as 3 seconds, a **different procedure for entering the Country code** is recommended. To do this, proceed as follows:

- open the bonnet;
- turn the ignition key from MARCIA to STOP: within 15 seconds the bonnet button must be pressed 7 times in quick succession in less than 10 seconds; 5 beeps will indicate entry in MANUAL DIAGNOSIS (see FAULT-FINDING). During these 5 beeps press the bonnet switch once again. A last long beep will signal the acceptance of this new operation;
- keep the button pressed throughout the duration of the long beep. The latter signals entry into the country programming mode, thus the possibility to enter the country code;
- release the switch and press it within 10 seconds the number of times mentioned in table 3 to select the operating mode of the country required (each press will have a feedback beep).

N.B. To enter another remote control repeat the operations from point 1 of simplified programming, provided that the memory has been "loked" as described below.

PROTECTED PROGRAMMING

To prevent unauthorised persons from entering their own code, it is necessary to protect ("lock") the memory; this operation takes place automatically after 256 activations/deactivations of the alarm system, or by entering the password (locking the memory manually).

Locking the memory manually

Protected programming can be entered by the Owner by entering the Password (four digit code on the transmitter label) before 256 activations/deactivations (for example on a new car during pre-delivery, when all the codes of the remote controls given to the Customer have been entered).

To enter the Password:

1. Press the button on receiver **D** for appr. 2 seconds; LED **C** will flash for the whole time in which the button is pressed.

2. Release button **D**: after appr. 2 seconds LED **C** will flash once indicating the possibility to enter the first digit of the password.

3. Press the button of the receiver **D** the number of times corresponding to the first figure of the password (for example if the Password is 5.2.0.3. press 5 times). Each time the button is pressed LED **C** lights up briefly to confirm;

4. After appr. 2 seconds from the last press on button **D** (the fifth in the example) led **C** will flash again to ask for the next figure.

5. Proceed as described above for all the other figures

NOTE:
When the password (see example) contains a "0" there is no need to press button D, simply wait for the request for confirmation of entry indicated by the next flash.

When the four figures of the Password have been entered, the LED on the receiver C can behave as follows:

- **it does not light up**: this means that the Password has been entered correctly and that it belongs to one of the codes of the remote controls memorised.
- **it stays on continuously** for several seconds meaning that the password has not been entered correctly or it does not correspond to any of the remote controls memorised. In this case, when LED C goes off, the correct Password should be entered beginning from point 1.

With the correct entry of the password the memory is "locked"
From now onwards, if attempts are made to memorise a new remote control, after transmitting the new code LED C on the ceiling light will stop flashing to indicate that the operation is unsuccessful.
In this case, to enter the code of the new remote control the memory has to be "re-opened" by the following procedure.

Memory opening

When the memory has been "locked" further remote control codes are entered by "**manual memory opening**".

The memory is opened as follows:

1. press the button on receiver D for appr. 2 seconds; LED C will flash for the whole time in which the button is pressed;

2. Release button D; after appr. 2 seconds LED C will flash once indicating the possibility to enter the first digit of the password.

3. Press the button of the receiver D the number of times corresponding to the first figure of the password (for example if the Password is 5.2.0.3. press 5 times). Each time button D is pressed LED C lights up briefly to confirm;

4. After appr. 2 seconds from the last press on button D (the fifth in the example) led will flash again to ask for the next figure.

5. Proceed as described above for all the other figures.It should be noted that when the password (see example) contains a "0" there is no need to press the button, simply wait for the next request.

When the Password hase been entered, the LED C can behave as follows:

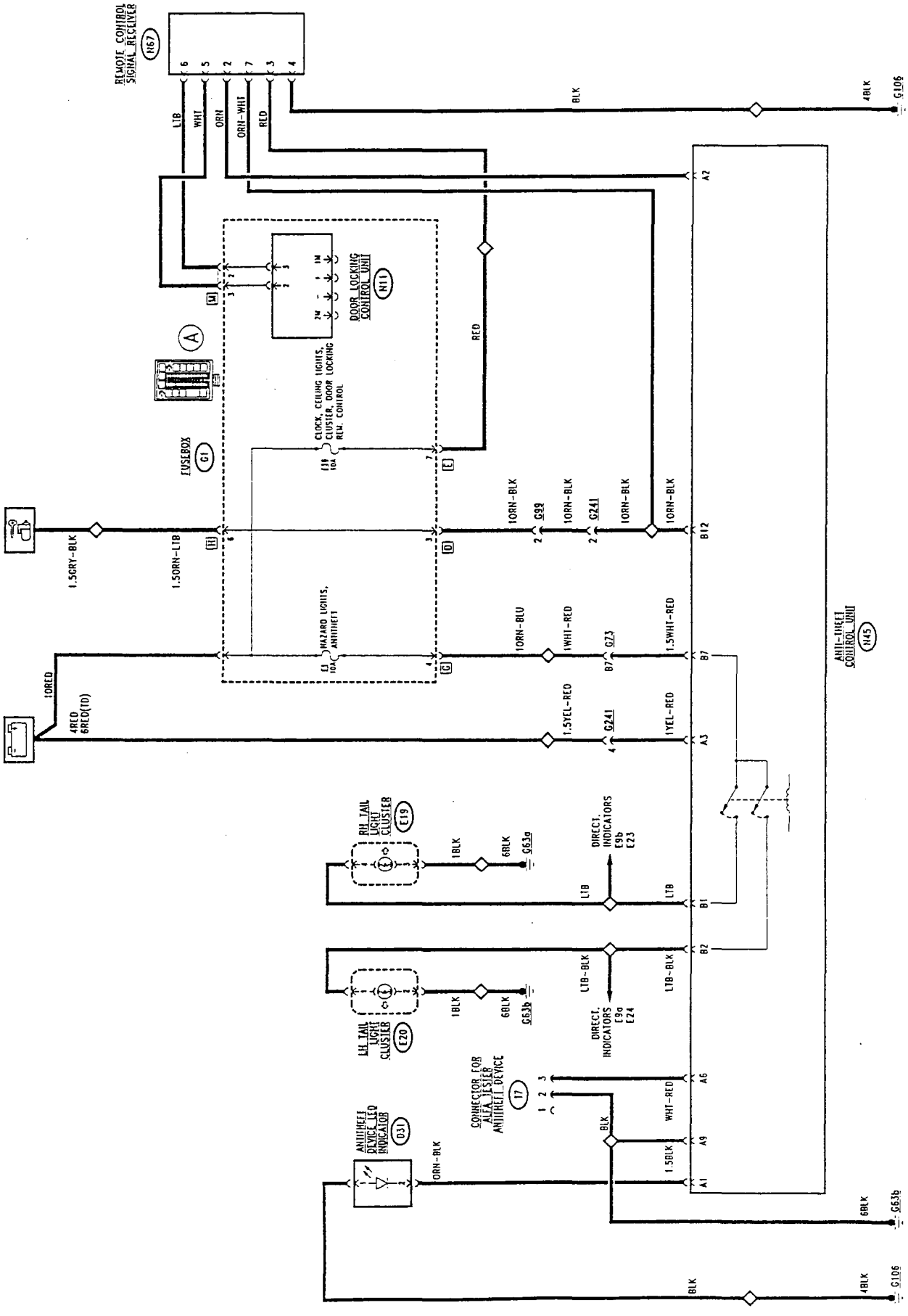
- **it stays on continuously** meaning that the password has not been entered correctly or it is not present in the memory. Repeat the memory opening operations (with the correct password) from point 1.
- **it starts flashing**: this means that the password has been entered correctly (memory opening) and that it belongs to one of the remote control codes memorised.

At this point to memorise the code of the new transmitter proceed as described at point 1 of "Simplified programming".
When the new remote control has been entered the memory returns to the "locked" mode

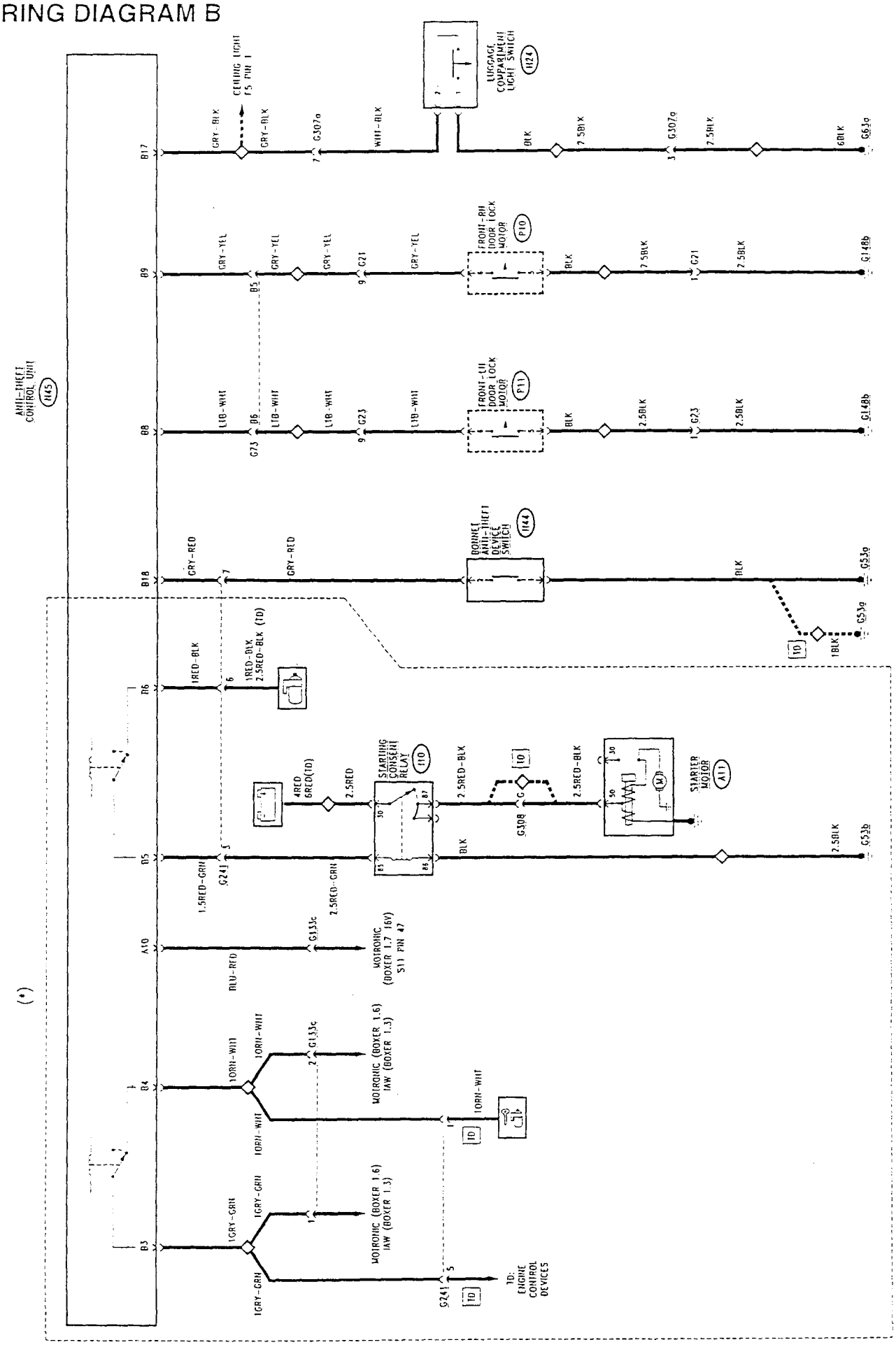
N.B.: The alarm system is activated de-activated only by the code of the last transmitter memorised correctly (with the key at "ON").
In fact this code is memorised contempraneously by both the receiver and the alarm control unit.
Any transmitters memorised previously in the receiver, though they have different codes, utilise the code of the last transmitter memorised to control the theft alarm.If previously the receiver and alarm system were regularly controlled by a transmitter and subsequently another transmitter is memorised with the alarm system key at "OFF", the code of this subsequent transmitter is memorised by the receiver, which regularly operates central door locking, while the code of the first transmitter remains in the control unit.Under these conditions, the alarm system can no longer be controlled by the transmitter, which can only operate door opening/closing.
Simply setting the alarm system key to "ON" and memorising another new transmitter, the problem remains unsolved, as the system can duly memorise a new code only if this has been memorised with the alarm system key at "ON" and in succession after the first transmitter. It is necessary to "open the memory" (as described previously) with the first transmitter, and then correctly enter the other transmitters.

WARNING: It should be noted that each single component of the anti- theft system installed on the car becomes an integral part of it and must not be altered or tested on other cars, even if of the same model.
Therefore, never exchange control units and/or receivers between two vehcicles. If a control unit is replaced, the memorising procedure must be repeated "re-opening" the memory. If a receiver (celing lamp) is changed, simplified programming must be carried out followed by protected programming.

WIRING DIAGRAM A



WIRING DIAGRAM B



FUNCTIONAL DESCRIPTION

The anti-theft system is controlled by electronic control unit **N45** integrated with the siren and the emergency key.

The control unit is supplied directly by the battery at pin A3; the key-operated supply reaches pin B12. Through fuse **F1** of fusebox **G1** pin B7 is supplied (blinker supply).

Pin A9 is earthed (**G53b**).

The system activation signal is sent from the receiver **N67** to pin A2 of the control unit; the same **serial connection line** is used to control the volumetric sensors, inserted with the receiver inside the ceiling light.

Through the receiver **N67** door opening/closing is controlled, by means of the door lock control unit **N11** of fusebox **G1** (for further details see "Door locking System").

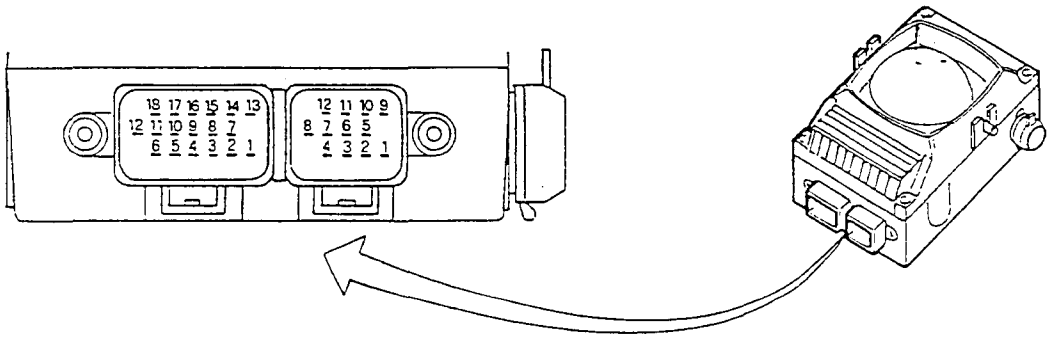
The control unit controls the closing of doors and bonnets via switches **P11** and **P10** of the doors (which are the same for the door locking device) which send an earth respectively to pins B8 and B9. The bonnet is controlled by switch **H44**, which is connected at pin B18, and the luggage compartment by switch **H24** (the same that turns on the luggage compartment light) which is connected at pin B17.

In addition to the closing of the doors, carried out directly by the receiver **N67**, the control unit activates the blinkers (hazard warning lights flashing) sending an intermittent signal: from pin B1 for the right-hand lights and from pin B2 for the left-hand lights.

Pin A1 of the control unit sends a duty-cycle signal to led **D31** when conditions so require.

ONLY FOR VERSIONS WITHOUT ALFA ROMEO CODE : the anti-theft system "intercepts" the key in the STARTING position signal (pin B6) which is "referred" to the starter motor **A11** (from pin B5) only if the system is **not** in an alarm condition.
In addition, in the case of alarm, the injection control unit supply is inhibited; this supply (12 V) reaches pin B4 and it is "returned" by pin B3 (Boxer 1.3 and 1.6 versions).
Pin A10 sends a specific block signal to the control unit (only Boxer 1.7 16V version).
For further details see the sections concerning engine ignition/injection.
For the TD version, the key-operated supply for the engine stop solenoid valve and glow plugs reaches pin B4, and it is "returned" by pin B3. For further details see "TD engine control devices".

Lastly the system can be connected with the Alfa Romeo Tester through connector **T7**; the diagnosis signal - line K - leaves from pin A6 of the control unit.



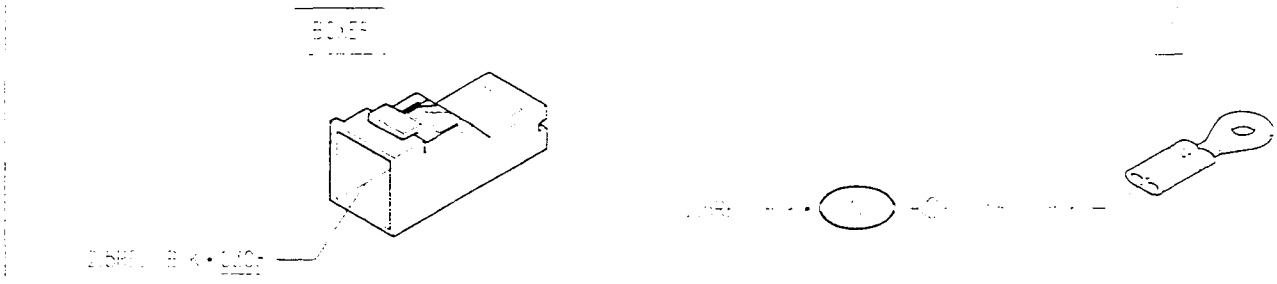
ANTI-THEFT CONTROL UNIT PIN-OUTS

- A1 Signalling led control
- A2 Serial connection line with receiver (ceiling light)
- A3 Direct supply
- A4 N.C.
- A5 N.C.
- A6 Diagnosis line K
- A7 N.C.
- A8 N.C.
- A9 Control unit earth
- (*) A10 Engine control inhibition (only for Boxer 1.7 16v)
- A11 N.C.
- A12 N.C.
- B1 RH direction indicators control
- B2 LH direction indicators control
- (*) B3 Fuel pump/injection supply consensus (Boxer 1.3 and 1.6) - "key-operated" supply for engine electric stop and glow plug warming (TD)
- (*) B4 Fuel pump/injection supply consensus (Boxer 1.3 and 1.6) - "key-operated" supply for engine electric stop and glow plug warming (TD)
- (*) B5 Starter motor supply
- (*) B6 STARTING signal from ignition switch
- B7 Blinker supply
- B8 LH door open signal
- B9 RH door open signal
- B10 N.C.
- B11 N.C.
- B12 "Key-operated" supply
- B13 N.C.
- B14 N.C.
- B15 N.C.
- B16 N.C.
- B17 Tailgate open signal
- B18 Tailgate closed signal

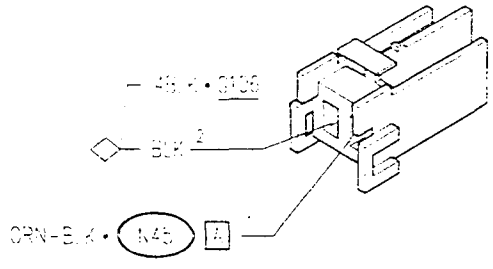
(*) Connected only for versions without ALFA ROMEO CODE

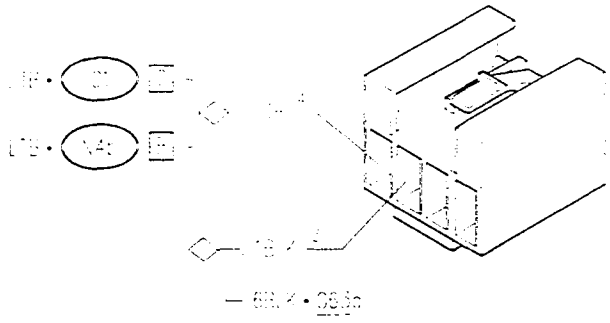
COMPONENTS AND CONNECTORS

Starter motor (*)	A11

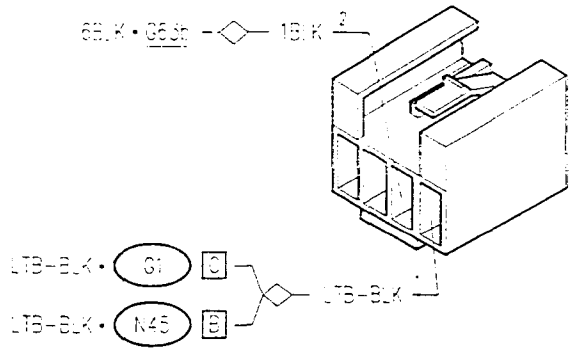


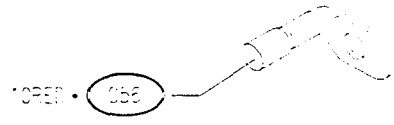
Car alarm led	D31	RH rear light	E19



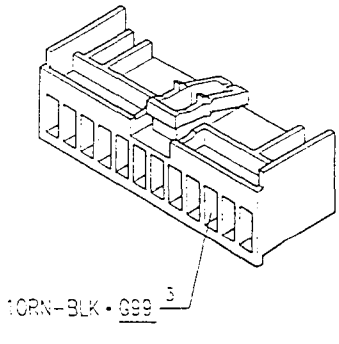


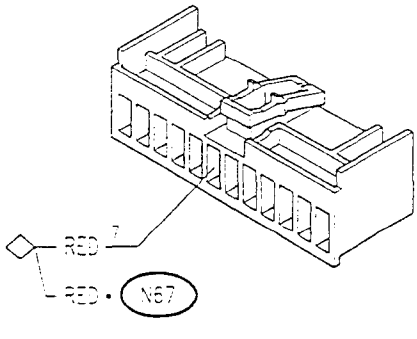
LH rear light	E20	Fusebox	G1





Fusebox	G1 D	Fusebox	G1 E

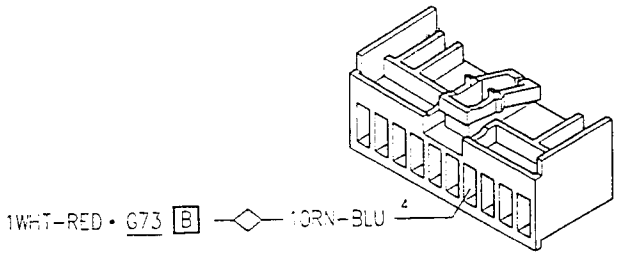




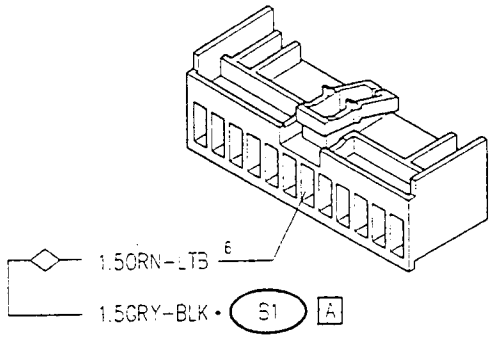
(*) Only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

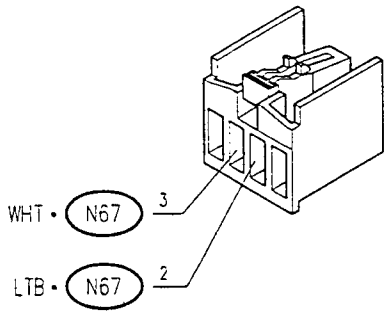
Fusebox	G1 G



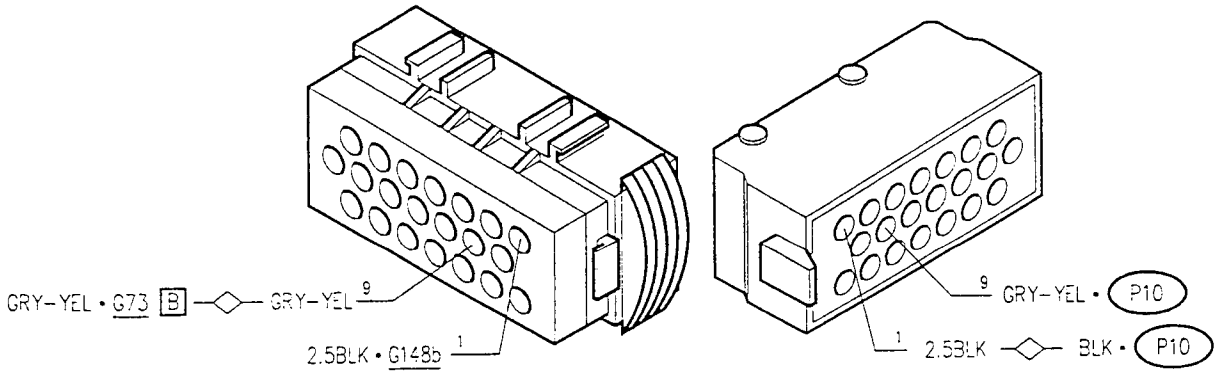
Fusebox	G1 H



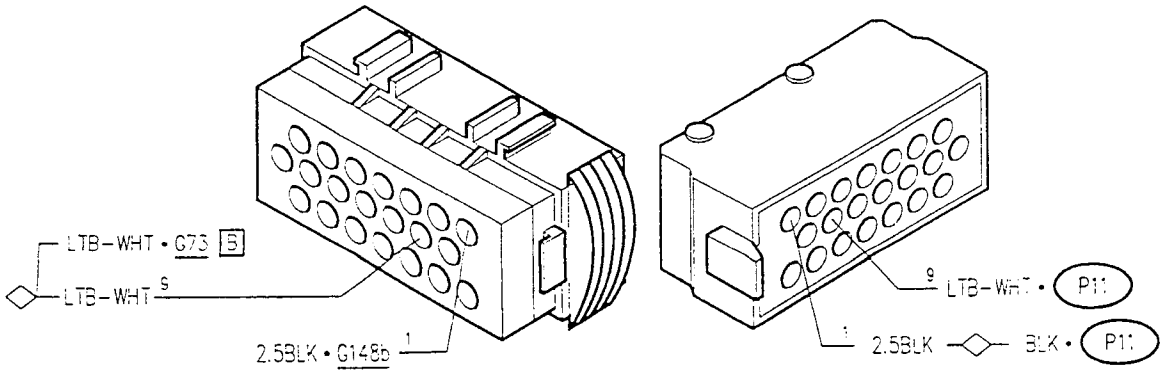
Fusebox	G1 M



RH front door wiring connector	G21

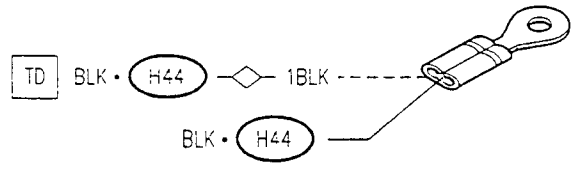


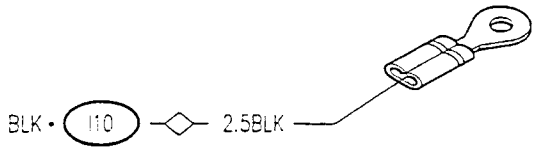
LH front door wiring connector	G23



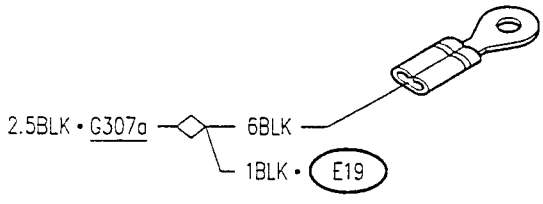
COMPONENTS AND CONNECTORS (cont.d)

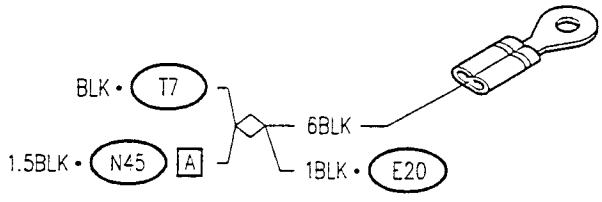
RH engine compartment earth	G53a	LH engine compartment earth (*)	G53b



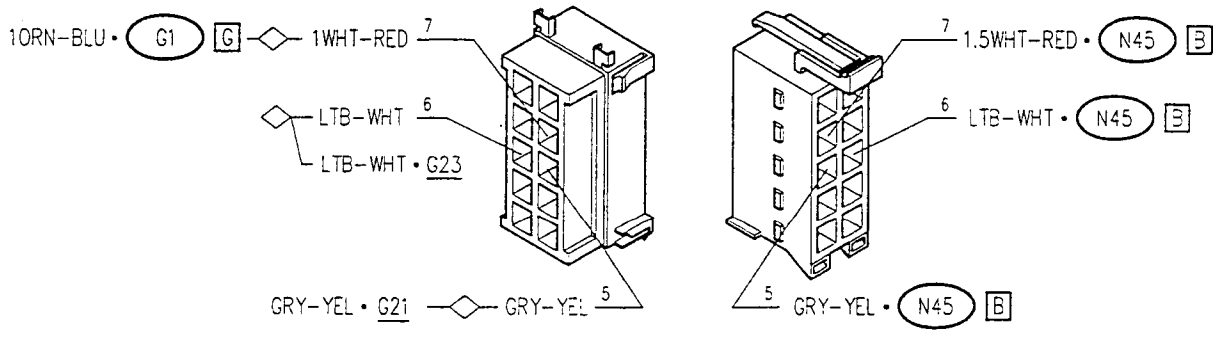


RH rear earth	G63a	LH rear earth	G63b

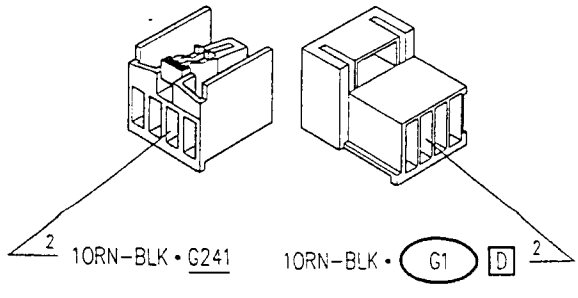


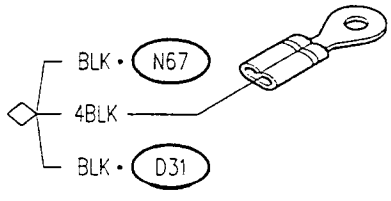


Rear services connector	G73 B



Dashboard/engine wiring connector	G99	Seat crossrail earth	G106

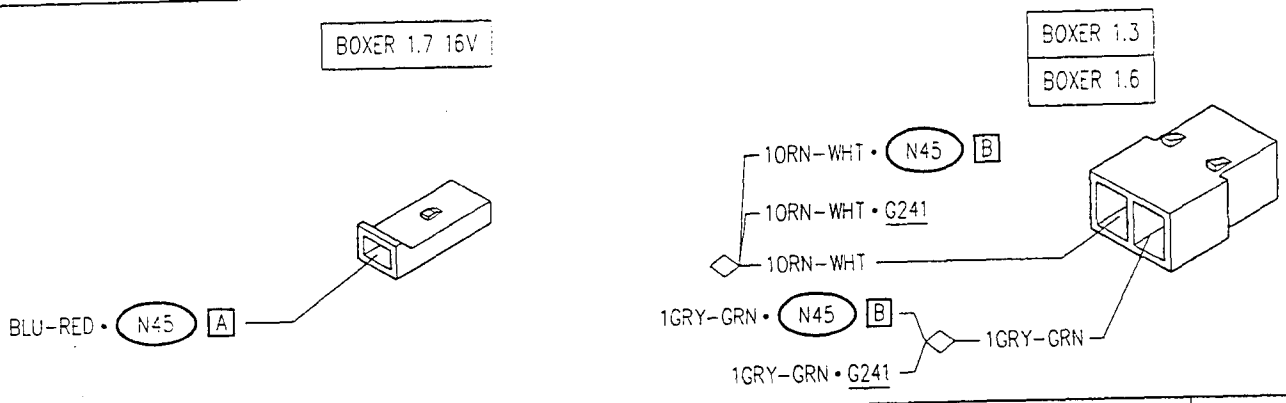




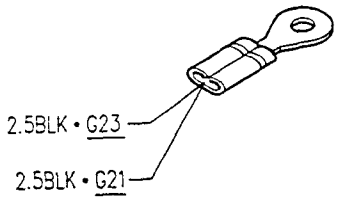
(*) only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

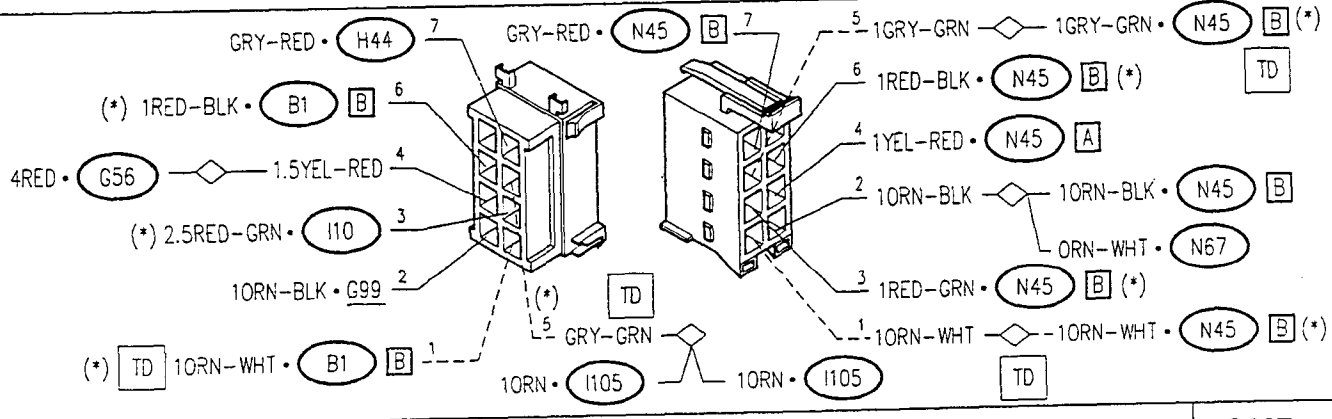
Electr. injection wiring connector C(*) — G133c



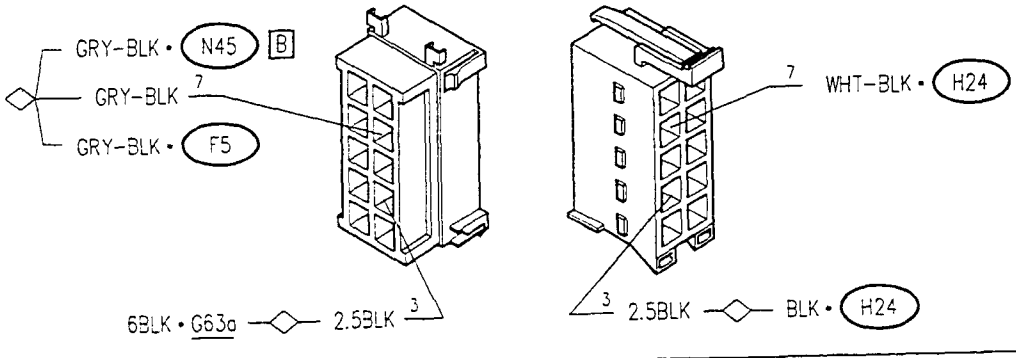
Earth under LH dashboard — G148b



Anti-theft wiring connector — G241



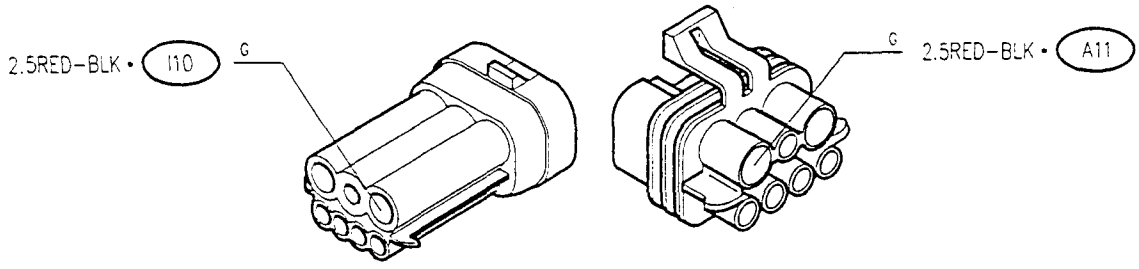
Rear/luggage compt. wiring connector A — G307a



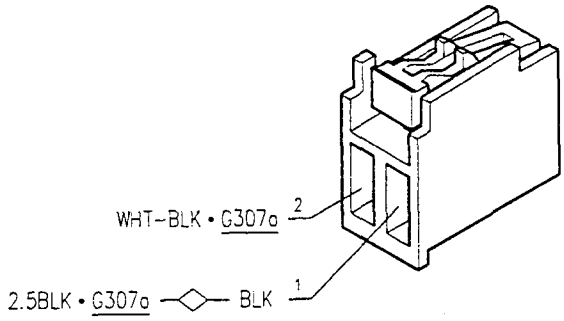
*) only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

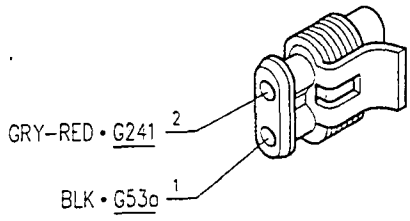
Engine sensors connetor (*) — G308



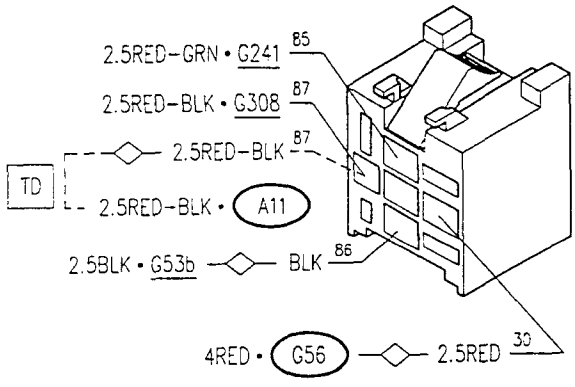
Luggage compartment light switch — H24



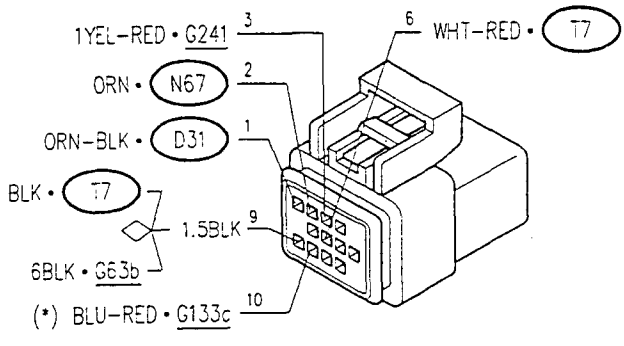
Bonnet anti- theft switch — H44



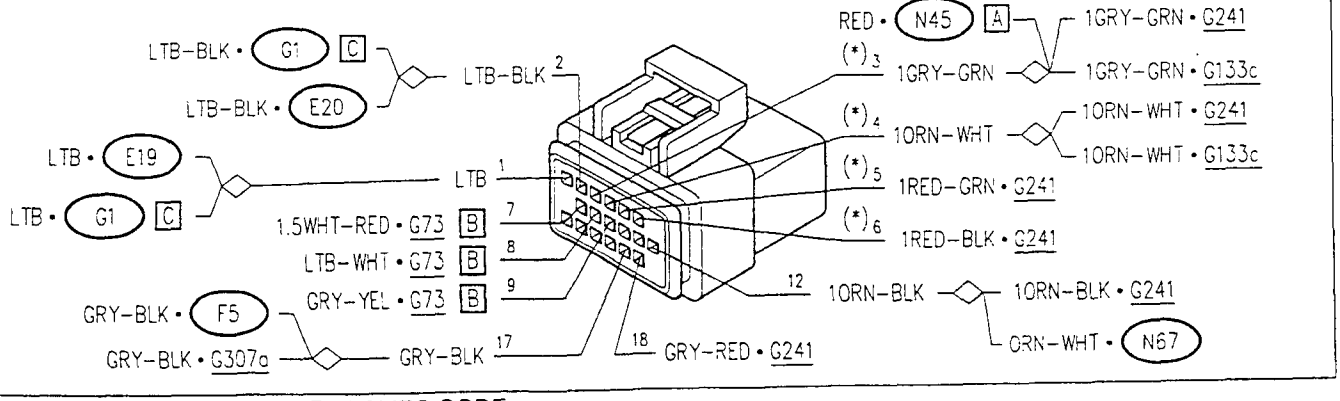
Starting consensus relay (*) — I10



Anti-theft control unit — N45 A

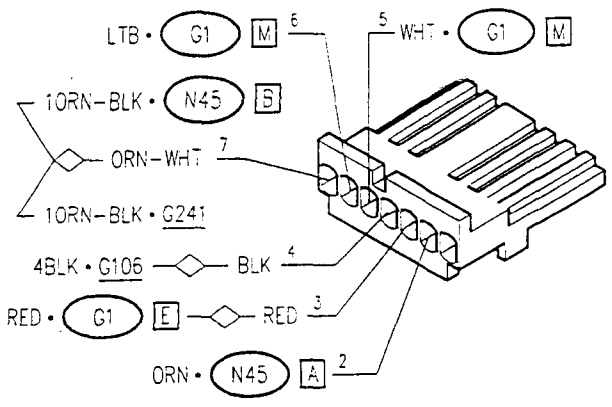
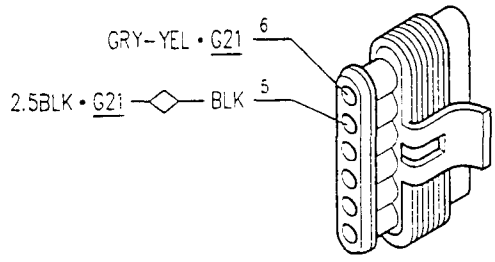
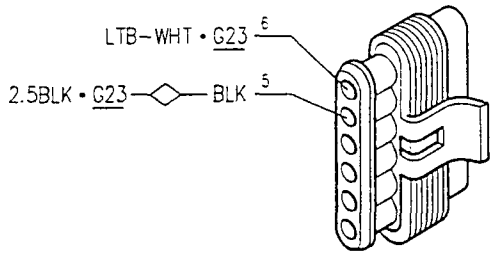
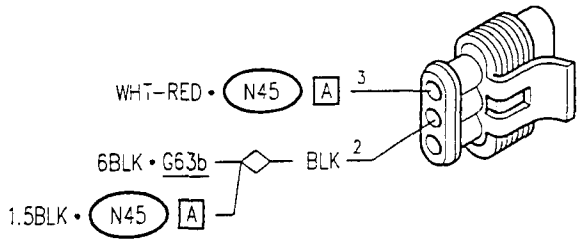


Anti-theft control unit — N45 B

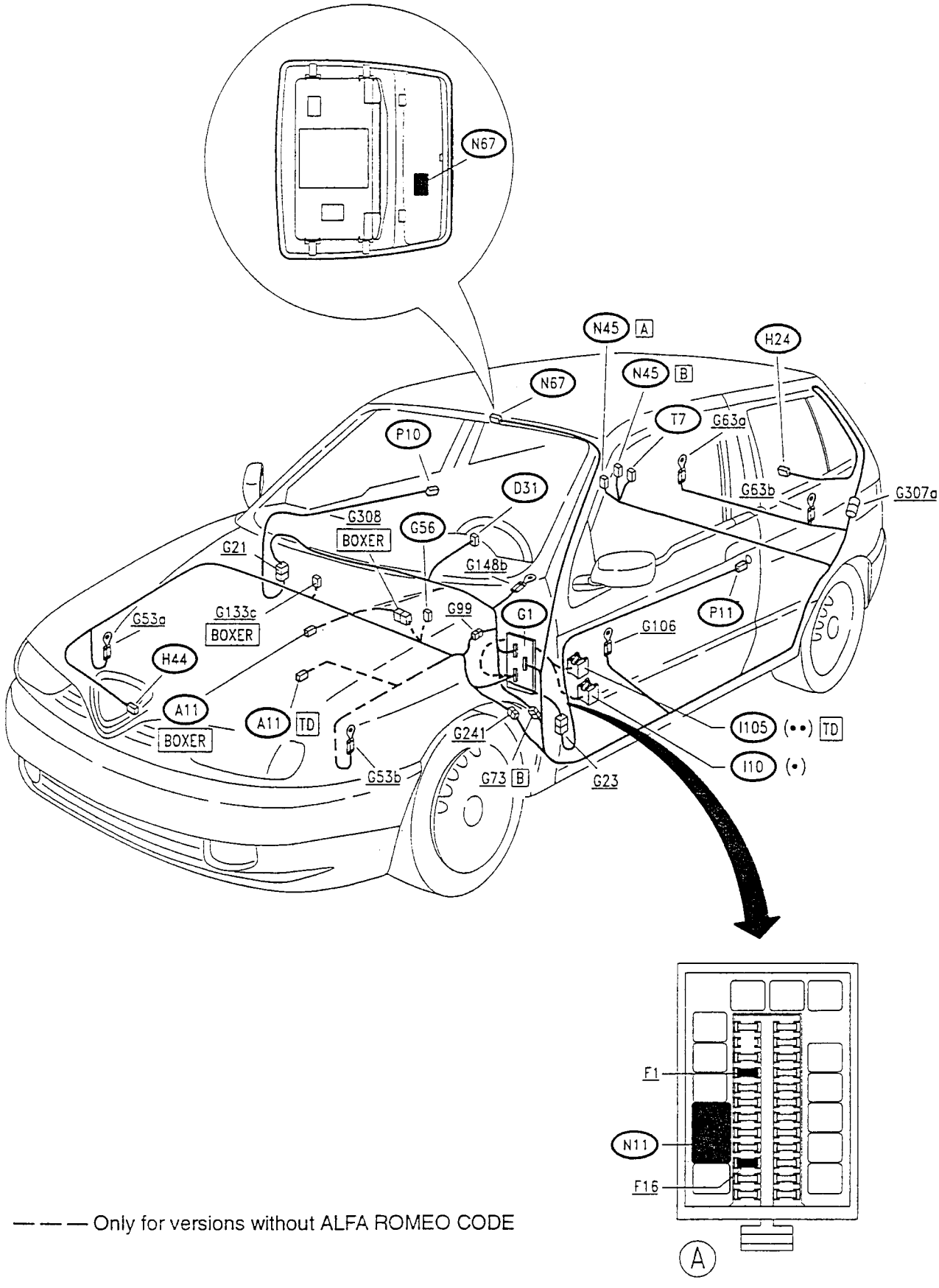


*) only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

Remote control receiver	N67	RH front door lock motor	P10
			
LH front door lock motor	**P11**	**Connector for Alfa Tester (anti-theft)**	**T7**
			

LOCATION OF COMPONENTS



——— Only for versions without ALFA ROMEO CODE

(•) yellow base

(••) grey base

FAULT-FINDING

When the system is activated and deactivated it automatically carries out **SELF-DIAGNOSIS** which reveals certain possible faults by flashing the led as shown below:

ACTIVATION:

Type of led flashing	Meaning	Test procedure
8 Hz, duration 2,5 sec.	Door/bonnet/tailgate left open or faulty switch	Check that doors and bonnets are correctly shut. Activate and deactivate the system. Count the number of flashes of the led and proceed as described in the next table
Fixed light, duration 2,5 sec.	Faulty volumetric sensors.	Check and if necessary change the electronic control unit contained in the front ceiling light. If necessary carry out **test H**
16 Hz, duration 2,5 sec.	Fault in the control unit electronics	Change the control unit N45
No flash	Fault of led	B

DEACTIVATION:

No. of Flashes of led	Component with alarm	Test to be carried out
1 Flash	RH front door	C
2 Flashes	LH front door	D
3 Flashes	-	
4 Flashes	-	
5 Flashes	Volumetric sensors on ceiling light	Check and if necessary change the electronic control unit contained in the front ceiling light. If necessary, carry out **test H**
6 Flashes	Bonnet	E
7 Flashes	Tailgate	F
8 Flashes	Key-operated supply cut off	A
9 Flashes	Battery supply cut off	A
10 Flashes	At least 3 causes of alarm contemporaneously	Repeat activation/deactivation of the system. If necessary, carry out all the above-mentioned tests.

Lastly, other tests are suggested by failures which can be noted directly and pointed out by the customer.

Fault	Test to be carried out	
Siren not working. Emergency key not working	Change the control unit **N45**	
Warning led not working	B	
Anti-theft fails to activate the blinkers(*)	G	
Anti-theft fails to activate the door locking device	H	
Remote control fails to operate	I	
Anti-theft blocks the engine completely (°)	**Boxer 1.7 16v** **Boxer 1.3 and 1.6 TD**	J K L
Anti-theft blocks the starter motor completely(°)	M	

(*) not foreseen for all Markets

(°) **WARNING: function present only for versions without ALFA ROMEO CODE.**

MANUAL DIAGNOSIS

It is possible to carry out MANUAL DIAGNOSIS, opening the bonnet and turning the ignition key from MARCIA to STOP: within 15 seconds the bonnet pushbutton mmust be pressed 7 times in rapid succession in less than 10 seconds; 5 beeps will then will then be heard signalling the start of manual diagnosis. After 10 seconds the blinkers will flash once (500 ms).

Entering this mode, the self-diagnosis procedure of the volumetric sensors connected to the control unit is started automatically. If the test result is positive the direction indicators will flash 3 times and 3 beeps will be heard from the control unit. After this first check, trigger the various switches of the doors, bonnet and tailgate: each triggering will correspond to a brief flash of the direction indicators and by a beep, accompanied by a flash of the warning LED. When the ignition switch is turned to MARCIA the siren will sound briefly (500 msec.) and the blinkers will flash (2.5 sec.).

This last operation concludes the manual diagnosis procedure. It is also possible to exit MANUAL DIAGNOSIS by not triggering any sensor for 30 seconds: exit from manual diagnosis will be signalled by the turning on of the direction indicators for appr. 2.5 seconds and a beep.

FAULT-FINDING USING THE ALFA ROMEO TESTER

In addition to the above, it is also possible to quickly located any faults connecting to the control unit through the Alfa Romeo Tester using the special cartridge.

N.B.: Beforehand, carry out **TEST A.**

PRELIMINARY CONTROL UNIT CHECK (N45)	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSES – Check the intactness of fuses **F1** and **F16** of fusebox **G1**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Change fuses F1 and/or **F16**
A2 CHECK VOLTAGE – Check for 12 V at pin A3 of control unit **N45**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore the wiring between pin A3 of **N45** and the branch terminal board
A3 CHECK VOLTAGE – With the ignition key turned, check for 12 V at pin B12 of control unit **N45**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between pin B12 of **N45** and the fusebox **G1**
A4 CHECK EARTH – Check that pin A9 of control unit **N45** is earthed (0 V)	OK ▶ ~~OK~~ ▶	Carry out **step A5** Restore the wiring between pin A9 of **N45** and earth **G63b**
A5 CHECK SERIAL CONNECTION – Check the continuity of the connection between pin A2 of **N45** and pin 2 of receiver **N67**	OK ▶ ~~OK~~ ▶	Carry out **step A6** Restore the wiring between **N67** and **N45**
A6 CHECK CONTINUITY – Check the continuity of the cables: - between pin A6 of **N45** and pin 3 of diagnosis connector **T7** - between pin 2 of **T7** and earth **G63b**	OK ▶ ~~OK~~ ▶	CONNECT TO THE DIAGNOSIS SOCKET **T7** AND CONTINUE OPERATIONS WITH THE ALFA TESTER, OR FOLLOW THE INSTRUCTIONS OF THE LED THAT SIGNALS THE RESULTS OF SYSTEM SELF-DIAGNOSIS Restore the wiring between **T7**, **N45** and **G63b**

CHECK WARNING LED (D31) — TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK LED – Disconnect led **D31** and check that it is working (applying for example, 5 V at the terminals)	OK ▶	Carry out **step B2**
	~~OK~~ ▶	Change the led **D31**
B2 CHECK CONTINUITY – Check continuity between: - one of the terminals of led **D31** and earth **G106** - the other terminal of led **D31** and pin A1 of control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between: - **D31** and earth **G106** - **D31** and pin A1 of **N45**

CHECK RH FRONT DOOR CONTACT (P10) — TEST C

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
C1 CHECK DOOR LOCKING DEVICE. – Check that the door locking device is working properly, with regard to the RH front door	OK ▶	Carry out **step C2**
	~~OK~~ ▶	Follow the instructions in FAULT-FINDING in the section "DOOR LOCKING SYSTEM"
C2 CHECK EARTH – With the door open, check for 0 V (earth at pin B9 of anti- theft control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between pin B9 of control unit **N45** and door lock **P10**

CHECK LH FRONT DOOR CONTACT (P11) — TEST D

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
D1 CHECK DOOR LOCKING DEVICE – Check that the door locking device is working properly, with regard to the LH front door	OK ▶	Carry out **step D2**
	~~OK~~ ▶	Follow the instructions given in FAULT-FINDING of the "DOOR LOCKING DEVICE" section
D2 CHECK EARTH – With the door open, check for 0 V (earth at pin B8 of the anti-theft control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between pin B8 of control unit **N45** and the door lock **P11**

CHECK BONNET CONTACT (H44) — TEST E

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
E1 CHECK CONTACT – Check the correct fastening of contact **H44** and of the striker on the bonnet	OK ▶	Carry out **step E2**
	~~OK~~ ▶	Fix or change contact **H44** or the corresponding striker
E2 CHECK EARTH – With the bonnet closed (switch pressed), check for an earth on both terminals of switch **H44**	OK ▶	Carry out **step E3**
	~~OK~~ ▶	Restore the wiring between **H44** and earth **G53a**
E3 CHECK EARTH – With the bonnet closed, check for 0 V (earth) at pin B18 of anti-theft control unit **N45**; opening the bonnet (releasing the switch) the signal becomes appr. 12 V	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between switch **H44** and pin B18 of control unit **N45**

CHECK TAILGATE CONTACT (H24) — TEST F

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
F1 CHECK LUGGAGE COMPARTMENT LIGHT – Check that the light turns on when the tailgate is opened **F5**	OK ▶	Carry out **step F2**
	~~OK~~ ▶	Follow the instructions given in FAULT-FINDING in the "CEILING LIGHTS" section
F2 CHECK EARTH – With the tailgate open, check for 0 V (earth at pin B17 of anti-theft control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between contact **H24** and pin B17 of control unit **N45**

THE ANTI-THEFT SYSTEM DOES NOT FLASH THE BLINKERS — TEST G

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
G1 CHECK OPERATION OF BLINKERS – Check that the hazard warning lights (blinkers) are working properly when activated manually	OK ▶	Carry out **step G2**
	~~OK~~ ▶	Follow the instructions in FAULT-FINDING of the "DIRECTION INDICATORS AND HAZARD WARNING LIGHTS" section
G2 CHECK VOLTAGE – Check for 12V at pin B7 of **N45**	OK ▶	Carry out **step G3**
	~~OK~~ ▶	Restore the wiring between **N45** and **G1**
G3 CHECK CONTINUITY – Check continuity between: - pin B1 of control unit **N45** and the right rear light **E19** - pin B2 of **N45** and the left rear light **E20**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore any faulty wiring

THE ANTI-THEFT FAILS TO OPERATE THE DOOR LOCKS — TEST H

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
H1 CHECK OPERATION OF THE DOOR LOCKING DEVICE – Check that the door locking device is working properly engaging the key in the door locks	OK ▶	Carry out **step H2**
	NO ▶	Follow the instructions in FAULT-FINDING of the "DOOR LOCKING DEVICE" section
H2 CHECK CONTINUITY – Check the continuity of the cables between fusebox **G1** - pin 3 and 2 of connector M - and receiver **N67** - pin 5 and 6 respectively	OK ▶	Check the connection between receiver **N67** and the anti- theft control unit **N45** (pin A2)
	NO ▶	Restore the wiring

REMOTE CONTROL NOT WORKING — TEST I

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
I1 CHECK REMOTE CONTROL – Check that the remote control is working properly: pressing the button the led should turn on	OK ▶	Carry out **step I2**
	NO ▶	Check the transmitter batteries. If necessary change the transmitter. **N.B.** In this case it will be necessary to reprogramme the whole system (see "Programming the transmitter")
I2 CHECK RECEIVER – Check that the receiver is working properly: pressing the button of the transmitter suitably pointed at the receiver **N67** the receiver led should light up to indicate that the signal has been received	OK ▶	Carry out **step I3**
	NO ▶	Change the tmsmitter **N67** located in the front ceiling light
I3 CHECK FUSE – Check the intactness of fuse **F16** of fusebox **G1**	OK ▶	Carry out **step I4**
	NO ▶	Change the fuse **F16**
I4 CHECK VOLTAGE – Check for 12 V "direct" at pin 3 of **N67** and 12 V "key-operated" at pin 7 of **N67**	OK ▶	Carry out **step I5**
	NO ▶	Restore the wiring between **N67** and fusebox **G1**
I5 CHECK EARTH – Check that pin 4 of **N67** is earthed	OK ▶	Change the receiver **N67**
	NO ▶	Restore the connection between **N67** and earth **G63b**

THE ANTI-THEFT BLOCKS THE ENGINE COMPLETELY (Boxer 1.7 16v) (*) — TEST J

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
J1 CHECK EARTH SIGNAL – With the ignition key at MARCIA and the anti-theft deactivated, check for 0 V at pin A10 of control unit **N45**; if the anti-theft "alarms" the signal becomes "high" (appr. 12 V)	OK ▶	Restore the wiring between pin A10 of **N45** and the Motronic system (pin 47 of control unit **S11**) (For further details see the section "Motronic M2.10.1")
	~~OK~~ ▶	Change the control unit **N45**

THE ANTI-THEFT BLOCKS THE ENGINE COMPLETELY (Boxer 1.3 and 1.6) (*) — TEST K

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
K1 CHECK VOLTAGE – With the ignition key at MARCIA and the anti-theft deactivated, check for 12 V at pin B3 of control unit **N45**	OK ▶	Carry out **step K2**
	~~OK~~ ▶	Restore the wiring between pin B3 of **N45** and the injection system (pin 86 of relay **I29** for Boxer 1.3 - pin 20 of control unit **S11** for Boxer 1.6)
K2 CHECK VOLTAGE – With the ignition key at MARCIA and the anti-theft deactivated, check for 12 V at pin B4 of control unit **N45**	OK ▶	Restore the wiring between pin B4 of **N45** and the injection system (pin 1 of connector **G133a** for Boxer 1.3 - pin 85 of relay **S12a** for Boxer 1.6) (For further details see the corresponding sections "IAW" and "Motronic MP3.1")
	~~OK~~ ▶	Change the control unit **N45**

(*) **Warning:** this function is active only for versions without ALFA ROMEO CODE.

THE ANTI-THEFT BLOCKS THE ENGINE COMOMPLETELY (TD version) (*)	TEST L

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
L1 CHECK VOLTAGE – With the ignition key at MARCIA, check for 12 V at pin B4 of control unit **N45**	OK ▶	Carry out **step L2**
	OK ▶	Restore the wiring between pin B4 of **N45** and the ignition switch **B1**
L2 CHECK VOLTAGE – With the ignition key at MARCIA, and anti-theft deactivated check for 12 V at pin B3 of control unit **N45**	OK ▶	Restore the wiring between pin B3 of **N45** and the relay for the diesel engine control devices **I105** (see the section "DIESEL ENGINE CONTROL DEVICES")
	OK ▶	Change the control unit **N45**

THE ANTI-THEFT BLOCKS THE STARTER MOTOR COMPLETELY (*)	TEST M

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
M1 CHECK VOLTAGE – With the key at START, check for 12V at pin B6 of control unit **N45**	OK ▶	Carry out **step M2**
	OK ▶	Restore the wiring between pin B6 of **N45** and the ignition switch **B1**
M2 CHECK VOLTAGE – With the key turned to START and the anti-theft deactivated, check for 12 V at pin B5 di **N45**	OK ▶	Check that the starter motor **A11** is working properly with the corresponding supply cables: if necessary also check the starting consensus relay **I10**: see the section "STARTING AND RECHARGING"
	OK ▶	Change the control unit **N45**

(*) **Warning:** this function is active only for versions without ALFA ROMEO CODE.

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ELECTRICAL SYSTEMS

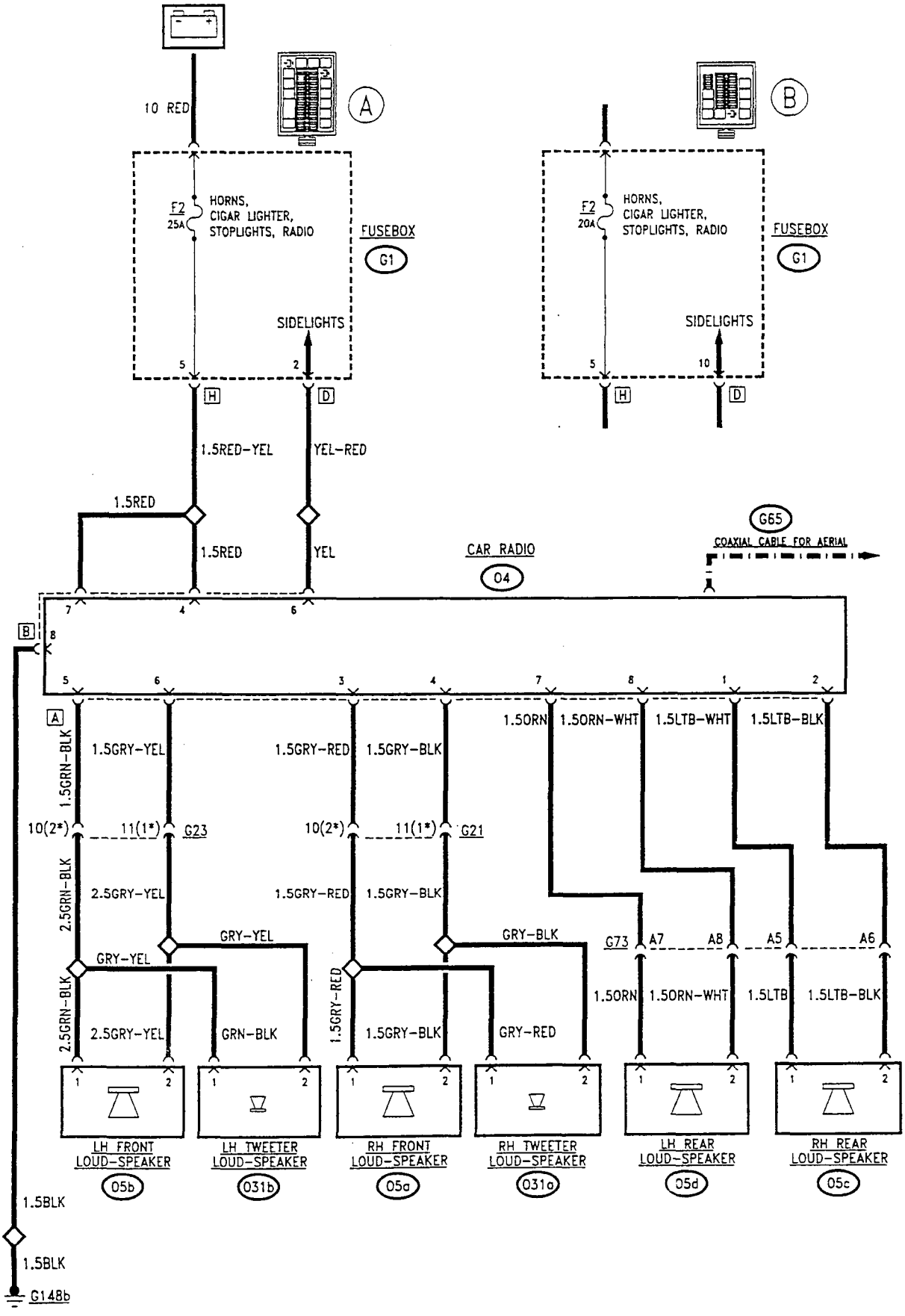
32 documents - 530 factory pages

CAR RADIO

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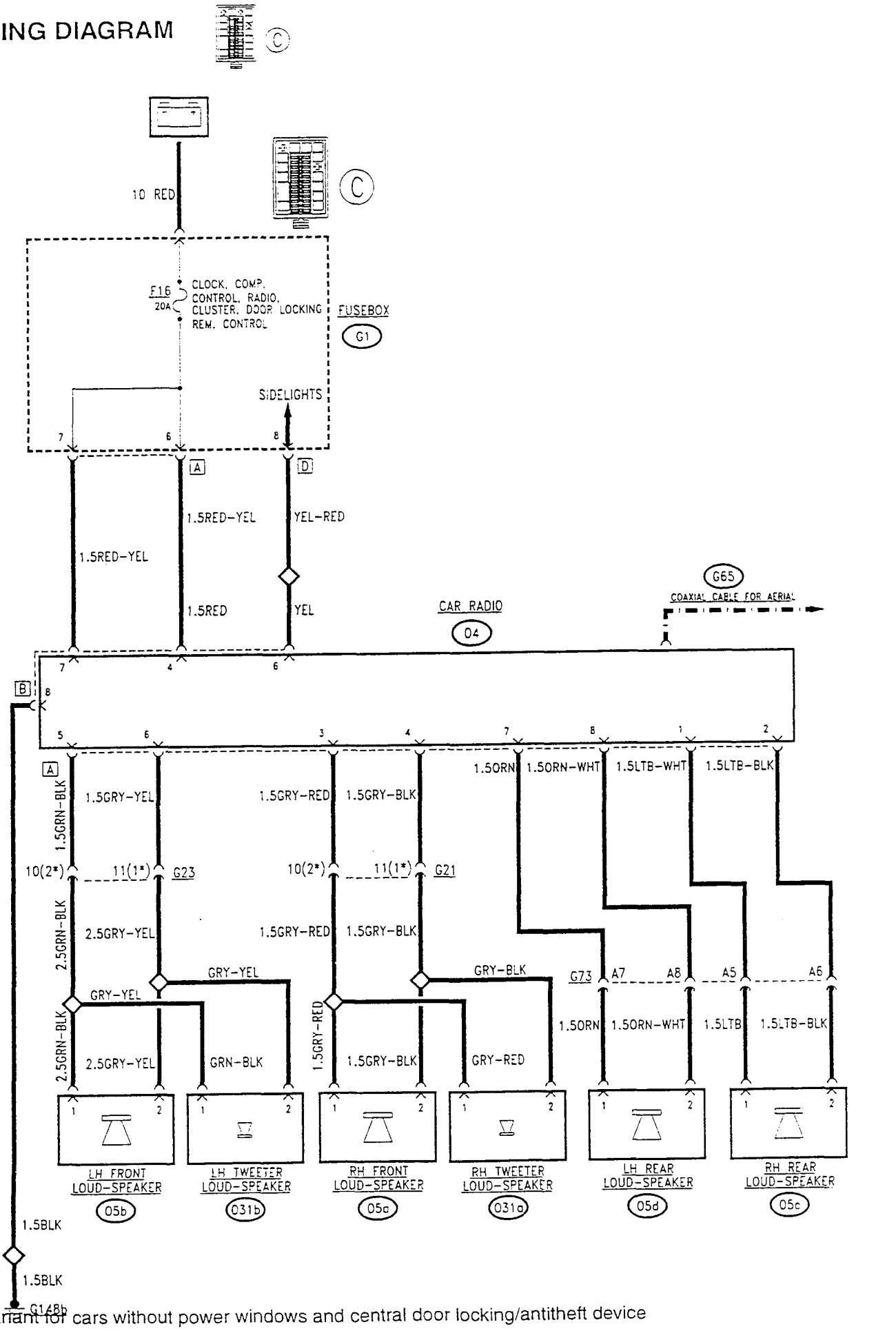
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WIRING DIAGRAM



(*) variant for cars without power windows and central door locking/antitheft device

WIRING DIAGRAM



(*) variant for cars without power windows and central door locking/antitheft device

GENERAL DESCRIPTION

The car is pre-wired for the installation of a car radio system complete with six speakers.
Upon request a fixed radio is supplied with two front speakers 165 mm in diameter with 2 separate tweeters, and two rear two-way speakers 130 mm in diameter.
The front speakers are located at the sides in the lower section of the doors, with the tweeters on the pillar, while the rear speakers are on the side panel at the side of the seat.
The aerial is a "stylus" type fitted on the roof panel and it is connected to the radio by a coaxial cable.

The radio is supplied directly from the battery; this makes it possible to memorise tuning, safety codes, etc. in the radio set.

An anti-disturbance condenser has also been fitted inside the stop lights switch **H3** to ensure "electronic silencing" towards the electric services that might interfere on the radio circuit.

The fixed radio is installed during production: it is a **PHILIPS DC 710/255** radio with RDS decoder and cassette player; the radio has a removable front panel to protect against theft and an internal security code for further protection. All the details about the features of the radio and how it works are described in the Instructions Handbook supplied with it.

FUNCTIONAL DESCRIPTION

The radio **O4** is supplied directly by battery current via fuse **F2** (**F16** for box "C") of fusebox **G1**: the supply for memory storage, etc. reaches pin 4 of connector B, while the power supply for operating the radio reaches pin 7 of the same connector.

Pin 8 of connector B is earthed.

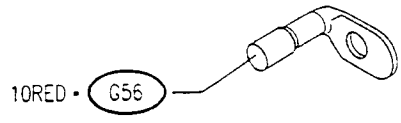
The "side lights on" signal reaches pin 6.

The cables carrying the signals lead from connector A of **O4** to the six speakers.

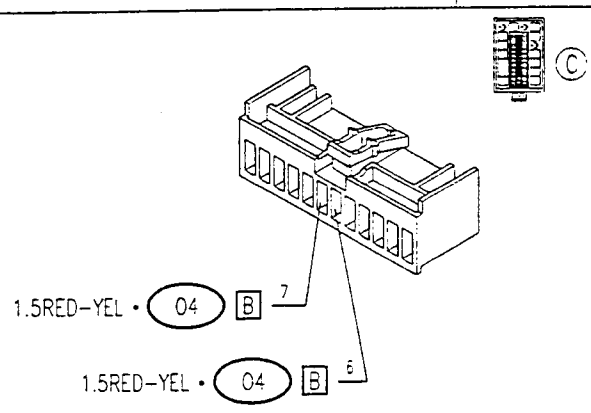
The aerial is connected to the radio via the special screened coaxial cable **G65**.

COMPONENTS AND CONNECTORS

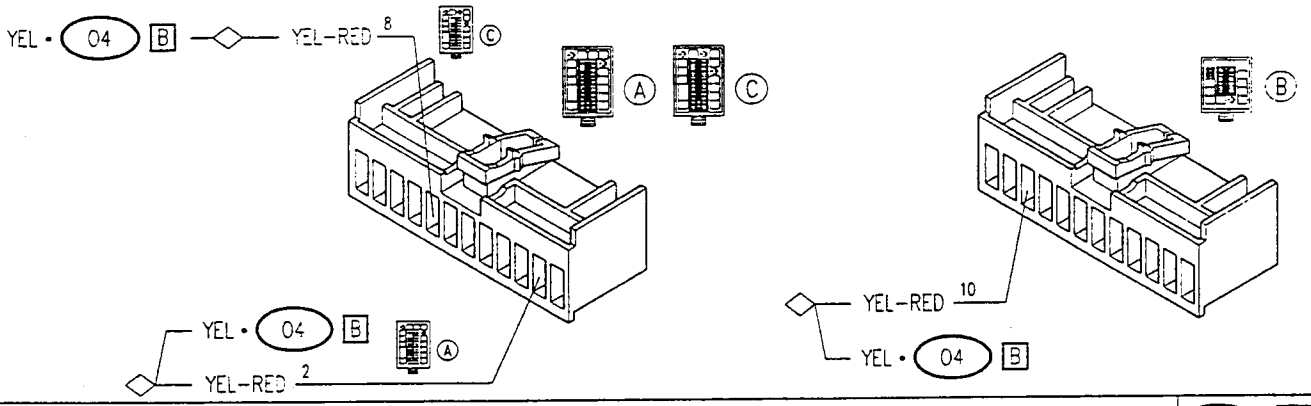
Fusebox	G1



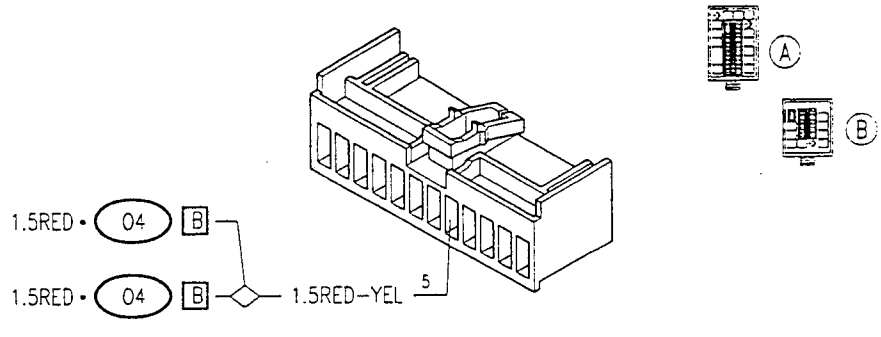
Fusebox	G1 A



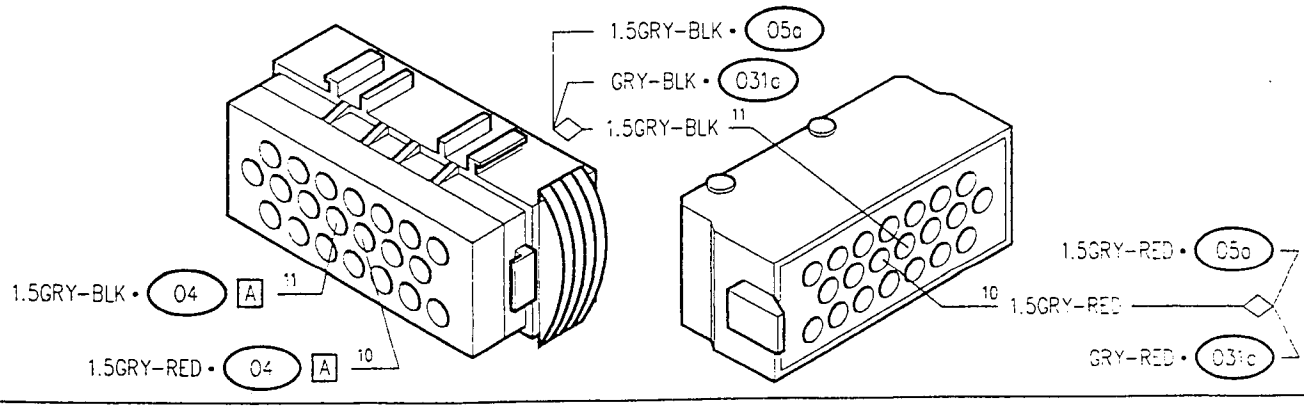
Fusebox	G1 D



Fusebox	G1 H

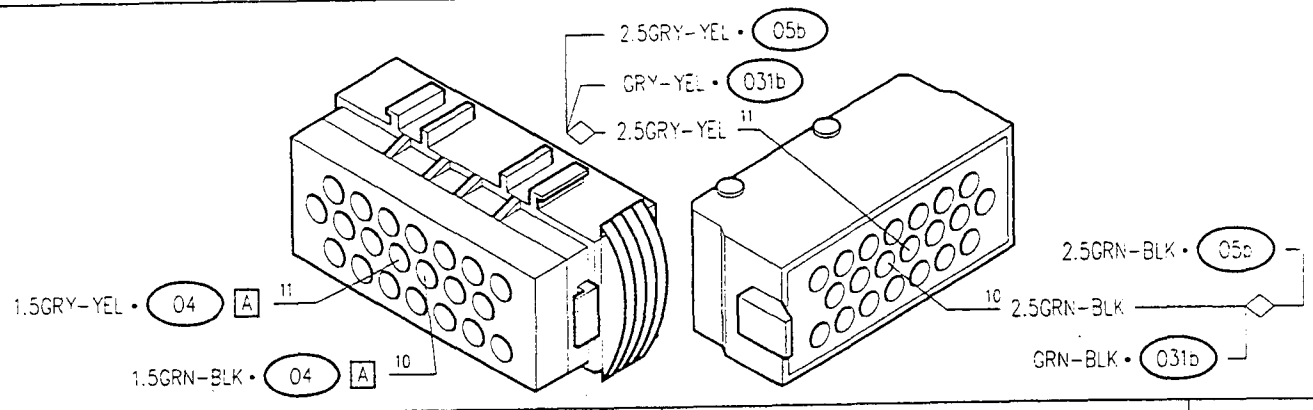


RH front door wiring connector	G21

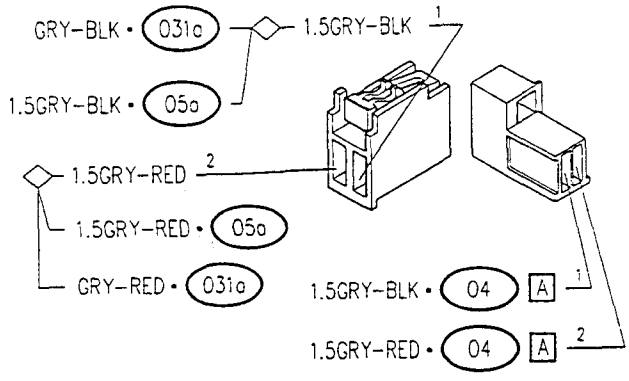


COMPONENTS AND CONNECTORS (cont.d)

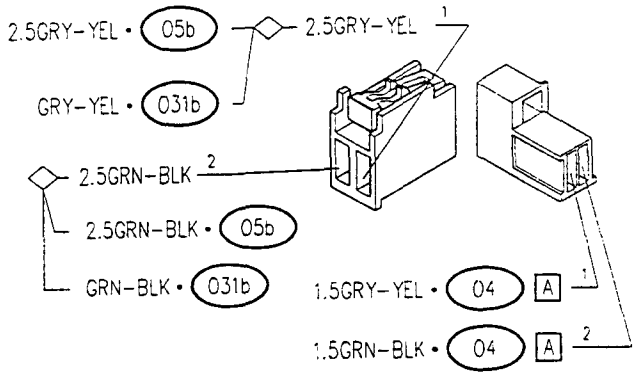
LH front door wiring connector — G23



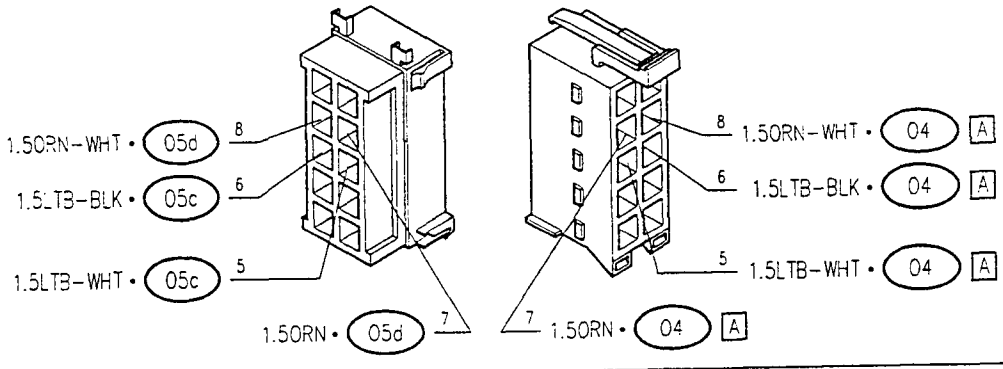
RH front door wiring connector (*) — G21



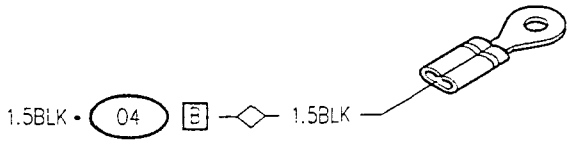
LH front door wiring connector (*) — G23



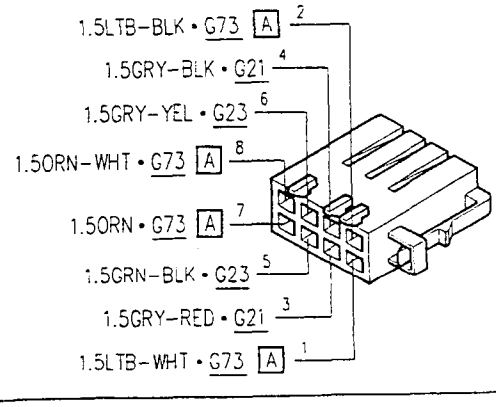
Rear services connector — G73 A



Earth under LH dashboard — G148b



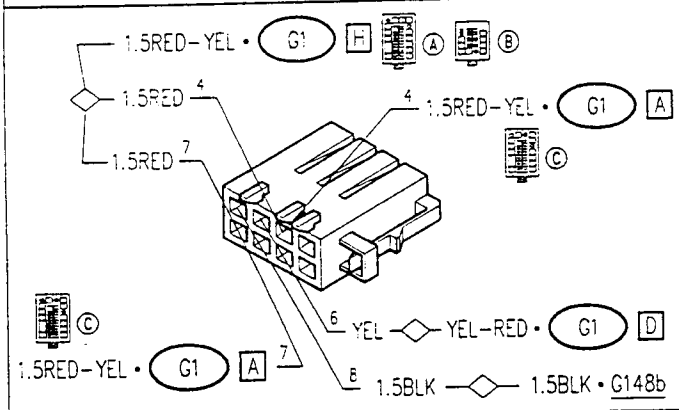
Car radio — O4 A



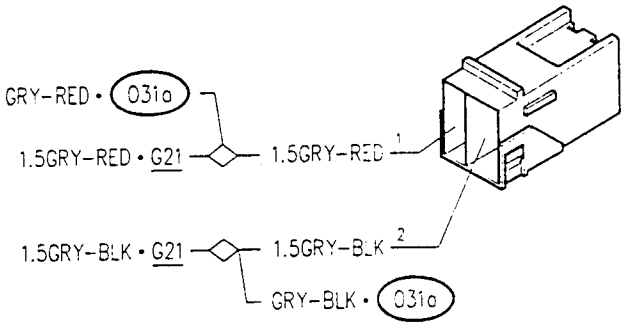
(*) variant for cars without power windows and central door lock/antitheft device

COMPONENTS AND CONNECTORS (cont.d)

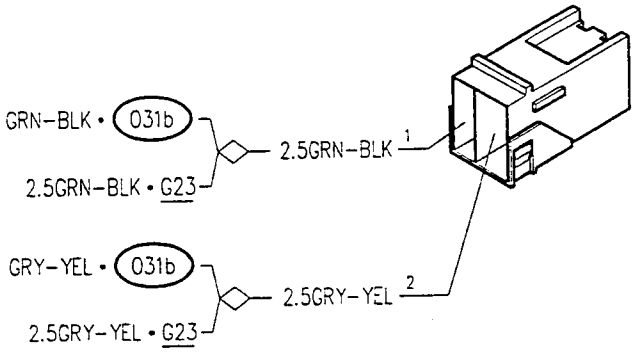
Car radio — O4 B



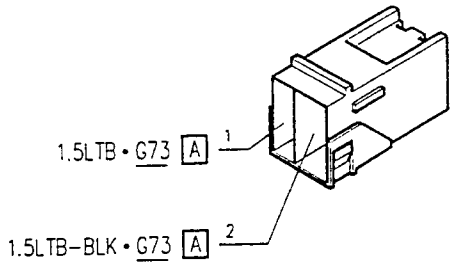
RH front speaker — O5a



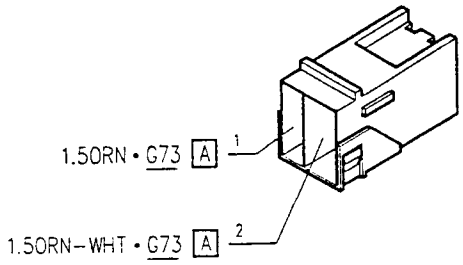
LH front speaker — O5b



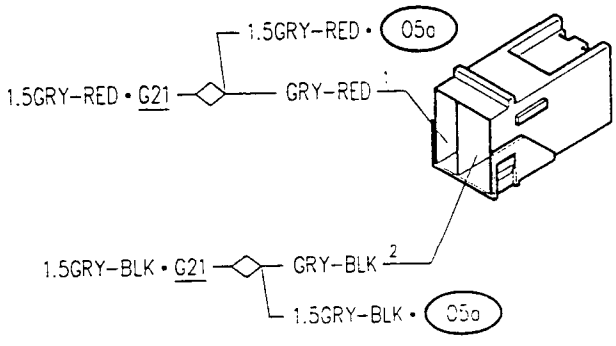
RH rear speaker — O5c



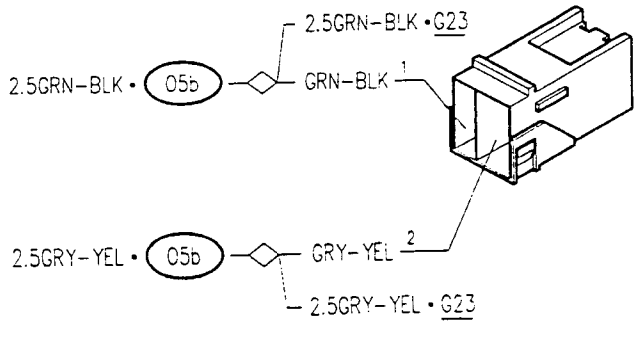
LH rear speaker — O5d



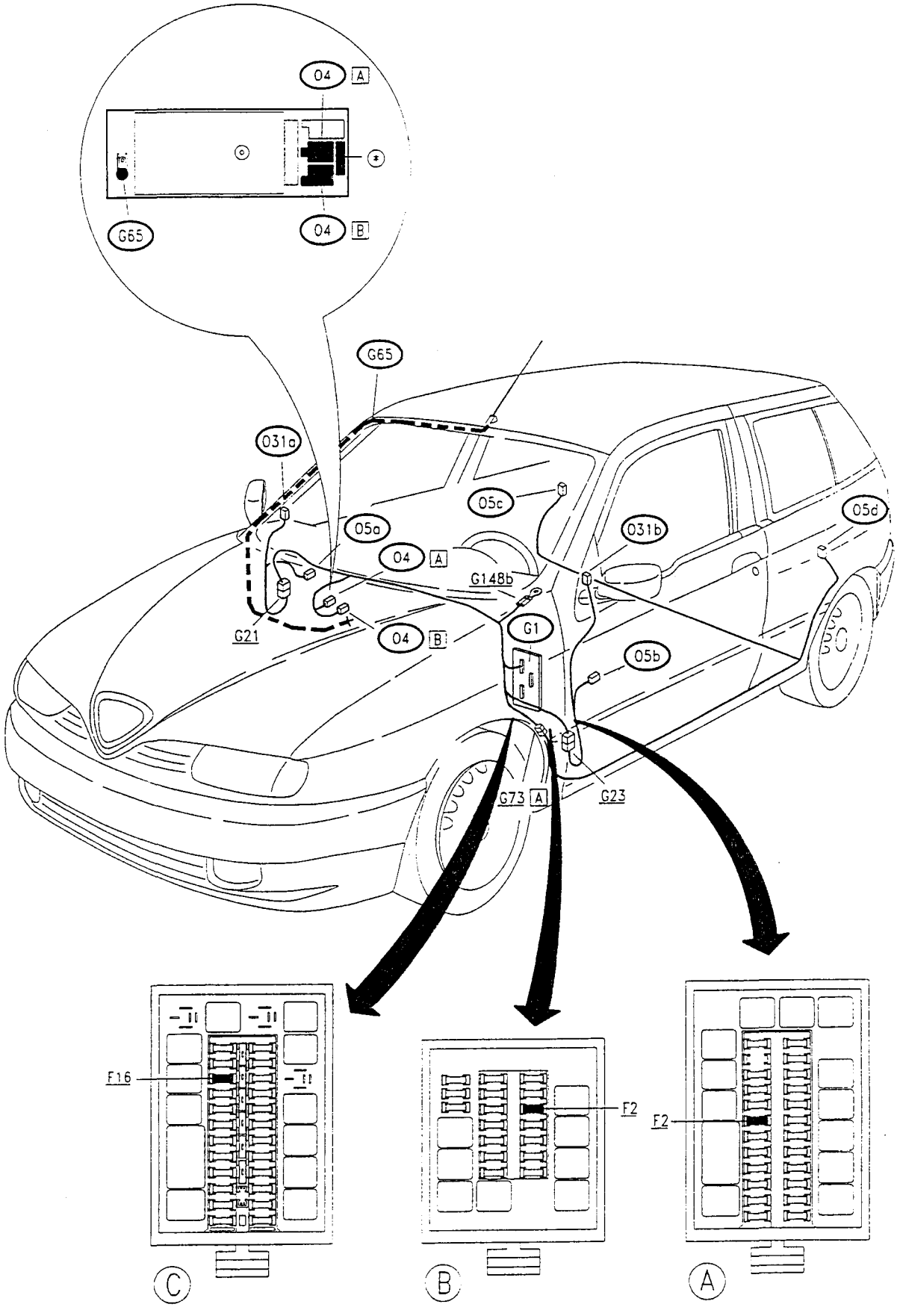
RH Tweeter speaker — O31a



LH Tweeter speaker — O31b



LOCATION OF COMPONENTS



(*) Extra fuse (10A) behind the radio (O4)

FAULTFINDING TABLE

Failure	Component to be checked									
	F2	F15	O4	O5a-O31a	O5b-O31b	O5c	O5d	G65	H3
Radio power failure (1)	•	•	•						
Poor reception			•					•	
RH front tweeter/speaker not working			•	•					
LH front speaker/tweeter not working			•		•				
RH rear speaker not working			•			•			
LH rear speaker not working			•				•		
Disturbance from other electric services (2)									•

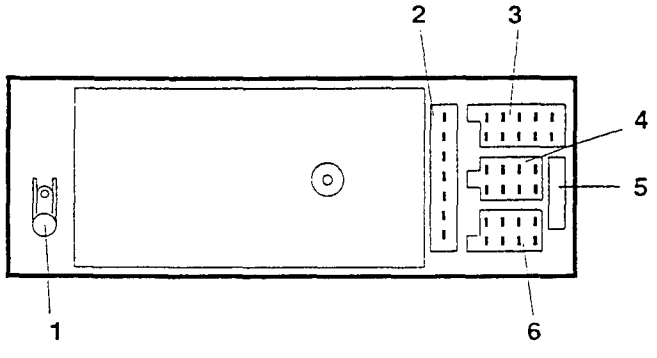
(1) **PHILIPS DC731** car radio, also check that the extra fuse (10A) on the rear of the radio is intact; change it if necessary.

(2) If there is a hissing noise or other signs of malfunctioning of the speakers when the stop lights are operated, check that the wiring is correctly connected and that the anti-disturbance condenser in switch **H3** is working properly (see the "Stop lights" section).

CHECKING COMPONENTS

Car radio (O4)

PHILIPS DC710/255 CAR RADIO: If any specific functions or devices of the radio itself are not working, consult the "Instructions Handbook" provided with it.



view of connectors side

1 - connection socket for aerial coaxial cable **G65**

2 - connector not connected

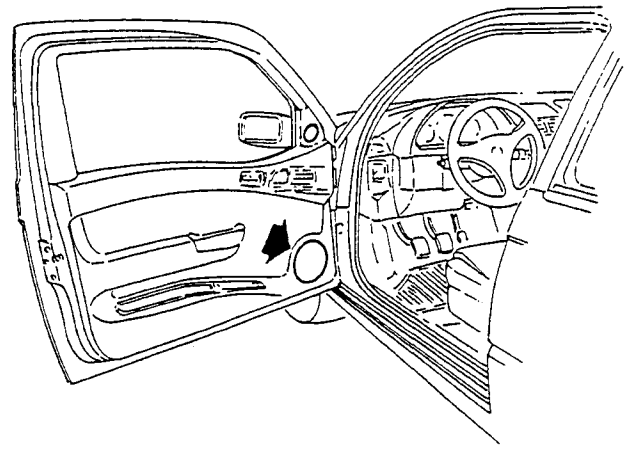
3 - connector not connected

4 - connector (O4) [A]

5 - extra fuse (10A)

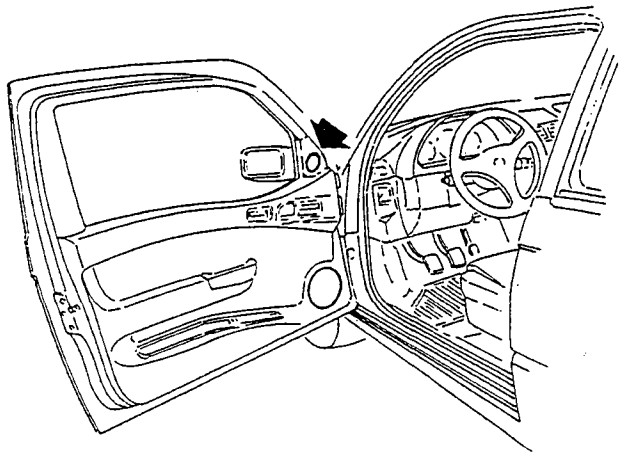
6 - connector (O4) [B]

Front speaker (O5a) - (O5b)



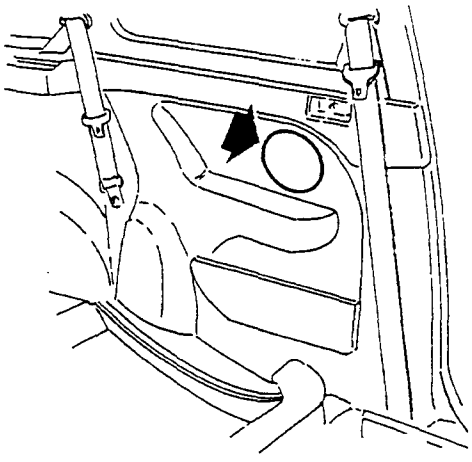
SPECIFICATIONS	
Passband	70 ÷ 12000 Hz
Resonance frequency	70 ± 12 Hz
Nominal impedance	4 ± 20% Ω
Induction	0.72 ± 7% T
RMS Power (DIN 45573)	20 W
Weight	430 ± 10% g.
ø of speaker	165 mm

Front Tweeter (O31a) - (O31b)



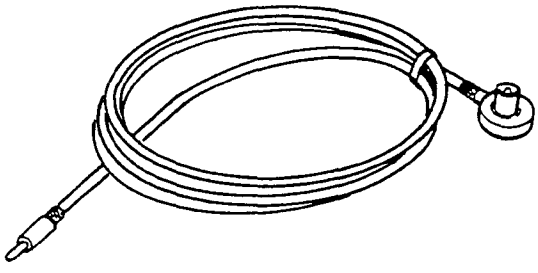
SPECIFICATIONS	
Passband	5000 ÷ 20000 Hz
Resonance frequency	2500 ± 600 Hz
Nominal impedance	4 ± 20% Ω
Induction	1.06 ± 7% T
RMS power (DIN 45573)	30 W
Weight	55 ± 15% g.
Type of crossover	3.3 µF
Crossover frequency	5000 Hz
Type of tweeter	DOME

Rear speaker (O5c) - (O5b)



SPECIFICATIONS	
Passband	105 ÷ 20000 Hz
Resonance frequency	105 ± 22 Hz
Nominal impedance	4 ± 20% Ω
Induction	1 ± 7% T
RMS power (DIN 45573)	20 W
Weight	375 ± 5% g.
ø of speaker	130 mm
Type of tweeter	PIEZO

Aerial coaxial cable (G65)



SPECIFICATIONS	
Total resistance (between plug and socket screens)	< 95 mΩ
Internal conductor resistance	≤ 2.2 Ω
Total capacity (measured on plug at 1 MHz)	103 ± 15% pF

CHECK PANEL

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Components and Connectors 18-9
Location of Components 18-11
FAULT-FINDING TABLE 18-12

GENERAL DESCRIPTION

The Check Panel display located in the centre of the dashboard integrates the indications of the instrument cluster with certain indicators and operating switches:

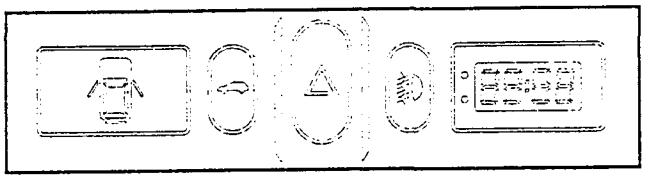
- doors open indicator
- luggage compartment opening switch
- hazard warning light switch (blinker)
- foglamp switch
- digital clock

This section describes the following functions

- **DOORS OPEN INDICATOR,**
- **CLOCK,**

while for the switches, reference should be made to the sections to which they belong, i.e.:

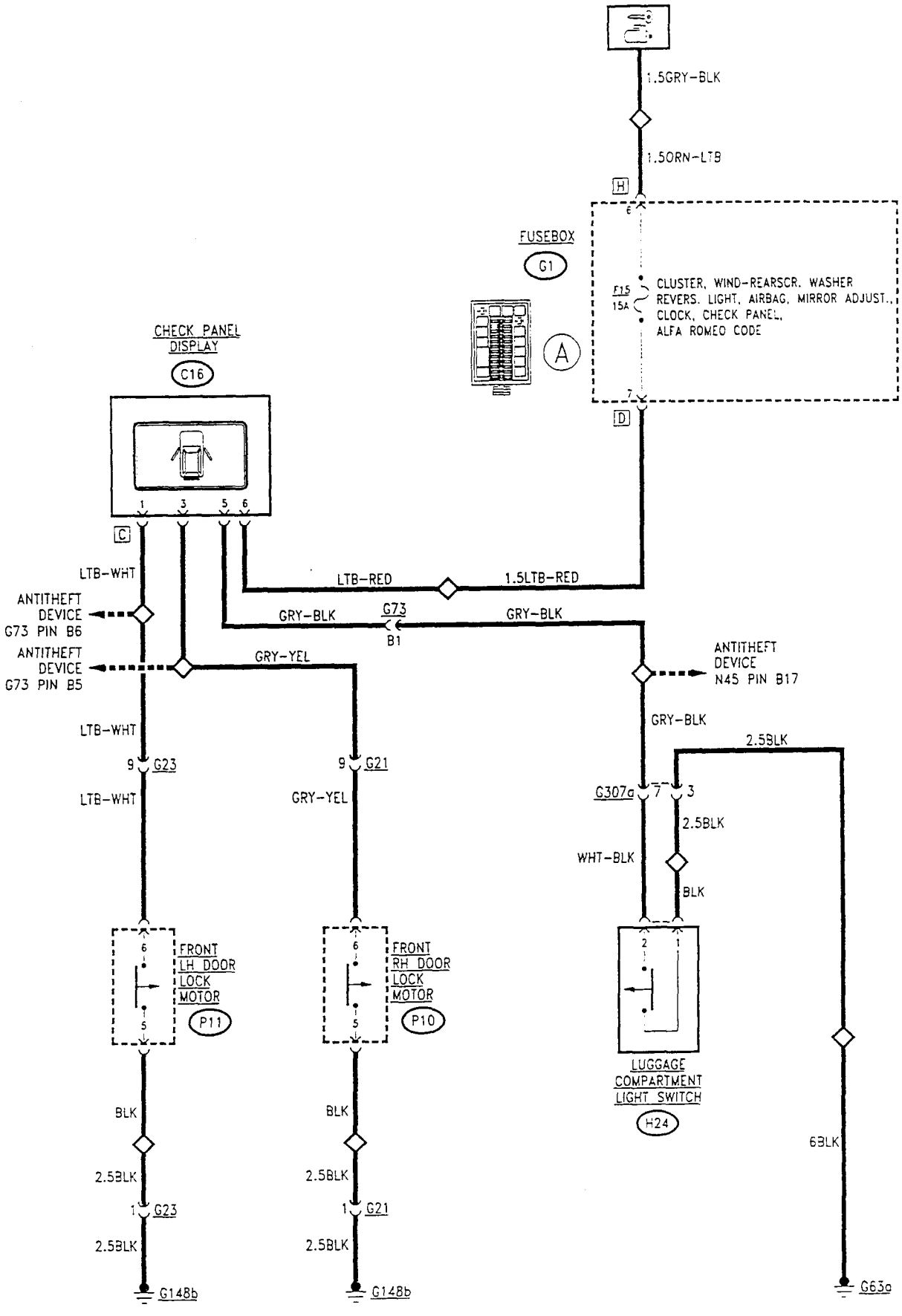
- luggage compartment opening switch: see section "Luggage compartment opening control"
- hazard warning light switch: see section: "Direction indicators and hazard warning lights"
- Foglamp switch: see section " Foglamps and rear fog guards".



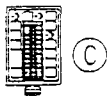
N.B.: Not all versions possess all these functions.

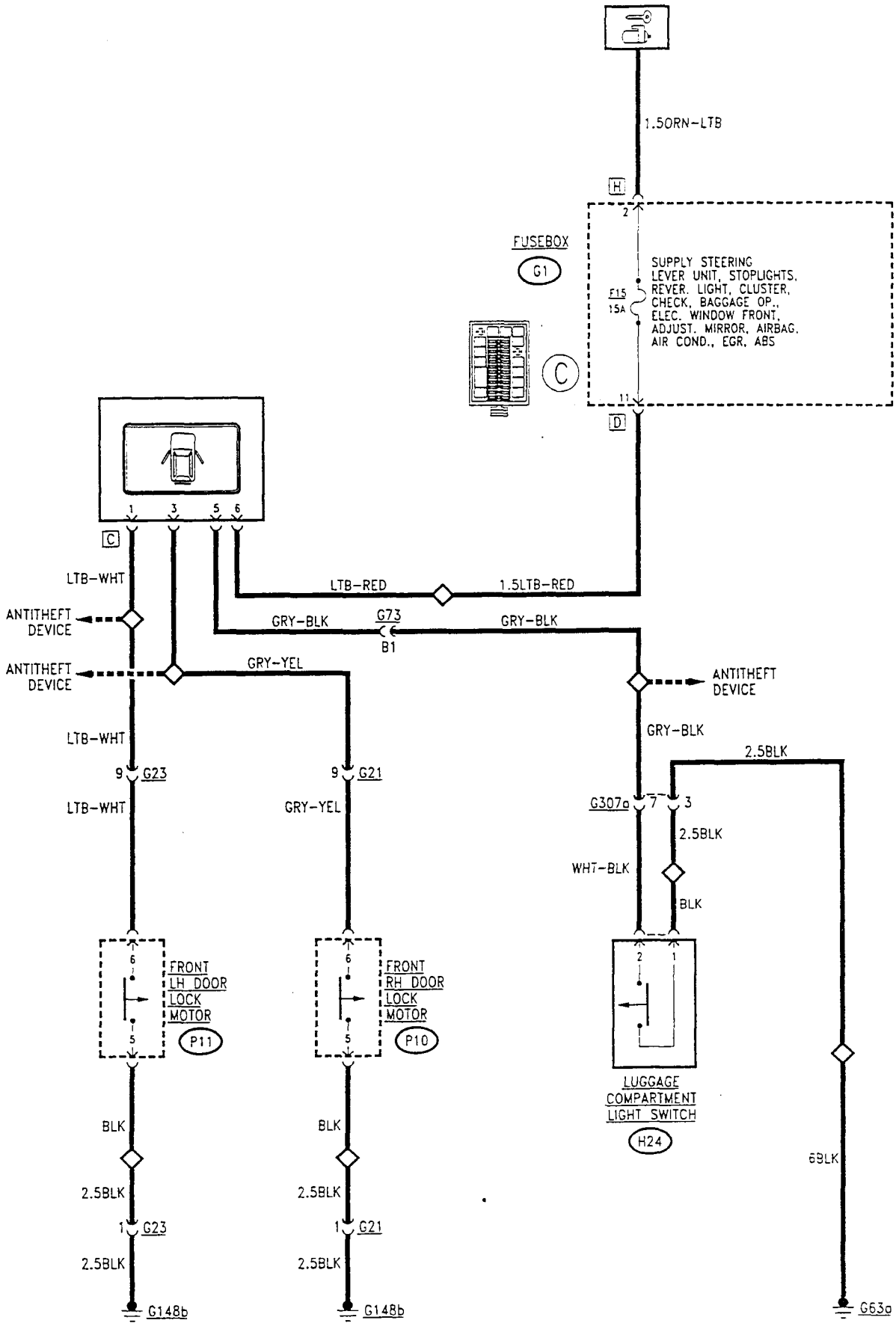
DOORS OPEN INDICATOR

Wiring Diagram



Wiring Diagram





Functional Description

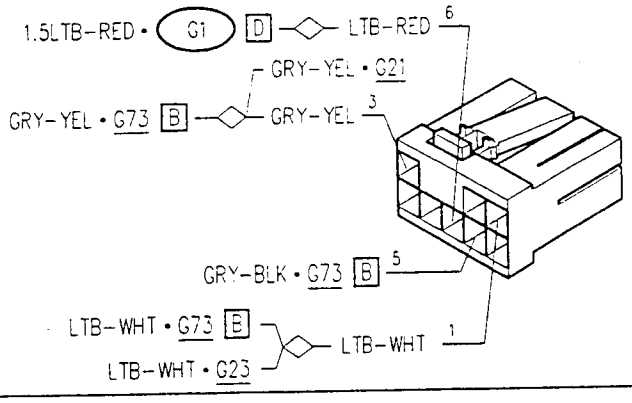
The door locking device **P10** and **P11**, located on each door in correspondence of the lock, also contains a microswitch which closes when the door is open, thereby sending an earth signal to the display **C16** at pins 3 and 1 respectively of connector C.

In a similar way switch **H24**, which turns on the light in the luggage compartment, closes when the tailgate is open, sending an earth to the display **C16** at pin 5 of connector C.

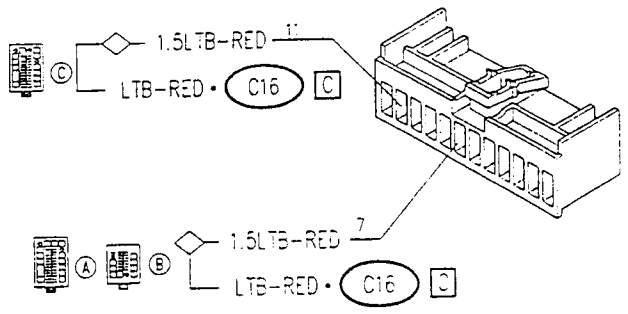
The "key-operated" supply reaches pin 6 of the same connector through fuse **F15** of fusebox **G1**; the earth signals from the doors turn on the corresponding red leds.

Components and Connectors

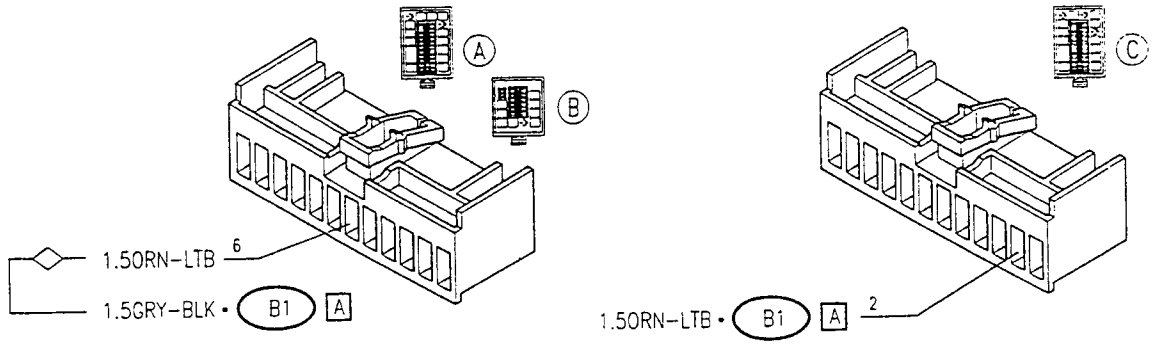
Check Panel Display	C16 C



Fusebox	G1 D

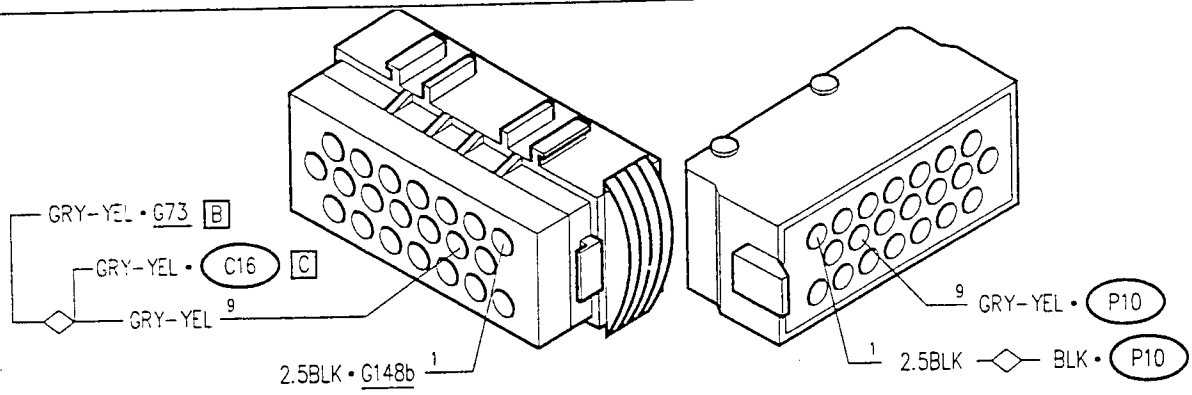


Fusebox	G1 H

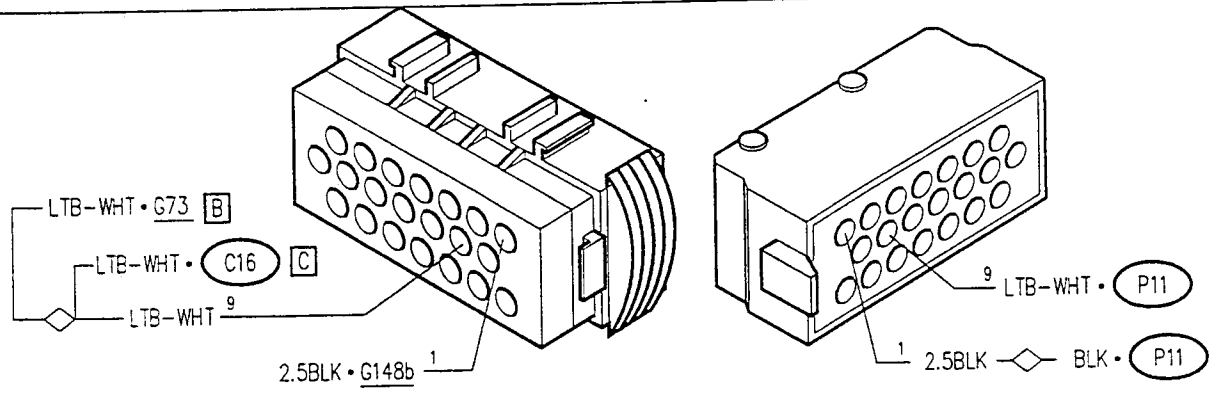


Components and Connectors (cont.d)

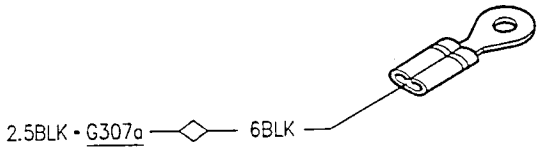
RH front door wiring connector	G21



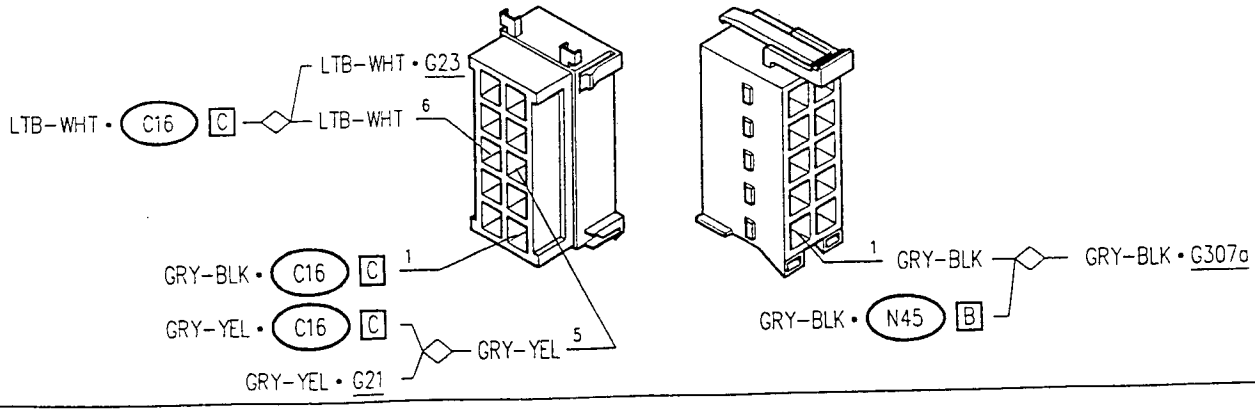
LH front door wiring connector	G23



RH rear earth	G63a

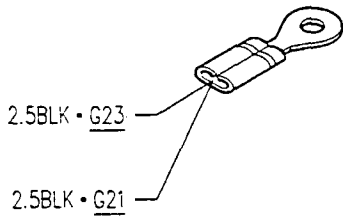


Rear services connector	G73 B

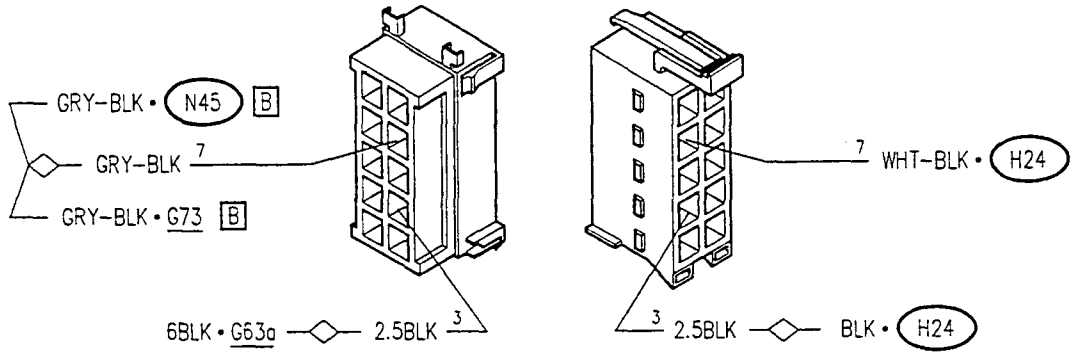


Components and Connectors (cont.d)

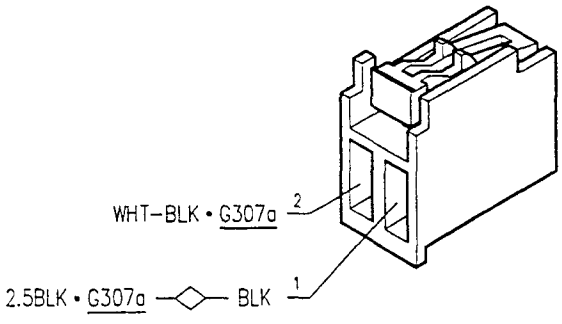
Earth under LH dashboard	G148b

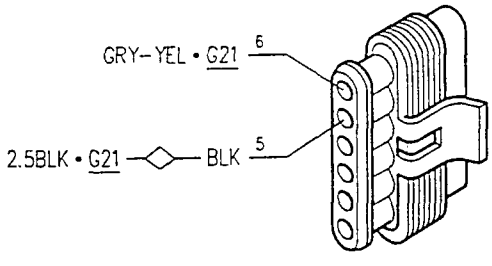


Rear wiring/luggage compt.wiring A connector	G307a

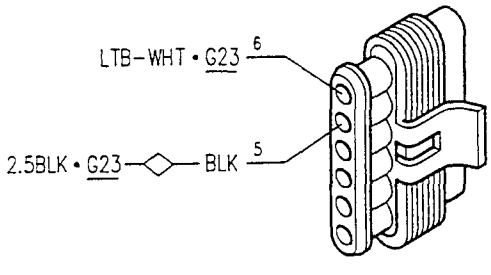


Luggage compartment light switch	H24	RH front door lock motor	P10

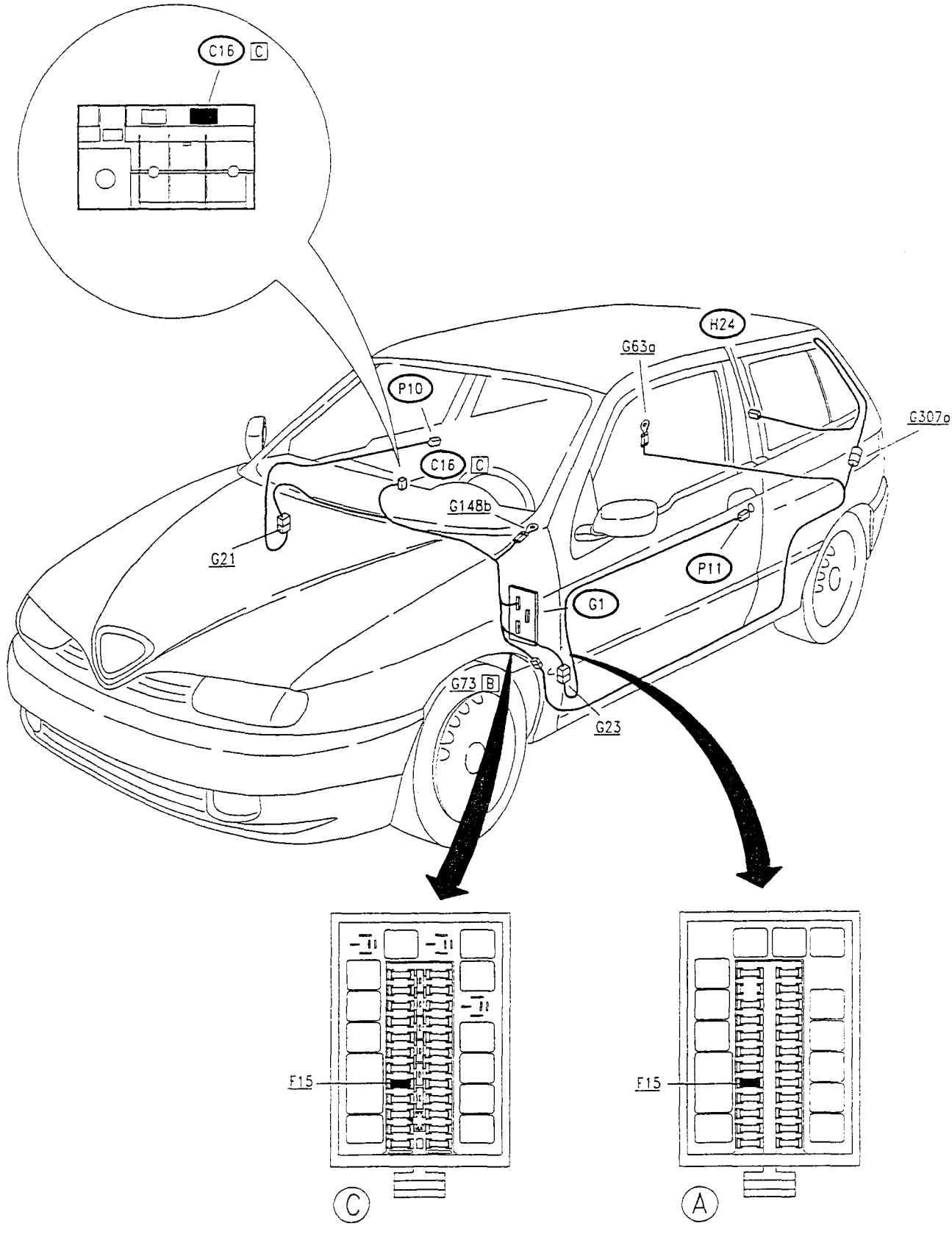




LH front door lock motor	P11

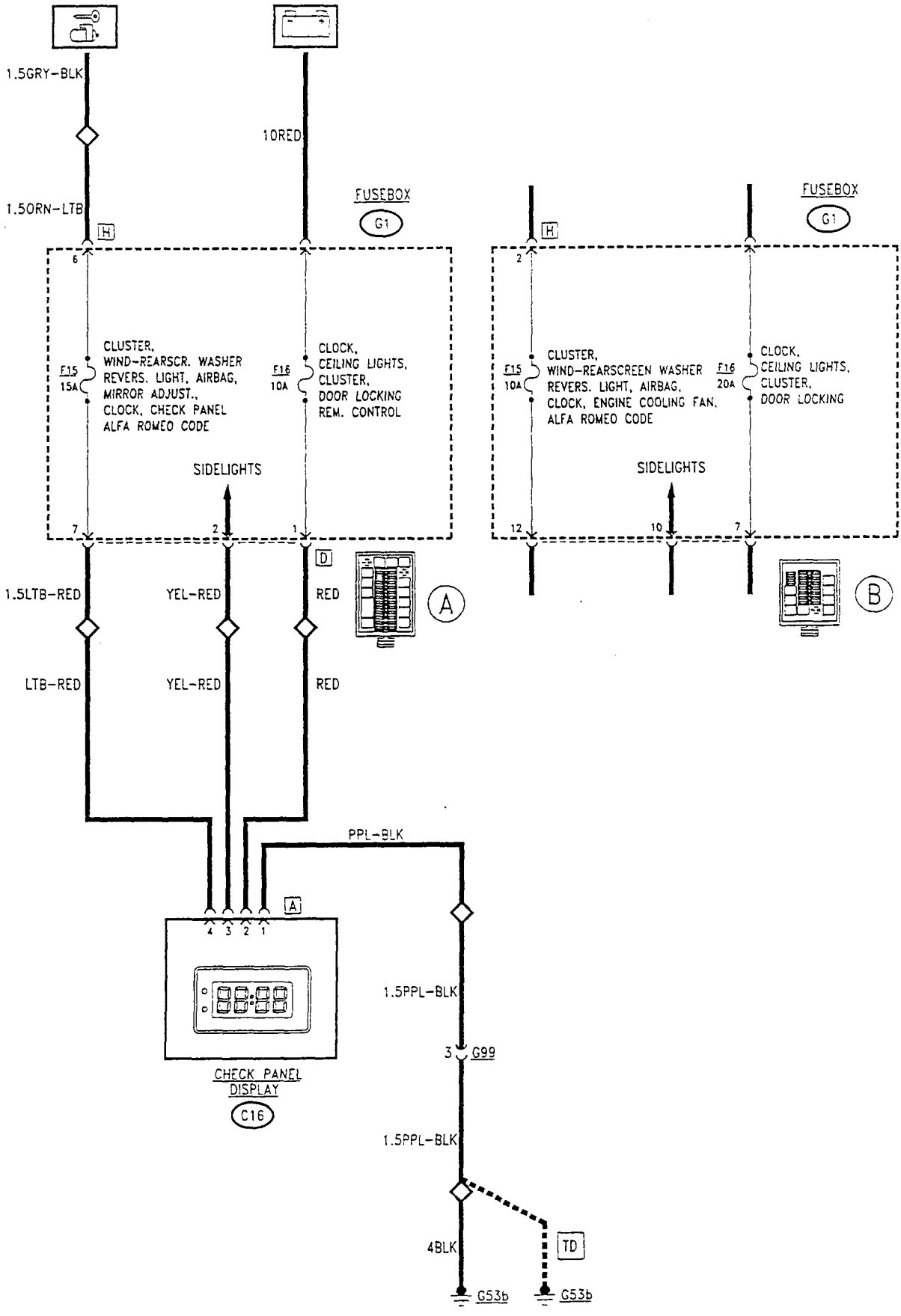


Location of Components

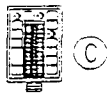


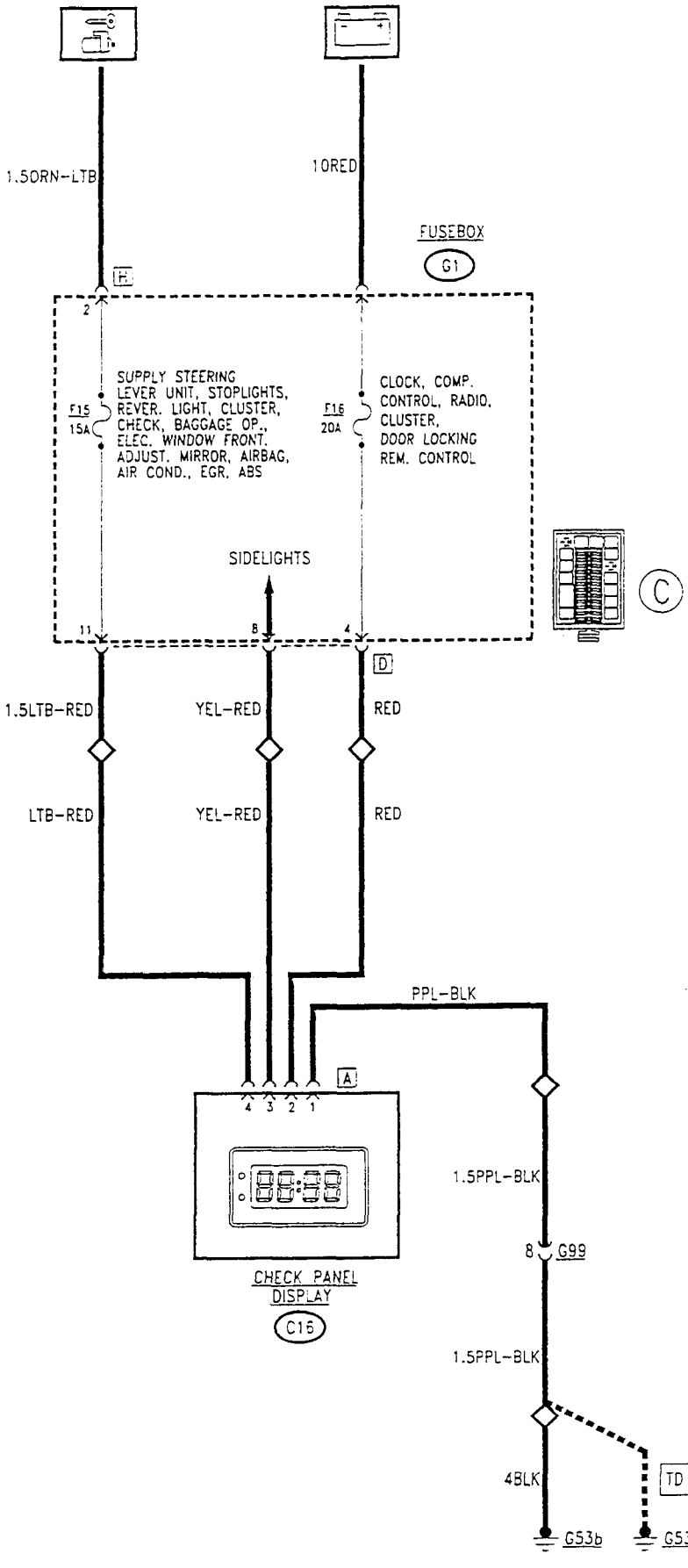
CLOCK

Wiring Diagram



Wiring Diagram





Functional Description

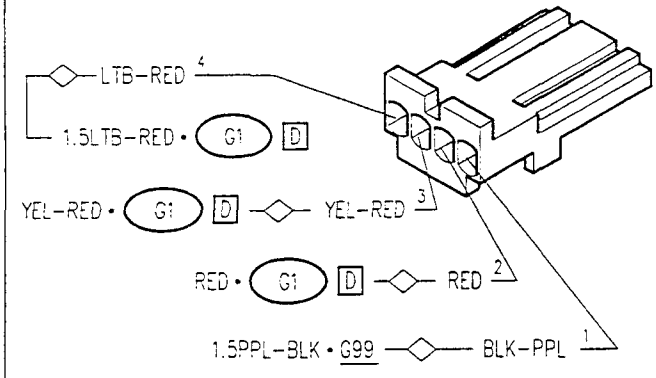
The clock, located in the display **C16**, is supplied by direct voltage (battery) through fuse **F16** of fusebox **G1** which is connected to pin 2 of connector A of the actual display.

N.B.: disconnecting the battery, the clock stops and must be reset using the 2 pushbuttons - hours and minutes - when the supply is re-connected.

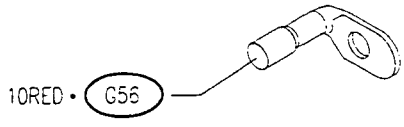
Pin 4 receives the "key-operated" supply through fuse **F15** of fusebox **G1**, while pin 1 is connected to earth; the key- operated supply lights up the numbers of the actual clock display (which stay off when the key is not engaged); lastly, a sidelights on signal reaches pin 3 which dims the light of the numbers.

Components and Connectors

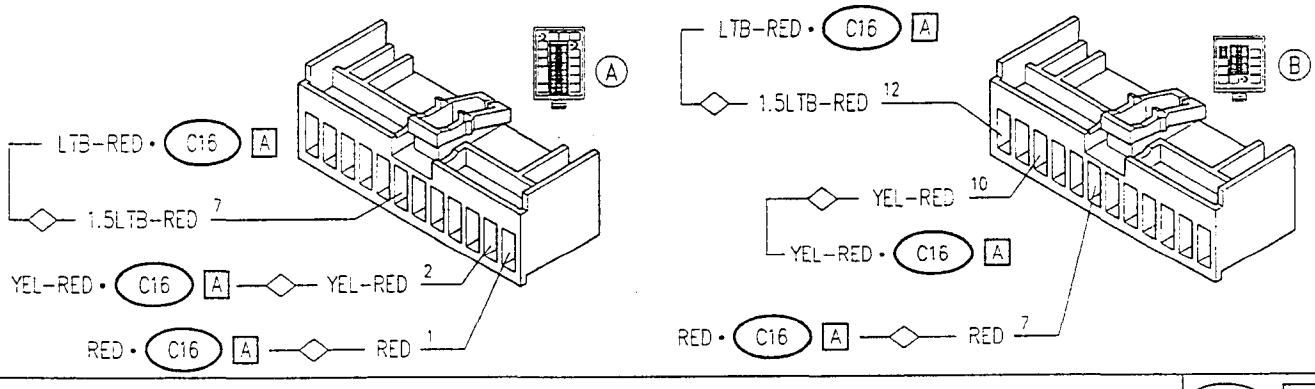
Check Panel Display C16 A



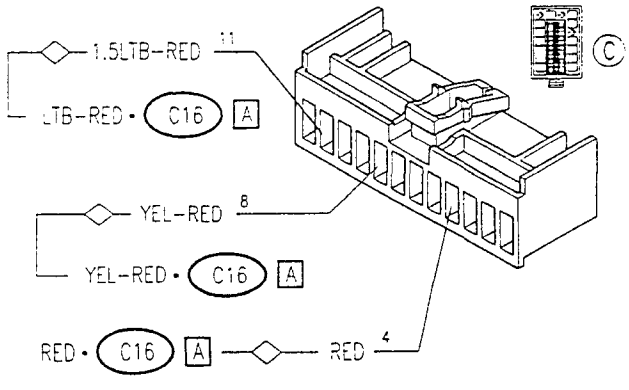
Fusebox G1



Fusebox G1 D

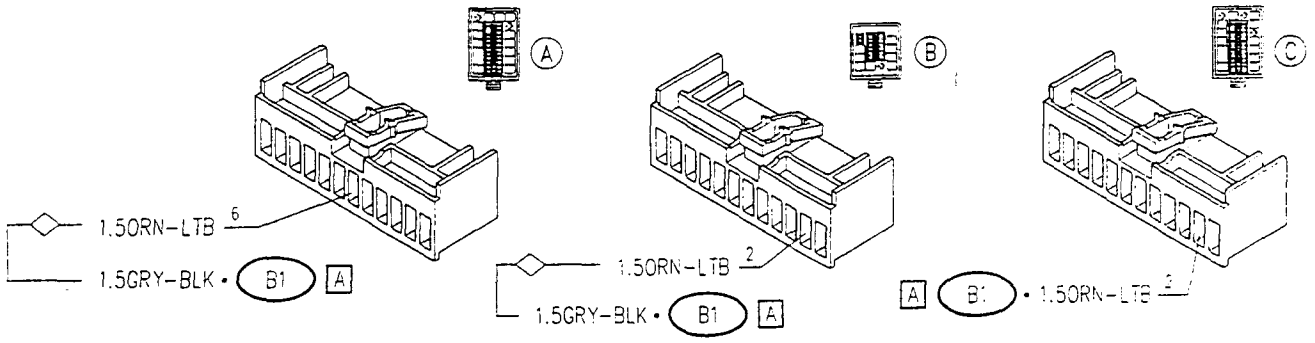


Fusebox G1 D

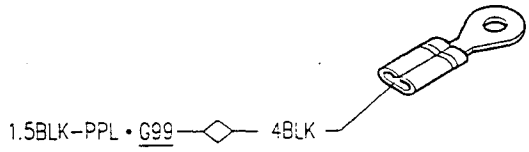


Components and Connectors (cont.d)

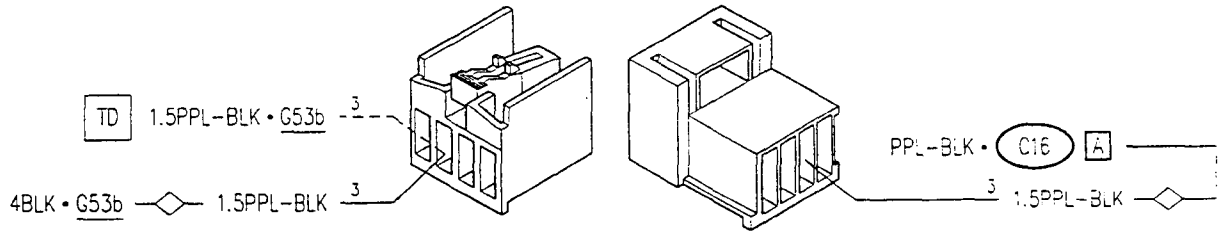
Fusebox	G1 H



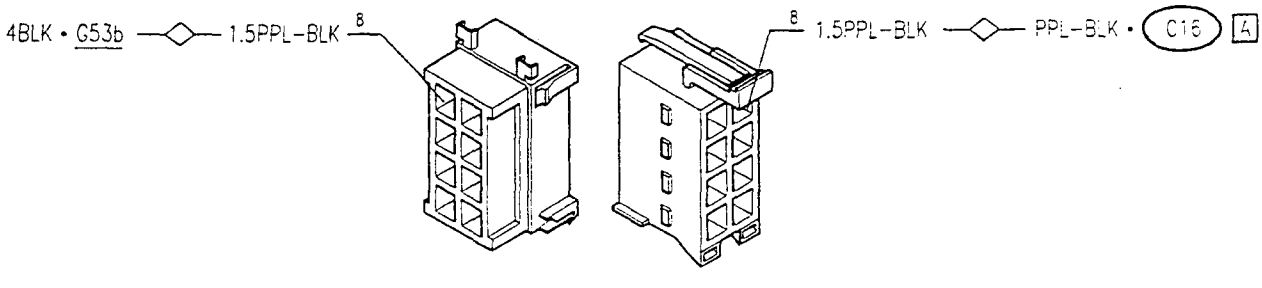
RH engine earth	G53b



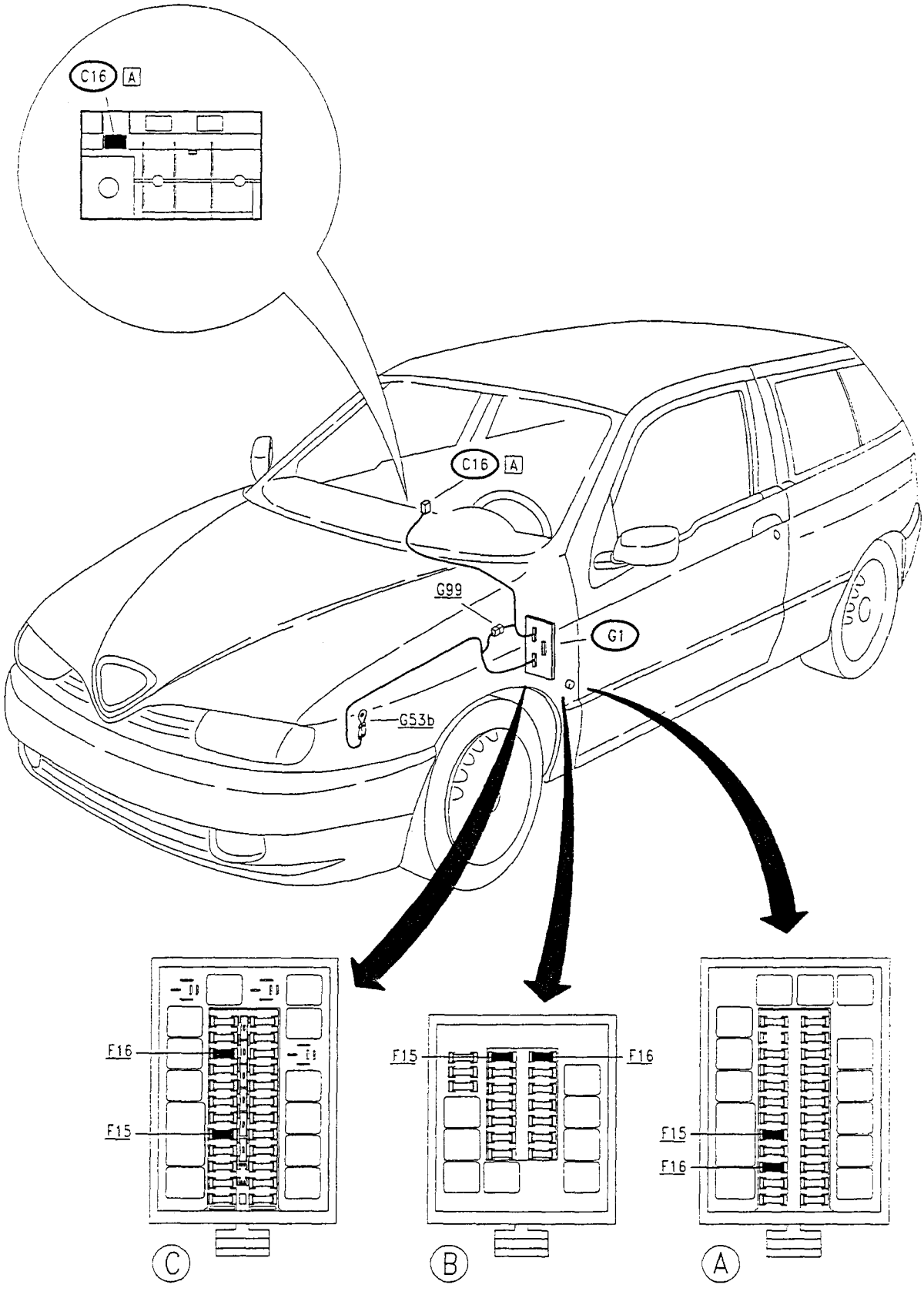
Dashboard/engine wiring connector (*)	G99



Dashboard/engine wiring connector (**)	G99



Location of Components



FAULT-FINDING TABLE

Fault	Component to be checked					
	F15	F16	C16 (*)	P10	P11	H24
Display out completely	•		•			
Clock		•	•			
Display fails to light up			•			
One of the switches not working			•			
RH front door open			•	•		
LH front door open			•		•	
Luggage compt.open						•

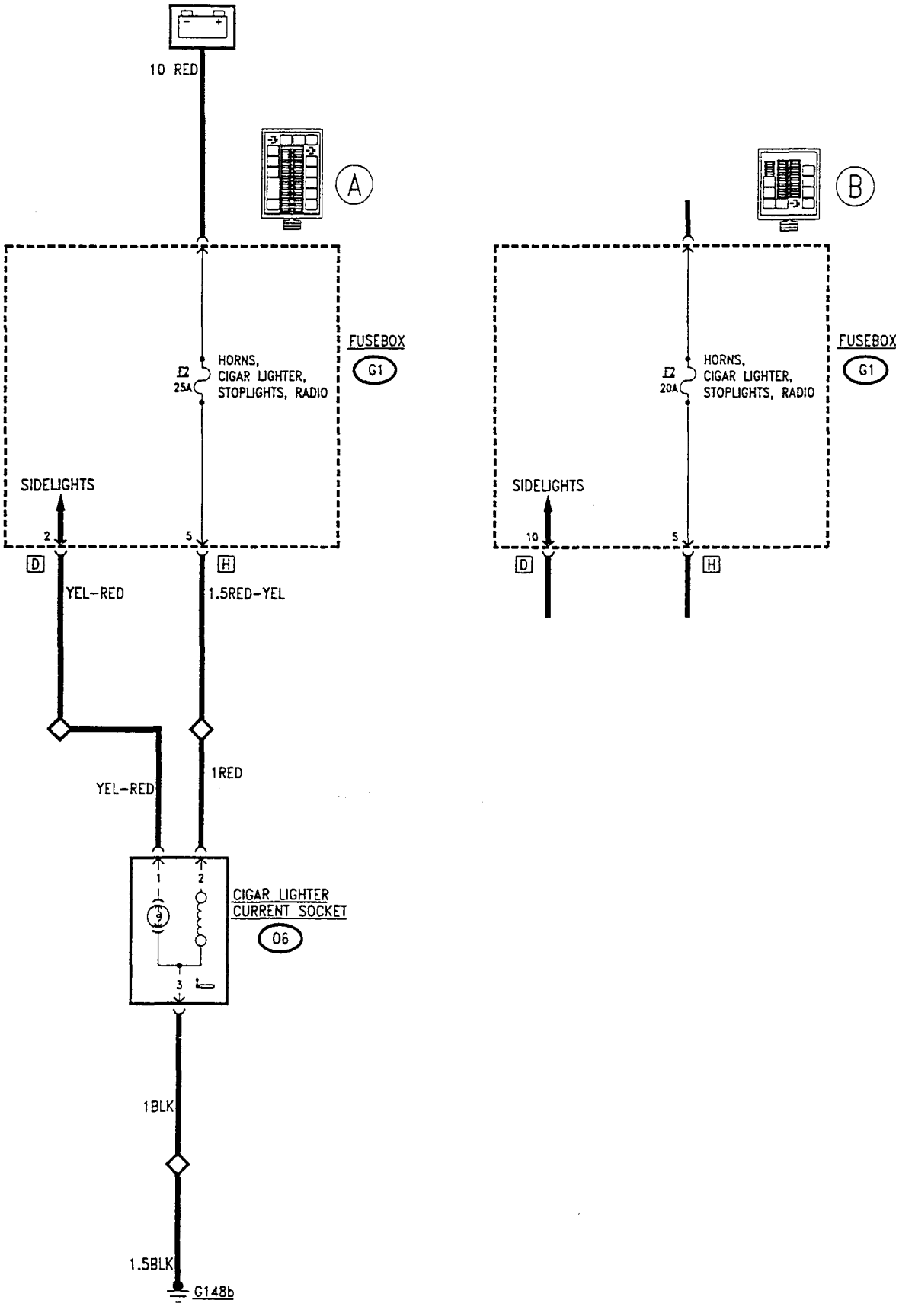
(*) The Check Panel display **C16** cannot be overhauled. Therefore, in the event of a failure, individual components (clock, doors display, switch) cannot be changed and the whole unit must be replaced

CIGAR LIGHTER - CURRENT SOCKET

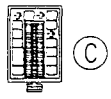
INDEX

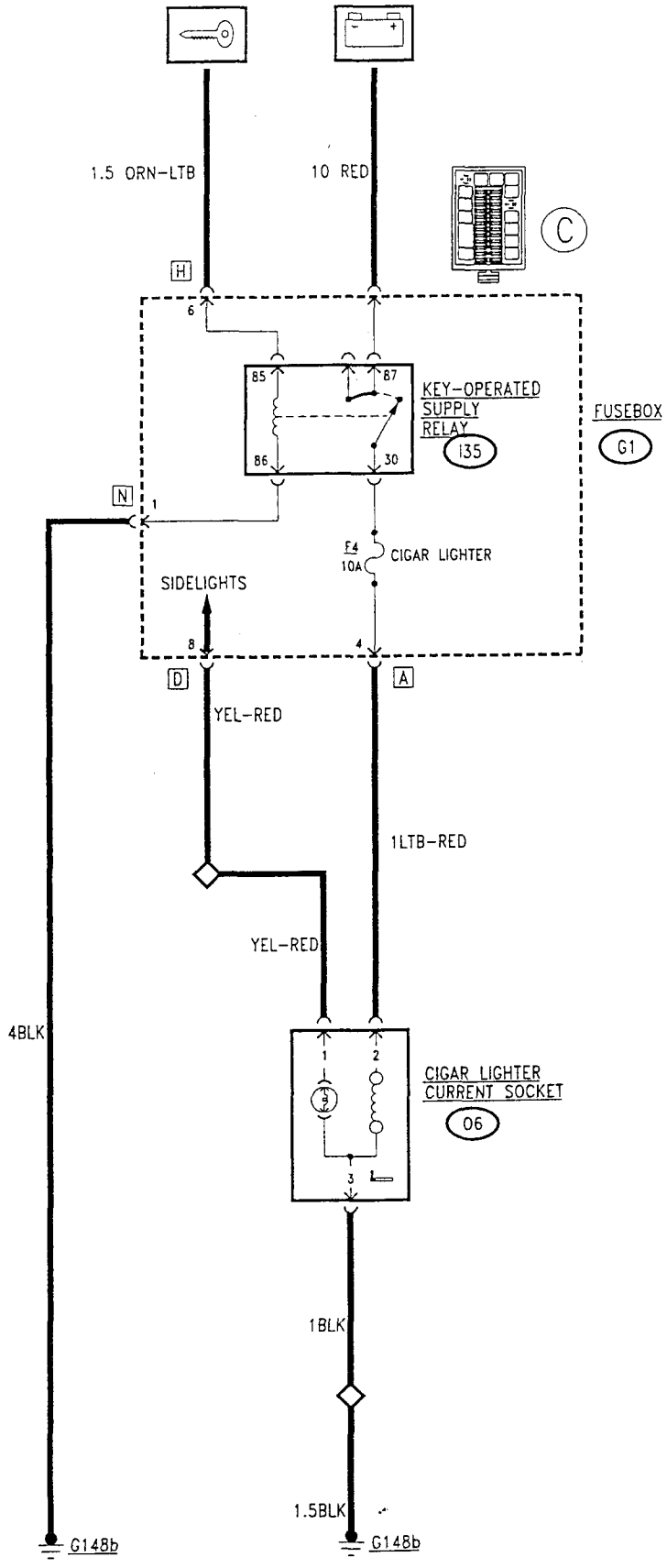
WIRING DIAGRAM 20-2
GENERAL DESCRIPTION 20-3
FUNCTIONAL DESCRIPTION 20-3
COMPONENTS AND CONNECTORS 20-3
FAULTFINDING TABLE 20-4
LOCATION OF COMPONENTS 20-5

WIRING DIAGRAM



WIRING DIAGRAM





GENERAL DESCRIPTION

The car offers the occupants three ashtrays: one at the centre of the dashboard, and two for the rear seats. The inside of the front ashtray is illuminated when the side lights are on (see "Illumination of controls and indicators"), next to it there is the "cigar lighter" resistance which is turned on pressing it into its socket: after a few seconds it pops out, ready for use, automatically This socket is of the standard type and it may also be used for connecting other instruments or appliances (provided that they operate at 12V).

N.B.: The socket is fitted with a thermal protection device: in the event of connections with high energy absorption devices, this protection "cuts out".

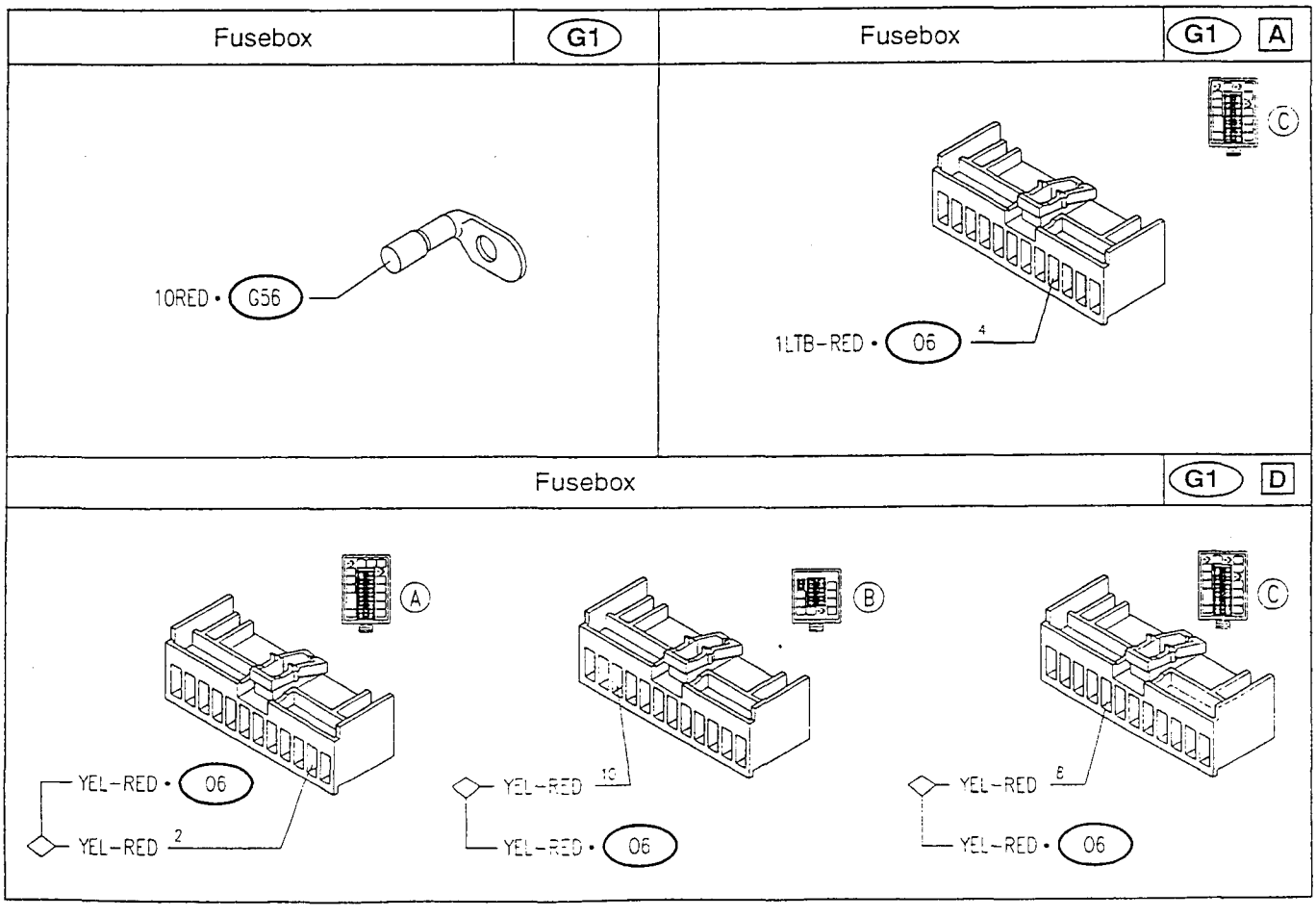
The socket is continuously supplied and may be used at any time even when the ignition key is disengaged.

FUNCTIONAL DESCRIPTION

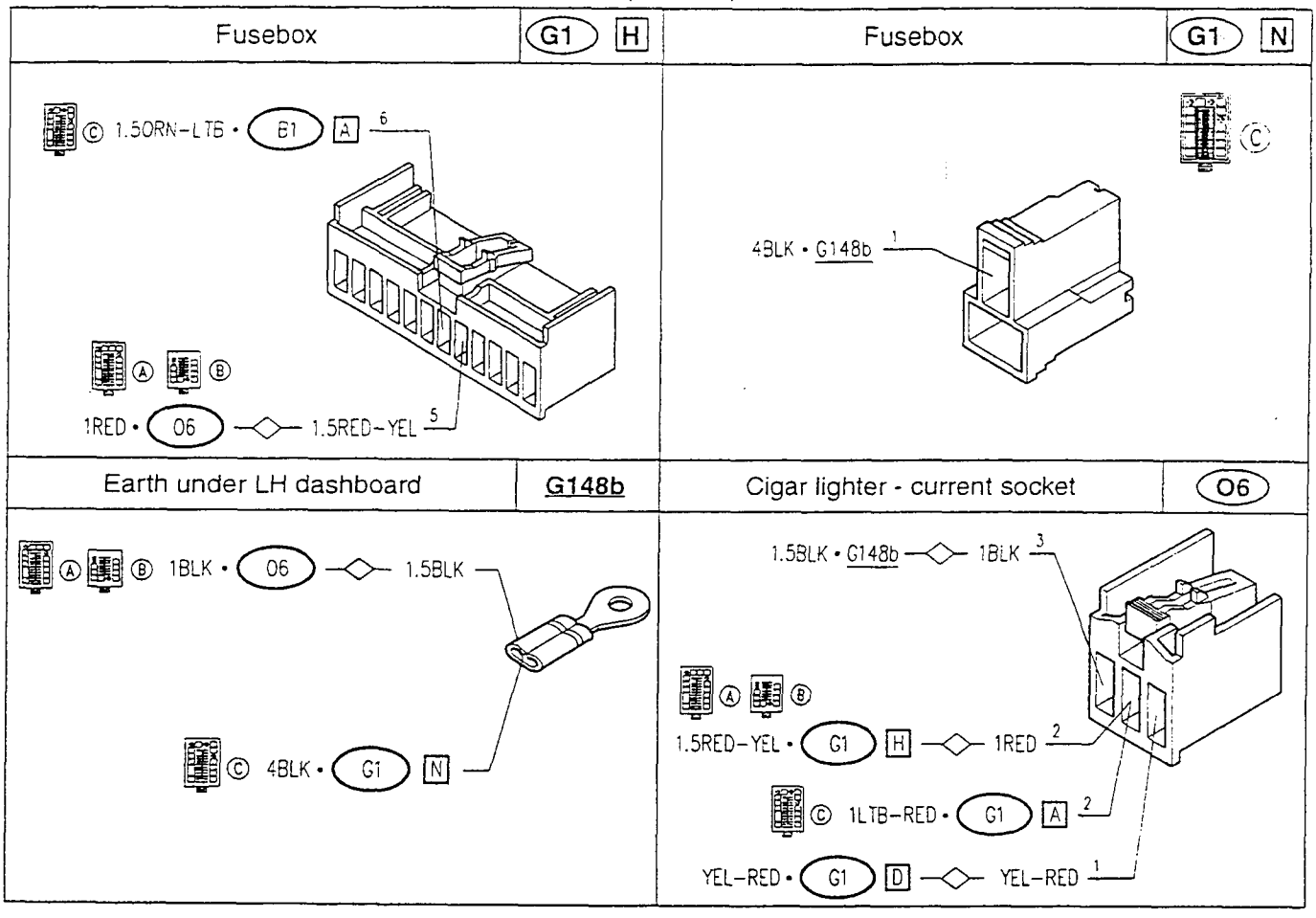
The connection socket for the cigar lighter resistance **O6** is supplied directly by battery current via fuse **F2** of fusebox **G1**, (box "A" and "B") which suitably protects the circuit or through relay **I35** (key-operated supply) and fuse **F4** in fusebox **G1** (box "C").

The cigar lighter bulb **O6** is turned on when the side lights are on (also see "Illumination of controls and indicators").

COMPONENTS AND CONNECTORS



COMPONENTS AND CONNECTORS (cont.d)

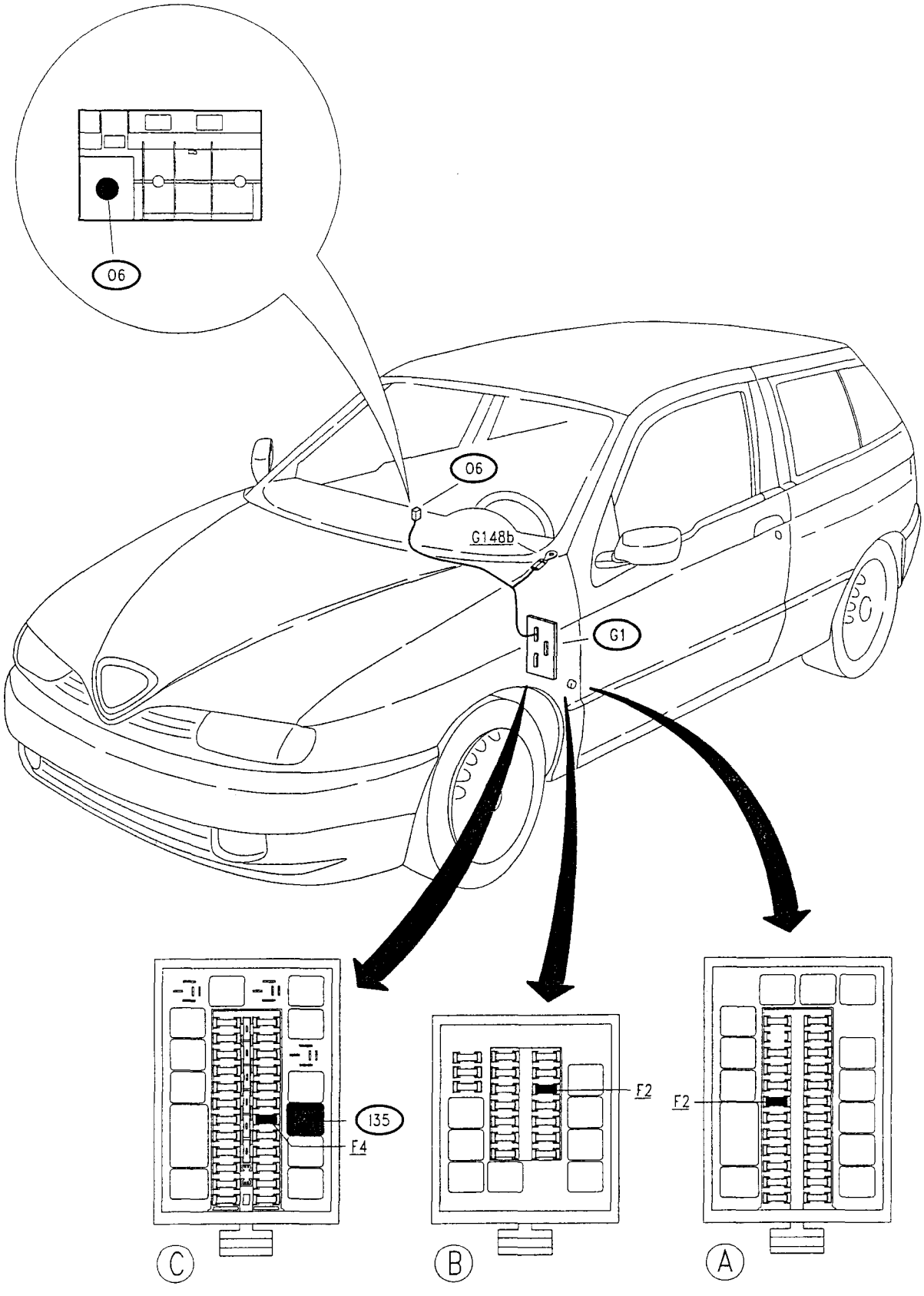


FAULTFINDING TABLE

Failure	Component to be checked	
	F2	O6 (*)
Cigar lighter - current socket	•	•
Cigar lighter light		•

(*) If the thermal protection device for the current socket cuts in, it can be changed at least 5 times without the need to change the complete socket.

LOCATION OF COMPONENTS



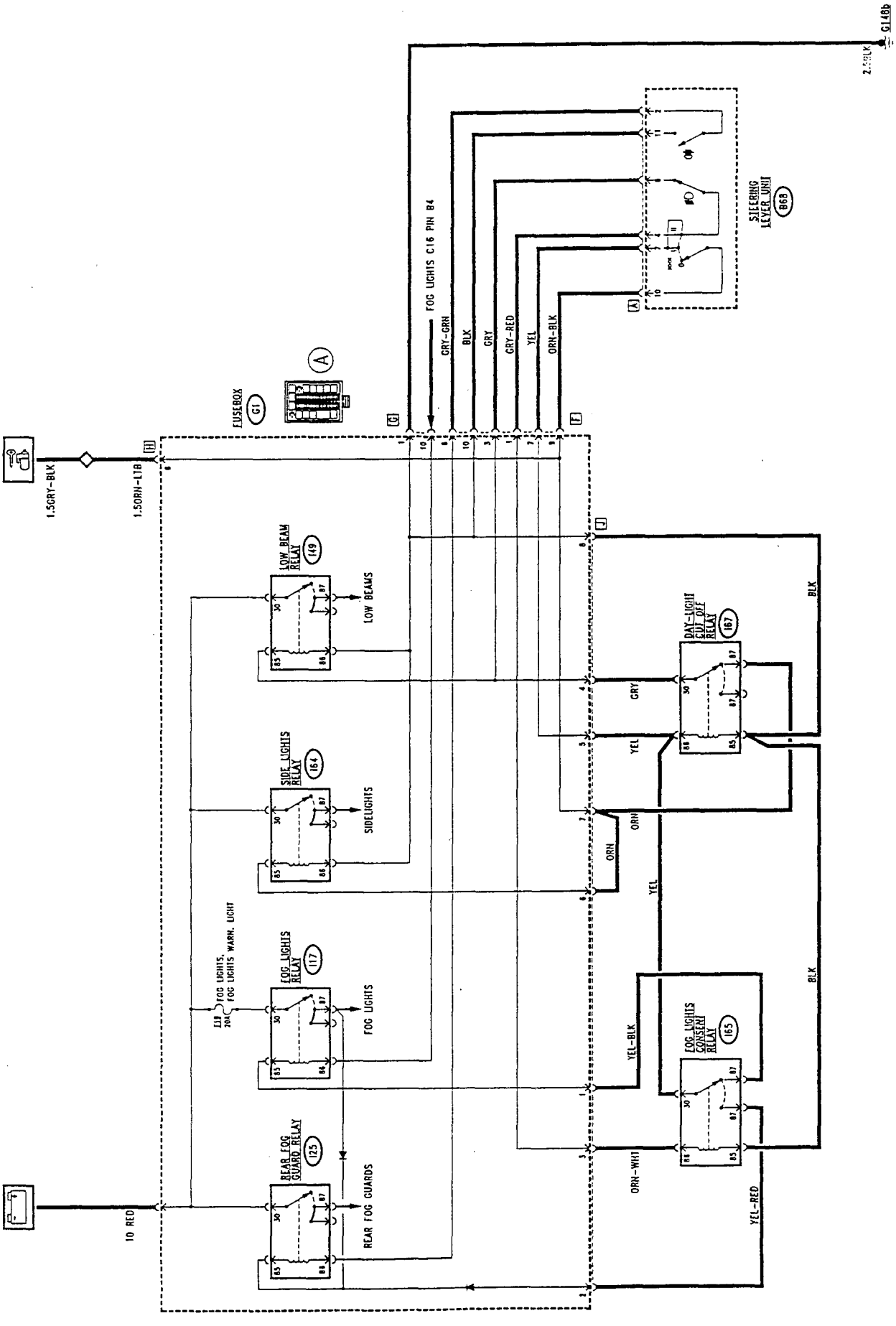
DAYLIGHTS

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LOCATION OF COMPONENTS 9-6

N.B.: only for certain markets

WIRING DIAGRAM



GENERAL DESCRIPTION

Models for some countries are equipped with DAYLIGHTS.
This device, in compliance with the laws of certain countries, **switches the sidelights on whenever the ignition key is engaged** and regulates, following a specific logic, the selection of dipped beam headlamps, fog lamps and rear fog guards:

- with the ignition key turned to "MARCIA": the sidelights and low beam headlamps are turned on;
- sidelights switch in the first position ("I"): only the sidelights stay on, and the fog lamps can be turned on;
- sidelights switch in the second position ("II"): the low beam headlamps are turned on again, the fog lamps are switched off, while it is possible to turn on the rear fog guards;
- operating the high beam headlamps: in the same way as for other models.

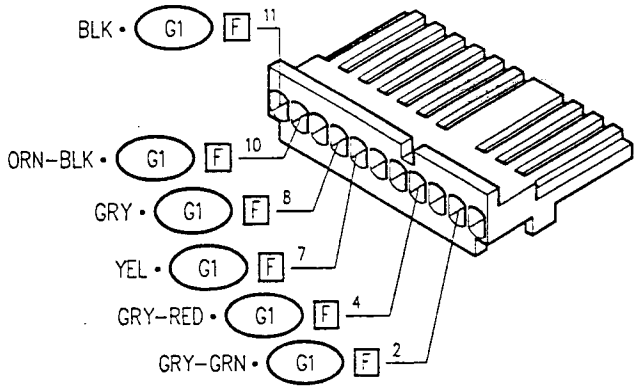
This logic takes place through the connection of two relays, by a special wiring connected to **connector J** of fusebox **G1**; the daylight cut-out relay **I67** turns on the low beam headlamps with the ignition key turned to "MARCIA", and turns them off with the sidelights switch at position "I"; the fog lamps consensus relay **I65** supplies the foglamp line when the switch is at "I", and the rear fog guard line when the switch is at "II".
With the exception of these two components all else remains unchanged as for the other versions: indeed, this wiring diagram only shows the part concerning the supply, up to the relays that turn on the various circuits (**I64** - sidelights; **I49** - low beams; **I17** - fog lamps; **I25** - rear fog guards)
Reference should therefore be made to the corresponding sections for further details about the above-mentioned circuits.

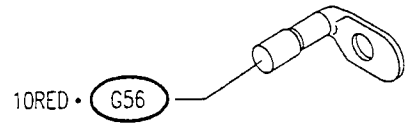
FUNCTIONAL DESCRIPTION

The sidelights circuit is directly connected to the key-operated supply as pins 6 and 7 of **connector J** of fuse box **G1** are bridged so that when the key is turned, the sidelights relay **I64** is energized (see "Sidelights").
This supply also reaches pin 87 of the daylight cut-out relay **I67**: when the relay is not energized (control lever unit switch **B68** in the rest position), the key-operated supply energizes relay **I49** thereby supplying the low beam headlamp circuit (see "Low beam and high beam headlamps").
Turning the switch of **B68** to position "I" ≥DC≤ - pin A7- relay **I67** -pin 85- is energized which therefore cuts off the supply for the low beam headlamps; contemporaneously, this supply crosses the foglamp consensus relay **I65** pin 87 and 30- thereby supplying the foglamp relay **I17**: in this way operating the foglamp switch **B10** the fog lamps are turned on (see "Foglamps and rear fog guards").
Turning the switch of **B68** still further to position "II" ≣D -pin A4- -pin 85- relay **I65** is energized, which cuts off the supply towards the foglamp circuit -the other pin 87- and diverts it to relay **I25** and the rear fog guard circuit - the other pin 87-, which may thus be turned on via the special switch on the lever unit **B68** (see "Foglamps and Rear Fog guards").

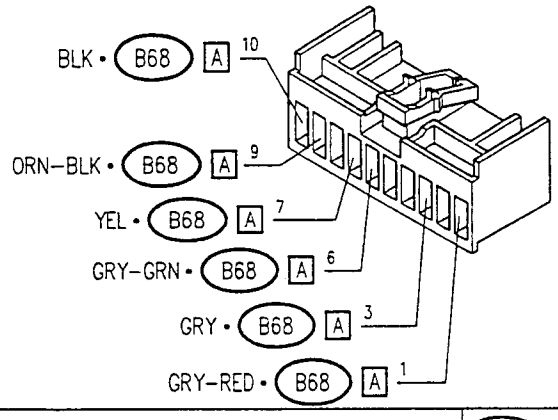
COMPONENTS AND CONNECTORS

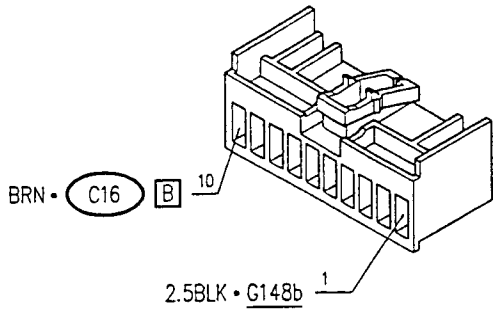
Lever unit	B68 A	Fusebox	G1



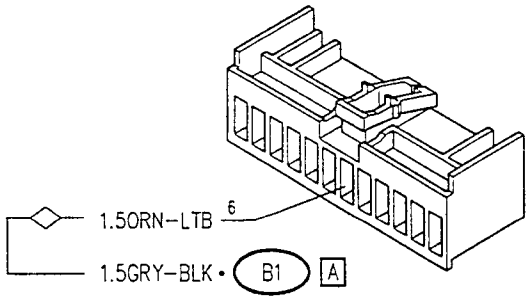


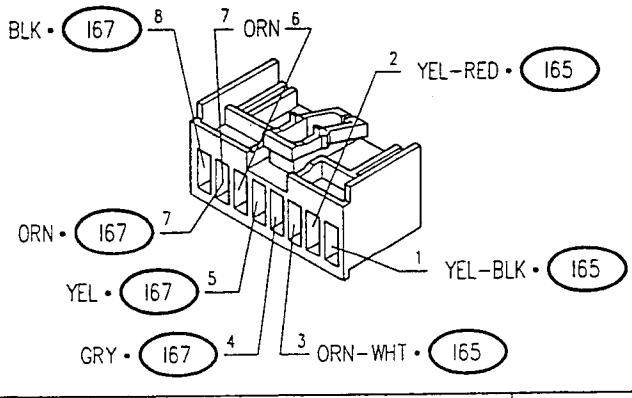
Fusebox	G1 F	Fusebox	G1 G



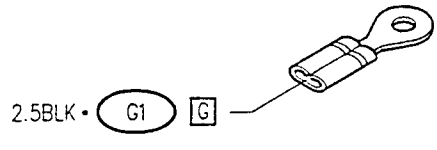


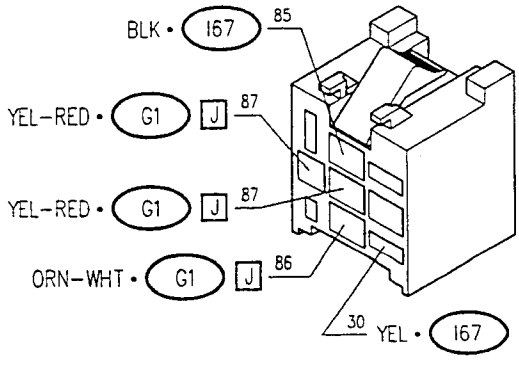
Fusebox	G1 H	Fusebox	G1 J





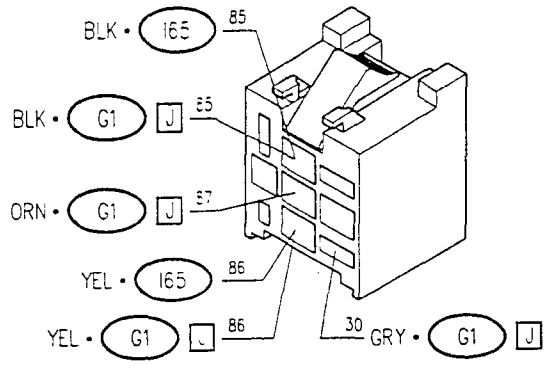
Earth under LH dashboard	G148b	Fog lamp consensus relay	I65





COMPONENTS AND CONNECTORS (cont.d)

Daylight cut-off relay	(167)



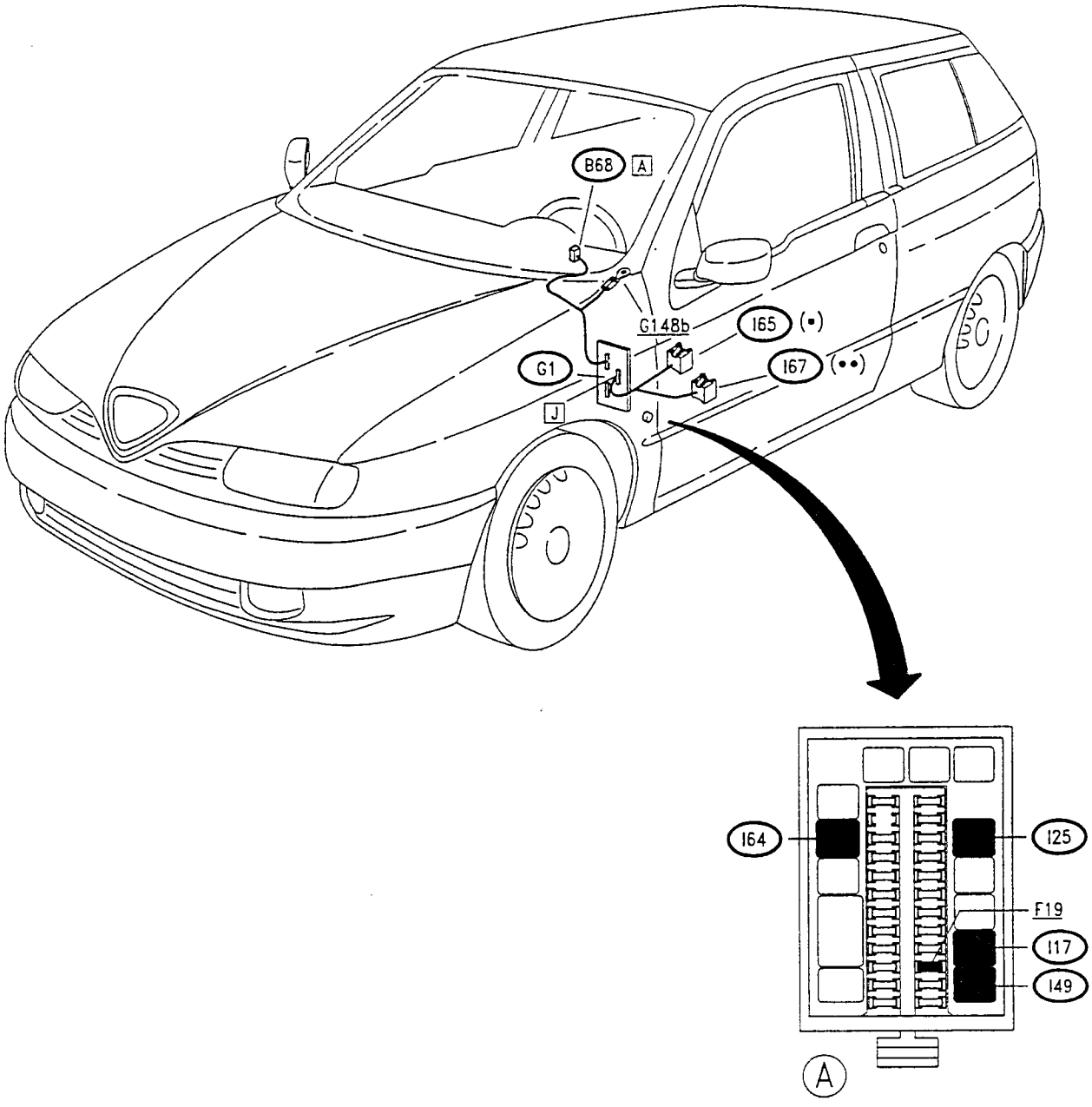
FAULT-FINDING TABLE

Note:
here **only the faults concerning the logic involving the dayights is considered.** For faults concerning the circuits of the sidelights, foglamps, rear fog guards, etc., refer to the FAULT-FINDING tables of the appropriate sections.

Fault	Component to be checked		
	(G1) [J] (*)	(167)	(165)
With ignition key turned: engagement of sidelights and low beams	•	•	
With sidelights on: engagement of sidelights and foglamps and low beams cut off	•	•	•
With low beam headlamps on: engagement of low beams, rear fog guards and fog lamps cut off	•		•

(*) **Specific bridge,** only for Markets with Daylights. For the other Markets a different bridge is installed: for further details, see the "Fusebox" section.

LOCATION OF COMPONENTS



(•) green base

(••) green base

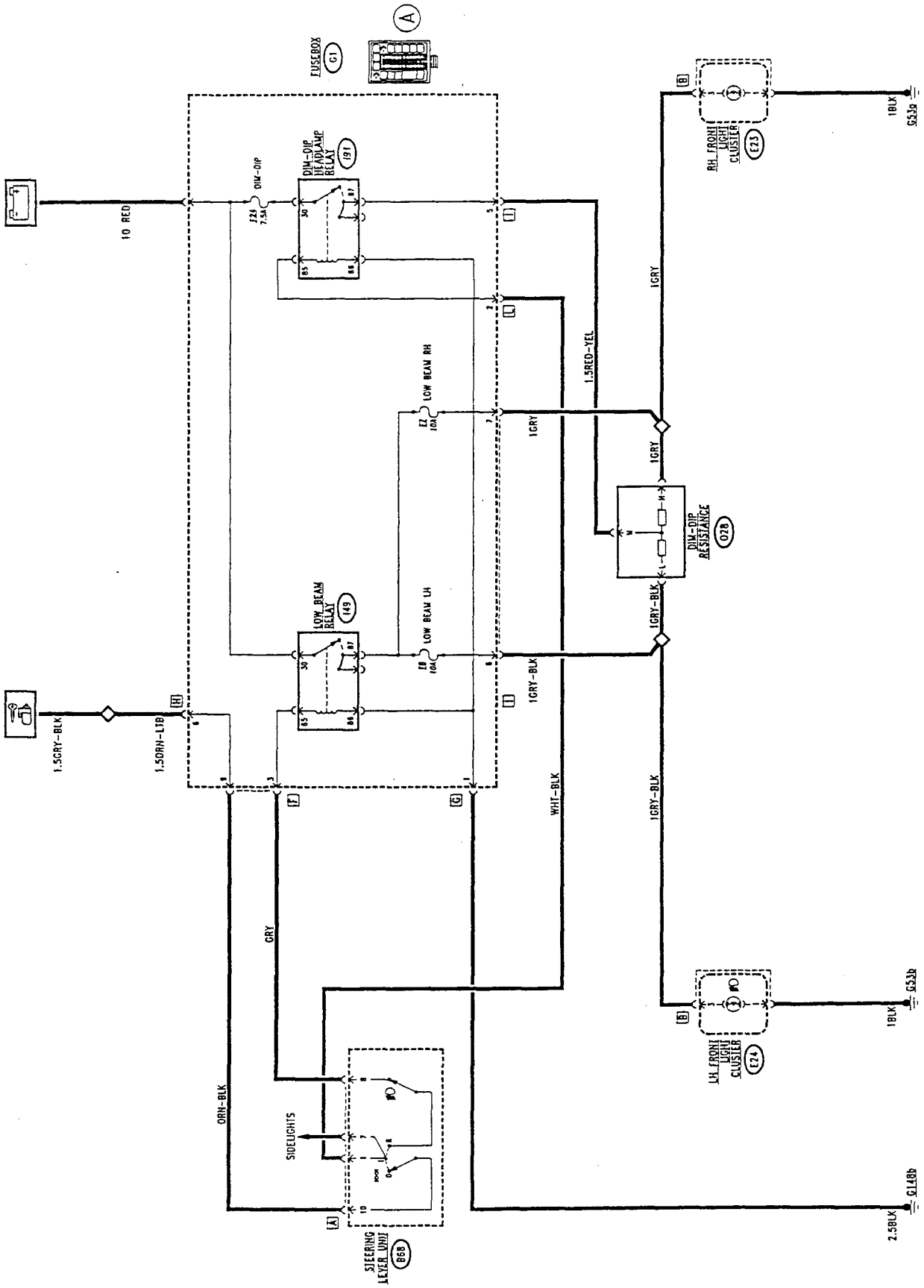
DIMMED LOW BEAMS ("DIM-DIP" DEVICE)

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CHECKING COMPONENTS 7-7

N.B.: for certain Markets only

WIRING DIAGRAM



GENERAL DESCRIPTION

Certain versions, of the car, specific for some Markets, are fitted with the "DIM-DIP" device.

In compliance with the laws of certain countries, this device enables two different levels of luminosity of the low beam headlamps: the first level (dimmed light) is turned on together with the sidelights, the second level (maximum luminosity) are the true and proper low beam lamps.

The device comprises a relay which supplies the lamps through a resistance when the sidelights are on, consequently reducing the intensity of the bulbs.

The normal circuit for the low beams by-passes this device and operates normally, as in the other versions (see the section "Low beam and high beam headlamps").

A special fuse protects the supply line for the "DIM-DIP" device.

FUNCTIONAL DESCRIPTION

The circuit of the "DIM-DIP" device is regulated by the special "DIM-DIP" relay **I91**, located in the fusebox **G1**.

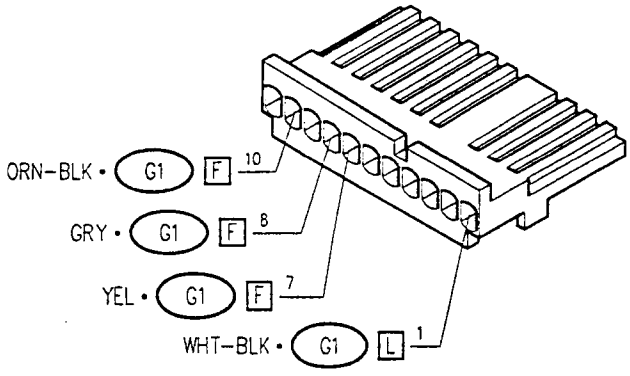
The relay is supplied by battery voltage through fuse **F24** which protects the whole line.

Moving the switch of the lever unit **B68** to position ≫D◇≪ - sidelights - the coil of relay **I91** is supplied which is thus energized: this way, in addition to the sidelights also the line for the low beam headlamps **E24** (left) and **E24** (right) is supplied through the **additional "DIM-DIP" resistance O28** : this way the brightness of the lamps is dimmed.

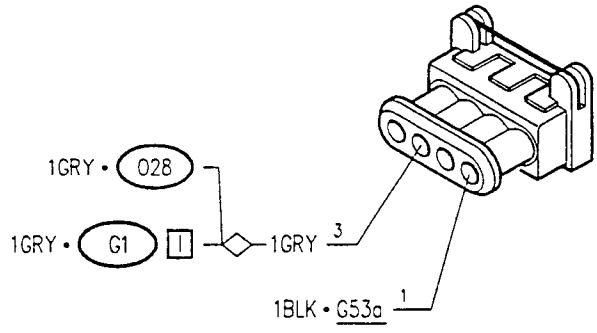
Moving the switch of the lever unit **B68** to position ≫D - low beams - the coil of relay **I49** of fusebox **G1** is supplied, sending the supply directly to the headlamps **E24** and **E23**, by-passing resistance **O28**, thereby obtaining the complete brightness of the headlamps (see the section "High beam and low beam headlamps").

COMPONENTS AND CONNECTORS

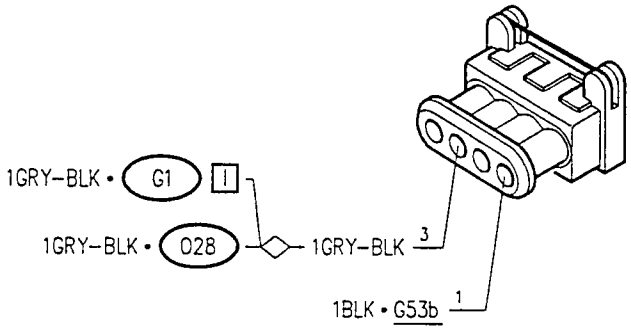
Lever unit	B68 A



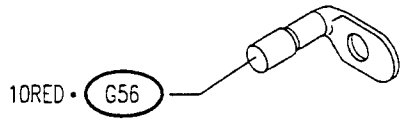
RH front light cluster	E23 B



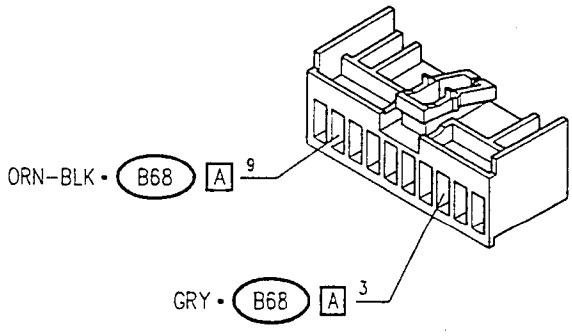
LH front light cluster	E24 B



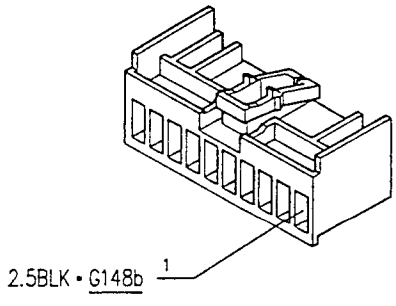
Fusebox	G1



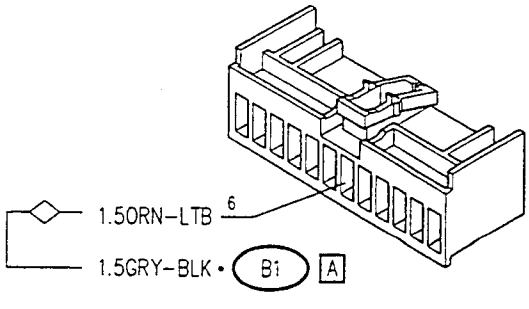
Fusebox	G1 F



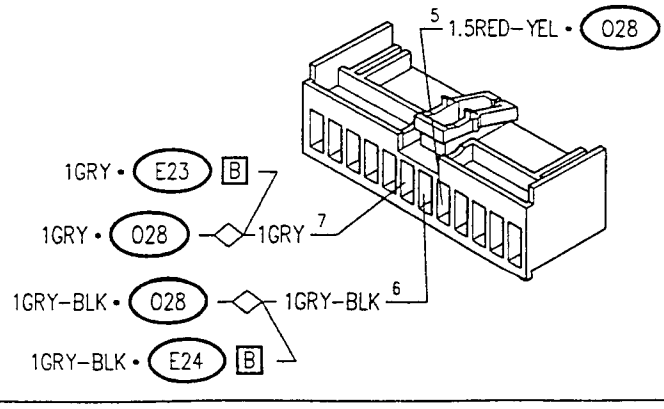
Fusebox	G1 G



Fusebox	G1 H

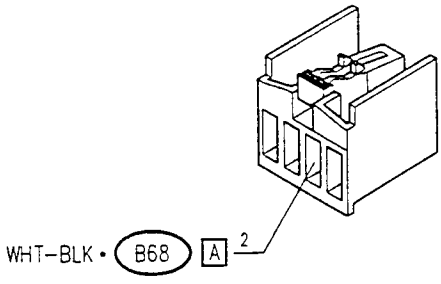


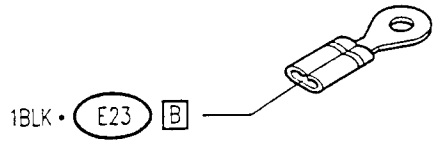
Fusebox	G1 I



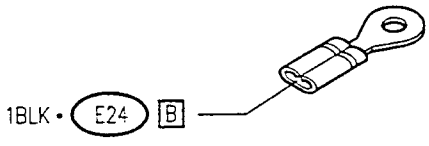
COMPONENTS AND CONNECTORS (cont.d)

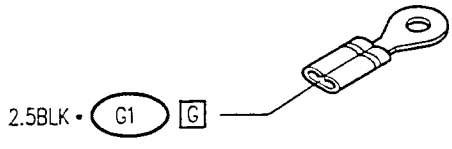
Fusebox	G1 L	RH engine compartment earth	G53a



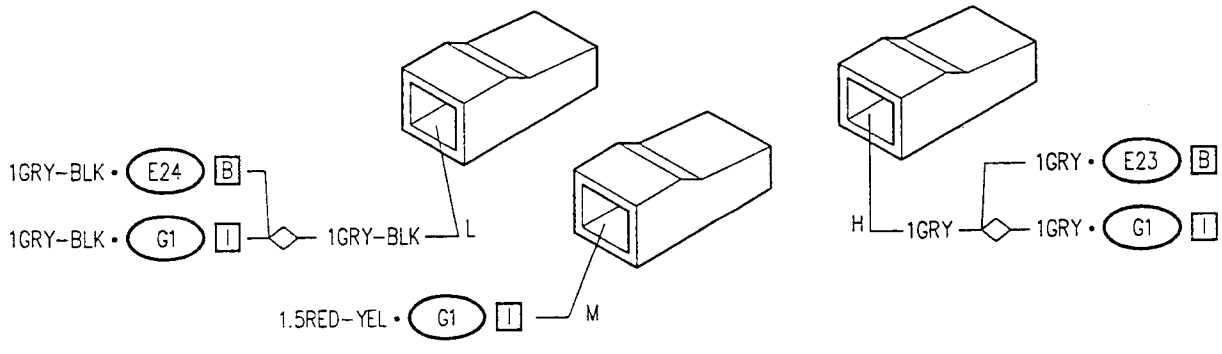


LH engine compartment earth	G53b	Earth under LH dashboard	G148b

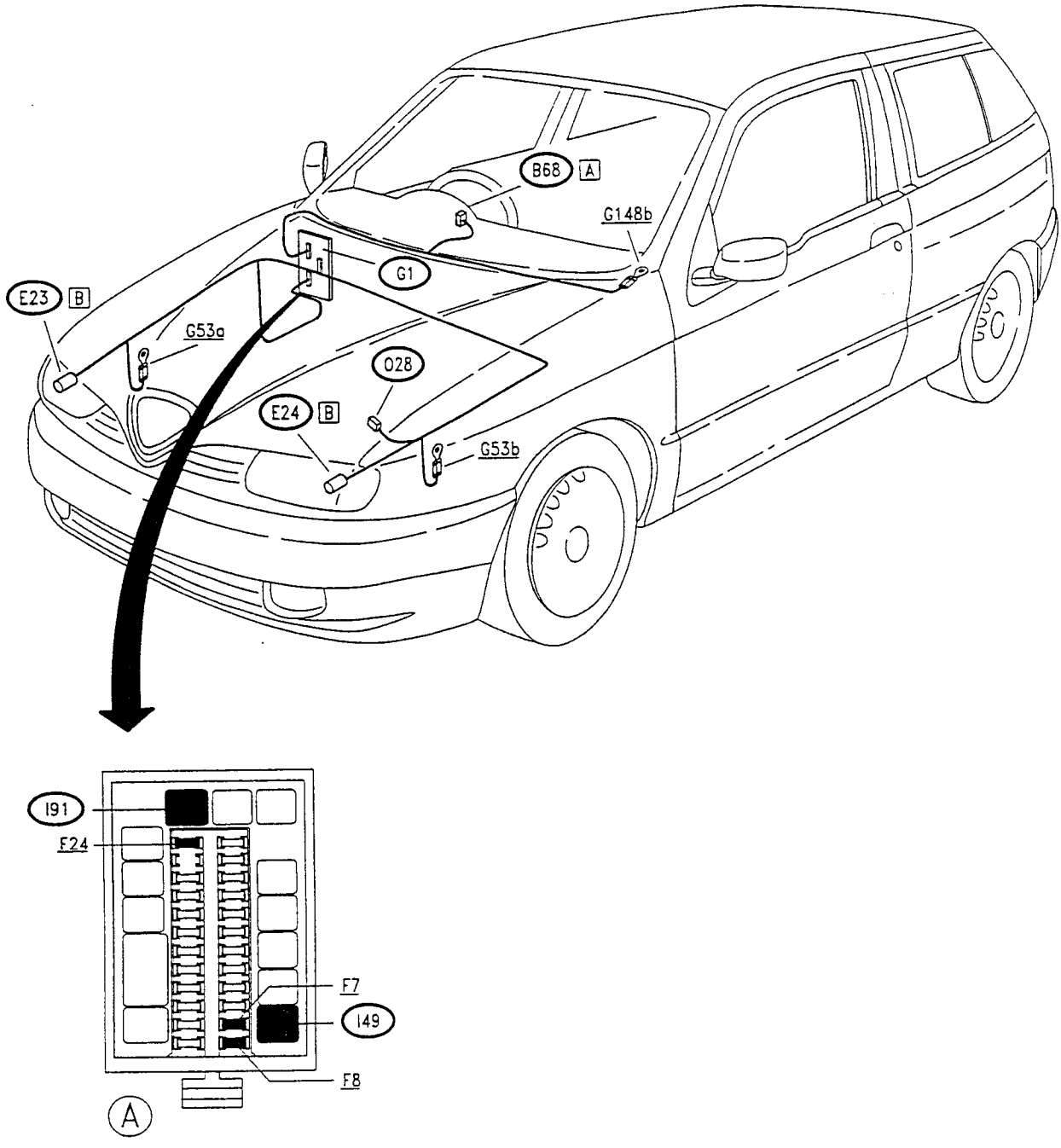




DIM-DIP resistance	O28



LOCATION OF COMPONENTS

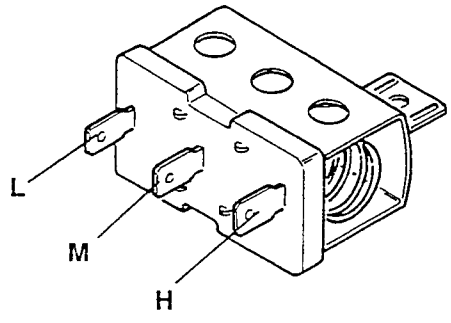


FAULT-FINDING TABLE

Fault	Component to be checked								
	F7	F8	F24	(E23)	(E24)	(O28)	(I91)	(I49)	(B68)
Both low beam lamps, in any case									•
Both low beam lamps dimmed			•			•	•		
Both low beam lamps, with full brightness								•	
RH low beam lamp, with full brightness	•			•					
LH low beam lamp, dimmed				•					
LH low beam lamp, with full brightness		•			•				
LH low beam lamp, dimmed					•				

CHECKING COMPONENTS

Additional "DIM-DIP" resistance (028)



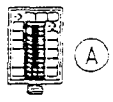
SPECIFICATIONS	
Resistance between terminals L-M or M-H	1.7 ± 0.1 Ω
Resistance between terminals L-H	3.4 ± 0.1 Ω

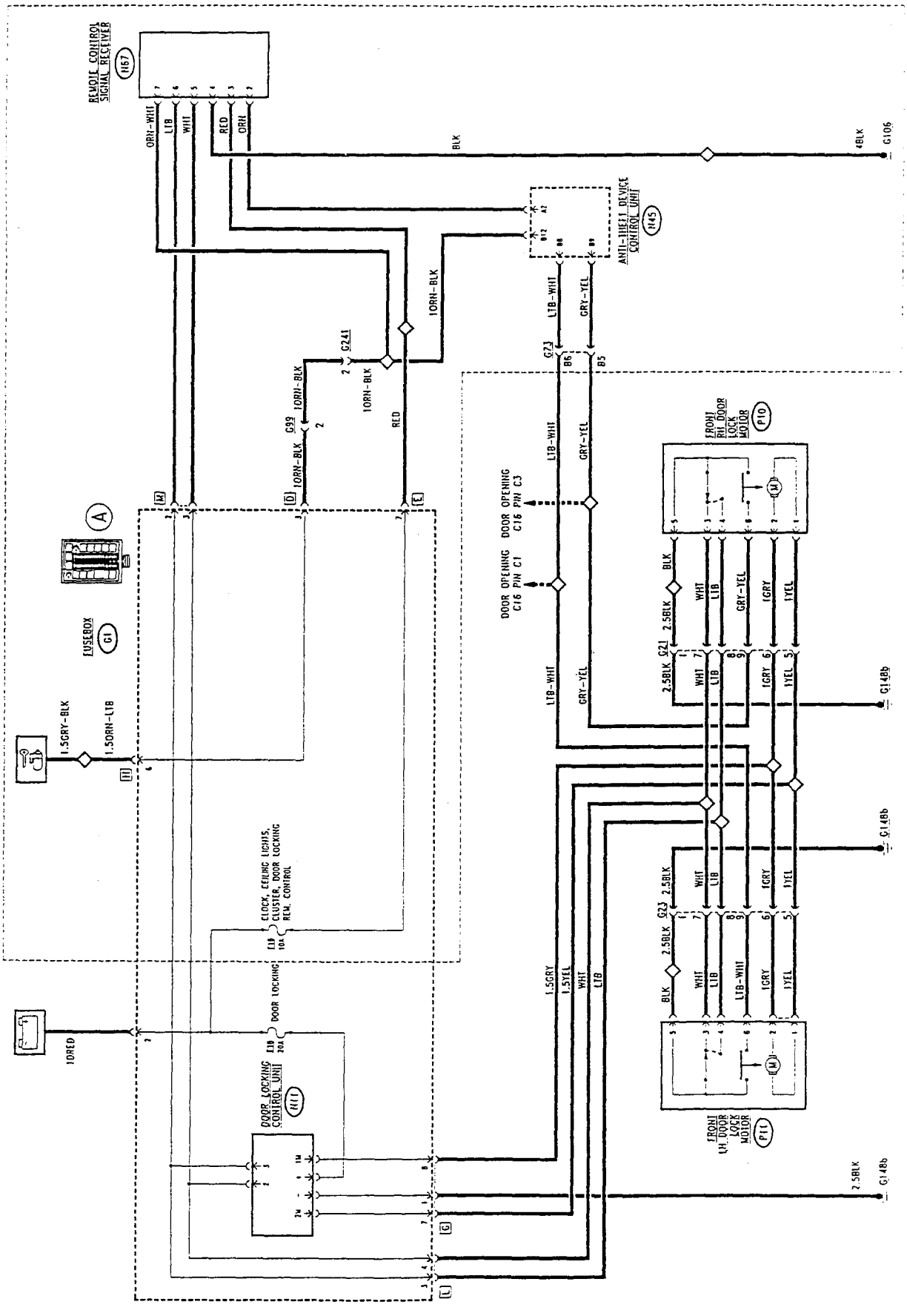
DOOR LOCKING SYSTEM

INDEX

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FAULTFINDING TABLE 21-10
CHECKING COMPONENTS 21-10

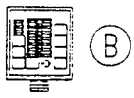
WIRING DIAGRAM

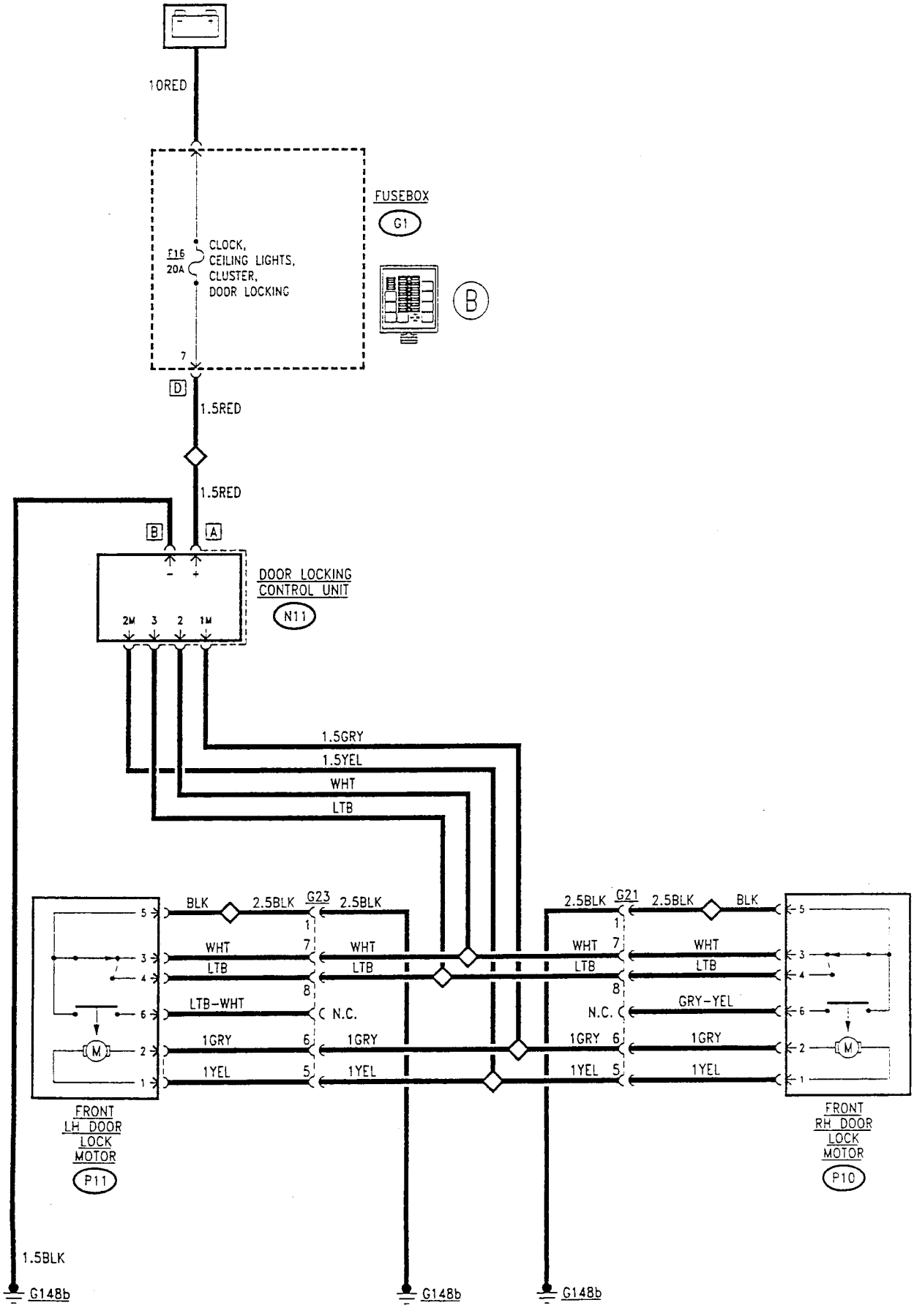




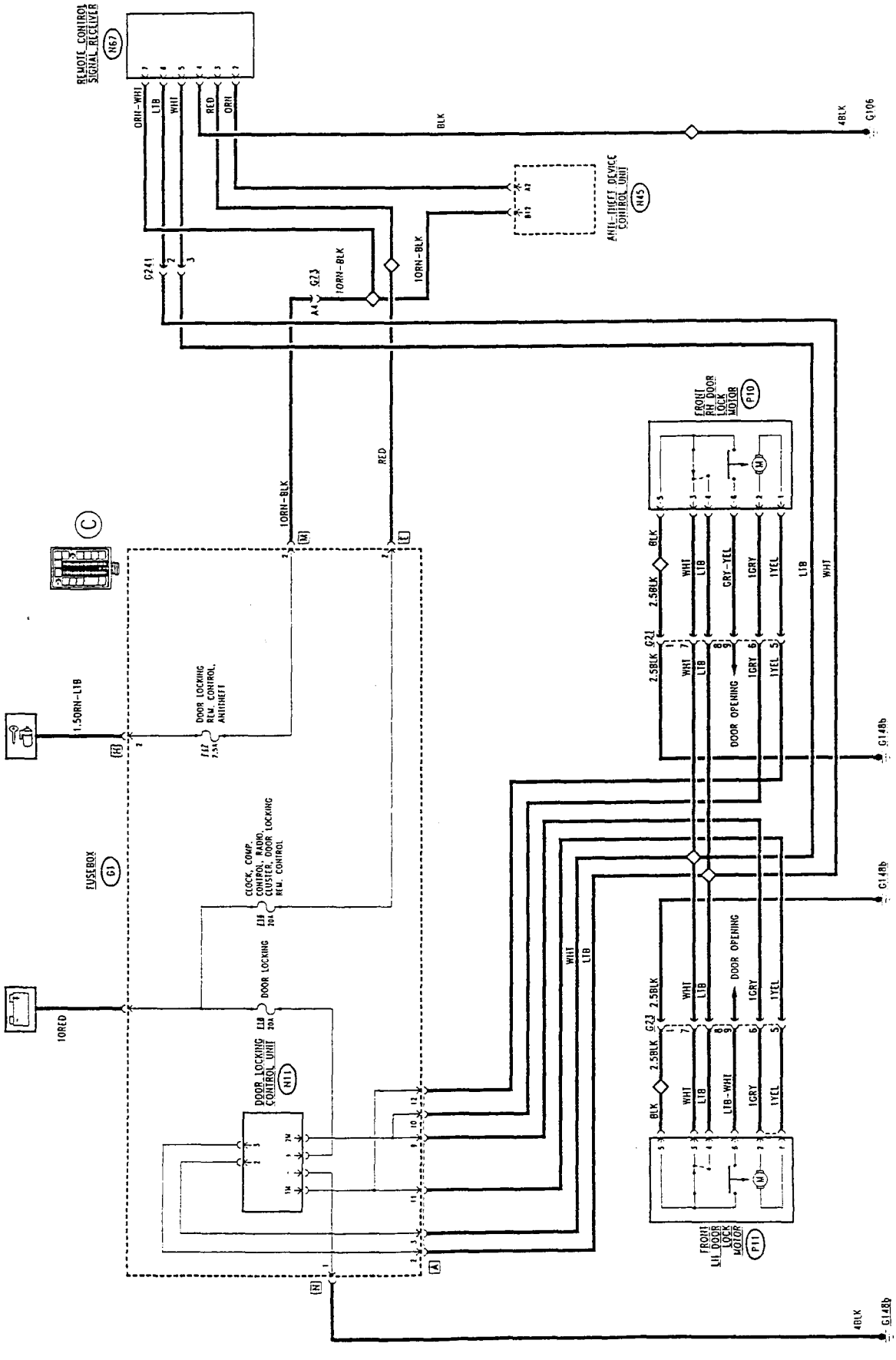
(*) only for versions with anti-theft device

WIRING DIAGRAM





WIRING DIAGRAM



GENERAL DESCRIPTION

The door locking system comprises an electronic control unit which controls and commands the door locks; each lock comprises a gear motor for locking/releasing the door lock, a control switch and a switch signalling that the doors are open.
The latter is used by the Check Panel (see "Doors open signalling") and by the anti-theft device (see "Antitheft device").
The gear motors are both operated simultaneously by acting on one of the control switches either from inside through the knobs or from the outside using the key.

NOTE: the control unit logic comprises a series of check and security operations:

- if the power supply is cut off, the locked doors are not released and they will only open when the supply has been restored;
- during release, if one of the control switches is mechanically impeded, release is cut off;
- if a failure causes the supply to the motors to last for over 4 seconds, this supply is cut off (only version for fusebox "A" and "C");
- if several opening/closing commands are received by the control unit from the key, only the last one to be sent will be considered;
- in the event of contrary commands (e.g. one with the key and one with the inside knob) the control unit will oscillate: oscillation ends after 8 consecutive commands (only for version for fusebox "A" and "C").

N.B.: In the **versions with anti-theft device** the door locking device is also operated via the remote control which works in the same way as manual locking/releasing. For further details see "Anti-theft device".

FUNCTIONAL DESCRIPTION

The door lock control unit **N11** is located in fusebox **G1** (fusebox "A" and "C") or on the bracket next to the fusebox (fusebox "B").
It is supplied by the battery voltage (pin +) through fuse **F18** (fusebox "A" and "C") or by fuse **F16** (fusebox "B"), while it is connected to earth (pin -).

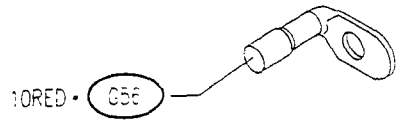
It receives an earth signal at pins 2 and 3 which represents the locking or release command leading from the control switches of the right front lock **P10** and the left one **P11**:

- **locking signal**: if the earth passes from pin 2 to pin 3;
- **releasing signal**: viceversa from pin 3 to pin 2.

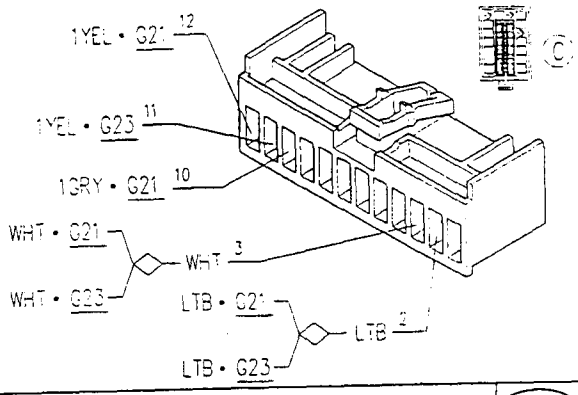
The logic of the control unit **N11** carries out the checks mentioned previously and sends the locking signal (pin 2M: 12V and pin 1M: earth) or releasing signal (pin 1M: 12V and pin 2M: earth) simultaneously to the door lock gear motors **P10** and **P11**.

COMPONENTS AND CONNECTORS

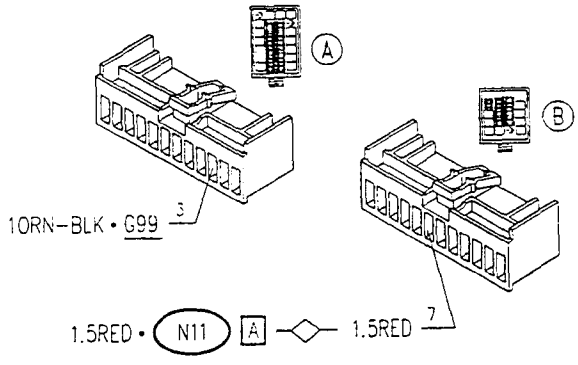
Fusebox G1



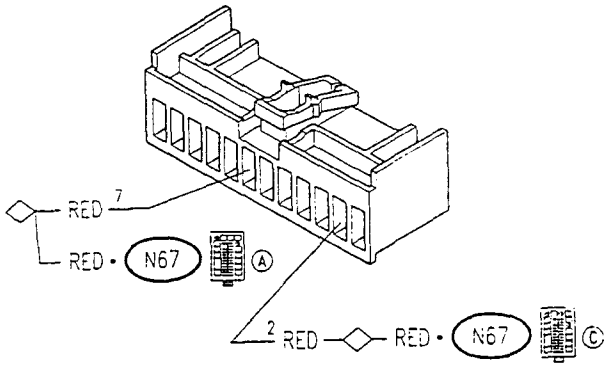
Fusebox G1 A



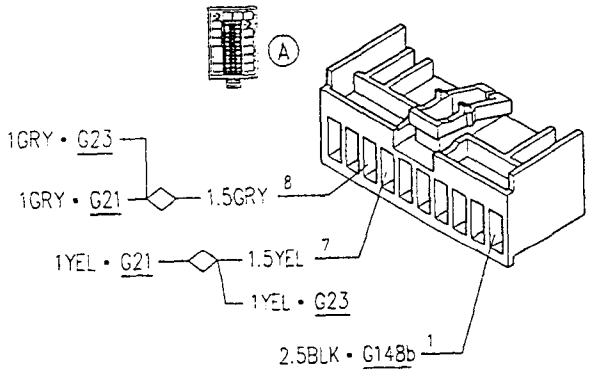
Fusebox G1 D



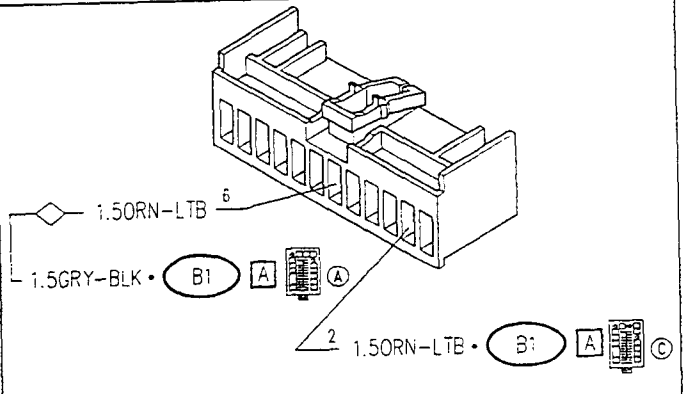
Fusebox G1 E



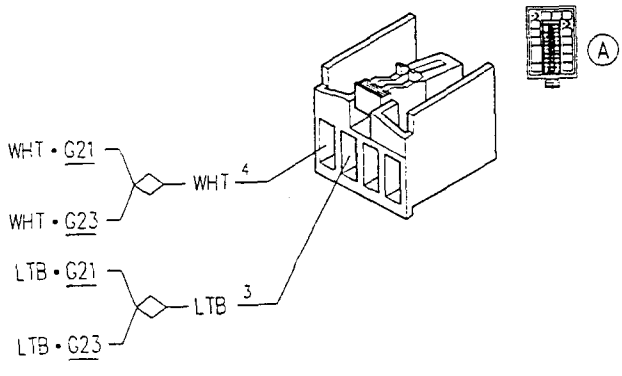
Fusebox G1 G



Fusebox G1 H

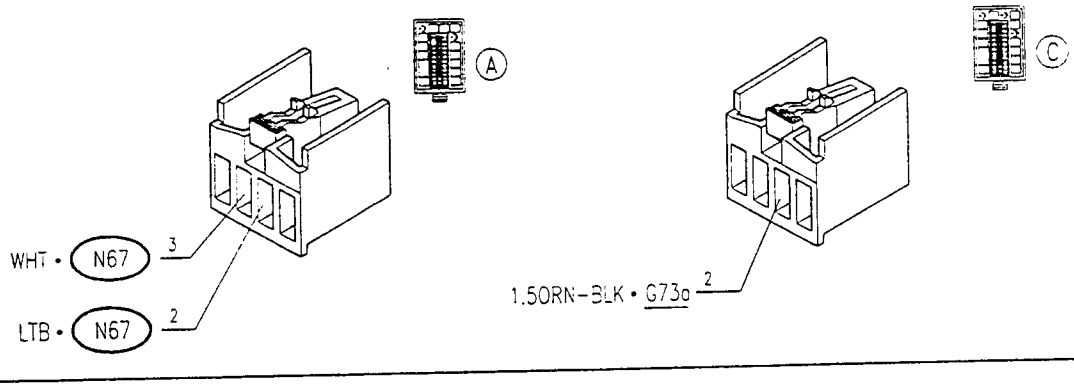


Fusebox G1 L

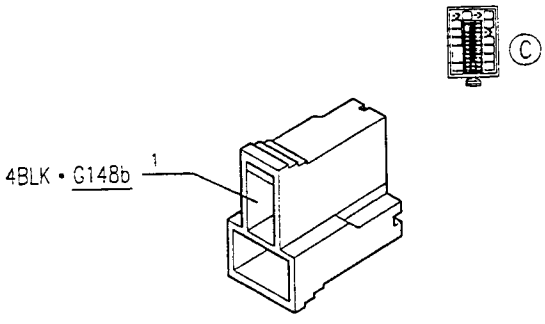


COMPONENTS AND CONNECTORS (cont.d)

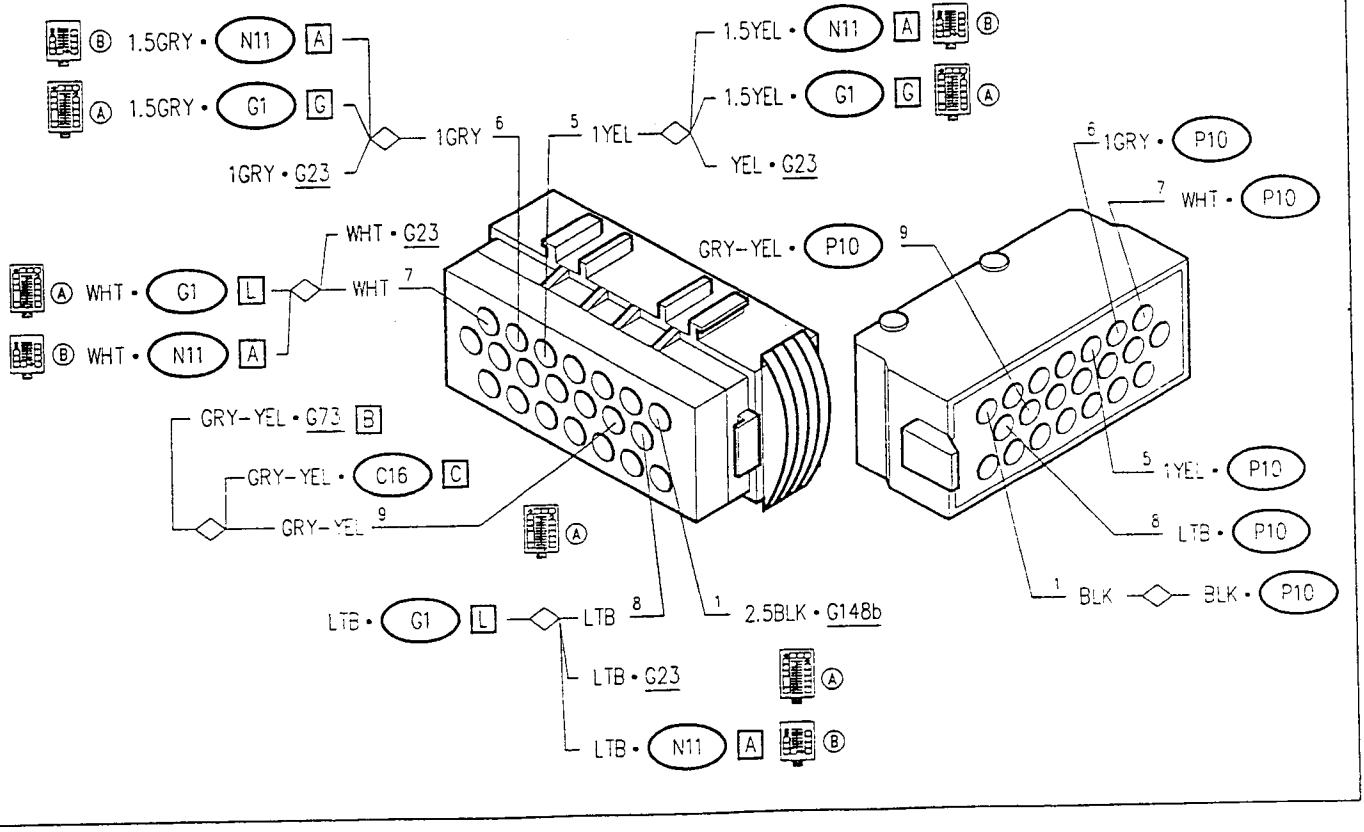
Fusebox — G1 M



Fusebox — G1 N

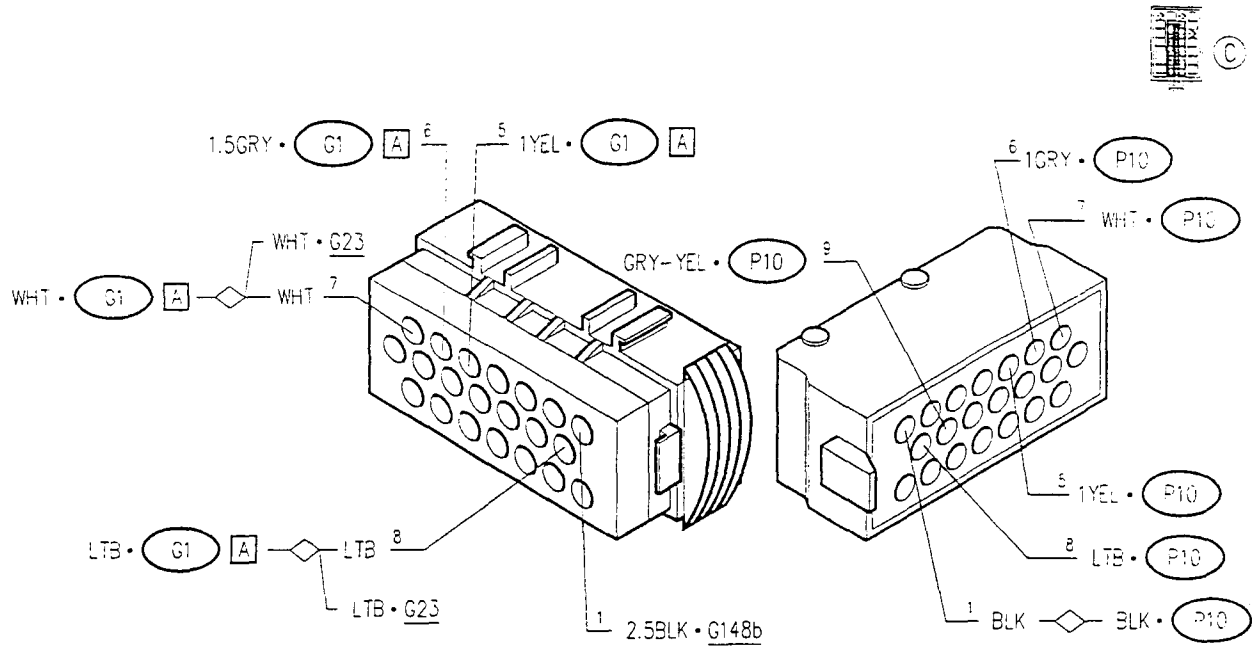


RH front door wiring connector — G21

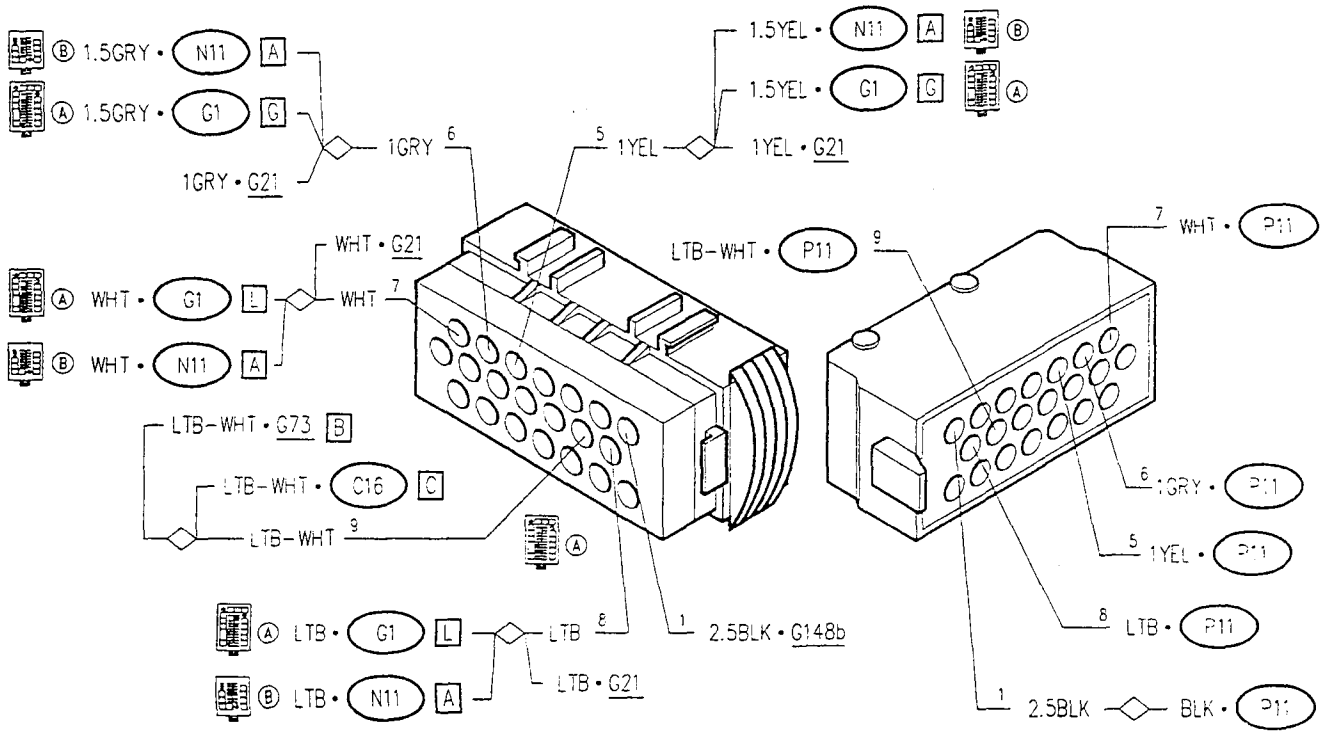


COMPONENTS AND CONNECTORS (cont.d)

RH front door wiring connector — G21

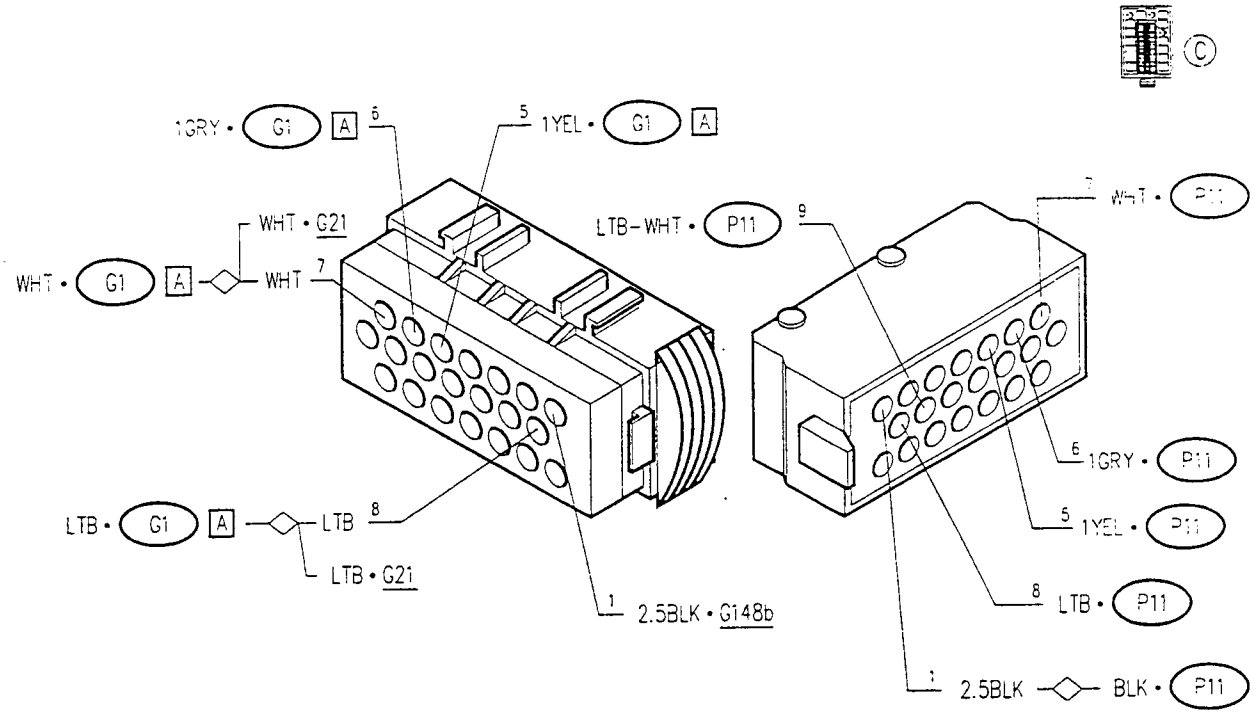


LH front door wiring connector — G23

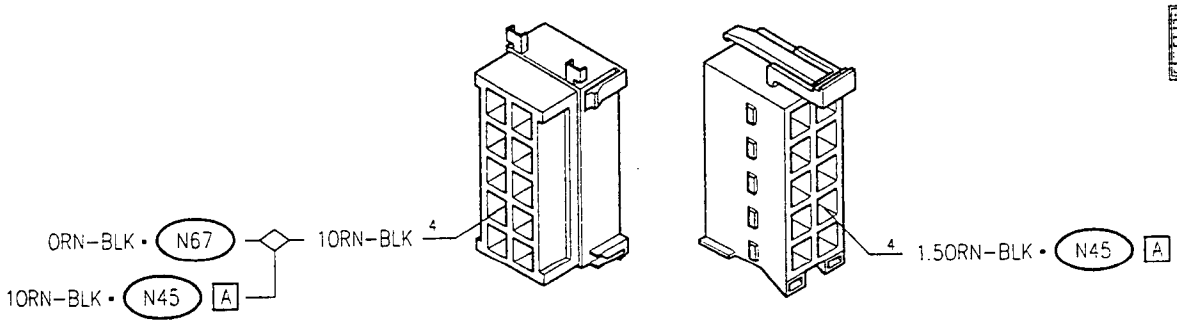


COMPONENTS AND CONNECTORS (cont.d)

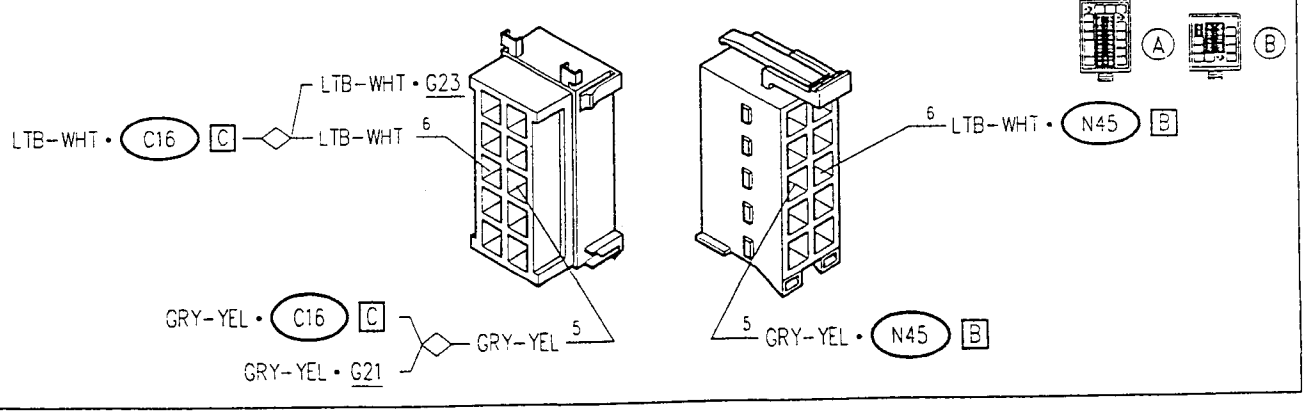
LH front door wiring connector	G23



Rear services connector	G73 A

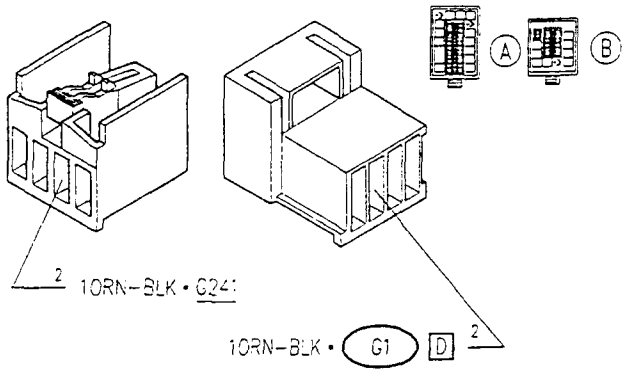


Rear services connector	G73 B

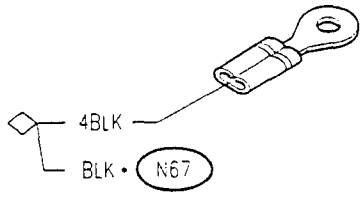


COMPONENTS AND CONNECTORS (cont.d)

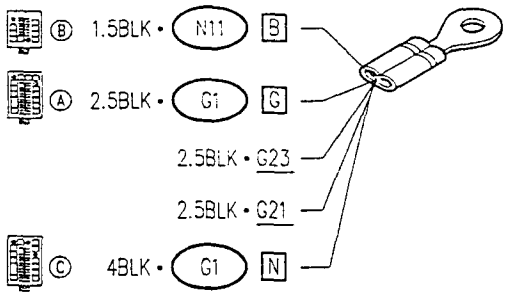
Connector for dashboard wiring/engine wiring	G99



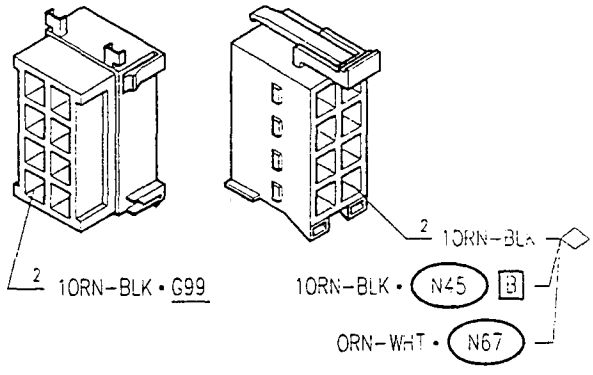
Seat crossmember earth	G106



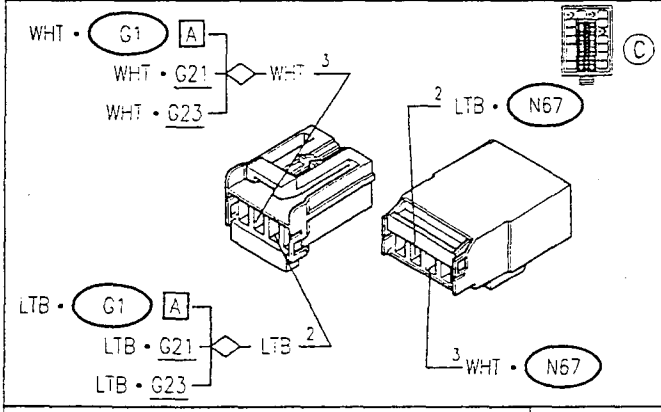
Earth under LH dashboard	G148b



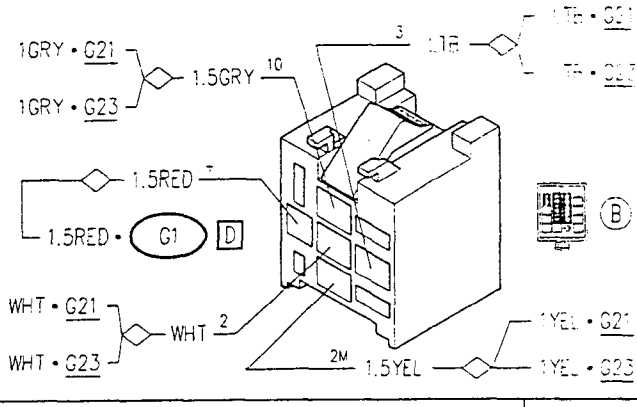
Anti-theft device wiring connector	G241



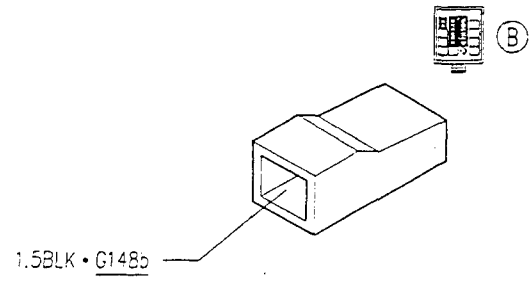
Anti-theft device wiring connector	G241



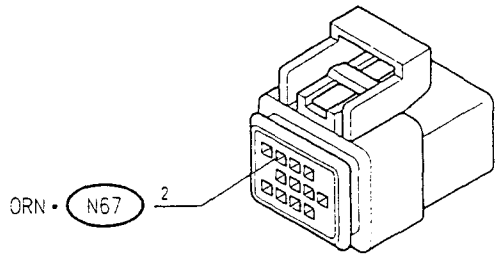
Door lock control unit	N11 A



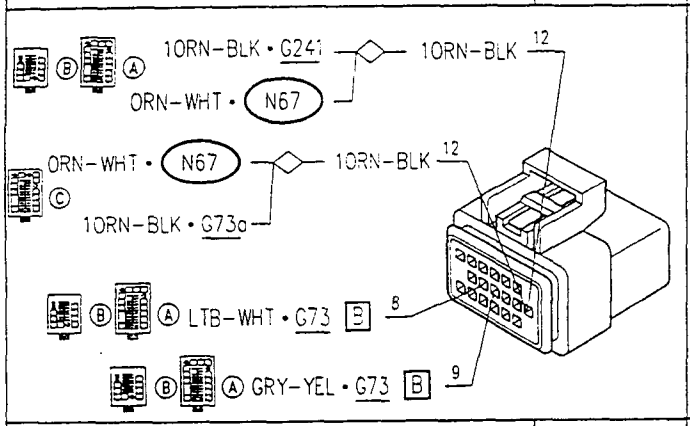
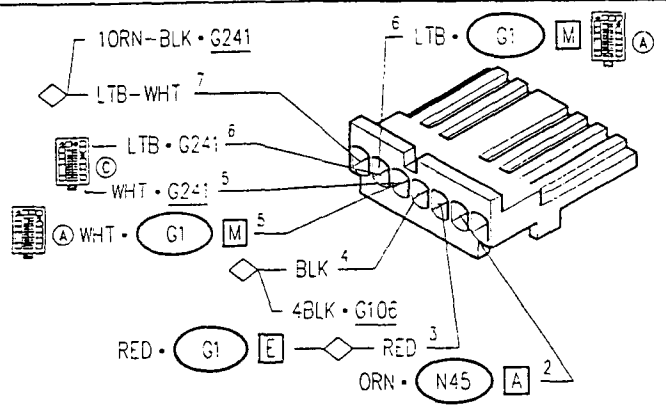
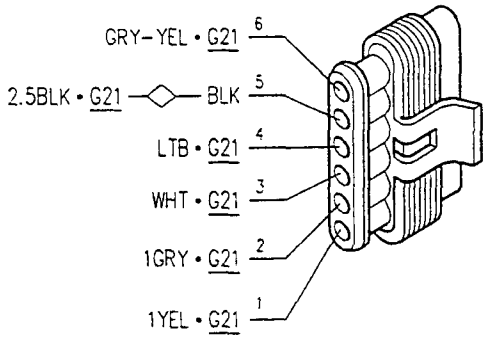
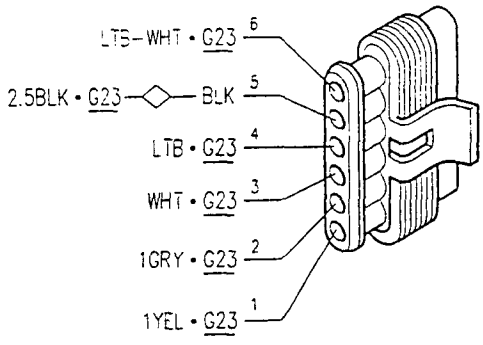
Door lock control unit	N11 B



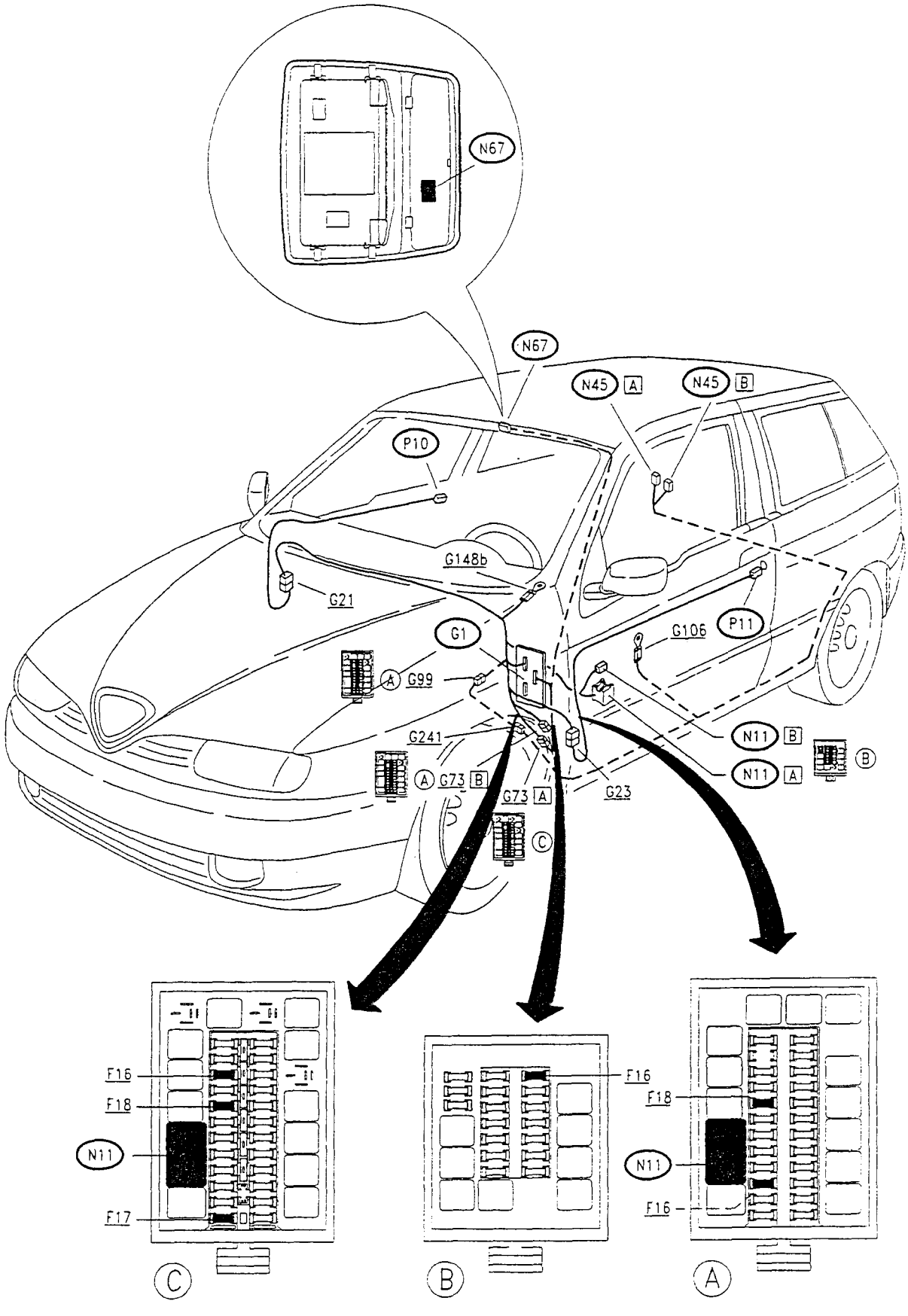
Anti-theft device control unit	N45 A



COMPONENTS AND CONNECTORS (cont.d)

Anti-theft device control unit	N45 B	Remote control signal receiver	N67
			
RH front door lock motor	**P10**	**LH front door lock motor**	**P11**
			

LOCATION OF COMPONENTS



– – – only for versions with anti-theft device

FAULTFINDING TABLE

CAUTION:
In the event of a mechanical failure on one of the door lock devices integrated with the lock, the control unit safety logic makes **the lock itself stay open**. In the unlikely event that the doors stay shut and locked, it is however still possible to open the lock manually: using the key from outside or raising the knob from inside.

N.B.: cutting off the supply does not "unlock" locked doors!! Locked doors will only open when the supply is received again.

Failure	Component to be checked				
	F16 (B)	F18 (A)	(N11)	(P10)	(P11)
Whole door locking system	•	•	•		
LH front door					•
RH front door				•	
Key not working in the LH front door			•		•
Key not working in the RH front door			•	•	

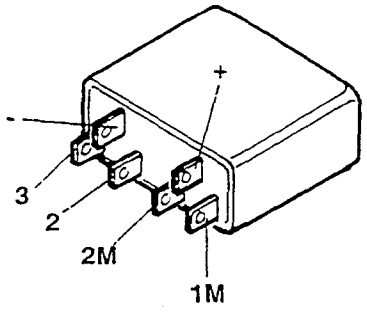
(A) Only fusebox "A"

(B) Only fusebox "B"

CHECKING COMPONENTS

Door locking control unit (N11)

(A)

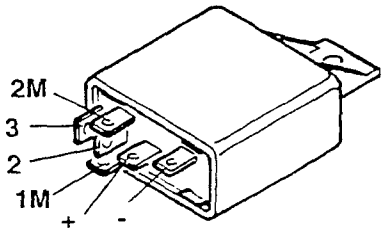


Checking the device:

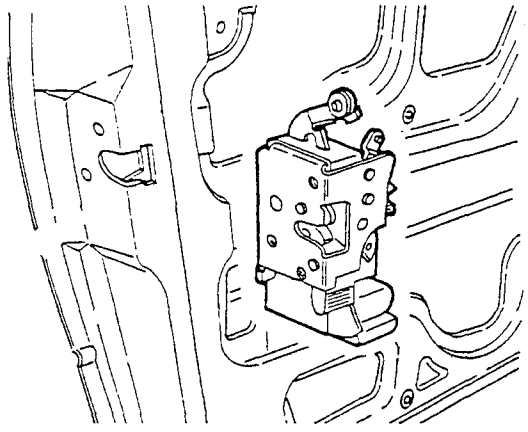
TEST A (for fusebox "A")

TEST B (for fusebox "B")

(B)



Door lock gear motor (P10) - (P11)



SPECIFICATIONS	
door closed	continuity between pin 5 and 6
door open	a.c. between pin 5 and 6
lock command	cuts off continuity between pin 5 and 3 and establishes it between pin 5 and 4
release command	cuts off continuity between pin 5 and 4 and establishes it between pin 5 and 3
motor operation	applying 12V between pins 1 and 2

CHECKING THE DOOR LOCK CONTROL UNIT (N11) (version for fusebox "A") — TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N11** and check on the base of fusebox **G1**: 12V between the + and - pins of **N11**	OK ▶	Carry out **step A2**
	OK ▶	Check fuse **F18** of fusebox **G1**. Check that **G1** is connected to earth: from pin 1 of connector G towards earth **G148b**
A2 CHECK LOCK/RELEASE COMMAND – Operate the door locking or release and check that an earth passes from pin 2 to pin 3 of **N11** or viceversa	OK ▶	Insert device **N11** on the base of **G1** and continue with **step A3**
	OK ▶	Restore the wiring between **N11** (**G1**) and the door lock motor (**P10** RH or **P11** LH) or change the latter
A3 CHECK LOCK/RELEASE ACTUATION – Operate the door lock or release device and check for 12V between pin 7 and 8 of connector G of fusebox **G1**	OK ▶	DEVICE **N11** IS WORKING PROPERLY: Check the door lock motor **P10** or **P11** and the corresponding connections
	OK ▶	Change device **N11**

CHECKING THE DOOR LOCK CONTROL UNIT (N11) (version for fusebox "B") — TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK VOLTAGE – Disconnect device **N11** and check on the base for 12V between the + and - pins of **N11**	OK ▶	Carry out **step B2**
	OK ▶	Check fuse **F16** of fusebox **G1**. Check the connection between **N11** and fusebox **G1**
B2 CHECK LOCK/RELEASE COMMAND SIGNAL – Operate the door lock or release and check for the passage of an earth signal from 2 to pin 3 of **N11** or viceversa	OK ▶	Insert device **N11** on the corresponding base and continue with **step B3**
	OK ▶	Restore the wiring between **N11** and the door lock motor (**P10** RH or **P11** LH) or change the latter
B3 CHECK ACTUATION OF LOCK/RELEASE – Operate the door lock or release and check for 12V between pin 1M and 2M of **N11**	OK ▶	DEVICE **N11** IS WORKING PROPERLY: Check the door lock motor **P10** or **P11** and the corresponding connections
	OK ▶	Change device **N11**

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REPAIR INSTRUCTIONS

ELECTRIC SYSTEM 55

ELECTRIC SYSTEM DIAGNOSIS 55

Sections 1 to 33

Alfa Romeo

PA493000000006

10-1996

UPDATE CHART

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UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
VOLUME III				
2 (9/1994)	145-146	-	Frontespice	
2 (9/1994)	145-146	Introd.	1	
11 (1/1999)	145-146	55	Indexl	
4 (5/1995)	145-146	55	Index II	
7 (12/1996)	145	55	2	
2 (9/1994)	145	55		2/1 to 2/2
11 (1/1999)	145	55		16/1 to 16/2
11 (1/1999)	145	55		18/1 to 18/2
10 (1/1998)	145	55	22/1 to 22/3	
4 (5/1995)	145	55		22/3
7 (12/1996)	145	55	22/4 to 22/6	
7 (12/1996)	145	55		22/7 to 22/8
7 (12/1996)	145	55	30	
7 (12/1996)	145	55		30/1 to 30/2
2 (9/1994)	145	55	37	
2 (9/1994)	145	55		38/1
4 (5/1995)	146	55	38/2	
7 (12/1996)	145	55		38/3 to 38/4
7 (12/1996)	145	55	40	
7 (12/1996)	145	55	43 to 44	
5 (9/1995)	145	55		44/1
7 (12/1996)	145	55	44/2	
11 (1/1999)	145	55		44/3 to 44/4
2(9/1994)	145	55		45 to 46
12 (2/1999)	145	55	Index	
10 (1/1998)	145	55-1	1	
4 (5/1995)	145	55-1	2	
3 (1/1995)	145	55-1	3 to 6	
2 (9/1994)	145	55-1	7	
3 (1/1995)	145	55-1	8	
4 (5/1995)	145	55-1	9 to 11	
6 (10/1996)	145	55-1	12	
10 (1/1998)	145	55-1	12/1	
8 (6/1997)	145	55-1	12/2	
6 (10/1996)	145	55-1	13 to 18	
12 (2/1999)	145	55-1	18/1 to 18/2	
12 (2/1999)	145	55-1	19	
9 (12/1997)	145	55-1	20 to 21	
12 (2/1999)	145	55-1	21/1	
10 (1/1998)	145	55-1		21/2
12 (2/1999)	145	55-1	21/3 to 21/4	
10 (1/1998)	145	55-1		21/5 to 21/6
10 (1/1998)	145	55-1	22	
12 (2/1999)	145	55-2	3 to 4	

UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
2 (9/1994)	145	55-2	5	
9 (12/1997)	145	55-2	6	
12 (2/1999)	145	55-2	6/1 to 6/2	
9 (12/1997)	145	55-2		6/3 to 6/4
6 (10/1996)	145	55-2	7	
2 (9/1994)	145	55-2	8	
8 (6/1997)	145	55-2	9	
9 (12/1997)	145	55-2	10	
10 (1/1998)	145	55-2	11	
12 (12/1999)	145	55-2	12 to 14	
9 (12/1997)	145	55-2	15	
10 (1/1998)	145	55-2	16	
12 (2/1999)	145	55-2	16/1	
9 (12/1997)	145	55-2		16/2
10 (1/1998)	145	55-2	17	
8 (6/1997)	145	55-3	1	
8 (6/1997)	145	55-3	4	
8 (6/1997)	145	55-3		4/1 to 4/2
6 (10/1996)	145	55-3	5 to 6	
6 (10/1996)	145	55-3	8	
6 (10/1996)	145	55-3	10 to 13	
6 (10/1996)	145	55-3	15	
10 (1/1998)	145	55-3	16 to 17	
8 (6/1997)	145	55-3	18	
12 (2/1999)	145	55-3	19 to 20	
9 (12/1997)	145	55-3	21	
8 (6/1997)	145	55-3		22 to 23
12 (2/1999)	145	55-3	24	
8 (6/1997)	145	55-3		25 to 26
10 (1/1998)	145	55-3	27	
8 (6/1997)	145	55-3	28	
10 (1/1998)	145	55-3	29	
10(1/1998)	145	55-4	1	
2 (9/1994)	145	55-4	2 to 7	
4 (5/1995)	145	55-4	8 to 9	
6 (10/1996)	145	55-4		9/1 to 9/2
6(10/1996)	145	55-4	10 to 12	
6 (10/1996)	145	55-4		12/1 to 12/2
6 (10/1996)	145	55-4	13	
9 (12/1997)	145	55-4	14 to 17	
10 (1/1998)	145	55-4	18	
10 (1/1998)	145	55-4		19 to 22
8 (6/1997)	145	55-5		2/1 to 2/2
8 (6/1997)	145	55-5	3	
8 (6/1997)	145	55-5	5 to 7	
8 (6/1997)	145	55-6		2/1 to 2/2
8 (6/1997)	145	55-6	3 to 7	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
13 (6/1999)	**145**	**55-6**	**8**	
8 (6/1997)	145	55-8	1	
6 (10/1996)	145	55-8	4	
6 (10/1996)	145	55-8		4/1
8 (6/1997)	145	55-8	4/2	
8 (6/1997)	145	55-8		4/3 to 4/4
8 (6/1997)	145	55-8	5 to 10	
8 (6/1997)	145	55-8		10/1 to 10/2
6 (10/1996)	145	55-8	11 to 12	
8 (6/1997)	145	55-10	1	
8 (6/1997)	145	55-10		2/1 to 2/2
8 (6/1997)	145	55-10	3	
8 (6/1997)	145	55-10	6 to 8	
8 (6/1997)	145	55-10		8/1 to 8/2
13 (6/1999)	**145**	**55-10**	**9**	
6 (10/1996)	145	55-11	2	
8 (6/1997)	145	55-11		2/1 to 2/2
8 (6/1997)	145	55-11	4	
8 (6/1997)	145	55-11	6	
8 (6/1997)	145	55-12	1	
8 (6/1997)	145	55-12		2/1 to 2/2
8 (6/1997)	145	55-12	3 to 8	
8 (6/1997)	145	55-12		8/1 to 8/2
2 (9/1994)	145	55-13	2	
8 (6/1997)	145	55-13		2/1 to 2/2
8 (6/1997)	145	55-13	3 to 5	
8 (6/1997)	145	55-14	1	
6 (10/1996)	145	55-14	2	
10 (1/1998)	145	55-14	2/1	
8 (6/1997)	145	55-14		2/2
6 (10/1996)	145	55-14	3	
10 (1/1998)	145	55-14	4	
9 (12/1997)	145	55-14	5	
10 (1/1998)	145	55-14	6 to 7	
8 (6/1997)	145	55-15		2/1 to 2/2
8 (6/1997)	145	55-15	3 to 5	
6 (10/1996)	145	55-16	1	
6 (10/1996)	145	55-16	4	
8 (6/1997)	145	55-16	4/1 to 4/2	
8 (6/1997)	145	55-16	5 to 8	
8 (6/1997)	145	55-16		8/1 to 8/2
8 (6/1997)	145	55-16	9	
7 (12/1996)	145	55-16	11	
12 (2/1999)	145	55-17	1 to 2	
6 (10/1996)	145	55-17	3 to 4	
12 (2/1999)	145	55-17	4/1.to 4/4	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
12 (2/1999)	145	55-17	5 to 7	
10(1/1998)	145	55-17	8	
4 (5/1995)	145	55-17	9 to 10	
12 (2/1999)	145	55-17	10/1	
10 (1/1998)	145	55-17		10/2
12 (2/1999)	145	55-17	10/3	
10 (1/1998)	145	55-17		10/4
6 (10/1996)	145	55-17	11	
13 (6/1999)	**145**	**55-17**	**12**	
13 (6/1999)	**145**	**55-17**	**12/1**	
10 (1/1998)	145	55-17	12/2	
13 (6/1999)	**145**	**55-17**	**13**	
10 (1/1998)	145	55-17	14	
13 (6/1999)	**145**	**55-17**	**14/1 to 14/2**	
12 (2/1999)	145	55-17	16	
12 (2/1999)	145	55-17	16/1	
9 (12-1997)	145	55-17	16/2	
8 (6/1997)	145	55-17	17 to 18	
13 (6/1999)	**145**	**55-17**	**19**	
10 (1/1998)	145	55-17	20	
13 (6/1999)	**145**	**55-17**	**21 to 25**	
13 (6/1999)	**145**	**55-17**		**26**
8(6/1997)	145	55-18	1	
8 (6/1997)	145	55-18	4	
8 (6/1997)	145	55-18		4/1 to 4/2
8 (6/1997)	145	55-18	7	
6 (10/1996)	145	55-18	8	
8 (6/1997)	145	55-18		8/1 to 8/2
8 (6/1997)	145	55-18	9 to 11	
8 (6/1997)	145	55-19		2/1 to 2/1
8 (6/1997)	145	55-19	3 to 4	
8 (6/1997)	145	55-19	6	
10 (1/1998)	145	55-20	2/1	
8 (6/1997)	145	55-20		2/2
8 (6/1997)	145	55-20	3 to 4	
10 (1/1998)	145	55-20	5	
8 (6/1997)	145	55-21	1	
6 (10/1996)	145	55-21	3	
8 (6/1997)	145	55-21	4	
8 (6/1997)	145	55-21		4/1 to 4/2
8 (6/1997)	145	55-21	5 to 8	
8 (6/1997)	145	55-21		8/1 to 8/2
8 (6/1997)	145	55-21	9	
5 (9/1995)	145	55-22	2	
8 (6/1997)	145	55-22		2/1 to 2/2
8 (6/1997)	145	55-22	3 to 6	

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			SOBST.	ADDED
8 (6/1997)	145	55-23	1	
6 (10/1996)	145	55-23	2 to 3	
8 (6/1997)	145	55-23	4	
8 (6/1997)	145	55-23		4/1 to 4/2
8 (6/1997)	145	55-23	5 to 9	
6 (10/1996)	145	55-24	1	
3 (1/1995)	145	55-24	2	
6 (10/1996)	145	55-24		2/1
10 (1/1998)	145	55-24	2/2	
8 (6/1997)	145	55-24	3	
10 (1/1998)	145	55-24	4	
8 (6/1997)	145	55-24	5 to 6	
8 (6/1997)	145	55-24		6/1 to 6/2
3 (1/1995)	145	55-24	7	
6 (10/1996)	145	55-24	8	
8 (6/1997)	145	55-25		2/1 to 2/2
8 (6/1997)	145	55-25	3	
8 (6/1997)	145	55-25	5	
6 (10/1996)	145	55-26	1	
2 (9/1994)	145	55-26	2	
2 (9/1994)	145	55-26	4 to 7	
2 (9/1994)	145	55-26	9 to 11	
2 (9/1994)	145	55-26	13 to 15	
2 (1/1995)	145	55-26	17	
2 (9/1994)	145	55-26	19	
2 (1/1995)	145	55-26	25 to 26	
9 (12/1997)	145	55-27	1	
13 (6/1999)	**145**	**55-27**	**2**	
6 (10/1996)	145	55-27		2/1
9 (12/1997)	145	55-27	2/2 to 2/4	
9 (12/1997)	145	55-27	3	
13 (6/1999)	**145**	**55-27**	**4**	
13 (6/1999)	**145**	**55-27**	**4/1**	
9 (12/1997)	145	55-27	4/2	
9 (12/1997)	145	55-27	**4/3 and 4/4 to be eliminated**	
12 (2/1999)	145	55-27	5	
13 (6/1999)	**145**	**55-27**	**6 to 8**	
9 (12/1997)	145	55-27	9 to 10	
6 (10/1996)	145	55-27	11	
12 (2/1999)	145	55-27A		1
13 (6/1999)	**145**	**55-27A**	**2 to 5**	
12 (2/1999)	145	55-27A		6
13 (6/1999)	**145**	**55-27A**	**7 to 9**	
12 (2/1999)	145	55-27A		10
2 (9/1994)	145	55-28	1	
8 (6/1997)	145	55-28		2/1 to 2/2

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	145	55-28	3 to 8	
8 (6/1997)	145	55-29		2/1 to 2/2
8 (6/1997)	145	55-29	3 to 6	
2 (1/1995)	145	55-30	1 to 3	
2 (9/1994)	145	55-30		4
9 (12/1997)	145	55-30A		1 to 5
10 (1/1998)	145	55-30B		1 to 6
8 (6/1997)	145	55-31A	1	
7 (12/1996)	145	55-31A		2 to 3
10 (1/1998)	145	55-31A	4	
8 (6/1997)	145	55-31A		4/1 to 4/2
8 (6/1997)	145	55-31A	5 to 6	
8 (6/1997)	145	55-31A		6/1 to 6/2
8 (6/1997)	145	55-31A	7 to 8	
12 (2/1999)	145	55-31B		1a 6
7 (12/1996)	145	55-32	1	
4 (5/1995)	145	55-32	2	
6 (10/1996)	145	55-32	3	
2 (9/1994)	145	55-32	9	
6 (10/1996)	145	55-32	10	
6 (10/1996)	145	55-32		10/1 a 10/2
6 (10/1996)	145	55-32	11 to 14	
6 (10/1996)	145	55-32		14/1 to 14/2
6 (10/1996)	145	55-32	15	
4 (5/1995)	145	55-32	16 to 20	
4 (5/1995)	145	55-32		20/1 to 20/7
6 (10/1996)	145	55-32	20/8	
6 (10/1996)	145	55-32	21 to 22	
6 (10/1996)	145	55-32		22/1 to 22/2
6 (10/1996)	145	55-32	23 to 27	
4 (5/1995)	145	55-32	28 to 34	
4 (5/1995)	145	55-32		34/1 to 34/4
6 (10/1996)	145	55-32	34/5 to 34/6	
6 (10/1996)	145	55-32	35/1 to 35/2	
6 (10/1996)	145	55-32	36 to 37	
4 (5/1995)	145	55-32	39 to 42	
10 (1/1998)	145	55-32A	1	
7 (12/1996)	145	55-32A		2 to 5
10 (1/1998)	145	55-32A	6	
8 (6/1997)	145	55-32A		6/1 to 6/2
8 (6/1997)	145	55-32A	7 to 9	
7 (12/1996)	145	55-32A		10
12 (2/1999)	145	55-32A	10/1	
8 (6/1997)	145	55-32A		10/2
9 (12/1997)	145	55-32A	11	
12 (2/1999)	145	55-32A	12 to 13	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
9 (12/1997)	145	55-32A	14	
8 (6/1997)	145	55-32A		14/1 to 14/2
8 (6/1997)	145	55-32A	15 to 18	
10 (1/1998)	145	55-32A		18/1 to 18/6
7 (12/1996)	145	55-32A		19 to 20
9 (12/1997)	145	55-32A	20/1	
12 (2/1999)	145	55-32A	20/2	
9 (12/1997)	145	55-32A	21 to 24	
9 (12/1997)	145	55-32A		24/1 to 24/2
8 (6/1997)	145	55-32A	25 to 26	
8 (6/1997)	145	55-32A		26/1 to 26/2
8 (6/1997)	145	55-32A	27 to 28	
8 (6/1997)	145	55-32A		28/1
12 (2/1999)	145	55-32A	28/2 to 28/6	
10 (1/1998)	145	55-32A	29	
8 (6/1997)	145	55-32A	30	
12 (2/1999)	145	55-32A	30/1	
10 (1/1998)	145	55-32A		30/2
10 (1/1998)	145	55-32A	31	
12 (2/1999)	145	55-32A	32	
7 (12/1996)	145	55-32A	33 to 36	
10 (1/1998)	145	55-32B	1	
7 (12/1996)	145	55-32B		2 to 5
10 (1/1998)	145	55-32B	6	
8 (6/1997)	145	55-32B		6/1 to 6/2
7 (12/1996)	145	55-32B		7
8 (6/1997)	145	55-32B	8 to 12	
8 (6/1997)	145	55-32B		12/1 to 12/2
7 (12/1996)	145	55-32B		13
12 (2/1999)	145	55-32B	14	
9 (12/1997)	145	55-32B	14/1 to 14/2	
12 (2/1999)	145	55-32B	15 to 16	
9 (12/1997)	145	55-32B	17	
7 (12/1996)	145	55-32B		18
8 (6/1997)	145	55-32B		18/1 to 18/2
8 (6/1997)	145	55-32B	19 to 21	
7 (12/1996)	145	55-32B		22
10 (1/1998)	145	55-32B		22/1 to 22/4
10 (1/1998)	145	55-32B	23	
8 (6/1997)	145	55-32B	24	
10 (1/1998)	145	55-32B		24/1 to 24/2
10 (1/1998)	145	55-32B		25
7 (12/1996)	145	55-32B		26 to 29
8 (6/1997)	145	55-33	1	
2 (9/1994)	145	55-33	1 to 3	
10 (1/1998)	145	55-33	4	

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8 (6/1997)	145	55-33		4/1 to 4/2
8 (6/1997)	145	55-33	5 to 8	
2 (1/1995)	145	55-33		9

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2 (9/1994)	145	55-34	1 to 2	
3 (1/1995)	145	55-34	3	
2 (9/1994)	145	55-34	4 to 6	
3 (1/1995)	145	55-34	7 to 8	
2 (9/1994)	145	55-34	9 to 13	
3 (1/1995)	145	55-34	14	
2 (9/1994)	145	55-34	15 to 16	
3 (1/1995)	145	55-34	17	
2 (9/1994)	145	55-34	18 a21	
2 (9/1994)	145	55-34		22
2 (9/1994)	145	55-35	1 to 3	
2 (9/1994)	145	55-35	12	
2 (1/1995)	145	55-35A		1
3 (1/1995)	145	55-35A	2	
2 (1/1995)	145	55-35A		3 to 7
3 (1/1995)	145	55-35A	8	
2 (1/1995)	145	55-35A		9 to 21
3 (1/1995)	145	55-36	2 to 3	
2 (1/1995)	145	55-36	4 to 5	
3 (1/1995)	145	55-36	6	
2 (9/1994)	146	55-36	7 to 11	
3 (1/1995)	145	55-36	12 to 16	
2 (9/1994)	145	55-36	21	
6 (10/1996)	145	55-36A	1	
4 (5/1995)	145	55-36A		2 to 25
8 (6/1997)	145	55-36B	1	
7 (12/1996)	145	55-36B	2	
6 (10/1996)	145	55-36B		3
8 (6/1997)	145	55-36B	4	
8 (6/1997)	145	55-36B		4/1 to 4/2
6 (10/1996)	145	55-36B		5 to 6
8 (6/1997)	145	55-36B	7	
6 (10/1996)	145	55-36B		8 to 9
8 (6/1997)	145	55-36B	10	
8 (6/1997)	145	55-36B		10/1 to 10/2

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11 (1/1999)	145-146	55	I	
4 (5/1995)	145-146	55	II	
7 (12/1996)	145	55	2	
2 (9/1994)	145	55		2/1 to 2/2
11 (1/1999)	145	55		16/1 to 16/2
11 (1/1999)	145	55		18/1 to 18/2
10 (1/1998)	145	55	22/1 to 22/3	
4 (5/1995)	145	55		22/3
7 (12/1996)	145	55	22/4 to 22/6	
7 (12/1996)	145	55		22/7 to 22/8
7 (12/1996)	145	55	30	
7 (12/1996)	145	55		30/1 to 30/2
2 (9/1994)	145	55	37	
2 (9/1994)	145	55		38/1
4 (5/1995)	146	55	38/2	
7 (12/1996)	145	55		38/3 to 38/4
7 (12/1996)	145	55	40	
7 (12/1996)	145	55	43 to 44	
5 (9/1995)	145	55		44/1
7 (12/1996)	145	55	44/2	
11 (1/1999)	145	55		44/3 to 44/4
2(9/1994)	145	55		45 to 46
12 (2/1999)	145	55		
10 (1/1998)	145	55-1	1	
4 (5/1995)	145	55-1	2	
3 (1/1995)	145	55-1	3 to 6	
2 (9/1994)	145	55-1	7	
3 (1/1995)	145	55-1	8	
4 (5/1995)	145	55-1	9 to 11	
6 (10/1996)	145	55-1	12	
10 (1/1998)	145	55-1	12/1	
8 (6/1997)	145	55-1	12/2	
6 (10/1996)	145	55-1	13 to 18	
12 (2/1999)	145	55-1	18/1 to 18/2	
12 (2/1999)	145	55-1	19	
9 (12/1997)	145	55-1	20 to 21	
12 (2/1999)	145	55-1	21/1	
10 (1/1998)	145	55-1		21/2
12 (2/1999)	145	55-1	21/3 to 21/4	
10 (1/1998)	145	55-1		21/5 to 21/6
10 (1/1998)	145	55-1	22	
12 (2/1999)	145	55-2	3 to 4	

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			SUBST.	ADDED
2 (9/1994)	145	55-2	5	
9 (12/1997)	145	55-2	6	
12 (2/1999)	145	55-2	6/1 to 6/2	
9 (12/1997)	145	55-2		6/3 to 6/4
6 (10/1996)	145	55-2	7	
2 (9/1994)	145	55-2	8	
8 (6/1997)	145	55-2	9	
9 (12/1997)	145	55-2	10	
10 (1/1998)	145	55-2	11	
12 (12/1999)	145	55-2	12 to 14	
9 (12/1997)	145	55-2	15	
10 (1/1998)	145	55-2	16	
12 (2/1999)	145	55-2	16/1	
9 (12/1997)	145	55-2		16/2
10 (1/1998)	145	55-2	17	
8 (6/1997)	145	55-3	1	
8 (6/1997)	145	55-3	4	
8 (6/1997)	145	55-3		4/1 to 4/2
6 (10/1996)	145	55-3	5 to 6	
6 (10/1996)	145	55-3	8	
6 (10/1996)	145	55-3	10 to 13	
6 (10/1996)	145	55-3	15	
10 (1/1998)	145	55-3	16 to 17	
8 (6/1997)	145	55-3	18	
12 (2/1999)	145	55-3	19 to 20	
9 (12/1997)	145	55-3	21	
8 (6/1997)	145	55-3		22 to 23
12 (2/1999)	145	55-3	24	
8 (6/1997)	145	55-3		25 to 26
10 (1/1998)	145	55-3	27	
8 (6/1997)	145	55-3	28	
10 (1/1998)	145	55-3	29	
10(1/1998)	145	55-4	1	
2 (9/1994)	145	55-4	2 to 7	
4 (5/1995)	145	55-4	8 to 9	
6 (10/1996)	145	55-4		9/1 to 9/2
6(10/1996)	145	55-4	10 to 12	
6 (10/1996)	145	55-4		12/1 to 12/2
6 (10/1996)	145	55-4	13	
9 (12/1997)	145	55-4	14 to 17	
10 (1/1998)	145	55-4	18	
10 (1/1998)	145	55-4		19 to 22
8 (6/1997)	145	55-5		2/1 to 2/2
8 (6/1997)	145	55-5	3	
8 (6/1997)	145	55-5	5 to 7	
8 (6/1997)	145	55-6		2/1 to 2/2
8 (6/1997)	145	55-6	3 to 7	

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8 (6/1997)	145	55-8	1	
6 (10/1996)	145	55-8	4	
6 (10/1996)	145	55-8		4/1
8 (6/1997)	145	55-8	4/2	
8 (6/1997)	145	55-8		4/3 to 4/4
8 (6/1997)	145	55-8	5 to 10	
8 (6/1997)	145	55-8		10/1 to 10/2
6 (10/1996)	145	55-8	11 to 12	
8 (6/1997)	145	55-10	1	
8 (6/1997)	145	55-10		2/1 to 2/2
8 (6/1997)	145	55-10	3	
8 (6/1997)	145	55-10	6 to 8	
8 (6/1997)	145	55-10		8/1 to 8/2
2 (9/1994)	145	55-10	9	
6 (10/1996)	145	55-11	2	
8 (6/1997)	145	55-11		2/1 to 2/2
8 (6/1997)	145	55-11	4	
8 (6/1997)	145	55-11	6	
8 (6/1997)	145	55-12	1	
8 (6/1997)	145	55-12		2/1 to 2/2
8 (6/1997)	145	55-12	3 to 8	
8 (6/1997)	145	55-12		8/1 to 8/2
2 (9/1994)	145	55-13	2	
8 (6/1997)	145	55-13		2/1 to 2/2
8 (6/1997)	145	55-13	3 to 5	
8 (6/1997)	145	55-14	1	
6 (10/1996)	145	55-14	2	
10 (1/1998)	145	55-14	2/1	
8 (6/1997)	145	55-14		2/2
6 (10/1996)	145	55-14	3	
10 (1/1998)	145	55-14	4	
9 (12/1997)	145	55-14	5	
10 (1/1998)	145	55-14	6 to 7	
8 (6/1997)	145	55-15		2/1 to 2/2
8 (6/1997)	145	55-15	3 to 5	
6 (10/1996)	145	55-16	1	
6 (10/1996)	145	55-16	4	
8 (6/1997)	145	55-16	4/1 to 4/2	
8 (6/1997)	145	55-16	5 to 8	
8 (6/1997)	145	55-16		8/1 to 8/2
8 (6/1997)	145	55-16	9	
7 (12/1996)	145	55-16	11	
12 (2/1999)	145	55-17	1 to 2	
6 (10/1996)	145	55-17	3 to 4	
12 (2/1999)	145	55-17	4/1 to 4/4	
12 (2/1999)	145	55-17	5 to 7	
10(1/1998)	145	55-17	8	

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			SUBST.	ADDED
4 (5/1995)	145	55-17	9 to 10	
12 (2/1999)	145	55-17	10/1	
10 (1/1998)	145	55-17		10/2
12 (2/1999)	145	55-17	10/3	
10 (1/1998)	145	55-17		10/4
6 (10/1996)	145	55-17	11	
10 (1/1998)	145	55-17	12	
10 (1/1998)	145	55-17	12/1 to 12/2	
10 (1/1998)	145	55-17	13 to 14	
10 (1/1998)	145	55-17	14/1 to 14/2	
12 (2/1999)	145	55-17	16	
12 (2/1999)	145	55-17	16/1	
9 (12-1997)	145	55-17	16/2	
8 (6/1997)	145	55-17	17 to 18	
9 (12/1997)	145	55-17	19	
10 (1/1998)	145	55-17	20	
4 (5/1995)	145	55-17	21 to 23	
4 (5/1995)	145	55-17	25	
8 (6/1997)	145	55-18	1	
8 (6/1997)	145	55-18	4	
8 (6/1997)	145	55-18		4/1 to 4/2
8 (6/1997)	145	55-18	7	
6 (10/1996)	145	55-18	8	
8 (6/1997)	145	55-18		8/1 to 8/2
8 (6/1997)	145	55-18	9 to 11	
8 (6/1997)	145	55-19		2/1 to 2/1
8 (6/1997)	145	55-19	3 to 4	
8 (6/1997)	145	55-19	6	
10 (1/1998)	145	55-20	2/1	
8 (6/1997)	145	55-20		2/2
8 (6/1997)	145	55-20	3 to 4	
10 (1/1998)	145	55-20	5	
8 (6/1997)	145	55-21	1	
6 (10/1996)	145	55-21	3	
8 (6/1997)	145	55-21	4	
8 (6/1997)	145	55-21		4/1 to 4/2
8 (6/1997)	145	55-21	5 to 8	
8 (6/1997)	145	55-21		8/1 to 8/2
8 (6/1997)	145	55-21	9	
5 (9/1995)	145	55-22	2	
8 (6/1997)	145	55-22		2/1 to 2/2
8 (6/1997)	145	55-22	3 to 6	
8 (6/1997)	145	55-23	1	
6 (10/1996)	145	55-23	2 to 3	
8 (6/1997)	145	55-23	4	
8 (6/1997)	145	55-23		4/1 to 4/2
8 (6/1997)	145	55-23	5 to 9	
6 (10/1996)	145	55-24	1	

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6 (10/1996)	145	55-24		2/1
10 (1/1998)	145	55-24	2/2	
8 (6/1997)	145	55-24	3	
10 (1/1998)	145	55-24	4	
8 (6/1997)	145	55-24	5 to 6	
8 (6/1997)	145	55-24		6/1 to 6/2
3 (1/1995)	145	55-24	7	
6 (10/1996)	145	55-24	8	
8 (6/1997)	145	55-25		2/1 to 2/2
8 (6/1997)	145	55-25	3	
8 (6/1997)	145	55-25	5	
6 (10/1996)	145	55-26	1	
2 (9/1994)	145	55-26	2	
2 (9/1994)	145	55-26	4 to 7	
2 (9/1994)	145	55-26	9 to 11	
2 (9/1994)	145	55-26	13 to 15	
2 (1/1995)	145	55-26	17	
2 (9/1994)	145	55-26	19	
2 (1/1995)	145	55-26	25 to 26	
9 (12/1997)	145	55-27	1	
6 (10/1996)	145	55-27	2	
6 (10/1996)	145	55-27		2/1
9 (12/1997)	145	55-27	2/2 to 2/4	
9 (12/1997)	145	55-27	3	
12 (2/1999)	145	55-27	4	
12 (2/1999)	145	55-27	4/1	
9 (12/1997)	145	55-27	4/2	
9 (12/1997)	145	55-27	**4/3 and 4/4 to be eliminated**	
12 (2/1999)	145	55-27	5 to 8	
9 (12/1997)	145	55-27	9 to 10	
6 (10/1996)	145	55-27	11	
12 (2/1999)	145	55-27A		1 to 10
2 (9/1994)	145	55-28	1	
8 (6/1997)	145	55-28		2/1 to 2/2
8 (6/1997)	145	55-28	3 to 8	
8 (6/1997)	145	55-29		2/1 to 2/2
8 (6/1997)	145	55-29	3 to 6	
2 (1/1995)	145	55-30	1 to 3	
2 (9/1994)	145	55-30		4
9 (12/1997)	145	55-30A		1 to 5
10 (1/1998)	145	55-30B		1 to 6
8 (6/1997)	145	55-31A	1	
7 (12/1996)	145	55-31A		2 to 3
10 (1/1998)	145	55-31A	4	
8 (6/1997)	145	55-31A		4/1 to 4/2
8 (6/1997)	145	55-31A	5 to 6	

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			SOBST.	ADDED
8 (6/1997)	145	55-31A		5/1 to 6/2
8 (6/1997)	145	55-31A	7 to 8	
12 (2/1999)	145	55-31B		1a 6
7 (12/1996)	145	55-32	1	
4 (5/1995)	145	55-32	2	
6 (10/1996)	145	55-32	3	
2 (9/1994)	145	55-32	9	
6 (10/1996)	145	55-32	10	
6 (10/1996)	145	55-32		10/1 a 10/2
6 (10/1996)	145	55-32	11 to 14	
6 (10/1996)	145	55-32		14/1 to 14.2
6 (10/1996)	145	55-32	15	
4 (5/1995)	145	55-32	16 to 20	
4 (5/1995)	145	55-32		20/1 to 20/7
6 (10/1996)	145	55-32	20/8	
6 (10/1996)	145	55-32	21 to 22	
6 (10/1996)	145	55-32		22/1 to 22.2
6 (10/1996)	145	55-32	23 to 27	
4 (5/1995)	145	55-32	28 to 34	
4 (5/1995)	145	55-32		34/1 to 34/4
6 (10/1996)	145	55-32	34/5 to 34/6	
6 (10/1996)	145	55-32	35/1 to 35/2	
6 (10/1996)	145	55-32	36 to 37	
4 (5/1995)	145	55-32	39 to 42	
10 (1/1998)	145	55-32A	1	
7 (12/1996)	145	55-32A		2 to 5
10 (1/1998)	145	55-32A	6	
8 (6/1997)	145	55-32A		6/1 to 6/2
8 (6/1997)	145	55-32A	7 to 9	
7 (12/1996)	145	55-32A		10
12 (2/1999)	145	55-32A	10/1	
8 (6/1997)	145	55-32A		10/2
9 (12/1997)	145	55-32A	11	
12 (2/1999)	145	55-32A	12 to 13	
9 (12/1997)	145	55-32A	14	
8 (6/1997)	145	55-32A		14/1 to 14.2
8 (6/1997)	145	55-32A	15 to 18	
10 (1/1998)	145	55-32A		18/1 to 18/6
7 (12/1996)	145	55-32A		19 to 20
9 (12/1997)	145	55-32A	20/1	
12 (2/1999)	145	55-32A	20/2	
9 (12/1997)	145	55-32A	21 to 24	
9 (12/1997)	145	55-32A		24/1 to 24.2
8 (6/1997)	145	55-32A	25 to 26	
8 (6/1997)	145	55-32A		26/1 to 26.2
8 (6/1997)	145	55-32A	27 to 28	
8 (6/1997)	145	55-32A		28/1

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10 (1/1998)	145	55-32A	29	
8 (6/1997)	145	55-32A	30	
12 (2/1999)	145	55-32A	30/1	
10 (1/1998)	145	55-32A		30/2
10 (1/1998)	145	55-32A	31	
12 (2/1999)	145	55-32A	32	
7 (12/1996)	145	55-32A	33 to 36	
10 (1/1998)	145	55-32B	1	
7 (12/1996)	145	55-32B		2 to 5
10 (1/1998)	145	55-32B	6	
8 (6/1997)	145	55-32B		6/1 to 6/2
7 (12/1996)	145	55-32B		7
8 (6/1997)	145	55-32B	8 to 12	
8 (6/1997)	145	55-32B		12/1 to 12/2
7 (12/1996)	145	55-32B		13
12 (2/1999)	145	55-32B	14	
9 (12/1997)	145	55-32B	14/1 to 14/2	
12 (2/1999)	145	55-32B	15 to 16	
9 (12/1997)	145	55-32B	17	
7 (12/1996)	145	55-32B		18
8 (6/1997)	145	55-32B		18/1 to 18/2
8 (6/1997)	145	55-32B	19 to 21	
7 (12/1996)	145	55-32B		22
10 (1/1998)	145	55-32B		22/1 to 22/4
10 (1/1998)	145	55-32B	23	
8 (6/1997)	145	55-32B	24	
10 (1/1998)	145	55-32B		24/1 to 24/2
10 (1/1998)	145	55-32B		25
7 (12/1996)	145	55-32B		26 to 29
8 (6/1997)	145	55-33	1	
2 (9/1994)	145	55-33	1 to 3	
10 (1/1998)	145	55-33	4	
8 (6/1997)	145	55-33		4/1 to 4/2
8 (6/1997)	145	55-33	5 to 8	
2 (1/1995)	145	55-33		9
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2 (9/1994)	145	55-34	1 to 2	
3 (1/1995)	145	55-34	3	
2 (9/1994)	145	55-34	4 to 6	
3 (1/1995)	145	55-34	7 to 8	

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			SOBST.	ADDED
2 (9/1994)	145	55-34	9 to 13	
3 (1/1995)	145	55-34	14	
2 (9/1994)	145	55-34	15 to 16	
3 (1/1995)	145	55-34	17	
2 (9/1994)	145	55-34	18 a21	
2 (9/1994)	145	55-34		22
2 (9/1994)	145	55-35	1 to 3	
2 (9/1994)	145	55-35	12	
2 (1/1995)	145	55-35A		1
3 (1/1995)	145	55-35A	2	
2 (1/1995)	145	55-35A		3 to 7
3 (1/1995)	145	55-35A	8	
2 (1/1995)	145	55-35A		9 to 21
3 (1/1995)	145	55-36	2 to 3	
2 (1/1995)	145	55-36	4 to 5	
3 (1/1995)	145	55-36	6	
2 (9/1994)	146	55-36	7 to 11	
3 (1/1995)	145	55-36	12 to 16	
2 (9/1994)	145	55-36	21	
6 (10/1996)	145	55-36A	1	
4 (5/1995)	145	55-36A		2 to 25
8 (6/1997)	145	55-36B	1	
7 (12/1996)	145	55-36B	2	
6 (10/1996)	145	55-36b		3
8 (6/1997)	145	55-36B	4	
8 (6/1997)	145	55-36B		4/1 to 4/2
6 (10/1996)	145	55-36B		5 to 6
8 (6/1997)	145	55-36B	7	
6 (10/1996)	145	55-36B		8 to 9
8 (6/1997)	145	55-36B	10	
8 (6/1997)	145	55-36B		10/1 to 10/2
8 (6/1997)	145	55-36B	11 to 12	
6 (10/1996)	145	55-36B		13 to 16
8 (6/1997)	145	55-36B	17	
6 (10/1996)	145	55-36B		18 to 24
9 (12/1997)	145	55-36C		1
12 (2/1999)	145	55-36C	2 to 10	
9 (12/1997)	145	55-36C		11
12 (2/1999)	145	55-36C	12	
12 (2/1999)	145	55-36C	13 to 15	
9 (12/1997)	145	55-36C		16 to 17
12 (2/1999)	145	55-36C	18	
6 (10/1996)	145	55-37	1	
4 (5/1995)	145	55-37	2 to 4	
4 (5/1995)	145	55-37		4/1 to 4/2
2 (9/1994)	145	55-37	5	
4 (5/1995)	145	55-37	6 to 19	
6 (10/1996)	145	55-37A	1 to 3	

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11 (1/1999)	145-146	55	Index I	
4 (5/1995)	145-146	55	Index II	
7 (12/1996)	145	55	2	
2 (9/1994)	145	55		2/1 to 2/2
11 (1/1999)	145	55		16/1 to 16/2
11 (1/1999)	145	55		18/1 a 18/2
10 (1/1998)	145	55	22/1 to 22/3	
4 (5/1995)	145	55		22/3
7 (12/1996)	145	55	22/4 to 22/6	
7 (12/1996)	145	55		22/7 to 22/8
7 (12/1996)	145	55	30	
7 (12/1996)	145	55		30/1 to 30/2
2 (9/1994)	145	55	37	
2 (9/1994)	145	55		38/1
4 (5/1995)	146	55	38/2	
7 (12/1996)	145	55		38/3 to 38/4
7 (12/1996)	145	55	40	
7 (12/1996)	145	55	43 to 44	
5 (9/1995)	145	55		44/1
7 (12/1996)	145	55	44/2	
11 (1/1999)	145	55		44/3 to 44/4
2(9/1994)	145	55		45 to 46
10 (1/1998)	145	55	Index	
10 (1/1998)	145	55-1	1	
4 (5/1995)	145	55-1	2	
3 (1/1995)	145	55-1	3 to 6	
2 (9/1994)	145	55-1	7	
3 (1/1995)	145	55-1	8	
4 (5/1995)	145	55-1	9 to 11	
6 (10/1996)	145	55-1	12	
10 (1/1998)	145	55-1	12/1	
8 (6/1997)	145	55-1	12/2	
6 (10/1996)	145	55-1	13 to 18	
10 (1/1998)	145	55-1	18/1	
9 (12/1997)	145	55-1	18/2	
9 (12/1997)	145	55-1	19 to 21	
10 (1/1998)	145	55-1		21/1 to 21/6
10 (1/1998)	145	55-1	22	
8 (6/1997)	145	55-2	3	
10 (1/1998)	145	55-2	4	
2 (9/1994)	145	55-2	5	
9 (12/1997)	145	55-2	6	

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			SUBST.	ADDED
8 (6/1997)	145	55-2	6/1	
4 (5/1995)	145	55-2		6/2
9 (12/1997)	145	55-2		6/3 to 6/4
6 (10/1996)	145	55-2	7	
2 (9/1994)	145	55-2	8	
8 (6/1997)	145	55-2	9	
9 (12/1997)	145	55-2	10	
10 (1/1998)	145	55-2	11	
9 (12/1997)	145	55-2	12	
10 (1/1998)	145	55-2	13	
8 (6/1997)	145	55-2	14	
9 (12/1997)	145	55-2	15	
10 (1/1998)	145	55-2	16	
9 (12/1997)	145	55-2		16/1 to 16/2
10 (1/1998)	145	55-2	17	
8 (6/1997)	145	55-3	1	
8 (6/1997)	145	55-3	4	
8 (6/1997)	145	55-3		4/1 to 4/2
6 (10/1996)	145	55-3	5 to 6	
6 (10/1996)	145	55-3	8	
6 (10/1996)	145	55-3	10 to 13	
6 (10/1996)	145	55-3	15	
10 (1/1998)	145	55-3	16 to 17	
8 (6/1997)	145	55-3	18	
10 (1/1998)	145	55-3	19	
9 (12/1997)	145	55-3	20 to 21	
8 (6/1997)	145	55-3		22 to 23
10 (1/1998)	145	55-3	24	
8 (6/1997)	145	55-3		25 to 26
10 (1/1998)	145	55-3	27	
8 (6/1997)	145	55-3	28	
10 (1/1998)	145	55-3	29	
10(1/1998)	145	55-4	1	
2 (9/1994)	145	55-4	2 to 7	
4 (5/1995)	145	55-4	8 to 9	
6 (10/1996)	145	55-4		9/1 to 9/2
6(10/1996)	145	55-4	10 to 12	
6 (10/1996)	145	55-4		12/1 to 12/2
6 (10/1996)	145	55-4	13	
9 (12/1997)	145	55-4	14 to 17	
10 (1/1998)	145	55-4	18	
10 (1/1998)	145	55-4		19 to 22
8 (6/1997)	145	55-5		2/1 to 2/2
8 (6/1997)	145	55-5	3	
8 (6/1997)	145	55-5	5 to 7	
8 (6/1997)	145	55-6		2/1 to 2/2
8 (6/1997)	145	55-6	3 to 7	
2 (9/1994)	145	55-6	8	

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6 (10/1996)	145	55-8	4	
6 (10/1996)	145	55-8		4/1
8 (6/1997)	145	55-8	4/2	
8 (6/1997)	145	55-8		4/3 to 4/4
8 (6/1997)	145	55-8	5 to 10	
8 (6/1997)	145	55-8		10/1 to 10/2
6 (10/1996)	145	55-8	11 to 12	
8 (6/1997)	145	55-10	1	
8 (6/1997)	145	55-10		2/1 to 2/2
8 (6/1997)	145	55-10	3	
8 (6/1997)	145	55-10	6 to 8	
8 (6/1997)	145	55-10		8/1 to 8/2
2 (9/1994)	145	55-10	9	
6 (10/1996)	145	55-11	2	
8 (6/1997)	145	55-11		2/1 to 2/2
8 (6/1997)	145	55-11	4	
8 (6/1997)	145	55-11	6	
8 (6/1997)	145	55-12	1	
8 (6/1997)	145	55-12		2/1 to 2/2
8 (6/1997)	145	55-12	3 to 8	
8 (6/1997)	145	55-12		8/1 to 8/2
2 (9/1994)	145	55-13	2	
8 (6/1997)	145	55-13		2/1 to 2/2
8 (6/1997)	145	55-13	3 to 5	
8 (6/1997)	145	55-14	1	
6 (10/1996)	145	55-14	2	
10 (1/1998)	145	55-14	2/1	
8 (6/1997)	145	55-14		2/2
6 (10/1996)	145	55-14	3	
10 (1/1998)	145	55-14	4	
9 (12/1997)	145	55-14	5	
10 (1/1998)	145	55-14	6 to 7	
8 (6/1997)	145	55-15		2/1 to 2/2
8 (6/1997)	145	55-15	3 to 5	
6 (10/1996)	145	55-16	1	
6 (10/1996)	145	55-16	4	
8 (6/1997)	145	55-16	4/1 to 4/2	
8 (6/1997)	145	55-16	5 to 8	
8 (6/1997)	145	55-16		8/1 to 8/2
8 (6/1997)	145	55-16	9	
7 (12/1996)	145	55-16	11	
10 (1/1998)	145	55-17	1	
6 (10/1996)	145	55-17	2 to 4	
10 (1/1998)	145	55-17	4/1	
8 (6/1997)	145	55-17	4/2	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
8 (6/1997)	145	55-17	5 to 7	
10(1/1998)	145	55-17	8	
4 (5/1995)	145	55-17	9 to 10	
10 (1/1998)	145	55-17		10/1 to 10/4
6 (10/1996)	145	55-17	11	
10 (1/1998)	145	55-17	12	
10 (1/1998)	145	55-17	12/1 to 12/2	
10 (1/1998)	145	55-17	13 to 14	
10 (1/1998)	145	55-17	14/1 to 14/2	
9 (12/1997)	145	55-17	16	
9 (12/1997)	145	55-17	16/1 to 16/2	
8 (6/1997)	145	55-17	17 to 18	
9 (12/1997)	145	55-17	19	
10 (1/1998)	145	55-17	20	
4 (5/1995)	145	55-17	21 to 23	
4 (5/1995)	145	55-17	25	
8 (6/1997)	145	55-18	1	
8 (6/1997)	145	55-18	4	
8 (6/1997)	145	55-18		4/1 to 4/2
8 (6/1997)	145	55-18	7	
6 (10/1996)	145	55-18	8	
8 (6/1997)	145	55-18		8/1 to 8/2
8 (6/1997)	145	55-18	9 to 11	
8 (6/1997)	145	55-19		2/1 to 2/1
8 (6/1997)	145	55-19	3 to 4	
8 (6/1997)	145	55-19	6	
10 (1/1998)	145	55-20	2/1	
8 (6/1997)	145	55-20		2/2
8 (6/1997)	145	55-20	3 to 4	
10 (1/1998)	145	55-20	5	
8 (6/1997)	145	55-21	1	
6 (10/1996)	145	55-21	3	
8 (6/1997)	145	55-21	4	
8 (6/1997)	145	55-21		4/1 to 4.2
8 (6/1997)	145	55-21	5 to 8	
8 (6/1997)	145	55-21		8/1 to 8.2
8 (6/1997)	145	55-21	9	
5 (9/1995)	145	55-22	2	
8 (6/1997)	145	55-22		2/1 to 2.2
8 (6/1997)	145	55-22	3 to 6	
8 (6/1997)	145	55-23	1	
6 (10/1996)	145	55-23	2 to 3	
8 (6/1997)	145	55-23	4	
8 (6/1997)	145	55-23		4/1 to 4.2
8 (6/1997)	145	55-23	5 to 9	
6 (10/1996)	145	55-24	1	

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6 (10/1996)	145	55-24		2/1
10 (1/1998)	145	55-24	2/2	
8 (6/1997)	145	55-24	3	
10 (1/1998)	145	55-24	4	
8 (6/1997)	145	55-24	5 to 6	
8 (6/1997)	145	55-24		6/1 to 6/2
3 (1/1995)	145	55-24	7	
6 (10/1996)	145	55-24	8	
8 (6/1997)	145	55-25		2/1 to 2/2
8 (6/1997)	145	55-25	3	
8 (6/1997)	145	55-25	5	
6 (10/1996)	145	55-26	1	
2 (9/1994)	145	55-26	2	
2 (9/1994)	145	55-26	4 to 7	
2 (9/1994)	145	55-26	9 to 11	
2 (9/1994)	145	55-26	13 to 15	
2 (1/1995)	145	55-26	17	
2 (9/1994)	145	55-26	19	
2 (1/1995)	145	55-26	25 to 26	
9 (12/1997)	145	55-27	1	
6 (10/1996)	145	55-27	2	
6 (10/1996)	145	55-27		2/1
9 (12/1997)	145	55-27	2/2 to 2/4	
9 (12/1997)	145	55-27	3 to 4	
9 (12/1997)	145	55-27	4/1 to 4/2	
9 (12/1997)	145	55-27	5 to 10	
6 (10/1996)	145	55-27	11	
2 (9/1994)	145	55-28	1	
8 (6/1997)	145	55-28		2/1 to 2/2
8 (6/1997)	145	55-28	3 to 8	
8 (6/1997)	145	55-29		2/1 to 2/2
8 (6/1997)	145	55-29	3 to 6	
2 (1/1995)	145	55-30	1 to 3	
2 (9/1994)	145	55-30		4
9 (12/1997)	145	55-30A		1 to 5
10 (1/1998)	145	55-30B		1 to 6
8 (6/1997)	145	55-31A	1	
7 (12/1996)	145	55-31A		2 to 3
10 (1/1998)	145	55-31A	4	
8 (6/1997)	145	55-31A		4/1 to 4/2
8 (6/1997)	145	55-31A	5 to 6	
8 (6/1997)	145	55-31A		6/1 to 6/2
8 (6/1997)	145	55-31A	7 to 8	
7 (12/1996)	145	55-32	1	
4 (5/1995)	145	55-32	2	
6 (10/1996)	145	55-32	3	

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			SOBST.	ADDED
2 (9/1994)	145	55-32	9	
6 (10/1996)	145	55-32	10	
6 (10/1996)	145	55-32		10/1 a10.2
6 (10/1996)	145	55-32	11 to 14	
6 (10/1996)	145	55-32		14/1 to 14/2
6 (10/1996)	145	55-32	15	
4 (5/1995)	145	55-32	16 to 20	
4 (5/1995)	145	55-32		20/1 to 20/7
6 (10/1996)	145	55-32	20/8	
6 (10/1996)	145	55-32	21 to 22	
6 (10/1996)	145	55-32		22/1 to 22/2
6 (10/1996)	145	55-32	23 to 27	
4 (5/1995)	145	55-32	28 to 34	
4 (5/1995)	145	55-32		34/1 to 34/4
6 (10/1996)	145	55-32	34/5 to 34/6	
6 (10/1996)	145	55-32	35/1 to 35/2	
6 (10/1996)	145	55-32	36 to 37	
4 (5/1995)	145	55-32	39 to 42	
10 (1/1998)	145	55-32A	1	
7 (12/1996)	145	55-32A		2 to 5
10 (1/1998)	145	55-32A	6	
8 (6/1997)	145	55-32A		6/1 to 6/2
8 (6/1997)	145	55-32A	7 to 9	
7 (12/1996)	145	55-32A		10
9 (12/1997)	145	55-32A	10/1	
8 (6/1997)	145	55-32A		10/2
9 (12/1997)	145	55-32A	11 to 14	
8 (6/1997)	145	55-32A		14/1 to 14/2
8 (6/1997)	145	55-32A	15 to 18	
10 (1/1998)	145	55-32A		18/1 to 18/6
7 (12/1996)	145	55-32A		19 to 20
9 (12/1997)	145	55-32A	20/1 to 20/2	
9 (12/1997)	145	55-32A	21 to 24	
9 (12/1997)	145	55-32A		24/1 to 24/2
8 (6/1997)	145	55-32A	25 to 26	
8 (6/1997)	145	55-32A		26/1 to 26/2
8 (6/1997)	145	55-32A	27 to 28	
8 (6/1997)	145	55-32A		28/1
10 (1/1998)	145	55-32A	28/2	
10 (1/1998)	145	55-32A		28/3 to 28/6
10 (1/1998)	145	55-32A	29	
8 (6/1997)	145	55-32A	30	
10 (1/1998)	145	55-32A		30/1 to 30/2
10 (1/1998)	145	55-32A	31 to 32	
7 (12/1996)	145	55-32A	33 to 36	
10 (1/1998)	145	55-32B	1	
7 (12/1996)	145	55-32B		2 to 5

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8 (6/1997)	145	55-32B		6/1 to 6/2
7 (12/1996)	145	55-32B		7
8 (6/1997)	145	55-32B	8 to 12	
8 (6/1997)	145	55-32B		12/1 to 12/2
7 (12/1996)	145	55-32B		13
9 (12/1997)	145	55-32B	14	
9 (12/1997)	145	55-32B	14/1 to 14/2	
9 (12/1997)	145	55-32B	15 to 17	
7 (12/1996)	145	55-32B		18
8 (6/1997)	145	55-32B		18/1 to 18/2
8 (6/1997)	145	55-32B	19 to 21	
7 (12/1996)	145	55-32B		22
10 (1/1998)	145	55-32B		22/1 to 22/4
10 (1/1998)	145	55-32B	23	
8 (6/1997)	145	55-32B	24	
10 (1/1998)	145	55-32B		24/1 to 24/2
10 (1/1998)	145	55-32B		25
7 (12/1996)	145	55-32B		26 to 29
8 (6/1997)	145	55-33	1	
2 (9/1994)	145	55-33	1 to 3	
10 (1/1998)	145	55-33	4	
8 (6/1997)	145	55-33		4/1 to 4/2
8 (6/1997)	145	55-33	5 to 8	
2 (1/1995)	145	55-33		9
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2 (9/1994)	145	55-34	1 to 2	
3 (1/1995)	145	55-34	3	
2 (9/1994)	145	55-34	4 to 6	
3 (1/1995)	145	55-34	7 to 8	
2 (9/1994)	145	55-34	9 to 13	
3 (1/1995)	145	55-34	14	
2 (9/1994)	145	55-34	15 to 16	
3 (1/1995)	145	55-34	17	
2 (9/1994)	145	55-34	18 a21	
2 (9/1994)	145	55-34		22
2 (9/1994)	145	55-35	1 to 3	
2 (9/1994)	145	55-35	12	
2 (1/1995)	145	55-35A		1
3 (1/1995)	145	55-35A	2	
2 (1/1995)	145	55-35A		3 to 7

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
3 (1/1995)	145	55-35A	8	
2 (1/1995)	145	55-35A		9 to 21
3 (1/1995)	145	55-36	2 to 3	
2 (1/1995)	145	55-36	4 to 5	
3 (1/1995)	145	55-36	6	
2 (9/1994)	146	55-36	7 to 11	
3 (1/1995)	145	55-36	12 to 16	
2 (9/1994)	145	55-36	21	
6 (10/1996)	145	55-36A	1	
4 (5/1995)	145	55-36A		2 to 25
8 (6/1997)	145	55-36B	1	
7 (12/1996)	145	55-36B	2	
6 (10/1996)	145	55-36b		3
8 (6/1997)	145	55-36B	4	
8 (6/1997)	145	55-36B		4/1 to 4/2
6 (10/1996)	145	55-36B		5 to 6
8 (6/1997)	145	55-36B	7	
6 (10/1996)	145	55-36B		8 to 9
8 (6/1997)	145	55-36B	10	
8 (6/1997)	145	55-36B		10/1 to 10/2
8 (6/1997)	145	55-36B	11 to 12	
6 (10/1996)	145	55-36B		13 to 16
8 (6/1997)	145	55-36B	17	
6 (10/1996)	145	55-36B		18 to 24
9 (12/1997)	145	55-36C		1
10 (1/1998)	145	55-36C	2	
9 (12/1997)	145	55-36C		3 to 4
10 (1/1998)	145	55-36C	5	
9 (12/1997)	145	55-36C		6 to 11
10 (1/1998)	145	55-36C	12 to 13	
9 (12/1997)	145	55-36C		14
10 (1/1998)	145	55-36C	15	
9 (12/1997)	145	55-36C		16 to 18
6 (10/1996)	145	55-37	1	
4 (5/1995)	145	55-37	2 to 4	
4 (5/1995)	145	55-37		4/1 to 4/2
2 (9/1994)	145	55-37	5	
4 (5/1995)	145	55-37	6 to 19	
6 (10/1996)	145	55-37A	1 to 3	
4 (5/1995)	145	55-37A		4 to 5
6 (10/1996)	145	55-37A	6 to 9	
6 (10/1996)	145	55-37A		9/1
8 (6/1997)	145	55-37A	9/2	
7 (12/1996)	145	55-37A	10	
4 (5/1995)	145	55-37A		11
8 (6/1997)	145	55-37A	12	

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			SOBST.	ADDED
6 (10/1996)	145	55-37A	13	
8 (6/1997)	145	55-37A	14	
6 (10/1996)	145	55-37A		14/1 to 14/4
8 (6/1997)	145	55-37A	15	
6 (10/1996)	145	55-37A	16	
7 (12/1996)	145	55-37A		
4 (5/1995)	145	55-37A		17 to 18
5 (9/1995)	145	55-37A	19	
4 (5/1995)	145	55-37A		20 to 21
10 (1/1998)	145	55-37B		1 to 21
10 (1/1998)	145	55-38	1	
6 (10/1996)	145	55-38	2	
2 (9/1994)	145	55-38	7	
6 (10/1996)	145	55-38	8	
8 (6/1997)	145	55-38		8/1 to 8/2
8 (6/1997)	145	55-38	9 to 10	
6 (10/1996)	145	55-38	11	
8 (6/1997)	145	55-38	12	
6 (10/1996)	145	55-38	12/1 to 12/2	
9 (12/1997)	145	55-38	12/3 to 12/8	
9 (12/1997)	145	55-38		12/9 to 12/10
10 (1/1998)	145	55-38		12/11 to 12/16
10 (1/1998)	145	55-38	13	
6 (10/1996)	145	55-38	14	
2 (9/1994)	145	55-39	2	
2 (9/1994)	145	55-39	6	
2 (9/1994)	145	55-39	9	
2 (9/1994)	145	55-39	17	
9 (12/1997)	145	55-39A	1	
6 (10/1996)	145	55-39A		2
8 (6/1997)	145	55-39A		2/1 to 2/2
8 (6/1997)	145	55-39A	3 to 6	
6 (10/1996)	145	55-39A		7 to 13
9 (12/1997)	145	55-39B		1 to 2
10 (1/1998)	145	55-39B	3	
9 (12/1997)	145	55-39B		4
10 (1/1998)	145	55-39B	5	
9 (12/1997)	145	55-39B		6 to 9
10 (1/1998)	145	55-40	1	
1 (9/1994)	145	55-40		2 to 6
6 (10/1996)	145	55-40	7	
1 (9/1994)	145	55-40		8 to 10
2 (9/1994)	145	55-40	11 to 12	
1 (9/1994)	145	55-40		13 to 14
6 (10/1996)	145	55-40	15 to 16	
6 (10/1996)	145	55-40		16/1

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
9 (12/1997)	145	55-40	16/2 to 16/4	
6 (10/1996)	145	55-40	17 to 18	
8 (6/1997)	145	55-40		18/1
10 (1/1998)	145	55-40	18/2	
10 (1/1998)	145	55-40	19 to 20	
9 (12/1997)	145	55-40	21	
10 (1/1998)	145	55-40	22	
9 (12/1997)	145	55-40	23	
10 (1/1998)	145	55-40	24	
10 (1/1998)	145	55-40	24/1	
9 (12/1997)	145	55-40	24/2	
9 (12/1997)	145	55-40	25	
10 (1/1998)	145	55-40	26	
10 (1/1998)	145	55-40		26/1 to 26/2
1 (1/1994)	145	55-40		27 to 28
3 (1/1995)	145	55-40	29	
9 (12/1997)	145	55-41		1
10 (1/1998)	145	55-41	2 to 6	
10 (1/1998)	145	55-A1	2 to 4	
10 (1/1998)	146	55	Indice	
10 (1/1998)	146	55-1	1	
5 (9/1995)	146	55-1	2	
3 (1/1995)	146	55-1	3 to 6	
2 (9/1994)	146	55-1		7
3 (1/1995)	146	55-1	8	
4 (5/1995)	146	55-1	9 to 11	
6 (10/1996)	146	55-1	12	
10 (1/1998)	146	55-1	12/1	
8 (6/1997)	146	55-1	12/2	
6 (10/1996)	146	55-1	13 to 17	
10 (6/1998)	146	55-1	18/1	
9 (12/1997)	146	55-1	18/2	
10 (1/1998)	146	55-1	19	
9 (12/1997)	146	55-1	20 to 21	
10 (1/1998)	146	55-1		21/1 to 21/6
10 (1/1998)	146	55-1	22	
2 (9/1994)	146	55-2		1 to 2
8 (6/1997)	146	55-2	3	
10 (1/1998)	146	55-2	4	
2 (9/1994)	146	55-2		5
9 (12/1997)	146	55-2	6	
8 (6/1997)	146	55-2	6/1	
5 (9/1995)	146	55-2		6/2
9 (12/1997)	146	55-2		6/3 to 6/4

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
6 (10/1996)	146	55-2	7	
2 (9/1994)	146	55-2		8
8 (6/1997)	146	55-2	9	
9 (12/1997)	146	55-2	10	
10 (1/1998)	146	55-2	11	
9 (12/1997)	146	55-2	12	
10 (1/1998)	146	55-2	13	
9 (12/1997)	146	55-2	14 to 15	
10 (1/1998)	146	55-2	16	
9 (12/1997)	146	55-2		16/1 to 16/2
10 (1/1997)	146	55-2	17	
9 (12/1997)	146	55-2	19	
8 (6/1997)	146	55-3	1	
2 (9/1994)	146	55-3		2 to 3
8 (6/1997)	146	55-3	4	
8 (6/1997)	146	55-3		4/1 to 4/2
6 (10/1996)	146	55-3	5 to 6	
2 (9/1994)	146	55-3		7
6 (10/1996)	146	55-3	8	
2 (9/1994)	146	55-3		9
6 (10/1996)	146	55-3	10 to 13	
2 (9/1994)	146	55-3		14
6 (10/1996)	146	55-3	15	
10 (1/1998)	146	55-3	16 to 17	
8 (6/1997)	146	55-3	18	
10 (1/1998)	146	55-3	19	
9 (12/1997)	146	55-3	20 to 21	
8 (6/1997)	146	55-3		22 to 23
10 (1/1998)	146	55-3	24	
8 (6/1997)	146	55-3		25 to 26
10 (1/1998)	146	55-3	27	
8 (6/1997)	146	55-3		28
10 (1/1998)	146	55-3	29	
2 (9/1994)	146	55-5		1 to 2
8 (6/1997)	146	55-5		2/1 to 2/2
8 (6/1997)	146	55-5	3	
2 (9/1994)	146	55-5		4
8 (6/1997)	146	55-5	5 to 7	
2 (9/1994)	146	55-5		8
8 (6/1997)	146	55-8	1	
2 (9/1994)	146	55-8		2 to 3
6 (10/1996)	146	55-8	4	
6 (10/1996)	146	55-8		4/1
8 (6/1997)	146	55-8	4/2	
8 (6/1997)	146	55-8		4/3 to 4/4
8 (6/1997)	146	55-8	5 to 10	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	146	55-8		10/1 to 10/2
6 (10/1996)	146	55-8	11	
6 (10/1996)	146	55-8		12
8 (6/1997)	146	55-11	1	
2 (9/1994)	146	55-11		2
6 (10/1996)	146	55-11	3	
8 (6/1997)	146	55-11	4	
8 (6/1997)	146	55-11		4/1 to 4/2
8 (6/1997)	146	55-11	5	
2 (9/1994)	146	55-11		6
8 (6/1997)	146	55-11	7 to 9	
2 (9/1994)	146	55-11		10 to 11
8 (6/1997)	146	55-11	1	
2 (9/1994)	146	55-12		2/1 to 2/2
8 (6/1997)	146	55-11	3 to 8	
8 (6/1997)	146	55-11		8/1 to 8/2
2 (9/1994)	146	55-12		9 to 10
2 (9/1994)	146	55-13		1
8 (6/1997)	146	55-13		2/1 to 2/2
8 (6/1997)	146	55-13	3 to 5	
8 (6/1997)	146	55-14	1	
6 (10/1996)	146	55-14	2	
10 (1/1998)	146	55-14	2/1	
8 (6/1997)	146	55-14		2/2
8 (6/1997)	146	55-14	3	
10 (1/1998)	146	55-14	4	
9 (12/1997)	146	55-14	5	
10 (1/1998)	146	55-14	6 to 7	
8 (6/1997)	146	55-16	1	
2 (9/1994)	146	55-16		2 to 3
6 (10/1996)	146	55-16	4	
8 (6/1997)	146	55-16	4/1 to 4/2	
8 (6/1997)	146	55-16	5 to 9	
2 (9/1994)	146	55-16	6	
6 (10/1996)	146	55-16	7 to 9	
2 (9/1994)	146	55-16	10	
7 (12/1996)	146	55-16	11	
2 (9/1994)	146	55-16		12 to 14
8 (6/1997)	146	55-18	1	
2 (9/1994)	146	55-18		2 to 3
8 (6/1997)	146	55-18	4	
8 (6/1997)	146	55-18		4/1 to 4/2
2 (9/1994)	146	55-18		5 to 8
6 (10/1996)	146	55-18	9	
8 (6/1997)	146	55-18	10	
8 (6/1997)	146	55-18		10/1 to 10/2

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			SOBST.	ADDED
8 (6/1997)	146	55-18	11 to 12	
2 (9/1994)	146	55-18		13
2 (9/1994)	146	55-19		1 to 2
8 (6/1997)	146	55-19		2/1 to 2/2
8 (6/1997)	146	55-19	3 to 4	
2 (9/1994)	146	55-19		5
8 (6/1997)	146	55-19	6	
2 (9/1994)	146	55-19		7
8 (6/1997)	146	55-19	8	
2 (9/1994)	146	55-19		9 to 11
8 (6/1997)	146	55-21	1	
2 (9/1994)	146	55-21		a 2
6 (10/1996)	146	55-21	3	
8 (6/1997)	146	55-21	4	
8 (6/1997)	146	55-21		4/1 to 4/2
8 (6/1997)	146	55-21	5 to 10	
8 (6/1997)	146	55-21		10/1 to 10/2
2 (9/1994)	146	55-21		11 to 13
2 (9/1994)	146	55-22		1
5 (9/1995)	146	55-22	2	
8 (6/1997)	146	55-22		2/1 to 2/2
8 (6/1997)	146	55-22	3 to 6	
2 (9/1994)	146	55-22		7
8 (6/1997)	146	55-23	1	
6 (10/1996)	146	55-23	2 to 3	
8 (6/1997)	146	55-23	4	
8 (6/1997)	146	55-23		4/1 to 4/2
8 (6/1997)	146	55-23	5 to 6	
6 (10/1996)	146	55-23	7	
8 (6/1997)	146	55-23	8 to 9	
2 (9/1994)	146	55-23		10
9 (12/1997)	146	55-23	10/1	
8 (6/1997)	146	55-23		10/2
8 (6/1997)	146	55-23	11 to 14	
8 (6/1997)	146	55-23		14/1 to 14/2
2 (9/1994)	146	55-23		15 to 17
8 (6/1997)	146	55-24	1	
3 (1/1995)	146	55-24	2	
6 (10/1996)	146	55-24		2/1
10 (1/1998)	146	55-24	2/2	
8 (6/1997)	146	55-24	3	
10 (1/1998)	146	55-24	4	
8 (6/1997)	146	55-24	5 to 6	
8 (6/1997)	146	55-24		6/1 to 6/2
3 (1/1995)	146	55-24		7
6 (10/1996)	146	55-24		8

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
6 (10/1996)	146	55-26	1	
2 (9/1994)	146	55-26		2 to 26
2 (9/1994)	146	55-A1		1
10 (1/1998)	146	55-A1	2 to 5	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
VOLUME III				
2 (9/1994)	145-146	-	Frontespice	
2 (9/1994)	145-146	Introd.	1	
7(12/1996)	145-146	55	Index I	
4 (5/1995)	145-146	55	Index II	
7 (12/1996)	145	55	2	
2 (9/1994)	145	55		2/1 to 2/2
10 (1/1998)	145	55	22/1 to 22/3	
4 (5/1995)	145	55		22/3
7 (12/1996)	145	55	22/4 to 22/6	
7 (12/1996)	145	55		22/7 to 22/8
7 (12/1996)	145	55	30	
7 (12/1996)	145	55		30/1 to 30/2
2 (9/1994)	145	55	37	
2 (9/1994)	145	55		38/1
4 (5/1995)	146	55	38/2	
7 (12/1996)	145	55		38/3 to 38/4
7 (12/1996)	145	55	40	
7 (12/1996)	145	55	43 to 44	
5 (9/1995)	145	55		44/1
7 (12/1996)	145	55	44/2	
2(9/1994)	145	55		45 to 46
10 (1/1998)	145	55	Indice	
10 (1/1998)	145	55-1	1	
4 (5/1995)	145	55-1	2	
3 (1/1995)	145	55-1	3 to 6	
2 (9/1994)	145	55-1	7	
3 (1/1995)	145	55-1	8	
4 (5/1995)	145	55-1	9 to 11	
6 (10/1996)	145	55-1	12	
10 (1/1998)	145	55-1	12/1	
8 (6/1997)	145	55-1	12/2	
6 (10/1996)	145	55-1	13 to 18	
10 (1/1998)	145	55-1	18/1	
9 (12/1997)	145	55-1	18/2	
9 (12/1997)	145	55-1	19 to 21	
10 (1/1998)	145	55-1		21/1 to 21/6
10 (1/1998)	145	55-1	22	
8 (6/1997)	145	55-2	3	
10 (1/1998)	145	55-2	4	
2 (9/1994)	145	55-2	5	
9 (12/1997)	145	55-2	6	
8 (6/1997)	145	55-2	6/1	
4 (5/1995)	145	55-2		6/2

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
9 (12/1997)	145	55-2		6/3 to 6/4
6 (10/1996)	145	55-2	7	
2 (9/1994)	145	55-2	8	
8 (6/1997)	145	55-2	9	
9 (12/1997)	145	55-2	10	
10 (1/1998)	145	55-2	11	
9 (12/1997)	145	55-2	12	
10 (1/1998)	145	55-2	13	
8 (6/1997)	145	55-2	14	
9 (12/1997)	145	55-2	15	
10 (1/1998)	145	55-2	16	
9 (12/1997)	145	55-2		16/1 to 16/2
10 (1/1998)	145	55-2	17	
8 (6/1997)	145	55-3	1	
8 (6/1997)	145	55-3	4	
8 (6/1997)	145	55-3		4/1 to 4/2
6 (10/1996)	145	55-3	5 to 6	
6 (10/1996)	145	55-3	8	
6 (10/1996)	145	55-3	10 to 13	
6 (10/1996)	145	55-3	15	
10 (1/1998)	145	55-3	16 to 17	
8 (6/1997)	145	55-3	18	
10 (1/1998)	145	55-3	19	
9 (12/1997)	145	55-3	20 to 21	
8 (6/1997)	145	55-3		22 to 23
10 (1/1998)	145	55-3	24	
8 (6/1997)	145	55-3		25 to 26
10 (1/1998)	145	55-3	27	
8 (6/1997)	145	55-3	28	
10 (1/1998)	145	55-3	29	
10(1/1998)	145	55-4	1	
2 (9/1994)	145	55-4	2 to 7	
4 (5/1995)	145	55-4	8 to 9	
6 (10/1996)	145	55-4		9/1 to 9/2
6(10/1996)	145	55-4	10 to 12	
6 (10/1996)	145	55-4		12/1 to 12/2
6 (10/1996)	145	55-4	13	
9 (12/1997)	145	55-4	14 to 17	
10 (1/1998)	145	55-4	18	
10 (1/1998)	145	55-4		19 to 22
8 (6/1997)	145	55-5		2/1 to 2/2
8 (6/1997)	145	55-5	3	
8 (6/1997)	145	55-5	5 to 7	
8 (6/1997)	145	55-6		2/1 to 2/2
8 (6/1997)	145	55-6	3 to 7	
2 (9/1994)	145	55-6	8	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	145	55-8	1	
6 (10/1996)	145	55-8	4	
6 (10/1996)	145	55-8		4/1
8 (6/1997)	145	55-8	4/2	
8 (6/1997)	145	55-8		4/3 to 4/4
8 (6/1997)	145	55-8	5 to 10	
8 (6/1997)	145	55-8		10/1 to 10/2
6 (10/1996)	145	55-8	11 to 12	
8 (6/1997)	145	55-10	1	
8 (6/1997)	145	55-10		2/1 to 2/2
8 (6/1997)	145	55-10	3	
8 (6/1997)	145	55-10	6 to 8	
8 (6/1997)	145	55-10		8/1 to 8/2
2 (9/1994)	145	55-10	9	
6 (10/1996)	145	55-11	2	
8 (6/1997)	145	55-11		2/1 to 2/2
8 (6/1997)	145	55-11	4	
8 (6/1997)	145	55-11	6	
8 (6/1997)	145	55-12	1	
8 (6/1997)	145	55-12		2/1 to 2/2
8 (6/1997)	145	55-12	3 to 8	
8 (6/1997)	145	55-12		8/1 to 8/2
2 (9/1994)	145	55-13	2	
8 (6/1997)	145	55-13		2/1 to 2/2
8 (6/1997)	145	55-13	3 to 5	
8 (6/1997)	145	55-14	1	
6 (10/1996)	145	55-14	2	
10 (1/1998)	145	55-14	2/1	
8 (6/1997)	145	55-14		2/2
6 (10/1996)	145	55-14	3	
10 (1/1998)	145	55-14	4	
9 (12/1997)	145	55-14	5	
10 (1/1998)	145	55-14	6 to 7	
8 (6/1997)	145	55-15		2/1 to 2/2
8 (6/1997)	145	55-15	3 to 5	
6 (10/1996)	145	55-16	1	
6 (10/1996)	145	55-16	4	
8 (6/1997)	145	55-16	4/1 to 4/2	
8 (6/1997)	145	55-16	5 to 8	
8 (6/1997)	145	55-16		8/1 to 8/2
8 (6/1997)	145	55-16	9	
7 (12/1996)	145	55-16	11	
10 (1/1998)	145	55-17	1	
6 (10/1996)	145	55-17	2 to 4	
10 (1/1998)	145	55-17	4/1	
8 (6/1997)	145	55-17	4/2	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
8 (6/1997)	145	55-17	5 to 7	
10(1/1998)	145	55-17	8	
4 (5/1995)	145	55-17	9 to 10	
10 (1/1998)	145	55-17		10/1 to 10/4
6 (10/1996)	145	55-17	11	
10 (1/1998)	145	55-17	12	
10 (1/1998)	145	55-17	12/1 to 12/2	
10 (1/1998)	145	55-17	13 to 14	
10 (1/1998)	145	55-17	14/1 to 14/2	
9 (12/1997)	145	55-17	16	
9 (12/1997)	145	55-17	16/1 to 16/2	
8 (6/1997)	145	55-17	17 to 18	
9 (12/1997)	145	55-17	19	
10 (1/1998)	145	55-17	20	
4 (5/1995)	145	55-17	21 to 23	
4 (5/1995)	145	55-17	25	
8 (6/1997)	145	55-18	1	
8 (6/1997)	145	55-18	4	
8 (6/1997)	145	55-18		4/1 to 4/2
8 (6/1997)	145	55-18	7	
6 (10/1996)	145	55-18	8	
8 (6/1997)	145	55-18		8/1 to 8/2
8 (6/1997)	145	55-18	9 to 11	
8 (6/1997)	145	55-19		2/1 to 2/1
8 (6/1997)	145	55-19	3 to 4	
8 (6/1997)	145	55-19	6	
10 (1/1998)	145	55-20	2/1	
8 (6/1997)	145	55-20		2/2
8 (6/1997)	145	55-20	3 to 4	
10 (1/1998)	145	55-20	5	
8 (6/1997)	145	55-21	1	
6 (10/1996)	145	55-21	3	
8 (6/1997)	145	55-21	4	
8 (6/1997)	145	55-21		4/1 to 4/2
8 (6/1997)	145	55-21	5 to 8	
8 (6/1997)	145	55-21		8/1 to 8/2
8 (6/1997)	145	55-21	9	
5 (9/1995)	145	55-22	2	
8 (6/1997)	145	55-22		2/1 to 2/2
8 (6/1997)	145	55-22	3 to 6	
8 (6/1997)	145	55-23	1	
6 (10/1996)	145	55-23	2 to 3	
8 (6/1997)	145	55-23	4	
8 (6/1997)	145	55-23		4/1 to 4/2
8 (6/1997)	145	55-23	5 to 9	
6 (10/1996)	145	55-24	1	

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			SOBST.	ADDED
3 (1/1995)	145	55-24	2	
6 (10/1996)	145	55-24		2/1
10 (1/1998)	145	55-24	2/2	
8 (6/1997)	145	55-24	3	
10 (1/1998)	145	55-24	4	
8 (6/1997)	145	55-24	5 to 6	
8 (6/1997)	145	55-24		6/1 to 6/2
3 (1/1995)	145	55-24	7	
6 (10/1996)	145	55-24	8	
8 (6/1997)	145	55-25		2/1 to 2/2
8 (6/1997)	145	55-25	3	
8 (6/1997)	145	55-25	5	
6 (10/1996)	145	55-26	1	
2 (9/1994)	145	55-26	2	
2 (9/1994)	145	55-26	4 to 7	
2 (9/1994)	145	55-26	9 to 11	
2 (9/1994)	145	55-26	13 to 15	
2 (1/1995)	145	55-26	17	
2 (9/1994)	145	55-26	19	
2 (1/1995)	145	55-26	25 to 26	
9 (12/1997)	145	55-27	1	
6 (10/1996)	145	55-27	2	
6 (10/1996)	145	55-27		2/1
9 (12/1997)	145	55-27	2/2 to 2/4	
9 (12/1997)	145	55-27	3 to 4	
9 (12/1997)	145	55-27	4/1 to 4/2	
9 (12/1997)	145	55-27	5 to 10	
6 (10/1996)	145	55-27	11	
2 (9/1994)	145	55-28	1	
8 (6/1997)	145	55-28		2/1 to 2/2
8 (6/1997)	145	55-28	3 to 8	
8 (6/1997)	145	55-29		2/1 to 2/2
8 (6/1997)	145	55-29	3 to 6	
2 (1/1995)	145	55-30	1 to 3	
2 (9/1994)	145	55-30		4
9 (12/1997)	145	55-30A		1 to 5
10 (1/1998)	145	55-30B		1 to 6
8 (6/1997)	145	55-31A	1	
7 (12/1996)	145	55-31A		2 to 3
10 (1/1998)	145	55-31A	4	
8 (6/1997)	145	55-31A		4/1 to 4/2
8 (6/1997)	145	55-31A	5 to 6	
8 (6/1997)	145	55-31A		6/1 to 6/2
8 (6/1997)	145	55-31A	7 to 8	
7 (12/1996)	145	55-32	1	
4 (5/1995)	145	55-32	2	
6 (10/1996)	145	55-32	3	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
2 (9/1994)	145	55-32	9	
6 (10/1996)	145	55-32	10	
6 (10/1996)	145	55-32		10/1 a10.2
6 (10/1996)	145	55-32	11 to 14	
6 (10/1996)	145	55-32		14.1 to 14.2
6 (10/1996)	145	55-32	15	
4 (5/1995)	145	55-32	16 to 20	
4 (5/1995)	145	55-32		20/1 to 20.7
6 (10/1996)	145	55-32	20/8	
6 (10/1996)	145	55-32	21 to 22	
6 (10/1996)	145	55-32		22.1 to 22.2
6 (10/1996)	145	55-32	23 to 27	
4 (5/1995)	145	55-32	28 to 34	
4 (5/1995)	145	55-32		34/1 to 34.4
6 (10/1996)	145	55-32	34/5 to 34/6	
6 (10/1996)	145	55-32	35/1 to 35/2	
6 (10/1996)	145	55-32	36 to 37	
4 (5/1995)	145	55-32	39 to 42	
10 (1/1998)	145	55-32A	1	
7 (12/1996)	145	55-32A		2 to 5
10 (1/1998)	145	55-32A	6	
8 (6/1997)	145	55-32A		6/1 to 6/2
8 (6/1997)	145	55-32A	7 to 9	
7 (12/1996)	145	55-32A		10
9 (12/1997)	145	55-32A	10/1	
8 (6/1997)	145	55-32A		10/2
9 (12/1997)	145	55-32A	11 to 14	
8 (6/1997)	145	55-32A		14/1 to 14.2
8 (6/1997)	145	55-32A	15 to 18	
10 (1/1998)	145	55-32A		18/1 to 18.6
7 (12/1996)	145	55-32A		19 to 20
9 (12/1997)	145	55-32A	20/1 to 20/2	
9 (12/1997)	145	55-32A	21 to 24	
9 (12/1997)	145	55-32A		24/1 to 24.2
8 (6/1997)	145	55-32A	25 to 26	
8 (6/1997)	145	55-32A		26/1 to 26.2
8 (6/1997)	145	55-32A	27 to 28	
8 (6/1997)	145	55-32A		28/1
10 (1/1998)	145	55-32A	28/2	
10 (1/1998)	145	55-32A		28/3 to 28.6
10 (1/1998)	145	55-32A	29	
8 (6/1997)	145	55-32A	30	
10 (1/1998)	145	55-32A		30/1 to 30.2
10 (1/1998)	145	55-32A	31 to 32	
7 (12/1996)	145	55-32A	33 to 36	
10 (1/1998)	145	55-32B	1	
7 (12/1996)	145	55-32B		2 to 5

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			SOBST.	ADDED
10 (1/1998)	145	55-32B	6	
8 (6/1997)	145	55-32B		6/1 to 6/2
7 (12/1996)	145	55-32B		7
8 (6/1997)	145	55-32B	8 to 12	
8 (6/1997)	145	55-32B		12/1 to 12/2
7 (12/1996)	145	55-32B		13
9 (12/1997)	145	55-32B	14	
9 (12/1997)	145	55-32B	14/1 to 14/2	
9 (12/1997)	145	55-32B	15 to 17	
7 (12/1996)	145	55-32B		18
8 (6/1997)	145	55-32B		18/1 to 18/2
8 (6/1997)	145	55-32B	19 to 21	
7 (12/1996)	145	55-32B		22
10 (1/1998)	145	55-32B		22/1 to 22/4
10 (1/1998)	145	55-32B	23	
8 (6/1997)	145	55-32B	24	
10 (1/1998)	145	55-32B		24/1 to 24/2
10 (1/1998)	145	55-32B		25
7 (12/1996)	145	55-32B		26 to 29
8 (6/1997)	145	55-33	1	
2 (9/1994)	145	55-33	1 to 3	
10 (1/1998)	145	55-33	4	
8 (6/1997)	145	55-33		4/1 to 4/2
8 (6/1997)	145	55-33	5 to 8	
2 (1/1995)	145	55-33		9
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9 (12/1997)	145	55	Index	
2 (9/1994)	145	55-34	1 to 2	
3 (1/1995)	145	55-34	3	
2 (9/1994)	145	55-34	4 to 6	
3 (1/1995)	145	55-34	7 to 8	
2 (9/1994)	145	55-34	9 to 13	
3 (1/1995)	145	55-34	14	
2 (9/1994)	145	55-34	15 to 16	
3 (1/1995)	145	55-34	17	
2 (9/1994)	145	55-34	18 a21	
2 (9/1994)	145	55-34		22
2 (9/1994)	145	55-35	1 to 3	
2 (9/1994)	145	55-35	12	
2 (1/1995)	145	55-35A		1
3 (1/1995)	145	55-35A	2	
2 (1/1995)	145	55-35A		3 to 7

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
3 (1/1995)	145	55-35A	8	
2 (1/1995)	145	55-35A		9 to 21
3 (1/1995)	145	55-36	2 to 3	
2 (1/1995)	145	55-36	4 to 5	
3 (1/1995)	145	55-36	6	
2 (9/1994)	146	55-36	7 to 11	
3 (1/1995)	145	55-36	12 to 16	
2 (9/1994)	145	55-36	21	
6 (10/1996)	145	55-36A	1	
4 (5/1995)	145	55-36A		2 to 25
8 (6/1997)	145	55-36B	1	
7 (12/1996)	145	55-36B	2	
6 (10/1996)	145	55-36b		3
8 (6/1997)	145	55-36B	4	
8 (6/1997)	145	55-36B		4/1 to 4/2
6 (10/1996)	145	55-36B		5 to 6
8 (6/1997)	145	55-36B	7	
6 (10/1996)	145	55-36B		8 to 9
8 (6/1997)	145	55-36B	10	
8 (6/1997)	145	55-36B		10/1 to 10/2
8 (6/1997)	145	55-36B	11 to 12	
6 (10/1996)	145	55-36B		13 to 16
8 (6/1997)	145	55-36B	17	
6 (10/1996)	145	55-36B		18 to 24
9 (12/1997)	145	55-36C		1
10 (1/1998)	145	55-36C	2	
9 (12/1997)	145	55-36C		3 to 4
10 (1/1998)	145	55-36C	5	
9 (12/1997)	145	55-36C		6 to 11
10 (1/1998)	145	55-36C	12 to 13	
9 (12/1997)	145	55-36C		14
10 (1/1998)	145	55-36C	15	
9 (12/1997)	145	55-36C		16 to 18
6 (10/1996)	145	55-37	1	
4 (5/1995)	145	55-37	2 to 4	
4 (5/1995)	145	55-37		4/1 to 4/2
2 (9/1994)	145	55-37	5	
4 (5/1995)	145	55-37	6 to 19	
6 (10/1996)	145	55-37A	1 to 3	
4 (5/1995)	145	55-37A		4 to 5
6 (10/1996)	145	55-37A	6 to 9	
6 (10/1996)	145	55-37A		9/1
8 (6/1997)	145	55-37A	9/2	
7 (12/1996)	145	55-37A	10	
4 (5/1995)	145	55-37A		11
8 (6/1997)	145	55-37A	12	

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			SOBST.	ADDED
6 (10/1996)	145	55-37A	13	
8 (6/1997)	145	55-37A	14	
6 (10/1996)	145	55-37A		14/1 to 14/4
8 (6/1997)	145	55-37A	15	
6 (10/1996)	145	55-37A	16	
7 (12/1996)	145	55-37A		
4 (5/1995)	145	55-37A		17 to 18
5 (9/1995)	145	55-37A	19	
4 (5/1995)	145	55-37A		20 to 21
10 (1/1998)	145	55-37B		1 to 21
10 (1/1998)	145	55-38	1	
6 (10/1996)	145	55-38	2	
2 (9/1994)	145	55-38	7	
6 (10/1996)	145	55-38	8	
8 (6/1997)	145	55-38		8/1 to 8/2
8 (6/1997)	145	55-38	9 to 10	
6 (10/1996)	145	55-38	11	
8 (6/1997)	145	55-38	12	
6 (10/1996)	145	55-38	12/1 to 12/2	
9 (12/1997)	145	55-38	12/3 to 12/8	
9 (12/1997)	145	55-38		12/9 to 12/10
10 (1/1998)	145	55-38		12/11 to 12/16
10 (1/1998)	145	55-38	13	
6 (10/1996)	145	55-38	14	
2 (9/1994)	145	55-39	2	
2 (9/1994)	145	55-39	6	
2 (9/1994)	145	55-39	9	
2 (9/1994)	145	55-39	17	
9 (12/1997)	145	55-39A	1	
6 (10/1996)	145	55-39A		2
8 (6/1997)	145	55-39A		2/1 to 2/2
8 (6/1997)	145	55-39A	3 to 6	
6 (10/1996)	145	55-39A		7 to 13
9 (12/1997)	145	55-39B		1 to 2
10 (1/1998)	145	55-39B	3	
9 (12/1997)	145	55-39B		4
10 (1/1998)	145	55-39B	5	
9 (12/1997)	145	55-39B		6 to 9
10 (1/1998)	145	55-40	1	
1 (9/1994)	145	55-40		2 to 6
6 (10/1996)	145	55-40	7	
1 (9/1994)	145	55-40		8 to 10
2 (9/1994)	145	55-40	11 to 12	
1 (9/1994)	145	55-40		13 to 14
6 (10/1996)	145	55-40	15 to 16	
6 (10/1996)	145	55-40		16/1

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			SOBST.	ADDED
9 (12/1997)	145	55-40	16/2 to 16/4	
6 (10/1996)	145	55-40	17 to 18	
8 (6/1997)	145	55-40		18/1
10 (1/1998)	145	55-40	18/2	
10 (1/1998)	145	55-40	19 to 20	
9 (12/1997)	145	55-40	21	
10 (1/1998)	145	55-40	22	
9 (12/1997)	145	55-40	23	
10 (1/1998)	145	55-40	24	
10 (1/1998)	145	55-40	24/1	
9 (12/1997)	145	55-40	24/2	
9 (12/1997)	145	55-40	25	
10 (1/1998)	145	55-40	26	
10 (1/1998)	145	55-40		26/1 to 26/2
1 (1/1994)	145	55-40		27 to 28
3 (1/1995)	145	55-40	29	
9 (12/1997)	145	55-41		1
10 (1/1998)	145	55-41	2 to 6	
10 (1/1998)	145	55-A1	2 to 4	
10 (1/1998)	146	55	Indice	
10 (1/1998)	146	55-1	1	
5 (9/1995)	146	55-1	2	
3 (1/1995)	146	55-1	3 to 6	
2 (9/1994)	146	55-1		7
3 (1/1995)	146	55-1	8	
4 (5/1995)	146	55-1	9 to 11	
6 (10/1996)	146	55-1	12	
10 (1/1998)	146	55-1	12/1	
8 (6/1997)	146	55-1	12/2	
6 (10/1996)	146	55-1	13 to 17	
10 (6/1998)	146	55-1	18/1	
9 (12/1997)	146	55-1	18/2	
10 (1/1998)	146	55-1	19	
9 (12/1997)	146	55-1	20 to 21	
10 (1/1998)	146	55-1		21/1 to 21/6
10 (1/1998)	146	55-1	22	
2 (9/1994)	146	55-2		1 to 2
8 (6/1997)	146	55-2	3	
10 (1/1998)	146	55-2	4	
2 (9/1994)	146	55-2		5
9 (12/1997)	146	55-2	6	
8 (6/1997)	146	55-2	6/1	
5 (9/1995)	146	55-2		6/2
9 (12/1997)	146	55-2		6/3 to 6/4

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			SOBST.	ADDED
6 (10/1996)	146	55-2	7	
2 (9/1994)	146	55-2		8
8 (6/1997)	146	55-2	9	
9 (12/1997)	146	55-2	10	
10 (1/1998)	146	55-2	11	
9 (12/1997)	146	55-2	12	
10 (1/1998)	146	55-2	13	
9 (12/1997)	146	55-2	14 to 15	
10 (1/1998)	146	55-2	16	
9 (12/1997)	146	55-2		16/1 to 16/2
10 (1/1997)	146	55-2	17	
9 (12/1997)	146	55-2	19	
8 (6/1997)	146	55-3	1	
2 (9/1994)	146	55-3		2 to 3
8 (6/1997)	146	55-3	4	
8 (6/1997)	146	55-3		4/1 to 4/2
6 (10/1996)	146	55-3	5 to 6	
2 (9/1994)	146	55-3		7
6 (10/1996)	146	55-3	8	
2 (9/1994)	146	55-3		9
6 (10/1996)	146	55-3	10 to 13	
2 (9/1994)	146	55-3		14
6 (10/1996)	146	55-3	15	
10 (1/1998)	146	55-3	16 to 17	
8 (6/1997)	146	55-3	18	
10 (1/1998)	146	55-3	19	
9 (12/1997)	146	55-3	20 to 21	
8 (6/1997)	146	55-3		22 to 23
10 (1/1998)	146	55-3	24	
8 (6/1997)	146	55-3		25 to 26
10 (1/1998)	146	55-3	27	
8 (6/1997)	146	55-3		28
10 (1/1998)	146	55-3	29	
2 (9/1994)	146	55-5		1 to 2
8 (6/1997)	146	55-5		2/1 to 2/2
8 (6/1997)	146	55-5	3	
2 (9/1994)	146	55-5		4
8 (6/1997)	146	55-5	5 to 7	
2 (9/1994)	146	55-5		8
8 (6/1997)	146	55-8	1	
2 (9/1994)	146	55-8		2 to 3
6 (10/1996)	146	55-8	4	
6 (10/1996)	146	55-8		4/1
8 (6/1997)	146	55-8	4/2	
8 (6/1997)	146	55-8		4/3 to 4/4
8 (6/1997)	146	55-8	5 to 10	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	146	55-8		10/1 to 10/2
6 (10/1996)	146	55-8	11	
6 (10/1996)	146	55-8		12
8 (6/1997)	146	55-11	1	
2 (9/1994)	146	55-11		2
6 (10/1996)	146	55-11	3	
8 (6/1997)	146	55-11	4	
8 (6/1997)	146	55-11		4/1 to 4/2
8 (6/1997)	146	55-11	5	
2 (9/1994)	146	55-11		6
8 (6/1997)	146	55-11	7 to 9	
2 (9/1994)	146	55-11		10 to 11
8 (6/1997)	146	55-11	1	
2 (9/1994)	146	55-12		2/1 to 2/2
8 (6/1997)	146	55-11	3 to 8	
8 (6/1997)	146	55-11		8/1 to 8/2
2 (9/1994)	146	55-12		9 to 10
2 (9/1994)	146	55-13		1
8 (6/1997)	146	55-13		2/1 to 2/2
8 (6/1997)	146	55-13	3 to 5	
8 (6/1997)	146	55-14	1	
6 (10/1996)	146	55-14	2	
10 (1/1998)	146	55-14	2/1	
8 (6/1997)	146	55-14		2/2
8 (6/1997)	146	55-14	3	
10 (1/1998)	146	55-14	4	
9 (12/1997)	146	55-14	5	
10 (1/1998)	146	55-14	6 to 7	
8 (6/1997)	146	55-16	1	
2 (9/1994)	146	55-16		2 to 3
6 (10/1996)	146	55-16	4	
8 (6/1997)	146	55-16	4/1 to 4/2	
8 (6/1997)	146	55-16	5 to 9	
2 (9/1994)	146	55-16	6	
6 (10/1996)	146	55-16	7 to 9	
2 (9/1994)	146	55-16	10	
7 (12/1996)	146	55-16	11	
2 (9/1994)	146	55-16		12 to 14
8 (6/1997)	146	55-18	1	
2 (9/1994)	146	55-18		2 to 3
8 (6/1997)	146	55-18	4	
8 (6/1997)	146	55-18		4/1 to 4/2
2 (9/1994)	146	55-18		5 to 8
6 (10/1996)	146	55-18	9	
8 (6/1997)	146	55-18	10	
8 (6/1997)	146	55-18		10/1 to 10/2

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			SOBST.	ADDED
8 (6/1997)	146	55-18	11 to 12	
2 (9/1994)	146	55-18		13
2 (9/1994)	146	55-19		1 to 2
8 (6/1997)	146	55-19		2/1 to 2/2
8 (6/1997)	146	55-19	3 to 4	
2 (9/1994)	146	55-19		5
8 (6/1997)	146	55-19	6	
2 (9/1994)	146	55-19		7
8 (6/1997)	146	55-19	8	
2 (9/1994)	146	55-19		9 to 11
8 (6/1997)	146	55-21	1	
2 (9/1994)	146	55-21		a 2
6 (10/1996)	146	55-21	3	
8 (6/1997)	146	55-21	4	
8 (6/1997)	146	55-21		4/1 to 4/2
8 (6/1997)	146	55-21	5 to 10	
8 (6/1997)	146	55-21		10/1 to 10/2
2 (9/1994)	146	55-21		11 to 13
2 (9/1994)	146	55-22		1
5 (9/1995)	146	55-22	2	
8 (6/1997)	146	55-22		2/1 to 2/2
8 (6/1997)	146	55-22	3 to 6	
2 (9/1994)	146	55-22		7
8 (6/1997)	146	55-23	1	
6 (10/1996)	146	55-23	2 to 3	
8 (6/1997)	146	55-23	4	
8 (6/1997)	146	55-23		4/1 to 4/2
8 (6/1997)	146	55-23	5 to 6	
6 (10/1996)	146	55-23	7	
8 (6/1997)	146	55-23	8 to 9	
2 (9/1994)	146	55-23		10
9 (12/1997)	146	55-23	10/1	
8 (6/1997)	146	55-23		10/2
8 (6/1997)	146	55-23	11 to 14	
8 (6/1997)	146	55-23		14/1 to 14/2
2 (9/1994)	146	55-23		15 to 17
8 (6/1997)	146	55-24	1	
3 (1/1995)	146	55-24	2	
6 (10/1996)	146	55-24		2/1
10 (1/1998)	146	55-24	2/2	
8 (6/1997)	146	55-24	3	
10 (1/1998)	146	55-24	4	
8 (6/1997)	146	55-24	5 to 6	
8 (6/1997)	146	55-24		6/1 to 6/2
3 (1/1995)	146	55-24		7
6 (10/1996)	146	55-24		8

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
6 (10/1996)	146	55-26	1	
2 (9/1994)	146	55-26		2 to 26
2 (9/1994)	146	55-A1		1
10 (1/1998)	146	55-A1	2 to 3	

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UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
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2 (9/1994)	145-146	-	Frontespice	
2 (9/1994)	145-146	Introd.	1	
7(12/1996)	145-146	55	Index I	
4 (5/1995)	145-146	55	Index II	
7 (12/1996)	145	55	2	
2 (9/1994)	145	55		2/1 to 2/2
4 (5/1995)	145	55		22/1 to 22/3
7 (12/1996)	145	55	22/4 to 22/6	
7 (12/1996)	145	55		22/7 to 22/8
7 (12/1996)	145	55	30	
7 (12/1996)	145	55		30/1 to 30/2
2 (9/1994)	145	55	37	
2 (9/1994)	145	55		38/1
4 (5/1995)	146	55	38/2	
7 (12/1996)	145	55		38/3 to 38/4
7 (12/1996)	145	55	40	
7 (12/1996)	145	55	43 to 44	
5 (9/1995)	145	55		44/1
7 (12/1996)	145	55	44/2	
2(9/1994)	145	55		45 to 46
7 (12/1996)	145	55	Index	
8 (6/1997)	145	55-1	1	
4 (5/1995)	145	55-1	2	
3 (1/1995)	145	55-1	3 to 6	
2 (9/1994)	145	55-1	7	
3 (1/1995)	145	55-1	8	
4 (5/1995)	145	55-1	9 to 11	
6 (10/1996)	145	55-1	12	
8 (6/1997)	145	55-1	12/1 to 12/2	
6 (10/1996)	145	55-1	13 to 18	
8 (6/1997)	145	55-1	18/1 to 18/2	
6 (10/1996)	145	55-1	19 to 20	
4 (5/1995)	145	55-1	21 to 22	
8 (6/1997)	145	55-2	3 to 4	
2 (9/1994)	145	55-2	5	
8 (6/1997)	145	55-2	6	
8 (6/1997)	145	55-2	6/1	
4 (5/1995)	145	55-2		6/2
6 (10/1996)	145	55-2	7	
2 (9/1994)	145	55-2	8	
8 (6/1997)	145	55-2	9	
8 (6/1997)	145	55-2	11	
6 (10/1996)	145	55-2	12	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
8 (6/1997)	145	55-2	13 to 14	
6 (10/1996)	145	55-2	15	
8 (6/1997)	145	55-2	16	
6 (10/1996)	145	55-2	17	
8 (6/1997)	145	55-3	1	
8 (6/1997)	145	55-3	4	
8 (6/1997)	145	55-3		4/1 to 4/2
6(10/1996)	145	55-3	5 to 6	
6(10/1996)	145	55-3	8	
6 (10/1996)	145	55-3	10 to 13	
6 (10/1996)	145	55-3	15	
8 (6/1997)	145	55-3	16 to 20	
8 (6/1997)	145	55-3		21 to 29
6 (10/1996)	145	55-4	1	
2 (9/1994)	145	55-4	2 to 7	
4 (5/1995)	145	55-4	8 to 9	
6 (10/1996)	145	55-4		9/1 to 9/2
6(10/1996)	145	55-4	10 to 12	
6 (10/1996)	145	55-4		12/1 to 12/2
6 (10/1996)	145	55-4	13	
4 (5/1995)	145	55-4	14 to 18	
8 (6/1997)	145	55-5		2/1 to 2/2
8 (6/1997)	145	55-5	3	
8 (6/1997)	145	55-5	5 to 7	
8 (6/1997)	145	55-6		2/1 to 2/2
8 (6/1997)	145	55-6	3 to 7	
2 (9/1994)	145	55-6	8	
8 (6/1997)	145	55-8	1	
6 (10/1996)	145	55-8	4	
6 (10/1996)	145	55-8		4/1
8 (6/1997)	145	55-8	4/2	
8 (6/1997)	145	55-8		4/3 to 4/4
8 (6/1997)	145	55-8	5 to 10	
8 (6/1997)	145	55-8		10/1 to 10/2
6 (10/1996)	145	55-8	11 to 12	
8 (6/1997)	145	55-10	1	
8 (6/1997)	145	55-10		2/1 to 2/2
8 (6/1997)	145	55-10	3	
8 (6/1997)	145	55-10	6 to 8	
8 (6/1997)	145	55-10		8/1 to 8/2
2 (9/1994)	145	55-10	9	
6 (10/1996)	145	55-11	2	
8 (6/1997)	145	55-11		2/1 to 2/2
8 (6/1997)	145	55-11	4	
8 (6/1997)	145	55-11	6	
8 (6/1997)	145	55-12	1	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	145	55-12		2/1 to 2/2
8 (6/1997)	145	55-12	3 to 8	
8 (6/1997)	145	55-12		8/1 to 8/2
2 (9/1994)	145	55-13	2	
8 (6/1997)	145	55-13		2/1 to 2/2
8 (6/1997)	145	55-13	3 to 5	
8 (6/1997)	145	55-14	1	
6 (10/1996)	145	55-14	2	
8 (6/1997)	145	55-14		2/1 to 2/2
6 (10/1996)	145	55-14	3	
8 (6/1997)	145	55-14	4 to 7	
8 (6/1997)	145	55-15		2/1 to 2/2
8 (6/1997)	145	55-15	3 to 5	
6 (10/1996)	145	55-16	1	
6 (10/1996)	145	55-16	4	
8 (6/1997)	145	55-16	4/1 to 4/2	
8 (6/1997)	145	55-16	5 to 8	
8 (6/1997)	145	55-16		8/1 to 8/2
8 (6/1997)	145	55-16	9	
7 (12/1996)	145	55-16	11	
8 (6/1997)	145	55-17	1	
6 (10/1996)	145	55-17	2 to 4	
6 (10/1996)	145	55-17		4/1
8 (6/1997)	145	55-17	4/2	
8 (6/1997)	145	55-17	5 to 7	
4 (5/1995)	145	55-17	8 to 10	
6 (10/1996)	145	55-17	11	
8 (6/1997)	145	55-17	12	
8 (6/1997)	145	55-17		12/1 to 12/2
8 (6/1997)	145	55-17	13	
6 (10/1996)	145	55-17	14	
4 (5/1995)	145	55-17	19	
8 (6/1997)	145	55-17	16	
8 (6/1997)	145	55-17		16/1 to 16/2
8 (6/1997)	145	55-17	17 to 20	
4 (5/1995)	145	55-17	21 to 23	
4 (5/1995)	145	55-17	25	
8 (6/1997)	145	55-18	1	
8 (6/1997)	145	55-18	4	
8 (6/1997)	145	55-18		4/1 to 4/2
8 (6/1997)	145	55-18	7	
6 (10/1996)	145	55-18	8	
8 (6/1997)	145	55-18		8/1 to 8/2
8 (6/1997)	145	55-18	9 to 11	
8 (6/1997)	145	55-19		2/1 to 2/1
8 (6/1997)	145	55-19	3 to 4	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
8 (6/1997)	145	55-19	6	
8 (6/1997)	145	55-20		2/1 to 2/2
8 (6/1997)	145	55-20	3 to 4	
8 (6/1997)	145	55-21	1	
6 (10/1996)	145	55-21	3	
8 (6/1997)	145	55-21	4	
8 (6/1997)	145	55-21		4/1 to 4/2
8 (6/1997)	145	55-21	5 to 8	
8 (6/1997)	145	55-21		8/1 to 8/2
8 (6/1997)	145	55-21	9	
5 (9/1995)	145	55-22	2	
8 (6/1997)	145	55-22		2/1 to 2/2
8 (6/1997)	145	55-22	3 to 6	
8 (6/1997)	145	55-23	1	
6 (10/1996)	145	55-23	2 to 3	
8 (6/1997)	145	55-23	4	
8 (6/1997)	145	55-23		4/1 to 4/2
8 (6/1997)	145	55-23	5 to 9	
6 (10/1996)	145	55-24	1	
3 (1/1995)	145	55-24	2	
6 (10/1996)	145	55-24		2.1
8 (6/1997)	145	55-24	2/2	
8 (6/1997)	145	55-24	3 to 6	
8 (6/1997)	145	55-24		6/1 to 6/2
3 (1/1995)	145	55-24	7	
6 (10/1996)	145	55-24	8	
8 (6/1997)	145	55-25		2/1 to 2/2
8 (6/1997)	145	55-25	3	
8 (6/1997)	145	55-25	5	
6 (10/1996)	145	55-26	1	
2 (9/1994)	145	55-26	2	
2 (9/1994)	145	55-26	4 to 7	
2 (9/1994)	145	55-26	9 to 11	
2 (9/1994)	145	55-26	13 to 15	
2 (1/1995)	145	55-26	17	
2 (9/1994)	145	55-26	19	
2 (1/1995)	145	55-26	25 to 26	
8 (6/1997)	145	55-27	1	
6 (10/1996)	145	55-27	2	
6 (10/1996)	145	55-27		2/1 to 2/4
6 (10/1996)	145	55-27	4	
6 (10/1996)	145	55-27		4/1
8 (6/1997)	145	55-27	4/2	
8 (6/1997)	145	55-27		4/3 to 4/4
8 (6/1997)	145	55-27	5 to 6	
6 (10/1996)	145	55-27	7	

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			SOBST.	ADDED
8 (6/1997)	145	55-27	8	
6 (10/1996)	145	55-27	9 to 11	
2 (9/1994)	145	55-28	1	
8 (6/1997)	145	55-28		2/1 to 2/2
8 (6/1997)	145	55-28	3 to 8	
8 (6/1997)	145	55-29		2/1 to 2/2
8 (6/1997)	145	55-29	3 to 6	
2 (1/1995)	145	55-30	1 to 3	
2 (9/1994)	145	55-30		4
8 (6/1997)	145	55-31A	1	
7 (12/1996)	145	55-31A		2 to 3
8 (6/1997)	145	55-31A	4	
8 (6/1997)	145	55-31A		4/1 to 4/2
8 (6/1997)	145	55-31A	5 to 6	
8 (6/1997)	145	55-31A		6/1 to 6/2
8 (6/1997)	145	55-31A	7 to 8	
7 (12/1996)	145	55-32	1	
4 (5/1995)	145	55-32	2	
6 (10/1996)	145	55-32	3	
2 (9/1994)	145	55-32	9	
6 (10/1996)	145	55-32	10	
6 (10/1996)	145	55-32		10/1 a10/2
6 (10/1996)	145	55-32	11 to 14	
6 (10/1996)	145	55-32		14/1 to 14/2
6 (10/1996)	145	55-32	15	
4 (5/1995)	145	55-32	16 to 20	
4 (5/1995)	145	55-32		20/1 to 20/7
6 (10/1996)	145	55-32	20/8	
6 (10/1996)	145	55-32	21 to 22	
6 (10/1996)	145	55-32		22/1 to 22/2
6 (10/1996)	145	55-32	23 to 27	
4 (5/1995)	145	55-32	28 to 34	
4 (5/1995)	145	55-32		34/1 to 34/4
6 (10/1996)	145	55-32	34/5 to 34/6	
6 (10/1996)	145	55-32	35/1 to 35/2	
6 (10/1996)	145	55-32	36 to 37	
4 (5/1995)	145	55-32	39 to 42	
8 (6/1997)	145	55-32A	1	
7 (12/1996)	145	55-32A		2 to 5
8 (6/1997)	145	55-32A	6	
8 (6/1997)	145	55-32A		6/1 to 6/2
8 (6/1997)	145	55-32A	7 to 9	
7 (12/1996)	145	55-32A		10
8 (6/1997)	145	55-32A		10/1 to 10/2
8 (6/1997)	145	55-32A	11 to 14	
8 (6/1997)	145	55-32A		14/1 to 14/2

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SUBST.	ADDED
8 (6/1997)	145	55-32A	15 to 18	
7 (12/1996)	145	55-32A		19 to 20
8 (6/1997)	145	55-32A		20/1 to 20/2
8 (6/1997)	145	55-32A	21 to 26	
8 (6/1997)	145	55-32A		26/1 to 26/2
8 (6/1997)	145	55-32A	27 to 28	
8 (6/1997)	145	55-32A		28/1 to 28/2
8 (6/1997)	145	55-32A	29 to 30	
7 (12/1996)	145	55-32A	31 to 36	
8 (6/1997)	145	55-32B	1	
7 (12/1996)	145	55-32B		2 to 5
8 (6/1997)	145	55-32B	6	
8 (6/1997)	145	55-32B		6/1 to 6/2
7 (12/1996)	145	55-32B		7
8 (6/1997)	145	55-32B	8 to 12	
8 (6/1997)	145	55-32B		12/1 to 12/2
7 (12/1996)	145	55-32B		13
			14	
8 (6/1997)	145	55-32B		14/1 to 14/2
8 (6/1997)	145	55-32B	15	
7 (12/1996)	145	55-32B		16
8 (6/1997)	145	55-32B		18/1 to 18/2
8 (6/1997)	145	55-32B	19 to 21	
7 (12/1996)	145	55-32B		22
8 (6/1997)	145	55-32B	23 to 24	
7 (12/1996)	145	55-32B		25 to 29
8 (6/1997)	145	55-33	1	
2 (9/1994)	145	55-33	1 to 3	
8 (6/1997)	145	55-33	4	
8 (6/1997)	145	55-33		4/1 to 4/2
8 (6/1997)	145	55-33	5 to 8	
2 (1/1995)	145	55-33		9

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7 (12/1996)	145	55	Index	
2 (9/1994)	145	55-34	1 to 2	
3 (1/1995)	145	55-34	3	
2 (9/1994)	145	55-34	4 to 6	
3 (1/1995)	145	55-34	7 to 8	
2 (9/1994)	145	55-34	9 to 13	
3 (1/1995)	145	55-34	14	
2 (9/1994)	145	55-34	15 to 16	
3 (1/1995)	145	55-34	17	
2 (9/1994)	145	55-34	18 a21	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
2 (9/1994)	145	55-34		22
2 (9/1994)	145	55-35	1 to 3	
2 (9/1994)	145	55-35	12	
2 (1/1995)	145	55-35A		1
3 (1/1995)	145	55-35A	2	
2 (1/1995)	145	55-35A		3 to 7
3 (1/1995)	145	55-35A	8	
2 (1/1995)	145	55-35A		9 to 21
3 (1/1995)	145	55-36	2 to 3	
2 (1/1995)	145	55-36	4 to 5	
3 (1/1995)	145	55-36	6	
2 (9/1994)	146	55-36	7 to 11	
3 (1/1995)	145	55-36	12 to 16	
2 (9/1994)	145	55-36	21	
6 (10/1996)	145	55-36A	1	
4 (5/1995)	145	55-36A		2 to 25
8 (6/1997)	145	55-36B	1	
7 (12/1996)	145	55-36B	2	
6 (10/1996)	145	55-36b		3
8 (6/1997)	145	55-36B	4	
8 (6/1997)	145	55-36B		4/1 to 4/2
6 (10/1996)	145	55-36B		5 to 6
8 (6/1997)	145	55-36B	7	
6 (10/1996)	145	55-36B		8 to 9
8 (6/1997)	145	55-36B	10	
8 (6/1997)	145	55-36B		10/1 to 10/2
8 (6/1997)	145	55-36B	11 to 12	
6 (10/1996)	145	55-36B		13 to 16
8 (6/1997)	145	55-36B	17	
6 (10/1996)	145	55-36B		18 to 24
6 (10/1996)	145	55-37	1	
4 (5/1995)	145	55-37	2 to 4	
4 (5/1995)	145	55-37		4/1 to 4/2
2 (9/1994)	145	55-37	5	
4 (5/1995)	145	55-37	6 to 19	
6 (10/1996)	145	55-37A	1 to 3	
4 (5/1995)	145	55-37A		4 to 5
6 (10/1996)	145	55-37A	6 to 9	
6 (10/1996)	145	55-37A		9/1
8 (6/1997)	145	55-37A	9/2	
7 (12/1996)	145	55-37A	10	
4 (5/1995)	145	55-37A		11
8 (6/1997)	145	55-37A	12	
6 (10/1996)	145	55-37A	13	
8 (6/1997)	145	55-37A	14	
6 (10/1996)	145	55-37A		14/1 to 14/4

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	145	55-37A	15	
6 (10/1996)	145	55-37A	16	
7 (12/1996)	145	55-37A		
4 (5/1995)	145	55-37A		17 to 18
5 (9/1995)	145	55-37A	19	
4 (5/1995)	145	55-37A		20 to 21
8 (6/1997)	145	55-38	1	
6 (10/1996)	145	55-38	2	
2 (9/1994)	145	55-38	7	
6 (10/1996)	145	55-38	8	
8 (6/1997)	145	55-38		8/1 to 8/2
8 (6/1997)	145	55-38	9 to 10	
6 (10/1996)	145	55-38	11	
8 (6/1997)	145	55-38	12	
6 (10/1996)	145	55-38	12/1 to 12/2	
8 (6/1997)	145	55-38	12/3 to 12/8	
6 (10/1996)	145	55-38	13 to 14	
2 (9/1994)	145	55-39	2	
2 (9/1994)	145	55-39	6	
2 (9/1994)	145	55-39	9	
2 (9/1994)	145	55-39	17	
6 (10/1996)	145	55-39A		1 to 2
8 (6/1997)	145	55-39A		2/1 to 2/2
8 (6/1997)	145	55-39A	3 to 6	
6 (10/1996)	145	55-39A		7 to 13
4 (5/1995)	145	55-40	1	
1 (9/1994)	145	55-40		2 to 6
6 (10/1996)	145	55-40	7	
1 (9/1994)	145	55-40		8 to 10
2 (9/1994)	145	55-40	11 to 12	
1 (9/1994)	145	55-40		13 to 14
6 (10/1996)	145	55-40	15 to 16	
6 (10/1996)	145	55-40		16/1
8 (6/1997)	145	55-40	16/2	
8 (6/1997)	145	55-40		16/3 to 16/4
6 (10/1996)	145	55-40	17 to 18	
8 (6/1997)	145	55-40		18/1 to 18/2
8 (6/1997)	145	55-40	19	
6 (10/1996)	145	55-40	20 to 23	
8 (6/1997)	145	55-40	24	
6 (10/1996)	145	55-40		24/1 to 24/2
6 (10/1996)	145	55-40	25	
8 (6/1997)	145	55-40	26	
1 (1/1994)	145	55-40		27 to 28
3 (1/1995)	145	55-40	29	
4 (5/1995)	145	55-A1	2	

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			SOBST.	ADDED
8 (6/1997)	145	55-A1	3	
7 (12/1996)	145	55-A1	4	
7 (12/1996)	146	55	Index	
8 (6/1997)	146	55-1	1	
5 (9/1995)	146	55-1	2	
3 (1/1995)	146	55-1	3 to 6	
2 (9/1994)	146	55-1		7
3 (1/1995)	146	55-1	8	
4 (5/1995)	146	55-1	9 to 11	
6 (10/1996)	146	55-1	12	
8 (6/1997)	146	55-1	12/1 to 12/2	
6 (10/1996)	146	55-1	13 to 18	
8 (6/1997)	146	55-1	18/1 to 18/2	
6 (10/1996)	146	55-1	19 to 20	
5 (9/1995)	146	55-1		21 to 22
2 (9/1994)	146	55-2		1 to 2
8 (6/1997)	146	55-2	3 to 4	
2 (9/1994)	146	55-2		5
8 (6/1997)	146	55-2	6	
8 (6/1997)	146	55-2	6/1	
5 (9/1995)	146	55-2		6/2
6 (10/1996)	146	55-2	7	
2 (9/1994)	146	55-2		8
8 (6/1997)	146	55-2	9	
2 (9/1994)	146	55-2		10
8 (6/1997)	146	55-2	11	
6 (10/1996)	146	55-2	12	
8 (6/1997)	146	55-2	13 to 16	
6 (10/1996)	146	55-2	17	
8 (6/1997)	146	55-3	1	
2 (9/1994)	146	55-3		2 to 3
8 (6/1997)	146	55-3	4	
8 (6/1997)	146	55-3		4/1 to 4/2
6 (10/1996)	146	55-3	5 to 6	
2 (9/1994)	146	55-3		7
6 (10/1996)	146	55-3	8	
2 (9/1994)	146	55-3		9
6 (10/1996)	146	55-3	10 to 13	
2 (9/1994)	146	55-3		14
6 (10/1996)	146	55-3	15	
8 (6/1997)	146	55-3	16 to 20	
8 (6/1997)	146	55-3		21 to 29
2 (9/1994)	146	55-5		1 to 2
8 (6/1997)	146	55-5		2/1 to 2/2
8 (6/1997)	146	55-5	3	

UPDATE CHART

UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
2 (9/1994)	146	55-5		4
8 (6/1997)	146	55-5	5 to 7	
2 (9/1994)	146	55-5		8
8 (6/1997)	146	55-8	1	
2 (9/1994)	146	55-8		2 to 3
6 (10/1996)	146	55-8	4	
6 (10/1996)	146	55-8		4/1
8 (6/1997)	146	55-8	4/2	
8 (6/1997)	146	55-8		4/3 to 4/4
8 (6/1997)	146	55-8	5 to 10	
8 (6/1997)	146	55-8		10/1 to 10/2
6 (10/1996)	146	55-8	11	
6 (10/1996)	146	55-8		12
8 (6/1997)	146	55-11	1	
2 (9/1994)	146	55-11		2
6 (10/1996)	146	55-11	3	
8 (6/1997)	146	55-11	4	
8 (6/1997)	146	55-11		4/1 to 4/2
8 (6/1997)	146	55-11	5	
2 (9/1994)	146	55-11		6
8 (6/1997)	146	55-11	7 to 9	
2 (9/1994)	146	55-11		10 to 11
8 (6/1997)	146	55-11	1	
2 (9/1994)	146	55-12		2/1 to 2/2
8 (6/1997)	146	55-11	3 to 8	
8 (6/1997)	146	55-11		8/1 to 8/2
2 (9/1994)	146	55-12		9 to 10
2 (9/1994)	146	55-13		1
8 (6/1997)	146	55-13		2/1 to 2/2
8 (6/1997)	146	55-13	3 to 5	
8 (6/1997)	146	55-14	1	
6 (10/1996)	146	55-14	2	
8 (6/1997)	146	55-14		2/1 to 2/2
8 (6/1997)	146	55-14	3 to 7	
2 (9/1994)	146	55-14		8 to 10
8 (6/1997)	146	55-16	1	
2 (9/1994)	146	55-16		2 to 3
6 (10/1996)	146	55-16	4	
8 (6/1997)	146	55-16	4/1 to 4/2	
8 (6/1997)	146	55-16	5 to 9	
2 (9/1994)	146	55-16	6	
6 (10/1996)	146	55-16	7 to 9	
2 (9/1994)	146	55-16	10	
7 (12/1996)	146	55-16	11	
2 (9/1994)	146	55-16		12 to 14
8 (6/1997)	146	55-18	1	

UPDATE CHART

146
146
VOLUME III
REPAIR
INSTRUCTIONS

UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
2 (9/1994)	146	55-18		2 to 3
8 (6/1997)	146	55-18	4	
8 (6/1997)	146	55-18		4/1 to 4/2
2 (9/1994)	146	55-18		5 to 8
6 (10/1996)	146	55-18	9	
8 (6/1997)	146	55-18	10	
8 (6/1997)	146	55-18		10/1 to 10/2
8 (6/1997)	146	55-18	11 to 12	
2 (9/1994)	146	55-18		13
2 (9/1994)	146	55-19		1 to 2
8 (6/1997)	146	55-19		2/1 to 2/2
8 (6/1997)	146	55-19	3 to 4	
2 (9/1994)	146	55-19		5
8 (6/1997)	146	55-19	6	
2 (9/1994)	146	55-19		7
8 (6/1997)	146	55-19	8	
2 (9/1994)	146	55-19		9 to 11
8 (6/1997)	146	55-21	1	
2 (9/1994)	146	55-21		a 2
6 (10/1996)	146	55-21	3	
8 (6/1997)	146	55-21	4	
8 (6/1997)	146	55-21		4/1 to 4/2
8 (6/1997)	146	55-21	5 to 10	
8 (6/1997)	146	55-21		10/1 to 10/2
2 (9/1994)	146	55-21		11 to 13
2 (9/1994)	146	55-22		1
5 (9/1995)	146	55-22	2	
8 (6/1997)	146	55-22		2/1 to 2/2
8 (6/1997)	146	55-22	3 to 6	
2 (9/1994)	146	55-22		7
8 (6/1997)	146	55-23	1	
6 (10/1996)	146	55-23	2 to 3	
8 (6/1997)	146	55-23	4	
8 (6/1997)	146	55-23		4/1 to 4/2
8 (6/1997)	146	55-23	5 to 6	
6 (10/1996)	146	55-23	7	
8 (6/1997)	146	55-23	8 to 9	
2 (9/1994)	146	55-23		10
8 (6/1997)	146	55-23		10/1 to 10/2
8 (6/1997)	146	55-23	11 to 14	
8 (6/1997)	146	55-23		14/1 to 14/2
2 (9/1994)	146	55-23		15 to 17
8 (6/1997)	146	55-24	1	
3 (1/1995)	146	55-24	2	
6 (10/1996)	146	55-24		2/1
8 (6/1997)	146	55-24	2/2	

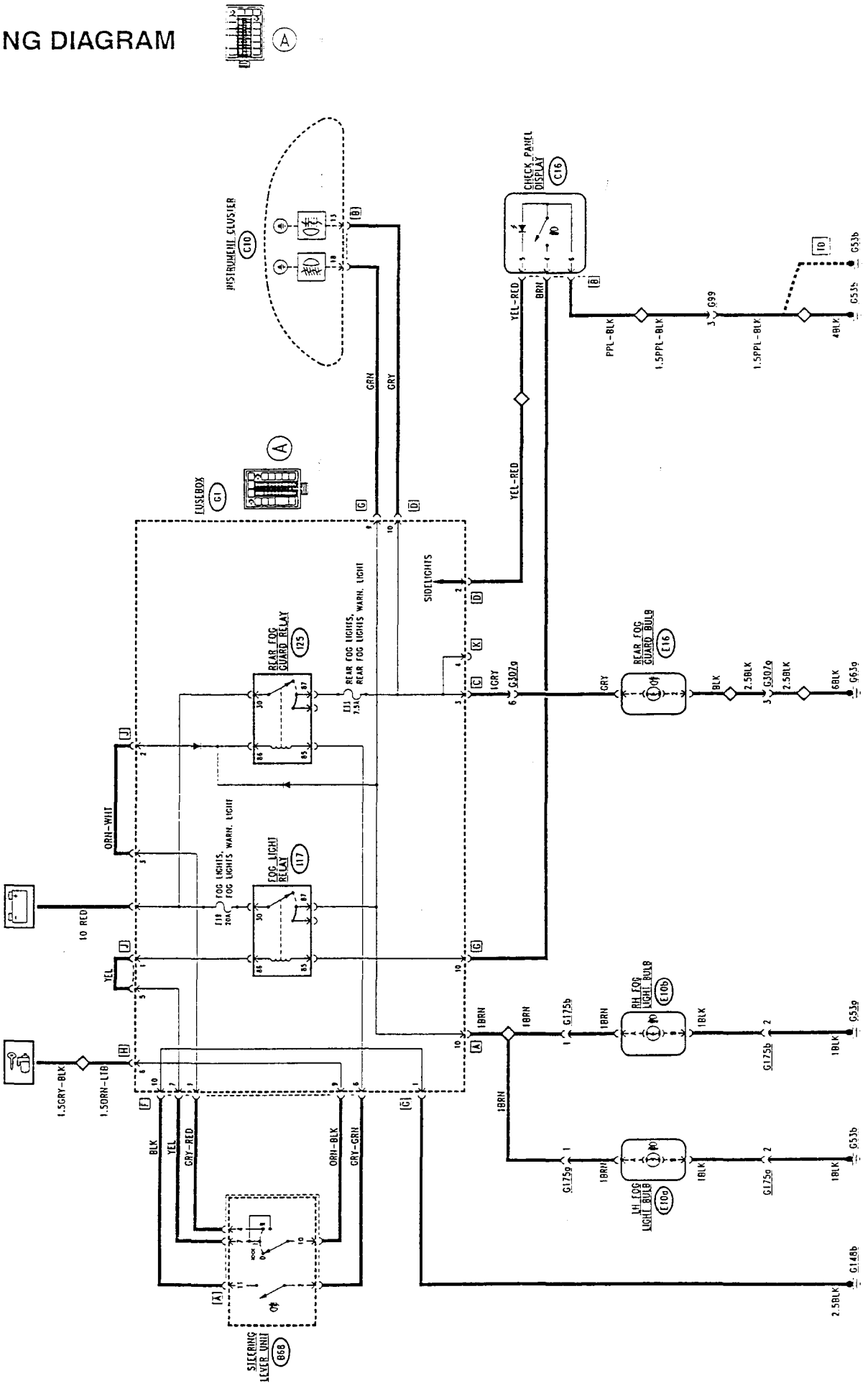
UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	146	55-24	3 to 6	
8 (6/1997)	146	55-24		6/1 to 6/2
3 (1/1995)	146	55-24		7
6 (10/1996)	146	55-24		8
6 (10/1996)	146	55-26	1	
2 (9/1994)	146	55-26		2 to 26
2 (9/1994)	146	55-A1		1
4 (5/1995)	146	55-A1	2	
8 (6/1997)	146	55-A1	3	
7 (12/1996)	146	55-A1	4	

FOG LIGHTS AND REAR FOG GUARDS

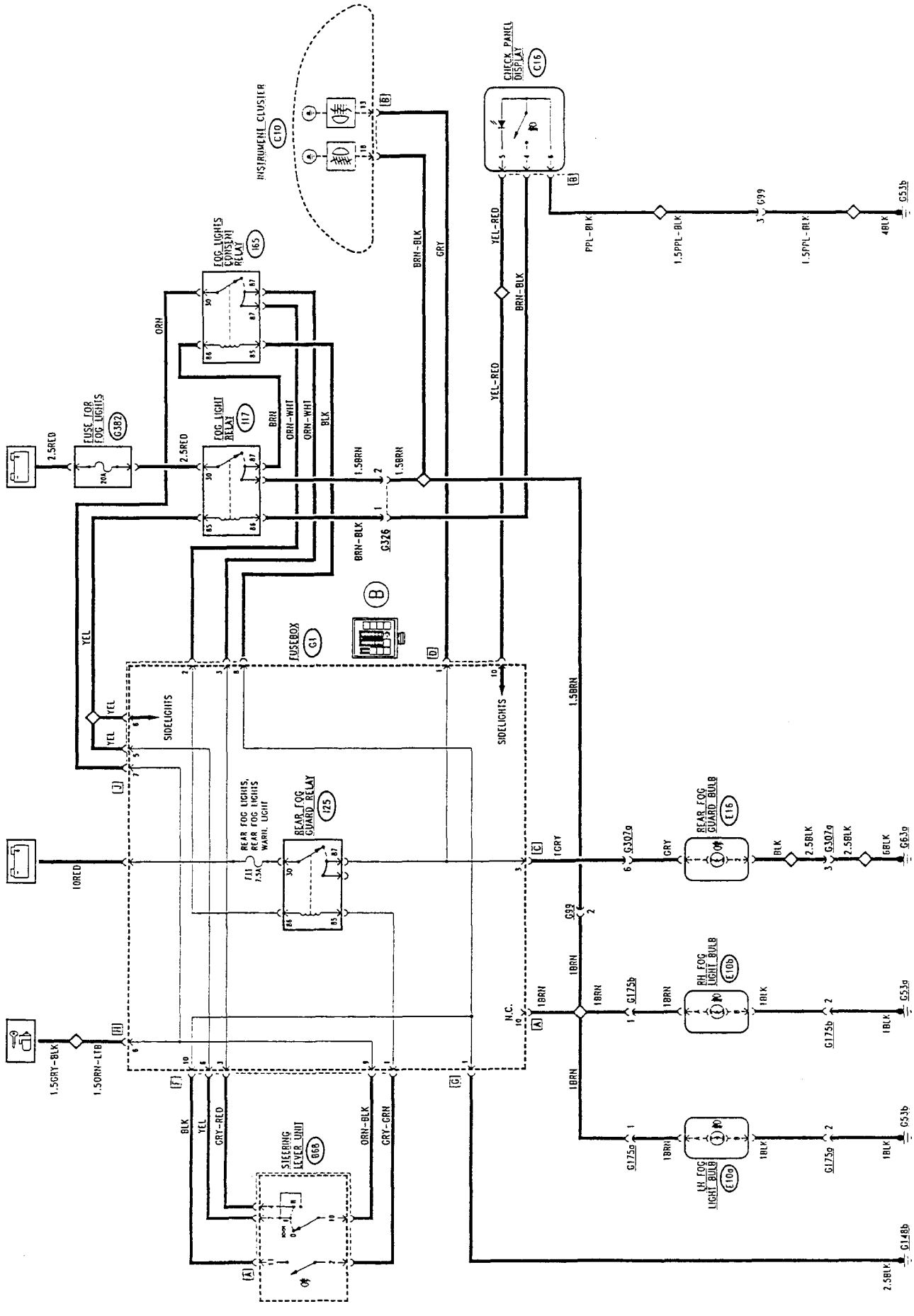
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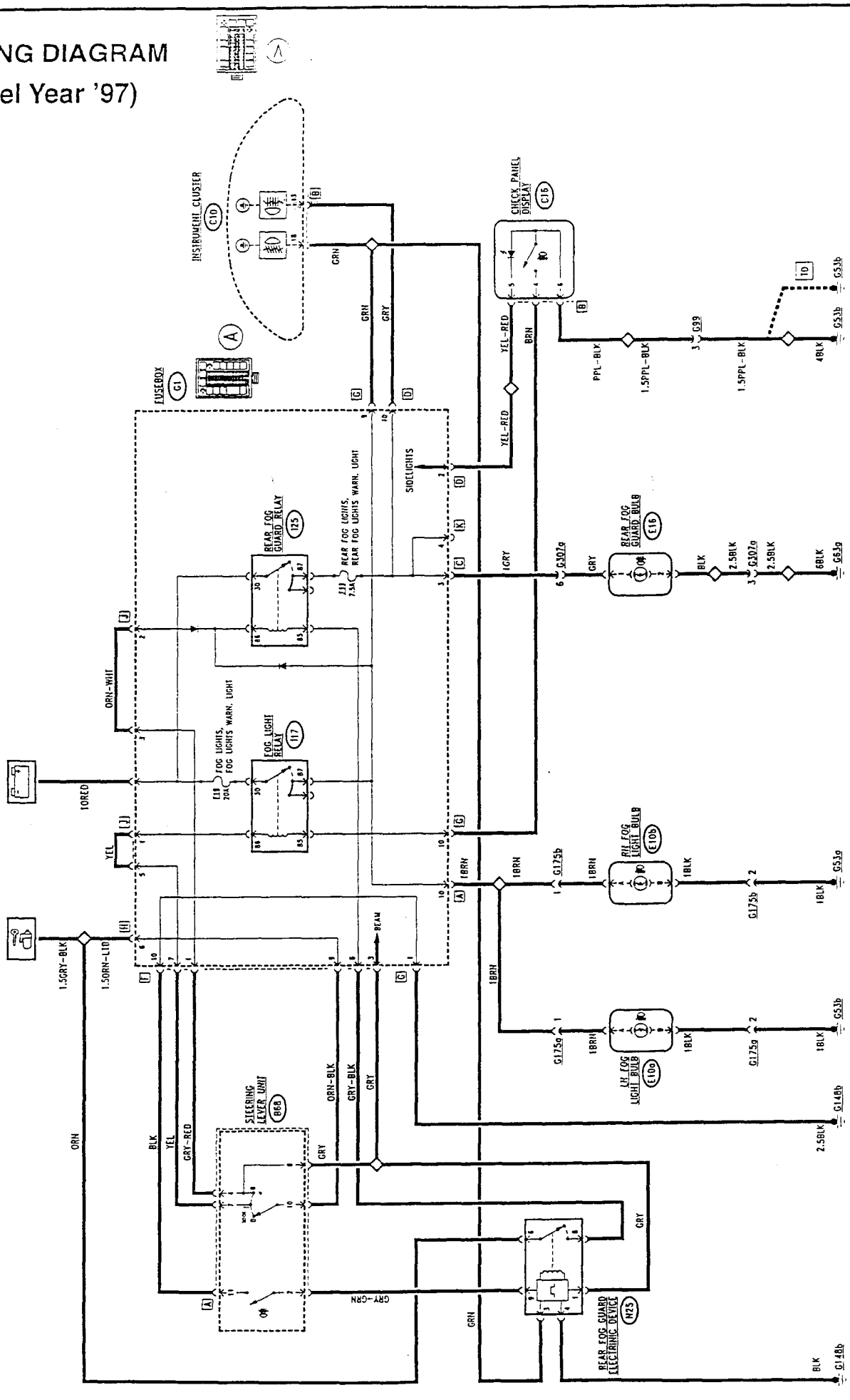
WIRING DIAGRAM



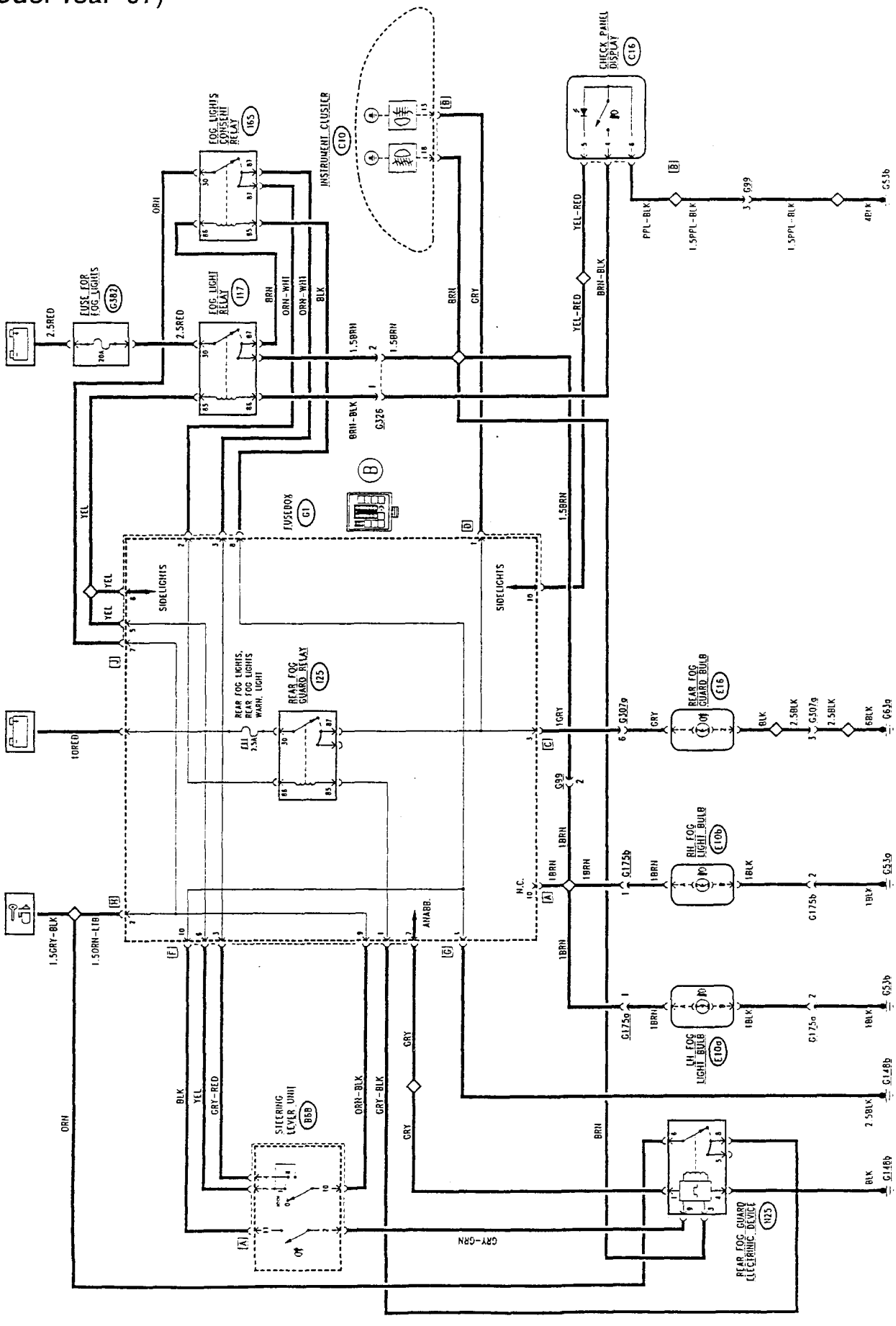
WIRING DIAGRAM



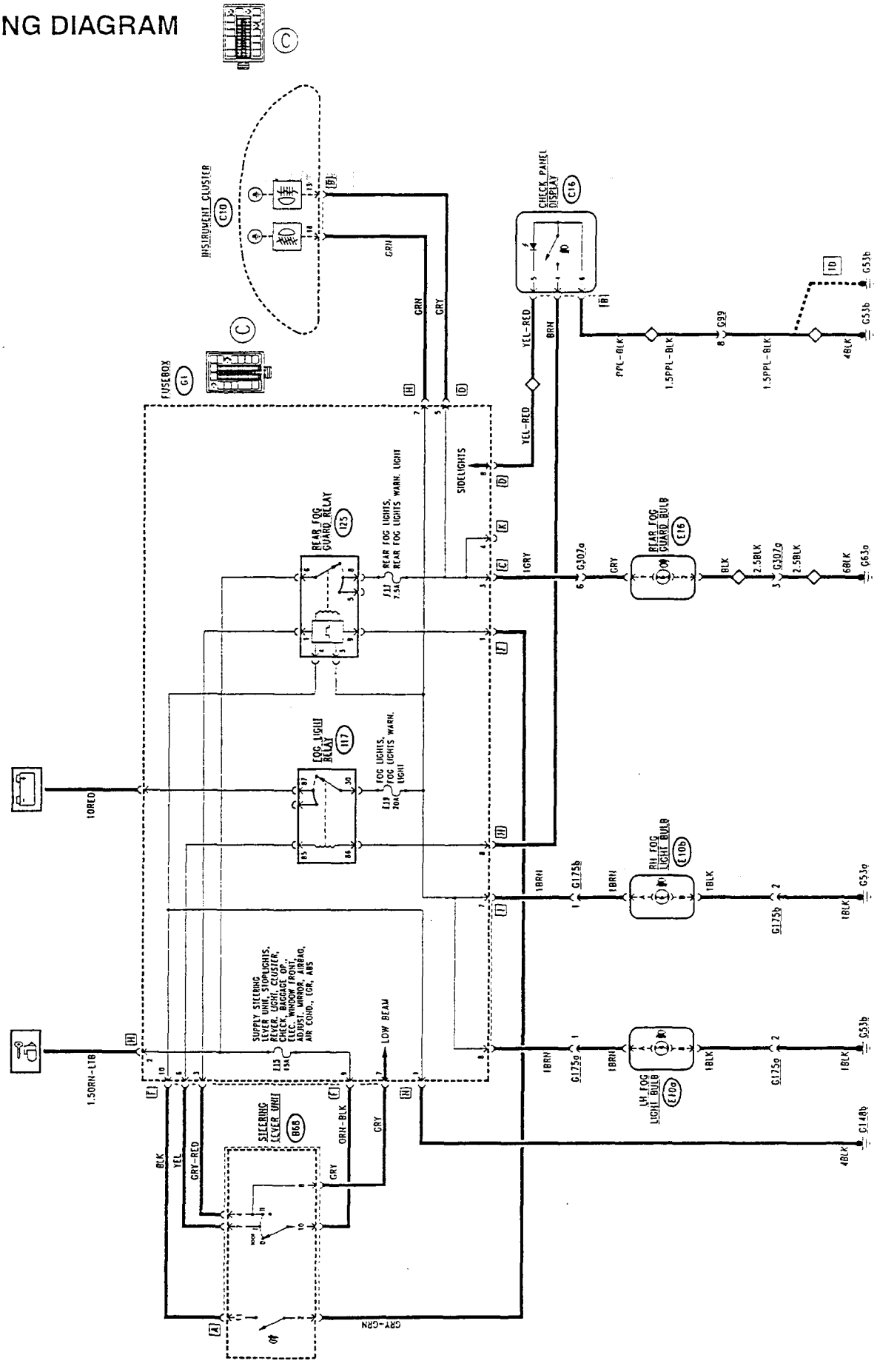
WIRING DIAGRAM
(Model Year '97)



WIRING DIAGRAM
(Model Year '97)



WIRING DIAGRAM



GENERAL DESCRIPTION

Upon request the car is fitted with special halogen fog lights, while the high luminosity rear fog guard is a standard item. This is located in the rear light cluster on the lefthand side of the tailgate and it is necessary under low visibility conditions.
Thus the entire system ensures the best possible active and passive visibility under all circumstances.
The fog lights are turned on by the switch on the dashboard inside the Check Panel, while the rear fog guard is turned on by the control on the lever unit.
The fog lights can be turned on when the side lights are on, while the rear fog guard can be turned on only with the low beam headlights or fog lights on (they turn off when these are turned out) and, from Model Year '97, they must be turned on again the next time the engine is started (key at MARCIA) .
A warning light on the instrument panel indicates that the fog lights are on and another one indicates that the rear fog guard is turned on.
Each of the two circuits is protected by a fuse.

NOTE
The versions for some countries are fitted with "Daylights" i.e. side lights that always stay on when the ignition key is turned and a different logic for turning on the low beam lights, fog lights and rear fog guards. In this case, the present section should be considered complementary to the **"Daylights" section which should therefore be consulted first.**

FUNCTIONAL DESCRIPTION

Fog lights

The circuit for the fog lights is controlled by the corresponding relay switch **I17** located in fuse box **G1** (box "A" or "C") or near to it (box "B").
By operating the switch located in the Check Panel **C16**, with the side lights on (lever unit switch **B68** in posizion "I") an earth is sent which energizes the coil of relay switch **I17** thereby closing the circuit which sends the supply to the two fog lights **E10a** and **E10b**.
The steering column lever unit **B68** is protected by fuse **F15** in fusebox **G1** - only for box "C".
The switch in **C16** is lit by a led when the side lights are on.
The fog lights circuit is protected by fuse **F19** of box **G1** (box "A") or by an outside floating fuse **G382** (box "B").
The supply line also sends a signal to the instrument cluster **C10** to turn on the corresponding warning light.

Rear fog guard

- Up to Model Year '96

The circuit of the rear fog guard is controlled by the corresponding relay switch **I25** located in fusebox **G1**. If the low beam headlights or the fog lights are on, through the switch on the lever unit (lever unit switch on position "II"), the supply and earth are sent to the coil of relay switch **I25** thereby closing the circuit that sends the supply to the rear fog guard **E16**. This consensus logic is carried out in the fusebox "A" by the connection inside the actual box, between pin 87 of **I17** and pin 86 of **I25**. For box "B" there is a special relay switch **I65**, located near the box, which is energized when the fog lights are on, thus supplying relay switch **I25** when the low beam lights or the fog lights are on.

The rear fog guard circuit is protected by fuse **F11** in box **G1**.
The supply line also sends a signal to the instrument panel **C10** to turn on the corresponding warning light.

- From Model Year '97

The rear fog guard circuit is controlled by device **N25** to be found next to fusebox **G1** (box "A" or "B") inside fusebox **G1** (box "C").

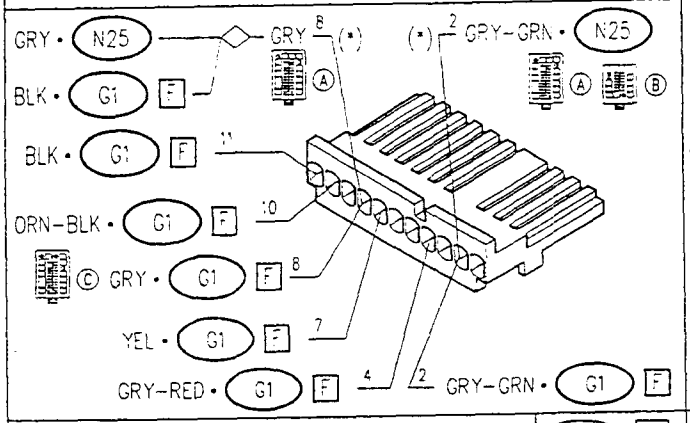
The fog guard circuit is operated by device **N25** located next to the fusebox **G1**.

Device **N25** receives the "key-operated" supply at pin 6; pin 4 is earthed, while at pin 9, 3 and 1 it receives the control and enable signals, which are respectively: request to turn the lights on (by the special switch on the lever unit **B68**); fog lamps on (the same signal of the fog lamp warning light) and low beam headlights on (from lever unit **B68**); when the request to turn on the lights is accompanied by one of the two enable signals, device **N25** closes the circuit on pin 8 which energises relay **I25** (box "A" or "B").
For box "C" the line from pin 8, protected by fuse **F11** of **G1**, supplies directly the lamp **E16**.

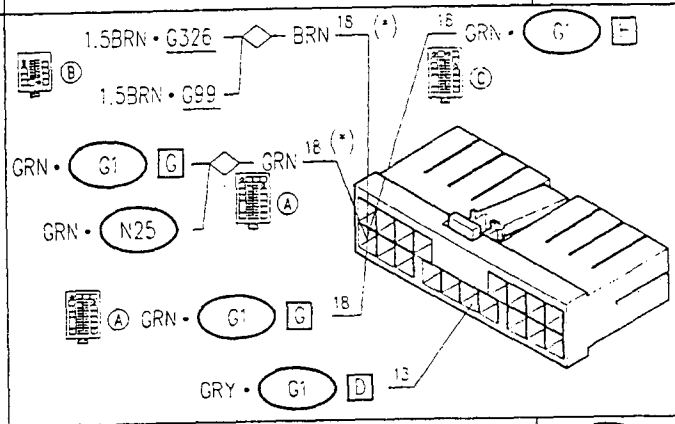
The device turns off the lights if it "loses" the "key-operated" signal; when the key is moved back to MARCIA, the reversing lights are turned on only pressing switch **B68** again.

COMPONENTS AND CONNECTORS

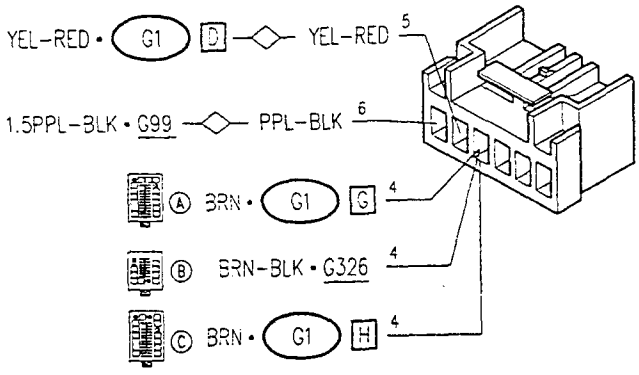
Lever unit — B68 A



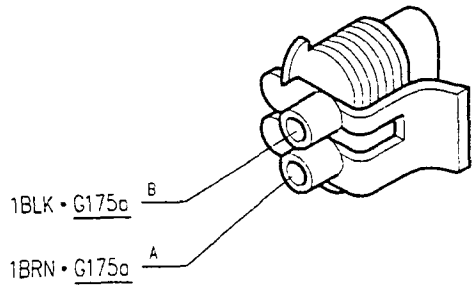
Instrument cluster — C10 B



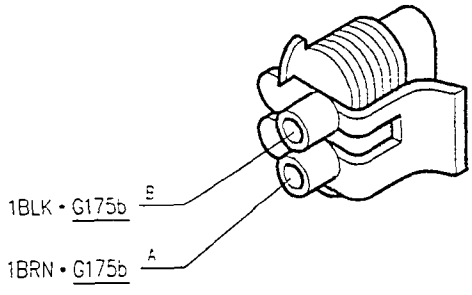
Check Panel display — C16 B



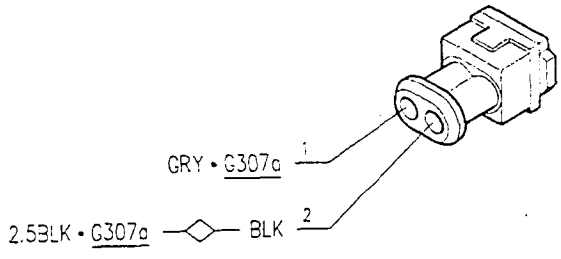
LH fog light bulb — E10a



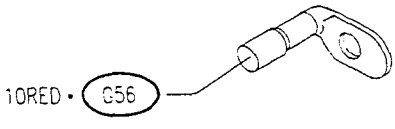
RH fog light bulb — E10b



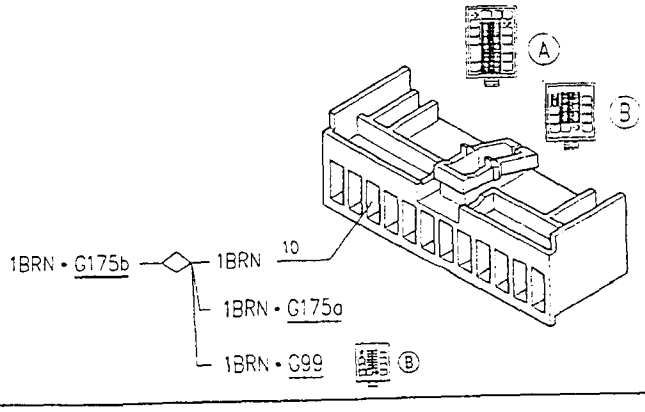
Rear fog guard bulb — E16



Fusebox — G1



Fusebox — G1 A

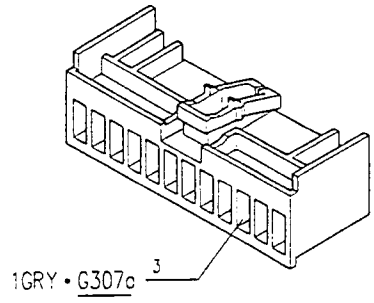


(*) from M.Y. '97

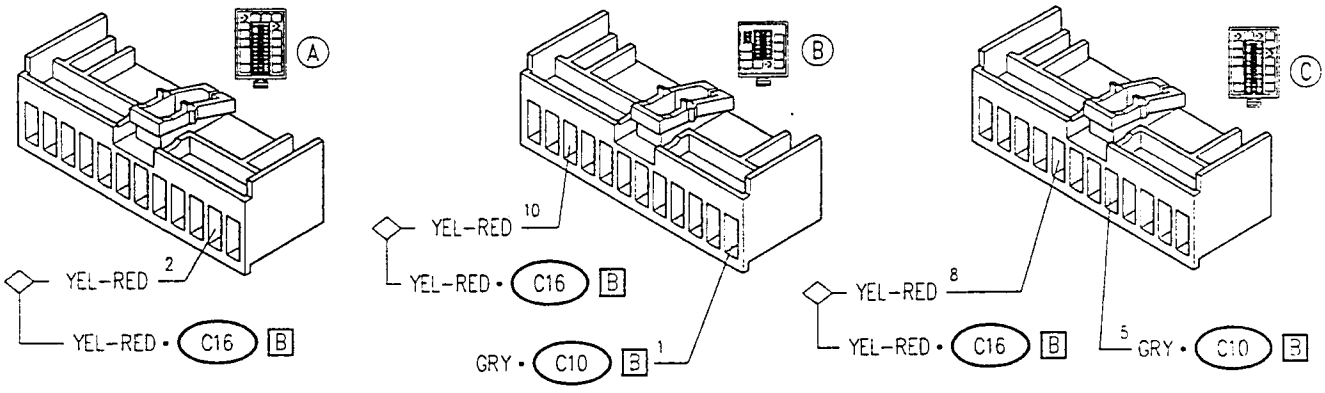
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COMPONENTS AND CONNECTORS (cont.d)

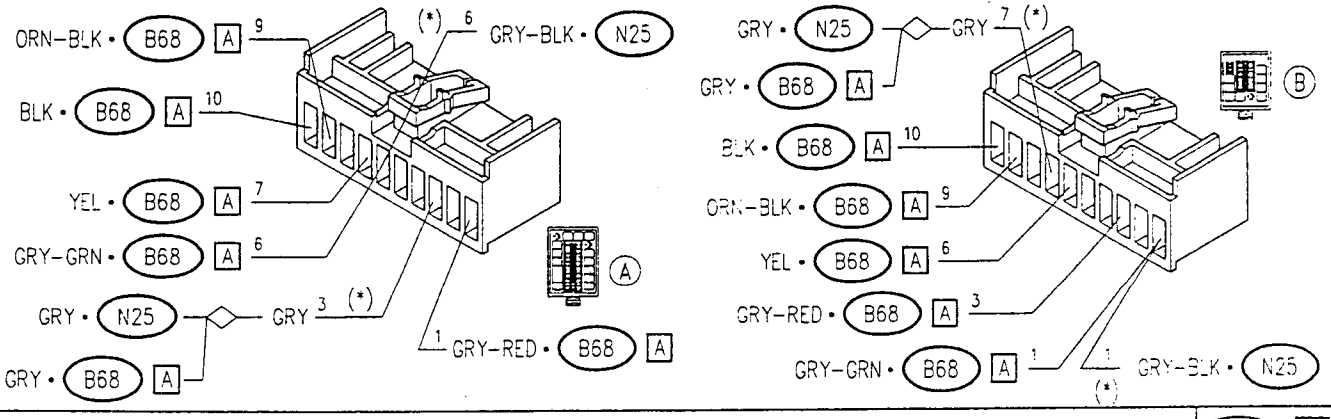
Fusebox — G1 C



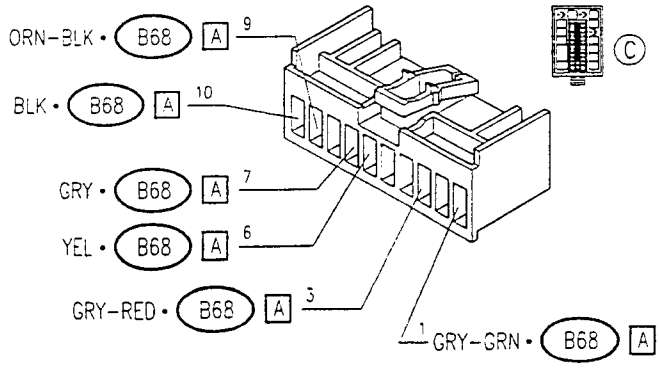
Fusebox — G1 D



Fusebox — G1 F



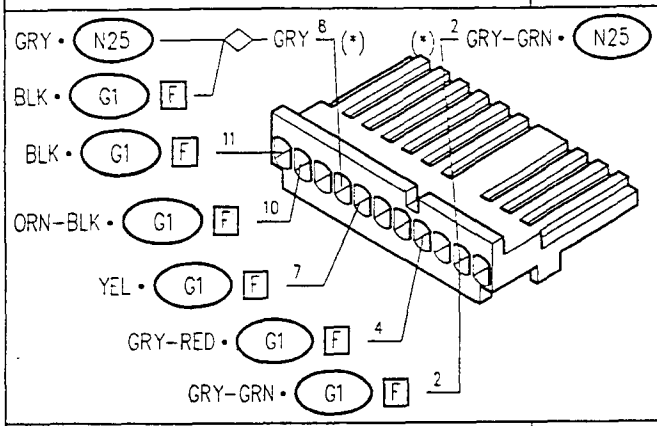
Fusebox — G1 F



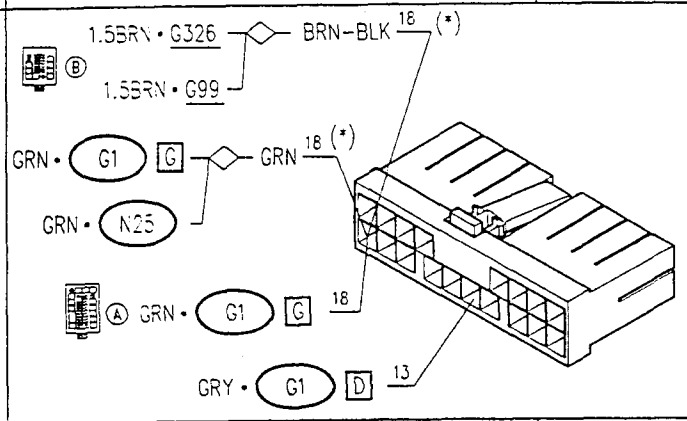
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COMPONENTS AND CONNECTORS

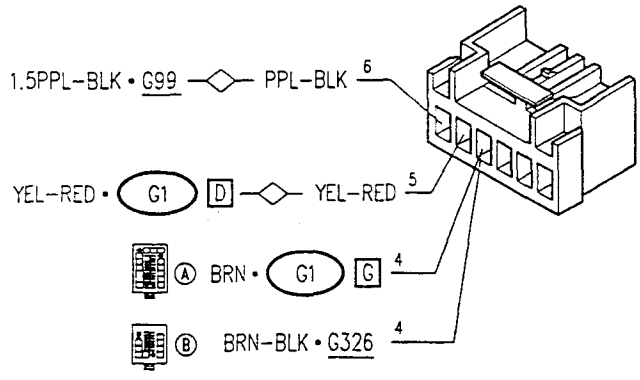
Lever unit — B68 A



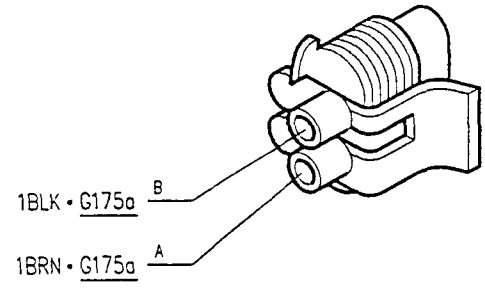
Instrument cluster — C10 B



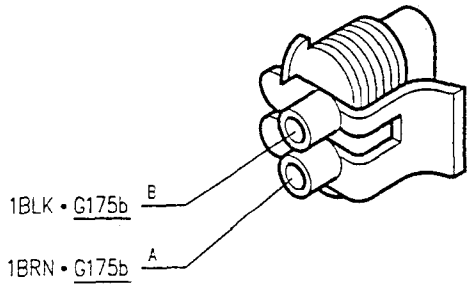
Check Panel display — C16 B



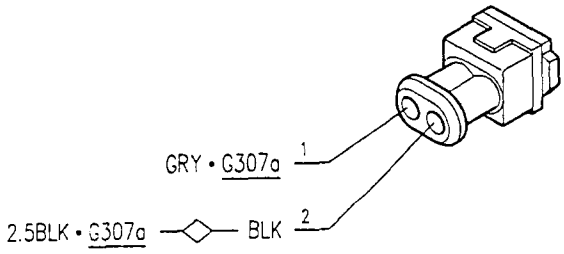
LH fog light bulb — E10a



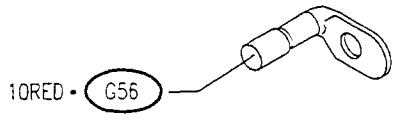
RH fog light bulb — E10b



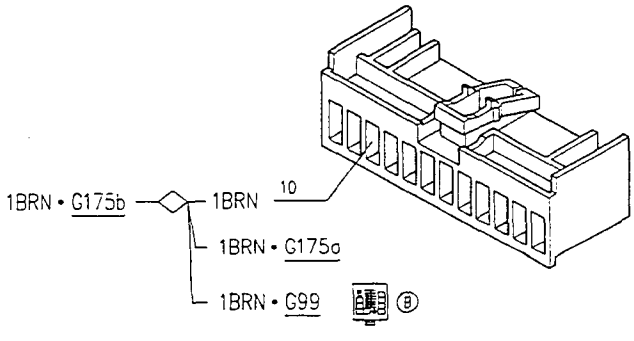
Rear fog guard bulb — E16



Fusebox — G1



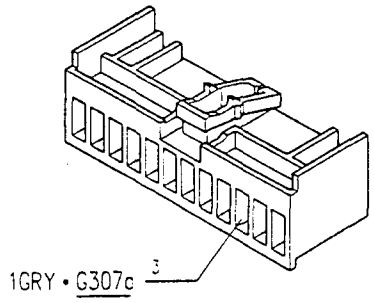
Fusebox — G1 A



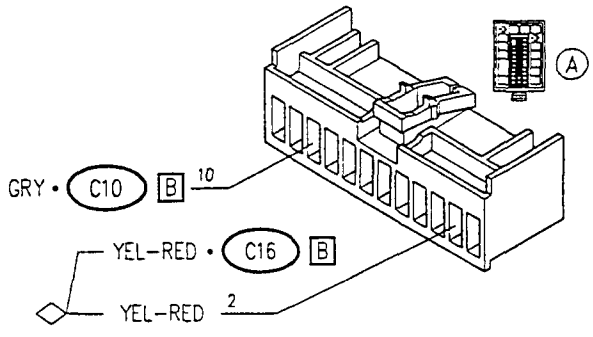
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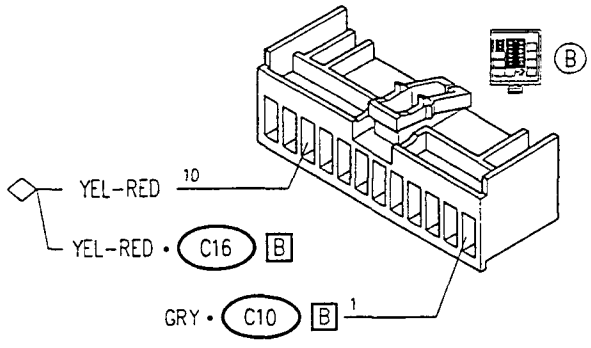
COMPONENTS AND CONNECTORS (cont.d)

Fusebox — G1 C

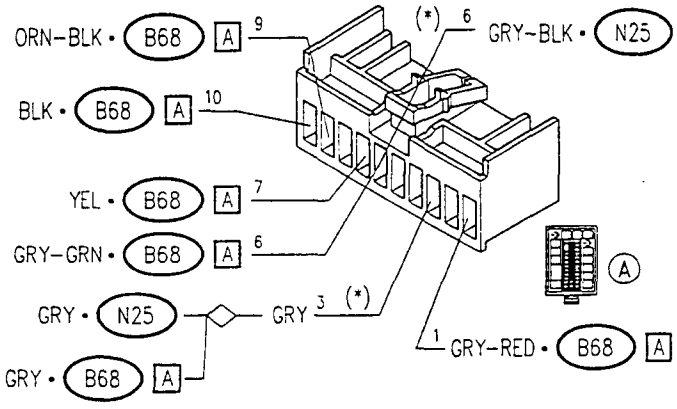


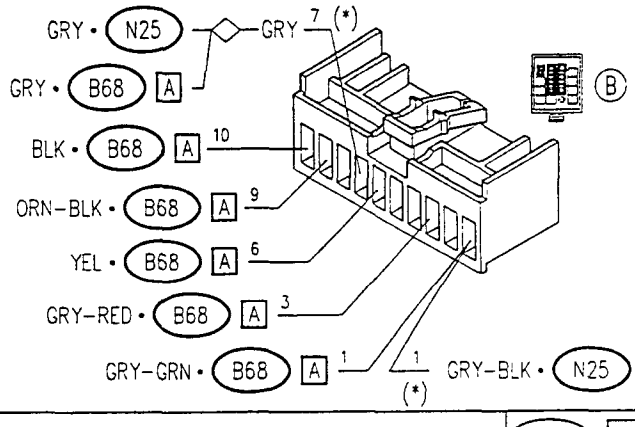
Fusebox — G1 D



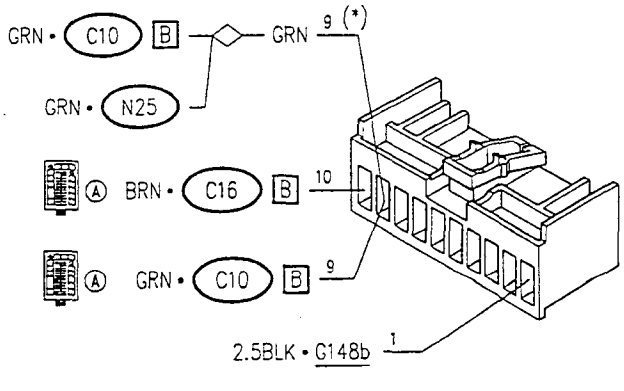


Fusebox — G1 F





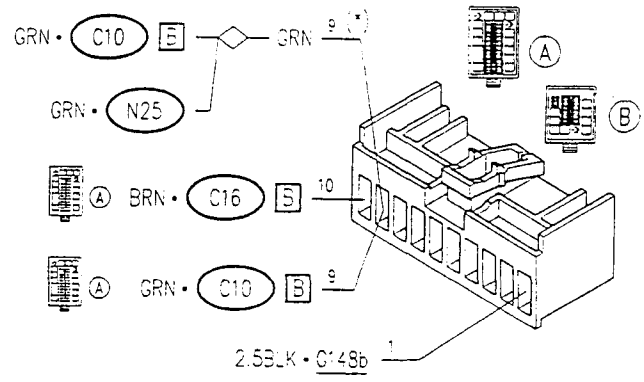
Fusebox — G1 G



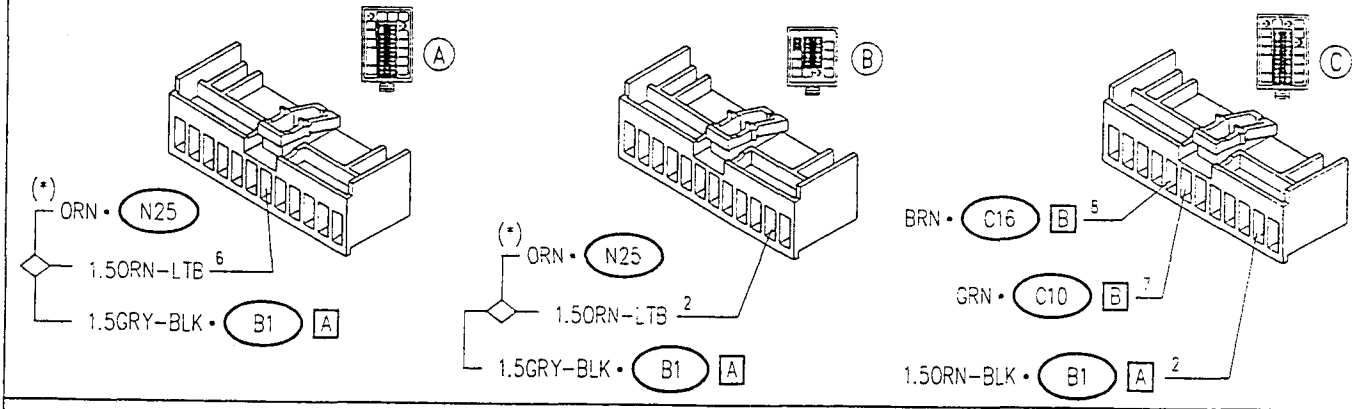
(*) from M.Y. '97

COMPONENTS AND CONNECTORS (cont.d)

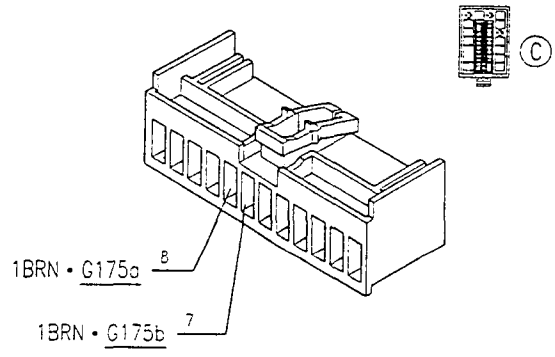
Fusebox — G1 G



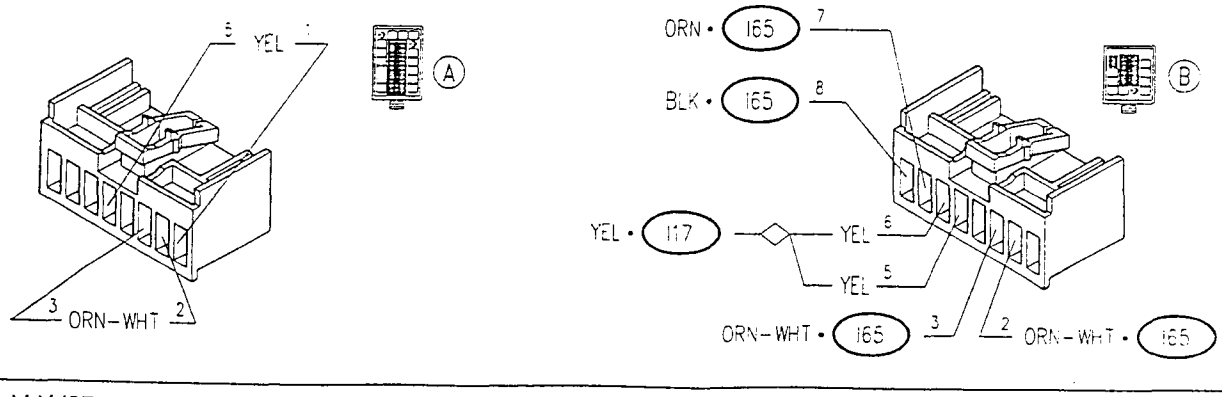
Fusebox — G1 H



Fusebox — G1 I



Fusebox — G1 J

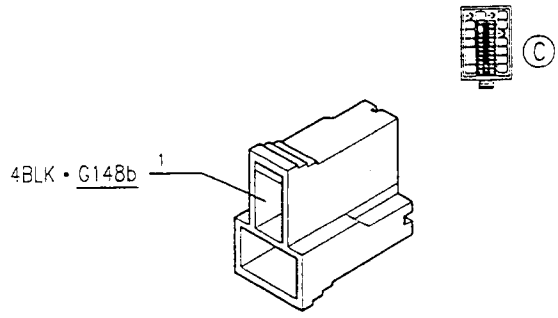


(*) from M.Y. '97

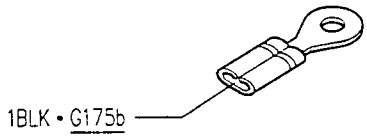
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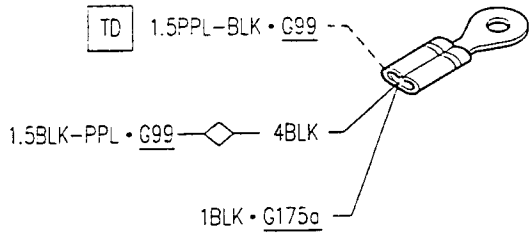
COMPONENTS AND CONNECTORS (cont.d)

Fusebox	G1 N

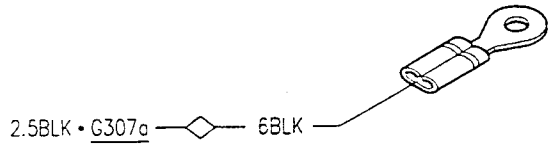


RH engine compt.earth	G53a	LH engine compt. earth	G53b

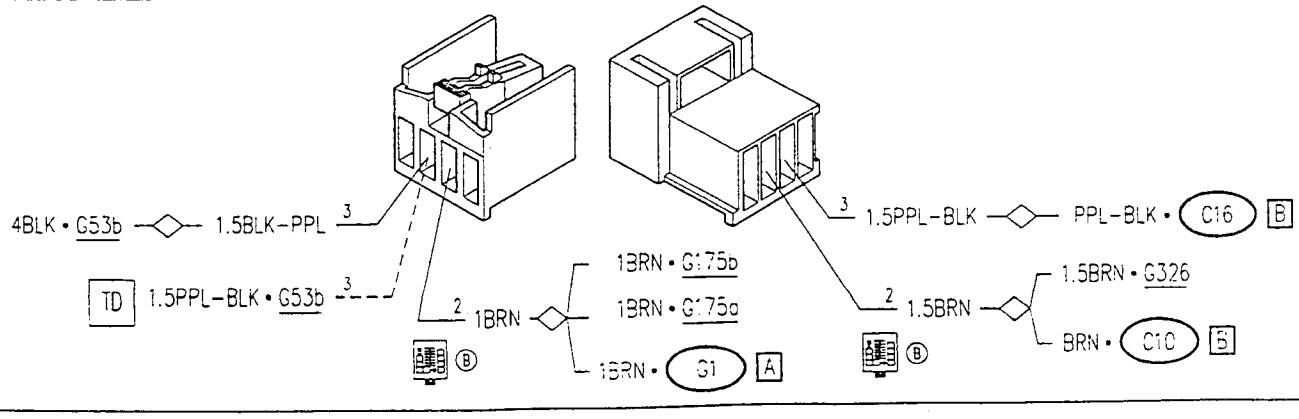




RH rear earth	G63a



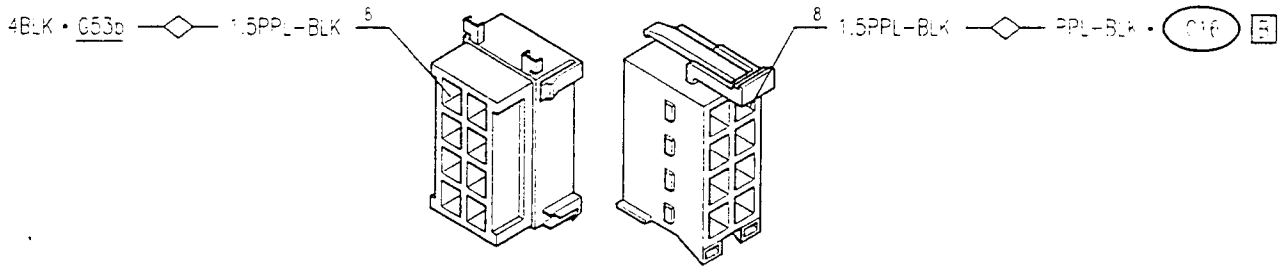
Dashboard/engine wiring connector (*)	G99



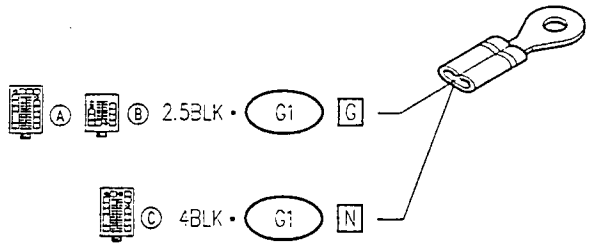
(*) up to chassis no.__
PA493000000008

COMPONENTS AND CONNECTORS (cont.d)

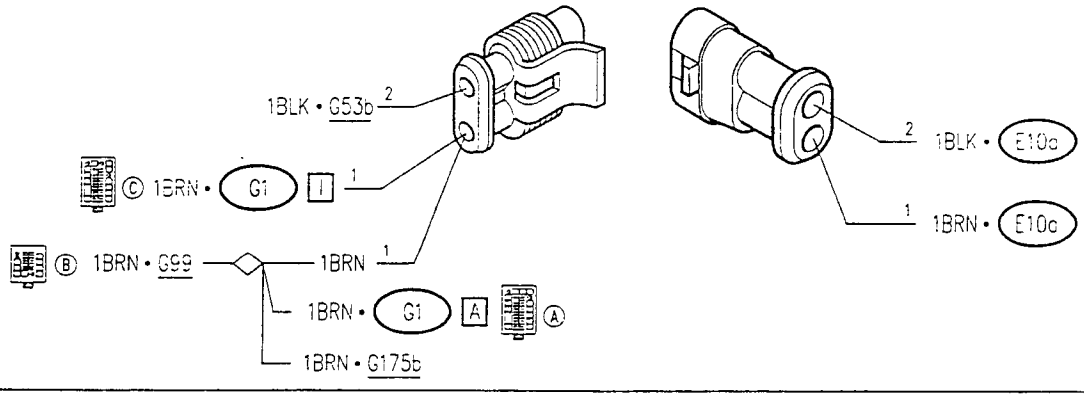
Dashboard/engine wiring connector (**)	G99



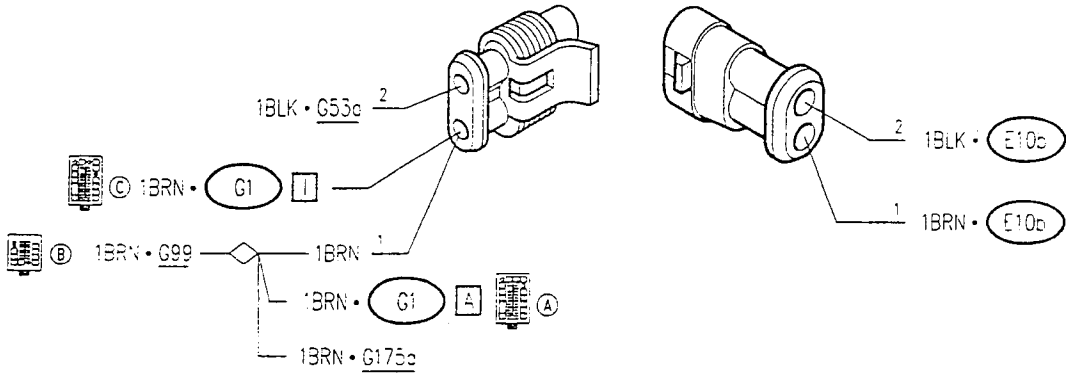
Earth under LH dashboard	G148b



LH fog light wiring connector	G175a



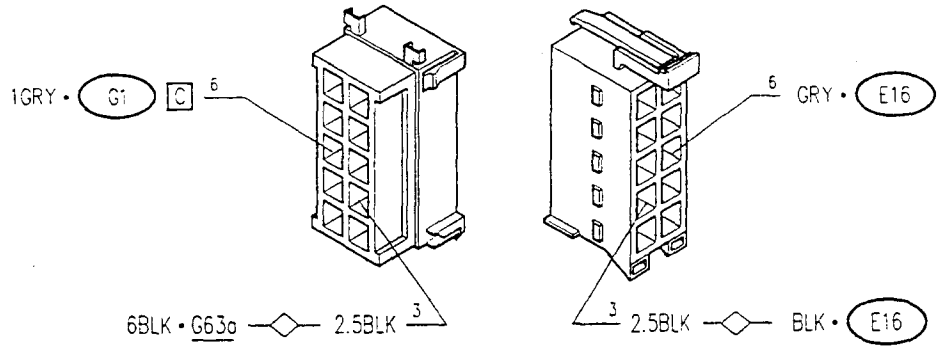
RH fog light wiring connector	G175b



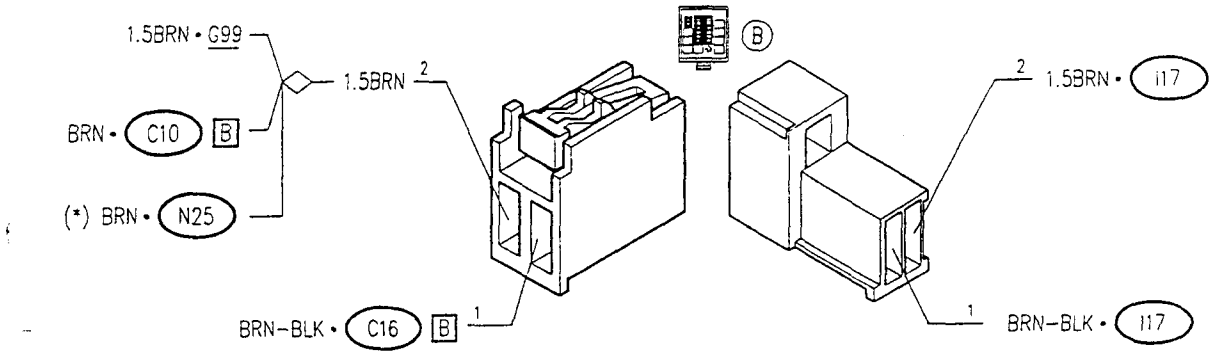
(*) from M.Y. '97
(**) from chassis no.__

COMPONENTS AND CONNECTORS (cont.d)

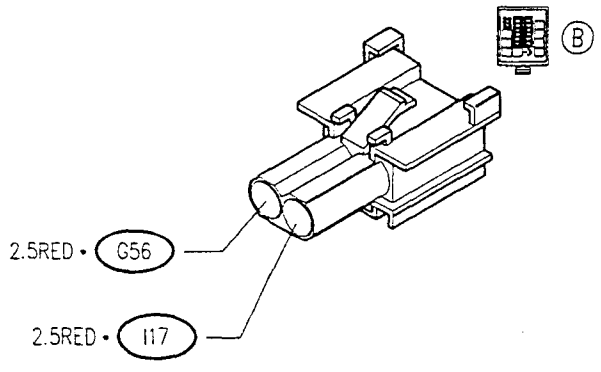
Rear/luggage compt. wiring connector A — G307a



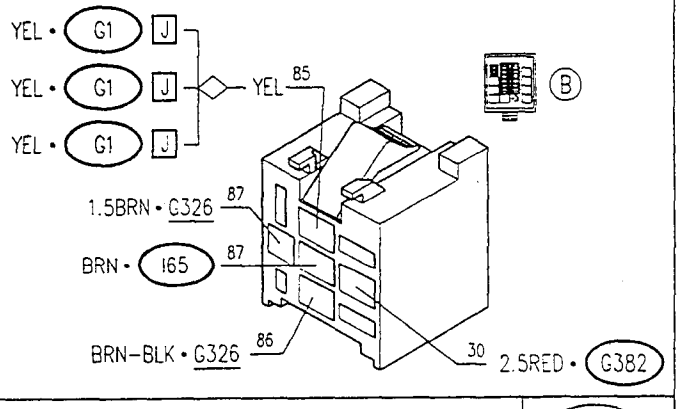
Rear fog guard wiring connector — G326



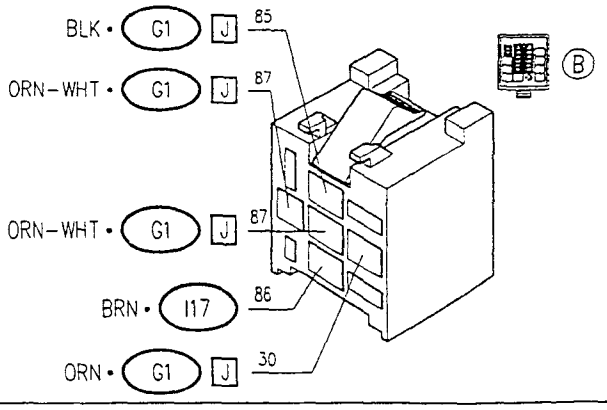
Floating fuse for rear fog guard — G382



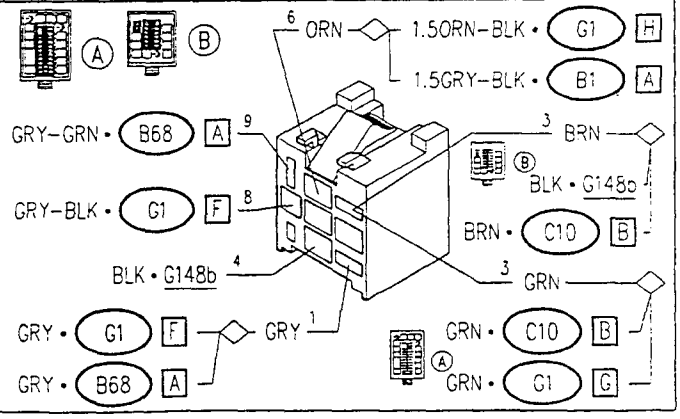
Fog guard relay switch — I17



Fog light consent relay switch — I65

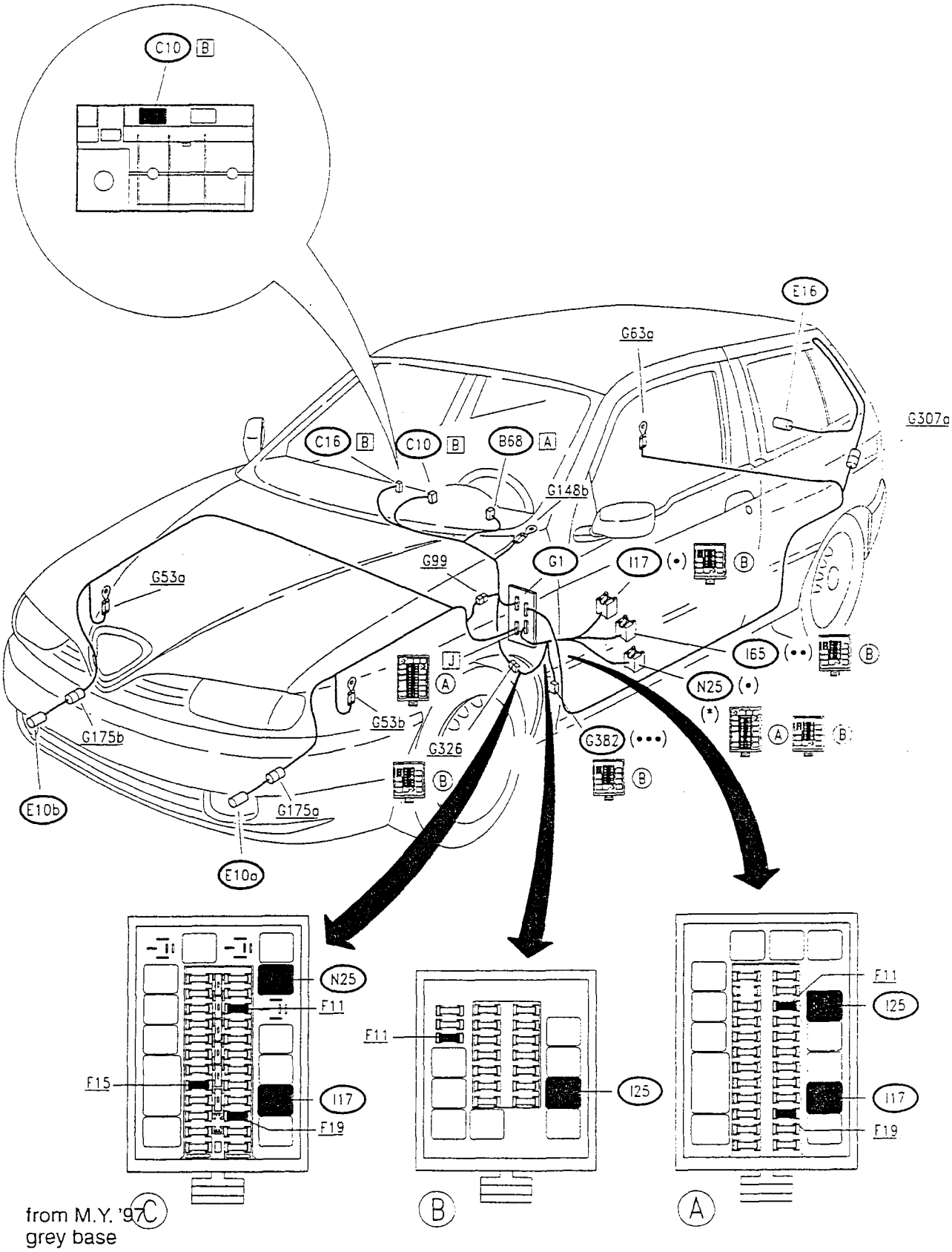


Rear fog guard electronic device — N25



(*) from M.Y. '97

LOCATION OF COMPONENTS



(*) from M.Y. '97
(•) grey base
(••) grey base
(•••) yellow fuseholder

FAULTFINDING TABLE

Failure	Component to be checked												
	F11	E16	F19 (A)	G382 (B)	E10a	E10b	I25	I17	N25 (•)	I65 (B)	B68	C16 (**)	C10 (*)
Rear fog guard	•	•					•		•	•	•		
Fog guard warning light	•								•				•
Both fog lights			•	•				•				•	
RH fog light						•							
LH fog light					•								
Fog light warning light			•	•									•
Lighting. fog light switch (with side lights on)												•	

(*) The instrument cluster **C10** cannot be repaired. Therefore, in the event of a failure it is not possible to change the single warning light and a new complete cluster must be fitted.

(**) The "Check Panel" display **C16** cannot be repaired. Therefore it is not possible to change the fog light switch and a new complete Check Panel must be fitted.

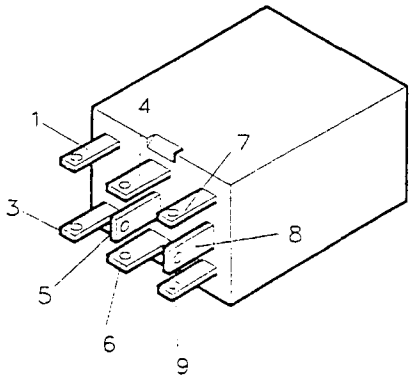
(A) Only fusebox "A"

(B) Only fusebox "B"

(•) Only from Model Year '97

CHECKING COMPONENTS

Rear fog guard electronic device (N25)



Check the device: see **TEST A**

CHECK REAR FOG GUARD DEVICE (N25)	TEST A

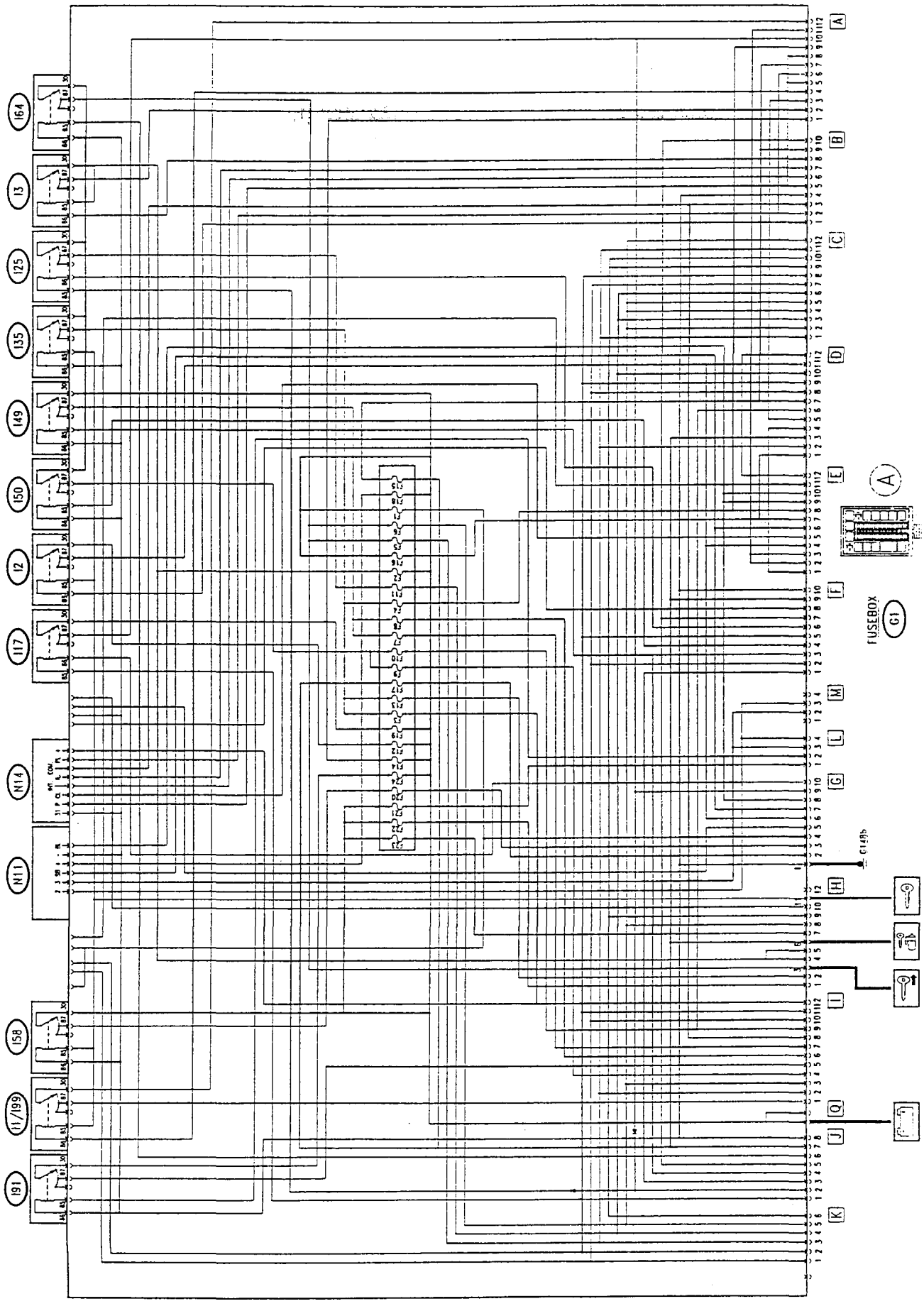
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N25** and check for "key-operated" 12V on the corresponding base at pin 6 of **N25**	OK ▶	Carry out **step A2**
	OK ▶	Restore the wiring between **N25** and the ignition switch **B1**
A2 CHECK EARTH – Check for 0V at pin 4 of **N25**	OK ▶	Carry out step **A3**
	OK ▶	Restore the wiring between **N25** and earth **G143b**
A3 CHECK CONTROL/ENABLE SIGNALS – Check the following signals on the pins of **N25**: • 0V at pin 9, turning on the fog guard switch in **B68**, • 12V at pin 3, turning on the fog lamps, • 12V at pin1, turning on the low beam headlamps	OK ▶	Insert device **N25** on its base and continue with step **A4**
	OK ▶	Check connection between **N25**, connector 1 of **G1** and the lever unit **B66**
A4 CHECK VOLTAGE – Turn on the fog guards with the low beam headlamps on or fog lamps on and check for 12V at pin 8 and 5 of **N25**	OK ▶	DEVICE **N25** IS WORKING PROPERLY Check the connections with the other components
	OK ▶	REPLACE DEVICE **N25**

FUSEBOX

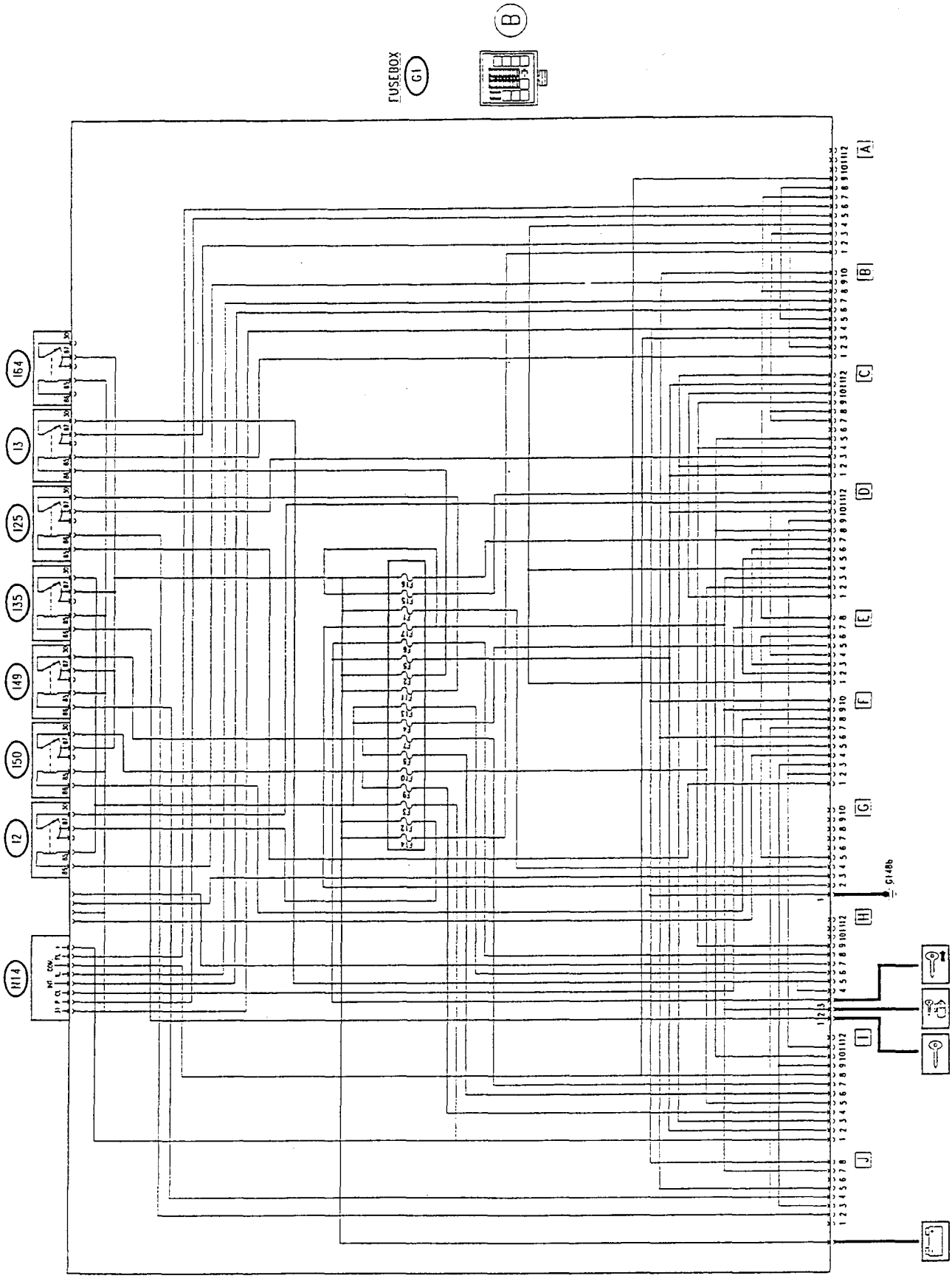
INDEX

WIRING DIAGRAM Box "A" ("high" versions) 3-2
WIRING DIAGRAM Box "B" ("low" versions) 3-3
WIRING DIAGRAM Box "C" 3-4
GENERAL DESCRIPTION 3-4/1
FUSES AND RELAYS ON AUXILIRY BRACKET 3-28

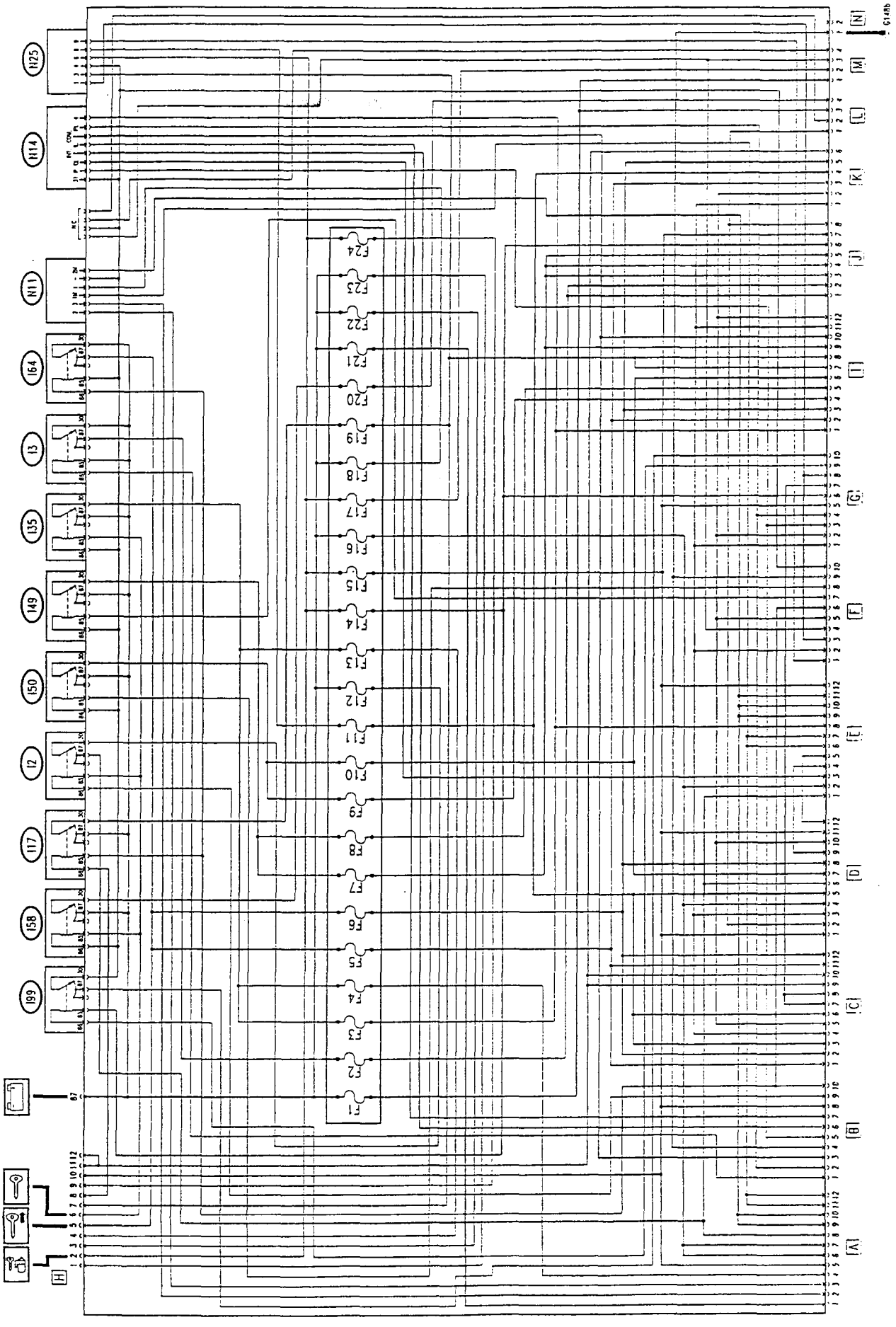
WIRING DIAGRAM Box "A" ("high" versions)



WIRING DIAGRAM Box "B" ("low" versions)



WIRING DIAGRAM Box "C"



GENERAL DESCRIPTION

This section describes the complete printed circuit that makes the connections inside the fusebox **G1**.

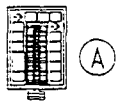
In the various diagrams referring to the individual systems and circuits only the lines associated with the case under examination are shown: this chart gives a complete, overall view of the entire fusebox **G1**.

The fusebox houses a number of relays and other devices, shown here with the corresponding codes, and the fuses (**F1**,....., **F24**).

NOTE: not all the output pins of the box **G1** are actually connected for all versions of the car: some lines therefore may be found to be redundant though they will be present on the printed circuit.
Next to the schematic drawings of the connectors a **list of output signals** from the different pins is given: this simplifies for instance faultfinding work on the different circuits affected. (NOTE: the letters N.C. indicate pins connected inside the fusebox but not used for the present versions of the car).

Two different fuseboxes have been used, the first one called BOX "A" for the "high" versions, i.e. fitted with a number of auxiliary accessories, and the second one known as BOX "B" for the "lower" versions: it is simpler and only contains the indispensible circuit.

Whenever necessary, all the wiring diagrams shown in this Group show the two different fuseboxes using the following symbols:

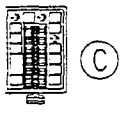


= fusebox "A";

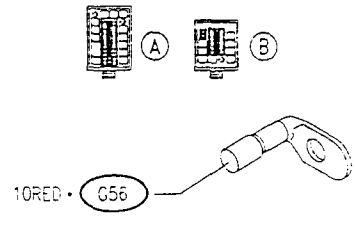


= fusebox "B".

From chassis no.___ the above two boxes have been replaced by a new box "C" used for all versions.

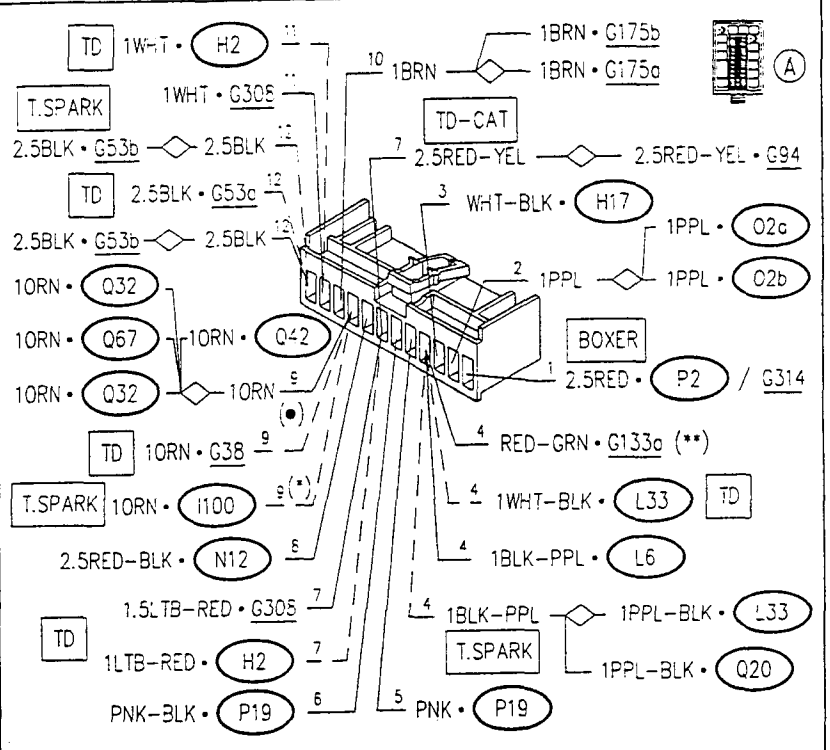


= fusebox "C".

