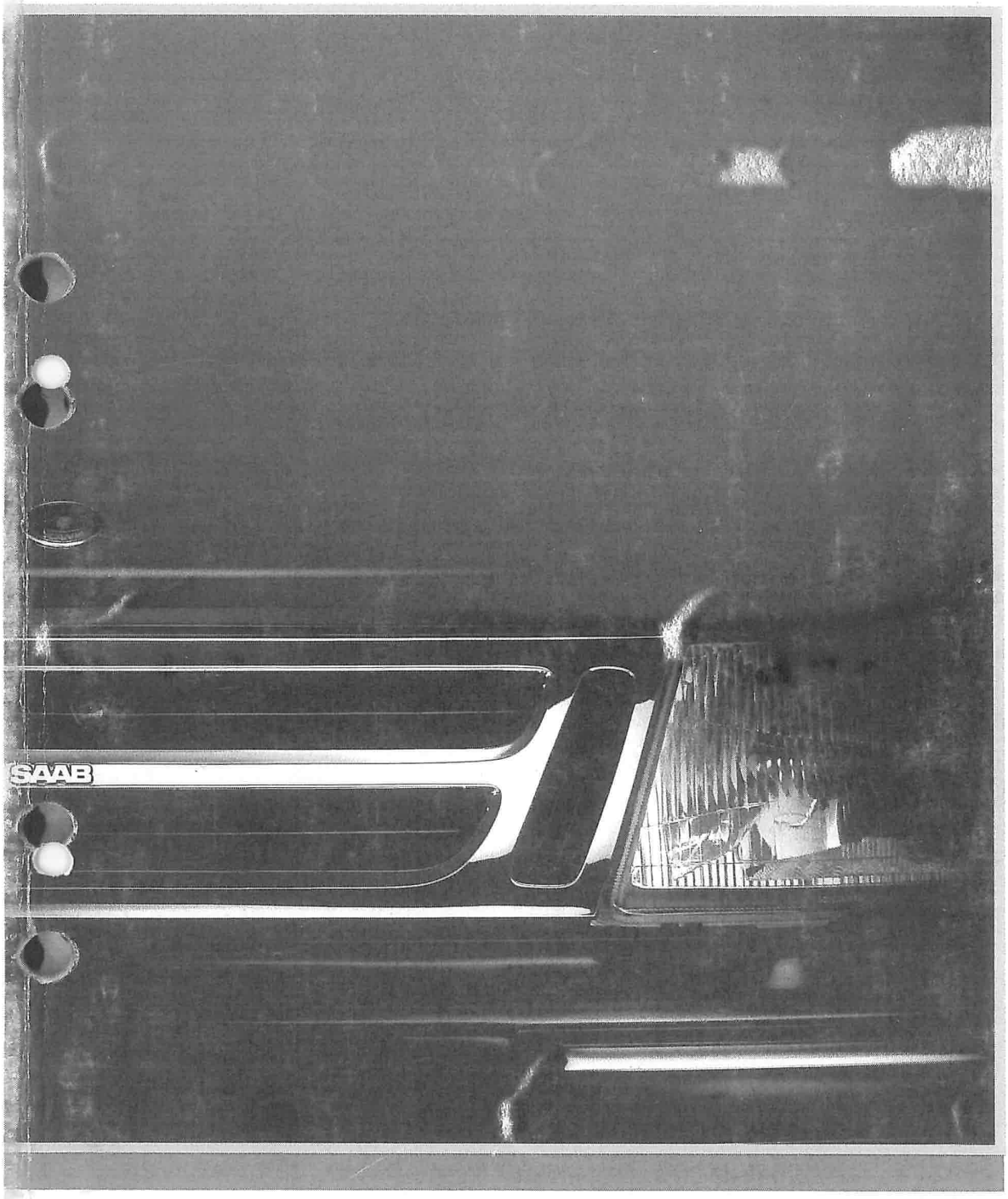
Saab 900

SERVICE MANUAL



SAAB

2:3 Fuel system, injection engine

M 1981–93

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Saab 900

SERVICE MANUAL

2:3 Fuel system Injection engine
M 1981–93

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Units

The basic and derived units used throughout the Service Manual are in accordance with the SI system. (Systéme International d'Unités)

For users not familiar with the SI units, some non-Continental units are given in brackets after the respective SI unit.

The following symbols and abbreviations are used:

SI unit	Equivalent unit and symbol
Millimeter (mm)	inch (in)
Kilograme (kg)	pound (lb)
Newton (N)	pound-force (lbf)
Newtonmeter (Nm)	foot pound (ft lb)
Atmosphere (bar)	pound-force per square inch (lbf/in^2) (Also abbreviated: psi)
Liter (l)	US liquid quart (liq qt) (Also abbreviated: qts)
	US gallon (USgal)
°Celcius (°C)	°Fahrenheit (°F)

Conversion factors

1 in = 25.4 mm	1 mm = 0.039 in
1 lb = 0.45 kg	1 kg = 2.20 lb
1 lbf = 4.45 N	1 N = 0.23 lbf
1 lbf ft = 1.36 Nm	1 Nm = 0.74 lbf ft
1 psi = 0.07 bar	1 bar = 14.5 lbf/in^2
1 US liq qt = 0.83 UKqt	1 l = 1.05 liq qt
	1 USgal = 0.83 UKgal
°F = °C x 9/5 + 32	°C = (°F - 32) x 5/9