SUPPLY TO FUSEBOX		
PIN	**CIRCUITS**	
-	Supply from terminal board	

CONNECTOR A

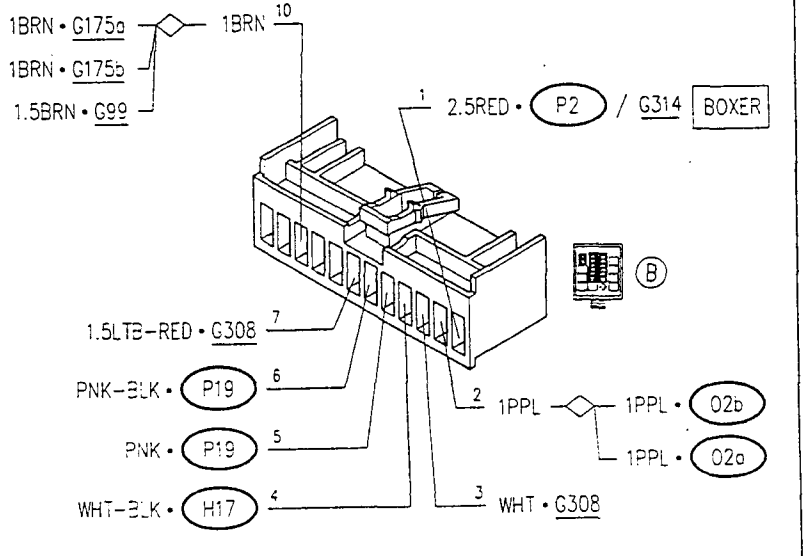
PIN	CIRCUITS
1	Engine fan supply
2	Horns
3	Brake fluid level signal
4	Radiator thermal contact signal
5	Windscreen washer
6	Rearscreen washer
7	Reversing light supply, E.G.R. (TD-CAT)
8	Headlamp washer control
9	Supply for compressor control unit and fan delaying device (TD), engine fan (T.SPARK)
10	Fog lamps
11	Reversing light control
12	Earth for engine fan (*)



(•) For TD version, up to chassis no....
(*) Also Boxer from chassis no. 4065018

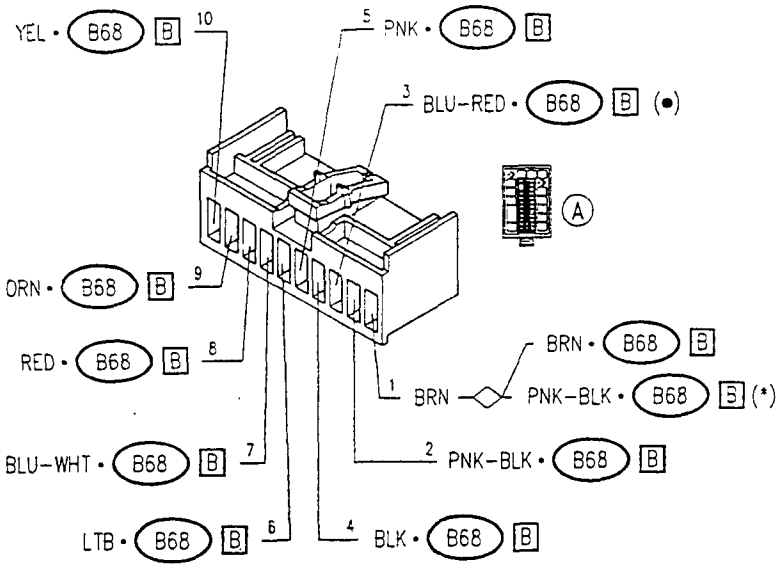
CONNECTOR A

PIN	CIRCUITS
1	Engine fan supply
2	Horns
3	Reversing lights control
4	Brake fluid level signal
5	Windscreen washer
6	Rearscreen washer
7	Reversing light supply
8	N.C.
9	N.C.
10	N.C.
11	N.C.
12	N.C.

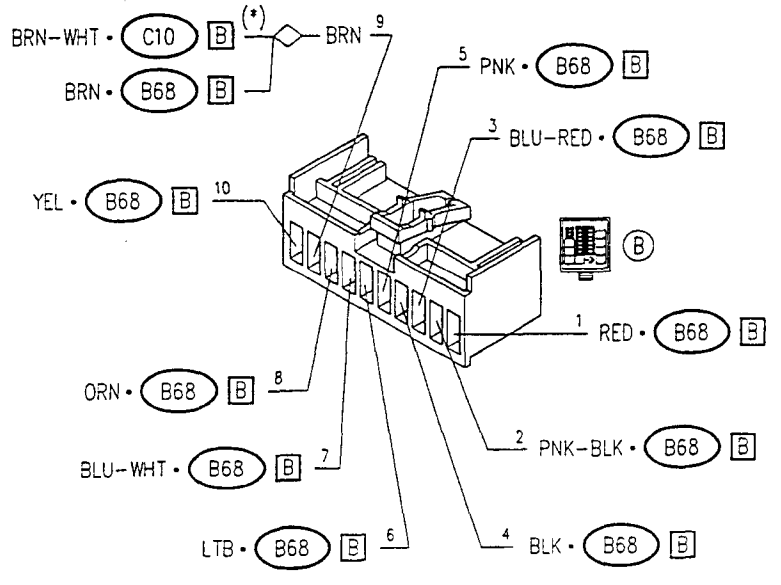


(•) For TD version, up to chassis no....
(**) From Model Year '97

CONNECTOR B	
PIN	**CIRCUITS**
1	Heated rearscreen control
2	Rearscreen washer control
3	Windscreen wiper control
4	Lever unit RH earth
5	Windscreen washer control
6	Windscreen washer intermittence control
7	Rearscreen wiper control
8	Horn control
9	Windscreen washer supply
10	RH lever unit lighting



CONNECTOR B	
PIN	**CIRCUITS**
1	Horn control
2	Rearscreen washer control
3	Windscreen wiper control
4	Lever unit RH earth
5	Windscreen washer control
6	Windscreen washer intermittence control
7	Rearscreen wiper control
8	Windscreen washer supply
9	Heated rearscreen control
10	RH lever unit lighting

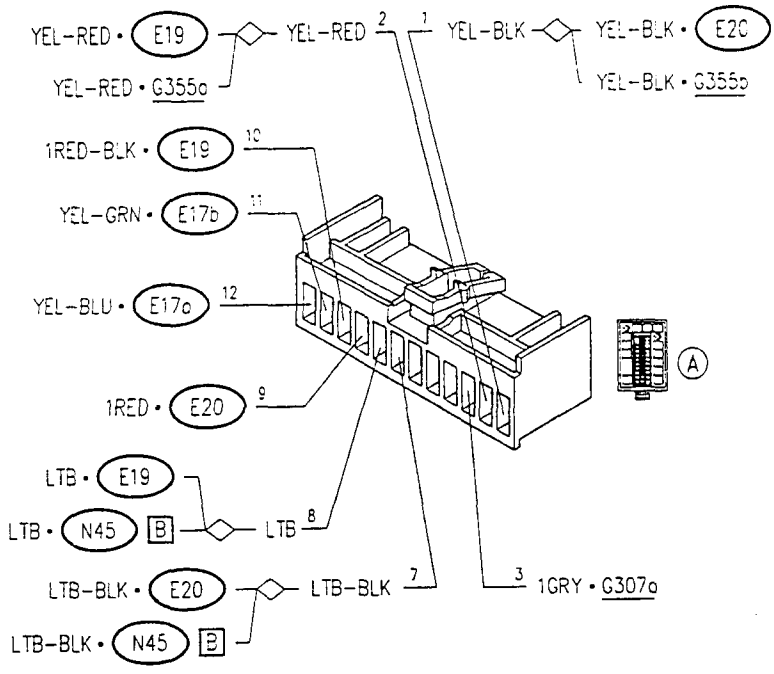


(•) only up to M.Y. '96

(*) from M.Y. '97

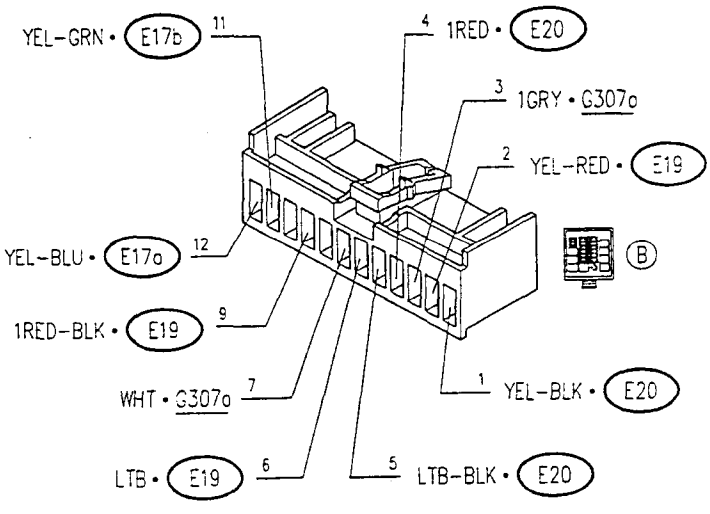
CONNECTOR C

PIN	CIRCUITS
1	LH rear sidelights
2	RH rear sidelights
3	Rear fog guard
4	N.C.
5	N.C.
6	N.C.
7	Rear LH direction indicator
8	RH rear direction indicator
9	LH stop light
10	RH stop light
11	RH number plate light
12	LH number plate



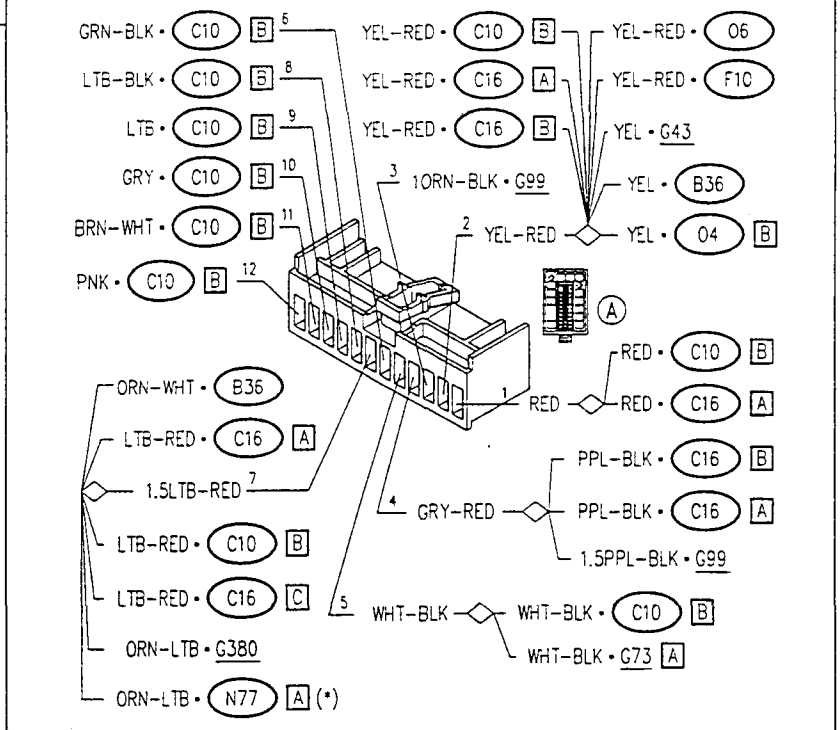
CONNECTOR C

PIN	CIRCUITS
1	LH rear sidelights
2	RH rear sidelights
3	Rear fog guard
4	LH stop light
5	Rear LH direction indicator
6	RH rear direction indicator
7	Reversing light
8	N.C.
9	RH stop light
10	N.C.
11	RH number plate light
12	LH number plate



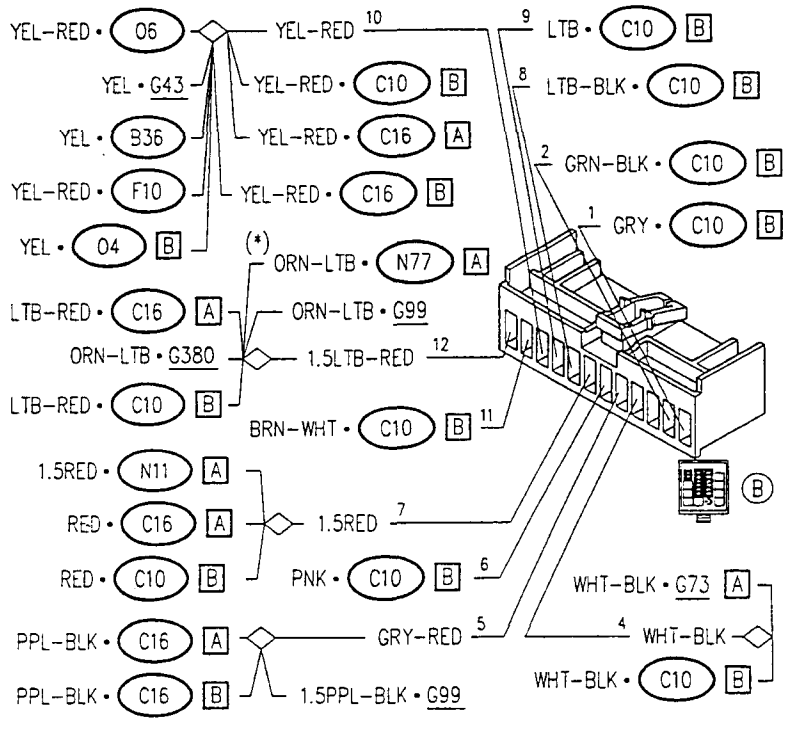
CONNECTOR D

PIN	CIRCUITS
1	Supply to instr.cluster, check panel (direct)
2	lighting for controls, indicators etc., sidelights warning light
3	Supply to anti-theft device & door lock relay door locks (key-operated)
4	Controlled earth
5	Handbrake/brake fluid warning light
6	High beam warning light
7	Supply to instr.cluster, check panel, wing mirror adj., airbag, ALFA ROMEO CODE control unit (*) (key-operated)
8	LH direction indicator warning light
9	RH direction indicator warning light
10	RH fog guard warning light
11	Heated rearscreen warning light
12	Fuel level gauge



CONNECTOR D

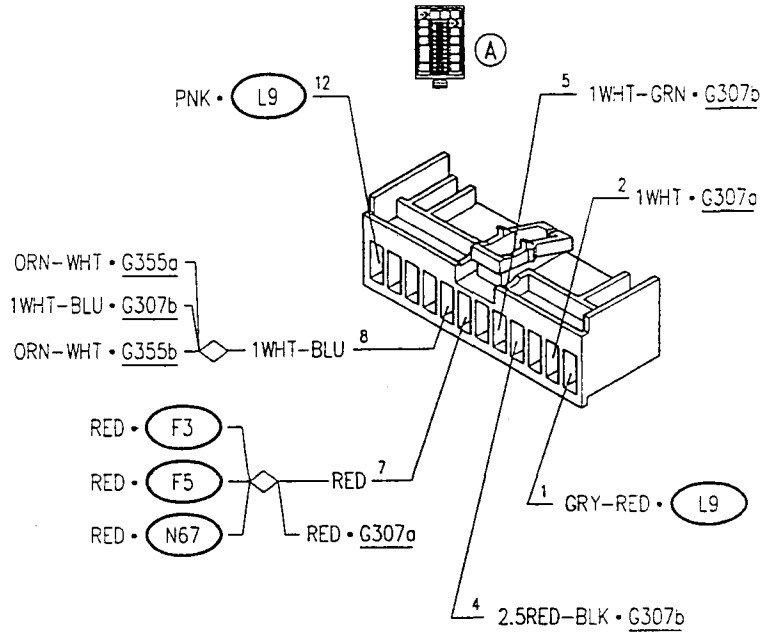
PIN	CIRCUITS
1	Fog guard warning light
2	High beam warning light
3	N.C.
4	Handbrake/brake fluid warning light
5	Controlled earth
6	Fuel level gauge
7	Supply to instr.cluster, check panel, door locking (direct)
8	LH direction indicator warning light
9	RH direction indicator warning light
10	Lighting for controls, indicators etc., side lights warning light
11	Heated rearscreen warning light
12	Supply for instr.cluster, check panel, airbag, engine fan, ALFA ROMEO control unit (*) (key-operated)



(*) only up to M.Y. '97

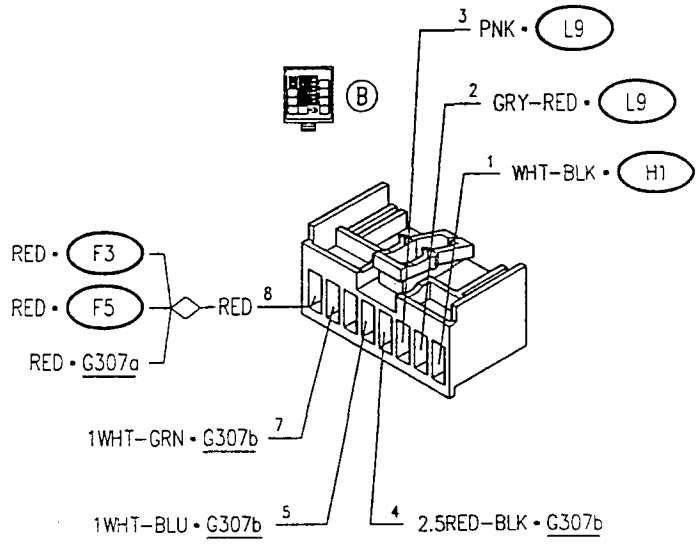
CONNECTOR E

PIN	CIRCUITS
1	Fuel level signal
2	Reversing lights
3	N.C.
4	Heated rearscreen
5	Heated rearscreen
6	N.C.
7	Supply for ceiling lamps & door locking control (direct)
8	Supply to heated rearscreen & heated seats (key-operated)
9	N.C.
10	N.C.
11	N.C.
12	Earth for fuel level



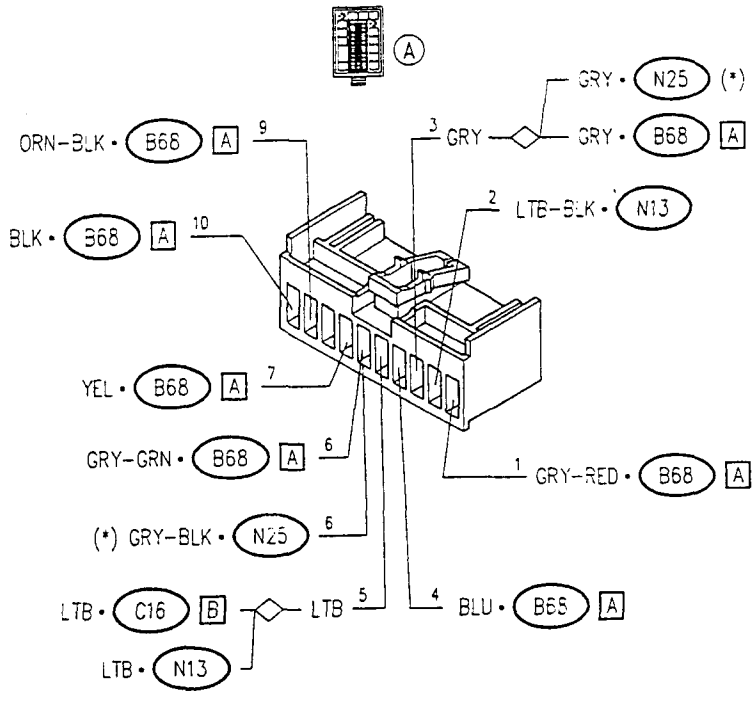
CONNECTOR E

PIN	CIRCUITS
1	Handbrake signal
2	Fuel level signal
3	Fuel level earth
4	Heated rearscreen
5	Heated rearscreen supply (key-operated)
6	N.C.
7	Heated rearscreen
8	Ceiling lights supply



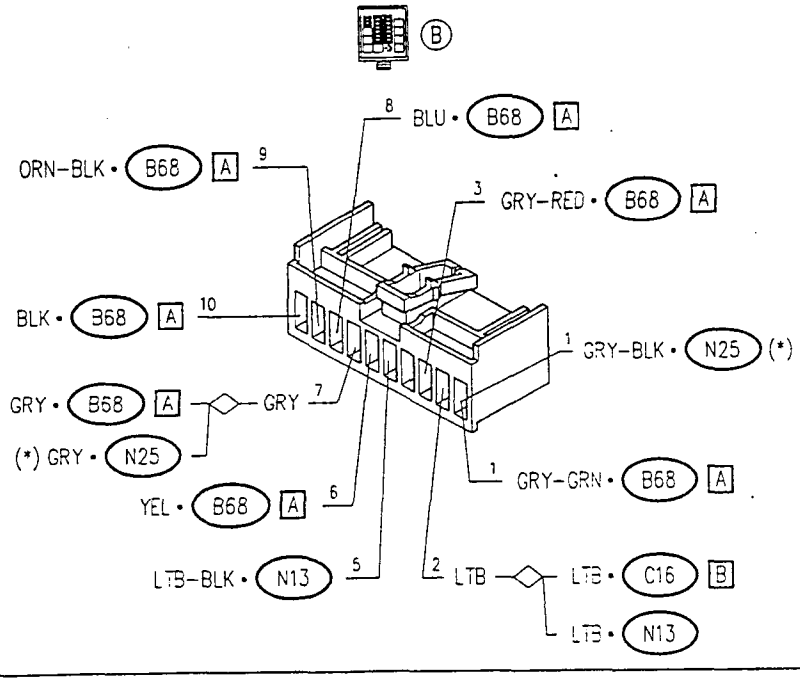
CONNECTOR F

PIN	CIRCUITS
1	Rear fog guard consent
2	LH direction indicator control
3	Low beam control
4	High beam control
5	RH direction indicator control
6	Rear fog guard control
7	Sidelights control & LH lever unit lighting
8	N.C.
9	Lever unit supply
10	LH lever unit earth



CONNECTOR F

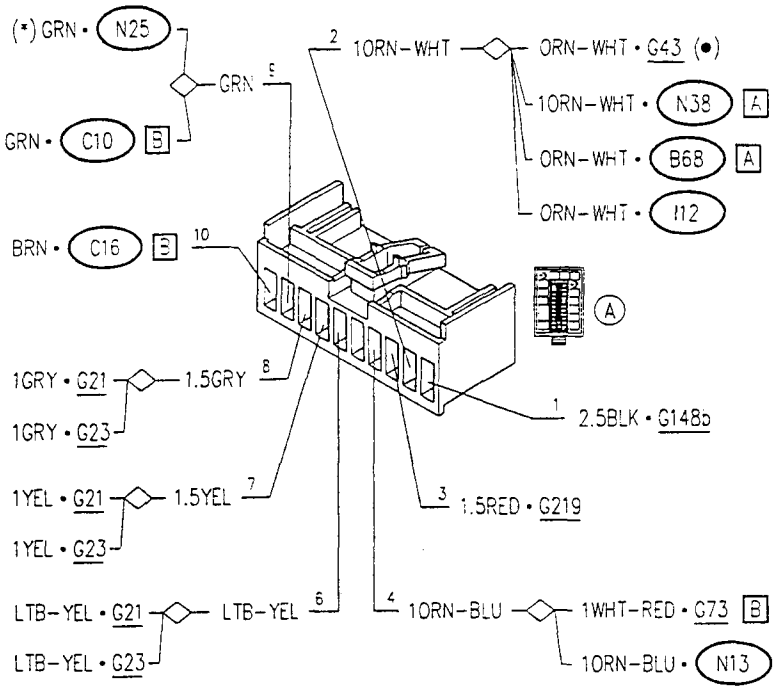
PIN	CIRCUITS
1	Rear fog guard control
2	RH direction indicator control
3	Rear fog guard consent
4	N.C.
5	LH direction indicator control
6	Sidelights control & LH lever unit lighting
7	Low beam control
8	High beam control
9	Lever unit supply
10	LH lever unit earth



(*) from Model Year '97

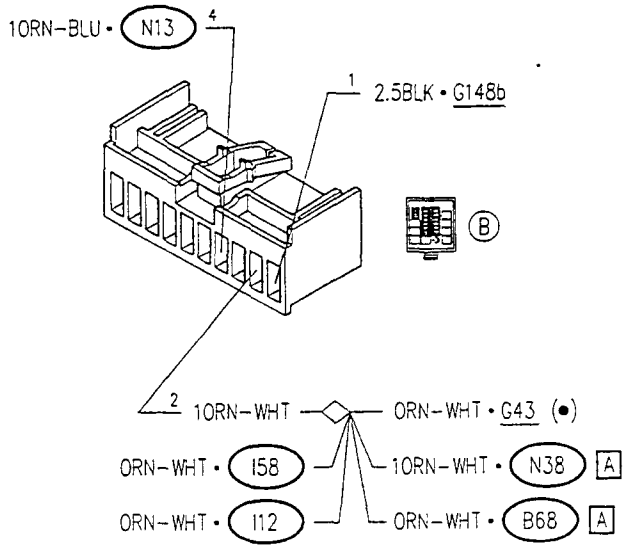
CONNECTOR G

PIN	CIRCUITS
1	**Fusebox earth**
2	Supply for side lights, power windows, luggage compt. opening, air conditioner (key-operated)
3	Sunroof
4	Hazard warning light supply
5	N.C.
6	Wing mirror defrosting
7	Door locking control
8	Door locking control
9	Fog lamp warning light
10	Fog lamp control



CONNECTOR G

PIN	CIRCUITS
1	**Fusebox earth**
2	Supply for side lights, power windows, air conditioner, sun roof (key-operated)
3	N.C.
4	Hazard warning light supply
5	N.C.
6	N.C.
7	N.C.
8	N.C.
9	N.C.
10	N.C.

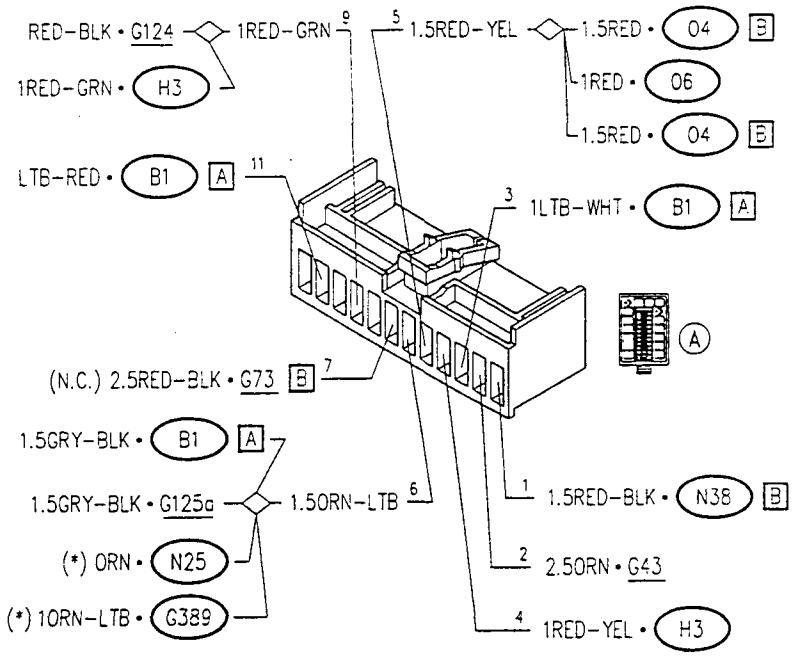


(*) from Model Year '97

(•) only up to chassis no. 4065017

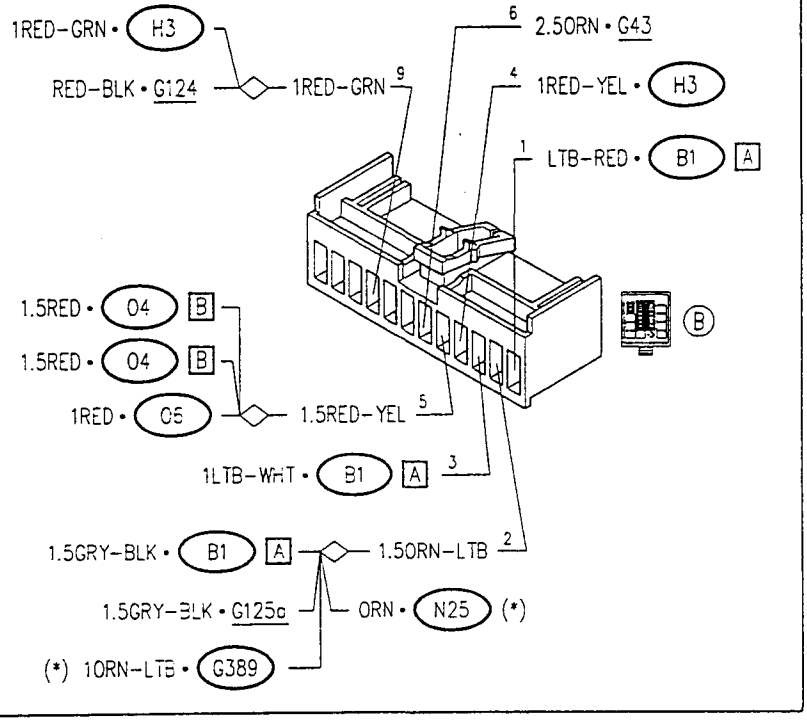
CONNECTOR H

PIN	CIRCUITS
1	Power window control unit supply (direct)
2	Heater fan supply
3	**"Key-operated" supply (PARKING)**
4	Stop lights supply
5	Supply for radio, cigar lighter
6	**"Key-operated" supply**
7	N.C.
8	N.C.
9	Stop lights control
10	N.C.
11	**"Key-operated" supply (except starting)**
12	N.C.



CONNECTOR H

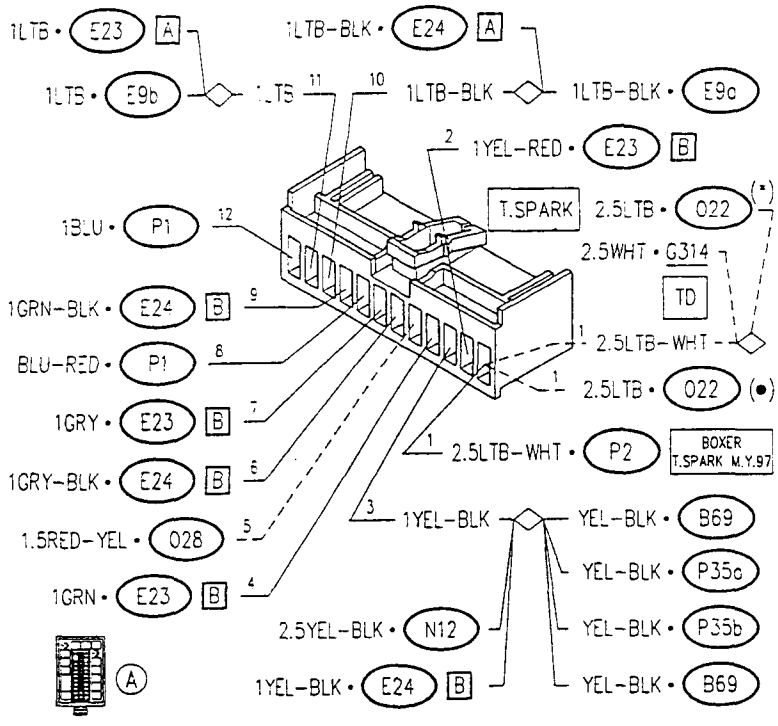
PIN	CIRCUITS
1	**"Key-operated" supply (except starting)**
2	**"Key-operated" supply**
3	**"Key-operated" supply (PARKING)**
4	Stop lights supply
5	Supply for radio, cigar lighter
6	Heater fan supply device
7	N.C.
8	N.C.
9	Stop lights control
10	N.C.
11	N.C.
12	N.C.



(*) from Model Year '97

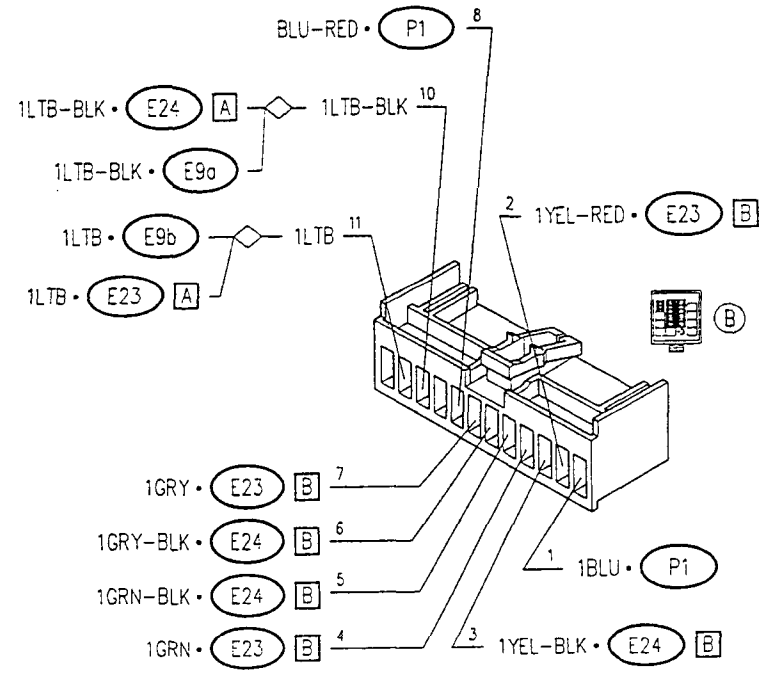
CONNECTOR I

PIN	CIRCUITS
1	Engine fan control
2	RH front sidelight
3	LH front sidelight, headlamp aiming device supply, contr.lighting
4	RH high beam
5	Dimmed high beams (only for certain Markets)
6	LH low beam
7	RH low beam
8	Windscreen wiper
9	LH low beam
10	LH front and side direction indicators
11	RH front and side direction indicators
12	Windscreen wiper supply



CONNECTOR I

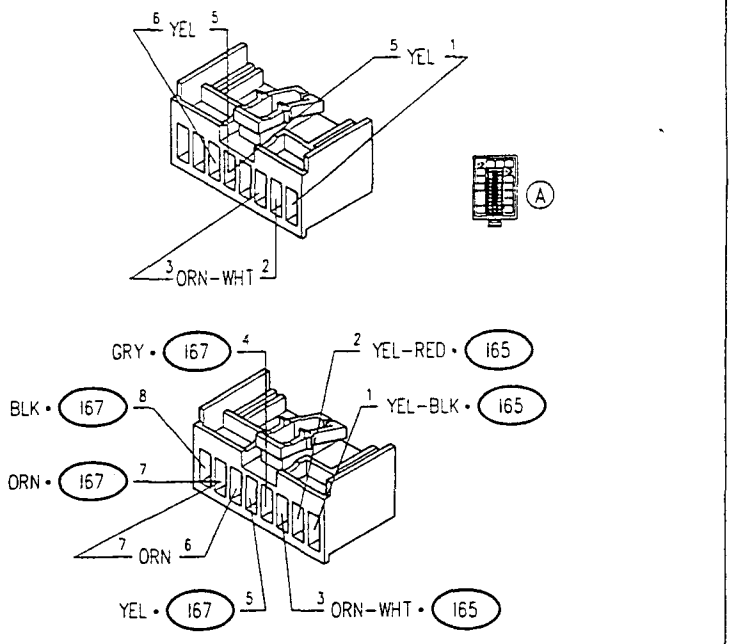
PIN	CIRCUITS
1	Windscreen wiper supply
2	RH front sidelight
3	LH front sidelight
4	RH high beam
5	LH high beam
6	LH low beam
7	RH low beam
8	Windscreen wiper
9	N.C.
10	LH front and side direction indicators
11	RH front and side direction indicators
12	N.C.



(•) TD version, from chassis no....

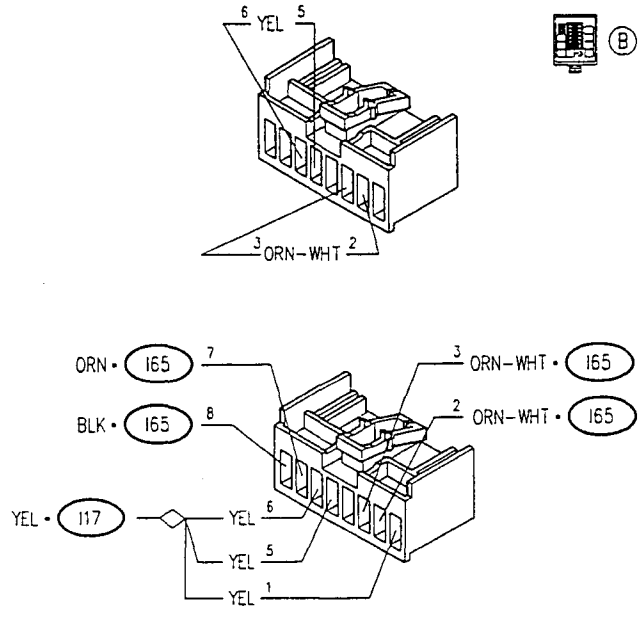
(*) also Boxer from chassis no. 4065018

CONNECTOR J	
PIN	**CIRCUITS**
1	Fog lamp consent
2	Rear fog guard consent
3	Low beam control
4	Low beam consent
5	Sidelights control
6	Sidelights consent
7	Key-operated supply
8	Earth



"Daylights" version

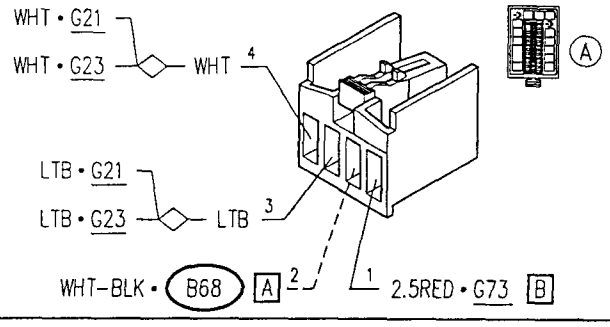
CONNECTOR J	
PIN	**CIRCUITS**
1	N.C.
2	Rear fog guard consent
3	Low beam control
4	N.C.
5	Sidelights control
6	Sidelights consent
7	Key-operated supply
8	Earth



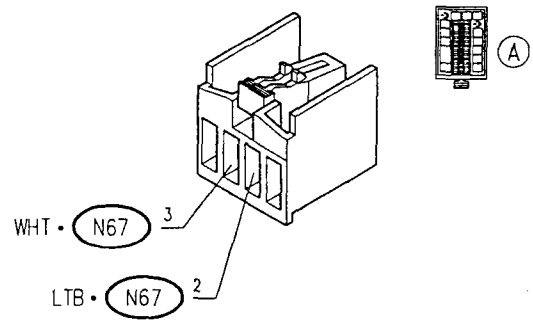
Version with fog lamps

CONNECTOR K		
PIN	CIRCUITS	
1	LH direction indicator	**Connector K**: provision for trailer (see "Trailer provision" section)
2	RH direction indicator	
3	LH sidelights	
4	Rear fog guard	
5	RH sidelights	
6	Stop lights	

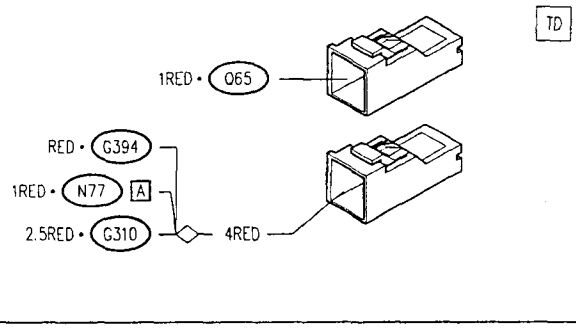
NOTE: in fusebox "B" there is no provision for trailer

CONNECTOR L		
PIN	CIRCUITS	
1	Heated rear seats supply (direct)	
2	Dimmed low beam control (only for certain Markets)	
3	Door release control	
4	Door locking control	

Not contained in fusebox "B"

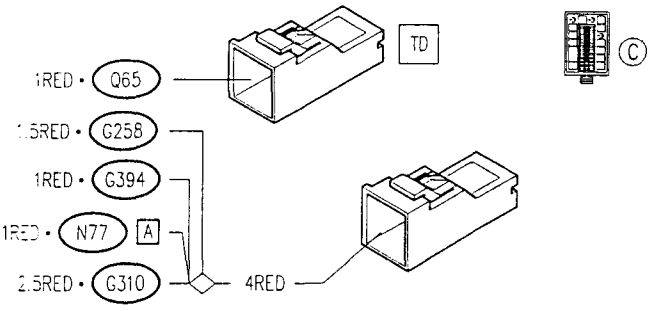
CONNECTOR M		
PIN	CIRCUITS	
1	N.C.	
2	Door release from remote control	
3	Door lock from remote control	
4	N.C.	

Not contained in fusebox "B"

CONNECTOR Q		
PIN	CIRCUITS	
-	Power windows and ALFA ROMEO CODE supply, door mirrors defrosting	
-	Conditioner compressor supply (TD from chassis no.... and TD-CAT)	

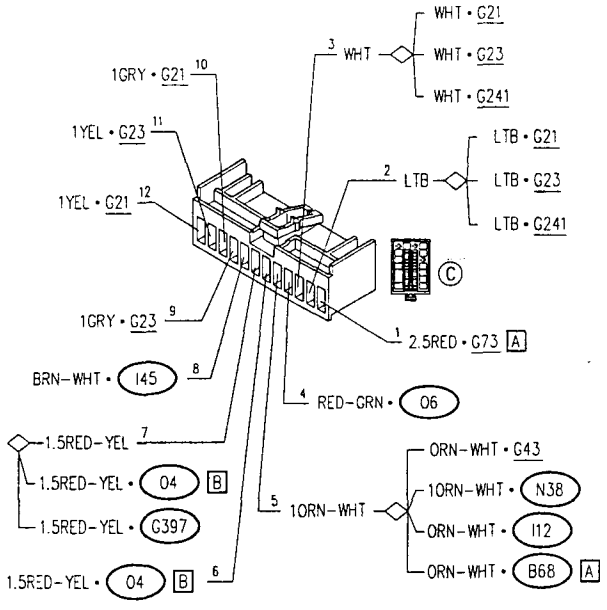
FUSEBOX SUPPLY

PIN	CIRCUITS
-	Supply for power windows ALFA ROMEO CODE control unit, wing mirror defrosting
-	Air conditioner compressor supply (TD and TD-CAT)



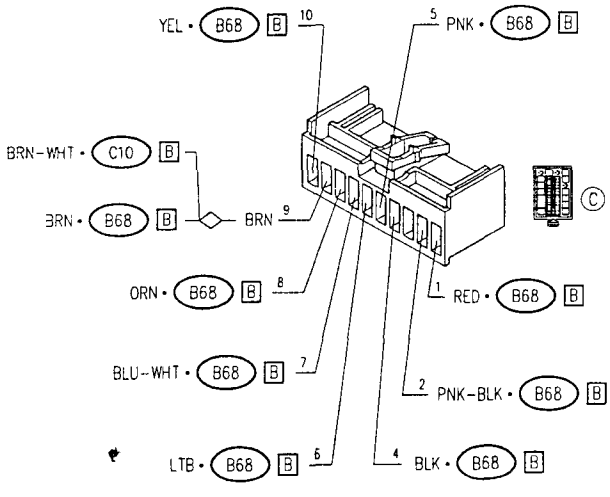
CONNECTOR A

PIN	CIRCUITS
1	Heated seats supply (direct)
2	Door release control
3	Door locking control
4	Cigar lighter supply
5	Supply for direction indicators/power windows/boot opening/conditioner (key-operated)
6	Radio supply (direct)
7	Radio supply and radio telephone (direct)
8	Wing mirror defrosting
9	Door locking device control
10	Door locking device control
11	Door locking device control
12	Door locking device control



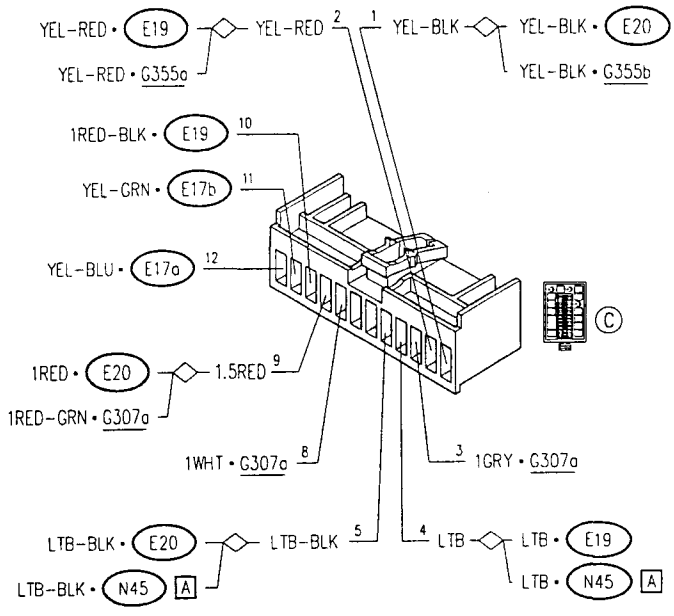
CONNECTOR B

PIN	CIRCUITS
1	Horns control
2	Rearscreen washer control
3	N.C.
4	RH lever unit earth
5	Windscreen washer control
6	Wiper intermittence control
7	Rearscreen wiper control
8	Windscreen washer supply
9	Rearscreen heating control
10	RH lever unit lighting



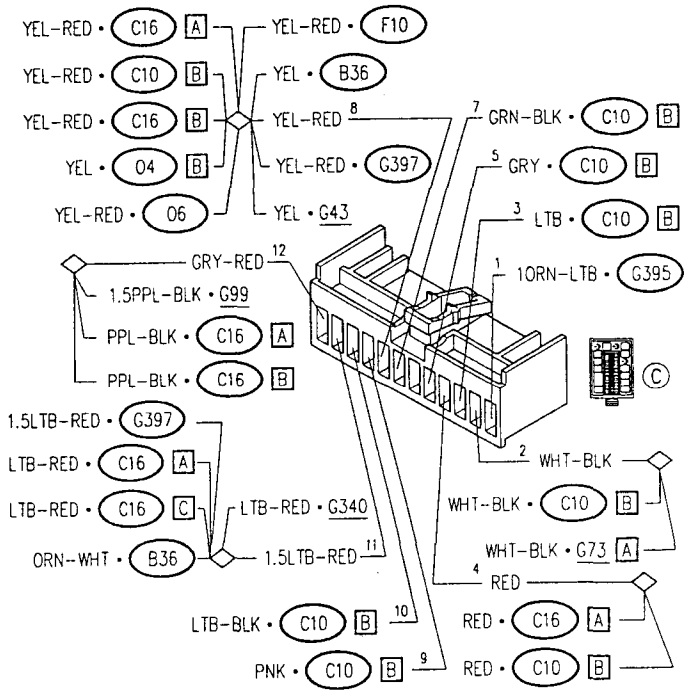
CONNECTOR C

PIN	CIRCUITS
1	LH rear sidelights
2	RH rear sidelights
3	Rear fog guard
4	RH rear sidelights
5	LH rear sidelights
6	N.C.
7	N.C.
8	Reversing lights
9	LH stop light
10	RH stop light
11	RH no. plate light
12	LH no. plate light



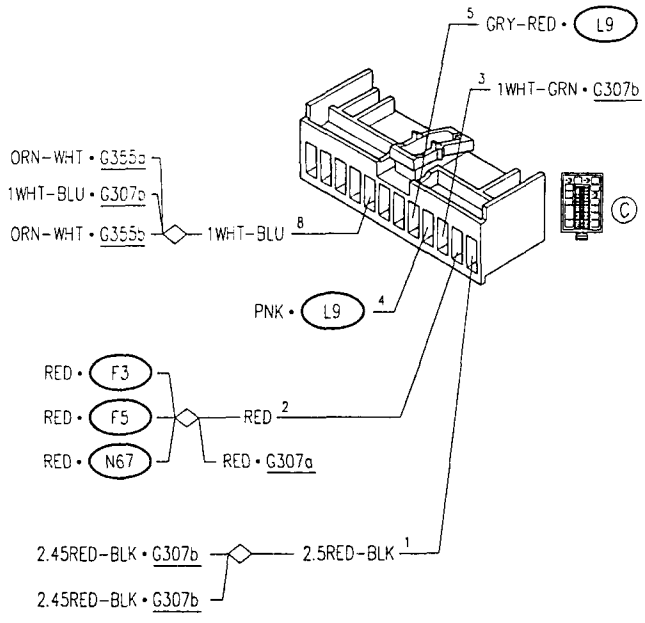
CONNECTOR D

PIN	CIRCUITS
1	Air Bag supply
2	Handbrake/brake fluid warning light
3	RH direction indicator warning light
4	Supply for cluster, check (direct)
5	Fog guard warning light
6	N.C.
7	Main beam warning light
8	Controls lighting, indicators etc. sidelights warning light
9	Fuel level gauge
10	LH sidelights warning light
11	Supply for check, wing mirror adj., radio telephone
12	Earth



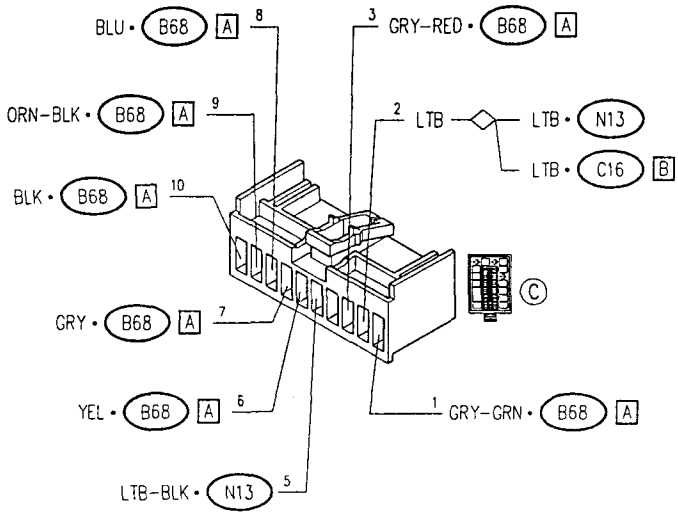
CONNECTOR E

PIN	CIRCUITS
1	Heated rearscreen
2	Supply for roof lamps and door lock remote control (direct)
3	Rearscreen wiper
4	Fuel level signal
5	Earth for fuel level
6	N.C.
7	N.C.
8	Supply for rearscreen wiper and heated seats (key-operated)
9	N.C.
10	N.C.
11	N.C.
12	N.C.



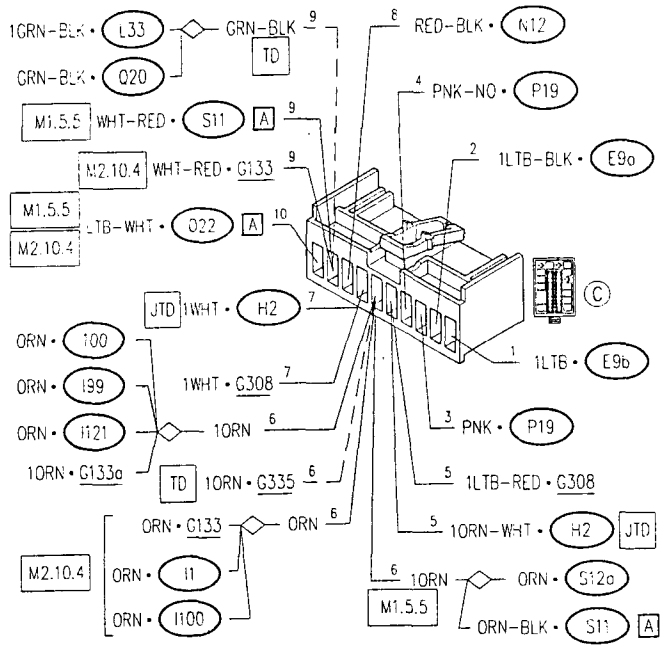
CONNECTOR F

PIN	CIRCUITS
1	Fog guard control
2	RH direction indicators control
3	Fog guard enable
4	N.C.
5	LH direction indicator control
6	Fog lamp enable
7	Dipped beam control
8	Main beam control
9	Lever unit supply
10	LH lever unit earth



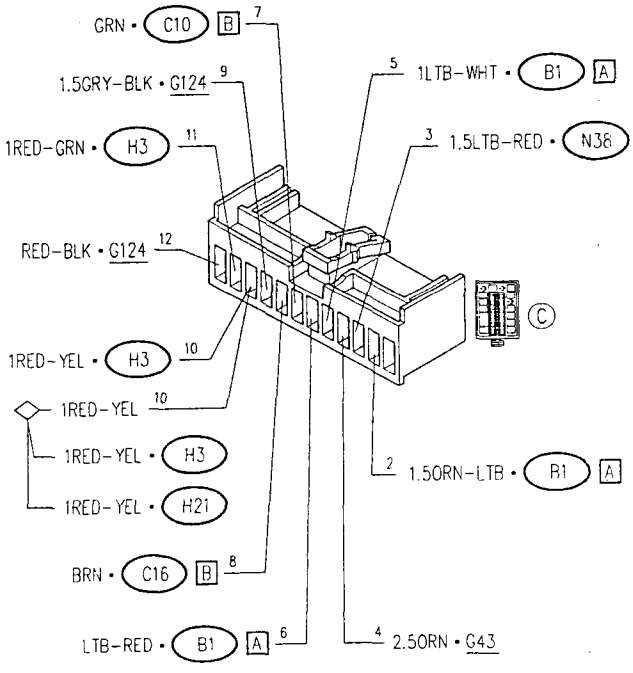
CONNECTOR G

PIN	CIRCUITS
1	Front RH and side direction indicators
2	Front LH and side direction indicators
3	Windscreen washer
4	Rearscreen washer
5	Supply for reversing light, EGR (TD-CAT)
6	Supply for engine fan/I.E control unit (key-operated) compressor disengagement control unit (TD)
7	Reversing light control
8	Headlamp washer control
9	Engine fan relay enable
10	Engine fan control



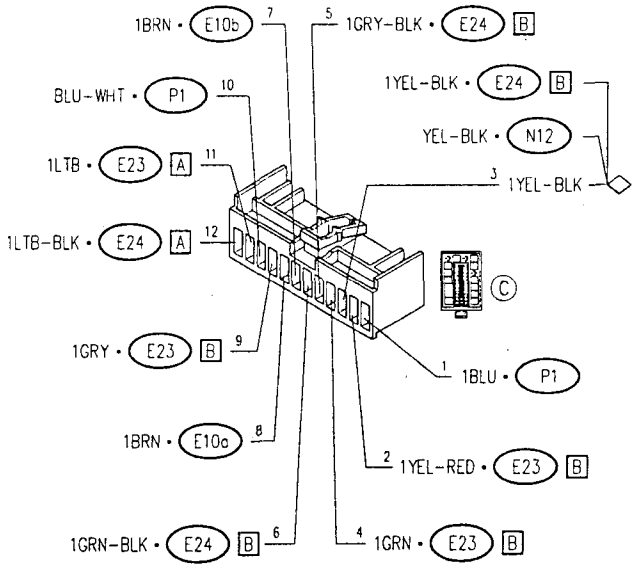
CONNECTOR H

PIN	CIRCUITS
1	N.C.
2	Key-operated supply
3	Supply for power window control unit (direct)
4	Supply for climate control fan
5	"Key-operated" supply (park)
6	Key-operated supply (exluding starting)
7	Foglamp warning light
8	Fog lamp supply
9	Supply for ABS control unit (key-operated)
10	Supply for stop lights, clutch pedal switch
11	Stop lights control
12	Stop lights control



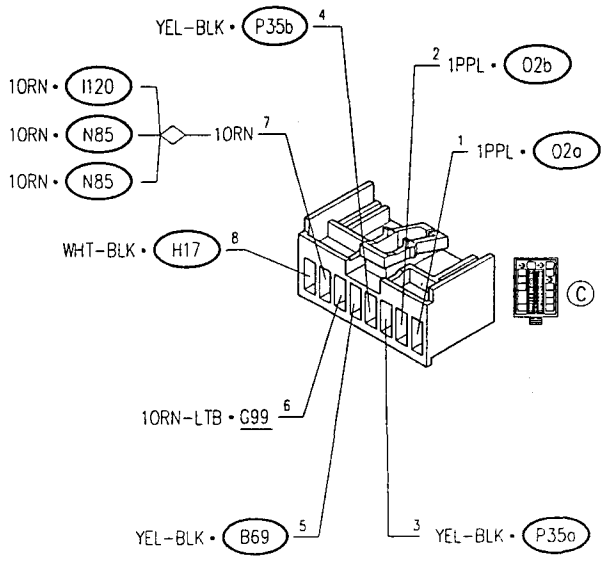
CONNECTOR I

PIN	CIRCUITS
1	Supply for windscreen wiper
2	RH front sidelight
3	LH front sidelight, headlamp washer timer
4	RH main beam
5	LH dipped beam
6	LH main beam
7	RH fog lamp
8	LH fog lamp
9	RH dipped beam
10	Windscreen wiper supply
11	RH front and side direction indicators
12	LH front and side direction indicators

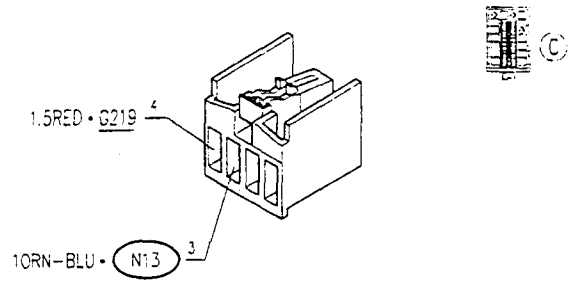


CONNECTOR J

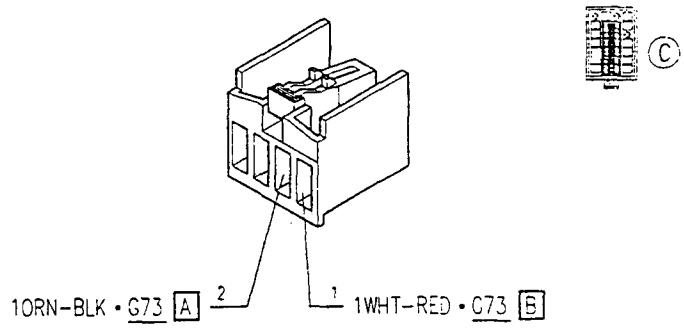
PIN	CIRCUITS
1	Low tone horn
2	High tone horn
3	LH headlamp aiming motor
4	RH headlamp aiming motor
5	Headlamp aiming control
6	CODE control unit supply
7	Additional heating control unit
8	Brake fluid level switch



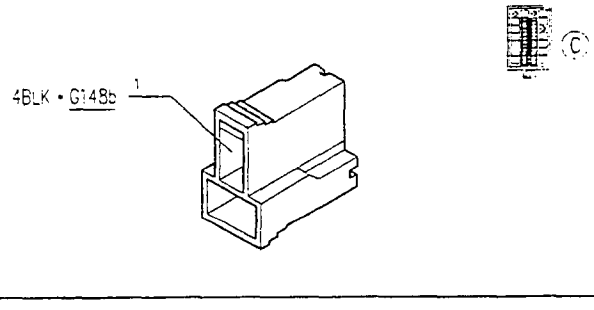
CONNECTOR L	
PIN	CIRCUITS
1	N.C.
2	N.C.
3	Supply for hazard warning lights
4	Sunroof supply



CONNECTOR M	
PIN	CIRCUITS
1	Supply for hazard warning lights/alarm
2	Supply for alarm control unit and remote control receiver
3	N.C.
4	N.C.



CONNECTOR N (EARTH)	
PIN	CIRCUITS
-	Fusebox earth



A list is also given of the fuses contained in the fusebox **G1**, with the corresponding symbol, amp rating and indications regarding the type of supply and circuits protected

Box "A"

FUSE			SUPPLY	SERVICES PROTECTED
SYMBOL	N°	AMP.		
	1	10A		Hazard warning lights, Anti-theft device
	2	25A		Horns, cigar lighter, stop lights, radio
	3	20A	135	Windscreen wiper
	4	25A	135	Rearscreen wiper, cmpressor control unit (TD), radiator fan (TD and T.SPARK) heated seats
	5	10A	164	Instr. cluster lighting, contr.lighting, LH rear side lights, RH no.plate, RH front sidelight, sidelights warning light
	6	10A	164	RH rear sidelight, LH no. plate, LH front sidelight, headlamp aiming device
	7	10A	149	Right low beam headlamp
	8	10A	149	Left low beam headlamp
	9	15A	150	Right high beam headlamp
	10	15A	150	Left high beam headlamp, high beam warning light
	11	7.5A	125	Rear fog guard, fog guard warning light
	12	30A		Heated rearscreen, heated rearscreen warning light, mirror defrosting
	13	20A	135	Heater, fan
	14	30A		Engine fan (Boxer)
SERVICES	15	15A		Instr. cluster, windscr.-hd.lamp washer pump, reversing lights, airbag, wing mirror adjustment, clock, check panel, ALFA ROMEO CODE, E.G.R.
	16	10A		Clock, interior lighting, instrument cluster, door lock remote control
	17	7.5A		Direction indicators, front power windows, compressor control, engine fan timer, luggage compartment opening control
	18	20A		Door lock
	19	20A		Fog lamps, fog lamp warning light
	20	30A	158	Electric sunroof
	21	30A		Heated seats
	22	25A		Left front power window
SERVICES	24	7.5A		Dim-Dip

Box "B"

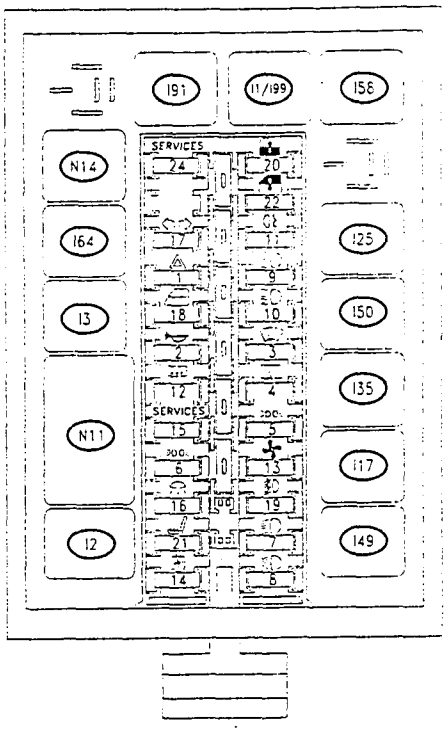
FUSE			SUPPLY	SERVICES PROTECTED
SYMBOL	N°	AMP.		
	1	10A		Hazard warning lights
	2	20A		Horns, cigar lighter, stop lights, radio
	3	20A	(135)	Windscreen wiper
	4	20A	(135)	Heated rearscreen
	5	10A	(164)	Instr.cluster lightiing, contr,lighting, rear LH sidelights, RH no.plate, front RH sidelight, sidelight warning light
	6	10A	(164)	Rear RH sidelight, LH no.plate, front LH sidelight
	7	10A	(149)	Right low beam headlamp
	8	10A	(149)	Left low beam headlamp
	9	10A	(150)	Right high beam headlamp
	10	10A	(150)	Left high beam headlamp, high beam warning light
	11	7.5A		Rear fog guard, fog guard warning light
	12	30A		Heated rearscreen, heated rearscreen warning light
	13	20A	(135)	Heater, fan
	14	25A		Engine fan
SERVICES	15	10A		Instr. cluster, windscr.-hd.lamp washer, rev. lights, airbag, clock, engine fan, ALFA ROMEO CODE
	16	20A		Clock, interior lighting, instrument cluster, door locks
	17	7.5A		Direction indicators, compressor control, engine fan timer, sunroof control

Box "C"

FUSE			SUPPLY	SERVICES PROTECTED
SYMBOL	N°	AMP.		
	1	10A		Hazard warning lights
	2	20A	I3	Horns
	3	20A	I35	Windscreen wiper, heated seats
SERVICES	4	10A	I35	Cigar lighter
	5	10A	I64	LH rear sidelight, RH number plate light, RH front sidelight
	6	10A	I64	RH rear sidelight, LH number plate light, LH front sidelight, sidelight warning light, cluster lighting, controls lighting
	7	10A	I49	Right low beam headlamp, headlamp aiming device
	8	10A	I49	Left low beam headlamp
	9	15A	I50	Right high beam headlamp
	10	15A	I50	Left high beam headlamp, high beam warning light
	11	7.5A	N25	Rear fog guard, rear fog guard warning light
	12	30A		Rearscreen heating, rearscreen heating warning light, wing mirror defroster
	13	30A	I35	Heater, fan
CODE	14	7.5A		Engine fan, CODE control unit, i.e. control unit, i.e. control unit (JTD), compressor control unit (TD)
SERVICES	15	15A		Lever unit supply, cluster, check panel, boot opening, front power window, wing mirror adjustment, Air Bag, air recirculation, compressor control, EGR (TD), ABS, radio telephone, additional heating control unit (JTD)
	16	20A		Clock, inner roof lights, instrument cluster, door locking remote control, radio, radio telephone
	17	7.5A		Door locking and alarm relay, TELEPASS supply
	18	20A		Door locking device
	19	20A	I17	Foglamps, foglamp warning light
	20	30A	I58	Sunroof
	21	30A		Heated seats
	22	25A		Left front power window
ABS	24	10A		ABS

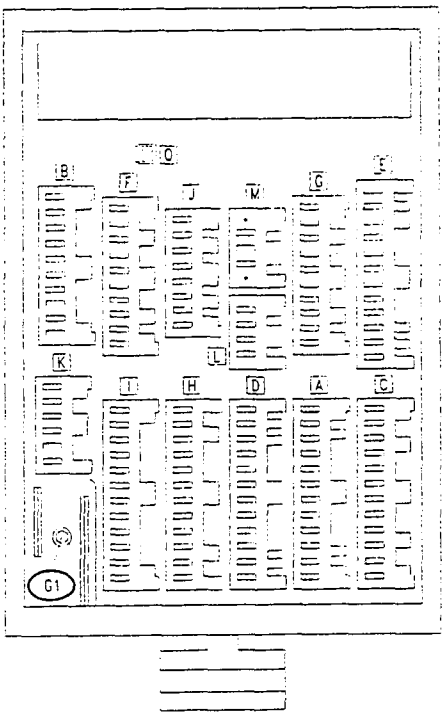
Lastly, two schematic drawings are given which show the location of the fuses and relays and the position of the connectors:

LOCATION OF FUSES AND RELAYS (Box "A")



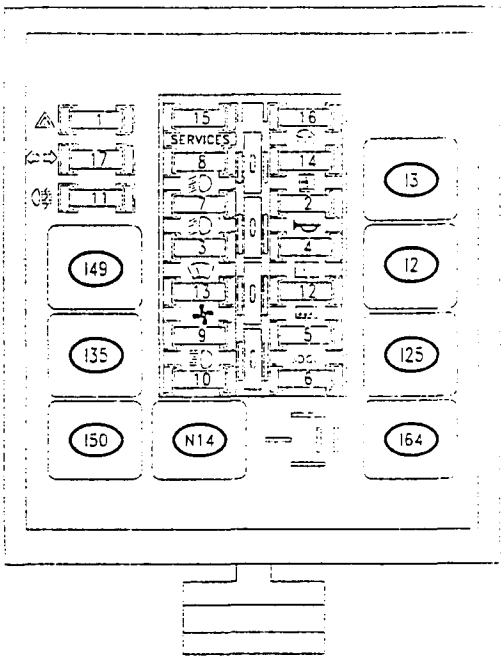
I1	Engine water cooling fan
(I99)	relay
I2	Heated rearscreen relay (*)
I3	Horn relay
I17	Fog lamp relay
I25	Rear fog guard relay
I35	Key-operated supply relay
I49	Low beam headlamp relay
I50	High beam headlamp relay
I58	Sunroof relay
I64	Sidelights relay
I91	DIM-DIP cut-in relay
N11	Door locking control unit
N14	Electronic windscreen wiper intermittence

REAR VIEW, CONNECTORS SIDE (Box "A")



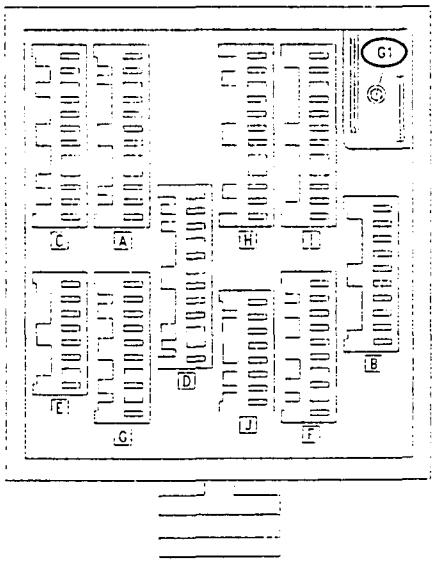
(*) timed from M.Y. '97

LOCATION OF FUSES AND RELAYS (Box "B")



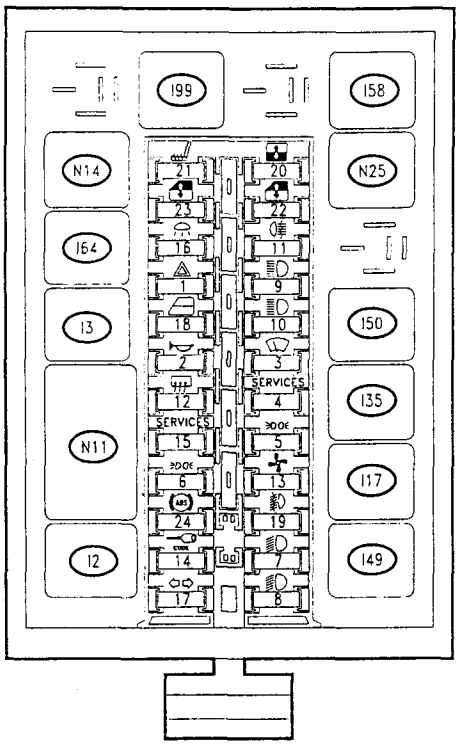
I2	Heated rearscreen relay (*)
I3	Horn relay
I25	Rear fog guard relay
I35	Key-operated supply relay
I49	Low beam headlamp relay
I50	High beam headlamp relay
I64	Sidelights relay
N14	Electronic windscreen wiper intermittence

REAR VIEW, CONNECTORS SIDE (Box "B")



(*) timed from M.Y. '97

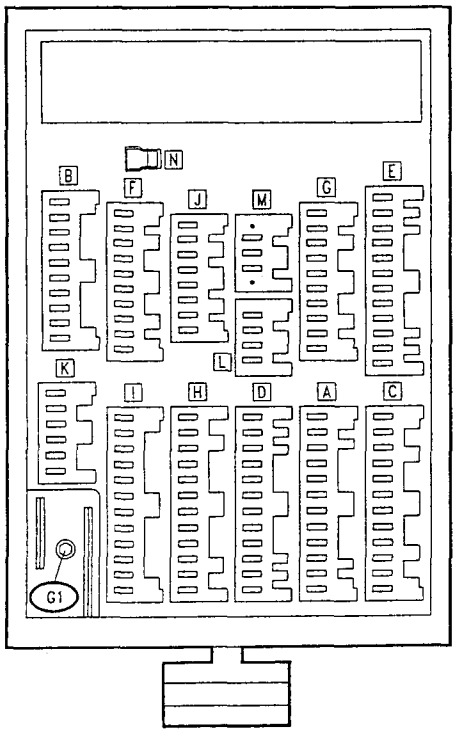
LOCATION OF FUSES AND RELAYS (Box "C")



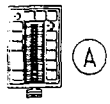
RELAYS:

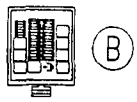
I2	Rearscreen heating relay
I3	Horn relay
I17	Fog lamp relay
I35	Key-operated supply relay
I49	Low beam headlamp relay
I50	High beam headlamp relay
I58	Sunroof relay
I64	Sidelight relay
I99	Engine water cooling fan relay
N11	Door locking control unit
N14	Windscreen wiper intermittent device
N25	Rear fog guard control unit

REAR VIEW, CONNECTORS SIDE (Box "C")



FUSES AND RELAYS ON AUXILIRY BRACKET





A set of fuses and relays is to be found on an auxiliary bracket (not removable) located on the left of the main fusebox; next to this there is the power window control unit **N38** and, for versions wth fusebox "B", also the door locking control unit **N11**.

The fuses and relays can be identified according to the colour of the base (fuse holder or relay holder) that connects them to the wiring, as shown in the table below:

COMPONENT	CODE	BASE COLOUR
Front power windows relay	**I12**	Black (Yellow*)
Luggage compartment opening relay	**I52**	Yellow
Hazard warning light and direction indicator flasher	**N13**	Grey
Timer for headlamp washer	**N12**	Black
Fuel warming device relay (TD only)	**I44**	White
Starting consent relay (•)	**I10**	Yellow
Diesel engine control devices relay (TD only)	**I105**	Grey
Engine cooling fan relay (*)	**I1/I99**	Yellow
Engine 2nd speed cooling fan relay (••)	**I100**	Yellow
Sunroof relay (*)	**I58**	White
Heater fan relay (*)	**I78**	Yellow
Fog lamp relay (*)	**I17**	Grey
Door mirrors defrosting relay	**I45**	White
Headlamp washer fuse (20A)	**G312**	Yellow
ABS fuse (10A)	**G125a**	Red
Fuse for power windows (30-25A)	**G310**	Green
Fuse for RH power window (25A) (*)	**G310**	White
Fuse for LH power window (25A) (*)	**G311**	White
Sunroof fuse (20A) (*)	**G261**	Yellow
Heater fan fuse (30A) (*)	**G255**	Green
Fog lamp fuse (20A) (*)	**G382**	Yellow
Door mirrors defrosting fuse (7.5A)	**G394**	Brown
Fog lamp consent relay (*) (**)	**I65**	Grey (*)/Green (**)
Daylight cut-off relay (**)	**I67**	Green
Electromagnetic joint control relay (••)	**Q22**	Grey
Auxiliary climate control relay (••)	**Q32**	Grey
Conditioner fan delaying device (•••)	**Q42**	White
Air conditioning system wander fuse (••)	**Q65**	Red
Rear fog guard electronic device (***)	**N25**	Grey
ALFA ROMEO CODE fuse (10A) (***)	**G389**	Grey

(*) Only for versions with **fusebox "B"**
(**) Only for certain Markets
(***) From M. Y. '97
(•) Ffor versions without ALFA ROMEO CODE, but with anti-theft system
(••) For T.SPARK version (M2.10.3) and TD versiones and boxer from chassis no....
(•••) Only for TD version from chassis no....

N.B.
In addition to the colour of the base, you are recommended to check the exact location of a relay or fuse by the colour of the wires converging on it (for this, refer to the corresponding wiring diagram).

FUSES AND RELAYS ON AUXILIARY BRACKET  Ⓒ

A set of fuses and relays is located on an auxiliary bracket (not removable) to the left of the main fusebox; next to this, there is also the power window control unit **N38**.

The fuses and relays are distinguished by the colour of the base (fuse holder or relay holder) which connects them to the wiring, according to the following table.

COMPONENT	CODE	BASE COLOUR
Front power window relay	**I12**	Black
Boot opening relay	**I52**	Yellow
Hazard warning light and direction indicator flasher	**N13**	Grey
Timer for headlamp washer	**N12**	Black
Fuel warming device relay (TD and JTD only)	**I44**	White
Diesel engine control devices relay (TD only)	**I105**	Grey
Engine cooling fan relay (•)	**I1**	Black
Engine cooling fan 2nd speed relay (•)	**I100**	Black
Wing mirror defroster relay	**I45**	White
Electromagnetic coupling relay (•)	**Q22**	Grey
Headlamp washer fuse (20A)	**G312**	Yellow
Power window fuse (30A)	**G310**	Green
Wing mirror defroster fuse (7.5A)	**G394**	Brown
Air conditioning system fuse	**Q65**	Red
Alarm fuse (20A)	**G258**	Yellow
Air bag and cluster fuse (10A)	**G395**	Red
Fuel oil warming fuse (25A) (JTD only)	**G352**	White
ALFA ROMEO CODE fuse (7.5A) (M1.5.5 only)	**G389**	Brown

(•) up to M.Y. '97

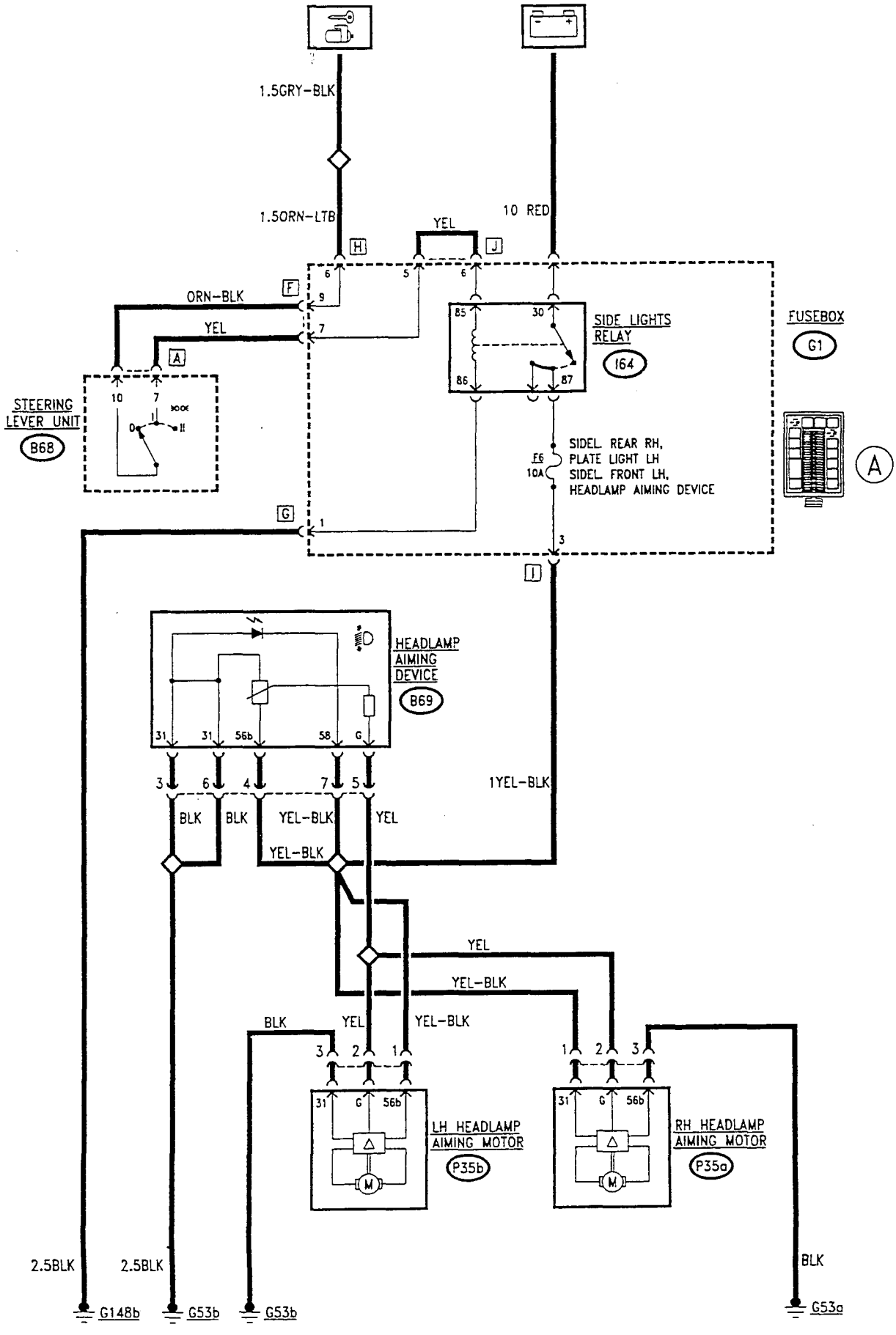
N.B. In addition to the colour of the base, it is always wise to check the exact location of a relay or fuse by the colour of the wires that converge on it (for these refer to the corresponding wiring diagram given on the next pages.

HEADLAMP AIMING DEVICE

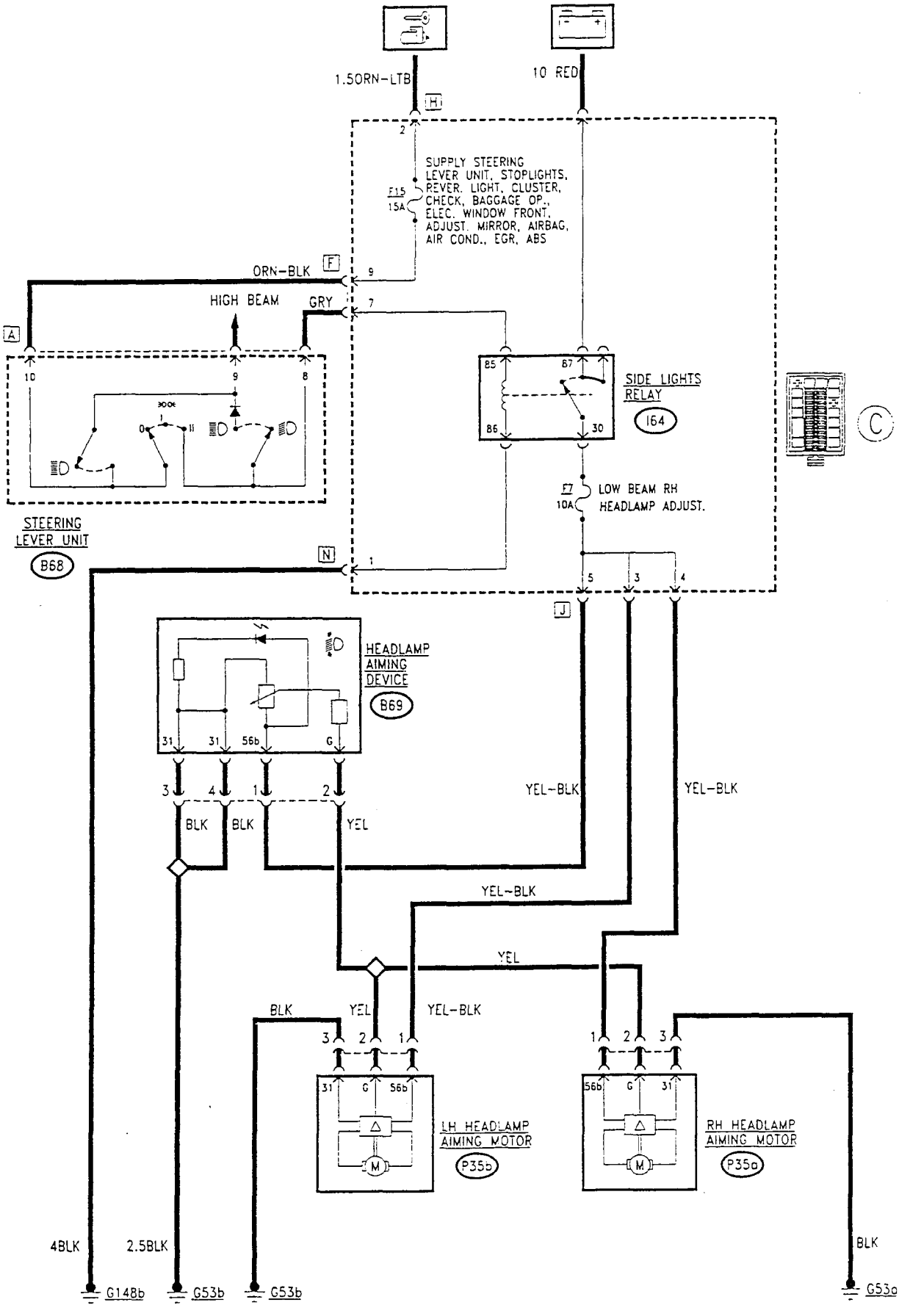
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WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

Some versions of the car offer the possibility to adjust the headlight beam in relation to the load directly from the driver's seat.
In this way the problem or invonveniences caused by incorrect headlamp aiming is avoided and the delicate task of direct lamp adjustment is simplified (this is not substituted by the electrical device but integrated with it)
The adjustment device consists of a motor fitted on each of the two headlamps which suitably slopes them to lower the beam when the car is heavily loaded and raise it when the load is lightened.
The driver operates the system directly by turning a knob on the dashboard, which allows four positions to be chosen according to the following table:

Position of knob	Load conditions
0	driver only or driver and passenger on front seat
1	all seats occupied
2	all seats occupied plus load in luggage compartment (until reaching max.allowed load on rear axle)
3	driver plus load in luggage compartment until reaching max. allowed load on rear axle)

The system can be operated only when the side lights are on; it is completely de-activated when they are off.

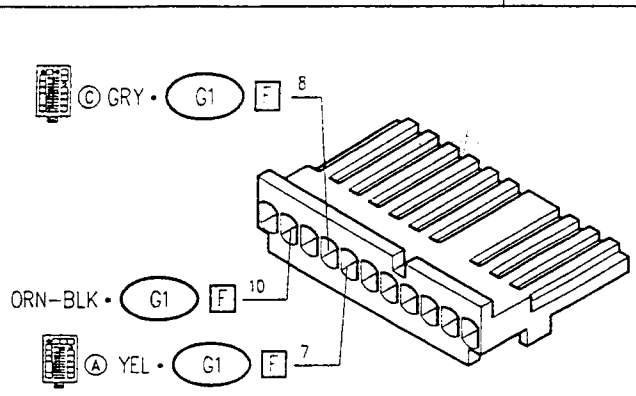
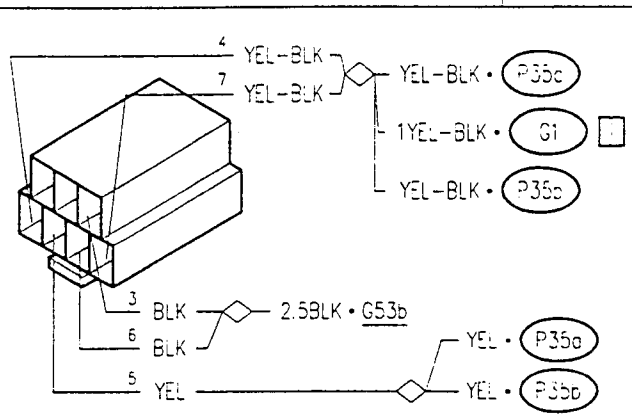
NOTE: for safety reasons the system is designed so that in the event of a failure it cannot be moved to a higher position than the one it is already at.

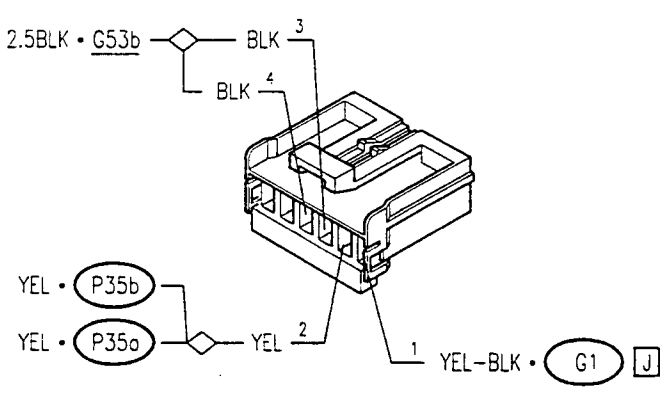
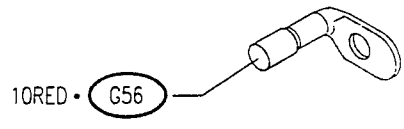
FUNCTIONAL DESCRIPTION

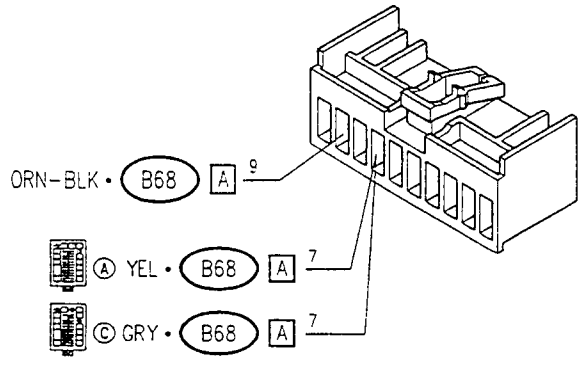
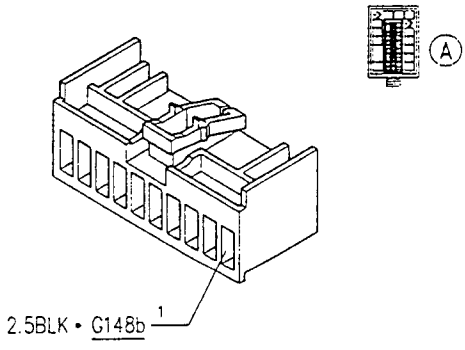
The headlamp aiming device **B69** is supplied at pin 56b by a line leading from the side lights circuit: this line receives voltage only when the side lights are on. The same supply (pin 58) turns on the led inside device **B69** itself which illuminates the ideogram identifying the function.
Pins 31 of device **B69** are earthed, while the adjustment signal obtained by pressing the four-position selection knob leads from pin G. This signal varies the output voltage through a potentiometer (100% voltage at position "0"; with voltage decreasing for the successive positions).

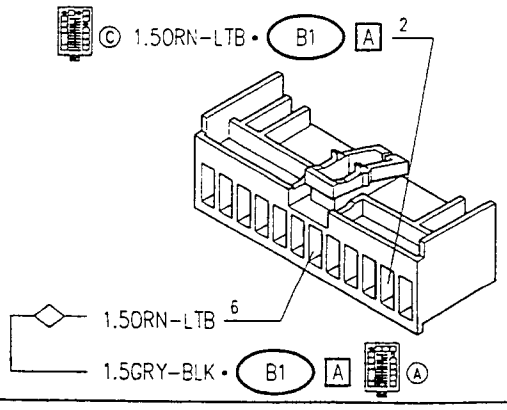
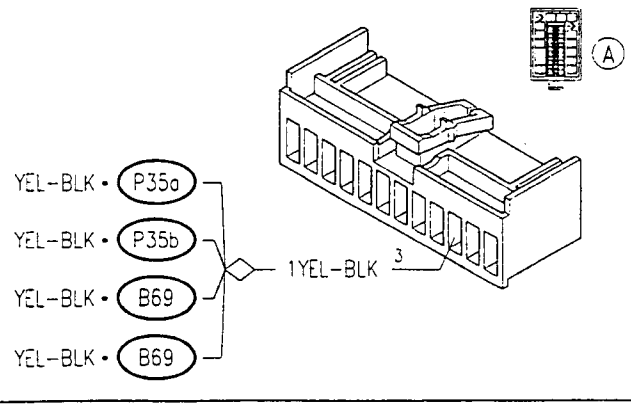
Motors **P35a** and **P35b** are formed by a motor in the strict sense of the word controlled by a transducer and an electronic control unit which establishes the stroke on the basis of the voltage of the adjustment signal reaching pins G from device **B69**.
The devices are supplied, at pin 56b, by the same line that supplies device **B69**, (up to chassis no. ... protected by fuse **F6** of box **G1** "A" and by fuse **F7** of box **G1** "C", while pins 31 are earthed.

COMPONENTS AND CONNECTORS

Lever unit	B68 A	Headlamp aiming device	B69
			

Headlamp aiming device	B69	Fusebox	G1
			

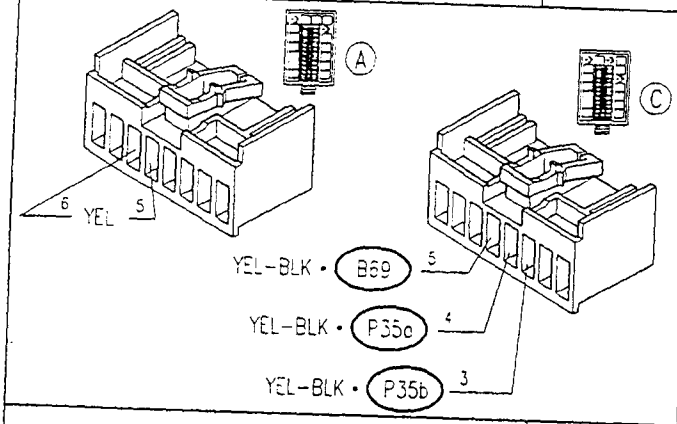
Fusebox	G1 F	Fusebox	G1 G
			

Fusebox	G1 H	Fusebox	G1 I
			

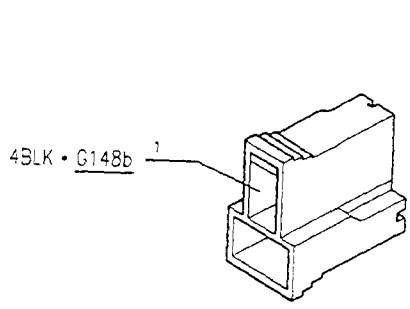
(*) from chassis no.__

COMPONENTS AND CONNECTORS (cont.d)

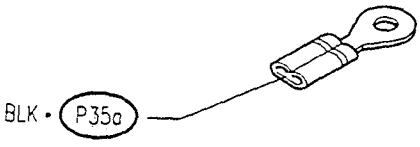
Fusebox	G1 J



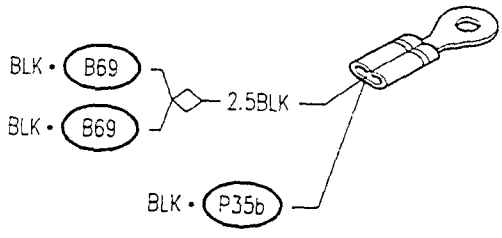
Fusebox	G1 N



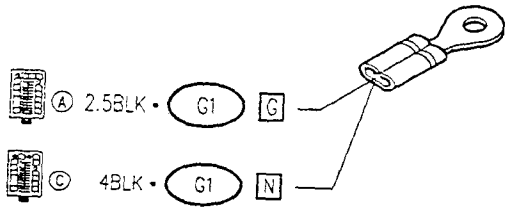
RH engine compartment earth	G53a



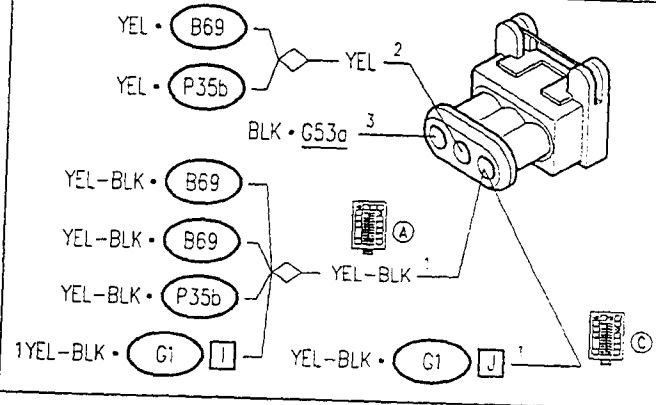
LH engine compartment earth	G53b



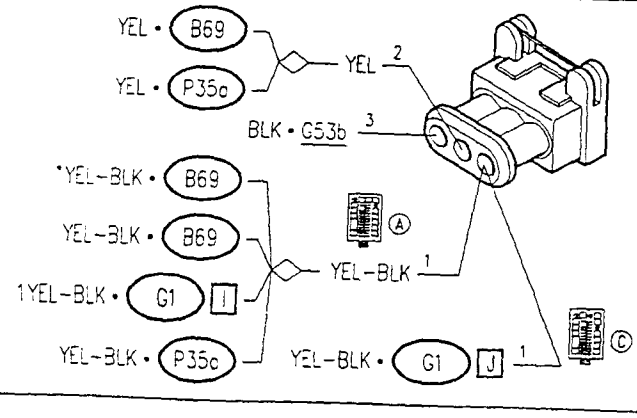
Earth under LH dashboard.	G148b



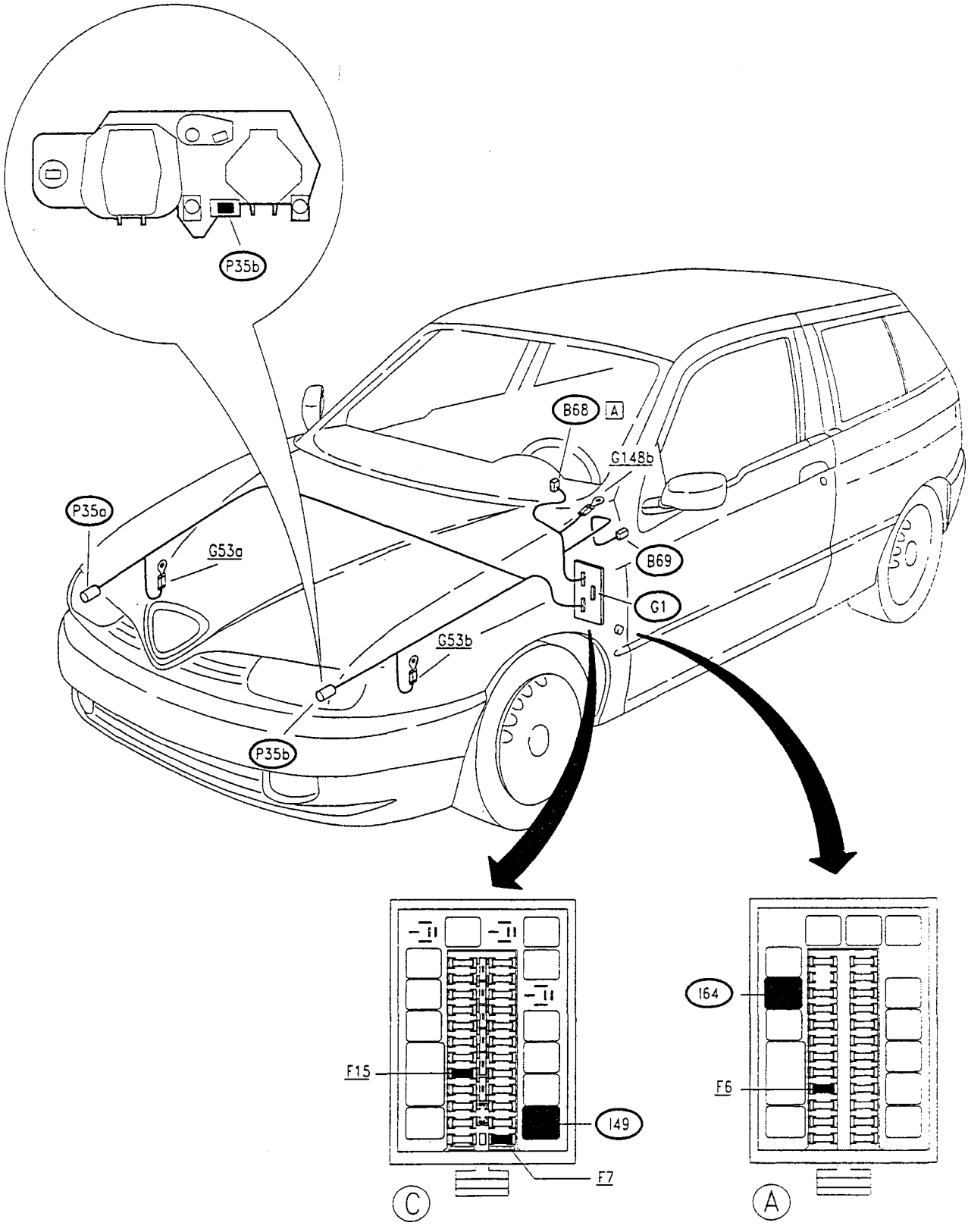
RH headlamp aiming motor	P35a



LH headlamp aiming motor	P35b



LOCATION OF COMPONENTS

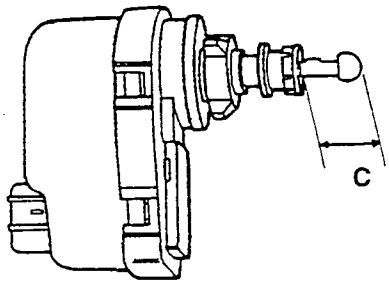


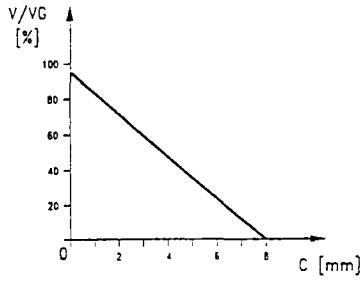
FAULTFINDING TABLE

Failure	Component to be checked		
	P35a	P35b	B69
Complete adjustment			•
RH headlamp aiming device	•		
LH headlamp aiming device		•	
Control device lighting			•

CHECKING COMPONENTS

RH/LH hedlamp adjustment motor P35a P35b



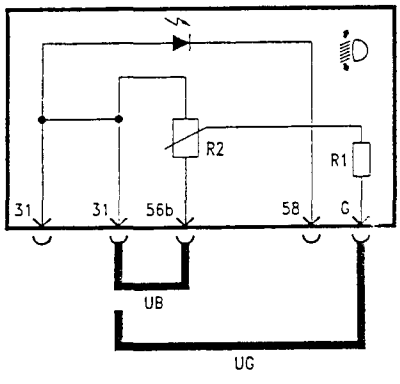


Operating diagram: course of stroke C in relation to the voltage V/VG

V = voltage between pin 56b and pin 31 (12V)

VG = voltage between pin G and pin 31

Headlamp aiming device B69



SPECIFICATIONS	
R1	390 Ω ± 3%
R2	4.7 kΩ

Knob position	Voltage between terminals G and 31 (UG)
0	94.9% UB ± 3%
1	86.6% UB ± 7%
2	79.7% UB ± 7%
3	66.4% UB ± 7%
4	51.2% UB ± 7%

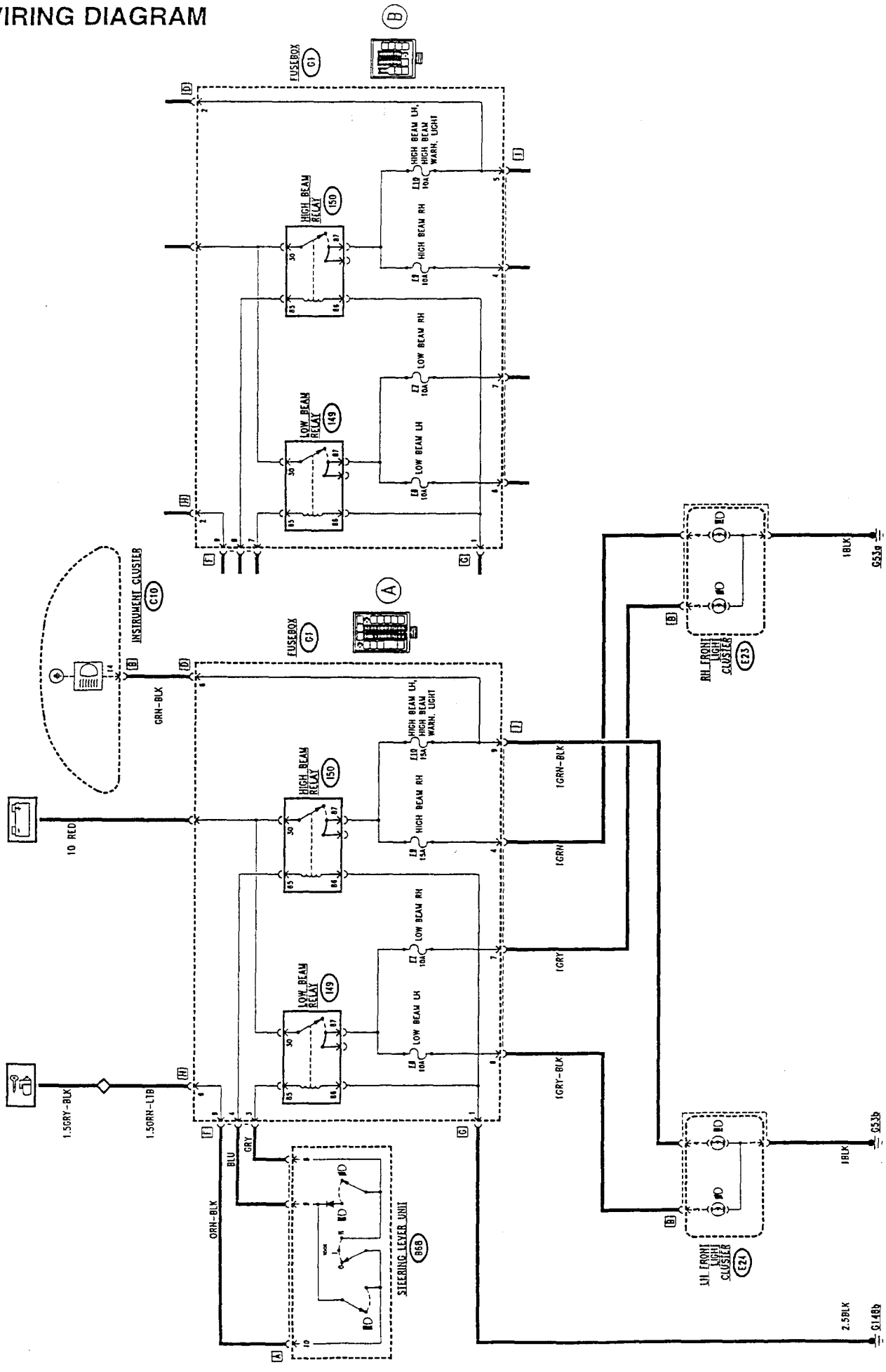
(UB: voltage between pins 31 and 56b = 12V)

HIGH AND LOW BEAM HEADLAMPS

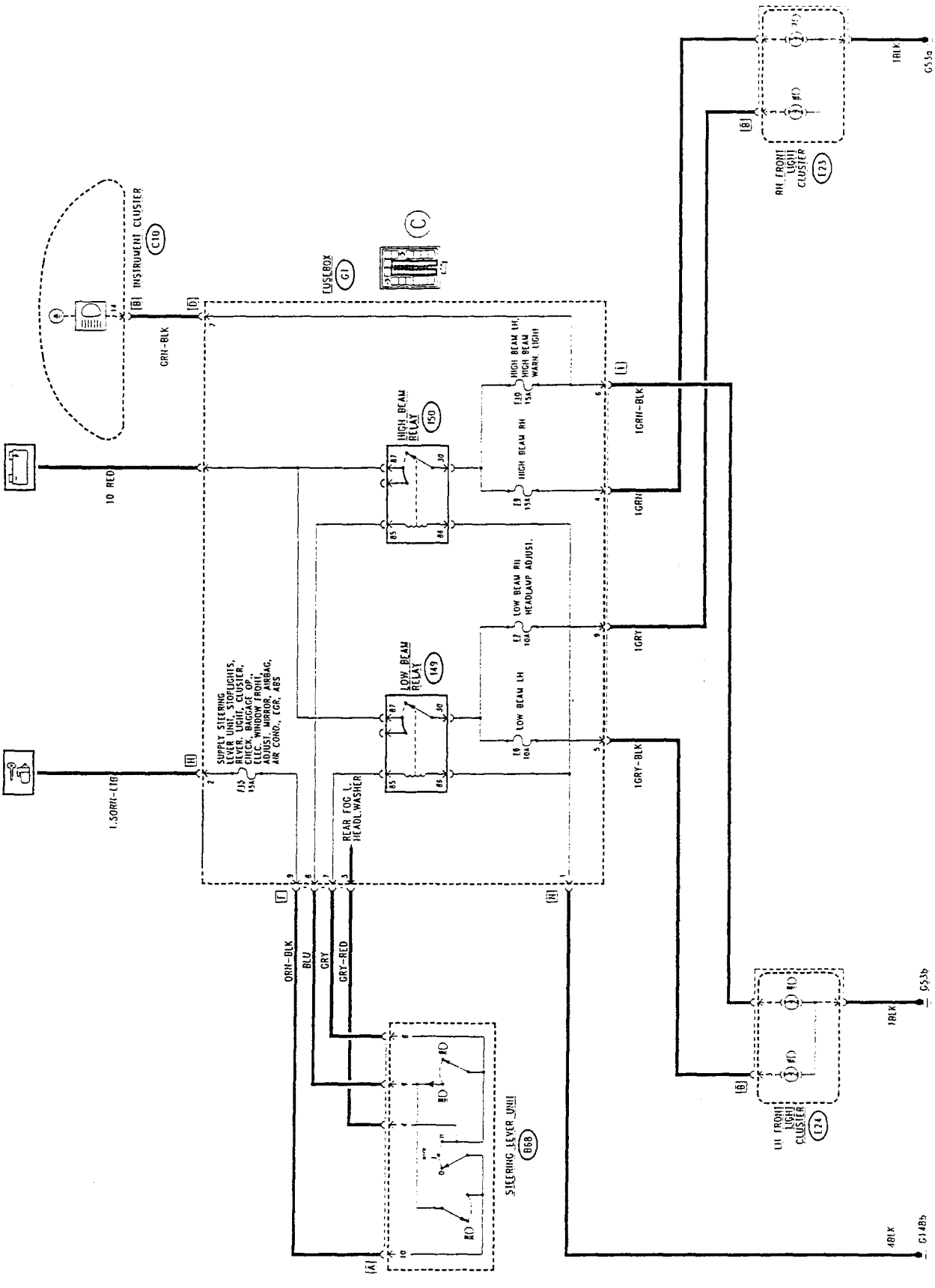
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WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The car is fitted with two separate lamps for the low beams and two for the high beams.

The low beams are turned on by the switch on the steering column lever unit one position on from the sidelights; from this position the high beam can be permanently selected operating the high/low beam switch; lightly pulling the lever towards the steering wheel activates the high beam "flashing" function for as long as the lever is pulled.

A warning light on the dashboard indicates when the high beams are on.

For safety reasons each single high and low beam lamp is protected by a fuse.

NOTE: some versions are equipped with an electrically- operated headlamp aiming device (see "Headlamp aiming device"); however a manual device enables quick and simple adjustment of the beam to the loading conditions of the vehicle.

FUNCTIONAL DESCRIPTION

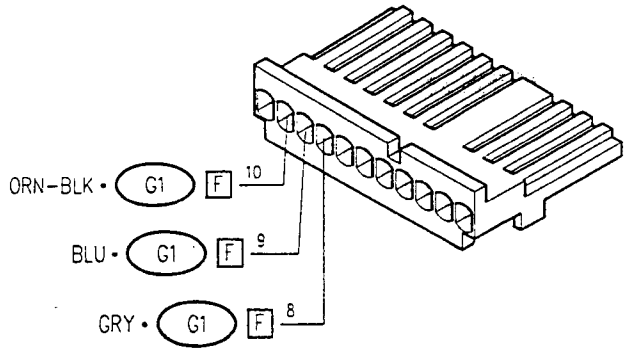
The circuit of the low beam headlamps is operated by relay switch **I49** located in fusebox **G1**.
Moving the lever unit switch **B68** to position II and with the switch in the low beam position the coil of relay switch **I49** is "turn key" supplied thereby closing the circuit supplying the left headlamp **E24** and the right headlamp **E23**.
Each circuit is protected by a fuse in fusebox **G1**: **F7** for the right headlamp and **F8** for the left one.
Fusebox **G1** "C" contains fuse **F15** which protects the services of the steering column lever unit **B68**.

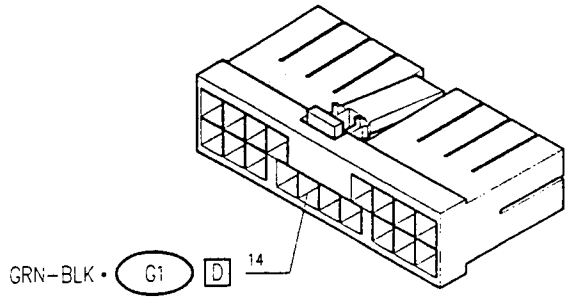
The high beam circuit is operated by relay switch **I50** located in fuse box **G1**.
Moving the switch to the high beam position with the lever unit switch **B68** on position II, or closing the "flashing" contact, the coil of relay switch **I50** is "turn key" supplied thereby closing the circuit that supplies the left headlamp **E24** and the right one **E23**. Each circuit is protected by a fuse in fusebox **G1**: **F9** for the right headlamp and **F10** for the left one.

The left high beam headlamp supply line also sends a signal to the instrument panel **C10** to turn on the high beam on warning light.

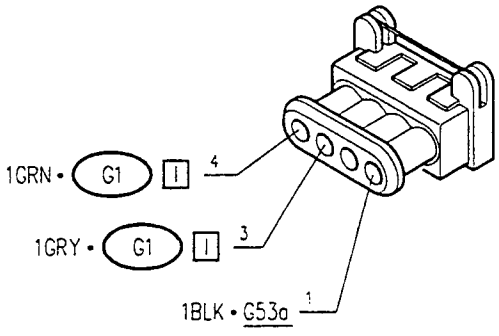
COMPONENTS AND CONNECTORS

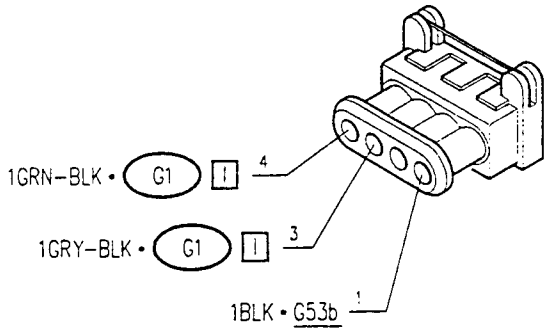
Lever unit	B68 A	Instrument cluster	C10 B



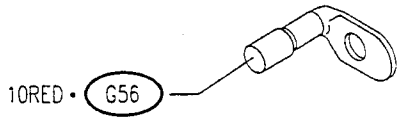


RH front light cluster	E23 B	LH front light cluster	E24 B

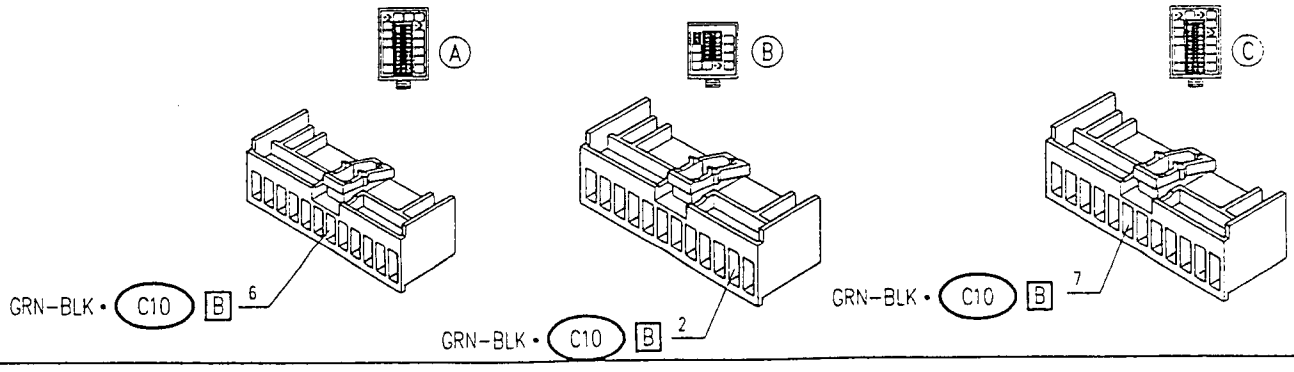




Fusebox	G1

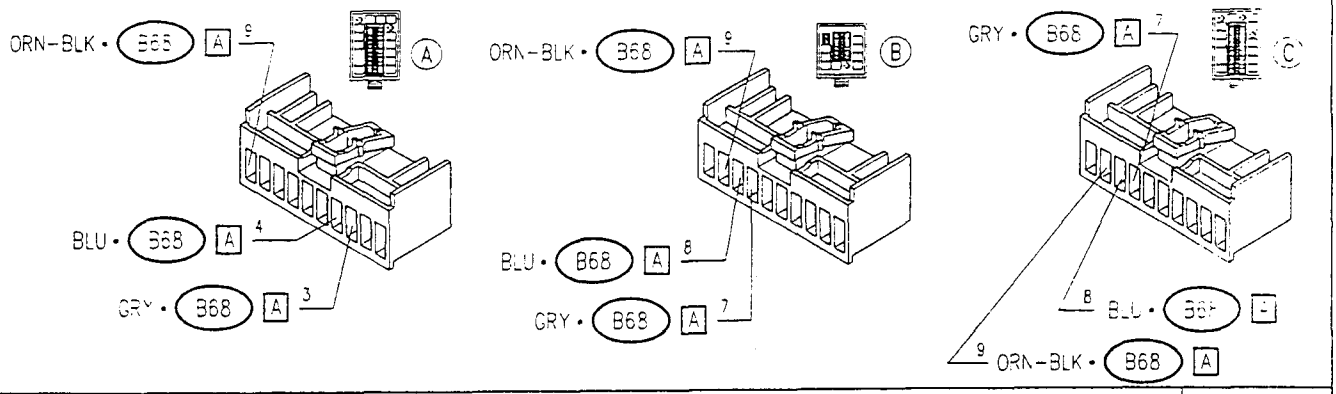


Fusebox	G1 D

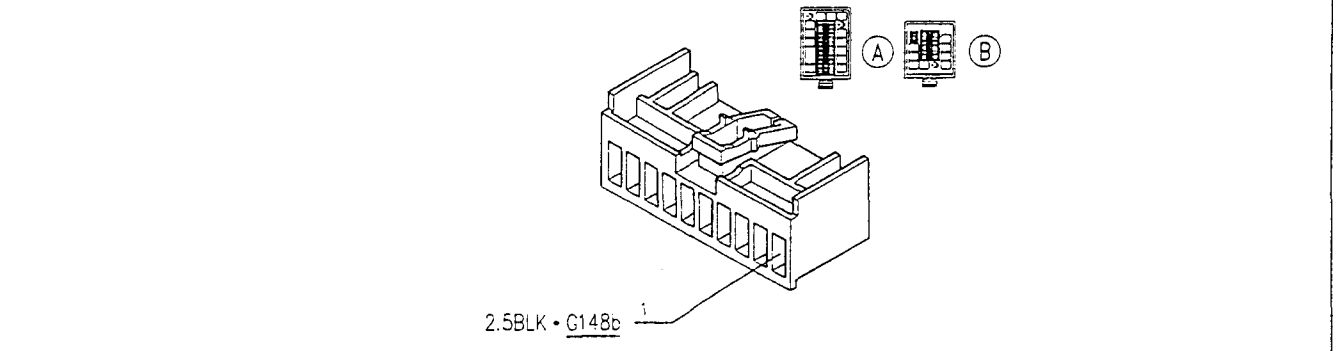


COMPONENTS AND CONNECTORS (cont.d)

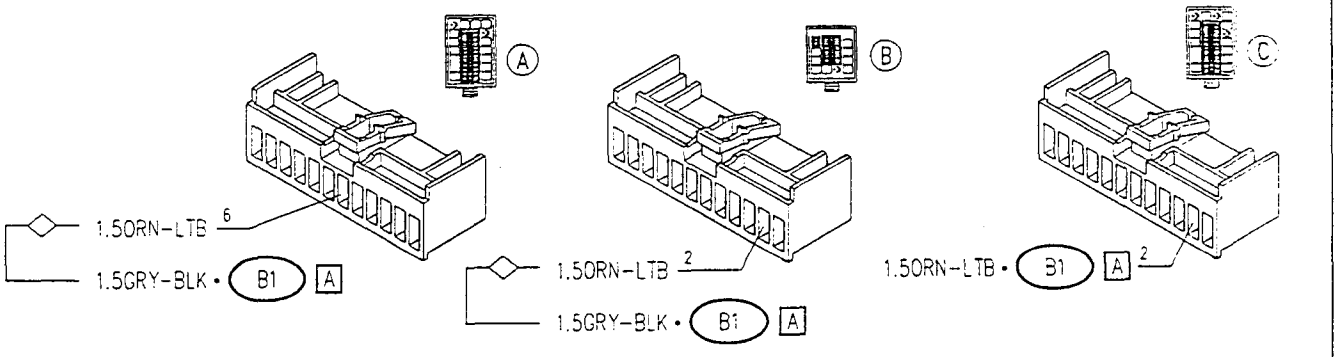
Fusebox — G1 F



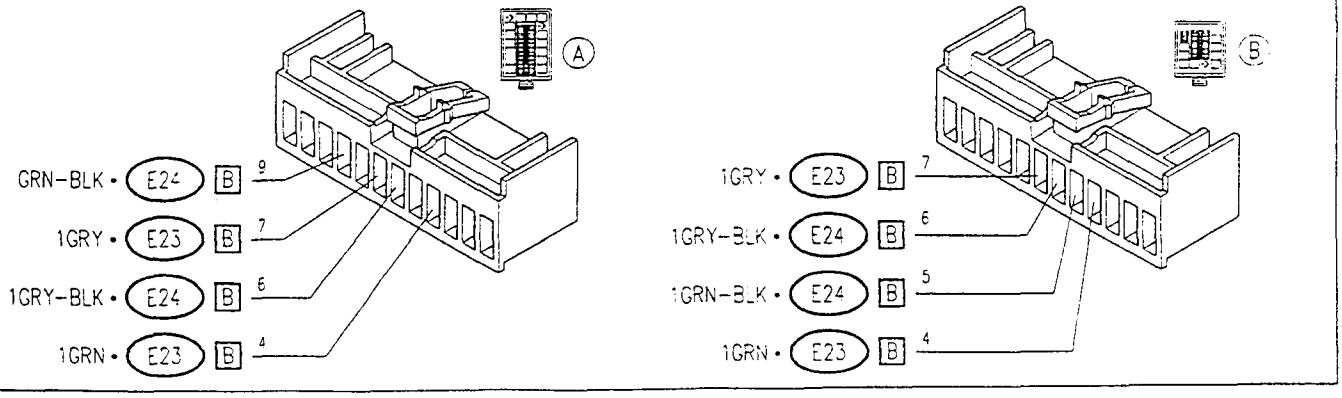
Fusebox — G1 G



Fusebox — G1 H

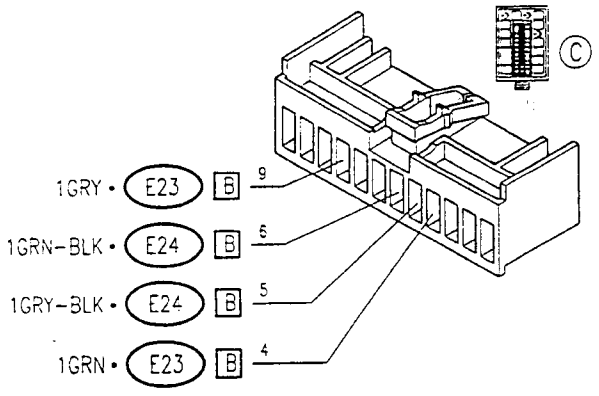


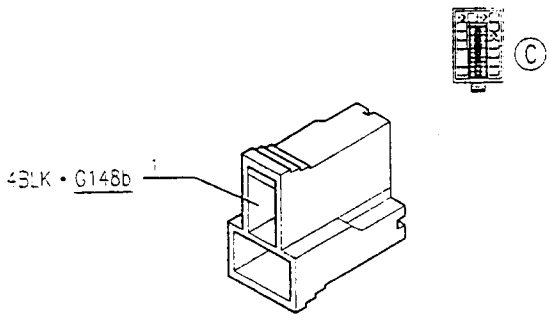
Fusebox — G1 I



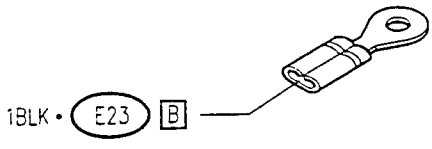
COMPONENTS AND CONNECTORS (cont.d)

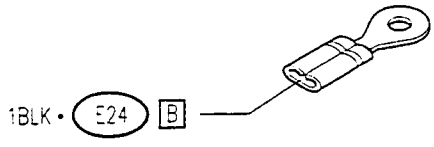
Fusebox	G1 I	Fusebox	G1 N



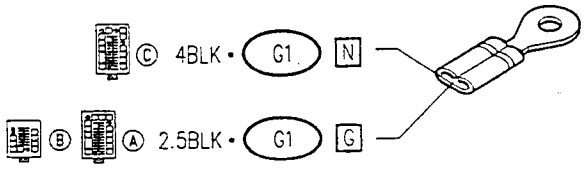


RH side engine comp. earth	G53a	RH side engine comp. earth	G53b

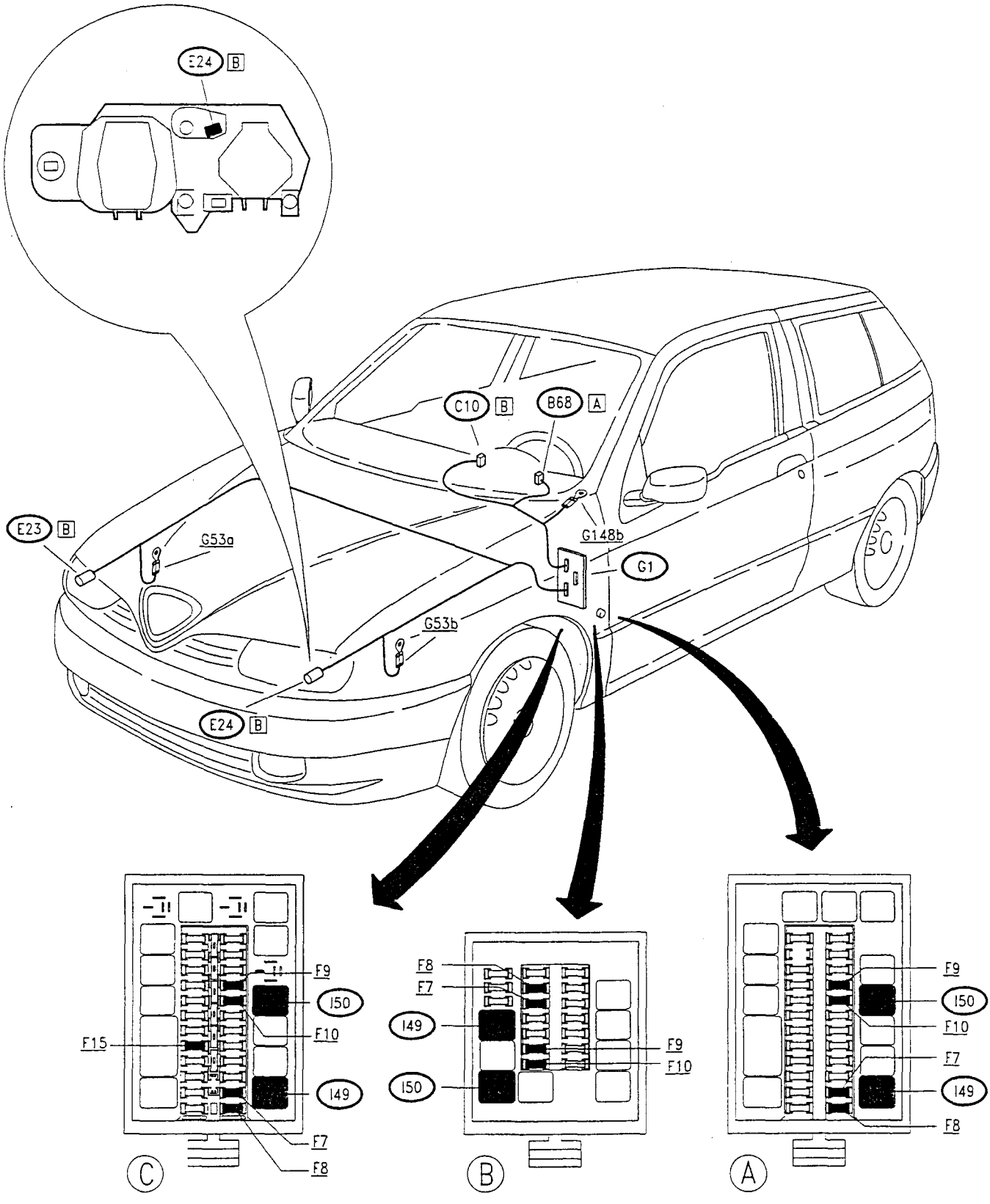




LH earth under dashboard	G148b



LOCATION OF COMPONENTS

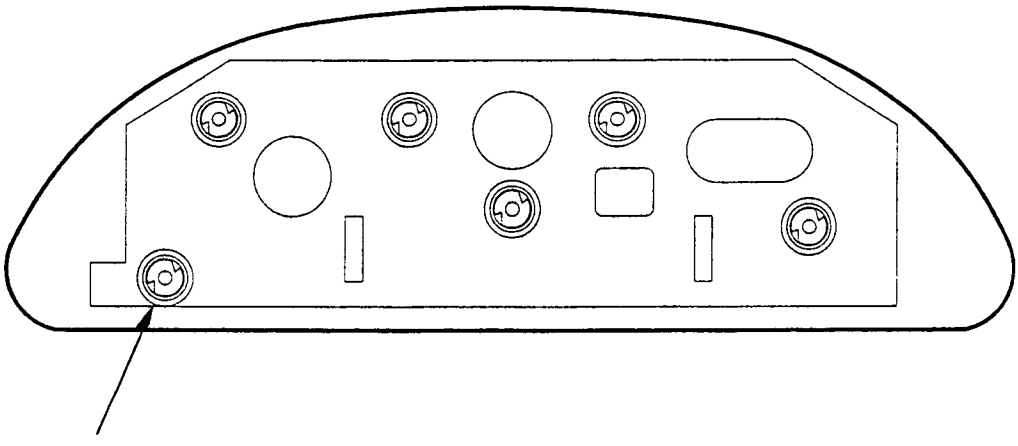


FAULTFINDING TABLE

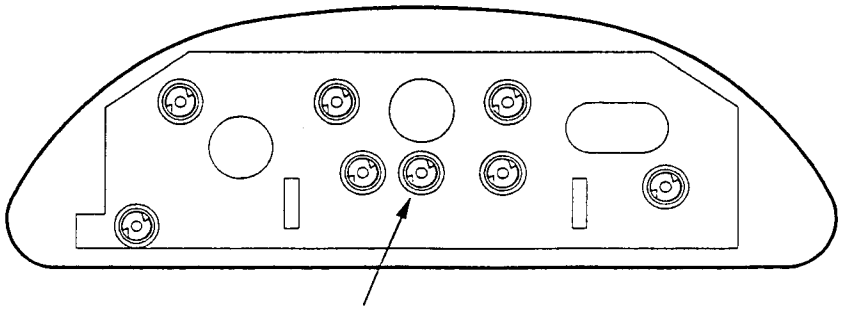
Failure	Component to be checked									
	F7	F8	F9	F10	E23	E24	I49	I50	B68	C10 (*)
Both low beam lamps							•		•	
RH low beam lamp	•				•					
LH low beam lamp		•				•				
Both high beam lamps								•	•	
RH high beam lamp			•		•					
LH high beam lamp				•		•				
High beam warning light				•						•

(*) **WARNING: the high beam warning light of the instrument cluster (C10) is replaceable**, as it is a bulb and not a led.

Up to M.Y. '98



From M.Y. '99

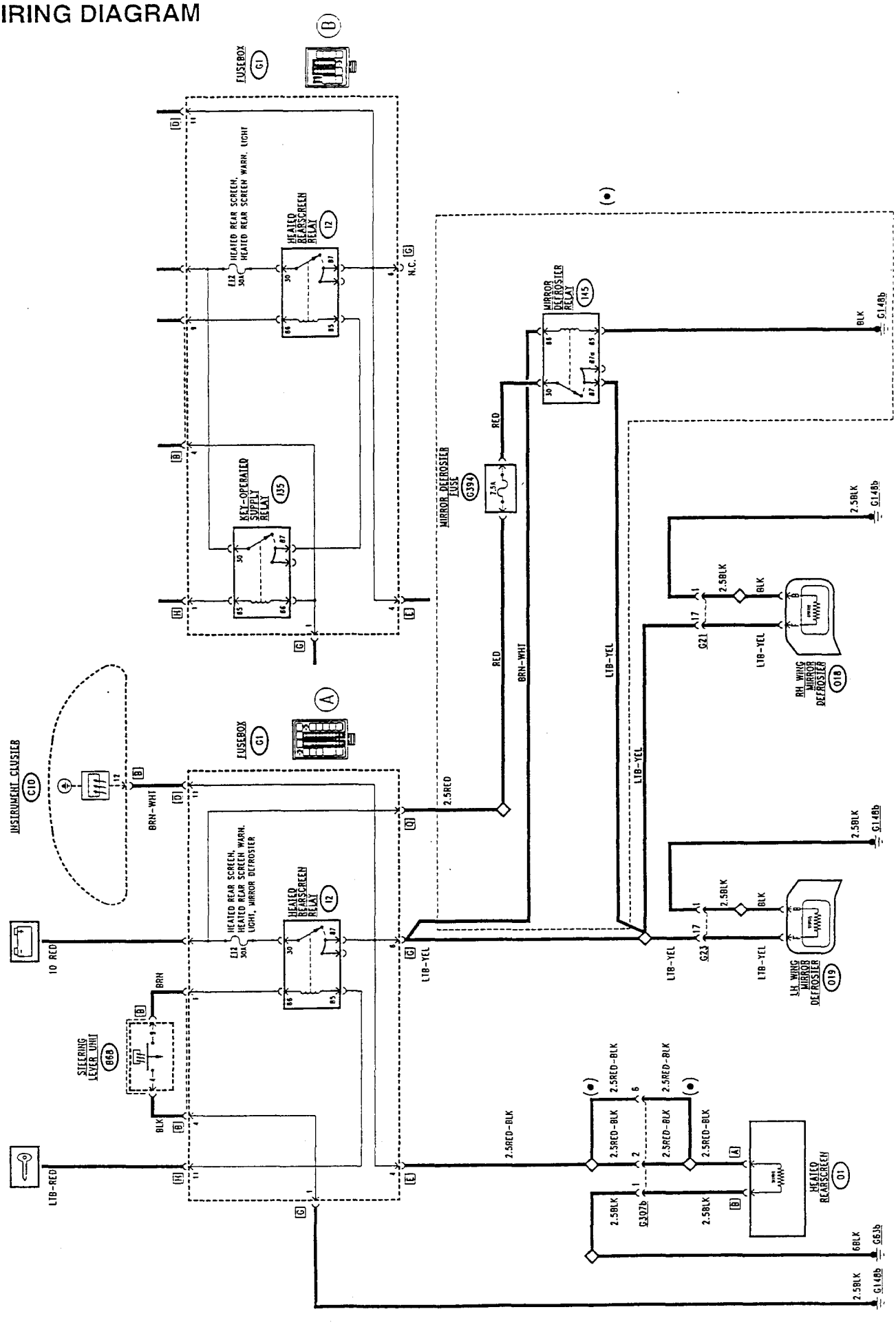


HEATED REARSCREEN AND DEFROSTING THE WING MIRRORS

INDEX

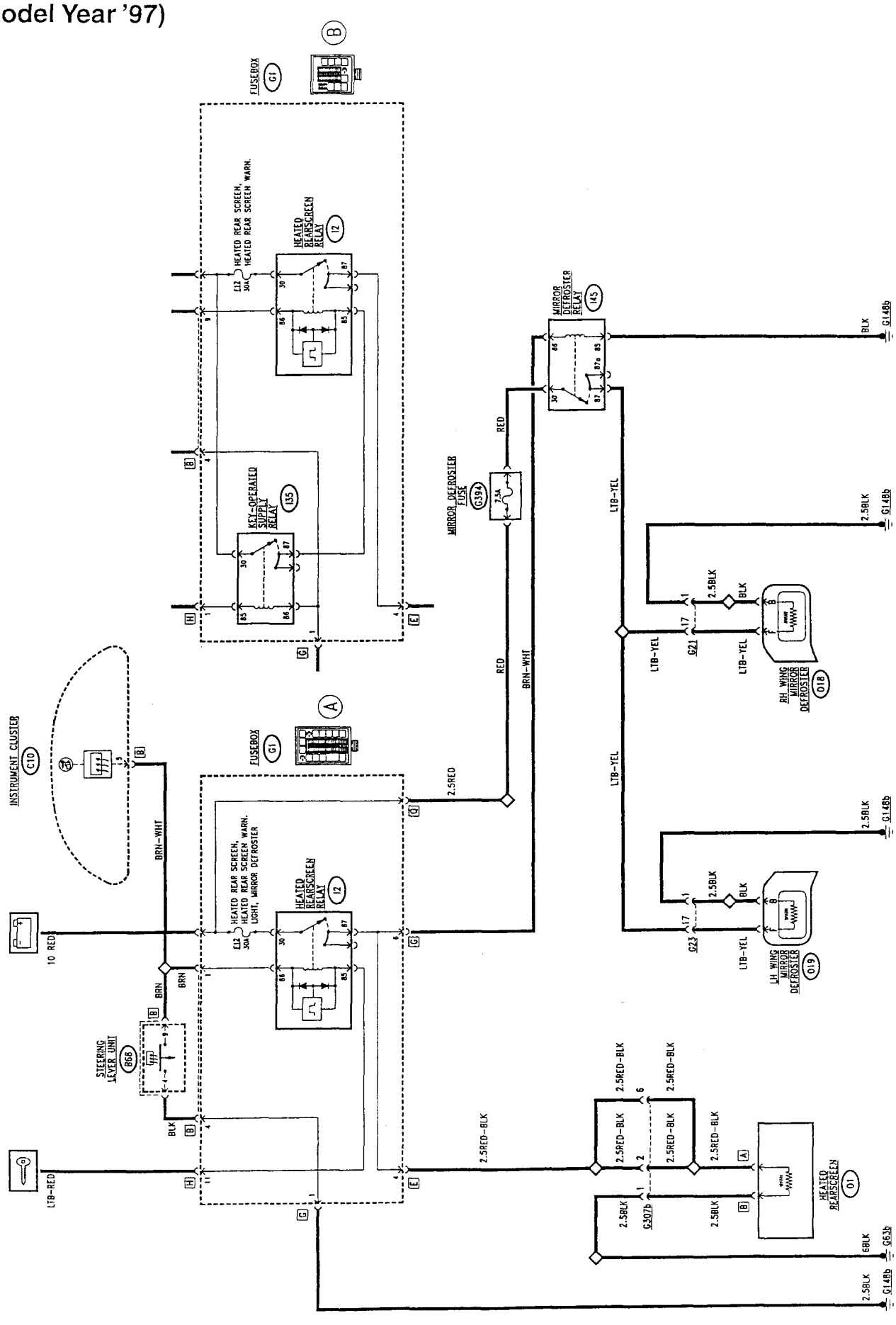
WIRING DIAGRAM 24-2
WIRING DIAGRAM MODEL YEAR '97 . . . . . 24-2/1
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FUNCTIONAL DESCRIPTION 24-3
COMPONENTS AND CONNECTORS 24-3
LOCATION OF COMPONENTS 24-6
FAULTFINDING TABLE 24-7
CHECKING COMPONENTS 24-7

WIRING DIAGRAM

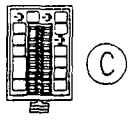


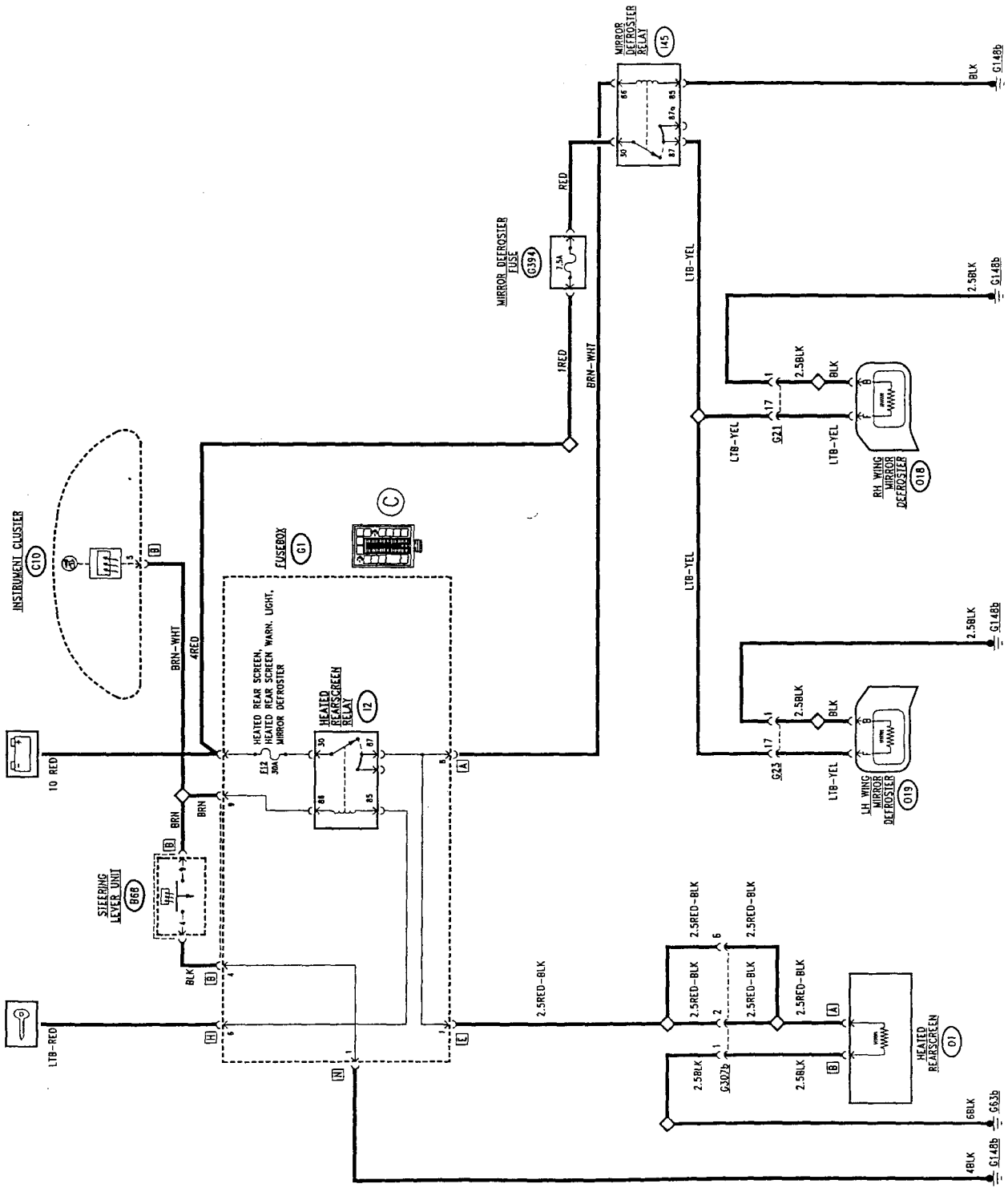
WIRING DIAGRAM

(Model Year '97)



WIRING DIAGRAM





GENERAL DESCRIPTION

The rearscreen and wing mirrors (in some countries/versions only) incorporate a wire that heats the surfaces it contacts when it is crossed by current, thereby quickly demisting and/or defrosting them.
The device is actuated by pressing the corresponding switch on the lever unit which controls the heated rearscreen relay.
A warning light on the instrument cluster indicates when the device is operating.

Actuation of the heated rearscreen also turns on the wing mirror defrosting function (if installed).

From chassis no. ... the supply for door mirror defrosting is through a dedicated line, with specific relay and fuse.

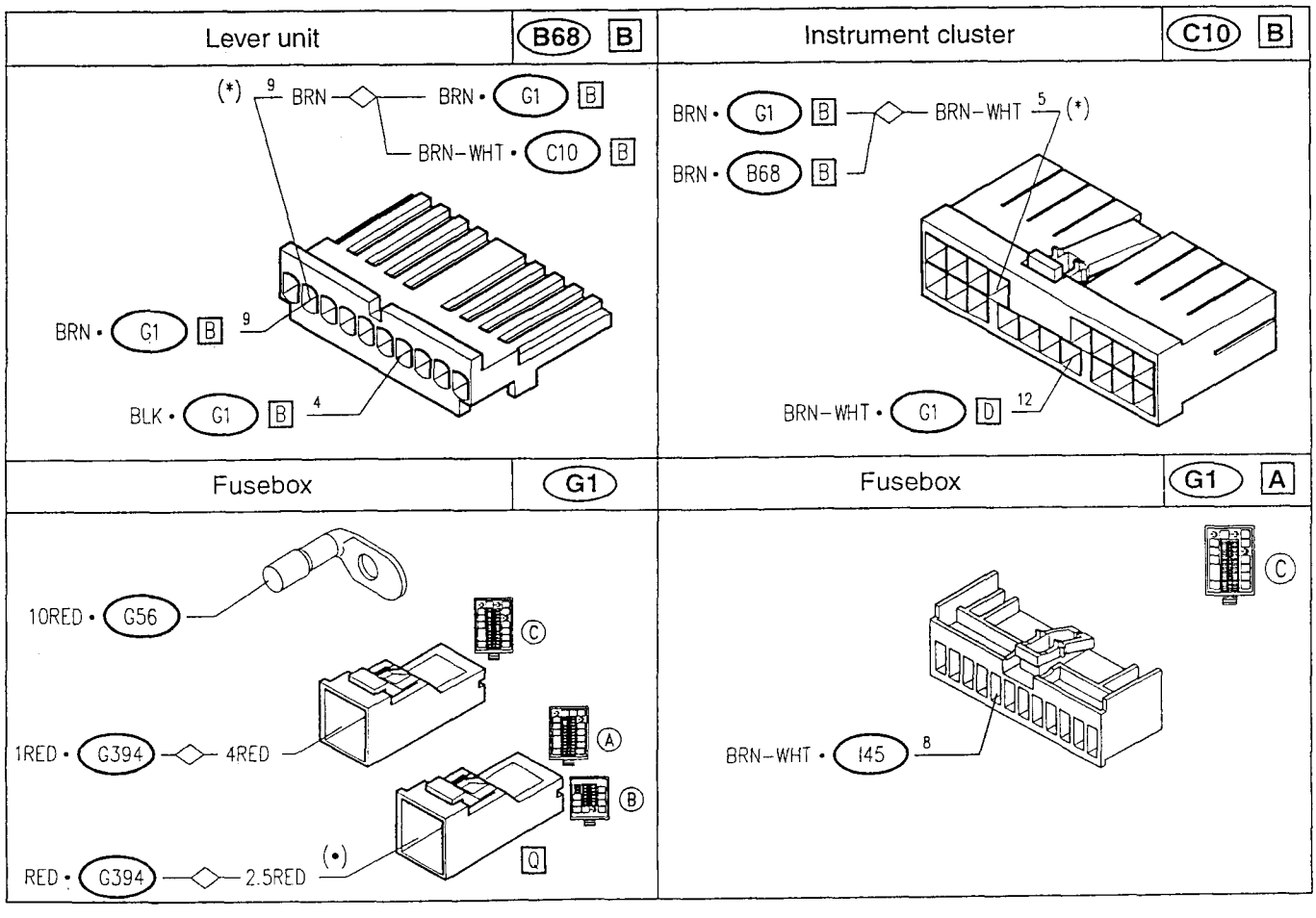
FUNCTIONAL DESCRIPTION

The line of fuse **F12** of fusebox **G1** supplies the rearscreen heating relay switch **I2**, the coil of which is supplied from the ignition switch and energized by an earth signal leading from switch on the lever unit **B68**.

From Model Year '97, the relay includes an electronic device which turns off the device after 5 minutes from 1st engagement and shorter times after any subsequent engagements.
Relay switch **I2** is also located in fusebox **G1**.
When the contact of relay switch **I2** closes the battery voltage supplies the line, which protected by fuse **F12** of **G1**, reaches the rearscreen **O1** and the resistances of the wing mirrors **O19** (left) and **O18** (right).
From chassis no..... the mirrors are supplied by the line of fuse **G394** (7.5A) through relay **I45**.
Thr same supply signal is also sent to to the instrument cluster **C10** to turn on the corresponding warning light.

WARNING: from Model Year '97 the warning light is in a different position - See "INSTRUMENT CLUSTER".

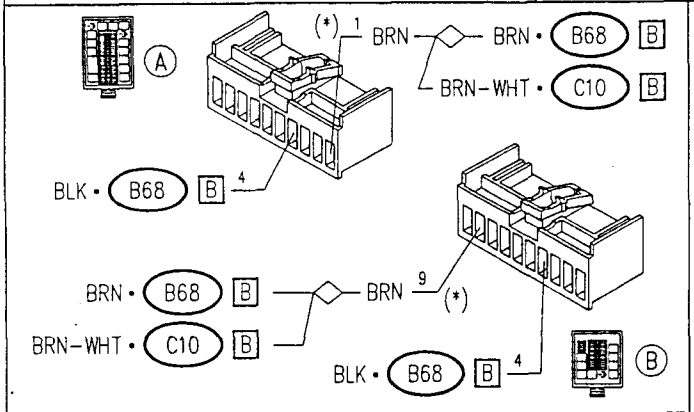
COMPONENTS AND CONNECTORS



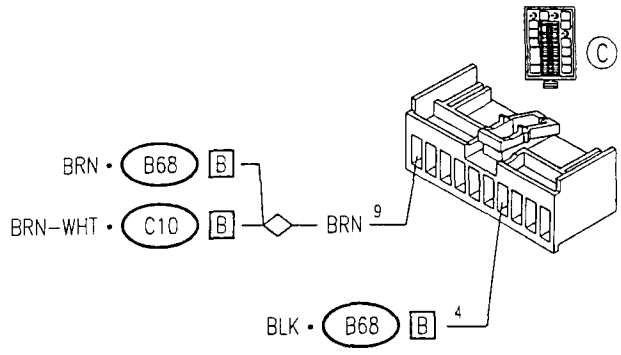
(•) from chassis no.....
(*) Model Year '97

COMPONENTS AND CONNECTORS (cont.d)

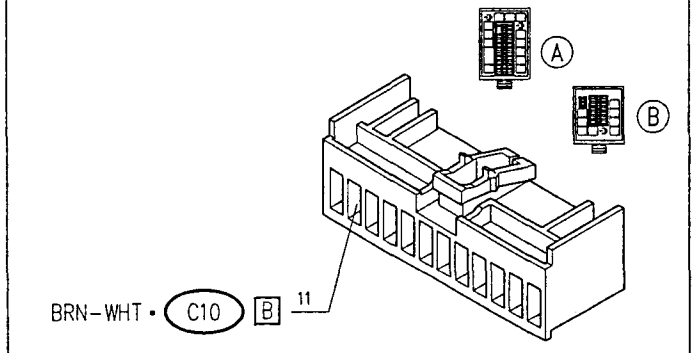
Fusebox G1 B



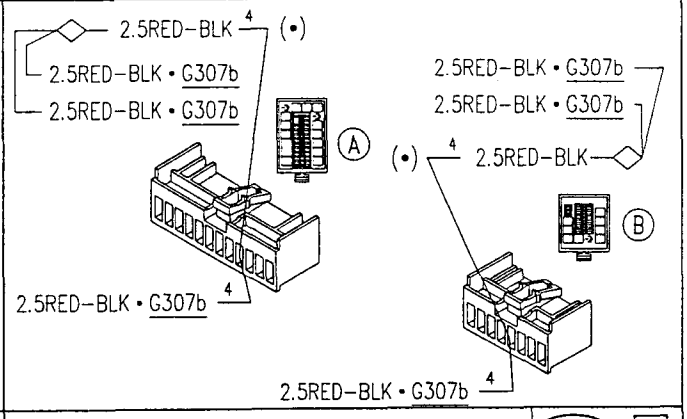
Fusebox G1 B



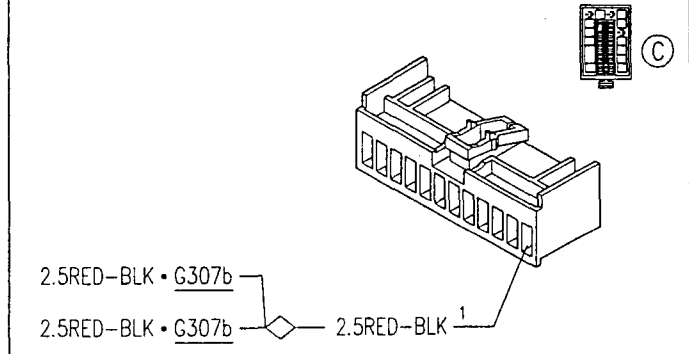
Fusebox G1 D



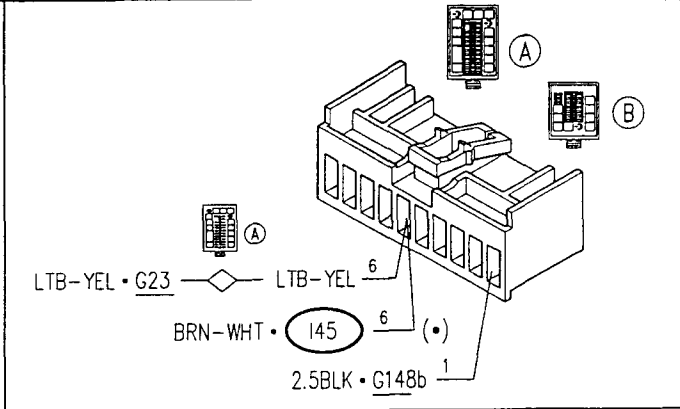
Fusebox G1 E



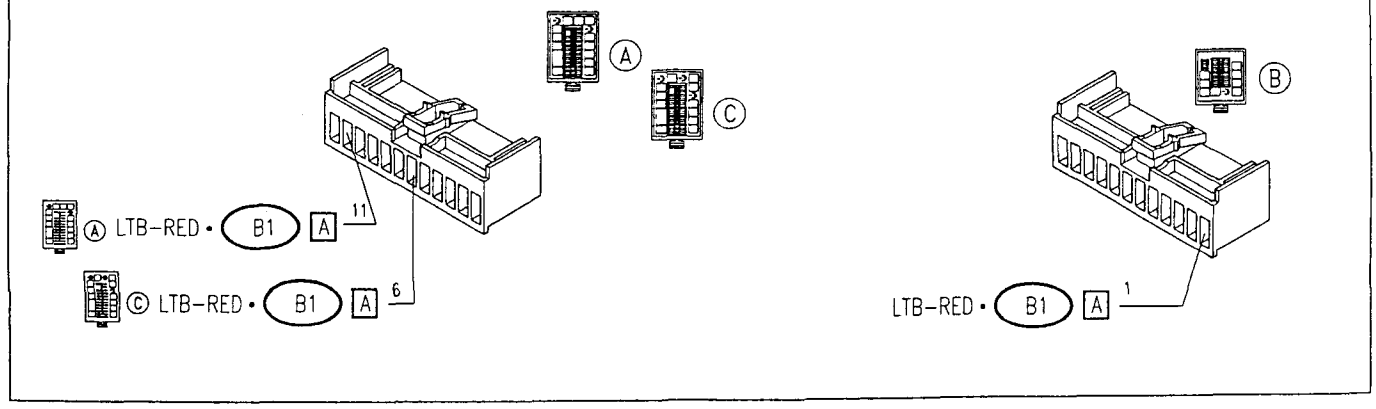
Fusebox G1 E



Fusebox G1 G



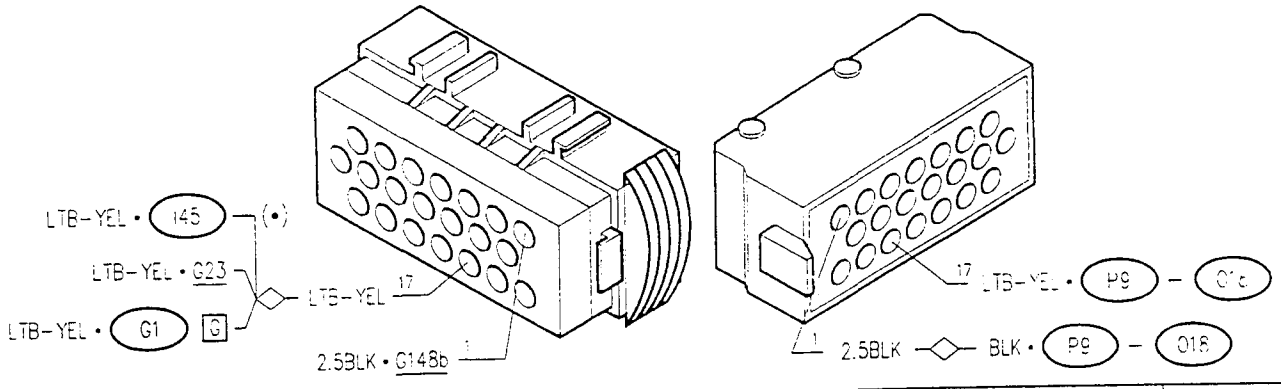
Fusebox G1 H



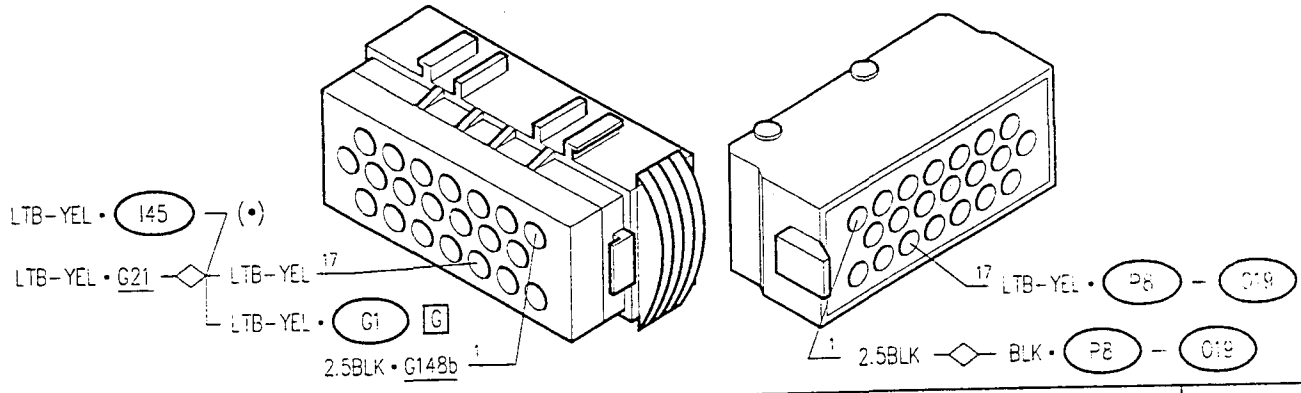
(•) from chassis no.....
PA493000000010

COMPONENTS AND CONNECTORS (cont.d)

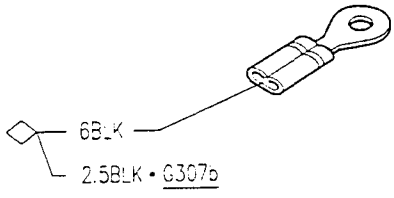
RH front door wiring connector — G21



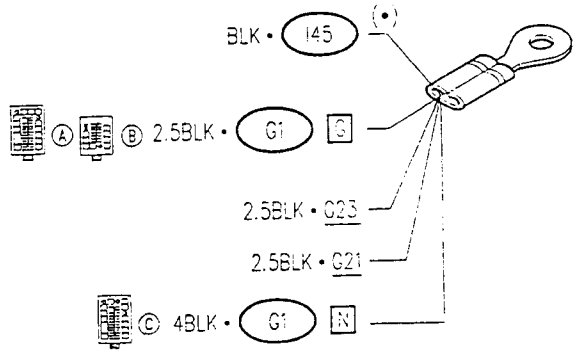
LH front door wiring connector — G23



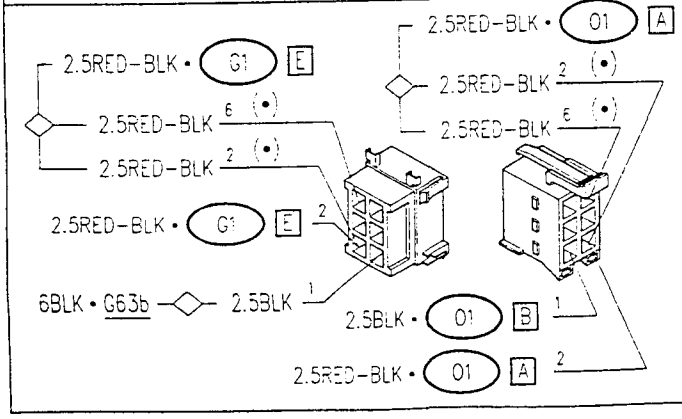
LH rear earth — G63b



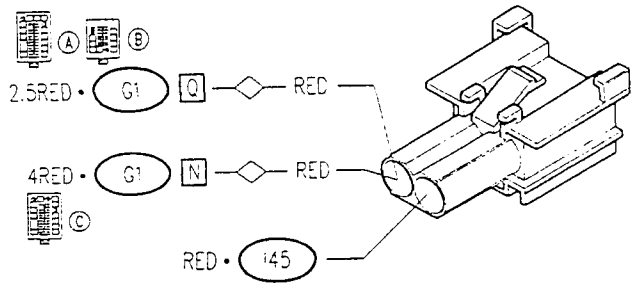
LH earth under dashboard — G148b



Rear/luggage compartment wiring connector B — G307b

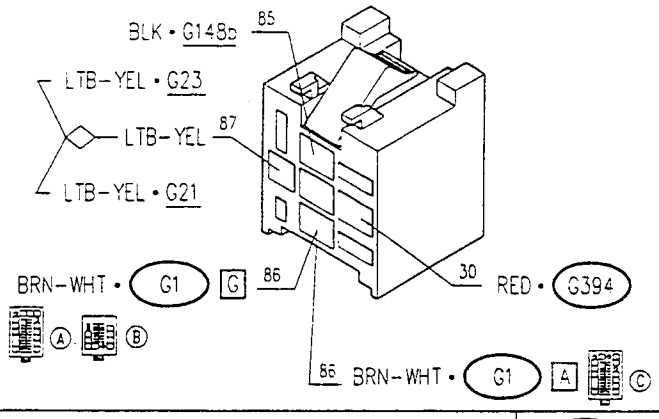
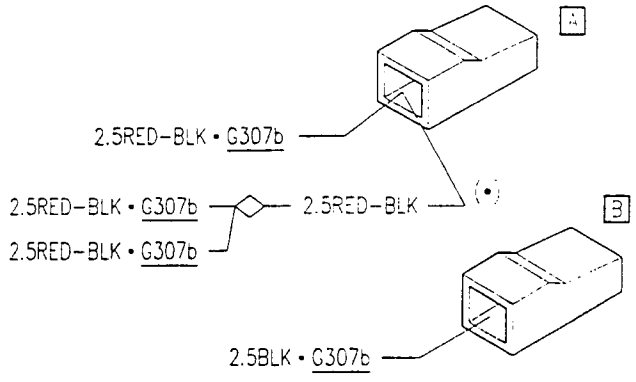
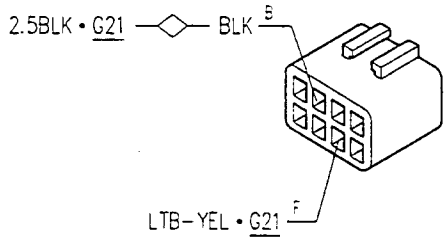
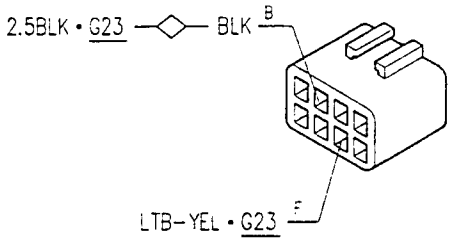


Door mirrors defrosting fuse (•) — G394



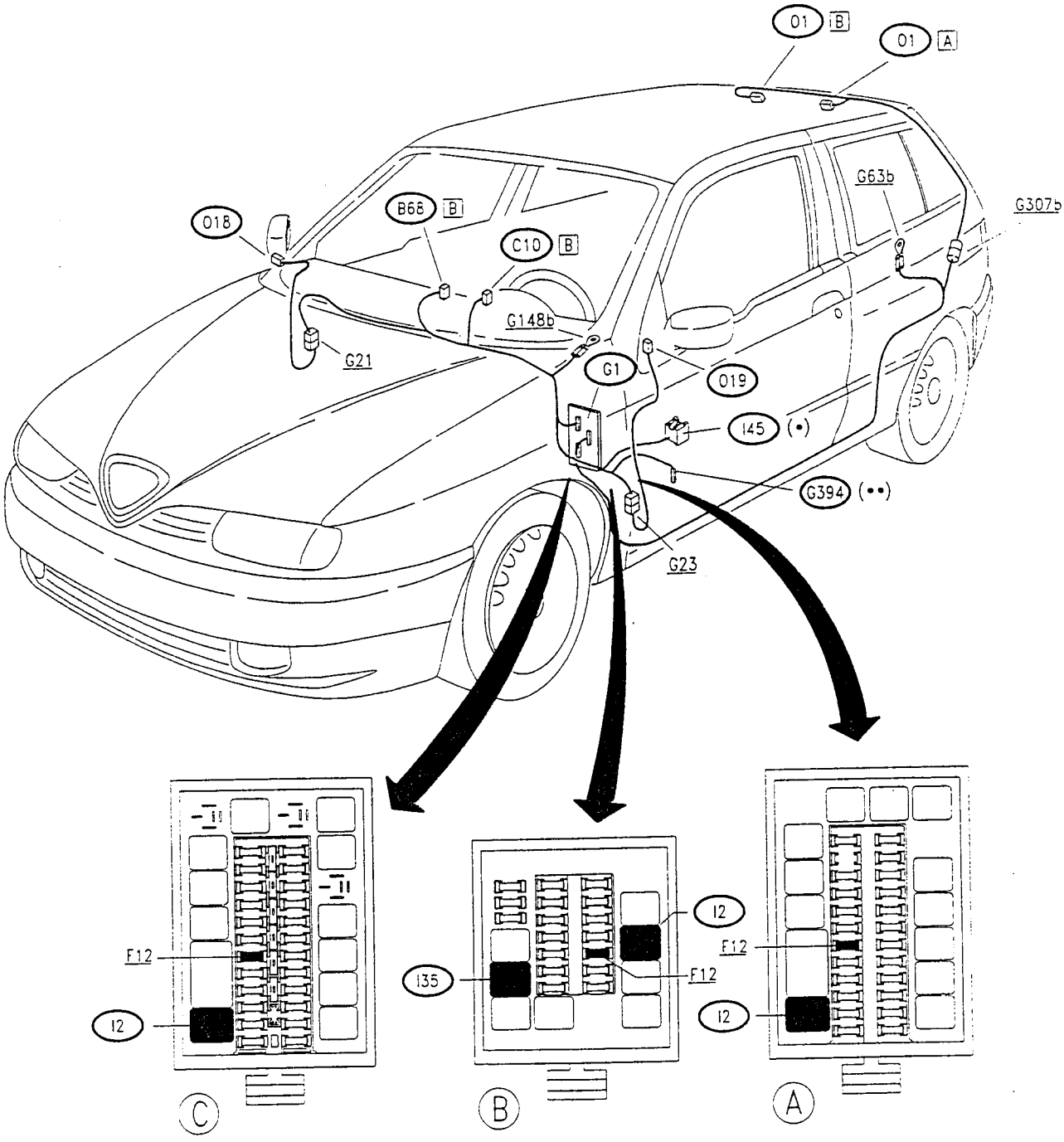
(•) from chassis no.....
PA493000000008

COMPONENTS AND CONNECTORS (cont.d)

Door mirrors defrosting relay (•)	I45	Heated rearscreen	O1
			
RH wing mirror defroster	**O18**	**LH wing mirror defroster**	**O19**
			

(•) from chassis no.....

LOCATION OF COMPONENTS



(•) White base

(••) Brown fuseholder

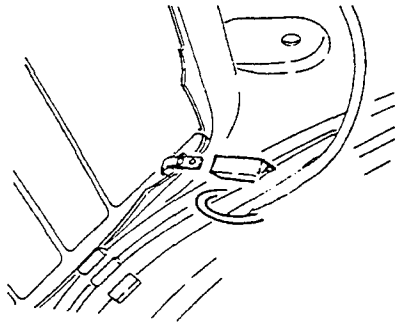
FAULTFINDING TABLE

Failure	Component to be checked								
	F12	I2	B68	O1	I45	G394	O19	O18	C10 (*)
Defrosting, under all circumstances	•	•	•						
Rearscreen defrosting				•					
Defrosting the wing mirrors					•	•			
LH wing mirror defrosting							•		
RH wing mirror defrosting								•	
Rearscreen warning light									•

(*) The instrument cluster **C10** cannot be repaired. Therefore, in the event of a failure it is not possible to change the single warning light and a new, complete cluster must be fitted.

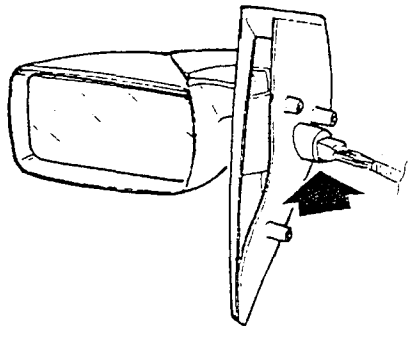
CHECKING COMPONENTS

Heated rearscreen (O1)



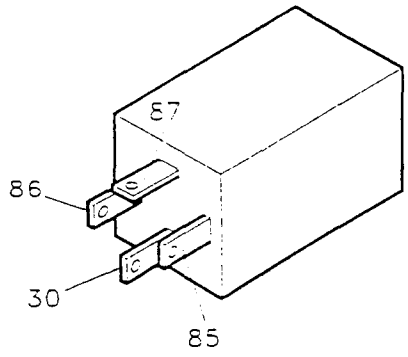
SPECIFICATIONS	
Max. absorbed current	15 ± 1A
Defrosting resistance (between terminals A and B)	0.7 ÷ 1 Ω

Wing mirrors defrosting (O18) (O19)



SPECIFICATIONS	
Defrosting resistance (between pins F and B of connector)	10 Ω

Rearscreen heating relay (timed) (I2)



Check the device: see **TEST A**

CHECK REARSCREEN RELAY (I2)	TEST A

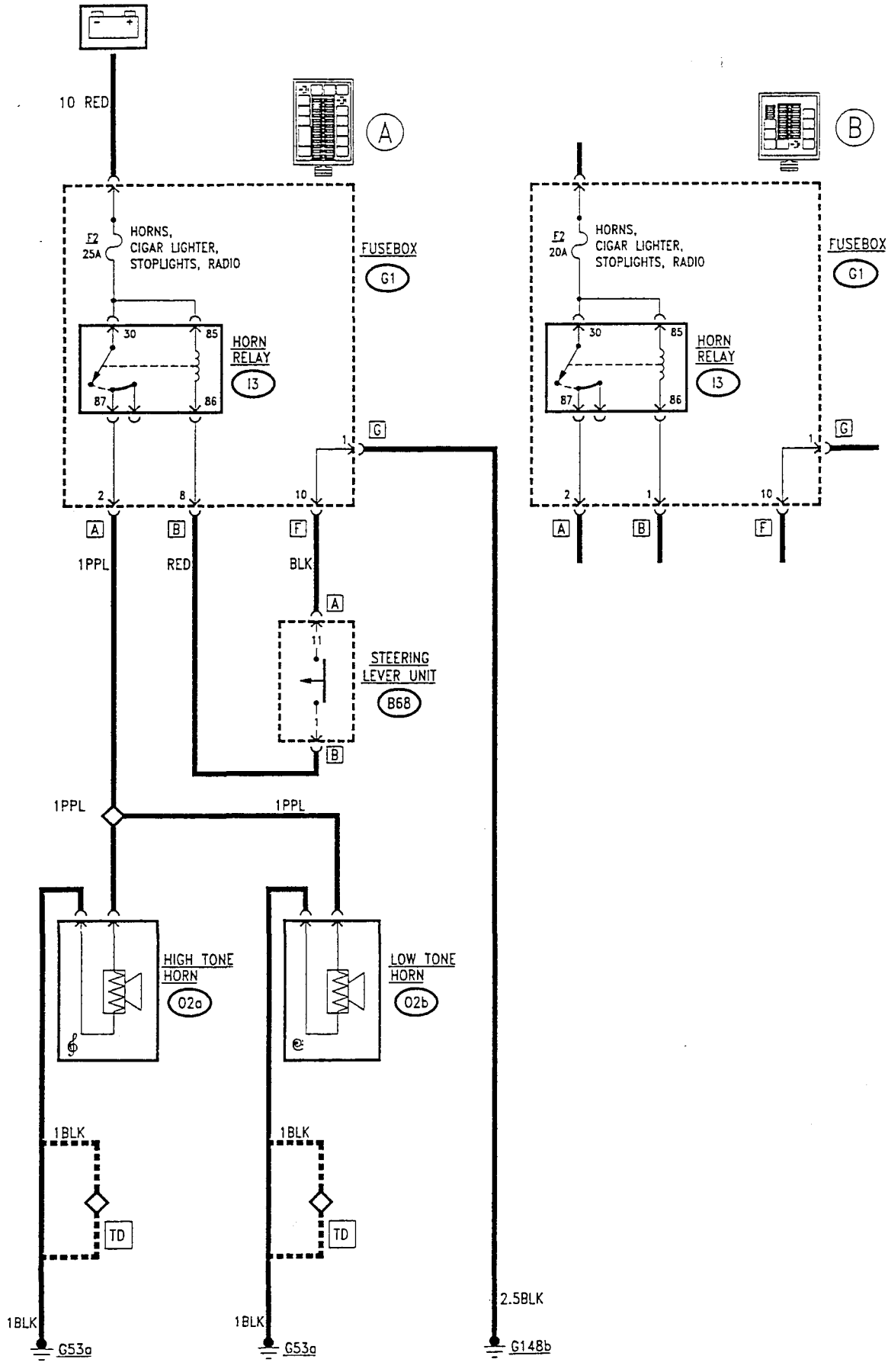
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **I2** and check on the base of fusebos **G1**: for 12V at pin 30. With key on RUN; 12V at pin 85.	OK ▶	Carry out step **A2**
	~~OK~~ ▶	Check fuse **F12** of **G1**
A2 CHECK CONTROL SIGNAL – Turn on defrosting and check for an earth at pin 88 of **I2**	OK ▶	Insert device **I2** on the base of **G1** and continue with step **A3**
	~~OK~~ ▶	Restore the wiring between **G1** and the switch on the lever unit **B68**, or replace the latter
A3 CHECK OPERATION OF DEFROSTING – Operate defrosting and check for 12V between pins 1 and 6 of connector G of **G1**; this voltage **ceases after 5 minutes**	OK ▶	DEVICE **I2** IS WORKING PROPERLY Check the other components of the system or the associated connections
	~~OK~~ ▶	REPLACE DEVICE **I2**

HORNS

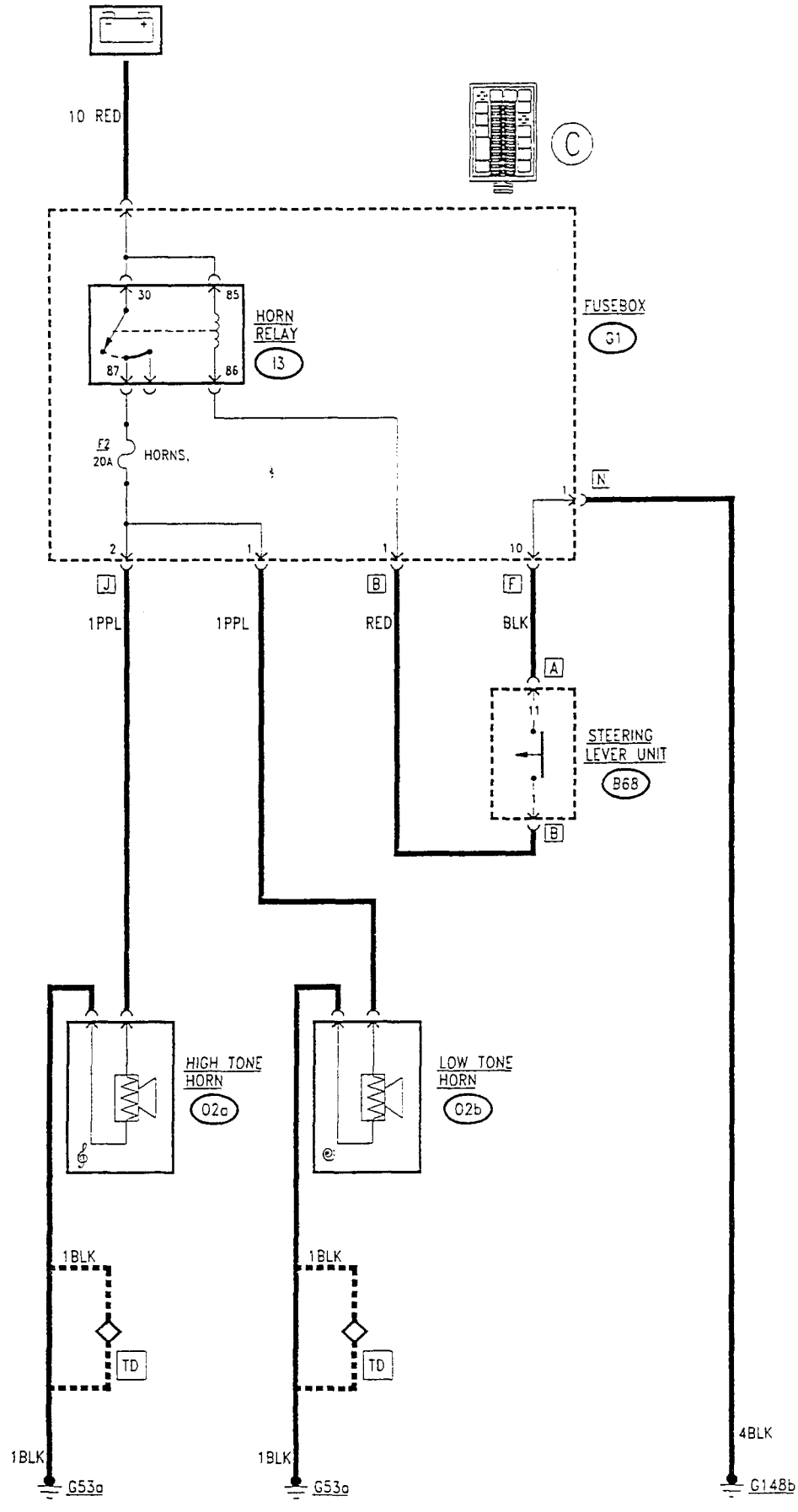
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LOCATION OF COMPONENTS 15-5
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WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The car horn system is formed of two horns with different tones: one high tone and the other low tone: they are both activated simultaneously.

The horns are operated conventionally pressing the button located in the centre of the steering wheel (versions without airbag) or one of the two switches on the spokes at the side of the airbag cushion (versions with airbag).

For the obvious safety reasons the horns can be activated at all times even if the ignition key is not engaged.

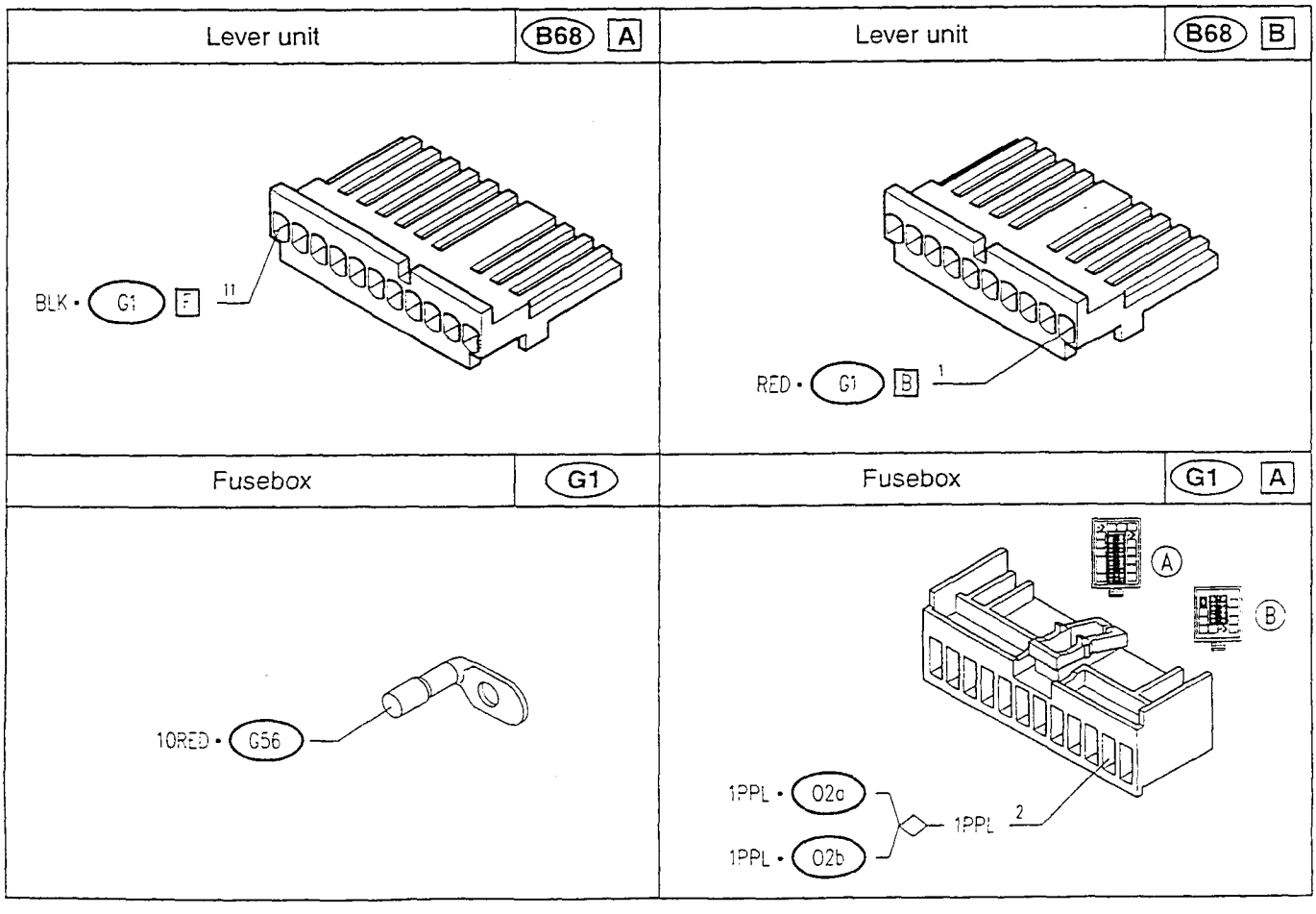
FUNCTIONAL DESCRIPTION

The horns relay switch **I3**, located in fusebox **G1**, is supplied by the battery through fuse **F2**, also in **G1**.

The coil of relay switch **I3** is energized with an earth signal leading from the horn control switch which is connected to the lever unit **B68** (this connection is made in a special way for the versions with airbag: see "Checking Components").

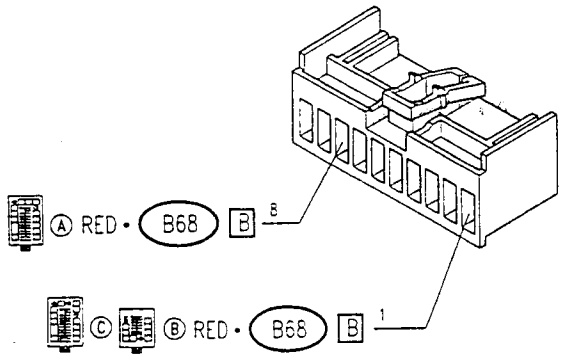
This way the supply is sent by the relay switch to the horns **O2**, which are already connected to earth.

COMPONENTS AND CONNECTORS

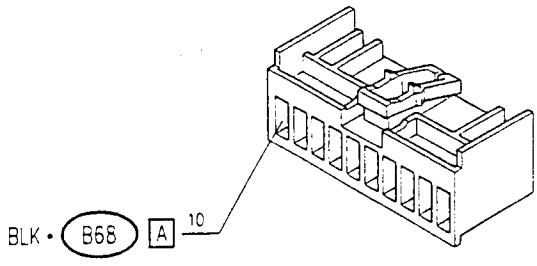


COMPONENTS AND CONNECTORS (cont.d)

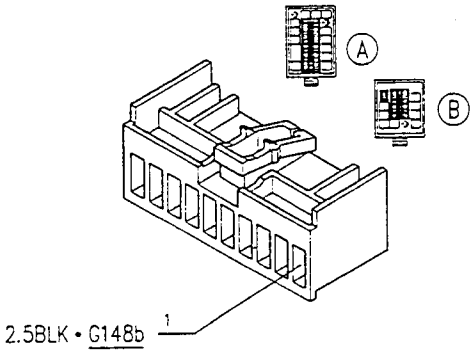
Fusebox	G1 B



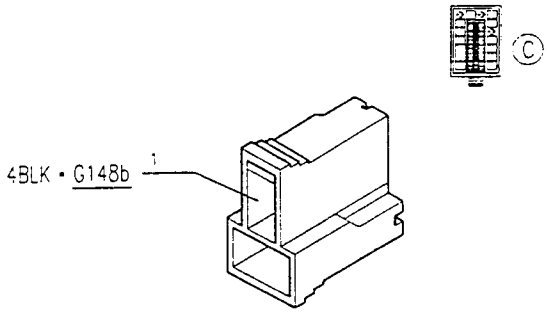
Fusebox	G1 F



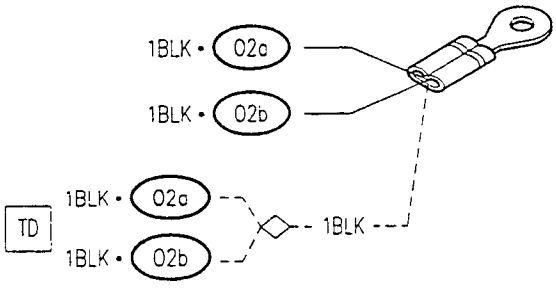
Fusebox	G1 G



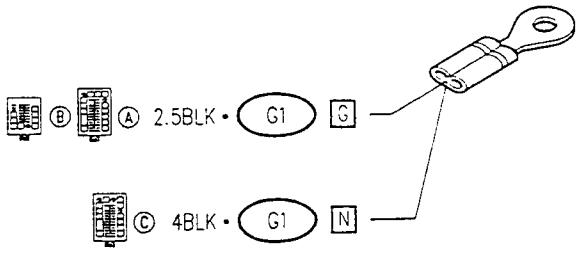
Fusebox	G1 N



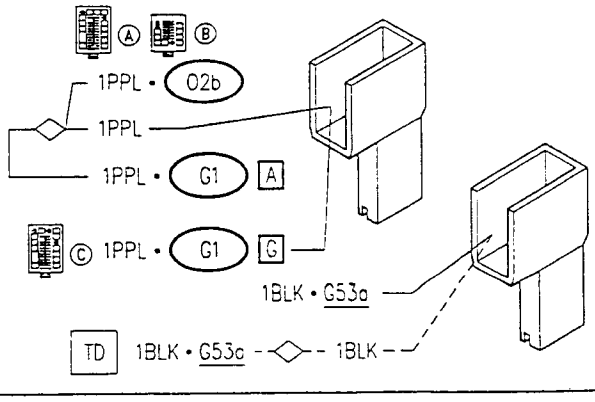
RH engine compartment earth	G53a



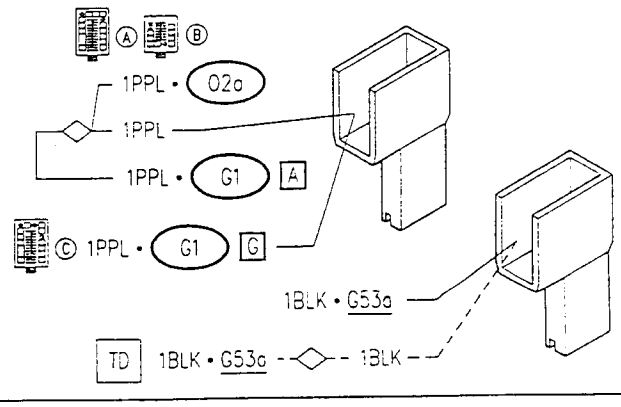
Earth under LH dashboard	G148b



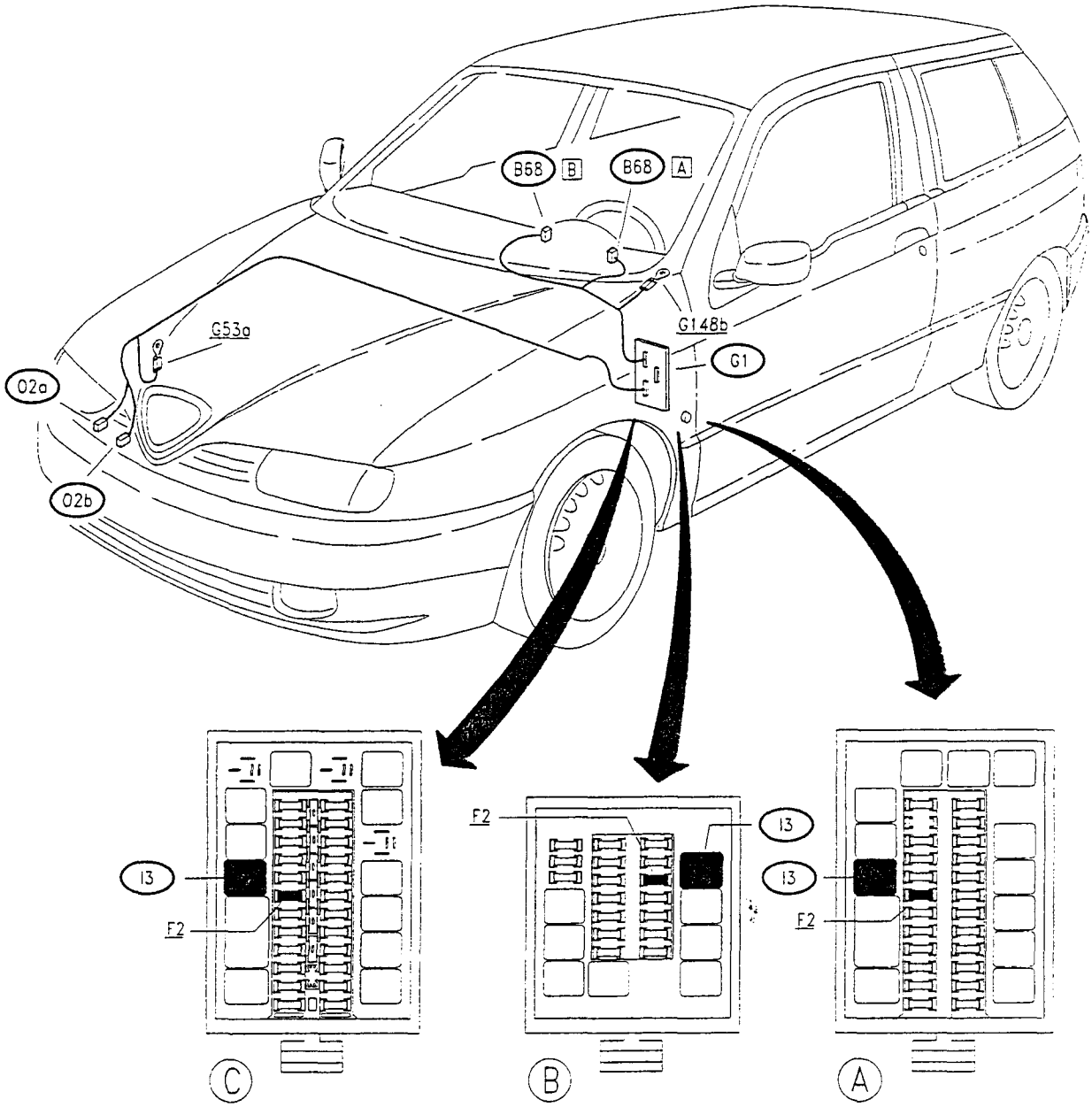
High-tone horn	O2a



Low-tone horn	O2b



LOCATION OF COMPONENTS



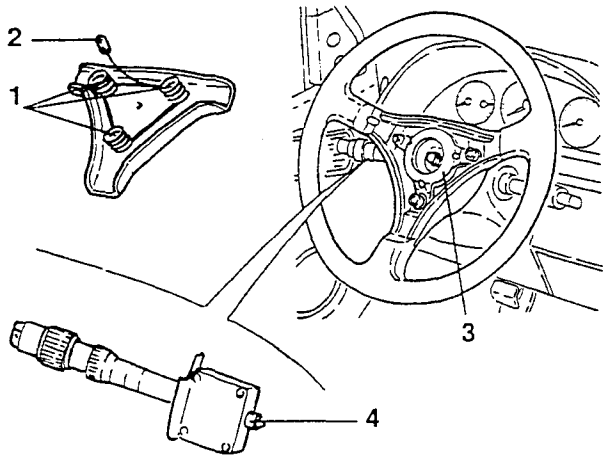
FAULTFINDING TABLE

Failure	Component to be checked			
	F2	O2	I3	B68
Horns failing to work	•	•	•	•
Horns working badly (out of tune)		•		

CHECKING COMPONENTS

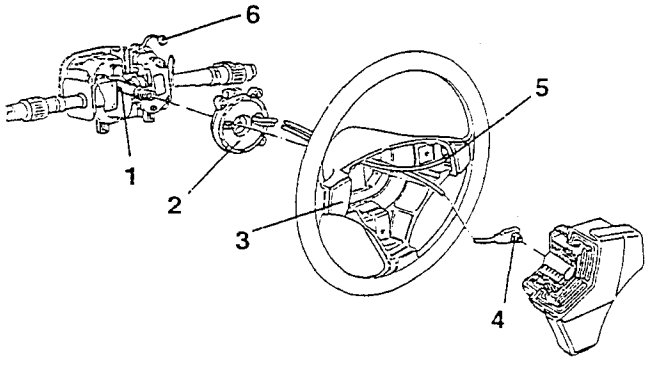
Horns control (in B68)

Versions without airbag



The three springs (1) on the steering wheel cover connect the earth plate (3) to earth through the special connection (2); the plate is in turn connected with contact (4) on the lever unit **B68**.

Versions with airbag



In cars with airbag the sliding contact is replaced by the clock spring cable (2) which connects the steering wheel to the steering column.

The horn pushbuttons (3) are connected to connector (5) (the left one is connected to the right one by a wire inside the steering wheel).

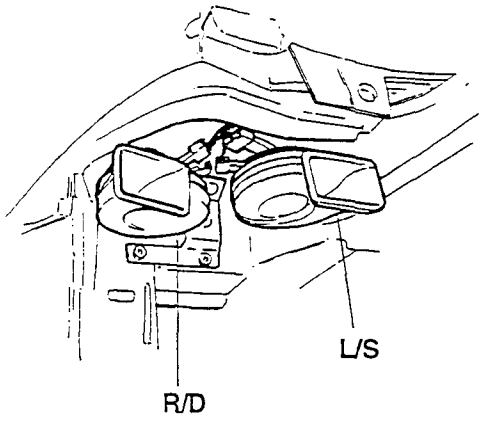
The control switch (1) is pressed through the clock spring cable and the ignition switch as for the versions without airbag.

N.B. To remove the airbag connector **G383** (6) and the module connector **R23** (4) extreme caution must be used: see the "Airbag" section and Group 70 - "SAFETY BELTS AND ACCESSORIES"

Horns (02)

"R/D" low tone

"L/S" high tone



SPECIFICATIONS	
Nominal voltage rating	12V
Current absorbed	<10A (the pair)
Total horn sound level	106 ÷ 118 dB a 2m
Sound level in band 1800 ÷ 3550 Hz	≥ 105 dB a 2m
Horn sound level L-H	≥ 108 dB a 2m
Fundamental frequency type H	480 ÷ 530 Hz
Fundamental frequency type L	380 ÷ 430 Hz

WARNING:
The "145-146 - INSTRUCTIONS FOR REPAIR" manual refers to both models according to the following logic:

for the parts in common, the information refers to model 145, while for the parts specific to model 146 special pages, or, where necessary, whole groups, have been added.

For further details refer to the indexes (blue cards) at the beginning of each group.

INTRODUCTION

The "145-146 - Repair Instructions" Manual is composed of three volumes as follows:

Volume I
- Technical Data;
- Engines;
- Mechanical Groups.

Volume II
- Heating-Ventilation;
- Bodywork.

Volume III
- Electric system;
- Electrical system diagnosis.

For overhauling engines and mechanical groups refere to the following manuals:

- PA493600000000 REPAIR INSTRUCTIONS - ENGINE OVERHAUL.
- PA494200000000 REPAIR INSTRUCTIONS - OVERHAULING MECHANICAL GROUPS.

In order to facilitate consultation, the structure of the manual mirrors the functional groups already defined for the "Repair Flat-rate Manual" in use by Alfa Romeo Authorized Service Network.

The characteristic data and the tables for vehicles identification are contained in the "Technical Data" at the beginning of Volume I.

The "Model identification" tables should be consulted before carrying out repair work in order to identify the model of the vehicle, the engine size and the groups which form the vehicle.

How to use this manual

The aim of this manual is to supply the Alfa Romeo Service Personnel with a tool enabling them to rapidly identify faults and to render the corrective interventions precise and efficient.

The manual shows the procedures relative to the removal and refitting and dismontling operations and the checks relative to the various groups forming the vehicle.

The procedures are illustrated in detail as are the procedures for using the tools. An appropriate symbology and explanatory texts next to the fundamental technical drawings make a complete and rapid consultation of the manual possible.

The procedures illustrate complete component disassembly procedures and should only be carried out in their entirety when absolutely unavoidable. The procedures for "assembly" and "refitting" are normally obtained by reversing the procedure followed for disassembly or removal in reverse and only the reassembly procedures which are significantly different are illustrated.

For information relative to the electrical systems onboard the vehicle refer to section 55 "ELECTRIC SYSTEM" and to the successive 55 "ELECTRIC SYSTEM DIAGNOSIS" which gives the wiring diagrams and the description of each function, the connector tables, the location of the components, the tables for fault diagnosis and the technical data for checking the components.

All the information contained in this manual is updaded at the time of publication.

Alfa Romeo reserves the right to make any modifications to its products that it deems necessary without warning. However the technical information and updates to this manual will be supplied as soon as possible.

Warnings for the operator

All the operations must be carried out with the greatest care to prevent damage occurring to the vehicle or persons.

- The use of Alfa Romeo specific tools are indicated for some procedures. These tools must be used to ensure safety and to avoid damaging parts involved in the procedure.
- To free parts which are solidly stuck together, tap with an aluminium or lead mallet if the parts are of metal. Use a wooden or resin mallet for light alloy parts.
- When dismantling ensure parts are marked correctly if required.
- When refitting lubricate the parts, if necessary, to prevent seizing and binding during the initial period of operation.
- Using adhesive paper or clean rags cover those parts of the engine which, following disassembly, present openings which may allow dust or foreign material to enter.
- When refitting, the tightening torques and adjustment data must be respected.
- When substituting the main component(s) the seal rings, oil seals, flexible washers, safety plates, self-locking nuts and all worn parts must also be replaced.
- Avoid marking the internal coverings in the passenger compartment.

Substitution of groups or disconnected parts must be carried out using original spare parts only. Only in this way can the suitability and perfect operation of each organ be guaranteed.

- The words **CAUTION** and **WARNING** accompany those procedures where particular care should be taken to prevent damage occurring to people or vehicle parts.



CAUTION:
used when insufficient care could cause damage to people



WARNING:
used when insufficient care could cause damage to the vehicle or its component parts.

- The safety regulations applied to workshops should be respected. Where necessary the manual also lists the specific precautions to be taken to prevent dangerous situations from arising.



When using chemical products follow the safety indications given on the safety cards which the supplier is obliged to deliver to the user (in Italy in compliance with D.M. n.46/1992).

NOTE:
It is possible that for certain subjects were not completed in time for printing.
However these subjects are given and highlighted in the indices of the single groups.
It is the duty of the Technical Services to supply documentation regarding these subjects as soon as possible through updates or "Technical Bulletins".

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146

ELECTRIC SYSTEM

55

THIS GROUP ONLY CONTAINS THE SPECIFIC SUBJECTS FOR 146 MODELS 146; FOR ITEMS NOT GIVEN HERE, REFER TO GROUP 55 OF 145 MODELS.

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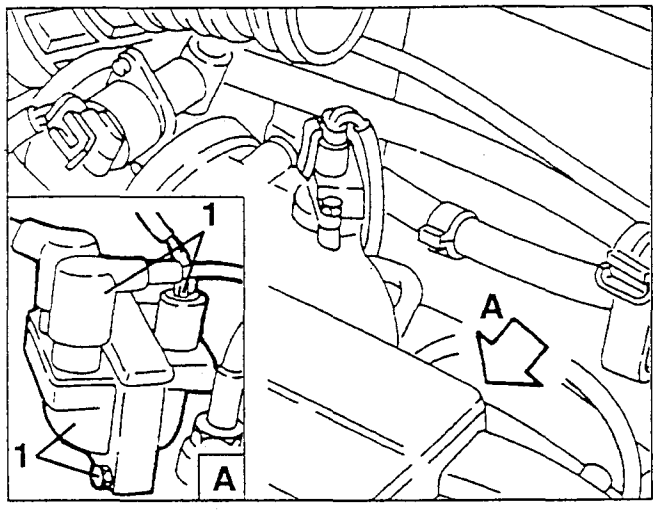
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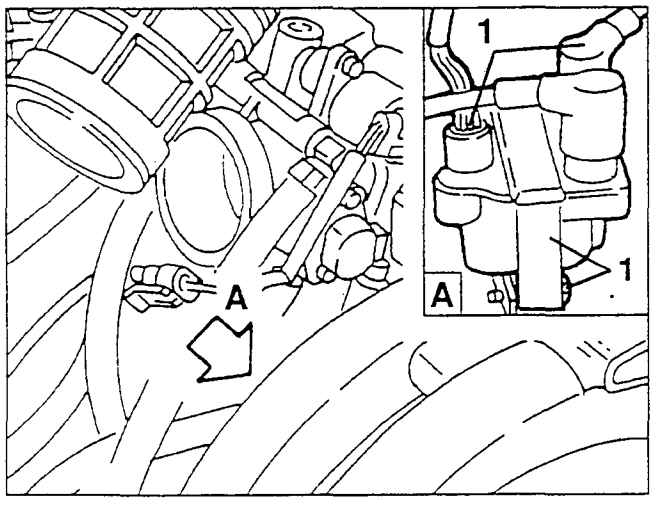
IGNITION COILS
(1351 IAW)

REMOVING REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection and the spark plug cables from the left ignition coil, then remove it after slackening the fastening screws.



- Remove the resounder, air intake pipe and corrugated sleeve (see specific paragraphs).
1. Disconnect the electrical connection and spark plug cables from the right ignition coil, then remove it after slackening the fastening screws.



CHECKS AND INSPECTIONS

- Check that the characteristics of the ignition coils are within the specified limits. If not, change the coils.

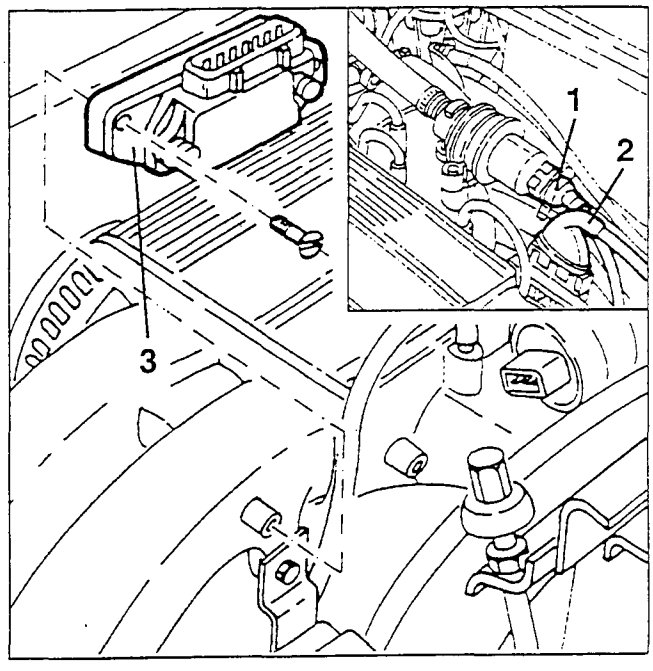
Characteristics	Resistence (*)
Main winding	550 mΩ ± 10%
Secondary winding	7.4 kΩ ± 10%

(*): At a temperature of 23°C ± 5°C

IGNITION MODULE
(1596 MP3.1)

REMOVING REFITTING

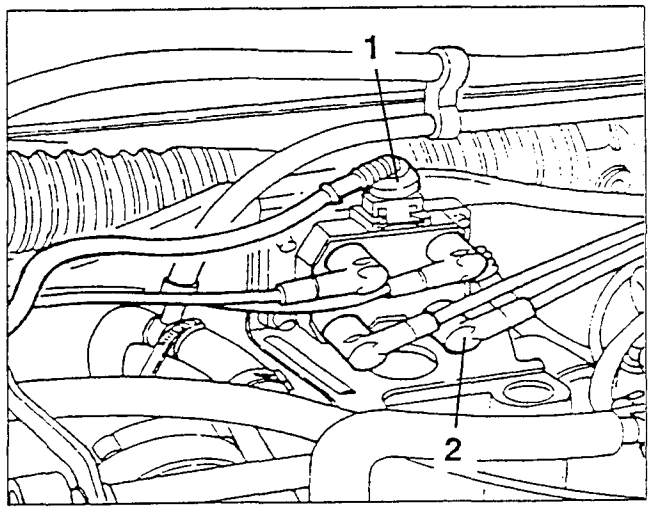
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection from the ignition module.
3. Slacken the two fastening screws and remove the ignition module complete with support.



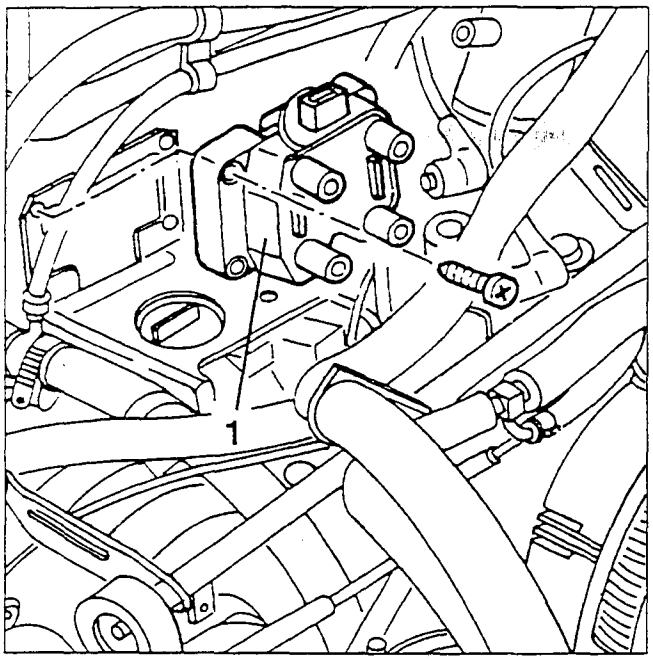
IGNITION COILS
(1596 MP3.1 - 1712 M2.10.3)

REMOVING REFITTING

- Remove the intake box (see GROUP 10).
1. Disconnect the electrical connection supplying the ignition coils.
2. Disconnect the spark plug cables from the ignition coils.



1. Slacken the four fastening screws and remove the ignition coils from the support bracket.



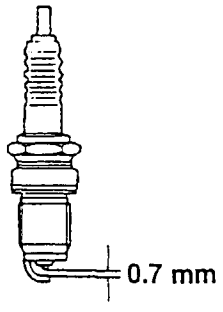
CHECKS AND INSPECTIONS

- Check that the characteristics of the ignition coils are within the specified limits. If not change the coils.

Characteristics	Resistence
Primary winding	0.5 Ω
Secondary winding	13.3 kΩ

SPARK PLUGS

The standard spark plugs fitted may be of the type with surface discharge with four peripheral points and a centre electrode for 8V engines and one point and central electrode for 16V engines.
The former does not need adjustment of the gap between the electrodes, while the latter has a precise dimension to be respected as illustrated.

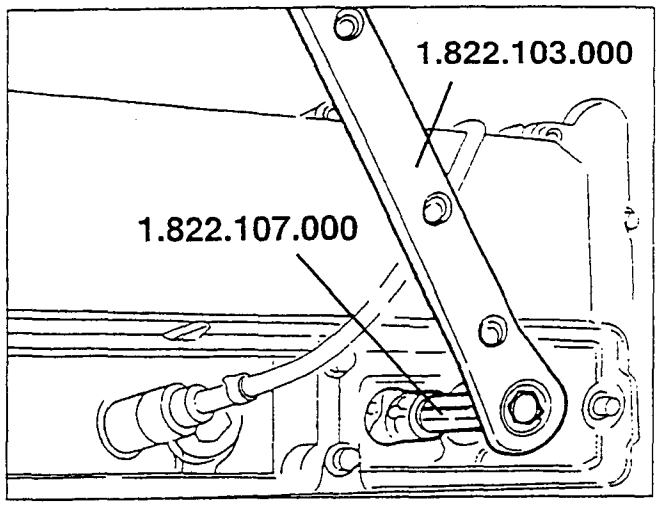


Firing order	1 - 3 - 2 - 4

CHECKING AND REPLACEMENT

- With the engine cold disconnect the spark plug cables
- Blow in the cavities to remove any impurities and traces of dirt.
- Slacken and remove the spark plugs.

For the BOXER 16V engine use tools no. N° 1.822.103.000 and no.1.822.107.000.



- Check the state of cleaning, or for any breaks of the ceramic insulation. In which case replace the spark plugs.

WARNING:
The use of spark plugs with specifications and size other than those specified may cause serious damage to the engine and alter the level of harmful emission at the exhaust.

WARNING:
A dirty or burnt spark plug is often a symptom of malfunctioning of the engine supply system.
For example:
- **traces of carbon dust: incorrect mixture, air cleaner very dirty;**
- **oil stains: oil leaks from the piston rings;**
- **formation of ash: presence of aluminium materials, to be found particularly in the oil;**
- **melted electrodes: overheating due to unsuitable fuel, faults in the valves;**
- **high electrode wear: harmful additives in the fuel or in the oil, pinging in the head, overheating;**
- **etc.**

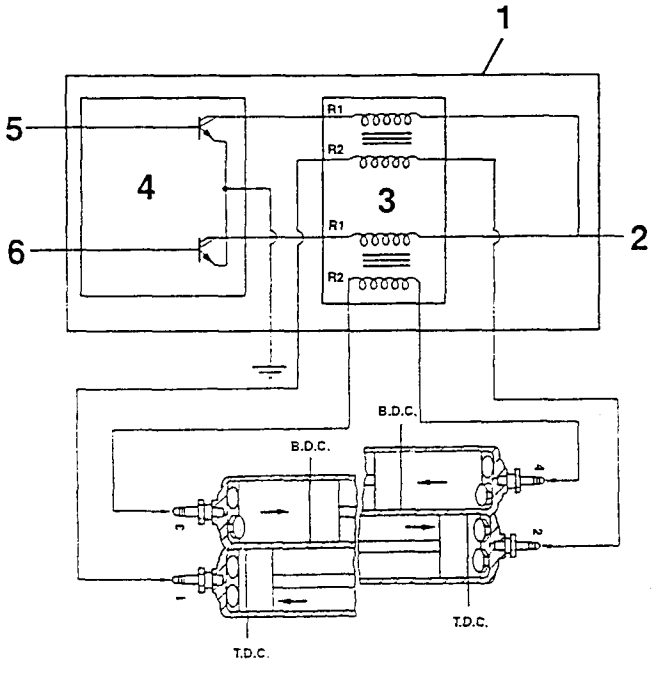
- When refitting tighten the spark plugs to a torque of:

25 ÷ 30 Nm 2.5 ÷ 3.1 kgm

IGNITION MODULE (1596 c.c. Rochester)

The ignition system is of the static, lost spark type, managed together with injection by the Rochester control unit. Static ignition no longer includes the distributor to distribute high voltage to the spark plugs; there are two coils integrated in a single unit with the corresponding power modules.
Each secondary winding of the coils is connected to the two spark plugs of the cylinders which, kynematically, move together (1-2 e 3-4).
The more important advantages are:
- higher power of the spark
- greater reliability
- reduction of radio distrubances
- smaller dimensions.

The control unit detects the angular position and speed of the crankshaft through the rpm and timing sensor.
Additionally, by processing the signals concerning the engine temperature and load, it calculates the spark advance governing the power module of the coil concerned.



1. Ignition module
2. Supply (+)
3. Coil unit
4. Power module
5. Command 1-2
6. Command 3-4

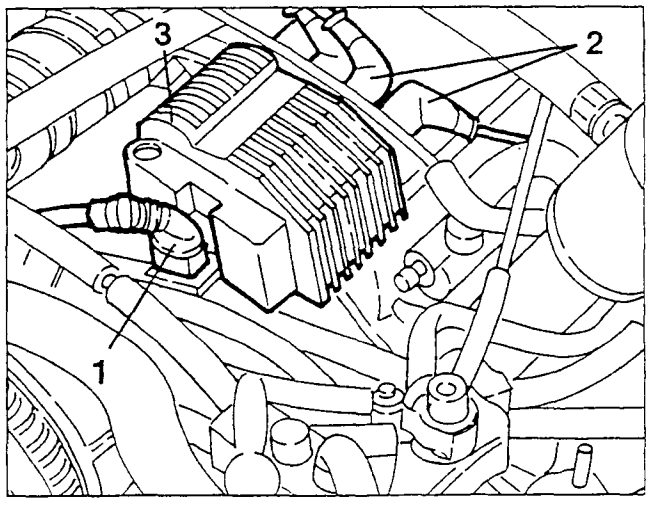
When the control unit removes the command from the power module, energy is transferred from the primary winding to the secondary.
This transfer instantaneously determines the presence of an induced voltage at the ends of the secondary winding, which will always have the same polarity (one end will have a positive potential and the other a negative potential).

These potentials will therefore also be taken by the central electrodes of the spark plugs connected to them (1-2 or 3-4).
Since the voltage induced on the secondary winding always has the same polarity, the discharge current of the coil on the two spark plugs concerned will always flow in the same direction, thus the sparks will strike in an opposed manner to one another: on the spark plug with the central electrode, with positive voltage, the spark strikes from the earth electrode towards the central electrode, whereas on the spark plug with central electrode, with negative voltage, the spark strikes from the central electrode towards the erath electrode.
The result of this, is that after a few thousand kilometers, analysing the spark plugs, the level of wear of the elctrodes may differ: on one, the central electrode with a higher level of wear and on the other, more wear on the earth electrode (this is normal).
The intensity of the sparks is determined by the working conditions of the spark plugs themselves.
In fact, in the cylinder at the T.D.C. at the end of the exhaust stroke, the spark will be very weak (lost spark) due to the presence of uncompressed exhaust gas (lower dielectric), while in the cylinder at the B.D.C. at the end of the compression stroke, there will be an intense spark (useful spark), due to the presence of the compressed air-fuel mixture (higher dielectric).

REMOVAL/REFITTING

- Disconnect the battery terminal (-).
- Remove the air intake box (see GROUP 10).

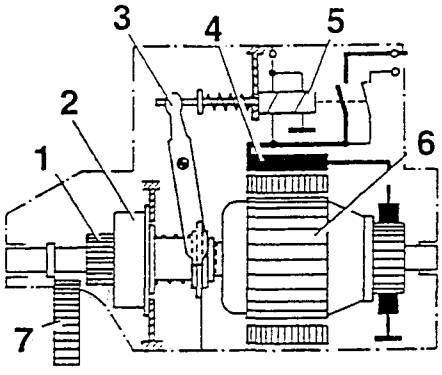
1. Disconnect the electrical connection from the ignition coil.
2. Disconnect the spark plugs from the ignition coil.
3. Slacken the three fastening screws and remove the ignition coil.



BLANK

STARTER MOTOR

Overcoming the inertia and frictions, the starter motor cranks the engine to a set number of revolutions in order to begin the formation of the mixture necessary for combustion and subsequent autonomous movement of the engine. The motion is transmitted by a direct current electric motor, powered by the battery current, through a coupling pinion which turns the ring gear on the flywheel.

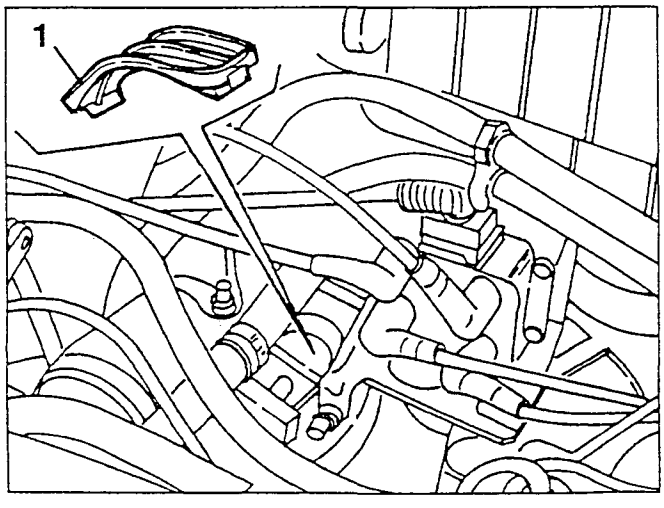


1. Pinion
2. Roller type freewheel
3. Coupling lever
4. Excitation coil
5. Relay
6. Rotor
7. Flywheel
8. Ring gear

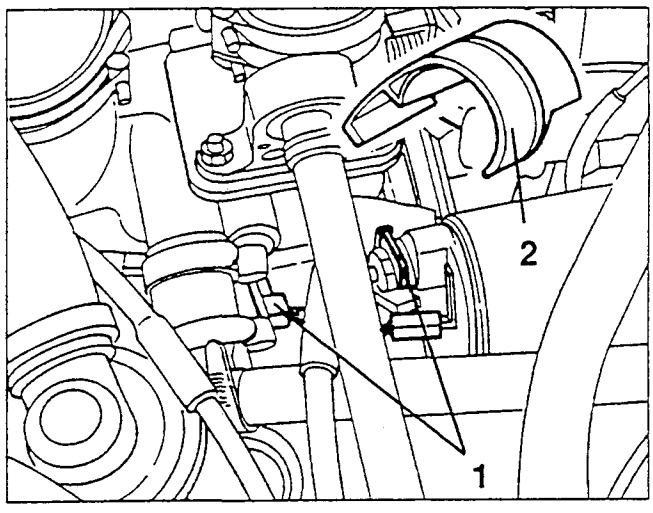
Due to a freewheel coupling, the pinion disengages when the main engine unit turns faster than the motor. A relay energized by the motor current engages the pinion through a fork. The starter motor installed is of the translating screw pinion type with relay housed directly above the starter motor.

REMOVING/REFITTING

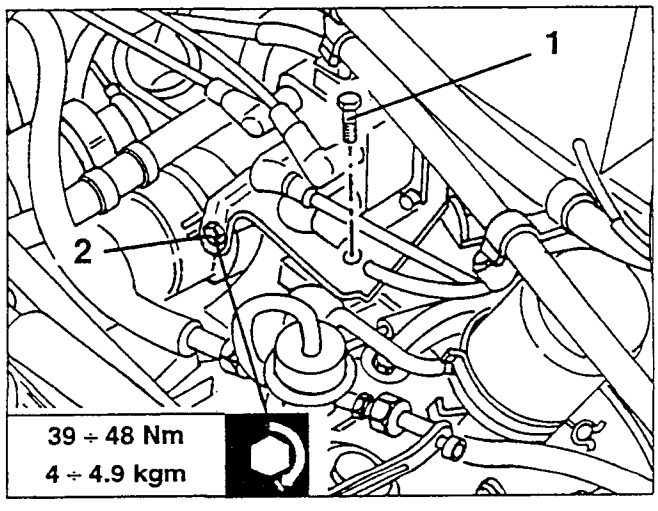
- Remove the intake box (see GROUP 10).
1. Remove starter motor inspection cover.



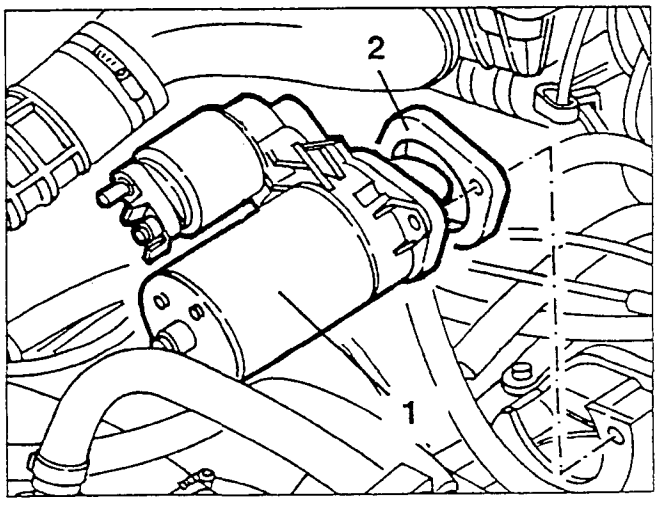
1. Disconnect the electrical connections from the starter motor.
2. Remove the plastic protection from the starter motor.



1. Slacken the screw fastening the ignition coil support bracket to the crankcase.
2. Slacken the two bolts fastening the starter motor (one bolt also fastens the ignition coil support bracket).

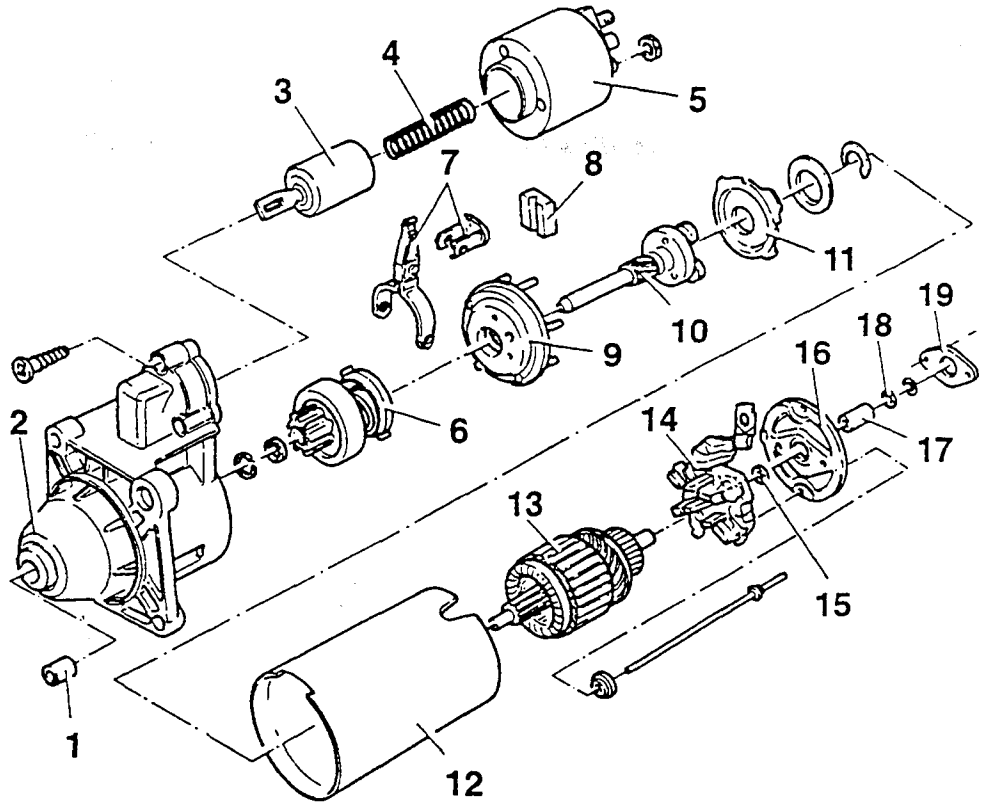


1. Remove the starter motor.
2. Remove the spacer.



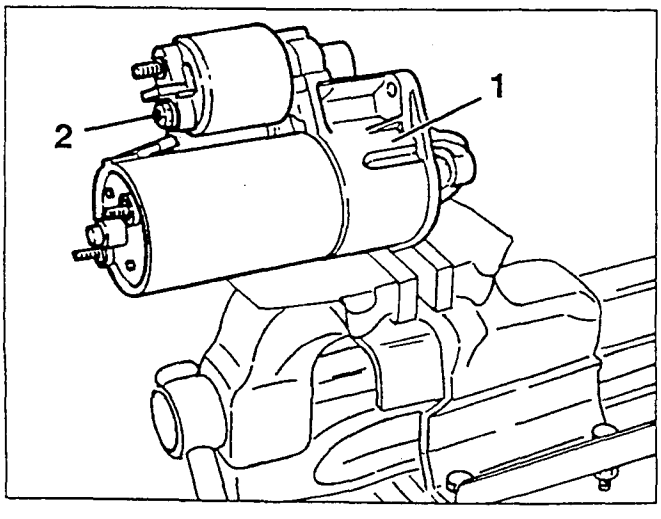
DIS-ASSEMBLY

1. *Bush*
2. *Support on drive side*
3. *Coupling relay rotor*
4. *Return spring*
5. *Coupling relay*
6. *Starting coupling*
7. *Fork levers*
8. *Rubber pad*
9. *Differential control gear*
10. *Inverter*
11. *Protection plate*
12. *Pole frame*
13. *Rotor*
14. *Brush holder plate*
15. *Felt ring*
16. *Collector side support*
17. *Bush*
18. *Compensation washer*
19. *Dust guard*

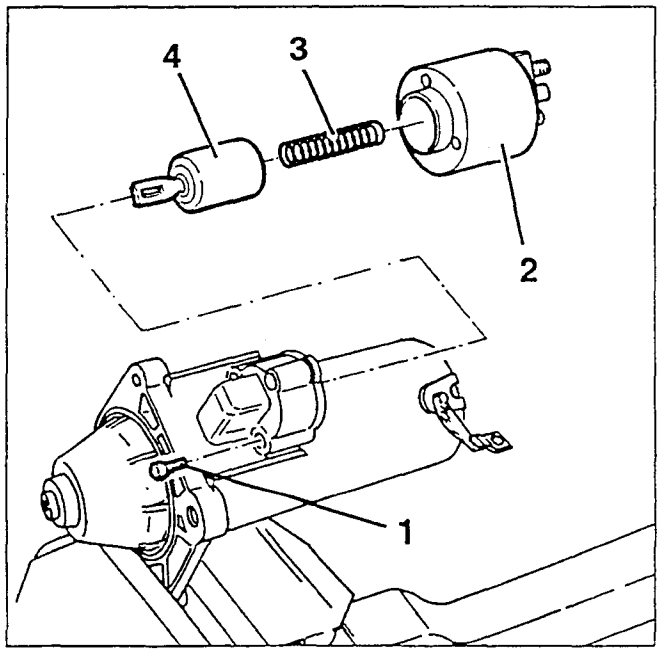


CAUTION:
Because of their structure these starter motors are more sensitive to knocks, blows and squashing than the previous versions.
Consequently, thay must be fastened only locking them in the clamp on the flange (not on the pole frame).

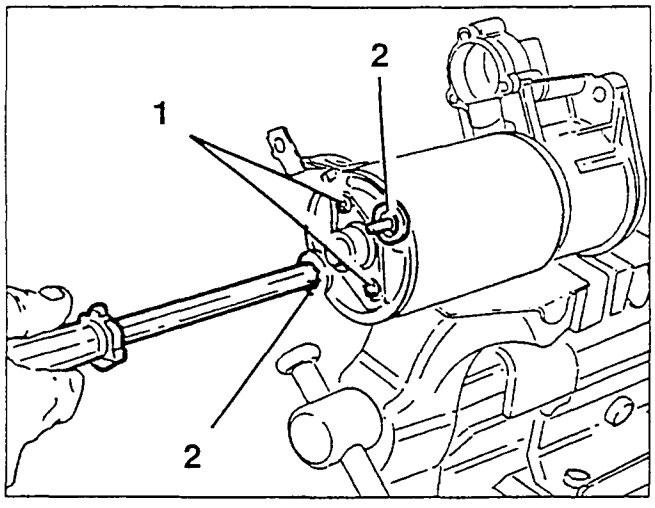
1. Fasten the starter motor on a vice with protective clamps as shown in the figure.
2. Slacken the nut fastening the terminal to thecoupling relay.



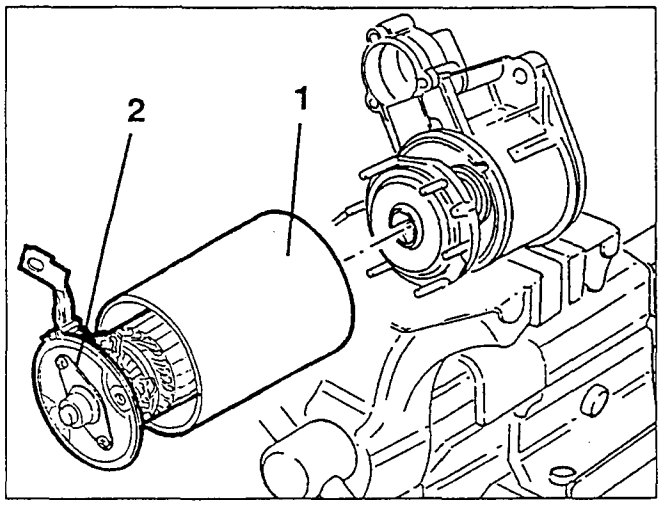
1. Slacken the three screws fastening the coupling relay to the drive side support.
2. Remove the coupling relay.
3. Retrieve the return spring.
4. Remove the coupling relay rotor.



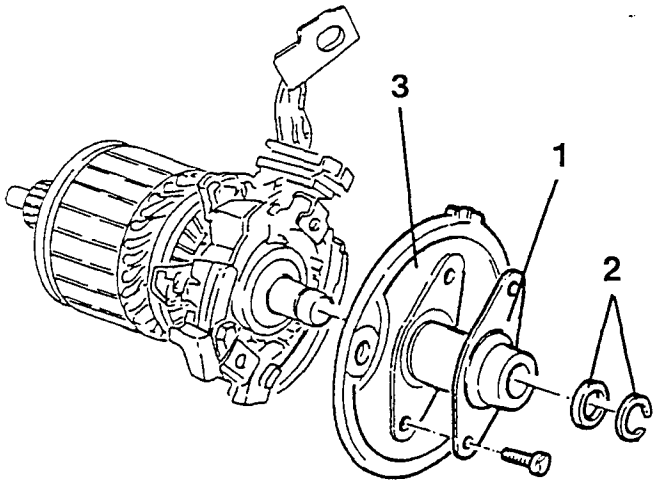
1. Slacken the two screws fastening the dust cover without removing them.
2. Slacken and renove the two thru screws.



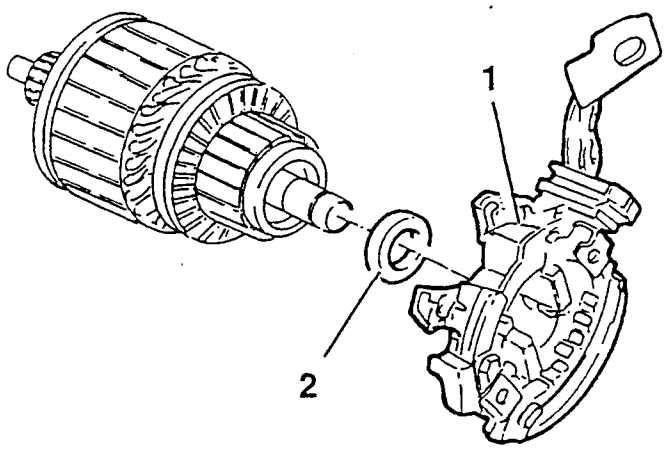
1. Remove the pole frame complete with rotor and collector side support.
2. Press the rotor carefully from the pole frame and at the same time push the seal out of the clamp.



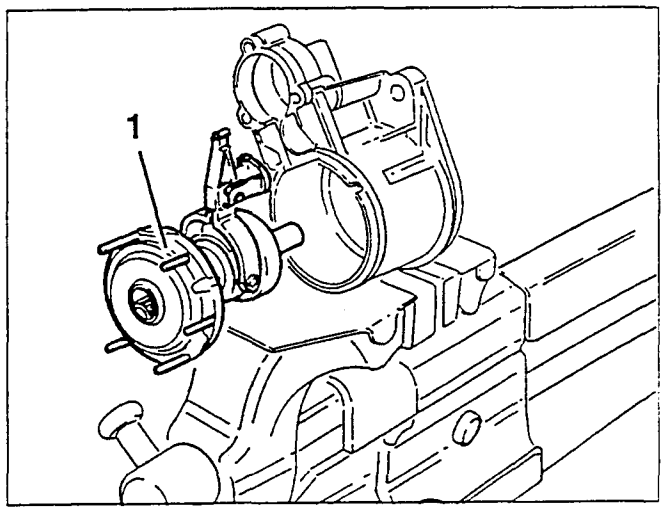
1. Completely slacken the fastening screws and remove the dust guard.
2. Remove the rest and compensation washers.
3. Remove the collector side support.



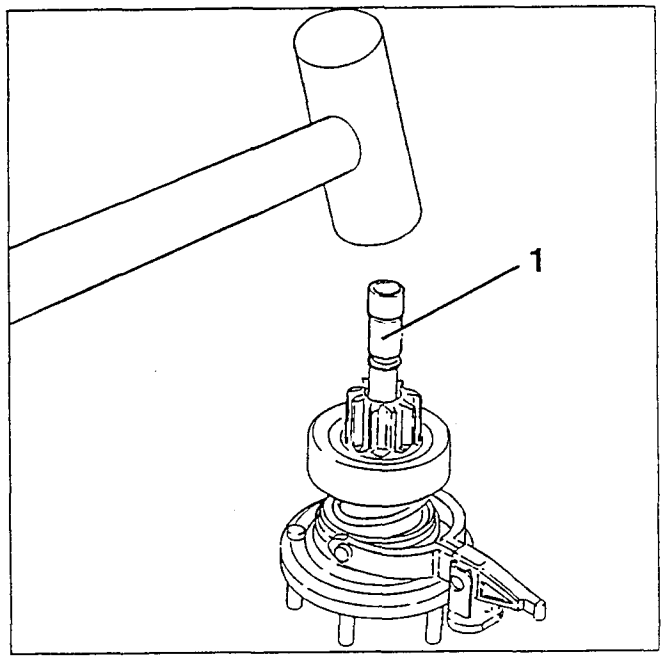
1. Remove the brush holder plate from the rotor.
2. Remove the felt seal.



- Remove the rubber pad using a screwdriver.
1. From the drive side support remove the spur gear with transmission and fork levers.

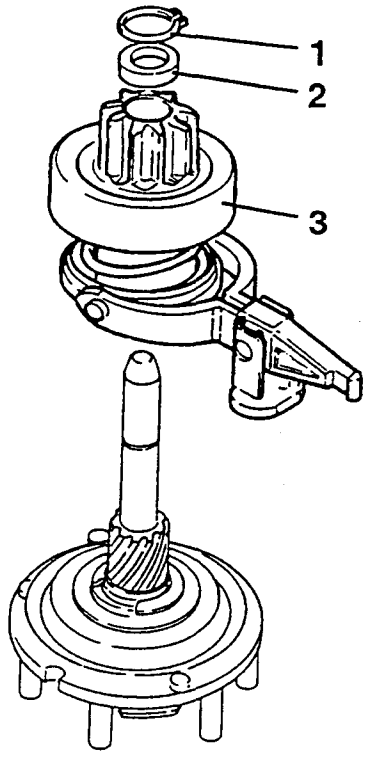


1. Hammer the starter coupling stop ring with a suitable bush and rubber mallet.

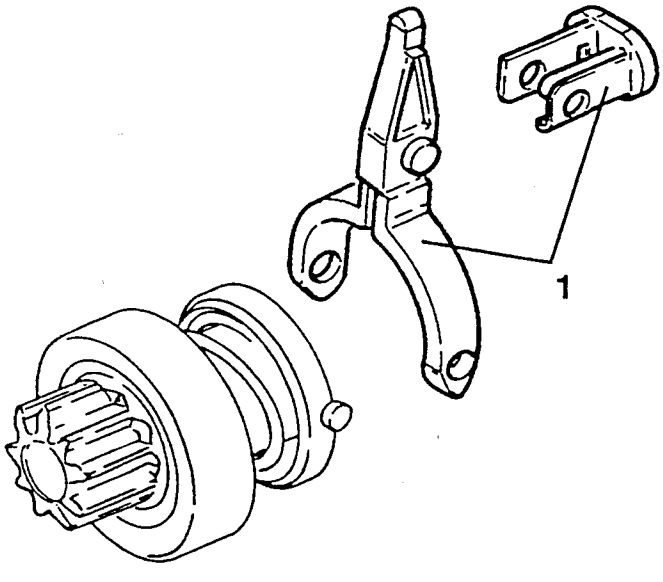


1. Using suitable pliers remove the split ring.
2. Remove the stop ring.
3. Remove the starter coupling from the reversing shaft.

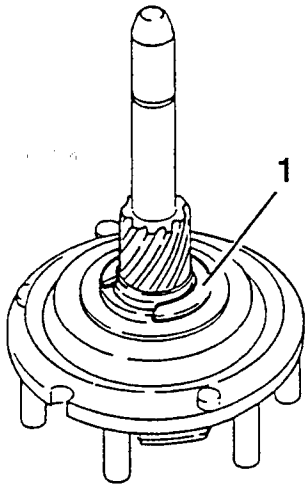
CAUTION:
Avoid damaging the reversing shaft when removing the split ring.
If necessary, accurately deburr the reversing shaft groove, otherwise the gear bush will be damaged.



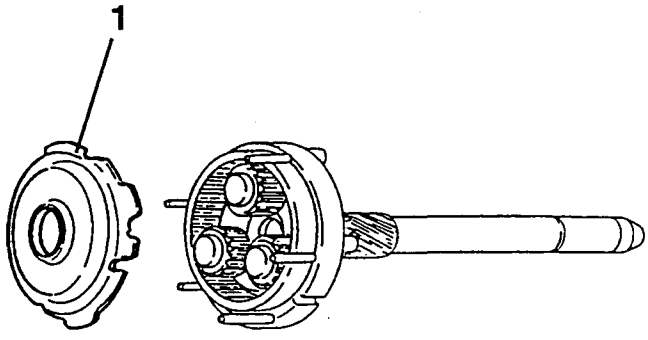
1. If necessary, remove the fork levers from the starter coupling.



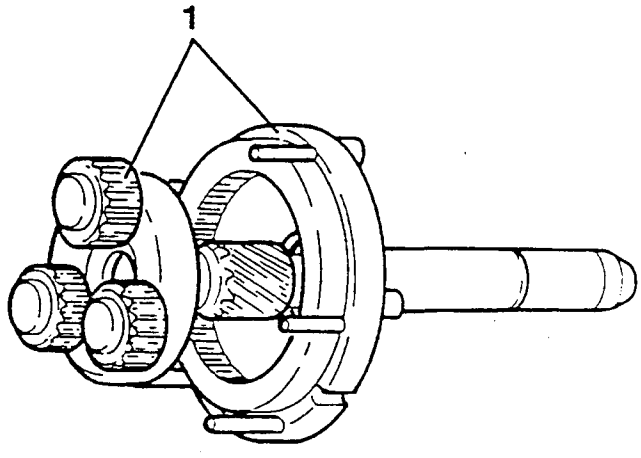
1. Remove the split ring fastening the reversing gear.



1. Remove the protection plate from the differential drive gear.



1. Separate the differential drive gear from the reversing gear.



- If necessary, using special punches replace the bushes on the collector side support and drive side support..

CHECKS AND INSPECTIONS

- Clean the rotor, ring gear with internal teeth, the gear with transmission and the relay using only compressed air (max 4 bar) and a clean cloth. Never use liquid detergents. The other parts, such as for example screws and the rotor shaft may be washed with non inflammable liquid detergents to be found normally in commerce.

CAUTION:
Carefully dry any washed parts, otherwise they might form explosive gases inside the sealed starter motor.

Checking the outside of the collector

- Check for any worn points; if necessary, proceed as follows:
• Tighten the rotor on the collector side and drive side support taking care not to damage the rotor shaft.

CAUTION:
When turning do not tighten the rotor shaft in the chuck.

• Turn the collector using suitable tools ensuring that its diameter is within the specified measurements.

Minimum collector diameter
31.2 mm

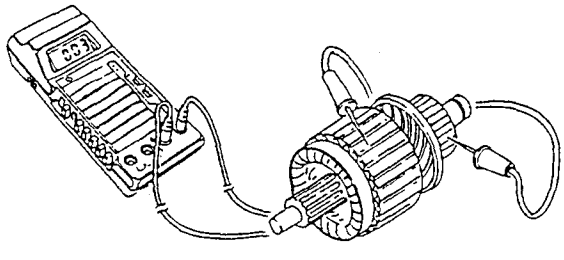
- Also check that the eccentricity of the collector and of the pack of plates is within the specified values.

Collector eccentricity	≤ 0.01 mm
Eccentricity of pack of plates	≤ 0.05 mm

- If there are annealed points or interruptions on the collector, change the rotor.

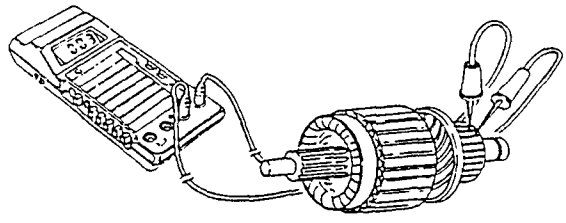
Collector continuity test

- Place the tester prods on the collector blades and check that the tester indicates the passage of current. In the lack of continuity, change the rotor.
- Repeat the above-mentioned operations for all the corresponding pairs of blades.



Rotor insulation test

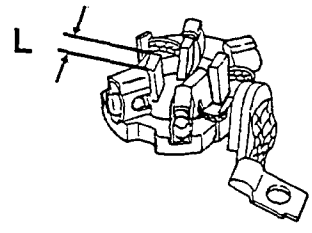
- Place one tester prod on the collector and the other on the blade pack or on the shaft and check that the tester does not indicate the passage of current. If insulation is lacking (short circuit), change the rotor.
- Repeat the above-mentioned tests for all the collector blades.



Checking brush wear

- To check the brushes, release the brush holder from its plate.
- Check that the length of the brushes is within the specified values and that they are not damaged; if necessary, change the whole brush holder plate.

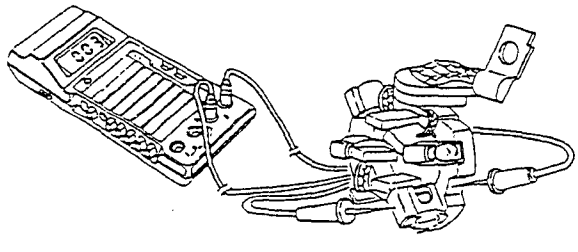
Minimum brush length
L = 8 mm



- Also check that the brush springs are not strained and are stiff enough to warrant good contact of the brushes on the collector.

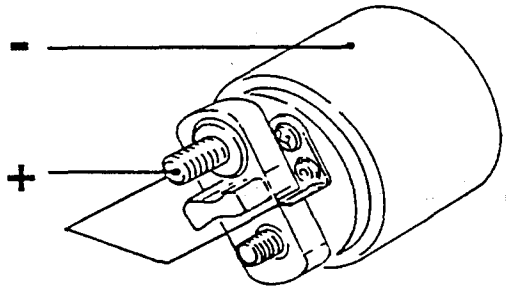
Brush holder insulation test

- Connect one prod of the tester to the brush holder support plate and the other on a positive brush holder and check that the tester does not indicate the passage of current.
- Repeat the test for the other positive brush holder.
- If insulation is lacking, change the brush holder plate.



Checking the efficiency of the coupling relay

- Set the coupling relay on the test bench and power the bench surface negatively (alternatively connect the relay frame to the battery (-) terminal). - Connect the positive terminal of the test bench or of the battery to the positive terminal of the short circuited relay with the starter pin. - The prod of the coupling relay that actuates the starter control fork must be triggered; if not, change the electromagnet.

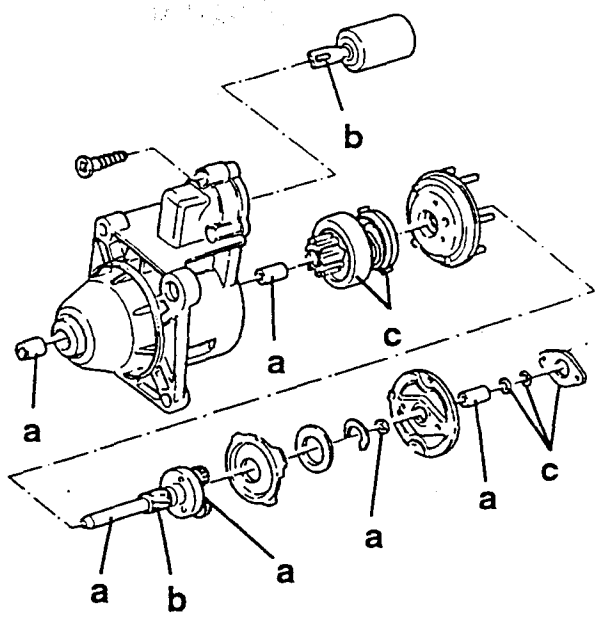


Checking the bush wear

- Check that the two bushes, the first one on the drive side support and the second on the collector side support are not excessively or unevenly worn.
- If necessary change them using special punches.

RE-ASSEMBLY

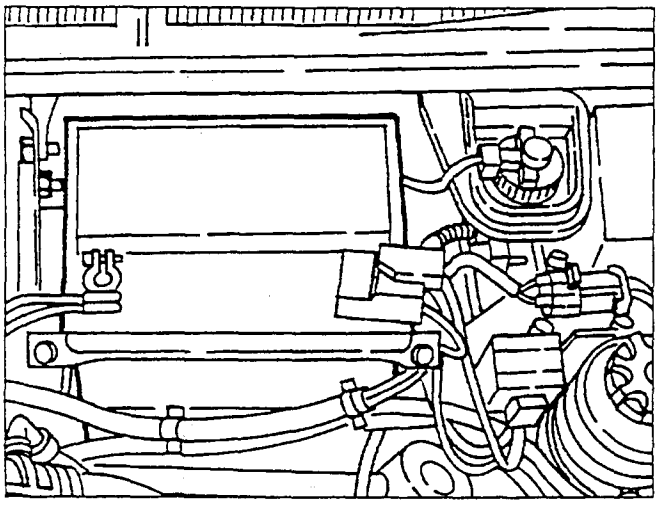
- Re-assemble the starter reversing the sequence followed for dis-assembly. - Lubricate the components shown in the following figure with the products described.



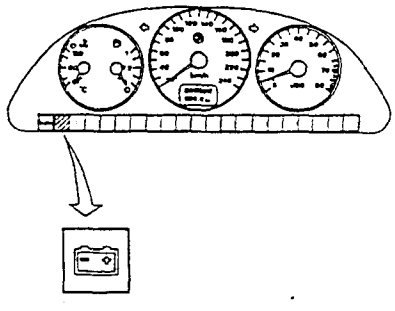
a. Oil
b. Grease
c. Silicone grease

BATTERY

The battery is located in the engine compartment supported by the power steering box support cross-smember.



It has been designed to ensure that the engine starts in the shortest time possible. For this reason a high torque and a predefined engine rpm are required. This is ensured by the optimal sizing of the 6 elements contained inside the battery, each of which delivers a voltage of ~ 2 V (12 V in all).
The battery adopted does not need periodical maintenance.
It maintains the charge much longer and also contains diluted sulphuric acid; for this reason it is necessary to keep it in the upright position even when it is not installed on the car. The battery body also has small ventilation holes to minimise the formation of gas during charging. Due to the reduction in the volume of gas produced, there is no corrosion and good contact at the terminals is ensured. The advantages of this battery are:
- highly reduced water consumption due to the new type of alloy used in the manufacture of the grills and plates, for which reason it is no longer necessary to top up the battery; - excellent starting capacity, as a result of very low self- discharging of up to 7 months thus enabling long term storage (at temperatures below 28°C).
When the vehicle is travelling the alternator recharges the battery. Whenever the charge is insufficient or the connection between the alternator and the battery is cut off, a warning light on the instrument cluster turns on to indicate a circuit failure.



If the battery appears to be flat, check the charge measuring the loadless voltage on the terminals using a Voltmeter.
If the voltage is below 12.30 V it is 50% charged; if it reaches 12.48 V it is 75% charged; and at 12.66 V it is 100% charged.

CAUTION:
If the electrolyte level in one of the cells of the battery has fallen below the minimum level mark on the plastic container, carefully open the cap cover and add de-ionized water, as with ordinary batteries.

NOTE:
It is highly unadvisable to recharge the battery quickly at voltages above 15.5 V.
When recharging use a normal 12 V battery charger, connecting the positive cable (red) to the battery (+) terminal and the negative cable (black) to the battery (-) terminal.
If the battery of the vehicle is connected temporarily to an external battery, connect the positive terminal to the positive terminal and the negative terminal to the negative terminal.

CAUTION:
- Do not connect or disconnect the battery to or from the electric system of the car when the engine is running.
- Do not invert the terminal connections (even for a moment) as this would damage the alternator rectifier.
- When connecting the battery charger to the battery, firstly connect the cables and then start the battery charger.
- if it becomes necessary to start the engine with temporary cables and with an auxiliary battery, the voltage of the latter must not exceed 12V.
- Before charging the battery the clamp should be removed from the negative terminal.
- When charging make sure that the temperature of the electrolyte does not exceed 45°C.
- Do not touch the positive and negative terminals at the same time with the hands.
- Keep all naked flames away from the battery when recharging.

When replacing the battery follow the directions for use.
If the charge of the replacement battery is potentially higher than that of the old one, the higher voltage might cause melting of the starter motor induction coil, or damage to the pinion or crown gear.

MAINTENANCE

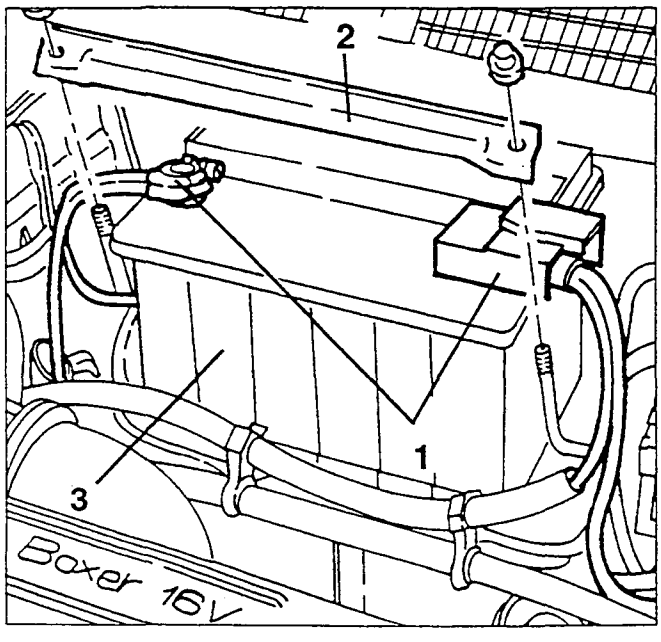
The capacity of the battery to start the engine depends on the charge within it; it is therefore necessary to check it regularly and carry out any maintenance, especially during the winter due to the greater load required by the starter motor and the reduced battery capacity at low temperatures. Clean the surfaces of the battery, the terminals and clamps with a solution of water and sodium bicarbonate. Before reconnting the clamps, coat them with a layer of grease.

CAUTION:
Do not let any of the fluid used for cleaning get into the battery as it will react with the electrolyte. The electrolyte fluid is an acid, therefore dangerous for eyes, hands and clothes.

NOTE:
Batteries stored in a warehouse or installed on cars left unused for long periods will slowly lose their charge so it will be necessary to recharge them before use.

REMOVAL/REFITTING

1. Disconnect the battery (-) terminal and then the (+) terminal.
2. Slacken the nuts and remove the battery fastening bracket.
3. Remove the battery.



- If necessary, remove the battery acid drain tray.

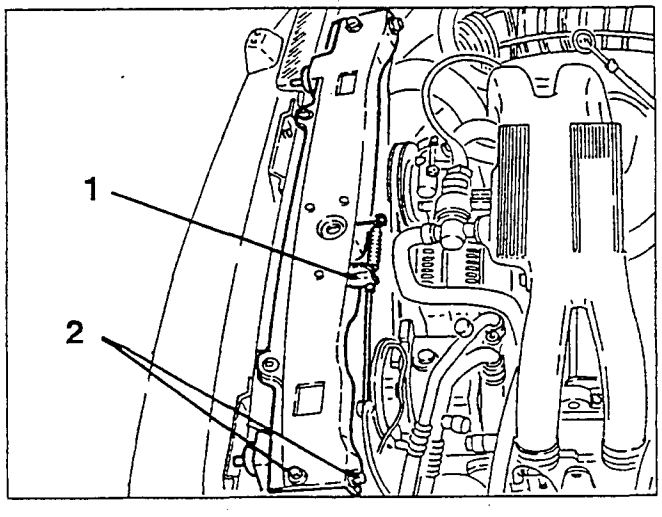
ALTERNATOR

The alternator supplies electrical energy to the electronic control units and to the various services when the engine is running. It also charges the accumulator (battery) so that it can deliver current when the engine is stationary. The electric current is produced by a stator which "cuts" the magnetic field generated by a rotary coil (rotor). The rotor is integral with a pulley operated directly by the crankshaft through a belt. The contact brushes supply the rotor with the excitation current.
The alternate current generated by the alternator is rectified by the diodes and adjusted by the voltage regulator located on the alternator body. The electronic voltage regulator used is compact in size and it warrants constant voltage in all fields of operation of the engine, regardless of the changes in load and rpm. A cooling fan turns together with the pulley to prevent it from reaching dangerous temperatures that might adversely affect its operation. The alternator installed is of the type with claw terminals and collector rings; it is light and very compact. It is fastened to the engine by brackets, one of which is slotted to simplify tensioning of the drive belt (see GROUP 00).

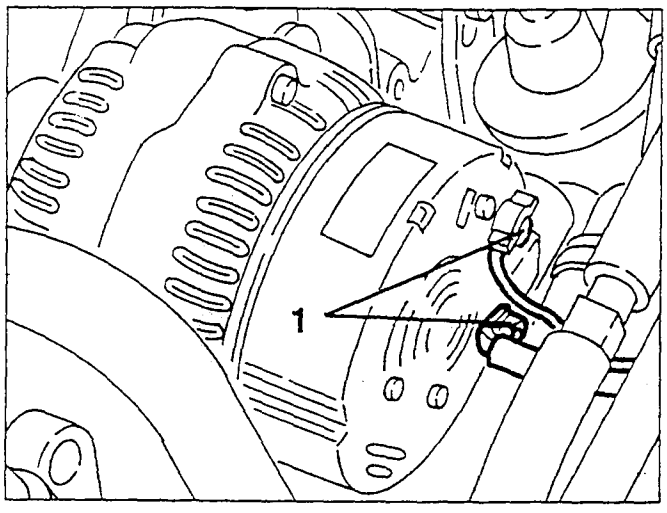
CAUTION:
The fan will correctly cool the alternator if it turns clockwise (seen from pulley side).

REMOVAL/REFITTING

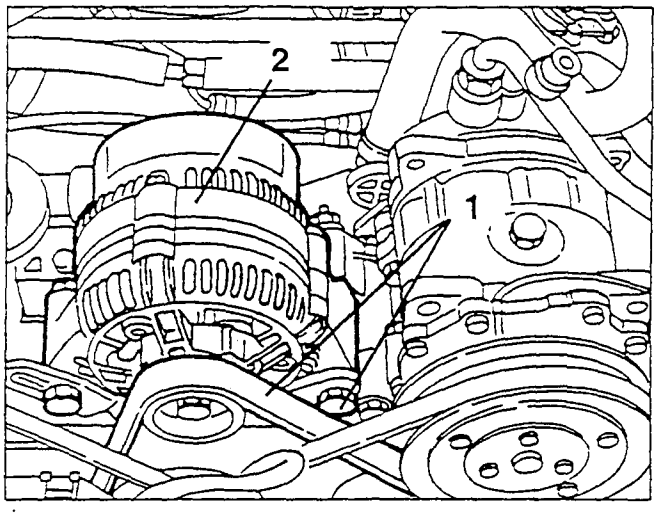
- Disconnect the battery (-) terminal.
- Remove the radiator grille (see GROUP 70).
1. Disconnect the opening cable from the bonnet lock.
2. Slacken the fastening screws and remove the upper radiator crossmember.



- Remove the intake box (see GROUP 10).
1. Disconnect the electrical connections from the alternator.

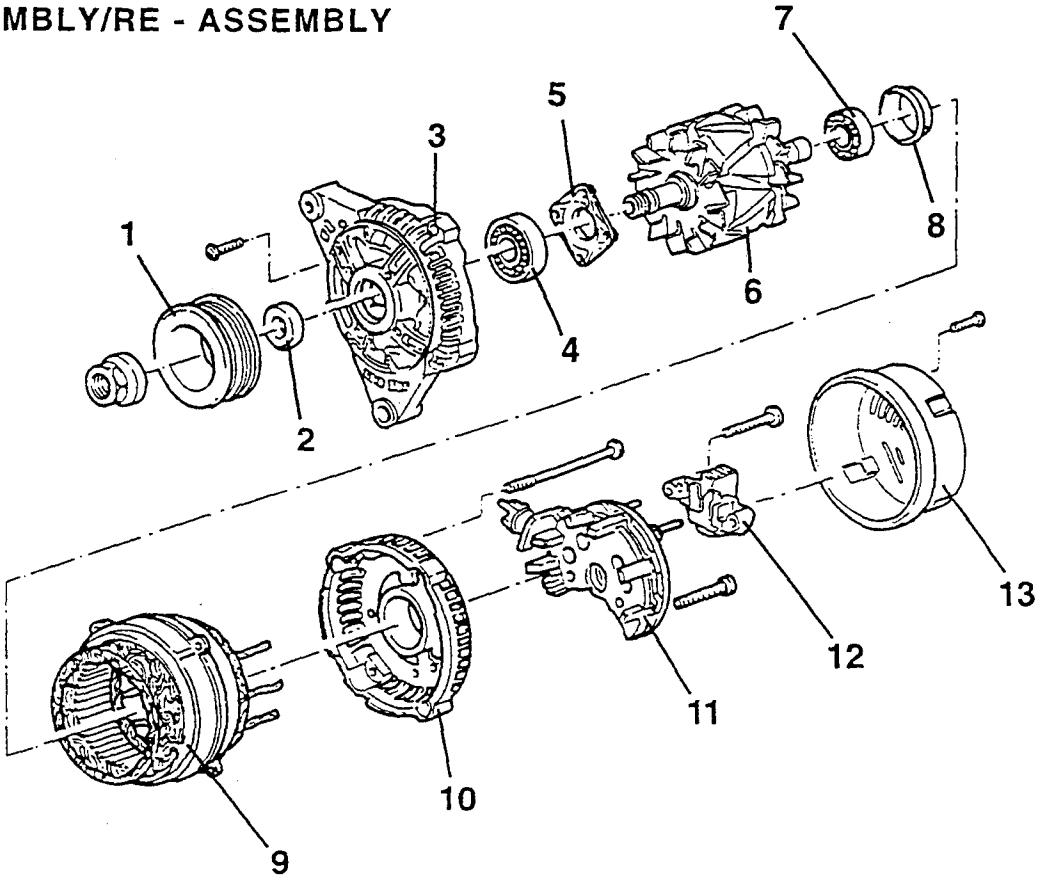


1. Slacken the two bolts fastening the alternator and prise off the drive belt without removing it.
2. Slacken the fastening bolts completely and remove the alternator.



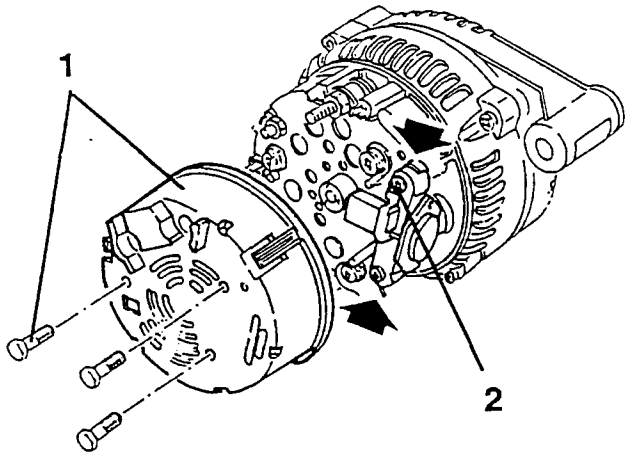
When refitting, tension the alternator - water pump drive belt (see GROUP 00).

DIS - ASSEMBLY/RE - ASSEMBLY

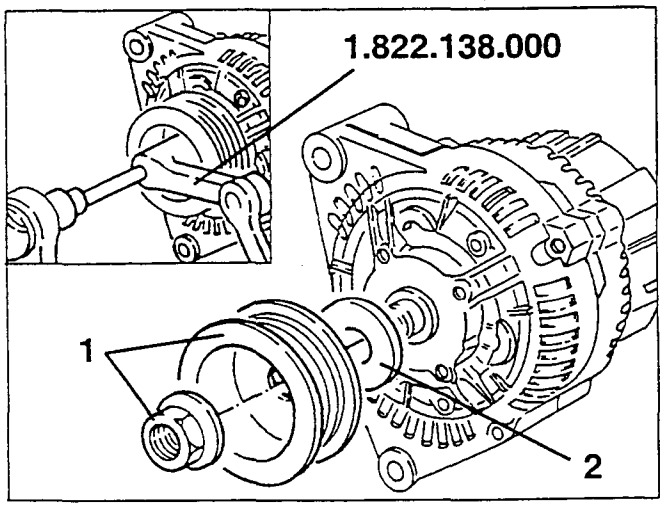


1. *Pulley*
2. *Spacer*
3. *Drive side support*
4. *Drive side bearing*
5. *Cover plate*
6. *Rotor*
7. *Regulator side bearing*
8. *Centering ring*
9. *Stator*
10. *Support for collector rings*
11. *Rectifier unit*
12. *Voltage regulator - brush holder*
13. *Protection cap*

- Fasten the alternator on a special support tool.
1. Slacken the three fastening screws and remove the protection cap releasing the lock clips.
2. Slacken the two screws fastenings the voltage regulator then remove it releasing it from the side catches.



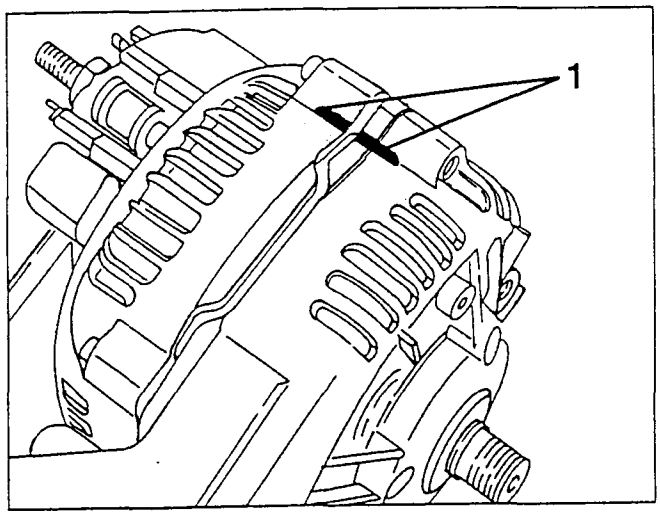
1. Using tool No. 1.822.138.000 together with wrench USAG XZN M10L, slacken the nut fastening the alternator pulley and remove it.
2. Retrieve the spacer.



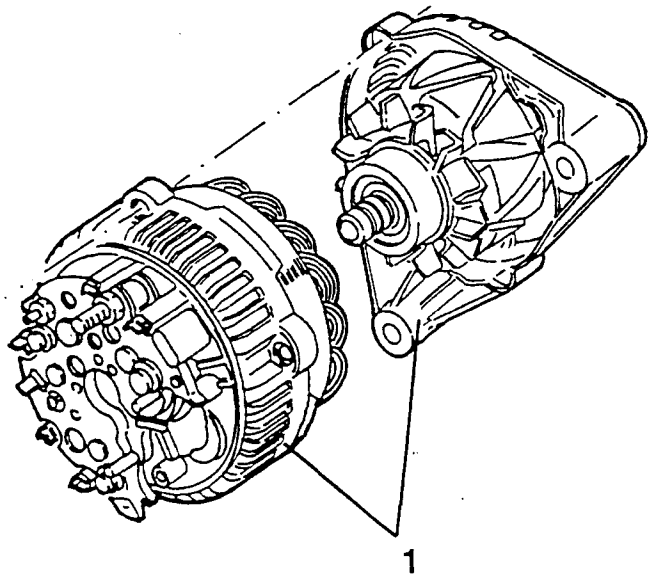
- When tightening the retaining nut with extension spanner N° 1.822.137.000, the torque values become:

300 mm for dynamometer spanner with arm	65 ÷ 74 Nm 6.6 ÷ 7.5 kgr
400 mm for dynamometer spanner with arm	67 ÷ 76 Nm 6.9 ÷ 7.8 kgr

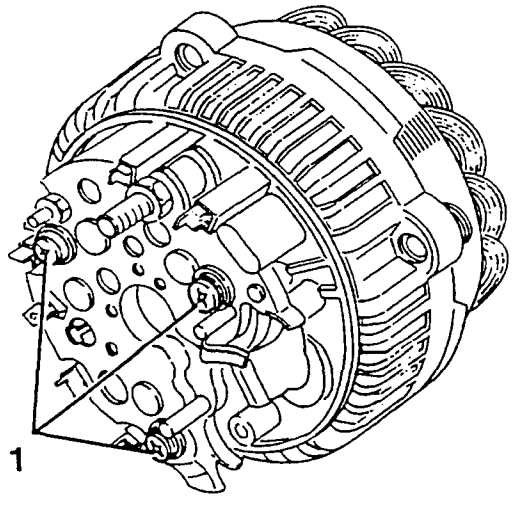
1. Make reference notches on the drive side support and on the connector ring support.



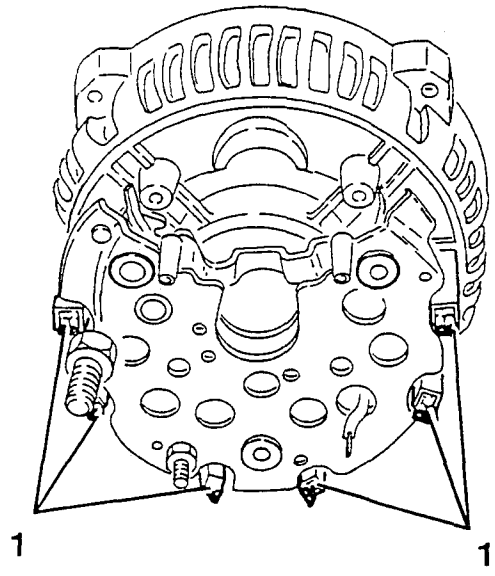
1. Slacken the four fastening screws and remove the drive side support with rotor from the collector ring support.



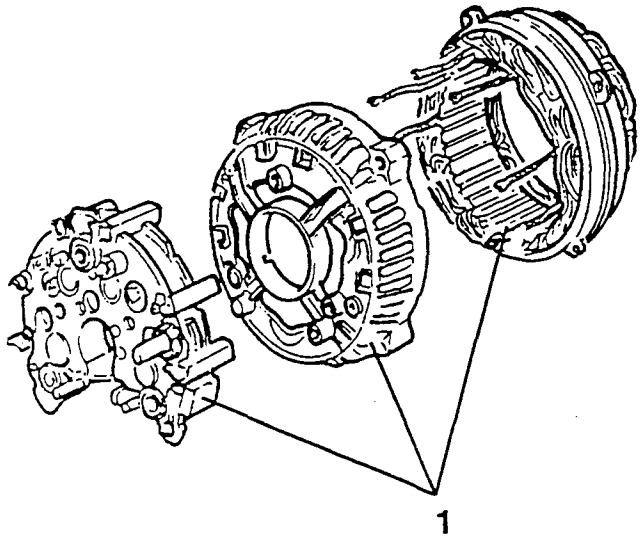
1. Slacken the three screws fastening the rectifier unit to the support.



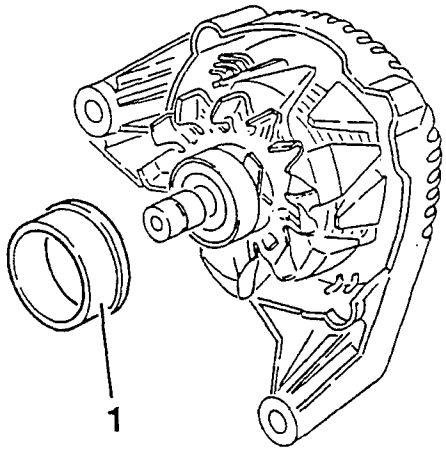
1. Using a screwdriver open the clamps fastening the stator wires.



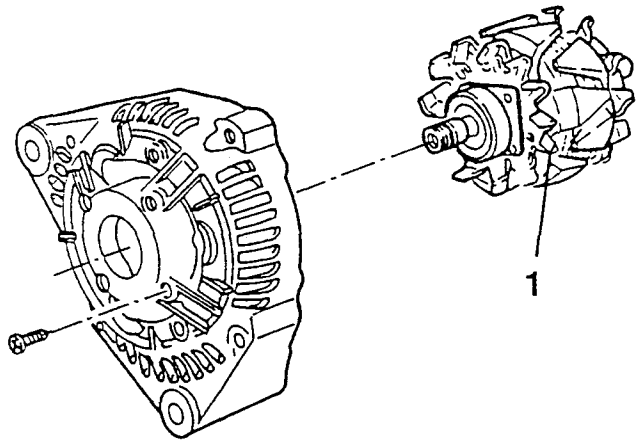
1. Separate the rectifier unit from the collector ring support and from the stator.



1. Remove the centering ring from the bearing on the regulator side.

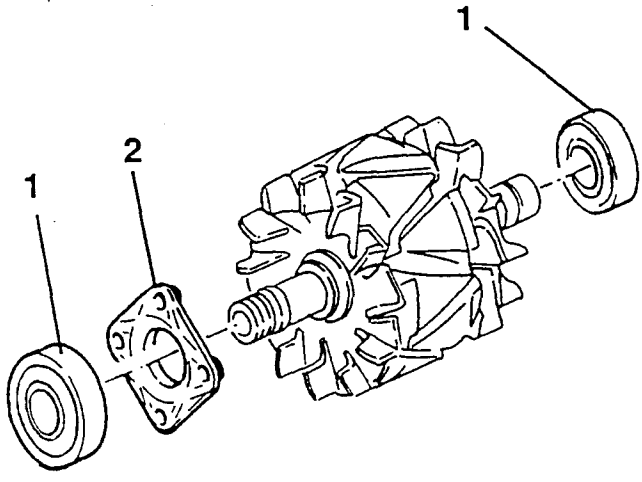


1. Slacken the four fastening screws and remove the rotor complete with bearings from the drive side support.



1. Using a suitable puller tool, remove the rotor bearings.
2. Retrieve the cover plate.

CAUTION:
When removing the regulator side bearing, do not use the shaft as a reference plane, as this is made from plastic and might be damaged.



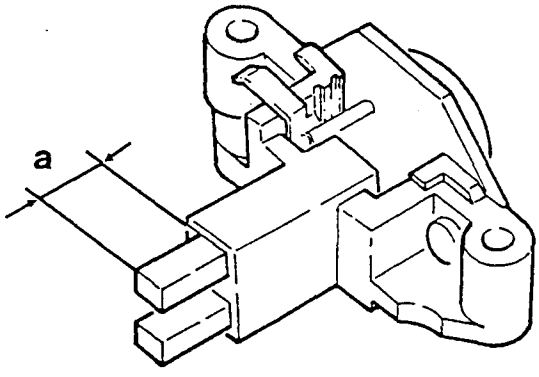
CHECKS AND INSPECTIONS

CAUTION:
The alternators are fitted with long life storage condensers for the suppression of receivers and transmitting systems.
When washing parts of the alternator, the condenser can discharge in contact with the cleaning fluid and this may set fire to inflammable liquids.

Checking the brush wear

- Check the outside of the voltage regulator for damage.
- Change the regulator if the brushes are split or if the protrusion dimension "a" is below the specified value.

Minimum brush length
a = 7 mm

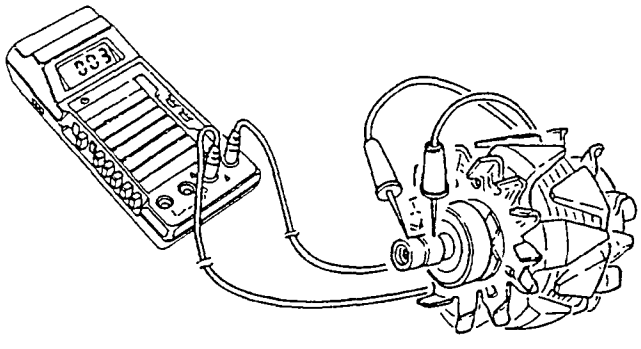


- Also check that the brushes run smoothly and that their springs are rigid enough to ensure good contact of the brushes on the collectors.

Continuity test of the rotor winding

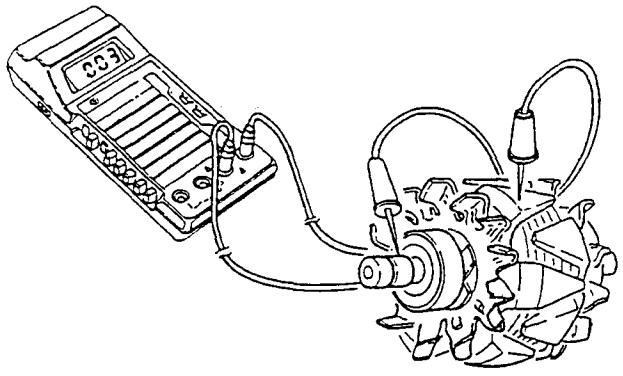
- Check that the resistance of the rotor winding is within the specified ratings connecting the prods of the tester on the collector rings.

Rotor winding resistance
2.6 ÷ 2.8 Ω



Rotor insulation test

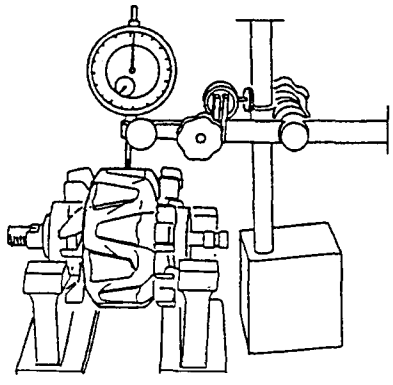
- Place one tester prod on a collector ring and the other one on the rotor core, then check that the tester does not signal the passage of current.
- Repeat the operation for the second collector ring.



Measuring the concentricity of the rotor and collector rings.

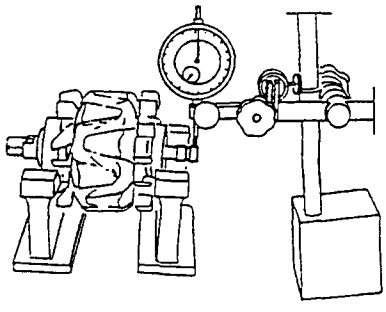
- Set the rotor on special supports and using a dial gauge on a magnetic support base, check that the eccentricity of the rotor outside diameter does not exceed the specified value.

Eccentricity of rotor outside diameter
≤ 0.05 mm



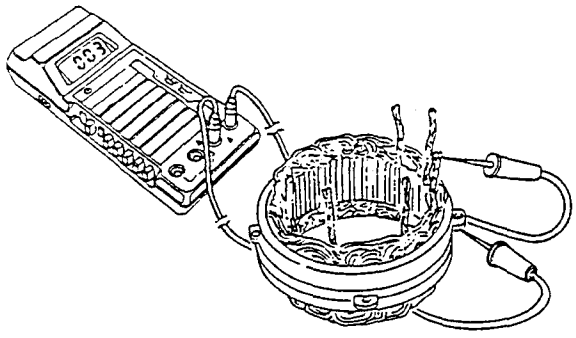
- In the same way, check that the difference on the collector rings does not exceed the specified value. If necessary, turn the outsides of the collector rings.

Eccentricity of collector rings
≤ 0.03 mm



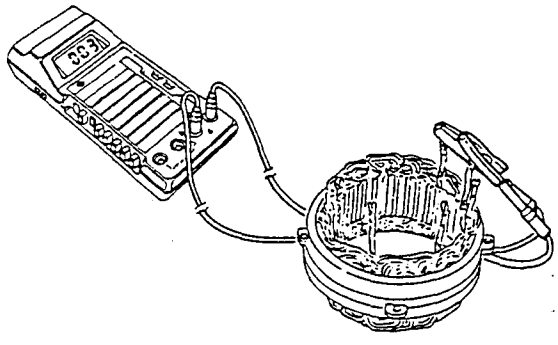
Insulation test for stator windings

- Place one prod of the tester on the stator pack and the other on the terminals of the first phase, then of the second and third. Check that the tester does not signal the passage of current.
Change the stator if insulation is insufficient.



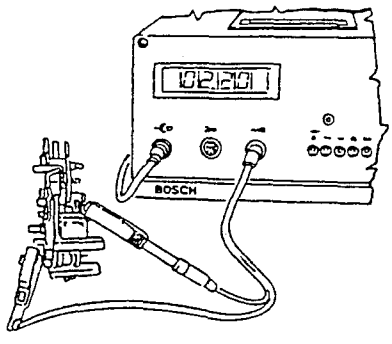
Continuity test of stator windings

- Check the tester termnals respectively on the terminals of phases 1-2, 1-3 and 2-3 and check that in all three cases the tester signals the passage of current. In the lack of continuity in the windings, change the stator.



Checking the anti-disturbance condenser on the rectifier

- Slacken the antidisturbance condenser connection tab (-) on the rectifier.
- Connect the tester to B+ of the rectifier and to the slackened connection tab of the condenser and check that the electrical capacity is 1.8 ÷ 2.6 microfarad.

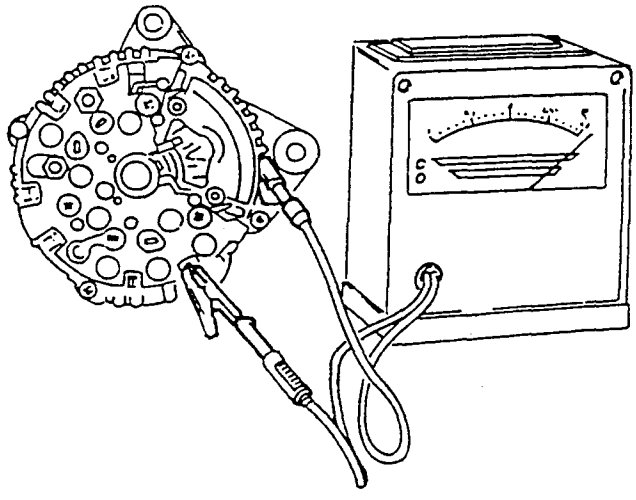


- If not, change the rectifier complete with anti- disturbance condenser.

CAUTION:
After this check, discharge the condenser by short circuit to prevent the liquid detergent from setting on fire when cleaning the components.

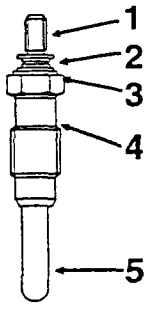
Checking the rectifier

- Check that the wired rectifier is working properly using special equipment.
- Connect the terminals of the test equipment to the following points of measurement:
a) Stator frame and connection weldings.
b) B+ and stator connection welding point.
c) D+ stator connection welding point.
The rectifier is in order if the tester dial is in the sector of both measurements.
If one or more dodes are faulty, change the complete rectifier.



GLOW PLUGS

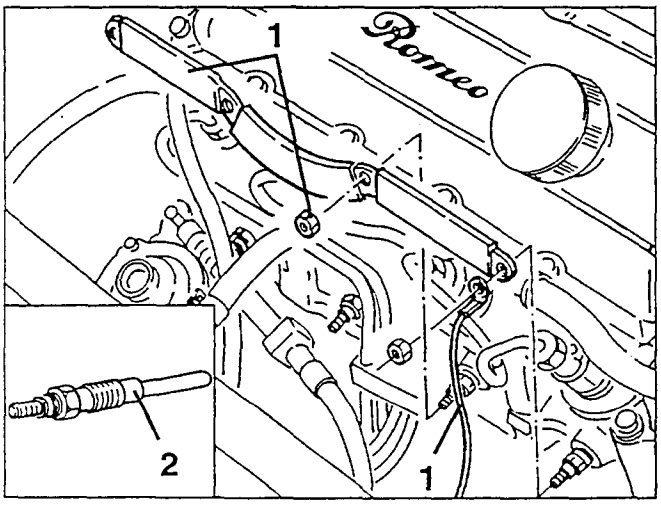
These are of the rapid incandescence bulb type and they reach a temperature of 850°C in the nominal time of ~ 7 seconds.
They have a resistance coil in "Alferon" with high resistivity and "Nickel" with low resistivity welded by laser. The outer bulb is in "Inconel 601" with a thickness of 0.7 mm.



1. *Threaded terminal*
2. *Spacer*
3. *Insulant*
4. *Body*
5. *Filament protection*

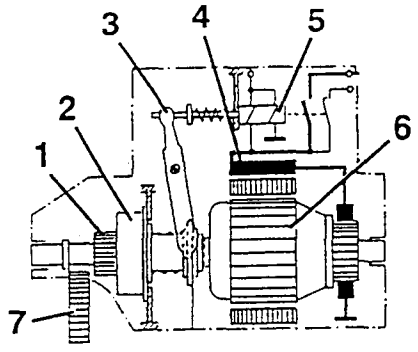
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Slacken the fastening nuts and remove the bar and the glow plug supply cable.
2. Remove the glow plugs.



STARTER MOTOR

Overcoming the inertia and frictions, the starter motor cranks the engine to a set number of revolutions in order to begin the formation of the mixture necessary for combustion and subsequent autonomous movement of the engine.
The motion is transmitted by a direct current electric motor, powered by the battery current, through a coupling pinion that turns the ring gear on the flywheel.
Due to a freewheel coupling, the pinion disengages when the main engine unit turns faster than the motor.

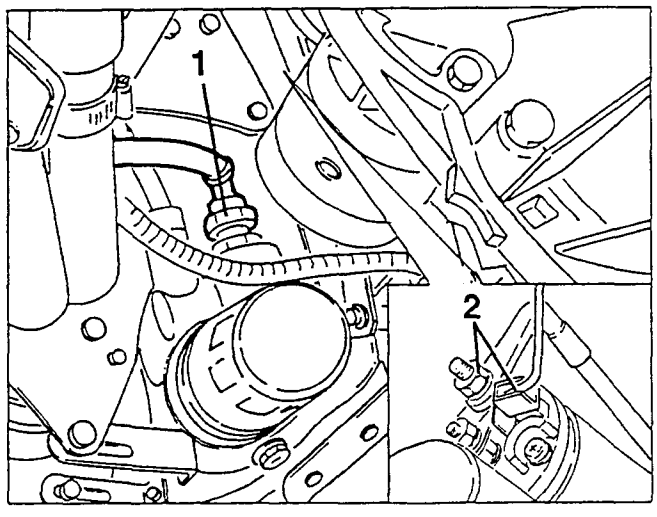


1. *Pinion*
2. *Roller free wheel*
3. *Coupling lever*
4. *Energizing coil*
5. *Relay*
6. *Rotor*
7. *Flywheel ring gear*

A relay energized by the motor current engages the pinion through a fork.
The starter motor installed is of the translating screw pinion type with relay housed directly above the motor.

REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
1. Disconnect the radiator return pipe from the oil filter support.
2. Disconnect the starter motor electrical connections.



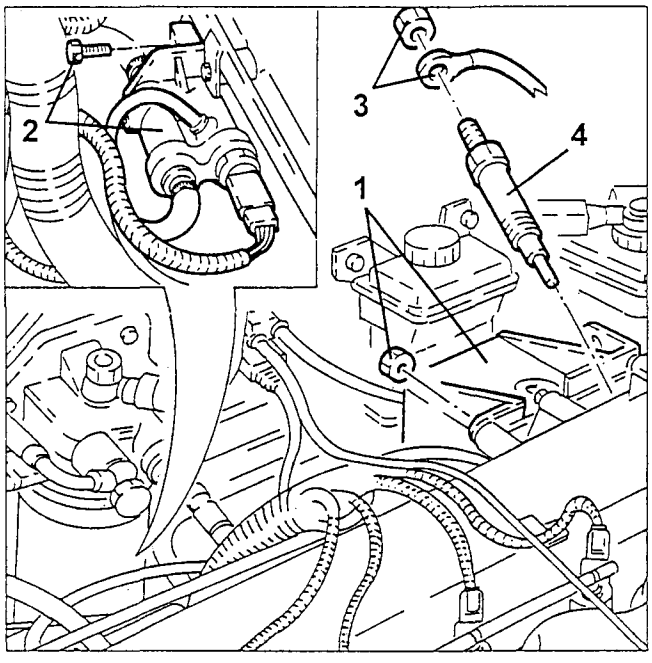
Slacken the three screws fastening the starter motor to the gearbox and remove it.

- For Dis-assembly/Re-assembly Checks and Inspections, proceed as described for the Boxer engines.

GLOW PLUGS

REMOVAL/REFITTING (for 1910 JTD version)

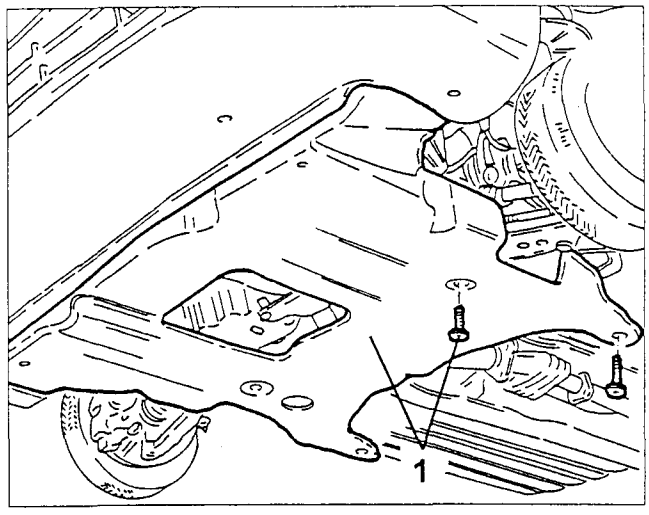
- Make sure that the ignition key is in the «STOP» position, then disconnect the (-) battery terminal.
1. Slacken the fastening nuts and move aside the oil vapour separator.
2. Slacken the fastening screws and move aside the fuel return manifold pipe.
3. Disconnect the electrical connections from the glow plugs.
4. Slacken and remove the glow plugs.



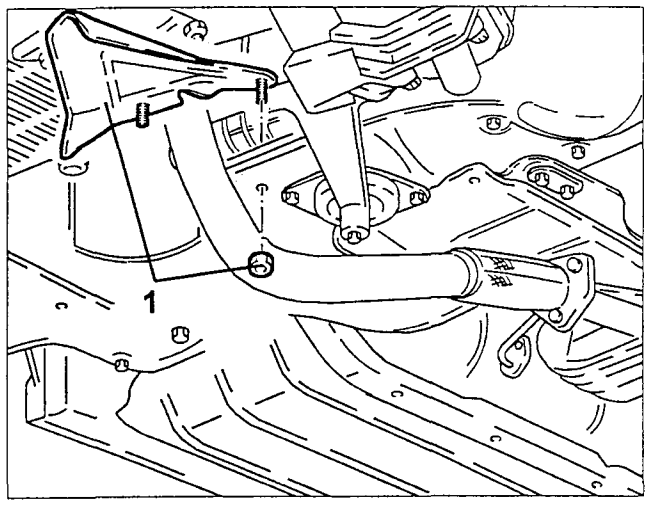
STARTER MOTOR

REMOVAL/REFITTING (for 1910 JTD version)

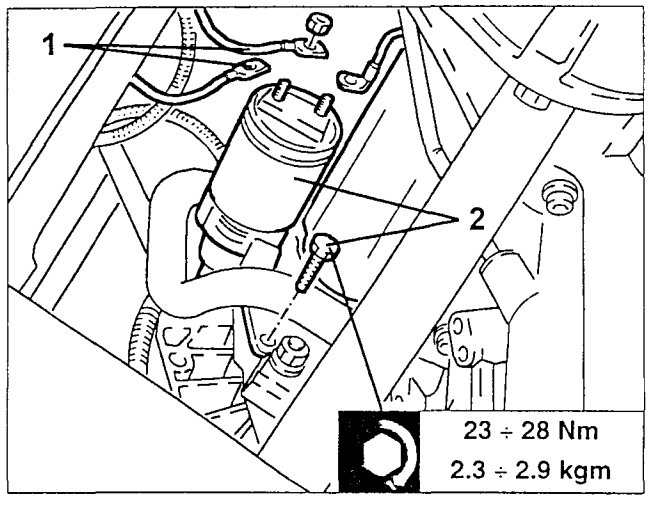
- Set the car on a lift.
- Make sure that the ignition key is in the «STOP» position, then disconnect the (-) battery terminal.
1. Slacken the fasteners and remove the under engine guard.



1. Slacken the nuts and remove the power steering box heat shield.



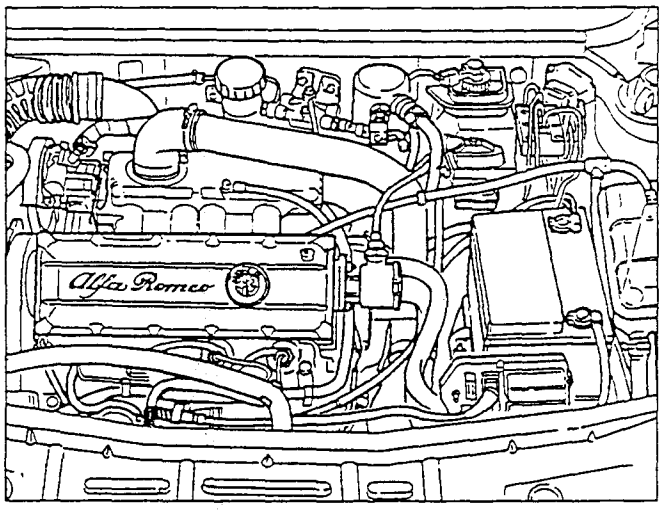
1. Disconnect the electrical connections from the starter motor.
2. Slacken the fastening screws and remove the starter motor.



WHITE

BATTERY

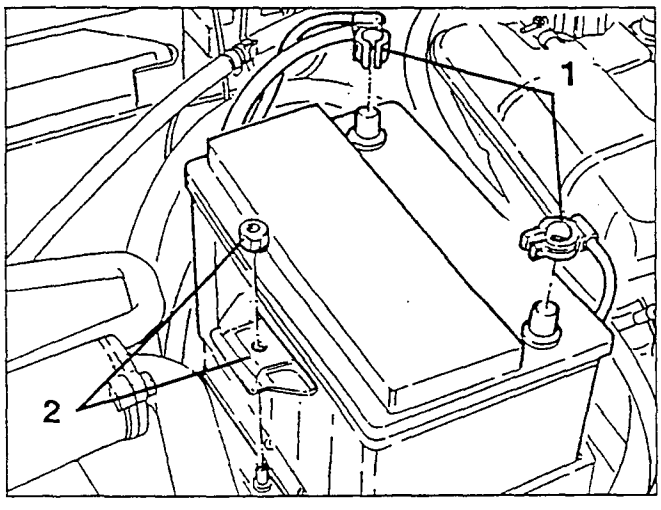
The battery is located in the left hand side of the engine compartment.



For the description, recharging and maintenance refer to the instructions for the Boxer engines.

REMOVAL/REFITTING

1. Disconnect the battery terminals.
2. Slacken the fastening nut and remove the battery clamp.
- Remove the battery.



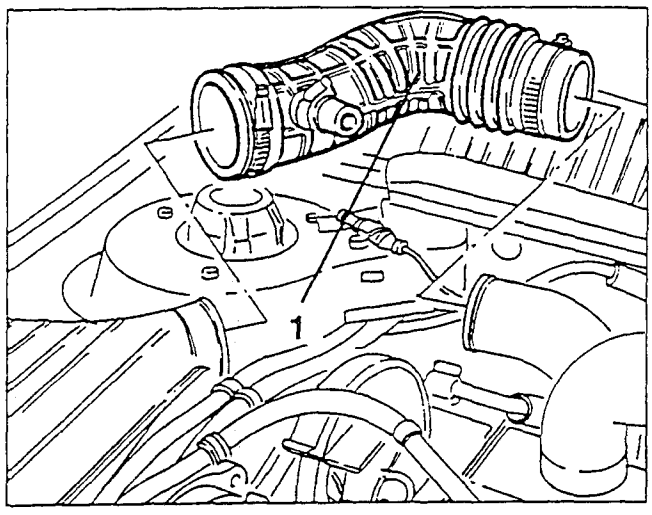
ALTERNATOR

Refer to the section on Boxer engines for the description.

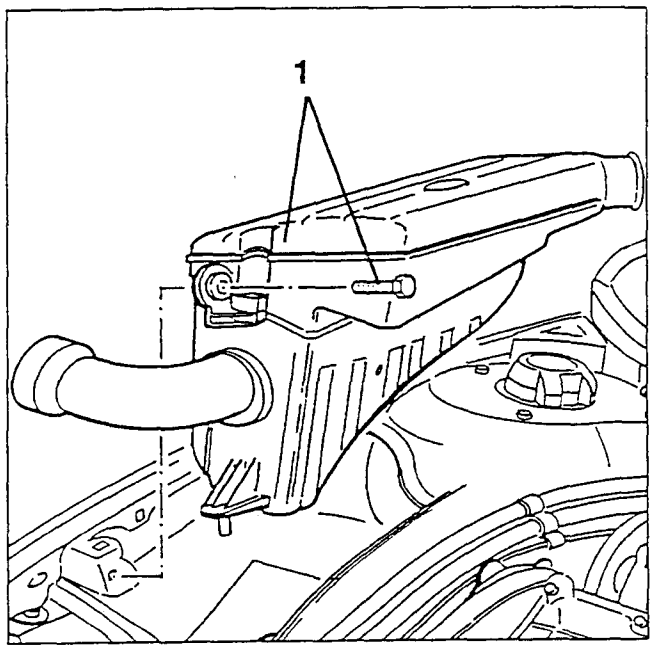
REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) cable.
- Disconnect the oil vapour recirculation hose from the corrugated air intake sleeve.

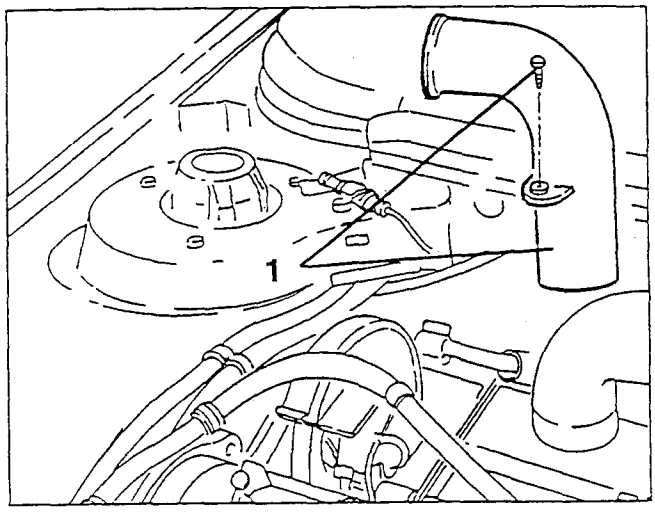
1. Remove the corrugated sleeve between the cleaner and the turbocharger.



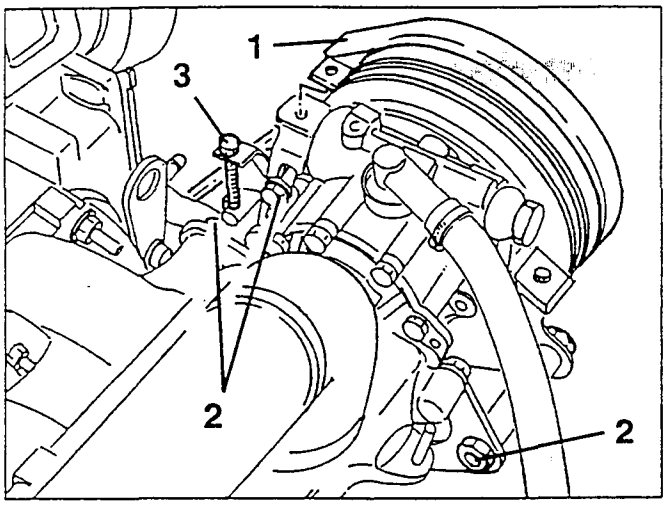
1. Slacken the fastening screws and remove the complete air cleaner.



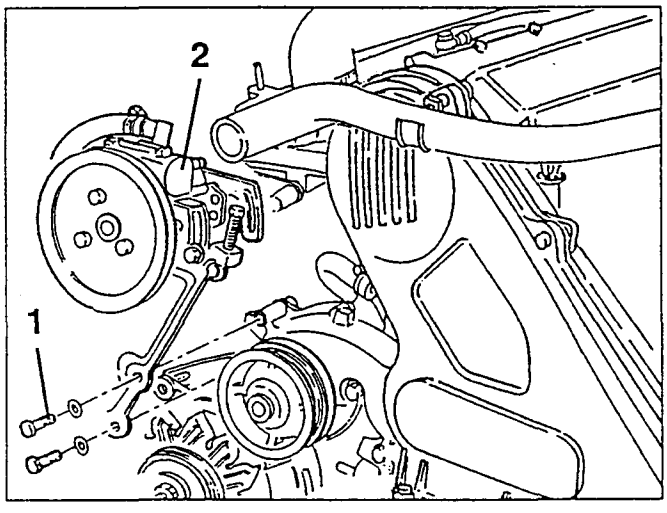
1. Remove the air intake pipe from the turbocharger.



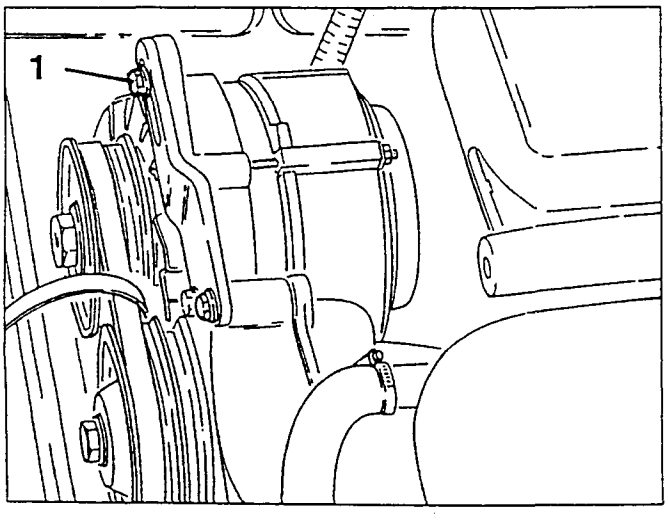
1. Remove the power steering pump belt guard.
2. Slacken the alternator fastening screws.
3. Lower the tension of the power steering pump drive belt working on the micrometric tensioner, then remove it.



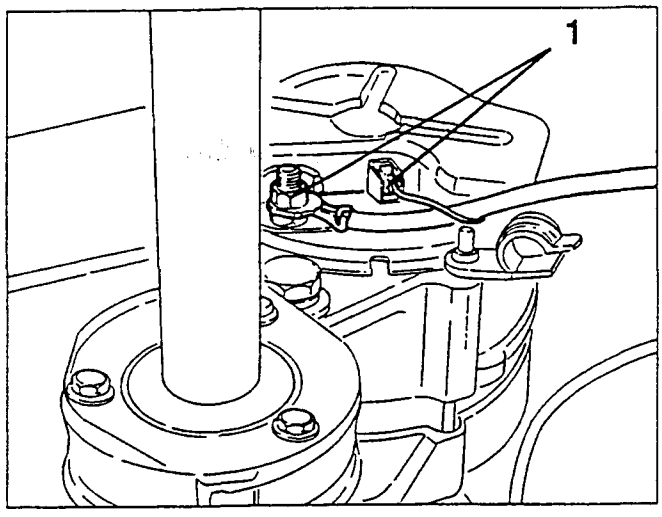
1. Back off the screws slackened previously and the two screws shown in the figure.
2. Remove the power steering pump complete with bracket without disconnecting the hoses.



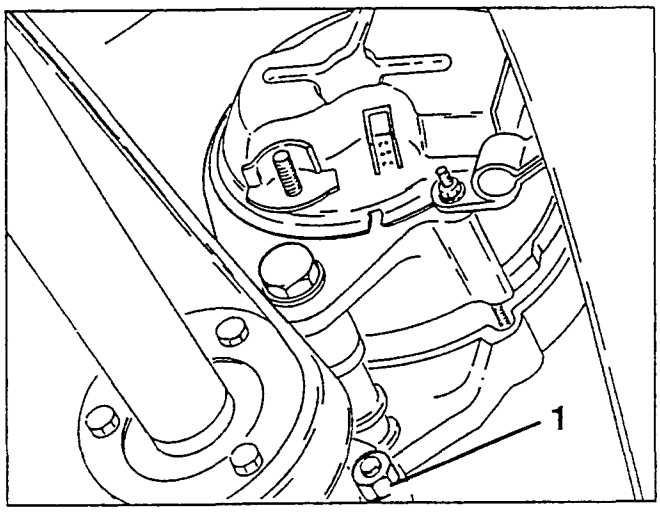
1. Slacken and remove the upper alternator fastening bolt.



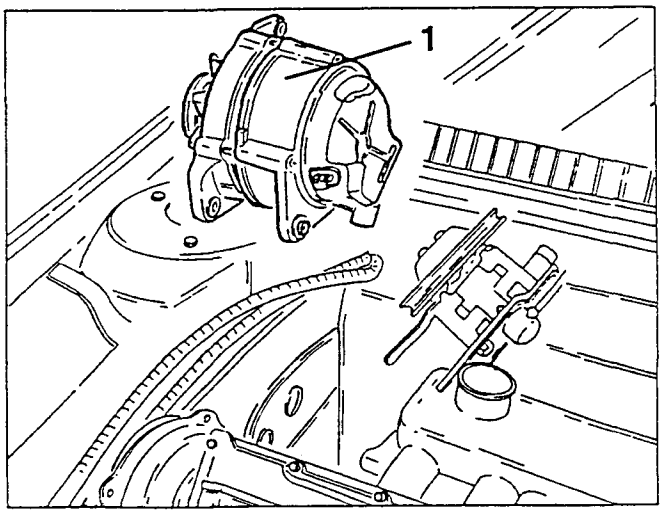
- Raise the car.
1. Disconnect the alternator connections.



1. Slacken and remove the lower alternator fastening bolt.



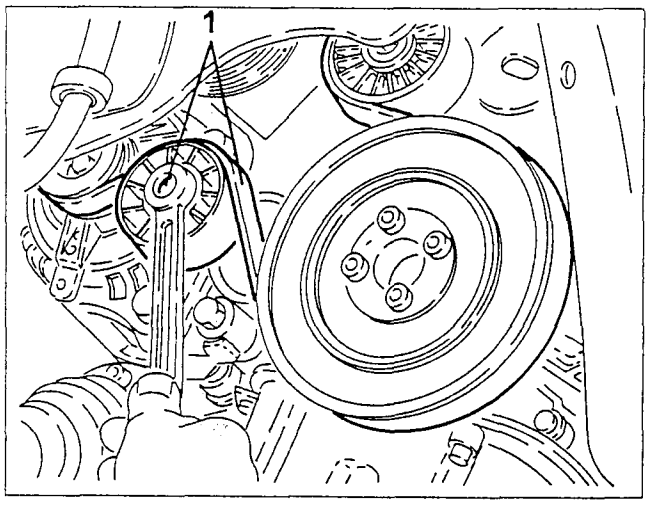
- Lower the car.
- Remove the alternator - water pump drive belt and retrieve the power steering pump drive belt.
- Remove the alternator upper support bracket.
1. Remove the alternator pulling it upwards.



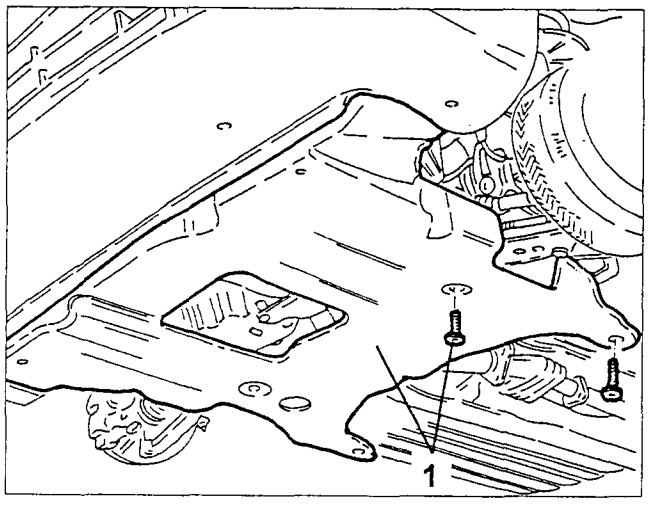
REMOVAL/REFITTING (for 1910 JTD version)

- Set the car on a lift.
- Make sure that the ignition key is at the "STOP" position, then disconnect the battery (-) terminal.
- Remove the right front wheel and dust guard.

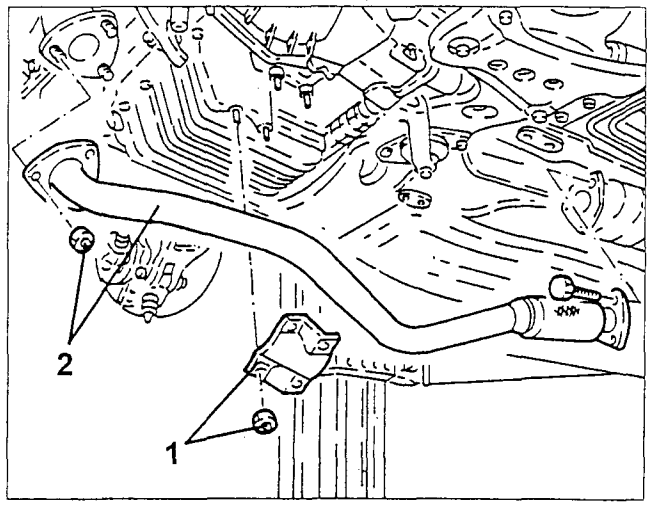
1. Working as illustrated, on the tensioner, loosen the tension of the engine components belt and remove it.



1. Slacken the fastenings and remove the under engine guard.

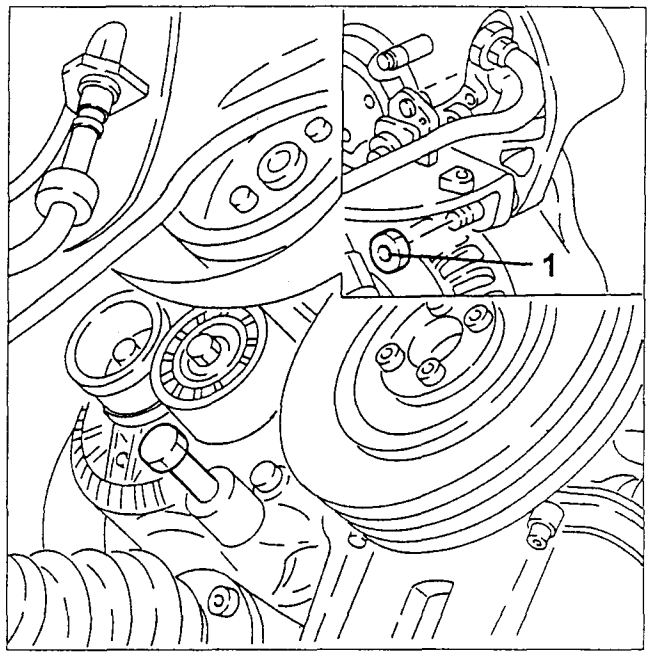


1. Slacken the fastening nuts and remove the reinforcement bracket.
2. Slacken the nuts and screws, then remove the front section of the exhaust pipe.

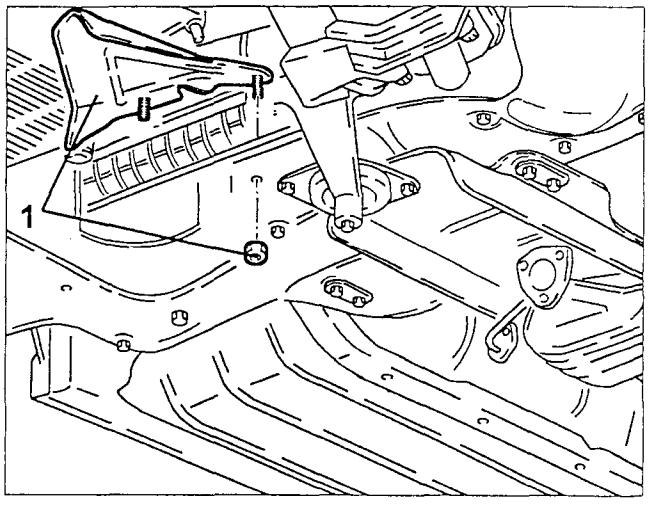


- Disconnect the electrical connections from the alternator.

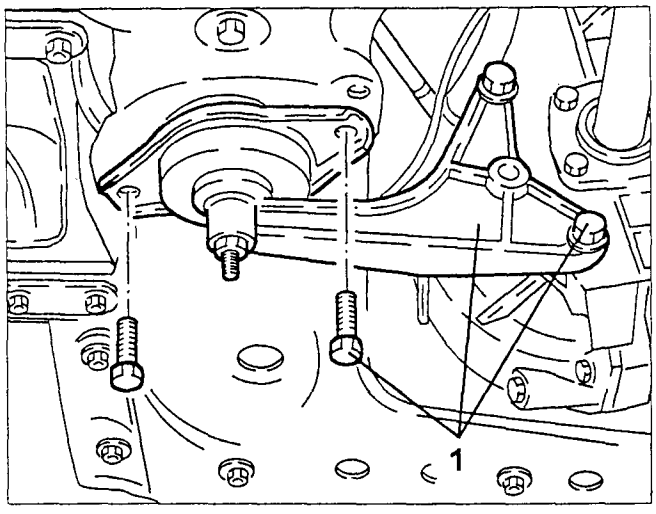
1. Slacken the alternator fastening bolts, then position it temporarily.



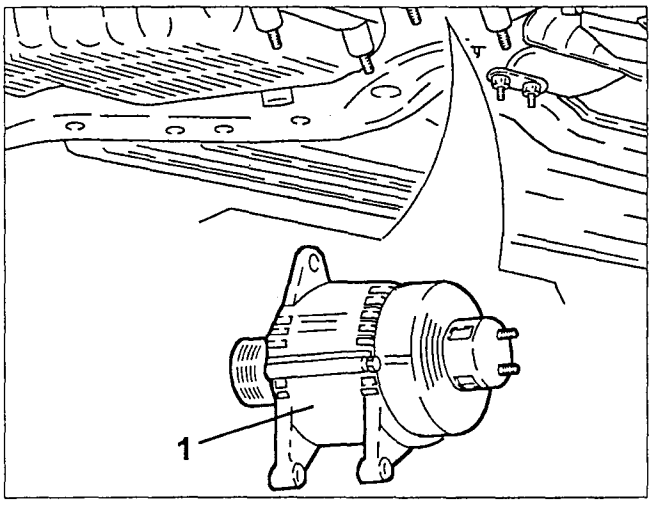
1. Slacken the fastening nuts and remove the heat shield from the power steering box.



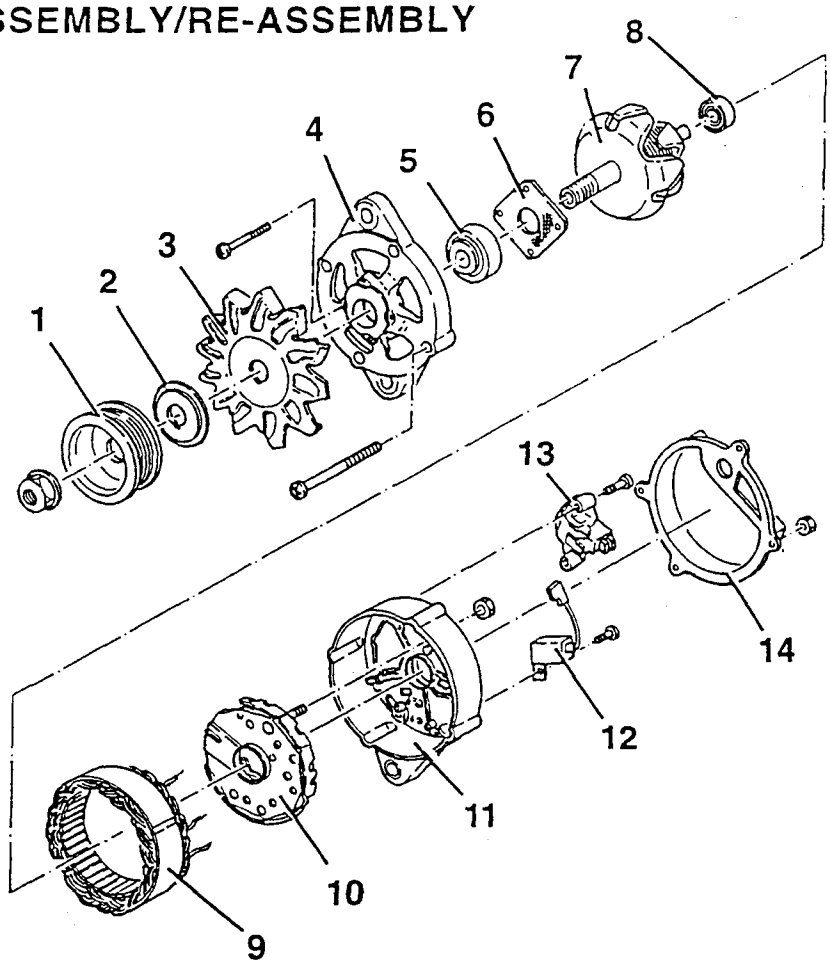
- Set a hydraulic jack under the engine.
1. Slacken the fastening screws and remove the complete power unit rear support.



1. Lower the hydraulic jack supporting the engine just enough to withdraw the alternator.
NOTE: To make it easier to remove the alternator lever on the front suspension crossmember to move the engine forward and make more room for removal.

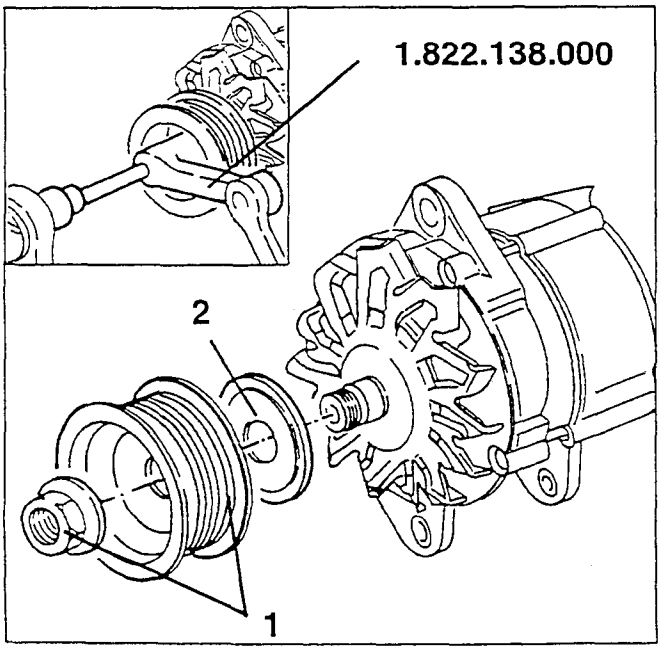


DIS-ASSEMBLY/RE-ASSEMBLY



1. *Pulley*
2. *Spacer*
3. *Fan*
4. *Drive side support*
5. *Drive side bearing*
6. *Cover plate*
7. *Rotor*
8. *Regulator side bearing*
9. *Stator*
10. *Rectifying unit*
11. *Collector ring support*
12. *Anti-disturbance condenser*
13. *Voltage regulator - brush holder*
14. *Protective cap*

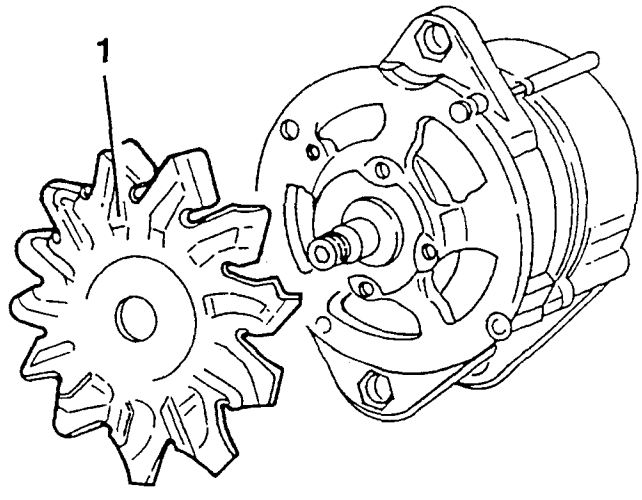
1. Using tool N. 1.822.138.000 together with wrench USAG XZN M10L slacken the nut fastening the alternator pulley and remove it.
2. Retrieve the spacer.



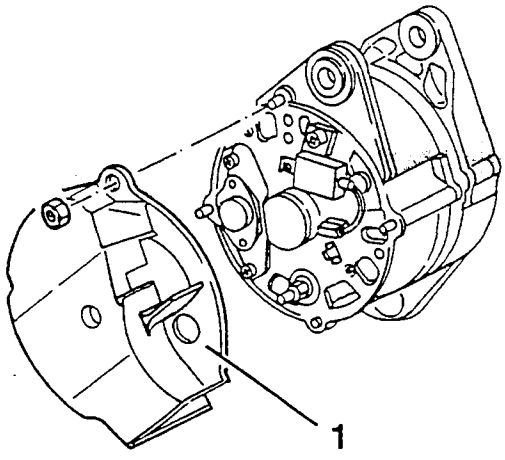
- When tightening the retaining nut with extension spanner N° 1.822.137.000, the torque values become:

300 mm for dynamometer spanner with arm	65 ÷ 74 Nm 6.6 ÷ 7.5 kgr
400 mm for dynamometer spanner with arm	67 ÷ 76 Nm 6.9 ÷ 7.8 kgr

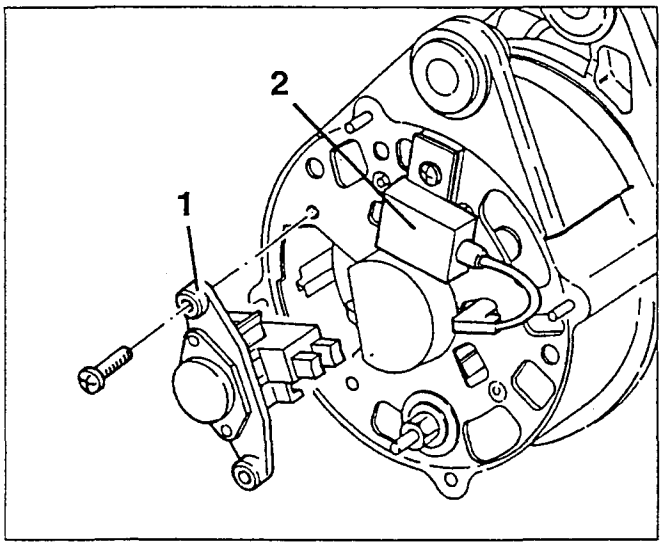
1. Take the cooling fan off the rotor shaft.



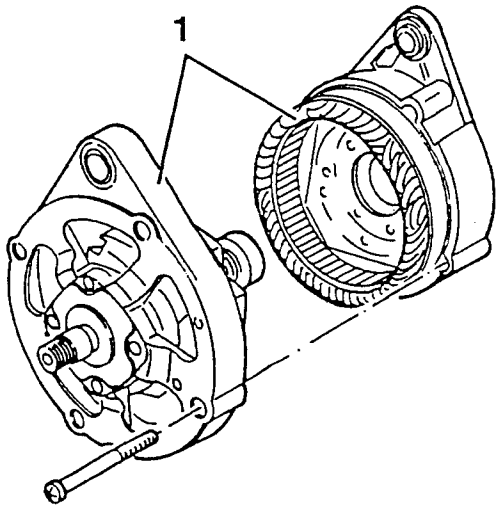
1. Slacken the three fastening nuts and remove the protective cap.



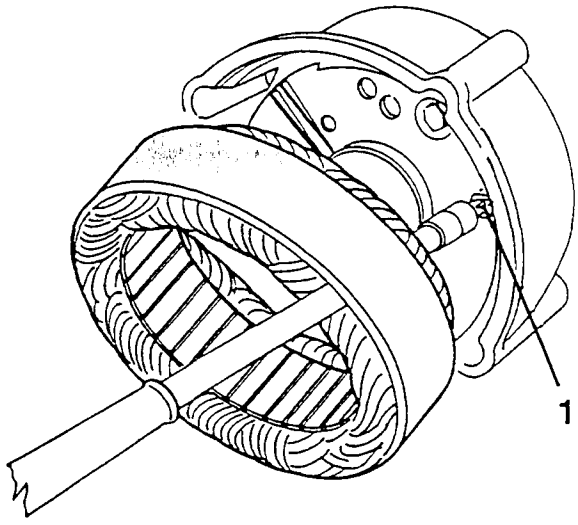
1. Slacken the two fastening screws and remove the brush holder voltage regulator.
2. Slacken the fastening screw, disconnect the electrical connection and remove the anti-disturbance condenser.



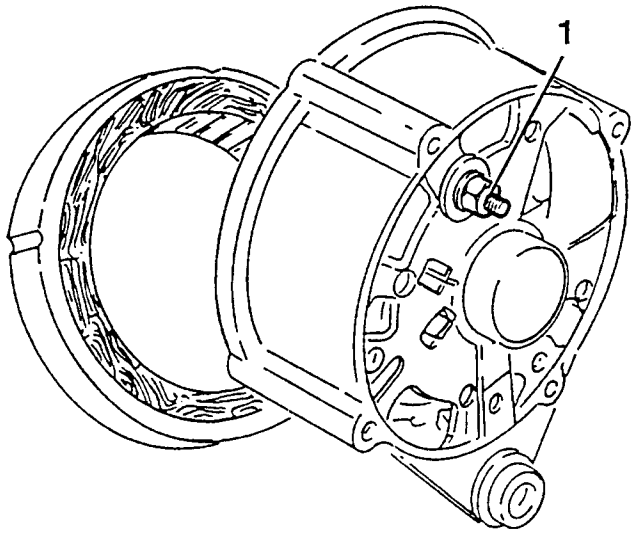
1. Slacken the four fastening screws and separate the drive side support complete with rotor from the collector rings support complete with stator and rectifying unit.



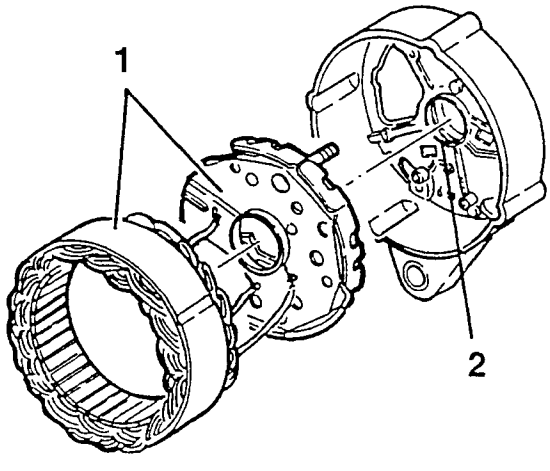
1. Slacken the three screws fastening the rectifying unit to the collector rings support.



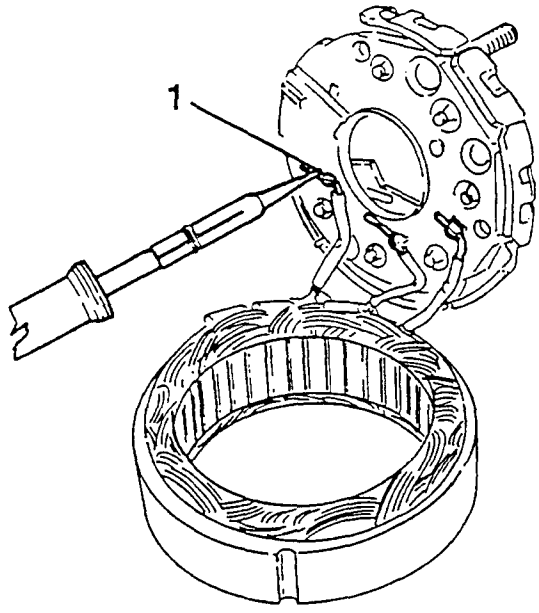
1. Slacken the nut fastening the pin for connecting the positive terminal.



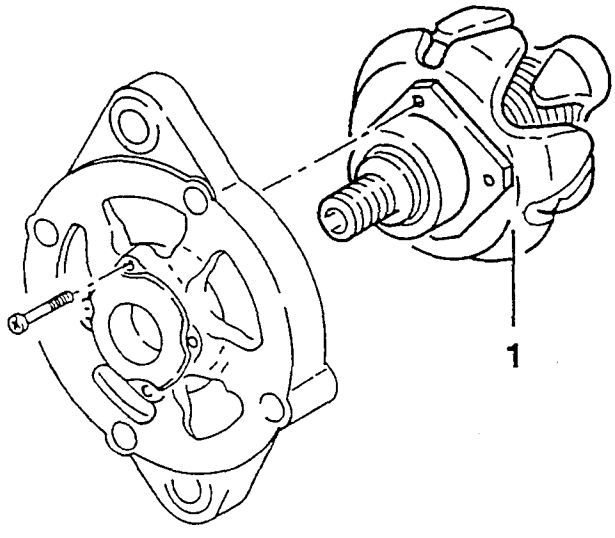
1. Remove the stator complete with rectifying unit from the collector rings support.
2. If necessary, remove the O-Ring from the collector rings support.



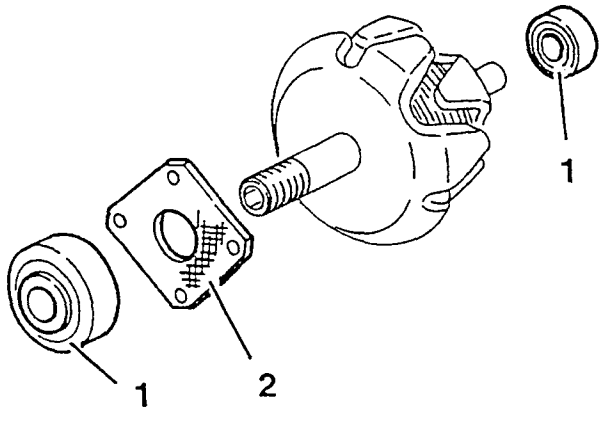
1. Unweld the connections of the three stator phases to the rectifying unit, then separate them.



1. Slacken the four fastening screws and remove the rotor complete with bearings from the drive side support.



1. Using a suitable puller tool, remove the rotor bearings.
2. Retrieve the cover plate.



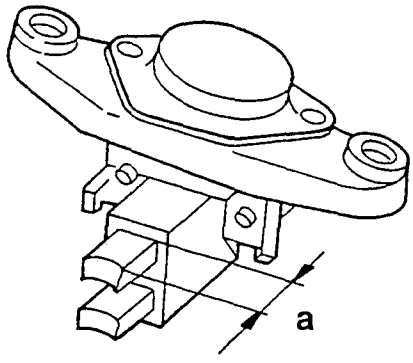
CHECKS AND INSPECTIONS

CAUTION:
Accurately clean the components with a jet of compressed air before proceeding with electrical tests.

Checking brush wear

- Check the outside of the voltage regulator for signs of damage.
- Change the regulator if the brushes are broken or if the protrusion " a " is lower than specified.

Minimum brush length
a = 7 mm

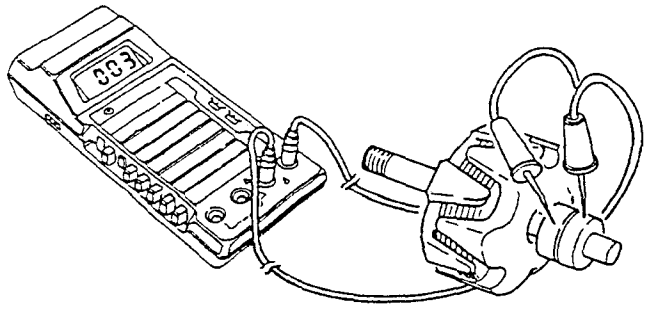


- Also check that the brushes run smoothly and that their springs are stiff enough to ensure good contact of the brushes on the collectors.

Continuity tests for the rotor winding

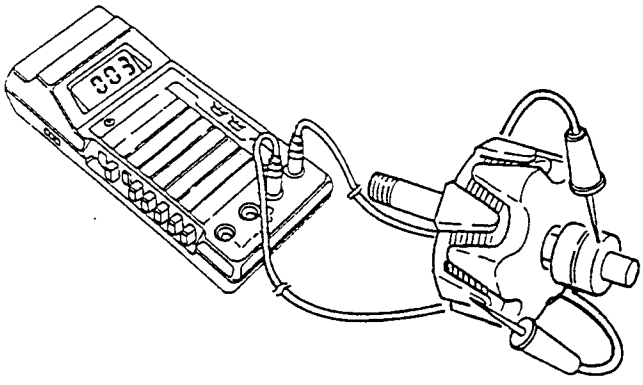
- Check that the resistance of the rotor winding is within the specified rates connecting the tester prods on the collector rings.

Rotor winding resistance (at 25°C)	
Cars without air conditioner	2.83 ± 0.28 Ω
Cars with air conditioner	2.6 ± 0.15 Ω



Rotor insulation test

- Place one tester prod on a collector ring and the other on the rotor core and check that the tester does not indicate the passage of current.
- Repeat the operation for the second collector ring.



Measuring concentricity of the rotor and collector rings

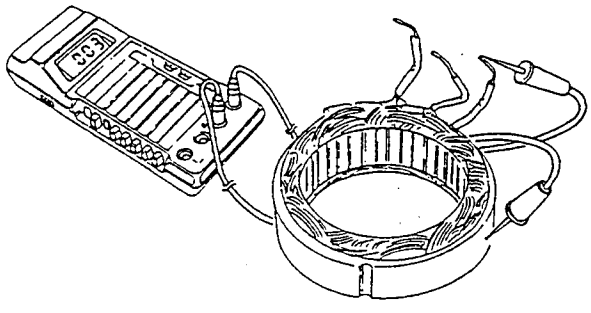
- Position the rotor on special supports and using a dial gauge on a magnetic base check that the eccentricity of the rotor outside diameter does not exceed 0.05 mm.
- In the same way, check that the movement on the collector rings does not exceed 0.03 mm.

Otherwise, turn the outside of the collector rings.

Stator winding insulation test

- Place one tester prod on the stator pack and the other on the terminal of the first phase, then on that of the second and third phase and check that the tester does not indicate the passage of current.

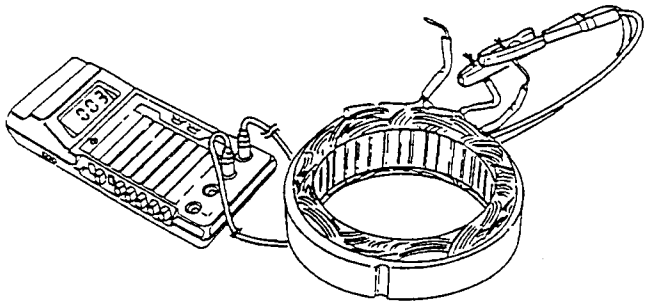
If insulation is lacking, change the stator.



Stator winding continuity test

- Connect the tester terminals respectively on the terminals of phases 1-2, 1-3 and 2-3 and check that the tester indicates the passage of current in all three phases.

In the lack of continuity, change the stator.

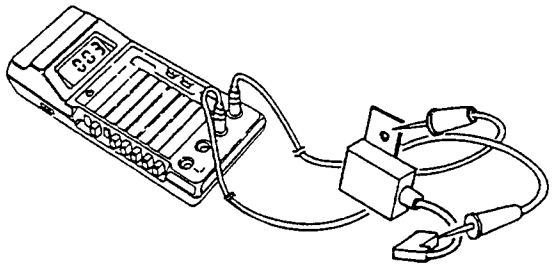


Checking the anti-disturbance condenser

- Connect the tester prods to the electrical connection and to the fastening plate of the condenser and check that the electrical capacity is within the specified rate.

Anti-disturbance condenser electrical capacity
2.2 µF

- In the lack of the specified rates, change the anti-disturbance condenser.



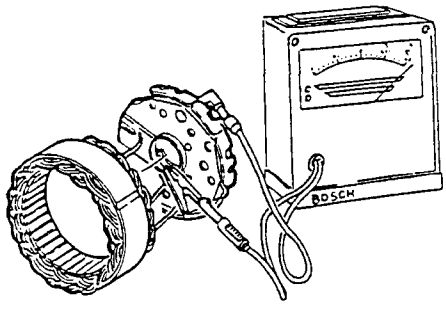
Checking the rectifier

- Check the operation of the cabled rectifier using suitable equipment.
- Connect the terminals of the test equipment to the following measurement points:

a) Winding frame and terminals
b) B+ and winding terminals
c) D+ and winding terminals

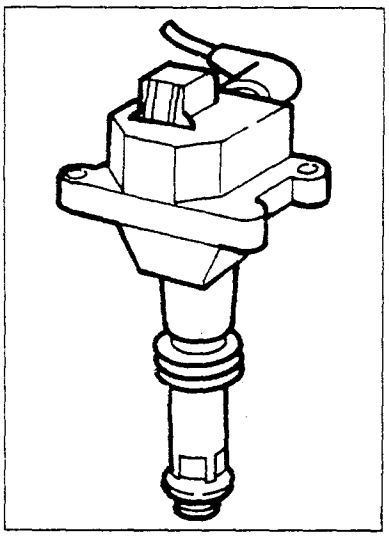
The rectifier is in order if the tester dial is in the sector in both measurements.

Change the whole rectifier if one or more diodes are faulty.



IGNITION COILS

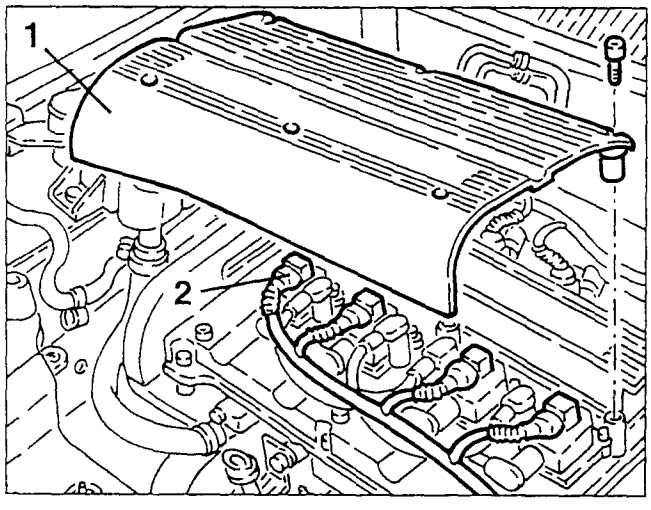
Ignition is ensured by means of two spark plugs per cylinder. The spark plugs are asymmetric and their sizes are different. This is a lost spark static distribution system in which four coils each power the spark plug of the cylinder located underneath it and that of the cylinder coupled to it, at the same time (1-4) (2-3).



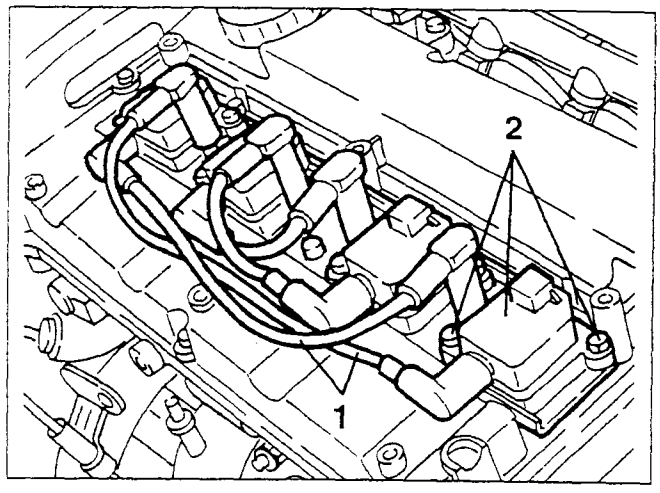
This system is a sophisticated evolution of the T.Spark ignition system. It offers the following advantages:
- reduced amount of high voltage wires consequently increasing reliability and reducing electric interference;
- the position and the length of the wires avoid accidental inversion of spark plug wires during servicing.

REMOVAL/REFITTING (Specific for pre-modification versions)

- Disconnect the (-) battery terminal.
1. Remove the fastening screws and remove the ignition coil cover.
2. Disconnect the ignition coil electric connections.

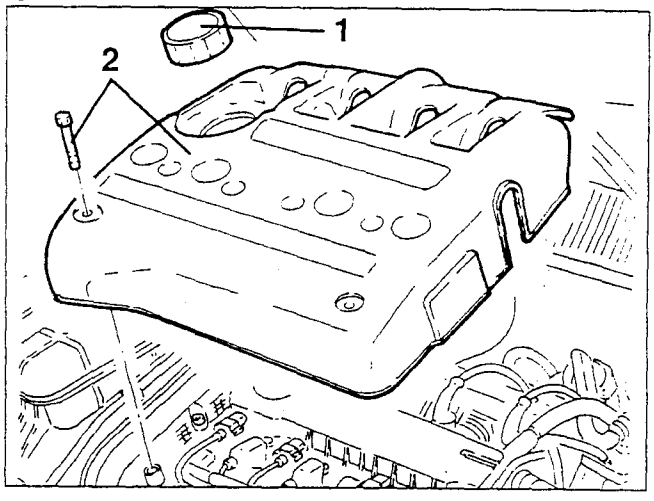


1. Remove the high voltage wires.
2. Remove the fastening screws and remove the ignition coils.
- If required, remove the fastening screws and remove the ignition coil support rod.

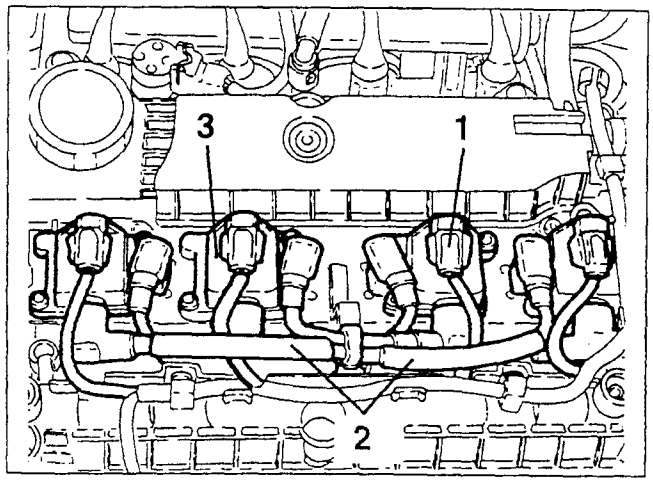


REMOVAL/REFITTING (Specific for post-modification versions)

- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.



- Refit the engine oil filler cap.
1. Disconnect the ignition coil electric connections.
2. Remove the high voltage wires.
3. Remove the fastening screws and remove the ignition coils.
- If required, remove the fastening screws and remove the ignition coil support rod.



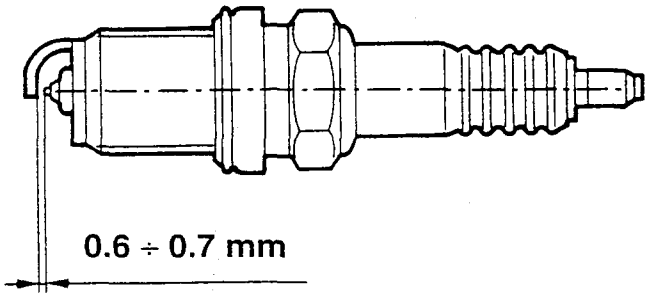
TESTING AND CHECKING

- Check whether the ignition coil features are those prescribed. If not, replace the coils.

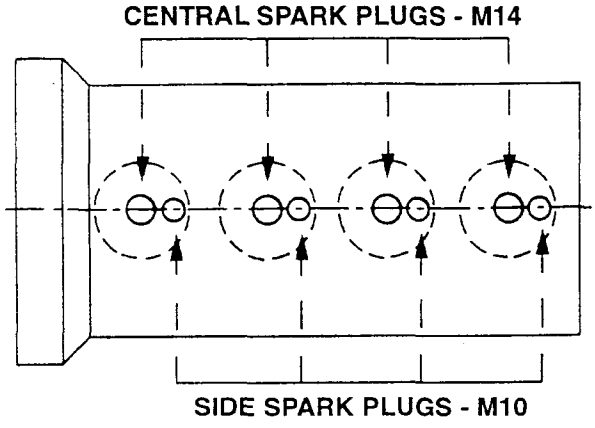
Technical features	
Primary coil resistance	0.3 Ω ± 12%
Secondary coil resistance	7 kΩ ± 12%

SPARK PLUGS

The spark plugs fitted in this vehicle are surface discharge spark plugs with central point and electrode.
The electrode distance must be respected in order for this type of spark plug to work.



The spark plugs are located in the combustion chamber asymmetrically. Their sizes are different, as can be seen in the following illustration.

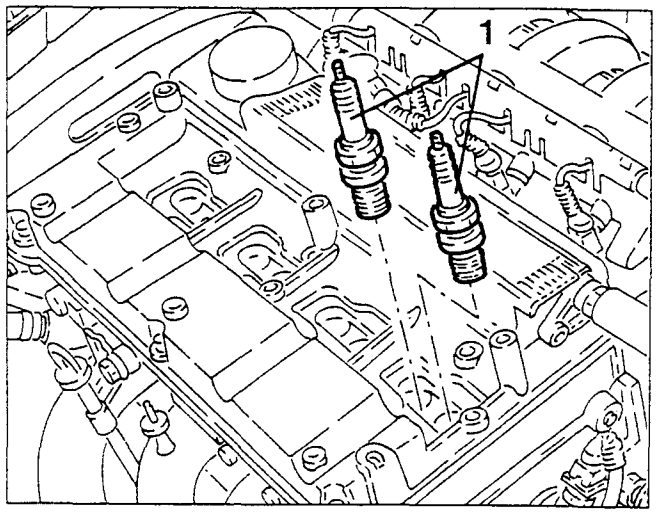


Firing order
1 - 3 - 4 - 2

CHECKING AND REPLACING

- When the engine is cold, remove the ignition coils (see specific paragraph).

1. Unscrew and remove the spark plugs after blowing air in the respective seats to remove dirt and debris.



- Check the ceramic insulator is clean and not cracked. If it is, replace the spark plugs.

IMPORTANT:
The use of spark plugs with different features or dimensions can severely damage the engine and alter the level of pollutants in exhaust.

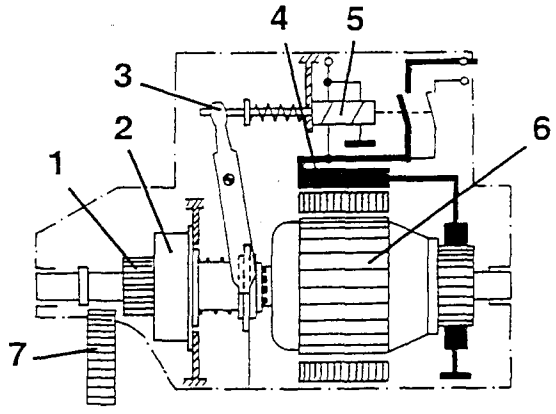
IMPORTANT:
A dirty or burnt spark plug is often the symptom of faulty engine fuel feeding.
- **Traces of dust and soot: incorrect mixture, air cleaner very dirty;**
- **Oil stains: oil leaking from gas rings;**
- **Ash forming: presence of aluminium material contained especially in the oil;**
- **Fused electrodes: overheating due to unsuitable fuel, faulty valves;**
- **High electrode wear: harmful additives in fuel or oil, engine knocking, overheating;**
- **Etc.**

- To refit, torque the spark plugs as follows:

Central spark plugs (large - M14)	25 ÷ 35 Nm 2.6 ÷ 3.6 kgm
Side spark plugs (small - M10)	10 ÷ 12 Nm 1.0 ÷ 1.2 kgm

STARTER MOTOR

Tht starter motor cranks the engine overcoming its inertial forces and frictions and bringing it to a determinate rpm to start the formation of the mixture necessary for combustion and thus autonomous motion of the engine.
The motion is transmitted by a d.c. electric motor, operated by the battery, through a coupling pinion which turns the toothed gear on the engine flywheel.



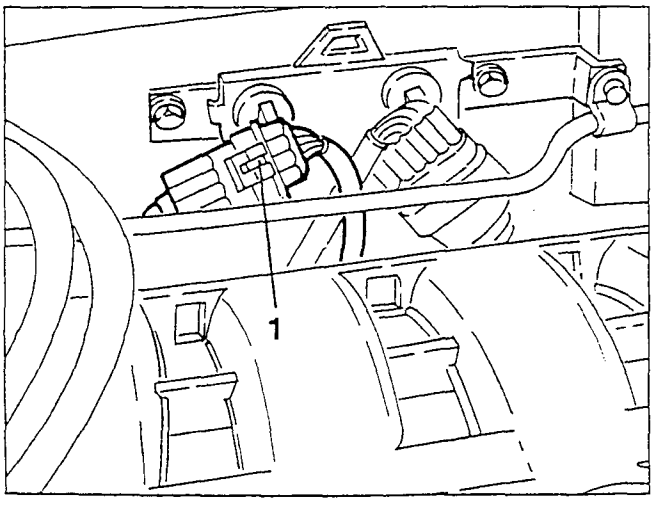
1. *Pinion*
2. *Idle roller gear*
3. *Engagement lever*
4. *Energising winding*
5. *Relay*
6. *Rotor*
7. *Flywheel toothed gear*

Due to an idle gear coupling, the pinion is disengaged when the main engine turns faster than the motor.
A relay energised by the motor current engages the pinion through a fork.
The starter motor installed is of the type with translation and screwing of the pinion with a relay housed directly above the motor itself.

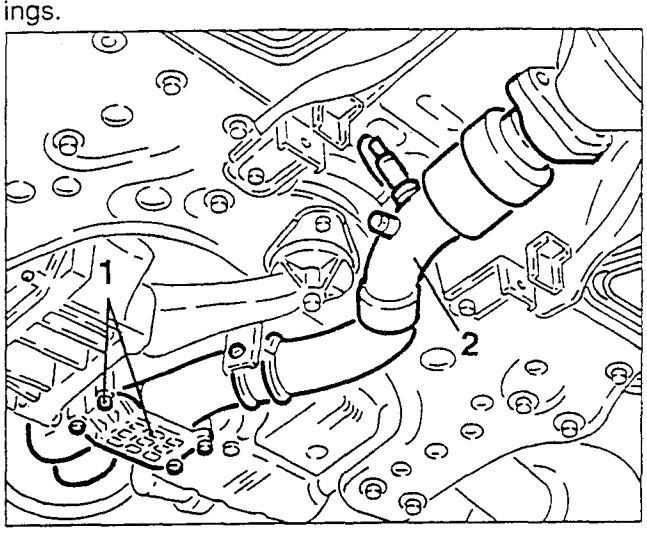
REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

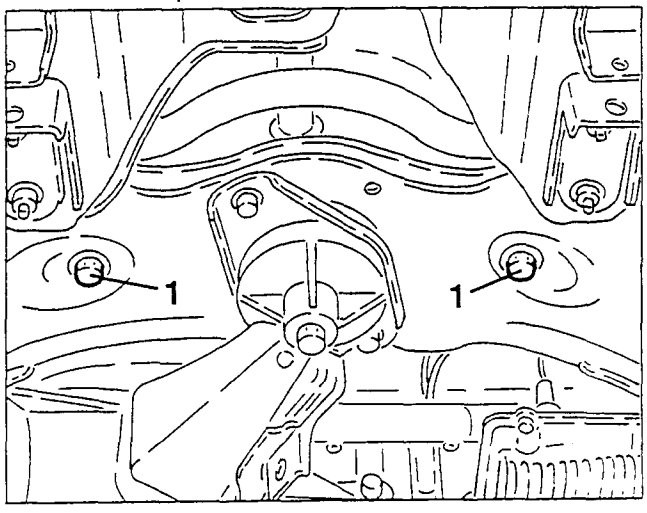
1. Disconnect the electrical connection of the lambda sensor.



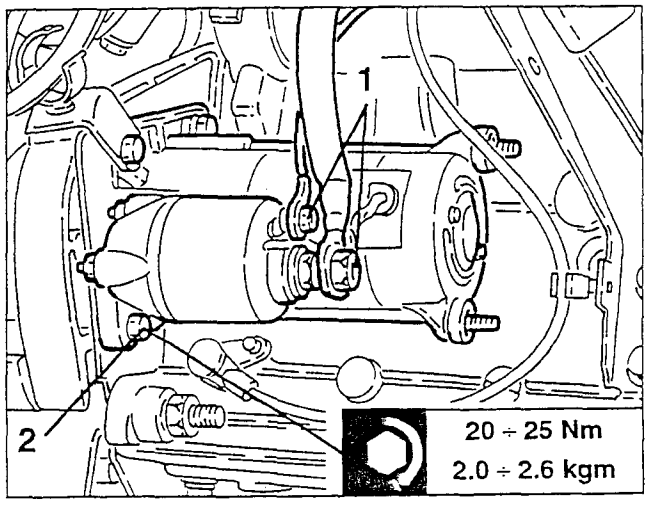
1. Raise the car, slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda sensor after slackening the fastenings.



1. Slacken the screws fastening the power steering box to the suspension crossmember.



1. Disconnect the electrical connections from the starter motor.
2. Slacken the three fastening screws and remove the starter motor.

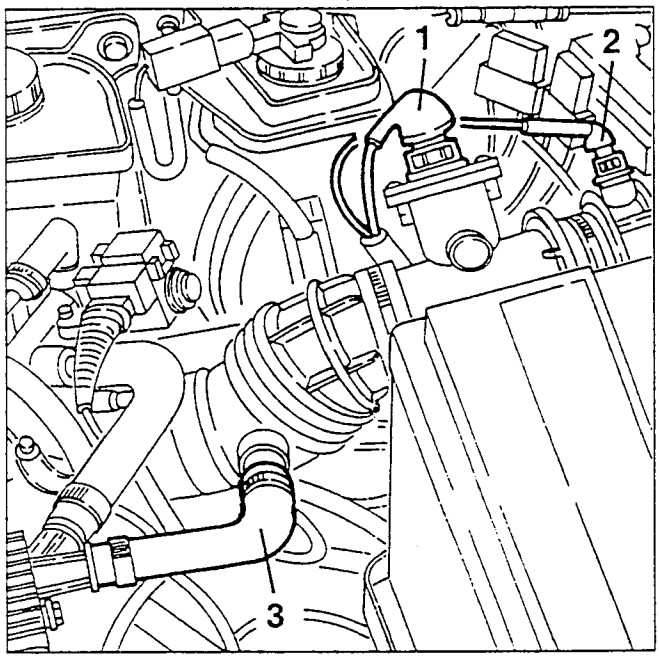


REMOVING/REFITTING

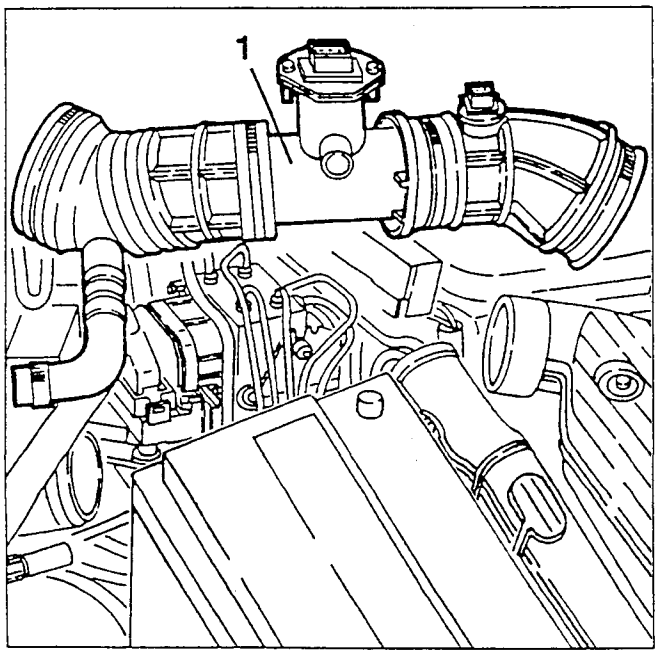
(Specific for 1370 T. SPARK 16V with gearbox C513.5 from chassis no.....)

- Set the car on a lift.
- Disconnect the battery (-) terminal.

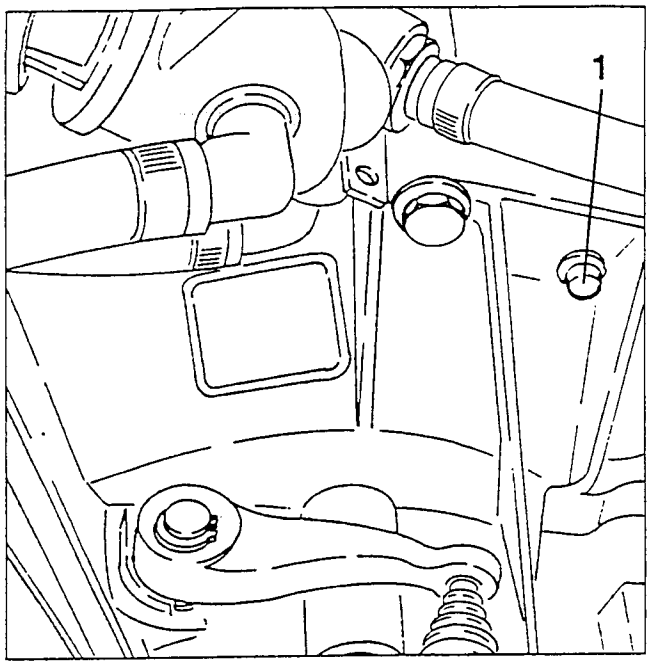
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor.
3. Slacken the fastening clamp and disconnect the oil vapour recirculation pipe from the cylinder head cover.



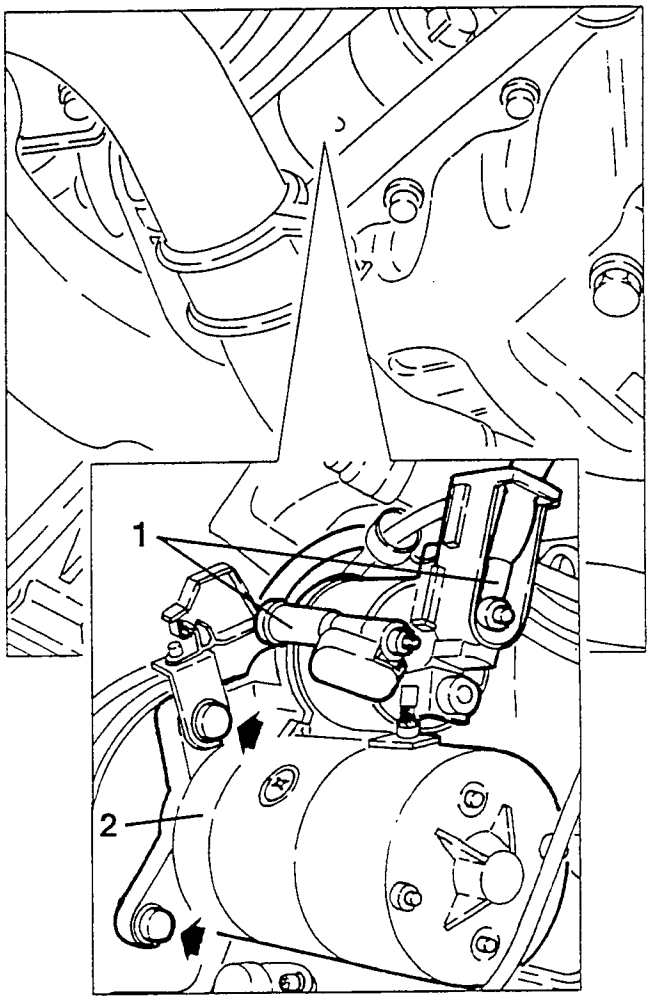
1. Slacken the two fastening clamps, then remove the corrugated sleeve complete.



1. Working from the space obtained by removing the corrugated sleeve, slacken the screw illustrated fastening the starter motor to the gearbox.



1. Raise the car then disconnect the electrical connections from the starter motor.
2. Slacken the remaining two fastening screws and remove the starter motor.

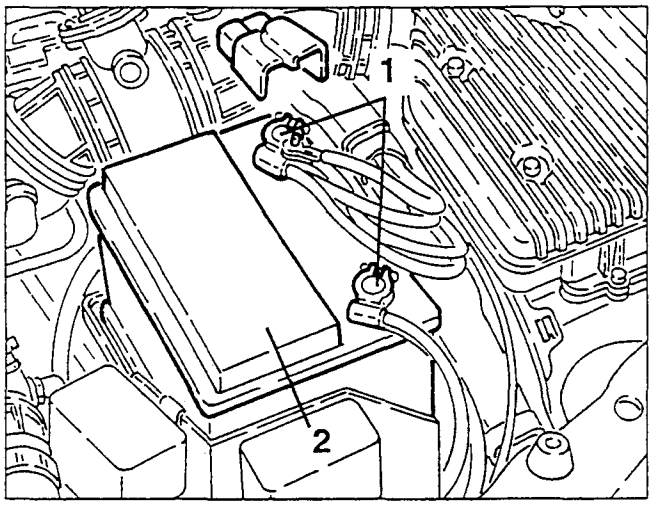


BATTERY

NOTE: For the complete description of the battery, see *Boxer engines*.

REMOVING/REFITTING

1. Disconnect the battery (-) terminal and then the (+) terminal.
2. Slacken the fastening bracket screw and remove the battery.



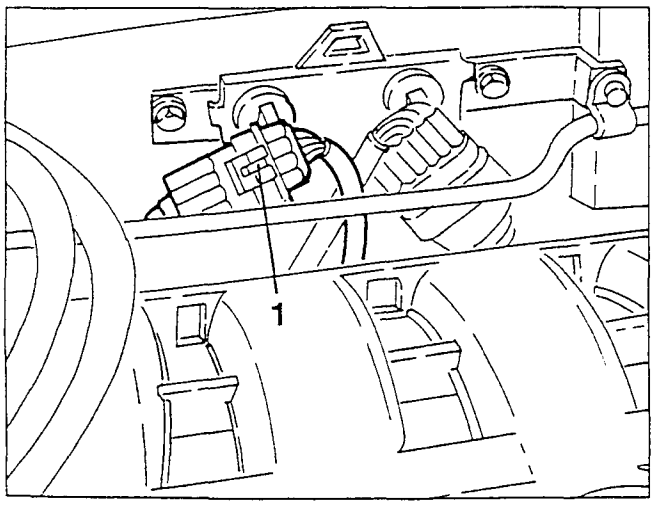
ALTERNATOR

NOTE: For the complete description of the alternator see *Boxer engines*.

REMOVING/REFITTING

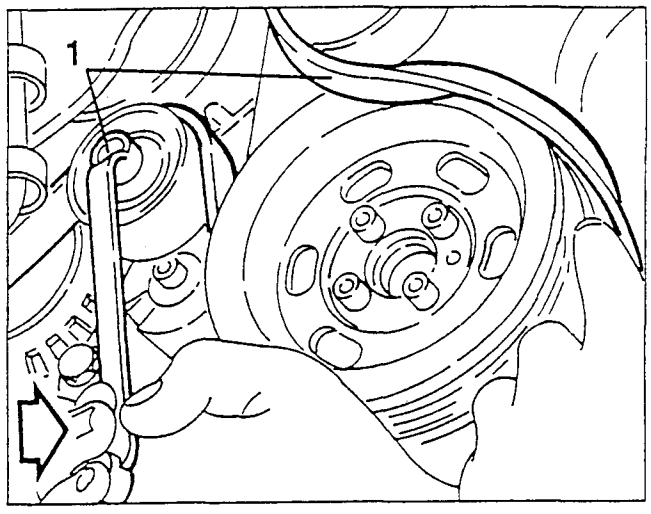
- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Disconnect the lambda sensor electrical connection.

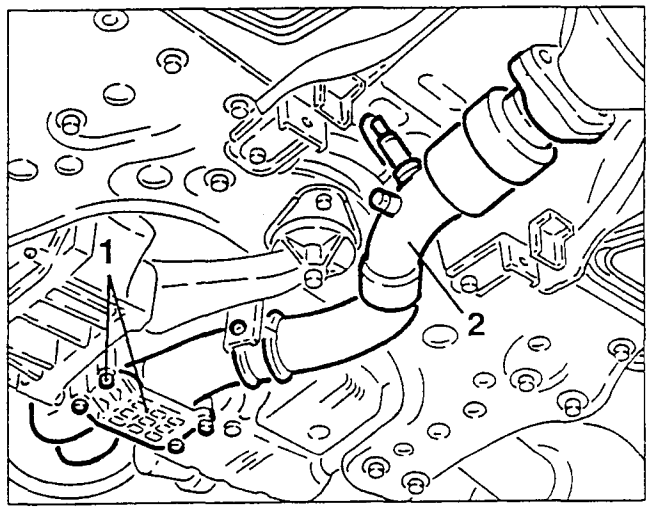


- Raise the car.
- Remove the right front wheel and mud flap.

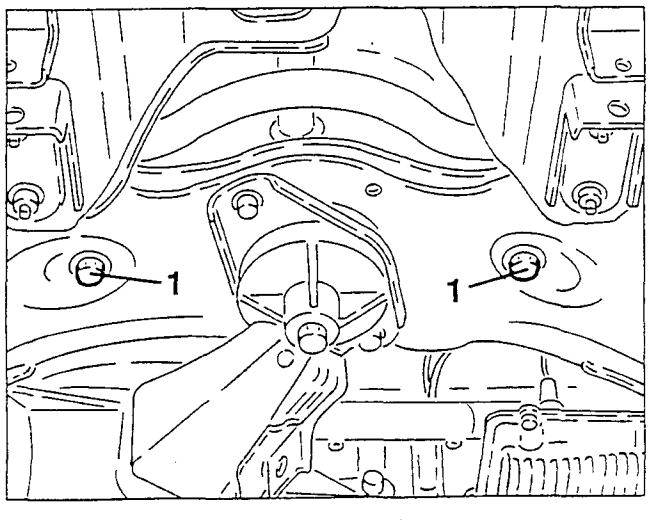
1. Working as illustrated on the pulley guide, slacken the tension of the auxiliary components drive belt and remove it.



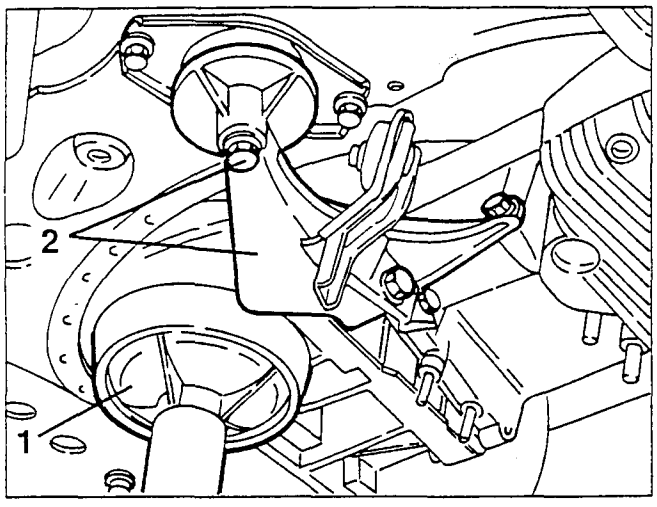
1. Slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda sensor after slackening the fastenings.



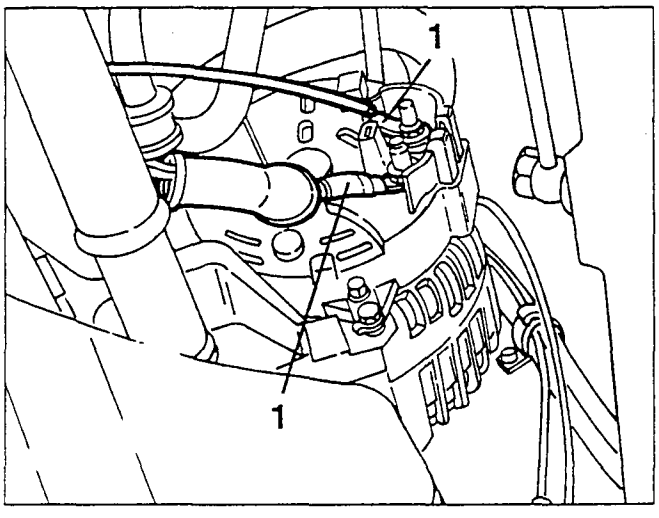
1. Slacken the screws fastening the power steering box to the suspension crossmember.



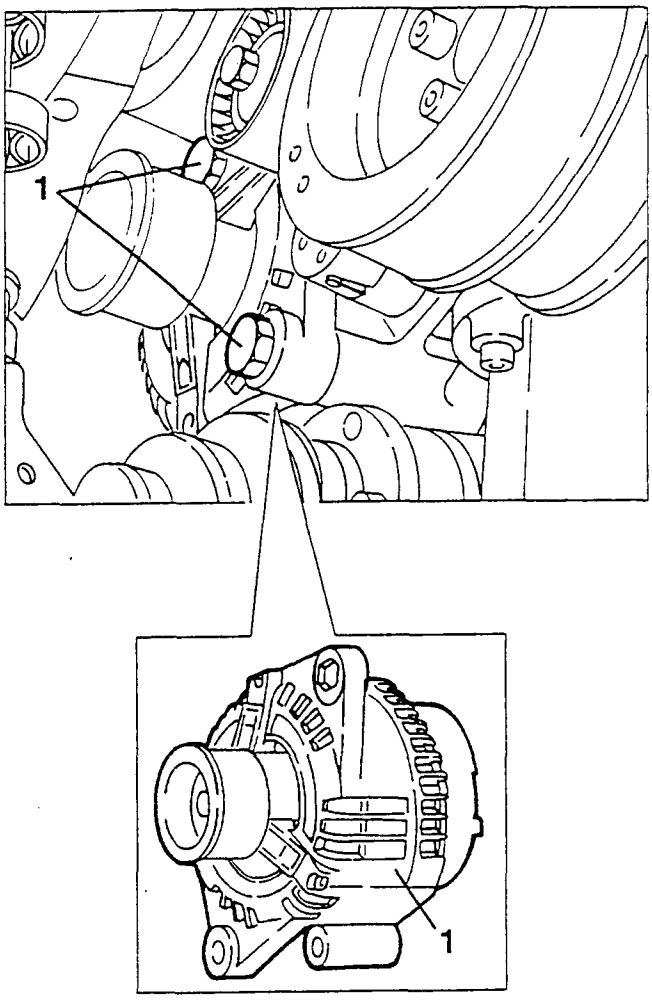
1. Set a hydraulic jack under the gearbox as illustrated.
2. Slacken the fastening screws and remove the rear power unit support.



1. Disconnect the electrical connections from the alternator.



1. Slacken the two fastening bolts and remove the alternator retrieving it from under the car withdrawing it from the recess obtained by removing the rear power unit support.

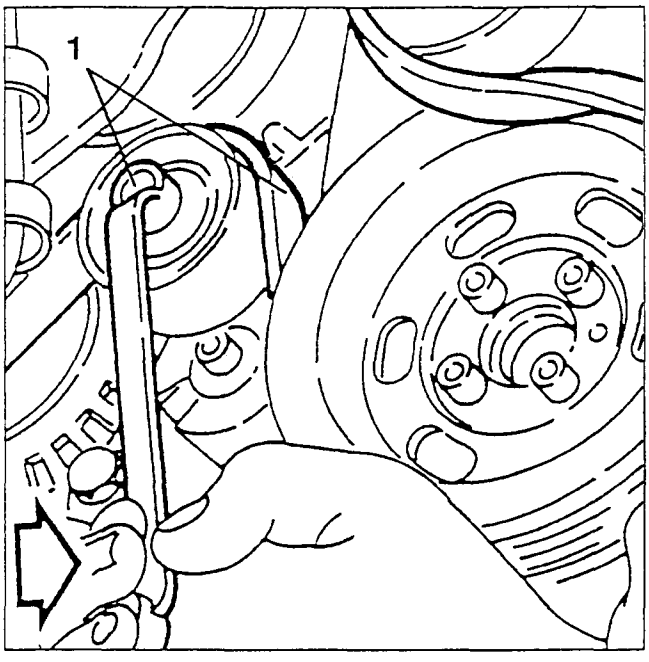


REMOVING/REFITTING

(Specific for 1370 T. SPARK 16V with gearbox C513.5 from chassis no. .....)

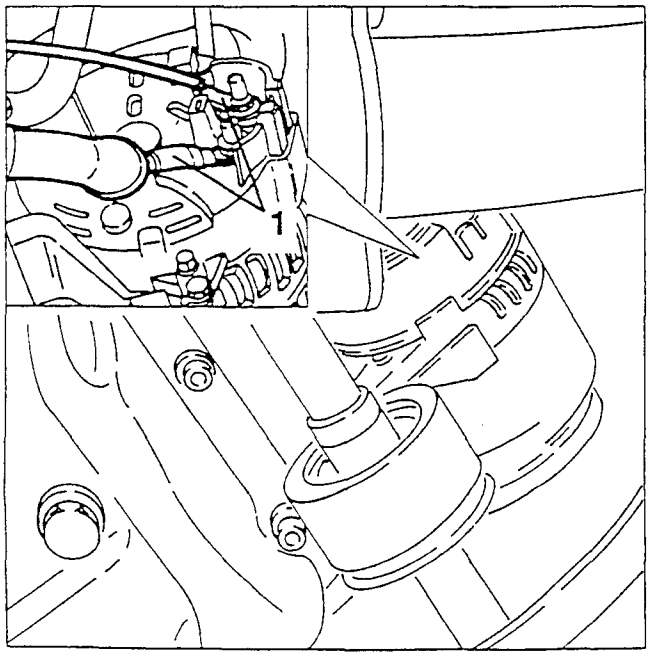
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car and remove the right front wheel and mud flap.

1. Working as illustrated on the pulley guide, slacken the tension of the auxiliary components drive belt and remove it.

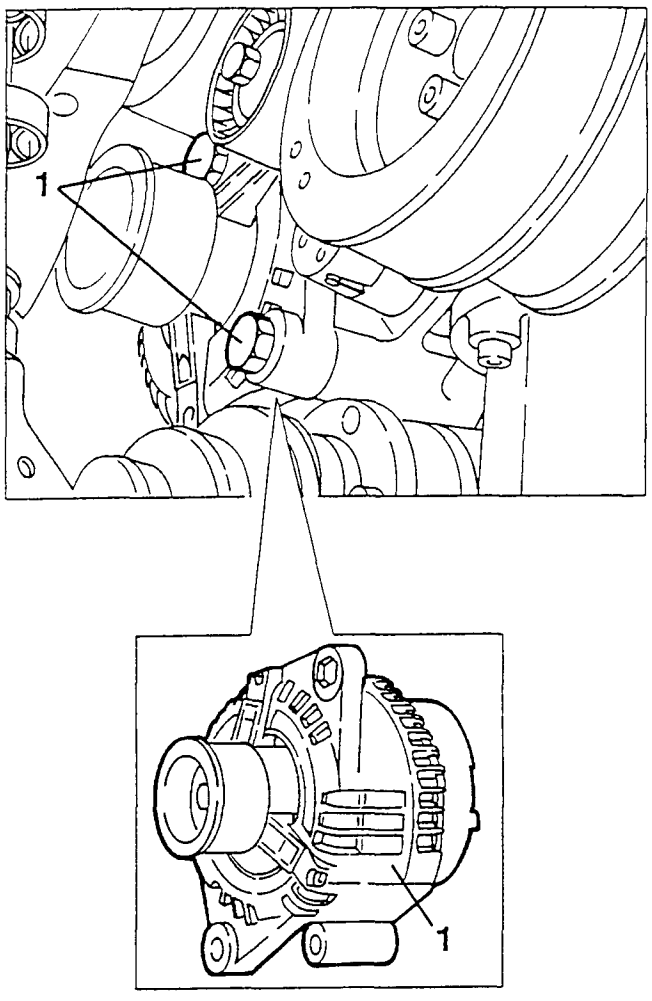


- Remove the right axle shaft (see GROUP 27).

1. Disconnect the electrical connections from the alternator.

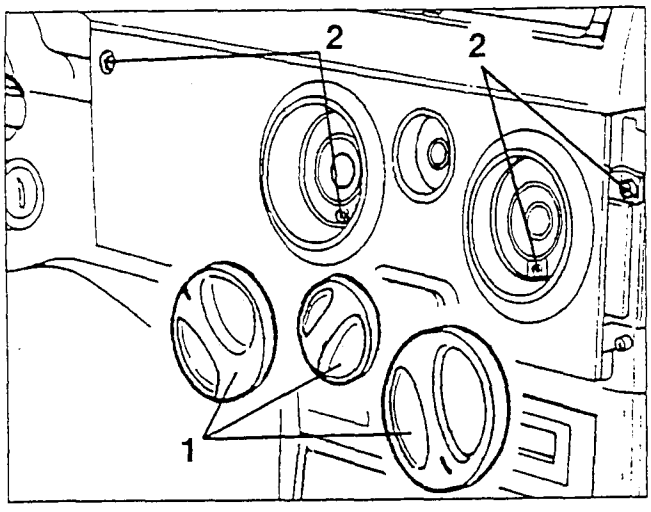


1. Slacken the two fastening bolts and remove the alternator withdrawing it from under the car.

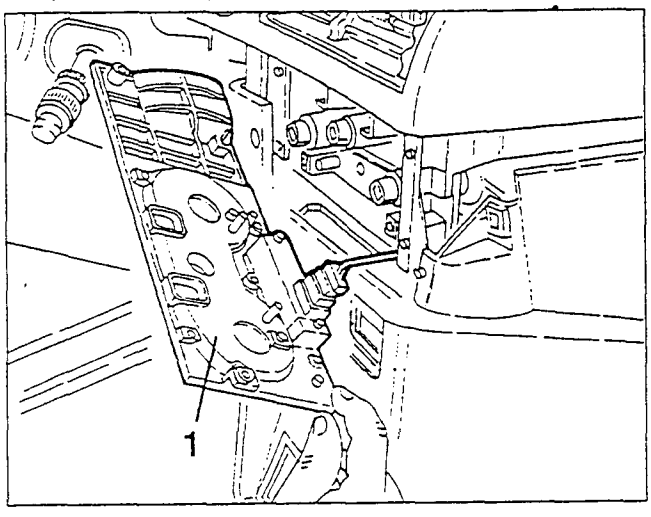


WHITE

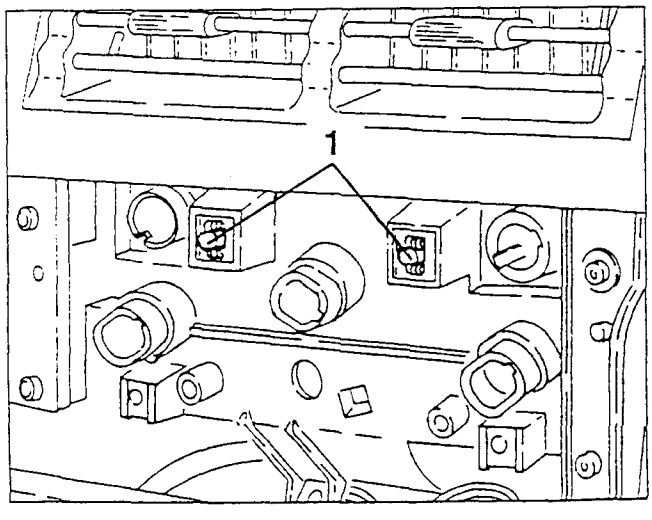
1. Prise and remove the climate control unit knobs.
2. Slacken the four screws fastening the climate unit controls trim.



1. Remove the climate control unit controls trim from the plastic rivet, then tilt it forwards.

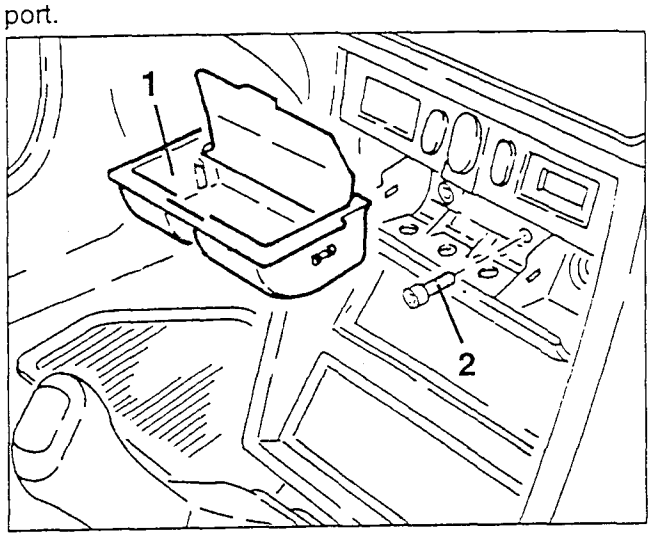


1. Remove the two climate unit controls light bulbs pulling outwards.

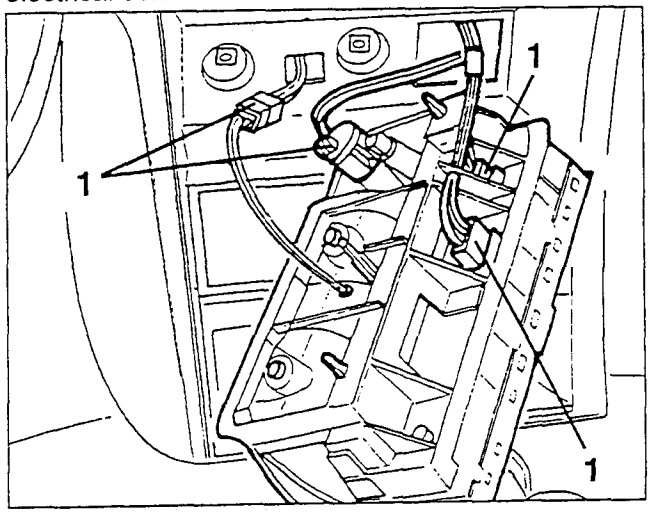


REPLACING ASHTRAY AND CIGAR LIGHTER BULBS

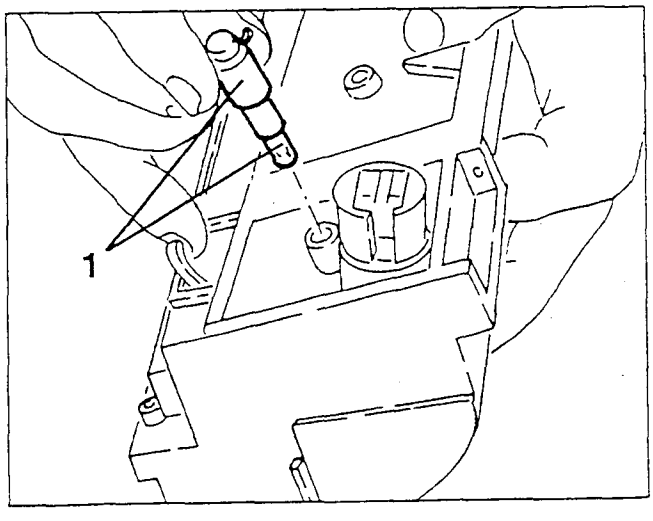
1. Remove the ashtray.
2. Slacken the two screws fastening the ashtray support.



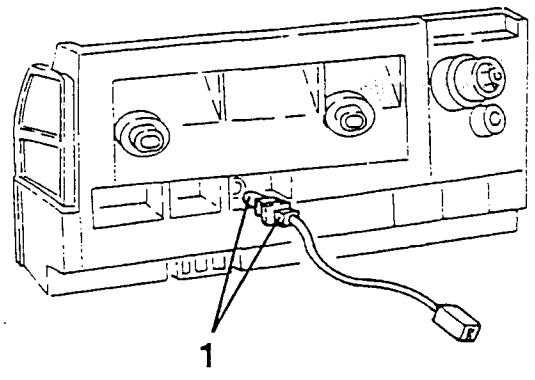
1. Prise the ashtray support complete with services control group and remove it after disconnecting the electrical connections



1. On the bench, withdraw the bulb holder and remove the bulb from it.

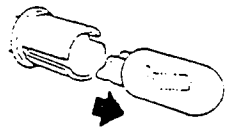
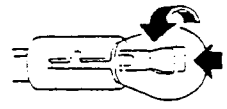
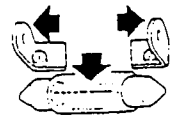
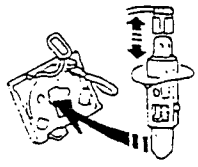


1. Remove the bulb holder complete with wiring and withdraw the ashtray bulb from it.



BULB TABLE

SERVICE	POWER RATING (W)	TTPE
HIGH BEAM	55	D
LOW BEAM	55	D
FRONT SIDE LIGHT	5	A
FRONT DIRECTION INDICATOR	21	B
SIDE REPEATERS	5	A
REAR DIRECTION INDICATORS	21	B
REAR STOP/ SIDE LIGHT	21/5	B
REVERSING LIGHT	21	B
REAR FOG GUARD	21	B
ROOF LIGHTS	10	C
NO. PLATE LIGHT	5	A
FOG LAMPS	55	D
READING SPOT LAMP	5	B
CONTROLS LIGHTING	1.2	A
THIRD STOP LIGHT	5	A

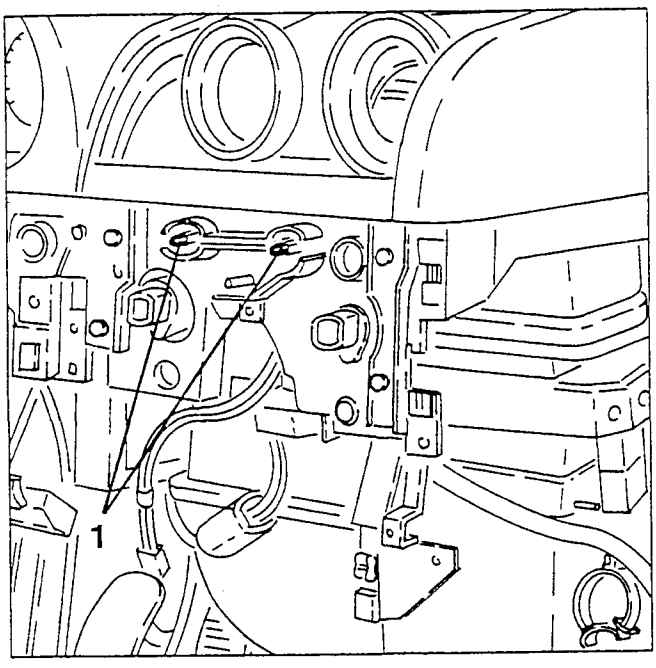
TYPES OF BULBS	
A 	**"All glass" bulbs** are snap fastened. To remove them, pull.
B 	**Bayonet bulbs** To remove them from the bulb holder: press the bulb, turn it counter-clockwise, then remove it.
C 	**Cylindrical bulbs** To remove them, release from the side contacts.
D 	**Halogen bulbs** To remove the bulb, release the fastening clip of the bulb from its housing.

CAUTION:
When changing a bulb always replace it with one of the same type.

REPLACING CLIMATE CONTROL UNIT CONTROLS BULBS

- Remove the climate control unit controls module (see GROUP 50).

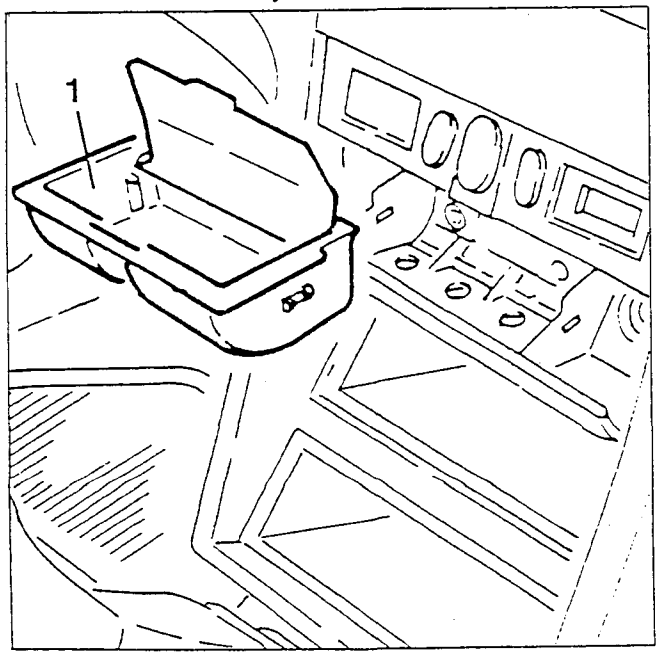
1. Remove the the two bulbs of the climate control unit controls pulling them outwards.



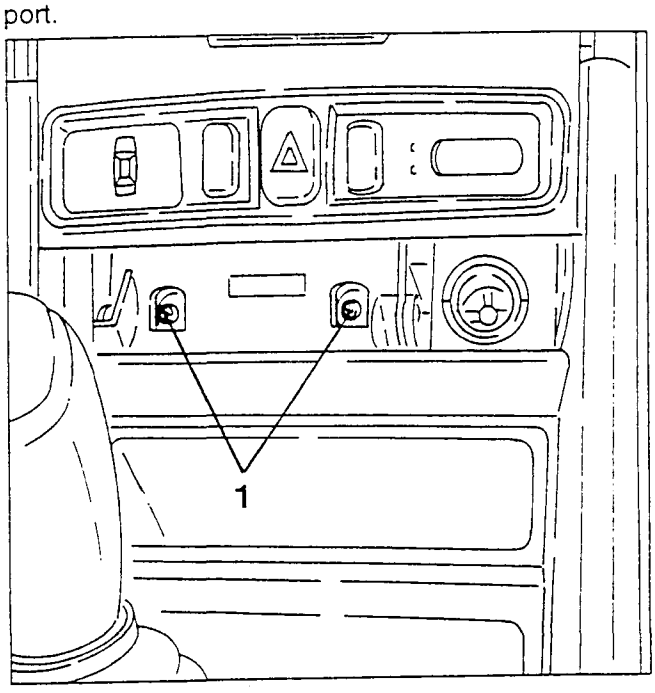
REPLACING ASHTRAY AND CIGAR LIGHTER BULBS

- Disconnect the battery (-) terminal.

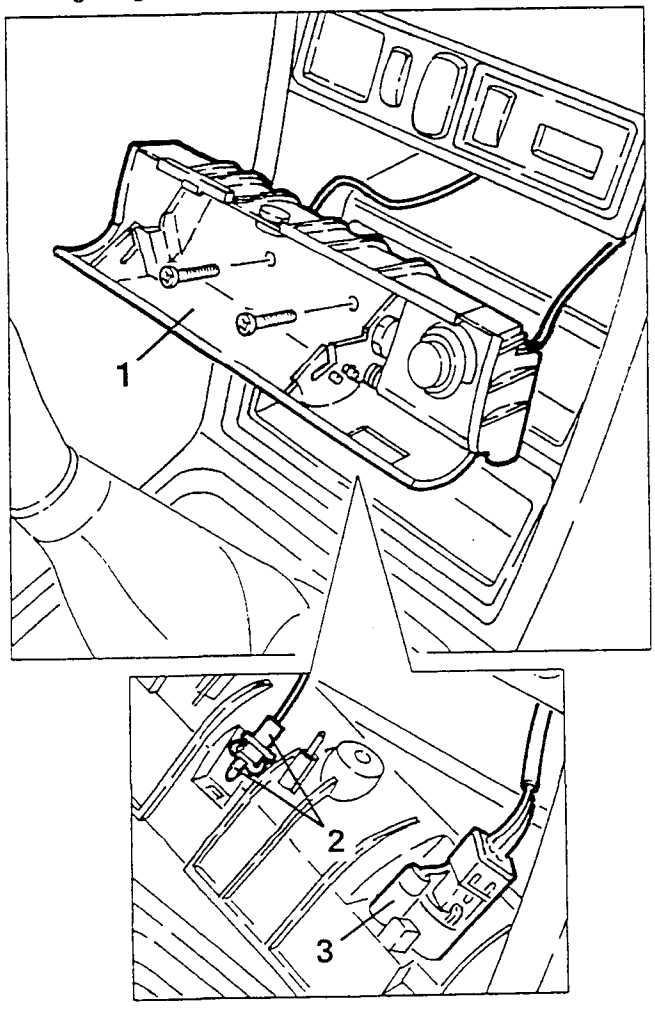
1. Remove the ashtray.



1. Slacken the two screws fastening the ashtray support.



1. Withdraw the ashtray support just enough to gain access to the electrical connections.
2. Withdraw the bulb holder complete with wiring and withdraw the ashtray bulb from it.
3. Remove the bulb holder and withdraw the bulb from the cigar lighter.

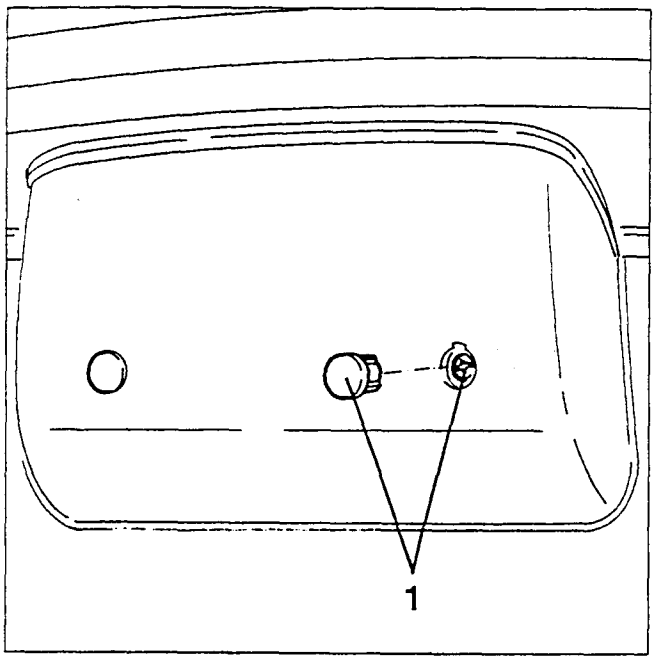


THIRD STOP LIGHT

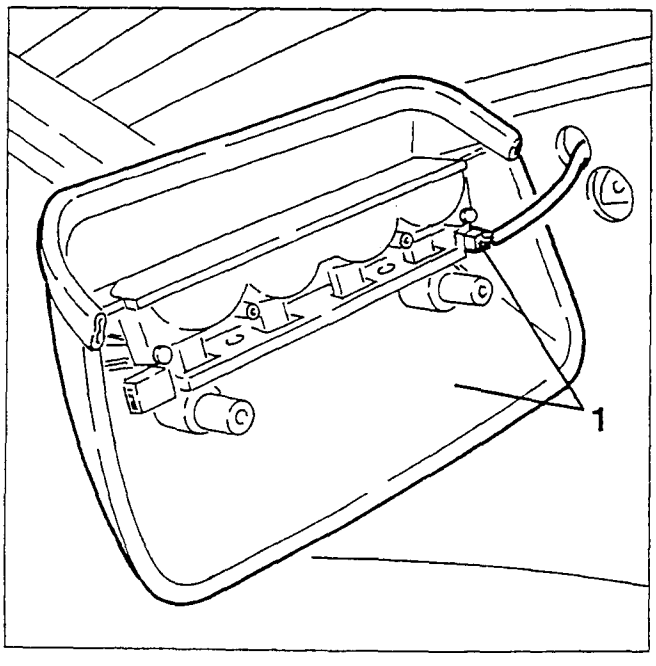
REMOVING/REFITTING

- Disconnect the battery (-) terminal.

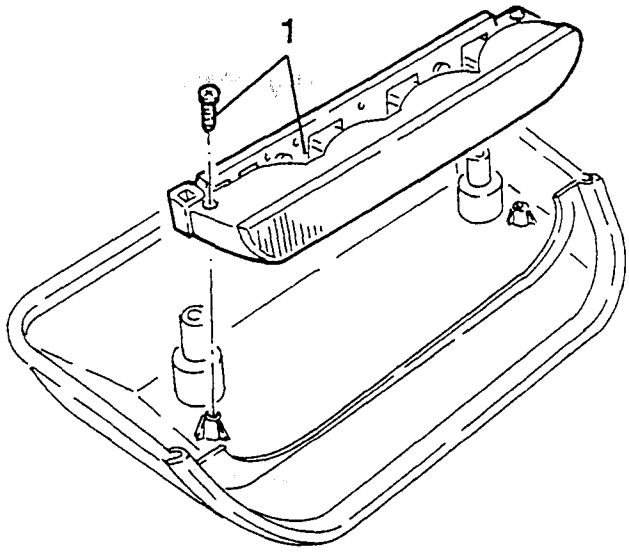
1. Working with the boot lid open, remove the two plastic caps and slacken the fastening screws below.



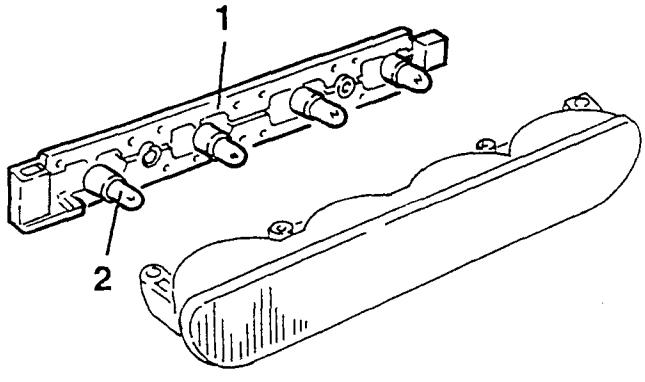
1. Move back the third stop light just enough to disconnect the electrical connection, then remove it.



1. On the bench, if necessary, slacken the two fastening screws and remove the bulb support unit.



1. Separate the bulb support base.
2. If necessary remove any bulbs to be changed pressing and turning them counter-clockwise.

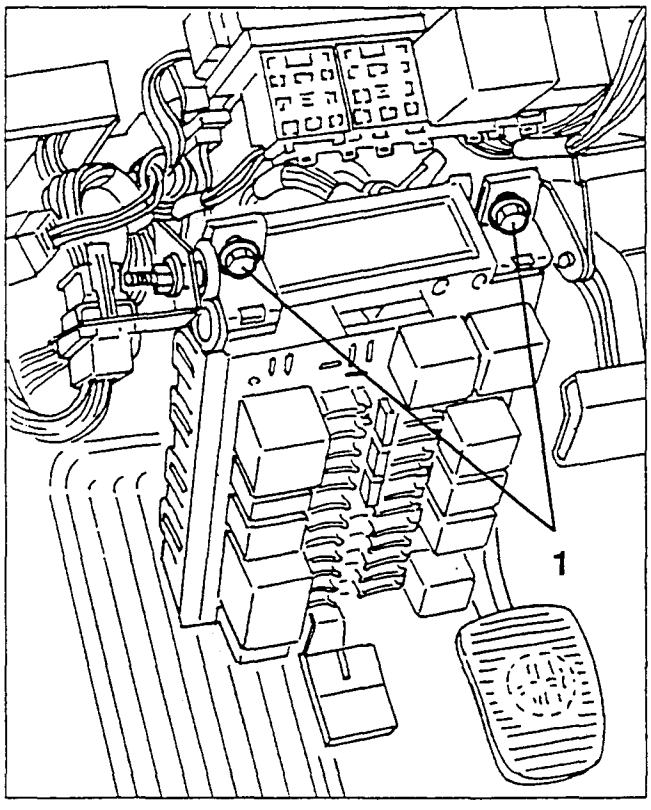


FUSE BOX

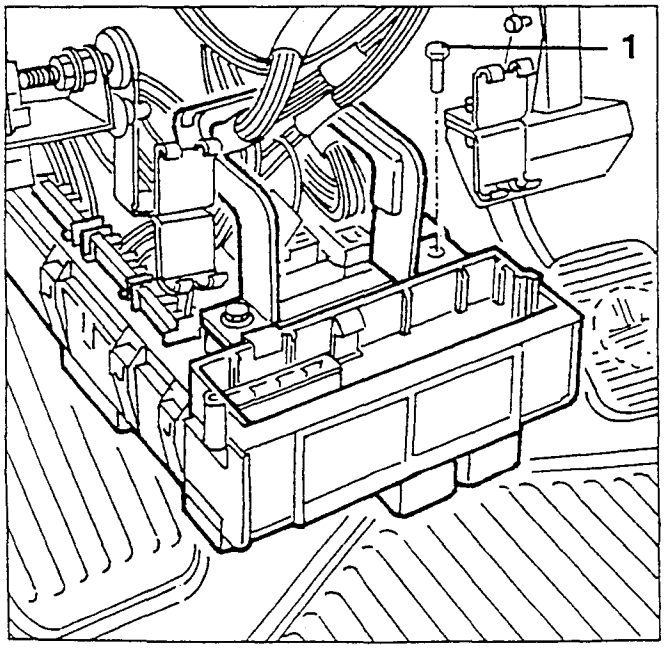
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the valve cover trim (see GROUP 70).

1. Loosen the two bolts fastening the fuse box to the support hinges.



1. Slacken the two screws fastening the cable bracket.
- Disconnect the electrical connections from the fuse box and remove it; retrieve the cable bracket.

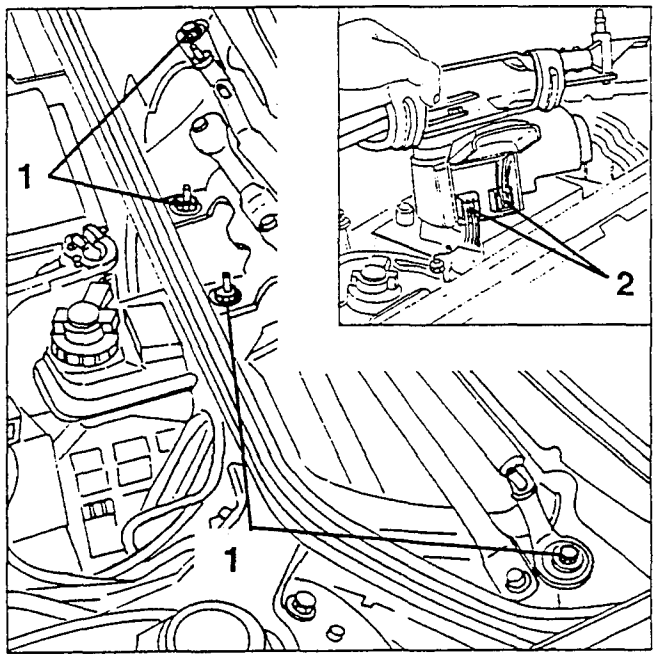


WINDSCREEN WIPER UNIT

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the air inlet grilles (see GROUP 70).

1. Slacken the two nuts and two screws fastening the windscreen wiper unit.
2. Raise the windscreen wiper unit just enough to disconnect the two electrical connections, then remove it.

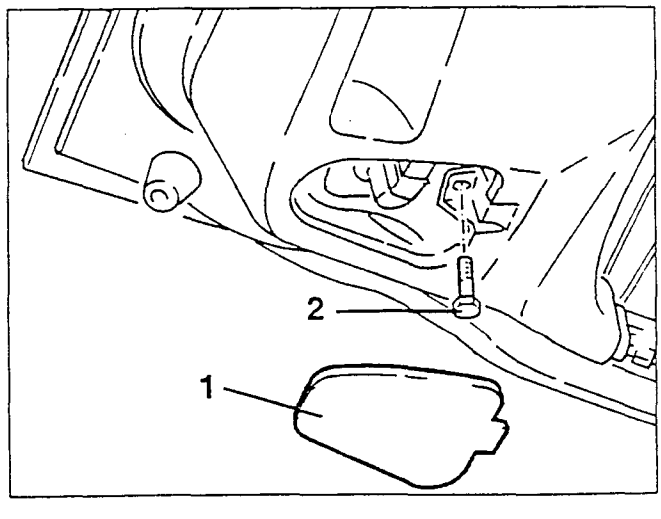


REARSCREEN WIPER UNIT

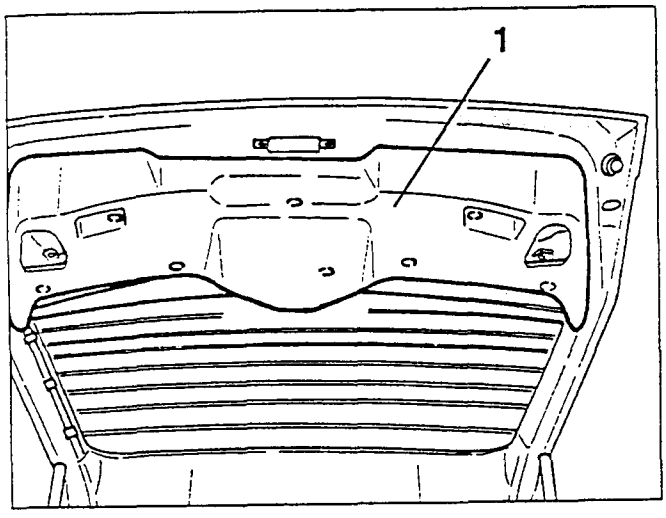
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

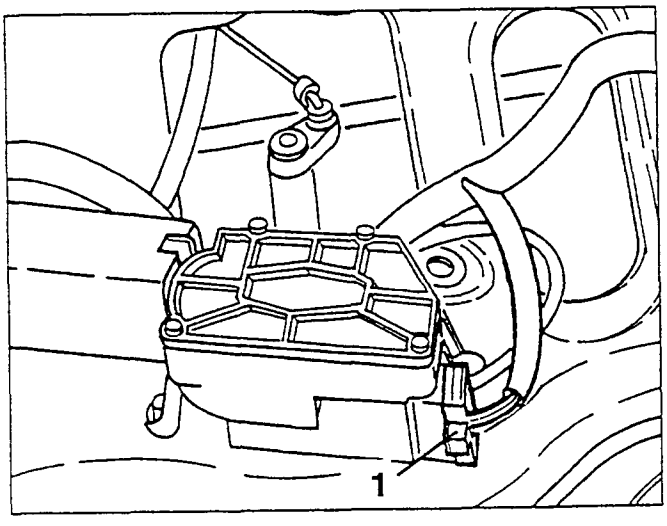
1. Remove the two bulb lids.
2. Slacken the two screws fastening the inner trim.



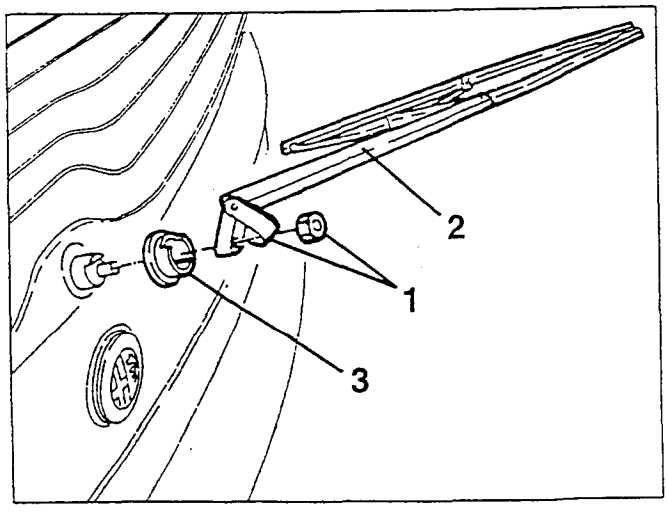
1. Remove the inner trim from the plastic nails positioned as shown in the figure and remove it.



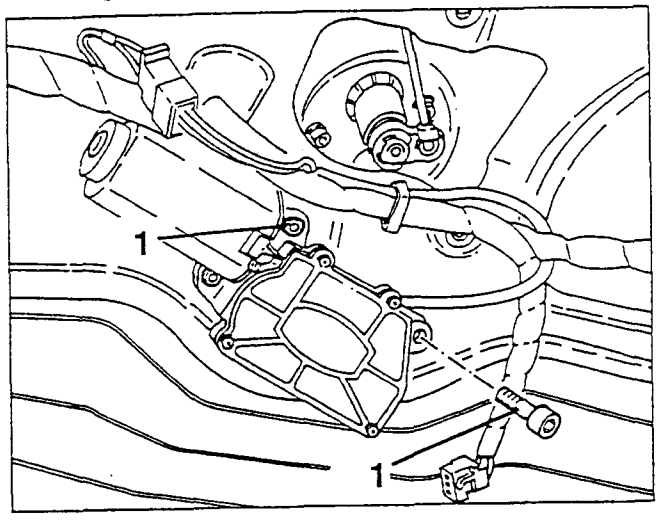
1. Disconnect the electrical connection of the rearscreen wiper.



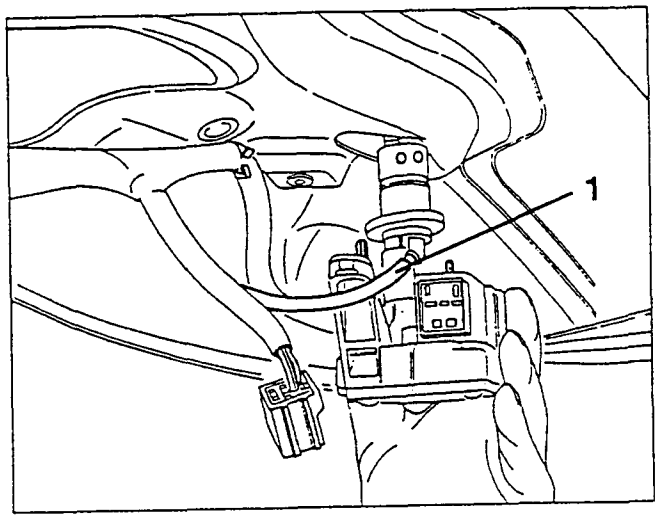
1. Lower the tailgate, raise the protection cap and slacken the nut fastening the rearscreen wiper arm.
2. Remove the rearscreen wiper arm.
3. Remove the rearscreen wiper protection rubber.



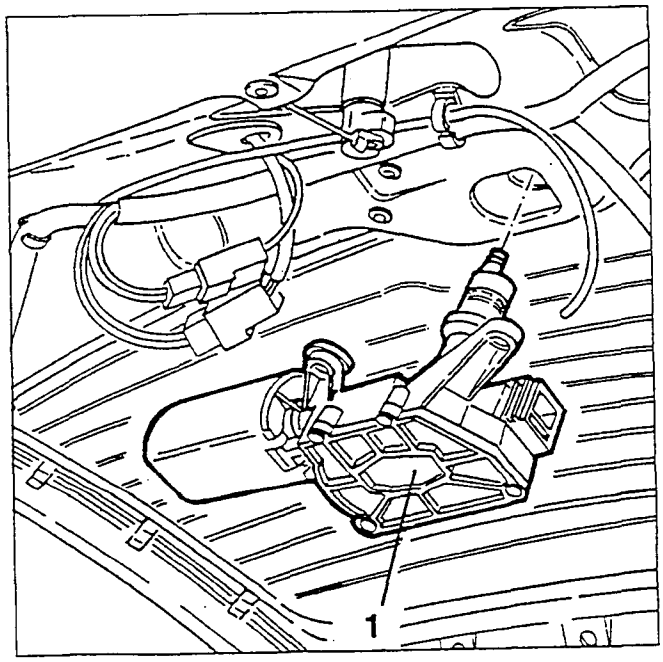
1. Raise the tailgate and slacken the three screws fastening the rearscreen wiper motor.



1. Pull out the rearscreen motor just enough to disconnect the cleaning fluid tube.



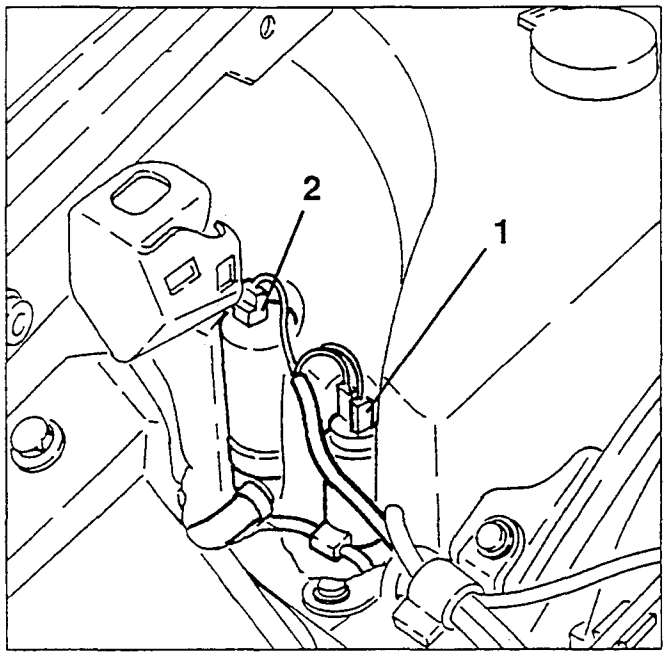
1. Remove the rearscreen motor.



WINDSCREEN WASHER & REARSCREEN WASHER PUMP AND HEADLIGHT WASHER PUMP

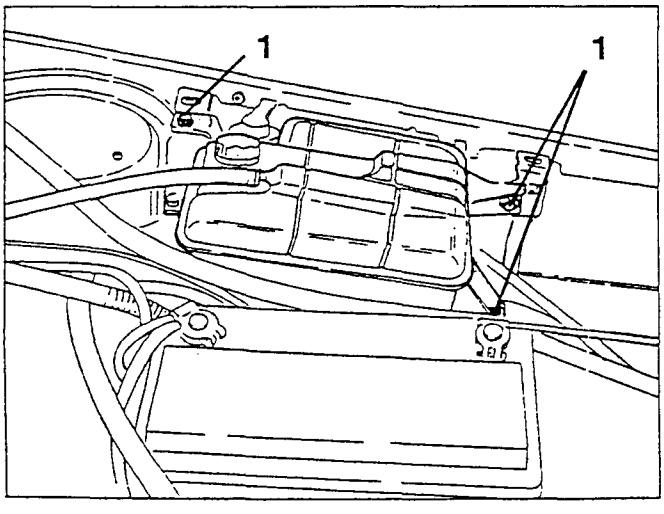
REMOVAL/REFITTING (Boxer versions)

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connections from the windscreen and rearscreen washer pump and remove it from its housing.
2. Disconnect the electrical connections from the headlight washer pump and remove it from its housing.

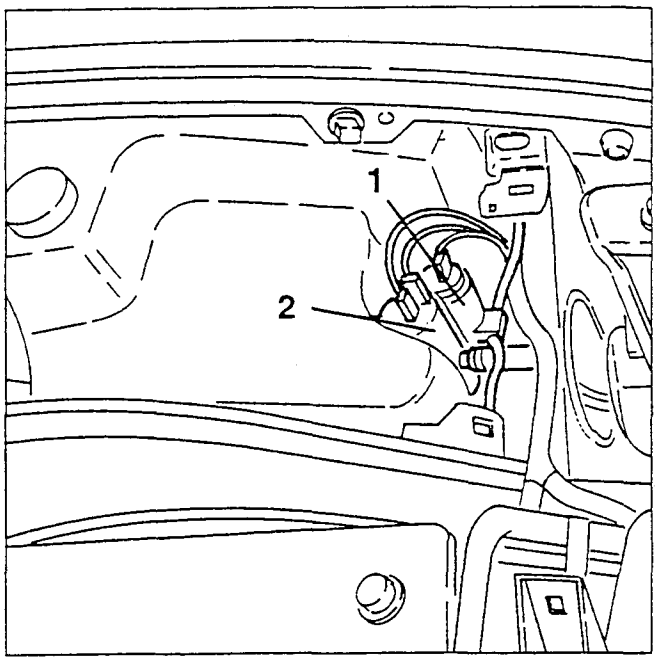


REMOVAL/REFITTING (Turbodiesel version)

1. Slacken the expansion tank fastening screws and move it to one side.



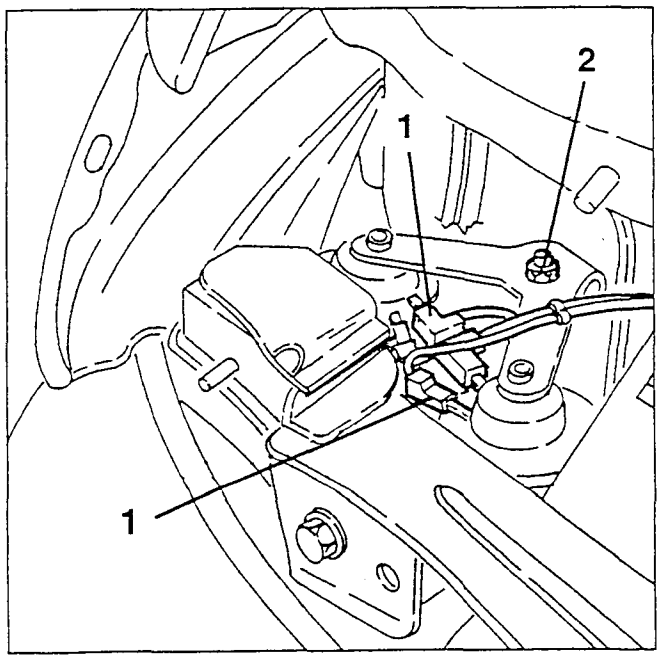
- Remove the windscreen/rear windscreen electric washer pump (1) and headlight electric washer pump (2) by proceeding as indicated for the Boxer versions.



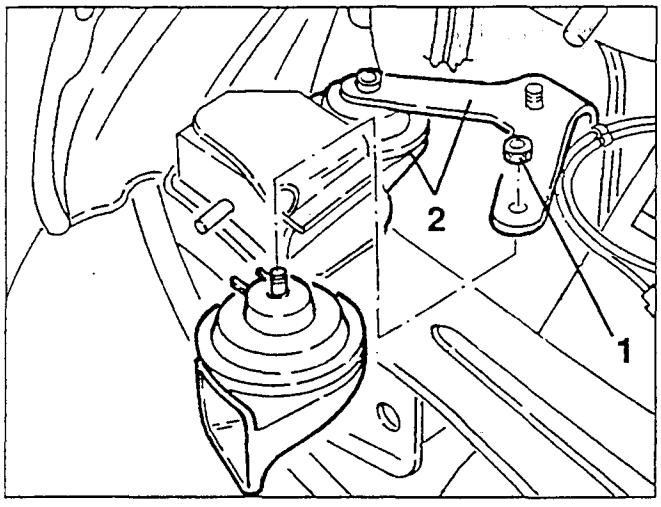
HORNS

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the radiator grille (see GROUP 70).
- Remove the right headlight (see specific paragraph).
1. Disconnect the electrical connections from the horns.
2. Slacken the nut fastening the horn support bracket to the body.



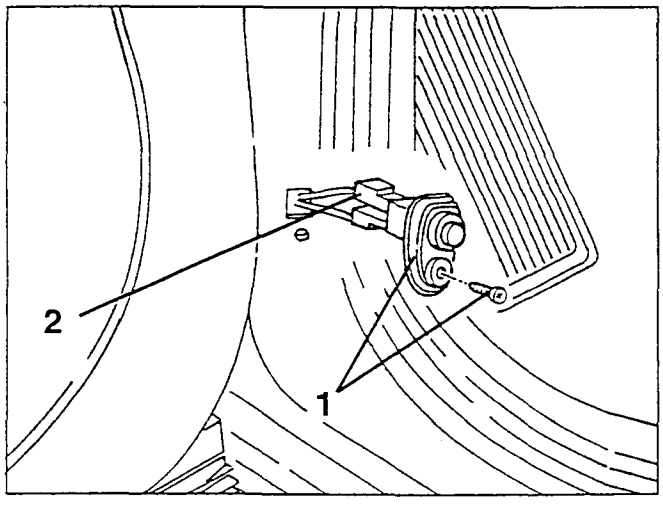
1. Slacken the nut fastening one horn to the bracket, then remove it.
2. Remove the other horn complete with support bracket.



CEILING LAMP CONTROL SWITCH ON DOOR PILLARS

REMOVAL/REFITTING

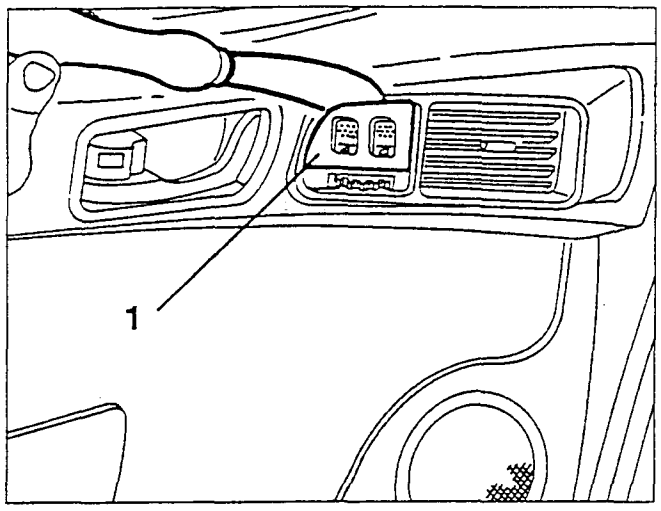
- Disconnect the battery (-) terminal.
1. Slacken the fastening screws and take the switch out of its housing.
2. Disconnect the two electrical connections and remove the ceiling lamp control switch.



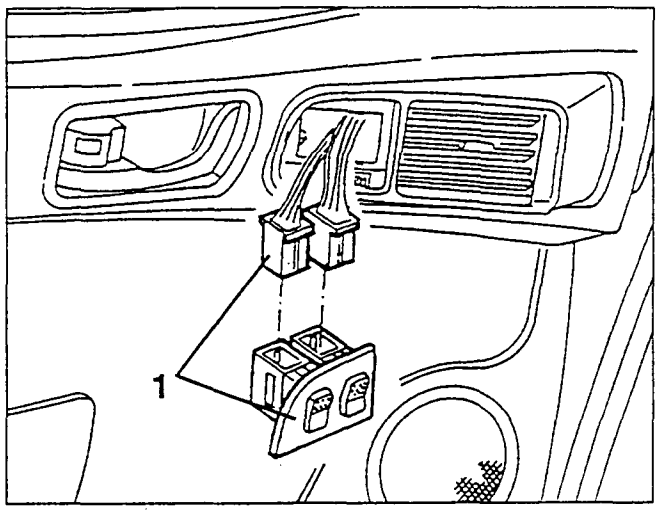
FRONT POWER WINDOW SWITCHES

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Remove the switches from the door panel.



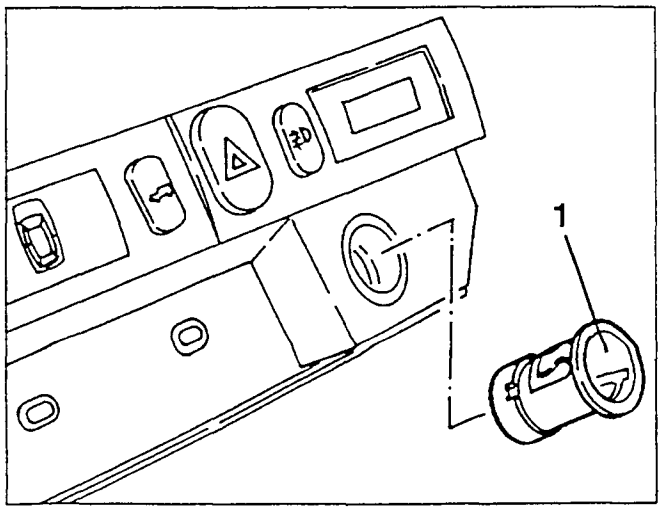
1. Disconnect the two electrical connections and remove the front power window switches.



CIGAR LIGHTER

REMOVAL/REFITTING

- Proceed as for the first three steps of the procedure described in the paragraph "CHANGING THE ASHTRAY AND CIGAR LIGHTER BULBS".
1. Working on the bench remove the cigar lighter.

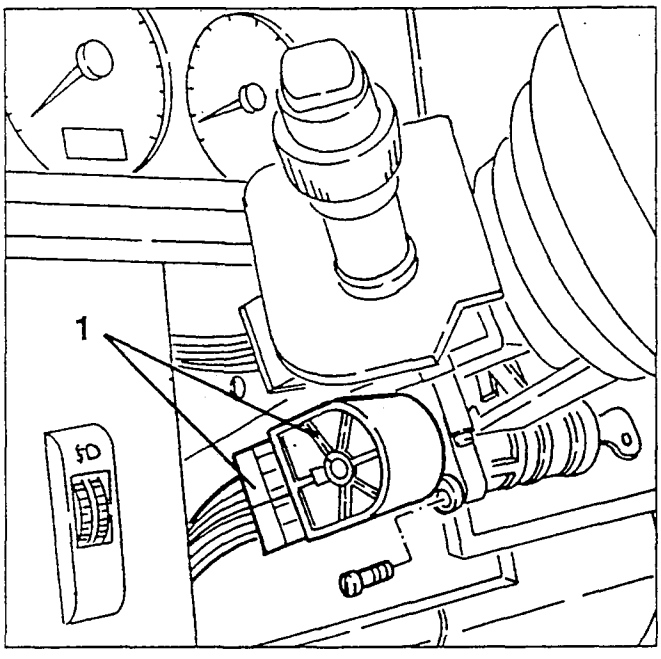


IGNITION SWITCH

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the steering column half cover.

1. Slacken the fastening screw, take the ignition switch off the starter block shaft, then remove it after disconnecting the electrical connections.

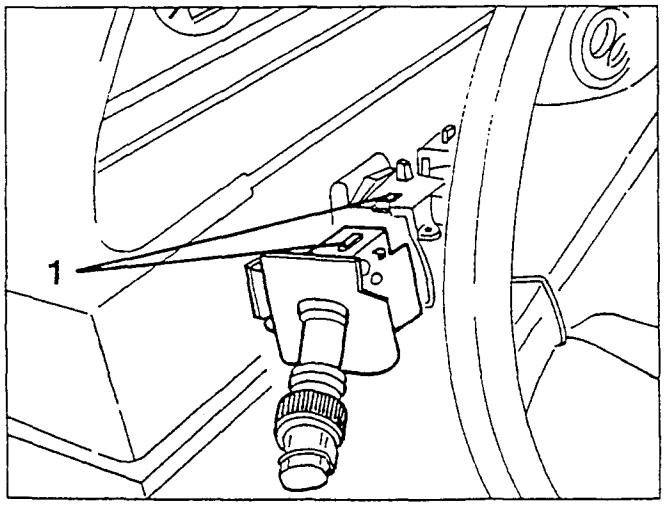


STEERING COLUMN LEVER UNIT

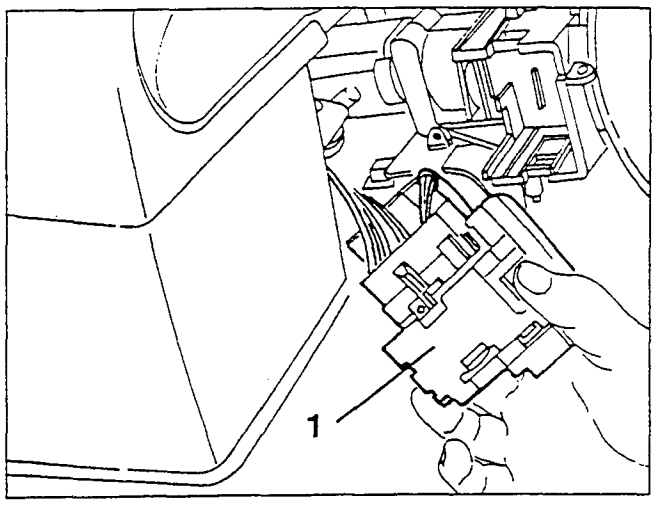
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the steering column half covers (see GROUP 70).

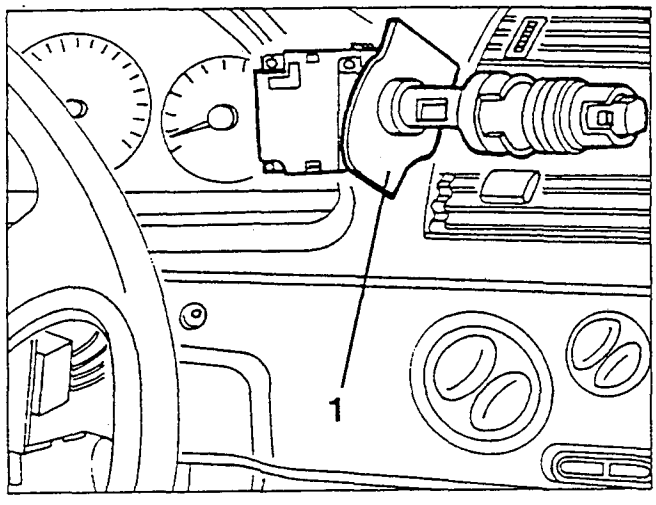
1. Contemporaneously press the two fastening tabs and remove the left control lever pulling it outwards.



1. Disconnect the electrical connection from the left control lever and remove it.



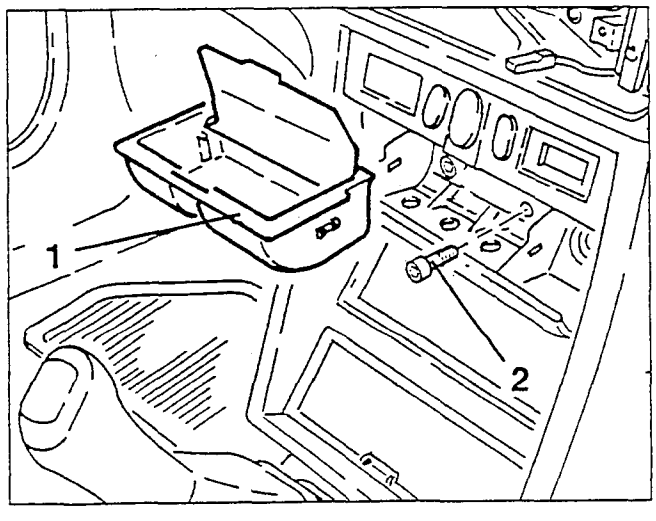
1. Proceed in the same way to remove the right control lever.



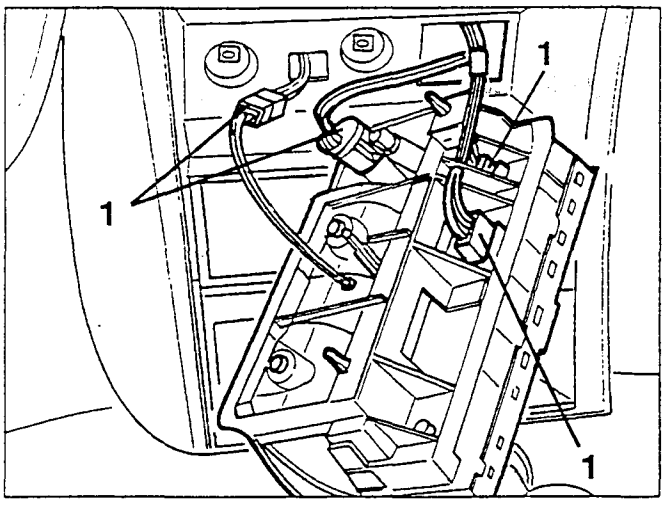
SERVICES CONTROL UNIT

REMOVAL/REFITTING

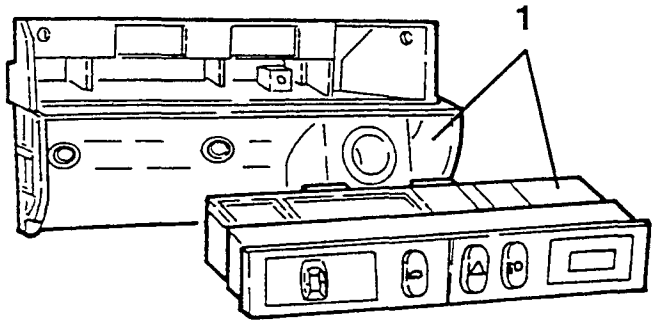
1. Remove the ashtray.
2. Slacken the two screws fastening the ashtray support.



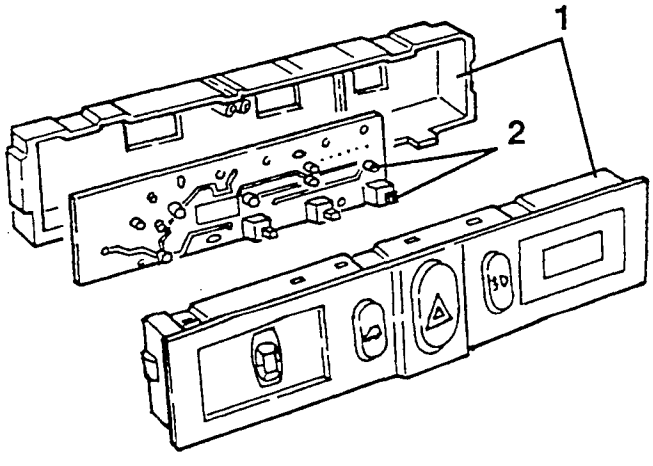
1. Remove the ashtray support complete with services control unit and remove it after disconnecting the electrical connections.



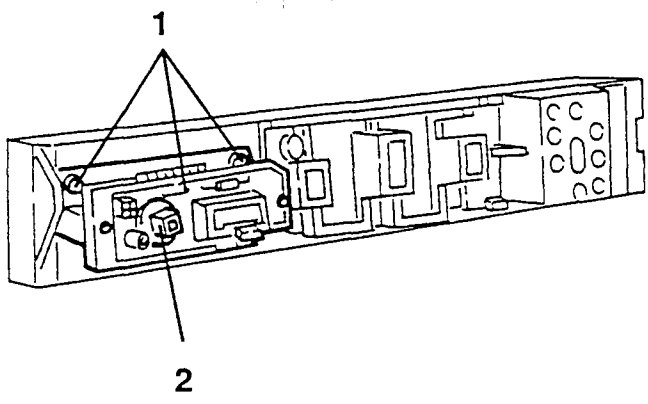
1. Release the clips and separate the ashtray from the services control unit.



1. Release the clips and open the services control unit.
2. If necessary, change the leds and switches.



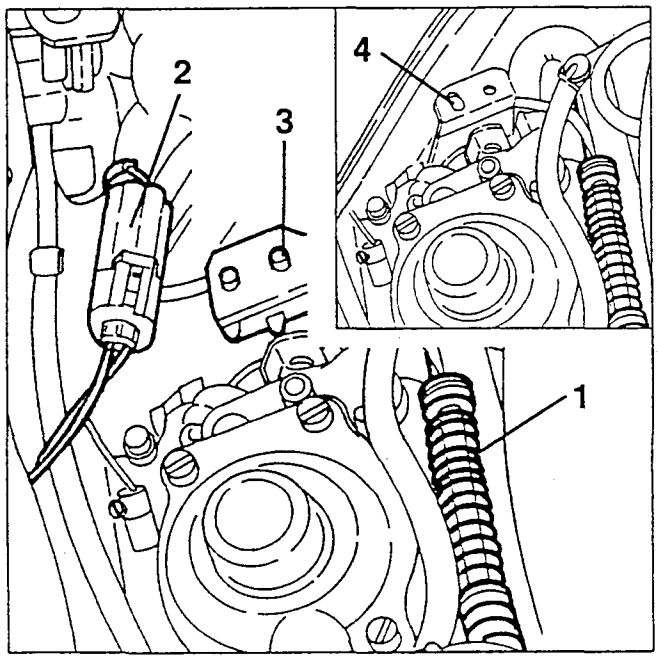
1. Slacken the fastening screws and remove the clock.
2. If necessary, take out the bulb holder and remove the clock light bulb.



FULL LOAD SWITCH FOR DISENGAGING THE CONDITIONER COMPRESSOR (1929 TD)

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the accelerator control cable from the injection pump.
2. Disconnect the electrical connection of the full load switch.
3. Slacken the two fastening screws and remove the full load switch.
4. When refitting adjust the position of the full load switch through the slot on the support bracket.

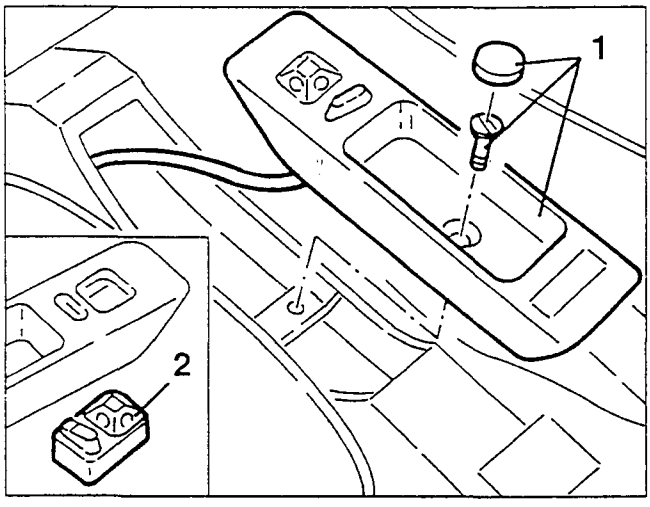


DOOR REARVIEW MIRROR ADJUSTMENT SWITCH

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

1. Remove the plastic cap, slacken the fastening screw and raise the plate just enough to disconnect the electrical connection, then remove it.
2. On the bench, remove the door mirror double adjustment switch from the plate.

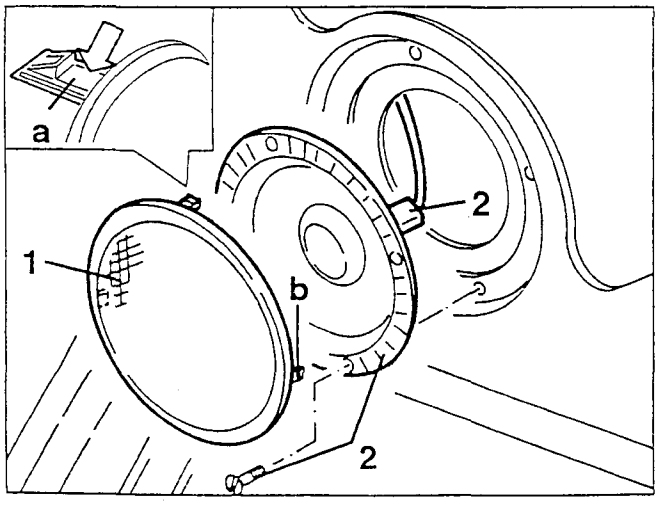


SPEAKERS

REMOVAL/REFITTING FRONT SPEAKERS

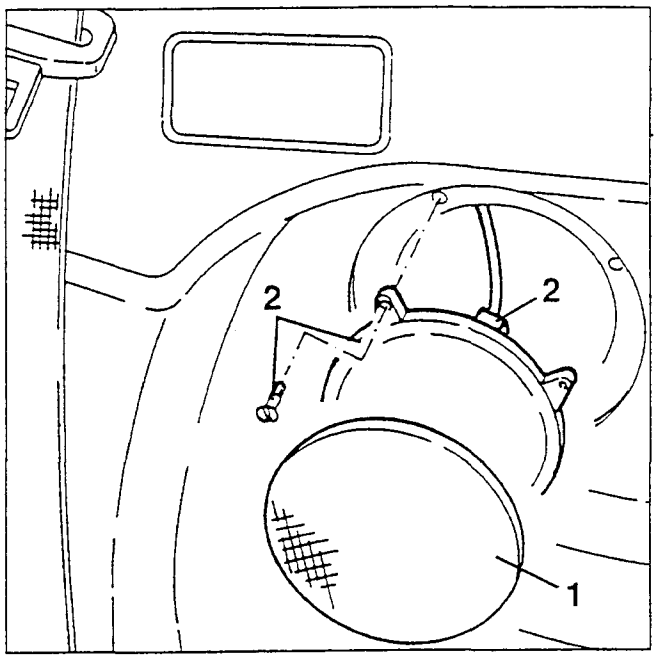
1. Remove the speaker protection grille proceeding as follows:
- using a suitable tool (eg. small flat screwdriver) press on the upper catch (a) hooking the grille to the door panel;
- proceed as described in the previous point on the rear catch (b);
- remove the grille.

2. Slacken the four fastening screws, withdraw the speaker just enough to disconnect the electrical connection, then remove it.



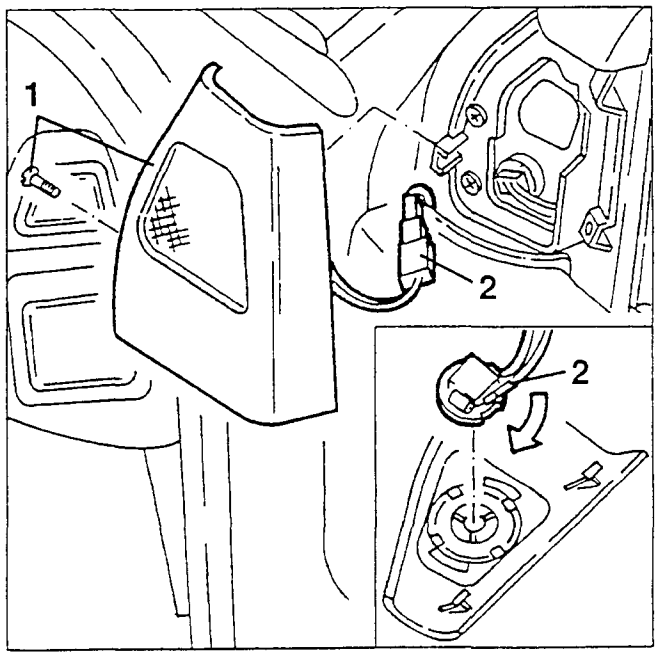
REMOVAL/REFITTING REAR SPEAKERS

1. Prise and remove the speaker protection grille.
2. Slacken the four fastening screws, withdraw the speaker just enough to disconnect the electrical connection, then remove it.



REMOVAL/REFITTING TWEETER

1. Slacken the fastening screw and remove the cover complete with tweeter.
2. Disconnect the electrical connection, turning it, remove the tweeter from the cover.



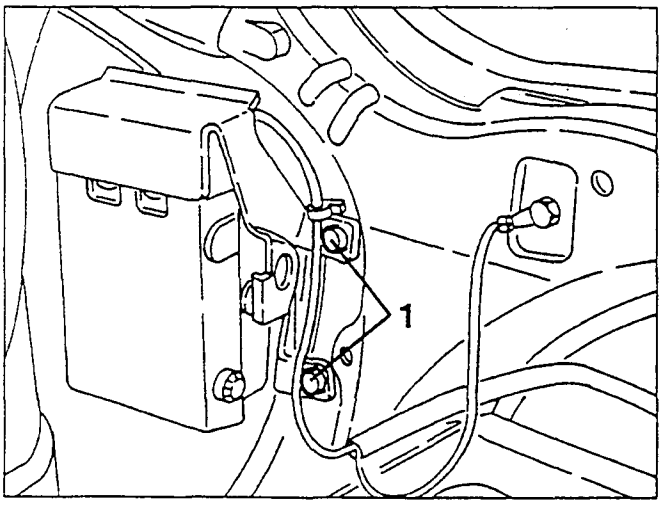
ANTI-THEFT DEVICE

For the description and diagnosis see "Electric system Diagnosis".

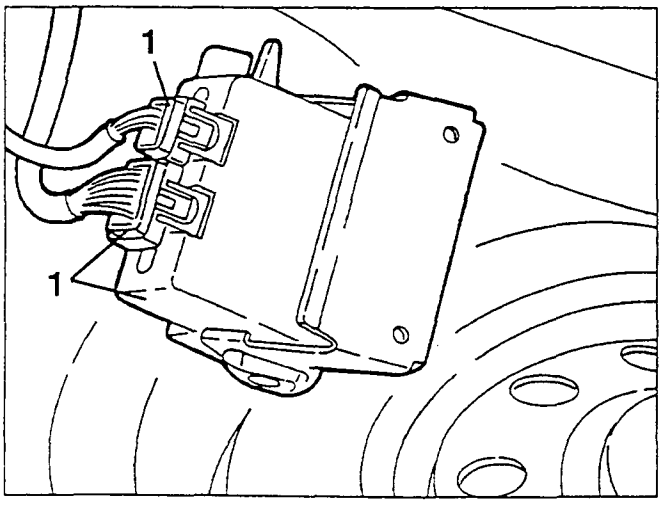
REMOVAL/REFITTING CONTROL UNIT-SIREN

- Disconnect the battery (-) terminal.
- Remove the luggage compartment protective trim (see GROUP 70).

1. Remove the trim just enough and slacken the two screws fastening the alarm system control unit-siren support bracket.



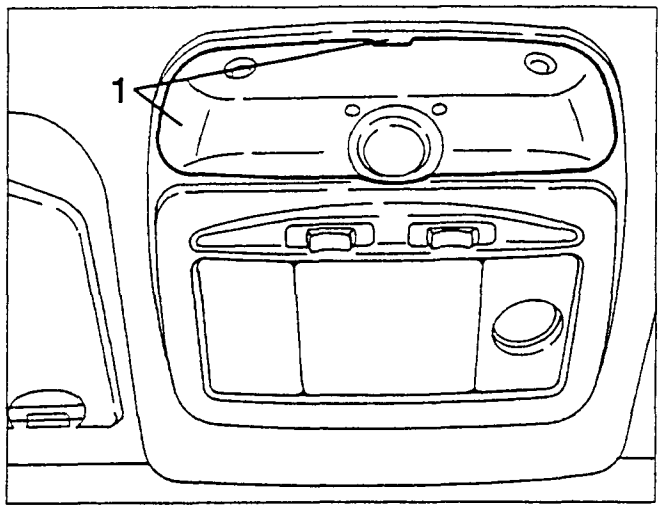
1. Disconnect the two electrical connections and remove the control unit-siren complete with support bracket.
- On the bench, if necessary, separate the control unit-siren from the support bracket.



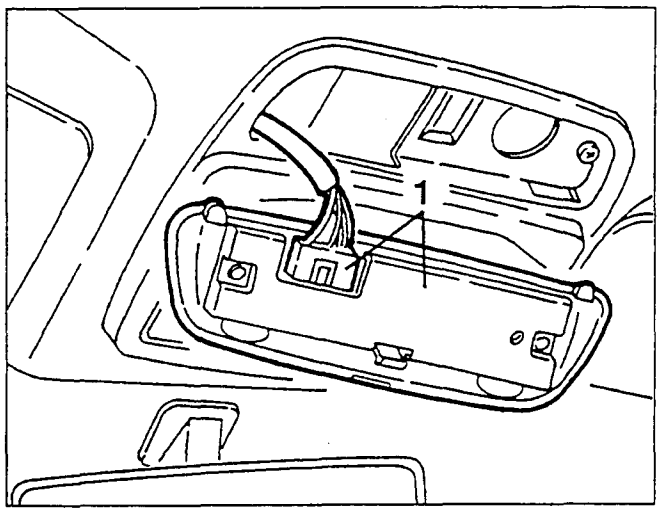
REMOVAL/REFITTING RECEIVER FOR REMOTE CONTROL AND VOLUMETRIC SENSORS

- Disconnect the battery (-) terminal.

1. Working on the points illustrated, remove the receiver and volumetric sensor support plate.



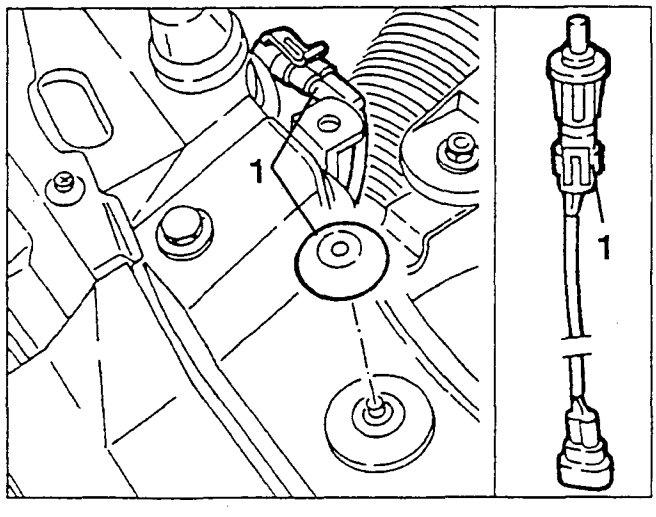
1. Disconnect the connection and remove the receiver-sensor assembly complete with plate.
- On the bench, slacken the two fastening screws and separate the plate from the receiver - volumetric sensors.



REMOVAL/REFITTING BONNET OPEN DETECTION SWITCH

- Disconnect the battery (-) terminal.

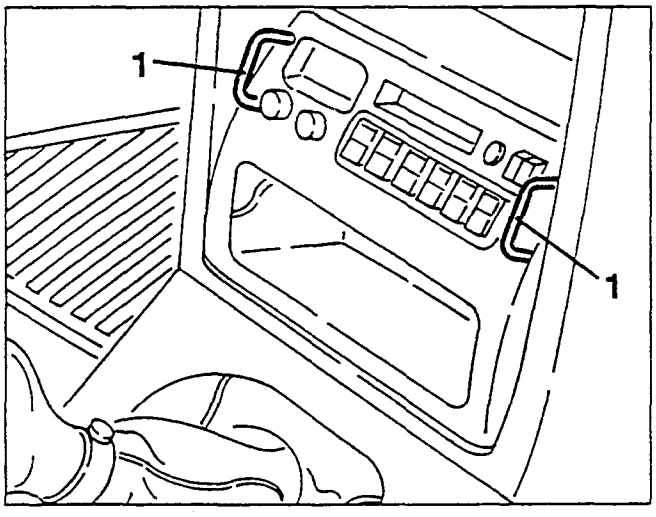
1. Disconnect the electrical connection, remove the upper finishing, then prise and remove the switch complete with wiring from its housing.



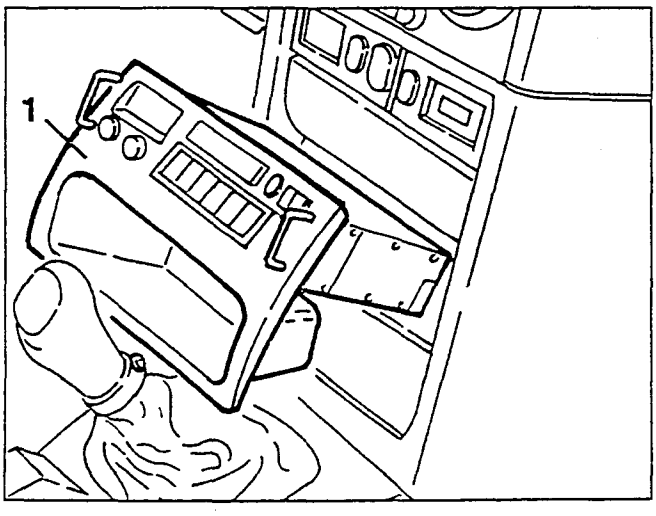
CAR RADIO

REMOVAL/REFITTING

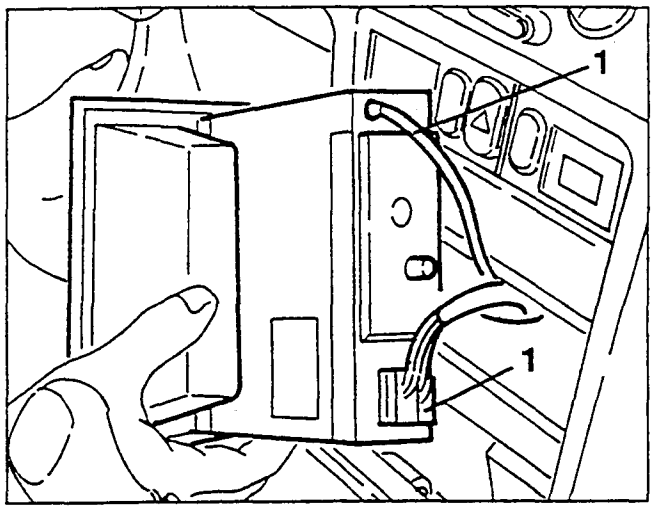
- Disconnect the battery (-) terminal.
1. Insert the special removal brackets in the holes provided on the radio as illustrated.



1. Withdraw the radio from its compartment just enough.



1. Disconnect the electrical connection and the radio aerial coaxial cable from the radio, then remove the radio.

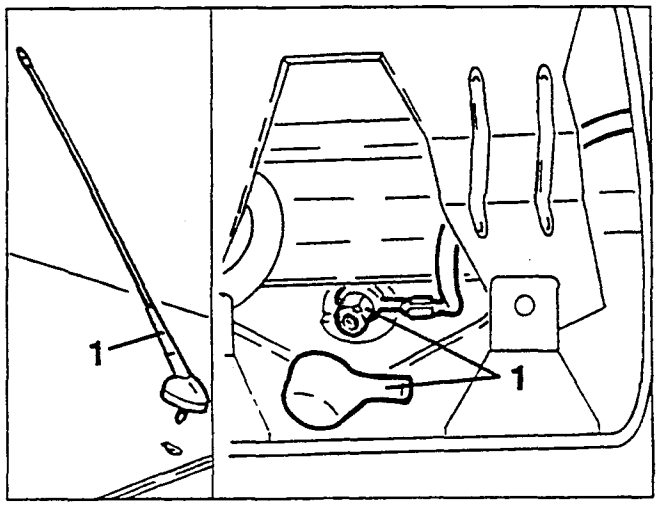


- On the bench, if necessary, separate the front frame
- utility compartment from the radio.

CAR RADIO AERIAL

REMOVAL/REFITTING

- Remove the front passenger compartment roof lamp (see GROUP 55).
1. Remove the protection cap, slacken the nut fastening the coaxial cable and aerial, then working from outside the car, remove the aerial.



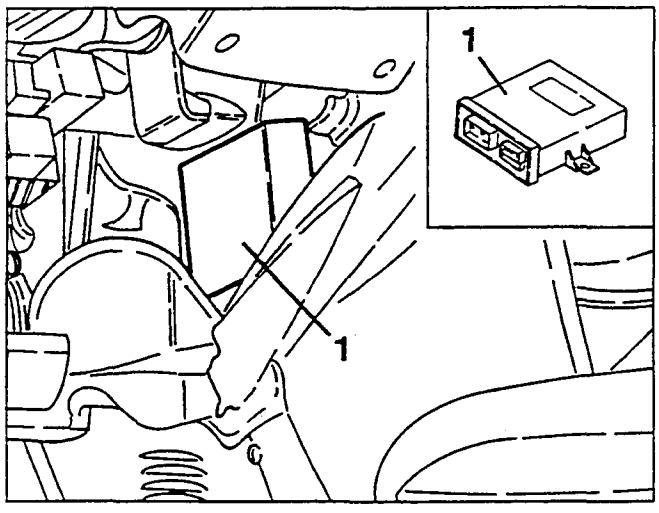
ALFA ROMEO CODE

NOTE: For the detailed description and operation of the Alfa Romeo Code see "Group 55 - ELECTRIC SYSTEM DIAGNOSIS".

REMOVING/REFITTING THE CONTROL UNIT

- Disconnect the battery (-) terminal.
- Remove the fusebox trim (see GROUPO 70).

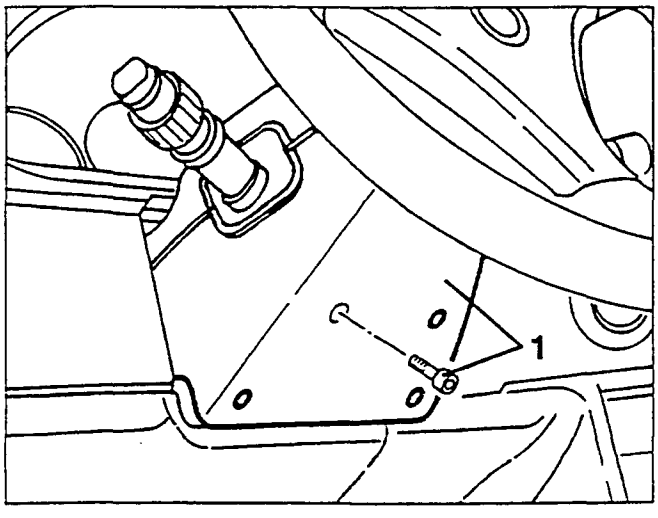
1. Slacken the two fastening bolts, withdraw the Alfa Romeo Code control unit, then remove it after disconnecting the two electrical connections.



REMOVING/REFITTING THE ANTENNA

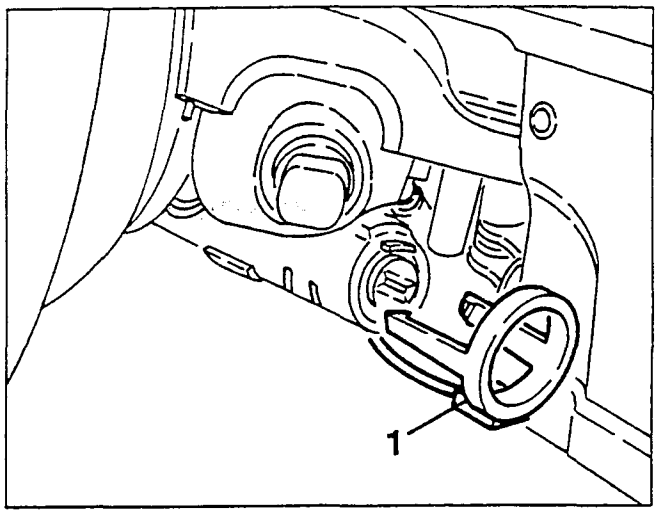
- Disconnect the battery (-) terminal.

1. Slacken the four fastening screws and remove the lower steering column half box.



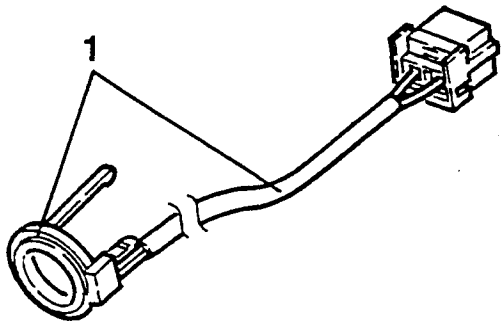
- Remove the fusebox cover (see GROUPO 70).

1. Release the fastening clips and withdraw the Alfa Romeo Code antenna from the steering block.



- Remove the Alfa Romeo Code control unit (see specific paragraph).

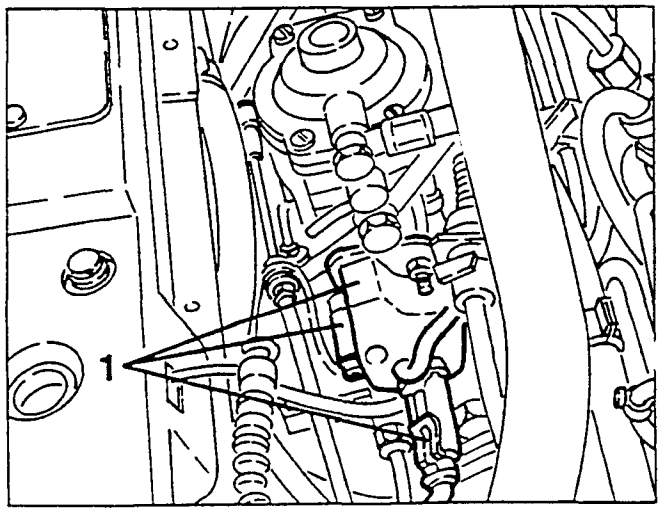
1. Remove the Alfa Romeo Code antenna complete with the wiring connecting to the control unit.



REMOVING/REFITTING THE ENGINE ELECTROSTOP VALVE (Specific for Turbodiesel engine)

- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection, slacken the fastenings and remove the engine electrostop valve.

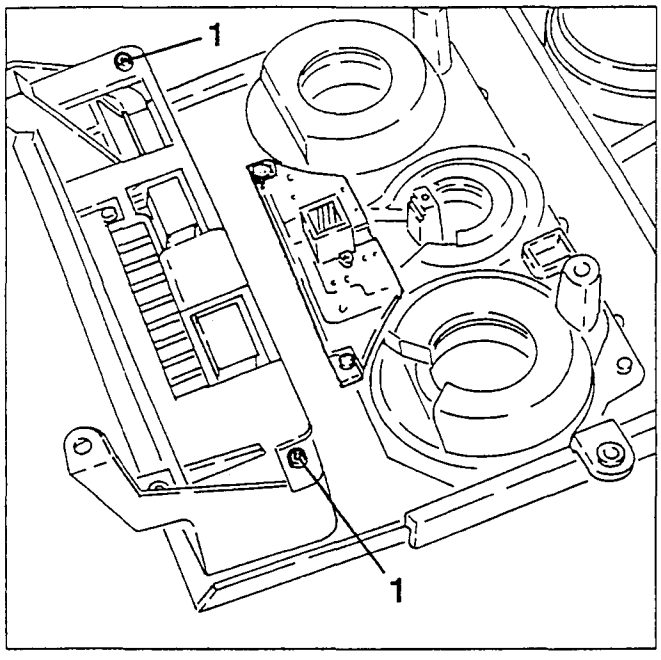


SERVICES CONTROL UNIT

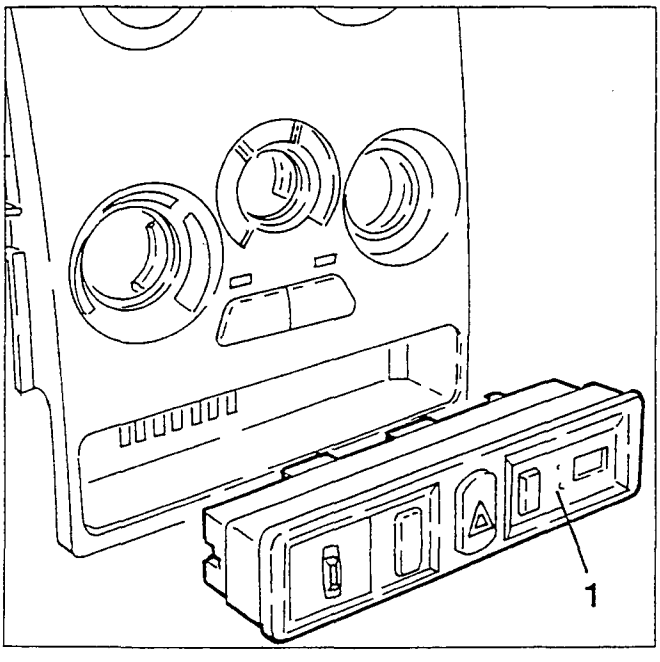
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Remove the climate control unit controls module (see GROUP 50).

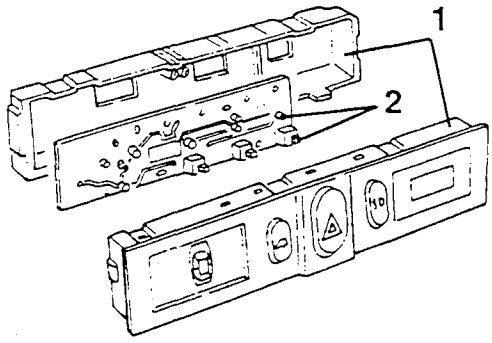
1. On the bench, slacken the two screws fastening the services control unit from the climate control unit controls module.



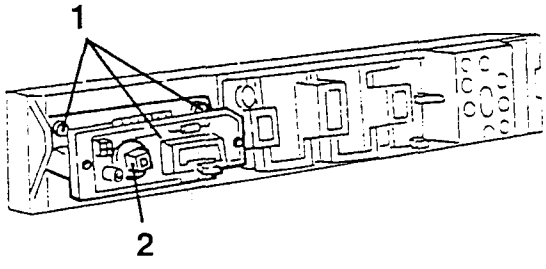
1. Remove the services controls unit from the climate control unit controls module.



1. If necessary, release the catches and open the services control unit.
2. Replace the leds and switches on the board.



1. Slacken the fastening screw and remove the clock.
2. Withdraw the bulb holder and remove the clock light bulb.

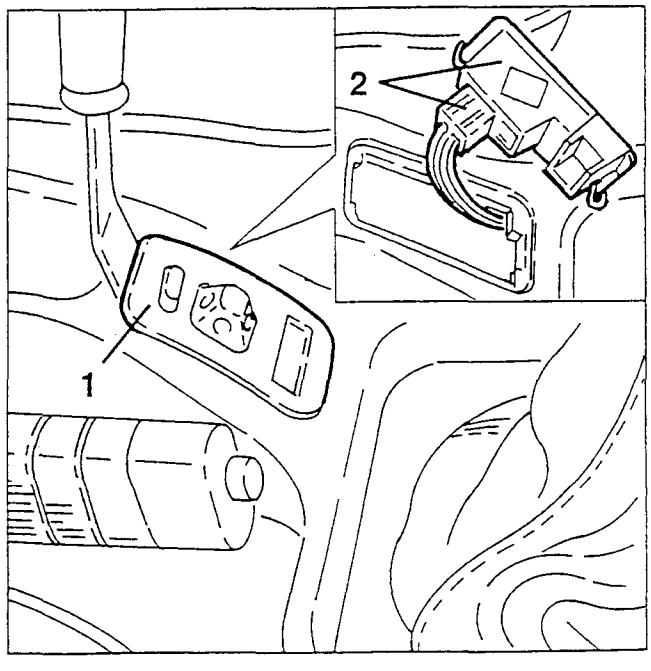


WING MIRROR ADJUSTMENT DOUBLE SWITCH

REMOVING/REFITTING

- Disconnect the battery (-) terminal.

1. Working as illustrated, remove the wing mirror double switch from its housing.
2. Disconnect the electrical connection and remove the wing mirror adjustment double switch.



WHITE

GENERAL

Before starting to work, make sure that the ignition key is in the "parking" position and the battery cable is disconnected and, in any case:

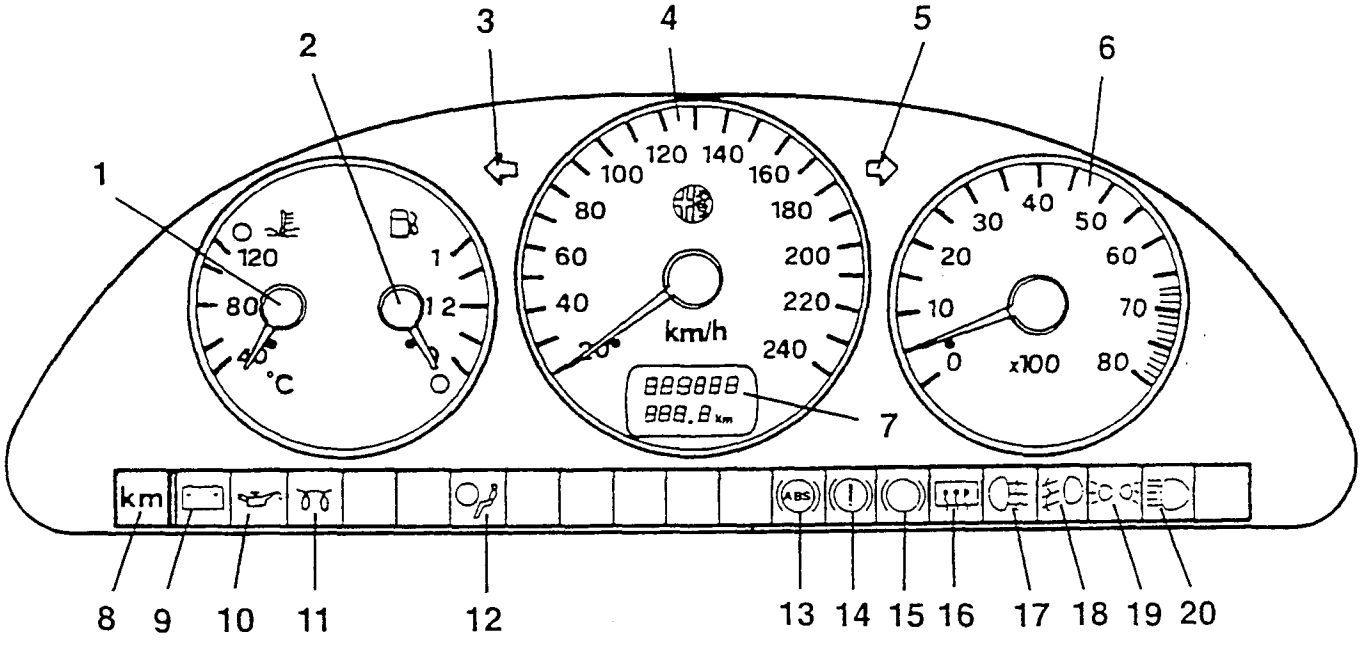
- avoid connecting the control unit output directly to the load;

- absolutely avoid working directly on devices with cables connected to "positivr" or earth without firstly disconnecting the control units;

- avoid short circuiting the sensors of the system unless otherwise specified;

- before doing any electric welding disconnect the control units to avoid damage to the electrical components due to induced current.

WARNINGS:
Work on systems foreseeing the possible consequences and avoid working on them when you are not perfectly aware of the characteristics of the components concerned.
After changing a component of the electric system, you are recommended to replenish your stock with original Alfa Romeo spares.
The use of other brands, with even only slightly different characteristics, may adversely affect reliability and safety in service.

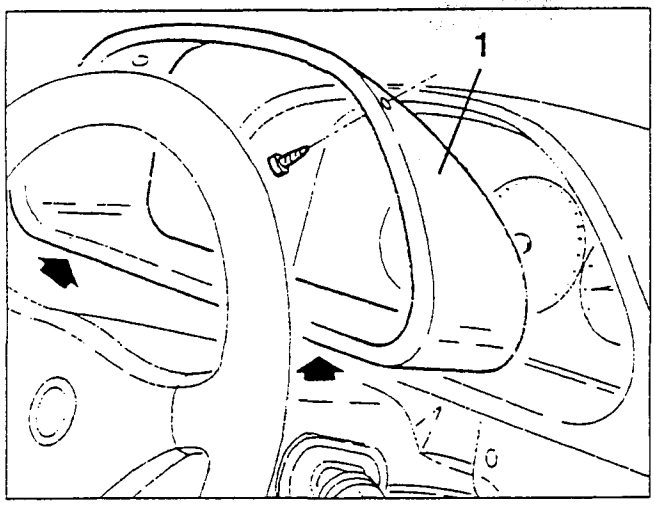


1. *Coolant fluid temperature gauge with maximum temperature indicator*
2. *Fuel level gauge with reserve indicator*
3. *Left direction indicator*
4. *Speedometer*
5. *Right direction indicator*
6. *Rev counter*
7. *Digital mileage recorder and trip meter*
8. *Trip meter reset*
9. *Low battery charge warning light*
10. *Low engine oil pressure warning light*
11. *Glow plug warming light*
12. *Air-Bag failure warning light*
13. *A.B.S. inefficient warning light*
14. *Hand brake on warning light/low brake fluid warning light*
15. *Brake pad wear warning light*
16. *Heateed rearscreen warning light*
17. *Rear fog guards warning light*
18. *Fog lamps warning light*
19. *Side lights and low beam warning light*
20. *High beam warning light*

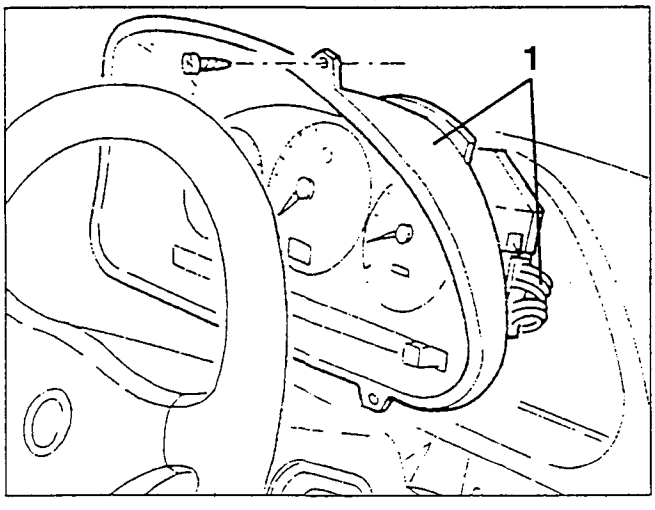
REMOVING/REFITTING

- Disconnect the battery (-) terminal.

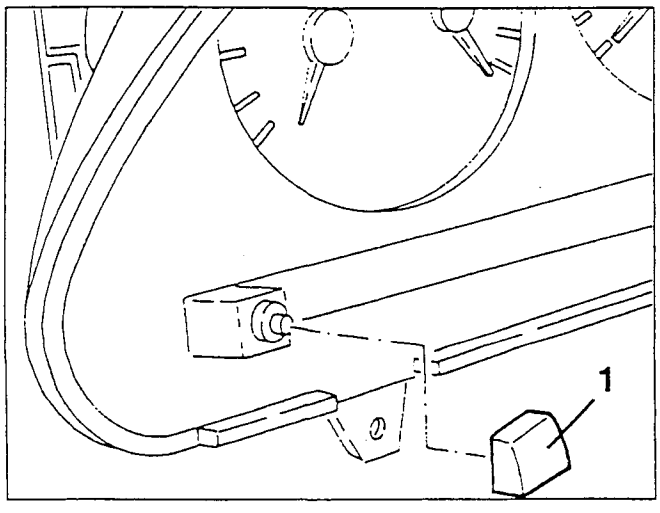
1. Slacken the two fastening screws and remove the control panel trim plate, prising in the points shown by the arrows.



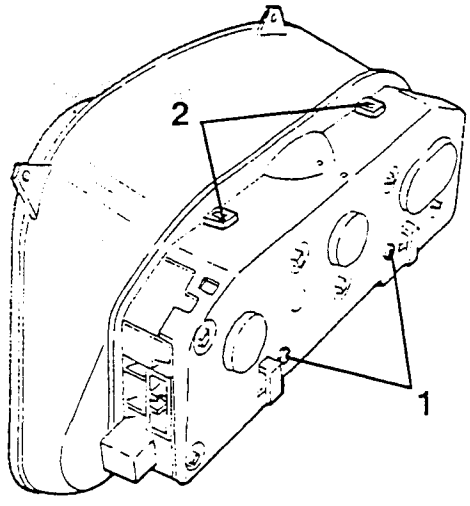
1. Slacken the four screws fastening the control panel and remove it from its housing jus enough to disconnect the two side connections, and remove it.



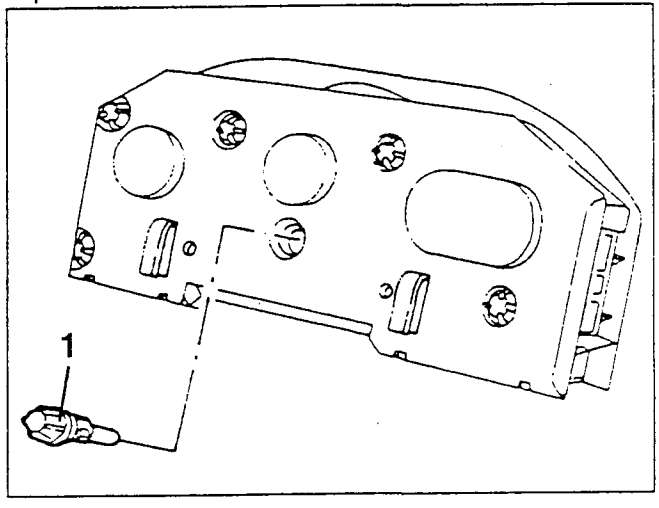
1. On the bench, remove the trip meter reset button.



1. Slacken the two control panel fastening screws from the transparent piece.
2. Release the two catches and separate the panel from the transparent piece.



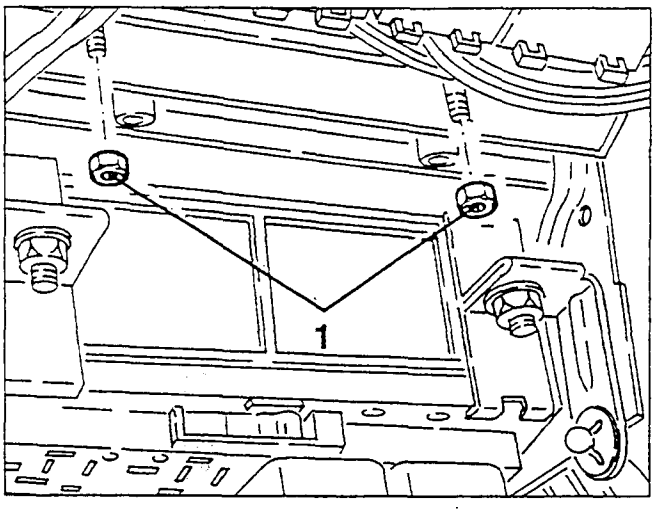
1. If necessary replace the panel lighting bulbs removing the bulb holder and removing the bulbs to be replaced.



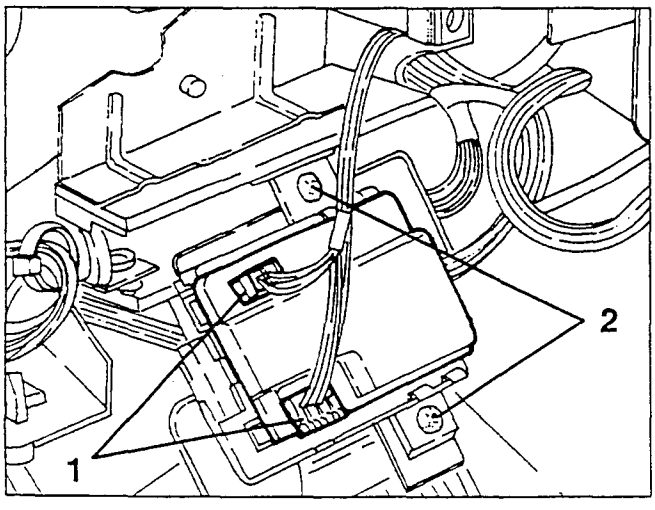
POWER WINDOW CONTROL UNIT

REMOVAL/REFITTING

The control unit is located under the dashboard on the lefthand side next to the main fuse box.
- Disconnect the battery (-) terminal.
- Remove the fuse box cover (see GROUP 70).
1. Slacken the two nuts fastening the power window control unit support.



1. Disconnect the two electrical connections of the power window control unit.
2. Slacken the two fastening nuts and remove the power window control unit.



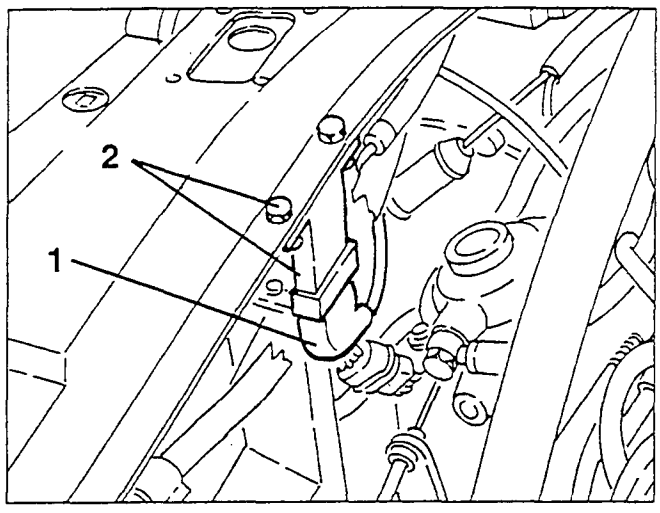
ALARM SYSTEM CONTROL UNIT

The vehicle alrm system is integrated with the siren and cannot therefore be removed separately. For Removal/Refitting operations see specific paragraph "Alarm System".

HEATING AND VENTILATION CONTROL UNIT (1929 TD)

REMOVAL/REFITTING

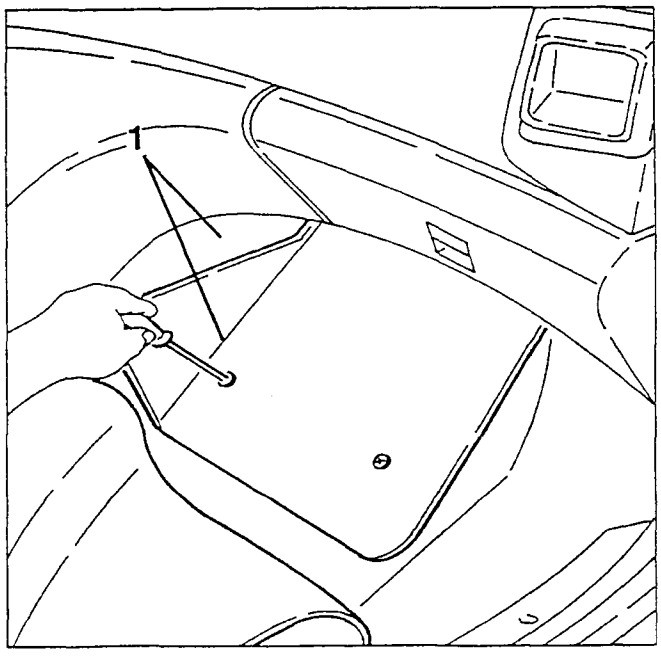
- Disconnect the battery (-) terminal..
1. Disconnect the control unit electrical connection.
2. Slacken the two screws fastening the control unit and remove it.



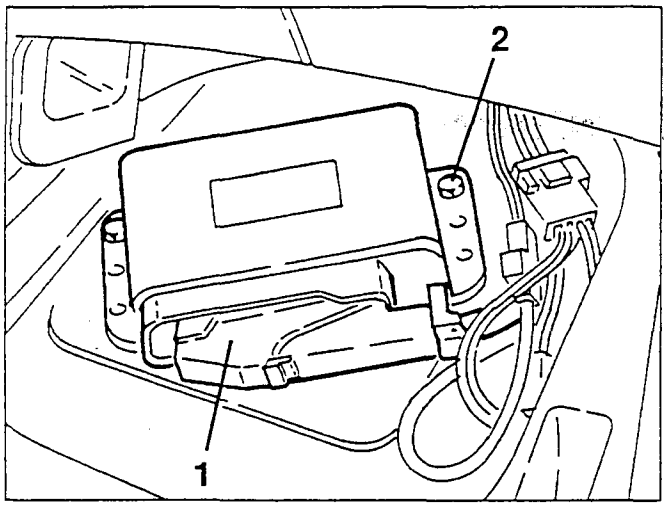
IGNITION-INJECTION CONTROL UNIT (Boxer versions)

REMOVAL/REFITTING

The following procedure refers to the MOTRONIC M2.10.3 system; and it is also valid for the IAW and MOTRONIC MP3.1 system.
1. Working in the front passenger floor area, turn back the specially cut mat, slacken the two fastening screws and remove the control unit cover.



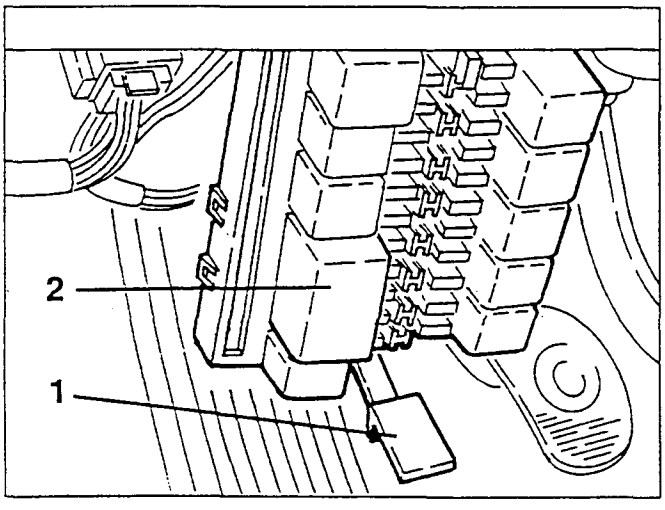
1. Disconnect the combs from the control unit.
2. Slacken the fastening screws and remove the control unit.



DOOR LOCK CONTROL UNIT

REMOVAL/REFITTING

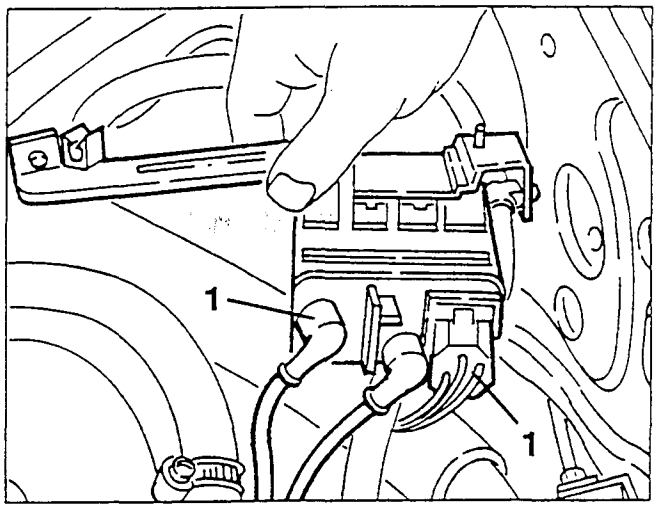
- Disconnect the battery (-) terminal.
1. Use the special lever to lower the fuse box.
2. Remove the door lock control unit.



GLOW PLUG WARMING CONTROL UNIT (1929 TD)

REMOVAL/REFITTING

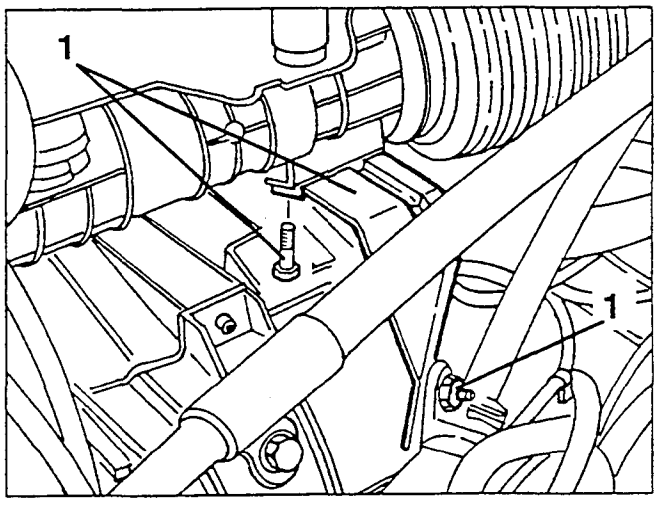
- Remove the battery and its support bracket.
1. Suitably turn the glow plug warming control unit and disconnect the electrical connections.
2. Remove the glow plug warming control unit complete with bracket, if necessary separate them on the bench.



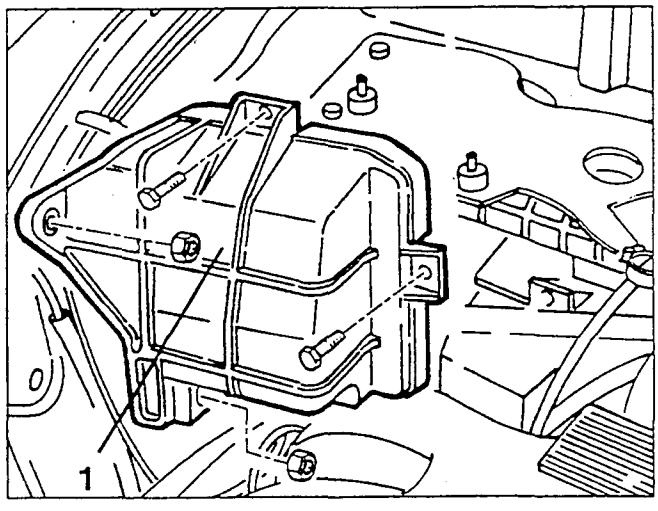
A.B.S. CONTROL UNIT

REMOVAL/REFITTING (Boxer versions)

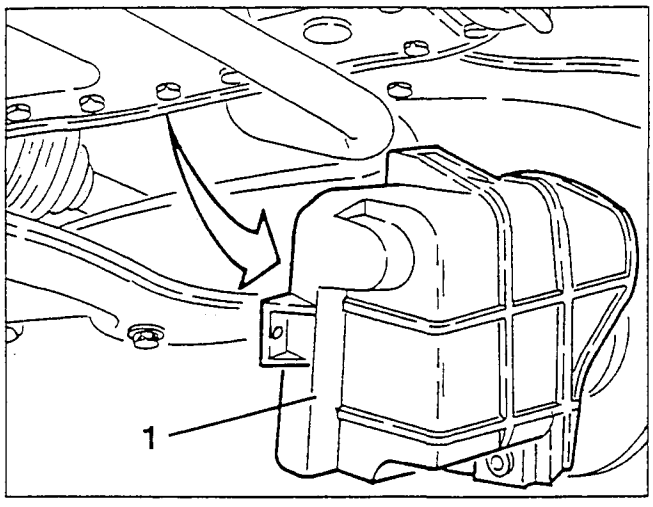
- Disconnect the battery (-) terminal..
- Remove the complete air cleaner (see GROUP 10).
1. Remove the power steering hose support bracket.



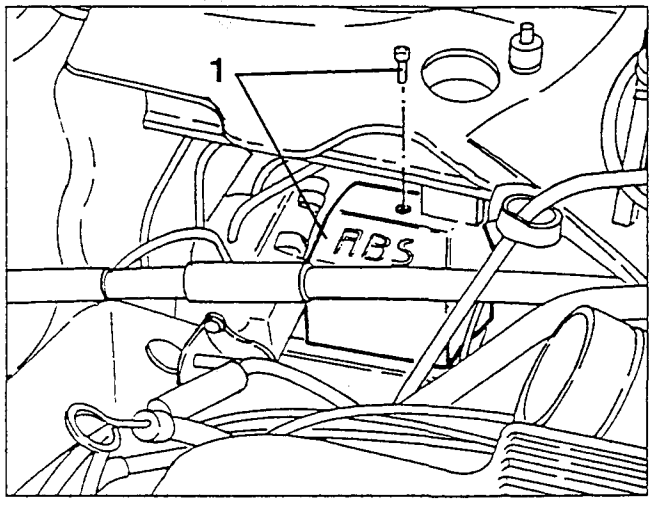
1. Slacken the screws and fastening nuts and remove the front half box of the A.B.S. hydraulic unit.



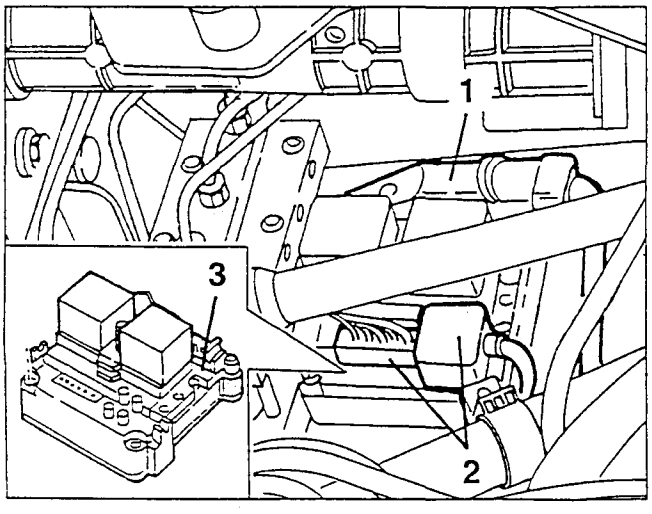
- Raise the car.
1. Slacken the remaining fastening nut and remove the rear half box of the A,B,S, hydraulic aggregate.



- Lower the car.
1. Slacken the fastening screw and remove the cover from the A.B.S. control unit.

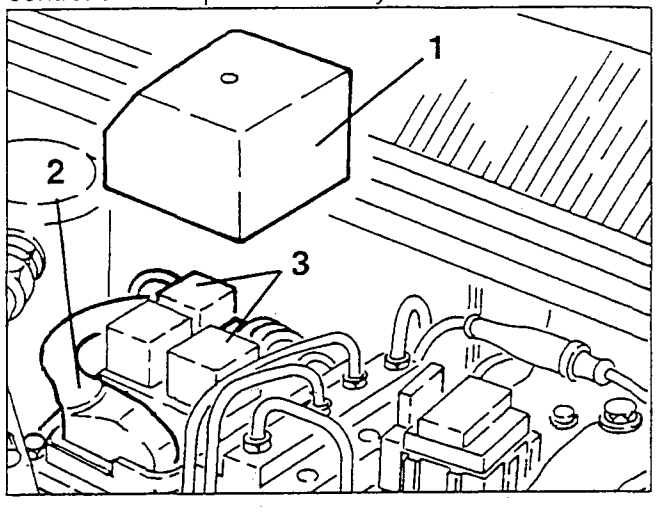


1. Disconnect the combs from the A.B.S. control unit.
2. Disconnect the two electrical connections.
3. Slacken the fastening screws and remove the A.B.S. A.B.S. control unit complete with relays.



REMOVING/REFITTING (1929 TD - T. SPARK 16V)

- Disconnect the battery (-) terminal.
- Slacken the fastening screw and raise the brake-clutch fluid reservoir as far as necessary.
1. Slacken the fastening screw and remove the cover from the A.B.S. electronic control unit.
2. Disconnect the electric wiring combs from the A.B.S. control unit.
3. Disconnect the two electrical connections illustrated from the A.B.S. control unit
- Slacken the fastening screws and remove the A.B.S. control unit complete with relays.

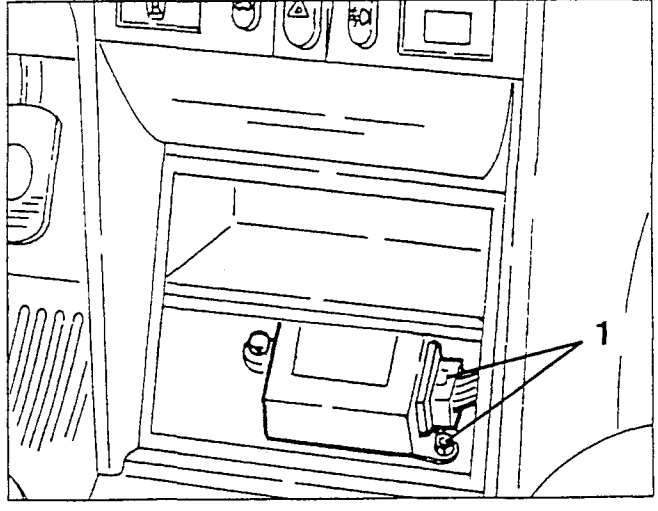


NOTE: The '97 versions with T. SPARK and TD engines have a BOSCH 5.3 ABS system which does not have the possibility to disassemble the hydraulic aggregate and this removal of the control unit; in the event of a fault the hydraulic aggregate must be replaced entirely (see GROUP 33).

AIR-BAG CONTROL UNIT

REMOVING/REFITTING

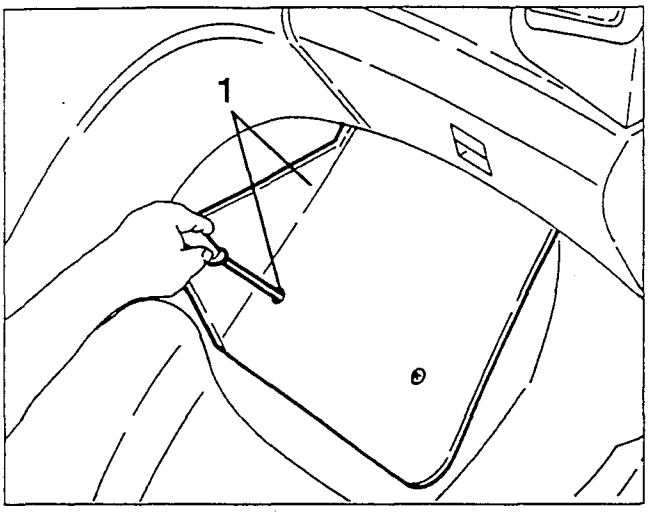
- Disconnect the battery (-) terminal.
- Remove the glovebox.
1. Disconnect the connection, slacken the two fastening nuts and remove the control unit.



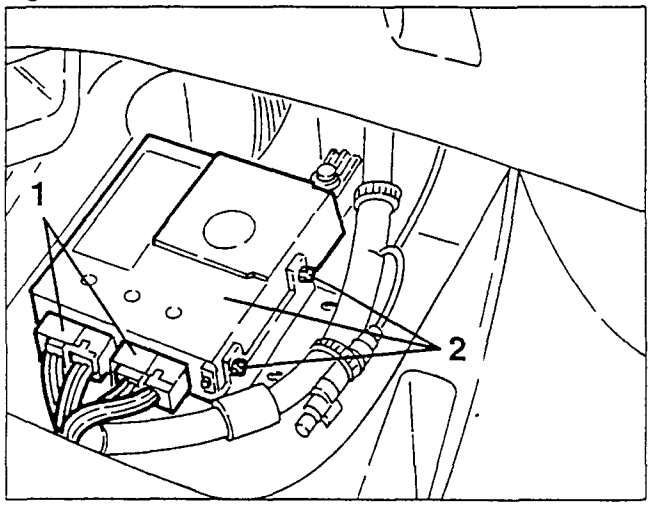
INJECTION - IGNITION CONTROL UNIT ROCHESTER (Boxer version 1596)

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Working in the front passenger floor area, overturn the mat, slacken the two fastening screws and remove the control unit cover.



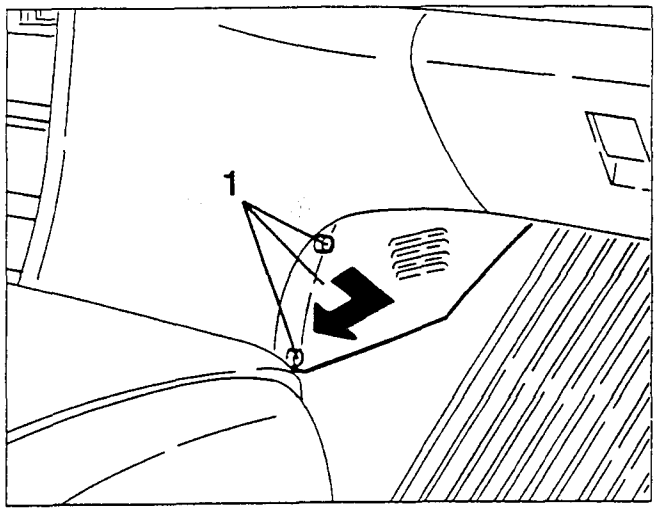
1. Disconnect the two electrical connections from the control unit.
2. Slacken the fastening nuts and remove the injection - ignition control unit.



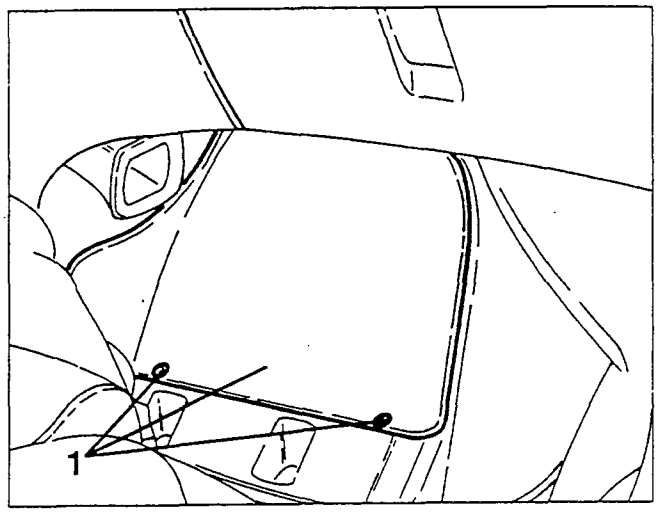
INJECTION - IGNITION CONTROL UNIT M2.10.3/M2.10.4 (T. Spark 16V versions)

REMOVING/REFITTING

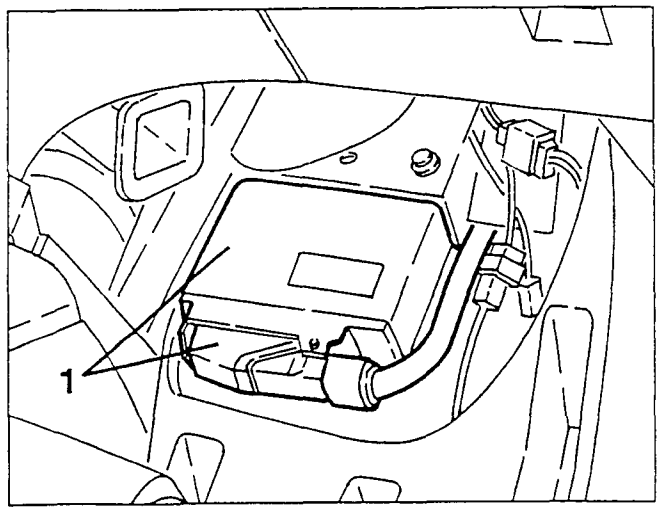
- Disconnect the battery (-) terminal.
1. Slacken the two fastening screws then remove the trim of the air vent to the front passenger feet area.



1. Overturn the mat, slacken the two fastening screws and remove the control unit cover.



1. Disconnect the combs from the control unit, then remove it after slackening the two fastening screws.



E.G.R. SYSTEM CONTROL UNIT

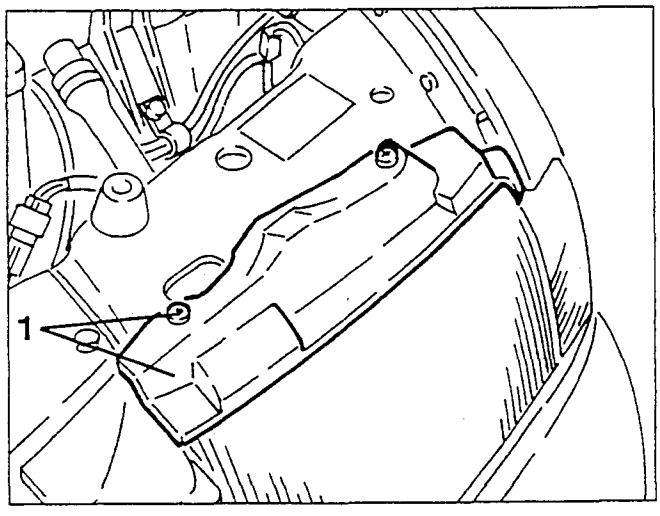
(1929 TD Cat)

NOTE:
For the operating logic of the control unit and the description of the exhaust gas recirculation system, refer to the corresponding paragraph in Group 10 specific for this car.

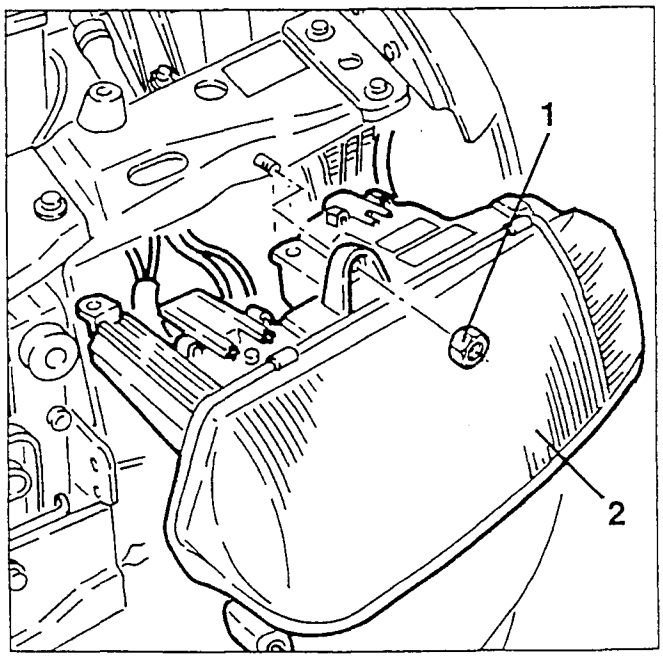
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Remove the radiator grille (see GROUP 70).

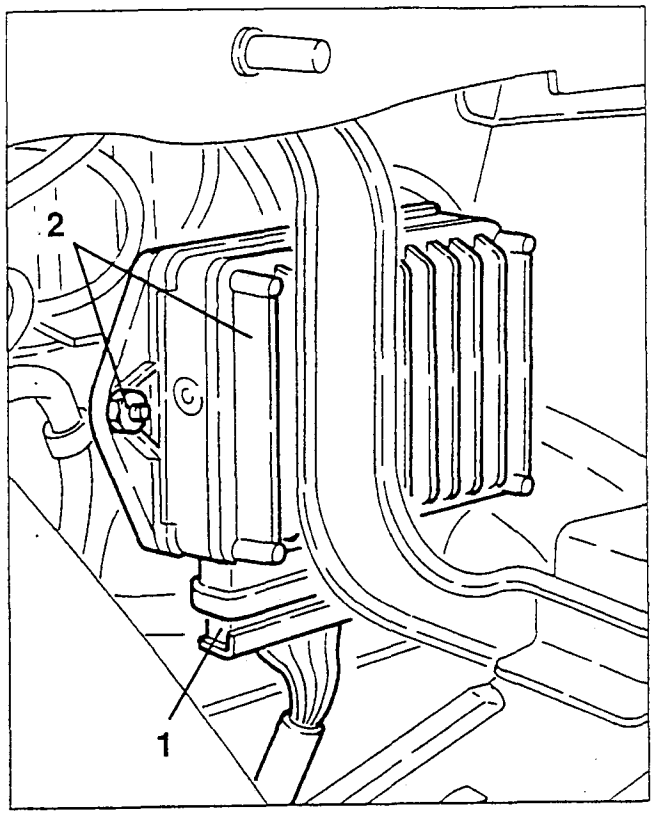
1. Slacken the fastening screws and remove the left front headlamp upper cover.



1. Slacken the three nuts fastening the left headlamp to the body.
2. Move the headlamp forward just enough to disconnect the electrical connections, then remove it complete with direction indicator.



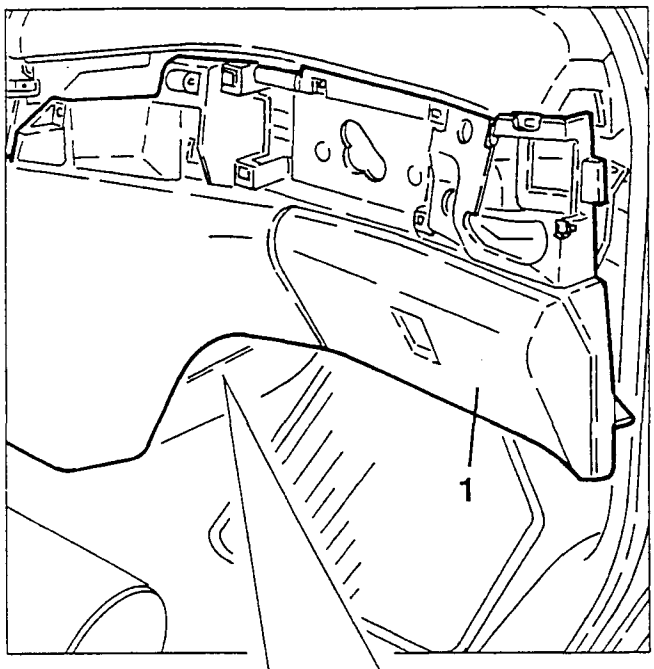
1. Working from the recess obtained by removing the headlamp, disconnect the electrical connection from the control unit.
2. Slacken the two fastening nuts, then remove the control unit.

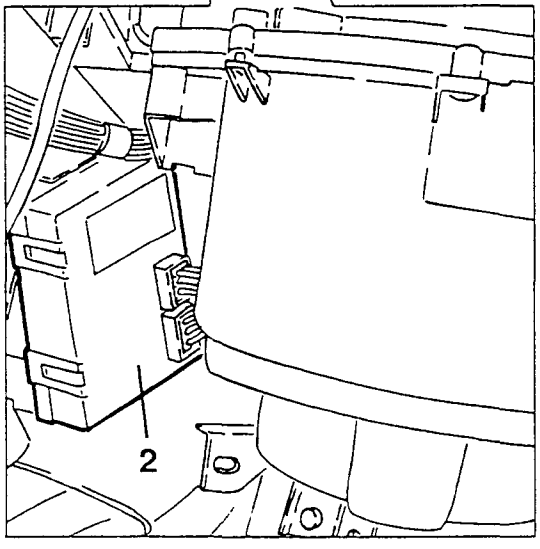


AUTOMATIC CLIMATE CONTROL SYSTEM CONTROL UNIT

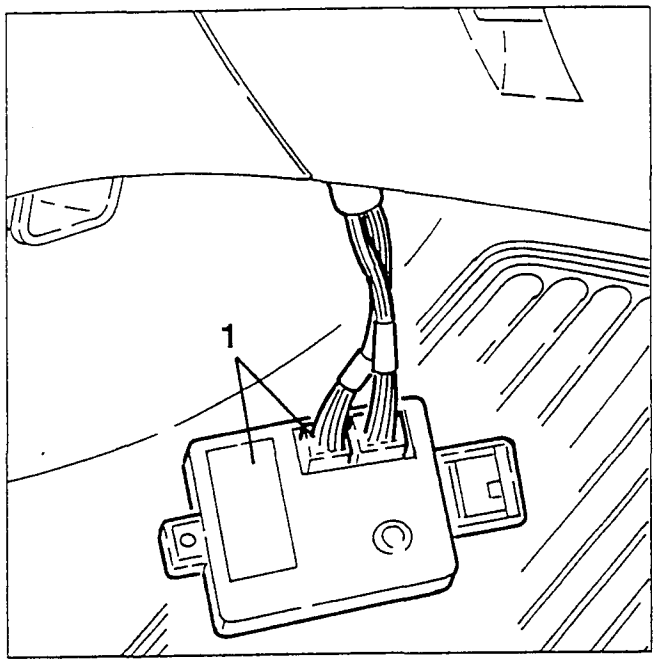
REMOVING/REFITTING

- Disconnect the battery (-) terminal.
1. Move away the lower part of the dashboard as illustrated (see GROUP 70).
2. Release the control unit from the fastening catch and withdraw it to gain access to the electrical connections.





1. Disconnect the electrical connections from the control unit, then remove it.

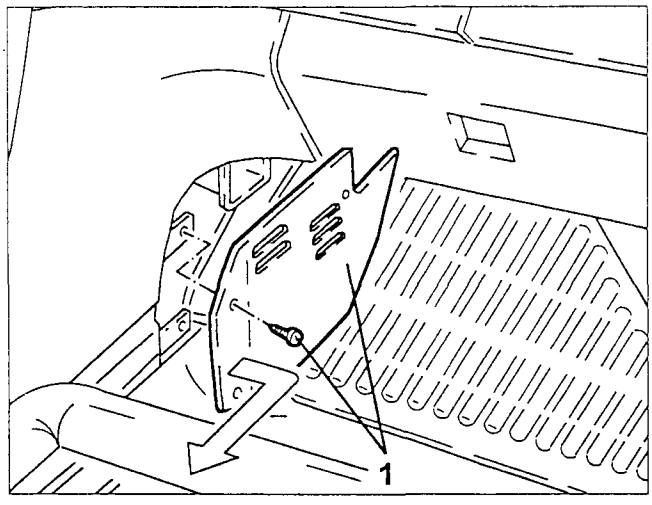


INJECTION CONTROL UNIT (1910 JTD Version)

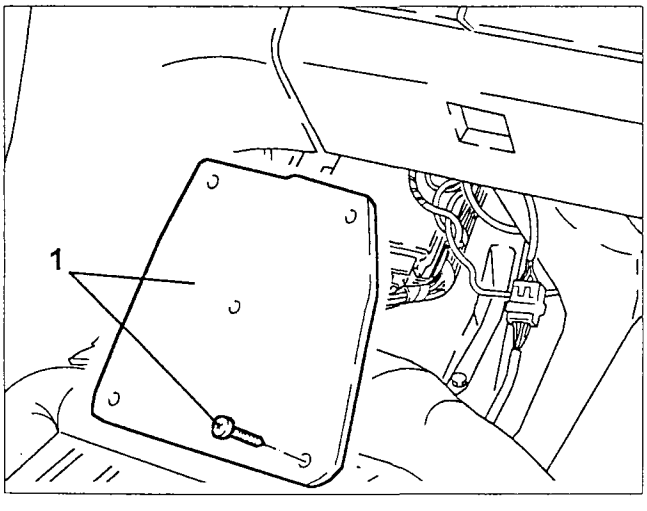
REMOVAL/REFITTING

- Make sure that the ignition key is in the «STOP» position, then disconnect the (-) battery terminal.

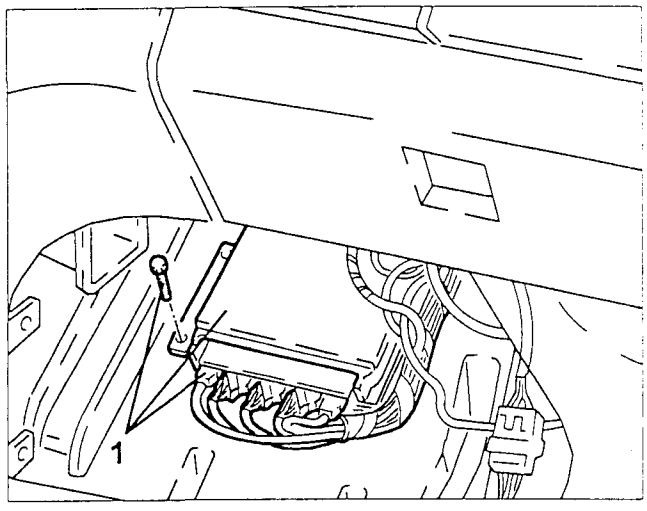
1. Slacken the two fastening screws, then remove the trim of the air delivery vent to the feet of the front passenger.



1. Move aside the mat, then remove the control unit cover after slackening the fastening screws.



1. Slacken the fastening screws, disconnect the electrical connections and remove the injection control unit.

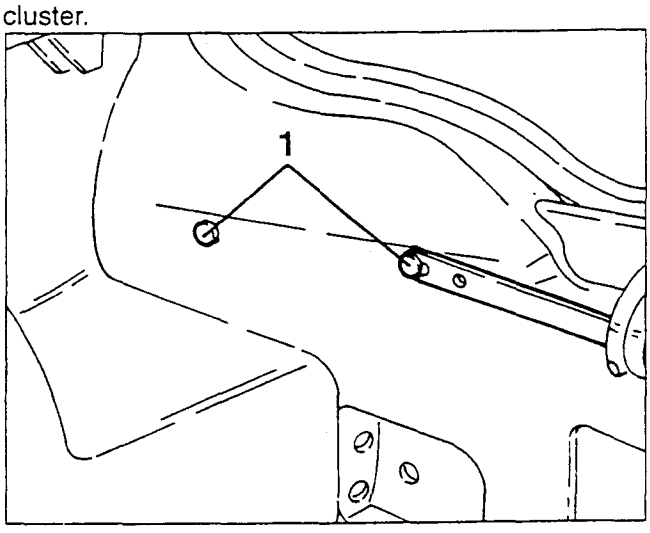


TAIL LIGHT CLUSTERS

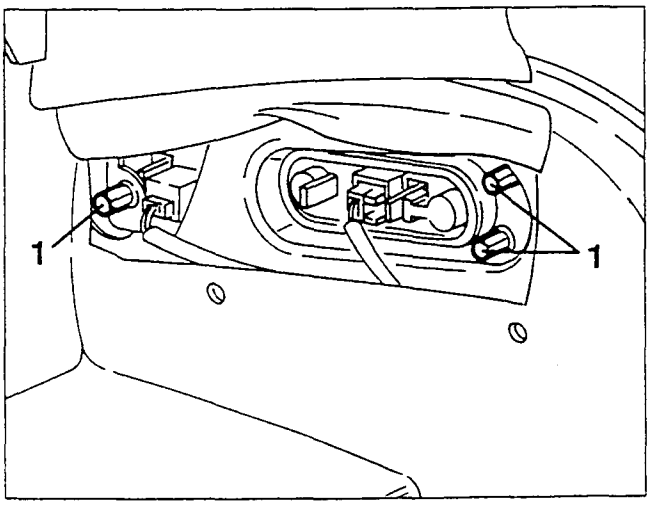
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

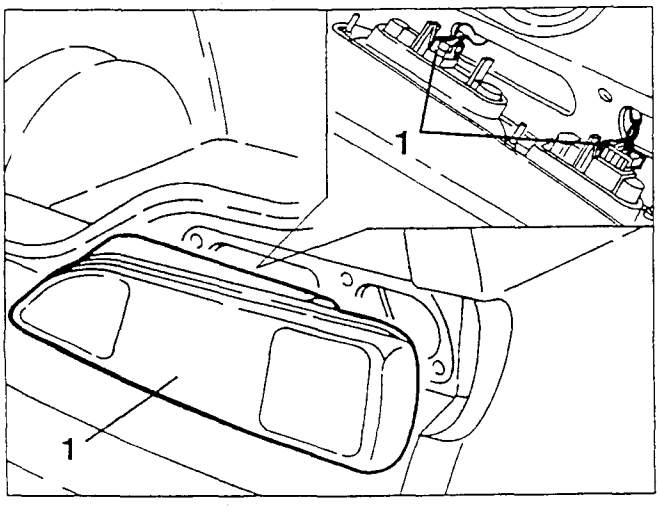
1. Working from the luggage compartment remove the two plastic buttons to gain access to the tail light cluster.



1. Raise the edge of the specially arranged trim, then slacken the four nuts fastening the tail light cluster to the body.



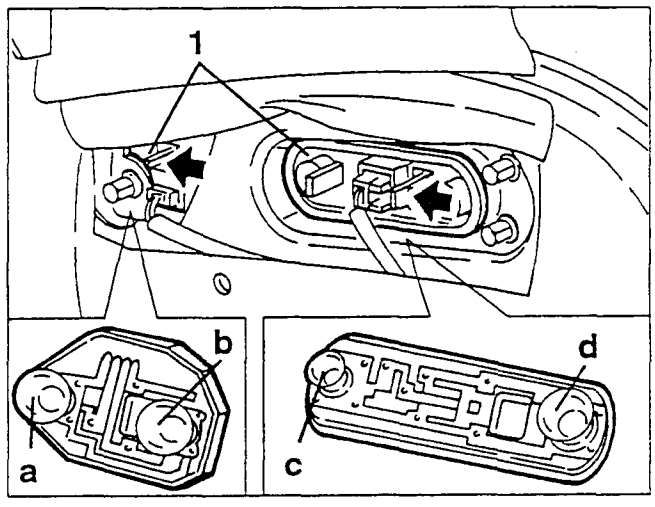
1. Working from the outside of the car, withdraw the tail light cluster just enough to disconnect the two electrical connections, then remove it.



REPLACING TAIL LIGHT CLUSTER BULBS

- Working from the luggage compartment remove the two plastic buttons to gain access to the tail light cluster.

1. Raise the edge of the specially arranged trim, then pressing the special tabs as illustrated, remove the two bulb holders.
2. Remove the direction indicator bulb (**a**), the fog guard bulb (**b**) (for the left-hand lamp it is the reversing light bulb), the side light bulb (**c**) and the stop light bulb (**d**) pressing and twisting them counter-clockwise.

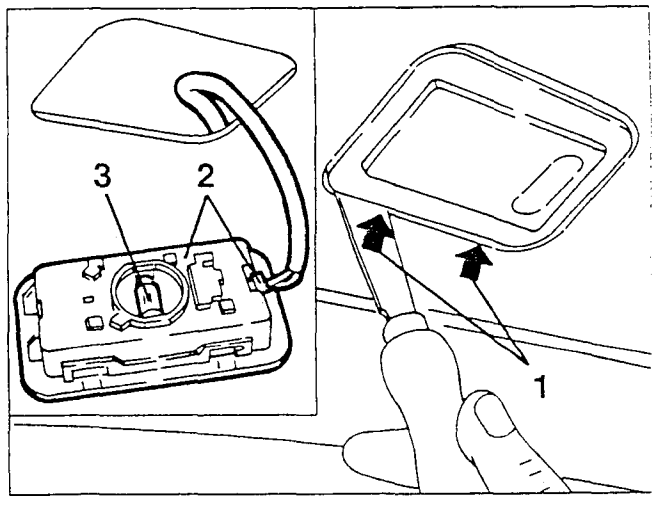


REAR CEILING LAMP

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

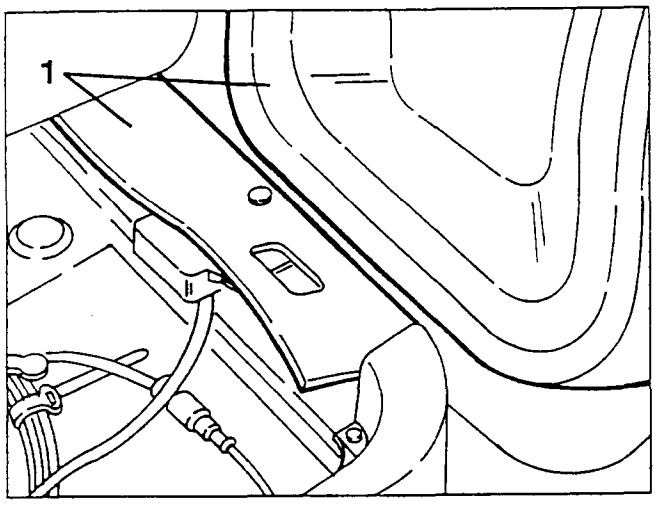
1. Working on the two catch teeth, positioned as illustrated, prise and pull out the rear ceiling lamp.
2. Disconect the electrical connection and remove the rear ceiling lamp.
3. If necessary, remove the bulb pulling it outwards and releasing it from the side contacts.



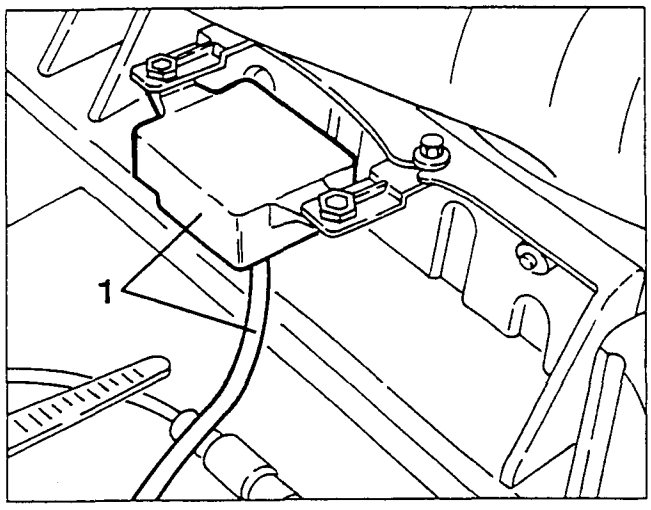
CEILING LAMP TIMER

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Raise the raight-hand side rear cushion and move aside the floor trim to gain access to the ceiling lamp timer.



1. Disconnect the electrical connection, slacken the two fastening screws and remove the ceiling lamp timer.

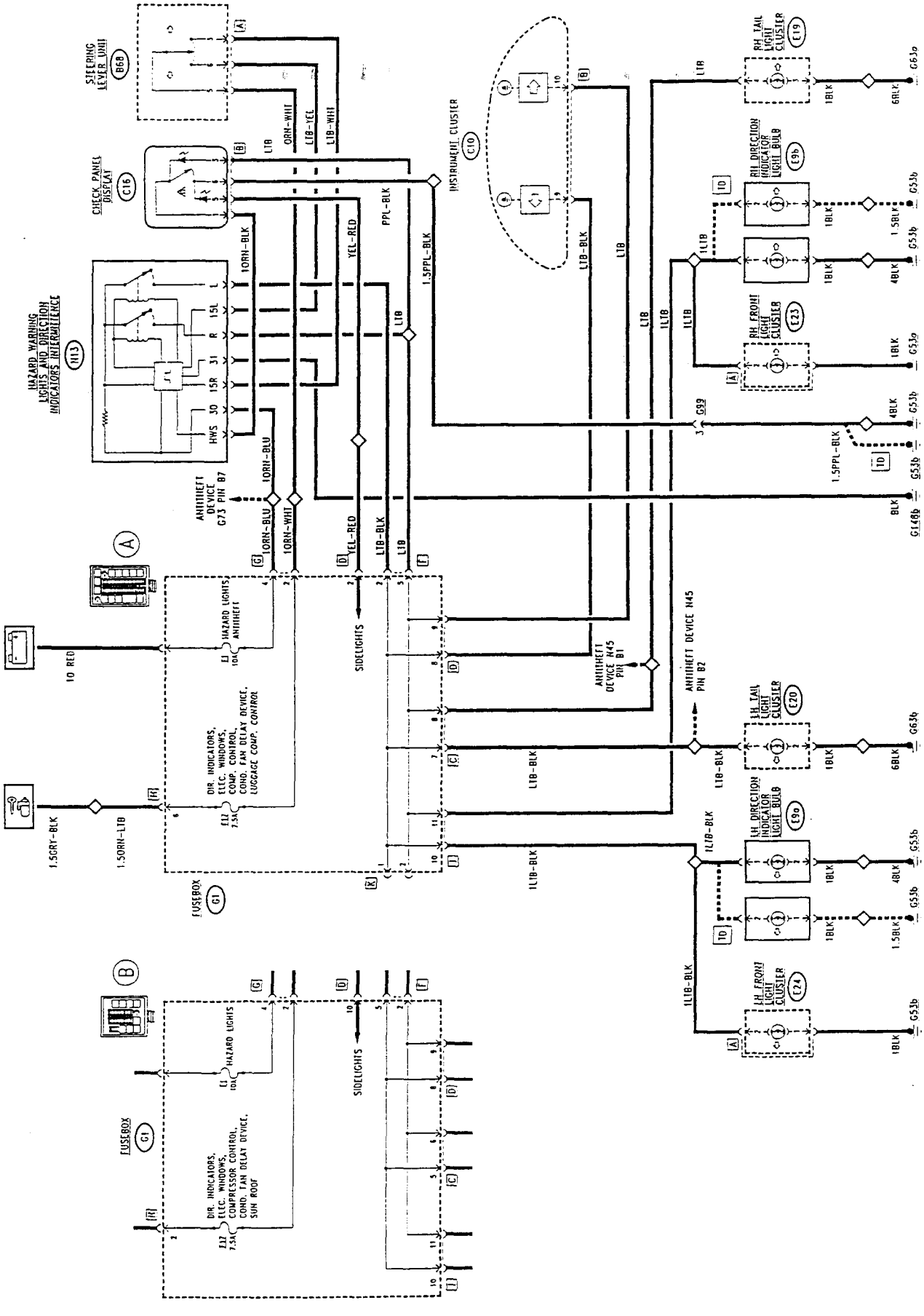


DIRECTION INDICATORS AND HAZARD WARNING LIGHTS

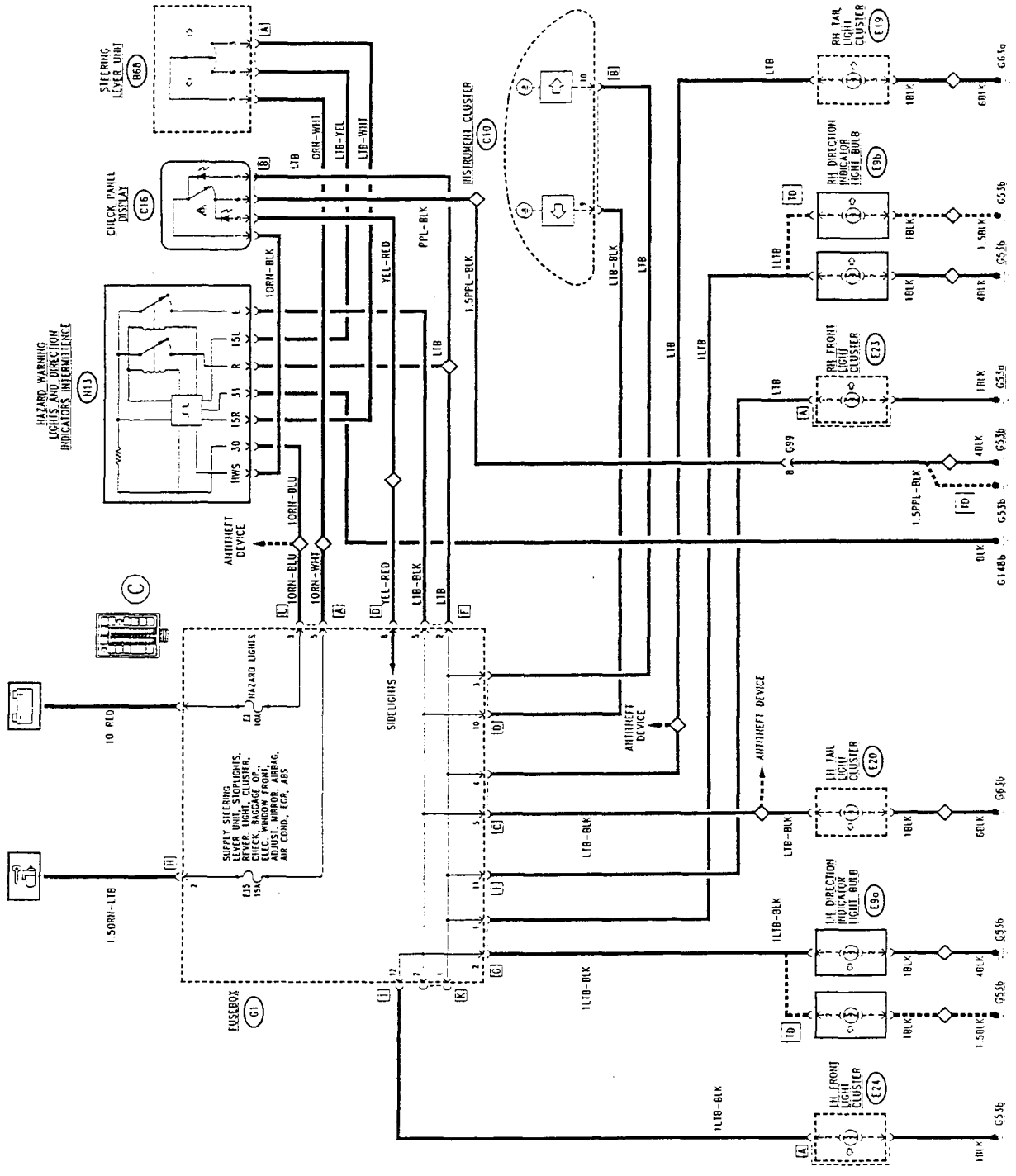
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CHECKING COMPONENTS 12-9

WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The intermittent direction indicators and hazard warning lights delineate the vehicle clearance.

The right or left direction indicators are turned on raising or lowering the lever on the steering column lever unit; the hazard warning lights (right and left indicators activated simultaneously) are switched on from the switch on the Check Panel.
The direction indicators operate when the ignition key is engaged, for the obvious safety reasons, they are supplied directly by the battery.
Two intermittent warning lights on the instrument cluster flash while the right and left indicators are operating. The hazard warning light indicates that these are operating by illuminating when they are turned on.

The circuit of the direction indicators is protected by a fuse and another fuse protects the circuit for the hazard warning lights.

FUNCTIONAL DESCRIPTION

The circuit is controlled by the hazard warning light and direction indicator flasher **N13** to be found next to the fusebox.

The flasher, earthed at pin 31, is supplied at pin 30 directly from the battery via the line of fuse **F1** of fusebox **G1**.

Pin 15R and 15L receive the signals (12V) from the lever unit **B68** when the "key-operated" supply of the line protected by fuse **F17** of box "A" and "B" is switched or from fuse **F15** of box **G1** "C", of **G1** for turning on the right direction indicator (pin 15R) and the left one (pin 15L).

Pin HWS receives a signal (earth) when the hazard warning light switch in the Check Panel **C16** is pressed.

Pins R and L send the intermittent supply signals for all the indicators: from pin R for those on the right, from pin L for those on the left, according to the following logic:

– only pin R (RH) if the signal reaches pin 15R

– only pin L (LH) if the signal reaches pin 15L

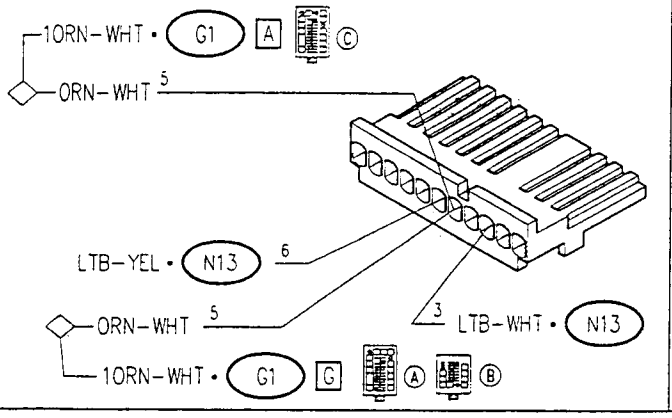
– both pins R and L if the signal reaches pin HWS.

This way operating the stalk of the lever unit **B68** turns on the righthand indicators (**E23, E9b** and **E19**) or the left ones (**E24, E9a** and **E20**) and simultaneously the corresponding warning light on the instrument cluster **C10** is turned on.

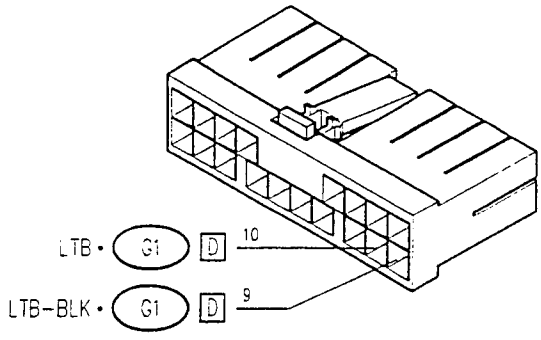
When the switch on the Check Panel **C16** is pressed, the right and left direction indicators are supplied contemporaneously and also the special led (pin 3) inside **C16** is supplied which lights up when the hazard warning lights are switched on. A second led (pin 3) illuminates the ideogram of the switch when the side lights are on - see section "Lighting of Controls and Indicators".

COMPONENTS AND CONNECTORS

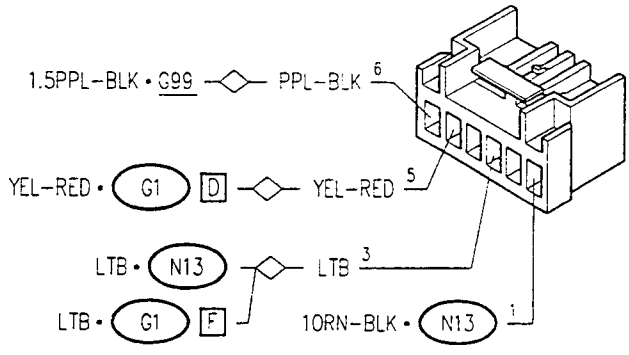
Lever unit — B68 A



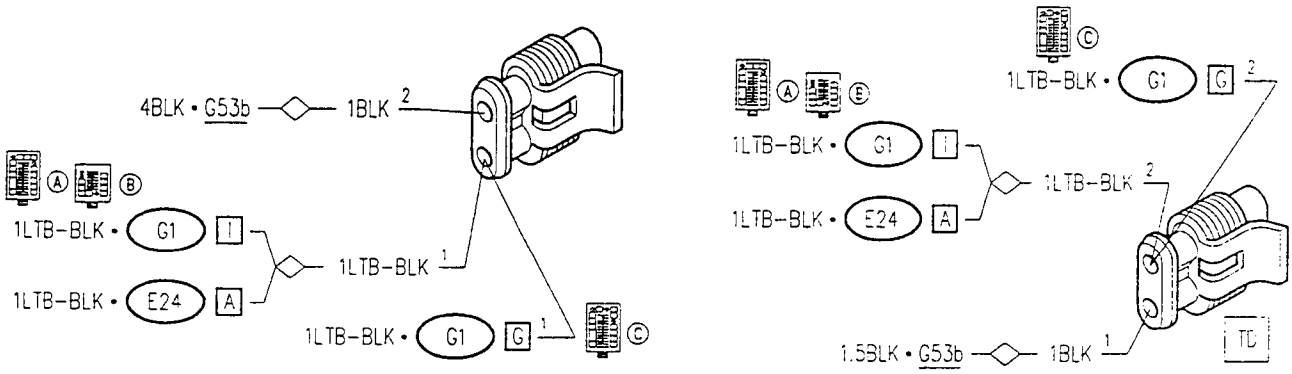
Instrument cluster — C10 B



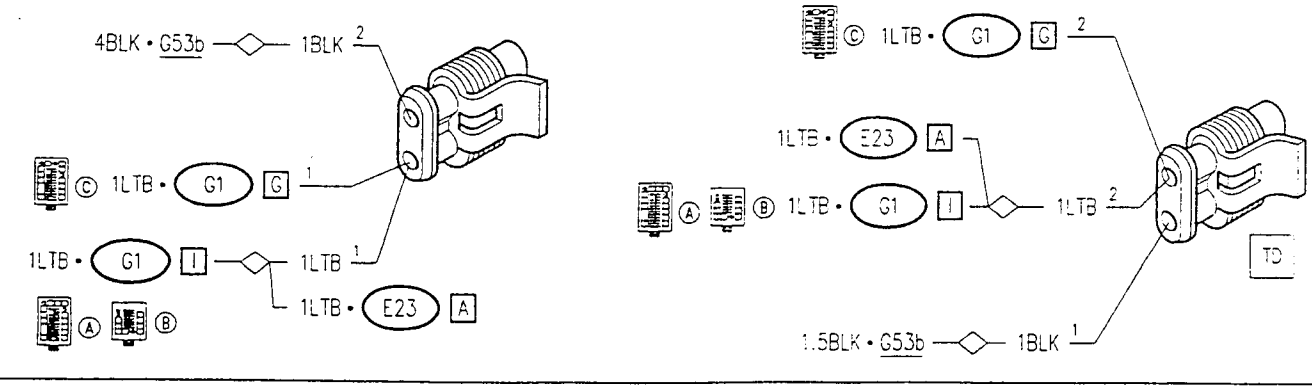
Check Panel Display — C16 B



LH direction indicator light bulb — E9a

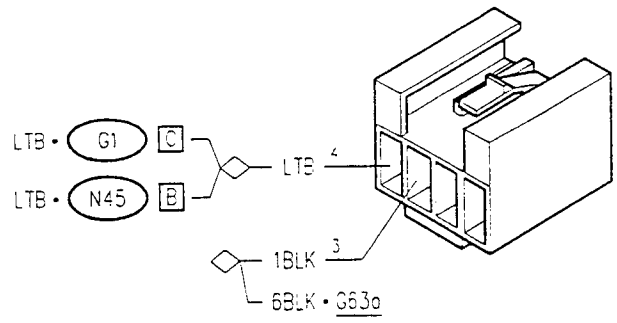


RH direction indicator light bulb — E9b

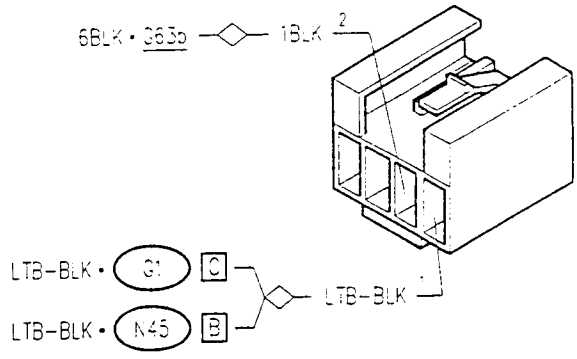


COMPONENTS AND CONNECTORS (cont.d)

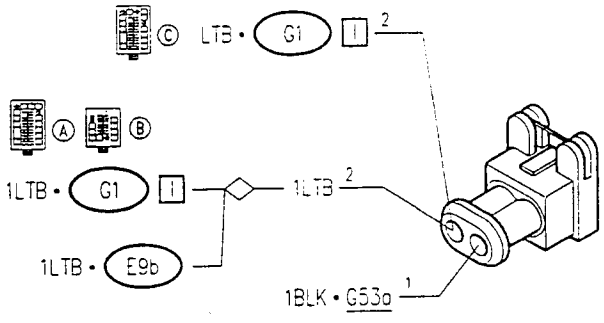
RH light bulb	E19



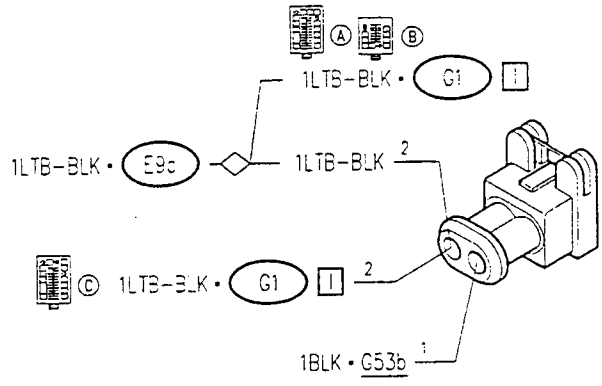
LH light bulb	E20



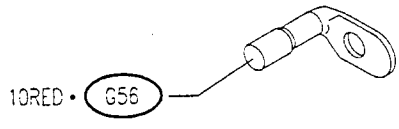
RH front light cluster	E23	A



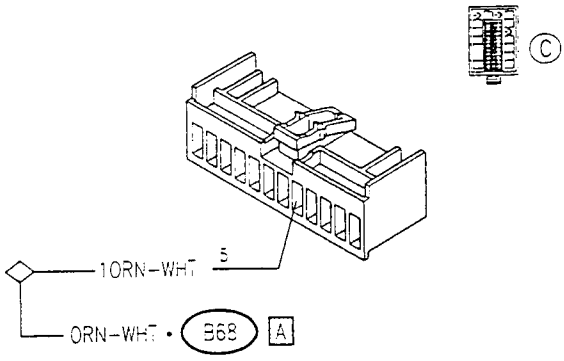
LH front light cluster	E24	A



Fusebox	G1

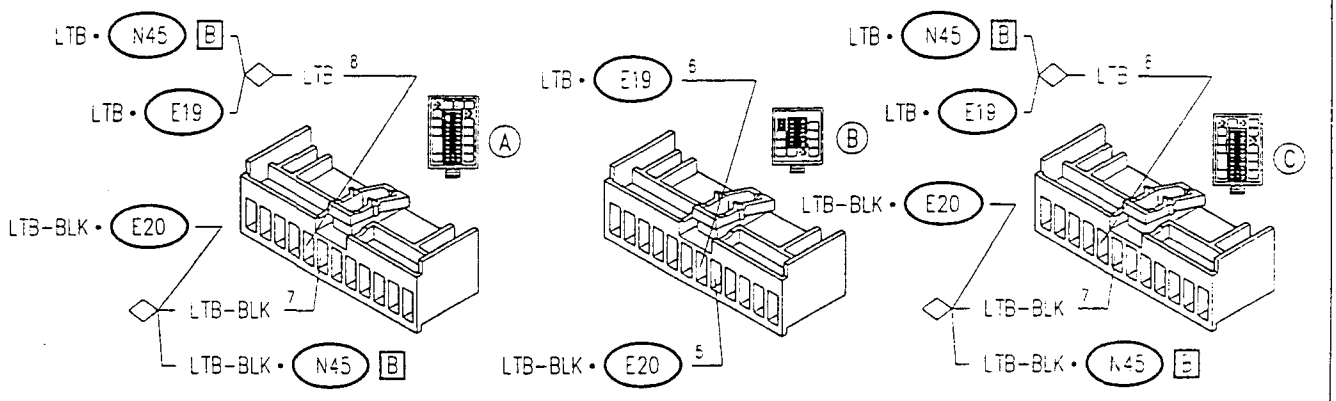


Fusebox	G1	A

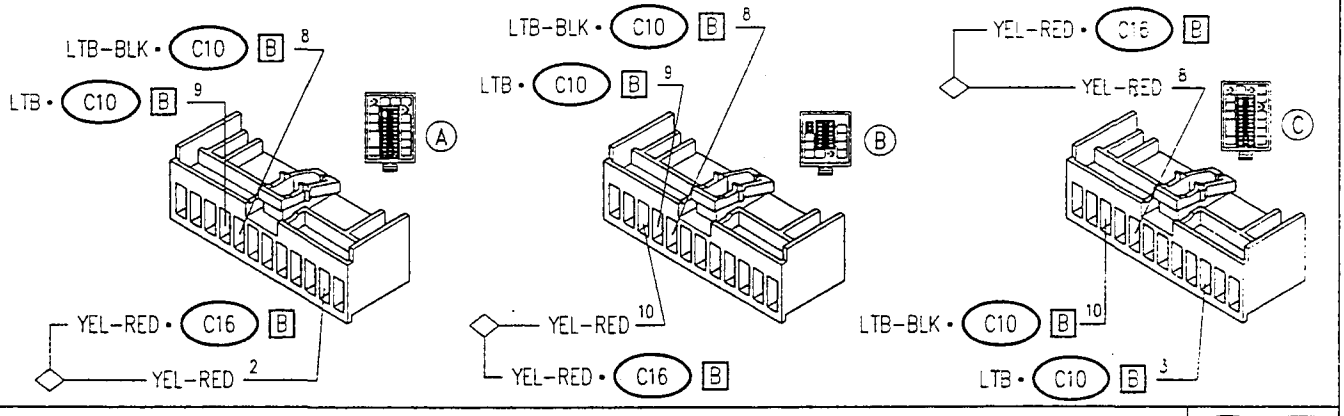


COMPONENTS AND CONNECTORS (cont.d)

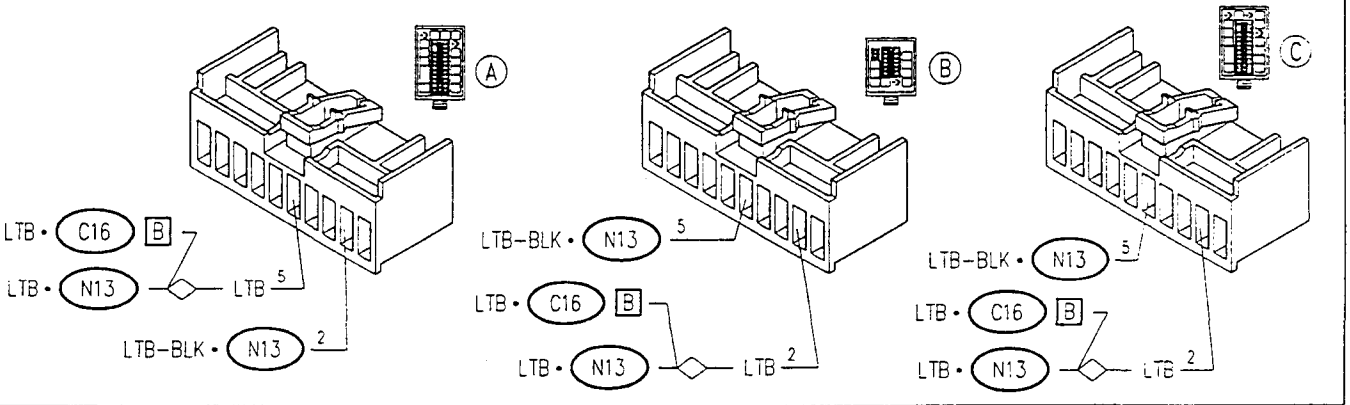
Fusebox G1 C



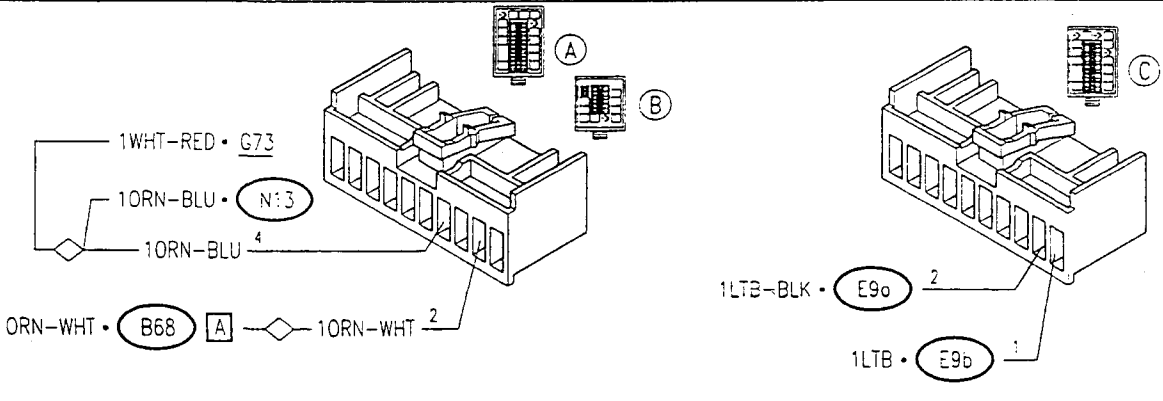
Fusebox G1 D



Fusebox G1 F

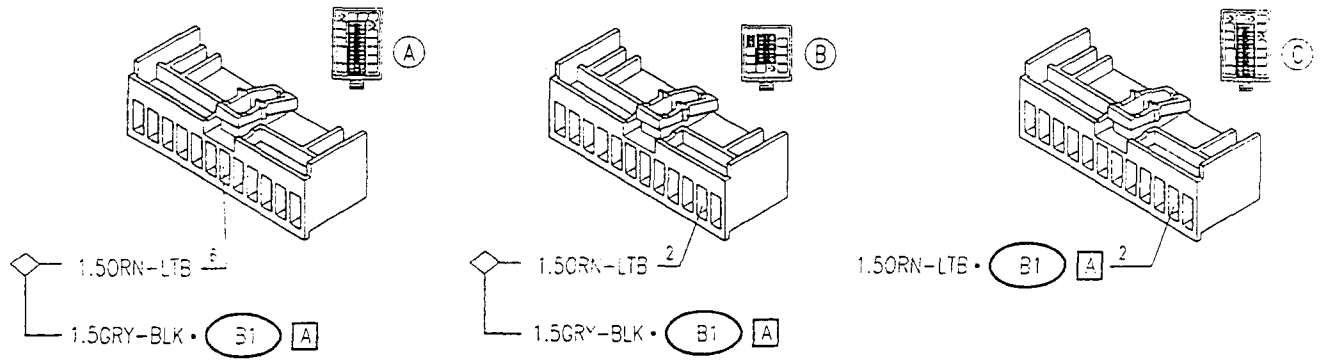


Fusebox G1 G

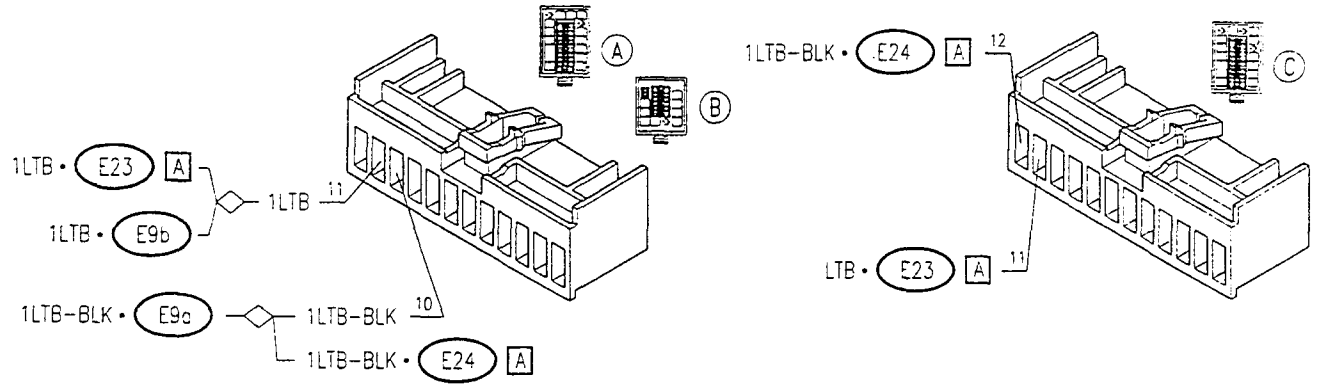


COMPONENTS AND CONNECTORS (cont.d)

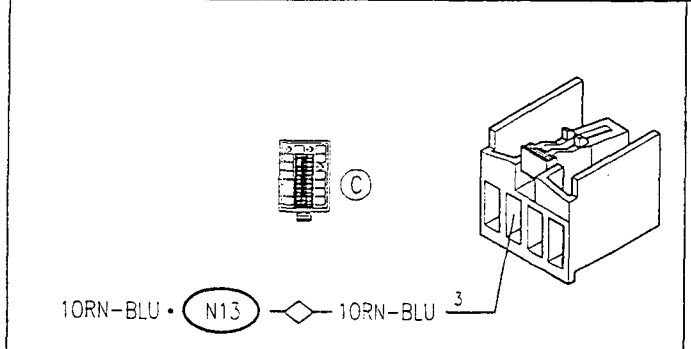
Fusebox — G1 H



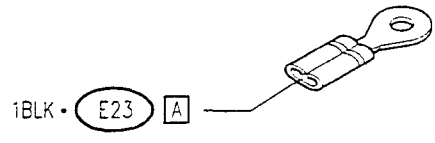
Fusebox — G1 I



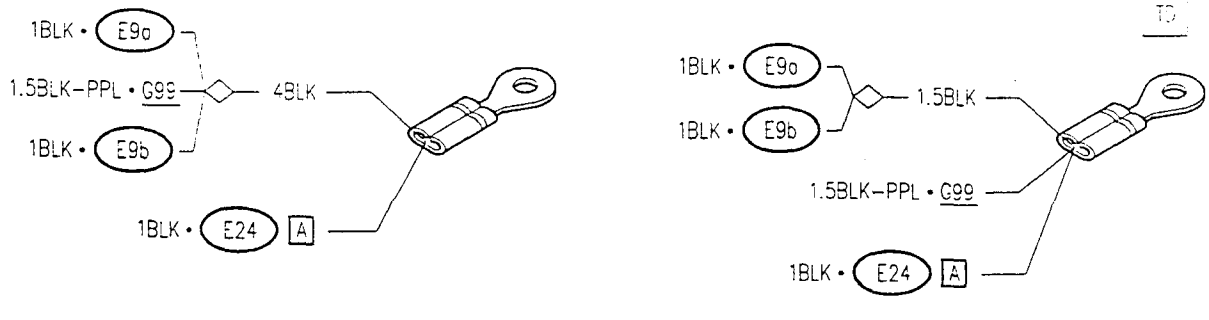
Fusebox — G1 L



RH engine compartment earth — G53a

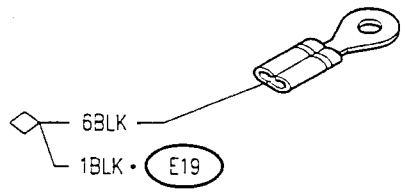


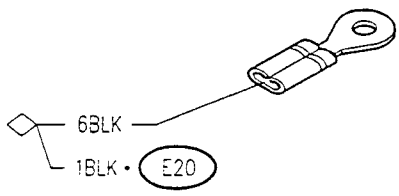
LH engine compartment earth — G53b



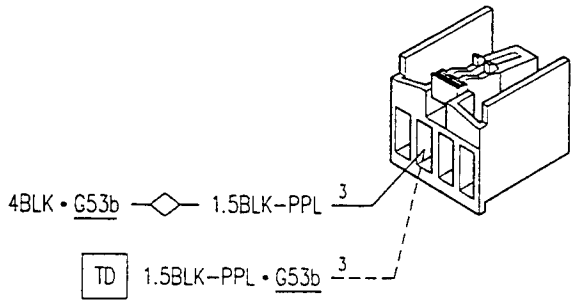
COMPONENTS AND CONNECTORS (cont.d)

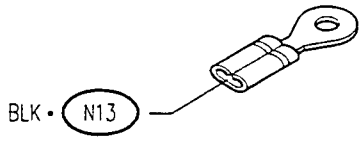
RH rear earth	G63a	LH under earth	G63b



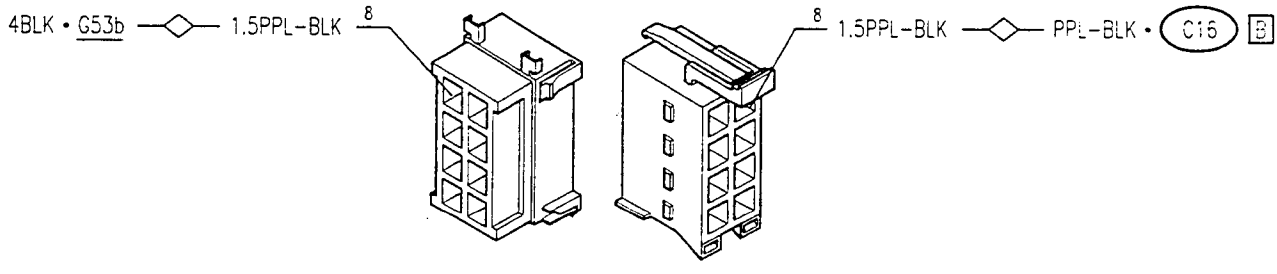


Dashboard/engine wiring connector (*)	G99	Earth under LH dashboard	G148b

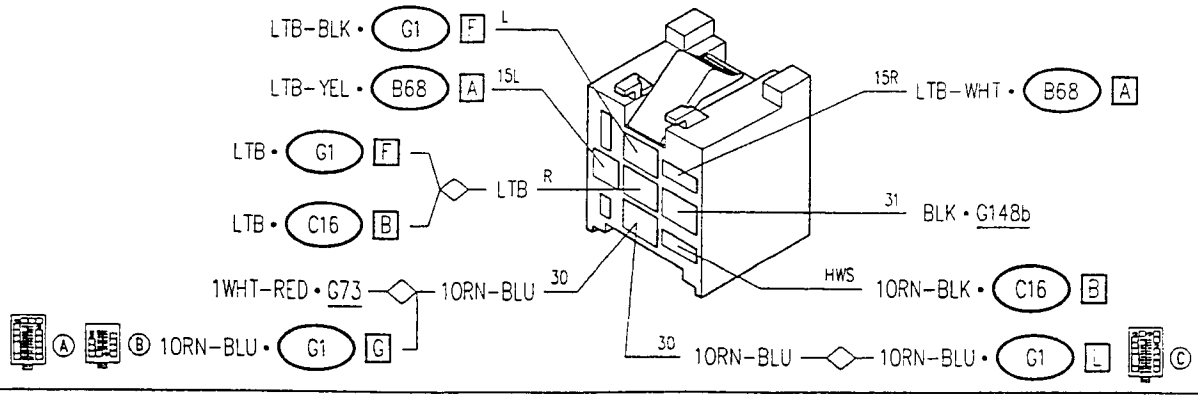




Dashboard/engine wiring connector (**)	G99



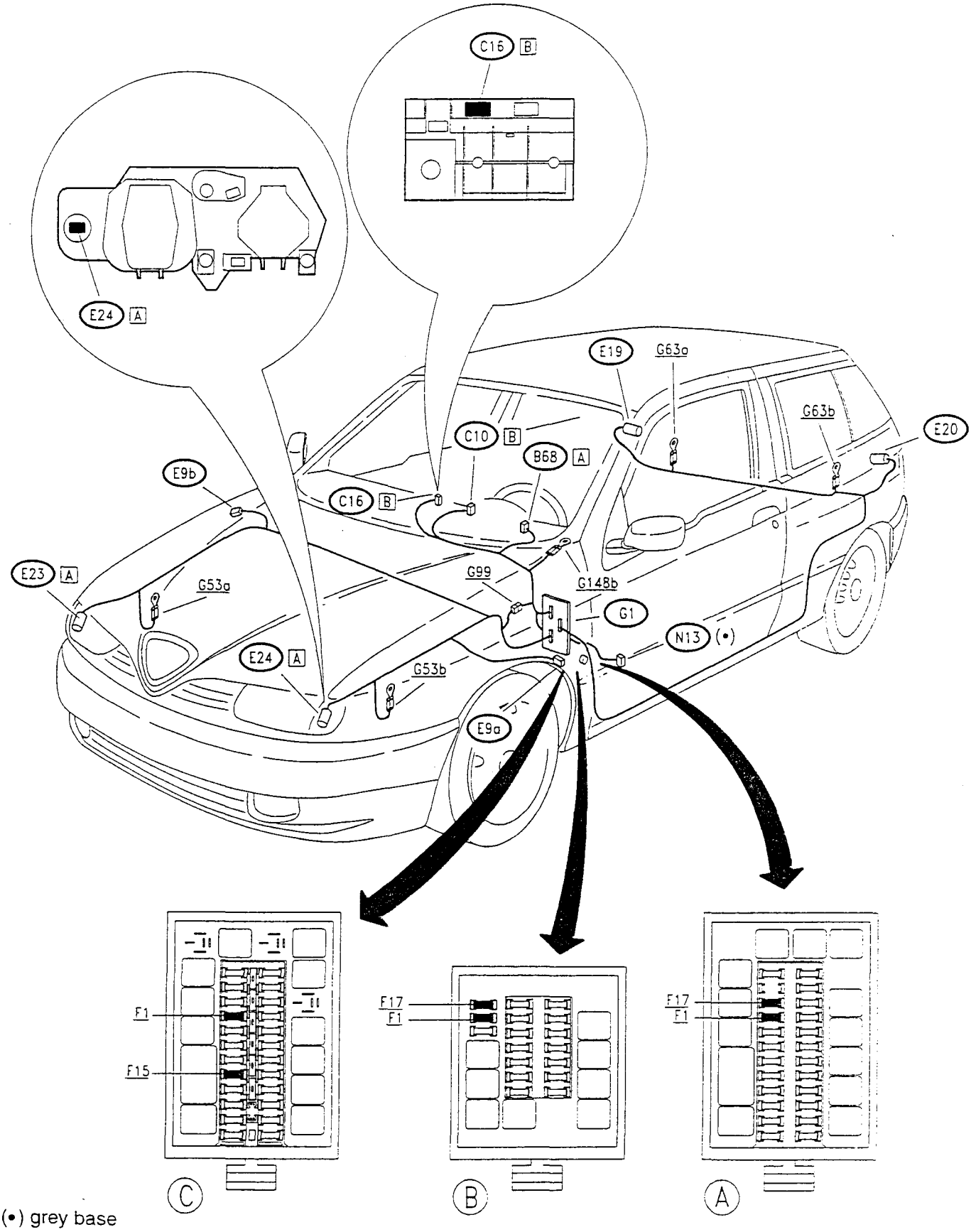
Indicator & hazard warning light flasher	N13



(*) up to chassis no.___

(**) from chassis no.___

LOCATION OF COMPONENTS



(•) grey base

FAULTFINDING TABLE

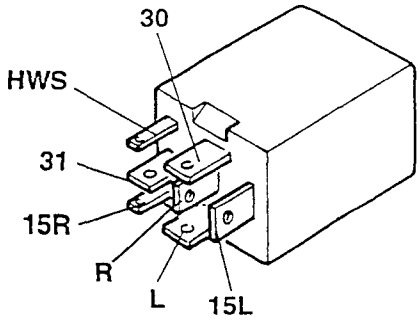
Failure	Component to be checked											
	F1	F17	E23	E24	E9a	E9b	E19	E20	N13	B68	C16 (**)	C10 (*)
All the direction indicators	•	•							•	•		
Hazard warning lights	•								•		•	
All the RH direction indicators									•	•		
All the LH direction indicators									•	•		
RH front light			•									
RH side light						•						
RH rear light							•					
LH front light				•								
LH side light					•							
LH rear light								•				
RH indicator warning light												•
LH indicator warning light												•
Hazard warning light switch illuminated with lights on											•	

(*) The instrument cluster **C10** cannot be repaired. Therefore in the event of a failure it is not possible to change the single warning light and a new complete cluster must be fitted.

(**) The "Check Panel" display **C16** cannot be repaired. Therefore, in the event of a failure it is not possible to replace the hazard warning light switch and a new complete Check Panel must be installed.

CHECKING COMPONENTS

Hazard warning light and indicator flasher (N13)



Checking the device: see **TEST A**

HAZARD WARNING LIGHT AND INDICATOR FLASHER (N13)	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect the flasher **N13** and on the base check for 12V at pin 30 of **N13**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Check fuse **F1** from fusebox **G1**. If necessary
A2 CHECK EARTH – Check for 0 V at pin 31 of **N13**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore the wiring between **N13** and earth **G148b**
A3 CHECK INTERMITTENT VOLTAGE – With the ignition key turned, operate the RH indicator and check for 12 V at pin 15R of **N13**; operate the LH indicator in the same way, check pin 15L of **N13**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between **N13** and lever unit **B68**, or replace the latter
A4 CHECK EARTH – Operate the hazard warning light switch and check for 0V at pin HWS of **N13**	OK ▶ ~~OK~~ ▶	Insert device **N13** on its base and continue with oseguire **step A5** Restore the wiring between **N13** and the switch in panel **C16**, or change the latter
A5 CHECK INTERMITTENT VOLTAGE – Operate the RH indicator and check for **intermittent 12V** at pin R of **N13**; do the same operating the LH indicator at pin L and operating the hazard warning lights at both pin R and pin L	OK ▶ ~~OK~~ ▶	DEVICE **N13** IS WORKING PROPERLY. Check the connections with the other components CHANGE DEVICE **N13**

INSTRUMENT CLUSTER

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GENERAL DESCRIPTION

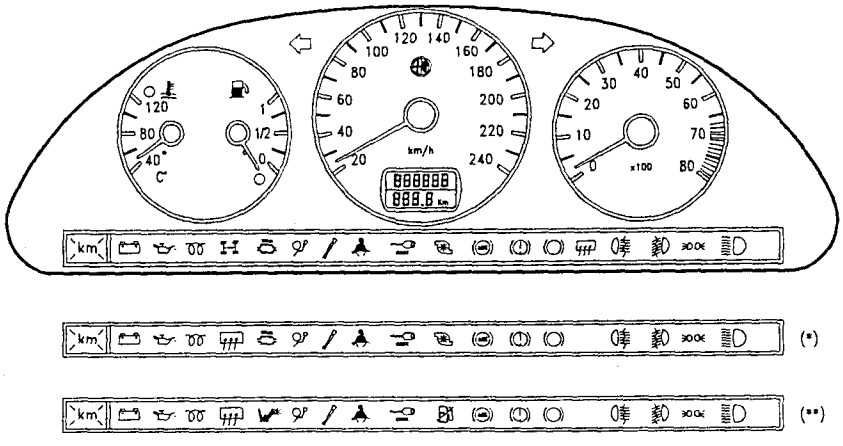
The instrument cluster offers all the indications and information about the conditions of the vehicle which are indispensible for safe and troublefree driving.
The cluster is of the analogue type with two large dials for the speedometer and rev counter, plus other gauges for the fuel level and coolant temperature.
A comprehensive set of plainly visible warning lights completes the information for the driver.

N.B.: The instrument cluster is made as a single component: all the internal connections are made on a printed circuit which brings together the contacts of the instruments and of the various warning lights.**Therefore, repair operations are not possible, not even the changing of a warning light bulb.**

Note: the section has been subdivided into 5 wiring diagrams:

- the **first diagram** considers all the internal connections of the printed circuit.
- the following 4 diagrams describe certain specific functions: here, only those functions that do not appear elsewhere are described and only with regard to the instrument cluster; other functions, such as warning lights, are included in the wiring diagram of the unit or system to which they refer : for example the high beam headlamp warning light is included in the diagram "High beam and low beam headlamps", etc...

N.B.: the first diagram shows the connections which supply the instrument cluster (or) and earth ( ); in the subsequent diagrams these lines are no longer shown, but this connection is indicated by the corresponding symbols, and may at all events be checked in the internal diagram.
The instrument cluster lighting, supplied when the sidelights are turned on, is described separately (see Lighting of controls and indicators")



(*) from Model Year '97 (**) from Model Year '99

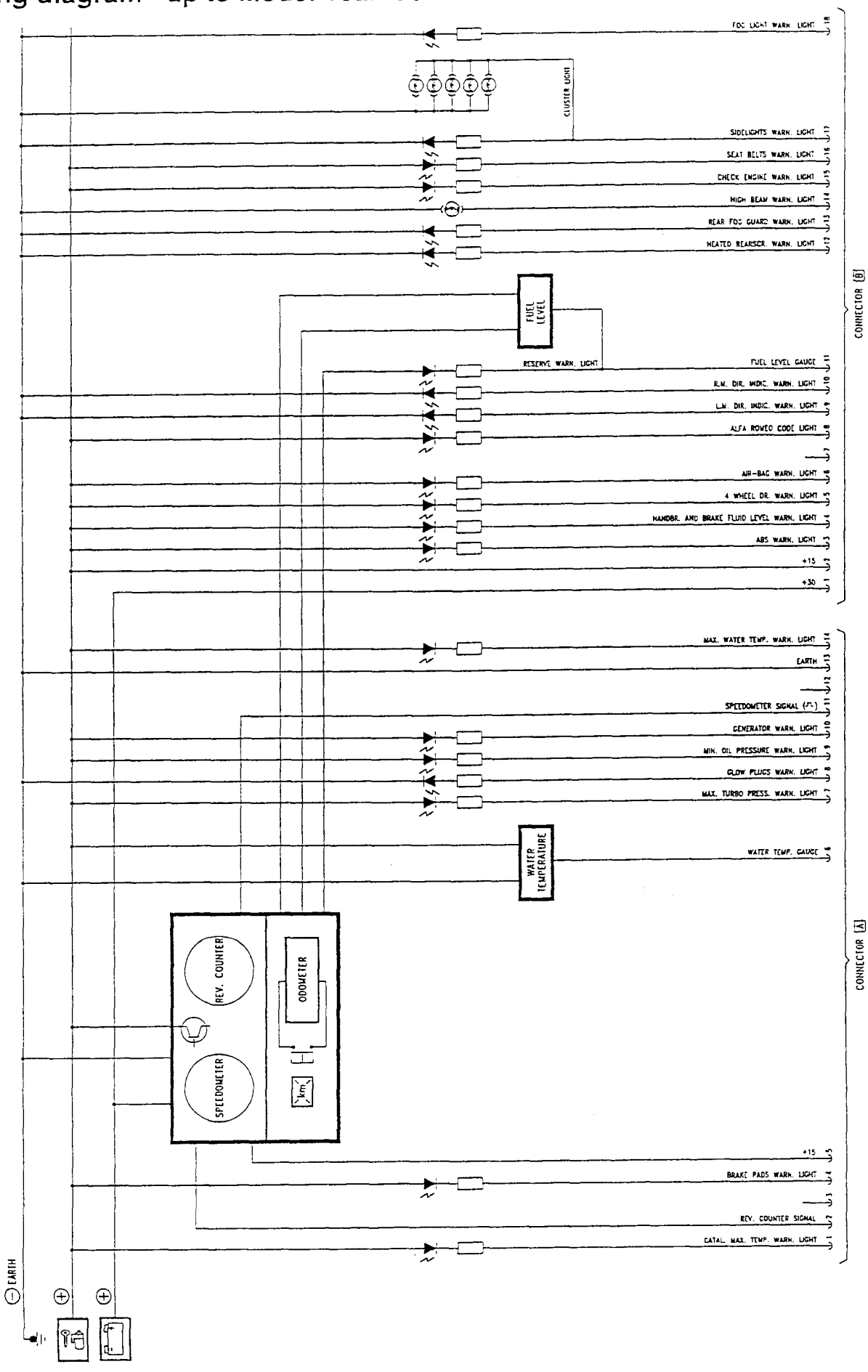
INTERNAL WIRING DIAGRAM (printed circuit)

Functional description

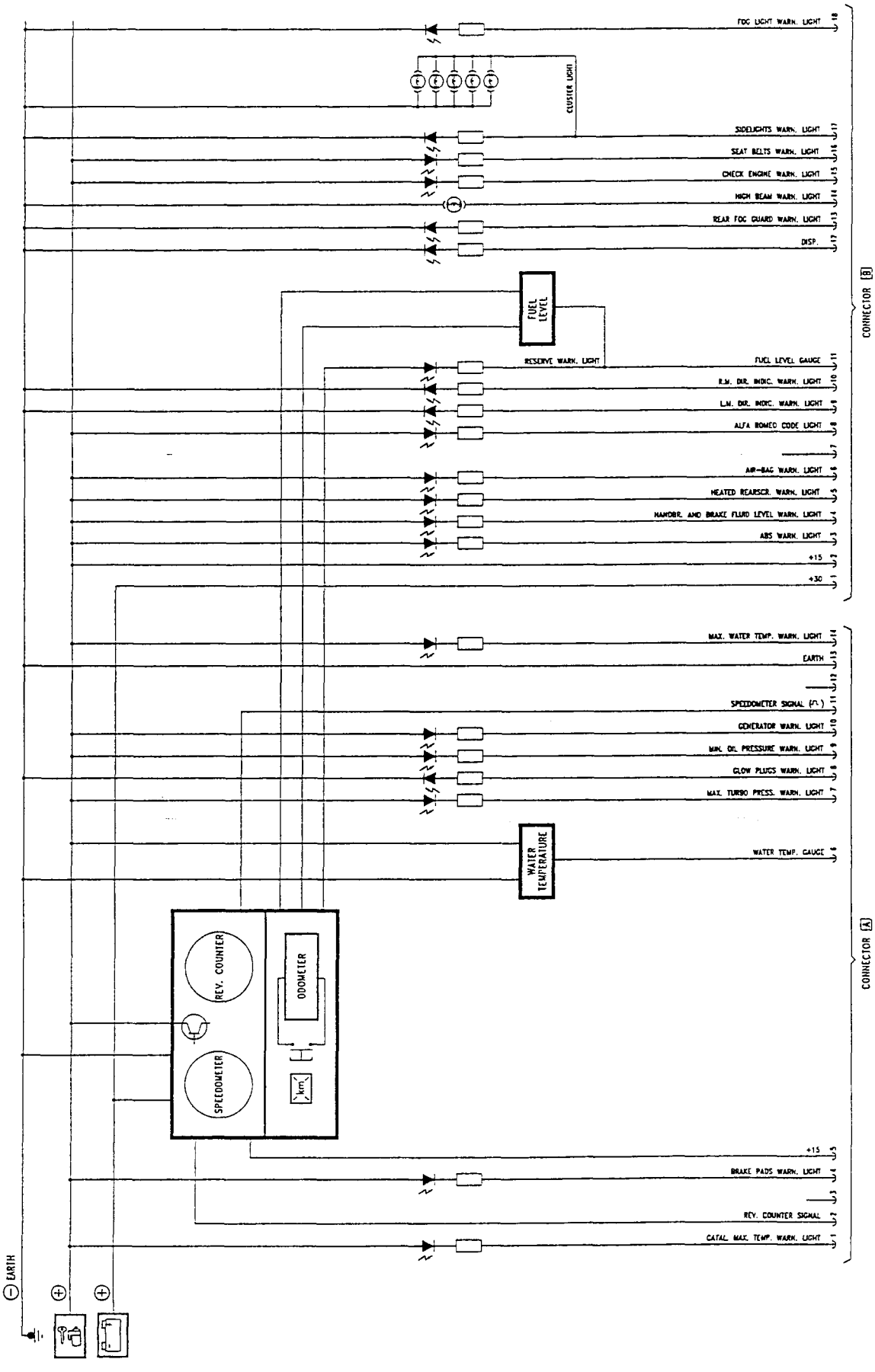
This wiring diagram represents the printed circuit and the connections inside the instrument cluster **C10**.shown, while this diagram gives an overall view of the entire instrument cluster **C10**. the other diarams concerning the outside connections of the cluster, only the lines concerned are shown, while this diagram gives an overall view of the entire instrument cluster **C10**.

NOTE: not all the output pins are connected for all the versions of the car: some lines in this diagram therefore might not be used (e.g. warning lights not connected) but they are still present on the printed circuit, which is the same for all versions.

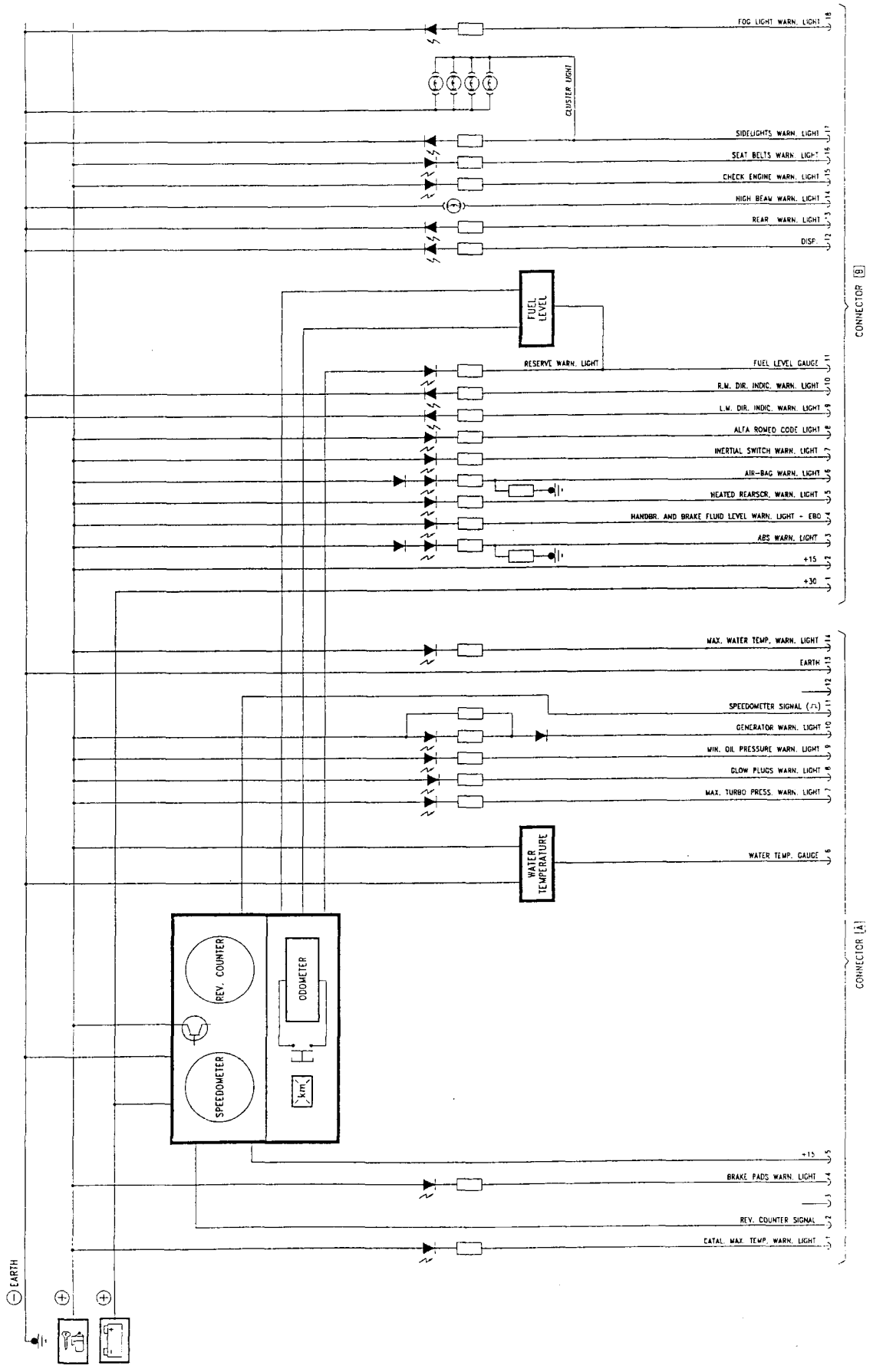
Wiring diagram - up to Model Year '96



Wiring diagram - from Model Year '97

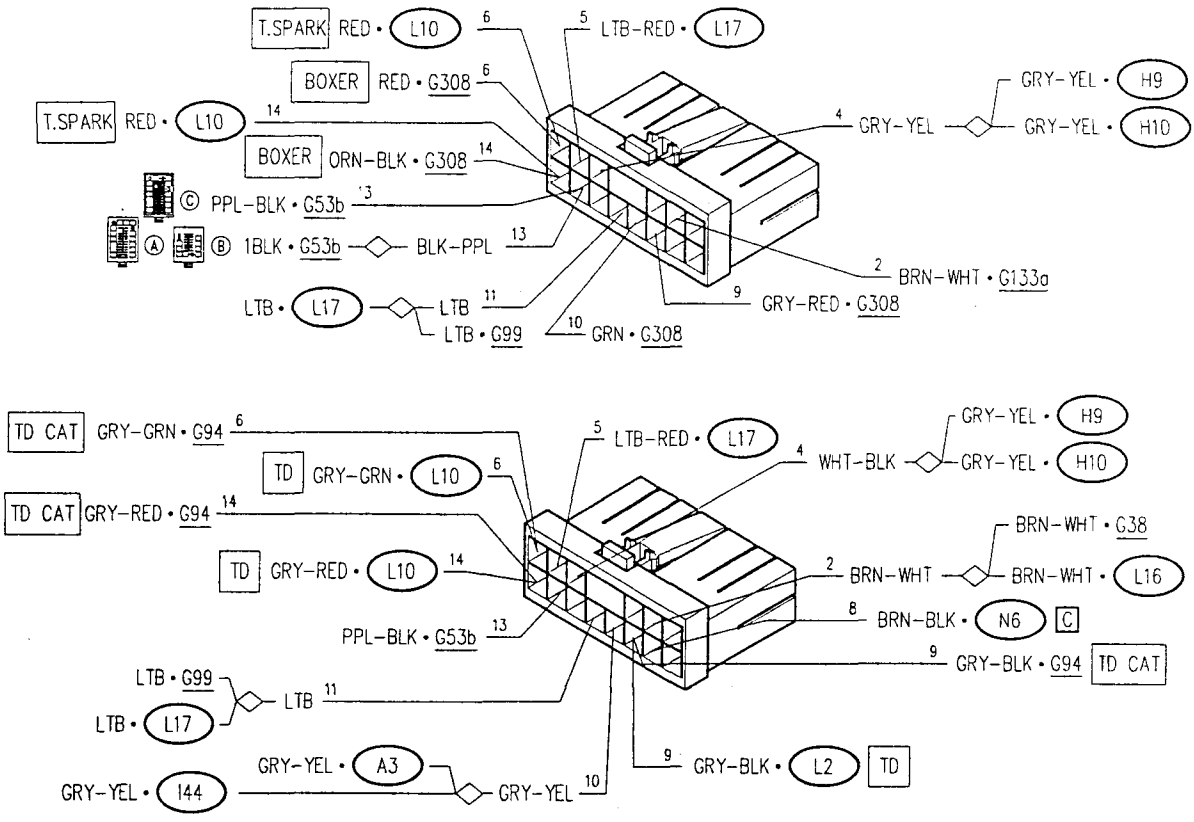


Wiring diagram - from Model Year '99



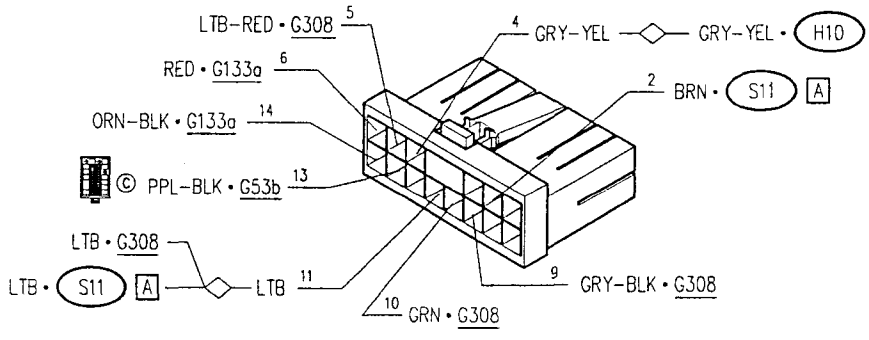
Components and Connectors

Instrument cluster (**) — C10 A

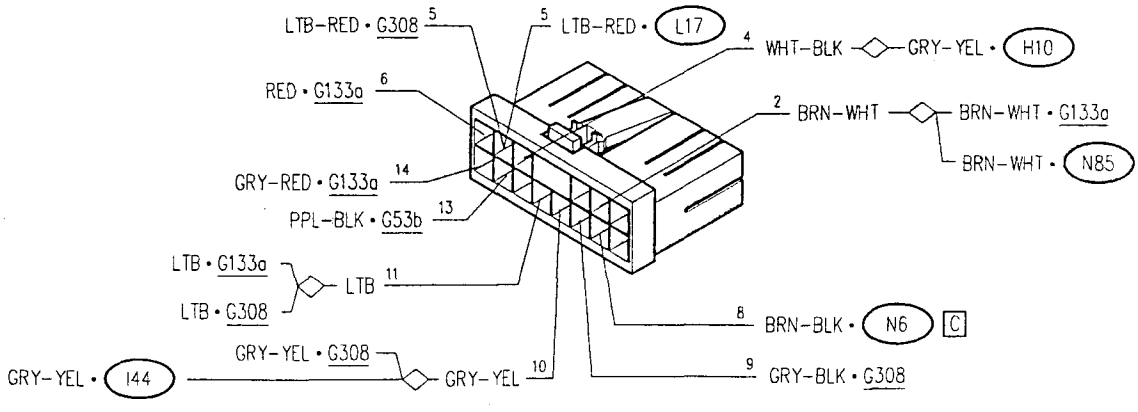


Instrument cluster (•) — C10 A

M1.5.5

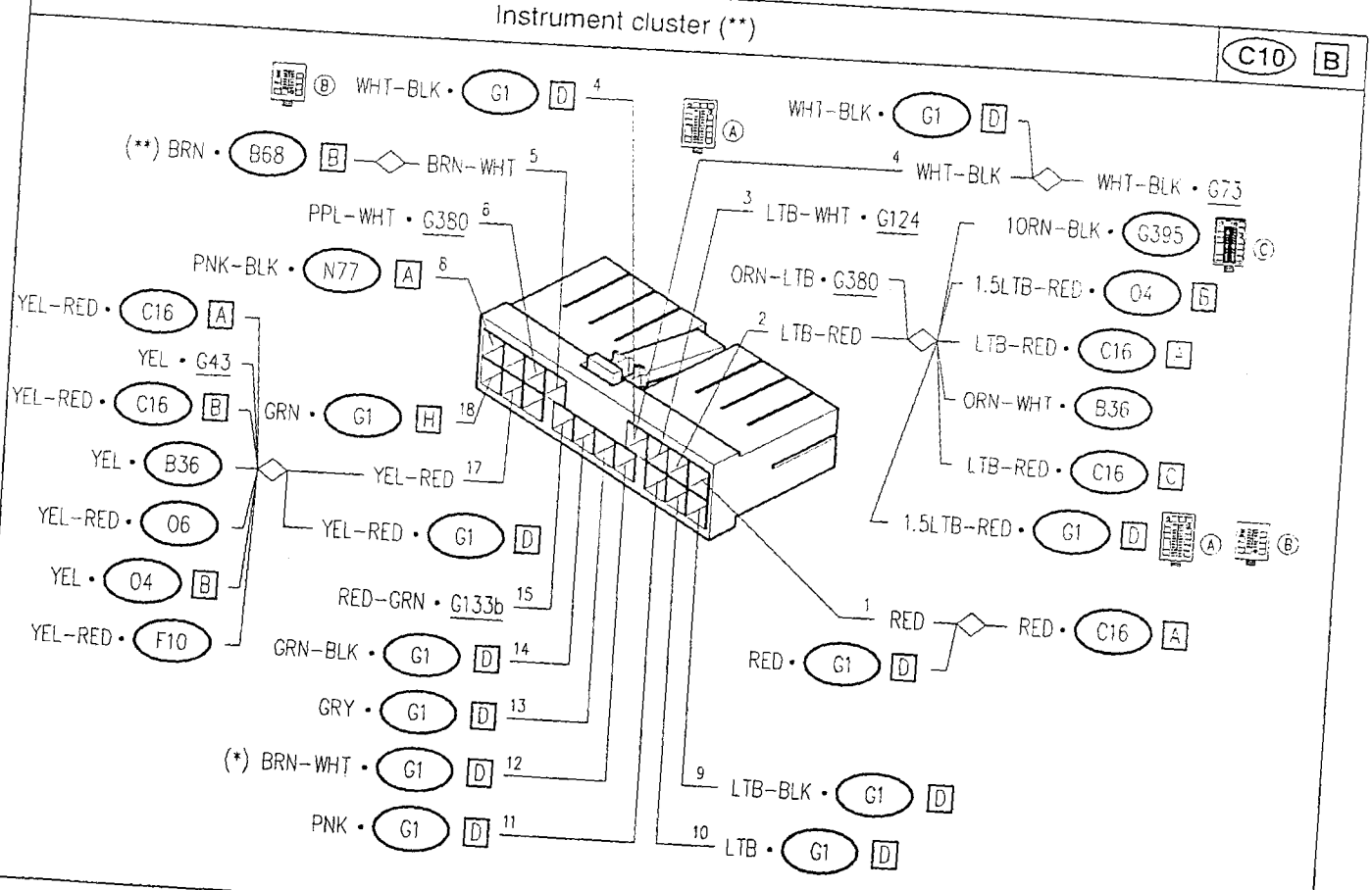


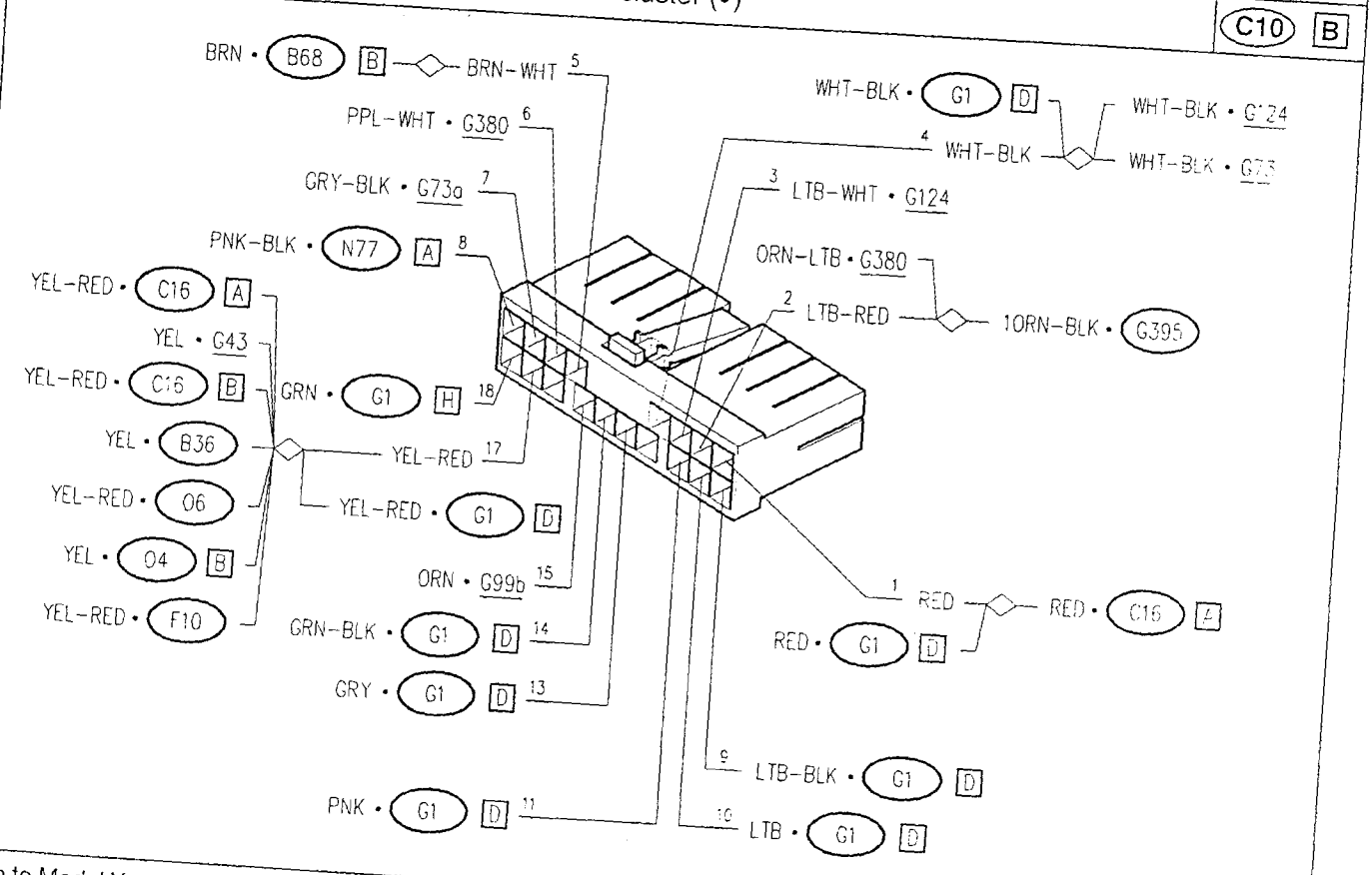
JTD



(*) up to Model Year '96 (**) up to Model Year '97 (•) Model Year '98

Components and Connectors (cont.d)



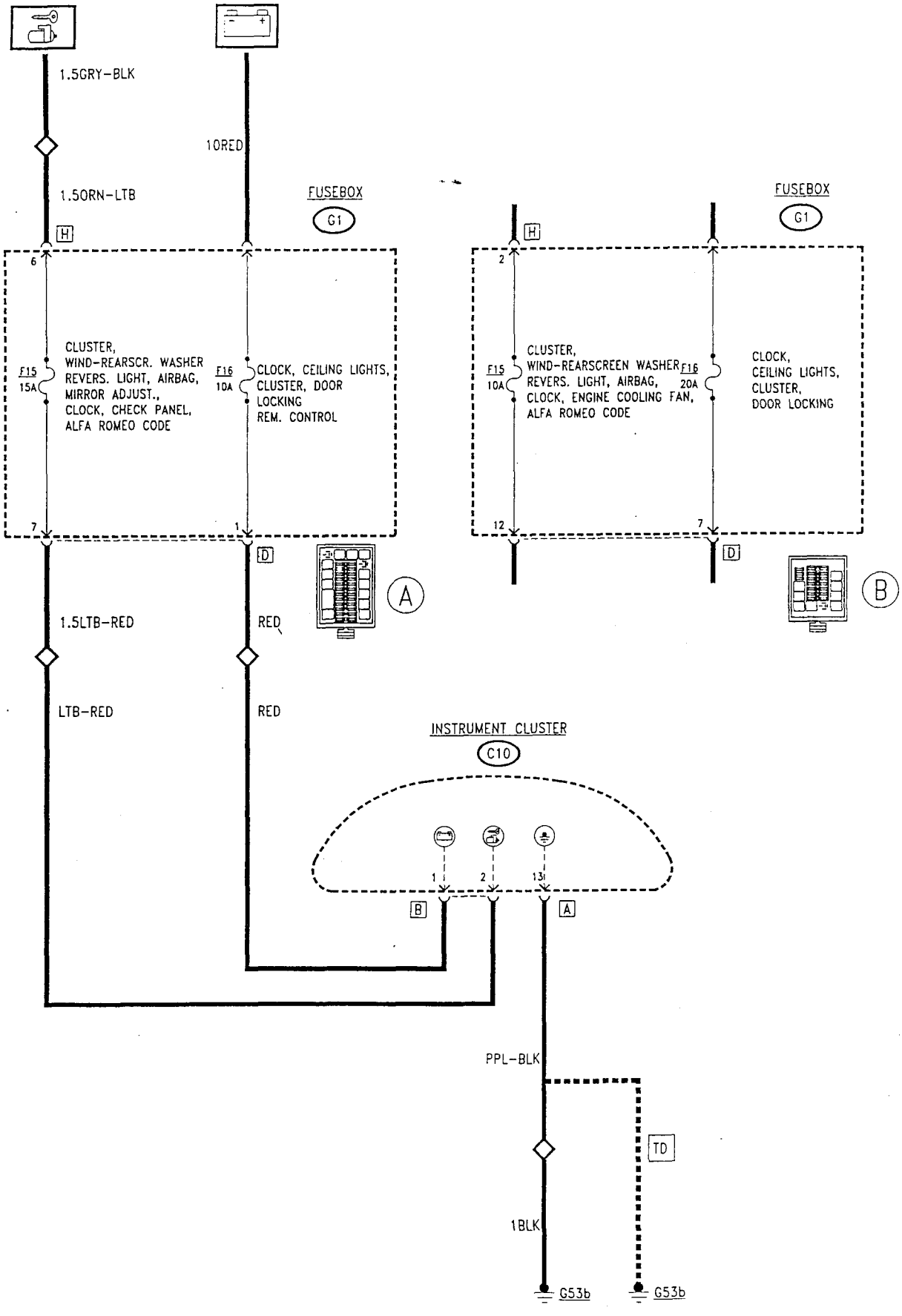


(*) up to Model Year '96
(**) up to Model Year '97
(•) Model Year '98

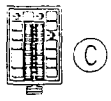
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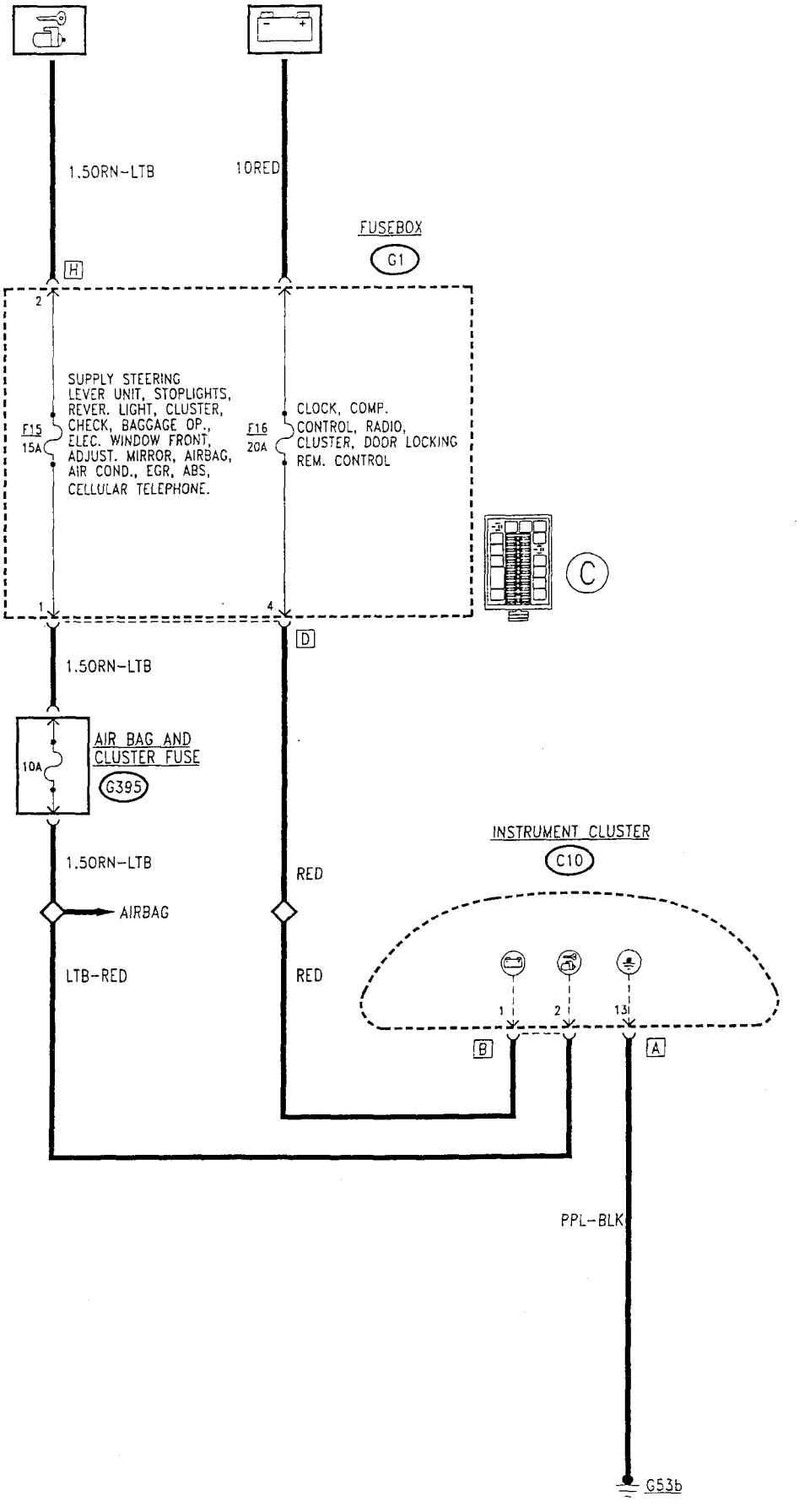
INSTRUMENT CLUSTER SUPPLY

Wiring diagram



Wiring diagram



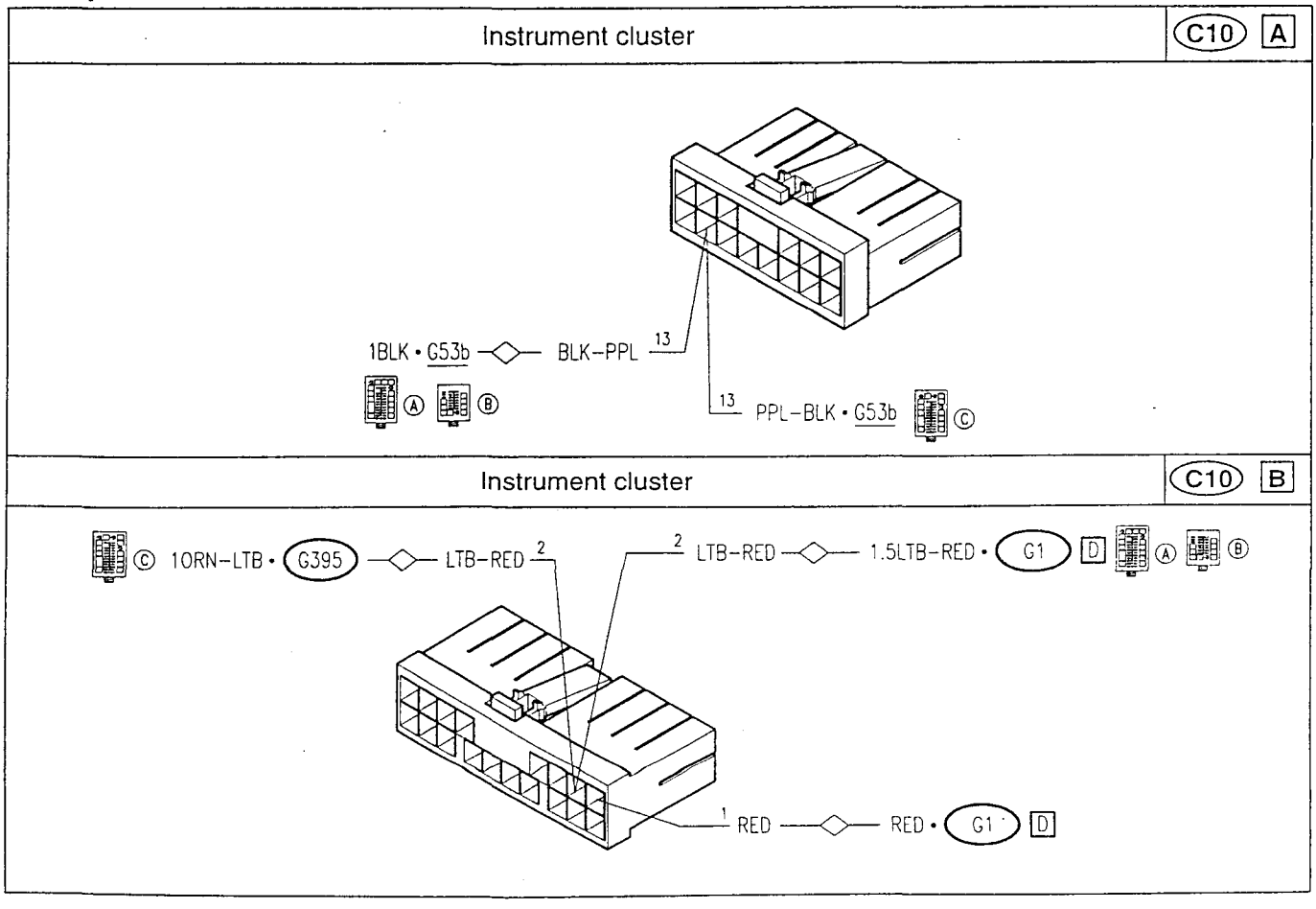


Functional Description

The instrument cluster is supplied by direct voltage via fuse **F16** and with "key-operated" voltage via fuse **F15** of fusebox **G1**.
For box "C" there is fuse **G395** next to it. Connection is made respectively at pin 1 and 2 of connector B of the cluster **C10**.
Connection takes place respectively at pins 1 and 2 of connector B of the cluster **C10**.

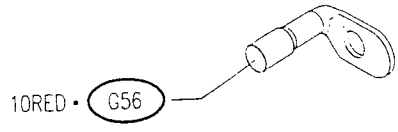
The cluster **C10** is connected to earth by the cable that leaves pin 13 of connector A towards earth **G53b**.

Components and Connectors

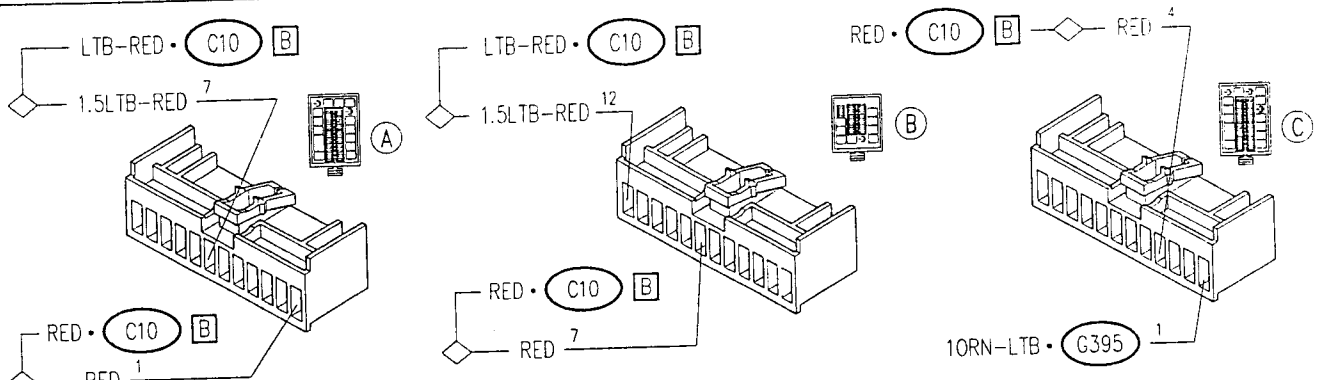


Components and Connectors (cont.d)

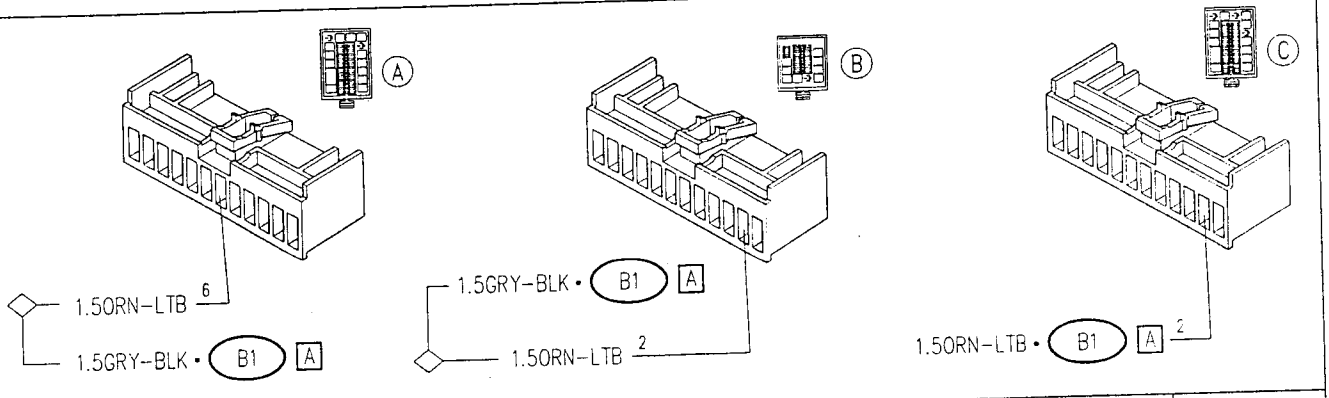
Fusebox — G1



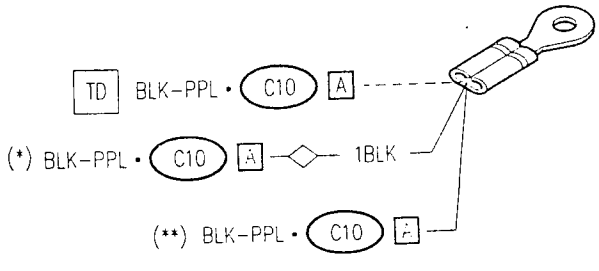
Fusebox — G1 D



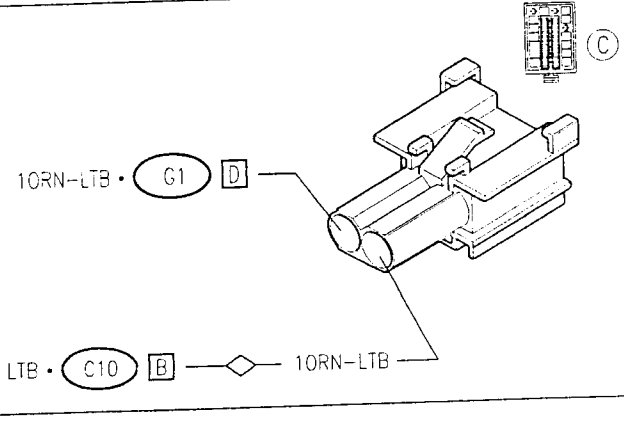
Fusebox — G1 H



LH engine compartment earth — G53b



Air Bag and cluster fuse — G395

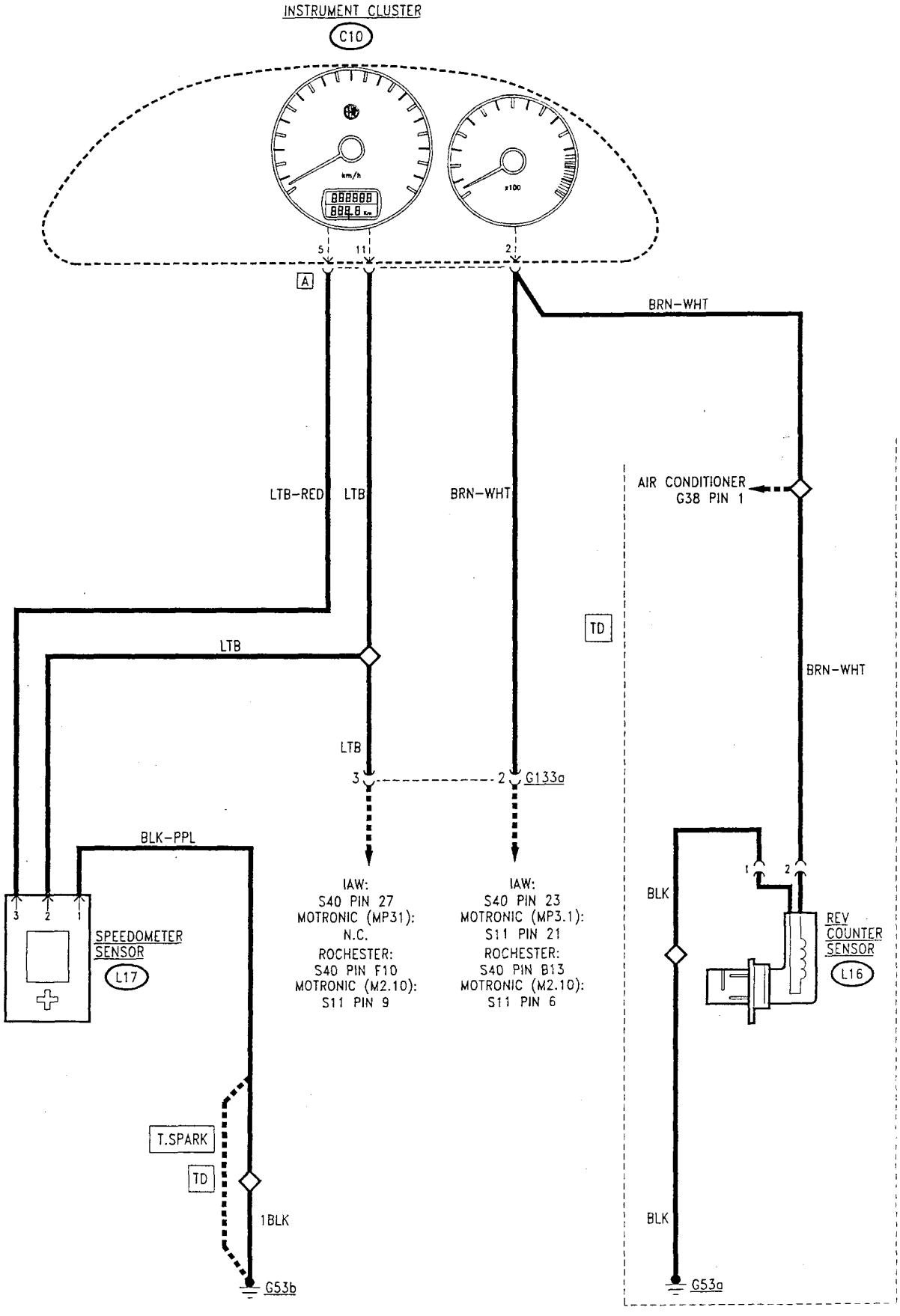


(*) up to chassis no.__
PA493000000012

(**) from chassis no.__

REV COUNTER AND SPEEDOMETER (up to M.Y. '97)

Wiring diagram



Functional Description

The **rev counter signal** is supplied to the instrument cluster:

for the **Petrol version:** by the engine injection/ignition control unit **S11/S40** which processes an "rpm" signal thanks to sensor **S31**.
The signal reaches the cluster **C10** at pin 2 of connector A, leading from connector **G133a** which connects the injection/ignition system with the other circuits; inside the cluster it then reaches the electronic device that operates the rev counter.

for the **TD version**: from the special sensor **L16** fitted on the flywheel ring gear so that it can constantly read the engine rpm.
The sensor is inductive and detects the engine rpm through the change in a magnetic field produced by the passage of the teeth of the flywheel ring gear. The signal reaches the instrument cluster **C10** at pin 2 of connector A, leading from sensor **L16**; inside the cluster it then reaches the electronic device that operates the rev counter.

The same signal is then sent to the heating and ventilation system, to the compressor cut-out control unit **Q67**.

The **speedometer signal** is supplied by the speedometer sensor **L17**: this is fitted on the gearbox and detects the speed of the car at all times.
This device is a pulse generator which generates and processes a signal that is proportionate with the speed of the camshaft at the gearbox output, therefore with that of the wheels: it is a "square-wave" signal obtained:

for the **Petrol versions**: through an electronic module, inside the actual sensor, which "squares" a sinusoidal signal captured by a magnetic core.

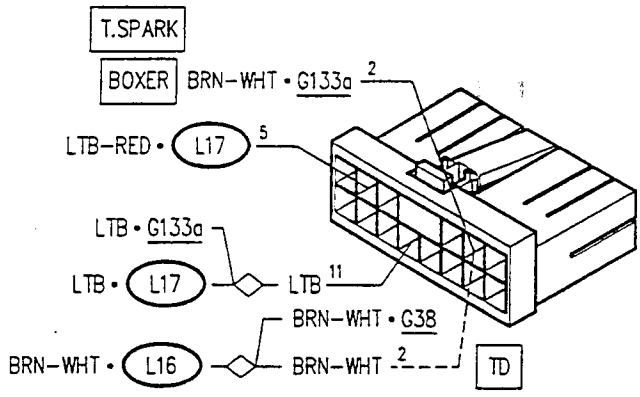
for the **TD version**: it is a Hall effect sensor which processes the output signal.

The sensor **L17** is supplied at pin 3 with stabilised voltage through an electronic device inside the instrument cluster (from pin 5 of connector A of **C10**); pin 1 is connected to earth **G53b**, while the tachometric signal (proportionate with the speed of the car leaves pin 2 and is sent to the instrument cluster **C10** at pin 11 of connector A, and from here to the electronic device that operates the speedometer and the two mileage recorders (total and trip).

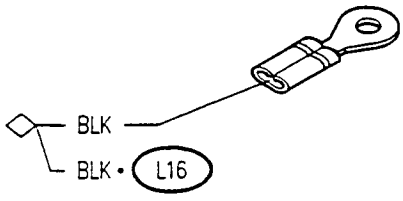
The same signal is also sent - for the **Petrol versions** - to the injection/ignition system which needs the "car speed" information (see the corresponding sections).

Components and Connectors

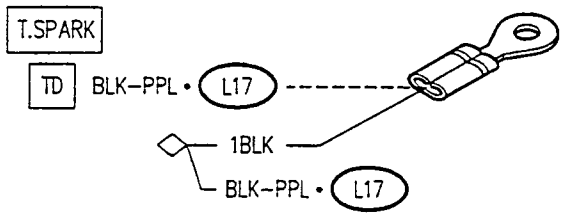
Instrument cluster	C10 A



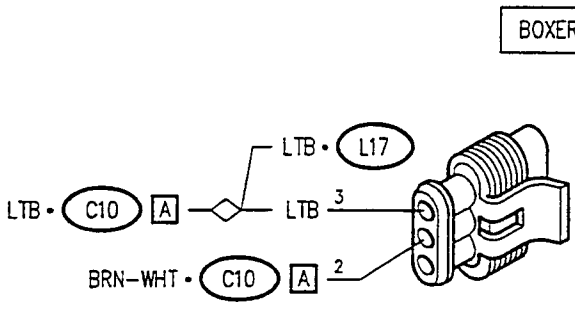
RH engine compartment earth	G53a

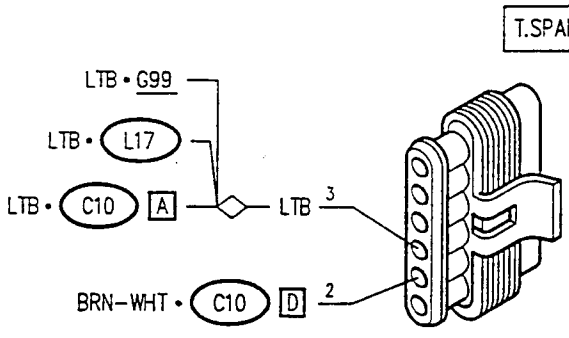


LH engine compartment earth	G53b

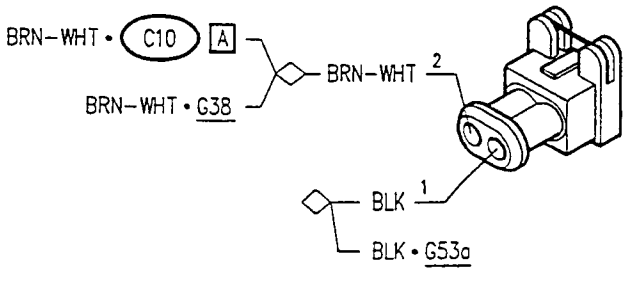


Electronic injection wiring connector A	G133a

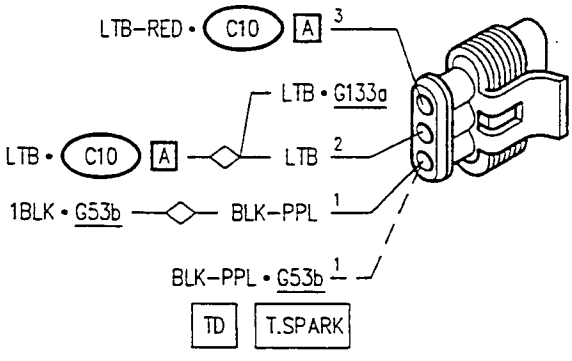




Rev counter sensor	L16

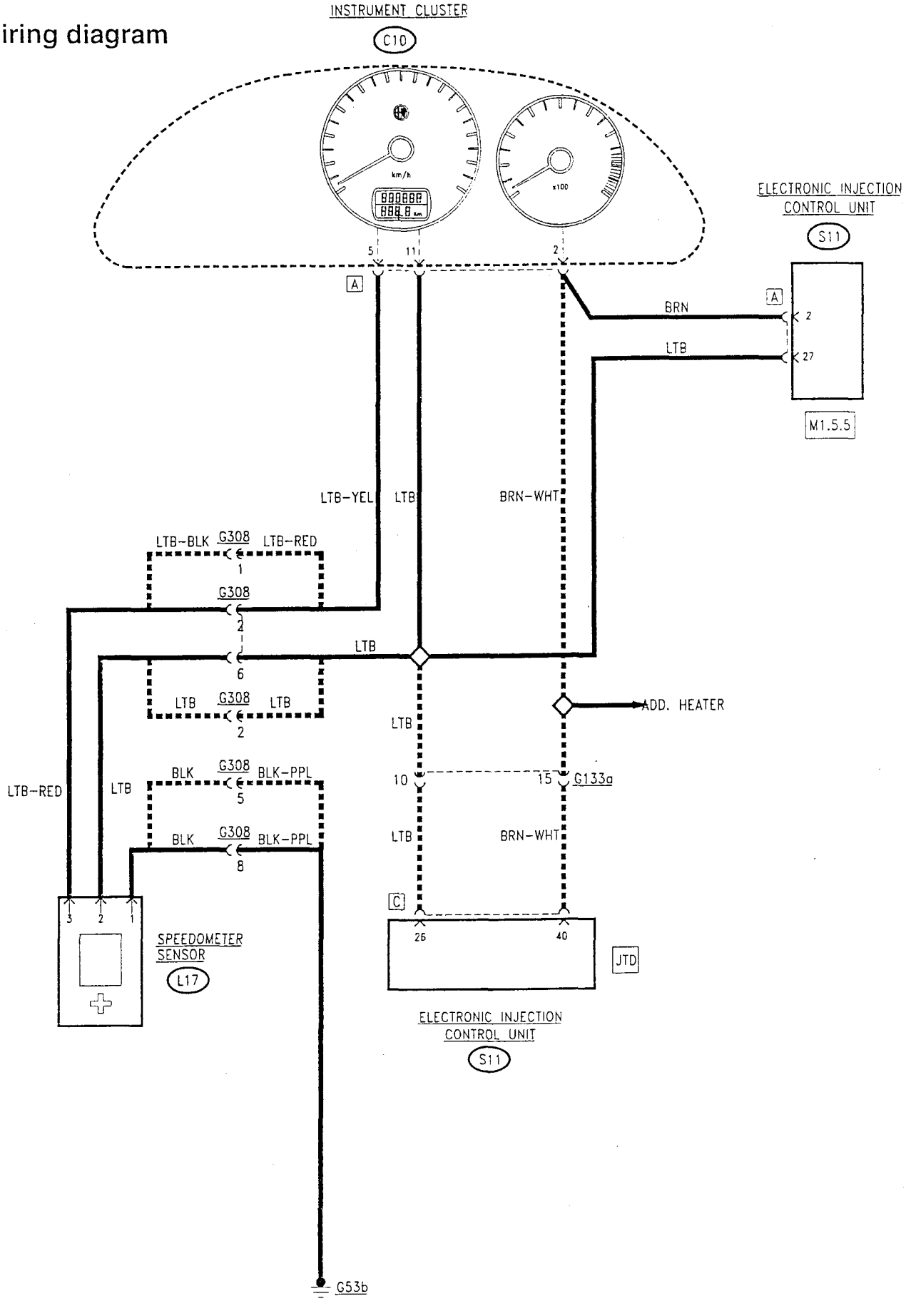


Speedometer sensor	L17



REV COUNTER AND SPEEDOMETER (from M.Y. '99)

Wiring diagram



Functional Description

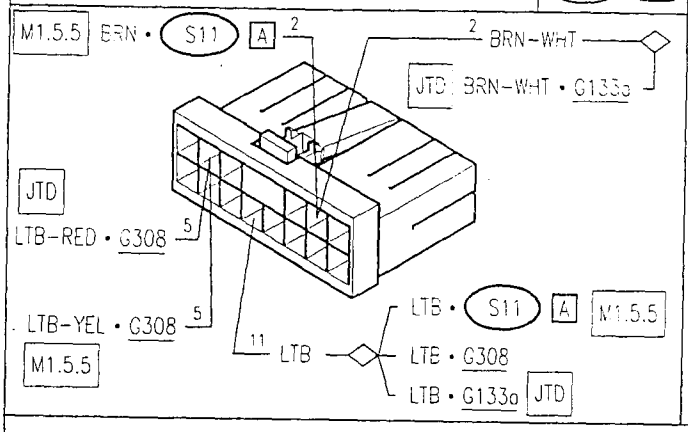
The **rpm signal** is supplied to the instrument cluster: from the engine injection control unit **S11** which receives an "engine rpm" signal from sensor **S31**. The signal reaches the cluster **C10** at pin 2 of connector A.

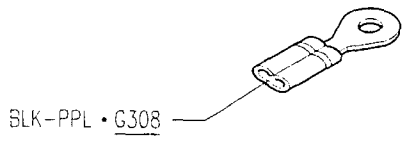
The **speedometer signal** is supplied by the speedometer sensor **L17**: this is fitted on the gearbox and detects the speed of the car at all times.
This device is a pulse generator which generates and processes a signal that is proportionate with the speed of the camshaft at the gearbox output, therefore with that of the wheels: it is a "square-wave".

The sensor **L17** is supplied at pin 3 with stabilised voltage through an electronic device inside the instrument cluster (from pin 5 of connector A of **C10**); pin 1 is connected to earth **G53b**, while the tachometric signal (proportionate with the speed of the car leaves pin 2 and is sent to the instrument cluster **C10** at pin 11 of connector A, and from here to the electronic device that operates the speedometer and the two mileage recorders (total and trip).

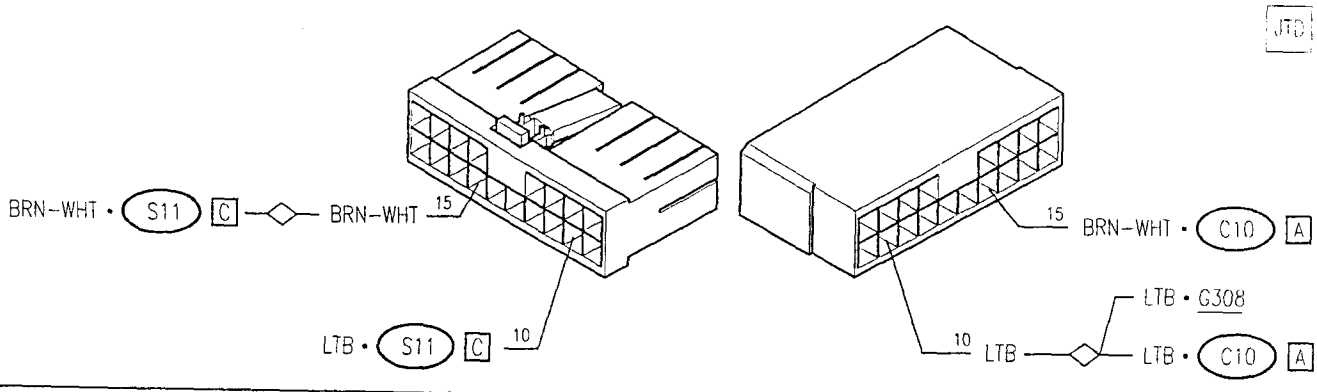
Components and Connectors

Instrument cluster	C10 A	LH engine compartment earth	G53b

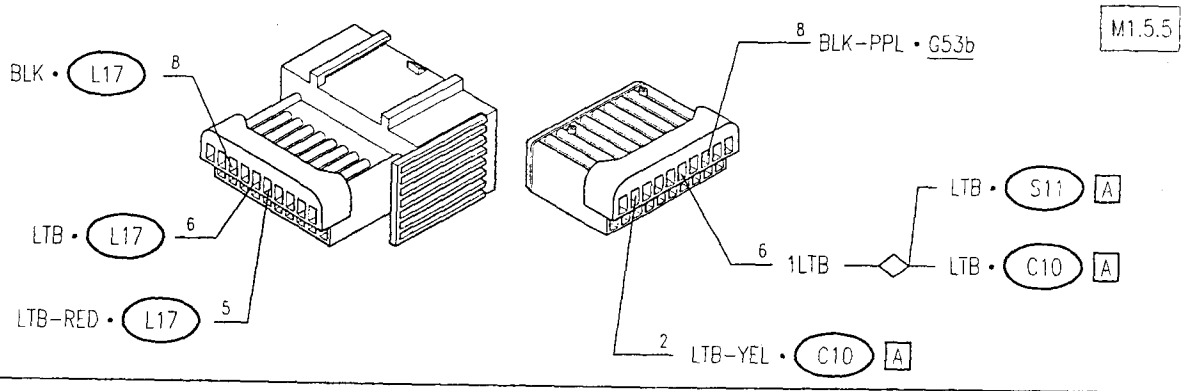




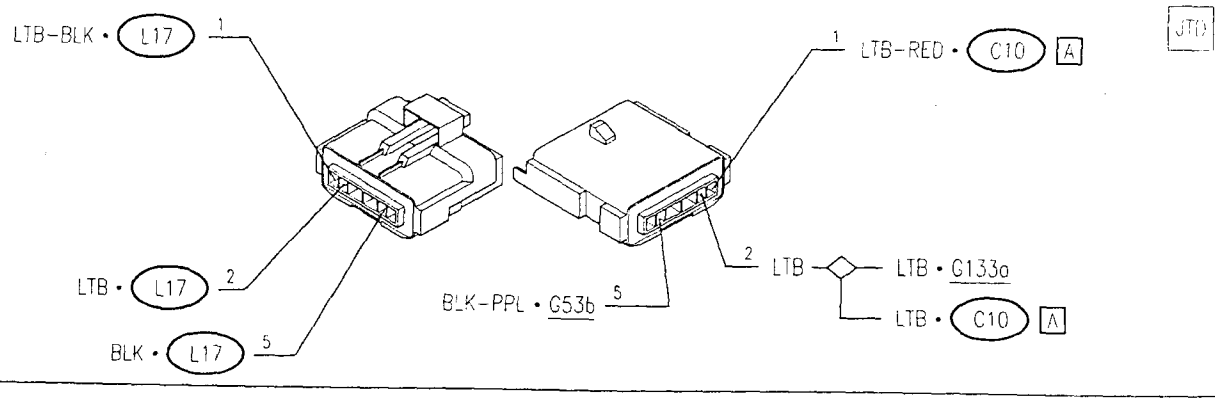
Electronic injection wiring connector A	G133a



Connector for engine sensors	G308

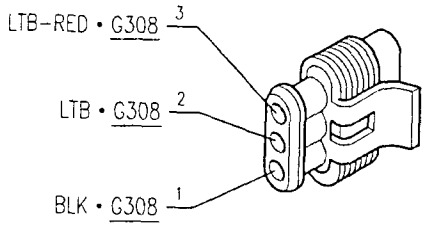


Connector for engine sensors	G308



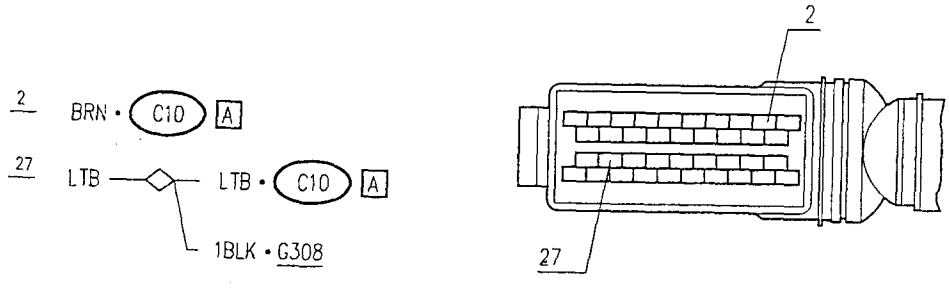
Components and Connectors (cont.d)

Speedometer sensor — L17



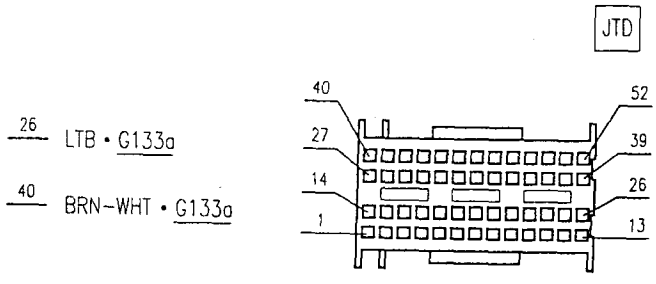
Electronic injection control unit — S11 A

M1.5.5



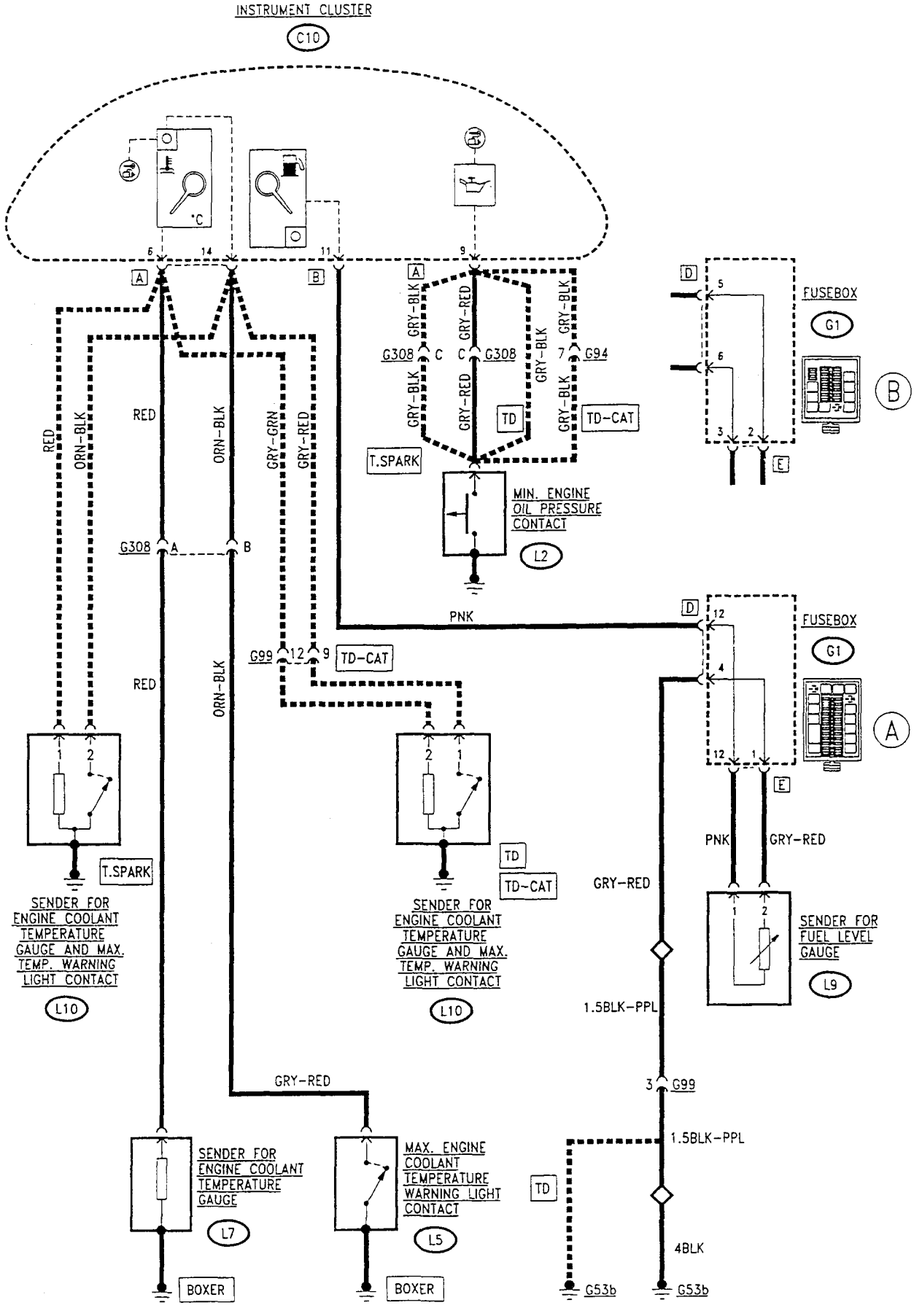
Electronic injection control unit — S11 C

JTD

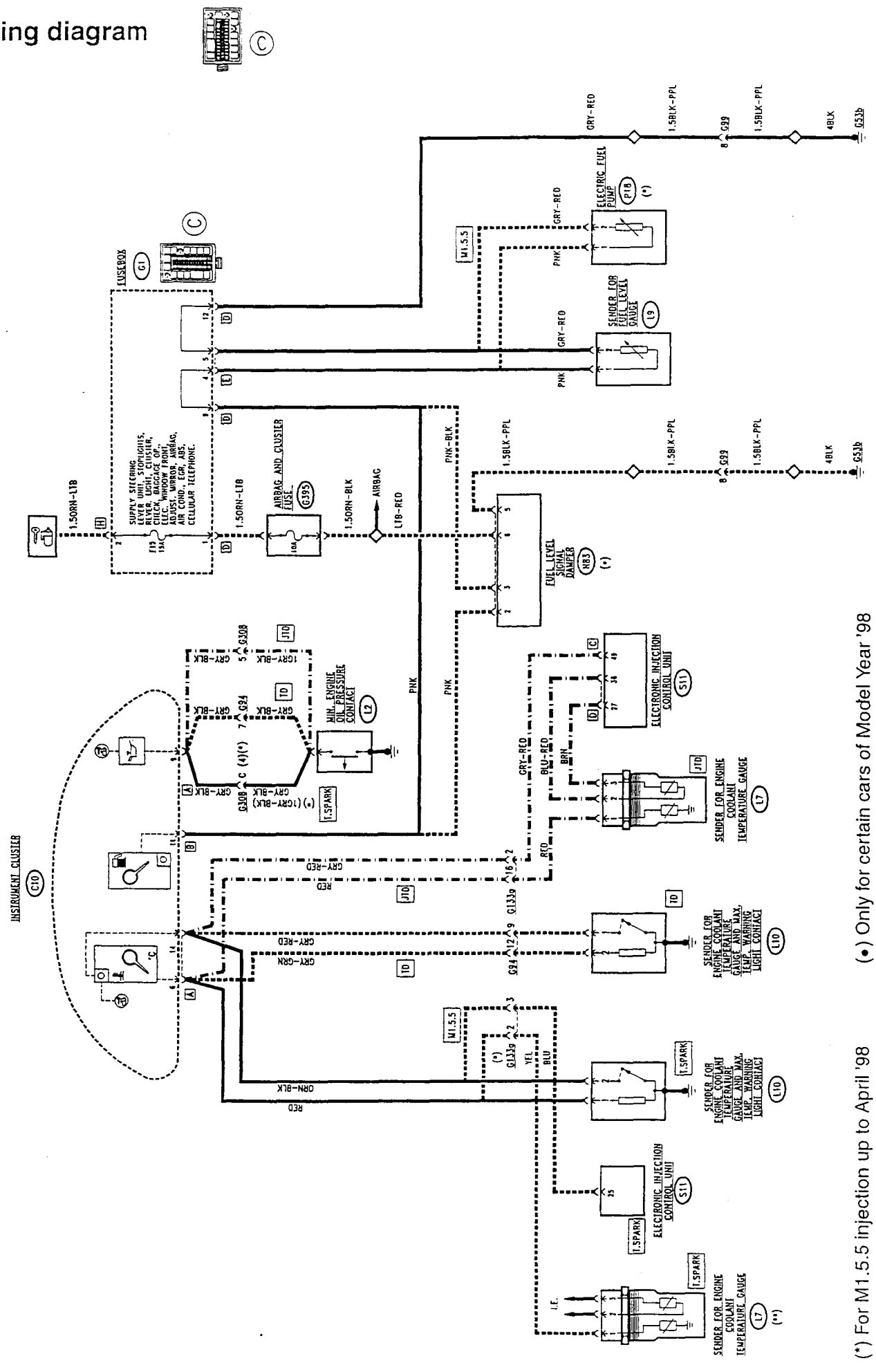


ENGINE WARNING LIGHTS

Wiring diagram



Wiring diagram



(•) Only for certain cars of Model Year '98

(*) For M1.5.5 injection up to April '98
(**) For M1.5.5 injection from May '98

Functional Description

The temperature of the engine coolant is shown continuously by the special analogue indicator and if the temperature is too high, the driver is alerted by the "maximum coolant temperature" warning light.

The engine coolant temperature sender and maximum temperature contact **L10 (for TD and T.SPARK Version up to April '98)** is fitted on the engine head and comprises a thermistor which generates a signal proportionate with the temperature of the fluid and a contact that closes to earth when the fluid temperature is too high. The first signal is sent to the instrument cluster **C10** at pin 6, while the second is sent to pin 14 of connector A.
For the **Boxer version** the sender **L7** and the thermal contact **L5** are separate, but their function and electrical connection are the same.

For the **JTD version and T.SPARK version from May '98**, the transmitter **L7** sends a signal proportionate with the temperature (the same signal is sent to the i.e. control unit **S11**, which supplies the maximum temperature signal to the cluster (from pin 49 connector C).

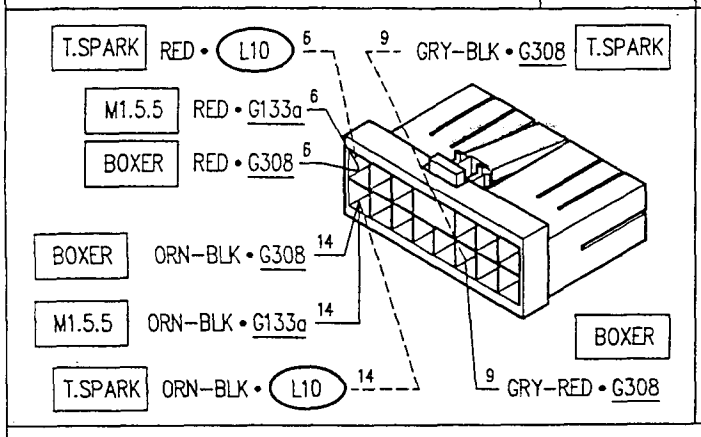
The fuel level sender **L9** is a sensor submerged in the fuel tank. Its resistance changes with the changing level in the tank changes.
An earth signal reaches pin 1 of **L9**, while a signal proportionate with the level is sent from pin 2, through fusebox **G1**, to the instrument cluster **C10**, at pin 11 of connector B.
For M1.5.5 injection the fuel level transmitter is integrated in the pump unit **P18**.
Inside the fuel level gauge an electronic device selects the signal corresponding to reserve and turns on the corresponding warning light.

The minimum oil pressure contact **L2**, also fitted on the crankcase, closes when the pressure falls below a certain limit sending an earth signal to the instrument cluster **C10** at pin 9 of connector A, thereby turning on the "low oil pressure" warning light.

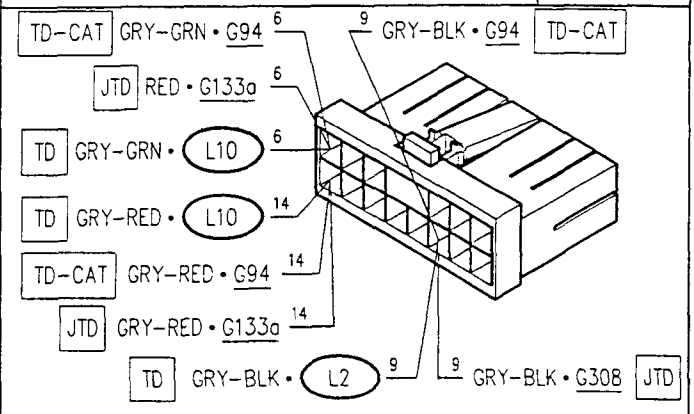
For some Model Year '98 cars an electronic damper **N83** has been inserted which corrects the signal of the fuel level transmitter **P18** which differs from the one described here.

Components and Connectors

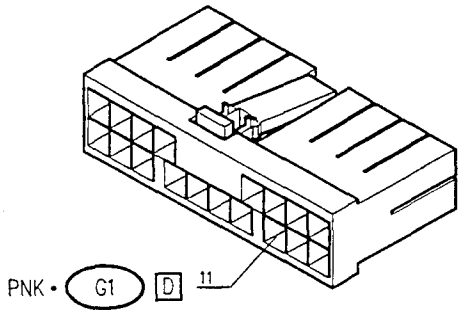
Instrument cluster C10 A



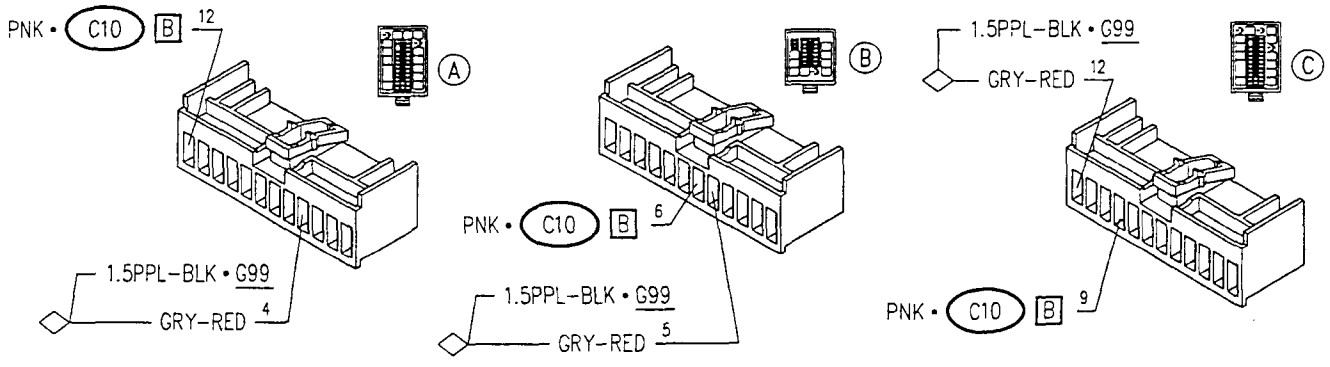
Instrument cluster C10 A



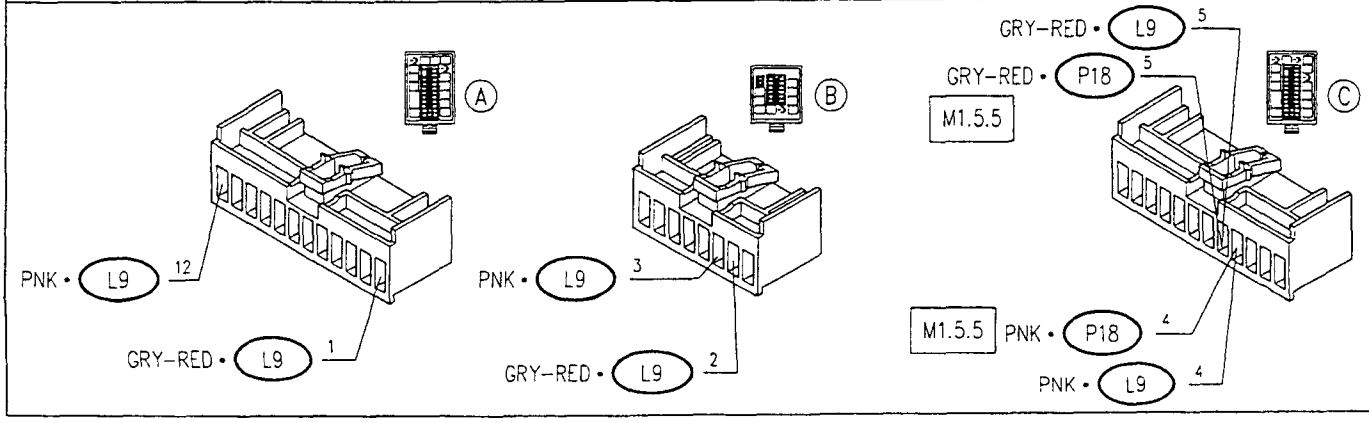
Instrument cluster C10 B



Fusebox G1 D

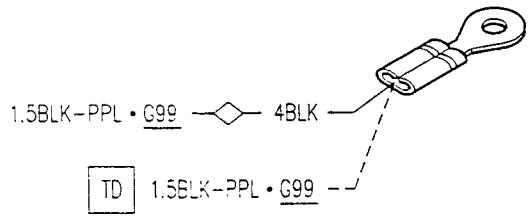


Fusebox G1 E

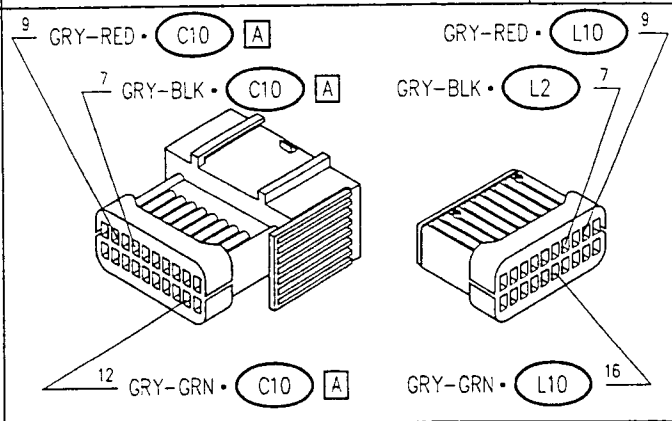


Components and Connectors (cont.d)

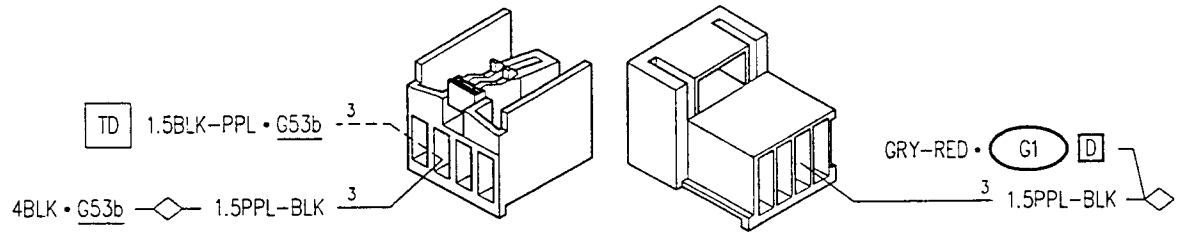
LH engine compartment earth	G53b



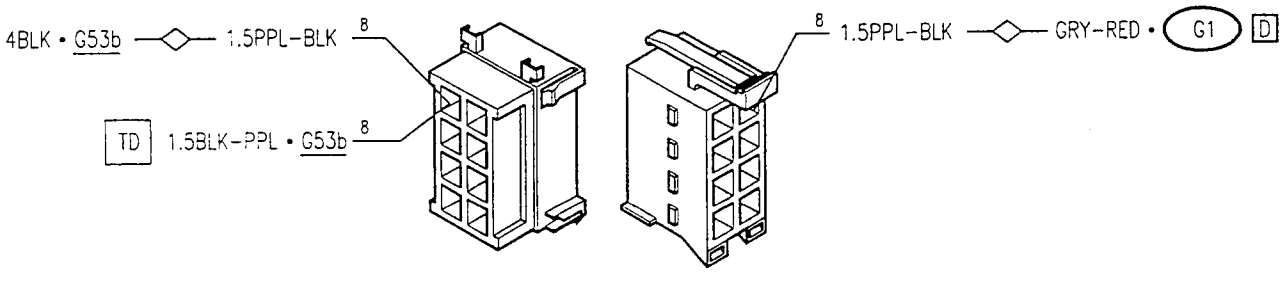
Engine compartment (••)	G94



Engine/dashboard wiring connector (*)	G99

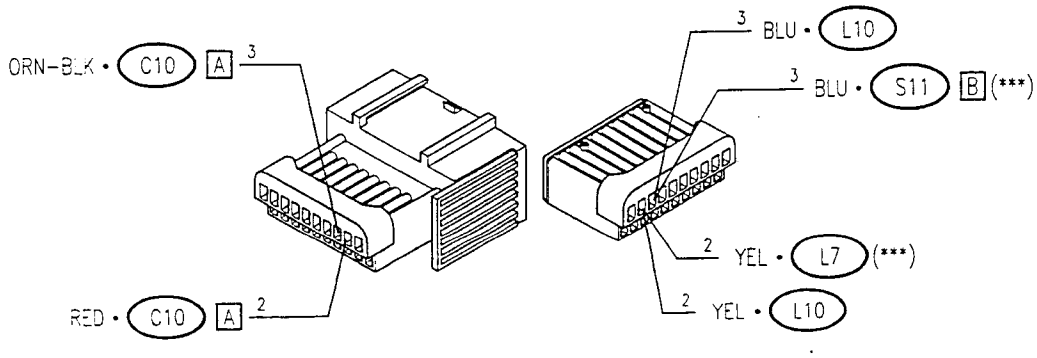


Engine/dashboard wiring connector (**)	G99



Connector for electronic injection wiring A (•)	G133a

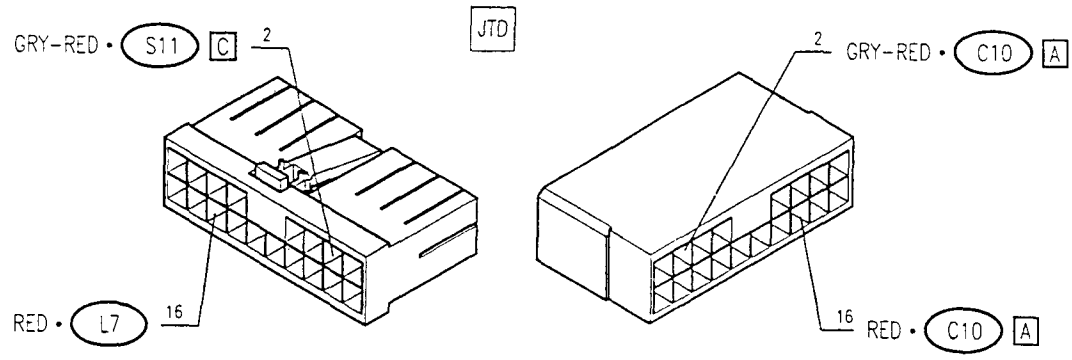
M1.5.5



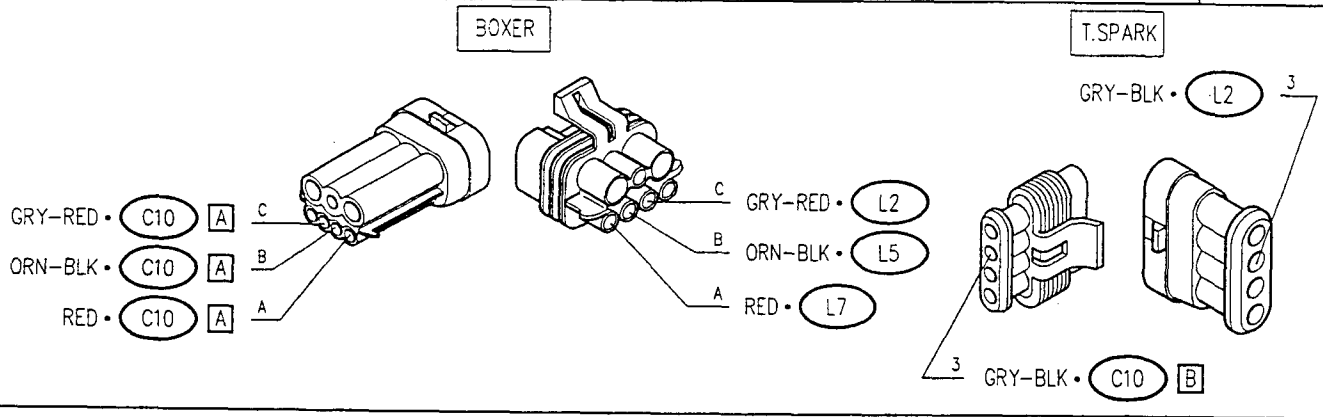
(*) up to chassis no.__ (**) from chassis no.___ (***) from May '98 (•) T.SPARK (••) TD-CAT

Components and Connectors (cont.d)

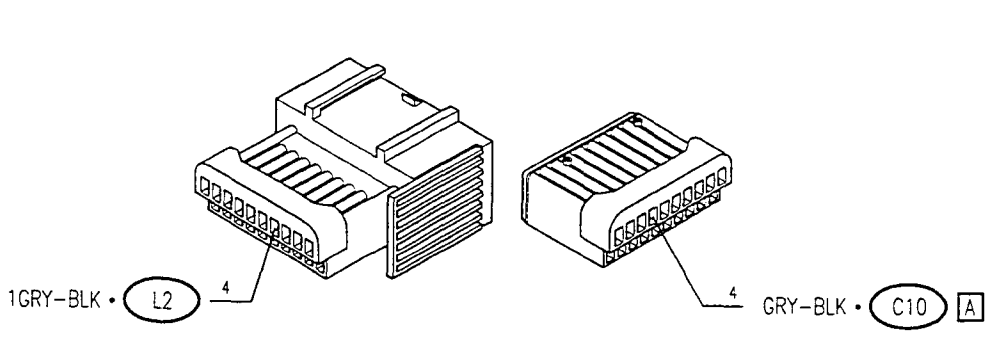
Connector for electronic injection wiring A	G133a



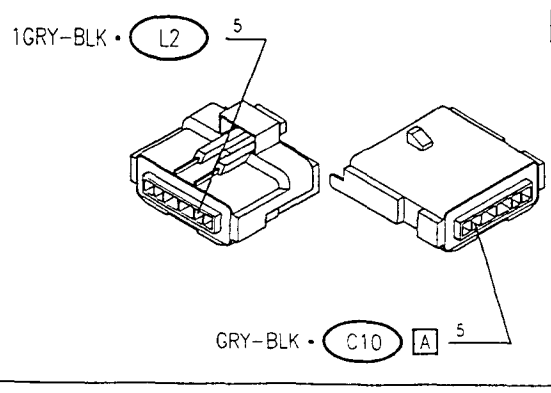
Engine sensors connector (•)	G308



Engine sensors connector (••)	G308



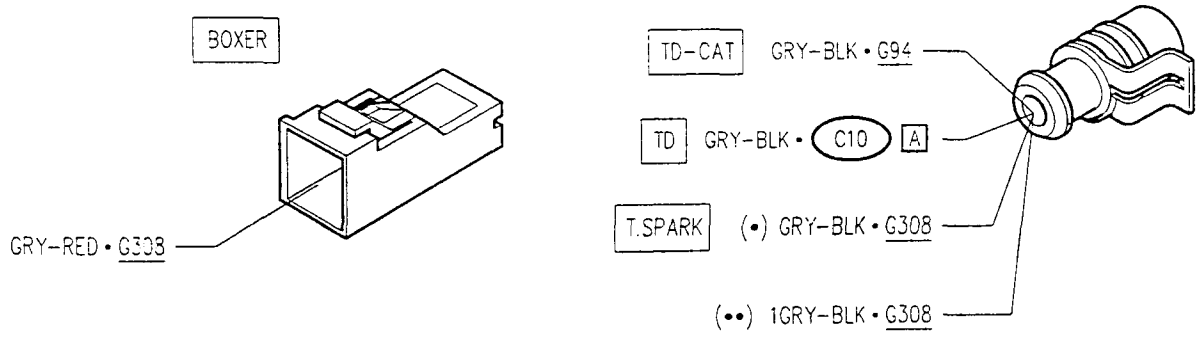
Engine sensors connector	G308



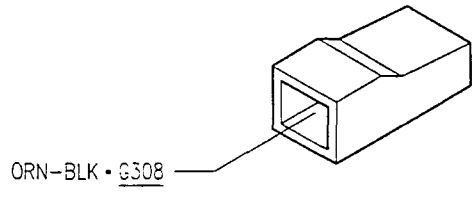
(•) up to M.Y. '97 (••) from M.Y. '98

Components and Connectors (cont.d)

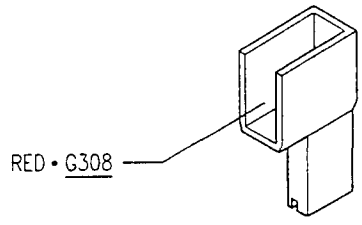
Minimum engine oil pressure sensor contact — L2



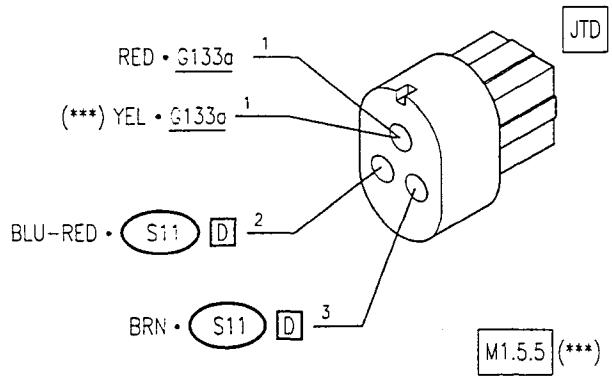
Max. engine coolant temperature warning light thermal contact — L5



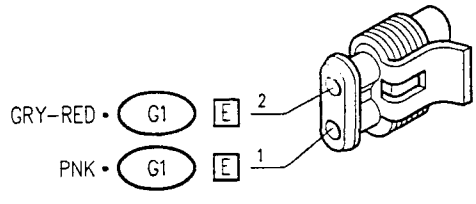
Sender for engine coolant temperature gauge — L7



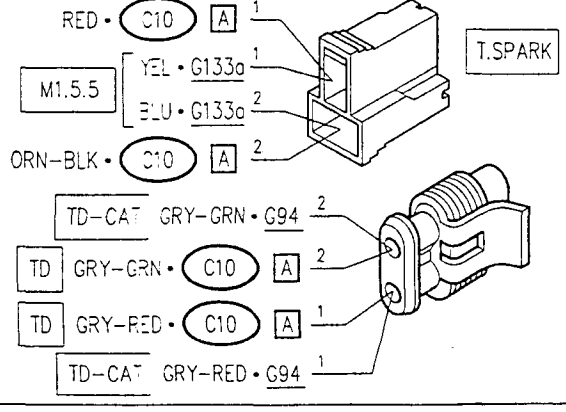
Sender for engine coolant temperature gauge — L7



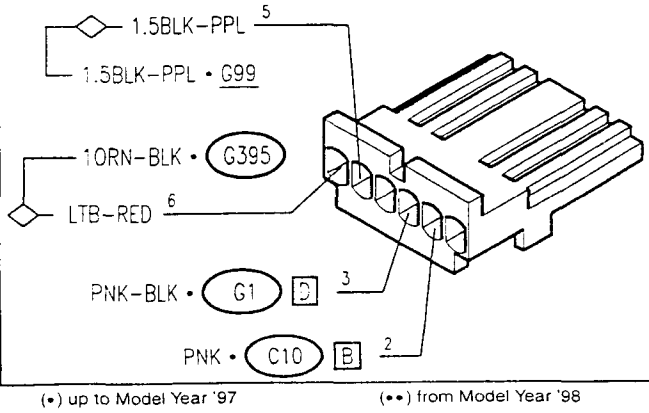
Sender for fuel level gauge (•) — L9



Sender engine coolant temp. gauge and max. temp. warning light contact — L10



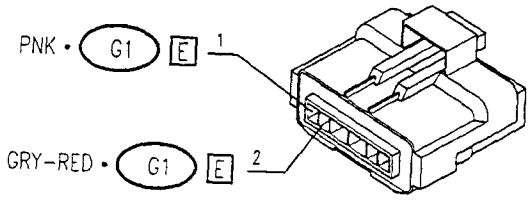
Fuel level signal damper (*) — N83

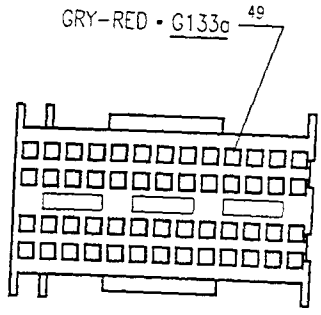


(*) only for certain cars of Model Year '98 (***) from May '98 (•) up to Model Year '97 (••) from Model Year '98

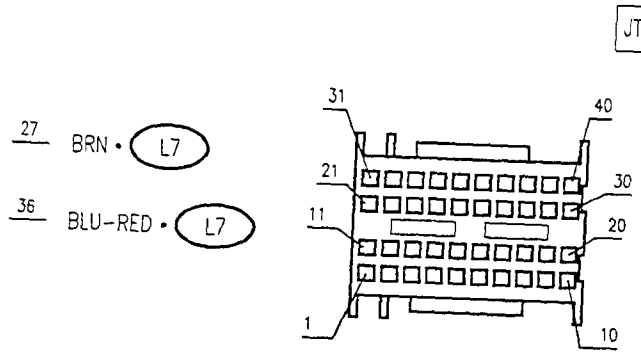
Components and Connectors (cont.d)

Electric fuel pump (••)	P18	Electronic injection control unit	S11 C

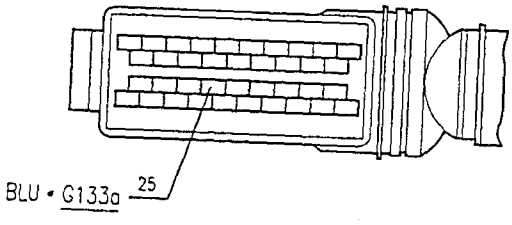




Electronic injection control unit	S11 D



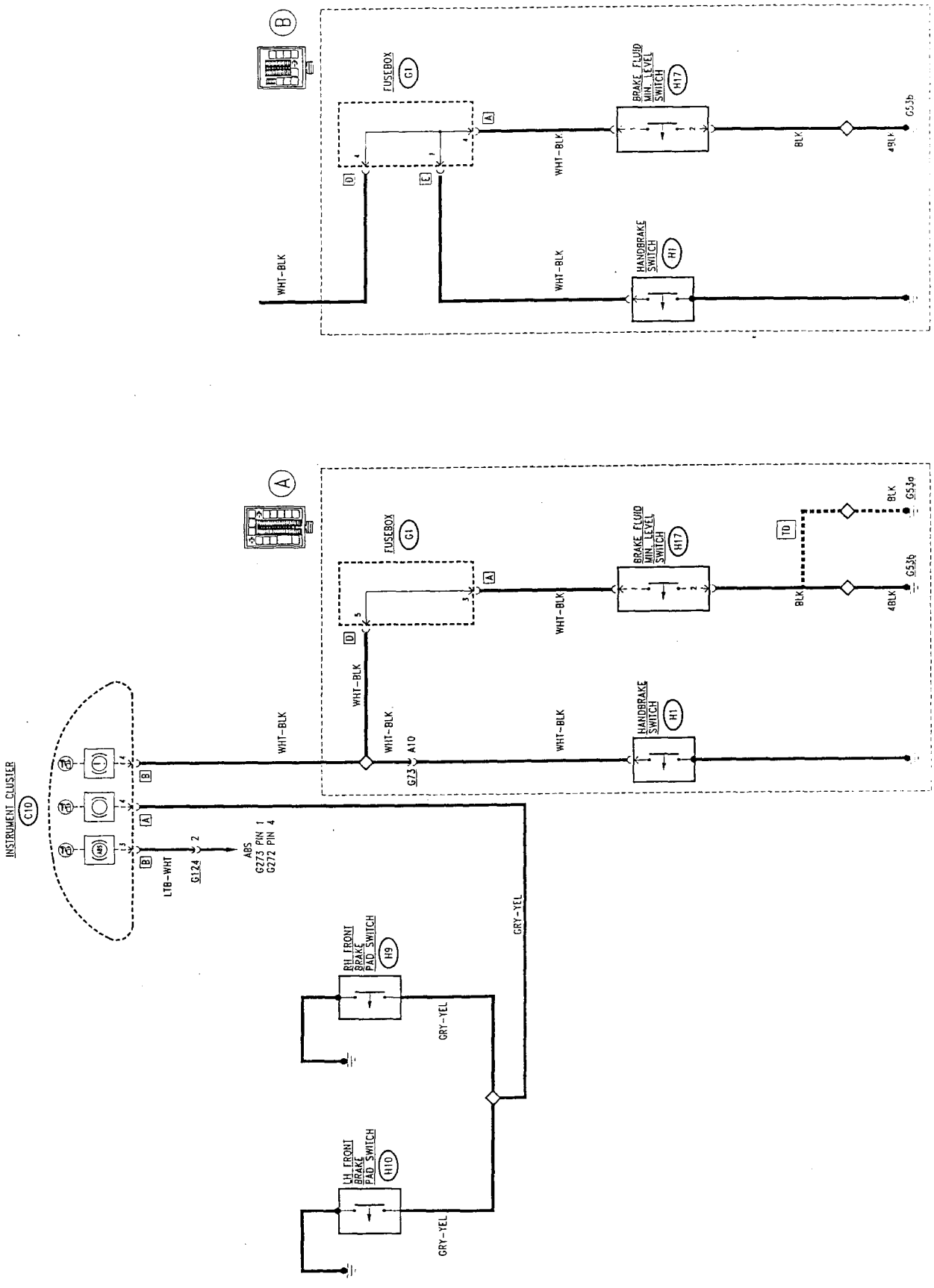
Electronic injection control unit (***)	S11 B



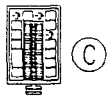
(••) From Model Year '98
(***) From May '98

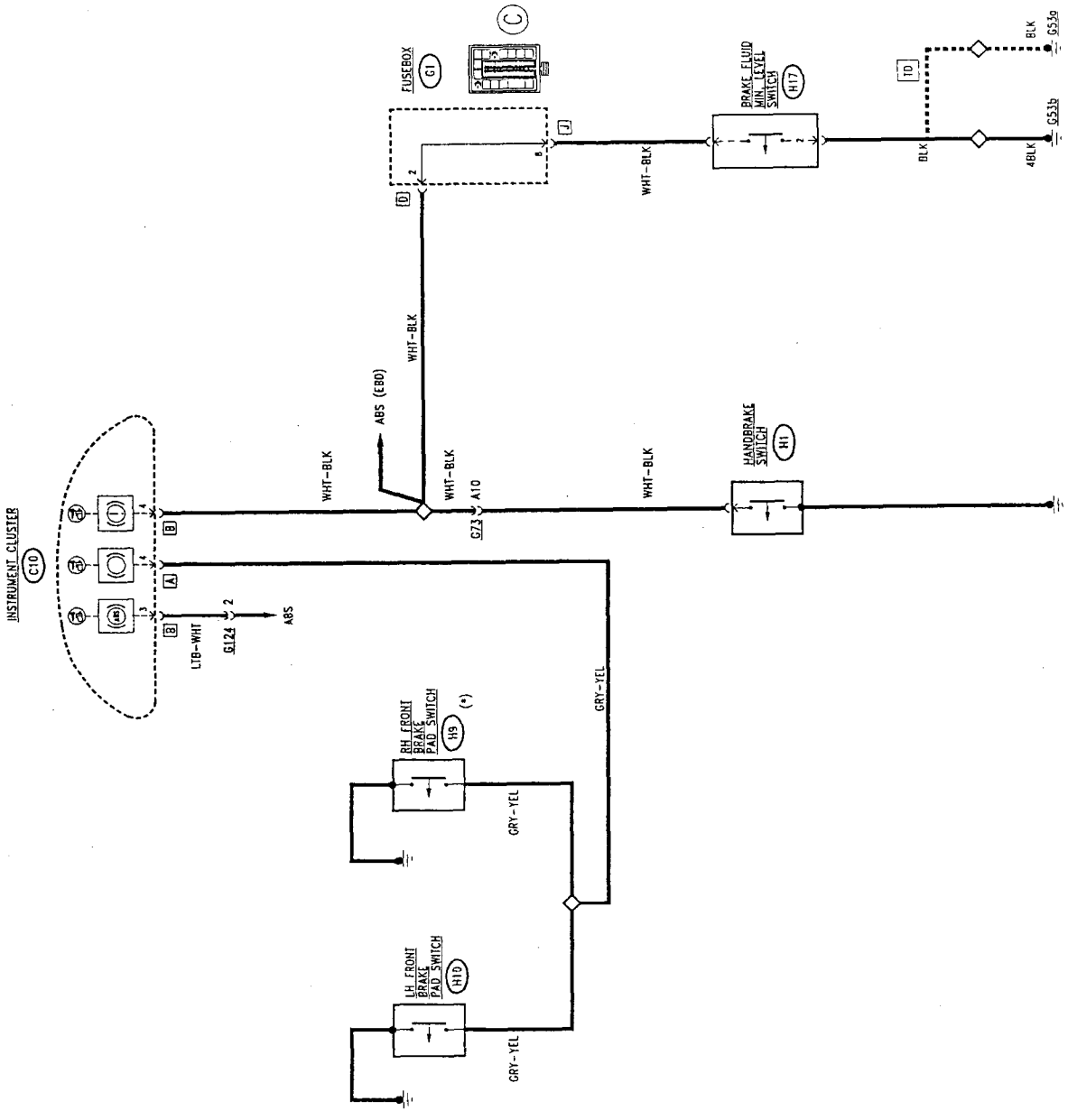
BRAKING SYSTEM WARNING LIGHTS

Wiring diagram



Wiring diagram





(*) from Model Year '98 no longer present in some versions

Functional Description

Three warning lights alert the driver in the event of problems with the braking system.
The two brake pad switches **H9** right and **H10** left are formed of a microswitch on the pad that closes to earth when the thickness of the pad thins, sending a signal to the instrument cluster **C10** at pin 4 of connector A, thereby turning on the "brake pad wear" warning light.

NOTE: RH switch, starting from M.Y. '98, no longer present in some versions.

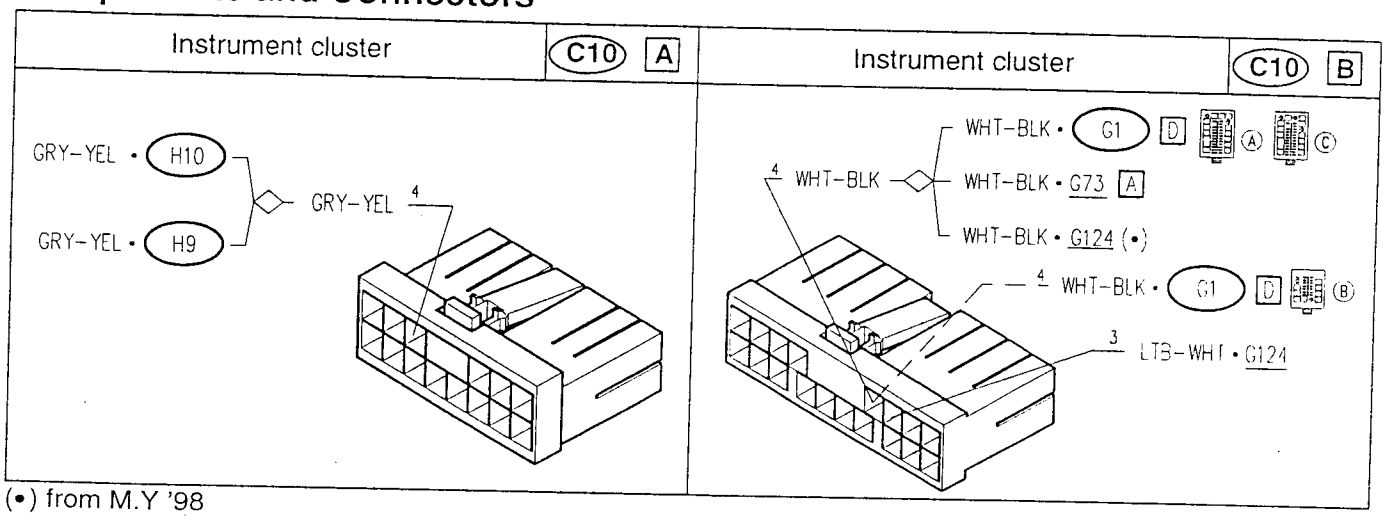
The handbrake switch **H1** closes when the handbrake lever is pulled and supplies a signal to the instrument cluster **C10**, at pin 4 of connector B, turning on the "handbrake engaged" warning light.

The same warning light is also turned on to indicate "low brake fluid level" through switch **H17** located in the fluid reservoir: this is a float device which closes a contact when the level of the fluid in the brake fluid reservoir falls below a certain reference.

The "handbrake on" and "low brake fluid level" warning light is also turned on by the ABS system to indicate a fault in the "EBD" electronic braking device (see section 39B "ABS 5.3 with EBD").

The third warning light referring to the braking system is the "ABS system failure" warning light which is described in the corresponding section (see "ABS").

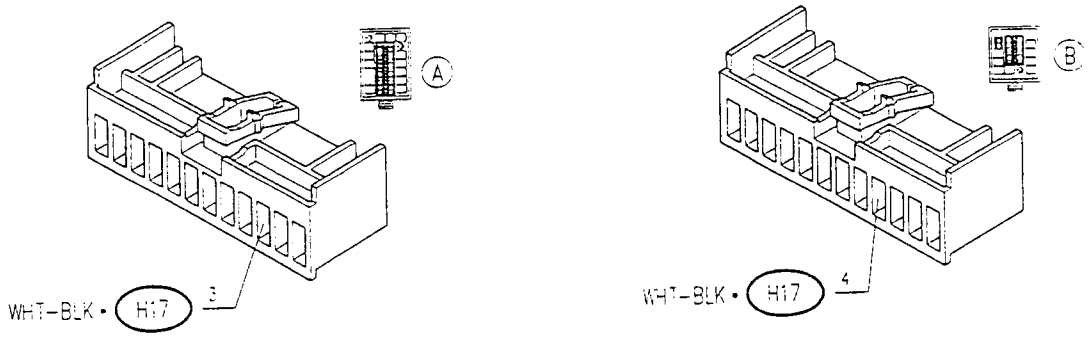
Components and Connectors



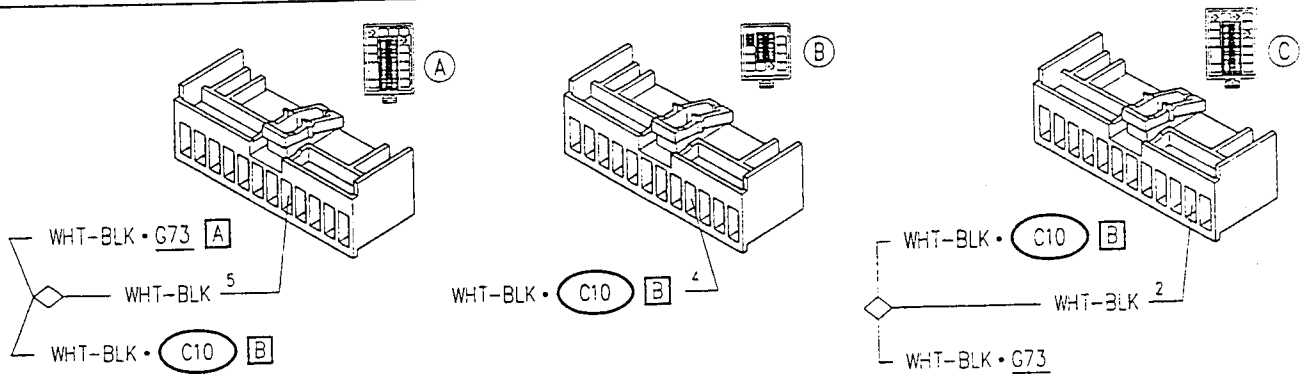
(•) from M.Y '98

Components and Connectors (cont.d)

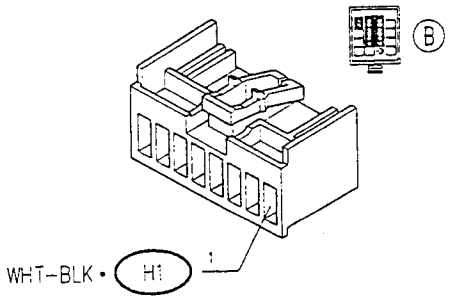
Fusebox	G1	A



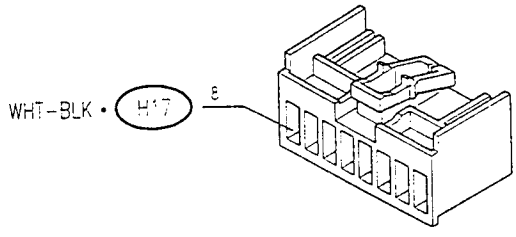
Fusebox	G1	D



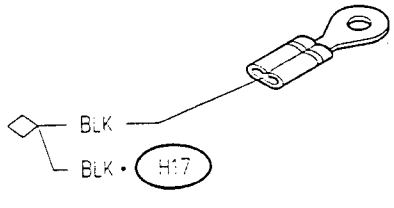
Fusebox	G1	E



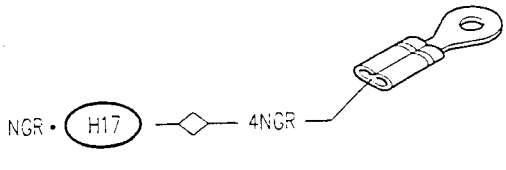
Fusebox	G1	J



RH engine compartment earth	G53a

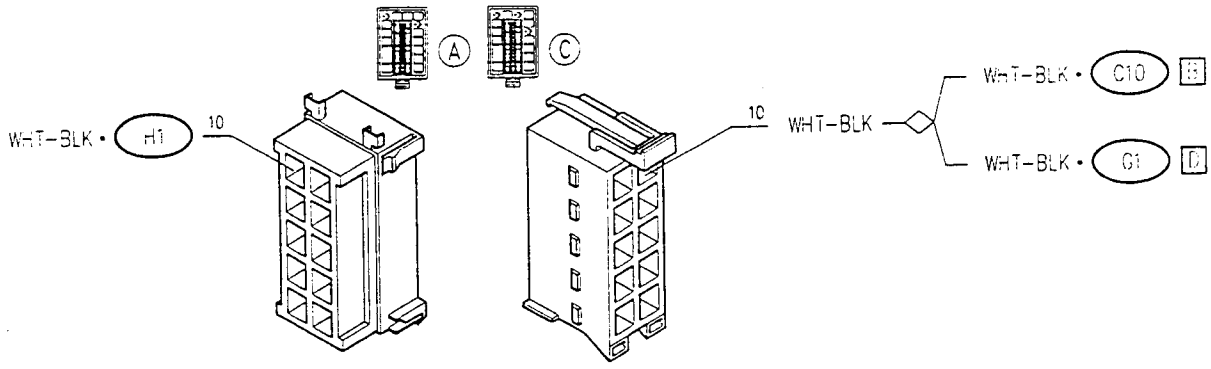


LH engine compartment earth	G53b

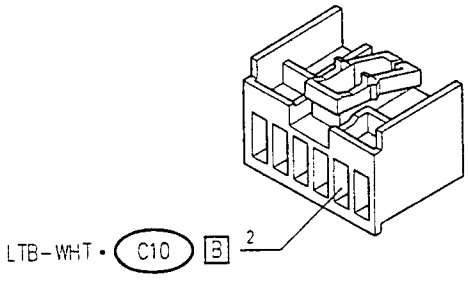


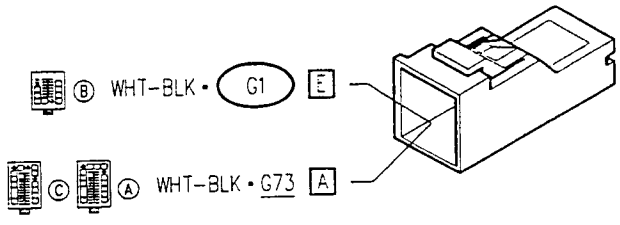
Components and Connectors (cont.d)

Rear services connector	G73 A

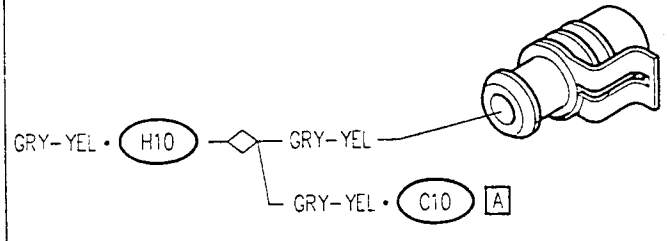


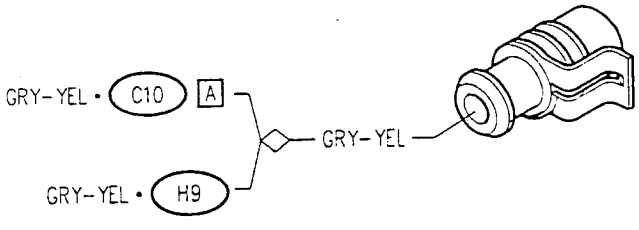
ABS system connector	G124	Handbrake switch	H1



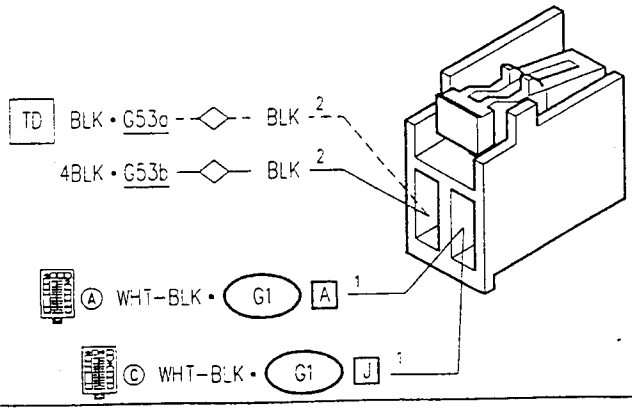


RH front brake pad switch.	H9	LH front brake pad switch	H10

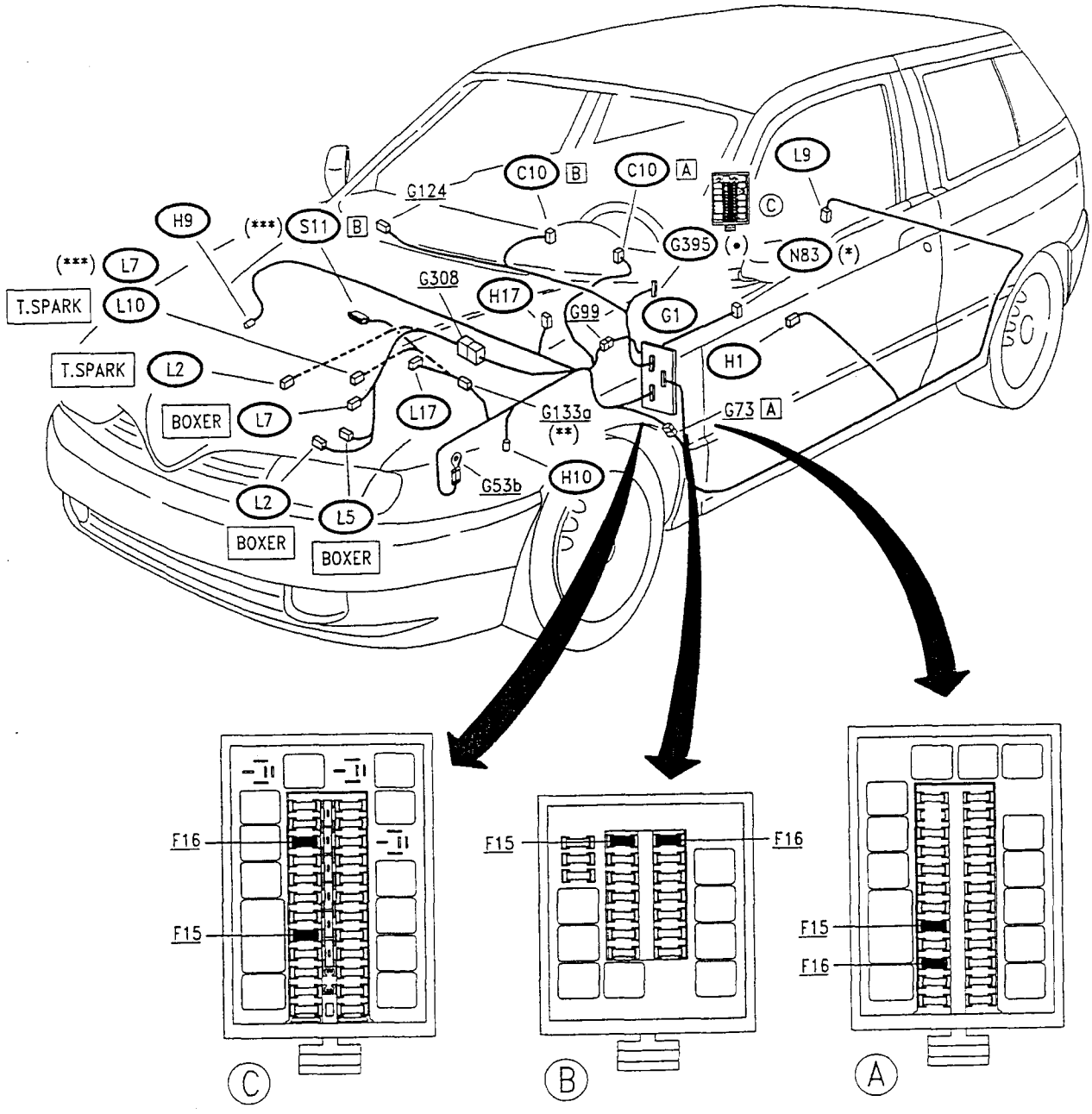




Minimum brake fluid level switch	H17

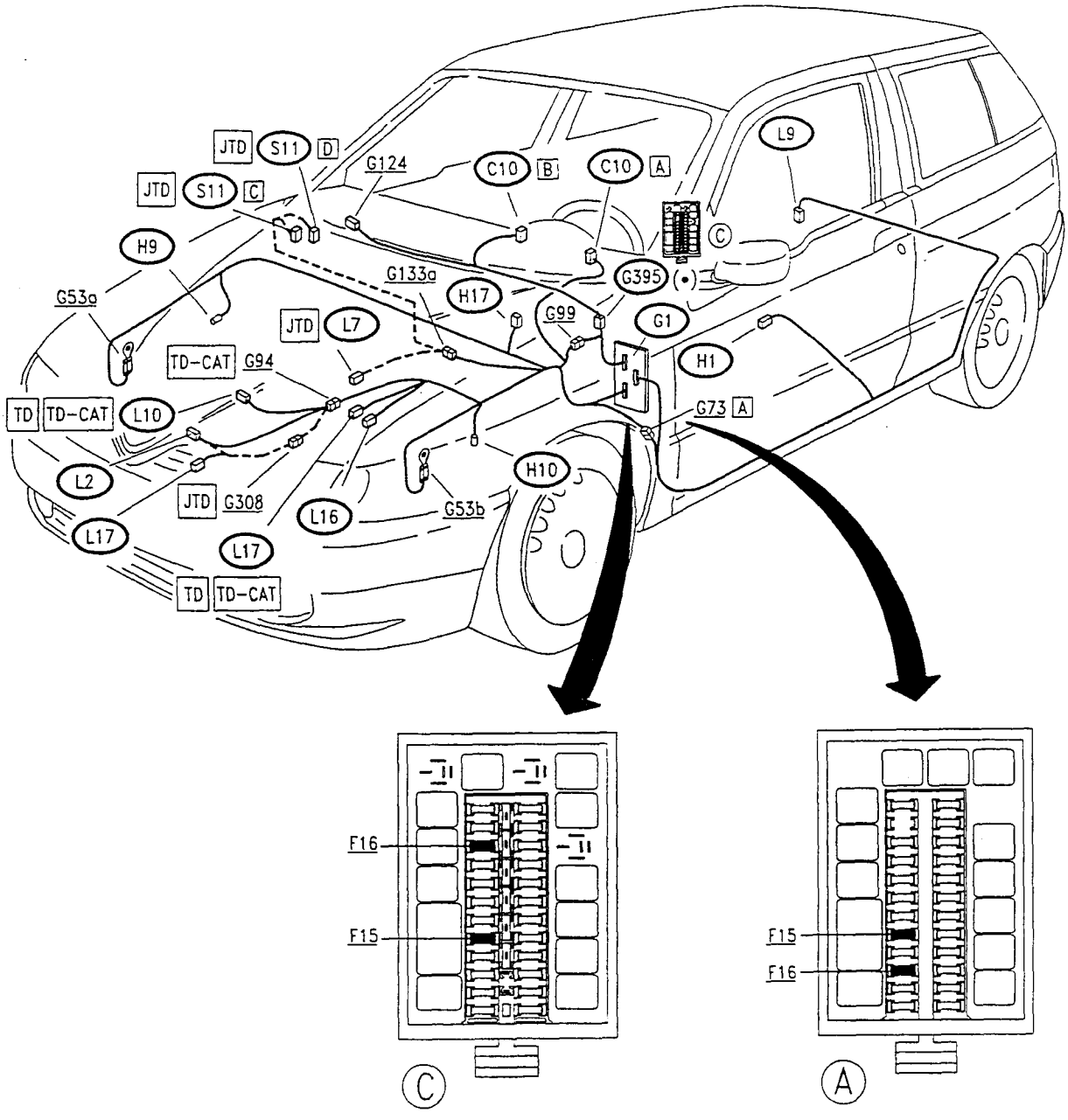


LOCATION OF COMPONENTS (Petol Versions)



(•) red fuseholder
(*) only for certain cars of Model Year '98
(**) from Model Year '98
(***) from May '98

LOCATION OF COMPONENTS (TD and JTD Version)



(•) red fuseholder

FAULT-FINDING TABLE

NOTE:
The faults described below ("warning light not working") give a summary of all the cases in which the warning light is not operating correctly: e.g. the warning light turns on to indicate a failure and this failure does not exist, or vice-versa, a function has been switched on and the warning light fails to show it, etc...

PRECAUTION:!
The instrument cluster C10 cannot be overhauled.
Therefore in the event of a failure, individual warning lights cannot be changed and the whole unit **C10** must be replaced (the only exceptions are the high beam warning light and the cluster lighting lamp) .
Also in the case of an incorrect setting of one of the indicators, it is not possible to change the individual component (e.g. rev counter, fuel level gauge, etc.) and the whole instrument cluster unit **C10** must be replaced.

Fault	Component to be checked													
	F15	F16	C10	L17	L16 (3)	L7 (2)	L5 (2)	L2	L10 (1)	L9	H17	H1	H9	H10
All lights on instrument panel are out	•		•											
Rev counter & speedometer (together)		•	•											
Speedometer			•	•										
Rev counter			•		•									
Water t. indicator			•			•			•					
Fuel gauge			•							•				
Handbrake & low brake fluid level warning light			•								•	•		
Brake pad wear warning light			•										•	•
Min. oil p. warning light			•					•						
Max. water t. warning light			•				•		•					

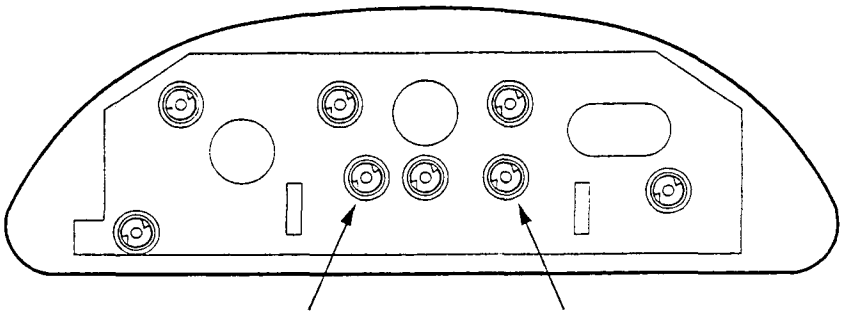
(1) TD or T.SPARK

(2) Boxer

(3) TD only and T.SPARK from May '98

NOTE:
The faults of warning lights not described here are to be found in the section concerning the system to which they belong: e.g. for the high beam headlamp warning light, see the section "High beam and low beam headlamps"

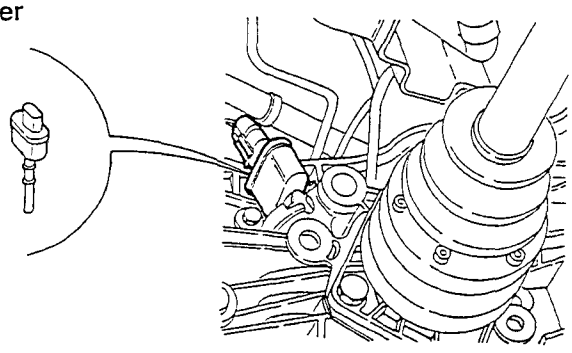
NOTE:
ABS and Air Bag "smart" warning lights (from M.Y. '99).
If one or both systems are not fitted on the vehicle, the "smart" warning light circuit is short circuited via a **yellow** coloured cap.

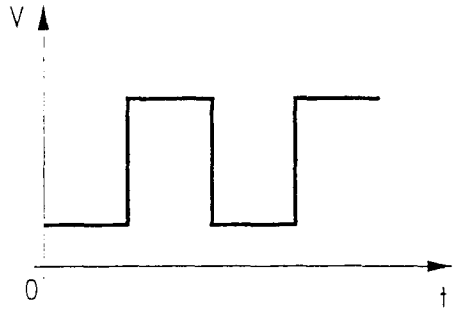


CHECKING COMPONENTS

Speedometer sensor (L17)

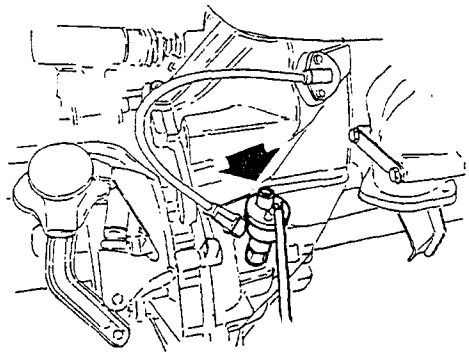
Boxer





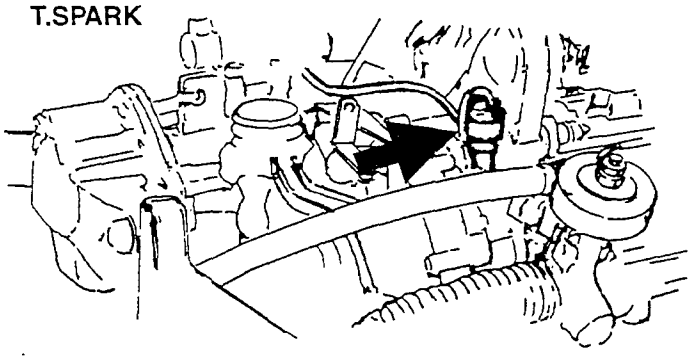
Output signal (with car on the move):
voltage at pin 2: pulses per turn

TD

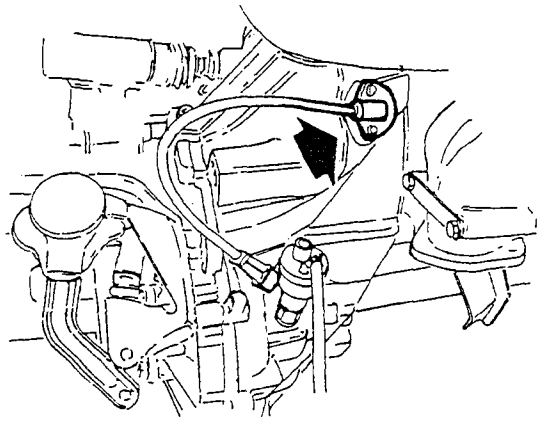


NOTE: The sensor differs, in the shape and internal functioning for the diffrent opgines, but the output signal is the same.

T.SPARK



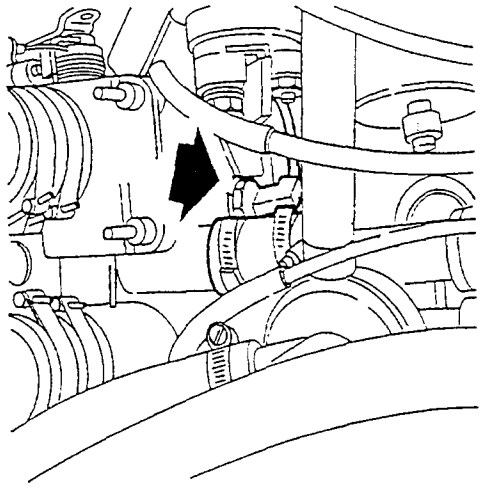
Rpm sensor (L16) (TD only)



SPECIFICATIONS	
Magnetic induction sensor	
Coil resistance	680 Ω ± 15%
Inductance	295 mH ± 10%
Gap on flywheel ring gear	0.25 ÷ 1.3 mm

Sender for engine coolant temperature gauge (L7)

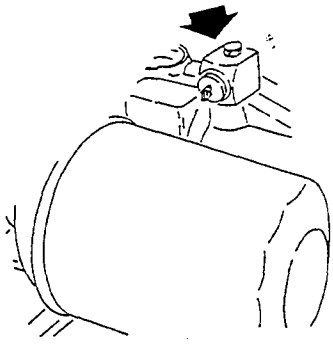
(Boxer only)



SPECIFICATIONS		
Temperature °C	Resistance Ω	Type of fluid for check
40	900 ÷ 1400	Water
60	470 ÷ 600	Water
80	235 ÷ 300	Water
90	175 ÷ 215	Water
100	135 ÷ 165	Glicerine
120	80 ÷ 100	Glicerine

Engine coolant max. temperature warning light contact (L5)

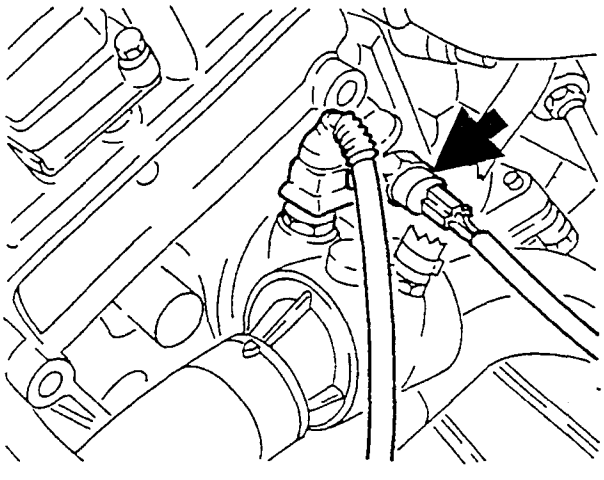
(Boxer only)



SPECIFICATIONS	
Cut-in temperature	117 ± 3°C
Cut-out temperature	100 ± 3°C

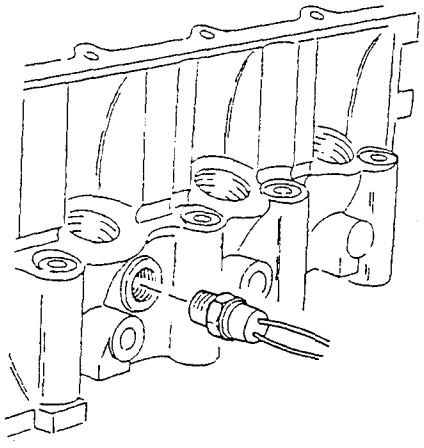
Sender for engine coolant temperature gauge & max. temp. warning light contact (L10)

(T.SPARK - Up to May '99)



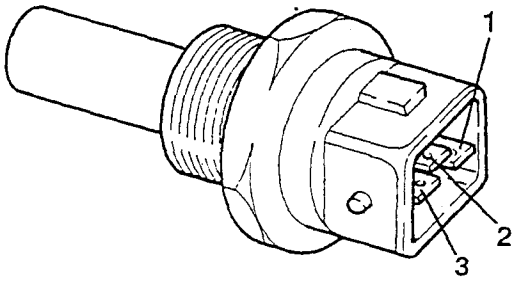
SPECIFICATIONS		
Sender		
Temperature °C	Resistance Ω	Type of fluid for check
60	525 ÷ 605	Water
90	195 ÷ 245	Water
120	82 ÷ 94	Glicerine
Contact		
Contact closes		122 ± 2°C
Contact opens		122 ± 3°C

Sender for engine coolant temperature gauge & max. temp. warning light contact (L10) (TD only)



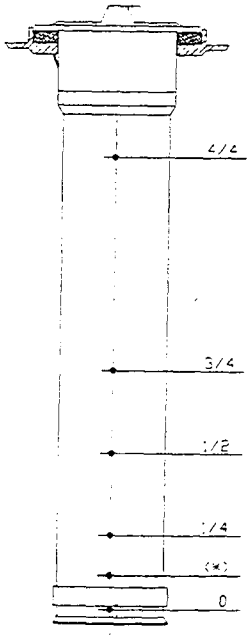
SPECIFICATIONS		
Sender		
Temperature °C	Resistance Ω	Type of fluid for check
60	470 ÷ 600	Water
90	160 ÷ 230	Water
120	73 ÷ 93	Glicerine
Contact		
Contact closes		120 ± 2°C
Contact opens		85°C

Sender engine temperature (L7) (JTD and T.SPARK from May '99)



SPECIFICATIONS	
Nominal resistance (at 20°C) between pin 1 and earth	2300 ÷ 2600 Ω

Fuel level gauge sender (L9)

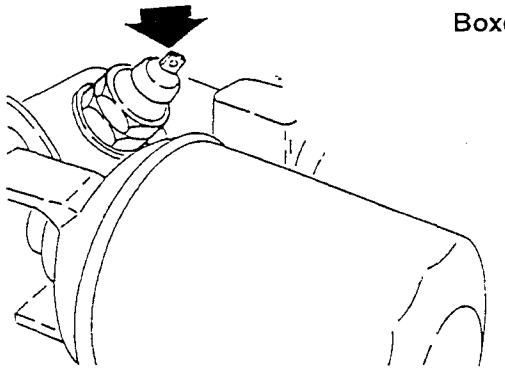


SPECIFICATIONS	
Level (see figure)	Resistance (Ω)
4/4	0 ÷7
3/4	56.5 ÷ 71.5
1/2	111 ÷ 131
1/4	181 ÷ 206
start of reserve (*)	262
0	290 ÷ 320

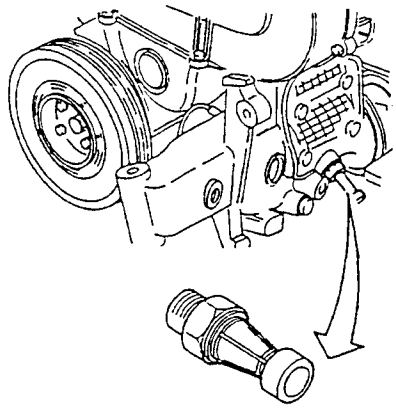
(*) appr. 7 litres

Minimum oil pressure contact (L2)

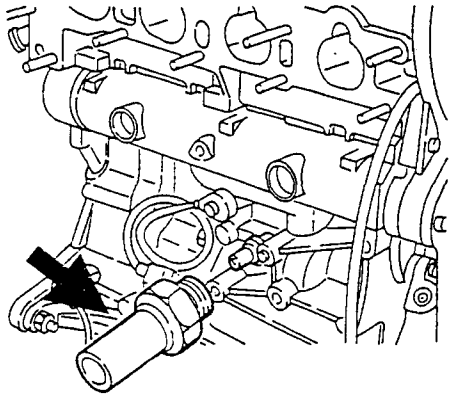
Boxer



TD

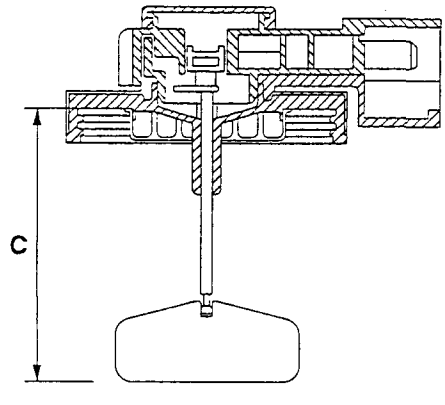


T.SPARK



SPECIFICATIONS	
contact closes (presure falling)	0.2 ÷ 0.5 bar
contact opens (pressure rising)	0.2 ÷ 0.5 bar

Min. brake fluid level switch (H17)



SPECIFICATIONS
The float closes the contact if dimension **C** (see figure) exceeds 40 ± 1 mm.

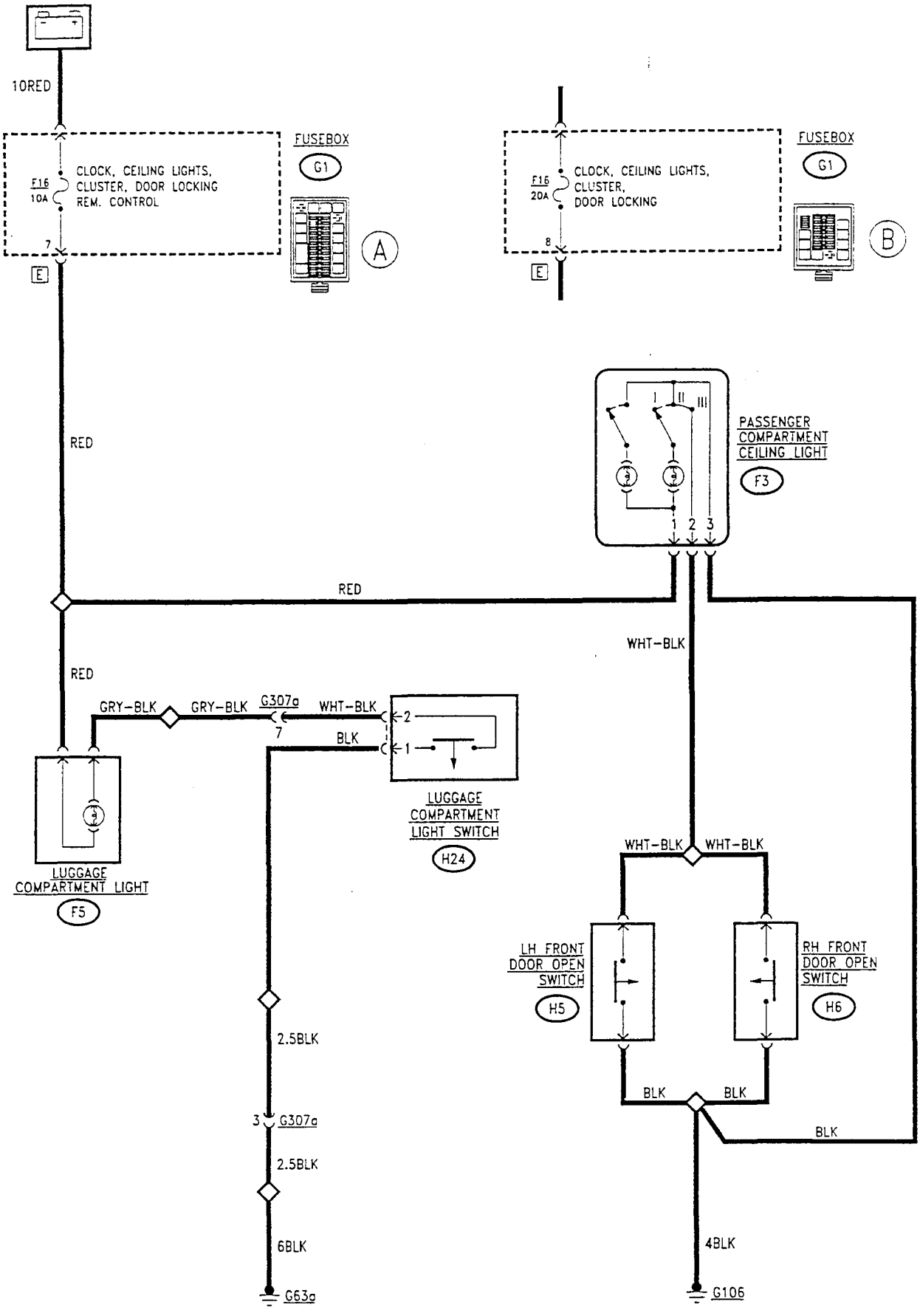
NOTA: to check the operation of the swithc, it is sufficient to lightl press on the upper end of the cover: in this case the contact closes and it is possible to check whether the warning light is working properly.

INTERIOR LIGHTING

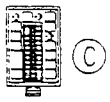
INDEX

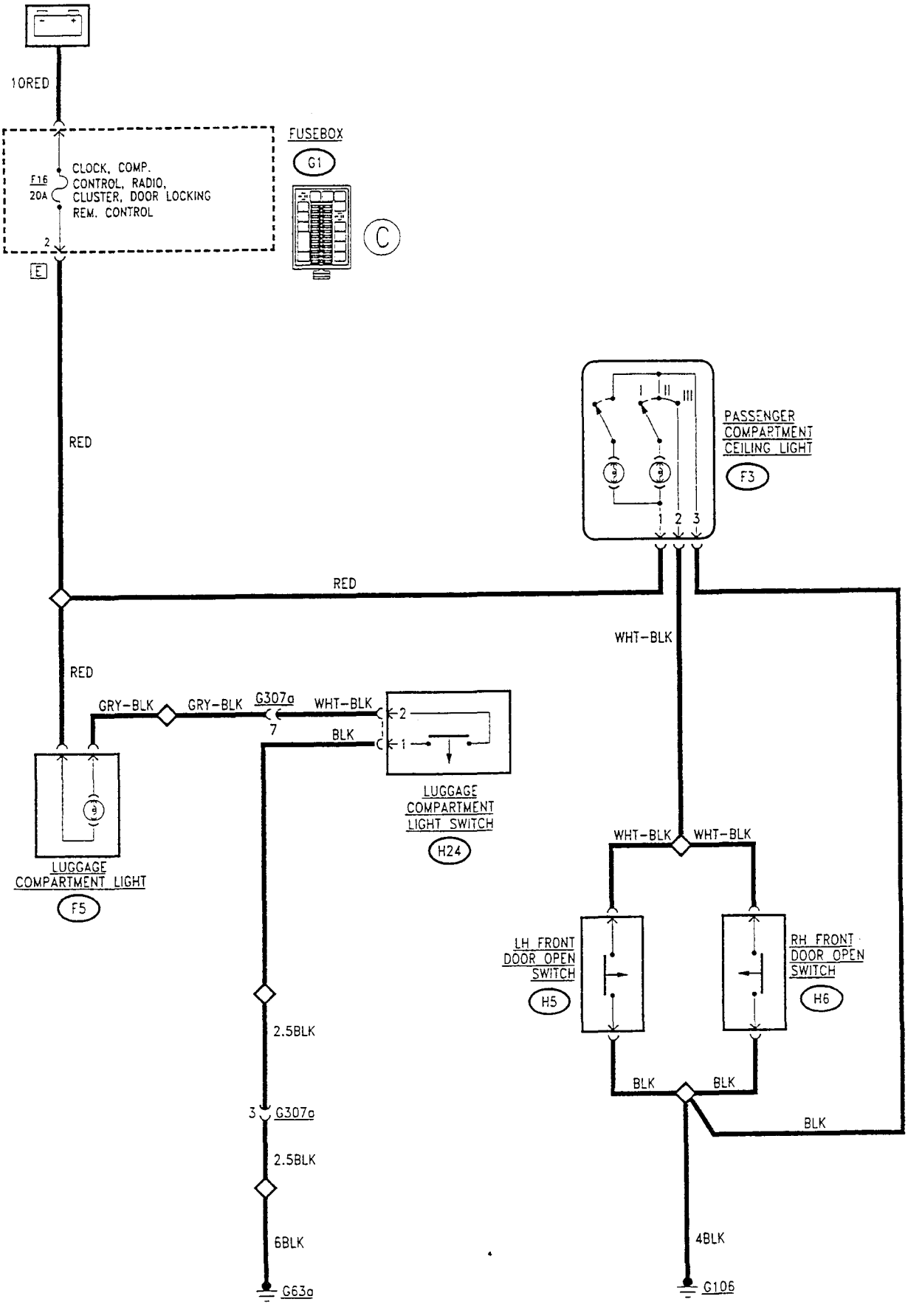
WIRING DIAGRAM 11-2
GENERAL DESCRIPTION 11-3
FUNCTIONAL DESCRIPTION 11-3
COMPONENTS AND CONNECTORS 11-4
LOCATION OF COMPONENTS 11-6
FAULTFINDING TABLE 11-7

WIRING DIAGRAM



WIRING DIAGRAM



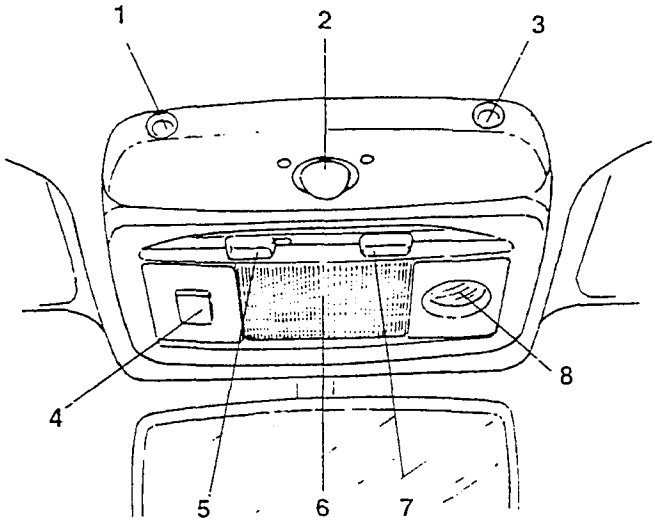


GENERAL DESCRIPTION

The numerous light sources provided ensure good lighting inside the passenger compartment and/or of some specific points under all conditions.
The front courtesy light **F3** is turned on automatically when one of the two doors is opened, and it is turned off when they are closed.
Of course, the same light may be turned on manually with its switch.

On the courtesy light there is also a reading lamp which makes for instance reading possible without disturbing the driver.

NOTE: The courtesy light is different for the versions with sunroof and car alarm. However operation remains unchanged as described below.



1 - antitheft volumetric sensor (See "Antitheft")
2 - antitheft I.R. receiver (See "Antitheft")
3 - antitheft volumetric sensor (See "Antitheft")
4 - sunroof control switch (See "Sunroof")
5 - courtesy light switch
6 - courtesy light
7 - spot light switch
8 - spot light

Lastly a special light **F5** illuminates the luggage compartment which is turned on when the tailgate is opened.

FUNCTIONAL DESCRIPTION

The courtesy light with passenger compartment lighting controls plus reading light **F3** is supplied directly by the battery through fuse **F16** (10A) of fusebox **G1**: this makes it possible to operate the courtesy light or reading light from the corresponding switch.

The switch has three positions:

I - courtesy light always off

II - courtesy light on

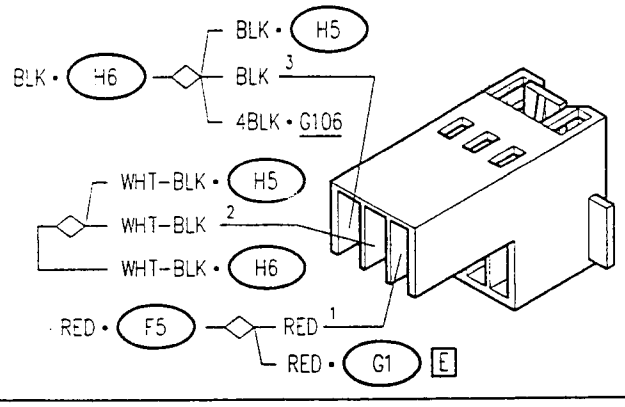
III - courtesy light turns on when one of the doors is opened

In fact, the courtesy light turns on automatically when the doors are opened, as a switch (**H6** for the RH door and **H5** for the LH door) sends an earth signal to the courtesy light **F3**.

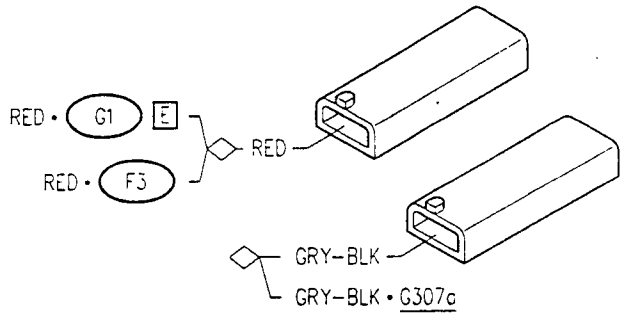
Also the luggage compartment light **F5** is supplied with battery voltage via the line protected by fuse **F16**; it is turned on when the tailgate is opened and switch **H24** sends an earth signal.

COMPONENTS AND CONNECTORS

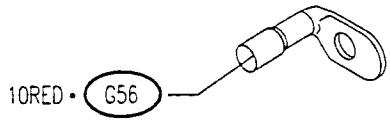
Passenger compt. ceiling light	F3



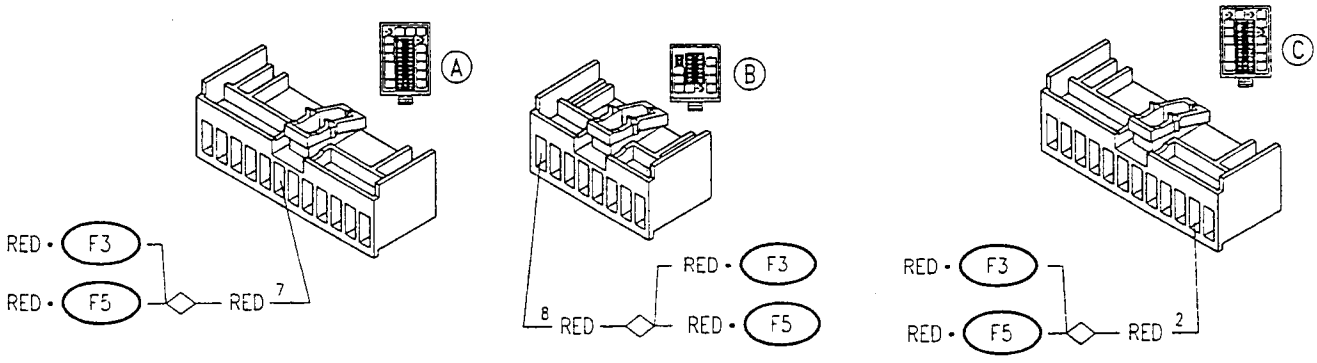
Luggage compt. light	F5



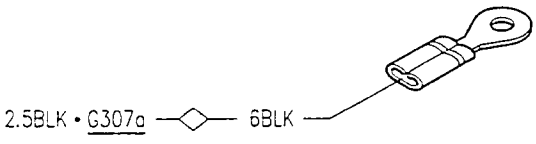
Fusebox	G1



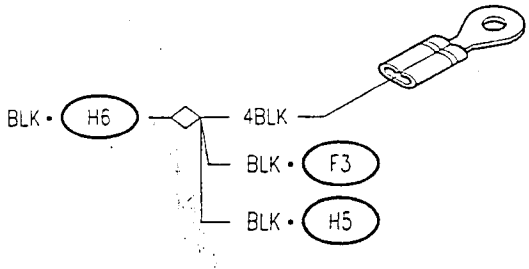
Fusebox	G1 E



RH rear earth	G63a

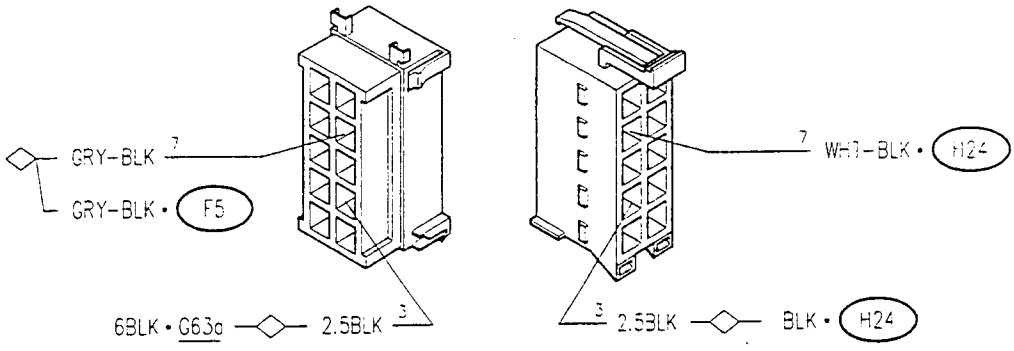


Seat crossmember earth	G106

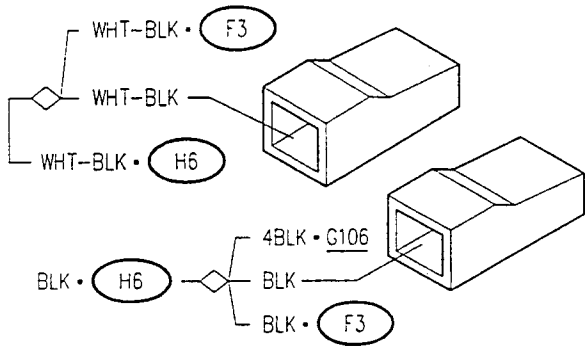


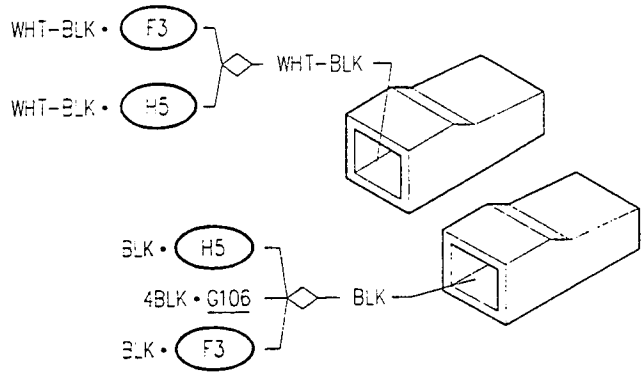
COMPONENTS AND CONNECTORS (cont.d)

Rear/luggage compt. wiring connector A	G307a

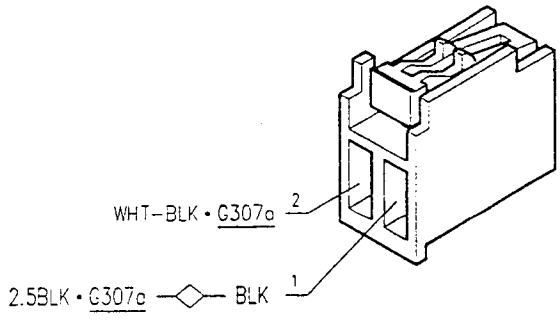


LH front door open switch	H5	RH front door open switch	H6

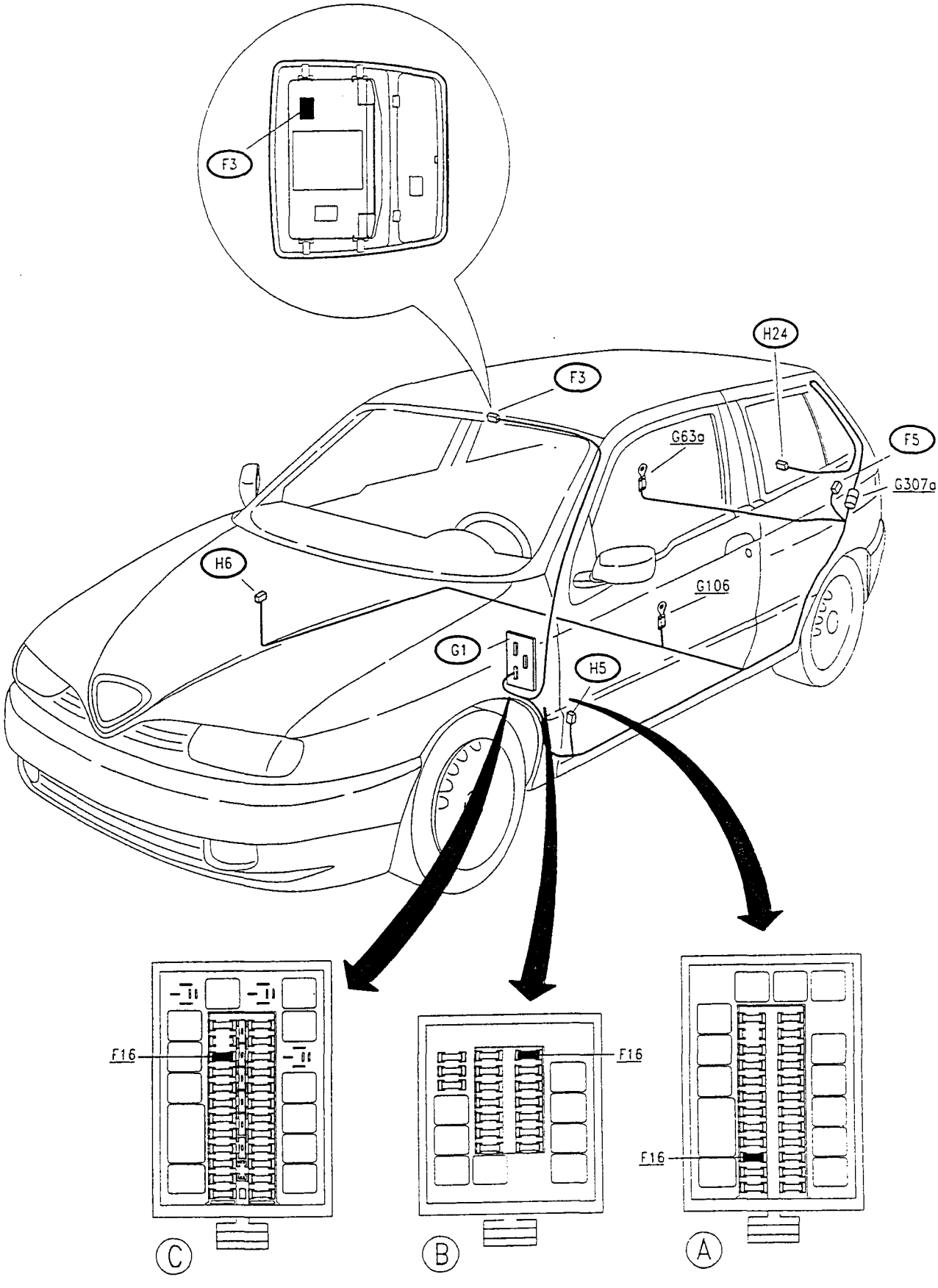




Luggage compartment light switch	H24



LOCATION OF COMPONENTS



FAULTFINDING TABLE

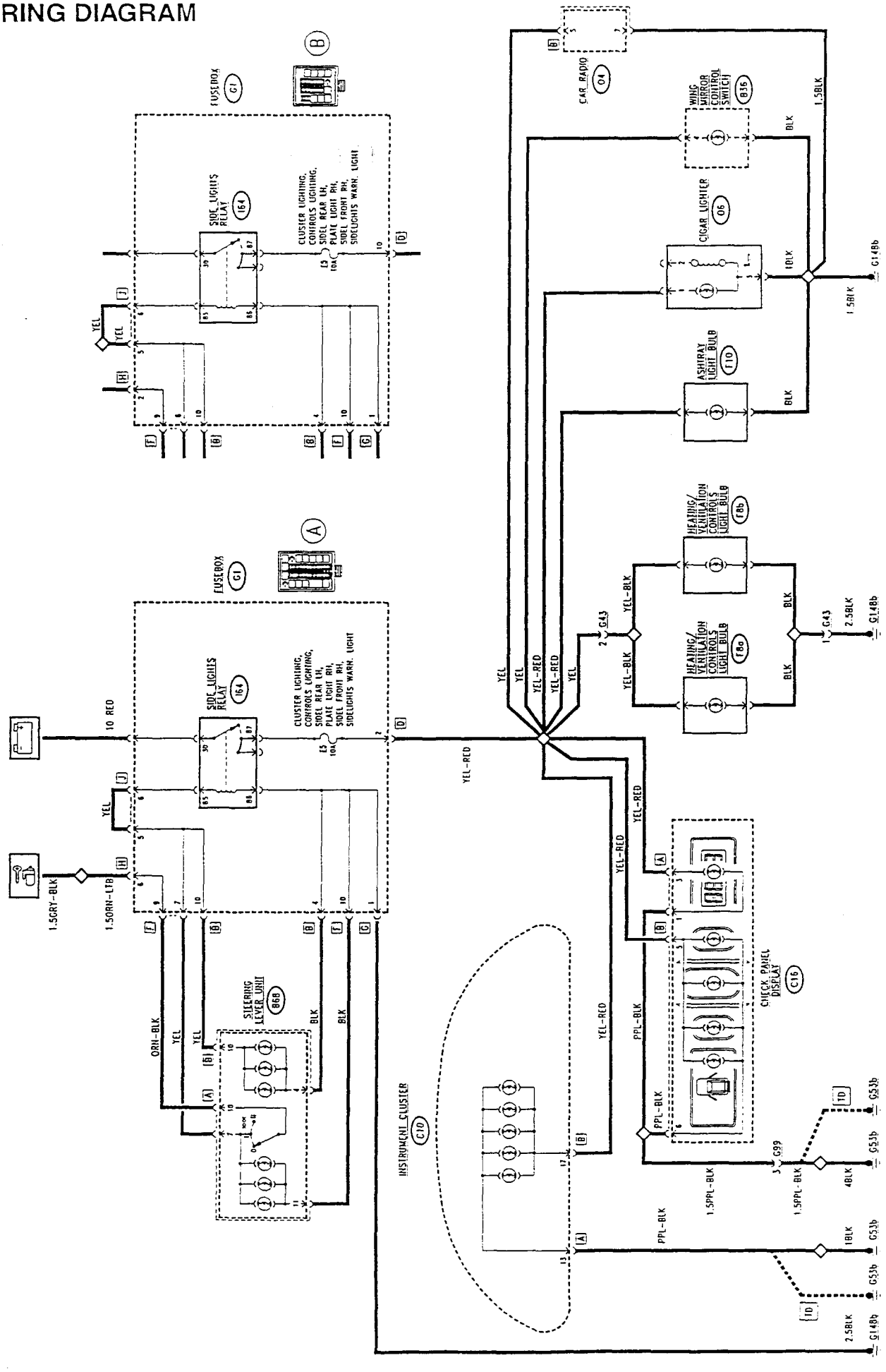
Failure	Component to be checked					
	F16	F3	F5	H5	H6	H24
All the interior lights	•					
Courtesy light under all circumstances		•				
Courtesy light: fails to turn on opening the RH door					•	
Courtesy light: fails to turn on opening the RH door				•		
Reading light in courtesy light		•				
Luggage compartment light			•			•

LIGHTING OF CONTROLS AND INDICATORS

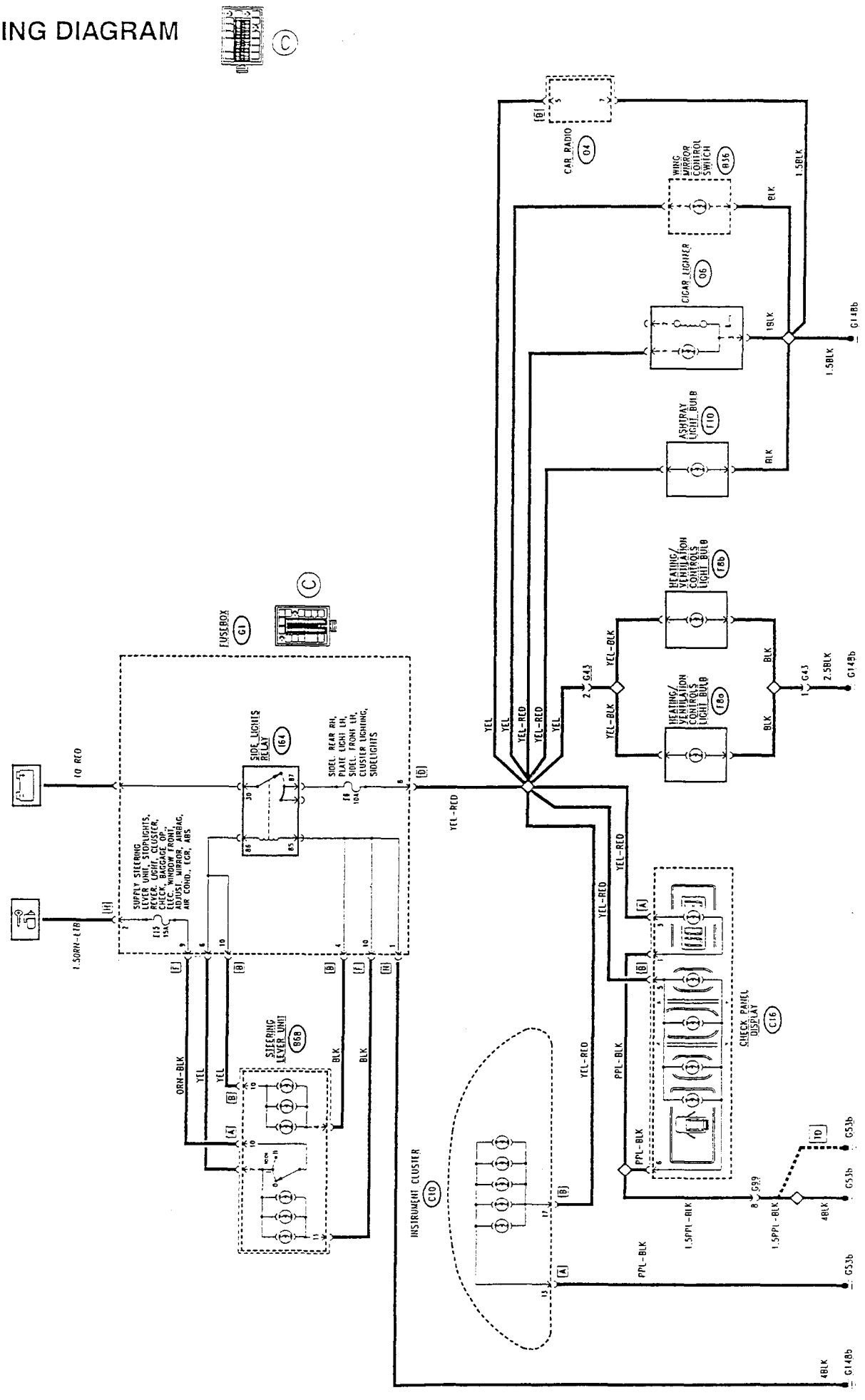
INDEX

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GENERAL DESCRIPTION 10-3
FUNCTIONAL DESCRIPTION 10-3
COMPONENTS AND CONNECTORS 10-4
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FAULTFINDING TABLE 10-9

WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The numerous light sources make it easy to locate the controls and switches under all conditions.
The wiring diagram shows the lights that illuminate the ideograms of the controls and switches when the side lights are switched on.

The following are illuminated when the side lights are turned on:

- the instrument cluster;
- lever unit ideograms (both levers);
- ideograms of the switches on the Check Panel;
- heating and ventilation control panel;
- light for cigar lighter/current socket and ashtray;
- wing mirror switches;
- radio (if fitted),

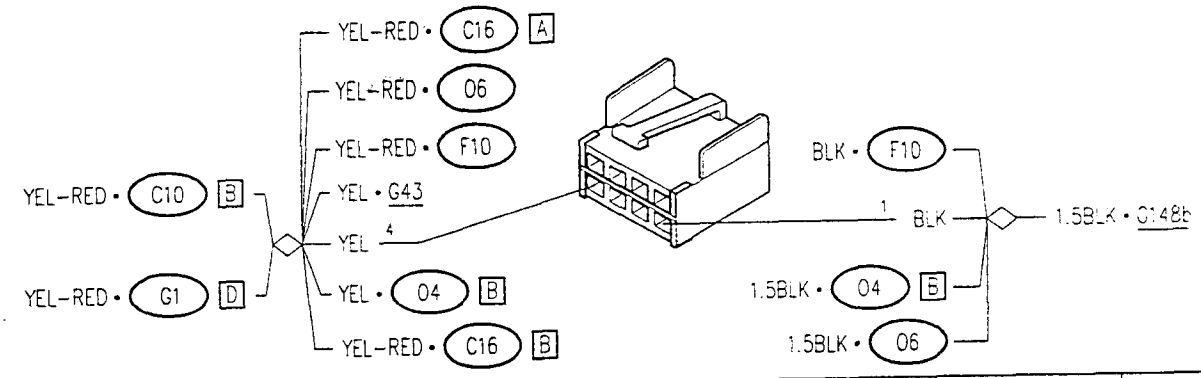
FUNCTIONAL DESCRIPTION

The pictograms of steering column lever unit **B68** are protected by fuse **F15** (for fusebox **G1** "C") they are turned on when the sidelights are turned on: the left ones directly by the light switch itself, the right ones through a supply that returns from the fusebox **G1**.

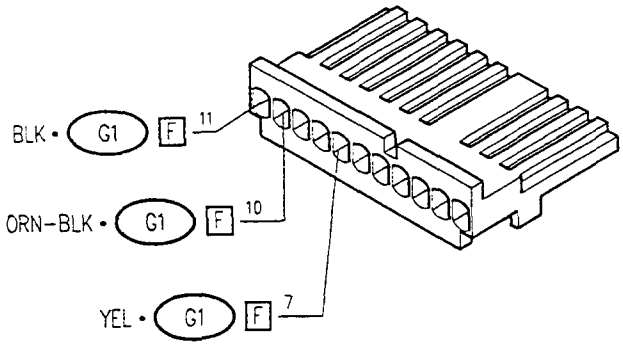
The heating and ventilation unit controls **F8a** and **F8b**, the light in the ashtray **F10** and the one for the cigar lighter **O6**, the wing mirror control switch **B36** and the radio **O4** are supplied through the side lights relay switch **I64** and fuse **F5** (**F6** for box "C") of **G1**.
The same supply also lights up numerous leds in the instrument cluster **C10** and on the Check Panel display **C16.**

COMPONENTS AND CONNECTORS

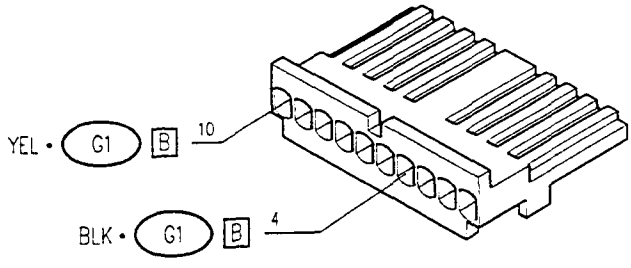
Wing mirror control switch — B36



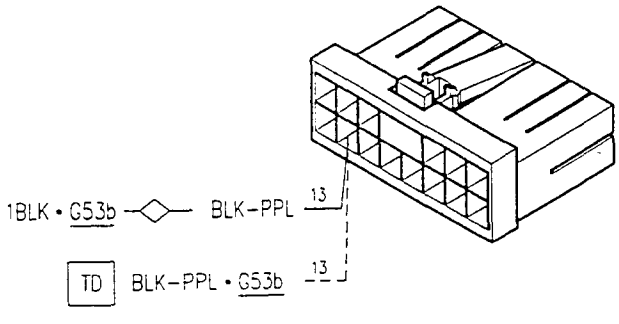
Lever unit — B68 A



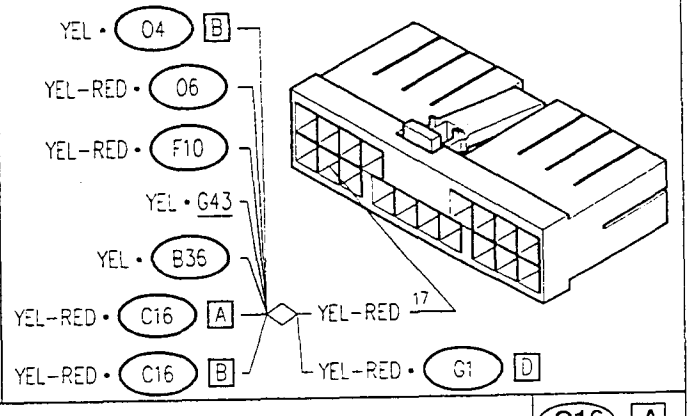
Lever unit — B68 B



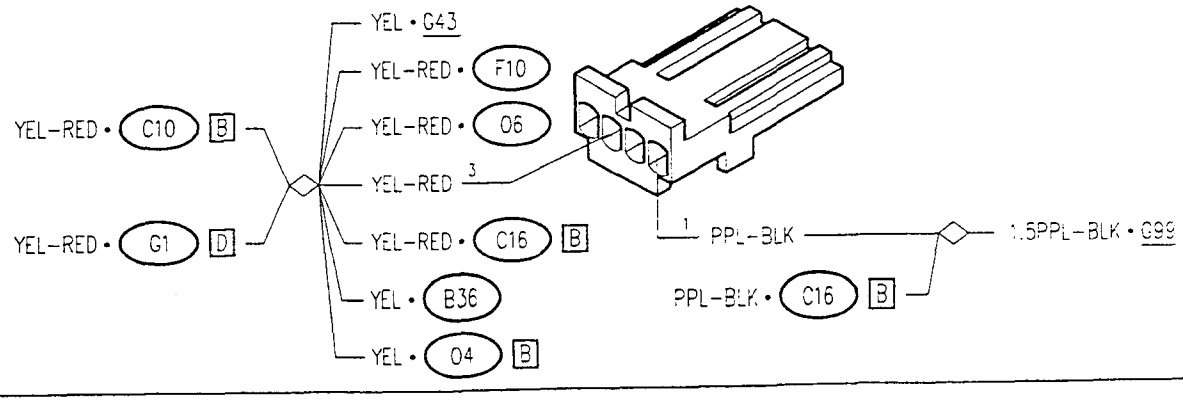
Instrument cluster — C10 A



Instrument cluster — C10 B

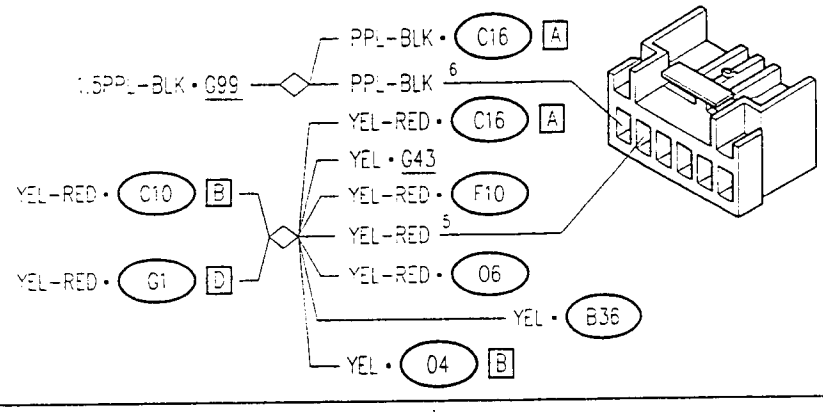


Check Panel Display — C16 A

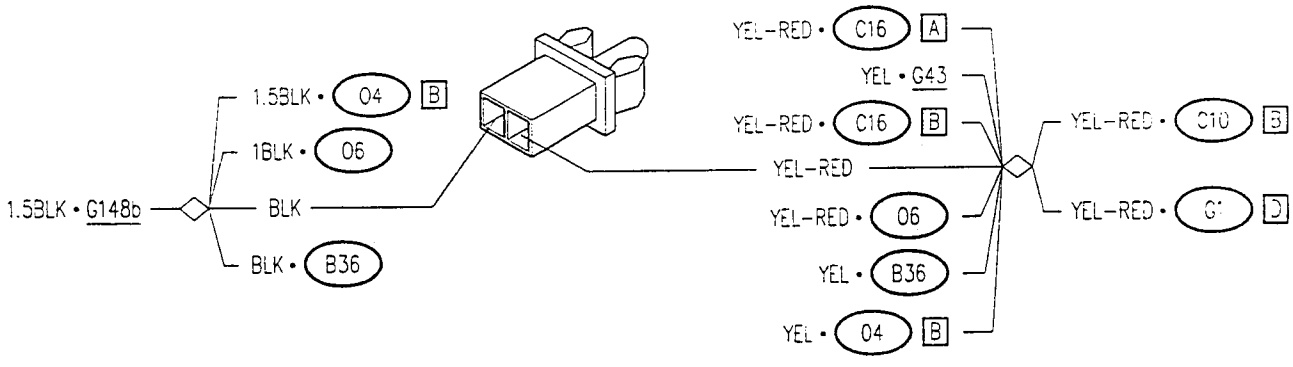


COMPONENTS AND CONNECTORS (cont.d)

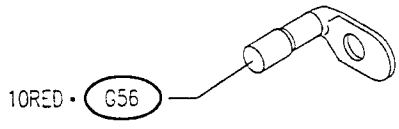
Check Panel Display — C16 B



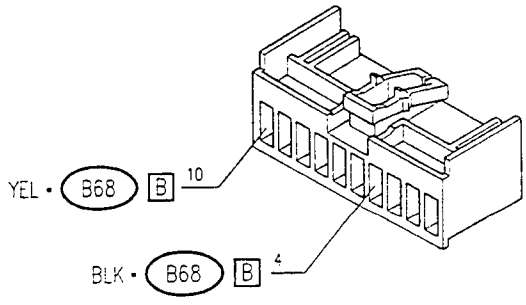
Ashtray light — F10



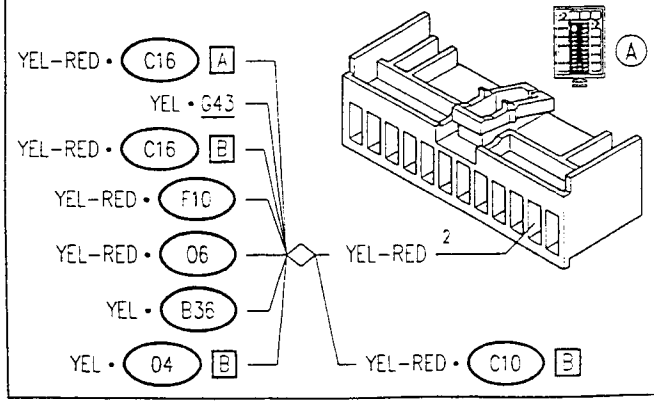
Fusebox — G1



Fusebox — G1 B

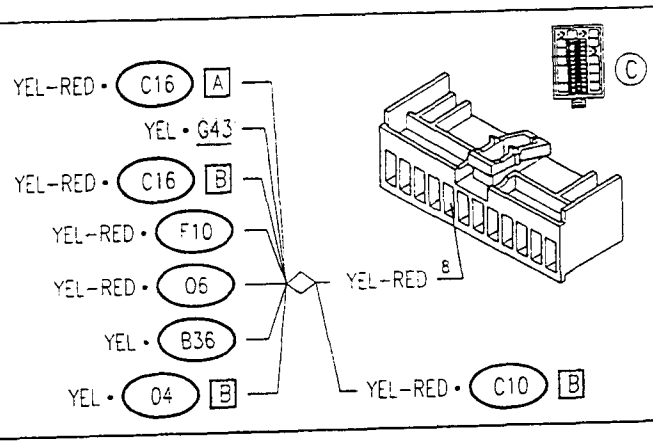


Fusebox — G1 D

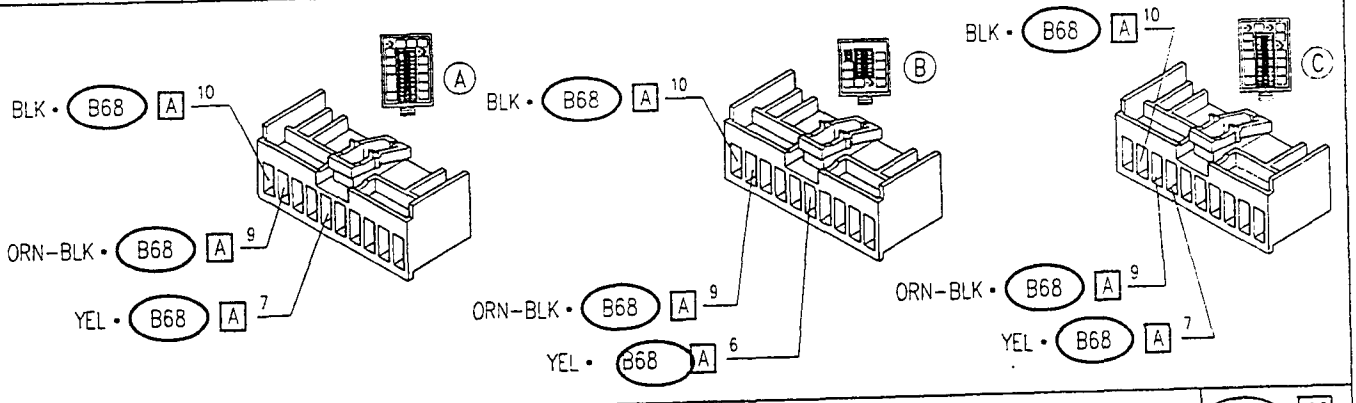


COMPONENTS AND CONNECTORS (cont.d)

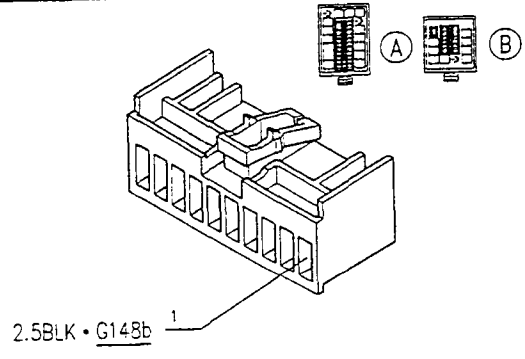
Fusebox — G1 D



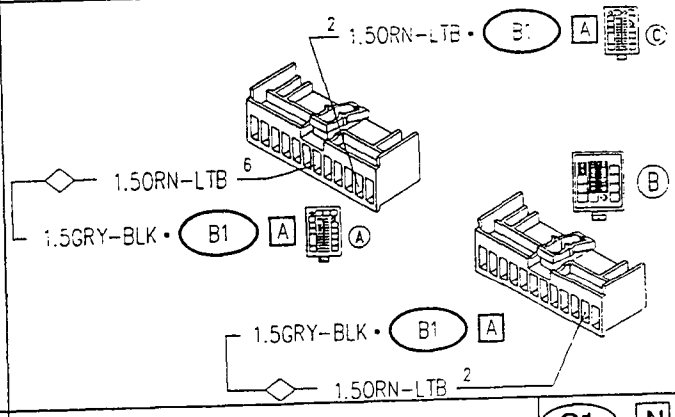
Fusebox — G1 F



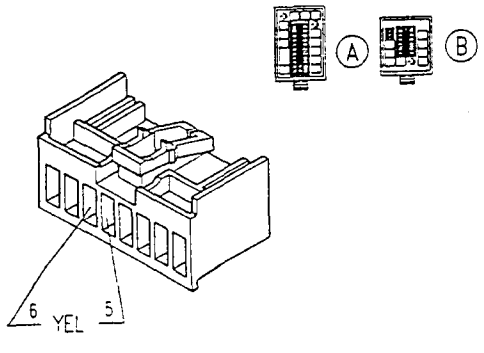
Fusebox — G1 G



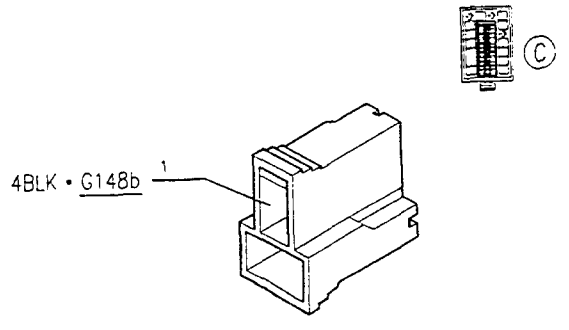
Fusebox — G1 H



Fusebox — G1 J

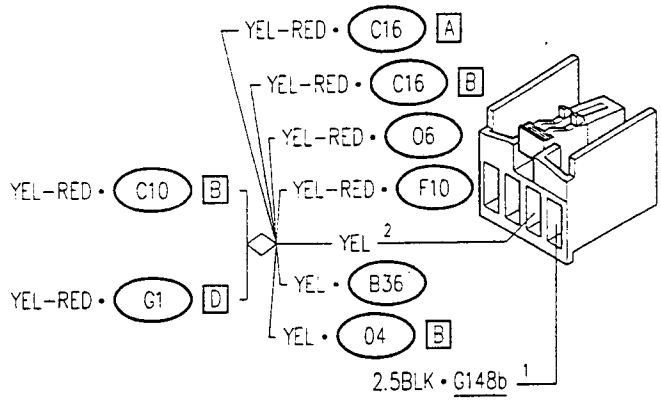


Fusebox — G1 N

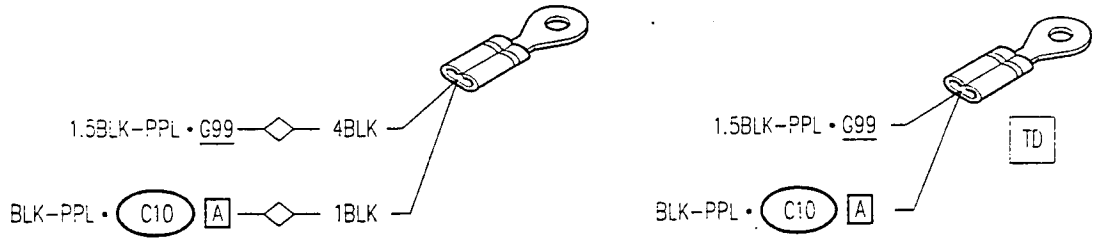


COMPONENTS AND CONNECTORS (cont.d)

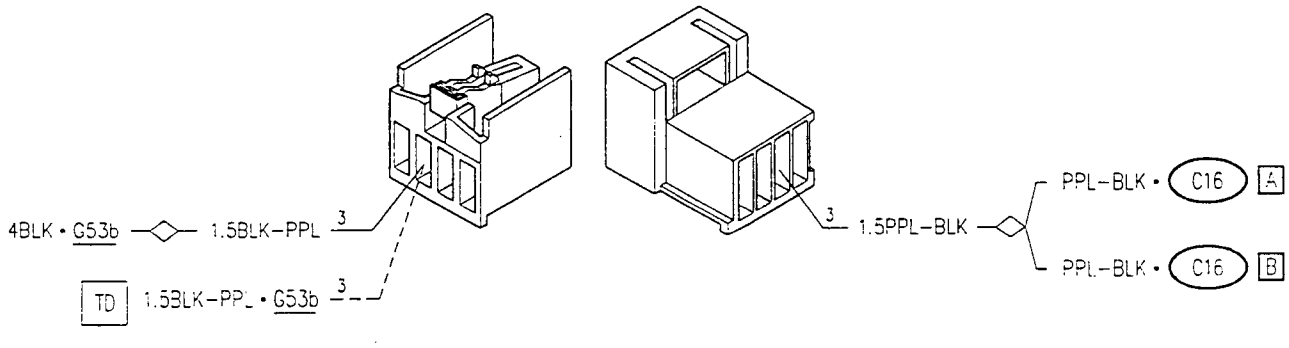
Heating & ventilation control wiring connector	G43



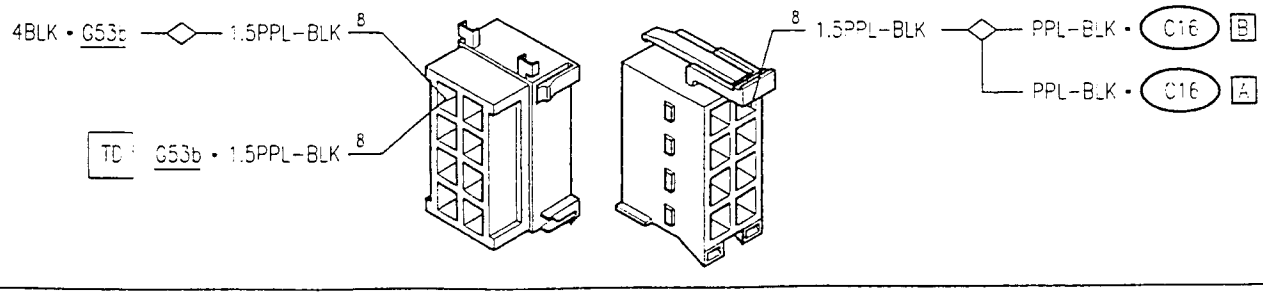
LH engine compt. earth	G53b



Dashboard/engine wiring connector (*)	G99



Dashboard/engine wiring connector (**)	G99

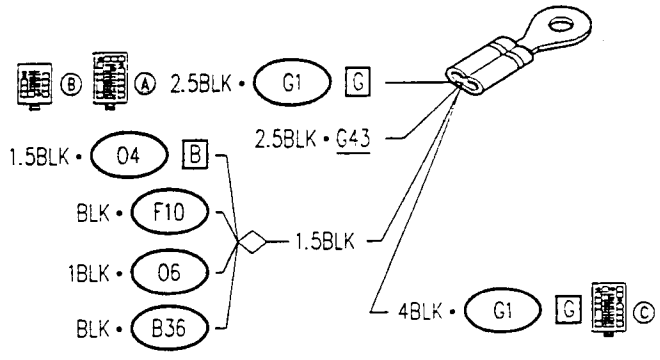


(*) up to chassis no.__

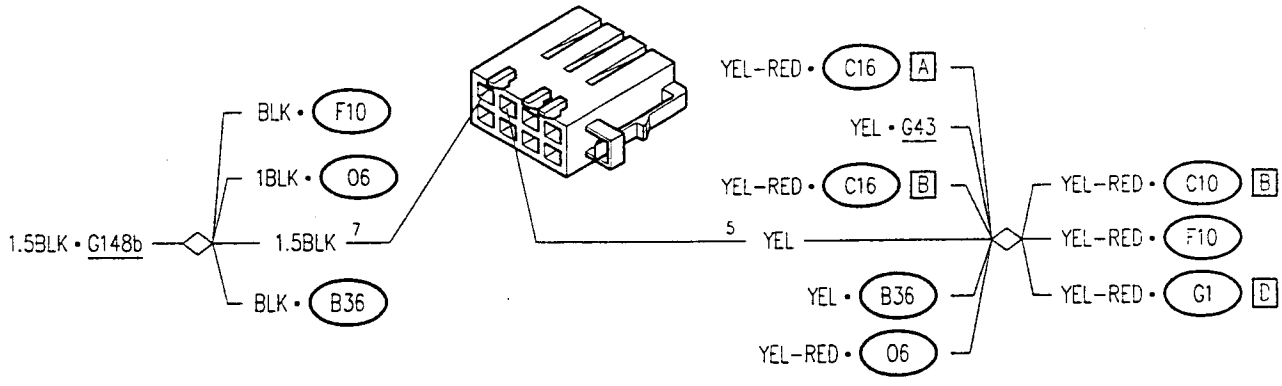
(**) from chassis no.__

COMPONENTS AND CONNECTORS (cont.d)

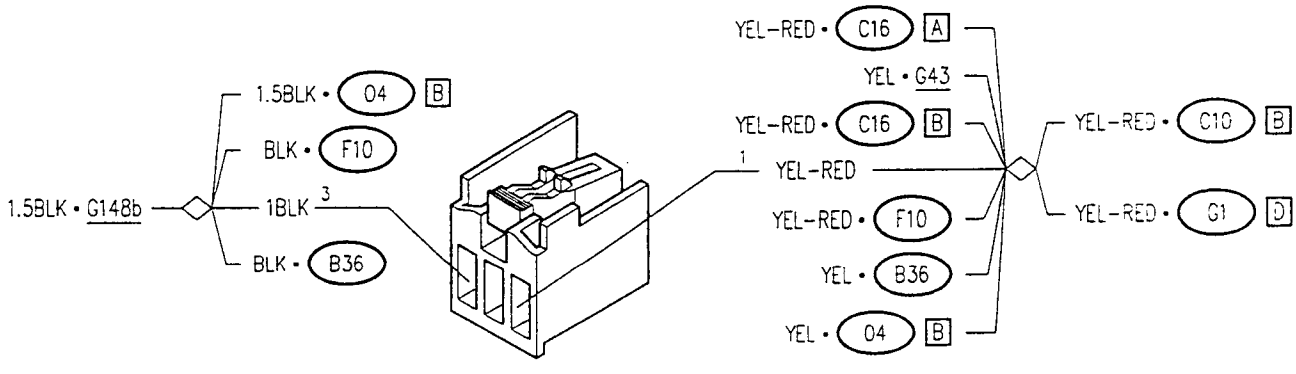
Earth under LH dashboard — G148b



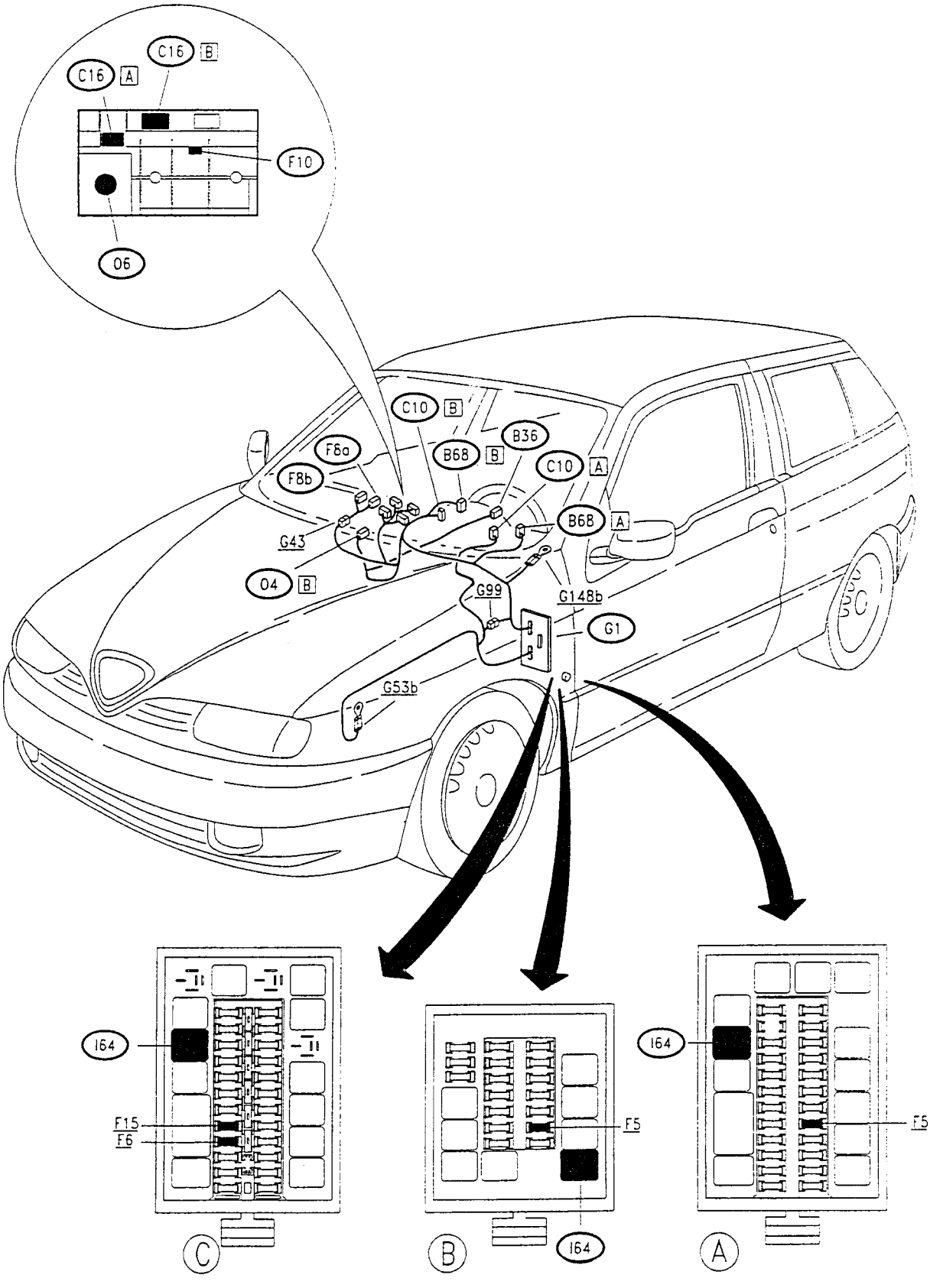
Radio — O4 B



Cigar lighter - current socket — O6



LOCATION OF COMPONENTS



FAULTFINDING TABLE

NOTE: Firstly check that the side lights are working properly (see "Side Lights")

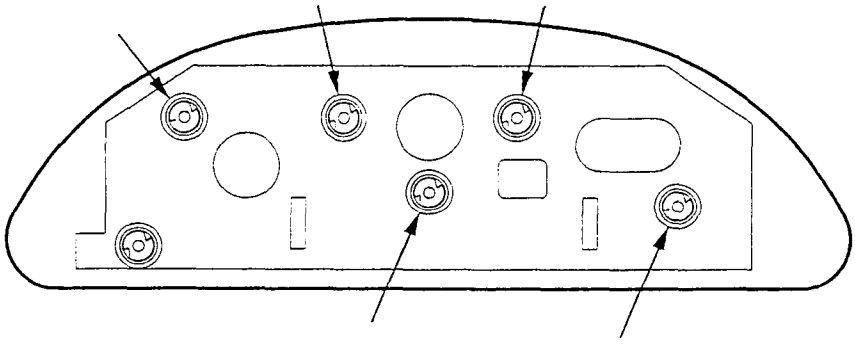
Failure	Component to be checked										
	F5	B68 (1)	F8a	F8b (2)	O6	F10 (2)	B36 (1)	O4 (1)	I64	C10 (3)	C16 (1)
All the control lighting	•								•		
Lever unit lighting		•									
Instrument cluster lighting										•	
Check Panel lighting											•
Heating & ventilation panel lighting			•								
Ashtray / cigar lighter lighting					•						
Wing mirror control lighting							•				
Radio lighting								•			

(1) In the event of a failure of the bulbs/leds **change the whole component**

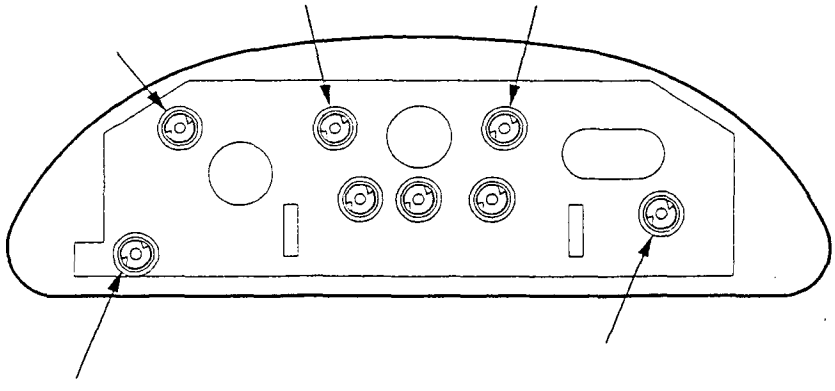
(2) **only change the bulbs** with bulb holder

(3) it is possible to **change the five light bulbs** shown in the figure.

Up to M.Y. '98



From M.Y. '99



LOCATION OF EARTHS

INDEX

GENERAL DESCRIPTION 2-2
WIRING DIAGRAMS 2-3
COMPONENTS AND CONNECTORS 2-13
LOCATION OF EARTHS ON THE CAR 2-17

GENERAL DESCRIPTION

The following diagrams show the diferent earths present on the vehicle and the connecting cables for each of them; each cable shows the circuit to which it refers and the component earthed through that line.

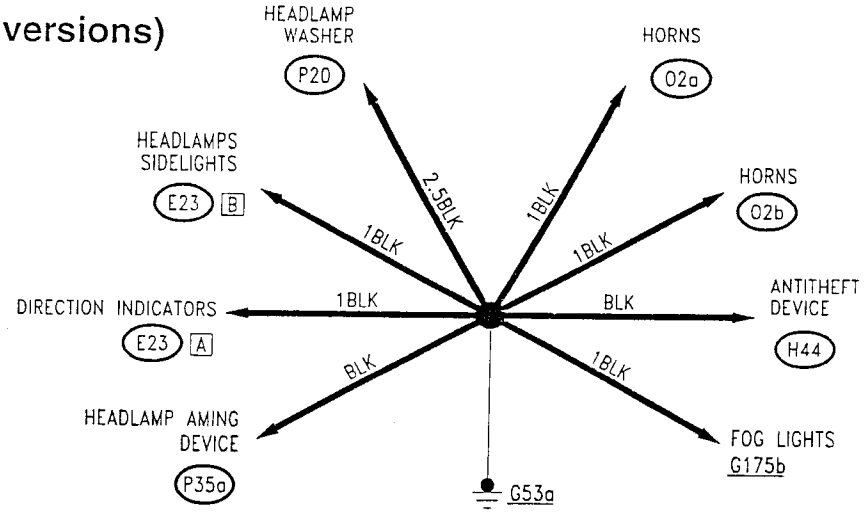
The earths shown are the following:

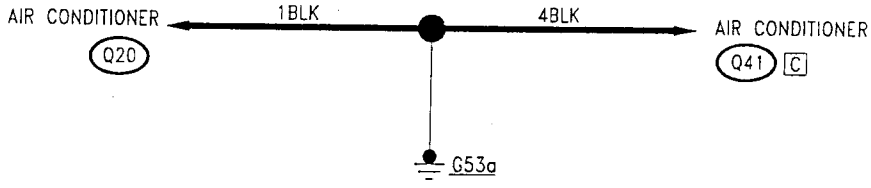
- **G53a** Right-hand engine compartment earth
- **G53b** Left-hand engine compartment earth
- **G55a** Right-hand side panel earth
- **G55b** Left-hand side panel earth
- **G60** Injection wiring earth **(G60a/b)**
- **G63a** Right-hand rear earth
- **G63b** Left-hand rear earth
- **G106** Seat cross rail earth
- **G109** Injection wiring earth
- **G143** Centre services tray earth
- **G148b** Earth under left-hand dashboard
- **G267** Earth on crankcase
- **G318** Earth on gearbox
- **G381** Airbag earth

NOTE: Using these diagrams it is easy to locate those circuits which are connected to earth by the same line: this simplifies faultfinding work in the event of problems affecting more than one system: for instance the oxidation of an earth can put several circuits and numerous functions out of order contemporaneously.

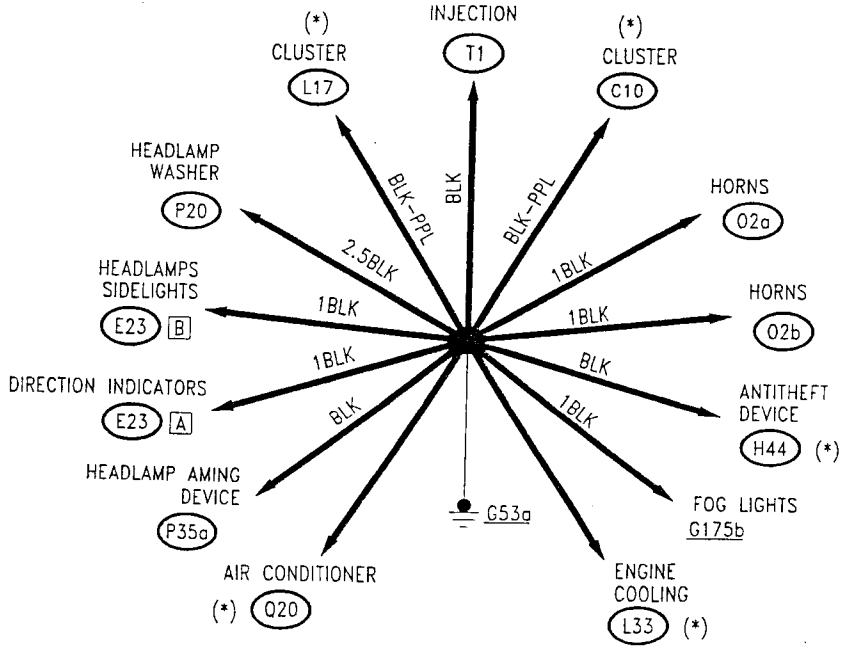
WIRING DIAGRAMS

G53a (Boxer versions)



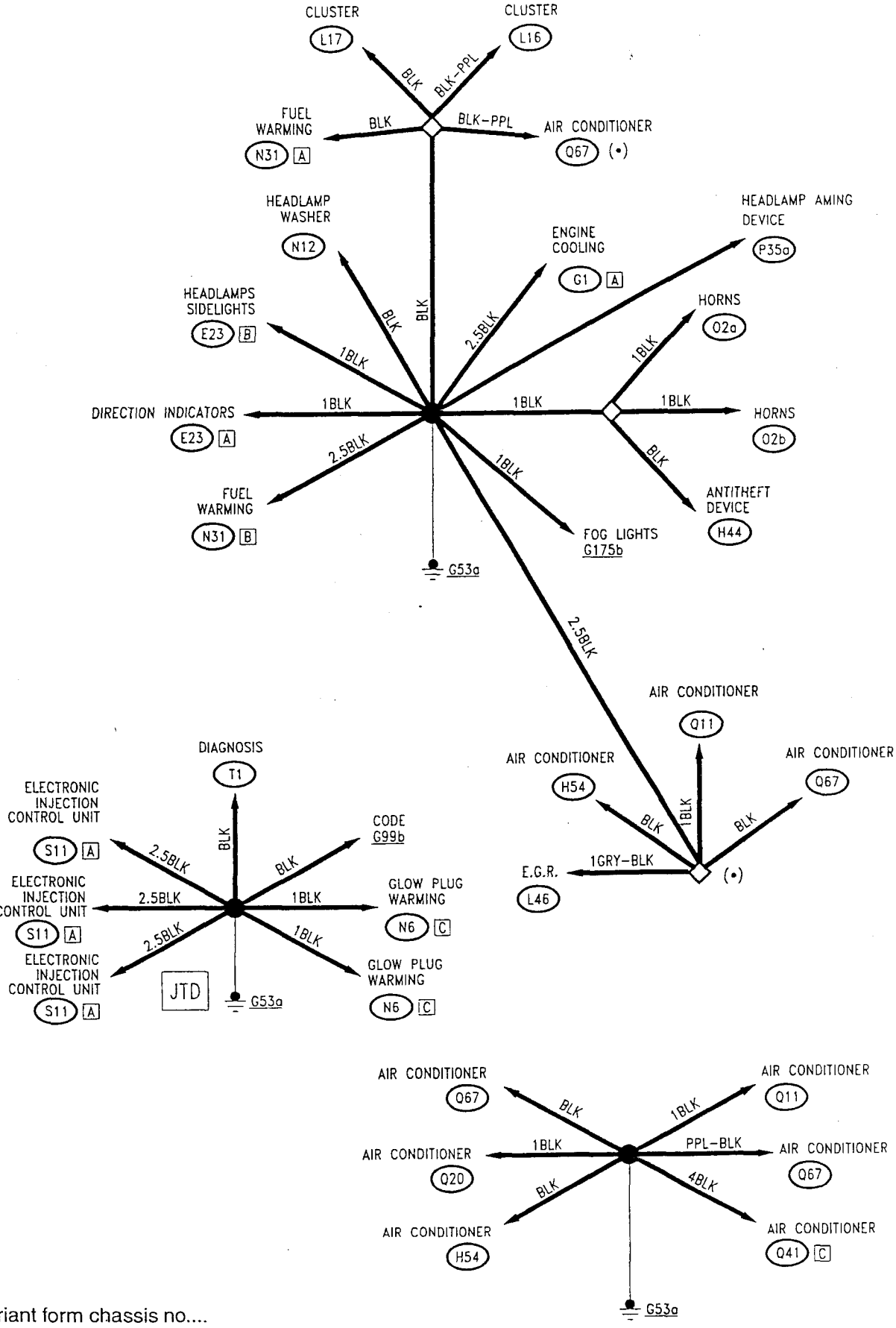


G53a (T.SPARK version)



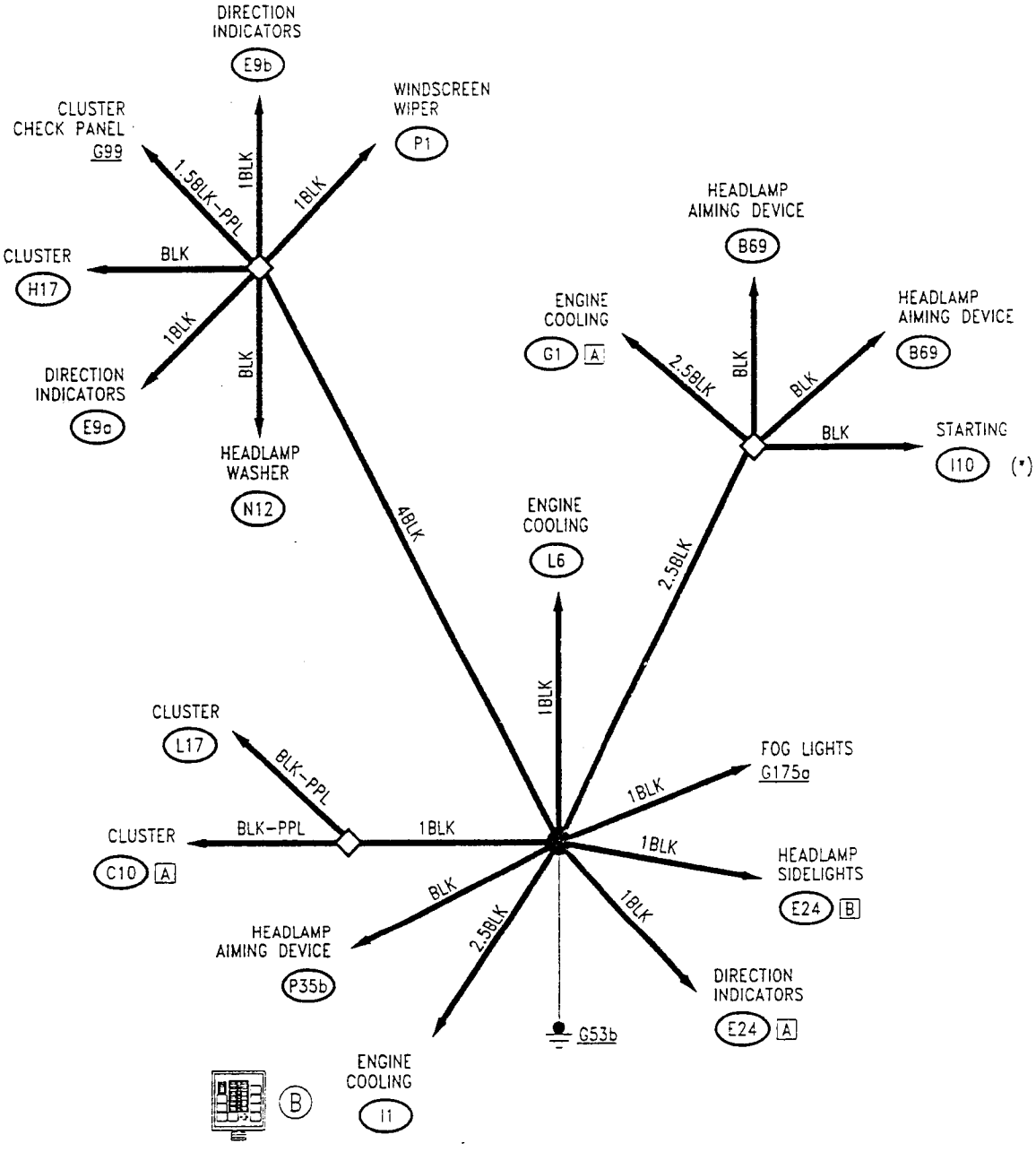
(**) from chassis no. 4065018
(*) up to chassis no.___

G53a (TD, TD-CAT, JTD version)



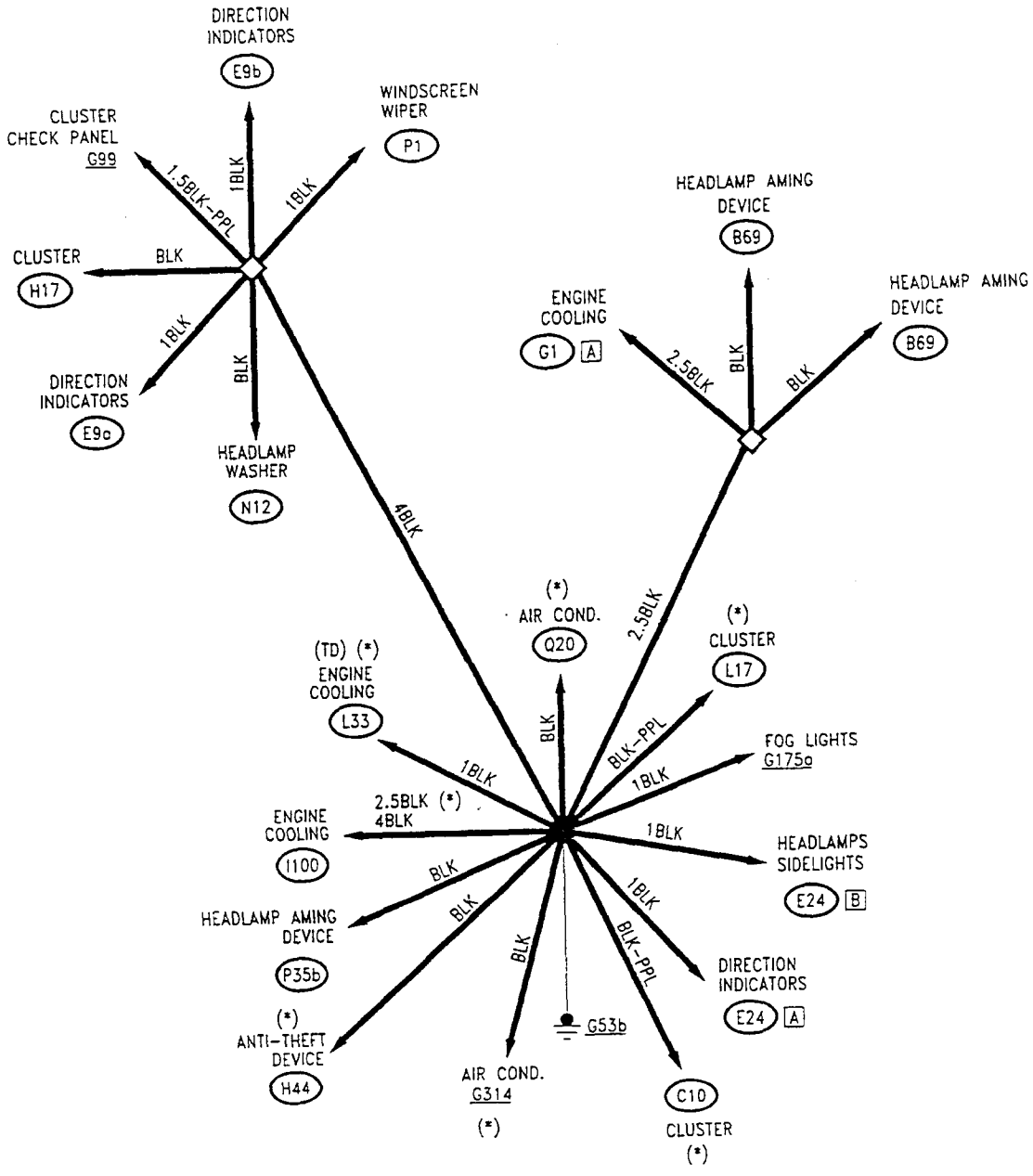
(•) Variant form chassis no....

G53b (Boxer versions)



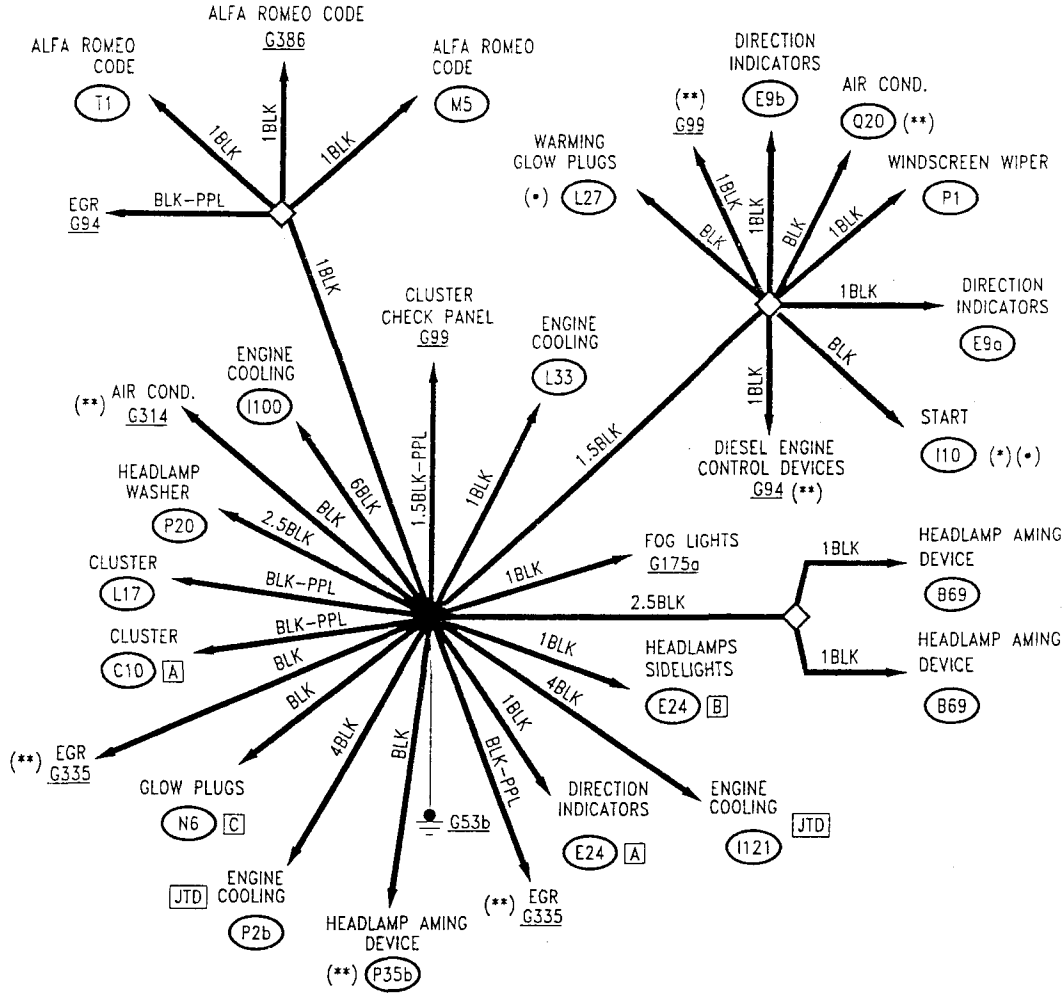
(*) Versions without ALFA ROMEO CODE

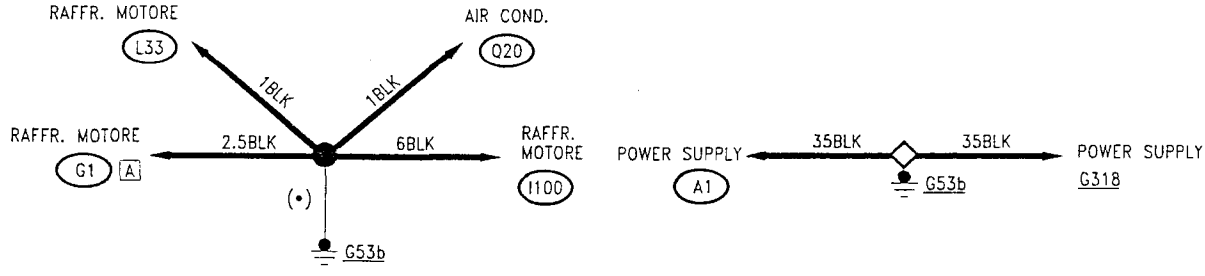
G53b (T.SPARK version)

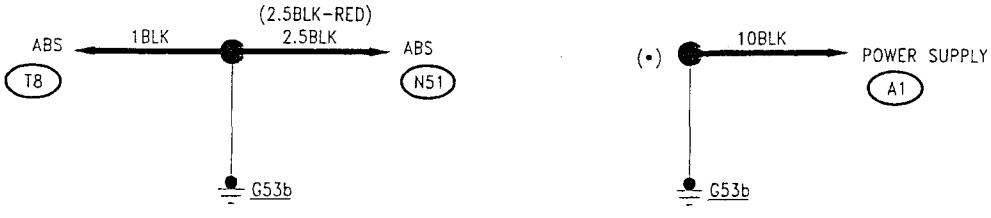


(*) from chassis no.__

G53b (TD, TD-CAT version)

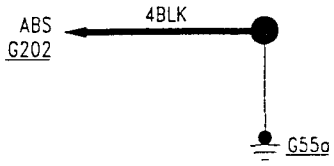






(*) Only versions without ALFA ROMEO CODE
(*) Variant from chassis no....
(•) Variant from chassis no....

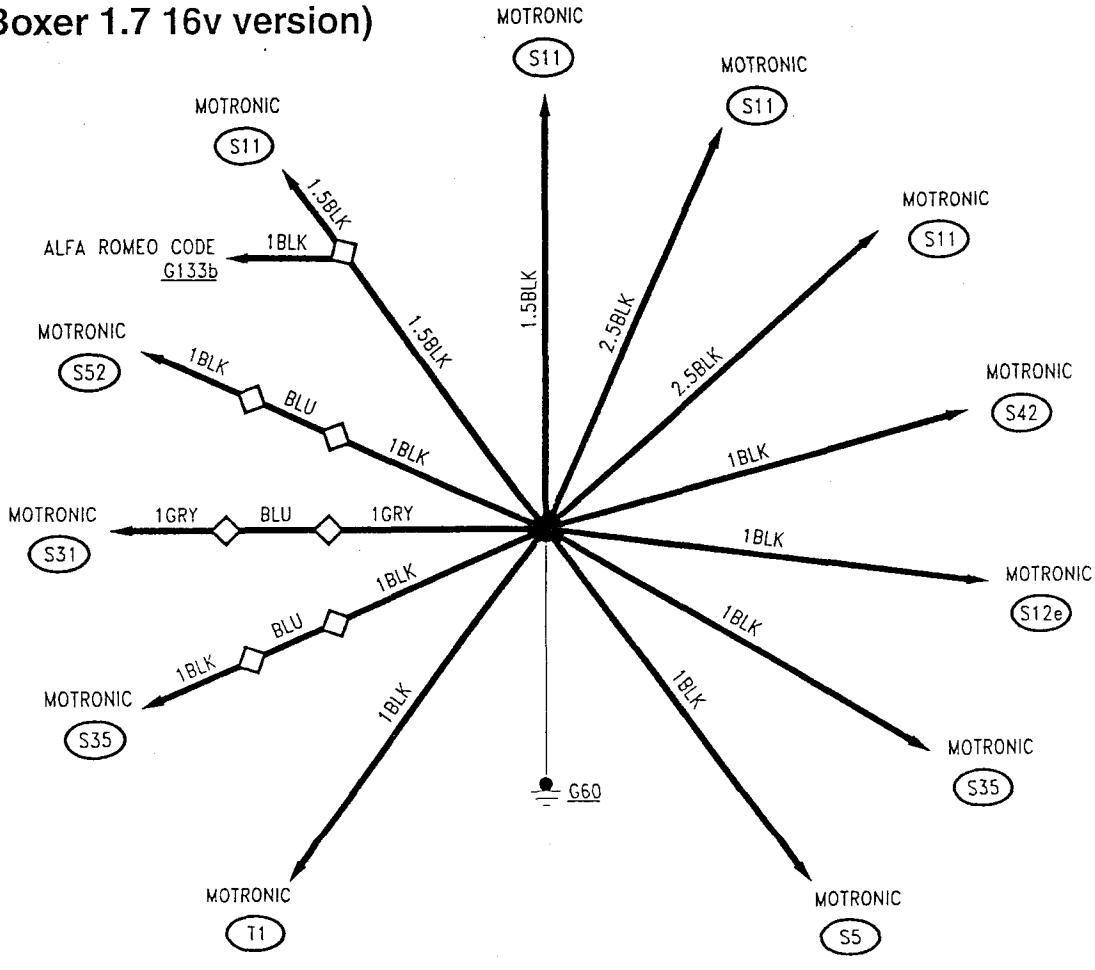
G55a (Boxer versions)



G55b (TD, T.SPARK and JTD version)

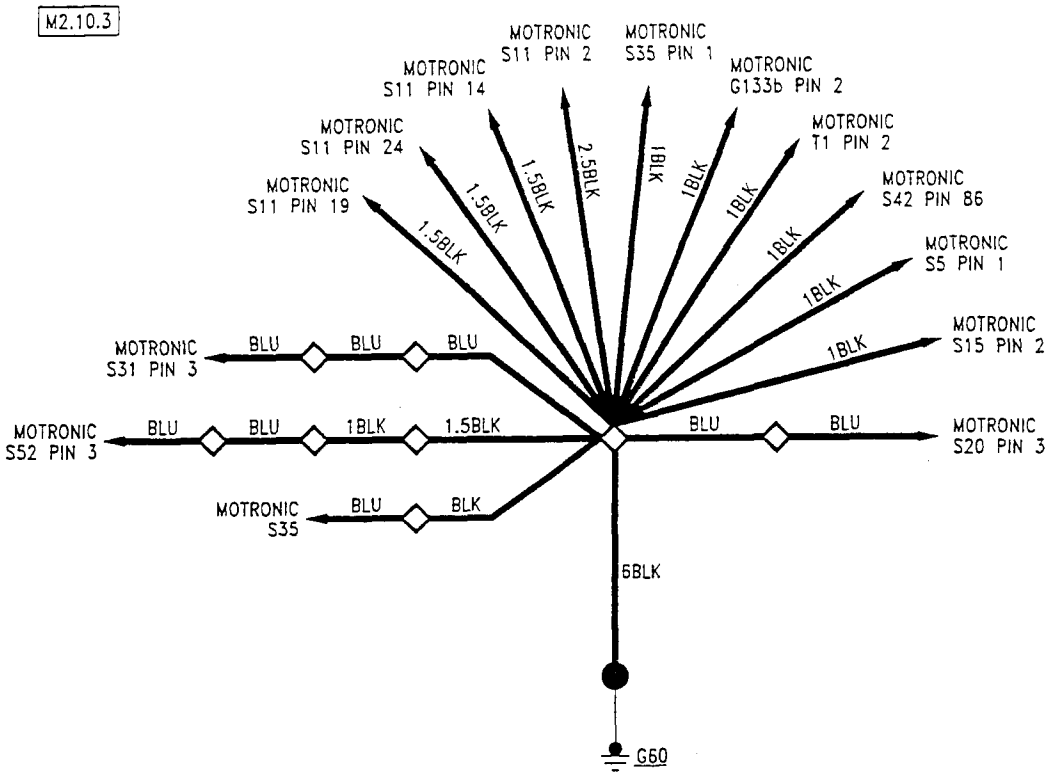


G60 (Boxer 1.7 16v version)

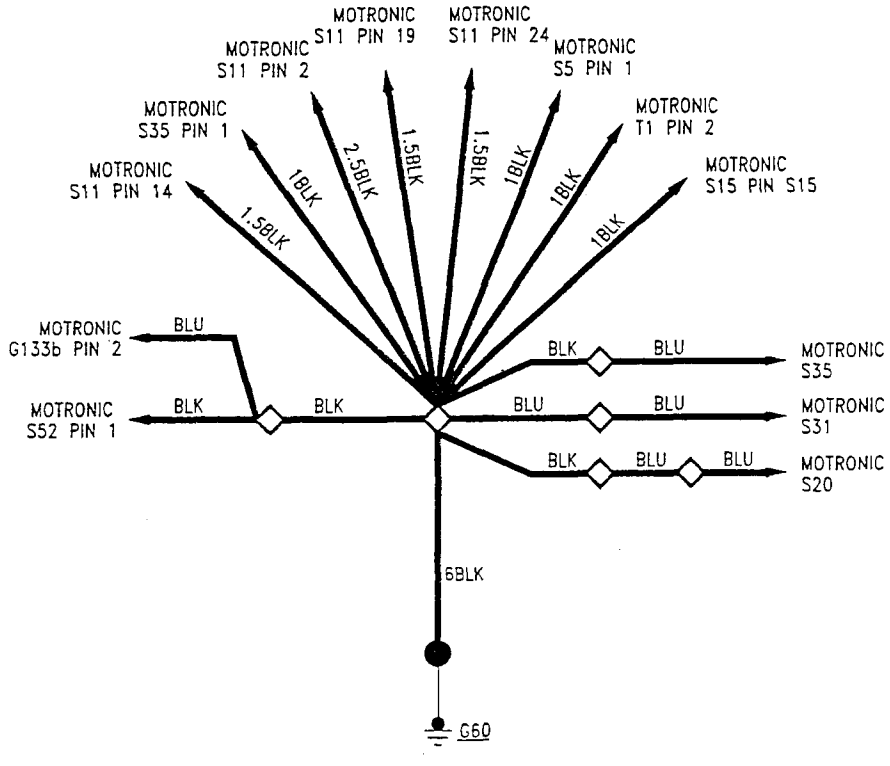


G60 (T.SPARK Version)

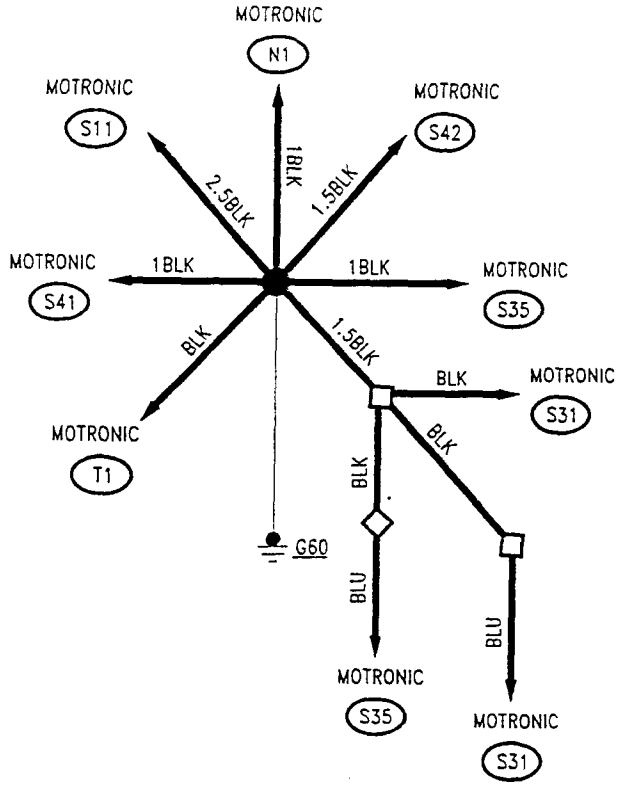
M2.10.3



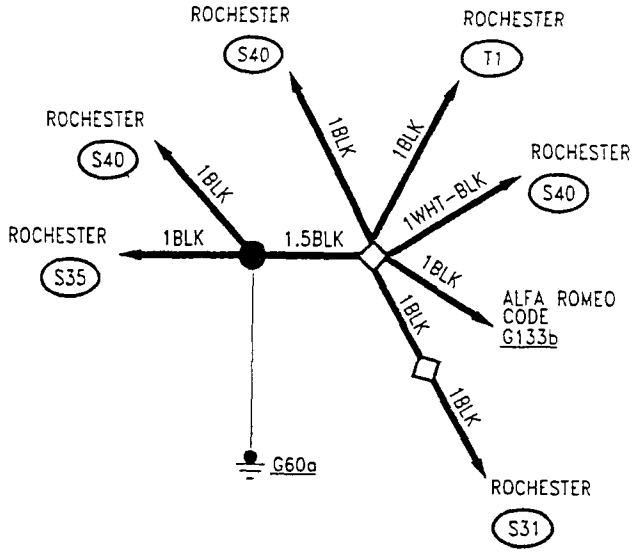
M2.10.4



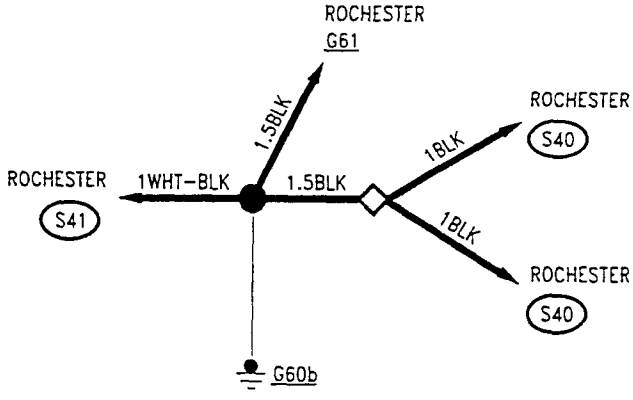
G60 (Boxer 1.6 - MP31 version)



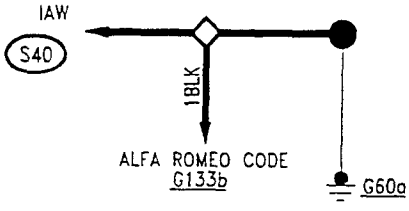
G60a (Boxer 1.6 - Rochester)



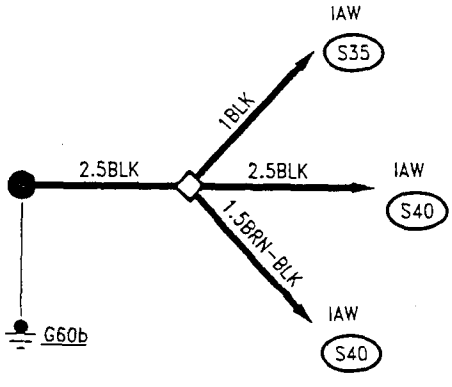
G60b (Boxer 1.6 - Rochester)



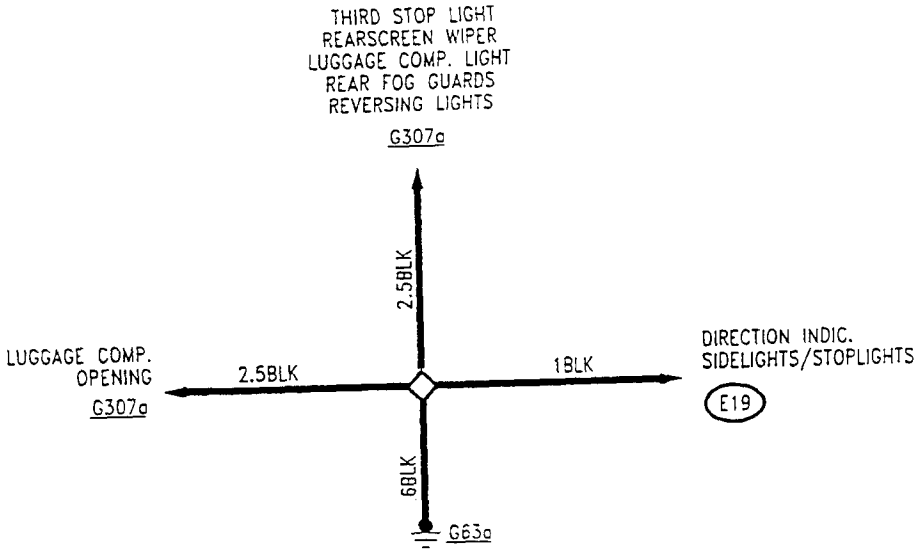
G60a (Boxer 1.3 version)



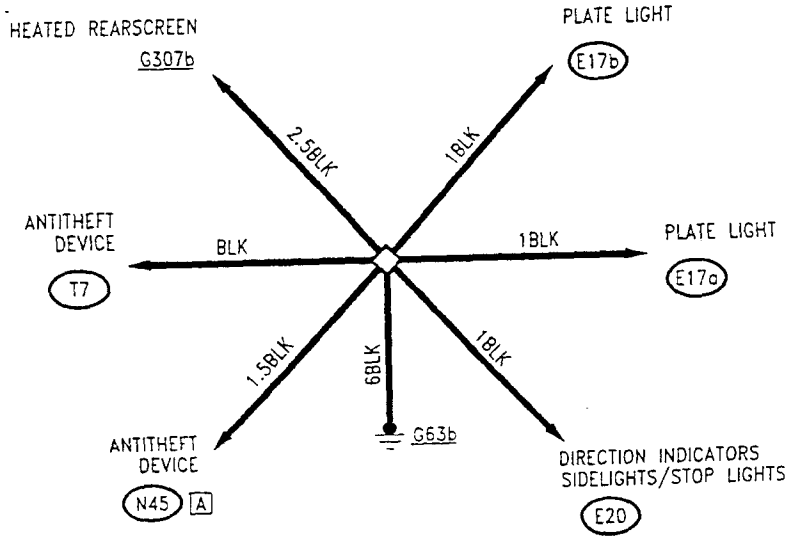
G60b (Boxer 1.3 version)



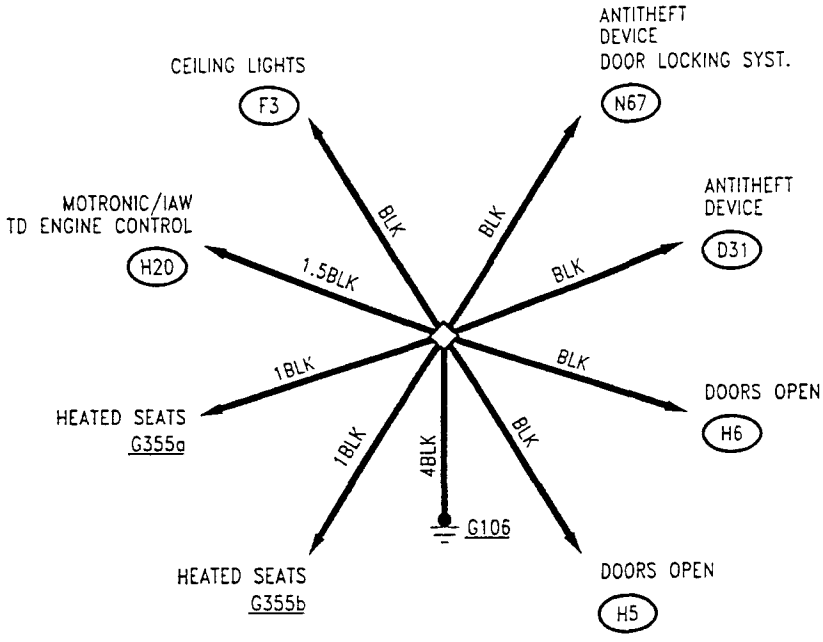
G63a


THIRD STOP LIGHT
REARSCREEN WIPER
LUGGAGE COMP. LIGHT
REAR FOG GUARDS
REVERSING LIGHTS
G307a
2.5BLK
LUGGAGE COMP.
OPENING
G307a
2.5BLK
1BLK
DIRECTION INDIC.
SIDELIGHTS/STOPLIGHTS
E19
6BLK
G63a

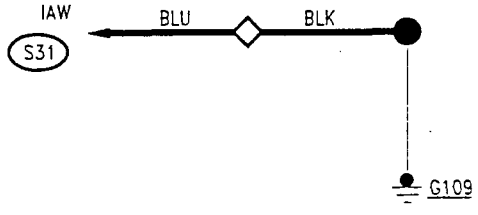
G63b


HEATED REARSCREEN
G307b
PLATE LIGHT
E17b
2.5BLK
1BLK
ANTITHEFT
DEVICE
T7
BLK
1BLK
PLATE LIGHT
E17a
1.5BLK
6BLK
1BLK
G63b
ANTITHEFT
DEVICE
N45 A
DIRECTION INDICATORS
SIDELIGHTS/STOP LIGHTS
E20

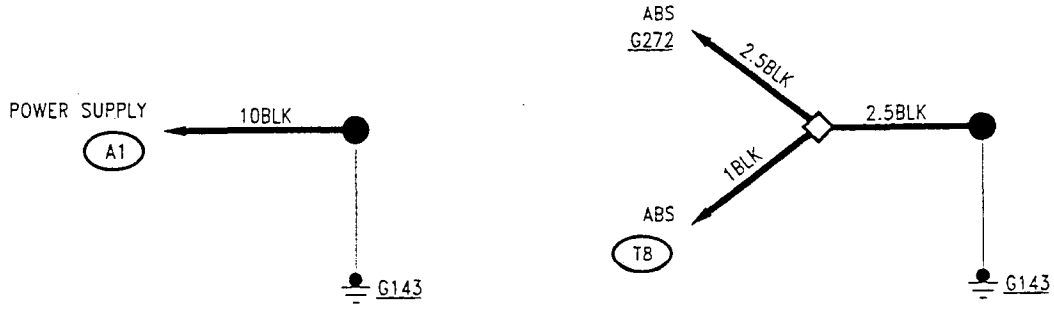
G106



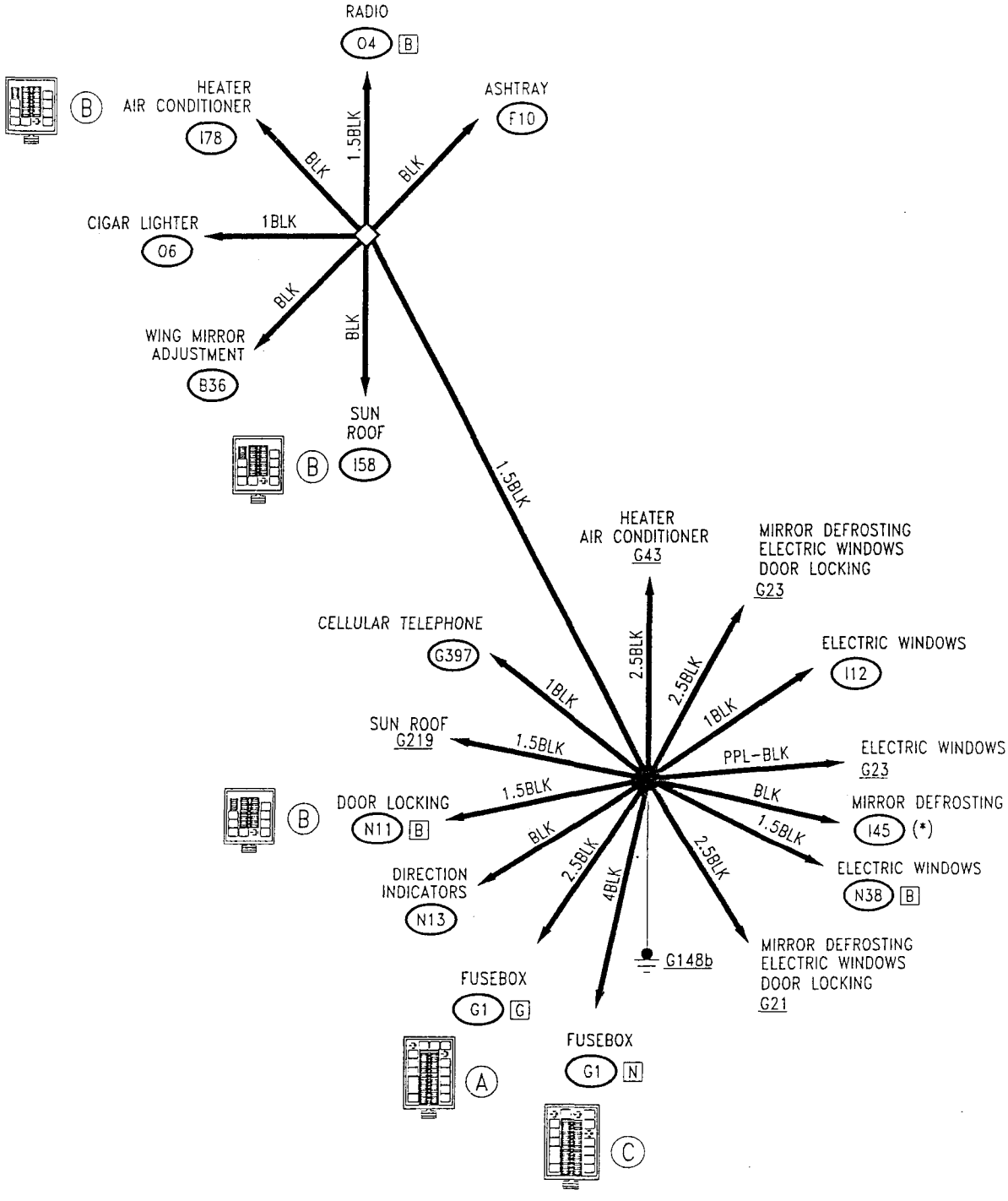
G109 (Boxer 1.3 version)



G143 (Boxer versions)

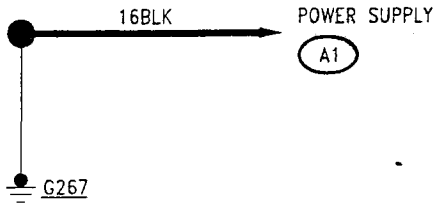


G148b

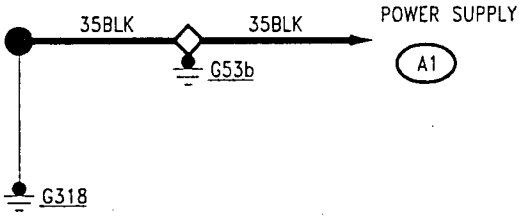


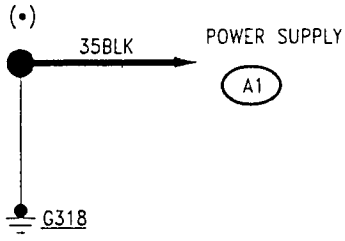
(*) from chassis no.__

G267 (Boxer versions)

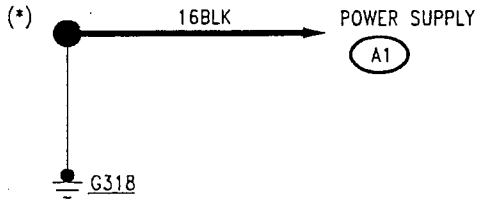


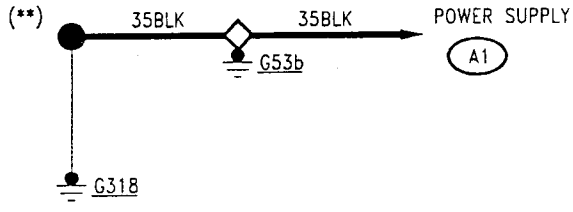
G318 (TD version)



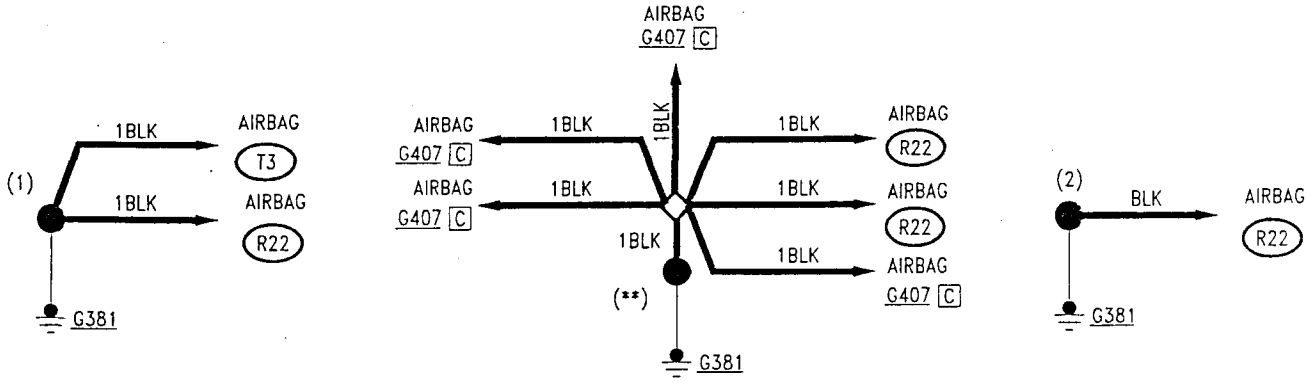


G318 (T.SPARK version)





G381

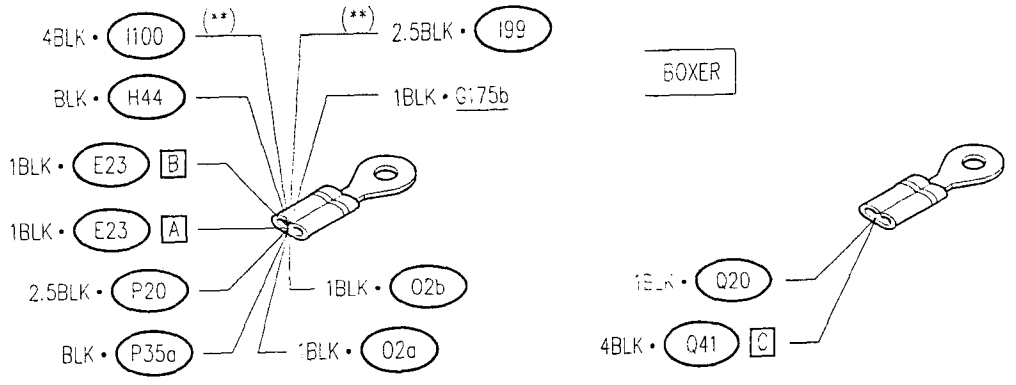


(•) Variant from chassis no...
(*) Up to Model Year '97
(**) From Model Year '98

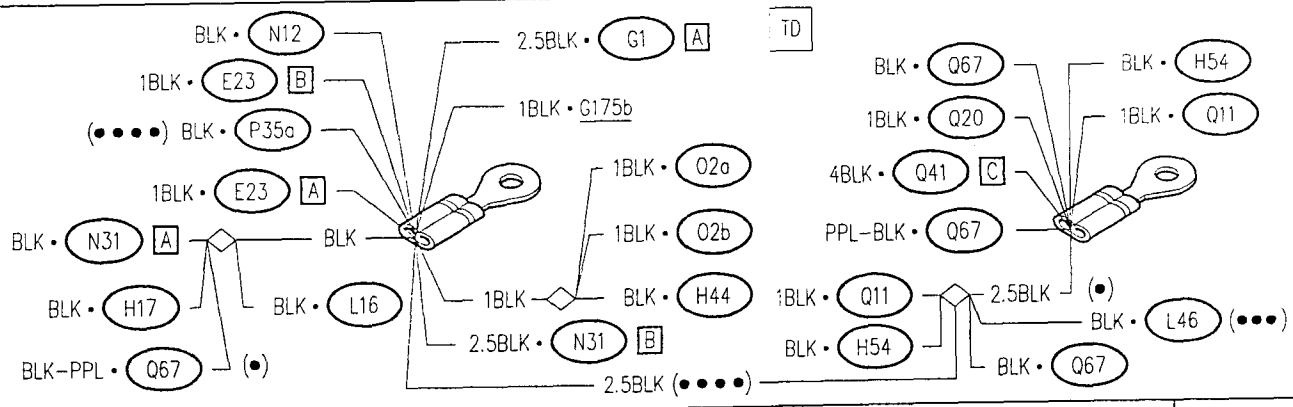
(1) control unit TRW
(2) control unit BECKER

COMPONENTS AND CONNECTORS

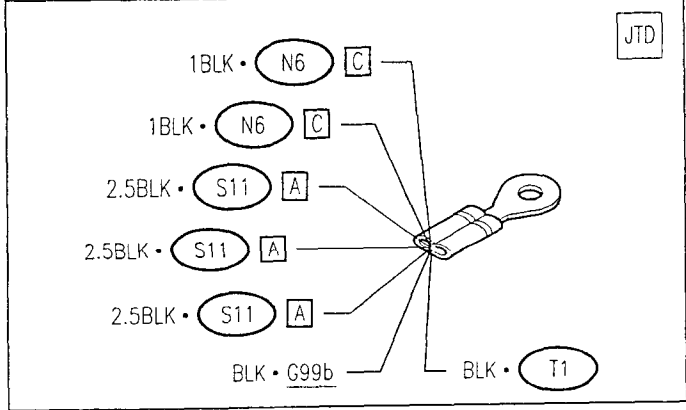
RH engine compartment earth — G53a



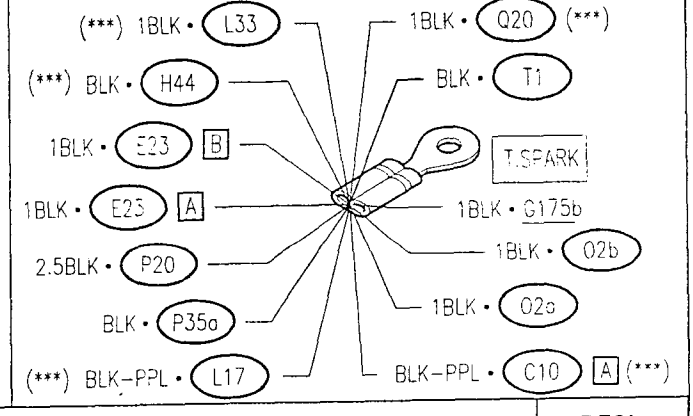
RH engine compartment earth — G53a



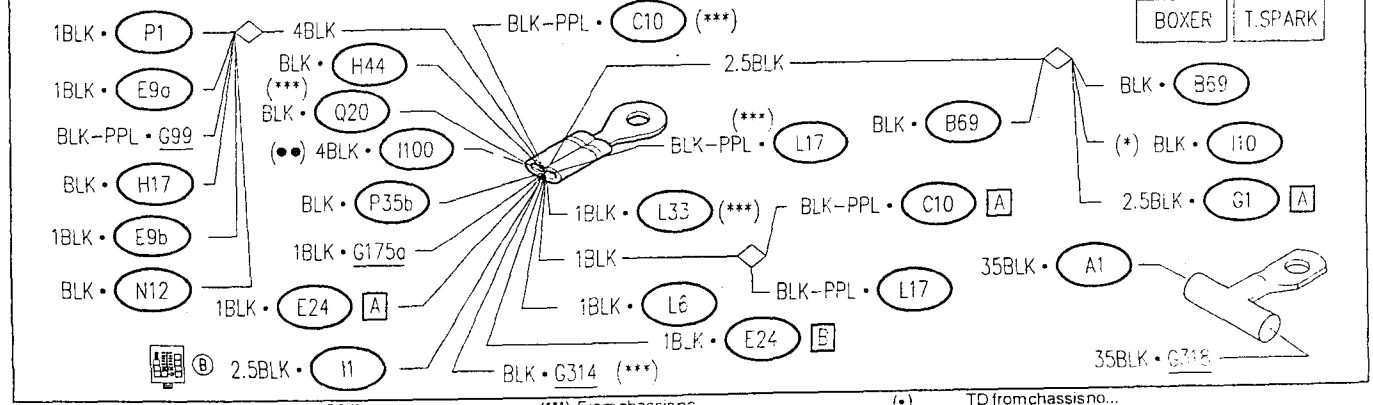
RH engine compartment earth — G53a



RH engine compartment earth — G53a



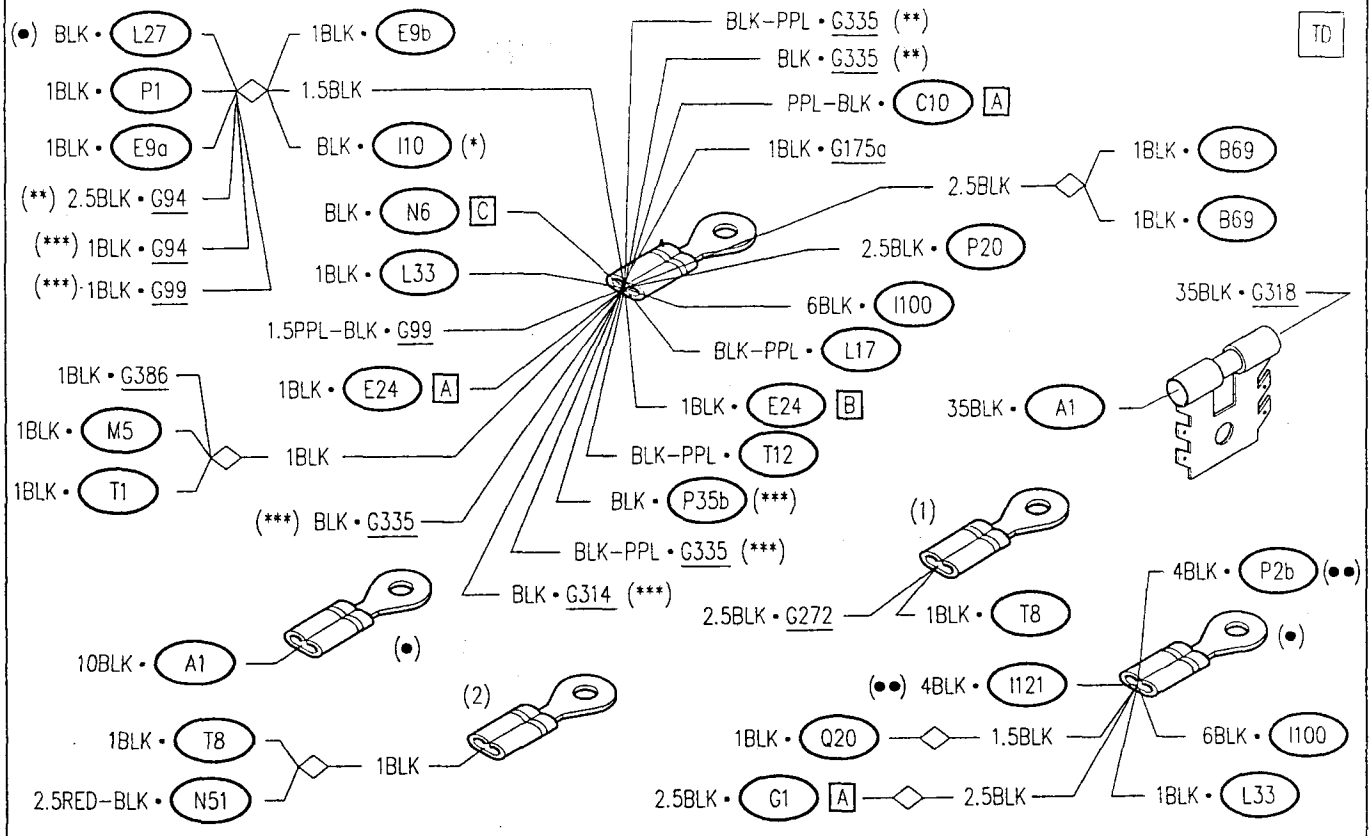
LH engine compartment earth — G53b



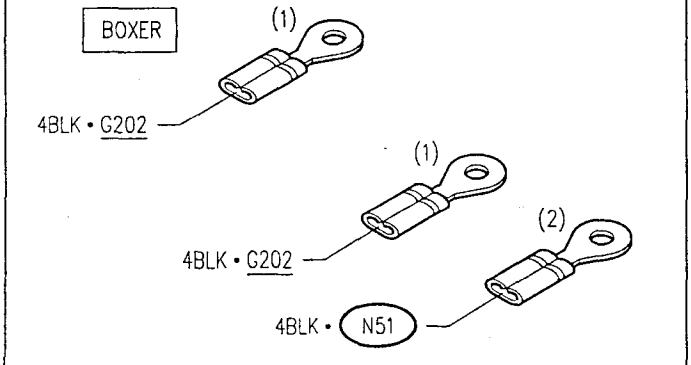
(*) VersionswithoutALFAROMEOCODE
(**) Fromchassisno.4065018
(***) Fromchassisno
(•) TD fromchassisno...
(••) Variant for T.SPARK version
(•••) TD-CAT
(••••) TD fromchassisno...

COMPONENTS AND CONNECTORS (cont.d)

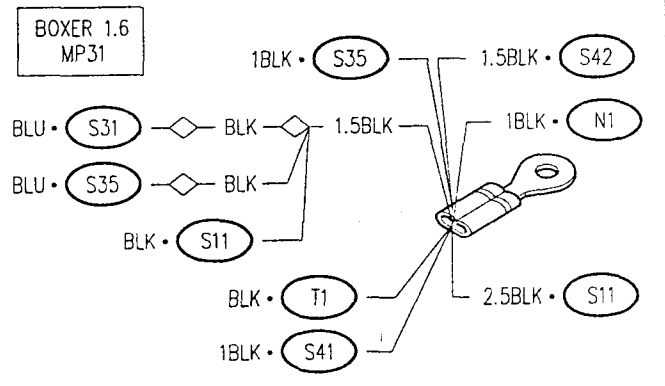
LH engine compartment earth — G53b



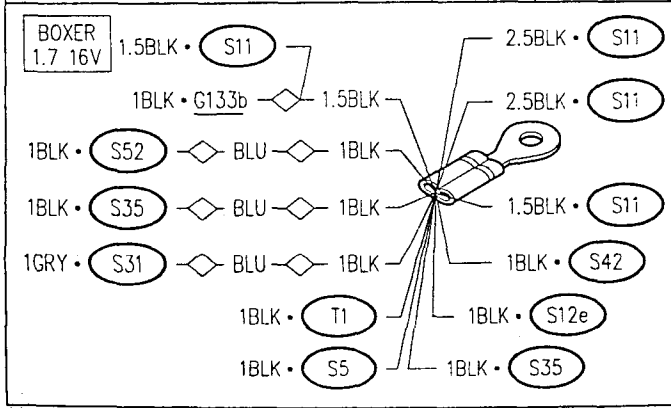
Side panel earth — G55b



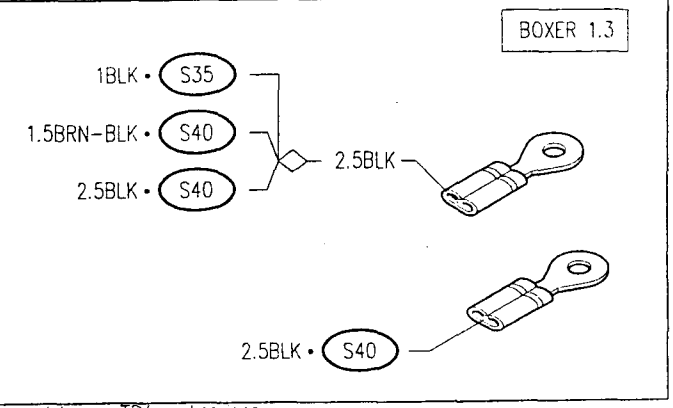
Injection wiring earth — G60



Injection wiring earth — G60



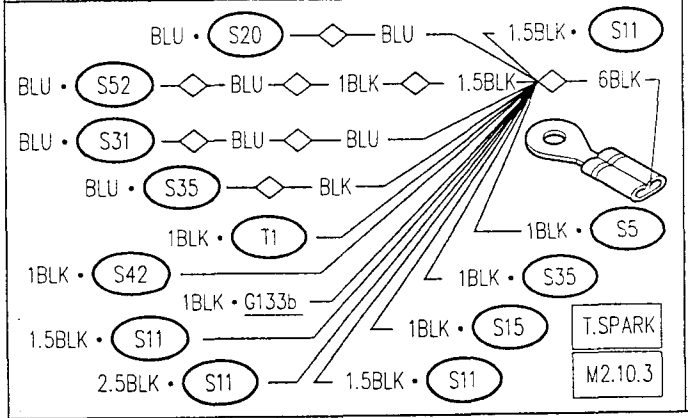
Injection wiring earth — G60



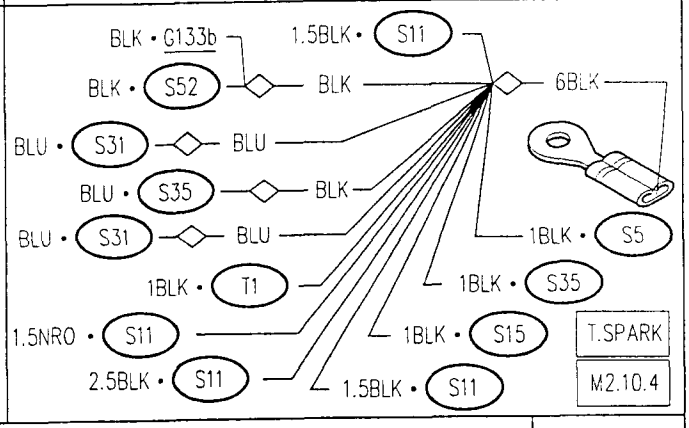
(*) Versions without ALFA ROMEO CODE
(1) ABS 2E/(2) ABS 5.3
(•) TD from chassis no...
(••) JTD
(**) TD-CAT
(***) TD from chassis no...

COMPONENTS AND CONNECTORS (cont.d)

Injection wiring earth	G60

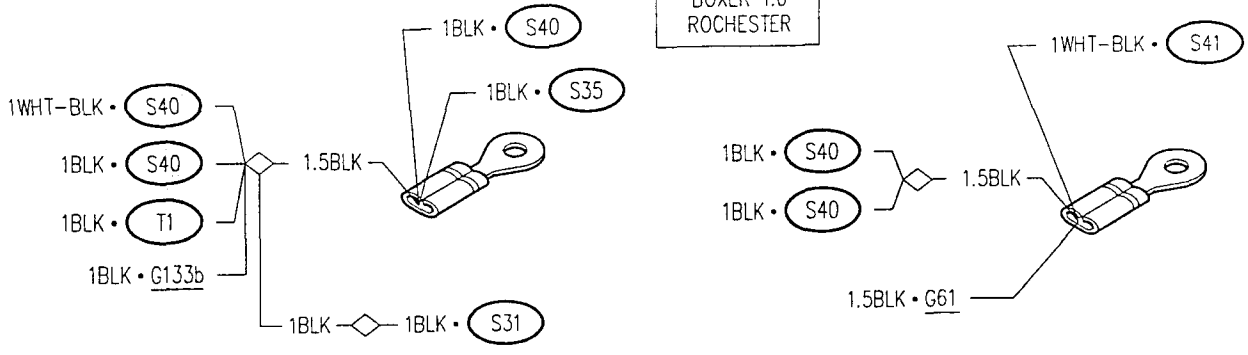


Injection wiring earth	G60



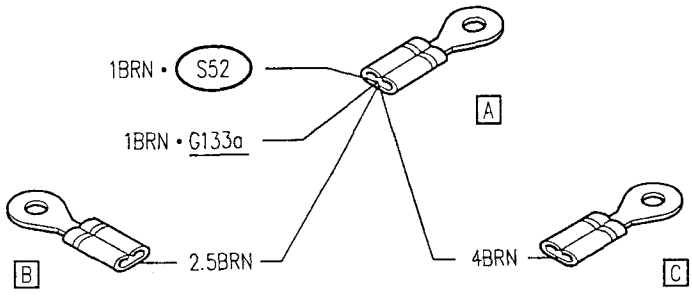
Injection wiring earth	G60

BOXER 1.6 ROCHESTER

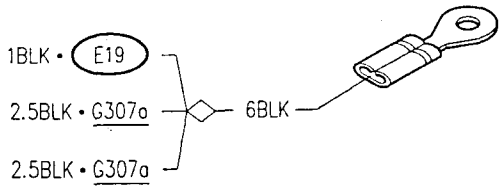


Injection wiring earth	G60

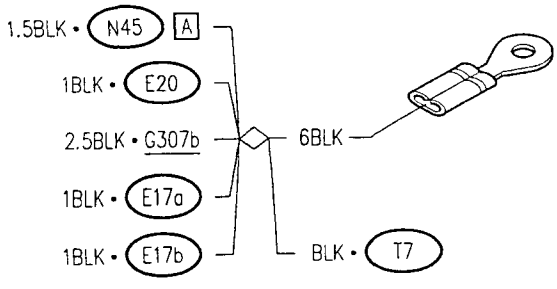
M1.5.5



RH rear earth	G63a

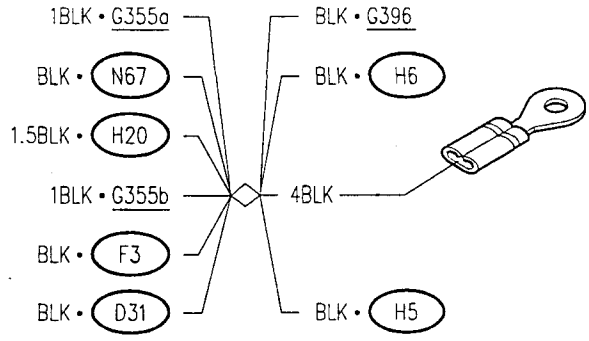


LH rear earth	G63b

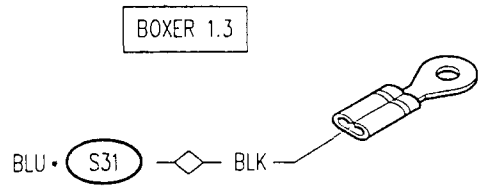


COMPONENTS AND CONNECTORS (cont.d)

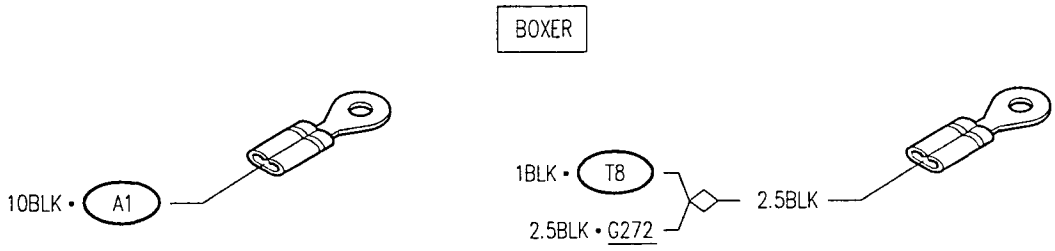
Seat cross rail earth	G106



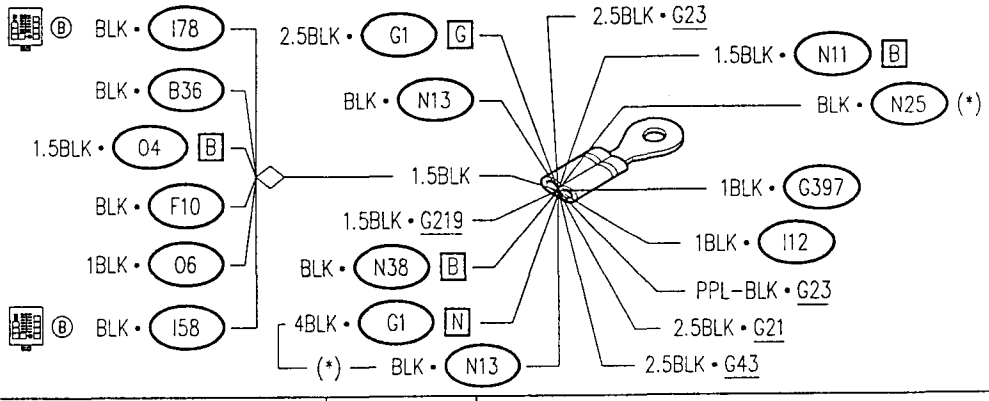
Injection wiring earth	G109



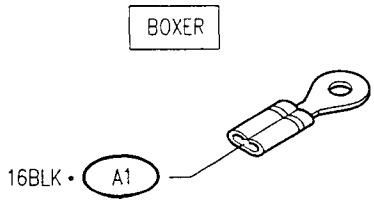
Centre services tray earth	G143



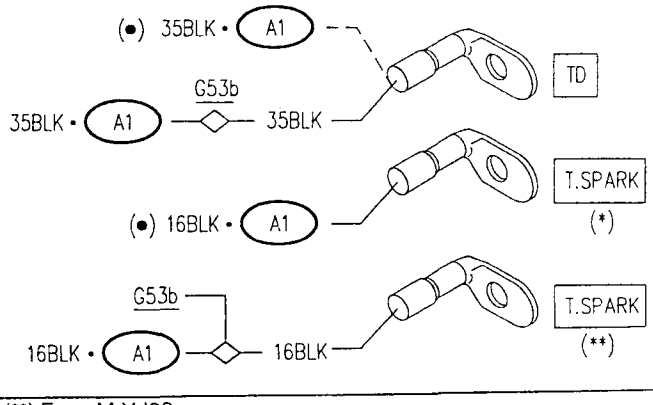
Earth under LH dashboard	G148b



Earth on crankcase	G267



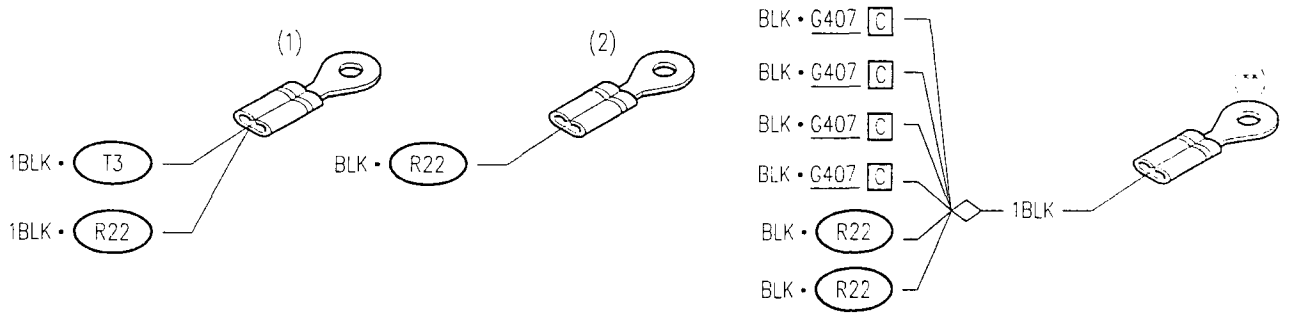
Earth on gearbox	G318



(•) From chassis no...
(*) From M.Y. '97
(**) From M.Y. '98

COMPONENTS AND CONNECTORS (cont.d)

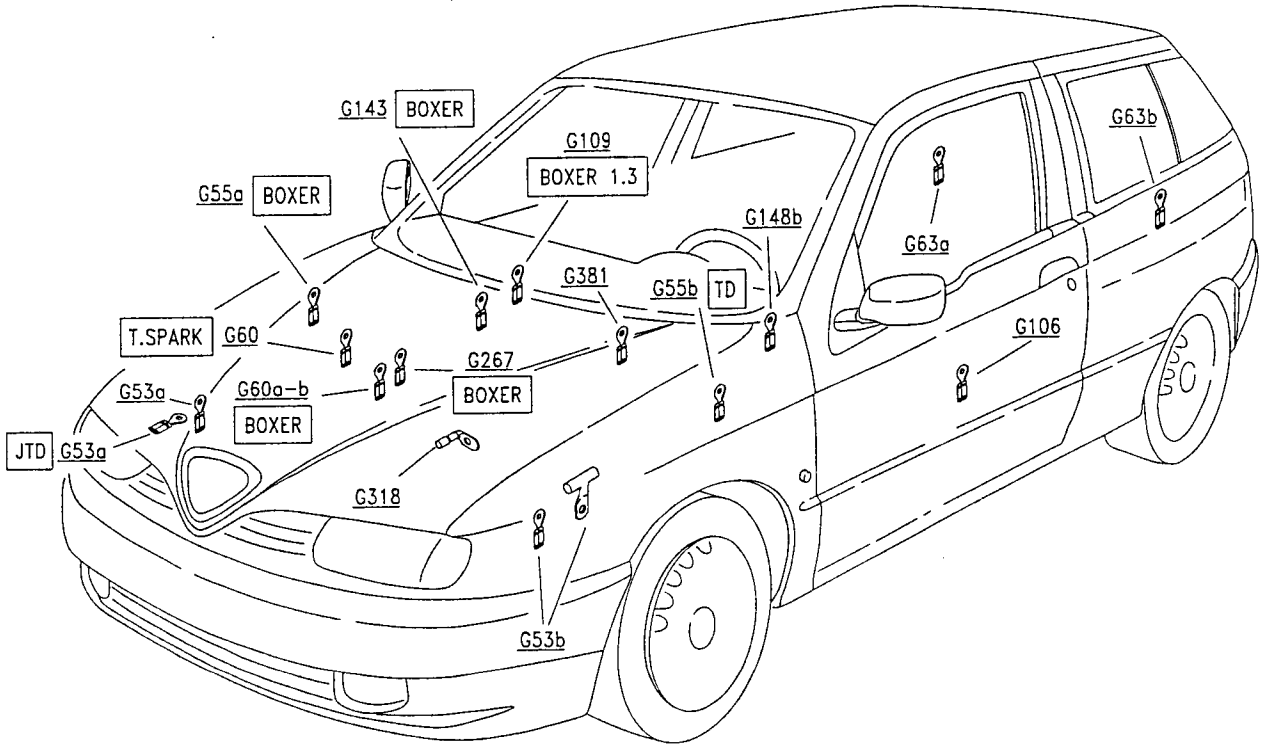
Airbag earth	G381



(•) From chassis no...
(*) FromM.Y.'97
(**) FromM.Y.'98

(1) BECKERcontrolunit
(2) TRWcontrolunit

LOCATION OF EARTHS ON THE CAR

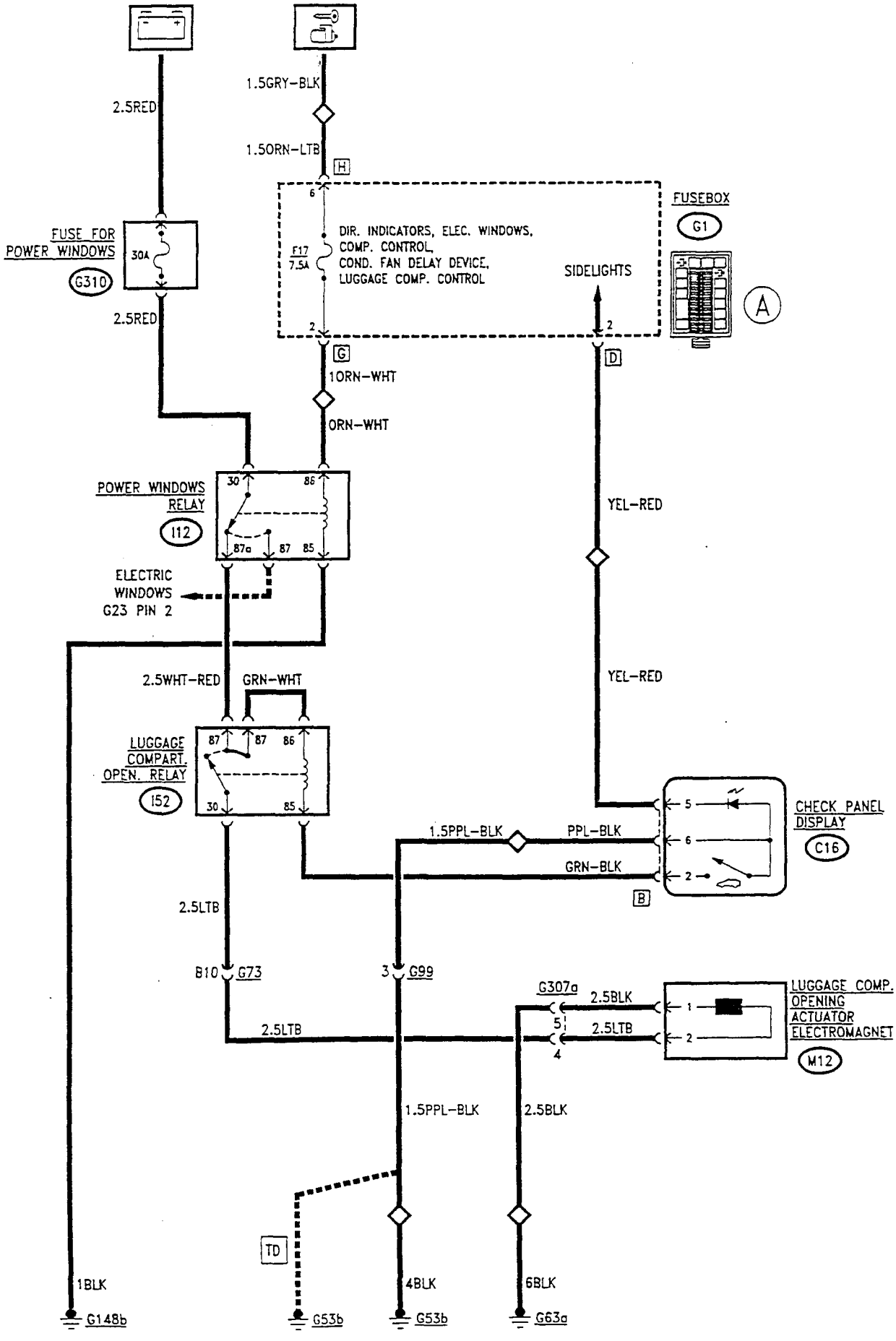


LUGGAGE COMPARTMENT OPENING CONTROL

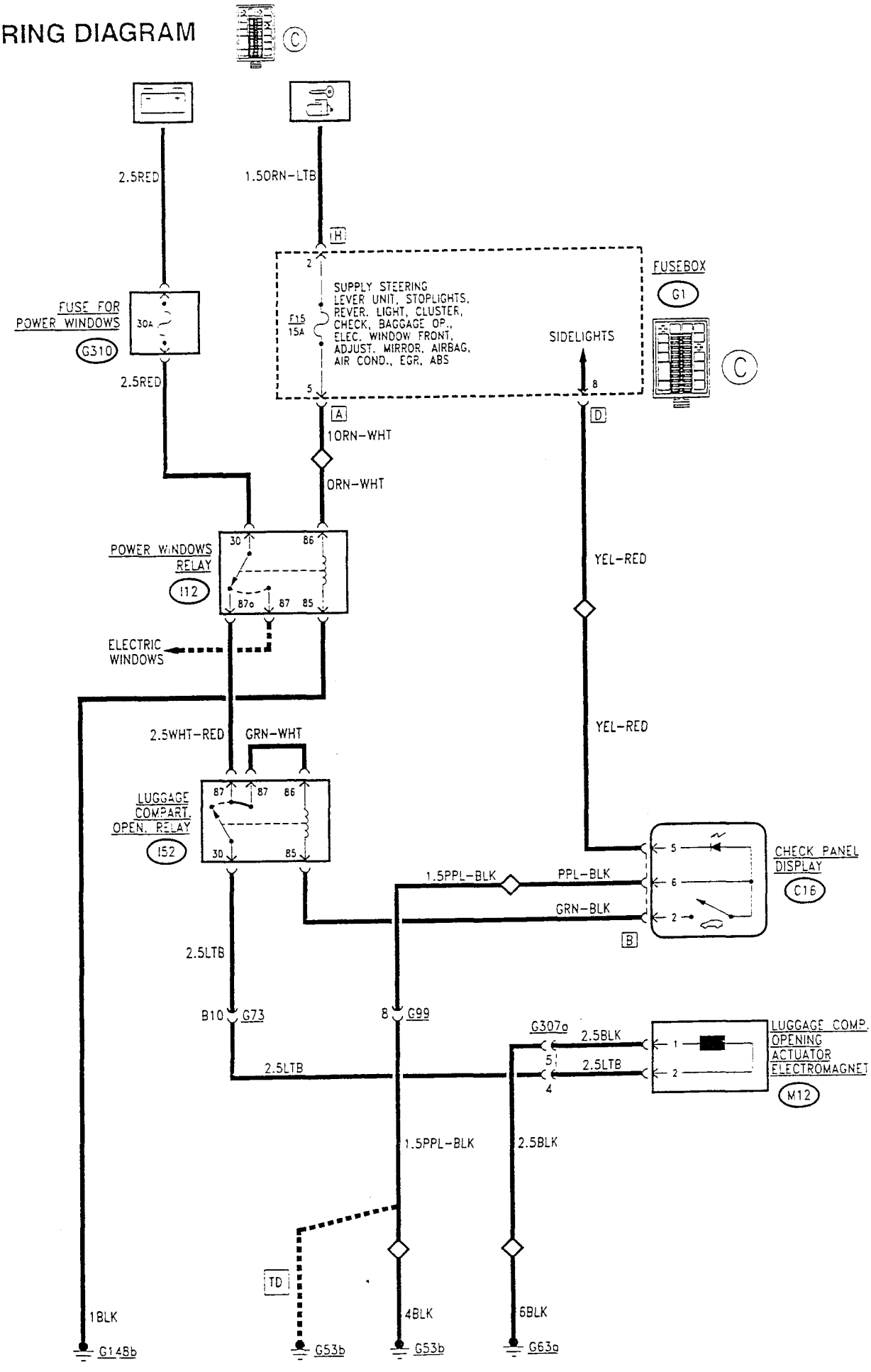
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WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

In addition to using the key in the rear lock, the luggage compartment can also be opened from inside the car through an electrical control.
The switch that opens the lock by an electromagnetic control is to be found on the "Check Panel" at the centre of the dashboard; the switch ideogram is illuminated when the side lights are on.
This device only works with the key either at STOP or disengaged; otherwise the boot must be opened manually.

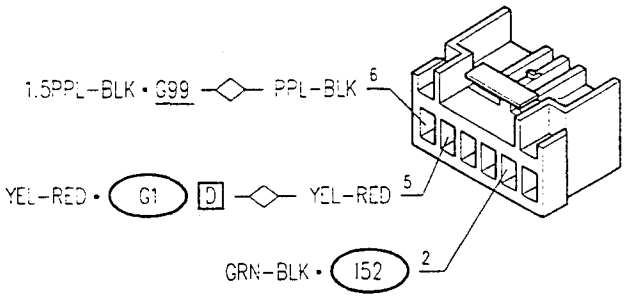
FUNCTIONAL DESCRIPTION

The boot opening relay **I52** controls the system.

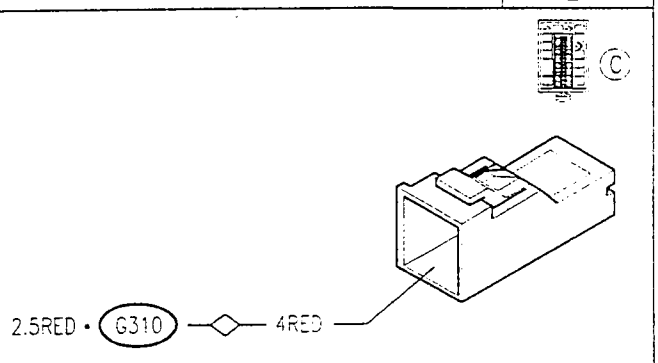
The relay is supplied when the "key-operated" supply is disengaged, through the line of the power windows, protected by wander fuse **G310** and through relay/switch **I12**.
With the ignition key disengaged or at STOP, the coil of relay switch **I52**, is energized by an earth signal leading from the luggage compartment opening switch located in **C16**.
The relay switch then sends the supply to the luggage compartment opening electromagnet **M12** which triggers the lock.
With the key at "MARCIA" relay **I52** is not supplied.
The switch in **C16** is illuminated when the side lights are on. For further details see "Illumination of controls and indicators".

COMPONENTS AND CONNECTORS

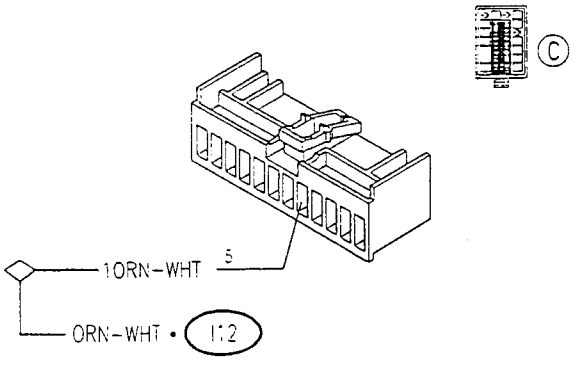
Check Panel display C16 B



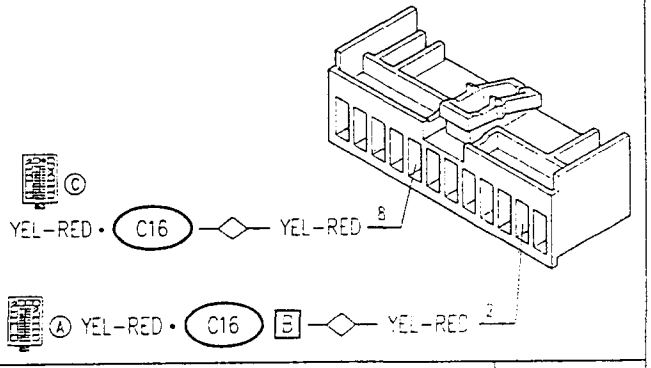
Fusebox G1



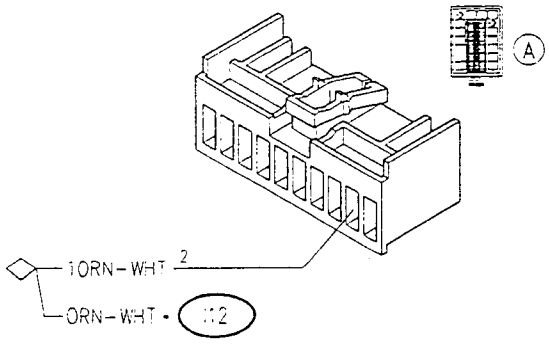
Fusebox G1 A



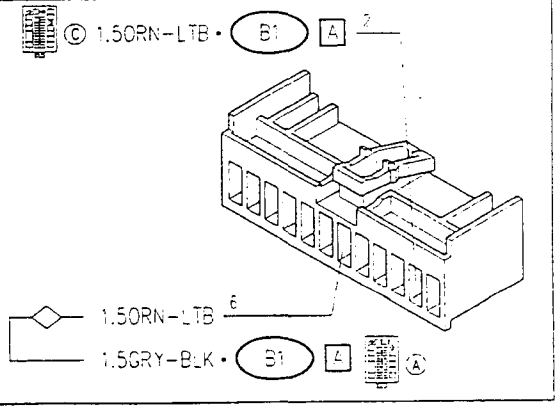
Fusebox G1 D



Fusebox G1 G

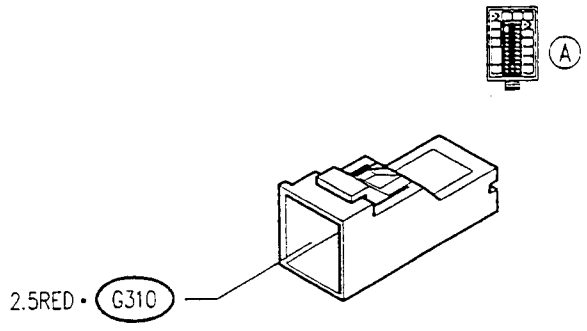


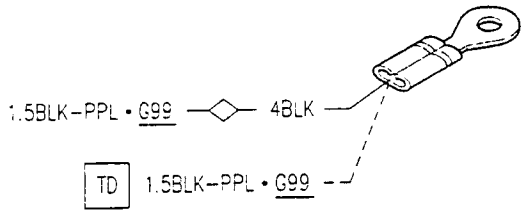
Fusebox G1 H



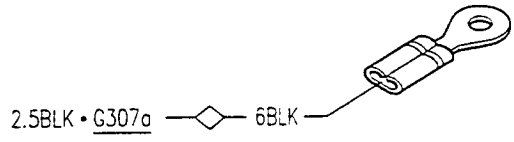
COMPONENTS AND CONNECTORS (cont.d)

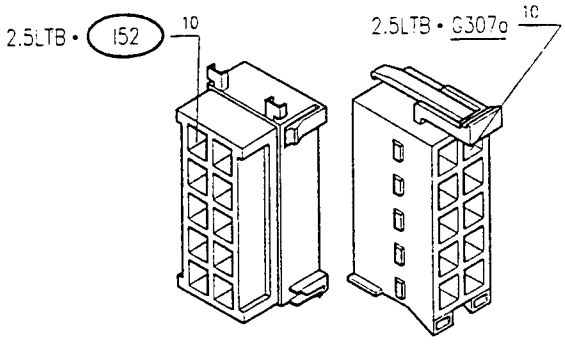
Fusebox	G1 Q	LH engine compartment earth	G53b



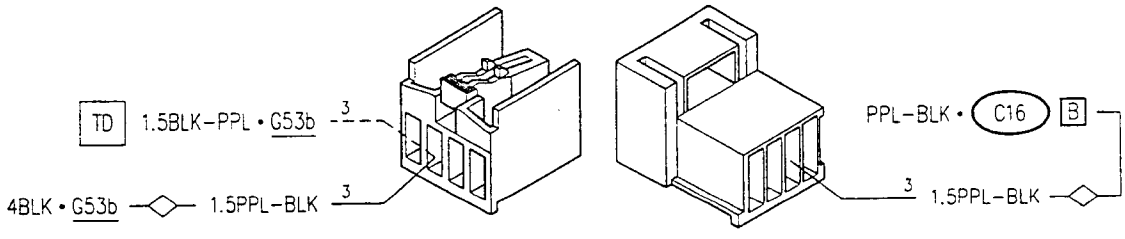


RH rear earth	G63a	Rear services connector	G73 B

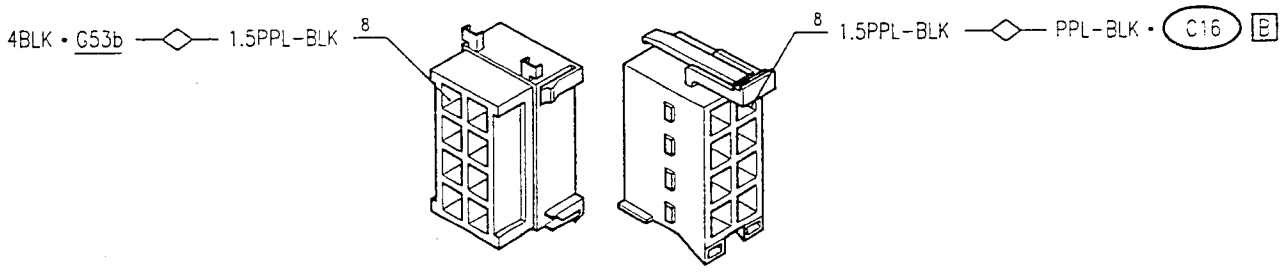




Dashboard/engine wiring connector (*)	G99



Dashboard/engine wiring connector (**)	G99

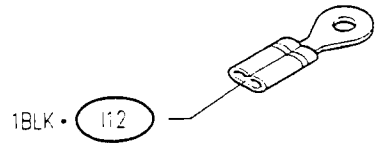


(*) up to chassis no.___

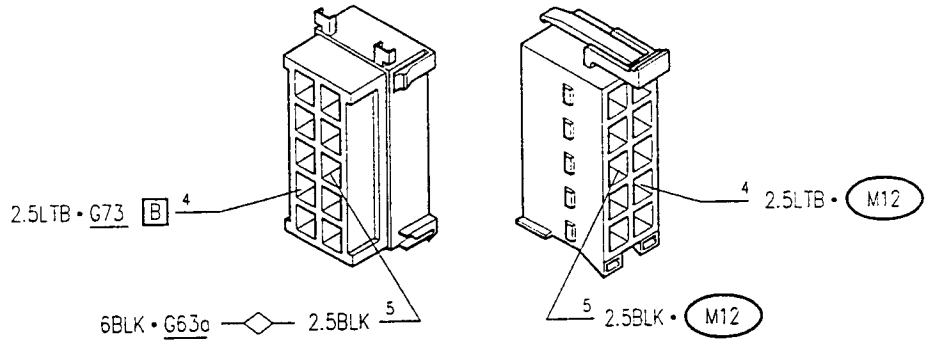
(**) from chassis no.___

COMPONENTS AND CONNECTORS (cont.d)

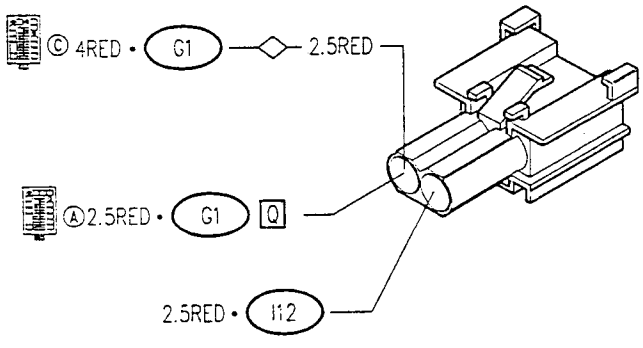
LH earth under dashboard	G148b



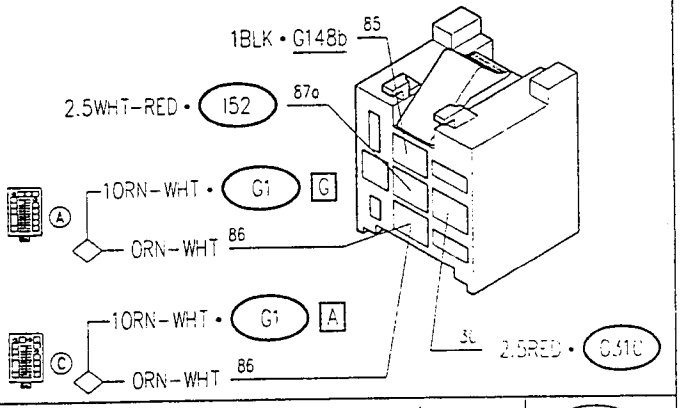
Rear/luggage compartment wiring connector A	G307a



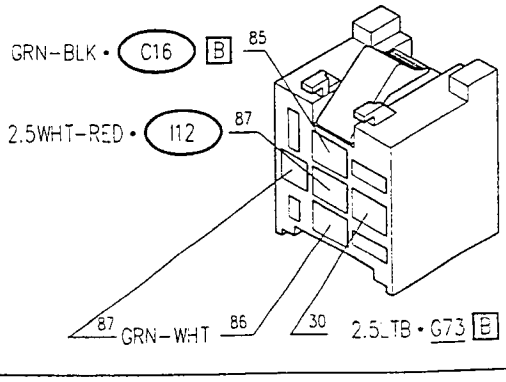
RH front power window fuse	G310



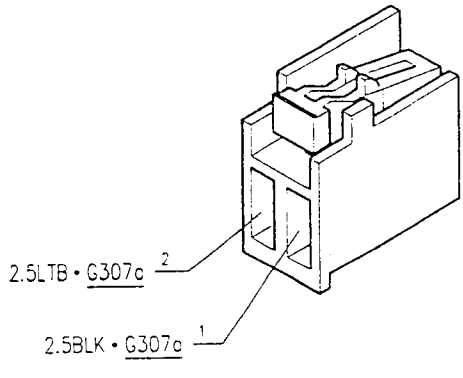
Front power window relay switch	I12



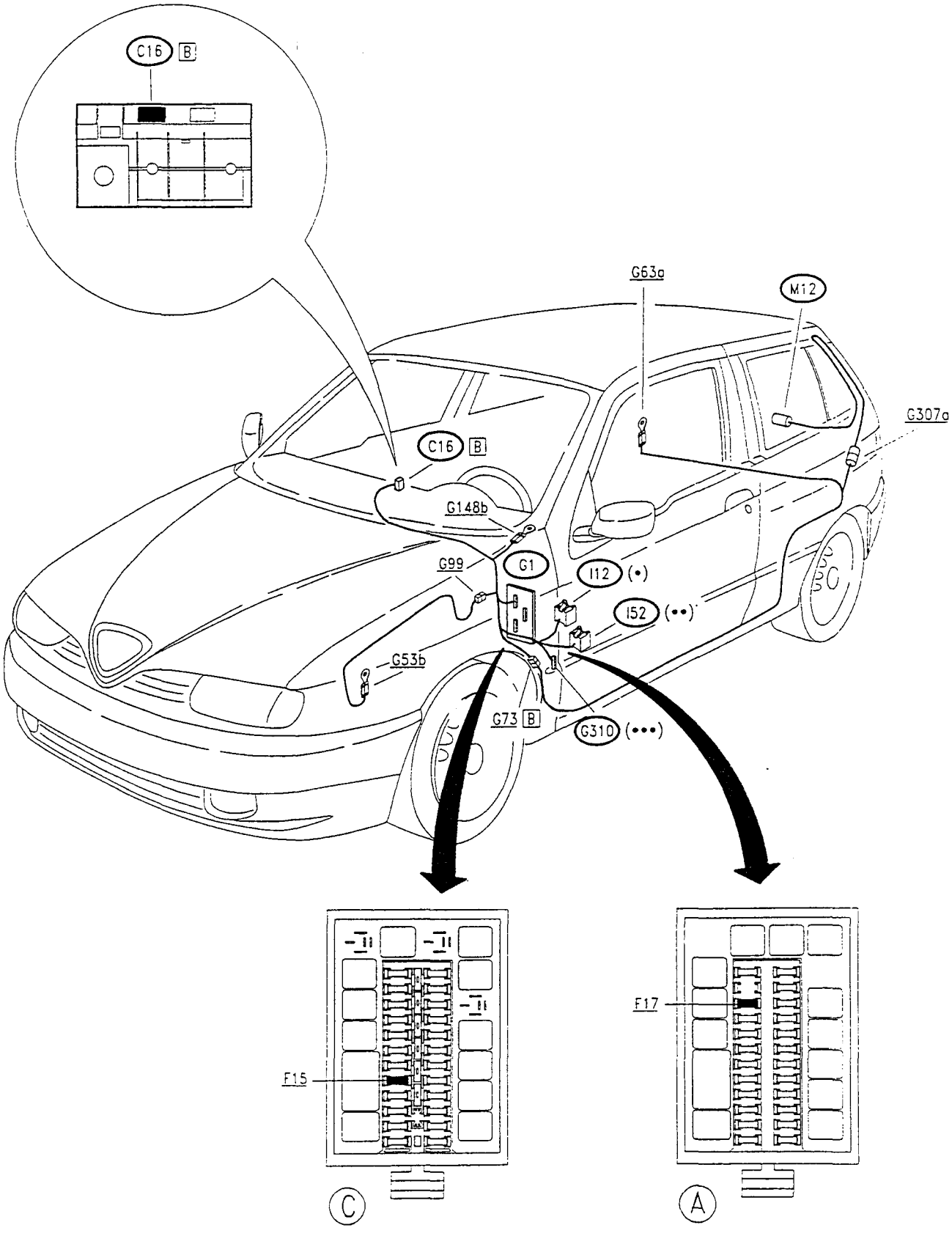
Luggage compartment opening switch	I52



Luggage compartment opening electromagnet	M12



LOCATION OF COMPONENTS



(•) black base
(••) yellow base
(•••) green fuseholder

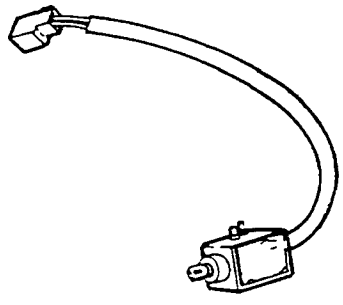
FAULTFINDING TABLE

Failure	Component to be checked				
	G310	M12	I52	I12	C16 (*)
Luggage compartment opening control	•	•	•	•	•
Luggage compartment opening switch light (with side lights on)					•

(*) The Check Panel display **C16** cannot be repaired. Therefore in the event of a failure it is not possible to change the switch and a complete new Check Panel must be fitted.

CHECKING COMPONENTS

Luggage compartment opening electromagnet (M12)



SPECIFICATIONS	
Nominal voltage	12V
Absorbed current	31A
Magnetic core stroke	10 ± 0,5 mm

ELECTRIC SYSTEM DIAGNOSIS

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ALFA ROMEO CODE
Alfa Romeo Code 40

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WARNING!

From chassis no.____ the 145 models are fitted with the "ALFA ROMEO CODE" system as a **standard** item: this is an **innovative electronic anti-theft protection system** which inhibits the operation of the engine management control unit (Petrol versions) or of the engine stop solenoid valve (TD version).

BEFORE PROCEEDING WITH ANY WORK ON THE ELECTRIC SYSTEM OF THE VEHICLE, IN PARTICULAR ON THE ENGINE CONTROL SYSTEMS, CAREFULLY READ THE SPECIAL SECTION: "ALFA ROMEO CODE".

POWER SUPPLY

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GENERAL DESCRIPTION

All the electric systems and devices are supplied by the battery **A1** at 12 V.
The lines through which the battery voltage is distributed to the various services are shown in the wiring diagrams corresponding to the various functions and systems.
This general diagram shows all the lines as they branch from the battery and from the branch terminal box **G56**, for further details, reference should be made to the specific diagrams.
Some circuits are supplied continuously, also when the vehicle is stopped and the key disengaged, as they are connected directly to the battery A1.
Other circuits are supplied turning the key in the ignition switch B1 to the different positions:

- inserting the key and turning it to the first position the key moves to "DRIVE" and supplies a number of circuits, which are in fact known as "key-operated";
- the second position "START" - supplies the starter motor, while disconnecting some other circuits (those that absorb more power) thereby ensuring the highest flow of current to the motor itself;
- removing the key and turning it in the opposite direction (and pressing the special button) the "PARK" position is engaged which supplies the sidelights also when the key has been removed.

In the wiring diagrams these different types of supply are shown schematically by the following symbols:


– line always supplied


– line supplied with the ignition key at "DRIVE"


– line supplied with the ignition key at "START"


– line supplied with key engaged (in both the previous positions).


– line supplied with the ignition key at "PARK"

NOTE: this general wiring diagram makes it possible to easily locate the circuits supplied by the same line: this simplifies fault-finding in the case of problems involving more than one system.

NOTE: (Boxer and TD version) the terminal branch box G56 has been newly designed and is highly reliable and safe. The procedure for removing and connecting the single connectors in the terminal box is described at the end of this section.

The T.SPARK version has a branch terminal box with incorporated fuses (see following pages).

Protection and safety systems

The entire electric system of the 145 has been designed and made taking account of the latest directives on the subject of safety and protection, especially against the possibility of fire.

There are two main types of protection:

- **active protection**, to reduce possible causes of faults "at the source"
- **passive protection**, to minimise the effects of any faults.

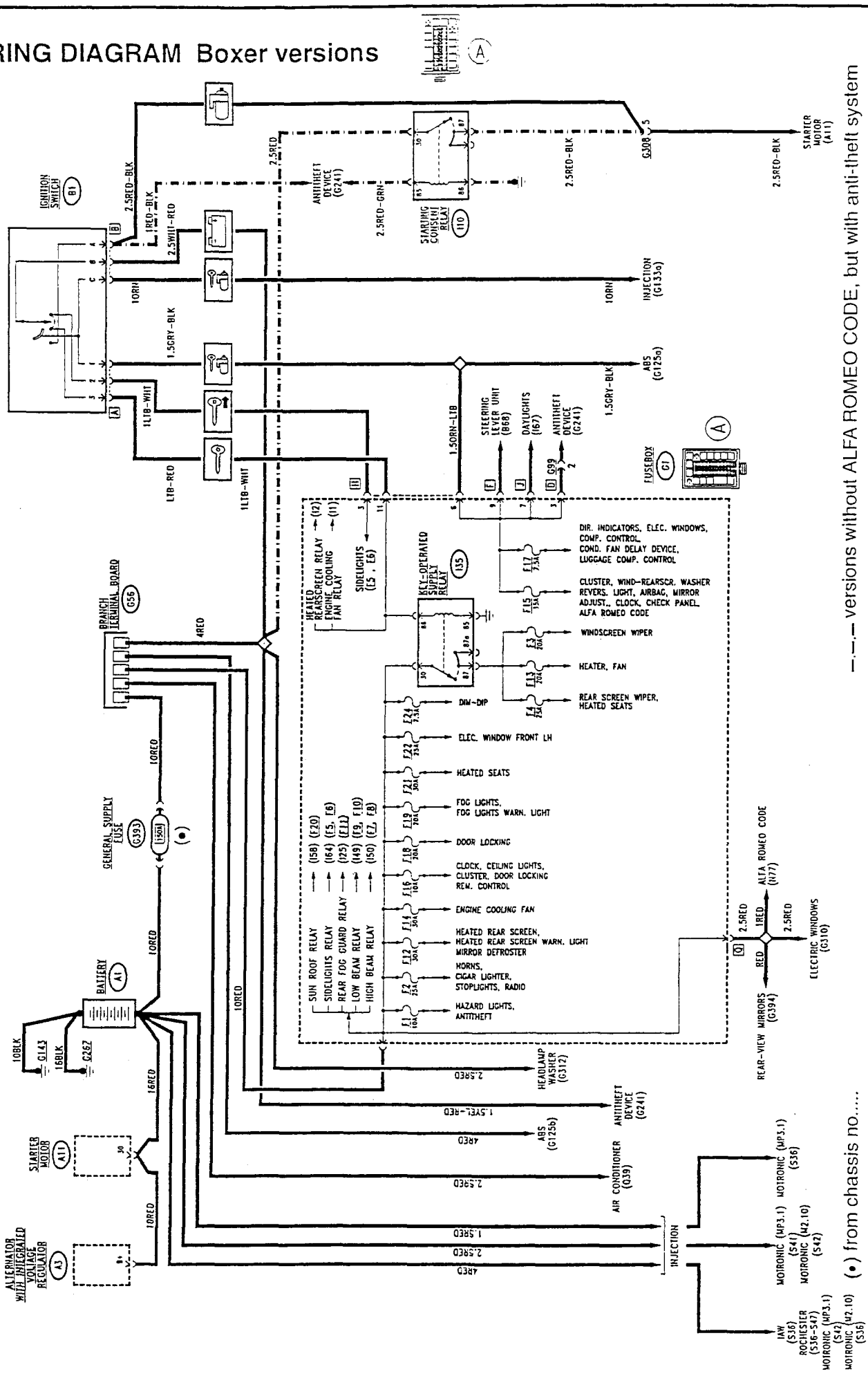
The first category involves attentive design of the wiring harnesses, positioning and fastening them accurately and carefully defining suitably shielded and protected routes.

For this reason the alternator and starter motor cables have been suitably modified, with the adoption of protective caps, etc.

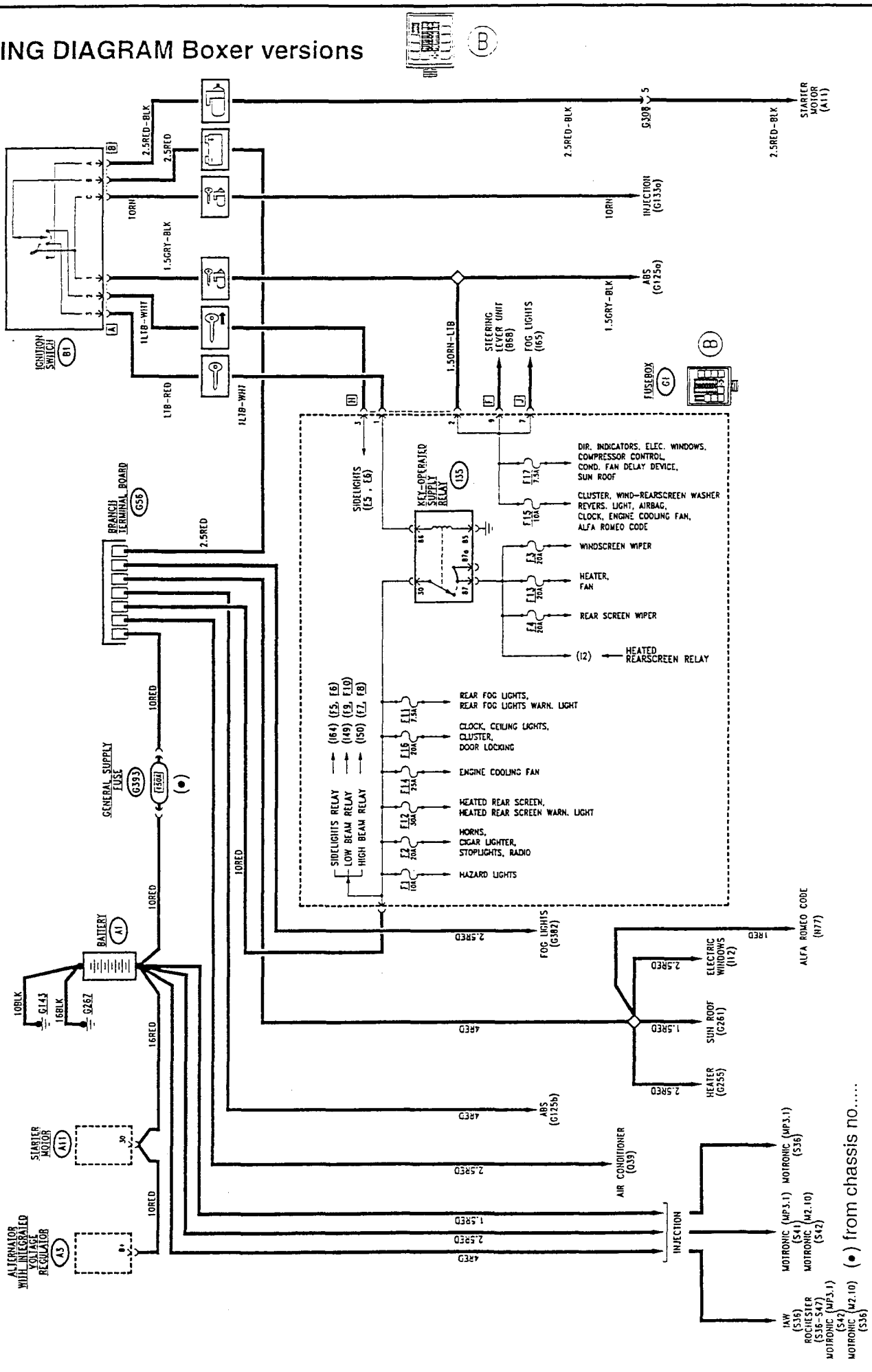
Passive protections include all measures, which have always been adopted on cars, to reduce high fault currents (overload and short circuit).

All the fuses of the system have been sized according to the nominal absorption of the loads that can be operated contemporaneously, and in such a way as to ensure that they cut in in the event of short circuit.

WIRING DIAGRAM Boxer versions

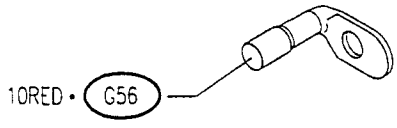


WIRING DIAGRAM Boxer versions

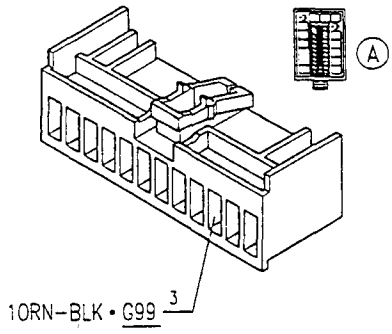


COMPONENTS AND CONNECTORS (cont.d)

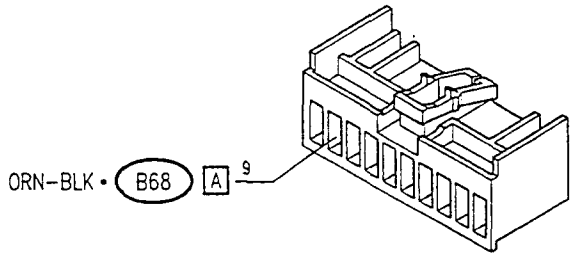
Fusebox G1



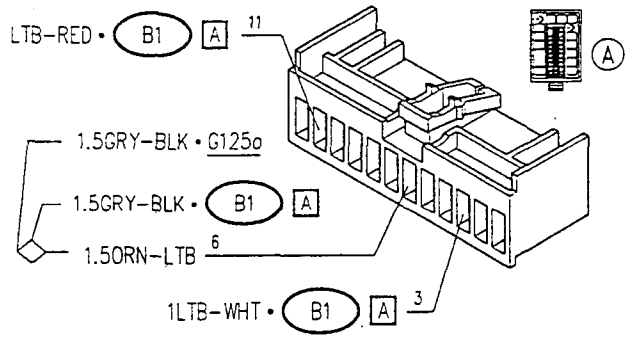
Fusebox G1 D

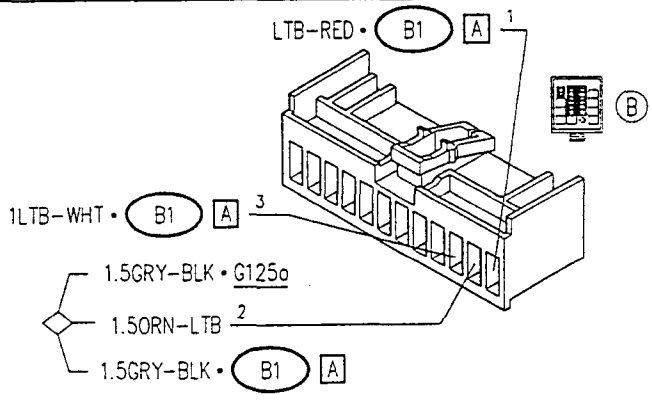


Fusebox G1 F

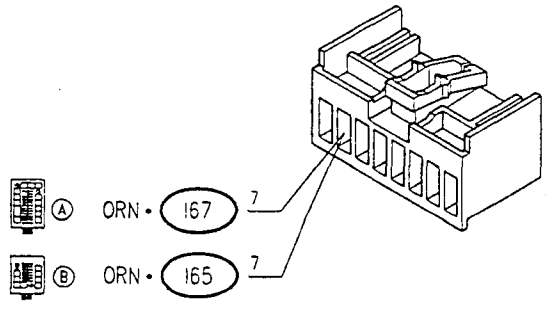


Fusebox G1 H

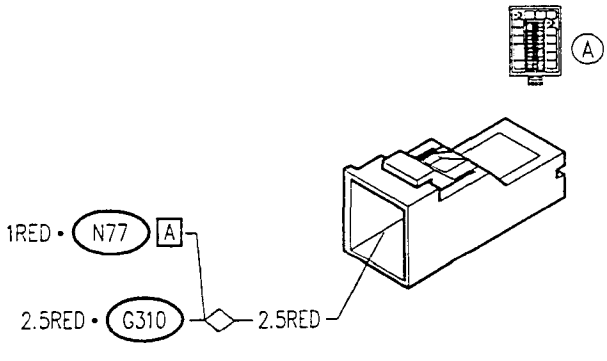




Fusebox G1 J

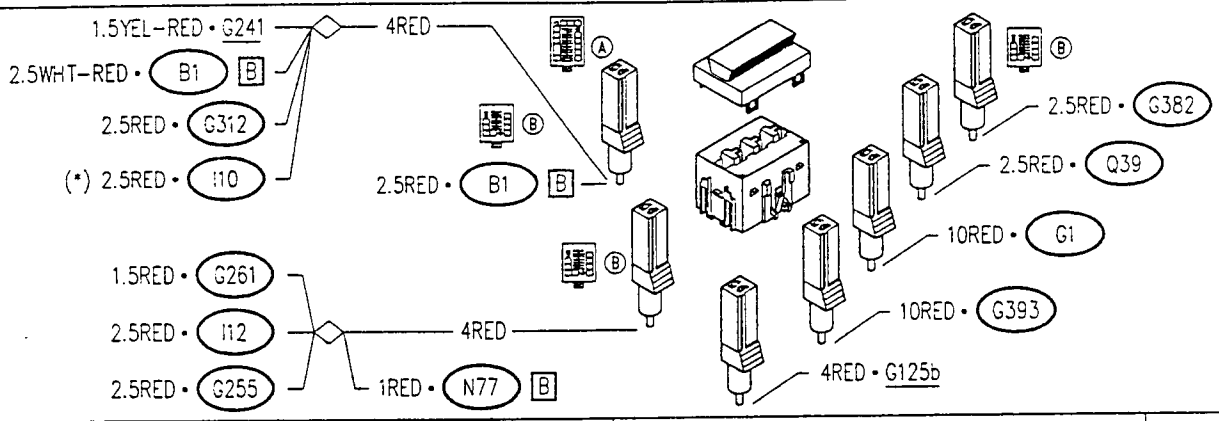


Fusebox G1 Q

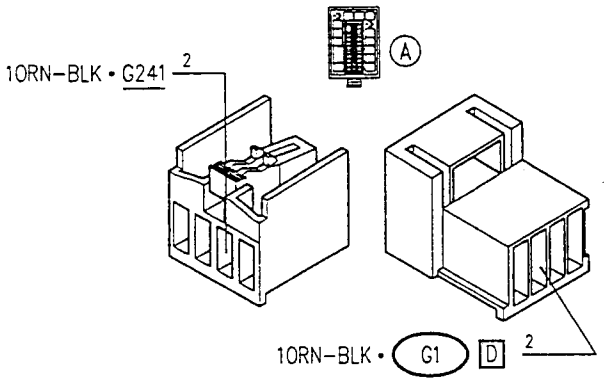


COMPONENTS AND CONNECTORS (cont.d)

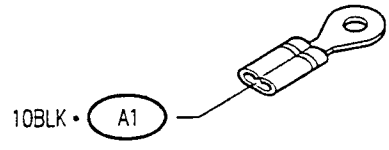
Branch terminal board — G56



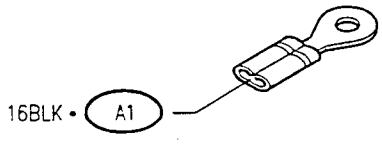
Dashboard/engine wiring connector — G99



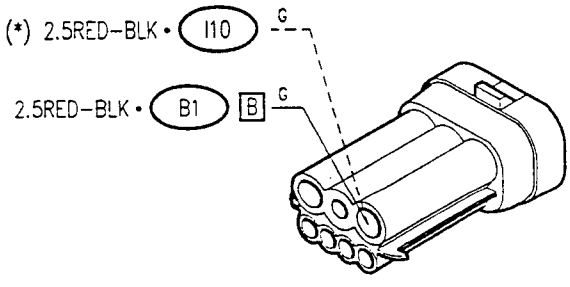
Services tray centre earth — G143



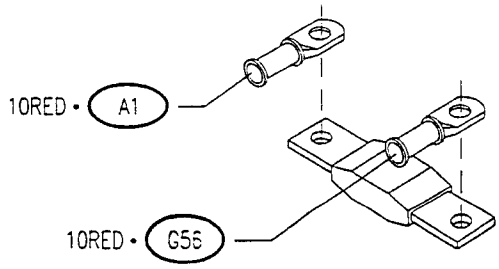
Earth on crankcase — G267



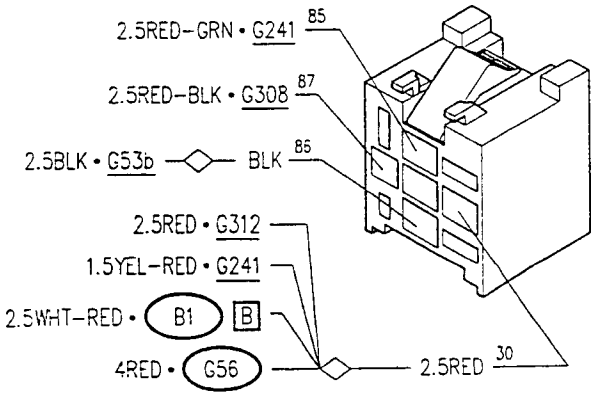
Engine sensors connector — G308



General supply fuse (•) — G393

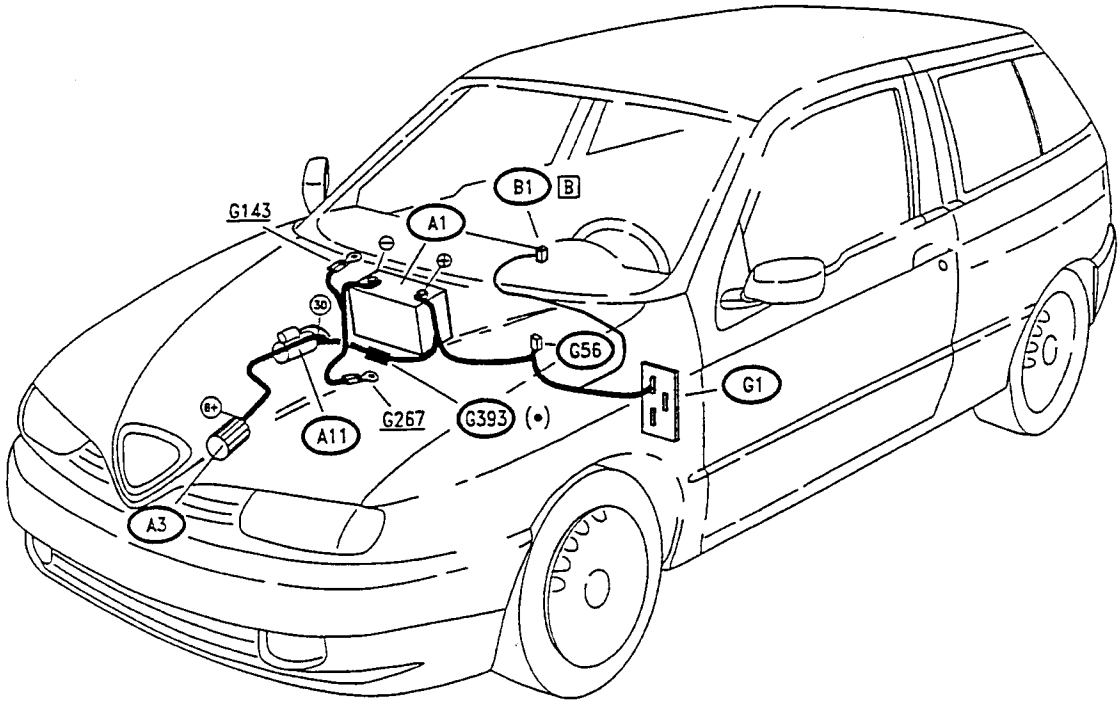


Starting consent relay (*) — I10



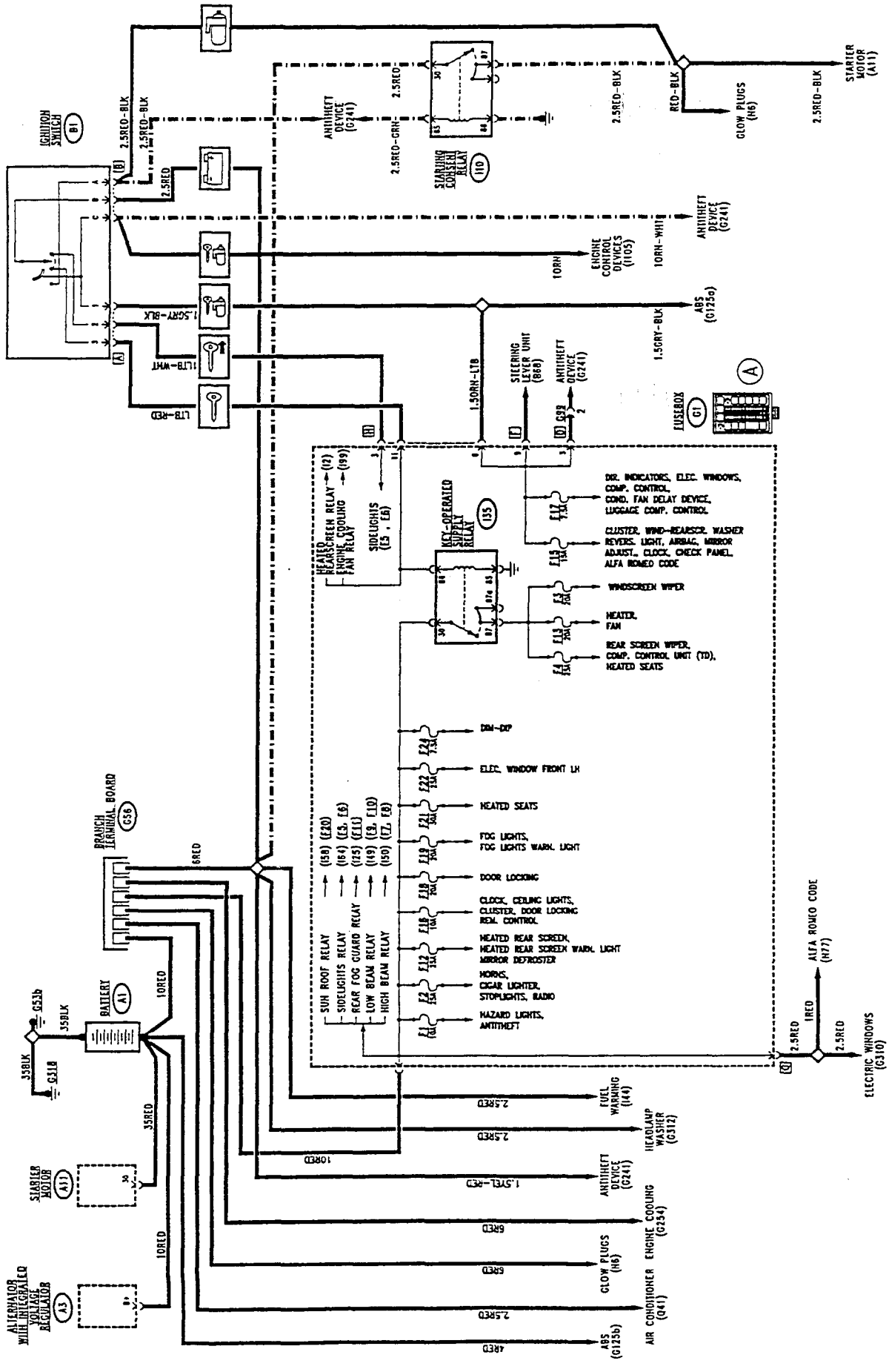
(*) versions without ALFA ROMEO CODE, but with anti-theft system (•) from chassis no.....

LOCATION OF COMPONENTS (Boxer versions)



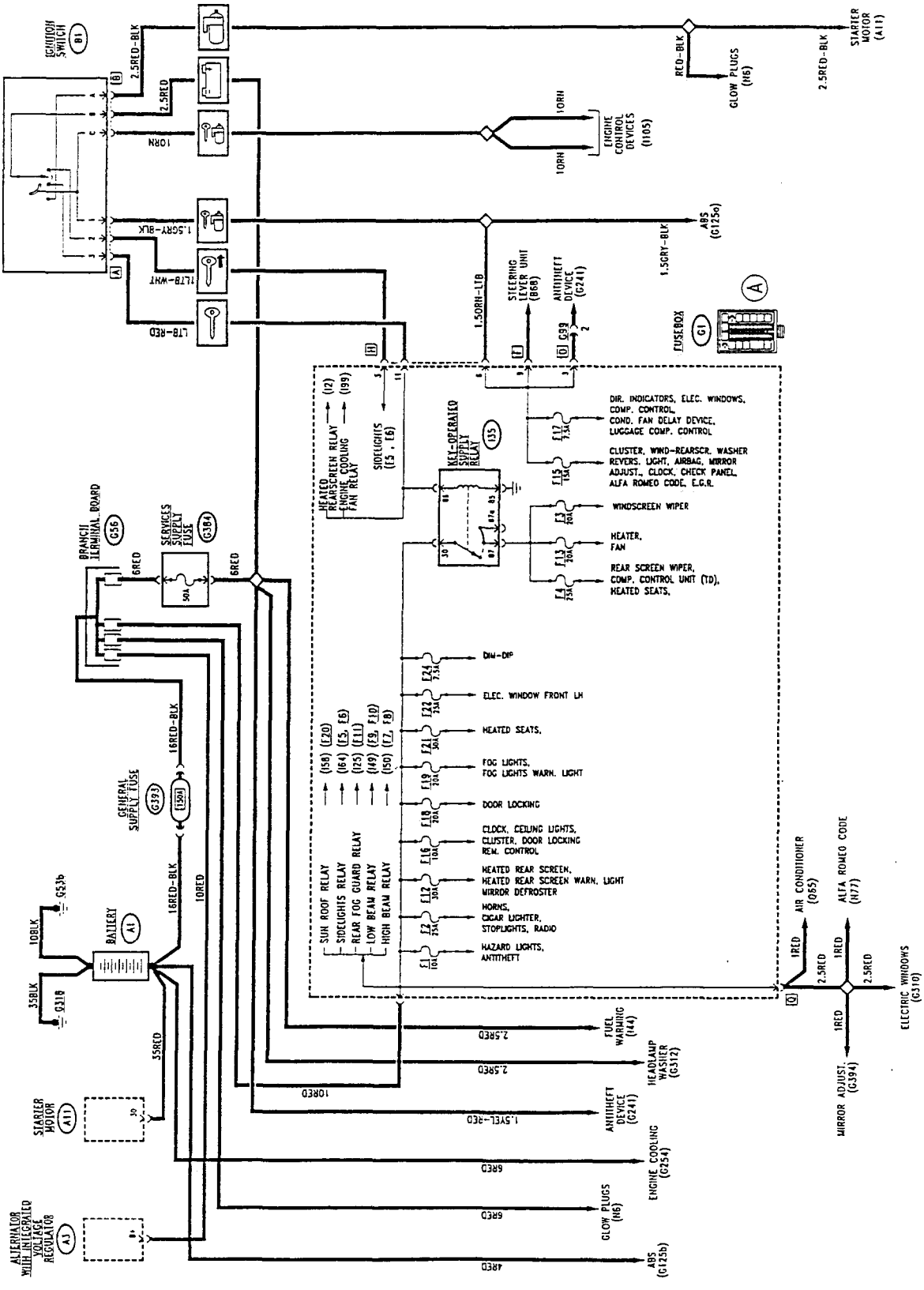
(•) from chassis no.....

WIRING DIAGRAM (TD version - up to chassis no. ....)

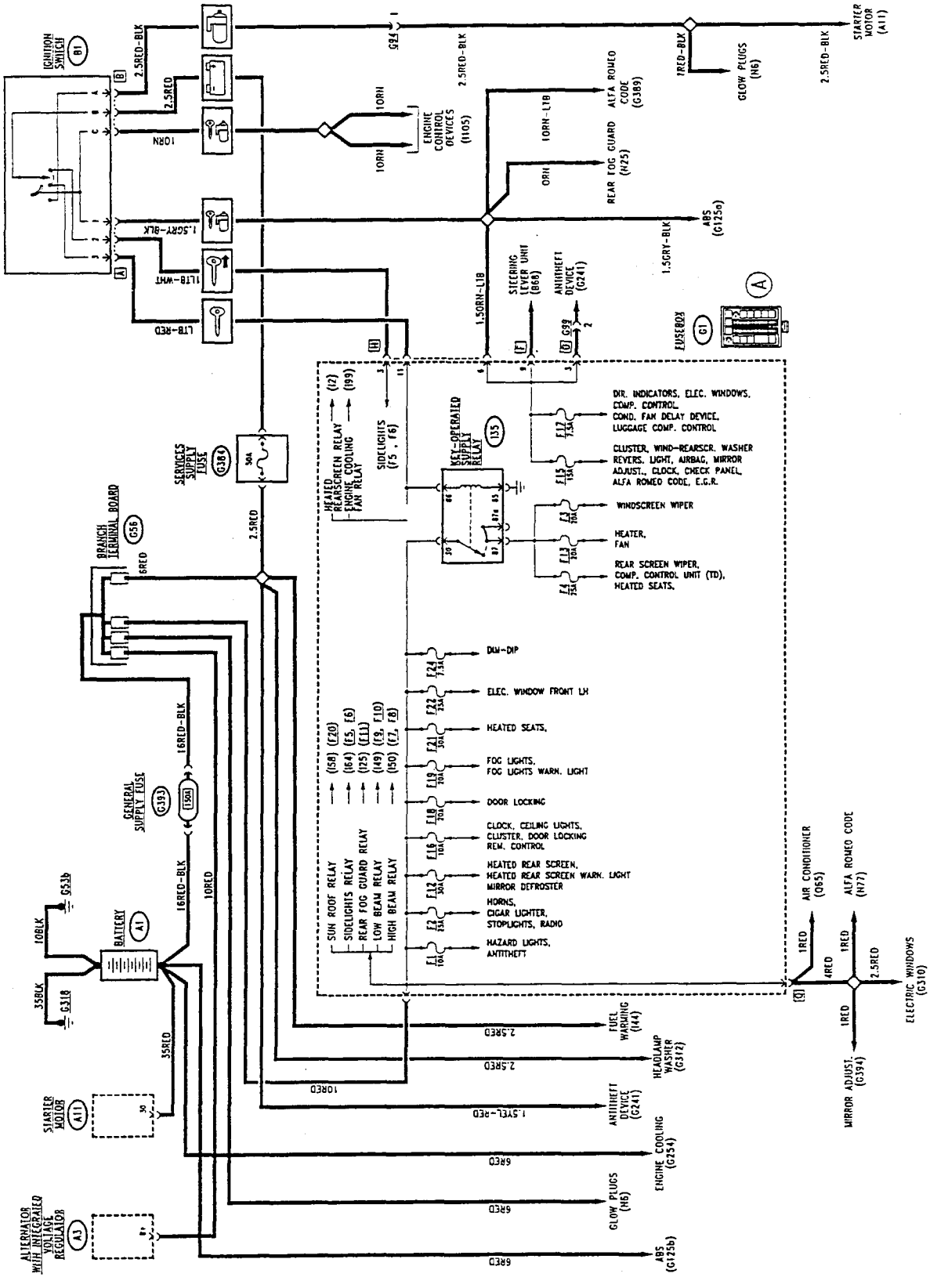


versions without ALFA ROMEO CODE, but w''' theft alarm

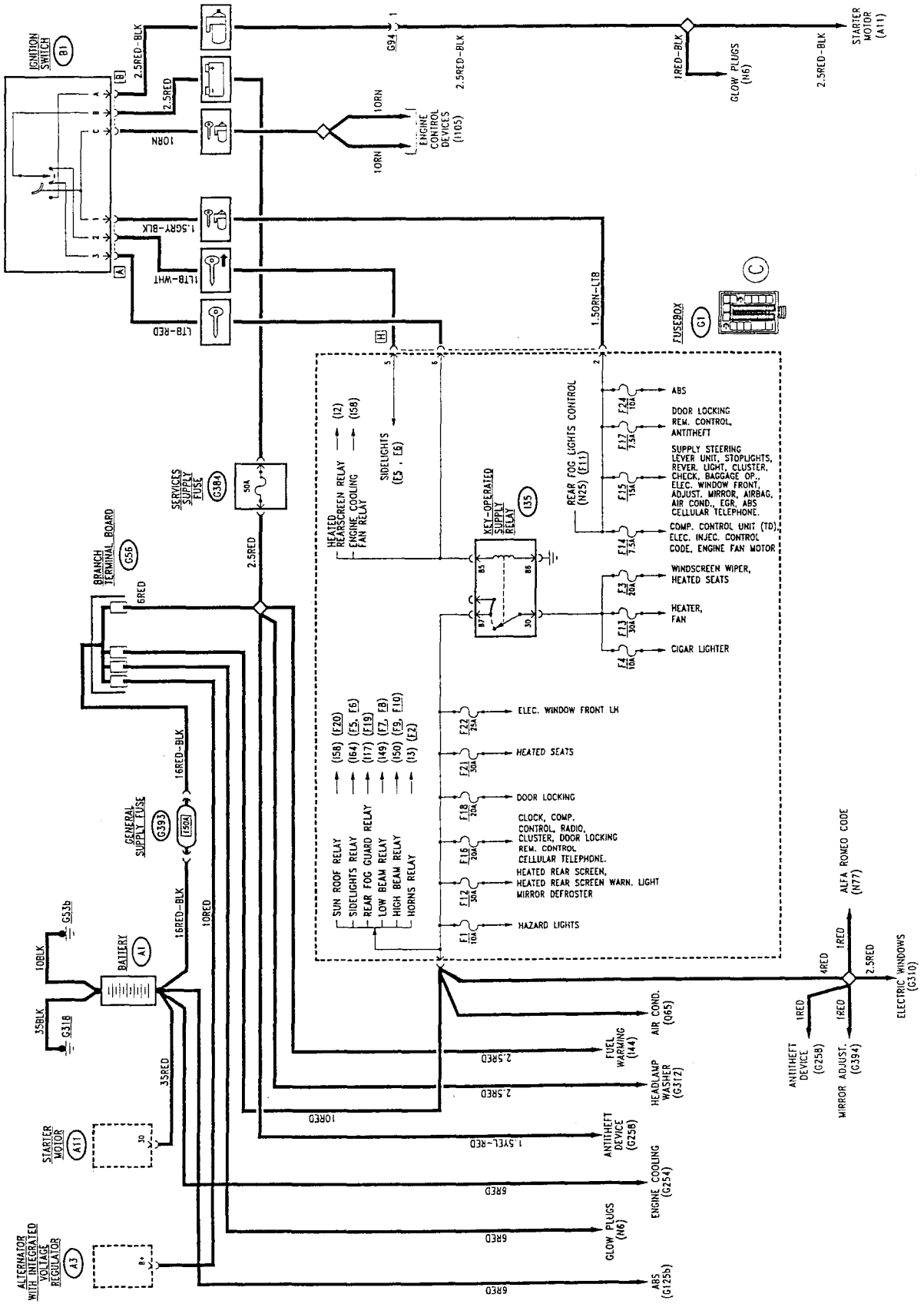
WIRING DIAGRAM (TD version from chassis no. ....)



WIRING DIAGRAM (TD-CAT version)



WIRING DIAGRAM (TD version)



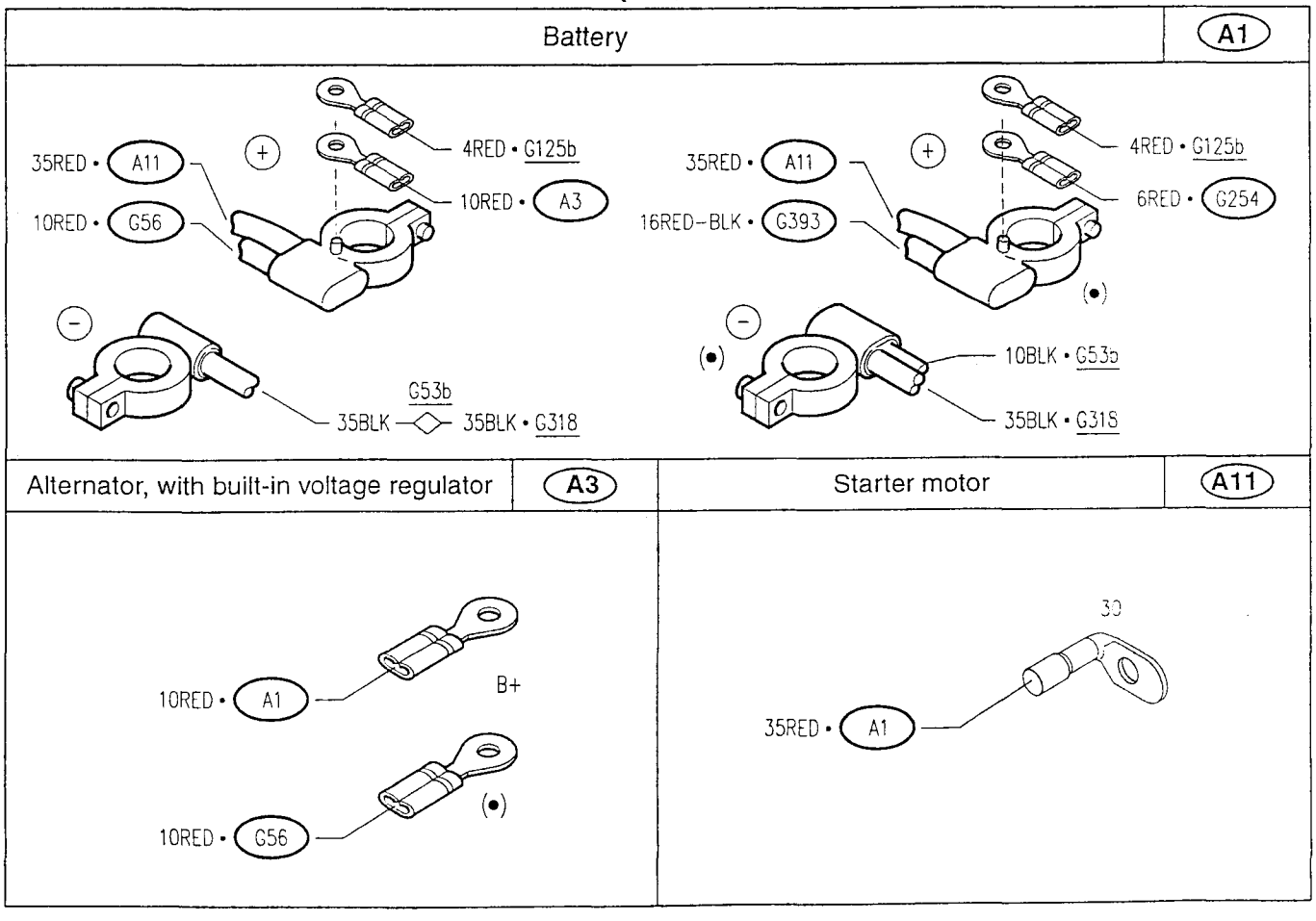
FUNCTIONAL DESCRIPTION (TD, TD-CAT version)

The supply leading from the battery **A1** is subdivided into the various lines in the branch terminal box **G56**, from which the numerous cables that directly supply certain systems (protected by specific "wander" fuses) and the line that supplies the fusebox **G1** lead; inside the fusebox, the supply is sorted to the various circuits, protected by the corresponding fuses (see the "Fusebox" section").
The battery charging line leads directly from the alternator **A3** or (from chassis no. .....) via the branch terminal box **G56.**
The ignition switch **B1** is also supplied through the branch terminal box **G56** at pin B of connector B.
The line leaving pin A of connector B is the one corresponding to the "START" position and directly supplies the starter motor **A11** (only for certain cars without ALFA ROMEO CODE but with theft alarm, through the alarm control unit **N45** and the starting consensus relay **I10**).

The line that leaves pin 3 of connector A - "DRIVE" position - via the fusebox **G1**, supplies the "key-operated" circuits, which are however disengaged in the "START" position.
The lines that leave pin 1 of connector A and pin C of connector B supply the "key-operated" circuits which remain engaged also when the ignition key is turned to "START", either directly or via the fusebox **G1**.
Lastly, the line that leaves pin 2 of connector A corresponds to the "PARK" position and supplies the sidelights circuit inside the fusebox **G1**.

From chassis no....., through the adoption of a special high capacity fuse (150A) **G393**, all the supply lines are protected with the exception of the starter motor cable (battery - starter motor) and the battery charging cable (starter motor - alternator) which are protected by an additional "reinforced" sheath.
A fuse **G384** (50A) has also been added to protect the supply for the ignition switch.

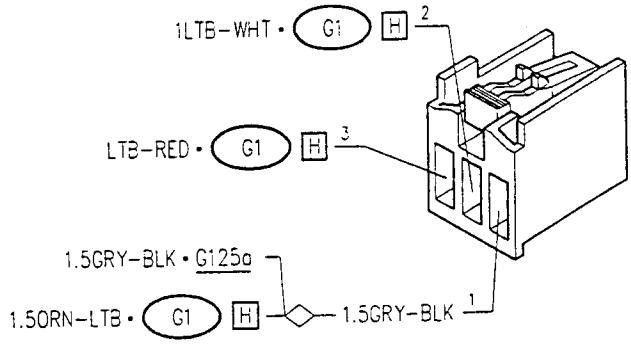
COMPONENTS AND CONNECTORS (TD, TD-CAT version)



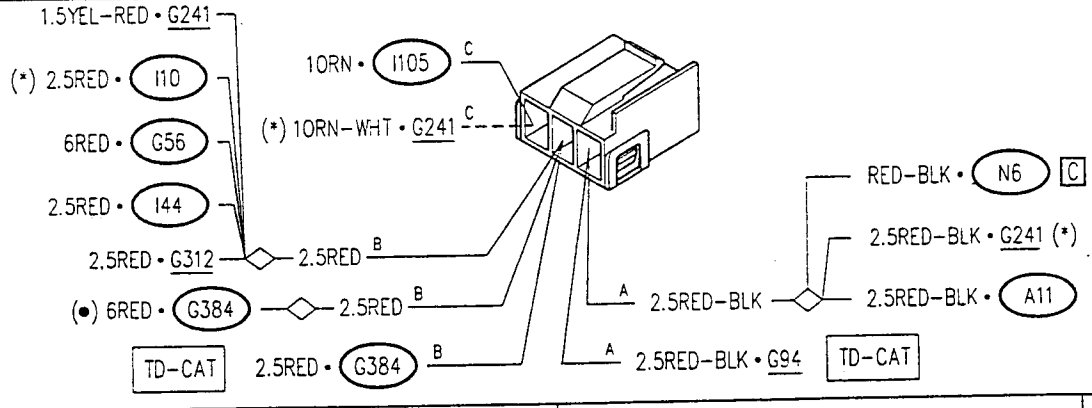
(•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

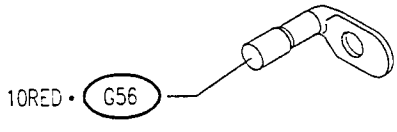
Ignition switch — B1 A



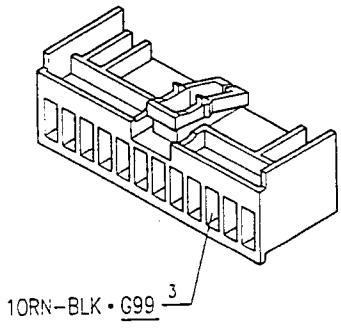
Ignition switch — B1 B



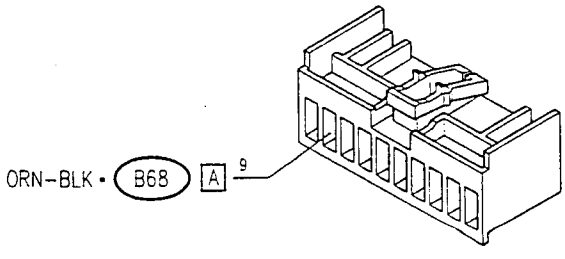
Fusebox — G1



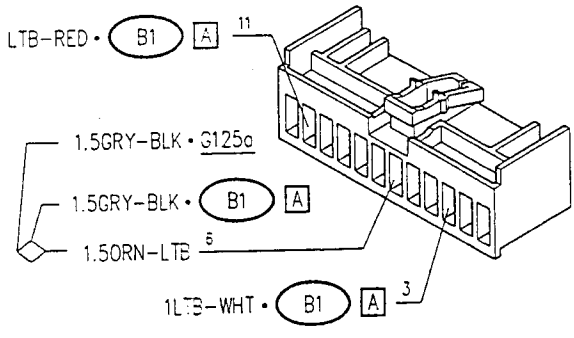
Fusebox — G1 D



Fusebox — G1 F



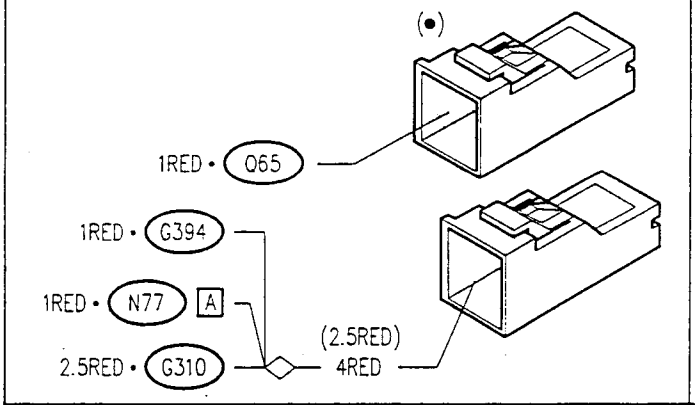
Fusebox — G1 H



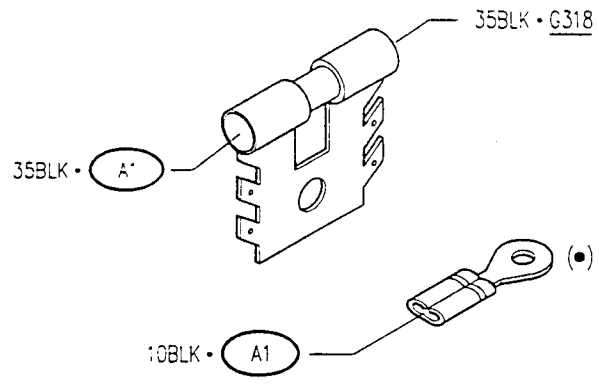
(*) Versions without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

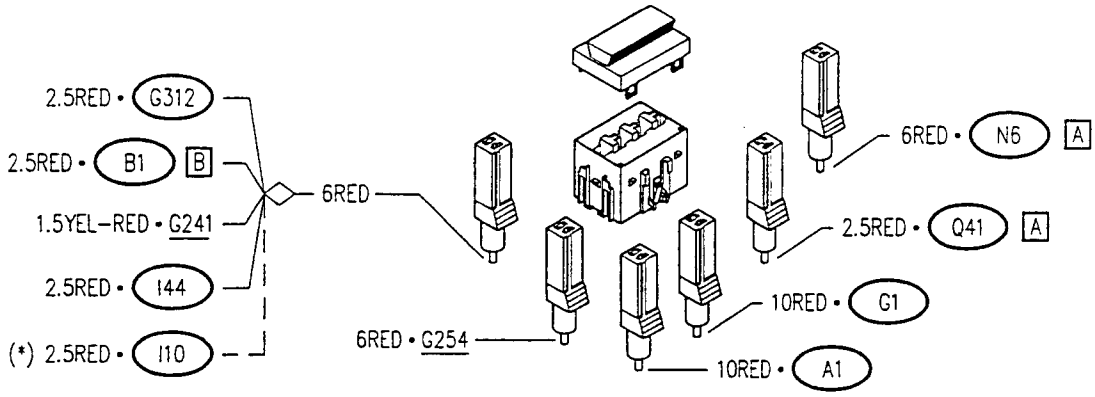
Fusebox	G1 Q

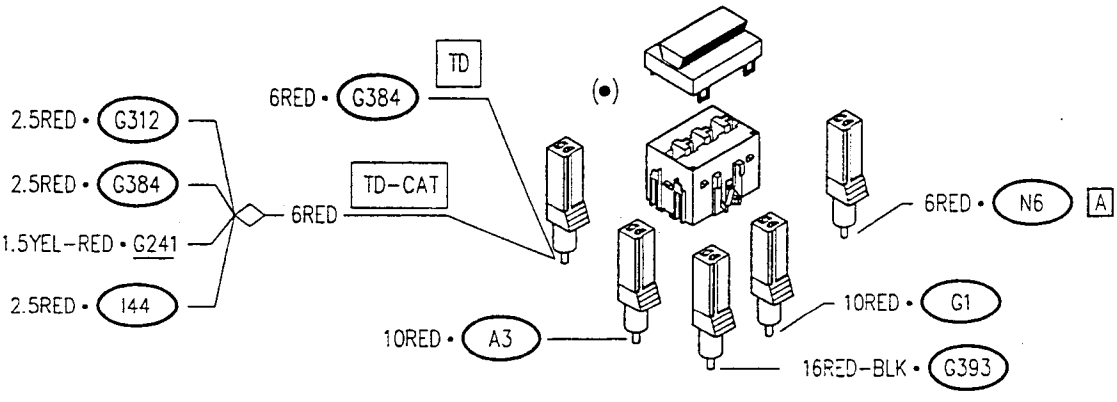


LH engine compt. earth	G53b

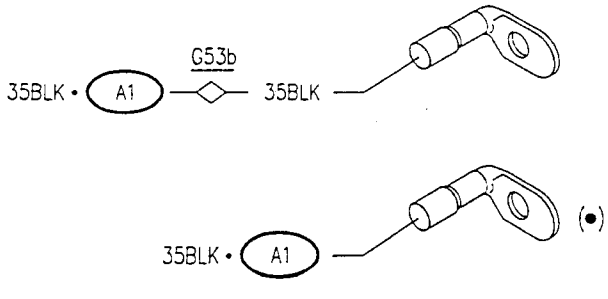


Branch terminal box	G56





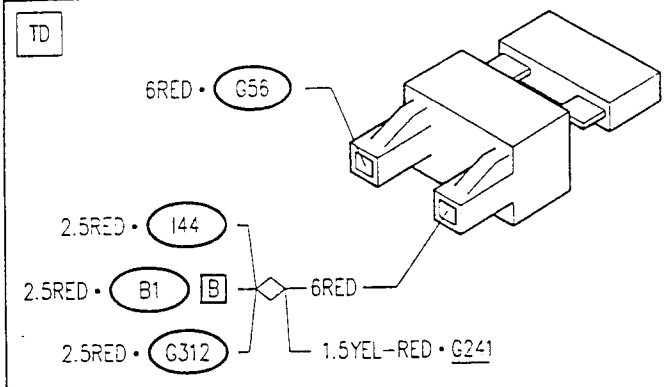
Earth on gearbox	G318



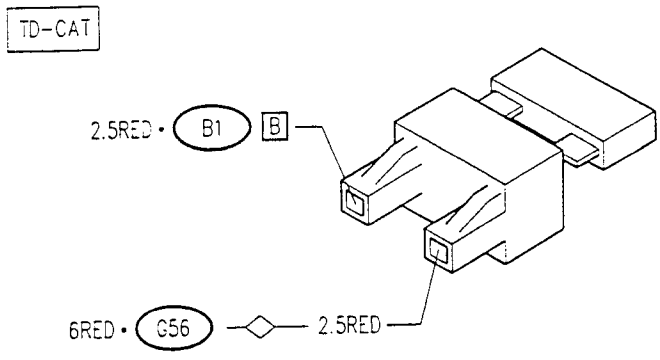
(*) Versions without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

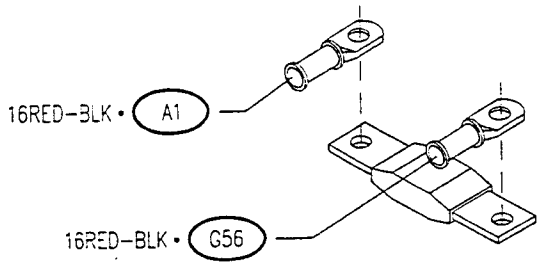
Services supply fuse (•)	G384



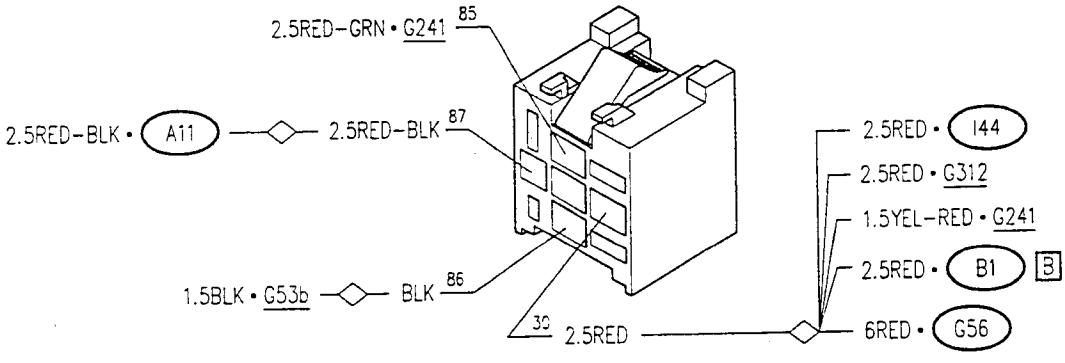
Services supply fuse	G384



General supply fuse (•)	G393



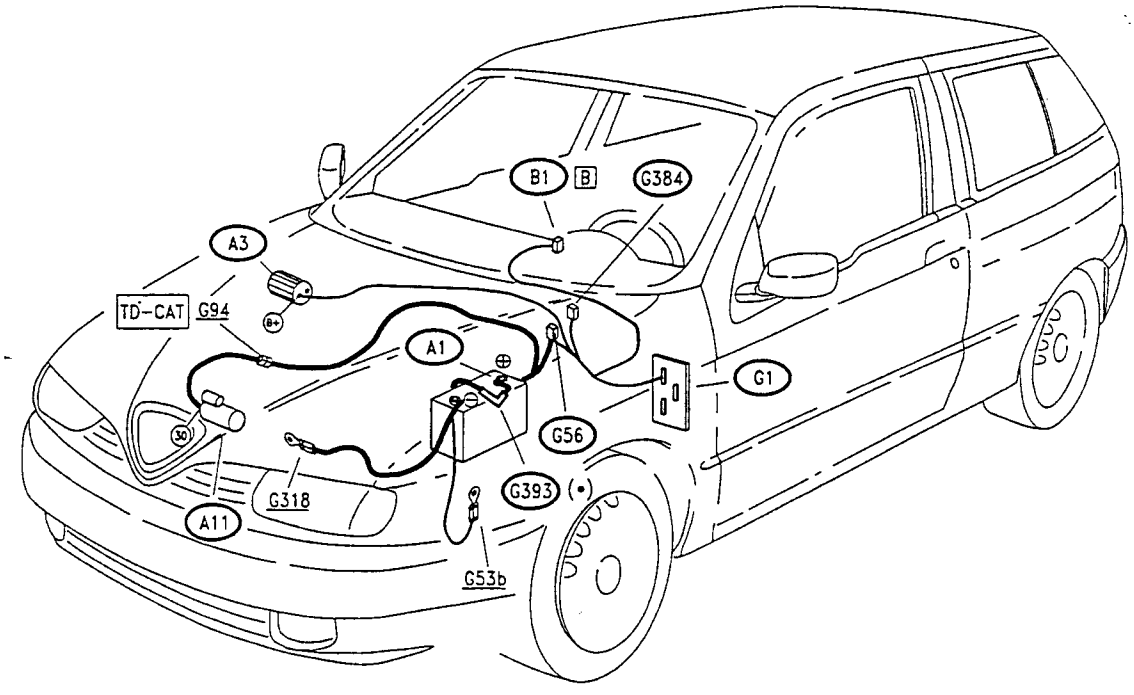
Starting consensus relay (*)	I10



(*) Versions without ALFA ROMEO CODE, but with anti-theft system

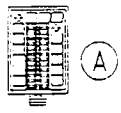
(•) Variant from chassis no....

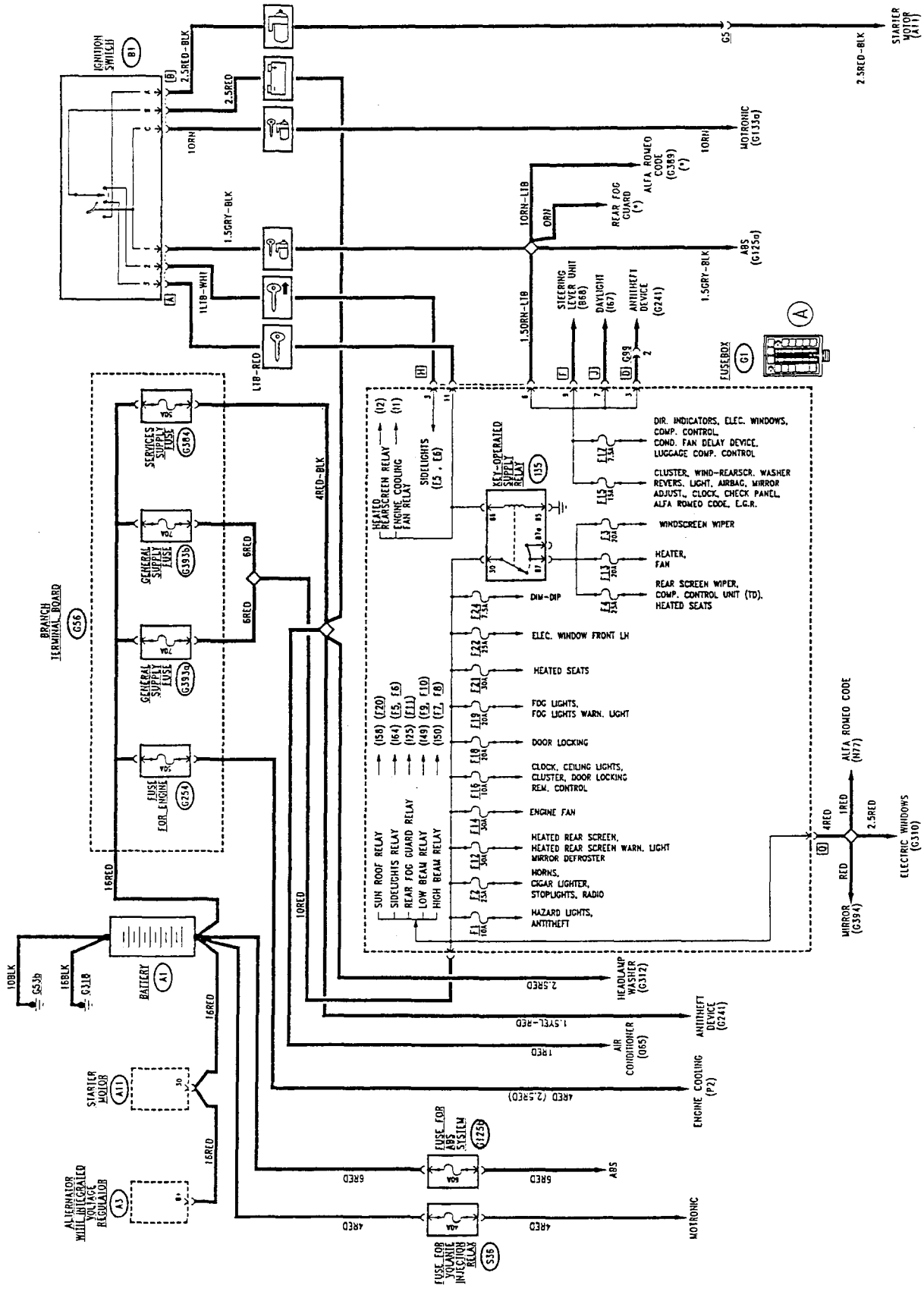
LOCATION OF COMPONENTS (TD, TD-CAT version)



(•) from chassis no.....

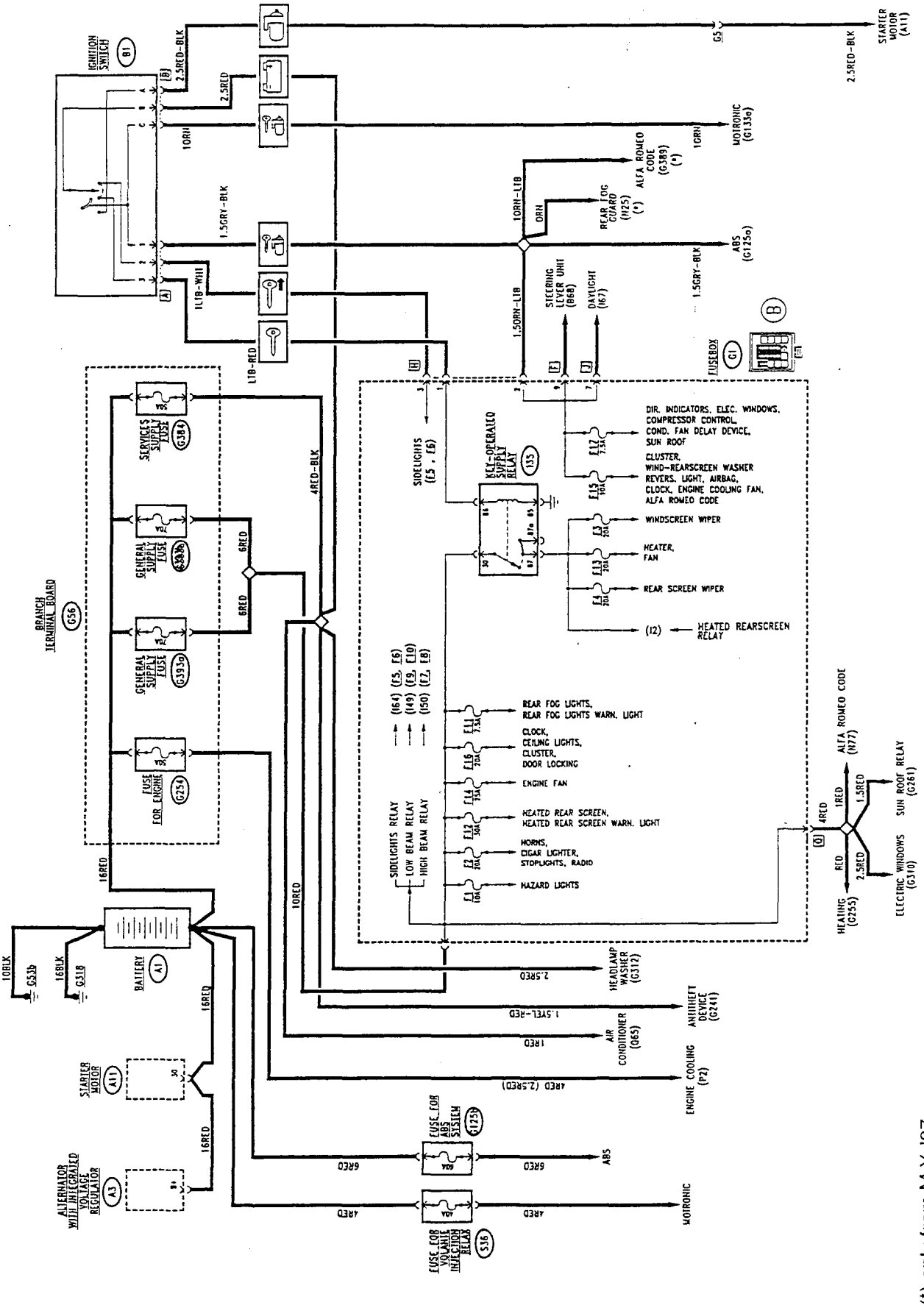
WIRING DIAGRAM (T.SPARK version)





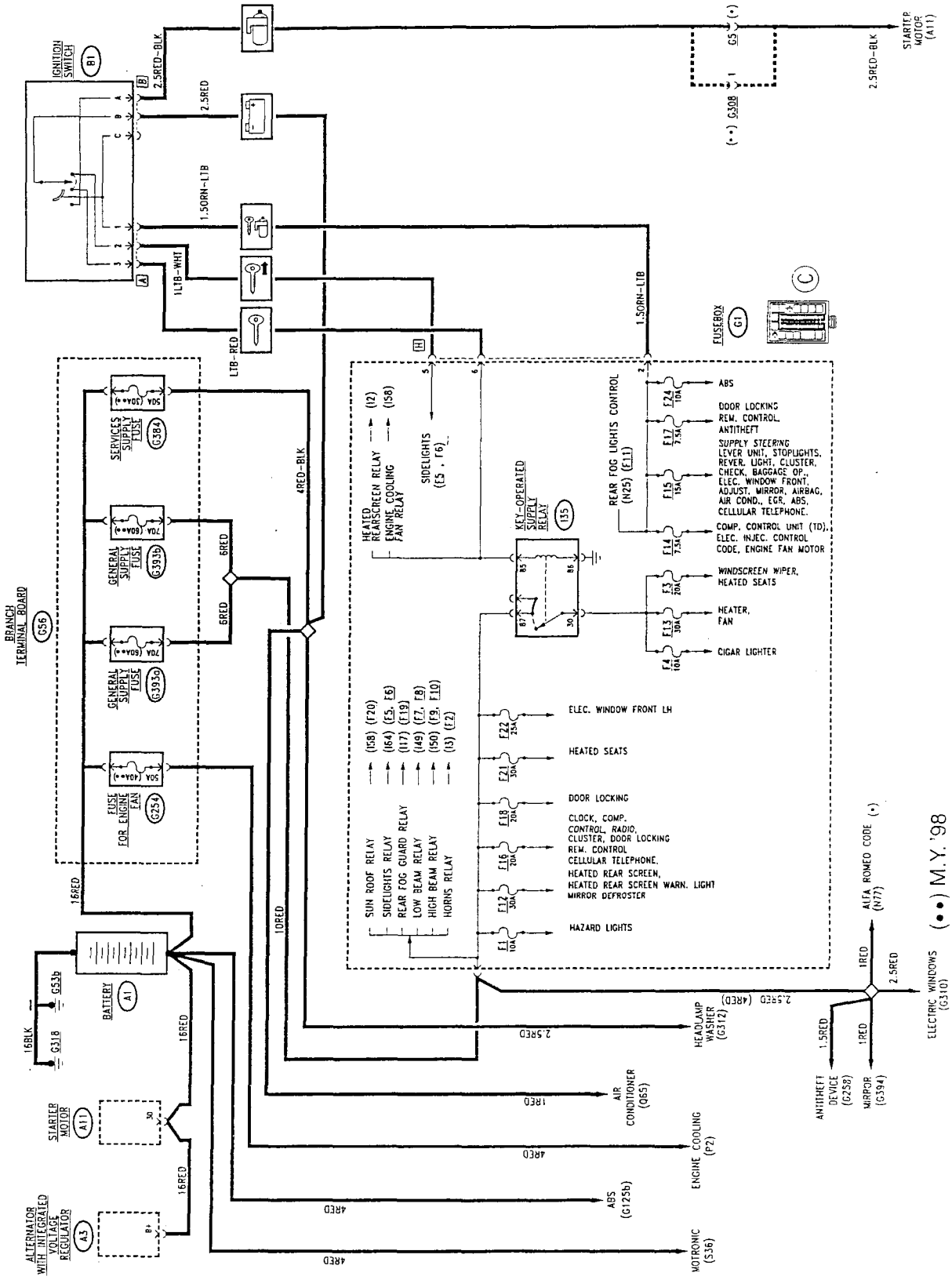
(*) only from M.Y. '97

WIRING DIAGRAM (T.SPARK version)



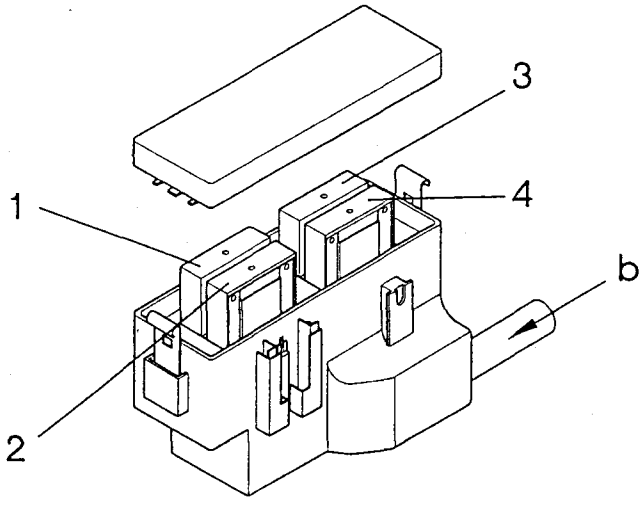
(*) only from M.Y. '97

WIRING DIAGRAM (T.SPARK version)



FUNCTIONAL DESCRIPTION (T.SPARK version)

The supply leading from the battery **A1** is subdivided into various lines in the branch terminal box **G56**. This is a branch terminal box with built-in fuses, which makes it possible to protect all the supply lines except the starter motor cable (battery-starter motor) and the battery charging cable (starter motor-alternator): these cables are however protected by an additional "reinforced" sheath.



b. line (16 mm cable) from the battery

Up to Model Year '97

1. Fan fuse (50A): **G254**
2. Services supply fuse (50A): **G384**
3. General supply fuse (70A): **G393a**
4. General supply fuse (70A): **G393b**

From Model Year '98

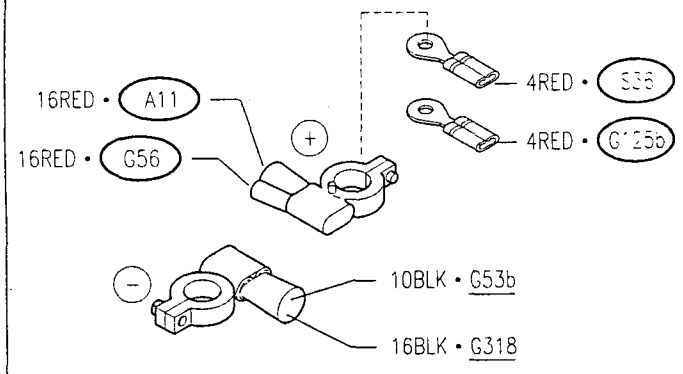
1. Fan fuse (40A): **G254**
2. Services supply fuse (30A): **G384**
3. General supply fuse (60A): **G393a**
4. General supply fuse (60A): **G393b**

From this, lead the cables which directly supply certain systems and the line that supplies the fusebox **G1**; inside the fusebox the supply is branched to the various circuits, protected by the corresponding fuses (see "Fusebox" section).
The battery charging line leads from the alternator **A3**, via the starter motor **A11.**
The ignition switch **B1** is also supplied via the branch terminal box **G56** and the specific fuse **G384** at pin B of connector B.
The line that leaves pin A of connector B is the one corresponding to the "START" position and directly supplies the starter motor **A11.**

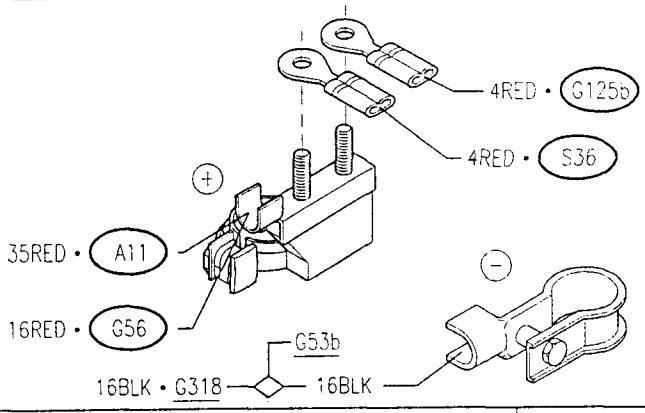
The line that leaves pin 3 of connector A - "DRIVE" position - supplies, via the fusebox **G1**, the "key-operated" circuits which are disengaged in the "START" position.
The lines that leave pin 1 of connector A and pin C of connector B supply, either directly or via the fusebox **G1**, the "key- operated" circuits which also remain engaged in the "START" position.
For fusebox **G1** "C"" pin C of connector B is not connected.
Lastly the line leaving pin 2 of connector A corresponds to the "PARK" position and supplies the sidelights circuit inside the fusebox **G1**.

COMPONENTS AND CONNECTORS (T.SPARK version)

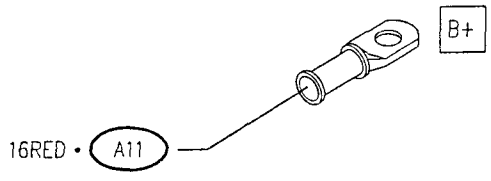
Battery	A1



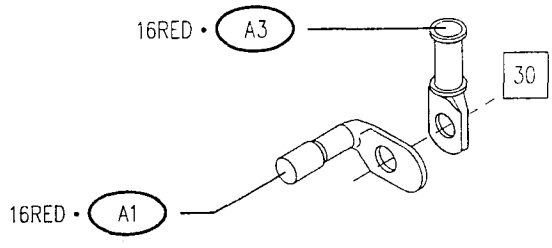
Battery (•)	A1



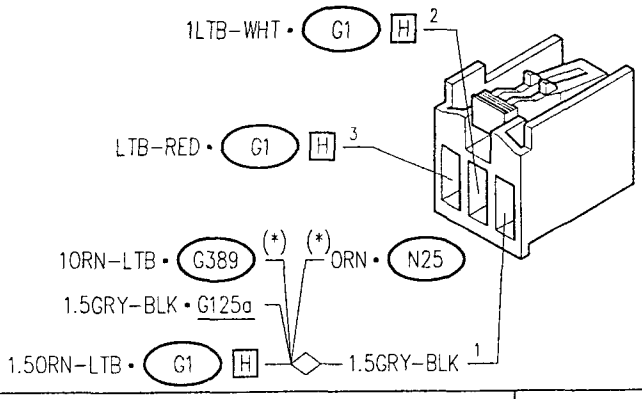
Alternator, with built-in voltage regulator	A3



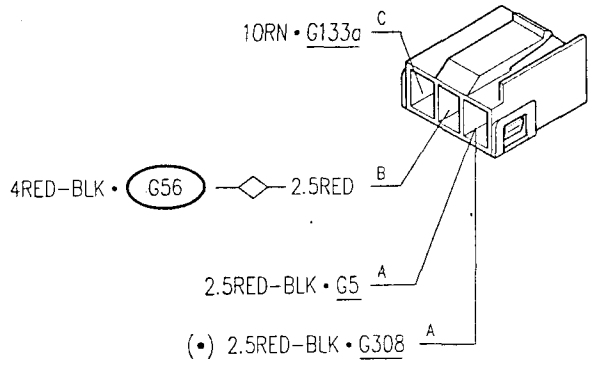
Starter motor	A11



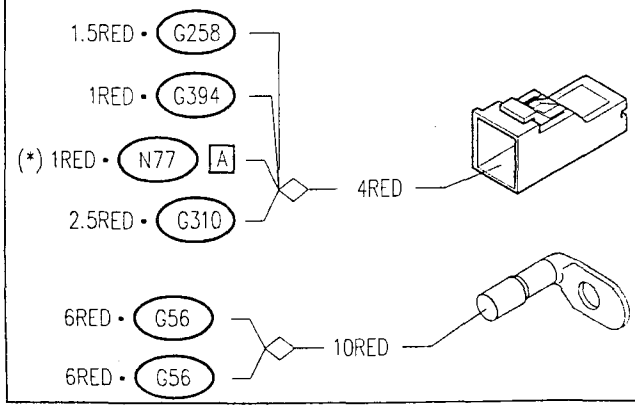
Ignition switch	B1	A



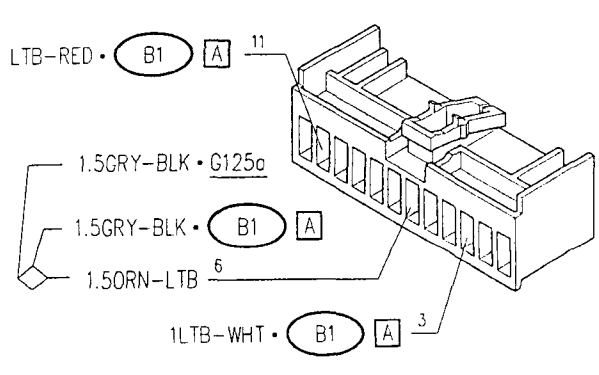
Ignition switch	B1	B



Fusebox	G1



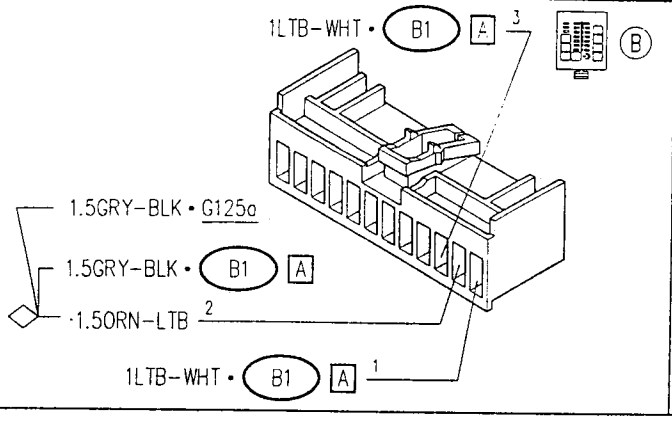
Fusebox	G1	H



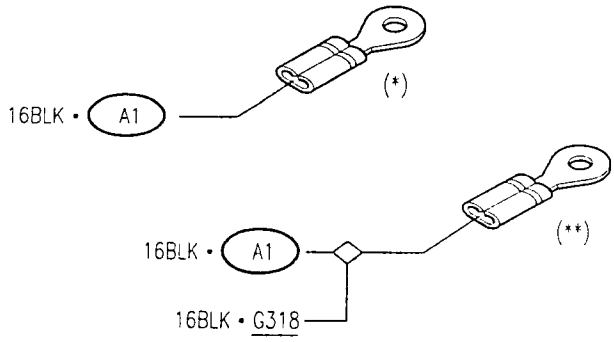
(*) from M.Y. '97

COMPONENTS AND CONNECTORS (contd.)

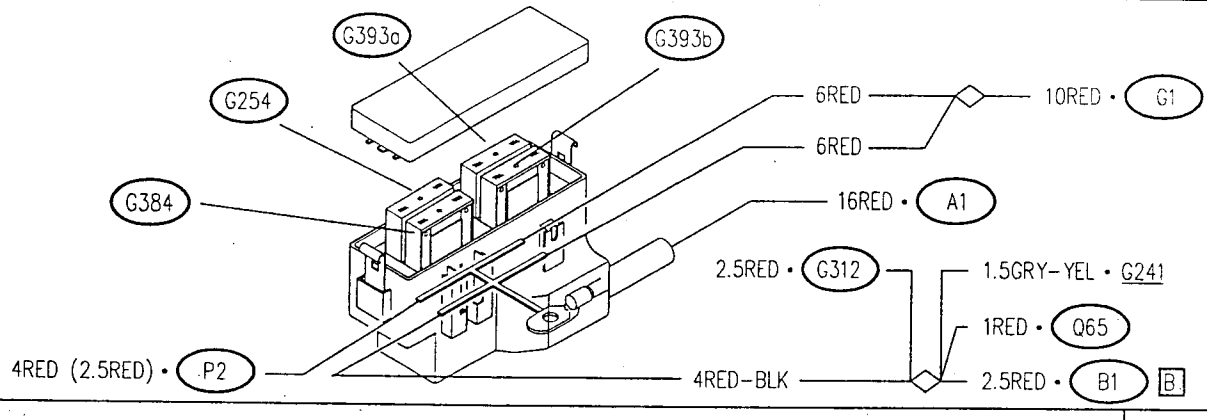
Fusebox	G1 H



LH engine compt. earth	G53b



Branch terminal box	G56

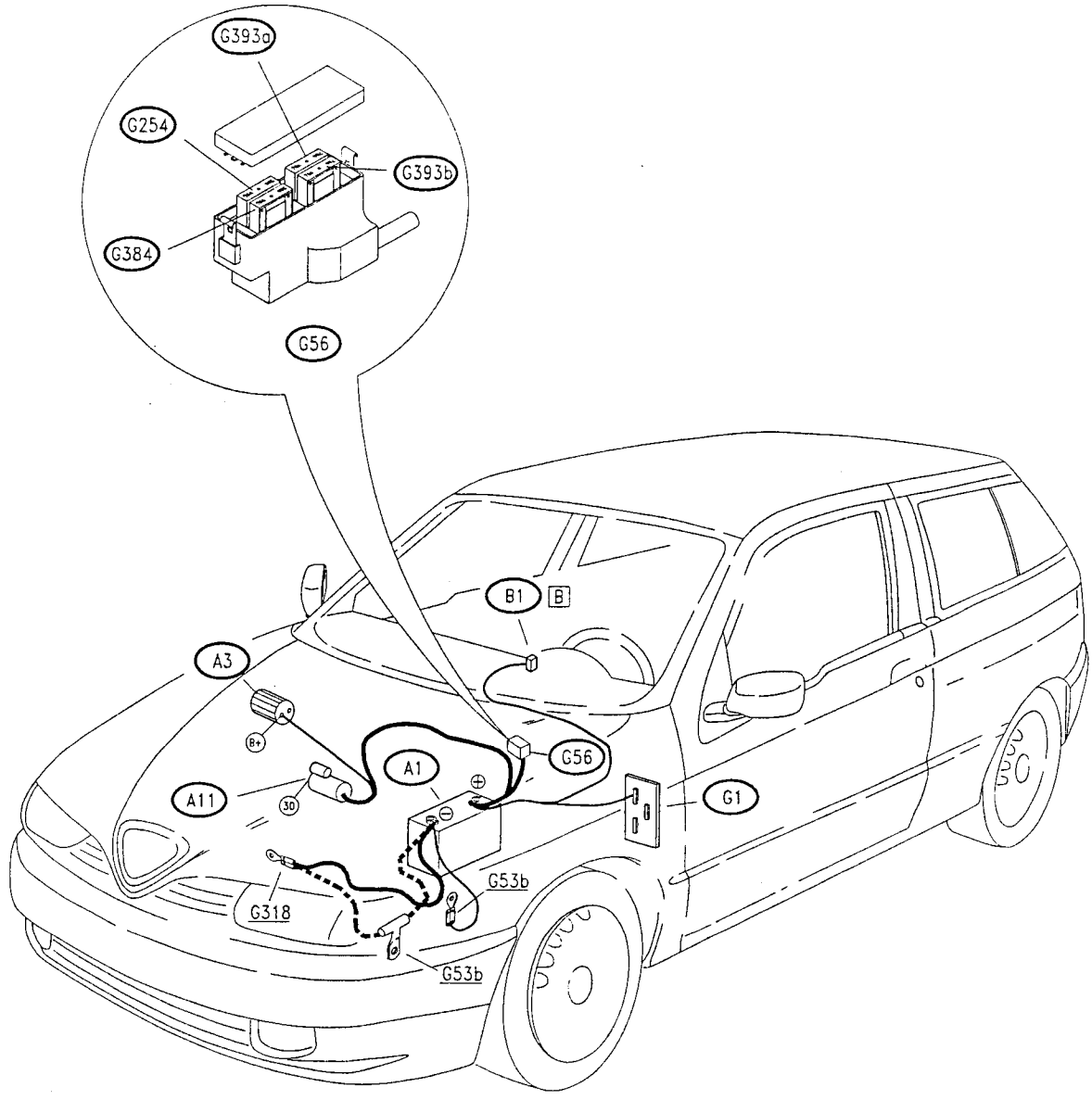


Earth on gearbox	G318



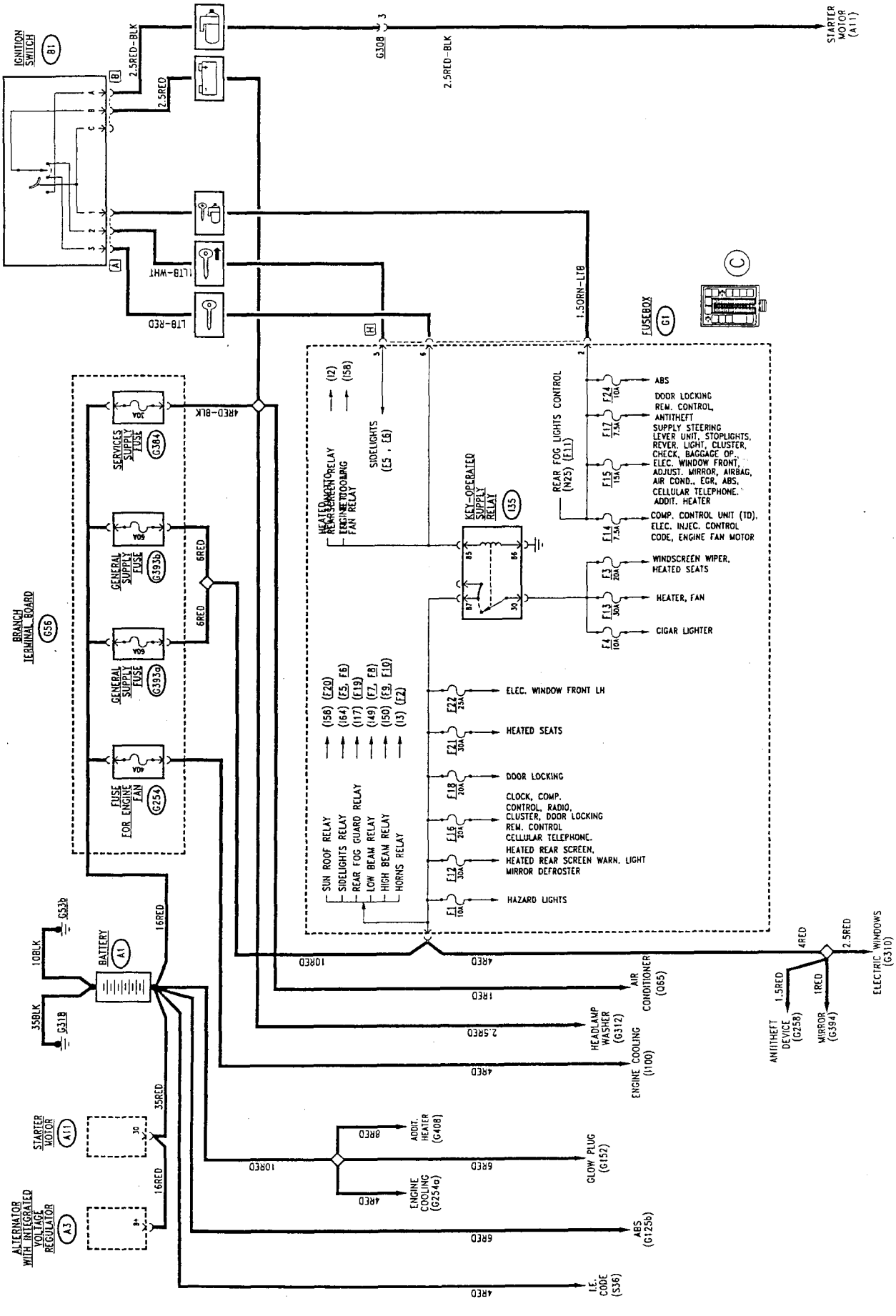
(*) from M.Y. '97
(**) from M.Y. '98

LOCATION OF COMPONENTS (T.SPARK version)



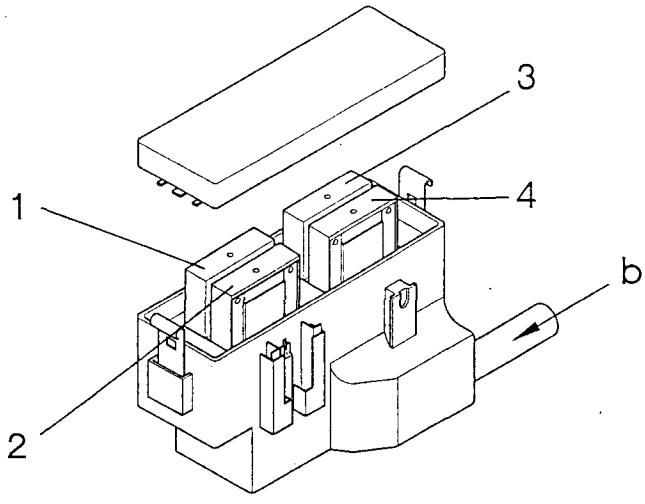
——— From Model Year '98

WIRING DIAGRAM (JTD version)



FUNCTIONAL DESCRIPTION (JTD version)

The supply leading from the battery **A1** is subdivided into various lines in the branch terminal box **G56**. This is a branch terminal box with built-in fuses, which makes it possible to protect all the supply lines except the starter motor cable (battery-starter motor) and the battery charging cable (starter motor-alternator): these cables are however protected by an additional "reinforced" sheath.



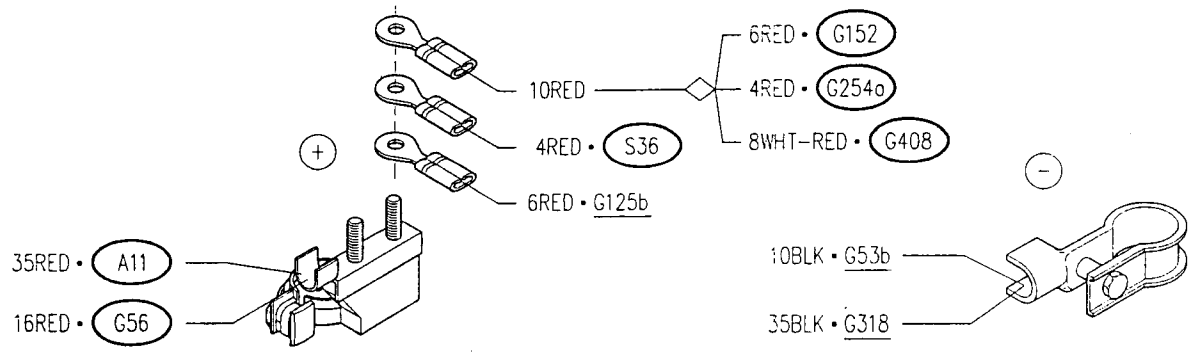
b. line (16 mm cable) from the battery
1. Fan fuse (50A): **G254**
2. Services supply fuse (30A): **G384**
3. General supply fuse (60A): **G393a**
4. General supply fuse (60A): **G393b**

From this, lead the cables which directly supply certain systems and the line that supplies the fusebox **G1**; inside the fusebox the supply is branched to the various circuits, protected by the corresponding fuses (see "Fusebox" section).
The battery charging line leads from the alternator **A3**, via the starter motor **A11.**
The ignition switch **B1** is also supplied via the branch terminal box **G56** and the specific fuse **G384** at pin B of connector B.
The line that leaves pin A of connector B is the one corresponding to the "START" position and directly supplies the starter motor **A11.**

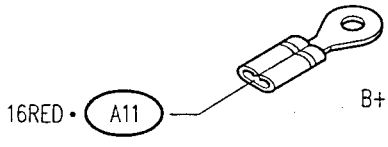
The line that leaves pin 3 of connector A - "DRIVE" position - supplies, via the fusebox **G1**, the "key-operated" circuits which are disengaged in the "START" position.
The lines that leave pin 1 of connector A and pin C of connector B supply, either directly or via the fusebox **G1**, the "key- operated" circuits which also remain engaged in the "START" position.
Pin C of connector B is not connected.
Lastly the line leaving pin 2 of connector A corresponds to the "PARK" position and supplies the sidelights circuit inside the fusebox **G1**.

COMPONENTS AND CONNECTORS (JTD version)

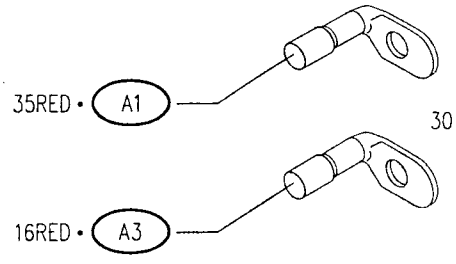
Battery — A1



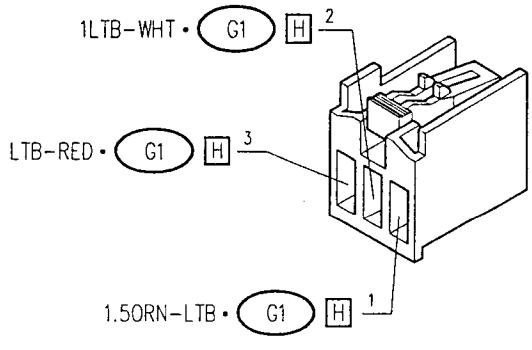
Alternator, with built-in voltage regulator — A3



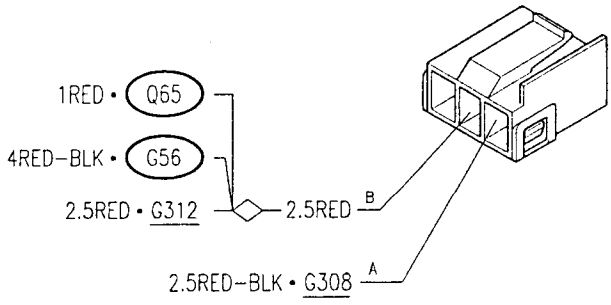
Starter motor — A11



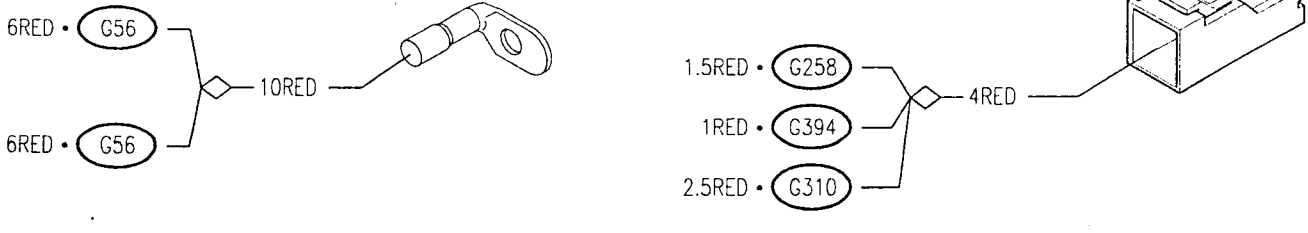
Ignition switch — B1 A



Ignition switch — B1 B

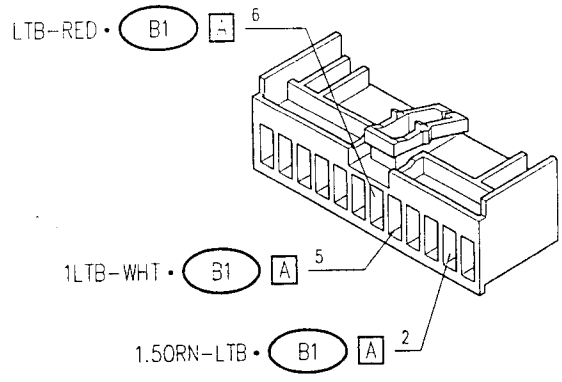


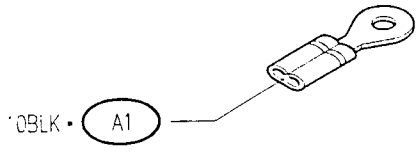
Fusebox — G1



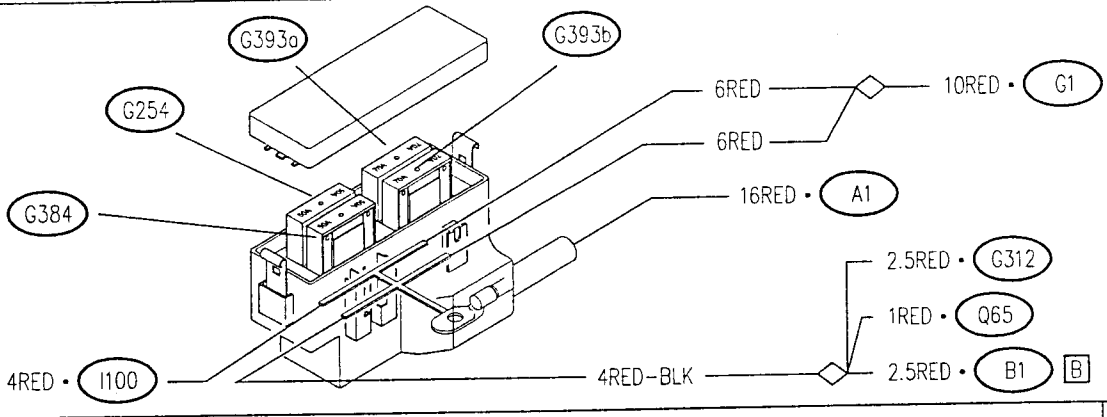
COMPONENTS AND CONNECTORS (contd.)

Fusebox	G1 H	LH engine compt. earth	G53b

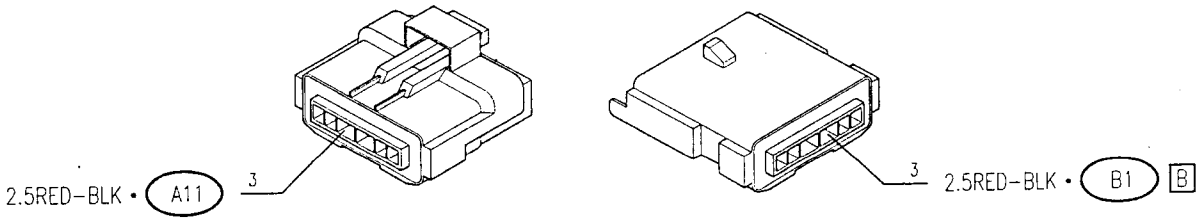




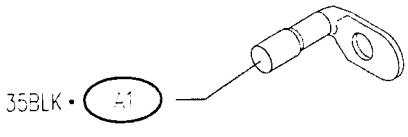
Branch terminal box	G56



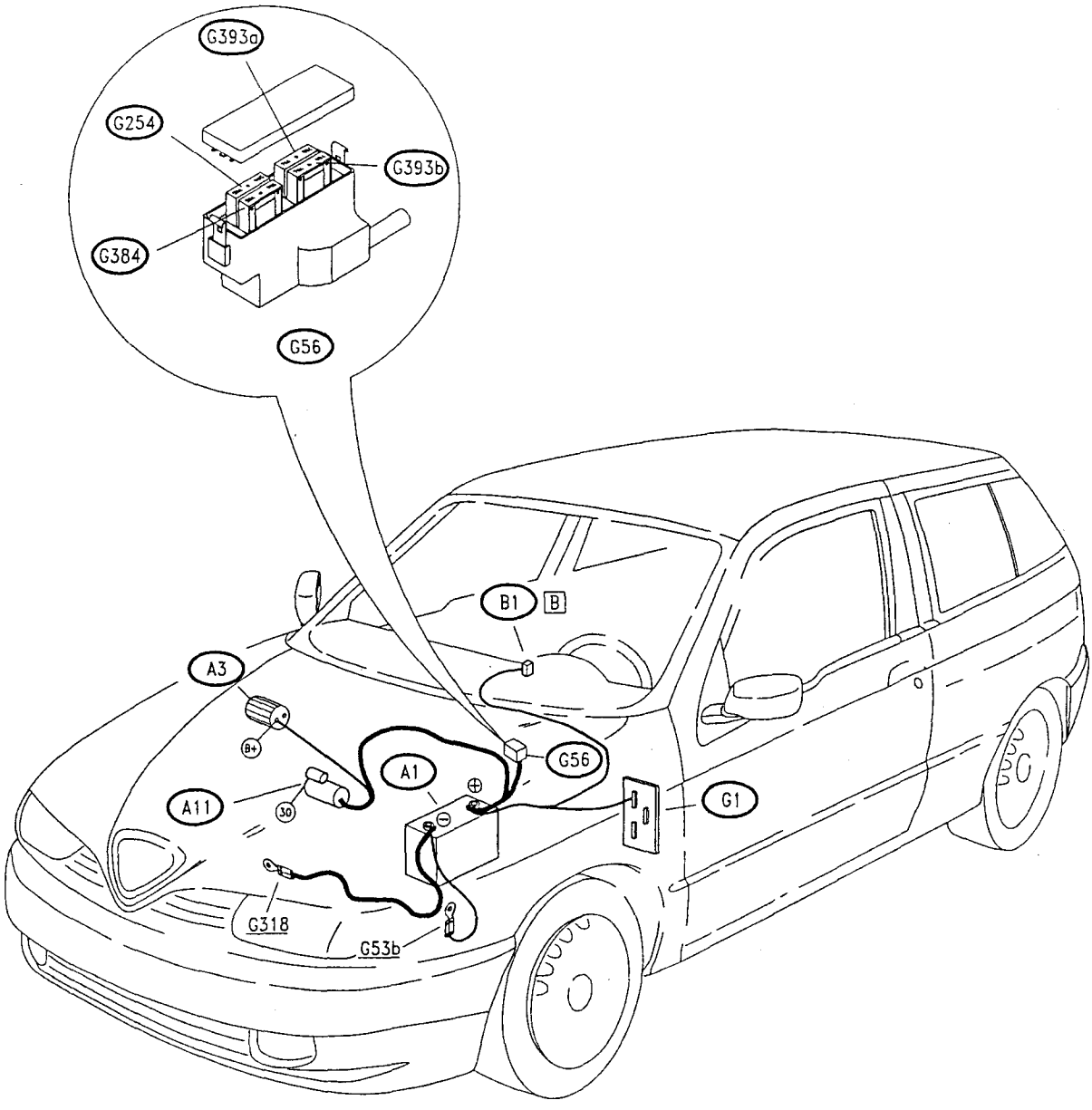
Connector for engine sensors	G308



Earth on gearbox	G318

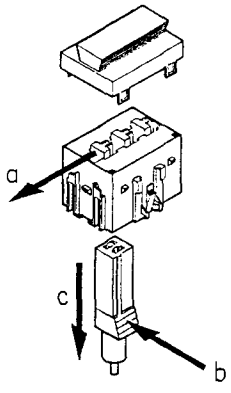


LOCATION OF COMPONENTS (JTD version)



CHECKING COMPONENTS

Branch terminal box (G56) (except T.SPARK and JTD)

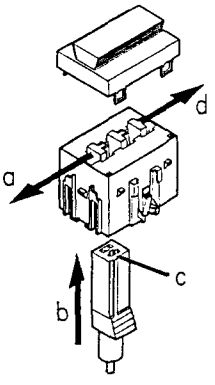


Removing a connector

a - move the "secondary-lock" to the left

b - press the release catch of the connector to be removed

c - remove the connector pulling downwards



Inserting a connector

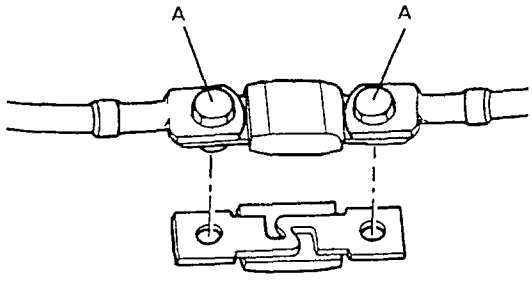
a - position the "secondary-lock" at the left

b - insert the connector

c - press the connector until it catches in the tooth

d - move the "secondary-lock" to the right

General supply fuse (G393) (except T.SPARK and JTD)



"MEGA" general supply protection fuse: (150A).

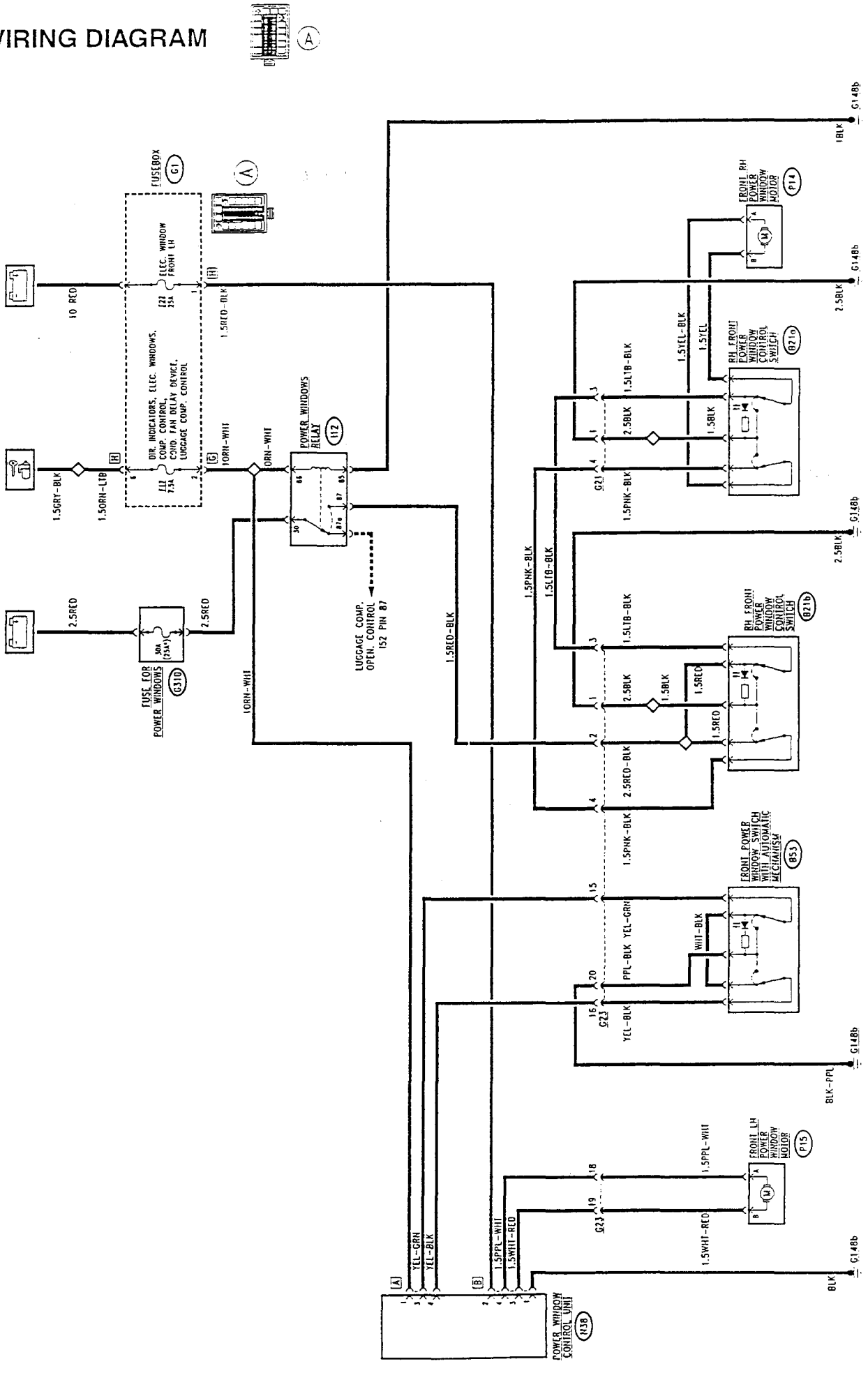
In the event of replacement tighten the two fastening screws **(A)**, proceeding with care, to a torque of appr. 25 Nm, without forcing the fuse excessively to avoid damaging the copper element.

POWER WINDOWS

INDEX

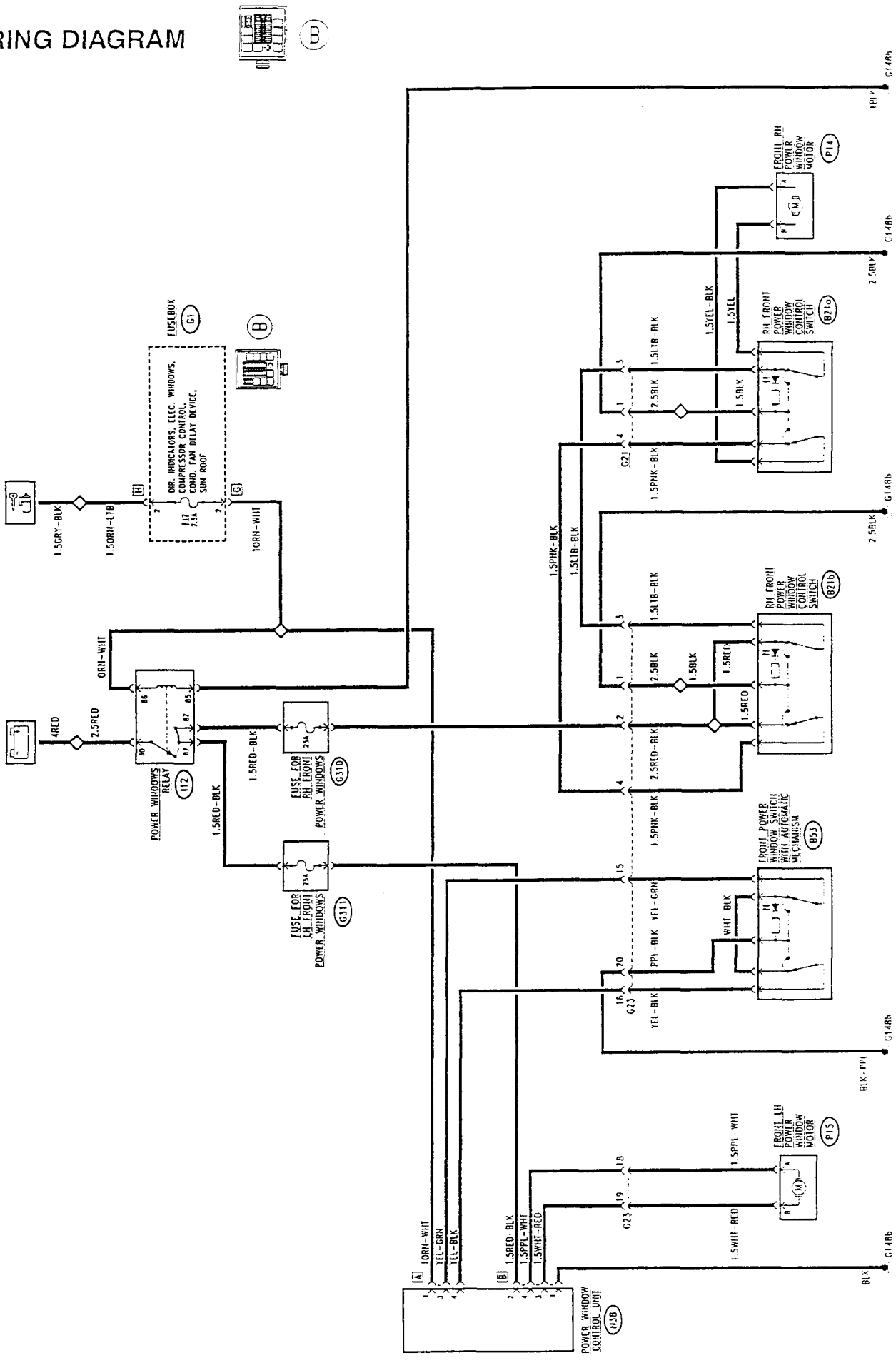
WIRING DIAGRAM A 23-2
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CHECKING COMPONENTS 23-10

WIRING DIAGRAM

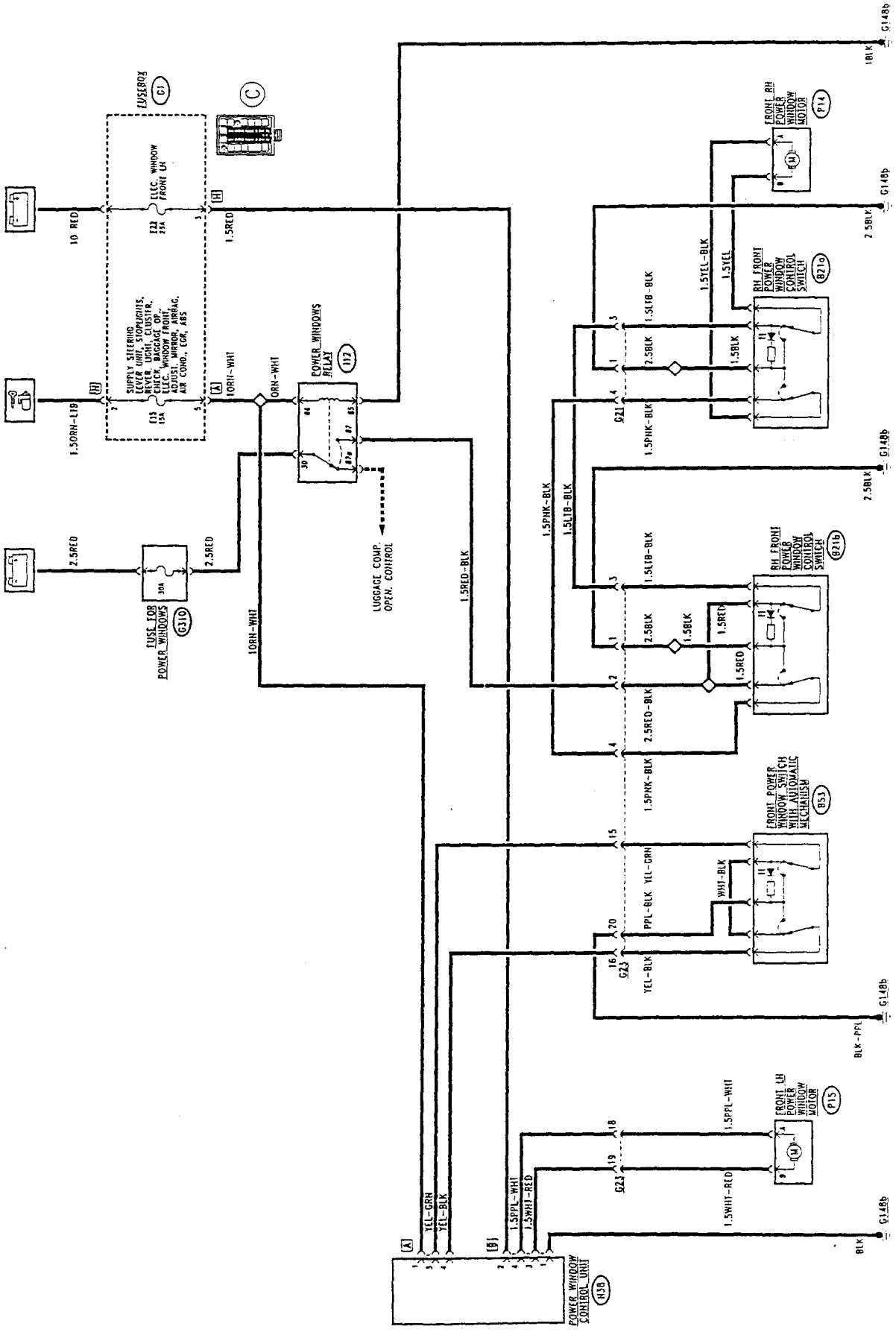


(*) for versions not fitted with electric luggage compartment opening device

WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The movmement of the left electric window (driver's side) is automatic, controlled by a control unit which operates it according to the following logic:

- keeping the pushbutton pressed (over 300 ms), the window opens or closes normally until the pushbutton is released;
- a short pulse (below appr. 300 ms.) operates the motor which automatically stops when the stop limit is reached (window open or closed completely);
- an even shorter pulse (less than appr. 50 ms.) is considered by the control unit as an accidental shock and no action will result.

This operating logic takes place through the "key-operated" supply".

The electrical mechanism that operates the right front window is of the conventional type: when the button is pressed the window rises or drops; it is fitted with two control switches: one on the right-hand door and one on the left-hand door; operation is only possible with the ignition key engaged.

FUNCTIONAL DESCRIPTION

Fusebox "A" or "C":

The power window control unit **38** is supplied at pin 2 of connector B by the battery voltage through fuse **F22** of fusebox **G1**.
The key-operated enable signal reaches pin 1 of connector A via fuse **F17** (box "A") or fuse **F15** (box "C") still of **G1**.
The control signals for the upward and downard stroke respectively reach pins 4 and 3 of connector A from the left-hand window control switch **B53**.
In fact, this double switch sends an earth to the control unit from the part in which the contact has been closed (pin 1 = up; pin 2 = down).
The operating signals (up or down) leave pins 3 and 4 of connector B of **N38** for the left-hand window motor **P15** 12 V and earth are inverted to change the direction of rotation

Pin 1 of connector B of **N38** is connected to earth.

Conversely, the operation of the right-hand motor is controlled directly by one of the two switches **B21** (**B21a** located on the right-hand door, **B21b** on the left) which are connected in series.
The "key-operated" supply passes through relay **I12**, supplied by direct voltage through the line of fuse **G310**. The relay is energised with the key-operated supply, via fuse **F17** (box "A") or fuse **F15** (box "C") still of **G1** the righthand window motor **P14** is operated by one of the two switches **B21** in one direction or the other depending on the origin of the 12V or earth signal.

Fusebox "B"

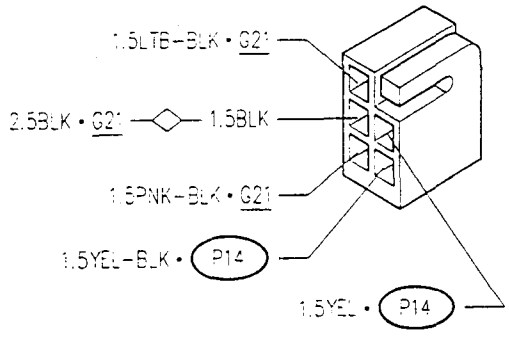
The power window control unit **N38** receives the key-operated supply at pin 2 of connector B via wander fuse **G311** and relay **I12**.
The key-operated consensur reaches at pin 1 of connector A via fuse **F17** still of **G1**.
The control signals respectively for raising and lowering the windo reach pins 4 and 3 of connector A leading from the control switch of the left-hand window **B53**.
This double switch sends an earth from the control unit from the part in which the contact has been closed (pin 1 = up; pin 2= down).
The operating signals (up or down) for the left-hand window motor **P15** leave from pins 3 and 4 of connector B of **N38** 12 V and earth are inverted to change the direction of rotation

Pin 1 of connector B of **N38** is connected to earth.

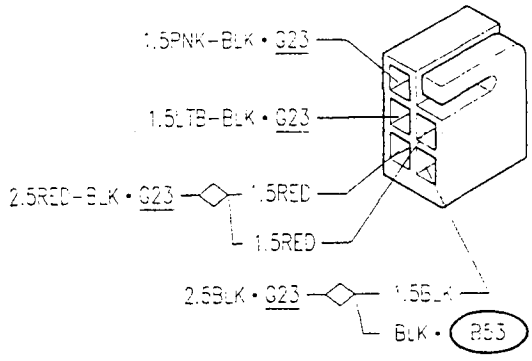
Operation of the right-hand window is controlled directly by one of the two switches **B21** (**B21a** located on the right-hand door, **B21b** on the left) which are connected in series
The "key-operated" supply leads through relay **I12**, energized through the line of fuse **F17** of **G1**, and wander fuse **G310**. The motor for the right-hand window **P14** is operated by one of the two switches **B21** in one direction or in the other depending on the origin of the 2V and earth signals.

COMPONENTS AND CONNECTORS

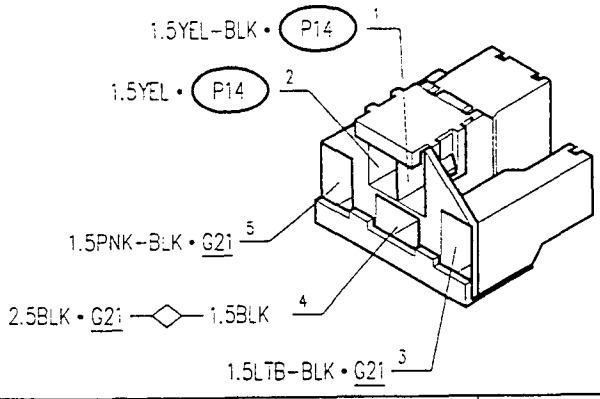
RH front power window control switch (on RH door) (*) — B21a



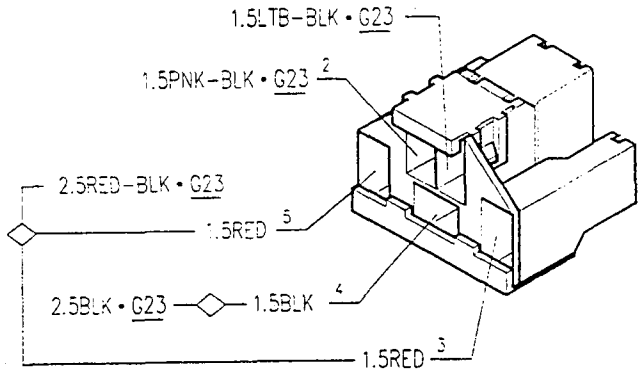
RH front power window control switch (on LH door) (*) — B21b



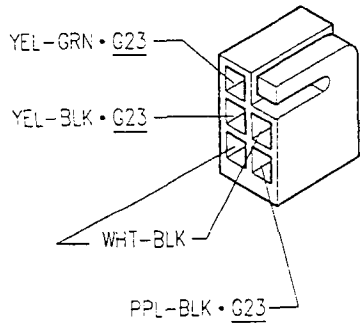
RH front power window control switch (on RH door) (•) — B21a



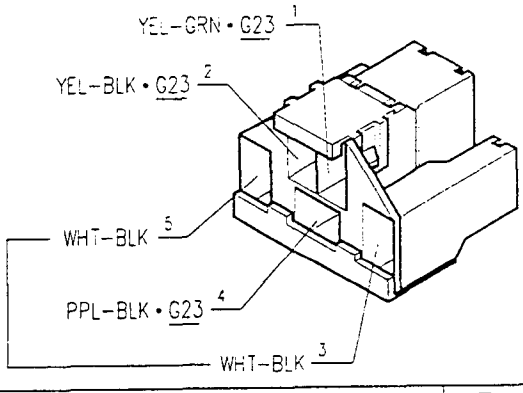
RH front power window control switch (on LH door) (•) — B21b



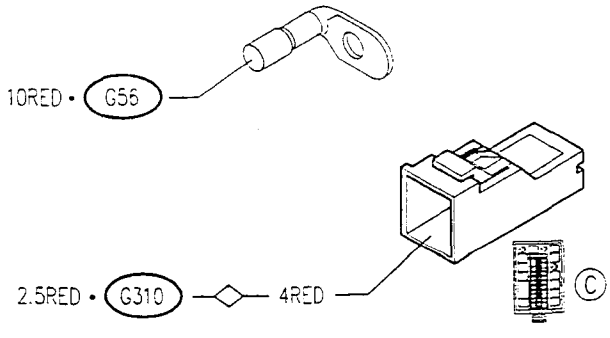
Front power window switch with automatic device (*) — B53



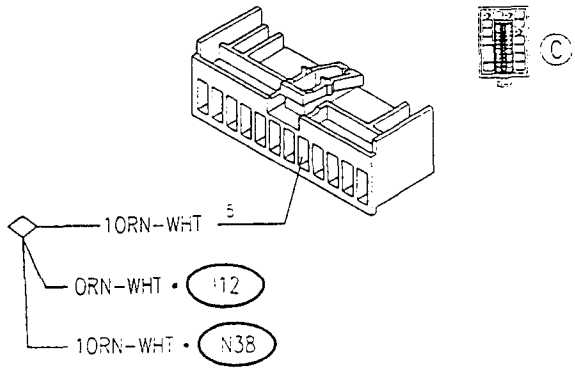
Front power window switch with automatic device (•) — B53



Fusebox — G1



Fusebox — G1 A

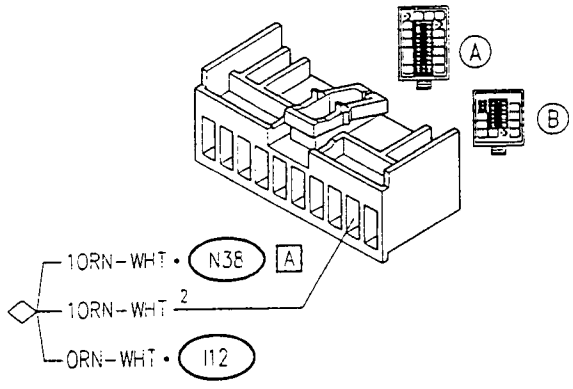


(*) up to chassis no....

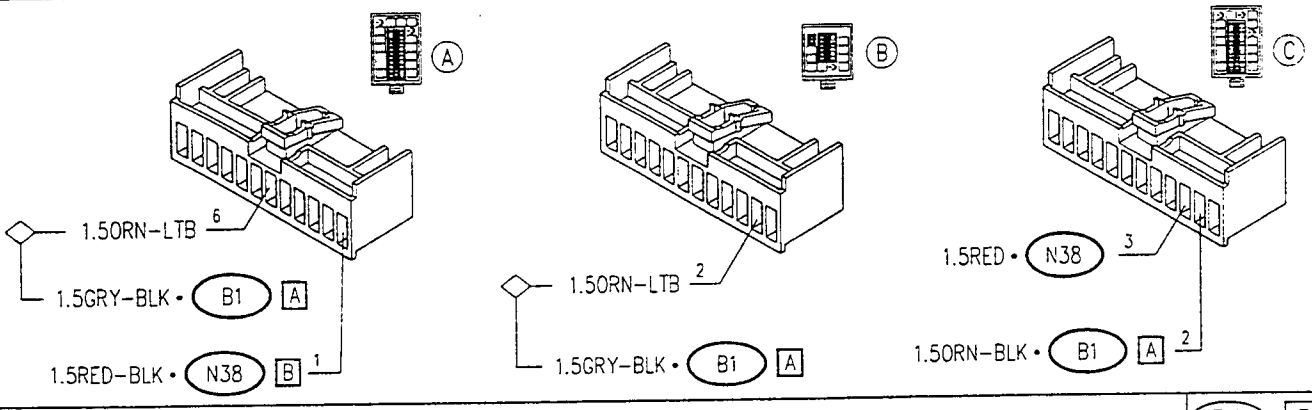
(•) from chassis no....

COMPONENTS AND CONNECTORS (cont.d)

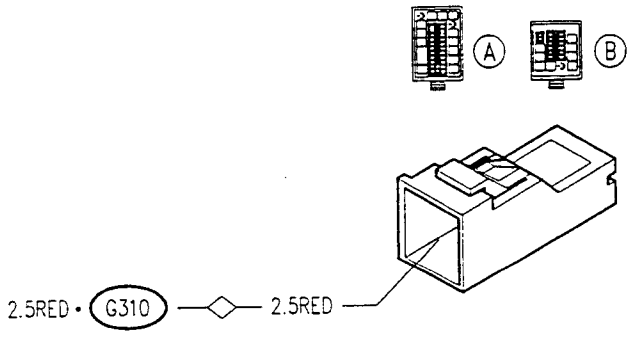
Fusebox — G1 G



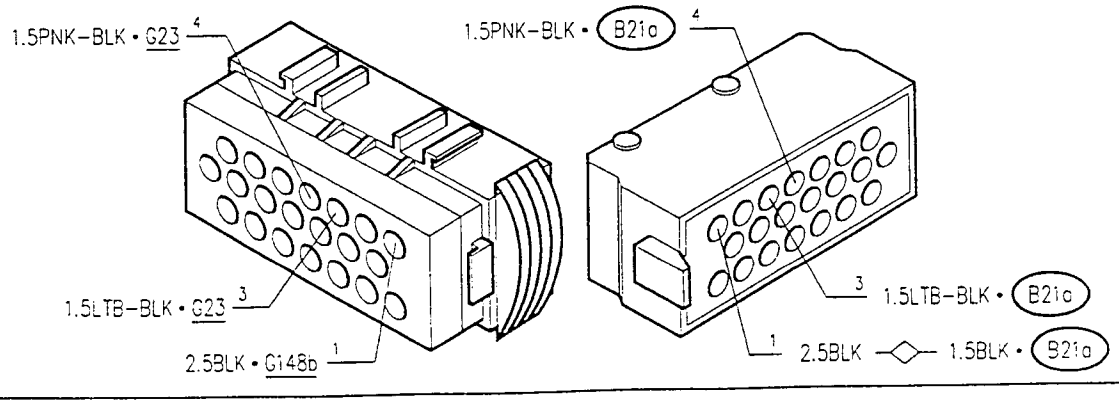
Fusebox — G1 H



Fusebox — G1 Q

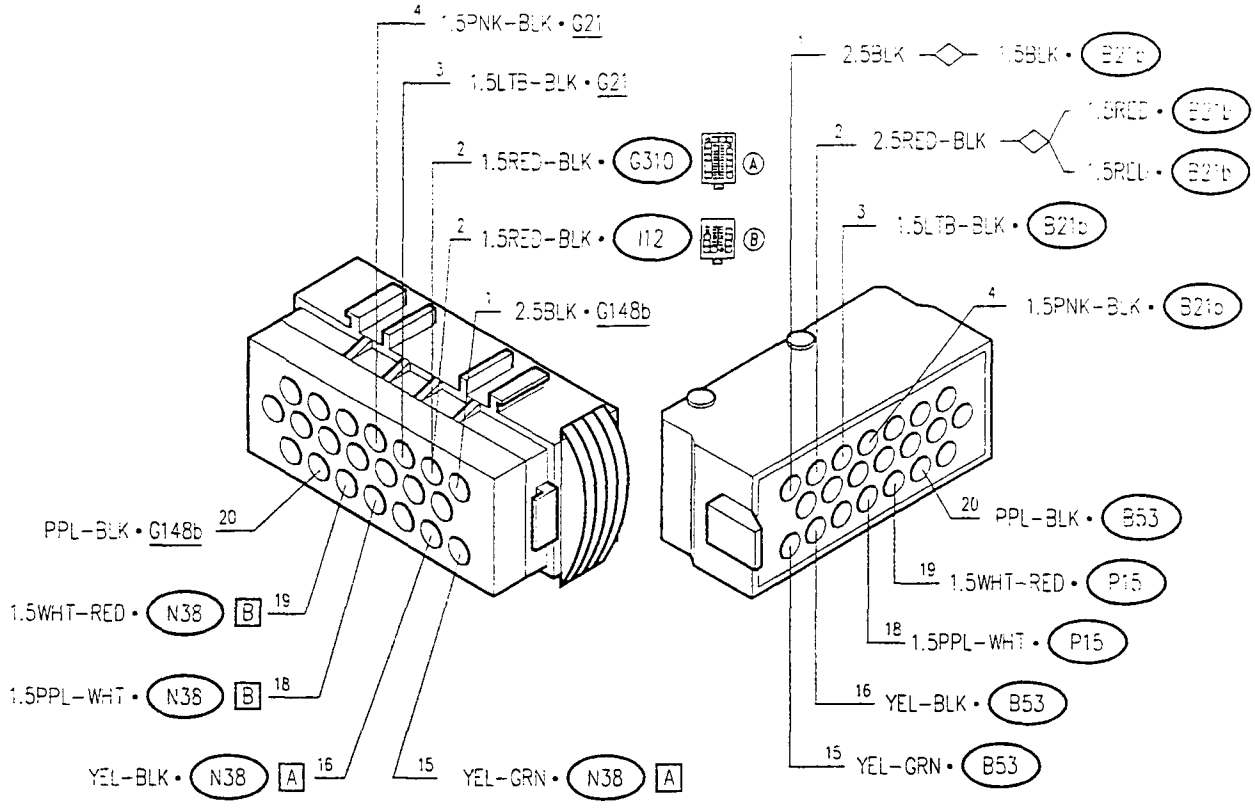


RH front door wiring connector — G21

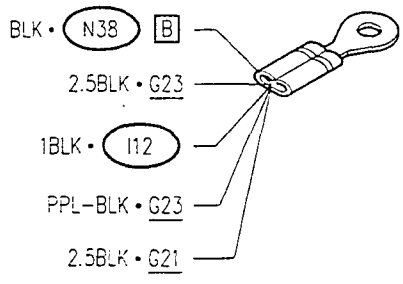


COMPONENTS AND CONNECTORS (cont.d)

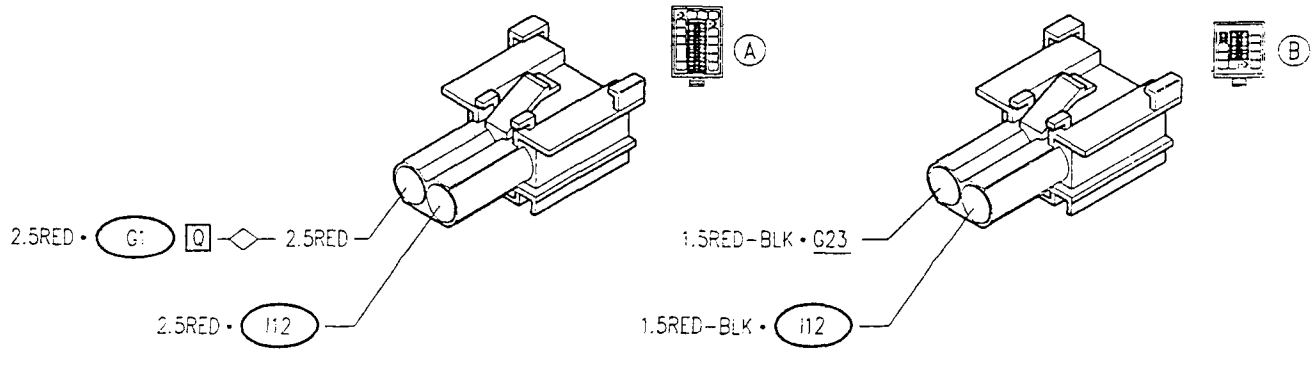
LH front door wiring connector	G23



Earth under LH dashboard	G148b

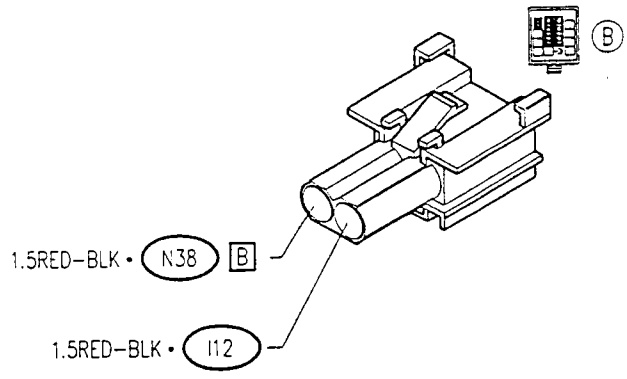


RH front power window fuse	G310

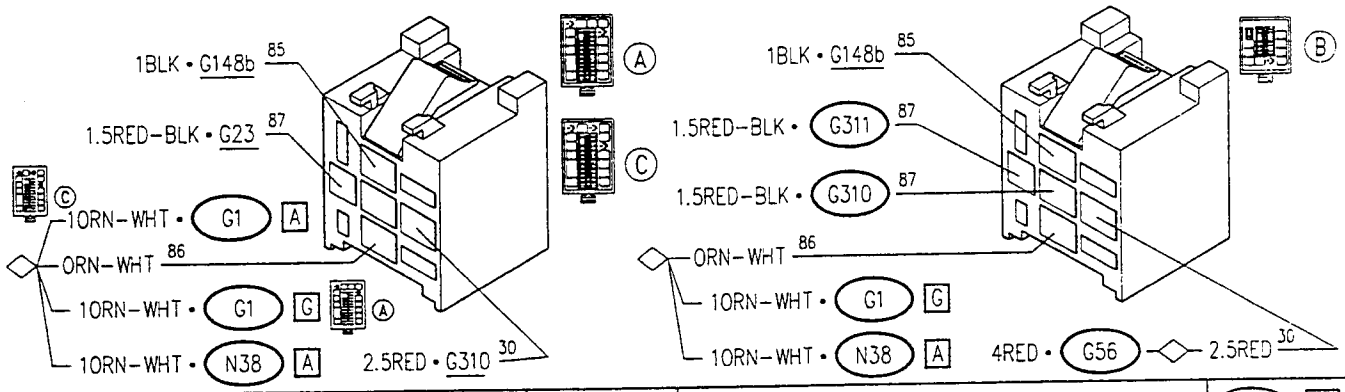


COMPONENTS AND CONNECTORS (cont.d)

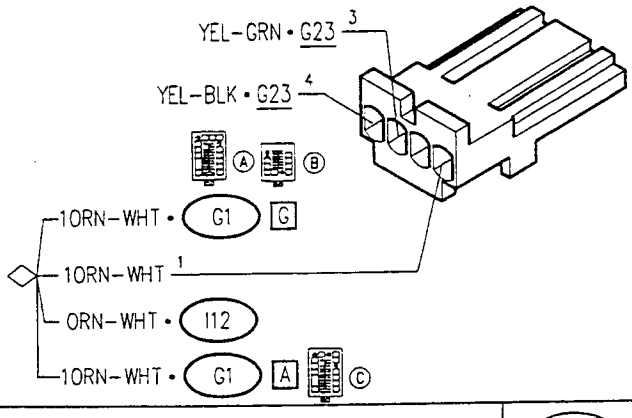
LH front power window fuse — G311



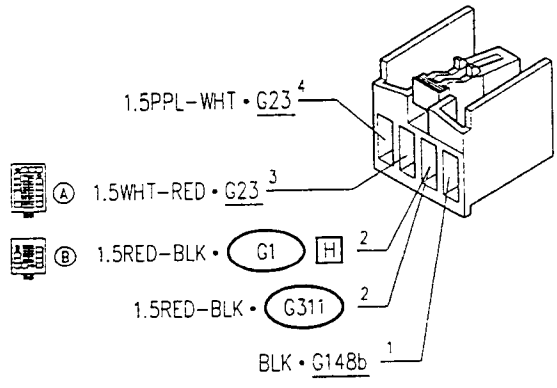
Front power window relay — I12



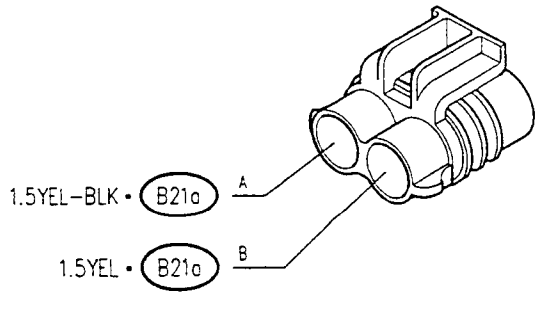
Power window control unit — N38 A



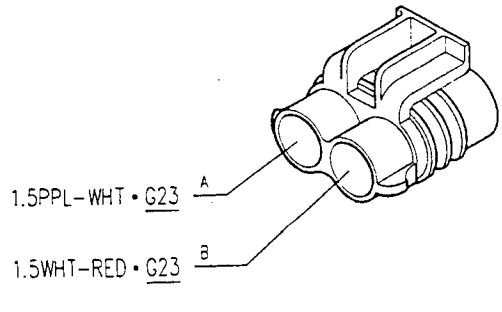
Power window control unit — N38 B



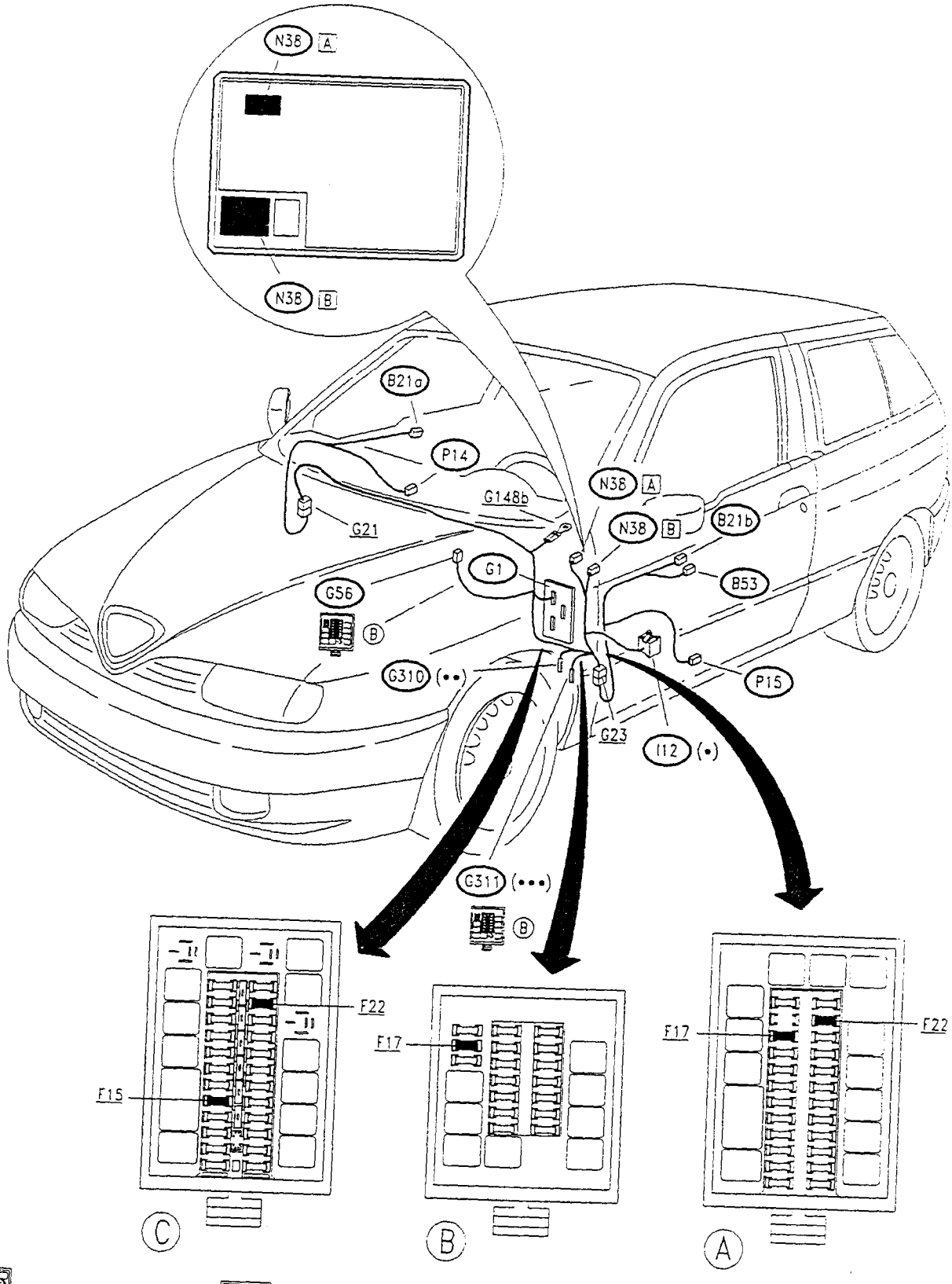
RH front power window motor — P14

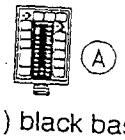


LH front power window motor — P15

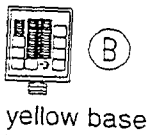


LOCATION OF COMPONENTS





(•) black base
(••) green fuseholder



(•) yellow base
(••) white fuseholder
(•••) white fuseholder

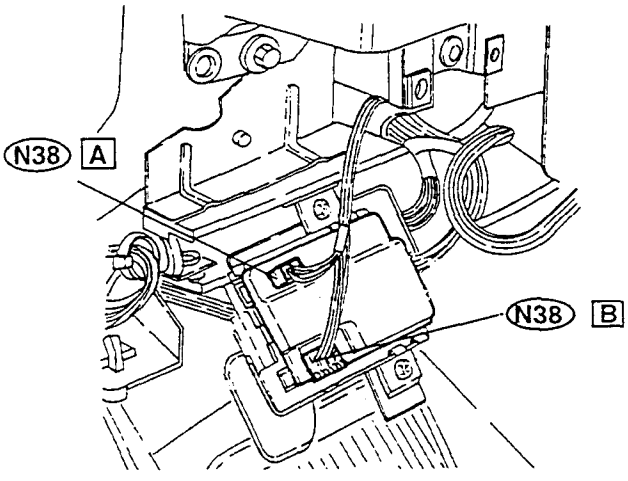
PA493000000008

FAULT-FINDING TABLE

Fault	Component to be checked									
	G310	F17	F22	P14	P15	N38	B21a	B21b	I12	B53
LH power window, under all circumstances		•		•	•				•	
LH power window		•	•			•				
RH power window	•	•		•			•		•	

CHECKING COMPONENTS

Power window control unit (N38)

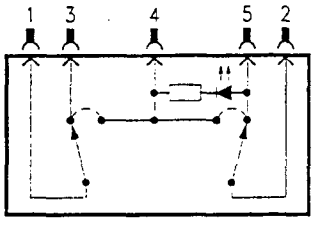


Checking the device:

test A (for fusebox "A")

test B (for fusebox "B")

Power window switches (B21a) (B21b) (B53)



SPECIFICATIONS
Checking operation: **at rest** : continuity between pin 3 and 1 and between pins 2 and 5, a.c. between the other pins operating up button: continuity between pins 4 and 1; a.c. between the other pins operation down button: continuity between pins 4 and 2; a.c. between the other pins

CHECK POWER WINDOW CONTROL UNIT (N38) (version for fusebox "A")	TEST A

Work with the component fitted on its connector, from the cable inlet side

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Check for 12V between pins 2 and 1 of connector B of **N38**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Check fuse **F22** of fusebox **G1**. Restore the wiring between **N38 B** and **G1** and between **N38 B** and earth **G148b**
A2 CHECK VOLTAGE – With the key turned to MARCIA, check for 12V between pin 1 of connector B and pin 1 of connector A of **N38**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Check fuse **F17** of **G1**. Restore the wiring between **N38 A** and **G1**
A3 CHECK MANUAL OPERATION – Operating the switch of the driver's side front window **B53,** check for 12V between pins 3 and 4 of connector B of **N38**; this voltage ceases as the action of the pushbutton ceases	OK ▶ ~~OK~~ ▶	Carry out **step A5** Carry out **step A4**
A4 CHECK MANUAL OPERATION – Operating switch **B53**, check for a voltage of 12V between pins 3 and 4 of connector A of **N38**	OK ▶ ~~OK~~ ▶	Change device **N38** Restore the wiring between **N38 A** and switch **B53**, or change the latter
A5 CHECK AUTOMATIC OPERATION – With the key turned to MARCIA, operating switch **B53** check for: • continuous 12V between pins 3 and 4 of connector B if the button is pressed for less then 300 ms • no voltage if the button is pressed for less than 50 ms • continuous 12V between pins 3 and 4 of connector B keeping the button pressed	OK ▶ ~~OK~~ ▶	DEVICE **N38** NOT WORKING PROPERLY. Check the connections with the other components Change device **N38**

CHECK POWER WINDOW CONTROL UNIT (N38) (version for fusebox "B")	TEST B

Work with the component fitted on its connector, working from the cable inlet side

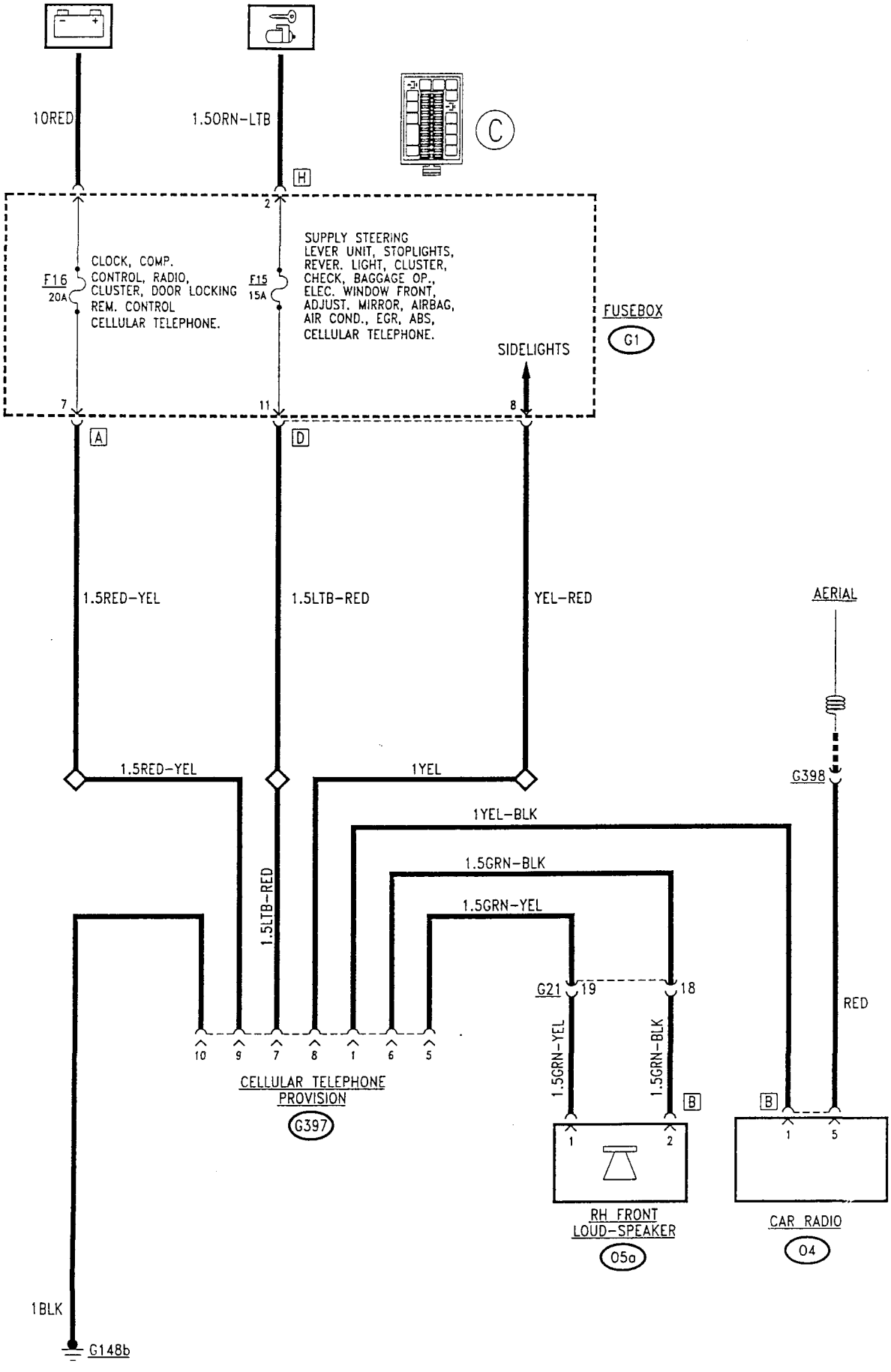
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK VOLTAGE – With the key turned to MARCIA, check for 12V between pins 2 and 1 of connector B of **N38**	OK ▶	Carry out **step B2**
	NO ▶	Check fuse **G311**. Restore the wiring between **N38** B and **G311** and between **N38** B and earth **G148b**
B2 CHECK VOLTAGE – With the key turned to MARCIA, check for 12V between pin 1 of connector B and pin 1 of connector A of **N38**	OK ▶	Carry out **step B3**
	NO ▶	Check fuse F17 of **G1**. Restore the wiring between **N38 A** and **G1**
B3 CHECK MANUAL OPERATION – Operating the front driver's side window switch **B53**, check for 12V between pins 3 and 4 of connector B of **N38**; this voltage ceases as the action on the button ceases	OK ▶	Carry out **step B5**
	NO ▶	Carry out **step B4**
B4 CHECK MANUAL OPERATION – Operating switch **B53**, check for 12V between pins 3 and 4 of connector A of **N38**	OK ▶	Change device **N38**
	NO ▶	Restore the wiring between **N38 A** and switch B53, or change the latter
B5 CHECK AUTOMATIC OPERATION – With the key turned to MARCIA, operating switch **B53** check for: • continuous 12V between pins 3 and 4 of connector B if the button is pressed for less than 300 ms • no voltage if the button is pressed for less than 50 ms • continuous 12V between pins 3 and 4 of connector B keeping the button pressed	OK ▶	DEVICE **N38** NOT WORKING PROPERLY. Check the connections with the other components
	NO ▶	Change the device **N38**

RADIO TELEPHONE PROVISION

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WIRING DIAGRAM



GENERAL DESCRIPTION

On request, the car can be fitted with a provision for installing a cellular telephone.

This provision comprises:

- a "dual purpose" aerial (the same as for the radio) with a specific connection cable;
- voice function speaker on the passenger's door. This is the same speaker as for the radio with two connections: one for the radio and one for the cell phone "voice" feature;
- supply connection, for charging the cell phone; this is located next to the radio and also acts as a support for the telephone.

The connection for the phone has two supplies; one is direct and one is key-operated; there is also a supply when the side lights are on, for lighting the phone, if fitted.

FUNCTIONAL DESCRIPTION

The provision connection **G397** receives the direct supply (pin 9) from the battery through the line of fuse **F16** of fusebox **G1**.

It receives the "key-operated" supply (pin 7) through the line of fuse **F15** of fusebox **G1**- When the side lights are on the supply reaches pin 8 through the line leading from the steering column lever unit (see "Sidelights").

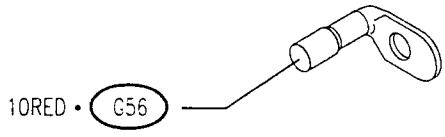
Pin 10 of the provision connection **G397** is earthed, while pins 5 and 6 supply the signal to the speaker **O5a**, connector B, while connector A is the one for the radio (see "Radio").

Pin 1 is connected to the radio **O4** to which it sends the "MUTE" signal when the telephone is in use.

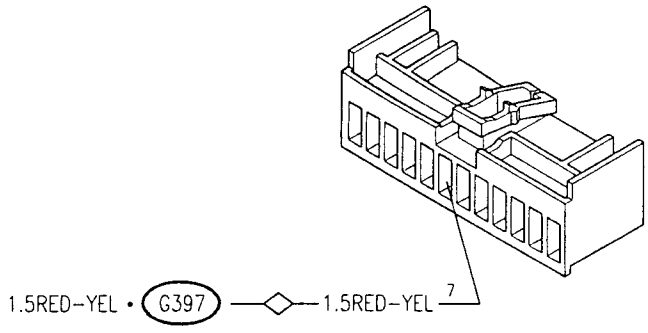
A supply is also sent from the radio to the amplifier at the base of the aerial, through connector **G398**.

COMPONENTS AND CONNECTORS

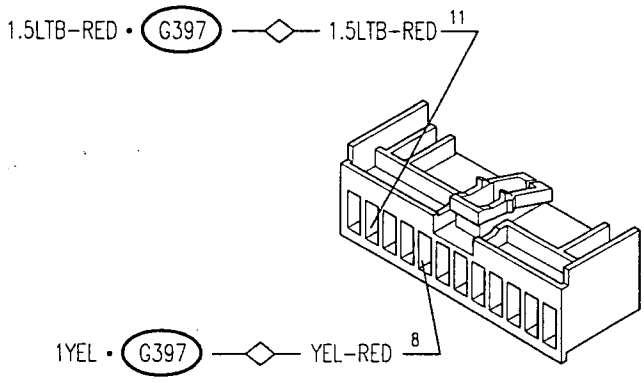
Fusebox	G1



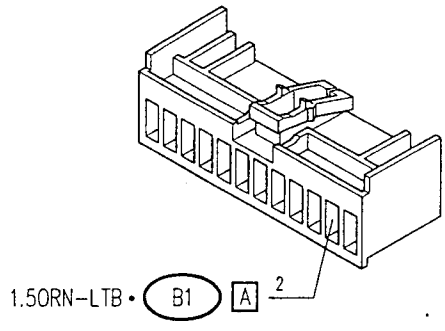
Fusebox	G1 A



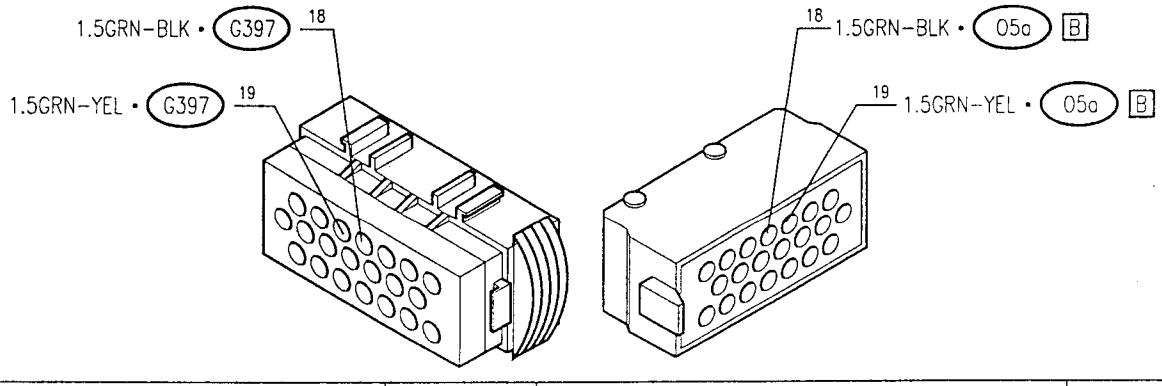
Fusebox	G1 D



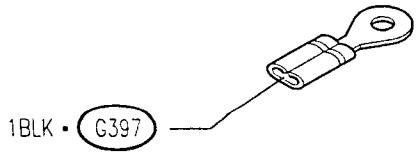
Fusebox	G1 H



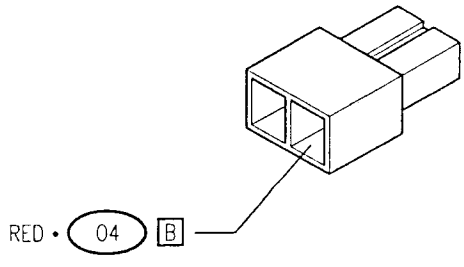
RH front door wiring connector	G21



LH earth under dashboard	G148b

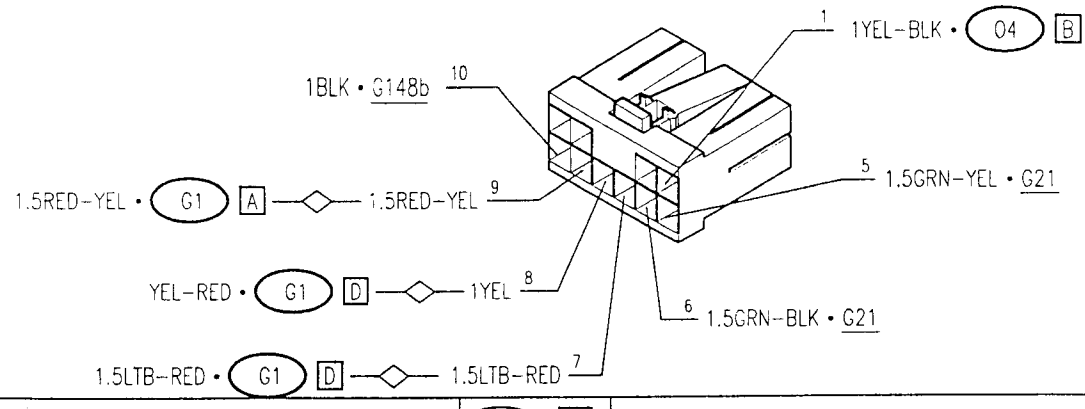


Aerial supply connection	G398

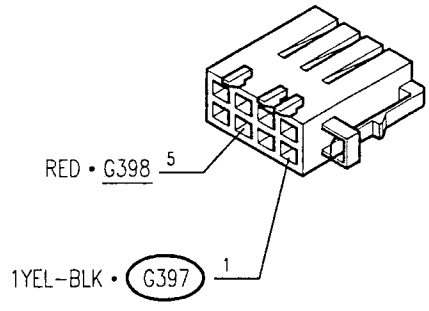


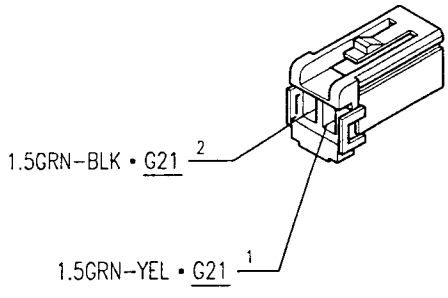
COMPONENTS AND CONNECTORS (continued)

Cellular phone provision	G397

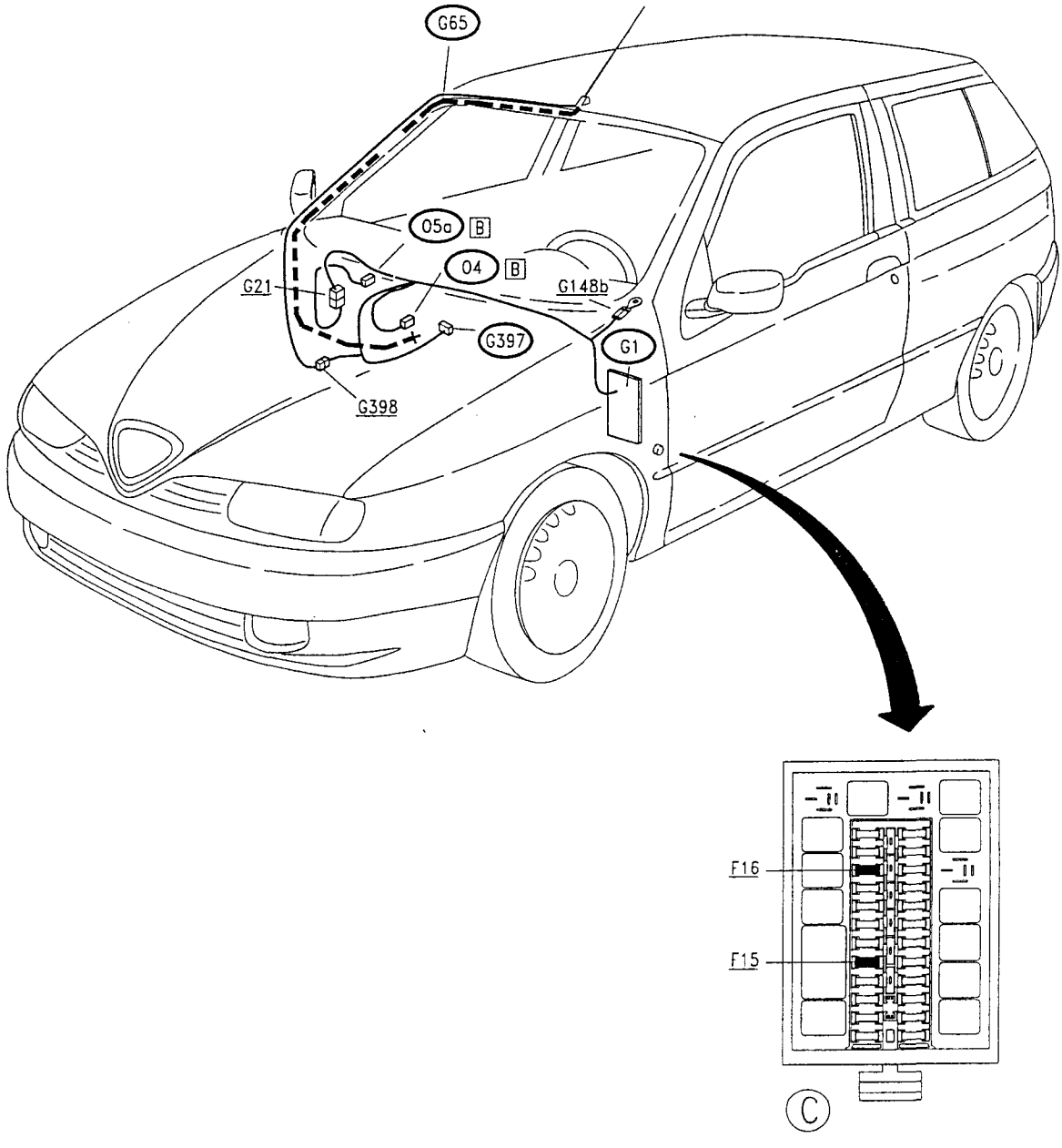


Radio	O4 B	RH front speaker	O5a B





LOCATION OF COMPONENTS

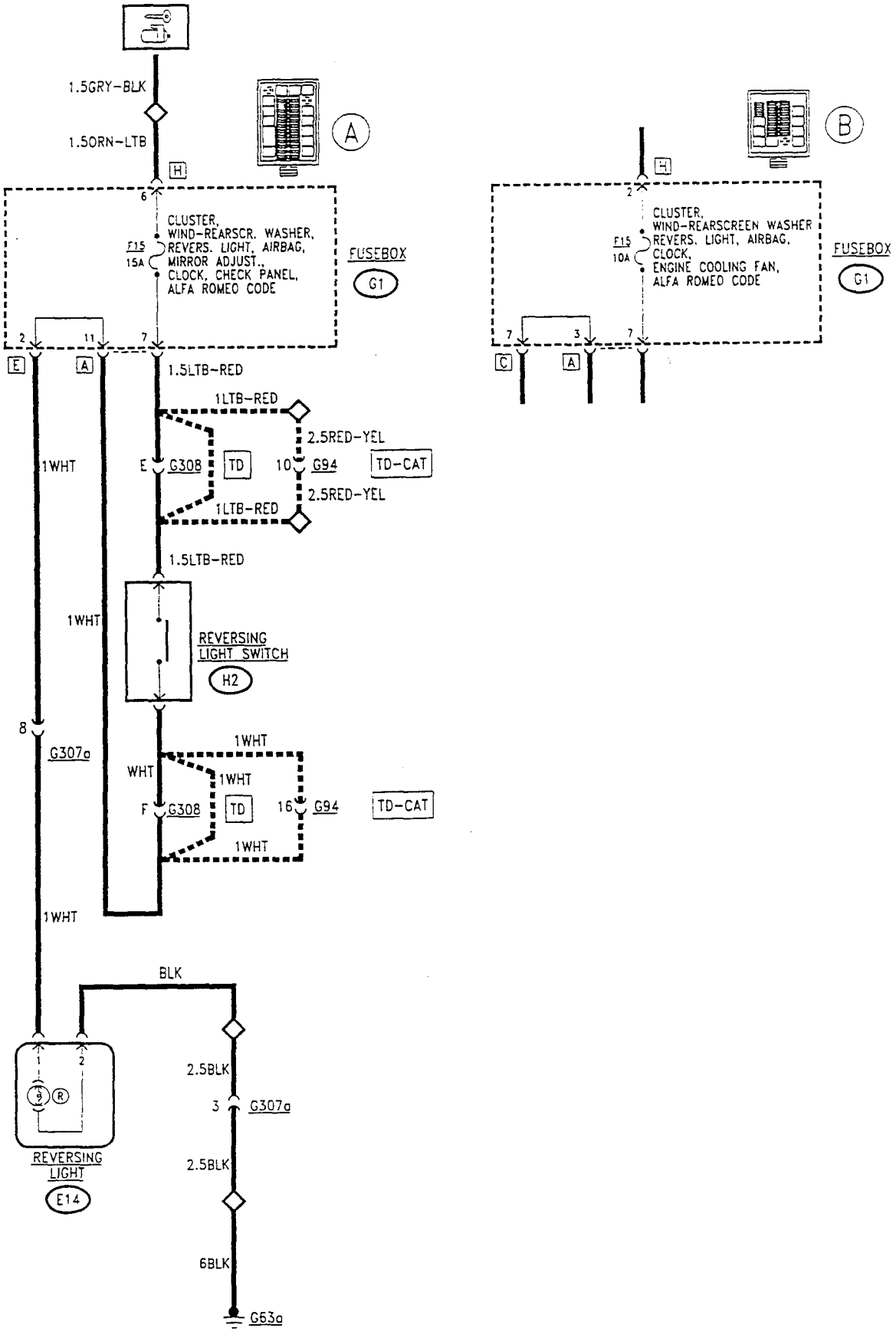


REVERSING LIGHTS

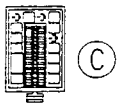
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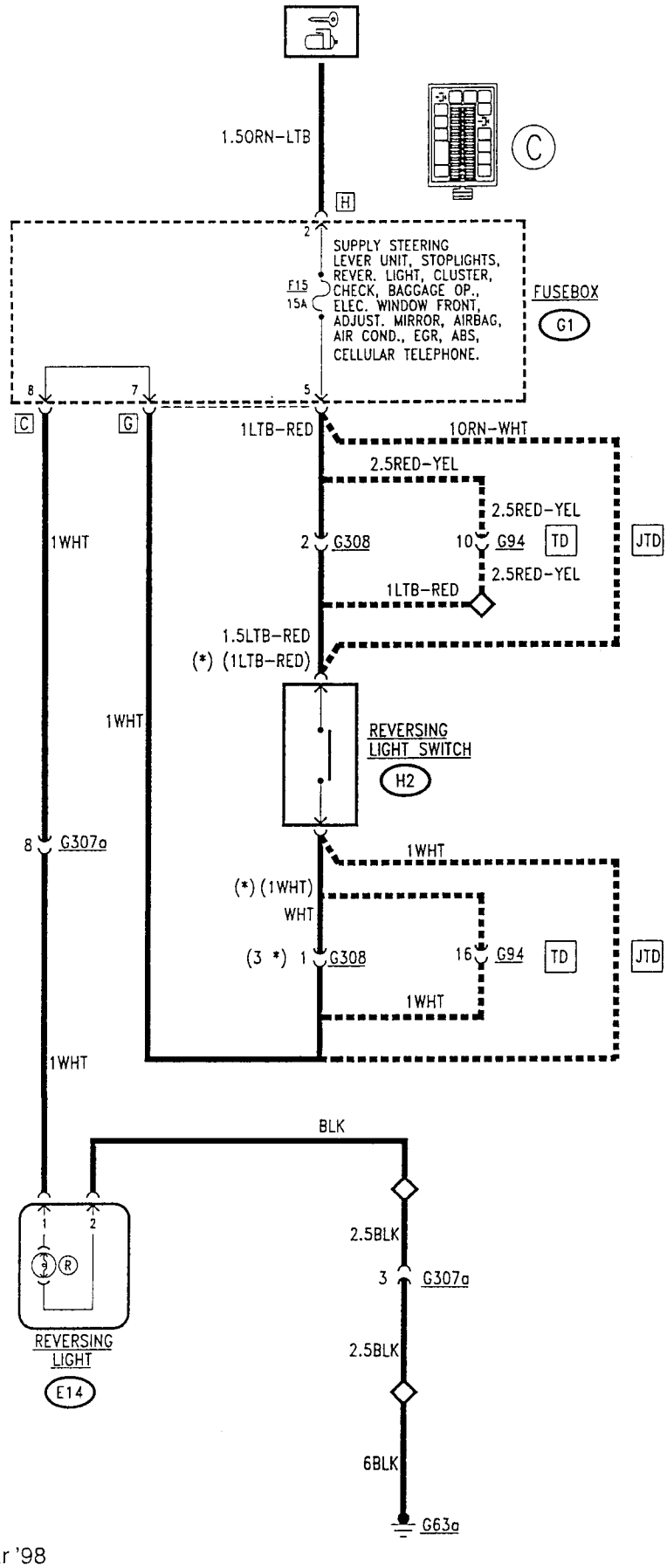
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LOCATION OF COMPONENTS 14-6

WIRING DIAGRAM



WIRING DIAGRAM





(*) From Model Year '98

GENERAL DESCRIPTION

The car is fitted with a reversing light located in the rear light on the righthand side of the tailgate.

When reverse gear is selected, the light is turned on automatically by a switch to be found on the gearbox.

The circuit is protected by a special fuse.

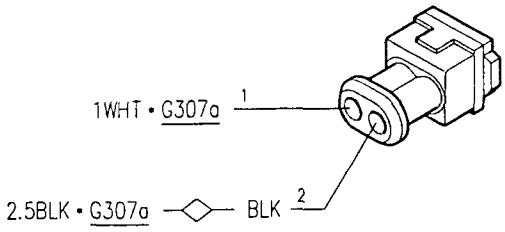
The reversing light is operated when the ignition key is engaged and it is independent of the other lights on the vehicle.

FUNCTIONAL DESCRIPTION

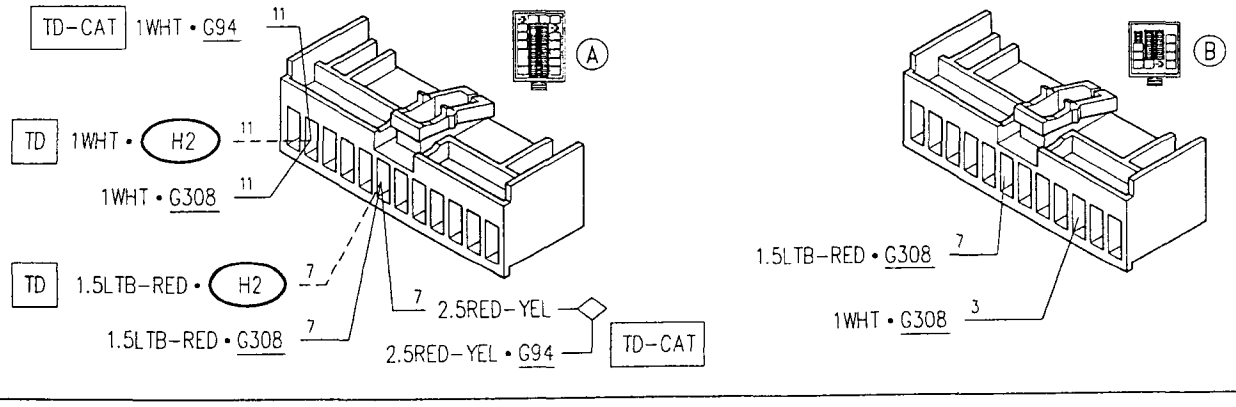
The reversing light circuit is supplied from the ignition switch through fuse **F15** of fusebox **G1**.
When reverse gear is engaged switch **H2** supplies the reversing light **E14.**

COMPONENTS AND CONNECTORS

Reversing light bulb — E14

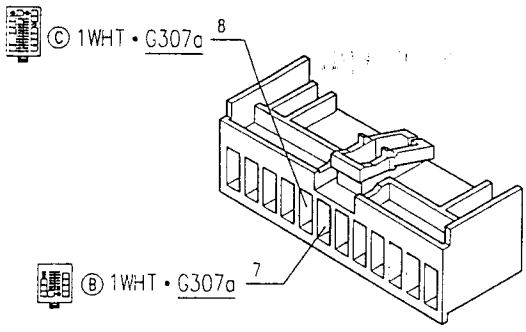


Fusebox — G1 A

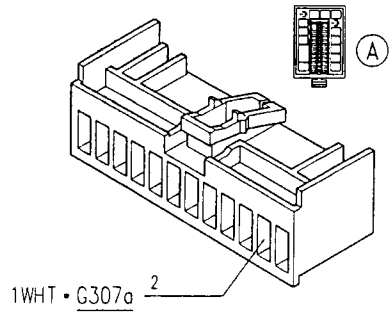


COMPONENTS AND CONNECTORS (cont.d)

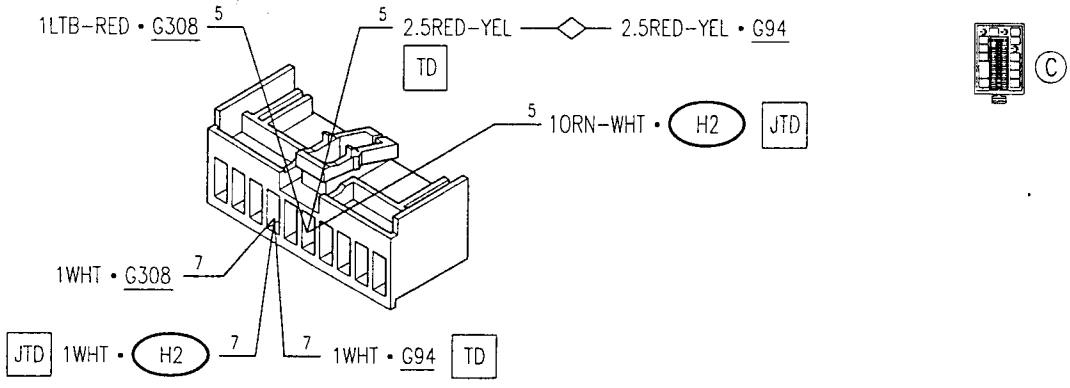
Fusebox	G1 C



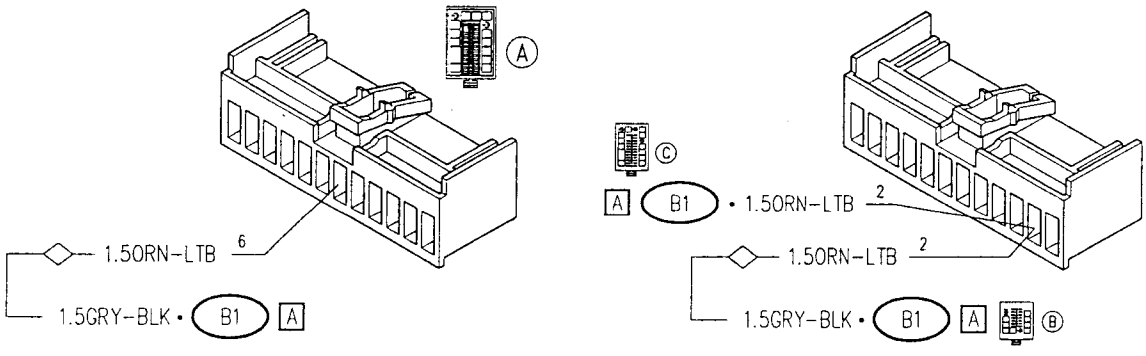
Fusebox	G1 E



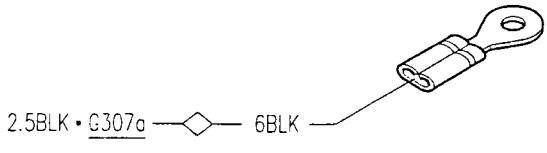
Fusebox	G1 G



Fusebox	G1 H



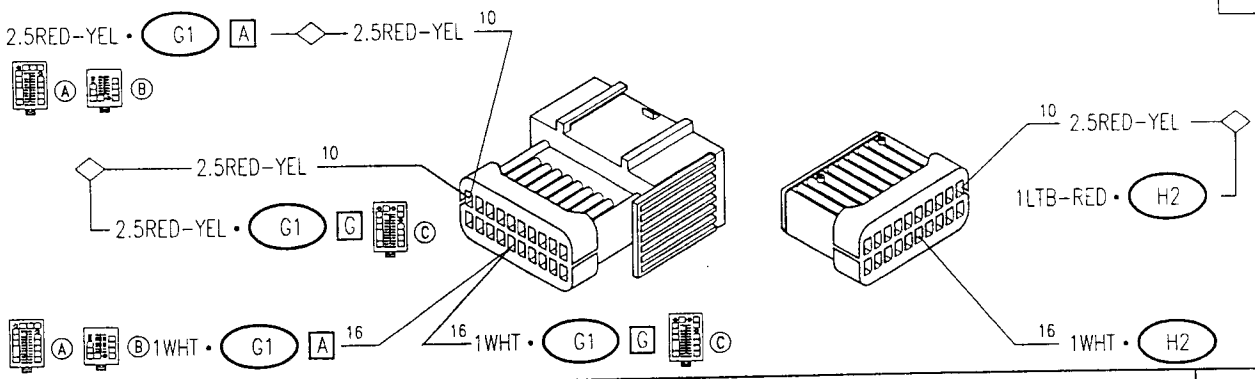
RH rear earth	G63a



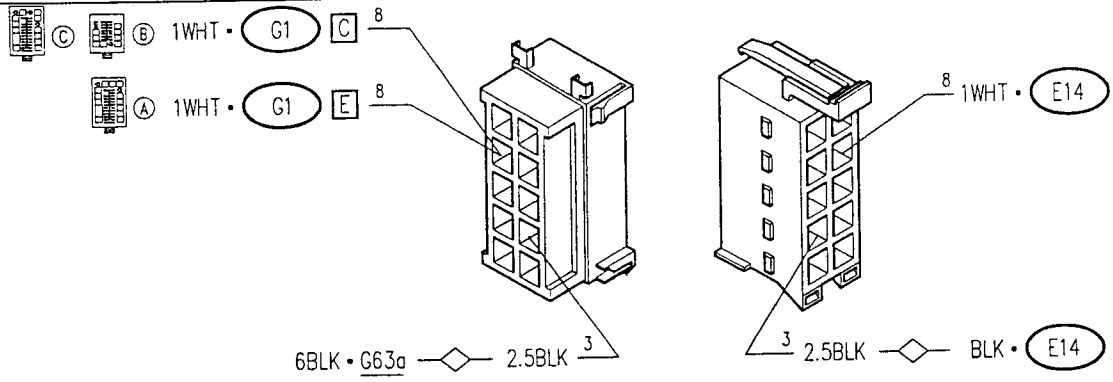
COMPONENTS AND CONNECTORS (cont.d)

Engine compartment connection — G94

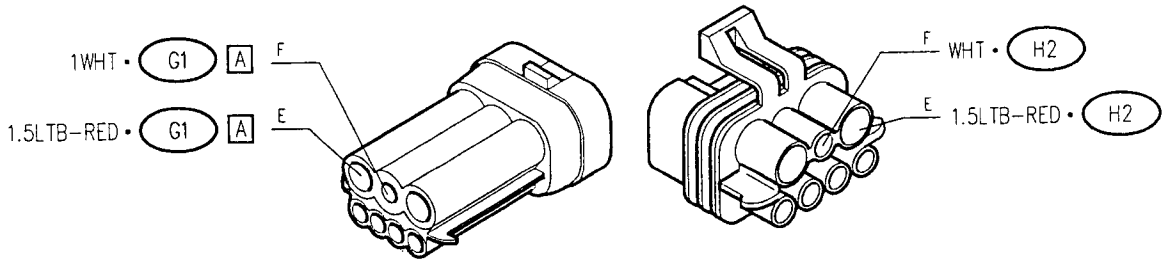
TD-CAT



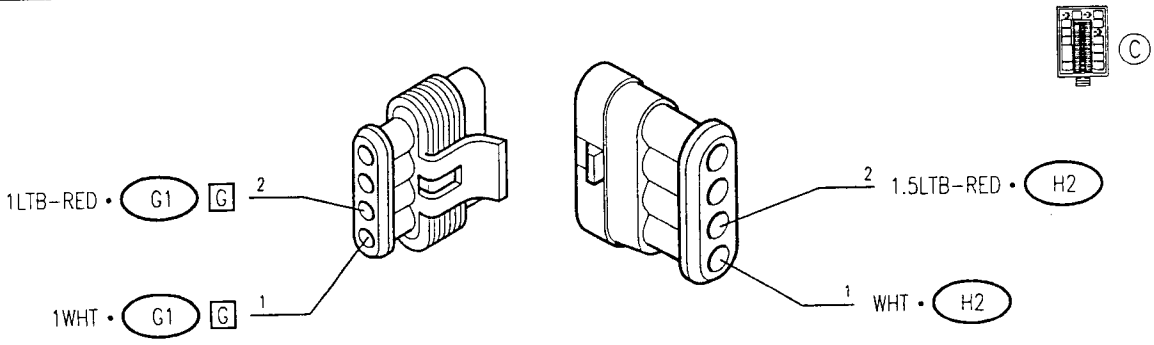
Rear/luggage compartment wiring connector A — G307a



Engine sensors connector (*) — G308

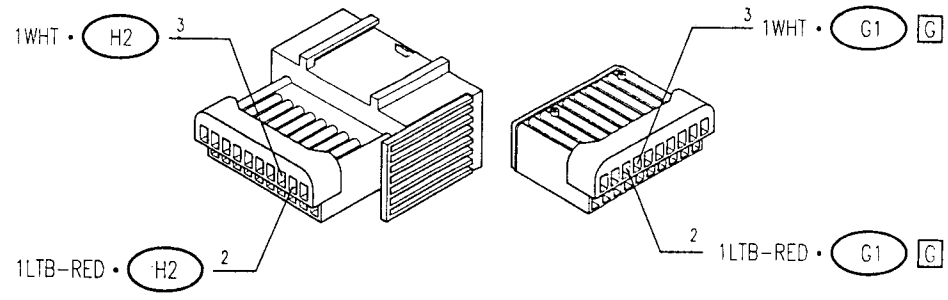


Engine sensors connector (•) — G308

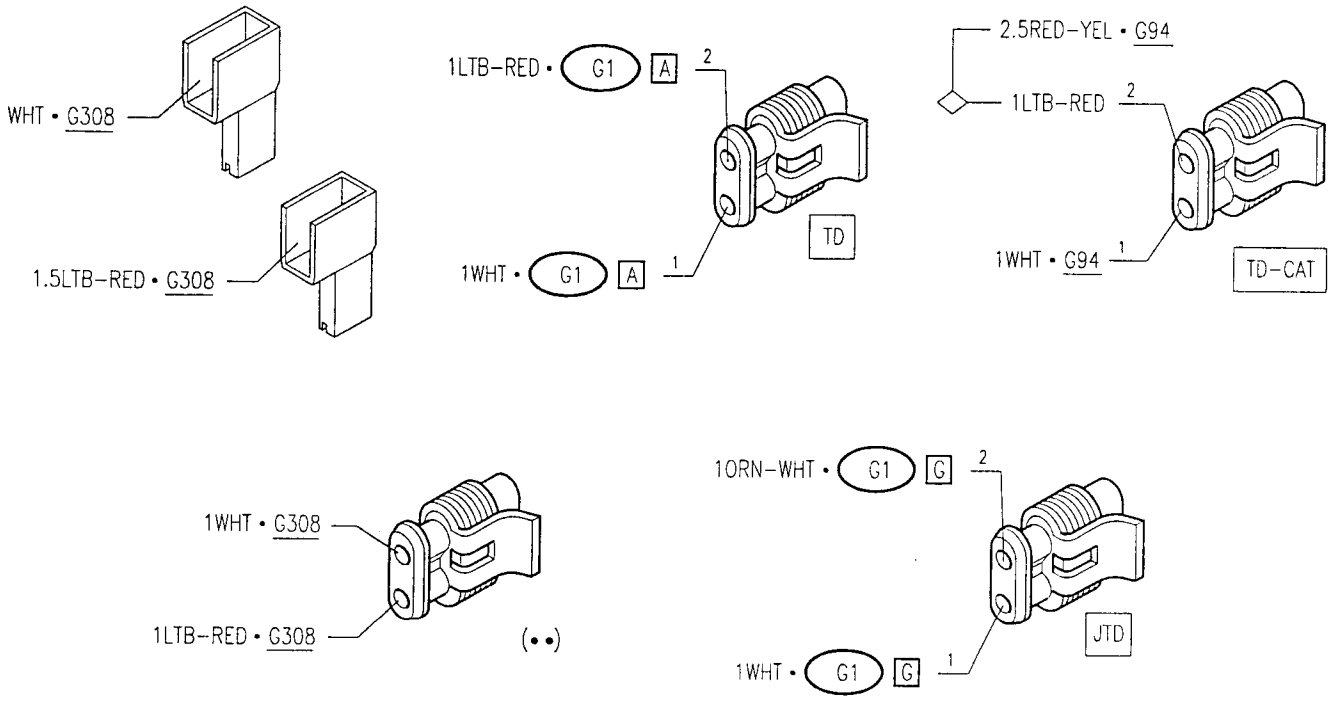


COMPONENTS AND CONNECTORS (cont.d)

Engine sensors connector (••)	G308



Reversing light switch	H2

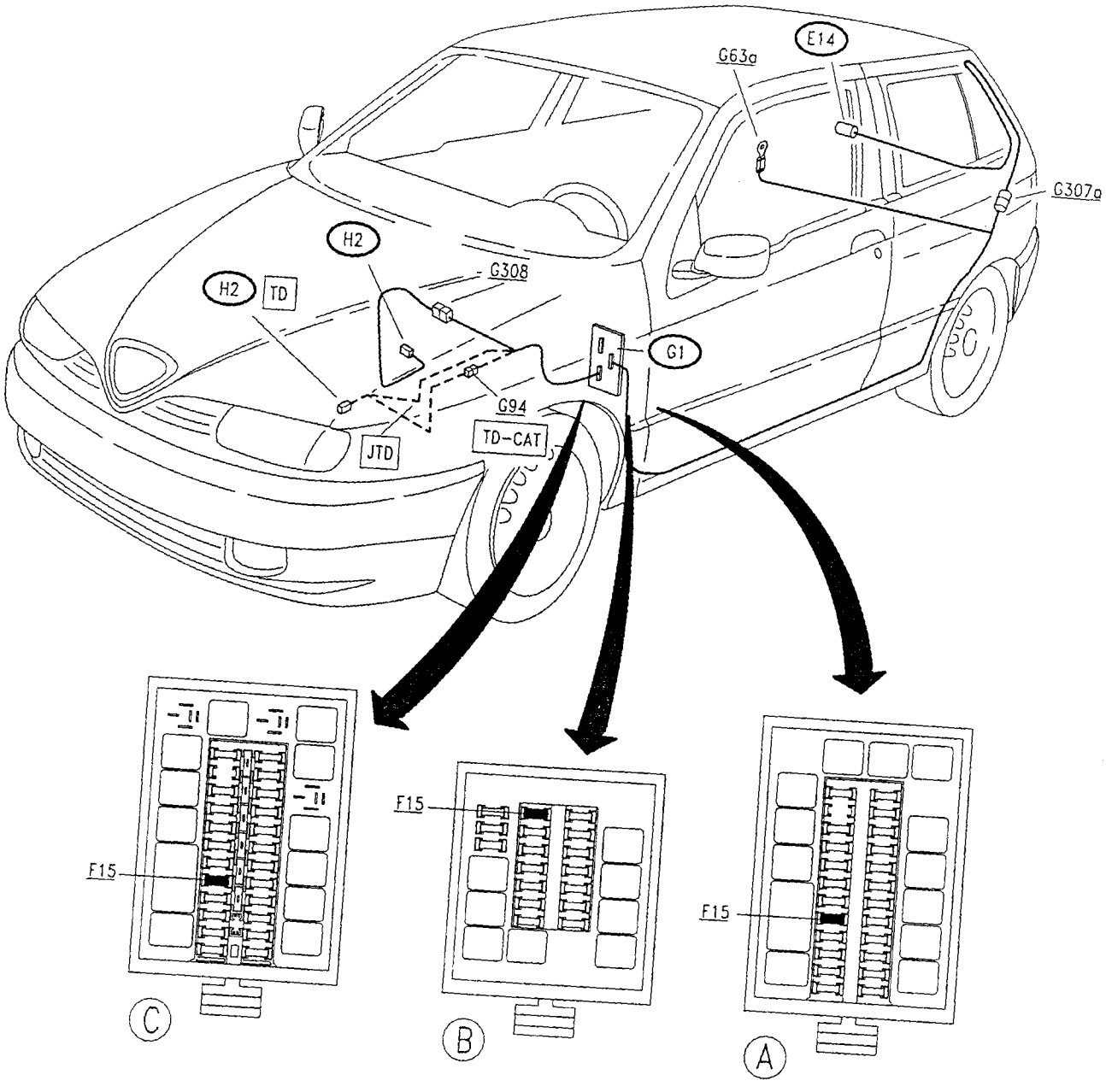


(••) from Model Year '98

FAULTFINDING TABLE

Failure	Component to be checked		
	F15	E14	H2
Reversing light	•	•	•

LOCATION OF COMPONENTS



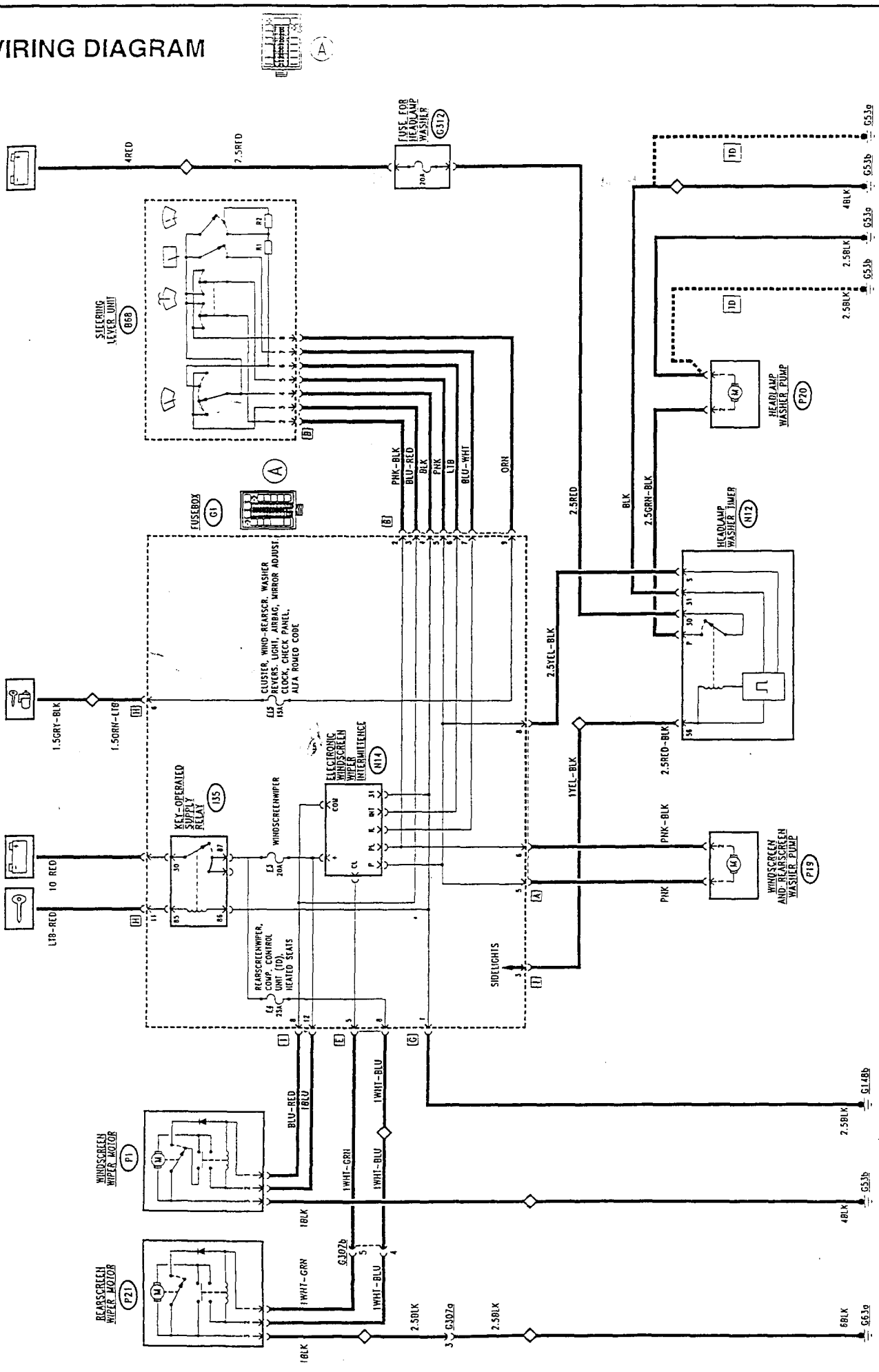
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WINDSCREEN WIPER/WASHER - REARSCREEN WIPER/WASHER - HEADLAMP WASHER

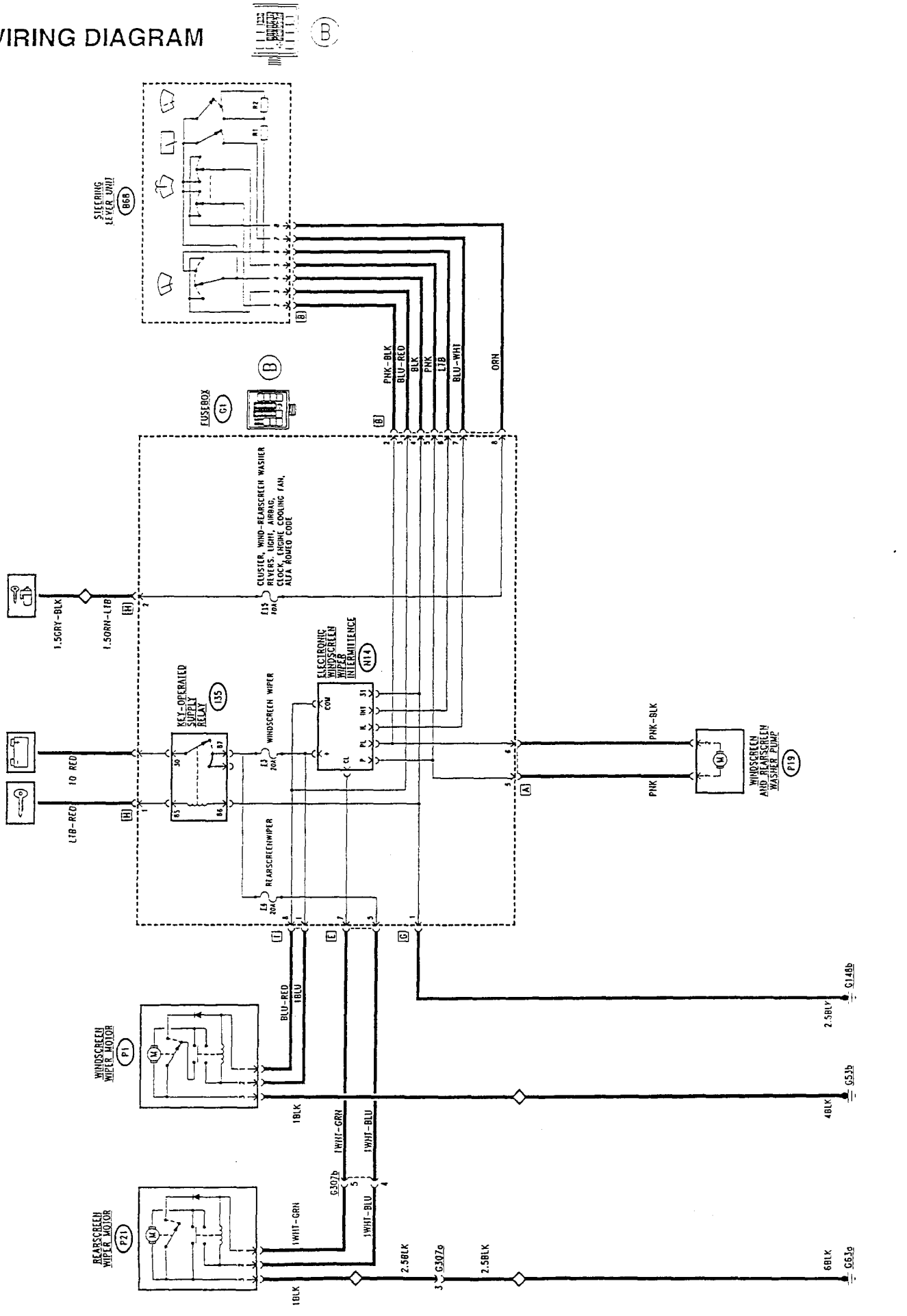
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CHECKING COMPONENTS 16-10

WIRING DIAGRAM

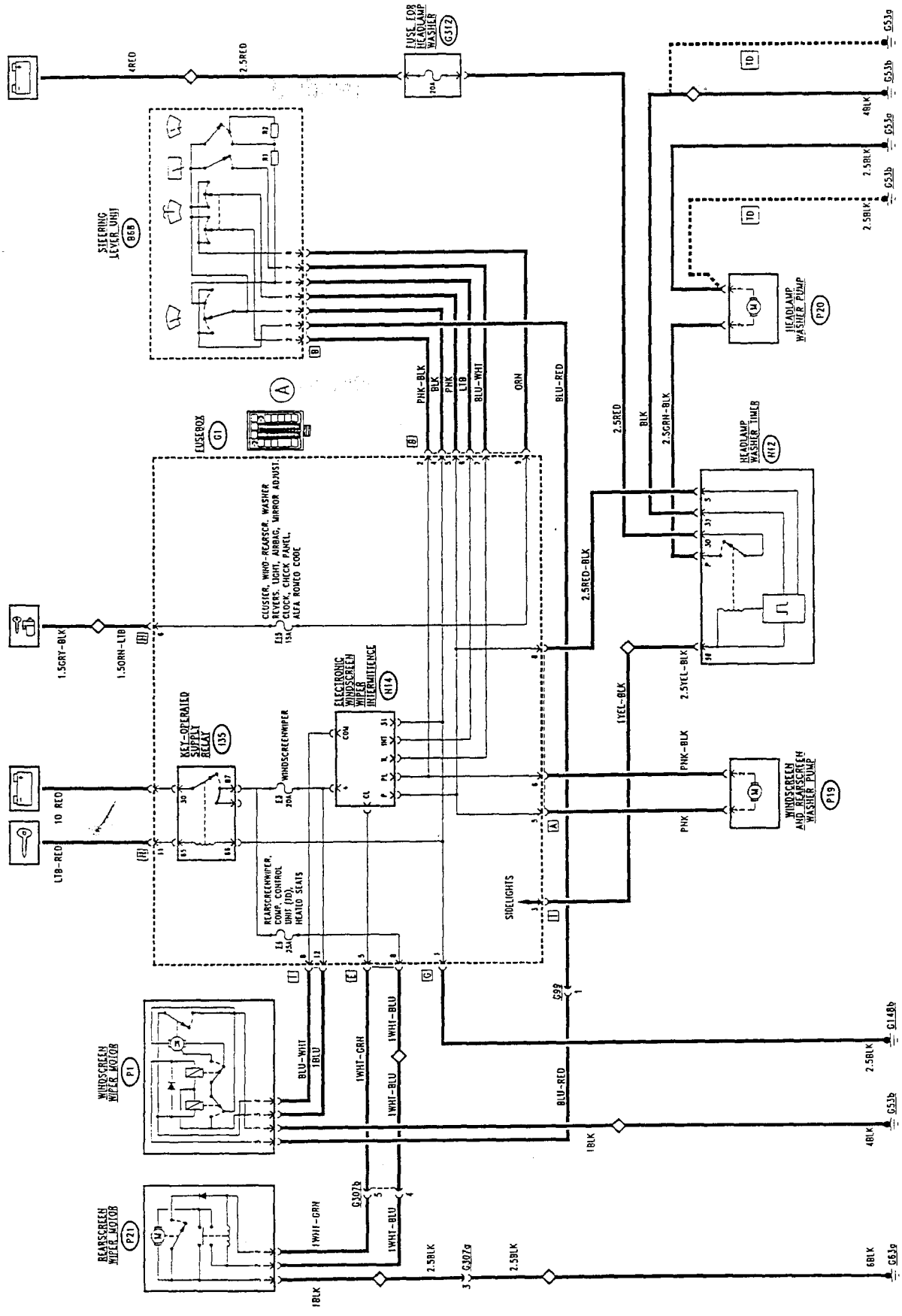


WIRING DIAGRAM

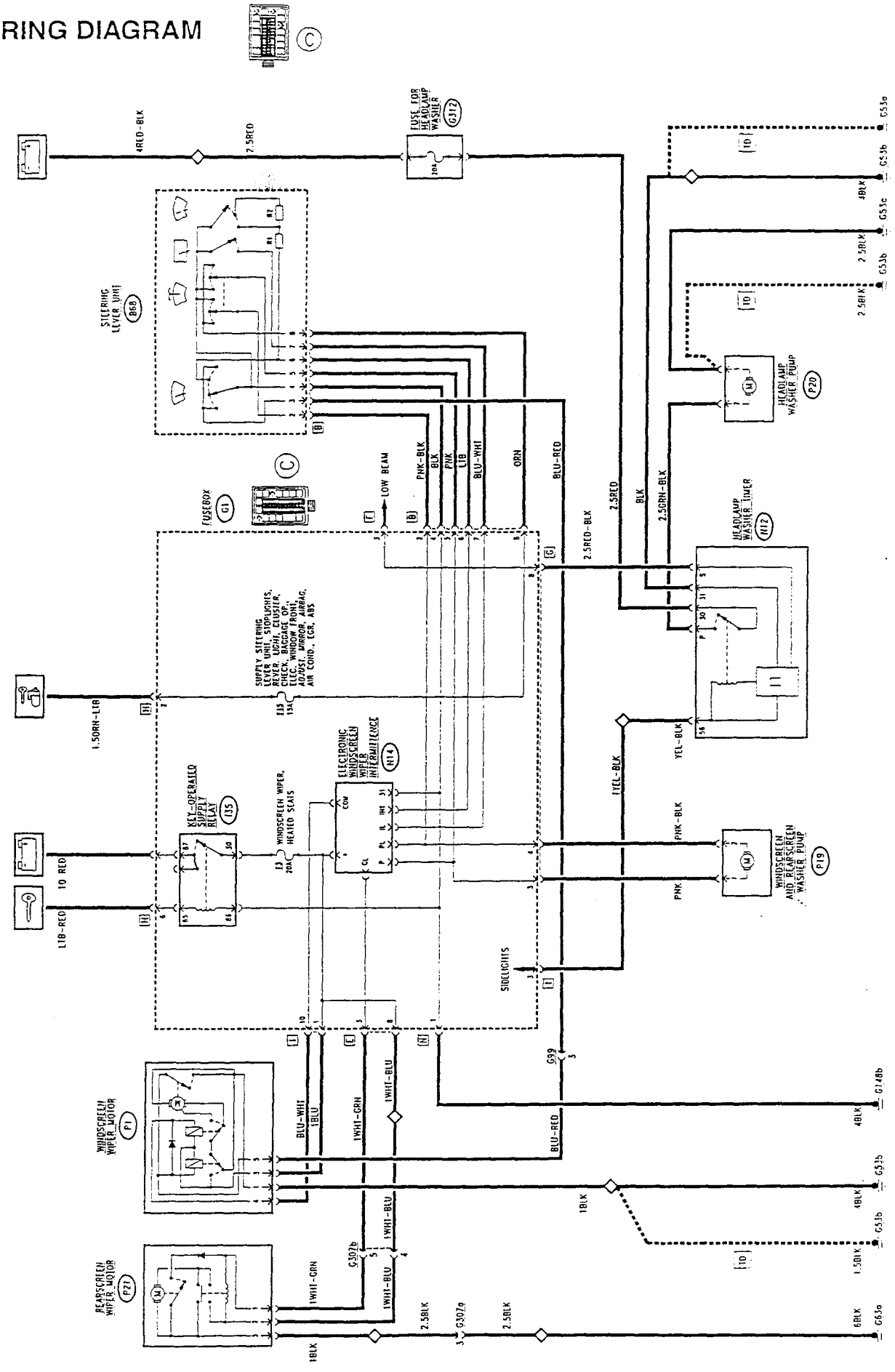


WIRING DIAGRAM

- Model Year '97



WIRING DIAGRAM



GENERAL DESCRIPTION

With the lever on the righthand side of the steering wheel it is possible to engage the different functions of the windscreen washer/wiper, rearscreen washer/wiper and headlamp washer system.
The windscreen wiper device can work continuously and intermittently at different speeds: moving the lever upwards and holding it in this position will select continuous operation (75 passes per min.) which is turned off when the lever is released; if the lever is pushed downwards firstly intermittent operation is engaged and then continuous operation: these functions stay on until the lever is moved upwards again.
With the lever in the rest position, through the special ring switch it is possible to select the different lengths of the intermittent functions (appr. 45, 25 and 11 passes per min.).

From Model Year '97 the device is changed to obtain a second continuous speed of 61 strokes/min and two intermittent speeds (27 and 11 strokes/min). The rearscreen wiper function (intermittent at 15 strokes) is turned on turning the special ring.

The windscreen washer is engaged slightly pulling the lever towards the steering wheel; the rearscreen washer by pushing it towards the dashboard: this way the windscreen/rearscreen washer pump is operated for appr. 4 seconds or until the lever is released.
When the side lights are on, the same windscreen washer controls also operate the headlamp washer: this is an electropneumatic device in which a pump sends the detergent fluid to a double nozzle that sprays a powerful jet onto the headlamp.
A timer operates the headlamp washer pump with successive impulses which last for about half a second.

NOTE: Operating the windscreen/rearscreen washer (and headlamp washer) without detergent fluid in the reservoir can damage the pump.

The entire system is regulated by a windscreen wiper intermittency device located in the fusebox, which controls the windscreen and rearscreen wiper motors, the windscreen and rearscreen washer pump and the headlamp washer device (timer and pump).
The windscreen wiper and washer and rearscreen wiper/washer can be operated with the ignition key engaged and, as mentioned previously, the headlamp washer can only work with the side lights on (chassis no.__ the dipped beam lights).

FUNCTIONAL DESCRIPTION

Windscreen wiper
The windscreen wiper intermittence device **N14**, located in fusebox **G1**, is supplied via the key-operated relay **I35** (pin +) and fuse **F3** also in **G1**.
When the windscreen wiper switch of the lever unit **B68** is operated, it sends two different signals depending on the function selected; from pin 3 for continuous speed and from pin 6 for intermittent operation.
The signal from pin 3 (continuous speed) passes directly to the wiper motor **P1** as a command signal: motor **P1** is connected to earth and supplied with the same line as the intermittent device **N14**. It comprises the the actual gear motor, stroke limit contacts (for automatic parking of the blades) and the supply relay switch.
The signal from pin 6 (intermittent speed) of **B68** reaches the intermittent device **N14** (pin INT) from where it is then sent to the motor **P1** (pin COM).
Turning the switch (ring) of the lever unit **B68** either no, or one (R1), or two (R2) resistances are connected on the same line, thereby obtaining three intermittent speeds.

Rearscreen wiper
Operating the rearscreen wiper ring switch the signal is sent from pin 7 of **B68** to **N14** (pin IL). The intermittent device sends a command (from pin CL to the rearscreen wiper motor **P21** which is supplied from the ignition switch key-operated supply through fuse **F4** of **G1** ("A" and "B") or from fuse **F3** of **G1** "C".
This motor comprises the gear motor, stroke limit contacts and the supply relay switch.

Windscreen/rearscreen washer
When operated, the windscreen washer (and headlamp washer) switch of the lever unit **B68** sends two signals from pin 2 and from pin 5 which reach the intermittent device **N14** (pin PL and P) for operating the windscreen washer for 4 sec., and they operate the windscreen washer pump **P19**; a command signal is also sent to the headlamp washer timer **N12**.

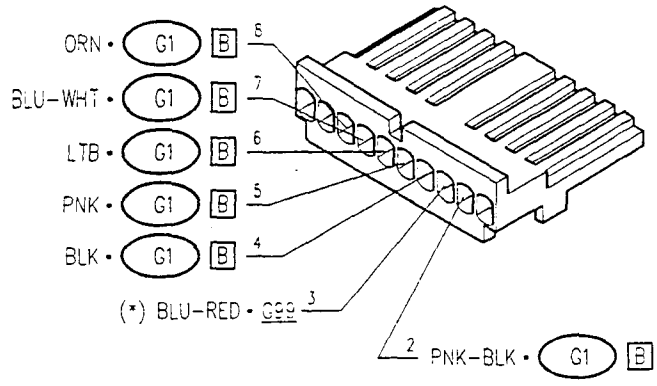
Pump **P19** is two-way: it sends water to the spray jets of the windscreen washer or rearscreen washer depending on the terminal supplied with 12V while the other is connected to earth.

Headlight washer
The timer **N12**, located on the bracket outside the fusebox **G1**, is supplied directly by the battery through fuse **G312** (20A).
When the consensus signal resulting from the side lights being on reaches the relay in addition to the lever unit switch command, the relay switch inside **N12** is energized which supplies the headlamp washer pump **P20** for about half a second.

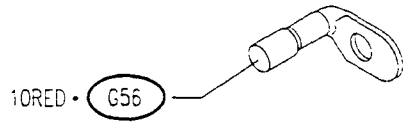
From chassis no.___ the enable signal is received by the turning on of the dipped beams.

COMPONENTS AND CONNECTORS

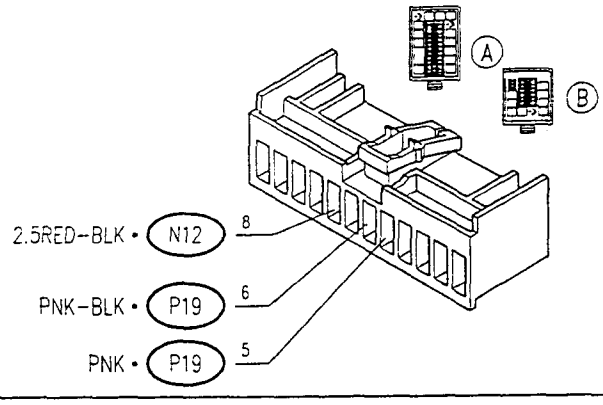
Lever unit (B68) [B]



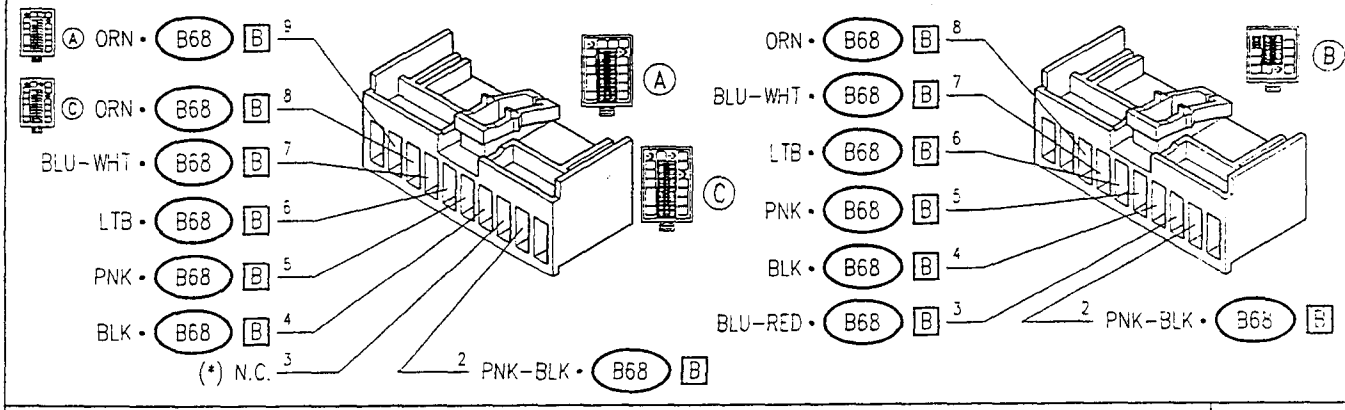
Fusebox (G1)



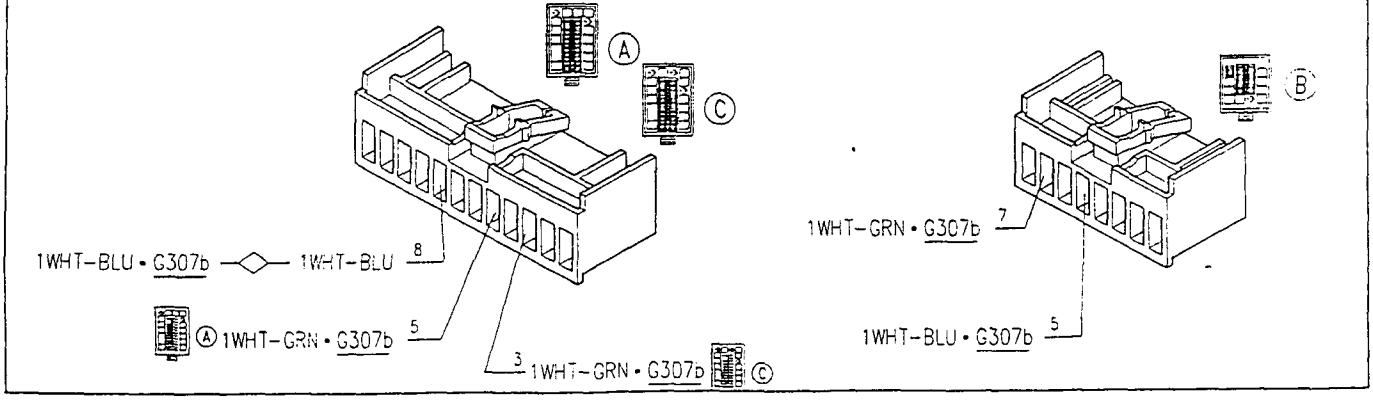
Fusebox (G1) [A]



Fusebox (G1) [B]



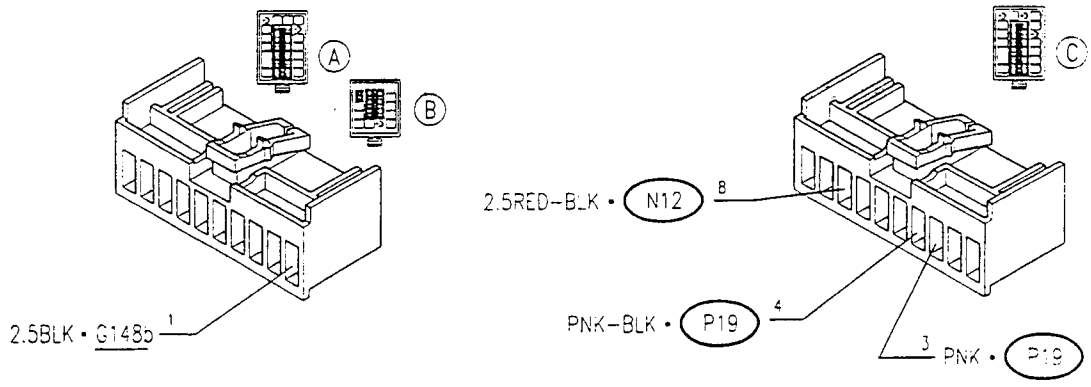
Fusebox (G1) [E]



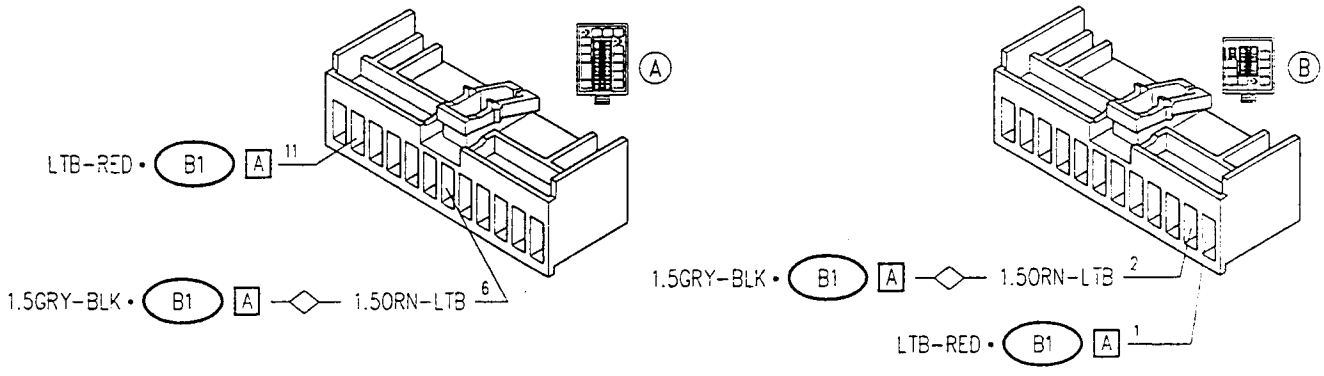
(*) from Model Year '97

COMPONENTS AND CONNECTORS (cont.d)

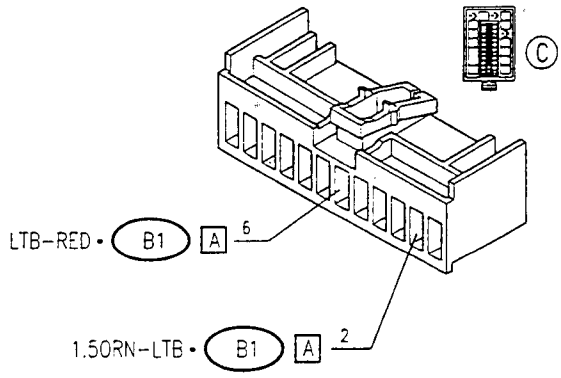
Fusebox — G1 G



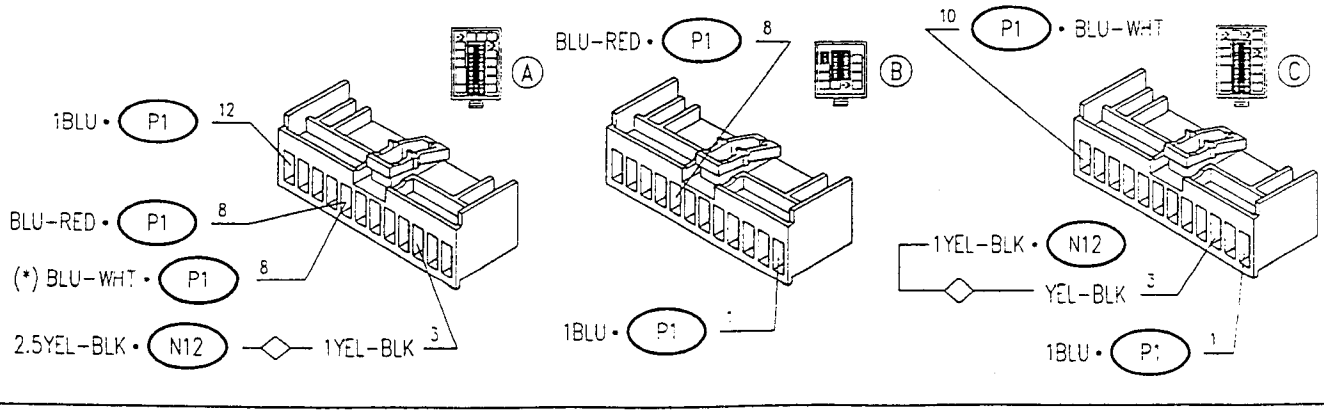
Fusebox — G1 H



Fusebox — G1 H



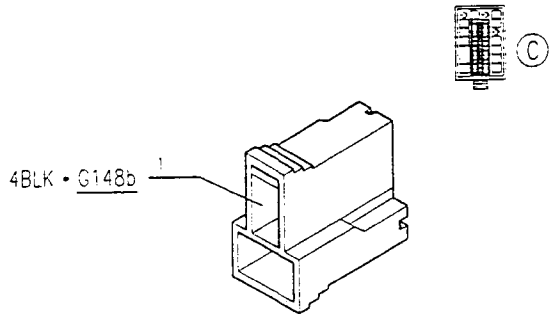
Fusebox — G1 I

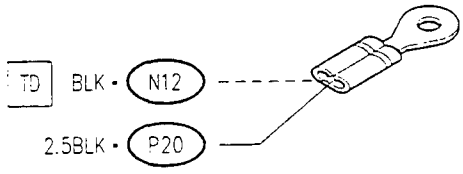


(*) from Model Year '97

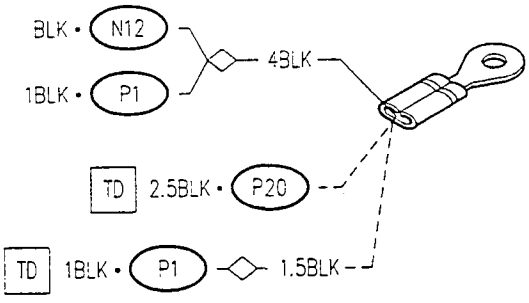
COMPONENTS AND CONNECTORS (cont.d)

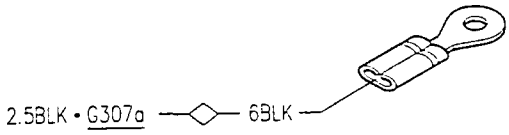
Fusebox	G1 N	RH engine compartment earth	G53a



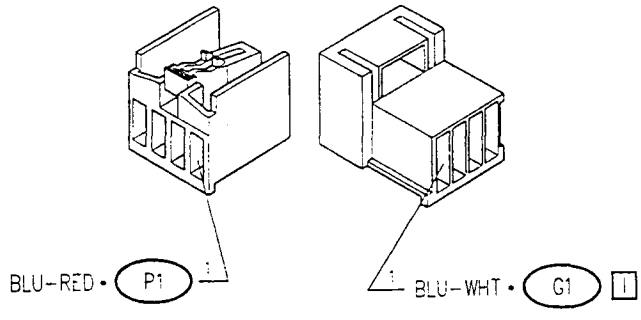


LH engine compartment earth	G53b	RH rear earth	G63a

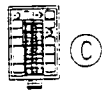


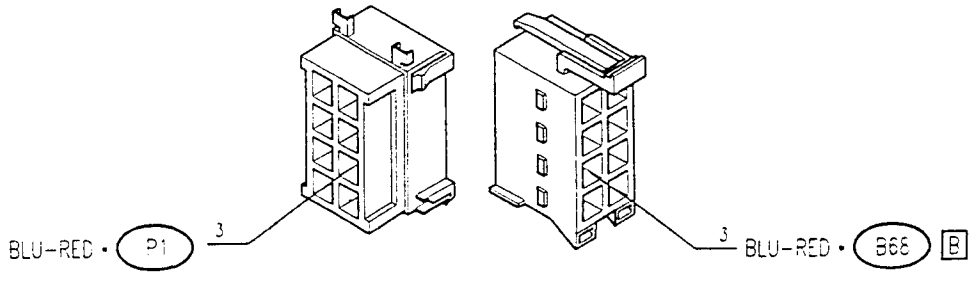


Connector for dashboard wiring/engine wiring (*)	G99



Connector for dashboard wiring/engine wiring (**)	G99



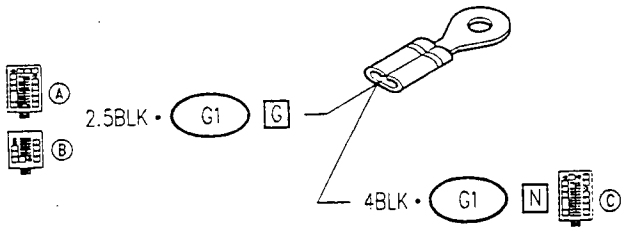


(*) from Model Year '97, up to chassis no. ___

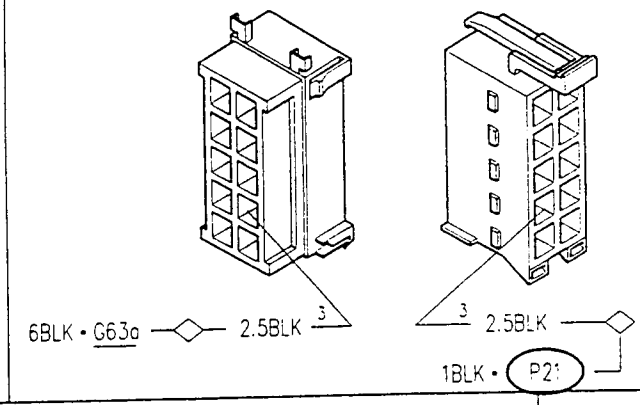
(**) from chassis no. ___

COMPONENTS AND CONNECTORS (cont.d)

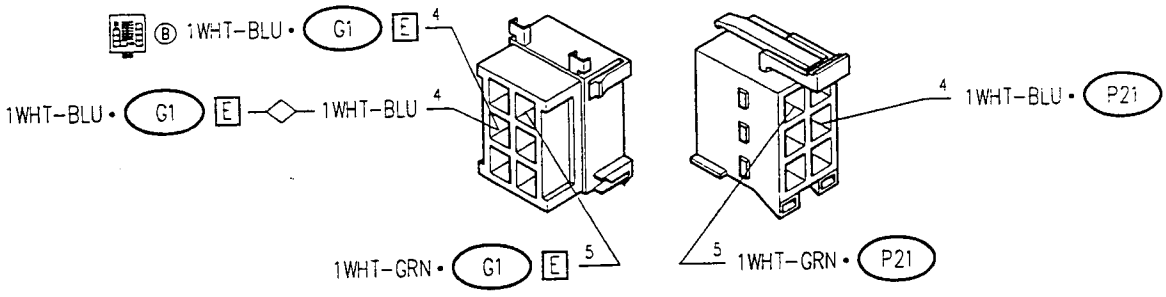
Earth under dashboard LH	G148b



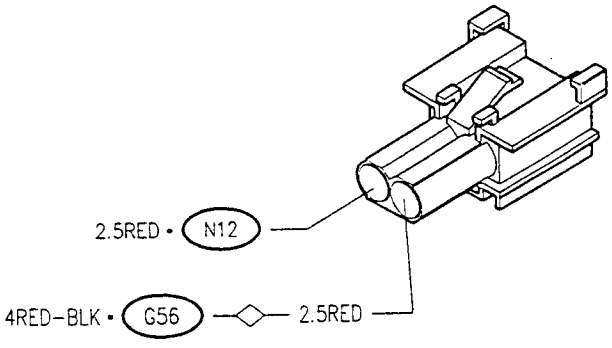
Rear/luggage compartment wiring connector A	G307a



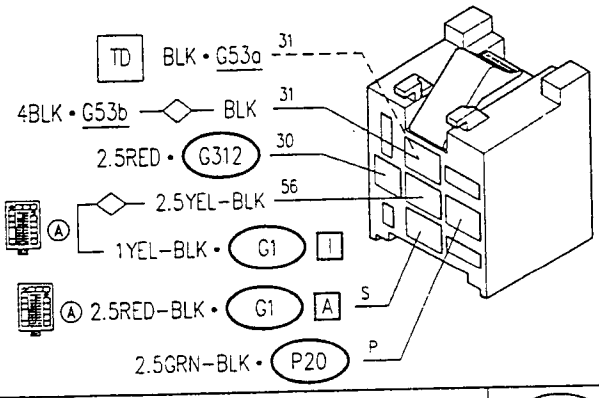
Rear/luggage compartment wiring connector B	G307b



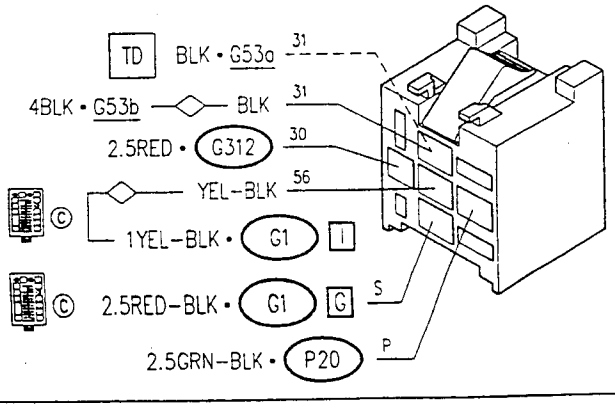
Fuse for headlamp washer	G312



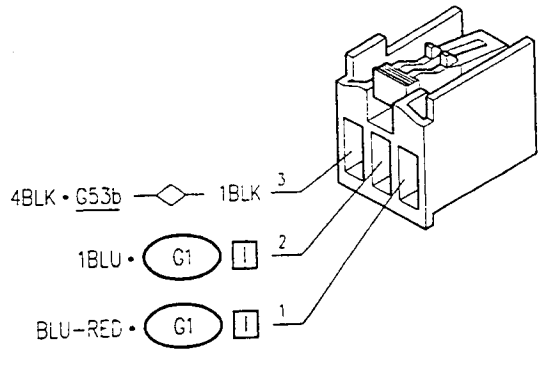
Timer for headlamp washer	N12



Timer for headlamp washer	N12



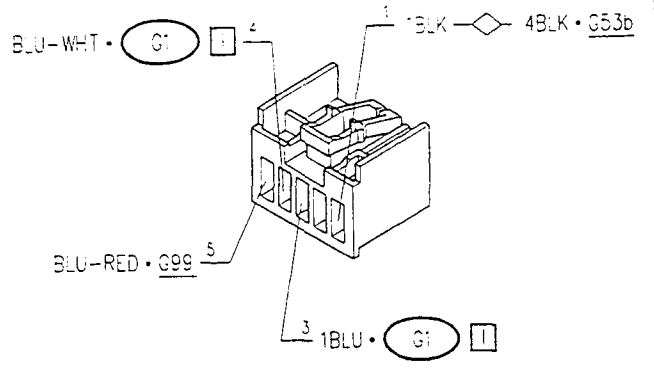
Windscreen wiper motor	P1



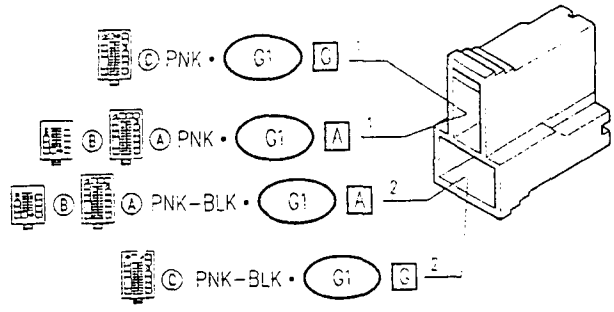
(*) from Model Year '97

COMPONENTS AND CONNECTORS (cont.d)

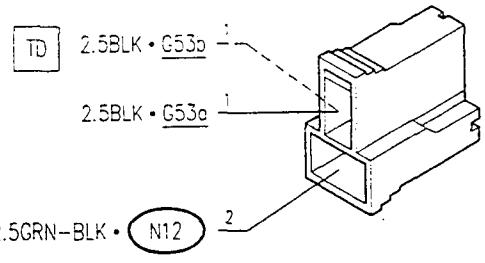
Windscreen wiper motor (*)	P1



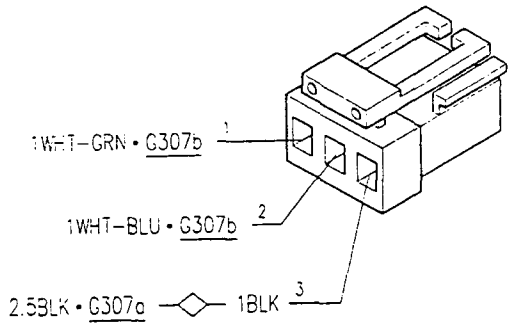
Windscreen/rearscreen washer pump	P19



Headlight washer pump	P20

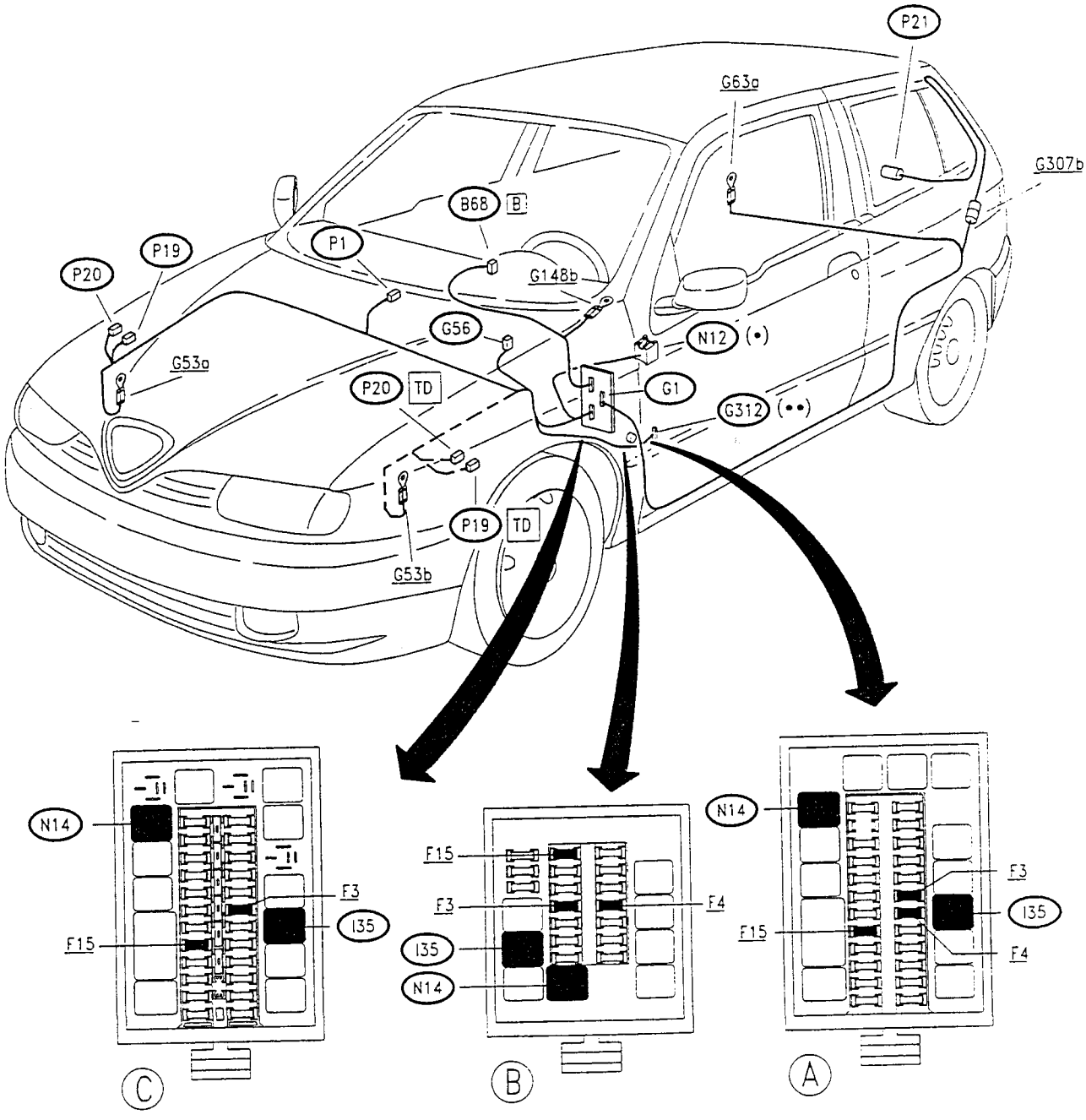


Rearscreen wiper motor	P21



(*) from Model Year '97

LOCATION OF COMPONENTS



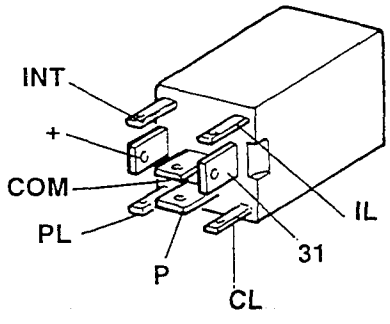
(•) black base
(••) yellow fuseholder

FAULTFINDING TABLE

Failure	Component to be checked										
	F3	F4	F15	G312	P1	P21	P20	P19	N14	N12	B68
Windscreen wiper (cont. speed)	•				•						•
Windscreen wiper (inter-mitt.speed)									•		•
Rearscreen wiper		•				•			•		
Windscreen/rearscreen washer			•					•			•
Headlight washer			•	•			•			•	

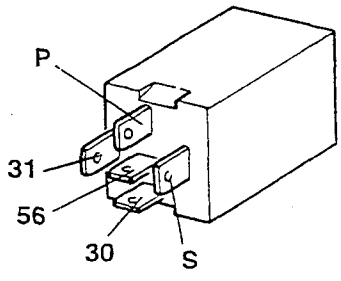
CHECKING COMPONENTS

Windscreen wiper electronic intermittent device (N14)



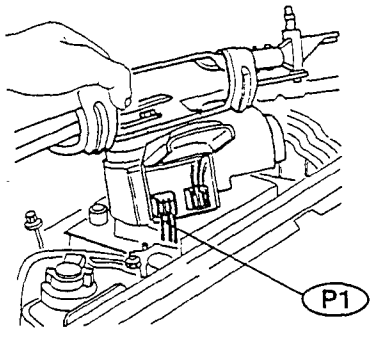
Checking the device: see **TEST A**

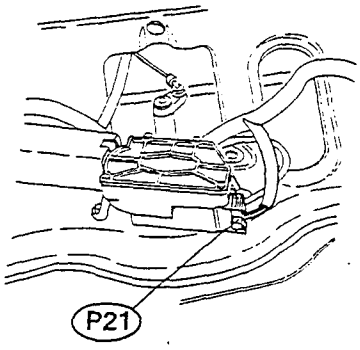
Headlamp washer timer (N12)



Checking the device: see **TEST B**

Windscreen wiper motor (P1) - rearscreen wiper motor (P21)





P1 up to Model Year '96, **P21**

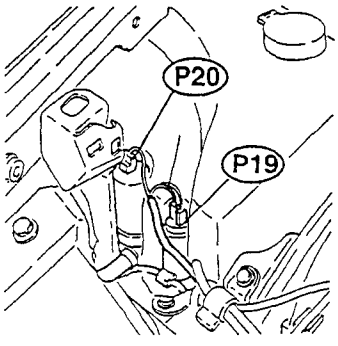
SPECIFICATIONS
with 12V at pin 3 and earth at pin 2: applying an earth at pin 1 the motor operates continuously

P1 from Model Year '97

SPECIFICATIONS
with 12V at pin 3 and earth at pin 1; applying an earth at pin 5 continuous motor operation is obtained at 1st speed; at pin 4 there is the 2nd speed. pag. 3

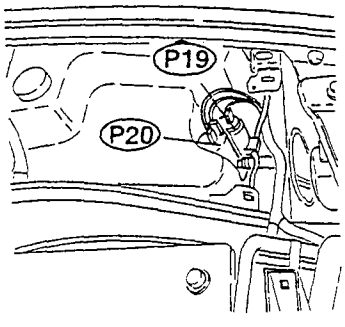
Windscreen/rearscreen washer pump(two-way) (P19)

Boxer



SPECIFICATIONS	
12V at pin 1 and 0V at pin 2	operation of windscreen washer
12V at pin 2 and 0V at pin 1	operation of rearscreen washer

TD



CHECKING WIPER ELECTRONIC INTERMITTENT DEVICE (N14) — TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N14** and on the corresponding base of the fusebox **G1**: with the key at MARCIA, check for 12V at pin + of **N14**	OK ➡	Carry out **step A2**
	NO ➡	Check fuse **F3** and relay switch **I35** of fusebox **G1**
A2 CHECK EARTH – Check for 0V at pin 31 of **N14**	OK ➡	Carry out **step A3**
	NO ➡	Check that fusebox **G1** is connected to earth: from pin 1 of connector G towards earth **G148b**
A3 CHECK WINDSCREEN WIPER INTERMITTENCE SIGNAL – Operate the different intermittent speeds of the windscreen wiper through the ring switch on the lever unit **B68** and check: - 0 Ω between pin INT and pin 31 at **N14** for max. speed - 1.3 kΩ between pin INT and pin 31 at **N14** for intermediate speed - 6 kΩ between pin INT and pin 31 at **N14** for min. speed	OK ➡	Carry out **step A4**
	NO ➡	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A4 CHECK WINDSCREEN WASHER SIGNAL – Operate the windscreen washer and check for 12V at pin P of **N14**	OK ➡	Carry out **step A5**
	NO ➡	Check fuse **F15** of **G1** or the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A5 CHECK REARSCREEN WASHER SIGNAL – Operate the rearscreen washer and check for 0V at pin PL of **N14**	OK ➡	Carry out **step A6**
	NO ➡	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A6 CHECK REARSCREEN WIPER SIGNAL – Operate the rearscreen and check for 0V at pin IL of **N14**	OK ➡	Insert device **N14** on the corresponding base of fusebox **G1** and continue with **step A7**
	NO ➡	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter

(cont.d)

CHECKING WIPER ELECTRONIC INTERMITTENT DEVICE (N14) — TEST A

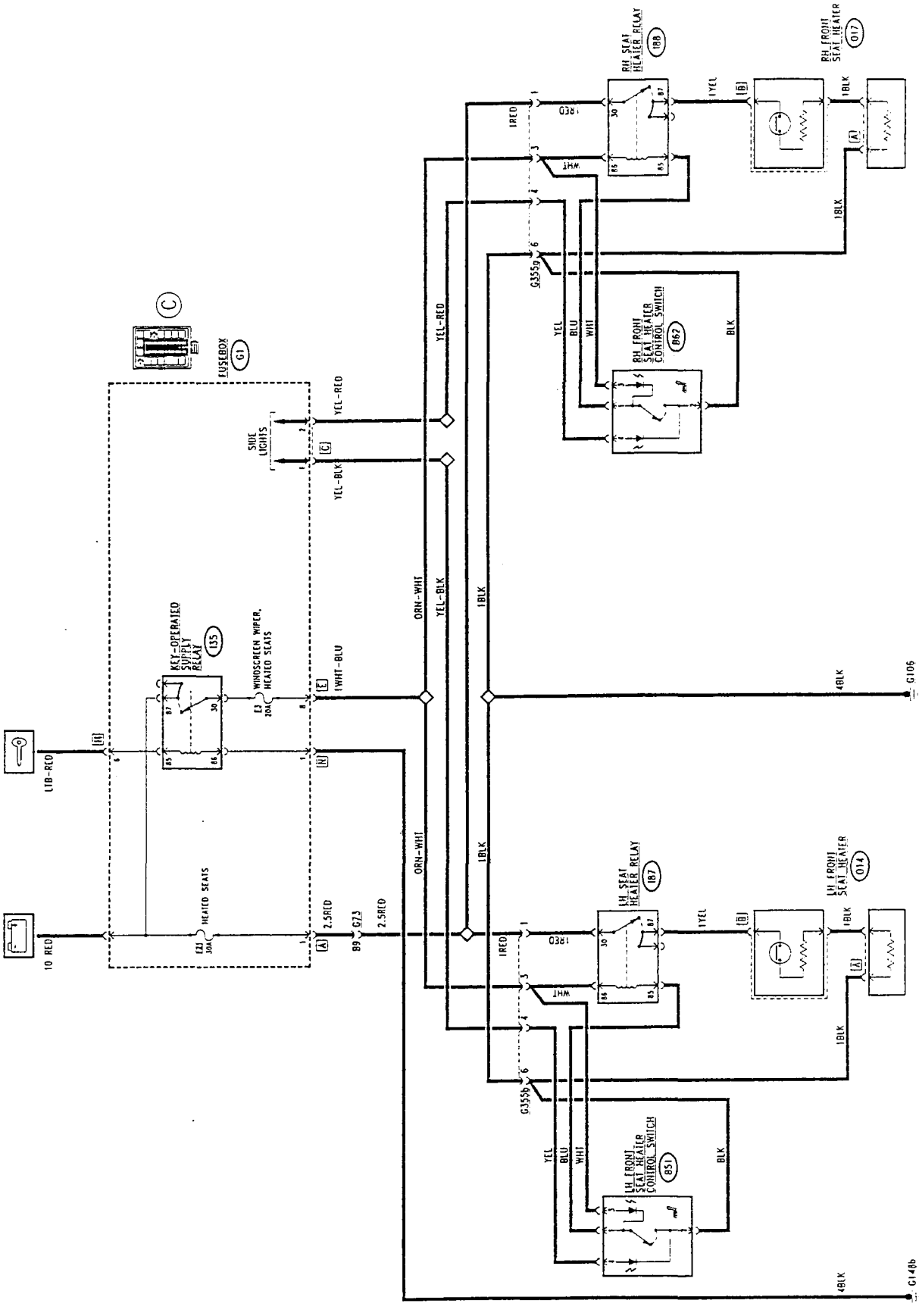
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A7 CHECK WINDSCREEN WIPER INTERMITTENT OPERATION		
– Operate the different intermittent speeds of the windscreen wiper through the ring switch on the lever unit **B68** and check for a cyclic signal at pin 8 of connector I of fusebox **G1**: - 45 cycles per minute for max. speed - 25 cycles per minute for intermediate speed - 15 cycles per minute for min. speed	OK ▶ ~~OK~~ ▶	Carry out **step A8** Change device **N14**
A8 CHECK WINDSCREEN WIPER ACTUATION FOR WINDSCREEN WASHER		
– Operating the windscreen washer, check for a continuous signal at pin 8 of connector I of **G1** for about 4 seconds	OK ▶ ~~OK~~ ▶	Carry out **step A9** Change device **N14**
A9 CHECK ACTUATION OF REARSCREEN WIPER FOR REARSCREEN WASHER		
– Operating the rearscreen washer, check for a cyclic signal (15 cycles per minute) at pin 8 of connector E at **G1**; this signal remains for about 4 seconds	OK ▶ ~~OK~~ ▶	Carry out **step A10** Change device **N14**
A10 CHECK ACTUATION OF REARSCREEN WIPER		
– Operating the rearscreen wiper, check for a cyclic signal (15 cycles per minute) at pin 8 of connector E of **G1**	OK ▶ ~~OK~~ ▶	DEVICE **N14** IS WORKING PROPERLY. Check the connections with the other components Change device **N14**

CHECKING THE HEADLAMP WASHER TIMER (N12)	TEST B

Work with the component fitted on its connector acting from the cable inlet side

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK VOLTAGE – Check for 12V between pins 30 and 31 of **N12**	OK ▶	Carry out **step B2**
	~~OK~~ ▶	Check fuse G312 (20A). Restore the wiring between **N12** and **G312**, and between **N12**and earth **G53b**
B2 CHECK VOLTAGE – With the side lights on, check for 12V at pin 56 of **N12**	OK ▶	Carry out **step B3**
	~~OK~~ ▶	Check that the side lights are working properly; also check the wiring between **N12** and **G1**
B3 CHECK VOLTAGE – Operating the windscreen washer with the side lights on, check for 12V at pin S of **N12**	OK ▶	Carry out **step B4**
	~~OK~~ ▶	Restore the wiring between **N12** and **G1** or check that the **windscreen washer** is working properly
B4 CHECK HEADLAMP WASHER CONTROL – Operating the windscreen washer with the side lights on, check for 12V at pin P di **N12** for about 0.5 seconds 0,5	OK ▶	DEVICE **N12** IS WORKING PROPERLY. Check the connections with the other components
	~~OK~~ ▶	Change device **N12**

WIRING DIAGRAM



GENERAL DESCRIPTION

The front seats are available - for certain markets - fitted with a heating device (comprising two plates located in the cushion and in the seat back) through which it is possible to heat the seat thus eliminating the inconvenience caused in very cold climates when the vehicle is parked outdoors for prolonged periods.

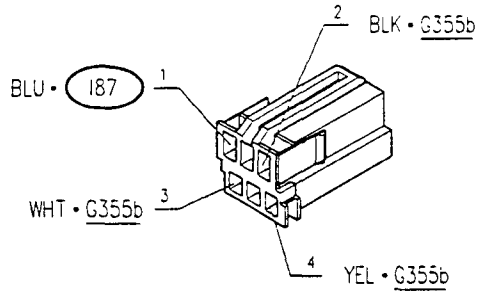
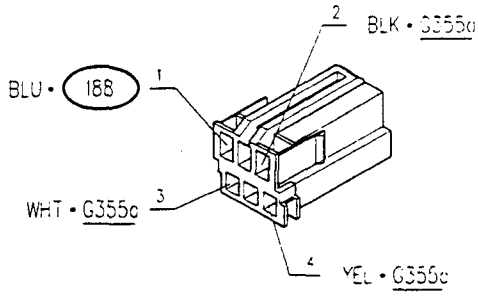
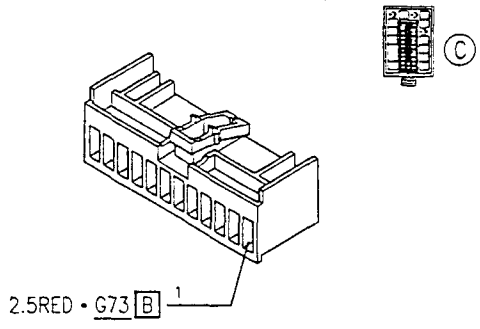
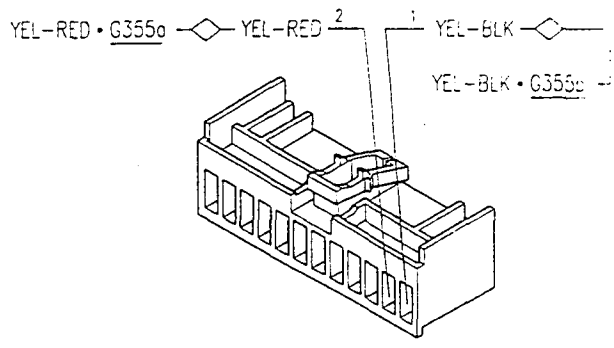
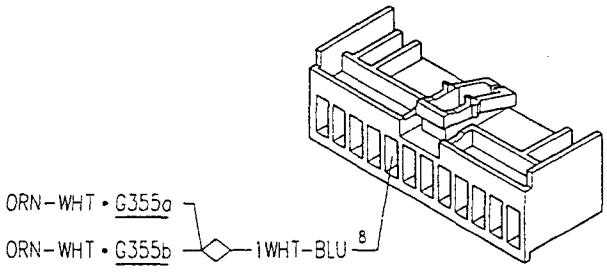
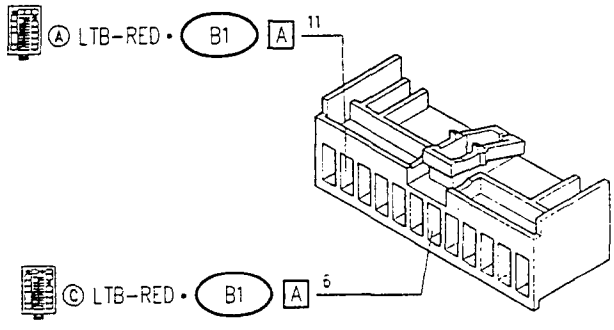
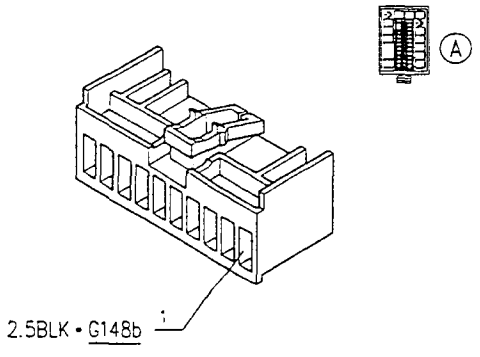
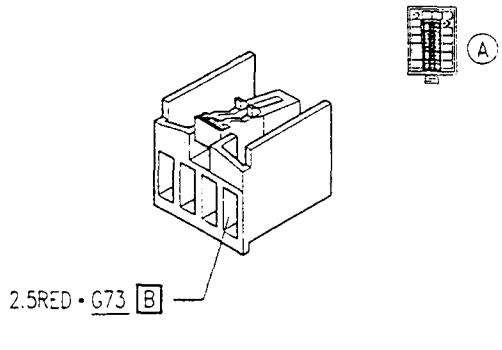
The heating system comprises two resistors operated through a switch and a relay; a thermostat cuts off heating automatically once a certain temperature has been reached.
The control switch for each seat is located one side of the seat itself and it is illuminated.

FUNCTIONAL DESCRIPTION

The seat heater relays **I88** (right) and **I87** (left) are supplied directly by a special line (fuse **F21**) and "key-operated" via fuse **F4**, of the fusebox **G1**, or fuse **F3** of **G1** "C".
The two resistances in series of the heating devices **O17** (right seat) and **O14** (left seat), connected to earth, are supplied by the respective relay with battery voltage. This is energised by the switch **B62** (right) and **B51** (left) which, as they close, send an earth signal to the corresponding coil.
A thermal contact inside the heaters automatically disconnects the resistances when the temperature exceeds a certain limit (appr. 26°C).

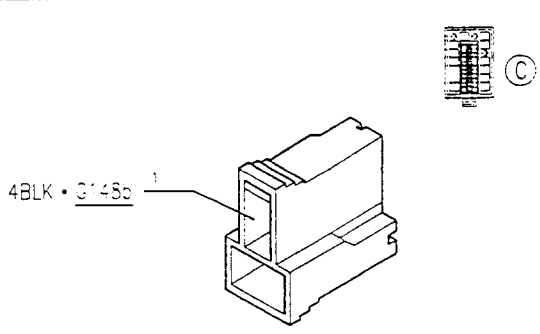
Inside the switches **B62** and **B51** there are two leds: one lights up when the heater is turned on, the other is illuminated when the side lights are on.

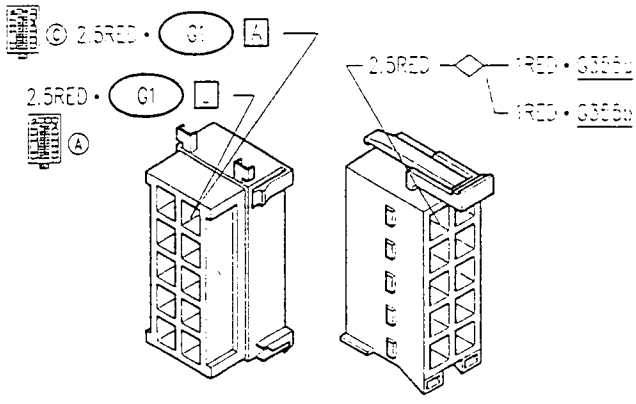
COMPONENTS AND CONNECTORS

LH front seat heater control switch (B51)	RH front seat heater control switch (B62)
	
Fusebox (G1) A	Fusebox (G1) C
	
Fusebox (G1) E	Fusebox (G1) H
	
Fusebox (G1) G	Fusebox (G1) L
	

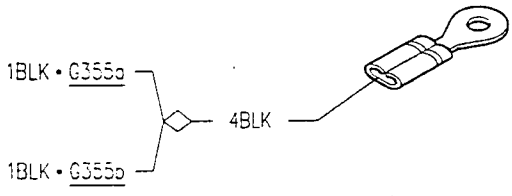
COMPONENTS AND CONNECTORS (cont.d)

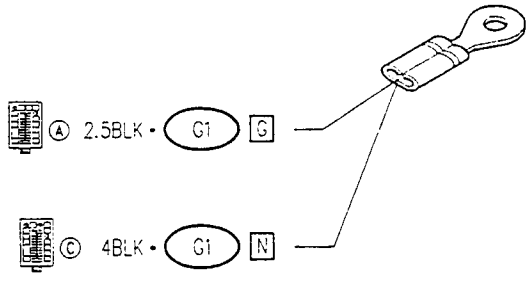
Fusebox	G1 N	Rear services connector	G73 B



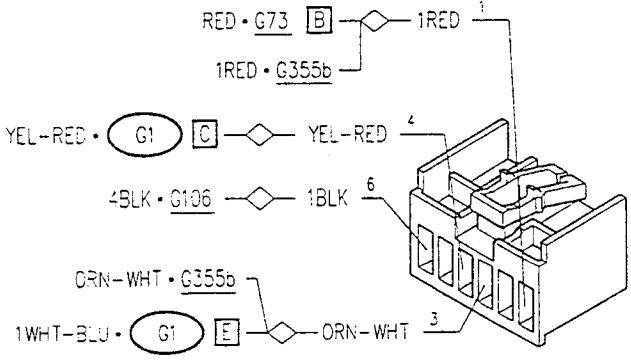


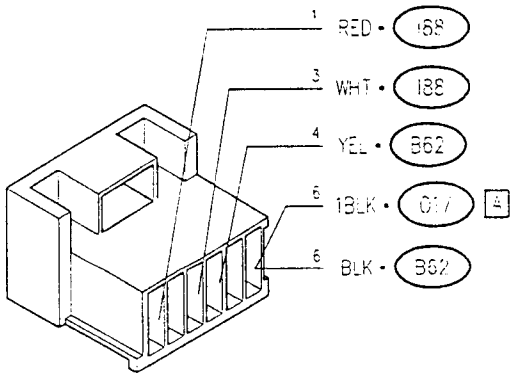
Seat crossrail earth	G106	Earth under LH dashboard	G148b



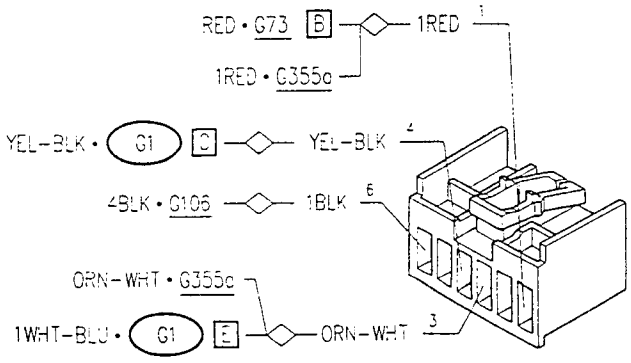


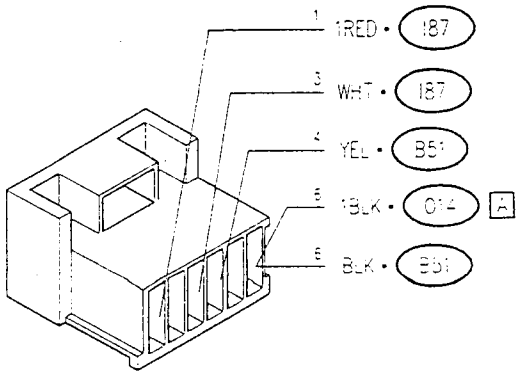
RH seat heater connector	G355a





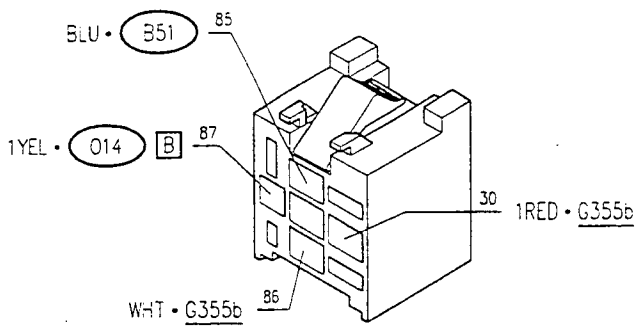
LH seat heater connector	G355b

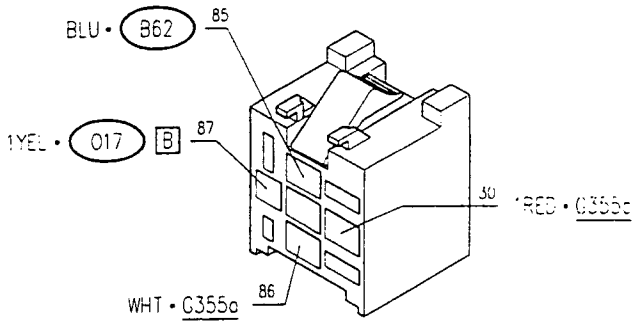




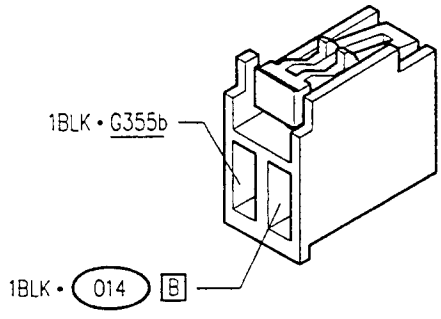
COMPONENTS AND CONNECTORS (cont.d)

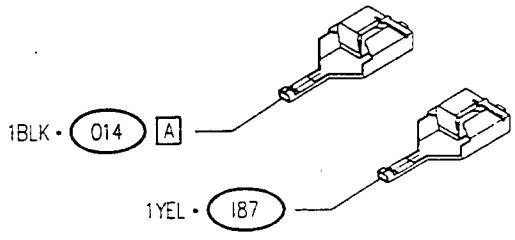
LH seat heater relay	(187)	RH seat heater relay	(188)



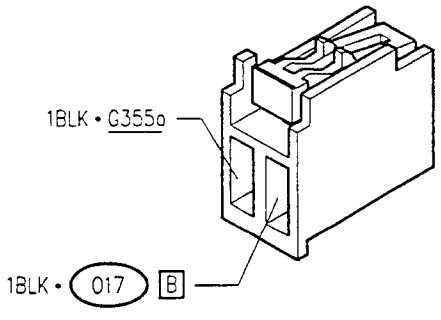


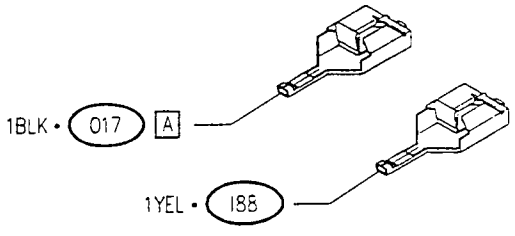
LH front seat heater	(O14) A	LH front seat heater	(O14) B



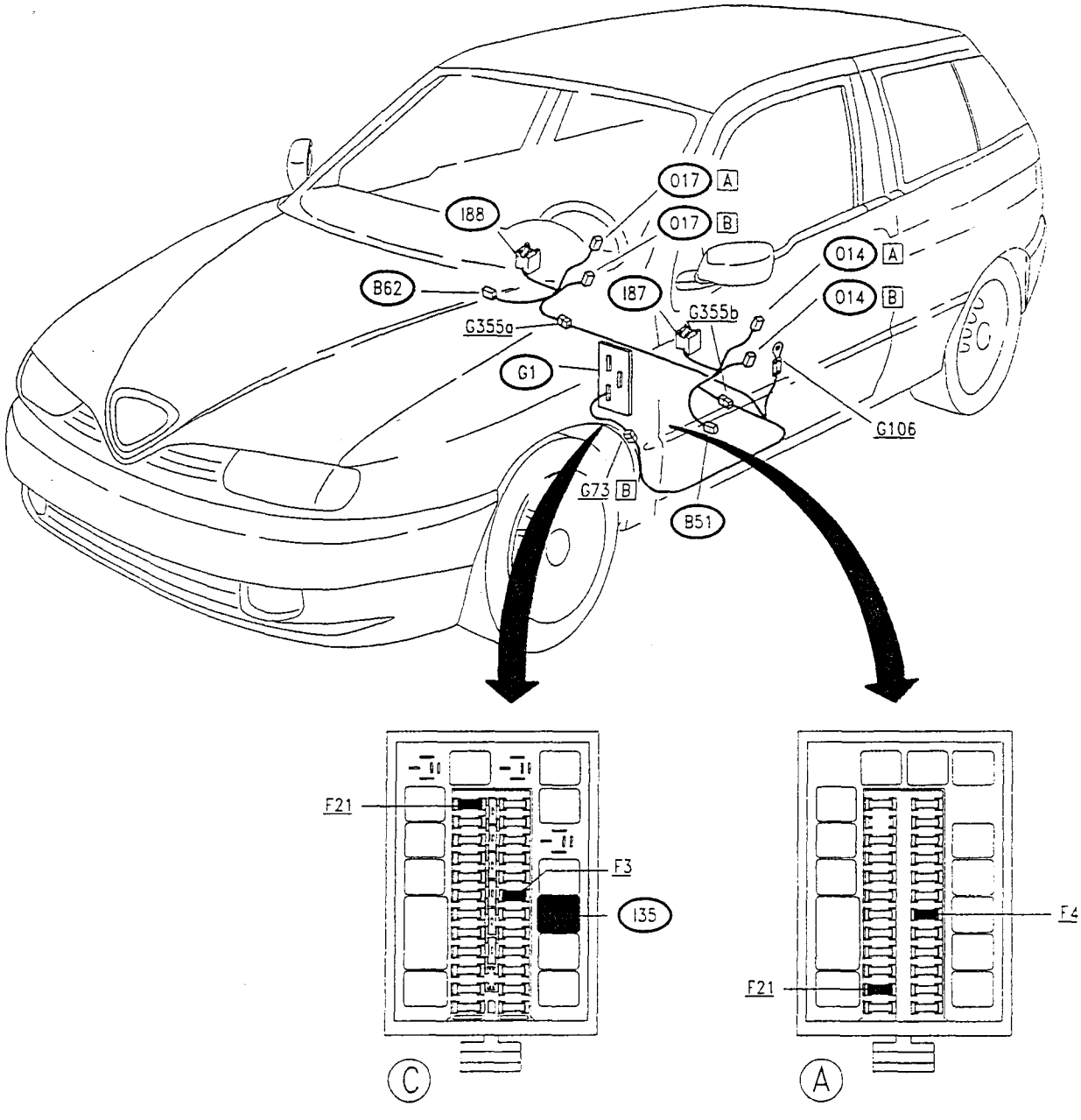


RH front seat heater	(O17) A	RH front seat heater	(O17) B





LOCATION OF COMPONENTS

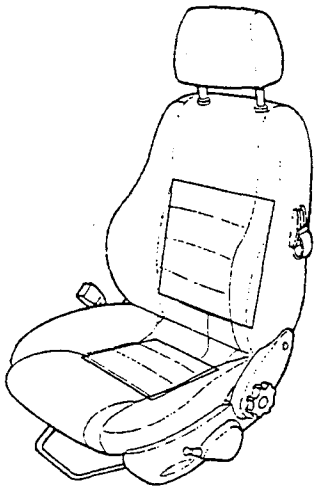


FAULT-FINDING TABLE

Fault	Component to be checked							
	F21	F4	I88	O17	I87	O14	B51	B62
RH seat heating	•	•	•	•				•
LH seat heating	•	•			•	•	•	
RH seat heating control lights								•
LH seat heating control lights							•	

CHECKING COMPONENTS

Seat heater O14 - O17



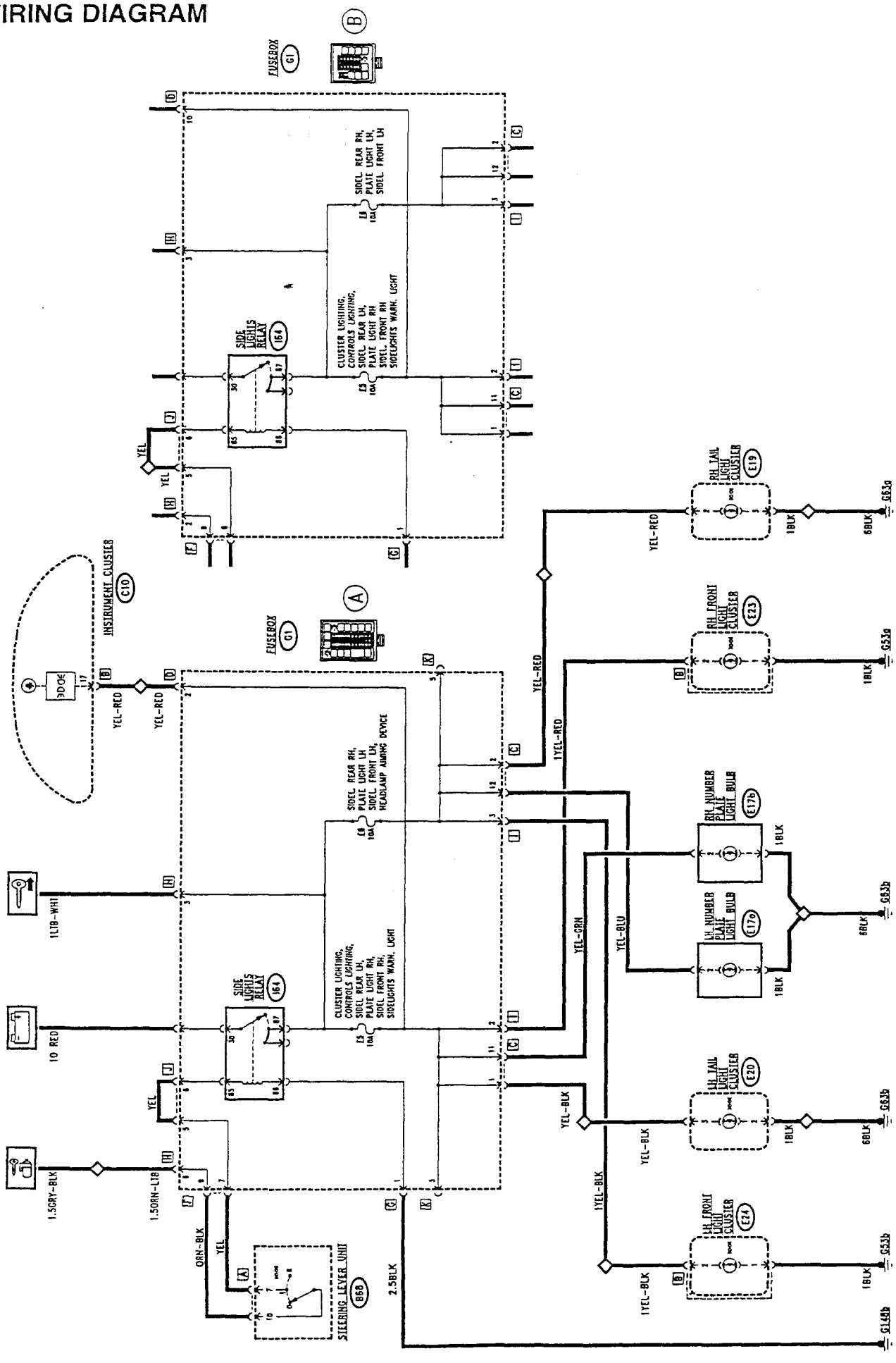
SPECIFICATIONS	
Cushion resistance (conn. B)	1.45 Ω
Seat back resistance (conn. A)	0.98 Ω
Thermal contact cut in temperature	26 ± 3°C

SIDE LIGHTS

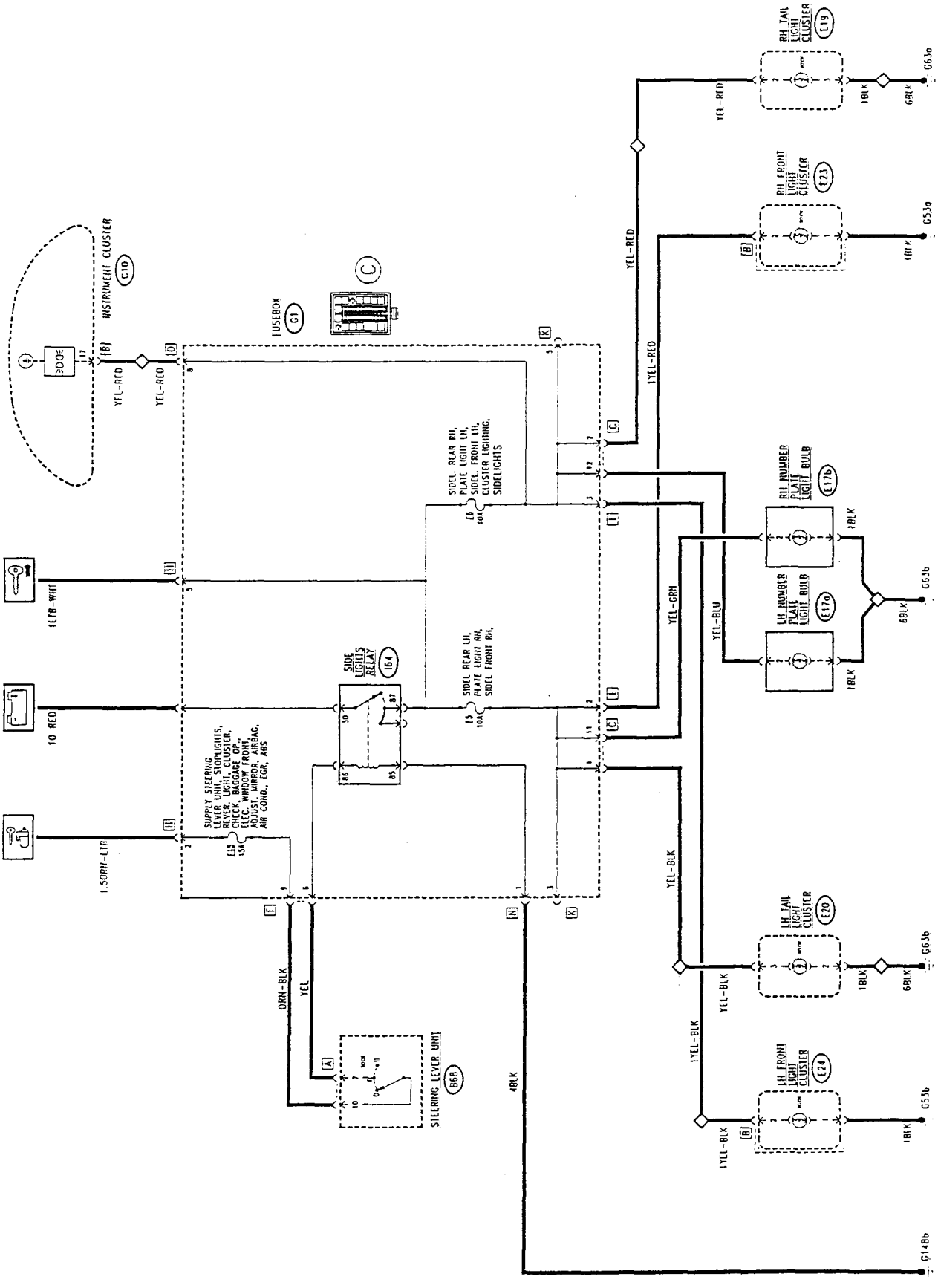
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GENERAL DESCRIPTION 5-3
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COMPONENTS AND CONNECTORS 5-3
LOCATION OF COMPONENTS 5-7
FAULTFINDING TABLE 5-8

WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The side lights are turned on when the switch on the lever unit is turned to the first position and only when the ignition key is engaged: this prevents the battery from discharging if the lights are inadvertently left on when leaving the car.
N.B.: They can also be turned on by slightly withdrawing the ignition key and turning it in the opposite direction holding down the special button: key in the "PARKING" position (see also "Power supply").
When the side lights are turned on, the number plate lights and numerous interior lights for lighting the passenger compartment, instruments and controls are also turned on (see "Controls lighting").
A warning light on the instrument panel indicates that the side lights are on.
For safety reasons the circuit is protected by two "crossed" fuses: one for the right front and left rear lights etc., the other for the left front and right rear lights, etc..

NOTE: In some countries the versions are equipped with "Daylights", i.e. the side lights are always on when the ignition key is turned and a different system is used for turning on the low beam headlights, fog lamps and rear fog guards. In this case, the present section should be considered complementary to the **"Daylights" section which should therefore be consulted first.**

FUNCTIONAL DESCRIPTION

The side lights circuit is activated by the corresponding relay switch **I64** located in fusebox **G1**.
Moving the switch on the lever unit **B68** to position "I" [illegible] when the ignition key is engaged the coil of relay switch **I64** is supplied thereby closing the circuit that supplies the side lights; this circuit is protected by two fuses of box **G1** (box "A" and "B") and by a third fuse still in box **G1** "C"; **F5** for the right front and left rear lights, **F6** for the front left and rear right and fuse **F15** - only box "C" - for protecting the services of the steering column lever unit **B68**. This way the front sidelights **E23** (right) and **E24** (left, the rear ones **E19** (right) and **E20** (left) and the number plate lights **E17a** and **E17b**.

The supply line of fuse **F5** - boxes "A" and "B" or of fuse **F6** - box "C" - also sends a signal to the instrument cluster **C10** to turn on the corresponding warning light.

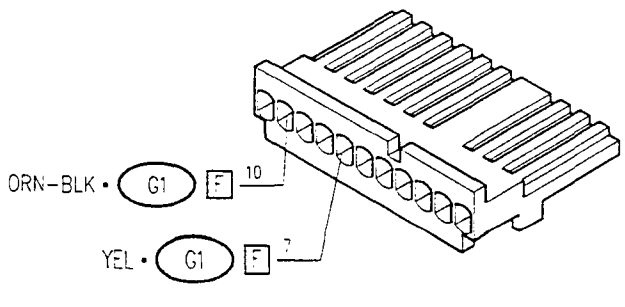
When the ignition key is at the "PARKING" position all the side lights are turned on as a direct supply is sent to fuses **F5** and **F6** in fusebox **G1**, "by-passing" relay switch **I64**.

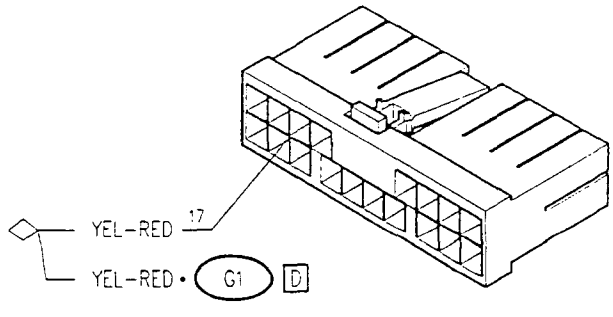
NOTE: Turning the side lights on also supplies numerous other circuits with "consent" signals (e.g. circuits that operate only when the side lights are on) or by supply lines in the real sense of the term (for example by illuminating the ideograms of the various buttons and controls...).

The former are described and illustrated in the diagrams relating to the components to which they refer and the latter in the "Controls lighting" section.

COMPONENTS AND CONNECTORS

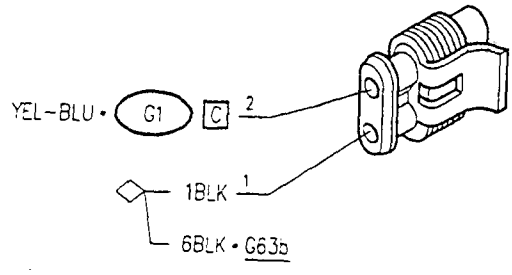
Lever unit	B68 A	Instrument cluster	C10 B



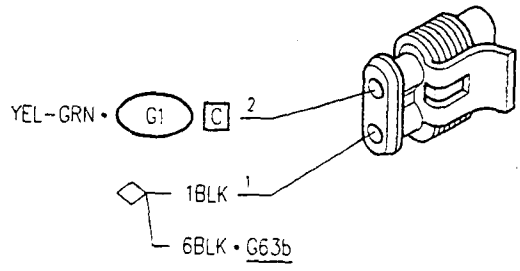


COMPONENTS AND CONNECTORS (cont.d)

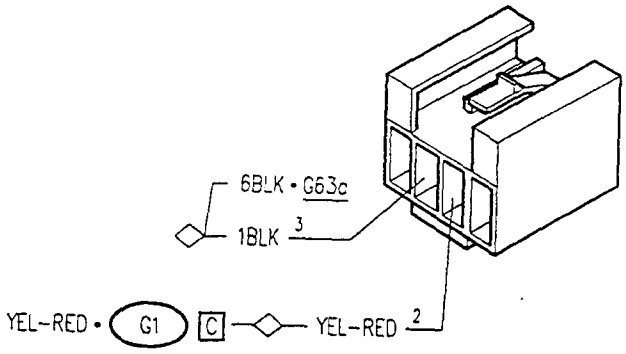
LH number plate light	E17a



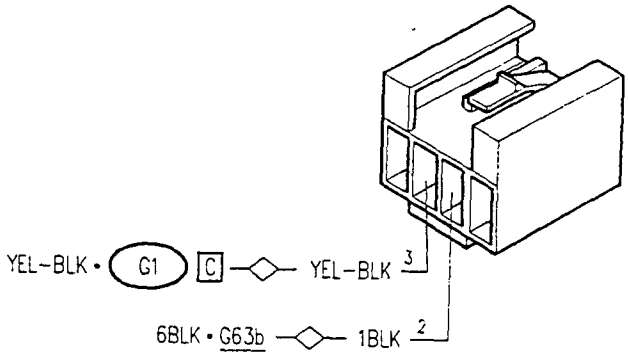
RH number plate light	E17b



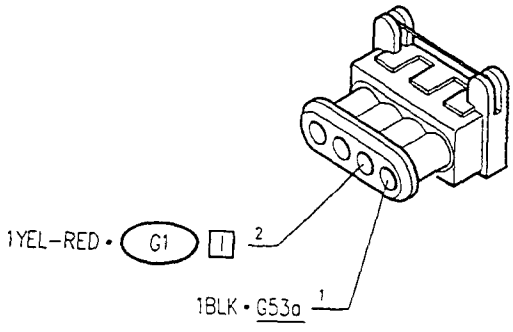
RH tail light cluster	E19



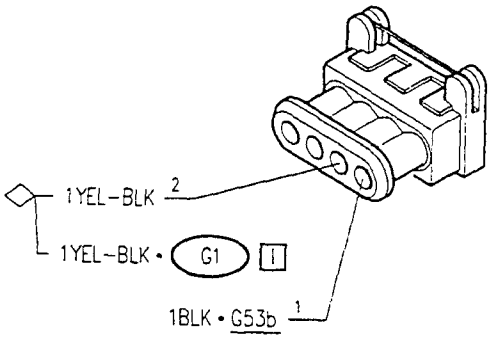
LH tail light cluster	E20



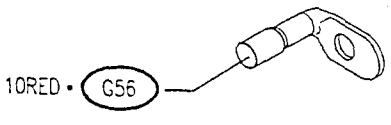
RH front light cluster	E23 B



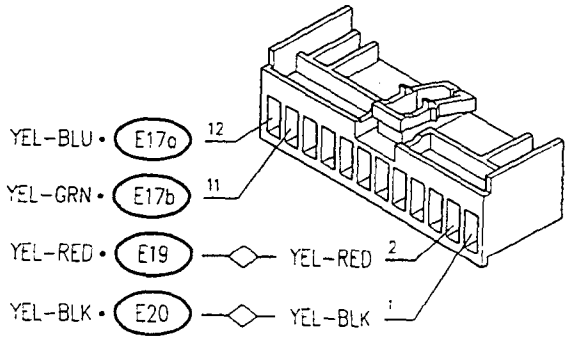
LH front light cluster	E24 B



Fusebox	G1

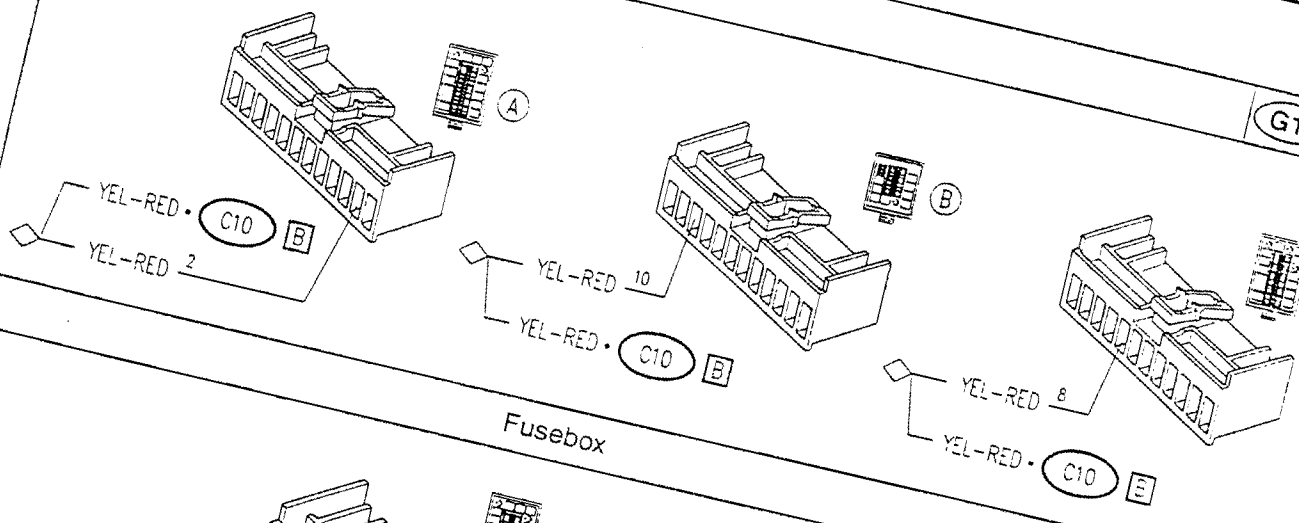


Fusebox	G1 C



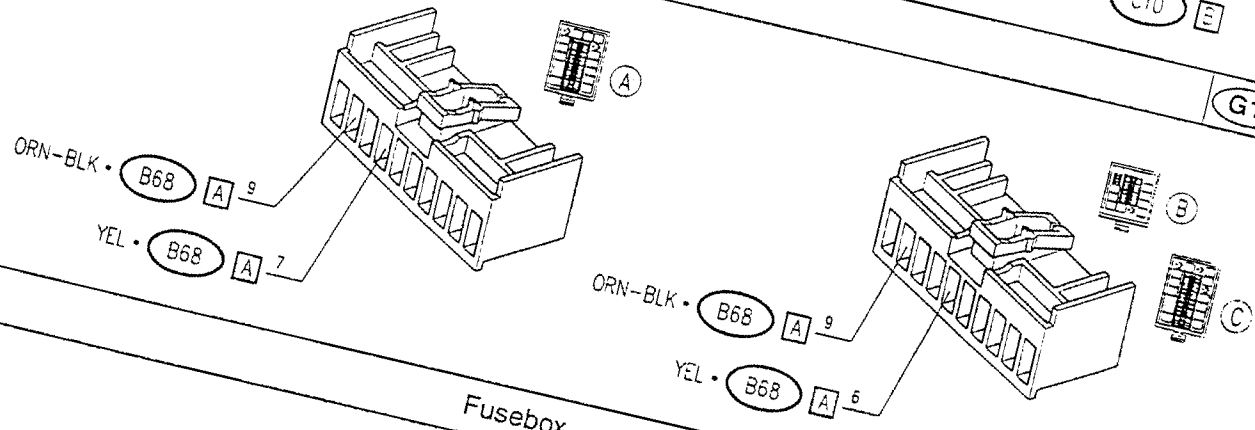
COMPONENTS AND CONNECTORS (cont.d)

Fusebox



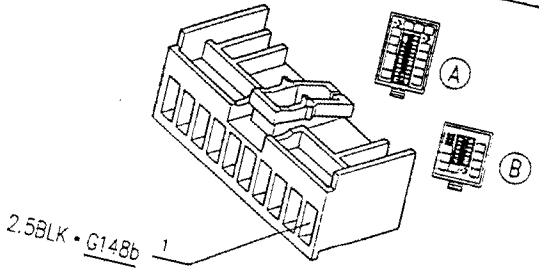
G1

Fusebox



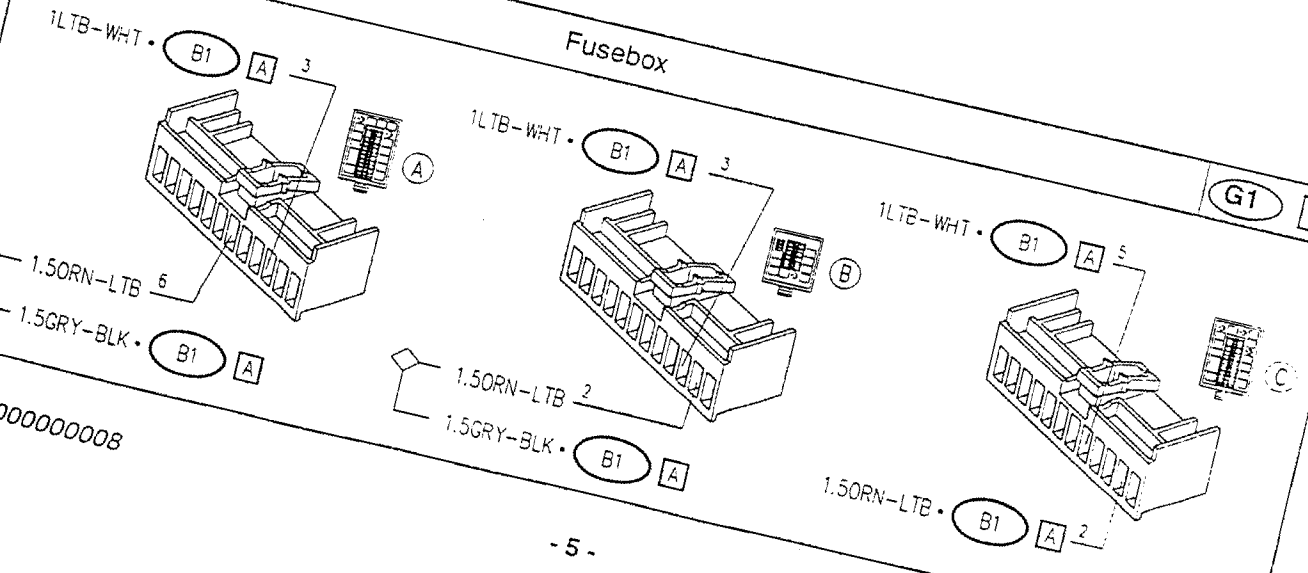
G1 F

Fusebox



G1 G

Fusebox

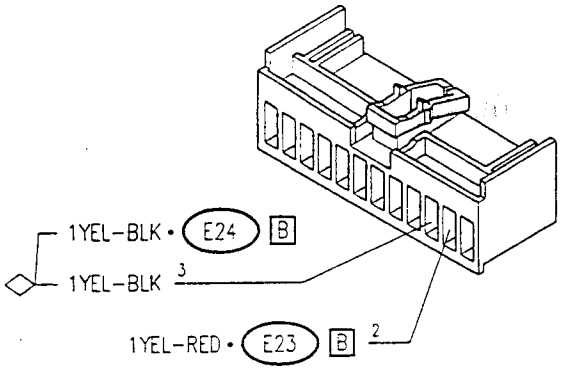


G1 H

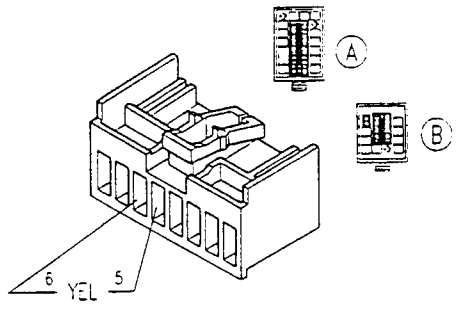
00000008

COMPONENTS AND CONNECTORS (cont.d)

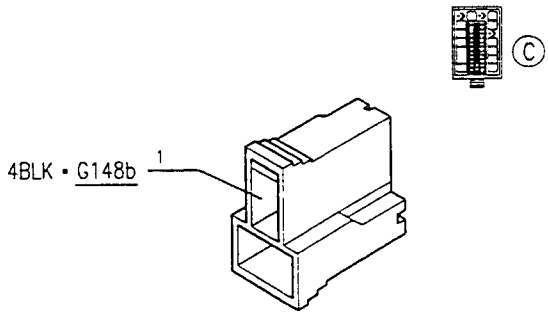
Fusebox	G1 I



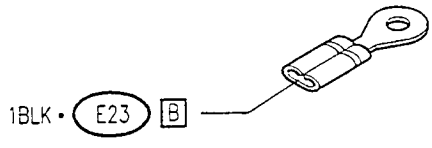
Fusebox	G1 J



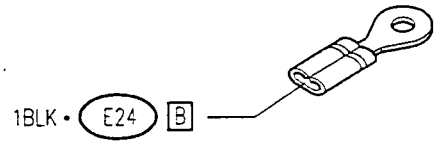
Fusebox	G1 N



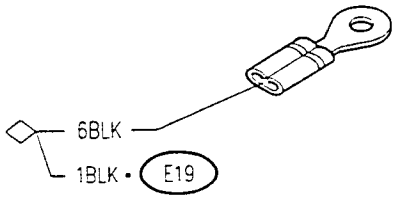
RH engine compartment earth	G53a



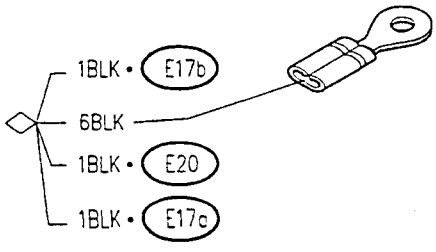
Left hand engine compartment earth	G53b



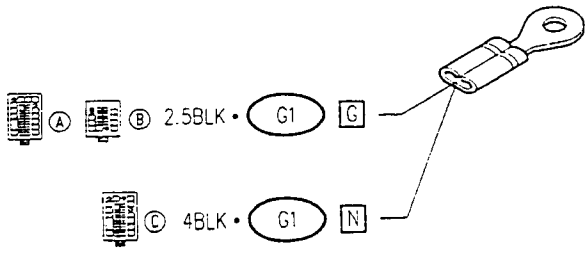
RH rear earth	G63a



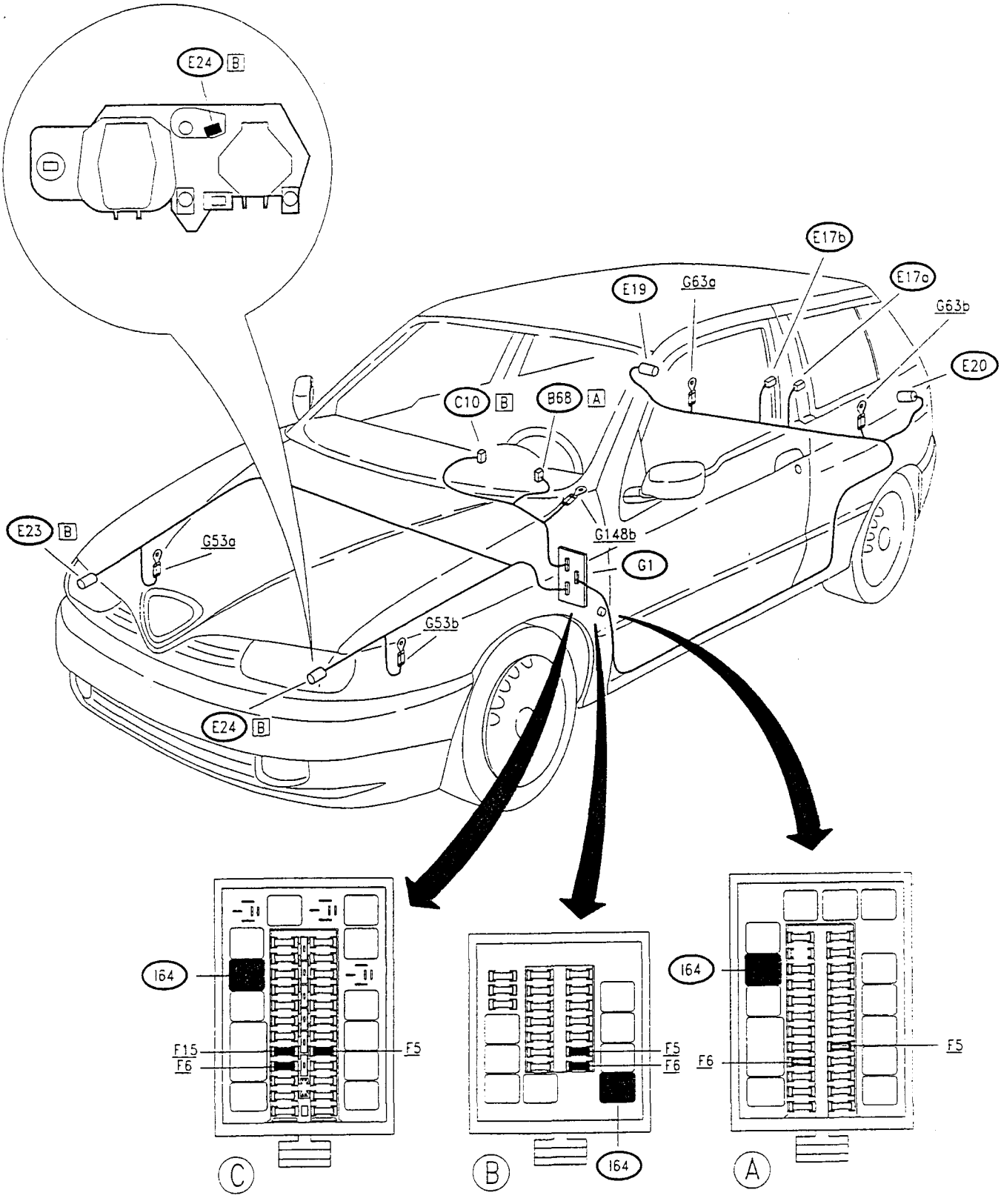
LH rear earth	G63b



LH earth under dashboard	G148b



LOCATION OF COMPONENTS



FAULTFINDING TABLE

Failure	Component to be checked										
	F5	F6	E23	E24	E19	E20	E17a	E17b	I64	B68	C10 (*)
All the side lights									•	•	
Front right	•		•								
Front left		•		•							
Right rear		•			•						
Left rear	•					•					
Right number plate	•							•			
Left number plate		•					•				
Side lights warning light	•										•

(*) The instrument cluster **C10** cannot be repaired. Therefore, in the event of a failure it is not possible to change the single warning light and a new complete cluster must be fitted.

STARTING AND CHARGING

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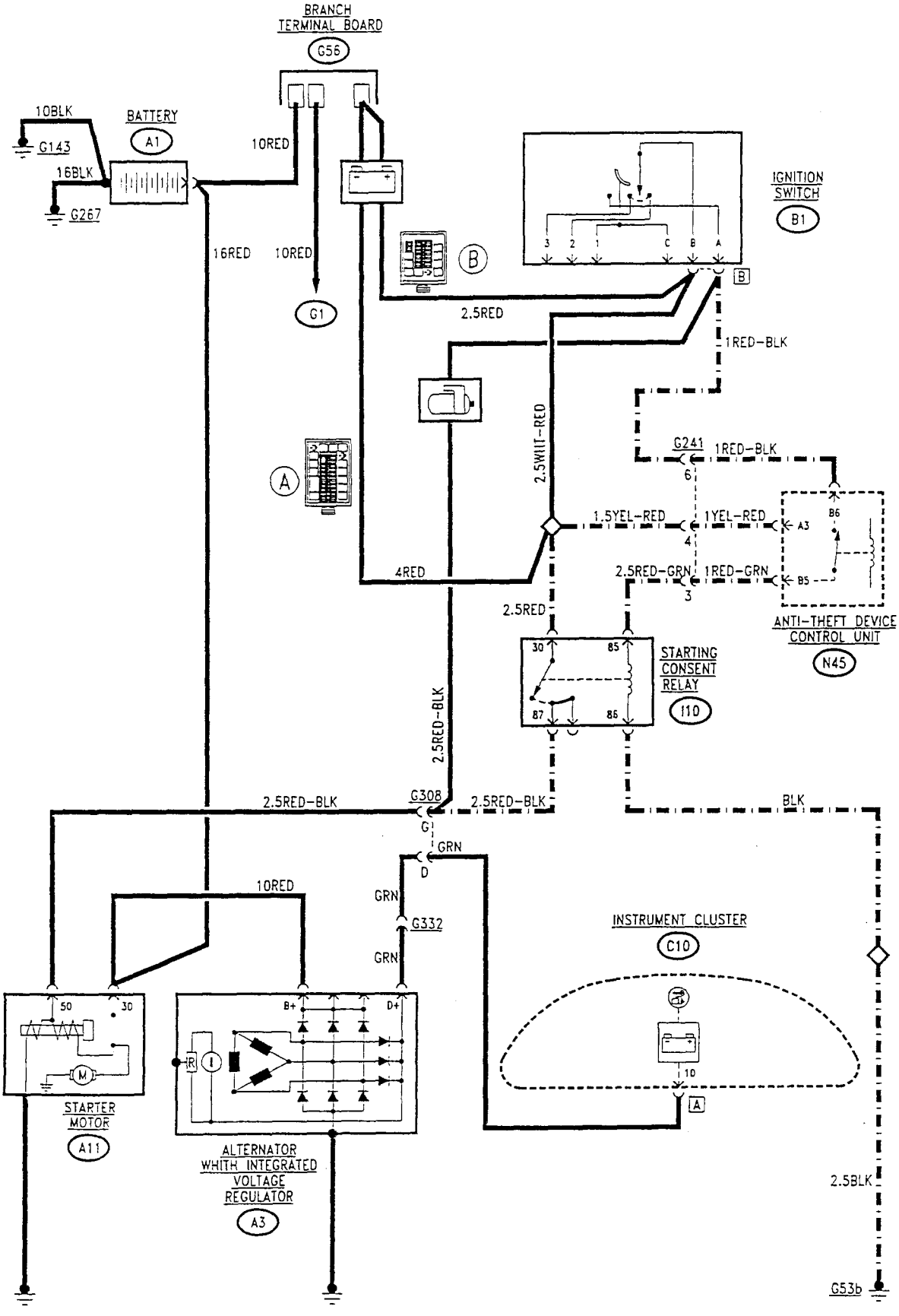
GENERAL DESCRIPTION

The starting and charging circuit comprises the battery, starter motor and the alternator.
The **battery** (12V) is sealed and maintenance-free.
The **starter motor** comprises a direct current motor supplied by the battery and a control and engagement solenoid.
By turning the ignition key, the voltage leading from the battery supplies the windings of the motor, generating the electromagnetic forces which turn the pinion of the motor itself: simultaneously, the solenoid is energized which operates the mechanism engaging the pinion in the flywheel ring gear, thereby setting the crankshaft into rotation.
The **alternator** recharges the battery during the normal rotation of the engine: the alternator shaft (rotor) turned directly by the crankshaft through a belt is supplied with the excitation current and generates a magnetic field which induces an alternate current on the fixed winding (stator); this is transformed into direct current by a rectifier bridge with diodes and sent to recharge the battery.
A voltage regulator built into the alternator makes it possible to maintain a constant voltage supply (appr. 12 V) for all the fields of load changes and engine speed.

In the versions **without ALFA ROMEO CODE but with anti- theft system** , the supply to the starter motor receives the necessary consent from the anti-theft control unit, which then operates the starting consent relay, thus also the motor itself.
In the event of an "alarm" the motor is not supplied and the engine cannot be started using the key.

In the versions with ALFA ROMEO CODE the starter motor is NOT inhibited, but only the engine (see the "ALFA ROMEO CODE" section).

WIRING DIAGRAM (Boxer versions)



—·—·— variant for cars without ALFA ROMEO CODE, but with anti-theft system

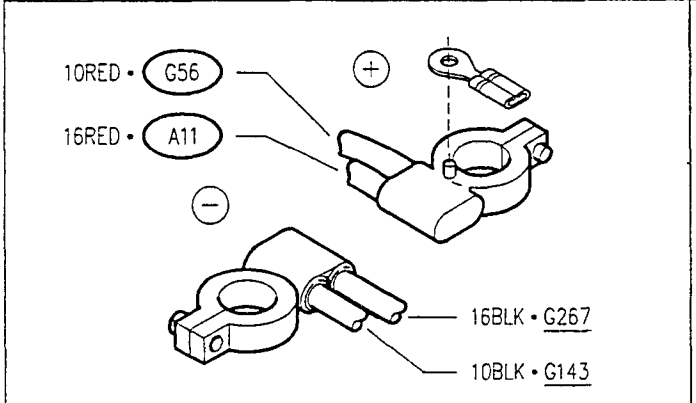
FUNCTIONAL DESCRIPTION (Boxer versions)

When the ignition key is turned in the ignition switch **B1** right round to the "STARTING" position, the windings of the solenoid (pin 50) of the starter motor **A11** are energized and the actual motor is supplied (pin 30) with the voltage leading from the battery **A1** in this way cranking the engine (In cars without ALFA ROMEO CODE, the starter motor supply "crosses" the anti-theft control unit **N45** (pin B5 - B6) which cuts off this supply in the event of an alarm and the starting consent relay **I10**).

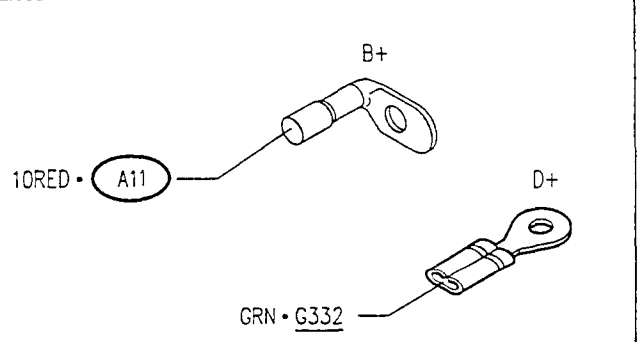
When the engine is running, the direct current generated by the alternator **A3** (pin B+) is sent via the starter motor **A11**, to recharge the battery **A1**.
All the lines for supplying the various electric systems of the car branch from the terminal board **G56**, connected to the + post of the battery **A1** (see "Power Supply").
When the alternator is not turning and therefore not charging the battery, an earth signal is sent from pin D+ to the instrument cluster **C10** to turn on the corresponding warning light; once the engine has started this signal becomes 12 V and the warning light goes off.

COMPONENTS AND CONNECTORS (Boxer versions)

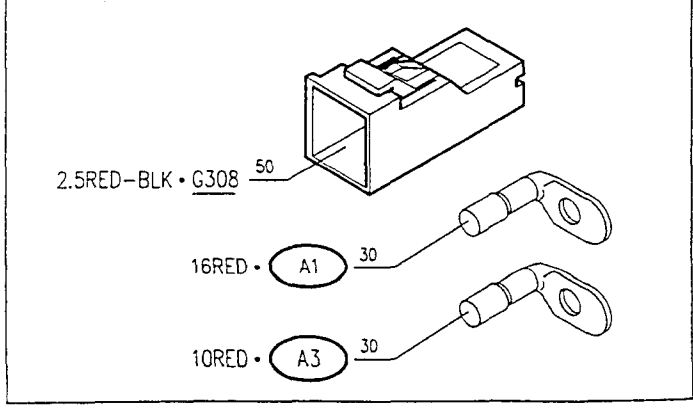
Battery A1



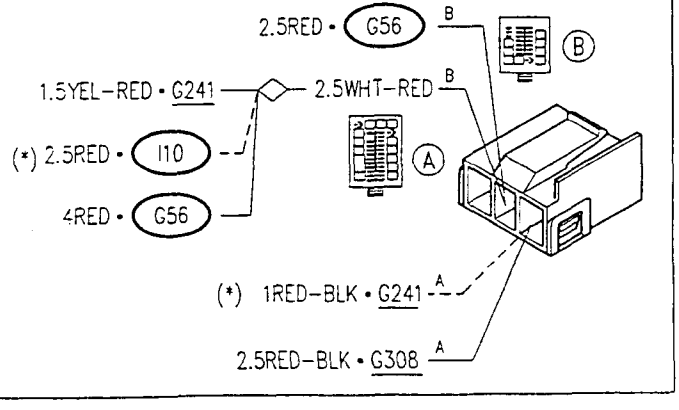
Alternator, with built-in voltage regulator A3



Starter motor A11



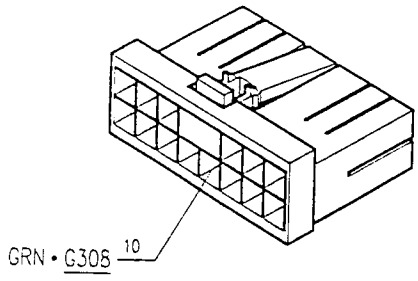
Ignition switch B1 B

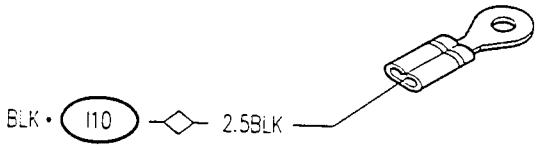


(*) Variant for cars without ALFA ROMEO CODE, but with anti-theft system

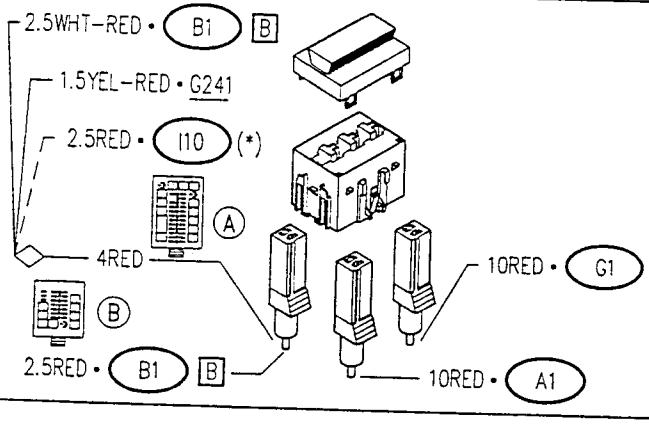
COMPONENTS AND CONNECTORS (cont.d)

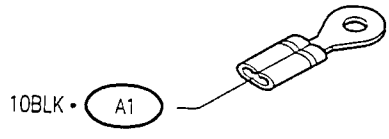
Instrument cluster	C10 A	LH engine compartment earth(*)	G53b



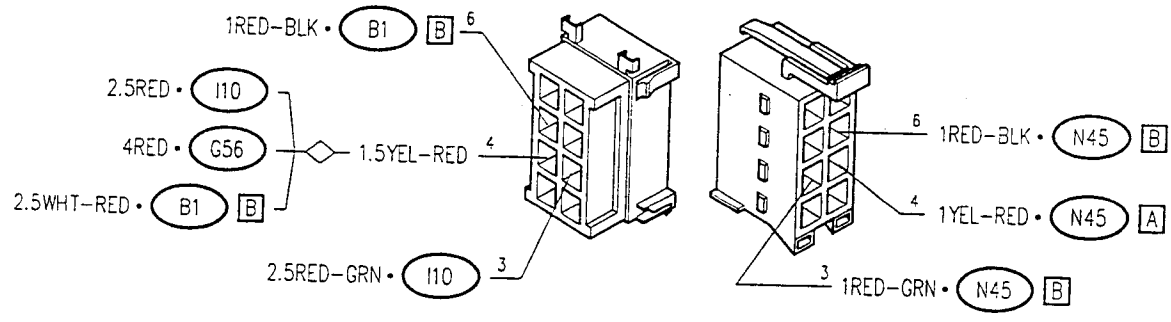


Branch terminal board	G56	Centre services tray earth	G143

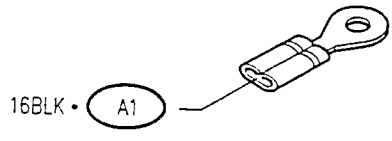




Anti-theft device wiring connector (*)	G241



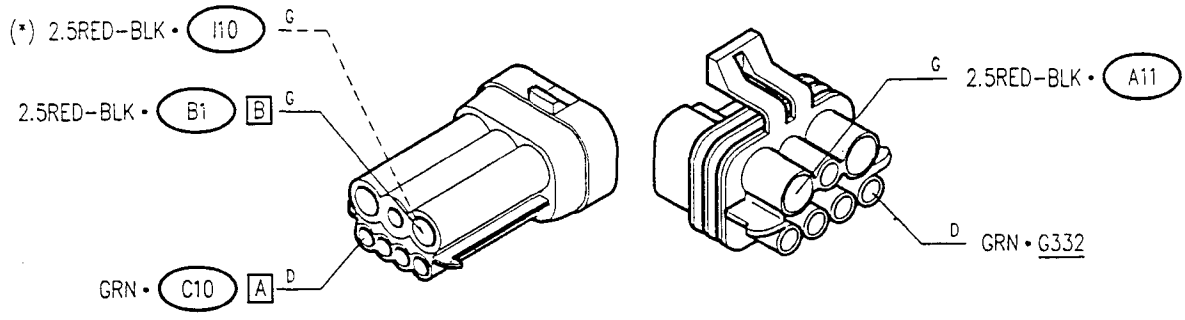
Earth on crankcase	G267



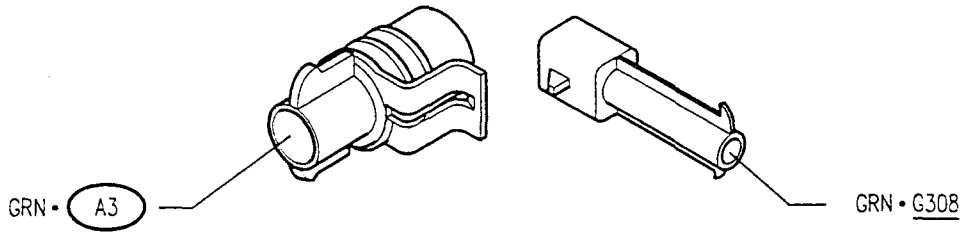
(*) Variant for cars without ALFA ROMEO CODE, but with anti-theft system

COMPONENTS AND CONNECTORS (cont.d)

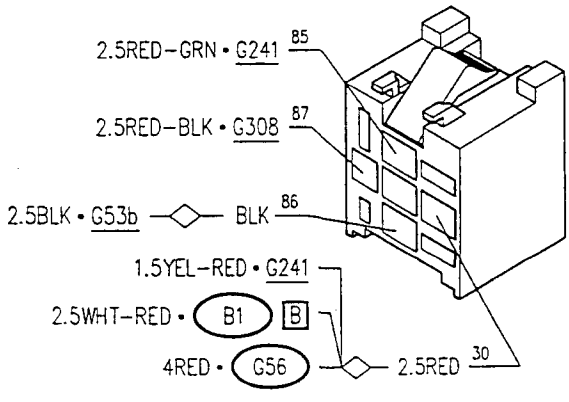
Engine sensors connector	G308

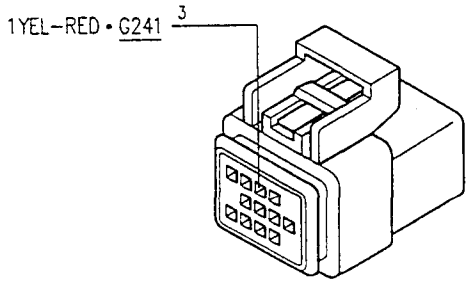


Alternator connector for recharging signal	G332

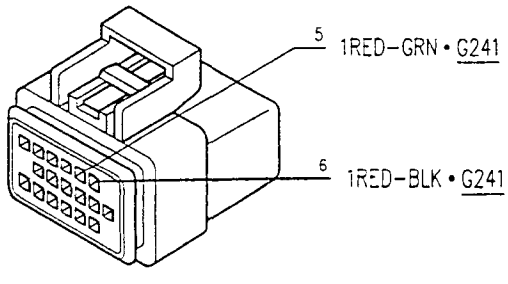


Starting consent relay(*)	I10	Anti-theft control unit(*)	N45 A



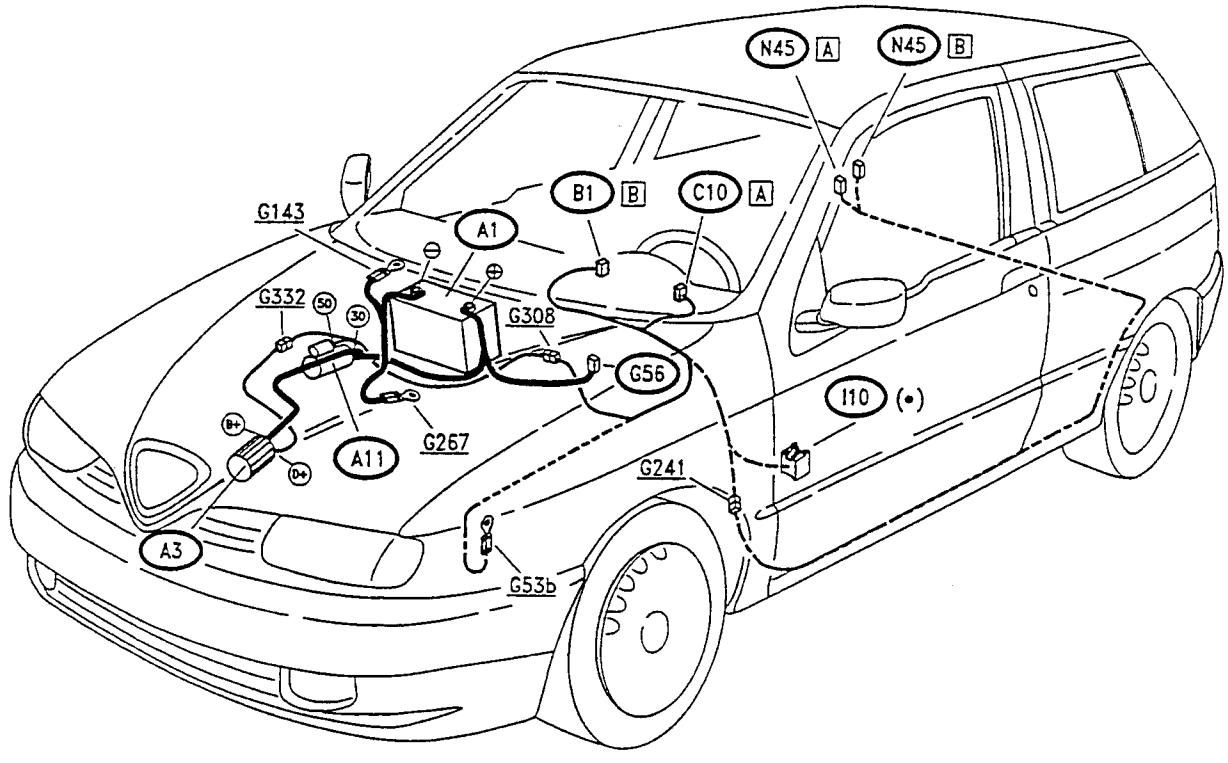


Anti-theft control unit (*)	N45 B



((*) Variant for cars without ALFA ROMEO CODE, but with anti-theft system

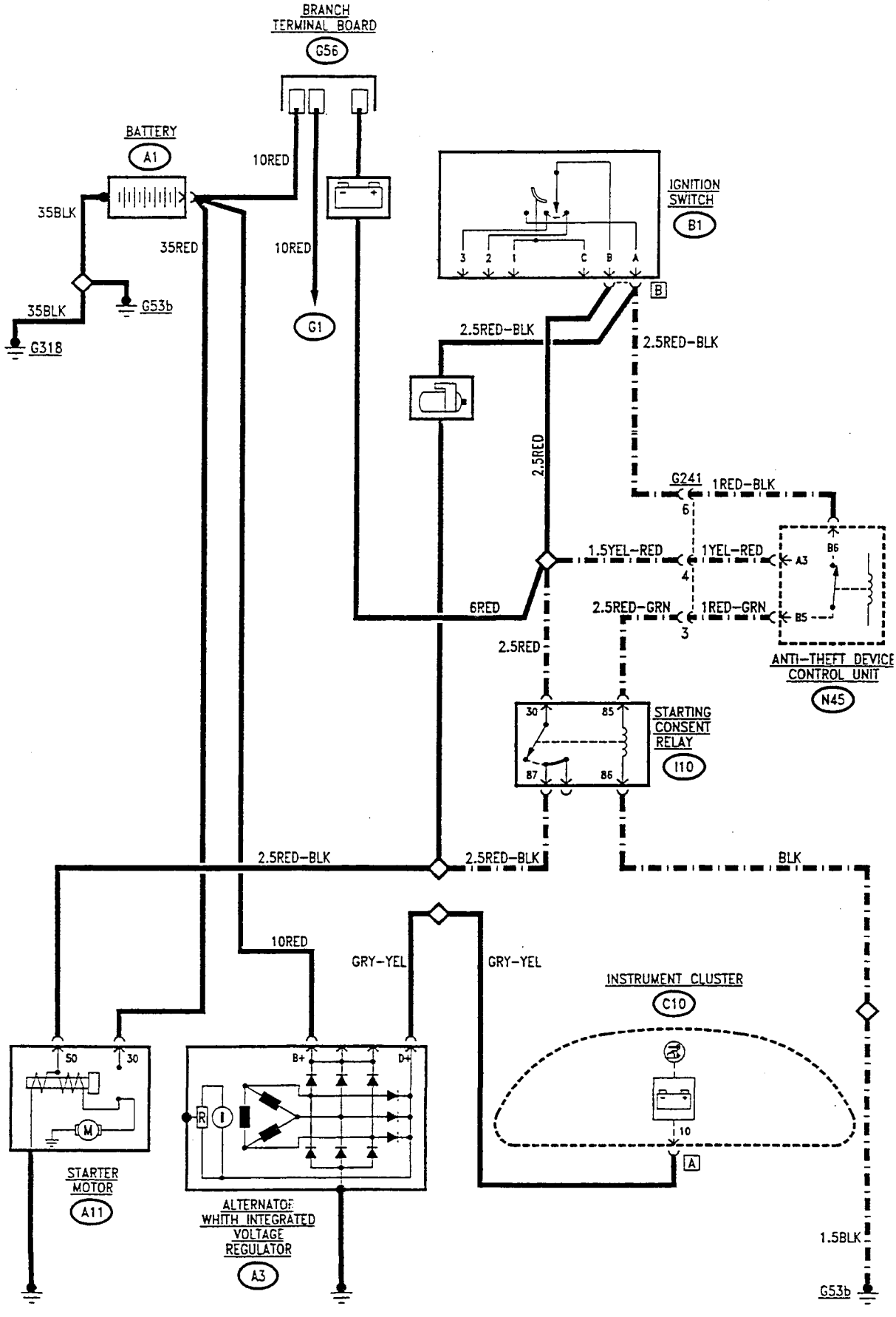
LOCATION OF COMPONENTS (Boxer versions)



_ _ _ _ _ Variant for cars without ALFA ROMEO CODE, but with anti-theft system

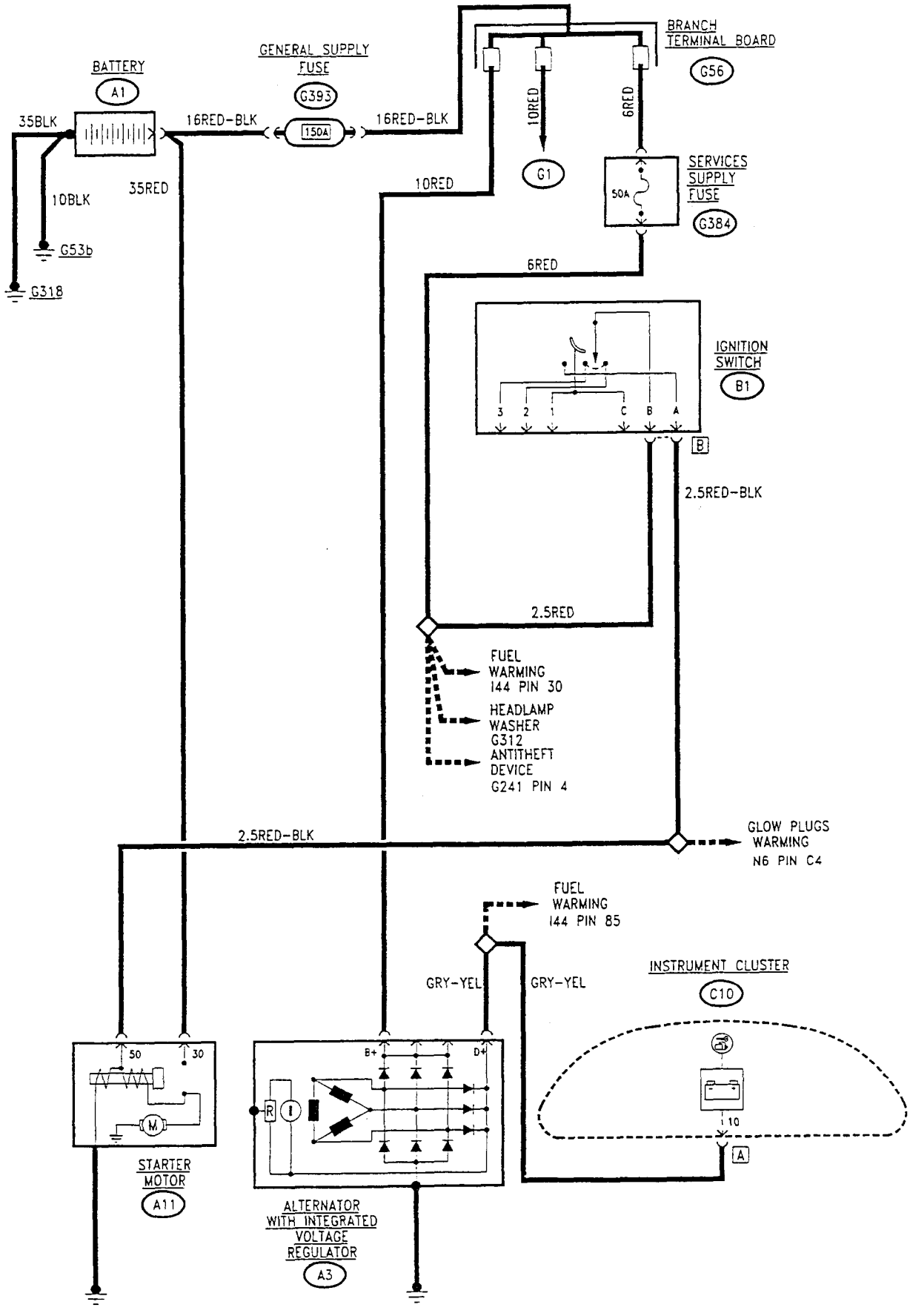
(•) yellow base

WIRING DIAGRAM (TD version - up to chassis no.....)

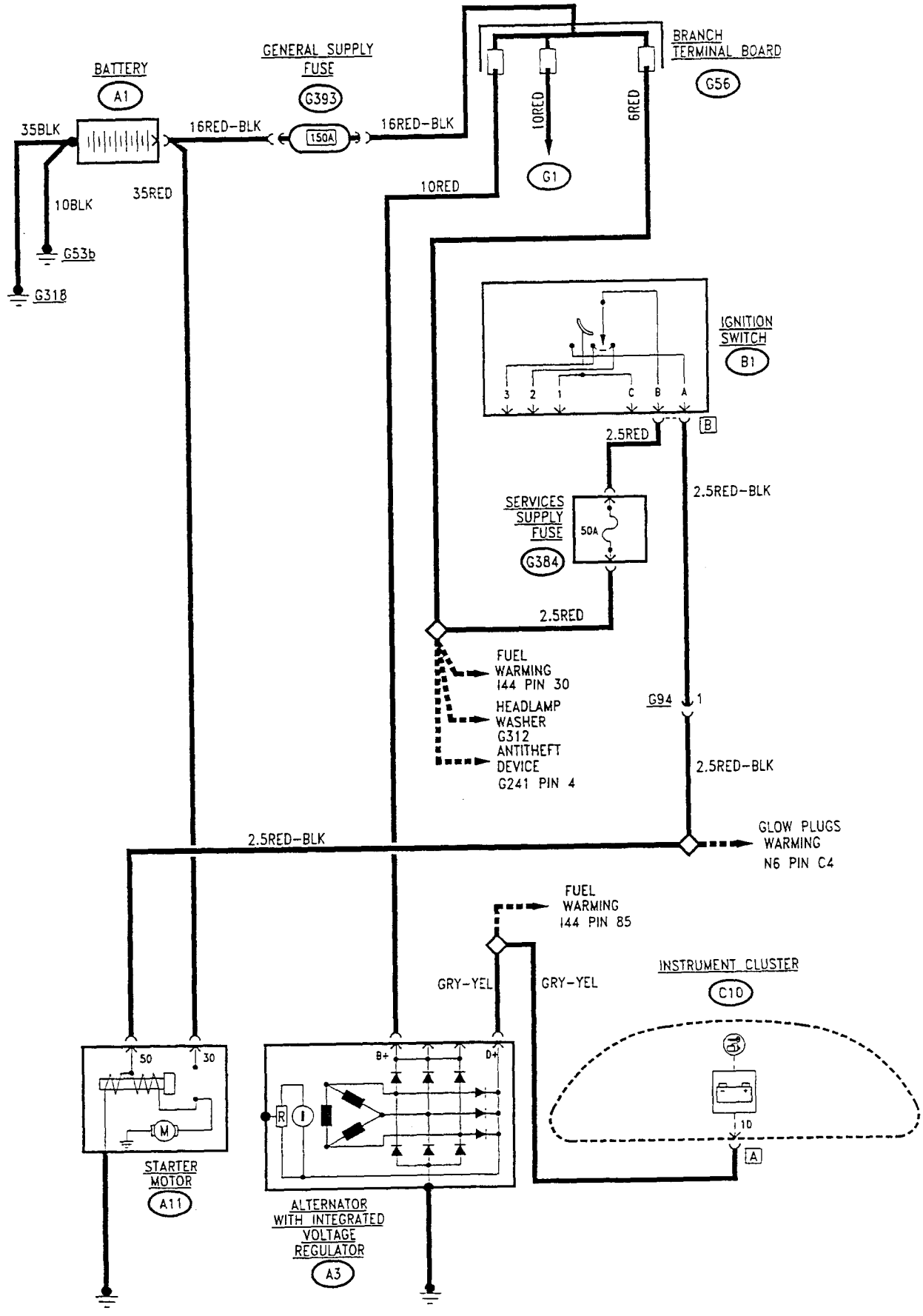


— • — • — variant for cars without ALFA ROMEO CODE, but with theft alarm

WIRING DIAGRAM (TD version - from chassis no.....)



WIRING DIAGRAM (TD-CAT version)



FUNCTIONAL DESCRIPTION (TD version)

When the key in the ignitions switch **B1** is turned to the "START" position, it energises the winding of the electromagnet (pin 50) of the starter motor **A11** and supplies (pin 30) the starter motor itself with current leading directly from the battery **A1** thereby cranking the engine (in cars without ALFA ROMEO CODE, but fitted with car alarm, the starter motor supply "crosses" the theft alarm control unit **N45** (pin B5 - B6) which cuts off the supply in the event of an alarm and the starting consent relay **I10**).

When the engine is running, the direct current generated by the alternator **A3** (pin B+) is sent to recharge the battery **A1**; from chassis no..... via the branch terminal box **G56** .
All the lines for supplying the various electric systems of the car branch from the terminal box **G56** connected to the + terminal of the battery **A1** (see "Supply").
When the alternator is not turning and therefore not charging the battery, an earth signal is sent from pin D+ to the instrument cluster **C10** to turn on the corresponding warning light; once the engine has been started this signal becomes 12 V and the warning light goes off.

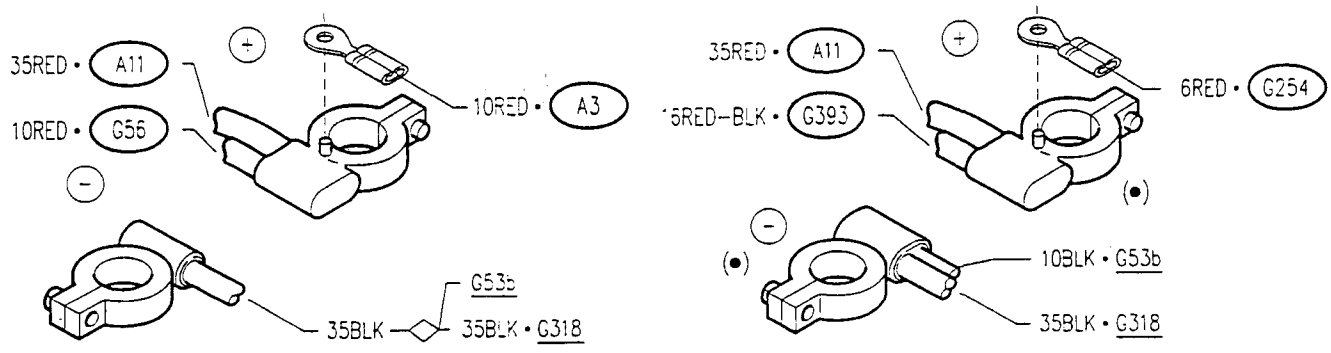
FUNCTIONAL DESCRIPTION (TD-CAT version)

When the key in the ignitions switch **B1** is turned to the "START" position, it energises the winding of the electromagnet (pin 50) of the starter motor **A11** and supplies (pin 30) the starter motor itself with current leading directly from the battery **A1** thereby cranking the engine.

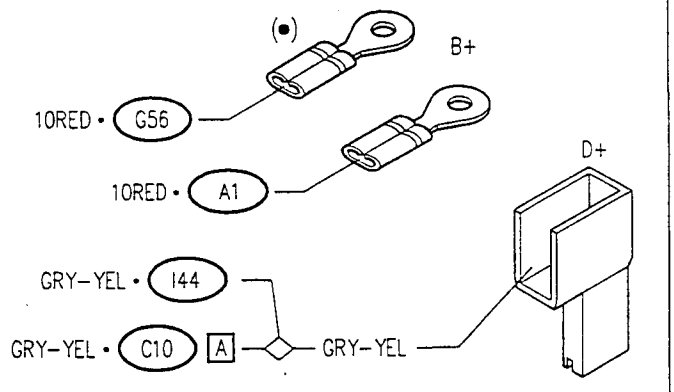
When the engine is running, the direct current generated by the alternator **A3** (pin B+) is sent to recharge the battery **A1**; via the branch terminal box **G56** .
All the lines for supplying the various electric systems of the car branch from the terminal box **G56** connected to the + terminal of the battery **A1** (see "Supply").
When the alternator is not turning and therefore not charging the battery, an earth signal is sent from pin D+ to the instrument cluster **C10** to turn on the corresponding warning light; once the engine has been started this signal becomes 12 V and the warning light goes off.

COMPONENTS AND CONNECTORS (TD version)

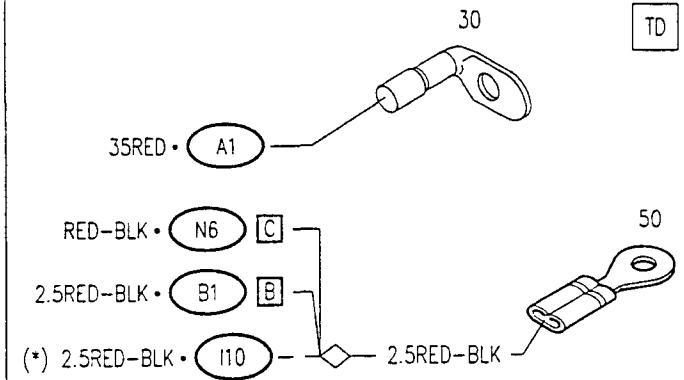
Battery — A1



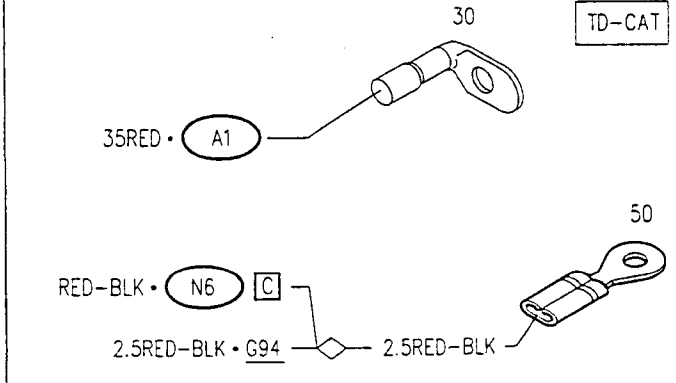
Alternator, with built-in voltage regulator — A3



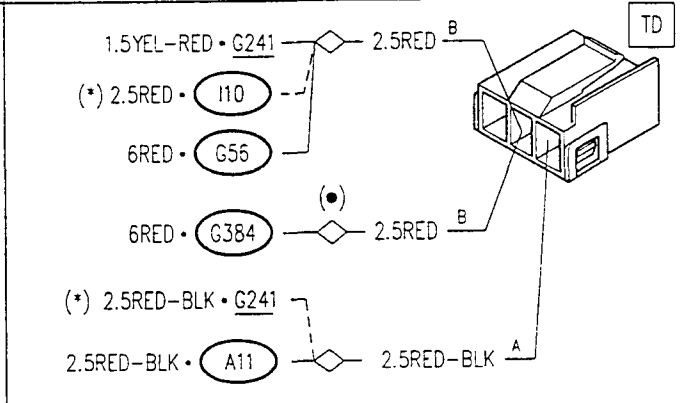
Starter motor — A11



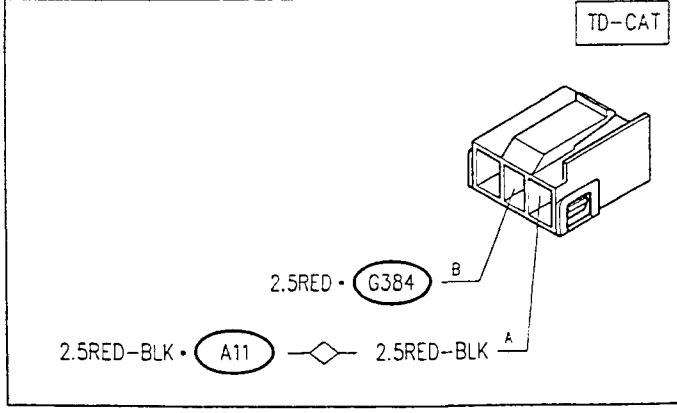
Starter motor — A11



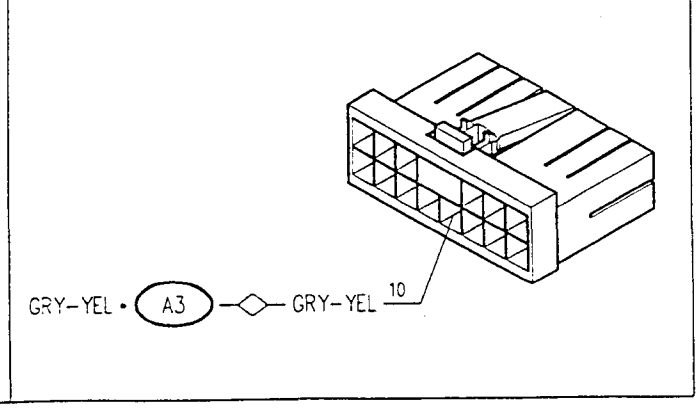
Ignition switch — B1 B



Ignition switch — B1 B



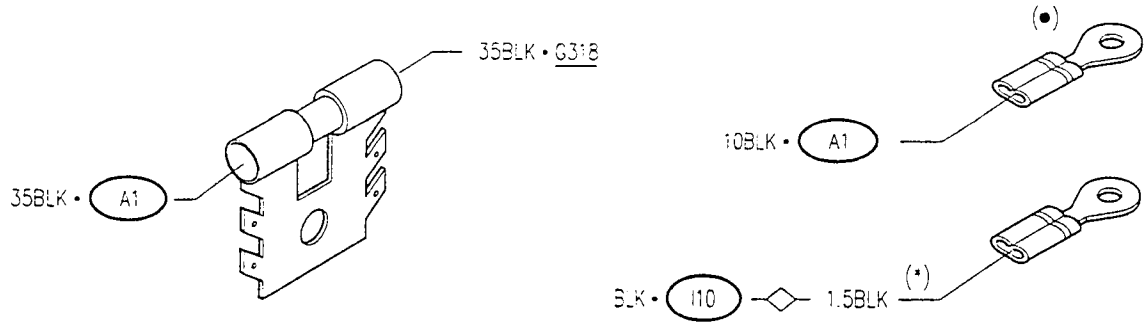
Instrument cluster — C10 A



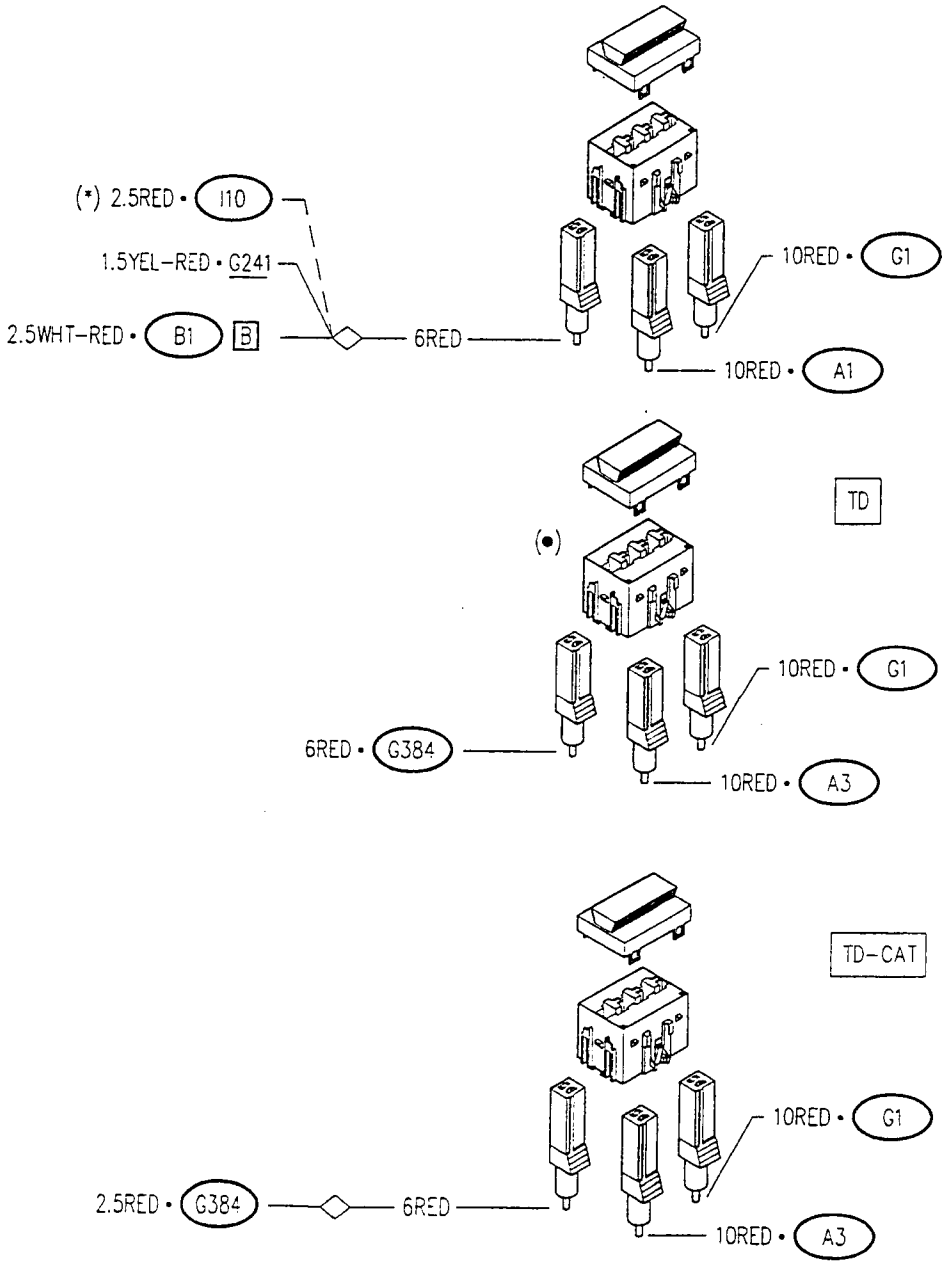
(*) Versions without ALFA ROMEO CODE, but with anti-theft system
(•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

LH enging compt. earth	G53b



Branch terminal box	G56

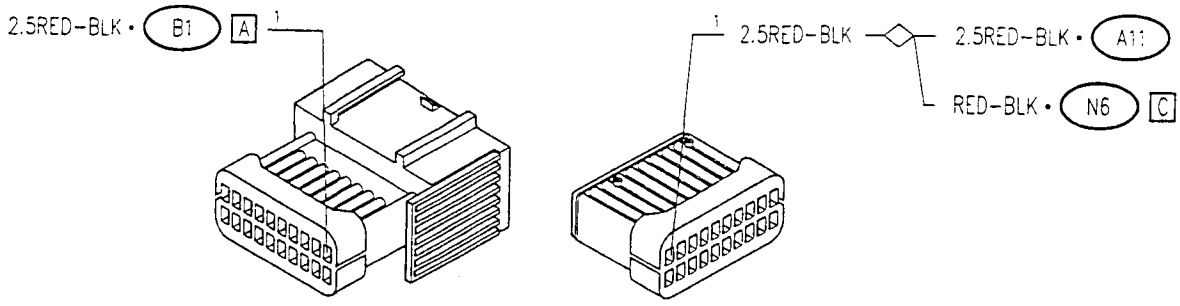


(*) Versions without ALFA ROMEO CODE, but with anti-theft system

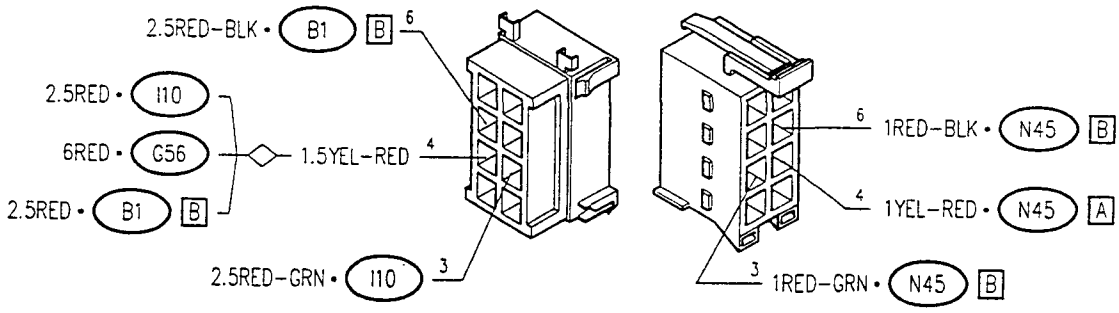
(•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

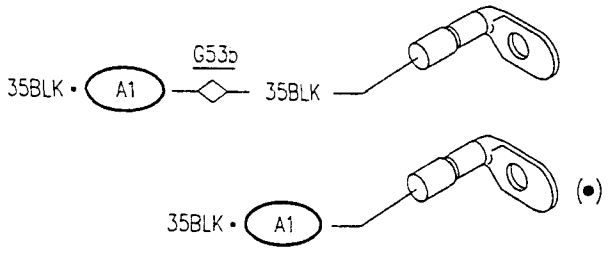
Engine compartment connection — G94



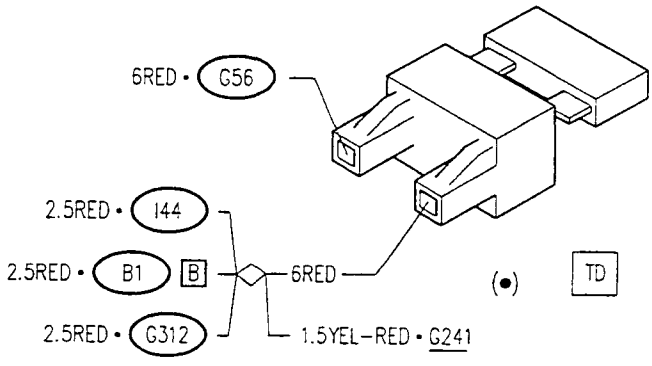
Alarm wiring connector (*) — G241



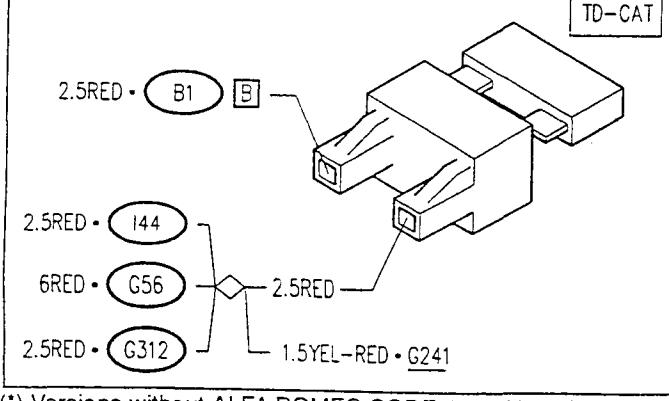
Earth on gearbox — G318



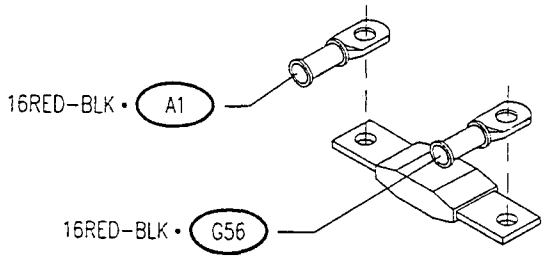
Services supply fuse — G384



Services supply fuse — G384



General supply fuse (•) — G393

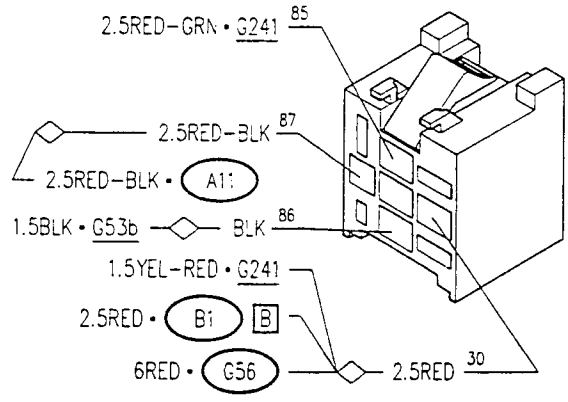


(*) Versions without ALFA ROMEO CODE, but with anti-theft system

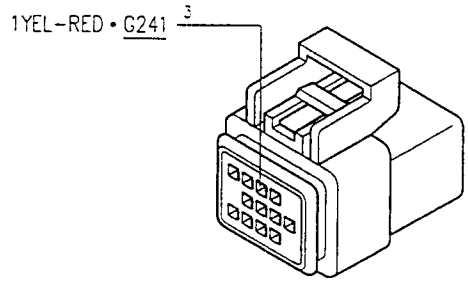
(•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

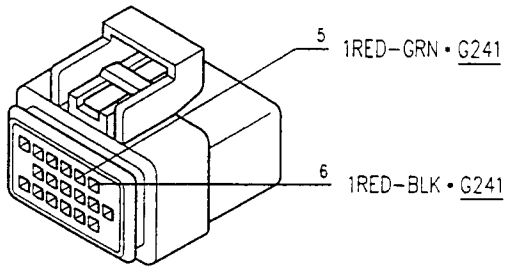
Starting consent relay (*) — I10



Alarm control unit (*) — N45 A

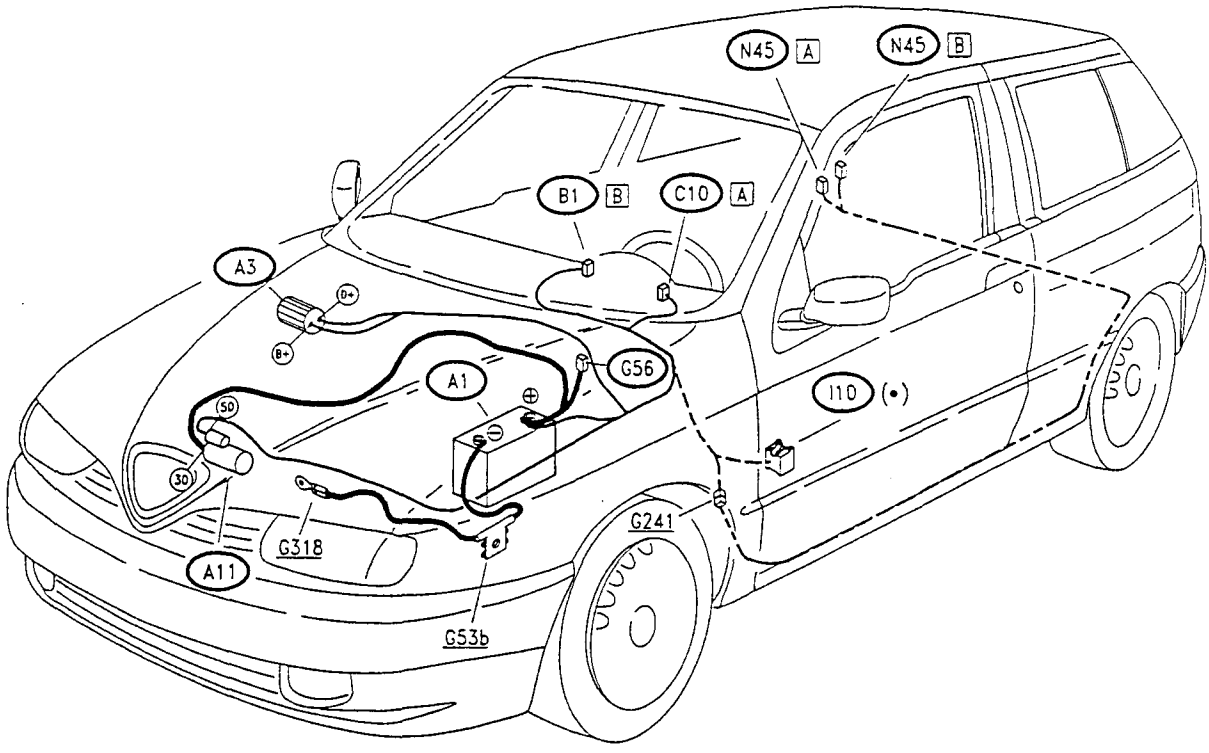


Alarm control unit (*) — N45 B

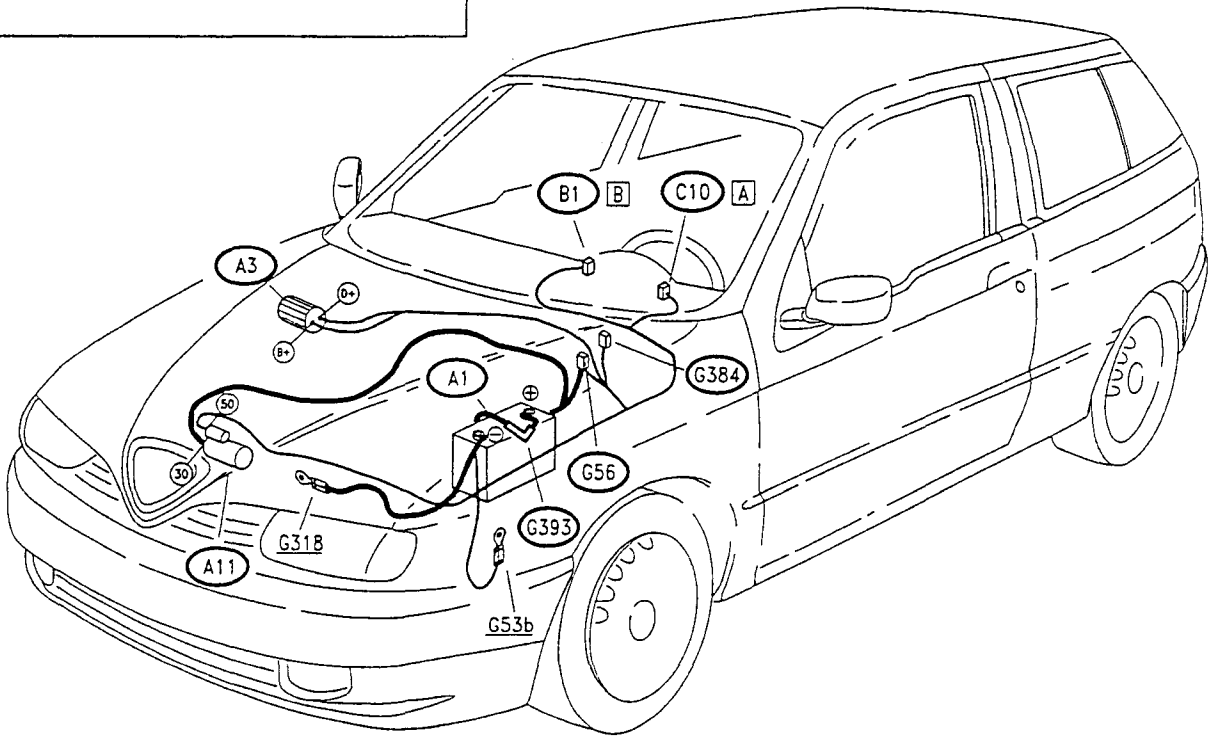


(*) Versions without ALFA ROMEO CODE, but with anti-theft system

LOCATION OF COMPONENTS (TD version)



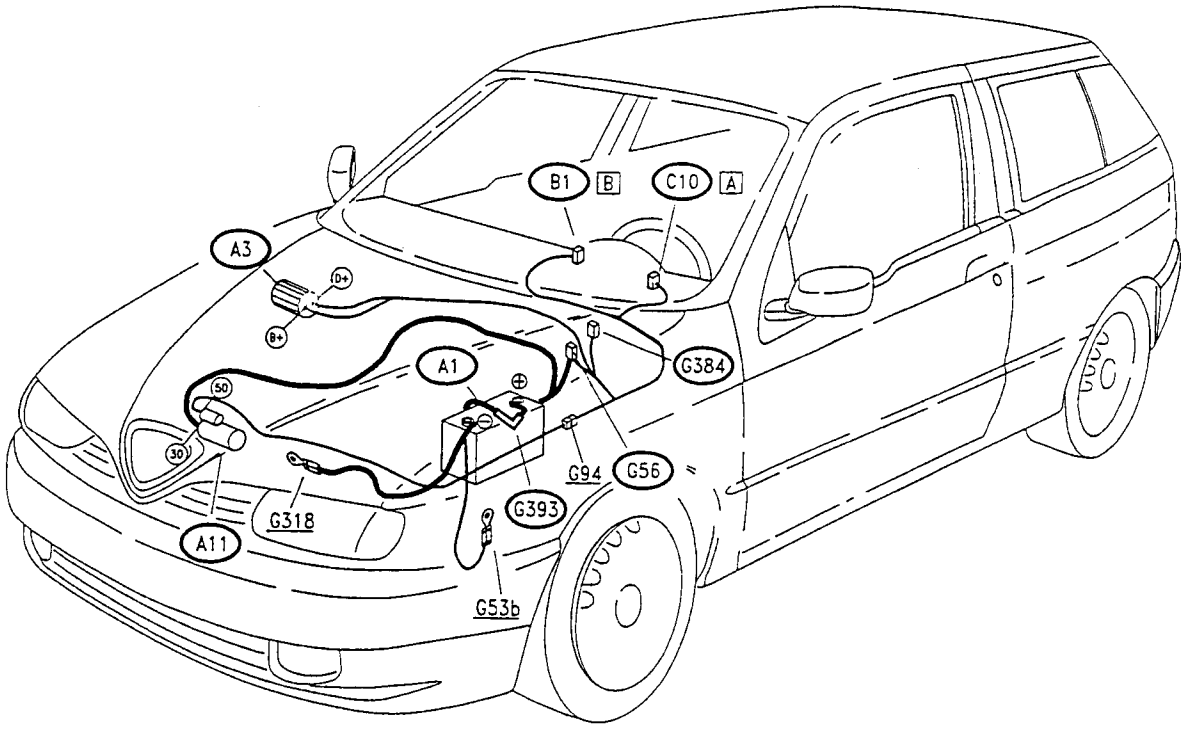
Variant from chassis no.....



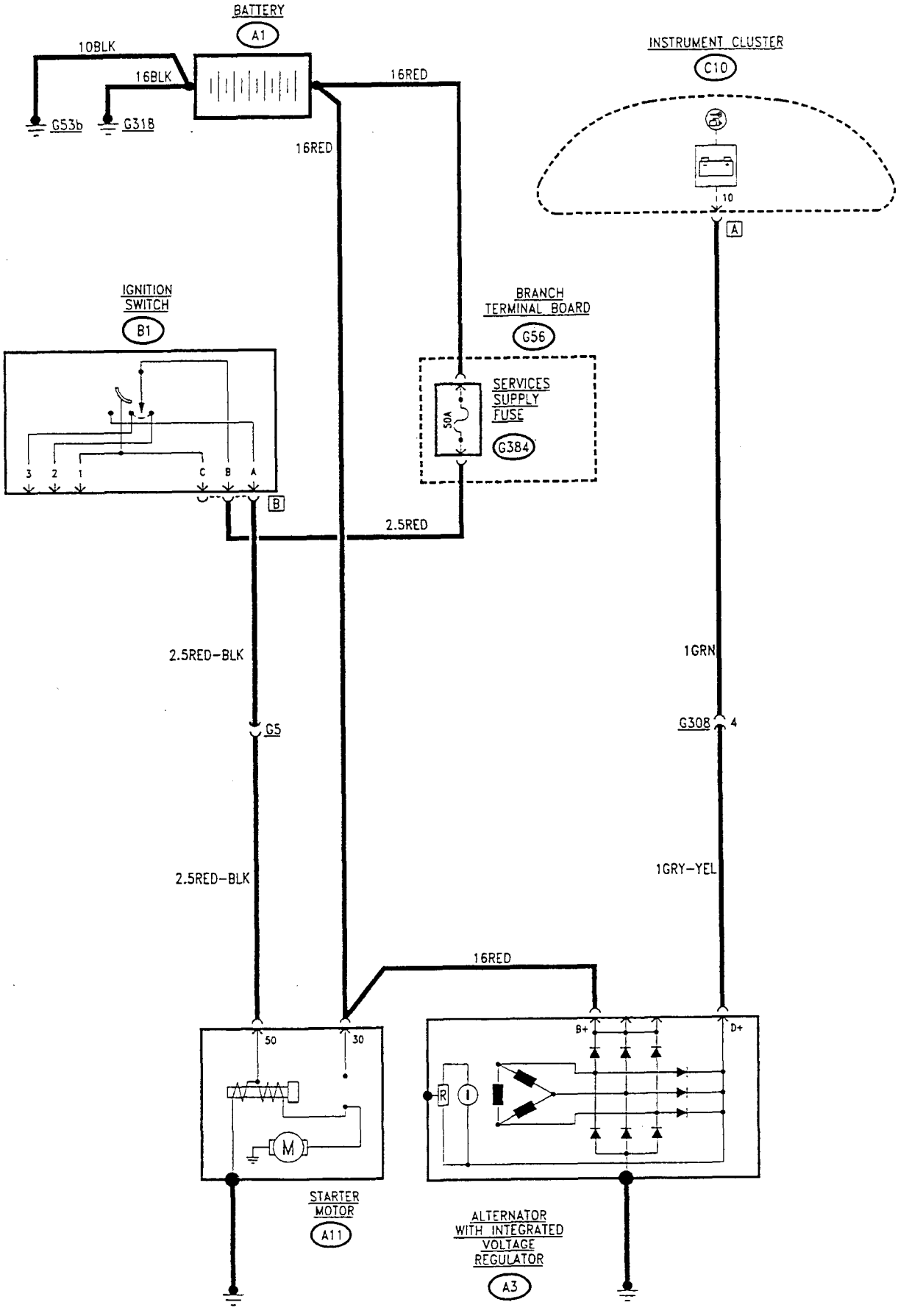
– – – – variant for cars without ALFA ROMEO CODE, but with theft alarm

(•) yellow base

LOCATION OF COMPONENTS (TD-CAT version)



WIRING DIAGRAM (T.SPARK version)

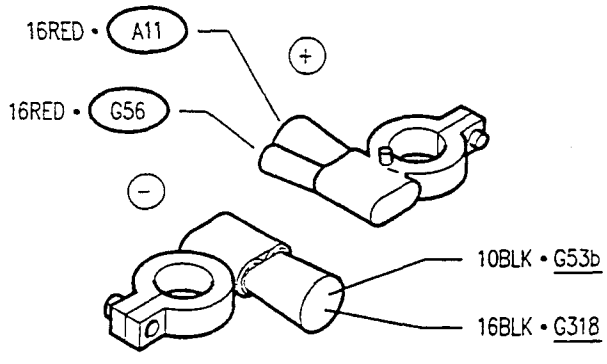
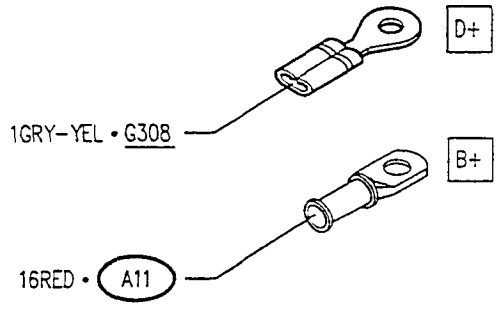
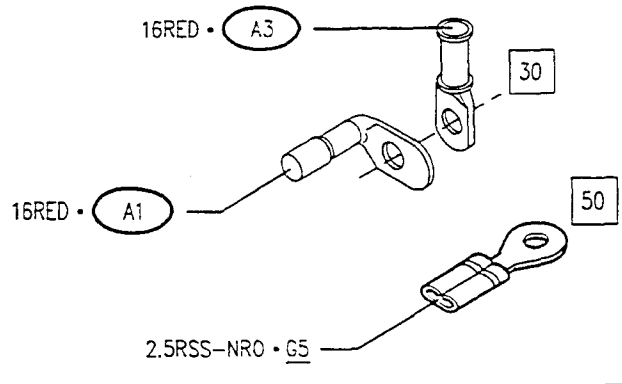
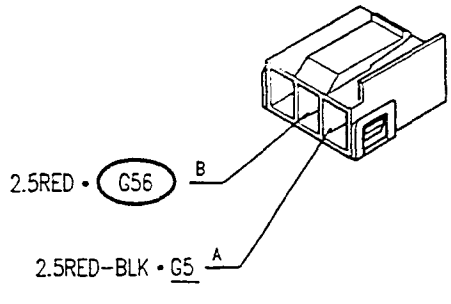


FUNCTIONAL DESCRIPTION (T.SPARK version)

When the key in the ignitions switch **B1** is turned to the "START" position, it energises the winding of the electromagnet (pin 50) of the starter motor **A11** and supplies (pin 30) the starter motor itself with current leading directly from the battery **A1** thereby cranking the engine.

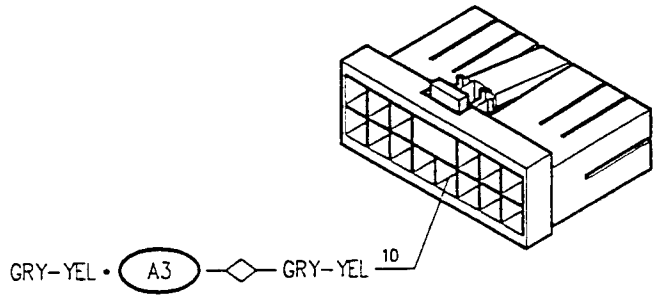
When the engine is running, the direct current generated by the alternator **A3** (pin B+) is sent to recharge the battery **A1** via the starter motor **A11**.
All the lines for supplying the various electric systems of the car branch from the terminal box **G56** connected to the + terminal of the battery **A1** (see "Supply"), in particular the supply for the ignition switch **B1** via fuse **G384** (50A)
When the alternator is not turning and therefore not charging the battery, an earth signal is sent from pin D+ to the instrument cluster **C10** to turn on the corresponding warning light; once the engine has been started this signal becomes 12 V and the warning light goes off.

COMPONENTS AND CONNECTORS (T.SPARK version)

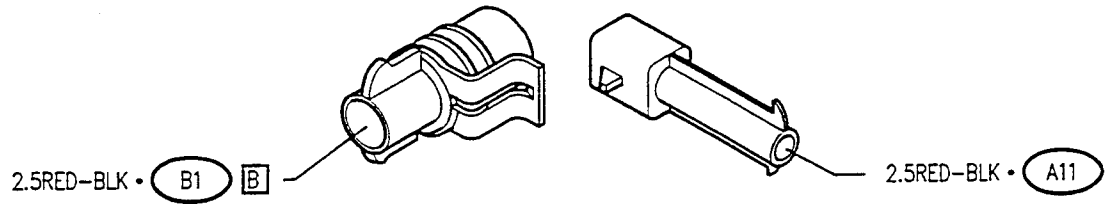
Battery	A1	Alternator, with built-in voltage regulator	A3
			
Starter motor	**A11**	**Ignition switch**	**B1 B**
			

COMPONENTS AND CONNECTORS (contd.)

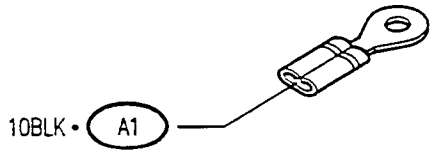
Instrument cluster	C10 A



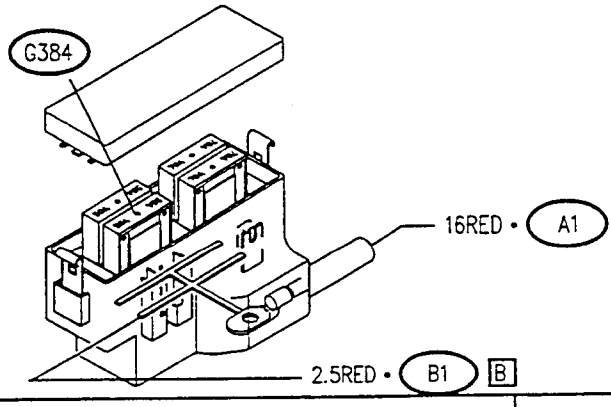
Single connector	G5



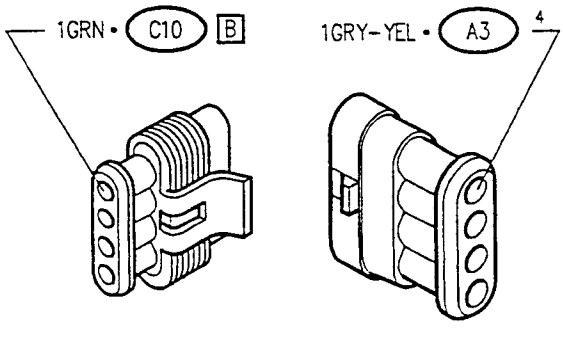
LH engine compt. earth	G53b



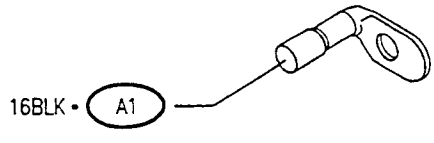
Branch terminal box	G56



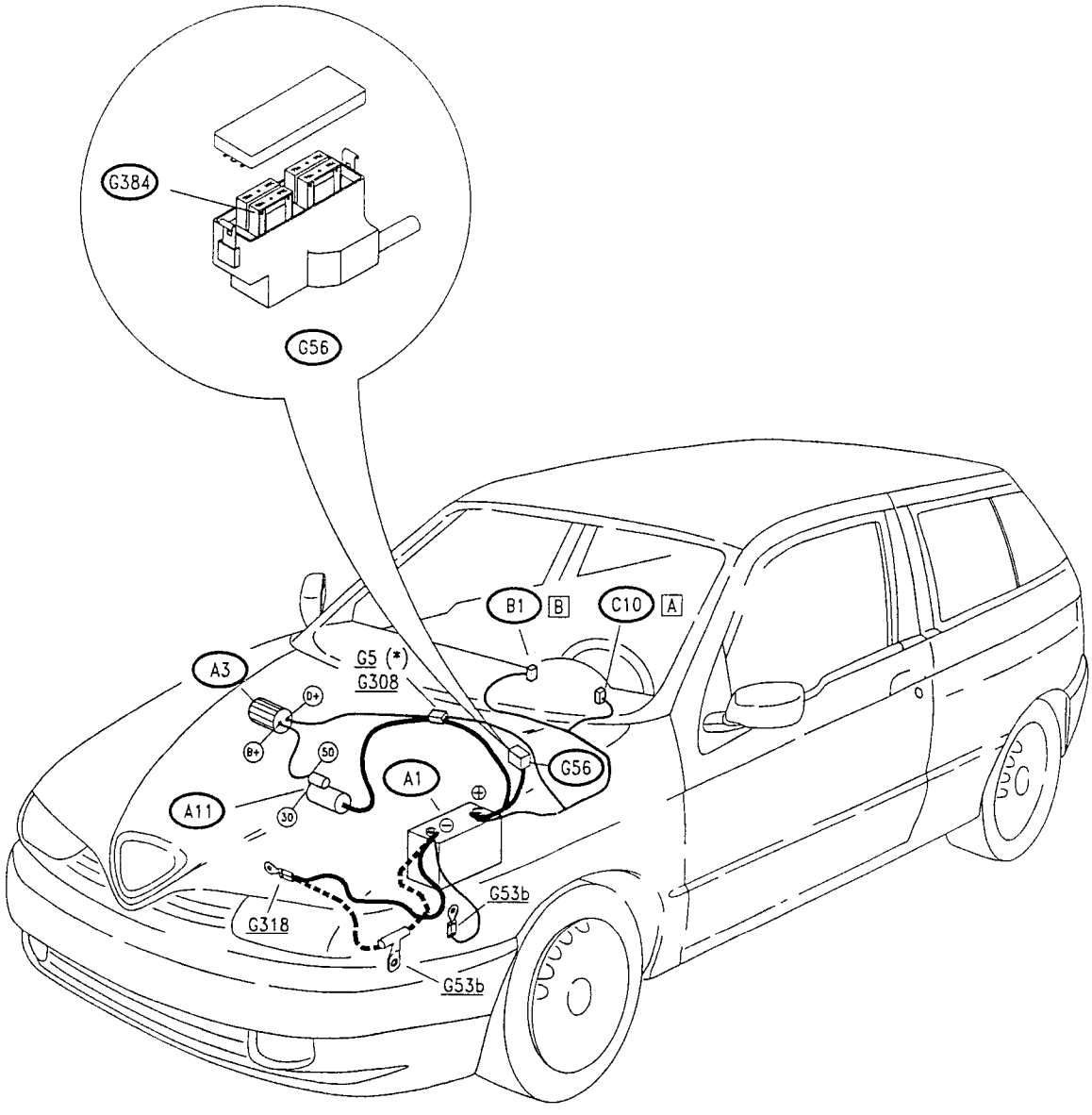
Engine sensors connector	G308



Earth on gearbox	G318

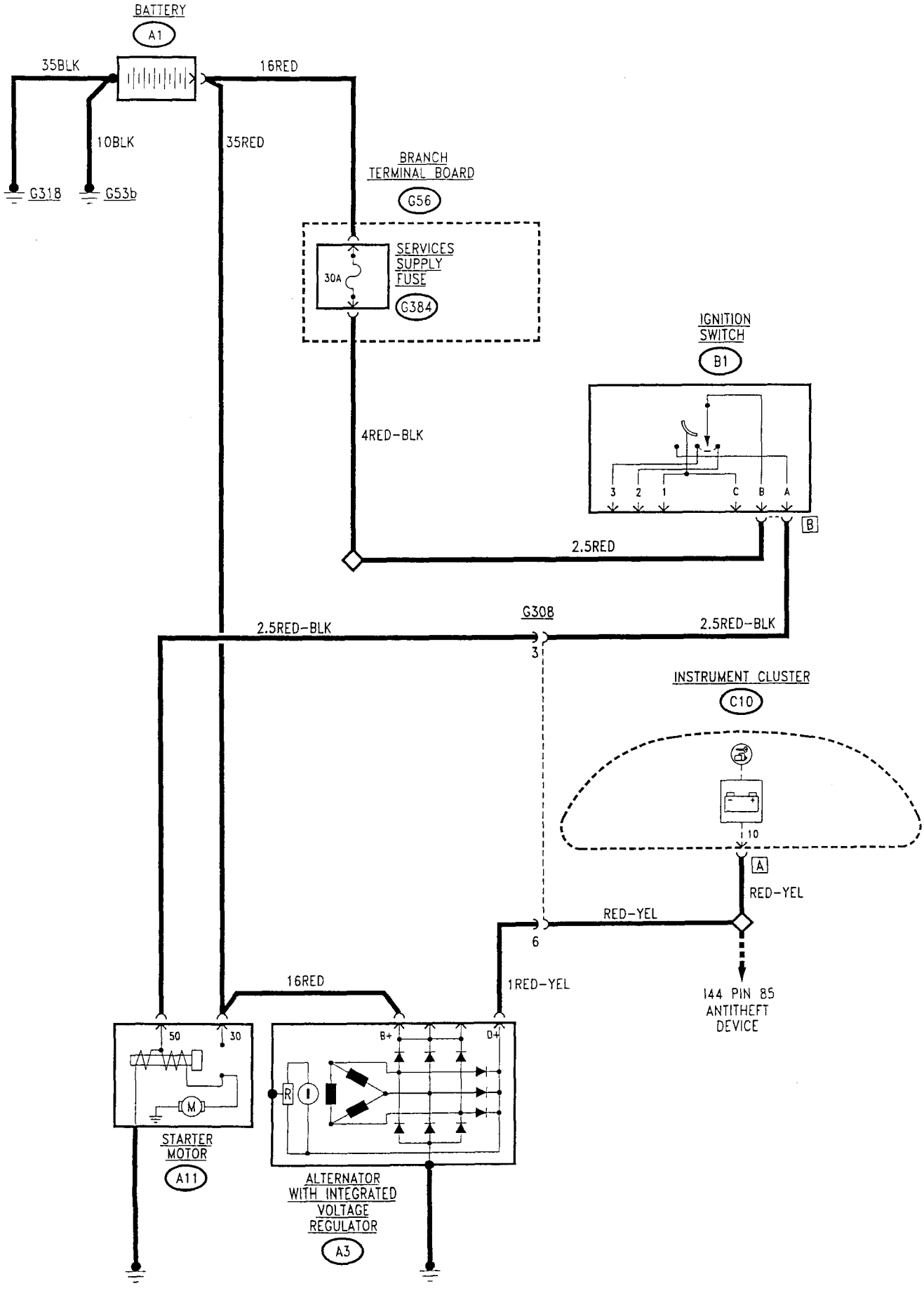


LOCATION OF COMPONENTS (T.SPARK version)



(*) Up to Model Year '97
— — — From Model Year '98

WIRING DIAGRAM (JTD version)

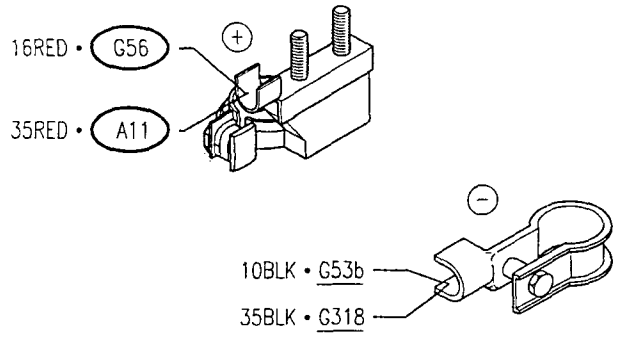
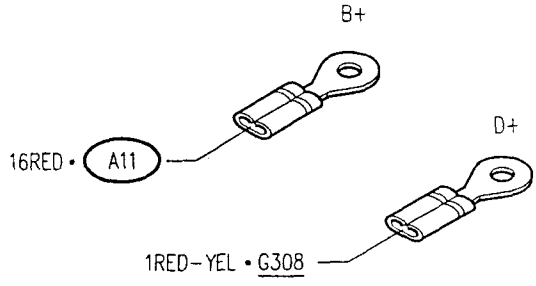
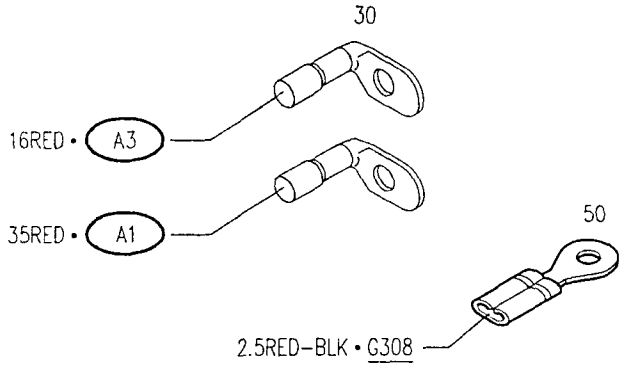
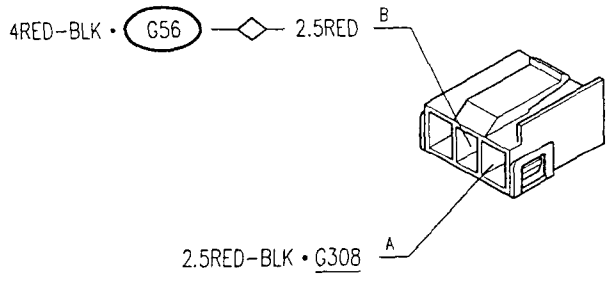
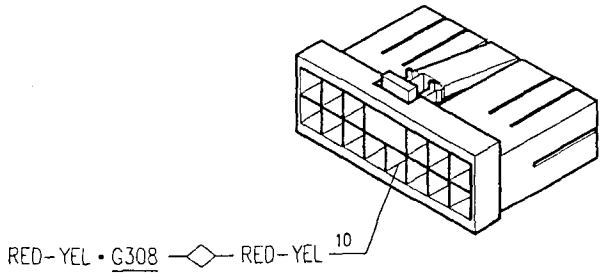
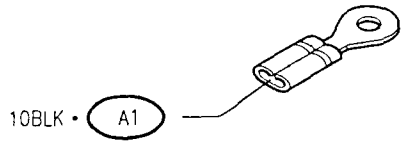


FUNCTIONAL DESCRIPTION (JTD version)

When the key in the ignitions switch **B1** is turned to the "START" position, it energises the winding of the electromagnet (pin 50) of the starter motor **A11** and supplies (pin 30) the starter motor itself with current leading directly from the battery **A1** thereby cranking the engine.
When the engine is running, the direct current generated by the alternator **A3** (pin B+) is sent to recharge the battery **A1** via the starter motor **A11**.

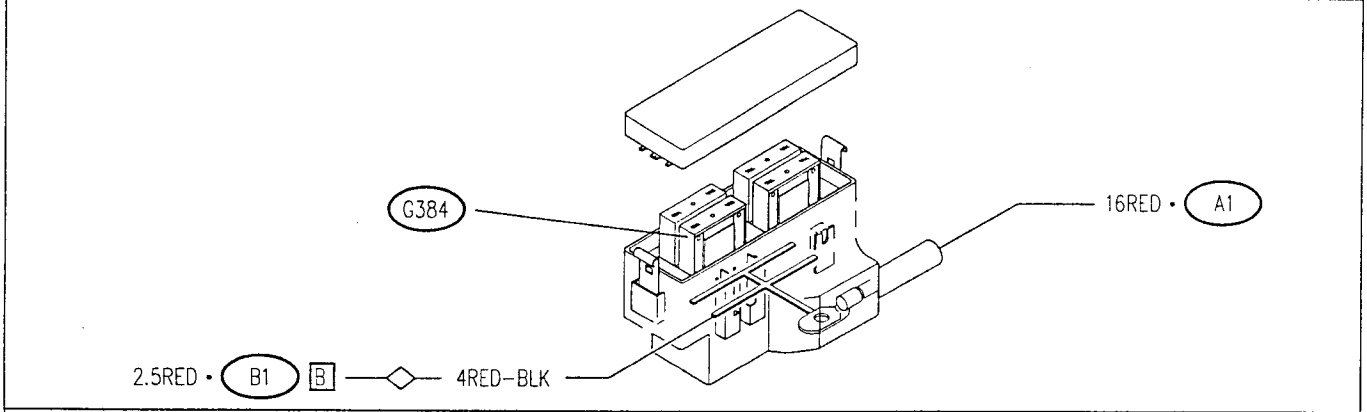
All the lines for supplying the various electric systems of the car branch from the terminal box **G56** connected to the + terminal of the battery **A1** (see "Supply"), in particular the supply for the ignition switch **B1** via fuse **G384** (30A). When the alternator is not turning and therefore not charging the battery, an earth signal is sent from pin D+ to the instrument cluster **C10** to turn on the corresponding warning light; once the engine has been started this signal becomes 12 V and the warning light goes off.

COMPONENTS AND CONNECTORS (JTD version)

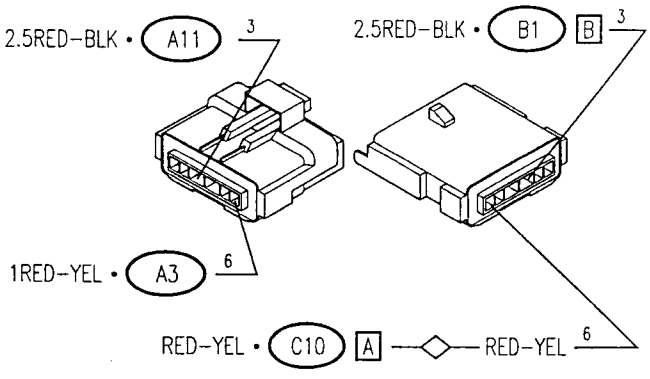
Battery	A1	Alternator, with built-in voltage regulator	A3
			
Starter motor	**A11**	**Ignition switch**	**B1** **B**
			
Instrument cluster	**C10** **A**	**LH engine compartment earth**	**G53b**
			

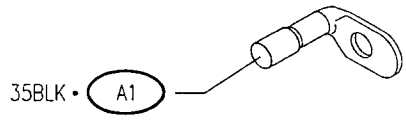
COMPONENTS AND CONNECTORS (contd.)

Branch terminal board	G56

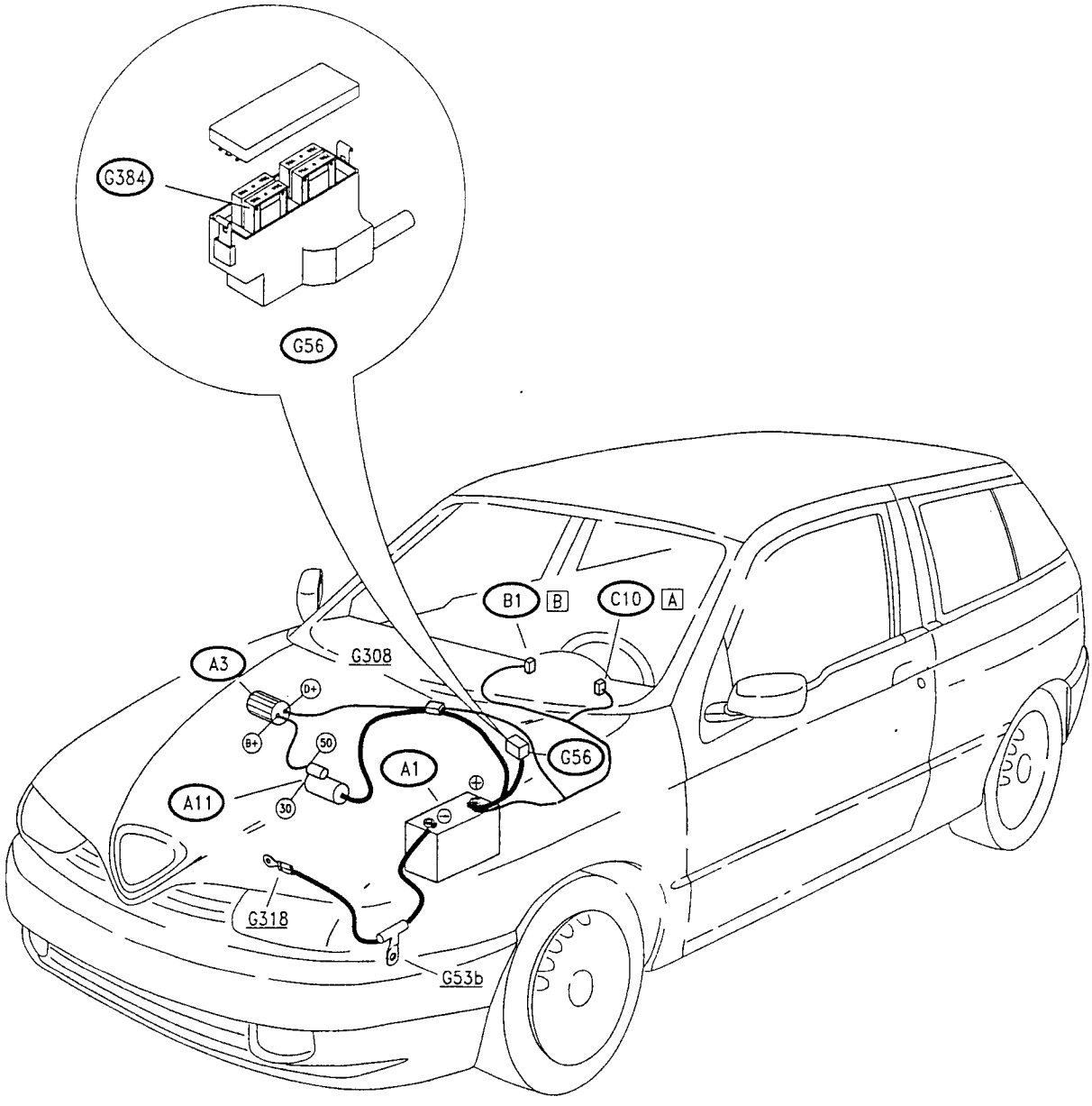


Connector for engine sensors	G308	Earth on gearbox	G318





LOCATION OF COMPONENTS (JTD version)



FAULT-FINDING TABLE

Fault	Component to be checked						
	A1	B1	G384 (*)	A11	A3	C10 (2)	I10 (1)
Engine starting (1)	•	•	•	•			•
Charging	•				•		
Charge warning light					•	•	

(1) Only for cars **without** ALFA ROMEO CODE, but **with** theft alarm: beforehand check that the theft alarm is working properly (see "Theft Alarm" section) as it may have cut off the supply to the starter motor.

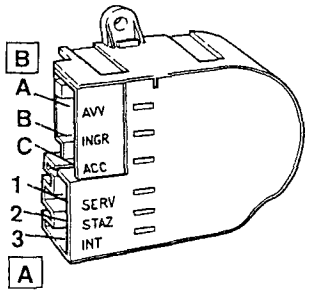
(2) The instrument cluster **C10** cannot be overhauled. Therefore, in the event of a fault it is not possible to replaced individual warning lights and a complete new instrument cluster must be installed.

(*) TD version only, from chassis no.....; T.SPARK and JTD

CHECKING COMPONENTS

Ignition switch (B1)

Check the internal connections following the table below:

Reed identification codes	POSITION OF KEY			
	PARK	key can be removed	STOP key can be removed	DRIVE key not removable
				

AVV
INGR
ACC
SERV
STAZ
INT

Starter motor (A11)

If necessary, refer to the starter motor specifications and instructions given in the section "ELECTRIC SYSTEM-ENGINE STARTING"

Alternator (A3)

If necessary, refer to the starter motor specifications and instructions given in the section "ELECTRIC SYSTEM-CURRENT GENERATION"

Battery (A1)

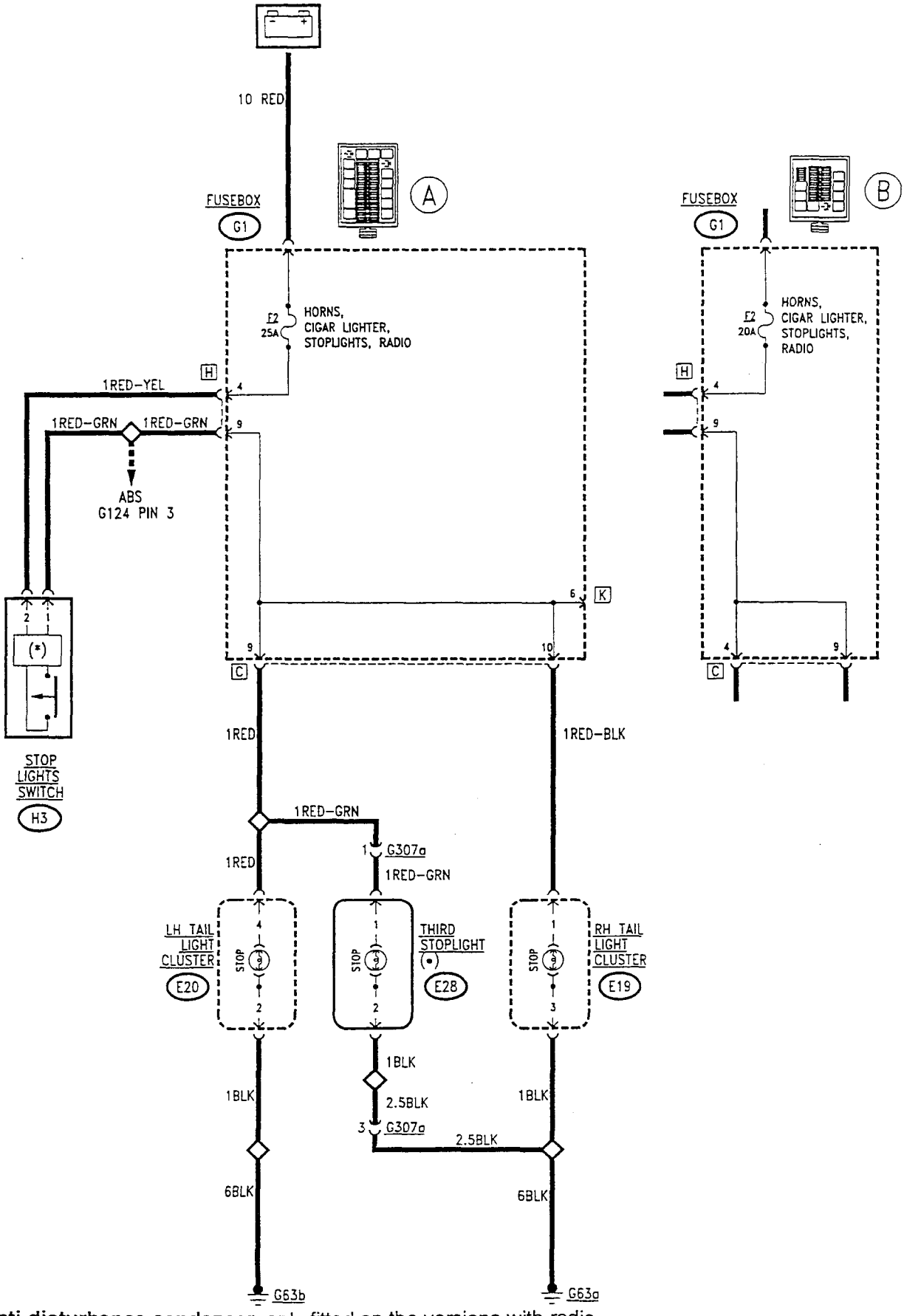
If necessary, refer to the starter motor specifications and instructions given in the section "ELECTRIC SYSTEM-CURRENT GENERATION"

STOP LIGHTS

INDEX

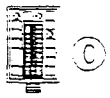
WIRING DIAGRAM 13-2
GENERAL DESCRIPTION 13-3
FUNCTIONAL DESCRIPTION 13-3
COMPONENTS AND CONNECTORS 13-3
FAULTFINDING TABLE 13-4
LOCATION OF COMPONENTS 13-5

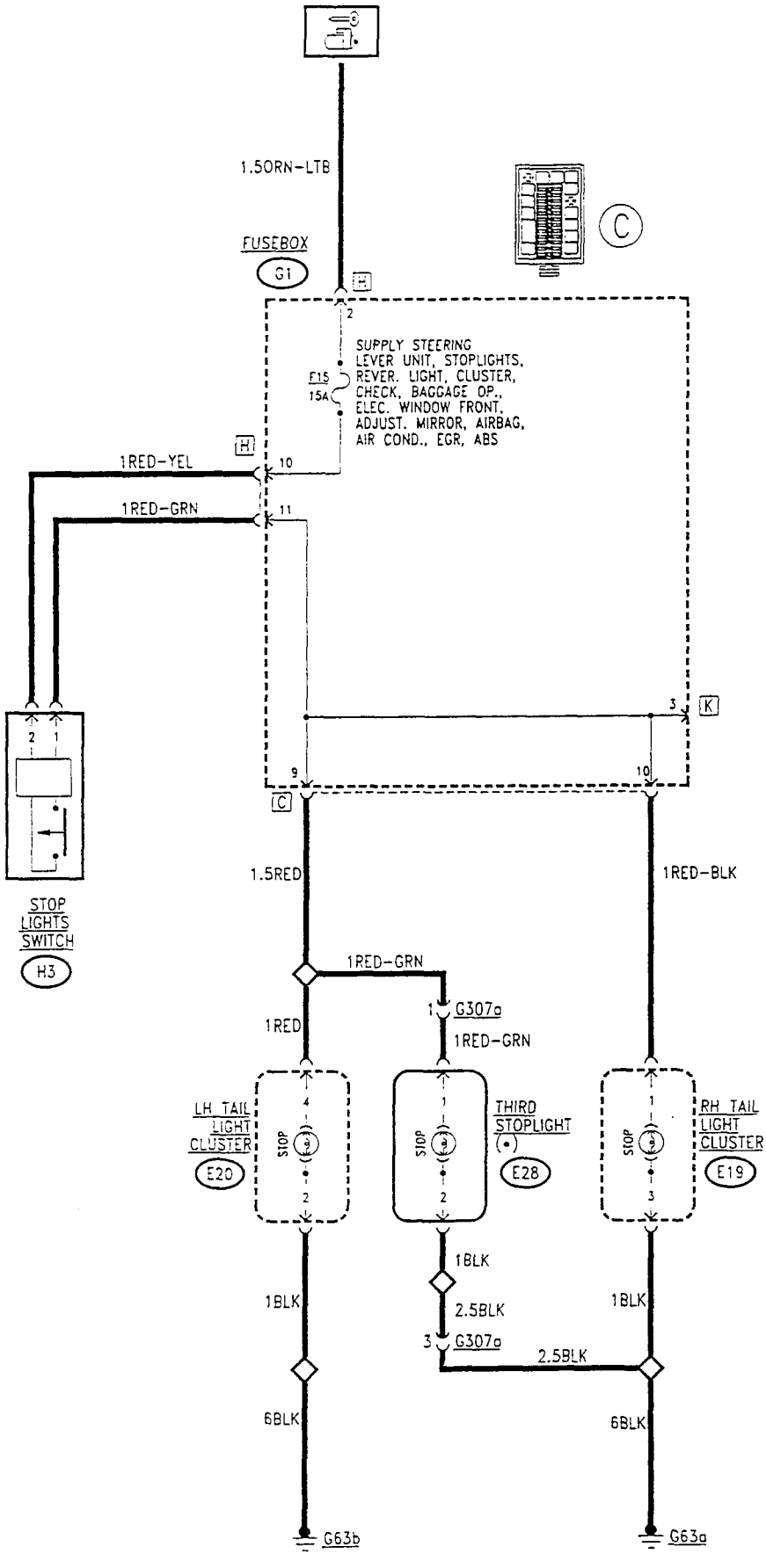
WIRING DIAGRAM



(*) **Anti-disturbance condenser**, only fitted on the versions with radio
(•) Only for certain Versions/Market

WIRING DIAGRAM





GENERAL DESCRIPTION

The car stop lights are operated each time the brake pedal is pressed; they are located at the rear in the side lights. The lights are turned on automatically through the switch on the brake pedal.
The circuit is protected by a special fuse.
The braking signal from the switch is also sent to the ABS system control unit which "recognizes" the situation and controls braking accordingly (see "ABS").
N.B.: In the versions on which a radio is installed, an anti-disturbance condenser is fitted on the switch to prevent interference in the area of the actual switch.

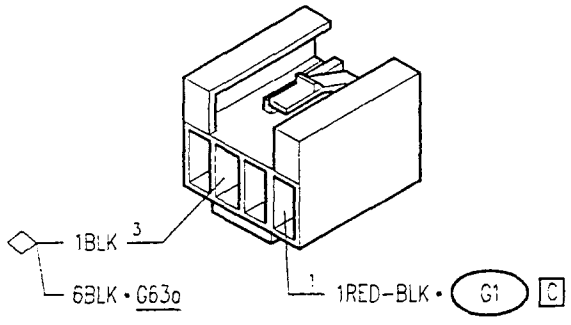
FUNCTIONAL DESCRIPTION

The stop lights circuit is supplied directly by battery voltage via fuse **F2** of fusebox **G1** (box "A" and "B"). For box "C" it receives the "key-operated" supply via fuse **F15** of box **G1**.
The stop lights switch **H3** comprises a contact which closes when the brake pedal is pressed, through which the stop lights are supplied in the rear side lights **E19** (right), **E20** (left).

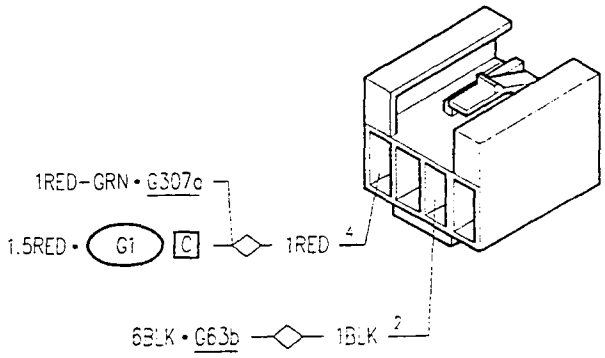
For certain Versions/Markets the third central stop light **E28** is foreseen

COMPONENTS AND CONNECTORS

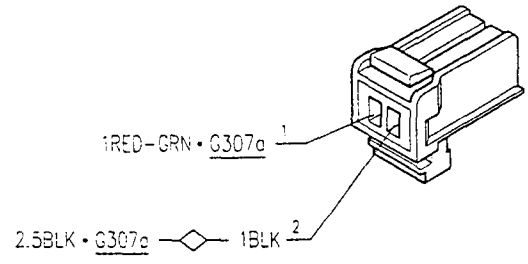
RH rear light E19



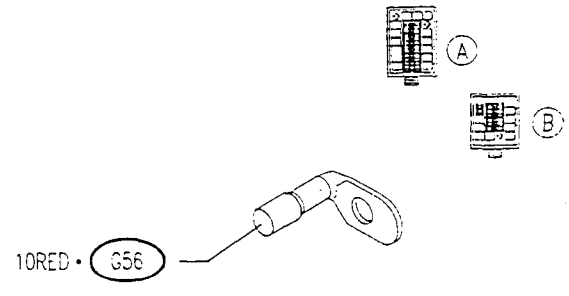
LH rear light E20



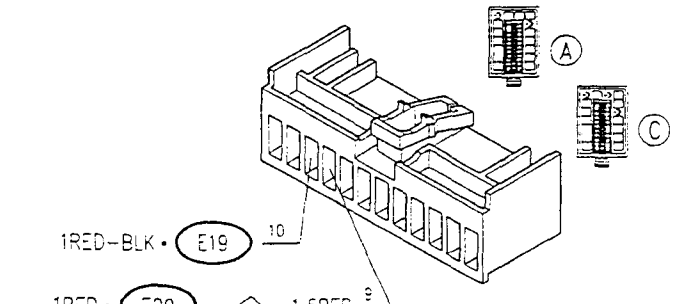
Third central stop light E28

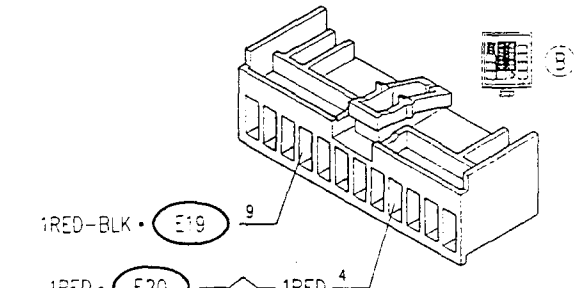


Fusebox G1

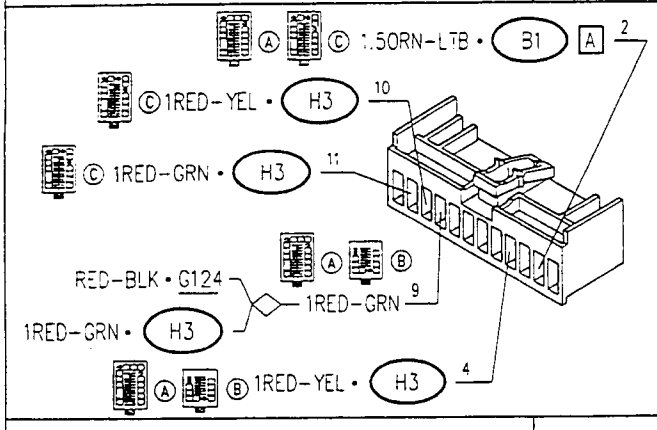
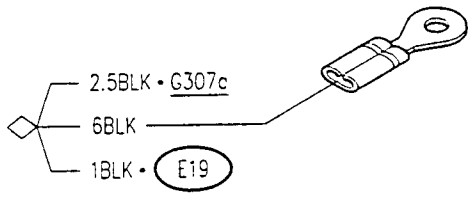
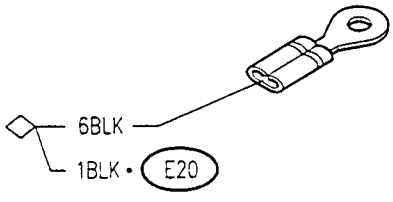
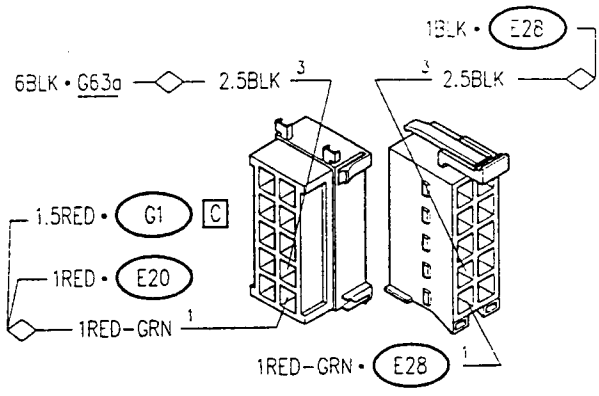
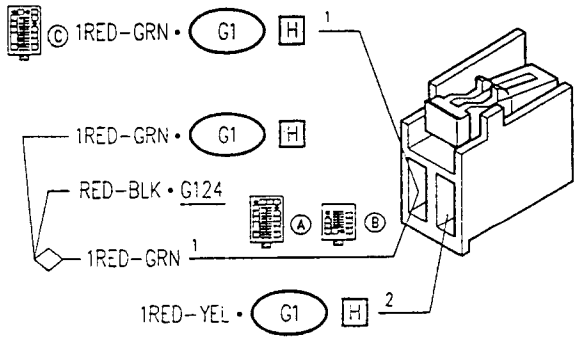


Fusebox G1 C





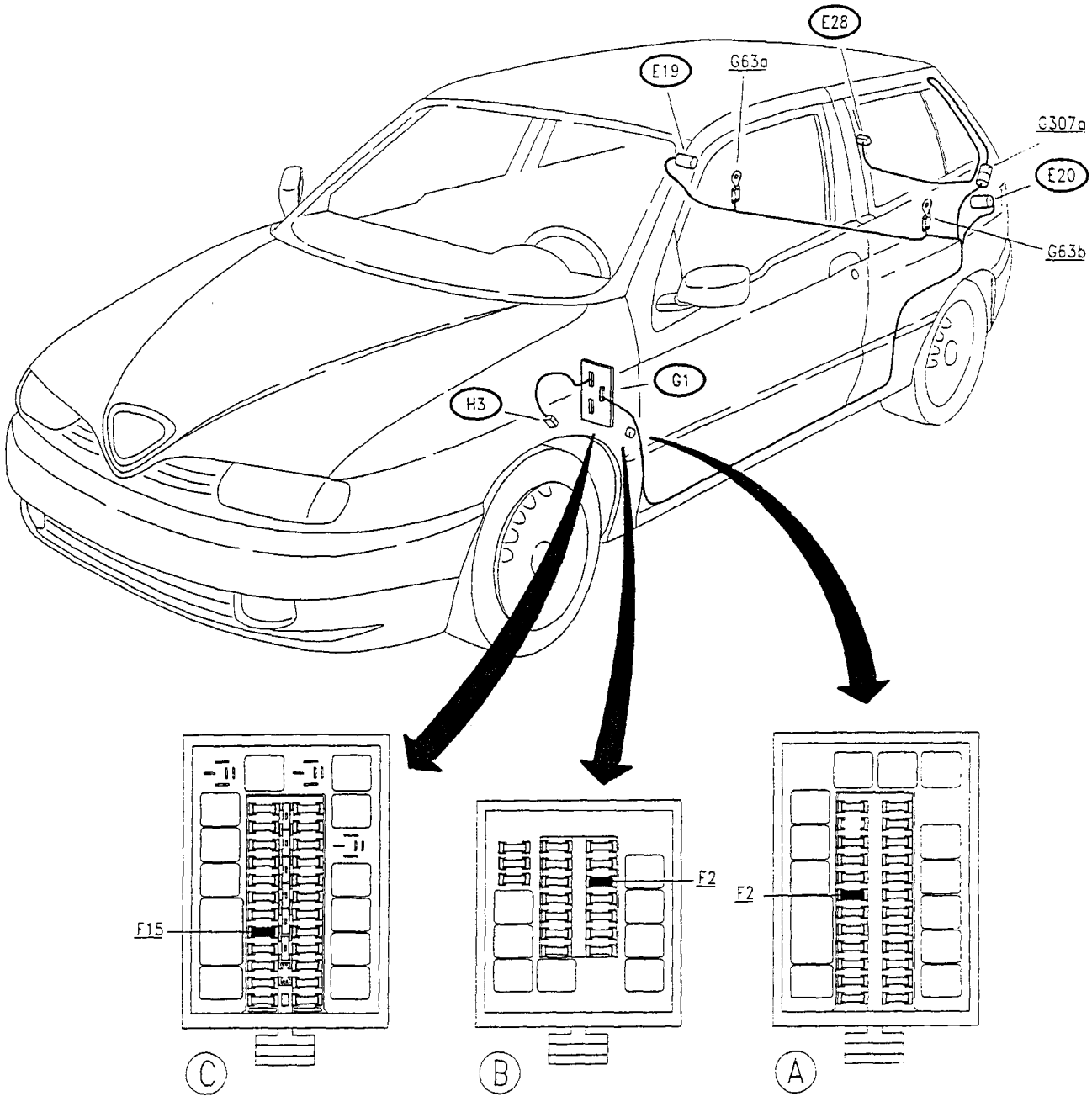
COMPONENTS AND CONNECTORS (cont.d)

Fusebox G1 H	RH rear earth G63a
	
LH rear earth G63b	**Connector for rear wiring/luggage compartment wiring A G307a**
	
Stop lights switch H3	
	

FAULTFINDING TABLE

Failure	Component to be checked				
	F2	E20	E19	E28	H3
All the stop lights	•				•
RH stop light			•		
LH stop light		•			
Central stop light				•	

LOCATION OF COMPONENTS

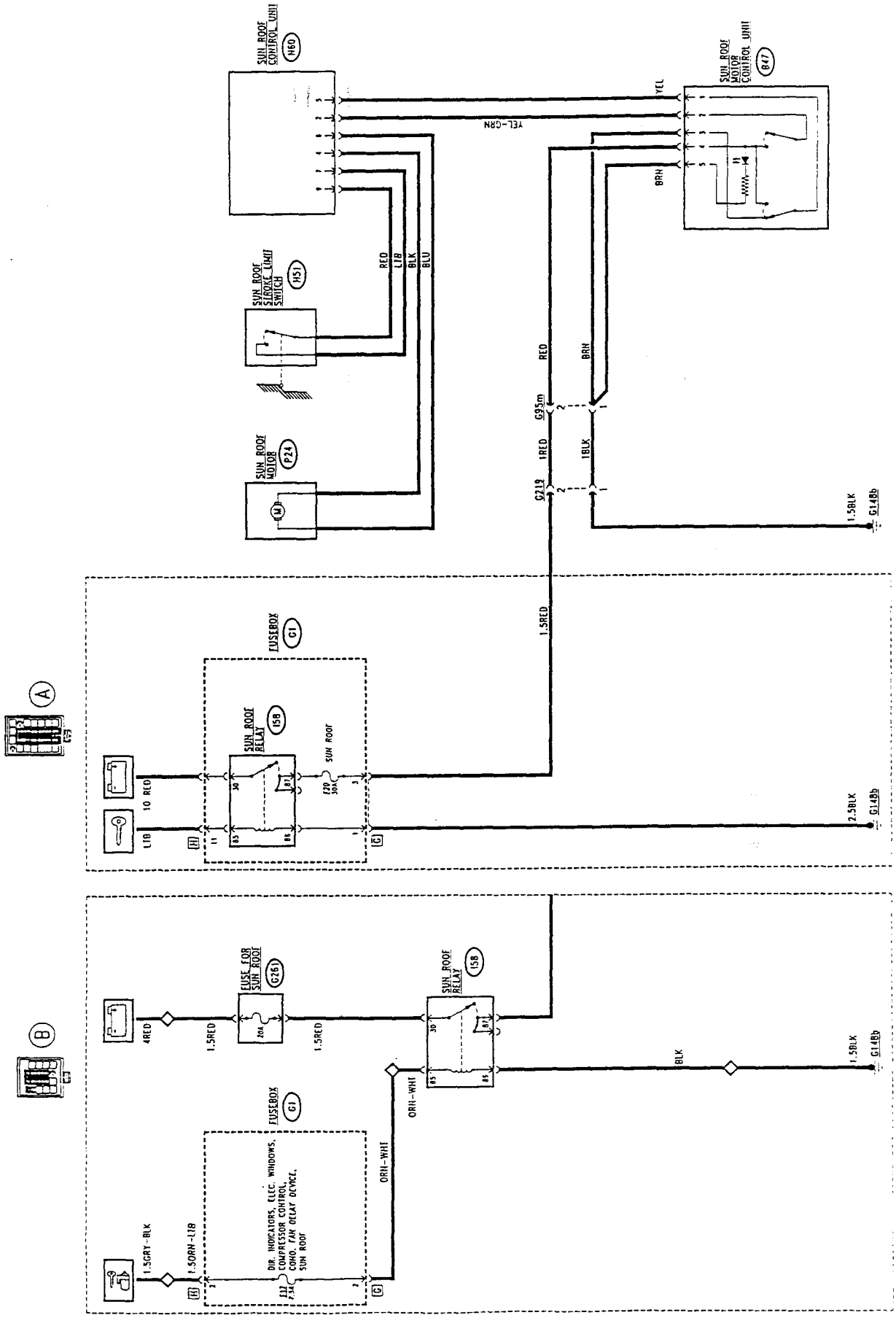


SUNROOF

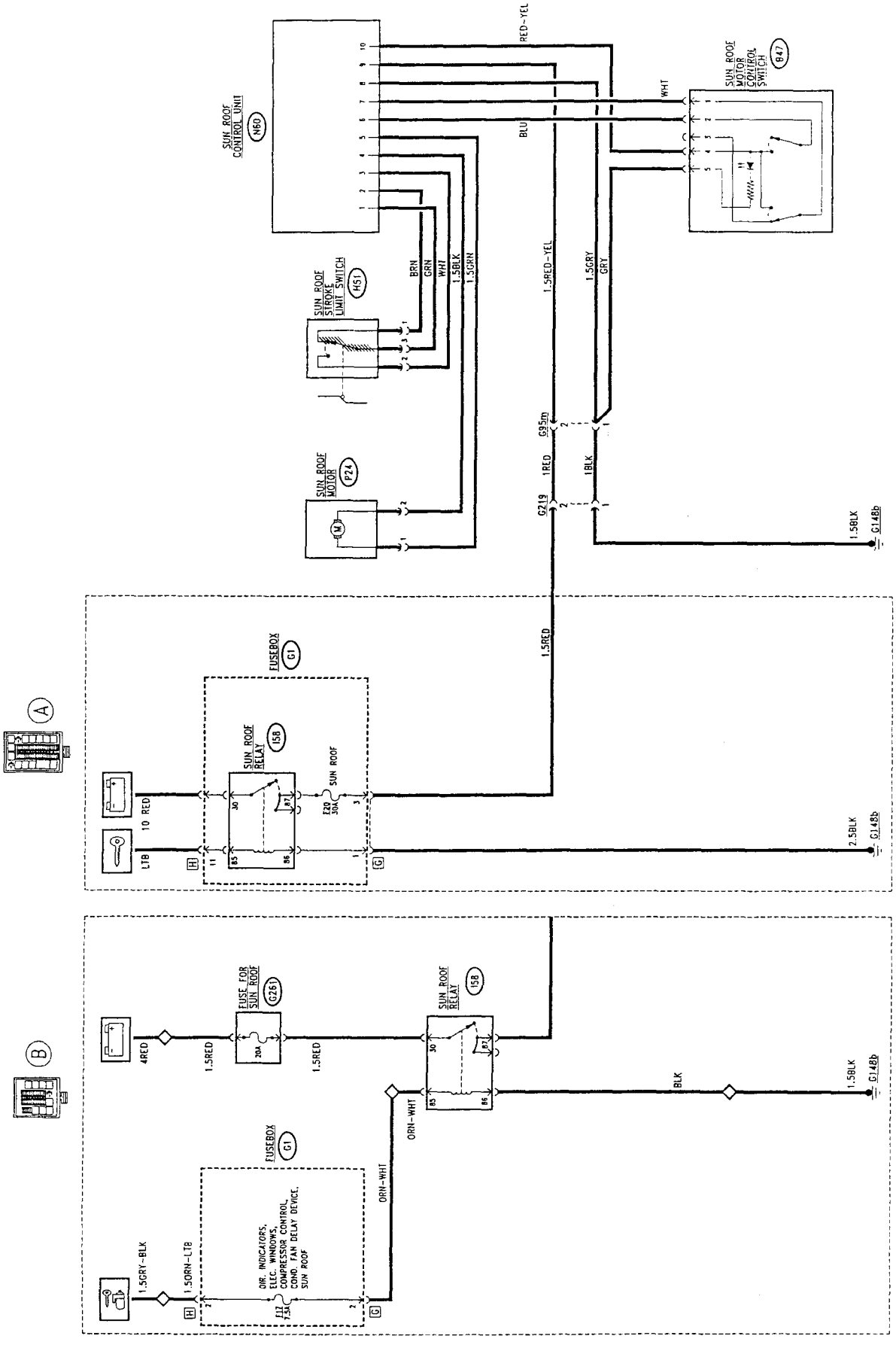
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FUNCTIONAL DESCRIPTION 33-4/1
COMPONENTS AND CONNECTORS 33-5
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FAULT-FINDING TABLE 33-9

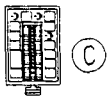
WIRING DIAGRAM (version WEBASTO)

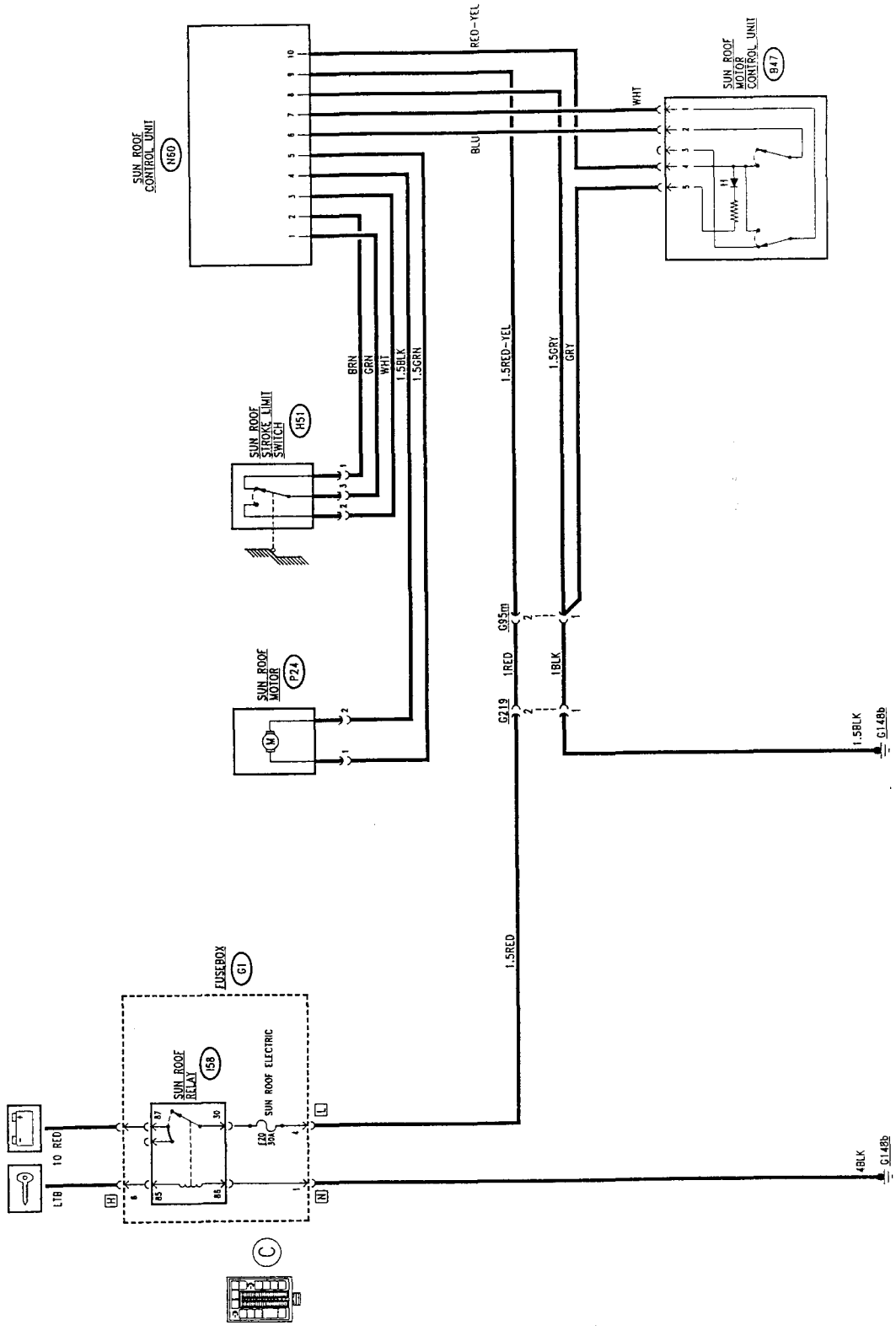


WIRING DIAGRAM (version INALFA)



WIRING DIAGRAM





GENERAL DESCRIPTION

WARNING: The sunroof installed on the 145 is supplied in **two** version:

- INALFA
- WEBASTO

The operating logic is the same, as also the outside appearance (the WEBASTO sunroof can be distinguished by **three notches on the front spoiler**).

The **WEBASTO version** is composed of a single unit comprising the control unit, motor and switches; the **INALFA version** has separate components.

The sliding roof allows additional ventilation of the passenger compartment during warm weather and, when necessary, quick air changing, thereby increasing passenger comfort.
The mobile part of the roof comprises a plexiglass panel and an interior sliding blind which is concealed in the roof panel trim.
A double switch located next to the front ceiling light operates a motor in two different ways: in the first, the motor raises the panel to the "quarter light" position, in the second, it opens the panel while drawing back the blind.
When the roof is subsequently closed, the blind, which can also be operated manually, is "accompanied" for a short stretch by the panel moving forwards. (For further details see GROUP 70 - "BODY-SUNROOF").
The whole system is controlled electronically by a control unit which regulates the various functions.The sunroof can only be operated with the ignition key engaged.

FUNCTIONAL DESCRIPTION

The sunroof control system is supplied by a special relay **I58**, located in fusebox **G1** for version "A" or "C" , and outside for version "B". The line is protected by a special fuse: **F20** of **G1** for fusebox "A" or "C". and by the outside wander fuse **G261** (20A) for fusebox "B". To sum up, the system is only turn-key supplied at pin 2 of connector **G95m**; pin 1 of the same connector supplies the reference earth.

WEBASTO Version:

The system is formed of a single functional unit which comprises:

- control unit **N60**;
- control switch **B47**;
- motor **P24**;
- stroke limit contact **H51**.

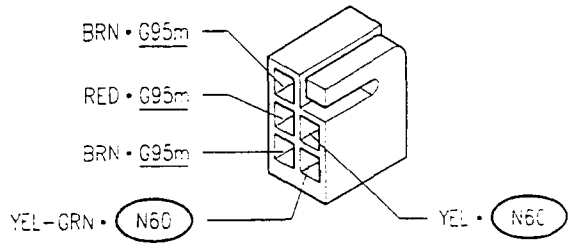
The control unit **N60** receives the actuating signals from switch **B47** (pin 2 and 5) and consequently operates the motor **P24** (pin 4 and 8), taking into account any stroke limit signal received from switch **H51** (pin 7 and 9).

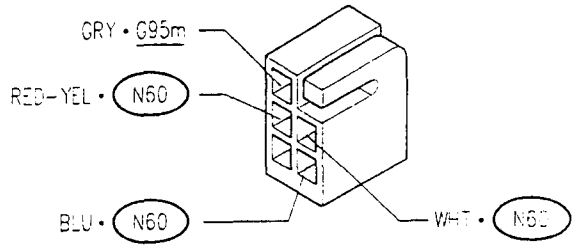
INALFA version:

The control unit **N60**, supplied directly at pins 8 and 9, receives the actuating signals from switch **B47** (pins 6, 7 and 10), and sends the command signals to the motor **P24** (pins 4 and 5); the stroke limit switch **H51** signals the control unit (pins 1, 2 and 3) the position of the sunroof stopping the motor when necessary.

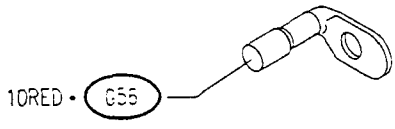
COMPONENTS AND CONNECTORS

Sun roof motor cont. switch (WEBASTO)	B47	Sun roof motor control switch (INALFA)	B47

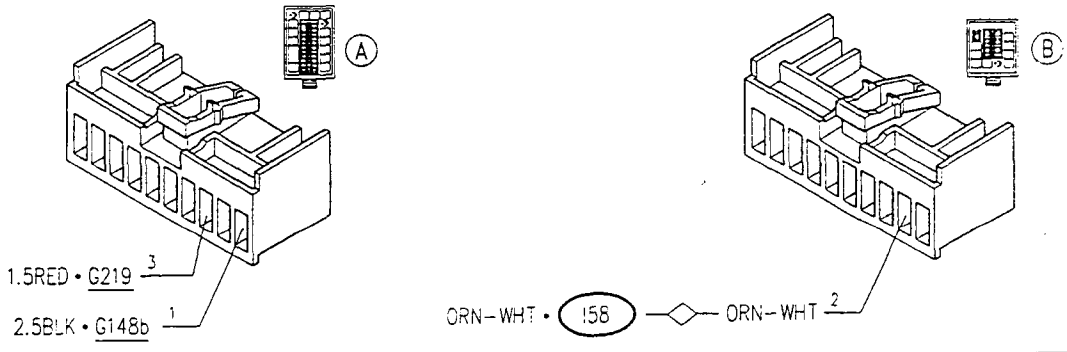




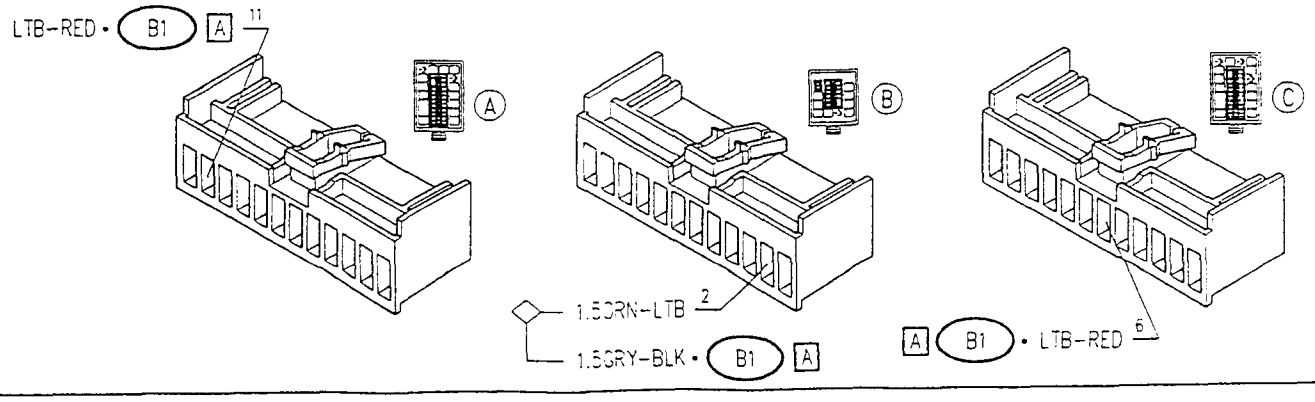
Fusebox	G1



Fusebox	G1 G

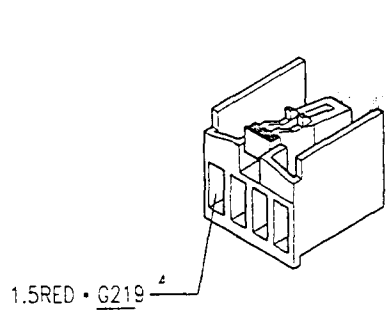


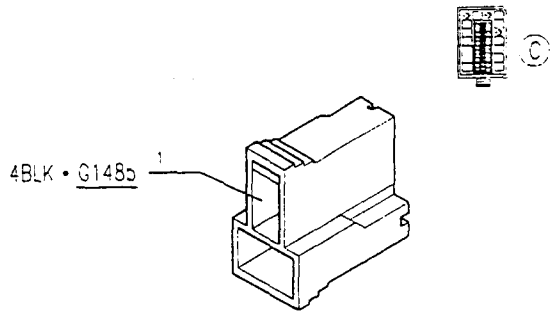
Fusebox	G1 H



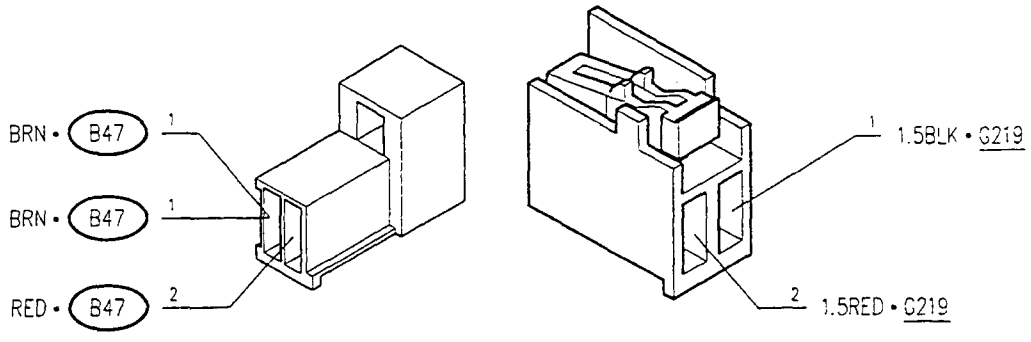
COMPONENTS AND CONNECTORS (cont.d)

Fusebox	G1 L	Fusebox	G1 N

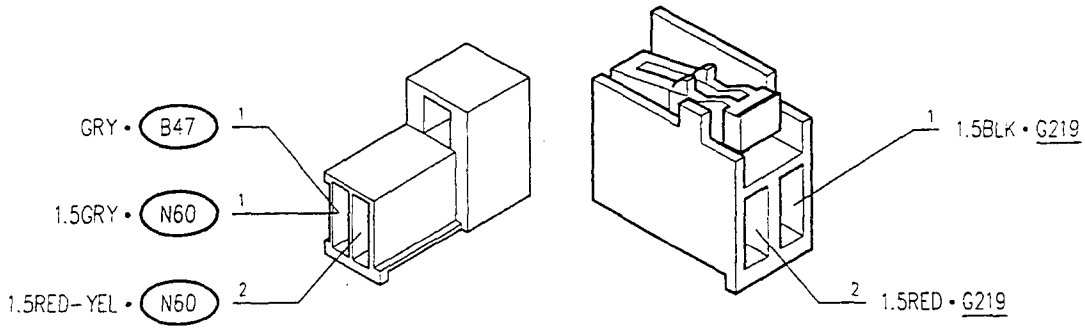




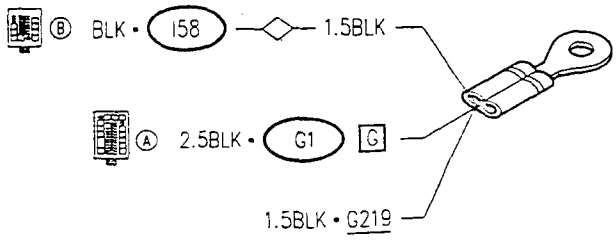
Sun roof connector (WEBASTO)	G95m



Sun roof connector (INALFA)	G95m

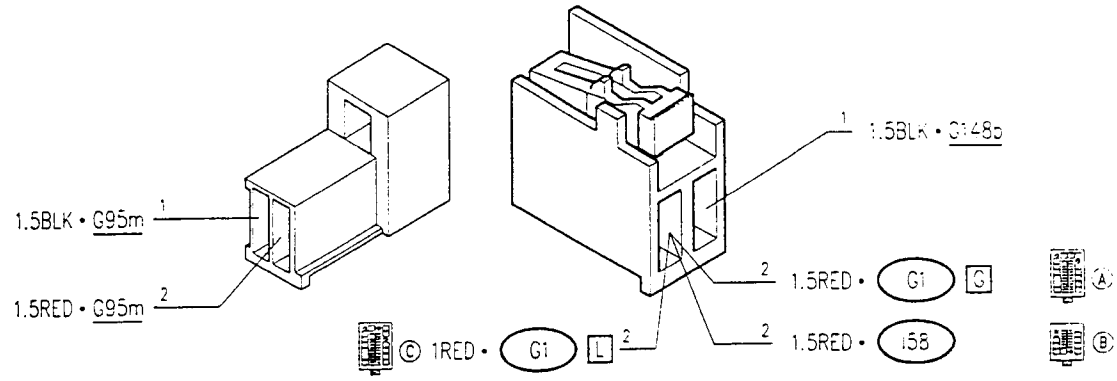


Earth under LH dashboard	G148b

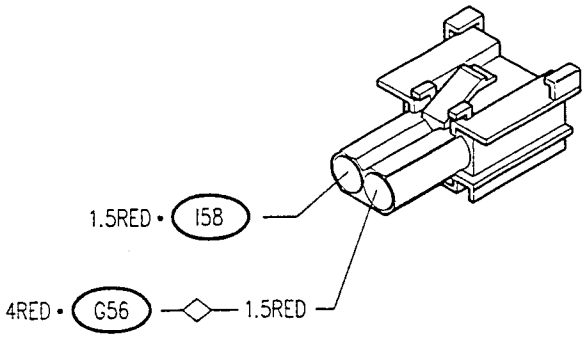


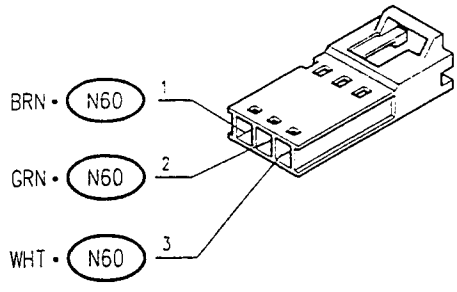
COMPONENTS AND CONNECTORS (cont.d)

Connector for sunroof	G219

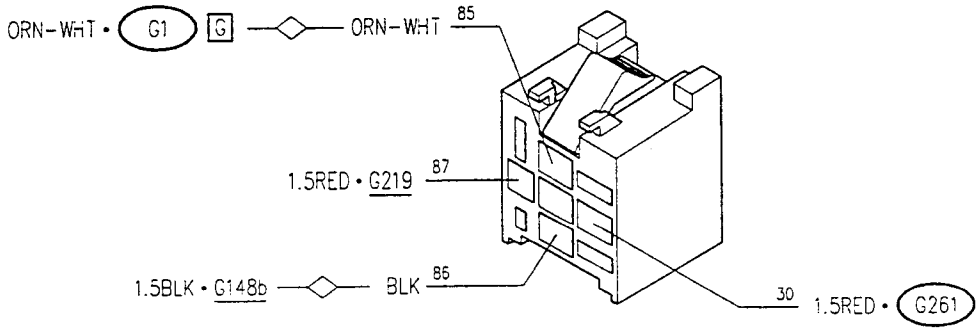


Sunroof fuse	G261	Sun roof stroke limit switch (INALFA)	H51

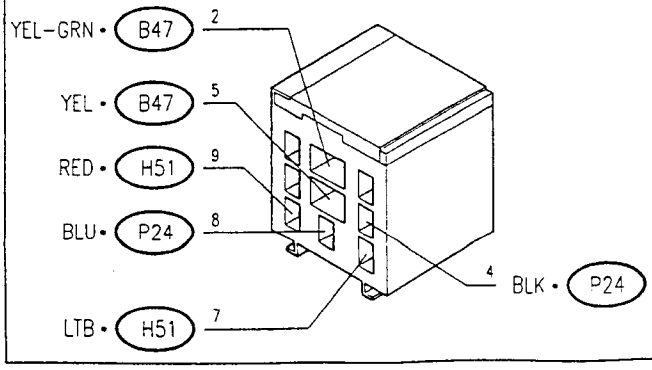


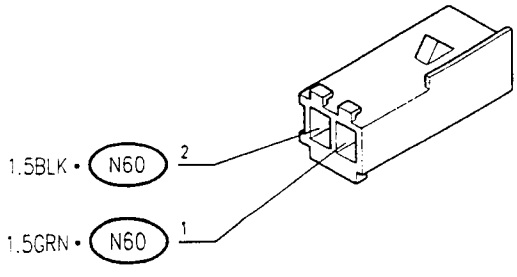


Sunroof relay	I58

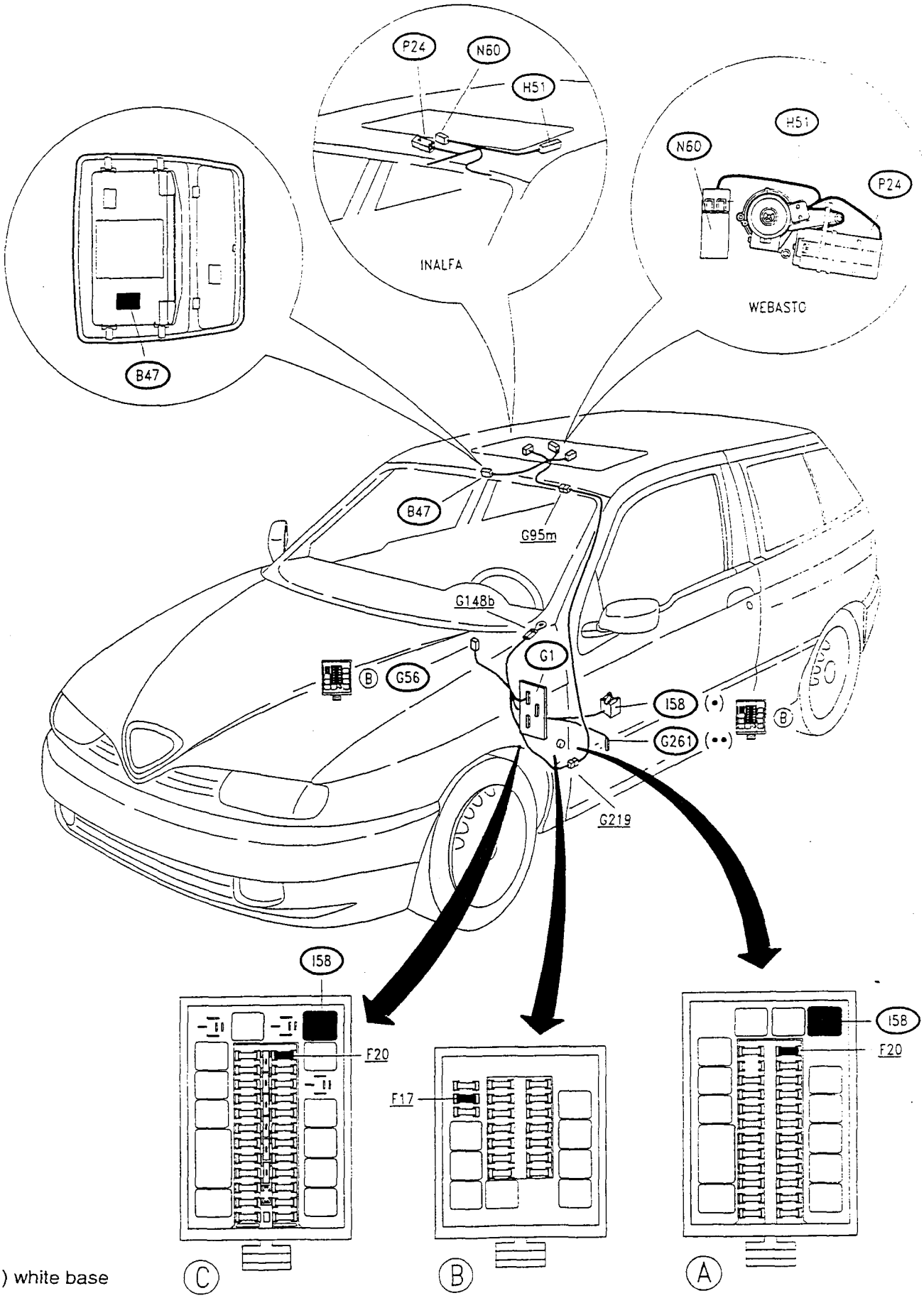


Sunroof control unit (WEBASTO)	N60	Sun roof motor (INALFA)	P24





LOCATION OF COMPONENTS



(•) white base

(••) yellow fuse holder

FAULT-FINDING TABLE

Failure	Component to be checked							
	F17 (B)	F20 (A)	G261 (B)	I58	N60	P24*	B47	H51*
Sunroof fails to operate	•	•	•	•	•	•	•	
Sunroof fails to close properly					•			•

(*) WEBASTO version: P24 and H51 are together in a single sunroof control unit N60 which must be changed completely in the event of a failure to a component.

(A) only fusebox "A"

(B) only fusebox "B"

TOWING ARRANGEMENT

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WIRING DIAGRAM B 30-4

GENERAL DESCRIPTION

The fusebox **G1** (type "A") is fitted with a special connector (**connector K**) provided with all the lines needed for connecting the trailer. Following the indications of the wiring diagram A, connect this connector with the socket for the tow hook **G115** which is then connected with the standardized connector on the trailer (see **wiring diagram A).**

WARNINGS:
For connection with the trailer a 7-pole 12V connector must be used according to CUNA - UNI 9128 Standards.

The socket must then be connected with a direct supply - in this case protect the line with a special fuse - and with an earth.

NOTE: Instead of the supply connection it is possible to use pin 2 - 54G for the rear fog guard.

WARNING:
The type "B" fusebox is not provided with a specific connector for the connection of a trailer.

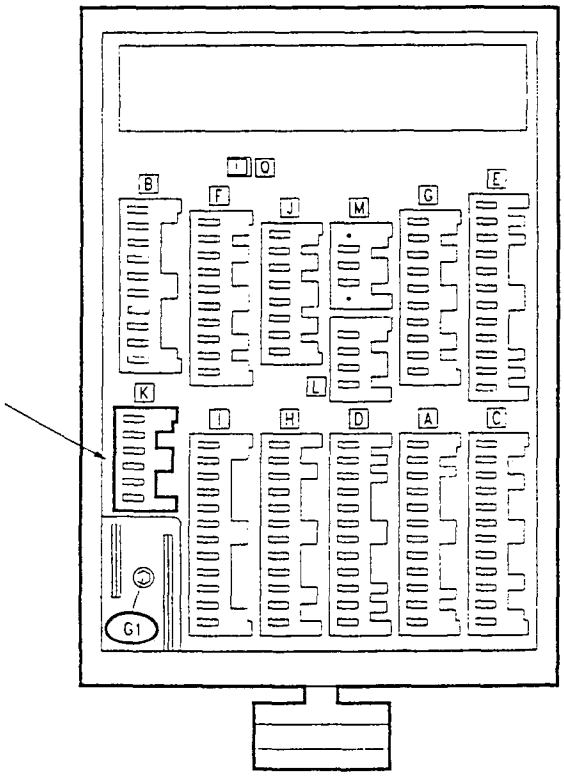
In this case, it is necessary to branch the signals for the single services connected from the respective output points of the fusebox **G1**, **connector C**, as shown in **wiring diagram B.**

When making the connections on the car adhere to the following precautions:

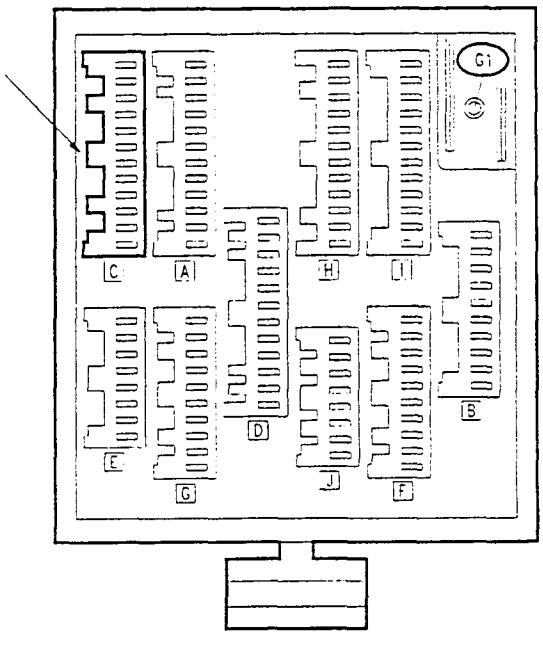
- avoid interferences between electrical cables and the exhaust pipe
- protect any holes for passing the cables with appropriate grommets;
- connect the car earth with the trailer earth through the 7-pole connector using a 2.5 sq.mm cable.
- replace the direction indicator electronic intermittent device **N13** with one of higher capacity, to withstand the additional load of two 21W bulbs.

With the exception of the regulation warning devices - and an electric brake that must be directly supplied from the battery, using a cable of no less than 2.5 sq.mm and a 30A fuse - **it is prohibited to connect the services installed on the trailer to the car's electric system** (fan, fridge, interior lighting, etc.), with the exception of a light bulb with a power rating of no more than 15W.

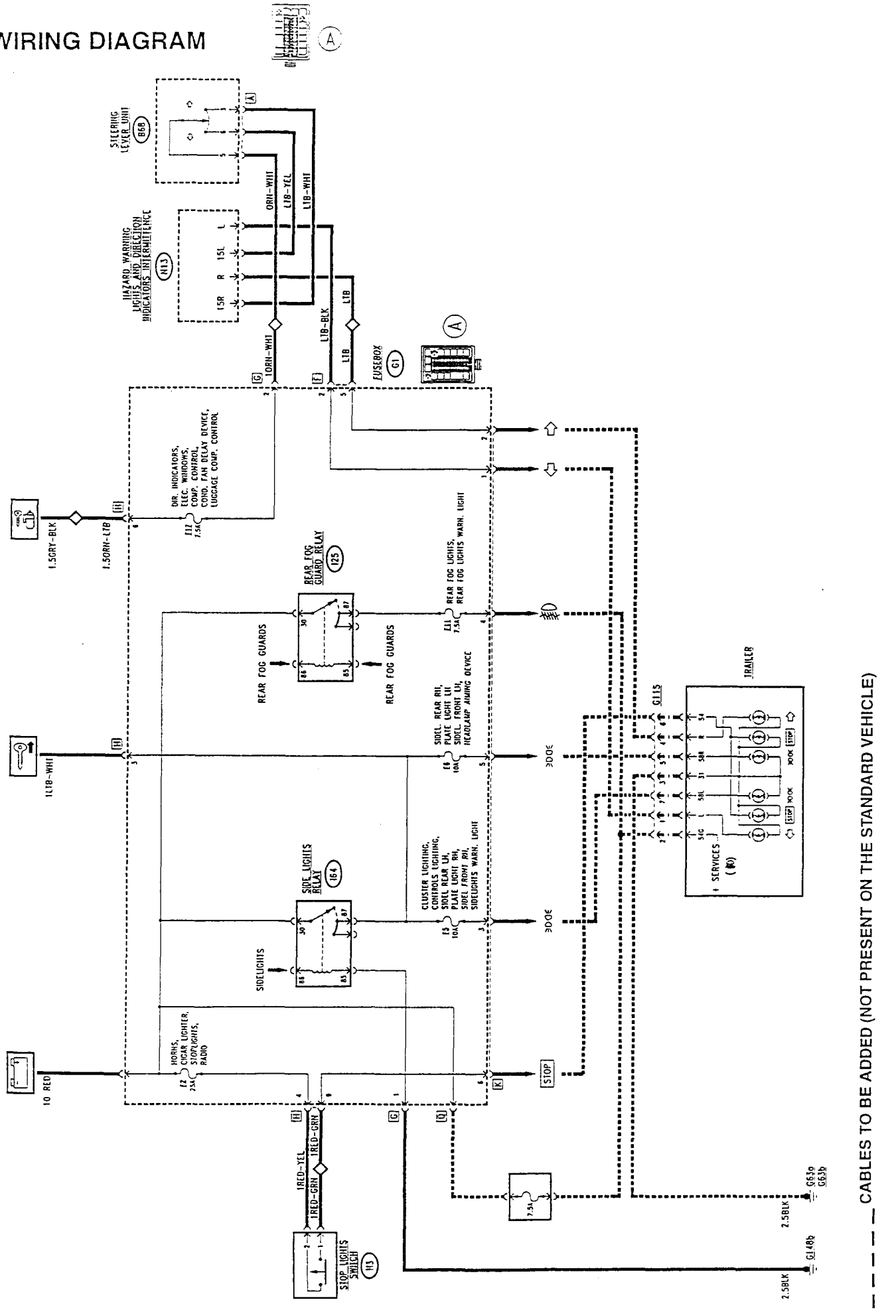
Fusebox type "A"



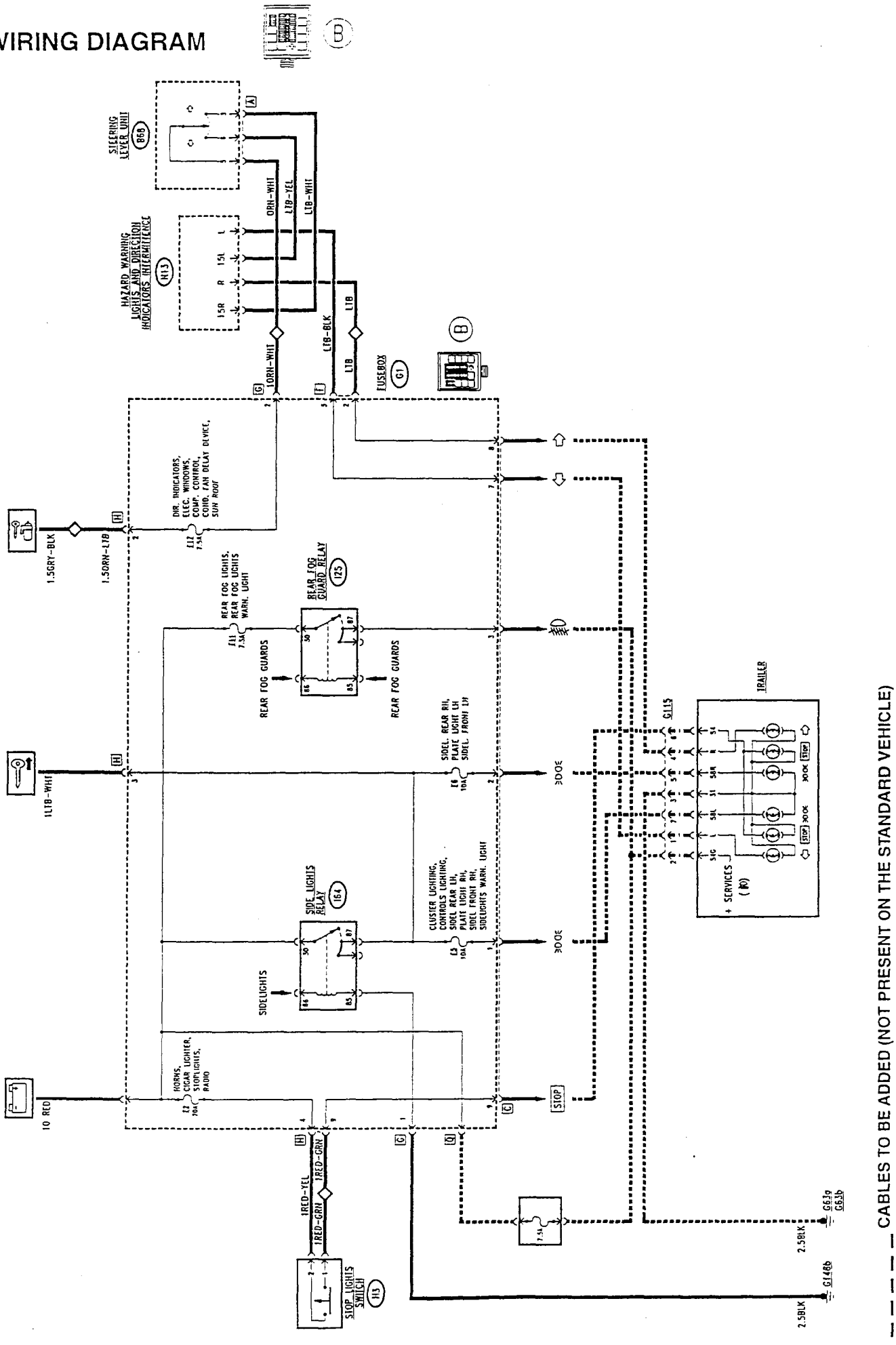
Fusebox type "B"



WIRING DIAGRAM



WIRING DIAGRAM

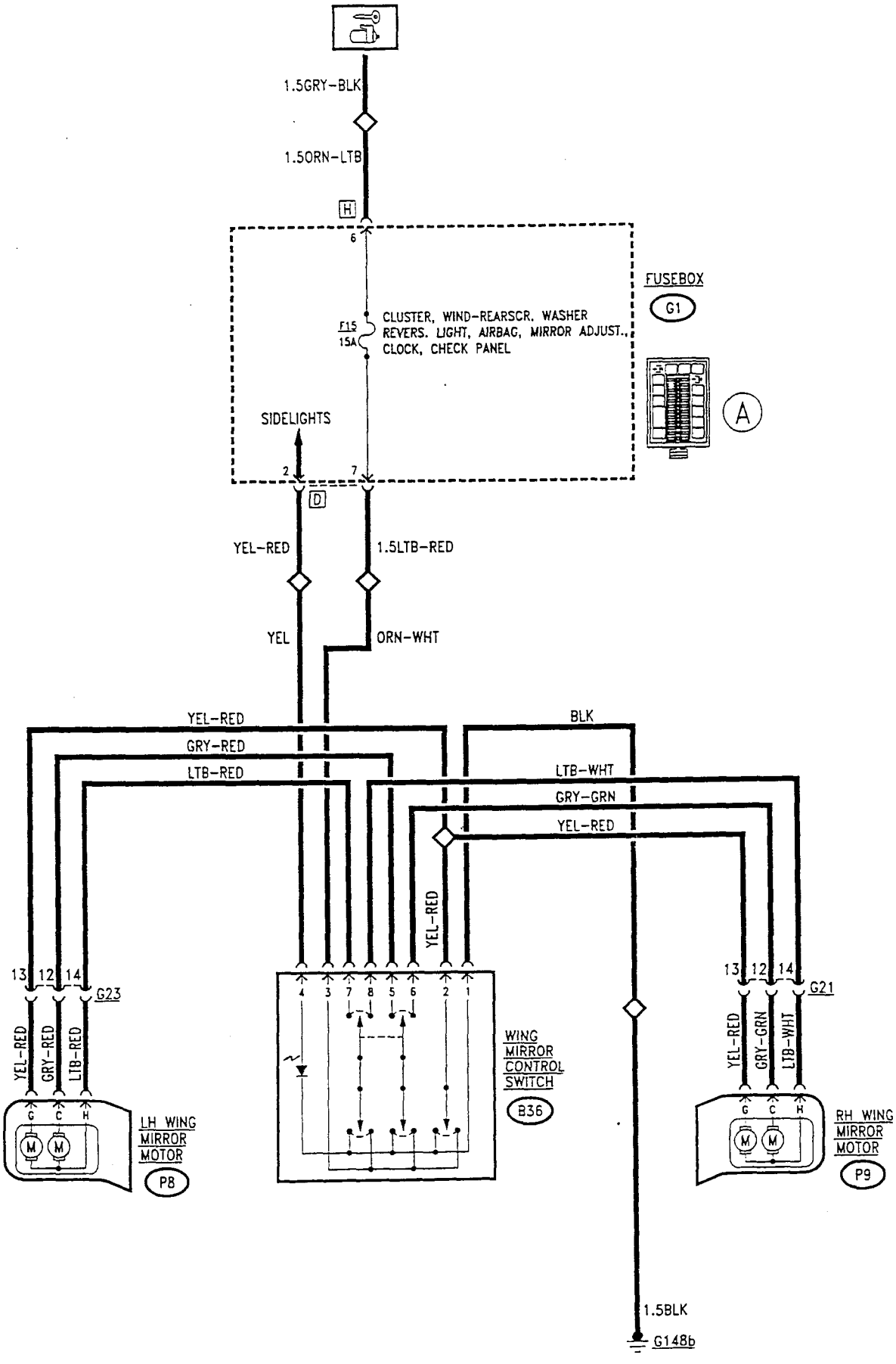


WING MIRROR ADJUSTMENT

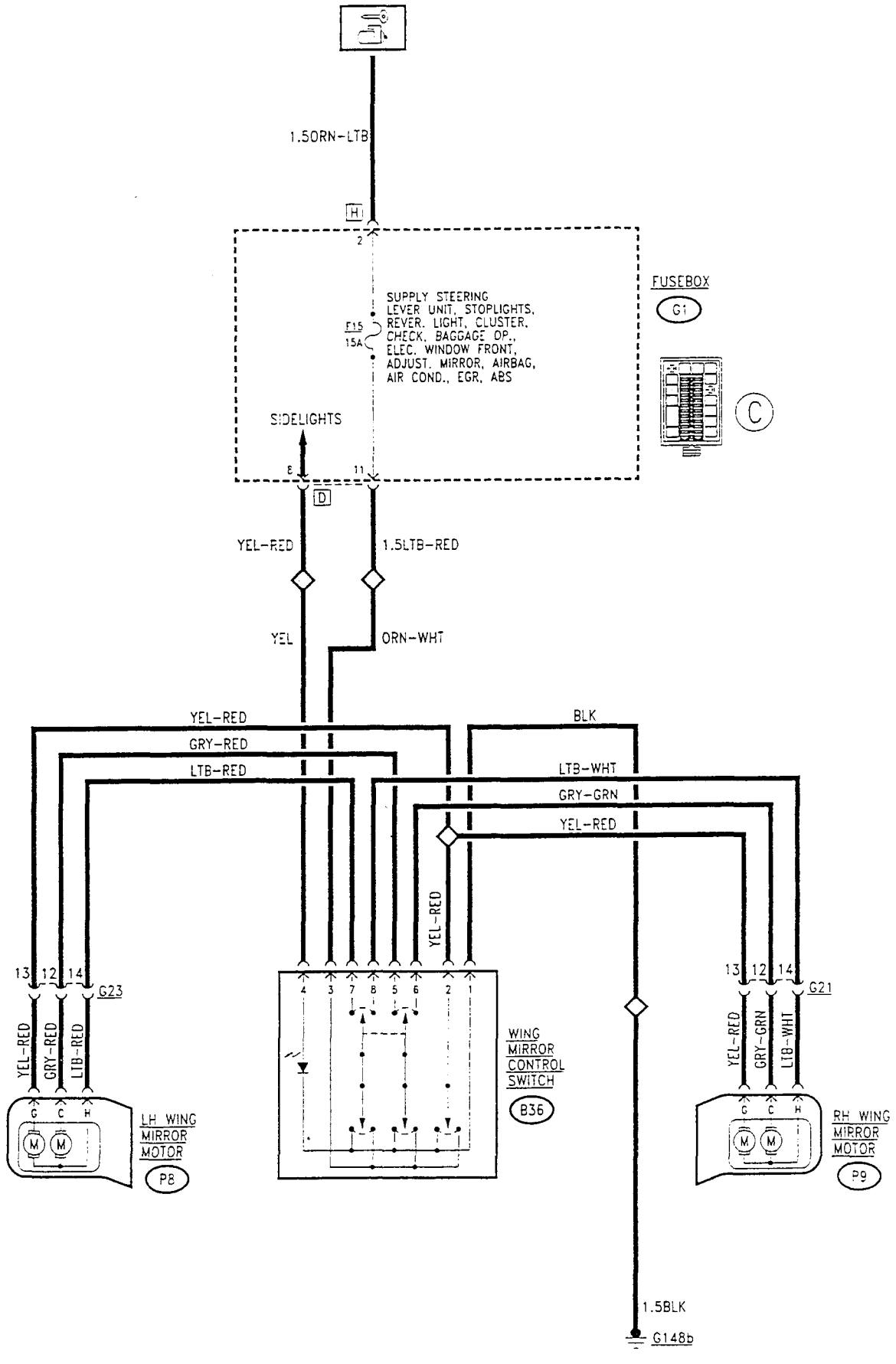
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CHECKING COMPONENTS 25-6

WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

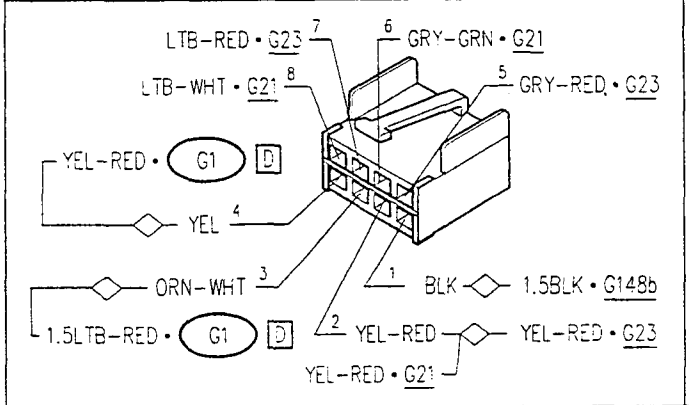
The two wing mirrors are adjusted through the special switch which controls the two electric motors located inside each mirror (one motor turns the mirror on horizontally, the other vertically).
A single switch operates both the left and right mirrors, as a selector makes it possible to switch from one to the other.

FUNCTIONAL DESCRIPTION

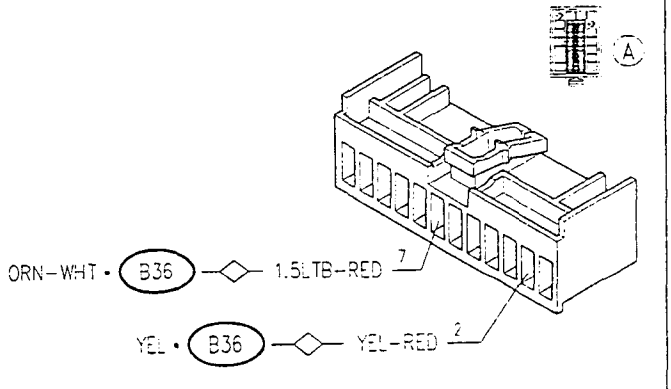
The double switch **B36** controls the two electric motors located in the mirrors **P8** (left) and **P9** (right).
The switch is "turn-key" supplied - pin 3 - through fuse **F15** of fusebox **G1**; pin 1 is earthed.
By actuating the switch **B36** in one of the possible directions, positive and earth signals are sent to one of the two motors, in addition to the shared signal - pin 2 -, thereby determining the direction of rotation. Depending on the position of the selector, the right motors **P9** (signals leaving pins 6 and 8 of **B36**) or the left ones **P8** (signals from pins 5 and 7 of **B36**) are connected; the switch is illuminated by a led, which is turned on when the side lights are on - pin 4 - (also see "Lighting and indicators").

COMPONENTS AND CONNECTORS

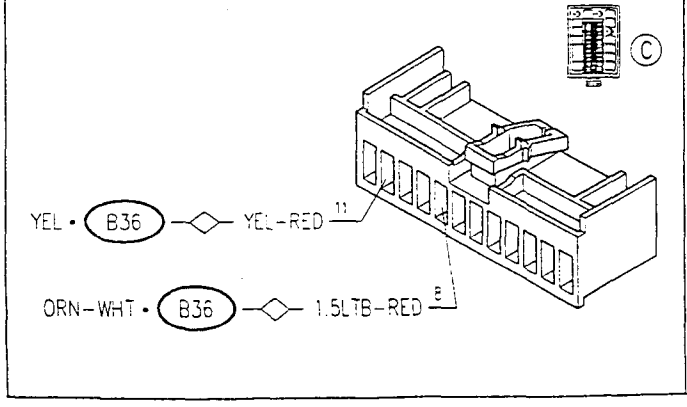
Wing mirrors control switch B36



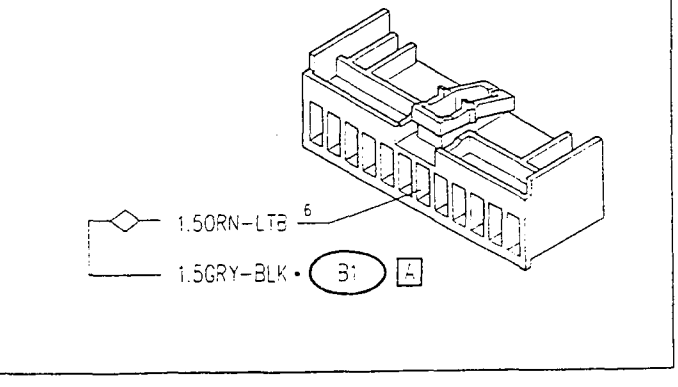
Fusebox G1 D



Fusebox G1 D

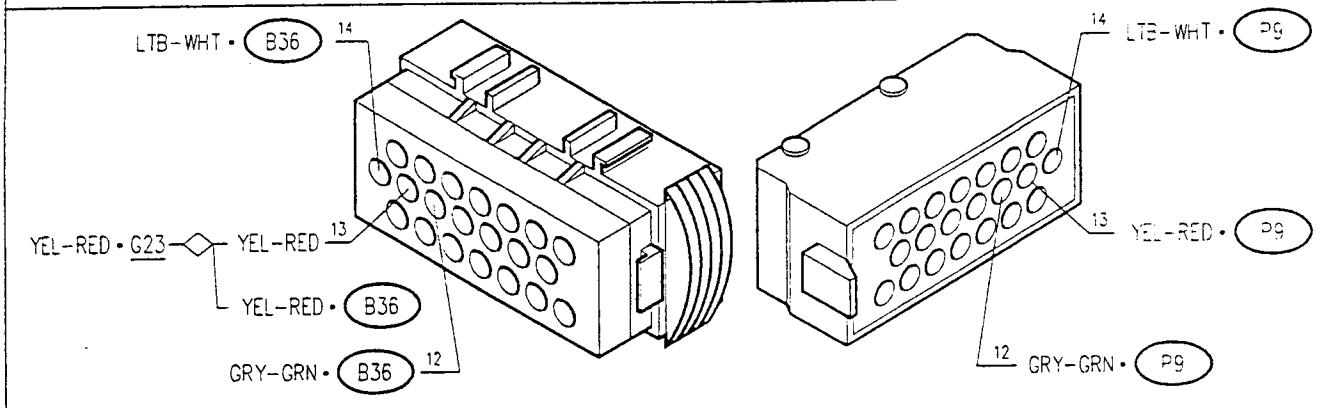


Fusebox G1 H

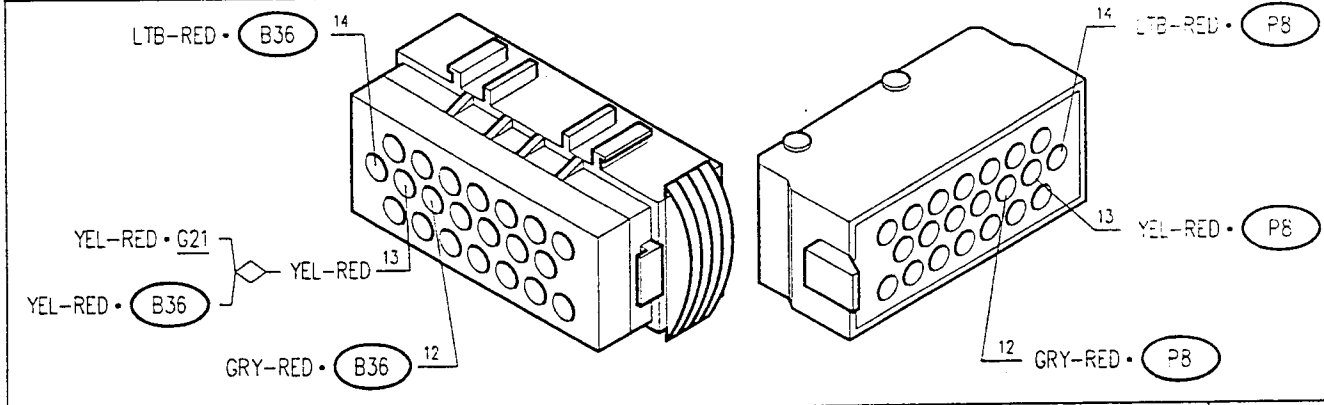


COMPONENTS AND CONNECTORS (cont.d)

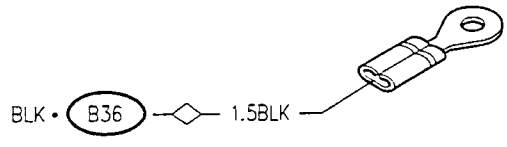
RH front door wiring connector — G21



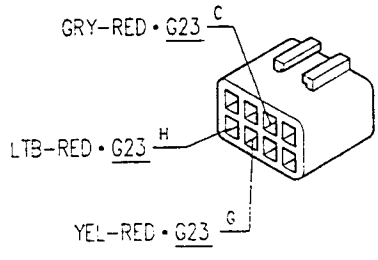
LH front door wiring connector — G23



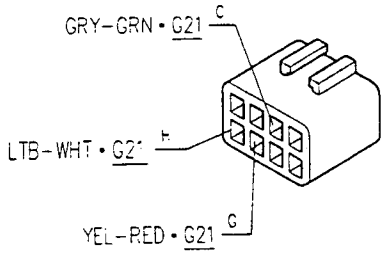
Earth under LH dashboard — G148b



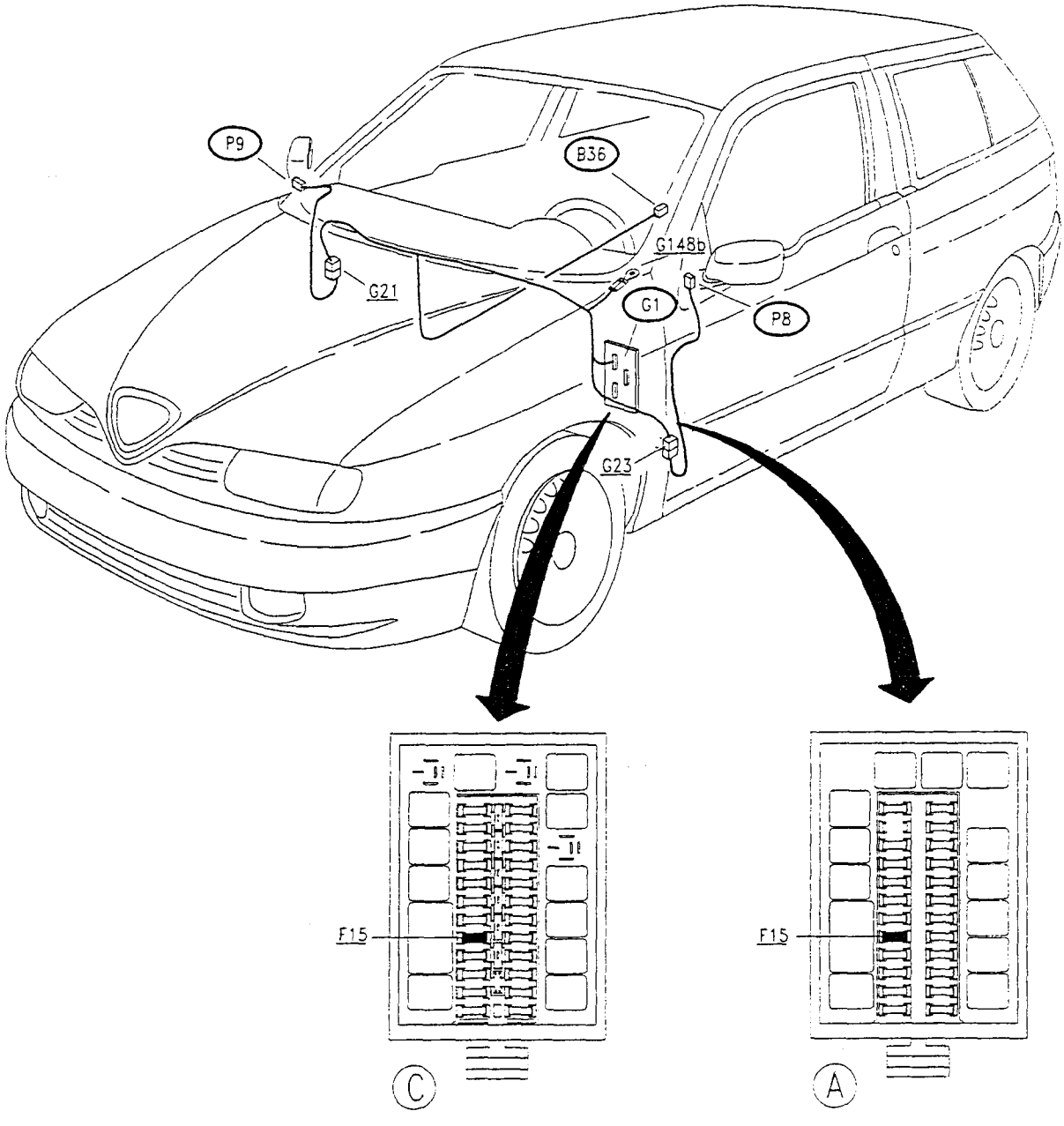
LH wing mirror motors — P8



RH wing mirror motors — P9



LOCATION OF COMPONENTS

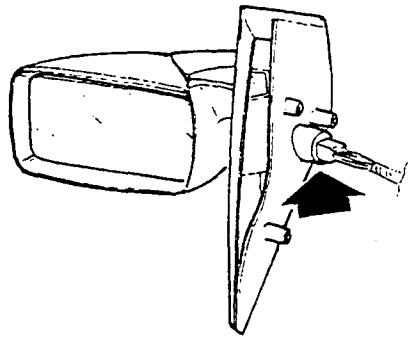


FAULTFINDING TABLE

Failure	Component to be checked			
	F15	P8	P9	B36
Wing mirror adjustment, under all circumstances	•			•
LH mirror adjustment		•		•
RH mirror adjustment			•	•
Switch illumination (with side lights on)				•

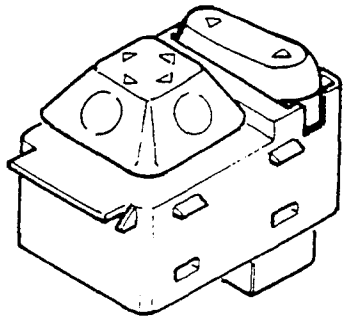
CHECKING COMPONENTS

RH/LH wing mirror motors (P8) (P9)



SPECIFICATIONS	
rotation upwards	12V at pin C, earth at pin G
rotation downwards	12V at pin G, earth at pin C
rotation rightwards	12V at pin G, earth at pin H
rotation leftwards	12V at pin H, earth at pin G

Double wing mirrors control switch (B36)



Checking the device: see **test A**

CHECKING DOUBLE WING MIRROR CONTROL SWITCH (B36) — TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – With the key engaged, check for 12V between pins 1 and 3 of **B36**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Check fuse **F15** (15A). Restore the wiring between **B36** and fusebox **G1** and earth **G148b**.
A2 CHECK VOLTAGE – With the side lights on, check for 12V at pin 4 of **B36**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Check that the side lights are working properly; also check the wiring between **B36** and **G1**
A3 CHECK VOLTAGE – Set the selector to the position for operating the **left** mirror and check: - 12V between pins G and H of mirror **P9** moving the switch rightward and leftward - 12V between pins G and C of mirror **P9** moving the switch upwards and downwards In the same way, moving the **right** mirror check: - 12V between pins G and H of mirror **P8** moving the switch leftward and rightward - 12V between pins G and C of mirror **P8** moving the switch upward and downward	OK ▶ ~~OK~~ ▶	THE SWITCH IS WORKING CORRECTLY. Check the connection with the other components Carry out **step A4**
A4 CHECK VOLTAGE – Set the selector to the position for operating the **left** mirror and check on **B36** for: - 12V between pins 7 and 2 moving the switch leftward and rightward - 12V between pins 5 and 2 moving the switch upward and downward In the same way, operating the **right** mirror check for: - 12V between pins 8 and 2 moving the switch leftward and rightward - 12V between pins 6 and 2 moving the switch upward and downward	OK ▶ ~~OK~~ ▶	Restore the wiring between **B36** and **P9** (RH) or **P8** (LH), or change one of the two motors Change switch **B36**

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ELECTRICAL DIAGNOSIS AND ENGINE MANAGEMENT

15 documents - 280 factory pages

ENGINE COOLING
(versions without air conditioner) (*)

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(*) in cars with air conditioner see the section "Air Conditioner"

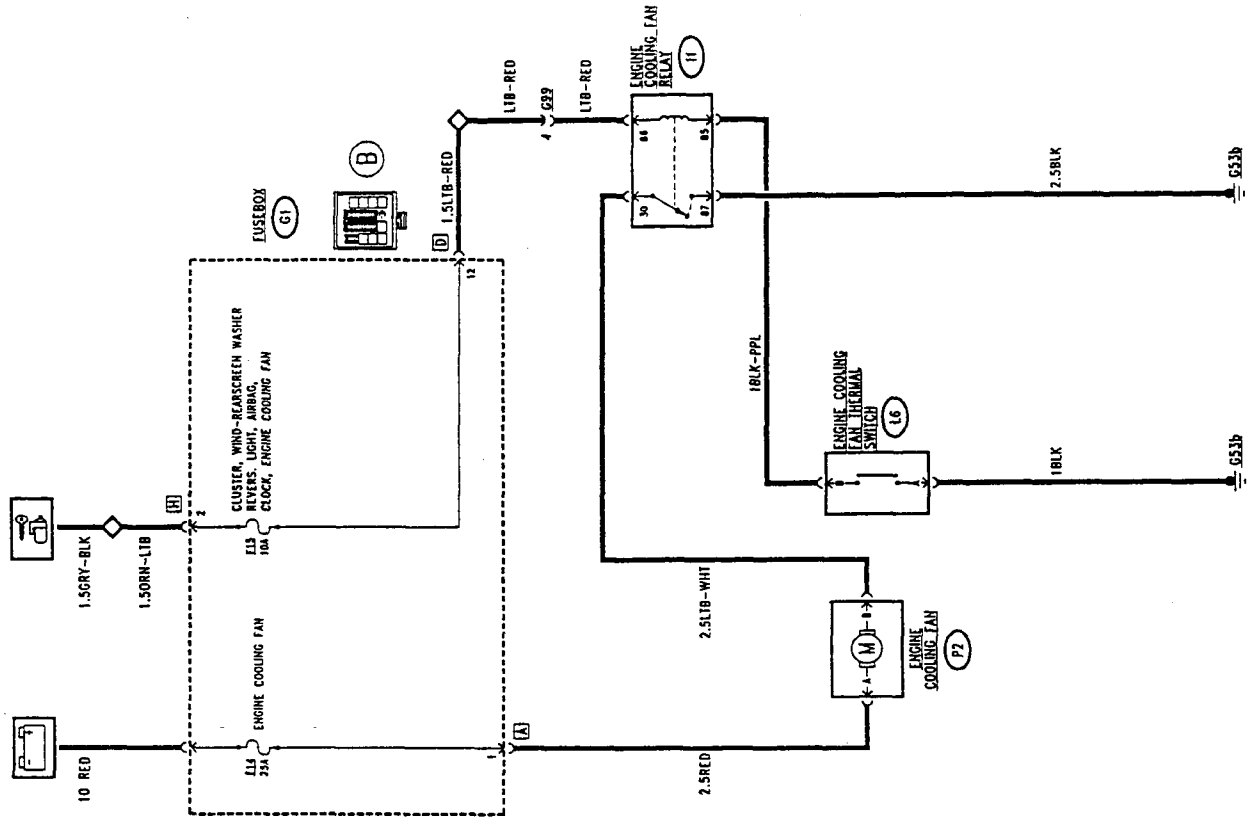
GENERAL DESCRIPTION

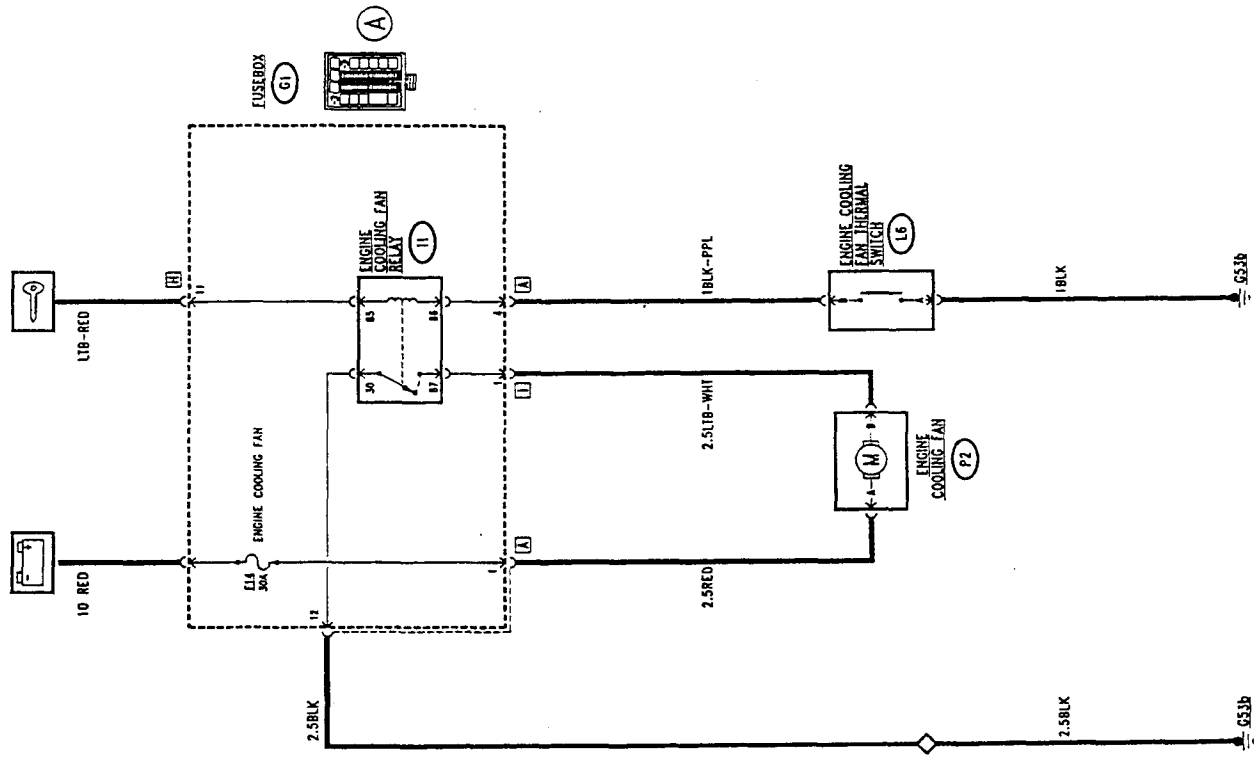
A fan helps the radiator to disperse the heat of the engine coolant, due to a thermometric switch that detects when the coolant temperature is too high and turns on the fan.

NOTE: The Boxer and T.SPARK versions (M.Y. '97) are fitted with a solenoid valve with only one speed, while the 2.0 T.SPARK version (M.Y. 96) and the TD and TD-CAT versions are fitted with a solenoid valve with two different speeds: the first is operated when the conditioner compressor is engaged with the car stationary at a first temperature level of the coolant fluid; the second speed cuts in at a higher temperature.

N.B. For versions with air conditioner, the electric circuit is shown in the section "Climate control".

WIRING DIAGRAM (Boxer Versions)



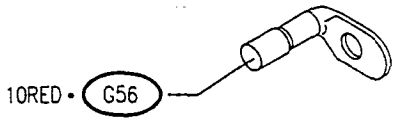


FUNCTIONAL DESCRIPTION (Boxer Versions)

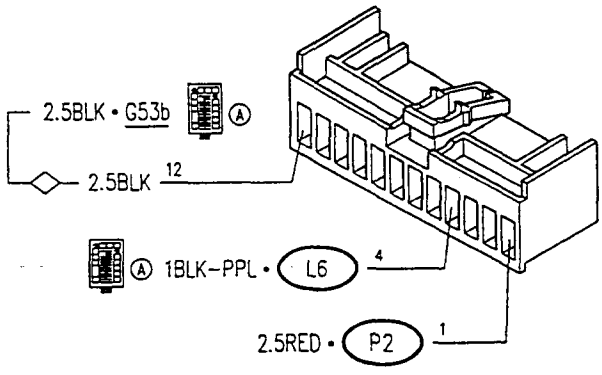
The fan **P2** is supplied directly with battery voltage via fuse **F14** of fusebox **G1**.
Relay **I1** - to be found inside fusebox "A" or outside for version "B" - that controls the fan is supplied from the ignition block (for fusebox "B" via fuse **F15** of the actual fusebox) and it is energized by an earth signal leading from the thermal contact **L6** which closes when the temperature of the coolant fluid reaches 92°C: this way relay **I1** sends an earth to the motor which operates the fan **P2**.
When the temperature falls below 87°C the contact opens, the relay is de-energized and the fan stops.

COMPONENTS AND CONNECTORS (Boxer Versions)

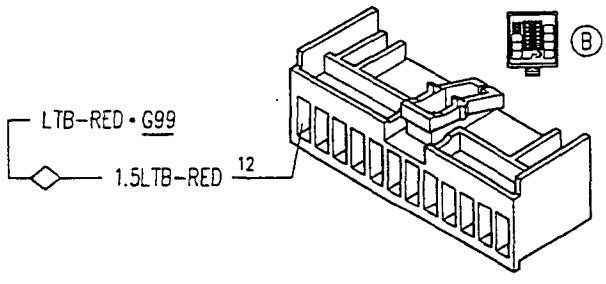
Fusebox G1



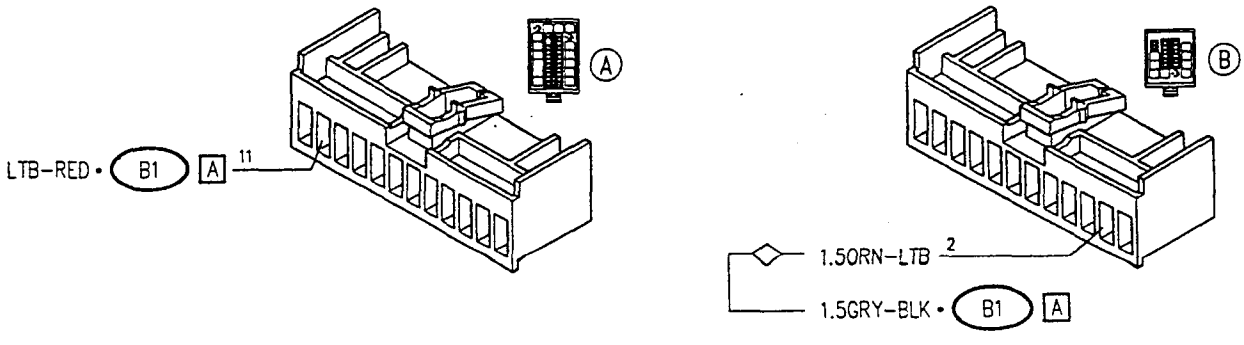
Fusebox G1 A



Fusebox G1 D

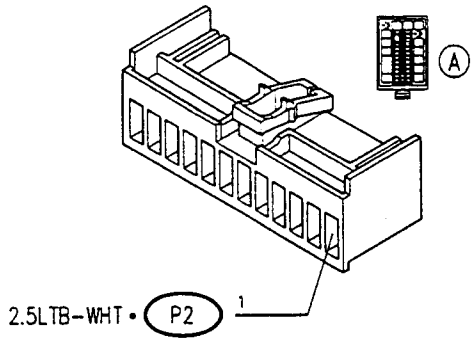


Fusebox G1 H

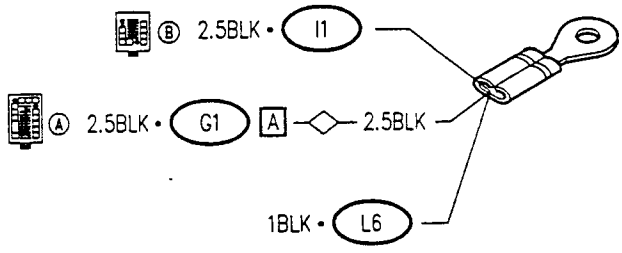


COMPONENTS AND CONNECTORS (cont.d)

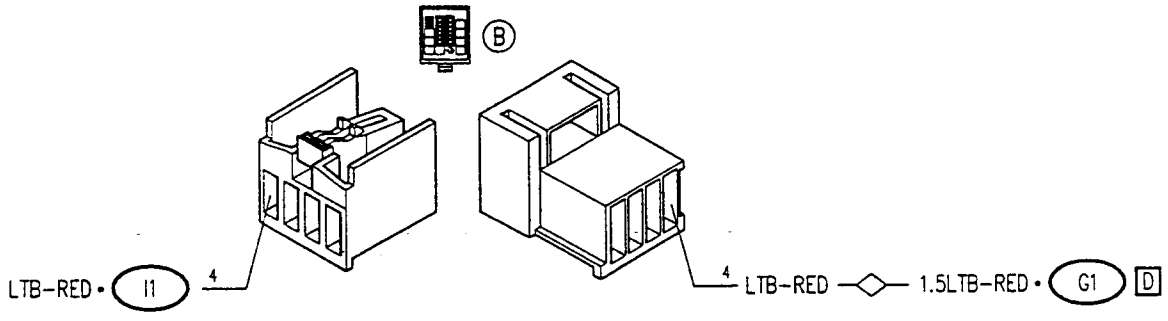
Fusebox	G1	I



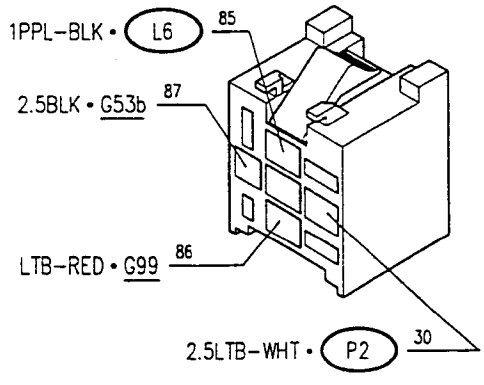
LH engine compartment earth	G53b



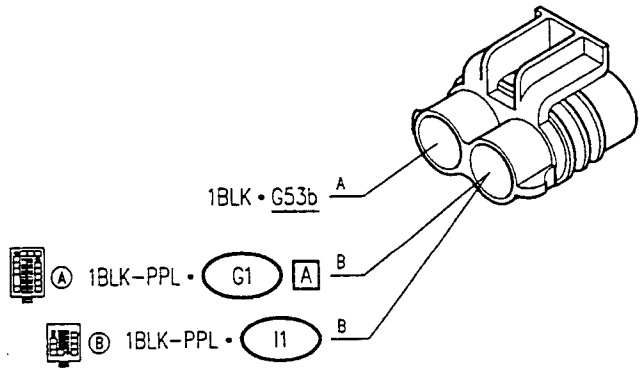
Dashboard/engine wiring connector	G99



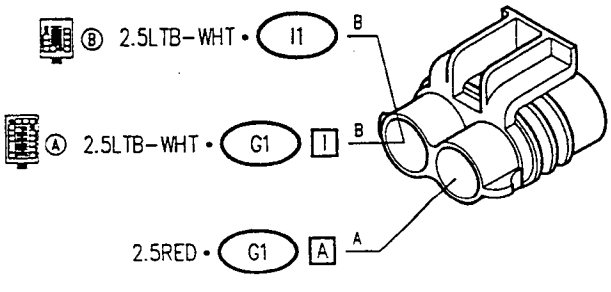
Engine water cooling fan switch	I1



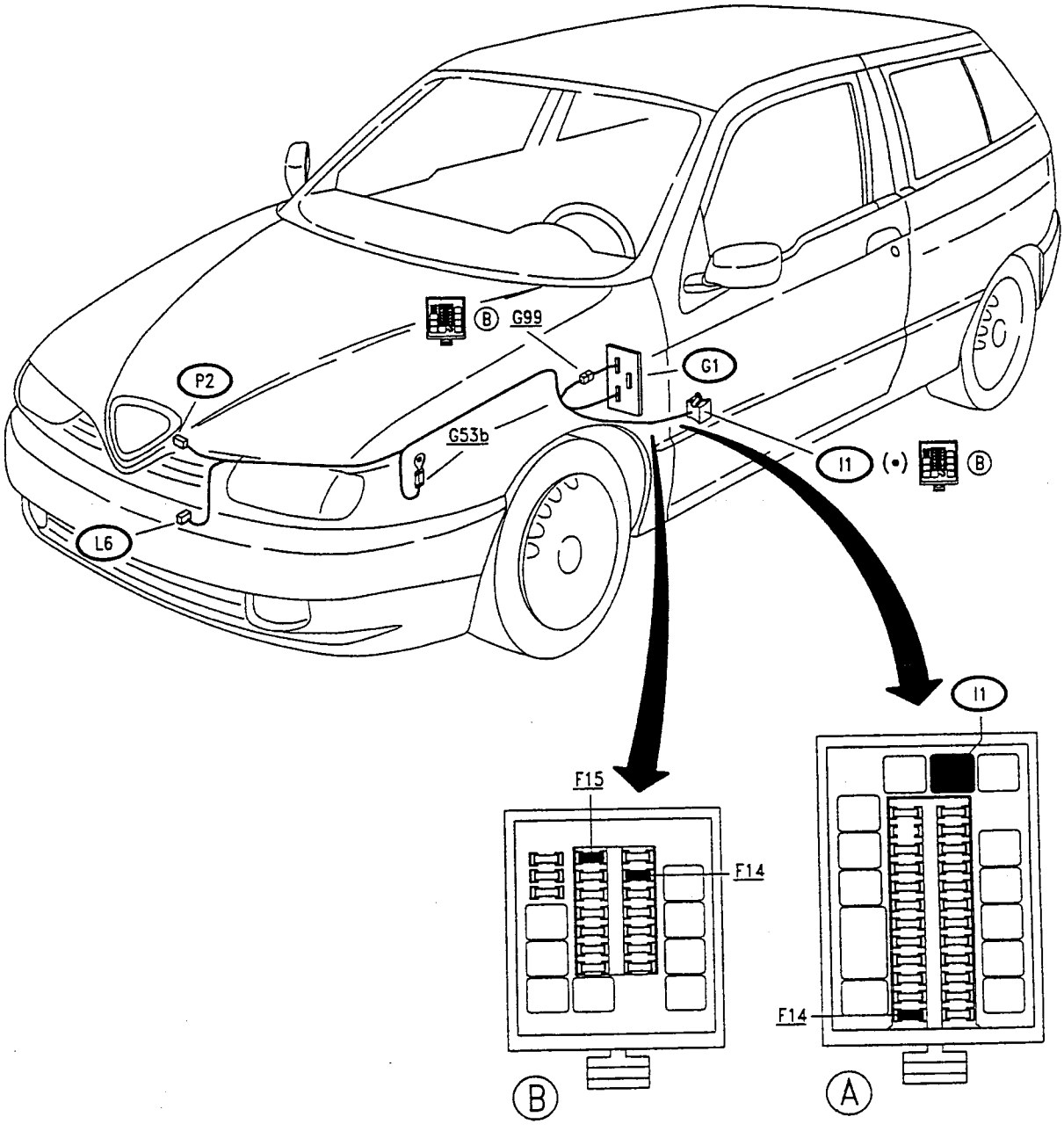
Engine cooling fan thermal contact	L6



Engine water cooling fan	P2

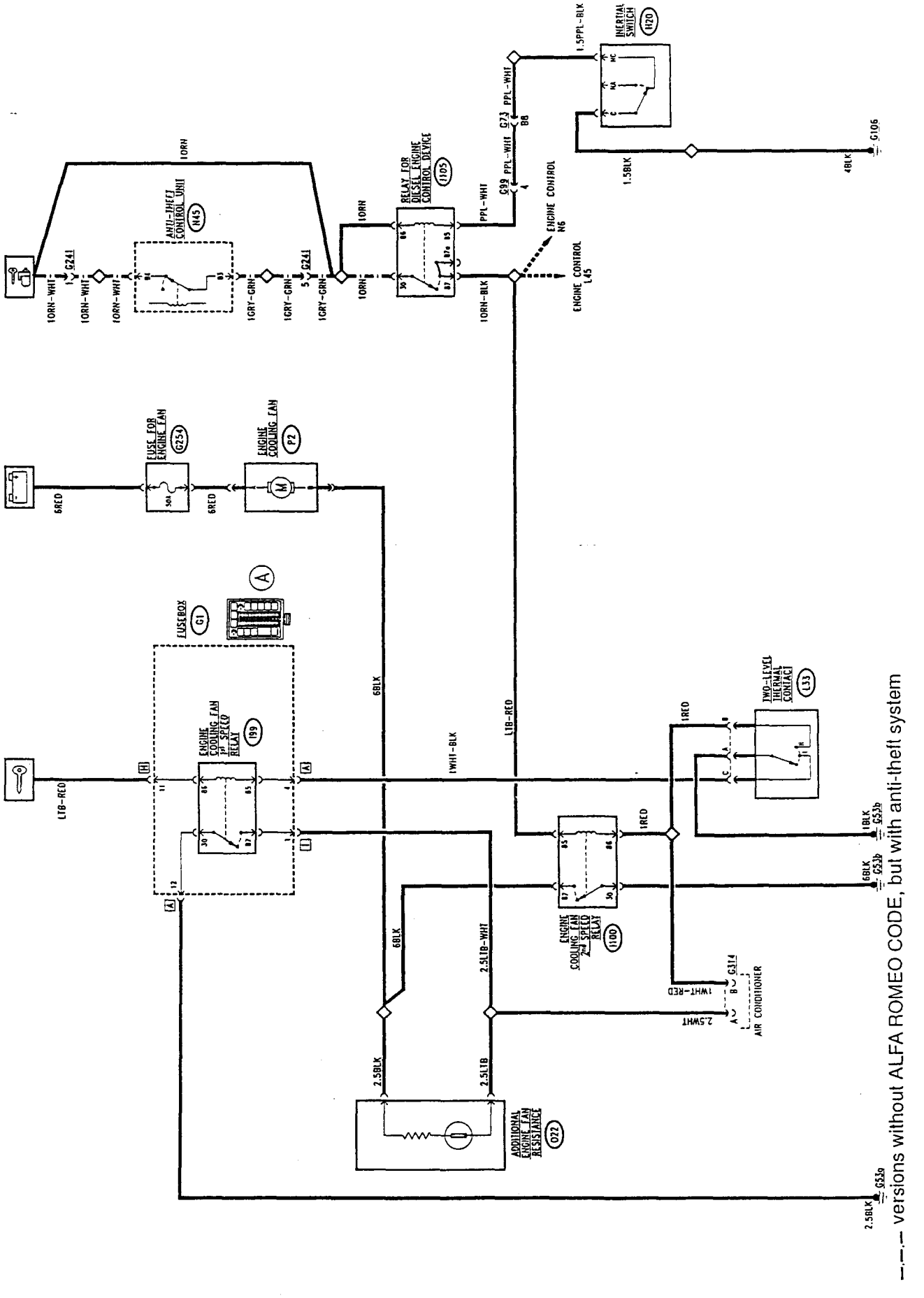


LOCATION OF COMPONENTS (Boxer Versions)

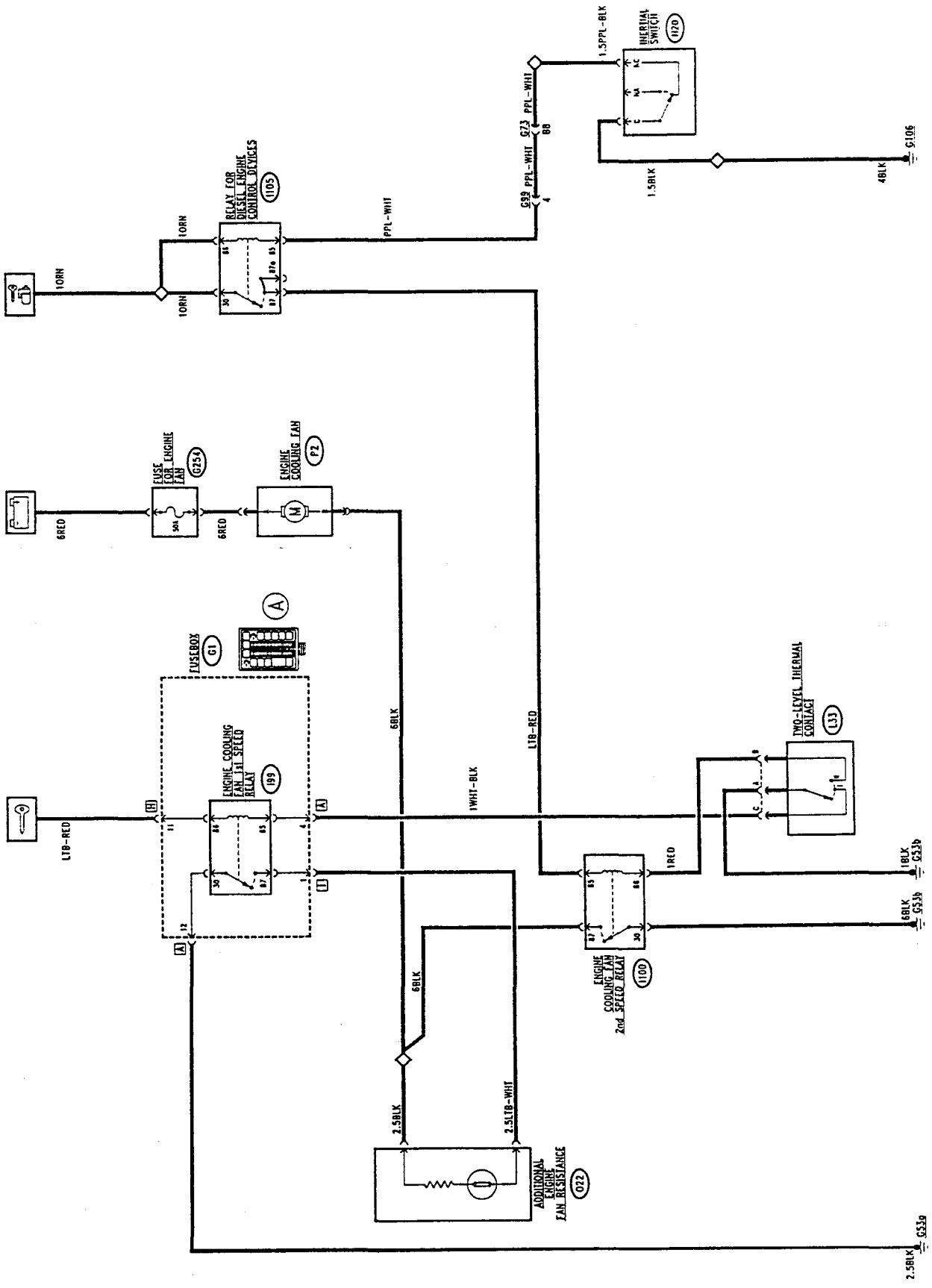


(•) yellow base

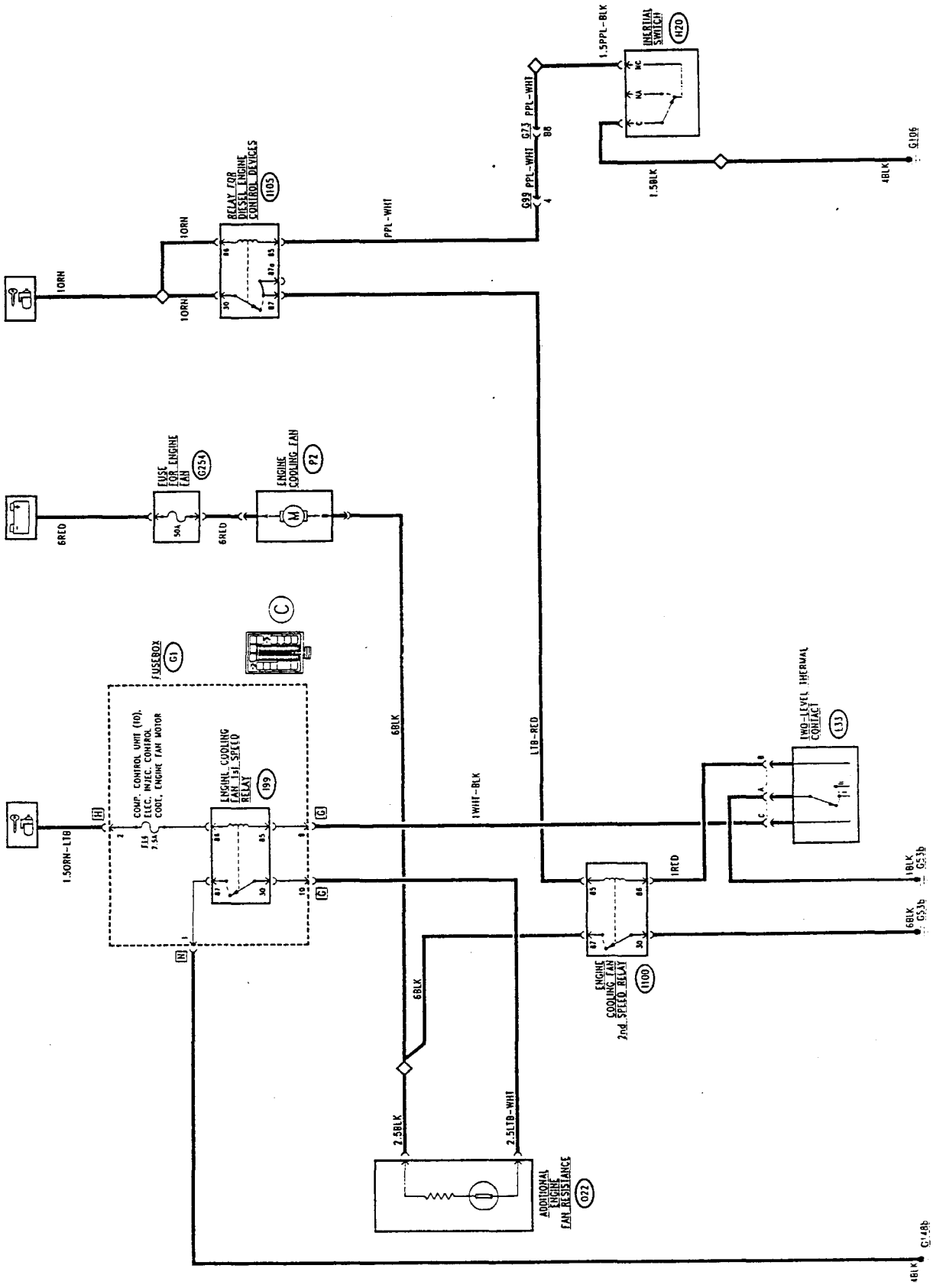
WIRING DIAGRAM (TD Version)



WIRING DIAGRAM (TD-CAT Version)



WIRING DIAGRAM (TD-CAT Version)



FUNCTIONAL DESCRIPTION (TD, TD-CAT Version)

The fan **P2** is supplied with battery voltage via a special fuse, **G254** (50A), and this way it is activated through an earth at the opposite terminal: if this earth leads directly from relay **I100** the 2nd speed is activated; when it leads from relay **I99** and crosses the additional resistance **O22**, the 1st speed is activated.

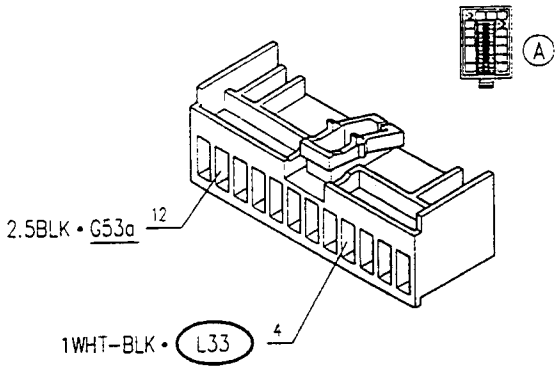
In fact, the fan operates at two different speeds, due to an additional resistance: the first speed is engaged at the first temperature level of the coolant detected by the thermal contact; the second speed cuts in at higher temperature (second level). The additional resistance is protected internally by a thermal fuse that cuts off the electric circuit if the temperature exceeds 184°C appr.

The signal from the 1st level (83-88°C) of the two-level thermal contact **L33** energizes relay **I99** - supplied from the ignition switch - thereby sending an earth signal to the additional resistance **O22** and from this to the fan, which is operated at the 1st speed.

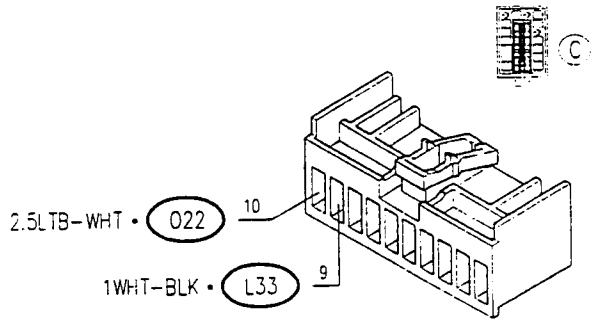
Conversely, if the coolant fluid reaches the 2nd level (87 - 92°C) of thermal contact **L33**, the earth signal energizes the coil of relay **I100** - supplied from the ignition block via relay **I105** and - only versions without ALFA ROMEO CODE - the antitheft control unit **N45** - directly operating the fan **P2** at 2nd speed.

CONENTS AND CONNECTORS (TD, TD-CAT Version)

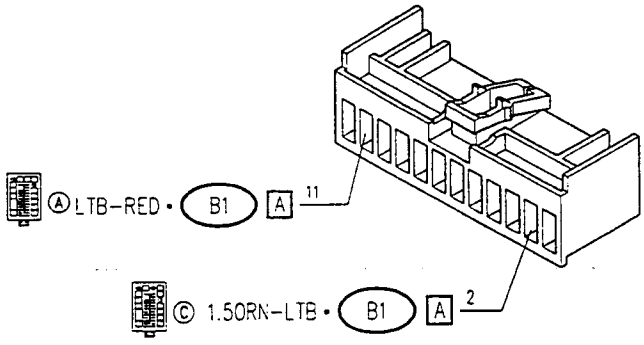
Fusebox	G1	A



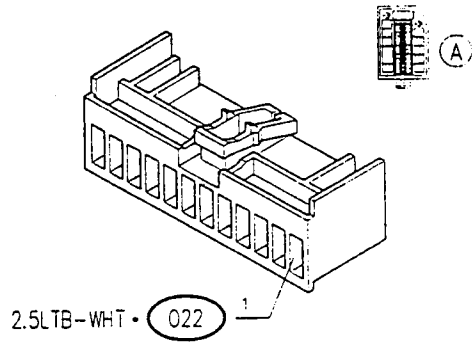
Fusebox	G1	G



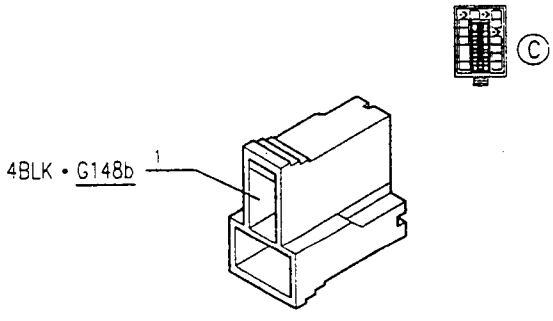
Fusebox	G1	H



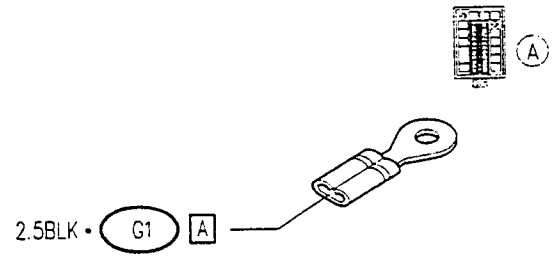
Fusebox	G1	I



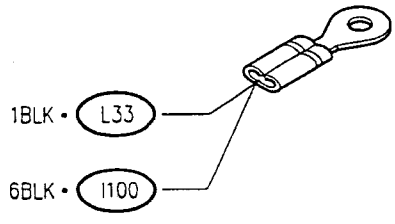
Fusebox	G1	N



RH engine compartment earth	G53a

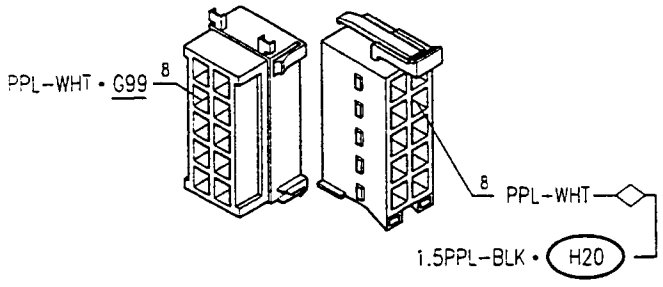


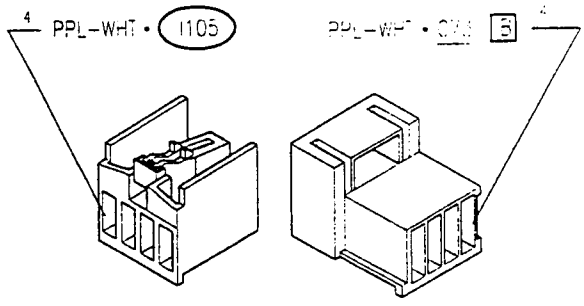
LH engine compartment earth	G53b



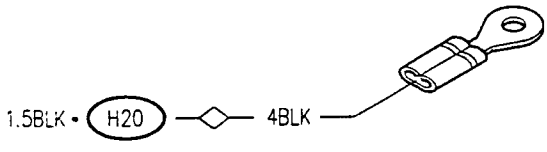
COMPONENTS AND CONNECTORS (cont.d)

Rear services connector	G73 B	Connector for dashboard wiring/engine wiring	G99

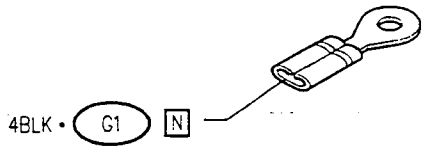




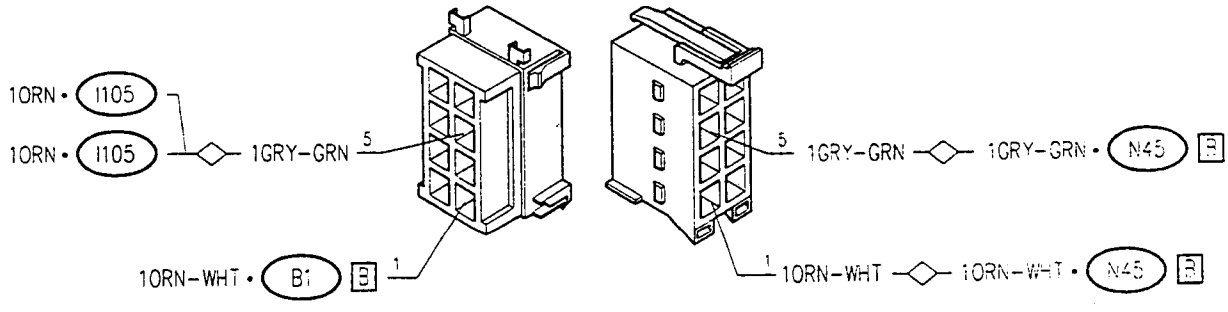
Seat cross rail earth	G106	Earth under dashboard LH	G148b



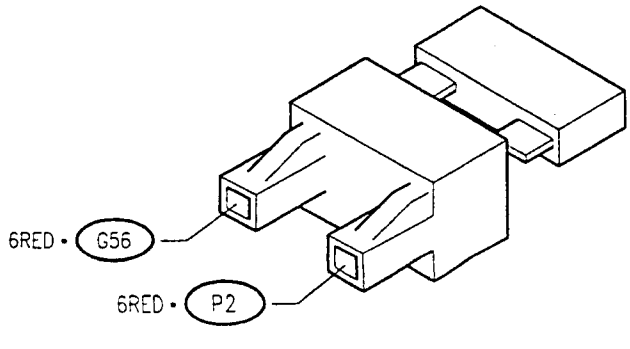


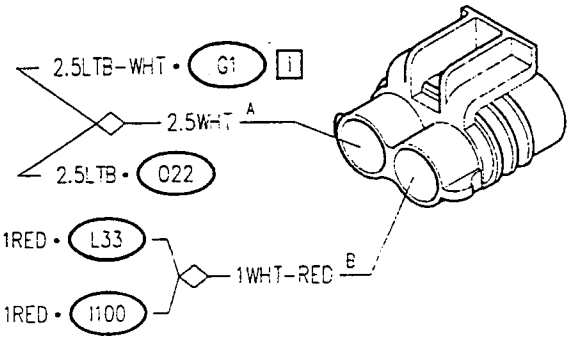


Anti-theft device wiring connector (*)	G241



Fuse for engine fan	G254	Connector for engine wiring / conditioner wiring	G314

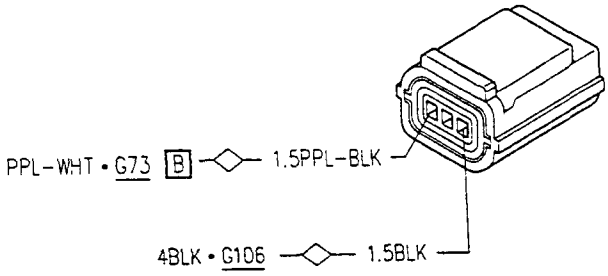




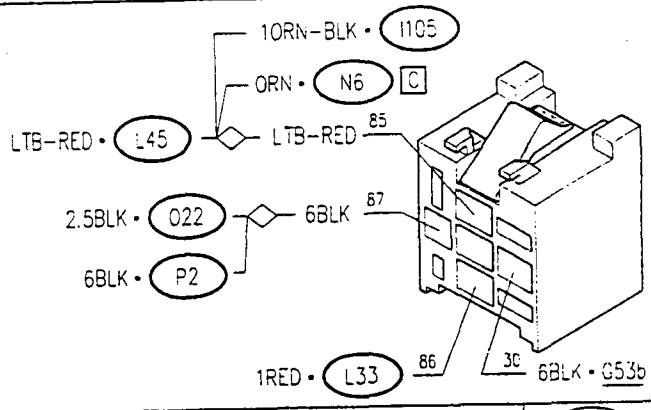
(*) versions without ALFA ROMEO CODE, but with anti-theft system system

COMPONENTS AND CONNECTORS (cont.d)

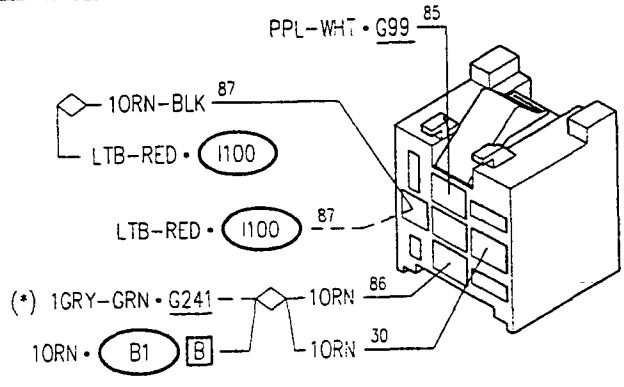
Inertial switch — H20



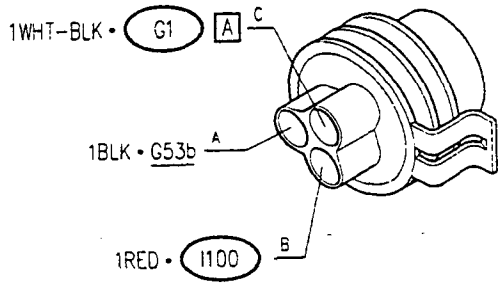
Engine cooling fan 2nd speed relay — I100



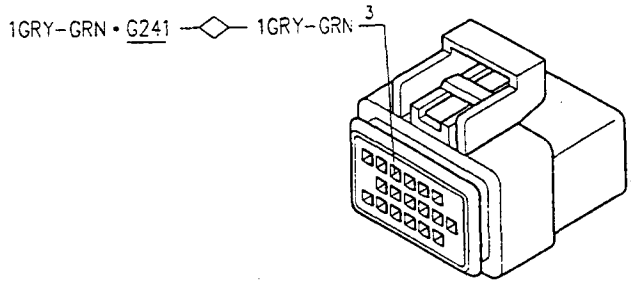
Diesel engine control devices relay — I105



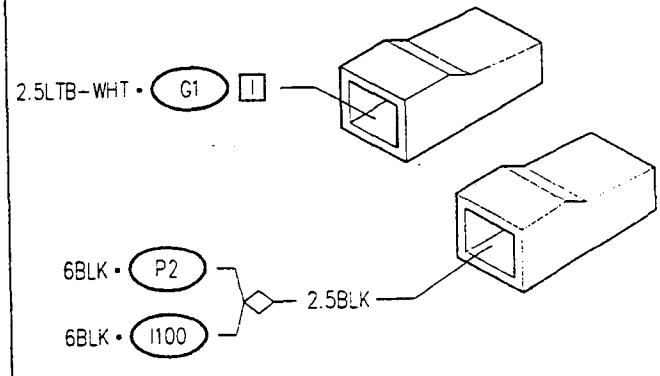
Two-level thermal contact — L33



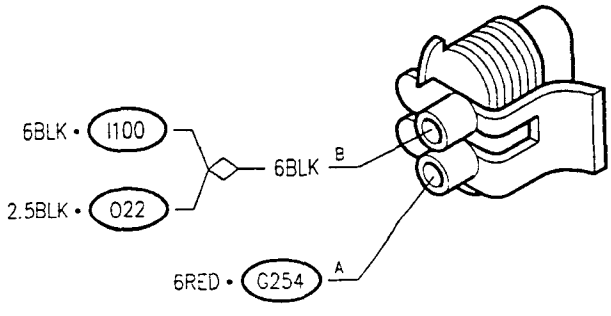
Anti-theft control unit (*) — N45 B



Engine cooling fan additional resistance — O22

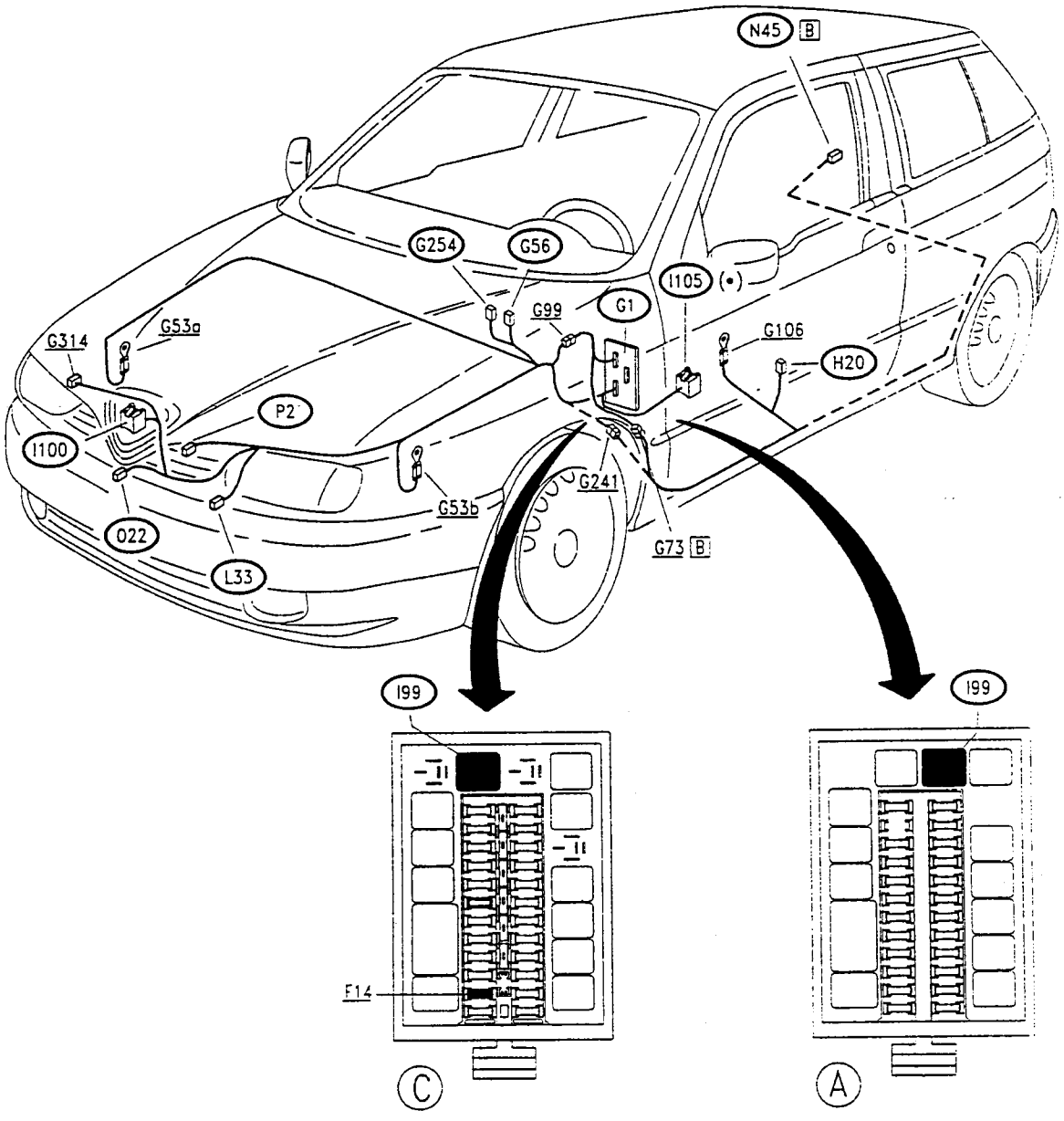


Engine water cooling fan — P2



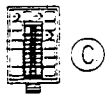
(*) versions without ALFA ROMEO CODE, but with anti-theft system system

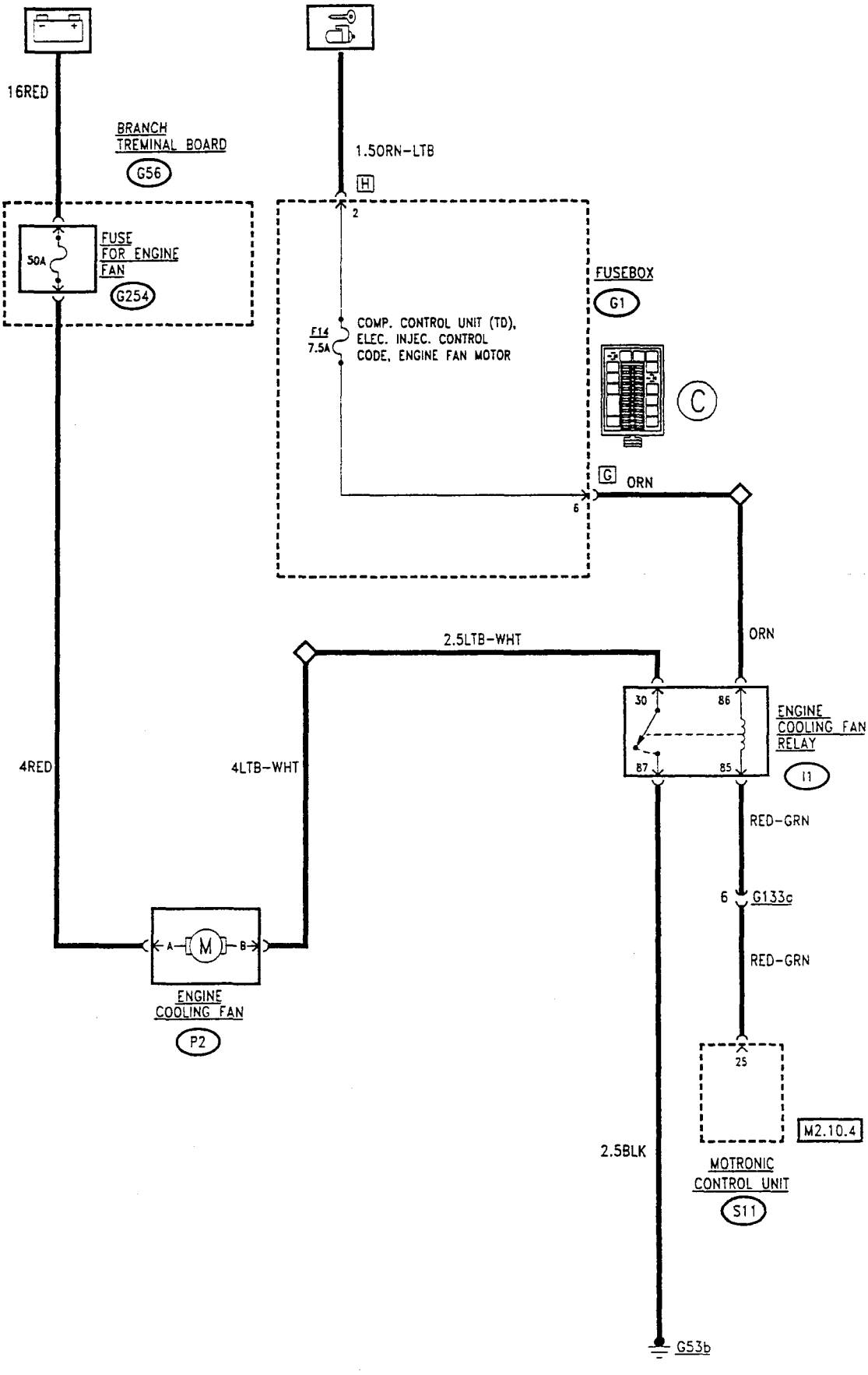
LOCATION OF COMPONENTS (TD, TD-CAT version)



(•) grey fuseholder
— — — versions without ALFA ROMEO CODE, but with anti-theft system system

WIRING DIAGRAM (T.SPARK Version)





FUNCTIONAL DESCRIPTION (T.SPARK version - Model Year '96)

The fan **P2**, provides the necessary ventilation of the cooling air for the engine radiator and for the air contioner condenser.

This fan is always supplied by battery voltage through the line protected by specific wander fuse **G254**, to be found in the branch terminal box: it is therefore operated by an earth command signal: this signal reaches it directly (2nd speed) or through the additional resistance **O22** (1st speed).

The fan **P2** is operated at the two different speeds by the two-level thermal contact **L33** which controls the temperature of the coolant in the engine radiator: when it reaaches the first level, relay **I99a** is energised, which is located in the fusebox **G1**, which sends the earth signal to the fan **P2** via resistance **O22**: 1st speed.

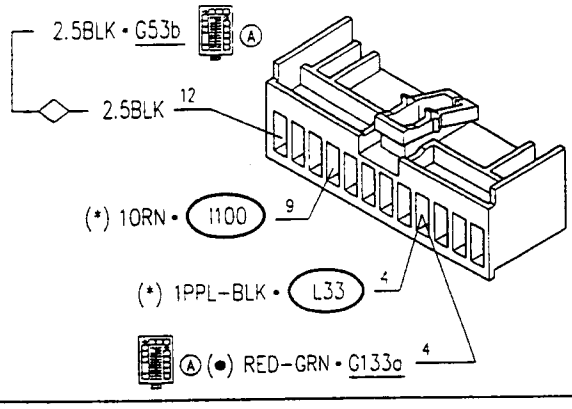
If the second temperature level is reached, relay **I100** is energised, located on the fan duct, which sends the earth signal directly to the fan **P2**: 2nd speed.
The two relays receive the "key-operated" supply; **I100** is supplied by the line of fuse **F4** of **G1**.

FUNCTIONAL DESCRIPTION (T.SPARK version - Model Year '97)

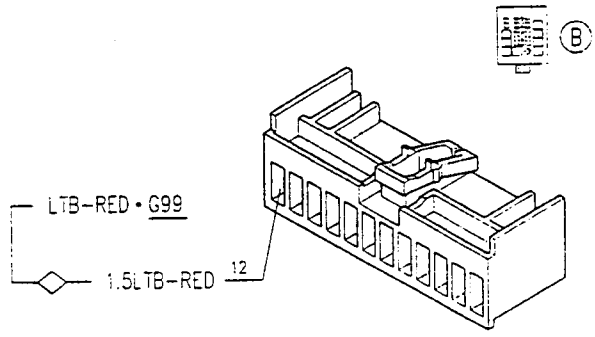
The fan **P2** is supplied directly with battery voltage via specific wander fuse **G254**.
Relay **I1** - to be found inside fusebox "A" or outside for version "B" "C" - that controls the fan is supplied from the ignition block (for fusebox "B" via fuse **F15** of the actual fusebox, for box "C" through fuse **F14**). and it is energized by an earth signal leading from control unit **S11** - pin 25 - which closes when the temperature of the coolant fluid increases 92°C: this way relay **I1** sends an earth to the motor which operates the fan **P2**.
When the temperature falls, the contact opens, the relay is de-energized and the fan stops.

COMPONENTS AND CONNECTORS (T.SPARK version)

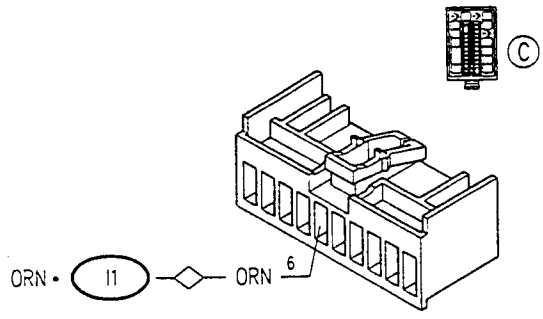
Fusebox | G1 | A



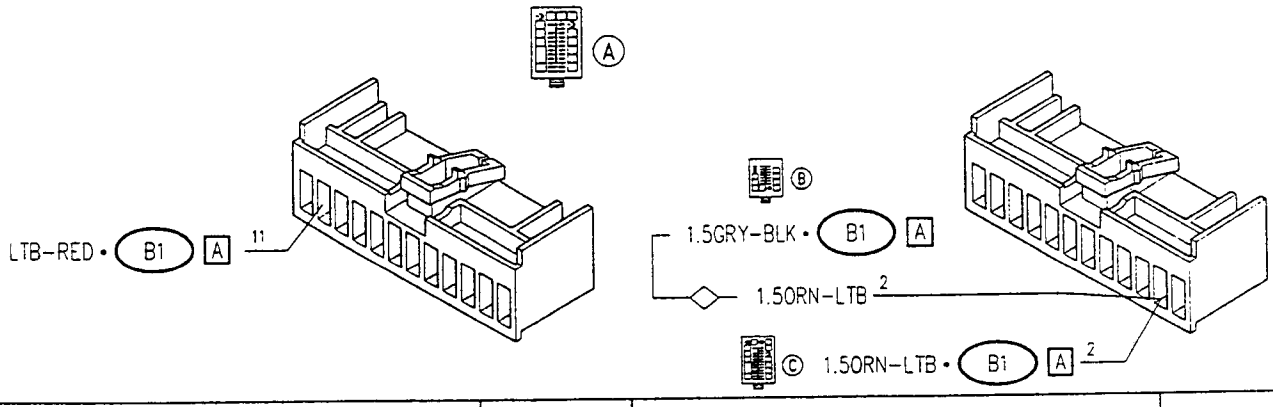
G1 | D



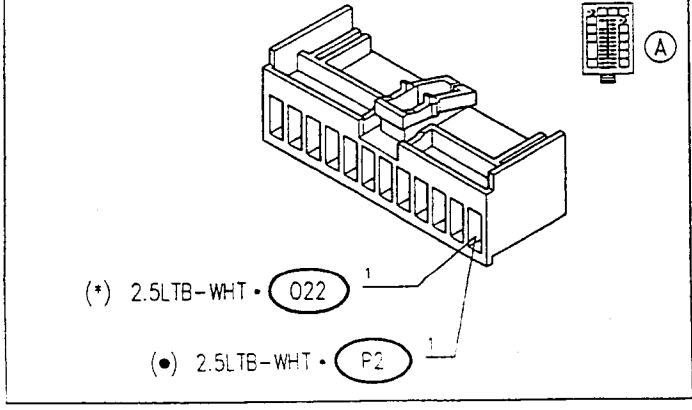
Fusebox | G1 | G



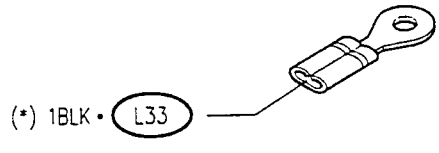
Fusebox | G1 | H



Fusebox | G1 | I



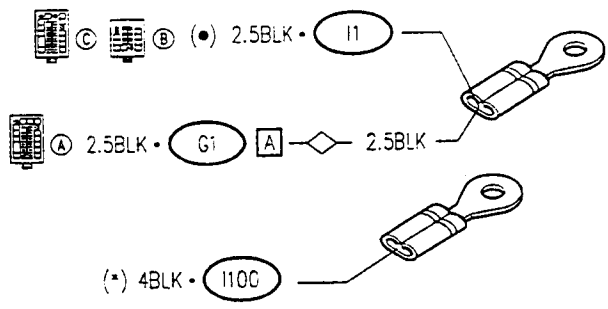
RH engine compartment earth | G53a



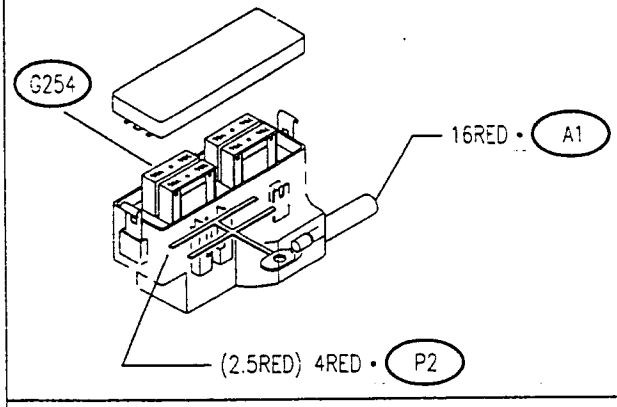
(*) Model Year '96
(•) Model Year '97

COMPONENTS AND CONNECTORS (contd.)

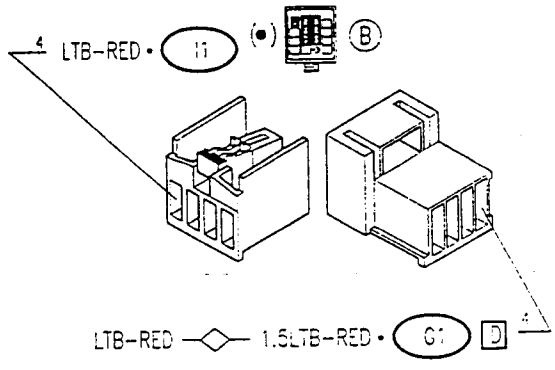
LH engine compartment earth	G53b



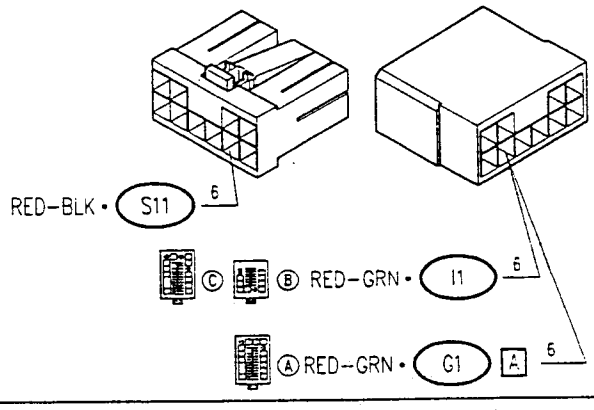
Branch terminal box	G56



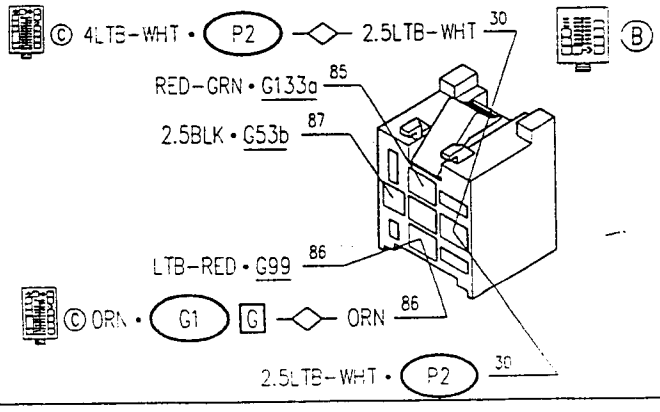
Connector for dashboard wiring/engine wiring	G99



Connector for electronic injection wiring A	G133a



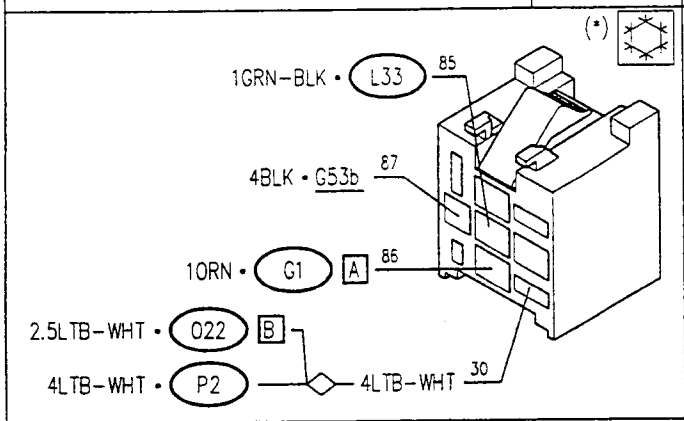
Engine cooling fan relay	I1

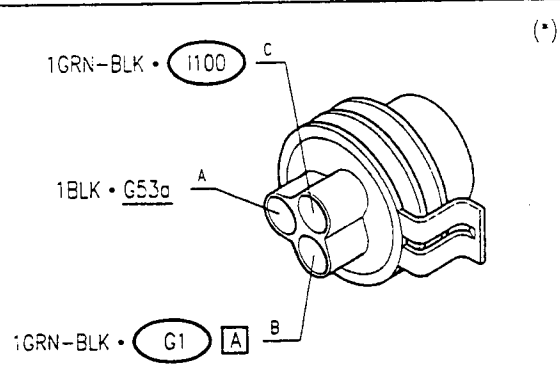


(*) Model Year '96
(•) Model Year '97

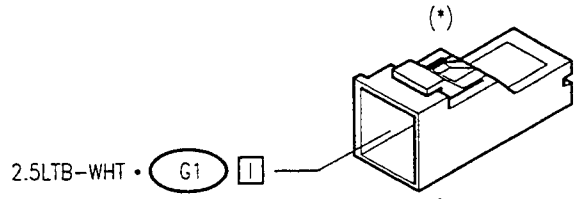
COMPONENTS AND CONNECTORS (contd.)

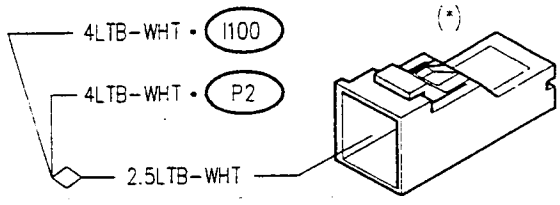
Engine cooling fan 2nd speed relay	I100	Two-level thermal contact	L33



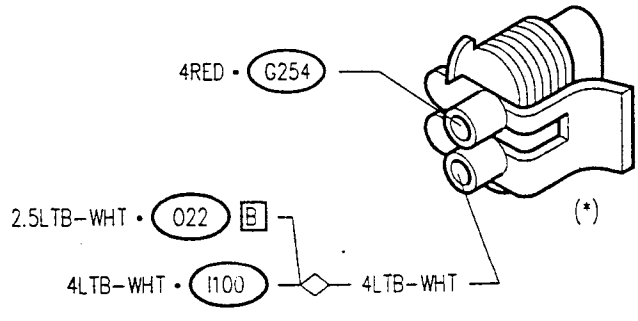


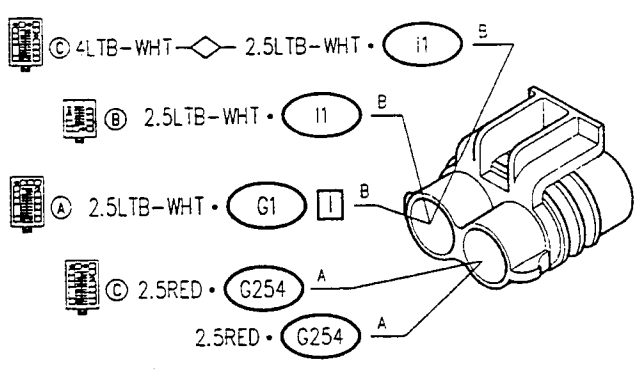
Engine fan additional resistance	O22 A	Engine fan additional resistance	O22 B





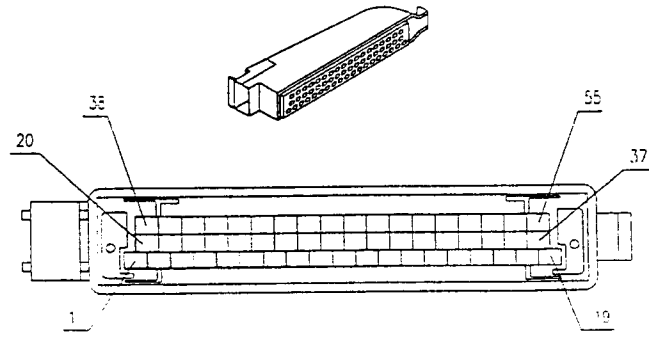
Engine water cooling fan (*)	P2	Engine water cooling fan (•)	P2





Motronic control unit (•)	S11

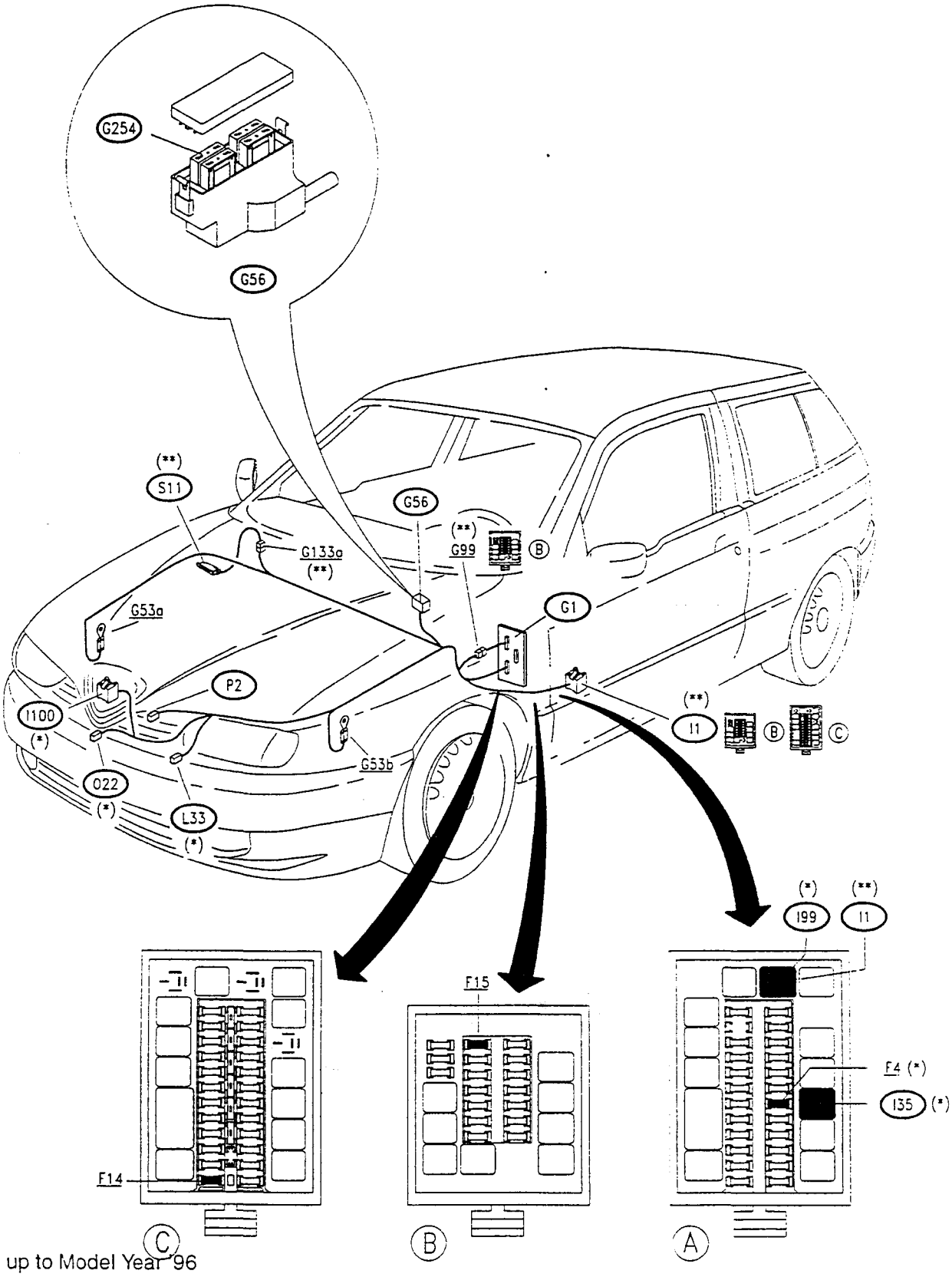
25 RED-BLK • G133a



(*) Model Year '96

(•) Model Year '97

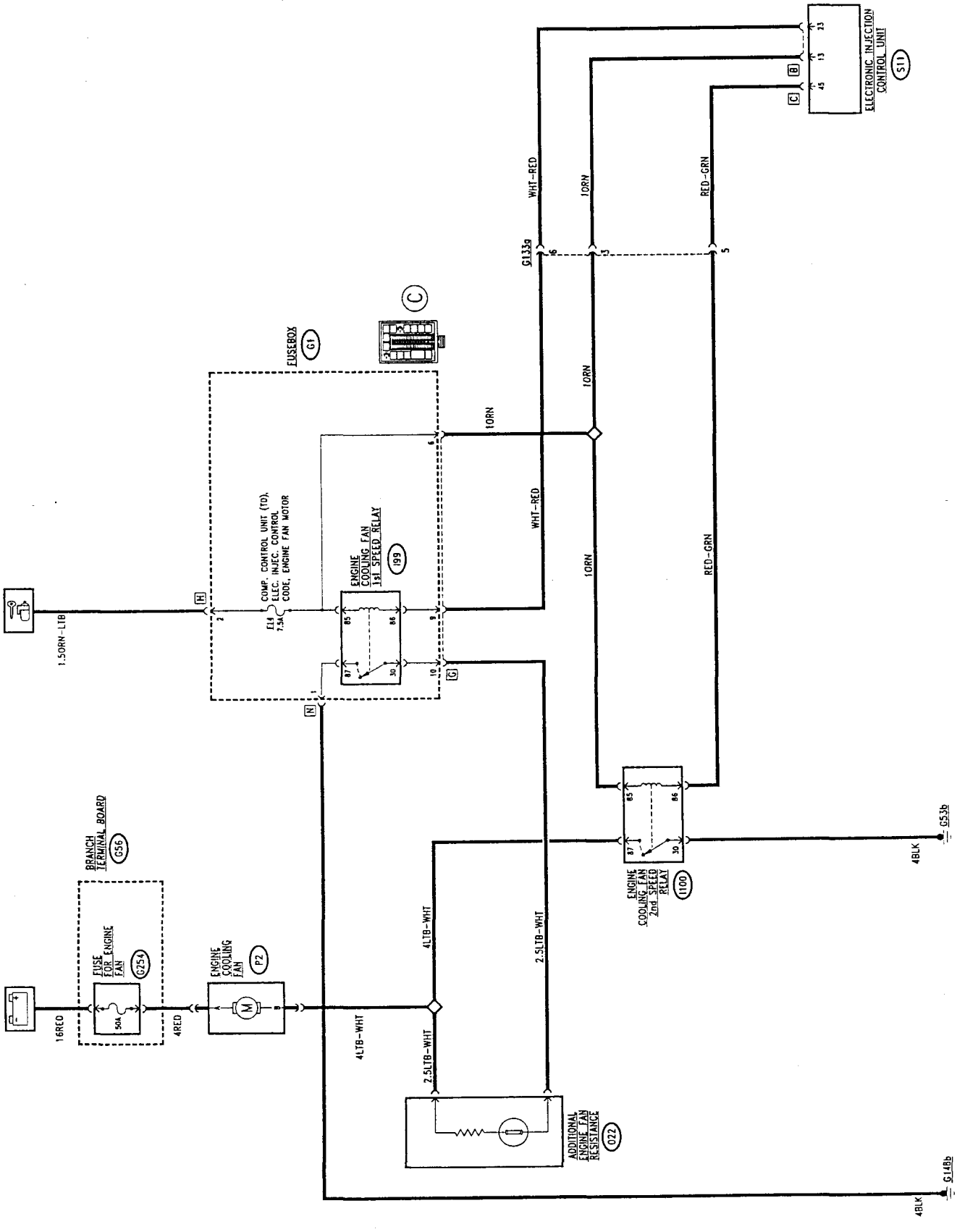
LOCATION OF COMPONENTS (T.SPARK version)



(*) only up to Model Year '96

(**) Model Year '97

WIRING DIAGRAM (JTD Version)

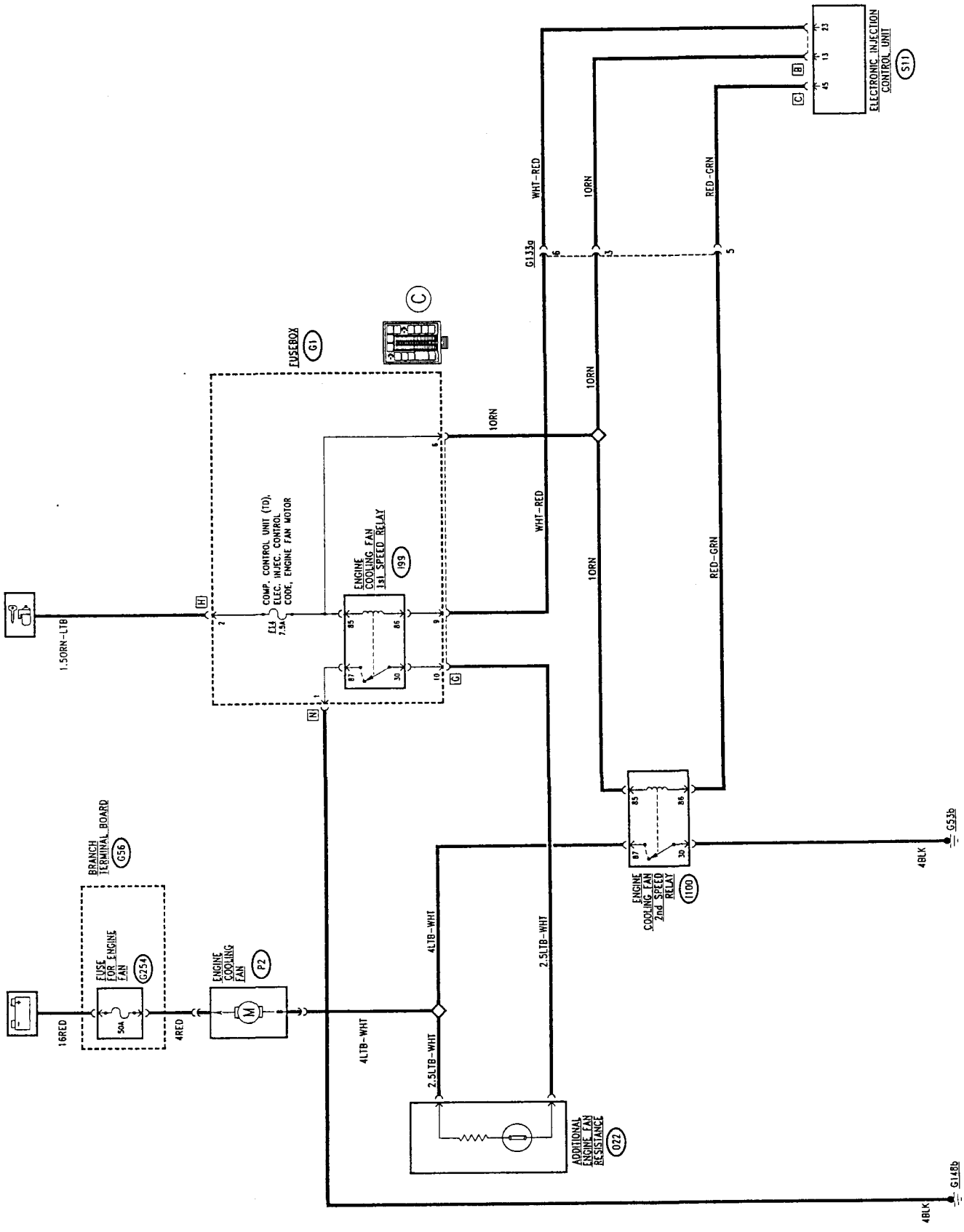


FUNCTIONAL DESCRIPTION

The fan **P2** is supplied with direct battery voltage via the wander fuse **G254**, located in the branch terminal box.
Relay **I99** - in fusebox **G1** - controls the fan and it receives the "key-operated" supply via fuse **F14** and is energised by an earth signal leading from the injection control unit **S11** - pin 23, connector C - when the engine reaches a certain temperature: this way relay **I99** sends an earth signal to the motor which operates the fan **P2** at 1st speed through resistance **O22**. When the temperature lowers, the contact opens, the relay is de-energised and the fan stops.

Conversely, if the temperature continues to rise, control unit **S11** sends a signal from pin 45 of connector C which energises the relay **I100**, that operates the fan **P2** directly (2nd speed).

WIRING DIAGRAM (JTD Version)



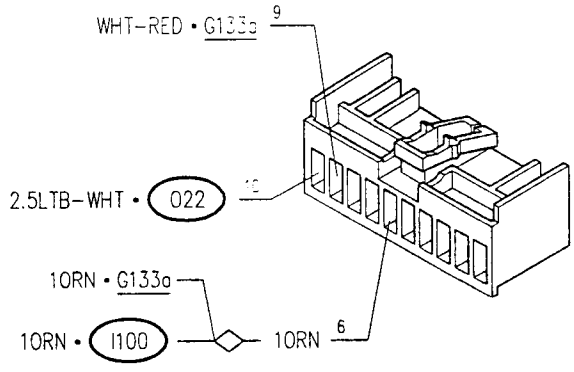
FUNCTIONAL DESCRIPTION

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Relay **I99** - in fusebox **G1** - controls the fan and it receives the "key-operated" supply via fuse **F14** and is energised by an earth signal leading from the injection control unit **S11** : pin 23, connector C - when the engine reaches a certain temperature: this way relay I99 sends an earth signal to the motor which operates the fan **P2** at 1st speed through resistance **O22**. When the temperature lowers, the contact opens, the relay is de-energised and the fan stops.

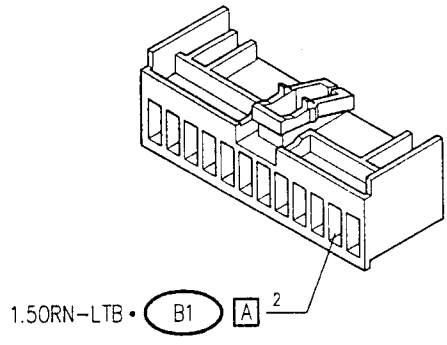
Conversely, if the temperature continues to rise, control unit **S11** sends a signal from pin 45 of connector C which energises the relay **I100**, that operates the fan **P2** directly (2nd speed).

COMPONENTS AND CONNECTORS (JTD version)

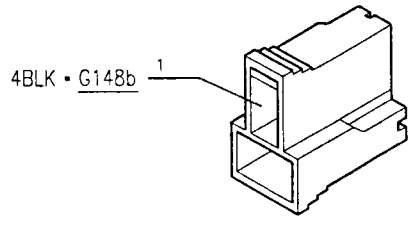
Fusebox	G1 G



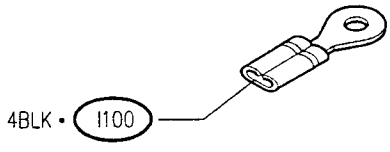
Fusebox	G1 H



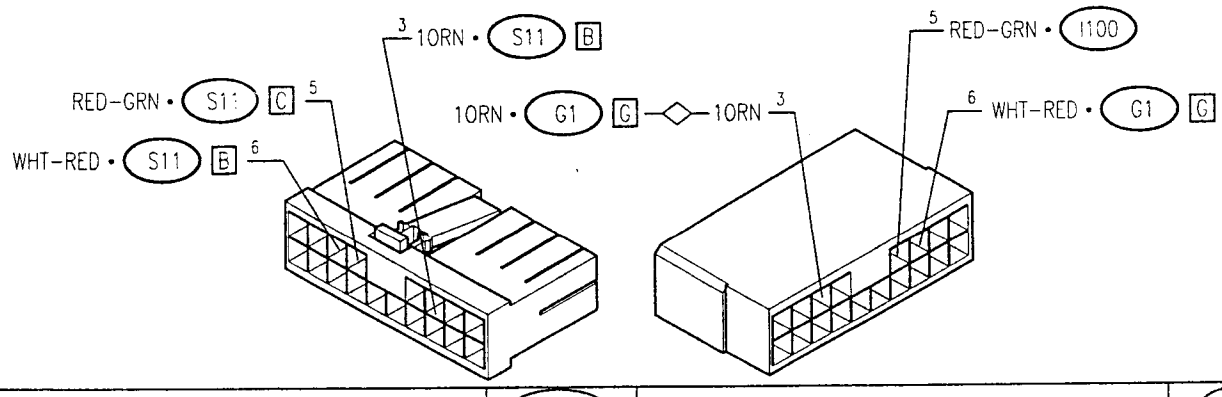
Fusebox	G1 N



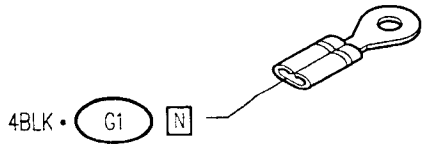
LH engine compartment earth	G53b



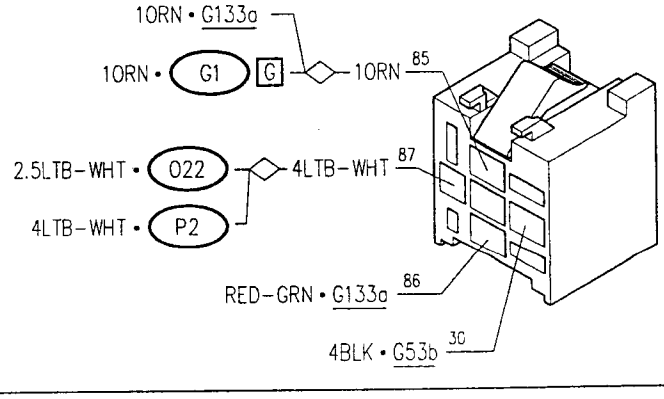
Connector for electronic injection wiring A	G133a



Earth under dashboard LH	G148b

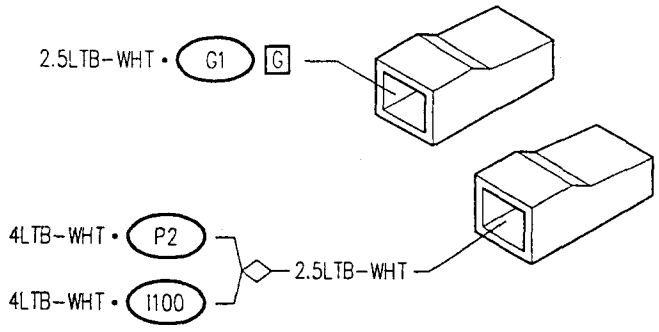


Engine cooling fan 2nd speed relay	I100

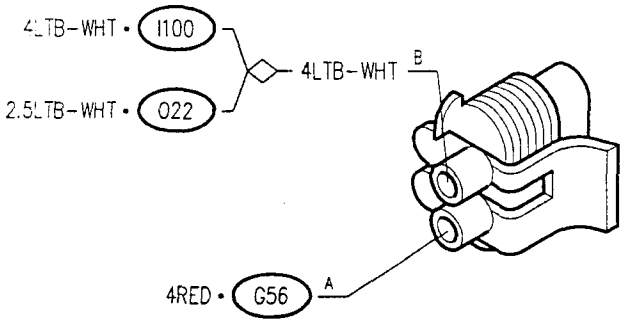


COMPONENTS AND CONNECTORS (contd.)

Additional engine fan resistance	O22



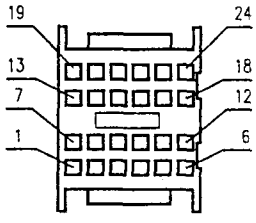
Engine cooling fan	P2



Electronic injection control unit	S11 B

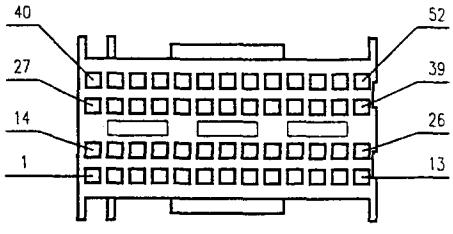
13 1ORN • G133a

23 WHT-RED • G133a

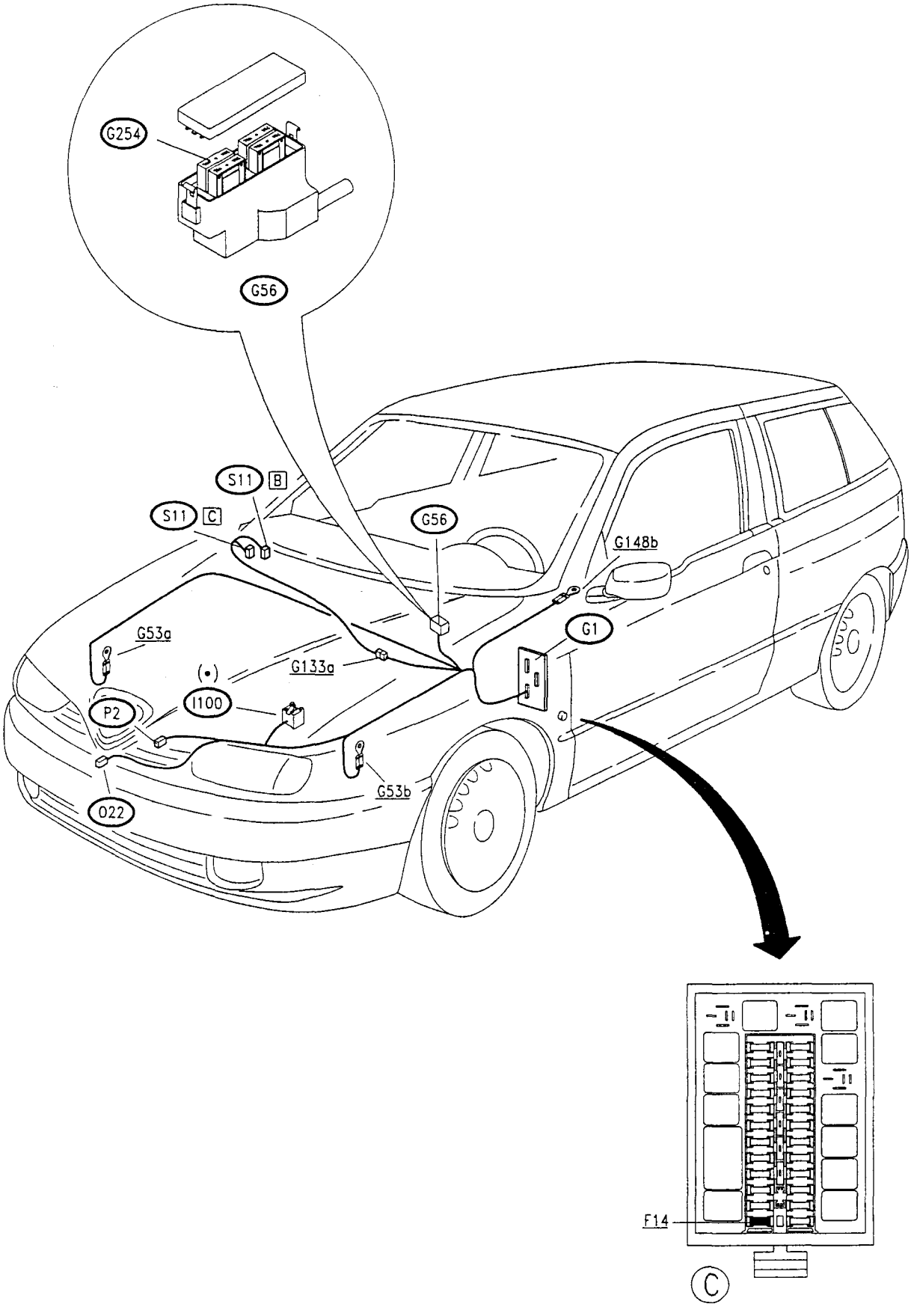


Electronic injection control unit	S11 C

45 RED-GRN • G133a



LOCATION OF COMPONENTS (JTD version)



(•) Black fuseholder

FAULT-FINDING TABLE

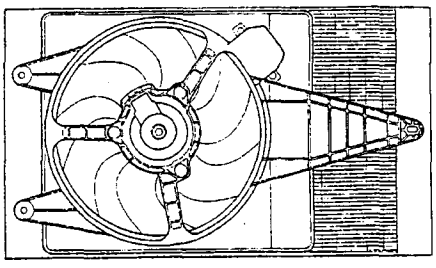
Fault		Component to be checked											
		F15 (B)	F4 (1)	F14	G254	P2	L6	L33	O22	S11	I1	I99	I100
Fan (under all circumstances)	Boxer	•		•		•					•		
	TD and T.SPARK (M.Y. '96)				•	•						•	•
	TD and T.SPARK (M.Y. '97)	•		•	•	•				•	•		
	JTD			•	•	•				•		•	
Fan (fails to start even if the coolant fluid temperature is high	Boxer						•						
	TD and T.SPARK (M.Y. '96)		•					•					
	TD and T.SPARK (M.Y. '97)									•	•		
	JTD									•			•
Fan at 2 different speeds	TD and T.SPARK (M.Y. '96)								•				
	JTD								•				•

(B) Only for fusebox "B"

(1) Only T.SPARK

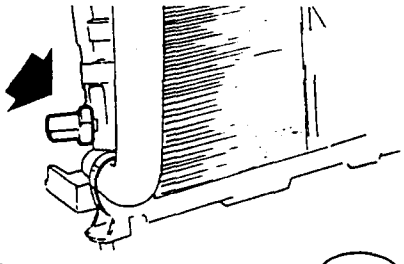
CHECK COMPONENTS

Cooling fan (P2)



SPECIFICATIONS	
Nominal voltage	12V
Speed at 12V in free air in duct	2350 ÷ 150 rpm. (minimum)
Direction of rotation of motor (shown on duct)	right-hand (impeller side)

Fan thermal contact (L6) (Boxer version)

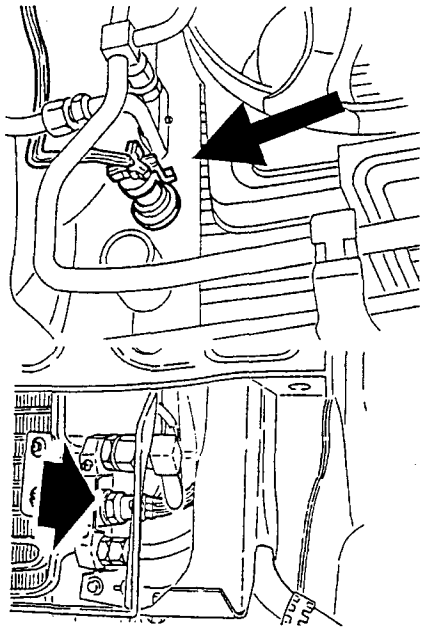


SPECIFICATIONS	
contact closes	92 ± 2°C
contact opens	87 ± 2°C

2 level fan thermal contact (L33) (TD and T.SPARK - M. Y. '96 versions)

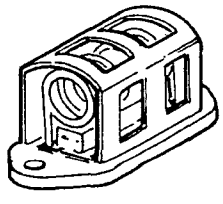
T.SPARK

TD



SPECIFICATIONS	
T.SPARK version	
1st level: contact closes contact opens	92 ± 2°C 87 ± 2°C
2nd level: contact closes contact opens	97 ± 2°C 92 ± 2°C
TD version	
1st level: contact closes contact opens	88 ± 2°C 83 ± 2°C
2nd level: contact closes contact opens	92 ± 2°C 87 ± 2°C

Fan resistance (O22) (TD and T.SPARK versions)



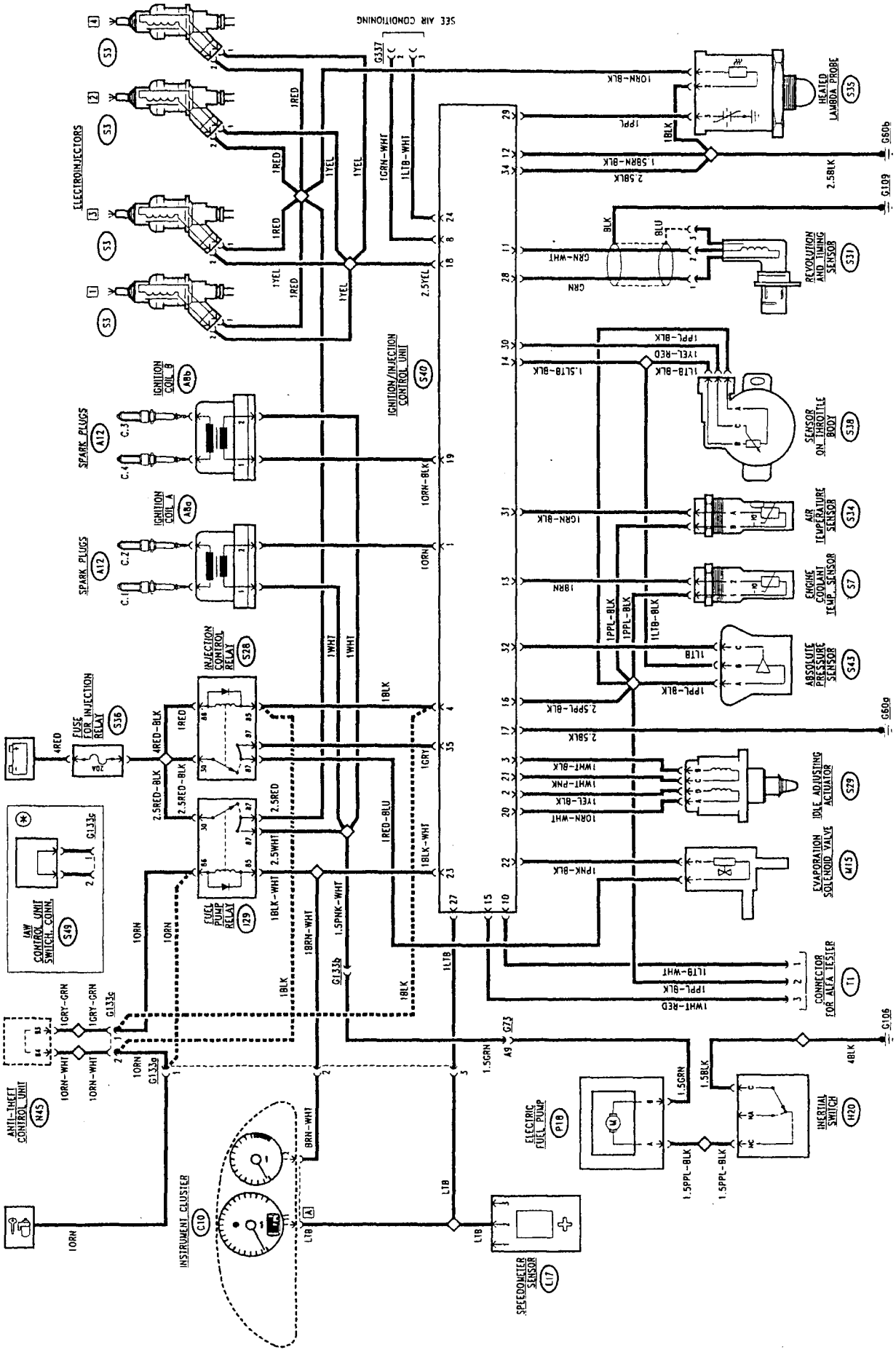
SPECIFICATIONS	
TD version	
resistance	0.3 ± 10% Ω
thermal fuse cut-in	184 $^{+0}_{-4}$ °C
T.SPARK version	
resistance	0.18 Ω ÷ 10%
thermal fuse cut-in	≤ 100°C

IAW INJECTION/IGNITION SYSTEM
- Boxer 1.3 Engine -

INDEX

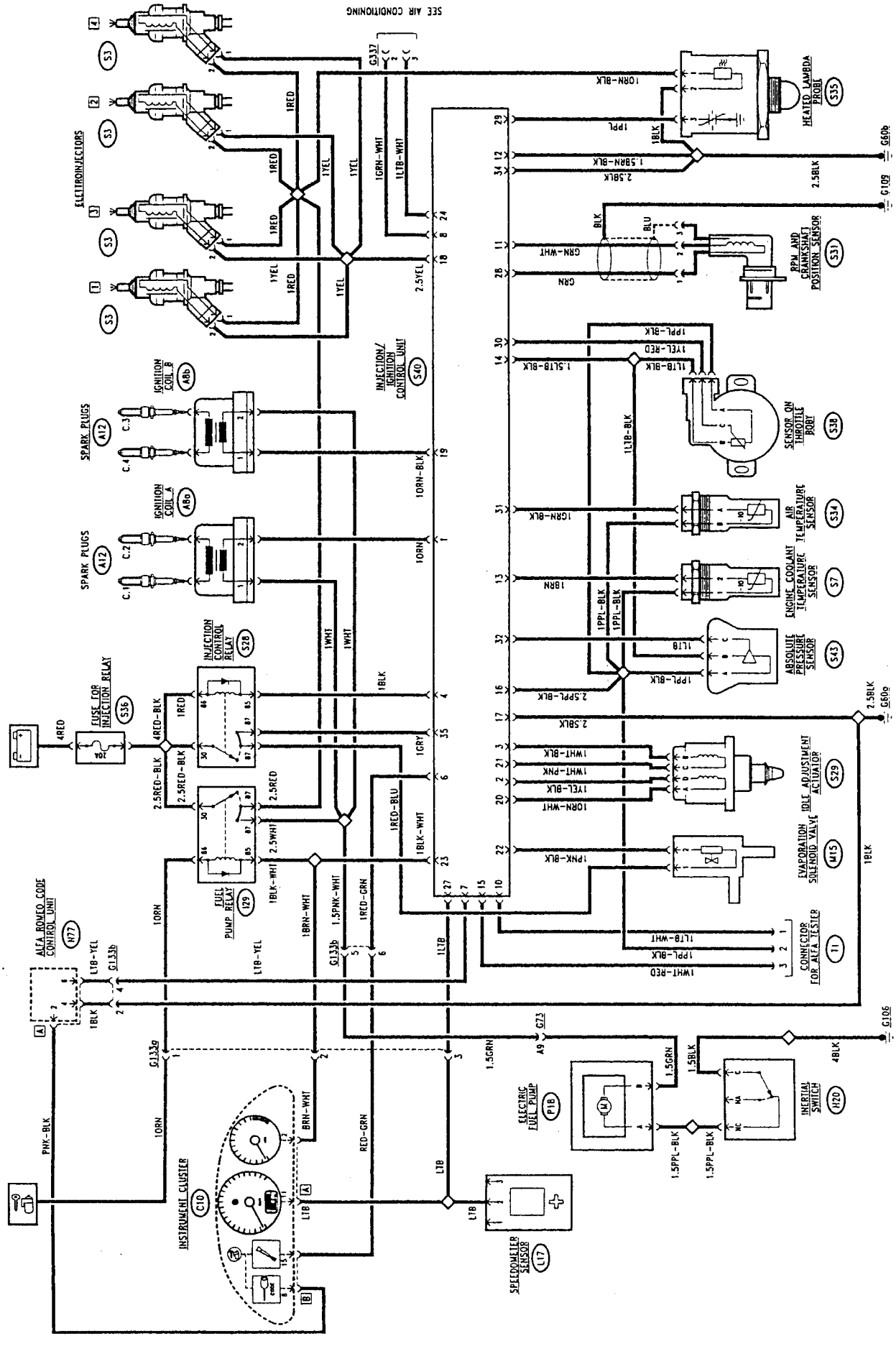
WIRING DIAGRAM 34-2
GENERAL DESCRIPTION 34-4
FUNCTIONAL DESCRIPTION 34-6
COMPONENTS AND CONNECTORS 34-9
LOCATION OF COMPONENTS 34-16
FAULT-FINDING 34-17
CHECKING COMPONENTS 34-18

WIRING DIAGRAM (for versions without ALFA ROMEO CODE)



– – – Temporary solution valid only for some vehicles not fitted with anti-theft system

WIRING DIAGRAM (for versions with ALFA ROMEO CODE)



GENERAL DESCRIPTION

The **I.A.W.** electronic control system - used here in the **8F.6B** version governs and controls all the operating parameters of the **Boxer 1.3** engine, optimising performance and consumption levels through response in real time to the different operating conditions. Indeed a single control unit controls injection and ignition. Injection is of the Multi- Point type with one injector per cylinder supplied at low pressure (2.5 bar) and governed by the control unit according to a defined logic. The calculation of the amount of air taken in is carried out by the control unit by indirect measurement, through the signals from the engine temperature and rpm sensors and from the air temperature and absolute pressure sensors: the amount of fuel to be injected is calculated on the basis of this value.

The ignition system adopted is electronic with "static distribution" (by semiconductors, without distributor, with two double output coils). The corresponding power modules are located inside the actual control unit. This solution, considerably improves reliability and reduces the number of high voltage cables and connections. Optimal ignition advance is determined by the control unit through a map stored in relation to the different operating parameters in order to optimise the need for full power, minimal consumption and minimal level of emissions at the exhaust.

For this reason the lambda probe is used which informs the control unit on the quantity of oxygen present at the exhaust, thereby making it possible to meter the air-fuel mixture correctly: when the mixture is "lean" the control unit increases the amount of fuel and when the mixture is "rich" the amount of fuel is decreased.

The control unit also controls operation at idle speed by governing a special regulator which adjusts the flow of air parallel to the throttle (by-pass).

Also the fuel vapour recirculation system is controlled by the control unit via the special solenoid valve which regulates the fuel vapour recovery canister allowing the vapours to return to the engine.
N.B. the simultaneous management of all these functions carried out by a single control unit makes it possible to adjust all the parameters in relation to the others in a completely interactive manner, in order to fully exploit the potential of all the functions. The system is also fitted with a "self-diagnosis" function which stores any faults, thereby ensuring that they can be quickly and effectively located connecting to the ALFA ROMEO Tester (see "Fault- finding").

WARNING: the IAW control unit is controlled by the ALFA ROMEO CODE system which enables the operation of it only after checking the secret memorised code (for further details see the "ALFA ROMEO CODE"section)

Operating logic

INJECTON: the control unit establishes the amount of fuel to be injected according to the result of the calculation of the quantity (in weight) of the intaken air: this calculation, known as the "intake air speed-density" type, is carried out with the information from the air temperature and pressure sensors and the engine rpm sensor. The control unit possesses a memorised map which provides an output value that operates the electroinjectors on the basis of the load detected and according to the optimal engine volumetric yield value: the parameter controlled is the opening time of the electroinjectors which is proportionate with the amount of ingoing fuel, as the pressure upstream of the injectors is kept constant by the special mechanical regulator.

Combustion control: through the oxygen sensor (or "lambda" probe) the control unit checks in real time the amount of oxygen at the exhaust, and therefore the correct air-fuel metering. The signal that the sensor sends to the control unit changes sharply when the composition of the mixture departs from lambda = 1 (optimum stoichiometric mixture). When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating. Therefore, through this sensor it is possible to adjust engine carburetion precisely and retroactively. Together with the adoption of the catalytic silencer at the exhaust, this makes it possible to keep exhaust emissions within the limits specified by law. Moreover, the IAW system automatically compensates the altitude, as the changes in the density of the air directly "adjust" the delivery from the electroinjectors via the signal from the absolute air pressure sensor. The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).

IGNITION: one of the maps in the control unit calculates the ignition advance according to the load and rpm of the engine. Through the rpm and crankshaft position sensor, the control unit detects the exact position in relation to the TDC: this way, the pulse is sent to the spark plug concerned in exactly the moment in which it is needed. Ignition is static, with two coils, each of which supplies two different cylinders by simultaneously sending the pulse to the spark plug of one cylinder (useful spark) and to that of the other (lost spark). A power module for each coil - located inside the control unit, therefore inaccessible - supplies the necessary signal.

IDLE SPEED ADJUSTMENT: the dynamic adjustment of the engine idle speed is carried out through the special actuator fitted with a step motor which is operated by the contol unit and adjusts the quantity of air in the throttle by- pass. This device acts as a regulator for cutting in the various services (e.g. conditioner compressor): in fact, when the throttle is closed, this valve adjusts the by-pass gap compensa-

the load required by the services in order to ensure that idle speed is as constant as possible.
In order to keep this value constant as soon as the engine is started, it is also necessary to increase the amount of fuel injected: this is done by the control unit which is informed of this condition through the engine temperature sensor.

The system also controls the following functions:

Fuel pump control: the electric fuel pump is governed by the control unit according to a precise logic which warrants top levels of safety:

- when the ingition key is turned to MARCIA, the pump is supplied, but this supply is cut off after a certain length of time (variable between 0.5 and 10 seconds according to the temperature of the engine) if the engine has not been duly started.
- the pump is supplied continuously if the engine rpm signal remains; if this signal falls below a certain minimum threshold (e.g. in the event of an accident in which the engine stops) the pump is deactivated instantaneously.

Inertial switch: on this car the pump control system is integrated by the inertial switch device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that connects the fuel pump to earth, thereby stopping the fuel pump instantaneously. This device is particularly important, integrating the safety offered by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents that do not cause the engine to stop immediately.

Cold-starting control: during cold starting the control unit uses special advance and injection time ratings with an "automatic choke" function: this function follows a precise course in relation to the temperature of the engine and it ceases when the engine is warm. Moreover, in these conditions the idle speed control logic also changes.

Control of enrichment during acceleration: upon the need for acceleration the control unit increases injection in order to quickly reach the torque/power required. This function is detected by a rapid change of the density of the intaken air, of engine rpms and of the signal from the potentiometer located on the throttle which instantaneously informs the control unit of the need for acceleration.

Fuel cut-off during deceleration: with the throttle closed and an engine speed above a certain threshold (which may vary according to the engine temperature) the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed and fuel consumption, controlled to a greater degree, is considerably reduced.

Rpm limiting: the control unit automatically stops the injection of fuel when engine rpm reaches high rates, (nearing the "over-revving" threshold), thereby preventing the engine from operating under such critical situations.

Connection with the conditioner compressor: the control unit is connected with the air conditioning system so that the idle rpm can be adapted to the increased load each time the compressor cuts in. In addition, the control unit temporarily inhibits (appr. 10 seconds) the compressor if high power is required by the engine (throttle position above a certain threshold).

Connection with the ALFA ROMEO CODE system: the system is connected to the ALFA ROMEO CODE control unit from which it receives the operation consent signal via a special serial line:

Alarm system: if the car is not fitted with ALFA ROMEO CODE, but with the electronic anti- theft device, the I.A.W. control unit receives consent to operate from the anti-theft control unit via the signal which operates the fuel pump relay, which in turn supplies the control unit.

Components

The electronic control unit (**S40**) receives the signals from the sensors which "read" the operation of the engine and processes them according to a logic memorised inside in "maps" which correlate the various parameters with one another in the best way possible, and it operates the actuators so that the engine always operates with the highest possible regularity and yield. The "maps" are the result of thorough experimentation on the bench and on the road in order to determine the optimum values and they are stored in a permanent ROM memory programmed when the control unit is assembled and which cannot be altered.
The parameters are calculated at each turn of the crankshaft, thereby enabling response in "real time" to the operating conditions of the system. The control unit is also capable of adapting the signal sent to the actutators according to the supply voltage, as the response of the actuators differs if the voltage changes. This is a latest-generation electronic control unit formed of hybrid thick film circuits in HCMOS technology, specifically designed for automotive purposes and featuring high level of immunity to electrical disturbances, high calculating speed and low energy consumption rates in stand-by.

The ensors are the following:

- rpm and crankshaft position sensor (**S31**);
- engine temperature sensor (**S7**);
- intaken air temperature sensor (**S34**);
- absolute pressure sensor (**S43**);
- throttle position sensor (**S38**);
- heated lambda sensor (**S35**).

The actuators are the following:

- electroinjectors (**S3**);
- ignition coils (**A8a**; **A8b**);
- fuel pump (**P18**);
- idle speed adjustment actuator (**S9**);
- evaporative solenoid valve (**M15**).

The control unit is also connected with:

- the climate control unit,
- the ALFA ROMEO CODE control unit **(N77)** or the anti-theft control unit (**N45**),
- the instrument cluster **(C10)** to which it supplies the signal for the rev counter and the signal for turning on the failure warning light,
- the tachometric sensor **(L17)** from which it receives the car speed signal.

The system is completed by two relays: the fuel pump relay **(I29)** and the injection control relay **(S28)** which operate the fuel pump, the injectors, the coils and the other components of the system. The supply line is protected by wander fuse **(S36)**. The injection relay and fuses are located in the engine compartment next to the branch terminal board, while relay (**I29**) is located in the container of control unit (**S40**); only for some vechicles without alarm system is located in the engine bay next to the injection relay.
Lastly, there are three earth points: **(G60a)** and **(G60b)** on the engine and **(G109)** next to the control unit.
The connector **(T1)** used for the connection with the ALFA ROMEO Tester is located in the engine bay in an easily accessible position. For some vehicles it is located near the control unit.

FUNCTIONAL DESCRIPTION

Control unit **S40** controls and regulates the whole electronic ignition and injection system.

The direct supply for the whole system is protected by fuse **S36** (20A).

Via the coil of relay **S28** this supply reaches pin 4 of **S40** enabling the preservation of the memories, etc.

When the key is at MARCIA the control unit supplies the whole system: in fact the information that the key has been turned to MARCIA reaches pin 23 of **S40** via the coil of relay **I29**; consequently, an earth is sent by pin 4 which energizes relay **S28**.

Only version without ALFA ROMEO CODE: the signal "key to MARCIA" crosses the anti-theft control unit **N45**, which gives the necessary consent to operate the entire system.
If the anti-theft system is not installed, the connector of connection **G133c** is bridged with connector **S49**.

Relay **S28** supplies the control unit itself at pin 35, and solenoid valve **M15.**

The coil of the fuel pump relay **I29** is "turnkey" supplied by the control unit **S40** from pin 23; this is the rpm signal which is also sent to the instrument cluster **C10**. The relay supplies the electric fuel pump **P18**, and also the electroinjectors **S3**, the two coils **A8** and the lambda sensor **S35**.

Due to safety reasons, it is the control unit **S40** that controls the supply to the fuel pump; this takes place via the consent signal to relay **I29**, at pin 23, following the logic described previously.

The earth reaches the pump **P18** via the inertial switch **H20** which cuts off the circuit in the event of a crash.

The power earth is supplied at pin 17 and 34 of **S40**.

The control unit **S40** receives a number of signals from the different sensors, thereby keeping all the engine operating parameters under control.

Pin 14 of the control unit sends a stabilised voltage (5V) to numerous sensors, while an electronic earth signal is sent from pin 16.

The rpm sensor **S31** supplies information about the engine speed and defines the position of the crankshaft.

The sensor is of the inductive type and detects the engine rpm through the change in a magnetic field produced by the passage of the teeth of a "phonic" wheel fitted on the flywheel; the wheel has 60 teeth which make it possible to detect the engine speed; two of these teeth are missing, and this makes it possible to locate the passage from the T.D.C. of the two pairs of cylinders (1-2 and 3-4); it is connected with the control unit at pin 11 and pin 28; the two cables are screened. This way the control unit **S40**, distinguishes

the operating stroke of each cylinder and controls the synchronism of the engine.

The throttle position sensor **S38**, connected with the control unit **S40** at pins 14 and 16, through a potentiometer sends a signal to pin30 and is porportionate with the degree of opening of the throttle. In fact, the mobile section of the potentiometer is keyed directly onto the shaft that turns the throttle.

The air temperature sensor **S34** - located on the intake piping-, is connected to the control unit **S40** at pin 16, and supplies a signal at pin 31 proportionate with the temperature of the air measured with NTC thermistor (resistance which lowers with the temperature).

The engine temperature sensor **S7**, connected to the control unit **S40** at pin 16, supplies a signal at pin 13 proportionate with the temperature of the engine coolant, detected near the thermostat, by an NTC thermistor (resistance that lowers with the temperature).

The absolute pressure sensor **S43**, connected to the control unit **S40** at pin 14 and 16, generates a signal sent to pin 32 which is proportionate with the absolute pressure of the incoming air. This signal is generated by a Wheatstone bridge device followed by an amplifier which detects the deflections of a diaphragm that "feels" absolute vacuum on one side and the vacuum in the intake manifold on the other: in fact, these deflections change the resistances of the bridge, thus the output signal.

The heated lambda sensor **S35** supplies the control unit **S40** information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the ehaust gases; this takes place via the signal sent to pin 29 of the control unit **S40.**

The sensor is heated by a resistance to make sure that it operates correctly also when the engine is cold; the resistance is supplied by the fuel pump relay **I29**.

On the basis of the signals received and the calculations carried out, the control unit **S40** controls the opening of the injectors **S3** through pin 18. The injectors are supplied by relay **I29**.

Ignition is of the static type controlled directly by the control unit which automatically adjusts the spark advance. The power modules are located inside the control unit **S40** and they send the command signals from pins 1 and 19 to the coils **A8a** and **A8b**, supplied by relay **I29**.

The idle speed adjustment actuator **S29** makes a by-pass of the flow of air around the throttle through an electric step motor which controls a screw/lead screw reduction gear and a shutter that changes the passage of the air in the by-pass.
The step motor is controlled by the control unit **S40** in two stages (forward/backward) from pins 2, 3, 20 and 21.

The evaporative solenoid valve **M15**, sends the fuel vapours from the canister towards the engine according to a command from the control unit: this signal - of the duty cycle type - is sent from pin 22. The valve is supplied by relay **I29**.

The control unit **S40** is informed instant by instant of the engine through sensor **S31**: this information is sent to the rev counter on the instrument cluster **C10**, via the signal of pin 23.

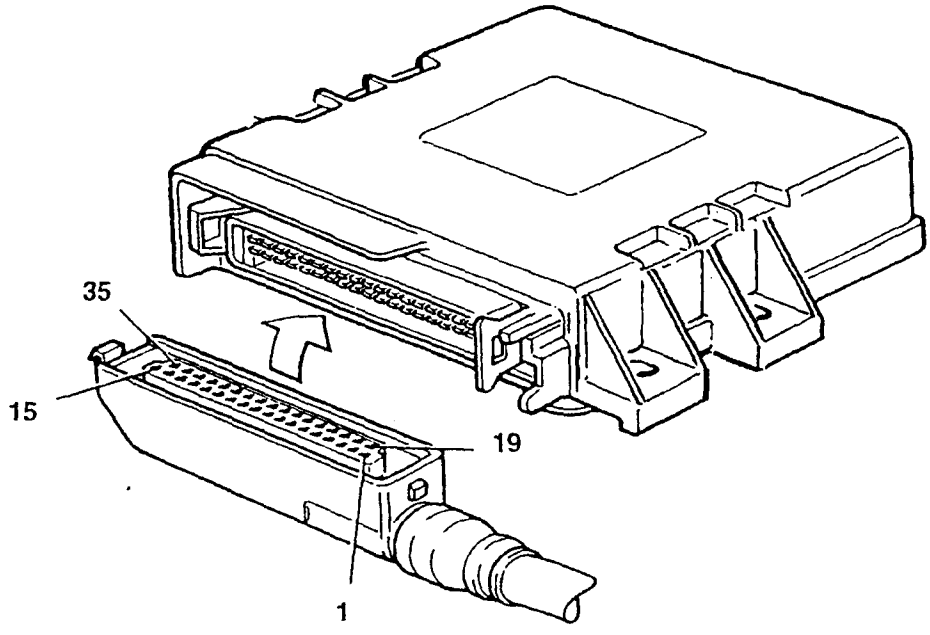
The detection of a failure by the control unit turns on the corresponding warning light on the instrument cluster by the signal from pin 6 of **S40**.

From sensor **L17**, the control unit receives, at pin 27, the car speed signal, used by the internal logic to optimise certain functions.

The control unit **S40** is connected with the air conditioning system via pins 8 and 24. This makes it possible to adapt the engine idle speed to the increase in power each time the compressor cuts in, or to cut it out if the engine needs full power. For further details see the "Heating and Ventilation" section.

The control unit **S40** is fitted with a self-diagnosis system which can be used connecting the ALFA ROMEO Tester to connector **T1**; here, the control unit sends the fault signals via the diagnosis line K -pin 15- and line L - pin 10-, while pin 16 supplies the electronic earth.

The connection with the ALFA ROMEO CODE contro unit is made with the special line leaving pin 7 of S40 For further details see the "ALFA ROMEO CODE' section.

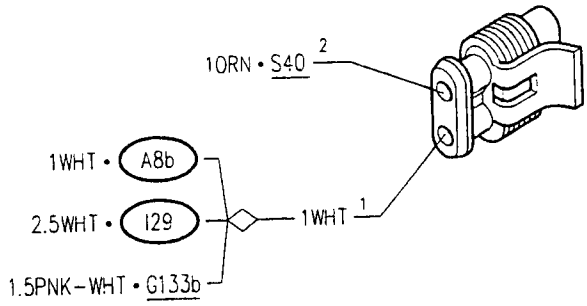


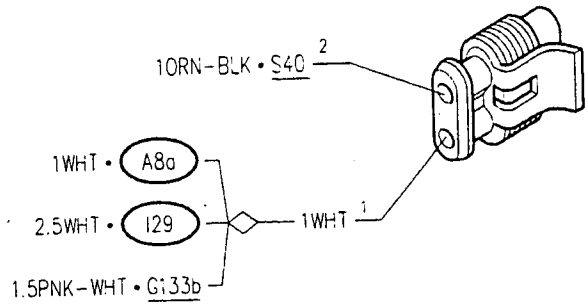
CONTROL UNIT PIN-OUTS

1. Ignition coil A control
2. Idle speed actuator output (phase B)
3. Idle speed actuator output (phase D)
4. Supply for control relay
5. N.C.
6. Signal for warning light on cluster.
7. Connection line with ALFA ROMEO CODE.
8. Signal requesting conditioner compressor cut-in
9. N.C.
10. Diagnosis line L
11. Rpm sensor signal
12. Earth for lambda sensor
13. Engine temperature signal
14. Reference voltage (5V) for sensors
15. Diagnosis line K
16. Electronic earth for sensors
17. Power earth
18. Electroinjector control
19. Ignition coil B control
20. Idle speed actuator output (phase A)
21. Idle speed actuator output (phase C)
22. Evaporative solenoid valve control
23. Pump relay - rev counter signal control
24. Conditioner compressor cut-in control
25. N.C.
26. N.C.
27. Car speed signal
28. Rpm sensor signal
29. Lambda sensor signal
30. Throttle position sensor
31. Intaken air temperature signal
32. Absolute pressure signal
33. N.C.
34. Power earth
35. Control unit supply

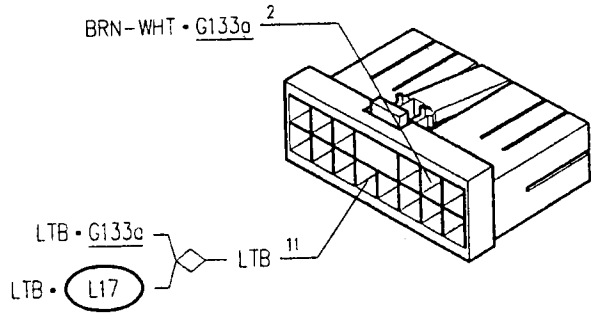
COMPONENTS AND CONNECTORS

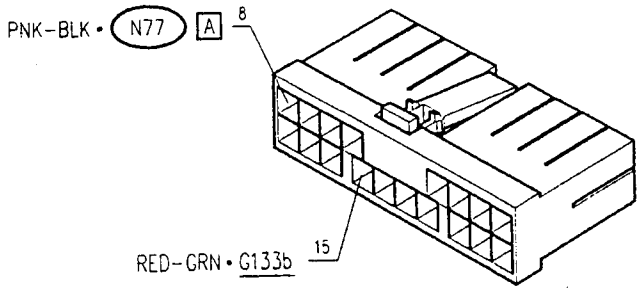
Ignition coil A	A8a	Ignition coil B	A8b



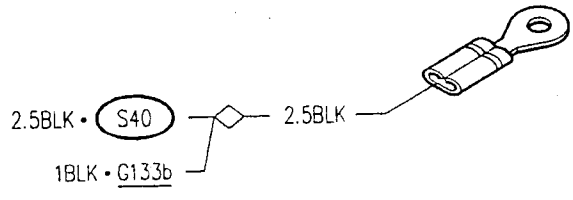


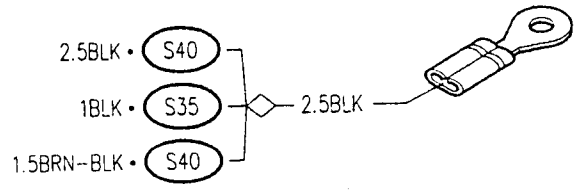
Instrument cluster	C10 A	Instrument cluster	C10 B



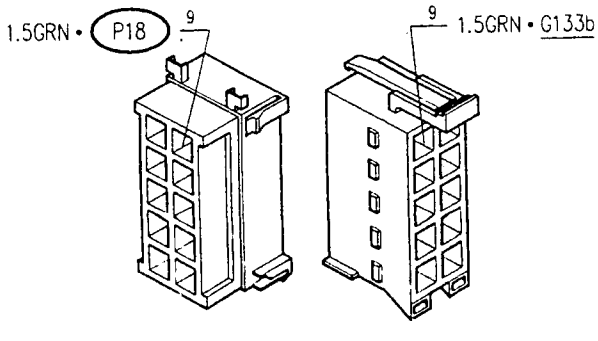


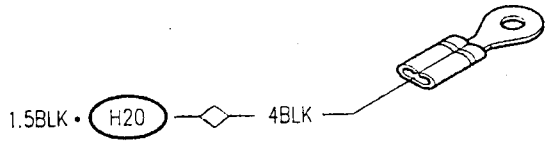
Injection wiring earth	G60a	Injection wiring earth	G60b





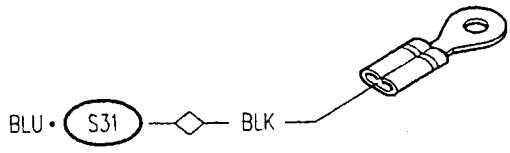
Connector for rear services	G73 A	Seat cross rail earth	G106



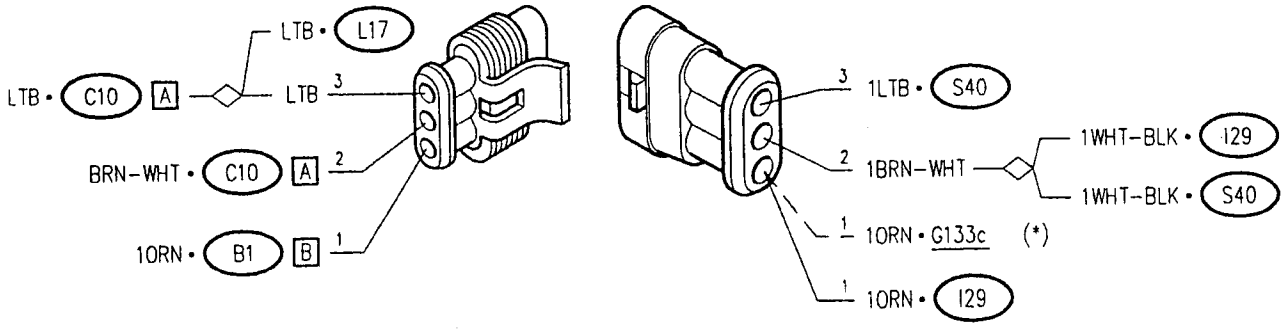


COMPONENTS AND CONNECTORS (cont.d)

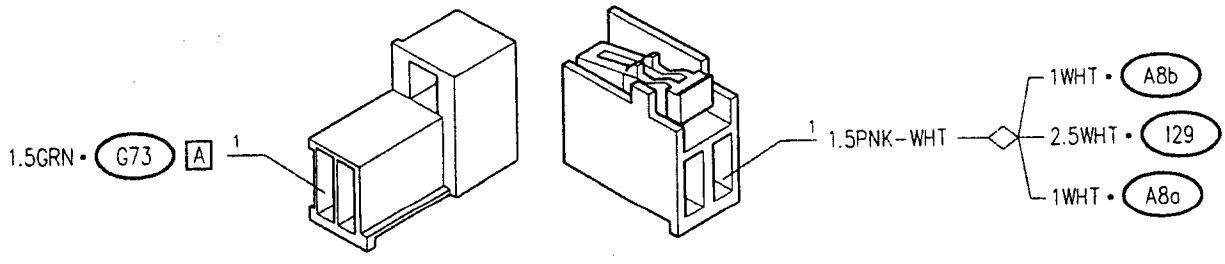
Injection wiring earth	G109



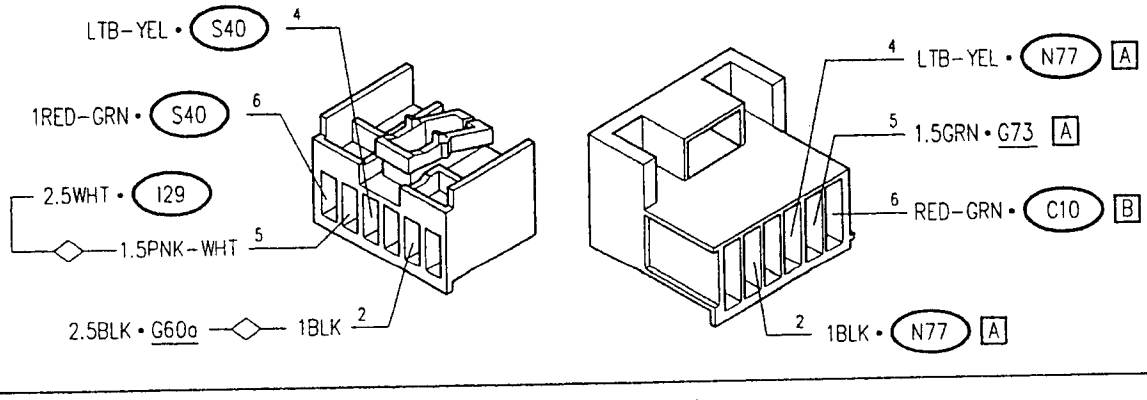
Electronic injection wiring connector A	G133a



Electronic injection wiring connector B (*)	G133b



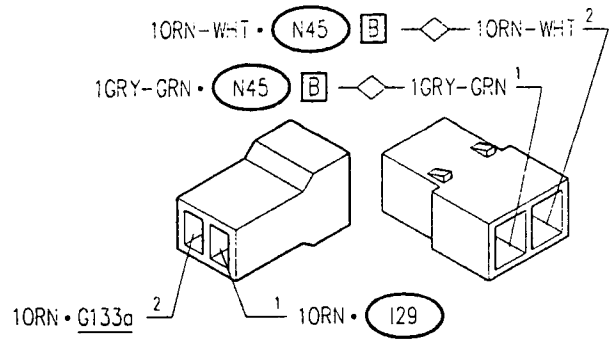
Electronic injection wiring connector B	G133b



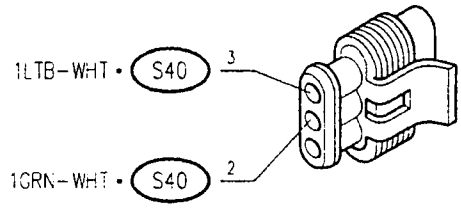
(*) for some vehicles without ALFA ROMEO CODE, but with anti-theft device

COMPONENTS AND CONNECTORS (cont.d)

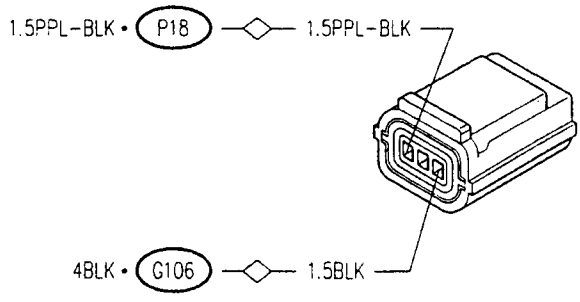
Electronic injection wiring connector C (*)	G133c



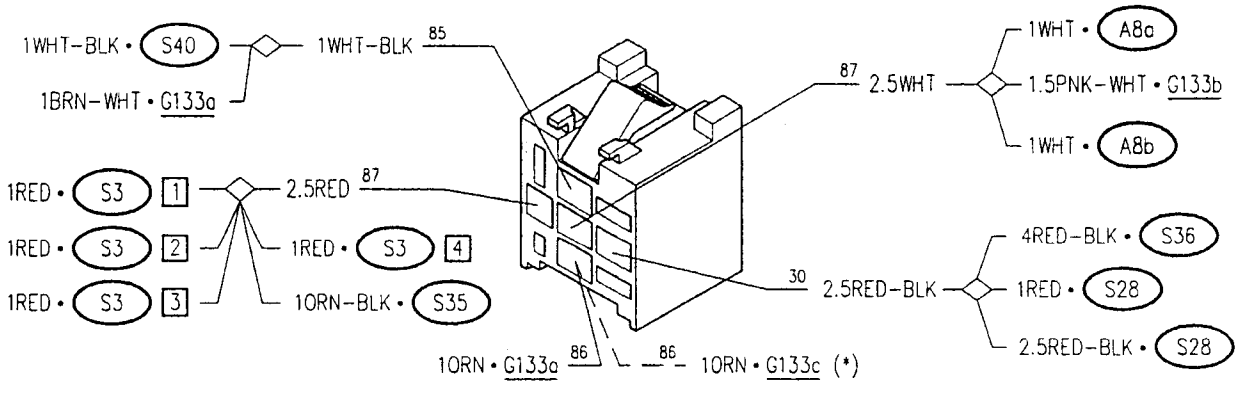
Conditioner system/ injection system connector	G337



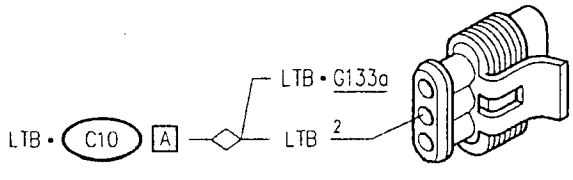
Inertial switch	H20



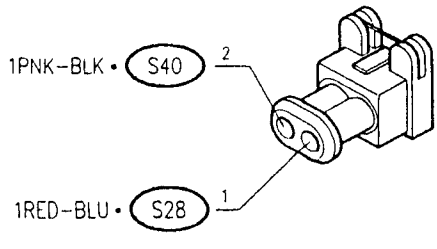
Fuel pump relay	I29



Speedometer sensor	L17



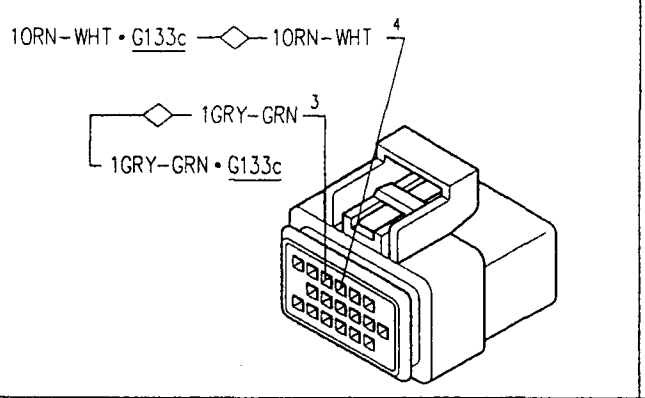
Evaporative solenoid valve	M15



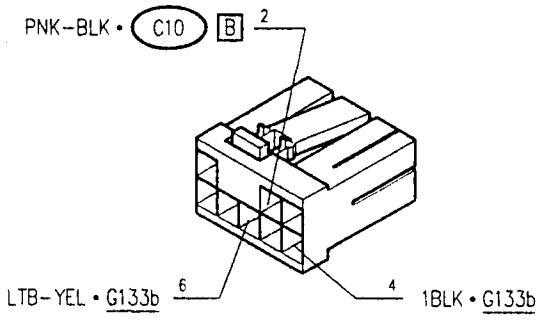
(*) for some vehicles without ALFA ROMEO CODE, but with anti-theft device

COMPONENTS AND CONNECTORS (cont.d)

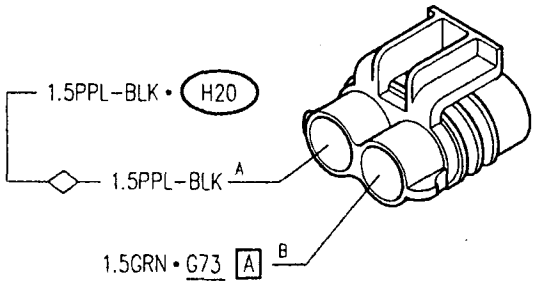
Anti-theft control unit (*) — N45 B



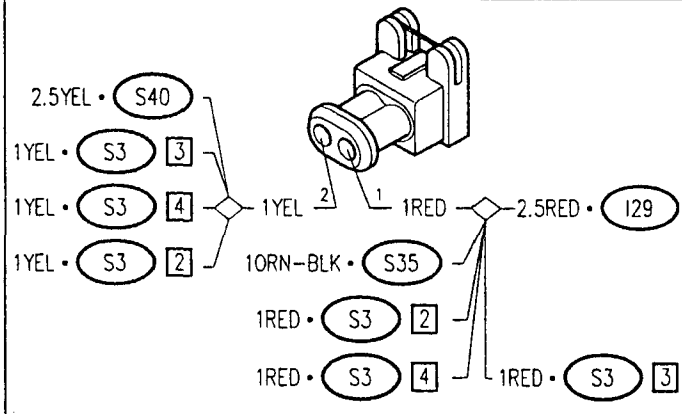
ALFA ROMEO CODE control unit — N77 A



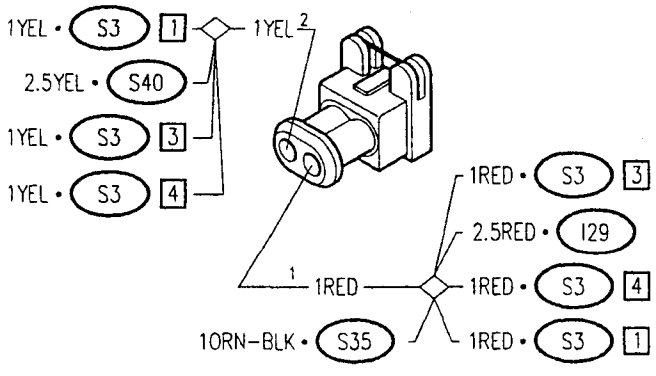
Electric fuel pump — P18



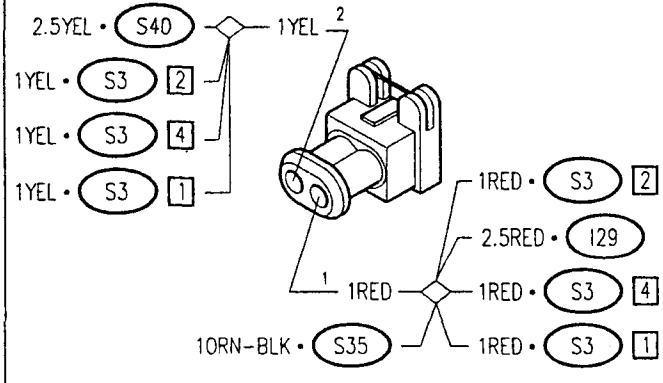
Electroinjector — S3 1



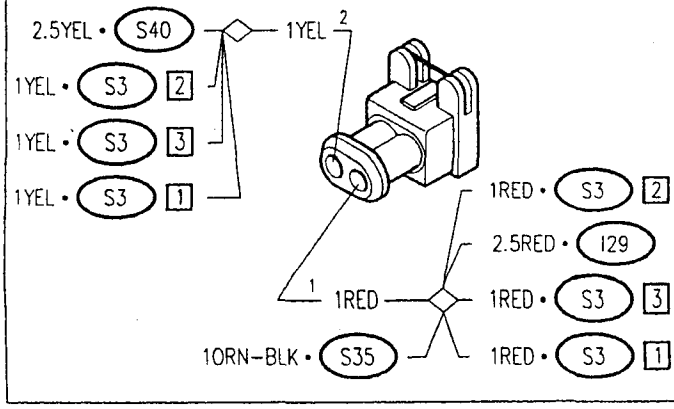
Electroinjector — S3 2



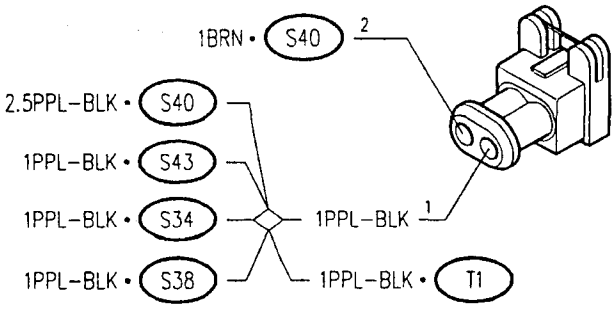
Electroinjector — S3 3



Electroinjector — S3 4



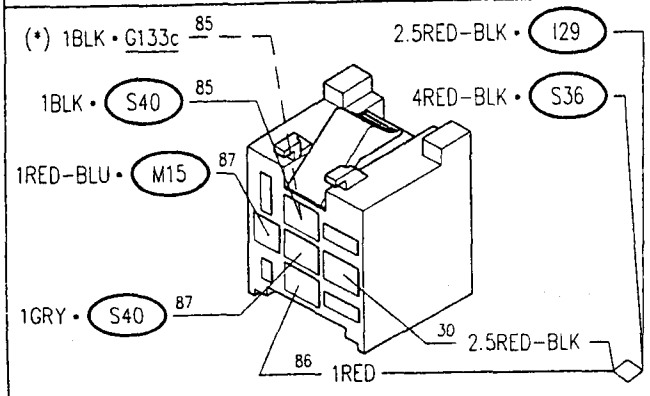
Engine temperature sensor — S7



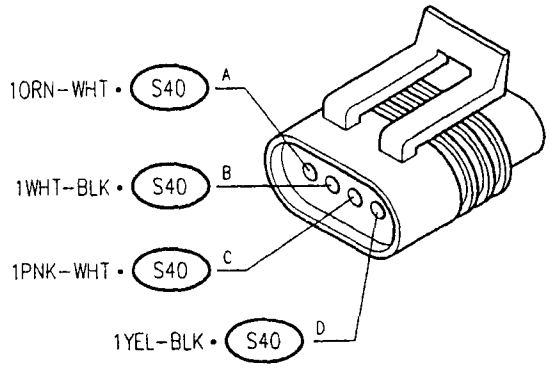
(*) for some vehicles without ALFA ROMEO CODE, but with anti-theft device

COMPONENTS AND CONNECTORS (cont.d)

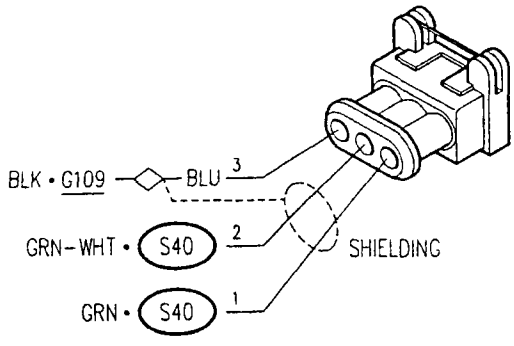
Injection control relay — S28



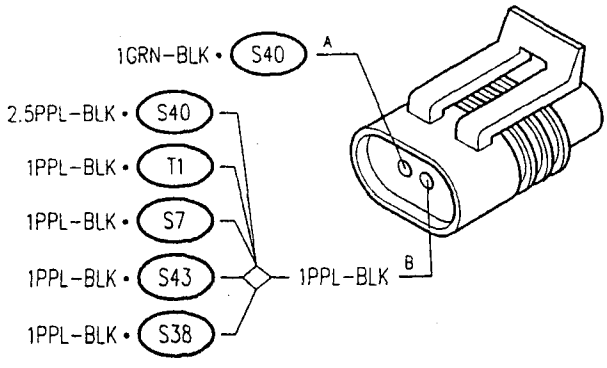
Idle speed adj. actuator — S29



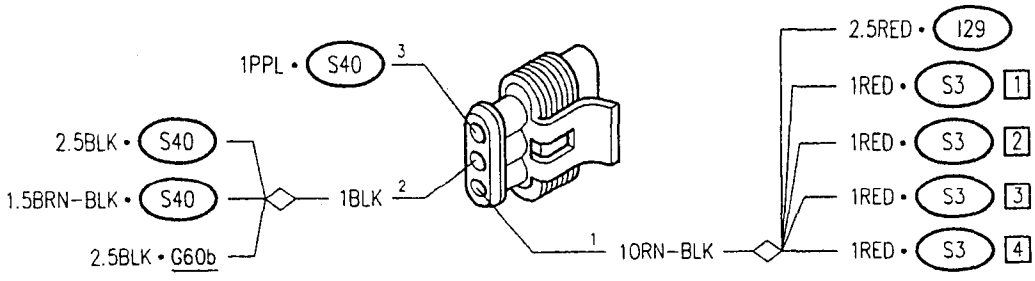
Rpm and crankshaft position sensor — S31



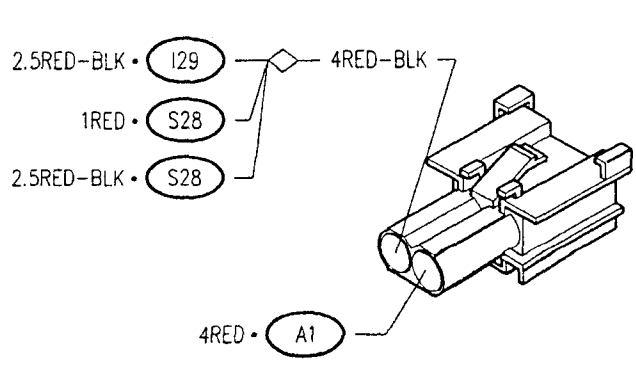
Air temperature sensor — S34



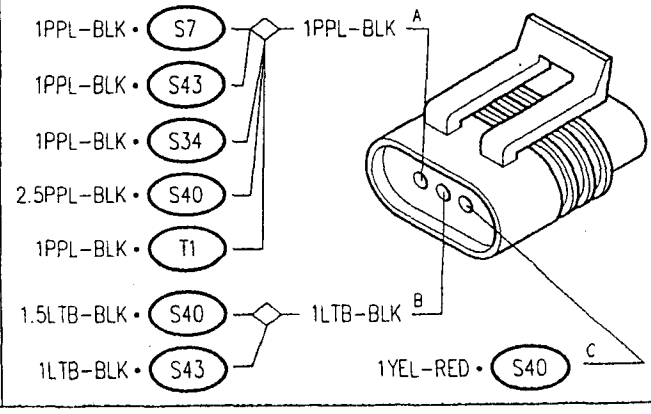
Heated lambda sensor — S35



Injection relay wander fuse — S36

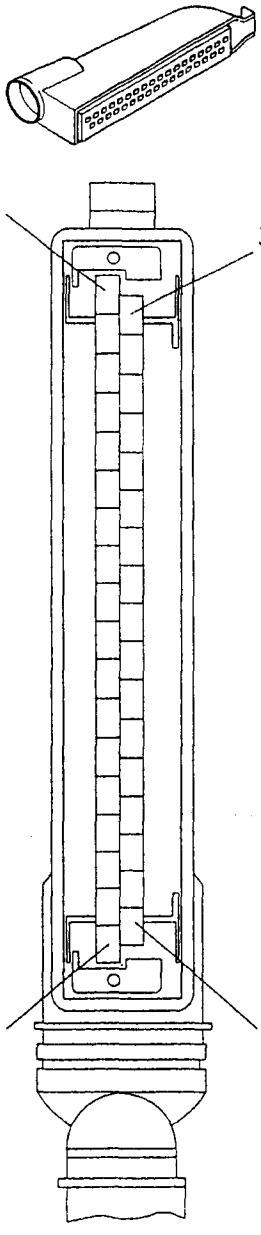


Sensor on throttle body — S38



COMPONENTS AND CONNECTORS (cont.d)

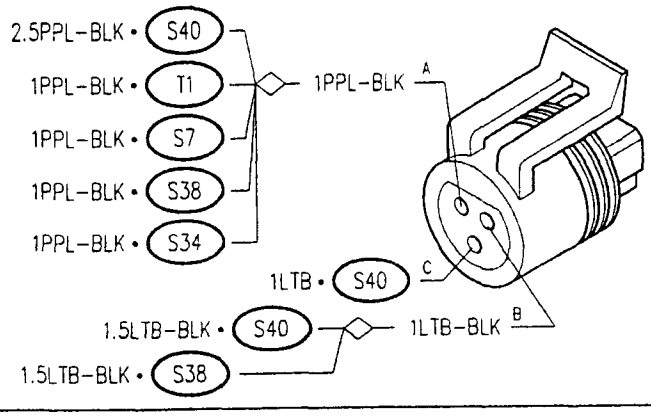
Injection/ignition control unit — S40

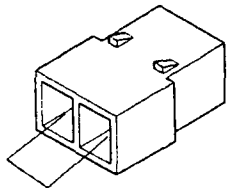


1 — 1ORN • A8a
2 — 1YEL-BLK • S29
3 — 1WHT-BLK • S29
4 — 1BLK • S28
6 — 1RED-GRN • G133b
7 — LTB-YEL • G133b
8 — 1GRN-WHT • G337
10 — 1LTB-WHT • T1
11 — GRN-WHT • S31
12 — 1.5BRN-BLK: 2.5BLK • S40; 1BLK • S35; 2.5BLK • G60b
13 — 1BRN • S7
14 — 1.5LTB-BLK: 1LTB-BLK • S43; 1LTB-BLK • S38
15 — 1WHT-RED • T1
16 — 2.5PPL-BLK: 1PPL-BLK • S7; 1PPL-BLK • S43; 1PPL-BLK • S38; 1PPL-BLK • S34; 1PPL-BLK • T1
17 — 2.5BLK • G60a
18 — 2.5YEL: 1YEL • S3 [1]; 1YEL • S3 [2]; 1YEL • S3 [3]; 1YEL • S3 [4]
19 — 1ORN-BLK • A8b
20 — 1ORN-WHT • S29
21 — 1PNK-WHT • S29
22 — 1PNK-BLK • M15
23 — 1WHT-BLK: 1WHT-BLK • I29; 1BRN-WHT • G133c
24 — 1LTB-WHT • G337
27 — 1LTB • G133a
28 — GRN • S31
29 — 1PPL • S35
30 — 1YEL-RED • S38
31 — 1GRN-BLK • S34
32 — 1LTB • S43
34 — 2.5BLK: 1.5BRN-BLK • S40; 1BLK • S35; 2.5BLK • G60b
35 — 1GRY • S28

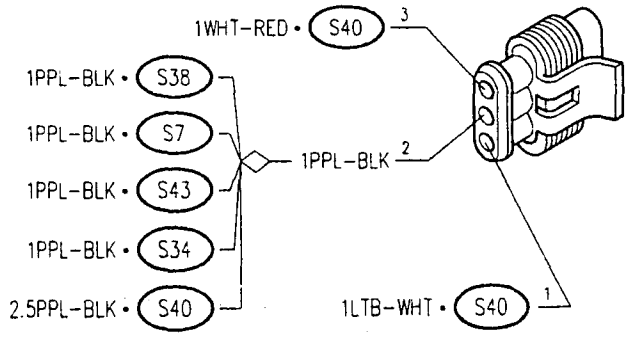
COMPONENTS AND CONNECTORS (cont.d)

Absolute pressure sensor	S43	IAW control unit switching connection IAW (**)	S49



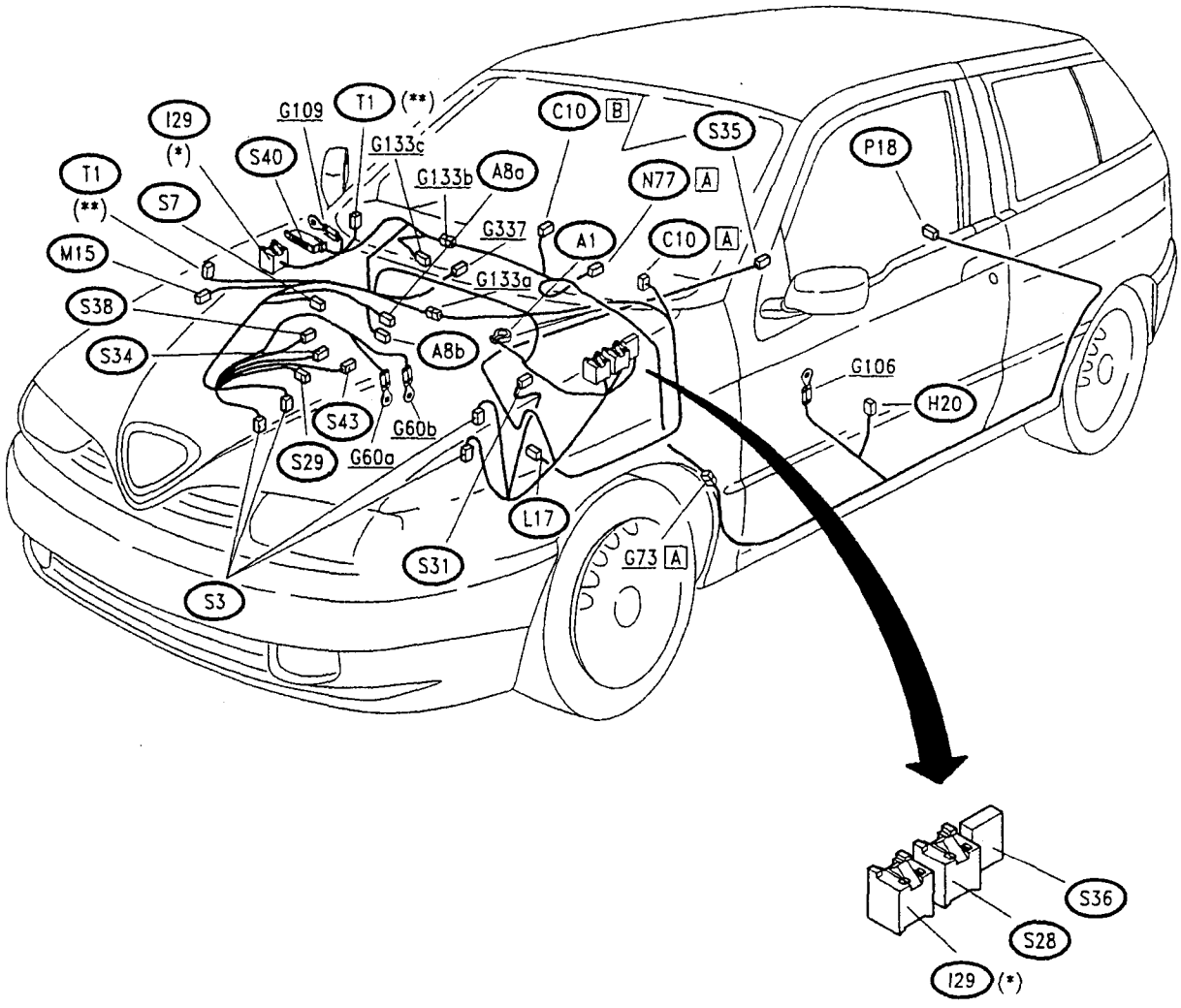


Connector for ALFA TESTER (IAW)	T1



(**) Only for certain cars without ALFA ROMEO CODE and without alarm system

LOCATION OF COMPONENTS



(*) Relay **I29** is, for some vehicles only, located in the engine bay next to relay **S28**: in all other cases it is located in the container of control unit **S40**.
(**) The connector **T1** is, for some vehicles only, located near the control unit **S40**; in all other cases it is located in the engine bay.

FAULT-FINDING

The control unit possesses a self-diagnosis system which continuously checks the signals leading from the different sensors with the limit values allowed, storing any faults. When such faults are detected the warning **light on the instrument** cluster is turned on. These faults may be easily located connecting to the ALFA ROMEO Tester.
In cars without ALFA ROMEO CODE: the warning light - if present - turns on for 3 seconds with the key at MARCIA: it stays on if a fault is present, otherwise it goes off (with faults during starting there are 3 seconds of "pause").
In cars with ALFA ROMEO CODE the procedure is the same, but the light stays on for 4 seconds.
The control unit has a permanent memory, namely it keeps the error indication even if the reason that caused it has ceased and if the ignition key has been turned to STOP; there is also a volatile memory which loses the error information as soon as its cause ceases. This makes it possible to locate errors of a sporadic nature more effectively.

Self-adaptation

The I.A.W. control unit is self-adapting
This means that it is capable of changing in time (and storing in the memory) a corrective factor of the injection time, which in turn affects the titration of the mixture. The control unit automatically carries out (in its own memory) the adaptations caused essentially by "ageing" of the engine, which in other systems, are carried out by the operator using the CO trimmer. **N.B.** Disconnecting the battery this information will be taken and once the control unit has been re-connected the control unit will start the above-mentioned adaptations from "scratch".

Recovery function

In the event of failures to the sensors the control unit, after turning on the warning light on the instrument cluster, replaces the value transmitted by the sensor with a so- called "recovery" value - contained in the actual memory of the control unit - the purpose of this is to make it possible to take the car to the nearest Service centre.

NOTE: This value is also transmitted to the Tester: therefore, during diagnosis it should be remembered that in the case of a failure the Tester signals the error of the sensor concerned and the display will show the recovery value.

Diagnosis using the ALFA TESTER

N.B. Before carrying out diagnosis with the Tester, carry out the preliminary check described below (**TEST A**).

The connection between the Tester and the electronic control unit must be carried out as follows:

1. Connect the ALFA Tester with adapter "ADAPTER ADT 101 A".
2. Power the Tester either through the cigar lighter socket or connecting it directly to the battery using the cable provided.
3. Connect the Tester socket to that of the control unit (the socket is to be found near the control unit itself).

The information the instrument can give comprises:

- display of the parameters;
- display of errors;
- active diagnosis.

Error clearing

Before ending diagnosis the contents of the "permanent" memory should be cleared by the Tester in the "Active Diagnosis" function.

In the failure to do so, the next time the Tester is connected, errors that have already been examined will be signalled.

The contents of the "permanent" memory may be cleared in the following ways:

- through the Tester in "Active Diagnosis".
- if the cause that determined the error is no longer present and the engine has been started 5 times (operating for no less than 20 minutes) with at least 2 minutes between one start and the next.

N.B.:
Disconnecting the control unit from the system; even for a very long time will not cancel the contents of the "permanent" memory.

Changing the control unit

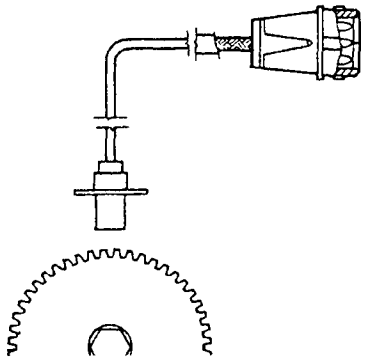
When **the control unit is changed**, displaying the lambda sensor parameter it is possible that the moving bar shows that the mixture titration has moved excessively towards the right or towards the left. If the **mixture is rich** the moving bar has moved towards the right of the display towards the "+" sign.
If the **mixture is lean**, the moving bar has moved to the left of the display towards the "-" sign.
Under normal operating conditions, the bar is between the two signs.

In this case, it is necessary to run a road test to allow the car to reach normal operating temperature and for the control unit (especially during stops with the engine idling) to intervene with the self-adapting function.

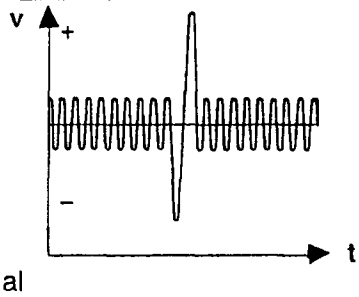
N.B.: This suggests that due care should also be taken when control units are exchanged between cars at the service centre!

CHECKING COMPONENTS

Rpm and crankshaft position sensor (S31)

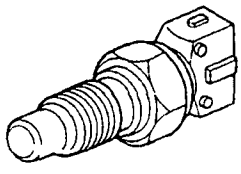


SPECIFICATIONS	
Coil resistance	680 Ω ± 10%
Inductance	295 mH ± 10 %
Gap between sensor and fly-wheel ring gear	0.25 ± 1.3 mm



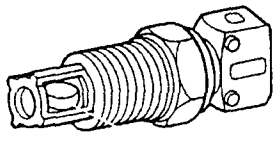
Output signal

Engine temperature sensor (S7)



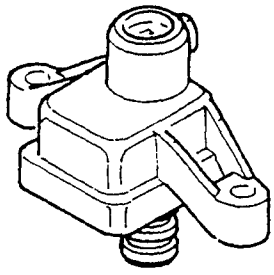
SPECIFICATIONS	
Temperature (°C)	Resistance (kΩ)
- 40	100.950
- 20	29.121
0	9.750
+ 20	3.747
+ 40	1.693
+ 60	0.798
+ 80	0.377

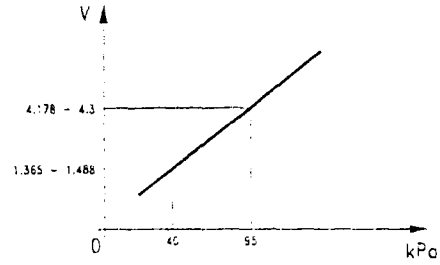
Intaken air temperature sensor (S34)



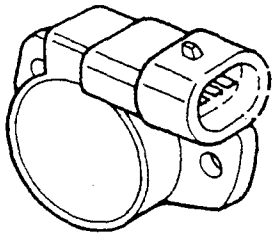
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
+ 100	181.10 ± 7.5
+ 128	82.13 ± 3.17

Absolute pressure sensor (S43)

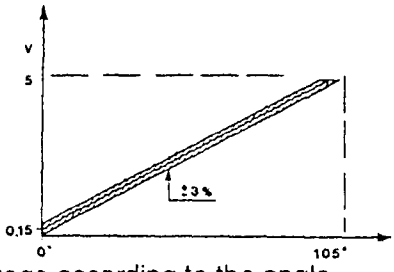


SPECIFICATIONS

Output voltage according to pressure on diaphragm

Throttle position sensor (S38)

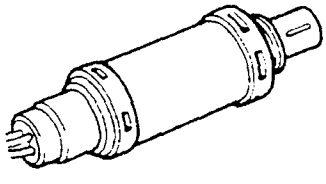


SPECIFICATIONS	
Useful electric angle	105 ± 2°
Mechanical angle	110 ± 4°
Resistance of the track	1200 Ω ± 20%
Temperature operating field	-30°C ÷ +125°C



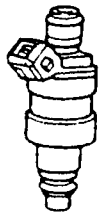
Output voltage according to the angle

Lambda sensor (S35)



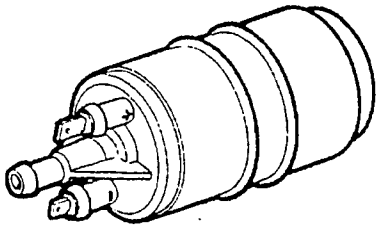
SPECIFICATIONS	
Heating resistance	3 Ω

Electroinjectors (S3)



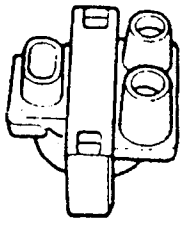
SPECIFICATIONS	
Winding resistance	14.5 Ω
Supply voltage	14 Volt
Minimum supply time	2.0 msec at 14 V
Operating temperature	-40 °C ÷ +120 °C

Fuel pump (P18)



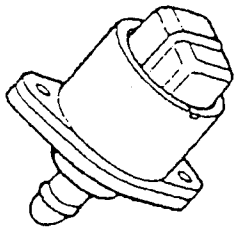
SPECIFICATIONS	
Flow rate	≥ 120 l/h
Pressure	4 bar
Nominal voltage	12 V

Ignition coils (A8a) (A8b)



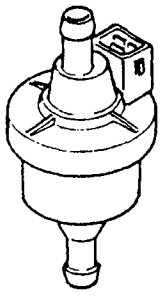
SPECIFICATIONS	
Primary resistance	550 mΩ ± 10%
Secondary resistance	7.4 kΩ ± 10%

Idle speed adjustment actuator (S29)



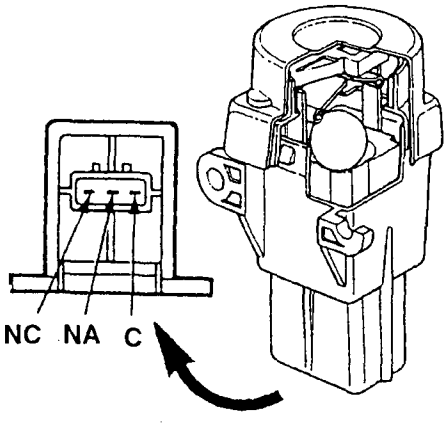
SPECIFICATIONS	
Resistance of windings	53Ω ± 10% a 20°C
Operating temperature	-40°C ÷ +85°C

Evaporative solenoid valve (M15)



SPECIFICATIONS	
Air flow rate	Min. 0.08 m^3/h Max. 3.0 m^3/h
Duty-cycle signal	12 V; 10 Hz
Ohmic resistance of the winding	45 Ω ± 1 %
When not energized the solenoid valve is normally open	

Inertial switch (H20)



SPECIFICATIONS
Check the continuity between pins NC and C: this continuity is interrupted in the event of a shock; the contact is closed again by pressing the special button

PRELIMINARY CHECK OF THE IAW SYSTEM	TEST A

NOTE: Firstly check that the ALFA ROMEO CODE system is working properly as it may have cut off the supply to the system (see the "ALFA ROMEO CODE" section, or, if the ALFA ROMEO CODE system is not installed, check the connection with the alarm system).

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check that fuse **S36** is intact	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Change the fuse (20A)
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relay **I29** and at pins 30 and 86 of relay **S28**	OK ▶	Carry out **step A3**
	~~OK~~ ▶	Restore the wiring between the battery **A1**, fuse **S36** and relays **S28** & **I29**
A3 CHECK VOLTAGE – With the key turned, check for 12 V at pin 86 of relay **I29**	OK ▶	Carry out **step A4**
	~~OK~~ ▶	Restore the wiring between the ignition switch **B1** and relay **I29**
A4 CHECK RELAYS – Check that relays **I29** and **S28** are working properly	OK ▶	Carry out **step A5**
	~~OK~~ ▶	Change any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – With the key turned, check for 12 V at pin 35 of the control unit **S40** and appr. 0 V (very low voltage) at pin 4 and 23 of **S40**	OK ▶	Carry out **step A6**
	~~OK~~ ▶	Restore the wiring between the control unit **S40** and the relays
A6 CHECK EARTH – Check for an earth at pin 17 and 34 of **S40**	OK ▶	**CONTINUE DIAGNOSIS USING THE ALFA TESTER**
	~~OK~~ ▶	Restore the wiring between **S40** and earth **G60a**, or **G60b**

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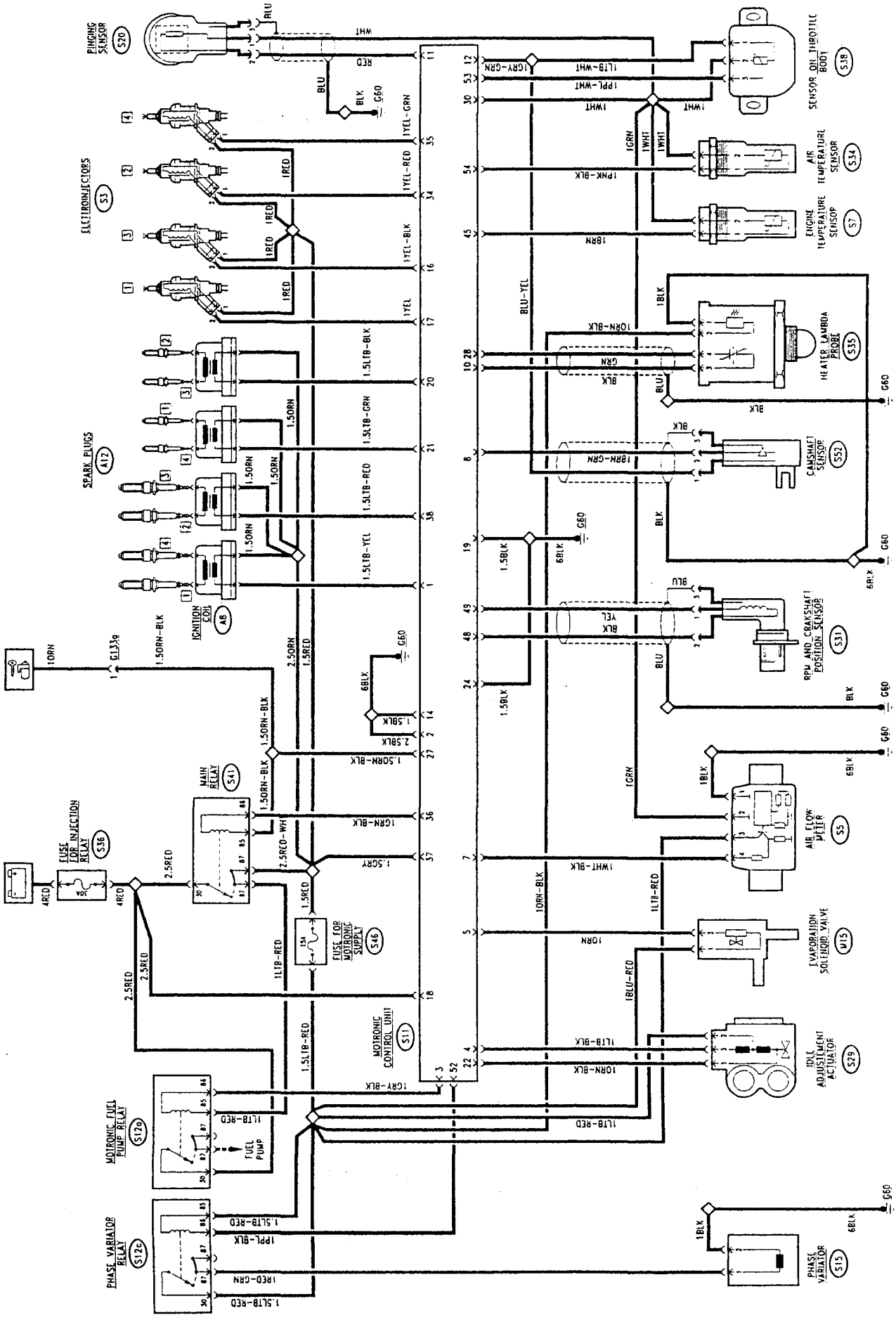
INJECTION/IGNITION SYSTEM MOTRONIC M2.10.4 Engine1.4, 1.6, 1.8 and 2.0 T.SPARK 16v:

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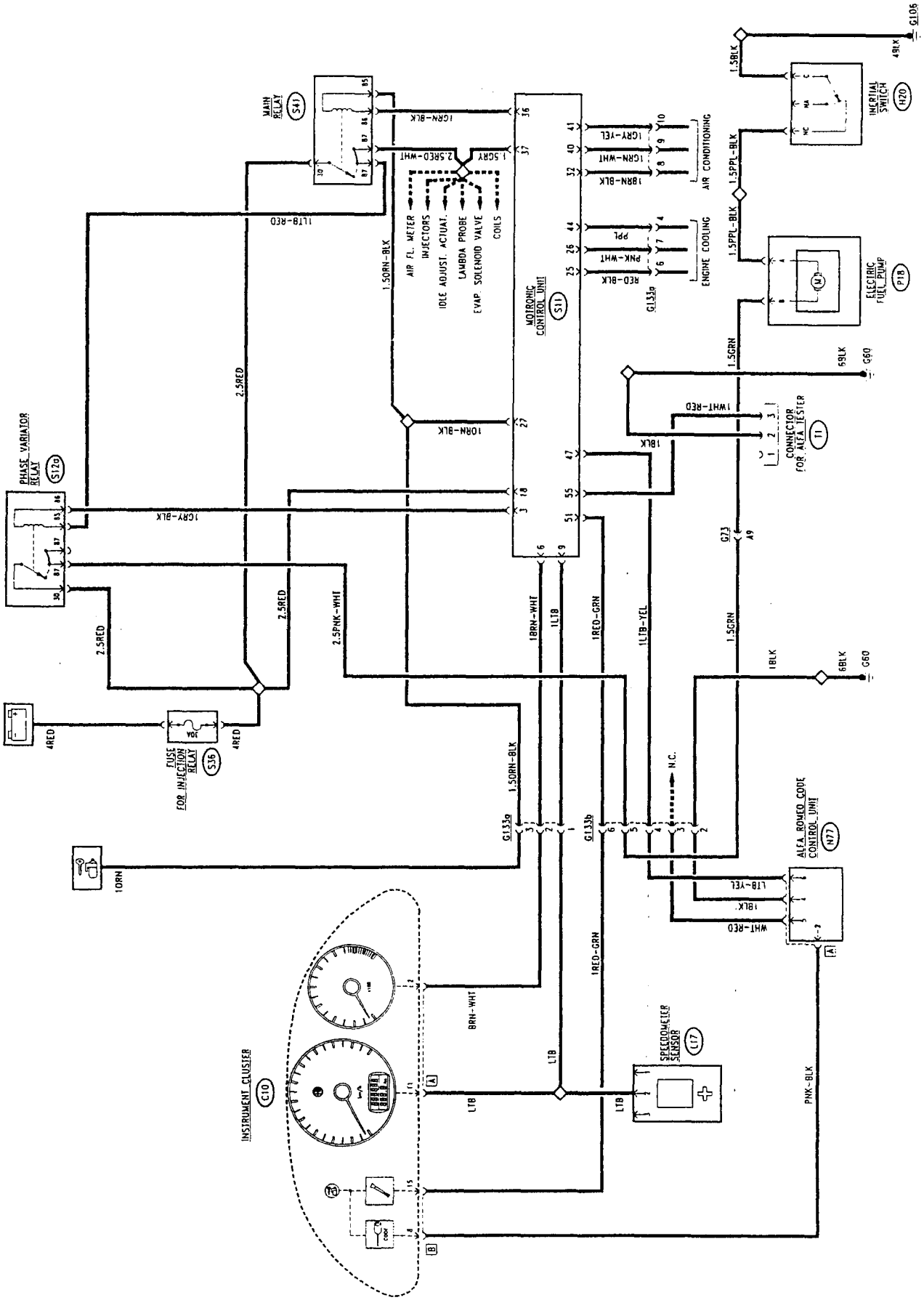
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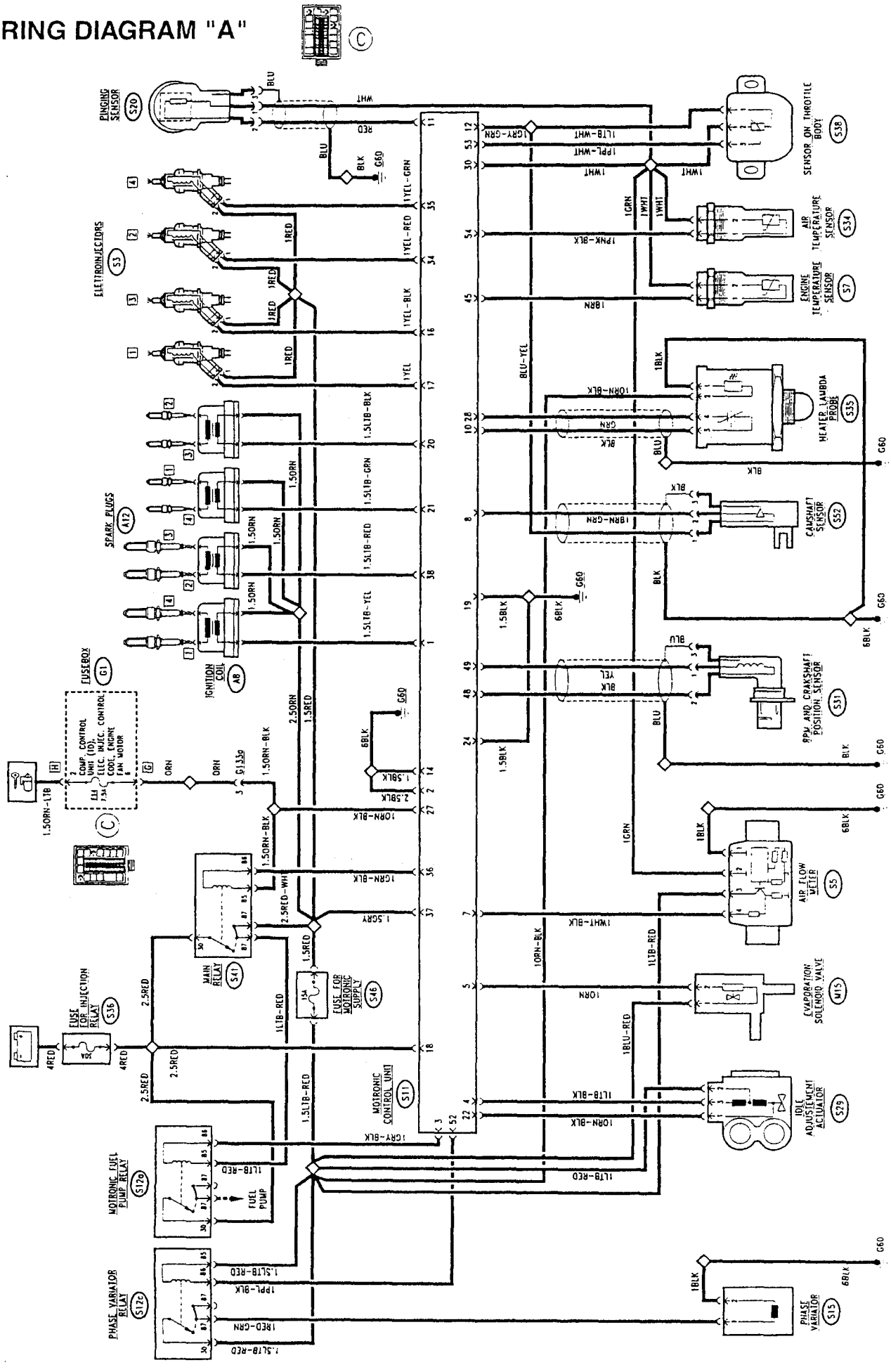
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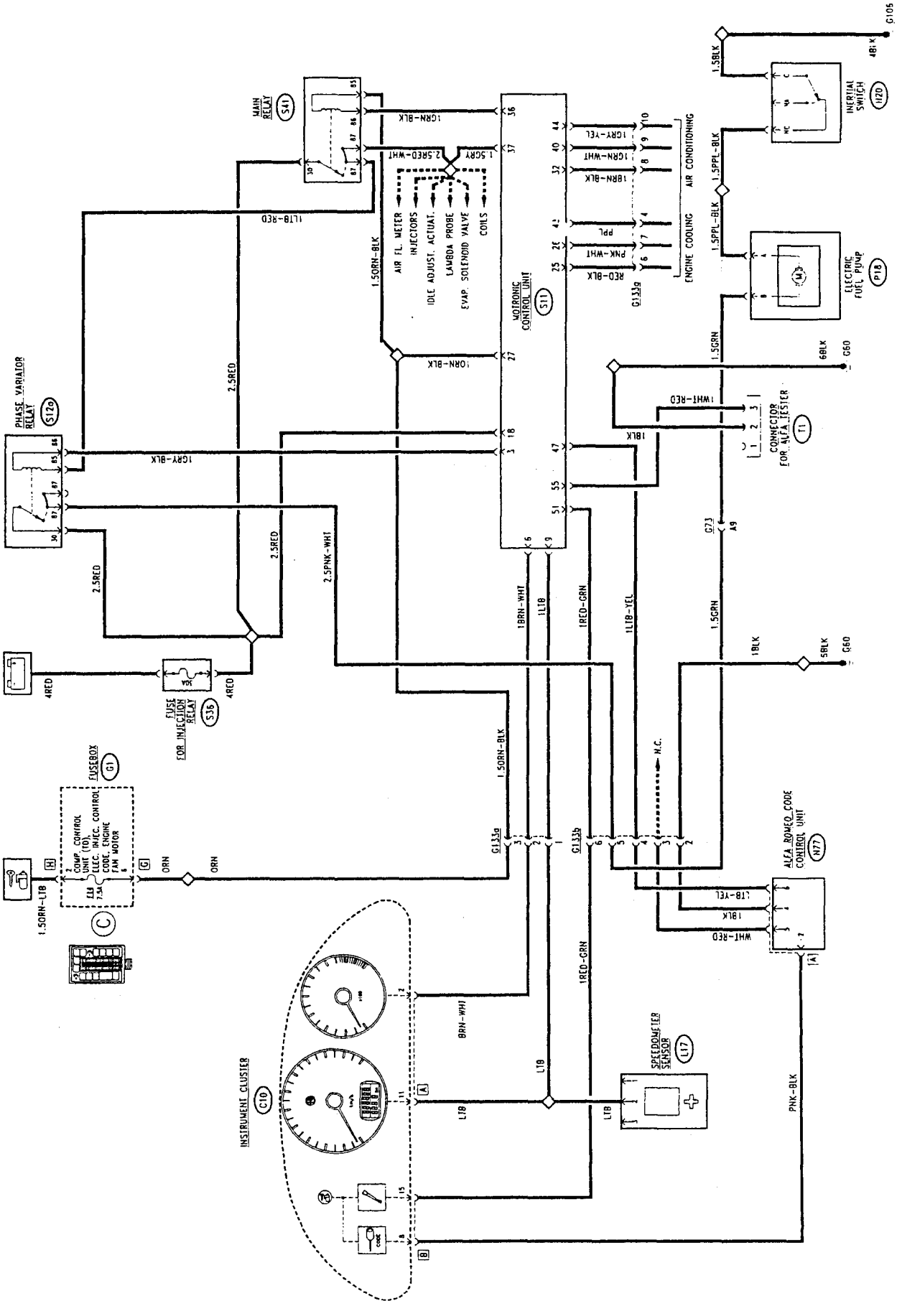
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WIRING DIAGRAM "A"



WIRING DIAGRAM "B"



GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions: this sophisticated latest generation system consists of a single control unit which controls both ignition (static with lost spark) and injection (timed).

This is the M 2.10.4 version of the proven and reliable BOSCH MOTRONIC system.

Compared with the previous versions this new M 2.10.4 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions (engine cooling fan).

As a result of the use of new sensors and revision of the control programmes, the system makes it possible to achieve considerable improvements in terms of consumption, emission levels and vehicle handling.

Another feature of this system is self-adaptation, i.e. the capability to recognise the changes that take place in the engine and to compensate them, according to functions which mainly correct:

- the mixture titration
- the caburetion parameters according to the command of the evaporative solenoid valve
- an adaptive programme for idle speed control.

FUNCTIONS OF THE SYSTEM

Sequential and timed injection (S.E.F.I.)

With this control unit, fuel injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds by the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimal point of injection, calculated by the control unit according to special maps depending on the load, speed and temperature of the engine.

Static ignition

An electronic ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences.

Static ignition takes place through four coils, according to the so-called "lost spark" logic: this solution exploits the different pressures and environments existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence c exhaust gas.

In a 4-cylinder in line engine, the paired cylinders are 1/4 and 2/3.

The solution adopted for this engine (T.SPARK and 16 valves) has required the adoption of a larger "central" spark plug and a smaller "side" spark plug.

Two of the four coils supply the small spark plug of the cylinder below and simultaneously the other two supply the large ones.

NOTE: This way it is also impossible to invert the spark plug cables during servicing operations.

Metering the air flow rate

The air flow meter adopted is of a more modern design known as the "hot film" type.

Outside, the air-flow meter looks like a part of duct between the intake manifold and the air cleaner.

Inside the air-flow meter there is an electronic circuit and a plate that is crossed by the air which passes into the duct. The film plate is kept at a constant temperature (appr. 120°C over the temperature of the incoming air) by a heating resistance placed in contact with it.

The mass of air flowing through the manifold tends to withdraw heat from the plate: therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.

N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure. etc.)

Cylinder detection

Following the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence. The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.

Conversely, the rpm sensor sends a reference signal for each turn of the engine and each subsequent tooth of the phonic wheel informs the control unit of an increase of the angular position of the crankshaft, so that injection is sent correctly to the suitable cylinder and the spark to the corresponding pair of cylinder

Fuel pump

The complex control logic of the fuel pump carried out by the control unit (mainly based on the rpm signal) immediately cuts off the supply to the pump as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.

In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously. This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents in which the engine does not stop immediately.

Timing variator

This T.SPARK 16 valve engine is fitted with an electromechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts intake timing (advance) in such a way that a larger amount of air is taken in. This device is activated by the control unit only after exceeding a determinate rpm and engine load to avoid adversely affecting correct operation of the engine at low speeds.

OPERATING LOGIC

– Identification of the "operating point":

the "point of operation of the engine" is located through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

– Adjustment of injection times (quantity of fuel): the control unit controls the injectors extremely quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine. .

– Ignition adjustment (calculation of advances):

the control unit calculates the advance on the basis of the engine load (rpm and air flow); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

– Cold starting control:

during cold starts the control unit uses special advance values and injection times.

When a determinate temperature/rpm ratio is reached, the control unit resumes normal operating conditions.

– Control of enrichment during acceleration:

upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

– Fuel cut-off during deceleration:

with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The cut-off threshold value varies according to the temperature of the engine and the speed of the car.

– Control of idle speed:

the adjustment of the engine idle speed is carried out through the special actuator fitted directly on the throttle body which acts on the throttle by-pass: in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.

– Maximum Rpm limiting:

above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

– Combustion control -lambda sensor-:

the oxygen sensor (or "lambda" sensor) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.

The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture). The electric signal sent by the sensor to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.

The signal from the lambda sensor is processed inside the control unit by a special integrator which prevents sudden "oscillations".

The sensor is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).

Through this sensor it is therefore possible to adjust engine carburetion precisely. Among other items, this makes it possible to meet emission limit regulations.

– Timing variator control:

The electro-mechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts the intake timing according to the load and rpm of the engine. This device is activated by the control unit at higher engine operating speeds (above 1,600 rpm and with load above 30%).

– Pinging control:

Through a knock sensor the control unit is informed if any pinging or "pinging" occurs and it corrects the spark advance "delaying" it accordingly; a further correction also takes account of the air temperature, in fact, when the temperature of the intake air is high, pinging is more accentuated.

N.B. The intaken air temperature sensor to be found just downstream of the air-flow meter, is not used to calculate the engine load but to control the pinging parameters.

– Fuel vapour recovery:

the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

– Connection with the air conditioner compressor:

the control unit is connected with the air conditioner system and it cuts in the compressor in relation to operation of the engine.

For further details see section "32A - Air Conditioner"

– Connection with the radiator cooling fan

in this version the thermal contact for controlling the cooling fan on the radiator has been eliminated. The command for the first and second speed of the fan is in fact supplied by the injection control unit in relati to the temperature measured by the coolant fl temperature sensor.

– Connection with ALFA ROMEO CODE system:

as soon as the Motronic control unit receives the signal that the key has been turned to MARCIA, it "asks" the above-mentioned system for consent to start the engine: this consent is given only if the ALFRA ROMEO CODE control unit recognizes the code of the key engaged in the ignition switch as correct.

This dialogue between the two control units takes place on the special serial line which connects them.

– Self-diagnosis:

the control unit possesses a **self-diagnosis system**, which continuously monitors the plausibility of the signals from the various sensors and compares them with the limits allowed: if these limits are exceeded, the system detects a fault and turns on the corresp ding warning light on the instrument cluster.

The warning light turns on when the engine is started to indicate the initial test of the entire system (appr. 4 seconds), it then turns off if no errors have been memorised: otherwise it stays on.

For certain parameters, the control unit replaces the abnormal values with suitable ones so that the car can "limp" to a point of the Service Network.

These "recovery" values depend on the other correct signals and they are defined individually by the control unit operating logic.

The self-diagnosis system also enables quick and effective location of faults connecting with the ALFA ROMEO Tester (see "Fault-finding"), through which all the errors memorised can be "read". It is also possible to check the operating parameters recorded by control unit and operate the single actuators to check whether they are working properly.

COMPONENTS

The electronic control unit receives the signals leading from the **sensors** which measure the engine operating parameters. It processes them according to a logic stored inside in "maps" which correlate the different parameters in the best way possible and it operates the **actuators** accordingly so that the engine always works with the highest level of regularity and yield.

The sensors are the following:

- engine temperature sensor (**S7**);
- air temperature sensor (**S34**);
- sensor on throttle body (**S38**);
- rpm sensor (**S31**);
- cam angle sensor (**S52**);
- heated lambda sensor (**S35**)
- air-flow meter (**S5**);
- pinging sensor (**S20**);

The actuators are the following:

- injectors (**S3**);
- ignition coils (**A8**);
- fuel pump (**P18**);
- idle adjustment actuator (**S29**);
- vapour recovery solenoid valve (**M15**) ;
- timing variator (**S15**).

The control unit is also connected with:

- the climate control unit and engine cooling system;
- the ALFA ROMEO CODE control unit (**N77**);
- the instrument cluster (**C10**) to which it supplies the signal for turning on the diagnosis warning light and for the rev counter,
- the tachometric sensor (**L17**) from which it receives the car speed signal.

The system is completed by three relays: the first two - the main relay (**S41**) and the fuel pump relay **S12a** operate the fuel pump, the injectors, the coils and the other components of the system, while the third - the timing variator relay (**S12c**) supplies the corresponding component.

The supply line for the entire system is protected by fuse **S36**, while the control unit is protected by wander fuse (**S46**).
Lastly, there is an earth point (**G60**) on the engine.
Connector **T1** enables connection with the ALFA ROMEO Tester: this is located inside the car next to the control unit.

FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and adjusts the entire electronic ignition and injection system; all the system supply lines are protected by fuse **S36** (30A).

The control unit is supplied at pin 18 directly from the battery via the above-mentioned fuse **S36**. At pin 37 it receives the supply from the main relay **S41**, while at pin 27 it receives the "key-operated" supply.
For box "C" the line is protected by fuse **F14** in fusebox **G1**.
Pins 2, 14, 19 and 24 are earthed and they serve as reference respectively for the ignition, injectors, electronic screening and for the final power stages.

The main relay **S41** controls the entire system; it is energised by a command signal - earth - leading from pin 36 of the control unit and consequently sends the supply (12V) to pin 37 of the control unit itself, to the fuel pump relay **S12a**, the injectors **S3**, coils **A8**, the EGR solenoid valve **L46** (if present), to the air flow meter **S5**, the sensor **S36**; in addition - via fuse **S46** (15A) - to the timing variator relay **S12c**, the vapour recovery solenoid valve **M15**, and to the idle speed actuator **S29**.

The fuel pump relay **S12a**, supplied by the main relay **S41**, is energised by a command signal - earth - leading from pin 3 of the control unit **S11**. Consequently, the relay supplies the fuel pump **P18**. The earth at the pump **P18** leads through the inertial switch **H20** which cuts off the circuit in the event of a crash.

The control unit **S11** receives numerous signals from the various sensors, thereby keeping all the engine parameters under control.
The rpm sensor **S31** sends information about engine speed through a frequency signal sent to pins 48 and 49 of the control unit; these two signals are very low in intensity and are therefore suitably screened.

The sensor is inductive and detects the engine rpm through the changing of the magnetic field produced by the passage of the teeth of a "phonic" wheel (60-2 teeth) fitted on the crankshaft.

The cam angle sensor **S52** (timing sensor), is supplied at 5 V from pin 12 of the control unit and sends a frequency signal corresponding to the phase at pin 8 of the control unit; these two signals are very low in intensity and are therefore suitably screened.

The sensor comprises a Hall effect device by which the voltage signal that is sent to the control unit "lowers" sharply when the hollow machined on the camshaft passes in front of the sensor itself.

The heated lambda sensor **S35** supplies the control unit information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin 28 of the control unit, while pin 10 supplies the reference earth; the above two signals are very low in intensity and are therefore suitably screened.

The sensor is heated with a resistance to make sure that it operates correctly even when the engine is cold; the resistance is supplied by the main relay **S41** and protected by a specific fuse **S46** (15A).

The throttle body sensor **S38**, supplied by the control unit from pins 12 and 30, relays a signal through a potentiometer to pin 53 which is proportionate with the degree of opening of the actual throttle.
The engine temperature sensor **S7**, connected to the electronic earth at pin 30, supplies a signal to pin 45 which is proportionate with the temperature of the engine coolant fluid, detected with an NTC material (resistance which lowers with the temperature).

The intake air temperature sensor **S34**, connected to the electronic earth at pin 30, supplies a signal to pin 54 proportionate with the temperature of the air entering the intake box which is detected by an NTC material (resistance which lowers with the temperature).

The pinging sensor **S20** supplies information about pinging conditions through a frequency signal sent to pin 11 of the control unit, while an electronic earth leads from pin 30; these two signals are very low in intensity and are therefore suitably screened.

The sensor comprises a piezoelectric plate, the purpose of which is to detect the vibrations produced by the engine running, exploiting a particular characteristic of piezoelectric materials which generate an output voltage when subjected to mechanical stresses; this voltage is filtered and analysed by the control unit which corrects the ignition parameters accordingly.

The air flow meter **S5** is supplied by relay **S41**; it receives the reference earth from pin 30 of the control unit, while it sends to pin 7 a signal proportionate with the air flow rate.
The air flow meter is of the "heated film" type; a diaphragm is placed in a measurement channel through which the intake air flows; this diaphragm is kept at a constant temperature by a heating resistance; the mass of air that crosses the measurement channel withdraws heat from the diaphragm, therefore, in order to keep it at a constant temperature, a certain current must flow through the resistance; this current, suitably measured, is proportionate with the mass of air that flows.

Depending on the signals received from the sensors and the calculations carried out, the control unit S11 controls the opening of the single injectors **S3** through special signals - of the duty-cycle type - pins 17 (cyl. 1), 34 (cyl. 2), 16 (cyl. 3) and 35 (cyl. 4). The injectors receive consent (12V) when the main relay **S41** opens.

The static ignition is managed directly by the control unit which adjusts the advance automatically.
N.B. The power modules which generate the high voltage pulses are located inside the control unit itself.
The command signals (earth) for the primary windings of the coils **A8** lead from the control unit, while the secondary winding sends the pulse to the spark plug **A12**: from pin 1 and 21 for cylinders 1-4 and from pin 28 and 30 for cylinders 2-3.

The primary windings of the coils **A8** are supplied with "key-operated" 12V from relay **S42**.
The power modules inside the control unit are connected to earth via pin 2.
The idle adjustment speed actuator **S29** forms a by-pass line of the flow of air; it comprises two windings: one opens and the other closes a valve which adjusts the gap of the by-pass section; it is controlled by the control unit through the duty-cycle signals of pin 22 (closing) and 4 (opening).

The vapour recovery solenoid valve **M15** allows the passage of fuel vapours towards the engine intake where they are added to the mixture admitted to the combustion chamber; the valve, supplied by the main relay S41, is opened by the control unit when the engine is under load through a duty-cycle signal fro pin 5.

The timing variator **S15** mechanically controls timing advance at the intake; it is controlled by the corresponding relay **S12c**; this is supplied by relay **S41** and is energised through a negative signal from the control unit, pin 52, thus it supplies the timing variator **S16**:

this signal operates the actuator which controls the flow of oil in the hydraulic unit of the device which adjusts the rotation of the camshaft.

The tachometric signal (car speed) reaches the control unit at pin 9 through sensor **L17**: while the control unit sends a "pulse" signal from pin 6 to the cluster proportionate with engine rpm; the signal for the "injection failure" warning light on the cluster **C10** leads from pin 51.

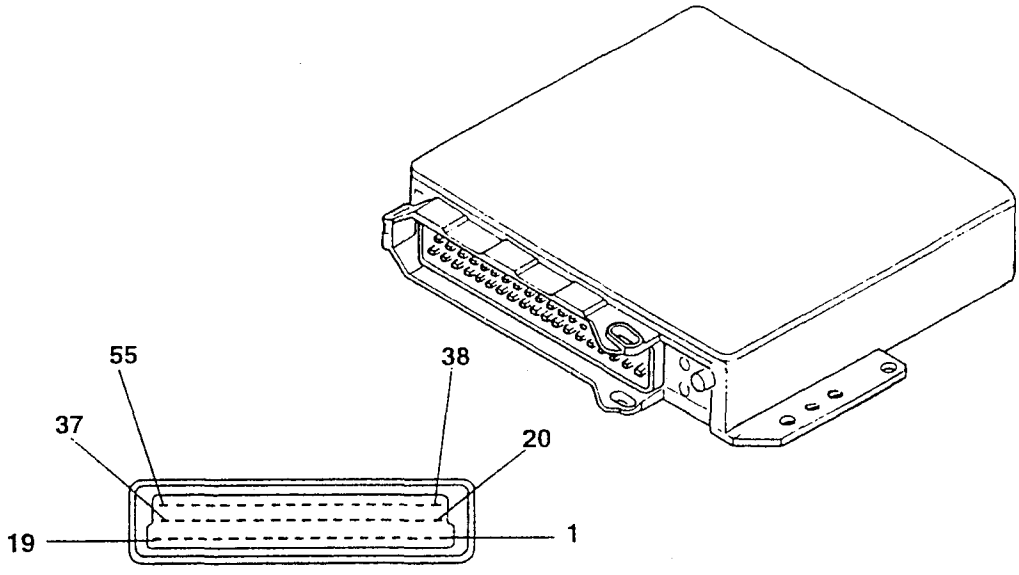
The control unit **S11** is connected with the air conditioning system via pins 32, 40, 43 and 44.

This makes it possible to adapt the engine idle speed to the increased load each time the compressor is engaged or to cut it out in the event of high speed or high engine loads.

The control unit **S11** controls and adjusts the engine water cooling fan/s **P2** operating system.
Pins 26 and 25 respectively give the command for engaging first and second speed of the fan.

The control unit **S11** is connected with the ALFA ROMEO CODE control unit **N77** through the special serial line from pin 47. This way, if the ALFA ROMEO CODE does not detect a correct "key code" it will not allow the Motronic control unit to start the engine.

The control unit is fitted with a self-diagnosis system, which can be used connecting with the ALFA ROMEO Tester at connector **T1**; it receives the fault signals from the control unit through the diagnosis line K - p 55 -, while the earth leads from **G60**.

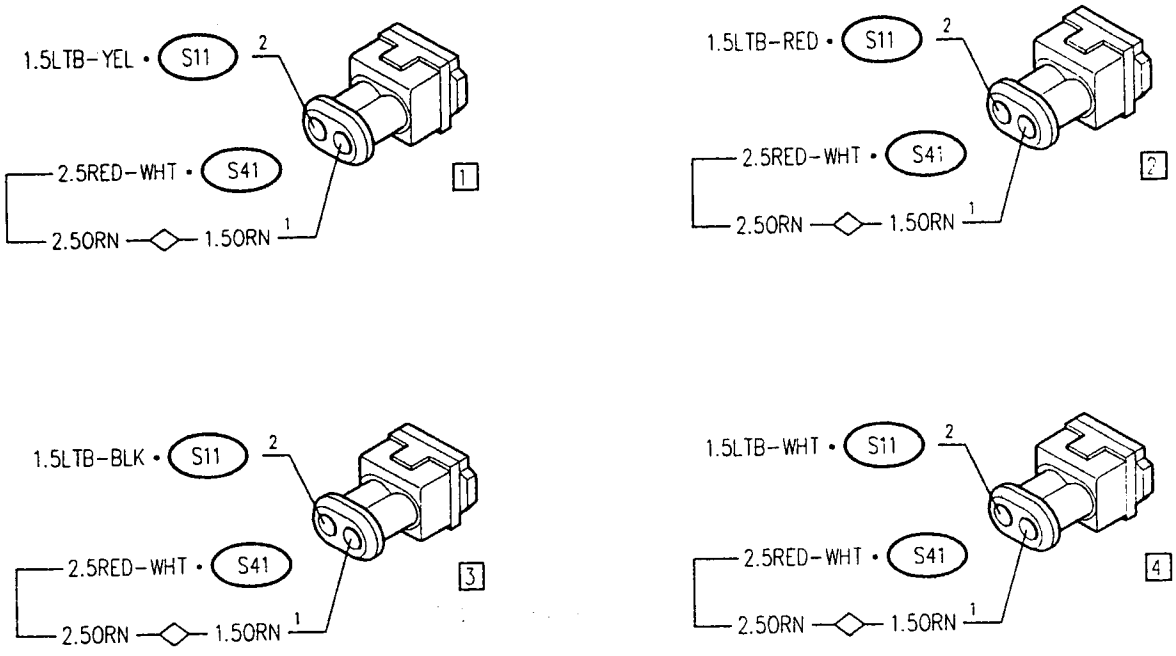


CONTROL UNIT PIN-OUT

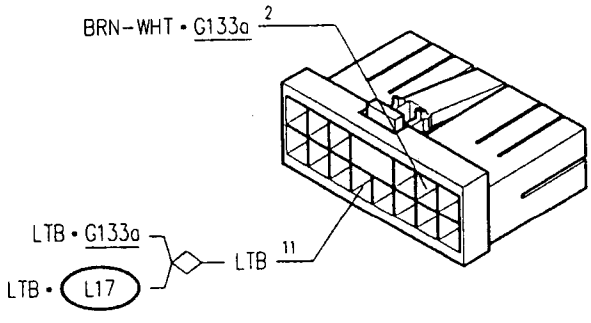
1. Ignition coil control - cyl. 1 and 4 -
2. Earth for ignition
3. Fuel pump relay control
4. Idle actuator control - opening
5. Evaporative solenoid valve control
6. Rev counter signal
7. Air flow meter signal
8. Timing signal
9. Car speed signal
10. Lambda sensor signal
11. Pinging sensor signal
12. Stabilized voltage (5V) for sensors
13. N.C.
14. Earth for injectors
15. N.C.
16. Cyl. 3 injector
17. Cyl. 1 injector
18. Direct supply
19. Electronic screening earth
20. Ignition coil control - cyl. 3 and 2
21. Ignition coil control - cyl. 4 and 1
22. Idle speed actuator control - closing
23. N.C.
24. Earth for final stages 25. Fan 2nd speed command
26. Fan 1st speed command
27. "Key-operated" supply
28. Lambda sensor earth
29. N.C.
30. Electronic earth for sensors
31. N.C.
32. Conditioner compressor relay control
33. N.C.
34. Injector cyl. 2
35. Injector cyl. 4
36. Main relay control
37. Supply from main relay
38. Cyl. 2 and 3 ignition coil control
39. N.C.
40. Compressor engagement request
41. N.C.
42. N.C.
43. Fand second speed engagement request
44. Fan first speed engagement request
45. Engine temperature signal
46. N.C.
47. Connection line with ALFA ROMEO CODE
48. Signal for rpm sensor
49. Rpm sensor signal
50. N.C.
51. "Check Engine" warning light
52. Timing variator control
53. Throttle position signal
54. Intaken air temperature signal
55. Diagnosis line K

COMPONENTS AND CONNECTORS

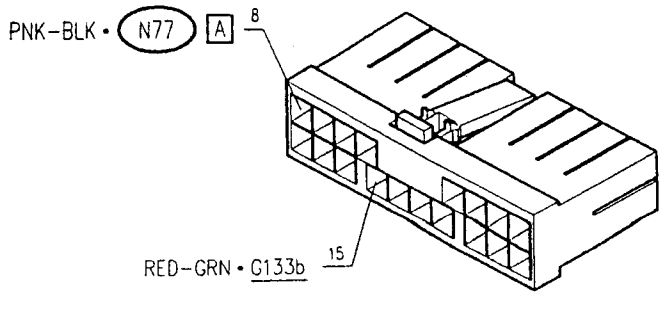
Ignition coil — A8



Instrument cluster — C10 A

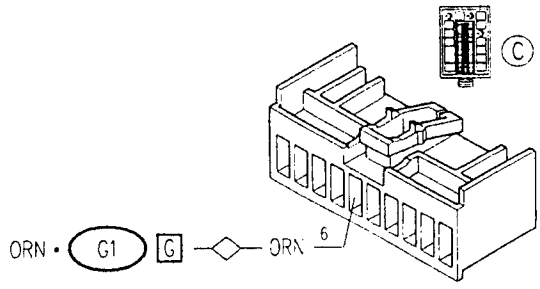


Instrument cluster — C10 B

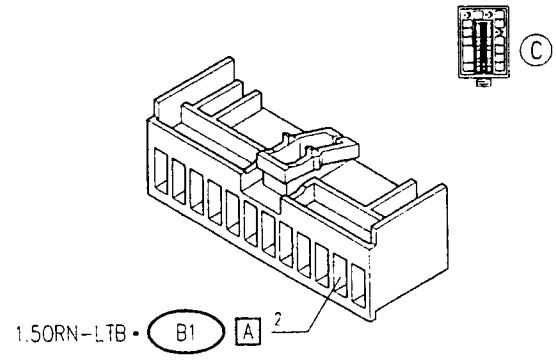


COMPONENTS AND CONNECTORS (contd.)

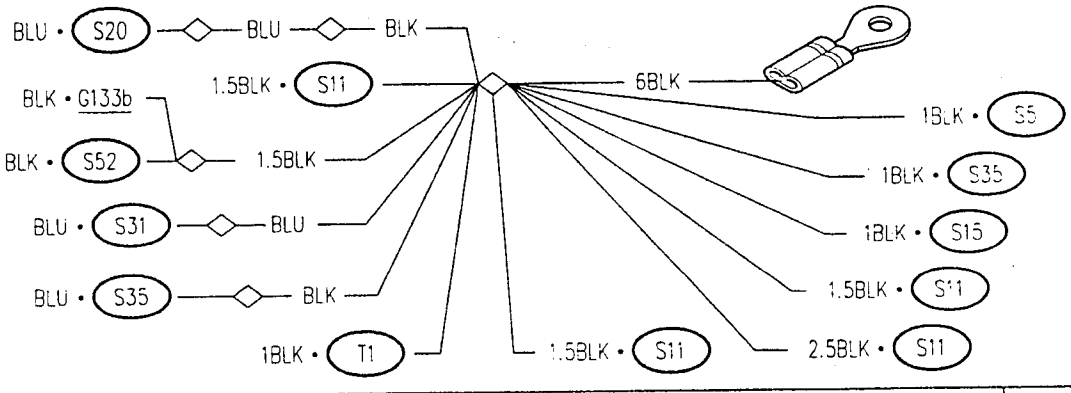
Fusebox	G1 G



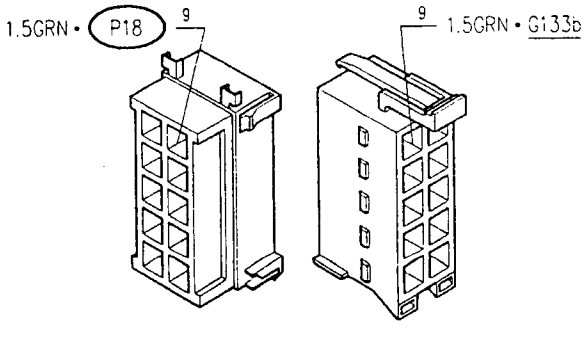
Fusebox	G1 H



Injection wiring earth	G60

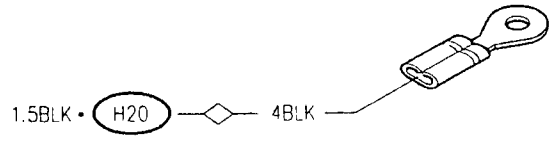


Rear services connector	G73 A

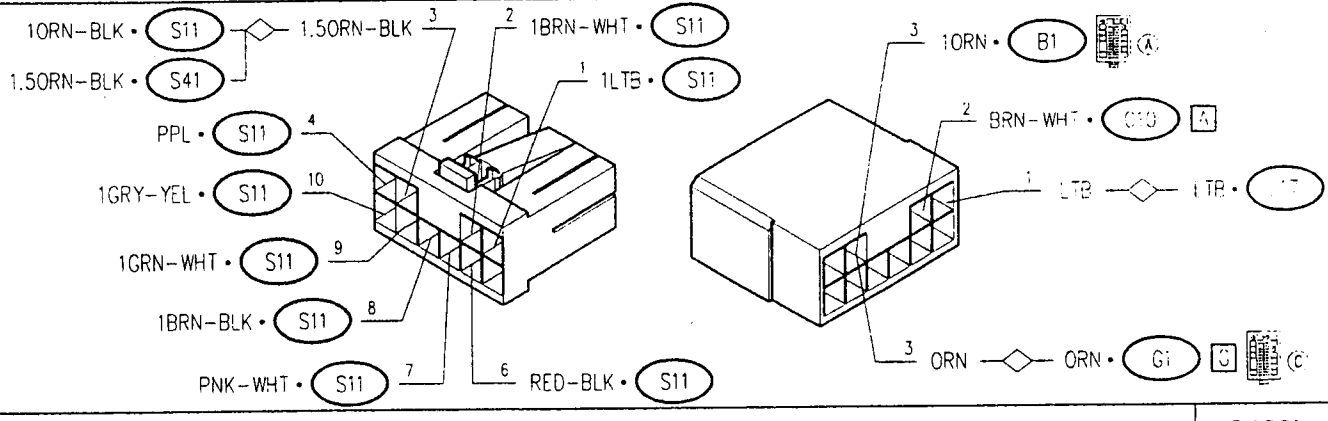


COMPONENTS AND CONNECTORS (contd.)

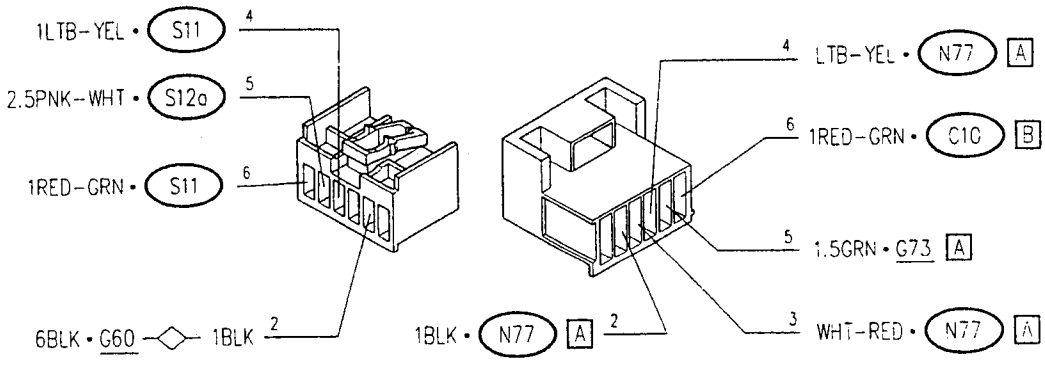
Seat crossmember earth	G106



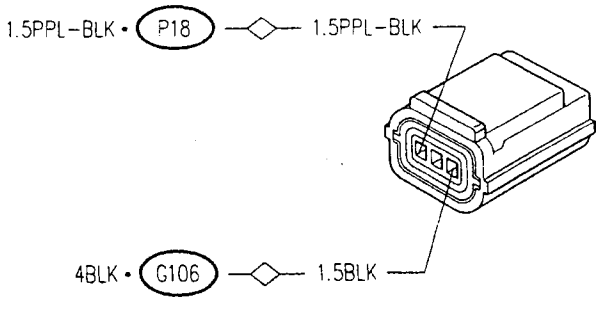
Electr. injection wiring connector A	G133a



Electr. injection wiring connector B	G133b

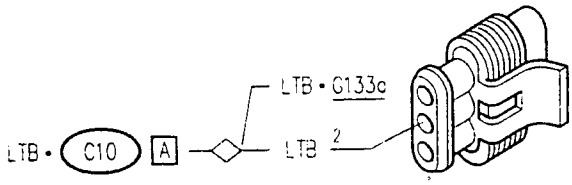


Inertial switch	H20

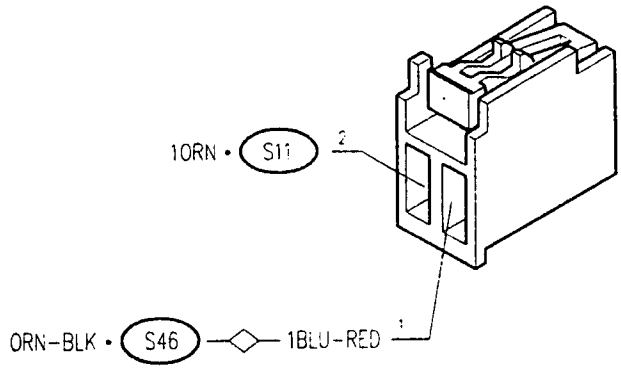


COMPONENTS AND CONNECTORS (contd.)

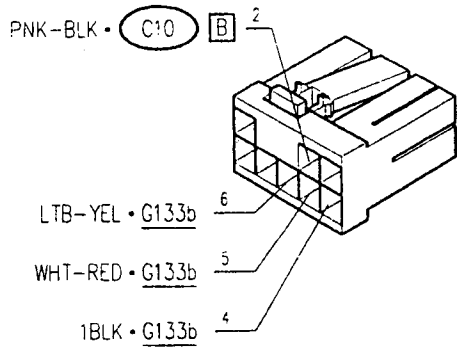
Tachometric sensor	L17



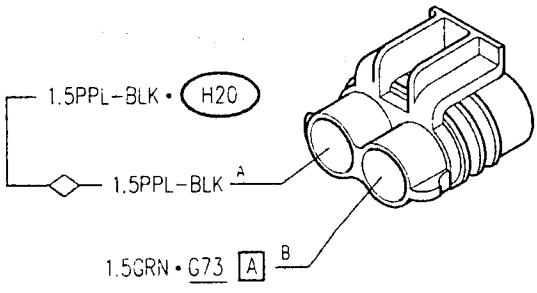
Evaporative solenoid valve	M15



ALFA ROMEO CODE control unit	N77 A

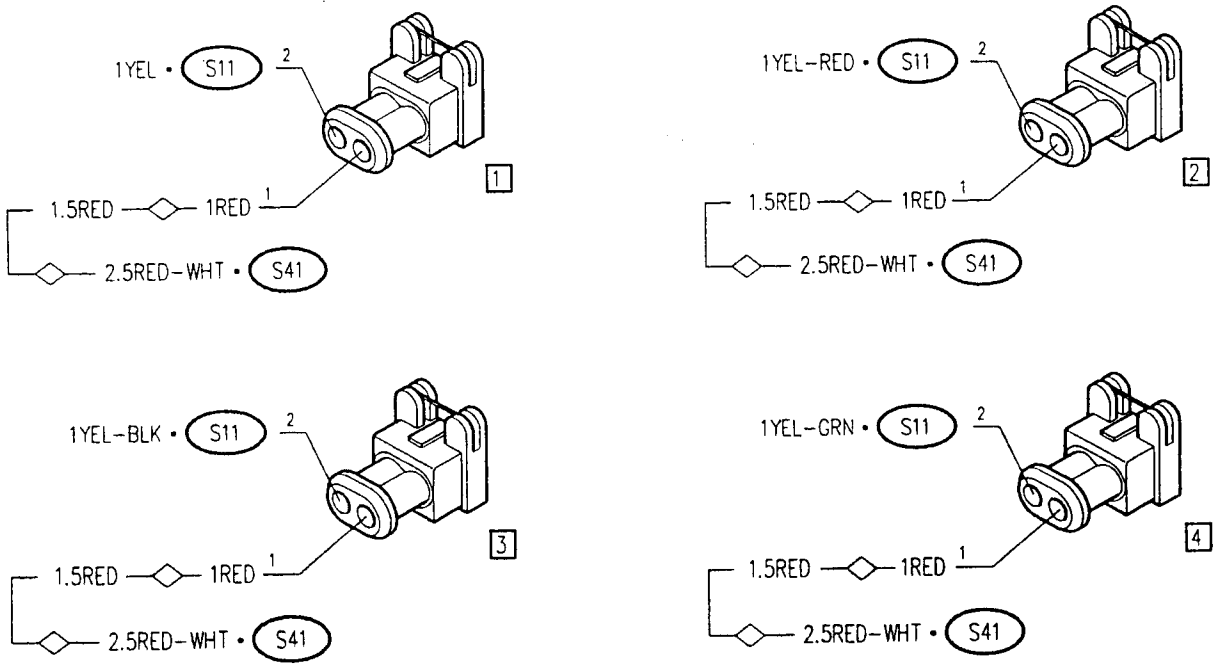


Electric fuel pump	P18

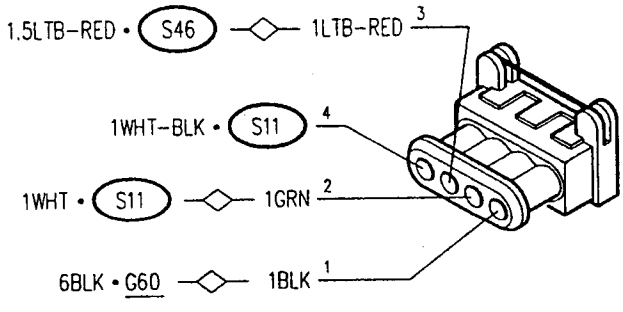


COMPONENTS AND CONNECTORS (contd.)

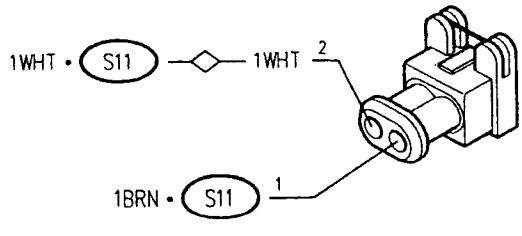
Injector — S3



Air-flow meter — S5

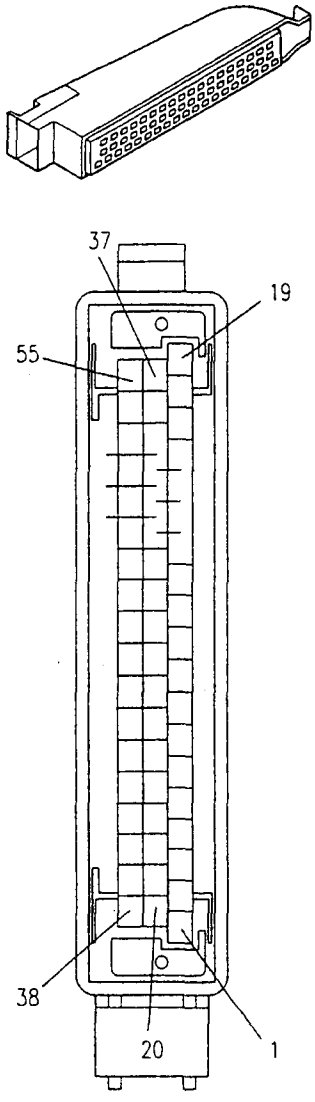


Engine temperature sensor — S7



COMPONENTS AND CONNECTORS (contd.)

Motronic control unit — S11



1 — 1.5LTB-YEL • A8 [1]

2 — 2.5BLK — 6BLK • G60

3 — 1GRY-BLK • S12a

4 — 1LTB-BLK • S29

5 — 1ORN • M15

6 — 1BRN-WHT • G133a

7 — 1WHT-BLK • S5

8 — 1BRN-GRN • S52

9 — 1LTB • G133a

10 — BLK • S35

11 — RED • S20

12 — 1GRY-GRN — 1LTB-WHT • S38; BLU-YEL • S52

14 — 1.5BLK

16 — 1YEL-BLK • S3 [3]

17 — 1YEL • S3 [1]

18 — 2.5RED — 4RED • S36

19 — 1.5BLK

20 — 1.5LTB-BLK • A8 [3]

21 — 1.5LTB-GRN • A8 [4]

22 — 1ORN-BLK • S29

24 — 1.5BLK — 6BLK • G60

25 — RED-GRN • G133a

26 — PNK-WHT • G133a

27 — 1ORN-BLK — 1ORN-BLK • G133a; 1ORN • S41

28 — GRN • S35

30 — 1WHT — 1WHT • S34; 1WHT • S38; 1WHT • S7; 1GRN • S5; 1WHT • S20

32 — 1BRN-BLK • G133a

34 — 1YEL-RED • S3 [2]

35 — 1YEL-GRN • S3 [4]

36 — 1GRN-BLK • S41

37 — 1.5GRY — 2.5RED-WHT • S41

38 — 1.5LTB-RED • A8 [2]

40 — 1GRN-WHT • G133a

43 — PPL • G133a

44 — 1GRY-YEL • G133a

45 — 1BRN • S7

47 — 1LTB-YEL • G133b

48 — BLK • S31

49 — YEL • S31

51 — RED-GRN • G133b

52 — 1PPL-BLK • S12c

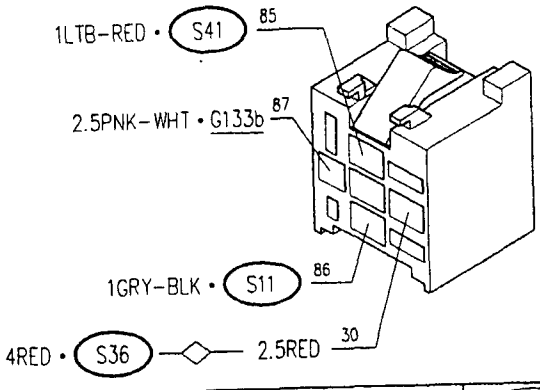
53 — 1PPL-WHT • S38

54 — 1PNK-BLK • S34

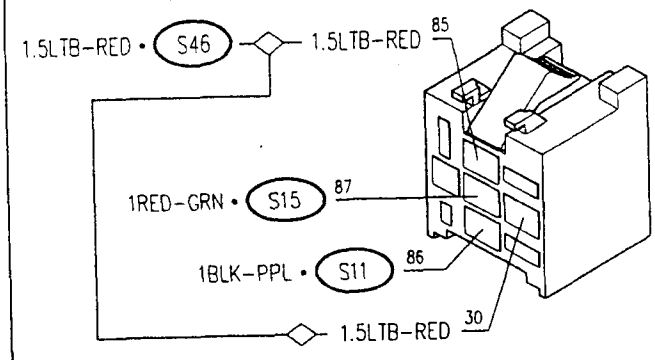
55 — 1WHT-RED • T1

COMPONENTS AND CONNECTORS (contd.)

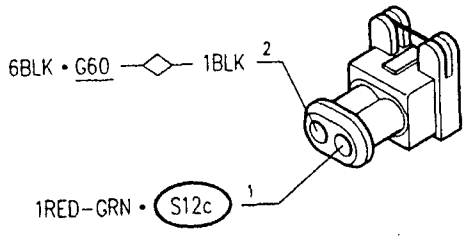
Fuel pump Motronic relay — S12a



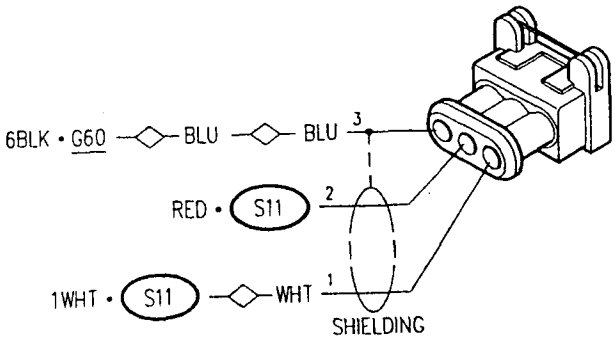
Timing variator relay — S12c



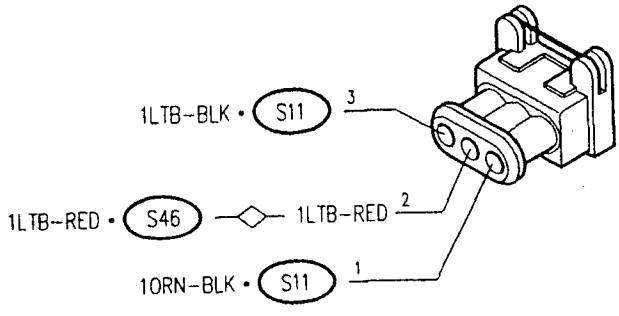
Timing variator — S15



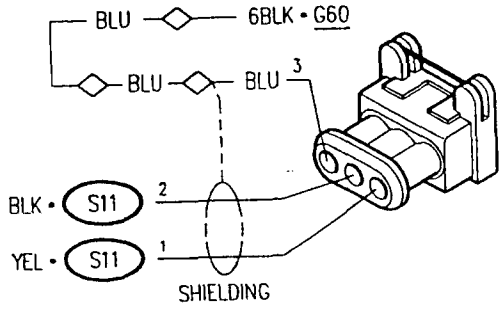
Knocking sensor — S20



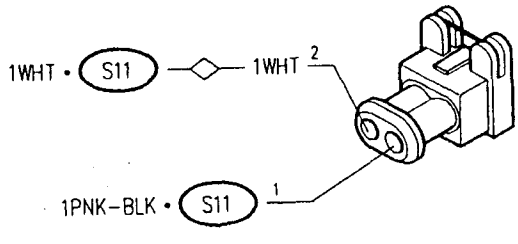
Idle adjustment actuator — S29



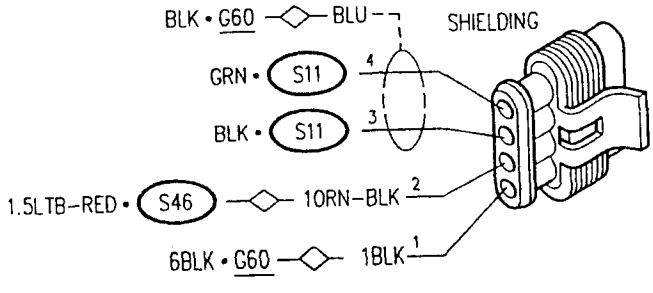
Rpm and crankshaft position sensor — S31



Air temperature sensor — S34

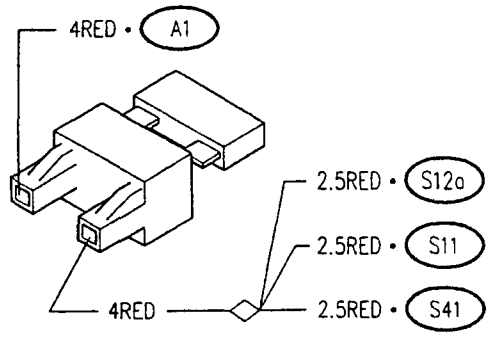


Heated lambda probe — S35

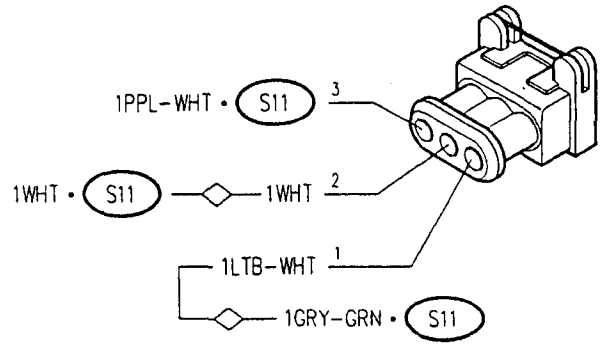


COMPONENTS AND CONNECTORS (contd.)

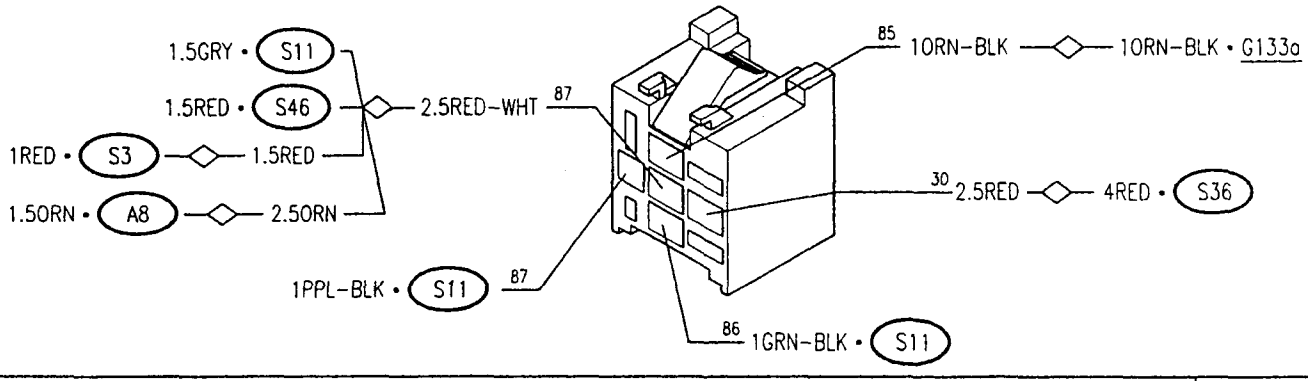
Injection wander fuse — S36



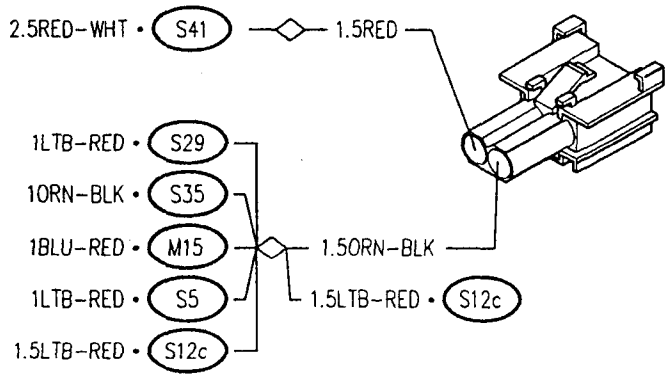
Sensor on throttle body — S38



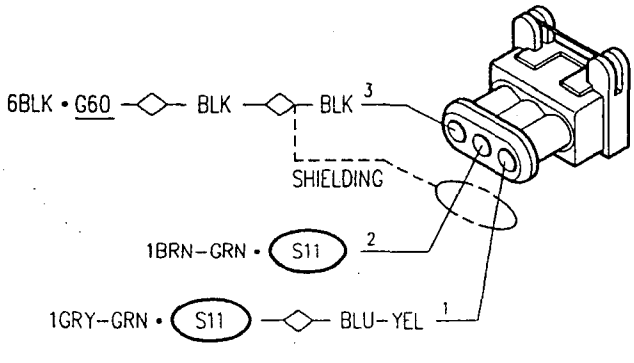
Main relay — S41



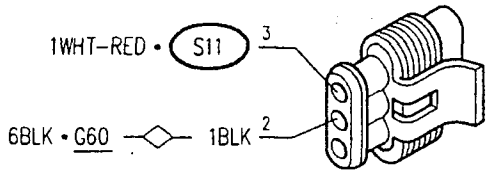
Fuse for Motronic supply — S46



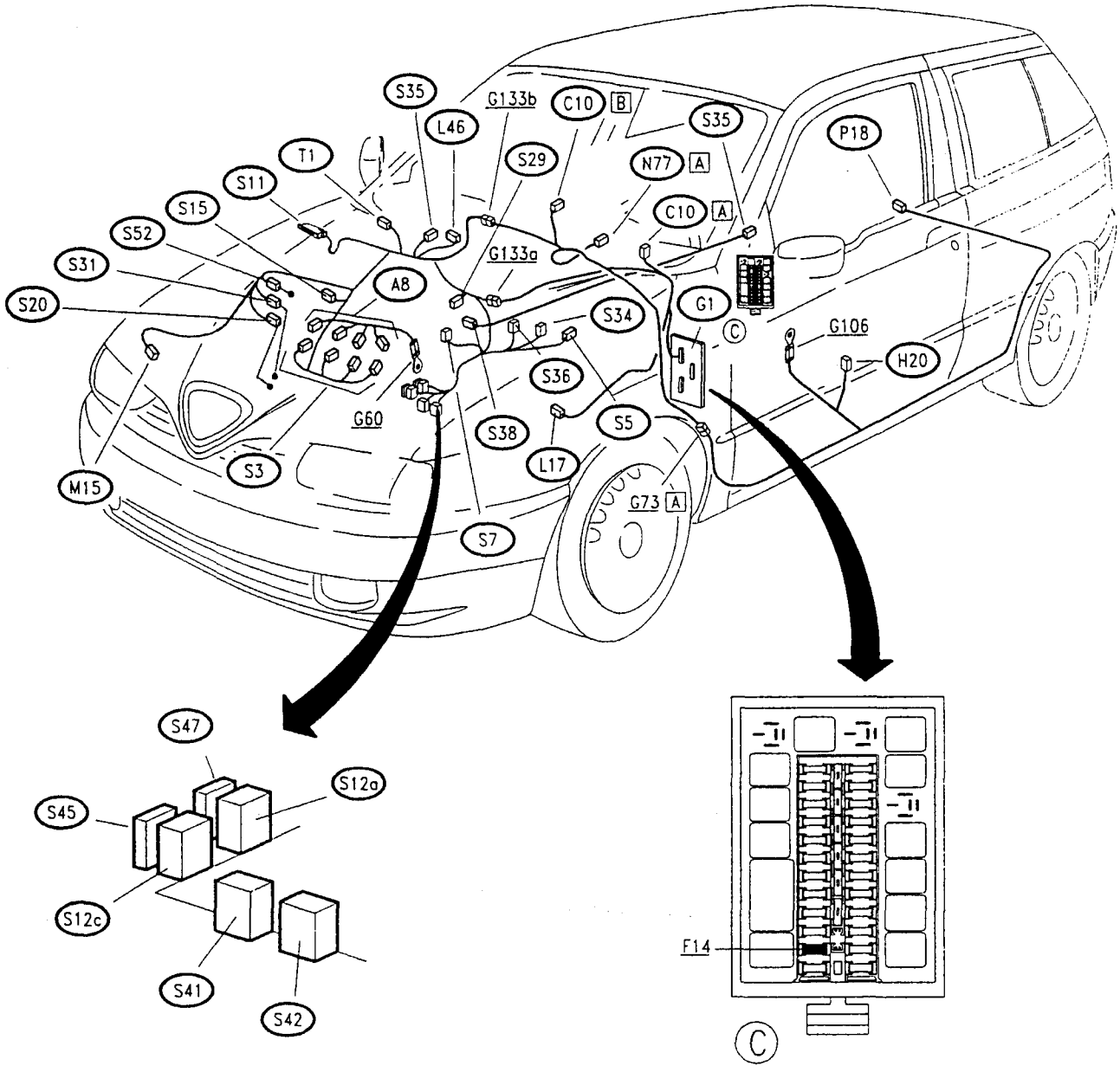
Cam angle sensor — S52



Connector for ALFA TESTER (Motronic) — T1

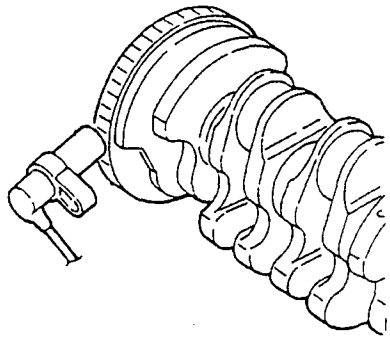


LOCATION OF COMPONENTS



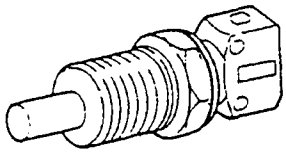
CHECKING COMPONENTS

Rpm sensor (S31)



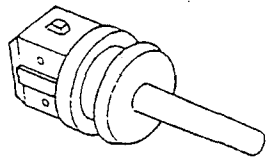
SPECIFICATIONS	
Sensor winding resistance (20 °C)	486 ÷ 594 Ω
Distance (gap) between sensor and phonic wheel	0.5 ÷ 1.5 mm

Engine temperature sensor (S7)



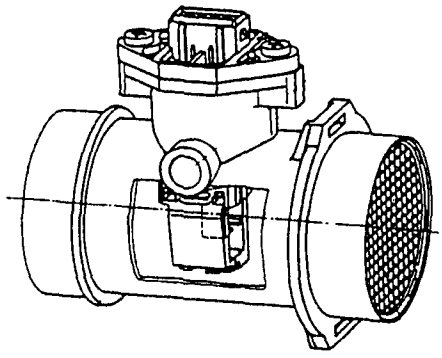
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

Intake air temperature sensor (S34)

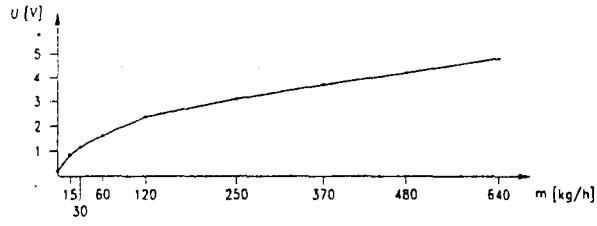


SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

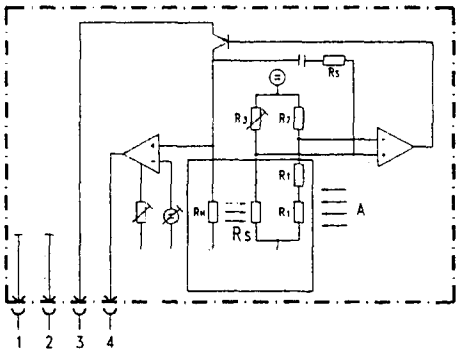
Air flow meter (S5)



SPECIFICATIONS	
Current that crosses the diaphragm:	
capacity (kg/h)	current (A)
0 640	≤ 0.25 ≤ 0.80

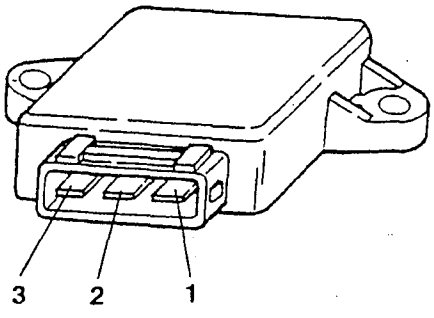


Sensor characteristic curve
m = capacity
U = voltage between pin 4 and 2



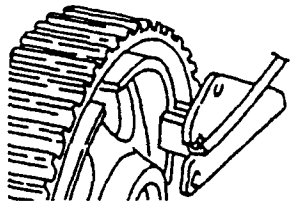
pin 1 - Earth
pin 2 - Reference earth
pin 3 - 12 V supply
pin 4 - Measurement signal
A = air
Rs = hot film sensor

Throttle position sensor (S38)

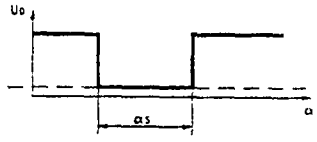


SPECIFICATIONS	
Resistance between terminals:	
1 - 2 (fixed)	≃ 2 kΩ
1 - 3 (throttle closed)	≃ 1 kΩ
1 - 3 (throttle completely open)	≃ 2.7 kΩ

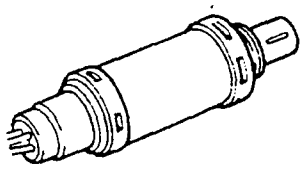
Cam angle sensor (S52)



SPECIFICATIONS
The voltage signal "lowers" abruptly when the hollow machined on the camshaft passes in front of the sensor:

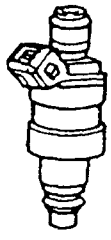


Lambda sensor (S35)



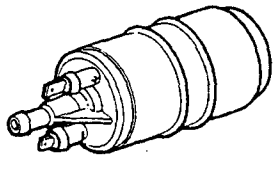
SPECIFICATIONS	
Heating resistance	3 Ω

Injectors (S3)



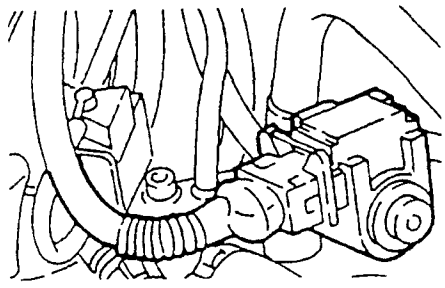
SPECIFICATIONS	
Winding resistance	15.9 ± 0.35 Ω

Fuel pump (P18)



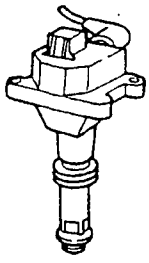
SPECIFICATIONS	
Capacity	≥120 l/h
Pressure	4 bar
Nominal voltage	12V

Idle speed adjustment actuator (S29)



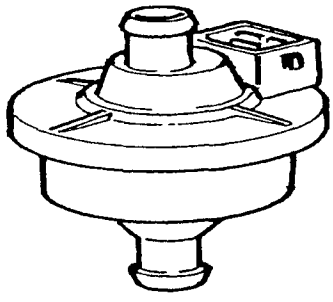
SPECIFICATIONS	
Resistance between terminals:	
1 - 3	~ 33 Ω
1 - 2	~ 17.5 Ω
2 - 3	~ 15.5 Ω

Ignition coils (A8)



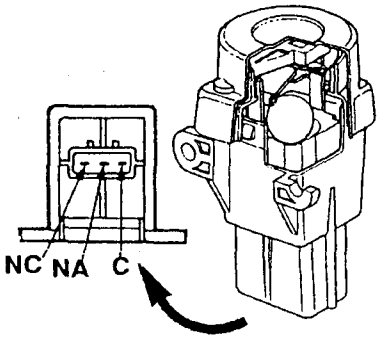
SPECIFICATIONS	
Primary resistance	0.3 Ω ± 12%
Secondary resistance	7 kΩ ± 12%

Evaporative solenoid valve (M15)



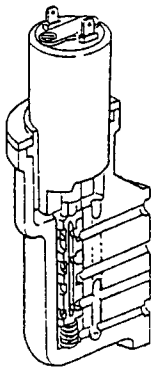
SPECIFICATIONS	
Duty-cycle signal	12 V; 10 Hz
Winding ohmic resistance ohmica	26 ± 4 Ω
When not energised the solenoid valve is normally closed	

Inertial switch (H20)



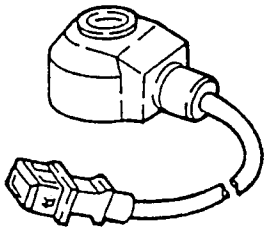
SPECIFICATIONS
Check continuity between pin NC and C: this continuity is cut off in case of a crash: the contact is closed again pressing the special push-button

Timing variator (S15)



SPECIFICATIONS	
Resistance between the two terminals	~ 10 Ω
Max. absorption at 13.5 V	1.34 A

Pinging sensor (S20)



SPECIFICATIONS		
Resonance frequency		> 20 kHz
Impedence		⊥ 1 MΩ
Allowed vibration	for long times	≤ 80 g
	for short times	≤ 400 g

FAULT-FINDING

The control unit possesses a self-diagnosis function which continuously checks the signals from the various sensors for plausibility and comparing them with the permissible limits: if these limits are exceeded, the system detects a fault and memorises it. It also turns on the special warning light on the instrument cluster,

For certain parameters the control unit replaces the abnormal values with appropriate mean values so that the car can "limp" to a point of the Service Network.
These values, known as "recovery" depend on the other correct signals and are defined individually by the control unit operating logic.
The self-diagnosis system also enables quick and effective location of faults connecting with the ALFA ROMEO Tester, through which the errors memorised may be "read". It is also possible to check the operating parameters recorded by the control unit and engage the single actuators to check whether they are working properly.

Diagnosis using the ALFA TESTER

N.B. Before carrying out diagnosis with the Tester, carry out the preliminary test described below (**TEST A**).

The Tester and electronic control unit should be connected as follows:

1. Power the Tester either through the cigar lighter socket or connecting it directly to the battery using the special cable.
2. Connect the socket of the Tester to the one for the control unit (to be found next to the control unit).

The information the instrument can provide is:

- display of parameters;
- display of errors;
- active diagnosis.

Error clearing

Before ending diagnosis the contents of the "permanent" memory are cancelled through the Tester in Active Diagnosis.

Otherwise, reconnecting the Tester errors already examined would be signalled.

The contents of the "permanent memory" can be erased as follows:

- through the tester in Active Diagnosis;
- if the cause that determined the error is no longer present and the engine has been started 10 times (running for no less than 20 minutes) with at least 2 minutes between one start and the next.

N. B.:
Disconnecting the control unit for at least 30 seconds the contents of the "permanent" memory are cleared

PRELIMINARY TEST OF BOSCH M2.10.4 SYSTEM — TEST A

NOTE: Beforehand check that the ALFA ROMEO CODE system is working correctly as it may have cut off the supply to the system!

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check the intactness of fuses **S36** and **S46**	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Change fuses **S36**: 30A **S46**: 15A
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relays **S41** and **S12a**	OK ▶	Carry out **step A3**
	~~OK~~ ▶	Restore the wiring between the battery **A1** and relays **41** and **S12a** through fuse **S36**
A3 CHECK VOLTAGE – With the key turned, check for 12 V at pin 85 of relay **S41**	OK ▶	Carry out **step A4**
	~~OK~~ ▶	Restore the wiring between the ignition switch **B1** and relay **S41**
A4 CHECK RELAYS – Check that relays **S41** and **S12a** are working properly	OK ▶	Carry out **step A5**
	~~OK~~ ▶	Replace any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – Check for 12 V at pin 18 of the control unit **S11**; with the key turned 12 V also at pins 27 and 37 of **S11** and for appr. 0 V (very low voltage) at pin 3 and 36 of **S11**	OK ▶	Carry out **step A6**
	~~OK~~ ▶	Restore the wiring between the control unit **S11** and relays **S41** and **S12a**
A6 CHECK EARTH – Check for an earth at pins 2, 14, 19 and 24 of **S11**	OK ▶	**CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER**
	~~OK~~ ▶	Restore the wiring between **S11** and earth **G60**

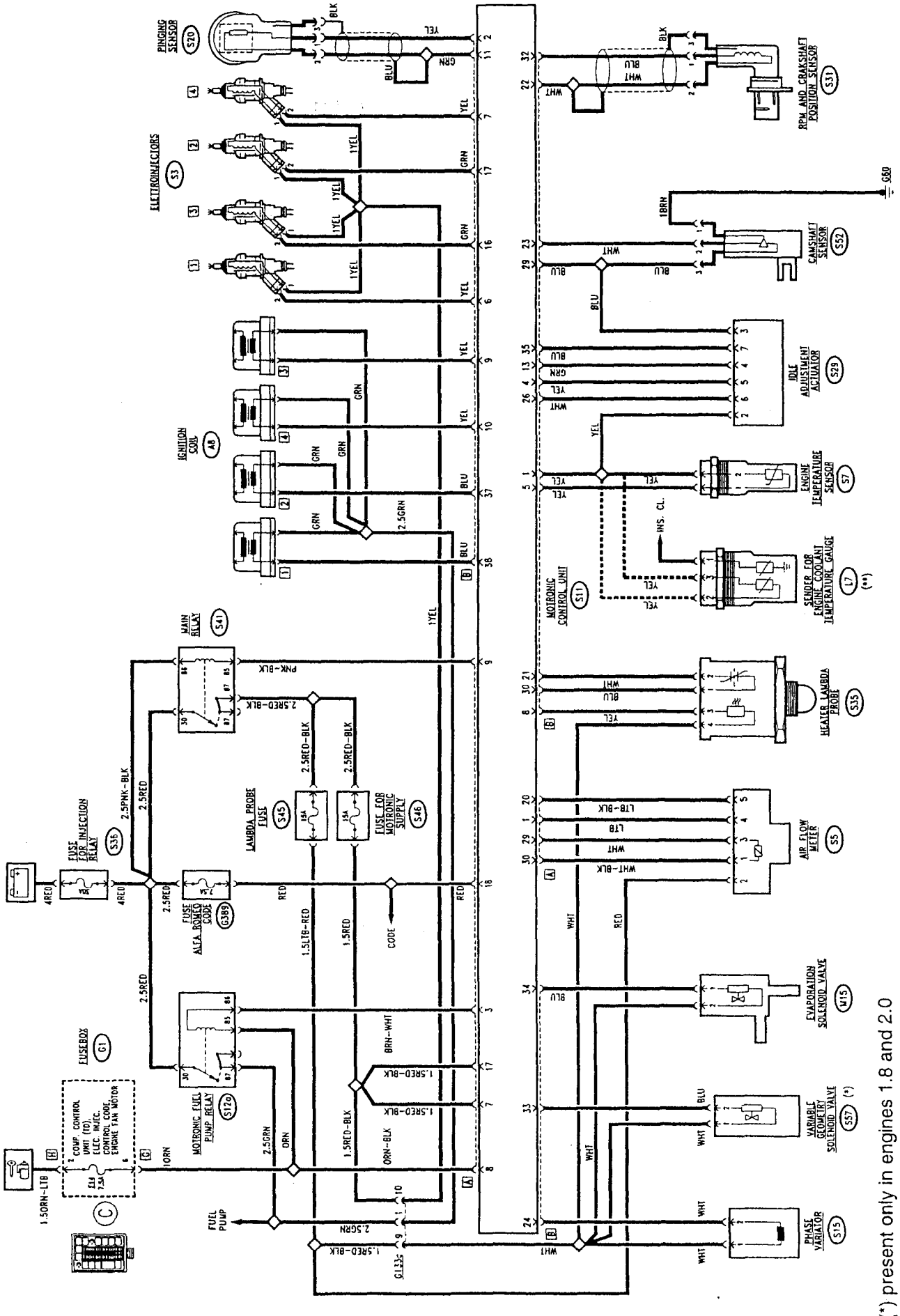
MOTRONIC M1.5.5 INJECTION/IGNITION SYSTEM - 1.4, 1.6, 1.8 and 2.0 T.SPARK 16v engines

INDEX

WIRING DIAGRAM "A" 36C-2
WIRING DIAGRAM "B" 36C-3
GENERAL DESCRIPTION 36C-4
FUNCTIONAL DESCRIPTION 36C-5
LOCATION OF COMPONENTS 36C-15
CHECKING COMPONENTS 36C-16

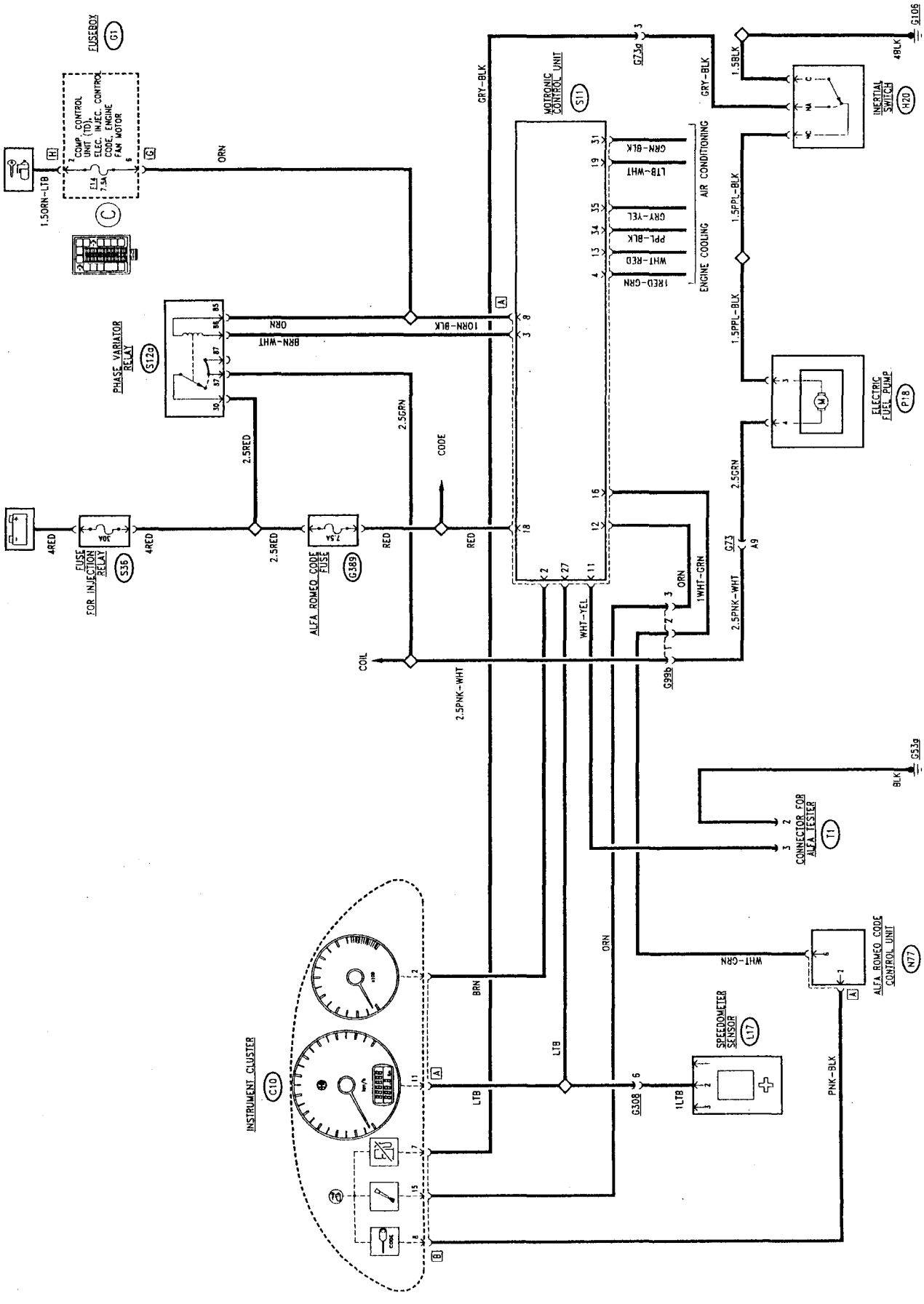
WARNING:
the new MOTRONIC M1.5.5 version replaces the previous MOTRONIC M2.10.4 version from MODEL YEAR '98

WIRING DIAGRAM "A"



(*) present only in engines 1.8 and 2.0
(**) from May '98

WIRING DIAGRAM "B"



GENERAL DESCRIPTION

An electronic control system monitors and adjusts all the engine parameters, optimising performance and consumption levels through response in real time to the different operating conditions.
The system is managed by a single control unit which controls both double ignition (static with lost spark) and injection (timed).
On the basis of signals received from a number of sensors, the control unit commands the actuators connected to it, controlling the following systems:

- fuel supply;
- air supply;
- engine cooling;
- exhaust with catalytic silencer;
- fuel vapour recirculation.

The control unit also controls the electrohydraulic timing variator, which is only used on T. SPARK engines.
Engines 1.8 and 2.0 are characterized by the use of variable geometry intake system, controlled by the control unit according to the engine operating conditions.

The Bosch Motronic M1.5.5 system belongs to the category of systems integrated with:

- digital electronic ignition with inductive discharge;
- static distribution;
- timed sequential electronic injection (1-3-4-2).

At idle speed the control unit controls:

- the ignition instant;
- air flow rate;

with the advantage of keeping the engine running smoothly as the environment conditions and loads applied change.

The control unit monitors and controls injection in such a way that the stoichiometric ratio (air/fuel) is always within the optimum value.
The essential conditions that must be met in preparing the air - fuel mixture for running controlled-ignition engines satisfactorily are mainly the following:

- "metering" (air fuel ratio) must be kept as close as possible to the stoichiometric value, to ensure the necessary combustion speed, avoiding pointless fuel consumption.
- "homogeneity" of the mixture, formed of fuel vapours, scattered in the air as finely and evenly as possible.

The information processed by the control unit to command optimum metering, is received through electric signals issued by:

- air-flow meter with integrated air temperature sensor, for the exact amount of intake air
- rpm sensor, which generates an alternate single-phase signal, the frequency of which indicates engine rpm
- throttle position potentiometer (integrated in the constant idle speed actuator), to detect the idle, partial and full load conditions
- lambda sensor to determine the oxygen contained in the exhaust gas.

The ignition system is of the static inductive discharge type (i.e. without High Voltage distributor) with power modules located inside the injection control unit.
The system has a single coil for each spark plug (MONOCOIL); the advantages of this solution are:

- lower electric overload;
- constant discharge on each spark plug.

The control unit storage contains a map of the whole series of optimum spark advance values (for the cylinder in the bursting stroke) that the engine can use according to the engine speed and load required.

The control unit corrects the advance value mainly according to:

- engine coolant fluid temperature
- intake air temperature
- pinging
- throttle valve position.

The information processed by the control unit to drive the monocoils, is received through electric signals issued by:

- air-flow meter with integrated air temperature sensor, for the exact amount of intake air
- rpm sensor, which generates an alternate single-phase signal, the frequency of which indicates engine rpm
- pinging sensor (on the rear of the crankcase between the 2nd and 3rd cylinder) to detect the cylinder that is pinging and correct the spark advance accordingly
- throttle position potentiometer (integrated in the constant idle speed actuator), to detect the idle, partial and full load conditions.

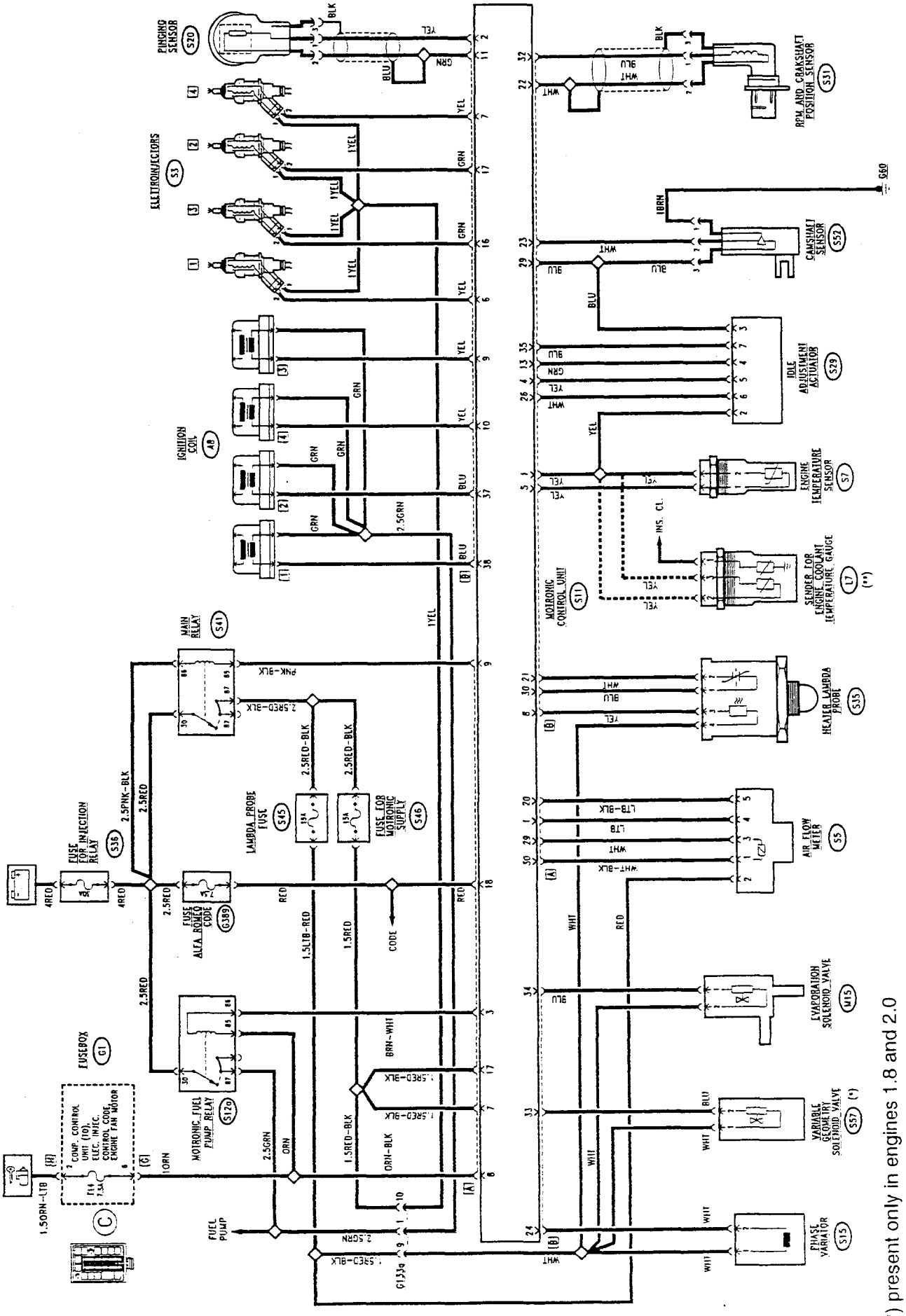
MOTRONIC M1.5.5 INJECTION/IGNITION SYSTEM - 1.4, 1.6, 1.8 and 2.0 T.SPARK 16v engines

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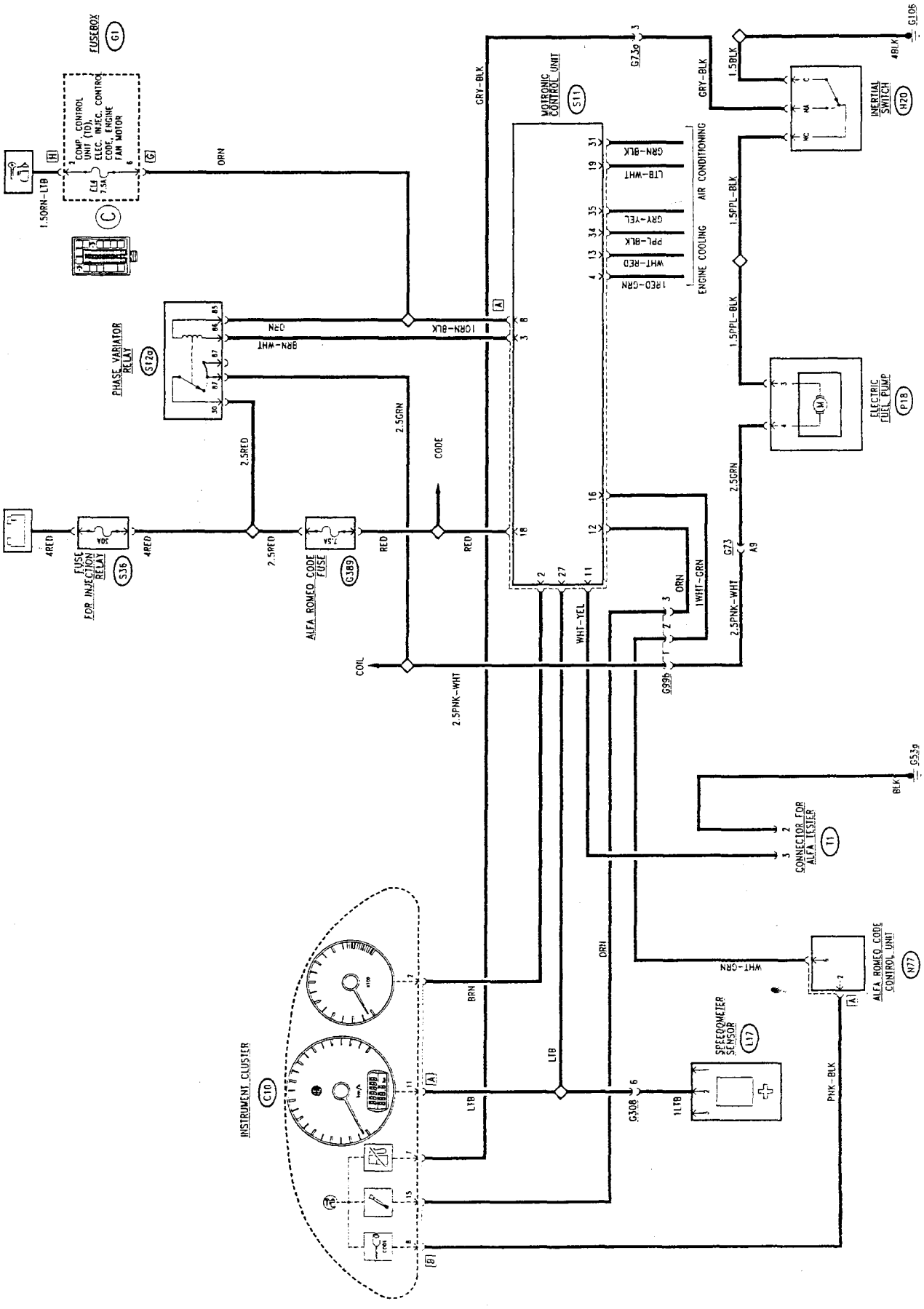
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WIRING DIAGRAM "A"



(*) present only in engines 1.8 and 2.0
(**) from May '98

WIRING DIAGRAM "B"



GENERAL DESCRIPTION

An electronic control system monitors and adjusts all the engine parameters, optimising performance and consumption levels through response in real time to the different operating conditions.
The system is managed by a single control unit which controls both double ignition (static with lost spark) and injection (timed).
On the basis of signals received from a number of sensors, the control unit commands the actuators connected to it, controlling the following systems:

- fuel supply;
- air supply;
- engine cooling;
- exhaust with catalytic silencer;
- fuel vapour recirculation.

The control unit also controls the electrohydraulic timing variator, which is only used on T. SPARK engines.
Engines 1.8 and 2.0 are characterized by the use of variable geometry intake system, controlled by the control unit according to the engine operating conditions.

The Bosch Motronic M1.5.5 system belongs to the category of systems integrated with:

- digital electronic ignition with inductive discharge;
- static distribution;
- timed sequential electronic injection (1-3-4-2).

At idle speed the control unit controls:

- the ignition instant;
- air flow rate;

with the advantage of keeping the engine running smoothly as the environment conditions and loads applied change.

The control unit monitors and controls injection in such a way that the stoichiometric ratio (air/fuel) is always within the optimum value.
The essential conditions that must be met in preparing the air - fuel mixture for running controlled-ignition engines satisfactorily are mainly the following:

- "metering" (air fuel ratio) must be kept as close as possible to the stoichiometric value, to ensure the necessary combustion speed, avoiding pointless fuel consumption.
- "homogeneity" of the mixture, formed of fuel vapours, scattered in the air as finely and evenly as possible.

The information processed by the control unit to command optimum metering, is received through electric signals issued by:

- air-flow meter with integrated air temperature sensor, for the exact amount of intake air
- rpm sensor, which generates an alternate single-phase signal, the frequency of which indicates engine rpm
- throttle position potentiometer (integrated in the constant idle speed actuator), to detect the idle, partial and full load conditions
- lambda sensor to determine the oxygen contained in the exhaust gas.

The ignition system is of the static inductive discharge type (i.e. without High Voltage distributor) with power modules located inside the injection control unit.
The system has a single coil for each spark plug (MONOCOIL); the advantages of this solution are:

- lower electric overload;
- constant discharge on each spark plug.

The control unit storage contains a map of the whole series of optimum spark advance values (for the cylinder in the bursting stroke) that the engine can use according to the engine speed and load required.

The control unit corrects the advance value mainly according to:

- engine coolant fluid temperature
- intake air temperature
- pinging
- throttle valve position.

The information processed by the control unit to drive the monocoils, is received through electric signals issued by:

- air-flow meter with integrated air temperature sensor, for the exact amount of intake air
- rpm sensor, which generates an alternate single-phase signal, the frequency of which indicates engine rpm
- pinging sensor (on the rear of the crankcase between the 2nd and 3rd cylinder) to detect the cylinder that is pinging and correct the spark advance accordingly
- throttle position potentiometer (integrated in the constant idle speed actuator), to detect the idle, partial and full load conditions.

FUNCTIONAL DESCRIPTION

The engine control unit **S11** controls and adjusts the entire electronic ingition and injection system.
The direct system supply leads from the battery via the line of the maxi wander fuse **S36**.
The key-operated supply leads from the line protected by fuse **F14** of fusebox **G1**.
The control unit **S11** is supplied directly by the battery at pin 18 of connector A, through the line protected by fuse **G389**. The "key-operated" supply reaches pin 8 of connector A.
The main relay **S41** controls the entire system: it is energised by a command signal (earth) leading from pin 9 of connector A of control unit **S11** and sends the supply accordingly:

- to pin 7 and 17 of connector A of the control unit itself and to the injectors **S3** through the line protected by fuse **S46**;
- to the air-flow meter **S5**, to the fuel vapour recovery solenoid valve **M15**, to the variable geometry solenoid control valve **S57**, to the timing variator **S15** and to the lambda sensor **S35**; (all these lines are protected by fuse **S45**).

The fuel pump relay **S12a** receives the "key-operated" supply through fuse **F14** of **G1**. It is energised with a command signal (earth) leading from pin 3 of connector A of control unit **S11** and supplies the electric fuel pump **P18**, which is connected to earth through the inertial switch **H20**, which in the event of a crash cuts off the circuit thereby stopping the dangerous delivery of fuel.

In case of intervention on switch **H20**, the relative telltale light on the panel **C10** is also turned on.

Remote switch **S12a** supplies power to the ignition coils **A8**.

The engine control unit motore **S11** receives the signals from the different sensors, thereby keeping all the engine operating parameter under control.

The rpm sensor **S31** through a frequency signal sent to pin 22 and 32 of connector B of control unit **S11**, supplies information about engine speed: these two signals are very low in intensity and are therefore suitably screened.

The timing sensor (cam angle **S52**) is supplied from pin 29 of connector B of control unit **S11** and sends a frequency signal corresponding to the phase to pin 23 of connector B of the control unit itself.

The engine temperature sensor **S7** receives a reference earth from 1 of connector B of control unit **S11** and supplies a signal proportionate with the temperature of the engine fluid at pin 5 of connector B of the control unit itself.

Starting from May '98, an engine temperature sender unit **L7** has been adopted which receives a reference earth from pin 1 of connector B of the control unit and provides a signal proportional to the temperature of the engine coolant to pin 5 of the same connector.

The heated lambda sensor **S35** sends the control unit **S11** information about the correct composition of the air-fuel mixture: the signal is sent to pin 30 of connector B of **S11**, while pin 21 supplies the reference earth. The sensor **S35** is heated with a resistance, to make sure that it works properly also when it is cold. The resistance is supplied by relay **S12a** and receives an earth signal from pin 8 of connector B of control unit **S11**.

The pinging sensor **S20**, through a frequency signal sent to pin 2 of connector B of control unit **S11**, makes it possible to obtain information about pinging conditions: it receives a reference earth from pin 11 of connector B. These signals are very low in intensity and are therefore suitably screened.

The air-flow meter **S5** (supplied by relay **S12a**) receives from pin 1 of connector A of control unit the reference voltage and sends to pin 20 of connector A a signal proportionate with the air flow rate. Inside **S5** there is also an air temperature sensor: the reference earth of the sensor is supplied by pin 29 of connector A di **S11**, while pin 30 of connector A receives the air temperature signal.

The control unit **S11** controls opening of the single injectors **S3**, through special duty-cycle signals sent from pin 6 (cyl 1), 17 (cyl 2), 16 (cyl 3) and 7 (cyl 4) of connector B of **S11**.

The injectors **S3** receive the enable supply from the main relay **S41**.

The control unit **S11** also controls the coils **A8** through command signals (earth) for the primary windings of the coils, while the secondary sends the pulse to the spark plugs: from pin 38 and 10 of connector B for cylinders 1-4 and from pin 9 and 37 pin of connector B of **S11** for cylinders 2-3.

The primaries of the coils **A8** receive the enable supply for opening from the main relay **S41**.

The idle speed actuator **S29** adjusts the flow of air at idle speed through the throttle. It receives the supply and the reference earth from pin 1 and 29 of connector B of control unit **S11**: pin 4 and 13 of connector B are connected with the potentiometer which detects the position of the throttle; pin 26 and 35 of connector B control the actuator of the throttle itself.

The fuel vapour recovery solenoid valve **M15** allows the flow of fuel vapours towards the engine intake, where they are added to the mixture that enters the combustion chamber. The valve **M15**, supplied by the main relay **S41**, is opened by the control unit when the engine is under load, through a signal - duty-cycle - by pin 34 of connector B of **S11**.

The variable geometry solenoid control valve (**only for engines 1.8 and 2.0**) **S57** is controlled by pin 33 of connector B of control unit **S11**.

The timing variator **S15** mechanically controls the timing advance at the intake : it is controlled by pin 24 of connector B of control unit **S11**.

The control unit **S11** is connected with the ALFA ROMEO CODE control unit at pin 6 of **N77** through the special line of pin 16 of connector A.

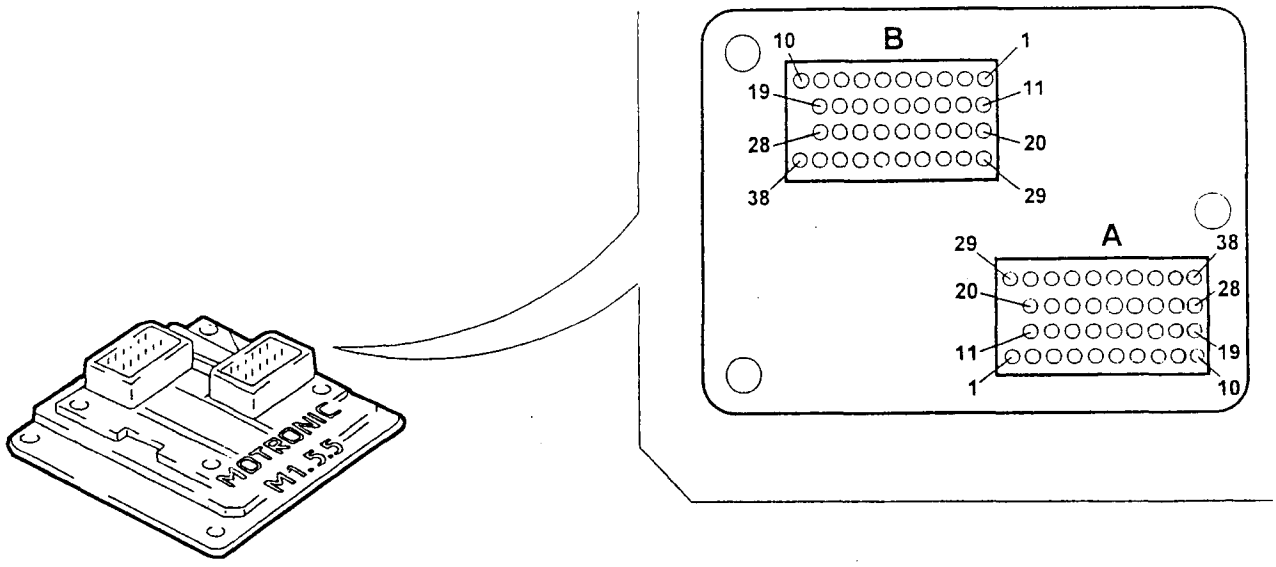
The control unit has a self-diagnosis system, which can be used connecting to the diagnosis connector **T1**: the signals reach it from pin 11 of connector A from the control unit **S11** through the special diagnosis line. The self-diagnosis system also generates the signal for the "injection failure" warning light, on the instrument cluster **C10**, which leads from pin 12 of connector A of control unit **S11**.

The tachometric signal (car speed) reaches pin 27 of connector A of control unit **S11** from sensor **L17**.

The control unit **S11** sends from pin 2 of connector A a signal proportionate with engine rpm to the instrument cluster **C10**.

The control unit **S11** is connected with the air conditioning system via pin 19 and 31 of connector A. This makes it possible to adapt the engine idle speed to the increased load each time the compressor is engaged, or to cut it off in the case of high speed or high engine loads.

The control unit also controls the engine cooling system: pin 4, 13, 34 and 35 of connector A control engagement of the corresponding fan.



Control unit pin-out

Connector A

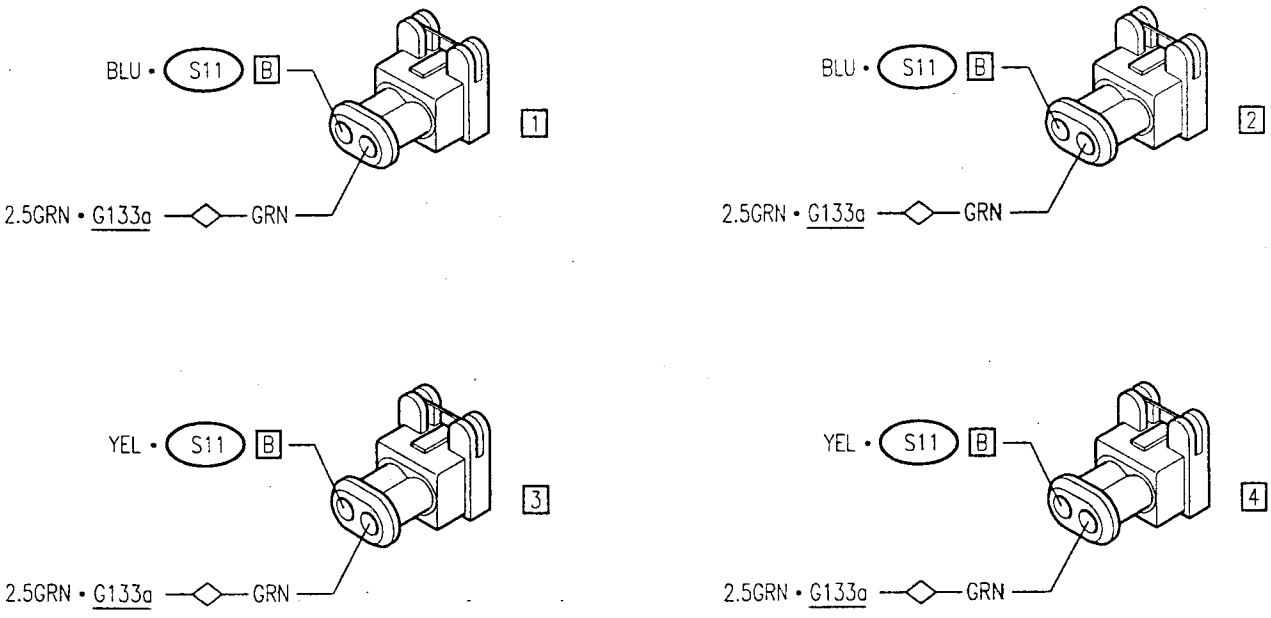
1. Sensor supply (air-flow meter)
2. Rev counter signal
3. Fuel pump relay command
4. Cooling fan 2nd speed relay command
5. N.C.
6. N.C.
7. Main relay supply
8. Key-operated supply
9. Main relay command
10. N.C.
11. Diagnosis connection (line K)
12. "i.e. failure" warning light
13. Cooling fan 1st speed relay command
14. N.C.
15. N.C.
16. Alfa Romeo CODE connection
17. Supply from main relay
18. Direct supply (battery)
19. Conditioner compressor relay command
20. Air-flow meter signal
21. N.C.
22. N.C.
23. N.C.
24. N.C.
25. N.C.
26. N.C.
27. Tachometric sensor signal
28. N.C.
29. Sensor earth
30. Air temperature sensor signal
31. Conditioning request switch (from pressure switch)
32. N.C.
33. N.C.
34. Request to turn on fan 1st speed
35. Request to turn on fan 2nd speed
36. N.C.
37. N.C.
38. N.C.

Connector B

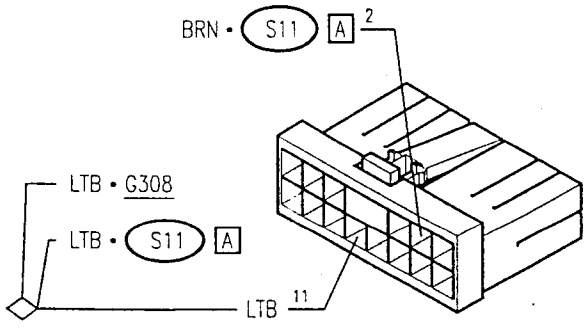
1. Sensor earth
2. Pinging sensor signal
3. N.C.
4. Throttle position potentiometer signal
5. Coolant fluid temperature sensor signal
6. Injector command for cyl 1
7. Injector command for cyl 4
8. Lambda sensor heating signal
9. Ignition coil control for cyl 3
10. Ignition coil control for 4
11. Pinging sensor signal
12. N.C.
13. Throttle potentiometer signal
14. N.C.
15. Idle switch signal
16. Injector command for cyl 3
17. Injector command for cyl 2
18. N.C.
19. N.C.
20. N.C.
21. Lambda sensor reference earth
22. Engine rpm sensor signal
23. Timing sensor signal
24. Timing variator actuator command
25. N.C.
26. Throttle actuator command
27. N.C.
28. N.C.
29. Sensor supplies
30. Lambda sensor
31. N.C.
32. Engine rpm sensor signal
33. Intake manifold solenoid valve command (present only in engines 1.8 and 2.0
34. Fuel vapour recovery solenoid valve command
35. Throttle actuator command
36. N.C.
37. Ignition coil control for cyl 2
38. Ignition coil control for cyl 1

COMPONENTS AND CONNECTORS

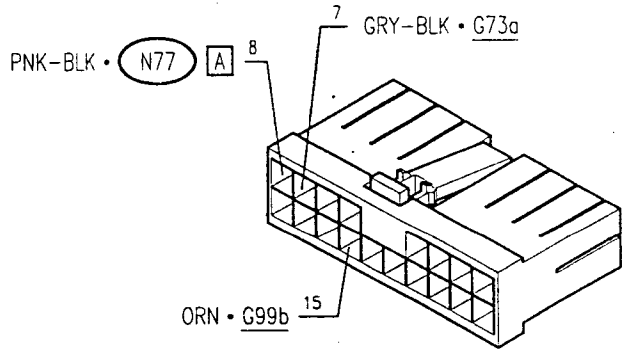
Ignition coils — A8



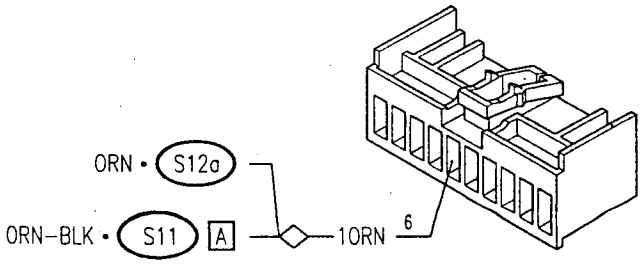
Instrument cluster — C10 A



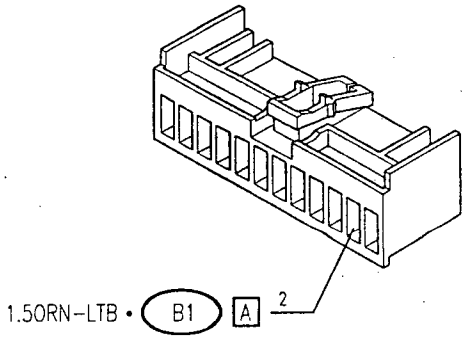
Instrument cluster — C10 B



Fusebox — G1 G

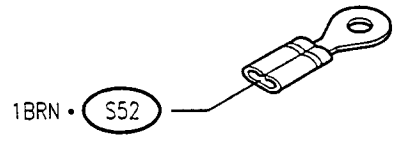


Fusebox — G1 H

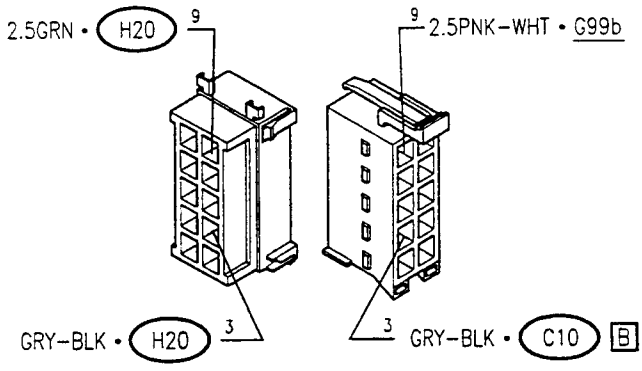


COMPONENTS AND CONNECTORS (continued)

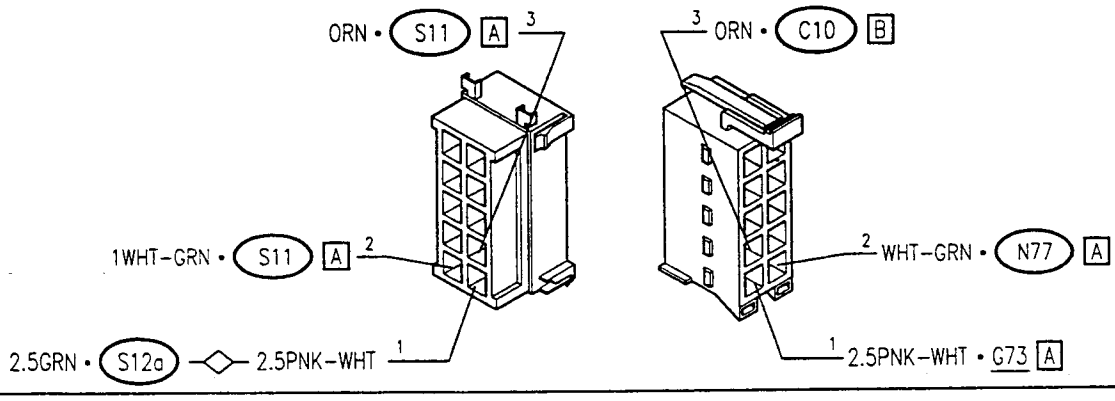
Injection wiring earth	G60



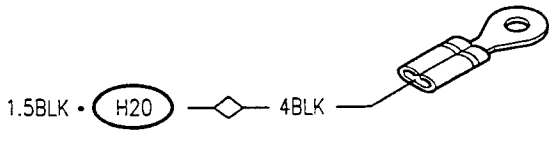
Rear services connector	G73 A



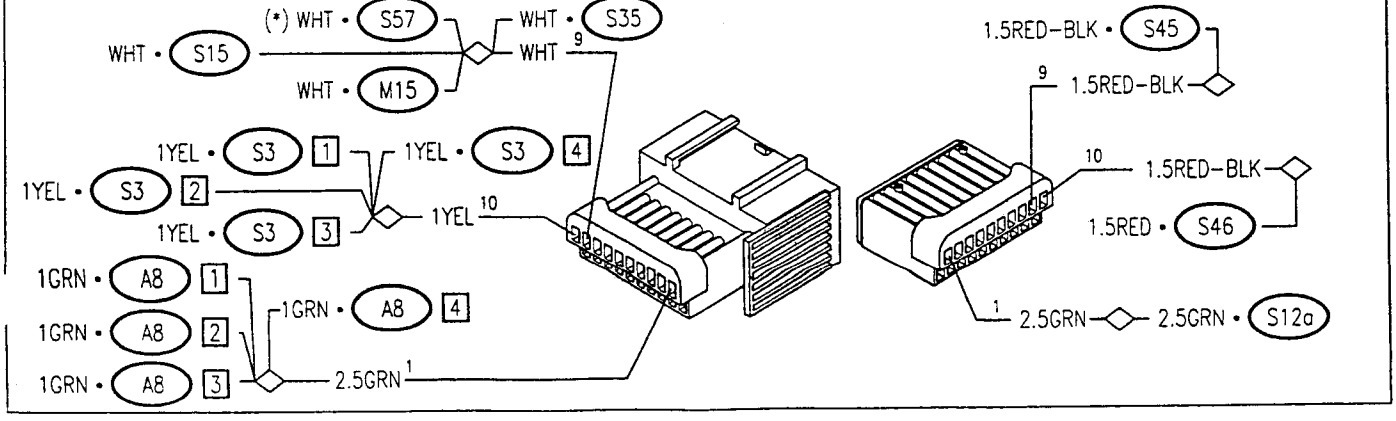
Dashboard/engine wiring connector	G99b



Seat crossmember earth	G106



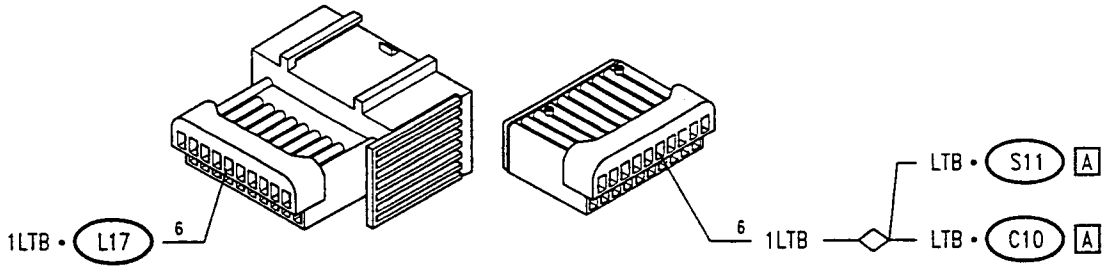
Electr. injection wiring connector A	G133a



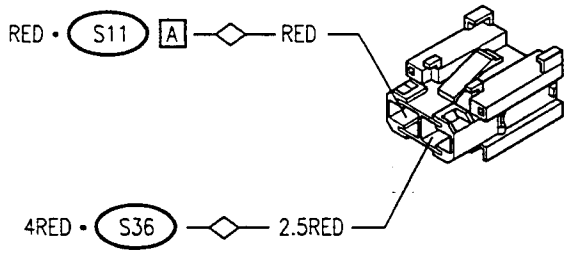
(*) only in engines 1.8 and 2.0

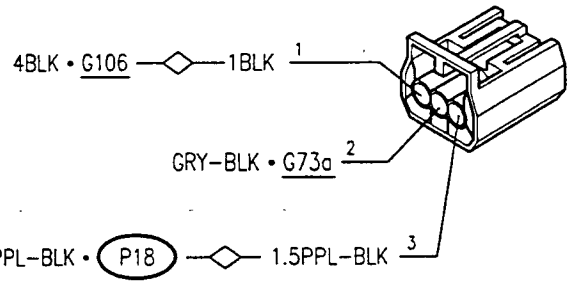
COMPONENTS AND CONNECTORS (continued)

Engine sensor connector	G308

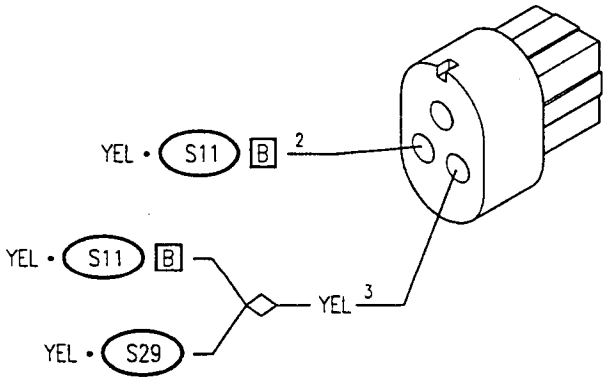


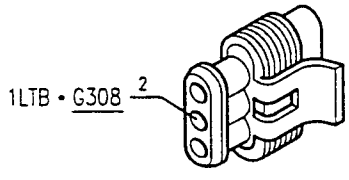
ALFA ROMEO CODE fuse	G389	Inertial switch	H20



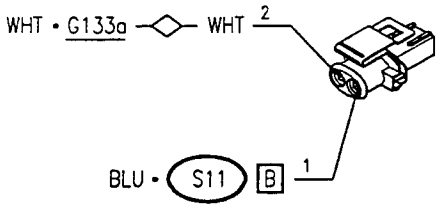


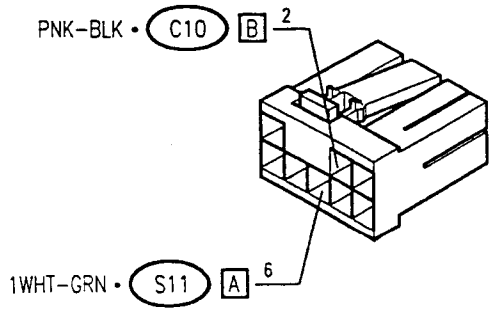
Sender for engine coolant temperature gauge (*)	L7	Tachometric sensor	L17





Evaporative solenoid valve	M15	ALFA ROMEO CODE control unit	N77 A

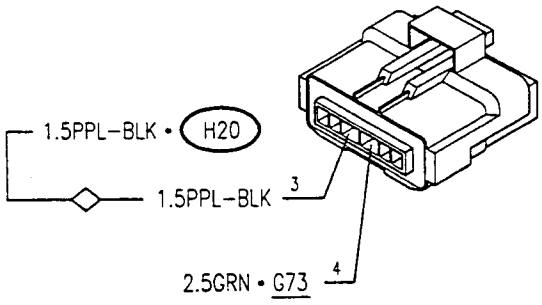




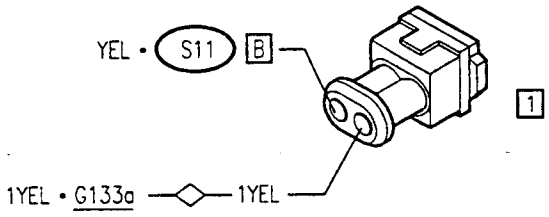
(*) from May '98

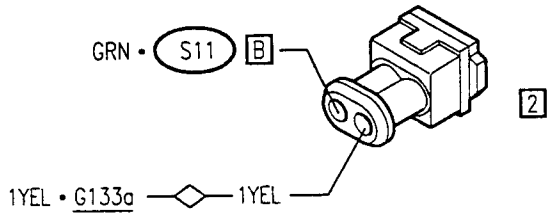
COMPONENTS AND CONNECTORS (continued)

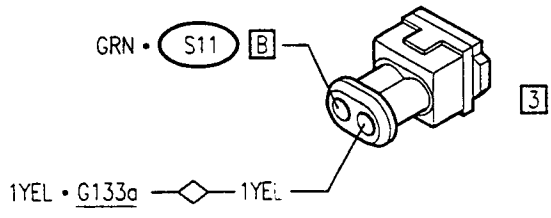
Electric fuel pump — P18

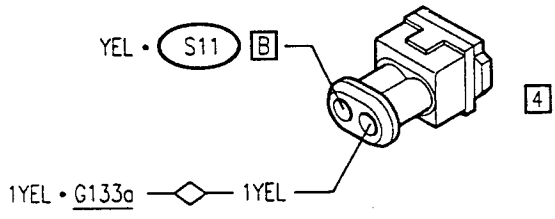


Injectors — S3

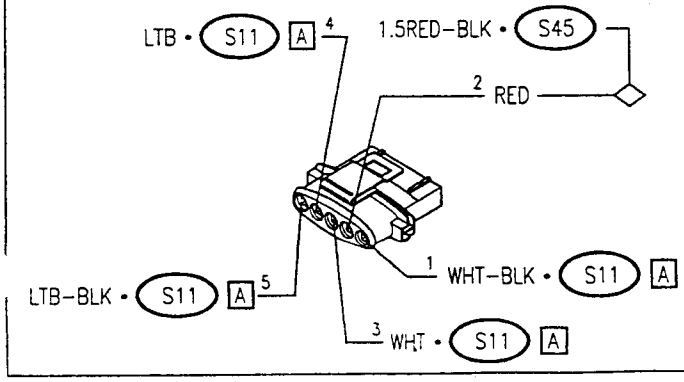




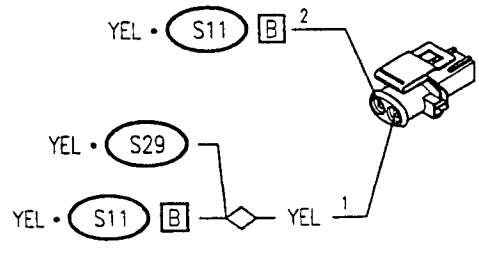




Air flow meter — S5



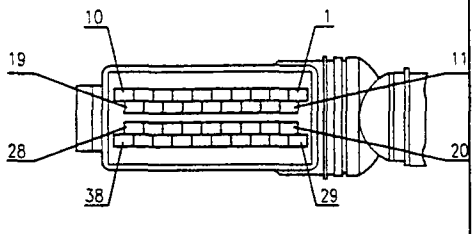
Engine temperature sensor — S7



COMPONENTS AND CONNECTORS (continued)

Motronic control unit — S11 A

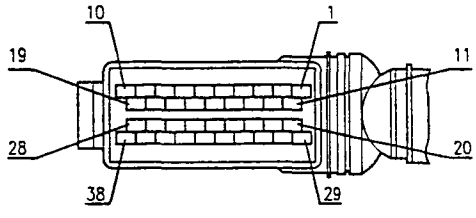
1 — LTB • S5
2 — BRN • C10 [A]
3 — BRN-WHT • S12a
4 — 1RED-GRN • I100
5 — N.C.
6 — N.C.
7 — 1RED-BLK ◇ 1.5RED • S46; 1.5RED-BLK • G133a
8 — ORN-BLK ◇ ORN • S12a; 1ORN • G1 [G]
9 — PNK-BLK • S41
10 — N.C.
11 — WHT-YEL • T1
12 — ORN • G99b
13 — WHT-RED • G1 [G]
14 — N.C.
15 — N.C.
16 — 1WHT-GRN • G99b
17 — 1RED-BLK
18 — RED ◇ RED • G389
19 — LTB-WHT • Q22
20 — LTB-BLK • S5
21 — N.C.
22 — N.C.
23 — N.C.
24 — N.C.
25 — N.C.
26 — N.C.



27 — LTB ◇ LTB • C10 [A]; LTB • G308
28 — N.C.
29 — WHT • S5
30 — WHT-BLK • S5
31 — GRN-BLK • S5
32 — N.C.
33 — N.C.
34 — PPL-BLK • Q20
35 — GRY-YEL • Q20
37 — N.C.
38 — N.C.

Motronic control unit — S11 B

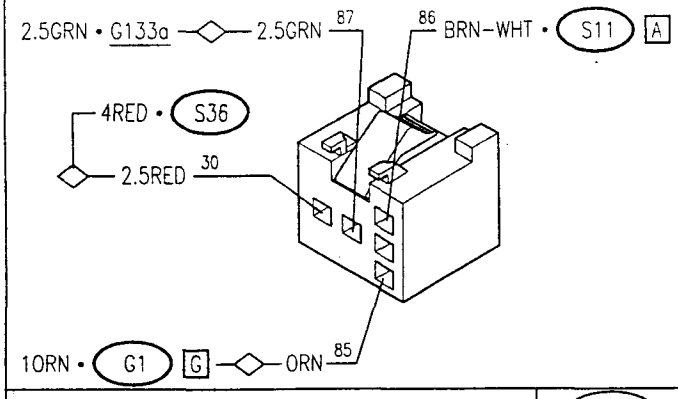
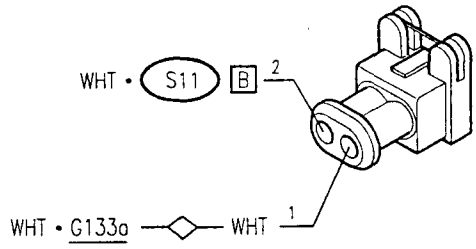
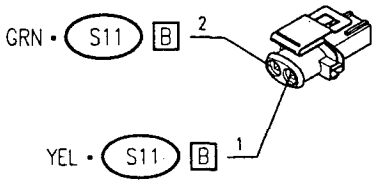
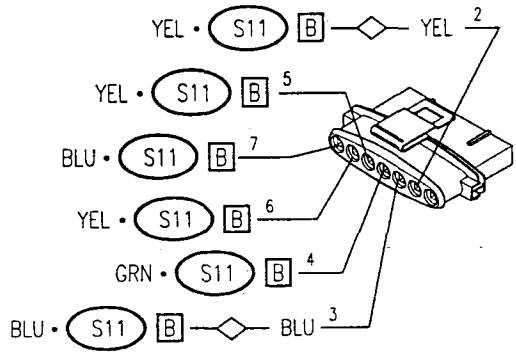
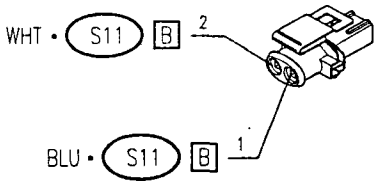
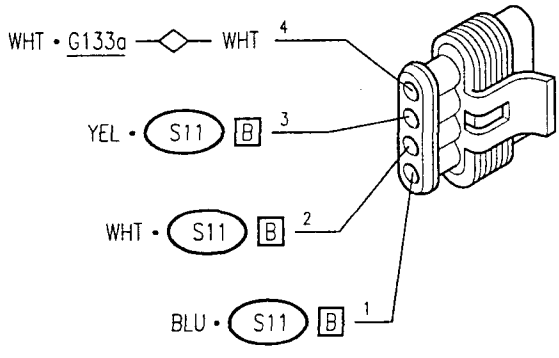
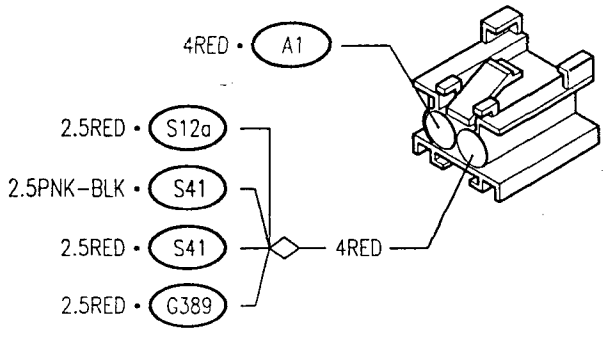
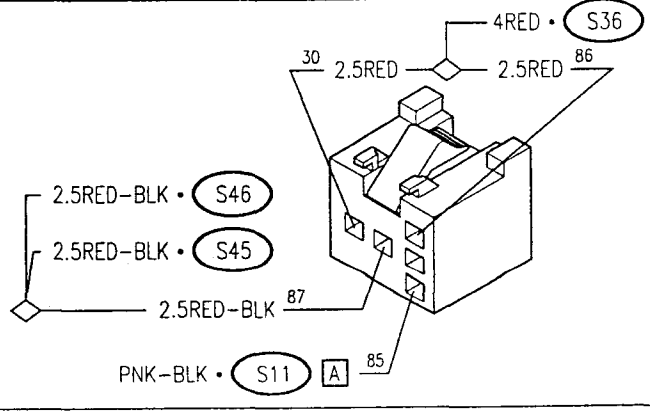
1 — YEL ◇ YEL • S7; YEL • L7 (**); YEL • S29
2 — YEL • S20
3 — N.C.
4 — YEL • S29
5 — YEL • S7
5 — YEL • L7 (**)
6 — YEL • S3 [1]
7 — YEL • S3 [4]
8 — YEL • S35
9 — YEL • A8 [3]
10 — YEL • A8 [4]
11 — GRN • S20
12 — N.C.
13 — GRN • S29
14 — N.C.
15 — N.C.
16 — GRN • S3 [3]
17 — GRN • S3 [2]
18 — N.C.
19 — N.C.
20 — N.C.
21 — WHT • S35
22 — WHT • S31
23 — WHT • S52
24 — WHT • S15
25 — N.C.



26 — YEL • S29
27 — N.C.
28 — N.C.
29 — BLU ◇ BLU • S52; BLU • S29
30 — BLU • S35
31 — N.C.
32 — BLU • S31
33 — BLU • S57
34 — BLU • M15
35 — BLU • S29
36 — N.C.
37 — BLU • A8 [2]
38 — BLU • A1 [1]

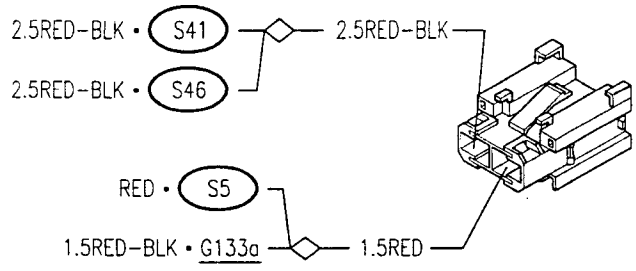
(*) only in engines 1.8 and 2.0
(**) from May '98

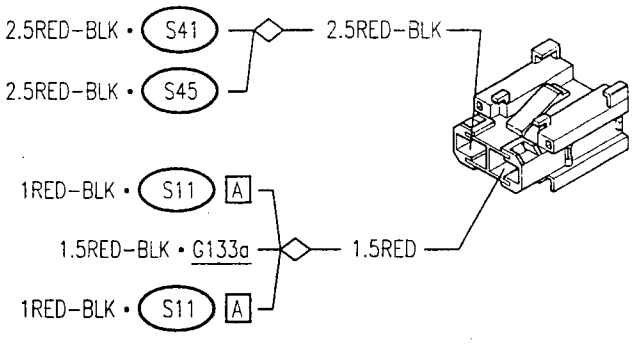
COMPONENTS AND CONNECTORS (continued)

Motronic fuel pump relay	S12a	Timing variator	S15
			
Pinging sensor	**S20**	**Idle speed adjustment actuator**	**S29**
			
Rpm & crankshaft position sensor	**S31**	**Heated lambda sensor**	**S35**
			
Injection wander fuse	**S36**	**Main relay**	**S41**
			

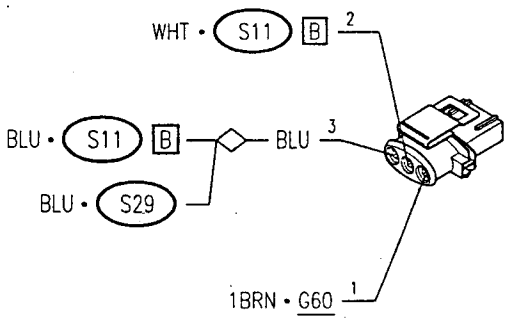
COMPONENTS AND CONNECTORS (continued)

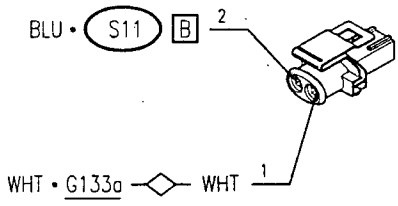
Lambda sensor wander fuse	S45	Motronic supply wander fuse	S46



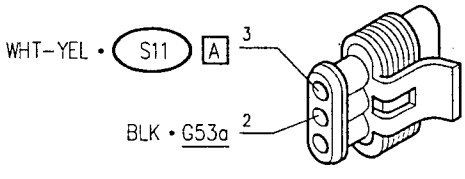


Cam angle sensor	S52	Variable geometry solenoid valve (*)	S57



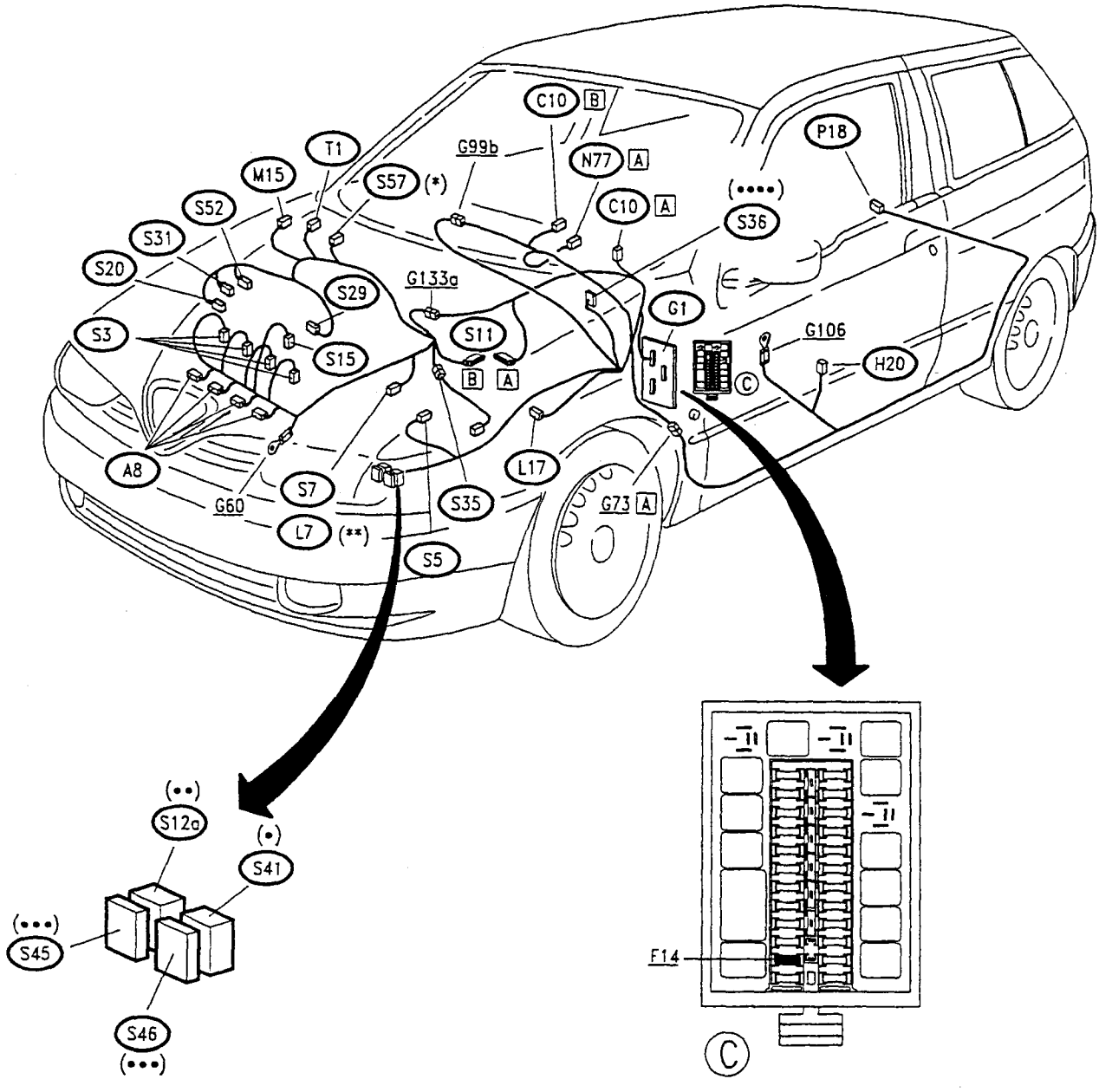


Connector for ALFA TESTER (Motronic)	T1



(*) only in engines 1.8 and 2.0

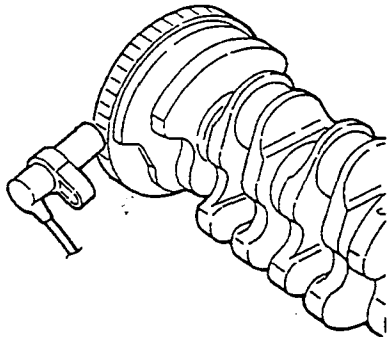
.OCATION OF COMPONENTS



(•) White base
(••) Black base
(••) Light blue fuseholder
(••••) Black fuseholder
(*) Only in engines 1.8 and 2.0
(**) from May '98

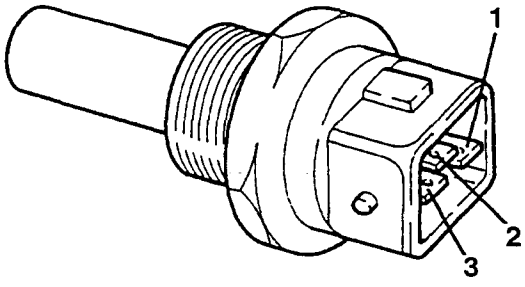
CHECKING COMPONENTS

Rpm sensor (S31)



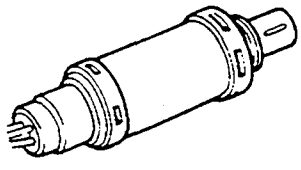
SPECIFICATIONS	
Sensor winding resistance (20 °C)	860 Ω ± 10%

Sender engine temperature (L7)



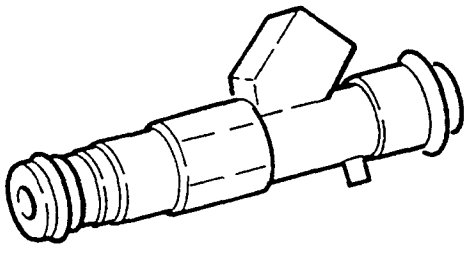
SPECIFICATIONS	
Nominal resistance (at 20 °C) between pins 2 and 3	2300 ÷ 2600 Ω

Sonda Lambda (S35)



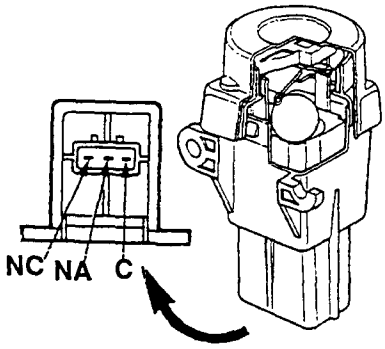
SPECIFICATIONS	
Heating resistance	9 ± 0.5 Ω

Injectors (S3)



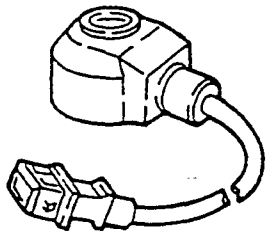
SPECIFICATIONS	
Winding resistance	15.9 ± 0.35 Ω

I. tial switch (H20)



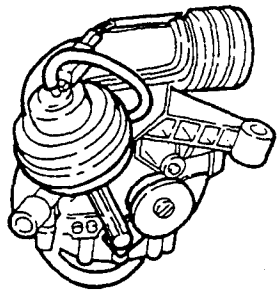
SPECIFICATIONS
Check continuity between pin NC and C: this continuity is interrupted in the event of a crash; the contact is closed again pressing the special button

Pinging sensor (S20)



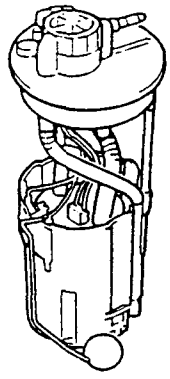
SPECIFICATIONS	
Resonance frequency	> 20 kHz
Impedence	≥ 1 MΩ

Variable geometry solenoid valve (S57)
(Only in engines 1.8 and 2.0)



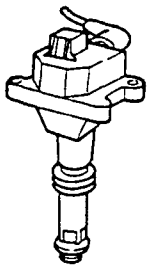
SPECIFICATIONS	
Winding resistance	40 ± 5 Ω

Fuel pump (P18)



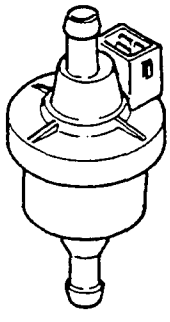
SPECIFICATIONS	
Pressure	3.5 ± 0.2 bar
Rated voltage	12V

Ignition coils (A8)



SPECIFICATIONS	
Primary resistance	0.3 Ω ± 12%
Secondary resistance	7 kΩ ± 12%

Evaporative solenoid valve (M15)



SPECIFICATIONS	
Winding ohmic resistance	26 ± 4 Ω

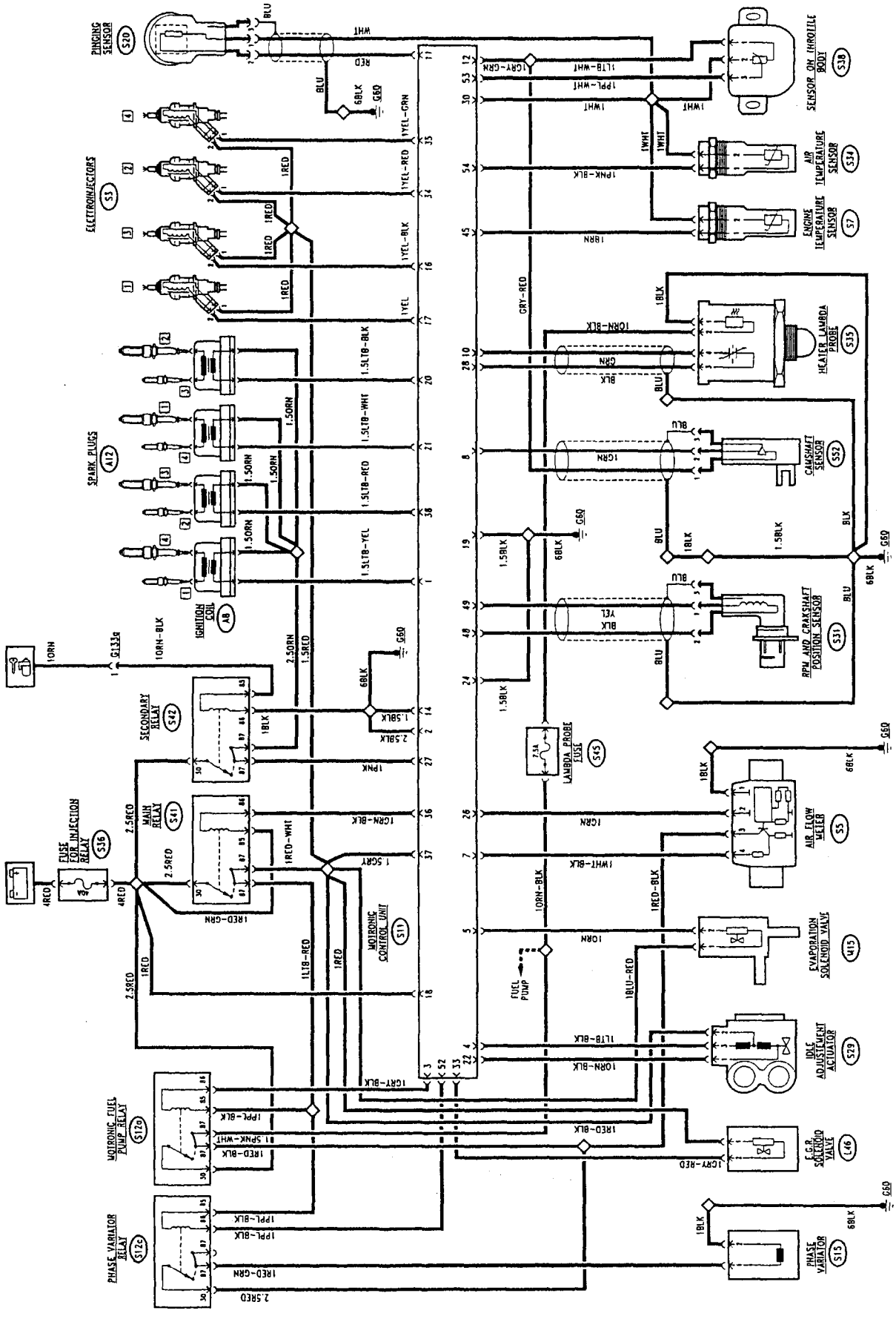
INJECTION/IGNITION SYSTEM
MOTRONIC M2.10.3
- 2.0 T.SPARK 16v Engine -

INDEX

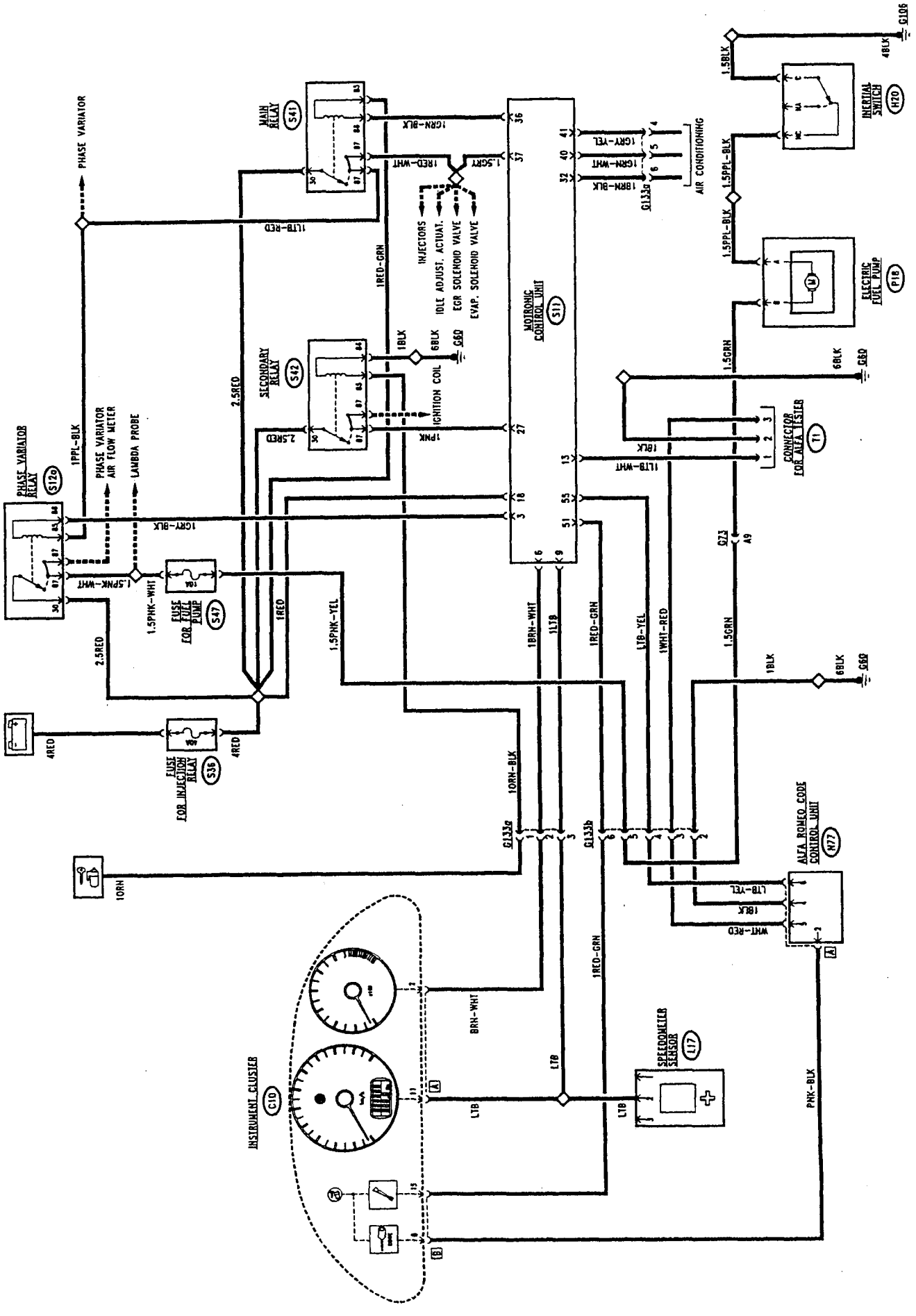
WIRING DIAGRAM A 36A-2
WIRING DIAGRAM B 36A-3
GENERAL DESCRIPTION 36A-4
FUNCTIONAL DESCRIPTION 36A-7
COMPONENTS AND CONNECTORS 36A-10
LOCATION OF COMPONENETS 36A-18
FAULT-FINDING 36A-19
CHECKING COMPONENTS 36A-20

WARNING
Only up to chassis no. ...

WIRING DIAGRAM A



WIRING DIAGRAM B



GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions.

This is the M 2.10.3 version of the proven and reliable BOSCH MOTRONIC system.
Compared with the previous versions this new M 2.10.3 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions.

As a result of the use of new sensors and revision of the control programmes, the system makes it possible to achieve considerable improvements in terms of consumption and emission levels and vehicle handling.

Another feature of this system is self-adaptation, i.e. the capability to recognise the changes that take place in the engine and to compensate them, according to functions which mainly correct:

- the mixture titration;
- the caburetion parameters according to the command of the evaporative solenoid valve;
- an adaptive programme for idle speed control.

FUNCTIONS OF THE SYSTEM

Sequential and timed injection (S.E.F.I.)

With this control unit, fuel injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds by the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimum point of injection, calculated by the control unit according to special maps depending on the load, speed and temperature of the engine.
NOTE: the instant considered in the design of the maps is that of the start of injection.

Static ignition

An electronic ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences; lastly it reduces the number of high voltage cables and connectors.
Static ignition takes place through two coils, according to the so-called "lost spark" logic: this solution exploits the different pressures and environments existi contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas.
In a 4-cylinder in line engine, the paired cylinders are 1/4 and 2/3.

The solution adopted for this engine (T.SPARK and 16 valves) has required the adoption of a larger "central" spark plug and a smaller "side" spark plug.
Each of the four coils supplies the small spark plug of the cylinder below and simultaneously the large one of the paired cylinder.

NOTE: This way it is impossible to invert the spark plug cables during servicing operations.

Metering the air flow rate

The newly designed air flow meter adopted is of the "heated film" type; the operating principle is based on a heated plate inserted in the intake manifold.
The film plate is kept at a constant temperature (appr. 120°C) by a heating resistance placed in contact with it.
The mass of air flowing through the manifold tends to withdraw heat from the plate: therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.

N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure, etc.)
This air flow meter does not have a built-in intake air temperature sensor. This sensor is separate and to be found just downstream of the air-flow meter itself.

Cylinder detection

Following the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence.
The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.

Fuel pump

The complex control logic of the fuel pump carried out by the control unit (mainly based on the rpm signal) immediately cuts off the supply to the pump as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.

In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously. This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents in which the engine does not stop immediately.

Timing variator

This T.SPARK 16 valve engine is fitted with an electromechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts intake timing (advance) in such a way that a larger amount of air is taken in. This device is activated by the control unit only after exceeding a determinate rpm and engine load to avoid adversely affecting correct operation of the engine at low speeds.

Percentage of exhaust gas recirculation

Nox (nitric oxide) is developed at high temperatures in the combustion chambers.
To reduce these emissions an E.G.R. (Exhaust Gas Recirculation) system is adopted which by recirculating part of the exhaust gases, lowers the temperature, thus the Nox produced, in the combustion chambers. In fact, part of the exhaust gas is withdrawn through the special E.G.R. Valve and re-admitted to the intake box where it is mixed with the intaken air and burnt again in the engine. The E.G.R. valve is modulated by a solenoid valve controlled by the injection control unit and, as a result of the type of control, in addition to reducing the amount of Nox, consumption levels are also reduced.

The percentage of exhaust gas to be returned to the engine is established by the control unit taking account of a specific characteristic curve which depends on the load, speed and temperature of the engine.

OPERATING LOGIC

– Identification of the "operating point":

the "point of operation of the engine" is located mainly through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

– Adjustment of injection times (quantity of fuel): the control unit controls the injectors very quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine. Injection is "sequential", i.e. the injectors are opened in correspondence of the exhaust stroke of the cylinder concerned.

– Ignition adjustment (calculation of advances):

the control unit calculates the advance on the basis of the engine load (rpm and air flow); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

– Cold starting control:

during cold starts the control unit uses special advance values and injection times.

When a determinate temperature/rpm ratio is reached, the control unit resumes normal operating conditions.

– Control of enrichment during acceleration:

upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

– Fuel cut-off during deceleration:

with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The cut-off threshold value varies according to the temperature of the engine and the speed of the car.

– Control of idle speed:

the adjustment of the engine idle speed is carried out through the special actuator which acts on the throttle by- pass. This also acts as a regulator for engaging the different services (eg. air conditioner compressor): in fact, when the throttle is closed, the actuator adjusts the by-pass compensating the load required by the services in order to ensure that idle speed is as constant as possible.

– Maximum Rpm limiting:

above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

– Combustion control -lambda probe-:

the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.

The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture). The electric signal sent by the probe to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
The signal from the lambda probe is processed inside the control unit by a special integrator which prevents sudden "oscillations".
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).
Through this probe it is therefore possible to adjust engine carburetion precisely. Among other items, this makes it possible to meet emission limit regulations.

– **Timing variator control:**

The electro-mechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts the intake timing according to the load and rpm of the engine. This device is activated by the control unit at higher engine operating speeds (above 1,600 rpm and with load above 30%).

– **E.G.R. valve control**

The percentage of exhaust gas to be returned to the engine is determined by the control unit taking account of a specific characteristic curve which depends on the engine load and speed: recirculation is only activated when the engine speed is between 2500 and 4000 rpm., also in relation to the temperature of the engine (higher recirculation percentage with high temperatures).

– **Knocking control:**

Through a knock sensor the control unit is informed if any pinging or "knocking" occurs and it corrects the spark advance "delaying" it accordingly; a further correction also takes account of the air temperature, in fact, when the temperature of the intake air is high, pinging is more accentuated.
N.B. The intaken air temperature sensor to be found just downstream of the air-flow meter, is not used to calculate the engine load but to control the knocking parameters.

– **Fuel vapour recovery:**

the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

– **Connection with the air conditioner compressor:**

the control unit is connected with the air conditioner compressor and it cuts in the compressor in relation to operation of the engine. As this service absorbs a considerable amount of power, the control unit:

- adapts the engine idle speed each time the compressor cuts in; if the engine speed falls below 700 rpm, the compressor is turned off;
- when there is the need for high power (high speed - over 6000 rpm - or full load - max. throttle opening), it momentaneously cuts out the compressor
- when the engine is being started the compressor is disabled until normal operating conditions have been reached.

– **Connection with ALFA ROMEO CODE system:**

on cars fitted with the ALFA ROMEO CODE system, as soon as the Motronic control unit receives the signal that the key has been turned to MARCIA, it "asks" the above-mentioned system for consent start the engine: this consent is given only if the ALFA ROMEO CODE control unit recognizes the code of the key engaged in the ignition switch as correct. This dialogue between the two control units takes place on diagnosis line K already used for the Alfa Romeo Tester.

COMPONENTS

The control unit receives the signals leading from the sensors which "read" the operating conditions of the engine according to a logic stored inside the control unit in "maps" which correlate the various parameters, operating the actuators accordingly to keep the engine at maximum yield and regularity.

The sensors are:

- engine temperature sensor (**S7**);
- air temperature sensor (**S34**);
- sensor on throttle body (**S38**);
- rpm sensor (**S31**);
- cam angle sensor (**S52**);
- heated lambda sensor (**S35**)
- air-flow meter (**S5**);
- pinging sensor (**S20**);

The actuators are:

- injectors (**S3**);
- ignition coils (**A8**);
- fuel pump (**P18**);
- idle speed adjustment actuator (**S29**);
- vapour recovery solenoid valve (**M15**) ;
- E.G.R. solenoid valve (**L46**);

– timing variator (**S15**)

The control unit is also connected with:

– the climate control system,

– ALFA ROMEO CODE control unit (**N77**)

– the instrument cluster (**C10**) to which it supplies the signal for the rev counter and for turning on the warning light,

– sensor **L17** from which it receives the car speed signal.

The system is completed by four relays: the first three - main relay (**S41**), secondary relay **S42** and fuel pump relay **S12a** operate the fuel pump, the injectors, coils and the other components of the system, while the fourth - the timing variator relay - **S12c** - supplies the timing variator.
The entire system is supplied by the line of fuse **S36**, while special fuses protect the pump (**S47**), and the resistance of the lambda sensor (**S45**).
Lastly, there is an earth point (**G60**) on the engine.
Connector **T1** enables connection with the ALFA ROMEO Tester: this is located in an easily accessible position in the engine compartment.

FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and adjusts the entire electronic ignition and injection system;
all the system supplies are protected by fuse **S36** (40A).

The control unit is supplied at pin 18 directly by the battery through fuse **S36**. At pin 37 it receives the supply from the main relay **S41**, while at pin 27 it receives the "key- operated" supply from the secondary relay **S42**.

Pins 2, 14, 19 and 24 are earthed and serve as reference respectively for the ignition, the injectors, electronic screening and the final power stages.

Two relays control the entire system:

The main relay **S41**, acts as supply relay for the whole system; it is energized by a control signal - earth - leading from pin 36 of the control unit and consequently sends the supply (12V) to pin 37 of the control unit itself, to the fuel pump relay **S12a**, to the timing variator relay **S12c**, to the vapour recovery solenoid valve **M15**, to the idle speed actuator **S29**, to the EGR solenoid valve **L46** and lastly to the injectors **S3**.

The secondary relay **S42**, energized by the "key-operated" supply, supplies the control unit at pin 27 and the primary windings of the coils **A8**.

The fuel pump relay **S12a**, supplied by the main relay **S41**, is energized by a control signal - earth - leading from pin 3 of the control unit **S11**. Consequently, the relay supplies the resistance of the lambda probe **S35**, the relay of the timing variator **S12c** and of course the fuel pump **P18**; this supply line is protected by a special fuse **S47** (10A).

The earth reaches the pump **P18** via the inertial switch **H20** which cuts off the circuit in the event of impact.

The control unit **S11** receives numerous signals from the different sensors, thereby keeping all the engine operating parameters under control.

Through a frequency signal sent to pins 48 and 49 of the control unit, the rpm sensor **S31** supplies information about the engine rpm; the two above-mentioned signals are very low in intensity and are therefore suitably screened.

The sensor is inductive and detects the number of revolutions of the engine through the change in a magnetic field produced by the passage of the teeth of a "phonic" wheel (60-2 teeth) fitted on the fluwheel.

The cam angle sensor **S52** (timing sensor), supplied at 12 V at pin 1, and connected to earth at pin 3, sends a signal in frequency from pin 2 corresponding to the phase to pin 8 of the control unit itself

The sensor comprises a Hall effect device due to which the voltage signal sent to the control unit "lowers" abruptly when the hollow machined on the camshaft passes in front of the sensor.

The heated lambda sensor **S35** supplies the control unit information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin 28 of the control unit, while pin 10 supplies the reference earth; these two signals are very low in intensity and are therefore suitably screened.
The sensor is heated by a resistance to make sure that it operates correctly also when the engine is cold; the resistance is supplied by the fuel pump relay **S12a** and it is protected by a specific fuse **S45** (7.5A).

The throttle body sensor **S38**, is supplied by the control unit from pins 12 and 30 and through a potentiometer it sends a signal to pin 53 which is proportionate with the degree of opening of the throttle itself.

The engine temperature sensor **S7**, connected to the electronic earth at pin 30, supplies a signal to pin 45 proportionate with the temperature of the engine coolant, detected with an NTC material (resistance that lowers with the temperature).

The knock sensor **S20**, through a frequency signal sent to pin 11 of the control unit, supplies information about the knocking conditions, while an electronic earth leads from pin 30; these two signals are very low in intensity and are therefore suitably screened.

The sensor comprises a piezoelectric plate which detects the vibrations produced when the engine is running, exploiting a particular characteristic of piezoelectric materials which generate an output voltage

when subjected to mechanical stresses; this voltage is filtered and analysed by the control unit which corrects the ignition parameters accordingly.

The intake air temperature sensor **S34**, connected to the electronic earth at pin 30, supplies a signal to pin 54 which is proportionate with the temperature of the air entering the intake box, detected by an NTC material (resistanmce that lowers with the temperature).

The air flow meter **S5**, is supplied by relay **S12e**: from pin 26 of the control unit it receives the reference earth, while it sends a signal proportionate with the air flow to pin 7.
The air flow meter is of the "heated film" type: a diaphragm is interposed in a measurement channel, through which the intake air flows: this diaphragm is kept at a constant temperature by a heating resistance; the mass of air that crosses the measurement channel tends to withdraw heat from the diaphragm, therefore, in order to maintain its temperature constant, a certain amount of current must flow through the resistance: this current, appropriately measured, is proportionate with the mass of air flowing in the channel.
On the basis of the signals received from the sensors and of the calculations carried out, the control unit **S11** controls the opening of the single injectors **S3** through special signals - of the duty-cycle type - pins 17 (cyl. 1), 34 (cyl. 2), 16 (cyl. 3) and 35 (cyl. 4). The injectors receive consent (12V) to open from the main relay **S41**.

The static ignition system is controlled by the control unit directly which automatically adjusts the advance. N.B. the power modules which generate the high voltage pulses are located inside the control unit. The control signals (earth) for the primary windings of the coils **A8** lead from the control unit, while the secondary winding sends the pulse to the spark plugs **A12**: from pins 1 and 21 for cylinders 1- 4 and from pins 18 and 30 for cylinders 2-3.
The primary windings of the coils **A8** are supplied at 12 V ("key-operated") by relay **S42**.

The power modules inside the control unit are connected to earth via pin 2.

The idle speed adjustment actuator **S29** forms a by-pass line for the flow of air; this comprises two windings: one opens and the other closes a valve that adjusts the gap of the by- pass section; a safety spring establishes a mean opening value in the event of a fault to the device; the actuator is supplied by the main relay **S41**, and controlled by the control unit through the duty-cycle signals of pins 22 (closing) and 4 (opening).

The vapour recovery solenoid valve **M15** allows the passage of the fuel vapours towards the engine intake where they are added to the mixture entering the combustion chamber; this valve, supplied by the main relay **S41**, is opened by the control unit when the engine is under load through a duty cycle signal from pin 5.

The E.G.R. solenoid valve **L46**, controlled by the control unit, operates the actual E.G.R. valve modulating its opening: the latter is a vacuum-operated diaphragm valve: the electropneumatic valve works by changing this vacuum which is withdrawn from the same "takeoff" used for the servobrake. The solenoid valve is controlled from pin 33 of the control unit while it is supplied at 12 V by main relay **S41**.

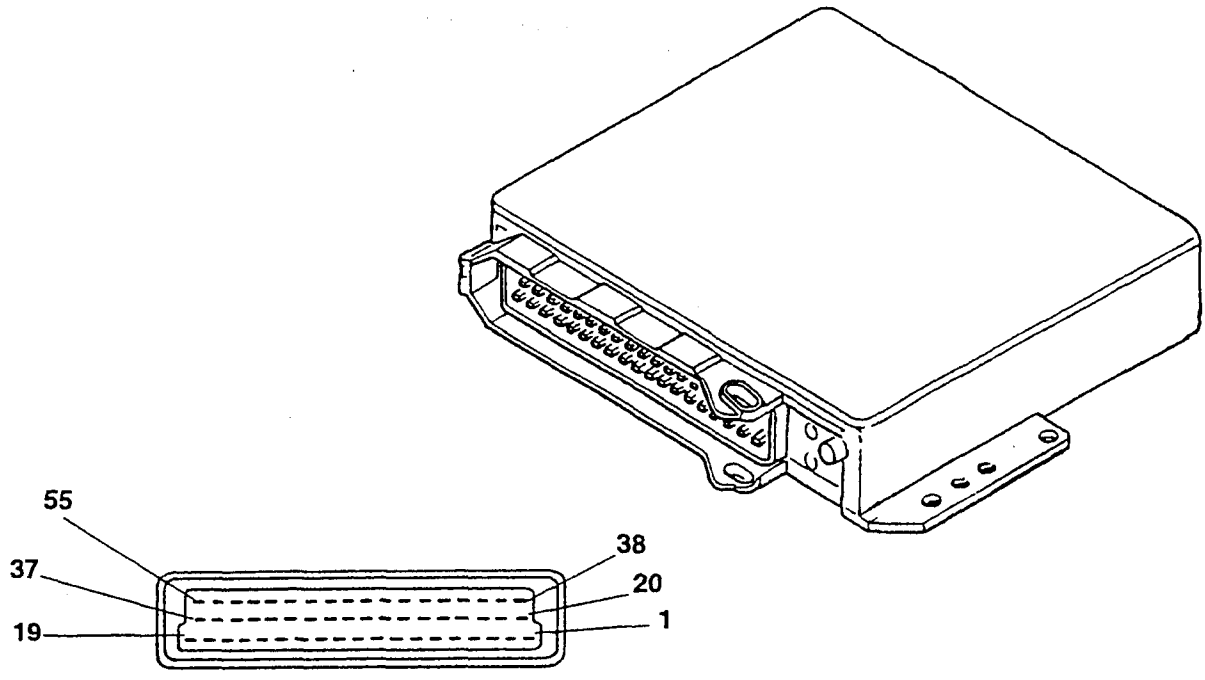
The timing variator **S15** mechanically controls timing advance at the intake; it is operated by the corresponding relay **S12c**: this relay is supplied by relays **S12a** and **S41** and it is energized via a negative signal from the control unit, pin 52, thus supplying the timing variator **S15**: this signal operates the actuator which controls the flow of oil in the hydraulic unit of the device that adjusts camshaft rotation.

The tachometric signal (car speed) reaches the control unit at pin 9 via sensor **L17**; while from pin 6 the control unit sends a "pulse" signal to the cluster which is proportionate with the number of revolutions of the engine; the signal for the warning light on the cluster **C10** leads from pin 51.

The control unit **S11** is connected with the air conditioning system through pins 32, 40 and 41.
This makes it possible to adapt the engine idle speed to the increased power each time the compressor cuts in, or to cut it out in the case of high speed or engine loads. For further details see the "Climate control" section.

The control unit **S11** is connected by pin 55 with the ALFA ROMEO CODE control unit **N77** via the diagnosis line K; if the ALFA ROMEO CODE system does not recognise a correct "key code" it will not enable the Motronic control unit to start the engine (for further details see the section "ALFA ROMEO CODE).

The control unit possesses a self-diagnosis system which can be used through connection to the ALFA ROMEO Tester at connector **T1**; the tester receives the fault signals from the control unit through the diagnosis lines L - pin 13 -and K - pin 55 -, while the earth leads from **G60** (line K is also used by the ALFA ROMEO CODE control unit).

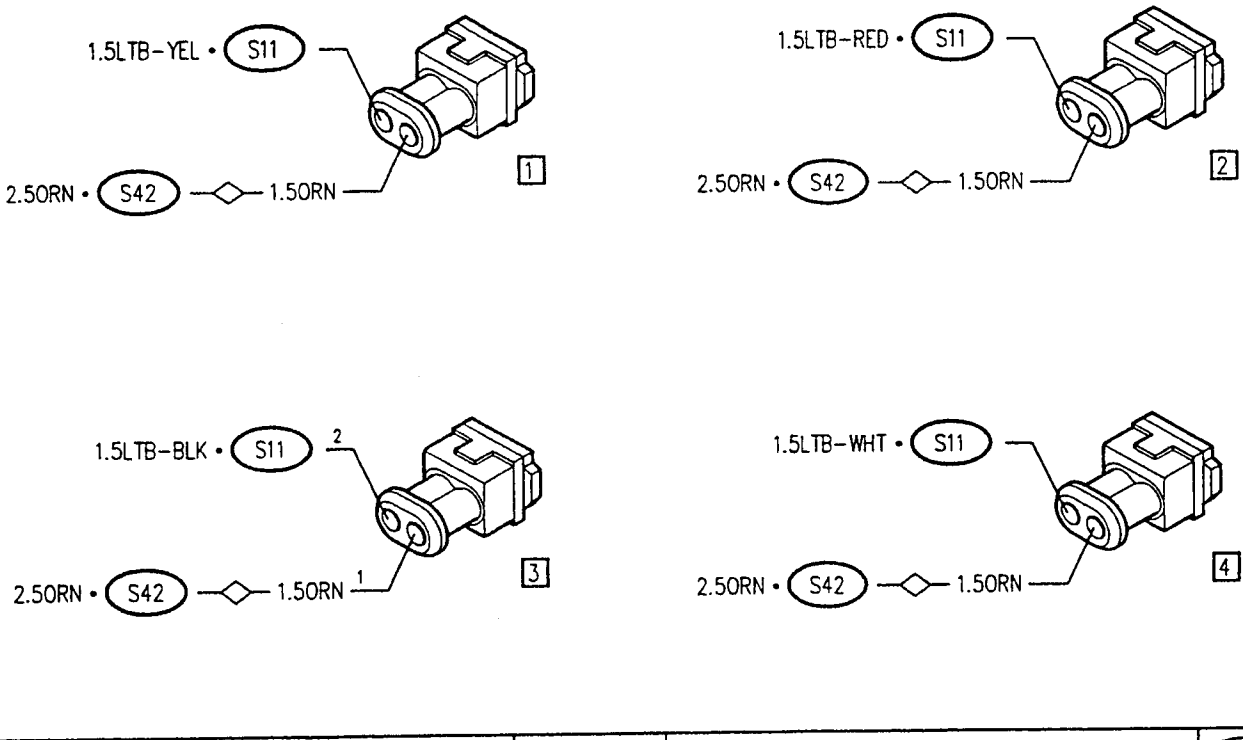


CONTROL UNIT PIN-OUTS

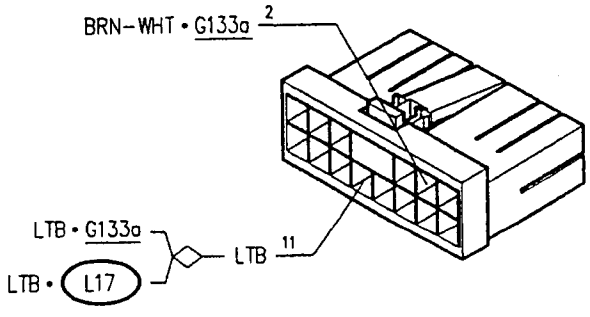
1. Ignition coil control - cyl. 1 and 4 -
2. Earth for ignition
3. Fuel pump relay control
4. Idle actuator control - opening
5. Evaporative solenoid valve control
6. Rev counter signal
7. Air flow meter signal
8. Timing signal
9. Car speed signal
10. Lambda probe signal
11. Knock sensor signal
12. Stabilized voltage (5V) for sensors
13. Diagnosis line L
14. Earth for injectors
15. N.C.
16. Cyl. 3 injector
17. Cyl. 1 injector
18. Direct supply
19. Electronic screening earth
20. Ignition coil control - cyl. 3 and 2
21. Ignition coil control - cyl. 4 and 1
22. Idle speed actuator control - closing
23. N.C.
24. Earth for final stages
25. N.C.
26. Air-flow meter earth
27. "Key-operated" supply, from secondary relay
28. Lambda probe earth
29. N.C.
30. Electronic earth for sensors
31. N.C.
32. Conditioner compressor relay control
33. E.G.R. solenoid valve control
34. Injector cyl. 2
35. Injector cyl. 4
36. Main relay control
37. Supply from main relay
38. Cyl. 2 and 3 ignition coil control
39. N.C.
40. Compressor engagement request
41. Conditioning system engagement request
42. N.C.
43. N.C.
44. N.C.
45. Engine temperature signal
46. N.C.
47. N.C.
48. Rpm sensor signal
49. Rpm sensor signal
50. N.C.
51. Signal for warning light on instrument cluster
52. Timing variator control
53. Throttle position signal
54. Intaken air temperature signal
55. Diagnosis line K (via ALFA ROMEO CODE control unit)

COMPONENTS AND CONNECTORS

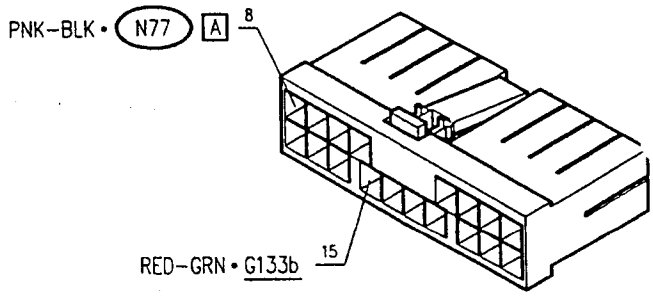
Ignition coil — A8



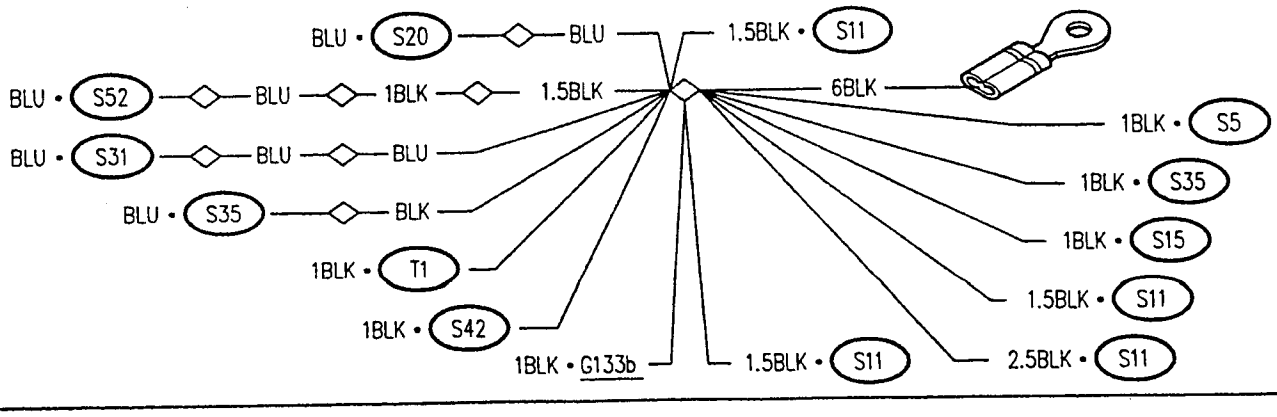
Instrument cluster — C10 A



Instrument cluster — C10 B

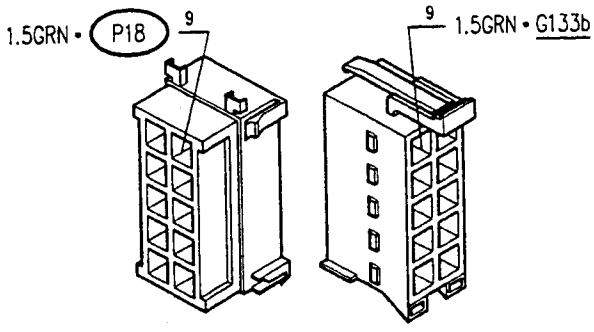


Injection wiring earth — G60

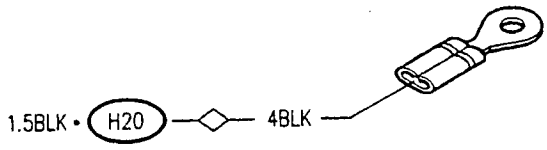


COMPONENTS AND CONNECTORS (contd.)

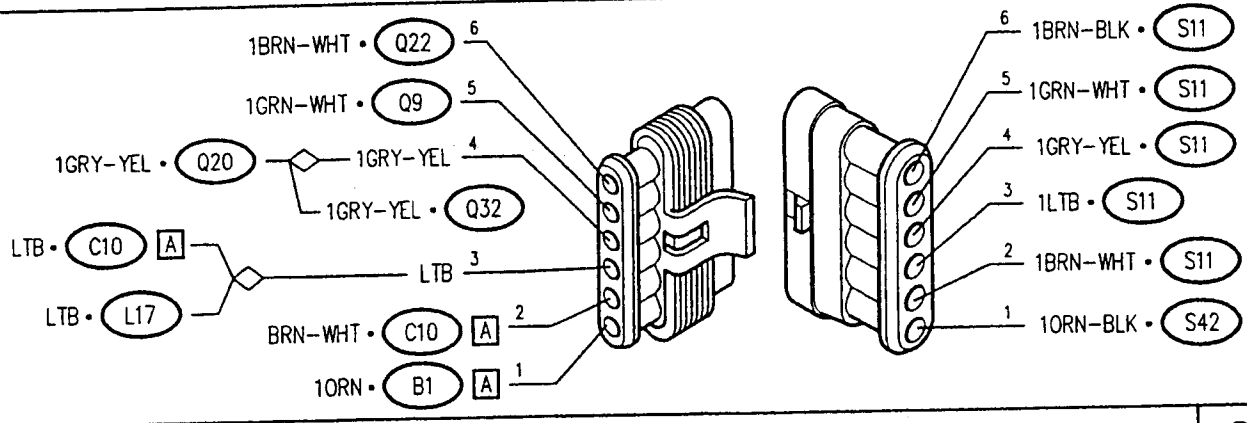
Rear services connector	G73 A



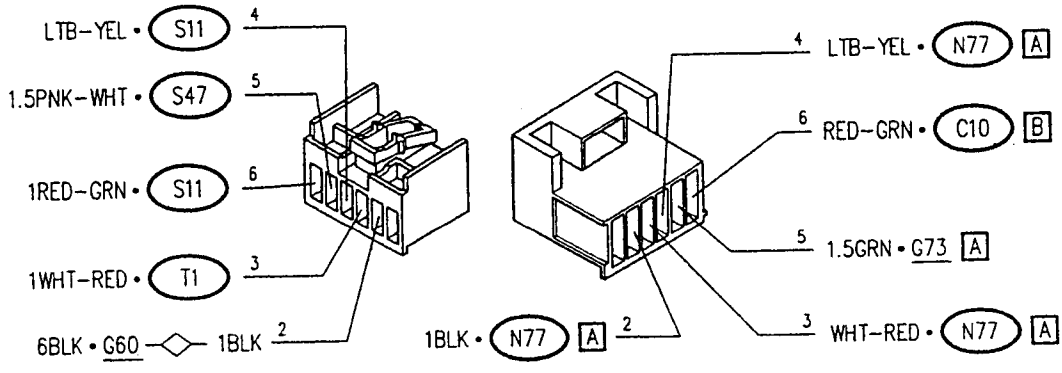
Seat crossmember earth	G106



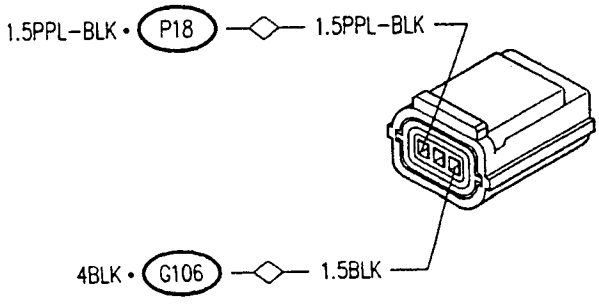
Electr. injection wiring connector A	G113a



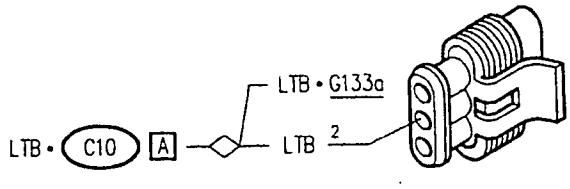
Electr. injection wiring connector B	G133b



Inertial switch	H20

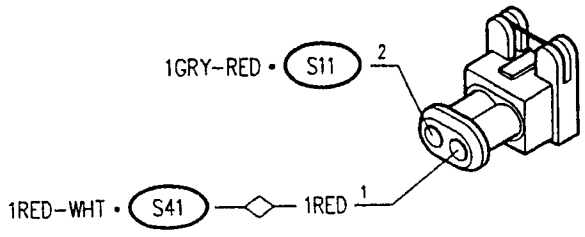


Tachometric sensor	L17

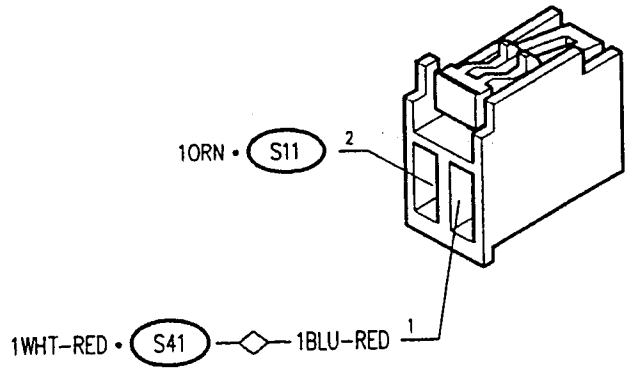


COMPONENTS AND CONNECTORS (contd.)

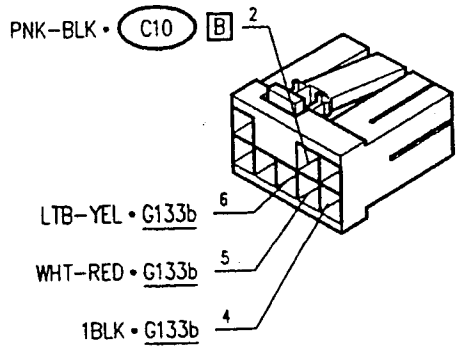
E.G.R. control solenoid valve	L46



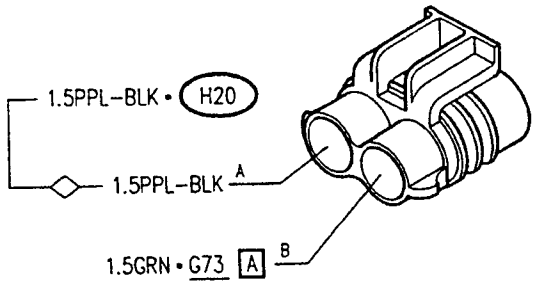
Evaporative solenoid valve	M15



ALFA ROMEO CODE control unit	N77 A

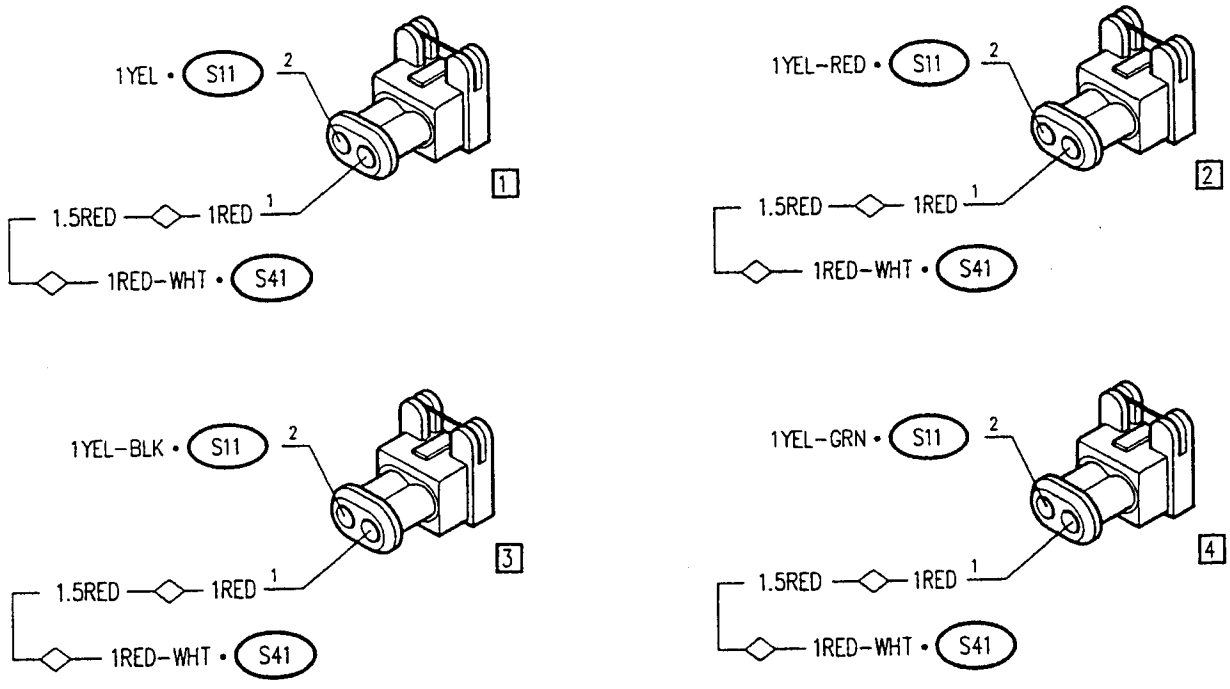


Electric fuel pump	P18

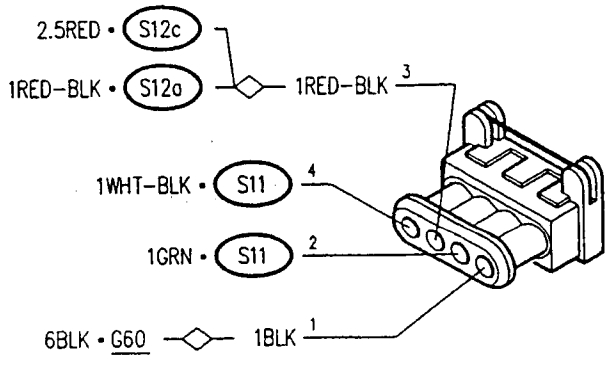


COMPONENTS AND CONNECTORS (contd.)

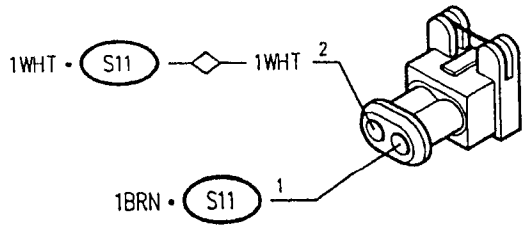
Injector — S3



Air-flow meter — S5

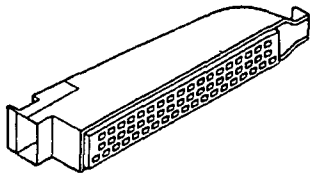


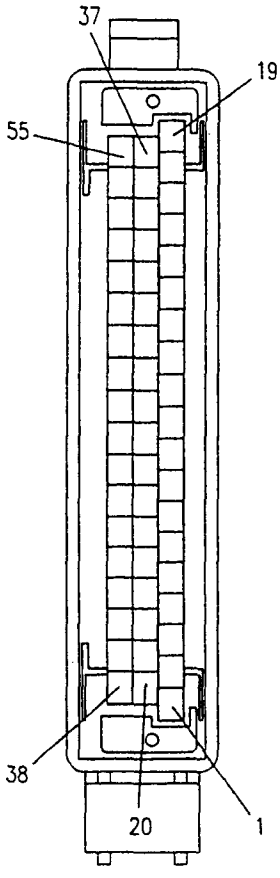
Engine temperature sensor — S7



COMPONENTS AND CONNECTORS (contd.)

Motronic control unit	S11



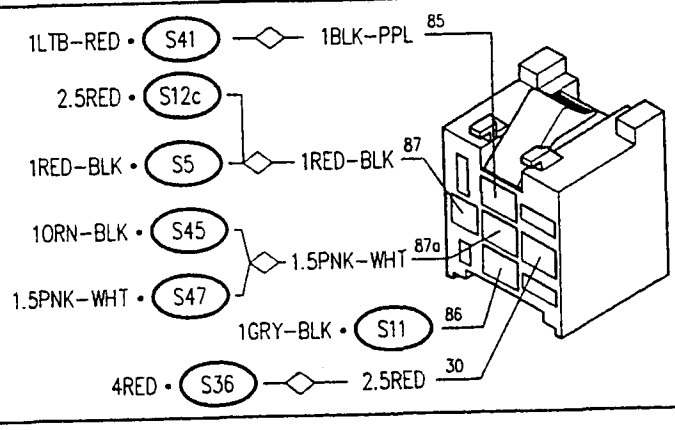


1 — 1.5LTB-YEL • A8 [1]
2 — 2.5BLK — 6BLK • G60
3 — 1GRY-BLK • S12a
4 — 1LTB-BLK • S29
5 — 1ORN • M15
6 — 1BRN-WHT • G133a
7 — 1WHT-BLK • S5
8 — 1GRN • S52
9 — 1LTB • G133a
10 — GRN • S35
11 — RED • S20
12 — 1GRY-GRN — 1LTB-WHT • S38; GRY-RED • S52
13 — 1LTB-WHT • T1
14 — 1.5BLK — 6BLK • G60
16 — 1YEL-BLK • S3 [3]
17 — 1YEL • S3 [1]
18 — 1RED — 4RED • S36
19 — 1.5BLK — 6BLK • G60
20 — 1.5LTB-BLK • A8 [3]
21 — 1.5LTB-WHT • A8 [4]
22 — 1ORN-BLK • S29
24 — 1.5BLK — 6BLK • G60
26 — 1GRN • S5
27 — 1PNK • S42
28 — BLK • S35
30 — 1WHT — 1WHT • S34; 1WHT • S38; 1WHT • S7; WHT • S20

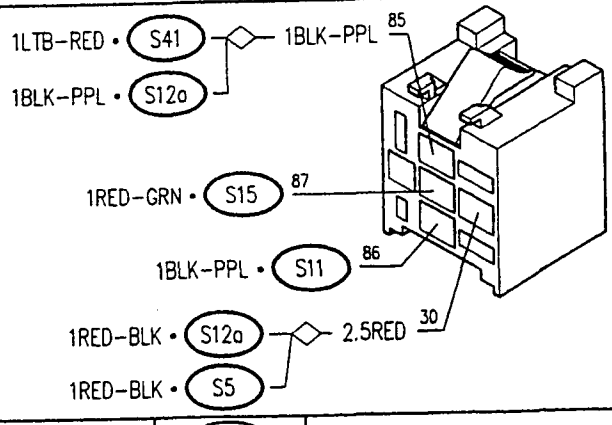
32 — 1BRN-BLK • G133a
33 — 1GRY-RED • L46
34 — 1YEL-RED • S3 [2]
35 — 1YEL-GRN • S3 [4]
36 — 1GRN-BLK • S41
37 — 1.5GRY — 1RED-WHT • S41
38 — 1.5LTB-RED • A8 [2]
40 — 1GRN-WHT • G133a
41 — 1GRY-YEL • G133a
45 — 1BRN • S7
48 — BLK • S31
49 — YEL • S31
51 — 1RED-GRN • G133b
52 — 1BLK-PPL • S12c
53 — 1PPL-WHT • S38
54 — 1PNK-BLK • S34
55 — 1WHT-GRN • G133b

COMPONENTS AND CONNECTORS (contd.)

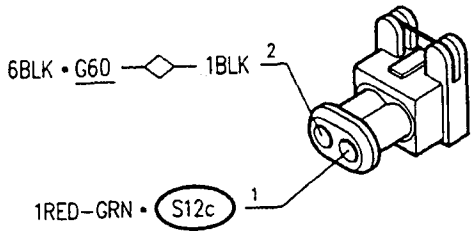
Fuel pump Motronic relay — S12a



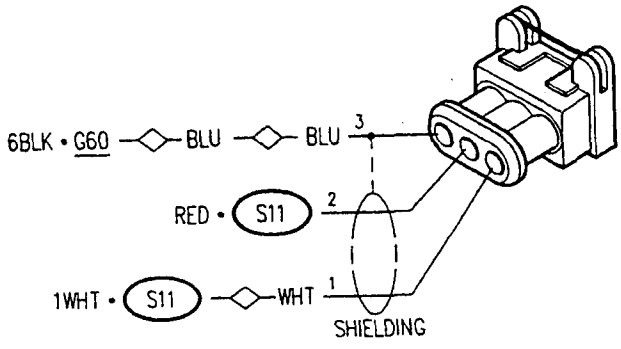
Timing variator relay — S12c



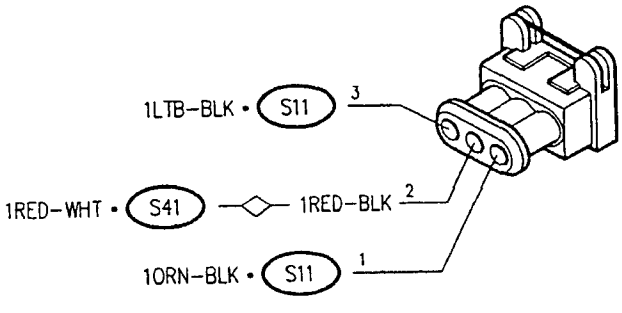
Timing variator — S15



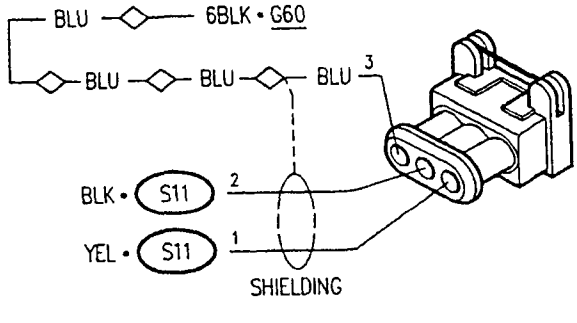
Knocking sensor — S20



Idle adjustment actuator — S29

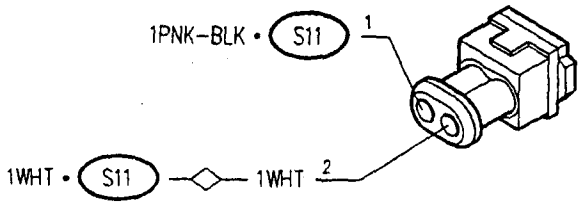


Rpm and crankshaft position sensor — S31

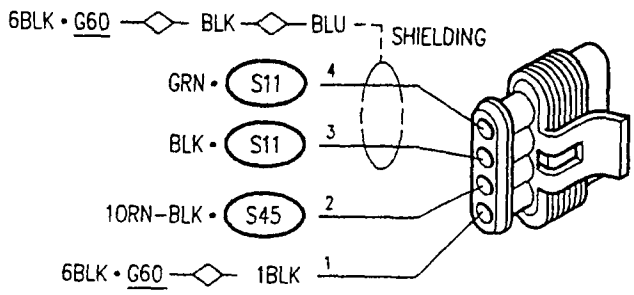


COMPONENTS AND CONNECTORS (contd.)

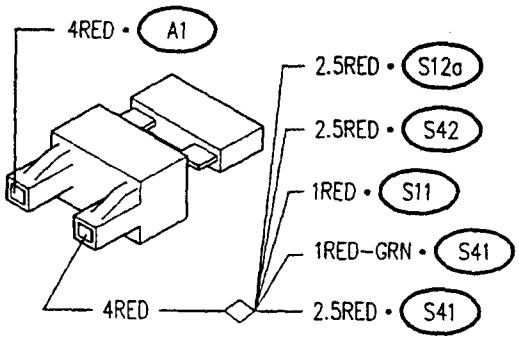
Air temperature sensor — S34



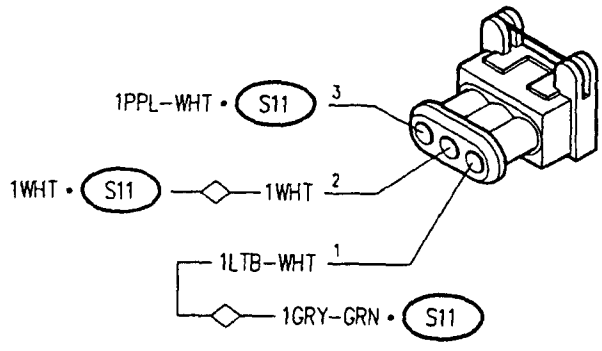
Heated lambda probe — S35



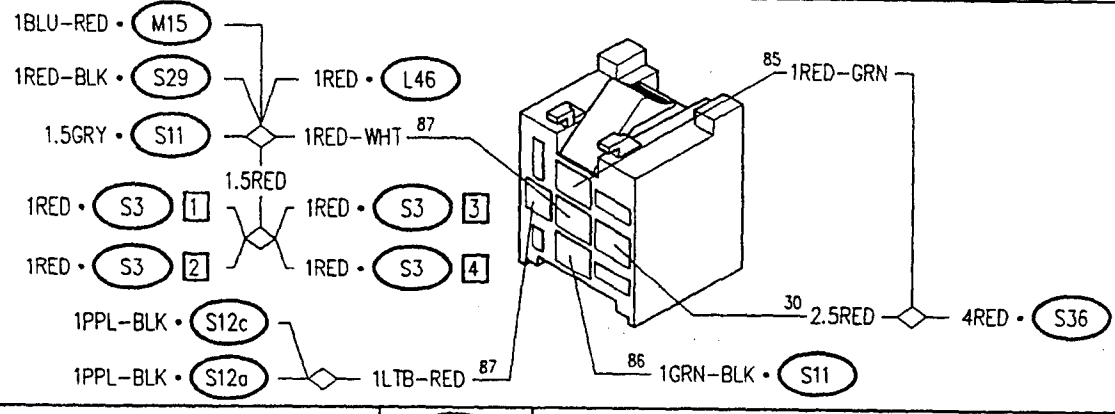
Injection wander fuse — S36



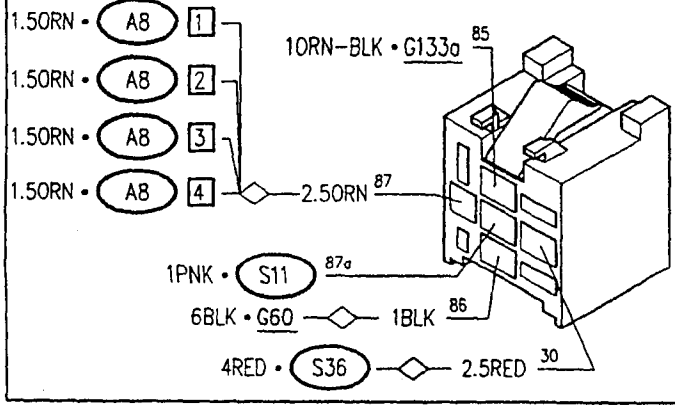
Sensor on throttle body — S38



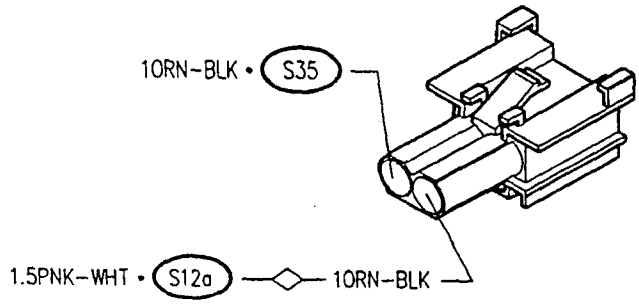
Main relay — S41



Secondary relay — S42

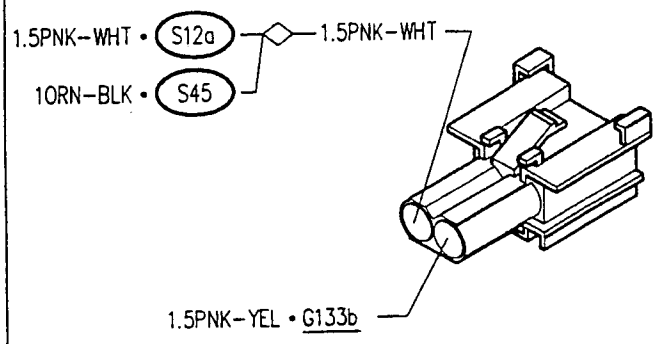


Lambda sensor wander fuse — S45

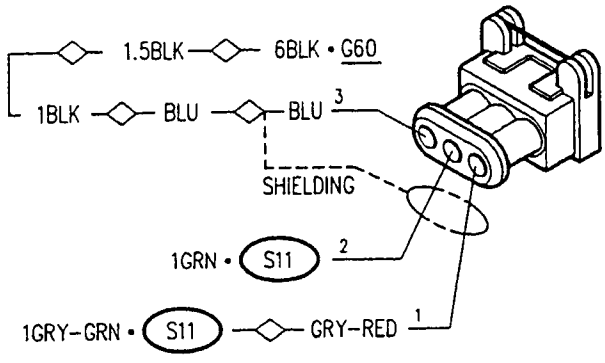


COMPONENTS AND CONNECTORS (contd.)

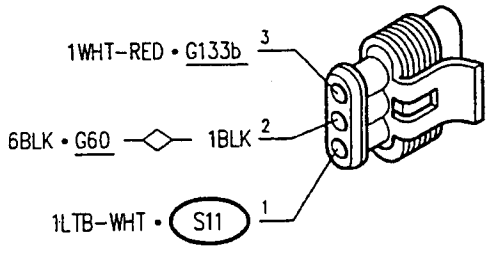
Fuel pump wander fuse — S47



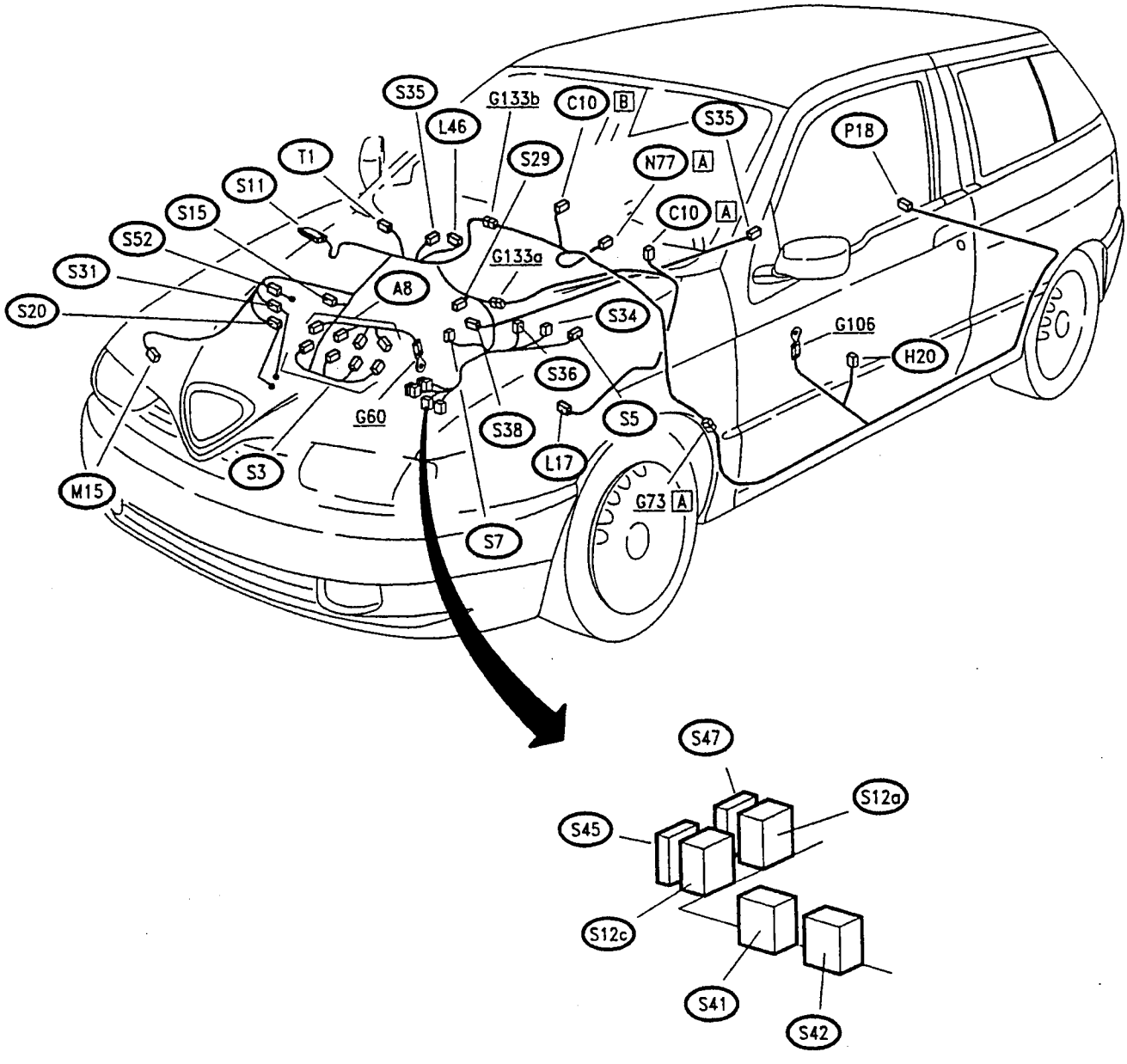
Cam angle sensor — S52



Connector for ALFA TESTER (Motronic) — T1



LOCATION OF COMPONENTS



FAULT-FINDING

the control unit possesses a **self-diagnosis system**, which continuously monitors the plausibility of the signals from the various sensors and compares them with the limits allowed: if these limits are exceeded, the system detects a fault and turns on the corresponding warning light on the instrument cluster.

The warning light turns on when the ignition key is at MARCIA and stays on until the engine is started, it then turns off. If it stays on, this means that a fault has been memorised.

For certain parameters, the control unit replaces the abnormal values with suitable ones so that the car can "limp" to a point of the Service Network.

These "recovery" values depend on the other correct signals and they are defined individually by the control unit operating logic.

The self-diagnosis system also enables quick and effective location of faults connecting with the ALFA ROMEO Tester, through which all the errors memorised can be displayed. It is also possible to check the operating parameters recorded by the control unit and operate the single actuators to check whether they are working properly.

Diagnosis using the ALFA TESTER

N.B. Before carrying out diagnosis with the Tester, carry out the preliminary check described below (**TEST A**).

The connection between the Tester and the electronic control unit must be carried out as follows:

1. Power the Tester either through the cigar lighter socket or connecting it directly to the battery using the cable provided.
2. Connect the Tester socket to that of the control unit (the socket is to be found near the control unit itself).

The information the instrument can give comprises:

- display of the parameters;
- display of errors;
- active diagnosis.

Error clearing

Before ending diagnosis the contents of the "permanent" memory should be cleared by the Tester in the "Active Diagnosis" function.

In the failure to do so, the next time the Tester is connected, errors that have already been examined will be signalled.

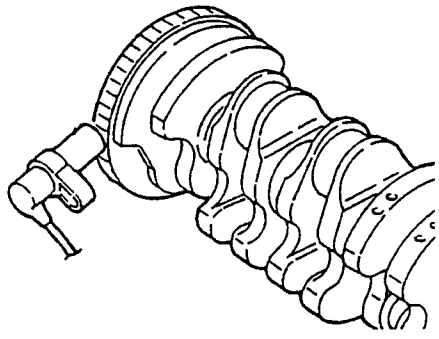
The contents of the "permanent" memory can be cleared as follows:

- using the Tester in Active Diagnosis
- if the cause that determined the error is no longer present and the engine has been started 10 times (operating for no less than 20 minutes) with at least 2 minutes between one start and the next.

N.B.:
Disconnecting the control unit from the system the contents of the "permanent" memory are erased.

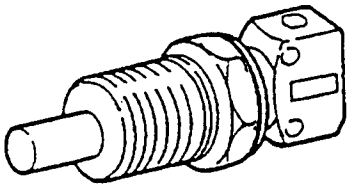
CHECKING COMPONENTS

Rpm sensor (S31)



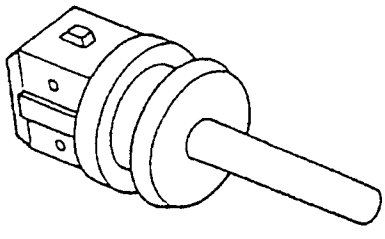
SPECIFICATIONS	
Sensor winding resistance 20 °C	486 ÷ 594 Ω
Gap between sensor and phonic wheel	0.5 ± 1.5 mm

Engine temperature sensor (S7)



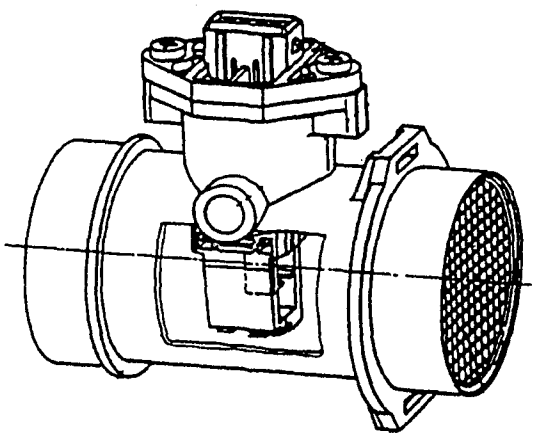
SPECIFICATIONS	
Temperature	Resistance
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

Intake air temperature sensor (S34)

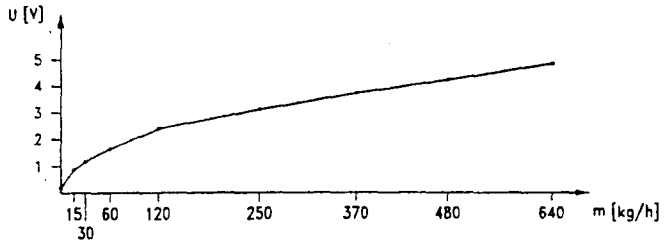


SPECIFICATIONS	
Temperature	Resistance
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

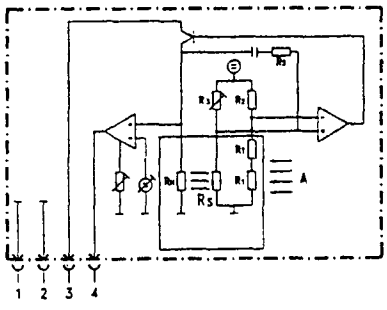
Air-flow meter (S5)



SPECIFICATIONS	
Current that crosses the diaphragm	
flow rate (kg/h)	current (A)
0 640	≤ 0.25 ≤ 0.80

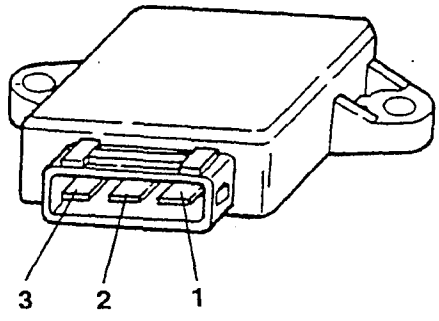


Characteristic curve of sensor
m = flow rate
U = voltage between pins 4 and 2



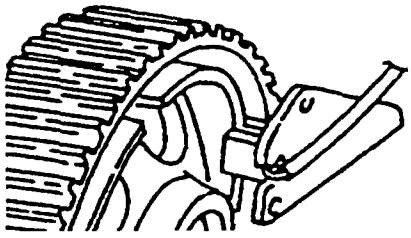
pin 1 - Earth
pin 2 - Reference earth
pin 3 - 12 V supply
pin 4 - Measurement signal
A = air
Rs = hot film sensor

Throttle position sensor (S38)

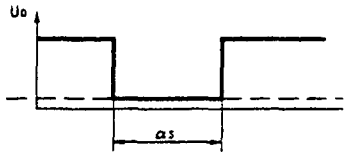


SPECIFICATIONS	
Resistance between terminals:	
1 - 2 (fixed)	≃ 2 kΩ
1 - 3 (throttle closed)	≃ 1 kΩ
1 - 3 (throttle completely open)	≃ 2.7 kΩ

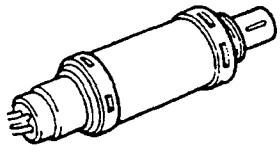
Cam angle sensor (S52)



SPECIFICATIONS
The voltage signal "lowers" abruptly when the tooth machined on the camshaft passes in front of the sensor itself:



Lambda sensor (S35)



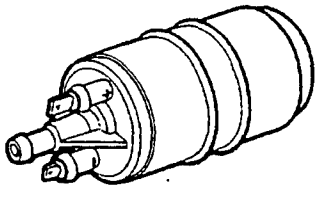
SPECIFICATIONS	
Heating resistance	3 Ω

Injectors (S3)



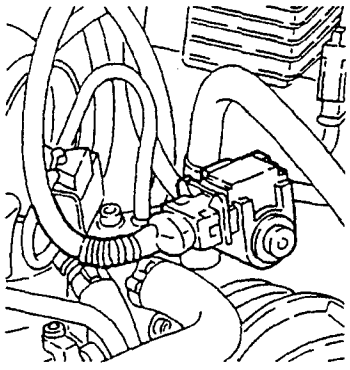
SPECIFICATIONS	
Winding resistance	15.9 ± 0.35 Ω

Fuel pump (P18)



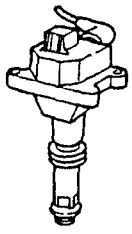
SPECIFICATIONS	
Flow rate	≥120 l/h
Pressure	4 bar
Nominal voltage	12V

Idle adjustment actuator (S29)



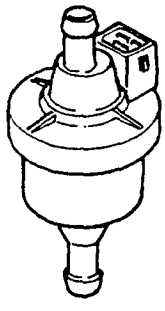
SPECIFICATIONS	
Resistance between terminals:	
1 - 3	~ 33 Ω
1 - 2	~ 17.5 Ω
2 - 3	~ 15.5 Ω

Ignition coil (A8)



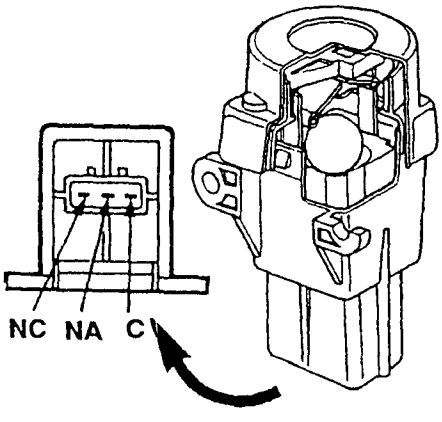
SPECIFICATIONS	
Primary resistance	0.3 Ω ± 12%
Secondary resistance	7 kΩ ± 12%

Evaporative solenoid valve (M15)



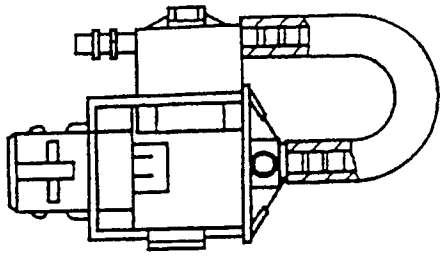
SPECIFICATIONS	
Duty-cycle signal	12 V; 10 Hz
Ohmic resistance of winding	26 ± 4 Ω
When not energised the solenoid valve is normally closed	

Inertial switch (H20)



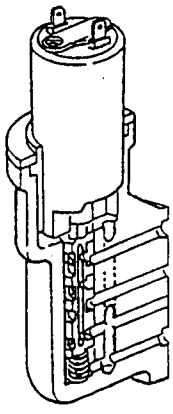
SPECIFICATIONS
Check continuity between pins NC and C: this continuity is cut off in the event of a crash; the contact is closed again pressing the special button

E.G.R solenoid valve (L46)



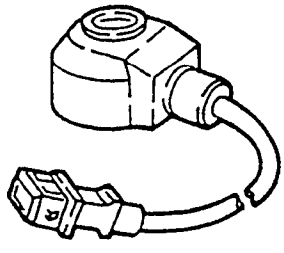
SPECIFICATIONS	
Duty-Cycle signal	12V; 15.3 Hz
Ohmic resistance of winding (20°C)	26.6 ÷ 1.4 Ω

Timing variator (S15)



SPECIFICATIONS	
Resistance between two terminals	~ 10 Ω
Max. absorption at 13.5V	1.34 A

Knock sensor (S20)



SPECIFICATIONS		
Resonance frequency		>20 kHz
Impedence		≥ 1Ω
Vibration allowed	for long times	≤ 80 g
	for short times	≤ 400 g

PRELIMINARY TEST OF BOSCH M2.10 SYSTEM	TEST A

NOTE: Beforehand check that the ALFA ROMEO CODE system is working properly as it may have cut off the supply to the system! (see section "ALFA ROMEO CODE")

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check the intactness of fuses **S36** and **S47**	OK ▶	Carry out **step A2**
	OK ▶	Replace the fuses **S36**: 40A **S47**: 10A
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relays **S41, S42** and **S12a** and also at pin 85 of **S41**	OK ▶	Carry out **step A3**
	OK ▶	Restore the wiring between the battery **A1** and relays **S41, S42** and **S12a**
A3 CHECK VOLTAGE – With the ignition key turned, check for 12 V at pin 85 of relay **S42**	OK ▶	Carry out step A4
	OK ▶	Restore the wiring between the ignition switch **B1** and relay **S42**
A4 CHECK RELAYS – Check the correct operation of relays **S41, S42** and **S12a**	OK ▶	Carry out **step A5**
	OK ▶	Replace any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – Check for 12 V at pin 18 of the control unit **S11**; with the key turned 12 V also at pins 27 and 37 of **S11** and appr. 0 V (very low voltage) at pin 3 and 36 of **S11**	OK ▶	Carry out **step A6**
	OK ▶	Restore the wiring between the control unit **S11** and the relays and between the control unit and fuse **S36**
A6 CHECK EARTH – Check for an earth at pins 19 and 24. Also check for an earth at pin 86 of **S42**	OK ▶	CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER
	OK ▶	Restore the wiring between **S11** and the relay and earth **G60**

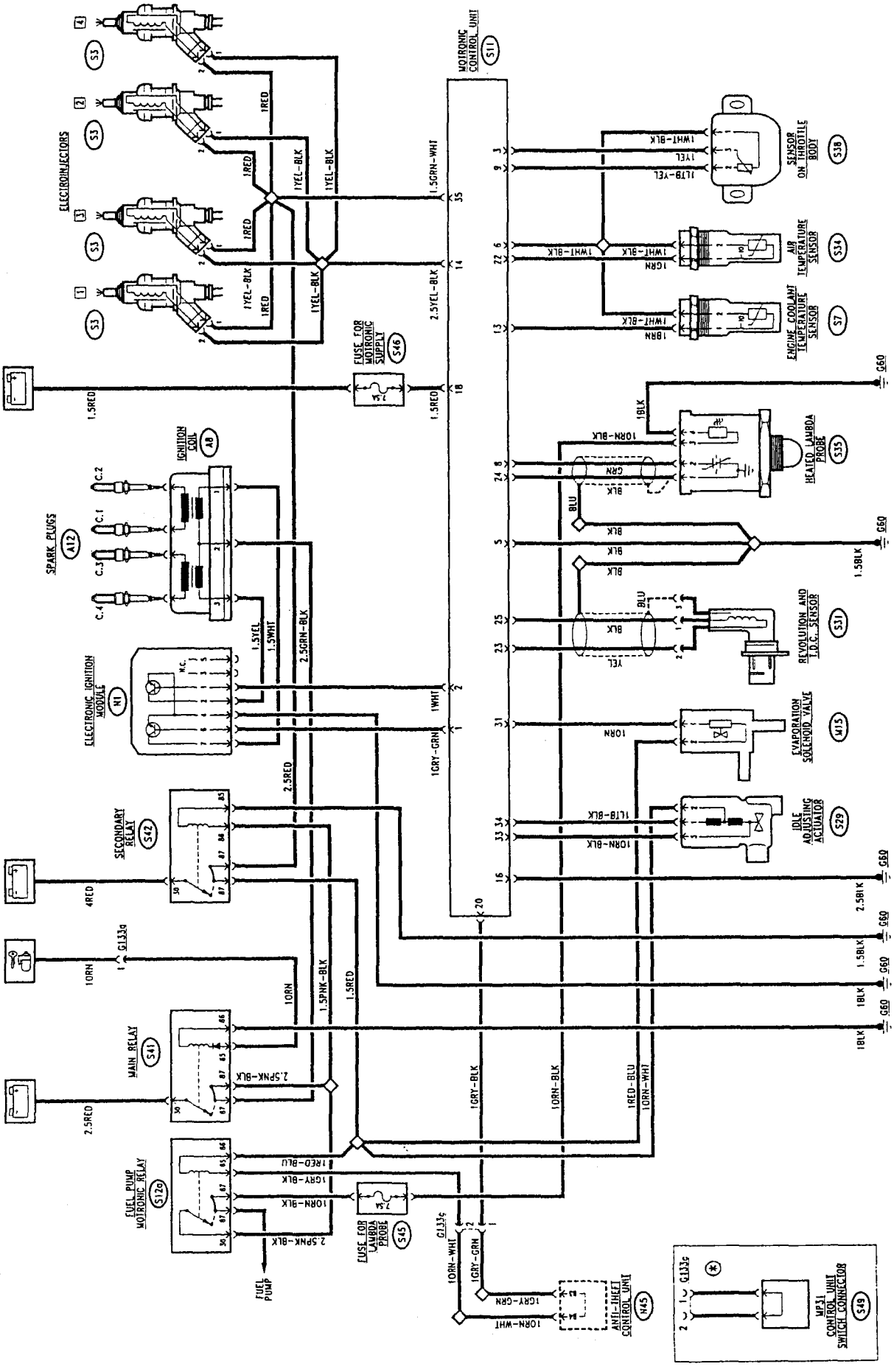
MOTRONIC MP3.1 INJECTION/ IGNITION SYSTEM (*)
- Boxer 1.6 Engine -

INDEX

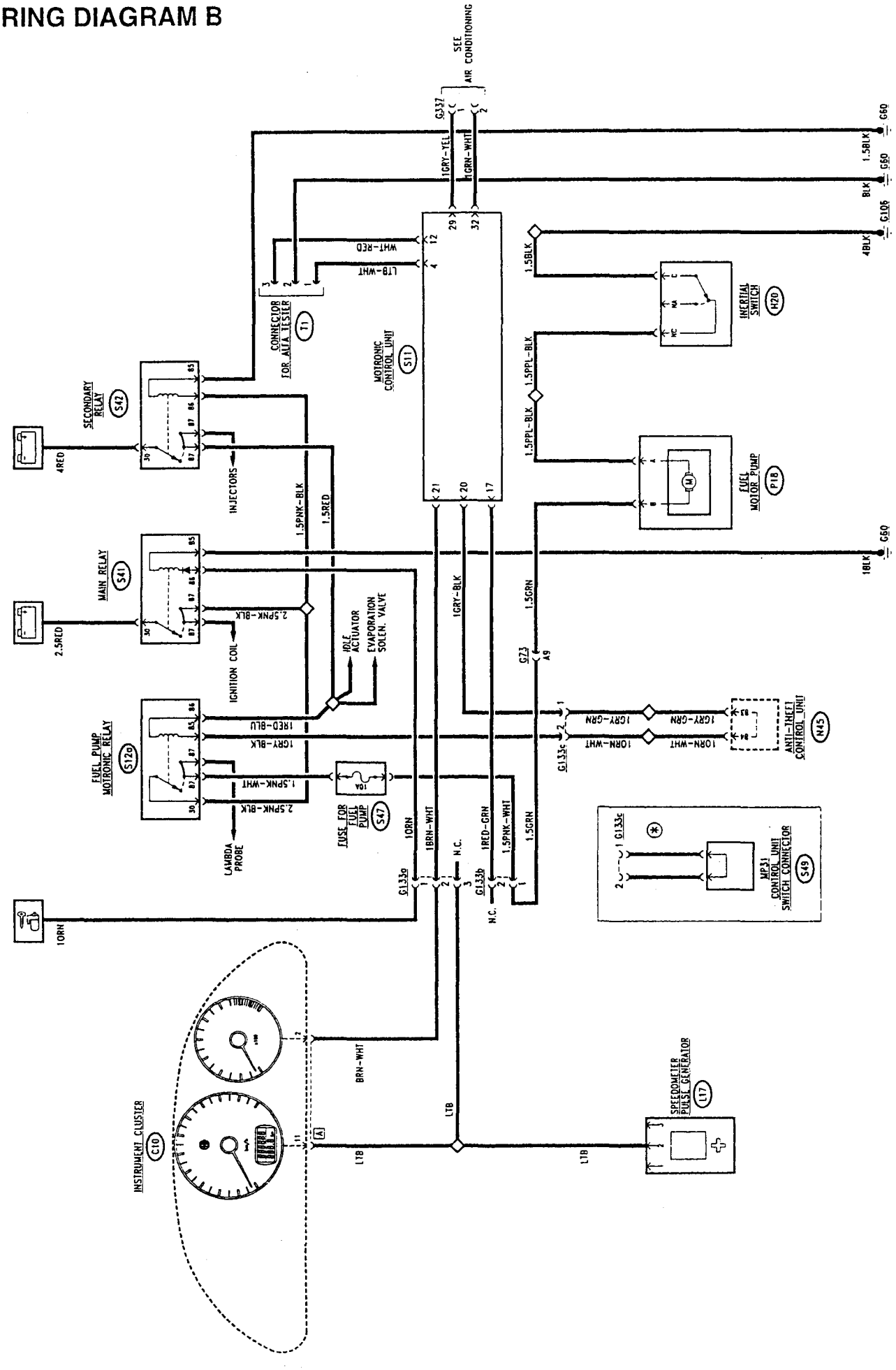
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(*) Only present up to chassis No.____, then replaced by the ROCHESTER system (Sect. 55-35A)

WIRING DIAGRAM A



WIRING DIAGRAM B



GENERAL DESCRIPTION

The MOTRONIC MP3.1 electronic control unit supervises and adjusts all the parmeters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions.
A single control unit governs both ignition and injection: in fact the point of operation of the engine is located by special sensors and the actuators are operated accordingly which carry out the following functions:

- injection time adjustment;
- ignition adjustment;
- combustion control - lambda sensor;
- idle speed control;
- fuel pump control;
- cold-starting control;
- control of enrichment during acceleration;
- fuel cut-off during deceleration;
- max. rpm limiting;
- fuel vapour recovery;
- connection with the air conditioning system;
- connection with the anti-theft system;

The system also possesses a "self-diagnosis function which memorises any faults simplifying their location and correction.

Operating logic

- **Adjustment of injection times (quantity of fuel):** the control unit controls the injectors extremely rapidly and accurately, calculating their opening time on the basis of the engine load (measured by the pressure sensor and corrected according to the air temperature) and the engine speed (detected by the rpm sensor), taking account also of other operating parameters such as battery voltage and engine temperature and also taking account of the signals from the lambda sensor.
  Injection is of the "pressure-speed" type and it is simultaneous, i.e. all the injectors are opened simultaneously at each turn, enabling correct supply to all the cylinders and improved operation during transient states.
- **Ignition adjustment (calculation of spark advances):**
  the control unit calculates the optimum advance for each engine condition according to the engine speed and the absolute pressure at the intake.
  The electronic ignition is of the "static distribution type" (with semi-conductors, without distributor) This solution considerably improves reliability and reduces the high voltage cables and connections.
  Ignition takes place with two coils controlled by a power module.
- ***Combustion control- lambda sensor:*** *the oxygen* sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering (lambda coefficient = 1). The electric signal that the sensor sends to the control unit changes sharply when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
  The lambda signal is processed inside the control unit by a special integrator which prevents abrupt "swaying".
  The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).
  Therefore, through this sensor it is possible to adjust engine carburetion precisely and retroactively - closed loop control. This also makes it possible to keep exhaust emissions within the limits specified by law.
- **Idle speed control**: the adjustment of the engine idle speed is carried out through the special actuator which acts on the the throttle by-pass.
  This device acts as a regulator for cutting in the various services (e.g. conditioner compressor): in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.
- **Fuel pump control**: the control unit logic cuts off the supply to the fuel pump as soon as the engine stops: in fact the supply is cut off at the pump and at the ignition coil.In addition, on this car the pump control system is integrated by the **inertial switch device:** this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that connects the fuel pump to earth, thereby stopping the fuel pump instantaneously. This device is particularly important, integrating the safety offered by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents that do not cause the engine to stop immediately.
- **Cold-starting control:** during cold starting (up to a certain number of rpms) the control unit uses special advance and injection time ratings.
  During cold starts the amount of fuel injected and the advance are also increased until the engine reaches a determinate temperature.
- ***Control of enrichment during acceleration****: upon* the need for acceleration the control unit increases injection in order to quickly reach the load required. This function is carried out by the detection of a rapid increase of the values of the parameter of the po-

tiometer located on the throttle which signals the need for acceleration.

- **Fuel cut-off during deceleration**: with the throttle closed and an engine speed above a certain threshold the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed and above all the car speed is reduced and also fuel consumption, which is controlled to a greater degree. The cut-off threshold value varies according to the temperature of the engine.
- **Rpm limiting:** the control unit automatically cuts off the injection of fuel when the engine rpm reaches a certain threshold, thereby preventing the engine from over- revving.
- **Fuel vapour recovery:** the fuel vapours collected in a special canister are ducted towards the engine where they are burnt; this takes place through a solenoid valve which is opened by the control unit only when the engine is in a load condition that will allow correct combustion without adversely affecting the operation of the engine.
- **Connection with the conditioner compressor:** the control unit is connected with the air conditioning system so that the idle rpm can be adapted to the increased power each time the compressor cuts in.
- **Connection with the anti-theft device:** if the car is fitted with the electronic anti-theft device, the Motronic control unit receives consent to operate from the anti-theft control unit via the signal which operates the fuel pump relay, which is therefore de-activated when the anti-theft device is operational.

Components

The electronic control unit (**S11**) receives the signals from the **sensors** which "read" the operation of the engine and processes them according to a logic stored inside in "maps" which correlate the various parameters with one another in the best way possible, and it operates the **actuators** accordingly so that the engine always operates with the highest possible regularity and yield.

The control sensors are the following:

- engine temperature sensor (**S7**);
- air temperature sensor (**S34**);
- sensor on throttle body (**S38**);
- rpm and timing sensor (**S31**);
- heated lambda sensor (**S35**)
- absolute pressure sensor (inside the control unit): this is connected to the intake box by a special pipe, also fitted with a stabilizer chamber.

The actuators controlled by the system are the following:

- electroinjectors (**S3**);
- ignition coil (**A8**), with power module (**N1**);
- fuel pump (**P18**);
- idle speed adjustment actuator (**S29**);
- vapour recovery solenoid valve (**M15**).

The control unit is also connected with:

- heating and ventilation system,
- anti-theft control unit (**N45**),
- the instrument cluster **(C10)** to which it supplies the signal for the rev. counter.

The system is completed by three relays: the main relay (**S41**), the secondary relay (**S42**) and the fuel pump relay (**S12a**) which operates the fuel pump, the injectors, the coils and the other components of the system. The supply line is protected by a wander fuse (**S46**), while special fuses protect the pump (**S47**), and the resistance of the lambda sensor (**S45**).
The main and secondary relays are located with the fuses in the engine compartment near the terminal branch board, while relay (**S12a**) is to be found, for some versions, in the container of the control unit (**S11**); only for some vehicles without alarm system is located in the engine bay next to the injection relay.

Lastly, there is an earth point (**G60**) on the engine.

Connector (**T1**) used for the connection with the ALFA ROMEO Tester is located in the engine bay in an easily accessible position. For some vehicles it is located near the control unit.

FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and adjusts the entire electronic ignition and injection system.
The control unit is supplied at pin 18 directly by the battery via fuse **S46** (7.5A).
Pin 5 and 16 are earthed.

Three relays control the entire system:

- The main relay **S41**, energized with the signal that the key is in the "MARCIA" position, supplies the secondary relay **S42**, the fuel pump relay **S12a**, and the primary windings of the coil **A8a**.
- The secondary relay **S42**, energized by the main relay **S41**, supplies the fuel pump relay **S12a**, the vapour recovery solenoid valve **M15**, the idle speed actuator **S29** and the injectors **S3**, in addition to the actual control unit **S11**, at pin **35**.
- The fuel pump relay **S12a**, supplied by the two above-mentioned relays, is energized by a signal (earth) leading from pin 20 of the control unit **S11** which crosses the anti-theft control unit **N45**, which gives the necessary consent. If the anti-theft device

is not installed, the connector of connection (**G133c**) is bridged with connector **S49**.

- The relay supplies the resistance of the lambda sensor **S35** and the fuel pump **P18**; this supply line is protected by a special fuse **S47** (10A).
  Additionally, the earth **P18** reaches the pump via the inertial switch **H20** which cuts off the circuit in the event of an impact.

The control unit **S11** receives numerous signals from the different sensors, thereby keeping all the engine parameters under control.

The rpm and timing sensor **S31** supplies, through the signal sent to pin 23 of the control unit, information about the engine rpm and timing, while from a reference earth is sent from pin 25; these two signals are very low in intensity, therefore they are suitably screened. The sensor is inductive and it detects the engine rpm through the change in a magnetic field produced by the passage of the teeth of a "phonic" wheel fitted on the flywheel: the wheel has 60 teeth, two of which are missing through which the timing is detected.

The throttle body sensor **S38**, is supplied by the control unit with 5 V from pin 9, while pin 6 supplies the reference earth; through a potentiometer a signal is generated which is sent to pin 3 and is proportionate with the degree of opening of the throttle itself.

The engine temperature sensor **S7**, to which the control unit supplies the reference earth from pin 6, sends a signal to pin 13 proportionate with the temperature of the engine coolant, detected with an NTC material (resistance that lowers with the temperature).
The intaken air temperature sensor **S34**, to which the control unit supplies the reference earth from pin 6, sends a signal to pin 22 that is proportionate with the temperature of the air in the intake capacity, detected with an NTC material (resistance that lowers with the temperature).

The heated lambda sensor **S35** supplies the control unit information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin 8 of the control unit, while pin 24 supplies the reference earth; these two signals are very low in intensity and are therefore suitably screened.
The sensor is heated by a resistance to make sure that it operates correctly also when the engine is cold; the resistance is supplied by the fuel pump relay **S12a** and it is protected by a specific fuse **S45** (7.5A).

NOTE: the control unit also processes a signal leading from the absolute pressure sensor, inside it, and connected to the intake box by a special pipe: inside the control unit, the pressure signal is then transformed into an electrical signal.

On the basis of the signals received from the sensors and of the calculations carried out, the control unit **S11** controls the opening of the injectors **S3** via pin 14. The injectors receive the supply from relay **S42**.

Ignition is static and controlled directly by the control unit which adjusts the advance automatically. A control signal (earth) is sent by the control unit, from pins 1 and 2, to the power module **N1** which generates the high voltage pulses sent to the coil **A8**: the primary windings are supplied by the module **N1**, the secondary winding sends the pulse to the spark plugs **A12**.

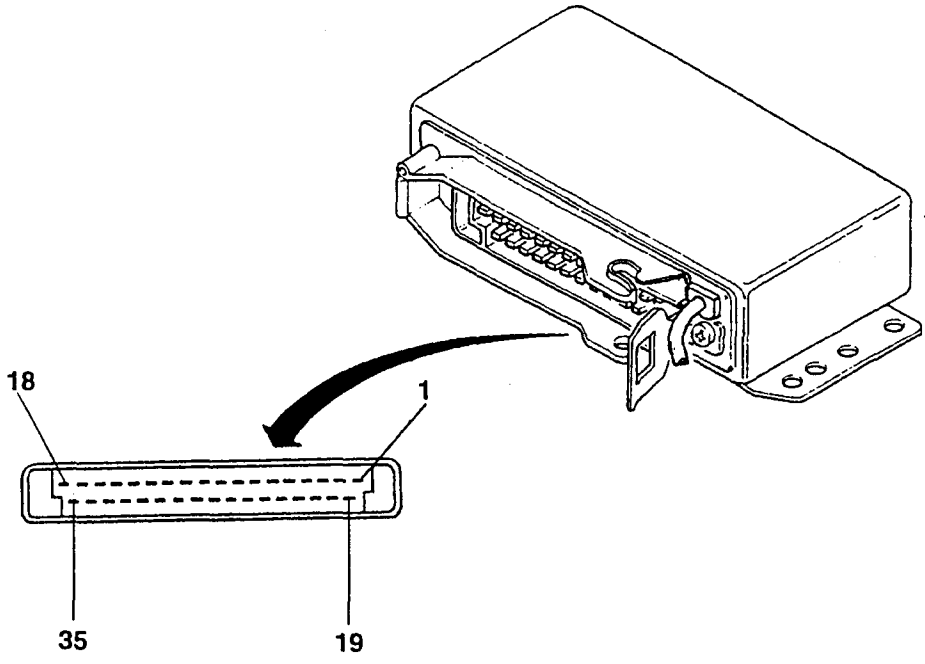
The idle speed adjustment actuator **S29** forms a by-pass line for the flow of air; this comprises two windings: one opens and the other closes a valve that adjusts the gap of the by- pass section; a safety spring establishes a mean opening value in the event of a failure to this device; the actuator is controlled by the control unit through the signals from pin 34 (opening) and 33 (closing).

The vapour recovery solenoid valve **M15** allows the passage of the vapours towards the engine intake where they are added to the mixture entering the combustion chamber; this is activated by the control unit when the engine is under load through a duty cycle signal from pin 31.

The control unit **S11** is informed instant by instant of the engine rpm through the sensor **S31**: this information is sent to the rev counter located on the instrument cluster **C10**, via the signal from pin 21.

The control unit **S11** is connected with the air conditioning system via pins 29 and 32.
This makes it possible to adapt the engine rpm to th increased power each time the compressor cuts in, for further details see the "Heating and Ventilation" section.

The control unit **S11** is fitted with a self-diagnosis system which can be used connecting the ALFA ROMEO Tester to connector **T1**; here, the control unit sends the fault signals via the diagnosis line L -pin 4- and line K - pin 12, while the earth is supplied from **G60.**

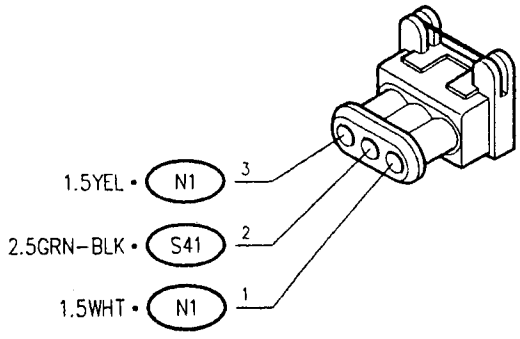


CONTROL UNIT PIN-OUTS

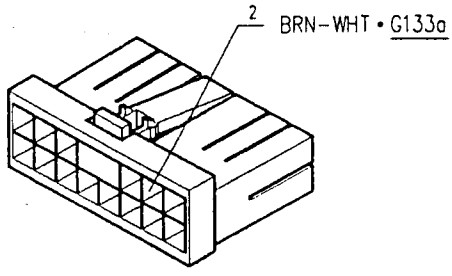
1. Ignition control module (for cyl. 1 & 4)
2. Ignition control module (for cyl. 2 & 3)
3. Throttle position signal
4. Diagnosis line L
5. Power earth
6. Electronic earth for sensors
7. N.C.
8. Lambda sensor signal
9. Reference voltage (5V) for throttle sensor
10. N.C.
11. N.C.
12. Diagnosis line K
13. Engine temperature signal
14. Electroinjector control
15. N.C.
16. Power earth
17. N.C.
18. Direct control unit supply
19. N.C.
20. Supply for fuel pump relay (via anti-theft control unit)
21. Rev counter signal
22. Intaken air temperature signal
23. Rpm sensor signal
24. Earth for lambda sensor
25. Earth for rpm sensor
26. N.C.
27. N.C.
28. N.C.
29. Compressor cut-in request signal
30. N.C.
31. Evaporative solenoid valve control
32. Compressor cut-in signal
33. Idle speed actuator control - closing
34. Idle speed actuator control - opening
35. Control unit supply ("key-operated")

COMPONENTS AND CONNECTORS

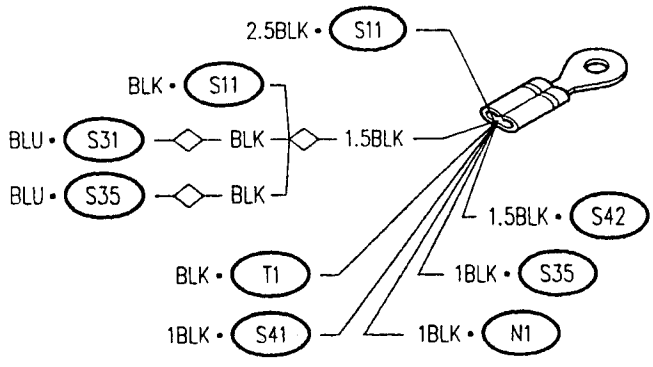
Ignition coil	A8



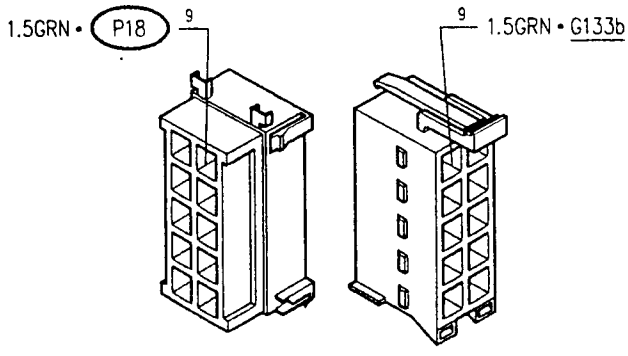
Instrument cluster	C10 A



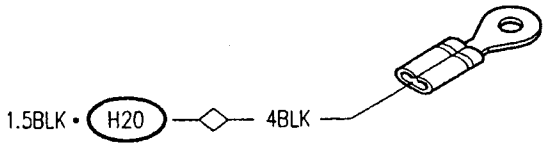
Injection wiring earth	G60



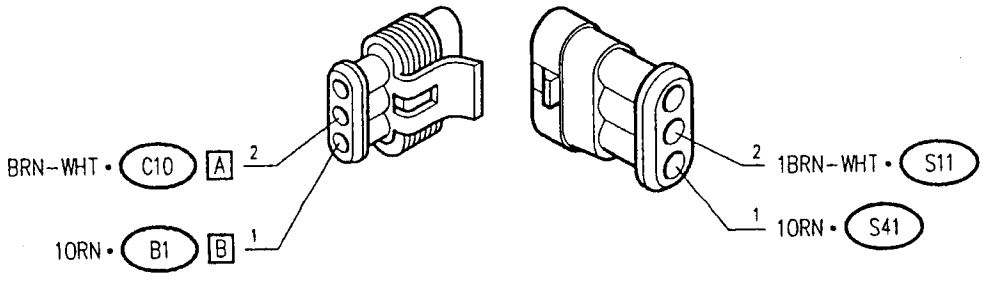
Rear services connector	G73 A



Seat cross rail earth	G106

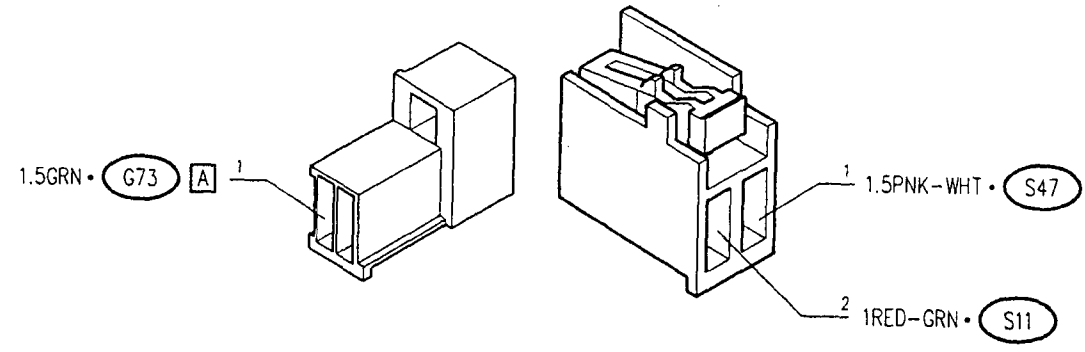


Electronic injection wiring connector A	G133a

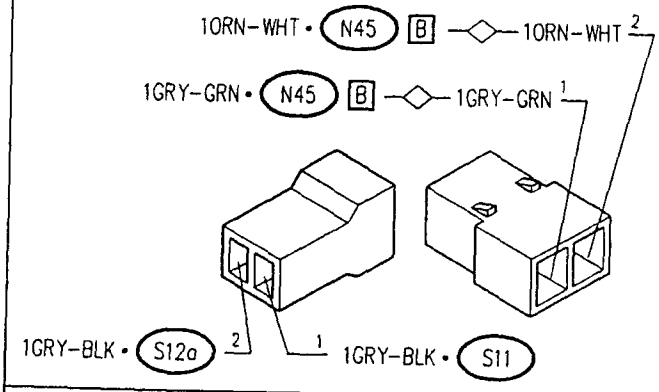


COMPONENTS AND CONNECTORS (cont.d)

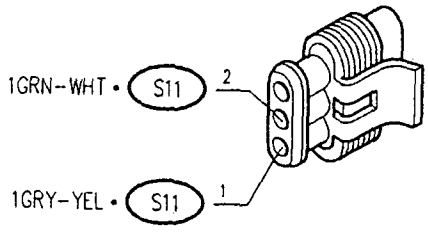
Electronic injection wiring connector B — G133b



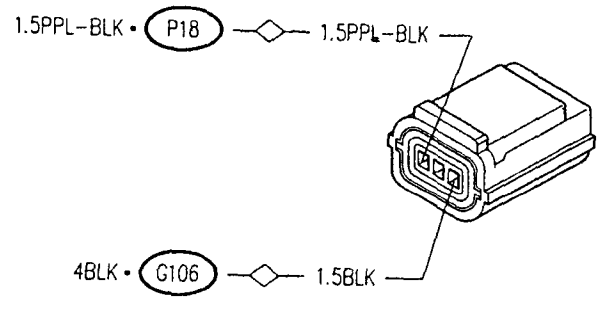
Electronic injectionwiringconnector C — G133c



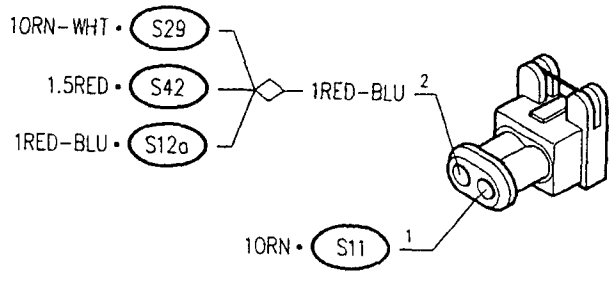
Conditioner/injection system connector — G337



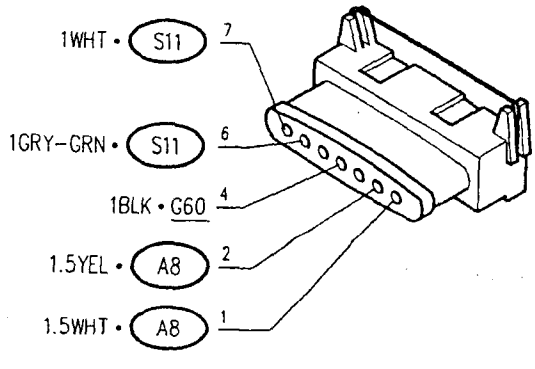
Inertial switch — H20



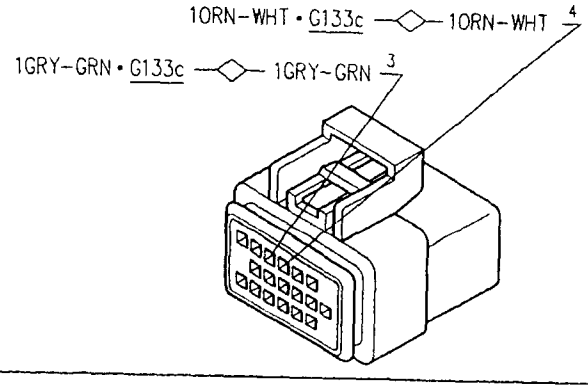
Evaporative solenoid valve — M15



Electronic ignition module — N1

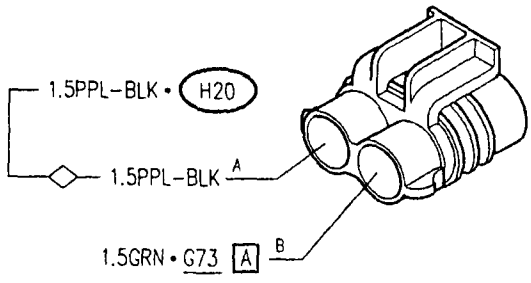


Anti-theft system control unit — N45 B

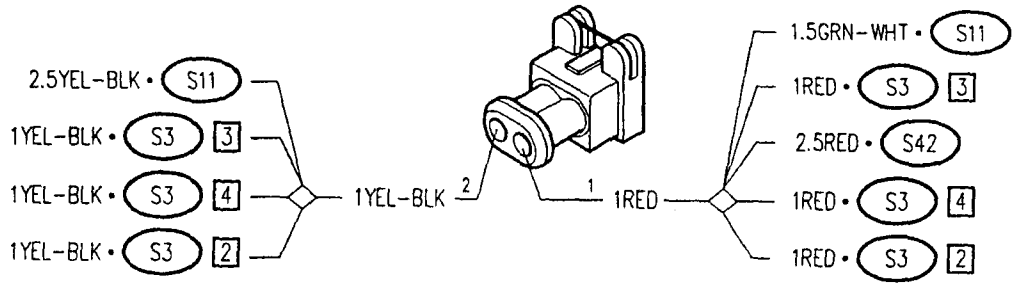


COMPONENTS AND CONNECTORS (cont.d)

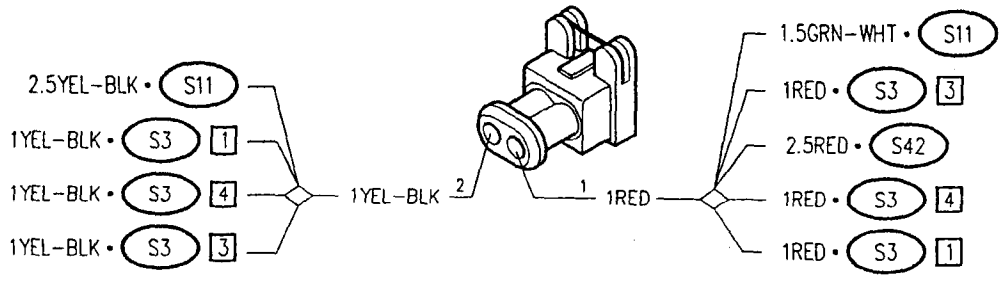
Electric fuel pump — P18



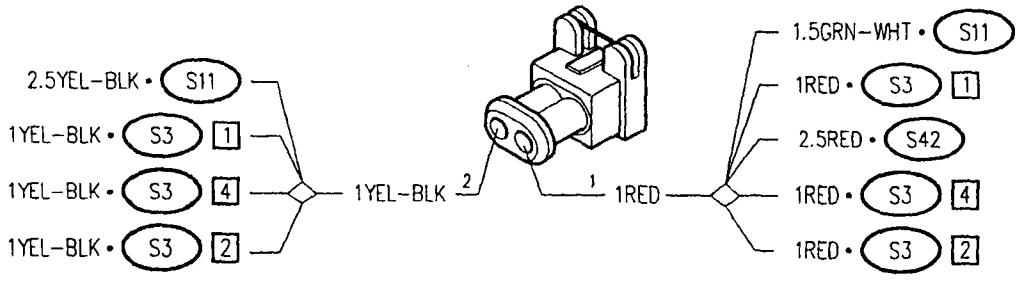
Electroinjector — S3 1



Electroinjector — S3 2

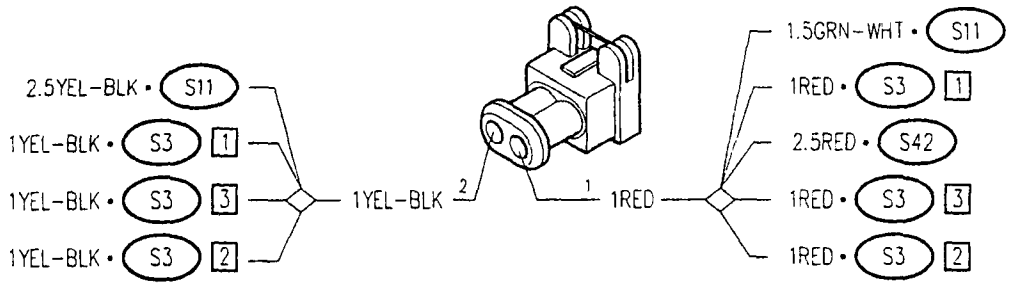


Electroinjector — S3 3

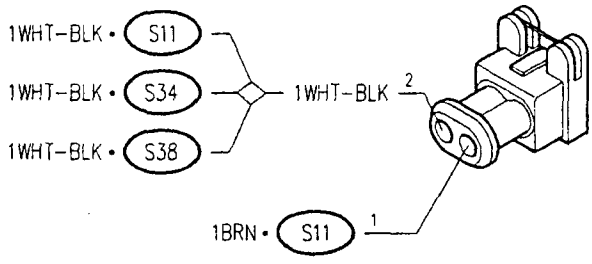


COMPONENTS AND CONNECTORS (cont.d)

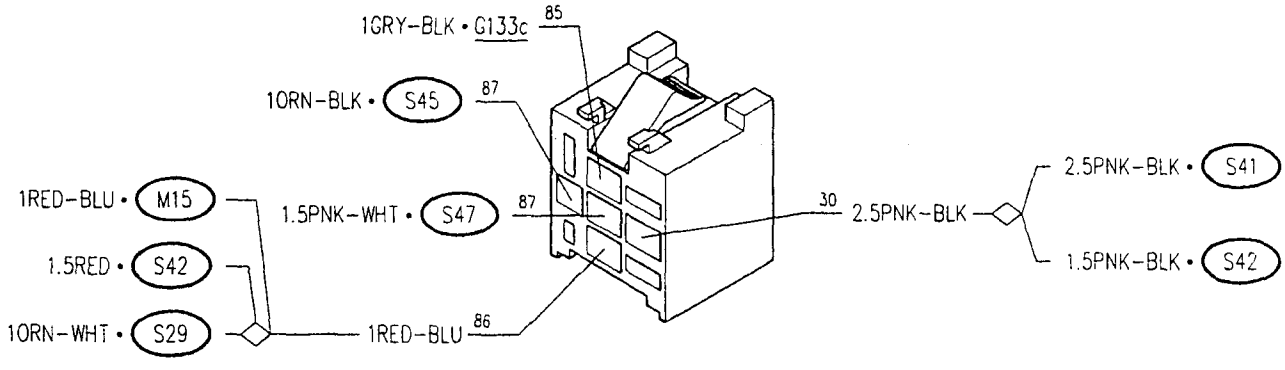
Electroinjector — S3 — 4



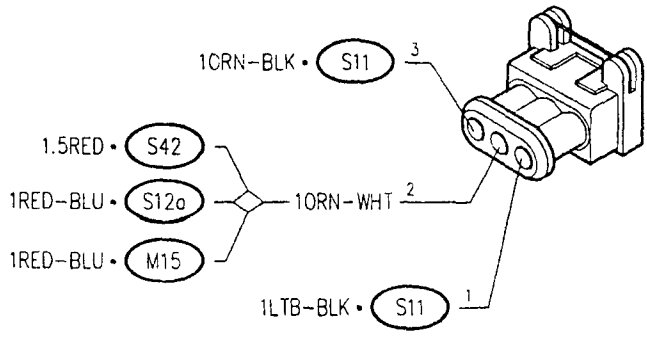
Engine temperature sensor — S7



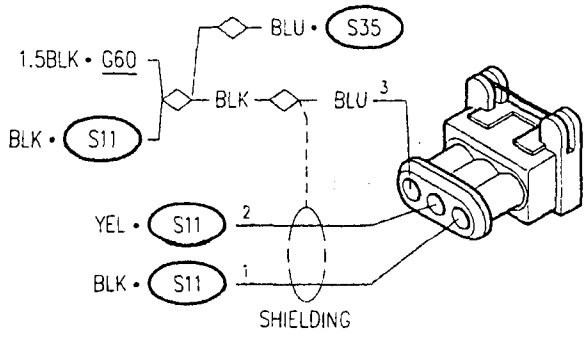
Fuel pump Motronic relay — S12a



Idle speed adjustment actuator — S29

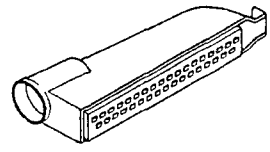


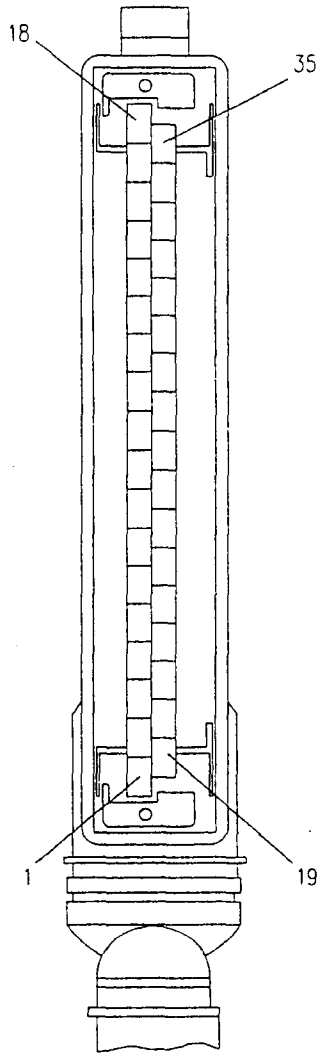
Rpm and crankshaft position sensor — S31



COMPONENTS AND CONNECTORS (cont.d)

Motronic control unit — S11



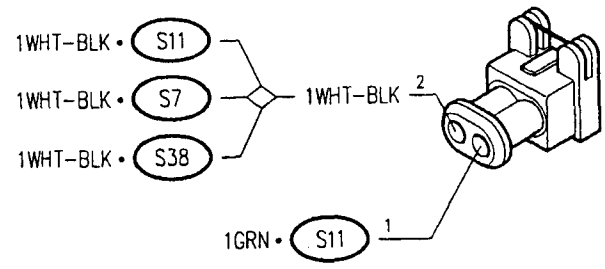


1 — 1GRY-GRN • N1
2 — 1WHT • N1
3 — 1YEL • S38
4 — LTB-WHT • T1
5 — BLK — 1.5BLK • G60; BLK — BLU • S31; BLK — BLU • S35
6 — 1WHT-BLK — 1WHT-BLK • S38; 1WHT-BLK • S34; 1WHT-BLK • S7
8 — GRN • S35
9 — 1LTB-YEL • S38
12 — WHT-RED • T1
13 — 1BRN • S7
14 — 2.5YEL-BLK — 1YEL-BLK • S3 [1]; 1YEL-BLK • S3 [2]; 1YEL-BLK • S3 [3]; 1YEL-BLK • S3 [4]
16 — 2.5BLK • G60
17 — 1RED-GRN • G133b
18 — 1.5RED • S46
20 — 1GRY-BLK • G133c
21 — 1BRN-WHT • G133a
22 — 1GRN • S34
23 — YEL • S31
24 — BLK • S31
25 — BLK • S35
29 — 1GRY-YEL • G337
31 — 1ORN • M15
32 — 1GRN-WHT • G337
33 — 1ORN-BLK • S29
34 — 1LTB-BLK • S29

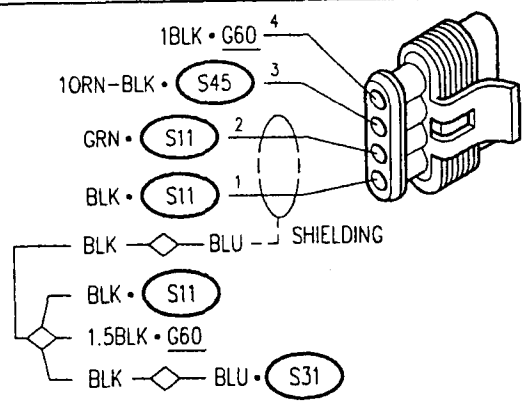
35 — 1.5GRN-WHT — 1RED • S3 [1]; 1RED • S3 [2]; 1RED • S3 [3]; 1RED • S3 [4]; 2.5RED • S42

COMPONENTS AND CONNECTORS (cont.d)

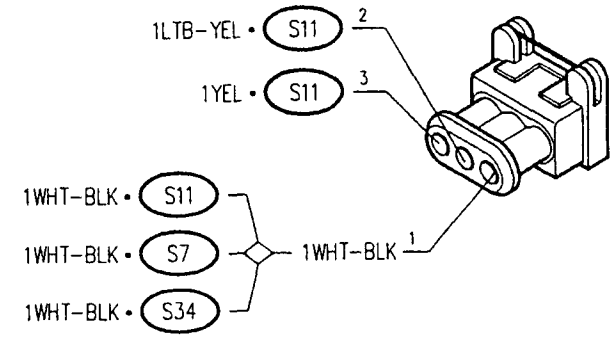
Air temperature sensor — S34



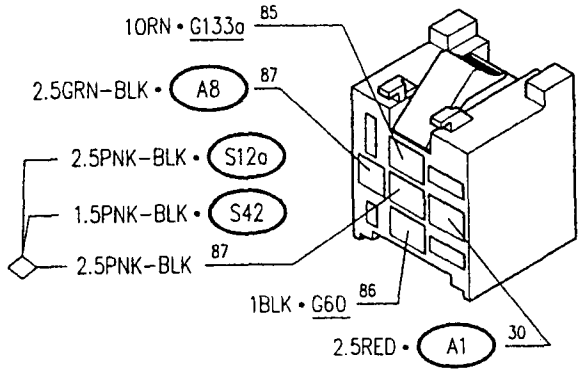
Heated lambda sensor — S35



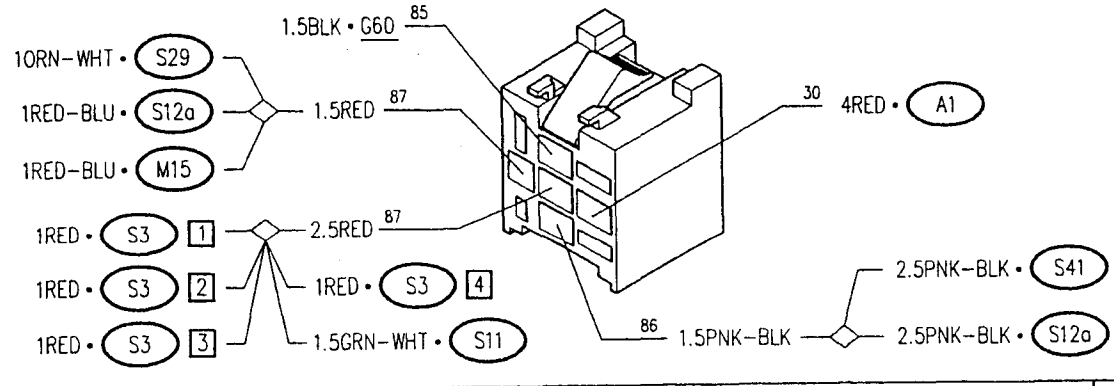
Sensor on throttle body — S38



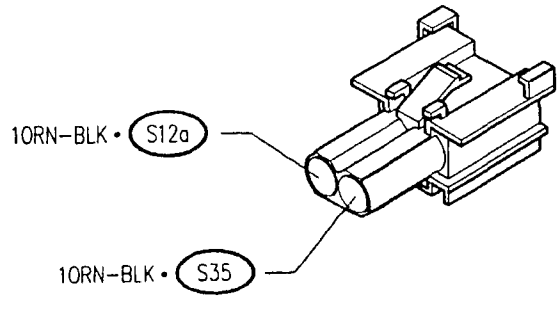
Main relay switch — S41



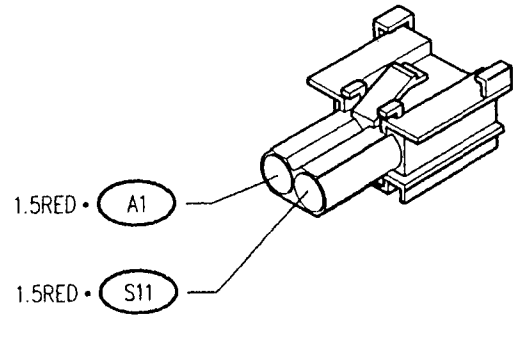
Secondary relay switch — S42



Lambda sensor wander fuse — S45

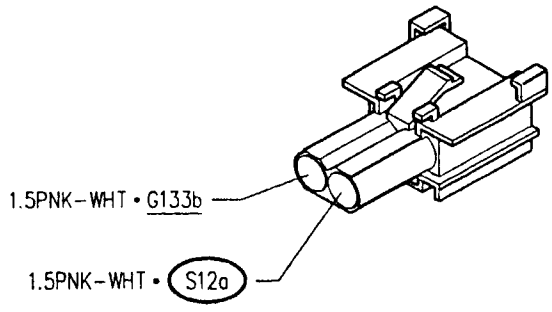


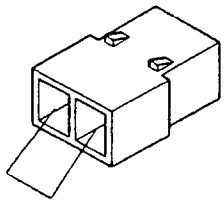
Motronic supply wander fuse — S46



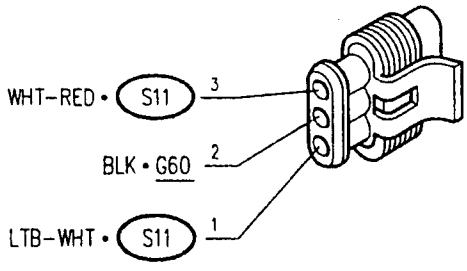
COMPONENTS AND CONNECTORS (cont.d)

Fuel pump wander fuse	S47	MP31 control unit switching connector	S49

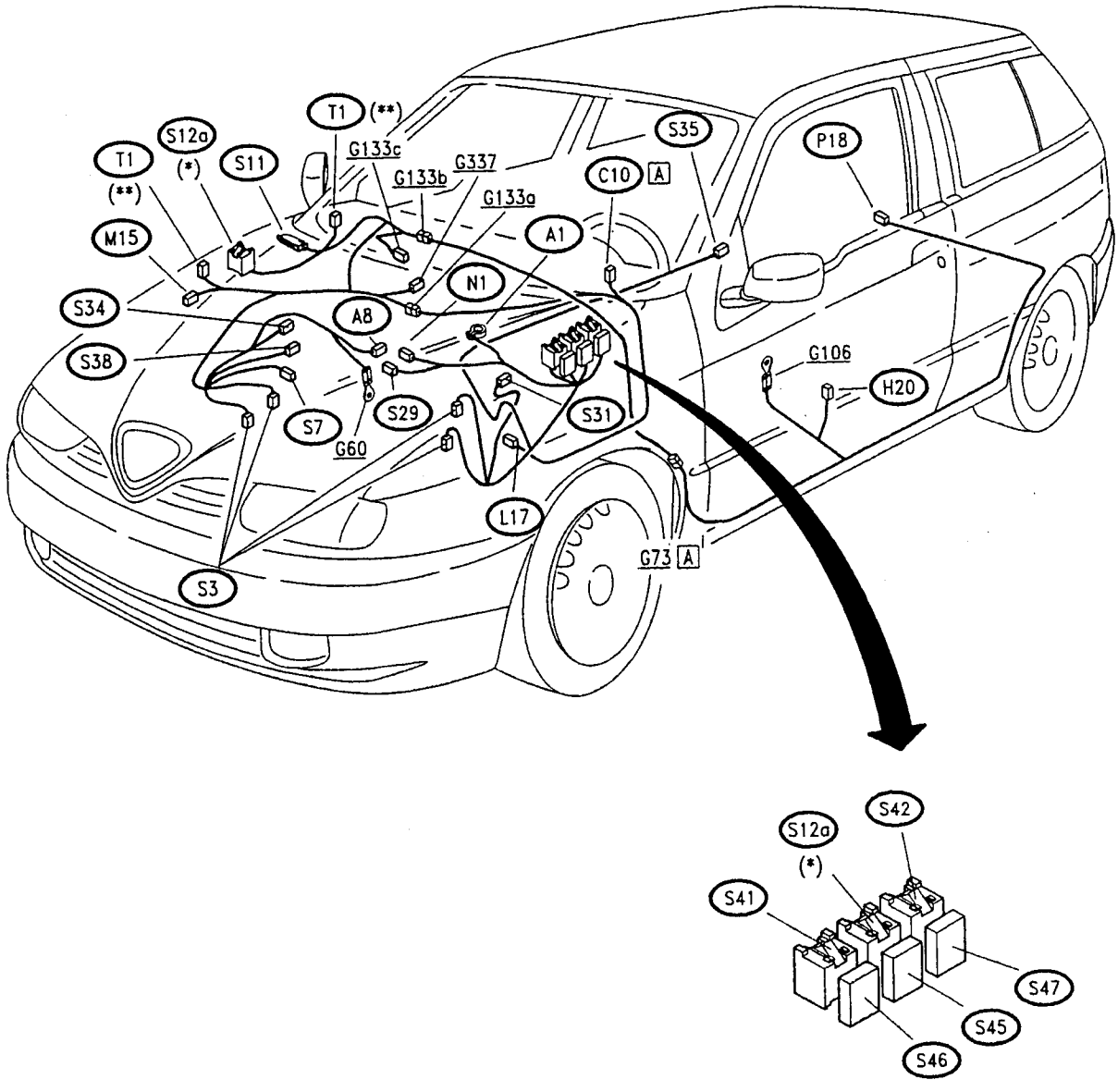




Connector for ALFA TESTER (Motronic)	T1



LOCATION OF COMPONENTS



(*) Relay **S12a** is, for some vehicles only, located in the engine bay next to other relays; in all other cases it is located in the container of control unit **S11**.
(**) The connector **T1** is, for some vehicles only, located near the control unit **S11**; in all other cases it is located in the engine bay.

FAULT-FINDING

The control unit is fitted with a self-diagnosis, which continuously checks the signals from the different sensors for plausibility and compares them with the limit values allowed: if these limits are exceeded, the system detects a failure: if the failure is not sporadic and remains "present" permanently it is acknowledged as "important" and stored in the memory. In addition, in the event of a failure, for certain parameters, the abnormal values are replaced by suitable mean values to make it possible for the car to "limp" to a Service Centre. The self-diagnosis system also enables quick and effective fault-finding connecting to the ALFA ROMEO Tester.

Diagnosis using the ALFA TESTER

N.B.
Before carrying out diagnosis with the Tester, carry out the preliminary check described below (**TEST A**).

The connection between the Tester and the electronic control unit must be carried out as follows:

1. Power the Tester either through the cigar lighter socket or connecting it directly to the battery using the cable provided.
2. Connect the Tester socket to that of the control unit (the socket is to be found near the control unit itself).

The information the instrument can give comprises:

– display of the parameters;

– display of errors;

– active diagnosis.

Error clearing

Before ending diagnosis the contents of the "permanent" memory should be cleared by the Tester in the "Active Diagnosis" function.

In the failure to do so, the next time the Tester is connected, errors that have already been examined will be signalled.

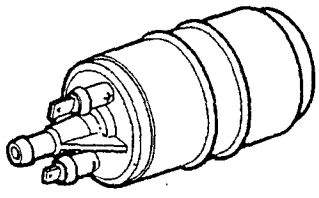
CHECKING COMPONENTS

Electroinjectors (S3)



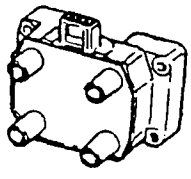
SPECIFICATIONS	
Winding resistance	16 ± 0.5 Ω

Fuel pump (P18)



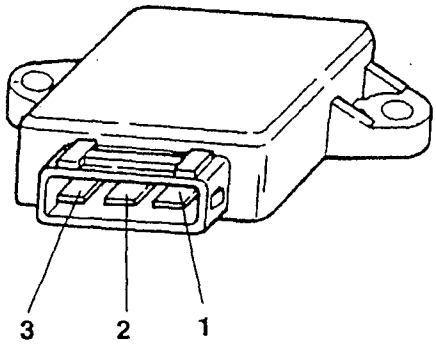
SPECIFICATIONS	
Flow rate	≥ 120 l/h
Pressure	4 bar
Nominal voltage	12 V

Ignition coil (A8)



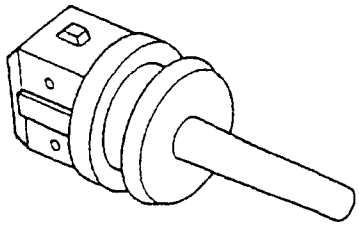
SPECIFICATIONS	
Primary resistance	0.5 Ω
Secondary resistance	13.3 Ω

Throttle position sensor (S38)



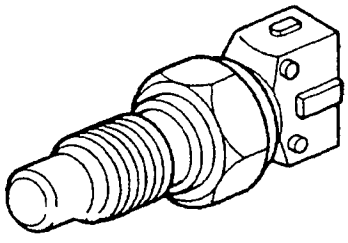
SPECIFICATIONS	
Resistance between terminals:	
1-2 (fixed)	≃ 2 kΩ
1-3 (throttle closed)	≃ 1 kΩ
1-3 (throttle completely open)	≃ 2.7 kΩ

Intaken air temperature sensor (S34)



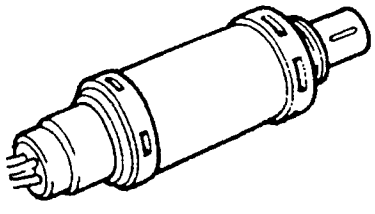
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10	8100 ÷ 10770
+ 20	2280 ÷ 2720
+ 80	292 ÷ 362

Engine temperature sensor (S7)



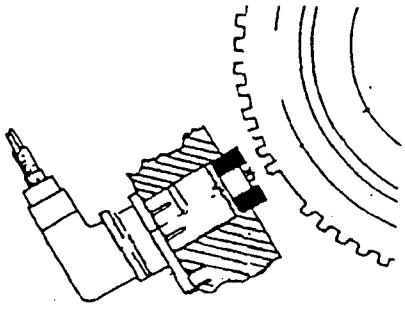
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10	8100 ÷ 10770
+ 20	2280 ÷ 2720
+ 80	292 ÷ 362

Lambda sensor (S35)



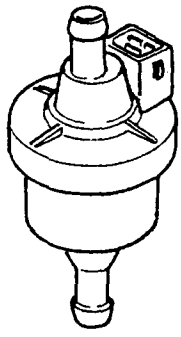
SPECIFICATIONS	
Heating resistance	3 Ω

Rpm and timing sensor (S31)



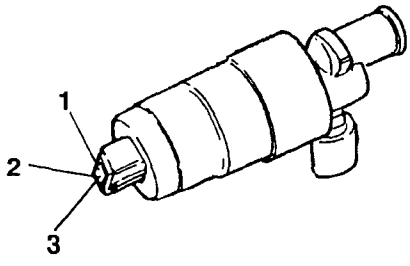
SPECIFICATIONS	
Sensor winding resistance at 20°C	486 ÷ 594 Ω
Distance (gap) between sensor & flywheel ring gear	0.25 ÷ 1.3 mm

Evaporative solenoid valve (M15)



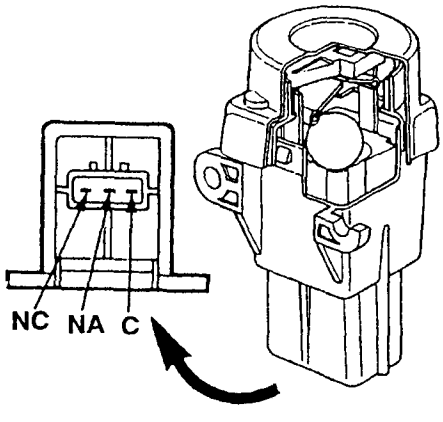
SPECIFICATIONS	
Air flow rate	Min. 0.08 m^3/h Max. 3.0 m^3/h
Duty-cycle signal	12 V; 10 Hz
Winding ohmic resistance	45 Ω ± 1%
When not energized the solenoid valve is normally open	

Idle speed adjustment actuator (S29)



SPECIFICATIONS	
Resistance between terminals 1-3	40 Ω
Resistance between terminals 2-3	20 Ω

Inertial switch (H20)



SPECIFICATIONS
Check continuity between pins NC and C: this continuity is cut off in the event of a crash; the contact is re-connected pressing the special pushbutton

PRELIMINARY CHECK FOR BOSCH MP3.1 SYSTEM	TEST A

NOTE: Beforehand, check that the anti-theft device is working properly (See "Antitheft Device" section) which might have cut off the supply to the system!

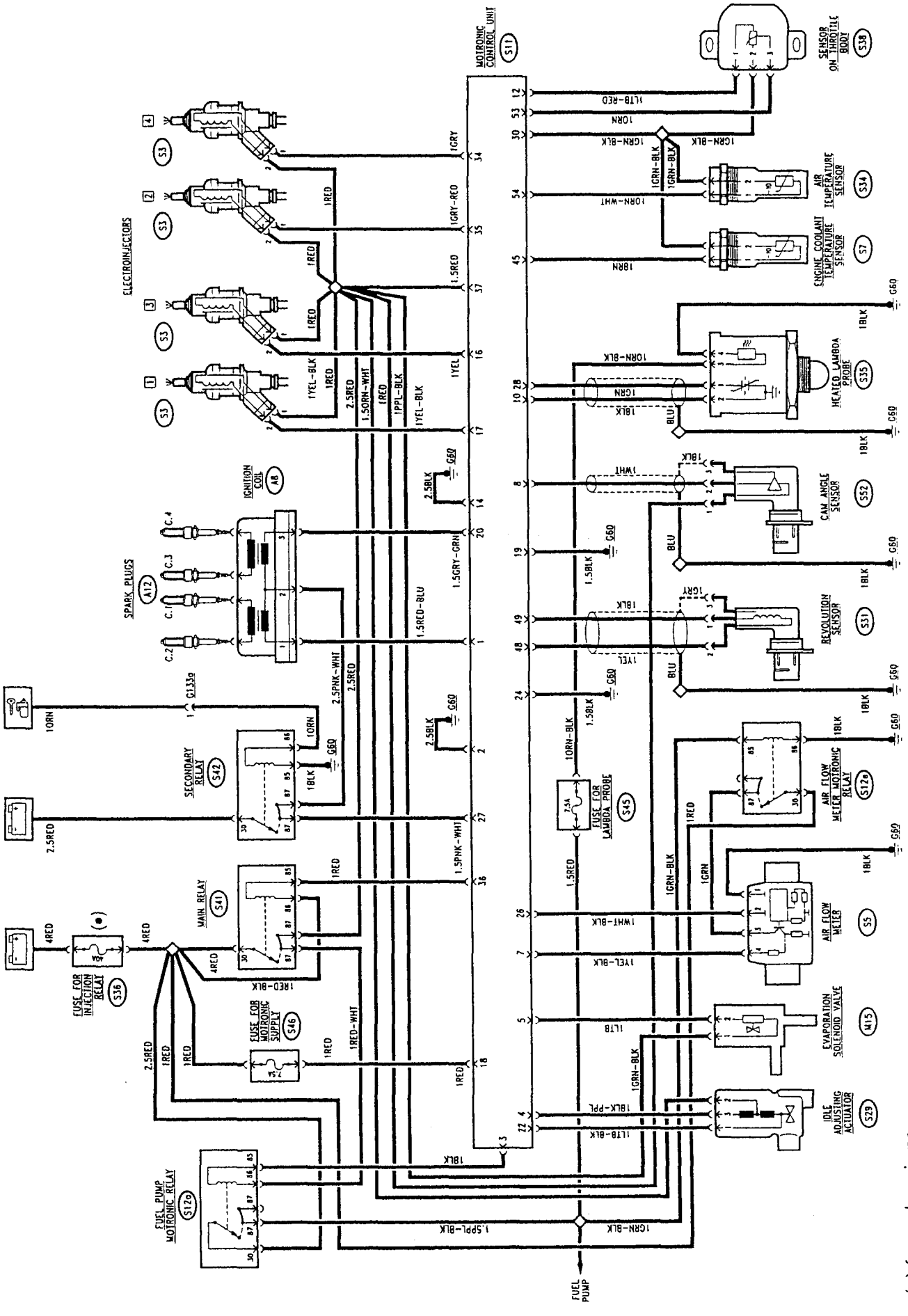
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check intactness of fuses **S45, S46** and **S47**	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Change fuses **S45** : 7.5 A **S46** : 7.5A **S47** : 10A
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relay **S41** and at pin 30 of relay **S42**	OK ▶	Carry out **step A3**
	~~OK~~ ▶	Restore the wiring between la batteria **A1**, ed i teleruttori **S41** e **S42**
A3 CHECK VOLTAGE – With the key turned, check for 12 V at pin 85 of relay **S41**, at pin 30 and 86 of relay **S12a** and at pin 86 of **S42**	OK ▶	Carry out **step A4**
	~~OK~~ ▶	Restore the wiring between the ignition switch **B1** and relay **S41**, between **S41** and **S12a** and between **S42** and **S12a**
A4 CHECK RELAYS – Check for correct operation of relays **S41, S42** e **S12a**	OK ▶	Carry out **step A5**
	~~OK~~ ▶	Change any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – Check for 12 V aT pin 18 of control unit **S11**; with the key turned 12 V also at pin 35 of **S11** and appr. 0 V (very low voltage) at pin 20 of **S11**	OK ▶	Carry out **step A6**
	~~OK~~ ▶	Restore the wiring between control unit **S11** and the relays and between the control unit and fuse **S46**
A6 CHECK EARTH – Check for an earth at pins 5 and 16 of **S11**. Also check for an earth at pin 85 of **S42** and at pin 86 of **S41**	OK ▶	**CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER**
	~~OK~~ ▶	Restore the wiring between **S11** and the relays and earth **G60**

INJECTION/IGNITION SYSTEM
MOTRONIC M2.10.3
- Boxer 1.7 16v Engine -

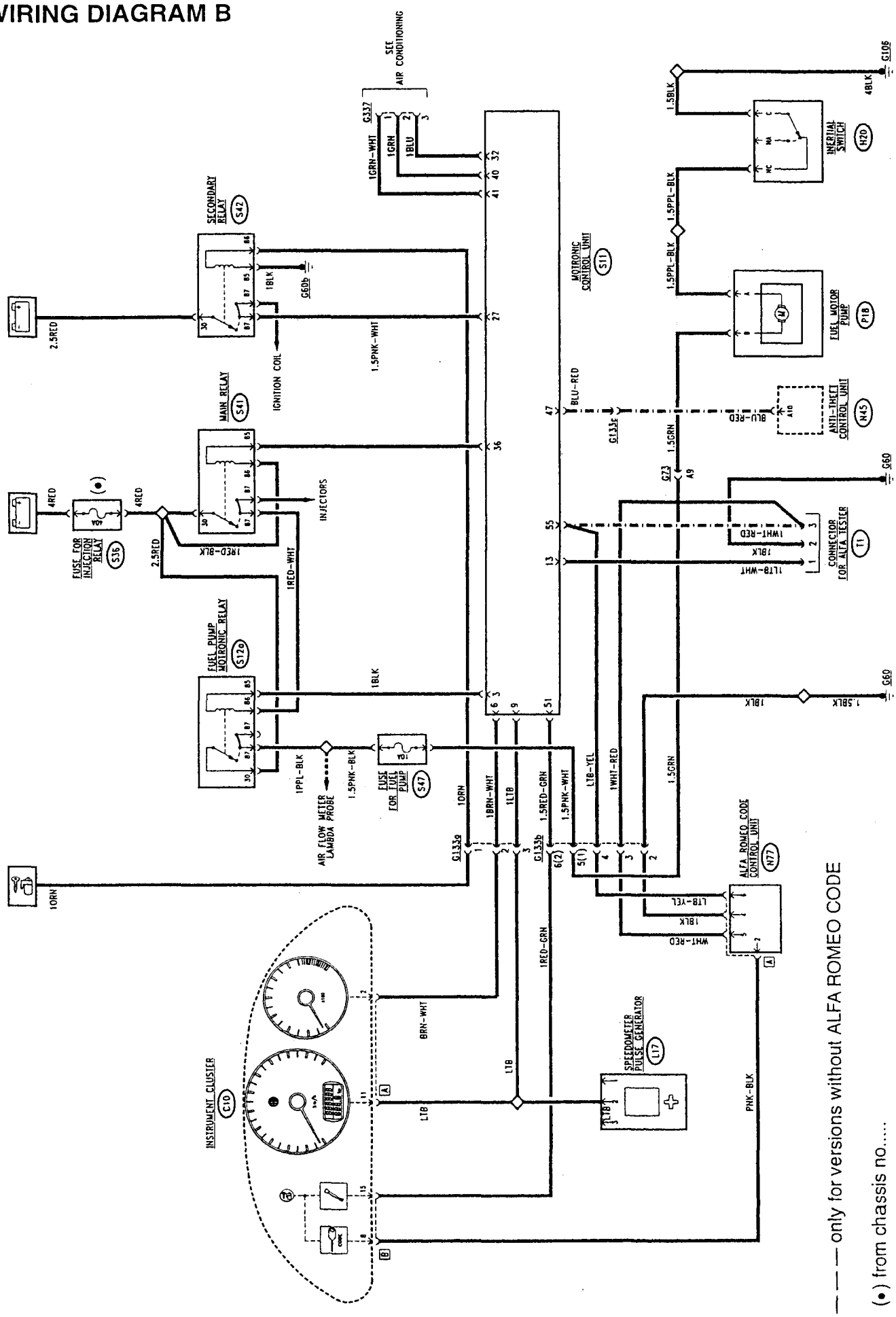
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WIRING DIAGRAM A



WIRING DIAGRAM B



GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions.
This is the M 2.10.3 version of the proven and reliable BOSCH MOTRONIC.
Compared with the previous versions this new M 2.10.3 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions.

WARNING: the MOTRONIC M2.10.3 control unit is controlled by the ALFA ROMEO CODE system which enables the operation of it only after cheking the secret memorised code (for further details see "ALFA ROMEO CODE")

FUNCTIONS OF THE SYSTEM

Sequential and timed injection (S.E.F.I.)

With this control unit injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds through the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimal point of injection, calculated by the control unit according to special maps according to the load, speed and temperature of the engine).
NOTE: the instant considered in the processing of the maps is that of the start of injection.

Static ignition

An ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences; lastly it reduces the number of high voltage cables and connectors.
Static ignition takes place through two coils, according to the "lost spark" logic: this solution exploits the different pressures and environments existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas.
he voltage needed to strike the arc between the spark plug electrodes is high (appr. 10 kV) in the cylinder in the bursting stroke, while in the exhaust stroke, this voltage is extremely low (appr. 500 V).
The instant in which the control unit removes the command to one of the power stages, the passage of current in one of the primary circuits of the coil is cut off, thereby generating on the secondary, by induction, a rise in the voltage (up to 30 kV loadless).
While the high voltage rises, one side of the secondary circuit of the coil is closed to earth by the "lost spark" which strikes with appr. 500 V on the spark plug in the cylinder in the exhaust stroke. This makes it possible to raise the voltage on the spark plug connected to the other side of the secondary circuit which is in contact with the mixture in the cylinder, thereby causing its combustion.

Metering the air flow rate

The air flow meter has been newly designed and it is of the "heated film" type: the operating principle is based on a heated plate which is inserted in the intake manifold.

The film plate is kept at a constant temperature appr. 120°C) by a heating resistance placed in contact with it.
The mass of air flowing through the manifold tends to withdraw heat from the plate: therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.

N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure, etc).
This new air flow meter does not incorporate the intaken air temperature sensor which is separate, to be found just downstream of the air flow meter.

Cylinder detection

Following the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence.
The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.

Fuel pump

The complex control logic of the fuel pump carried out by the control unit immediately cuts off the supply to the engine as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.

In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously. This device is particularly importan' as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from

behind or in the case of other accidents in which the engine does not stop immediately.

OPERATING LOGIC

– Identification of the "operating point":

the "point of operation of the engine" is located through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

– Adjustment of injection times (quantity of fuel):

the control unit controls the injectors very quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine. Injection is "sequential", i.e. the injectors are opened in correspondence of the exhaust stroke of the corresponding cylinder

– Ignition adjustment (calculation of advances):

the control unit calculates the advance on the basis of the engine load (rpm and air flow); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

– Cold starting control:

during cold starts the control unit uses special advance values and injection times.

When a determinate temperature/rpm ratio is reached, the control unit resumes normal operating conditions.

– Control of enrichment during acceleration:

upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

– Fuel cut-off during deceleration:

with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The threshold values varies according to the temperature of the engine and the speed of the car.

– Control of idle speed:

the adjustment of the engine idle speed is carried out through the special actuator which acts on the throttle by- pass.

This device acts as a regulator for cutting in the various services (e.g. conditioner compressor): in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.

– Maximum Rpm limiting:

above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

– Combustion control -lambda probe-:

the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.
The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture). The electric signal sent by the probe to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
The signal from the lambda probe is processed inside the control unit by a special integrator which prevents sudden "oscillations".
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).
Through this probe it is also possible to adjust engine carburetion precisely and among other items, this makes it possible to meet emission limit regulations.

– Fuel vapour recovery:

the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

– Connection with the conditioner compressor:

the control unit is connected with the air conditioning system and controls the cutting in of the compressor according to the operating conditions of the engine.

As the conditioner absorbs a considerable amount of power, the control unit:

- adapts the engine idle speed each time the compressor cuts in; if the engine speed falls below 700, the compressor is cut out;
- in the case of the need for power (high speed - above 6000 rpm - or full load - max. throttle opening the compressor is cut out momentaneously.
- it prevents the compressor from cutting in when the engine is started until normal operating conditions are reached.
- **Connection with ALFA ROMEO CODE:** on cars fitted with the ALFA ROMEO CODE, as soon as the Motonic control unit receivers the "key at MARCIA" signal, it "asks" this system for consent to start the engine: this consent only takes place if the "ALFA ROMEO CODE" control unit recognises the code of the key engaged in the ignition swich as correct. This dialogue between the two control units takes place on diagnosis line K already used for the Alfa Romeo Tester.
- **Connection with the anti-theft device (on cars without ALFA ROMEO CODE):**

if the car is fitted with the electronic anti-theft device, the Motronic control unit receives consent to operate from the anti-theft control unit via a special signal: if this signal is "low" -earth- the control unit operates normally. If the signal becomes "high" - appr. 12 V - the control unit is deactivated and the engine will not start.

COMPONENTS

The electronic control unit receives the signals leading from the **sensors** which "read" the operation of the engine, it processes them according to a logic stored inside in "maps" which correlate the different parameters in the best way possible and it operates the **actuators** accordingly so that the engine always works with the highest level of regularity and yield.

The control sensors are the following:

- engine temperature sensor (**S7**);
- air temperature sensor (**S34**);
- sensor on throttle body (**S38**);
- rpm sensor (**S31**);
- cam angle sensor (**S52**);
- heated lambda sensor (**S35**)
- air flow meter (**S5**);

The actuators controlled by the system are the following:

- electroinjectors (**S3**);
- ignition coil (**A8**);
- fuel pump (**P18**);
- idle speed adjustment actuator (**S29**);
- vapour recovery solenoid valve (**M15**) .

The control unit is also connected with:

- the heating and ventilation system,
- The ALFA ROMEO CODE control unit **(N77)** or the alarm control unit **(N 45)**
- the instrument cluster **(C10)** to which it sends the signal for the rev counter, while it receives the car speed signal.
- sensor **L17** from which it receives the car speed signal.

The system is completed by four relays: the first three - the main relay (**S41**), secondary relay **S42** and fuel pump relay **S12a** operate the fuel pump, the injectors, the coils and the other components of the system, while the fourth - the air flow meter relay (**S12e**) - supplies the air flow meter.

The whole system is supplied by the line of fuse **S36** (40A) (only from chassis no. ...).

The supply line is protected by a wander fuse (**S46**), while special fuses protect the pump (**S47**), and the resistance of the lambda probe (**S45**).

Lastly there is an earth point (**G60**) on the engine.

The connector **T1** used for the connection with ALFA ROMEO Tester is located in the engine bay in an easily accessible position. For some vehicles it is located near the control unit.

FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and adjusts the entire electronic ignition and injection system.

The control unit is supplied at pin 18 directly by the battery through fuse **S46** (7.5A). At pin 37 it receives the supply from the main relay **S41**, while at pin 27 it receives the "key-operated" supply from the secondary relay **S42**.
Pins 2, 14, 19 and 24 are earthed and serve as reference respectively for the ignition, the injectors, electronic screening and the final power stages.

Two relays control the entire system:

The main relay **S41**, acts as supply relay for the whole system; it is energized by a control signal - earth - leading from pin 36 of the control unit and consequently sends the supply (12V) to pin 37 of the control unit itself, to the fuel pump relay **S12a**, to the vapour recovery solenoid valve **M15**, to the idle speed actuator **S29**, to the cam angle sensor **S52** and lastly to the injectors **S3**.
The secondary relay **S42**, energized by the "key-operated" supply, supplies the control unit at pin 27 and the primary windings of the coil **A8a**.

The secondary relay **S42**, energized by the "key-operated" supply, supplies the control unit at pin 27 and the primary windings of the coil **A8a**.

The fuel pump relay **S12a**, supplied by the main relay **S41**, is energized by a control signal - earth - leading from pin 3 of the control unit **S11**. Consequently, the relay supplies the resistance of the lambda probe **S35**, the air flow meter relay **S12e**, and of course the fuel pump **P18**; this supply line is protected by a special fuse **S47** (10A).

The earth reaches the pump **P18** via the inertial switch **H20** which cuts off the circuit in the event of impact.

The control unit **S11** receives numerous signals from the different sensores, thereby keeping all the engine operating parameters under control.

Through a frequency signal sent to pins 48 and 49 of the control unit, the rpm sensor **S31** supplies information about the engine rpm: the two above-mentioned signals are very low in intensity and are therefore suitably screened.

The sensor is inductive and detects the number of revolutions of the engine through the change in a magnetic field produced by the passage of the teeth of a "phonic" wheel (60 teeth) fitted on the flywheel.

The cam angle sensor **S52** (timing sensor), supplied at 12 V at pin 1, and connected to earth pin 3, sends a signal from pin 2 in frequency corresponding to the phase at pin 8 of the control unit itself.
The sensor comprises a Hall effect device due to which the voltage signal sent to the control unit "lowers" abruptly when the tooth machined on the camshaft passes in front of the sensor.

The heated lambda sensor **S35** supplies the control unit information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin 28 of the control unit, while pin 10 supplies the reference earth; these two signals are very low in intensity and are therefore suitably screened.
The sensor is heated by a resistance to make sure that it operates correctly also when the engine is cold; the resistance is supplied by the fuel pump relay **S12a** and it is protected by a specific fuse **S45** (7.5A).

The throttle body sensor **S38**, is connected with the control unit at pins 12 and 30, and generates a signal through a potentiometer which is sent to pin 53 and is proportionate with the degree of opening of the throttle itself.

The engine temperature sensor **S7**, connected to the reference earth at pin 30, supplies a signal to pin 45 proportionate with the temperature of the engine coolant, detected with an NTC material (resistance that lowers with the temperature).

The intaken air temperature sensor **S34**, connected to the reference earth at pin 30, supplies a signal at pin 54 that is proportionate with the temperature of the air in the intake box, detected with an NTC material (resistance that lowers with the temperature). The air flow meter **S5**, is supplied by the special relay **S12e**: from pin 26 of the control unit it receives the reference earth, while it sends a signal proportionate with the air flow to pin 7.

The air flow meter is of the "heated film" type: a diaphragm is interposed in a measurement channel, through which the intake air flows: this diaphragm is kept at a constant temperature by a heating resistance;the mass of air that crosses the measurement chanel tends to withdraw heat from the diaphragm, therefore, in order to maintain its temperature constant, a certain amount of current must flow through the resistance: this current, appropriately measured, is proportionate with the mass of air flowing in the channel.

Relay **S12e**, supplied directly with 12 V, is energized by the fuel pump relay **S12a** and thus supplies the meter **S5** itself.

On the basis of the signals received from the sensors and of the calculations carried out the control unit **S11** controls the opening of the single injectors **S3** through special signals - of the duty-cycle type - pins 17 (cyl. 1), 35 (cyl. 2), 16 (cyl. 3) and 34 (cyl. 4). The injectors receive consent (12V) to open from the main relay **S41**.

The static ignition system is controlled by the control unit directly which automatically adjusts the advance.
N.B. the power modules which generate the high voltage pulses are located inside the control unit. The control signals (earth) lead from the control unit (pin 1 and 20) for the primary windings of the coil **A8**, while the secondary winding sends the pulse to the spark plugs **A12**.
The primary windings of the coil **A8** are supplied at 12 V ("key-operated") by relay **S42**.

The power modules inside the control unit are connected to earth via pin 2.

The idle speed adjustment actuator **S29** forms a by-pass line for the flow of air; this comprises two windings: one opens and the other closes a valve that adjusts the gap of the by- pass section; a safety spring establishes a mean opening value in the event of a failure to this device; the actuator, supplied by the main relay, **S41**, is controlled by the control unit through the duty-cycle signals from pin 22 (opening) and 4 (closing).

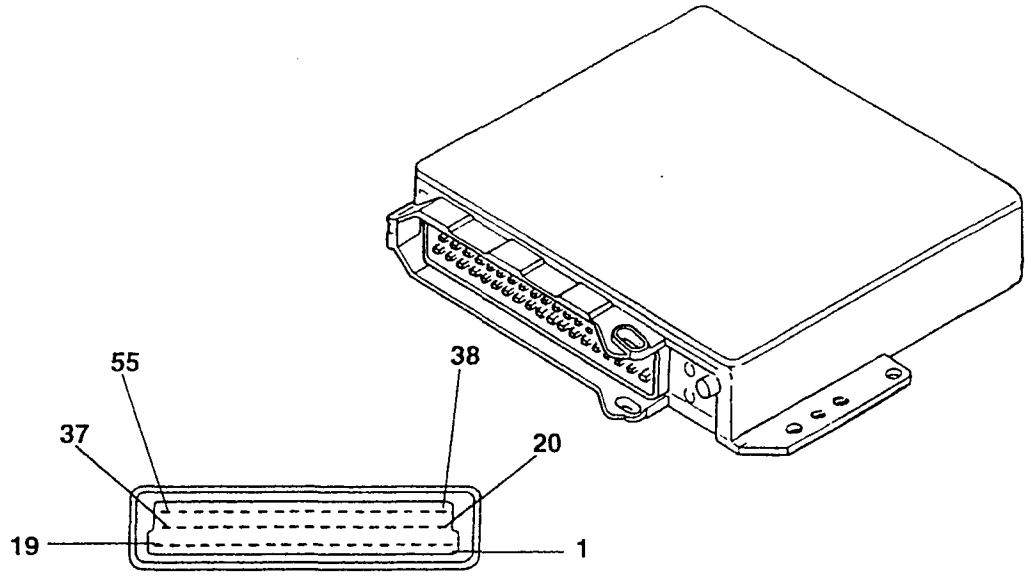
The vapour recovery solenoid valve **M15** allows the passage of the vapours towards the engine intake where they are added to the mixture entering the combustion chamber; this valve, supplied by the main relay **S41**, is opened by the control unit when the engine is under load through a duty cycle signal from pin 5.

The tachometric signal (car speed) reaches the control unit at pin 9 via sensor **L17**; while from pin 6 the

control unit sends a "pulse" signal to the cluster which is proportionate with the number of revolutions of the engine; the signal for the warning light on the instrument cluster **C10** leaves from pin 51.
The control unit **S11** is connected with the air conditioning system through pins 32, 40 and 41.
This makes it possible to adapt the engine idle speed to the increased power each time the compressor cuts in, or to cut it out in the case of high speed or engine loads. For further details see the "Heating and ventilation" section.

The control unit **S11** is connected from pin 55 with the ALFA ROMEO CODE control unit **N77** via the diagnosis line K; this way if it does not detect a correct "key code" it does not give consent to the Motronic control unit which does not begin the normal operating stage (for further details see the "ALFA ROMEO CODE" section).

Only for versions without ALFA ROMEO CODE:
From pin 47 the control unit **S11** is connected with the anti- theft control unit **N45** from which it receives the necessary consent to operate the entire system: an earth signal enables normal operation; a voltage or a.c. signal inhibits the operation of the entire control unit.
The control unit possesses a self-diagnosis system which can be used through connection to the ALFA ROMEO Tester at connector **T1**; the tester receives the fault signals from the control unit through thediagnosis lines L - pin 13 -and K - pin 55 -, while the earth leads from **G60** (line K is also used by the ALFA ROMEO CODE control unit).

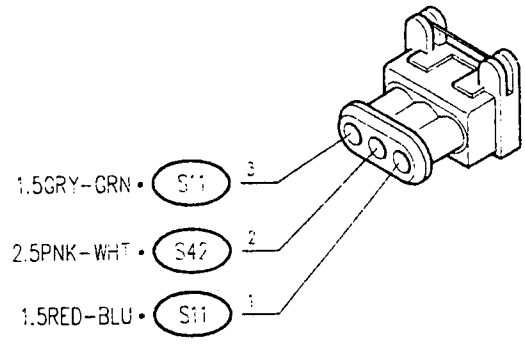


CONTROL UNIT PIN-OUTS

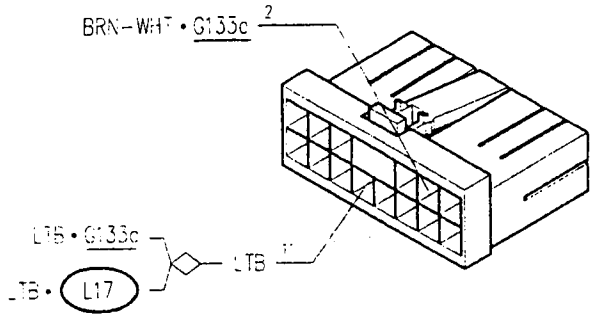
1. Ignition coil control - cyl. 2 and 3 - (from internal final stage)
2. Earth for ignition
3. Fuel pump control relay
4. Idle speed actuator control - opening
5. Evaporative solenoid valve control
6. Rev counter signal
7. Air flow meter signal
8. Timing signal
9. Car speed signal
10. Lambda probe signal
11. N.C.
12. Stabilised voltage (5V) for throttle sensor
13. Diagnosis line L
14. Earth for injectors
15. N.C.
16. Injector cyl. 3
17. Injector cyl. 1
18. Direct supply
19. Electronic screening earth
20. Ignition coil control - cyl. 1 and 4 - (from internal final stage)
21. N.C.
22. Idle speed actuator control - closing
23. N.C.
24. Earth for final stages
25. N.C.
26. Air flow meter earth
27. "key-operated" supply, from secondary relay
28. Lambda probe signal
29. N.C.
30. Electronic earth for sensors
31. N.C.
32. Air conditioner compressor relay control
33. N.C.
34. Injector cyl. 4
35. Injector cyl. 3
36. Main relay control
37. Supply from main relay
38. N.C.
39. N.C.
40. Request to cut in compressor
41. Request to cut out conditioning system
42. N.C.
43. N.C.
44. N.C.
45. Engine temperature signal
46. N.C.
47. Switch for anti-theft (for cars without ALFA ROMEO CODE)
48. Rpm sensor signal
49. Rpm sensor signal
50. N.C.
51. Signal for warning light on instrument cluster
52. N.C.
53. Throttle position signal
54. Intaken air temperature signal
55. Diagnosis line K (via ALFA ROMEO CODE control unit)

COMPONENTS AND CONNECTORS

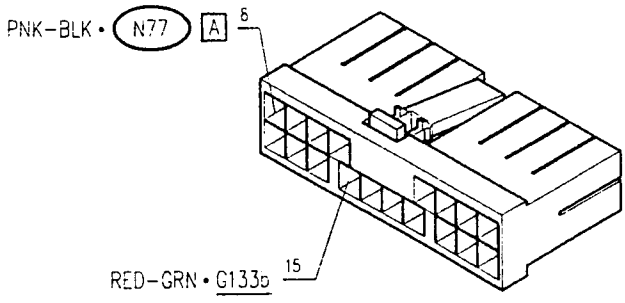
Ignition coil	A8



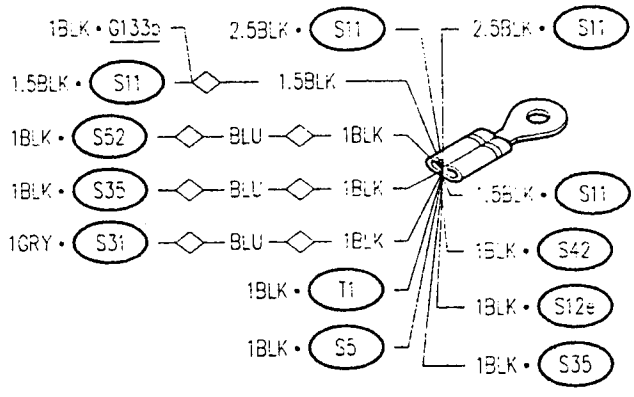
Instrument cluster	C10 A



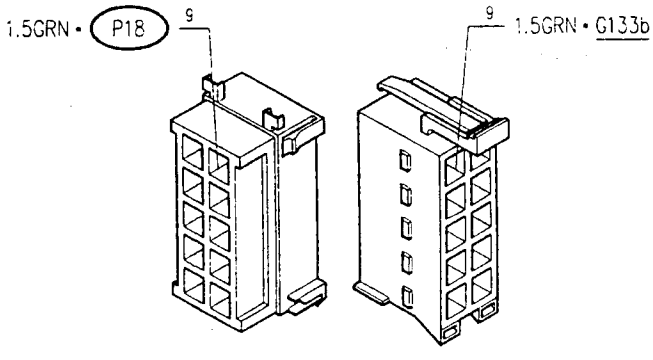
Instrument cluster	C10 B



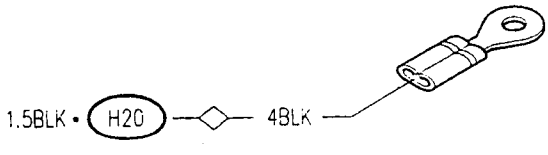
Injection wiring earth	G60



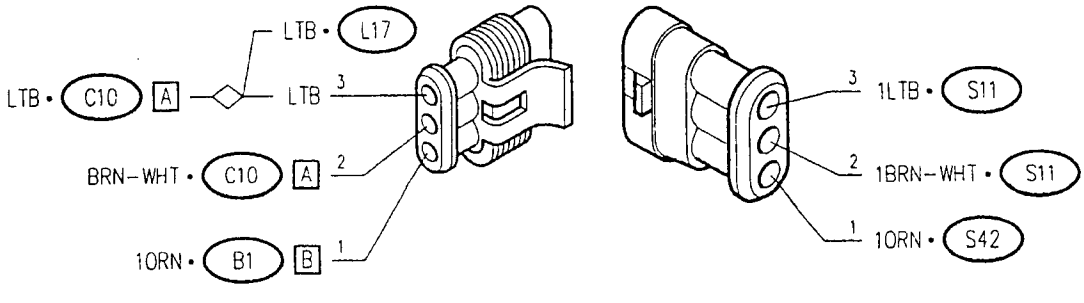
Rear services connector	G73 A



Seat crossrail earth	G106

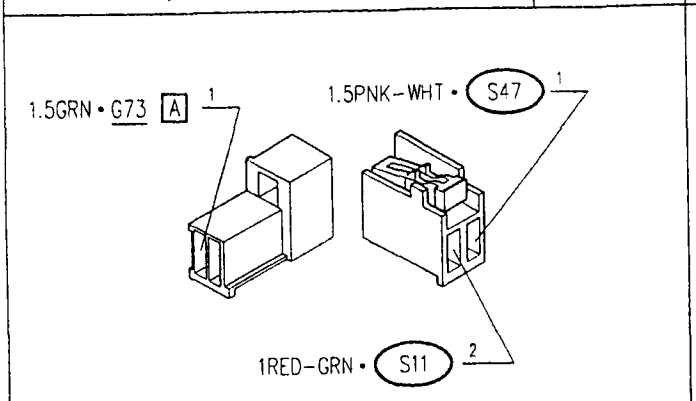


Electronic injection wiring connector A	G133a

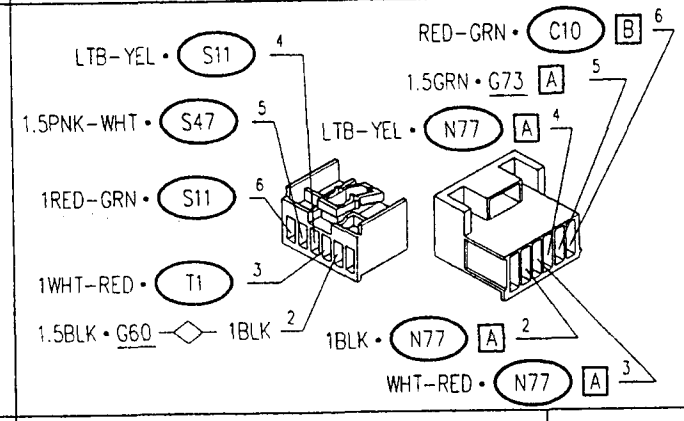


COMPONENTS AND CONNECTORS (cont.d

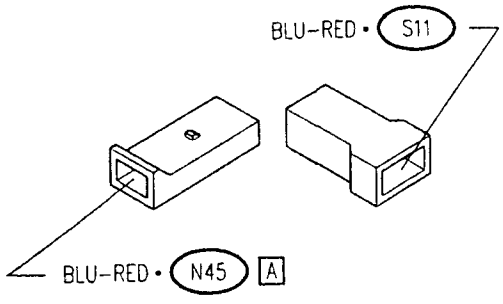
Electronic injection wiring connector B (*)	G133b



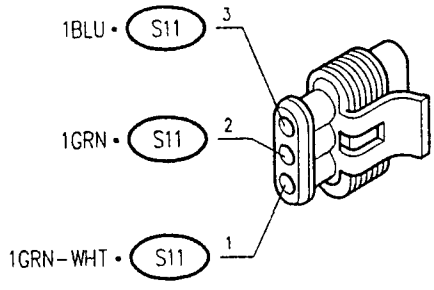
Connector for electronic injection wiring B	G133b



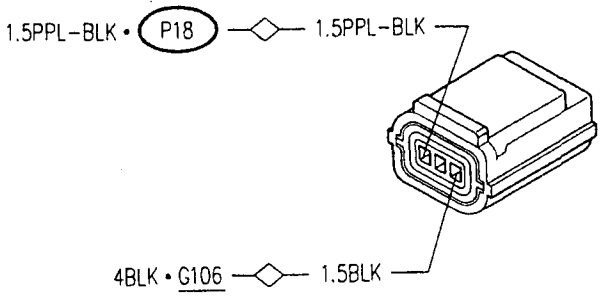
Electronic injection wiring connector C (*)	G133c



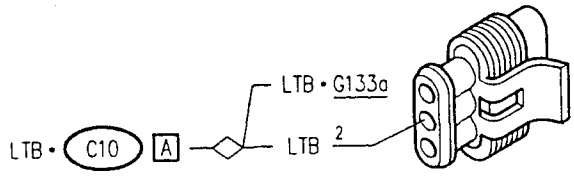
Conditioner/injection system connector	G337



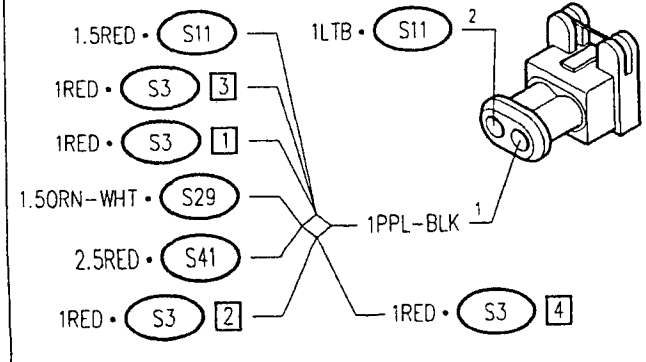
Inertial switch	H20



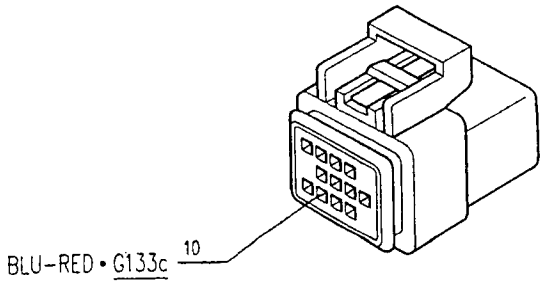
Tachometric sensor	L17



Evaporative solenoid valve	M15



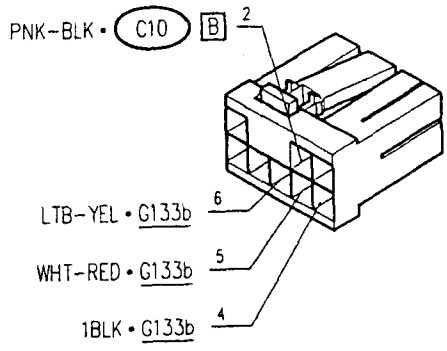
Anti-theft control unit (*)	N45 A



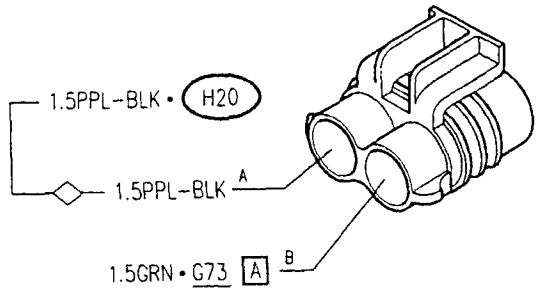
(*)only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

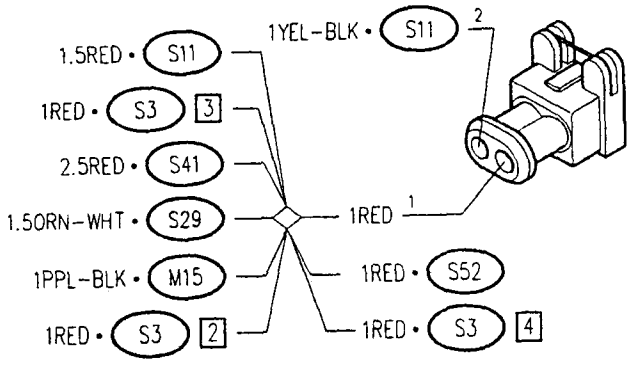
ALFA ROMEO CODE control unit — N77 A



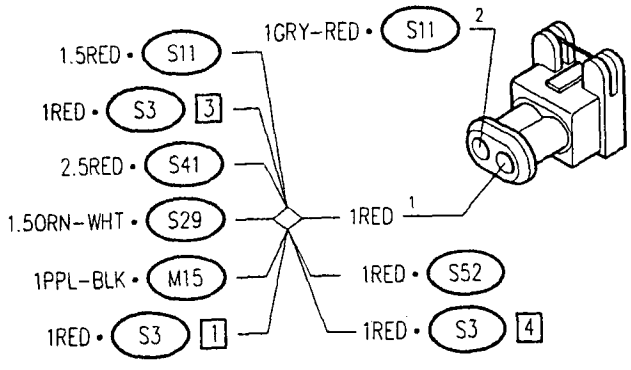
Electric fuel pump — P18



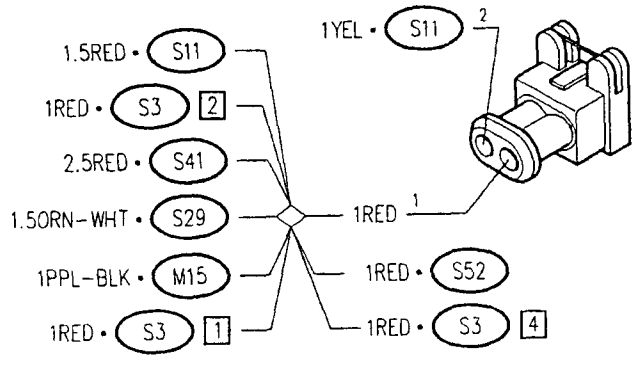
Electroinjector — S3 1



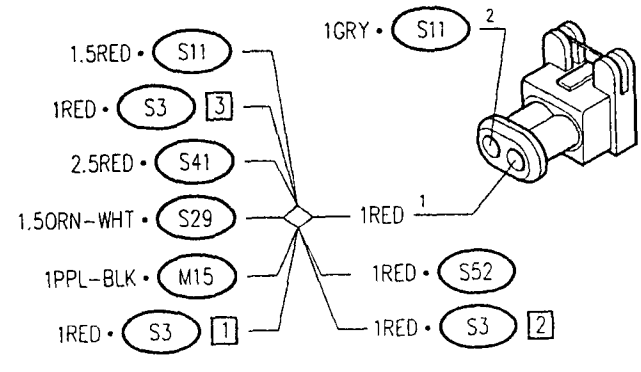
Electroinjector — S3 2



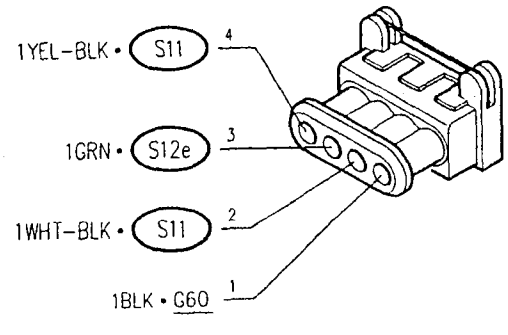
Electroinjector — S3 3



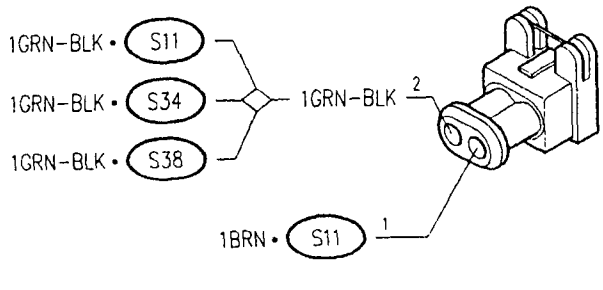
Electroinjector — S3 4



Air flow meter — S5

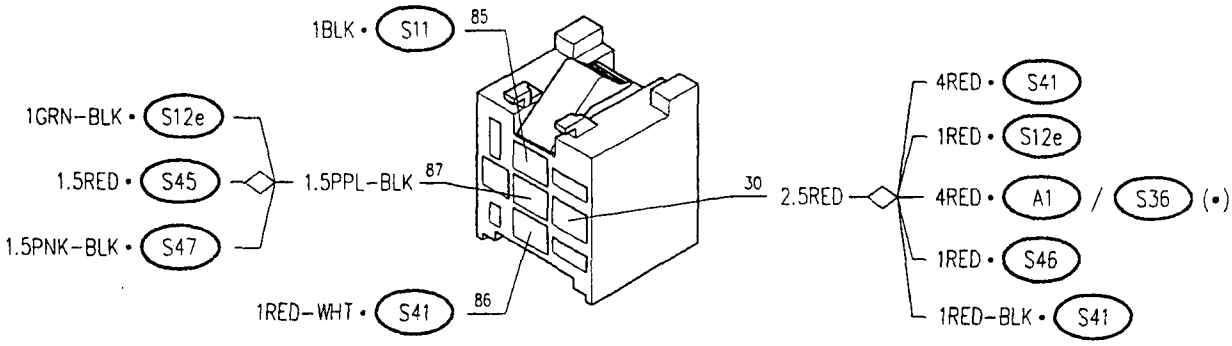


Engine temperature sensor — S7

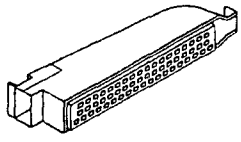


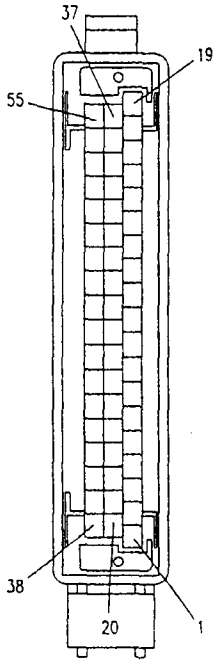
COMPONENTS AND CONNECTORS (cont.d)

Fuel pump Motronic relay — S12a



Motronic control unit — S11





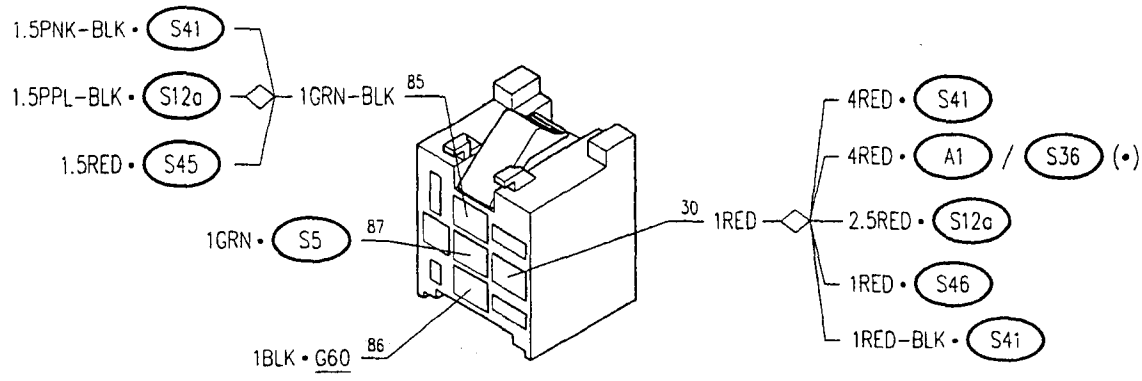
1 1.5RED-BLU • A8
2 2.5BLK • G60
3 1BLK • S12a
4 1BLK-PPL • S29
5 1LTB • M15
6 1BRN-WHT • G133a
7 1YEL-BLK • S5
8 1WHT • S52
9 1LTB • G133a
10 1BLK • S35
12 1LTB-RED • S38
13 1LTB-WHT • T1
14 2.5BLK • G60
16 1YEL • S3 [3]
17 1YEL-BLK • S3 [1]
18 1RED • S46
19 1.5BLK • G60
20 1.5GRY-GRN • A8
22 1LTB-BLK • S29
24 1.5BLK • G60
26 1WHT-BLK • S5
27 1.5PNK-WHT • S42
28 1GRN • S35
30 1GRN-BLK — 1GRN-BLK • S34 / 1GRN-BLK • S38 / 1GRN-BLK • S7
32 1BLU • G337
34 1GRY • S3 [4]
35 1GRY-RED • S3 [2]
36 1RED • S41
37 1.5RED — 1RED • S3 [3] / 1RED • S3 [1] / 1.5ORN-WHT • S29 / 1PPL-BLK • M15 / 2.5RED • S41 / 1RED • S52 / 1RED • S3 [2] / 1RED • S3 [4]
40 1GRN • G337
41 1GRN-WHT • G337
45 1BRN • S7
47 BLU-RED • G133c (*)
48 1YEL • S31
49 1BLK • S31
51 1RED-GRN • G133b
53 1ORN • S38
54 1ORN-WHT • S34
55 LTB-YEL • G133b
(1WHT-RED) • T1 (*)

(*)only for versions without ALFA ROMEO CODE

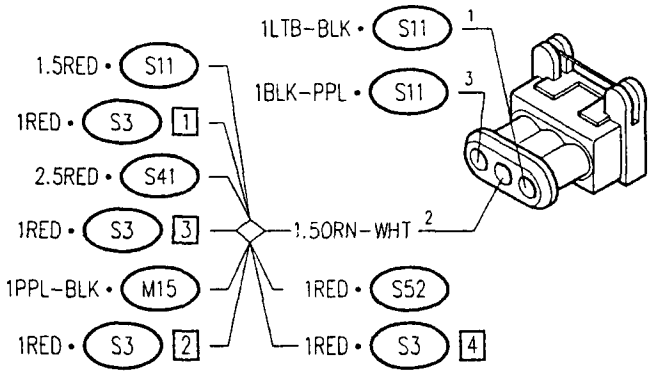
(•) from chassis no.....

COMPONENTS AND CONNECTORS (cont.d)

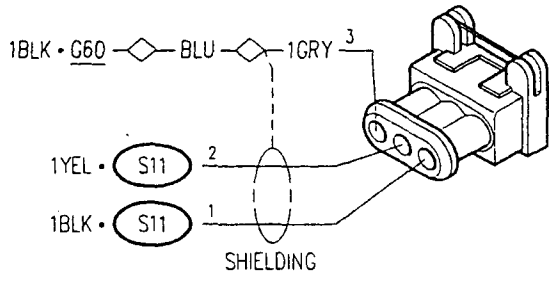
Air flow meter relay — S12e



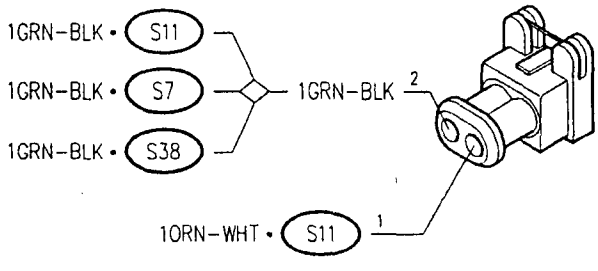
Idle speed adjustment actuator — S29



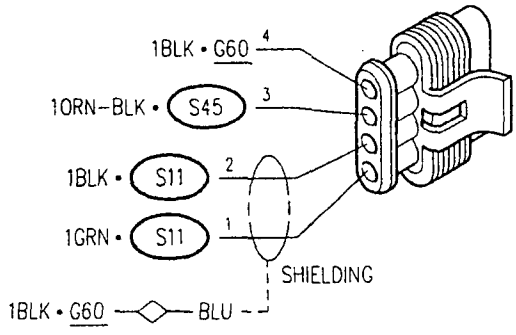
Rpm and crankshaft position sensor — S31



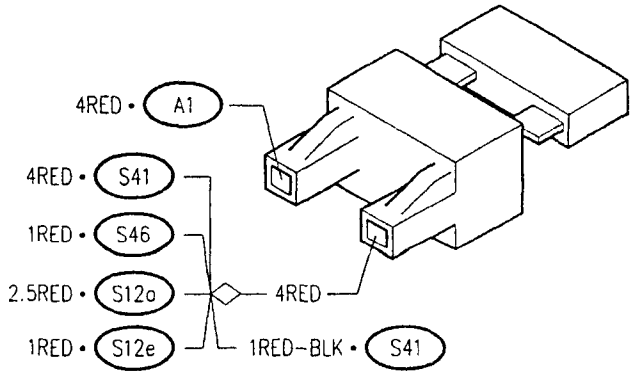
Air temperature sensor — S34



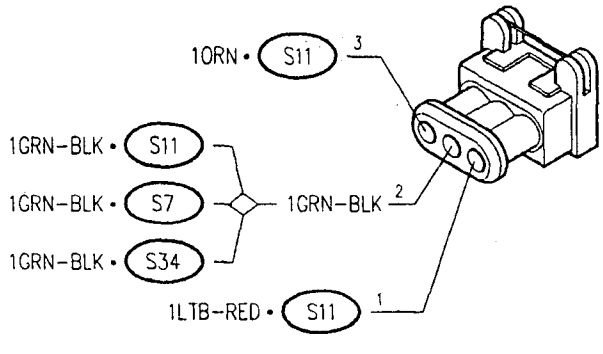
Heated lambda probe — S35



Fuse for injection relay (•) — S36



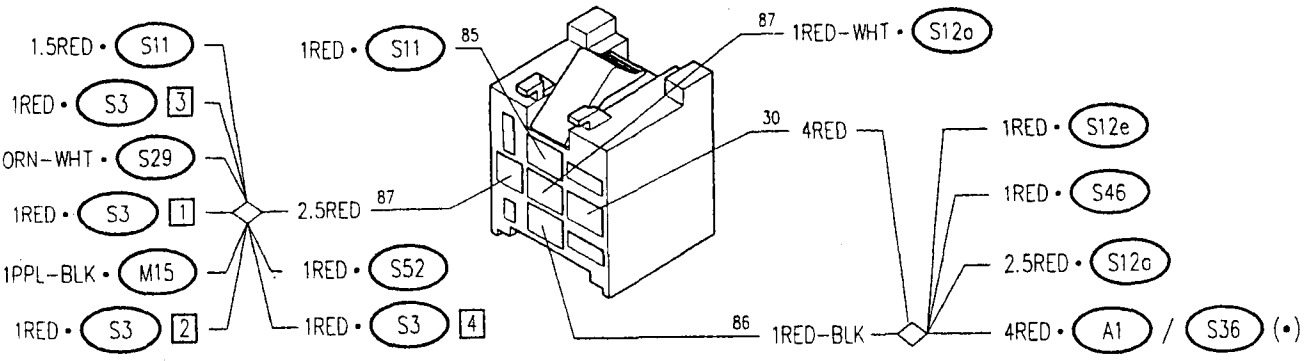
Sensor on throttle body — S38



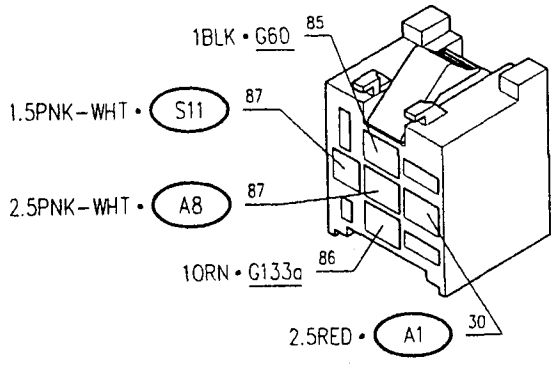
(•) from chassis no.....

COMPONENTS AND CONNECTORS (cont.d)

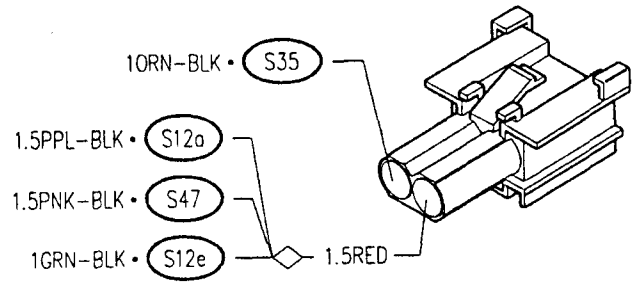
Main relay — S41



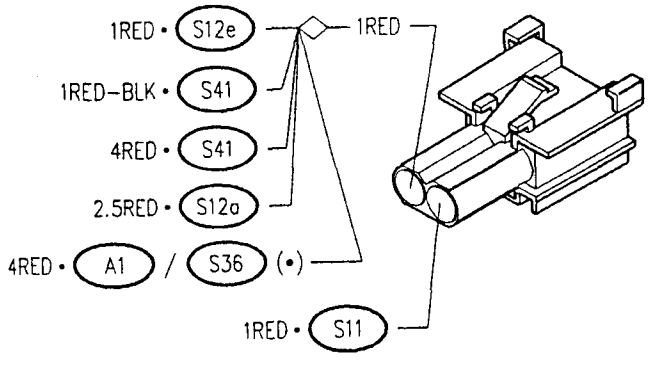
Secondary relay — S42



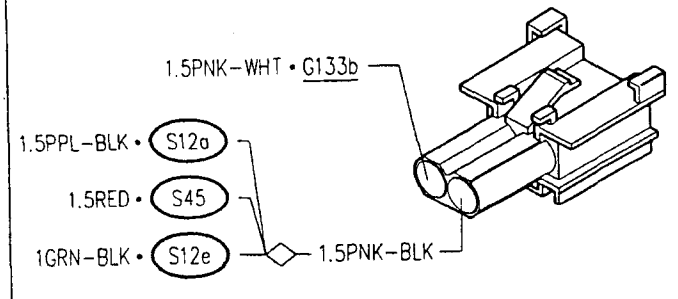
Lambda probe wander fuse — S45



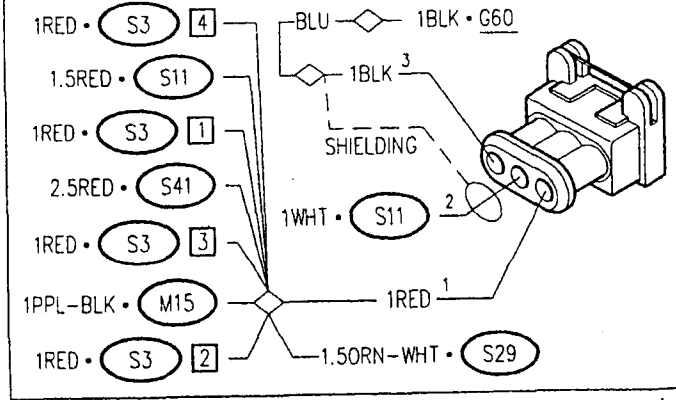
Motronic supply wander fuse — S46



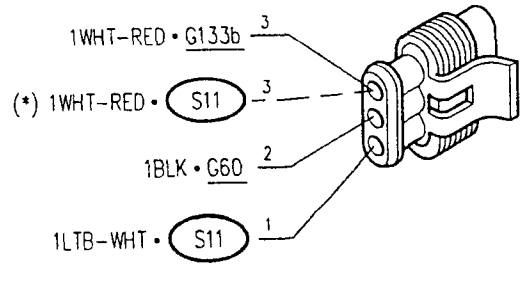
Fuel pump wander fuse — S47



Cam angle sensor — S52



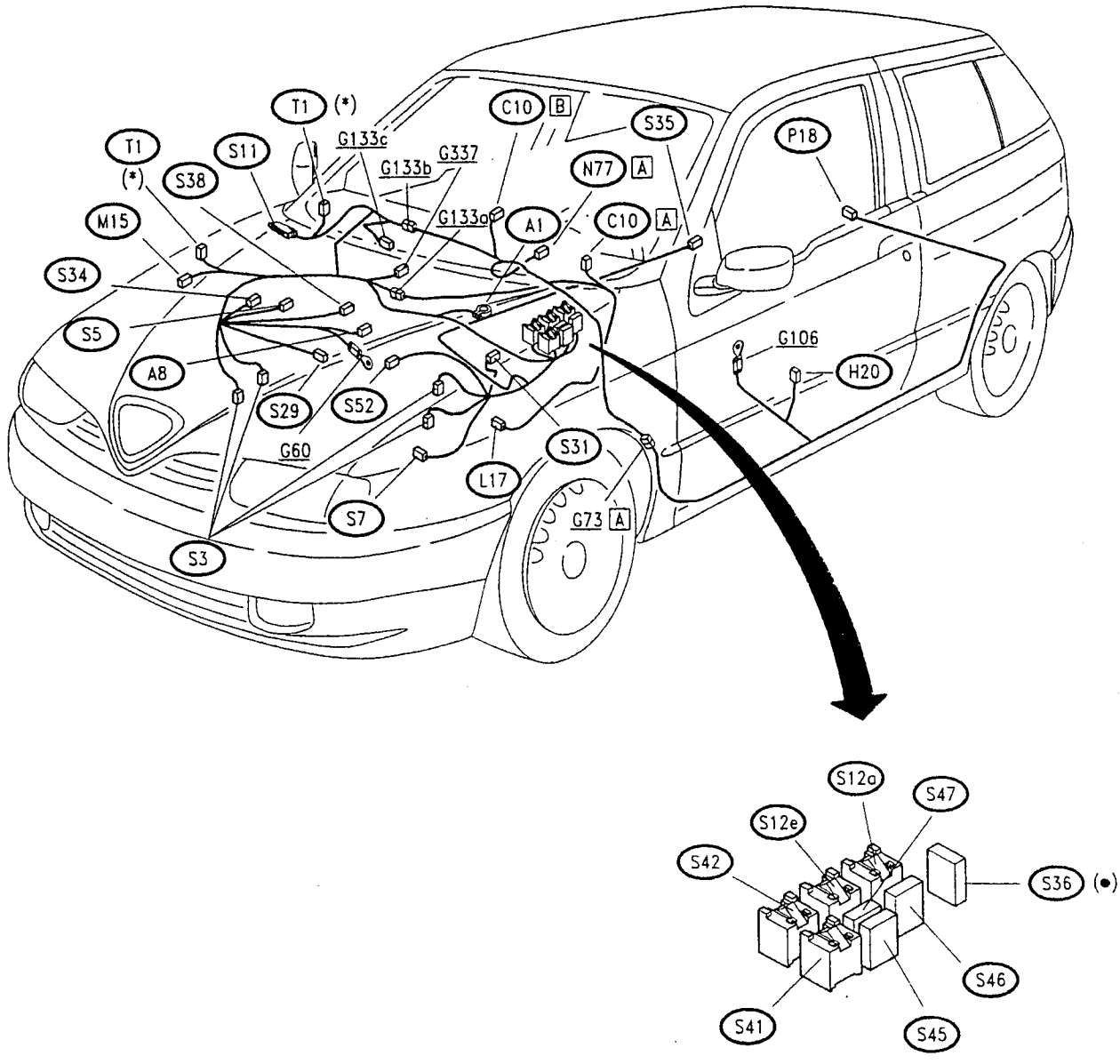
Connector for ALFA TESTER (Motronic) — T1



(*)only for versions without ALFA ROMEO CODE

(•) from chassis no.....

LOCATION OF COMPONENTS



(*) The connector **T1** is, for some vehicles only, located near the control unit **S11**; in all other cases it is locate in the engine bay.

(•) from chassis no.....

FAULT-FINDING

The control unit is fitted with a **self-diagnosis**, which continuously checks the signals from the different sensors for plausibility and compares them with the limit values allowed: if these limits are exceeded, the system detects a fault and stores it in the memory, and also turns on the special **warning light on the instrument cluster.**
With the key at MARCIA, the warning light turns on and stays on until the engine has been started, then it goes off. If it stays on, this means that a fault has been memorised.
For certain parameters, the abnormal values are replaced by suitable mean values to make it possible for the car to "limp" to a Service Centre. These are known as "recovery" values. They depend on other signals that are not failing and are defined each time by the operating logic of the control unit.

The self-diagnosis system also enables quick and effective fault-finding connecting to the ALFA ROMEO Tester, through which all the errors stored may be "read". It is also possible to check the operating parameters recorded by the control unit and command the turning on of the single actuators to check whether they are working properly.

Diagnosis using the ALFA TESTER

N.B.Before carrying out diagnosis with the Tester, carry out the preliminary check described below (**TEST A**).

The connection between the Tester and the electronic control unit must be carried out as follows:

1. Power the Tester either through the cigar lighter socket or connecting it directly to the battery using the cable provided.
2. Connect the Tester socket to that of the control unit (the socket is to be found near the control unit itself).

The information the instrument can give comprises:

- display of the parameters;
- display of errors;
- active diagnosis.

Error clearing

Before ending diagnosis the contents of the "permanent" memory should be cleared by the Tester in the "Active Diagnosis" function.

In the failure to do so, the next time the Tester is connected, errors that have already been examined will be signalled.

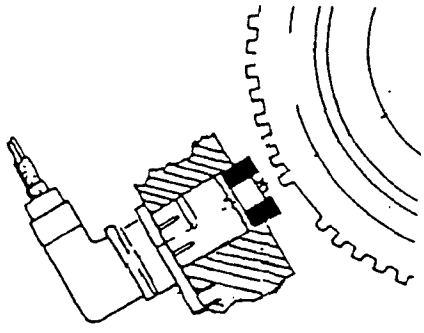
The contents of the "permanent" memory can be cleared as follows:

- using the Tester in Active Diagnosis
- if the cause that determined the error is no longer present and the engine has been started 10 times (operating for no less than 20 minutes) with at least 2 minutes between one start and the next.

N.B.: Disconnecting the control unit from the system the "permanent" memory is deleted.

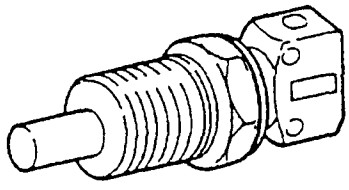
CHECKING COMPONENTS

Rpm sensor (S31)



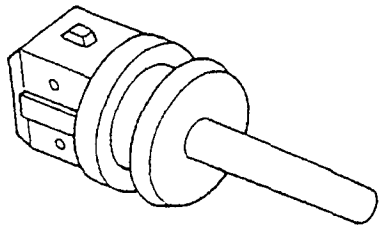
SPECIFICATIONS	
Sensor winding resistance 20 °C	486 ÷ 594 Ω
Gap between sensor and fly-wheel ring gear	0.25 ± 1.3 mm

Engine temperature sensor (S7)



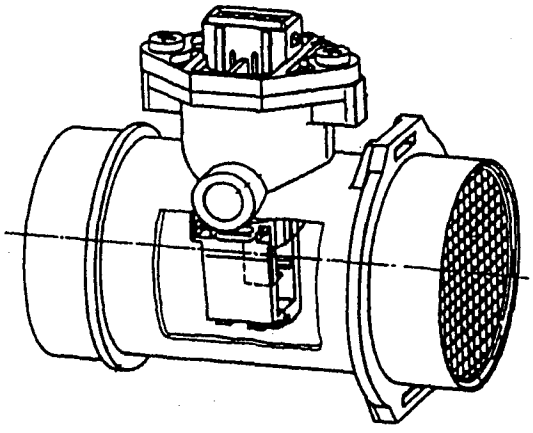
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

Intaken air temperature sensor (S34)

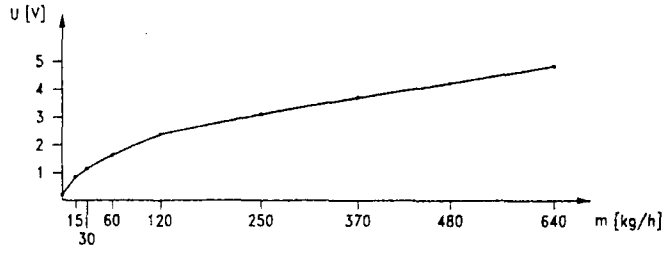


SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

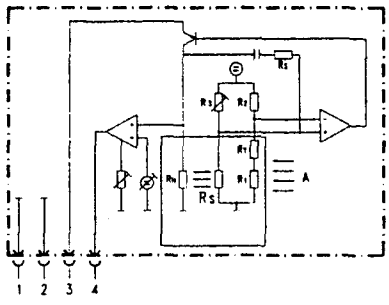
Air flow meter (S5)



SPECIFICATIONS	
Current that crosses the diaphragm:	
flow rate (kg/h)	current (A)
0 640	≤ 0.25 ≤ 0.80

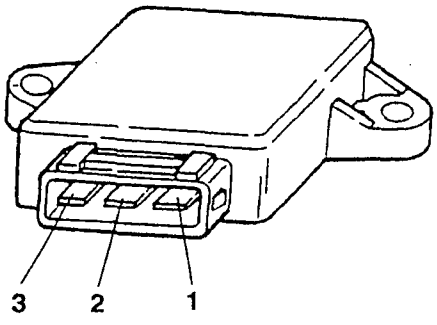


Characteristic curve of sensor
m = flow rate
U = voltage between pins 4 and 2



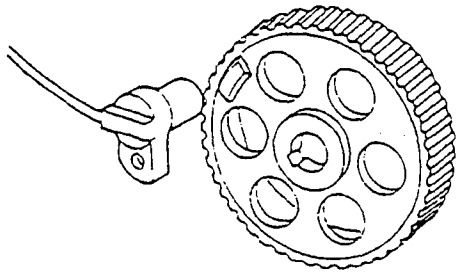
pin 1 - Earth
pin 2 - Reference earth
pin 3 - 12 V supply
pin 4 - Measurement signal
A = air
Rs = hot film sensor

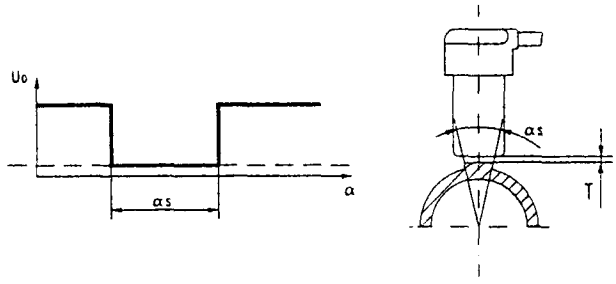
Throttle position sensor (S38)

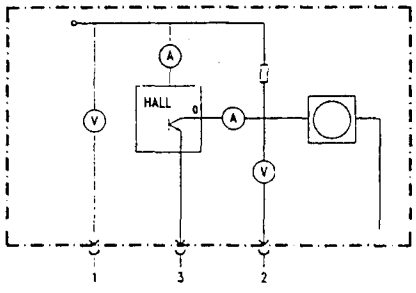


SPECIFICATIONS	
Resistance between terminals:	
1 - 2 (fixed)	≃ 2 kΩ
1 - 3 (throttle closed)	≃ 1 kΩ
1 - 3 (throttle completely open)	≃ 2.7 kΩ

Cam angle sensor (S52)

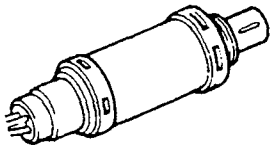


SPECIFICATIONS
The voltage signal "lowers" sharply when the tooth machined on the camshaft passes in front of the sensor itself:

Gap T = 0.1 ÷ 1.5 mm



pin 1 - Supply
pin 2 - Output signal
pin 3 - Earth

Lambda probe (S35)



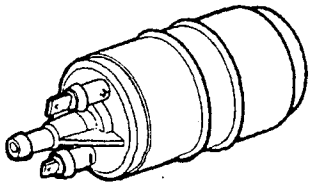
SPECIFICATIONS	
Heating resistance	3 Ω

Electroinjectors (S3)



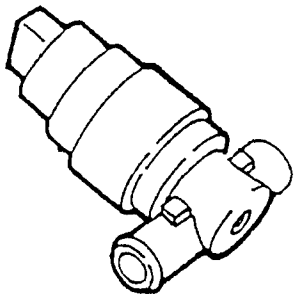
SPECIFICATIONS	
Winding resistance	16 ± 0.5 Ω

Fuel pump (P18)



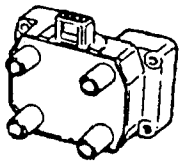
SPECIFICATIONS	
Flow rate	≥120 l/h
Pressure	4 bar
Nominal voltage	12V

Idle speed adjustment actuator (S29)



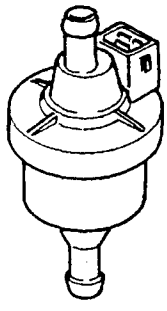
SPECIFICATIONS	
Resistance between terminals:	
1 - 3	~ 24 Ω
1 - 2	~ 12 Ω
2 - 3	~ 12 Ω

Ignition coil (A8)



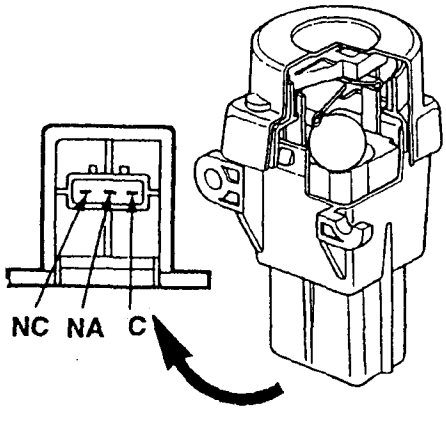
SPECIFICATIONS	
Primary resistance	0.5 Ω
Secondary resistance	13.3 Ω

Evaporative solenoid valve (M15)



SPECIFICATIONS	
Duty-cycle signal	12 V; 10 Hz
Ohmic resistance of the winding	45 Ω ± 1 %
When not energized the solenoid valve is normally closed	

Inertial switch (H20)



SPECIFICATIONS
Check the continuity between pins NC and C: this continuity is cut off in the event of a crash; the contact is re- connected by pressing the special pushbutton

PRELIMINARY CHECK OF THE BOSCH M2.10 SYSTEM	TEST A

NOTE: Beforehand, check that the ALFA ROMEO CODE system is working properly as it may have cut off the supply to the system (see "ALFA ROMEO CODE" section) or, if the ALFA ROMEO CODE is not installed check the connection with the anti-theft system.

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check intactness of fuses **S45**, **S46** and **S47**	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Change fuses **S45**: 7.5A **S46**: 7.5A **S47** : 10A
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relays **S41, S42, S12a** and **S12e** and also at pin 86 of **S41**	OK ▶	Carry out **step A3**
	~~OK~~ ▶	Restore the wiring between the battery **A1** and relays **S41, S42, S12a** and **S12e**
A3 CHECK VOLTAGE – With the key turned, check for 12 V at pin 86 of relay **S42** and at pin 86 of **S12a**	OK ▶	Carry out step A4
	~~OK, a~~ ▶	Restore the wiring between the ignition switch **B1** and relay **S42** and between **S41** and **S12**
A4 CHECK RELAYS – Check the correct operation of relays **S41**, **S42** and **S12a**	OK ▶	Carry out **step A5**
	~~OK~~ ▶	Change any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – Check for 12 V at pin 18 of control unit **S11**; with the key turned 12 V also at pins 27 and 37 of **S11** and appr. 0 V (very low voltage) at pin 3 and 36 of **S11**	OK ▶	Carry out **step A6**
	~~OK~~ ▶	Restore the wiring between the control unit **S11** and the relays and between the control unit and fuse **S46**
A6 CHECK EARTH – Check for an earth at pins 19 and 24. Also check for an earth at pin 85 of **S42** and at pin 86 of **S41**	OK ▶	**CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER**
	~~OK~~ ▶	Restore the wiring between **S11** and the relays and earth **G60**

JTD ELECTRONIC INJECTION

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INTRODUCTION

An electronic control system supervises and adjusts all the engine parameters, optimising performance and consumption through response in real time to the different operating conditions.

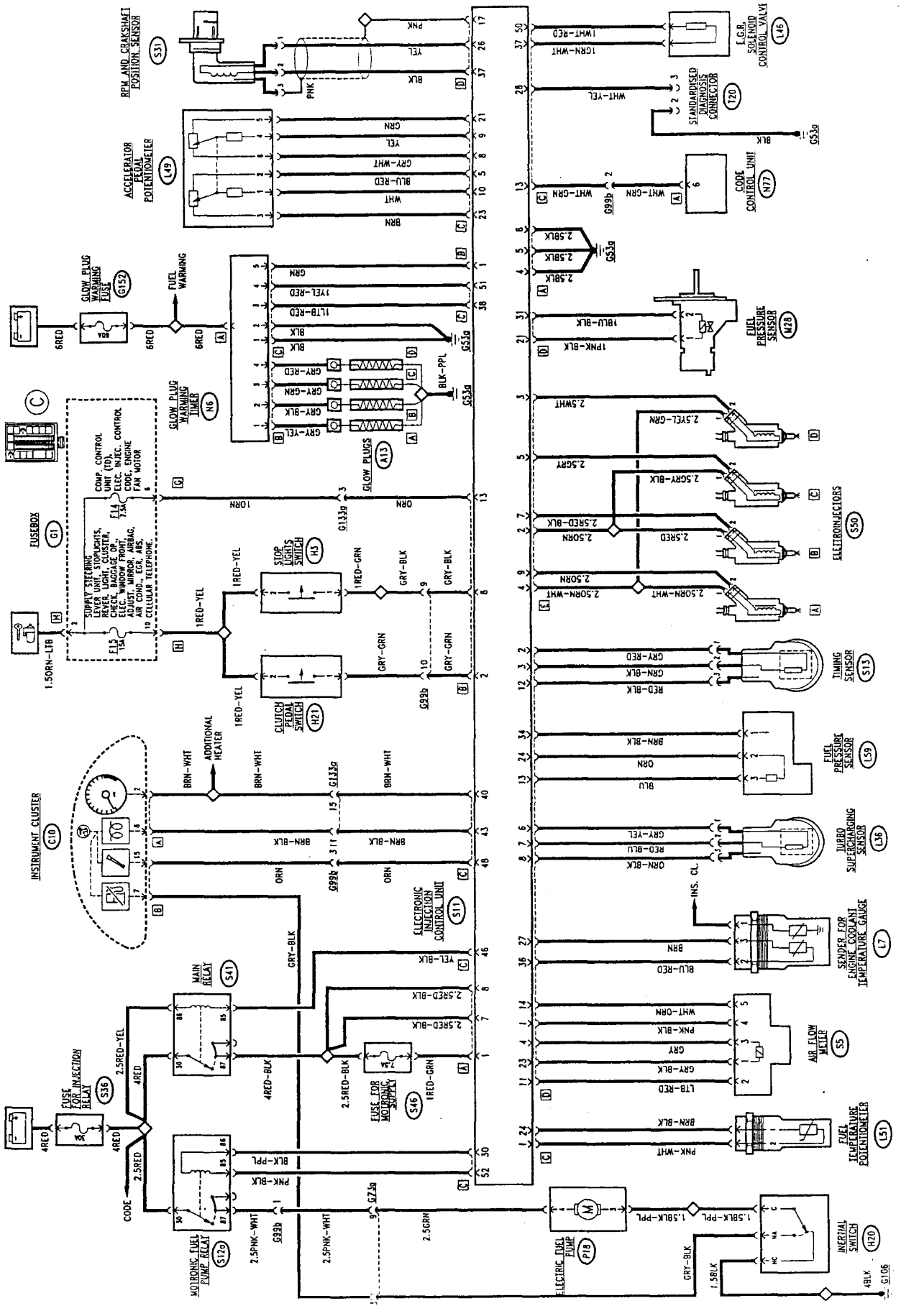
The Diesel engine is fitted with a UNIJET "COMMON RAIL" injection system. This features the use of a high injection pressure controlled electronically. Fuel delivery, called pilot injection, is optimised by the electronic control unit through the injector rather than being controlled by the pump.

Depending on the signals received from a number of sensors, the control unit drives the actuators connected to it, controlling the following systems:

- fuel supply;
- air supply;
- glow plug warming;
- accelerator pedal;
- engine cooling;
- fuel warming.

JTD DIRECT INJECTION

Wiring Diagram



General Description

The system controls the engine and all the systems that make it run:

- fuel supply system;
- air supply system;
- engine cooling system;
- exhaust system with catalytic silencer;
- oil vapour recirculation system;
- exhaust gas recirculation system (E.G.R.).

Operation of these systems is optimised by an electronic control system governed by a control unit.

This is a high pressure electronic injection system for fast diesel engines with direct injection.

Its main features are:

- high injection pressures (1350 bar);
- possibility of modulating these pressures between 150 bar up to the maximum operating pressure of 1350 bar, regardless of the engine speed and load;
- capability of working at high engine speeds (up to 6000 rpm);
- injection control precision (advance and length of injection);
- reduction of consumption levels;
- reduction of emissions.

The main functions of the system are the following:

- fuel temperature control;
- engine coolant fluid temperature control;
- injected fuel quantity control;
- idle speed control;
- fuel cut-off during deceleration;
- cylinder balancing control at idle speed;
- anti-sawing control;
- smoke control at the exhaust during acceleration;
- exhaust gas recirculation control (E.G.R.);
- maximum torque limiting control;
- maximum rpm limiting control;
- glow plug control;
- climate control system engagement control;
- auxiliary fuel pump control;
- cylinder position control;
- main and pilot injection advance control;
- injection pressure closed loop control;
- electrical balance control;
- supercharging pressure control;
- self-diagnostics;
- connection with Alfa Romeo CODE control unit.

Operation

The control unit controls the amount of fuel injected, adjusting the line pressure and injection times.

The information processed by the control unit to control the amount of fuel to be injected is the following:

- engine rpm;
- coolant fluid temperature;
- supercharging pressure;
- air temperatue;
- intake air quantity;
- battery voltage;
- fuel pressure;
- accelerator pedal position.

Self-diagnostics

The control unit self-diagnostic system checks the signals leading from the sensors comparing them with the allowed limit data and carries out the following

- warning of faults at starting
  - warning light on for 4 seconds: indicates testing;
  - warning light off after 4 seconds: indicates no fault to components which may affect the values required by antipollution regulations;
  - warning light on after 4 seconds: indicates a fault.
- fault signalling when the engine is running:
  - warning light on: indicates a fault;
  - warning light off: indicates no fault to components which may affect the values required by antipollution regulations.

Functional Description

The engine control unit **S11** controls and adjusts the entire electronic injection and ignition system.

The control unit receives the key-operated supply at pin 13 of connector B from the line protected by fuse **F14** of fusebox **G1**.

Relay **S41** controls the system supply: it is supplied from the battery, by the line of fuse **S36**. The enable signal from pin 46 of connector C of the control unit **S11** energises relay **S41** and sends the supply to the control unit itself, at pins 7, 8 and 1 of connector A (the line that leads from **S41** to pin 1 is also protected by wander fuse **S46**).

The pump relay **S12a** is also supplied from the battery, by the line of fuse **S36**: the signals that energise the pump relay **S12a**, which supplies the electric fuel pump **F18** lead from pins 30 and 52 of connector C of the control unit. The fuel pump is connected to an inertial switch **H20**, which in the event of a crash cuts off the circuit, thereby stopping the dangerous flow of fuel.

In case of intervention on switch **H20**, the relative telltale light on the panel **C10** is also turned on.

The control unit **N6** controls glow plug warming **A13**: this is supplied directly by the battery through the line protected by fuse **G352**. It receives the commands from pin 38 and 51 of connector C of **S11** and sends a feedback signal to pin 1 of connector B of the control unit.

Pins 4, 5 and 6 of connector A of **S11** are earthed.

The control unit receives the signals from the different sensors, thereby keeping all the engine operating parameters under control.

The rpm sensor **S31** supplies information about the engine speed, through a frequency signal sent to pin 26 of connector D of the control unit **S11**. From pin 37 of connector D of the control unit it receives an earth signal. Both signals are weak in intensity and are, therefore, suitably screened.

The timing sensor **S13** is supplied from pin 12 of connector D of **S11**. It receives a reference earth signal from pin 2 of connector D of the control unit to which it sends a frequency signal at pin 3 of the same connector.

The engine temperature transmitter **L7**, receives a reference earth from pin 27 of connector D of the control unit, and supplies a signal proportionate with the temperature of the engine fluid to pin 36 of the same connector.

The air flow meter **S5** receives the main supply from pin 11 of connector D of the control unit and a reference voltage from pin 1 of the same connector. To pin 14 of connector D it sends a signal proportionate with the flow of air. Inside **S5** there is also an air temperature sensor: the reference earth of the sensor is supplied by pin 4 of connector D of **S11**, while pin 23 of the same connector receives the air temperature signal.

The accelerator pedal **L49** is fitted with two integrated potentiometers (a main one and and a safety one). The main one receives the supply and earth respectively from pin 5 and 23 of connector C of **S11** and sends the corresponding signal to pin 10 of the same connector. The other one receives the supply and earth respectively from pin 21 and 8 of connector C and it sends the signal to pin 9 of connector C of **S11**.

The fuel temperature sensor **L51**, fitted on the return manifold, detects the temperature of the fuel oil leaving the injectors. It receives a reference earth from pin 1 of connector C of **S11** and sends the fuel temperature signal to pin 24 of the same connector.

The supercharging sensor **L36** detects the turbo charger (activated) pressure. It is supplied from pin 8 of connector D of **S11** and receives a reference earth from pin 7 of the same connector. The signal is sent to pin 6 of connector D of the control unit itself.

The fuel pressure sensor **L59** has the task of sending the injection control unit a feedback signal for regulating the pressure and length of injection. It receives the supply and the reference earth respectively from pin 13 and 34 of connector D of **S11**; then it sends the pressure signal to pin 24 of the same connector.

The task of the fuel pressure regulator **M28** is to keep the pressure of the fuel in the accumulator constant. The two command signals lead from pin 31 and 21 of connector D of the control unit.

The EGR solenoid valve **L46** controls exhaust gas recirculation- It is supplied by pin 37 of connector C of **S11** and sends a signal to pin 50 of the same connector.

Pin 8 of connector C of **S11** receives the signal leading from the brake light switch **H3**, which receives the "key-operated" supply from fuse F15 of fusebox **G1**.

Pin 2 of connector C of **S11** receives the signal leading from the clutch pedal switch **H21**, which also receives the "key-operated" supply from fuse **F15**.

The injectors **S50** receive the supply to enable opening from pin 2 (cylinders 1 and 4) and 4 (cylinders 2 and 3) of connector E of **S11**.

The engine control unit sends the commands to the injectors from pin 9, 7, 5 and 3 of connector E, respectively for cylinders 1, 2, 3 and 4.

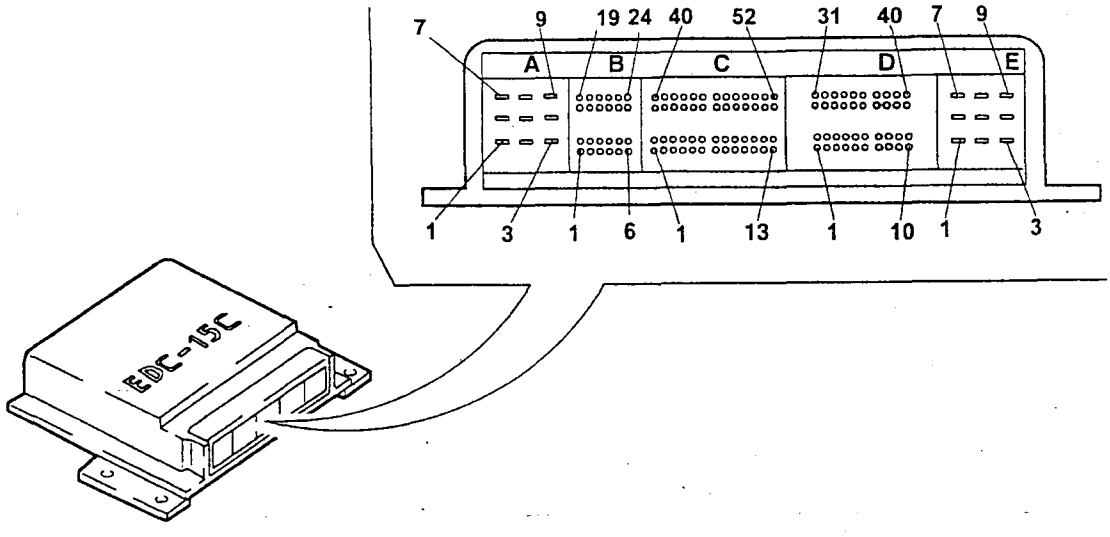
When the instrument cluster **C10** receives (pin 15 of connector B) the earth signal from pin 48 of connector C of **S11**, it turns on the "injection failure" warning light"; in the same way at pin 8 of connector A of **C10**, when the earth signal reaches pin 43 of connector C, the "glow plug warming" warning light turns on.

The control unit S11 connects with the ALFA ROMEO CODE control unit **N77** through the special line from pin 13 of connector C; this way, if the ALFA ROMEO CODE system does not detect a correct code it will not send its enable signal and the engine is not started.

The control unit is fitted with a self-diagnostics system which can be used connecting to connector **T1**, through pin 28 of connector C.

Lastly from pin 40 of connector C the control unit **S11** sends a signal proportionate with the engine rpm to the instrument cluster **C10**.

Control unit Pin-out



CONNECTOR A

1. Supply from main relay
2. N.C.
3. N.C.
4. Earth
5. Earth
6. Earth
7. Supply from main relay
8. Supply from main relay
9. N.C.

CONNECTOR B

1. Glow plug timing signal
2. Clutch pedal switch
3. Air conditioner engagement request
4. N.C.
5. N.C.
6. N.C.
7. N.C.
8. Brake pedal switch
9. N.C.
10. N.C.
11. N.C.
12. N.C.
13. Key-operated supply
14. N.C.
15. N.C.
16. N.C.
17. N.C.
18. N.C.
19. N.C.
20. N.C.
21. N.C.
22. N.C.
23. Request to engage fan 1st speed
24. N.C.

CONNECTOR C

1. Fuel temperature sensor earth
2. N.C.
3. N.C.
4. N.C.
5. Sensor 1 supply - accelerator pedal
6. N.C.
7. N.C.
8. Sensor 2 earth - accelerator pedal
9. Sensor 2 signal - accelerator pedal
10. Sensor 1 signal - accelerator pedal
11. N.C.
12. N.C.
13. Alfa Romeo Code
14. N.C.
15. N.C.
16. N.C.
17. N.C.
18. N.C.
19. N.C.
20. Enable from 4-level pressure switch

21. Sensor 2 supply - accelerator pedal
22. N.C.
23. Sensor 1 earth - accelerator pedal
24. Fuel temperature sensor signal
25. N.C.
26. Car speed signal
27. N.C.
28. Diagnostics connection (line K)
29. N.C.
30. Electric fuel pump supply
31. N.C.
32. N.C.
33. N.C.
34. N.C.
35. N.C.
36. N.C.
37. E.G.R. drive supply
38. Glow plug timer command (+)
39. N.C.
40. Rpm signal
41. N.C.
42. N.C.
43. Glow plug warning light
44. N.C.
45. Request to engage fan 2nd speed
46. Enable for main relay
47. N.C.
48. "i.e." failure" warning light
49. Water temperature sensor
50. E.G.R. drive
51. Glow plug temperature command (-)
52. Electric fuel pump

CONNECTOR D

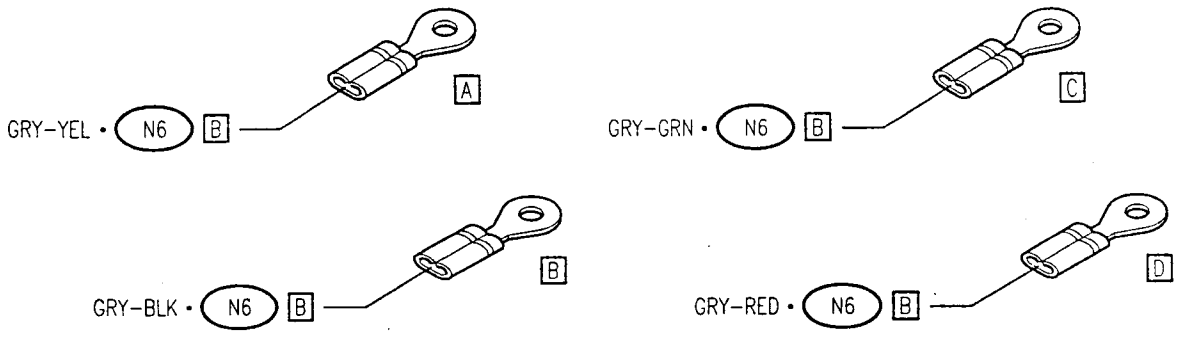
1. Air flow meter supply
2. Timing sensor earth
3. Timing sensor signal
4. Air temperature sensor earth
5. N.C.
6. Supercharging pressur sensor signal
7. Overpressure sensor earth
8. Overpressure sensor supply
9. N.C.
10. N.C.
11. Air flow meter supply
12. Timing sensor supply
13. Supply (5V) for fuel pressure sensor
14. Air flow meter signal
15. Quadrinary signal
16. N.C.
17. Rpm sensor screening
18. N.C.
19. N.C.
20. N.C.
21. Fuel pressure regulator command
22. N.C.
23. Air temperature sensor signal
24. Fuel pressure sensor signal
25. N.C.
26. Rpm sensor signal
27. Engine temperature sensor earth
28. N.C.
29. N.C.
30. N.C.
31. Pressure regulator command
32. Air conditioning system relay
33. N.C.
34. Fuel pressure sensor earth
35. N.C.
36. Engine temperature sensor signal
37. N.C.
38. N.C.
39. N.C.
40. N.C.

CONNECTOR E

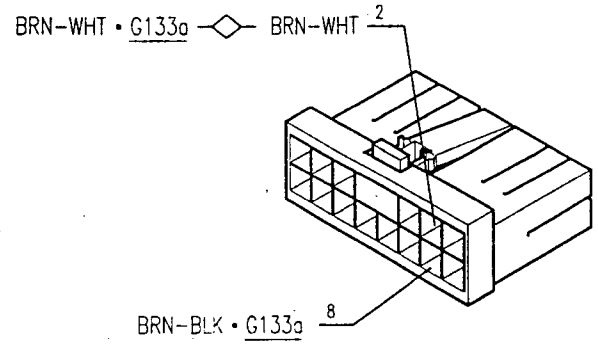
1. N.C.
2. Supply for injectors cyl. 2 and 3
3. Injector command signal cyl. 4
4. Supply for injectors cyl. 1 and 4
5. Injector command signal cyl. 3
6. N.C.
7. Injector command signal cyl. 2
8. N.C.
9. Injector command signal cyl. 1

Components and Connectors

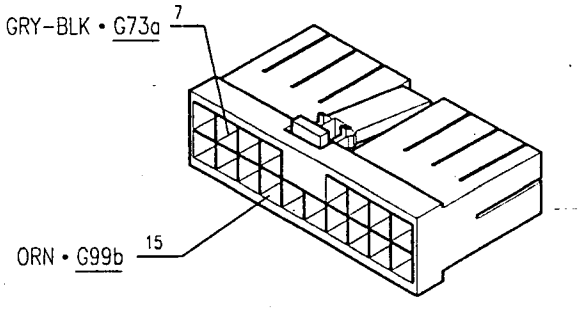
Glow plugs — A13



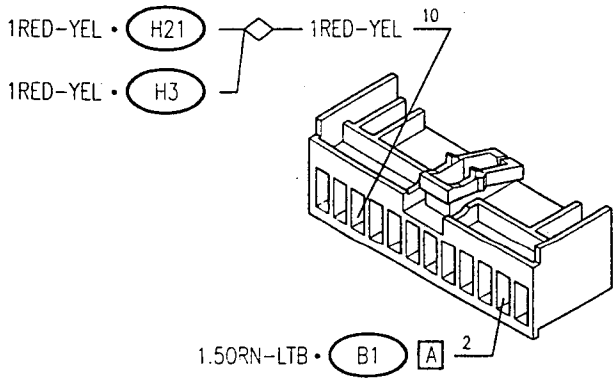
Instrument cluster — C10 A



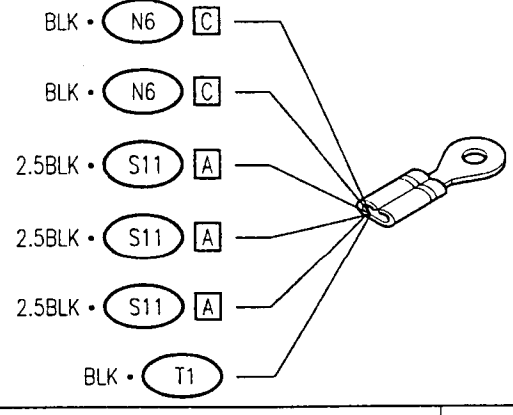
Instrument cluster — C10 B



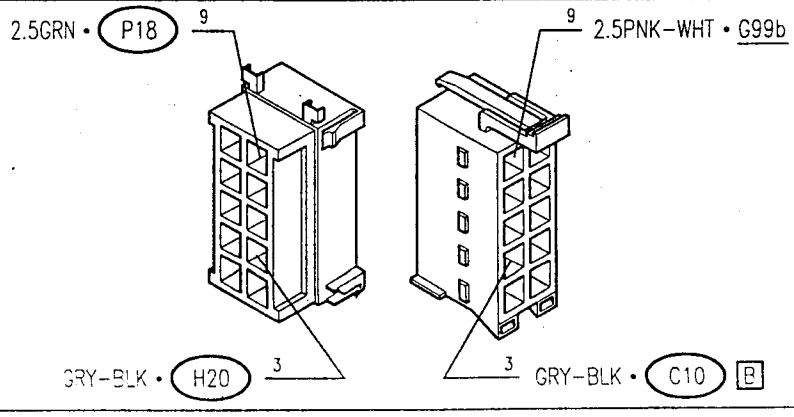
Fusebox — G1 H



RH eng. compartment earth — G53a

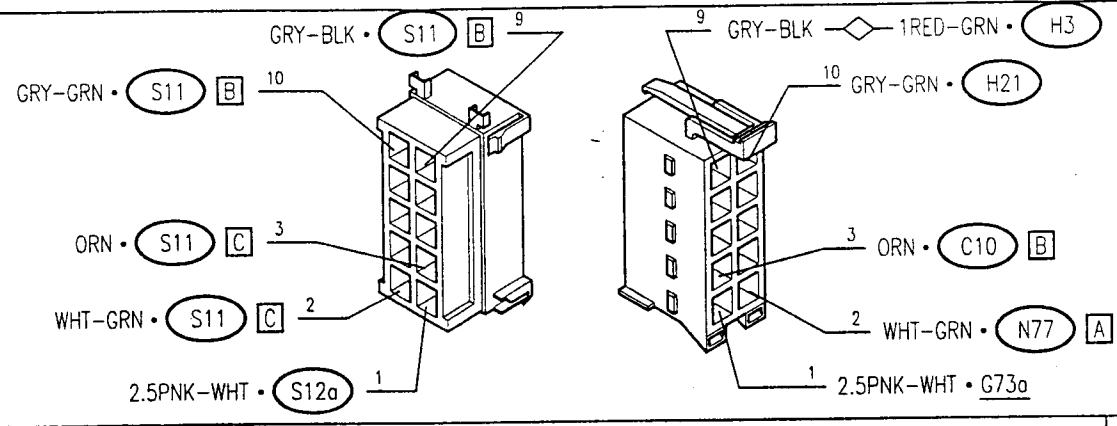


Rear services connector — G73a

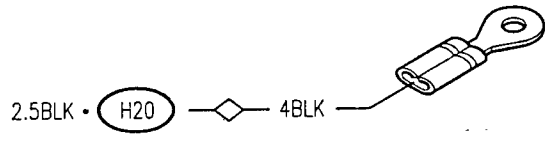


Components and Connectors (continued)

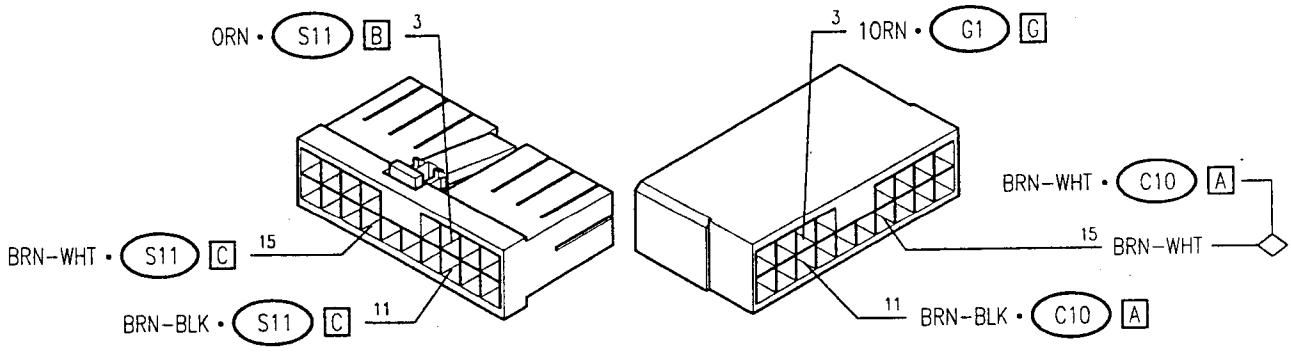
Dashboard/i.e. wiring connector — G99b



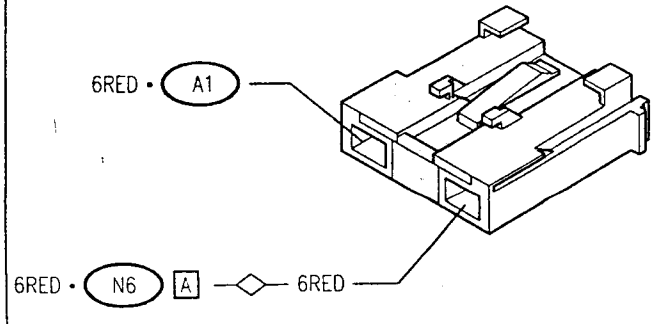
Seat crossmember earth — G106



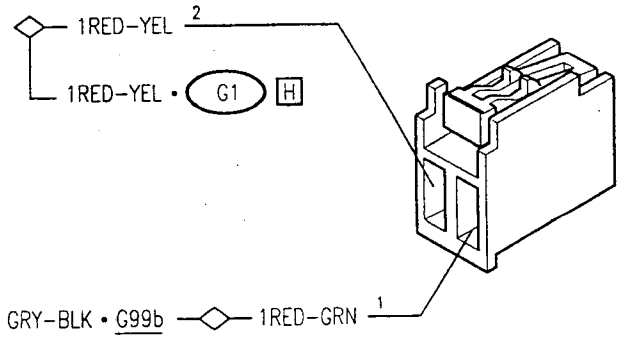
Electronic injection wiring connector A — G133a



Glow plug warming fuse — G152

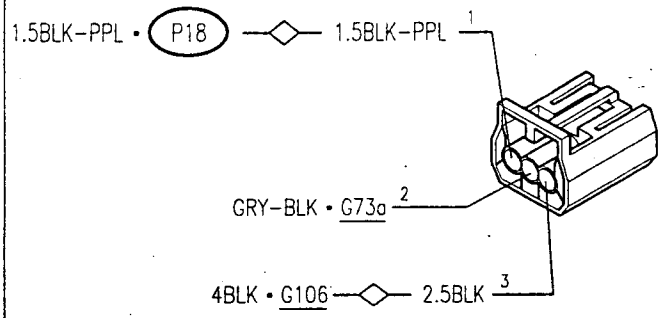


Brake light switch — H3

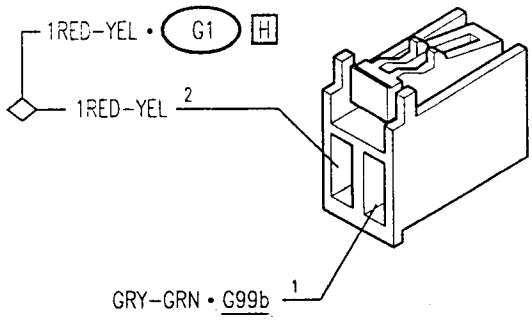


Components and Connectors (continued)

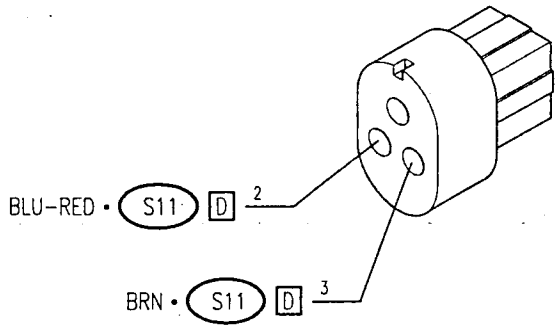
Inertial switch	H20



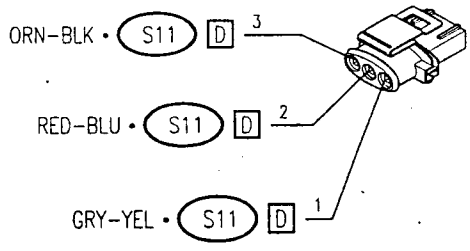
Clutch pedal switch	H21



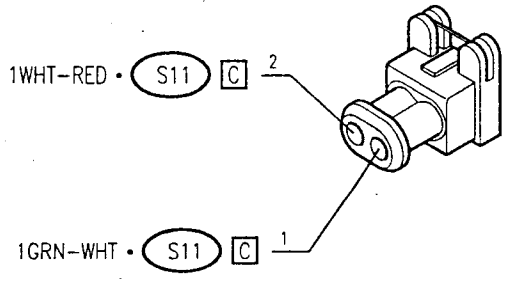
Engine coolant fluid temperature gauge transmitter	L7



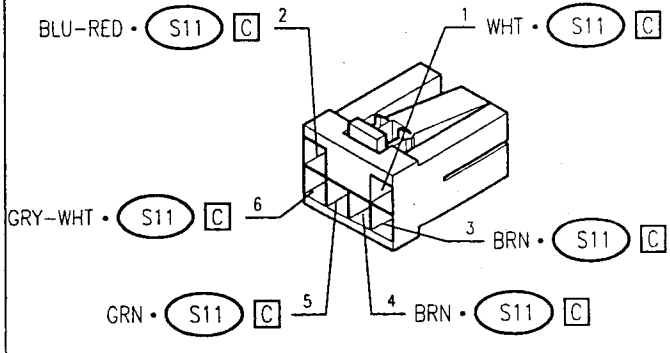
Turbo supercharging sensor	L36



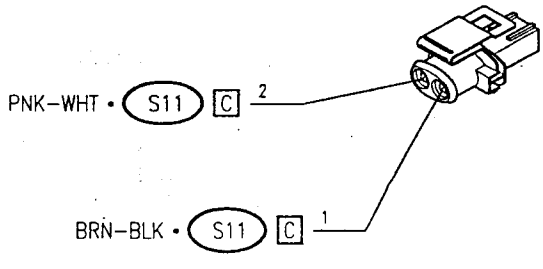
E.G.R. solenoid control valve	L46



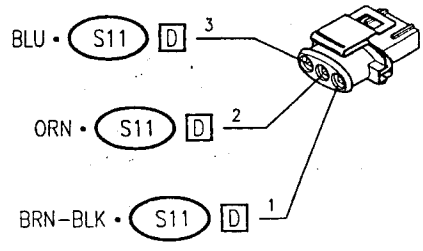
Accelerator pedal potentiometer	L49



Fuel temperature sensor	L51

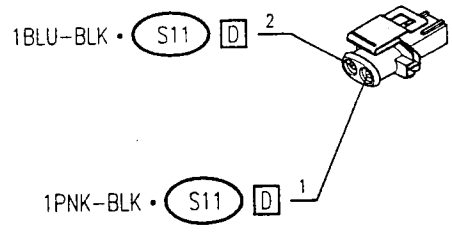


Fuel pressure sensor	L59

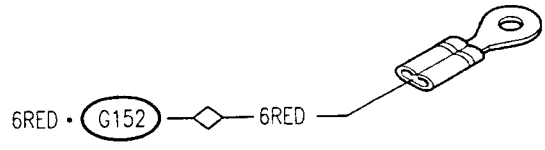


Components and Connectors (continued)

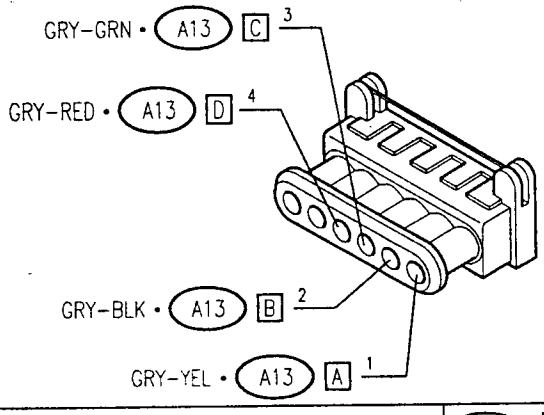
Fuel pressure regulator — M28



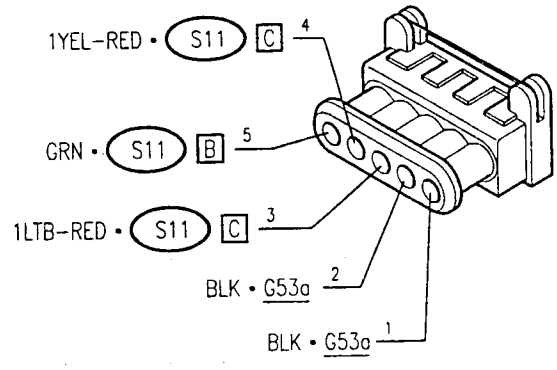
Glow plug warming timer — N6 A



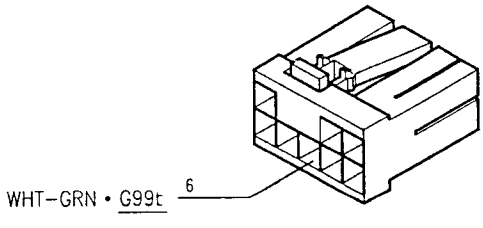
Glow plug warming timer — N6 B



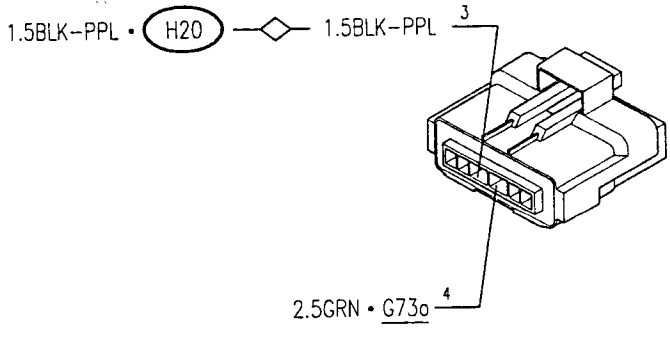
Glow plug warming timer — N6 C



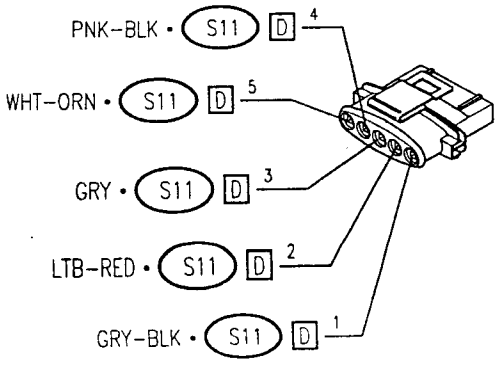
ALFA ROMEO CODE control unit — N77 A



Electric fuel pump — P18



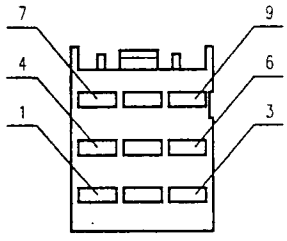
Air flow meter — S5



Components and Connectors (continued)

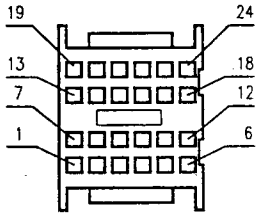
Electronic injection control unit — S11 A

1 — 1RED-GRN • S46
4 — 2.5BLK • G53a
5 — 2.5BLK • G53a
6 — 2.5BLK • G53a
7 — 2.5RED-BLK — 4RED-BLK • S41
8 — 2.5RED-BLK



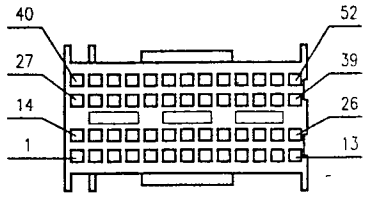
Electronic injection control unit — S11 B

1 — GRN • N6 C
2 — GRY-GRN • G99b
8 — GRY-BLK • G99b
13 — ORN • G133a



Electronic injection control unit — S11 C

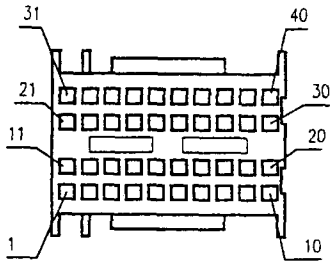
1 — PNK-WHT • L51
5 — BLU-RED • L49
8 — GRY-WHT • L49
9 — YEL • L49
10 — WHT • L49
13 — WHT-GRN • G99b
21 — GRN • L49
23 — BRN • L49
24 — BRN-BLK • L51
28 — WHT-YEL • T1
30 — BLK-PPL • S12a
37 — 1GRN-WHT • L46
38 — 1LTB-RED • N6 C
40 — BRN-WHT • G133a
43 — BRN-BLK • G133a
46 — YEL-BLK • S41
48 — ORN • G99b
50 — 1WHT-RED • L46
51 — 1YEL-RED • N6 C
52 — PNK-BLK • S12a



Components and Connectors (continued)

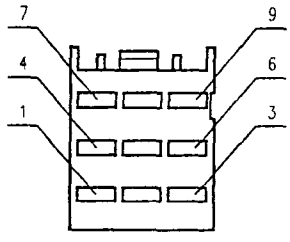
Electronic injection control unit — S11 D

1 — PNK-BLK • S5
2 — GRY-RED • S13
3 — GRN-BLK • S13
4 — GRY • S5
6 — GRY-YEL • L36
7 — RED-BLU • L36
8 — ORN-BLK • L36
11 — LTB-RED • S5
12 — RED-BLK • S13
13 — BLU • L59
14 — WHT-ORN • S5
17 — PNK ◇ PNK • S31
21 — 1PNK-BLK • M28
23 — GRY-BLK • S5
24 — ORN • L59
26 — YEL • S31
27 — BRN • S7
31 — 1BLU-BLK • M28
34 — BRN-BLK • L59
36 — BLU-RED • S7
37 — BLK • S31



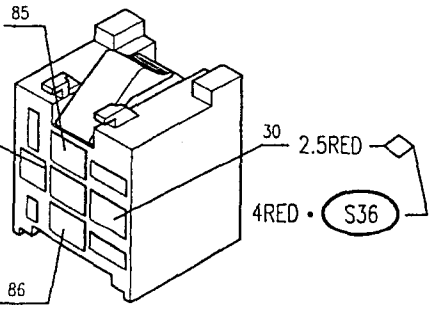
Electronic injection control unit — S11 E

2 — 2.5ORN ◇ 2.5GRY-BLK • S50 C
2.5RED • S50 B
3 — 2.5WHT • S50 D
4 — 2.5ORN-WHT ◇ 2.5WHT-BLK • S50 D
2.5ORN-WHT • S50 A
5 — 2.5GRY • S50 C
7 — 2.5RED-BLK • S50 B
9 — 2.5ORN • S50 A



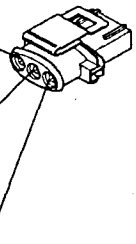
Fuel pump relay — S12a

PNK-BLK • S11 C — 85
2.5PNK-WHT • G99b — 87
30 — 2.5RED
4RED • S36
BLK-PPL • S11 C — 86



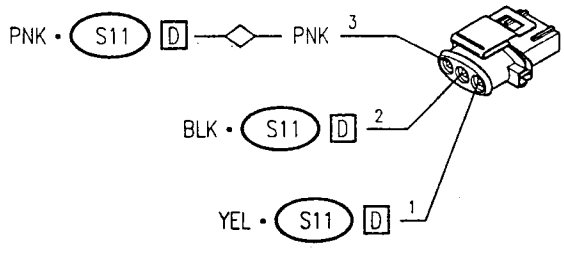
Timing sensor — S13

RED-BLK • S11 D — 3
GRN-BLK • S11 D — 2
GRY-RED • S11 D — 1

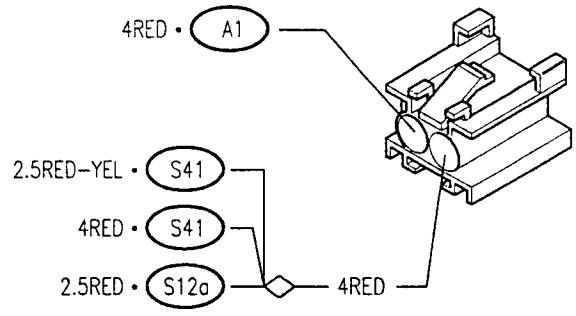


Components and Connectors (continued)

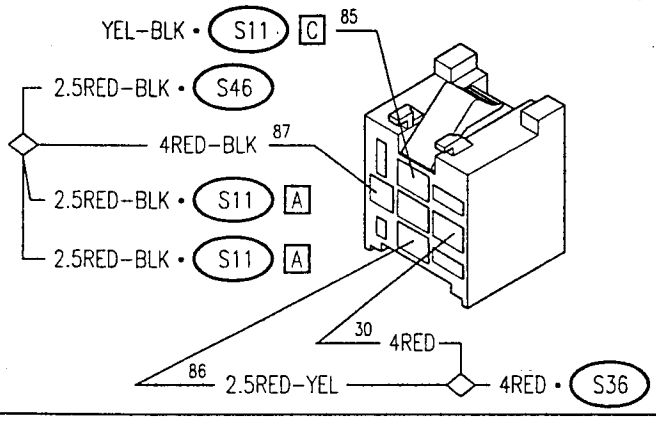
Rpm sensor	S31



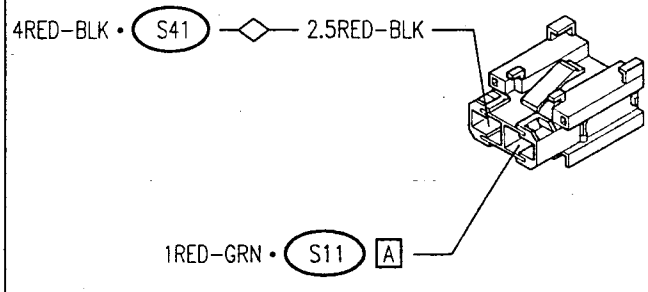
Injection relay wander fuse	S36



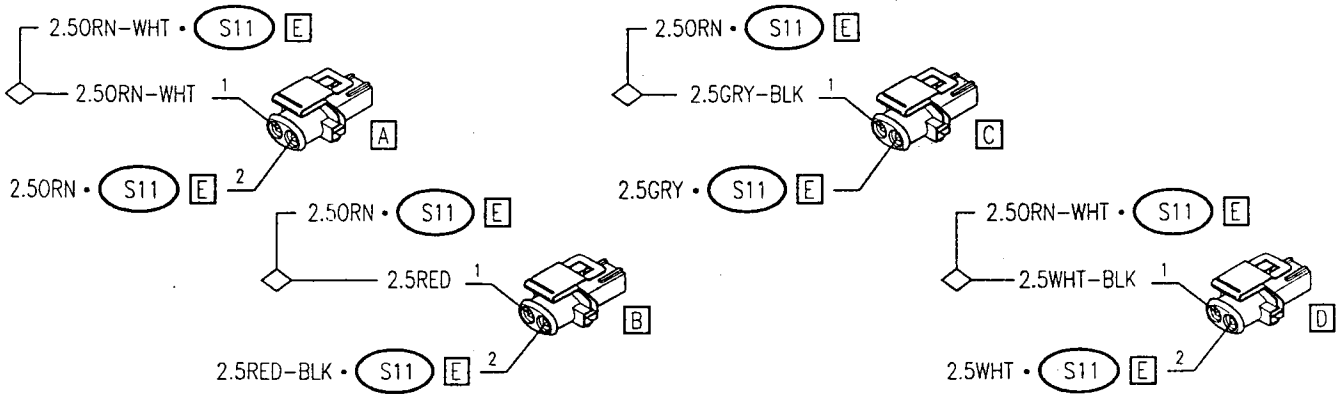
Main relay	S41



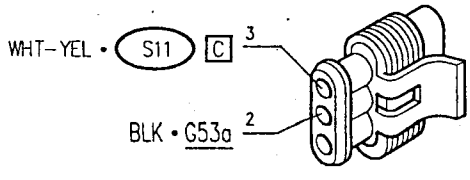
Injection supply wander fuse	S46



Injectors (JTD)	S50

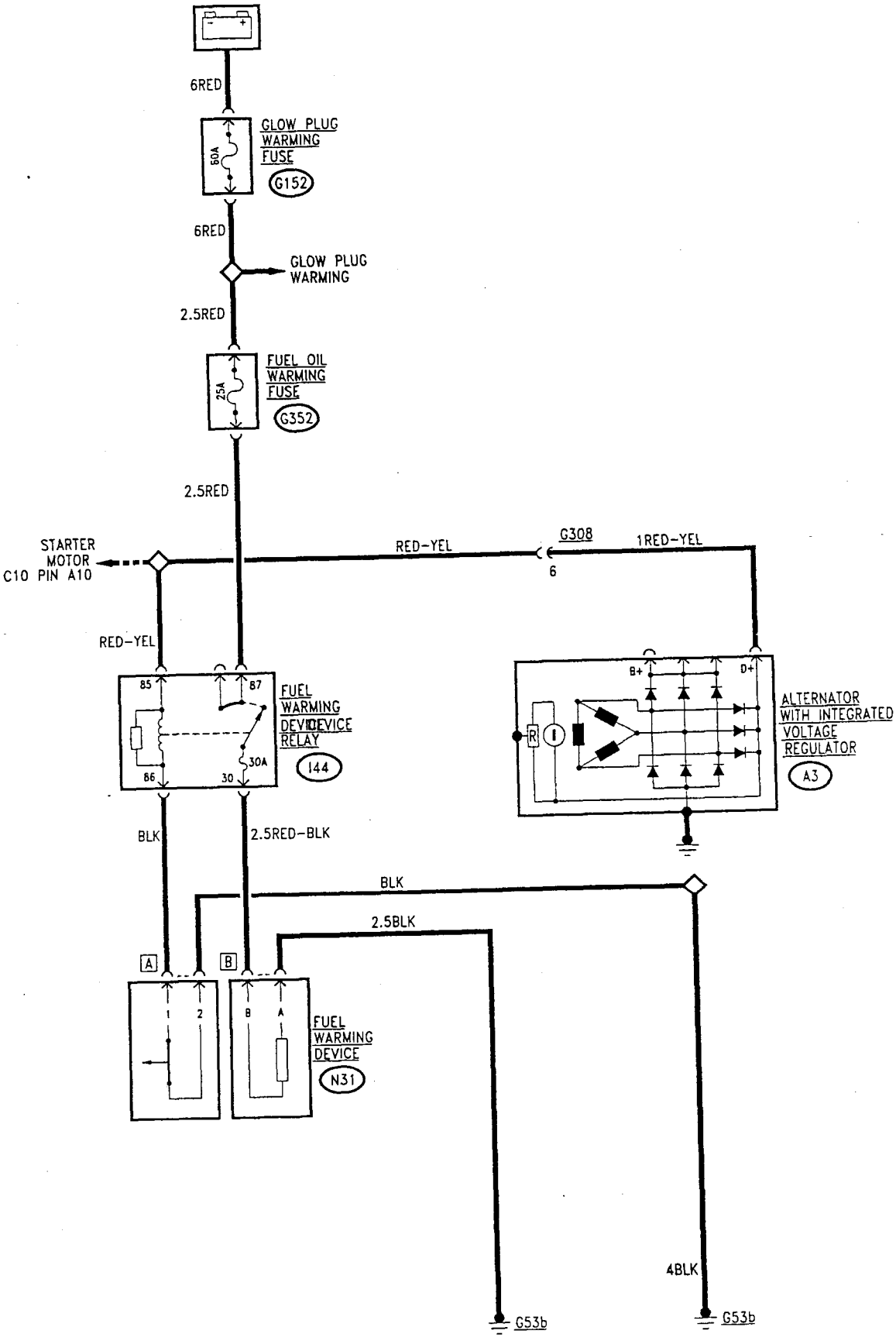


Connector for ALFA TESTER (engine and electronic key management)	T1



FUEL WARMING

Wiring diagram



General Description

The performance of a Diesel engine at low temperatures may be compromised by the possible solidification of the paraffins contained in the fuel oil which prevents it from flowing correctly.

Therefore, the engine is fitted with a fuel warming device on the fuel filter.

A thermal switch on the filter support detects low fuel oil temperatures: in fact this device is a thermal contact which closes for very low temperatures.

If the engine is running (information given by the turning off of the alternator "battery charging" signal) a relay engages the warming module in the upper part of the fuel oil filter: this module comprises two variable PTC resistances which, when crossed by current, warm the fuel that passes through the filter: initially, at low temperature, the resistance is low and the current is high with considerable heating power; gradually the resistance increases and the heating is reduced.

Functional Description

The fuel warming device relay **I44** controls operation of the whole system; the relay is supplied by the line protected by a specific fuse **G352** and by fuse **G152** which also protects the glow plug warming system.

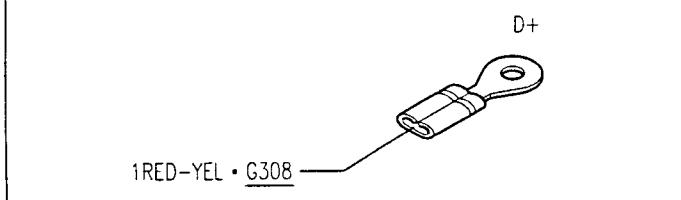
When (below 6°C) the thermal switch contact - connector A of device **N31** - closes and at the same time the engine is running (12 V signal leading from pin D+ of the alternator), relay **I44** is energised.

This way the resistances - connector B of device **N31** - are supplied, thereby warming the fuel that crosses the filter.

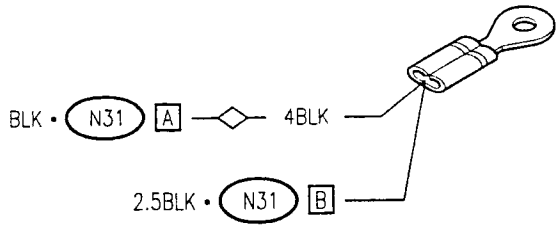
When the thermal switch contact opens (above 15°C), or if the engine is not running, the supply is stopped and warming ceases.

Components and Connectors

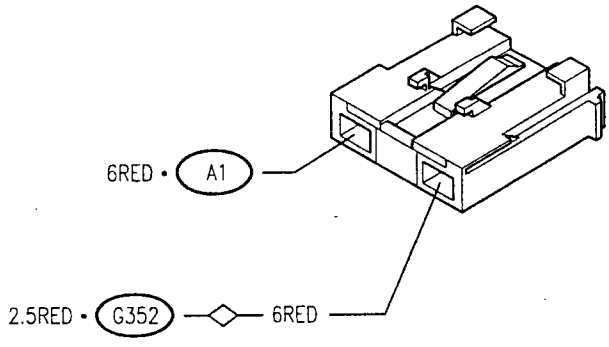
Alternator, with voltage regulator incorporated	A3



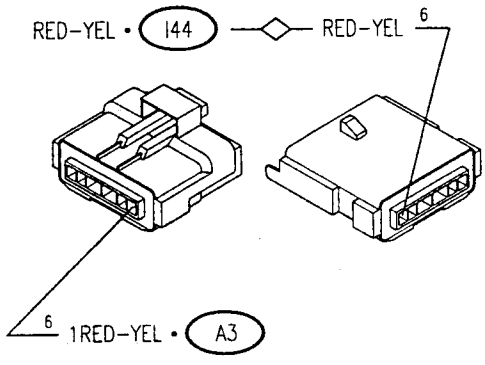
RH engine compartment earth	G53b



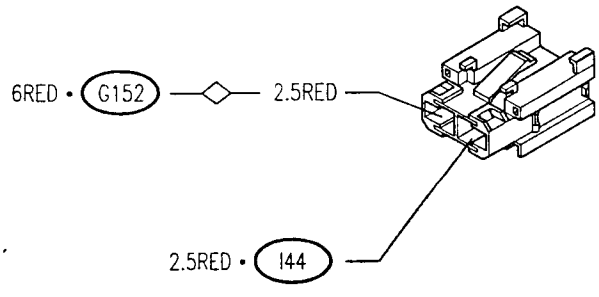
Glow plug warming fuse	G152



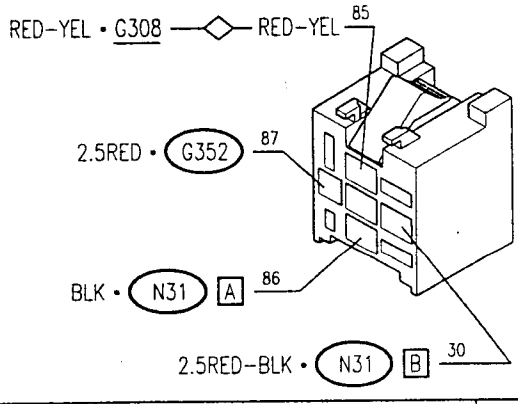
Engine sensors connector	G308



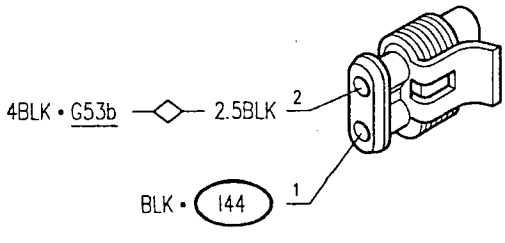
Fuel oil warming fuse	G352



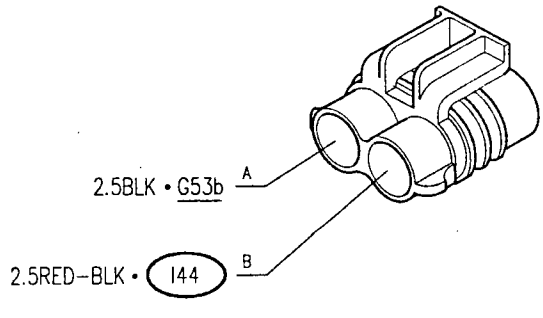
Fuel warming device relay	I44



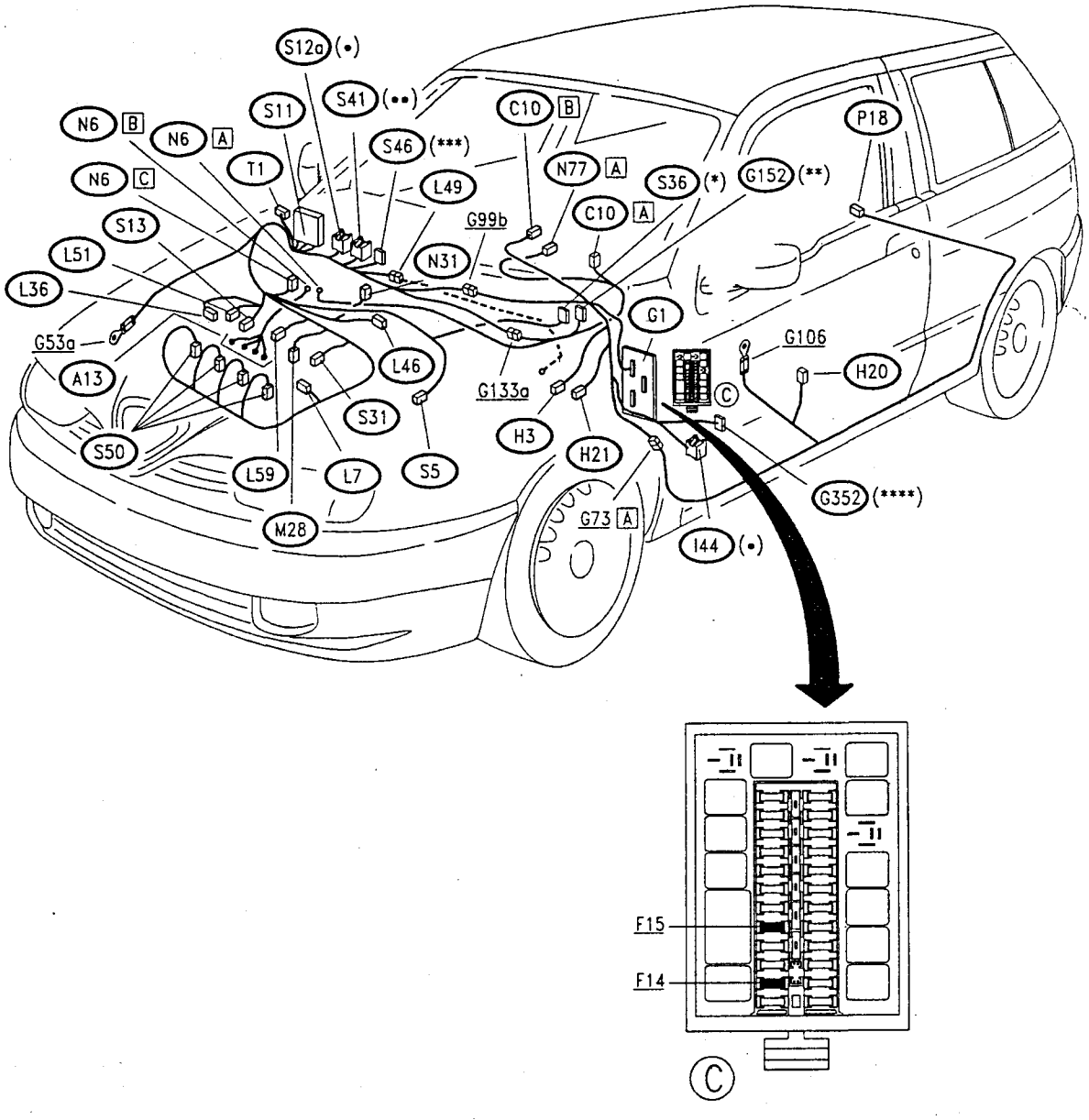
Fuel warming device	N31 A



Fuel warming device	N31 B



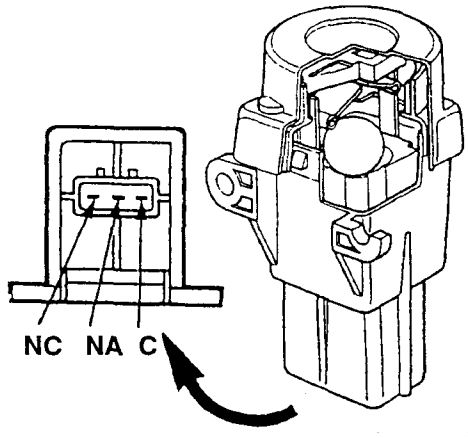
LOCATION OF COMPONENTS



(•) White base
(••) Black base
(*) Green fuseholder
(**) Black fuseholder
(***) Brown fuseholder
(****) White fuseholder

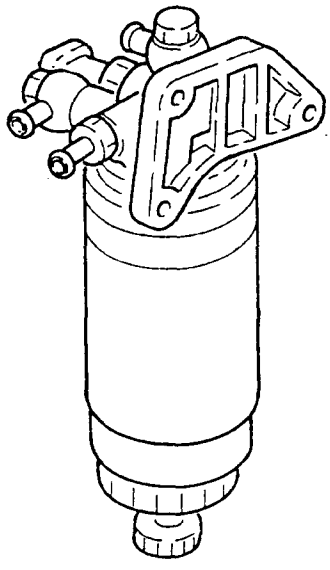
CHECKING COMPONENTS

Inertial switch (H20)



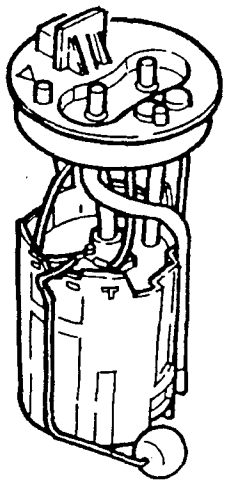
SPECIFICATIONS
Check the continuity between pin NC and C: this continuity is cut off in the event of a crash ; The contact is closed again pressing the special button

Fuel warming device (N31)



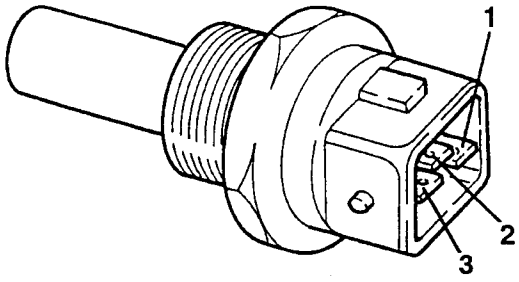
SPECIFICATIONS	
Thermal contact (conn. A)	
Contact closes (with decreasing temperature)	< 6°C
Contact opens (with increasing temperature)	> 15°C

Fuel pump (P18)



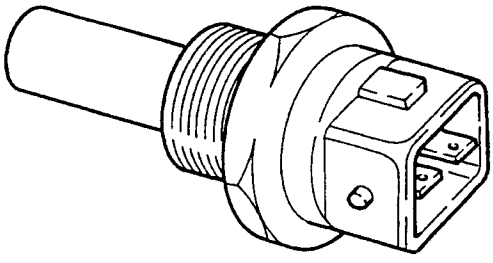
SPECIFICATIONS	
Fuel pressure at idle speed	> 2.0 bar

Engine temperature transmitter (L7)



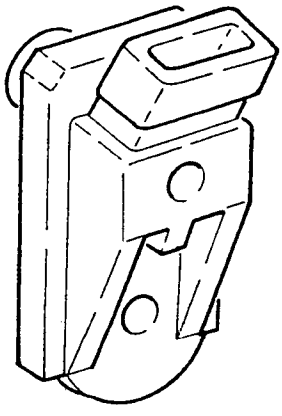
SPECIFICATIONS	
Rated resistance (at 20°C) between pin 2 and 3	2300÷2600 Ω

Fuel temperature sensor (L51)



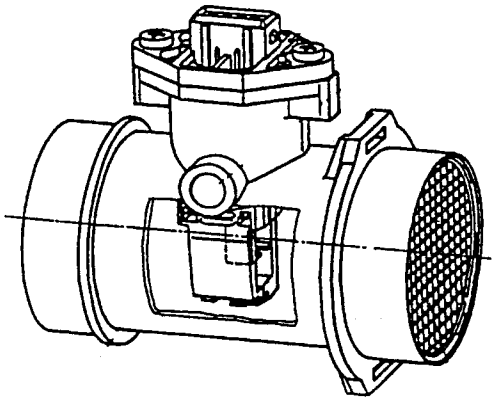
SPECIFICATIONS	
Rated resistance (at 20°C)	2300÷2600 Ω

Supercharging sensor (L36)



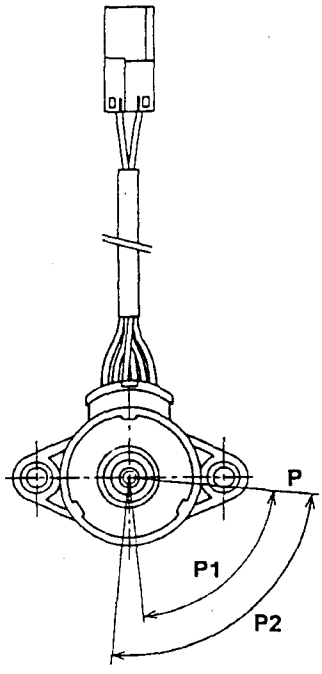
SPECIFICATIONS	
Rated resistance (at 20°C)	2500 ± 5% Ω

Air flow meter (S5)



SPECIFICATIONS	
Resistance between pin 1 and 3: air temperature sensor (at 25°C)	2000 ± 5% Ω

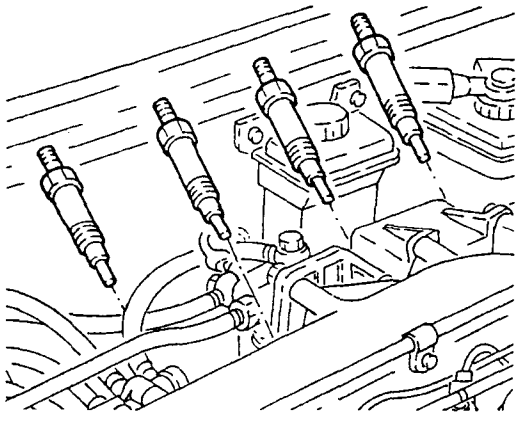
Accelerator pedal potentiometer (L49)



SPECIFICATIONS		
Voltage ratio of pins 1-3 and 2-3	88°	0.95 ± 0.04
	70°	0.786 ± 0.04
	0°	0.15 ± 0.01
Voltage ratio of pins 4-6 and 5-6	88°	0.475 ± 0.06
	70°	0.393 ± 0.06
	0°	0.075 ± 0.02

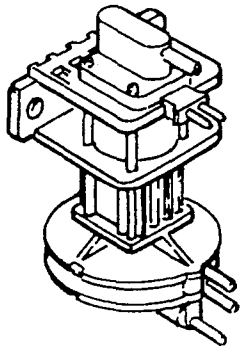
P = 0° (minimum)
P1 = 0 ° ÷ 70°
P2 = 88° (mechanical stop)

Glow plugs (A13)



SPECIFICATIONS	
Internal resistance	0.6 Ω

E.G.R. solenoid control valve (L46)



SPECIFICATIONS	
Coil resistance (at 20°C)	5.5 ± 0.5 Ω

KEY TO COMPONENTS

A STARTING - RECHARGING
A1 Battery
A3 Alternator, with integrated voltage regulator
A8 Ignition coil
A8a Ignition coil A
A8b Ignition coil B
A11 Starter motor
A12 Spark plugs
A13 Glow plugs

B MANUAL ELECTRICAL CONTROLS
B1 Ignition switch
B21a Right front power window control switch (on RH door)
B21b Right front power window control switch (on LH door)
B36 Wing mirror control switch
B47 Sun roof motor control switch
B51 LH front seat heater control switch
B53 Front power window switch with automatic mechanism
B62 RH front seat heater control switch
B68 Steering column lever unit
B69 Headlamp aiming device
B98 Air recirculation switch

C INSTRUMENTATION
C10 Instrument cluster
C16 Check Panel display

D WARNING LIGHTS
D31 Anti-theft device led indicator

E EXTERIOR LIGHTS
E9a LH direction indicator light bulb
E9b RH direction indicator light bulb
E10a LH fog light bulb
E10b RH fog light bulb
E14 Reversing light bulb
E16 Rear fog guard bulb
E17a LH number plate light bulb
E17b RH number plate light bulb
E19 RH tail light cluster
E20 LH tail light cluster
E23 RH front light cluster
E24 LH front light cluster
E28 Third stoplight

F INTERIOR LIGHTS
F3 Passenger compartment ceiling light
F5 Luggage compartment light
F8 Heating/ventilation controls light bulb
F8a Heating/ventilation controls light bulb a
F8b Heating ventilation controls light bulb b
F10 Ashtray light bulb

G FUSEBOX - CONNECTORS - EARTHS
G1 Fusebox
G5 Simple connector
G21 Connector for RH front door wiring
G23 Connector for LH front door wiring
G38 Air conditioner wiring connector
G43 Connector for heating and ventilation control wiring
G53a RH engine compartment earth
G53b LH engine compartment earth
G55a RH side panel earth
G55b LH side panel earth
G56 Branch terminal board
G60 Injection wiring earth
G60a Injection wiring earth
G60b Injection wiring earth
G61 Ignition coil connection
G63a RH rear earth
G63b LH rear earth
G65 Coaxial cable for aerial
G73 Connector for rear services
G94 Engine compartment
G95m Sun roof connector
G99 Connector for dashboard wiring/engine wiring
G99b Dashboard/engine wiring connector
G106 Seat cross rail earth
G109 Injection wiring earth
G115 Connector for tow bar trailer socket
G124 ABS system connector
G125a ABS system fuse
G125b ABS system fuse
G133a Connector for electronic injection wiring A
G133b Connector for electronic injection wiring B
G133c Connector for electronic injection wiring C
G143 Services tray centre earth
G148b Earth under dashboard LH
G152 Glow plug warming fuse
G175a Connector for LH fog light wiring
G175b Connector for RH fog light wiring
G202 Connector for ABS system earth
G219 Connector for sun roof
G241 Anti-theft device wiring connector
G254 Fuse for engine fan
G254b Fuse for engine fan
G255 Fuse for heating and ventilation fan
G261 Fuse for sun roof
G267 Earth on crankcase
G272 Connector for ABS hydraulic unit
G273 ABS control unit connector
G307a Connector for rear wiring/luggage compartment wiring A
G307b Connector for rear wiring / luggage compartment wiring B
G308 Connector for engine sensors
G310 Fuse for RH front power window
G311 Fuse for LH front power window
G312 Fuse for headlamp washer
G313 Connector for additional conditioner wiring
G314 Connector for engine wiring/conditioner wiring
G318 Earth on gearbox
G326 Connector for rear fog guard wiring
G332 Alternator connector for recharging signal
G335 Connector for E.G.R.
G337 Connector for conditioner syst./injection syst.
G355a Pre-installed connector for heating RH seats
G352 Fuel oil warming fuse
G355b Pre-installed connector for heating LH seats
G380 Airbag connector

G381 Earth for airbag
G382 Fuse for fog lights
G383 Connector for airbag capsule
G384 Services supply fuse
G386 ALFA ROMEO CODE system connector
G389 ALFA ROMEO CODE fuse
G393 General supply fuse
G394 Door mirrors defrosting fuse
G395 Air Bag and cluster fuse
G396 Connector for TELEPASS
G397 Cellular telephone provision
G398 Aerial supply connection
G407 Seam for Side Bag
G408 Additional heating fuse

H SWITCHES
H1 Handbrake switch
H2 Brake pedal switch
H3 Stop lights switch
H5 LH front door open switch
H6 RH front door open switch
H9 RH front brake pad switch
H10 LH front brake pad switch
H17 Brake fluid minimum level switch
H20 Inertial switch
H21 Clutch pedal switch
H24 Luggage compartment light switch
H44 Bonnet anti-theft device switch
H51 Sun roof stroke limit switch
H54 Full load switch

I RELAYS
I1 Engine cooling fan relay
I2 Heated rearscreen relay
I3 Horn relay
I10 Starting consent relay
I12 Power windows relay
I17 Fog light relay
I25 Rear fog guard relay
I29 Fuel pump relay
I35 Key-operated supply relay
I44 Fuel warming device relay
I45 Door mirrors defrosting relay
I49 Low beam relay
I50 High beam relay
I52 Luggage compartment opening relay
I58 Sun roof relay
I64 Side lights relay
I65 Fog lights consent relay
I67 Day-light cut off relay
I78 Heating and ventilation fan relay
I87 LH seat heater relay
I88 RH seat heater relay
I91 DIM-DIP headlamp relay
I99 Engine cooling fan 1st speed relay
I99a Engine cooling fan 1st speed relay
I99b Engine cooling fan 1st speed relay
I100 Engine cooling fan 2nd speed relay
I105 Relay for Diesel engine control devices
I118 Additional heater remote switch -1
I119 Additional heater remote switch -2
I120 Additional heater safety remote switch
I121 Engine cooling solenoid valve remote switch

L SENDERS
L2 Minimum engine oil pressure
L5 Max. engine coolant temperature warning light contact
L6 Engine cooling fan thermal switch
L7 Sender for engine coolant temperature gauge
L9 Sender for fuel level gauge
L10 Sender for engine coolant temperature gauge and max. temperature warning light contact
L16 Rev counter sensor
L17 Speedometer sensor
L27 Water temperature sensor for warming glow plugs
L28 RH front phonic wheel inductive sensor
L29 LH front phonic wheel inductive sensor
L30 RH rear phonic wheel inductive sensor
L31 LH rear phonic wheel inductive sensor
L33 Two-level thermal contact
L36 Turbo supercharging sensor
L45 K.S.B. water temperature sensor
L46 E.G.R. solenoid control valve
L47 Potentiometer for E.G.R.
L49 Accelerator pedal potentiometer
L51 Fuel temperature sensor
L59 Fuel pressure sensor
L60 Water temperature sensor for additional heater

M ELETTROMAGNETS - SOLENOID VALVES
M5 Engine stop electromagnet
M12 Luggage compartment opening actuator electromagnet
M15 Evaporation solenoid valve
M28 Fuel pressure regolator

N ELECTRONIC DEVICES - INTERMITTENCES-TIMERS
N1 Electronic ignition module
N6 Glow plug warming timer
N11 Door locking control unit
N12 Headlamp washer timer
N13 Hazard warning lights and direction indicators intermittence
N14 Electronic windscreen wiper intermittence
N25 Rear fog guard electronic device
N31 Fuel warming device
N38 Power window control unit
N45 Anti-theft device control unit
N51 Hydraulic unit with ABS control unit
N60 Sun roof control unit
N65 E.G.R. control unit
N67 Remote control signal receiver
N77 ALFA ROMEO CODE control unit
N78 ALFA ROMEO CODE receiver
N83 Fuel level signal damper
N85 Additional heater control unit

O SERVICES
O1 Heated rearscreen
O2a High tone horn
O2b Low tone horn
O4 Car radio

O5a RH front loud-speaker
O5b LH front loud-speaker
O5c RH rear loud-speaker
O5d LH rear loud-speaker
O6 Cigar lighter - current socket
O14 LH front seat heater
O17 RH front seat heater
O18 RH wing mirror defroster
O19 LH wing mirror defroster
O22 Additional engine fan resistance
O27 K.S.B. device
O28 DIM-DIP Resistance
O31a RH Tweeter loud-speaker
O31b LH Tweeter loud-speaker
O38 Additional heater glow plugs

P ELECTRIC MOTORS
P1 Windscreen wiper motor
P2 Engine cooling fan
P2a Engine cooling fan
P2b Engine cooling fan
P8 LH wing mirror motor
P9 RH wing mirror motor
P10 Front RH door lock motor
P11 Front LH door lock motor
P14 Front RH power window motor
P15 Front LH power window motor
P18 Electric fuel pump
P19 Windscreen and rearscreen washer pump
P20 Headlamp washer pump
P21 Rearscreen wiper motor
P24 Sun roof motor
P35a RH headlamp aiming motor
P35b LH headlamp aiming motor

Q HEATING/VENTILATION - AIR CONDITIONING
Q1 Heater fan
Q4 Heater fan control
Q5 Heater fan speed adjustment resistance
Q9 Minimum pressure switch
Q11 Compressor electromagnetic coupling
Q12 Compressor electromagnetic coupling cut-off thermal contact
Q20 Min. and max. sensor pressure contact
Q21 Climate control system control unit
Q22 Electromagnetic coupling relay
Q24 Outside temperature sensor
Q25 Treated air temperature sensor
Q26 Antifrost sensor
Q27 Air recirculation flap control motor
Q30 Air mixing control motor
Q31 Climate control electronic regulator
Q32 Auxiliary relay for heating and ventilation
Q33 Passenger compartment air temperature sensor
Q34 Required air adjustment control
Q39 Fuse for conditioning system - 30 A
Q41 Set of relay and fuses for air conditioner
Q42 Conditioner fan delay device
Q65 Fuse for conditioning system-7.5 A
Q66 Fuse for conditioning system-3A
Q67 Compressor disengagement control unit
Q68 Compressor and air recirculation engagement switches
Q69 Heater fan 1st speed relay
Q71 Antifrost thermostat
Q72 Fast defrosting switch
Q73a Air recirculation relay
Q73b Air recirculation relay

R SAFETY DEVICES
R22 Airbag control unit
R23 Capsule on steering wheel for airbag
R27 Passenger's side airbag capsule
R30 Passenger present sensor for Air Bag
R31 LH Side Bag sensor
R32 RH Side Bag sensor
R33 LH Side Bag capsule
R34 RH Side Bag capsule

S ELECTRONIC INJECTION
S3 Elettroinjectors
S5 Air flow meter
S7 Engine temperature sensor
S11 Electronic injection control unit
S12a Fuel pump relay
S12c Timing variator relay
S12e Air flow meter relay
S13 Timing sensor
S15 Timing variator
S20 Pinging sensor
S28 Injection control relay
S29 Idle adjustment actuator
S31 Rpm sensor
S34 Air temperature sensor
S35 Heated lambda probe
S36 Fuse for injection relay
S38 Sensor on throttle body
S40 Injection/ignition control unit
S41 Main relay
S42 Secondary relay
S43 Absolute pressure sensor
S45 Lambda probe fuse
S46 Injection supply wander fuse
S47 Fuse for fuel pump
S49 MP31/IAW control unit switching connector
S50 Injectors (JTD)
S52 Cam angle sensor
S56 Temperature sensor for E.G.R.
S57 Variable geometry solenoid valve

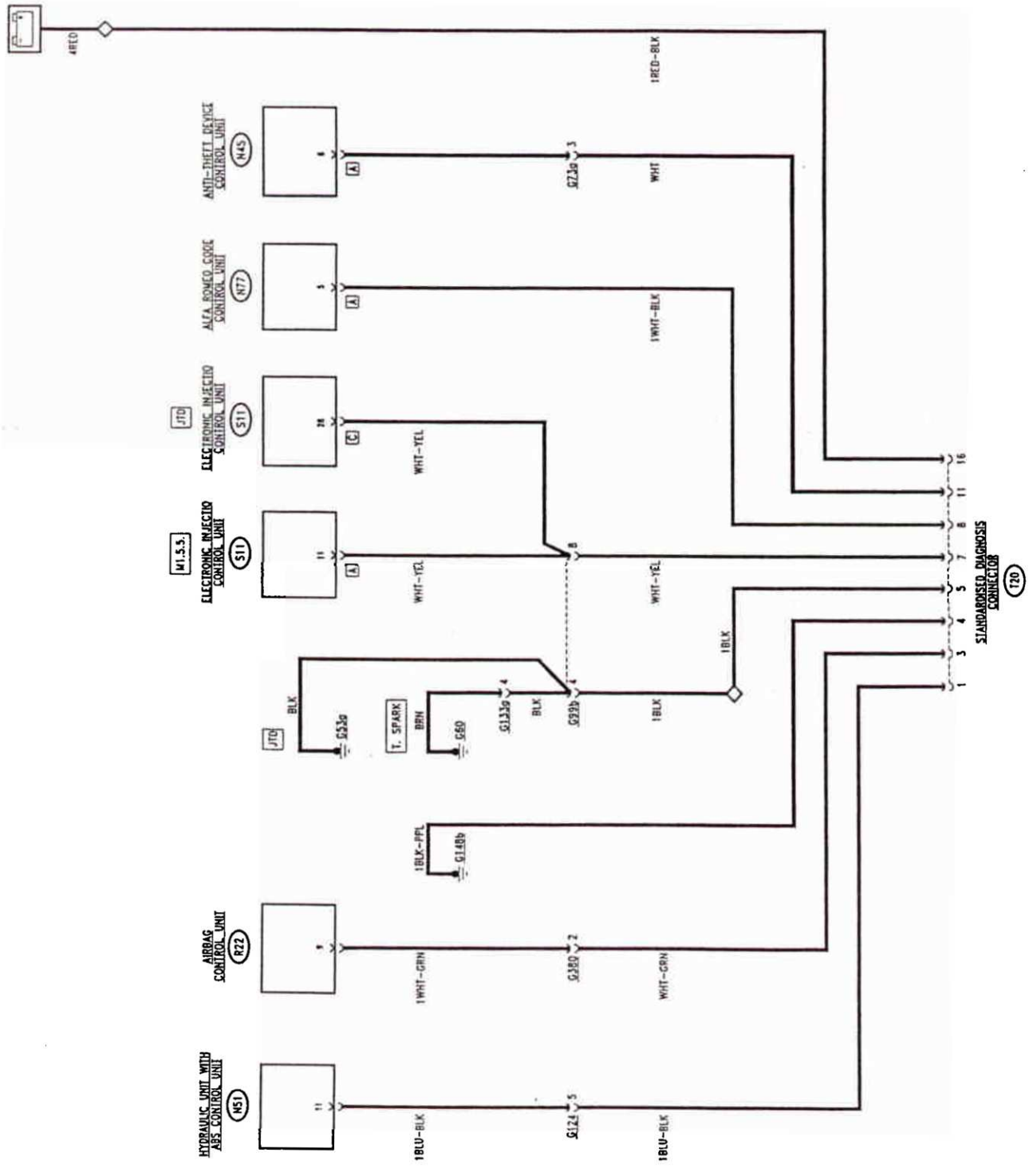
T DIAGNOSIS
T1 Connector for ALFA TESTER (engine and electronic key management)
T3 Connector for ALFA TESTER (airbag)
T7 Connector for ALFA TESTER (anti-theft device)
T8 Connector for ALFA TESTER (ABS)
T10 Connector for ALFA TESTER (Heating/ventilation)
T12 Connector for ALFA TESTER (E.G.R.)

MULTIPLE DIAGNOSIS CONNECTOR

INDEX

WIRING DIAGRAM 41-2
GENERAL DESCRIPTION 41-3
FUNCTIONAL DESCRIPTION 41-3
LOCATION OF COMPONENTS 41-6

WIRING DIAGRAM



GENERAL DESCRIPTION

The car is fitted with a number of control units with a self-diagnosis function.

Connecting to these control units with a diagnosis device (Examiner or other tools) it is possible to read the self- diagnosis data (parameters) or run the diagnosis activities provided.

This car does not have a specific diagnosis connection socket for each control unit; a single, standardised, 16-way diagnosis socket has been adopted, which is located on the lefthand side of the dashboard, above the control box.

The diagnosis equipment (Examiner or other device) is connected to it through a special adapter, called "MPX97". In fact, this adapter makes it possible to select the system on which connection to self-diagnosis is required.

FUNCTIONAL DESCRIPTION

The diagnosis socket **T20** is powered directly by the battery at pin 16 from the line protected by the MAXIFUSES of the branch terminal strip G56. Pins 4 and 5 are earthed.

Pin 1 is connected to the ABS control unit **N51** (pin 11).

Pin 3 is connected to the Air Bag control unit **R22** (pin 9).

Pin 11 is connected to the alarm control unit **N45** (pin 6 of connector A).

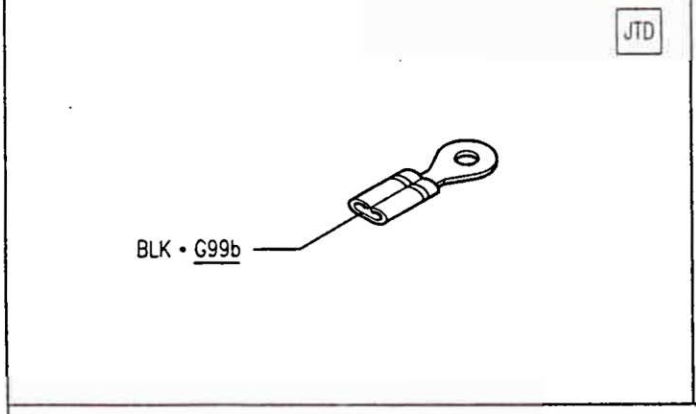
Pin 8 is connected to the Code control unit **N77** (pin 5 of connector A).

Motor T.SPARK:
Pin 7 is connected to the i.e. control unit **S11** through a dedicated line (pin 11 of connector A).

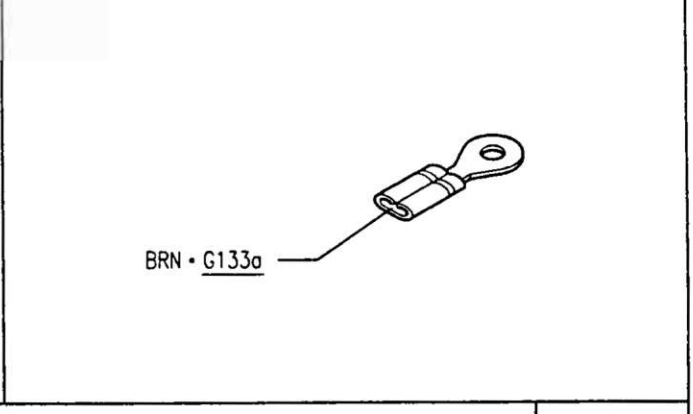
Motor JTD:
Pin 7 is connected to the i.e. control unit **S11** through a dedicated line (pin 28 of connector C).

COMPONENTS AND CONNECTORS

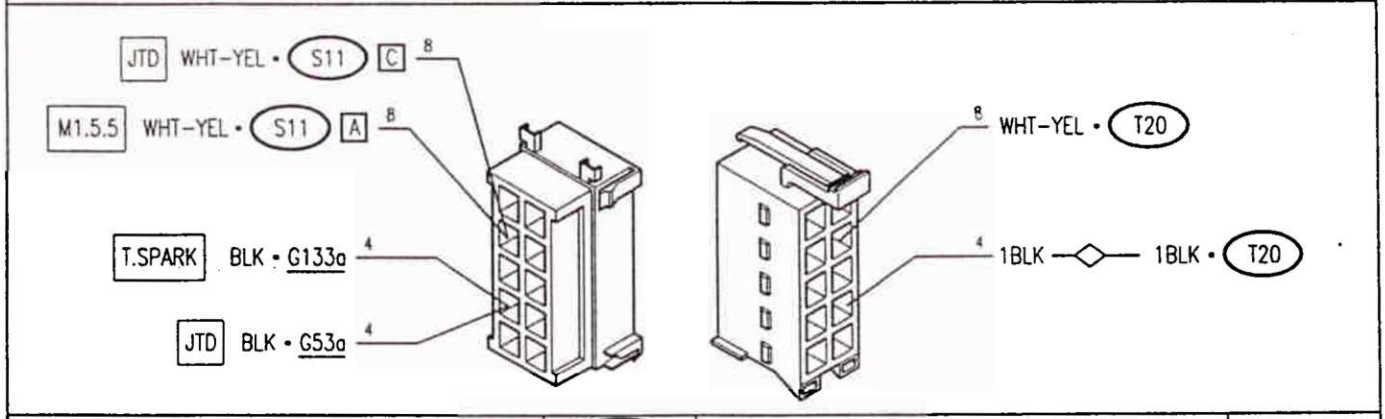
RH engine compartment earth	G53a



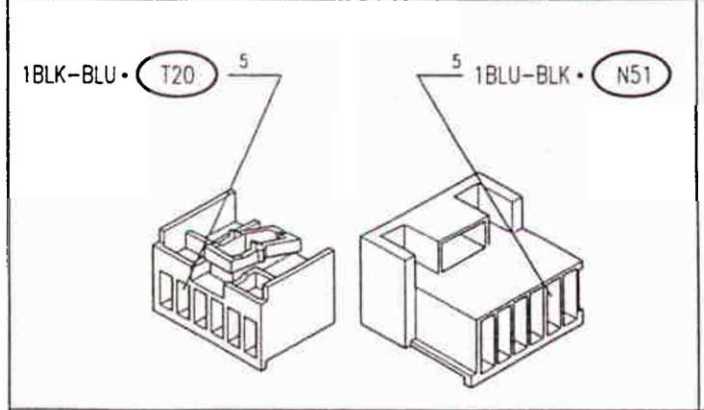
Injection wiring earth	G60



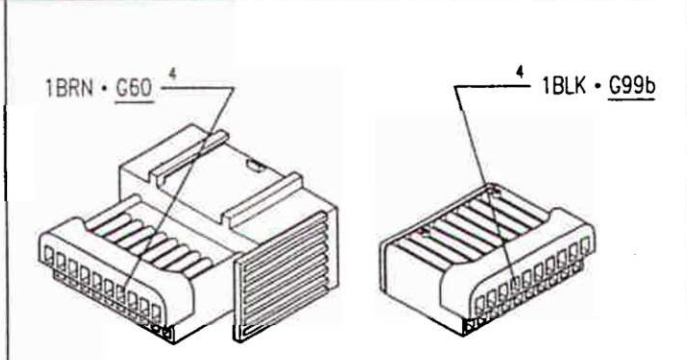
Connector for dashboard wiring/engine wiring	G99b



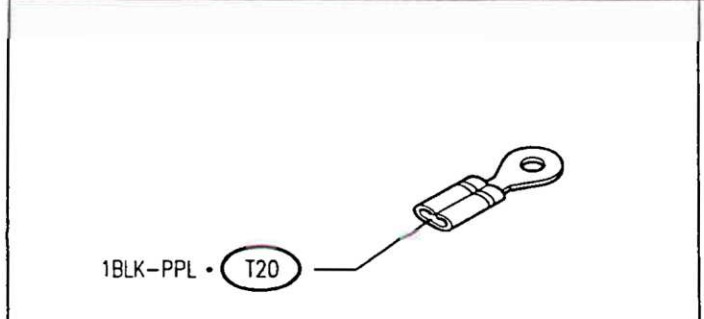
ABS system connector	G124



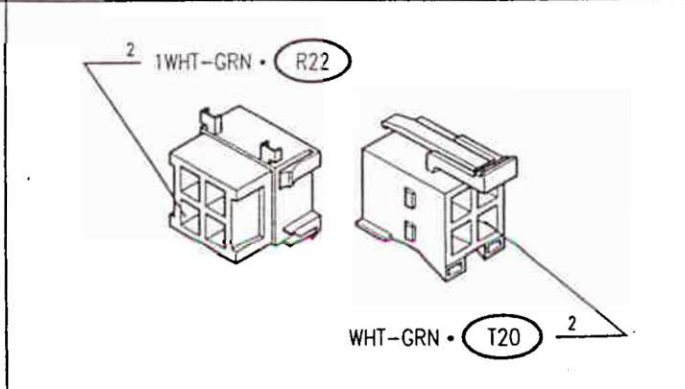
Connector for electronic injection wiring A	G133a



Earth under dashboard LH	G148b

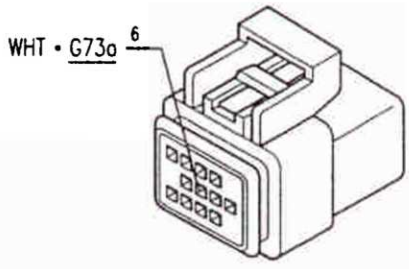


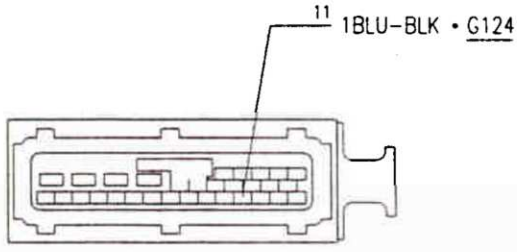
Airbag connector	G380



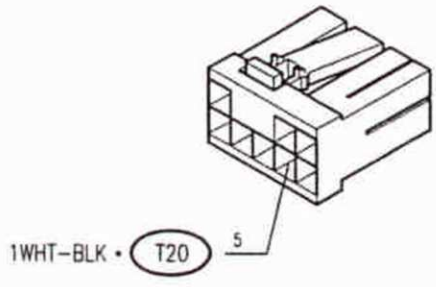
COMPONENTS AND CONNECTORS

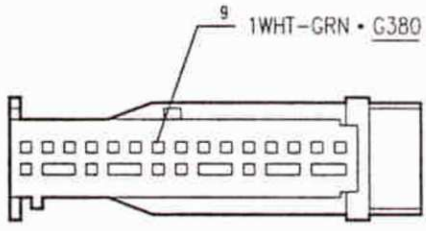
Alarm control unit	N45 A	Hydraulic unit with ABS control unit	N51





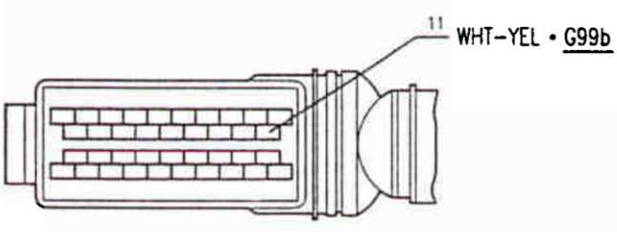
ALFA ROMEO CODE control unit	N77 A	Air bag control unit	R22



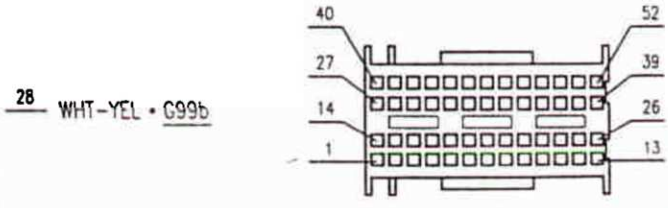


Motronic control unit	S11 A	Electronic injection control unit	S11 C

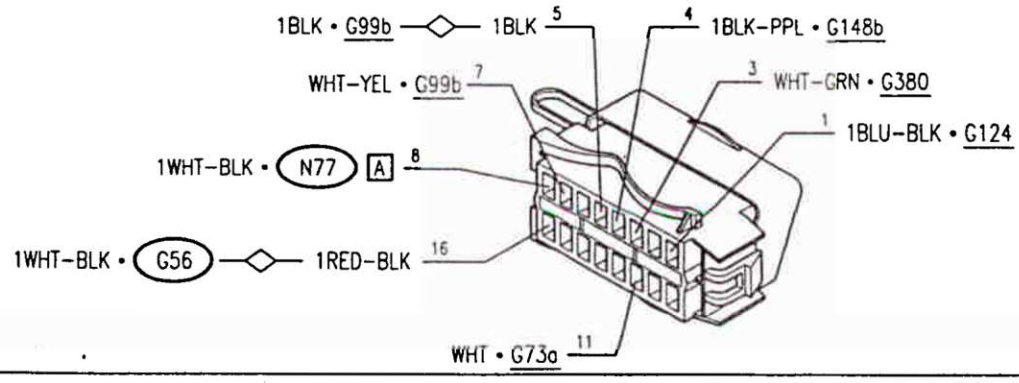
M1.5.5



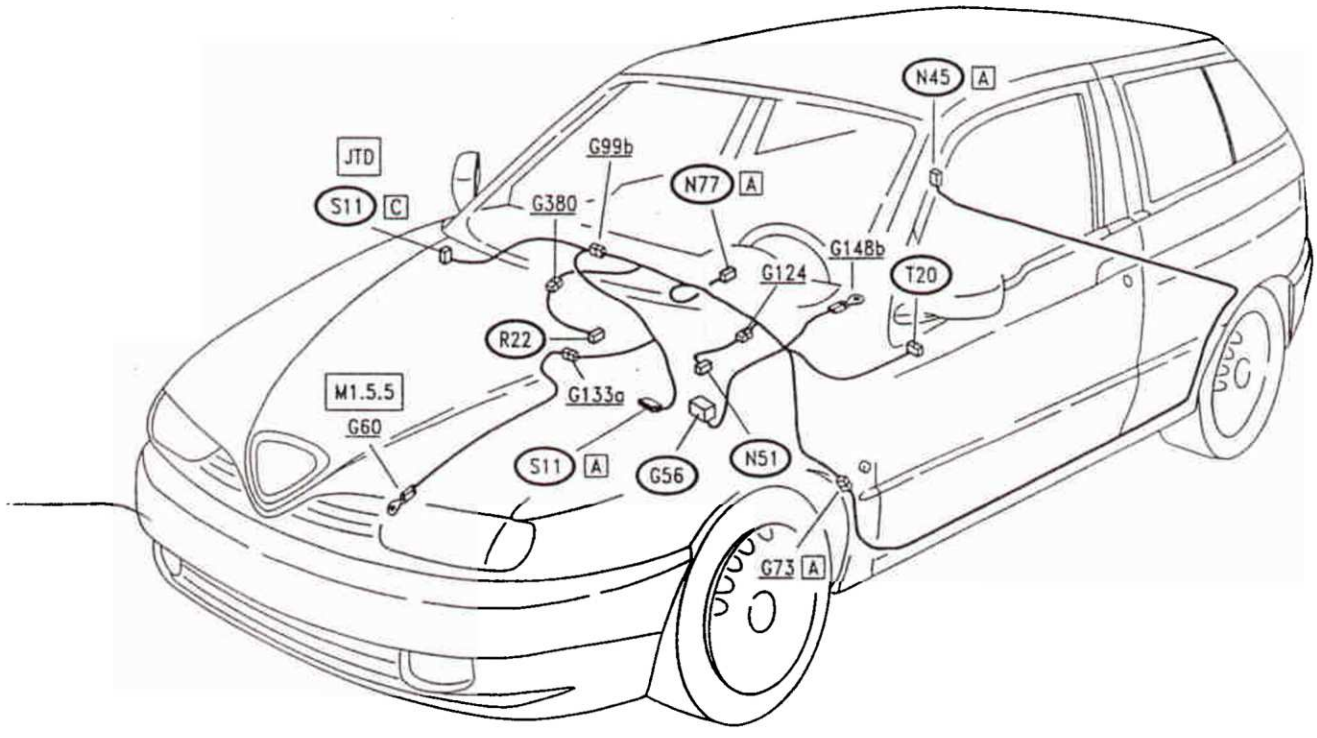
JTD



Standardised diagnosis connector	T20



LOCATION OF COMPONENTS



ROCHESTER INJECTION/IGNITION SYSTEM (*)

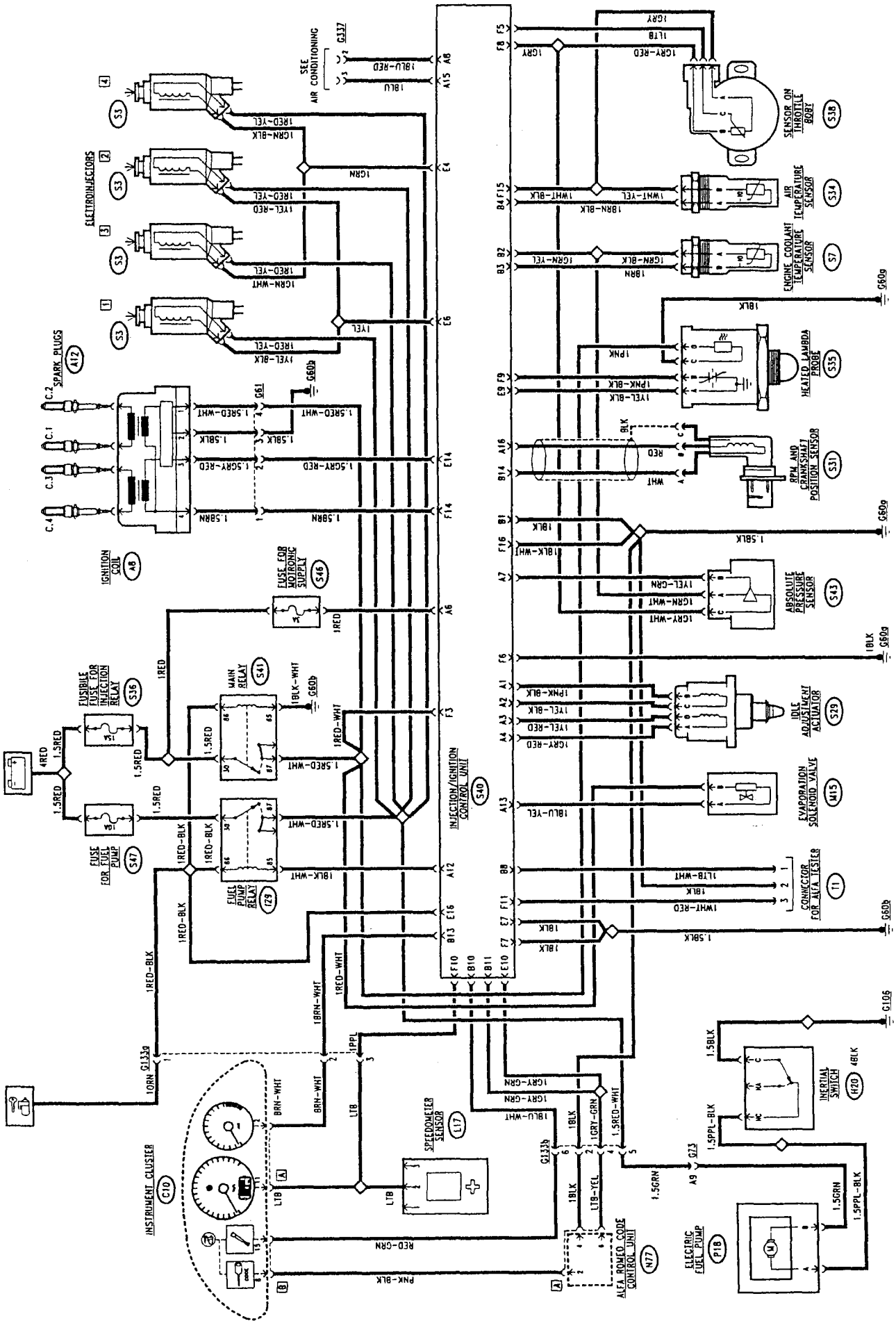
- Boxer 1.6 engine -

INDICE

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GENERAL DESCRIPTION 35A-3
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COMPONENTS AND CONNECTORS 35A-8
LOCATION OF COMPONENTS 35A-15
TROUBLESHOOTING 35A-16
CHECKING COMPONENTS 35A-17

(*) from chassis No.___ it replaces the MOTRONIC MP3.1 system (sect. 55-35)

WIRING DIAGRAM



GENERAL DESCRIPTION

The **Rochester injection/ignition management control unit** (ACG Multec XM) belongs to the category of integrated digital electronic ignition systems with lost spark static distribution of the high voltage, and semi-sequential, timed, multipoint injection.

The calculation of the **base injection time** is carried out following the indirect measurement of the engine load by the calculation of the absolute pressure in the intake manifold and the engine rpm (SPEED-DENSITY system).

This value is then corrected, to optimise the stoichiometric ratio, according to the following parameters:

- water temperature;
- air temperature;
- lambda probe signal;
- transient stages.

The **electroinjectors** are connected in pairs (1-2 and3-4) injecting half the fuel dose at each turn of the crankshaft (semi- sequential injection).

The **spark advance** is calculated according to the engine speed and load, through a control unit map defined experimentally.

This value is optimised according to the:

- water temperature;
- air temperature;
- transient stages;
- altitude (calculated by a specific map according to the rpm, absolute pressure and throttle opening);
- idle speed control;
- starting phase.

The **distribution of the high voltage** to the spark plugs takes place through an ignition module comprising two coils and two power modules.

The control unit is **self-adaptive**.

The self-adaptation function allows the system to adjust to ageing of the engine components or to the production tolerances of new engines and components.

The control unit is therefore capable of detecting the changes which take place in the engine (different internal friction at different temperatures, settling of the engine over the course of time, etc.).

Operating logic

The functions of the control unit are the following:

- starting, cold starting;
- engine warming;
- transient stages;
- full load;
- fuel cut-off;
- spark advance control
- idle speed control;
- rpm limiting;
- exhaust gas control;
- fuel vapour recovery;
- conditioner compressor connection;
- connection with the ALFA ROMEO CODE system;
- system self-diagnosis;

Starting, cold starting

During starting the control unit carries out a specific electroinjector command logic, subdivided into two times:

- Prime Pulse;
- Alternating Simultaneous Double Fire Crank.

The Prime Pulse (with opening of all the injectors) takes place as soon as possible to minimise the starting time. The quantity of it depends on the temperature of the coolant fluid.

Subsequently the alternating simultaneous double fire crank takes place twice for every turn of the crankshaft and lasts until the engine speed exceeds 350 rpm.

At this point, normal alternating simultaneous injection is activated.

During cold starts the mixture is boosted by values mapped according to the temperature of the coolant fluid and absolute pressure.

Suitable anti-flooding functions reduce boosting for prolonged starting times.

Engine warming

The warming phase begins when starting has ended and it lasts until the conditions occur for "Closed Loop" operation (operating field of the lambda probe).

During this phase the mixture is richer and it is gradually leaned as the coolant fluid temperature increases.

Transient stages

Enrichment during acceleration and leaning during deceleration are activated in relation to the change of the throttle opening and of the absolute pressure.

Full load

When the engine is operating at full load the mixture is boosted to allow the engine to reach maximum power (outside the stoichiometric ratio): indeed, the reading of the lambda probe is disabled.

Fuel cut-off

When the accelerator pedal is released and depending on the engine rpm, engine load and coolant fluid temperature, the control unit cuts off injection, which will be restored depending on the same conditions.

Spark advance control

The electronic control unit also processes the static electronic firing control logic.

The optimal spark advance is calculated as follows:

- A base advance angle is calculated through a map stored in the memory in which the input parameters are the engine rpm, the absolute pressure detected of the intake manifold and the throttle closed or open condition.
- The values obtained in this way are added to the correction concerning the coolant temperature throughout the cold starting phase.
- The idle speed table value is further corrected if the idle rpm falls abruptly (for example resulting from the engagement of a service).
- In the case of deceleration and the consequent cut-off action, a subtractive correction is carried out.
- The advance angle value is also subjected to correction in the throttle transient stages or return from cut-off to engine idle rpm threshold.
- During starting a specific table is displayed.

Idle speed control

The control unit controls the idle speed in three ways:

- through an idle actuator (stepper motor) which acts on the throttle by pass through a prod;
- by correcting the spark advance;
- by correcting the injection time.

The idle control is activated to compensate the power absorbed by the various services in order to ensure the most constant operating speed possible.

Rpm limiting

Injection is cut off upon exceeding 6500 rpm.

Exhaust gas control - Lambda Probe

The control unit ensures a metering of the air-fuel mixture nearing the stoichiometric ratio and keeping it so for the longest time possible, in order to limit the emission of harmful substances, and obtain correct and longlasting operation of the catalytic silencer.

Fuel vapour recovery

The fuel vapours leading from the fuel tank are gathered in an active carbon filter (canister) to be re-admitted to the intake and then burnt.

The amount of vapours taken in is managed by the control unit through a solenoid valve, driven in a Duty Cycle, according to engine rpm, engine load and the injection time.

Air conditioner compressor connection

The control unit is interfaced with the air conditioning system (if fitted).

When it receives the request to turn on the compressor, after checking the engine rpm, coolant temperature and the throttle angle, the control unit commands engagement of the compressor.

It will also intervene appropriately to keep the idle speed constant (compensating the higher load caused by the cutting in and out of the compressor).

Connection with the "ALFA ROMEO CODE" system

The system is connected to the ALFA ROMEO CODE control unit, from which it receives the operating consent signal via a special connection line.

The engine control unit is only enabled when the ALFA ROMEO CODE control unit recognises the code of the key engaged in the ignition lock as correct.

System self-diagnosis

The control unit cyclically checks the input and output signals in addition to its internal circuits, memorising any errors detected, in the event of faults.

The errors are entered on two maps:

- the CURRENT map (or table) associated with a volatile memory (RAM);
- the HISTORY map (or table) associated with a non volatile or permanent memory (STAND-BY RAM).

The moment in which the control unit detects an error this is written in the CURRENT table (RAM).

If the error lasts for a certain length of time (validation time) the error is also written in the HISTORY table (STAND-BY RAM).

When the error ceases it is eliminated from the CURRENT table, but not from the HISTORY table where it remains until one of the following conditions arises which cause it to be cancelled:

- 20 starts (also not consecutive), without the error occurring again
- via command from the ALFA ROMEO TESTER
- after disconnecting the control unit from the wiring.

With regard to the actuators (electroinjectors, coil, etc.), these are tested using the ALFA ROMEO TESTER in "Active Diagnosis" (operating the actuators), because in certain cases they cannot be detected by the control unit as faulty components.

The driver is alerted of a fault on the injection/ignition system by the turning on of a failure warning light on the instrument cluster.

It turns off when the fault has been repaired or if the fault is "intermittent", (fault memorised, but no longer present).

When an error is present the control unit also replaces the lacking parameter with fixed replacement parameters memorised inside the control unit (RECOVERY), thereby allowing the engine to operate in "emergency" conditions, when possible.

Components

The electronic control unit receives the signals leading from the **sensors** which detect the engine operating parameters, processes them according to a logic stored inside it in maps which correlate the different parameters in an optimal manner, and it commands the **actuators** accordingly so that the engine always runs with maximum yield and regularity.

The sensors are the following:

- engine temperature sensor (**S7**)
- air temperature sensor (**S34**)
- sensor on throttle body (**S38**)
- rpm sensor (**S31**)
- heated lambda probe (**S35**)
- absolute pressure sensor (**S43**)

The actuators are the following:

- electroinjectors (**S3**)
- ignition module (**A8**)
- fuel pump (**P18**)
- idle speed adjustment actuator (**S29**)
- vapour recovery solenoid valve (**M15**)

The control unit is also connected with:

- the climate control unit
- the electronic key control unit (**N77**)
- the instrument cluster (**C10**) to which it sends the rev counter signal and the command for turning on the failure warning light
- the tachometric sensor (**L17**) from which it receives the car speed signal.

The system is completed by two relays: the main relay (**S41**) and the fuel pump relay (**I29**). The control unit supply line is protected by wander fuse (**S46**), the two relays are protected respectively by the injection relay wander fuse (**S36**) and the fuel pump wander fuse (**S47**).There is an earth point (**G60a** and **G60b**) on the engine.The connector (**T1**) enables connection with the ALFA ROMEO TESTER.

FUNCTIONAL DESCRIPTION

The control unit **S40** controls and adjusts the entire electronic ignition and injection system.
The control unit receives a positive direct from the battery - pin A6 - protected by fuse **S46** (3A).

Fuse **S47** (10A) protects the fuel pump relay **I29**; Fuse **S36** (15A) protects the main relay **S41**.

The key at MARCIA signal reaches pin E16 of the control unit and supplies the coils of the two relays: **S41** (main relay) and **I29** (fuel pump relay).

The former is energised and supplies the ignition module **A8**, the lambda probe resistance **S35** and the evaporative solenoid valve **M15**.

The control unit sends an earth from pin A12 which energises relay **I29** (supply to the injectors **S3** and to the fuel pump **P18**), only after it has received the engine "rpm signal". Additionally, the earth reaches the pump **P18** via the inertial switch **H20** which interrupts the circuit in the event of an impact, for safety reasons.

The power earth is supplied at pins B1, E7, F7 and F16 of **S40**, the earth at pin F6 disables a specific function).

The control unit **S40** receives numerous signals from the various sensors, thereby keeping all the engine operating parameters under control.

From pin F8 of the control unit a stabilised voltage is sent (+5V) to a number of sensors, while from pins B3 and F15 an electronic earth signal is sent.

The rpm sensor **S31** supplies information about the engine speed and the position of the crankshaft.

This sensor is inductive and detects the number of revolutions of the engine through the change in a magnetic field produced by the passage of the teeth of a "phonic" wheel installed on the flywheel; the wheel has 60-2 teeth: the lack of 2 teeth makes it possible to locate the T.D.C. of the two pairs of cylinders (1-2 and 3-4). The sensor is connected to the control unit at pins B14 and A16; the two cables are screened.

The throttle position sensor **S38**, supplied by the control unit **S40** from pins F8 and F15, sends a signal to pin F5 which is proportionate with the degree of opening of the actual throttle. The mobile part of the potentiometer is in fact keyed directly onto the spindle which turns the throttle.

The air temperature sensor **S34** - located on the air intake pipe - is connected to the control unit **S40** at pin F15, and supplies a signal at pin B4 proportionate with the temperature of the air in the intake manifold.

The engine temperature sensor **S7**, connected to the control unit **S40** at pin B2, supplies a signal to pin B3 proportionate with the temperature of the engine coolant, detected next to the thermostat.

The absolute pressure sensor **S43**, supplied by the control unit **S40** from pins F8 and B2, sends a signal to pin A7 which is proportionate with the absolute pressure in the intake box.

The heated lambda probe **S35** supplies the control unit **S40** information about the correct composition of the air - fuel mixture measuring the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin F9 of the control unit **S40**, while it receives a reference earth from pin E9.
The probe is heated with a resistance, to ensure that it operates correctly.

The resistance is supplied by the main relay **S41**.

On the basis of the signals received from the sensors and the calculations carried out, the control unit **S40** controls the opening of the injectors **S3** through pins E4 and E6. The injectors receive the supply from rela **I29**.
The static ignition is operated directly by the control unit.
The power modules and coils are located in the module **A8**; the control unit **S40** sends the command signal from pins E14 and F14, while the actual module is supplied by relay **S41**.

The idle speed adjustment actuator **S29** (step motor) by-passes the flow of air. It is controlled by the control unit **S40** in two phases (forward/backward) from pins A1, A2, A3 and A4.

The evaporative solenoid valve **M15**, sends the fuel vapours from the canister towards the engine upon a command from the control unit: this signal - of the duty cycle type - is sent from pin A13. The valve is supplied by relay **S41**.

The control unit **S40**, which calculates the engine rpm through sensor **S31**, sends a signal from pin B13 t the rev counter indicator, located on the instrument cluster **C10**.

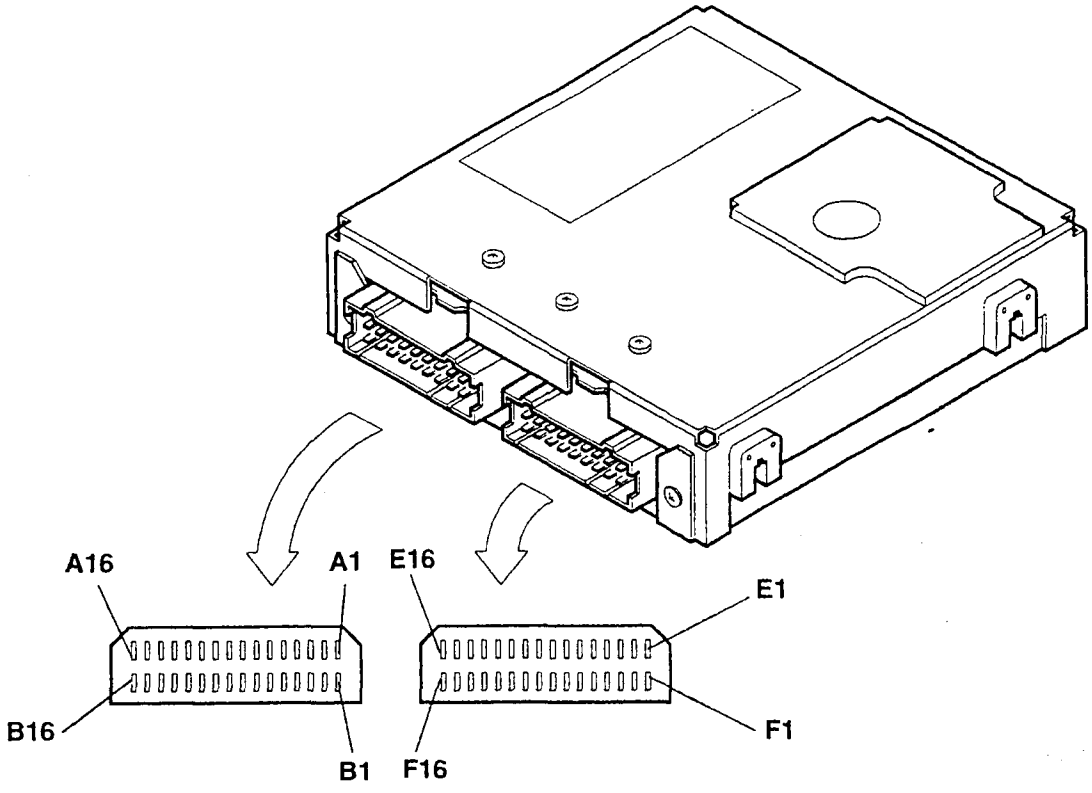
The detection of a fault by the control unit **S40** (see "Self- diagnosis" turns on the corresponding warning light on the instrument cluster via the signal from pin B10.

From the tachometric sensor **L17** the control unit receives at pin F10 the car speed signal, used by the internal logic to optimise certain functions.

The control unit **S40** is connected with the air conditioning system via pins A8 and A15. This makes it possible to adapt the idle speed of the engine to the increased load each time the compressor is engaged, or to disengage it in the event of the need for maximum engine power. For further details, see "Climate control".

The control unit **S40** possesses a self-diagnosis s stem, with the possibility of dialogue with the ALFA ROMEO Tester (connector **T1**); reached by the diagnosis line K - pin F11 - and line L - pin B8 -.

The connection with the ALFA ROMEO CODE control unit is through the special line of pins B10 and B11 (signal input and output) of **S40**. For further details see "ALFA ROMEO CODE".



CONTROL UNIT PIN-OUTS

A1 Idle actuator output (phase D)
A2 Idle actuator output (phase C)
A3 Idle actuator output (phase A)
A4 Idle actuator output (phase B)
A5 N.C.
A6 Control unit direct supply
A7 Pressure sensor signal
A8 Compressor cut-in request signal
A9 N.C.
A10 N.C.
A11 N.C.
A12 Fuel pump relay command
A13 Evaporative solenoid valve control
A14 N.C.
A15 Compressor cut-in command
A16 Rpm sensor signal

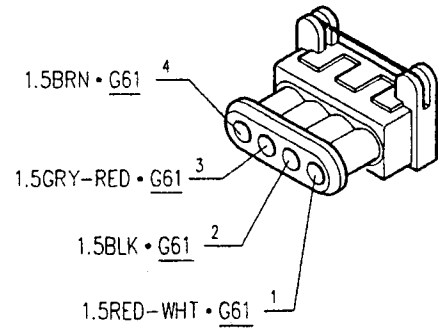
B1 Power earth
B2 Earth for sensors
B3 Water temperature signal
B4 Intake air temperature signal
B5 N.C.
B6 N.C.
B7 N.C.
B8 Diagnosis line L
B9 N.C.
B10 Failure warning light signal
B11 Connection line with ALFA ROMEO CODE
B12 N.C.
B13 Rev counter signal
B14 Rpm sensor signal
B15 N.C.
B16 N.C.

E1 N.C.
E2 N.C.
E3 N.C.
E4 Command to electroinjectors 4/3
E5 N.C.
E6 Command to electroinjectors 1/2
E7 Power earth
E8 N.C.
E9 Lambda probe earth
E10 Connection line with ALFA ROMEO CODE
E11 N.C.
E12 N.C.
E13 N.C.
E14 Ignition control module
E15 N.C.
E16 Key-operated supply

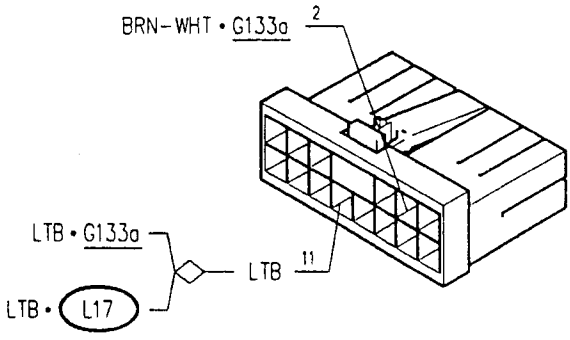
F1 N.C.
F2 N.C.
F3 "Key-operated" supply, ignition module, lambda probe, evaporative solenoid valve
F4 N.C.
F5 Throttle position signal
F6 Earth for provision
F7 Power earth
F8 Sensors supply (5V)
F9 Lambda probe signal
F10 Tachometric signal
F11 Diagnosis line K
F12 N.C.
F13 N.C.
F14 Ignition module command
F15 Earth for sensors
F16 Power earth

COMPONENTS AND CONNECTORS

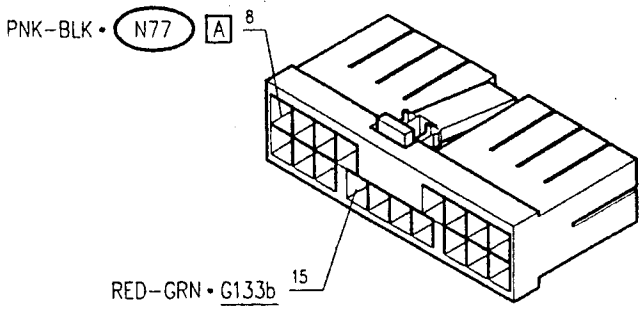
Ignition coil	A8



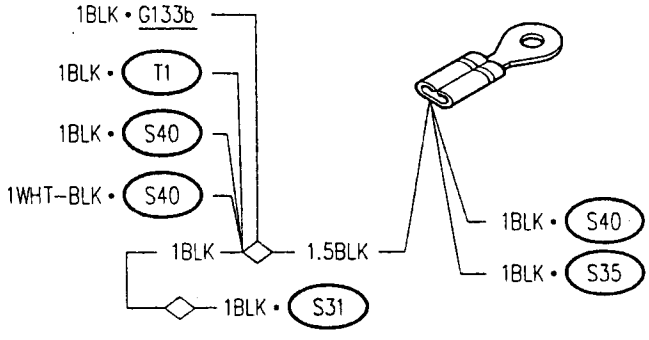
Instrument cluster	C10 A



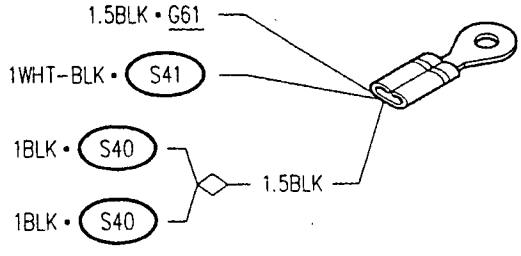
Instrument cluster	C10 B



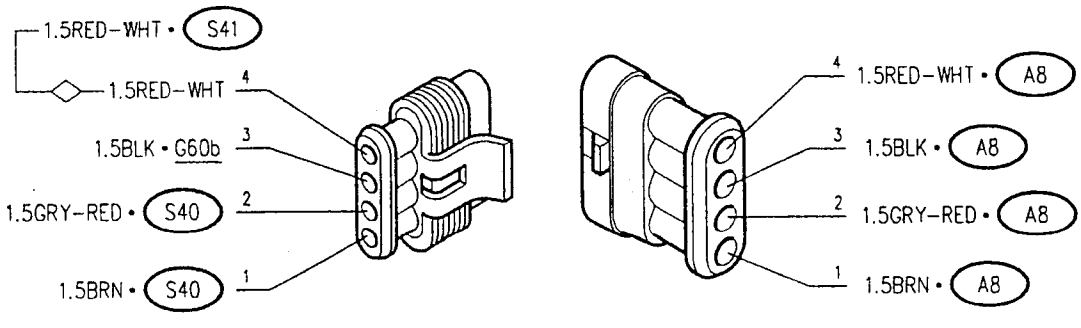
Injection wiring earth	G60a



Injection wiring earth	G60b

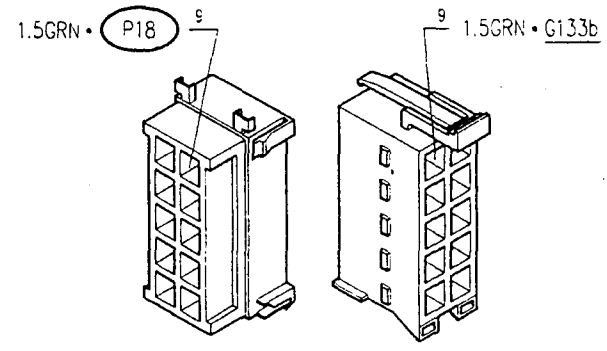


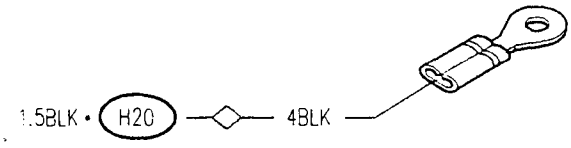
Connector for ignition coil	G61



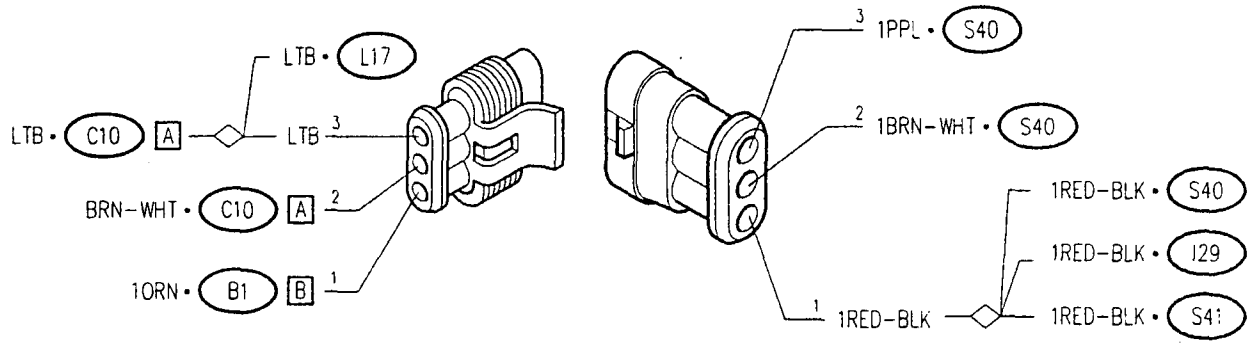
COMPONENTS AND CONNECTORS (cont.d)

Rear services connector	G73 [A]	Seat crossrail earth	G106

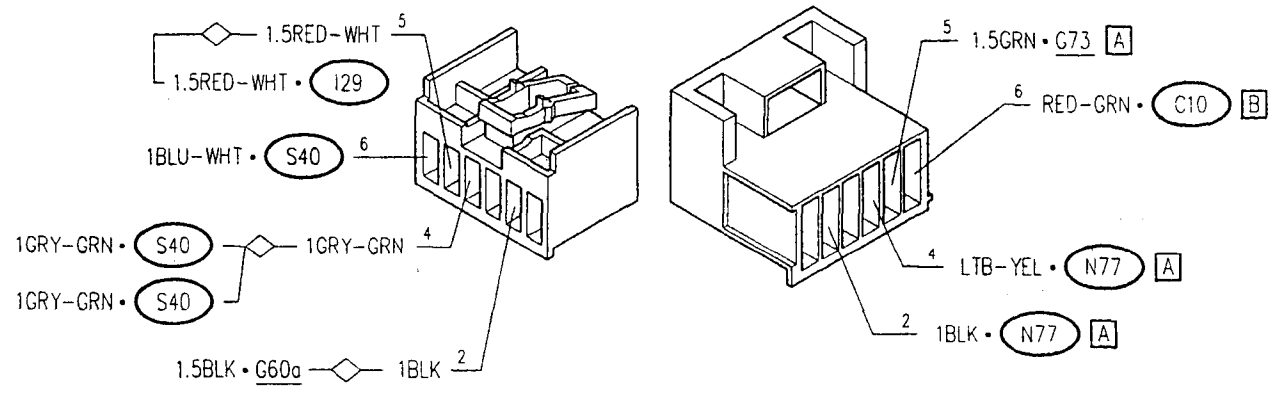




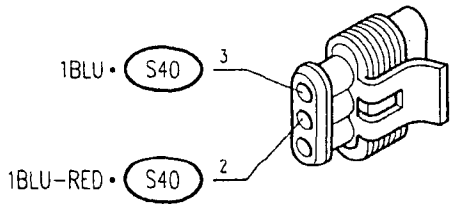
Injection wiring connector A	G133a

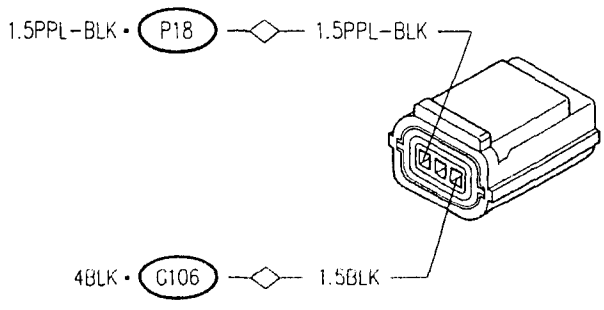


Injection wiring connector B	G133b



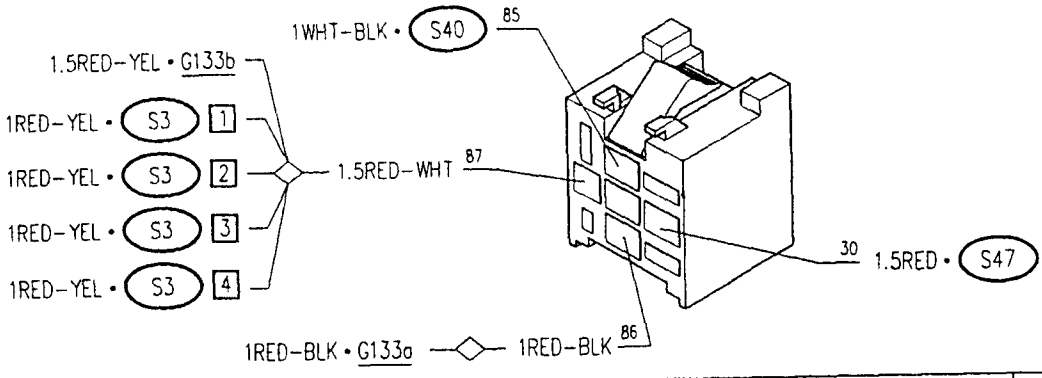
Conditioner system/injection system connector	G337	Inertial switch	H20



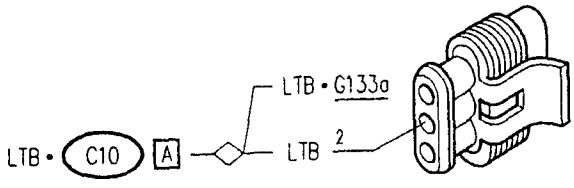


COMPONENTS AND CONNECTORS (cont.d)

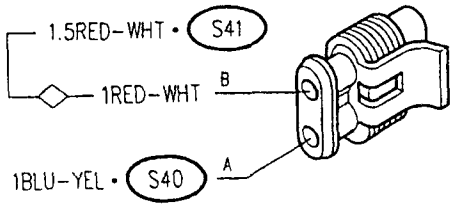
Fuel pump relay — I29



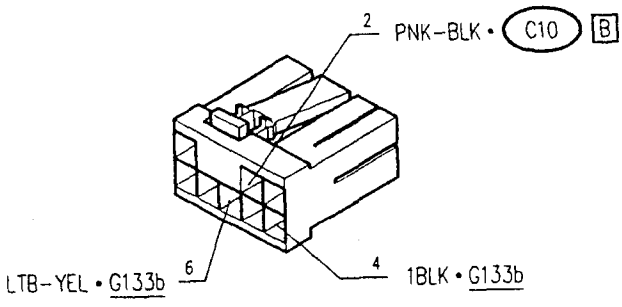
Tachometric sensor — L17



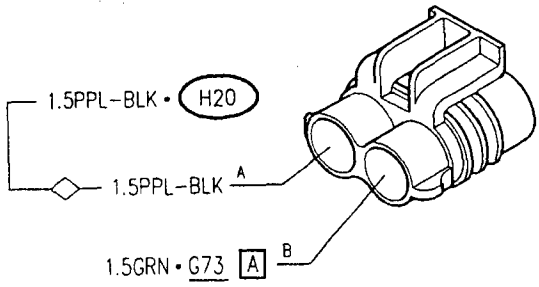
Evaporative solenoid valve — M15



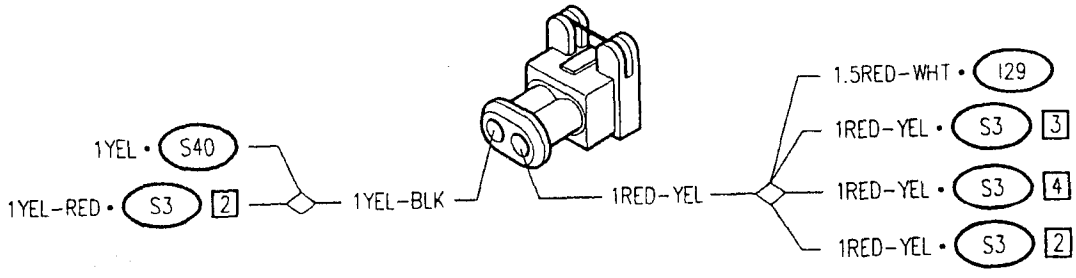
ALFA ROMEO CODE control unit — N77 A



Electric fuel pump — P18

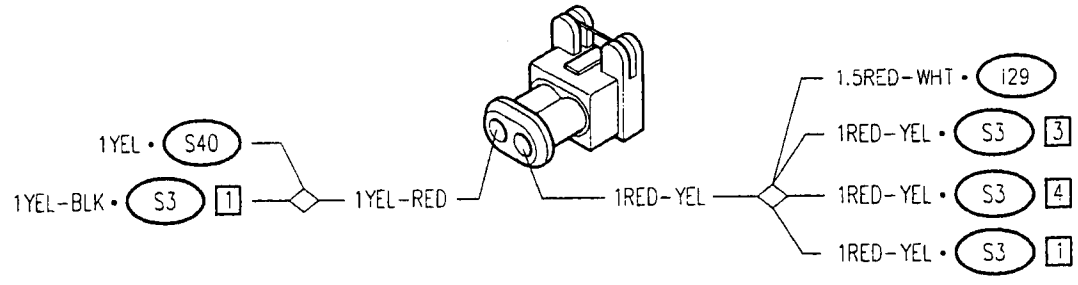


Electroinjector — S3 1

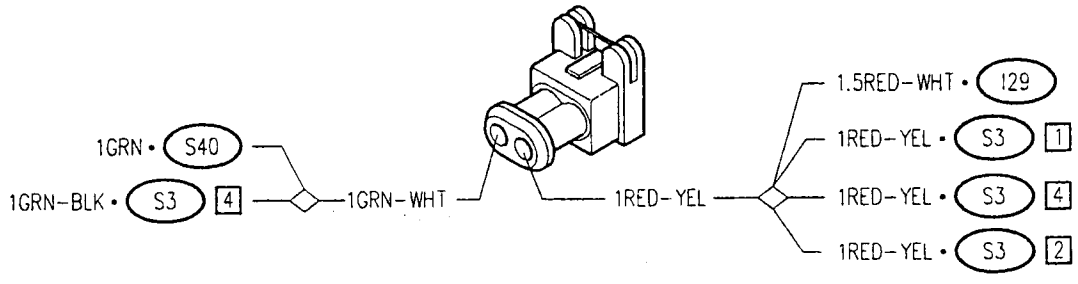


COMPONENTS AND CONNECTORS (cont.d)

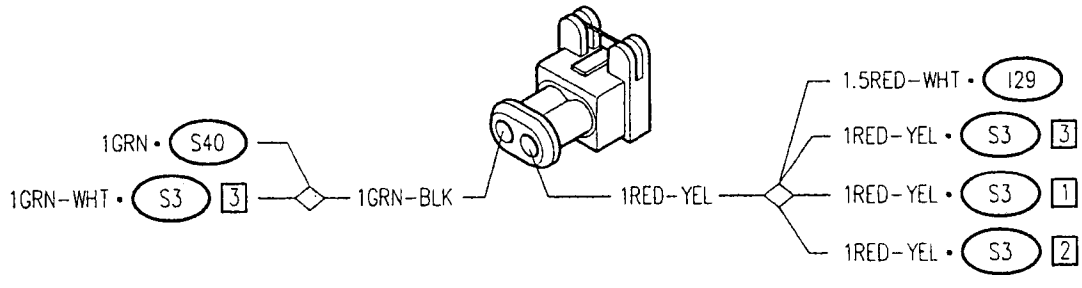
Electroinjector	S3 2



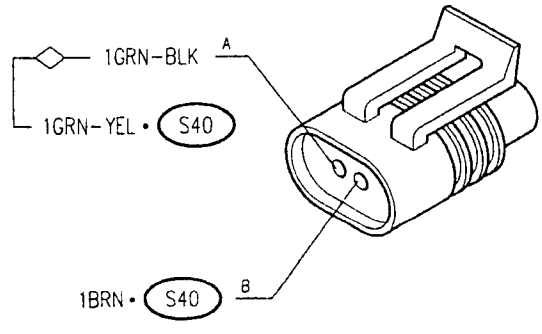
Electroinjector	S3 3



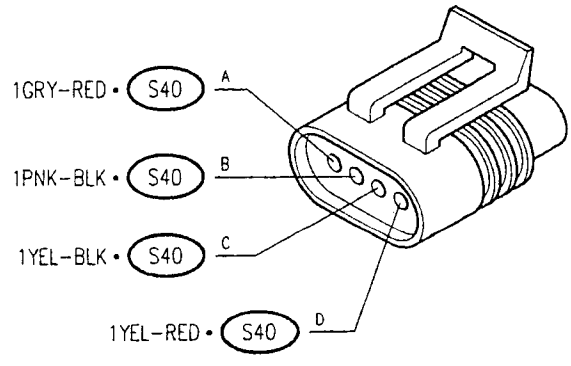
Electroinjector	S3 4



Engine temperature sensor	S7

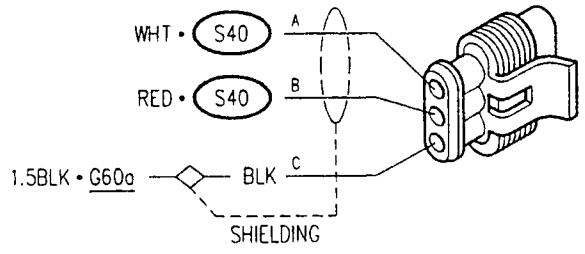


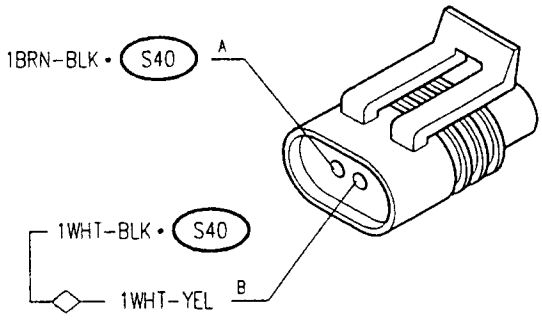
Idle speed adjustment actuator	S29



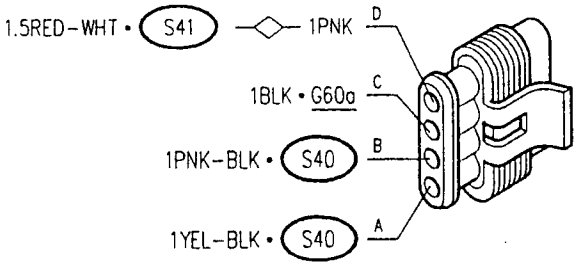
COMPONENTS AND CONNECTORS (cont.d)

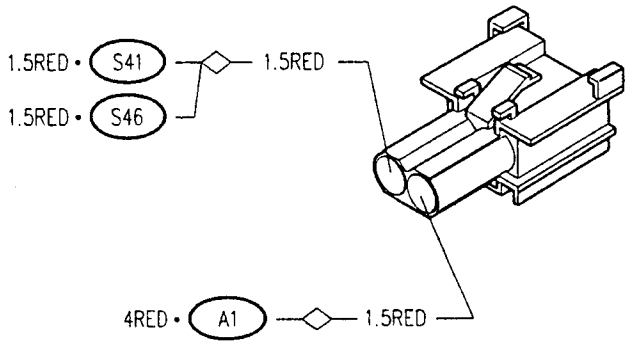
Rpm and crankshaft position sensor	S31	Air temperature sensor	S34



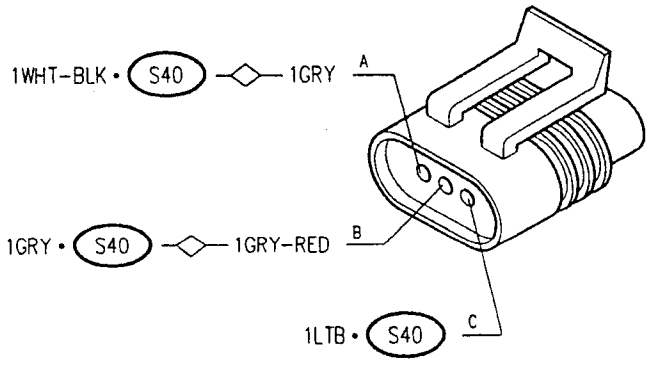


Heated lambda probe	S35	Injection relay wander fuse	S36



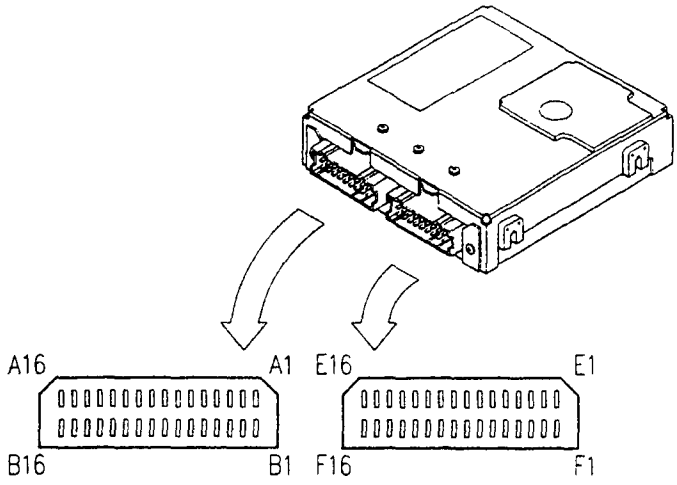


Sensor on throttle body	S38



COMPONENTS AND CONNECTORS (cont.d)

Injection/ignition control unit	S40



A1 1PNK-BLK • S29
A2 1YEL-BLK • S29
A3 1YEL-RED • S29
A4 1GRY-RED • S29
A6 1RED • S46
A7 1YEL-GRN • S43
A8 1BLU-RED • G337
A12 1WHT-BLK • I29
A13 1BLU-YEL • M15
A15 1BLU • G337
A16 RED • S31

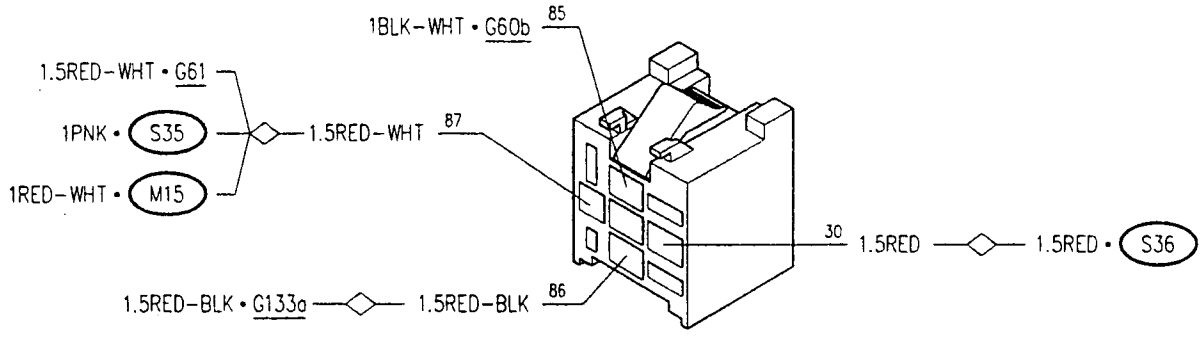
B1 1BLK — 1.5BLK • G60a
B2 1GRN-YEL — 1GRN-BLK • S7
1GRN-WHT • S43
B3 1BRN • S7
B4 1BRN-BLK • S34
B8 1LTB-WHT • T1
B10 1BLU-WHT • G133b
B11 1GRY-GRN — 1GRY-GRN • G133b
B13 1BRN-WHT • G133a
B14 WHT • S31

E4 1GRN — 1GRN-BLK • S3 [4]
1GRN-WHT • S3 [3]
E6 1YEL — 1YEL-BLK • S3 [1]
1YEL-RED • S3 [2]
E7 1BLK — 1.5BLK • G60b
E9 1YEL-BLK • S35
E10 1GRY-GRN — 1GRY-GRN • G133b
E14 1.5GRY-RED • G61
E16 1RED-BLK — 1RED-BLK • G133a

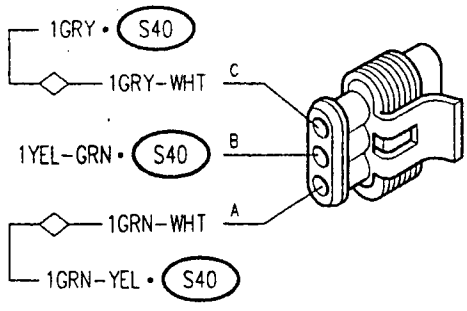
F3 1RED-WHT — 1.5RED-WHT • S41
F5 1LTB • S38
F6 1BLK • G60a
F7 1BLK — 1BLK • G60b
F8 1GRY — 1GRY-RED • S38
1GRY-WHT • S43
F9 1PNK-BLK • S35
F10 1PPL • G133a
F11 1WHT-RED • T1
F14 1.5BRN • G61
F15 1WHT-BLK — 1WHT-YEL • S34
1GRY • S38
F16 1BLK-WHT — 1.5BLK • G60a

COMPONENTS AND CONNECTORS (cont.d)

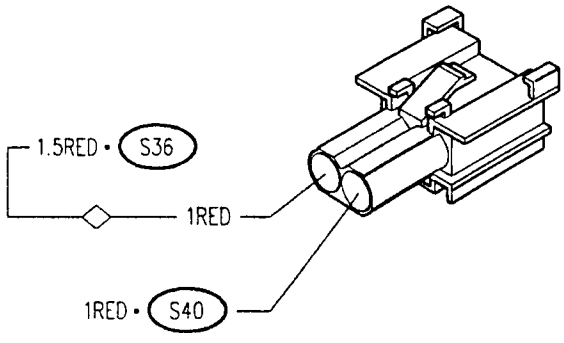
Main relay — S41



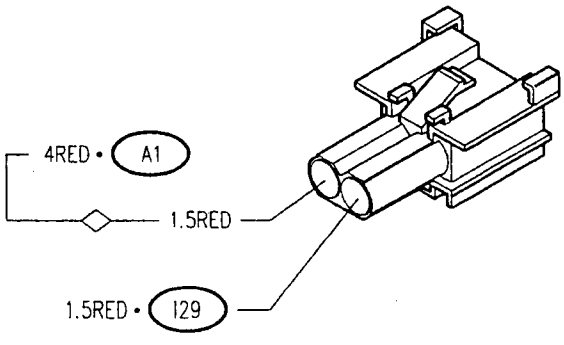
Absolute pressure sensor — S43



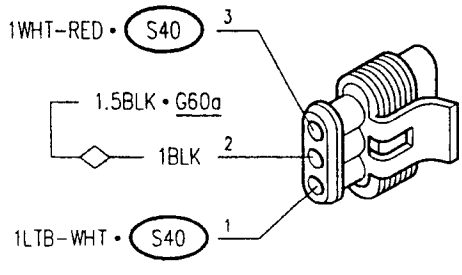
Motronic supply wander fuse — S46



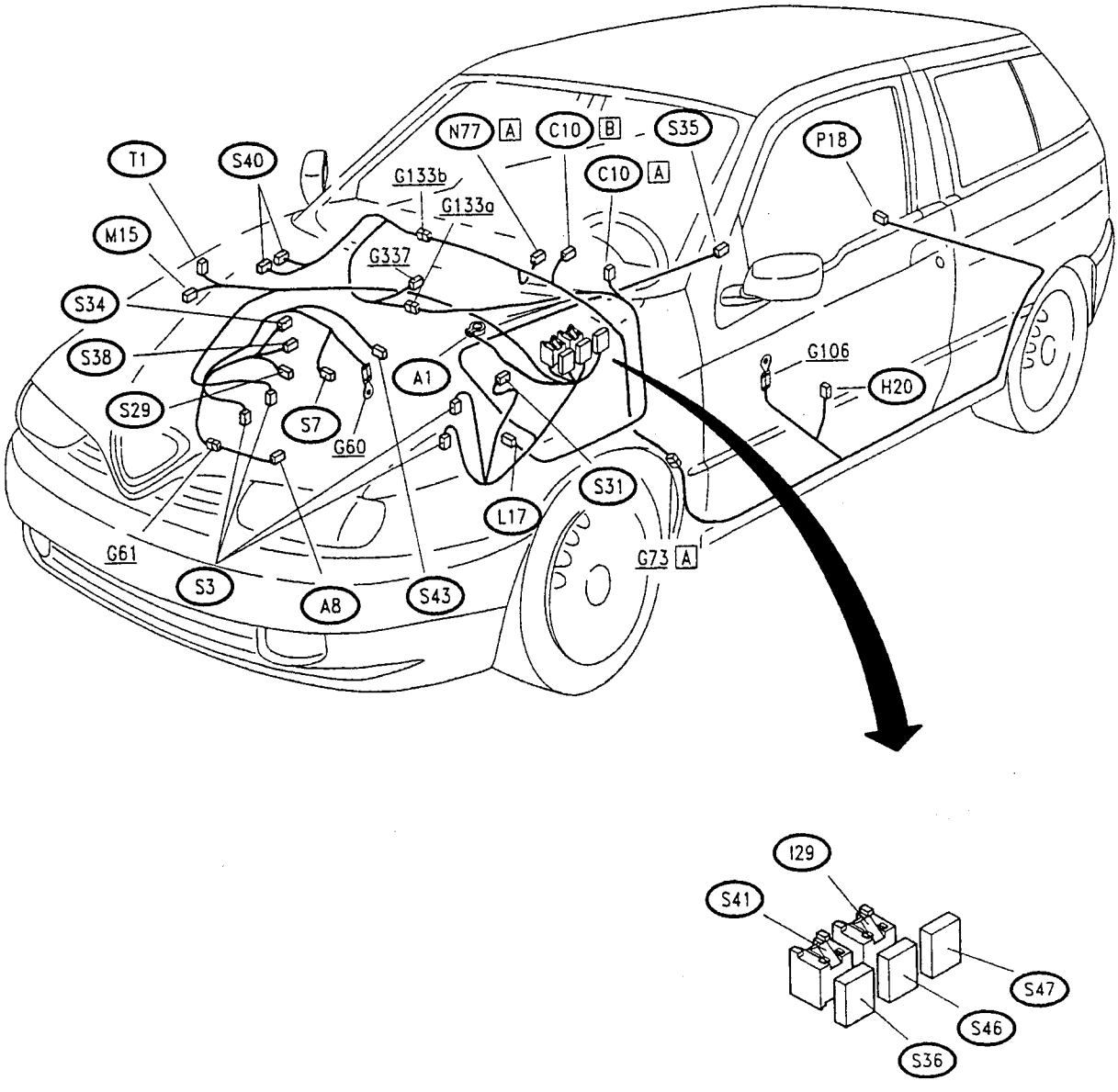
Fuel pump wander fuse — S47



Connector for ALFA TESTER — T1



LOCATION OF COMPONENTS



TROUBLESHOOTING

The control unit possesses a self-diagnosis system which cyclically checks the input and output circuits and its internal circuits, memorising the errors detected in the event of faults.

The errors are entered on two maps:

- the CURRENT map (or table) associated with a volatile memory (RAM);
- the HISTORY map (or table) associated with a non volatile or permanent memory (STAND-BY RAM).

The moment in which the control unit detects an error this is written in the CURRENT table (RAM).

If the error lasts for a certain length of time (validation time) the error is also written in the HISTORY table (STAND-BY RAM).

The driver is alerted of a fault on the injection/ignition system by the turning on of a failure warning light on the instrument cluster.

It turns off when the fault has been repaired or if the fault is "intermittent", (fault memorised, but no longer present).

When an error is present the control unit also replaces the lacking parameter with fixed replacement parameters memorised inside the control unit (RECOVERY), thereby allowing the engine to operate in "emergency" conditions, when possible.

Error cancelling

When the error ceases it is eliminated from the CURRENT table, but not from the HISTORY table where it remains until one of the following conditions arises which cause it to be cancelled:

- 20 starts (also not consecutive), without the error occurring again;
- via command from the ALFA ROMEO TESTER;
- disconnecting the control unit from the wiring.

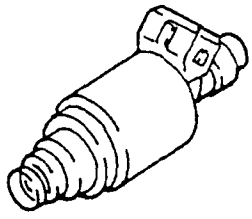
With regard to the actuators (electroinjectors, coil, etc.), these are tested using the ALFA ROMEO TESTER in "Active Diagnosis" (operating the actuators), because in certain cases they cannot be detected by the control unit as faulty components.

Diagnosis with the ALFA TESTER

N.B. Before carrying out diagnosis with the Tester, carry out the preliminary test described (**TEST A**).

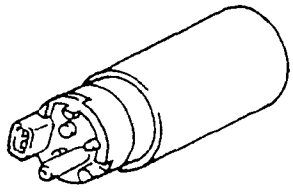
CHECKING COMPONENTS

Electroinjectors (S3)



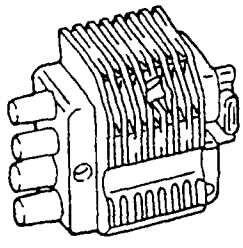
SPECIFICATIONS	
Winding resistance	12 ± 0.4 Ω
Operating pressure	300 ± 0.2% kPa

Fuel pump (P18)



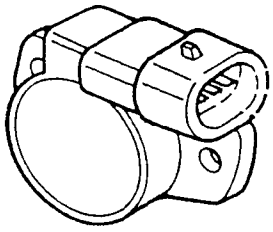
SPECIFICATIONS	
Nominal flow rate	~ 90 l/h
Max. absorption (at 13.5V and 350 kPa)	7.75A
Maximum pressure (with nil flow - pipes clogged) (safety valve setting)	450 kPa

Ignition coil (A8)

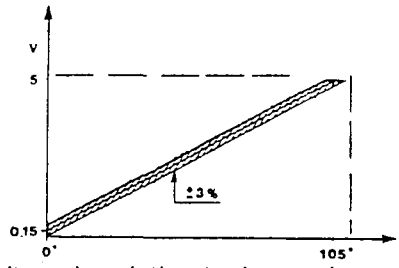


SPECIFICATIONS	
Secondary resistance	6 kΩ

Throttle position sensor (S38)

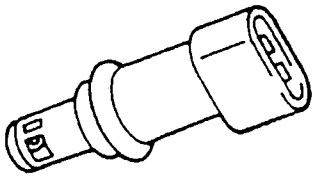


SPECIFICATIONS	
Useful electric angle	105 ± 2°
Mechanical angle	110 ± 4°
Resistance of track	1200 Ω ± 20%
Temperature operating field	-30°C ÷ +125°C



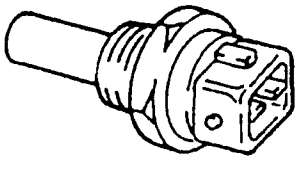
Output voltage in relation to the angle

Air temperature sensor (S34)



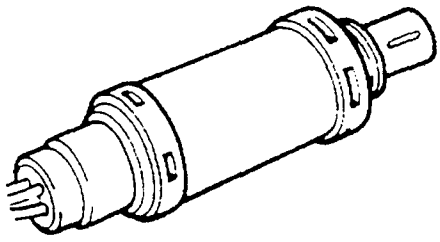
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
+ 100	181.10 ± 7.5
+ 128	82.13 ± 3.17

Engine temperature sensor (S7)



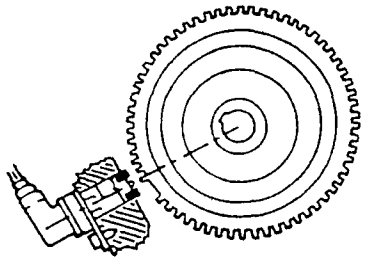
SPECIFICATIONS	
Temperature (°C)	Resistance (kΩ)
- 40	100.707
- 20	28.677
0	9.423
+ 20	3.515
+ 40	1.459
+ 60	0.667
+ 80	0.332

Lambda probe (S35)



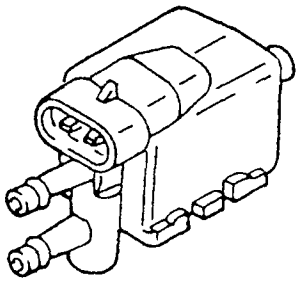
SPECIFICATIONS	
Heating resistance	3 Ω
Response time (from lean to rich & vice-versa at 260°C)	100 msec
Output voltage at 260°C for rich mixture for lean mixture	 800 mVmin 20 mV max

Rpm sensor (S31)



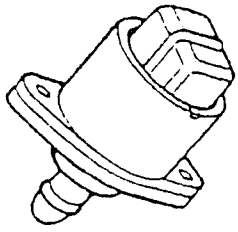
SPECIFICATIONS	
Sensor winding resistance at 25 ± 5°C	540 ± 10%Ω
Sensor winding inductance at 25 ± 5°C	240 mH ± 15% at 1 kHz
Electric signal	600 mV at 60 RPM
Distance (gap) between sensor and flywheel ring gear	1 ± 0.7 mm

Evaporative solenoid valve (M15)



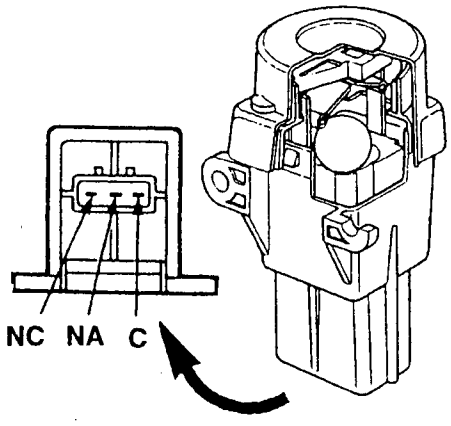
SPECIFICATIONS	
Air flow rate open 100% open 70% open 30%	50 ÷ 58 l/min 33 ÷ 46 l/min 11 ÷ 20 l/min
Duty-cycle signal	16 Hz
Ohmic resistance of winding (at 20°C)	33 Ω
When not energised the solenoid valve is normally closed	

Idle adjustment actuator (S29)



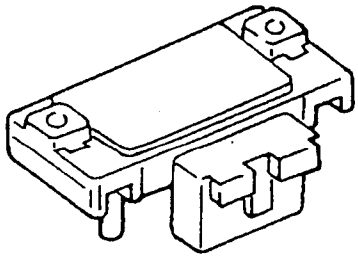
SPECIFICATIONS	
Resistance of windings	53Ω ± 10% at 20°C
Operating temperature	-40°C ÷ +85°C

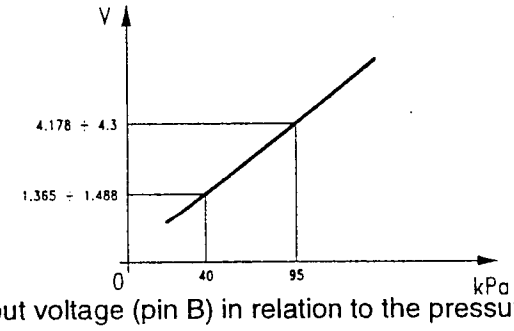
Inertial switch (H20)



SPECIFICATIONS
Check continuity between pins NC and C: this continuity is cut off in the event of impact; the contact is closed again operating the special pushbutton.

Absolute pressure sensor (S43)



SPECIFICATIONS


Output voltage (pin B) in relation to the pressure on the diaphragm

ROCHESTER SYSTEM PRELIMINARY CHECK	TEST A

NOTE: Beforehand, check that the ALFA ROMEO CODE system is working properly as it may have cut off the supply to the system (see "ALFA ROMEO CODE" section) or, if the ALFA ROMEO CODE is not installed check the connection with the anti-theft system.

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check that fuses **S36** and **S47** are intact	OK ▶ ~~OK~~ ▶	Carry out step A2 **Change fuse** S36 **(15A) or** S47 **(10A)**
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relay **I29** and at pins 30 and 86 of relay **S41**	OK ▶ ~~OK~~ ▶	Carry out step A3 ***Restore the wiring between the battery*** A1, **fuses** S36 **and** S47 **and relays** S41 **and** I29
A3 CHECK VOLTAGE – With the key turned, check for 12 V at pin 86 of relays **I29** and **S41**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between the ignition switch **B1** and relays **I29** and **S41**
A4 CHECK RELAYS – Check that relays **I29** and **S41** are working properly	OK ▶ ~~OK~~ ▶	Carry out **step A5** Change any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – With the key turned, check for 12 V at pin E16 of the control unit **S40**	OK ▶ ~~OK~~ ▶	Carry out **step A6** Restore the wiring between the control unit **S40** and the ignition switch **B1**
A6 CHECK EARTH – Check for an earth at pins B1, E7, F6, F7 and F16 of **S40**	OK ▶ ~~OK~~ ▶	**CONTINUE DIAGNOSIS USING THE ALFA TESTER** Restore the wiring between **S40** and earth **G60a**, or **G60b**

WARNING:
From Model Year '97, - and previously for certain Markets - it replaces the previous "TD" version - Refer to the section 37.

TD - CAT ENGINE CONTROL DEVICES

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FOREWORD

The TD engine (1930 cc:) is supplied - **in the "TD-CAT" version** - with a series of additional devices which further enhance performance regarding the emission of pollutants owing to a series of notions to reduce the production of such pollutants at their origin:

- **Degussa catalyst;**
- **new injection pump with specific innovations for optimising the operating features of the engine under all conditions;**
- **adoption of a potentiometer on the pump itself to control the accelerator;**
- **exhaust gas recirculation system (E.G.R.) with electronic control.**

This section brings together the devices and systems - controlled and/or operated **elettrically** - which govern the operation of this engine.

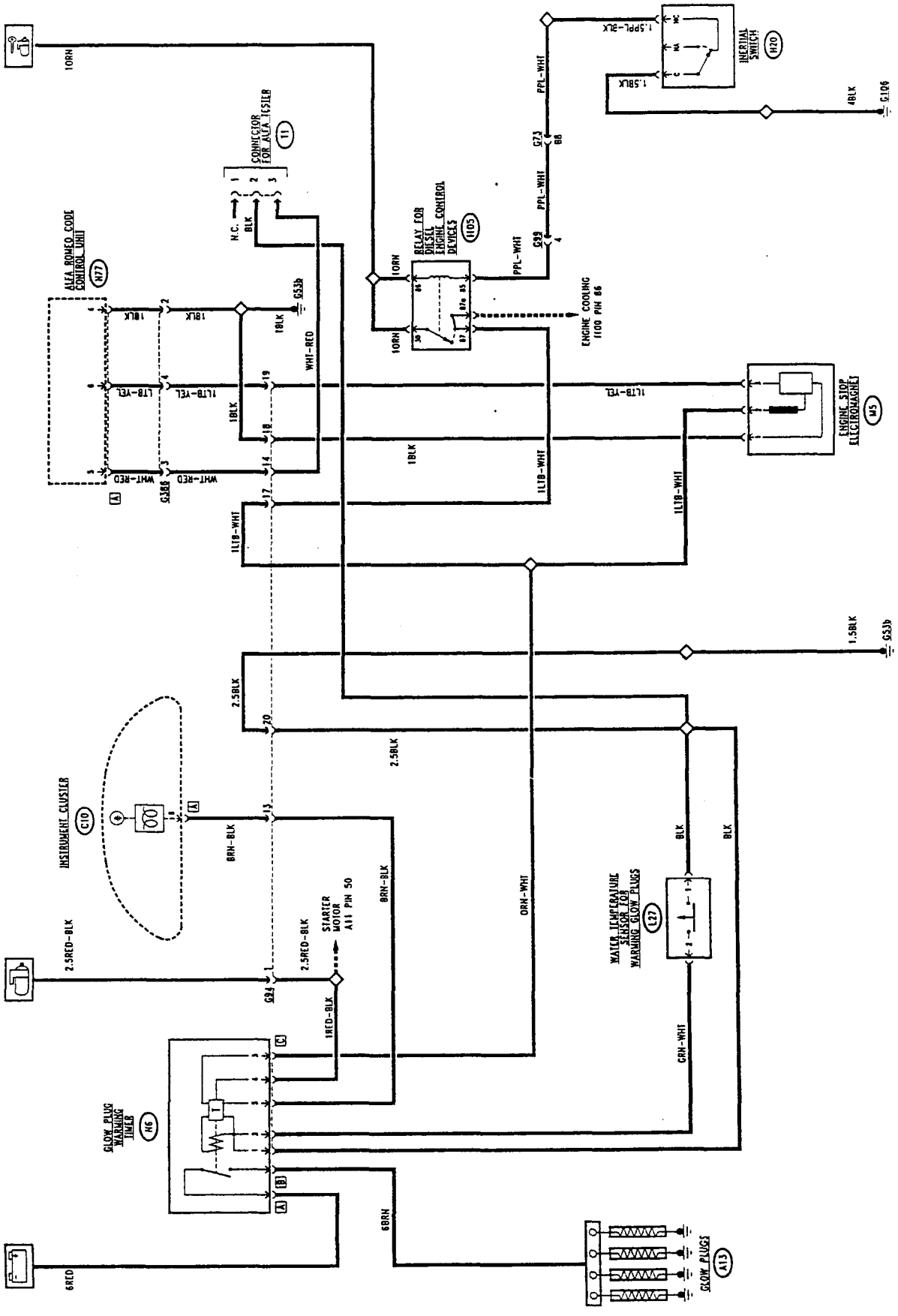
These are:

- **GLOW PLUG WARMING;**
- **ENGINE STOP;**
- **COLD ADVANCE (KSB);**
- **E.G.R. CONTROL**
- **FUEL WARMING**

For the complete, mechanical and functional description of the various systems, refer to GROUP 10: "ENGINE - SUPPLY"

WARNING:
The ENGINE STOP function is controlled by the ALFA ROMEO CODE system, which allows it to operate only after checking the secret memorised code (for further details see section "ALFA ROMEO CODE").

GLOW PLUG WARMING - ENGINE STOP
WIRING DIAGRAM



GLOW PLUG WARMING

General Description

As we all know, in Diesel or "compression ignition" engines, the air/fuel mixture is ignited without outside sparks, simply by compressing the mixture.

However, when the engine is started cold, it is necessary to pre-heat the precombustion chambers - where the fuel and air mix - in order to increase the temperature of the mixture to values that enable self-ignition, upon compression in the cylinders.

This pre-heating is carried out through "**rapid incandescence Glow plugs**" of the bulb type, fitted in the cylinder head, one for each precombustion chamber.

The glow plugs are controlled by a special electronic device which adjusts the operating times and the operating logic, while a warning light on the instrument cluster alerts the driver that the pre-heating function is operational.

The electronic control unit is located in the engine compartment next the battery; it incorporates an NTC sensor - on the thermostat - which detects the temperature in the engine compartment. The device delivers a considerable amount of current to the glow plugs for a given amount of time, which is calculated according to the following logic, in three stages:

1) pre-heating time, with "glow plug warming" warning light on the instrument cluster on:
this varies according to the engine temperature detected by the special sensor.
At the end of this time the warning light turns off to inform the driver that the engine can be started.

2) pre-heating time with warning light off:
if the engine is not started immediately, the logic of the device ensures the supply to the glow plugs for a time known as "maintenance time", of 10 seconds with the warning light off.

3) *after-heating time*:
this is a further period of supply to the glow plugs after starting (key released from the START position), after which the supply of current is cut off.

This time, too, depends on the temperature of the engine.

The control logic also prevents any inconvenience or damage to the engine cutting off the supply if accidental earth contacts are detected at any of the glow plugs or of their supply cables .

Functional Description

The glow plug warming electronic timer device **N6** is connected, as shown in the wiring diagram:

The eyelet of connector A is connected to the battery supply through the branch terminal board.
The eyelet of connector B is connected to the conductor bar of the glow plugs **A13** to which it sends the warming current for the length of time established by the electronic device.
Pin 1 - connector C - is earthed. The electronic timer circuit is operated when the cluster is turned on via the "key-operated" signal which reaches pin 3 via relay **I105** (relay **I105** supplies this and other engine control devices: intervention of the inertial switch **H20** de-energizes the relay and cuts off the supply in the event of a crash/accident). Pin 4 receives the starting signal. Lastly a signal from pin 5 - still of connector C - turns on the "glow plug warming" warning light on the instrument cluster **C10**

ENGINE STOP

General Description

In a Diesel engine the engine is stopped by interrupting the supply of fuel to the injection pump; this takes place through a special solenoid valve which controls the passage through which the fuel flows into the injection pump.

With the key at MARCIA and the consent of the ALFA ROMEO CODE control unit, the electromagnet opens the flow of fuel, as soon as the switch is turned to the STOP position, the flow is cut off and, after a few turns, the engine stops.

In the event of violent impact the supply to the solenoid valve might not be cut off, therefore, often the engine stays on. The presence of the inertial switch cuts off the supply, thereby stopping the engine in the case of impact of a certain degree.

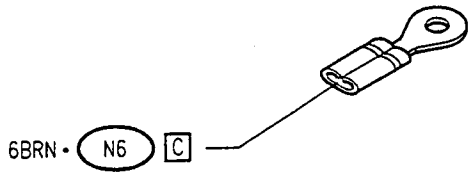
Functional Description

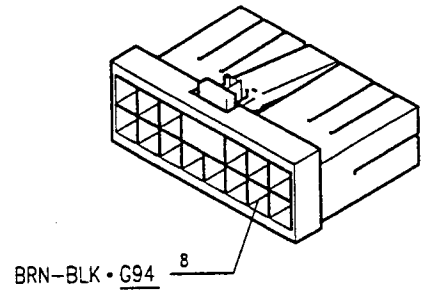
Device **M5** comprises an electronic control circuit which activates the electromagnet when it receives the "key- operated" signal (pin 2) but also the consent signal (pin 3) from the ALFA ROMEO CODE control unit **N77**.

With the ignition switch in the STOP position - or with the anti-theft of the inertial switch **H20** - this supply ceases and the electromagnet is deactivated thereby cutting off the flow of fuel to the injection pump.

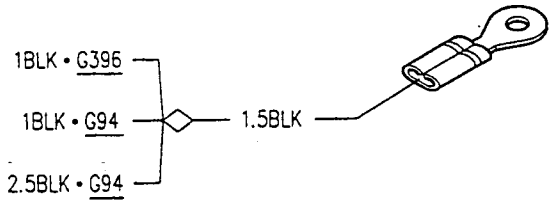
COMPONENTS AND CONNECTORS

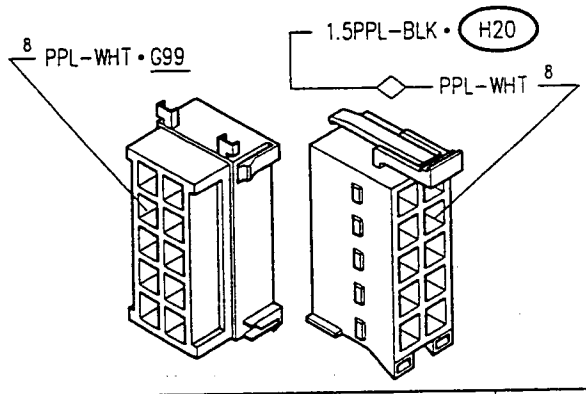
Glow plugs	A13	Instrument cluster	C10 A



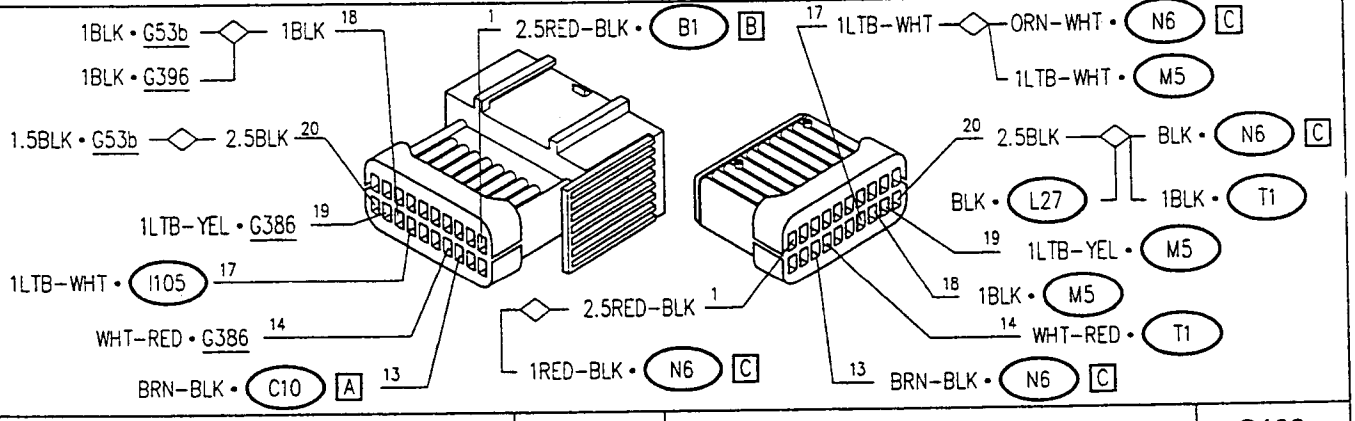


RH engine compt. earth	G53b	Connector for rear services	G73 B

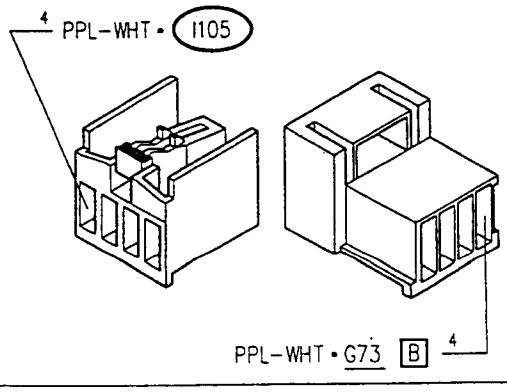


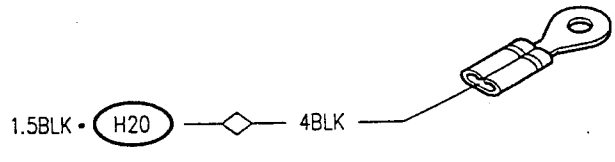


Engine compartment connector	G94



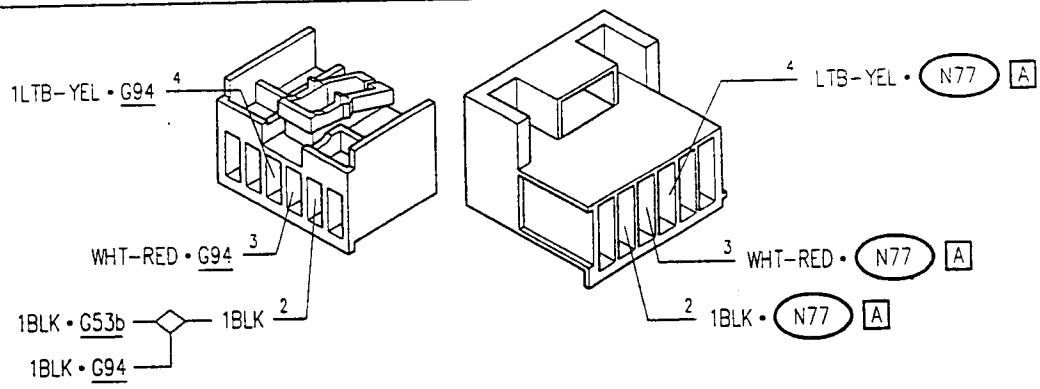
Dashboard/engine wiring connector	G99	Seat crossmember earth	G106



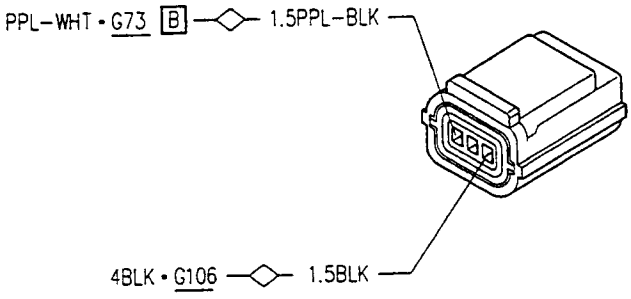


COMPONENTS AND CONNECTORS (contd.)

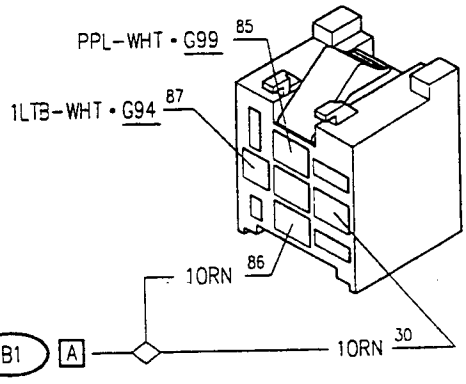
ALFA ROMEO CODE system connector — G386



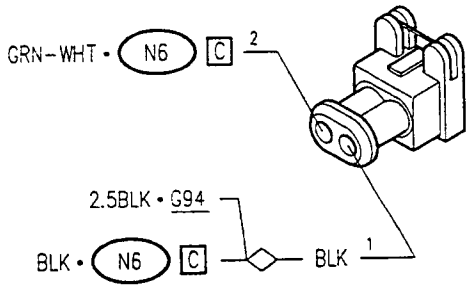
Inertial switch — H20



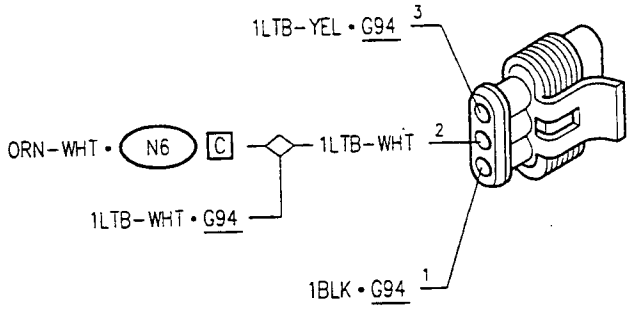
Diesel engine control devices relay — I105



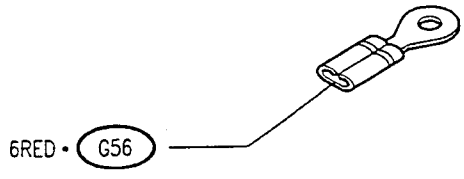
Water temperature sensor for glow plug warming — L27



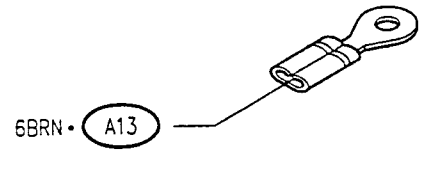
Engine stop electromagnet — M5



Glow plug warming timer — N6 A

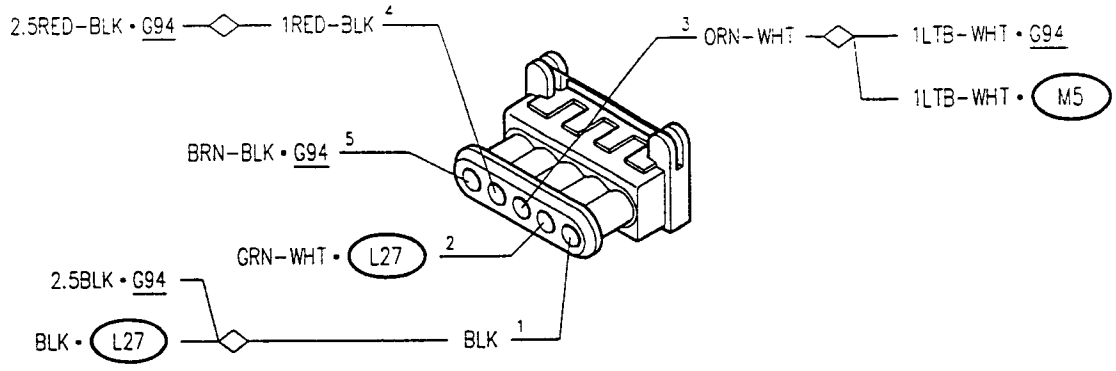


Glow plug warming timer — N6 B

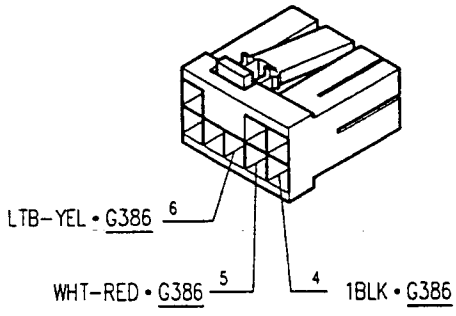


COMPONENTS AND CONNECTORS (contd.)

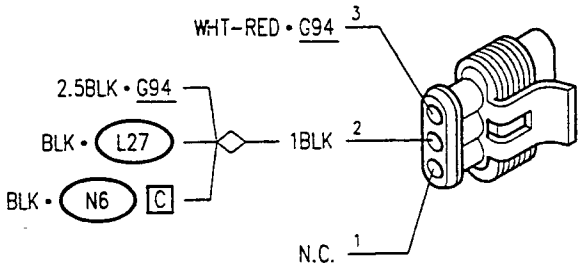
Glow plug warming timer — N6 C



ALFA ROMEO CODE control unit — N77 A

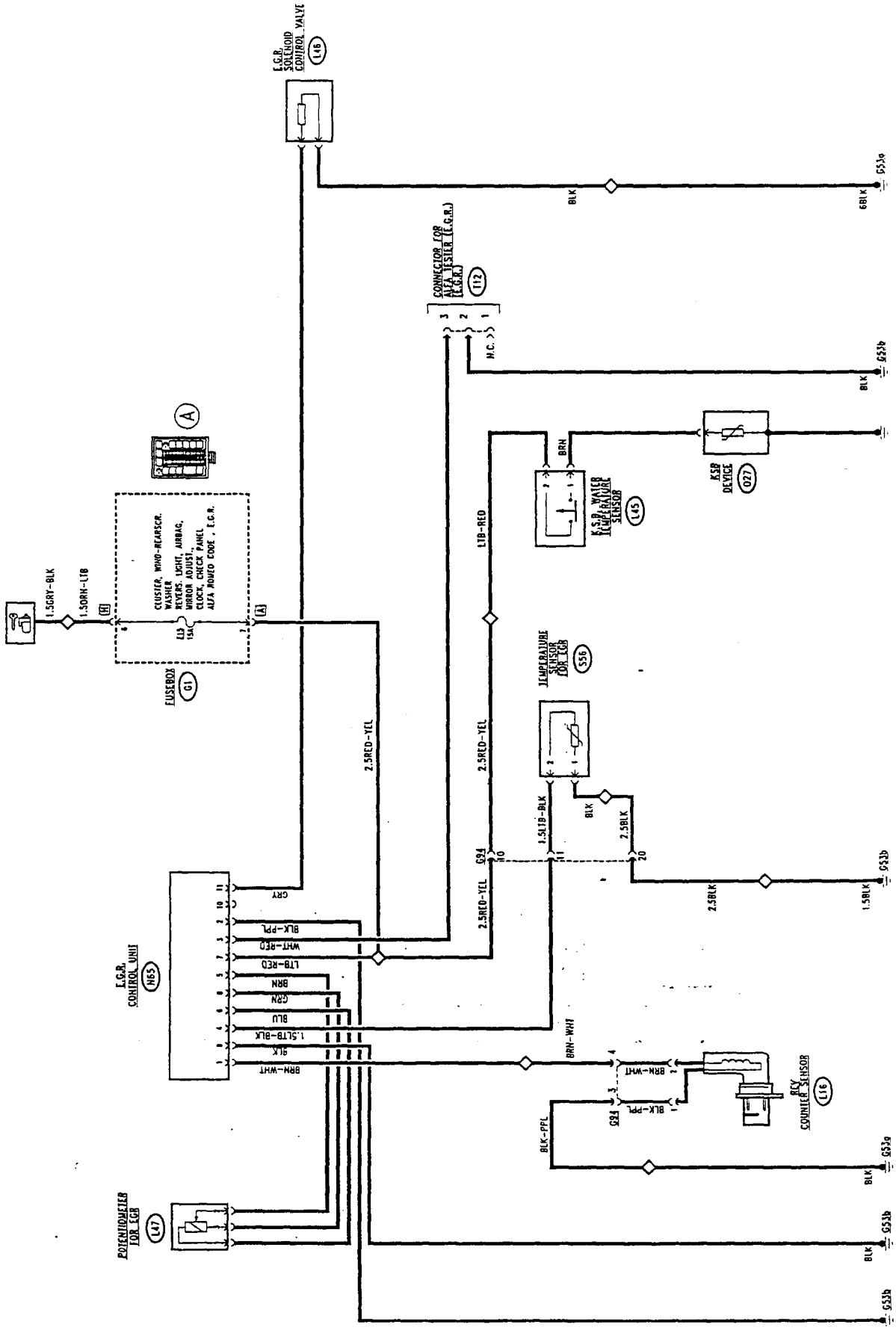


Connector for ALFA ROMEO TESTER (engine management-ALFA ROMEO CODE) — T1

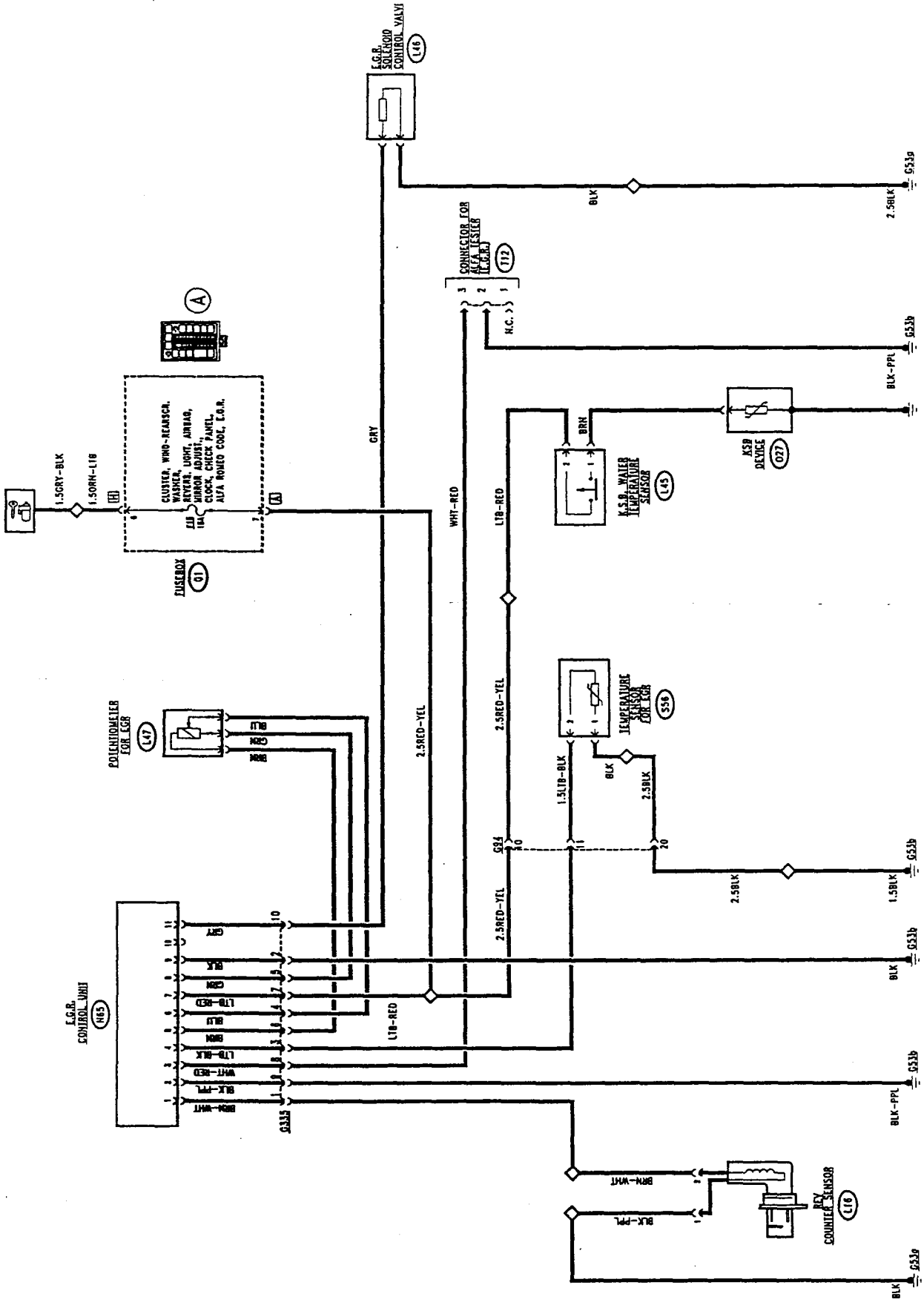


E.G.R. CONTROL - COLD ADVANCE

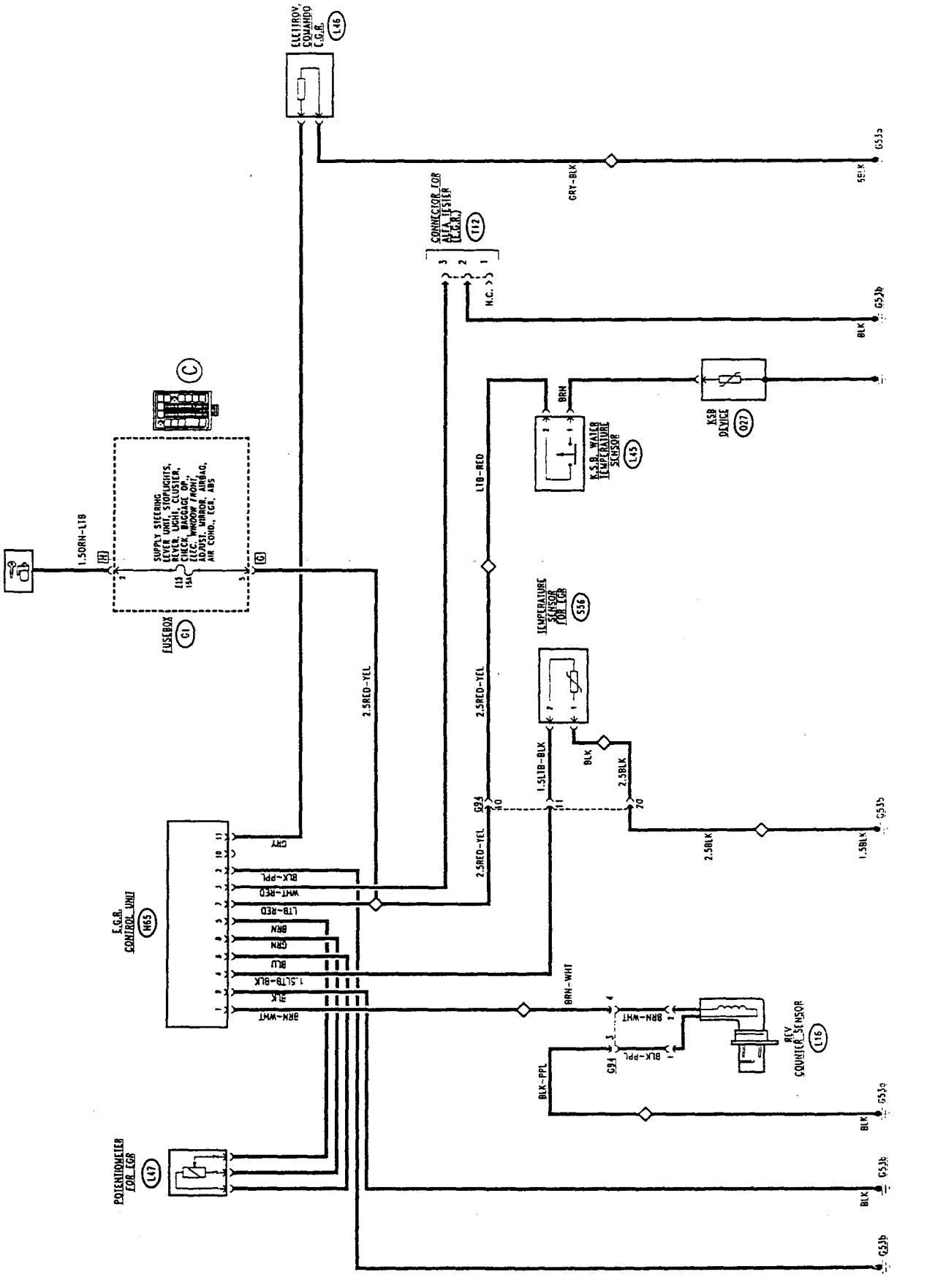
Wiring Diagram (up to chassis no. ...)



Wiring Diagram (from chassis no. ...)



Wiring Diagram



E.G.R. CONTROL

General Description

This system makes it possible to send part (5 ÷ 15%) of the exhaust gas back to the intake, under determinate operating conditions of the engine.
This way the fuel mixture is diluted with inert gases, lowering the peak temperature in the combustion chamber: this reduces the formation of nitric oxides (NOx), reducing them by 30 ÷ 50% at the exhaust.
Gas recirculation is only allowed at medium-high loads, when the fuel-air ratio is very high and the operation of the engine is not adversely affected by the presence of inert gas instead of air.
The recirculation system is controlled by an electronic control unit which receives the signals of the potentiometer on the accelerator lever and from the rpm and coolant fluid temperature sensors, and sends a command signal for the Borg Warner E.G.R. control modulating solenoid valve. The latter is connected to the atmosphere by a filter and, on the basis of the signals it receives, it transmits a lower or higher vacuum, leading from the special servobrake vacuum pump to the Pierburg E.G.R. valve.
This valve, if the vacuum is sufficient, opens, putting the exhaust manifold into communication with the intake manifold.
It is therefore possible to change the amount of gas recirculated adjusting the opening of the Pierburg E.G.R. valve continuously, using the maps stored containg the degree of opening in relation to the signals received.

The control unit has a connector for the serial output for the Alfa Tester, through which it is possible to reveal any faults detected during operation for servicing purposes.

Functional Description

The control unit **N65** controls the E.G.R. system detecting certain signals from special sensors and controlling the E.G.R. solenoid valve in such a way as to adjust recirculation according to the different engine parameters.

The control unit receives the "key-operated" supply at pin 7 through the line of fuse **F15** of fusebox **G1**; pin 2 and pin 9 area earthed.

The potentiometer **L47** installed on the injection pump, detects the angular position of the accelerator lever and informs the control unit about the engine load.
The rotation of the lever changes the internal resistance of the potentiometer, therefore, with a supply at 3.7± 0.2 V constant supplied by the control unit from pins 8 and 6, output voltages are obtaied varying between 0.57 V at idle speed. to 1 ÷ 2.9 V at full load: this signal is sent to pin 5 of **N65.**

The rpm sensor **L16** fitted on the gearbox cover in correspondence of he flywheel ring gear. is a passive. electromagnetic detector: at the passage of each flywheel tooth, it supplies a sinusoidal shaped voltage signal, which is variable in amplitude and frequency according to the engine rpm: signal sent to pin 1 of **N65**

Sensor **S56** is fitted on the thermostat body with the sensitive part in contact with the coolant fluid. This comprises an NTC resistance which changes its resistance inversely proportionately with the temperature: pin 4 of **N65**.

The Borg Warner solenoid valve **L46** is connected to the pneumatic system of the E.G.R. by a vacuum takeoff, leading from the servobrake vacuum pump, with an output to be connected to the Pierburg E.G.R. valve and with two atmospheric pressure takeoffs which draw from a filter (for further details see GROUP 10 - ENGINE SUPPLY -).

The solenoid valve is driven directly by the electronic control unit **N65** - pin 11 - with a square wave signal at a frequency of 140 Hz, a voltage of 12V and a variable Duty- Cycle which determines a current of from 0 to appr. 800 mA, condition in which the maximum vacuum rate is transmitted to the Pierburg valve.

Lastly at pin 8 of **N65** the diagnosis connector **T12** is connected.

COLD ADVANCE (K.S.B.)

General Description

When the engine is cold, the adjustment of injection advance is carried out through a specific automatic device (called K.S.B.), which replaces the conventional manual control: this enables regular operation of the engine even when it is cold, thus improving starting under all circumstances.

The automatic K.S.B. device acts through a solenoid valve which opens or closes the flow of fuel - inside the injection pump - towards the transfer pressure adjustment valve, consequently increasing or decreasing the pressure on the advance variator.

The solenoid valve is of the type with wax thermal bulb: the supply voltage heats the wax bulb which operates the ball valve that opens.

The solenoid valve is controlled by a thermal contact on the thermostatic cup which opens it when the temperature of the engine coolant is above 60°C.

Functional Description

The K.S.B. water temperature sensor **L45** receives the "key- operated" supply via relay **I105** of the fusebox **F15**.

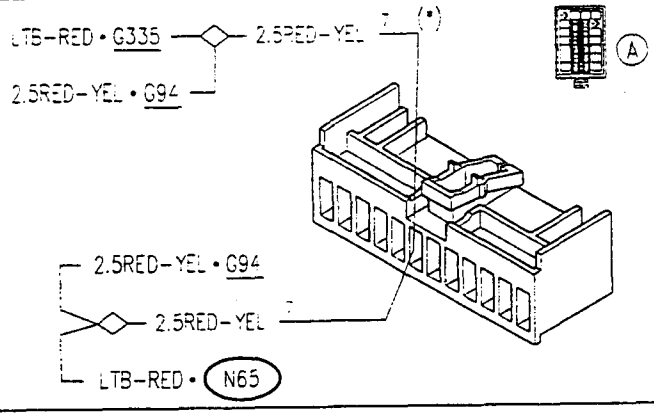
Adjustment takes place with the following logic:

- with the engine coolant temperature below 60 ± 2 °C, the thermal contact is open and the solenoid valve of the K.S.B. device **O27**, not supplied, is closed: as a result - through the transfer pressure of the pump - the injection advance is increased;
- when the engine coolant temperature exceeds 60 ± 2°C, the thermal contact closes, the solenoid valve of **O27** is supplied with 12 V (in fact it has an internal earth connection) and opens: as a result, the injection advance returns to normal ratings since the transfer pressure is reduced.
- with decreasing temperature, the thermal contact re-opens below 50 ± 2°C.

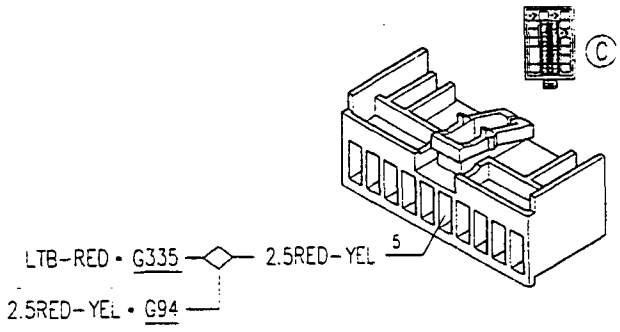
For further details, refer to this subject in Group 10 "ENGINE - SUPPLY".

COMPONENTS AND CONNECTORS

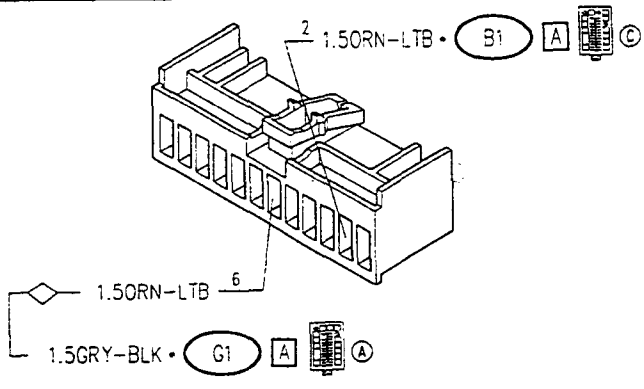
Fusebox — G1 A



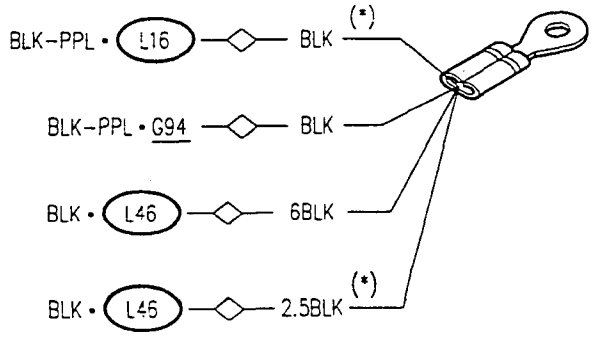
Fusebox — G1 G



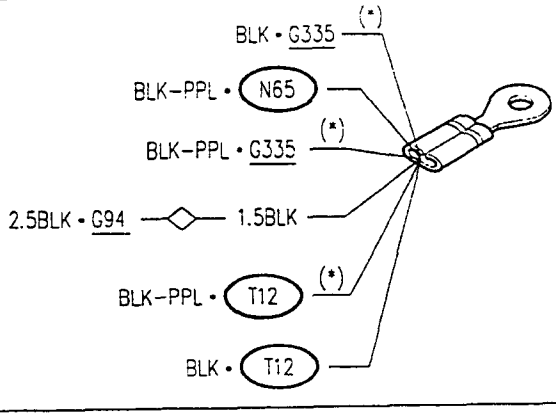
Fusebox — G1 H



RH engine compartment earth — G53a



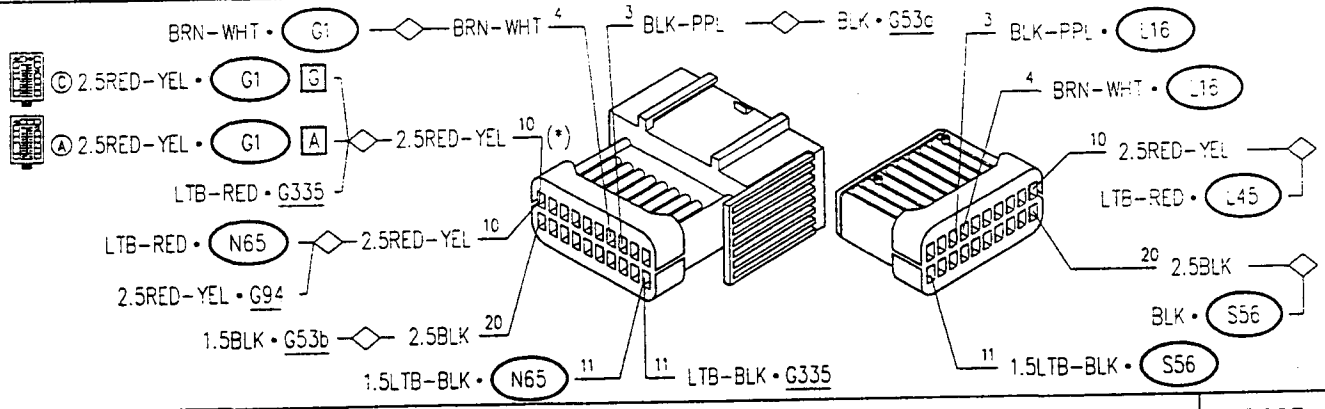
LH engine compartment earth — G53b



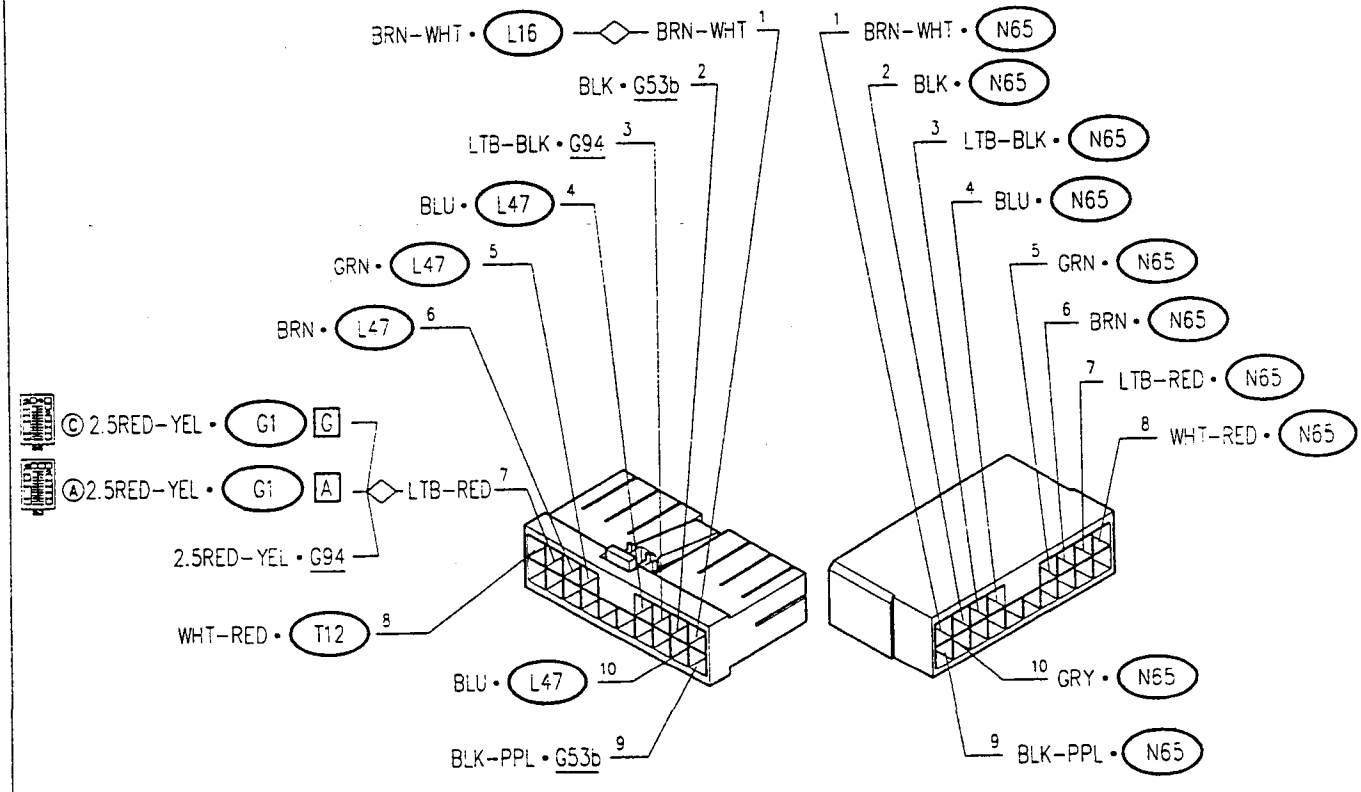
(*) from chassis no. ...
PA493000000008

COMPONENTS AND CONNECTORS (contd.)

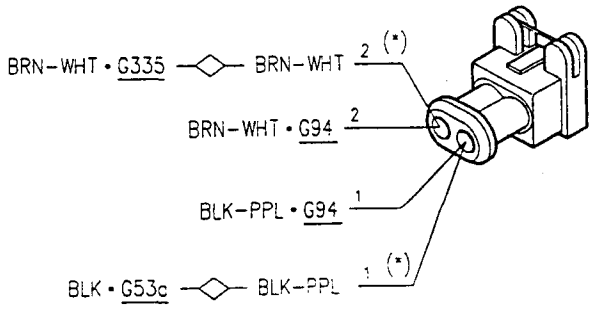
Engine compartment connector — G94



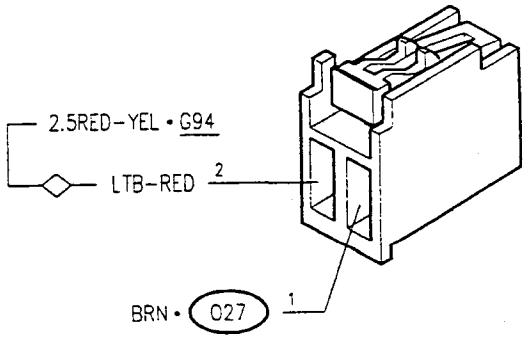
E.G.R. connector — G335



Rev counter sensor — L16



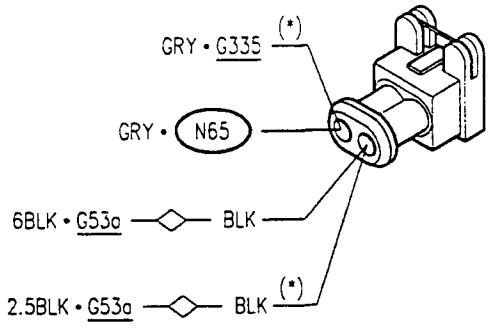
K.S.B. water temperature sensor — L45



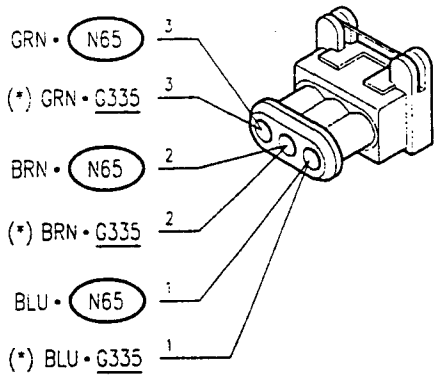
(*) from chassis no. ...

COMPONENTS AND CONNECTORS (contd.)

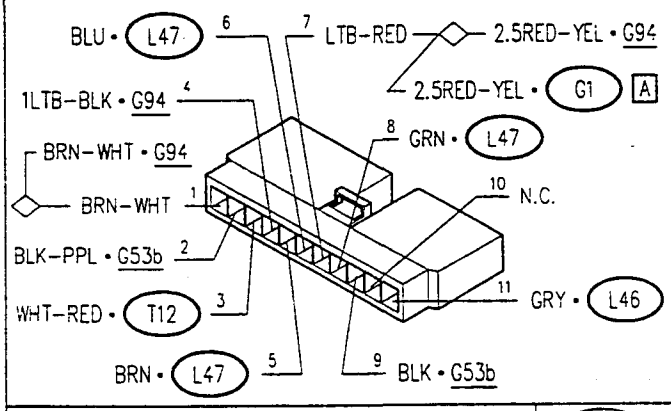
E.G.R. control solenoid valve — L46



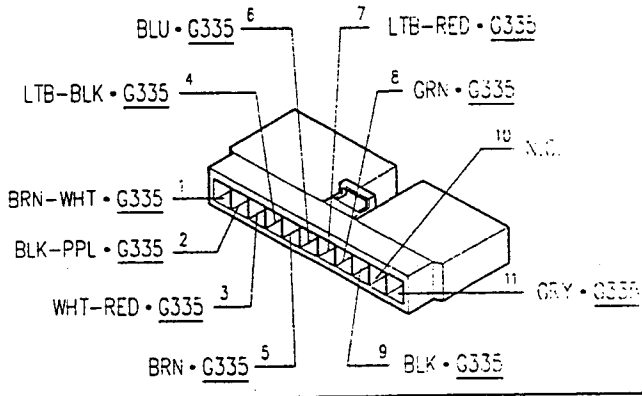
Potentiometer for E.G.R. — L47



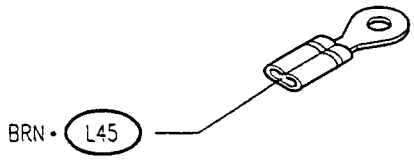
E.G.R. control unit — N65



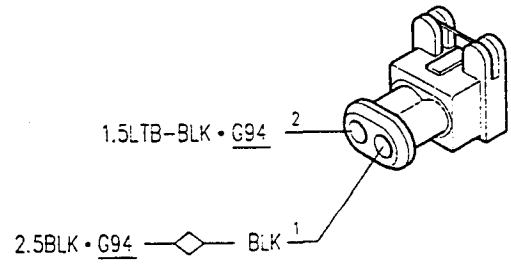
E.G.R. control unit (*) — N65



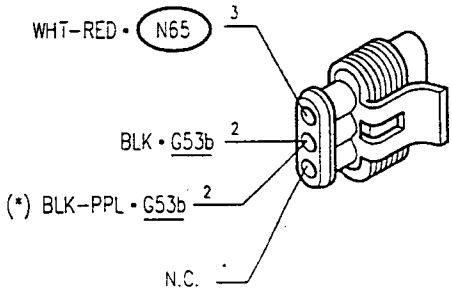
K.S.B. device — O27



Water temperature sensor for E.G.R. — S56

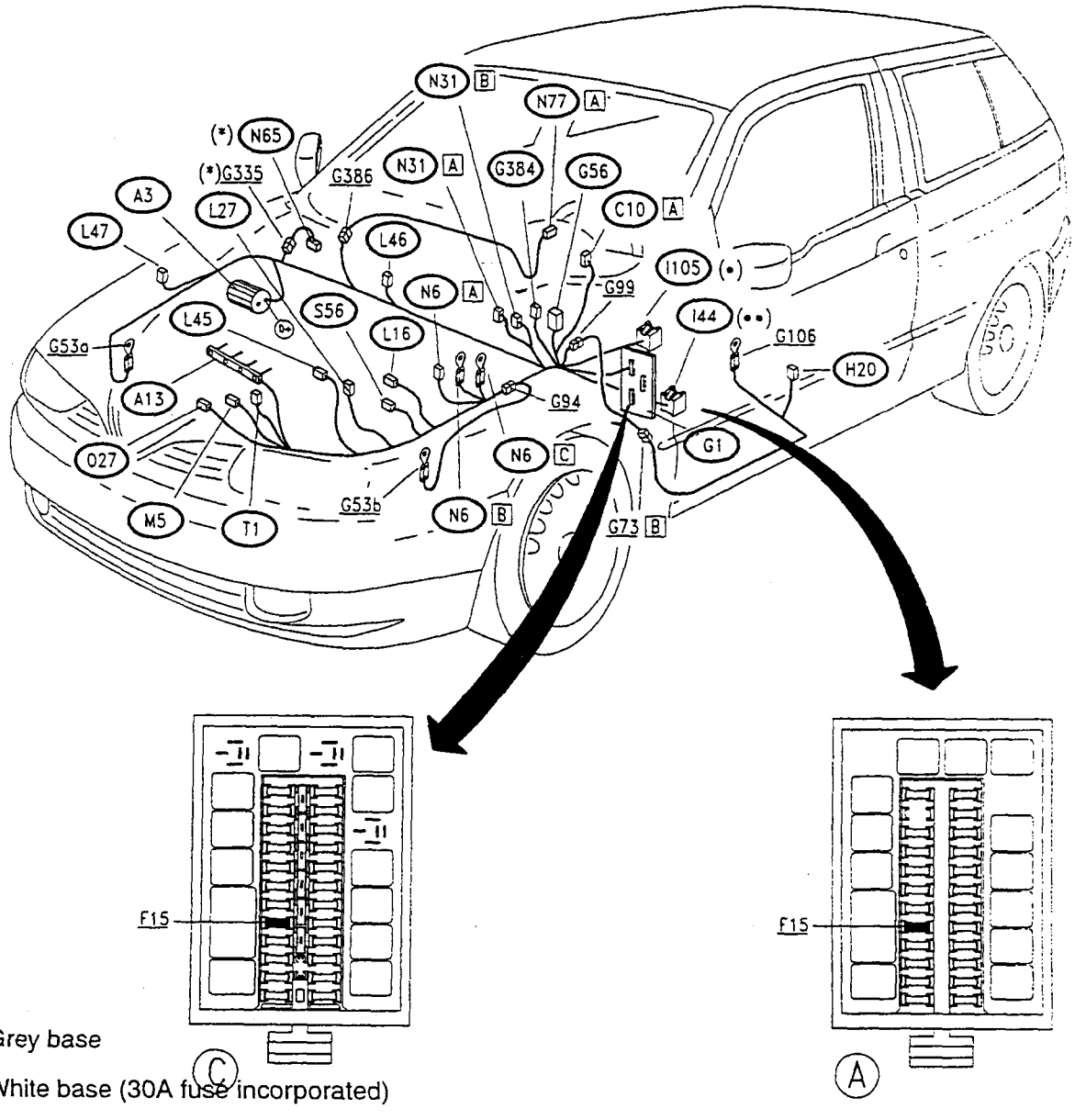


Connector for ALFA TESTER (E.G.R.) — T12



(*) from chassis no. ...

LOCATION OF COMPONENTS



(•) Grey base

(••) White base (30A fuse incorporated)

(*) From chassis no. ...

FAULT-FINDING TABLE

N.B.
A fault to the devices described here may also originate from other mechanical components of the fuel supply system, particularly the injection pump, fuel filter, etc....
(For furtner details see GROUP 10 "ENGINE SUPPLY").

Fault	Component to be checked											
	A1	H20	M5	A13	N6	L27	C10 (2)	N31	I44	L45	O27	N65 (3)
Engine fails to start (1)	•	•	•	•	•							
Glow plugs not working properly				•	•	•						
Glow plug warning light fails to light up when starting					•		•					
The engine fails to start regularly when cold				•				•	•			
The cold engine fails to "deliver" when accelerating										•	•	
Engine fails to stop			•									
High levels of emission at the exhaust					•							•

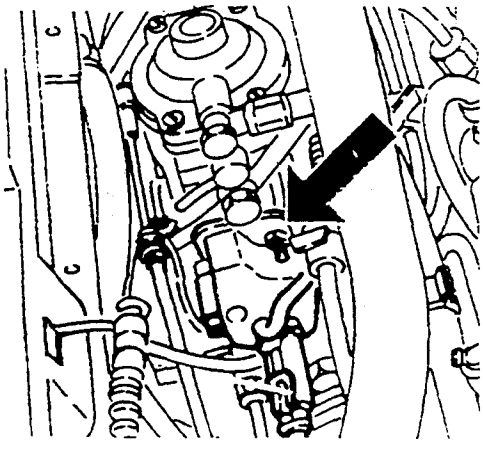
(1) If the engine fails to start, check - as described - firstly the battery **A1** or, especially after a crash, even slight or sharp braking, the inertial switch **H20** and the electromagnet **M5**. Also check the ALFA ROMEO CODE system (see section: "ALFA ROMEO CODE").

(2) The instrument cluster **C10** cannot be overhauled. Therefore in the event of a fault it is not possible to replace individual warning lights and a new complete instrument cluster must be installed.

(3) The E.G.R. control unit **N65** is fitted with self- diagnosis which may be used through the Alfa Tester - See: FAULT FINDING - , before connecting with the Tester, carry out TEST B

CHECKING COMPONENTS

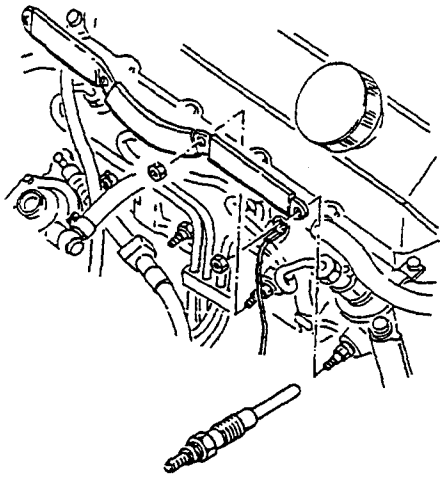
Engine stop device (M5)



SPECIFICATIONS	
pin 1	earth
pin 2	12 V
pin 3	square-wave consent signal from the control unit of the ALFA ROMEO CODE

In these conditions the solenoid valve opens, while it closes when one of the three signals ceases

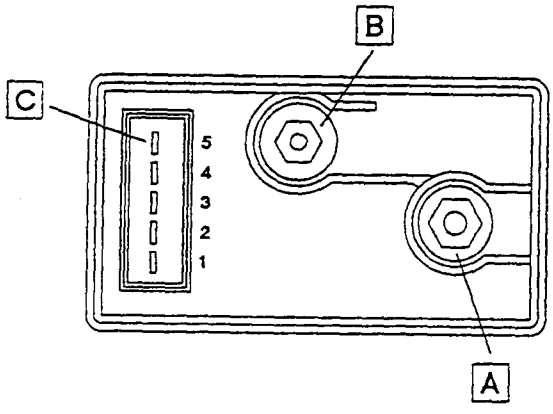
Glow plugs (A13)



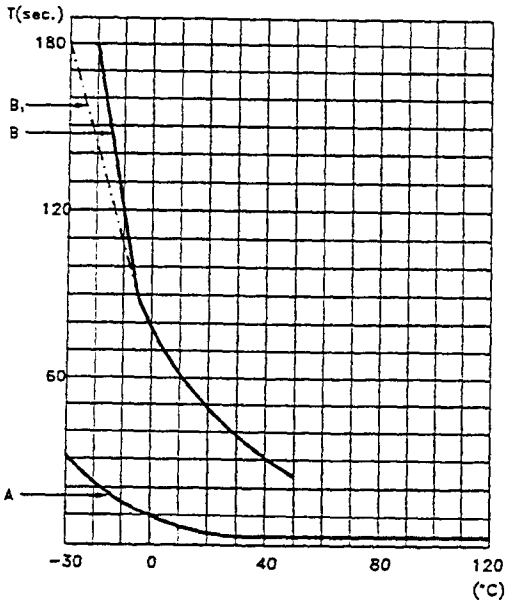
SPECIFICATIONS	
Internal resistance	~ 0.6 Ω
Check the correct fastening and cleaning of the conductor bars connecting the glow plugs	

N.B. : Failure to operate of the glow plugs may be caused by blow-by from the cylinder head gasket (see group 10 "ENGINE- SUPPLY")

Glow plug warming timer (N6)

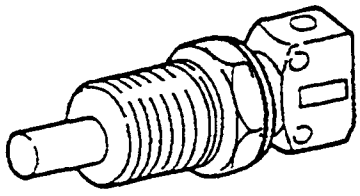


Check the device: see **test A**



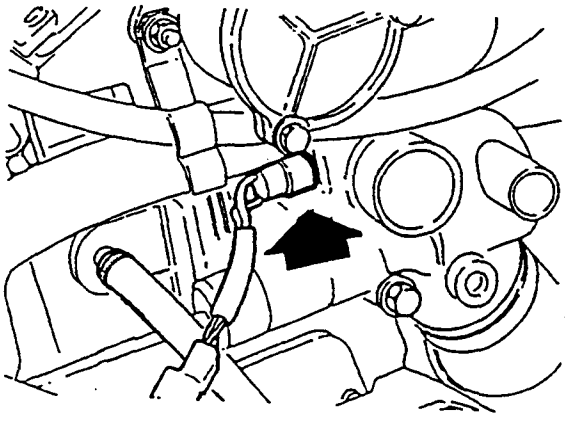
Changes of the glow plug warming time
– Curva A shows the warming times (glow plugs supplied warning light on) depending on the engine cooling water temperature. Warming must not be interrupted for engine water temperatures below 80°C
– **"Maintenance" time** (glow plugs supplied warning light off) = 10 sec. constant counted starting from the instant the warning light goes out.
– Curve B **shows the after-warming times (glow plugs supplied warning light off) counted starting from the instant the engine is started. At the end of the after-warming phase the device cuts itself off. (B1 = permissible after-warming curve).**

Water temperature sensor for warming glow plugs (L27)



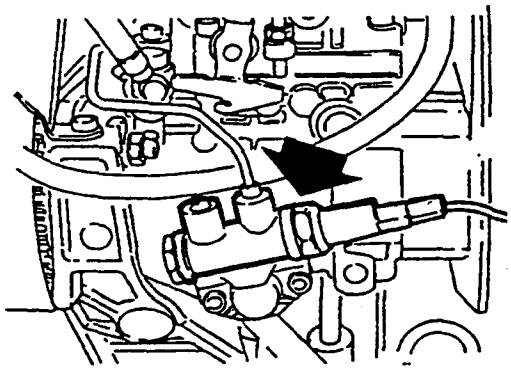
SPECIFICATIONS	
Temperature	Resistance
-10°C	8100 ÷ 10770 Ω
+20°C	2280 ÷ 2720 Ω
+80°C	292 ÷ 362 Ω

K.S.B. temperature sensor (L45)



SPECIFICATIONS	
Thermal contact opens (with increasing temperature)	> 60° ± 2°C
Thermal contact closes (with decreasing temperature)	< 50° ± 2°C

K.S.B. device (O27)



SPECIFICATIONS
supplied at 12V the valve must be closed; as the supply ceases, it must open again

PRELIMINARY CHECK FOR E.G.R. SYSTEM	TEST B

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
B1	CHECK FUSE		
– Check the intactness of fuse **F15** at the fusebox **G1**		OK ▶	Carry out **step B2**
		OK ▶	Replace the fuse (15A)
B2	CHECK VOLTAGE		
– Check for **12 V** with the key turned at pin 7 of **N65**		OK ▶	Carry out **step B3**
		OK ▶	Restore the wiring between **G1**, connector A and **N65**
B3	CHECK EARTH		
– Check that pins 2 and 9 of **N65** are earthed (OV)		OK ▶	CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER.
		OK ▶	Restore the wiring between **N65** and earth **G53b**

WARNING: From Model Year '97, the "TD" version - previously also for certain Markets - by the version with catalyst known as TD-CAT.
N.B. For the TD-CAT version, refer to the next section 37A.

TD ENGINE CONTROL DEVICES

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FOREWORD

The **TD** engine (1930 cc.) meets **ECE08 regulations** on the emission of harmful pollutants due to a series of interventions to reduce the production of these pollutants at the origin:

- the injection pump has a special setting which ensure low levels of smoke;
- the turbocharger operates more smoothly and gradually;
- other devices (mechanical, pneumatic, electric) control the correct operation of the engine itself.

This section brings together these devices and the systems which are controlled and/or actuated **electrically** and adjust the operation of the 1930 TD engine.

These are:

- **GLOW PLUG WARMING;**
- **ENGINE STOP;**
- **COLD ADVANCE (KSB);**
- **FUEL PREHEATING.**

A wiring diagram describes the first 3; a second diagram refers to the fourth (fuel pre-heating).

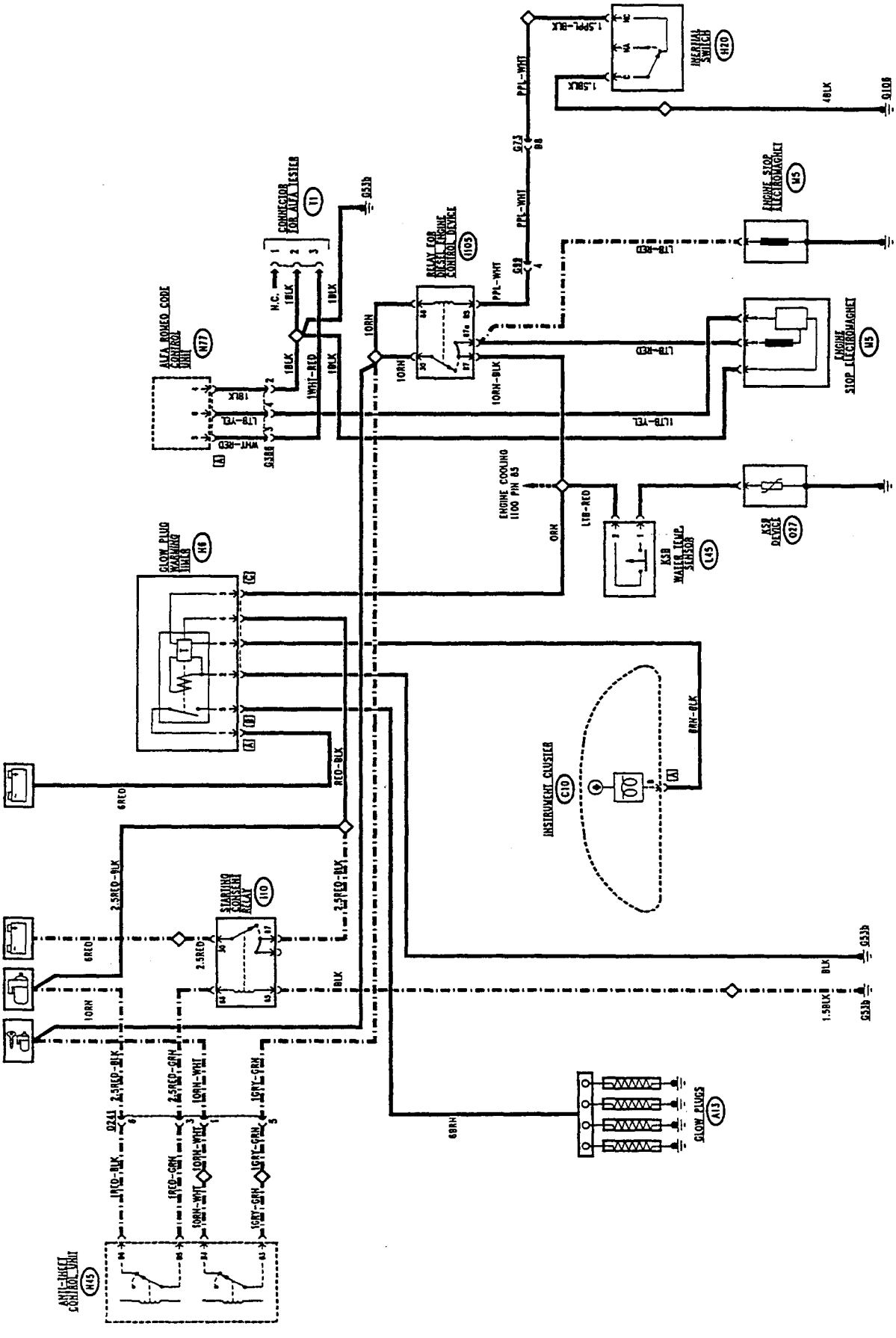
With regard to the complete description of the various systems, refer to GROUP 10: "ENGINE - SUPPLY"

INERTIAL SWITCH

Also the TD version has the protection system with **inertial switch**: this is an electromechanical switch that, in the event of heavy impact, opens to cut off the circuit that supplies the engine stop electromagnet: this way the engine is stopped immediately, thereby preventing any danger.
The supply is also stopped to other circuits (cold advance, glow plugs, engine solenoid valve) which are otherwise always supplied.
This makes it possible to dramatically reduce the hazard of fire, which, though restricted, is also present in Diesel engines.

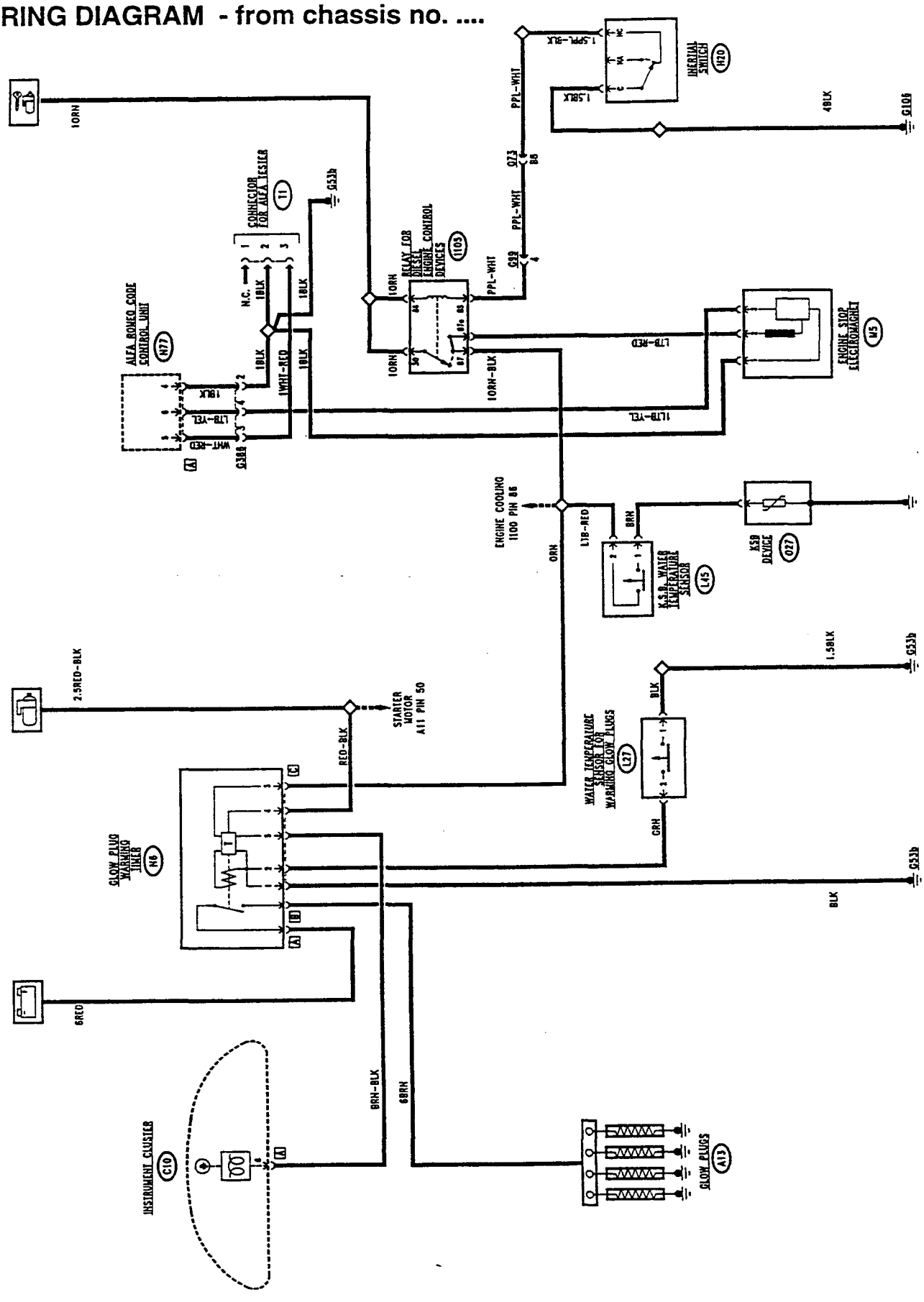
From chassis n. ...., the adoption of a new control unit for glow plug warming lowers the emission of pollutants especially during starting.

GLOW PLUG WARMING - ENGINE STOP - COLD ADVANCE WIRING DIAGRAM - up to chassis no. ....



GLOW PLUG WARMING - ENGINE STOP - COLD ADVANCE

WIRING DIAGRAM - from chassis no. ....



GLOW PLUG WARMING

General Description

As we all know, in Diesel or "compression ignition" engines, the air/fuel mixture is ignited without outside sparks, simply by compressing the mixture.

However, when the engine is started cold, it is necessary to pre-heat the precombustion chambers - where the fuel and air mix - in order to increase the temperature of the mixture to values that enable self-ignition, upon compression in the cylinders.

This pre-heating is carried out through **"rapid incandescence Glow plugs"** of the bulb type, fitted on the cylinder head, one for each precombustion chamber.

The glow plugs are controlled by a special electronic device which adjusts the operating times and the operating logic, while a warning light on the instrument cluster alerts the driver that the pre-heating function is operational.

Up to chassis no. ....:

The electronic control unit is located in the engine compartment next to the battery; it incorporates an NTC sensor which detects the temperature in the engine compartment. The device delivers a considerable amount of current to the glow plugs for a certain amount of time, calculated according to the following logic, in three stages:

1) pre-heating time, with "glow plug warming" warning light on the instrument cluster on:
this varies according to the temperature detected: from 1.5 to 4.5 seconds at appr. 70°C up to a maximum of 20-27 seconds at -20°C.
At the end of this time the warning light turns off to inform the driver that the engine can be started.

2) pre-heating time with warning light off:
if the engine is not started immediately, the logic of the device ensures the supply to the glow plugs for a time known as "distraction time", of 15-20 seconds with the warning light off.

3) after-heating time:
this is a further period of 15-20 seconds of supply to the glow plugs after starting (key released from the START position), after which the supply of current is cut off.

From chassis no. ....:

The electronic control unit is located in the engine compartment next to the battery; it is connected to the NTC sensor, to be found on the thermostat, which detects the temperature of the engine. The device delivers a considerable amount of current to the glow plugs for a certain amount of time, calculated according to the following logic, in three stages:

1) pre-heating time, with "glow plug warming" warning light on the instrument cluster on:
this varies according to the temperature of the engine which is detected by a special sensor.
At the end of this time the warning light turns off to inform the driver that the engine can be started.

2) pre-heating time with warning light off:
if the engine is not started immediately, the logic of the device ensures the supply to the glow plugs for a time known as "maintenance" for 10 seconds with the warning light off.

3) after-warming time:
this is a further period of supply to the glow plugs after starting (key released from the START position), after which the supply of current is cut off.

This period, too, depends on the engine temperature detected.

In both cases, the control logic also prevents any inconvenience or damage to the engine cutting off the supply if accidental earth contacts are detected at any of the glow plugs or of their supply cables.

Functional Description

The glow plug warming electronic timer device **N6** is connected, as shown in the wiring diagram:

The eyelet of connector A is connected to the battery supply through the branch terminal board.
The eyelet of connector B is connected to the conductor bar of the glow plugs **A13** to which it sends the warming current for the length of time established by the electronic device.

Up to chassis no. .....:

Pin 2 - connector C - is earthed. The electronic timer circuit is operated when the cluster is turned on via the "key- operated" signal which reaches pin 3 via relay **I105** and - for vehicles without ALFA ROMEO CODE - the consent of the theft alarm control unit **N45** (relay **I105** supplies this and other engine control devices: intervention of the inertial switch **H20** de-energizes the relay and cuts off the supply in the event of a crash/accident). Pin 4 receives the starting signal, also controlled - for vehicles without ALFA ROMEO CODE - by the theft alarm control unit **N45**.
Lastly a signal from pin 6 - still of connector C - turns on the "glow plug warming" warning light on the instrument cluster **C10.**

From chassis no. .....:

Pin 1 - connector C - is earthed. The electronic timing circuit is operated by the turning on of the instrument cluster via the "key-operated" signal which reaches pin 3 through relay **I105** (relay **I105** supplies this and other engine control devices: intervention of the inertial switch **H20** de-energizes the relay and cuts off the supply in the event of a crash/accident).
Pin 4 receives the starting signal from the ignition switch.

Pin 2 receives the signal from sensor **L27** which detects the temperature of the engine. Lastly a signal from pin 5 - still of connector C - turns on the "glow plug warming" warning light on the instrument cluster **C10.**

ENGINE STOP

General Description

In a Diesel engine the engine is stopped by interrupting the supply of fuel to the injection pump; this takes place through a special solenoid valve which controls the passage through which the fuel flows into the injection pump.

With the key is at MARCIA and the consent of the ALFA ROMEO CODE control unit, the electromagnet opens the flow of fuel. As soon as the switch is turned to the STOP position, the flow is cut off and, after a few turns, the engine stops.

In the event of violent impact the supply to the solenoid valve might not be cut off, therefore, often the engine stays on. The presence of the inertial switch cuts off the supply, thereby stopping the engine in the case of impact of a certain degree.

Functional Description

For cars without ALFA ROMEO CODE: The engine stop electromagnet **M5**, connected to earth, is activated if supplied by the "key-operated" line (MARCIA position) of the ignition switch. This line crosses relay **I105**, which supplies this and other devices under the control of the inertial switch **H20).**

For cars with ALFA ROMEO CODE: device **M5** comprises an electronic control circuit which activates the electromagnet when it receives the "key-operated" signal (pin 2) but also the consent signal (pin 3) from the ALFA ROMEO CODE control unit **N77**.

With the ignition switch in the STOP position - or with the anti-theft of the inertial switch **H20** - this supply ceases and the electromagnet is deactivated thereby cutting off the flow of fuel to the injection pump.

COLD ADVANCE (K.S.B.)

General Description

When the engine is cold, the adjustment of injection advance is carried out through a specific automatic device (called K.S.B.), which replaces the conventional manual control: this enables regular operation of the engine even when it is cold, thus improving starting under all circumstances.

The automatic K.S.B. device acts through a solenoid valve which opens or closes the flow of fuel - inside the injection pump - towards the transfer pressure adjustment valve, consequently increasing or decreasing the pressure on the advance variator.

The solenoid valve is of the type with wax thermal bulb: the supply voltage heats the wax bulb which operates the ball valve that opens.

The solenoid valve is controlled by a thermal contact on the thermostatic cup which opens it when the temperature of the engine coolant is above 60°C.

Functional Description

The K.S.B. water temperature sensor **L45** receives the "key- operated" supply via relay **I105** and - if fitted - the consent of the anti-theft control unit **N45** (relay **I105** supplies this and other devices under the control of the inertial switch **H20**).

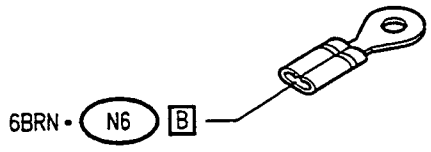
Adjustment takes place with the following logic:

- with the engine coolant temperature below 60 ± 2 °C, the thermal contact is open and the solenoid valve of the K.S.B. device **O27**, not supplied, is closed: as a result - through the transfer pressure of the pump - the injection advance is increased;
- when the engine coolant temperature exceeds 60 ± 2°C, the thermal contact closes, the solenoid valve of **O27** is supplied with 12 V (in fact it has an internal earth connection) and opens: as a result, the injection advance returns to normal ratings since the transfer pressure is reduced.
- with decreasing temperature, the thermal contact re-opens below 50 ± 2°C.

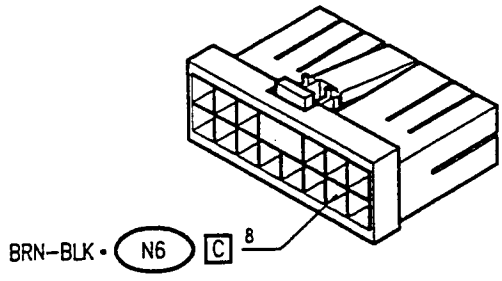
For further details, refer to this subject in Group 10 "ENGINE - SUPPLY".

COMPONENTS AND CONNECTORS

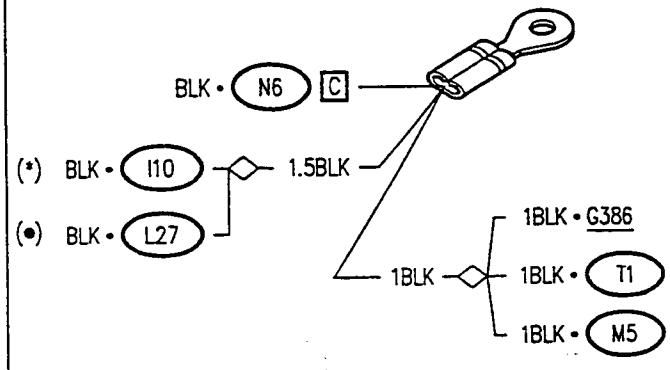
Glow plugs	A13



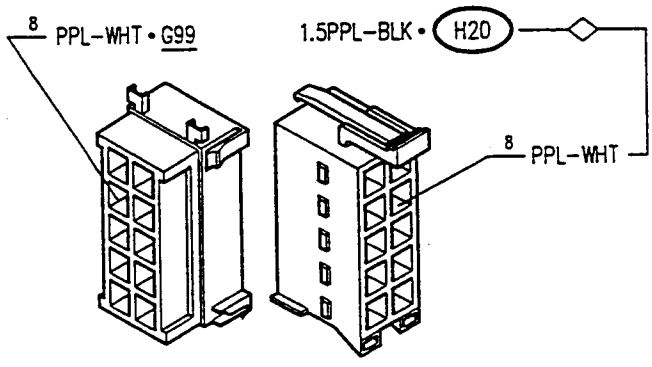
Instrument cluster	C10 A



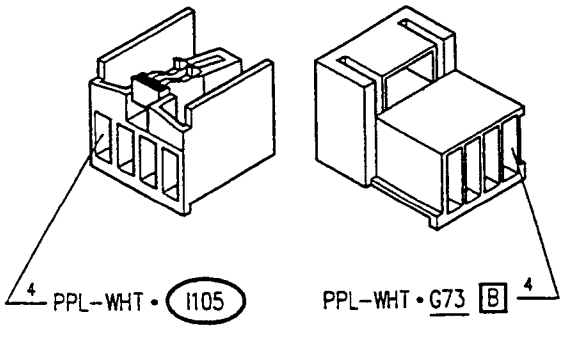
LH engine compartment earth	G53b



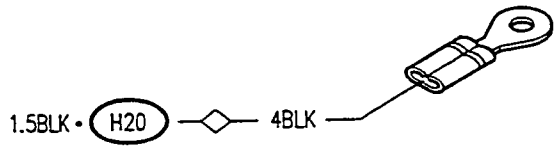
Rear services connector	G73 B



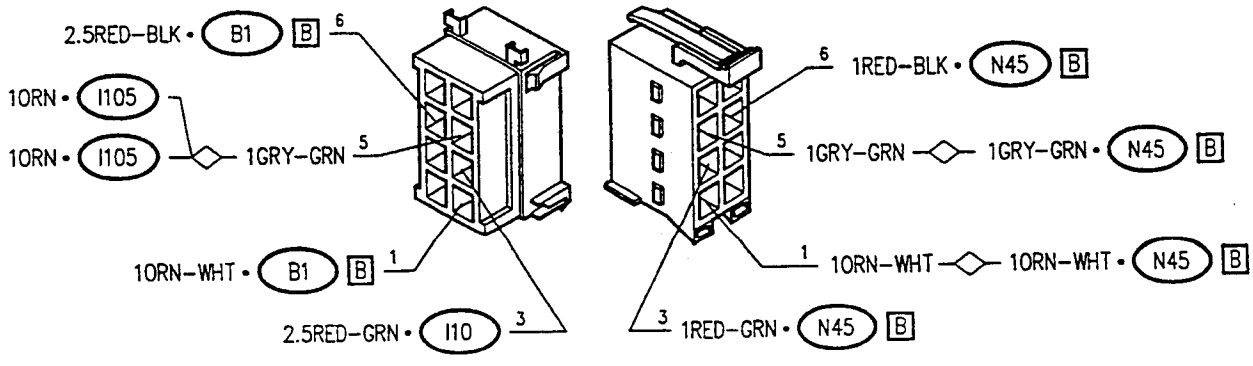
Engine/dashboard wiring connector	G99



Seat crossmember earth	G106



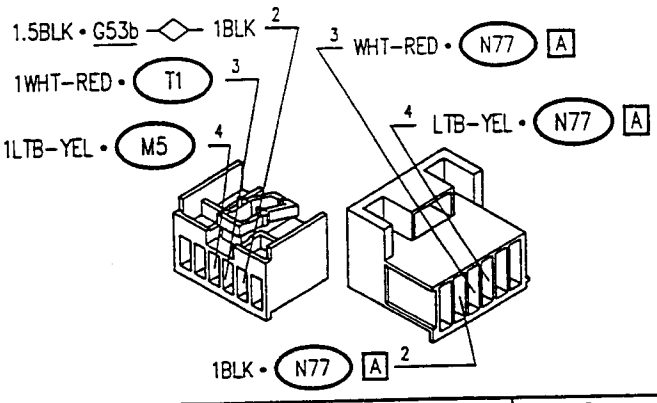
Anti-theft wiring connector (*)	G241



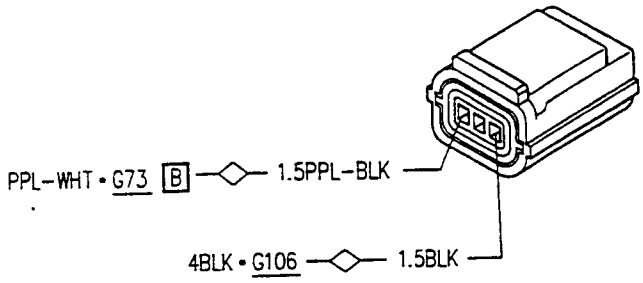
(*)Version without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

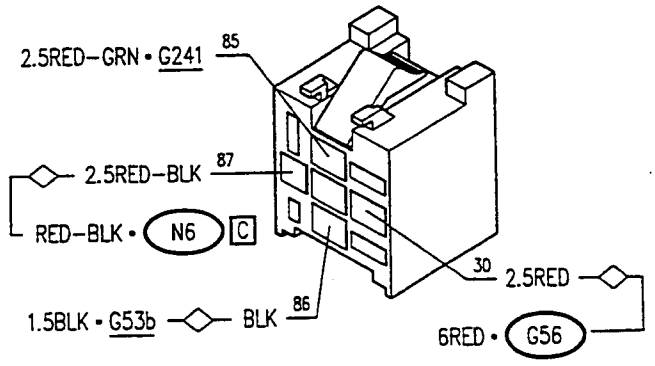
ALFA ROMEO CODE connector	G386



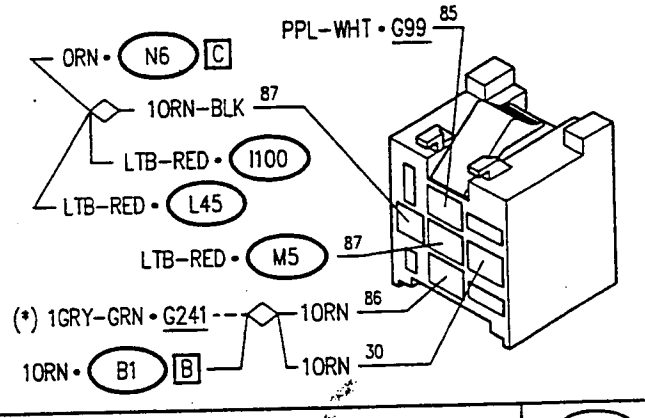
Inertial switch	H20



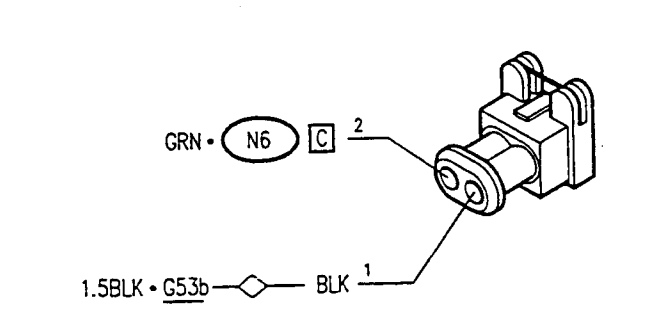
Starting consent relay (*)	I10



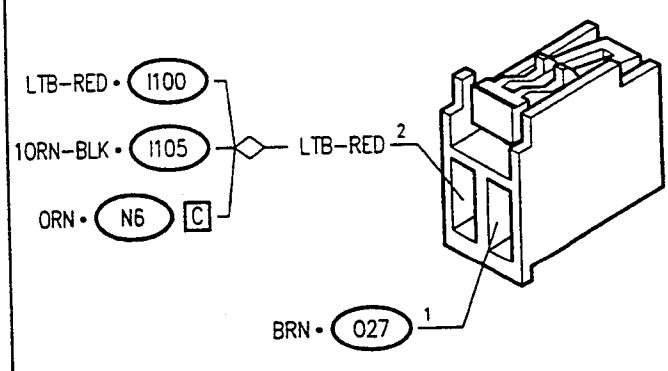
Diesel engine control devices relay	I105



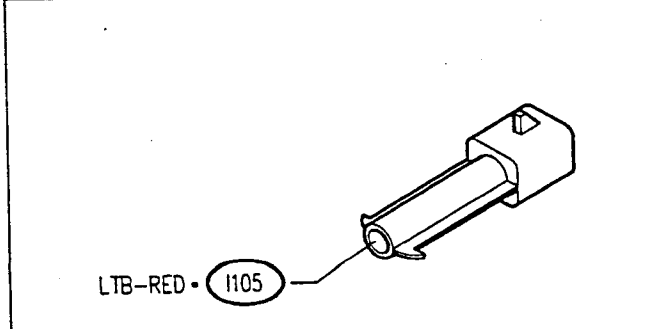
Water temperature sensor for glow plug warming (•)	L27



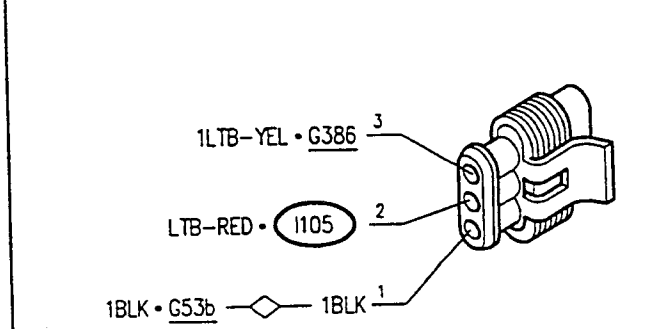
K.S.B. water temperature sensor	L45



Engine stop electromagnet (*)	M5



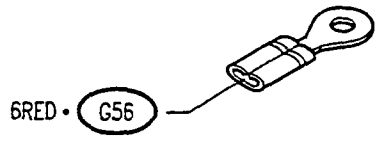
Engine stop electromagnet	M5



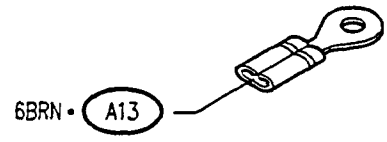
(*)Version without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

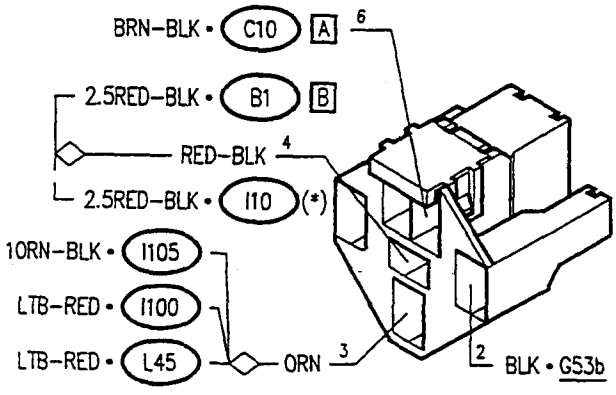
Glow plug warming timer	N6 A



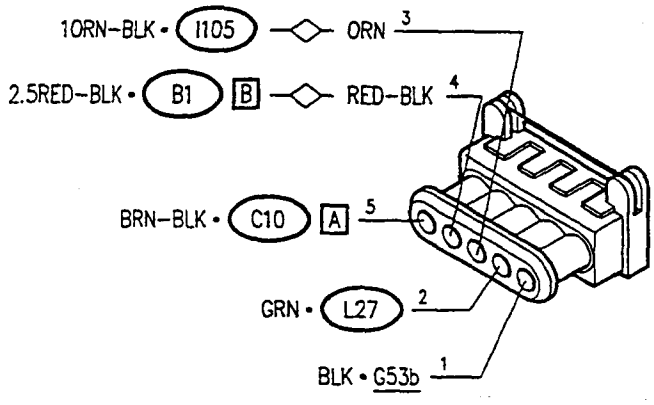
Glow plug warming timer	N6 B



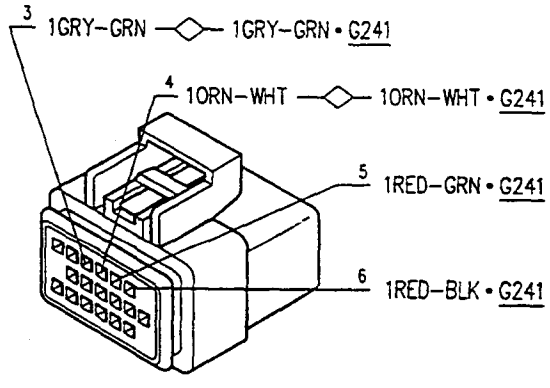
Glow plug warming timer	N6 C



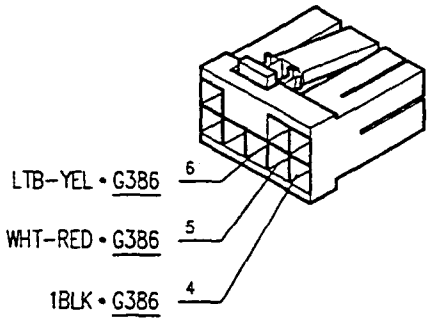
Glow plug warming timer (•)	N6 C



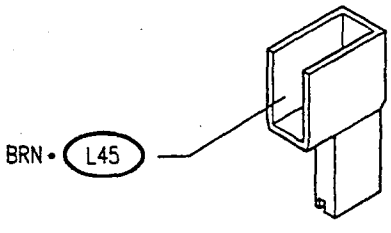
Anti-theft control unit (*)	N45 B



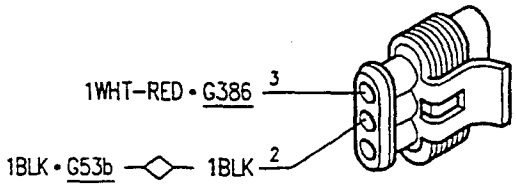
ALFA ROMEO CODE control unit	N77 A



K.S.N. device	O27



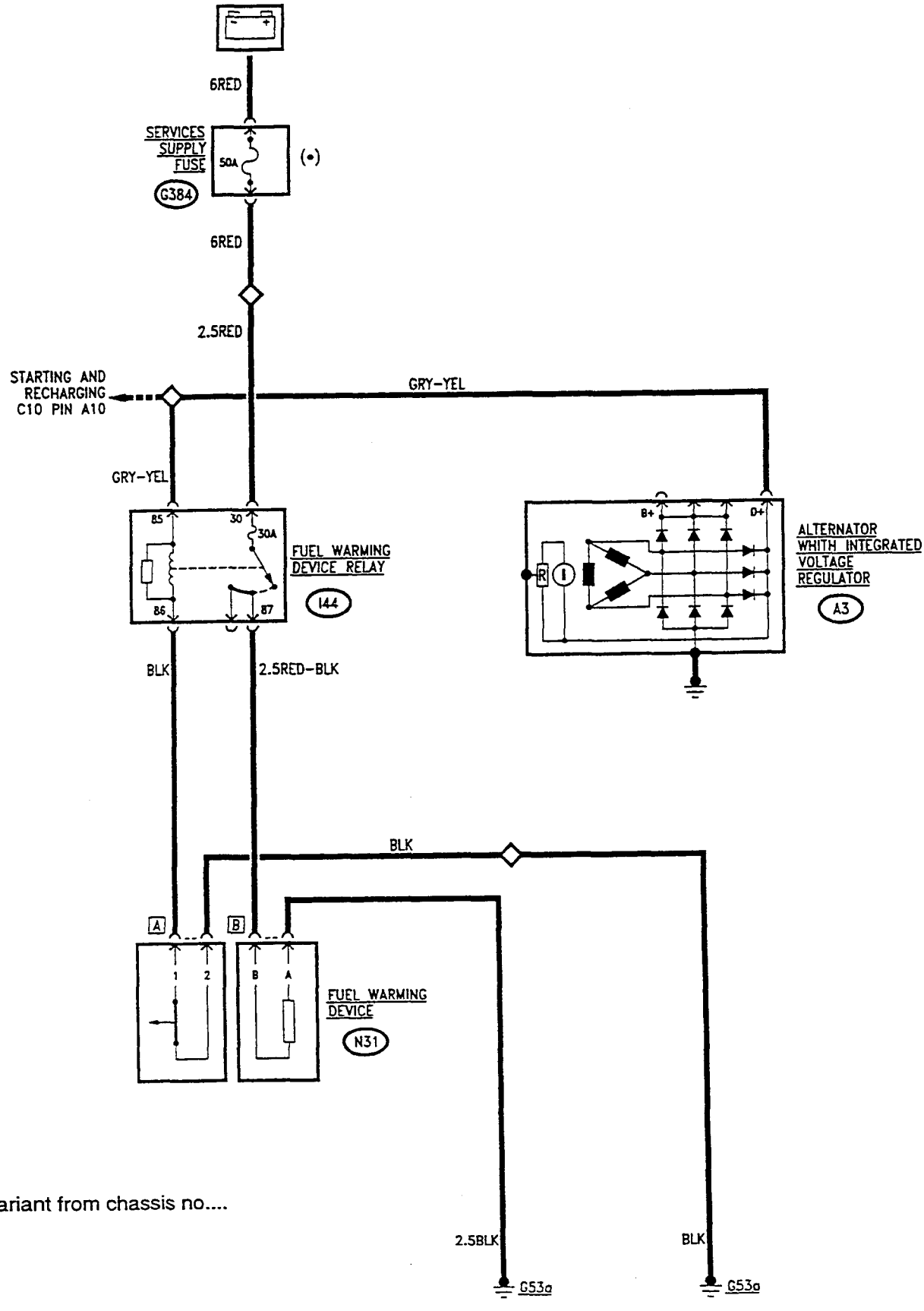
Connector for ALFA TESTER	T1



(*)Version without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

FUEL WARMING

Wiring diagram



(•) Variant from chassis no....

General Description

Satisfactory operation of a Diesel engine at low temperatures may be compromised by the possible solidification of the paraffins contained in the fuel (fuel oil) which impedes the correct flow.

The engine is therefore fitted with a fuel warming device, located on the fuel filter.

A thermal switch, on the filter support, detects low temperatures of the fuel oil: in fact this contact closes for temperatures below 6°C (and re-opens above 15°C).

When the engine is running (information supplied by the turning off of the "battery charging" signal of the alternator) a relay commands the connection of the heating module, in the upper section of the fuel oil filter; this module comprises two variable PTC resistances which, when crossed by current, heat the fuel that flows through the filter: initially, at low temperature, the resistance is low and the current is high; gradually the resistance increases, thereby reducing heating.

Functional Description

The fuel warming device relay **I44** - with built-in fuse (30A) - controls the operation of the entire system.

From chassis no. .... the line that supplies the relay is protected by the services supply fuse **G384**.

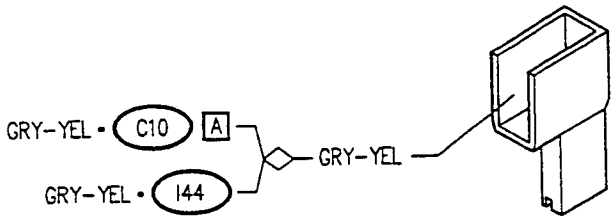
When (below 6°C) the contact of the thermal switch - connector A of device **N31** - closes and at the same time the engine is running (12 V signal from pin D+ of the alternator), relay **I44** is energized.

This way the resistances are supplied - connector B of device **N31** - which heat the fuel passing through the filter.

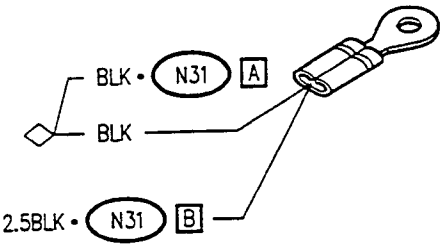
When the thermal switch contact opens (above 15°C), or if the engine is not running, the supply is cut off and heating ceases.

Components and Connectors

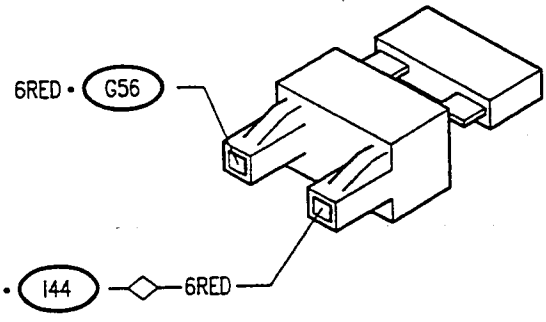
Alternator, with voltage regulator incorporated	A3



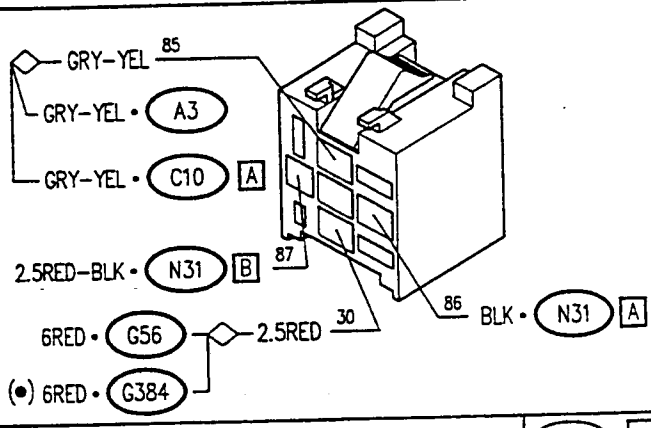
RH engine compt. earth	G53a



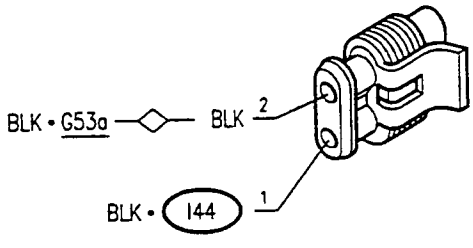
Services supply fuse (•)	G384



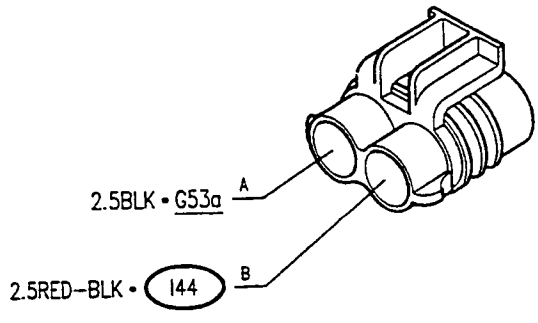
Fuel warming device relay	I44



Fuel warming device	N31 A

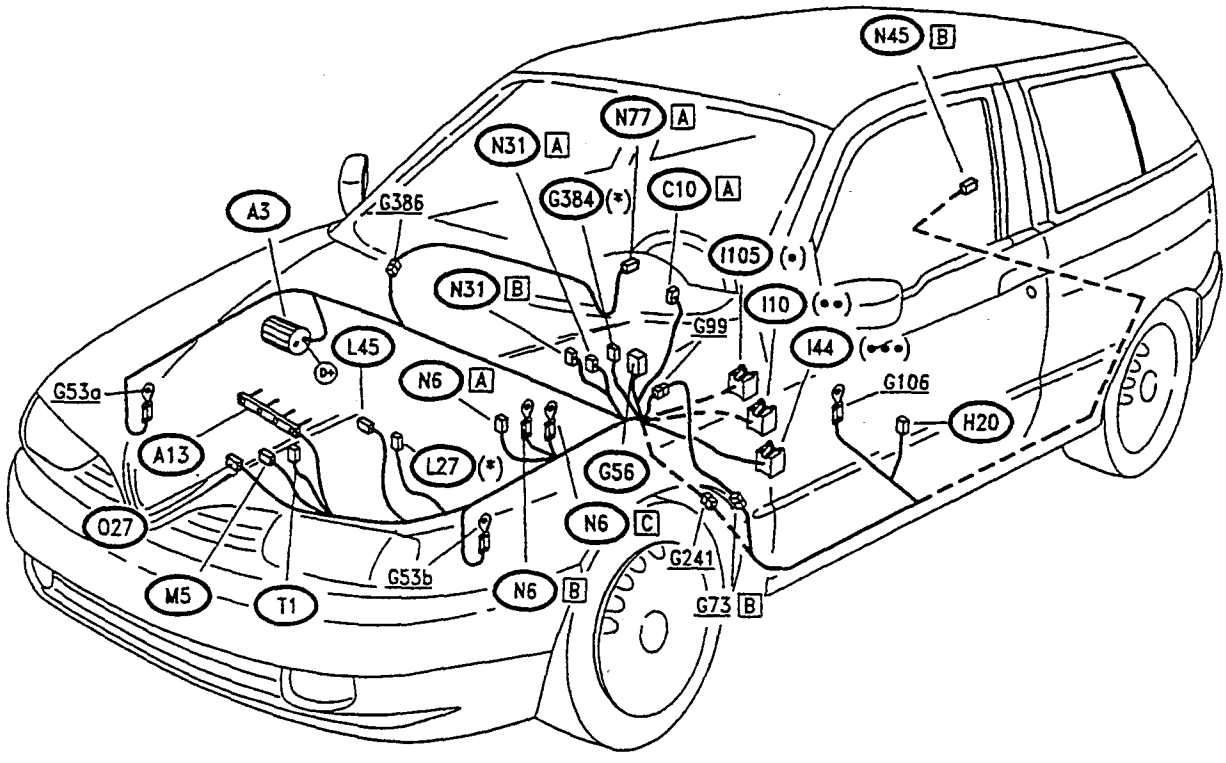


Fuel warming device	N31 B



(•) Variant from chassis no....

LOCATION OF COMPONENTS



(•) grey base
(••) yellow base
(•••) white base (N.B. Built-in 30A fuse)
(*) present from chassis no.....

— — — — only versions without ALFA ROMEO CODE and with anti-theft

N.B.
A fault to the devices described here may also originate from other mechanical components of the fuel supply system such as the injection pump, fuel filter, etc....
(For further details see GROUP 10 "ENGINE SUPPLY")

FAULT-FINDING TABLE

Fault	Component to be checked												
	A1	H20	M5	A13	N6	L27	C10 (2)	G384	N31	I44	A3 (3)	L45	O27
The engine fails to start (1)	•	•	•	•	•								
Glow plugs not working properly				•	•	•							
The glow plug warning light fails to turn on when starting					•		•						
Engine fails to start properly when cold				•				•	•	•	•		
Engine fails to "deliver" when accelerating												•	•
Engine fails to stop (1)			•										

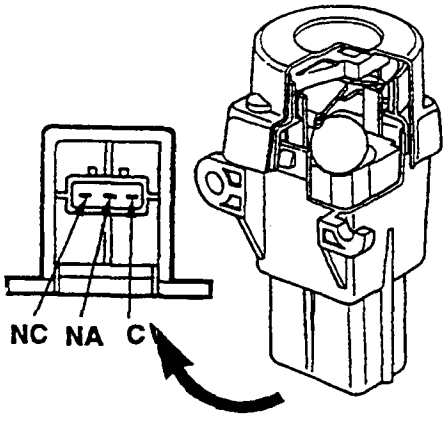
(1) If the engine fails to start, check - as described - firstly the battery **A1** or, especially after a crash even if light, or sharp braking, the inertial switch **H20** and the electromagnet **M5**. Also check the ALFA ROMEO CODE system (see section: "ALFA ROMEO CODE").

(2) The instrument cluster **C10** cannot be overhauled. Therefore in the event of a fault, it is not possible to replace individual warning lights and a new complete instrument cluster must be installed.

(3) Check that the "generator" warning light turns on correctly until the alternator recharges, or check the alternator **A3** itself: see section "Starting and Charging".

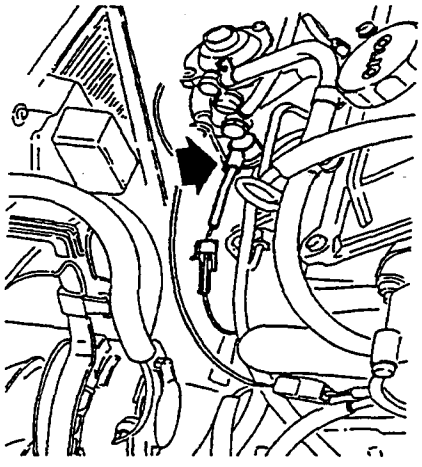
CHECKING COMPONENTS

Inertial switch (H20)



SPECIFICATIONS
Check continuity between pins NC and C : this continuity is cut off in the event of a crash: the contact is closed again pressing the special button

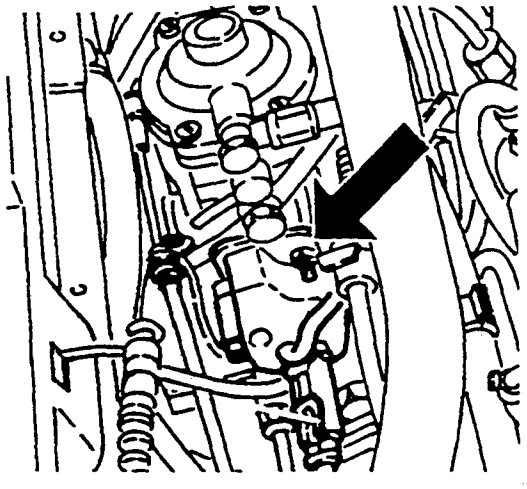
Engine stop electromagnet (cars without ALFA ROMEO CODE) (M5)



SPECIFICATIONS
Supplying the electromagnet with 12V the solenoid valve opens, while it closes with the supply cut off: **N.B.** : valve "seizure" is also possible thus failing to close when the electric supply ceases

NOTE: applying 12V the electromagnet "trips" (the characteristic noise is heard)

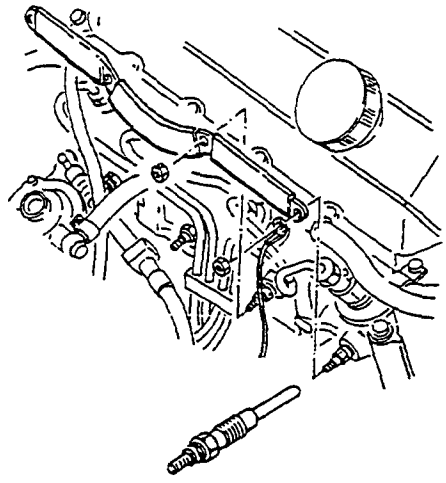
Engine stop device (cars with ALFA ROMEO CODE) (M5)



SPECIFICATIONS	
pin 1	earth
pin 2	12 V
pin 3	square-wave consent signal from the control unit of the ALFA ROMEO CODE

Under these conditions the solenoid valve opens, while it closes when one of the three signals ceases

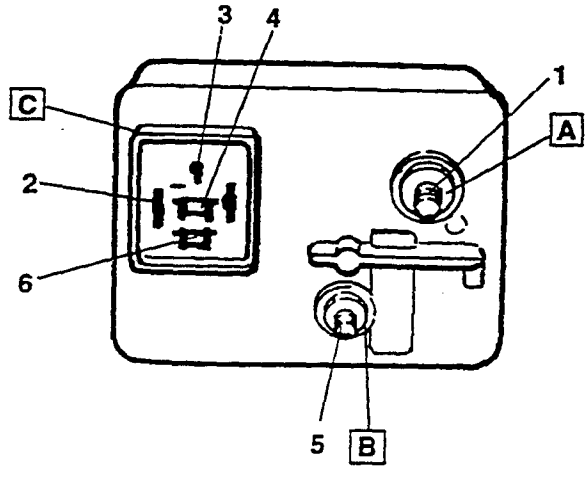
Glow plugs (A13)



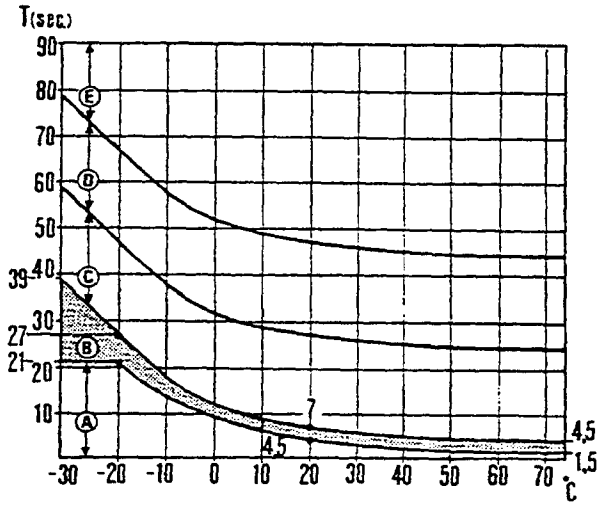
SPECIFICATIONS	
Internal resistance	~ 0.6 Ω
Check the correct fastening and cleaning at the conductor bars connecting the glow plugs	

N.B. : Failure to operate of the glow plugs may be caused by blow-by from the cylinder head gasket (see group 10 "ENGINE- SUPPLY")

Glow plug warming timer (up to chassis no.....) (N6)

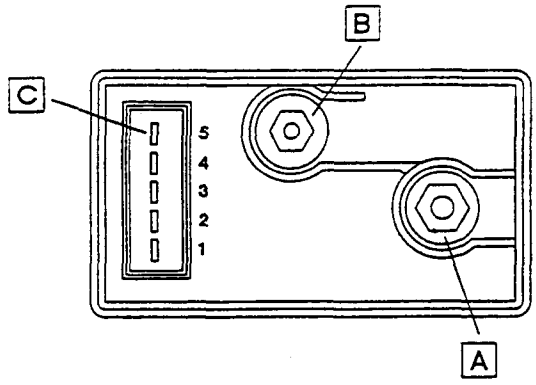


Check device: see **test A**

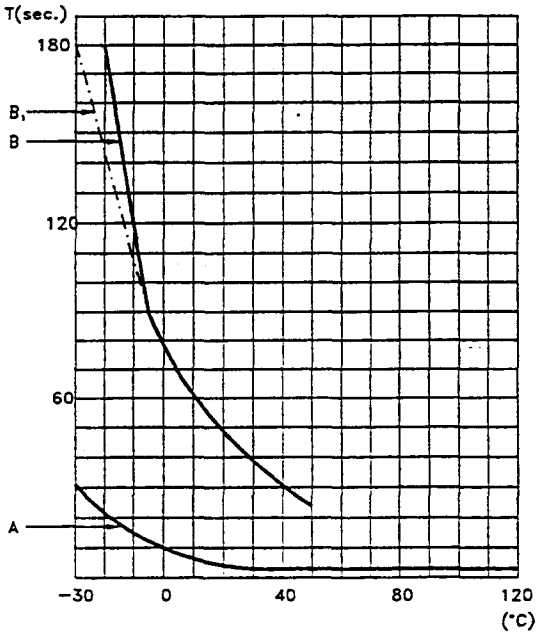


Changes in glow plug warming time in relation to the temperature in the engine compartment	
A	Period with warning light on and warming engaged
B	Field of tolerance in which the warning light turns off with warming engaged (dashed area).
C	Period with warming engaged and warning light off. This phase, characterised by 15 ÷ 20 sec. of constant operation, is counted starting from the turning off of the warning light
D	After-warming period, with glow plugs engaged and warinng light off. This phase, characterised ba 15 ÷ 20 sec. of constant operation, is counted beginning from the end of starting with the engine running
E	Period with warning light and warming off

Glow plug warming timer (from chassis no.....) (N6)

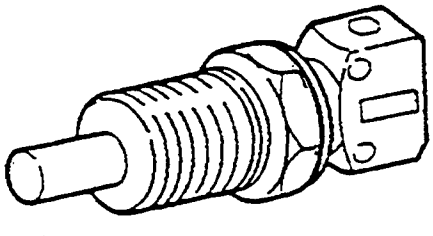


Check device: see **test A**



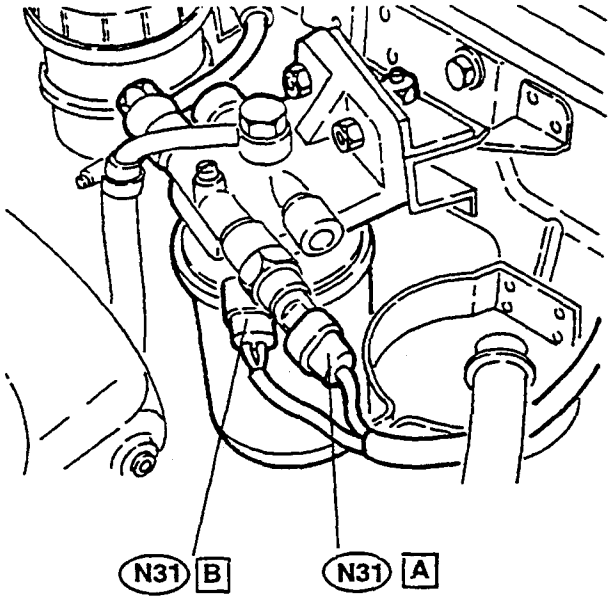
Changes in glow plug warming time
– **Curve A** shows the warming times (glow plugs supplied warning light on) in relation to the temperature of the engine cooling water. Warming must not be stopped for temperatures of the engine water below 80°C
– **"Maintenance" time** (glow plugs supplied warning light off) = 10 constant sec. counted from the moment the warning light goes off.
– **Curve B** shows the after-warming times (glow plugs supplied warning light off) counted starting from the instant the engine starts. The device cuts itself off at the end of the after-warming phase. (B1 = permissible after-warming curve).

Water temperature sensor for glow plug warming (L27)



SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
-10°C	8100 ÷ 10770 Ω
+20°C	2280 ÷ 2720 Ω
+80°C	292 ÷ 362 Ω

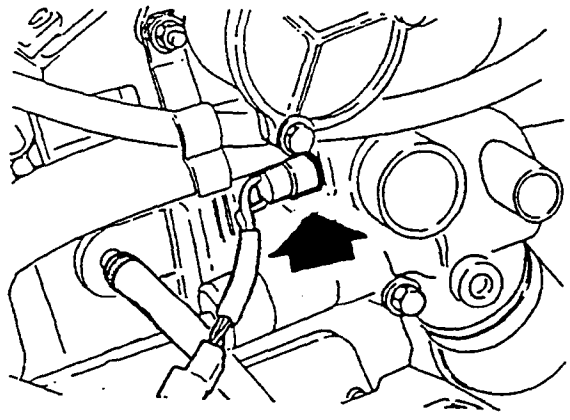
Fuel warming device (N31)



SPECIFICATIONS	
Thermal contact (conn. A)	
Contact closes (with decreasing temperature)	< 6°C
Contact opens (with increasing temperature)	> 15°C
Heating resistances (conn. B)	
supplied at 12V the device must heat	
NOTE: as these resistances are PTC, heating varies according to the temperature: at low temperature the resistance is low and the current is high; gradually - after appr. 60 sec - the temperature reaches such a level that the current thus heating are decreased). N.B.: carry out the test disconnecting the device	

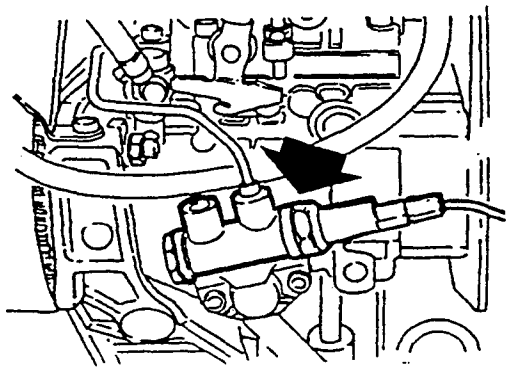
NOTE: a fault to the fuel warming system may also be caused by other mechanical components of the fuel supply system

K.S.B. temperature sensor (L45)



SPECIFICATIONS	
Thermal contact opens (with increasing temperature)	> 60° ± 2°C
Thermal contact closes (with decreasing temperature)	< 50° ± 2°C

K.S.B. device (O27)



SPECIFICATIONS
supplied at 12V the valve must be closed; when the supply ceases, it must open again

CHECK GLOW PLUG WARMING TIMER (version up to chassis no.....) (N6)	TEST A

Work without disconnecting the device, checking as mentioned on the cable input side

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK TIMER – With the ignition key at MARCIA check for 12V at connector B of **N6** for appr. 30 seconds (*) and at pin 6 of connector C for appr. 7 seconds (*). Start the engine and check for 12V at connector B for another 20 seconds appr. (*), there is no supply at pin 6 of connector C.	OK ▶ ~~OK~~ ▶	THE DEVICE IS WORKING PROPERLY Check the connections with other components Carry out step **A2**
A2 CHECK VOLTAGE – Check for 12 V at connector A of **N6**	OK ▶ ~~OK~~ ▶	Carry out step **A3** Restore the wiring between connector A of **N6** and the branch terminal box **G56**
A3 CHECK VOLTAGE – Check, with the key turned, for 12 V at pin 3 (connector C) of **N6**	OK ▶ ~~OK~~ ▶	Carry out step **A4** Restore the wiring between pin 3 (connector C) of **N6** and the ignition switch **B1**, through relay **I105** and - where fitted - the anti-theft control unit **N45**. Also check that the anti- theft system is working properly
A4 CHECK VOLTAGE – Check, with the starter motor energised (key at START), for 12 V at pin 4 (connector C) of **N6**	OK ▶ ~~OK~~ ▶	Carry out step **A5** Restore the wiring between pin 4 (connector C) of **N6** and the ignition switch **B1** through - where fitted - relay **I10** and the anti-theft control unit **N45** Also check that the anti-theft system is working properly
A5 CHECK EARTH – Check for 0 V at pin 2 (connector A) of **N6**	OK ▶ ~~OK~~ ▶	Replace device **N6** Restore the wiring between pin 2 (connector A) of **N6** and earth **G53b**

(*) Temperatures variable depending on the engine temperature - see corresponding graph; the values given refer to a temperature of 20°C in the engine compartment.

CHECK GLOW PLUG WARMING TIMER (version from chassis no.....) (N6)	TEST A

Work without disconnecting the device, checking the items mentioned on the cable input side

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK TIMER – With the ignition key at MARCIA check for 12V at connector B of **N6** for appr. 45 seconds (*) and at pin 5 of connector C for appr. 5 seconds (*). Start the engine and check for 12V at connector B for another 45 seconds appr. (*), while there is no supply at pin 5 of connector C.	OK ▶ ~~OK~~ ▶	THE DEVICE IS WORKING PROPERLY Check the connections with other components Carry out **step A2**
A2 CHECK VOLTAGE – Check for 12 V at connector A of **N6**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore the wiring between connector A of **N6** and the branch terminal box **G56**
A3 CHECK VOLTAGE – Check, with the key turned, for 12 V at pin 3 (connector C) of **N6**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between pin 3 (connector C) of **N6** and the ignition switch **B1**, through relay **I105**.
A4 CHECK VOLTAGE – Check, with the starter motor energised (key at START), for 12 V at pin 4 (connector C) of **N6**	OK ▶ ~~OK~~ ▶	Carry out **step A5** Restore the wiring between pin 4 (connector C) of **N6** and the ignition switch **B1**.
A5 CHECK EARTH – Check for 0 V at pin 1 (connector A) of **N6**	OK ▶ ~~OK~~ ▶	Replace device **N6** Restore the wiring between pin 1 (connector A) of **N6** and earth **G53b**

(*) Temperatures variable depending on engine temperature - see corresponding graph; the values given refer to 20°C

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VOLUME III
SECTION II

REPAIR INSTRUCTIONS

ELECTRIC SYSTEM DIAGNOSIS

55

Section 34 to 40, Appendix and specific 146 sections

Alfa Romeo

PA493000000006

10-1996

UPDATE CHART

146
146
VOLUME III
REPAIR
INSTRUCTIONS

UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	145	55-36B	11 to 12	
6 (10/1996)	145	55-36B		13 to 16
8 (6/1997)	145	55-36B	17	
6 (10/1996)	145	55-36B		18 to 24
9 (12/1997)	145	55-36C		1
13 (6/1999)	**145**	**55-36C**	**2**	
12 (2/1999)	145	55-36C	3 to 4	
13 (6/1999)	**145**	**55-36C**	**5 to 6**	
12 (2/1999)	145	55-36C	7 to 9	
13 (6/1999)	**145**	**55-36C**	**10**	
9 (12/1997)	145	55-36C		11
13 (6/1999)	**145**	**55-36C**	**12**	
12 (2/1999)	145	55-36C	13 to 14	
13 (6/1999)	**145**	**55-36C**	**15 to 17**	
12 (2/1999)	145	55-36C	18	
6 (10/1996)	145	55-37	1	
4 (5/1995)	145	55-37	2 to 4	
4 (5/1995)	145	55-37		4/1 to 4/2
2 (9/1994)	145	55-37	5	
4 (5/1995)	145	55-37	6 to 19	
6 (10/1996)	145	55-37A	1 to 3	
4 (5/1995)	145	55-37A		4 to 5
6 (10/1996)	145	55-37A	6 to 9	
6 (10/1996)	145	55-37A		9/1
8 (6/1997)	145	55-37A	9/2	
7 (12/1996)	145	55-37A	10	
4 (5/1995)	145	55-37A		11
8 (6/1997)	145	55-37A	12	
6 (10/1996)	145	55-37A	13	
8 (6/1997)	145	55-37A	14	
6 (10/1996)	145	55-37A		14/1 to 14/4
8 (6/1997)	145	55-37A	15	
6 (10/1996)	145	55-37A	16	
7 (12/1996)	145	55-37A		
4 (5/1995)	145	55-37A		17 to 18
5 (9/1995)	145	55-37A	19	
4 (5/1995)	145	55-37A		20 to 21
10 (1/1998)	145	55-37B		1 to 2
12 (2/1999)	145	55-37B	3	
10 (1/1998)	145	55-37B		4
12 (2/1999)	145	55-37B	5 to 15	
10 (1/1998)	145	55-37B		16
12 (2/1999)	145	55-37B	17 to 18	
10 (1/1998)	145	55-38	1	
6 (10/1996)	145	55-38	2	
2 (9/1994)	145	55-38	7	

UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
6 (10/1996)	145	55-38	8	
8 (6/1997)	145	55-38		8/1 to 8/2
8 (6/1997)	145	55-38	9 to 10	
6 (10/1996)	145	55-38	11	
8 (6/1997)	145	55-38	12	
6 (10/1996)	145	55-38	12/1 to 12/2	
9 (12/1997)	145	55-38	12/3 to 12/8	
9 (12/1997)	145	55-38		12/9 to 12/10
10 (1/1998)	145	55-38		12/11 to 12/16
10 (1/1998)	145	55-38	13	
6 (10/1996)	145	55-38	14	
2 (9/1994)	145	55-39	2	
2 (9/1994)	145	55-39	6	
2 (9/1994)	145	55-39	9	
2 (9/1994)	145	55-39	17	
9 (12/1997)	145	55-39A	1	
6 (10/1996)	145	55-39A		2
8 (6/1997)	145	55-39A		2/1 to 2/2
8 (6/1997)	145	55-39A	3 to 6	
6 (10/1996)	145	55-39A		7 to 13
9 (12/1997)	145	55-39B		1
12 (2/1999)	145	55-39B	2 to 6	
9 (12/1997)	145	55-39B		6 to 8
12 (2/1999)	145	55-39B	9	
10 (1/1998)	145	55-40	1	
12 (2/1999)	145	55-40	2	
1 (9/1994)	145	55-40		3 to 6
12 (2/1999)	145	55-40	7	
1 (9/1994)	145	55-40		8 to 10
12 (2/1999)	145	55-40	11 to 13	
1 (9/1994)	145	55-40		14
6 (10/1996)	145	55-40	15 to 16	
6 (10/1996)	145	55-40		16/1
9 (12/1997)	145	55-40	16/2	
12 (2/1999)	145	55-40	16/3 to 16/4	
6 (10/1996)	145	55-40	17 to 18	
8 (6/1997)	145	55-40		18/1
12 (2/1999)	145	55-40	18/2	
12 (2/1999)	145	55-40	19	
10 (1/1998)	145	55-40	20	
9 (12/1997)	145	55-40	21	
12 (2/1999)	145	55-40	22 to 23	
10 (1/1998)	145	55-40	24	
12 (2/1999)	145	55-40	24/1	
9 (12/1997)	145	55-40	24/2	
12 (2/1999)	145	55-40	25	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
10 (1/1998)	145	55-40	26	
12 (2/1999)	145	55-40	26/1	
10 (1/1998)	145	55-40		26/2
1 (1/1994)	145	55-40		27 to 28
3 (1/1995)	145	55-40	29	
12 (2/1999)	145	55-41	1 to 6 to be eliminated	
12 (2/1999)	145	55-A1	2 to 4	
12 (2/1999)	146	55	Index	
10 (1/1998)	146	55-1	1	
5 (9/1995)	146	55-1	2	
3 (1/1995)	146	55-1	3 to 6	
2 (9/1994)	146	55-1		7
3 (1/1995)	146	55-1	8	
4 (5/1995)	146	55-1	9 to 11	
6 (10/1996)	146	55-1	12	
10 (1/1998)	146	55-1	12/1	
8 (6/1997)	146	55-1	12/2	
6 (10/1996)	146	55-1	13 to 17	
12 (2/1999)	146	55-1	18/1 to 18/2	
12 (2/1999)	146	55-1	19	
9 (12/1997)	146	55-1	20 to 21	
12 (2/1999)	146	55-1	21/1	
10 (1/1998)	146	55-1		21/2
12 (2/1999)	146	55-1	21/3 to 21/4	
10 (1/1998)	146	55-1		21/5 to 21/6
10 (1/1998)	146	55-1	22	
2 (9/1994)	146	55-2		1 to 2
12 (2/1999)	146	55-2	3 to 4	
2 (9/1994)	146	55-2		5
9 (12/1997)	146	55-2	6	
12 (2/1999)	146	55-2	6/1 to 6/2	
9 (12/1997)	146	55-2		6/3 to 6/4
6 (10/1996)	146	55-2	7	
2 (9/1994)	146	55-2		8
12 (2/1999)	146	55-2	9	
9 (12/1997)	146	55-2	10	
10 (1/1998)	146	55-2	11	
12 (2/1999)	146	55-2	12 to 15	
10 (1/1998)	146	55-2	16	
12 (2/1999)	146	55-2	16/1	
9 (12/1997)	146	55-2		16/2
10 (1/1997)	146	55-2	17	
12 (2/1999)	146	55-2	19 to 20	
8 (6/1997)	146	55-3	1	
2 (9/1994)	146	55-3		2 to 3

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	146	55-3	4	
8 (6/1997)	146	55-3		4/1 to 4/2
6 (10/1996)	146	55-3	5 to 6	
2 (9/1994)	146	55-3		7
6 (10/1996)	146	55-3	8	
2 (9/1994)	146	55-3		9
6 (10/1996)	146	55-3	10 to 13	
2 (9/1994)	146	55-3		14
6 (10/1996)	146	55-3	15	
10 (1/1998)	146	55-3	16 to 17	
8 (6/1997)	146	55-3	18	
10 (1/1998)	146	55-3	19	
9 (12/1997)	146	55-3	20 to 21	
8 (6/1997)	146	55-3		22 to 23
12 (2/1999)	146	55-3	24	
8 (6/1997)	146	55-3		25 to 26
10 (1/1998)	146	55-3	27	
8 (6/1997)	146	55-3		28
10 (1/1998)	146	55-3	29	
2 (9/1994)	146	55-5		1 to 2
8 (6/1997)	146	55-5		2/1 to 2/2
8 (6/1997)	146	55-5	3	
2 (9/1994)	146	55-5		4
8 (6/1997)	146	55-5	5 to 7	
2 (9/1994)	146	55-5		8
8 (6/1997)	146	55-8	1	
2 (9/1994)	146	55-8		2 to 3
6 (10/1996)	146	55-8	4	
6 (10/1996)	146	55-8		4/1
8 (6/1997)	146	55-8	4/2	
8 (6/1997)	146	55-8		4/3 to 4/4
8 (6/1997)	146	55-8	5 to 10	
8 (6/1997)	146	55-8		10/1 to 10/2
6 (10/1996)	146	55-8	11	
6 (10/1996)	146	55-8		12
12 (2/1999)	146	55-11	1	
2 (9/1994)	146	55-11		2
6 (10/1996)	146	55-11	3	
8 (6/1997)	146	55-11	4	
8 (6/1997)	146	55-11		4/1 to 4/2
8 (6/1997)	146	55-11	5	
2 (9/1994)	146	55-11		6
8 (6/1997)	146	55-11	7 to 9	
2 (9/1994)	146	55-11		10
12 (2/1999)	146	55-11	11	
12 (2/1999)	146	55-11A		1 to 9

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			SOBST.	ADDED
8 (6/1997)	146	55-12	1	
2 (9/1994)	146	55-12		2/1 to 2/2
8 (6/1997)	146	55-12	3 to 8	
8 (6/1997)	146	55-12		8/1 to 8/2
2 (9/1994)	146	55-12		9 to 10
2 (9/1994)	146	55-13		1
8 (6/1997)	146	55-13		2/1 to 2/2
8 (6/1997)	146	55-13	3 to 5	
8 (6/1997)	146	55-14	1	
6 (10/1996)	146	55-14	2	
10 (1/1998)	146	55-14	2/1	
8 (6/1997)	146	55-14		2/2
8 (6/1997)	146	55-14	3	
10 (1/1998)	146	55-14	4	
9 (12/1997)	146	55-14	5	
10 (1/1998)	146	55-14	6 to 7	
8 (6/1997)	146	55-16	1	
2 (9/1994)	146	55-16		2 to 3
6 (10/1996)	146	55-16	4	
8 (6/1997)	146	55-16	4/1 to 4/2	
8 (6/1997)	146	55-16	5 to 9	
2 (9/1994)	146	55-16	6	
6 (10/1996)	146	55-16	7 to 9	
2 (9/1994)	146	55-16	10	
7 (12/1996)	146	55-16	11	
2 (9/1994)	146	55-16		12 to 14
8 (6/1997)	146	55-18	1	
2 (9/1994)	146	55-18		2 to 3
8 (6/1997)	146	55-18	4	
8 (6/1997)	146	55-18		4/1 to 4/2
2 (9/1994)	146	55-18		5 to 8
6 (10/1996)	146	55-18	9	
8 (6/1997)	146	55-18	10	
8 (6/1997)	146	55-18		10/1 to 10/2
8 (6/1997)	146	55-18	11 to 12	
2 (9/1994)	146	55-18		13
2 (9/1994)	146	55-19		1 to 2
8 (6/1997)	146	55-19		2/1 to 2/2
8 (6/1997)	146	55-19	3 to 4	
2 (9/1994)	146	55-19		5
8 (6/1997)	146	55-19	6	
2 (9/1994)	146	55-19		7
8 (6/1997)	146	55-19	8	
2 (9/1994)	146	55-19		9 to 11
8 (6/1997)	146	55-21	1	
2 (9/1994)	146	55-21		a 2

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
6 (10/1996)	146	55-21	3	
8 (6/1997)	146	55-21	4	
8 (6/1997)	146	55-21		4/1 to 4/2
8 (6/1997)	146	55-21	5 to 10	
8 (6/1997)	146	55-21		10/1 to 10/2
2 (9/1994)	146	55-21		11 to 13
2 (9/1994)	146	55-22		1
5 (9/1995)	146	55-22	2	
8 (6/1997)	146	55-22		2/1 to 2/2
8 (6/1997)	146	55-22	3 to 6	
2 (9/1994)	146	55-22		7
8 (6/1997)	146	55-23	1	
6 (10/1996)	146	55-23	2 to 3	
8 (6/1997)	146	55-23	4	
8 (6/1997)	146	55-23		4/1 to 4/2
8 (6/1997)	146	55-23	5 to 6	
6 (10/1996)	146	55-23	7	
8 (6/1997)	146	55-23	8 to 9	
2 (9/1994)	146	55-23		10
9 (12/1997)	146	55-23	10/1	
8 (6/1997)	146	55-23		10/2
8 (6/1997)	146	55-23	11 to 14	
8 (6/1997)	146	55-23		14/1 to 14/2
2 (9/1994)	146	55-23		15 to 17
8 (6/1997)	146	55-24	1	
3 (1/1995)	146	55-24	2	
6 (10/1996)	146	55-24		2/1
10 (1/1998)	146	55-24	2/2	
8 (6/1997)	146	55-24	3	
10 (1/1998)	146	55-24	4	
8 (6/1997)	146	55-24	5 to 6	
8 (6/1997)	146	55-24		6/1 to 6/2
3 (1/1995)	146	55-24		7
6 (10/1996)	146	55-24		8
6 (10/1996)	146	55-26	1	
2 (9/1994)	146	55-26		2 to 26
2 (9/1994)	146	55-A1		1
12 (2/1999)	146	55-A1	2 to 5	

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			SOBST.	ADDED
4 (5/1995)	145	55-37A		4 to 5
6 (10/1996)	145	55-37A	6 to 9	
6 (10/1996)	145	55-37A		9/1
8 (6/1997)	145	55-37A	9/2	
7 (12/1996)	145	55-37A	10	
4 (5/1995)	145	55-37A		11
8 (6/1997)	145	55-37A	12	
6 (10/1996)	145	55-37A	13	
8 (6/1997)	145	55-37A	14	
6 (10/1996)	145	55-37A		14/1 to 14/4
8 (6/1997)	145	55-37A	15	
6 (10/1996)	145	55-37A	16	
7 (12/1996)	145	55-37A		
4 (5/1995)	145	55-37A		17 to 18
5 (9/1995)	145	55-37A	19	
4 (5/1995)	145	55-37A		20 to 21
10 (1/1998)	145	55-37B		1 to 2
12 (2/1999)	145	55-37B	3	
10 (1/1998)	145	55-37B		4
12 (2/1999)	145	55-37B	5 to 15	
10 (1/1998)	145	55-37B		16
12 (2/1999)	145	55-37B	17 to 18	
10 (1/1998)	145	55-38	1	
6 (10/1996)	145	55-38	2	
2 (9/1994)	145	55-38	7	
6 (10/1996)	145	55-38	8	
8 (6/1997)	145	55-38		8/1 to 8/2
8 (6/1997)	145	55-38	9 to 10	
6 (10/1996)	145	55-38	11	
8 (6/1997)	145	55-38	12	
6 (10/1996)	145	55-38	12/1 to 12/2	
9 (12/1997)	145	55-38	12/3 to 12/8	
9 (12/1997)	145	55-38		12/9 to 12/10
10 (1/1998)	145	55-38		12/11 to 12/16
10 (1/1998)	145	55-38	13	
6 (10/1996)	145	55-38	14	
2 (9/1994)	145	55-39	2	
2 (9/1994)	145	55-39	6	
2 (9/1994)	145	55-39	9	
2 (9/1994)	145	55-39	17	
9 (12/1997)	145	55-39A	1	
6 (10/1996)	145	55-39A		2
8 (6/1997)	145	55-39A		2/1 to 2/2
8 (6/1997)	145	55-39A	3 to 6	
6 (10/1996)	145	55-39A		7 to 13
9 (12/1997)	145	55-39B		1

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
12 (2/1999)	145	55-39B	2 to 6	
9 (12/1997)	145	55-39B		6 to 8
12 (2/1999)	145	55-39B	9	
10 (1/1998)	145	55-40	1	
12 (2/1999)	145	55-40	2	
1 (9/1994)	145	55-40		3 to 6
12 (2/1999)	145	55-40	7	
1 (9/1994)	145	55-40		8 to 10
12 (2/1999)	145	55-40	11 to 13	
1 (9/1994)	145	55-40		14
6 (10/1996)	145	55-40	15 to 16	
6 (10/1996)	145	55-40		16/1
9 (12/1997)	145	55-40	16/2	
12 (2/1999)	145	55-40	16/3 to 16/4	
6 (10/1996)	145	55-40	17 to 18	
8 (6/1997)	145	55-40		18/1
12 (2/1999)	145	55-40	18/2	
12 (2/1999)	145	55-40	19	
10 (1/1998)	145	55-40	20	
9 (12/1997)	145	55-40	21	
12 (2/1999)	145	55-40	22 to 23	
10 (1/1998)	145	55-40	24	
12 (2/1999)	145	55-40	24/1	
9 (12/1997)	145	55-40	24/2	
12 (2/1999)	145	55-40	25	
10 (1/1998)	145	55-40	26	
12 (2/1999)	145	55-40	26/1	
10 (1/1998)	145	55-40		26/2
1 (1/1994)	145	55-40		27 to 28
3 (1/1995)	145	55-40	29	
12 (2/1999)	145	55-41	1 to 6 to be eliminated	
12 (2/1999)	145	55-A1	2 to 4	
12 (2/1999)	146	55		
10 (1/1998)	146	55-1	1	
5 (9/1995)	146	55-1	2	
3 (1/1995)	146	55-1	3 to 6	
2 (9/1994)	146	55-1		7
3 (1/1995)	146	55-1	8	
4 (5/1995)	146	55-1	9 to 11	
6 (10/1996)	146	55-1	12	
10 (1/1998)	146	55-1	12/1	
8 (6/1997)	146	55-1	12/2	
6 (10/1996)	146	55-1	13 to 17	
12 (2/1999)	146	55-1	18/1 to 18/2	
12 (2/1999)	146	55-1	19	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
9 (12/1997)	146	55-1	20 to 21	
12 (2/1999)	146	55-1	21/1	
10 (1/1998)	146	55-1		21/2
12 (2/1999)	146	55-1	21/3 to 21/4	
10 (1/1998)	146	55-1		21/5 to 21/6
10 (1/1998)	146	55-1	22	
2 (9/1994)	146	55-2		1 to 2
12 (2/1999)	146	55-2	3 to 4	
2 (9/1994)	146	55-2		5
9 (12/1997)	146	55-2	6	
12 (2/1999)	146	55-2	6/1 to 6/2	
9 (12/1997)	146	55-2		6/3 to 6/4
6 (10/1996)	146	55-2	7	
2 (9/1994)	146	55-2		8
12 (2/1999)	146	55-2	9	
9 (12/1997)	146	55-2	10	
10 (1/1998)	146	55-2	11	
12 (2/1999)	146	55-2	12 to 15	
10 (1/1998)	146	55-2	16	
12 (2/1999)	146	55-2	16/1	
9 (12/1997)	146	55-2		16/2
10 (1/1997)	146	55-2	17	
12 (2/1999)	146	55-2	19 to 20	
8 (6/1997)	146	55-3	1	
2 (9/1994)	146	55-3		2 to 3
8 (6/1997)	146	55-3	4	
8 (6/1997)	146	55-3		4/1 to 4/2
6 (10/1996)	146	55-3	5 to 6	
2 (9/1994)	146	55-3		7
6 (10/1996)	146	55-3	8	
2 (9/1994)	146	55-3		9
6 (10/1996)	146	55-3	10 to 13	
2 (9/1994)	146	55-3		14
6 (10/1996)	146	55-3	15	
10 (1/1998)	146	55-3	16 to 17	
8 (6/1997)	146	55-3	18	
10 (1/1998)	146	55-3	19	
9 (12/1997)	146	55-3	20 to 21	
8 (6/1997)	146	55-3		22 to 23
12 (2/1999)	146	55-3	24	
8 (6/1997)	146	55-3		25 to 26
10 (1/1998)	146	55-3	27	
8 (6/1997)	146	55-3		28
10 (1/1998)	146	55-3	29	
2 (9/1994)	146	55-5		1 to 2
8 (6/1997)	146	55-5		2/1 to 2/2

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	146	55-5	3	
2 (9/1994)	146	55-5		4
8 (6/1997)	146	55-5	5 to 7	
2 (9/1994)	146	55-5		8
8 (6/1997)	146	55-8	1	
2 (9/1994)	146	55-8		2 to 3
6 (10/1996)	146	55-8	4	
6 (10/1996)	146	55-8		4/1
8 (6/1997)	146	55-8	4/2	
8 (6/1997)	146	55-8		4/3 to 4/4
8 (6/1997)	146	55-8	5 to 10	
8 (6/1997)	146	55-8		10/1 to 10/2
6 (10/1996)	146	55-8	11	
6 (10/1996)	146	55-8		12
12 (2/1999)	146	55-11	1	
2 (9/1994)	146	55-11		2
6 (10/1996)	146	55-11	3	
8 (6/1997)	146	55-11	4	
8 (6/1997)	146	55-11		4/1 to 4/2
8 (6/1997)	146	55-11	5	
2 (9/1994)	146	55-11		6
8 (6/1997)	146	55-11	7 to 9	
2 (9/1994)	146	55-11		10
12 (2/1999)	146	55-11	11	
12 (2/1999)	146	55-11A		1 to 9
8 (6/1997)	146	55-12	1	
2 (9/1994)	146	55-12		2/1 to 2/2
8 (6/1997)	146	55-12	3 to 8	
8 (6/1997)	146	55-12		8/1 to 8/2
2 (9/1994)	146	55-12		9 to 10
2 (9/1994)	146	55-13		1
8 (6/1997)	146	55-13		2/1 to 2/2
8 (6/1997)	146	55-13	3 to 5	
8 (6/1997)	146	55-14	1	
6 (10/1996)	146	55-14	2	
10 (1/1998)	146	55-14	2/1	
8 (6/1997)	146	55-14		2/2
8 (6/1997)	146	55-14	3	
10 (1/1998)	146	55-14	4	
9 (12/1997)	146	55-14	5	
10 (1/1998)	146	55-14	6 to 7	
8 (6/1997)	146	55-16	1	
2 (9/1994)	146	55-16		2 to 3
6 (10/1996)	146	55-16	4	
8 (6/1997)	146	55-16	4/1 to 4/2	
8 (6/1997)	146	55-16	5 to 9	

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UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
2 (9/1994)	146	55-16	6	
6 (10/1996)	146	55-16	7 to 9	
2 (9/1994)	146	55-16	10	
7 (12/1996)	146	55-16	11	
2 (9/1994)	146	55-16		12 to 14
8 (6/1997)	146	55-18	1	
2 (9/1994)	146	55-18		2 to 3
8 (6/1997)	146	55-18	4	
8 (6/1997)	146	55-18		4/1 to 4/2
2 (9/1994)	146	55-18		5 to 8
6 (10/1996)	146	55-18	9	
8 (6/1997)	146	55-18	10	
8 (6/1997)	146	55-18		10/1 to 10/2
8 (6/1997)	146	55-18	11 to 12	
2 (9/1994)	146	55-18		13
2 (9/1994)	146	55-19		1 to 2
8 (6/1997)	146	55-19		2/1 to 2/2
8 (6/1997)	146	55-19	3 to 4	
2 (9/1994)	146	55-19		5
8 (6/1997)	146	55-19	6	
2 (9/1994)	146	55-19		7
8 (6/1997)	146	55-19	8	
2 (9/1994)	146	55-19		9 to 11
8 (6/1997)	146	55-21	1	
2 (9/1994)	146	55-21		a 2
6 (10/1996)	146	55-21	3	
8 (6/1997)	146	55-21	4	
8 (6/1997)	146	55-21		4/1 to 4/2
8 (6/1997)	146	55-21	5 to 10	
8 (6/1997)	146	55-21		10/1 to 10/2
2 (9/1994)	146	55-21		11 to 13
2 (9/1994)	146	55-22		1
5 (9/1995)	146	55-22	2	
8 (6/1997)	146	55-22		2/1 to 2/2
8 (6/1997)	146	55-22	3 to 6	
2 (9/1994)	146	55-22		7
8 (6/1997)	146	55-23	1	
6 (10/1996)	146	55-23	2 to 3	
8 (6/1997)	146	55-23	4	
8 (6/1997)	146	55-23		4/1 to 4/2
8 (6/1997)	146	55-23	5 to 6	
6 (10/1996)	146	55-23	7	
8 (6/1997)	146	55-23	8 to 9	
2 (9/1994)	146	55-23		10
9 (12/1997)	146	55-23	10/1	
8 (6/1997)	146	55-23		10/2

UPDATE CHART				
UPDATE (DATE)	MODEL	SECTION	PAGE	
			SOBST.	ADDED
8 (6/1997)	146	55-23	11 to 14	
8 (6/1997)	146	55-23		14/1 to 14/2
2 (9/1994)	146	55-23		15 to 17
8 (6/1997)	146	55-24	1	
3 (1/1995)	146	55-24	2	
6 (10/1996)	146	55-24		2/1
10 (1/1998)	146	55-24	2/2	
8 (6/1997)	146	55-24	3	
10 (1/1998)	146	55-24	4	
8 (6/1997)	146	55-24	5 to 6	
8 (6/1997)	146	55-24		6/1 to 6/2
3 (1/1995)	146	55-24		7
6 (10/1996)	146	55-24		8
6 (10/1996)	146	55-26	1	
2 (9/1994)	146	55-26		2 to 26
2 (9/1994)	146	55-A1		1
12 (2/1999)	146	55-A1	2 to 5	

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ALFA ROMEO 146 SUPPLEMENTS

19 documents - 320 factory pages

ANTI-THEFT DEVICE/ALARM

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This section deals with the INFRARED CONTROL alarm system.
For the version with RADIO FREQUENCY CONTROL, refer to the special publication "ALARM SYSTEM PA500500000000".

GENERAL DESCRIPTION

Upon request the car is pre-wired for the installation of an alarm system, combined with the door locking system with remote control.

The V.A.S.(Vehicle Alarm System) is a system which offers both both perimeter and interior protection: it is able to survey the state of the doors and note the presence of foreign bodies inside the passenger compartment; the system is controlled by a single compact unit which comprises the electronic control unit and siren.

The system is "universal" as it offers the possibility to configure the control unit according to the requirements of the different countries (alarm sound level and types of light flashing for activation/deactivation.

In addition, a sophisticated self-diagnosis system controls:

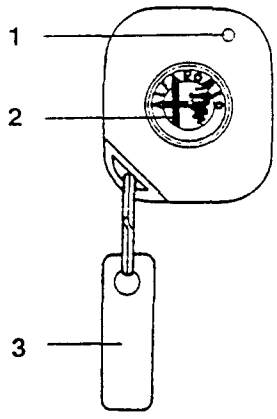
- intermittent and permanent errors or faults;
- number of activations of the anti-theft device and the number of alarms sounded;
- specific faults of the control unit;

WARNING:
For the 146 the alarm system is supplied in two different versions:

- **cars without ALFA ROMEO CODE: V.A.S. ALARM system with volumetric. perimetral protection and internal counter measures in the event of alrm (engine and starter motor lock);**
- **cars with ALFA ROMEO CODE: V.A.S. ALARM system with volumetricand perimetral protection: without engine control carried out by the above-mentioned system (see the corresponding section "ALFA ROMEO CODE").**

COMPONENTS

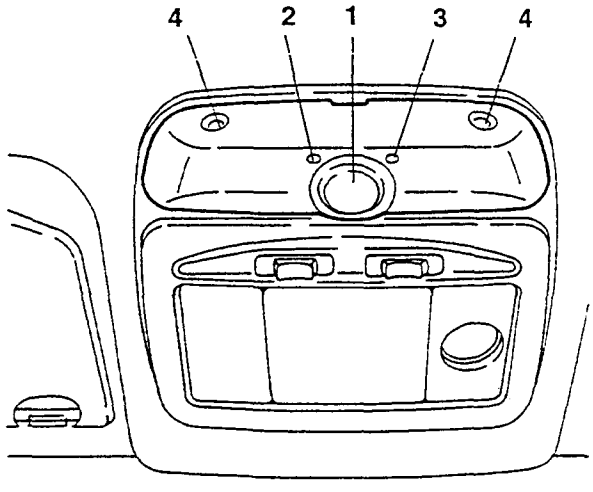
The **transmitter**, protected by a shockproof rubber cover, comprises a printed circuit and an infrared ray sender; it is battery-powered (2 3V lithium batteries) and, each time the control button is pressed, it sends a beam of rays in the direction in which it is pointed. This infrared ray device continuously transmits the code for the whole time in which the button is pressed. An indicator (led) turns on each time a signal is emitted.



Transmitter

1 - Luminous led
2 - Control button
3 - Transmitter code label

The **receiver**, incorporated in the front ceiling lamp, is an electronic device that picks up the infrared ray signal through a half-ball protruding from the receiver. There is also a led on the receiver which lights up when the signal is received, while a special button makes it possible to memorise the secret control code. The special half round shape makes it possible to capture the signal through 360 degrees, provided that the transmitter is no more than 5 metres away

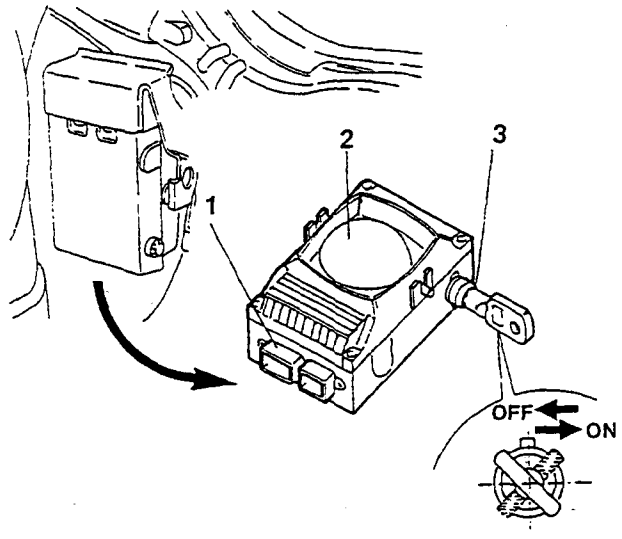


Receiver and volumetric sensors

1 - Half-ball receiver
2 - Luminous led
3 - Memorising button
4 - Volumetric sensors

.**The electronic control unit** also comprises the compact **siren** : it is to be found at the rear in the luggage compartment.
The siren operates at different intensity depending on the programming for the different countries (see description below).

The **emergency key** for deactivating the system is located on the actual control unit, thus access to it is quick and easy.



Control unit

1 - Electronic control unit
2 - Siren
3 - Emergency key

For the control of the doors and luggage compartment the same switches as for the door locking system are used (see sections "Door locking system" and "Luggage compartment opening control"): all the switches signal when the doors are "not closed" (door open = earth signal to the control unit.
There is a special **switch** on the bonnet which operates with the opposite logic: (bonnet closed = earth signal).

The two **volumetric sensors** enable extra surveillance controlling that there are no intrusions inside the car. They are incorporated in the front ceiling light; one acts as a transmitter and the other as receiver; the beam of ultrasounds emitted by the former (left) must be wholly picked up by the latter (right), after a number of "rebounds" inside the passenger compartment: if not, an alarm signal is sent to the control unit.

The system **signalling led** (red, of the high efficiency type), is located on the dashboard, on the upper half cover of the steering column behind the steering wheel, and it signals the state of the system and any faults (see following description).

OPERATION

ENABLING/DISABLING

It is only possible to enable the alarm when the ignition key is in the STOP position.

ENABLING is possible by pressing the button on the transmitter.

DISABLING is obtained by pressing the same button once again.

To obtain the most efficient switching, press the button until a visual and acoustic signal are noted (feedback).

N.B. The system is protected against unauthorised recording of the secret code.

Enabling

Press the button whilst pointing the transmitter towards the receiver dome. Acoustic and optical signals will be noted (for the markets/versions foreseen).

Disabling

Press the button pointing the transmitter towards the receiver dome.
Also for disabling acoustic and optical signals will be noted (for the markets/versions foreseen).

COMPLETE DEACTIVATION OF THE SYSTEM

If the batteries of the transmitter are flat or the system is not working properly, the alarm system can be deactivated using the emergency key on the control unit.
When the car is delivered this emergency key must be in the "ON" position.
Turning the key to "OFF" the system is deactivated completely. In the specific version for some markets, only the batteries inside the control unit/siren are deactivated, leaving the alarm system activated as it is still supplied by the car battery.
With the key at "OFF" the surveillance of the cable cutting/battery disconnection is no longer activated.

Set this key to "OFF" and disconnect the battery cable if the vehicle is left unused for long periods (over 1 month).

"SURVEILLANCE" MODE

During the "surveillance" mode (car closed and alarm activated) the dissuasion led flashes at 0.8 Hz, in this conditions, the system;

– checks the doors, bonnet and tailgate;

– checks that the battery is connected and that the leads are intact;

- checks that the ignition key is not being tampered with;
- checks movements inside the passenger compartment (volumetric sensors);
- only for versions without ALFA ROMEO CODE: cuts off the supply to the starter motor (provided that the key is turned to MARCIA)and deactivates the engine electronic control unit (Boxer 1.7 16 v version).

ALARM MODE

The system enters the alarm mode when one of the surveillance sensors detects an abnormal situation.

The alarm mode can trigger a warning system to the outside (activation of the siren and blinkers, with times varying according to the versions/markets). Only for versions without ALFA ROMEO CODE there are other countermeasures such as: cutting off the engine supply (Motronic control unit supply - Boxer 1.3 and 1.6 version - or stop solenoid valve supply and glow plug warming device - TD version).

The alarm ceases:

- with a command from the transmitter (deactivation);
- 25 min. after the last activation of the alarm mode;
- by turning the emergency key.
  (N.B.: in this case the alarm activated condition is stored in the control unit memory).

SELF-DIAGNOSIS

UPON ACTIVATION the system carries out self-diagnosis (indicated by the flashing of the LED at 4 Hz). If a fault is found, the LED will identify it through a special flashing code as shown in **table 1.**

Table 1: Selfdiagnosis signals

Type of flashing	Meaning
8 Hz, duration 2,5 sec.	Door/bonnet/tailgate left open or faulty switch
Fixed light, duration 2,5 sec.	Faulty volumetric sensors
16 Hz, duration 2,5 sec.	Fault in electronic control unit

When a door or bonnet/tailgate is found to be open/faulty or when a fault is detected on the volumetric sensors, the corresponding sensor is cut off by the surveillance mode and a beep signal is given one second after they are reactivated.

WHEN THE ALARM IS DISABLED the dissuasion LED flashes to indicate which of the sensors triggered an alarm during surveillance (see **table 2**).

N.B.: the signal is cancelled turning the ignition key to MARCIA

Table 2: Signals indicating alarms

N. Flashes*	Component with alarm
1 Flash	Right front door
2 Flashes	Left front door
3 Flashes	Rh door rear
4 Flashes	LH rear door
5 Flashes	Volumetric sensors on ceiling light
6 Flashes	Bonnet
7 Flashes	Tailgate
8 Flashes	Key-operated supply cut off
9 Flashes	Battery supply cut off
10 Flashes	At least 3 causes of alarm contemporaneously

(*) If there is more than one, the alarm codes are presented in sequence.

The flashes last for 0.5 sec. with an interval of 1.5 sec. between them.

In addition to the automatic SELF-DIAGNOIS described here, it is also possible to check the system by MANUAL DIAGNOSIS (see "FAULT-FINDING").

INHIBITING THE INTERIOR SURVEILLANCE SYSTEM

It is possible to inhibit interior surveillance in one of the following ways:

a) in close sequence (prior to enabling the alarm system): starting from the MARCIA position, move the key to: STOP, MARCIA, STOP.

Confirmation of the inhibition of the interior surveillance system is given by the lighting up of the dissuasion LED for appr. 2 sec.

b) starting from the key in the MARCIA position, press the button on the receiver (for less than 0.5 sec.) no longer than 8 sec. before turning the key to STOP. Confirmation that the interior surveillance system is deactivated is given by the lighting up of the LED on the ceiling light for appr. 2 sec.

The next time the key is turned to MARCIA the interior surveillance system is re-enabled.

WARNING: It will be possible to turn the key to MARCIA for a maximum of 30 sec. without re-enabling the interior surveillance system (for example to allow the closing of electric windows which may have been left open accidentally).

SELF-ENABLING (only for certain Markets and for versions without ALFA ROMEO CODE)

The self-enabling system ensures that the alarm system is partially enabled automatically after a certain period of time - 4 minutes - from when the car is left by the driver.

This takes place under the following two conditions:

– ignition key moved from MARCIA to STOP;

– opening followed by closing of the driver's door.

The surveillance system operates in the same way as when activated by the remote control with the exception of the following points:

– the doors are not locked;

– interior surveillance is not activated.

The opening of the driver's door before the delay time for self-enabling - 4 minutes - stops and resets the counter: the closing of the door will make the counter resume from the beginning.

In order to regain possession of the car, the owner must disable the system via the remote control, which must be pressed twice in two separate phases:

- **the first press activates the alarm system completely;**
- **the second one deactivates the alarm system and opens the doors.**

PROGRAMMING THE TRANSMITTER

Upon leaving the factory the receiver contains a **"UNIVERSAL" code** which can be controlled by a "UNIVERSAL" transmitter for inspection and moving the car in the factory. On delivery it is therefore necessary to reprogramme the receiver with the transmitter code so that only the owner will have authorised use of the vehicle.

There are two possible programming modes:

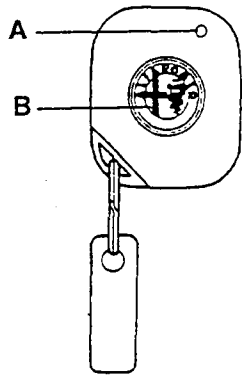
a) before entering the password: **SIMPLIFIED PROGRAMMING**;

b) after entering the password: **PROTECTED PROGRAMMING**;

The memorising of a transmitter must be carried out with:

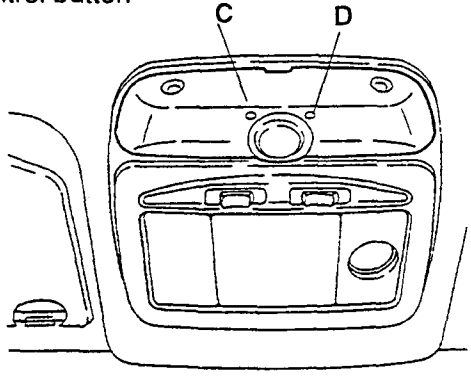
- the alarm system deactivated (by remote control); the warning led on the panel must be off;
- the emergency key at "ON";
- the ignition key at STOP.

Each transmitter has a label with a four-figure number to protect the system from unauthorised programming (protected programming) which must be removed by the customer on delivery of the vehicle and kept in a safe place.



Transmitter

A - Luminous led
B - Control button



Receiver

C - Luminous led
D - memorising button

SIMPLIFIED PROGRAMMING

Simplified programming is for use when no remote controller data has previously been entered in the memory and the system needs to accept all transmitters, i.e. when the memory has not yet been "locked" by protected programming.

In this programming mode as many codes as required are recognised, but only the last four are memorised.

Proceed as follows:

1. press button **D** on the ceiling light: LED **C** flashes;
NOTE: if the led does NOT flash, check that the alarm system is de-activated or that the receiver on the ceiling lamp is correctly powered.

2. keeping the receiver button **D** pushed, press the transmitter button **B**, point it towards the receiver, but at least 20 cm. from it: the led of transmitter **A**, must flash no more than once;

3. LED **C** lights continuously indicating that the code has been memorised: at this point the operator can release button **D** to end programming.
In the 3 sec. following the release of the button, it is possible to programme the country code to suit the country in which the car will be used.

This is performed by pressing in quick succession the button of the receiver **D**, as shown in **table 3**.

If the button is not pressed, the country code defaults to E.E.C. In the event of further memory storage operations, the last one remains in the memory.

If the procedure has been carried out correctly, the LED on receiver **C** will flash 6 times, indicating that the code has been memorised on both the ceiling light receiver and in the control unit, if not, LED **C** will flash 18 times and it will be necessary to repeat the entire procedure starting from point 1 of simplified programming, after checking the correct connection between the control unit and the ceiling lamp

Table 3: Country Codes

No. of presses	Country
1	ITALY
2	GERMANY (*)
3	FRANCE
4	SWITZERLAND
5	UNITED KINGDOM
6	HOLLAND
7	USA
8	EEC
9 / 10	Others

(*) Not used in this country, for versions without ALFA ROMEO CODE, because in this country a specific control unit with a special operating logic is foreseen.

As it is not easy to carry out this procedure in such a short time as 3 seconds, a **different procedure for entering the Country code** is recommended. To do this, proceed as follows:

- open the bonnet;
- turn the ignition key from MARCIA to STOP: within 15 seconds the bonnet button must be pressed 7 times in quick succession in less than 10 seconds; 5 beeps will indicate entry in MANUAL DIAGNOSIS (see FAULT-FINDING). During these 5 beeps press the bonnet switch once again. A last long beep will signal the acceptance of this new operation;
- keep the button pressed throughout the duration of the long beep. The latter signals entry into the country programming mode, thus the possibility to enter the country code;
- release the switch and press it within 10 seconds the number of times mentioned in table 3 to select the operating mode of the country required (each press will have a feedback beep).

N.B. To enter another remote control repeat the operations from point 1 of simplified programming, provided that the memory has been "loked" as described below.

PROTECTED PROGRAMMING

To prevent unauthorised persons from entering their own code, it is necessary to protect ("lock") the memory; this operation takes place automatically after 256 activations/deactivations of the alarm system, or by entering the password (locking the memory manually).

Locking the memory manually

Protected programming can be entered by the Owner by entering the Password (four digit code on the transmitter label) before 256 activations/deactivations (for example on a new car during pre-delivery, when all the codes of the remote controls given to the Customer have been entered).

To enter the Password:

1. Press the button on receiver **D** for appr. 2 seconds; LED **C** will flash for the whole time in which the button is pressed.

2. Release button **D**: after appr. 2 seconds LED **C** will flash once indicating the possibility to enter the first digit of the password.

3. Press the button of the receiver **D** the number of times corresponding to the first figure of the password (for example if the Password is 5.2.0.3. press 5 times). Each time the button is pressed LED **C** lights up briefly to confirm;

4. After appr. 2 seconds from the last press on button **D** (the fifth in the example) led **C** will flash again to ask for the next figure.

5. Proceed as described above for all the other figures.

NOTE:
When the password (see example) contains a "0" there is no need to press button **D**, simply wait for the request for confirmation of entry indicated by the next flash.

When the four figures of the Password have been entered, the LED on the receiver **C** can behave as follows:

- **it does not light up**: this means that the Password has been entered correctly and that it belongs to one of the codes of the remote controls memorised;
- **it stays on continuously** for several seconds meaning that the password has not been entered correctly or it does not correspond to any of the remote controls memorised. In this case, when LED **C** goes off, the correct Password should be entered beginning from point 1.

With the correct entry of the password the memory is "locked".
From now onwards, if attempts are made to memorise a new remote control, after transmitting the new code, LED **C** on the ceiling light will stop flashing to indicate that the operation is unsuccessful.
In this case, to enter the code of the new remote control the memory has to be "re-opened" by the following procedure.

Memory opening

When the memory has been "locked" further remote control codes are entered by "**manual memory opening**".

The memory is opened as follows:

1. press the button on receiver **D** for appr. 2 seconds; LED **C** will flash for the whole time in which the button is pressed;

2. Release button **D**: after appr. 2 seconds LED **C** will flash once indicating the possibility to enter the first digit of the password.

3. Press the button of the receiver **D** the number of times corresponding to the first figure of the password (for example if the Password is 5.2.0.3. press 5 times). Each time button **D** is pressed LED **C** lights up briefly to confirm;

4. After appr. 2 seconds from the last press on button **D** (the fifth in the example) led will flash again to ask for the next figure.

5. Proceed as described above for all the other figures.It should be noted that when the password (see example) contains a "0" there is no need to press the button, simply wait for the next request.

When the Password hase been entered, the LED **C** can behave as follows:

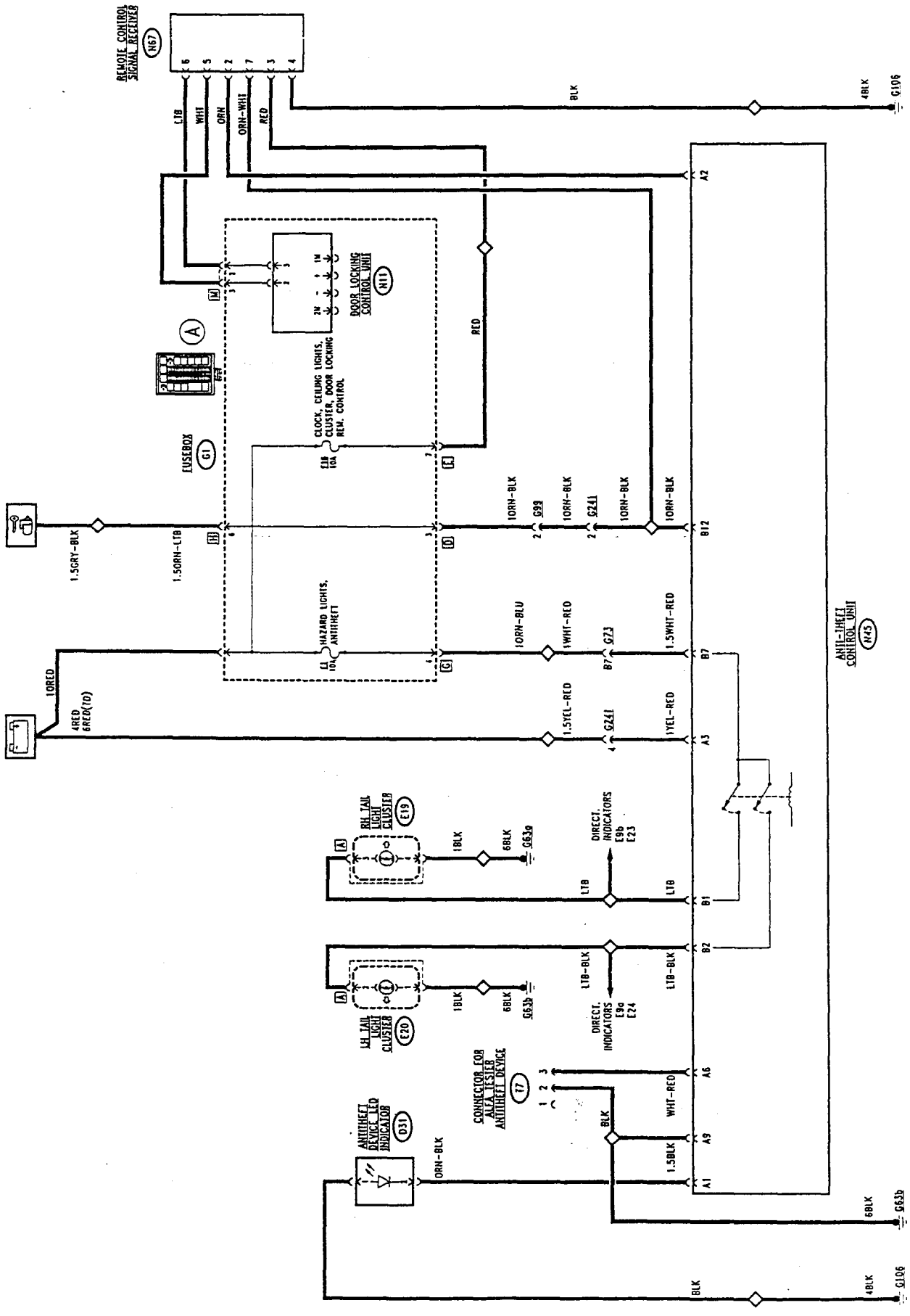
- **it stays on continuously** meaning that the password has not been entered correctly or it is not present in the memory. Repeat the memory opening operations (with the correct password) from point 1;
- **it starts flashing**; this means that the password has been entered correctly (memory opening) and that it belongs to one of the remote control codes memorised.

At this point to memorise the code of the new transmitter proceed as described at point 1 of "Simplified programming".
When the new remote control has been entered the memory returns to the "locked" mode.

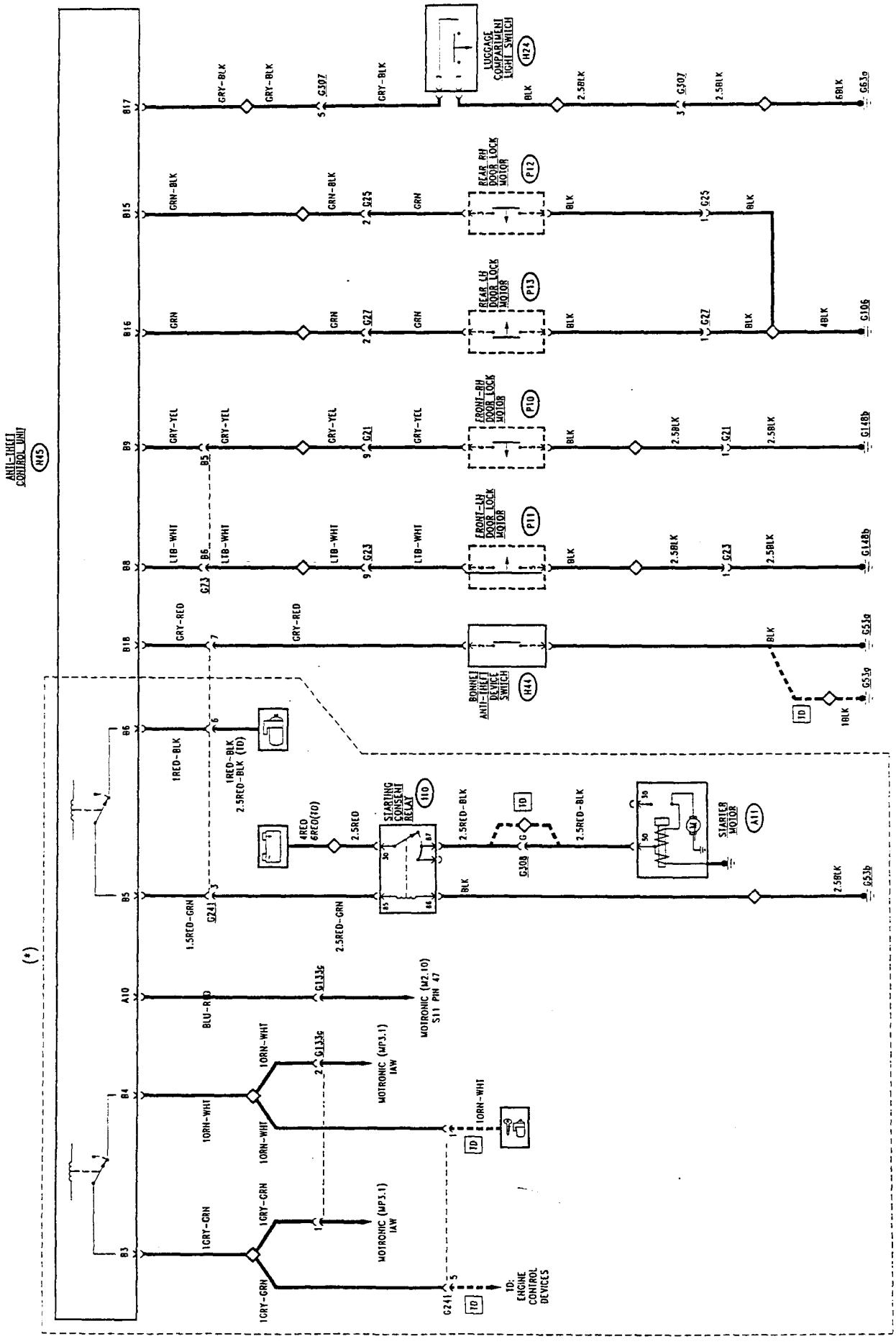
N.B.: The alarm system is activated/de-activated only by the code of the last transmitter memorised correctly (with the key at "ON").
In fact this code is memorised contempraneously by both the receiver and the alarm control unit.
Any transmitters memorised previously in the receiver, though they have different codes, utilise the code of the last transmitter memorised to control the theft alarm.If previously the receiver and alarm system were regularly controlled by a transmitter and subsequently another transmitter is memorised with the alarm system key at "OFF", the code of this subsequent transmitter is memorised by the receiver, which regularly operates central door locking, while the code of the first transmitter remains in the control unit.Under these conditions, the alarm system can no longer be controlled by the transmitter, which can only operate door opening/closing.
Simply setting the alarm system key to "ON" and memorising another new transmitter, the problem remains unsolved, as the system can duly memorise a new code only if this has been memorised with the alarm system key at "ON" and in succession after the first transmitter. It is necessary to "open the memory" (as described previously) with the first transmitter, and then correctly enter the other transmitters.

WARNING: It should be noted that each single component of the anti- theft system installed on the car becomes an integral part of it and must not be altered or tested on other cars, even if of the same model.
Therefore, never exchange control units and/or receivers between two vehcicles. If a control unit is replaced, the memorising procedure must be repeated "re-opening" the memory. If a receiver (celing lamp) is changed, simplified programming must be carried out followed by protected programming.

WIRING DIAGRAM A



WIRING DIAGRAM B



(*) only versions without ALFA ROMEO CODE

FUNCTIONAL DESCRIPTION

The anti-theft system is controlled by electronic control unit **N45** integrated with the siren and the emergency key.

The control unit is supplied directly by the battery at pin A3; the key-operated supply reaches pin B12. Through fuse **F1** of fusebox **G1** pin B7 is supplied (blinker supply).

Pin A9 is earthed (**G53b**).

The system activation signal is sent from the receiver **N67** to pin A2 of the control unit; the same **serial connection line** is used to control the volumetric sensors, inserted with the receiver inside the ceiling light.

Through the receiver **N67** door opening/closing is controlled, by means of the door lock control unit **N11** of fusebox **G1** (for further details see "Door locking System").

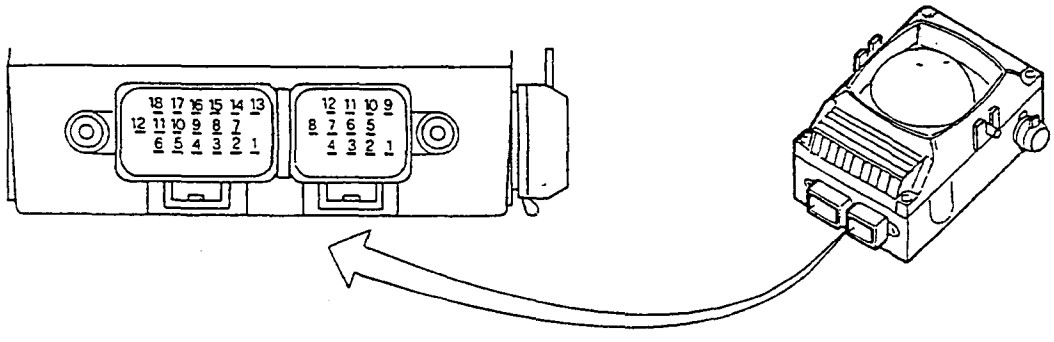
The control unit controls the closing of doors and bonnets via switches **P10**, **P11**, **P12** and **P13** of the doors (which are the same for the door locking device) which send an earth respectively to pins B8, B9, B15 and B16. The bonnet is controlled by switch **H44**, which is connected at pin B18, and the luggage compartment by switch **H24** (the same that turns on the luggage compartment light) which is connected at pin B17.

In addition to the closing of the doors, carried out directly by the receiver **N67**, the control unit activates the blinkers (hazard warning lights flashing) sending an intermittent signal: from pin B1 for the right-hand lights and from pin B2 for the left-hand lights.

Pin A1 of the control unit sends a duty-cycle signal to led **D31** when conditions so require.

ONLY FOR VERSIONS WITHOUT ALFA ROMEO CODE : the anti-theft system "intercepts" the key in the STARTING position signal (pin B6) which is "referred" to the starter motor **A11** (from pin B5) only if the system is **not** in an alarm condition.
In addition, in the case of alarm, the injection control unit supply is inhibited; this supply (12 V) reaches pin B4 and it is "returned" by pin B3 (Boxer 1.3 and 1.6 versions).
Pin A10 sends a specific block signal to the control unit (only Boxer 1.7 16V version).
For further details see the sections concerning engine ignition/injection.
For the TD version, the key-operated supply for the engine stop solenoid valve and glow plugs reaches pin B4, and it is "returned" by pin B3. For further details see "TD engine control devices".

Lastly the system can be connected with the Alfa Romeo Tester through connector **T7**; the diagnosis signal - line K - leaves from pin A6 of the control unit.



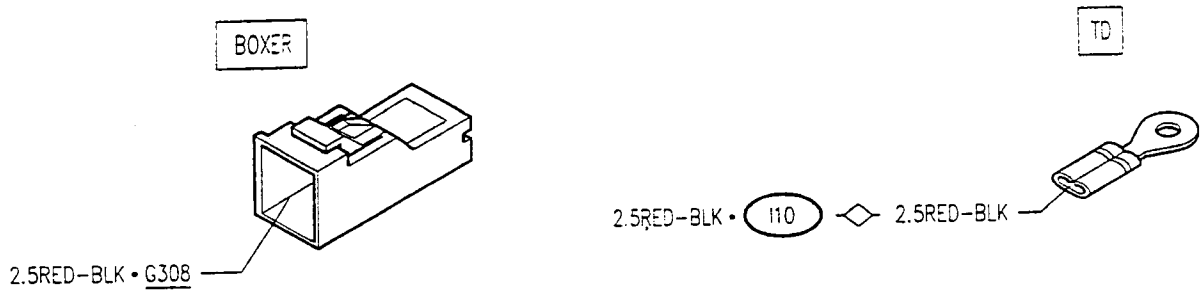
ANTI-THEFT CONTROL UNIT PIN-OUTS

- A1 Signalling led control
- A2 Serial connection line with receiver (ceiling light)
- A3 Direct supply
- A4 N.C.
- A5 N.C.
- A6 Diagnosis line K
- A7 N.C.
- A8 N.C.
- A9 Control unit earth
- (*) A10 Engine control inhibition (only for Boxer 1.7 16v)
- A11 N.C.
- A12 N.C.
- B1 RH direction indicators control
- B2 LH direction indicators control
- (*) B3 Fuel pump/injection supply consensus (Boxer 1.3 and 1.6) - "key-operated" supply for engine electric stop and glow plug warming (TD)
- (*) B4 Fuel pump/injection supply consensus (Boxer 1.3 and 1.6) - "key-operated" supply for engine electric stop and glow plug warming (TD)
- (*) B5 Starter motor supply
- (*) B6 STARTING signal from ignition switch
- B7 Blinker supply
- B8 LH front door open signal
- B9 RH front door open signal
- B10 N.C.
- B11 N.C.
- B12 "Key-operated" supply
- B13 N.C.
- B14 N.C.
- B15 RH rear door pen signal
- B16 LH rear door open signal.
- B17 Tailgate open signal
- B18 Tailgate closed signal

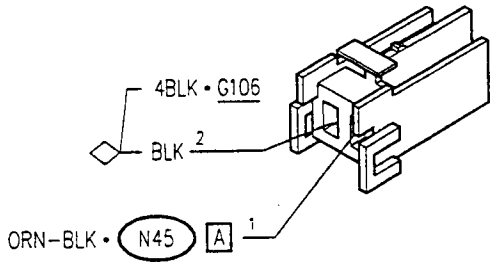
(*) Connected only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS

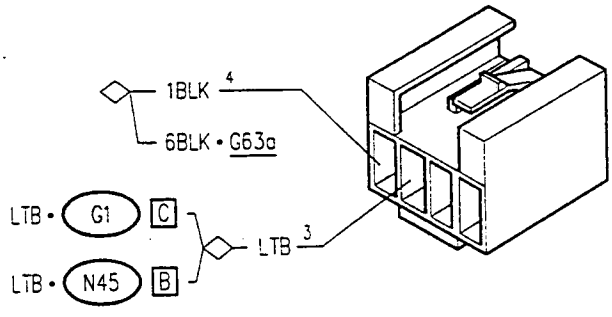
Starter motor (*) — A11



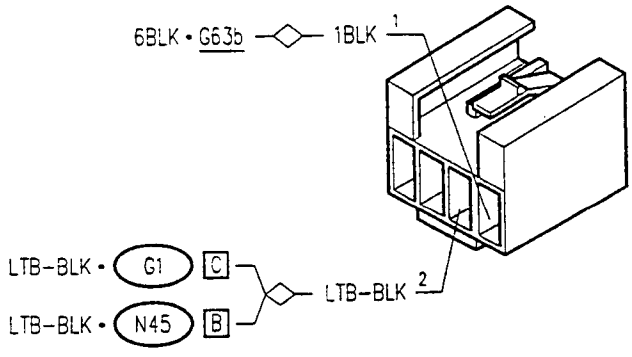
Car alarm led — D31



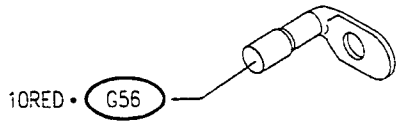
RH rear light — E19 A



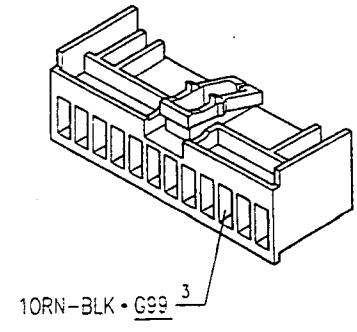
LH rear light — E20 A



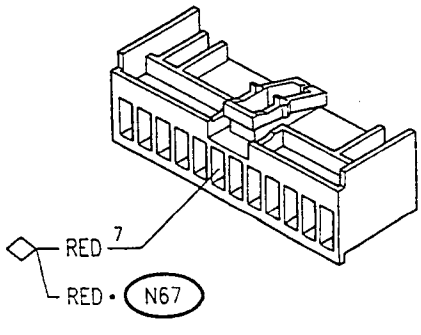
Fusebox — G1



Fusebox — G1 D



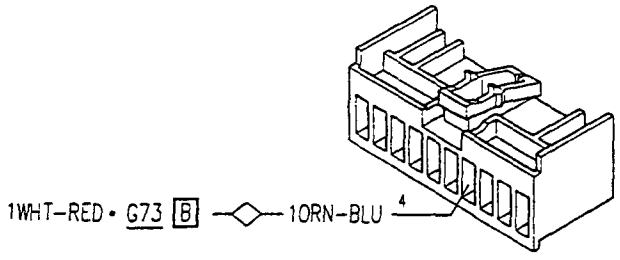
Fusebox — G1 E



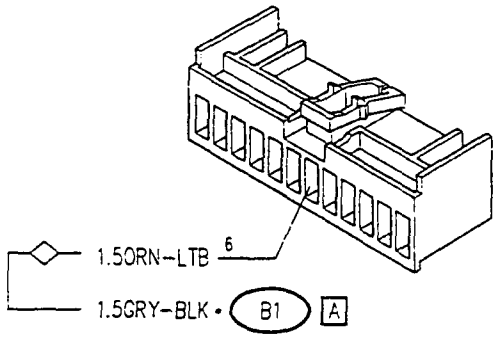
(*) Only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

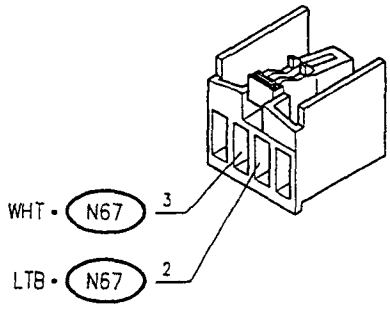
Fusebox	G1 G



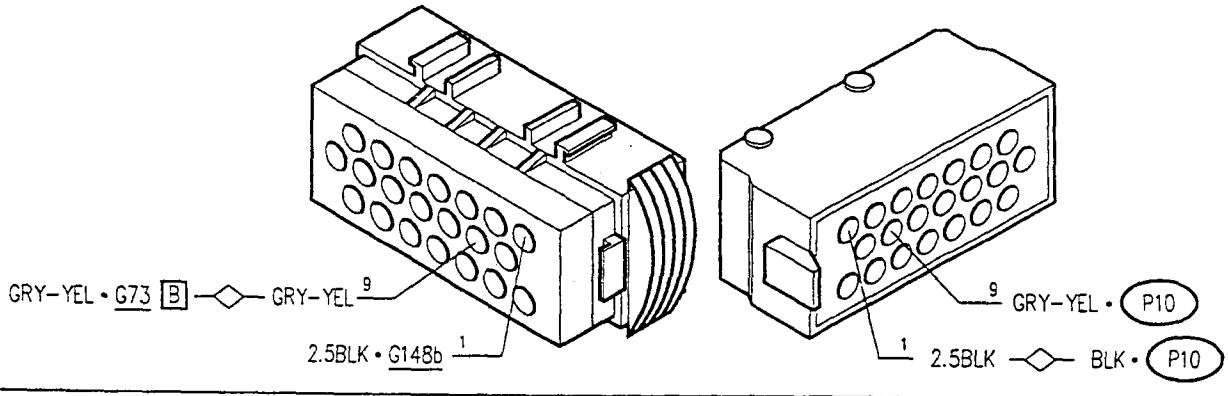
Fusebox	G1 H



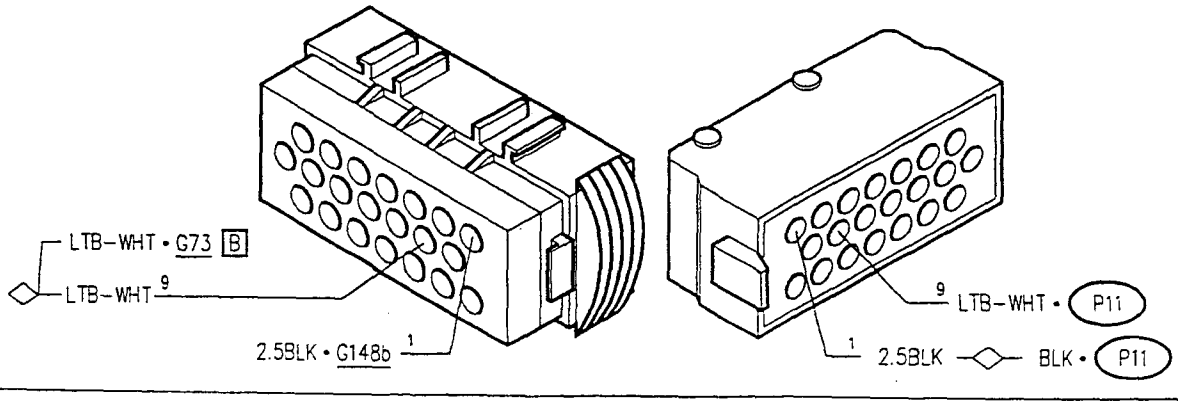
Fusebox	G1 M



RH front door wiring connector	G21

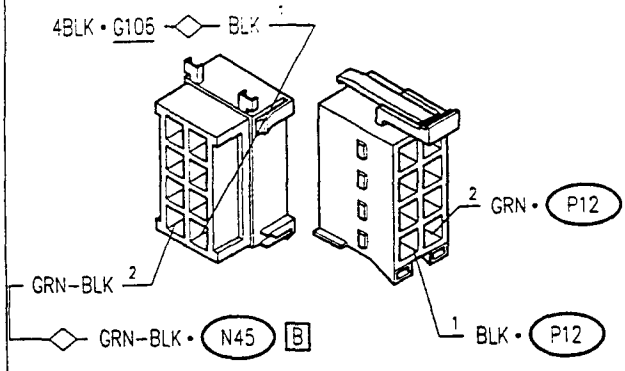


LH front door wiring connector	G23

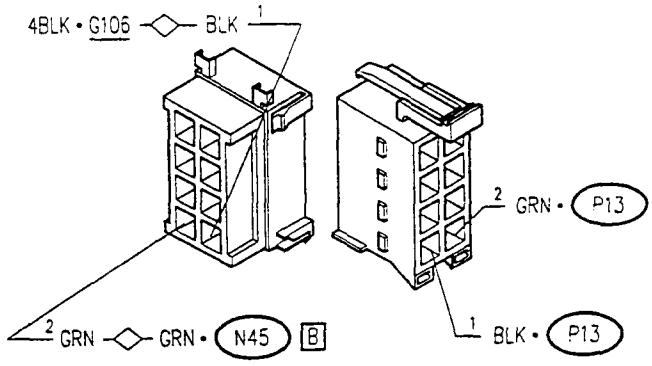


COMPONENTS AND CONNECTORS (cont.d)

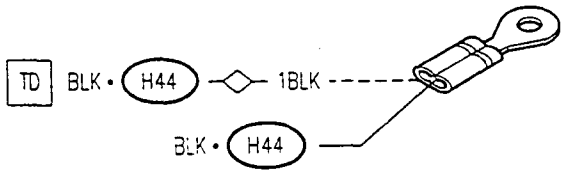
RH rear door wiring connector	G25



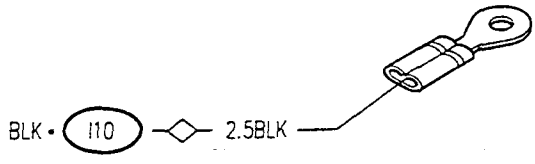
LH rear door wiring connector	G27



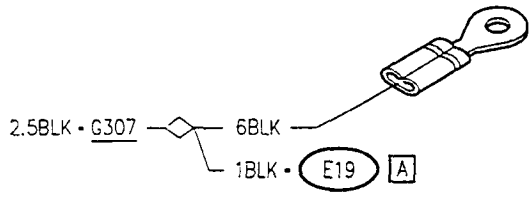
RH engine compartment earth	G53a



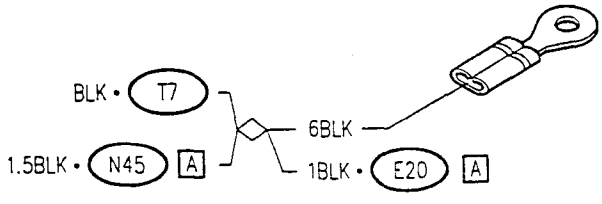
LH engine compartment earth (*)	G53b



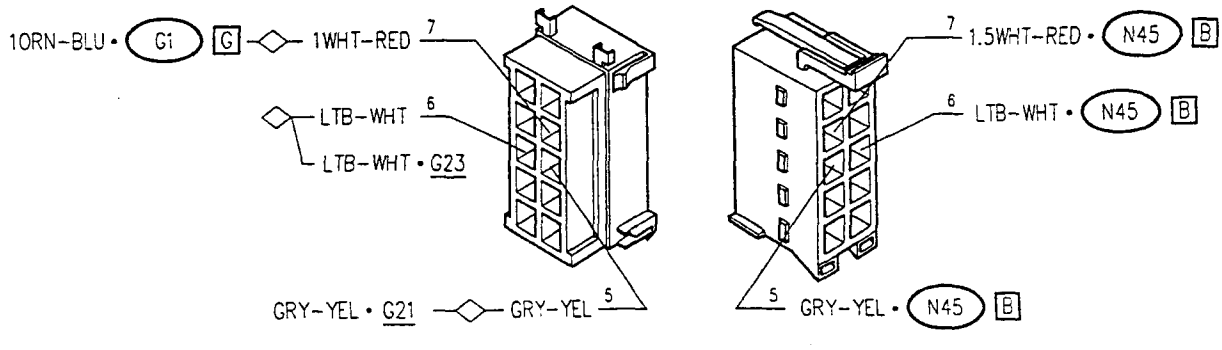
RH rear earth	G63a



LH rear earth	G63b



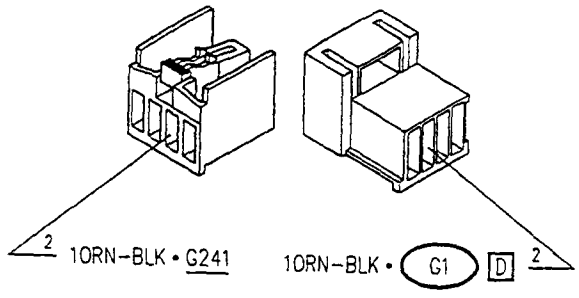
Rear services connector	G73 B

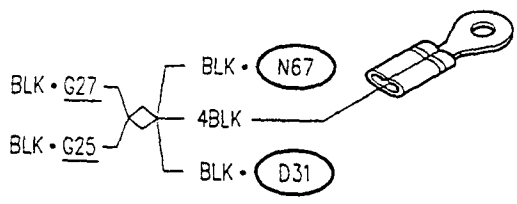


(*) only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

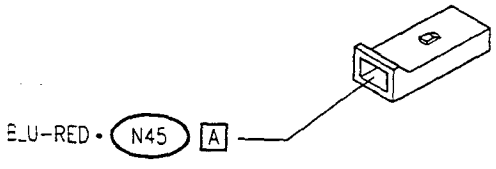
Dashboard/engine wiring connector	G99	Seat crossrail earth	G106



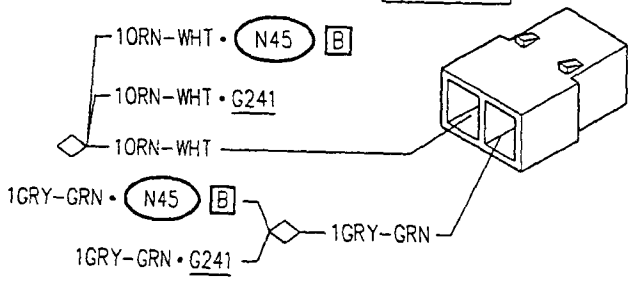


Electr. injection wiring connector C(*)	G133c

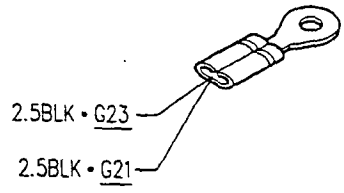
BOXER 1.7 16V



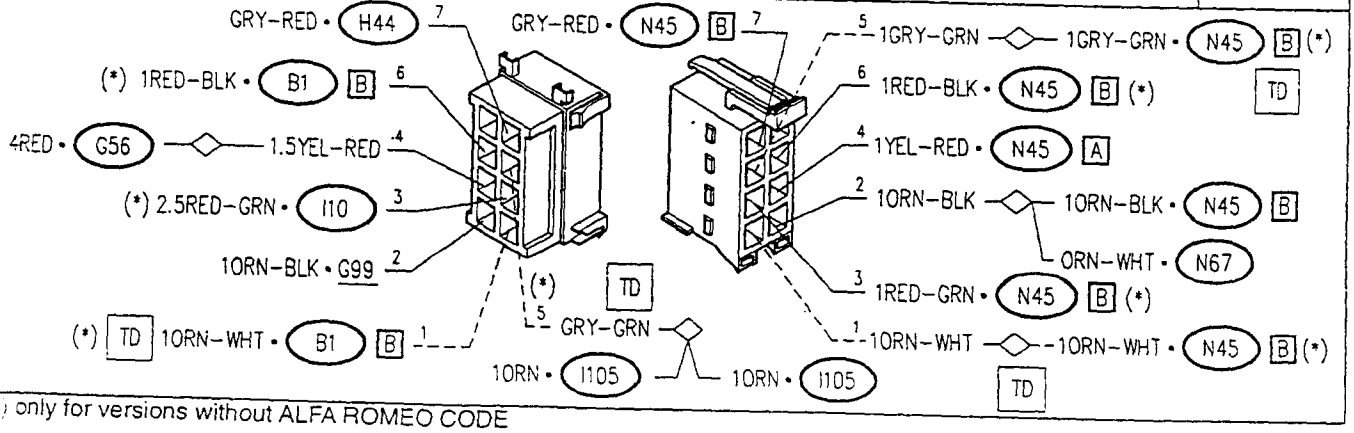
BOXER 1.3
BOXER 1.6



Earth under LH dashboard	G148b



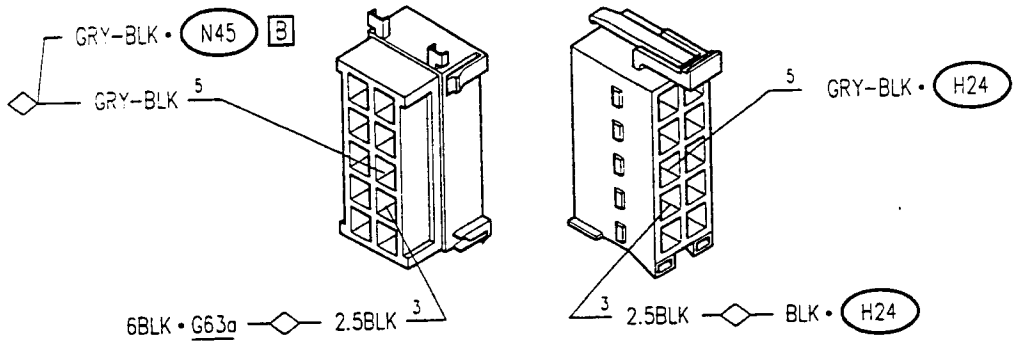
Anti-theft wiring connector	G241



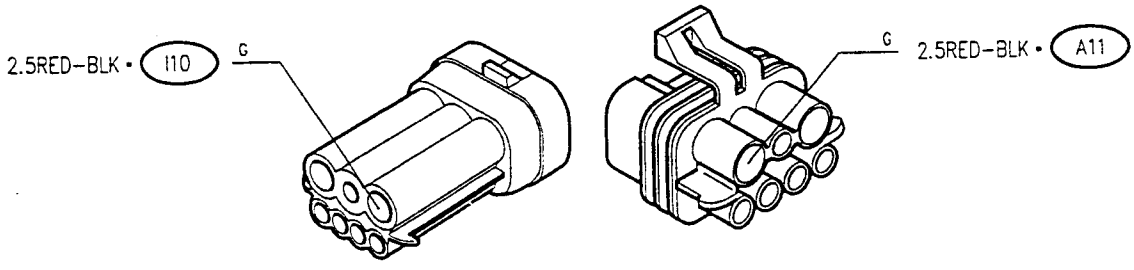
*) only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

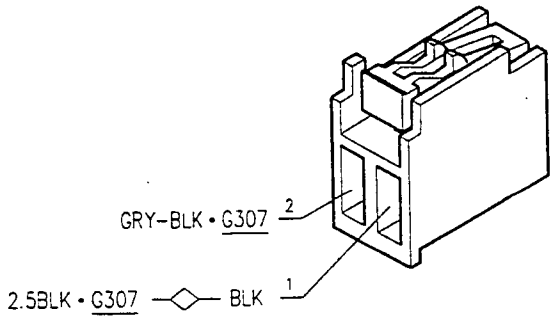
Rear/luggage compt. wiring connector — G307



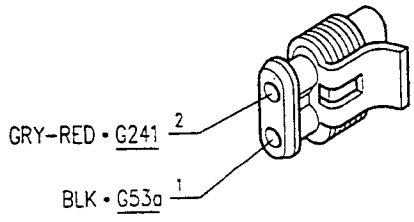
Engine sensors connetor (*) — G308



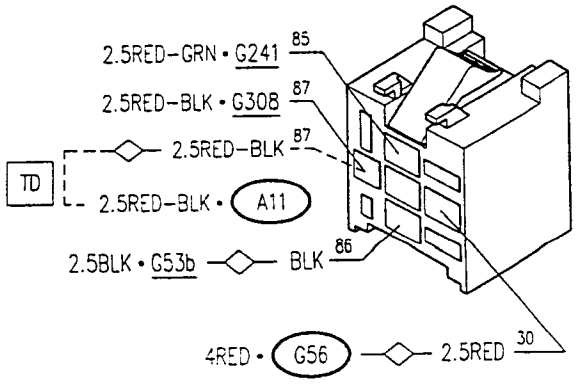
Luggage compartment light switch — H24



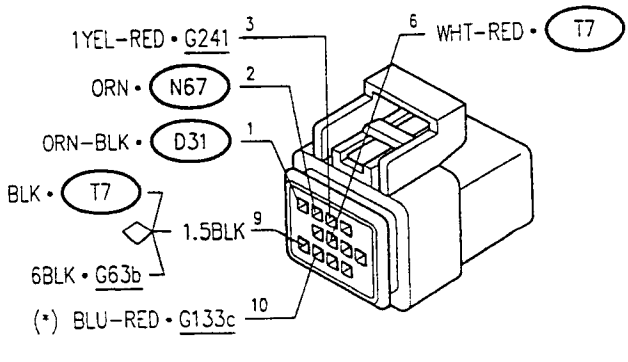
Bonnet anti- theft switch — H44



Starting consensus relay (*) — I10



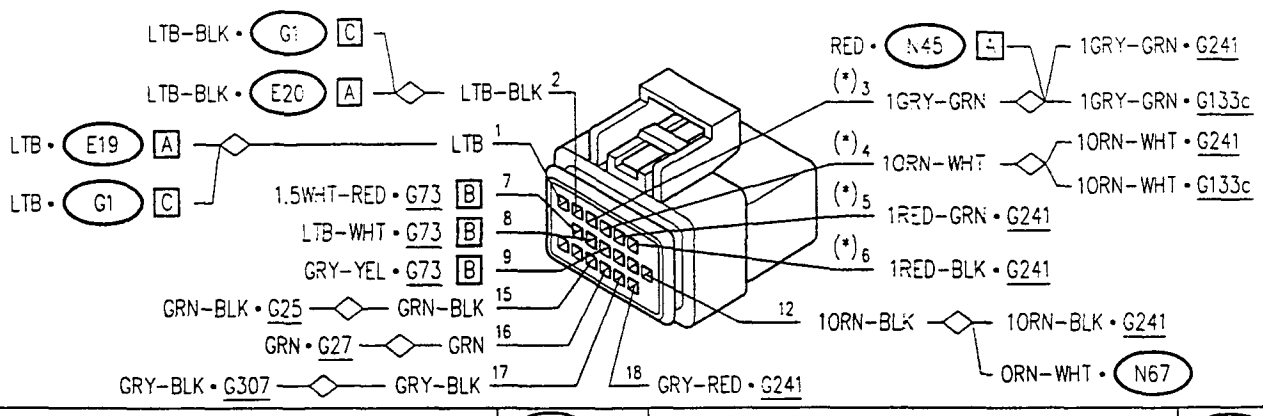
Anti-theft control unit — N45 A



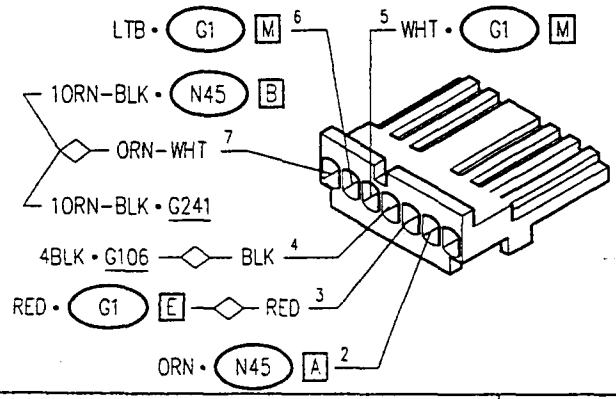
*) only for versions without ALFA ROMEO CODE

COMPONENTS AND CONNECTORS (cont.d)

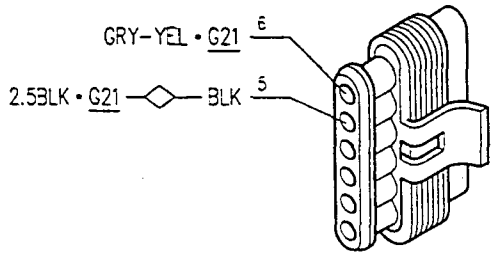
Anti-theft control unit



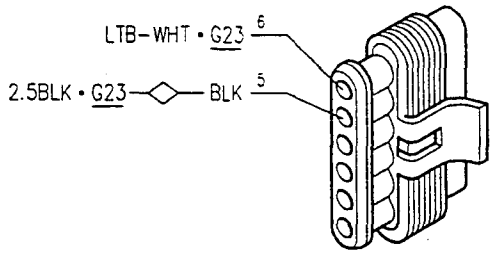
Remote control receiver — N67



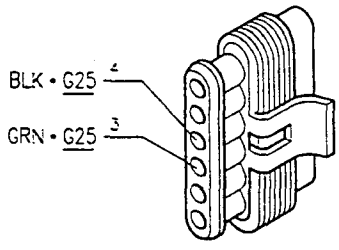
RH front door lock motor — P10



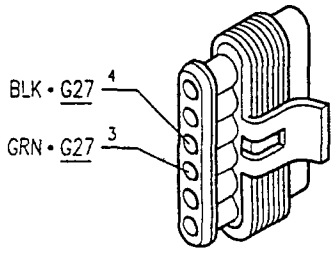
LH front door lock motor — P11



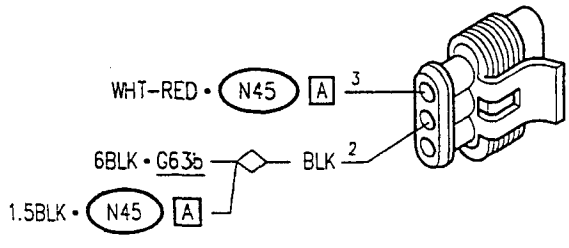
RH reardoor lock motor — P12



LHreardoor lock motor — P13

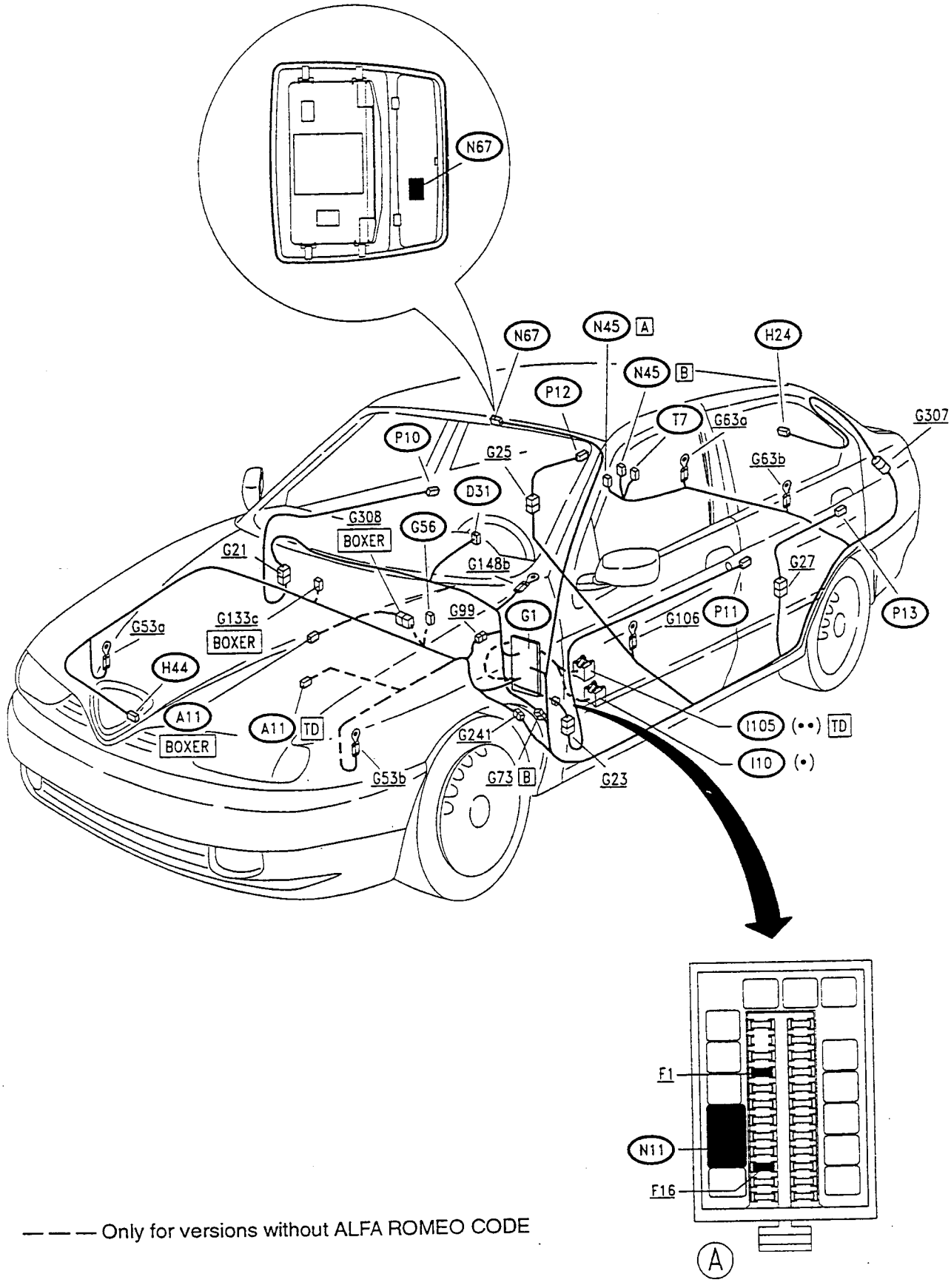


Connector for Alfa Tester (anti-theft) — T7



*) only for versions without ALFA ROMEO CODE

LOCATION OF COMPONENTS



——— Only for versions without ALFA ROMEO CODE

(•) yellow base

(••) grey base

FAULT-FINDING

When the system is activated and deactivated it automatically carries out **SELF-DIAGNOSIS** which reveals certain possible faults by flashing the led as shown below:

ACTIVATION:

Type of led flashing	Meaning	Test procedure
8 Hz, duration 2,5 sec.	Door/bonnet/tailgate left open or faulty switch	Check that doors and bonnets are correctly shut. Activate and deactivate the system. Count the number of flashes of the led and proceed as described in the next table
Fixed light, duration 2,5 sec.	Faulty volumetric sensors.	Check and if necessary change the electronic control unit contained in the front ceiling light. If necessary carry out **test J**
16 Hz, duration 2,5 sec.	Fault in the control unit electronics	Change the control unit N45
No flash	Fault of led	**B**

DEACTIVATION:

No. of Flashes of led	Component with alarm	Test to be carried out
1 Flash	RH front door	**C**
2 Flashes	LH front door	**D**
3 Flashes	RH rear door	**E**
4 Flashes	LH rear door	**F**
5 Flashes	Volumetric sensors on ceiling light	Check and if necessary change the electronic control unit contained in the front ceiling light. If necessary, carry out **test H**
6 Flashes	Bonnet	**G**
7 Flashes	Tailgate	**H**
8 Flashes	Key-operated supply cut off	**A**
9 Flashes	Battery supply cut off	**A**
10 Flashes	At least 3 causes of alarm contemporaneously	Repeat activation/deactivation of the system. If necessary, carry out all the above-mentioned tests.

Lastly, other tests are suggested by failures which can be noted directly and pointed out by the customer.

Fault	Test to be carried out	
Siren not working. Emergency key not working	Change the control unit **N45**	
Warning led not working	**B**	
Anti-theft fails to activate the blinkers(*)	**I**	
Anti-theft fails to activate the door locking device	**J**	
Remote control fails to operate	**K**	
Anti-theft blocks the engine completely (°)	**Boxer 1.7 16v** **Boxer 1.3 and 1.6** **TD**	**L** **M** **N**
Anti-theft blocks the starter motor completely(°)	**P**	

(*) not foreseen for all Markets

(°) WARNING: function present only for versions without ALFA ROMEO CODE.

MANUAL DIAGNOSIS

It is possible to carry out MANUAL DIAGNOSIS, opening the bonnet and turning the ignition key from MARCIA to STOP: within 15 seconds the bonnet pushbutton mmust be pressed 7 times in rapid succession in less than 10 seconds; 5 beeps will then will then be heard signalling the start of manual diagnosis. After 10 seconds the blinkers will flash once (500 ms).

Entering this mode, the self-diagnosis procedure of the volumetric sensors connected to the control unit is started automatically. If the test result is positive the direction indicators will flash 3 times and 3 beeps will be heard from the control unit. After this first check, trigger the various switches of the doors, bonnet and tailgate: each triggering will correspond to a brief flash of the direction indicators and by a beep, accompanied by a flash of the warning LED. When the ignition switch is turned to MARCIA the siren will sound briefly (500 msec.) and the blinkers will flash (2.5 sec.).

This last operation concludes the manual diagnosis procedure. It is also possible to exit MANUAL DIAGNOSIS by not triggering any sensor for 30 seconds: exit from manual diagnosis will be signalled by the turning on of the direction indicators for appr. 2.5 seconds and a beep.

FAULT-FINDING USING THE ALFA ROMEO TESTER

In addition to the above, it is also possible to quickly located any faults connecting to the control unit through the Alfa Romeo Tester using the special cartridge.

N.B.: Beforehand, carry out **TEST A.**

PRELIMINARY CONTROL UNIT CHECK (N45)	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSES – Check the intactness of fuses **F1** and **F16** of fusebox **G1**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Change fuses **F1** and/or **F16**
A2 CHECK VOLTAGE – Check for 12 V at pin A3 of control unit **N45**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore the wiring between pin A3 of **N45** and the branch terminal board
A3 CHECK VOLTAGE – With the ignition key turned, check for 12 V at pin B12 of control unit **N45**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between pin B12 of **N45** and the fusebox **G1**
A4 CHECK EARTH – Check that pin A9 of control unit **N45** is earthed (0 V)	OK ▶ ~~OK~~ ▶	Carry out **step A5** Restore the wiring between pin A9 of **N45** and earth **G63b**
A5 CHECK SERIAL CONNECTION – Check the continuity of the connection between pin A2 of **N45** and pin 2 of receiver **N67**	OK ▶ ~~OK~~ ▶	Carry out **step A6** Restore the wiring between **N67** and **N45**
A6 CHECK CONTINUITY – Check the continuity of the cables: - between pin A6 of **N45** and pin 3 of diagnosis connector **T7** - between pin 2 of **T7** and earth **G63b**	OK ▶ ~~OK~~ ▶	CONNECT TO THE DIAGNOSIS SOCKET T7 AND CONTINUE OPERATIONS WITH THE ALFA TESTER, OR FOLLOW THE INSTRUCTIONS OF THE LED THAT SIGNALS THE RESULTS OF SYSTEM SELF-DIAGNOSIS Restore the wiring between **T7**, **N45** and **G63b**

CHECK WARNING LED (D31) — TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK LED – Disconnect led **D31** and check that it is working (applying for example, 5 V at the terminals)	OK ▶	Carry out **step B2**
	~~OK~~ ▶	Change the led **D31**
B2 CHECK CONTINUITY – Check continuity between: - one of the terminals of led **D31** and earth **G106** - the other terminal of led **D31** and pin A1 of control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between: - **D31** and earth **G106** - **D31** and pin A1 of **N45**

CHECK RH FRONT DOOR CONTACT (P10) — TEST C

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
C1 CHECK DOOR LOCKING DEVICE – Check that the door locking device is working properly, with regard to the RH front door	OK ▶	Carry out **step C2**
	~~OK~~ ▶	Follow the instructions in FAULT-FINDING in the section "DOOR LOCKING SYSTEM"
C2 CHECK EARTH – With the door open, check for 0 V (earth at pin B9 of anti- theft control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between pin B9 of control unit **N45** and door lock **P10**

CHECK LH FRONT DOOR CONTACT (P11) — TEST D

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
D1	CHECK DOOR LOCKING DEVICE		
– Check that the door locking device is working properly, with regard to the LH front door		OK ▶	Carry out **step D2**
		~~OK~~ ▶	Follow the instructions given in FAULT-FINDING of the "DOOR LOCKING DEVICE" section
D2	CHECK EARTH		
– With the door open, check for 0 V (earth at pin B8 of the anti-theft control unit **N45**		OK ▶	Change the control unit **N45**
		~~OK~~ ▶	Restore the wiring between pin B8 of control unit **N45** and the door lock **P11**

CHECK RH REAR DOOR CONTACT (P12) — TEST E

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
E1	CHECK DOOR LOCKING DEVICE		
– Check that the door locking device is working properly, with regard to the rear RHdoor		OK ▶	Carry out **step E2**
		~~OK~~ ▶	Follow the instructions in FAULT-FINDING in the section "DOOR LOCKING SYSTEM"
E2	CHECK EARTH		
– With the door open, check for 0 V (earth at pin B15 of anti- theft control unit **N45**		OK ▶	Change the control unit **N45**
		~~OK~~ ▶	Restore the wiring between pin B15 of control unit **N45** and door lock **P12**

CHECK LH REAR DOOR CONTACT (P13) — TEST F

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
F1 CHECK DOOR LOCKING DEVICE – Check that the door locking device is working properly, with regard to the LH rear door	OK ▶	Carry out **step F2**
	~~OK~~ ▶	Follow the instructions given in FAULT-FINDING of the "DOOR LOCKING DEVICE" section
F2 CHECK EARTH – With the door open, check for 0 V (earth) at pin B16 of the anti-theft control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between pin B16 of control unit **N45** and the door lock **P13**

CHECK BONNET CONTACT (H44) — TEST G

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
G1 CHECK CONTACT – Check the correct fastening of contact **H44** and of the striker on the bonnet	OK ▶	Carry out **step G2**
	~~OK~~ ▶	Fix or change contact **H44** or the corresponding striker
G2 CHECK EARTH – With the bonnet closed (switch pressed), check for an earth on both terminals of switch **H44**	OK ▶	Carry out **step G3**
	~~OK~~ ▶	Restore the wiring between **H44** and earth **G53a**
G3 CHECK EARTH – With the bonnet closed, check for 0 V (earth) at pin B18 of anti-theft control unit **N45**; opening the bonnet (releasing the switch) the signal becomes appr. 12 V	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between switch **H44** and pin B18 of control unit **N45**

CHECK TAILGATE CONTACT (H24) — TEST H

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
H1 CHECK LUGGAGE COMPARTMENT LIGHT – Check that the light turns on when the tailgate is opened **F5**	OK ▶	Carry out **step H2**
	~~OK~~ ▶	Follow the instructions given in FAULT-FINDING in the "CEILING LIGHTS" section
H2 CHECK EARTH – With the tailgate open, check for 0 V (earth at pin B17 of anti-theft control unit **N45**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore the wiring between contact **H24** and pin B17 of control unit **N45**

THE ANTI-THEFT SYSTEM DOES NOT FLASH THE BLINKERS — TEST I

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
I1 CHECK OPERATION OF BLINKERS – Check that the hazard warning lights (blinkers) are working properly when activated manually	OK ▶	Carry out **step I2**
	~~OK~~ ▶	Follow the instructions in FAULT-FINDING of the "DIRECTION INDICATORS AND HAZARD WARNING LIGHTS" section
I2 CHECK VOLTAGE – Check for 12V at pin B7 of **N45**	OK ▶	Carry out **step I3**
	~~OK~~ ▶	Restore the wiring between **N45** and **G1**
I3 CHECK CONTINUITY – Check continuity between: - pin B1 of control unit **N45** and the right rear light **E19** - pin B2 of **N45** and the left rear light **E20**	OK ▶	Change the control unit **N45**
	~~OK~~ ▶	Restore any faulty wiring

THE ANTI-THEFT FAILS TO OPERATE THE DOOR LOCKS — TEST J

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
J1 CHECK OPERATION OF THE DOOR LOCKING DEVICE – Check that the door locking device is working properly engaging the key in the door locks	OK ▶	Carry out **step J2**
	~~OK~~ ▶	Follow the instructions in FAULT-FINDING of the "DOOR LOCKING DEVICE" section
J2 CHECK CONTINUITY – Check the continuity of the cables between fusebox **G1** - pin 3 and 2 of connector M - and receiver **N67** - pin 5 and 6 respectively	OK ▶	Check the connection between receiver **N67** and the anti- theft control unit **N45** (pin A2)
	~~OK~~ ▶	Restore the wiring

REMOTE CONTROL NOT WORKING — TEST K

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
K1 CHECK REMOTE CONTROL – Check that the remote control is working properly: pressing the button the led should turn on	OK ▶	Carry out **step K2**
	~~OK~~ ▶	Check the transmitter batteries. If necessary change the transmitter. **N.B.** In this case it will be necessary to reprogramme the whole system (see "Programming the transmitter")
K2 CHECK RECEIVER – Check that the receiver is working properly: pressing the button of the transmitter suitably pointed at the receiver **N67** the receiver led should light up to indicate that the signal has been received	OK ▶	Carry out **step K2**
	~~OK~~ ▶	**Change the trnsmitter N67** located in the front ceiling light
K3 CHECK FUSE – Check the intactness of fuse **F16** of fusebox **G1**	OK ▶	Carry out **step K4**
	~~OK~~ ▶	**Change the fuse F16**
K4 CHECK VOLTAGE – Check for 12 V "direct" at pin 3 of **N67** and 12 V "key-operated" at pin 7 of **N67**	OK ▶	Carry out **step K2**
	~~OK~~ ▶	Restore the wiring between **N67** and fusebox **G1**
K5 CHECK EARTH – Check that pin 4 of **N67** is earthed	OK ▶	Change the receiver **N67**
	~~OK~~ ▶	Restore the connection between **N67** and earth **G63b**

THE ANTI-THEFT BLOCKS THE ENGINE COMPLETELY (Boxer 1.7 16v) (*) — TESTL

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
L1 CHECK EARTH SIGNAL – With the ignition key at MARCIA and the anti-theft deactivated, check for 0 V at pin A10 of control unit **N45**; if the anti-theft "alarms" the signal becomes "high" (appr. 12 V)	OK ▶	Restore the wiring between pin A10 of **N45** and the Motronic system (pin 47 of control unit **S11**) (For further details see the section "Motronic M2.10.1")
	~~OK~~ ▶	Change the control unit **N45**

THE ANTI-THEFT BLOCKS THE ENGINE COMPLETELY (Boxer 1.3 and 1.6) (*) — TEST M

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
M1 CHECK VOLTAGE – With the ignition key at MARCIA and the anti-theft deactivated, check for 12 V at pin B3 of control unit **N45**	OK ▶	Carry out **step M2**
	~~OK~~ ▶	Restore the wiring between pin B3 of **N45** and the injection system (pin 86 of relay **I29** for Boxer 1.3 - pin 20 of control unit **S11** for Boxer 1.6)
M2 CHECK VOLTAGE – With the ignition key at MARCIA and the anti-theft deactivated, check for 12 V at pin B4 of control unit **N45**	OK ▶	Restore the wiring between pin B4 of **N45** and the injection system (pin 1 of connector **G133a** for Boxer 1.3 - pin 85 of relay **S12a** for Boxer 1.6) (For further details see the corresponding sections "IAW" and "Motronic MP3.1")
	~~OK~~ ▶	Change the control unit **N45**

(*) **Warning:** this function is active only for versions without ALFA ROMEO CODE.

THE ANTI-THEFT BLOCKS THE ENGINE COMOMPLETELY (TD version) (*)	TEST N

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
N1	CHECK VOLTAGE – With the ignition key at MARCIA, check for 12 V at pin B4 of control unit **N45**	OK ▶	Carry out **step N2**
		~~OK~~ ▶	Restore the wiring between pin B4 of **N45** and the ignition switch **B1**
N2	CHECK VOLTAGE – With the ignition key at MARCIA, and anti-theft deactivated check for 12 V at pin B3 of control unit **N45**	OK ▶	Restore the wiring between pin B3 of **N45** and the relay for the diesel engine control devices **I105** (see the section "DIESEL ENGINE CONTROL DEVICES")
		~~OK~~ ▶	Change the control unit **N45**

THE ANTI-THEFT BLOCKS THE STARTER MOTOR COMPLETELY (*)	TEST P

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
P1	CHECK VOLTAGE – With the key at START, check for 12V at pin B6 of control unit **N45**	OK ▶	Carry out **step P2**
		~~OK~~ ▶	Restore the wiring between pin B6 of **N45** and the ignition switch **B1**
P2	CHECK VOLTAGE – With the key turned to START and the anti-theft deactivated, check for 12 V at pin B5 di **N45**	OK ▶	Check that the starter motor **A11** is working properly with the corresponding supply cables: if necessary also check the starting consensus relay **I10**: see the section "STARTING AND RECHARGING"
		~~OK~~ ▶	Change the control unit **N45**

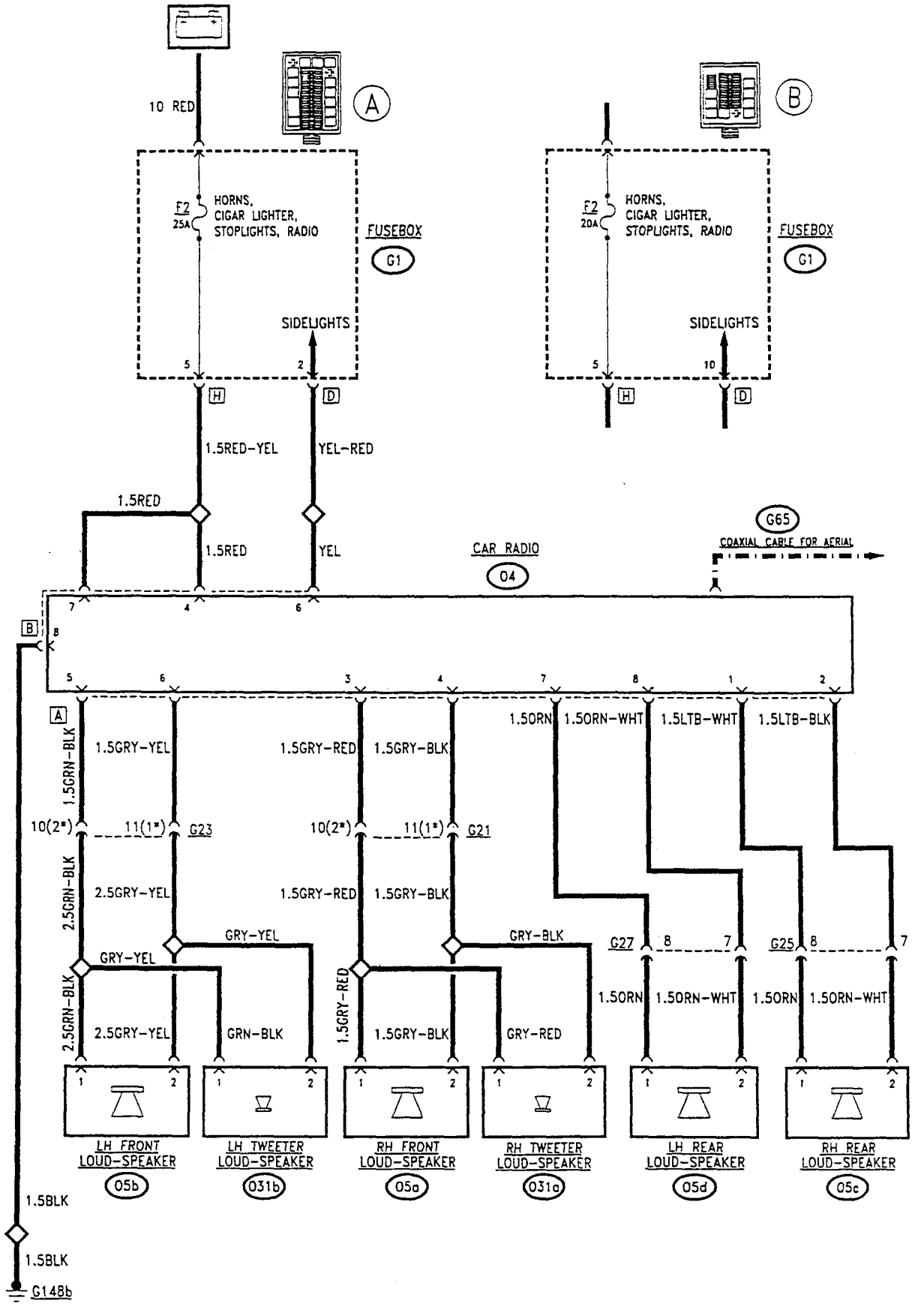
(*) **Warning:** this function is active only for versions without ALFA ROMEO CODE.

CAR RADIO

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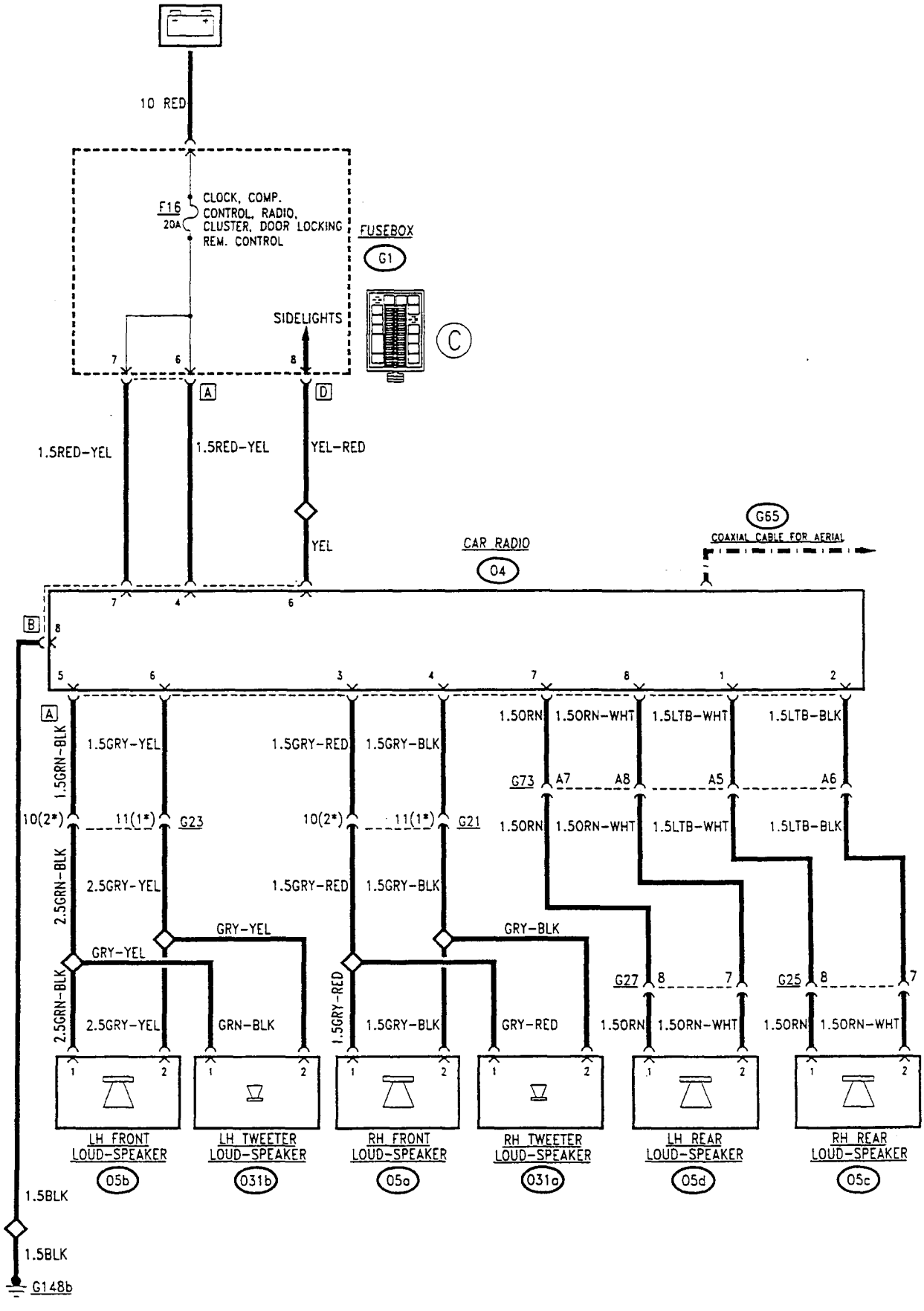
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FAULTFINDING TABLE 19-8
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WIRING DIAGRAM



(*) variant for cars without power windows and central door locking/antitheft device

WIRING DIAGRAM



(*) variant for cars without power windows and central door locking/antitheft device

GENERAL DESCRIPTION

The car is pre-wired for the installation of a car radio system complete with six speakers.
Upon request a fixed radio is supplied with two front speakers 165 mm in diameter with 2 separate tweeters, and two rear two-way speakers 130 mm in diameter.
The front speakers are located at the sides in the lower part of the front doors, with the tweeters on the pillar, while the rear speakers are the centre of the rear doors
The aerial is a "stylus" type fitted on the roof panel and it is connected to the radio by a coaxial cable.

The radio is supplied directly from the battery; this makes it possible to memorise tuning, safety codes, etc. in the radio set.

An anti-disturbance condenser has also been fitted inside the stop lights switch **H3** to ensure "electronic silencing" towards the electric services that might interfere on the radio circuit.

The fixed radio is installed during production: it is a **PHILIPS DC 710/255** radio with RDS decoder and cassette player; the radio has a removable front panel to protect against theft and an internal security code for further protection. All the details about the features of the radio and how it works are described in the Instructions Handbook supplied with it.

FUNCTIONAL DESCRIPTION

The radio **O4** is supplied directly by battery current via fuse **F2** (**F16** for box "C") of fusebox **G1**: the supply for memory storage, etc. reaches pin 4 of connector B, while the power supply for operating the radio reaches pin 7 of the same connector.

Pin 8 of connector B is earthed.

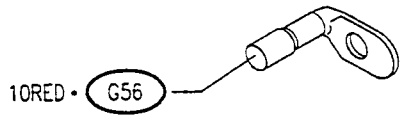
The "side lights on" signal reaches pin 6.

The cables carrying the signals lead from connector A of **O4** to the six speakers.

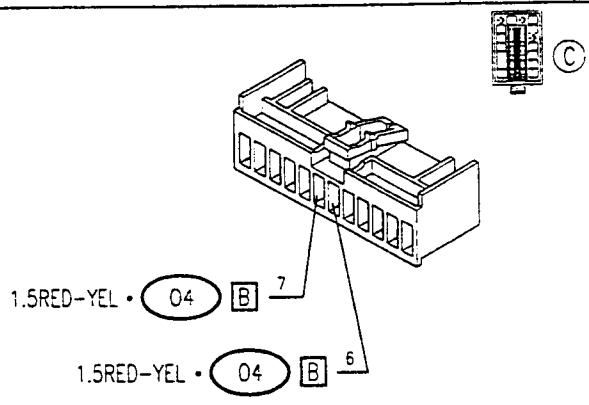
The aerial is connected to the radio via the special screened coaxial cable **G65**.

COMPONENTS AND CONNECTORS

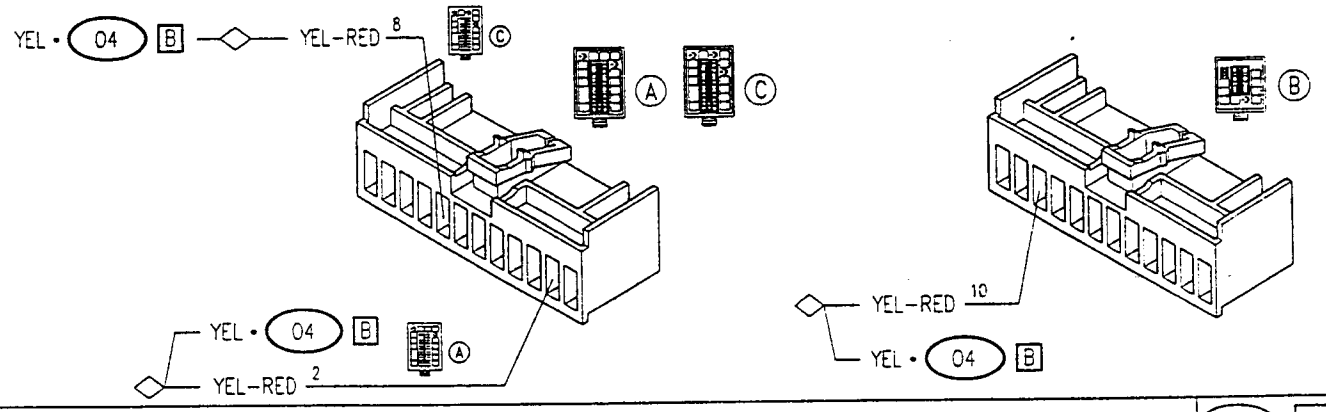
Fusebox	G1



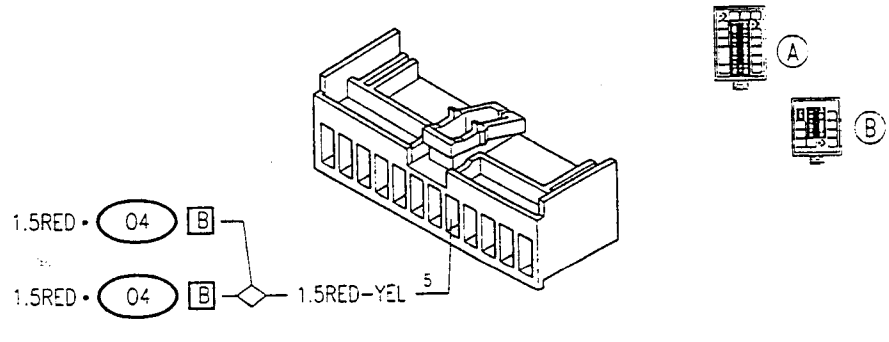
Fusebox	G1 A



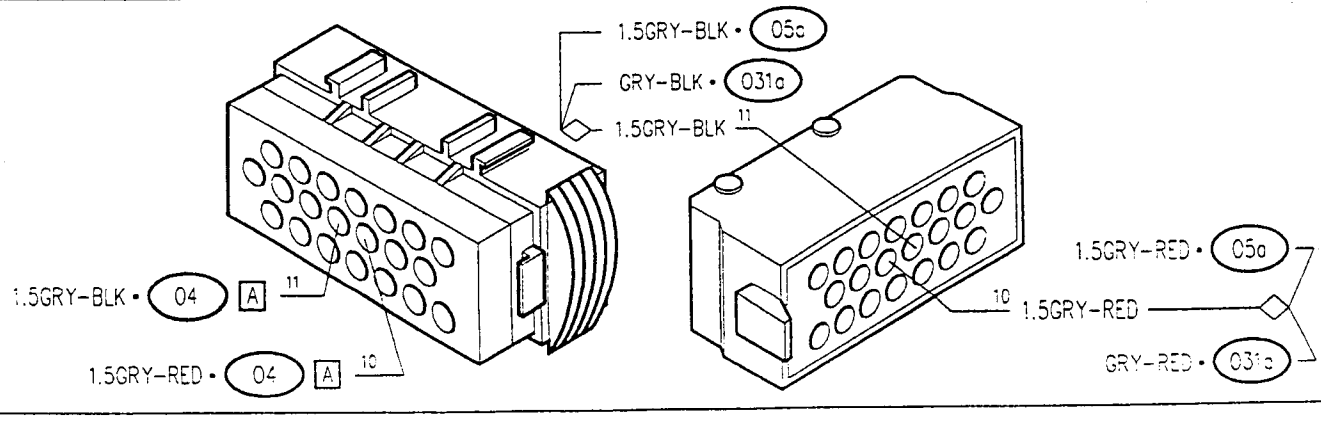
Fusebox	G1 D



Fusebox	G1 H

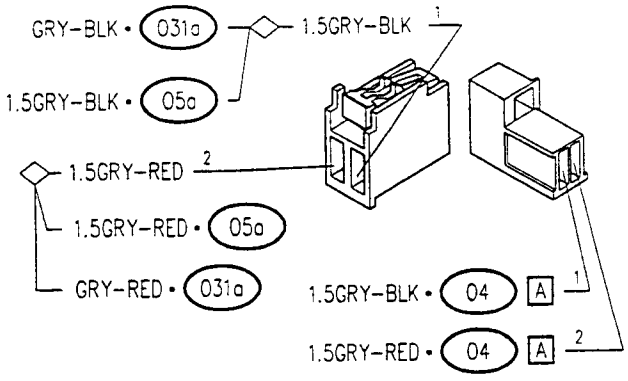


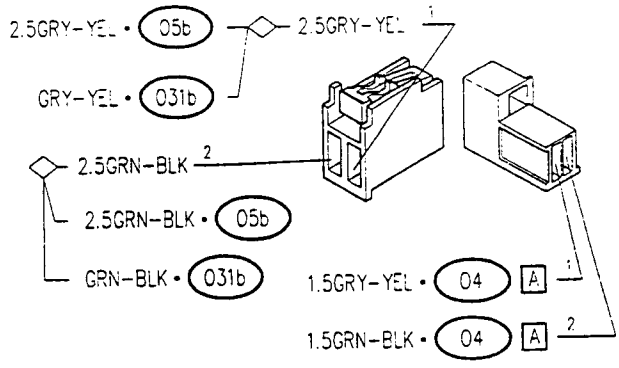
RH front door wiring connector	G21



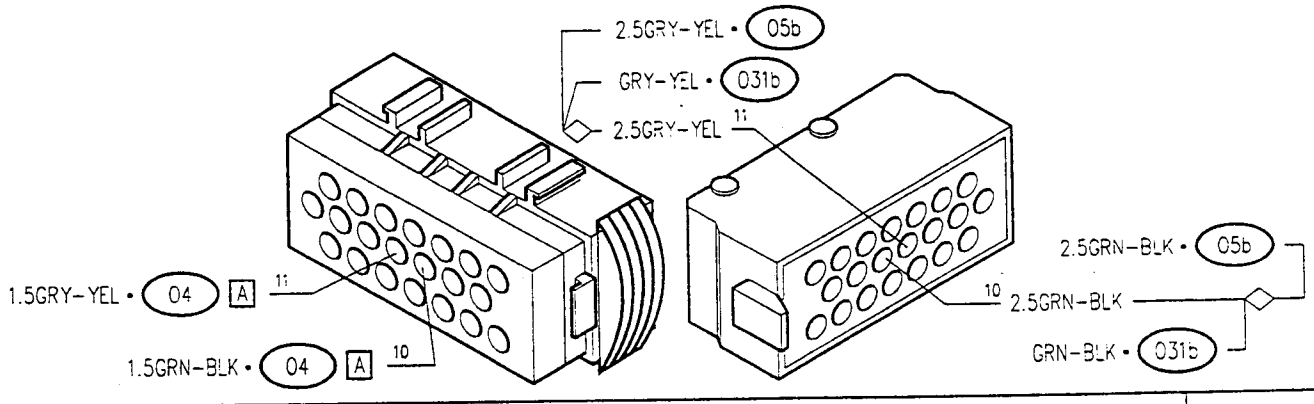
COMPONENTS AND CONNECTORS (cont.d)

RH front door wiring connector (*)	G21	LH front door wiring connector (*)	G23

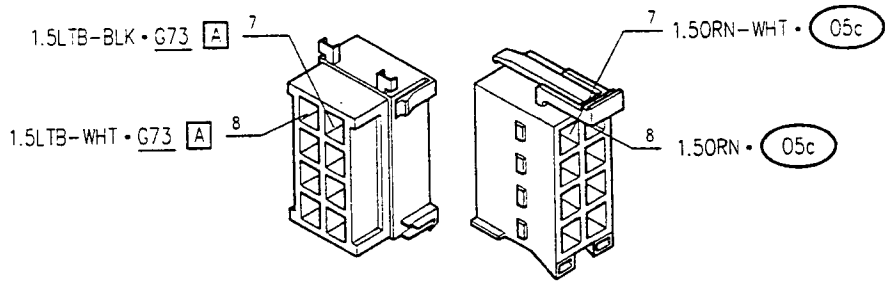




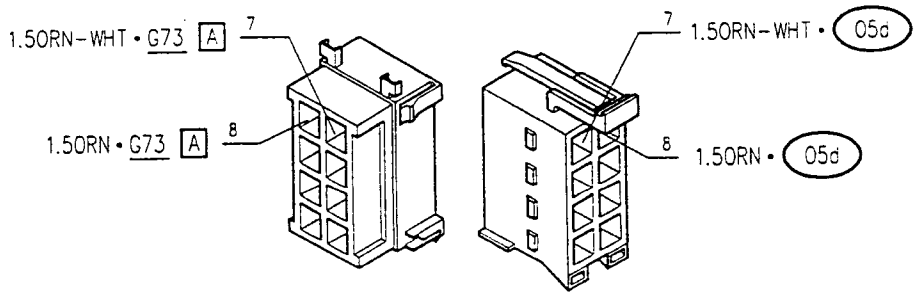
LH front door wiring connector	G23



RH rear door wiring connector	G25



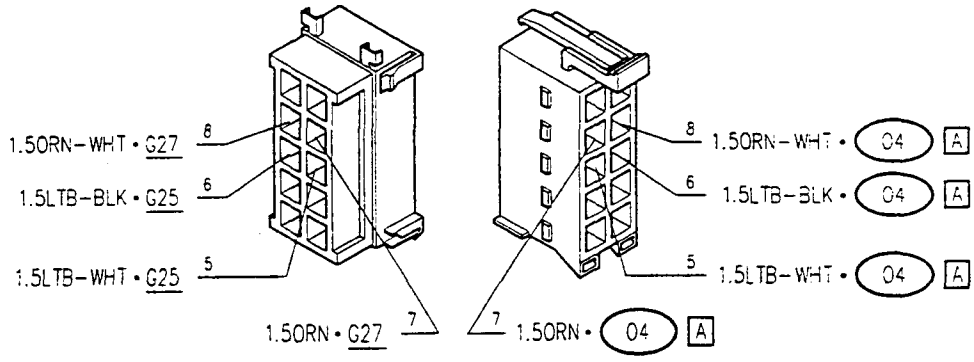
LH rear door wiring connector	G27



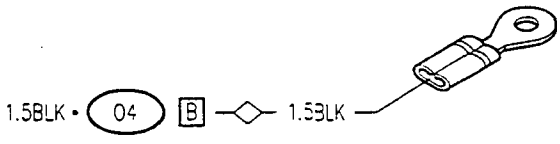
(*) variant for cars without power windows and central door lock/antitheft device

COMPONENTS AND CONNECTORS (cont.d)

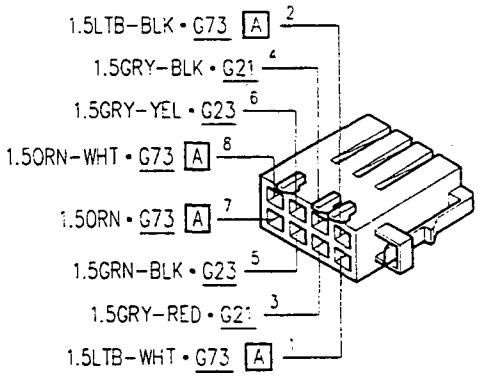
Rear services connector — G73 A



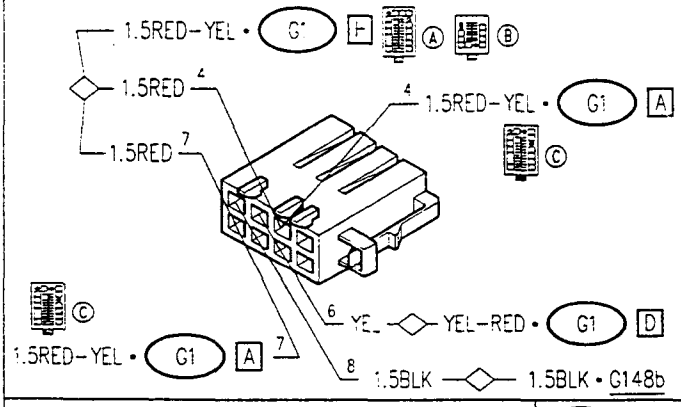
Earth under LH dashboard — G148b



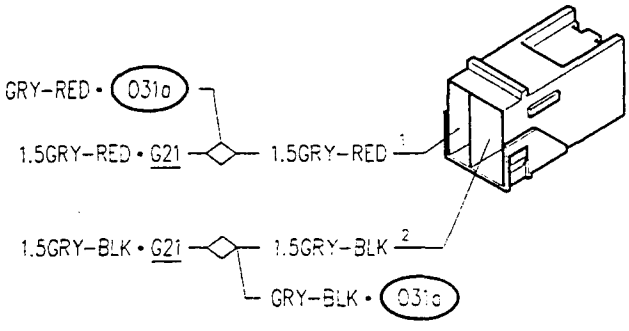
Car radio — O4 A



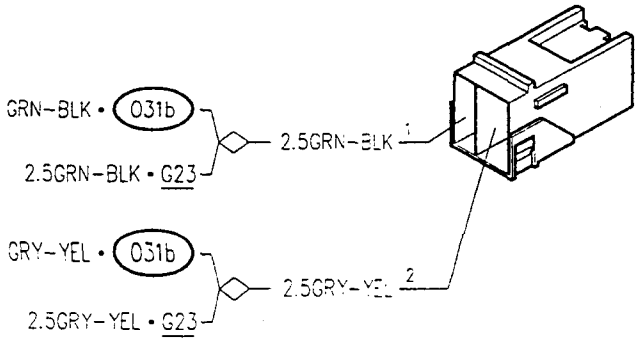
Car radio — O4 B



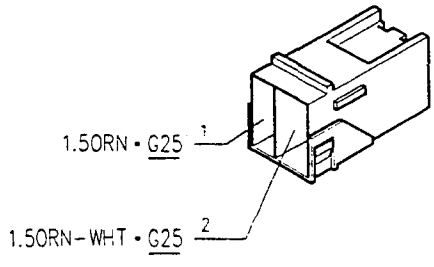
RH front speaker — O5a



LH front speaker — O5b

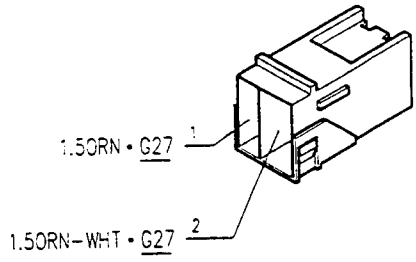


RH rear speaker — O5c

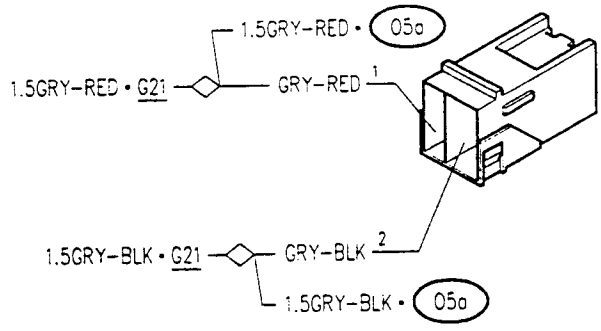


COMPONENTS AND CONNECTORS (cont.d)

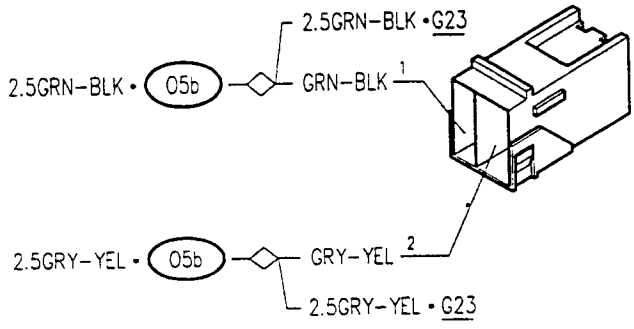
LH rear speaker	O5d



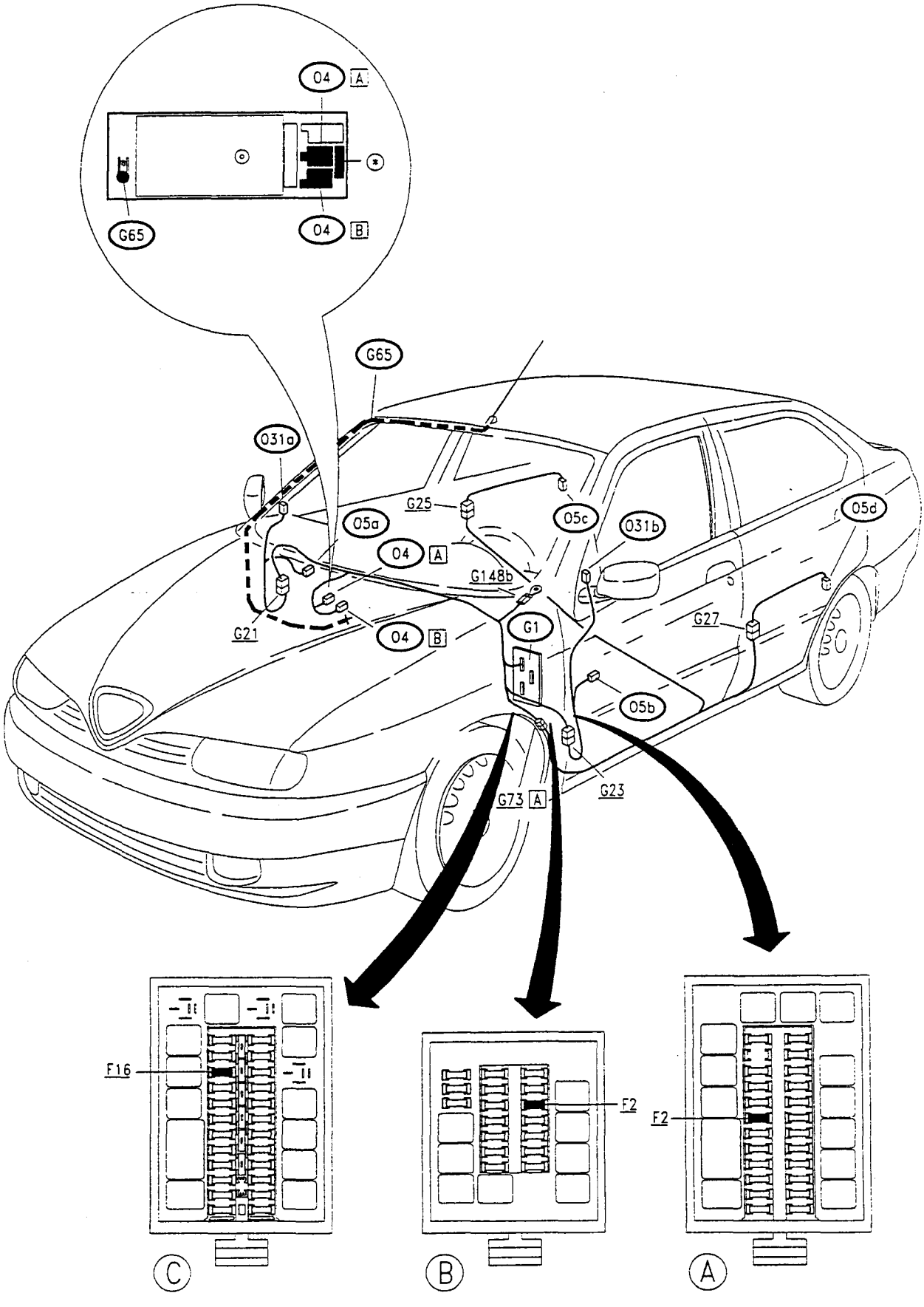
RH Tweeter speaker	O31a



LH Tweeter speaker	O31b



LOCATION OF COMPONENTS



(*) Extra fuse (10A) behind the radio (O4)

FAULTFINDING TABLE

Failure	Component to be checked									
	F2	F15	O4	O5a-O31a	O5b-O31b	O5c	O5d	G65	H3
Radio power failure (1)	•	•	•						
Poor reception			•					•	
RH front tweeter/speaker not working			•	•					
LH front speaker/tweeter not working			•		•				
RH rear speaker not working			•			•			
LH rear speaker not working			•				•		
Disturbance from other electric services (2)									•

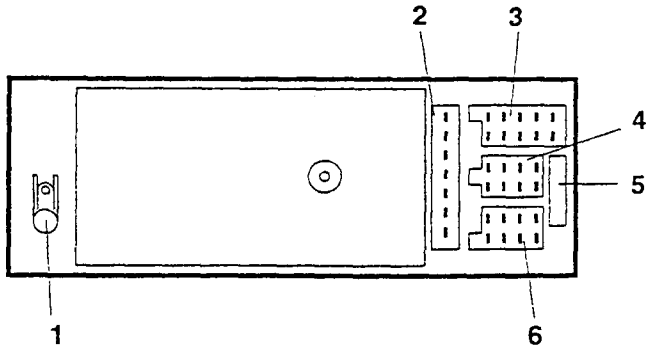
(1) **PHILIPS DC731** car radio, also check that the extra fuse (10A) on the rear of the radio is intact; change it if necessary.

(2) If there is a hissing noise or other signs of malfunctioning of the speakers when the stop lights are operated, check that the wiring is correctly connected and that the anti-disturbance condenser in switch **H3** is working properly (see the "Stop lights" section).

CHECKING COMPONENTS

Car radio (O4)

PHILIPS DC710/255 CAR RADIO: If any specific functions or devices of the radio itself are not working, consult the "Instructions Handbook" provided with it.



view of connectors side

1 - connection socket for aerial coaxial cable **G65**

2 - connector not connected

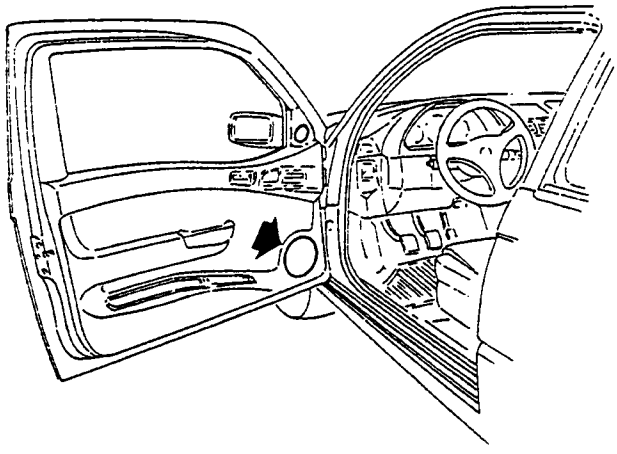
3 - connector not connected

4 - connector (O4) [A]

5 - extra fuse (10A)

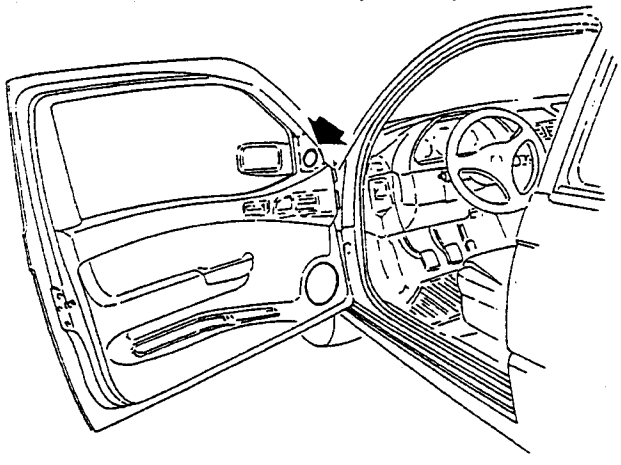
6 - connector (O4) [B]

Front speaker (O5a) - (O5b)



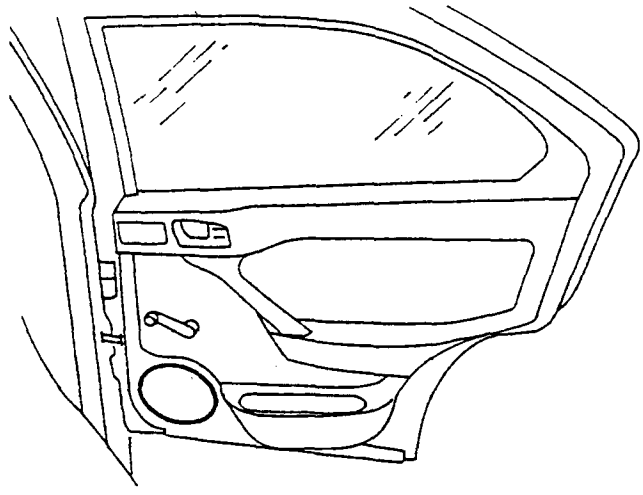
SPECIFICATIONS	
Passband	70 ÷ 12000 Hz
Resonance frequency	70 ± 12 Hz
Nominal impedance	4 ± 20% Ω
Induction	0.72 ± 7% T
RMS Power (DIN 45573)	20 W
Weight	430 ± 10% g.
ø of speaker	165 mm

Front Tweeter (O31a) - (O31b)



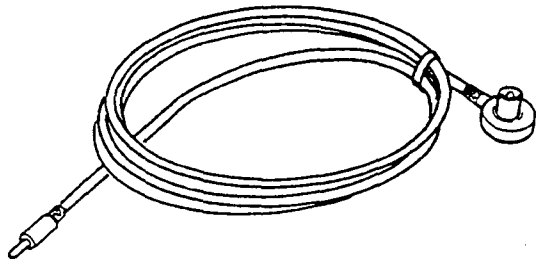
SPECIFICATIONS	
Passband	5000 ÷ 20000 Hz
Resonance frequency	2500 ± 600 Hz
Nominal impedance	4 ± 20% Ω
Induction	1.06 ± 7% T
RMS power (DIN 45573)	30 W
Weight	55 ± 15% g.
Type of crossover	3.3 µF
Crossover frequency	5000 Hz
Type of tweeter	DOME

Rear speaker (O5c) - (O5d)



SPECIFICATIONS	
Passband	105 ÷ 20000 Hz
Resonance frequency	105 ± 22 Hz
Nominal impedance	4 ± 20% Ω
Induction	1 ± 7% T
RMS power (DIN 45573)	20 W
Weight	375 ± 5% g.
ø of speaker	130 mm
Type of tweeter	PIEZO

Aerial coaxial cable (G65)



SPECIFICATIONS	
Total resistance (between plug and socket screens)	< 95 mΩ
Internal conductor resistance	≤ 2.2 Ω
Total capacity (measured on plug at 1 MHz)	103 ± 15% pF

CHECK PANEL

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Functional Description 18-10/2
Components and Connectors 18-10/2
Location of Components 18-12
FAULT-FINDING TABLE 18-13

GENERAL DESCRIPTION

The Check Panel display located in the centre of the dashboard integrates the indications of the instrument cluster with certain indicators and operating switches:

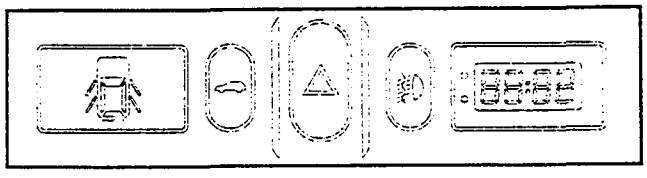
- doors open indicator
- luggage compartment opening switch
- hazard warning light switch (blinker)
- foglamp switch
- digital clock

This section describes the following functions

- **DOORS OPEN INDICATOR,**
- **CLOCK,**

while for the switches, reference should be made to the sections to which they belong, i.e.:

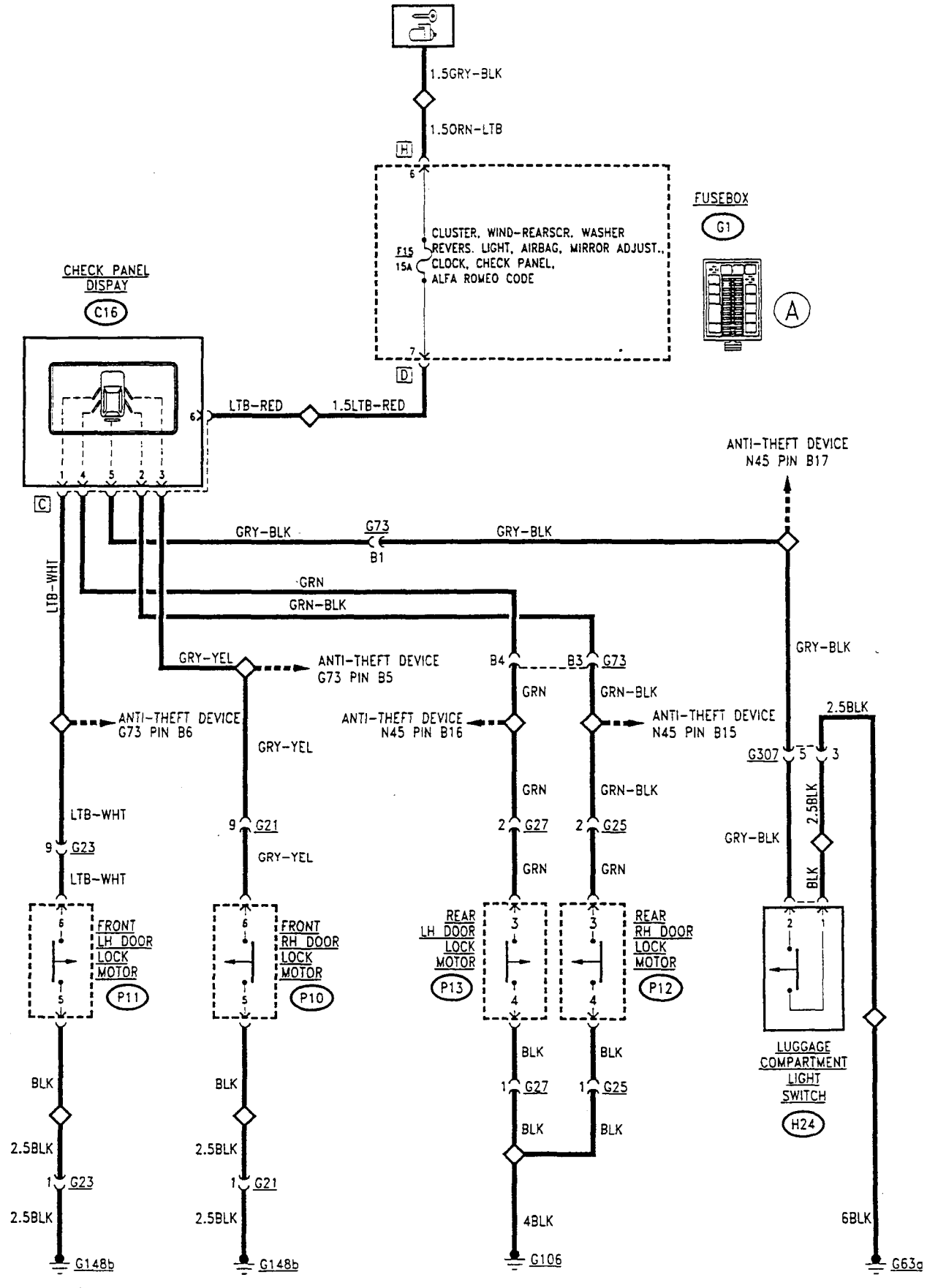
- luggage compartment opening switch: see section "Luggage compartment opening control"
- hazard warning light switch: see section: "Direction indicators and hazard warning lights"
- Foglamp switch: see section " Foglamps and rear fog guards".



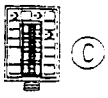
N.B.: Not all versions possess all these functions.

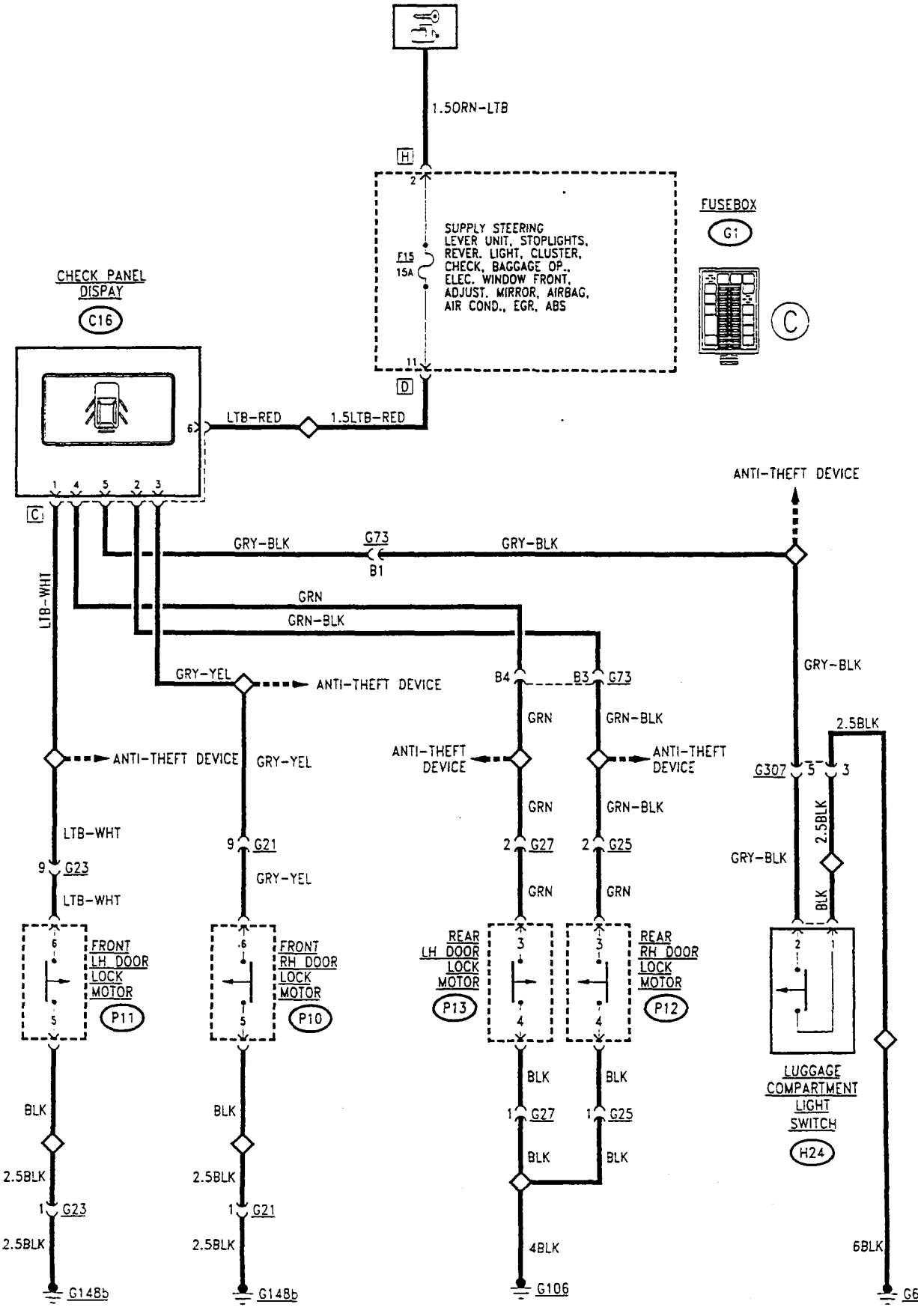
DOORS OPEN INDICATOR

Wiring Diagram



Wiring Diagram





Functional Description

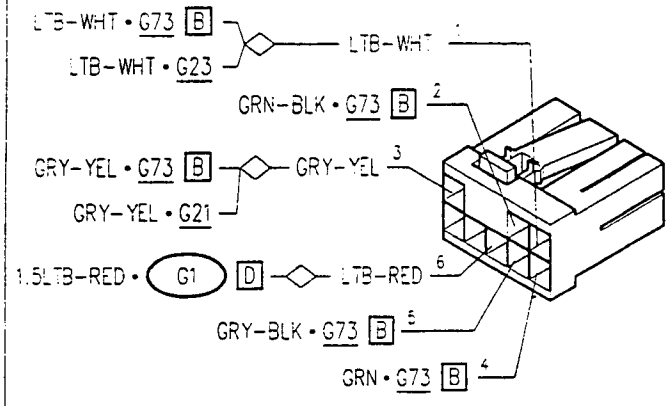
The door locking device **P10**, **P11**, **P12** and **P13** located on each door in correspondence of the lock, also contains a microswitch which closes when the door is open, thereby sending an earth signal to the display **C16** at pins 1 and 4 respectively of connector C.

In a similar way switch **H24**, which turns on the light in the luggage compartment, closes when the tailgate is open, sending an earth to the display **C16** at pin 5 of connector C.

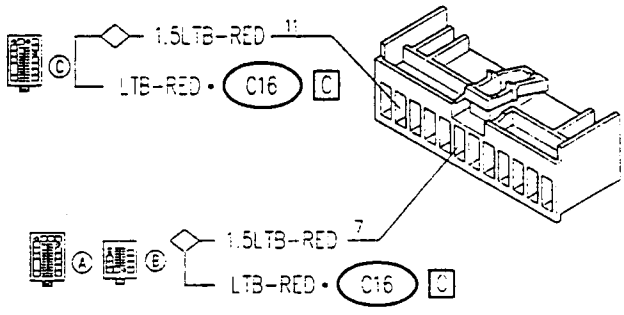
The "key-operated" supply reaches pin 6 of the same connector through fuse **F15** of fusebox **G1**; the earth signals from the doors turn on the corresponding red leds.

Components and Connectors

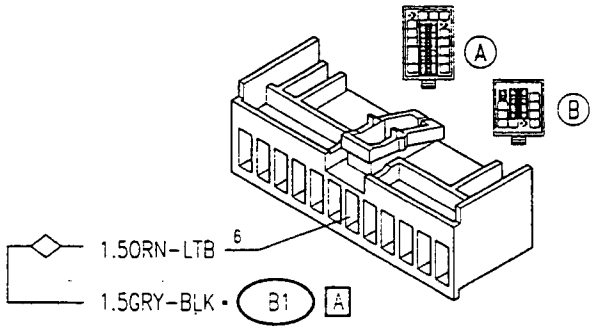
Check Panel Display	C16 C

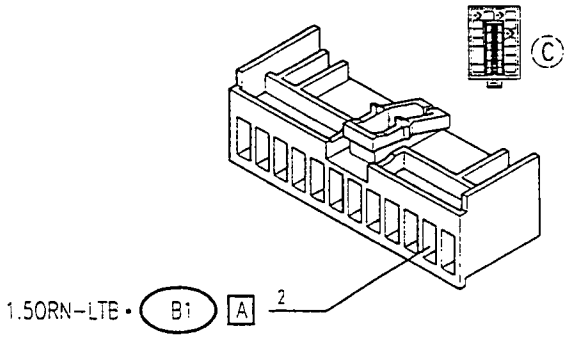


Fusebox	G1 D



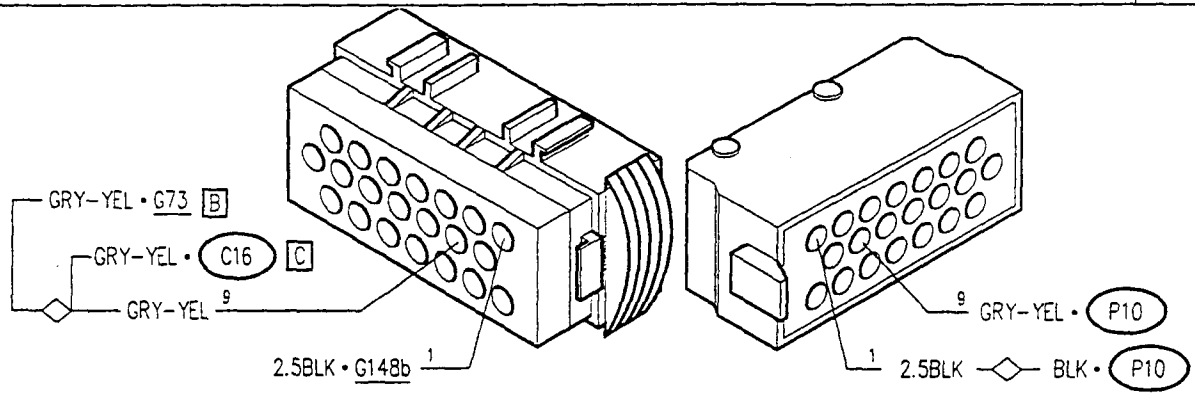
Fusebox	G1 H



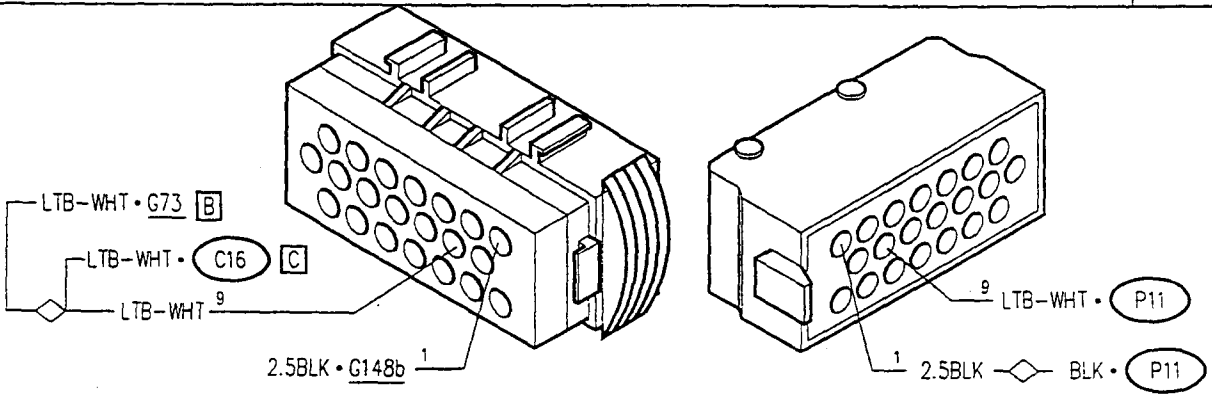


Components and Connectors (cont.d)

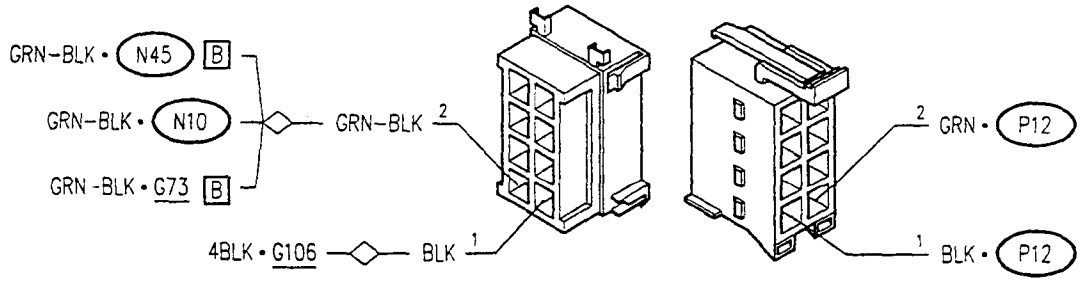
RH front door wiring connector	G21



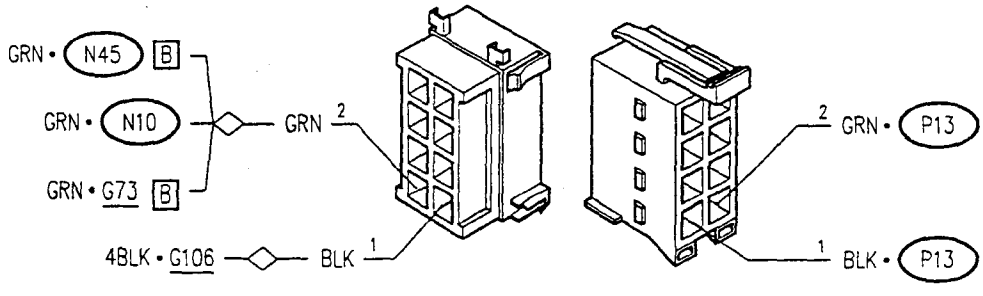
LH front door wiring connector	G23



Connector for RH rear door wiring	G25

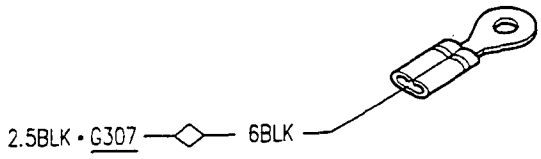


Connector for LH rear door wiring	G27

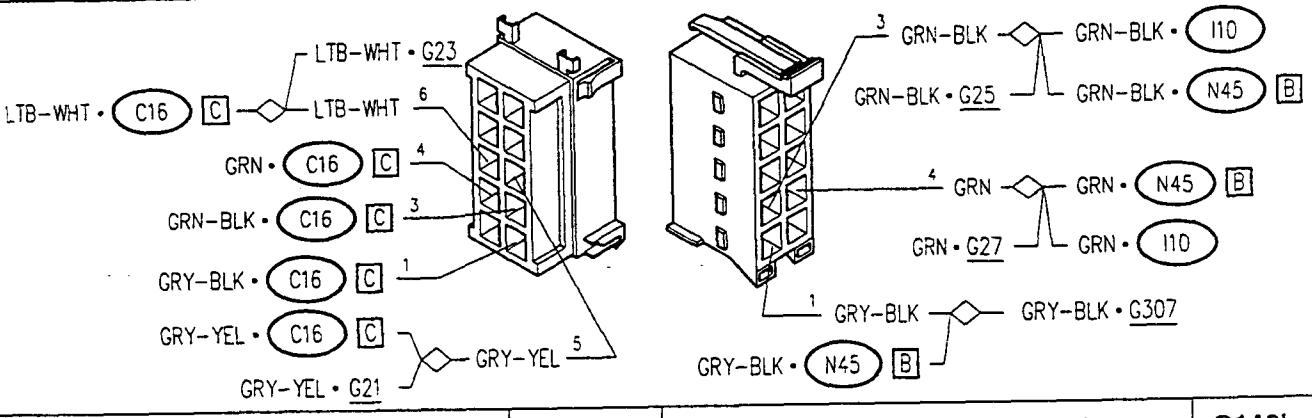


Components and Connectors (cont.d)

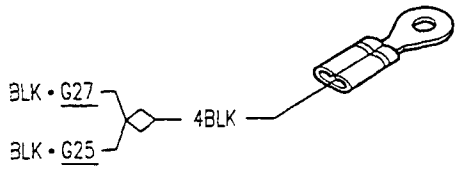
RH rear earth — G63a



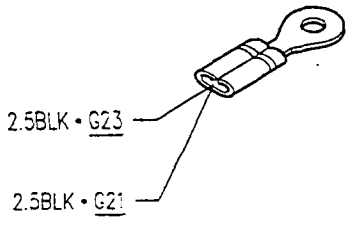
Connector for rear services — G73 B



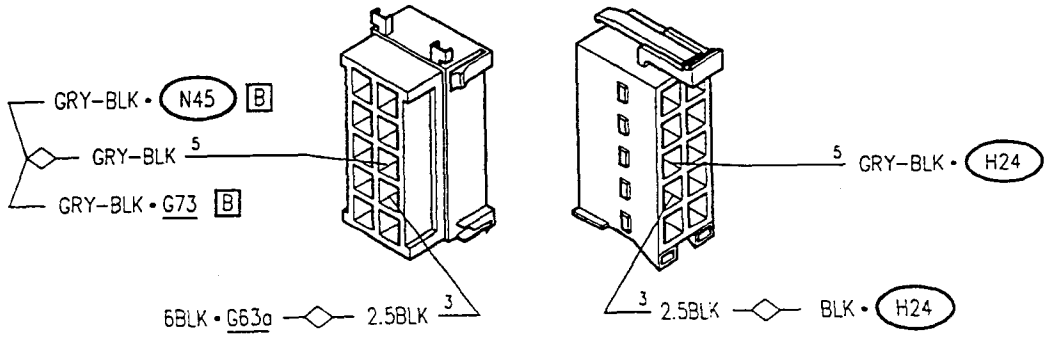
Seat cross rail earth — G106



Earth under LH dashboard — G148b

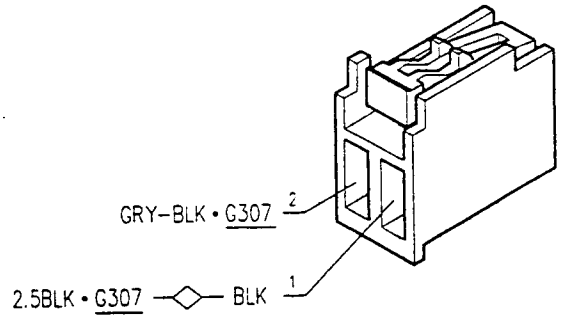


Connector for rear wiring/luggage compartment wiring — G307

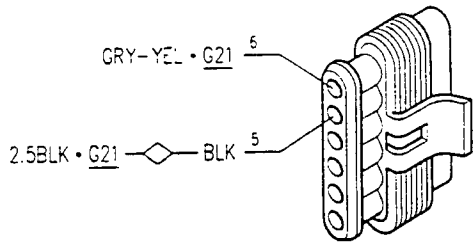


Components and Connectors (cont.d)

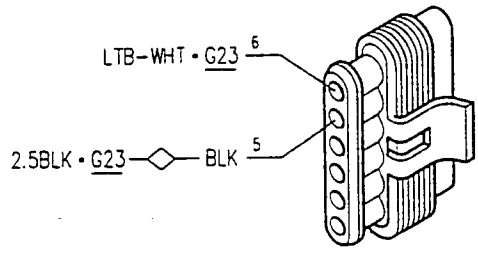
Luggage compartment light switch	H24



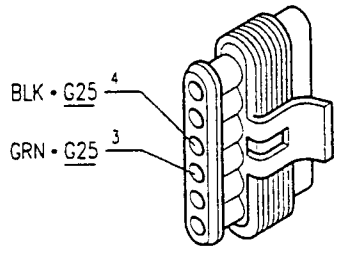
RH front door lock motor	P10



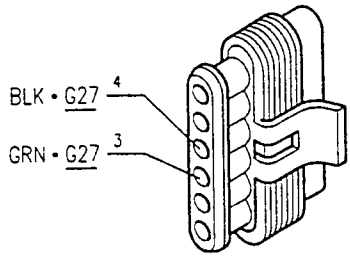
Front LH door lock motor	P11



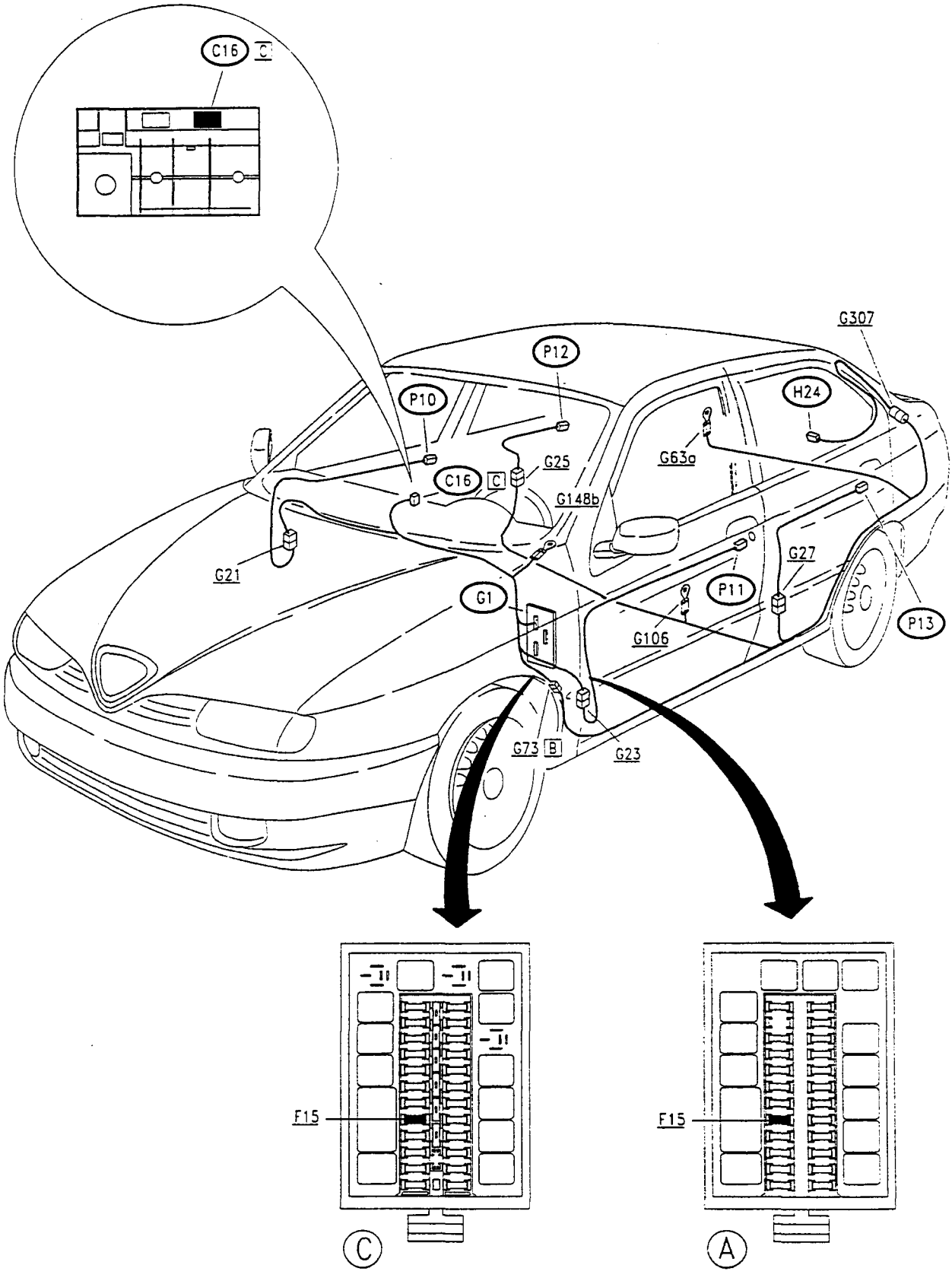
Rear RH door lock motor	P12



Rear LH door lock motor	P13

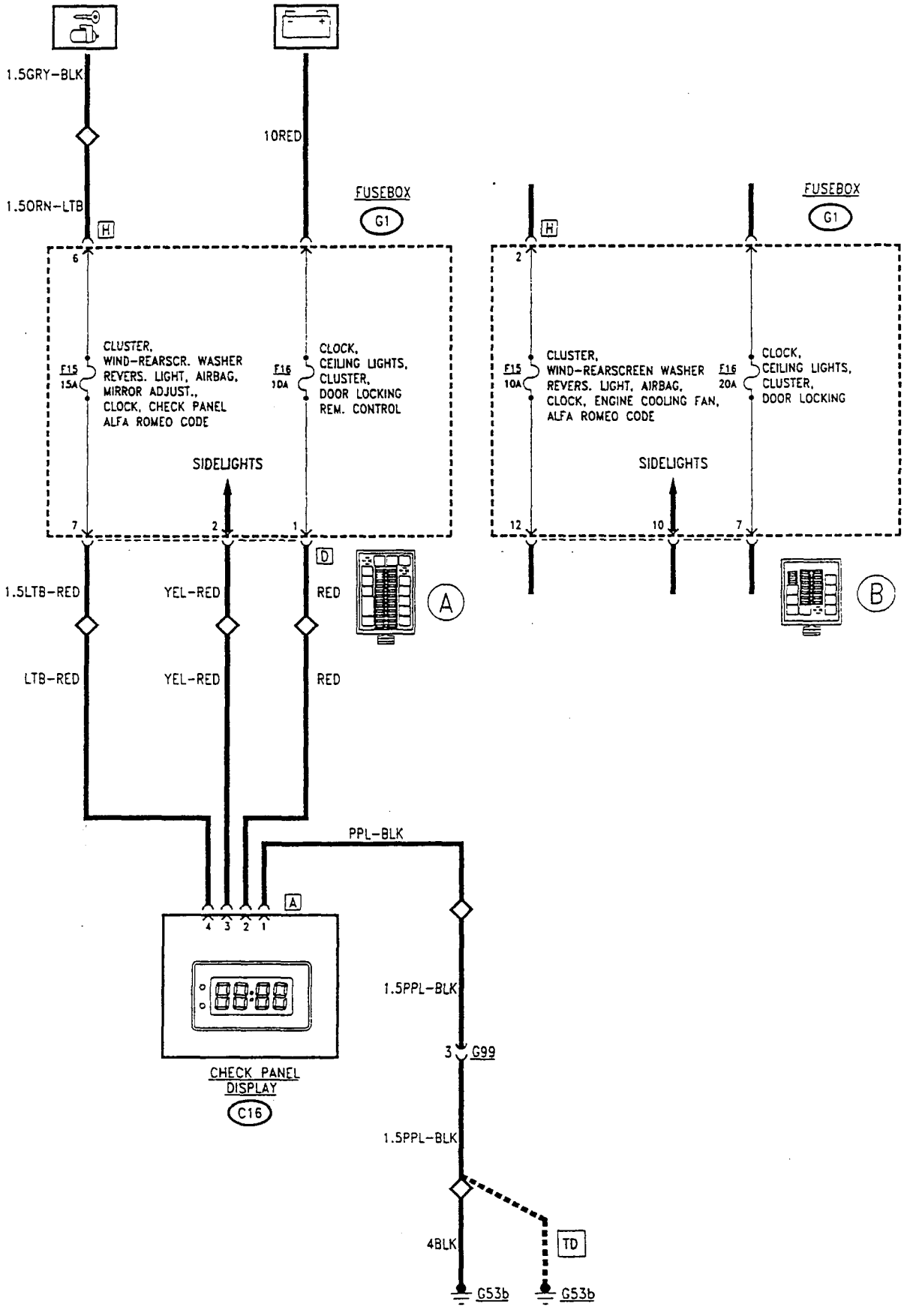


Location of Components

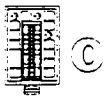


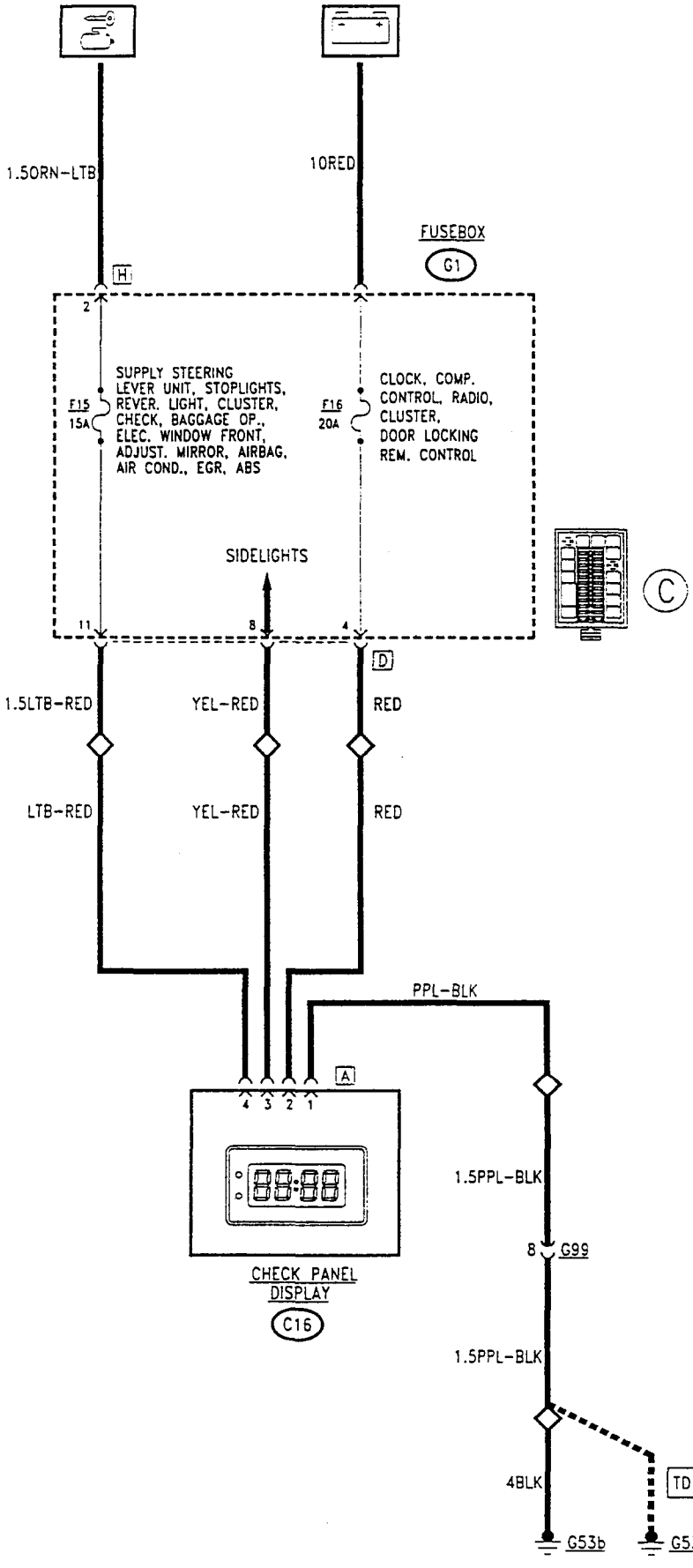
CLOCK

Wiring Diagram



Wiring Diagram





Functional Description

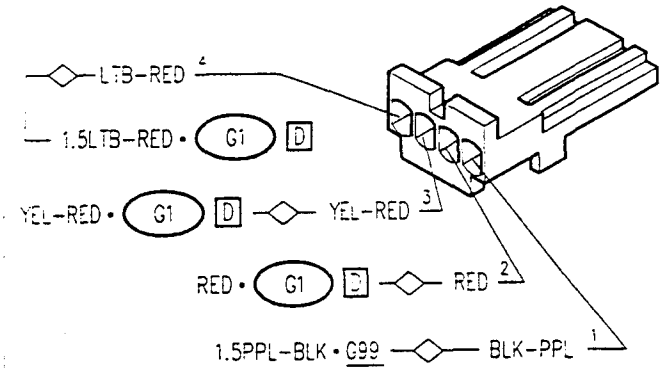
The clock, located in the display **C16**, is supplied by direct voltage (battery) through fuse **F16** of fusebox **G1** which is connected to pin 2 of connector A of the actual display.

N.B.: disconnecting the battery, the clock stops and must be reset using the 2 pushbuttons - hours and minutes - when the supply is re-connected.

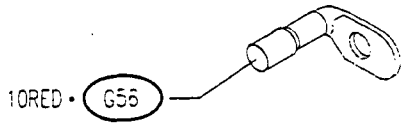
Pin 4 receives the "key-operated" supply through fuse **F15** of fusebox **G1**, while pin 1 is connected to earth; the key- operated supply lights up the numbers of the actual clock display (which stay off when the key is not engaged); lastly, a sidelights on signal reaches pin 3 which dims the light of the numbers.

Components and Connectors

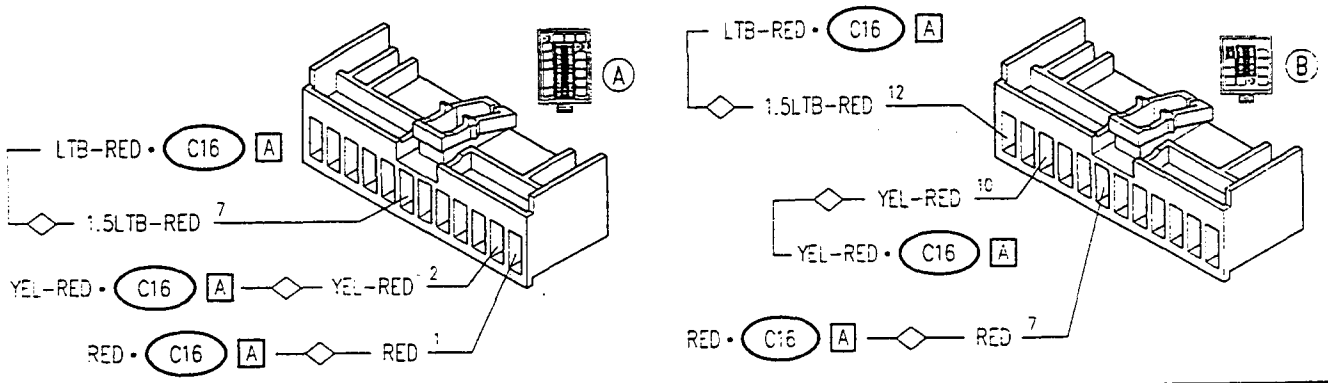
Check Panel Display	C16 A



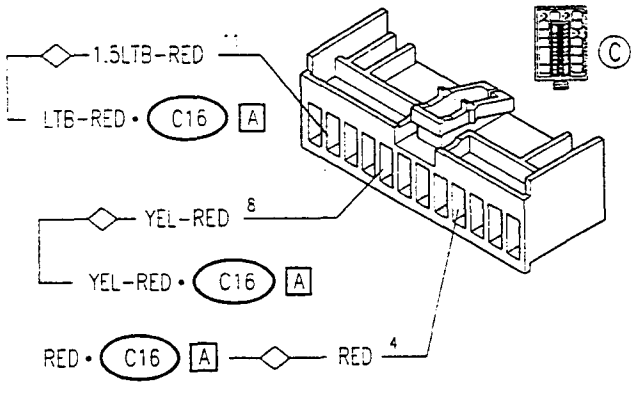
Fusebox	G1



Fusebox	G1 D



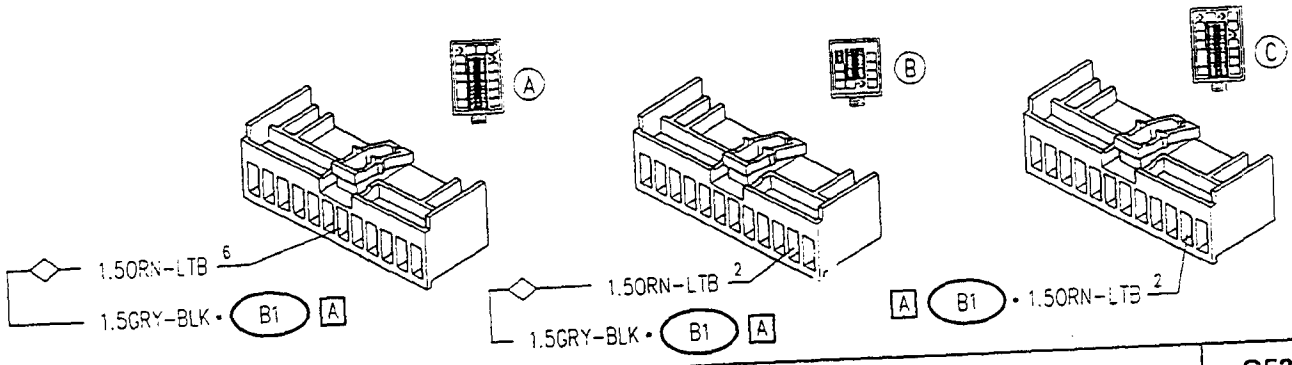
Fusebox	G1 D



Components and Connectors (cont.d)

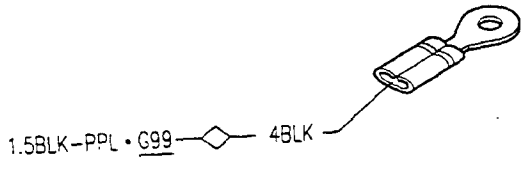
G1 H

Fusebox



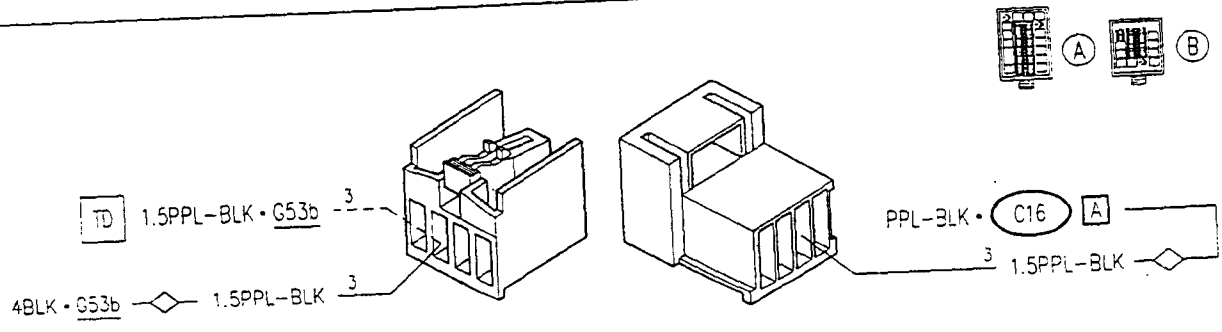
G53b

RH engine earth



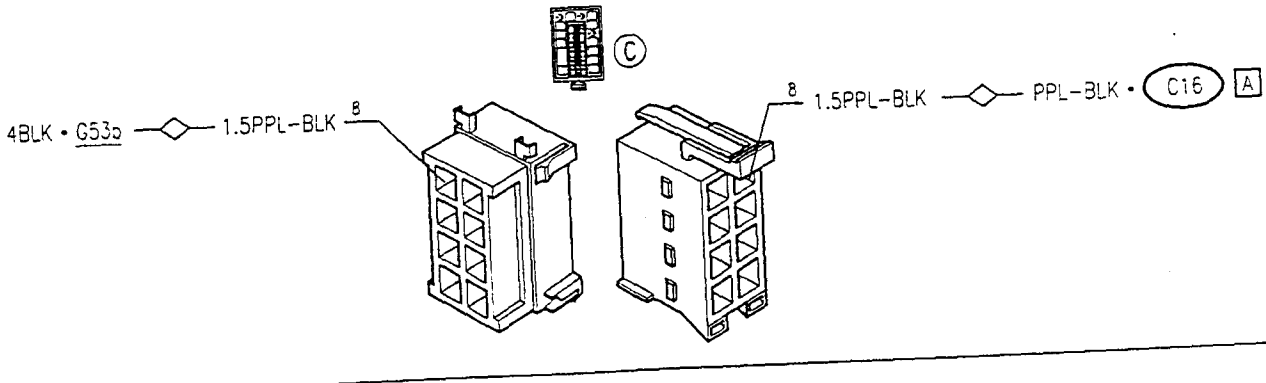
G99

Dashboard/engine wiring connector (*)



G99

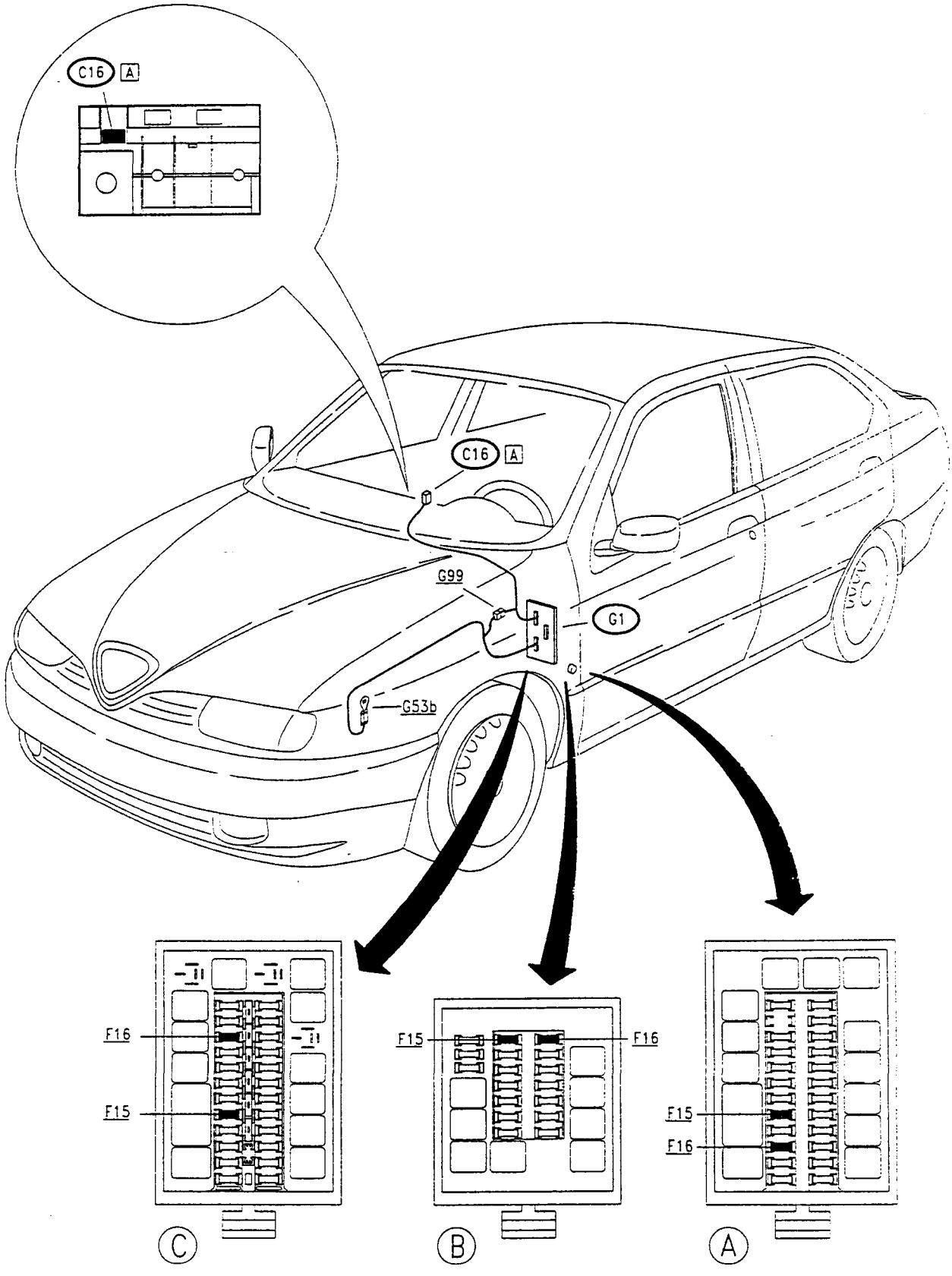
Dashboard/engine wiring connector (**)



(*) up to chassis no.
PA493000000008

(**) from chassis no.

Location of Components



FAULT-FINDING TABLE

Fault	Component to be checked							
	F15	F16	C16 (*)	P10	P11	P12	P13	H24
Display out completely	•		•					
Clock		•	•					
Display fails to light up			•					
One of the switches not working			•					
RH front door open			•	•				
LH front door open			•		•			
RH rear door open			•			•		
LH rear door open			•				•	
Luggage compt.open								•

(*) The Check Panel display **C16** cannot be overhauled. Therefore, in the event of a failure, individual components (clock, doors display, switch) cannot be changed and the whole unit must be replaced

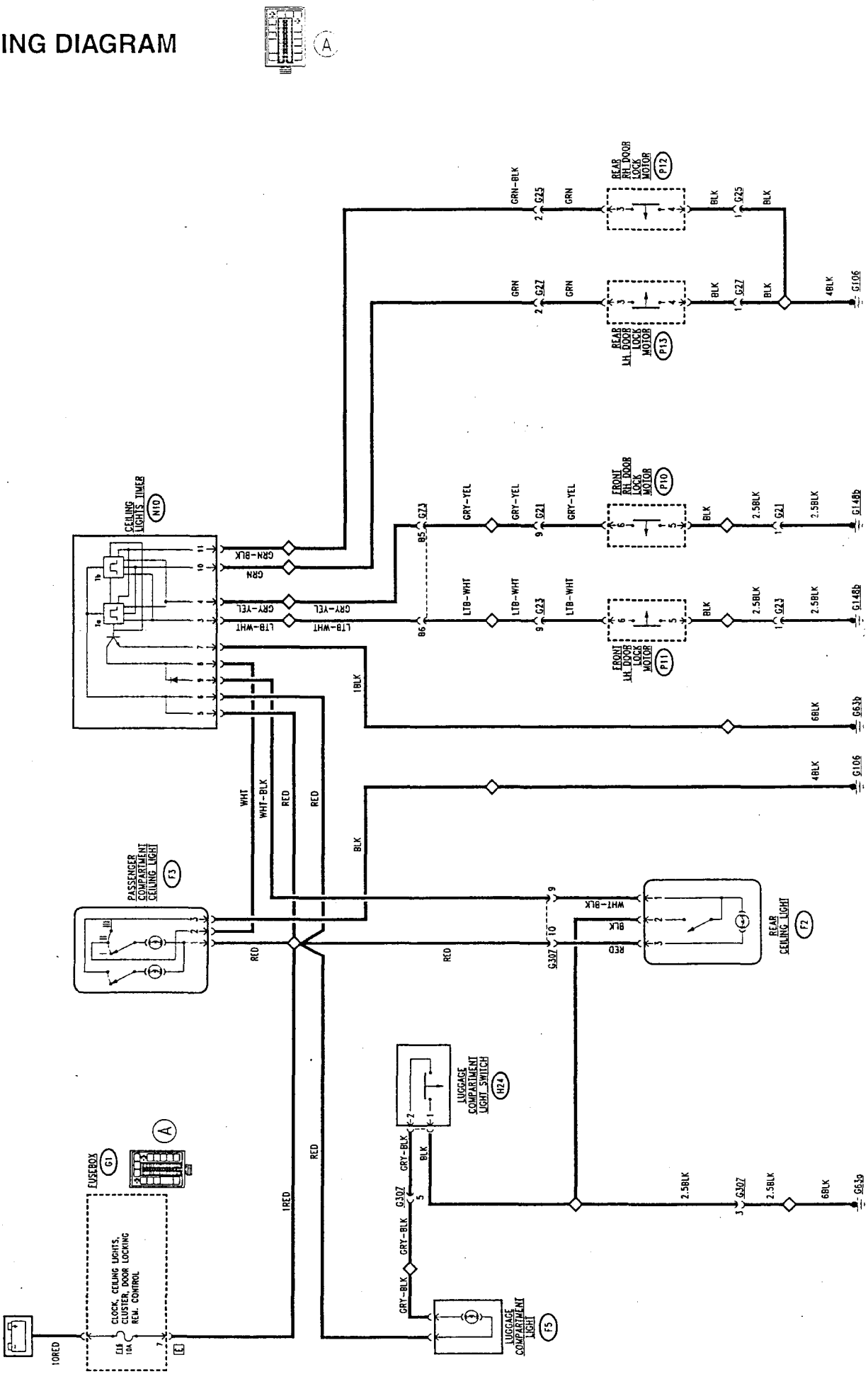
COURTESY LIGHTS
(up to M.Y. '98) (*)

INDIX

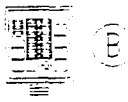
WIRING DIAGRAM A 11-2
WIRING DIAGRAM B 11-3
WIRING DIAGRAM C 11-4
GENERAL DESCRIPTION 11-4/2
FUNCTIONAL DESCRIPTION 11-4/2
COMPONENTS AND CONNECTORS 11-5
LOCATION OF COMPONENTS 11-9
FAULT-FINDING TABLE 11-10
CHECKING COMPONENTS 11-10

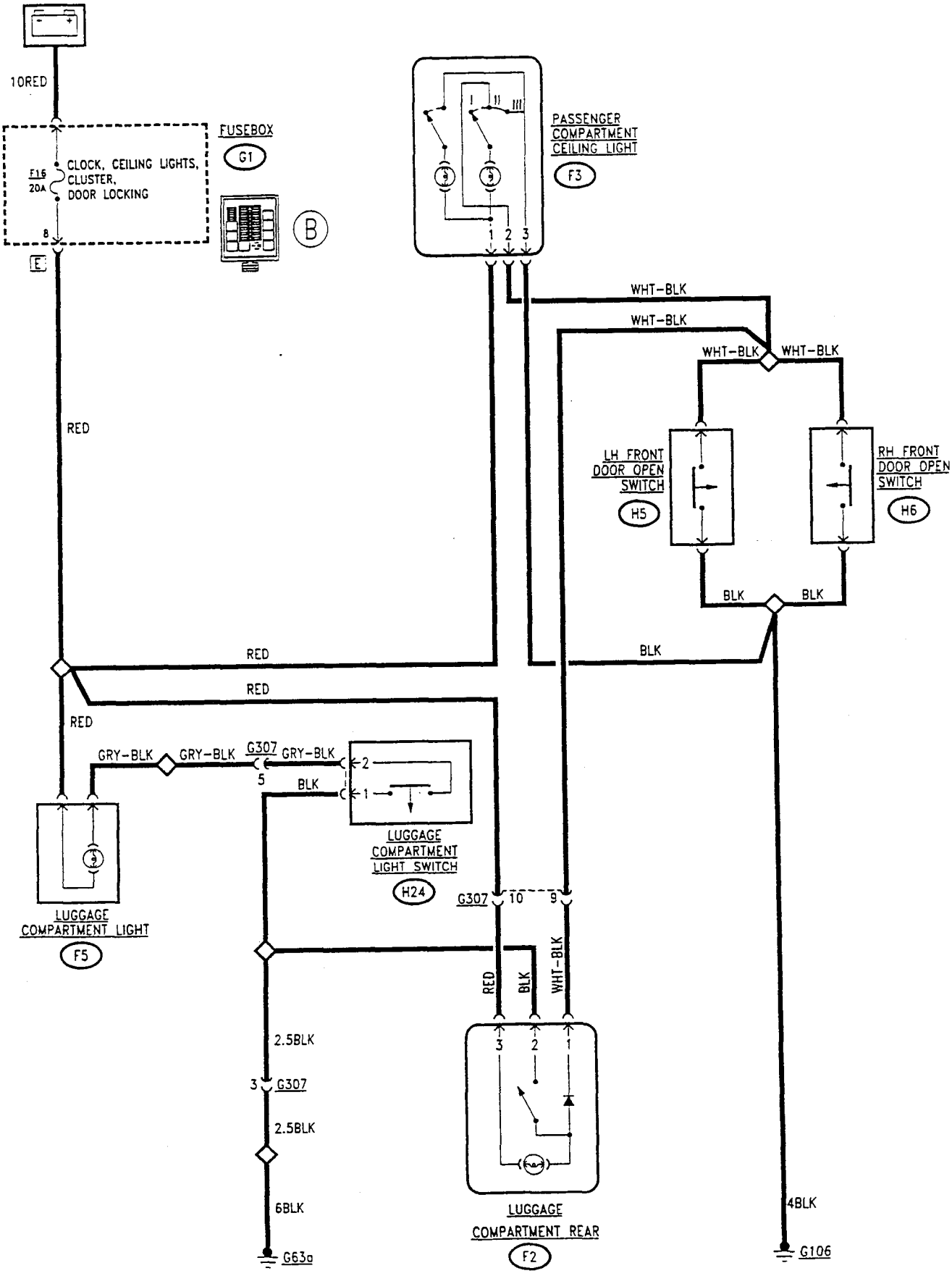
(*) M.Y. '99 see Section 11A

WIRING DIAGRAM

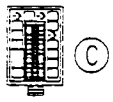


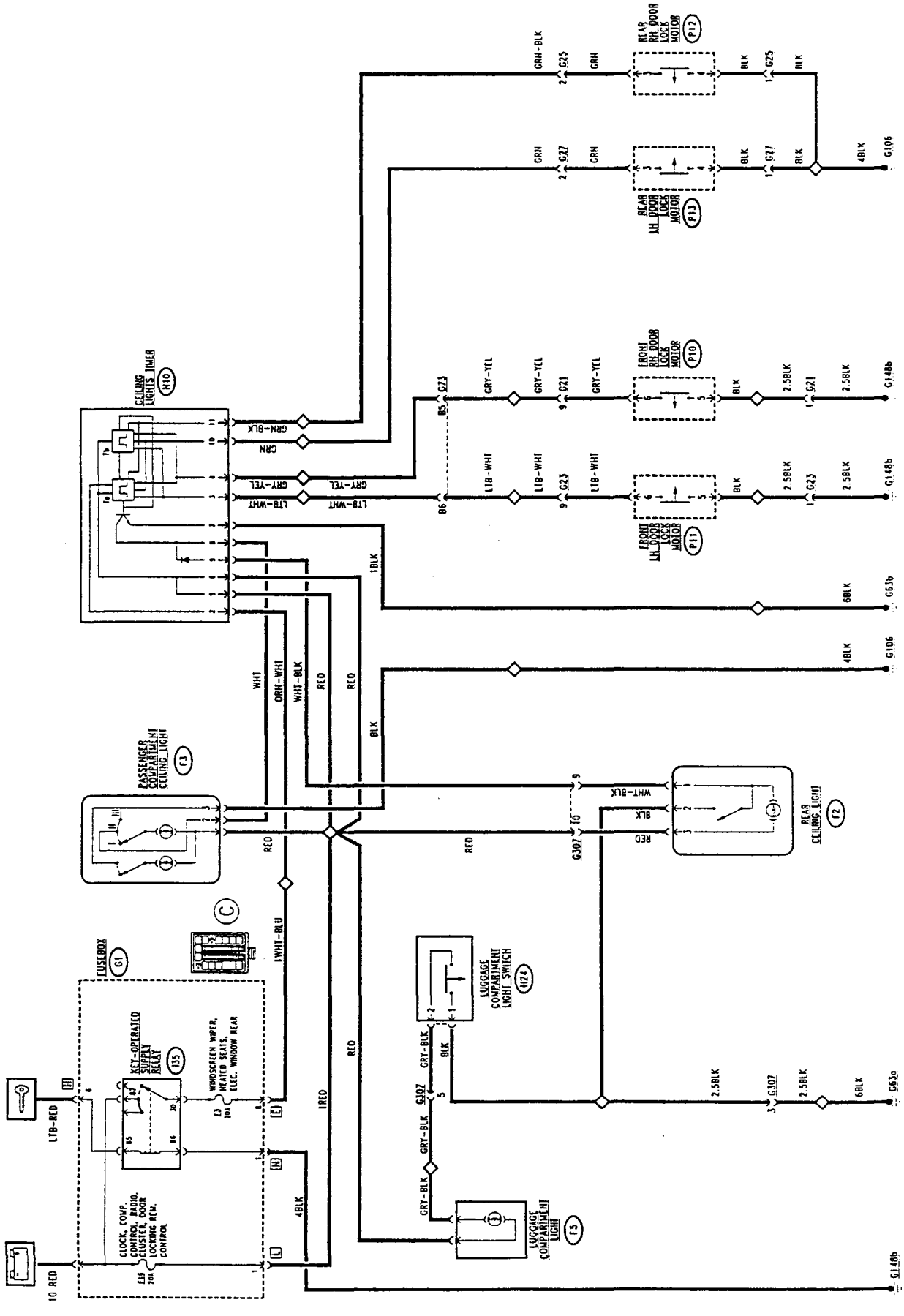
WIRING DIAGRAM





WIRING DIAGRAM





GENERAL DESCRIPTION

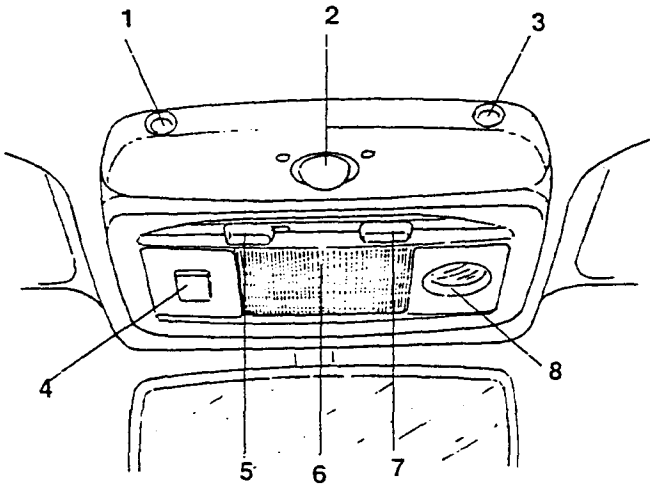
The numerous light sources provided ensure good lighting inside the passenger compartment and/or of some specific points under all conditions.
The front courtesy light **F3** and the rear courtesy light **F2** are turned on automatically when the doors are opened, in different ways depending on the versions:

- **"top" versions (with fusebox "A" or "C"):**
  the two courtesy lights are "timed": they both turn on when one of the four doors is opened for 100 ÷ 200 seconds; they stay on for appr. another 15 seconds from when the door is closed.
  From chassis no.__ the roof lamp will also be turned off when the ignition key is turned to MAR.

- **"low" versions (with fusebox "B"):**
  the two courtesy lights both turn on when one of the front doors is opened; and they turn off when they are closed.
  N.B. the rear doors do NOT turn on the courtesy lights.

Of course, both lights may be turned on manually, with the switch to be found on them.

On the front courtesy light **F3** there is also a lamp which makes for instance reading possible without disturbing the driver.
NOTE: This light is different for the versions with sunroof and with antitheft system. Nothing changes however with regard to the operation described here.



1 - anti-theft volumetric sensor (See "Anti-theft")
2 - anti-theft I.R. receiver (See "Anti-theft")
3 - anti-theft volumetric sensor (See "Anti-theft")
4 - sunroof control switch
(See "Sunroof")
5 - courtesy light switch
6 - courtesy light
7 - reading light switch
8 - reading light

A special lamp **F5** illuminates the luggage compartment, which is turned on when the tailgate is opened.

FUNCTIONAL DESCRIPTION

The courtesy light **F3** receives the supply directly from the battery through fuse **F16** of fusebox **G1**: this makes it possible to operate the reading light or the courtesy light from the corresponding switch.

The switch has three positions:

I - courtesy light always off

II - courtesy light controlled by the opening/closing of the doors

III - courtesy light turned on manually

Also light **F2** is supplied by the same line, and it is fitted with a switch for manual use.

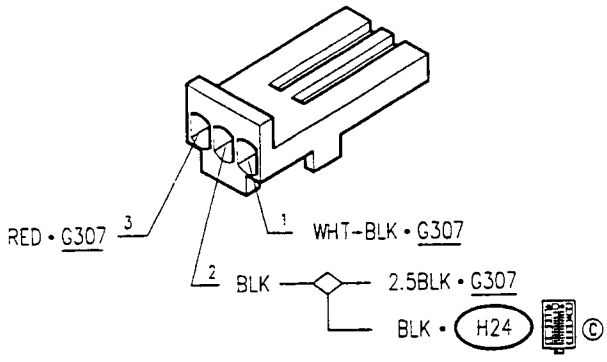
"Top" versions:
The roof lamp timer **N10** - under the rear seat - is also supplied by the line of fuse **F16** from chassis no.__ it also receives the "key-operated" supply (this makes it possible to cut off timing when the key is at MAR), from fuse **F3** of box G1 "C". It receives a door opening signal (earth) from one of the four switches in the door locking devices **P10**, **P11**, **P12** or **P13**; the timed control signal is thus sent to the two roof lamps **F3** and **F2**.

"Low" versions:
The courtesy lights are turned on automatically when the doors are opened, as a special switch (**H6** for the RH door and **H5** for the LH door) sends an earth signal to the courtesy lights **F3** and **F2**.

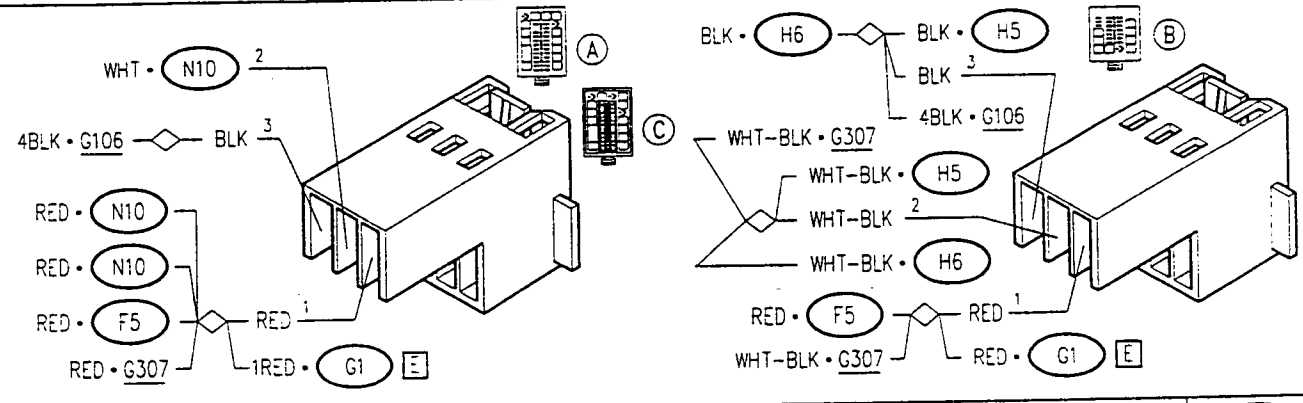
Also the luggage compartment light **F5** is supplied with battery voltage via the line protected by fuse **F16**; it is turned on when the boot is opened and switch **H24** sends an earth signal.

COMPONENTS AND CONNECTORS

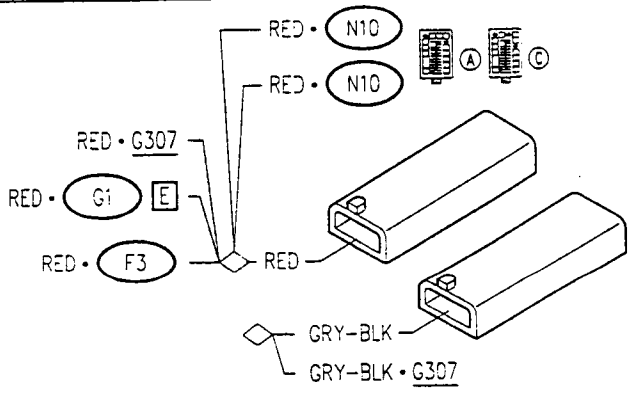
Rear courtesy light — F2



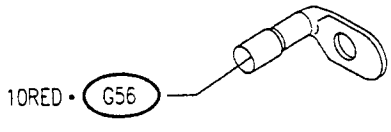
Passenger compt. courtesy light — F3



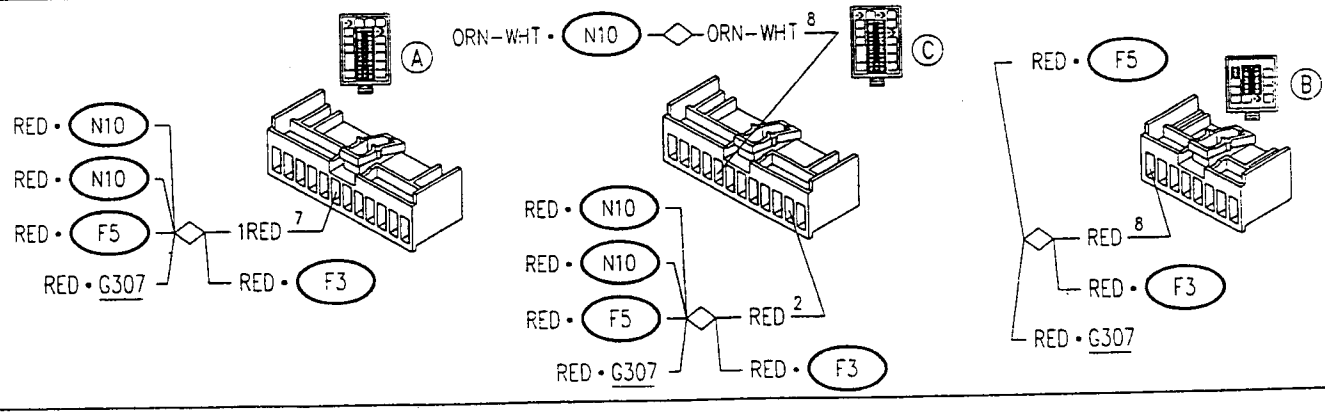
Luggage compartment light — F5



Fusebox — G1

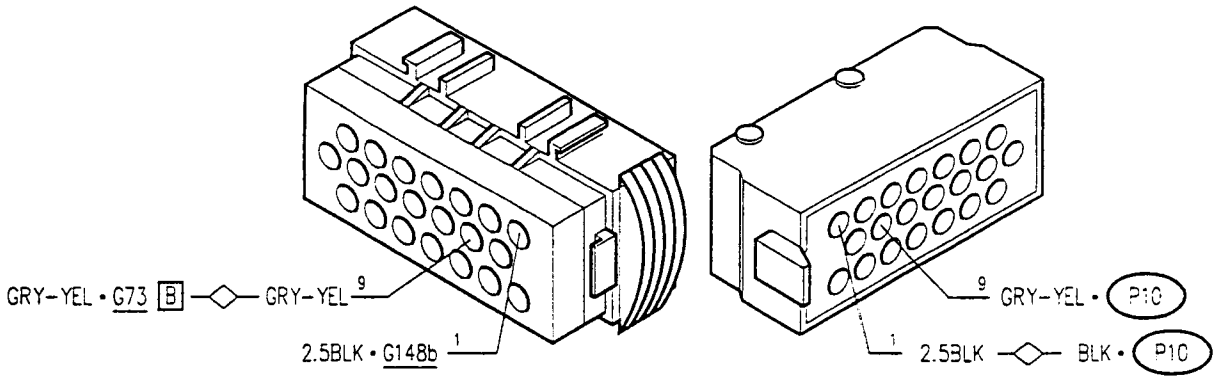


Fusebox — G1 E

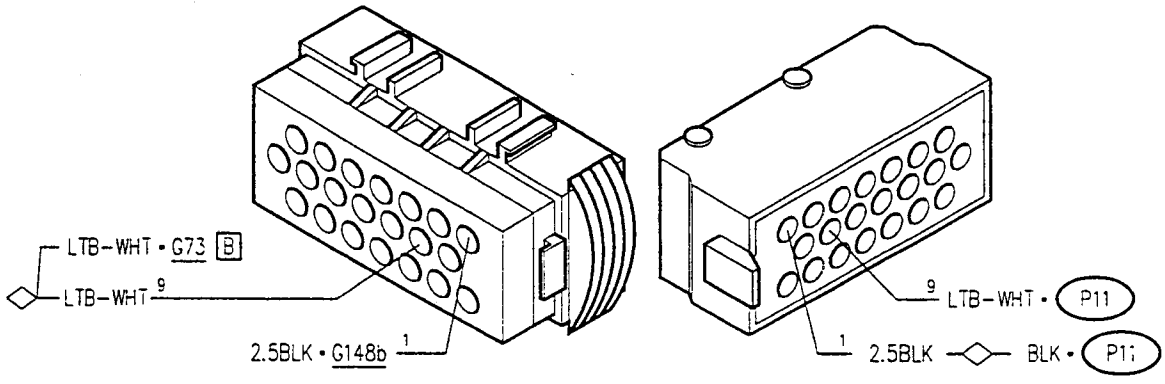


COMPONENTS AND CONNECTORS (cont.d)

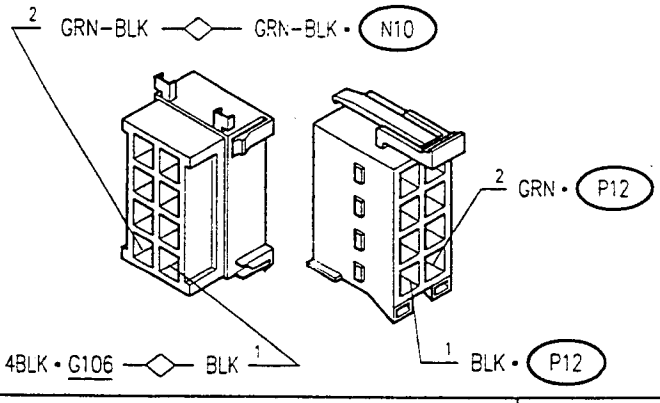
RH front door wiring connector	G21



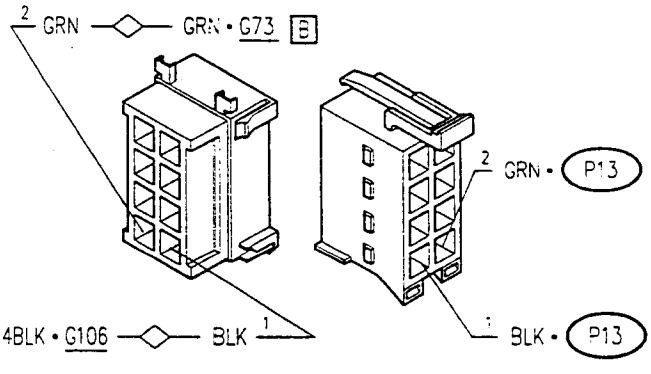
LH front door wiring connector	G23



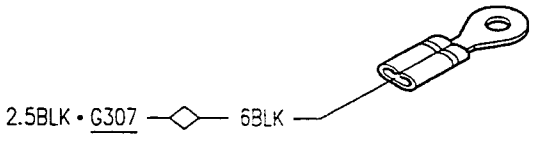
RH rear door wiring connector	G25



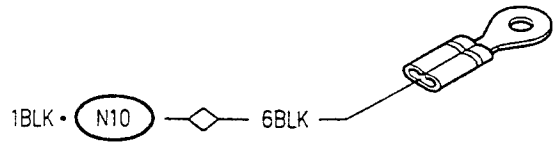
LH rear door wiring connector	G27



RH rear earth	G63a

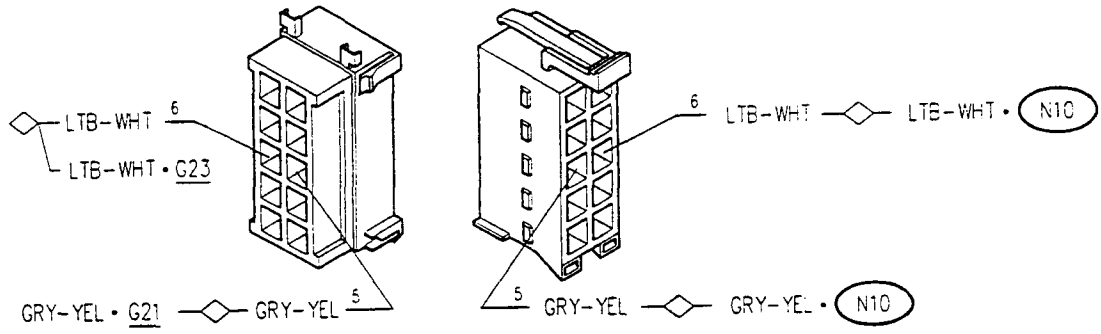


LH rear earth	G63b

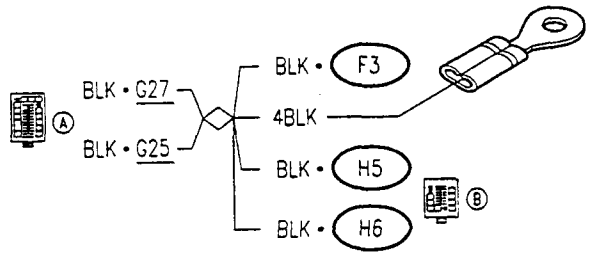


COMPONENTS AND CONNECTORS (cont.d)

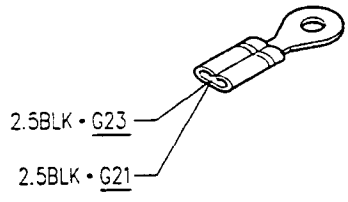
Rear services connector — G73 B



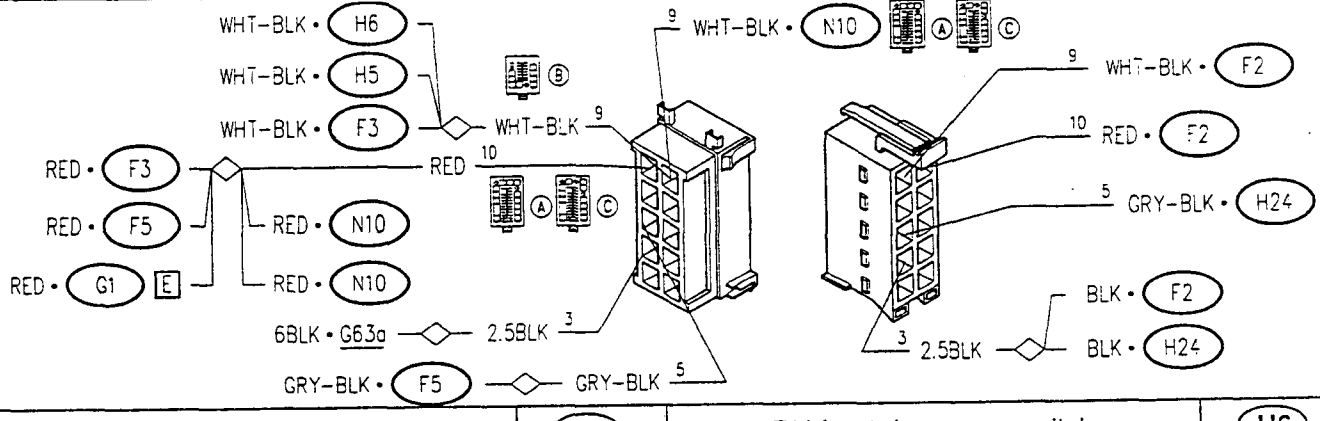
Seat crossrail earth — G106



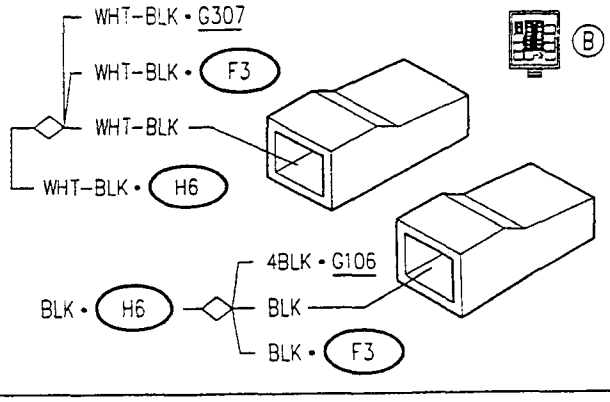
Earth under LH dashboard — G148b



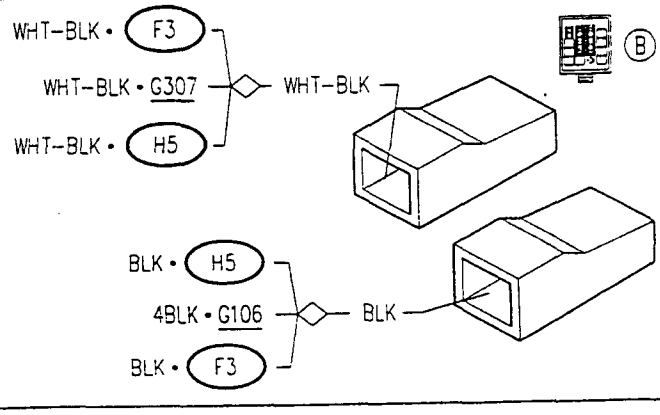
Rear wiring/boot wiring connector — G307



LH front door open switch — H5

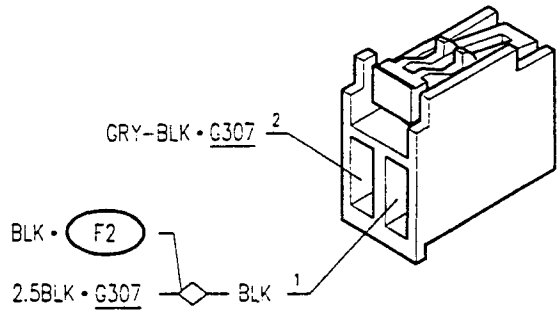


RH front door open switch — H6

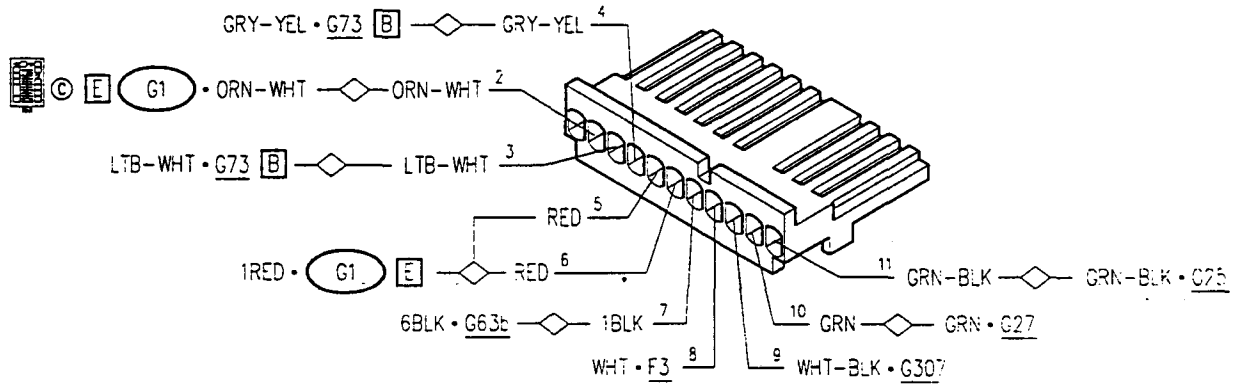


COMPONENTS AND CONNECTORS (cont.d)

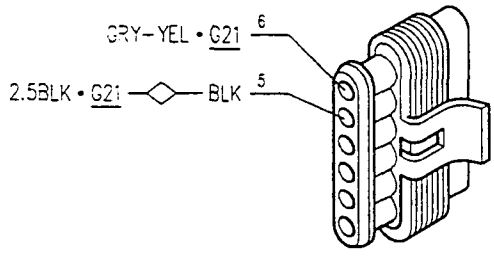
Luggage compartment light switch	H24



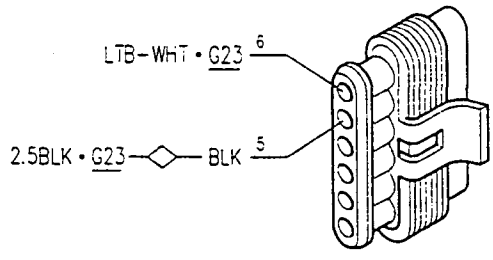
Courtesy lights timer	N10



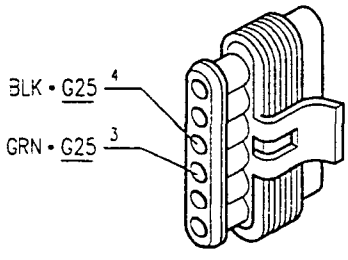
RH front door locking motor	P10



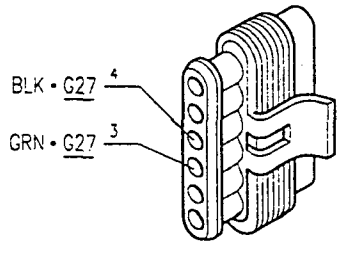
LH front door locking motor	P11



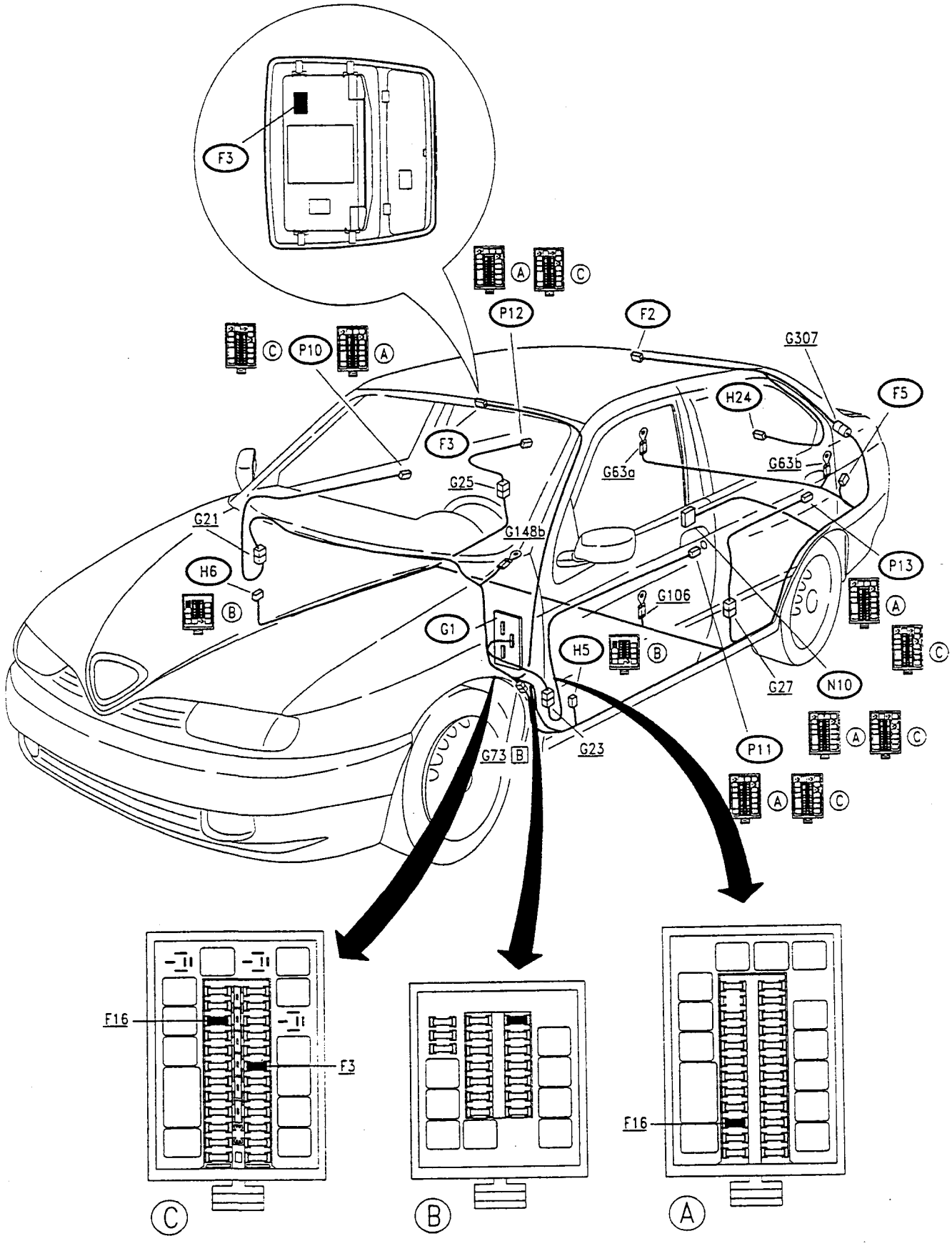
RH rear door locking motor	P12



LH rear door locking motor	P13



LOCATION OF COMPONENTS



FAULT-FINDING TABLE

Fault	Component to be checked											
	F16	F3	F2	F5	H5 (B)	H6 (B)	N10 (A)	P10 (A)	P11 (A)	P12 (A)	P13 (A)	H24
All the courtesy lights	•											
Front courtesy light, under all circumstances		•										
Rear courtesy light, under all circumstances			•									
The two lights fail to turn on opening the RH front door						•	•	•				
The two lights fail to turn on opening the LH front door					•		•		•			
The two lights fail to turn on opening the RH rear door (1)							•			•		
The two lights fail to turn on opening the LH rear door (1)							•				•	
Luggage compartment light				•								•

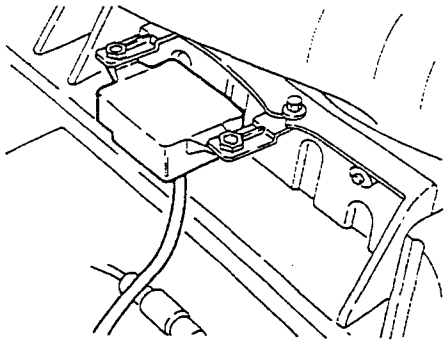
(1) **N.B. opening the rear doors, in the versions with fusebox "B", the two courtesy lights do NOT turn on**

(A) Only fusebox "A"

(B) Only fusebox "B"

CHECKING COMPONENTS

Courtesy light timer (N10)



SPECIFICATIONS	
Door opening timer (Ta)	100 ÷ 200 sec.
Door closing timer (Tb)	15 ± 5 sec

Check the device : see **TEST A**

CHECK COURTESY LIGHT TIMER (N10)	TEST A

N.B. ; only for versions with fusebox "A"

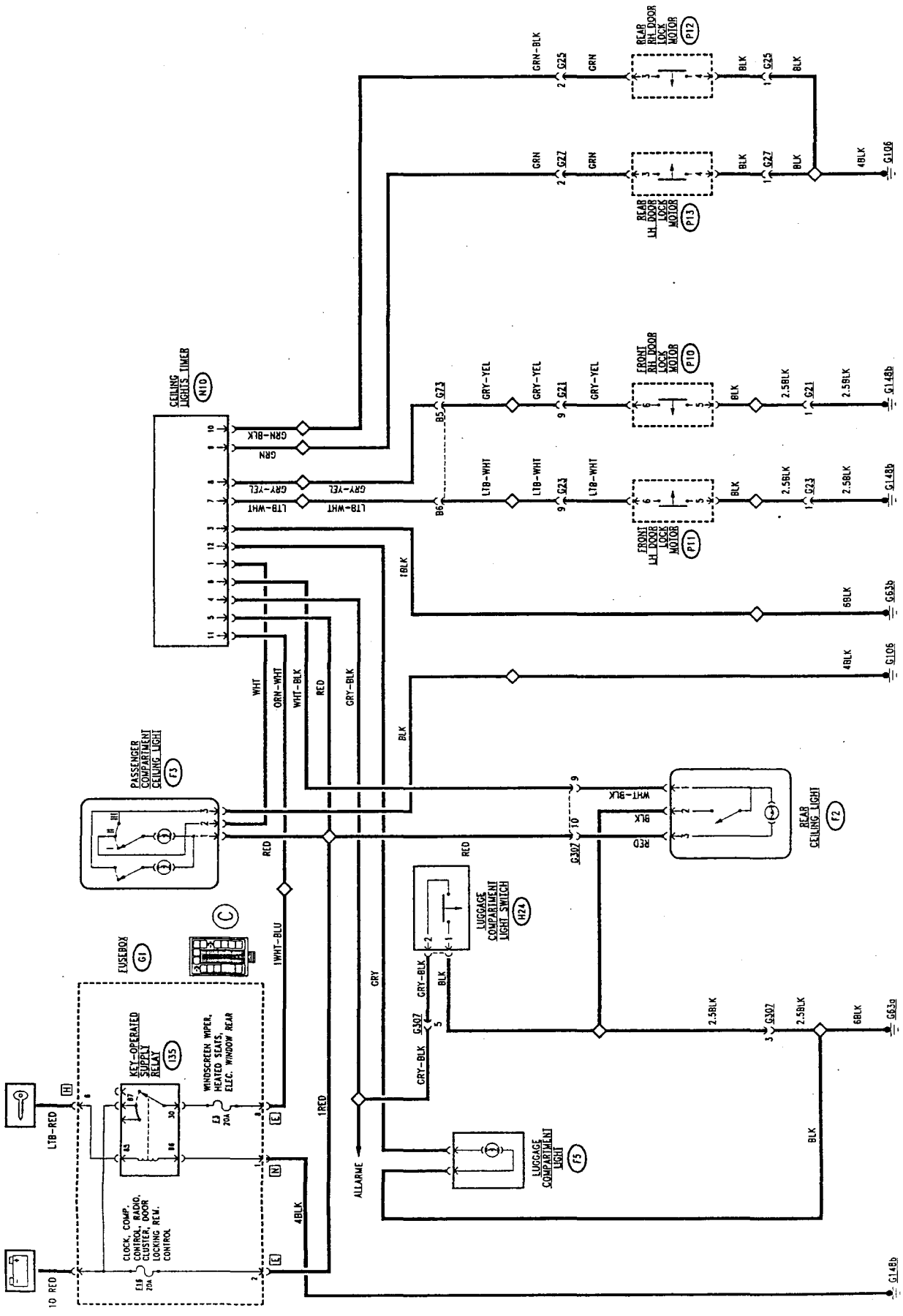
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N10** and check the connector for 12 V at pins 5 and 6	OK ▶ ~~OK~~ ▶	Carry out **step A2** Check fuse **F16** of **G1**. If necessary
A2 CHECK EARTH – Check for pin 7 of **N10** is an earth	OK ▶ ~~OK~~ ▶	Carry out step A3 **Restore the wiring between N10 and earth G63b**
A3 CHECK EARTH SIGNAL – Open each of the four doors and check for an earth at the respective pins on **N10**: LH front door : pin 3 RH front door: pin 4 LH rear door : pin 10 RG rear door : pin 11	OK ▶ ~~OK~~ ▶	Insert device **N10** on the connector, then carry out **step A4** Restore the wiring between **N10** and respectively **P11, P10, P13** and **P12**
A4 CHECK EARTH SIGNAL – Open one of the doors and check for 100 ÷ 200 sec. for an earth leaving pins 8 and 9 of **N10**; when the door is closed again the earth remains for appr. 15 sec.	OK ▶ ~~OK~~ ▶	Restore the wiring between **N10** and courtesy lights **F3** and **F2** **CHANGE DEVICE N10**

COURTESY LIGHTS
(from M.Y. '99)

INDIX

WIRING DIAGRAM 11A-2
GENERAL DESCRIPTION 11A-3
FUNCTIONAL DESCRIPTION 11A-3
COMPONENTS AND CONNECTORS 11A-4
LOCATION OF COMPONENTS 11A-8
FAULT-FINDING TABLE 11A-9

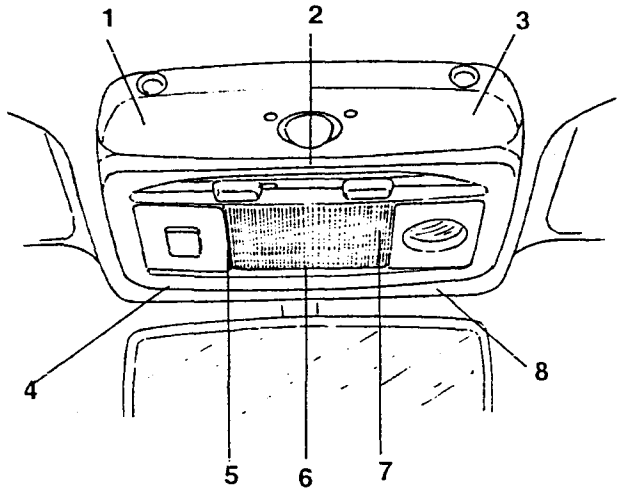
WIRING DIAGRAM



GENERAL DESCRIPTION

In all conditions the numerous sources of light fitted provide good lighting in the interior of the passenger compartment and/or of some specific points.
The front ceiling lamp **F3** and rear ceiling lamp **F2** turn on automatically when opening the doors: these two ceiling lamps are timed: they both turn on when one of the four doors is opened for 100 ÷ 200 seconds; after closing the doors they stay on for about another 15 seconds; they can be turned off when the key is turned to MAR.

Both ceiling lights can obviously be turned on manually by means of the switch located on them.
There is also a spotlight on the support of the front ceiling light **F3**, which allows reading, for example, without disturbing the driver.
NOTE: This ceiling light system is different for the versions with convertible top and anti-theft system. However, everything is the same regarding the operation indicated here.



1 – Volumetric anti-theft sensor (see "Anti-theft")
2 - I.R. anti-theft receiver (see "Anti-theft ")
3 - Volumetric anti-theft sensor (see "Anti-theft")
4 - Sunroof control switch (see "Sunroof")
5 - Ceiling light switch
6 - Ceiling light
7 – Spotlight switch
8 - Spotlight

A special service light **F5** illuminates the baggage compartment, controlled by opening of the boot.
This light is also timed (for about 20 minutes), which prevents the battery from discharging if the boot is unintentionally left open.

FUNCTIONAL DESCRIPTION

Service light **F3** receives power directly from the battery through fuse **F16** of fuse box **G1**: this allows the reading spotlight to be turned on by means of its own switch or the ceiling light by means of its own switch.

The switch has three positions:

I – ceiling light always off

II – ceiling light controlled by opening/closing the doors

III – ceiling light turned on manually

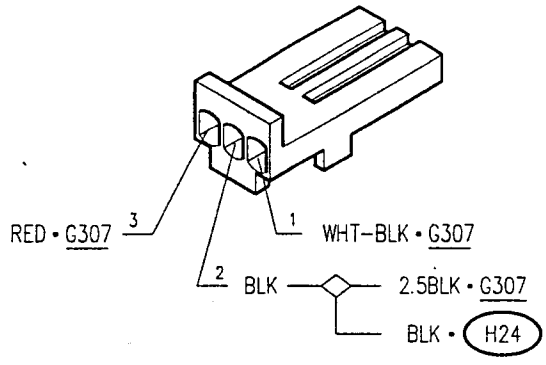
Ceiling light **F2** is also powered by the same line, and has a switch for manual operation.

The ceiling light timer **N10** – located under the rear seat – is powered by the line of fuse **F16**, and is also protection-powered (this allows interruption of the timing when the key is turned to MAR), by fuse **F3** of fuse box **G1** "C". Receives a signal (earth) to open the doors from one of the four switches located on the door locking devices **P10**, **P11**, **P12** or **P13**; the timed control signal is thus sent to the two ceiling lights **F3** and **F2**.

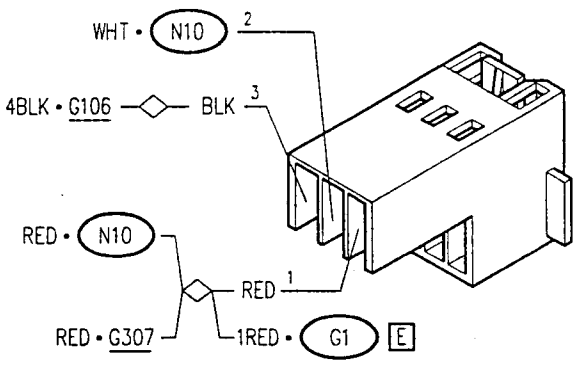
It also receives the boot opening signal from the relative switch **H24**, and consequently sends a timed command to ceiling light **F5**.

COMPONENTS AND CONNECTORS

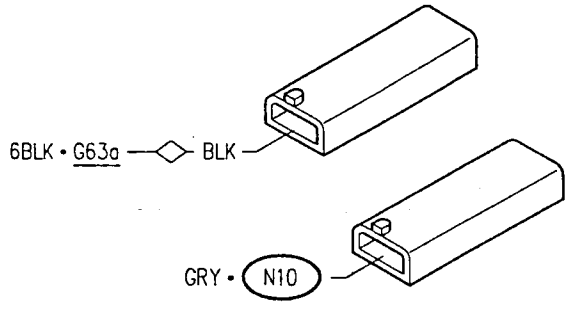
Rear courtesy light	F2



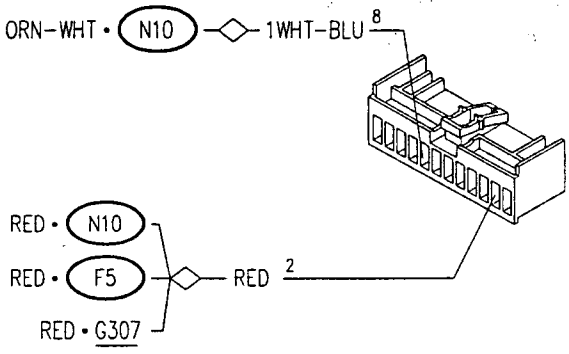
Passenger compt. courtesy light	F3



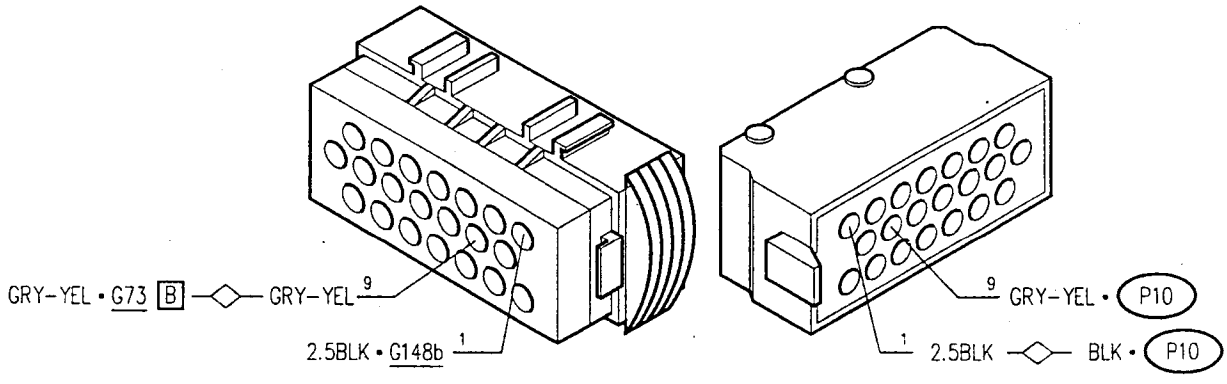
Luggage compartment light	F5



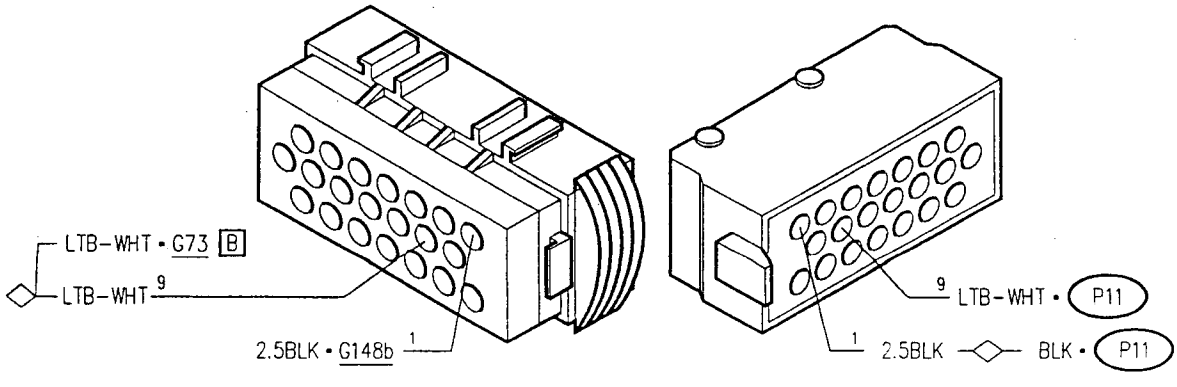
Fusebox	G1 E



RH front door wiring connector	G21

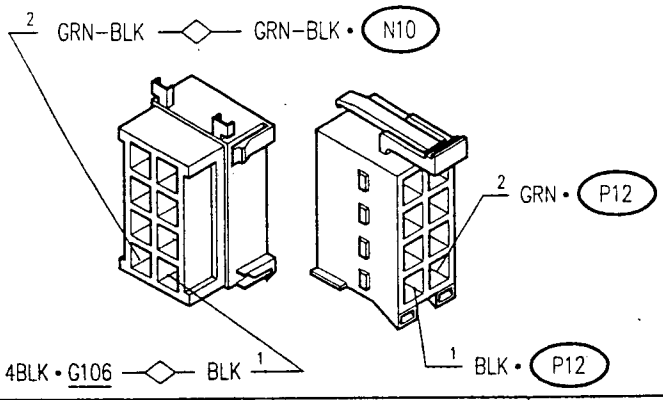


LH front door wiring connector	G23

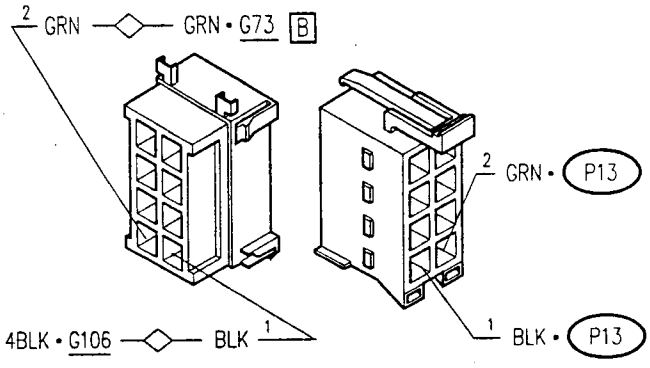


COMPONENTS AND CONNECTORS (continued)

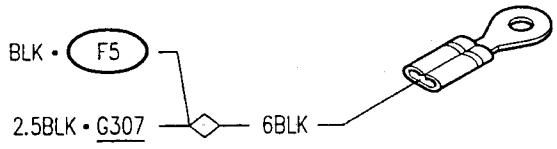
RH rear door wiring connector	G25



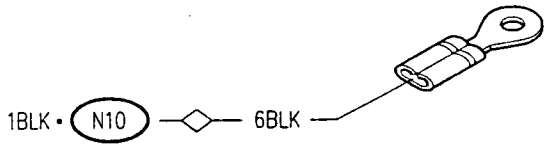
LH rear door wiring connector	G27



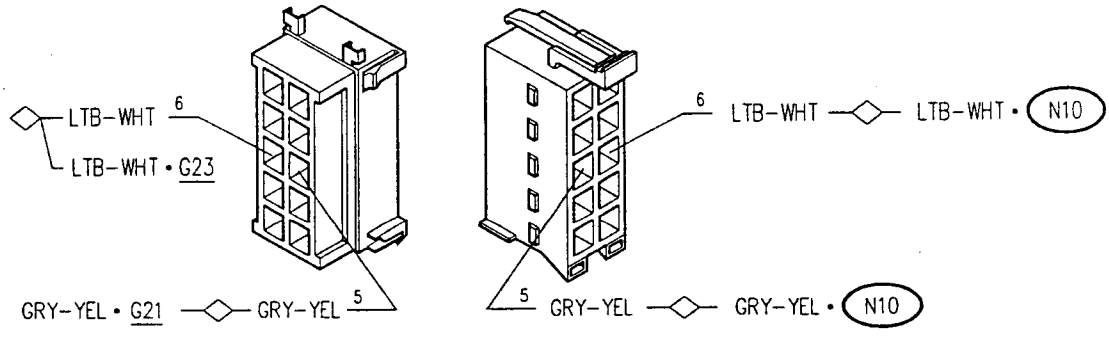
RH rear earth	G63a



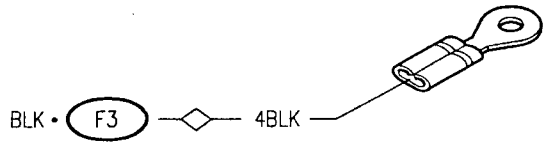
LH rear earth	G63b



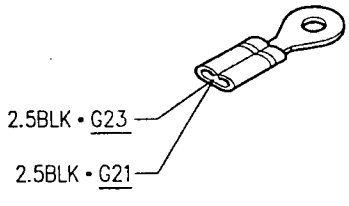
Rear services connector	G73 B



Seat crossrail earth	G106

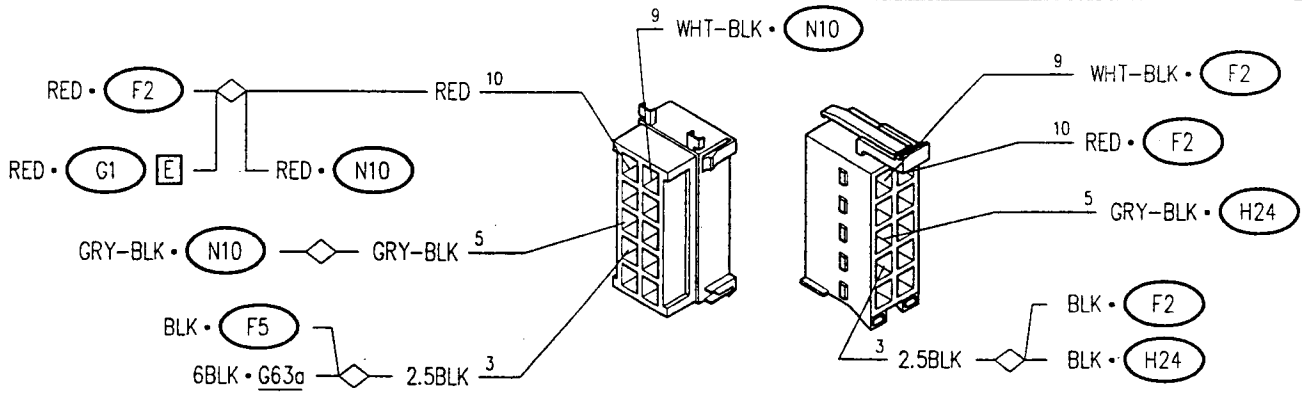


Earth under LH dashboard	G148b

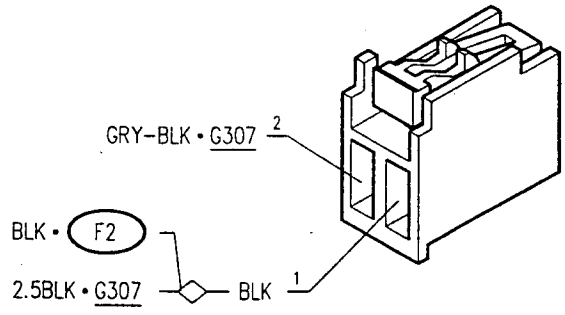


COMPONENTS AND CONNECTORS (continued)

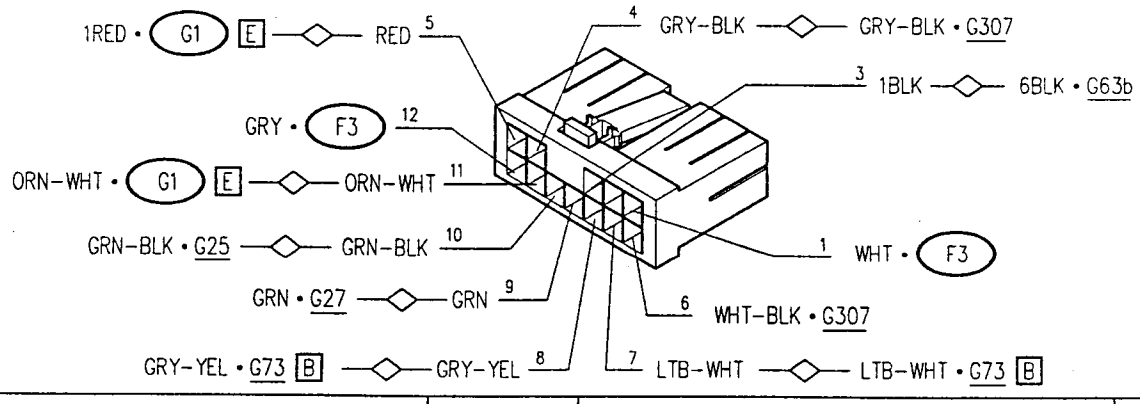
Rear wiring/boot wiring connector	G307



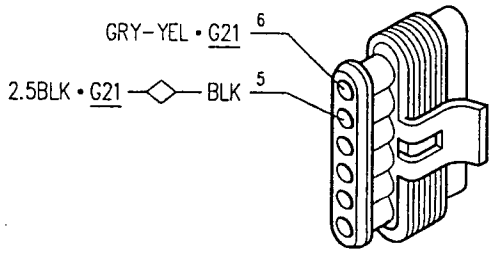
Luggage compartment light switch	H24

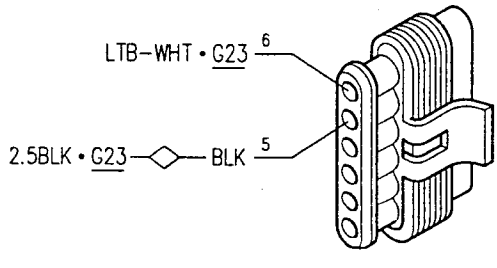


Courtesy lights timer	N10

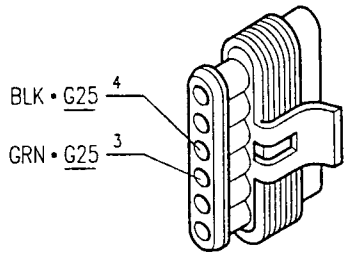
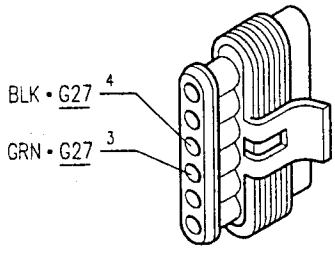


RH front door locking motor	P10	LH front door locking motor	P11

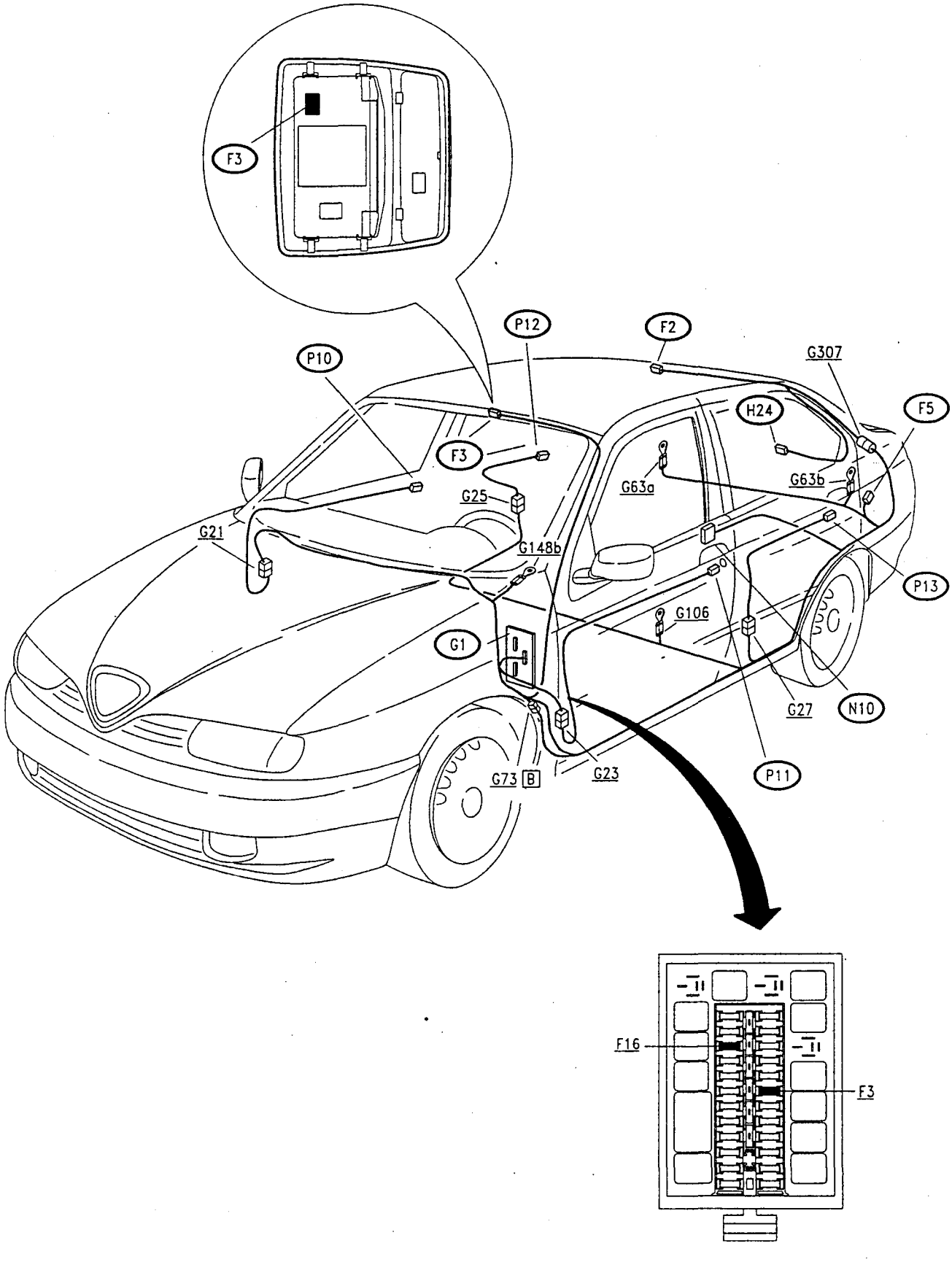




COMPONENTS AND CONNECTORS (continued)

RH rear door locking motor	P12	LH rear door locking motor	P13
			

LOCATION OF COMPONENTS



FAULT-FINDING TABLE

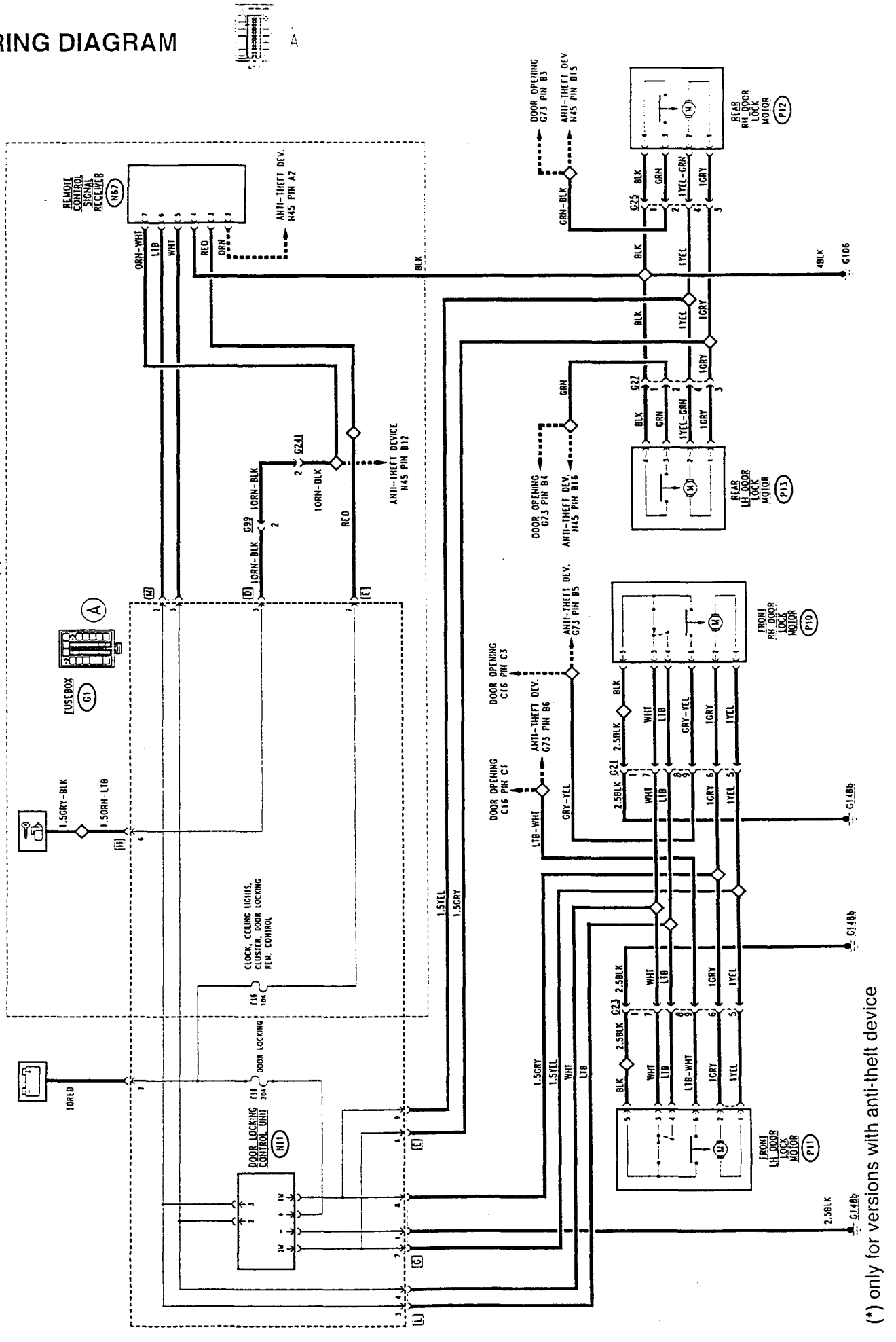
Failure	Component to be checked										
	F3	F16	(F3)	(F2)	(F5)	(N10)	(P10)	(P11)	(P12)	(P13)	(H24)
All the courtesy lights	•										
Front ceiling lights, under all circumstances			•								
Rear ceiling lights, under all circumstances				•							
The two ceiling lights do not turn on when opening the doors	•					•	•				
The two ceiling lights do not turn on when opening the doors	•					•		•			
Boot light					•						
Boot light not timed						•					•

DOOR LOCKING SYSTEM

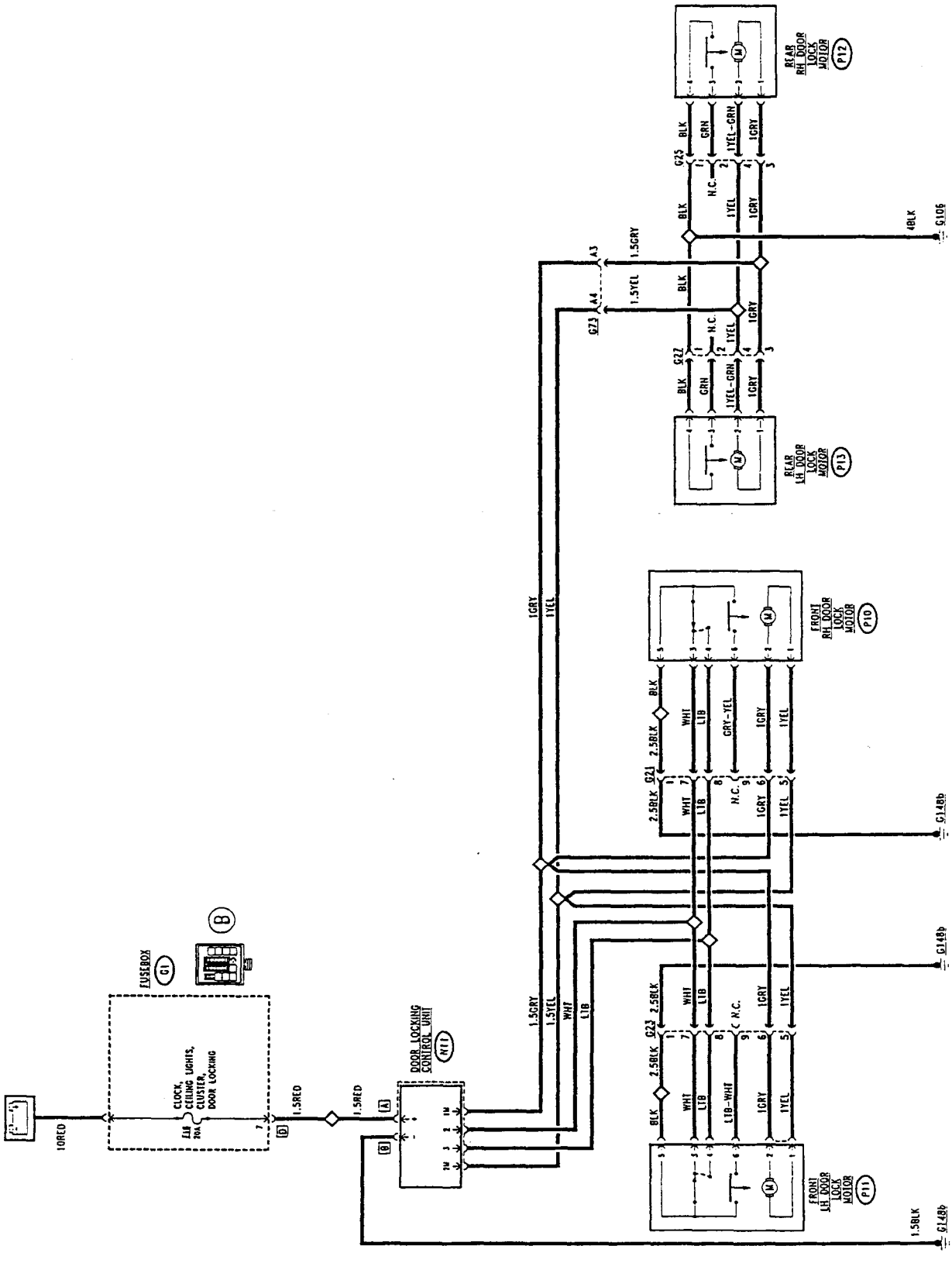
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LOCATION OF COMPONENTS 21-10
FAULTFINDING TABLE 21-11
CHECKING COMPONENTS 21-11

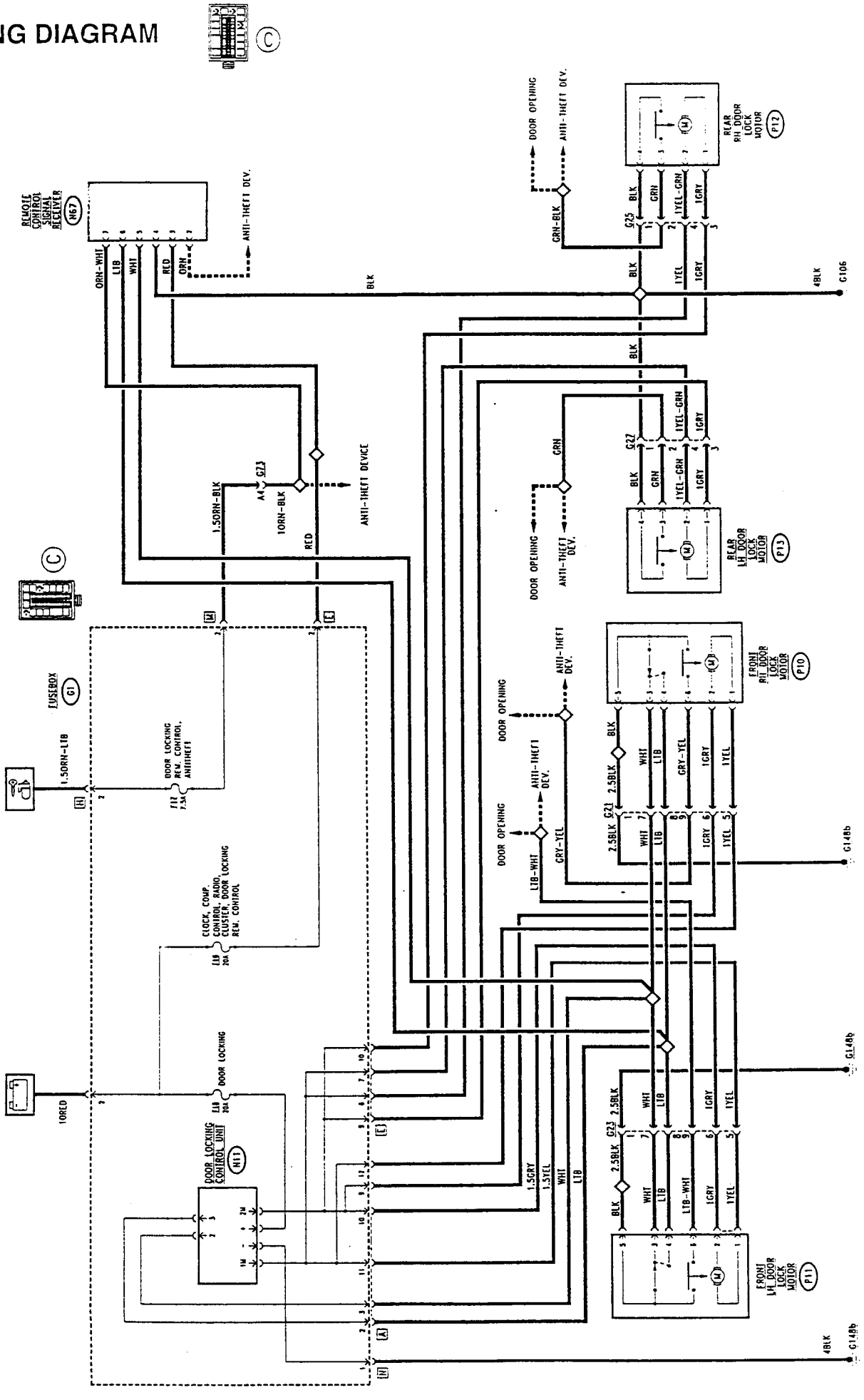
WIRING DIAGRAM



WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The door locking system comprises an electronic control unit which controls and commands the door locks; each lock comprises a gear motor for locking/releasing the door lock, a control switch (connected to the electric circuit only for the tront doors) and a switch signalling that the doors are open.
The latter is used by the Check Panel (see "Doors open signalling") and by the anti-theft device (see "Antitheft device").
The gear motors are operated simultaneously by acting on one of the control switches of the frart door either from inside through the knobs or from the outside using the key. Due to safey reasons the devices for the rear doors are mechanical only (they work closing the door concerned) and do not operate as an electric lock/release command.

NOTE: the control unit logic comprises a series of check and security operations:

- if the power supply is cut off, the locked doors are not released and they will only open when the supply has been restored;
- during release, if one of the control switches is mechanically impeded, release is cut off;
- if a failure causes the supply to the motors to last for over 4 seconds, this supply is cut off (only version for fusebox "A" and "C");
- if several opening/closing commands are received by the control unit from the key, only the last one to be sent will be considered;
- in the event of contrary commands (e.g. one with the key and one with the inside knob) the control unit will oscillate: oscillation ends after 8 consecutive commands (only for version for fusebox "A" and "C").

N.B.: In the **versions with anti-theft device** the door locking device is also operated via the remote control which works in the same way as manual locking/releasing. For further details see "Anti-theft device".

FUNCTIONAL DESCRIPTION

The door lock control unit **N11** is located in fusebox **G1** (fusebox "A" and "C") or on the bracket next to the fusebox (fusebox "B").
It is supplied by the battery voltage (pin +) through fuse **F18** (fusebox "A" and "C") or by fuse **F16** (fusebox "B"), while it is connected to earth (pin -).

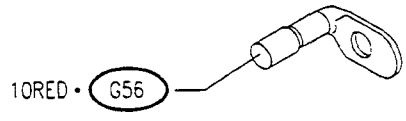
It receives an earth signal at pins 2 and 3 which represents the locking or release command leading from the control switches of the right front lock **P10** and the left one **P11**:

- **locking signal**: if the earth passes from pin 2 to pin 3;
- **releasing signal**: viceversa from pin 3 to pin 2.

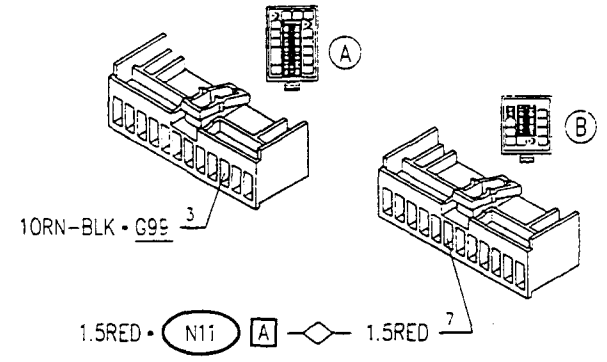
The logic of the control unit **N11** carries out the checks mentioned previously and sends the locking signal (pin 2M: 12V and pin 1M: earth) or releasing signal (pin 1M: 12V and pin 2M: earth) simultaneously to the door lock gear motors **P10**, **P11**, **P12** and **P13.**

COMPONENTS AND CONNECTORS

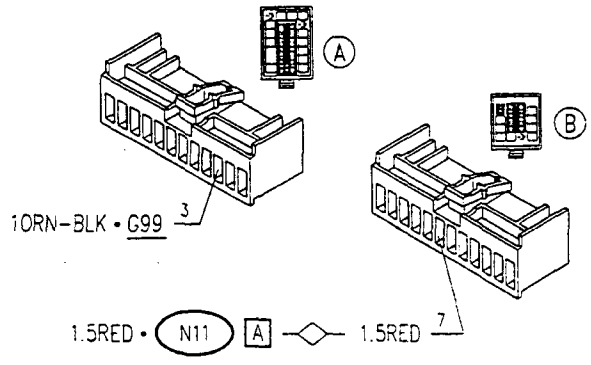
Fusebox G1



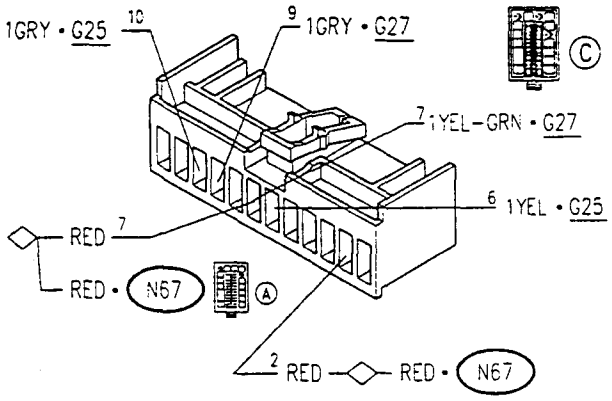
Fusebox G1 A



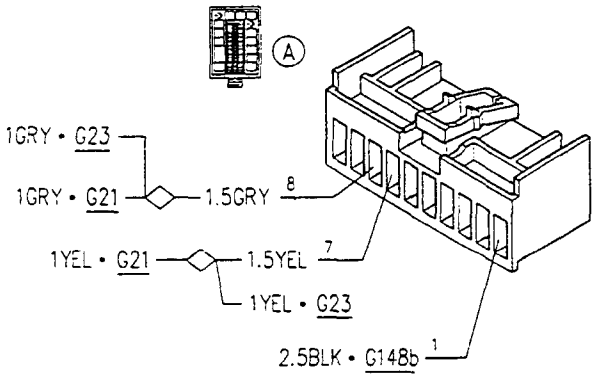
Fusebox G1 D



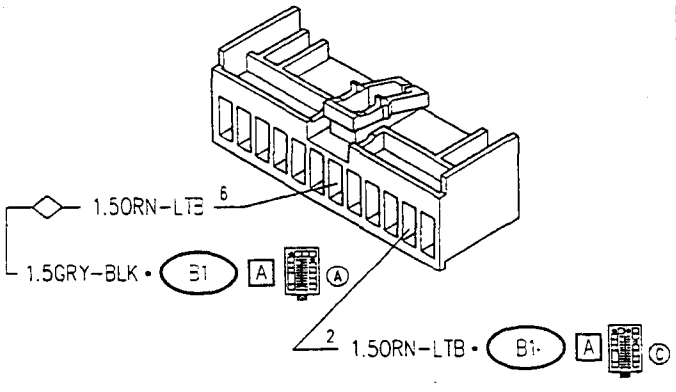
Fusebox G1 E



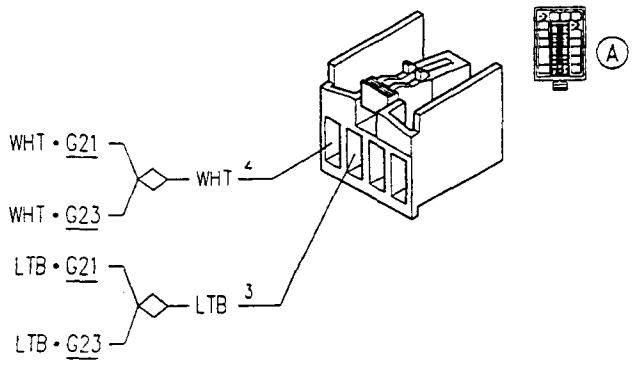
Fusebox G1 G



Fusebox G1 H

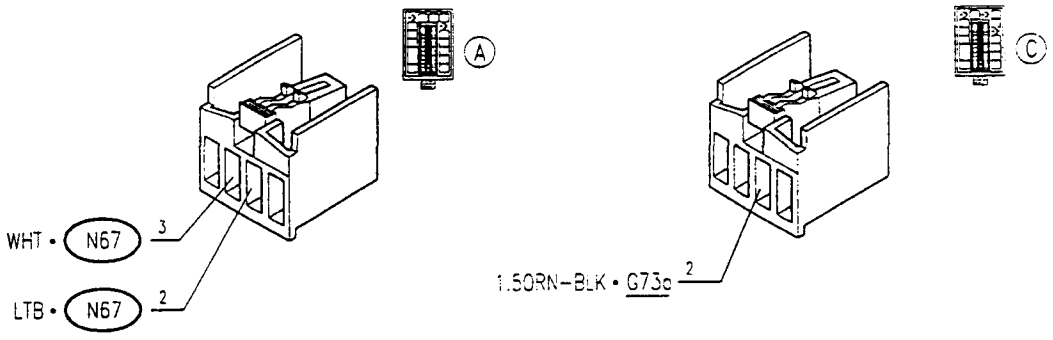


Fusebox G1 L

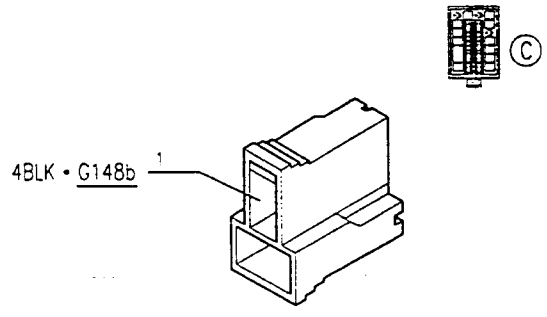


COMPONENTS AND CONNECTORS (cont.d)

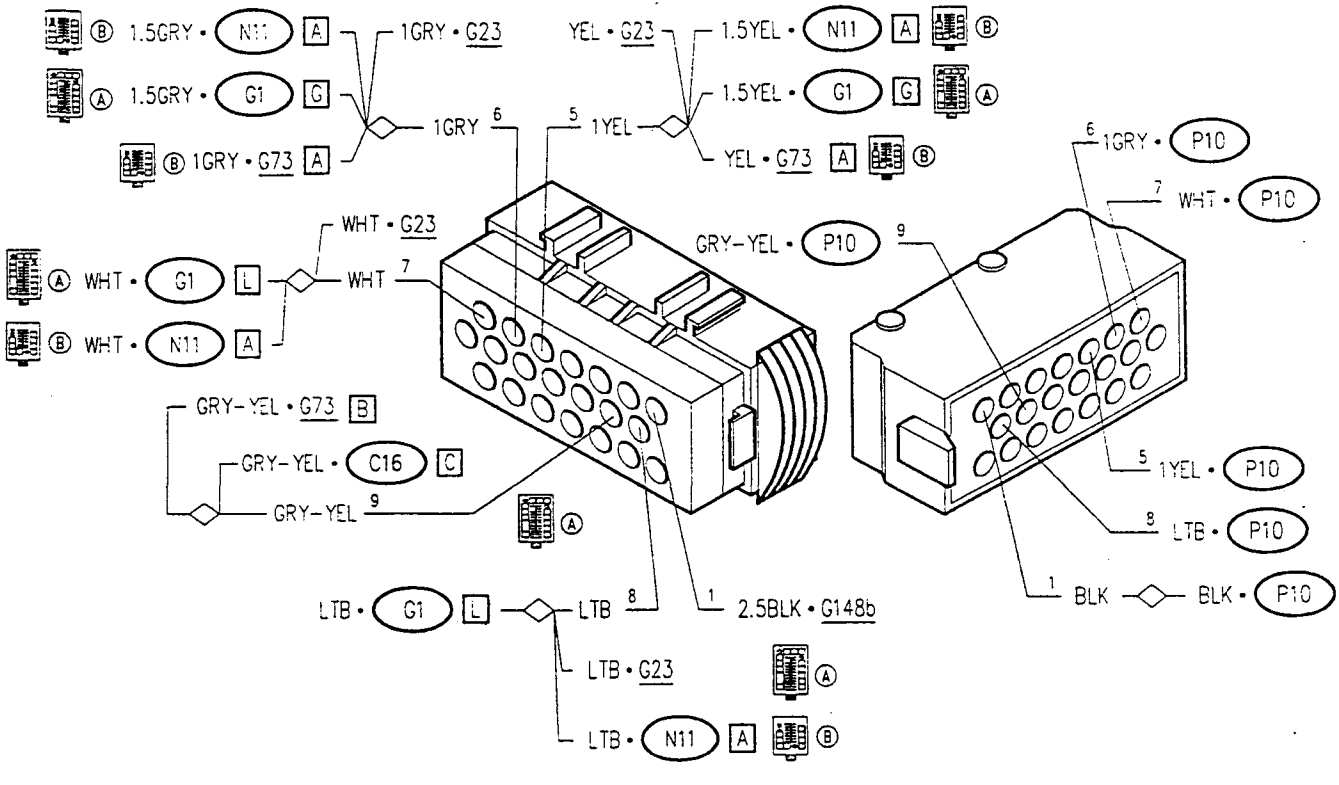
Fusebox	G1 M



Fusebox	G1 N

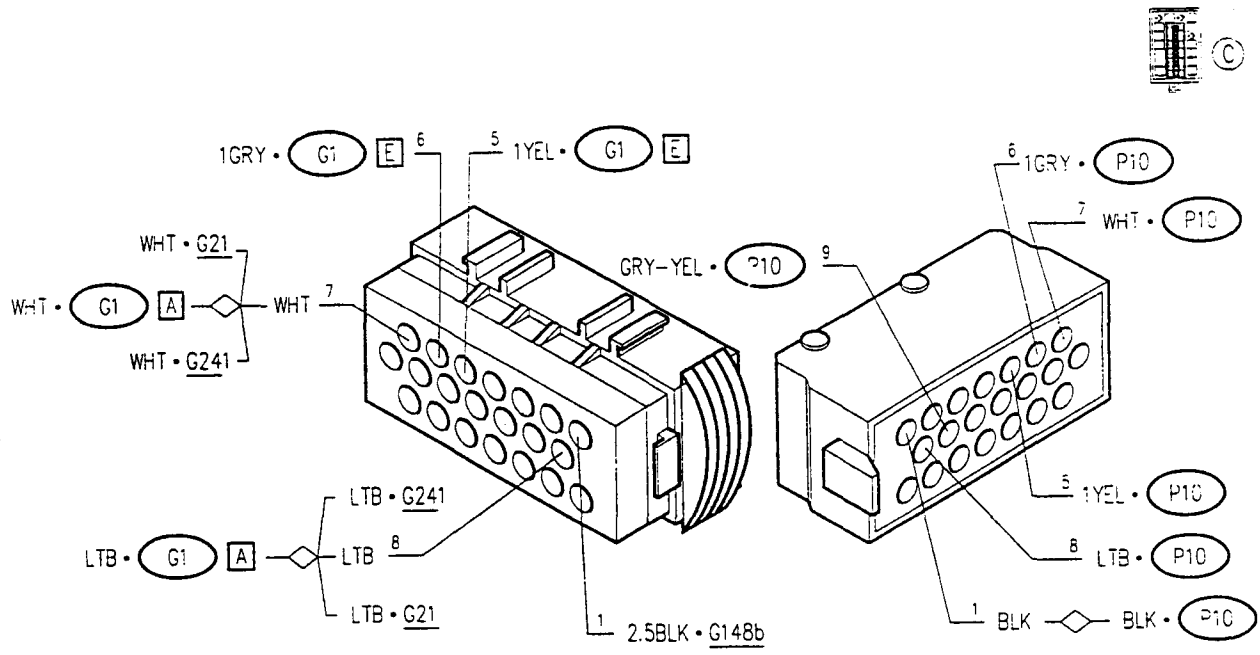


Fusebox	G21

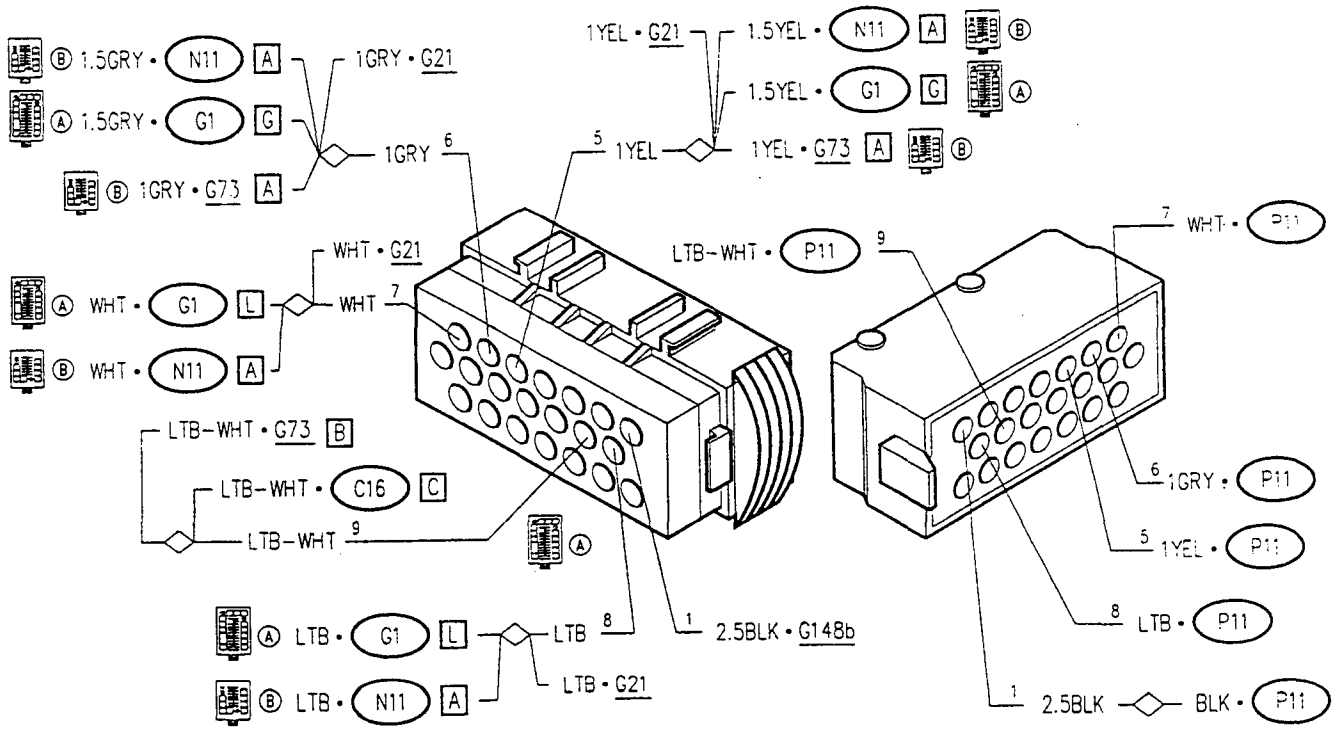


COMPONENTS AND CONNECTORS (cont.d)

RH front door wiring connector	G21

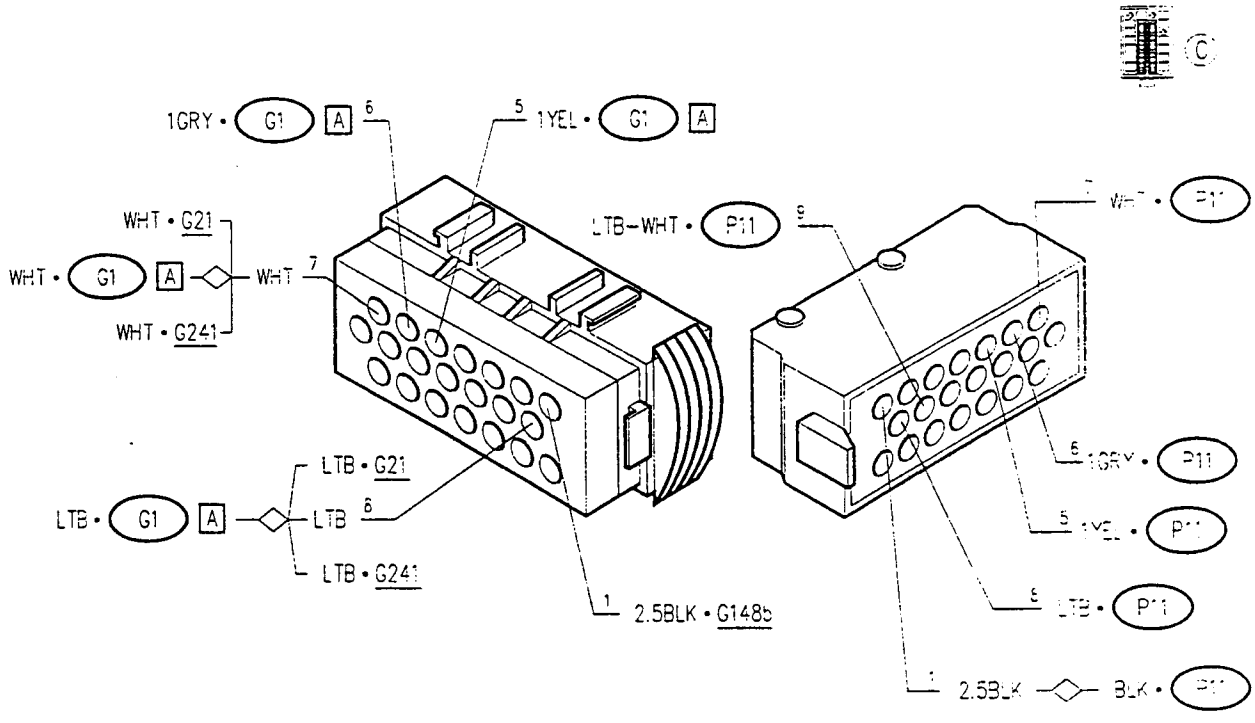


LH front door wiring connector	G23

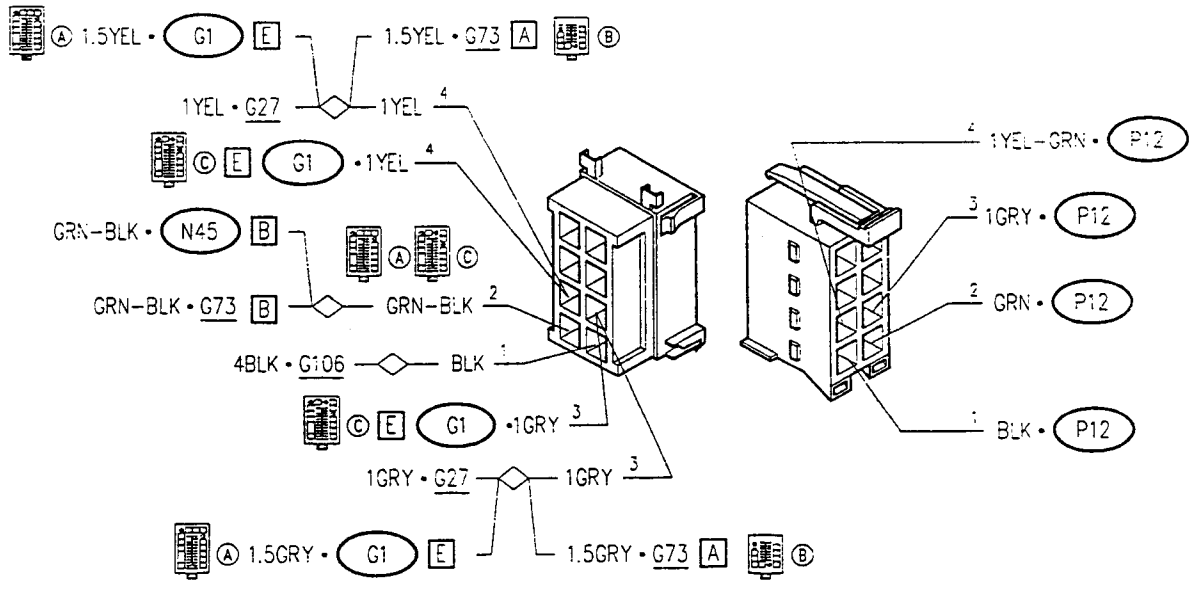


COMPONENTS AND CONNECTORS (cont.d)

LH front door wiring connector	G23

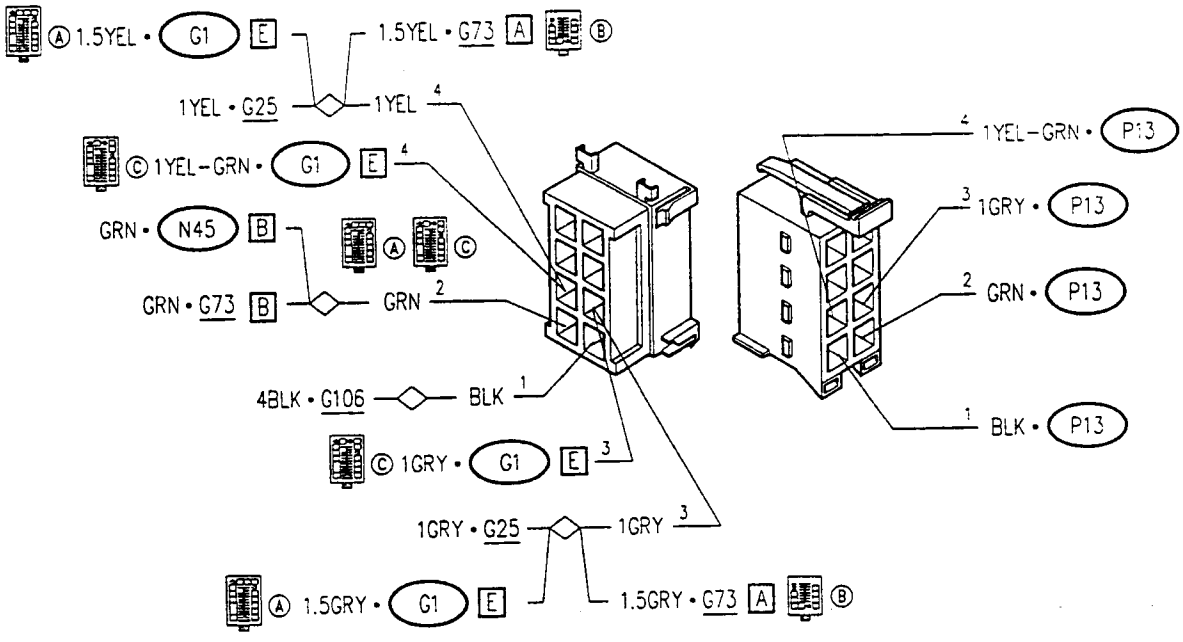


RH rear door wiring connector	G25

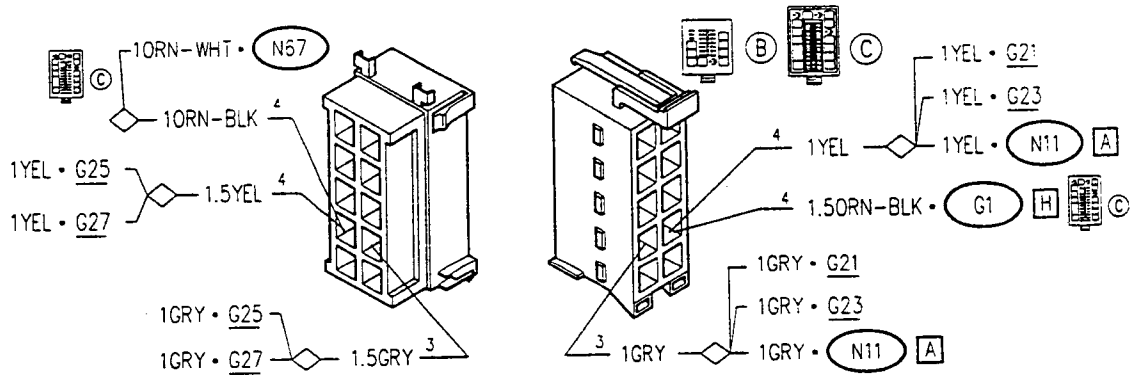


COMPONENTS AND CONNECTORS (cont.d)

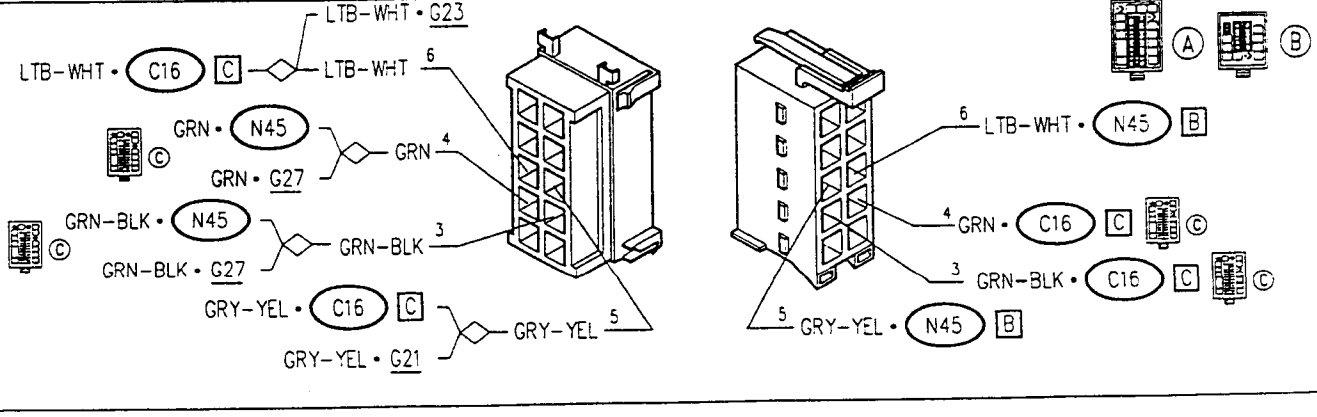
LH reart door wiring connector	G27



Rear services connector	G73 A

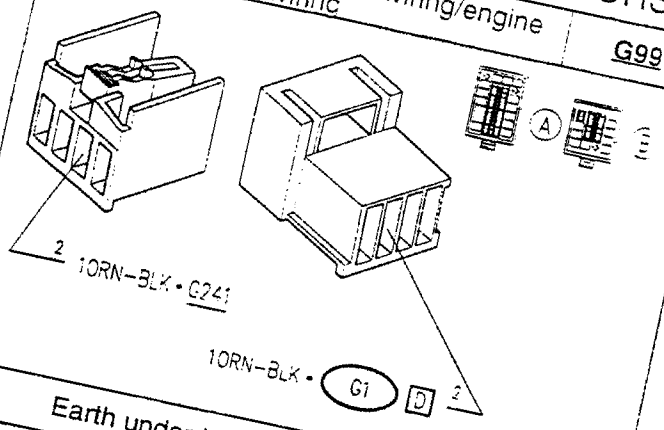


Rear services connector	G73 B

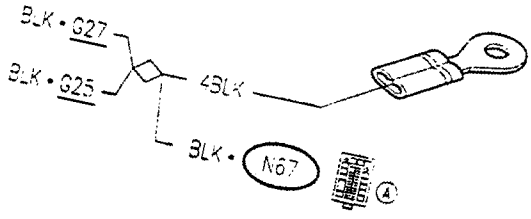


COMPONENTS AND CONNECTORS (cont.d)

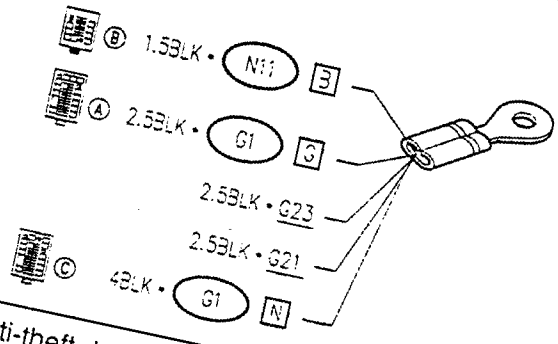
Connector for dashboard wiring/engine wiring — G99



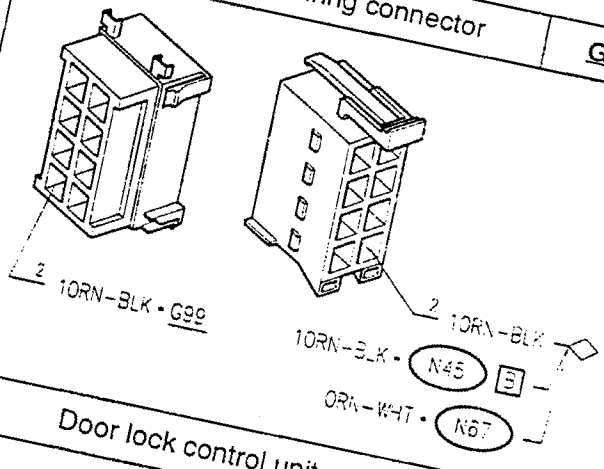
Seat crossmember earth — G106



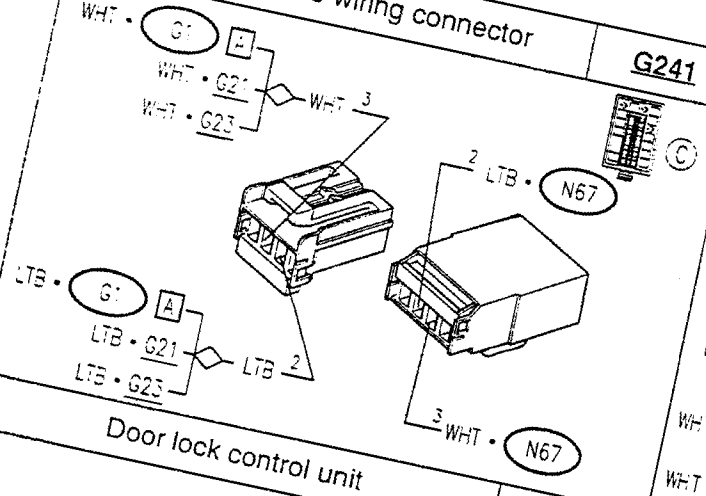
Earth under LH dashboard — G148b



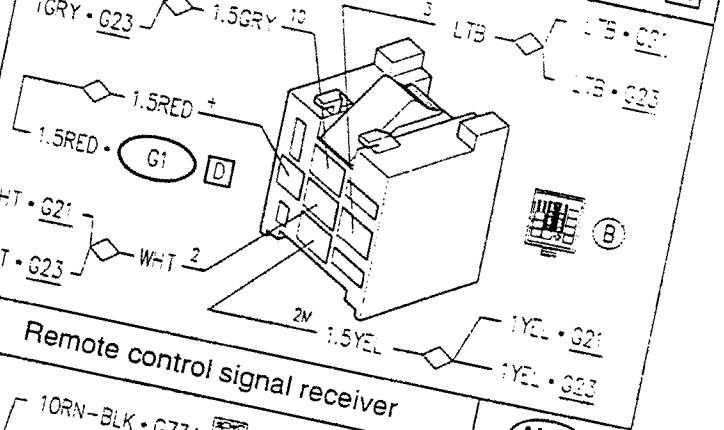
Anti-theft device wiring connector — G241



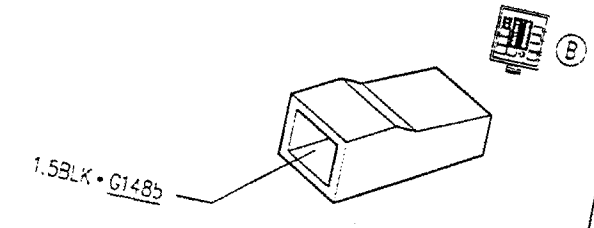
Anti-theft device wiring connector — G241



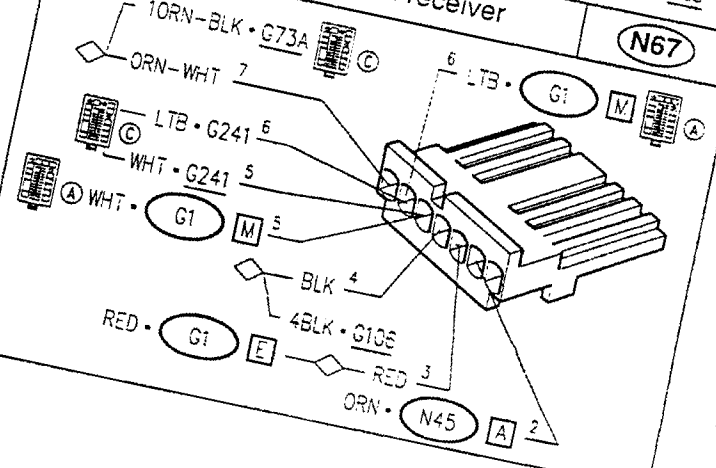
Door lock control unit — N11 A



Door lock control unit — N11 B

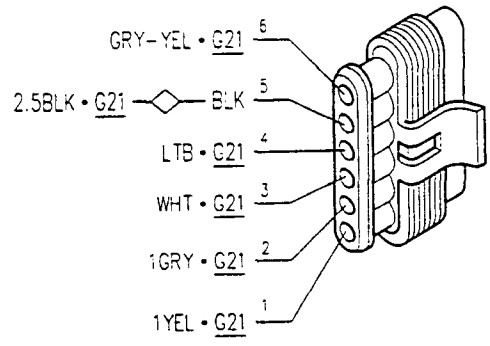


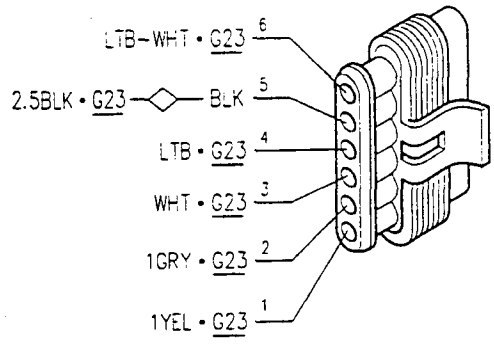
Remote control signal receiver — N67



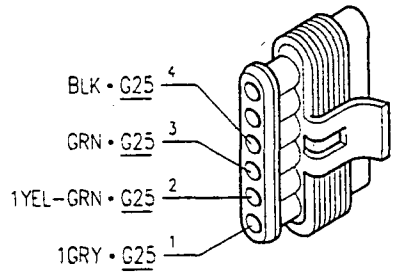
COMPONENTS AND CONNECTORS (cont.d)

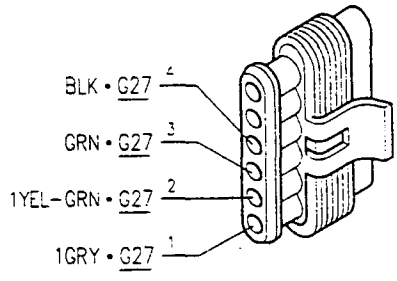
RH front door lock motor	P10	LH front door lock motor	P11



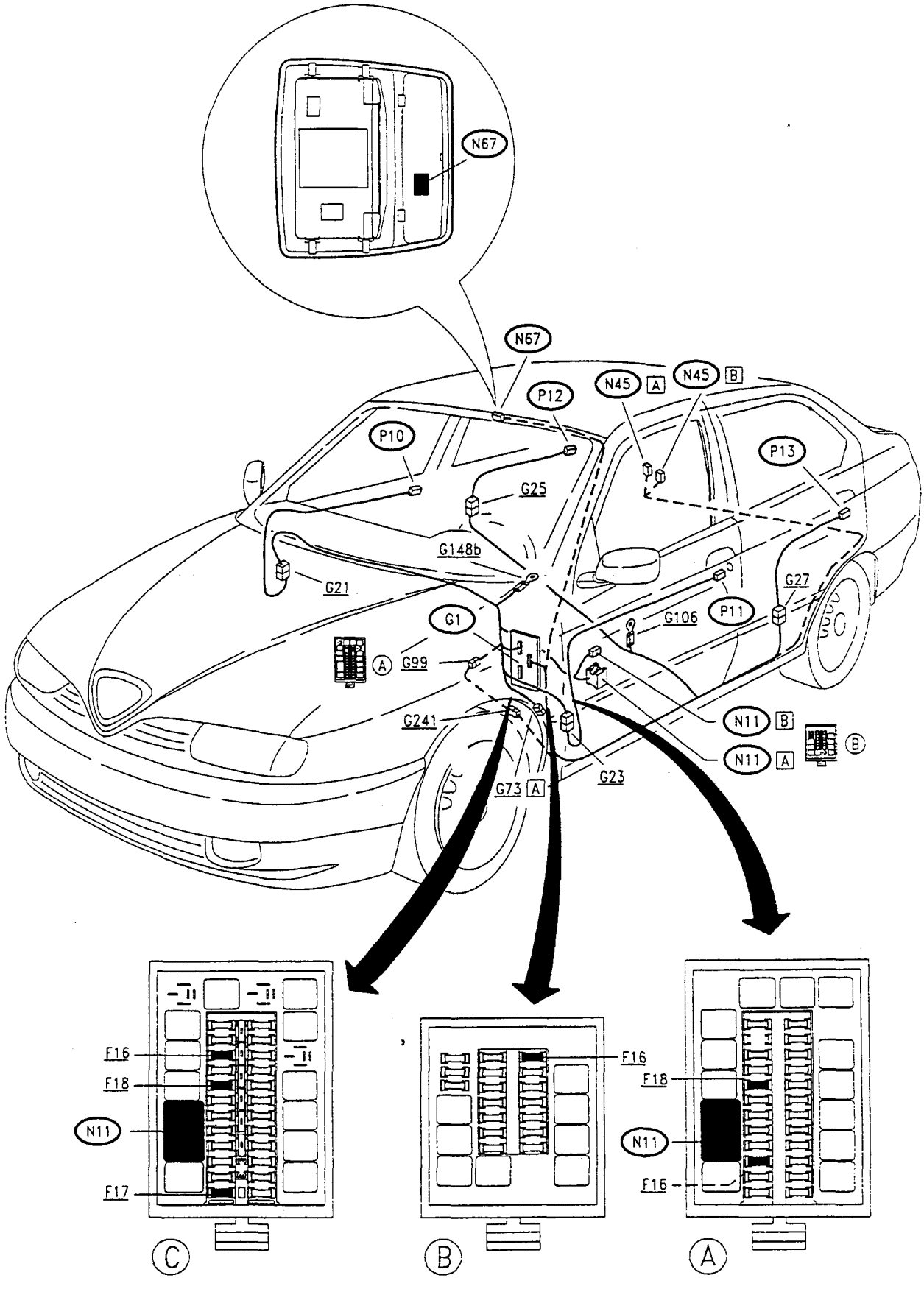


RH rear door lock motor	P12	LH rear door lock motor	P13





LOCATION OF COMPONENTS



– – – only for versions with anti-theft device

FAULTFINDING TABLE

CAUTION:
In the event of a mechanical failure on one of the door lock devices integrated with the lock, the control unit safety logic makes **the lock itself stay open**. In the unlikely event that the doors stay shut and locked, it is however still possible to open the lock manually: using the key from outside or raising the knob from inside.

N.B.: cutting off the supply does not "unlock" locked doors!! Locked doors will only open when the supply is received again.

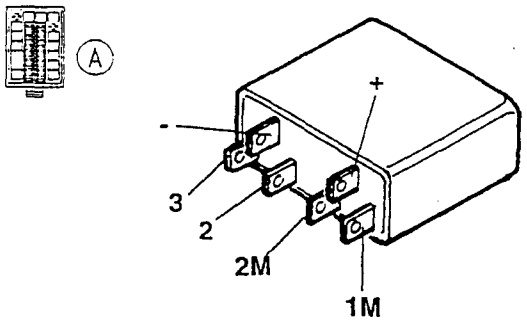
Failure	Component to be checked						
	F16 (B)	F18 (A)	N11	P10	P11	P12	P13
Whole door locking system	•	•	•				
LH front door					•		
RH front door				•			
LH rear door							•
RH rear door						•	

(A) Only fusebox "A"

(B) Only fusebox "B"

CHECKING COMPONENTS

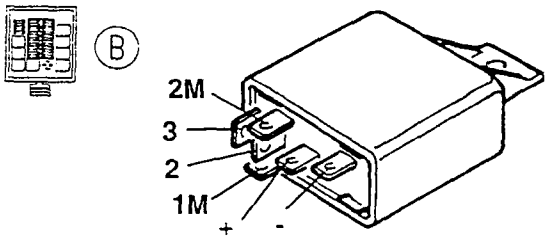
Door locking control unit (N11)



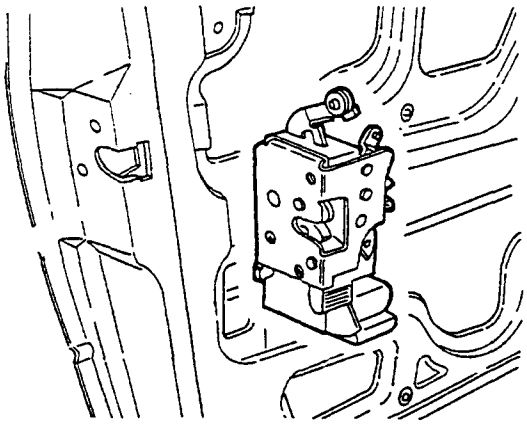
Checking the device:

TEST A (for fusebox "A")

TEST B (for fusebox "B")

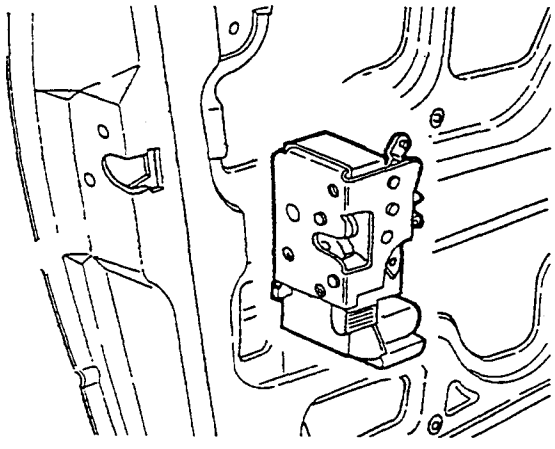


Front door lock gear motor (P10) - (P11)



SPECIFICATIONS	
door closed	continuity between pin 5 and 6
door open	a.c. between pin 5 and 6
lock command	cuts off continuity between pin 5 and 3 and establishes it between pin 5 and 4
release command	cuts off continuity between pin 5 and 4 and establishes it between pin 5 and 3
motor operation	applying 12V between pins 1 and 2

Rear door lock gear motor (P12)- (P13)



SPECIFICATIONS	
door closed	continuity between pin 3 and 4
door open	a.c. between pin 3 and 4
motor operation	applying 12V between pins 1 and 2

CHECKING THE DOOR LOCK CONTROL UNIT (N11) (version for fusebox "A")

TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N11** and check on the base of fusebox **G1**: 12V between the + and - pins of **N11**	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Check fuse **F18** of fusebox **G1**. Check that **G1** is connected to earth: from pin 1 of connector G towards earth **G148b**
A2 CHECK LOCK/RELEASE COMMAND – Operate the door locking or release and check that an earth passes from pin 2 to pin 3 of **N11** or viceversa	OK ▶	Insert device **N11** on the base of **G1** and continue with **step A3**
	~~OK~~ ▶	Restore the wiring between **N11** (**G1**) and the door lock motor (**P10, P11, P12** or **P13**) or change the latter .
A3 CHECK LOCK/RELEASE ACTUATION – Operate the door lock or release device and check for 12V between pin 7 and 8 of connector G of fusebox **G1**	OK ▶	DEVICE **N11** IS WORKING PROPERLY: Check the door lock motor **P10** , **P11**, **P12** or **P13** and the corresponding connections
	~~OK~~ ▶	Change device **N11**

CHECKING THE DOOR LOCK CONTROL UNIT (N11) (version for fusebox "B")

TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK VOLTAGE – Disconnect device **N11** and check on the base for 12V between the + and - pins of **N11**	OK ▶	Carry out **step B2**
	~~OK~~ ▶	Check fuse **F16** of fusebox **G1**. Check the connection between **N11** and fusebox **G1**
B2 CHECK LOCK/RELEASE COMMAND SIGNAL – Operate the door lock or release and check for the passage of an earth signal from 2 to pin 3 of **N11** or viceversa	OK ▶	Insert device **N11** on the corresponding base and continue with **step B3**
	~~OK~~ ▶	Restore the wiring between **N11** and the door lock motor (**P10, P11, P12** or **P13**) or change the latter
B3 CHECK ACTUATION OF LOCK/RELEASE – Operate the door lock or release and check for 12V between pin 1M and 2M of **N11**	OK ▶	DEVICE **N11** IS WORKING PROPERLY: Check the door lock motor **P10** ,**P11**, **P12** or **P13** and the corresponding connections
	~~OK~~ ▶	Change device **N11**

FUSEBOX

INDEX

WIRING DIAGRAM Box "A" ("high" versions) 3-2

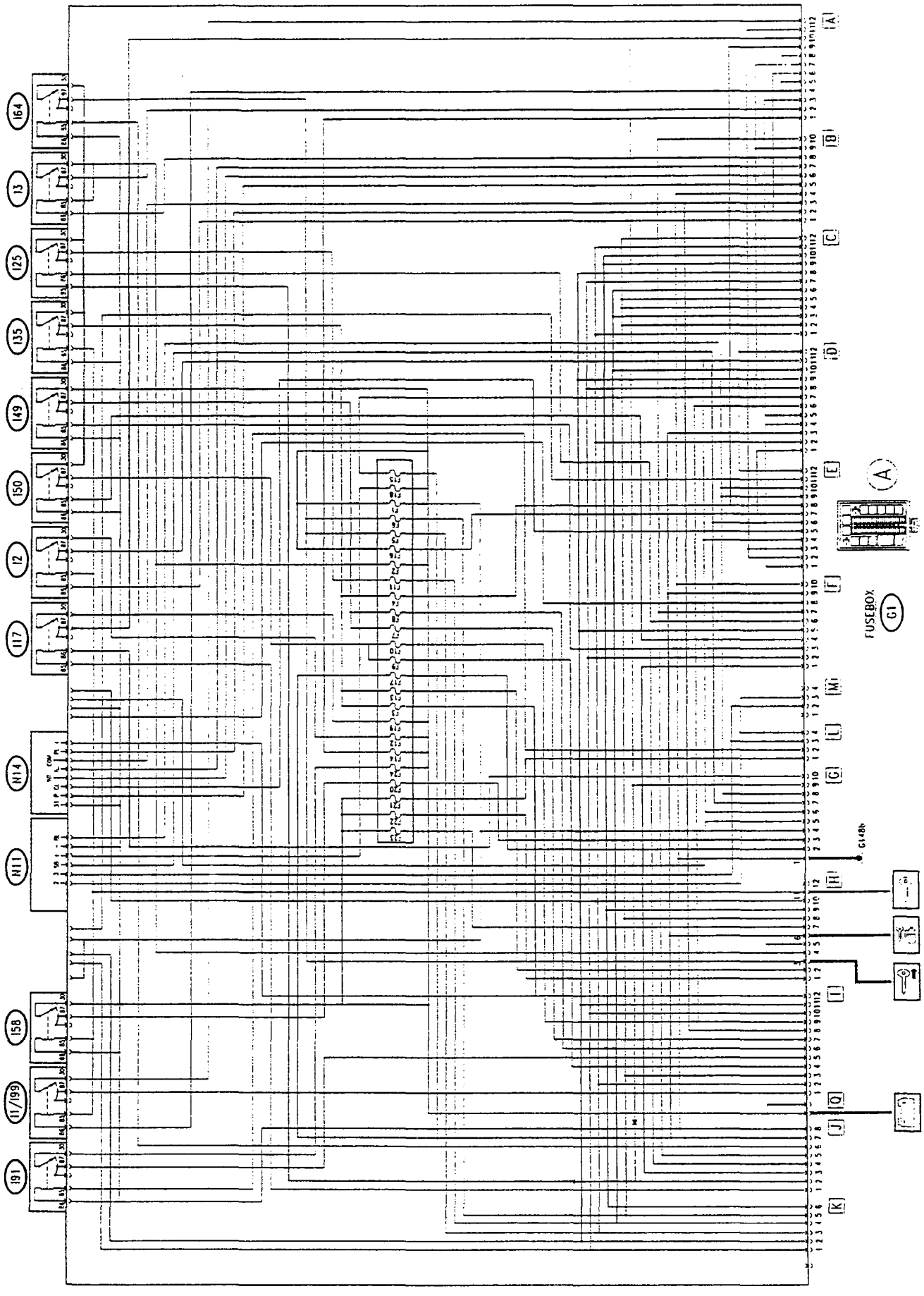
WIRING DIAGRAM Box "B" ("low" versions) 3-3

WIRING DIAGRAM Box "C" 3-4

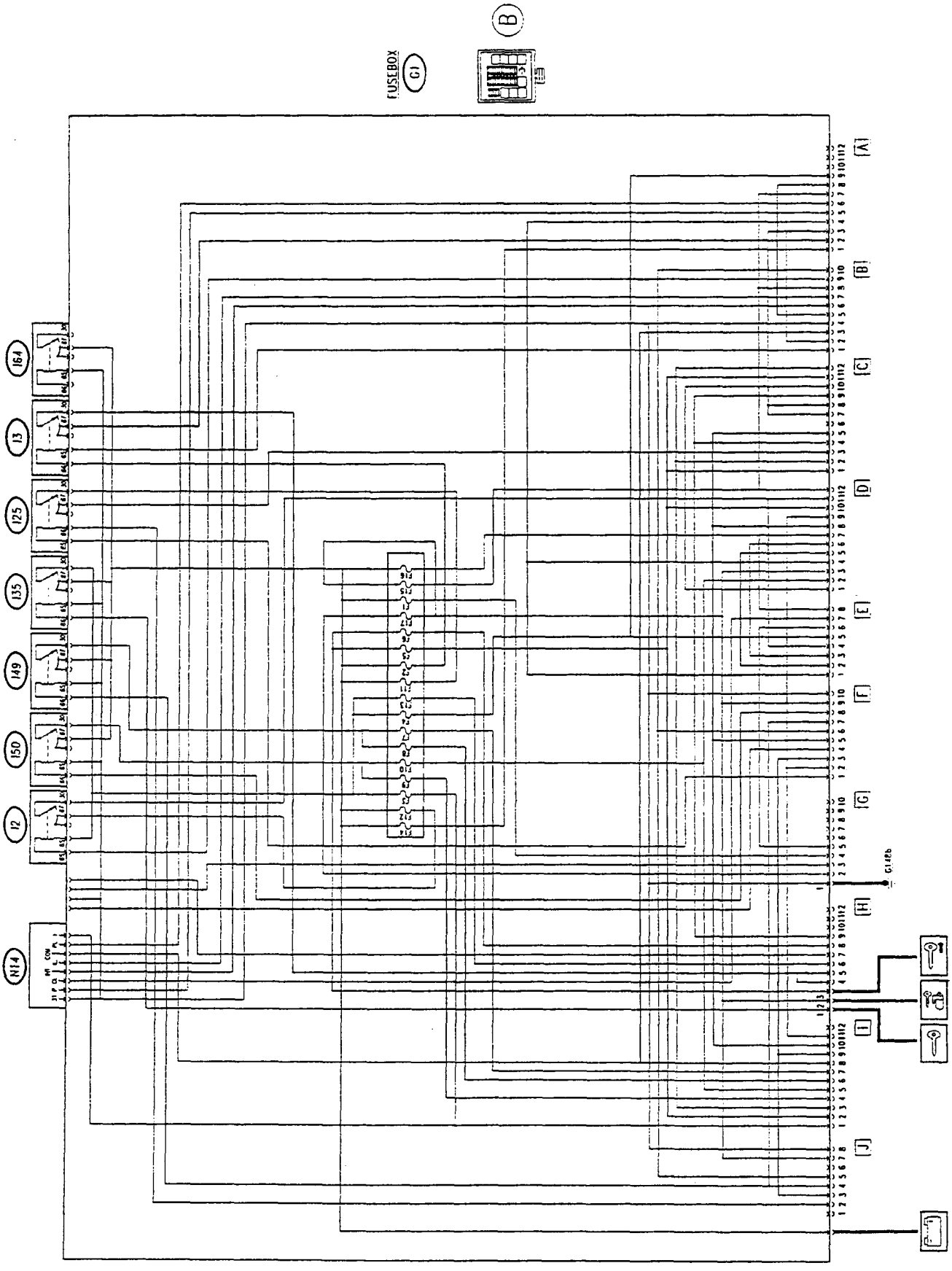
GENERAL DESCRIPTION 3-4/1

FUSES AND RELAYS ON AUXILIRY BRACKET 3-28

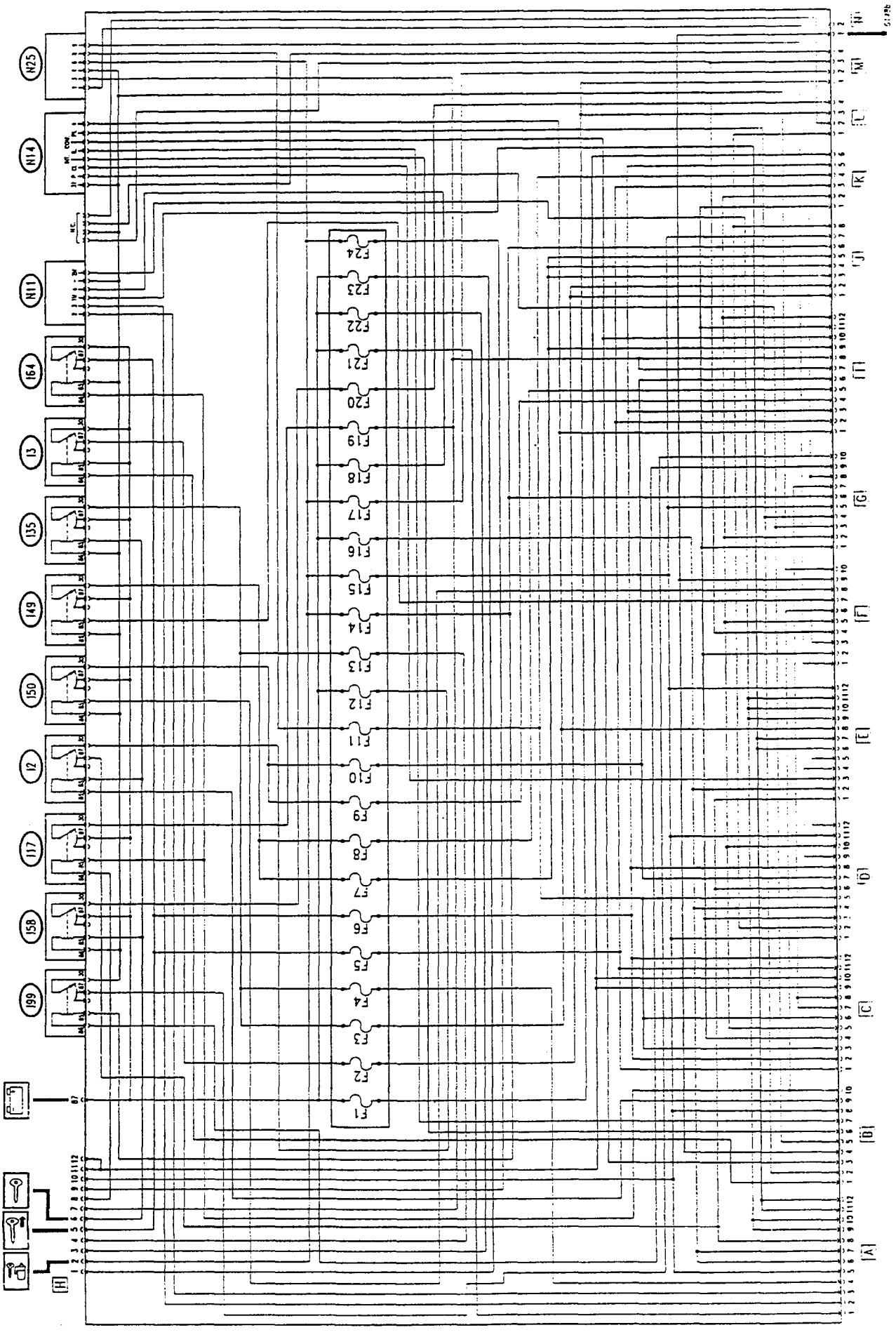
WIRING DIAGRAM Box "A" ("high" versions)



WIRING DIAGRAM Box "B" ("low" versions)



WIRING DIAGRAM Box "C"



GENERAL DESCRIPTION

This section describes the complete printed circuit that makes the connections inside the fusebox **G1**.

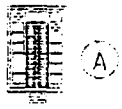
In the various diagrams referring to the individual systems and circuits only the lines associated with the case under examination are shown: this chart gives a complete, overall view of the entire fusebox **G1**.

The fusebox houses a number of relays and other devices, shown here with the corresponding codes, and the fuses (**F1**,...., **F24**).

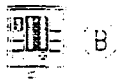
NOTE: not all the output pins of the box **G1** are actually connected for all versions of the car: some lines therefore may be found to be redundant though they will be present on the printed circuit.
Next to the schematic drawings of the connectors a ***list of output signals*** *from the different pins is given:* this simplifies for instance faultfinding work on the different circuits affected. (NOTE: the letters N.C. indicate pins connected inside the fusebox but not used for the present versions of the car).

Two different fuseboxes have been used, the first one called BOX "A" for the "high" versions, i.e. fitted with a number of auxiliary accessories, and the second one known as BOX "B" for the "lower" versions: it is simpler and only contains the indispensible circuit.

Whenever necessary, all the wiring diagrams shown in this Group show the two different fuseboxes using the following symbols:

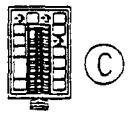


= fusebox "A";

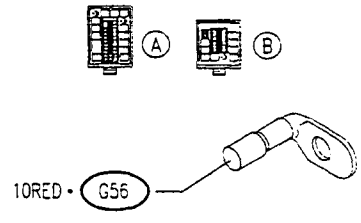


= fusebox "B".

From chassis no.__ the above two boxes have been replaced by a new box "C" used for all versions.

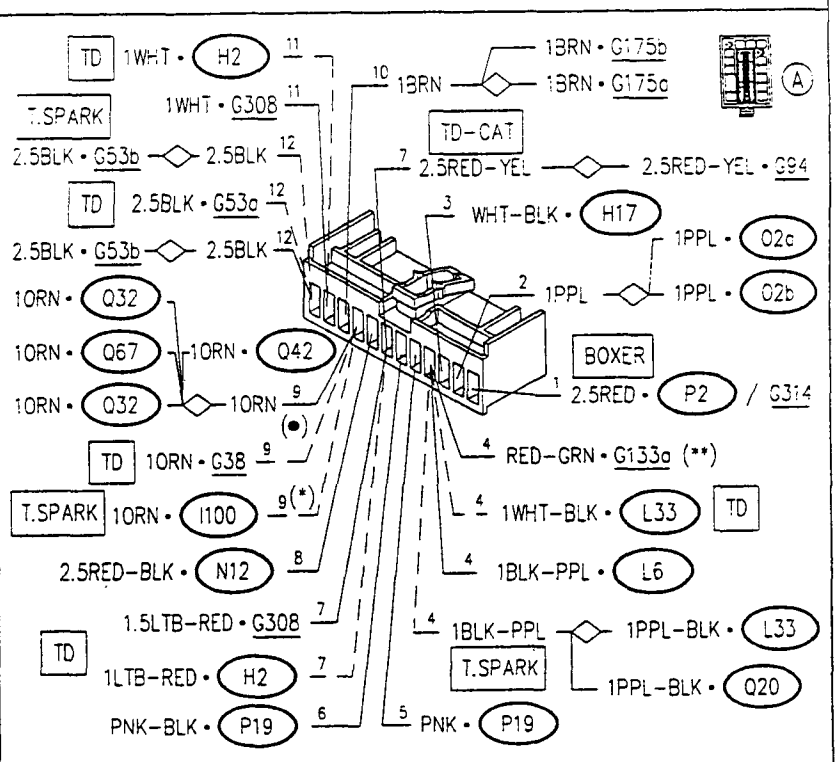


= fusebox "C".

SUPPLY TO FUSEBOX		
PIN	**CIRCUITS**	
-	Supply from terminal board	

CONNECTOR A

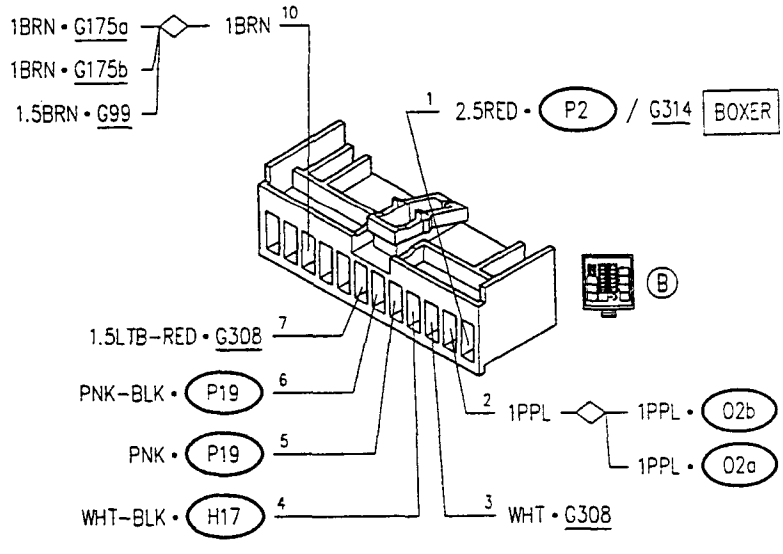
PIN	CIRCUITS
1	Engine fan supply
2	Horns
3	Brake fluid level signal
4	Radiator thermal contact signal
5	Windscreen washer
6	Rearscreen washer
7	Reversing light supply
8	Headlamp washer control
9	Supply for compressor control unit and fan delaying device (TD), engine fan (T.SPARK)
10	Fog lamps
11	Reversing light control
12	Earth for engine fan (*)



(•) TD version, from chassis no....
(*) also Boxer from chassis no. 4065018

CONNECTOR A

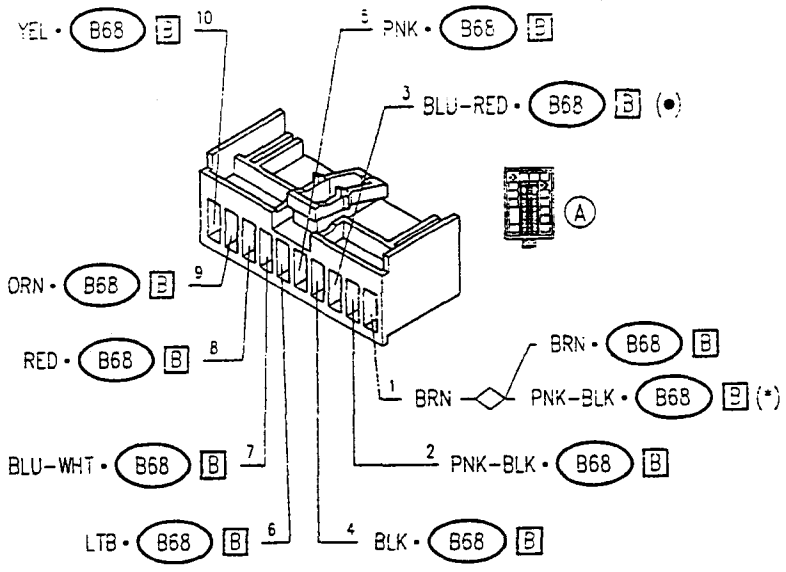
PIN	CIRCUITS
1	Engine fan supply
2	Horns
3	Reversing lights control
4	Brake fluid level signal
5	Windscreen washer
6	Rearscreen washer
7	Reversing light supply
8	N.C.
9	N.C.
10	N.C.
11	N.C.
12	N.C.



(•) TD version, from chassis no....
(**) from M.Y. '97

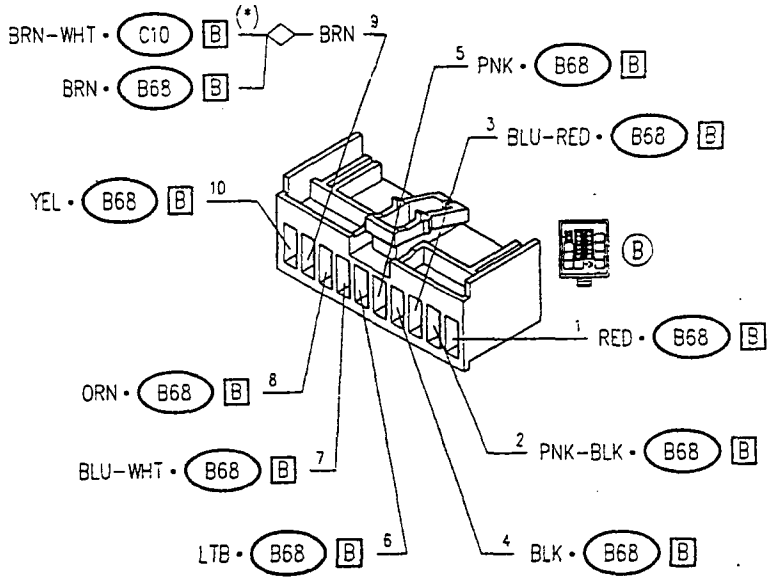
CONNECTOR B

PIN	CIRCUITS
1	Heated rearscreen control
2	Rearscreen washer control
3	Windscreen wiper control
4	Lever unit RH earth
5	Windscreen washer control
6	Windscreen washer intermittence control
7	Rearscreen wiper control
8	Horn control
9	Windscreen washer supply
10	RH lever unit lighting



CONNECTOR B

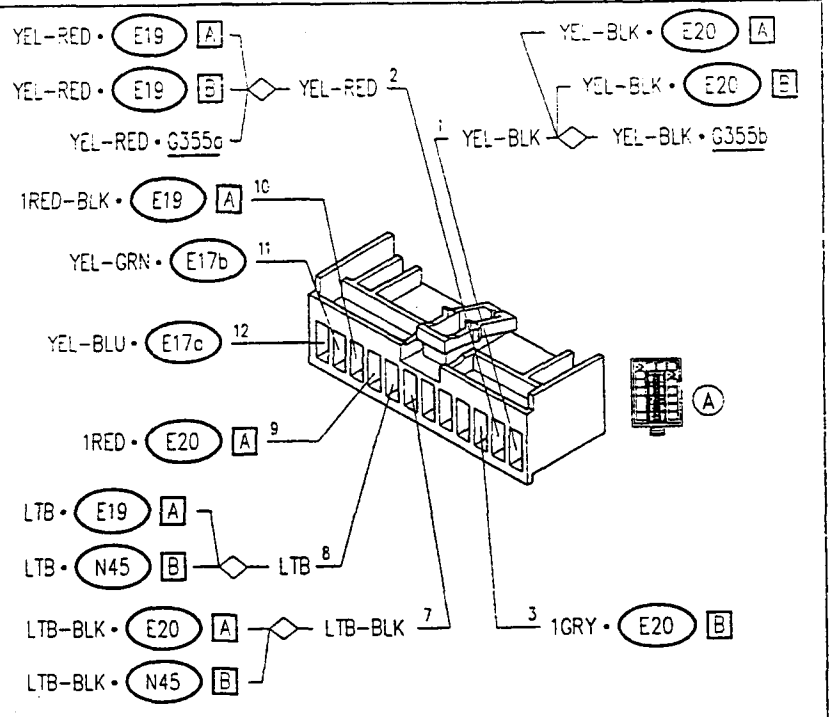
PIN	CIRCUITS
1	Horn control
2	Rearscreen washer control
3	Windscreen wiper control
4	Lever unit RH earth
5	Windscreen washer control
6	Windscreen washer intermittence control
7	Rearscreen wiper control
8	Windscreen washer supply
9	Heated rearscreen control
10	RH lever unit lighting



(•) only up to M.Y. '96
(*) from M.Y. '97

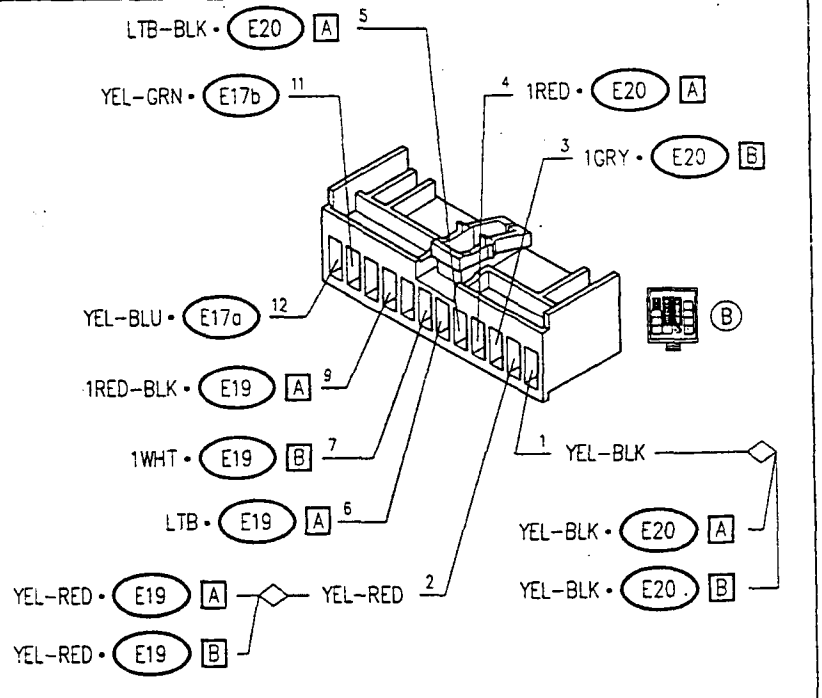
CONNECTOR C

PIN	CIRCUITS
1	LH rear sidelights
2	RH rear sidelights
3	Rear fog guard
4	N.C.
5	N.C.
6	N.C.
7	Rear LH direction indicator
8	RH rear direction indicator
9	LH stop light
10	RH stop light
11	RH number plate light
12	LH number plate



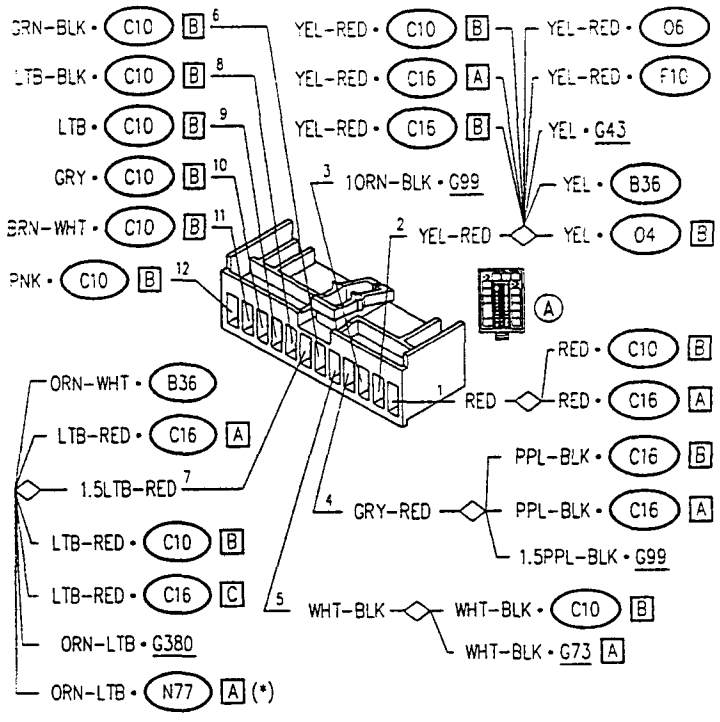
CONNECTOR C

PIN	CIRCUITS
1	LH rear sidelights
2	RH rear sidelights
3	Rear fog guard
4	LH stop light
5	Rear LH direction indicator
6	RH rear direction indicator
7	Reversing light
8	N.C.
9	RH stop light
10	N.C.
11	RH number plate light
12	LH number plate



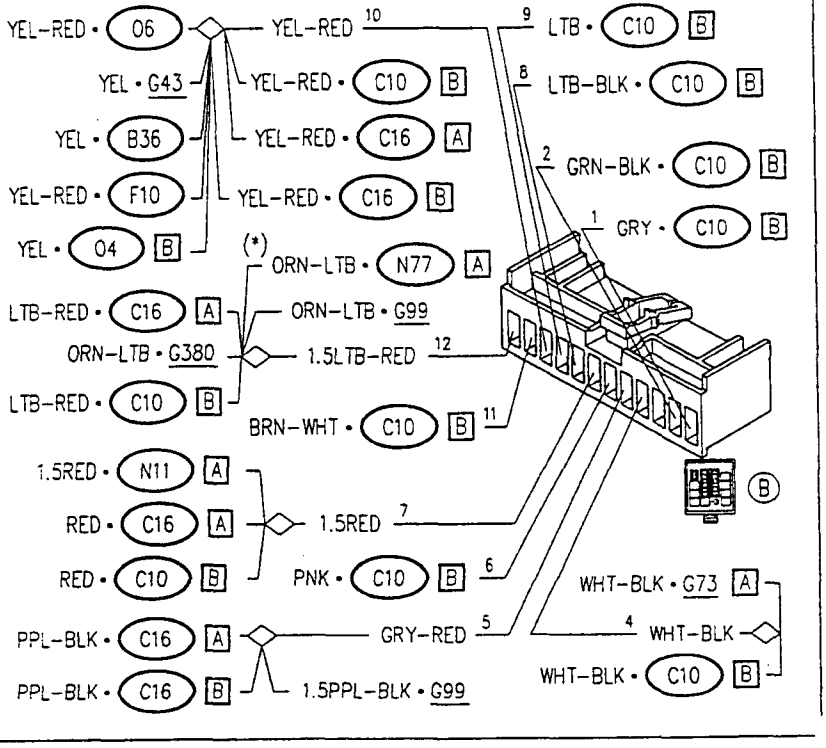
CONNECTOR D

PIN	CIRCUITS
1	Supply to instr.cluster, check panel (direct)
2	lighting for controls, indicators etc., sidelights warning light
3	Supply to anti-theft device & door lock relay door locks (key-operated)
4	Controlled earth
5	Handbrake/brake fluid warning light
6	High beam warning light
7	Supply to instr.cluster, check panel, wing mirror adj., airbag, ALFA ROMEO CODE control unit (*) (key-operated)
8	LH direction indicator warning light
9	RH direction indicator warning light
10	RH fog guard warning light
11	Heated rearscreen warning light Fuel level gauge



CONNECTOR D

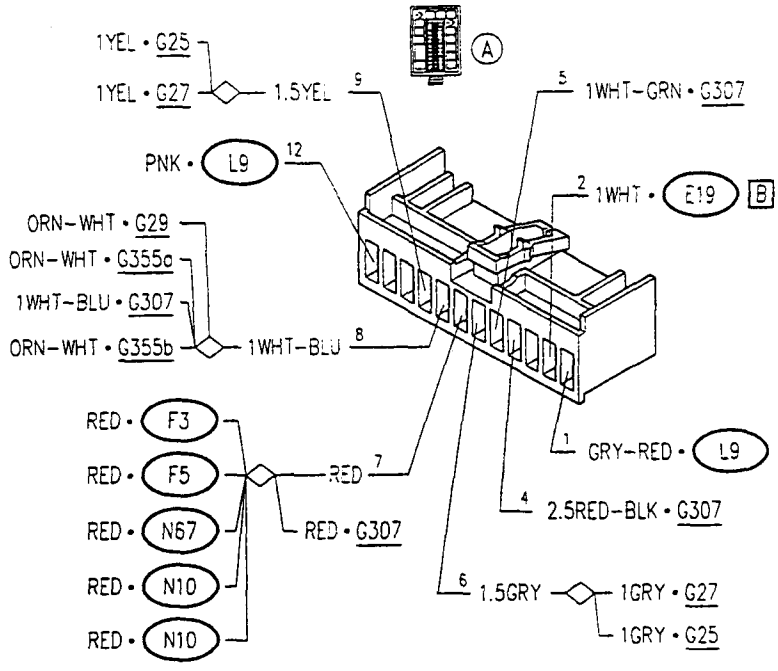
PIN	CIRCUITS
1	Fog guard warning light
2	High beam warning light
3	N.C.
4	Handbrake/brake fluid warning light
5	Controlled earth
6	Fuel level gauge
7	Supply to instr.cluster, check panel, door locking (direct)
8	LH direction indicator warning light
9	RH direction indicator warning light
10	Lighting for controls, indicators etc., side lights warning light
11	Heated rearscreen warning light
12	Supply for instr.cluster, check panel, airbag, engine fan, ALFA ROMEO control unit (*) (key-operated)



(•) only up to M.Y. '96

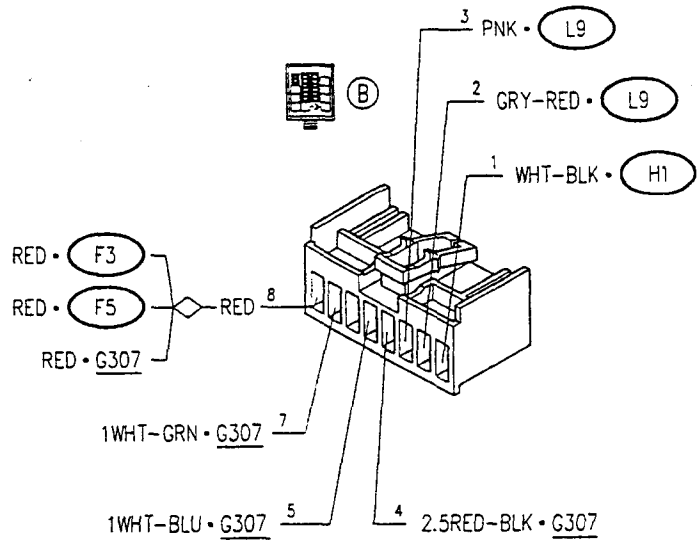
CONNECTOR E

PIN	CIRCUITS
1	Fuel level signal
2	Reversing lights
3	N.C.
4	Heated rearscreen
5	Heated rearscreen
6	N.C.
7	Supply for ceiling lamps & door locking control (direct)
8	Supply to heated rearscreen & heated seats (key-operated)
9	N.C.
10	N.C.
11	N.C.
12	Earth for fuel level

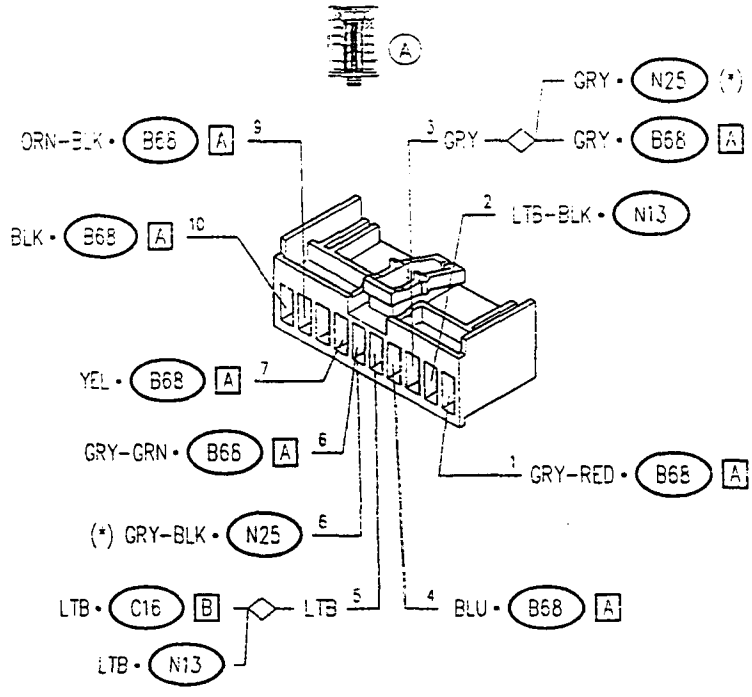


CONNECTOR E

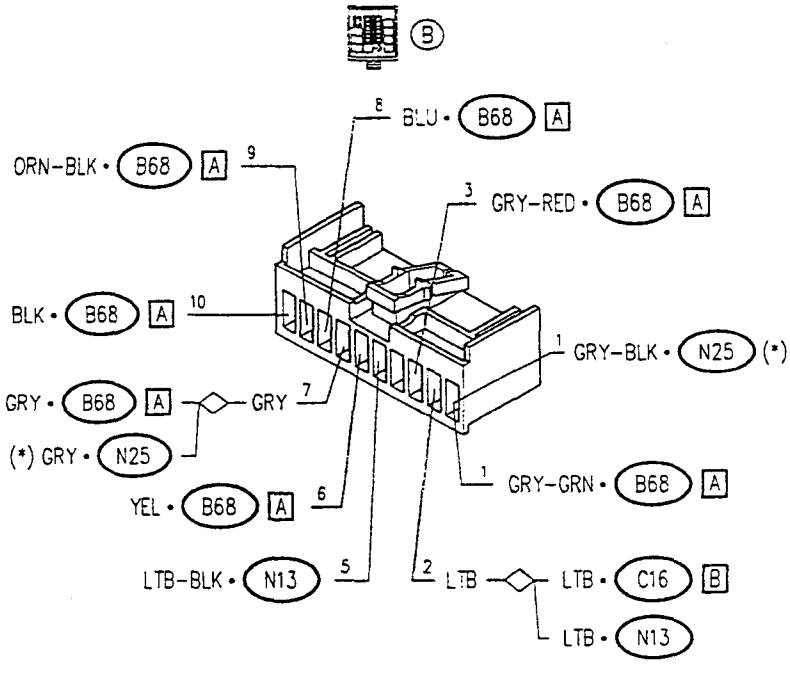
PIN	CIRCUITS
1	Handbrake signal
2	Fuel level signal
3	Fuel level earth
4	Heated rearscreen
5	Heated rearscreen supply (key-operated)
6	N.C.
7	Heated rearscreen
8	Ceiling lights supply



CONNECTOR F	
PIN	**CIRCUITS**
1	Rear fog guard consent
2	LH direction indicator control
3	Low beam control
4	High beam control
5	RH direction indicator control
6	Rear fog guard control
7	Sidelights control & LH lever unit lighting
8	N.C.
9	Lever unit supply
10	LH lever unit earth



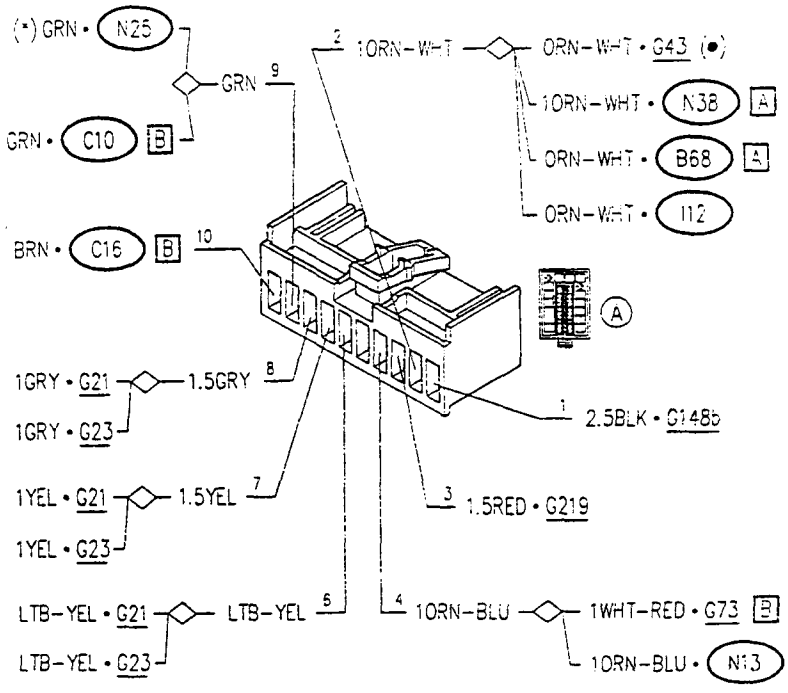
CONNECTOR F	
PIN	**CIRCUITS**
1	Rear fog guard control
2	RH direction indicator control
3	Rear fog guard consent
4	N.C.
5	LH direction indicator control
6	Sidelights control & LH lever unit lighting
7	Low beam control
8	High beam control
9	Lever unit supply
10	LH lever unit earth



(*) from M.Y. '97

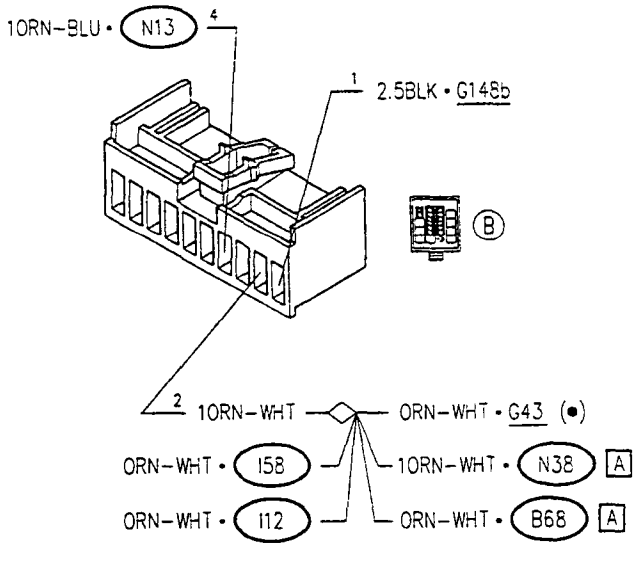
CONNECTOR G

PIN	CIRCUITS
1	**Fusebox earth**
2	Supply for side lights, power windows, luggage compt. opening, air conditioner (key-operated)
3	Sunroof
4	Hazard warning light supply
5	N.C.
6	Wing mirror defrosting
7	Door locking control
8	Door locking control
9	Fog lamp warning light
10	Fog lamp control



CONNECTOR G

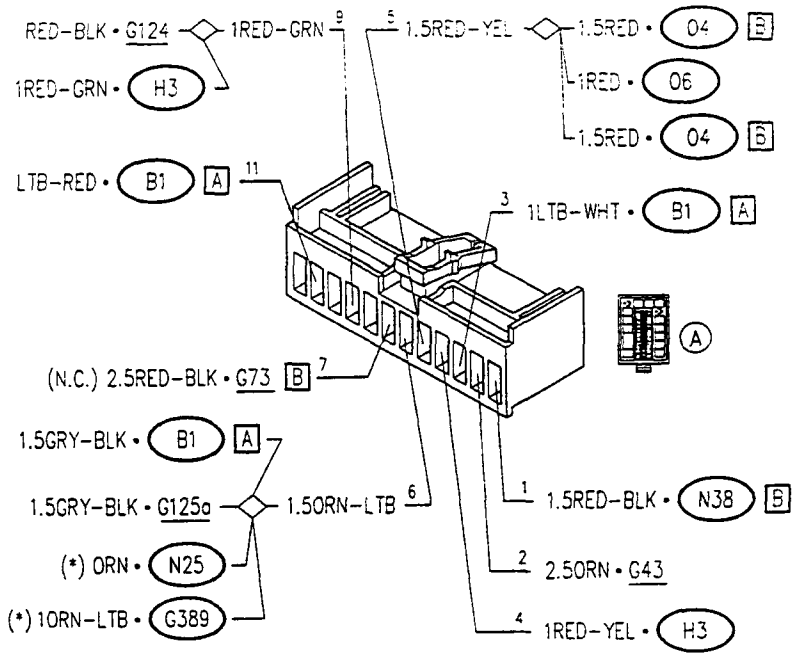
PIN	CIRCUITS
1	**Fusebox earth**
2	Supply for side lights, power windows, air conditioner, sun roof (key-operated)
3	N.C.
4	Hazard warning light supply
5	N.C.
6	N.C.
7	N.C.
8	N.C.
9	N.C.
10	N.C.



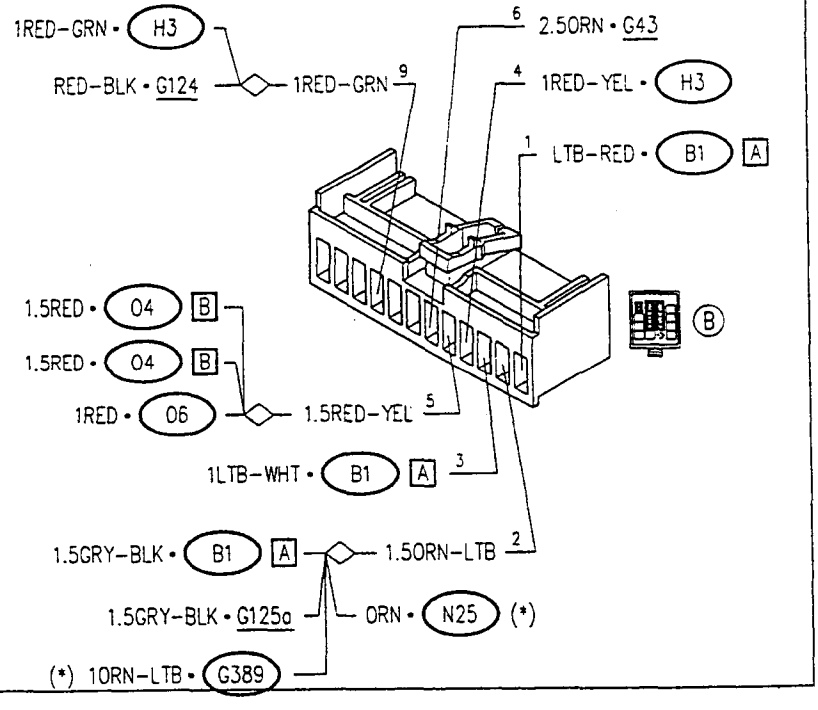
(*) from M.Y. '97

(•) only up to chassis no. 4065017

CONNECTOR H	
PIN	**CIRCUITS**
1	Power window control unit supply (direct)
2	Heater fan supply
3	"Key-operated" supply (PARKING) Stop lights supply
4	Supply for radio, cigar lighter
5	"Key-operated" supply
6	N.C.
7	N.C.
8	Stop lights control
9	N.C.
10	"Key-operated" supply (except starting)
11	N.C.
12	



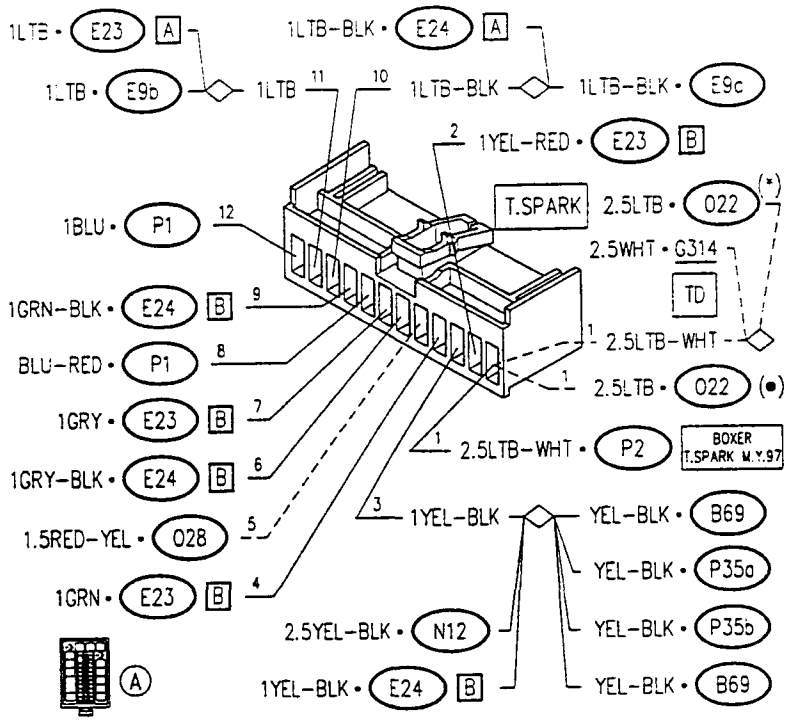
CONNECTOR H	
PIN	**CIRCUITS**
1	"Key-operated" supply (except starting)
2	"Key-operated" supply
3	"Key-operated" supply (PARKING) Stop lights supply
4	Supply for radio, cigar lighter
5	Heater fan supply device
6	N.C.
7	N.C.
8	Stop lights control
9	N.C.
10	N.C.
11	N.C.
12	



(*) from M.Y. '97

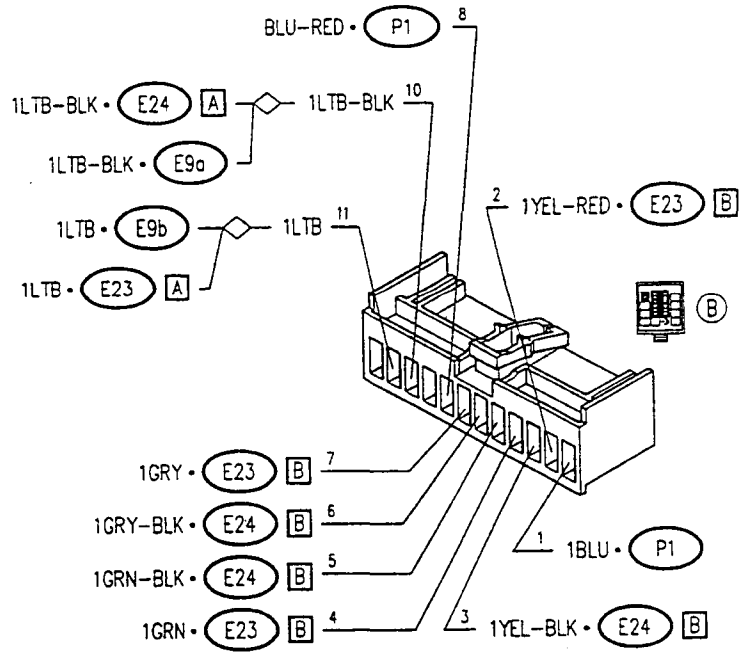
CONNECTOR I

PIN	CIRCUITS
1	Engine fan control
2	RH front sidelight
3	LH front sidelight, headlamp aiming device supply, contr.lighting
4	RH high beam
5	Dimmed high beams (only for certain Markets)
6	LH low beam
7	RH low beam
8	Windscreen wiper
9	LH low beam
10	LH front and side direction indicators
11	RH front and side direction indicators
12	Windscreen wiper supply



CONNECTOR I

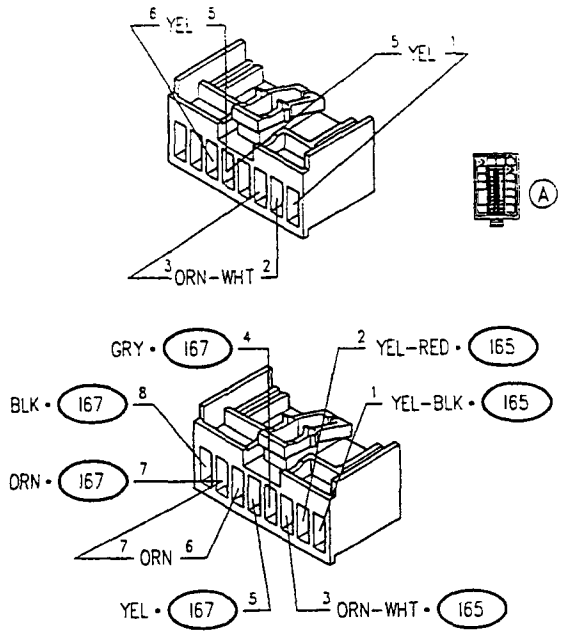
PIN	CIRCUITS
1	Windscreen wiper supply
2	RH front sidelight
3	LH front sidelight
4	RH high beam
5	LH high beam
6	LH low beam
7	RH low beam
8	Windscreen wiper
9	N.C.
10	LH front and side direction indicators
11	RH front and side direction indicators
12	N.C.



(•) TD version, from chassis no....

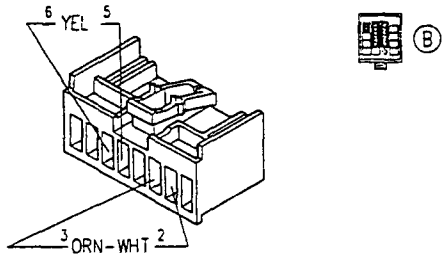
(*) also Boxer from chassis no.4065018

CONNECTOR J	
PIN	**CIRCUITS**
1	Fog lamp consent
2	Rear fog guard consent
3	Low beam control
4	Low beam consent
5	Sidelights control
6	Sidelights consent
7	Key-operated supply
8	Earth

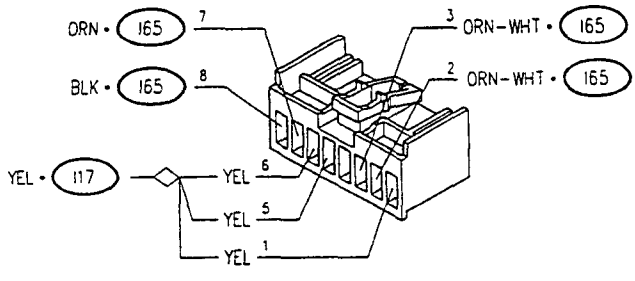


"Daylights" version

CONNECTOR J	
PIN	**CIRCUITS**
1	N.C.
2	Rear fog guard consent
3	Low beam control
4	N.C.
5	Sidelights control
6	Sidelights consent
7	Key-operated supply
8	Earth



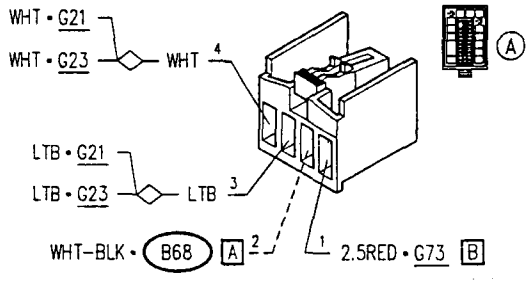
Version without fog lamps



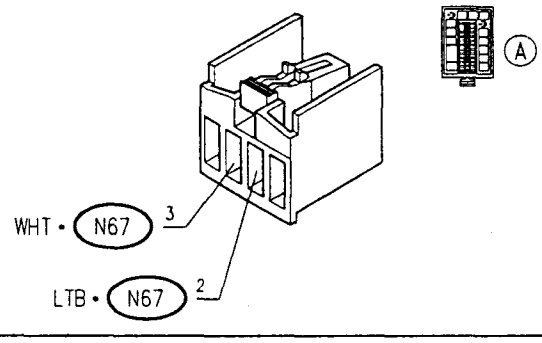
Version with fog lamps

CONNECTOR K		
PIN	**CIRCUITS**	
1	LH direction indicator	**Connector K**: provision for trailer (see "Trailer provision" section)
2	RH direction indicator	
3	LH sidelights	
4	Rear fog guard	
5	RH sidelights	
6	Stop lights	

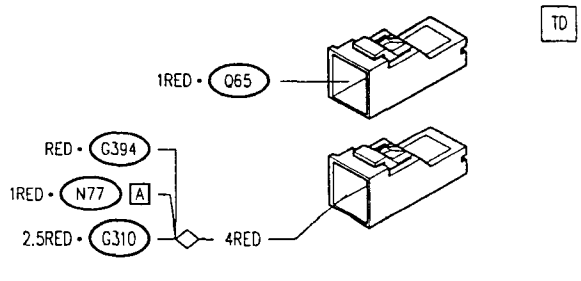
NOTE: in fusebox "B" there is no provision for trailer

CONNECTOR L		
PIN	**CIRCUITS**	
1	Heated rear seats supply (direct)	
2	Dimmed low beam control (only for certain Markets)	
3	Door release control	
4	Door locking control	

Not contained in fusebox "B"

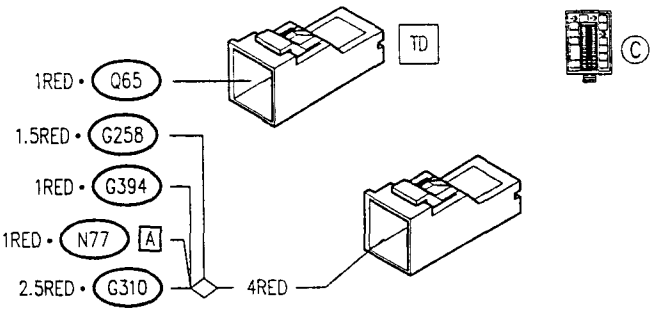
CONNECTOR M		
PIN	**CIRCUITS**	
1	N.C.	
2	Door release from remote control	
3	Door lock from remote control	
4	N.C.	

Not contained in fusebox "B"

CONNECTOR Q		
PIN	**CIRCUITS**	
-	Power windows and ALFA ROMEO CODE supply, door mirrors defrosting	
-	Conditioner compressor supply (TD and TD-CAT)	

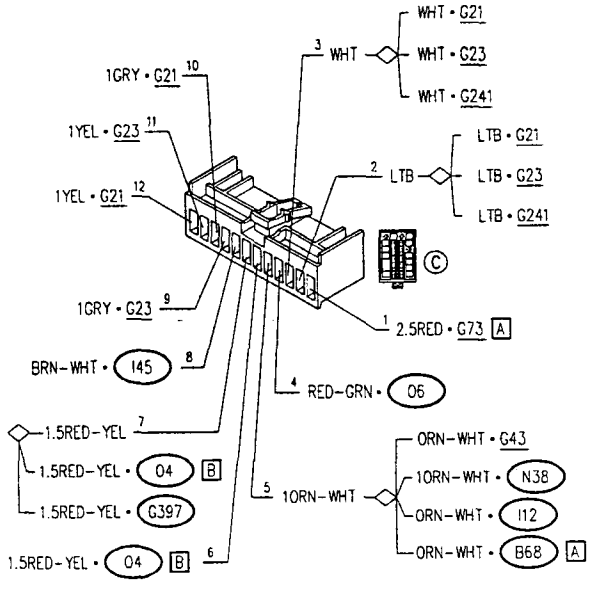
FUSEBOX SUPPLY

PIN	CIRCUITS
-	Supply for power windows ALFA ROMEO CODE control unit, wing mirror defrosting
-	Air conditioner compressor supply (TD and TD-CAT)



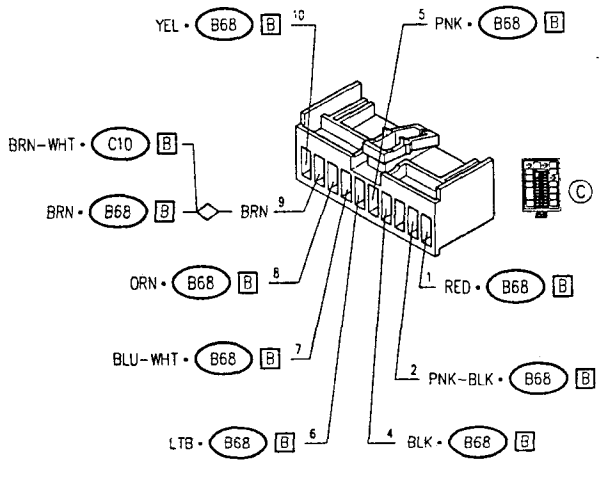
CONNECTOR A

PIN	CIRCUITS
1	Heated seats supply (direct)
2	Door release control
3	Door locking control
4	Cigar lighter supply
5	Supply for direction indicators/power windows/boot opening/conditioner (key-operated)
6	Radio supply (direct)
7	Radio supply and radio telephone (direct)
8	Wing mirror defrosting
9	Door locking device control
10	Door locking device control
11	Door locking device control
12	Door locking device control



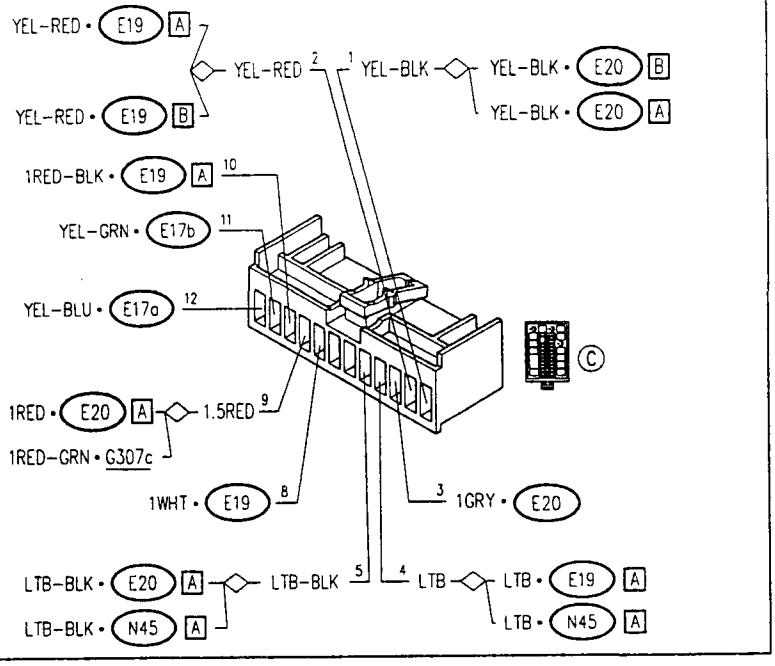
CONNECTOR B

PIN	CIRCUITS
1	Horns control
2	Rearscreen washer control
3	N.C.
4	RH lever unit earth
5	Windscreen washer control
6	Wiper intermittence control
7	Rearscreen wiper control
8	Windscreen washer supply
9	Rearscreen heating control
10	RH lever unit lighting



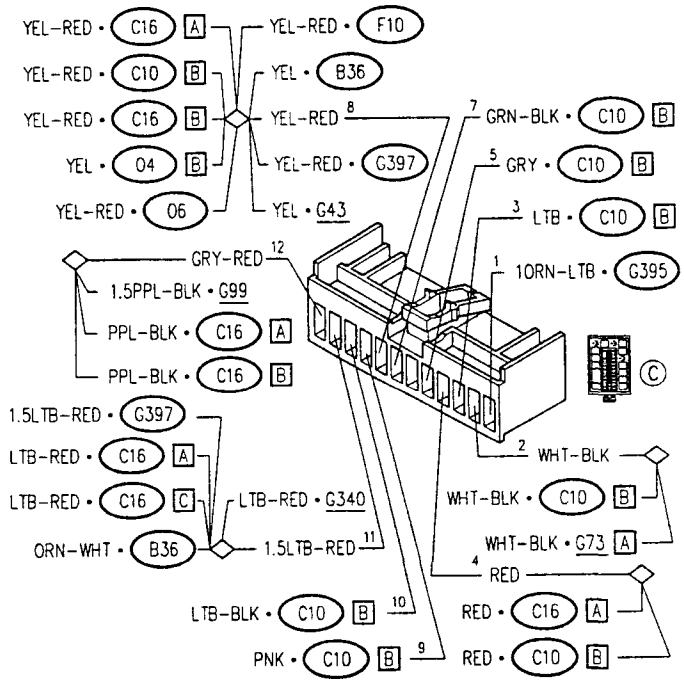
CONNECTOR C

PIN	CIRCUITS
1	LH rear sidelights
2	RH rear sidelights
3	Rear fog guard
4	RH rear direction indicators
5	LH rear direction indicators
6	N.C.
7	N.C.
8	Reversing lights
9	LH stop light
10	RH stop light
11	RH number plate light
12	LH number plate light



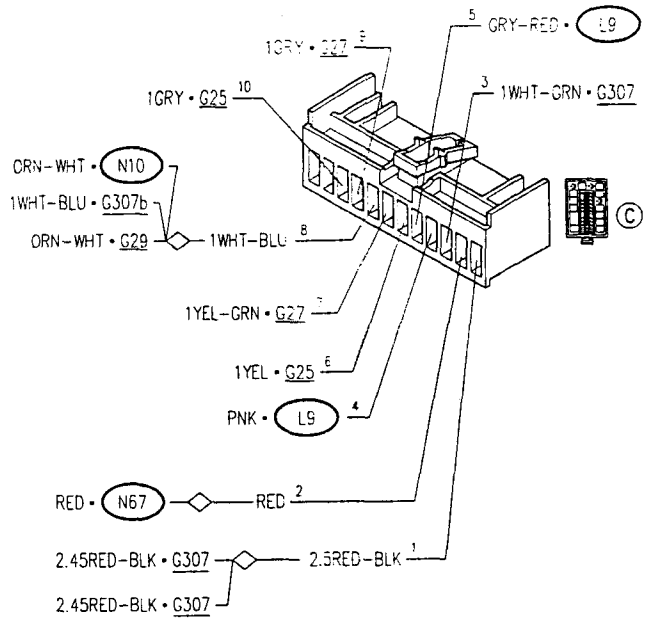
CONNECTOR D

PIN	CIRCUITS
1	Air Bag supply
2	Handbrake/brake fluid warning light
3	RH direction indicator warning light
4	Supply for cluster, check (direct)
5	Fog guard warning light
6	N.C.
7	Main beam warning light
8	Controls lighting, indicators etc. sidelights warning light
9	Fuel level gauge
10	LH sidelights warning light
11	Supply for check, wing mirror adj., radio telephone
12	Earth



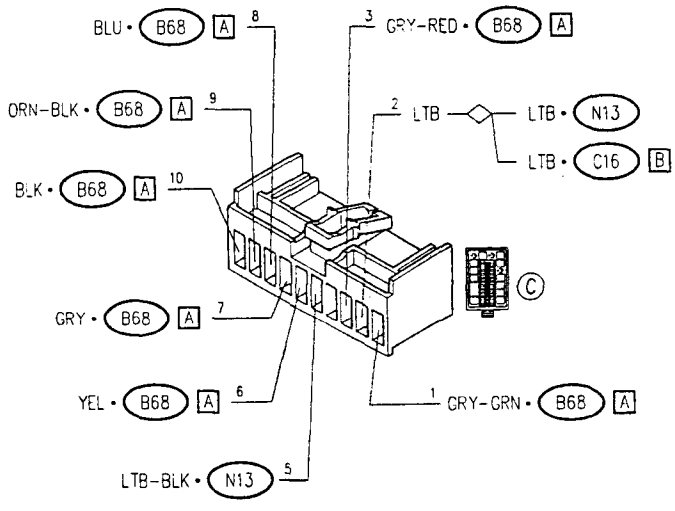
CONNECTOR E

PIN	CIRCUITS
1	Heated rearscreen
2	Supply for door locking remote control (direct)
3	Rearscreen wiper
4	Fuel level signal
5	Earth for fuel level
6	Door locking control
7	Door locking control
8	Supply for rearscreen wiper and heated seats, rear power windows (key-operated)
9	Door locking control
10	Door locking control
11	N.C.
12	N.C.



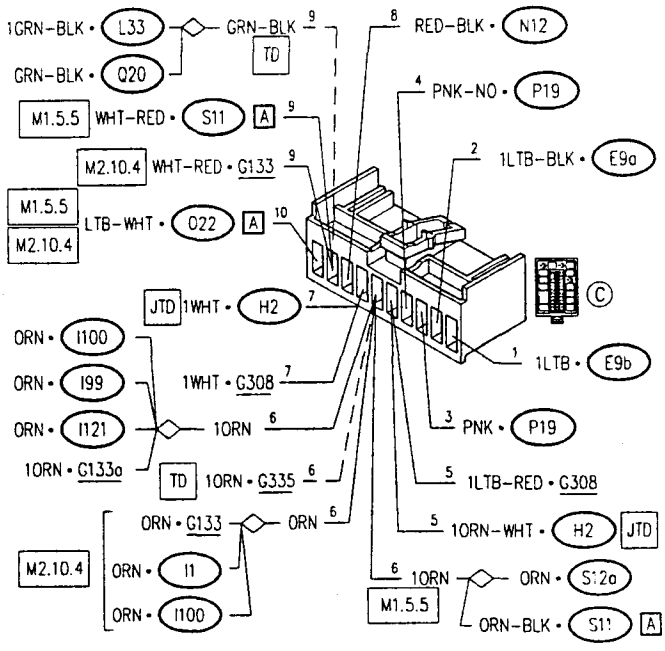
CONNECTOR F

PIN	CIRCUITS
1	Fog guard control
2	RH direction indicators control
3	Fog guard enable
4	N.C.
5	LH direction indicator control
6	Fog lamp enable
7	Dipped beam control
8	Main beam control
9	Lever unit supply
10	LH lever unit earth



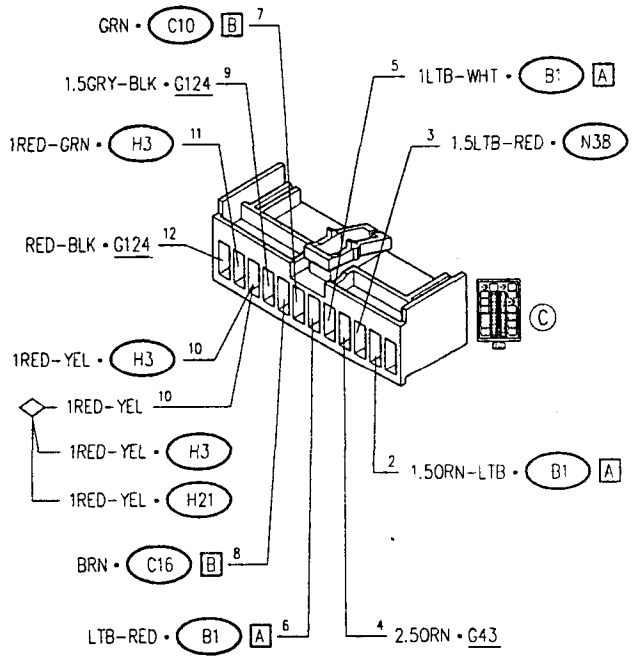
CONNECTOR G

PIN	CIRCUITS
1	Front RH and side direction indicators
2	Front LH and side direction indicators
3	Windscreen washer
4	Rearscreen washer
5	Supply for reversing light, EGR (TD-CAT)
6	Supply for engine fan/I.E control unit (key-operated) compressor disengagement control unit (TD)
7	Reversing light control
8	Headlamp washer control
9	Engine fan relay enable
10	Engine fan control



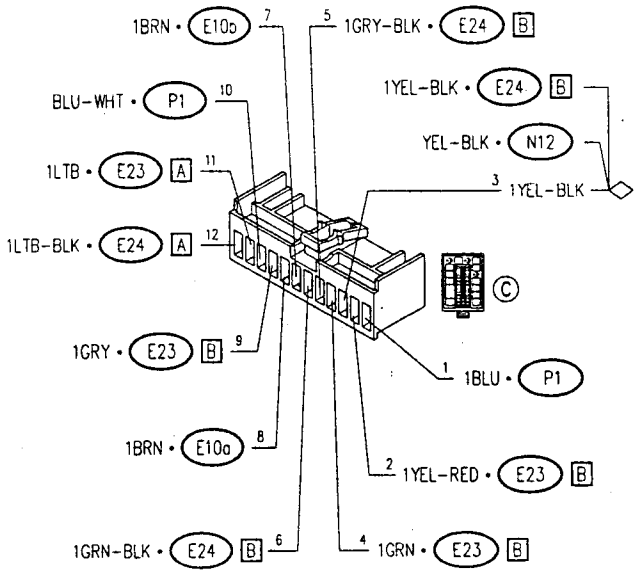
CONNECTOR H

PIN	CIRCUITS
1	N.C.
2	Key-operated supply
3	Supply for power window control unit (direct)
4	Supply for climate control fan
5	"Key-operated" supply (park)
6	Key-operated supply (exluding starting)
7	Foglamp warning light
8	Fog lamp supply
9	Supply for ABS control unit (key-operated)
10	Supply for stop lights, clutch pedal switch (JTD)
11	Stop lights control
12	Stop lights control



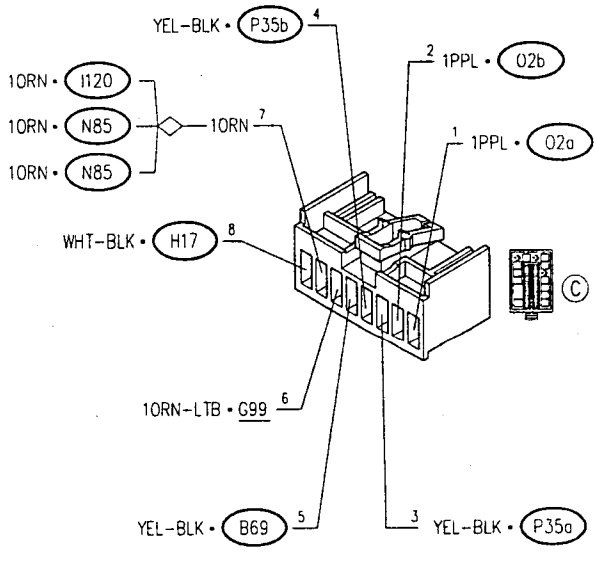
CONNECTOR I

PIN	CIRCUITS
1	Supply for windscreen wiper
2	RH front sidelight
3	LH front sidelight, headlamp washer timer
4	RH main beam
5	LH dipped beam
6	LH main beam
7	RH fog lamp
8	LH fog lamp
9	RH dipped beam
10	Windscreen wiper supply
11	RH front and side direction indicators
12	LH front and side direction indicators

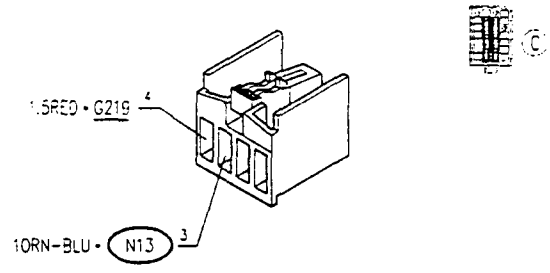


CONNECTOR J

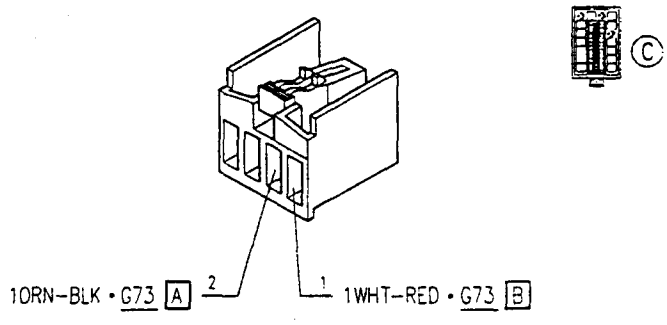
PIN	CIRCUITS
1	Low tone horn
2	High tone horn
3	LH headlamp aiming motor
4	RH headlamp aiming motor
5	Headlamp aiming control
6	CODE control unit supply
7	Additional heating control unit (JTD)
8	Brake fluid level switch



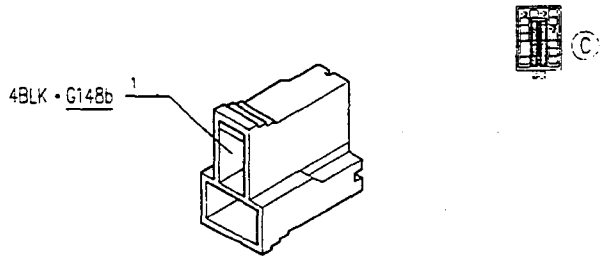
CONNECTOR L	
PIN	**CIRCUITS**
1	N.C.
2	N.C.
3	Supply for hazard warning lights
4	Sunroof supply



CONNECTOR M	
PIN	**CIRCUITS**
1	Supply for hazard warning lights/alarm
2	Supply for alarm control unit and remote control receiver
3	N.C.
4	N.C.



CONNECTOR N (EARTH)	
PIN	**CIRCUITS**
-	Fusebox earth



A list is also given of the fuses contained in the fusebox **G1**, with the corresponding symbol, amp rating and indications regarding the type of supply and circuits protected

Box "A"

FUSE			SUPPLY	SERVICES PROTECTED
SYMBOL	N°	AMP.		
	1	10A		Hazard warning lights, Anti-theft device
	2	25A		Horns, cigar lighter, stop lights, radio
	3	20A	135	Windscreen wiper
	4	25A	135	Rear. wiper, compressor control (TD), radiator fan (TD - T.SPARK) heated seats, rear power windows
	5	10A	164	Instr. cluster lighting, contr.lighting, LH rear side lights, RH no.plate, RH front sidelight, sidelights warning light,
	6	10A	164	RH rear sidelight, LH no. plate, LH front sidelight, headlamp aiming device
	7	10A	149	Right low beam headlamp
	8	10A	149	Left low beam headlamp
	9	15A	150	Right high beam headlamp
	10	15A	150	Left high beam headlamp, high beam warning light
	11	7.5A	125	Rear fog guard, fog guard warning light
	12	30A		Heated rearscreen, heated rearscreen warning light, mirror defrosting
	13	20A	135	Heater, fan
	14	30A		Engine fan (Boxer)
SERVICES	15	15A		Instr. cluster, windscr.-hd.lamp washer pump, reversing lights, airbag, wing mirror adjustment, clock, check panel, ALFA ROMEO CODE, E.G.R.
	16	10A		Clock, interior lighting, instrument cluster, door lock remote control
	17	7.5A		Direction indicators, front power windows, compressor control, engine fan timer, luggage compartment opening control
	18	20A		Door lock
	19	20A		Fog lamps, fog lamp warning light
	20	30A	158	Electric sunroof
	21	30A		Heated seats
	22	25A		Left front power window
SERVICES	24	7.5A		Dim-Dip

Box "B"

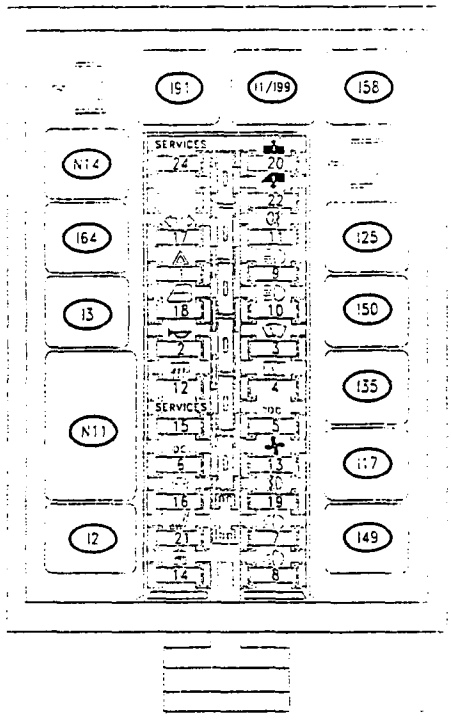
FUSE			SUPPLY	SERVICES PROTECTED
SYMBOL	N°	AMP.		
	1	10A		Hazard warning lights
	2	20A		Horns, cigar lighter, stop lights, radio
	3	20A	135	Windscreen wiper
	4	20A	135	Heated rearscreen
	5	10A	164	Instr.cluster lightiing, contr,lighting, rear LH sidelights, RH no.plate, front RH sidelight, sidelight warning light, power windows sidelight
	6	10A	164	Rear RH sidelight, LH no.plate, front LH sidelight
	7	10A	149	Right low beam headlamp
	8	10A	149	Left low beam headlamp
	9	10A	150	Right high beam headlamp
	10	10A	150	Left high beam headlamp, high beam warning light
	11	7.5A		Rear fog guard, fog guard warning light
	12	30A		Heated rearscreen, heated rearscreen warning light
	13	20A	135	Heater, fan
	14	25A		Engine fan
SERVICES	15	10A		Instr. cluster, windscr.-hd.lamp washer, rev. lights, airbag, clock, engine fan, ALFA ROMEO CODE
	16	20A		Clock, interior lighting, instrument cluster, door locks
	17	7.5A		Direction indicators, compressor control, engine fan timer, sunroof control

Box "C"

FUSE			SUPPLY	SERVICES PROTECTED
SYMBOL	N°	AMP.		
	1	10A		Hazard warning lights
	2	20A	(13)	Horns
	3	20A	(135)	Windscreen wiper, heated seats, rear power windows, roof lights
SERVICES	4	10A	(135)	Cigar lighter
	5	10A	(164)	LH rear sidelight, RH number plate light, RH front sidelight
	6	10A	(164)	RH rear sidelight, LH number plate light, LH front sidelight, sidelight warning light, cluster lighting, controls lighting
	7	10A	(149)	Right low beam headlamp, headlamp aiming device
	8	10A	(149)	Left low beam headlamp
	9	15A	(150)	Right high beam headlamp
	10	15A	(150)	Left high beam headlamp, high beam warning light
	11	7.5A	(N25)	Rear fog guard, rear fog guard warning light
	12	30A		Rearscreen heating, rearscreen heating warning light, wing mirror defroster
	13	30A	(135)	Heater, fan
CODE	14	7.5A		Engine fan, CODE control unit, i.e. control unit, i.e. control unit (JTD), compressor control unit (TD)
SERVICES	15	15A		Lever unit supply, cluster, check panel, boot opening, front power window, wing mirror adjustment, Air Bag, air recirculation, compressor control, EGR (TD), ABS, radio telephone, additional heating (JTD)
	16	20A		Clock, inner roof lights, instrument cluster, door locking remote control, radio telephone
	17	7.5A		Door locking and alarm relay, TELEPASS supply
	18	20A		Door locking device
	19	20A	(117)	Foglamps, foglamp warning light
	20	30A	(158)	Sunroof
	21	30A		Heated seats
	22	25A		Left front power window
	23	25A		Rear power windows
ABS	24	10A		ABS

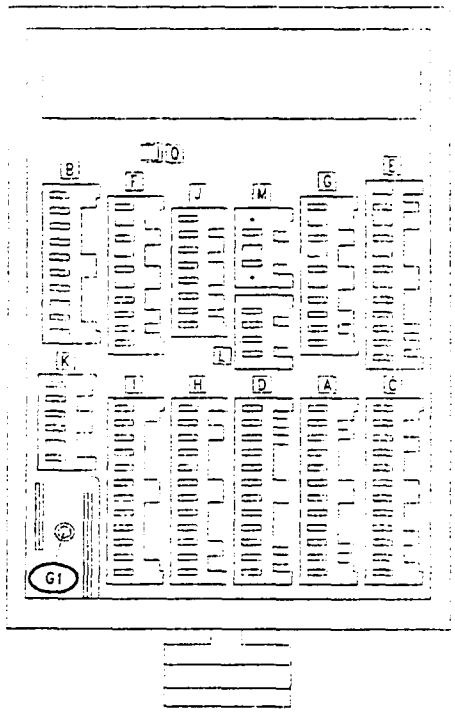
Lastly, two schematic drawings are given which show the location of the fuses and relays and the position of the connectors:

LOCATION OF FUSES AND RELAYS (Box "A")



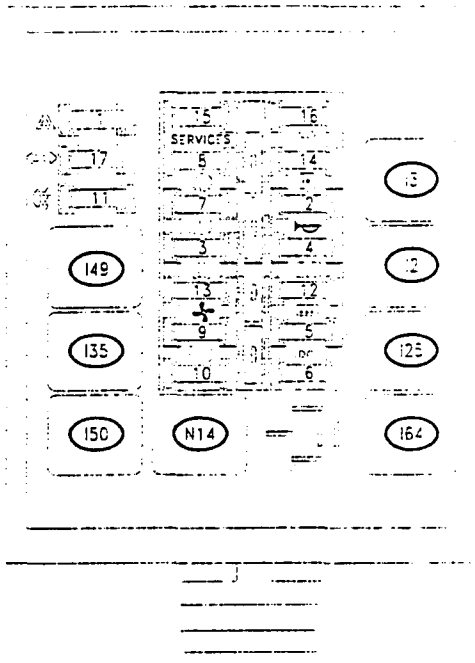
I1	Engine water cooling fan
(I99)	relay
I2	Heated rearscreen relay (*)
I3	Horn relay
I17	Fog lamp relay
I25	Rear fog guard relay
I35	Key-operated supply relay
I49	Low beam headlamp relay
I50	High beam headlamp relay
I58	Sunroof relay
I64	Sidelights relay
I91	DIM-DIP cut-in relay
N11	Door locking control unit
N14	Electronic windscreen wiper intermittence

REAR VIEW, CONNECTORS SIDE (Box "A")



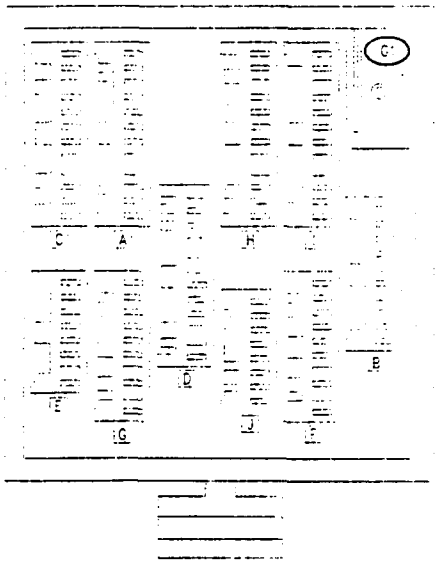
(*) timed from M.Y. '97

LOCATION OF FUSES AND RELAYS (Box "B")



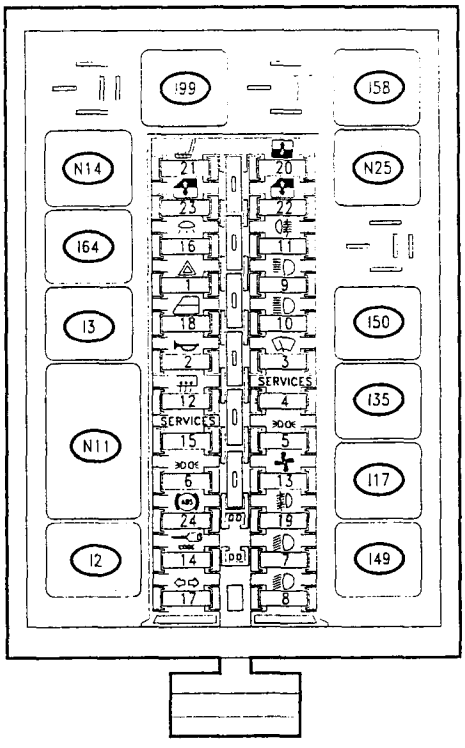
I2	Heated rearscreen relay (*)
I3	Horn relay
I25	Rear fog guard relay
I35	Key-operated supply relay
I49	Low beam headlamp relay
I50	High beam headlamp relay
I64	Sidelights relay
N14	Electronic windscreen wiper intermittence

REAR VIEW, CONNECTORS SIDE (Box "B")



(*) timed from M.Y. '97

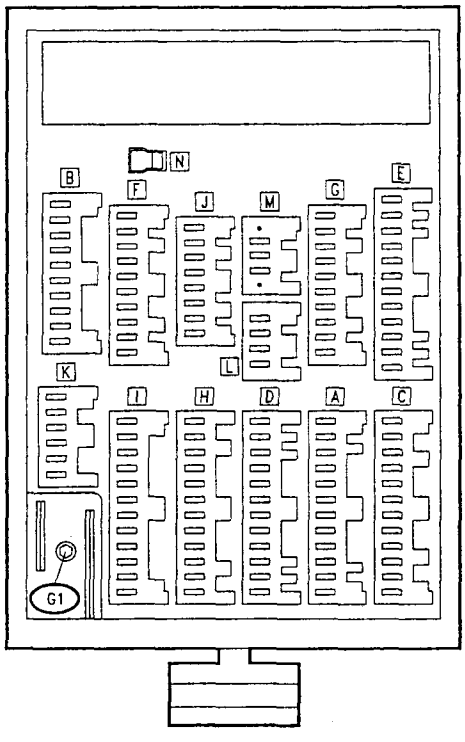
LOCATION OF FUSES AND RELAYS (Box "C")



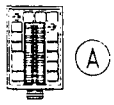
RELAYS:

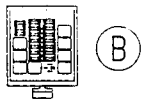
I2	Rearscreen heating relay
I3	Horn relay
I17	Fog lamp relay
I35	Key-operated supply relay
I49	Low beam headlamp relay
I50	High beam headlamp relay
I58	Sunroof relay
I64	Sidelight relay
I99	Engine water cooling fan relay
N11	Door locking control unit
N14	Windscreen wiper intermittent device
N25	Rear fog guard control unit

REAR VIEW, CONNECTORS SIDE (Box "C")



FUSES AND RELAYS ON AUXILIRY BRACKET





A set of fuses and relays is to be found on an auxiliary bracket (not removable) located on the left of the main fusebox; next to this there is the power window control unit **N38** and, for versions wth fusebox "B", also the door locking control unit **N11**.

The fuses and relays can be identified according to the colour of the base (fuse holder or relay holder) that connects them to the wiring, as shown in the table below:

COMPONENT	CODE	BASE COLOUR
Front power windows relay	**I12**	Black (Yellow*)
Luggage compartment opening relay	**I52**	Yellow
Hazard warning light and direction indicator flasher	**N13**	Grey
Timer for headlamp washer	**N12**	Black
Fuel warming device relay (TD only)	**I44**	White
Starting consent relay (•)	**I10**	Yellow
Diesel engine control devices relay (TD only)	**I105**	Grey
Engine cooling fan relay (*)	**I1/I99**	Yellow
Engine 2nd speed cooling fan relay (••)	**I100**	Yellow
Sunroof relay (*)	**I58**	White
Heater fan relay (*)	**I78**	Yellow
Fog lamp relay (*)	**I17**	Grey
Door mirrors defrosting relay	**I45**	White
Headlamp washer fuse (20A)	**G312**	Yellow
ABS fuse (10A)	**G125a**	Red
Fuse for power windows (30-25A)	**G310**	Green
Fuse for RH power window (25A) (*)	**G310**	White
Fuse for LH power window (25A) (*)	**G311**	White
Sunroof fuse (20A) (*)	**G261**	Yellow
Heater fan fuse (30A) (*)	**G255**	Green
Fog lamp fuse (20A) (*)	**G382**	Yellow
Door mirrors defrosting fuse (7.5A)	**G394**	Brown
Fog lamp consent relay (*) (**)	**I65**	Grey (*)/Green (**)
Daylight cut-off relay (**)	**I67**	Green
Electromagnetic joint control relay (••)	**Q22**	Grey
Auxiliary climate control relay (••)	**Q32**	Grey
Conditioner fan delaying device (•••)	**Q42**	White
Air conditioning system wander fuse (••)	**Q65**	Red
Rear fog guard electronic device (***)	**N25**	Grey
ALFA ROMEO CODE fuse (10A) (***)	**G389**	Grey

(*) Only for versions with **fusebox "B"**
(**) Only for certain Markets
(***) From M. Y. '97
(•) Ffor versions without ALFA ROMEO CODE, but with anti-theft system
(••) For T.SPARK version (M2.10.3) and TD versiones and boxer from chassis no....
(•••) Only for TD version from chassis no....

N.B.
In addition to the colour of the base, you are recommended to check the exact location of a relay or fuse by the colour of the wires converging on it (for this, refer to the corresponding wiring diagram).

FUSES AND RELAYS ON AUXILIARY BRACKET  ©

A set of fuses and relays is located on an auxiliary bracket (not removable) to the left of the main fusebox; next to this, there is also the power window control unit **N38**.

The fuses and relays are distinguished by the colour of the base (fuse holder or relay holder) which connects them to the wiring, according to the following table.

COMPONENT	CODE	BASE COLOUR
Front power window relay	**I12**	Black
Boot opening relay	**I52**	Yellow
Hazard warning light and direction indicator flasher	**N13**	Grey
Timer for headlamp washer	**N12**	Black
Fuel warming device relay (TD and JTD only)	**I44**	White
Diesel engine control devices relay (TD only)	**I105**	Grey
Engine cooling fan relay (•)	**I1**	Black
Engine cooling fan 2nd speed relay (•)	**I100**	Black
Wing mirror defroster relay	**I45**	White
Electromagnetic coupling relay (•)	**Q22**	Grey
Headlamp washer fuse (20A)	**G312**	Yellow
Power window fuse (30A)	**G310**	Green
Wing mirror defroster fuse (7.5A)	**G394**	Brown
Air conditioning system fuse	**Q65**	Red
Alarm fuse (20A)	**G258**	Yellow
Air bag and cluster fuse (10A)	**G395**	Red
Fuel oil warming fuse (25A) (JTD only)	**G352**	White
ALFA ROMEO CODE fuse (7.5A) (M1.5.5 only)	**G389**	Brown

(•) up to M.Y. '97

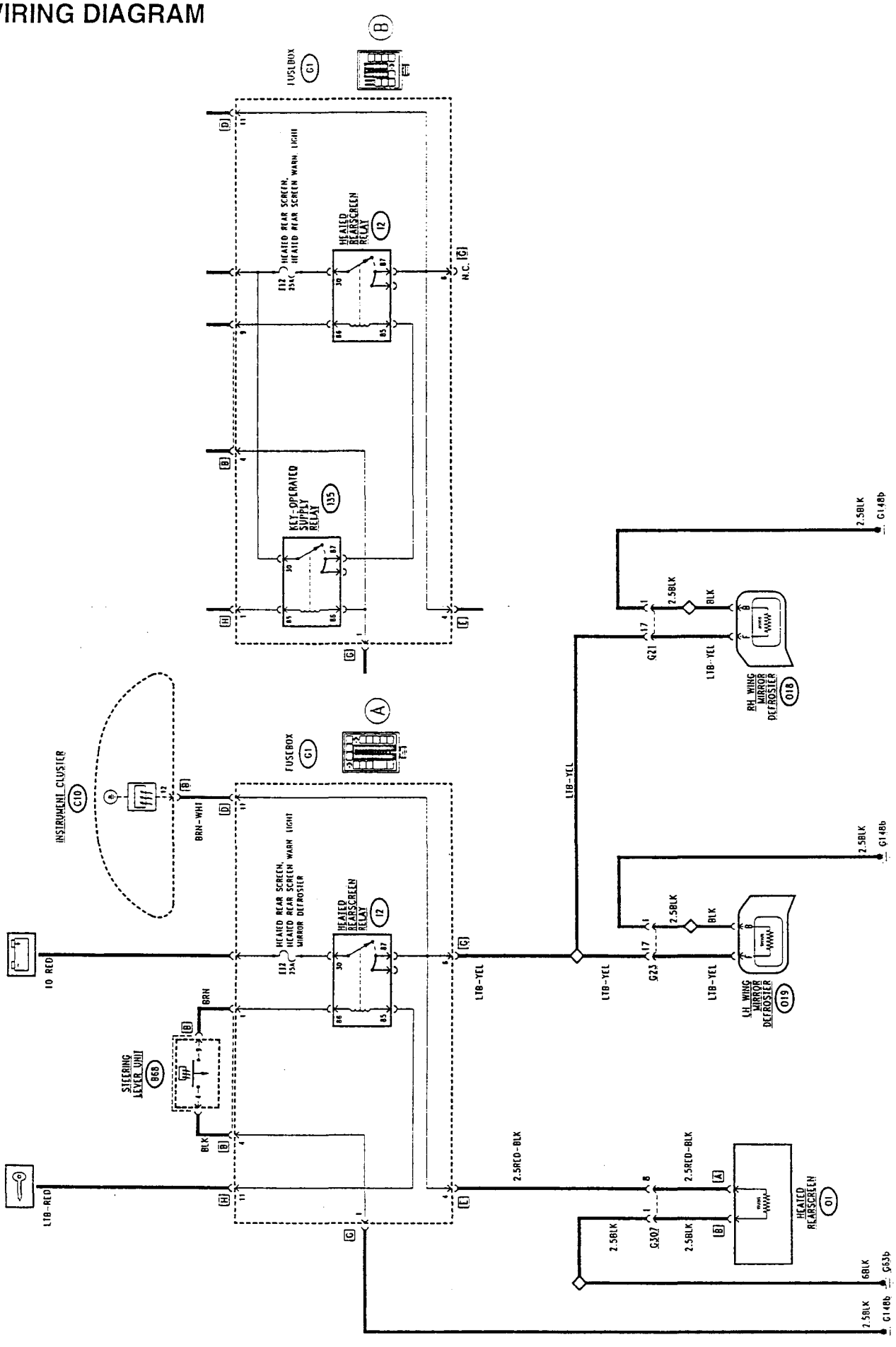
N.B.
In addition to the colour of the base, it is always wise to check the exact location of a relay or fuse by the colour of the wires that converge on it (for these refer to the corresponding wiring diagram given on the next pages.

HEATED REARSCREEN AND DEFROSTING THE WING MIRRORS

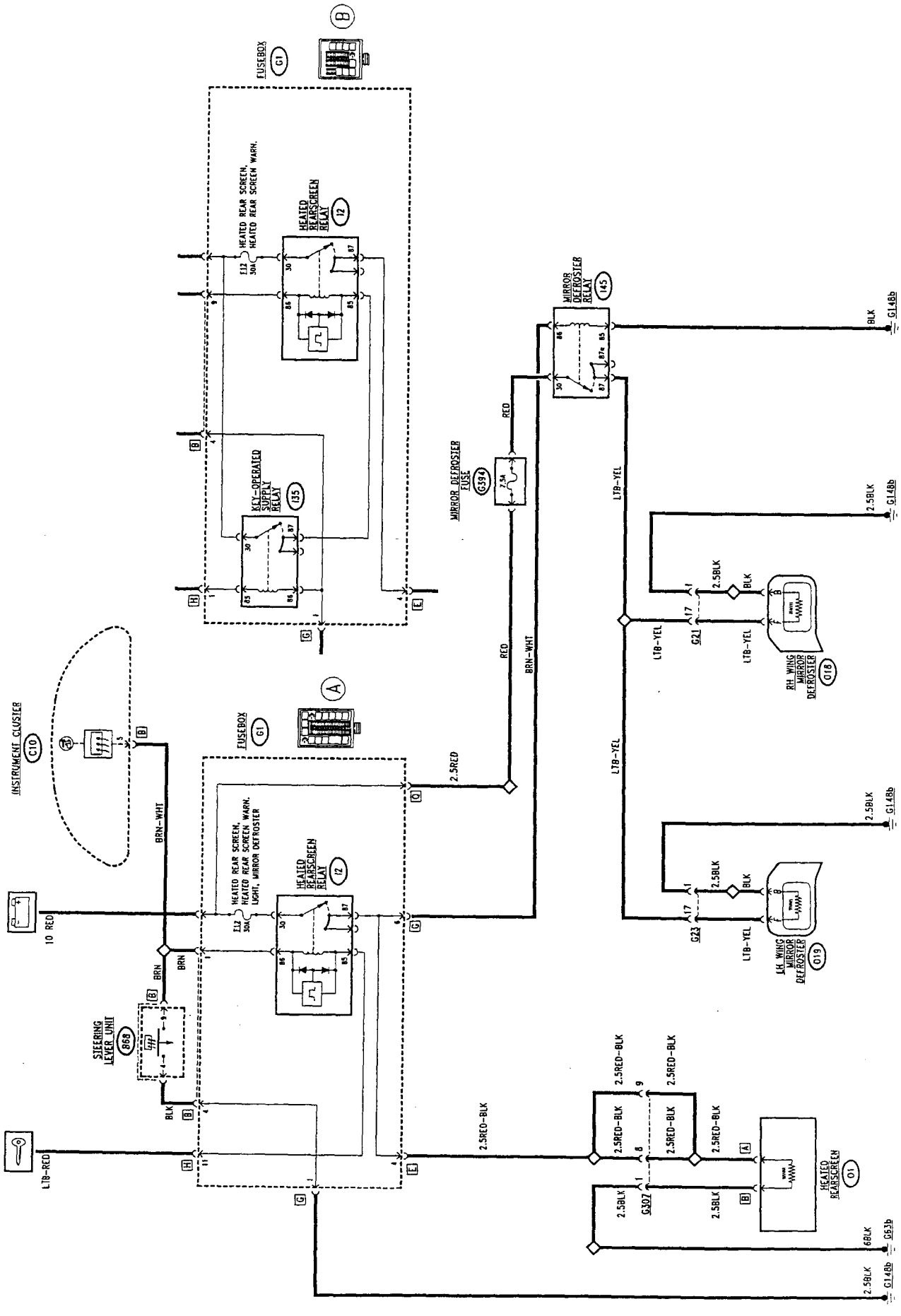
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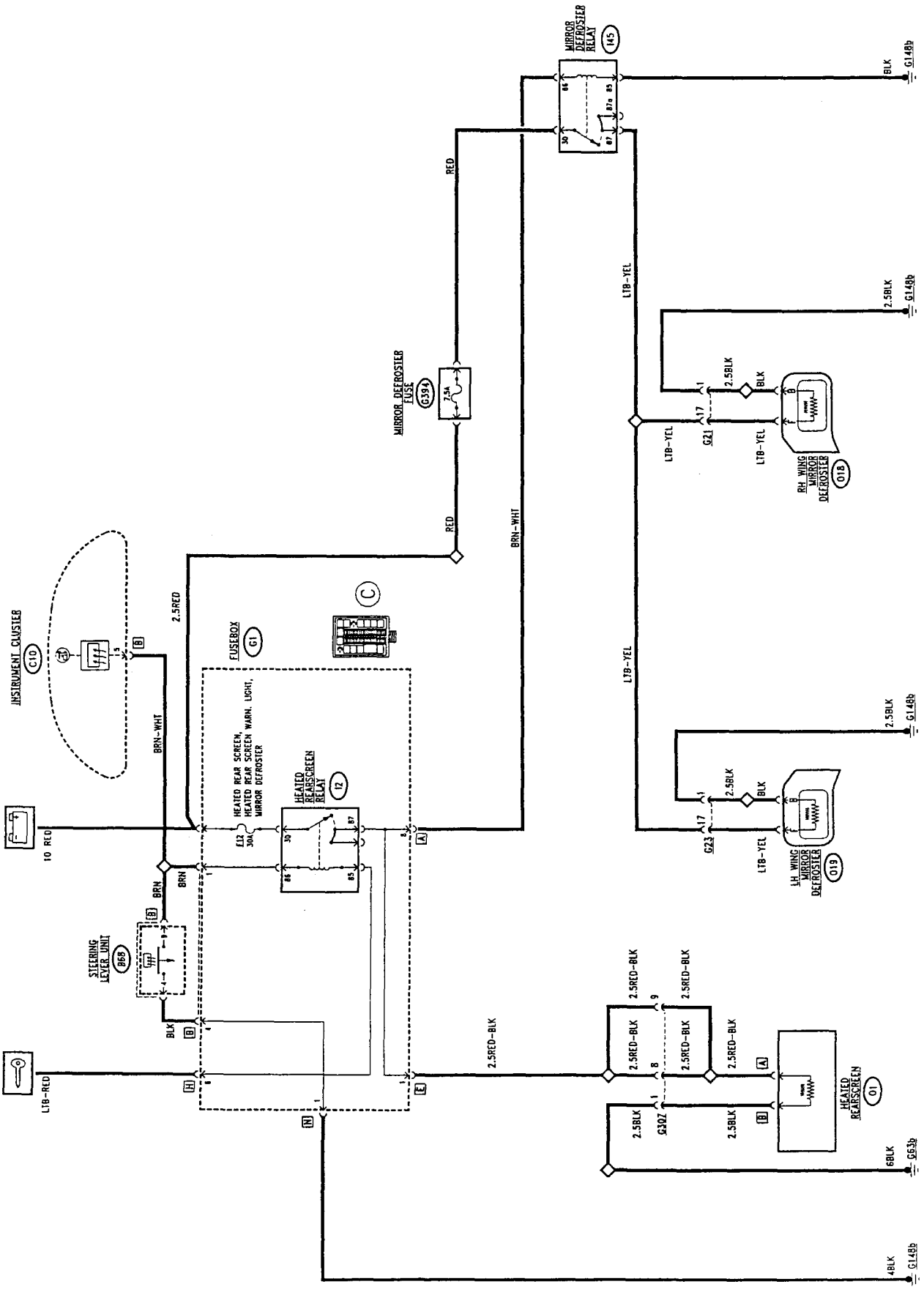
WIRING DIAGRAM



WIRING DIAGRAM - Model Year '97 -



WIRING DIAGRAM



GENERAL DESCRIPTION

The rearscreen and wing mirrors (in some countries/versions only) incorporate a wire that heats the surfaces it contacts when it is crossed by current, thereby quickly demisting and/or defrosting them.
The device is actuated by pressing the corresponding switch on the lever unit which controls the heated rearscreen relay.
A warning light on the instrument cluster indicates when the device is operating.

Actuation of the heated rearscreen also turns on the wing mirror defrosting function (if installed).

From chassis no. ... the supply for door mirror defrosting is through a dedicated line, with specific relay and fuse.

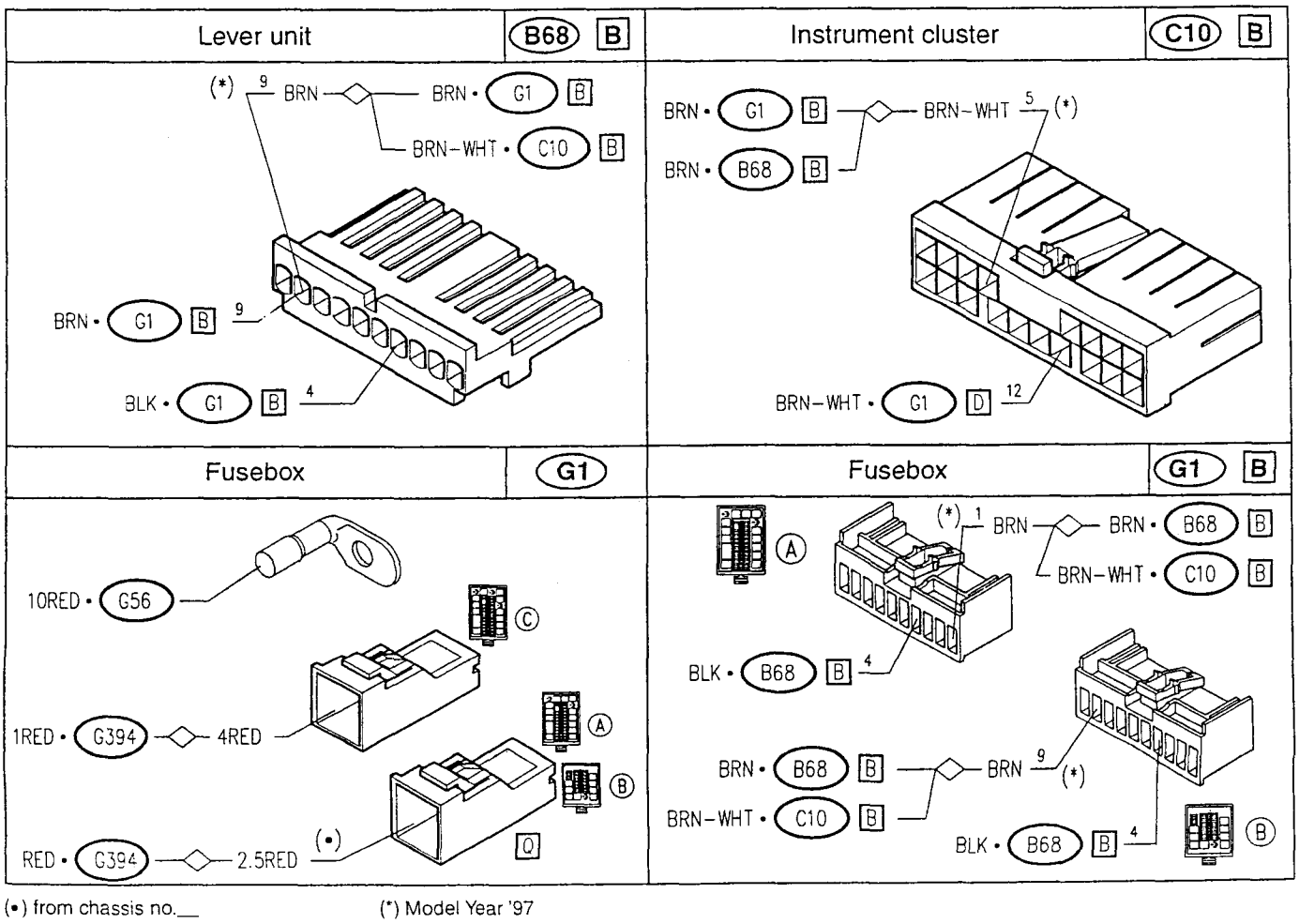
FUNCTIONAL DESCRIPTION

The line of fuse **F12** of fusebox **G1** supplies the rearscreen heating relay switch **I2**, the coil of which is supplied from the ignition switch and energized by an earth signal leading from switch ⫷ on the lever unit **B68**.

From Model Year '97, the relay includes an electronic device which turns off the device after 5 minutes from 1st engagement and shorter times after any subsequent engagements.
Relay switch **I2** is also located in fusebox **G1**.
When the contact of relay switch **I2** closes the battery voltage supplies the line, which protected by fuse **F12** of **G1**, reaches the rearscreen **O1** and the resistances of the wing mirrors **O19** (left) and **O18** (right).
From chassis no..... the mirrors are supplied by the line of fuse **G394** (7.5A) through relay **I45**.
Thr same supply signal is also sent to to the instrument cluster **C10** to turn on the corresponding warning light.

WARNING: from Model Year '97 the warning light is in a different position - See "INSTRUMENT CLUSTER".

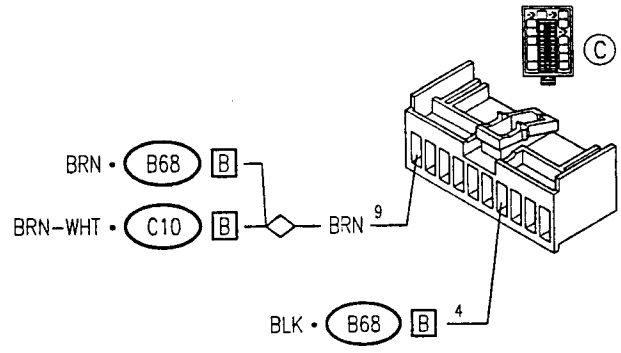
COMPONENTS AND CONNECTORS



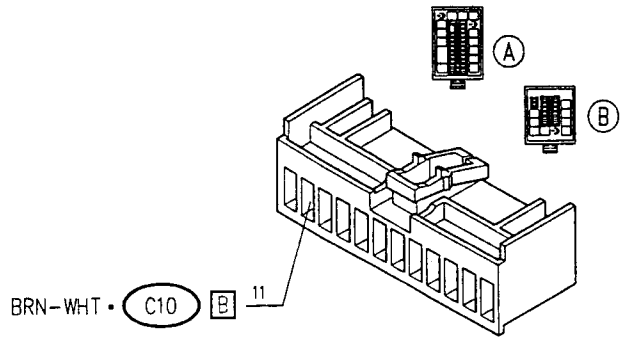
(•) from chassis no.__ (*) Model Year '97

COMPONENTS AND CONNECTORS (cont.d)

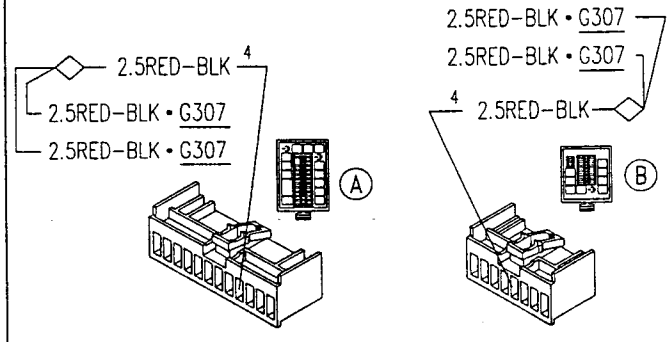
Fusebox G1 B



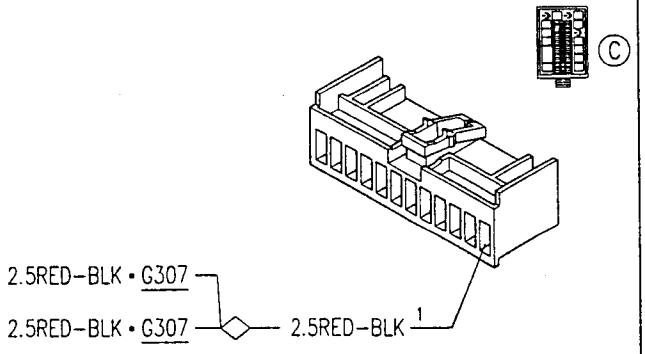
Fusebox G1 D



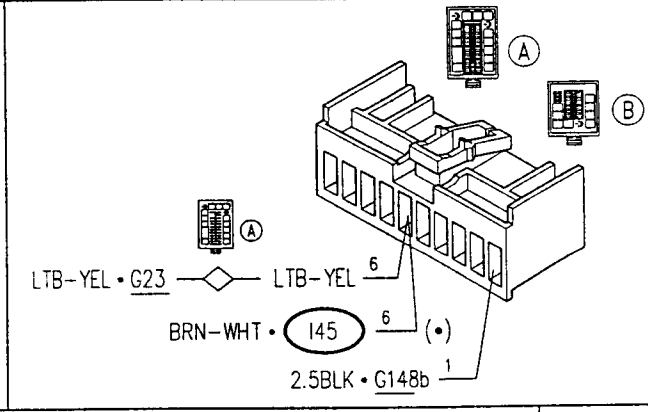
Fusebox G1 E



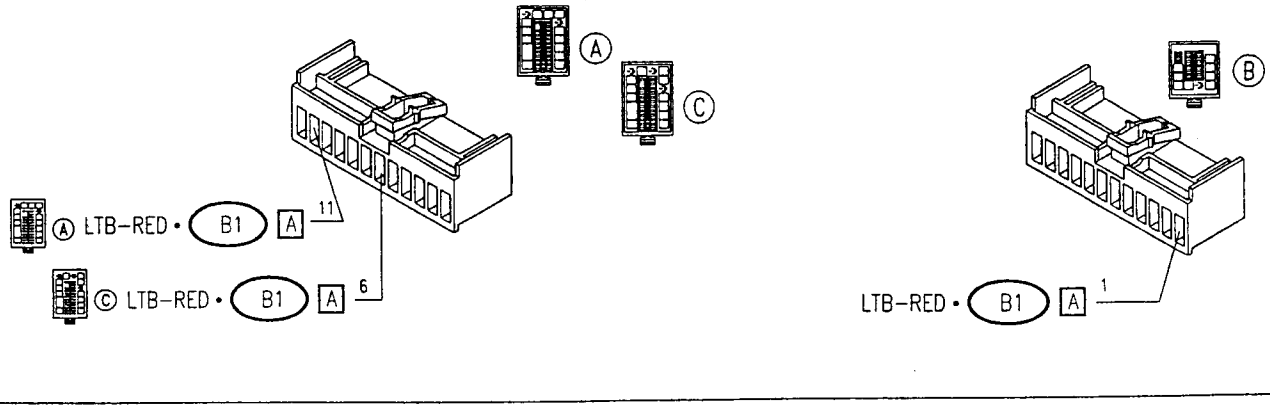
Fusebox G1 E



Fusebox G1 G



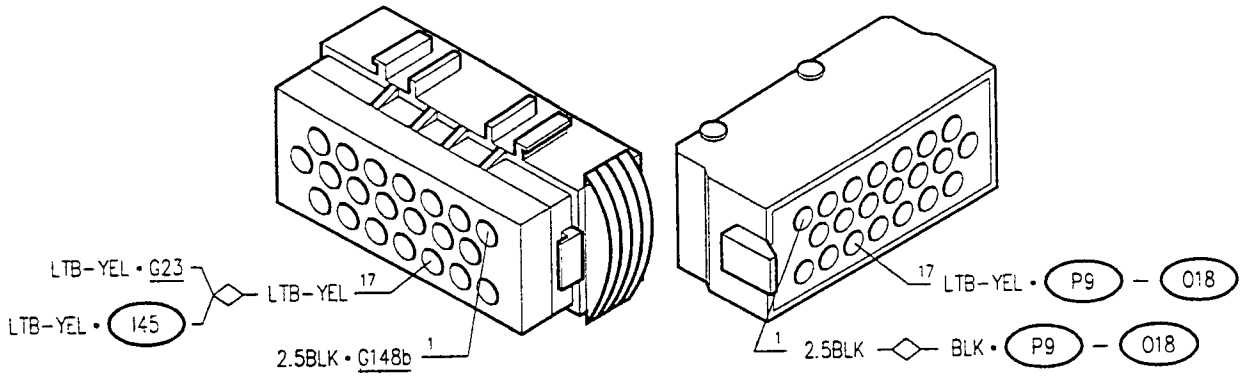
Fusebox G1 H



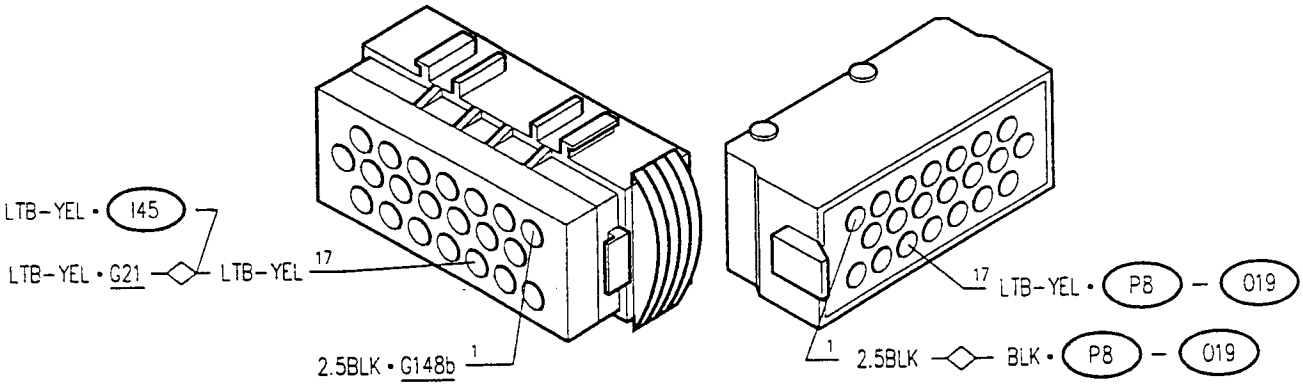
(•) from chassis no.__ (*) Model Year '97

COMPONENTS AND CONNECTORS (cont.d)

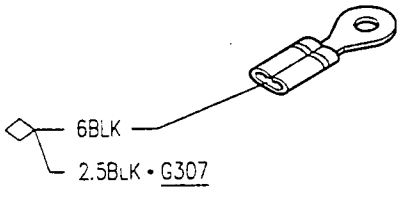
RH front door wiring connector — G21



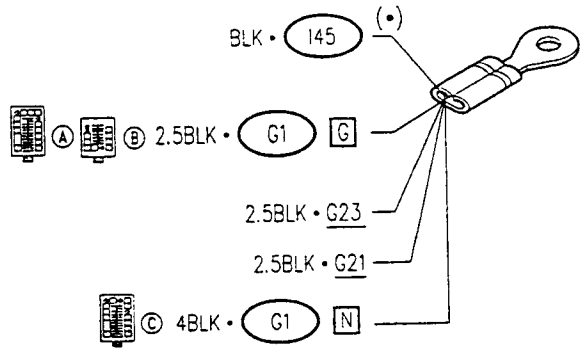
LH front door wiring connector — G23



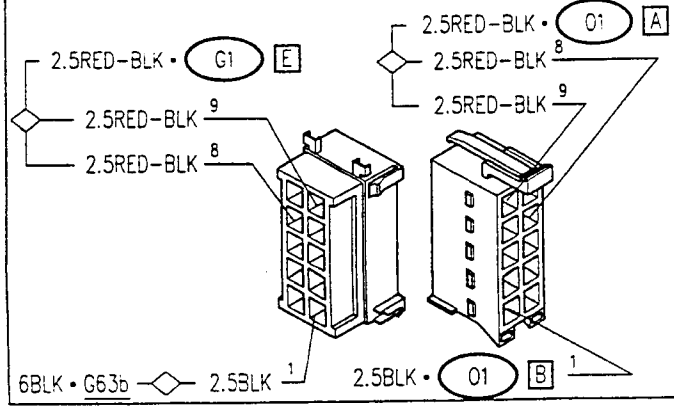
LH rear earth — G63b



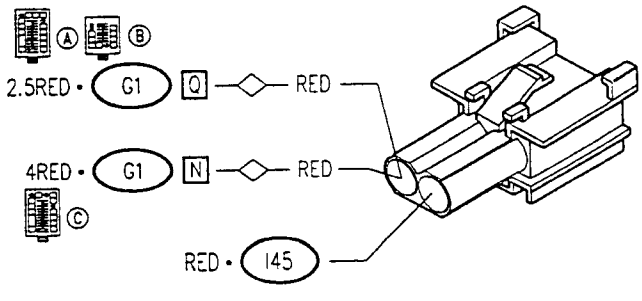
LH earth under dashboard — G148b



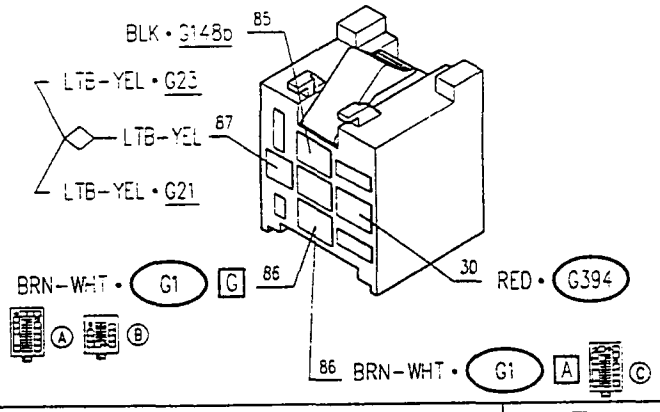
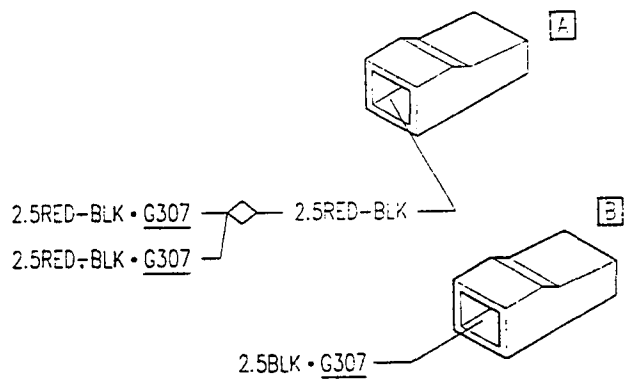
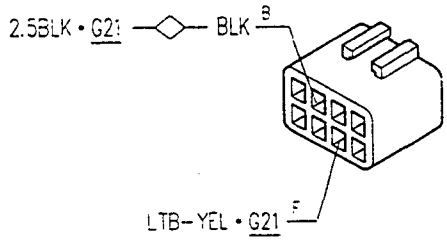
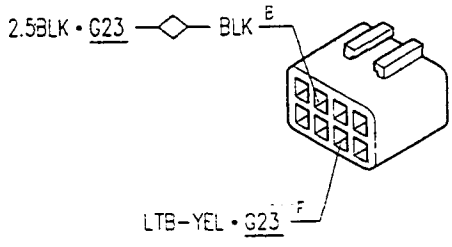
Rear/luggage compart. wiring connector — G307



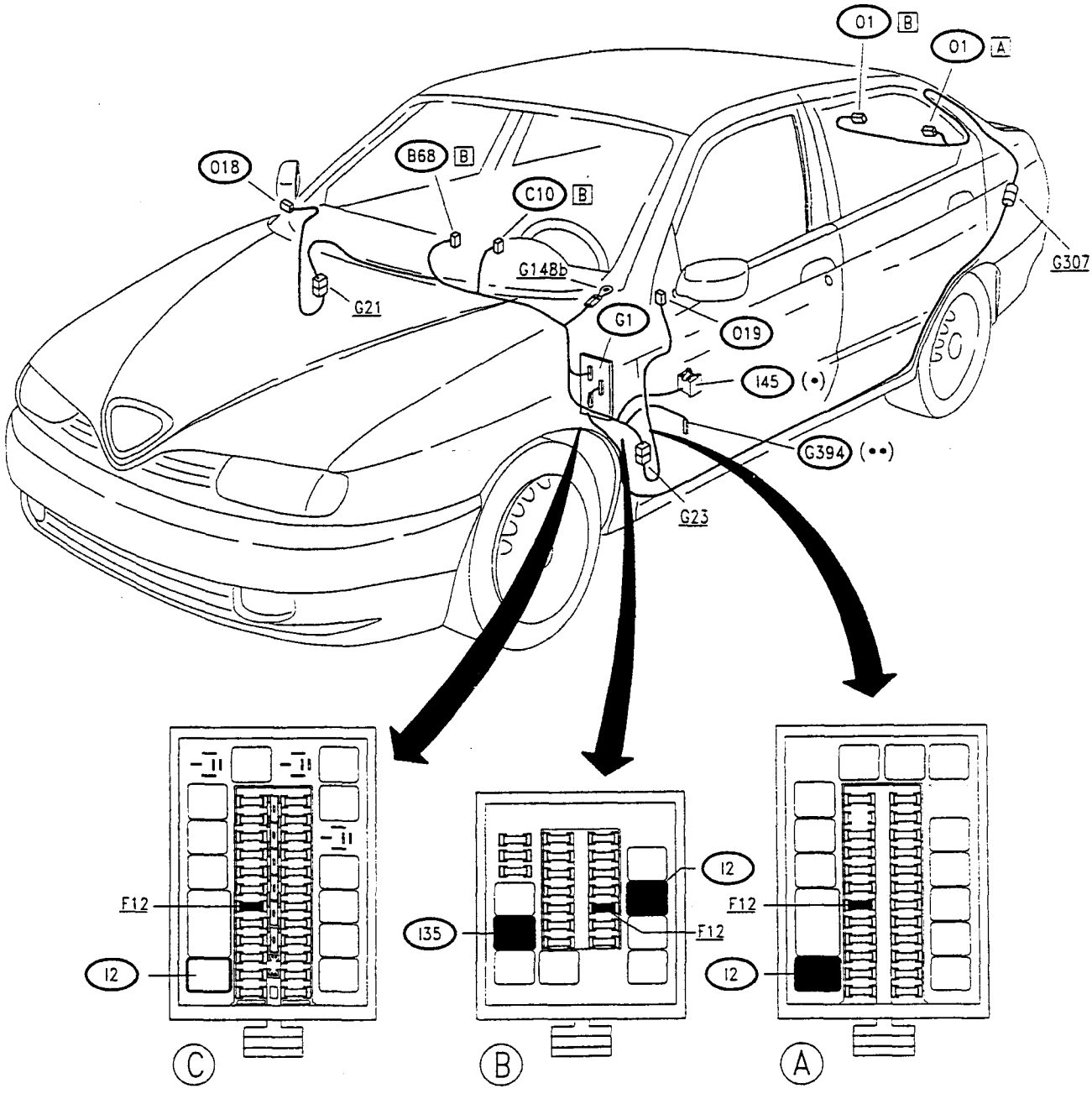
Door mirror defrosting fuse — G394



COMPONENTS AND CONNECTORS (cont.d)

Door mirror defrosting relay	(145)	Heated rearscreen	(01)
			
RH wing mirror defroster	**(018)**	**LH wing mirror defroster**	**(019)**
			

LOCATION OF COMPONENTS



(•) White base

(•) Brown fuseholder

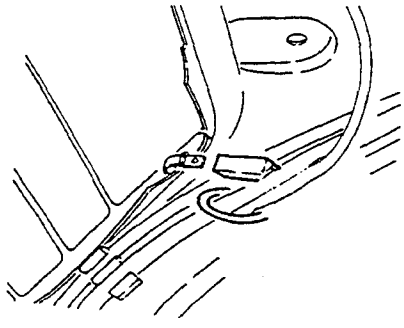
FAULTFINDING TABLE

Failure	Component to be checked								
	F12	I2	B68	O1	I45	G394	O19	O18	C10 (*)
Defrosting, under all circumstances	•	•	•						
Rearscreen defrosting				•					
Door mirror defrosting					•	•			
LH wing mirror defrosting							•		
RH wing mirror defrosting								•	
Rearscreen warning light									•

(*) The instrument cluster **C10** cannot be repaired. Therefore, in the event of a failure it is not possible to change the single warning light and a new, complete cluster must be fitted.

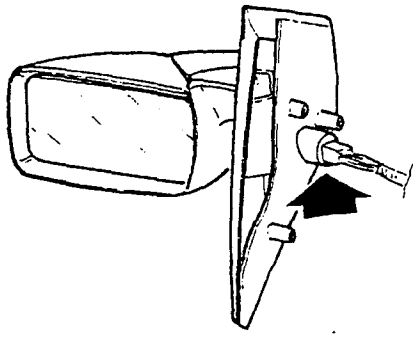
CHECKING COMPONENTS

Heated rearscreen (O1)



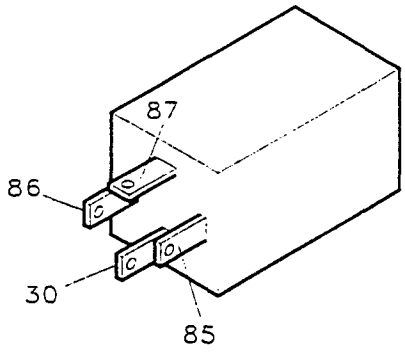
SPECIFICATIONS	
Max. absorbed current	~ 22A
Defrosting resistance (between terminals A and B)	~ 1.8 Ω

Wing mirrors defrosting (O18) (O19)



SPECIFICATIONS	
Defrosting resistance (between pins F and B of connector)	10 Ω

Rearscreen heating relay (timed) (I2)



Check the device: see **TEST A**

CHECK REARSCREEN RELAY (I2)	TEST A

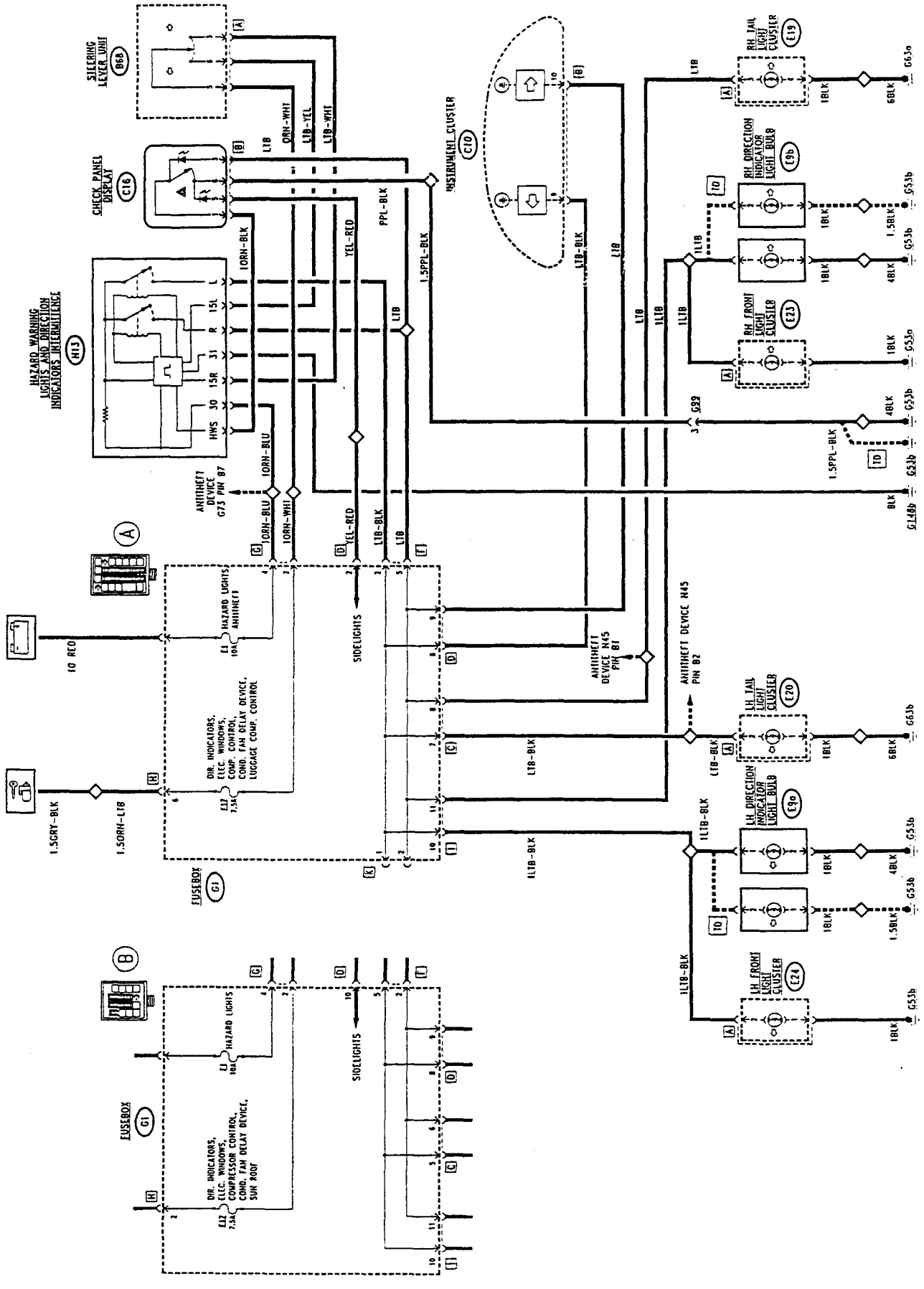
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **I2** and check on the base of fusebos **G1**: for 12V at pin 30.	OK ▶	Carry out step **A2**
	OK ▶	Check fuse **F12** of **G1**
A2 CHECK CONTROL SIGNAL – Turn on defrosting and check for an earth at pin 88 of **I2**	OK ▶	Insert device **I2** on the base of **G1** and continue with step **A3**
	OK ▶	Restore the wiring between **G1** and the switch on the lever unit **B68**, or replace the latter
A3 CHECK OPERATION OF DEFROSTING – Operate defrosting and check for 12V between pins 1 and 6 of connector G of **G1**; this voltage **ceases after 5 minutes**	OK ▶	DEVICE **I2** IS WORKING PROPERLY Check the other components of the system or the associated connections
	OK ▶	REPLACE DEVICE **I2**

DIRECTION INDICATORS AND HAZARD WARNING LIGHTS

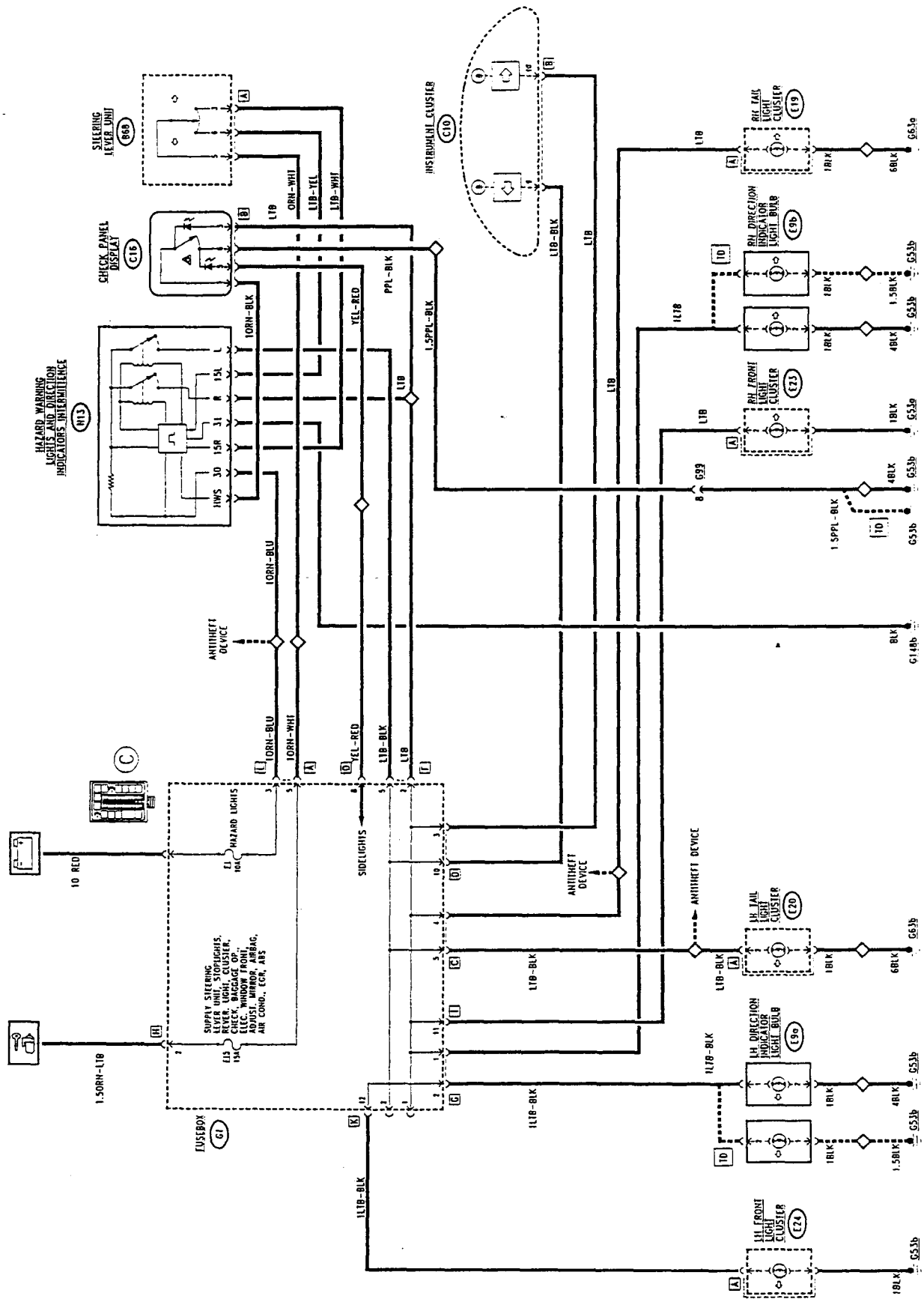
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GENERAL DESCRIPTION 12-3
FUNCTIONAL DESCRIPTION 12-3
COMPONENTS AND CONNECTORS 12-4
LOCATION OF COMPONENTS 12-8/1
FAULTFINDING TABLE 12-9
CHECKING COMPONENTS 12-9

WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

The intermittent direction indicators and hazard warning lights delineate the vehicle clearance.

The right or left direction indicators are turned on raising or lowering the lever on the steering column lever unit; the hazard warning lights (right and left indicators activated simultaneously) are switched on from the switch on the Check Panel.
The direction indicators operate when the ignition key is engaged, for the obvious safety reasons, they are supplied directly by the battery.
Two intermittent warning lights on the instrument cluster flash while the right and left indicators are operating. The hazard warning light indicates that these are operating by illuminating when they are turned on.

The circuit of the direction indicators is protected by a fuse and another fuse protects the circuit for the hazard warning lights.

FUNCTIONAL DESCRIPTION

The circuit is controlled by the hazard warning light and direction indicator flasher **N13** to be found next to the fusebox.

The flasher, earthed at pin 31, is supplied at pin 30 directly from the battery via the line of fuse **F1** of fusebox **G1**.

Pin 15R and 15L receive the signals (12V) from the lever unit **B68** when the "key-operated" supply of the line protected by fuse **F17** of box "A" and "B" is switched or from fuse **F15** of box **G1** "C", of **G1** for turning on the right direction indicator (pin 15R) and the left one (pin 15L).

Pin HWS receives a signal (earth) when the hazard warning light switch in the Check Panel **C16** is pressed.

Pins R and L send the intermittent supply signals for all the indicators: from pin R for those on the right, from pin L for those on the left, according to the following logic:

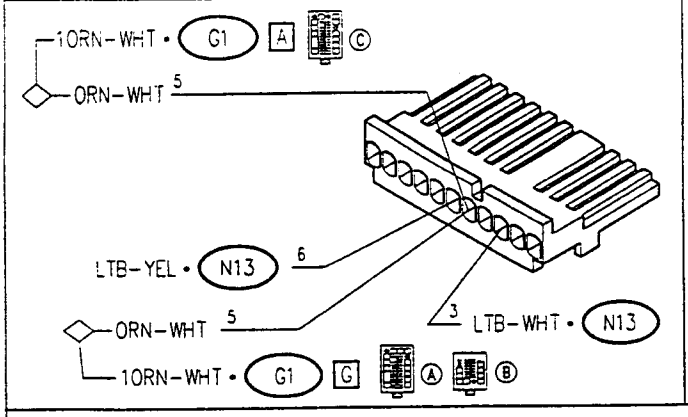
- only pin R (RH) if the signal reaches pin 15R
- only pin L (LH) if the signal reaches pin 15L
- both pins R and L if the signal reaches pin HWS.

This way operating the stalk of the lever unit **B68** turns on the righthand indicators (**E23, E9b** and **E19**) or the left ones (**E24, E9a** and **E20**) and simultaneously the corresponding warning light on the instrument cluster **C10** is turned on.

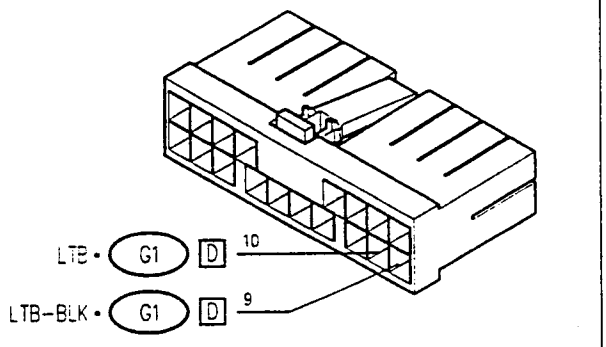
When the switch on the Check Panel **C16** is pressed, the right and left direction indicators are supplied contemporaneously and also the special led (pin 3) inside **C16** is supplied which lights up when the hazard warning lights are switched on. A second led (pin 3) illuminates the ideogram of the switch when the side lights are on - see section "Lighting of Controls and Indicators".

COMPONENTS AND CONNECTORS

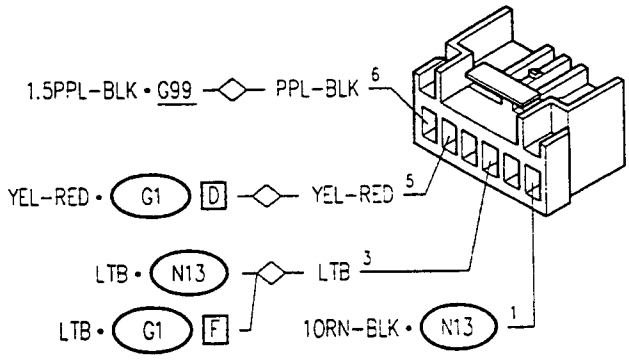
Lever unit — B68 A



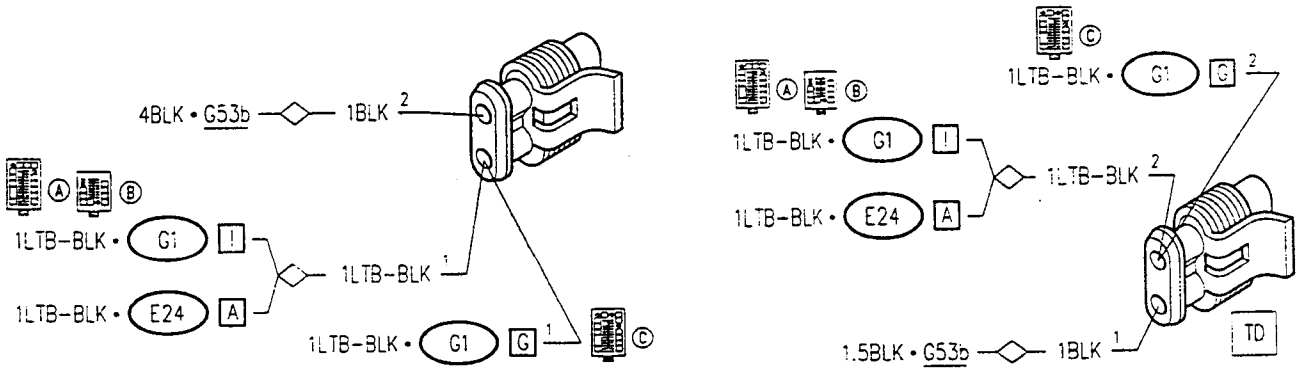
Instrument cluster — C10 B



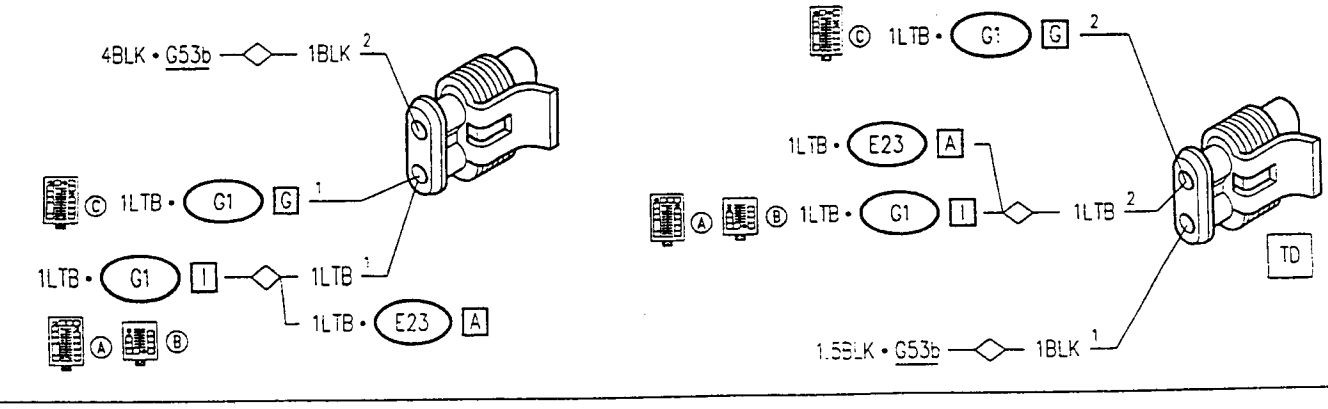
Check Panel Display — C16 B



LH direction indicator light bulb — E9a

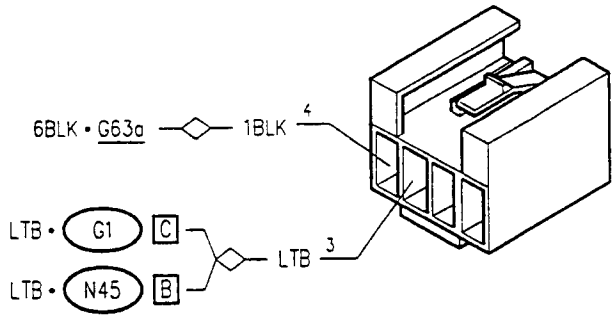


RH direction indicator light bulb — E9b

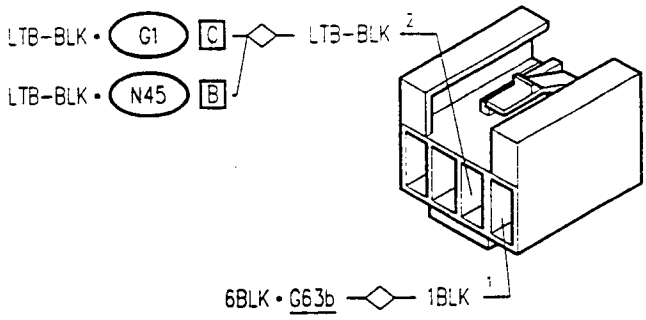


COMPONENTS AND CONNECTORS (cont.d)

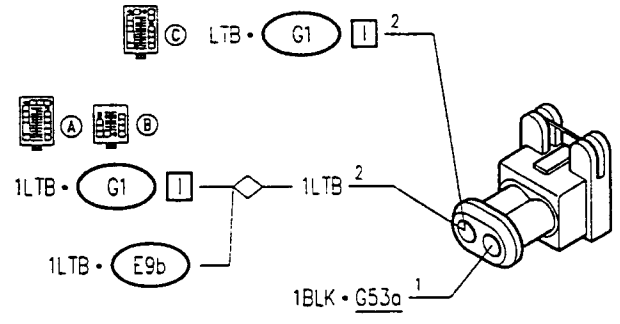
RH light bulb	E19 A



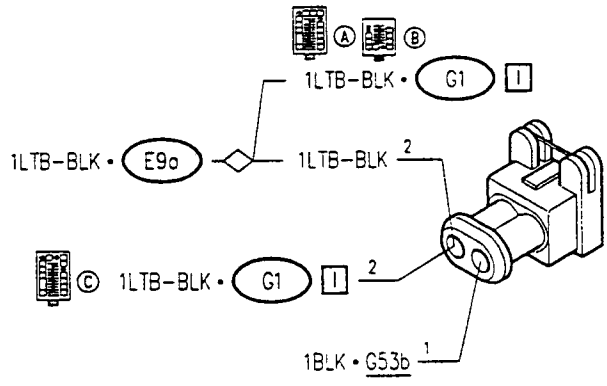
LH light bulb	E20 A



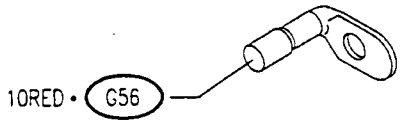
RH front light cluster	E23 A



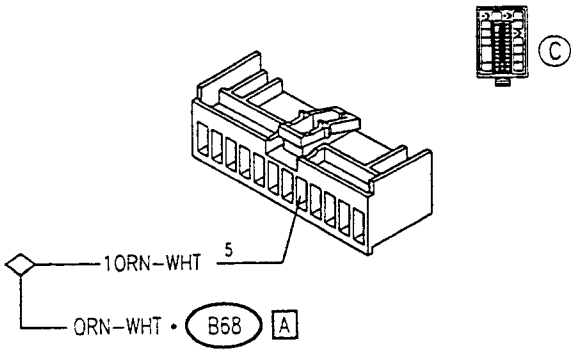
LH front light cluster	E24 A



Fusebox	G1

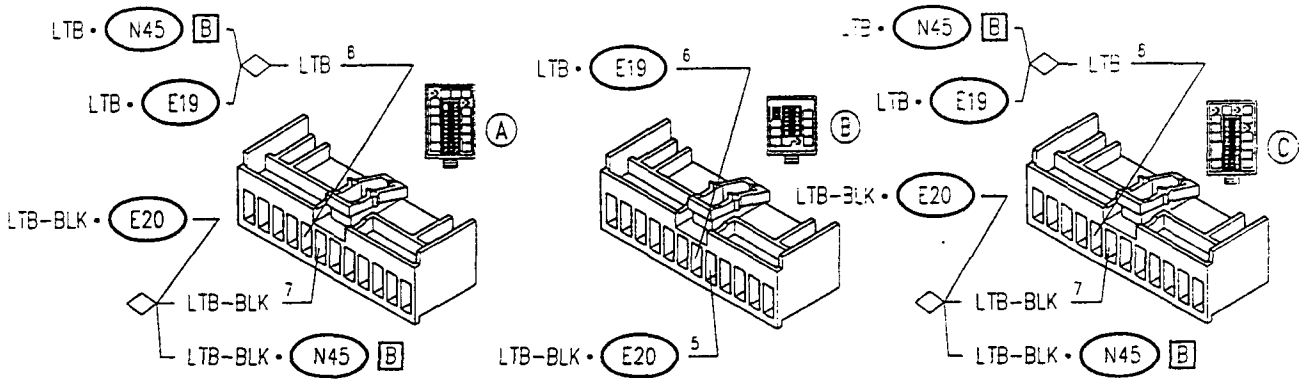


Fusebox	G1 A

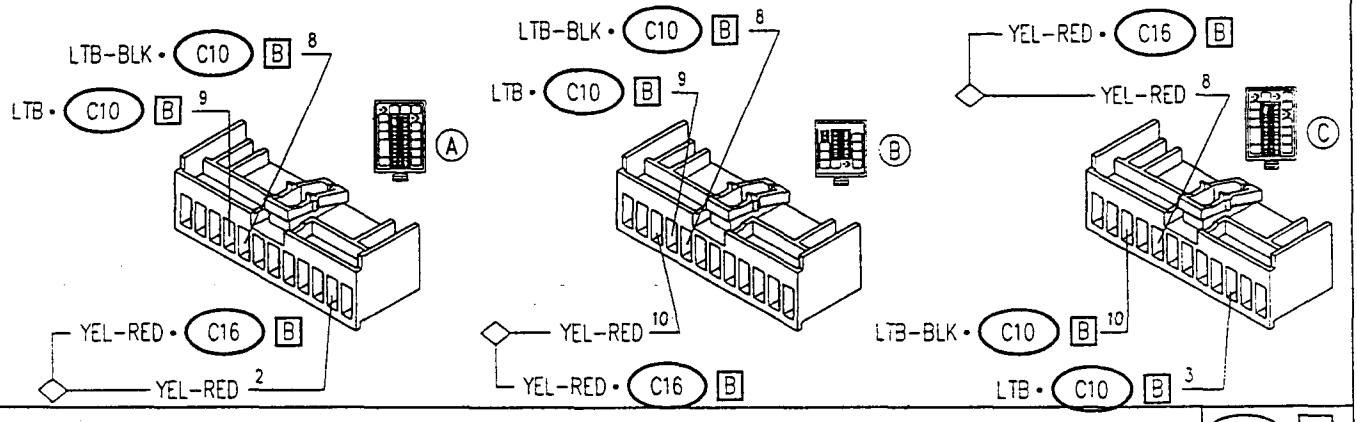


COMPONENTS AND CONNECTORS (cont.d)

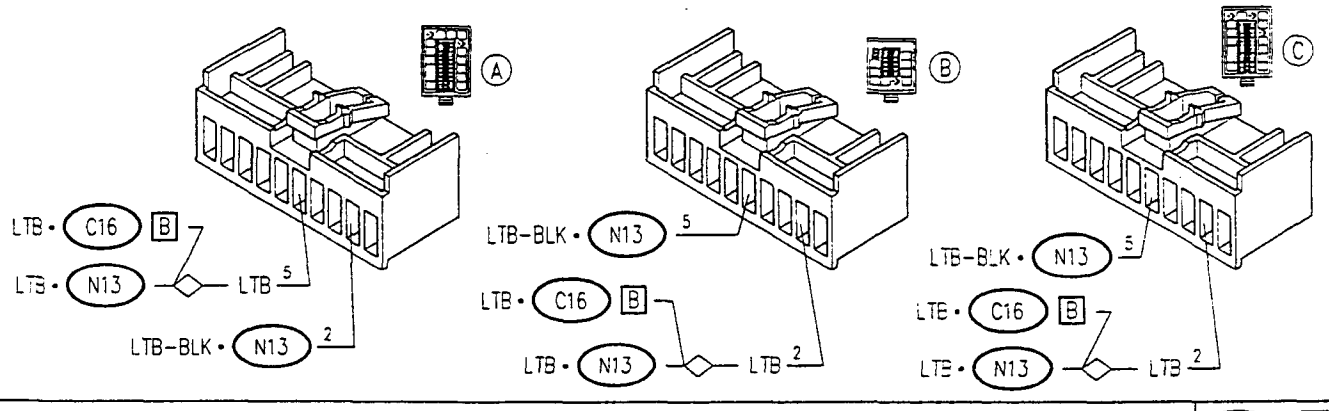
Fusebox G1 C



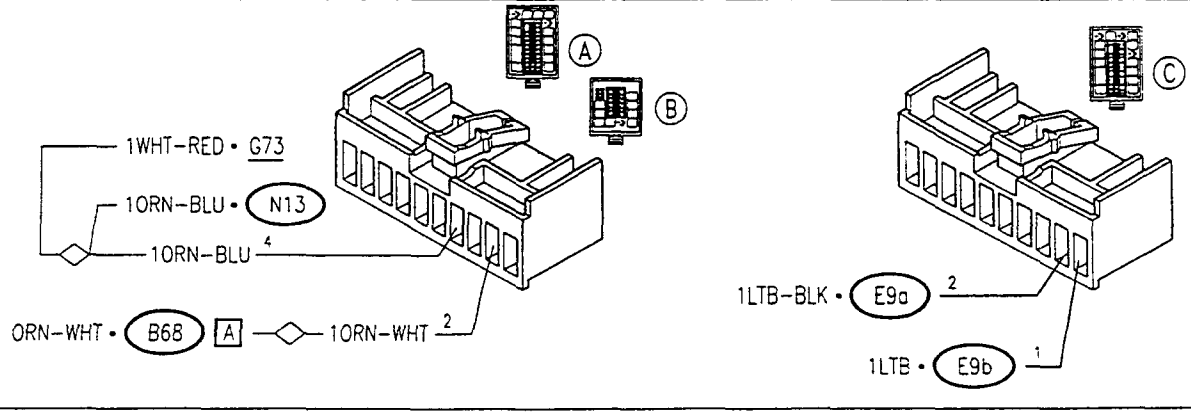
Fusebox G1 D



Fusebox G1 F

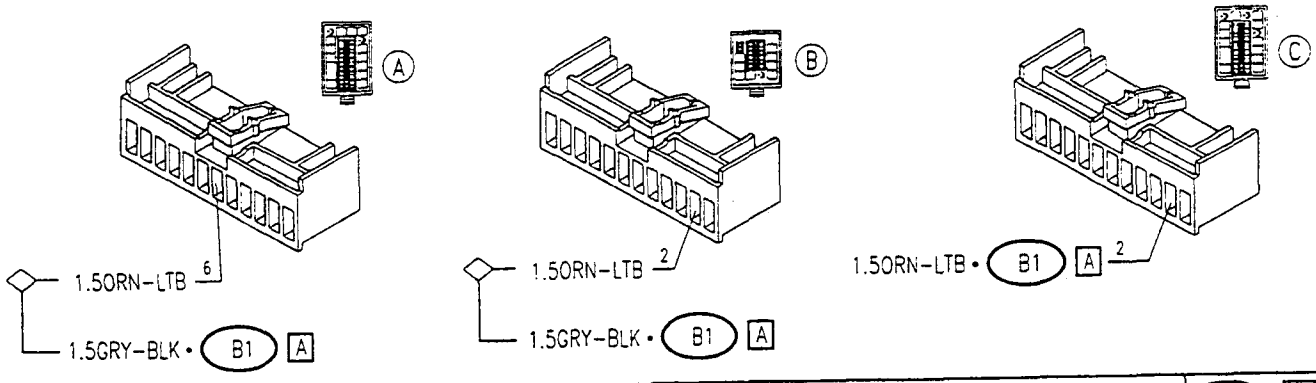


Fusebox G1 G

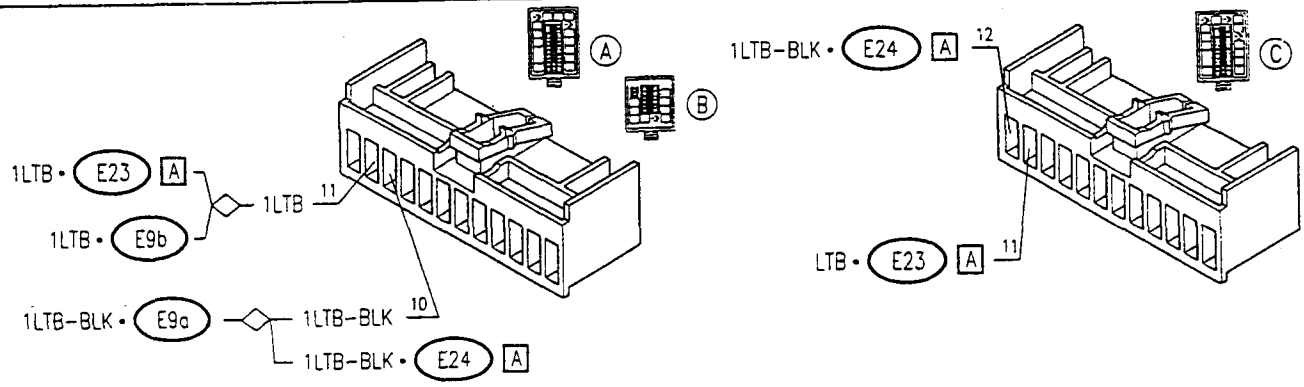


COMPONENTS AND CONNECTORS (cont.d)

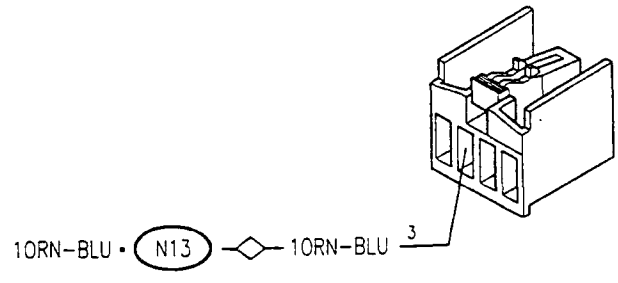
Fusebox — G1 H



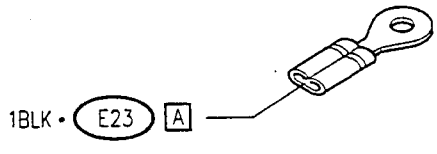
Fusebox — G1 I



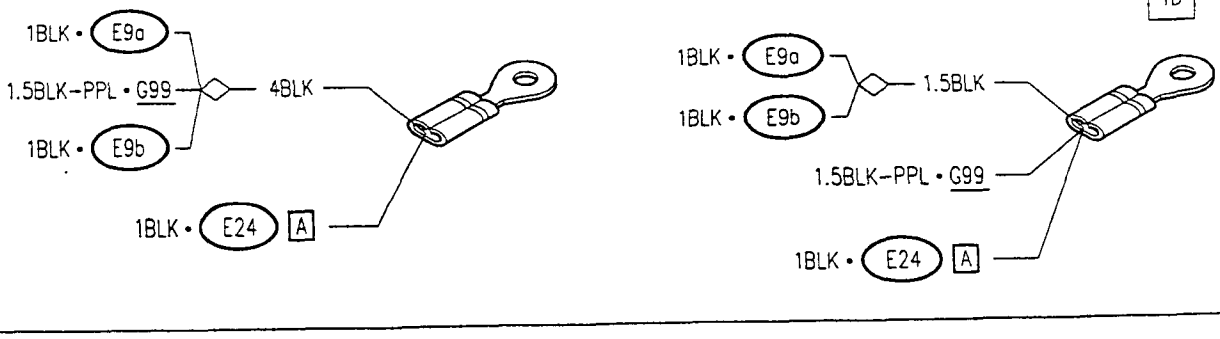
Fusebox — G1 L



RH engine compartment earth — G53a

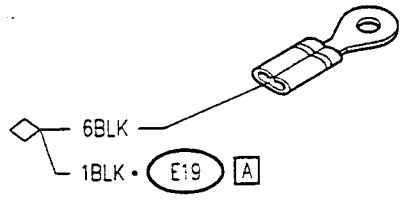


LH engine compartment earth — G53b

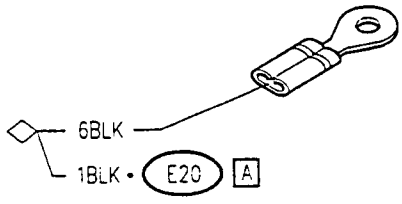


COMPONENTS AND CONNECTORS (cont.d)

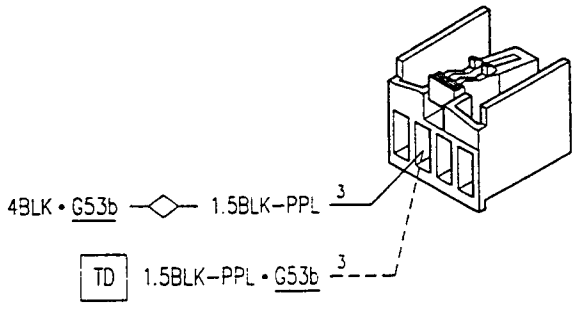
RH rear earth	G63a



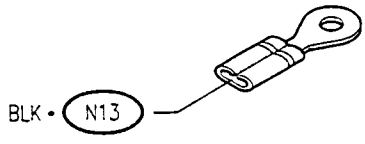
LH under earth	G63b



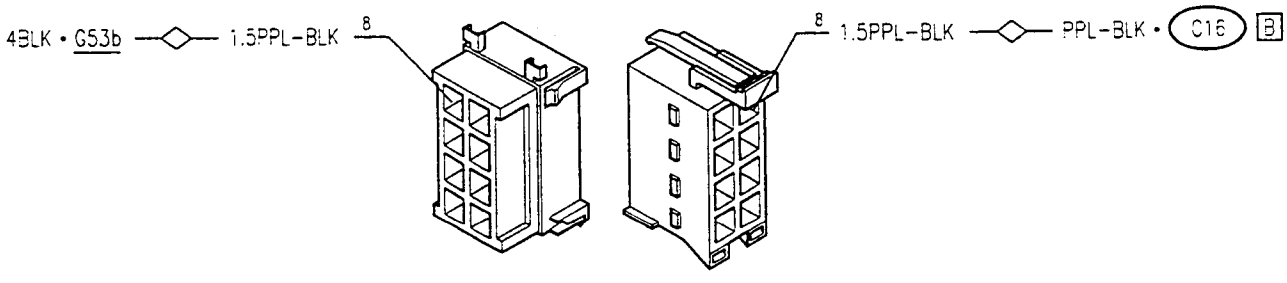
Dashboard/engine wiring connector (*)	G99



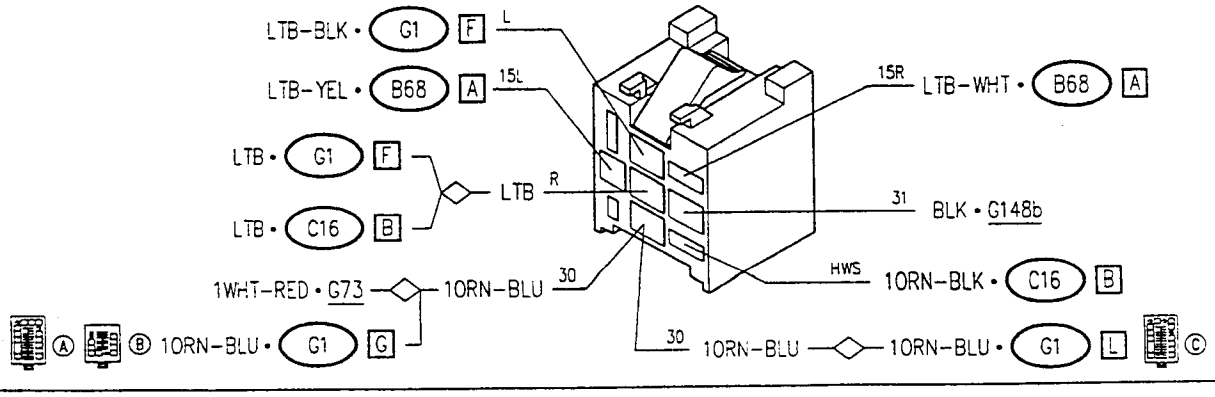
Earth under LH dashboard	G148b



Dashboard/engine wiring connector (**)	G99



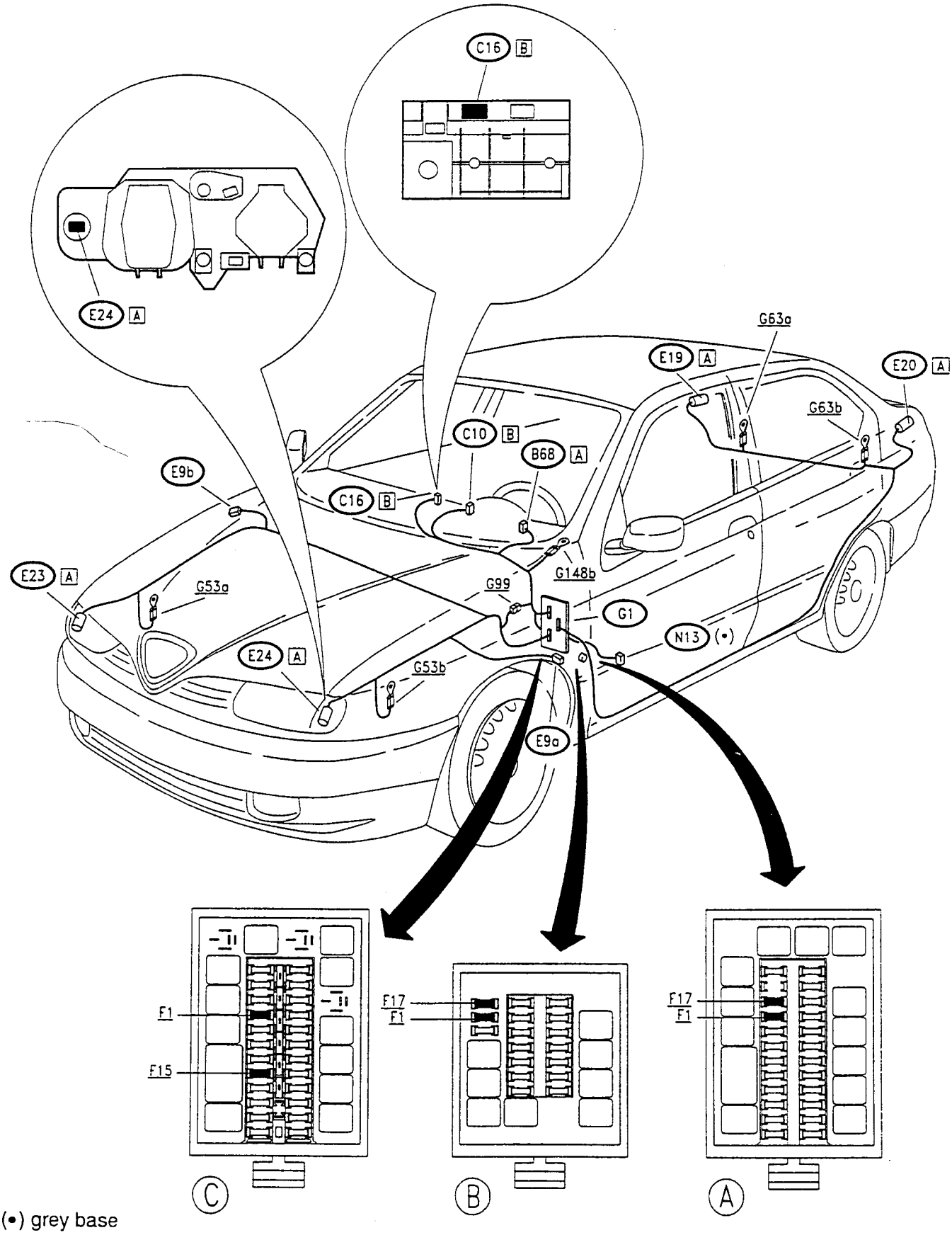
Indicator & hazard warning light flasher	N13



(*) up to chassis no.__

(**) from chassis no.__

LOCATION OF COMPONENTS



(•) grey base

FAULTFINDING TABLE

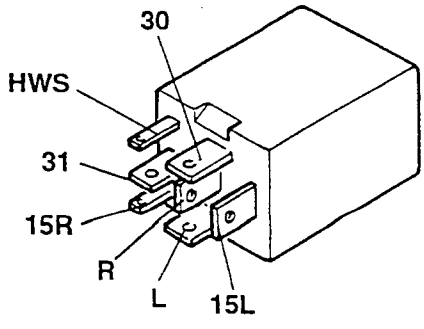
Failure	Component to be checked											
	F1	F17	E23	E24	E9a	E9b	E19	E20	N13	B68	C16 (**)	C10 (*)
All the direction indicators	•	•							•	•		
Hazard warning lights	•								•		•	
All the RH direction indicators									•	•		
All the LH direction indicators									•	•		
RH front light			•									
RH side light						•						
RH rear light							•					
LH front light				•								
LH side light					•							
LH rear light								•				
RH indicator warning light												•
LH indicator warning light												•
Hazard warning light switch illuminated with lights on											•	

(*) The instrument cluster **C10** cannot be repaired. Therefore in the event of a failure it is not possible to change the single warning light and a new complete cluster must be fitted.

(**) The "Check Panel" display **C16** cannot be repaired. Therefore, in the event of a failure it is not possible to replace the hazard warning light switch and a new complete Check Panel must be installed.

CHECKING COMPONENTS

Hazard warning light and indicator flasher (N13)



Checking the device: see **TEST A**

HAZARD WARNING LIGHT AND INDICATOR FLASHER (N13) — TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect the flasher **N13** and on the base check for 12V at pin 30 of **N13**	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Check fuse **F1** from fusebox **G1**. If necessary
A2 CHECK EARTH – Check for 0 V at pin 31 of **N13**	OK ▶	Carry out **step A3**
	~~OK~~ ▶	Restore the wiring between **N13** and earth **G148b**
A3 CHECK INTERMITTENT VOLTAGE – With the ignition key turned, operate the RH indicator and check for 12 V at pin 15R of **N13**; operate the LH indicator in the same way, check pin 15L of **N13**	OK ▶	Carry out **step A4**
	~~OK~~ ▶	Restore the wiring between **N13** and lever unit **B68**, or replace the latter
A4 CHECK EARTH – Operate the hazard warning light switch and check for 0V at pin HWS of **N13**	OK ▶	Insert device **N13** on its base and continue with oseguire **step A5**
	~~OK~~ ▶	Restore the wiring between **N13** and the switch in panel **C16**, or change the latter
A5 CHECK INTERMITTENT VOLTAGE – Operate the RH indicator and check for **intermittent 12V** at pin R of **N13**; do the same operating the LH indicator at pin L and operating the hazard warning lights at both pin R and pin L	OK ▶	DEVICE **N13** IS WORKING PROPERLY. Check the connections with the other components
	~~OK~~ ▶	CHANGE DEVICE **N13**

KEY TO COMPONENTS

A STARTING - RECHARGING
A1 Battery
A3 Alternator, with integrated voltage regulator
A8 Ignition coil
A8a Ignition coil A
A8b Ignition coil B
A11 Starter motor
A12 Spark plugs
A13 Glow plugs

B MANUAL ELECTRICAL CONTROLS
B1 Ignition switch
B21a Right front power window control switch (on RH door)
B21b Right front power window control switch (on LH door)
B22 Left rear power window control switch
B23 Right rear power window control switch
B24 Left rear power window control switch
B25 Rear power window consensus switch
B36 Wing mirror control switch
B47 Sun roof motor control switch
B51 LH front seat heater control switch
B53 Front power window switch with automatic mechanism
B62 RH front seat heater control switch
B68 Steering column lever unit
B69 Headlamp aiming device
B98 Air recirculation switch

C INSTRUMENTATION
C10 Instrument cluster
C16 Check Panel display

D WARNING LIGHTS
D31 Anti-theft device led indicator

E EXTERIOR LIGHTS
E9a LH direction indicator light bulb
E9b RH direction indicator light bulb
E10a LH fog light bulb
E10b RH fog light bulb
E14 Reversing light bulb
E16 Rear fog guard bulb
E17a LH number plate light bulb
E17b RH number plate light bulb
E19 RH tail light cluster
E20 LH tail light cluster
E23 RH front light cluster
E24 LH front light cluster
E28 Third stoplight

F INTERIOR LIGHTS
F2 Rear ceiling light
F3 Passenger compartment ceiling light
F5 Luggage compartment light
F8 Heating/ventilation controls light bulb
F8a Heating/ventilation controls light bulb a
F8b Heating ventilation controls light bulb b
F10 Ashtray light bulb

G FUSEBOX - CONNECTORS - EARTHS
G1 Fusebox
G21 Connector for RH front door wiring
G23 Connector for LH front door wiring
G25 Connector for RH rear door wiring
G27 Connector for LH rear door wiring
G29 Rear power window wiring connector
G38 Air conditioner connector
G43 Connector for heating and ventilation control wiring
G53a RH engine compartment earth
G53b LH engine compartment earth
G55a RH side panel earth
G55b LH side panel earth
G56 Branch terminal board
G60 Injection wiring earth
G60a Injection wiring earth
G60b Injection wiring earth
G61 Ignition coil connection
G63a RH rear earth
G63b LH rear earth
G65 Coaxial cable for aerial
G73 Connector for rear services
G94 Engine sempartment connector
G95m Sun roof connector
G99 Connector for dashboard wiring/engine wiring
G99b Dashboard/engine wiring connector
G106 Seat cross rail earth
G109 Injection wiring earth
G115 Connector for tow bar trailer socket
G124 ABS system connector
G125a ABS system fuse
G125b ABS system fuse
G133a Connector for electronic injection wiring A
G133b Connector for electronic injection wiring B
G133c Connector for electronic injection wiring C
G143 Services tray centre earth
G148b Earth under dashboard LH
G152 Glow plug warming fuse
G175a Connector for LH fog light wiring
G175b Connector for RH fog light wiring
G202 Connector for ABS system earth
G219 Connector for sun roof
G241 Anti-theft device wiring connector
G254 Fuse for engine fan
G254b Fuse for engine fan
G255 Fuse for heating and ventilation fan
G261 Fuse for sun roof
G267 Earth on crankcase
G272 Connector for ABS hydraulic unit
G273 ABS control unit connector
G307a Connector for rear wiring/luggage compartment wiring A
G307b Connector for rear wiring / luggage compartment wiring B
G308 Connector for engine sensors
G310 Fuse for RH front power window
G311 Fuse for LH front power window

G312 Fuse for headlamp washer
G313 Connector for additional conditioner wiring
G314 Connector for engine wiring/conditioner wiring
G318 Earth on gearbox
G326 Connector for rear fog guard wiring
G332 Alternator connector for recharging signal
G335 Connector for E.G.R.
G337 Connector for conditioner syst./injection syst.
G352 Fuel oil warming fuse
G355a Pre-installed connector for heating RH seats
G355b Pre-installed connector for heating LH seats
G380 Airbag connector
G381 Earth for airbag
G382 Fuse for fog lights
G383 Connector for airbag capsule
G384 Services supply fuse
G386 Electronic ALFA ROMEO CODE
G389 ALFA ROMEO CODE fuse
G393 General supply fuse
G394 Door mirrors defrosting fuse
G395 Air Bag and cluster fuse
G396 Connector for TELEPASS
G397 Cellular telephone provision
G398 Aerial supply connection
G407 Seam for Side Bag
G408 Additional heating fuse

H SWITCHES
H1 Handbrake switch
H2 Brake pedal switch
H3 Stop lights switch
H5 LH front door open switch
H6 RH front door open switch
H9 RH front brake pad switch
H10 LH front brake pad switch
H17 Brake fluid minimum level switch
H20 Inertial switch
H21 Clutch pedal switch
H24 Luggage compartment light switch
H44 Bonnet anti-theft device switch
H51 Sun roof stroke limit switch
H54 Full load switch

I RELAYS
I1 Engine cooling fan relay
I2 Heated rearscreen relay
I3 Horn relay
I10 Starting consent relay
I12 Power windows relay
I13 Rear power windows relay
I17 Fog light relay
I25 Rear fog guard relay
I29 Fuel pump relay
I35 Key-operated supply relay
I44 Fuel warming device relay
I45 Door mirrors defrosting relay
I49 Low beam relay
I50 High beam relay
I52 Luggage compartment opening relay
I58 Sun roof relay
I64 Side lights relay
I65 Fog lights consent relay
I67 Day-light cut off relay
I78 Heating and ventilation fan relay
I87 LH seat heater relay
I88 RH seat heater relay
I91 DIM-DIP headlamp relay
I99 Engine cooling fan 1st speed relay
I99a Engine cooling fan 1st speed relay
I99b Engine cooling fan 1st speed relay
I100 Engine cooling fan 2nd speed relay
I105 Relay for Diesel engine control devices
I118 Additional heater remote switch -1
I119 Additional heater remote switch -2
I120 Additional heater safety remote switch
I121 Engine cooling solenoid valve remote switch

L SENDERS
L2 Minimum engine oil pressure
L5 Max. engine coolant temperature warning light contact
L6 Engine cooling fan thermal switch
L7 Sender for engine coolant temperature gauge
L9 Sender for fuel level gauge
L10 Sender for engine coolant temperature gauge and max. temperature warning light contact
L16 Rev counter sensor
L17 Speedometer sensor
L27 Water temperature sensor for warming glow plugs
L28 RH front phonic wheel inductive sensor
L29 LH front phonic wheel inductive sensor
L30 RH rear phonic wheel inductive sensor
L31 LH rear phonic wheel inductive sensor
L33 Two-level thermal contact
L36 Turbo supercharging sensor
L45 K.S.B. water temperature sensor
L46 E.G.R. solenoid control valve
L47 Potantiometer for E.G.R.
L49 Accelerator pedal potentiometer
L51 Fuel temperature sensor
L59 Fuel pressure sensor
L60 Water temperature sensor for additional heater

M ELETTROMAGNETS - SOLENOID VALVES
M5 Engine stop electromagnet
M12 Luggage compartment opening actuator electromagnet
M15 Evaporation solenoid valve
M28 Fuel pressure regolator

N ELECTRONIC DEVICES - INTERMITTENCES-TIMERS
N1 Electronic ignition module
N6 Glow plug warming timer
N10 Ceiling lights timer
N11 Door locking control unit

N12 Headlamp washer timer
N13 Hazard warning lights and direction indicators intermittence
N14 Electronic windscreen wiper intermittence
N25 Rear fog guard electronic device
N31 Fuel warming device
N38 Power window control unit
N45 Anti-theft device control unit
N51 Hydraulic unit with ABS control unit
N60 Sun roof control unit
N65 E.G.R. control unit
N67 Remote control signal receiver
N77 ALFA ROMEO CODE control unit
N78 ALFA ROMEO CODE receiver
N83 Fuel level signal damper
N85 Additional heater control unit

O SERVICES
O1 Heated rearscreen
O2a High tone horn
O2b Low tone horn
O4 Car radio
O5a RH front loud-speaker
O5b LH front loud-speaker
O5c RH rear loud-speaker
O5d LH rear loud-speaker
O6 Cigar lighter - current socket
O14 LH front seat heater
O17 RH front seat heater
O18 RH wing mirror defroster
O19 LH wing mirror defroster
O22 Additional engine fan resistance
O27 K.S.B. device
O28 DIM-DIP Resistance
O31a RH Tweeter loud-speaker
O31b LH Tweeter loud-speaker
O38 Additional heater glow plugs

P ELECTRIC MOTORS
P1 Windscreen wiper motor
P2 Engine cooling fan
P2a Engine cooling fan
P2b Engine cooling fan
P8 LH wing mirror motor
P9 RH wing mirror motor
P10 Front RH door lock motor
P11 Front LH door lock motor
P12 Rear RH door lock motor
P13 Rear LH door lock motor
P14 Front RH power window motor
P15 Front LH power window motor
P16 Rear RH power window motor
P17 Rear LH power window motor
P18 Electric fuel pump
P19 Windscreen and rearscreen washer pump
P20 Headlamp washer pump
P21 Rearscreen wiper motor
P24 Sun roof motor
P35a RH headlamp aiming motor
P35b LH headlamp aiming motor

Q HEATING/VENTILATION - AIR CONDITIONING
Q1 Heater fan
Q4 Heater fan control
Q5 Heater fan speed adjustment resistance
Q9 Minimum pressure switch
Q11 Compressor electromagnetic coupling
Q12 Compressor electromagnetic coupling cut-off thermal contact
Q20 Min. and max. sensor pressure contact
Q21 Climate control system control unit
Q22 Electromagnetic coupling relay
Q24 Outside temperature sensor
Q25 Treated air temperature sensor
Q26 Antifrost sensor
Q27 Air recirculation flap control motor
Q30 Air mixing control motor
Q31 Climate control electronic regulator
Q32 Auxiliary relay for heating and ventilation
Q33 Passenger compartment air temperature sensor
Q34 Required air adjustment control
Q39 Fuse for conditioning system - 30 A
Q41 Set of relay and fuses for air conditioner
Q42 Conditioner fan delay device
Q65 Fuse for conditioning system-7.5 A
Q66 Fuse for conditioning system-3A
Q67 Compressor disengagement control unit
Q68 Compressor and air recirculation engagement switches
Q69 Heater fan 1st speed relay
Q71 Antifrost thermostat
Q72 Fast defrosting switch
Q73a Air recirculation relay
Q73b Air recirculation relay

R SAFETY DEVICES
R22 Airbag control unit
R23 Capsule on steering wheel for airbag
R27 Passenger's side airbag capsule
R30 Passenger present sensor for Air Bag
R31 LH Side Bag sensor
R32 RH Side Bag sensor
R33 LH Side Bag capsule
R34 RH Side Bag capsule

S ELECTRONIC INJECTION
S3 Elettroinjectors
S5 Air flow meter
S7 Engine temperature sensor
S11 Electronic injection control unit
S12a Fuel pump relay
S12c Timing variator relay
S12e Air flow meter relay
S13 Timing sensor
S20 Pinging sensor
S28 Injection control relay
S29 Idle adjustment actuator

S31 Rpm sensor
S34 Air temperature sensor
S35 Heated lambda probe
S36 Fuse for injection relay
S38 Sensor on throttle body
S40 Injection/ignition control unit
S41 Main relay
S42 Secondary relay
S43 Absolute pressure sensor
S45 Lambda probe fuse
S46 Injection supply wander fuse
S47 Fuse for fuel pump
S49 MP31/IAW control unit switching connector
S50 Injectors (JTD)
S52 Cam angle sensor
S56 Temperature sensor for E.G.R.
S57 Variable geometry solenoid valve

T DIAGNOSIS
T1 Connector for ALFA TESTER (engine and ALFA ROMEO CODE management)
T3 Connector for ALFA TESTER (airbag)
T7 Connector for ALFA TESTER (anti-theft device)
T8 Connector for ALFA TESTER (ABS)
T10 Connector for ALFA TESTER (Heating/ventilation)
T12 Connector for ALFA TESTER (E.G.R.)

LOCATION OF EARTHS

INDEX

GENERAL DESCRIPTION 2-2
WIRING DIAGRAMS 2-3
COMPONENTS AND CONNECTORS 2-13
LOCATION OF EARTHS ON THE CAR 2-17

GENERAL DESCRIPTION

The following diagrams show the diferent earths present on the vehicle and the connecting cables for each of them; each cable shows the circuit to which it refers and the component earthed through that line.

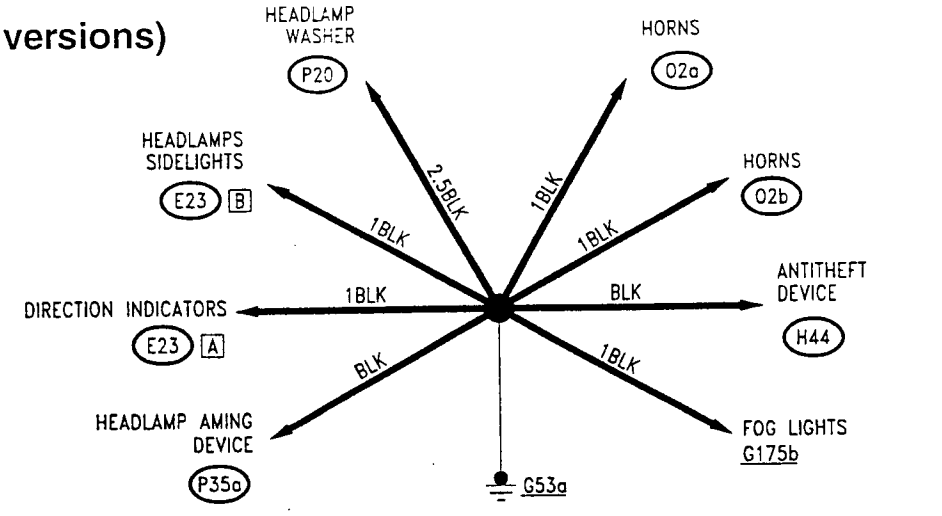
The earths shown are the following:

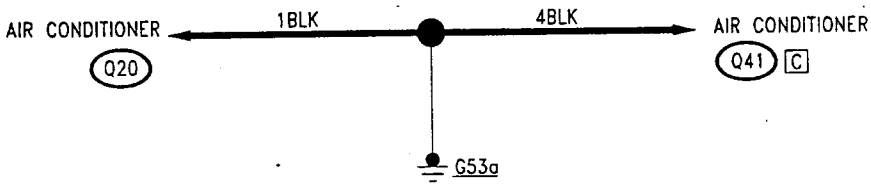
- **G53a** Right-hand engine compartment earth
- **G53b** Left-hand engine compartment earth
- **G55a** Right-hand side panel earth
- **G55b** Left-hand side panel earth
- **G60** Injection wiring earth **(G60a/b)**
- **G63a** Right-hand rear earth
- **G63b** Left-hand rear earth
- **G106** Seat cross rail earth
- **G109** Injection wiring earth
- **G143** Centre services tray earth
- **G148b** Earth under left-hand dashboard
- **G267** Earth on crankcase
- **G318** Earth on gearbox
- **G381** Airbag earth

NOTE: Using these diagrams it is easy to locate those circuits which are connected to earth by the same line: this simplifies faultfinding work in the event of problems affecting more than one system: for instance the oxidation of an earth can put several circuits and numerous functions out of order contemporaneously.

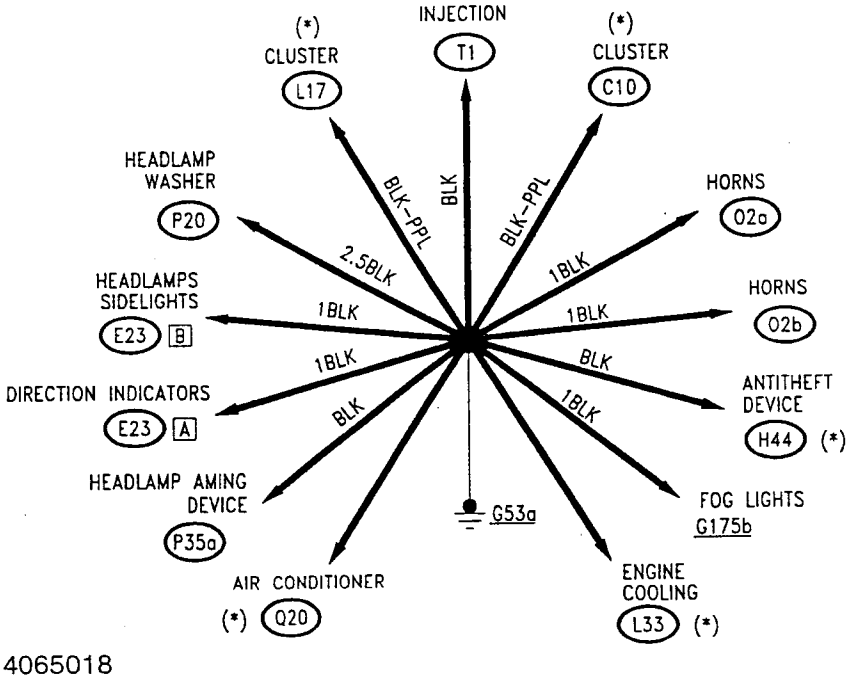
WIRING DIAGRAMS

G53a (Boxer versions)



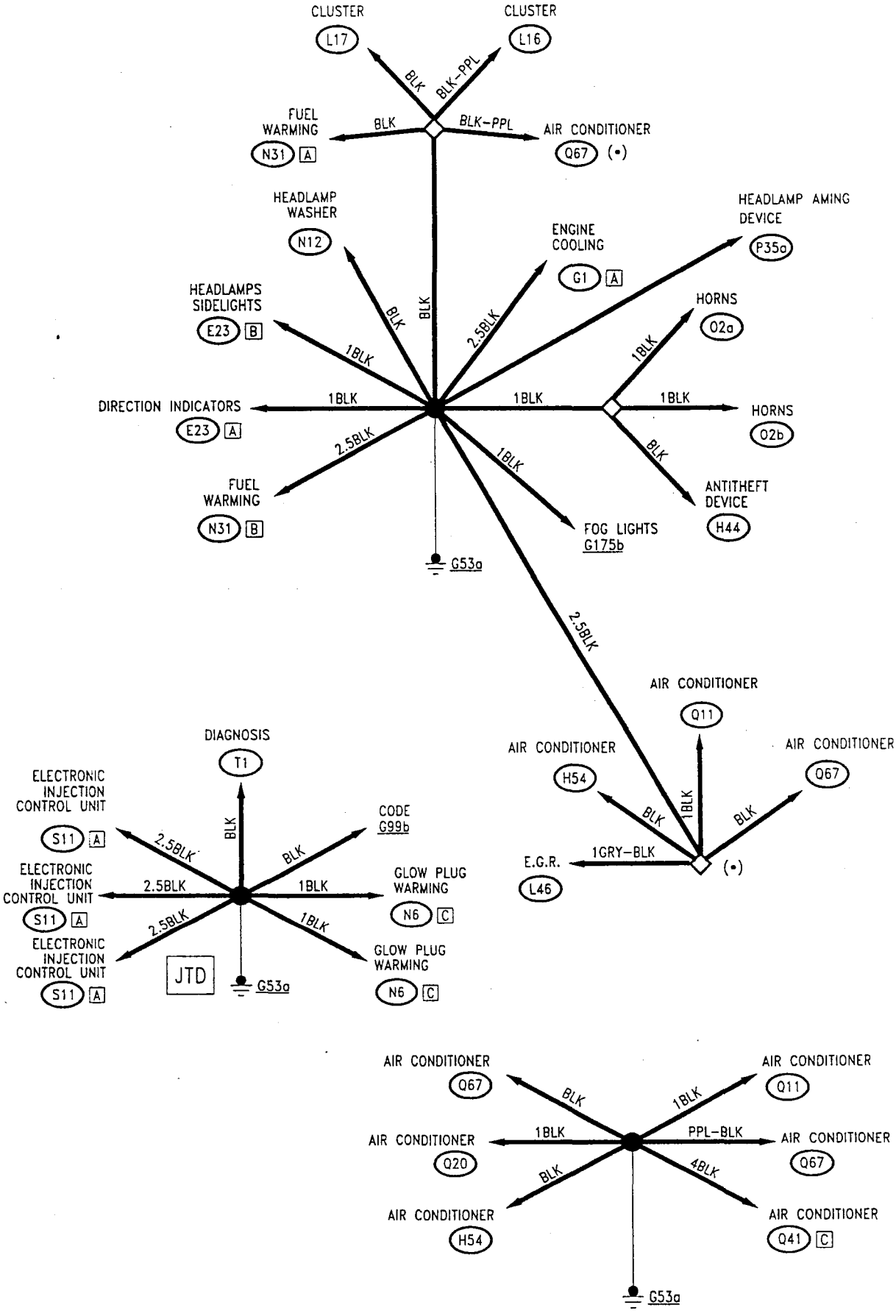


G53a (T.SPARK version)



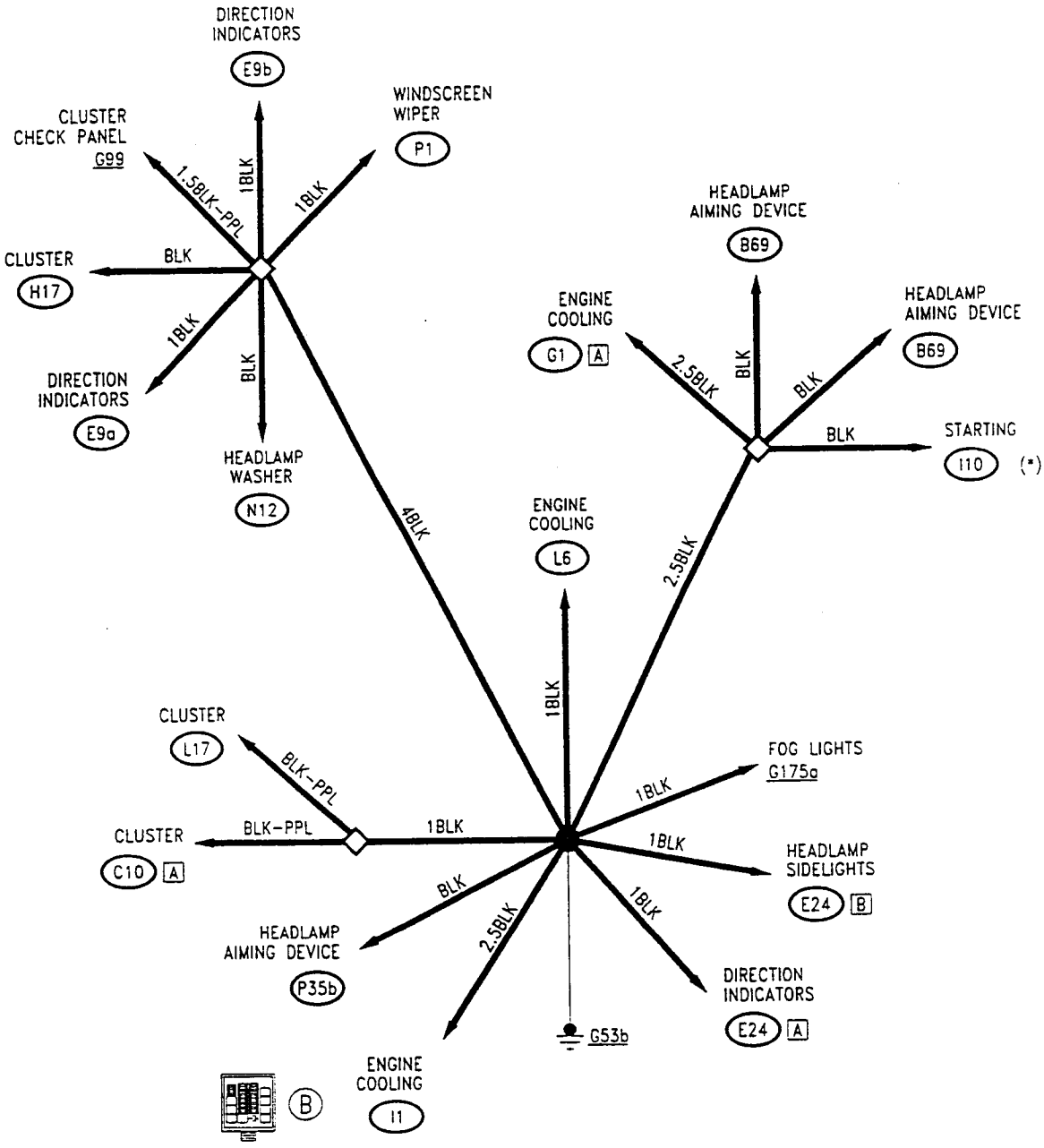
(**) from chassis no. 4065018
(•) up to chassis no.____

G53a (TD, TD-CAT, JTD version)



(•) Variant form chassis no....

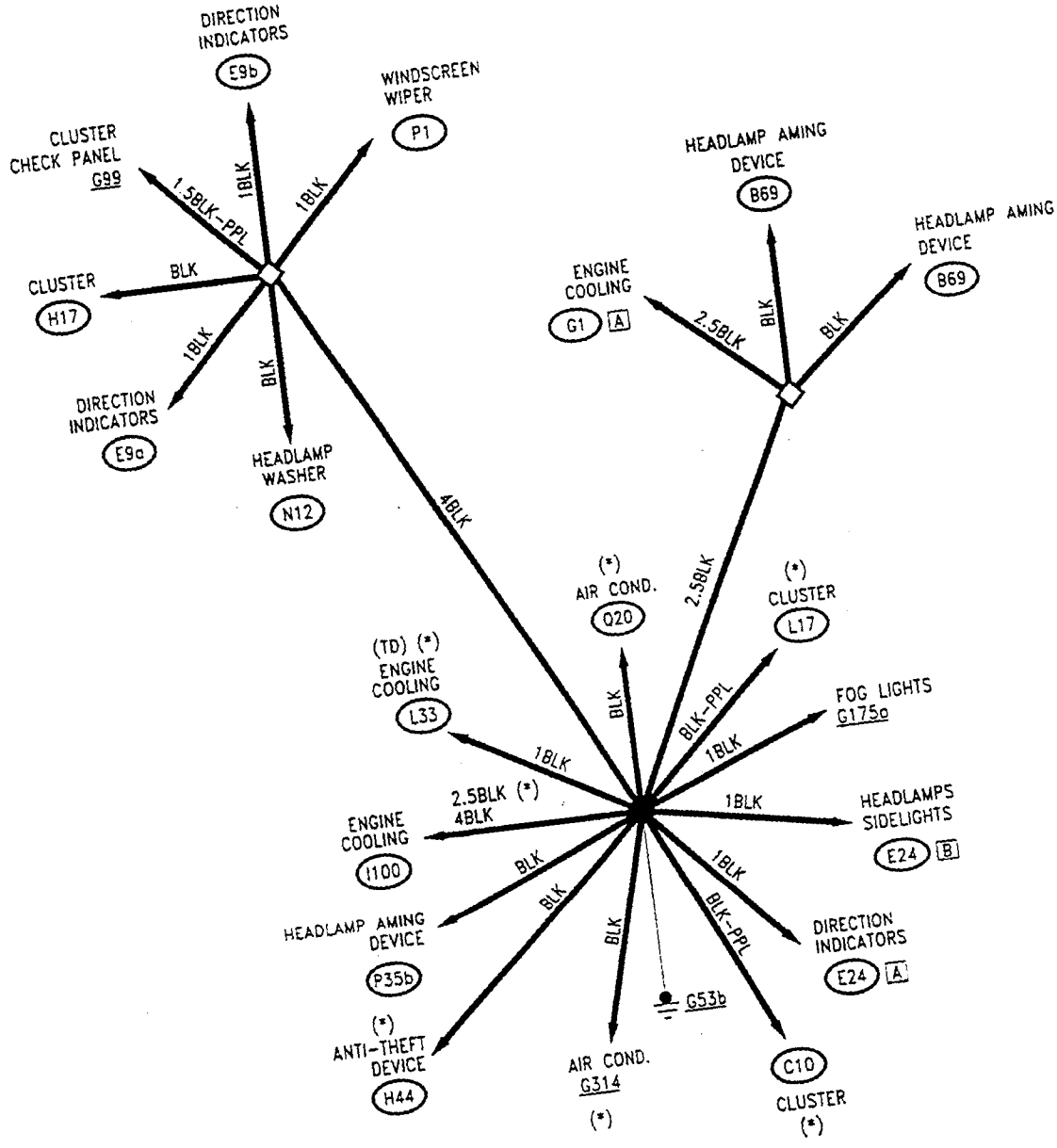
G53b (Boxer versions)



(*) Versions without ALFA ROMEO CODE

46

3b (T.SPARK version)

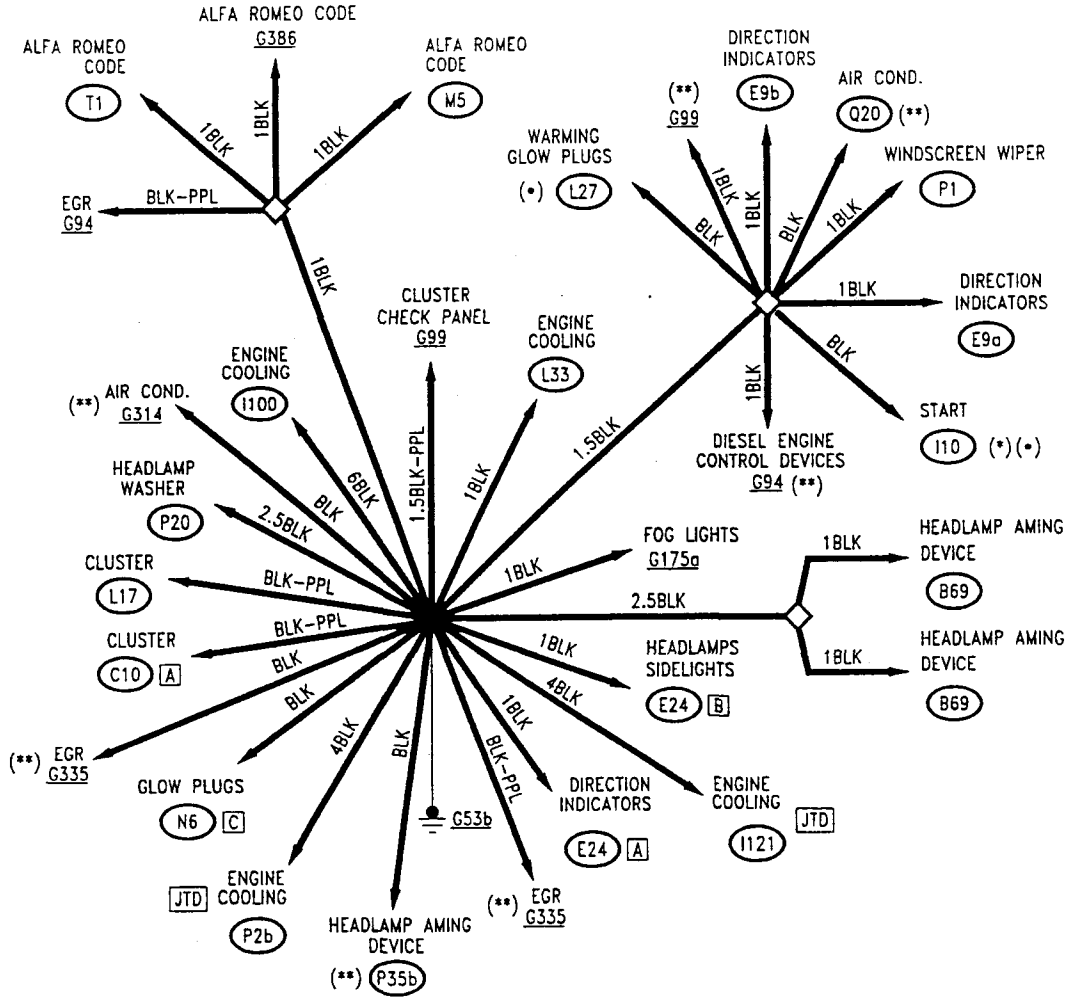


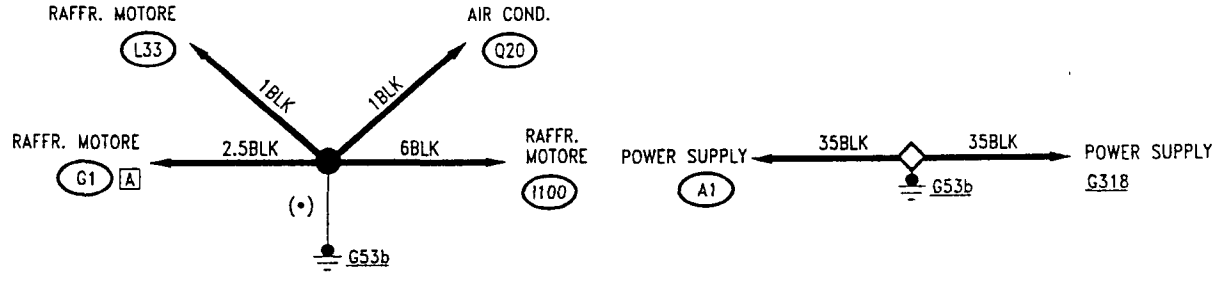
(*) from chassis no.____

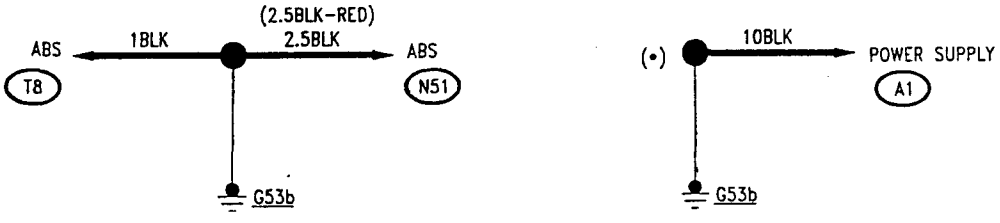
6-1997

PA493000000008

G53b (TD, TD-CAT version)

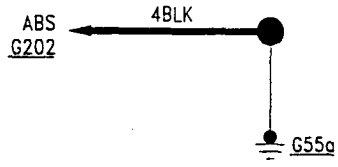




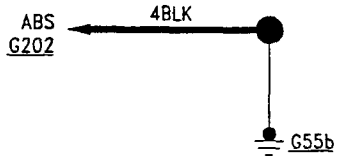


(*) Only versions without ALFA ROMEO CODE
(**) Variant from chassis no....
(•) Variant from chassis no....

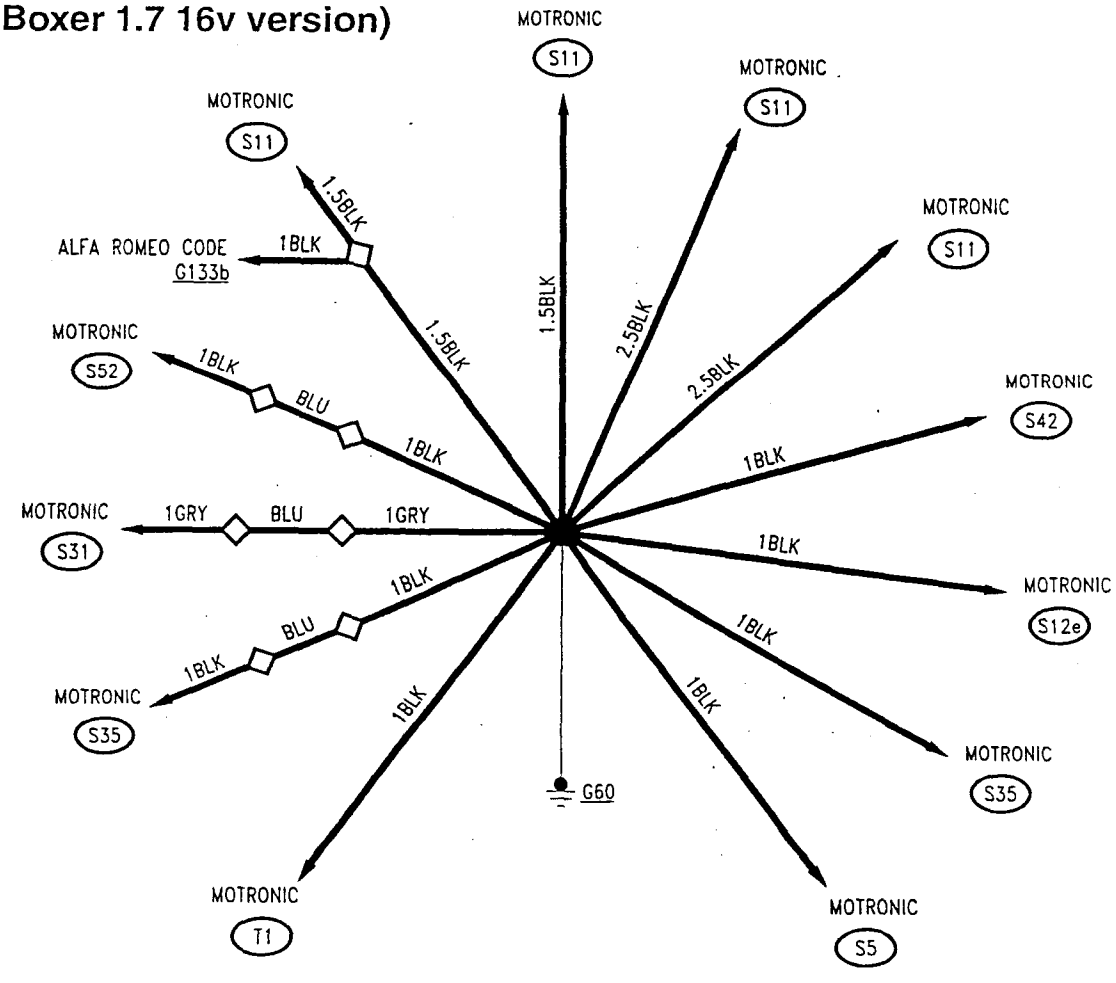
G55a (Boxer versions)



G55b (TD, T.SPARK and JTD version)

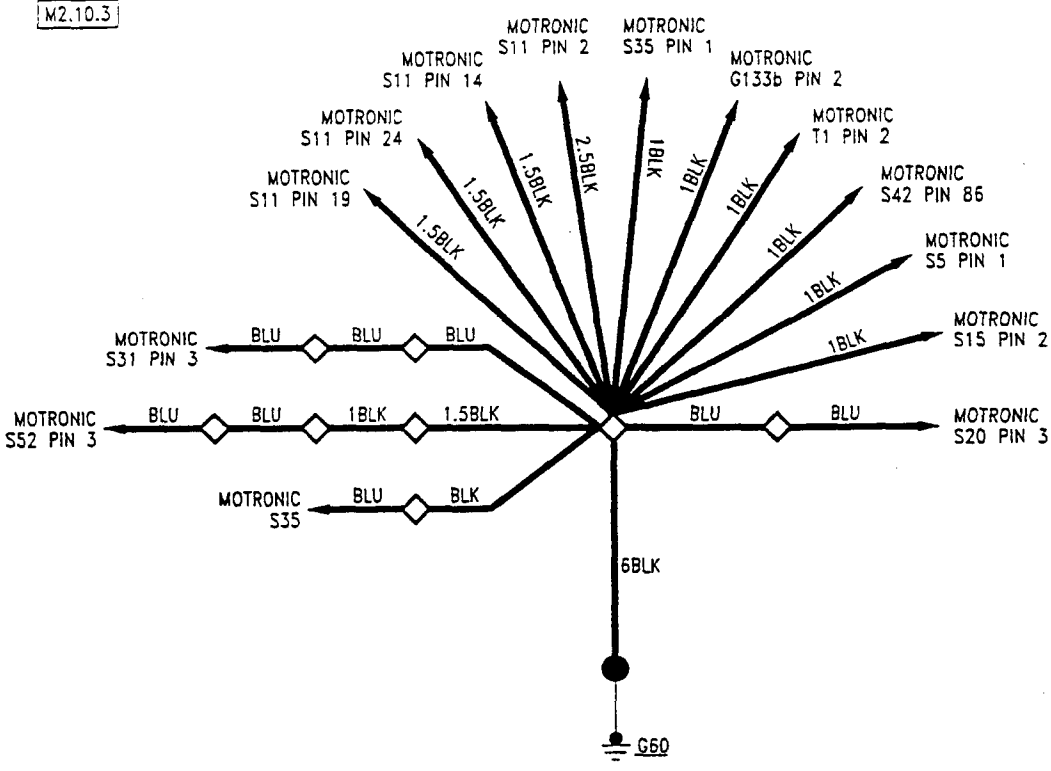


G60 (Boxer 1.7 16v version)

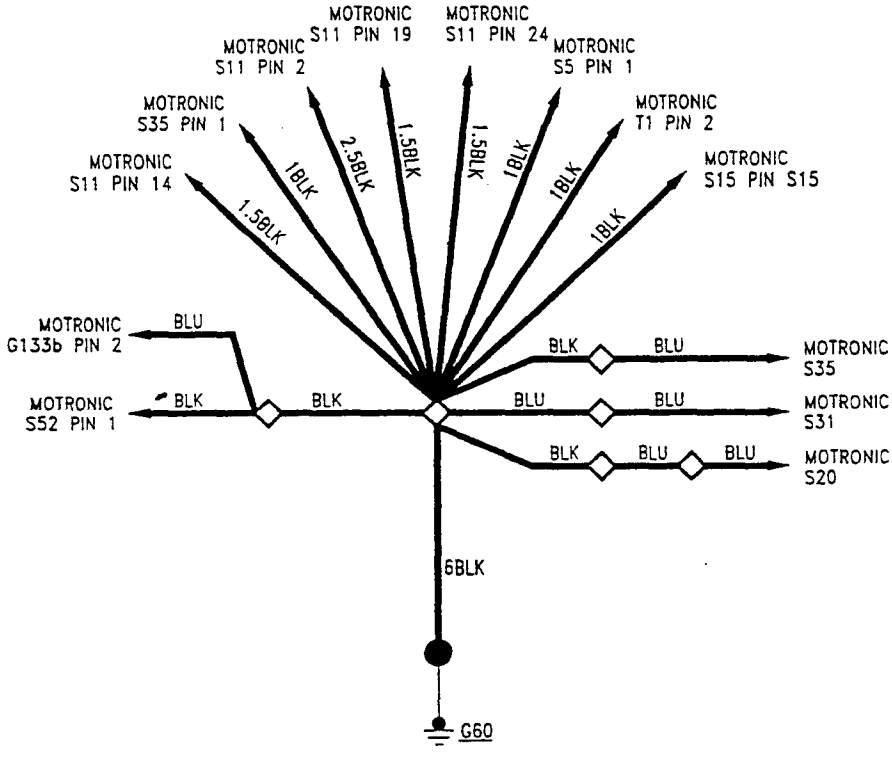


G60 (T.SPARK Version)

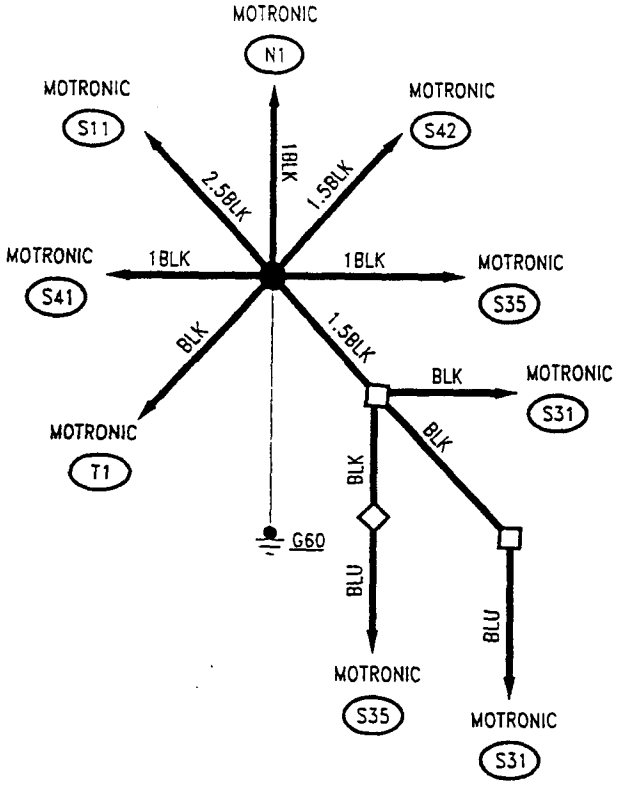
M2.10.3



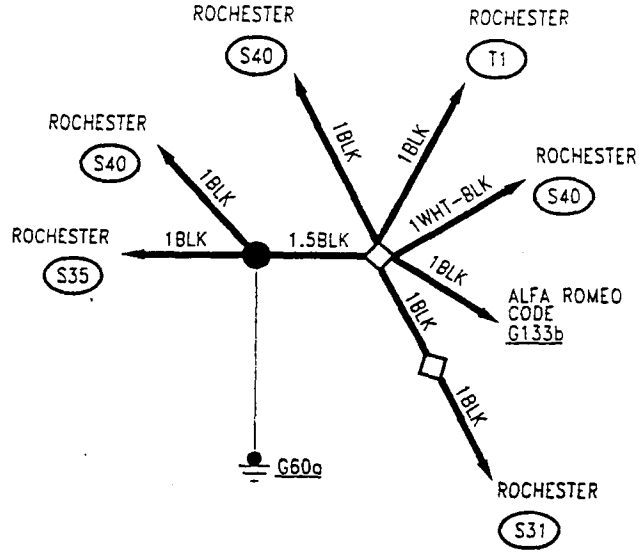
M2.10.4



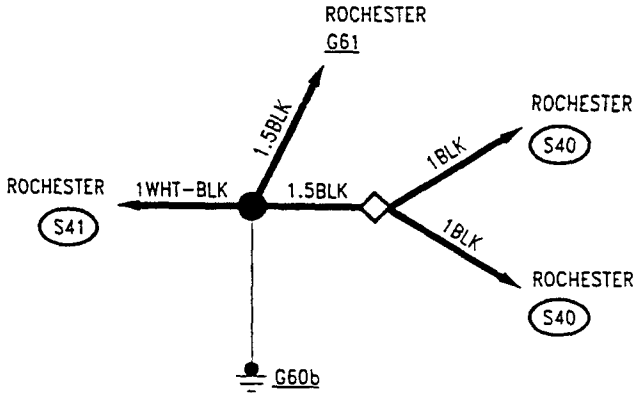
G60 (Boxer 1.6 - MP31 version)



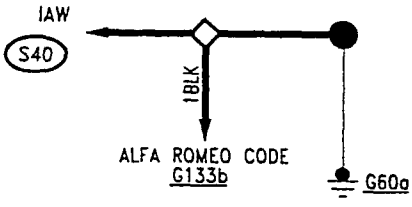
G60a (Boxer 1.6 - Rochester)



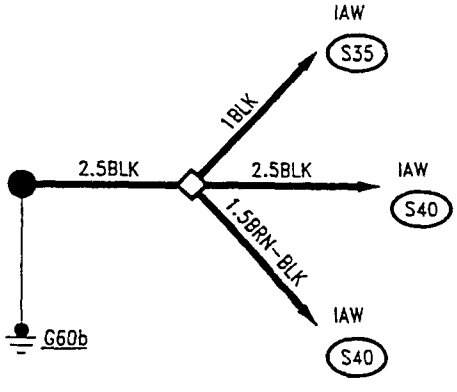
G60b (Boxer 1.6 - Rochester)



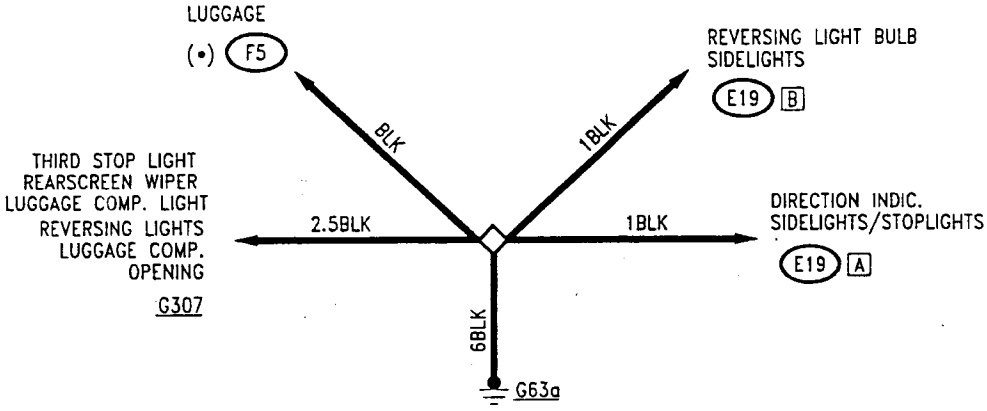
G60a (Boxer 1.3 version)



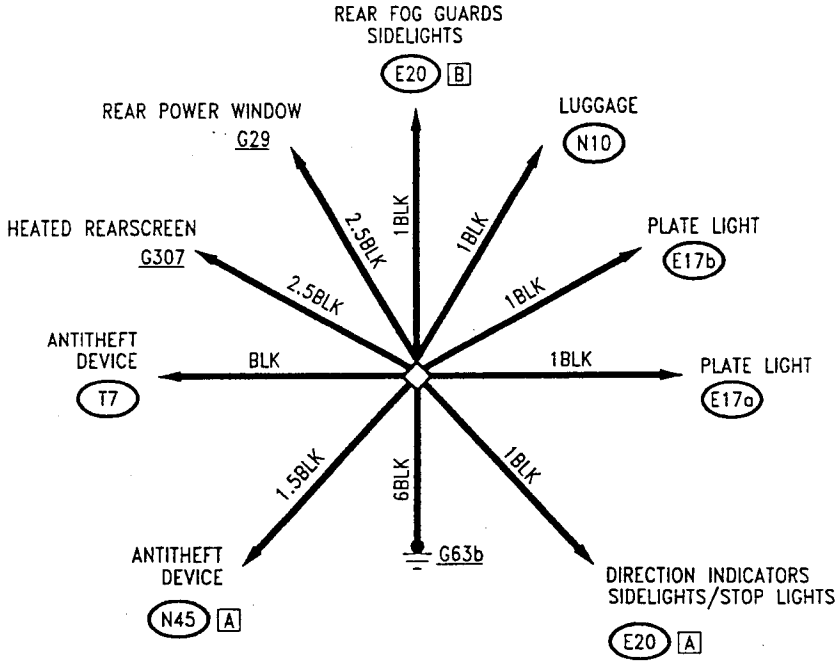
G60b (Boxer 1.3 version)



G63a

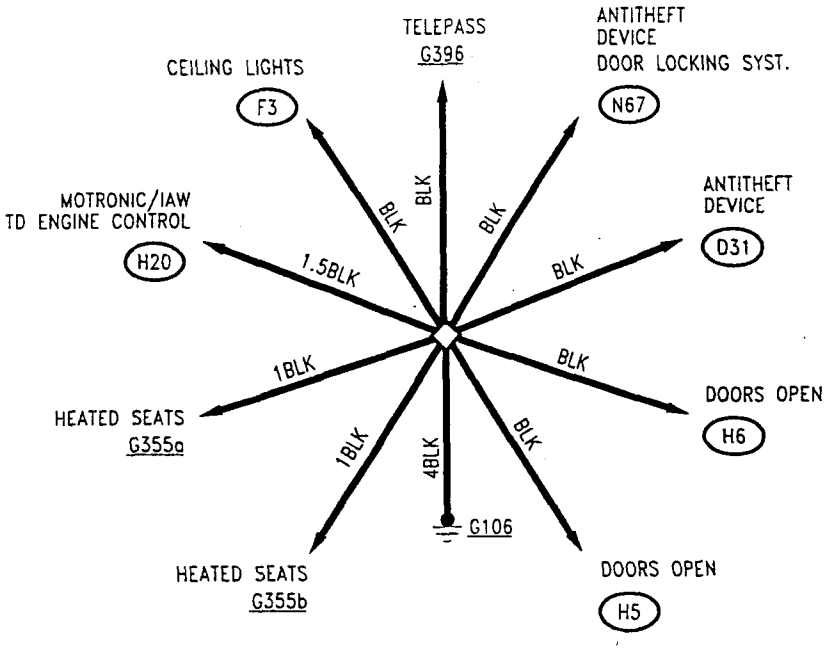


G63b

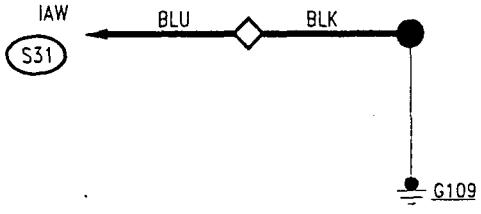


(•) from M.Y. '99

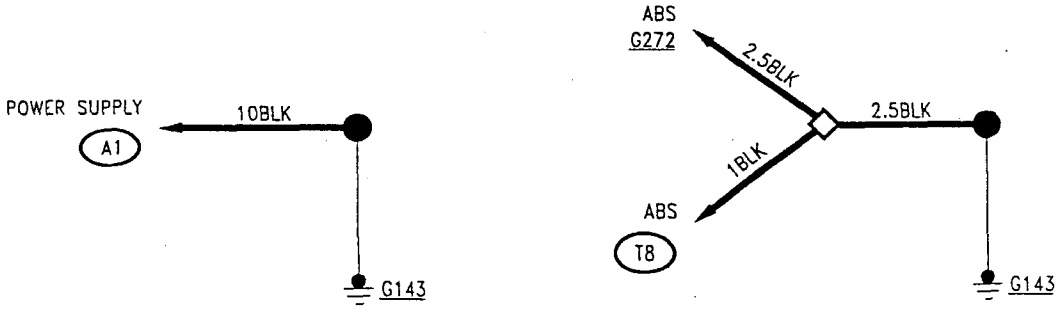
G106



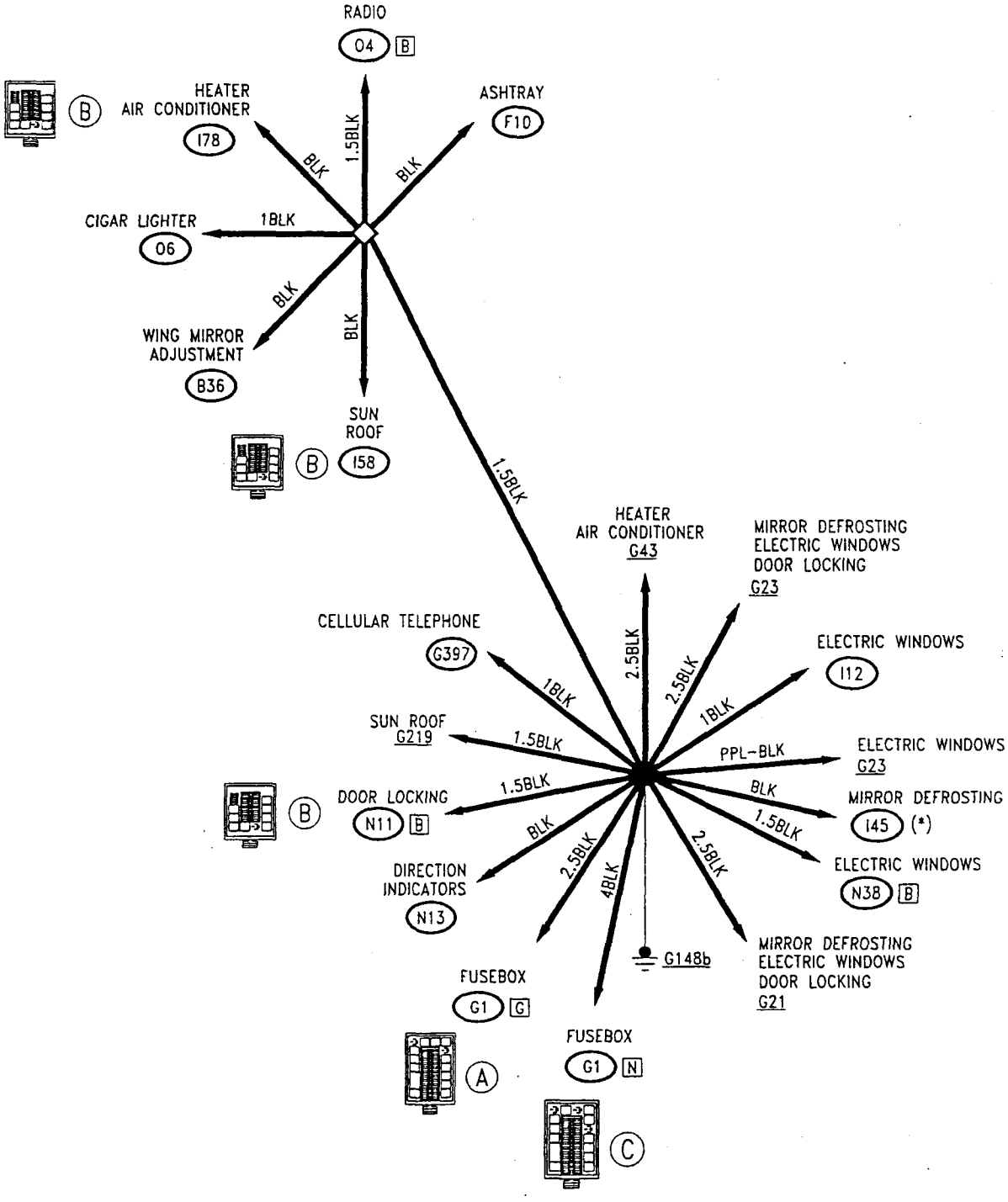
G109 (Boxer 1.3 version)



G143 (Boxer versions)

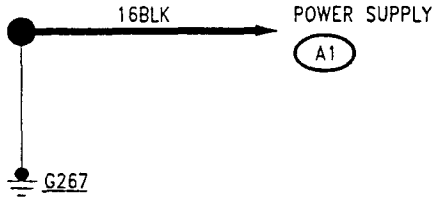


G148b

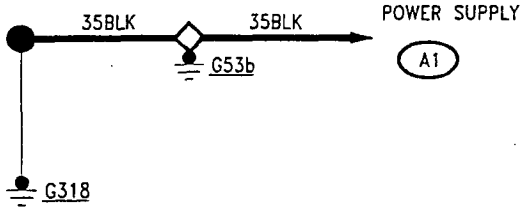


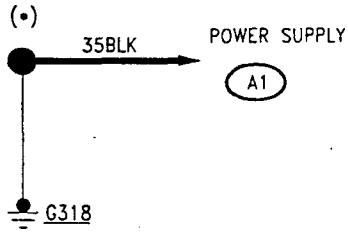
(*) Variant from chassis no.___

G267 (Boxer versions)

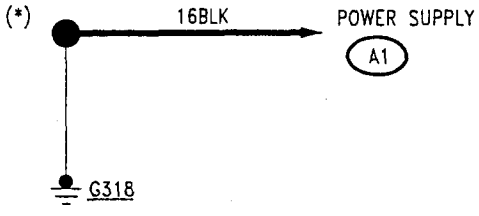


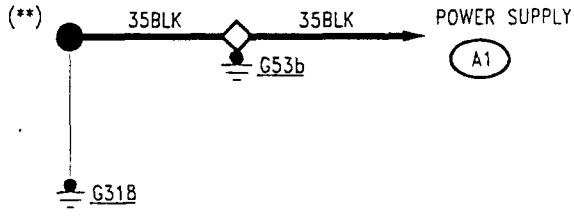
G318 (TD version)



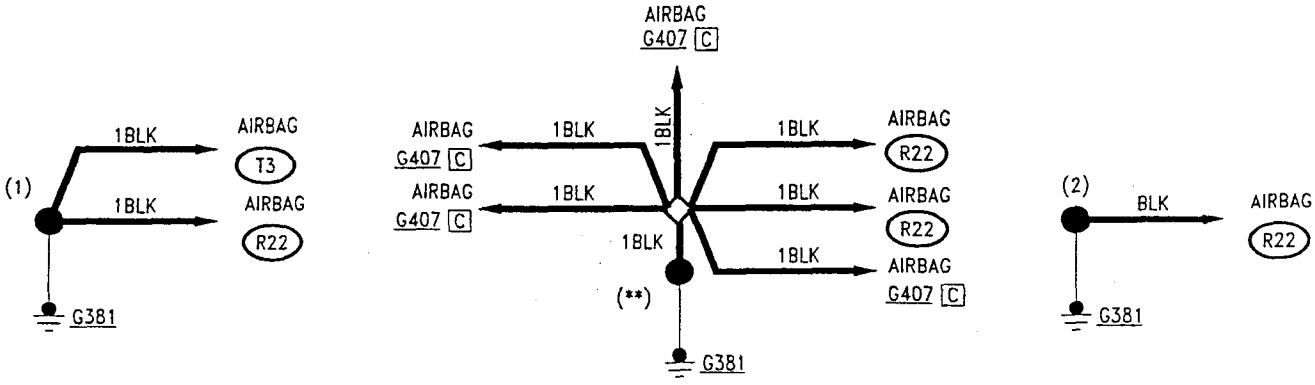


G318 (T.SPARK version)





G381

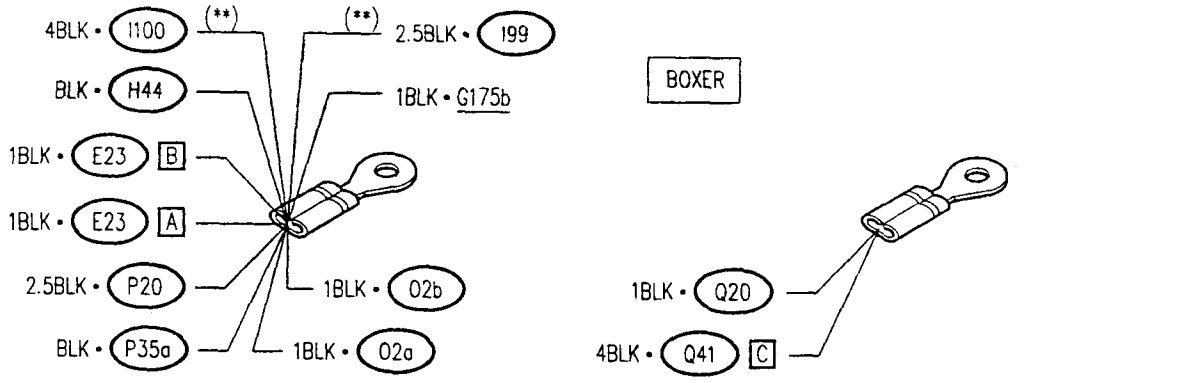


(•) variant from chassis no...
(*) up to Model Year '97
(**) from Model Year' 98

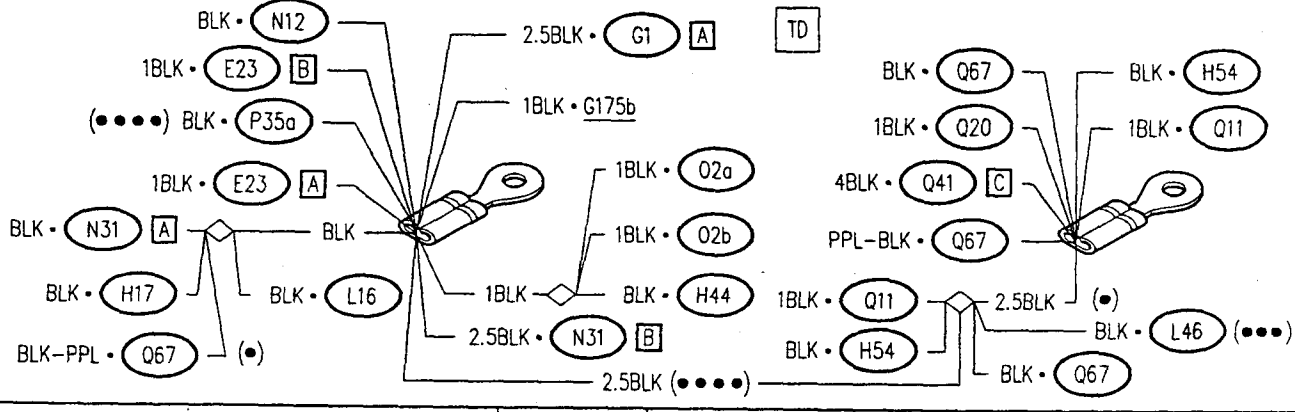
(1) control unit TRW
(2) control unit BECKER

COMPONENTS AND CONNECTORS

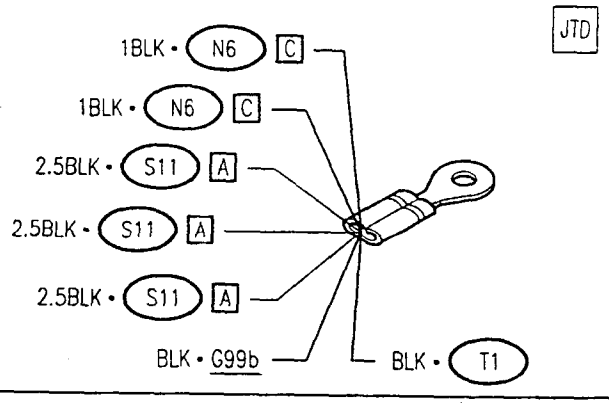
RH engine compartment earth — G53a



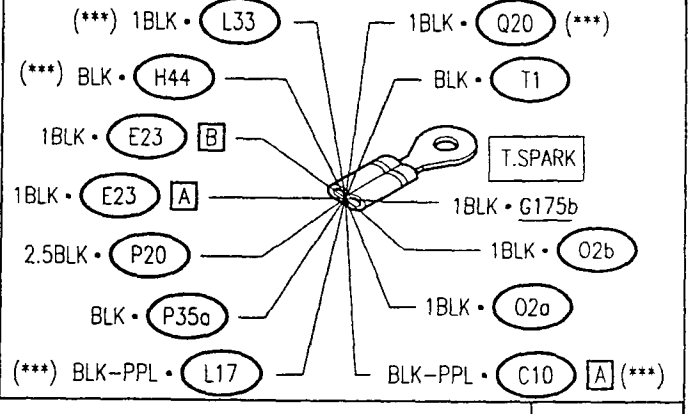
RH engine compartment earth — G53a



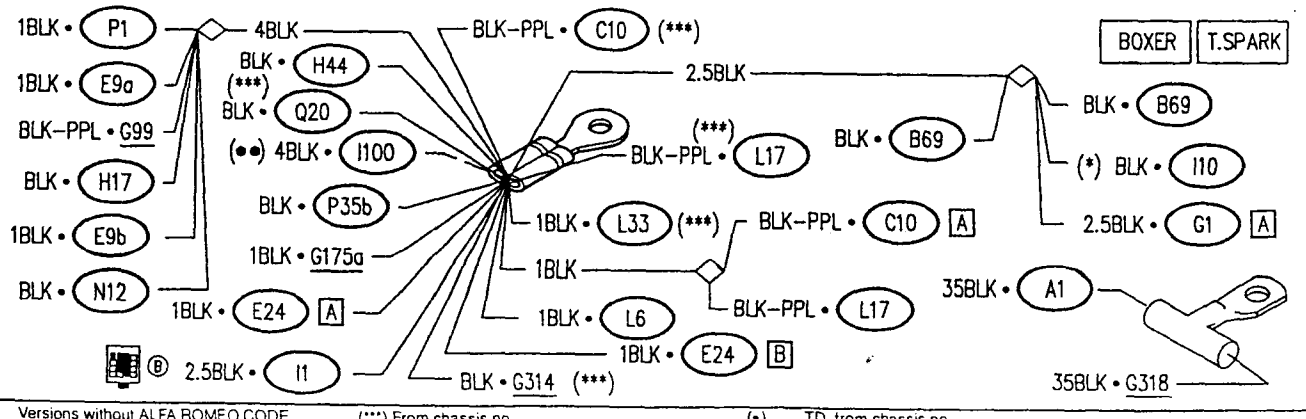
RH engine compartment earth — G53a



RH engine compartment earth — G53a



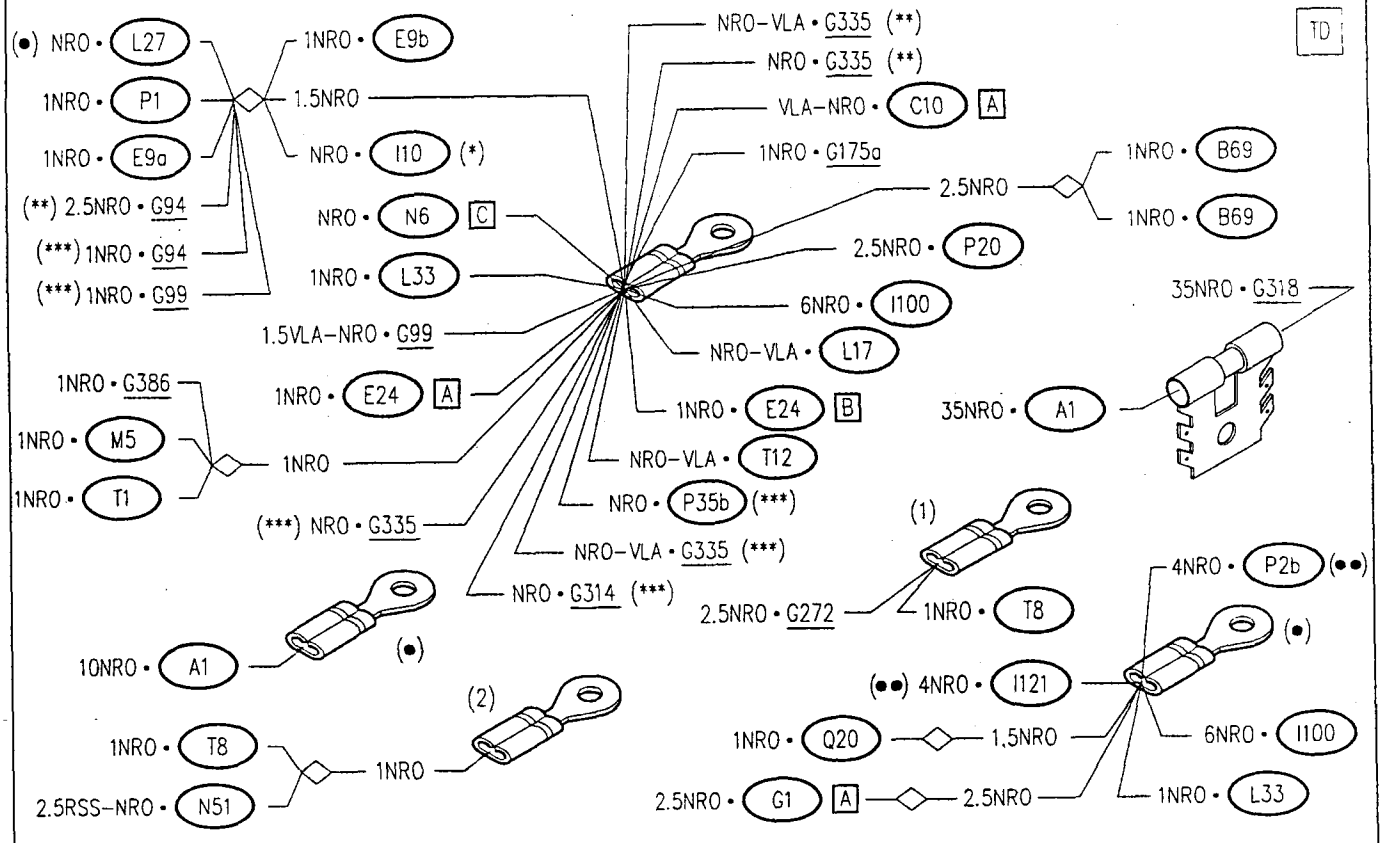
LH engine compartment earth — G53b



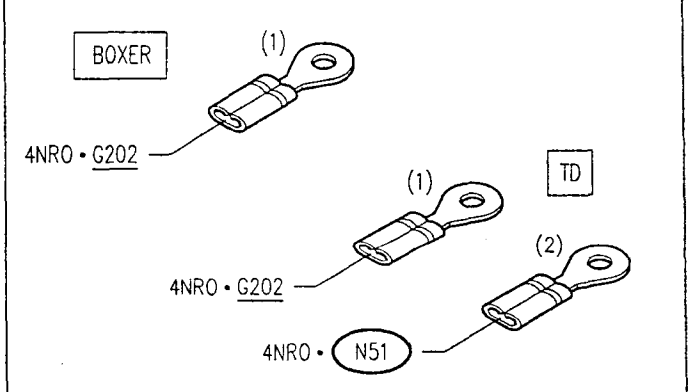
(*) Versions without ALFA ROMEO CODE
(**) From chassis no 4065018
(***) From chassis no.....
(•) TD from chassis no...
(••) Variant for T.SPARK version
(•••) TD-CAT
(••••) TD from chassis no...

COMPONENTI E CONNETTORI (segue)

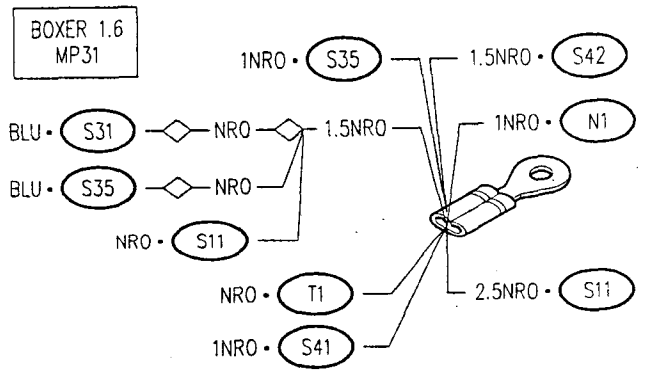
Massa vano motore lato sx. — G53b



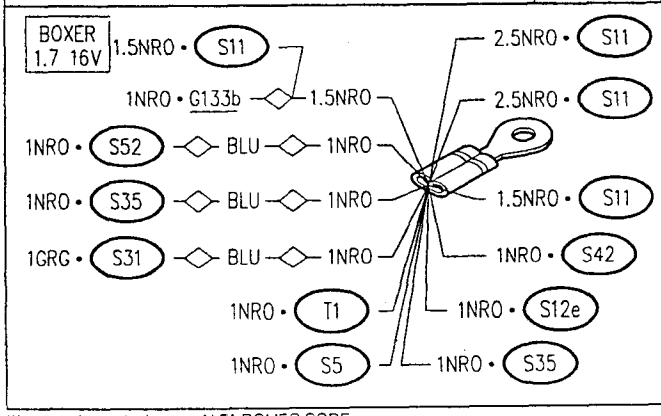
Massa fianchetto sinistro — G55b



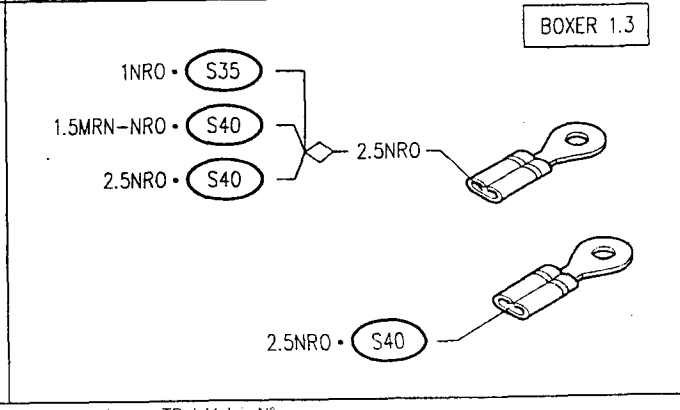
Massa cablaggio iniezione — G60



Massa cablaggio iniezione — G60



Massa cablaggio iniezione — G60

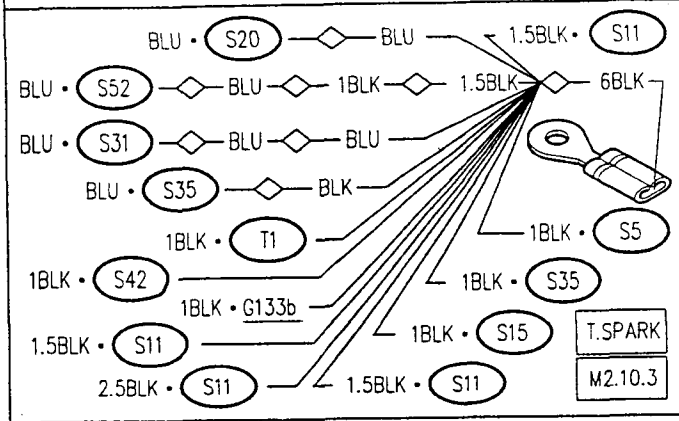


(*) solo versioni senza ALFA ROMEO CODE
(1) ABS 2E / (2) ABS 5.3

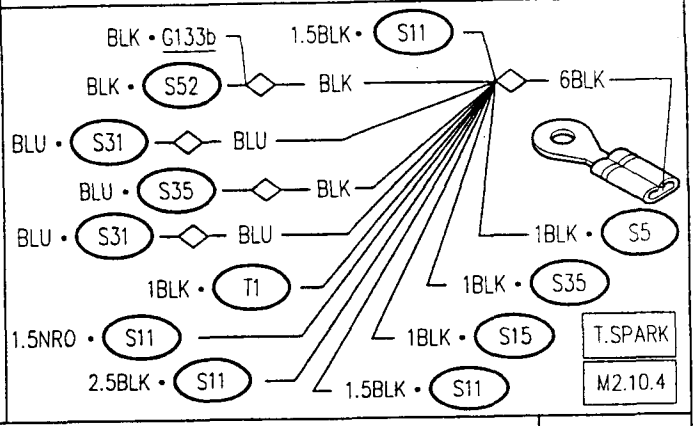
(•) TD dal telaio N°....
(••) JTD
(*) TD-CAT
(***) TD dal telaio N°....

COMPONENTS AND CONNECTORS (cont.d)

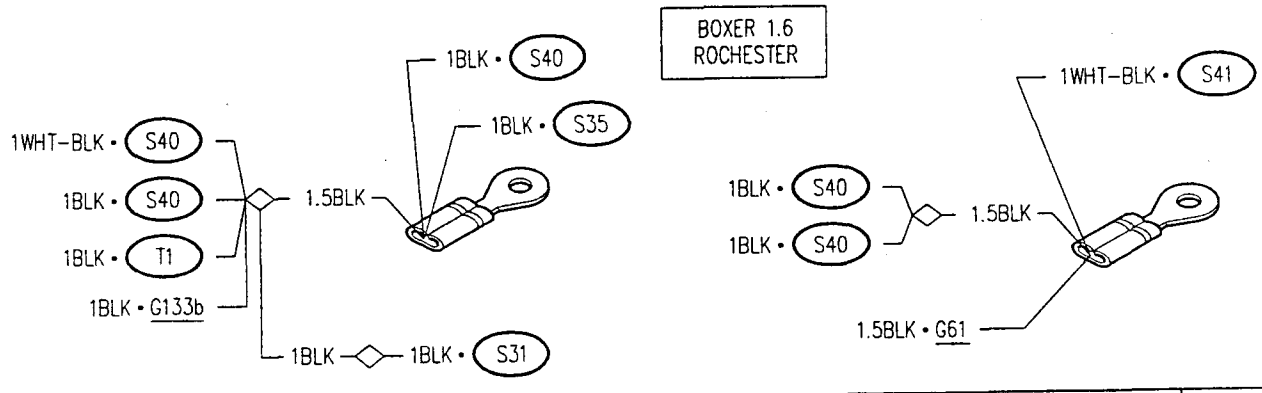
Injection wiring earth — G60



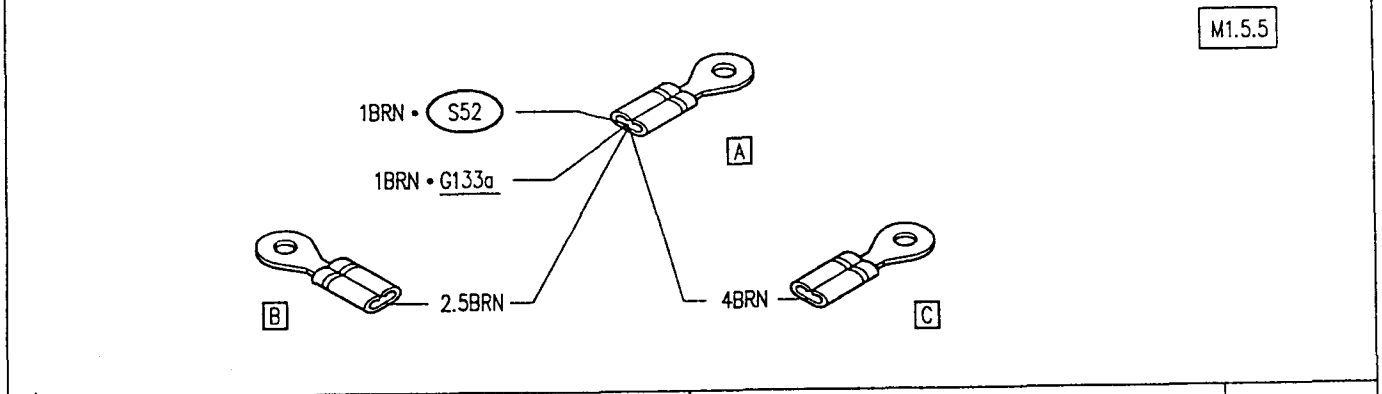
Injection wiring earth — G60



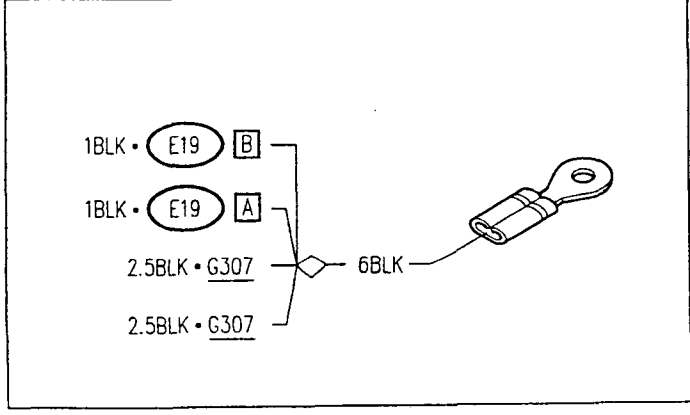
Injection wiring earth — G60



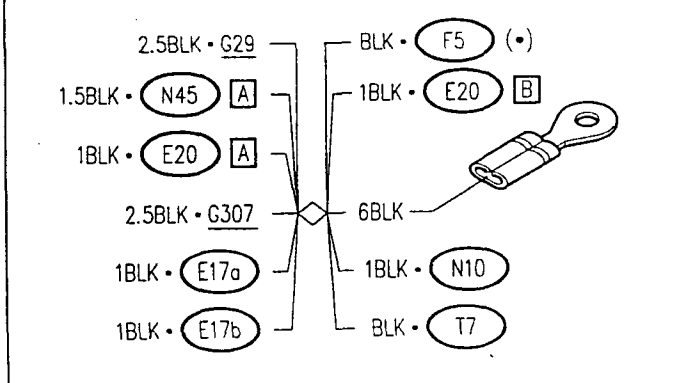
Injection wiring earth — G60



RH rear earth — G63a



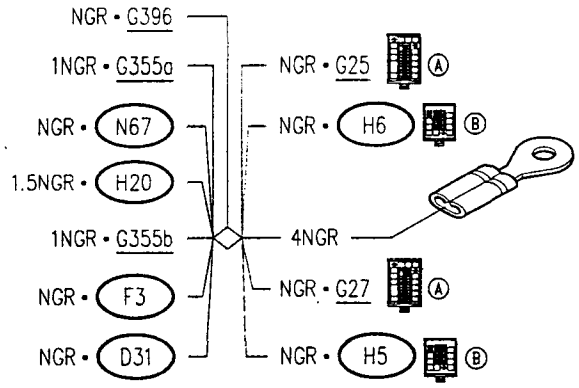
LH rear earth — G63b



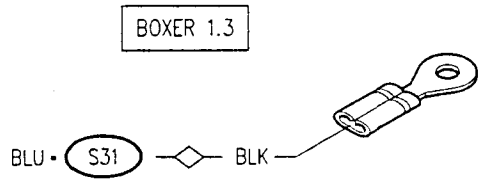
(•) From M.Y. '99

COMPONENTS AND CONNECTORS (cont.d)

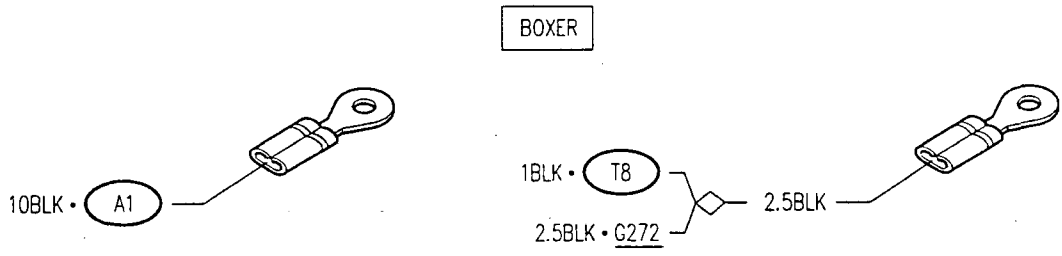
Seat cross rail earth — G106



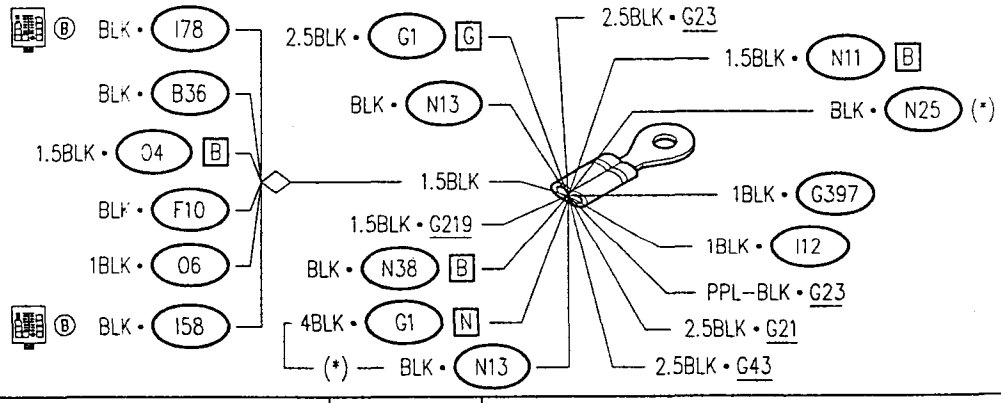
Injection wiring earth — G109



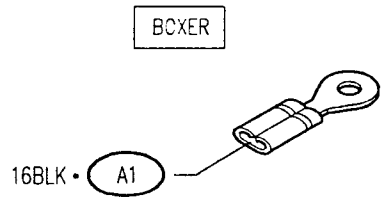
Centre services tray earth — G143



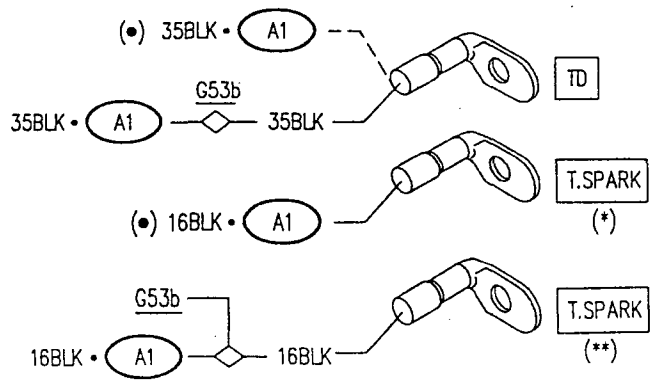
Earth under LH dashboard — G148b



Earth on crankcase — G267



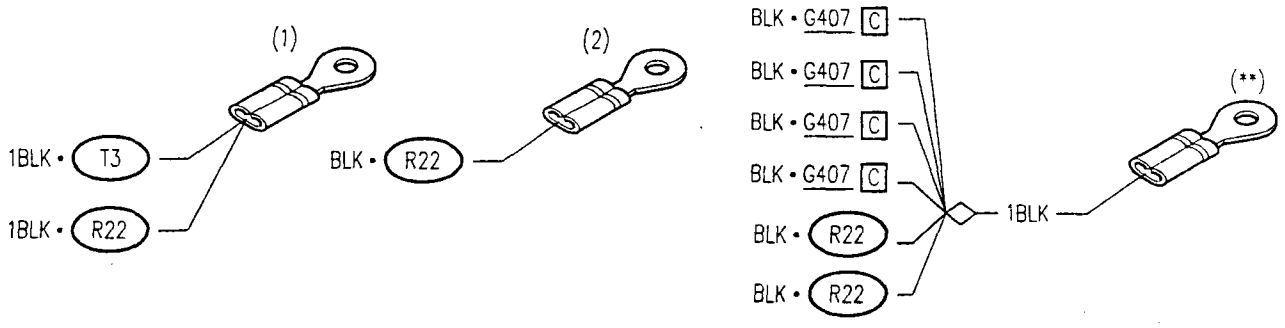
Earth on gearbox — G318



(•) TD from chassis no...
(*) from M.Y. '98
(**) from M.Y. '98

COMPONENTS AND CONNECTORS (cont.d)

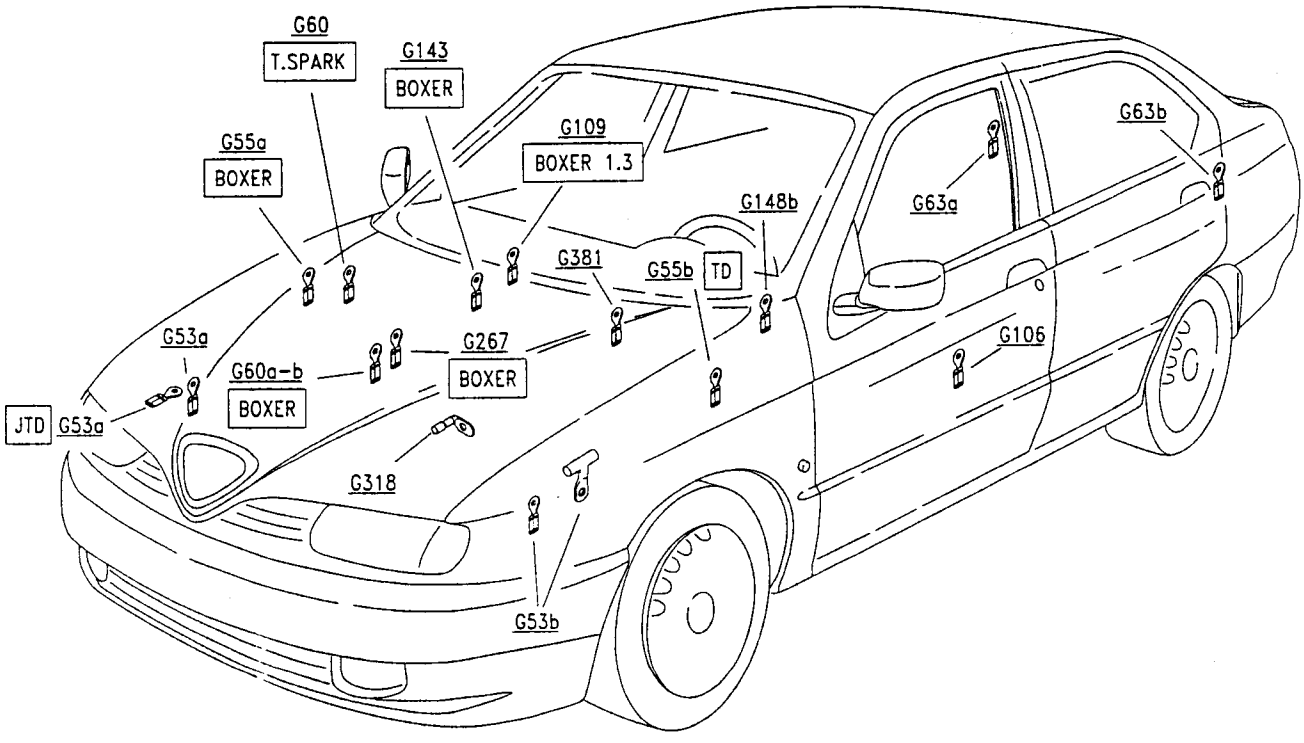
Airbag earth	G381



(•) From chassis no...
(*) From M.Y. '97
(**) From M.Y. '98

(1) BECKER control unit
(2) TRW control unit

LOCATION OF EARTHS ON THE CAR

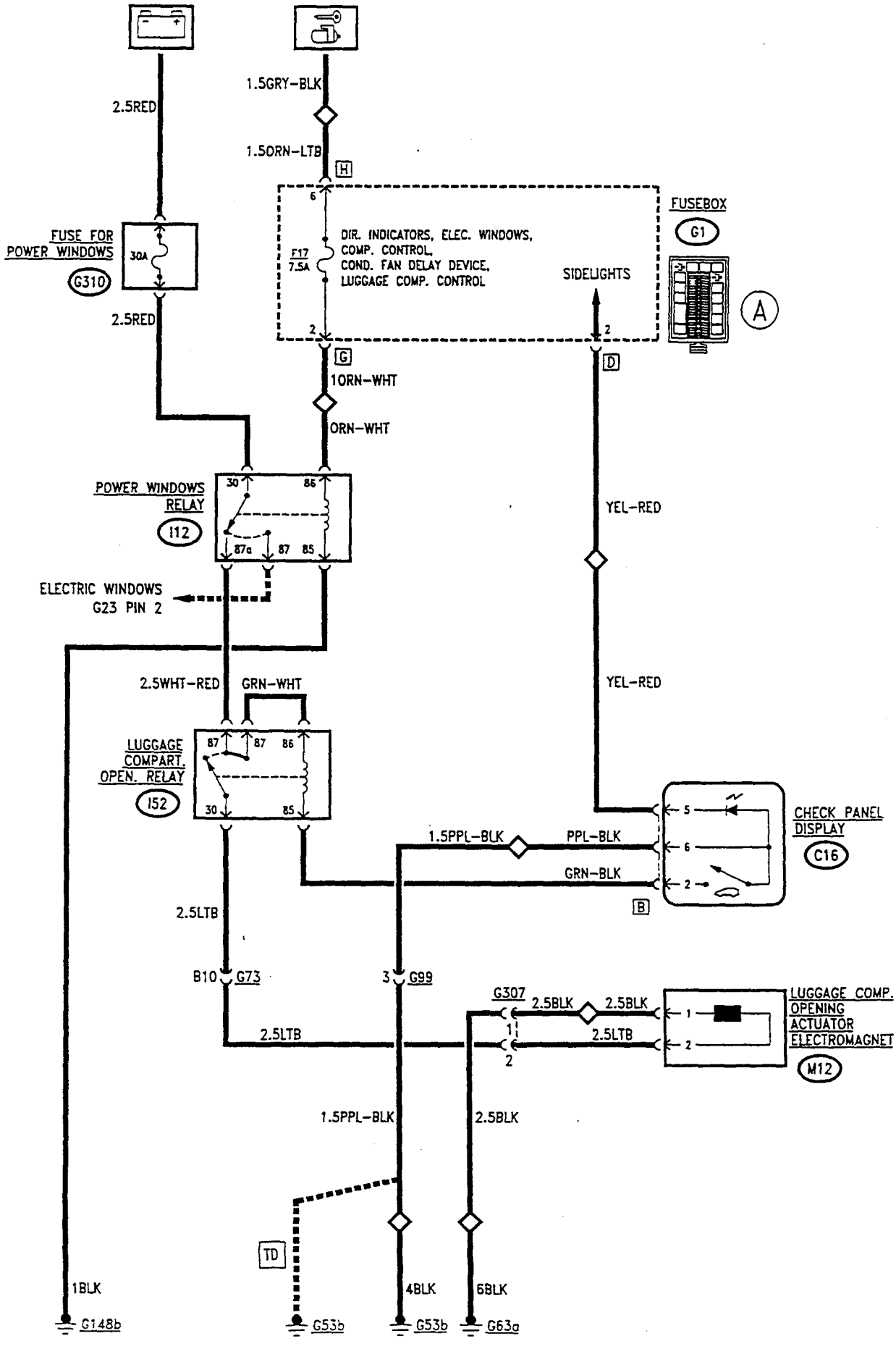


LUGGAGE COMPARTMENT OPENING CONTROL

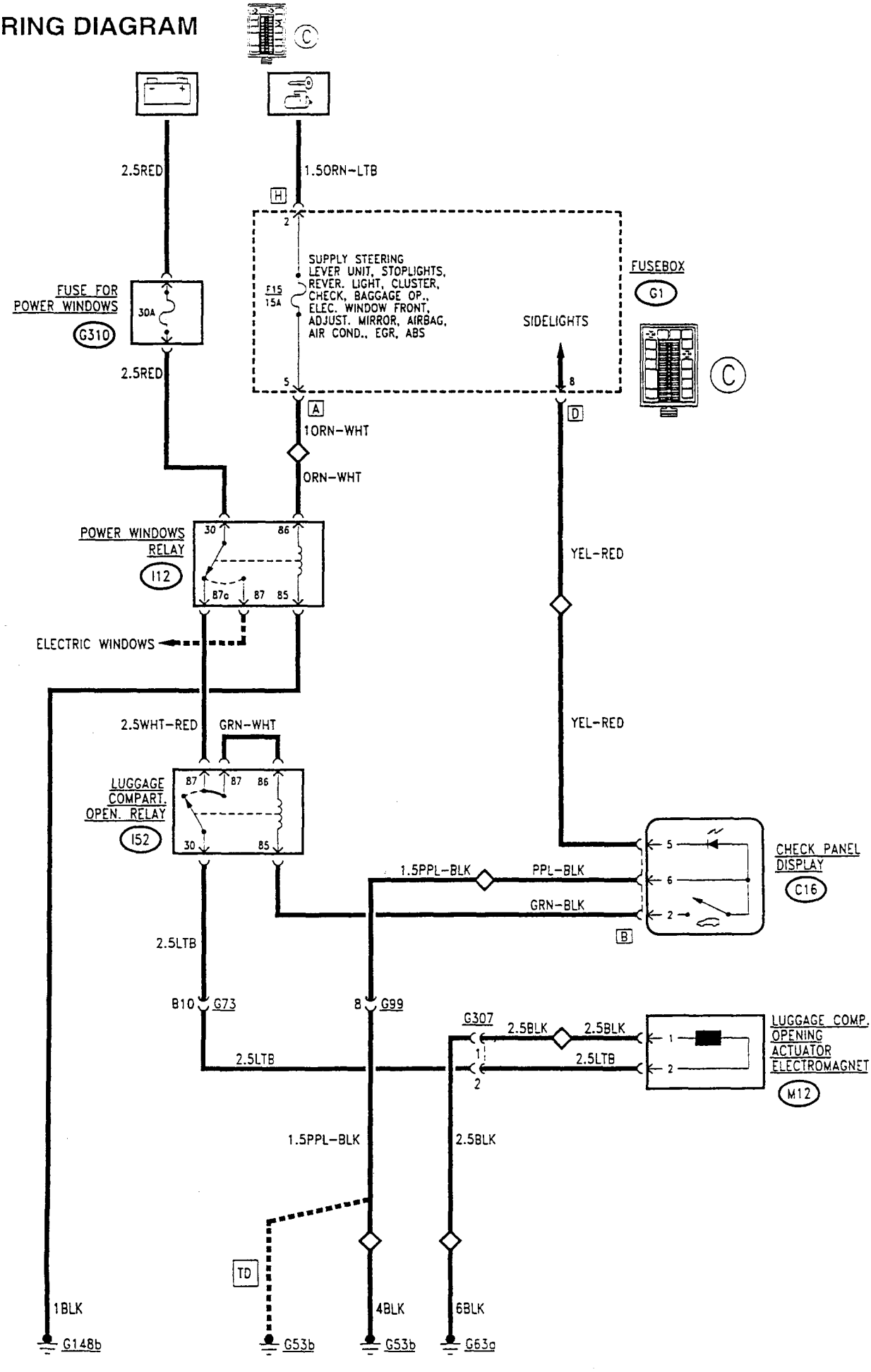
INDEX

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WIRING DIAGRAM



WIRING DIAGRAM



GENERAL DESCRIPTION

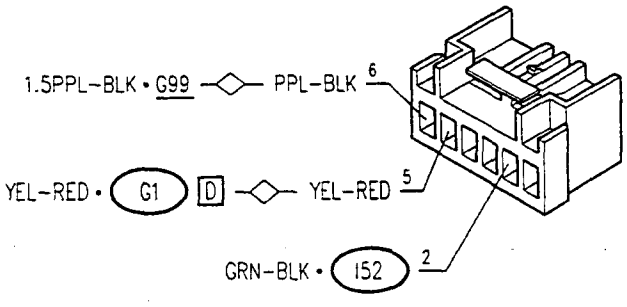
In addition to using the key in the rear lock, the luggage compartment can also be opened from inside the car through an electrical control.
The switch that opens the lock by an electromagnetic control is to be found on the "Check Panel" at the centre of the dashboard; the switch ideogram is illuminated when the side lights are on.
This device only works with the key either at STOP or disengaged; otherwise the boot must be opened manually.

FUNCTIONAL DESCRIPTION

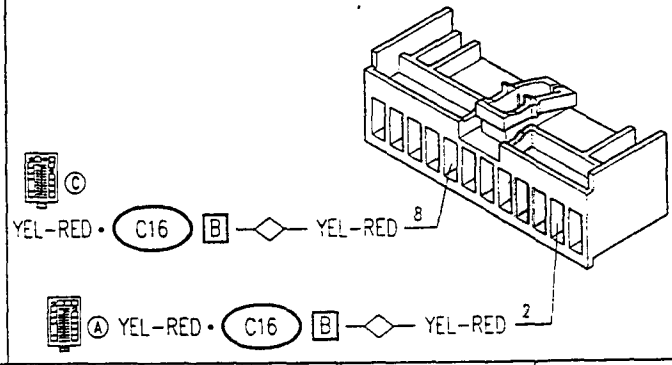
The boot opening relay **I52** controls the system. The relay is supplied when the "key-operated" supply is disengaged, through the line of the power windows, protected by wander fuse **G310** and through relay/switch **I12**. With the ignition key disengaged or at STOP, the coil of relay switch **I52**, is energized by an earth signal leading from the luggage compartment opening switch located in **C16**.
The relay switch then sends the supply to the luggage compartment opening electromagnet **M12** which triggers the lock.
With the key at "MARCIA" relay **I52** is not supplied.
The switch in **C16** is illuminated when the side lights are on. For further details see "Illumination of controls and indicators".

COMPONENTS AND CONNECTORS

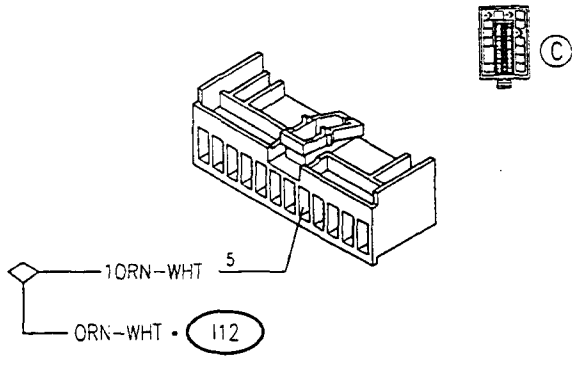
Check Panel display — C16 B



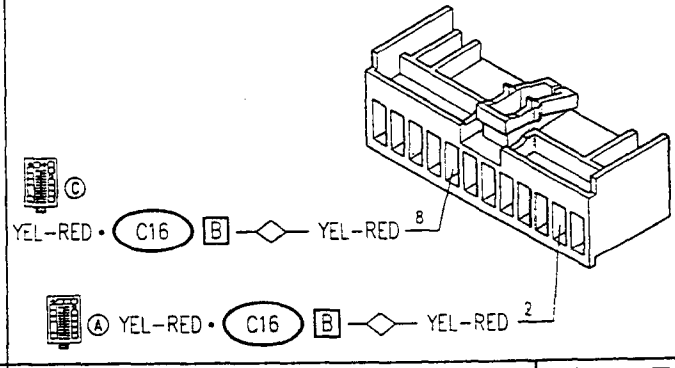
Fusebox — G1 D



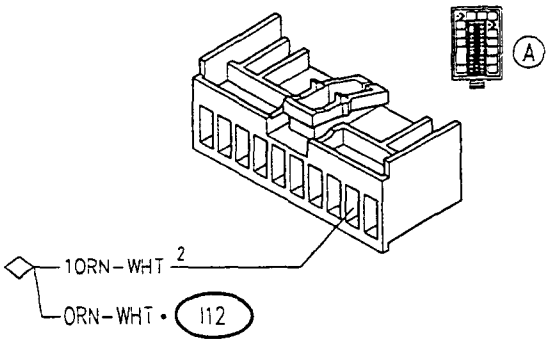
Fusebox — G1 A



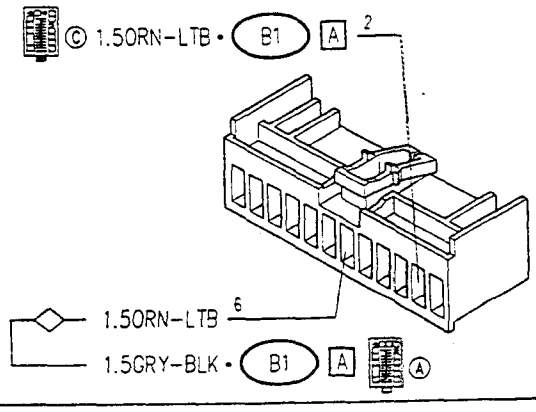
Fusebox — G1 D



Fusebox — G1 G

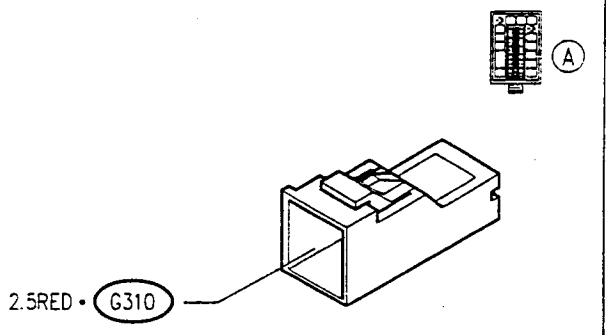


Fusebox — G1 H

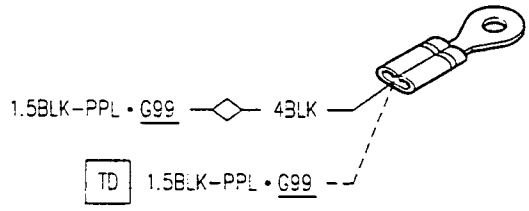


COMPONENTS AND CONNECTORS (cont.d)

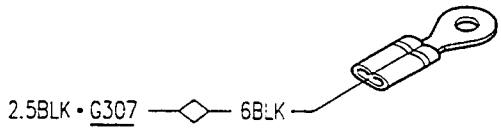
Fusebox	G1 Q



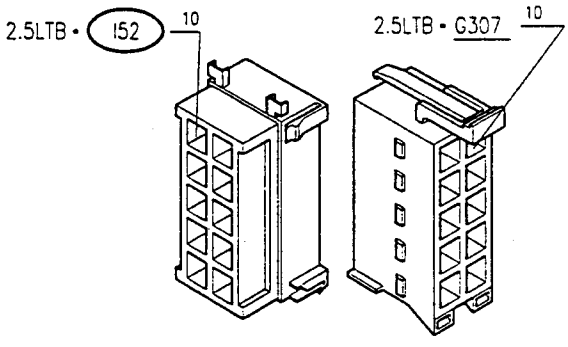
LH engine compartment earth	G53b



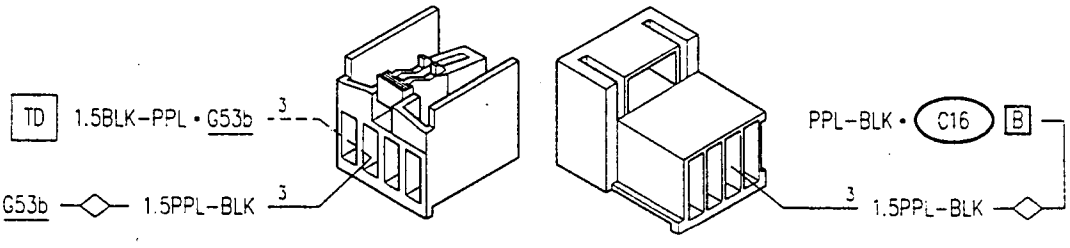
RH rear earth	G63a



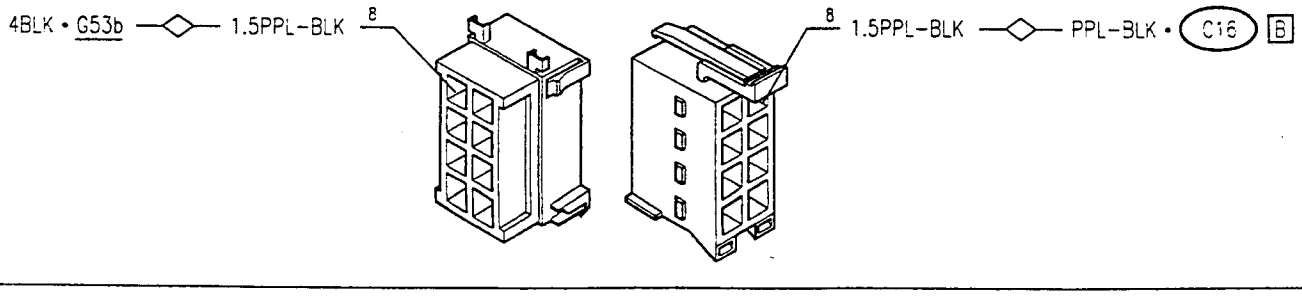
Rear services connector	G73 B



Dashboard/engine wiring connector (*)	G99



Dashboard/engine wiring connector (**)	G99

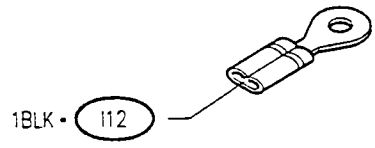


(*) up to chassis no.__
PA493000000008

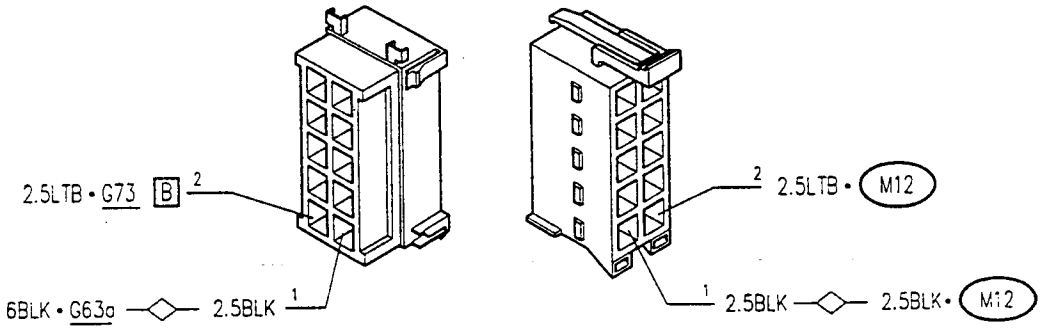
(**) from chassis no.__

COMPONENTS AND CONNECTORS (cont.d)

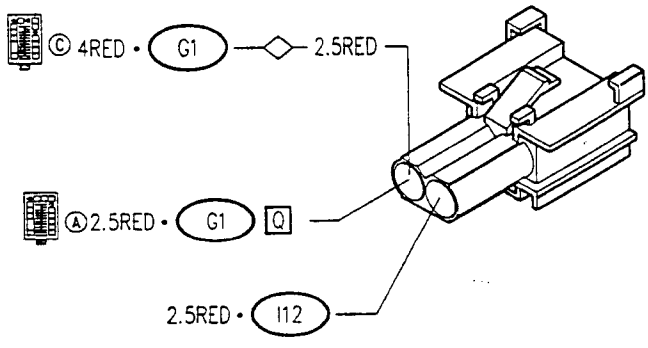
LH earth under dashboard	G148b



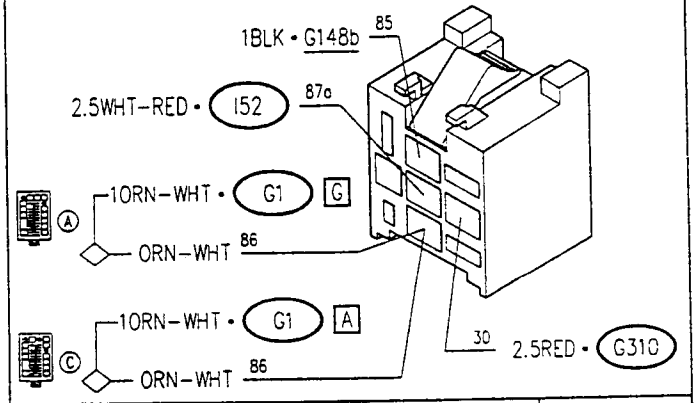
Rear/luggage compartment wiring connector	G307



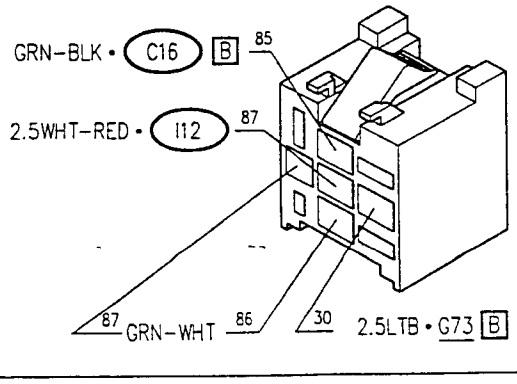
RH front power window fuse	G310



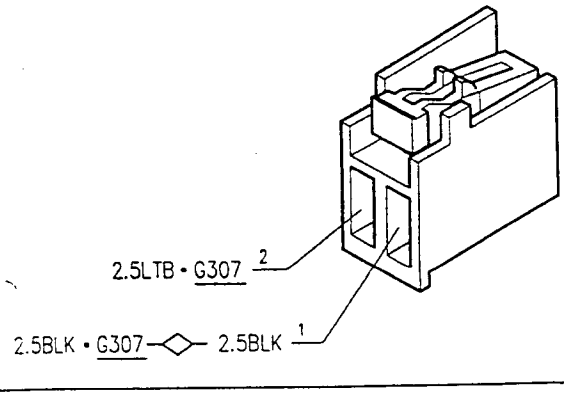
Front power window relay switch	I12



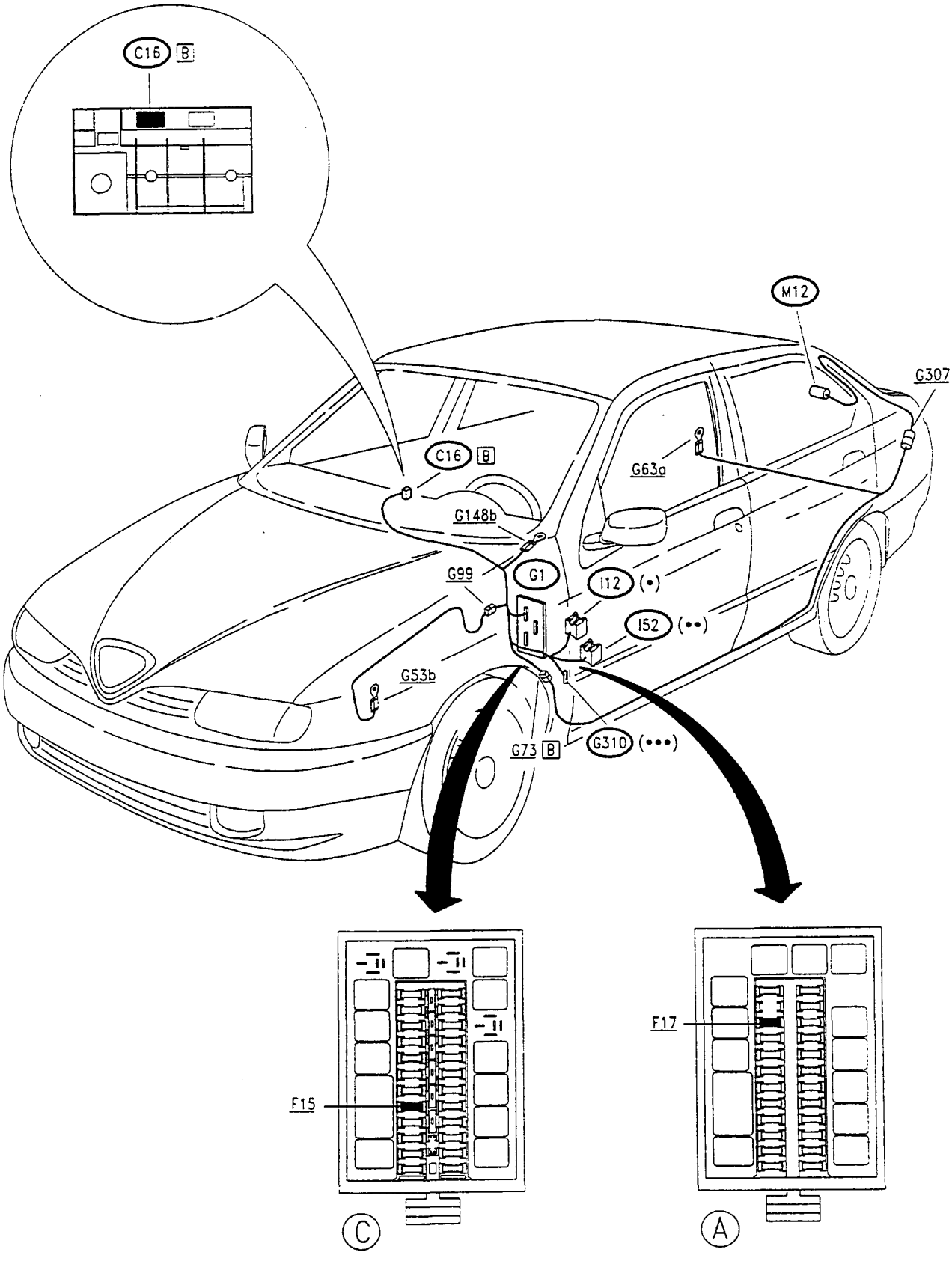
Luggage compartment opening switch	I52



Luggage compartment opening electromagnet	M12



LOCATION OF COMPONENTS



(•) black base
(••) yellow base
(•••) green fuseholder

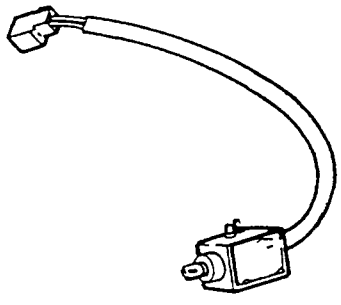
FAULTFINDING TABLE

Failure	Component to be checked				
	G310	M12	I52	I12	C16 (*)
Luggage compartment opening control	•	•	•	•	•
Luggage compartment opening switch light (with side lights on)					•

(*) The Check Panel display **C16** cannot be repaired. Therefore in the event of a failure it is not possible to change the switch and a complete new Check Panel must be fitted.

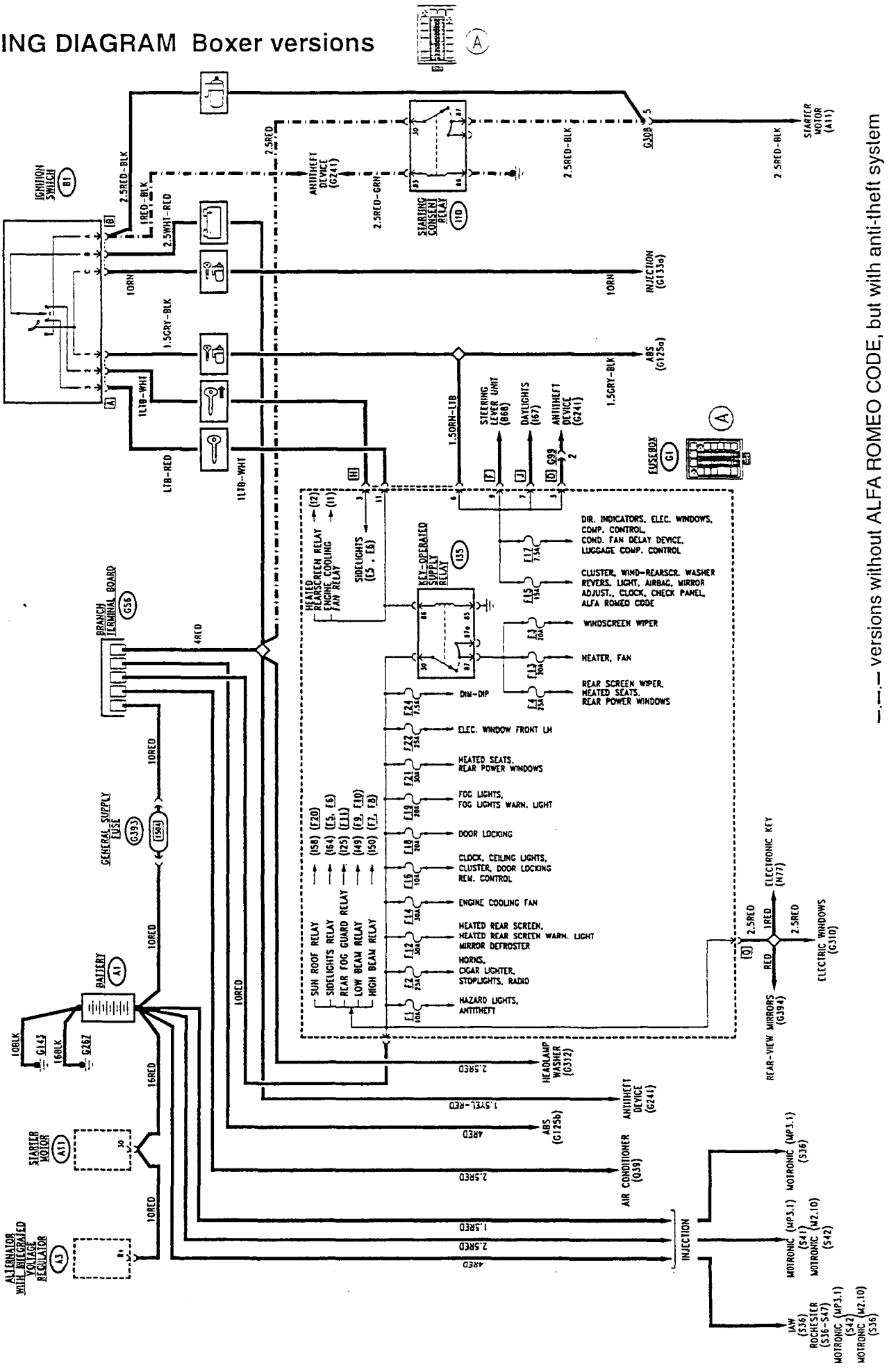
CHECKING COMPONENTS

Luggage compartment opening electromagnet (M12)



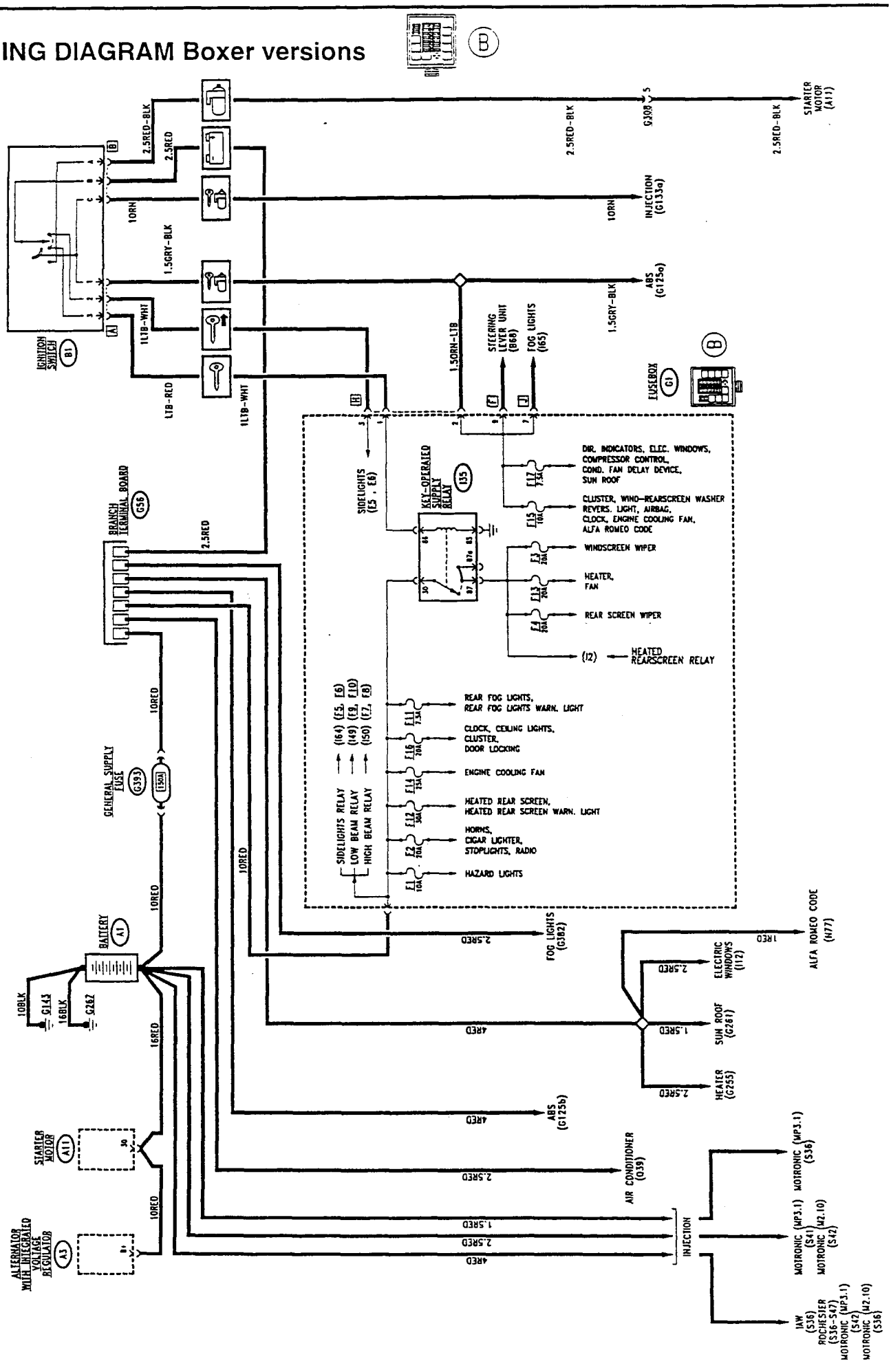
SPECIFICATIONS	
Nominal voltage	12V
Absorbed current	31A
Magnetic core stroke	10 ± 0,5 mm

WIRING DIAGRAM Boxer versions



—.—.— versions without ALFA ROMEO CODE, but with anti-theft system

WIRING DIAGRAM Boxer versions



FUNCTIONAL DESCRIPTION (Boxer versions)

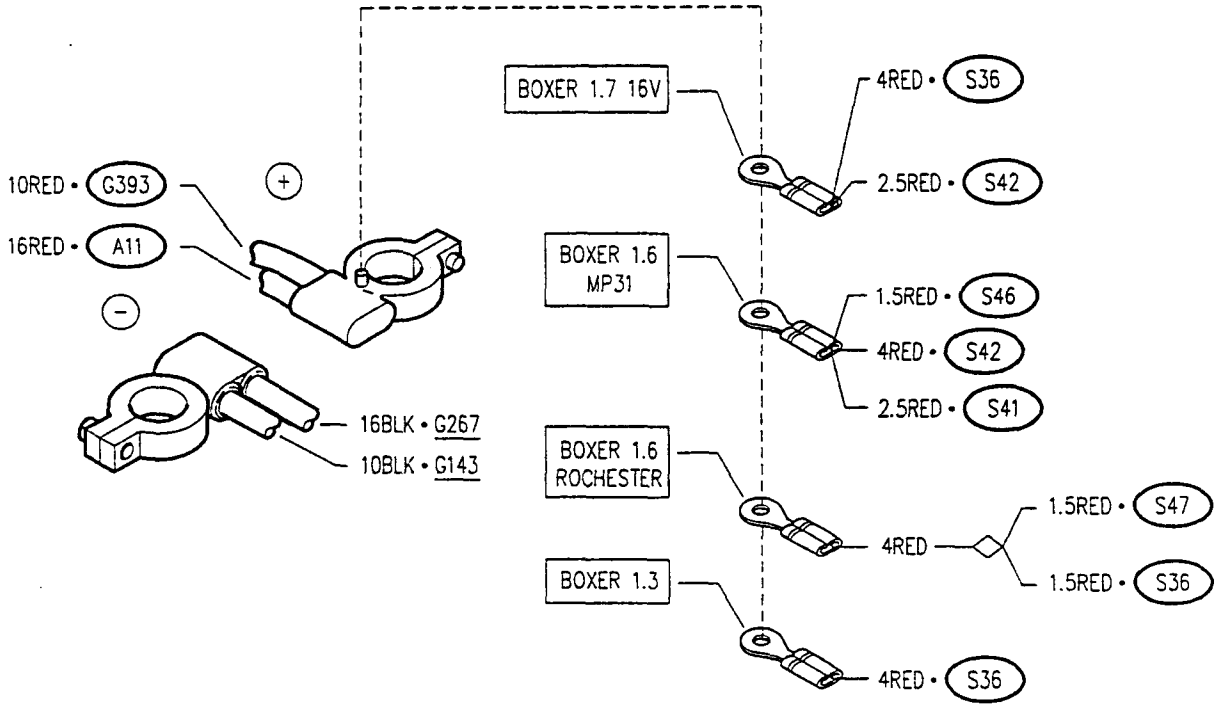
The supply leading from the battery **A1** is divided among various lines in the branch terminal board **G56**, from where numerous cables lead, directly supplying some systems (protected by special "wander" fuses) and the fusebox **G1**; inside the fusebox the power is distributed to the various circuits, protected by the corresponding fuses (see the "Fusebox" section).
The battery recharging line leads from the alternator **A3**, through the starter motor **A11**.
The ignition switch **B1** is also supplied via the terminal board **G56** at pin B of connector B.
The line that leaves pin A of connector B corresponds to the "STARTING" position and it supplies the starter motor **A11**, (only for certain cars without ALFA ROMEO CODE but with anti-theft system, through the antitheft control uni **N45** and stating consent relay **I10**)

The line leaving pin 3 of connector A - "RUN" position - via the fusebox **G1**, supplies the "key-operated" circuits, which are however disengaged in the "STARTING" position.
The lines that leave pin 1 of connector A and pin C of connector B supply, either directly or through the fusebox **G1**, the "key-operated" circuits which also remain engaged in the "STARTING" position.
Lastly, the line that leaves pin 2 of connector A corresponds to the "PARKING" position and supplies the sidelights circuit inside the fusebox **G1**.

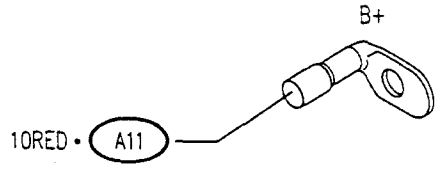
With the adoption of a **special high capacity fuse (150A) G393** all the supplies are protected, with the exception of the starter motor cable (battery - motor) and the recharging cable (motor - alternator): these cables are protected by a supplementary "armored" sheath.

COMPONENTS AND CONNECTORS (Boxer versions)

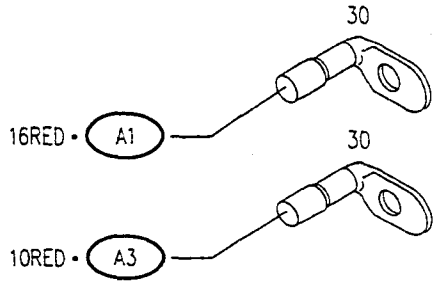
Battery — A1



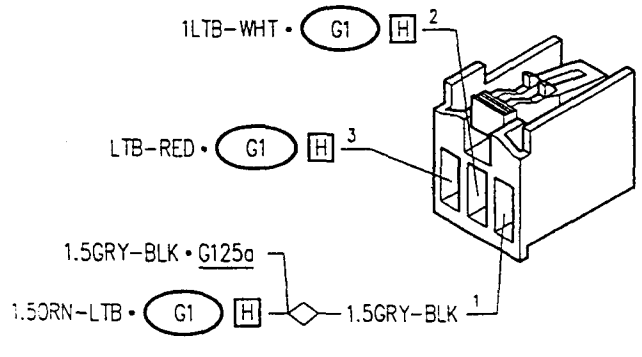
Alternator, with built-in voltage regulator — A3



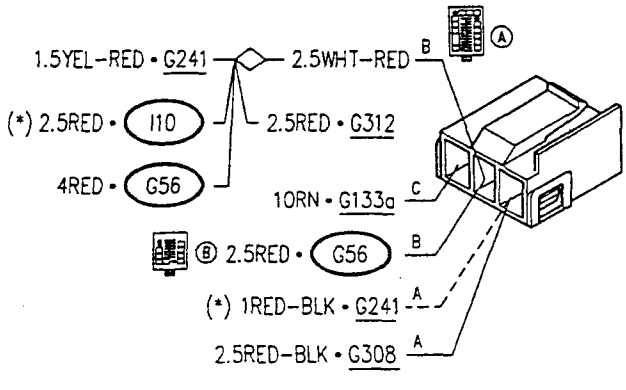
Starter motor — A11



Ignition switch — B1 A



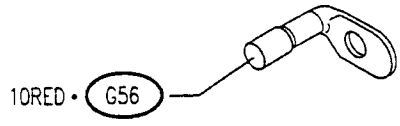
Ignition switch — B1 B



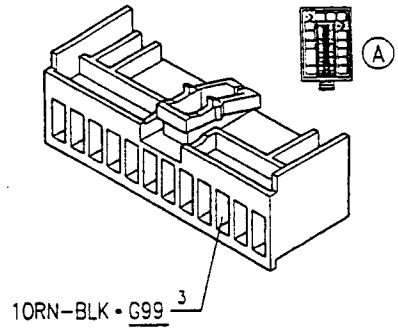
(*) versions without ALFA ROMEO CODE. but with anti-theft system

COMPONENTS AND CONNECTORS (cont.d)

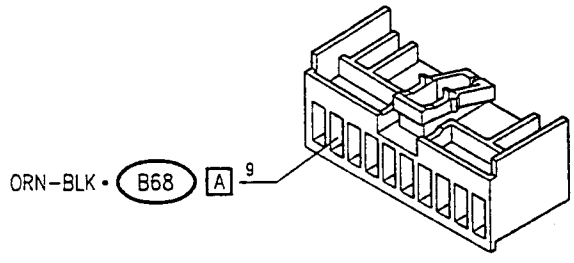
Fusebox G1



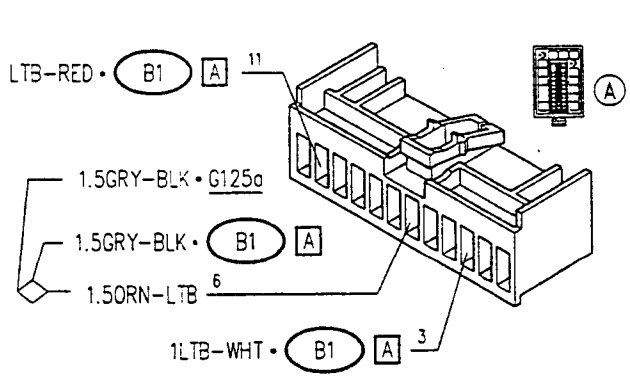
Fusebox G1 D

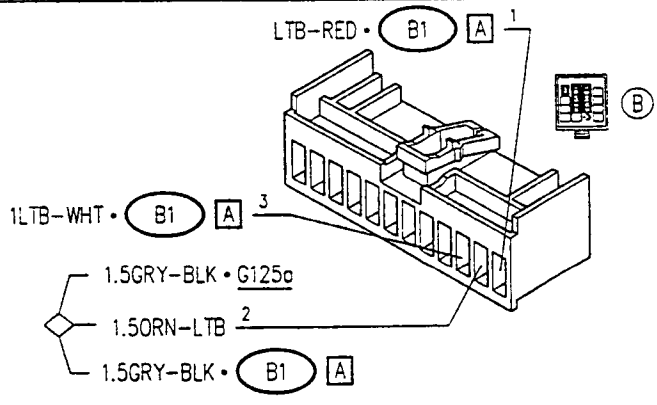


Fusebox G1 F

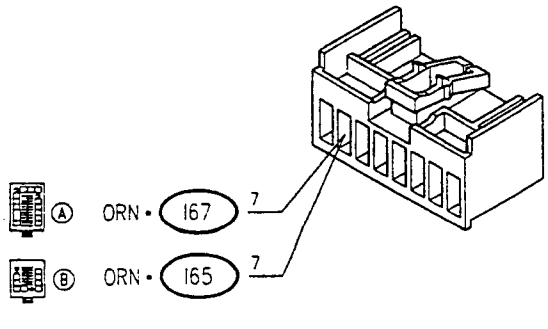


Fusebox G1 H

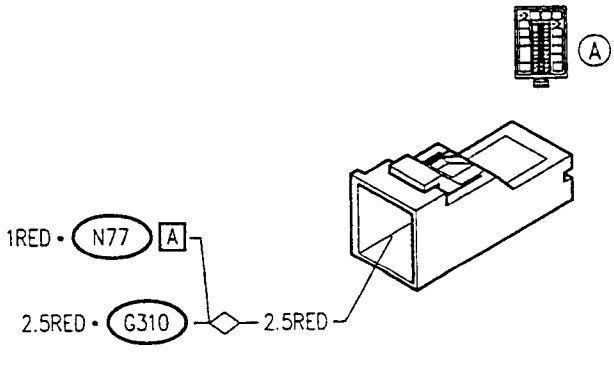




Fusebox G1 J

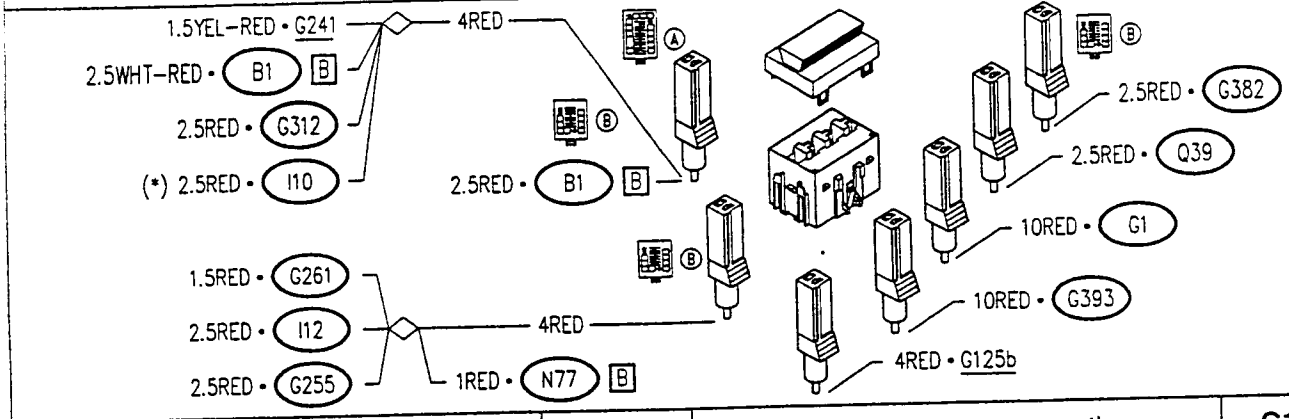


Fusebox G1 Q

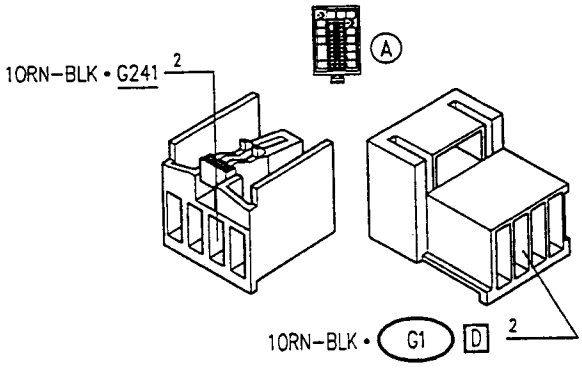


COMPONENTS AND CONNECTORS (cont.d)

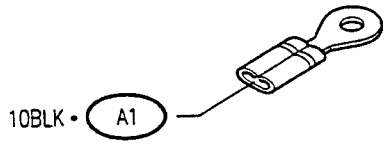
Branch terminal board — G56



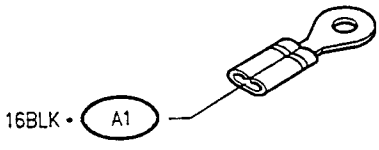
Dashboard/engine wiring connector — G99



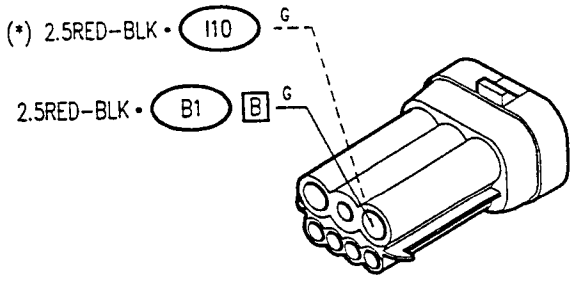
Services tray centre earth — G143



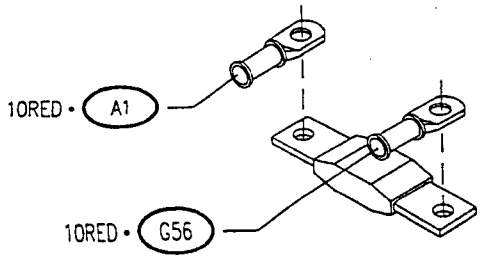
Earth on crankcase — G267



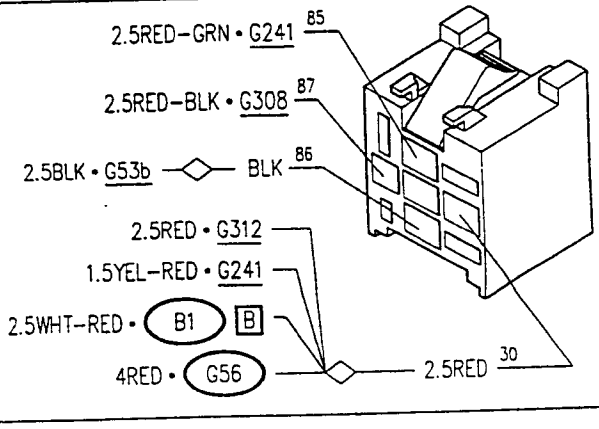
Engine sensors connector — G308



General supply fuse — G393

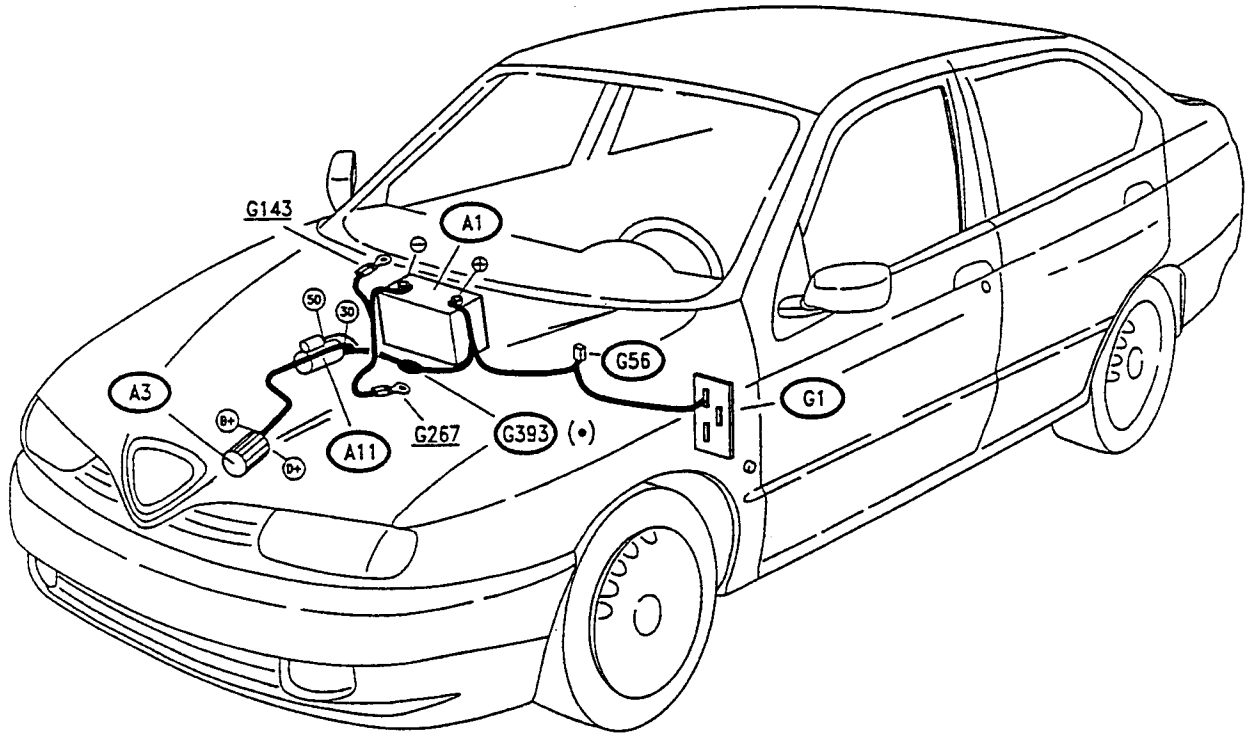


Starting consent relay (*) — I10



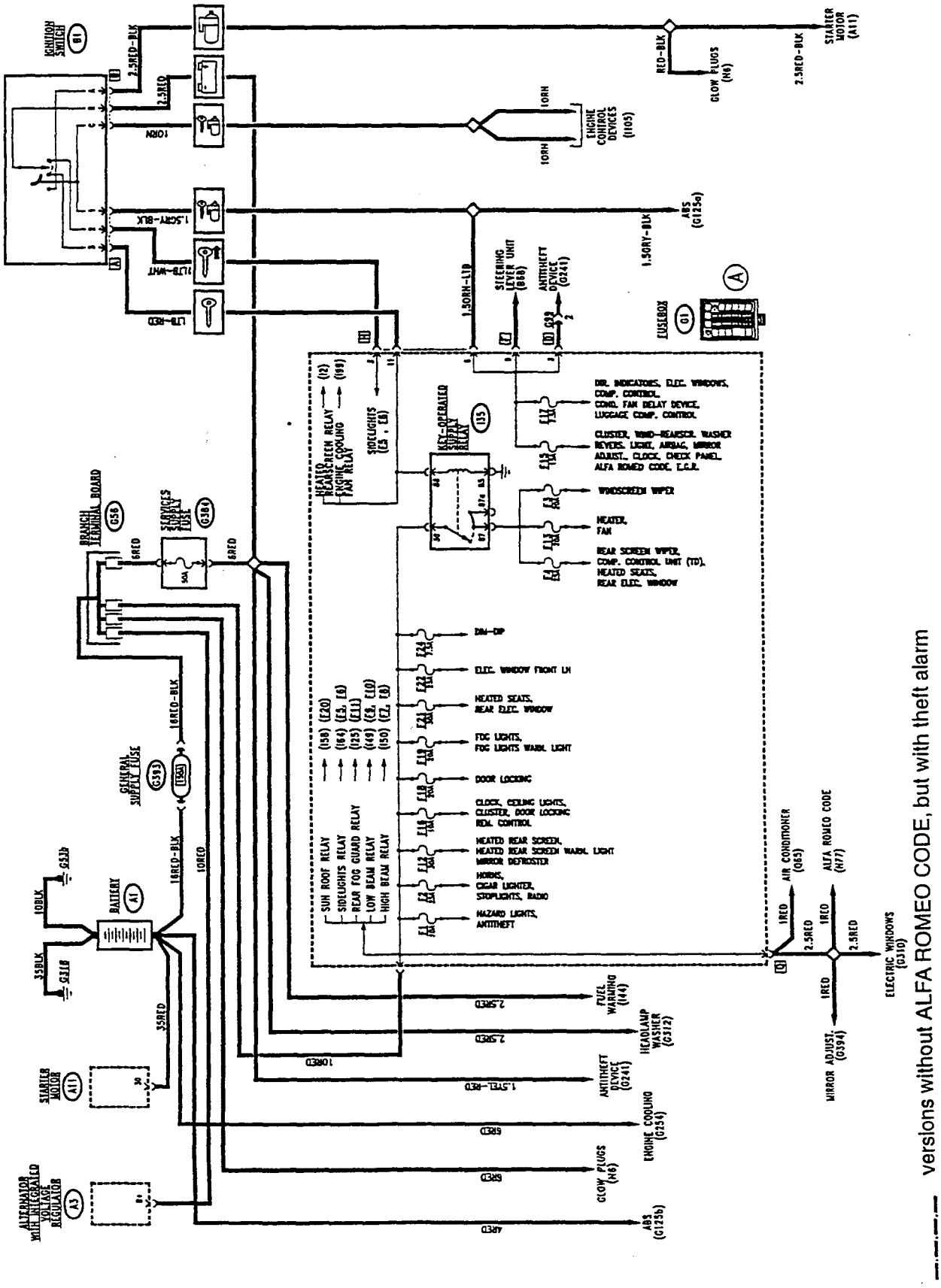
(*) versions without ALFA ROMEO CODE, but with anti-theft system

LOCATION OF COMPONENTS (Boxer versions)

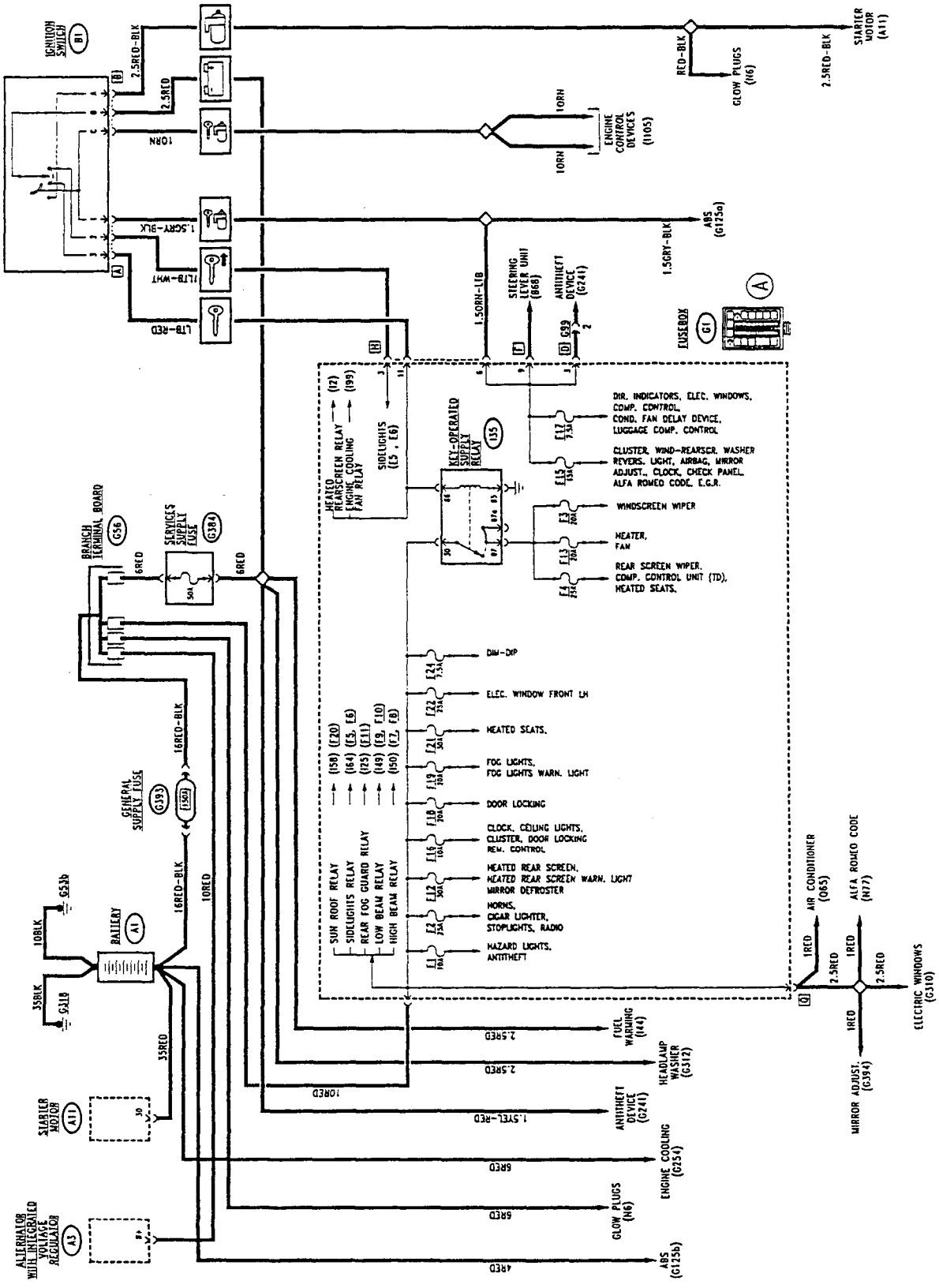


(•) from chassis no.....

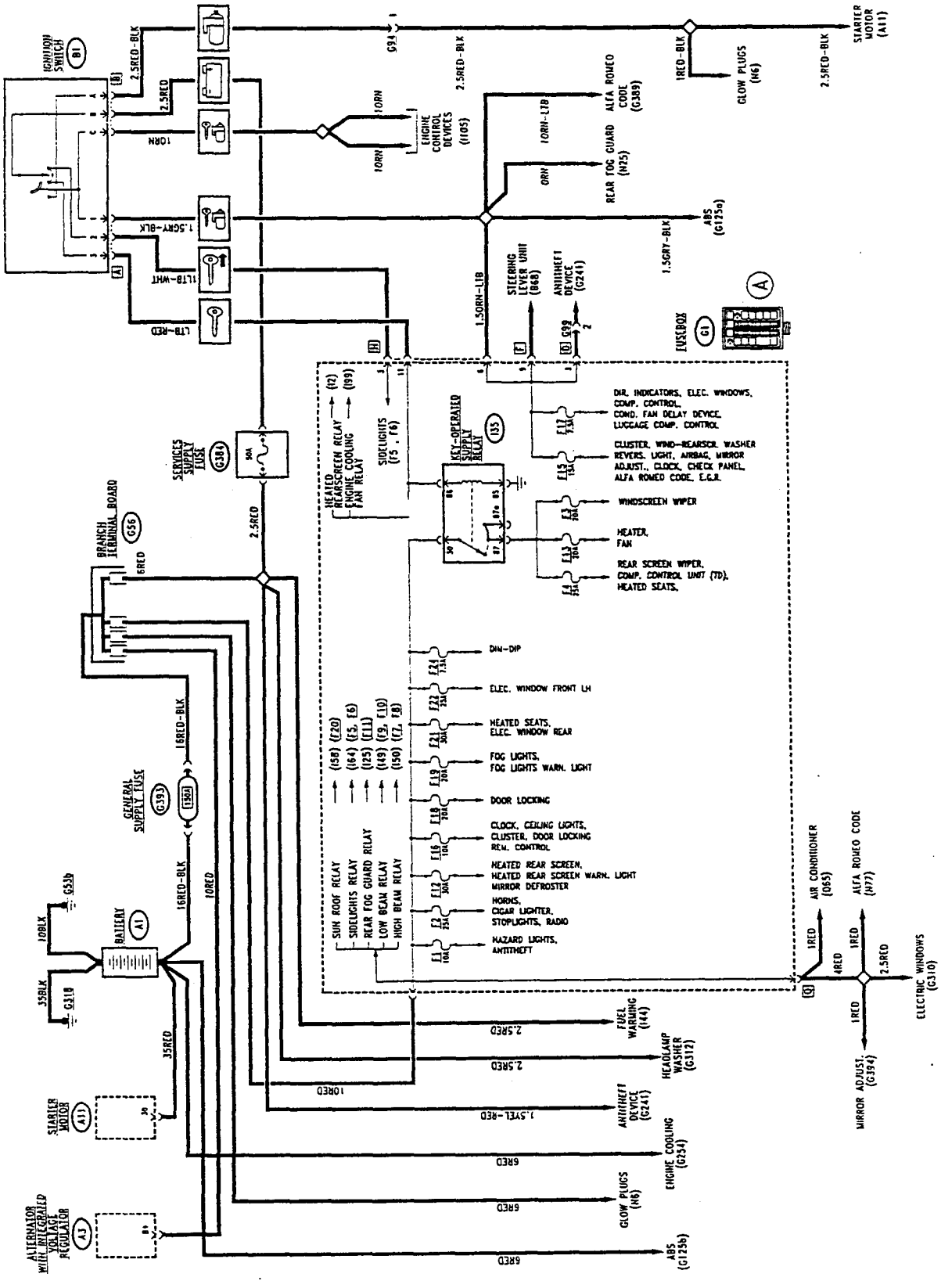
WIRING DIAGRAM (TD version - up to chassis no. ....)



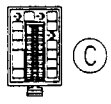
WIRING DIAGRAM (TD version from chassis no. ....)

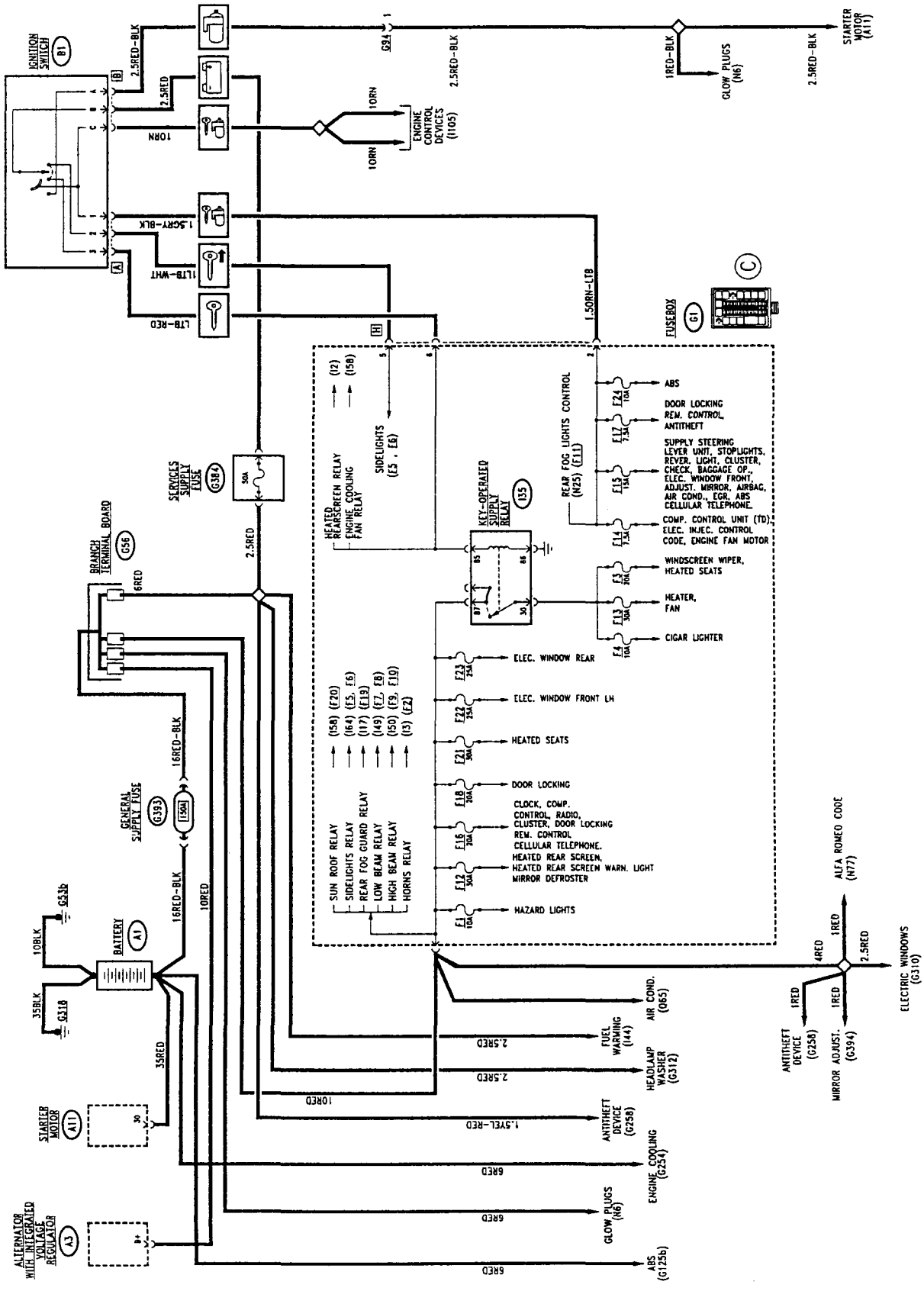


WIRING DIAGRAM (TD-CAT version)



WIRING DIAGRAM (TD-CAT version)





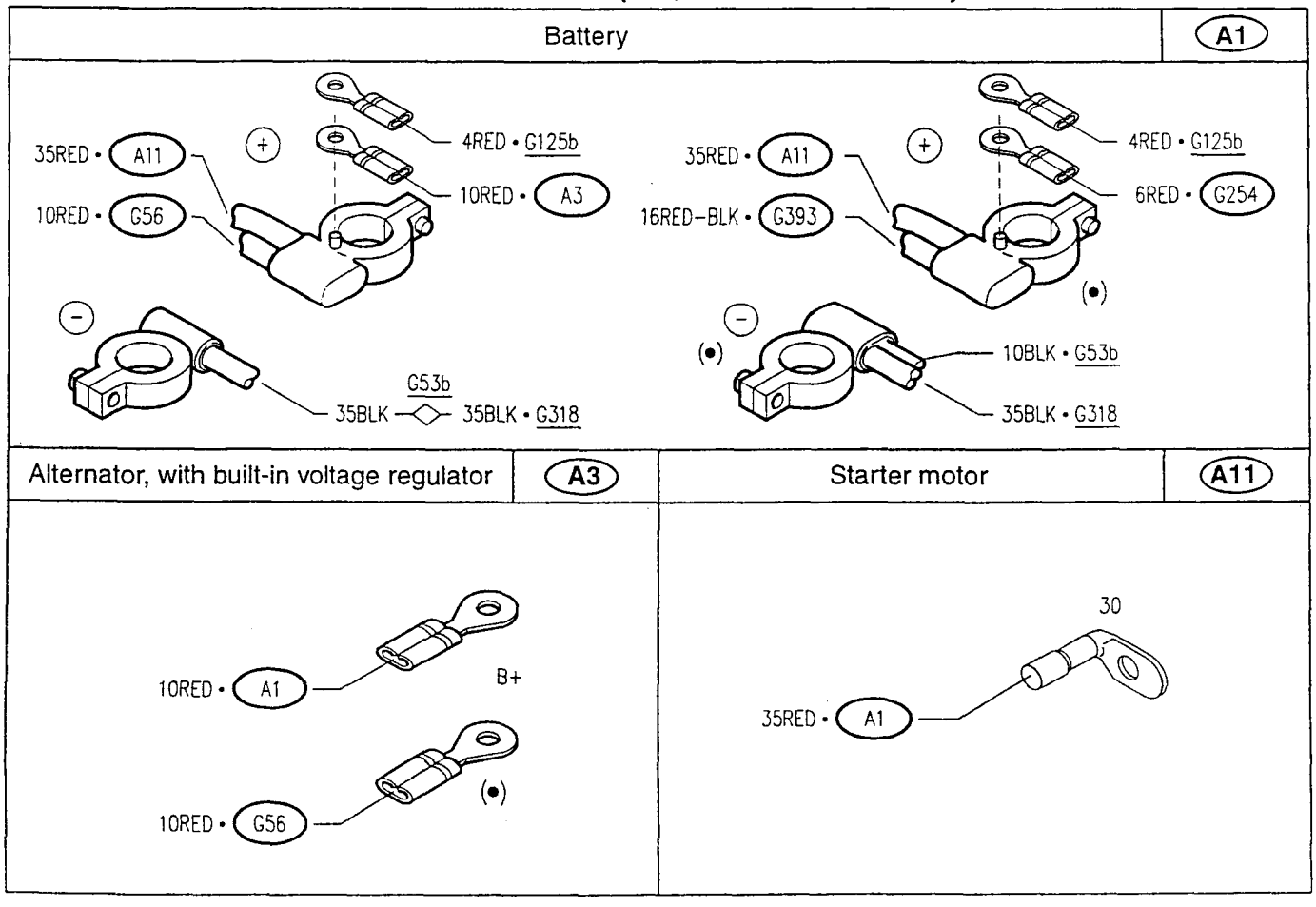
FUNCTIONAL DESCRIPTION (TD, TD-CAT version)

The supply leading from the battery **A1** is subdivided into the various lines in the branch terminal box **G56**, from which the numerous cables that directly supply certain systems (protected by specific "wander" fuses) and the line that supplies the fusebox **G1** lead; inside the fusebox, the supply is sorted to the various circuits, protected by the corresponding fuses (see the "Fusebox" section").
The battery charging line leads directly from the alternator **A3** or (from chassis no. .....) via the branch terminal box **G56.**
The ignition switch **B1** is also supplied through the branch terminal box **G56** at pin B of connector B.
The line leaving pin A of connector B is the one corresponding to the "START" position and directly supplies the starter motor **A11** (only for certain cars without ALFA ROMEO CODE but with theft alarm, through the alarm control unit **N45** and the starting consensus relay **I10**).

The line that leaves pin 3 of connector A - "DRIVE" position - via the fusebox **G1**, supplies the "key-operated" circuits, which are however disengaged in the "START" position.
The lines that leave pin 1 of connector A and pin C of connector B supply the "key-operated" circuits which remain engaged also when the ignition key is turned to "START", either directly or via the fusebox **G1**.
Lastly, the line that leaves pin 2 of connector A corresponds to the "PARK" position and supplies the sidelights circuit inside the fusebox **G1**.

From chassis no....., through the adoption of a special high capacity fuse (150A) **G393**, all the supply lines are protected with the exception of the starter motor cable (battery - starter motor) and the battery charging cable (starter motor - alternator) which are protected by an additional "reinforced" sheath.
A fuse **G384** (50A) has also been added to protect the supply for the ignition switch.

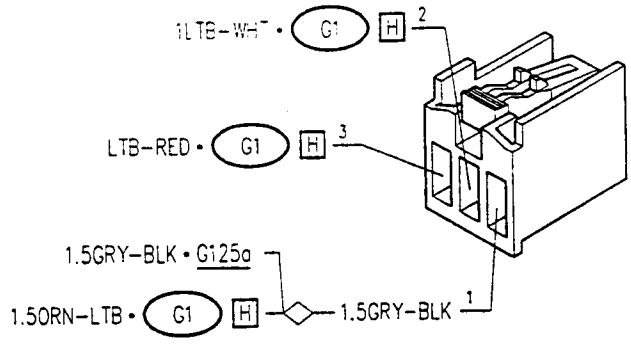
COMPONENTS AND CONNECTORS (TD, TD-CAT version)



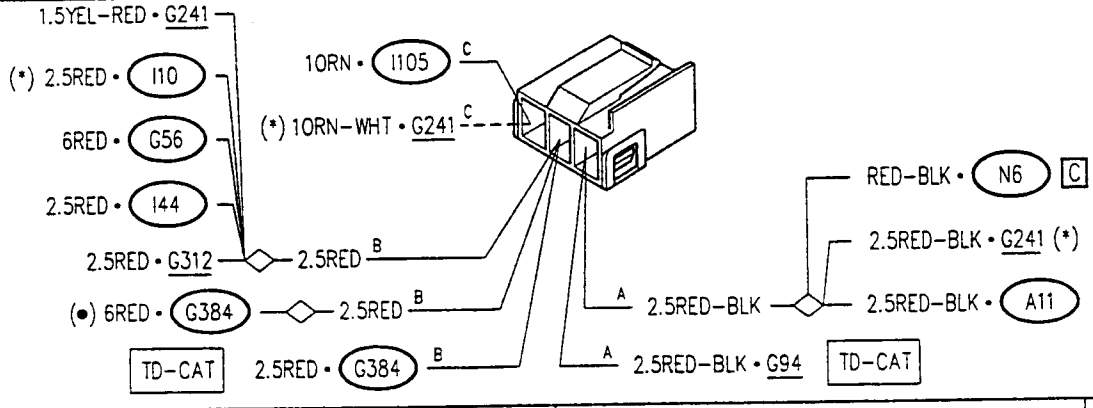
(•) Variant from chassis no....

COMPONENTS AND CONNECTORS (contd.)

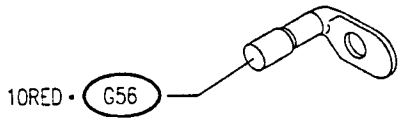
Ignition switch — B1 A



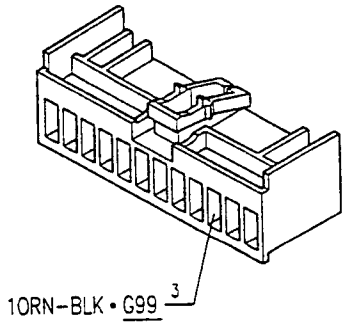
Ignition switch — B1 B



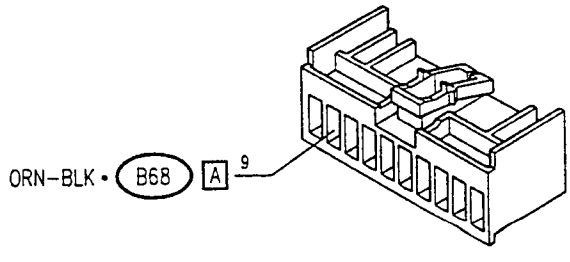
Fusebox — G1



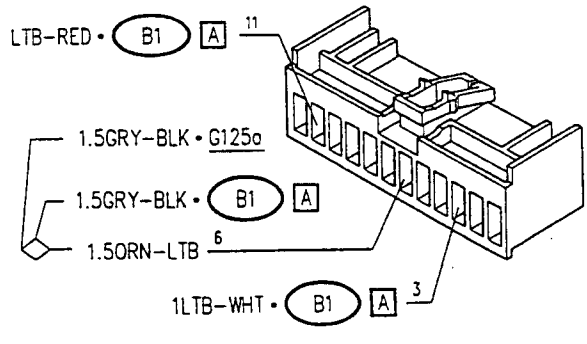
Fusebox — G1 D



Fusebox — G1 F



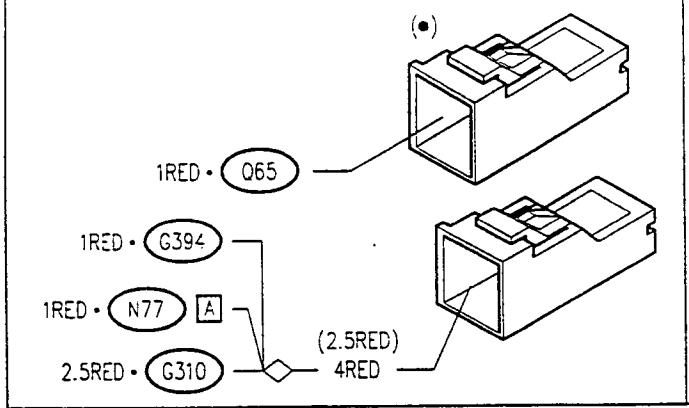
Fusebox — G1 H

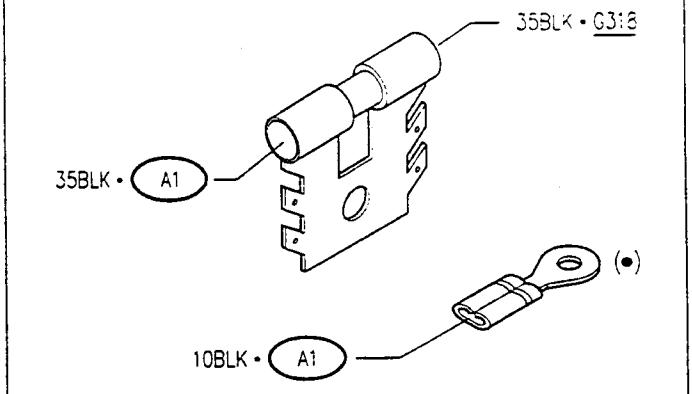


(*) Versions without ALFA ROMEO CODE, but with anti-theft system (•) Variant from chassis no....

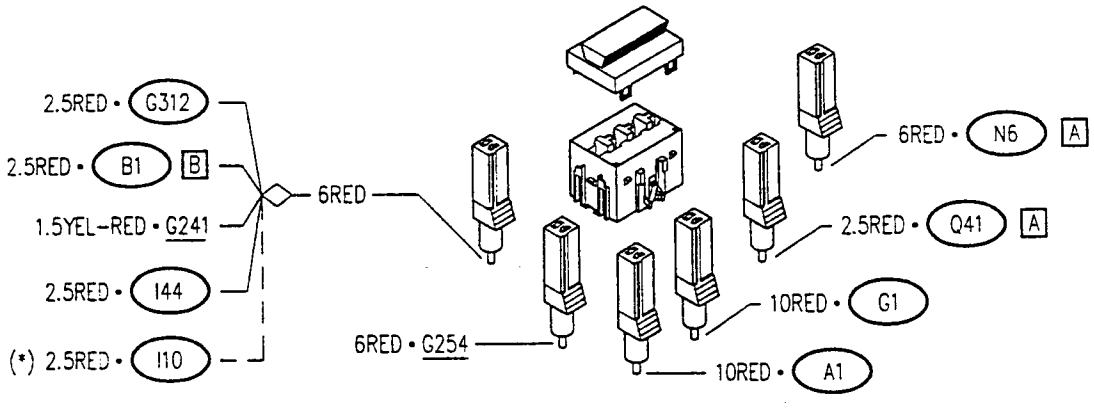
COMPONENTS AND CONNECTORS (contd.)

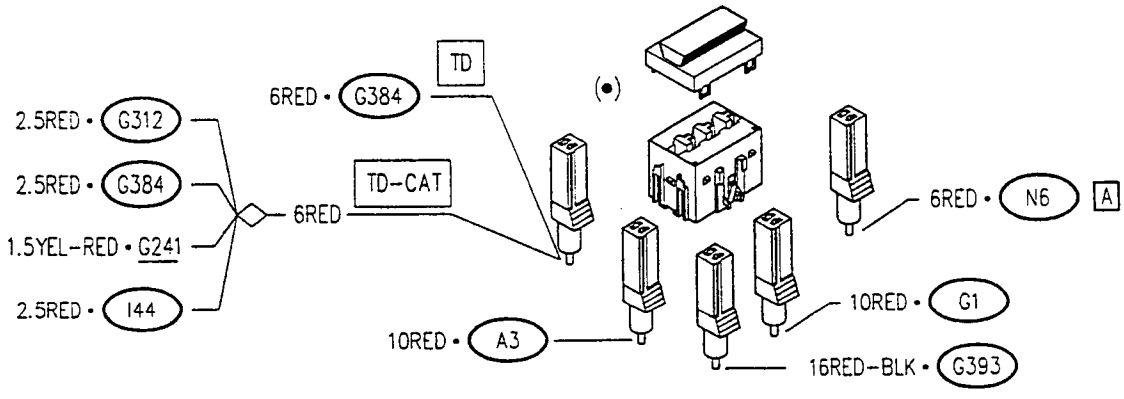
Fusebox	G1 Q	LH engine compt. earth	G53b



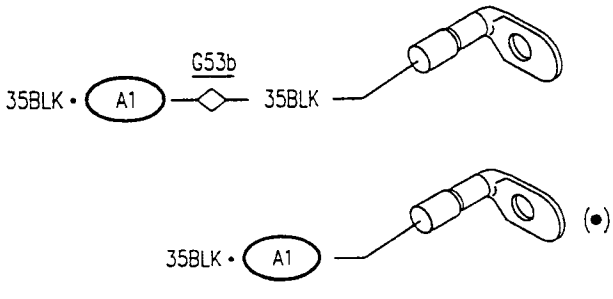


Branch terminal box	G56





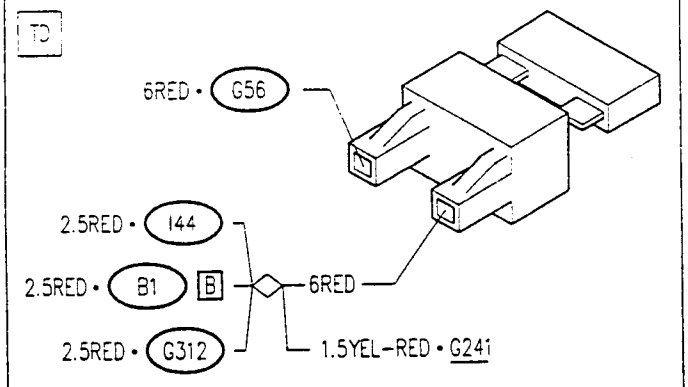
Earth on gearbox	G318

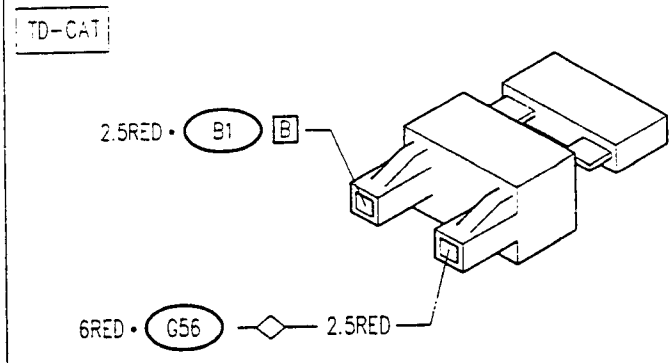


(*) Versions without ALFA ROMEO CODE, but with anti-theft system
(•) Variant from chassis no....

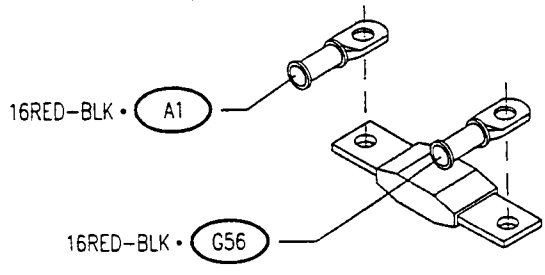
COMPONENTS AND CONNECTORS (contd.)

Services supply fuse (•)	G384	Services supply fuse	G384

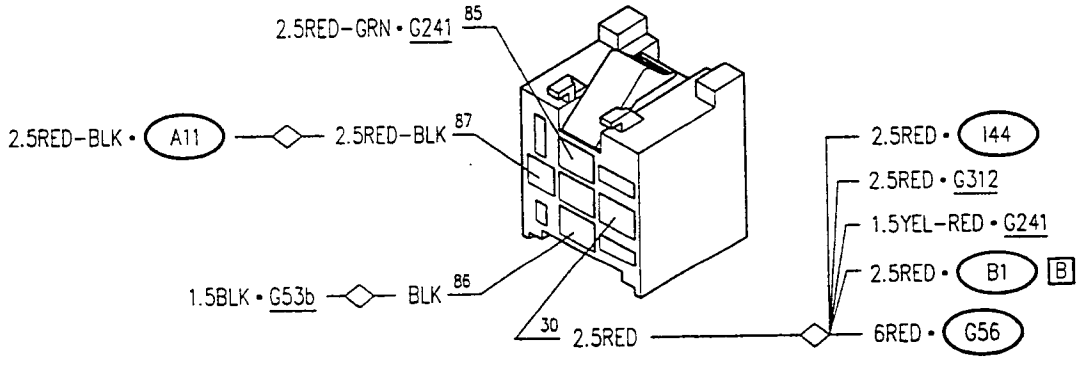




General supply fuse (•)	G393



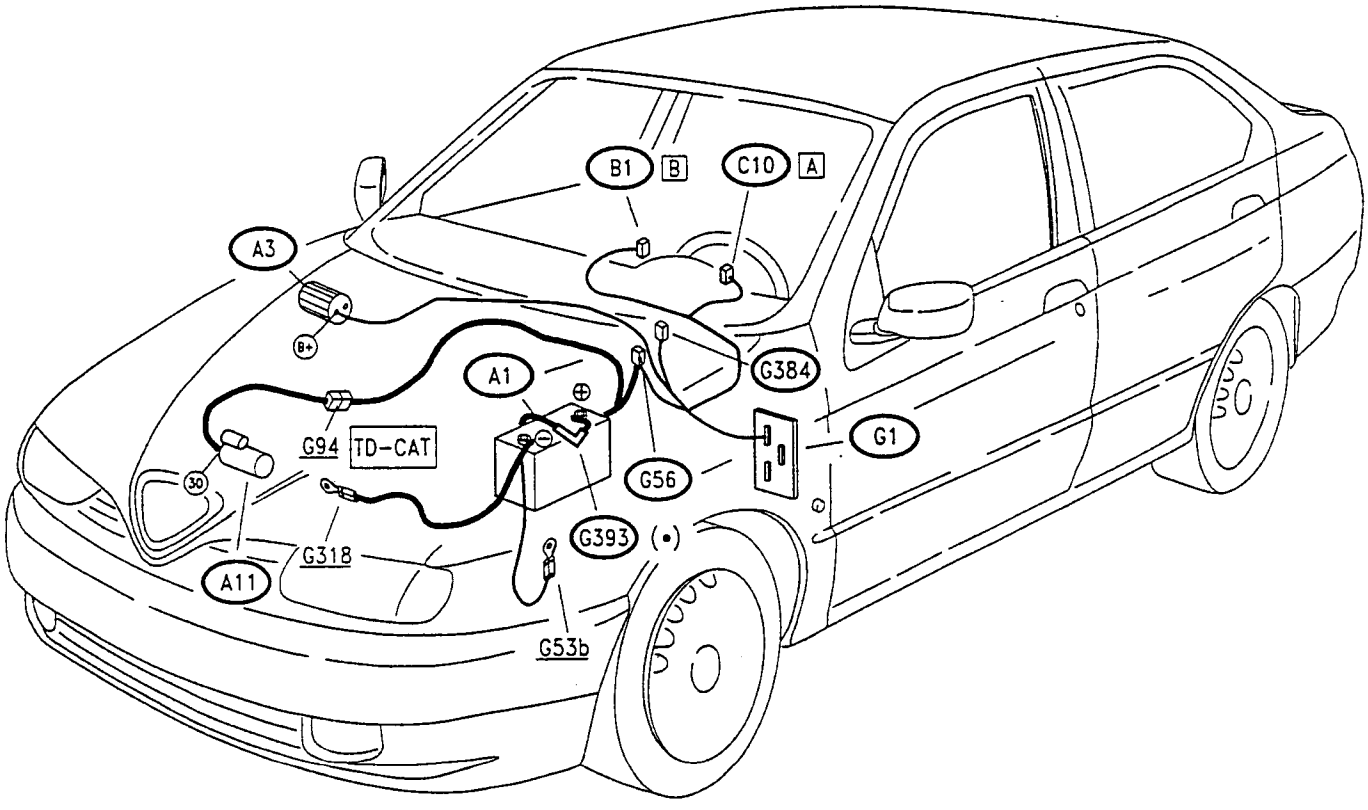
Starting consensus relay (*)	I10



(*) Versions without ALFA ROMEO CODE, but with anti-theft system

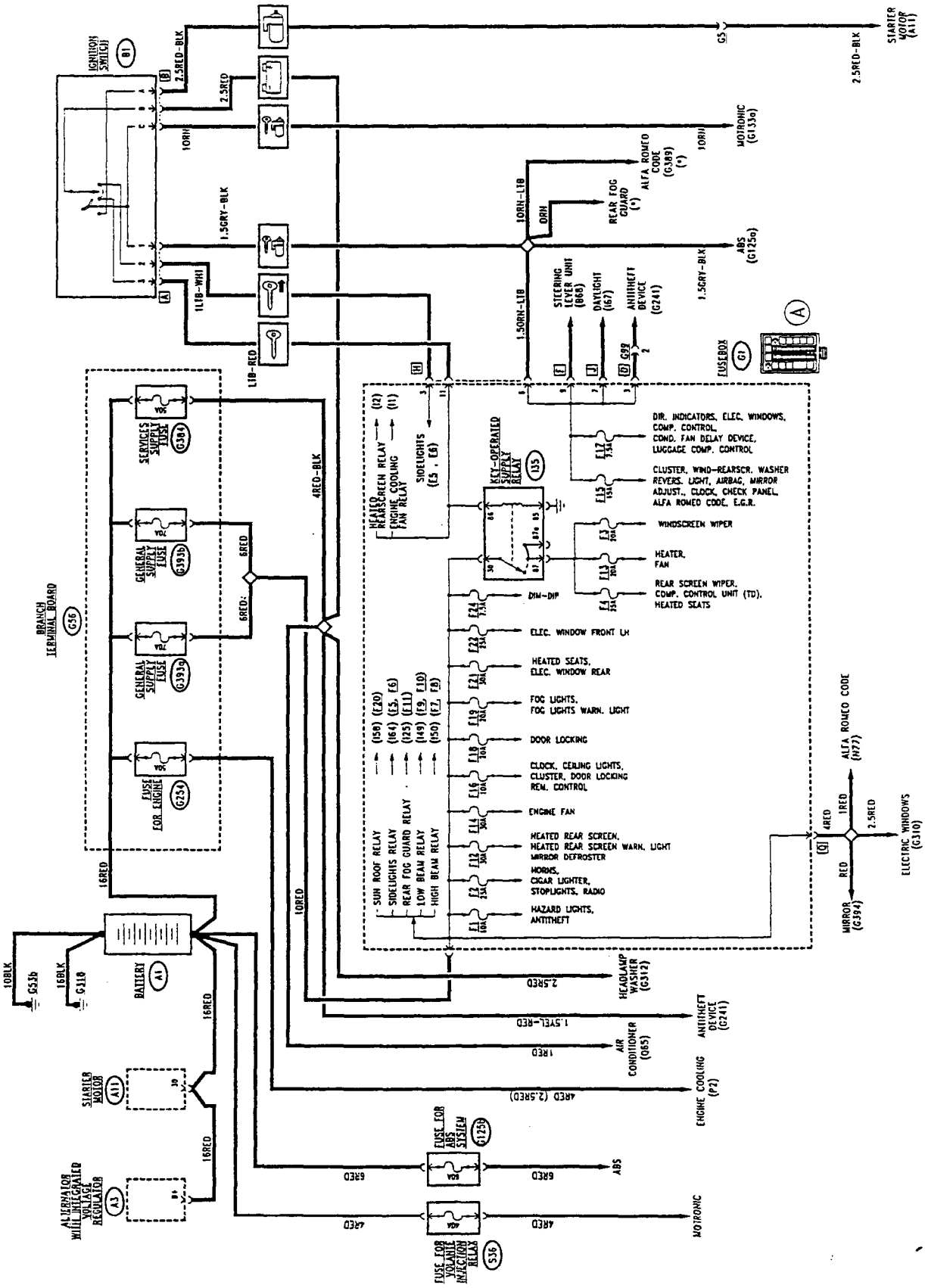
(•) Variant from chassis no....

LOCATION OF COMPONENTS (TD, TD-CAT version)



(•) from chassis no.....

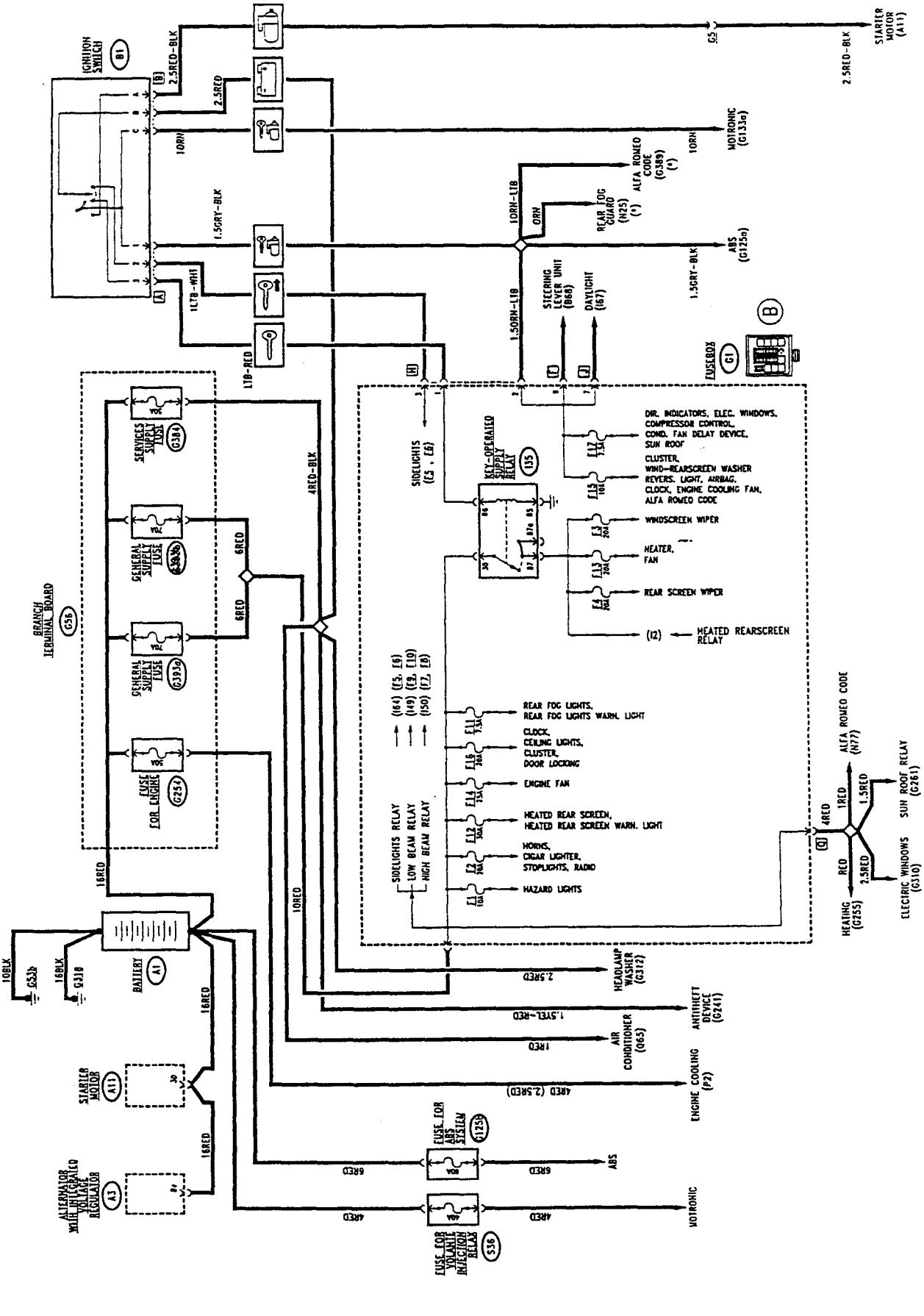
WIRING DIAGRAM (T.SPARK version)



(*) only from M.Y. '97

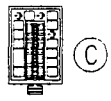
WIRING DIAGRAM (T.SPARK version)





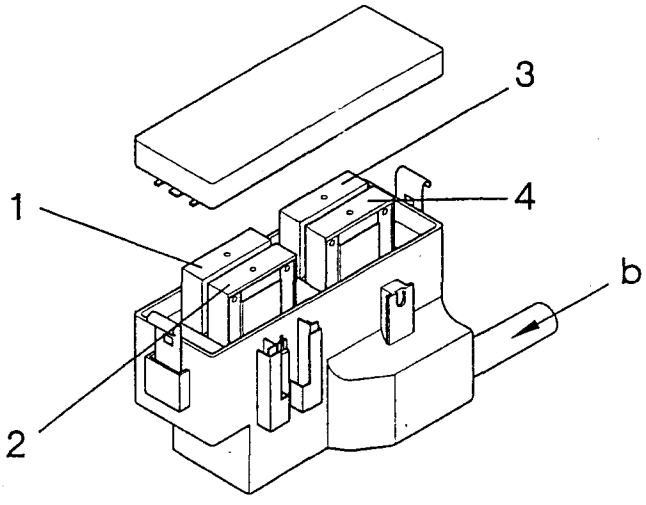
(*) only from M.Y. '97

WIRING DIAGRAM (T.SPARK version)



FUNCTIONAL DESCRIPTION (T.SPARK version)

The supply leading from the battery **A1** is subdivided into various lines in the branch terminal box **G56**. This is a branch terminal box with built-in fuses, which makes it possible to protect all the supply lines except the starter motor cable (battery-starter motor) and the battery charging cable (starter motor-alternator): these cables are however protected by an additional "reinforced" sheath.



b. line (16 mm cable) from the battery

Up to Model Year '97

1. Fan fuse (50A): **G254**
2. Services supply fuse (50A): **G384**
3. General supply fuse (70A): **G393a**
4. General supply fuse (70A): **G393b**

From Model Year '98

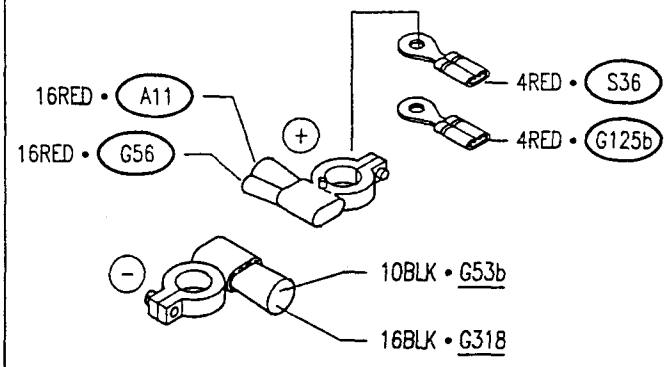
1. Fan fuse (40A): **G254**
2. Services supply fuse (30A): **G384**
3. General supply fuse (60A): **G393a**
4. General supply fuse (60A): **G393b**

From this, lead the cables which directly supply certain systems and the line that supplies the fusebox **G1**; inside the fusebox the supply is branched to the various circuits, protected by the corresponding fuses (see "Fusebox" section).
The battery charging line leads from the alternator **A3**, via the starter motor **A11.**
The ignition switch **B1** is also supplied via the branch terminal box **G56** and the specific fuse **G384** at pin B of connector B.
The line that leaves pin A of connector B is the one corresponding to the "STASRT" position and directly supplies the starter motor **A11.**

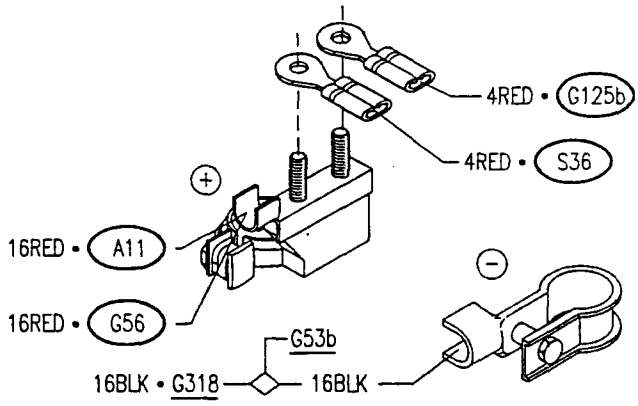
The line that leaves pin 3 of connector A - "DRIVE" position - supplies, via the fusebox **G1**, the "key-operated" circuits which are disengaged in the "START" position.
The lines that leave pin 1 of connector A and pin C of connector B supply, either directly or via the fusebox **G1**, the "key- operated" circuits which also remain engaged in the "START" position.
For fusebox G1 "C"" pin C of connector B is not connected.
Lastly the line leaving pin 2 of connector A corresponds to the "PARK" position and supplies the sidelights circuit inside the fusebox **G1**.

COMPONENTS AND CONNECTORS (T.SPARK version)

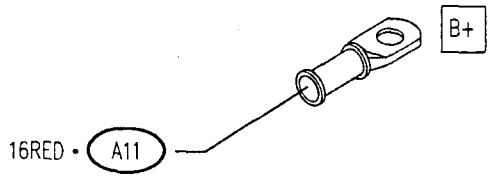
Battery	A1



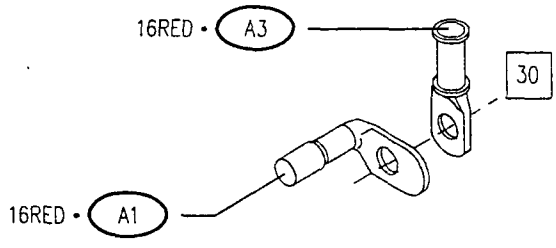
Battery (•)	A1



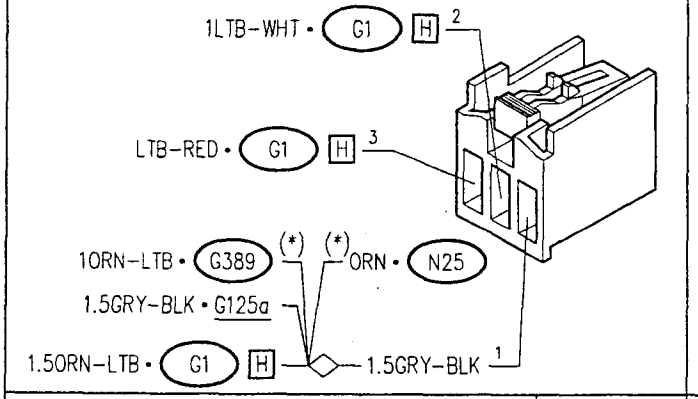
Alternator, with built-in voltage regulator	A3



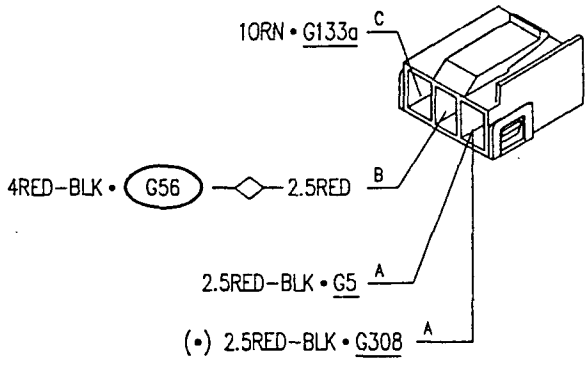
Starter motor	A11



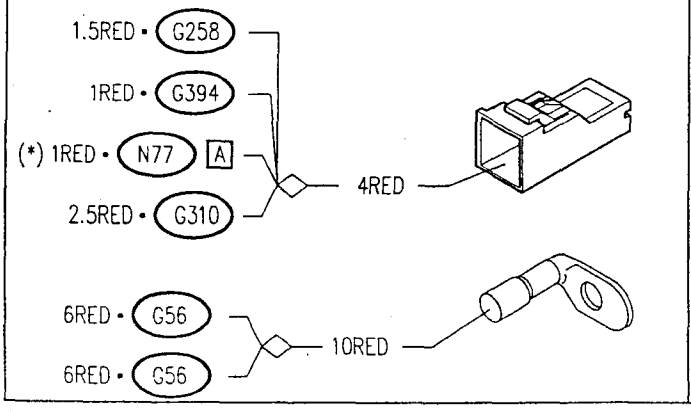
Ignition switch	B1	A



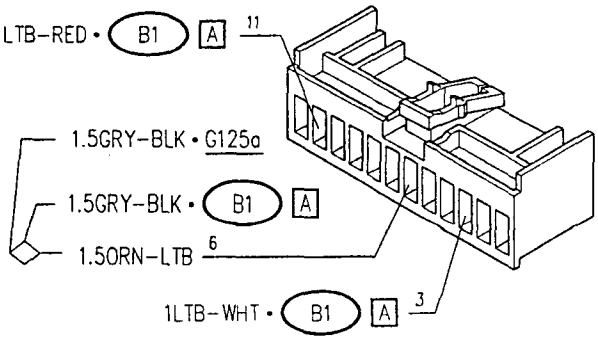
Ignition switch	B1	B



Fusebox	G1



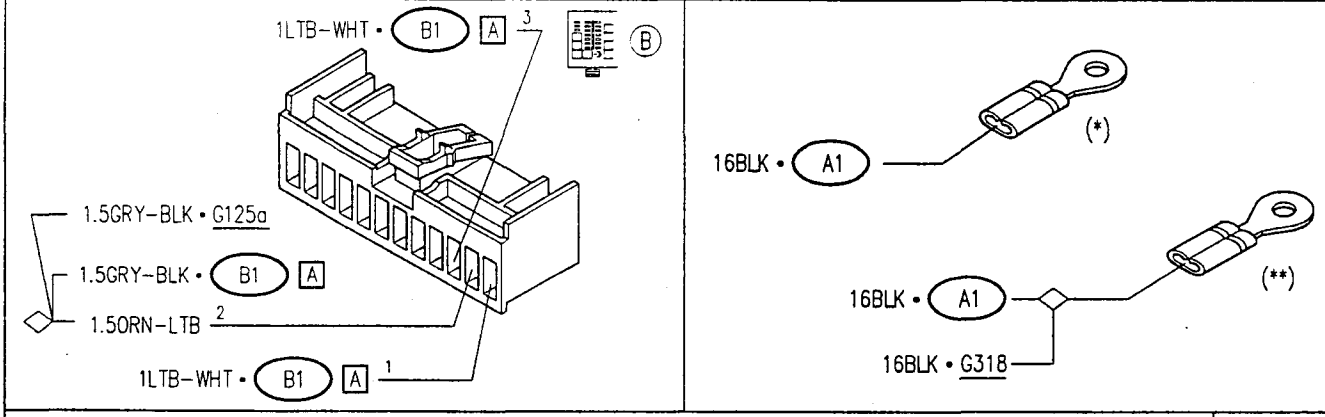
Fusebox	G1	H



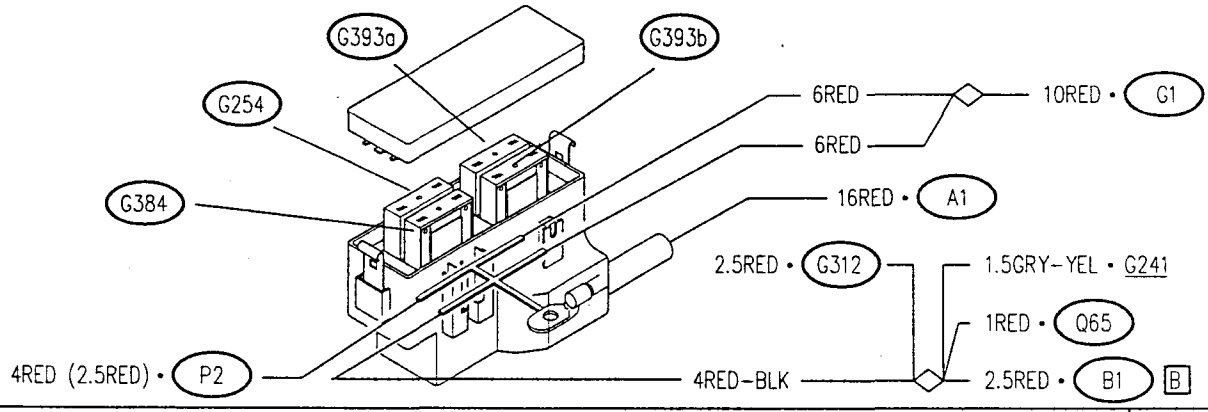
(*) from M.Y. '97

COMPONENTS AND CONNECTORS (contd.)

Fusebox	G1 H	LH engine compt. earth	G53b



Branch terminal box	G56

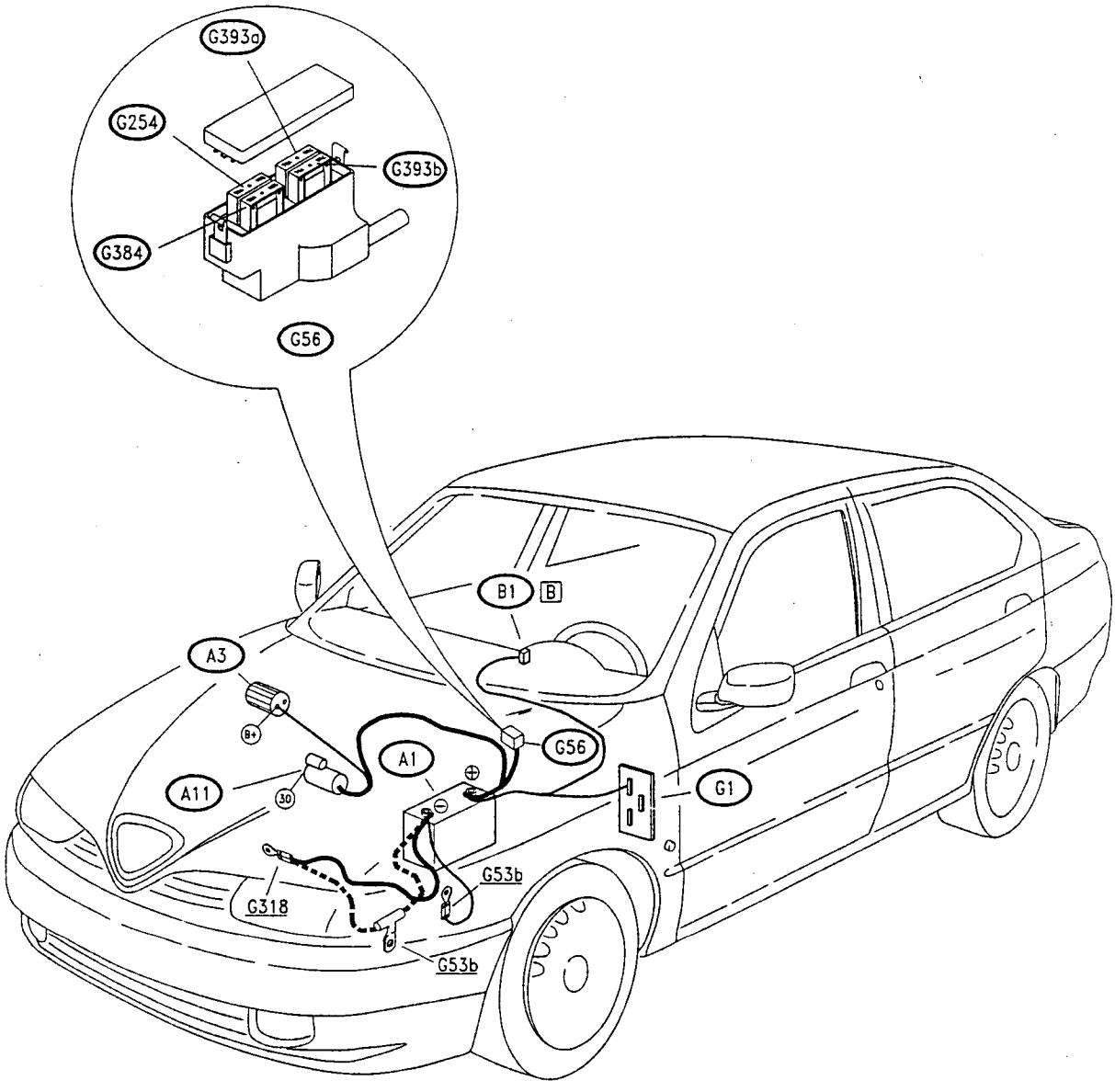


Earth on gearbox	G318



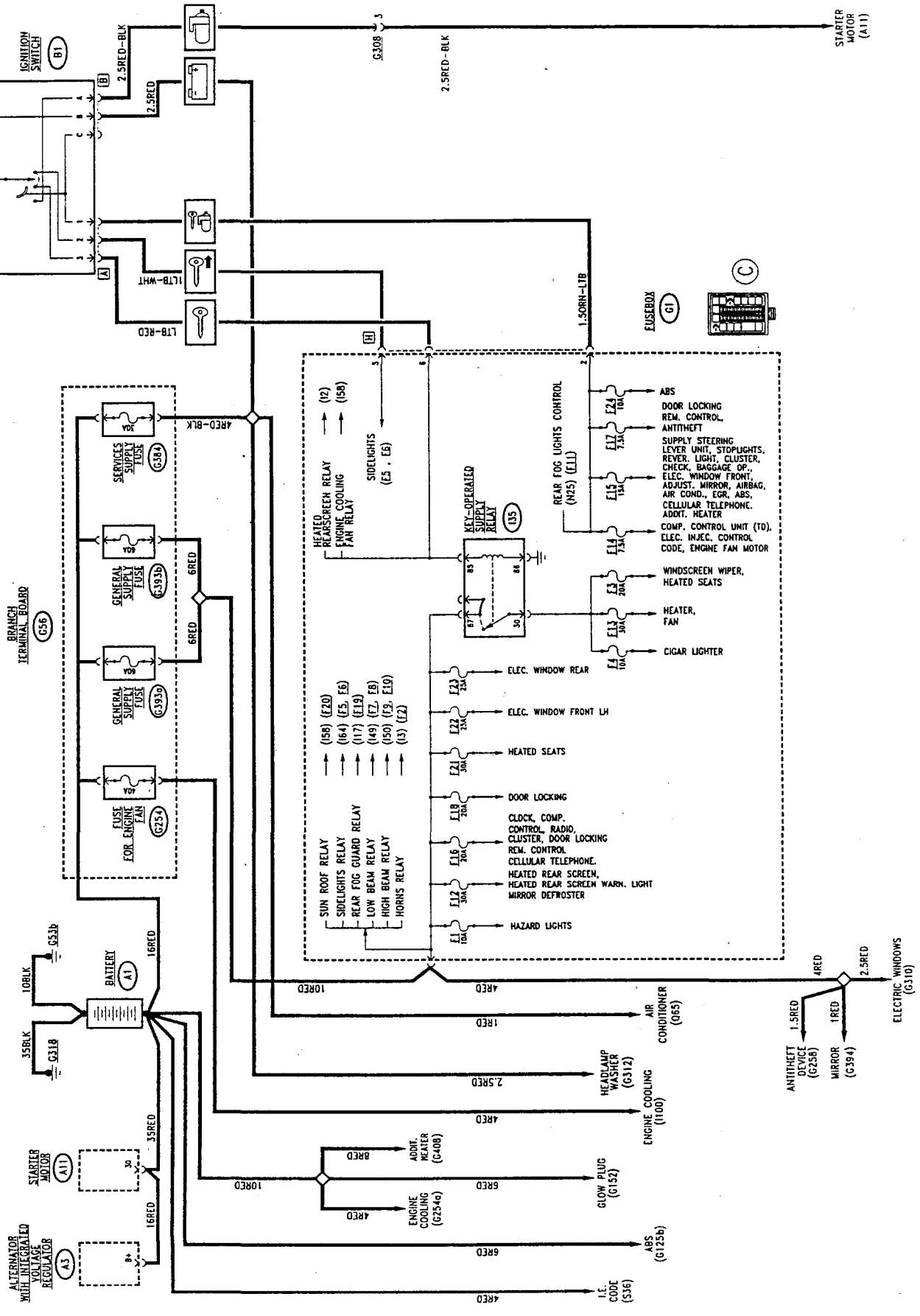
(*) from M.Y. '97
(**) from M.Y. '98

LOCATION OF COMPONENTS (T.SPARK version)



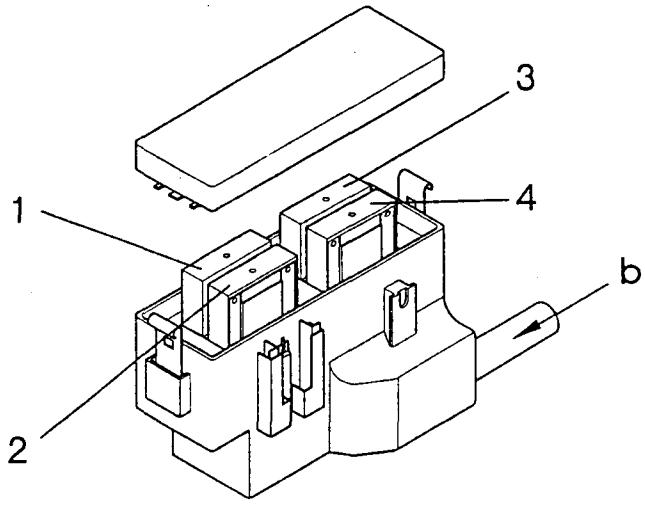
— — — from Model Year '98

WIRING DIAGRAM (JTD version)



FUNCTIONAL DESCRIPTION (JTD version)

The supply leading from the battery **A1** is subdivided into various lines in the branch terminal box **G56**. This is a branch terminal box with built-in fuses, which makes it possible to protect all the supply lines except the starter motor cable (battery-starter motor) and the battery charging cable (starter motor-alternator): these cables are however protected by an additional "reinforced" sheath.



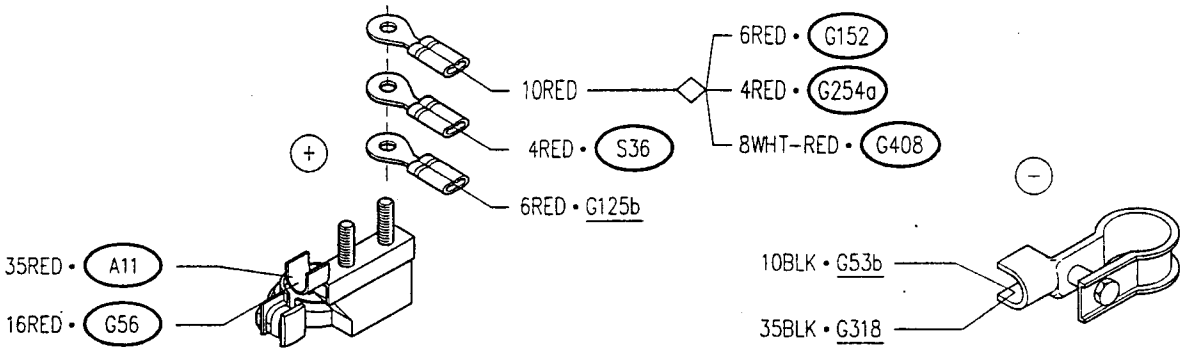
b. line (16 mm cable) from the battery
1. Fan fuse (50A): **G254**
2. Services supply fuse (30A): **G384**
3. General supply fuse (60A): **G393a**
4. General supply fuse (60A): **G393b**

From this, lead the cables which directly supply certain systems and the line that supplies the fusebox **G1**; inside the fusebox the supply is branched to the various circuits, protected by the corresponding fuses (see "Fusebox" section).
The battery charging line leads from the alternator **A3**, via the starter motor **A11.**
The ignition switch **B1** is also supplied via the branch terminal box **G56** and the specific fuse **G384** at pin B of connector B.
The line that leaves pin A of connector B is the one corresponding to the "STASRT" position and directly supplies the starter motor **A11.**

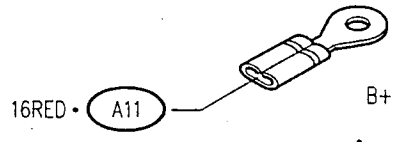
The line that leaves pin 3 of connector A - "DRIVE" position - supplies, via the fusebox **G1**, the "key-operated" circuits which are disengaged in the "START" position.
The lines that leave pin 1 of connector A and pin C of connector B supply, either directly or via the fusebox **G1**, the "key- operated" circuits which also remain engaged in the "START" position.
Pin C of connector B is not connected.
Lastly the line leaving pin 2 of connector A corresponds to the "PARK" position and supplies the sidelights circuit inside the fusebox **G1**.

COMPONENTS AND CONNECTORS (JTD version)

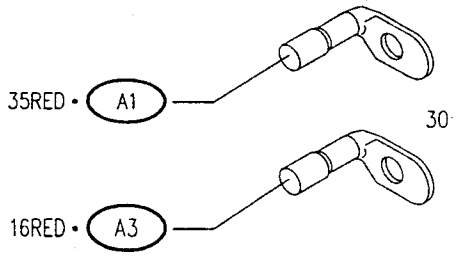
Battery — A1



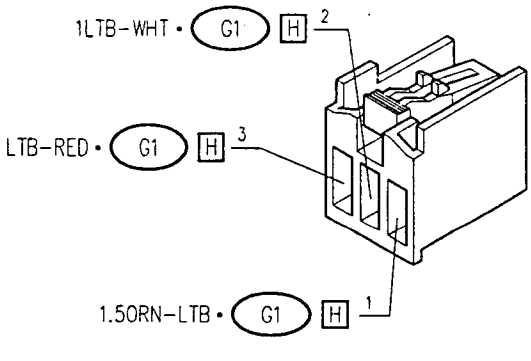
Alternator, with built-in voltage regulator — A3



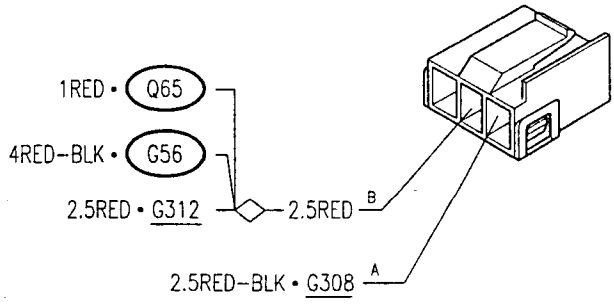
Starter motor — A11



Ignition switch — B1 A



Ignition switch — B1 B

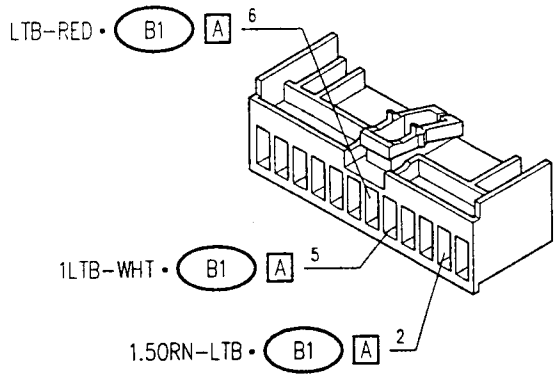


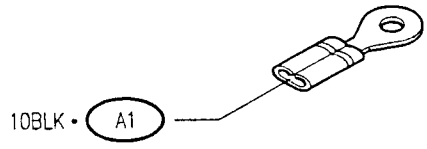
Fusebox — G1



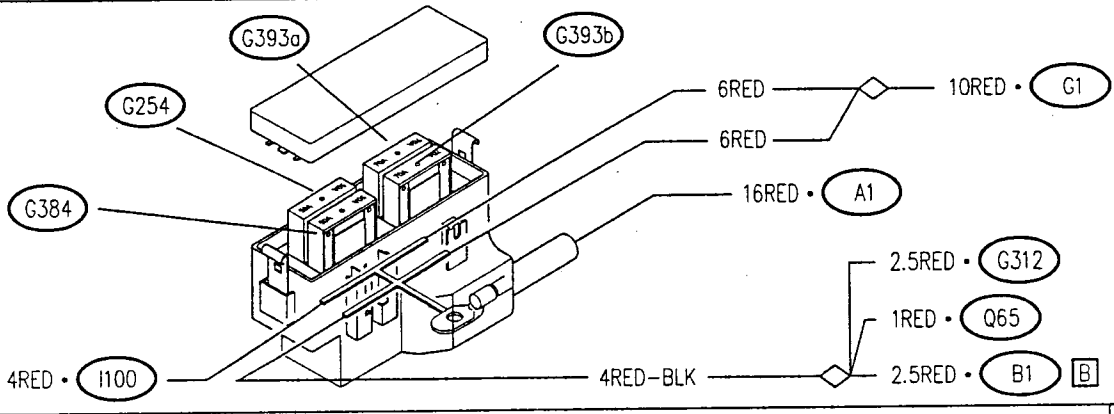
COMPONENTS AND CONNECTORS (contd.)

Fusebox	G1 H	LH engine compartment earth	G53b

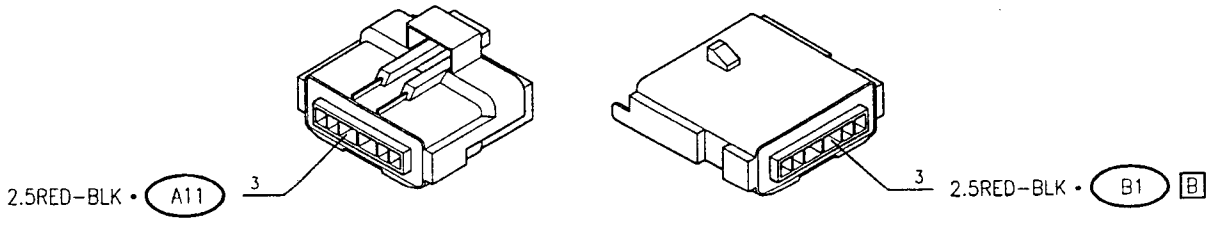




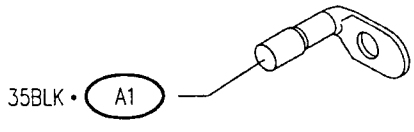
Branch terminal board	G56



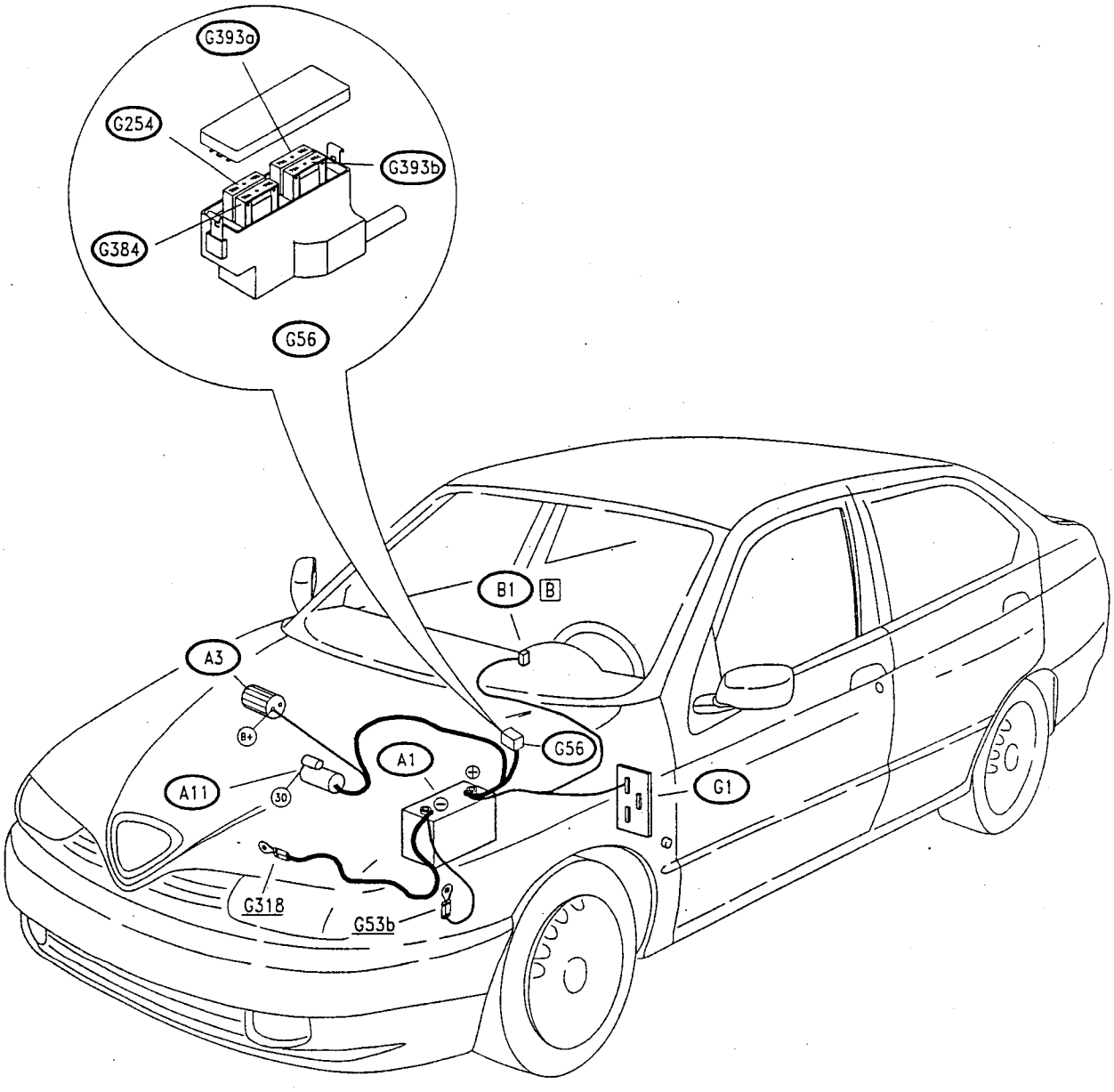
Connector for engine sensors	G308



Earth on gearbox	G318

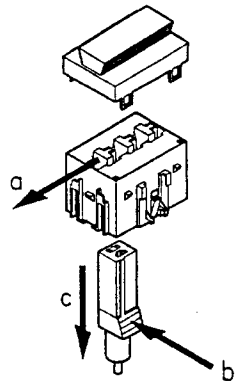


LOCATION OF COMPONENTS (JTD version)



CHECKING COMPONENTS

Branch terminal box (G56) (except T.SPARK and JTD)

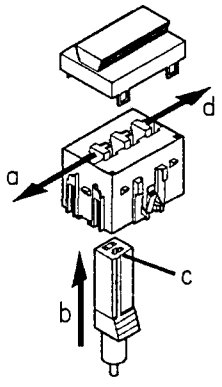


Removing a connector

a - move the "secondary-lock" to the left

b - press the release catch of the connector to be removed

c - remove the connector pulling downwards



Inserting a connector

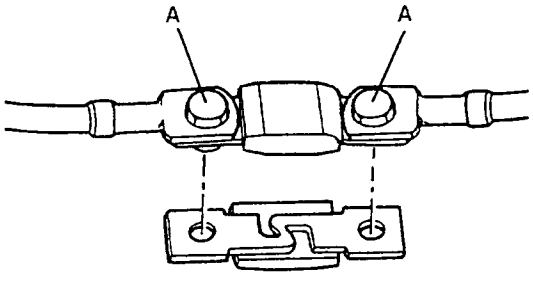
a - position the "secondary-lock" at the left

b - insert the connector

c - press the connector until it catches in the tooth

d - move the "secondary-lock" to the right

General supply fuse (G393) (except T.SPARK and JTD)



"MEGA" general supply protection fuse: (150A).

In the event of replacement tighten the two fastening screws **(A)**, proceeding with care, to a torque of appr. 25 Nm, without forcing the fuse excessively to avoid damaging the copper element.

POWER WINDOWS

INDIX

FRONT POWER WINDOWS

Wiring diagram A 23-2

Wiring diagram B 23-3

Wiring diagram B 23-4

General Description 23-4/1

Functional Description 23-4/1

Components and Connectors 23-5

Location of Components 23-9

REAR POWER WINDOWS

Schema elettrico 23-10

General Description 23-11

Functional Description 23-11

Components and Connectors 23-12

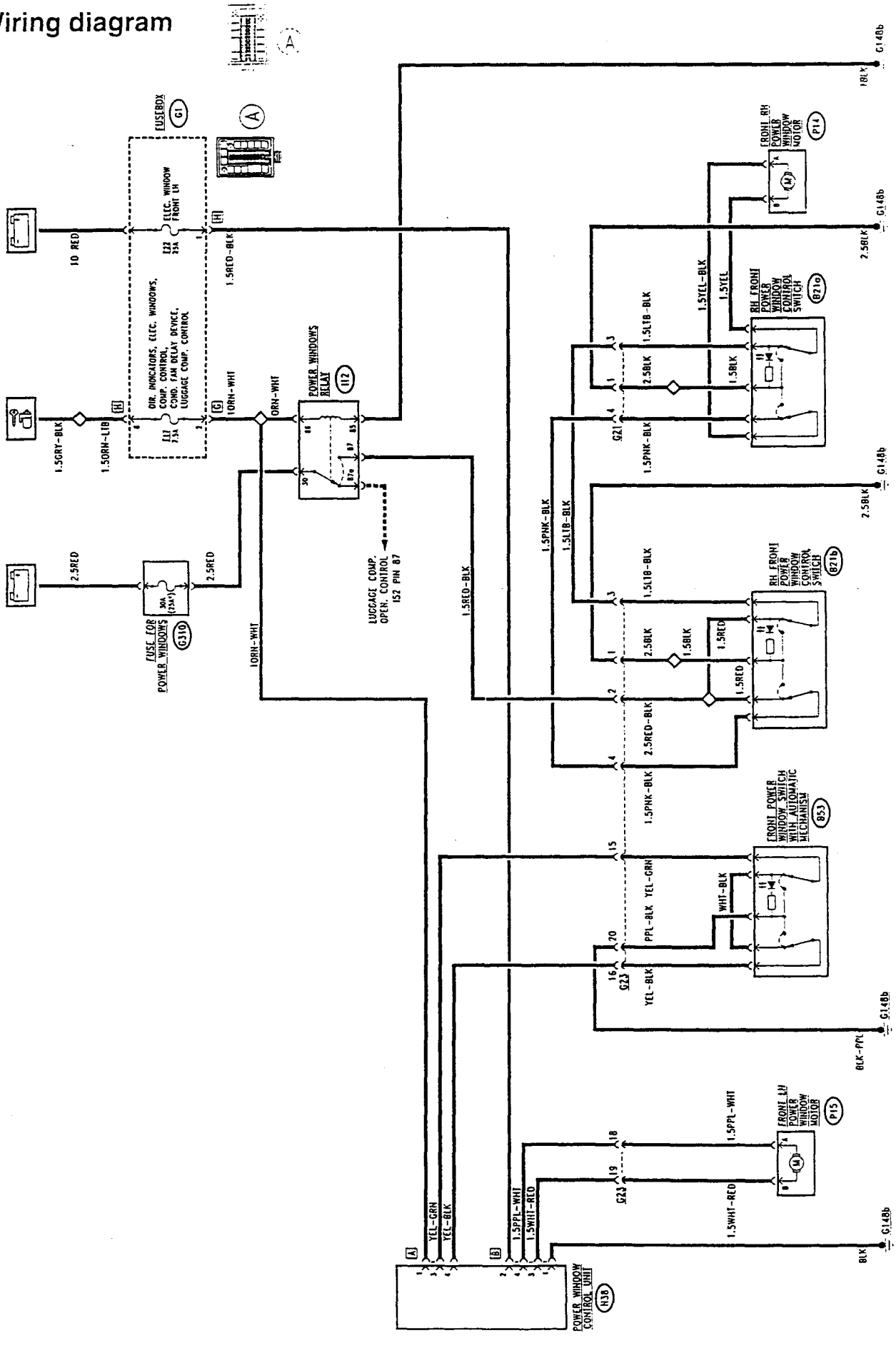
Location of Components 23-14

FAULT-FINDING TABLE 23-15

CHECK POWER WINDOW CONTROL UNIT 23-16

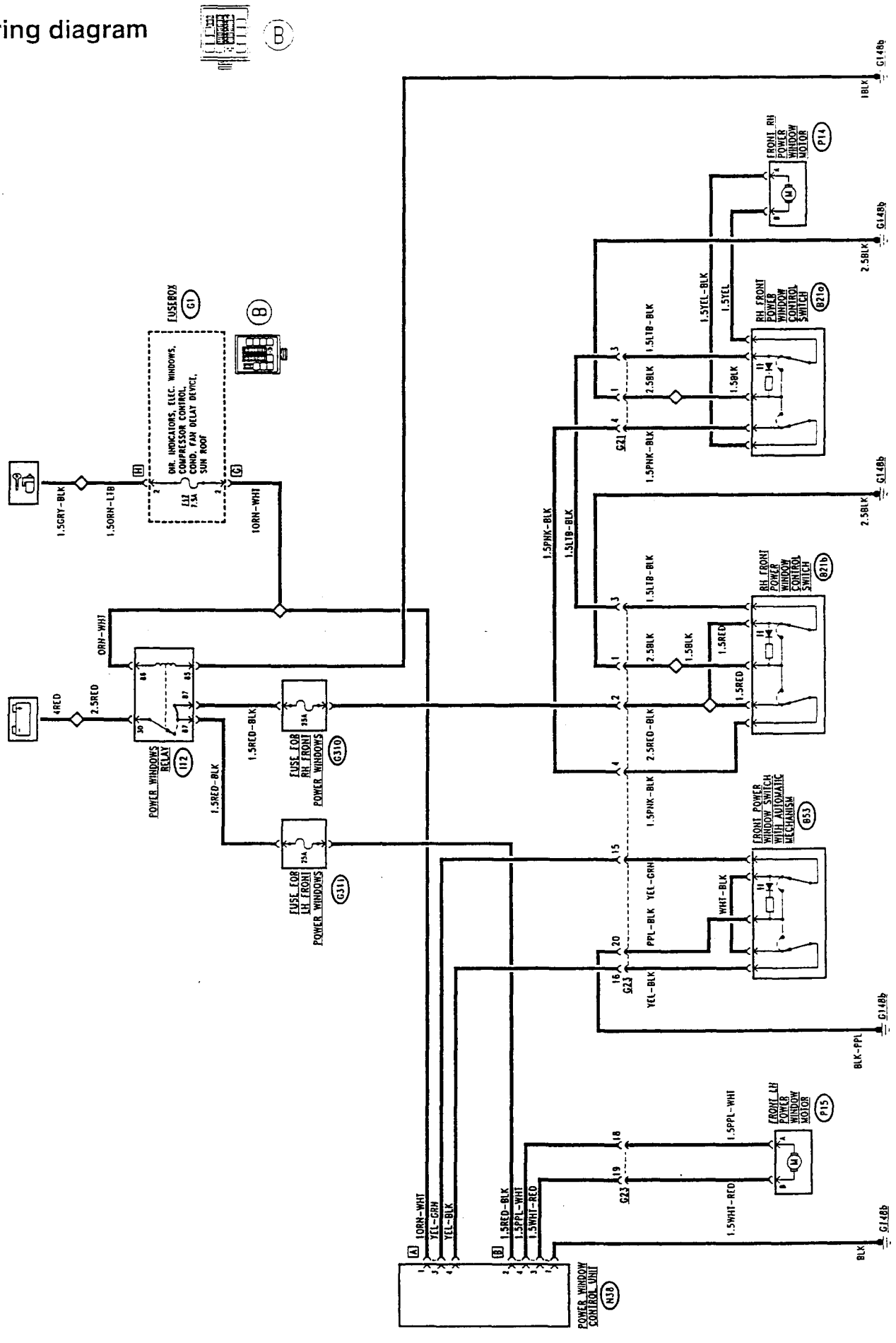
FRONT POWER WINDOWS

Wiring diagram

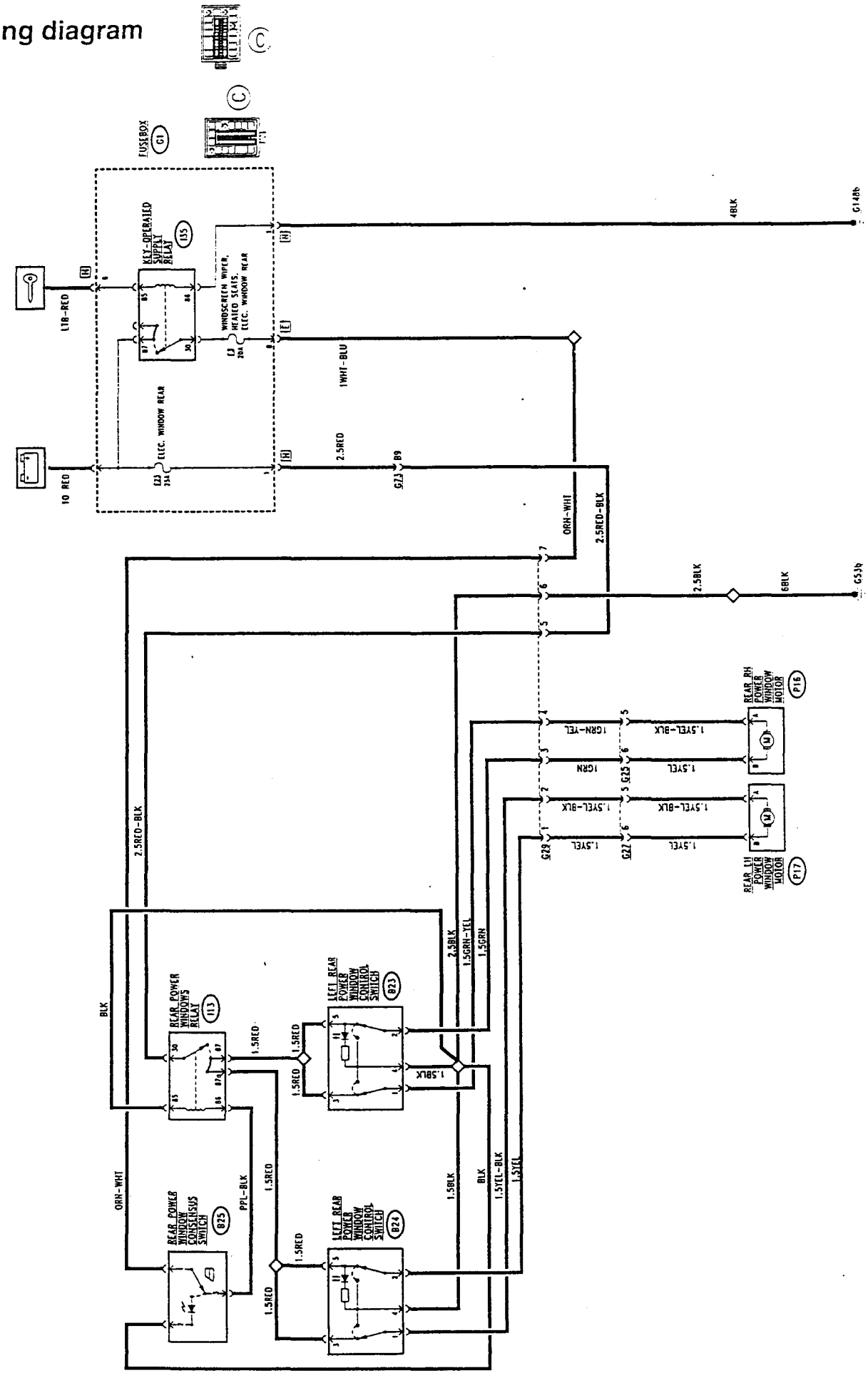


(*) for versions not fitted with electric bool opening device

Wiring diagram



Wiring diagram



General Description

For versions with fusebox "A":
The movement of the **left front** electric window (driver's side) is **automatic**, controlled by a control unit which operates it according to the following logic:

- keeping the pushbutton pressed (over 300 ms) the window opens or closes normally until the pushbutton is released;
- a short pulse (below appr. 300 ms.) operates the motor which automatically continues and only stops at the end of the stroke (window completely open or closed);
- an even shorter pulse (less than appr. 50 ms.) is considered by the control unit as an accidental shock and no action will result.

This operating logic takes place throughtthe "key-operated" supply.

For versions with fusebox "B":
The movement of the **left front** window is **manual**: when the button is pressed in one direction or the other the window moves upwards or downwards: this only takes place through the "key-operated" supply.

The electrical mechanism that operates the **right front** window is - in both cases - of the conventional type: when the button is pressed the window rises or drops; it is fitted with two control switches: one on the right-hand door and one on the left-hand door; operation is only possible with the ignition key engaged.

Functional description

For versions with fusebox "A" or "C":
The power window control unit **N38** is supplied at pin 2 of connector B by battery voltage through fuse **F22** of fusebox **G1**.
The key-operated enable signal reaches pin 1 of connector A via fuse **F17** (box "A") or fuse **F15** (box "C") still of **G1**.
The control signals for the upward and downward stroke respectively reach pins 4 and 3 of connector A from the left-hand window control switch **B53**.
In fact, this double switch sends an earth to the control unit from the part in which the contact has been closed.
The operating signals (up or down) leave pins 3 and 4 of connector B of **N38** for left-hand window motor **P15**: 12 V and earth are inverted to change the direction of rotation
Pin 1 of connector B of **N38** is connected to earth.

Conversely, the operation of the right-hand motor is controlled directly by one of the two switches **B21** (**B21a** located on the right-hand door, **B21b** on the left) which are connected in series.
The "key-operated" supply passes through relay **I12**, supplied by direct voltage through the line of fuse **G310**. The relay is energised with the key-operated supply, via fuse **F17** (box "A") or fuse **F15** (box "C") still of **G1**.: the righthand window motor **P14** is operated by one of the two switches **B21** in one direction or the other depending on the origin of the 12V or earth signal.

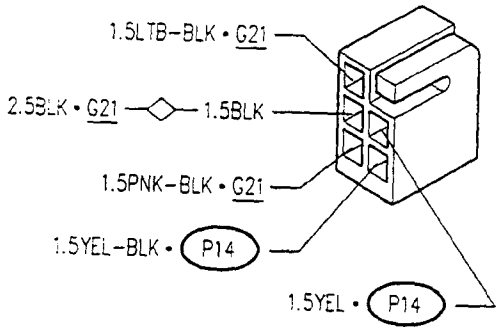
For versions with fusebox "B":
The power window control unit **N38** comprises a "bridge" on connector B which "relays" the supply and earth to the control switch of the left-hand window **B22**. This supply leads through wander fuse **G311** and relay **I12**.

The "key-operated" consensus is received through fuse **F17** of **G1**.
The double switch **B22** sends the operating signals (up or down) for the left-hand window motor **P15**: 12 V and earth are inverted to change the direction of rotation.

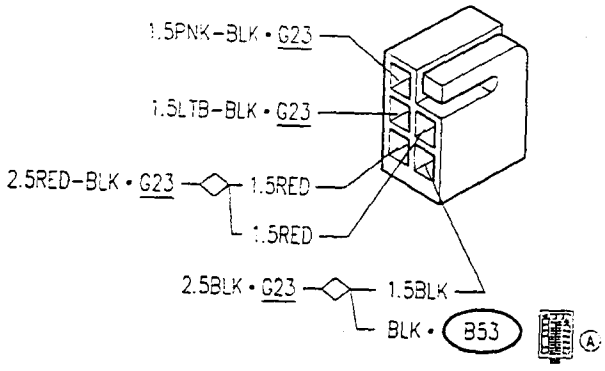
Operation of the right-hand window is controlled directly by one of the two switches **B21** (**B21a** located on the right-hand door, **B21b** on the left) which are connected in series
The "key-operated" supply leads through relay **I12**, energized through the line of fuse **F17** of **G1**, and wander fuse **G310**. The motor for the right-hand window **P14** is operated by one of the two switches **B21** in one direction or in the other depending on the origin of the 2V and earth signals.

Components and Connectors

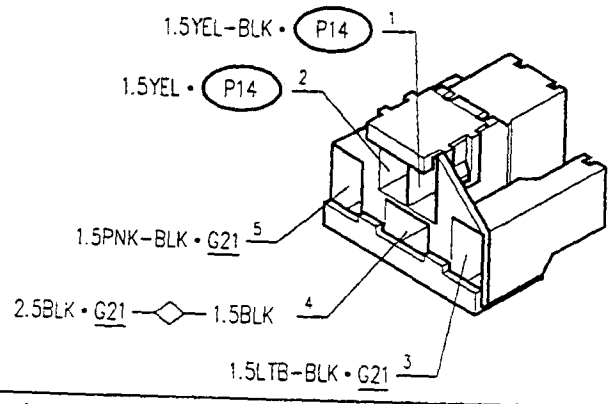
RH front power window control switch (on RH door) (*) — B21a



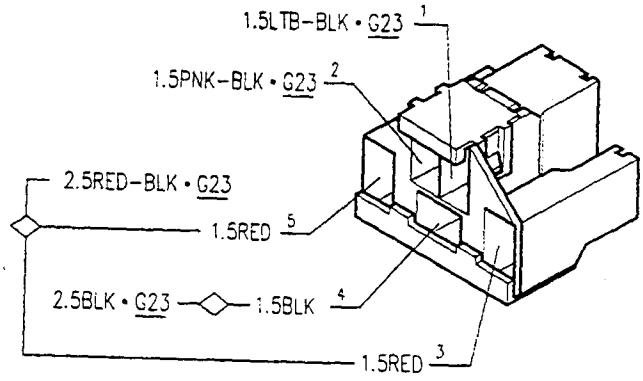
RH front power window control switch (on LH door) (*) — B21b



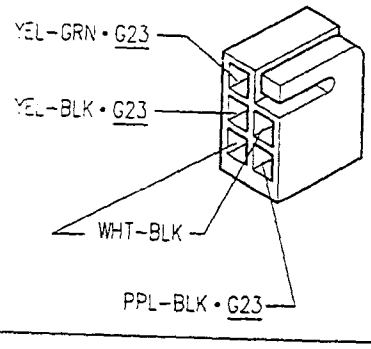
RH front power window control switch (on RH door) (•) — B21a



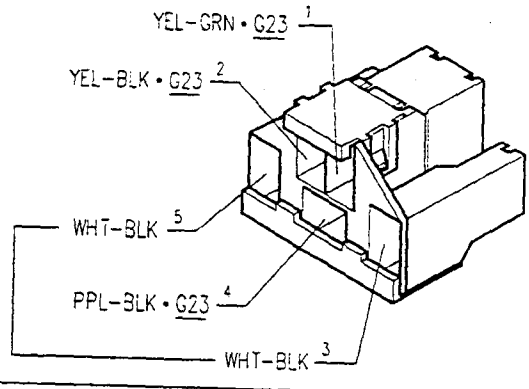
RH front power window control switch (on LH door) (•) — B21b



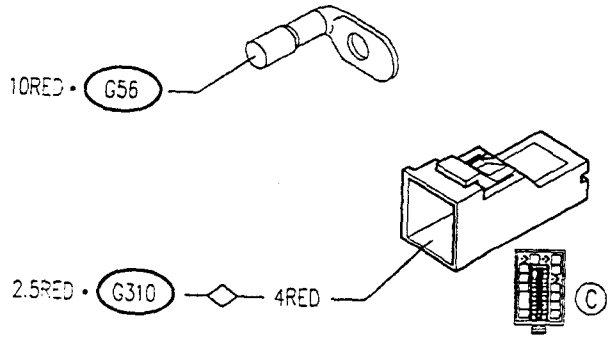
Front power window switch with automatic device (*) — B53



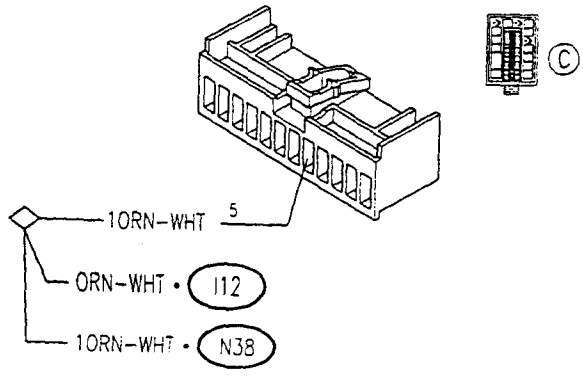
Front power window switch with automatic device (•) — B53



Fusebox — G1



Fusebox — G1 A

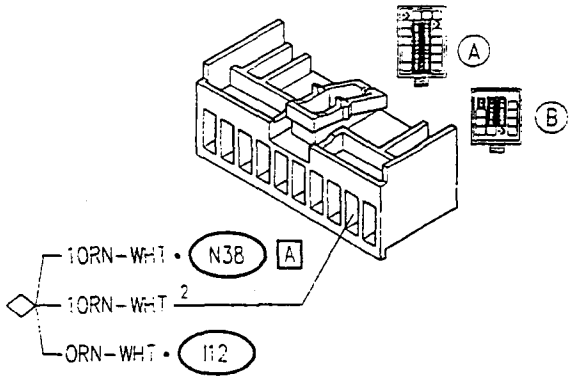


(*) up to chassis no.__
PA493000000008

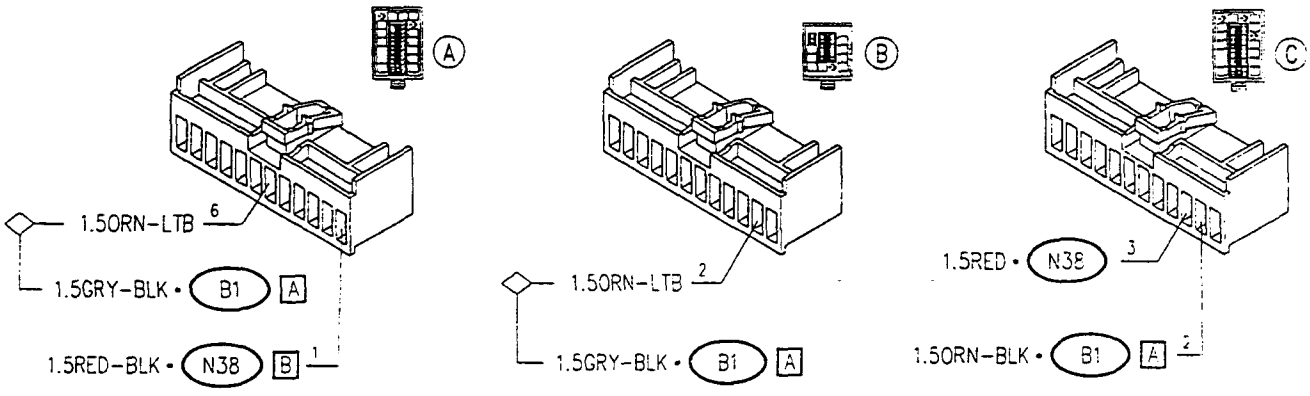
(•) from chassis no.___

Components and Connectors (cont.d)

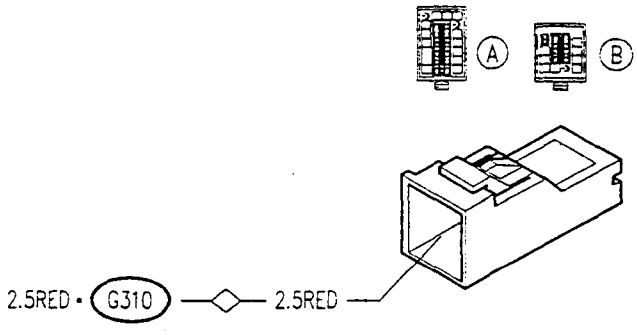
Fusebox	G1 G



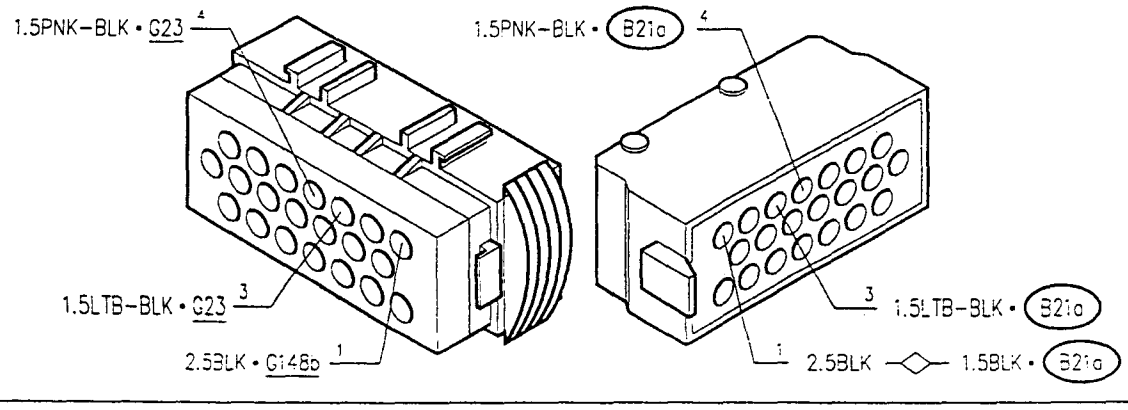
Fusebox	G1 H



Fusebox	G1 Q

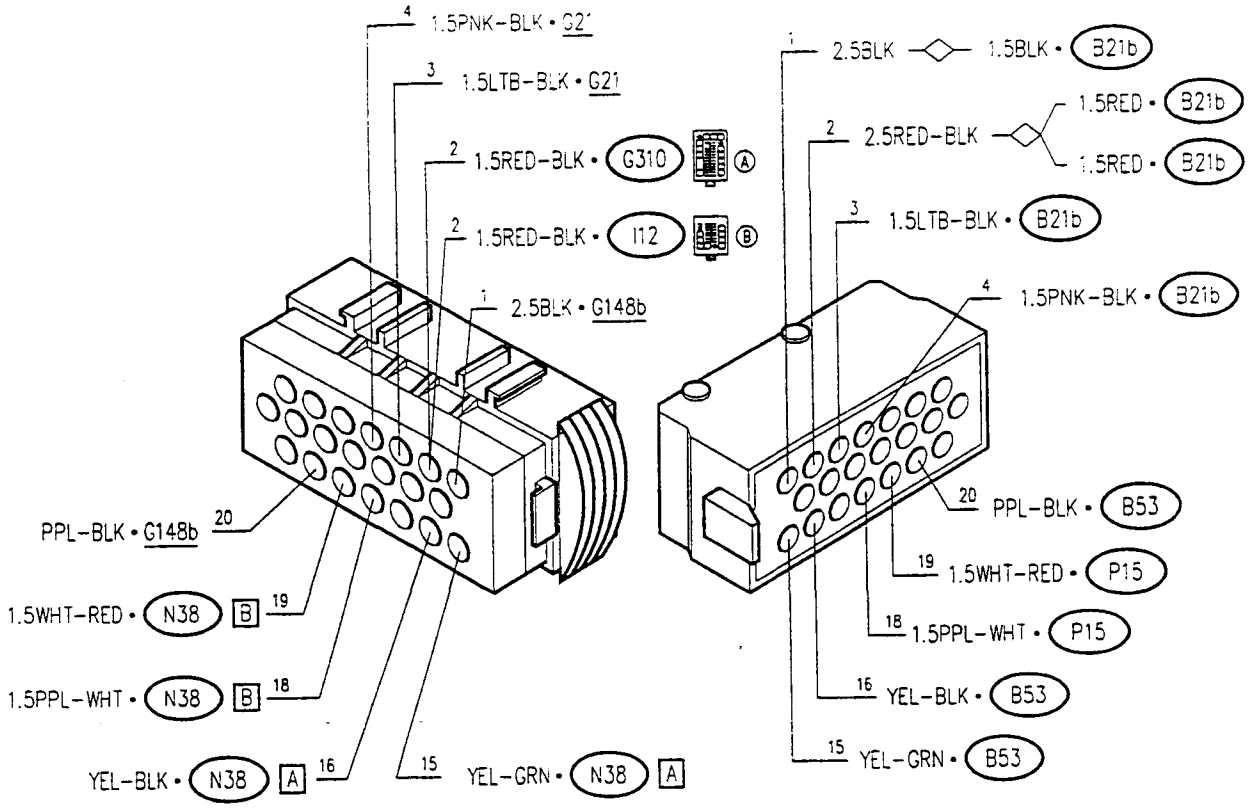


RH front door wiring connector	G21

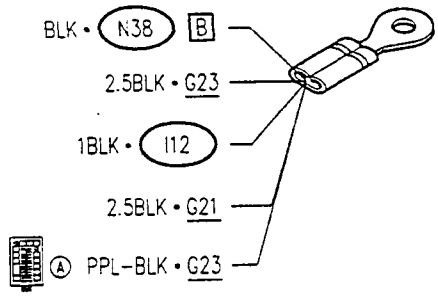


Components and Connectors (cont.d)

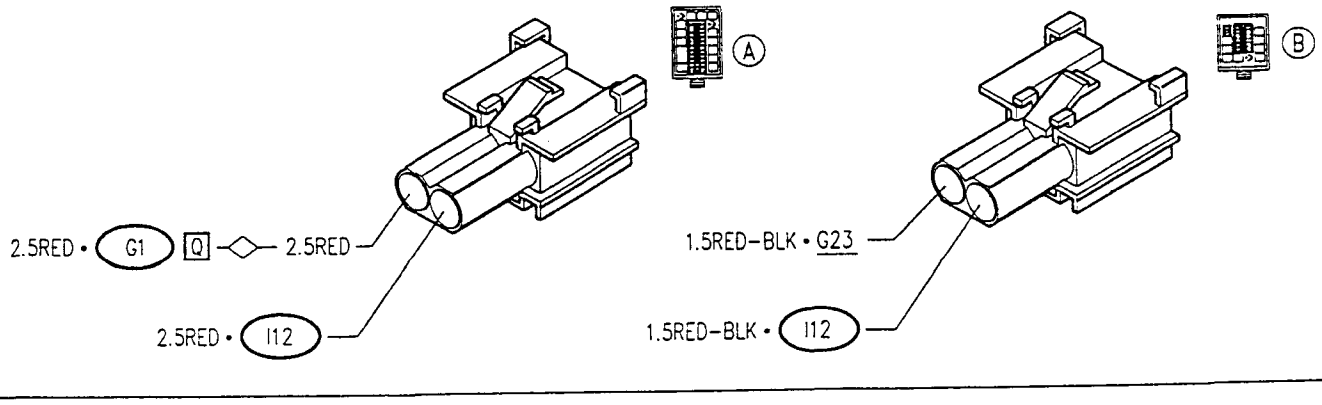
LH front door wiring connector	G23



Earth under LH dashboard	G148b

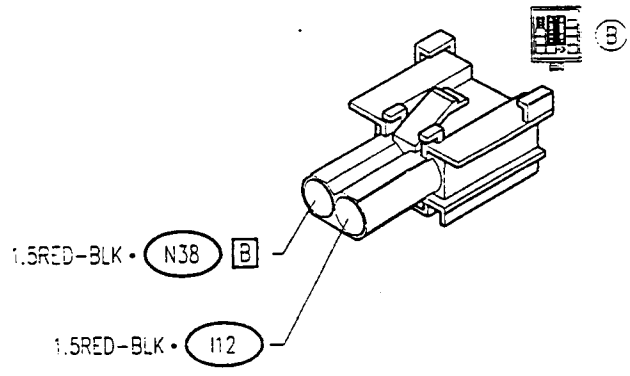


RH front power window fuse	G310

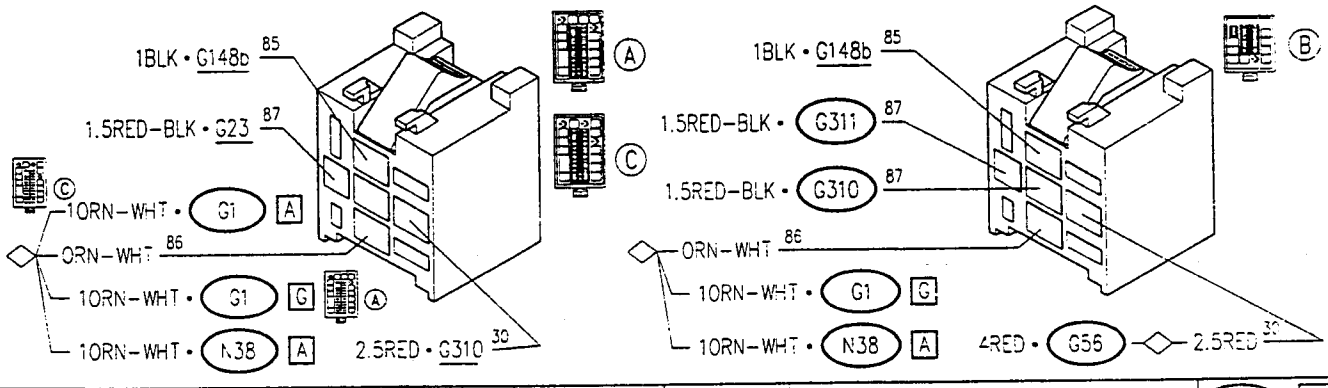


Components and Connectors (cont.d)

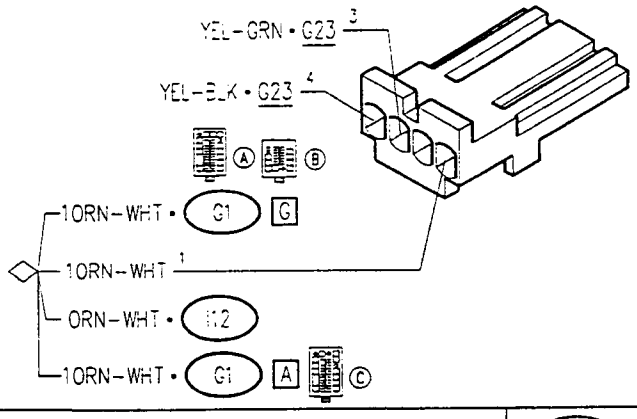
LH front power window fuse — G311



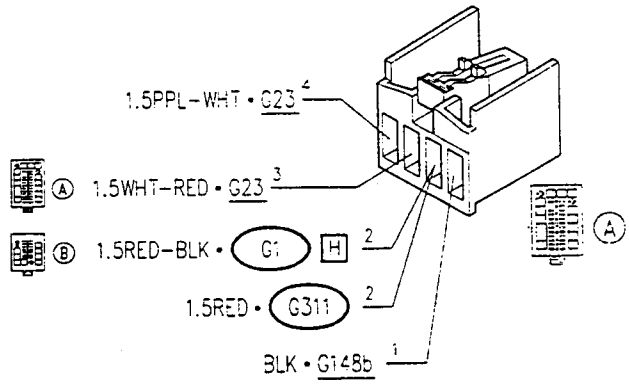
Front power window relay — I12



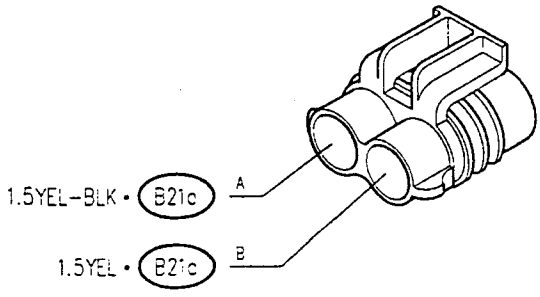
Power window control unit — N38 A



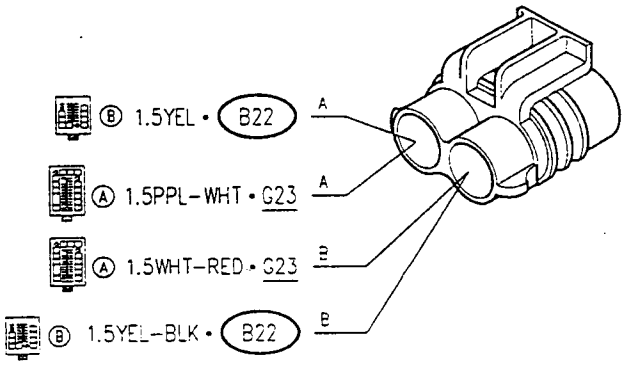
Power window control unit — N38 B



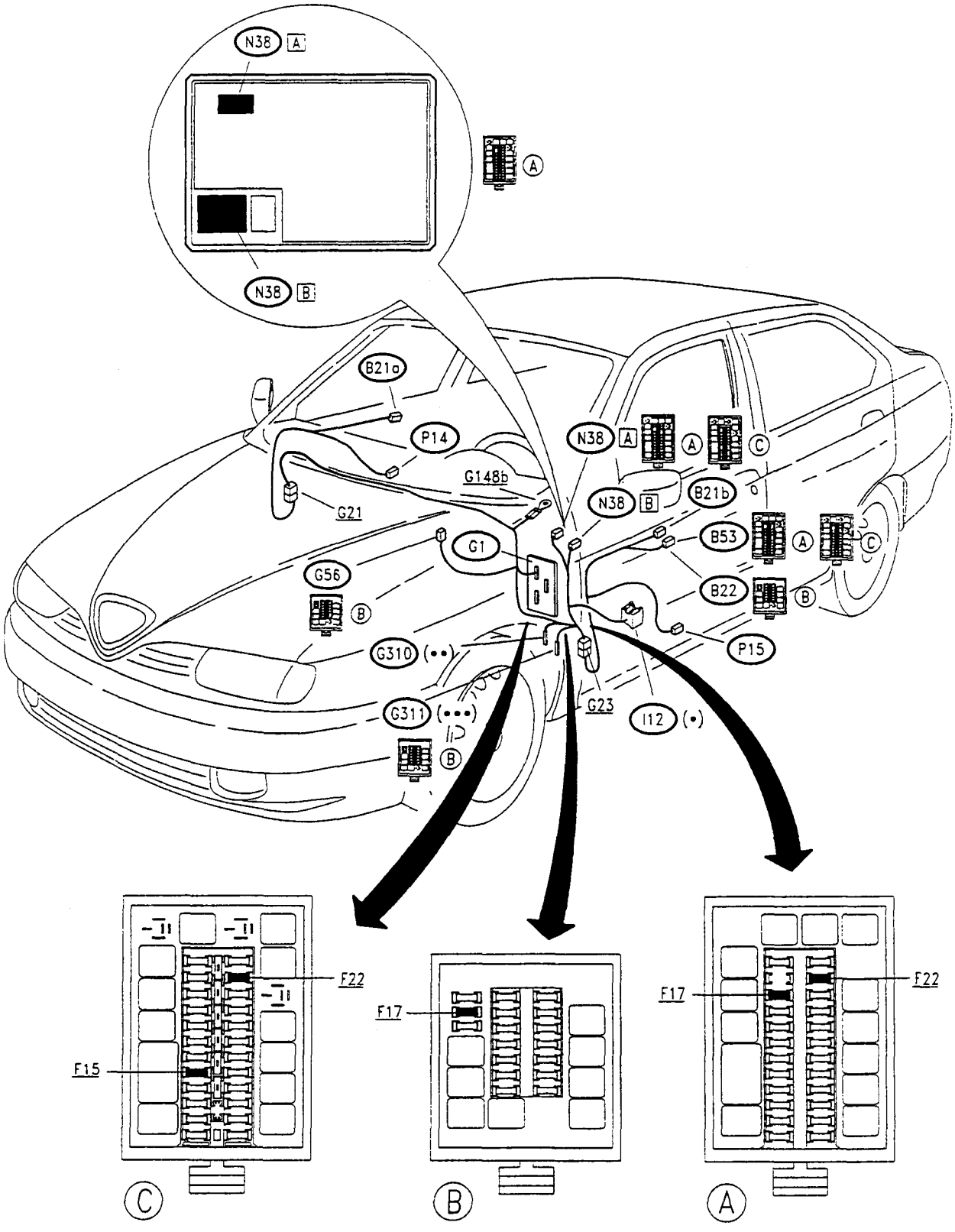
RH front power window motor — P14



LH front power window motor — P15

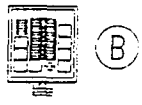


Location of Components





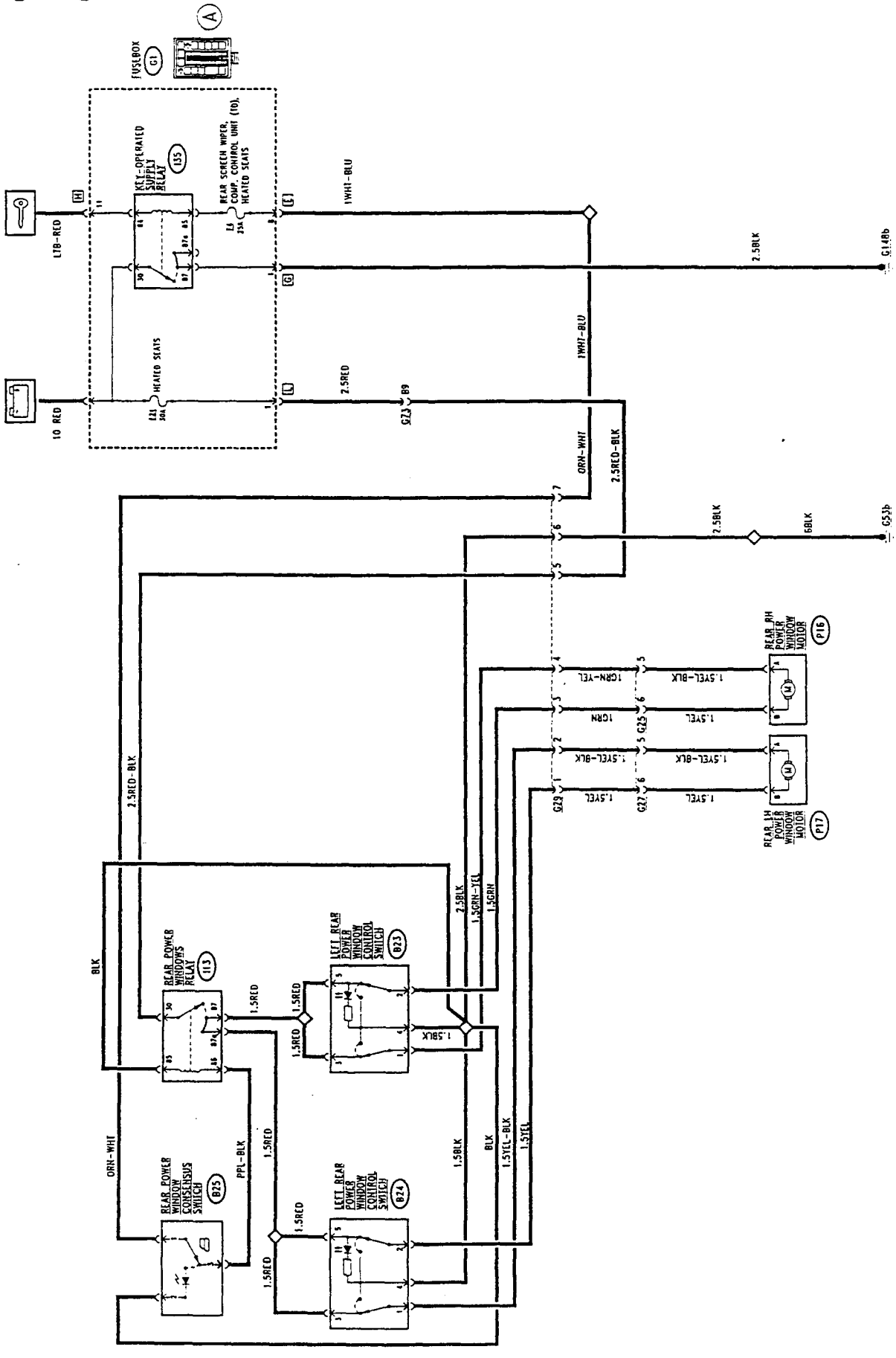
(•) black base
(••) green fuse holder



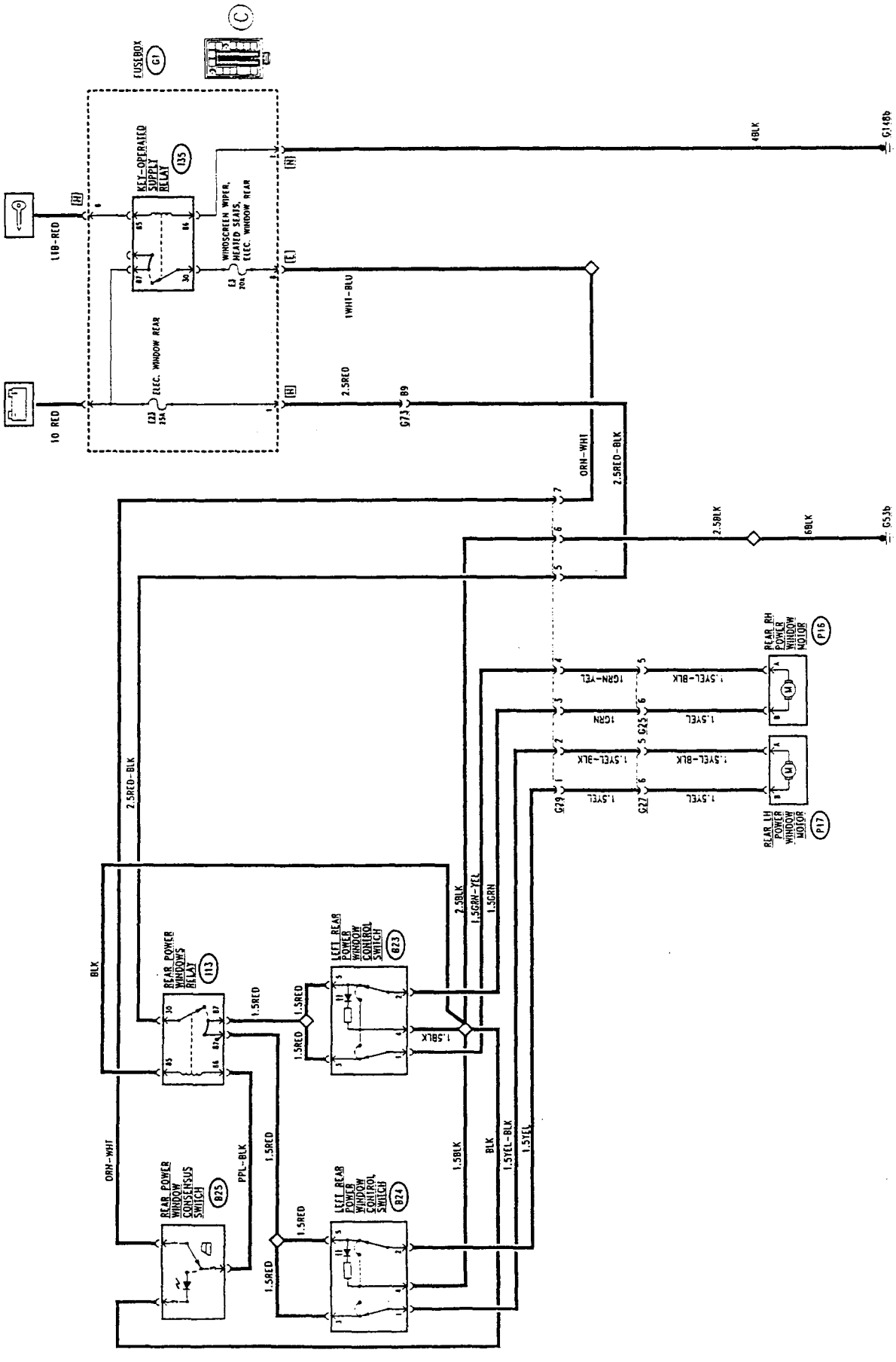
(•) yellow base
(••) white fuse holder
(•••) white fuse holder

REAR POWER WINDOWS

Wiring diagram



Wiring diagram



General Description

The electric mechanism that operates the rear windows is of the conventional type (button pressed - in one direction or the other - the window closes or opens): the control switch is located on the centre console and may also be operated from the front seats.

For safety reasons a special consensus switch, also on the centre console, makes it possible to cut off the supply to the switches.

Operation of the rear power windows is only possible with the ignition switch engaged.

Functional Description

The rear power window relay **I13** supplies and controls the entire system.

The relay coil is energised by a "key-operated" signal, leading from the ignition switch supply relay **I35** and from fuse **F4** of fusebox **G1** (box "A") or from fuse **F3** of box **G1** (box "C");

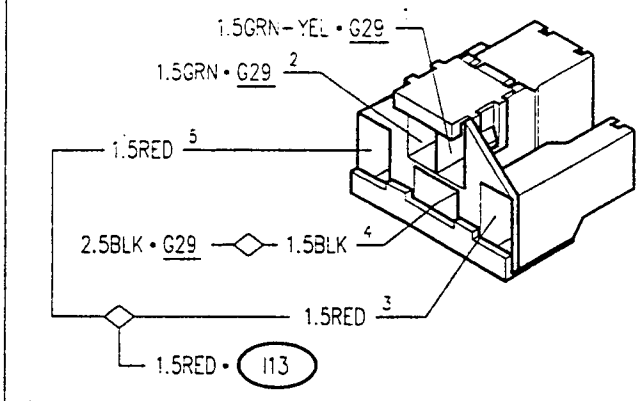
this supply crosses the safety switch for consensus for the rear power windows **B25**: if pressed, this switch de- energises the coil of **I13**, completely cutting off the supply to the circuit, and contemporaneously turning on a led which lights up the ideogram.

Once the coil of relay **I13** is energised, switches **B23** and **B24** are supplied with battery voltage which leads through the rear power window fuse **F21** of fusebox **G1** (box "A") or through fuse **F23** of **G1** (box "C").

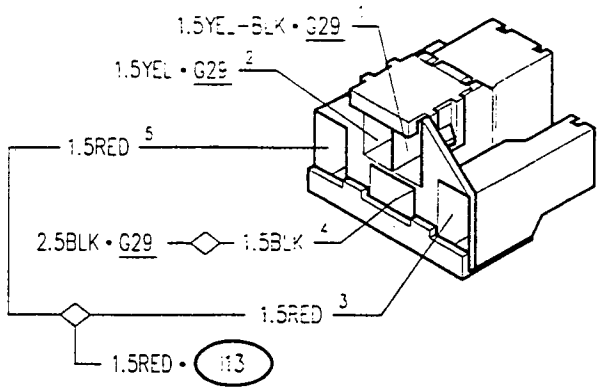
The double switches supply the motors **P16** and **P17**, sending a supply and an earth, inverting the signals depending on the contact that has been closed, thereby establishing the direction of rotation of the motor.

Components and Connectors

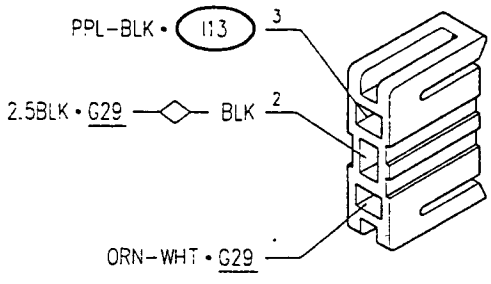
RH rear power window control switch	B23



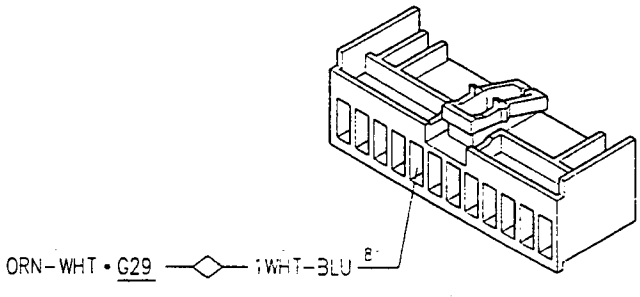
LH rear power window control switch	B24



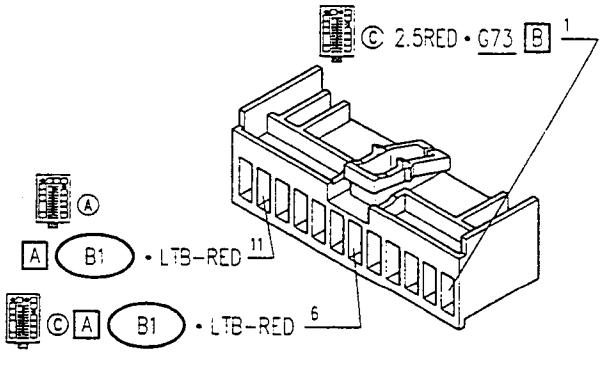
Rear power window consensus switch	B25



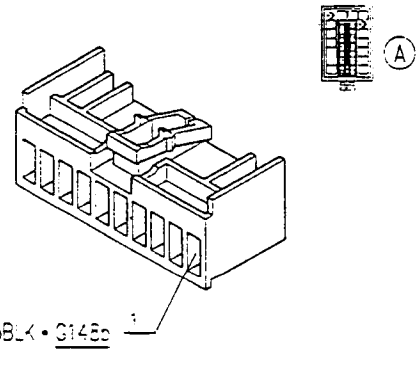
Fusebox	G1	E



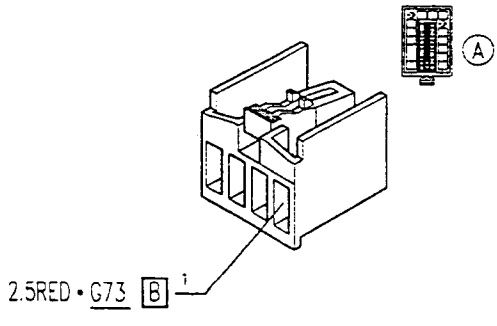
Fusebox	G1	H



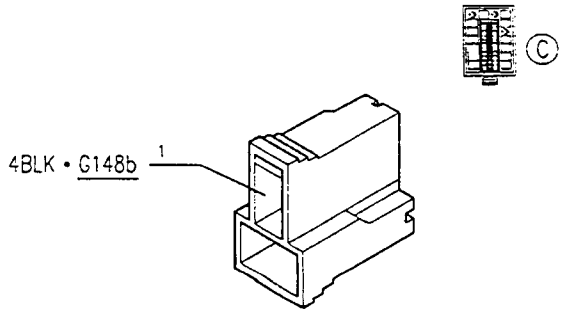
Fusebox	G1	G



Fusebox	G1	L

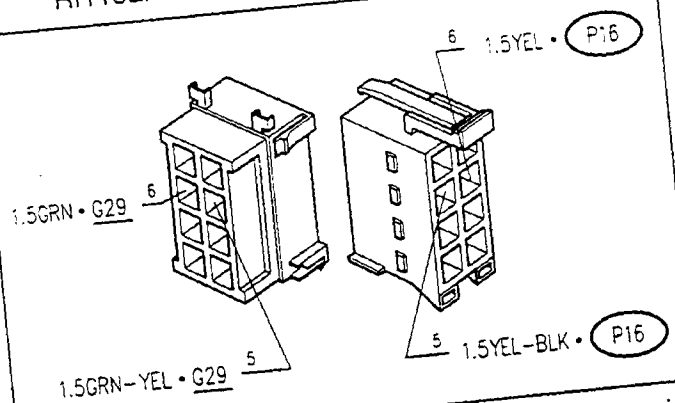


Fusebox	G1	N

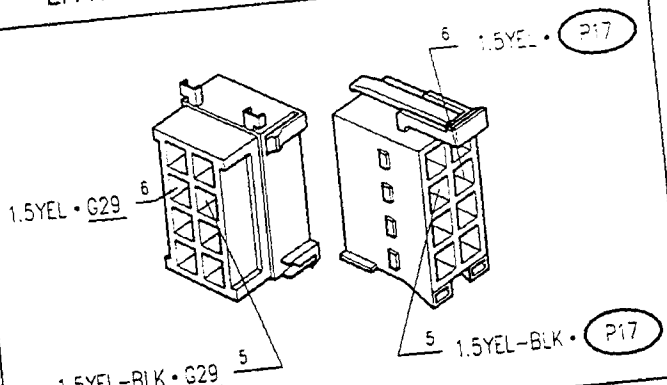


Components and Connectors (cont.d)

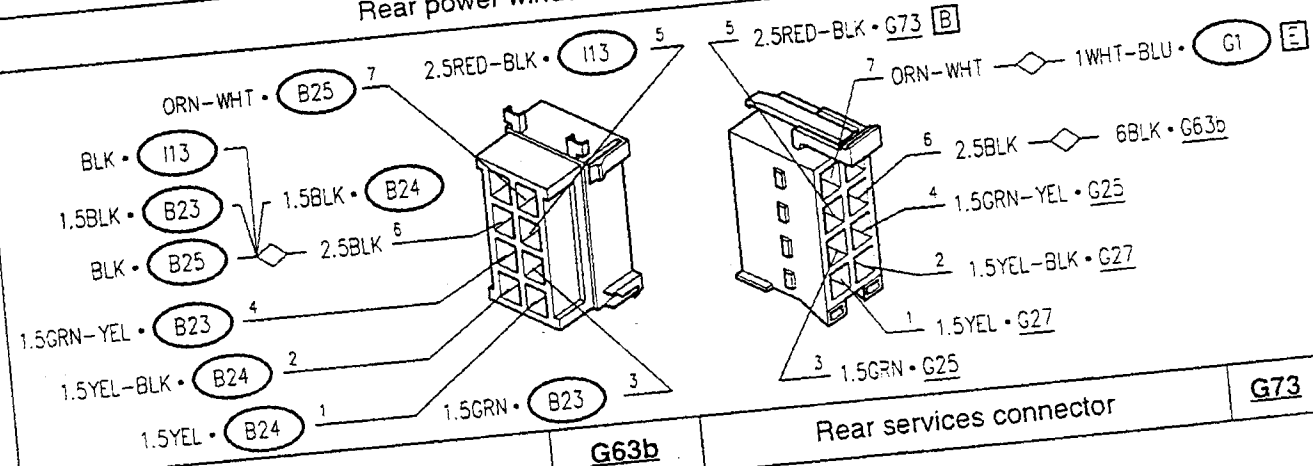
RH rear door wiring connector — G25



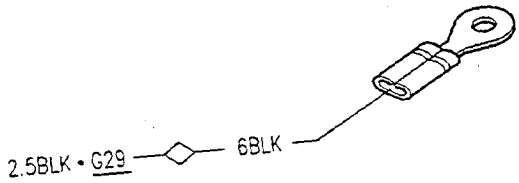
LH rear door wiring connector — G27



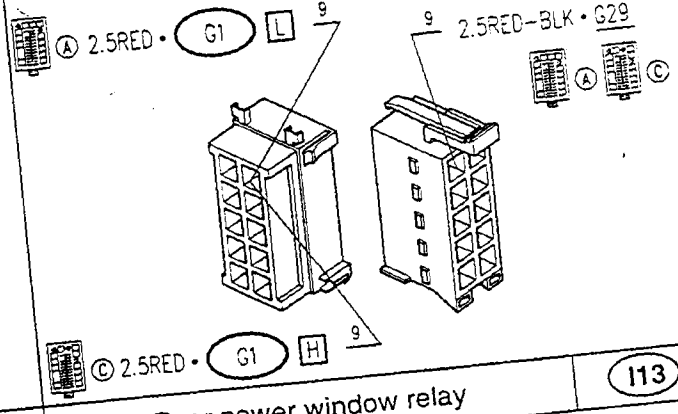
Rear power window wiring connector — G29



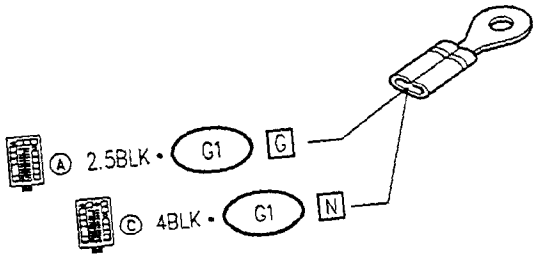
LH rear earth — G63b



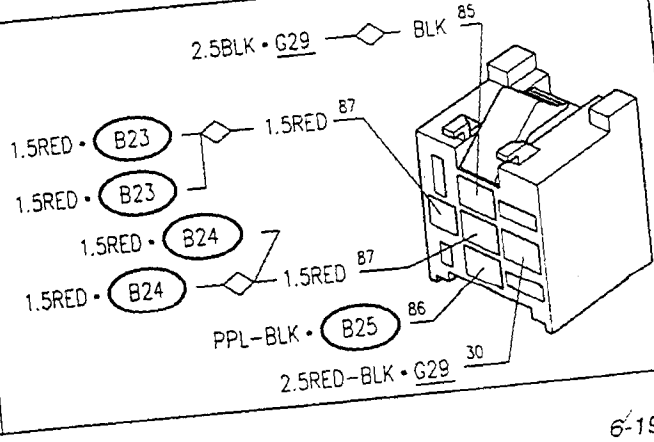
Rear services connector — G73 B



Earth under LH dasboard — G148b



Rear power window relay — I13

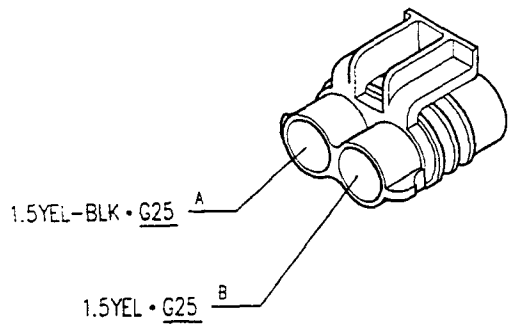


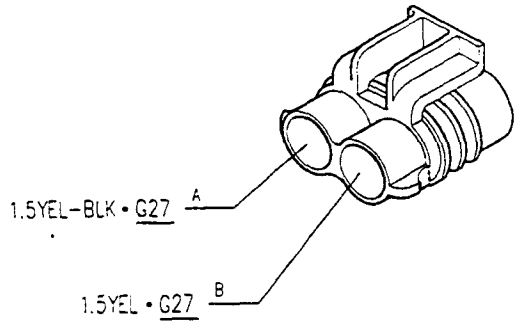
6-19

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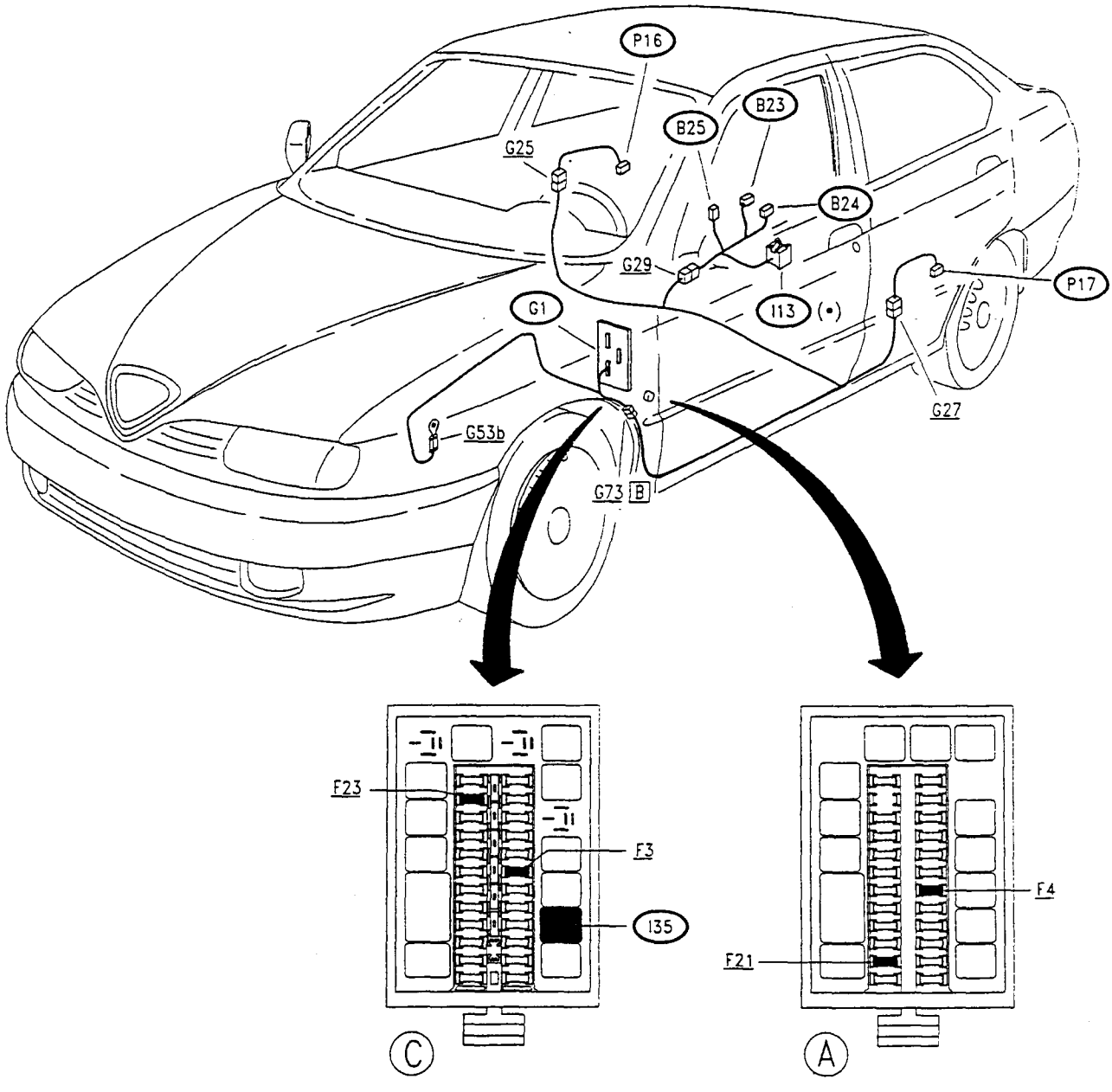
Components and Connectors (cont.d)

RH rear power window motor	P16	LH rear power window motor	P17





Location of Components



(•) grey base

FAULT-FINDING TABLE

Fault	Component to be checked											
	G311 (B)	G310	F17	F22 (A)	P14	P15	N38 (A)	B21a	B21b	I12	B53 (A)	B22 (B)
LH front power window, in all circumstances	•		•	•		•	•			•	•	•
LH front power window, automatic operation				•			•					
RH front power window		•	•		•			•		•		

(cont.d)

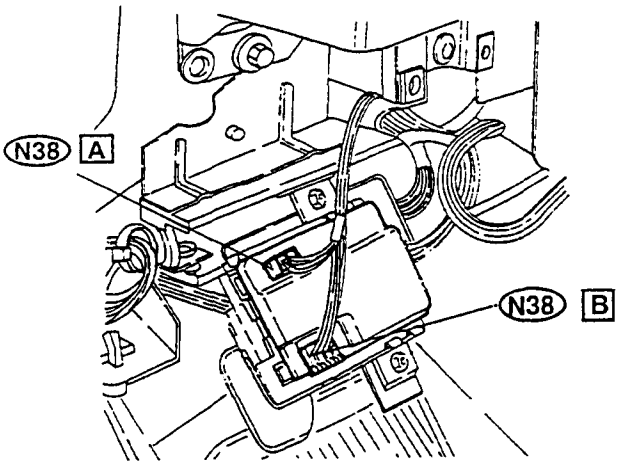
(A) Versions with fusebox "A"

(B) Versions with fusebox "B"

Fault	Component to be checked							
	F21	F4	P17	P16	B24	B23	I13	B25
Both rear power windows	•	•					•	•
LH rear power window			•		•			
RH rear power window				•		•		

CHECKING COMPONENTS

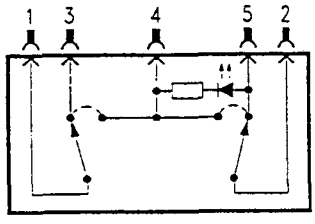
Power window control unit (N38)



Check device:

test A (only for fusebox "A")

Power window switches (B21a) (B21b) (B22) (B23) (B24)



SPECIFICATIONS
Check operation: **at rest**: continuity between pin 3 and 1 and between pin 2 and 5, a.c. between the other pins operating pushbutton for **closing**: continuity between pin 4 and 1; a.c. between the other pins operating pushbutton for **opening**: continuity between pin 4 and 2, a.c. between the other pins

CHECK POWER WINDOW CONTROL UNIT (N38) (version for fusebox "A")	TEST A

Work with the component fitted on its connector, from the cable inlet side

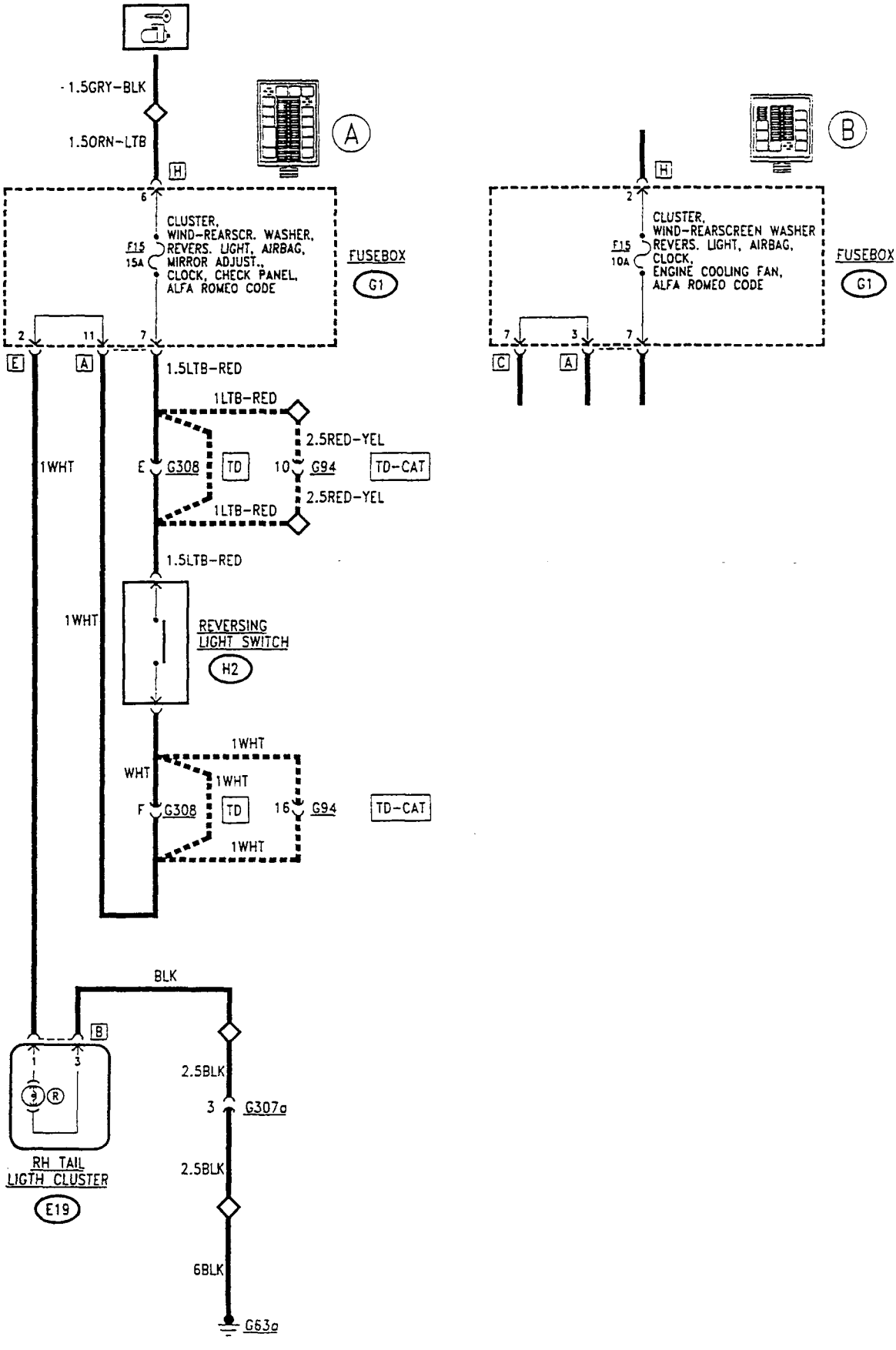
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Check for 12V between pin 2 and 1 of connector B of **N38**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Check fuse **F22** of fusebox **G1**. Restore the wiring between **N38 B** and **G1** and between **N38 B** and earth **G148b**
A2 CHECK VOLTAGE – With the key at MARCIA, check for 12V between pin 1 of connector B and pin 1 of connector A of **N38**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Check fuse **F17** of **G1**. Restore the wiring between **N38 A** and **G1**
A3 CHECK MANUAL OPERATION – Operating the driver's side front power window switch **B53**, check for 12V between pin 3 and 4 of connector B of **N38**; this voltage ceases when operation of the button stops	OK ▶ ~~OK~~ ▶	Carry out **step A5** Carry out **step A4**
A4 CHECK MANUAL OPERATION – Operating switch **B53**, check for a voltage of 12V between pins 3 and 4 of connector A of **N38**	OK ▶ ~~OK~~ ▶	Change device **N38** Restore the wiring between **N38 A** and switch **B53**, or change the latter
A5 CHECK AUTOMATIC OPERATION – With the key at MARCIA, operating switch **B53** check for: • 12V d.c. between pins 3 and 4 of connector B if the button is pressed for less than 300 ms • no voltage if the button is pressed for less than 50 ms • 12V d.c. between pins 3 and 4 of connector B keeping the button pressed	OK ▶ ~~OK~~ ▶	DEVICE **N38** IS WORKING PROPERLY. Check the connections with the other components Change device **N38**

REVERSING LIGHTS

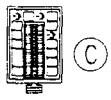
INDEX

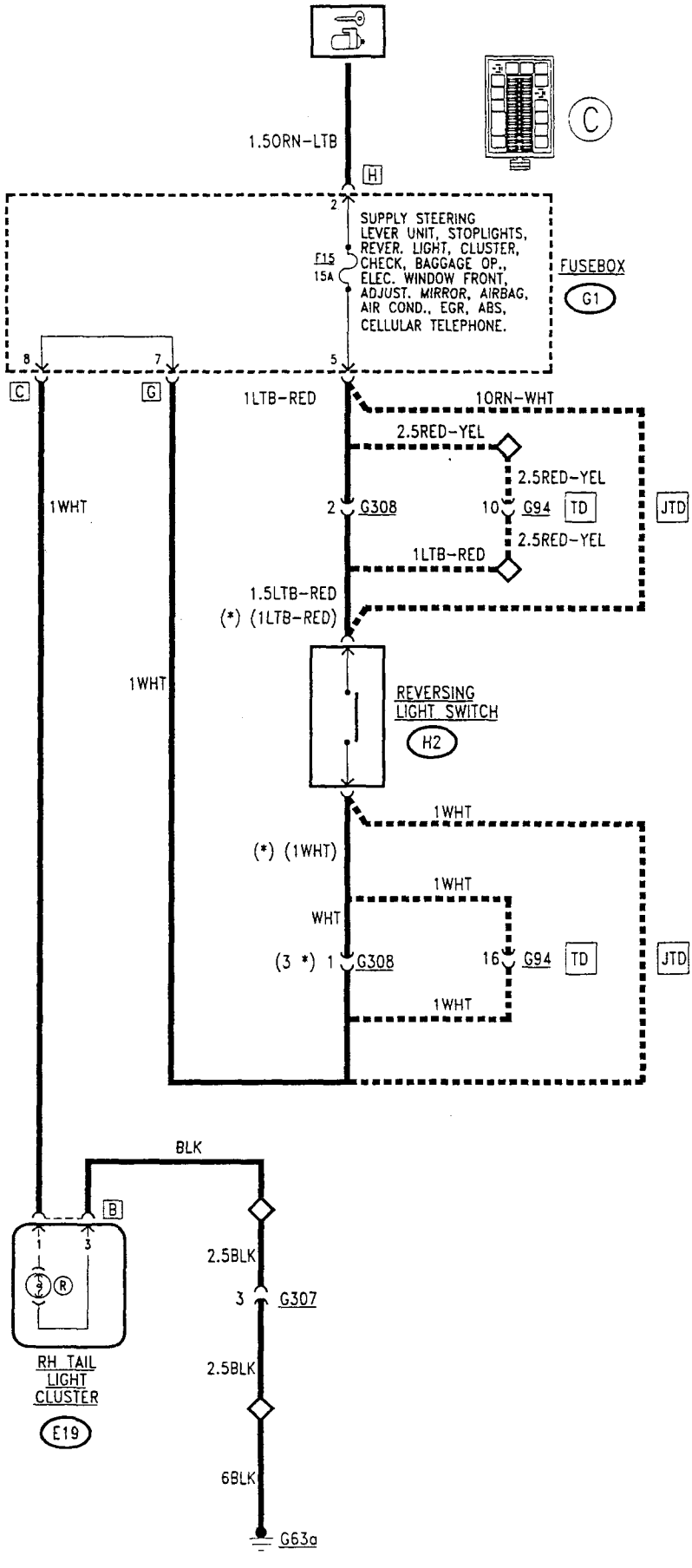
WIRING DIAGRAM 14-2
GENERAL DESCRIPTION 14-3
FUNCTIONAL DESCRIPTION 14-3
COMPONENTS AND CONNECTORS 14-3
FAULTFINDING TABLE 14-5
LOCATION OF COMPONENTS 14-6

WIRING DIAGRAM



WIRING DIAGRAM





(*) from Model Year '98

GENERAL DESCRIPTION

The car is fitted with a reversing light located in the right-hand tail light.

When reverse gear is selected, the light is turned on automatically by a switch to be found on the gearbox.

The circuit is protected by a special fuse.

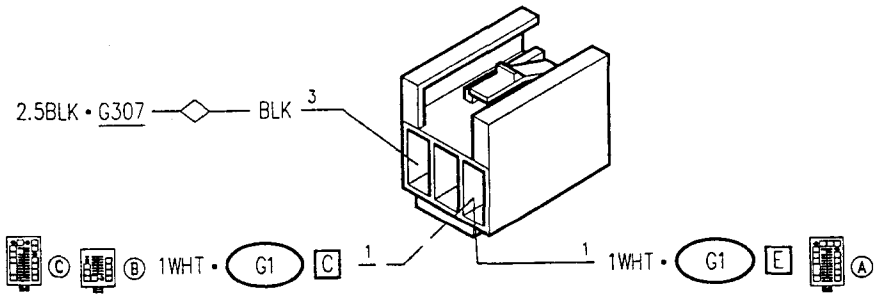
The reversing light is operated when the ignition key is engaged and it is independent of the other lights on the vehicle.

FUNCTIONAL DESCRIPTION

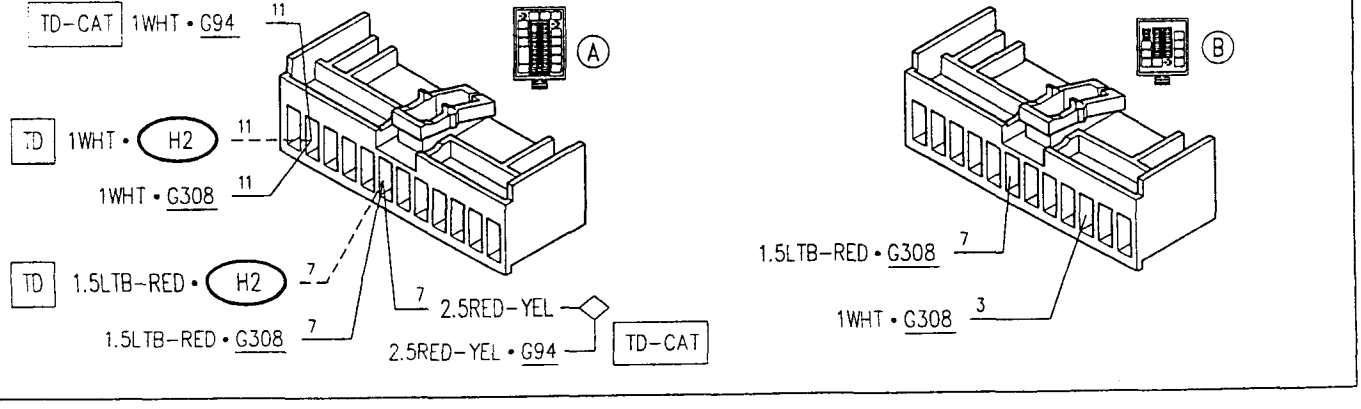
The reversing light circuit is supplied from the ignition switch through fuse **F15** of fusebox **G1**.
When reverse gear is engaged switch **H2** supplies the reversing light **E19.**

COMPONENTS AND CONNECTORS

RH tail light cluster — E19 B

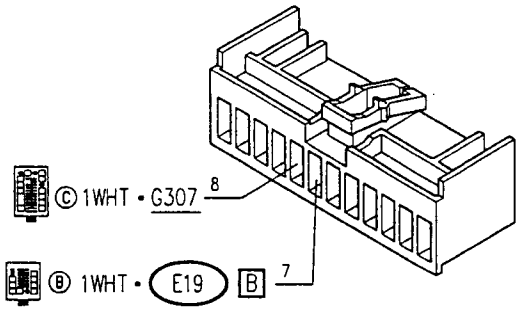


Fusebox — G1 A

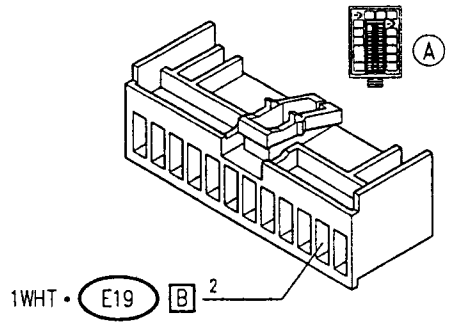


COMPONENTS AND CONNECTORS (cont.d)

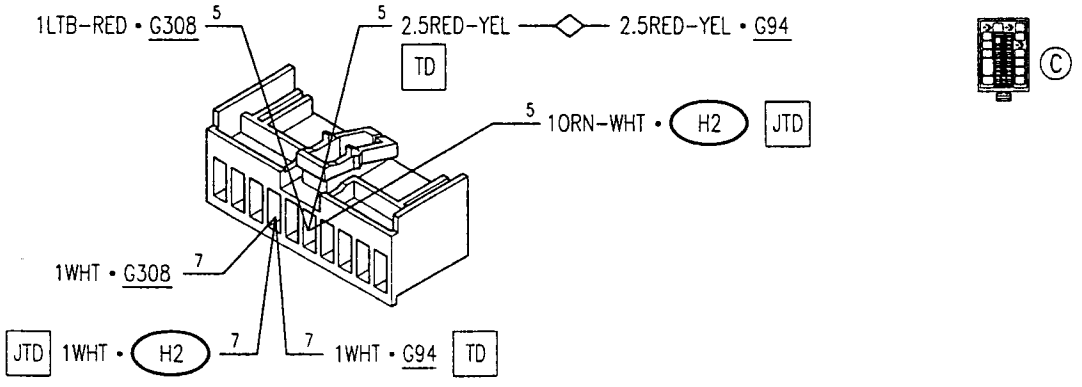
Fusebox	G1 C



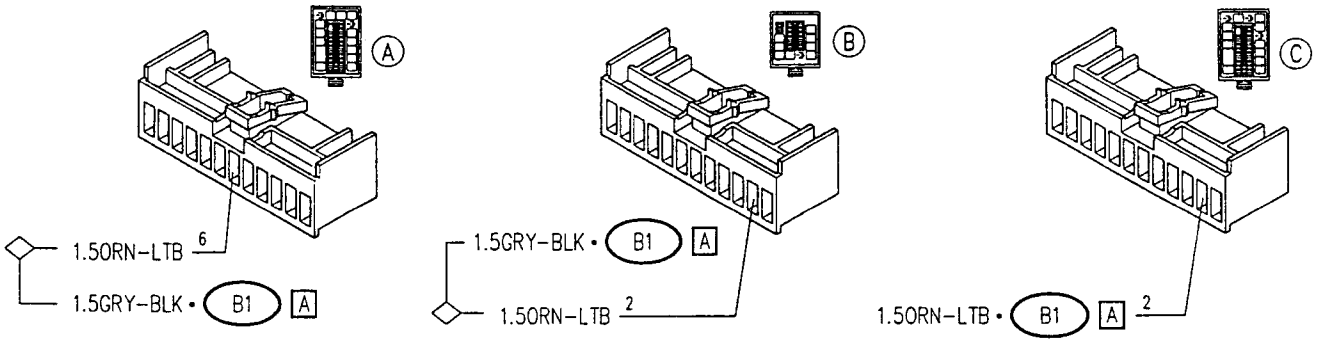
Fusebox	G1 E



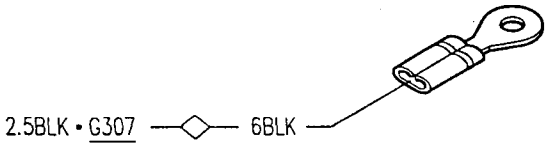
Fusebox	G1 G



	G1 H



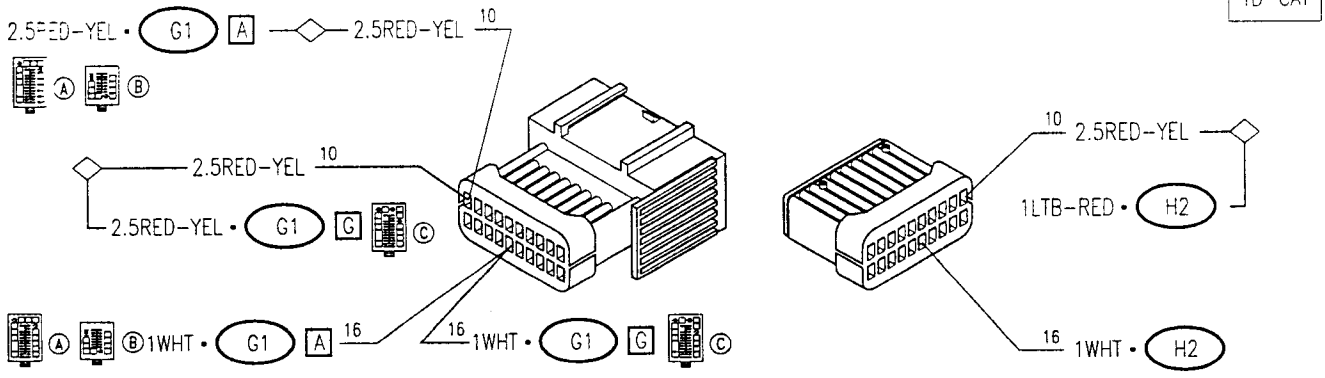
RH rear earth	G63a



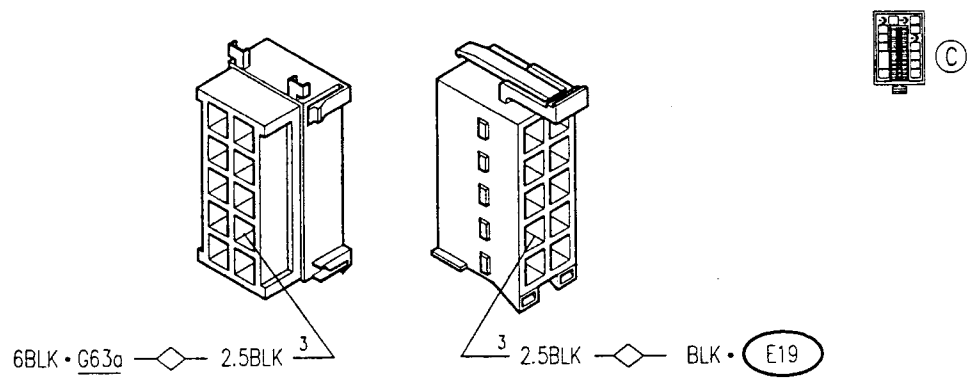
COMPONENTS AND CONNECTORS (cont.d)

Engine compartment connection	G94

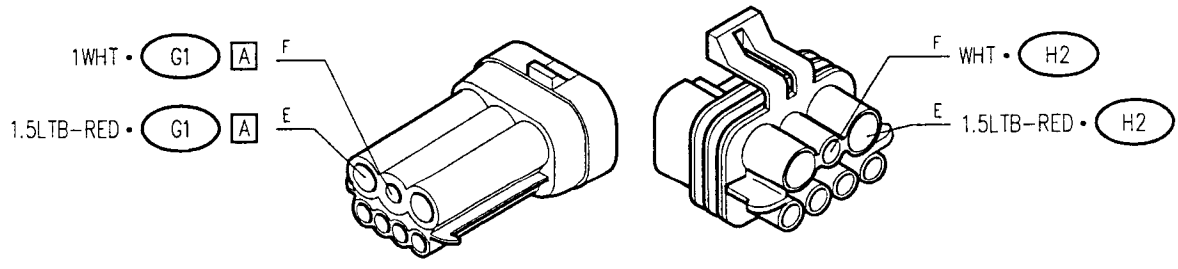
TD-CAT



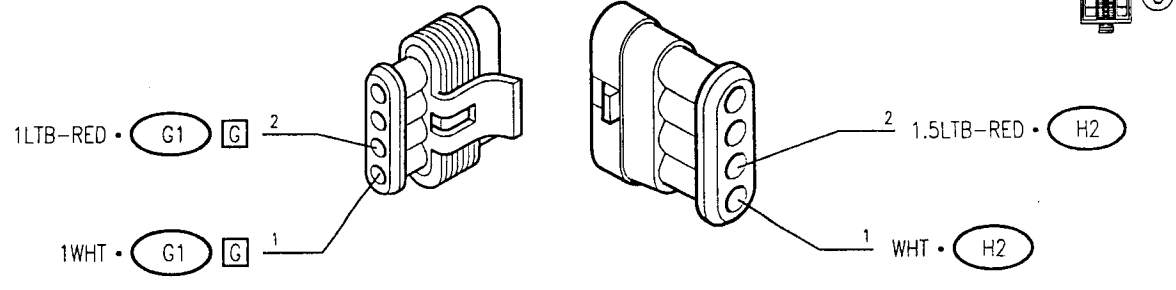
Connector for rear wiring/luggage compartment wiring	G307



Engine sensors connector (*)	G308



Engine sensors connector (•)	G308

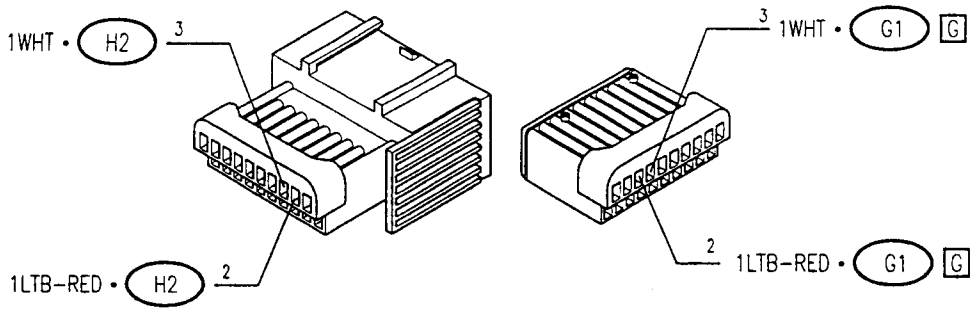


(*) up to chassis no.____
PA493000000009

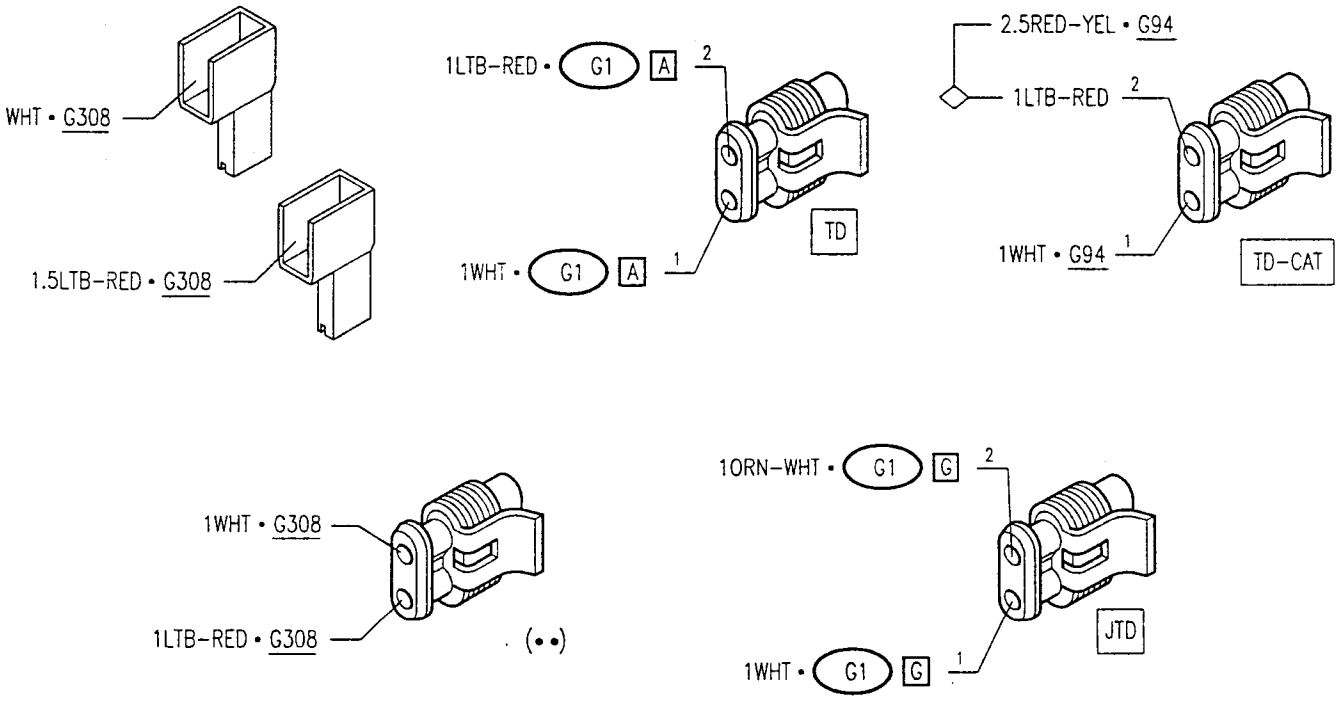
(•) up to M.Y. '97

COMPONENTS AND CONNECTORS (cont.d)

Engine sensors connector (••) — G308



Reversing light switch — H2

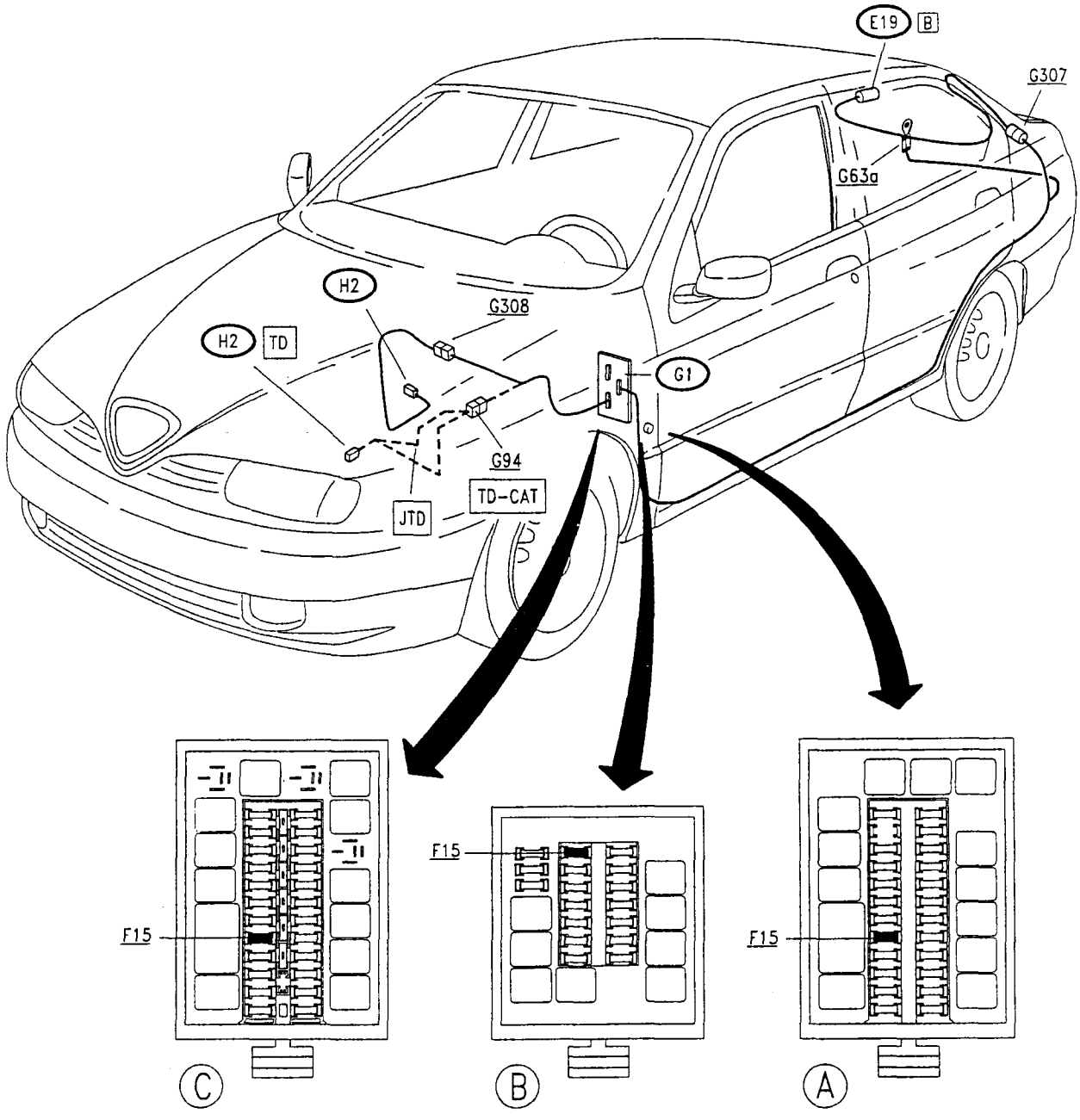


(••) from M.Y. '98

FAULTFINDING TABLE

Failure	Component to be checked		
	F15	E19	H2
Reversing light	•	•	•

LOCATION OF COMPONENTS

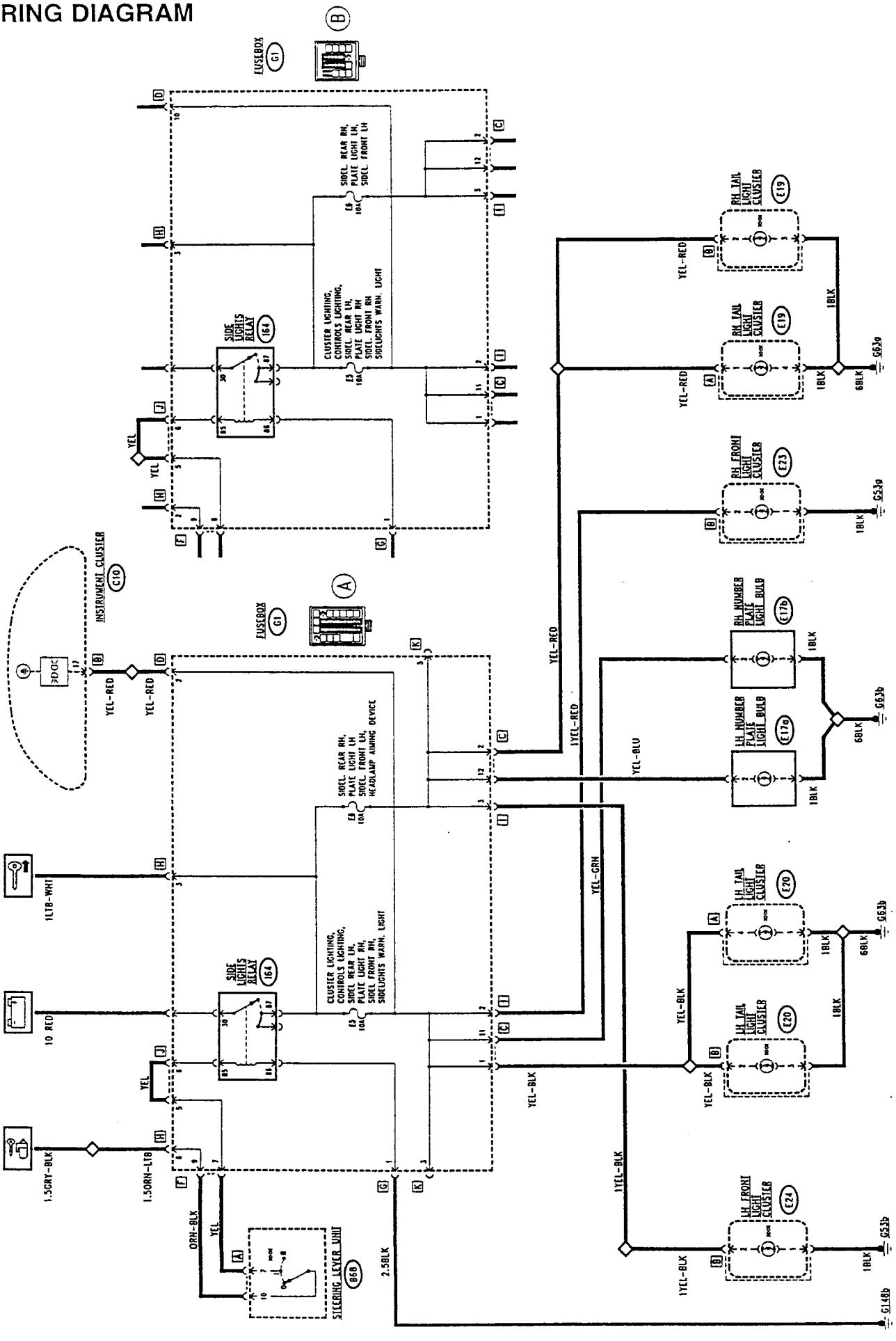


SIDE LIGHTS

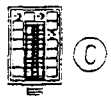
INDEX

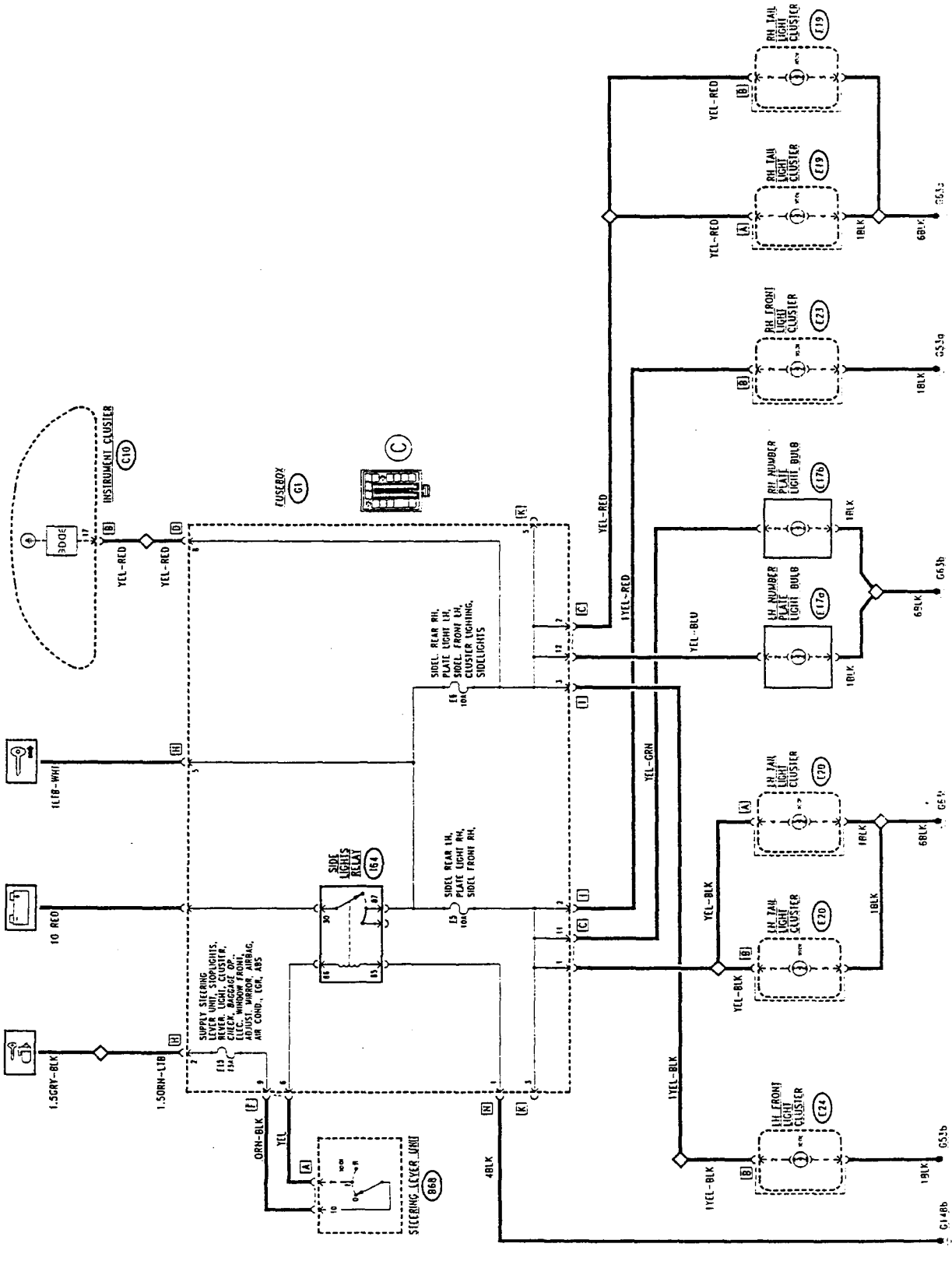
WIRING DIAGRAM 5-2
GENERAL DESCRIPTION 5-3
FUNCTIONAL DESCRIPTION 5-3
COMPONENTS AND CONNECTORS 5-3
LOCATION OF COMPONENTS 5-7
FAULTFINDING TABLE 5-8

WIRING DIAGRAM



WIRING DIAGRAM





GENERAL DESCRIPTION

The side lights are turned on when the switch on the lever unit is turned to the first position and only when the ignition key is engaged: this prevents the battery from discharging if the lights are inadvertently left on when leaving the car.
N.B.: They can also be turned on by slightly withdrawing the ignition key and turning it in the opposite direction holding down the special button: key in the "PARKING" position (see also "Power supply").
When the side lights are turned on, the number plate lights and numerous interior lights for lighting the passenger compartment, instruments and controls are also turned on (see "Controls lighting").
A warning light on the instrument panel indicates that the side lights are on.
For safety reasons the circuit is protected by two "crossed" fuses: one for the right front and left rear lights etc., the other for the left front and right rear lights, etc..

FUNCTIONAL DESCRIPTION

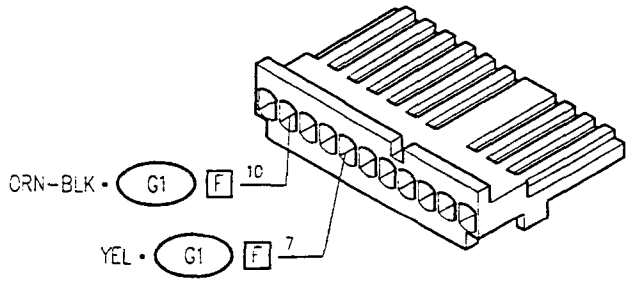
The side lights circuit is activated by the corresponding relay switch **I64** located in fusebox **G1**.

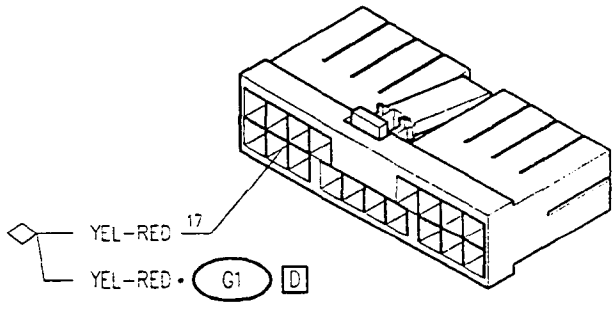
Moving the switch on the lever unit **B68** to position "I" and when the ignition key is engaged the coil of relay switch **I64** is supplied thereby closing the circuit that supplies the side lights; this circuit is protected by two fuses of box **G1** (box "A" and "B") and by a third fuse still in box G1 "C"; **F5** for the right front and left rear lights, **F6** for the front left and rear right and fuse **F16** - only box "C" - for protecting the services of the steering column lever unit **B68**. This way the front sidelights **E23** (right) and **E24** (left, the rear ones **E19** (right) and **E20** (left) and the number plate lights **E17a** and **E17b**.
The supply line of fuse **F5** - boxes "A" and "B" or of fuse **F6** - box "C" - also sends a signal to the instrument cluster **C10** to turn on the corresponding warning light.
When the ignition key is at the "PARKING" position all the side lights are turned on as a direct supply is sent to fuses **F5** and **F6** in fusebox **G1**, "by-passing" relay switch **I64**.

NOTE: Turning the side lights on also supplies numerous other circuits with "consent" signals (e.g. circuits that operate only when the side lights are on) or by supply lines in the real sense of the term (for example by illuminating the ideograms of the various buttons and controls...).The former are described and illustrated in the diagrams relating to the components to which they refer and the latter in the "Controls lighting" section.

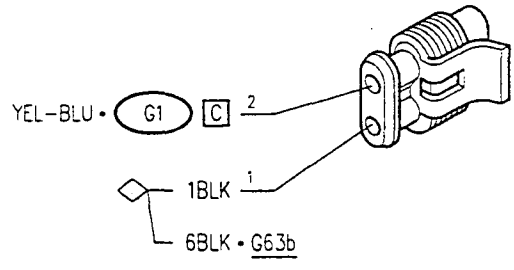
COMPONENTS AND CONNECTORS

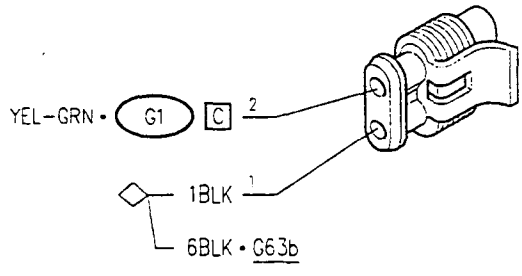
Lever unit	B68 A	Instrument cluster	C10 B





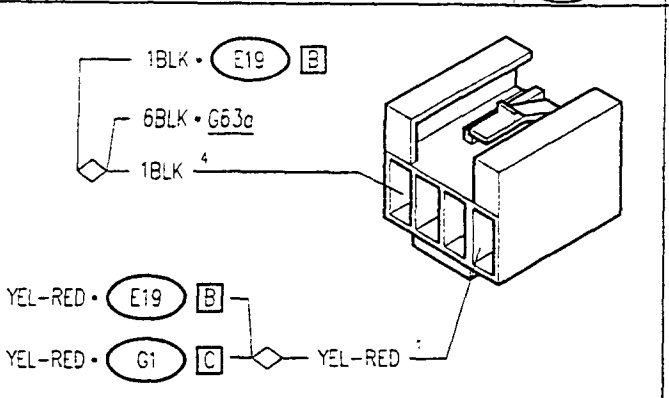
LH number plate light	E17a	RH number plate light	E17b



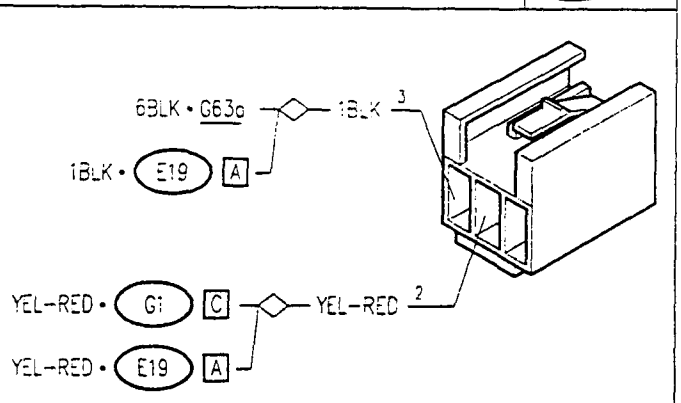


COMPONENTS AND CONNECTORS (cont.d)

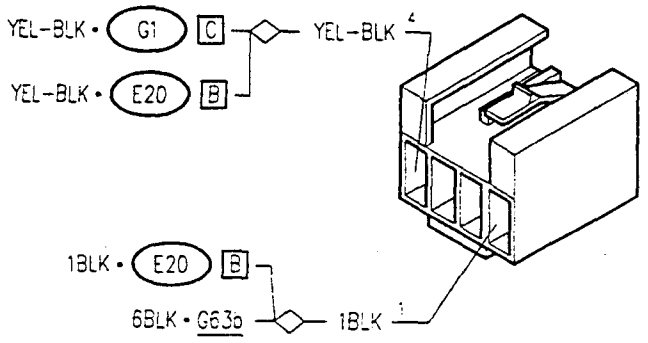
RH tail light cluster	E19 A



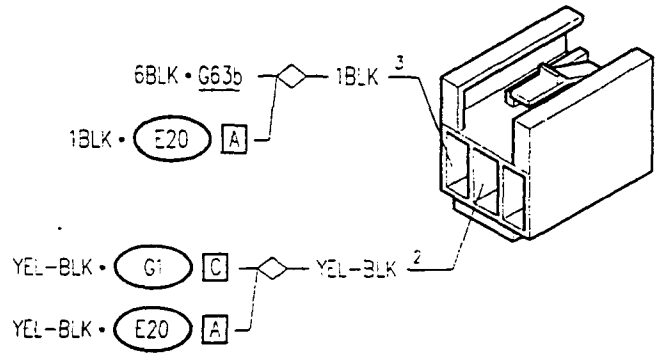
RH tail light cluster	E19 B



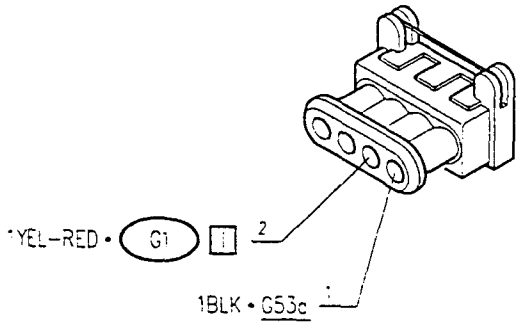
LH tail light cluster	E20 A



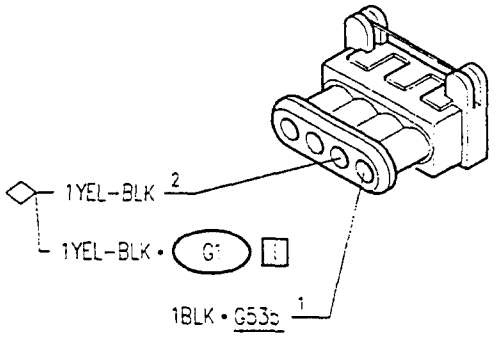
LH tail light cluster	E20 B



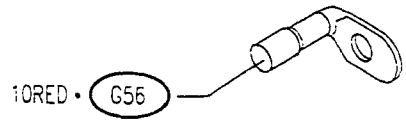
RH front light cluster	E23 B



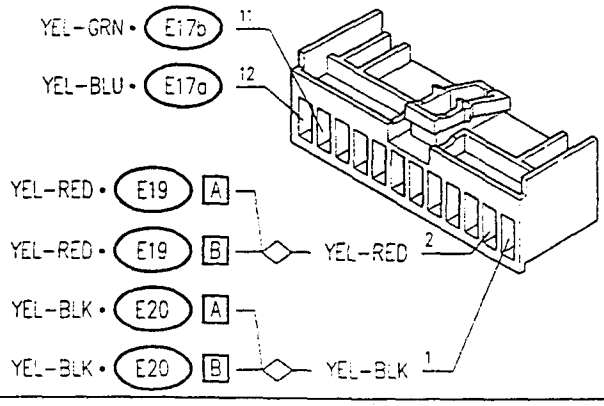
LH front light cluster	E24 B



Fusebox	G1

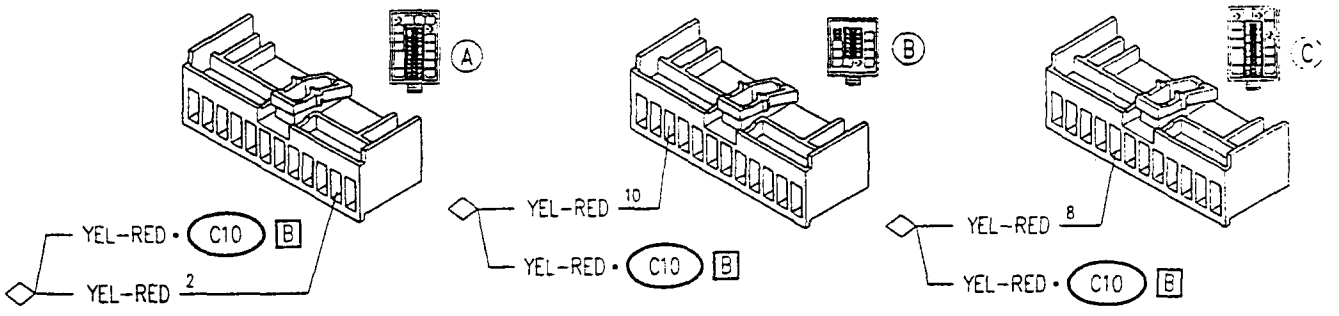


Fusebox	G1 C

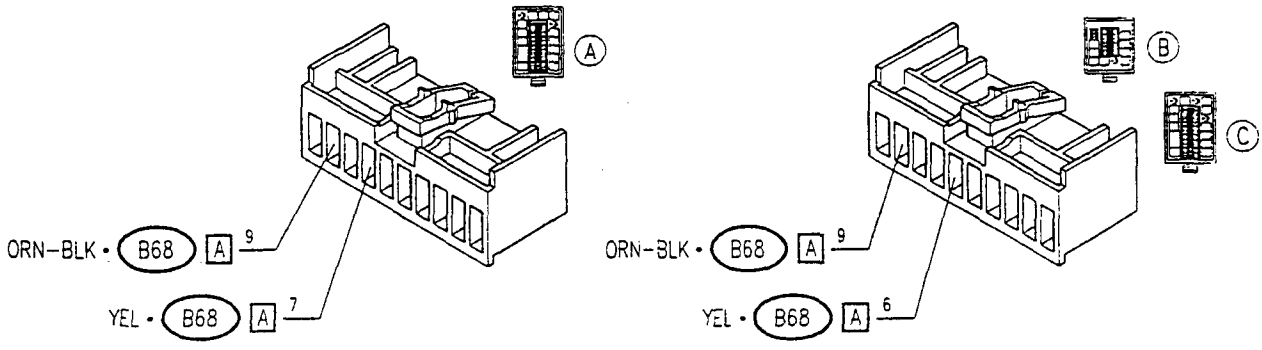


COMPONENTS AND CONNECTORS (cont.d)

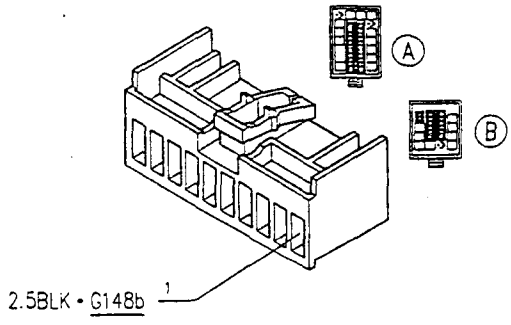
Fusebox — G1 D



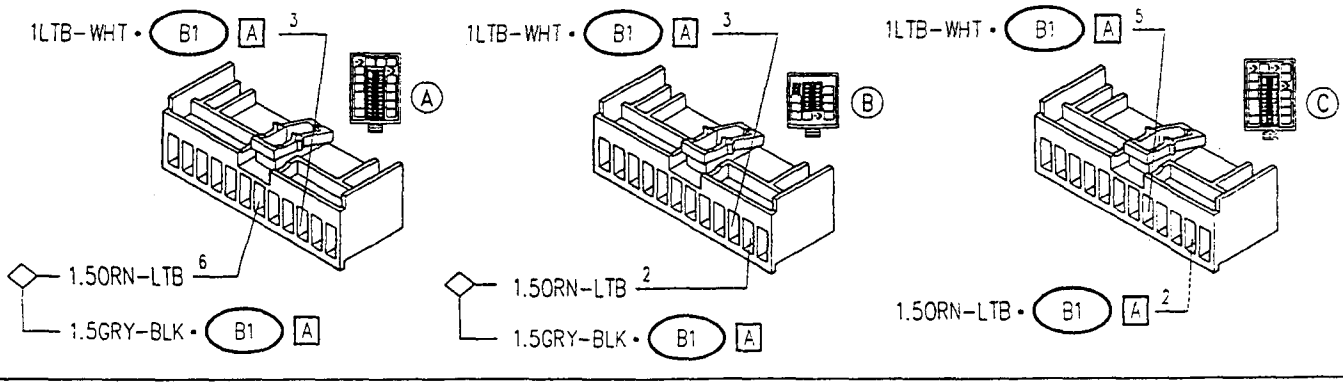
Fusebox — G1 F



Fusebox — G1 G

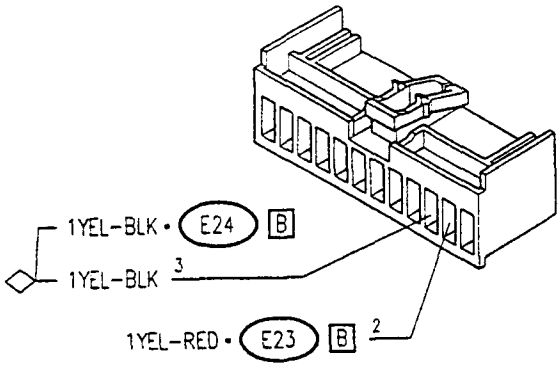


Fusebox — G1 H

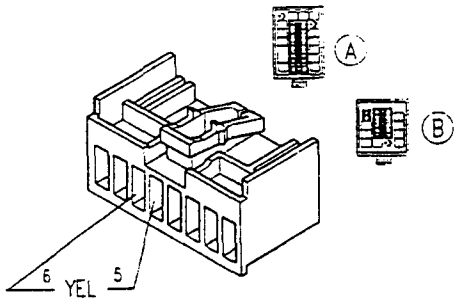


COMPONENTS AND CONNECTORS (cont.d)

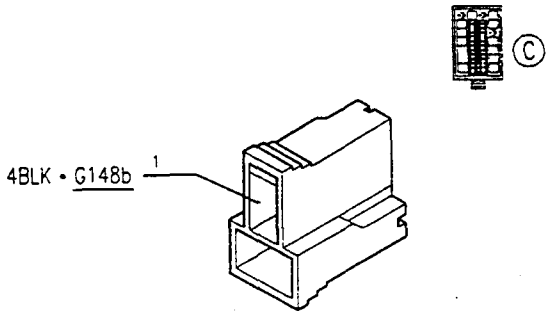
Fusebox	G1 I



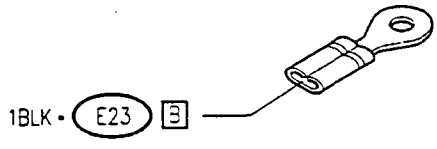
Fusebox	G1 J



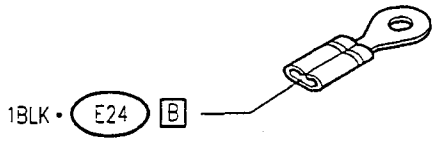
Fusebox	G1 N



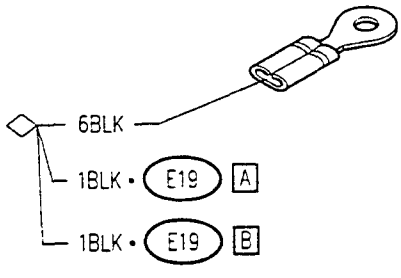
RH engine compartment earth	G53a



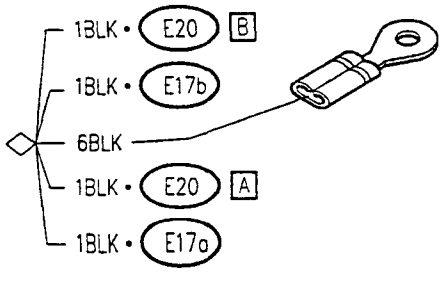
Left hand engine compartment earth	G53b



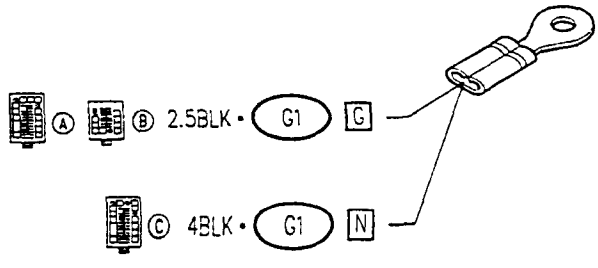
RH rear earth	G63a



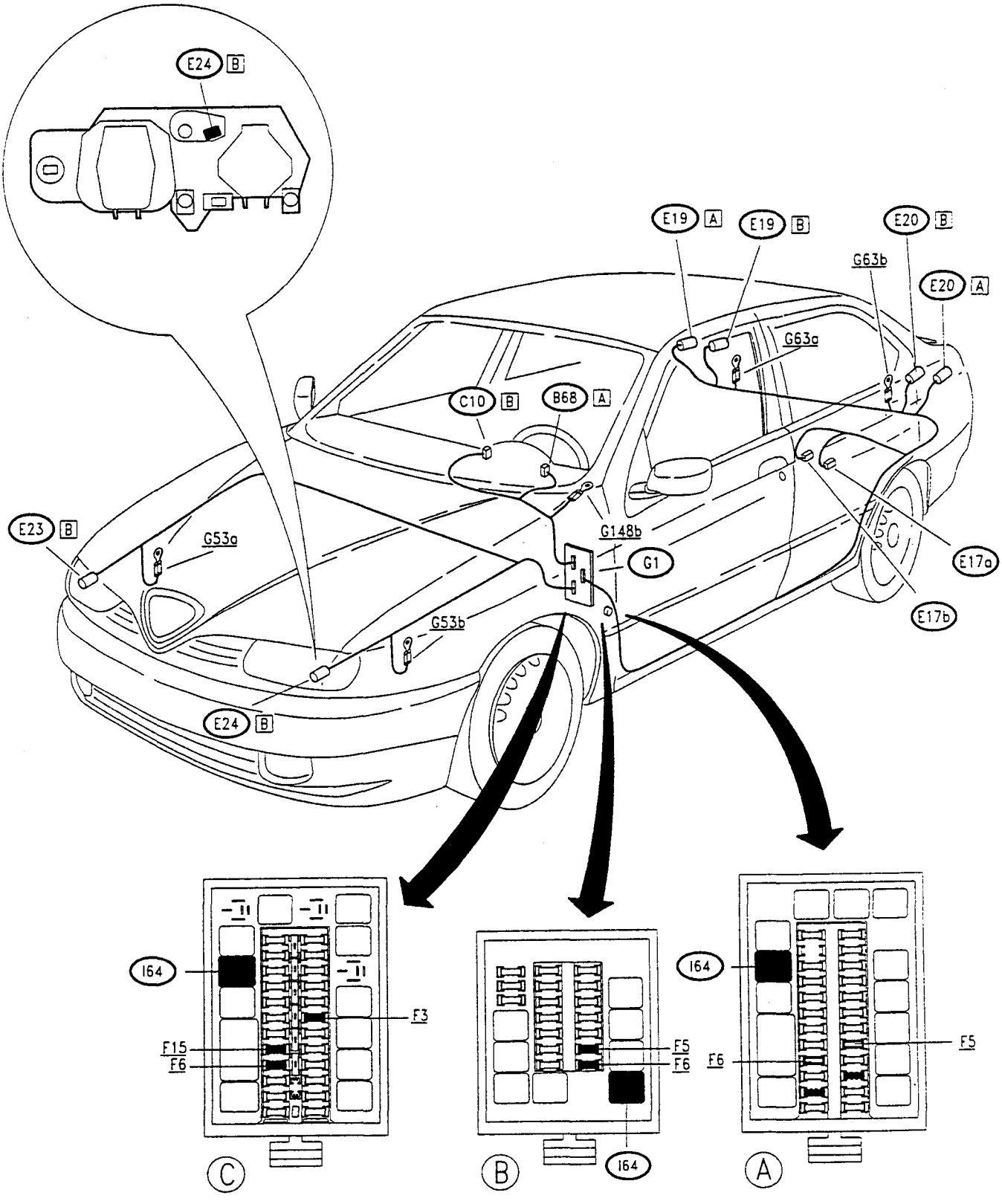
LH rear earth	G63b



LH earth under dashboard	G148b



LOCATION OF COMPONENTS



FAULTFINDING TABLE

Failure	Component to be checked										
	F5	F6	E23	E24	E19	E20	E17a	E17b	I64	B68	C10 (*)
All the side lights									•	•	
Front right	•		•								
Front left		•		•							
Right rear (two lamps)		•			•						
Left rear (two lamps)	•					•					
Right number plate	•							•			
Left number plate		•					•				
Side lights warning light	•										•

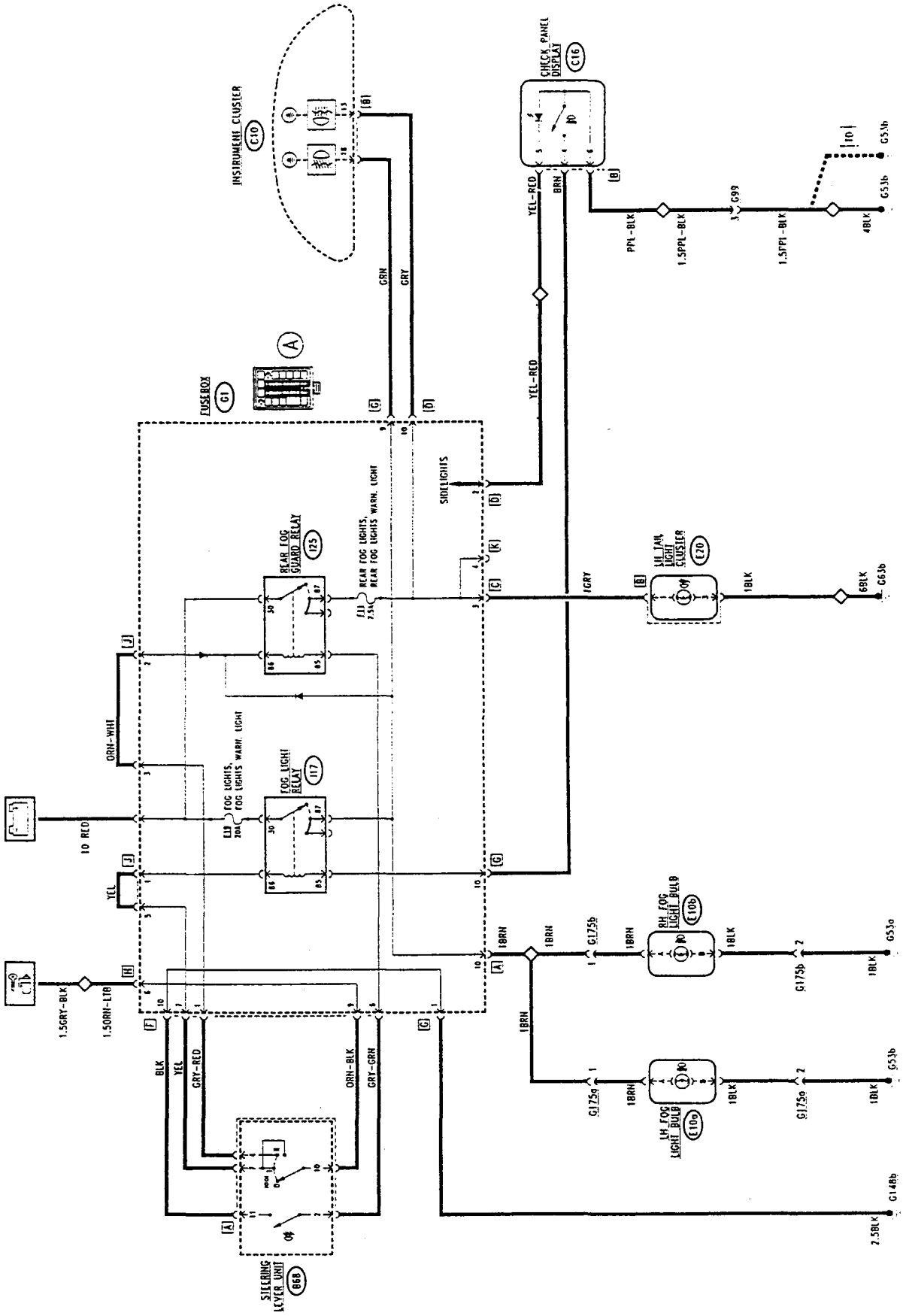
(*) The instrument cluster **C10** cannot be repaired. Therefore, in the event of a failure it is not possible to change the single warning light and a new complete cluster must be fitted.

FOG LIGHTS AND REAR FOG GUARDS

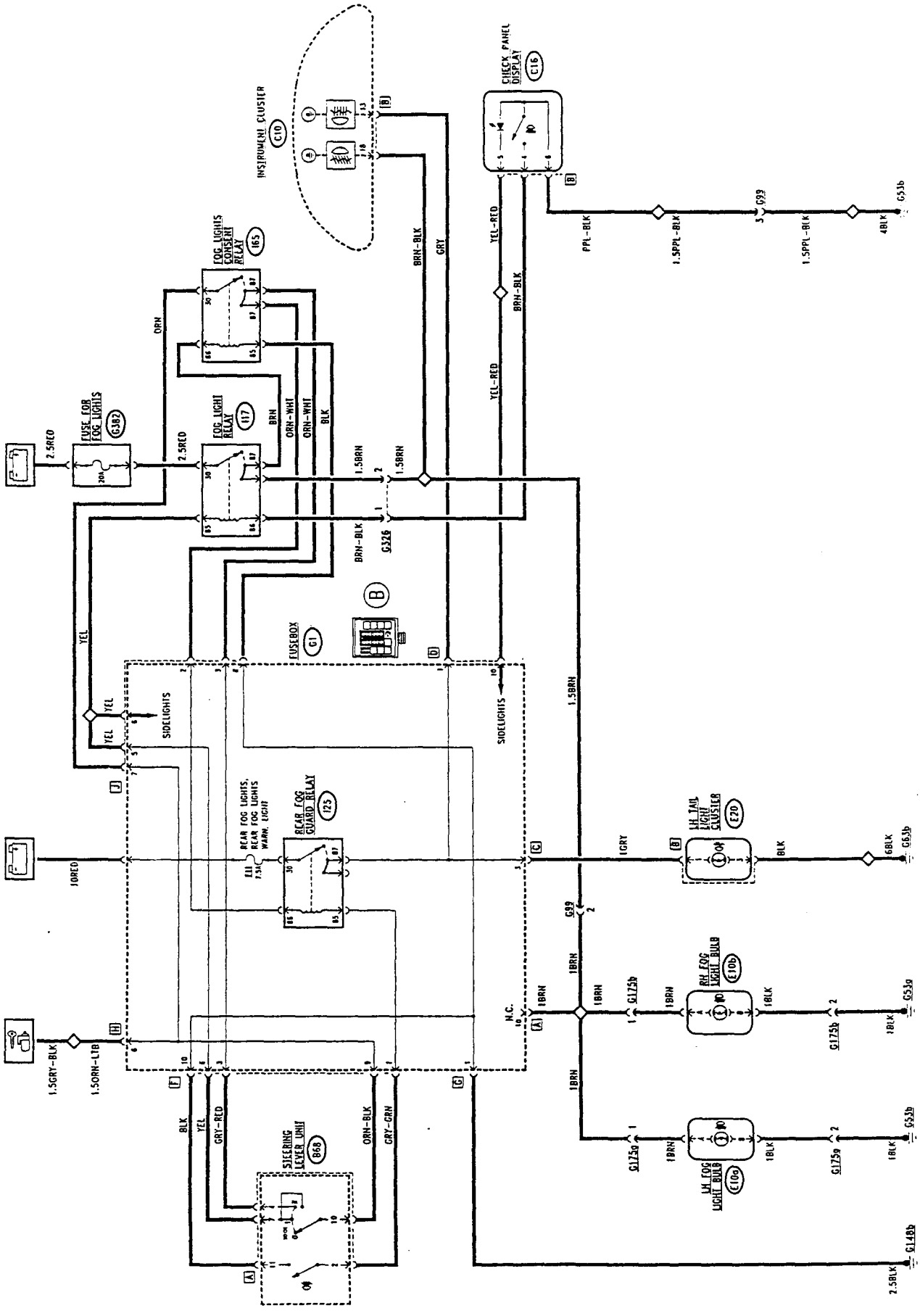
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FAULTFINDING TABLE 8-11
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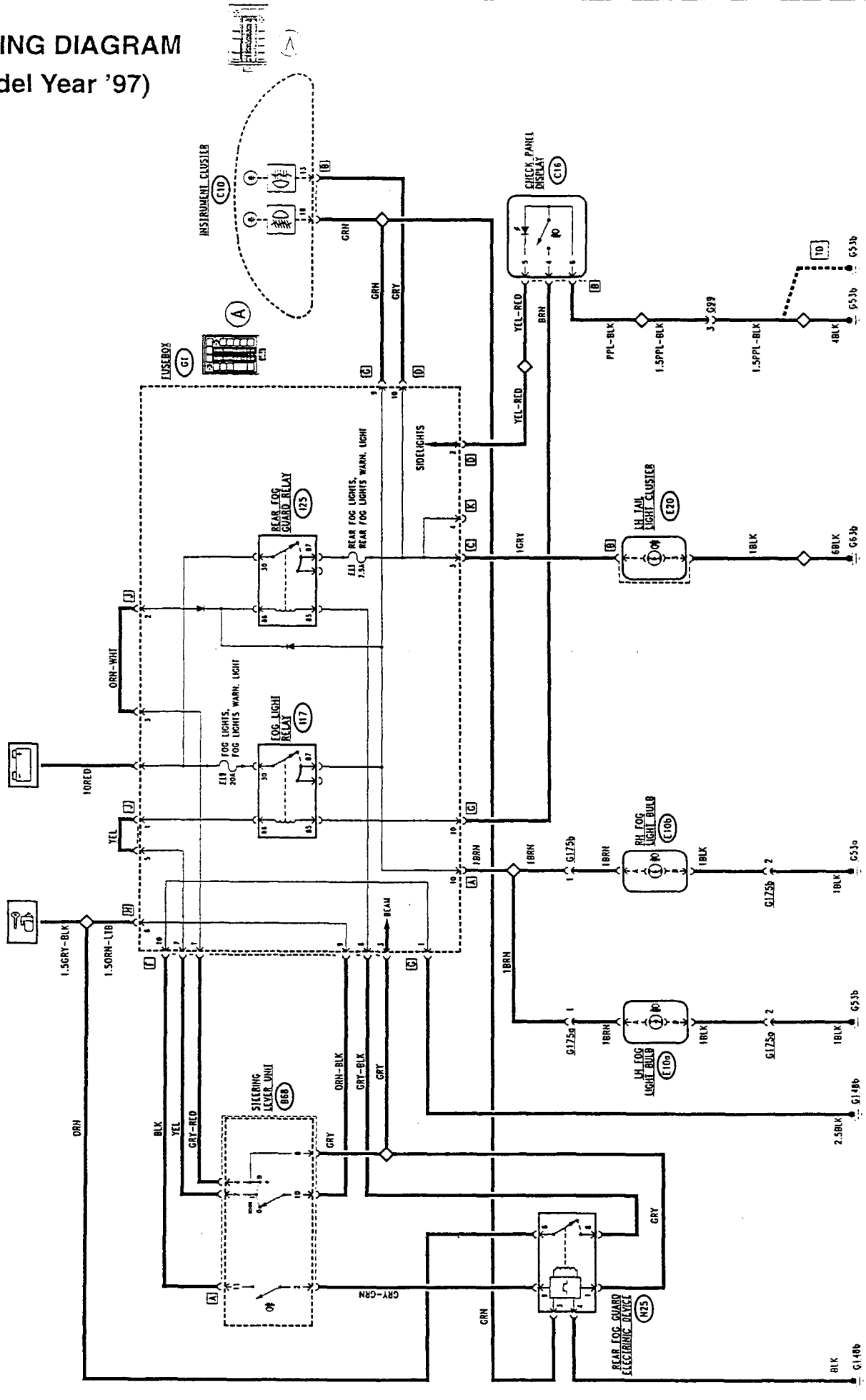
WIRING DIAGRAM



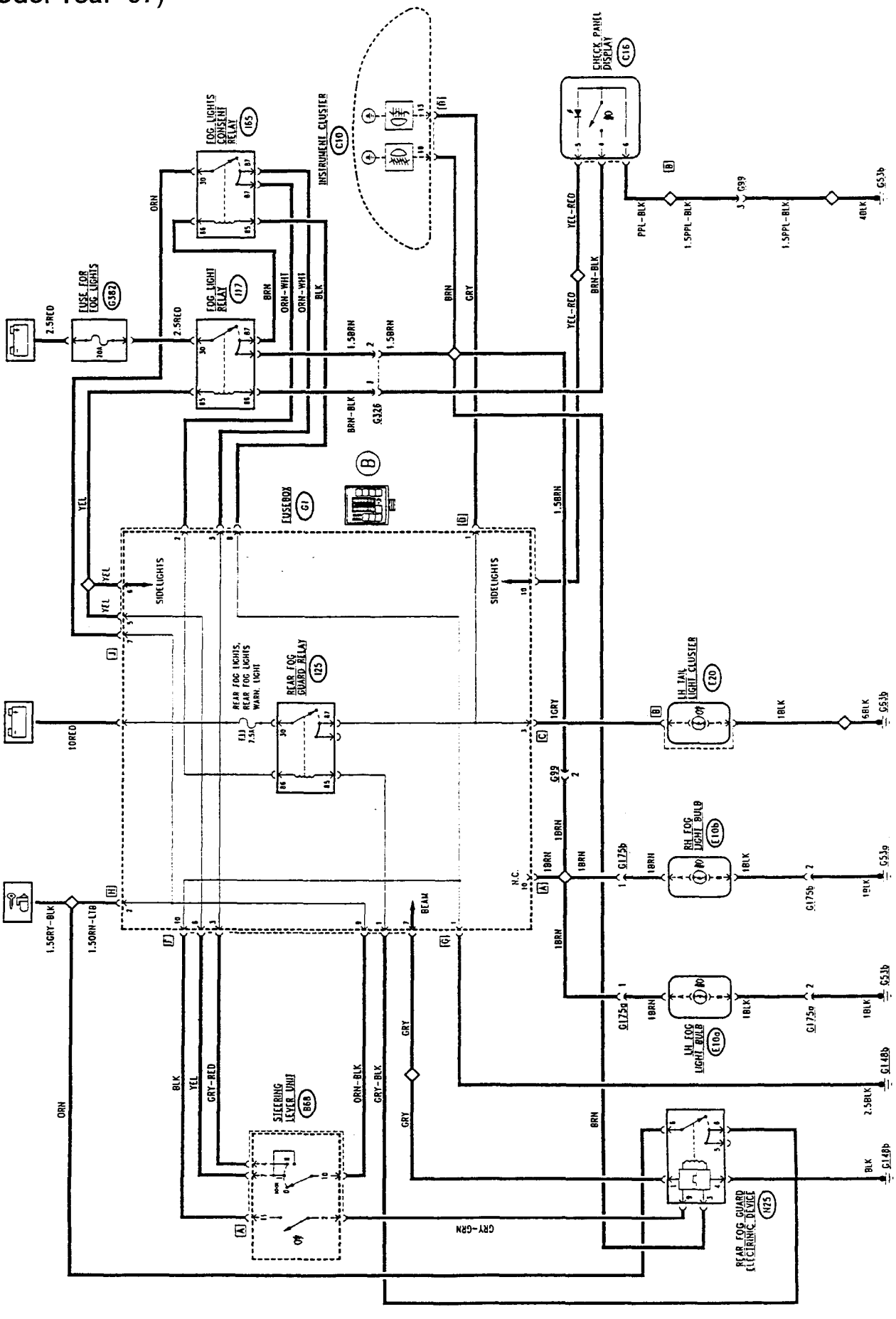
WIRING DIAGRAM



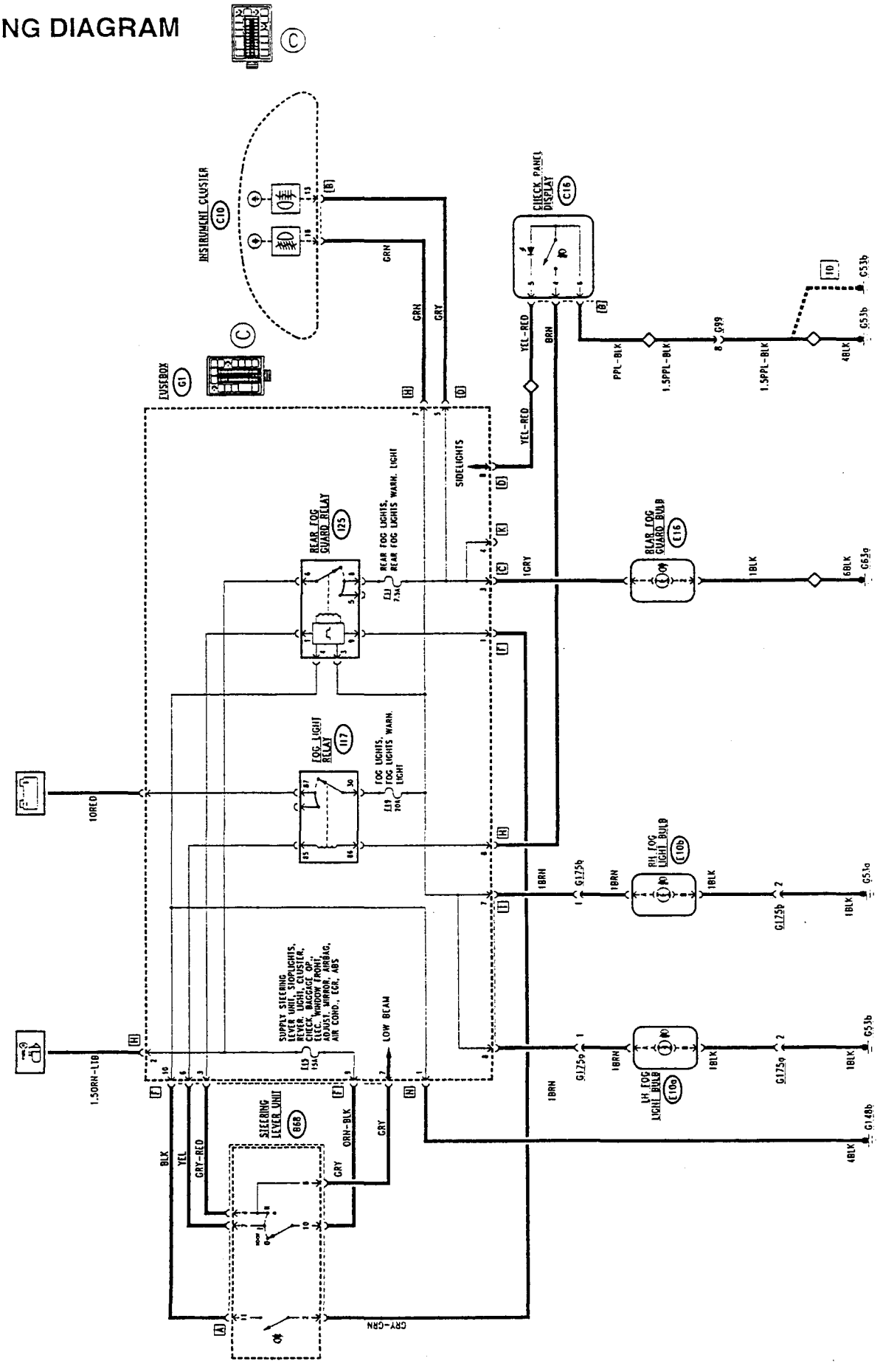
WIRING DIAGRAM
(Model Year '97)



WIRING DIAGRAM
(Model Year '97)



WIRING DIAGRAM



GENERAL DESCRIPTION

Upon request the car is fitted with special halogen fog lights, while the high luminosity rear fog guard is a standard item. This is located in the rear light cluster on the lefthand side of the tailgate and it is necessary under low visibility conditions.
Thus the entire system ensures the best possible active and passive visibility under all circumstances.
The fog lights are turned on by the switch on the dashboard inside the Check Panel, while the rear fog guard is turned on by the control on the lever unit.
The fog lights can be turned on when the side lights are on, while the rear fog guard can be turned on only with the low beam headlights or fog lights on (they turn off when these are turned out) and, from Model Year '97, they must be turned on again the next time the engine is started (key at MARCIA) .
A warning light on the instrument panel indicates that the fog lights are on and another one indicates that the rear fog guard is turned on.
Each of the two circuits is protected by a fuse.

NOTE
The versions for some countries are fitted with "Daylights" i.e. side lights that always stay on when the ignition key is turned and a different logic for turning on the low beam lights, fog lights and rear fog guards. In this case, the present section should be considered complementary to the **"Daylights" section which should therefore be consulted first.**

FUNCTIONAL DESCRIPTION

Fog lights

The circuit for the fog lights is controlled by the corresponding relay switch **I17** located in fuse box **G1** (box "A" or "C") or near to it (box "B").
By operating the switch located in the Check Panel **C16**, with the side lights on (lever unit switch **B68** in posizion "I") an earth is sent which energizes the coil of relay switch **I17** thereby closing the circuit which sends the supply to the two fog lights **E10a** and **E10b**.
The steering column lever unit **B68** is protected by fuse **F15** in fusebox **G1** - only for box "C".
The switch in **C16** is lit by a led when the side lights are on.
The fog lights circuit is protected by fuse **F19** of box **G1** (box "A" or "C") or by an outside floating fuse **G382** (box "B").
The supply line also sends a signal to the instrument cluster **C10** to turn on the corresponding warning light.

Rear fog guard

- Up to Model Year '96

The circuit of the rear fog guard is controlled by the corresponding relay switch **I25** located in fusebox **G1**. If the low beam headlights or the fog lights are on, through the switch on the lever unit (lever unit switch on position "II"), the supply and earth are sent to the coil of relay switch **I25** thereby closing the circuit that sends the supply to the rear fog guard in **E20**. This consensus logic is carried out in the fusebox "A" by the connection inside the actual box, between pin 87 of **I17** and pin 86 of **I25**. For box "B" there is a special relay switch **I65**, located near the box, which is energized when the fog lights are on, thus supplying relay switch **I25** when the low beam lights or the fog lights are on.

The rear fog guard circuit is protected by fuse **F11** in box **G1**.
The supply line also sends a signal to the instrument panel **C10** to turn on the corresponding warning light.

- From Model Year '97

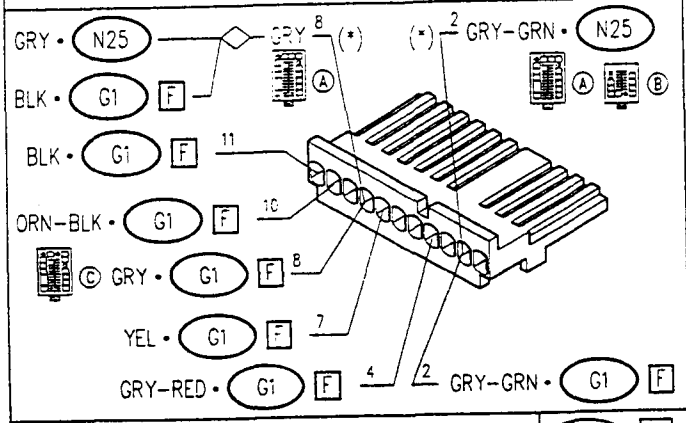
The rear fog guard circuit is controlled by device **N25** to be found next to fusebox **G1** (box "A" or "B") inside fusebox **G1** (box "C").

Device **N25** receives the "key-operated" supply at pin 6; pin 4 is earthed, while at pin 9, 3 and 1 it receives the control and enable signals, which are respectively: request to turn the lights on (by the special switch on the lever unit **B68**); fog lamps on (the same signal of the fog lamp warning light) and low beam headlights on (from lever unit **B68**); when the request to turn on the lights is accompanied by one of the two enable signals, device **N25** closes the circuit on pin 8 which energises relay **I25** (box "A" or "B").
For box "C" the line from pin 8, protected by fuse **F11** of **G1**, supplies directly the lamp **E20**.

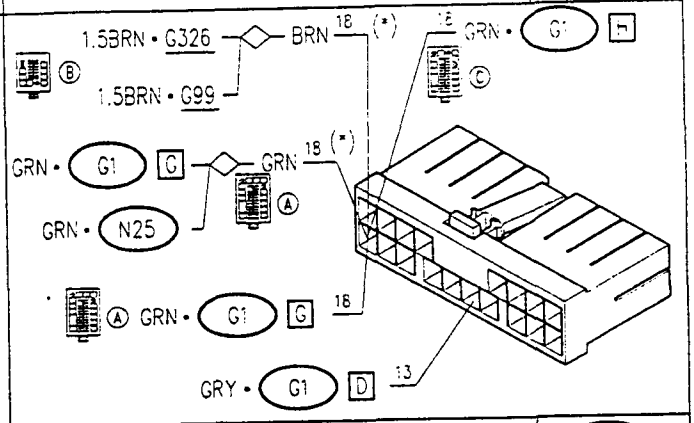
The device turns off the lights if it "loses" the "key-operated" signal; when the key is moved back to MARCIA, the reversing lights are turned on only pressing switch **B68** again.

COMPONENTS AND CONNECTORS

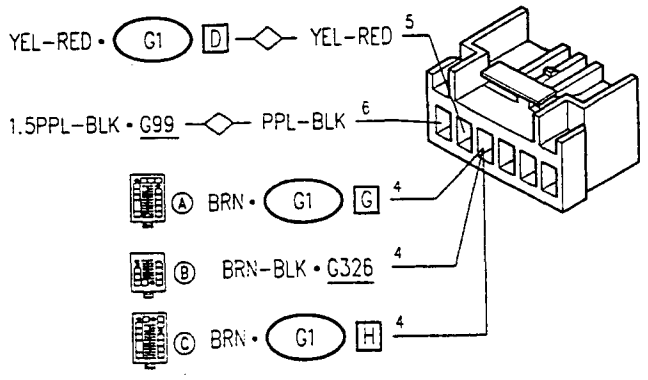
Lever unit — B68 A



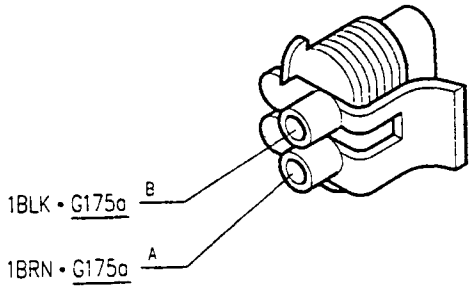
Instrument cluster — C10 B



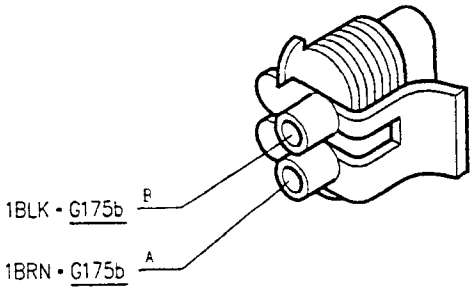
Check Panel display — C16 B



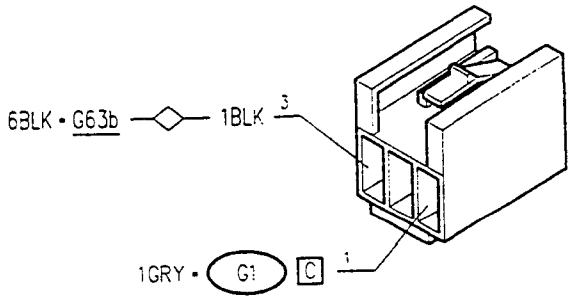
LH fog light bulb — E10a



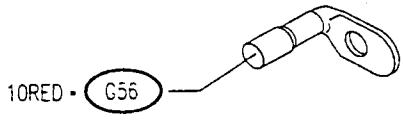
RH fog light bulb — E10b



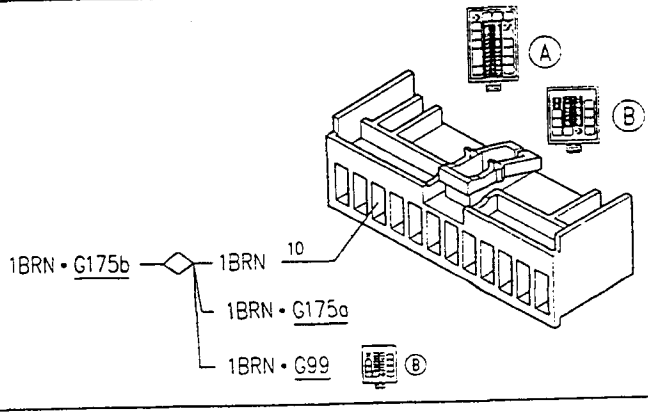
LH tail light cluster — E20 B



Fusebox — G1



Fusebox — G1 A

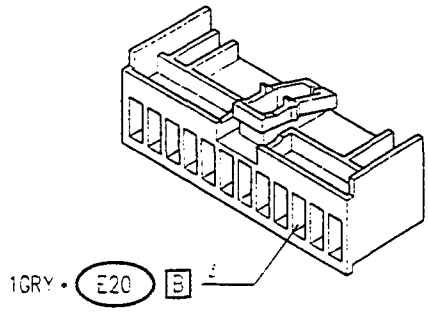


(*) from M.Y. '97

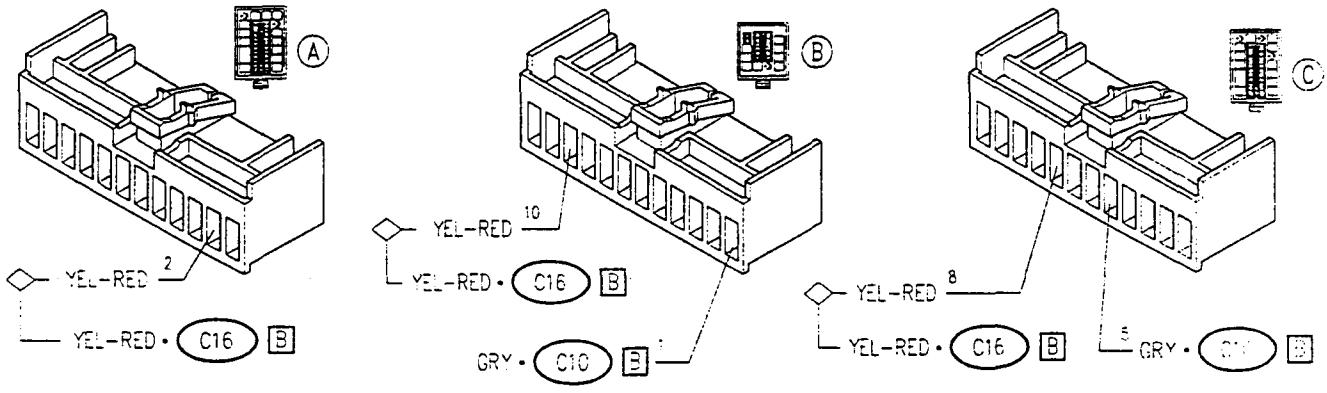
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COMPONENTS AND CONNECTORS (cont.d)

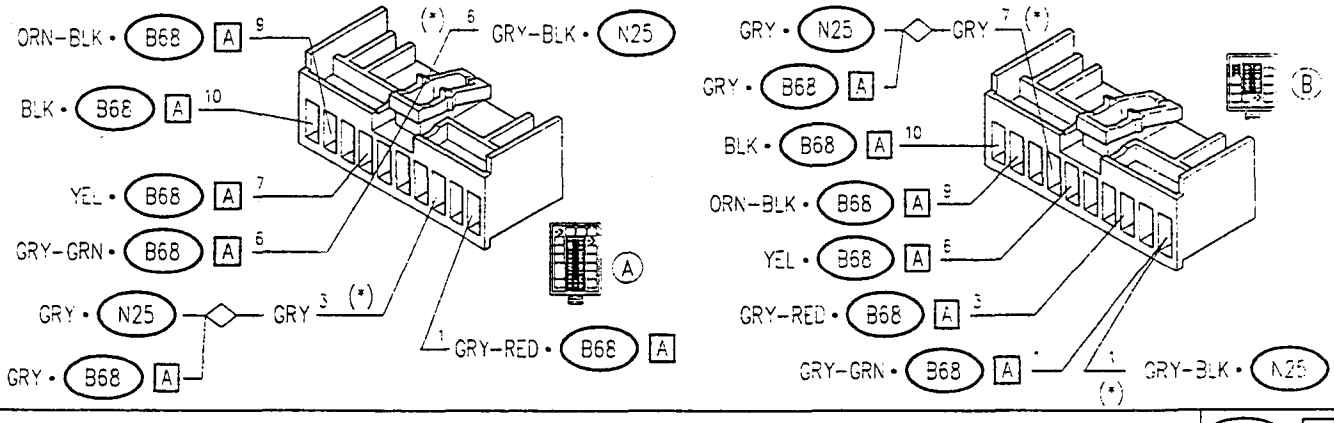
Fusebox — G1 C



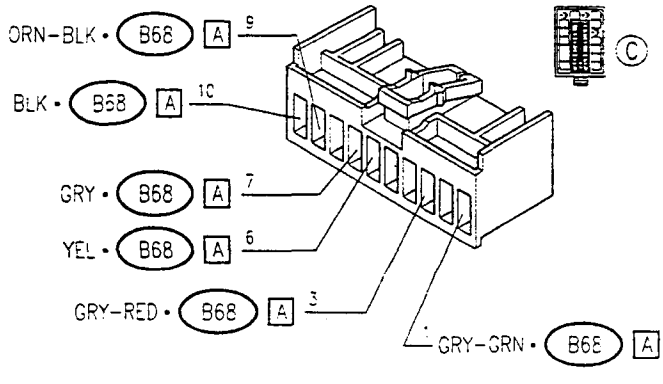
Fusebox — G1 D



Fusebox — G1 F



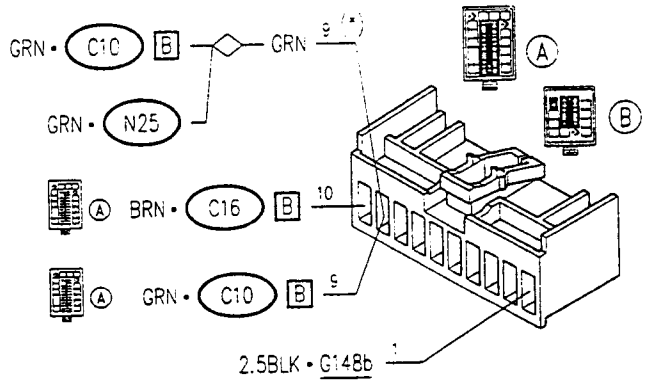
Fusebox — G1 F



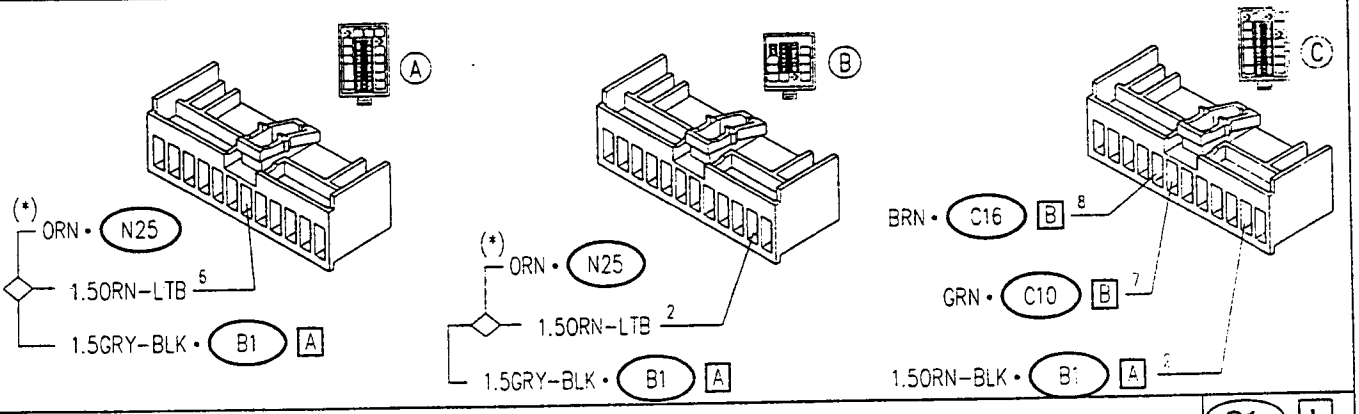
(*) from M.Y. '97

COMPONENTS AND CONNECTORS (cont.d)

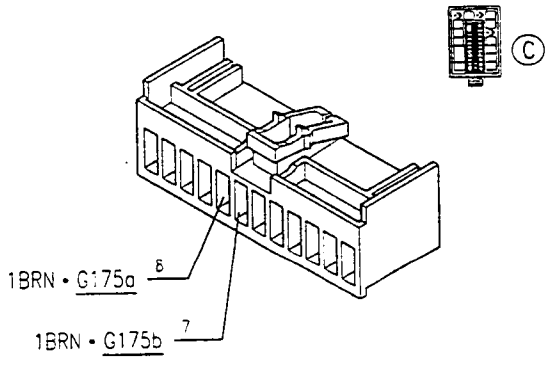
Fusebox — G1 G



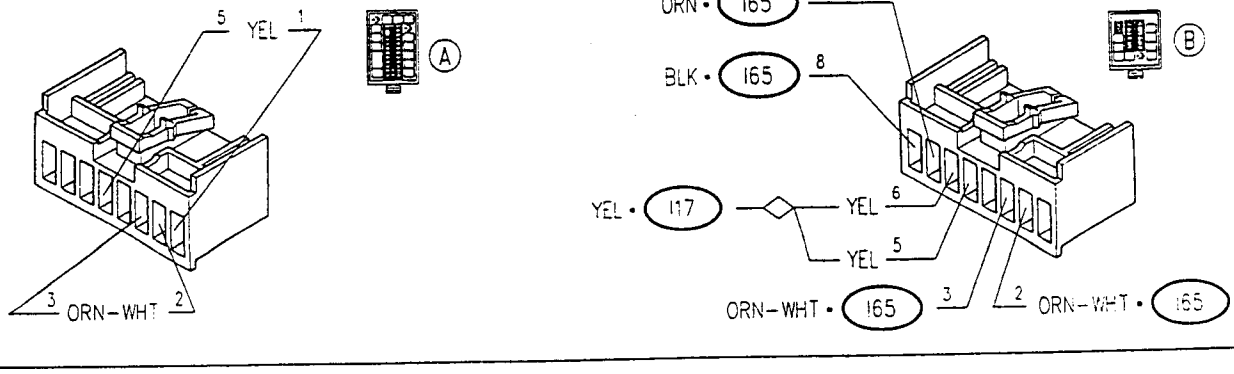
Fusebox — G1 H



Fusebox — G1 I

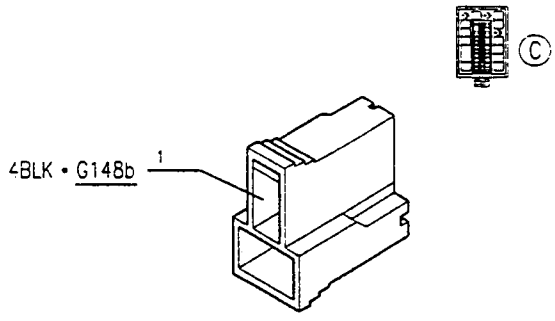


Fusebox — G1 J

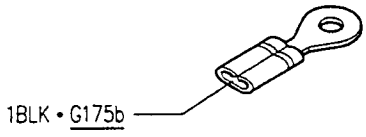


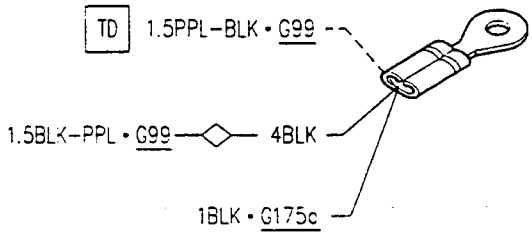
COMPONENTS AND CONNECTORS (cont.d)

Fusebox	G1 N

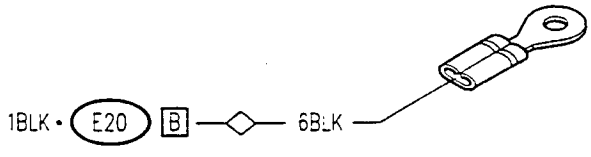


RH engine compt.earth	G53a	LH engine compt. earth	G53b

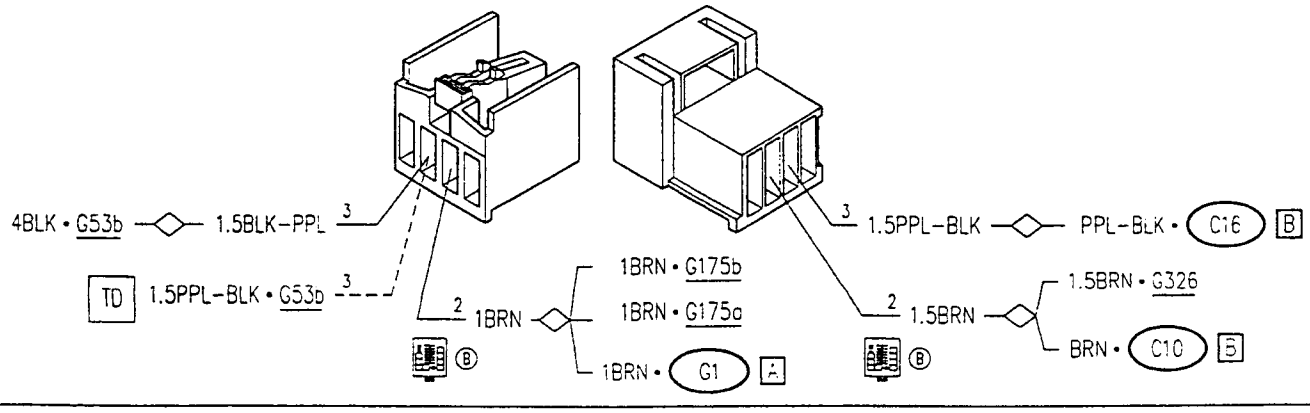




LH rear earth	G63b



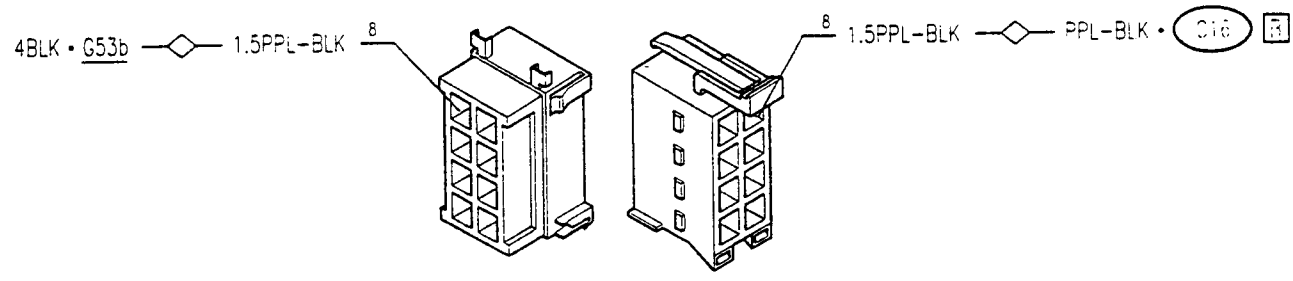
Dashboard/engine wiring connector (•)	G99



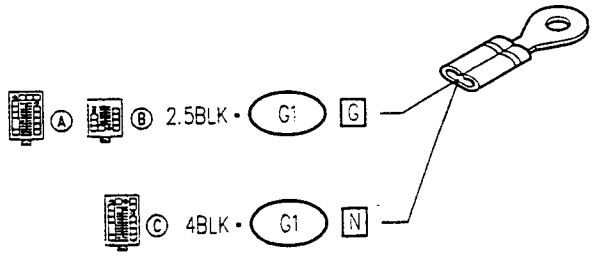
(*) from M.Y. '97
(•) from chassis no.___

COMPONENTS AND CONNECTORS (cont.d)

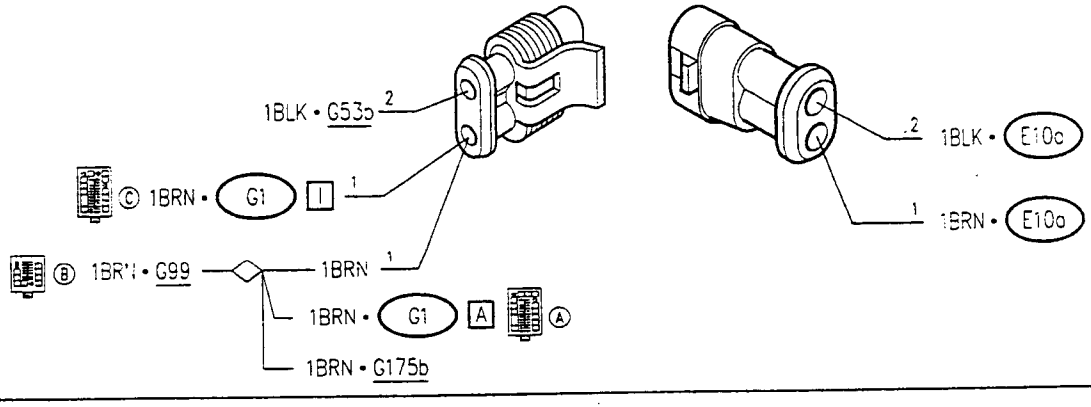
Dashboard/engine wiring connector (•)	G99



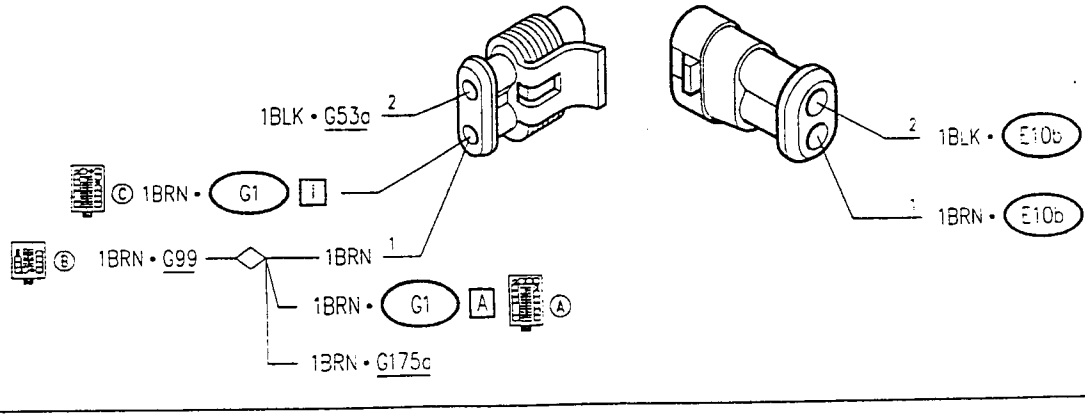
Earth under LH dashboard	G148b



LH fog light wiring connector	G175a

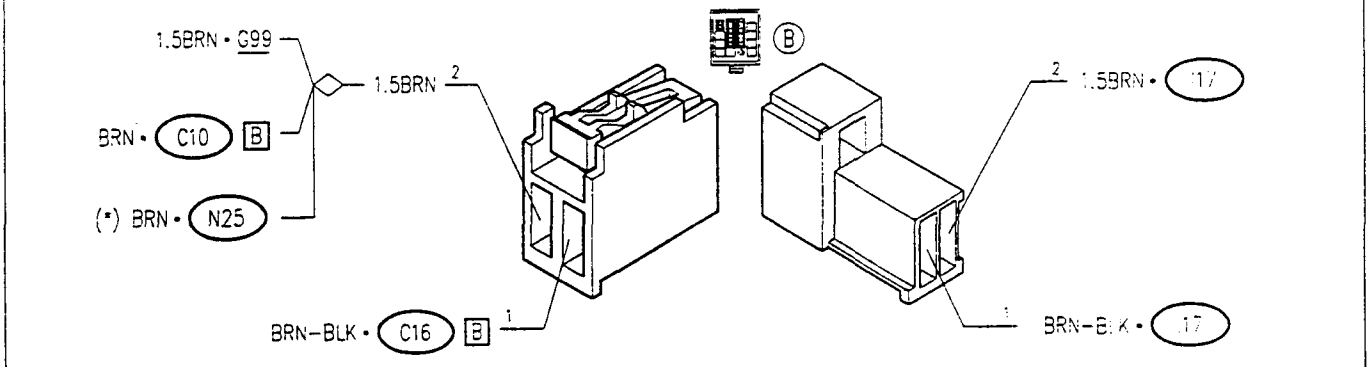


RH fog light wiring connector	G175b

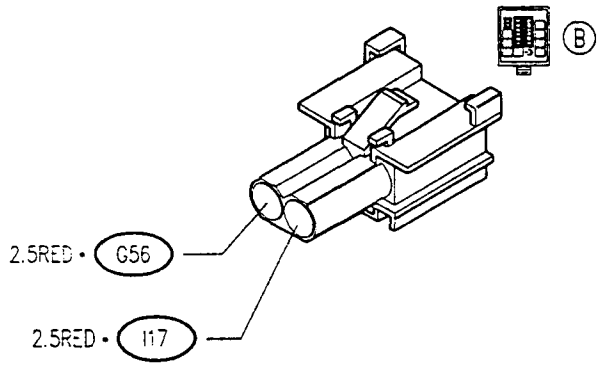


COMPONENTS AND CONNECTORS (cont.d)

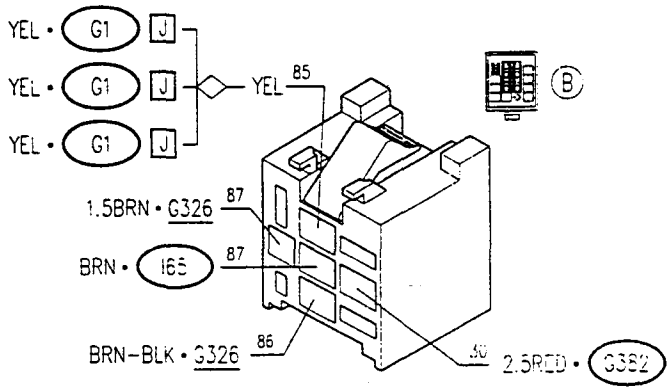
Rear fog guard wiring connector	G326



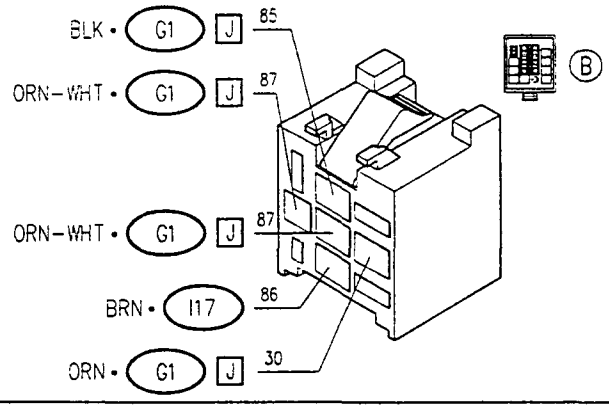
Floating fuse for rear fog guard	G382



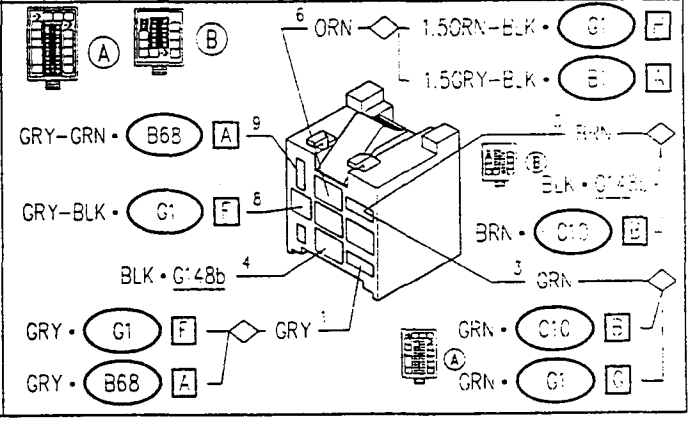
Fog guard relay switch	I17



Fog light consent relay switch	I65

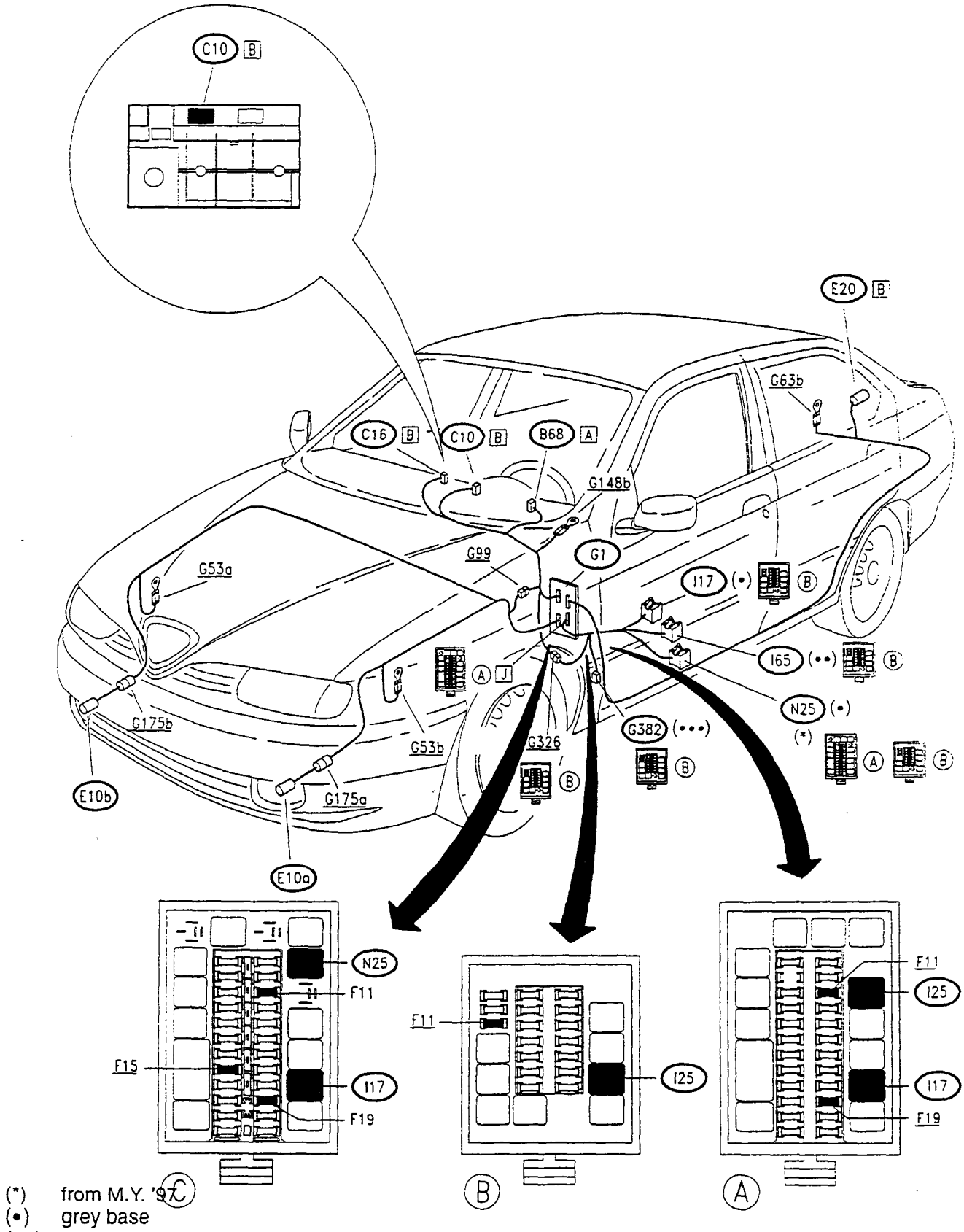


Rear fog guard electronic device (*)	N25



(*) from M.Y. '97

LOCATION OF COMPONENTS



(*) from M.Y. '97
(•) grey base
(••) grey base
(•••) yellow fuseholder

FAULTFINDING TABLE

Failure	Component to be checked												
	F11	E20	F19 (A)	G382 (B)	E10a	E10b	I25	I17	N25 (•)	I65 (B)	B68	C16 (**)	C10 (*)
Rear fog guard	•	•					•		•	•	•		
Fog guard warning light	•								•				•
Both fog lights			•	•				•				•	
RH fog light						•							
LH fog light					•								
Fog light warning light			•	•									•
Lighting. fog light switch (with side lights on)												•	

(*) The instrument cluster **C10** cannot be repaired. Therefore, in the event of a failure it is not possible to change the single warning light and a new complete cluster must be fitted.

(**) The "Check Panel" display **C16** cannot be repaired. Therefore it is not possible to change the fog light switch and a new complete Check Panel must be fitted.

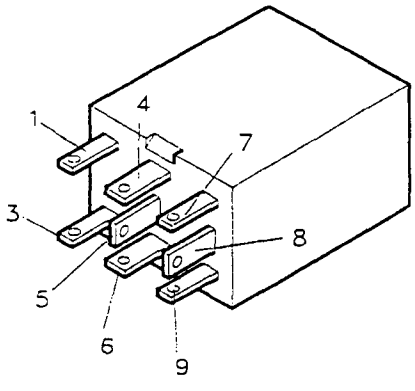
(A) Only fusebox "A"

(B) Only fusebox "B"

(•) Only from Model Year '97

CHECKING COMPONENTS

Rear fog guard electronic device (N25)



Check the device: see **TEST A**

CHECK REAR FOG GUARD DEVICE (N25)	TEST A

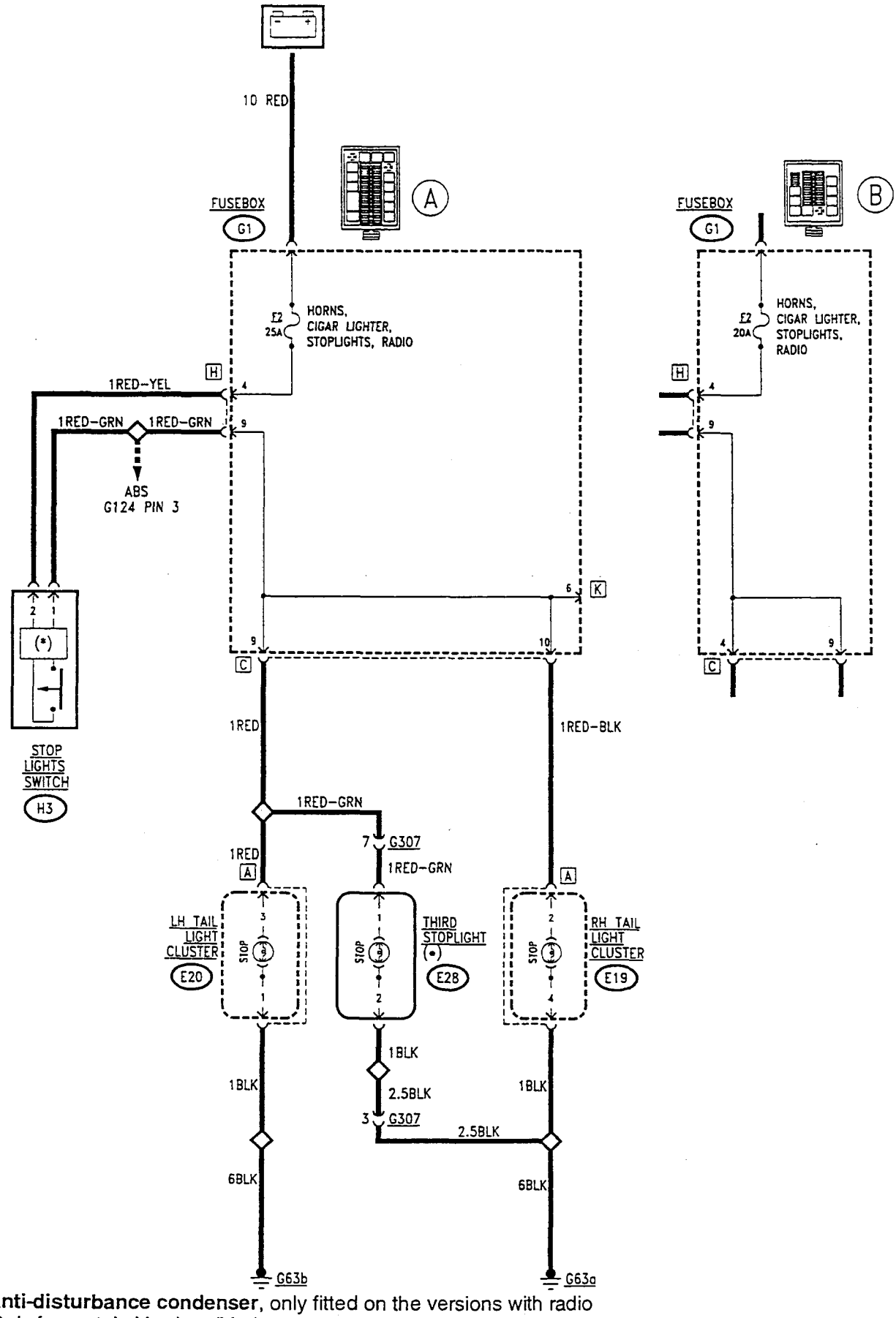
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N25** and check for "key-operated" 12V on the corresponding base at pin 6 of **N25**	OK ▶	Carry out **step A2**
	~~OK~~ ▶	Restore the wiring between **N25** and the ignition switch **B1**
A2 CHECK EARTH – Check for 0V at pin 4 of **N25**	OK ▶	Carry out step **A3**
	~~OK~~ ▶	Restore the wiring between **N25** and earth **G143b**
A3 CHECK CONTROL/ENABLE SIGNALS – Check the following signals on the pins of **N25**: • 0V at pin 9, turning on the fog guard switch in **B68**, • 12V at pin 3, turning on the fog lamps, • 12V at pin1, turning on the low beam headlamps	OK ▶	Insert device **N25** on its base and continue with step **A4**
	~~OK~~ ▶	Check connection between **N25**, connector 1 of **G1** and the lever unit **B66**
A4 CHECK VOLTAGE – Turn on the fog guards with the low beam headlamps on or fog lamps on and check for 12V at pin 8 and 5 of **N25**	OK ▶	DEVICE **N25** IS WORKING PROPERLY Check the connections with the other components
	~~OK~~ ▶	REPLACE DEVICE **N25**

STOP LIGHTS

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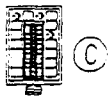
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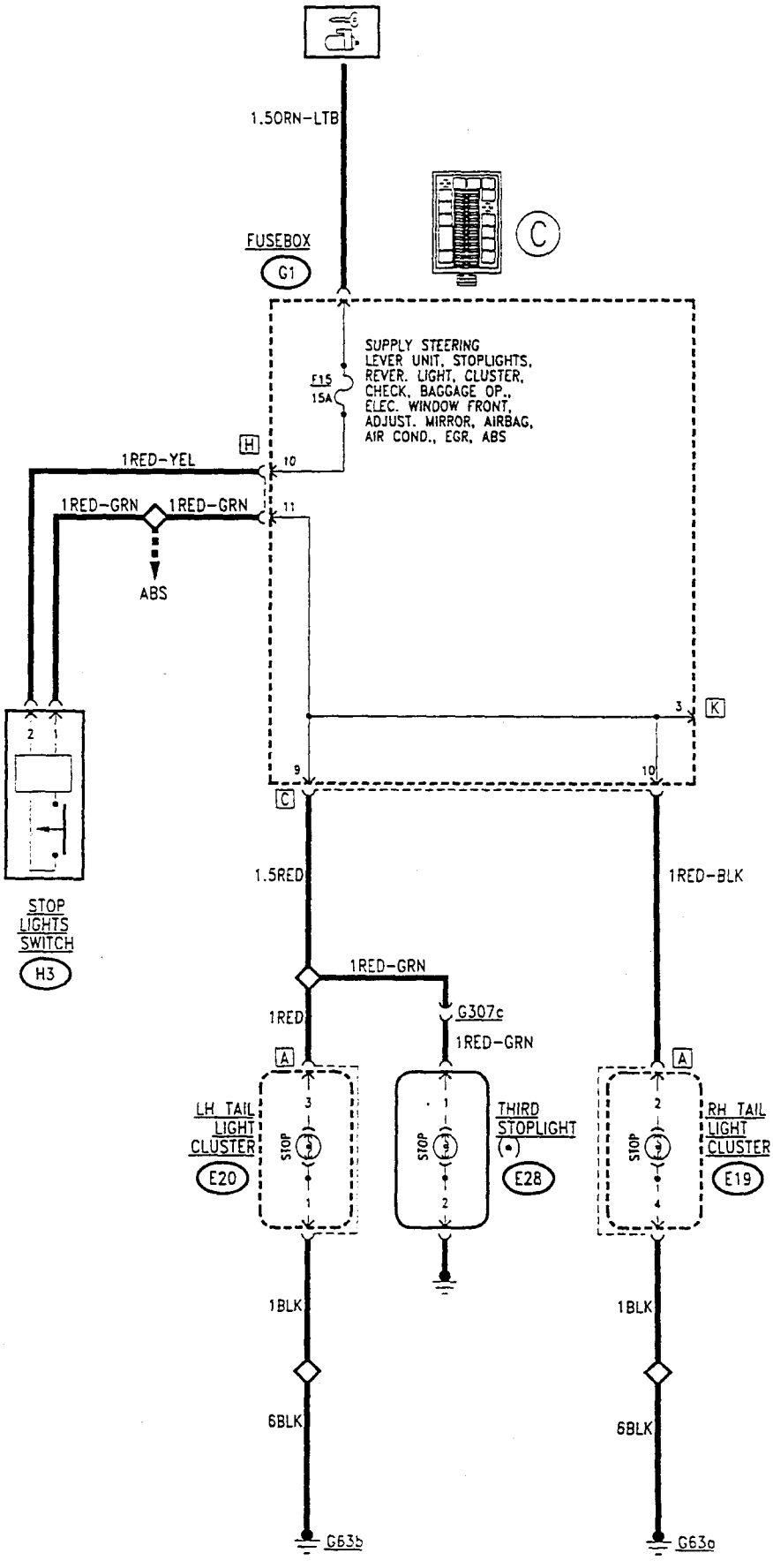
WIRING DIAGRAM



(*) **Anti-disturbance condenser**, only fitted on the versions with radio
(•) Only for certain Versions/Market

WIRING DIAGRAM





GENERAL DESCRIPTION

The car stop lights are operated each time the brake pedal is pressed; they are located at the rear in the side lights. The lights are turned on automatically through the switch on the brake pedal.
The circuit is protected by a special fuse.
The braking signal from the switch is also sent to the ABS system control unit which "recognizes" the situation and controls braking accordingly (see "ABS").
N.B.: In the versions on which a radio is installed, an anti-disturbance condenser is fitted on the switch to prevent interference in the area of the actual switch.

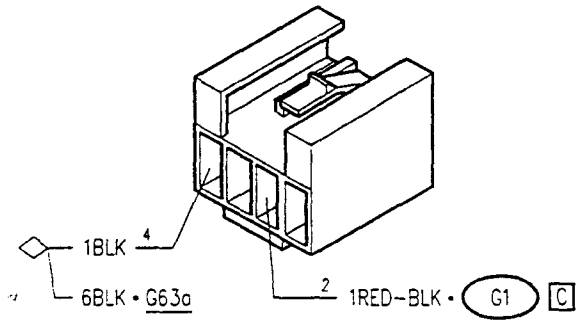
FUNCTIONAL DESCRIPTION

The stop lights circuit is supplied directly by battery voltage via fuse **F2** of fusebox **G1** (box "A" and "B"). For box "C" it receives the "key-operated" supply via fuse **F15** of box **G1**.
The stop lights switch **H3** comprises a contact which closes when the brake pedal is pressed, through which the stop lights are supplied in the rear side lights **E19** (right), **E20** (left).

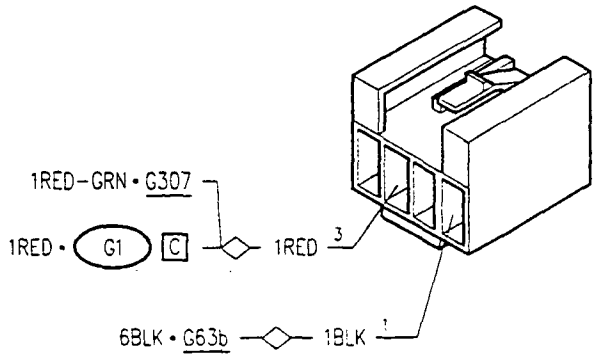
For certain Versions/Markets the third central stop light **E28** is foreseen

COMPONENTS AND CONNECTORS

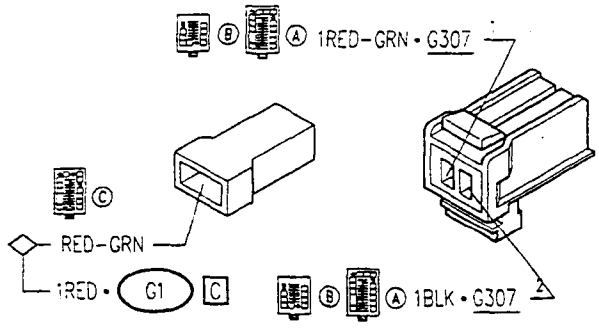
RH rear light — E19 A



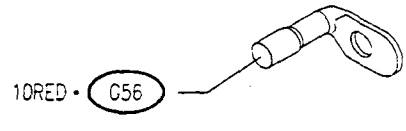
LH rear light — E20 A



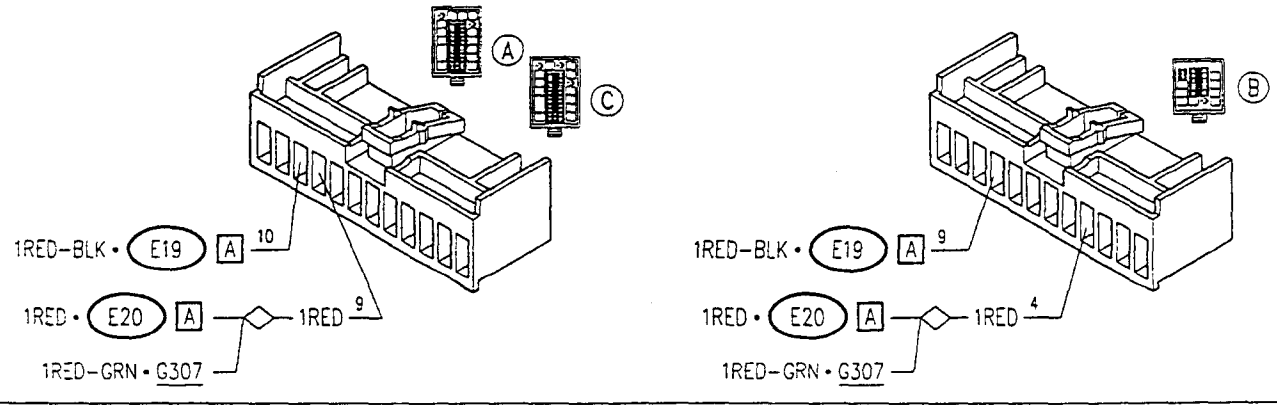
Third central stop light — E28



Fusebox — G1

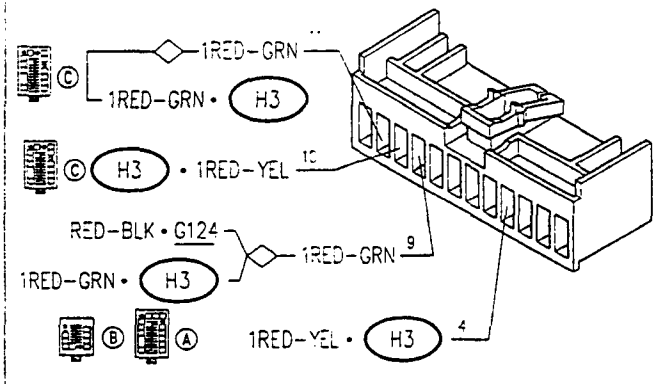


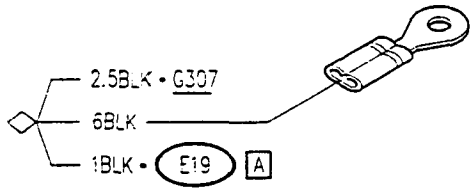
Fusebox — G1 C



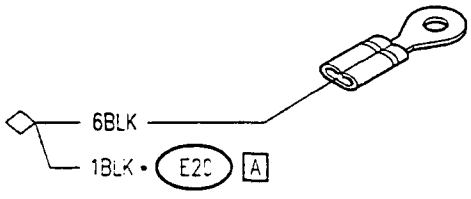
COMPONENTS AND CONNECTORS (cont.d)

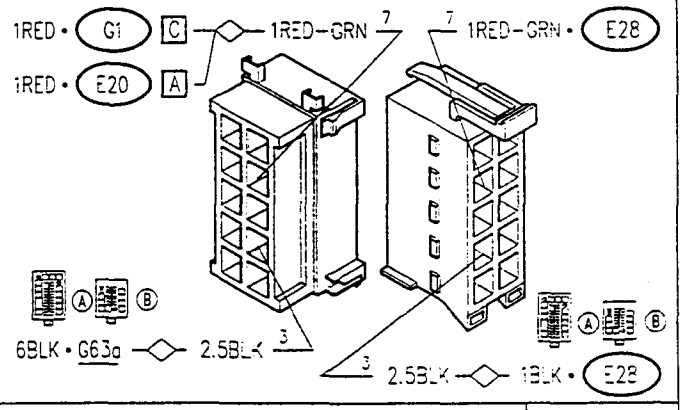
Fusebox	G1 H	RH rear earth	G63a



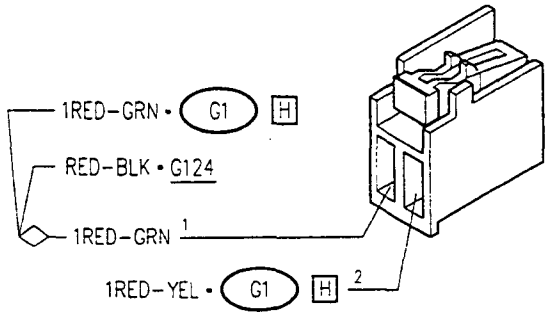


LH rear earth	G63b	Connector for rear wiring/luggage compartment wiring	G307





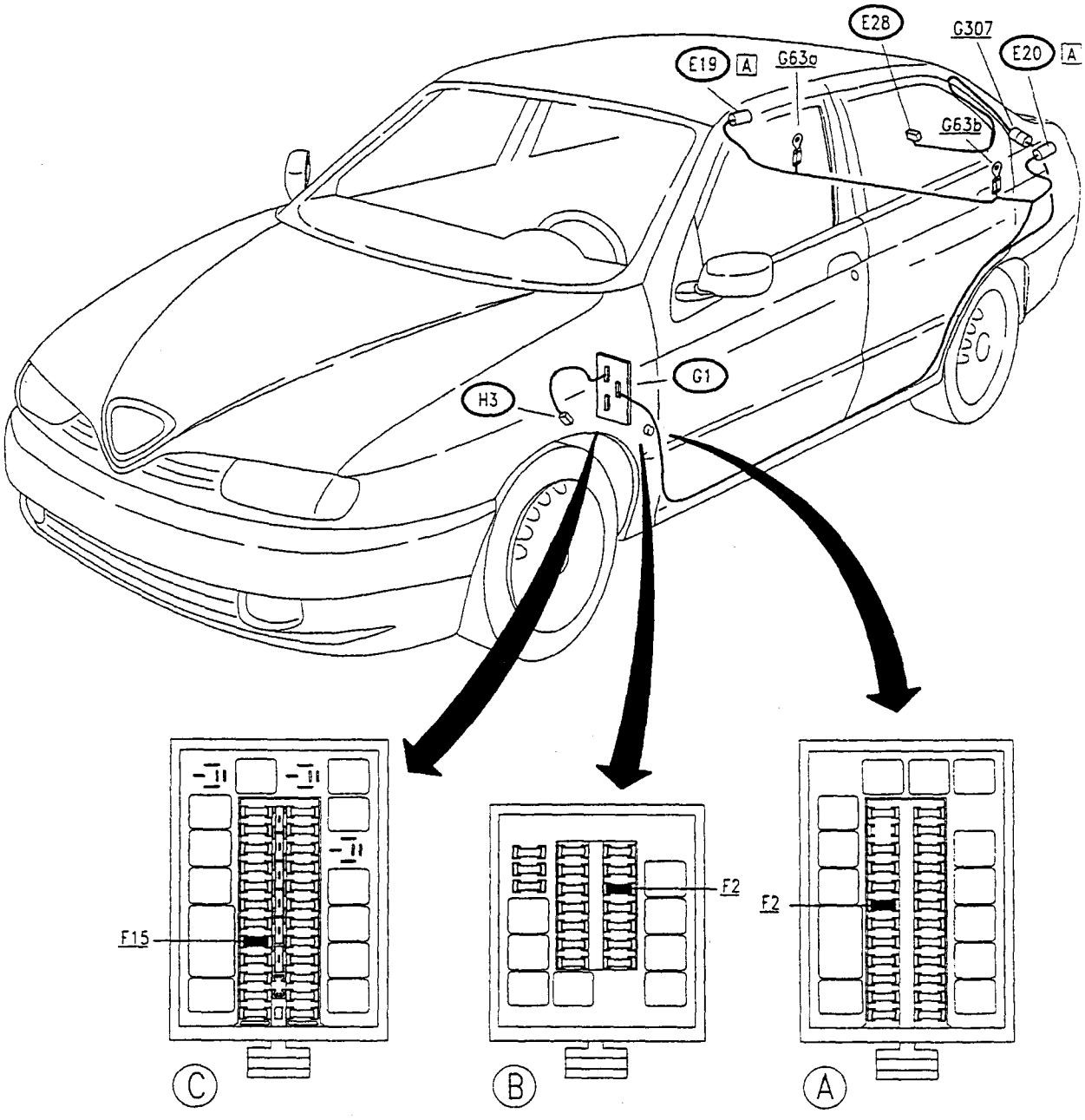
Stop lights switch	H3



FAULTFINDING TABLE

Failure	Component to be checked				
	F2	E20	E19	E28	H3
All the stop lights	•				•
RH stop light			•		
LH stop light		•			
Central stop light				•	

LOCATION OF COMPONENTS

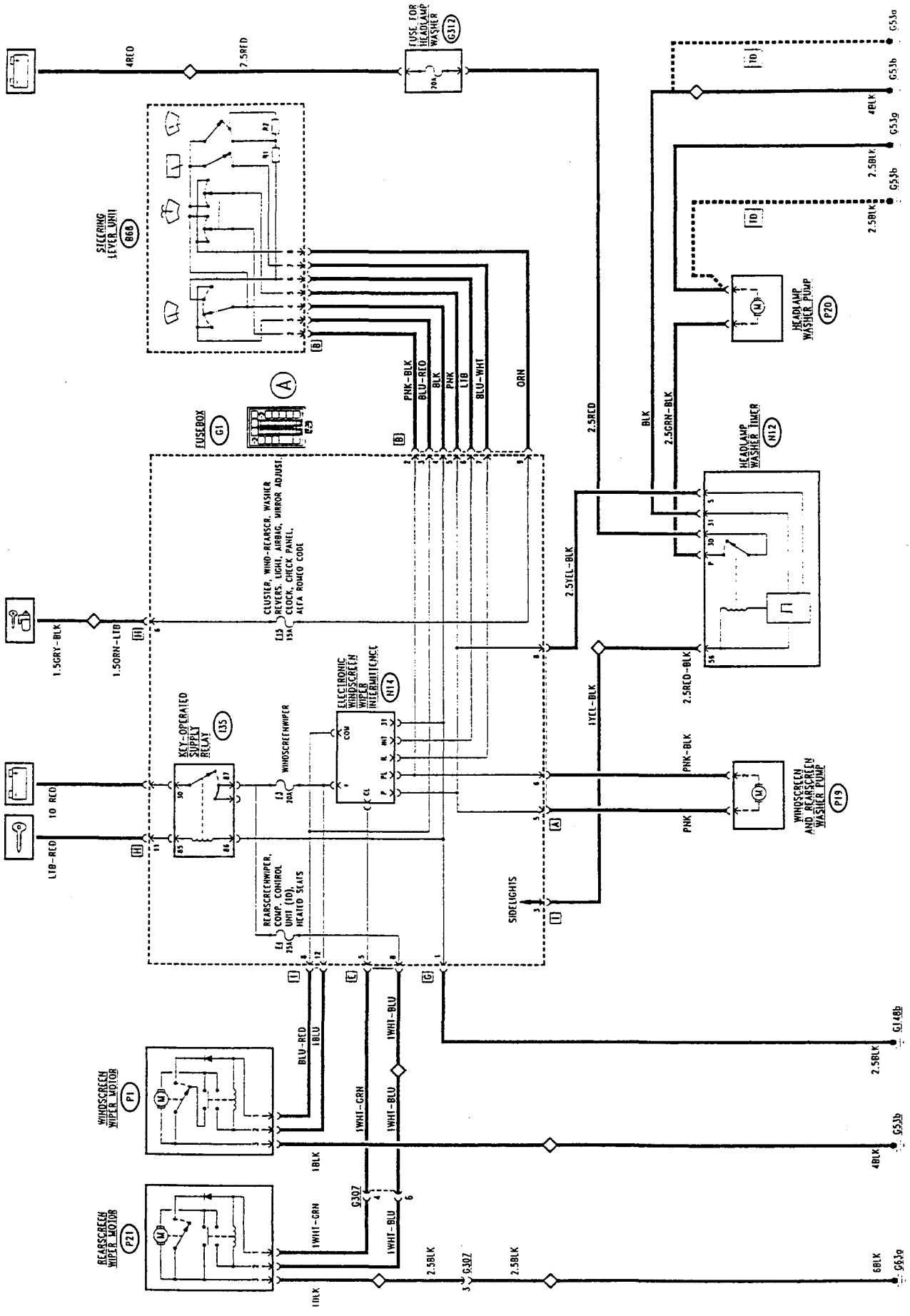


WINDSCREEN WIPER/WASHER - REARSCREEN WIPER/WASHER - HEADLAMP WASHER

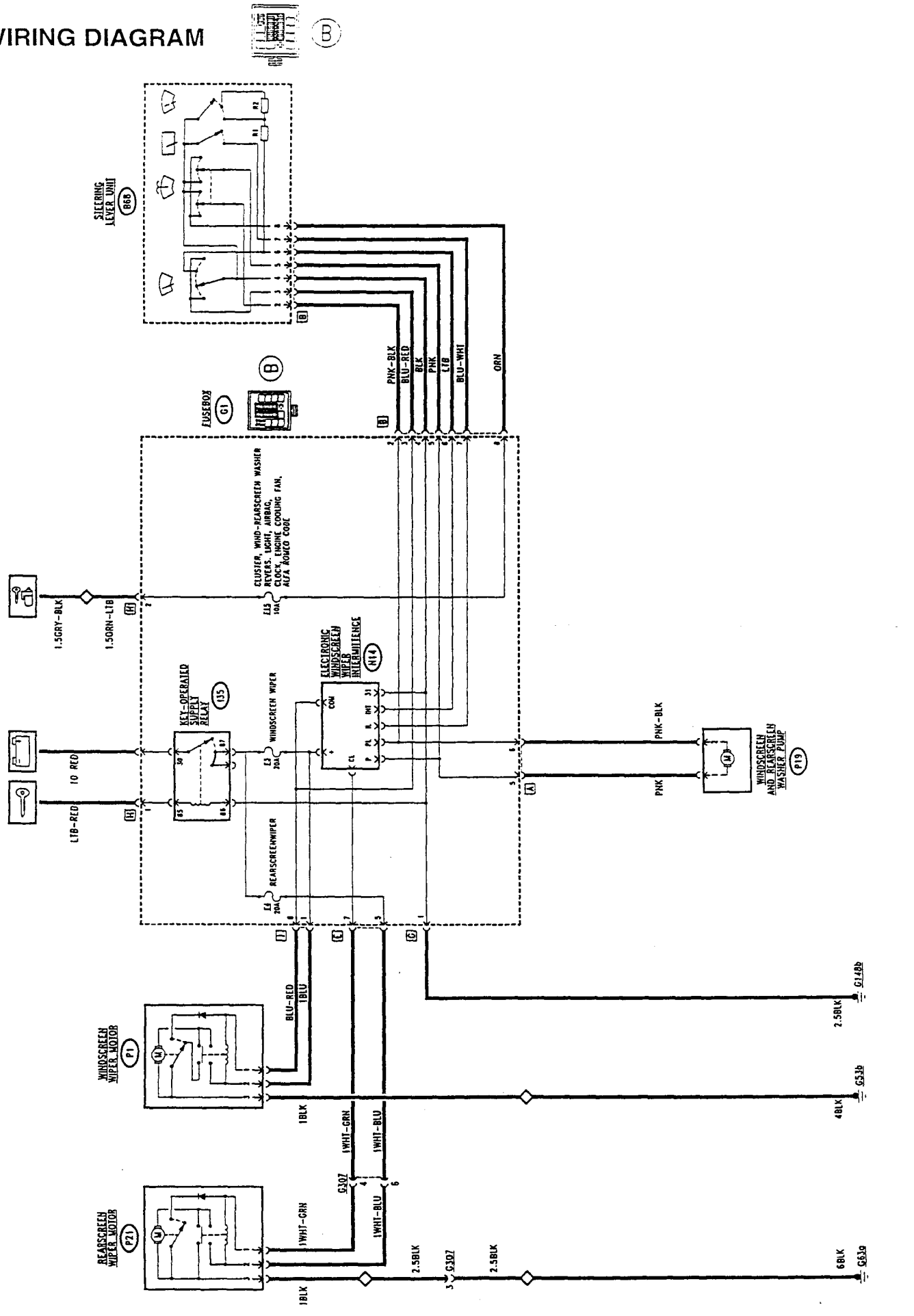
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WIRING DIAGRAM

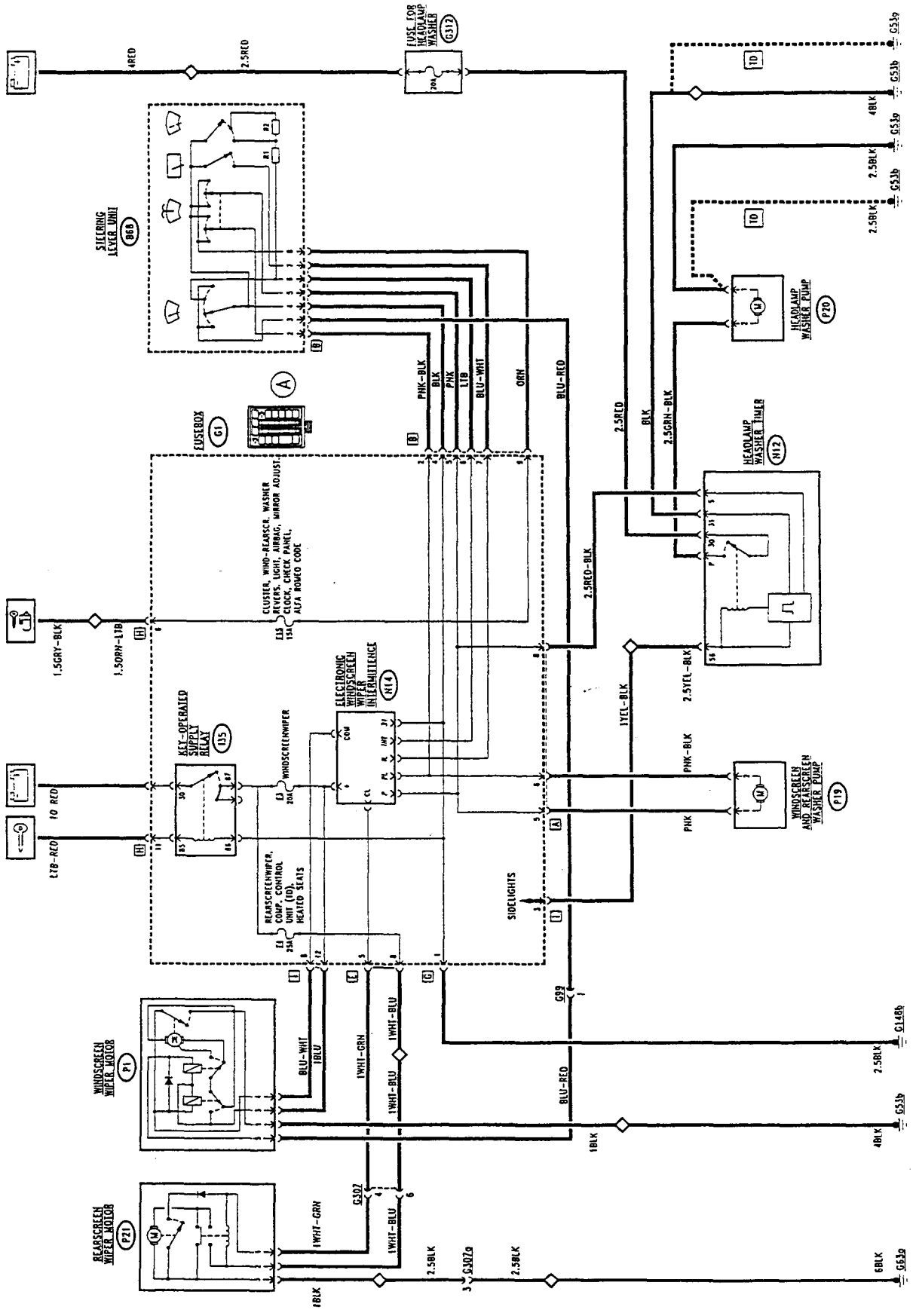


WIRING DIAGRAM

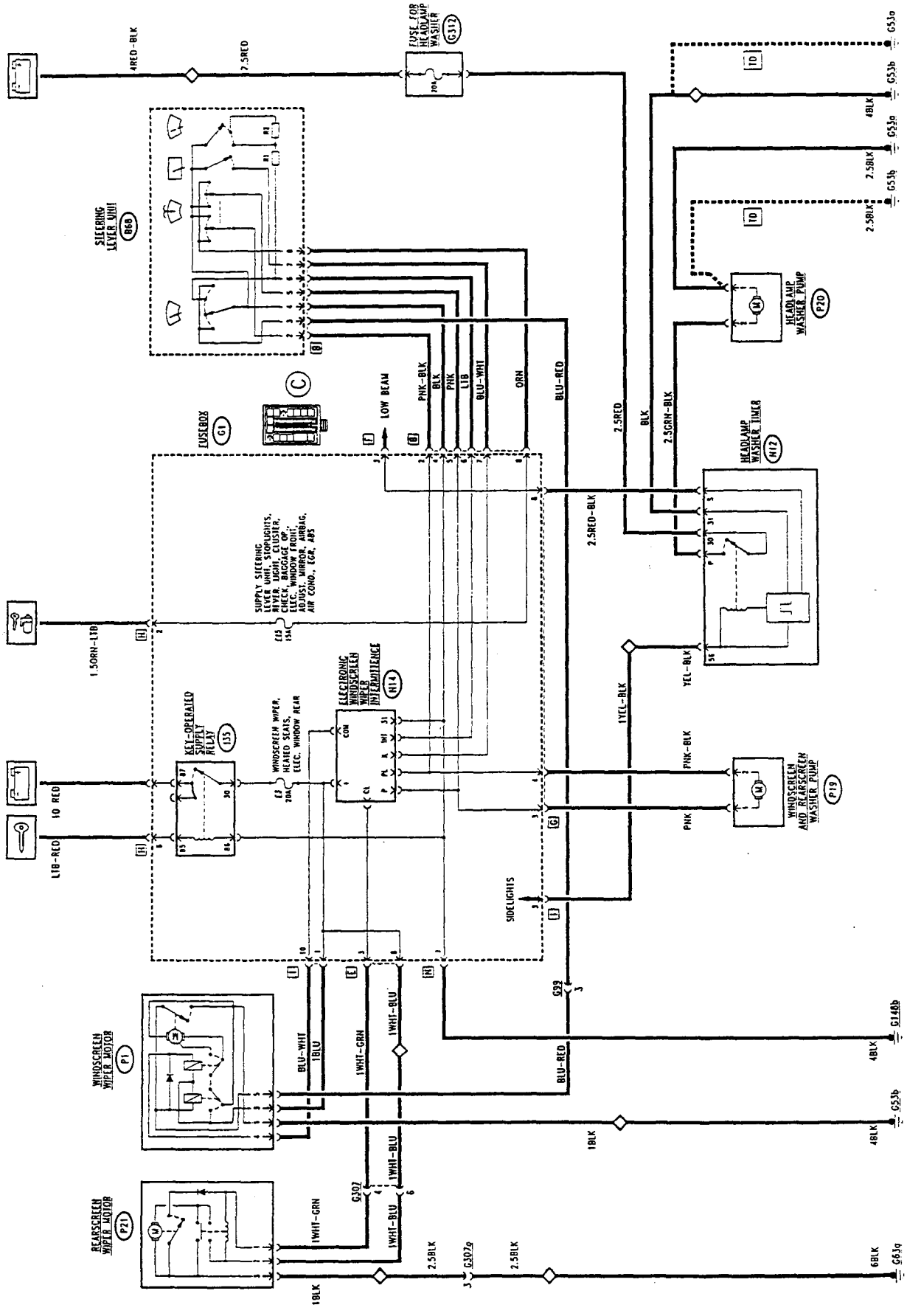


WIRING DIAGRAM

- Model Year '97



WIRING DIAGRAM



GENERAL DESCRIPTION

With the lever on the righthand side of the steering wheel it is possible to engage the different functions of the windscreen washer/wiper, rearscreen washer/wiper and headlamp washer system.
The windscreen wiper device can work continuously and intermittently at different speeds: moving the lever upwards and holding it in this position will select continuous operation (75 passes per min.) which is turned off when the lever is released; if the lever is pushed downwards firstly intermittent operation is engaged and then continuous operation: these functions stay on until the lever is moved upwards again.
With the lever in the rest position, through the special ring switch it is possible to select the different lengths of the intermittent functions (appr. 45, 25 and 11 passes per min.).

From Model Year '97 the device is changed to obtain a second continuous speed of 61 strokes/min and two intermittent speeds (27 and 11 strokes/min). The rearscreen wiper function (intermittent at 15 strokes) is turned on turning the special ring.

The windscreen washer is engaged slightly pulling the lever towards the steering wheel; the rearscreen washer by pushing it towards the dashboard: this way the windscreen/rearscreen washer pump is operated for appr. 4 seconds or until the lever is released.
When the side lights are on, the same windscreen washer controls also operate the headlamp washer: this is an electropneumatic device in which a pump sends the detergent fluid to a double nozzle that sprays a powerful jet onto the headlamp.
A timer operates the headlamp washer pump with successive impulses which last for about half a second.

NOTE: Operating the windscreen/rearscreen washer (and headlamp washer) without detergent fluid in the reservoir can damage the pump.

The entire system is regulated by a windscreen wiper intermittency device located in the fusebox, which controls the windscreen and rearscreen wiper motors, the windscreen and rearscreen washer pump and the headlamp washer device (timer and pump).
The windscreen wiper and washer and rearscreen wiper/washer can be operated with the ignition key engaged and, as mentioned previously, the headlamp washer can only work with the side lights on (chassis no. ... the dipped beam lights).

FUNCTIONAL DESCRIPTION

Windscreen wiper
The windscreen wiper intermittence device **N14**, located in fusebox **G1**, is supplied via the key-operated relay **I35** (pin +) and fuse **F3** also in **G1**.
When the windscreen wiper switch ... of the lever unit **B68** is operated, it sends two different signals depending on the function selected; from pin 3 for continuous speed and from pin 6 for intermittent operation.
The signal from pin 3 (continuous speed) passes directly to the wiper motor **P1** as a command signal; motor **P1** is connected to earth and supplied with the same line as the intermittent device **N14**. It comprises the the actual gear motor, stroke limit contacts (for automatic parking of the blades) and the supply relay switch.
The signal from pin 6 (intermittent speed) of **B68** reaches the intermittent device **N14** (pin INT) from where it is then sent to the motor **P1** (pin COM).
Turning the switch (ring) ... of the lever unit **B68** either no, or one (R1), or two (R2) resistances are connected on the same line, thereby obtaining three intermittent speeds.

Rearscreen wiper
Operating the rearscreen wiper ring switch ... the signal is sent from pin 7 of **B68** to **N14** (pin IL). The intermittent device sends a command (from pin CL to the rearscreen wiper motor **P21** which is supplied from the ignition switch via fuse **F4** of **G1** (box "A" or "B") and via fuse **F3** of **G1** (box "C").
This motor comprises the gear motor, stroke limit contacts and the supply relay switch.

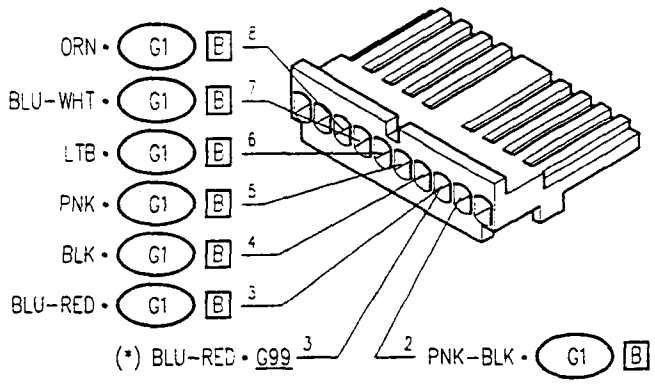
Windscreen/rearscreen washer
When operated, the windscreen washer (and headlamp washer) switch ... of the lever unit **B68** sends two signals from pin 2 and from pin 5 which reach the intermittent device **N14** (pin PL and P) for operating the windscreen washer for 4 sec., and they operate the windscreen washer pump **P19**; a command signal is also sent to the headlamp washer timer **N12.**

Pump **P19** is two-way: it sends water to the spray jets of the windscreen washer or rearscreen washer depending on the terminal supplied with 12V while the other is connected to earth.

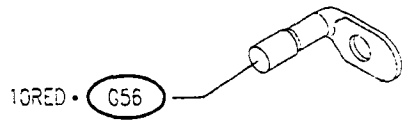
Headlight washer
The timer **N12**, located on the bracket outside the fusebox **G1**, is supplied directly by the battery through fuse **G312** (20A).
When the consensus signal resulting from the side lights being on reaches the relay in addition to the lever unit switch command, the relay switch inside **N12** is energized which supplies the headlamp washer pump **P20** for about half a second.
From chassis no.__ the enable signal is received by the turning on of the dipped beams.

COMPONENTS AND CONNECTORS

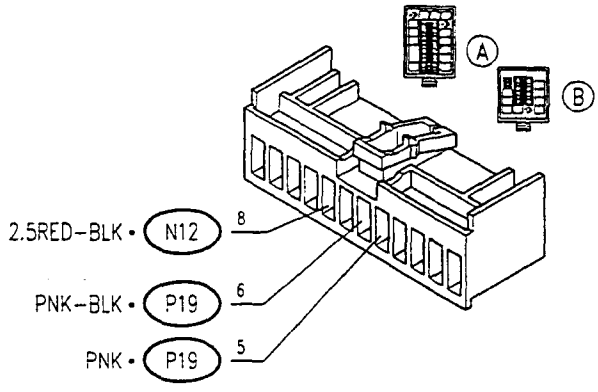
Lever unit	B68 B



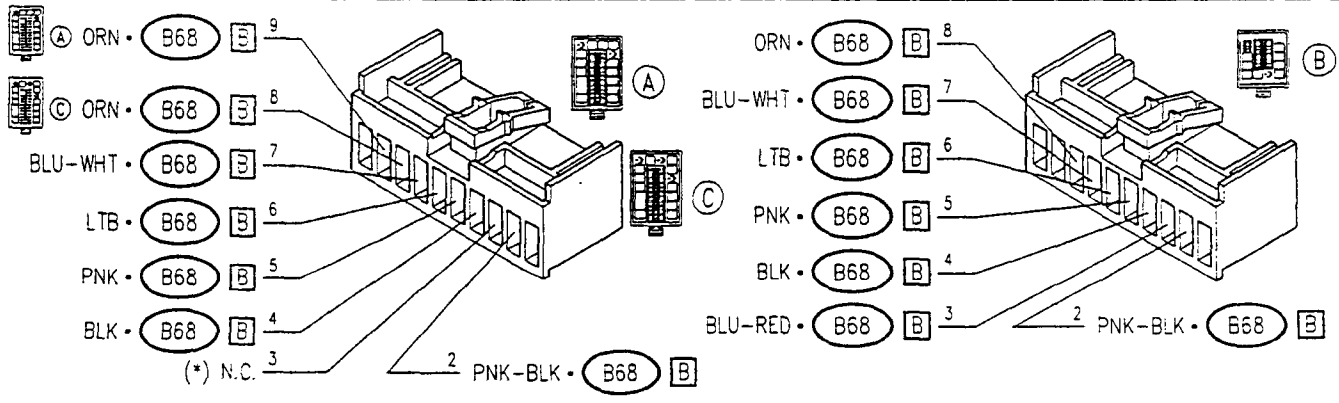
Fusebox	G1



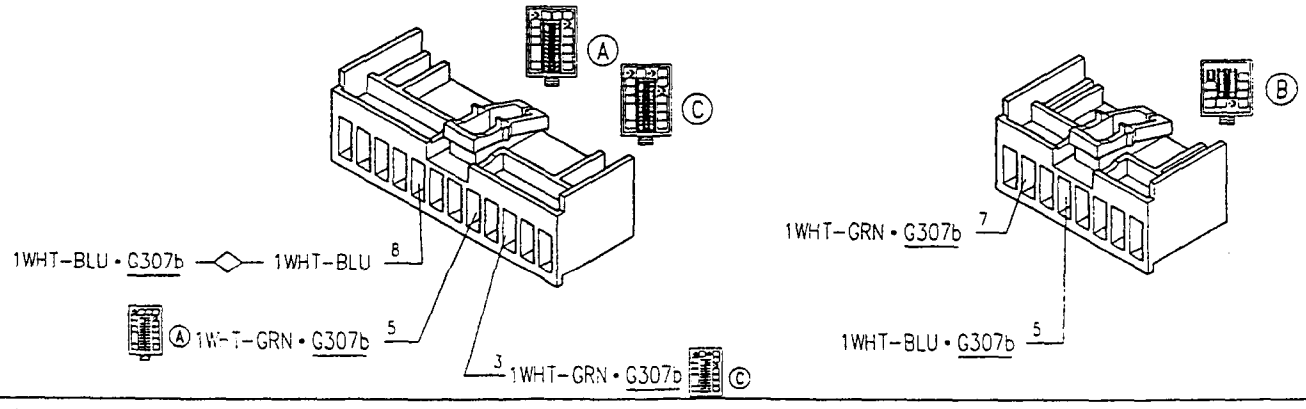
Fusebox	G1 A



Fusebox	G1 B



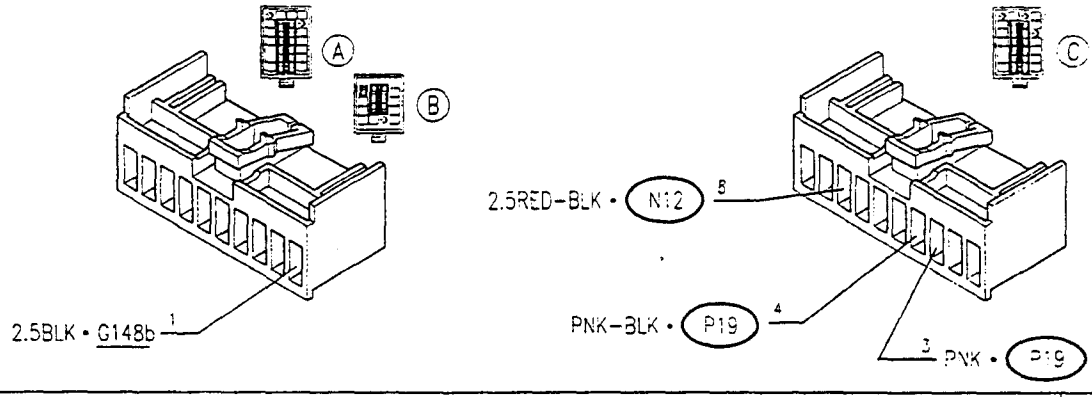
Fusebox	G1 E



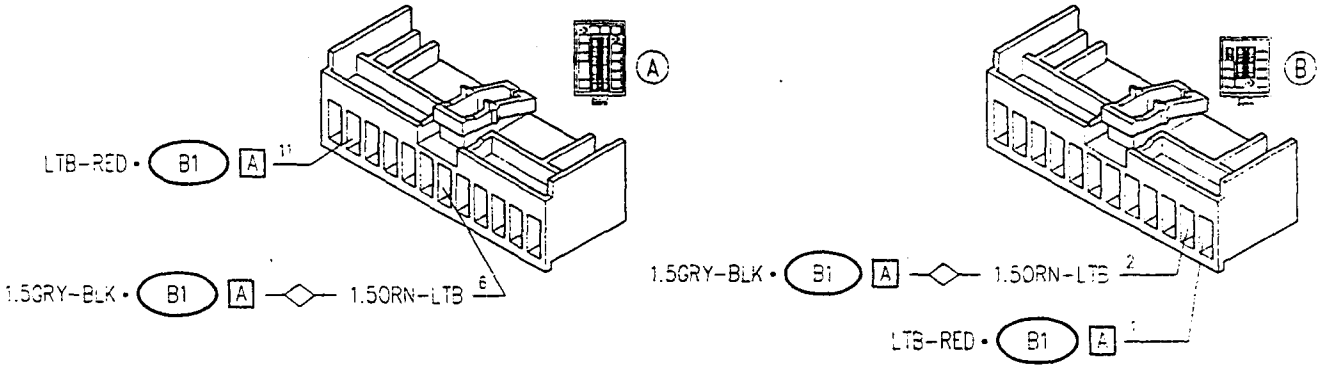
(*) from Model Year '97

COMPONENTS AND CONNECTORS (cont.d)

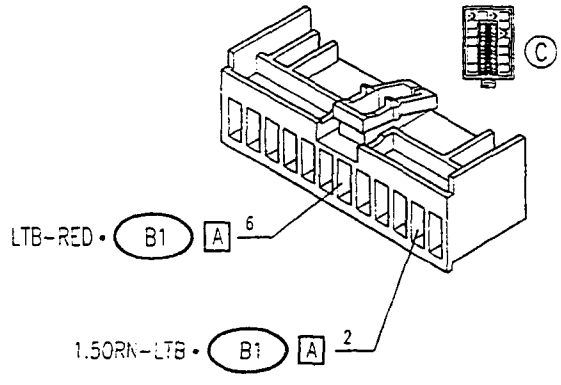
Fusebox — G1 G



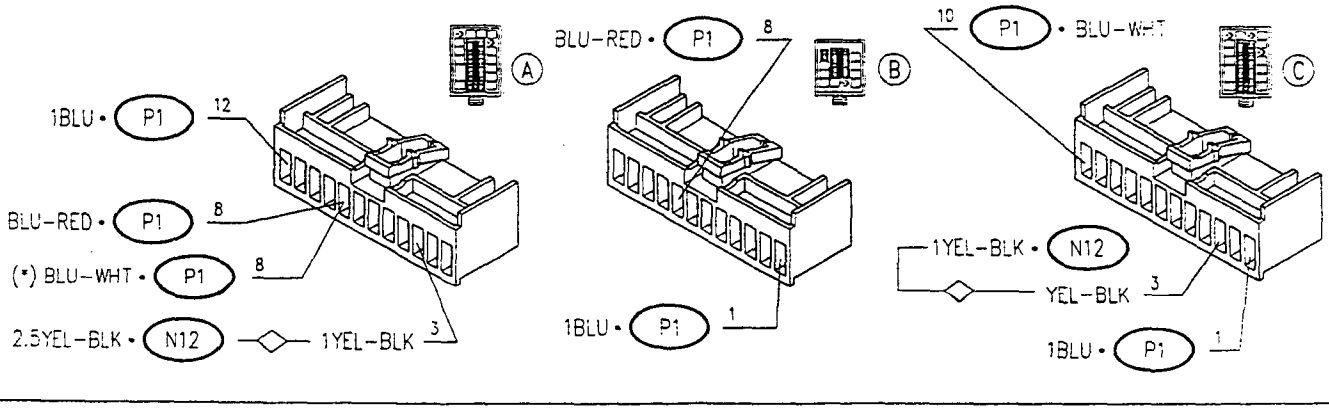
Fusebox — G1 H



Fusebox — G1 H

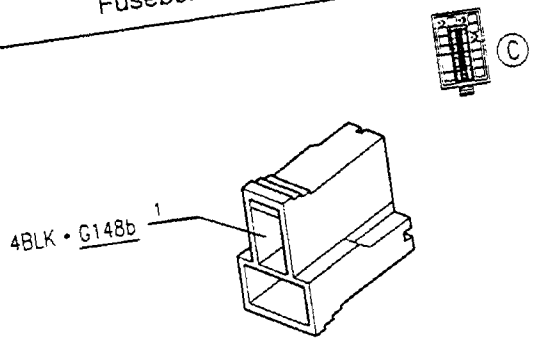


Fusebox — G1 I

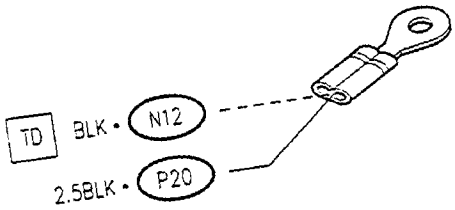


COMPONENTS AND CONNECTORS (cont.d)

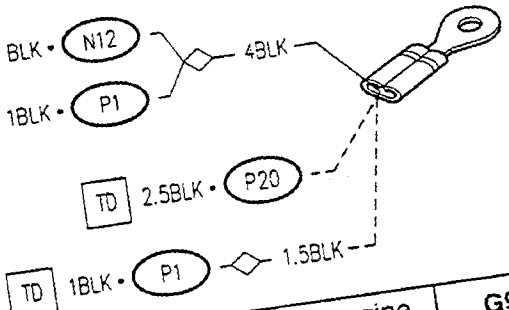
Fusebox — G1 N



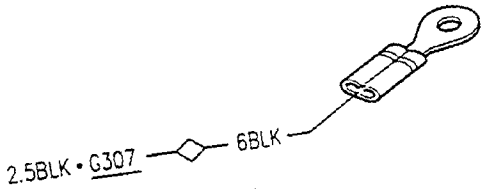
RH engine compartment earth — G53a



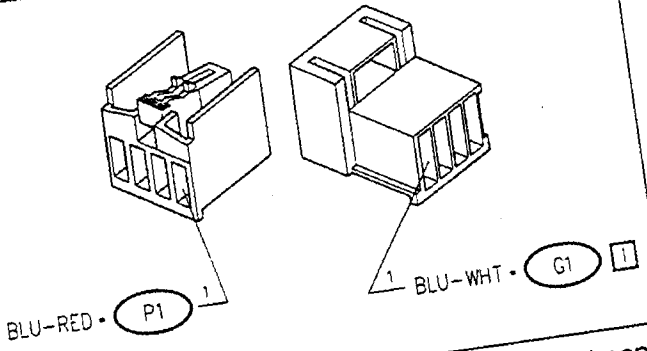
LH engine compartment earth — G53b



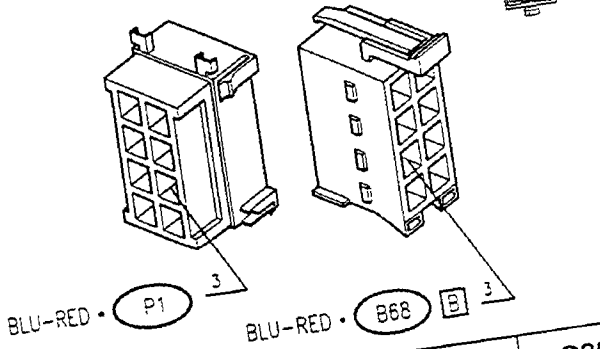
RH rear earth — G63a



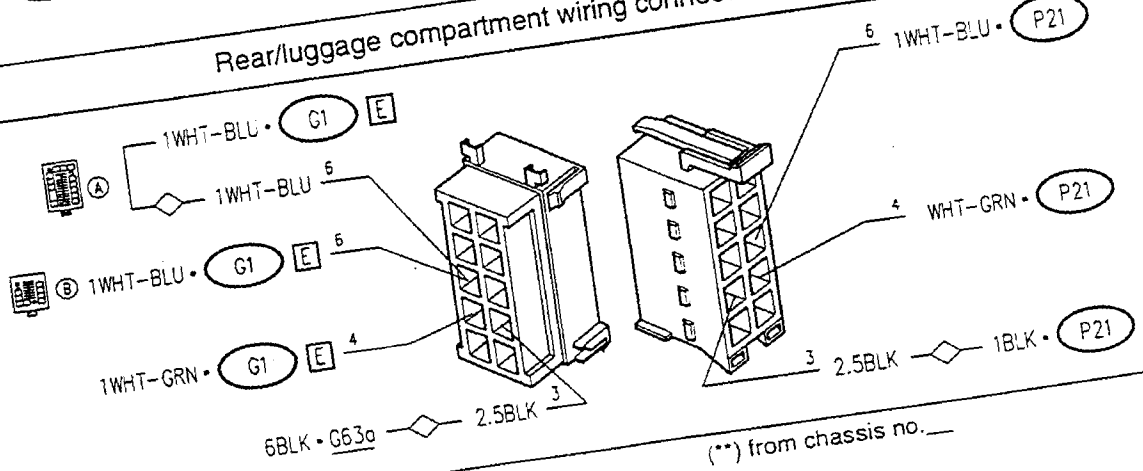
Connector for dashboard wiring/engine wiring (*) — G99



Connector for dashboard wiring/engine wiring (**) — G99



Rear/luggage compartment wiring connector — G307



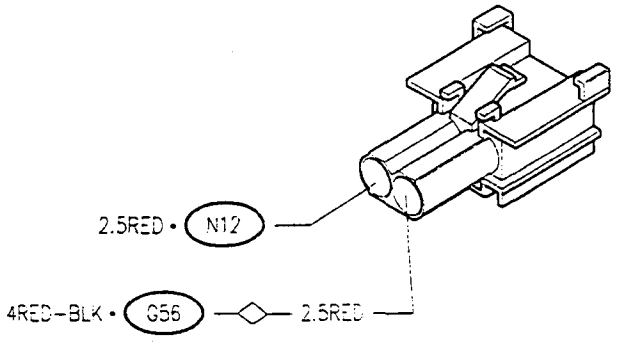
(*) from Model Year '97 - up to chassis no.

(**) from chassis no.

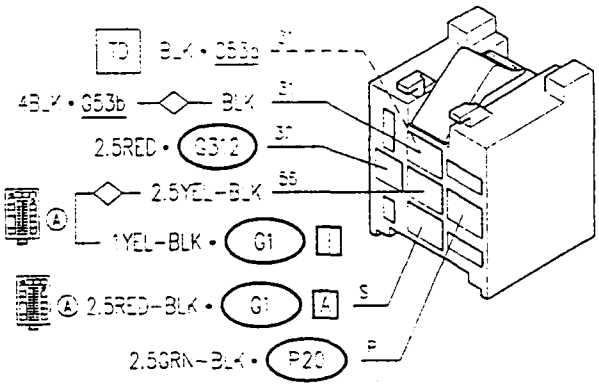
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COMPONENTS AND CONNECTORS (cont.d)

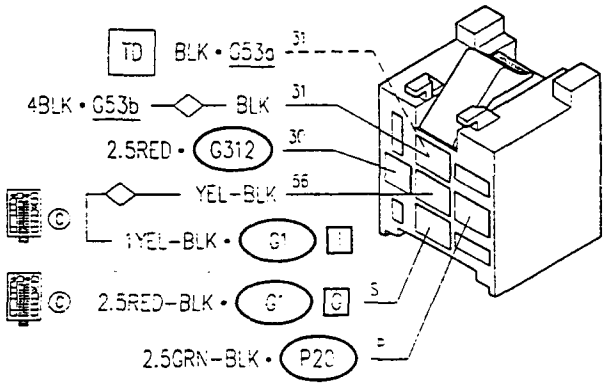
Fuse for headlamp washer — G312



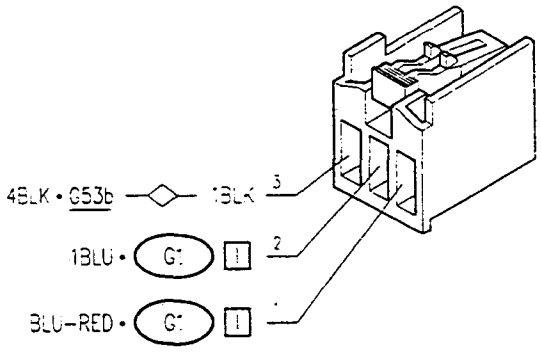
Timer for headlamp washer — N12



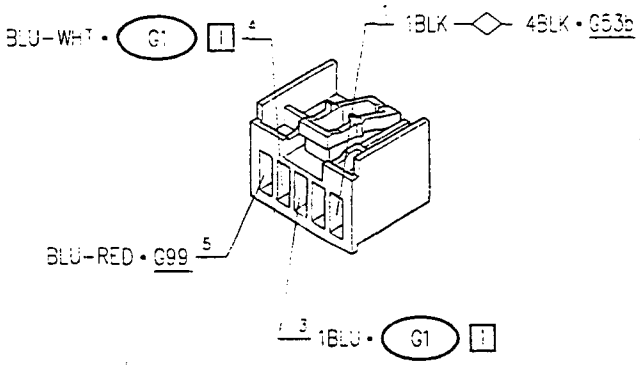
Timer for headlamp washer — N12



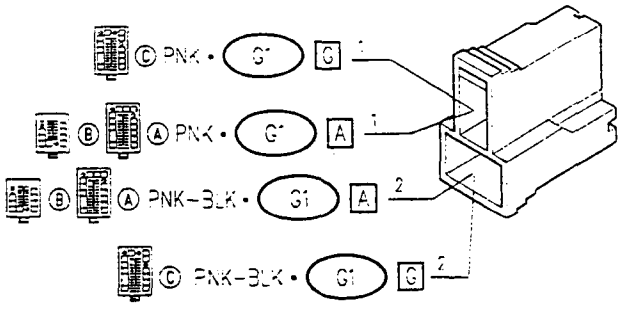
Windscreen wiper motor — P1



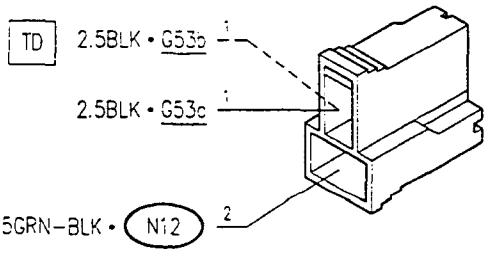
Windscreen wiper motor (*) — P1



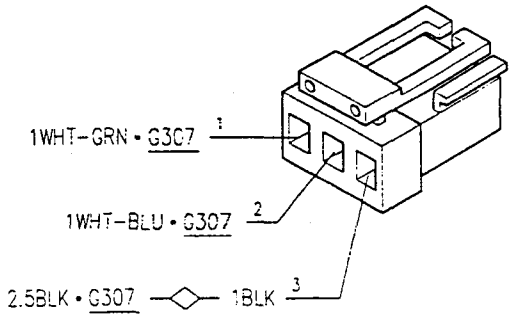
Windscreen/rearscreen washer pump — P19



Headlight washer pump — P20

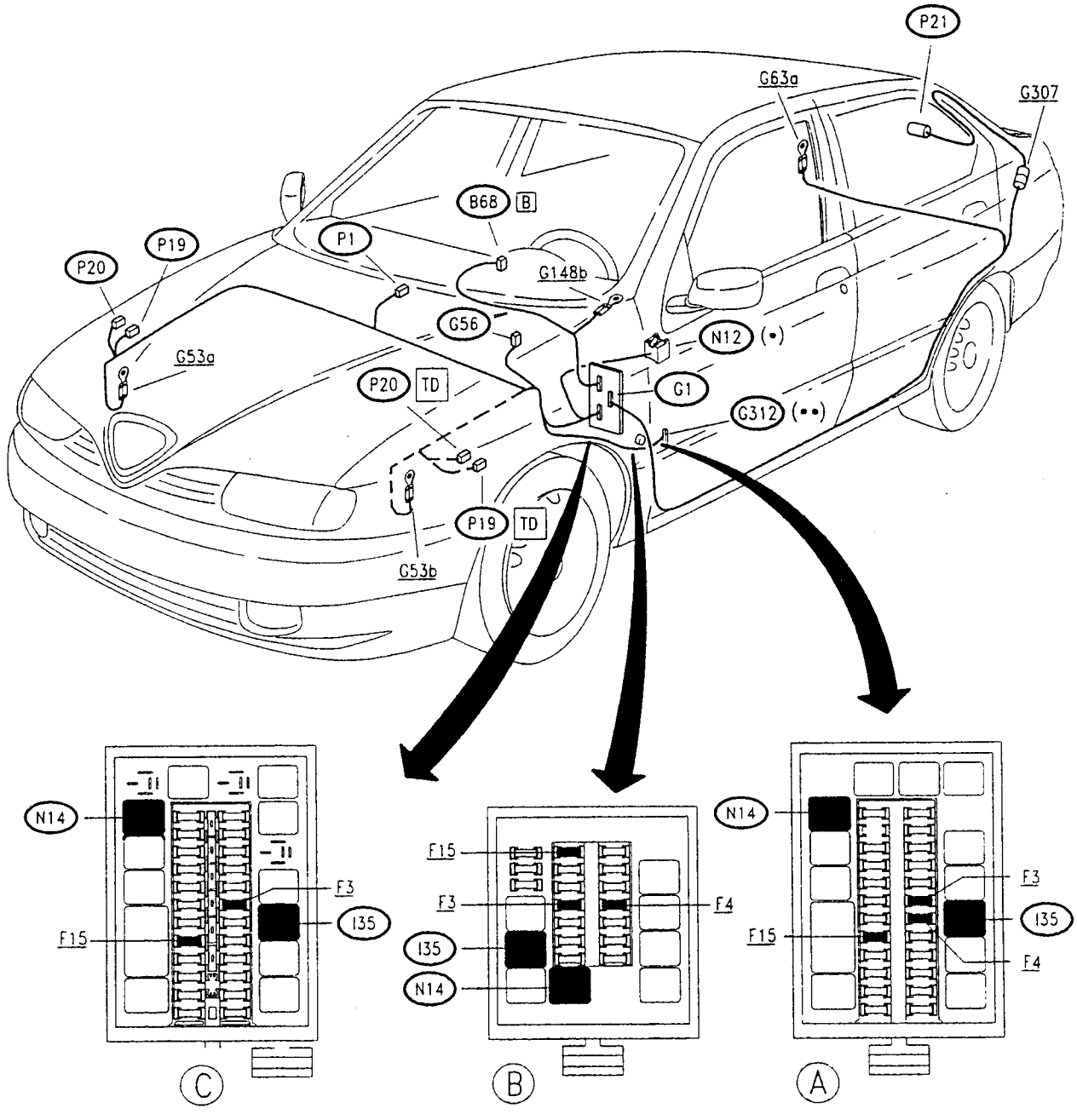


Rearscreen wiper motor — P21



(*) from Model Year '97

LOCATION OF COMPONENTS



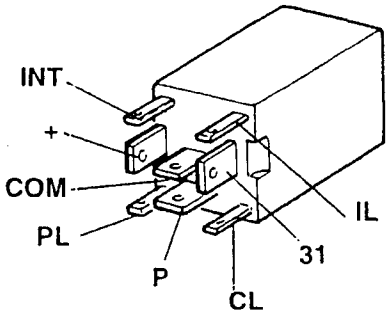
(•) black base
(••) yellow fuseholder

FAULTFINDING TABLE

Failure	Component to be checked										
	F3	F4	F15	G312	P1	P21	P20	P19	N14	N12	B68
Windscreen wiper (cont. speed)	•				•						•
Windscreen wiper (intermitt.speed)									•		•
Rearscreen wiper		•				•			•		
Windscreen/rearscreen washer			•					•			•
Headlight washer			•	•			•			•	

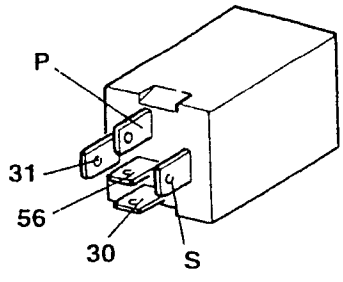
CHECKING COMPONENTS

Windscreen wiper electronic intermittent device (N14)



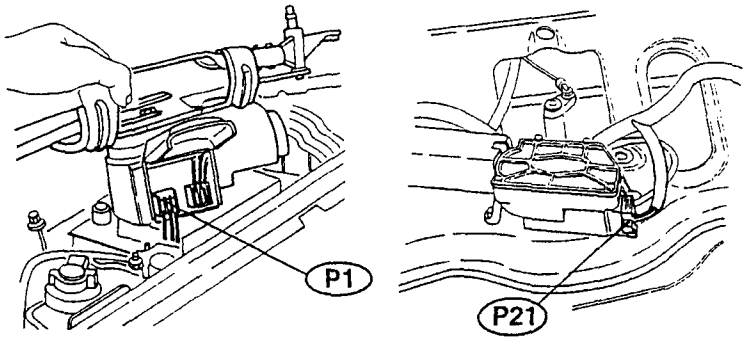
Checking the device: see **TEST A**

Headlamp washer timer (N12)



Checking the device: see **TEST B**

Windscreen wiper motor (P1) - rearscreen wiper motor (P21)



P1 up to Model Year '96, **P21**

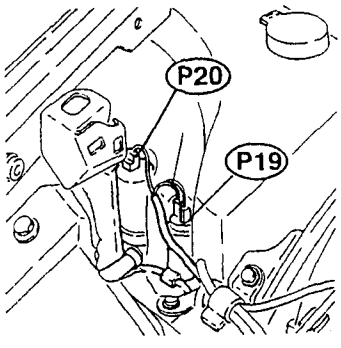
SPECIFICATIONS
with 12V at pin 3 and earth at pin 2: applying an earth at pin 1 the motor operates continuously

P1 from Model Year '97

SPECIFICATIONS
with 12V at pin 3 and earth at pin 1; applying an earth at pin 5 continuous motor operation is obtained at 1st speed; at pin 4 there is the 2nd speed. pag. 3

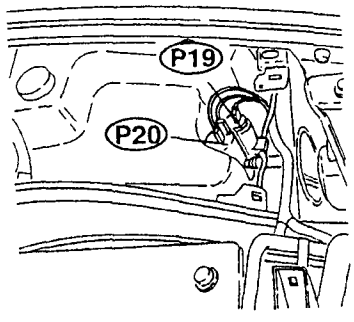
Windscreen/rearscreen washer pump (two-way) (P19)

Boxer



SPECIFICATIONS	
12V at pin 1 and 0V at pin 2	operation of windscreen washer
12V at pin 2 and 0V at pin 1	operation of rearscreen washer

TD

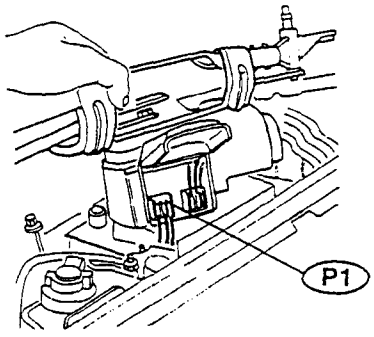


CHECKING WIPER ELECTRONIC INTERMITTENT DEVICE (N14) — TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N14** and on the corresponding base of the fusebox **G1**: with the key at MARCIA, check for 12V at pin + of **N14**	OK →	Carry out **step A2**
	NO →	Check fuse **F3** and relay switch **I35** of fusebox **G1**
A2 CHECK EARTH – Check for 0V at pin 31 of **N14**	OK →	Carry out **step A3**
	NO →	Check that fusebox **G1** is connected to earth: from pin 1 of connector G towards earth **G148b**
A3 CHECK WINDSCREEN WIPER INTERMITTENCE SIGNAL – Operate the different intermittent speeds of the windscreen wiper through the ring switch on the lever unit **B68** and check: - 0 Ω between pin INT and pin 31 at **N14** for max. speed - 1.3 kΩ between pin INT and pin 31 at **N14** for intermediate speed - 6 kΩ between pin INT and pin 31 at **N14** for min. speed	OK →	Carry out **step A4**
	NO →	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A4 CHECK WINDSCREEN WASHER SIGNAL – Operate the windscreen washer and check for 12V at pin P of **N14**	OK →	Carry out **step A5**
	NO →	Check fuse **F15** of **G1** or the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A5 CHECK REARSCREEN WASHER SIGNAL – Operate the rearscreen washer and check for 0V at pin PL of **N14**	OK →	Carry out **step A6**
	NO →	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A6 CHECK REARSCREEN WIPER SIGNAL – Operate the rearscreen and check for 0V at pin IL of **N14**	OK →	Insert device **N14** on the corresponding base of fusebox **G1** and continue with **step A7**
	NO →	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter

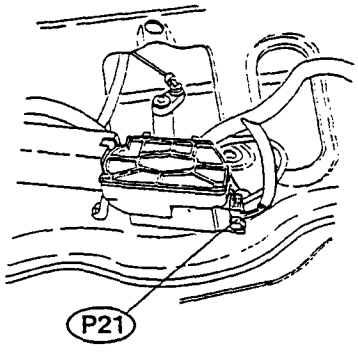
(cont.d)

Windscreen wiper motor (P1) - rearscreen wiper motor (P21)



P1 up to Model Year '96

SPECIFICATIONS
with 12V at pin 3 and earth at pin 2: applying an earth at pin 1 the motor operates continuously

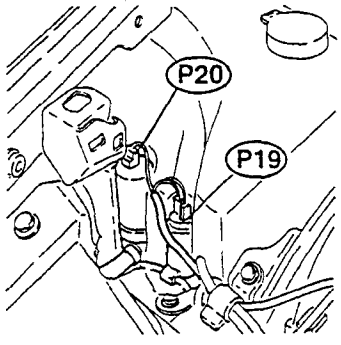


P1 from Model Year '97

SPECIFICATIONS
with 12V at pin 3 and earth at pin 1; applying an earth at pin 5 continuous motor operation is obtained at 1st speed; at pin 4 there is the 2nd speed. pag. 3

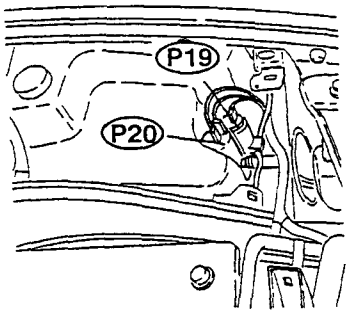
Windscreen/rearscreen washer pump(two-way) (P19)

Boxer



SPECIFICATIONS	
12V at pin 1 and 0V at pin 2	operation of windscreen washer
12V at pin 2 and 0V at pin 1	operation of rearscreen washer

TD



CHECKING WIPER ELECTRONIC INTERMITTENT DEVICE (N14) — TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N14** and on the corresponding base of the fusebox **G1**: with the key at MARCIA, check for 12V at pin + of **N14**	OK ➡	Carry out **step A2**
	~~OK~~ ➡	Check fuse **F3** and relay switch **I35** of fusebox **G1**
A2 CHECK EARTH – Check for 0V at pin 31 of **N14**	OK ➡	Carry out **step A3**
	~~OK~~ ➡	Check that fusebox **G1** is connected to earth: from pin 1 of connector G towards earth **G148b**
A3 CHECK WINDSCREEN WIPER INTERMITTENCE SIGNAL – Operate the different intermittent speeds of the windscreen wiper through the ring switch on the lever unit **B68** and check: - 0 Ω between pin INT and pin 31 at **N14** for max. speed - 1.3 kΩ between pin INT and pin 31 at **N14** for intermediate speed - 6 kΩ between pin INT and pin 31 at **N14** for min. speed	OK ➡	Carry out **step A4**
	~~OK~~ ➡	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A4 CHECK WINDSCREEN WASHER SIGNAL – Operate the windscreen washer and check for 12V at pin P of **N14**	OK ➡	Carry out **step A5**
	~~OK~~ ➡	Check fuse **F15** of **G1** or the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A5 CHECK REARSCREEN WASHER SIGNAL – Operate the rearscreen washer and check for 0V at pin PL of **N14**	OK ➡	Carry out **step A6**
	~~OK~~ ➡	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter
A6 CHECK REARSCREEN WIPER SIGNAL – Operate the rearscreen and check for 0V at pin IL of **N14**	OK ➡	Insert device **N14** on the corresponding base of fusebox **G1** and continue with **step A7**
	~~OK~~ ➡	Check the wiring between **N14** (**G1**) and the lever unit **B68**, or change the latter

(cont.d)

CHECKING WIPER ELECTRONIC INTERMITTENT DEVICE (N14)	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A7 CHECK WINDSCREEN WIPER INTERMITTENT OPERATION		
– Operate the different intermittent speeds of the windscreen wiper through the ring switch on the lever unit **B68** and check for a cyclic signal at pin 8 of connector I of fusebox **G1**: - 45 cycles per minute for max. speed - 25 cycles per minute for intermediate speed - 15 cycles per minute for min. speed	OK ▶ ~~OK~~ ▶	Carry out **step A8** Change device **N14**
A8 CHECK WINDSCREEN WIPER ACTUATION FOR WINDSCREEN WASHER		
– Operating the windscreen washer, check for a continuous signal at pin 8 of connector I of **G1** for about 4 seconds	OK ▶ ~~OK~~ ▶	Carry out **step A9** Change device **N14**
A9 CHECK ACTUATION OF REARSCREEN WIPER FOR REARSCREEN WASHER		
– Operating the rearscreen washer, check for a cyclic signal (15 cycles per minute) at pin 8 of connector E at **G1**; this signal remains for about 4 seconds	OK ▶ ~~OK~~ ▶	Carry out **step A10** Change device **N14**
A10 CHECK ACTUATION OF REARSCREEN WIPER		
– Operating the rearscreen wiper, check for a cyclic signal (15 cycles per minute) at pin 8 of connector E of **G1**	OK ▶ ~~OK~~ ▶	DEVICE **N14** IS WORKING PROPERLY. Check the connections with the other components Change device **N14**

CHECKING THE HEADLAMP WASHER TIMER (N12) — TEST B

Work with the component fitted on its connector acting from the cable inlet side

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK VOLTAGE – Check for 12V between pins 30 and 31 of **N12**	OK ▶	Carry out **step B2**
	~~OK~~ ▶	Check fuse **G312** (20A). Restore the wiring between **N12** and **G312**, and between **N12**and earth **G53b**
B2 CHECK VOLTAGE – With the side lights on, check for 12V at pin 56 of **N12**	OK ▶	Carry out **step B3**
	~~OK~~ ▶	Check that the side lights are working properly; also check the wiring between **N12** and **G1**
B3 CHECK VOLTAGE – Operating the windscreen washer with the side lights on, check for 12V at pin S of **N12**	OK ▶	Carry out **step B4**
	~~OK~~ ▶	Restore the wiring between **N12** and **G1** or check that the **windscreen washer** is working properly
B4 CHECK HEADLAMP WASHER CONTROL – Operating the windscreen washer with the side lights on, check for 12V at pin P di **N12** for about 0.5 seconds 0,5	OK ▶	DEVICE **N12** IS WORKING PROPERLY. Check the connections with the other components
	~~OK~~ ▶	Change device **N12**

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ELECTRIC SYSTEM DIAGNOSIS 55

INDEX

This group: "146 - ELECTRIC SYSTEM DIAGNOSIS" only contains the sections which are specific to the car in question. For all the sections not contained herein - marked with * in the index below -, refer to: "145 - ELECTRIC SYSTEM DIAGNOSIS" because the items or systems described are the same as those for the 145 model.

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For all the other sections not contained herein - marked with * - refer to: "145 - ELECTRIC SYSTEM DIAGNOSIS"

WARNING!

From chassis no._____ the 146 models are fitted with the "ALFA ROMEO CODE" system as a **standard** item: this is an **innovative electronic anti-theft protection system** which inhibits the operation of the engine management control unit (Petrol versions) or of the engine stop solenoid valve (TD version).

BEFORE PROCEEDING WITH ANY WORK ON THE ELECTRIC SYSTEM OF THE VEHICLE, IN PARTICULAR ON THE ENGINE CONTROL SYSTEMS, CAREFULLY READ THE SPECIAL SECTION: "ALFA ROMEO CODE".

POWER SUPPLY

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GENERAL DESCRIPTION

All the electric systems and devices are supplied by the battery **A1** at 12 V.
The lines through which the battery voltage is distributed to the various services are shown in the wiring diagrams corresponding to the various functions and systems.
This general diagram shows all the lines as they branch from the battery and from the branch terminal box **G56**, for further details, reference should be made to the specific diagrams.
Some circuits are supplied continuously, also when the vehicle is stopped and the key disengaged, as they are connected directly to the battery A1.
Other circuits are supplied turning the key in the ignition switch B1 to the different positions:

- inserting the key and turning it to the first position the key moves to "DRIVE" and supplies a number of circuits, which are in fact known as "key-operated";
- the second position "START" - supplies the starter motor, while disconnecting some other circuits (those that absorb more power) thereby ensuring the highest flow of current to the motor itself;
- removing the key and turning it in the opposite direction (and pressing the special button) the "PARK" position is engaged which supplies the sidelights also when the key has been removed.

In the wiring diagrams these different types of supply are shown schematically by the following symbols:


- line always supplied


- line supplied with the ignition key at "DRIVE"


- line supplied with the ignition key at "START"


- line supplied with key engaged (in both the previous positions).


- line supplied with the ignition key at "PARK"

NOTE: this general wiring diagram makes it possible to easily locate the circuits supplied by the same line: this simplifies fault-finding in the case of problems involving more than one system.

NOTE: (Boxer and TD version) the terminal branch box G56 has been newly designed and is highly reliable and safe. The procedure for removing and connecting the single connectors in the terminal box is described at the end of this section.

The T.SPARK version has a branch terminal box with incorporated fuses (see following pages).

Protection and safety systems

The entire electric system of the 146 has been designed and made taking account of the latest directives on the subject of safety and protection, especially against the possibility of fire.

There are two main types of protection:

- **active protection**, to reduce possible causes of faults "at the source"
- **passive protection**, to minimise the effects of any faults.

The first category involves attentive design of the wiring harnesses, positioning and fastening them accurately and carefully defining suitably shielded and protected routes.

For this reason the alternator and starter motor cables have been suitably modified, with the adoption of protective caps, etc.

Passive protections include all measures, which have always been adopted on cars, to reduce high fault currents (overload and short circuit).

All the fuses of the system have been sized according to the nominal absorption of the loads that can be operated contemporaneously, and in such a way as to ensure that they cut in in the event of short circuit.