Market codes

The codes refer to market specifications

AT	Austria	GB	Great Britain
AU	Australia	GR	Greece
BE	Belgium	IS	Iceland
CA	Canada	IT	Italy
CH	Switzerland	JP	Japan
DE	Germany	ME	Middle East
DK	Denmark	NL	Netherlands
ES	Spain	NO	Norway
EU	Europe	SE	Sweden
FE	Far East	US	USA
FI	Finland	UC	US California
FR	France		

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Production: Service Support, Saab Automobile AB, Trollhättan, Sweden

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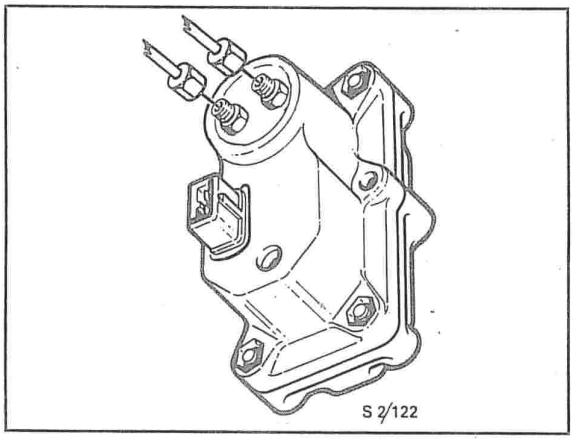
Technical data

Fuel system,
B201 fuel injection engine. 022-1
Fuel system,
B202 fuel injection engine. 022-4
Setting of idling speed 022-11

Fuel system, B201 engine

Pressure

		Turbo	Other engines
System pressure, checking value	bar (psi)	5.1-5.8 (74-84)	4.5-5.2 (65-75)
setting value	bar (psi)	5.3-5.5 (77-80)	4.7-4.9 (68-71)
Tightness test, minimum pressure after 20 min.	bar (psi)	1.5 (21.5)	1.5 (21.5)
Control pressure, engine at normal operating temperature	bar (psi)	3.4-3.8 (46-55)	3.4-3.8 (46-55)
Control pressure at full load, engine at normal operating temperature, boost pressure >0.4 bar (5.8 psi)	bar (psi)	2.4-2.8 (35-41)	



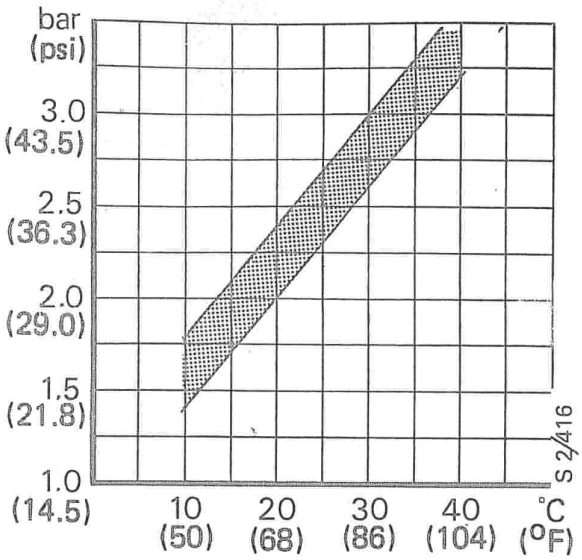
Control pressure regulator

Turbo,	1981-82	Bosch No. 0438140:	...085
	1983	Bosch No. 0438140:	...084 (US)
	1982-	Bosch No. 0438140:	...102
	1984-	Bosch No. 0438140:	...136 (US, CA)*
Other	-1982	Bosch No. 0438140:	...020
	1982	Bosch No. 0438140:	...085 (CA, manual gearbox) ...020 (CA, automatic transmission)
	-1983	Bosch No. 0438140:	...084 (US)
	1983	Bosch No. 0438140:	...011
	1983-84	Bosch No. 0438140:	...111 (superseded by ...020 in 1984)
	1984-	Bosch No. 0438140:	...136 (US, CA)
	1985-	Bosch No. 0438140:	...020

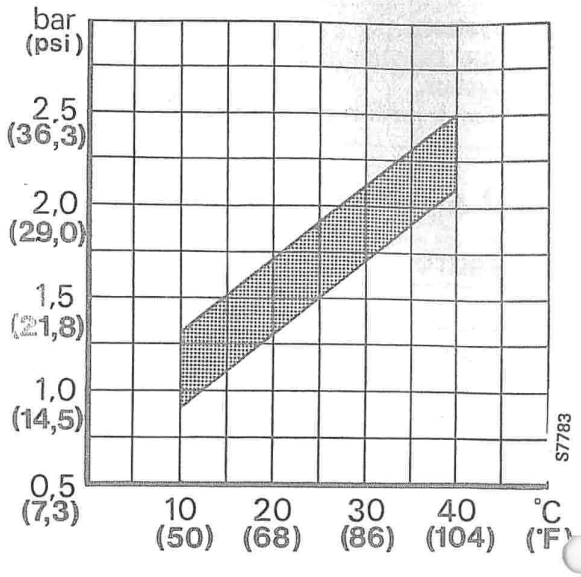
*) Earlier 1984 cars:
Bosch No. 0438140084 with green colour code.

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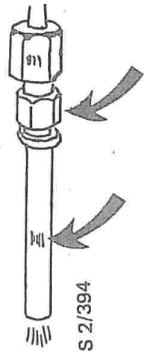
Control pressure, cold engine

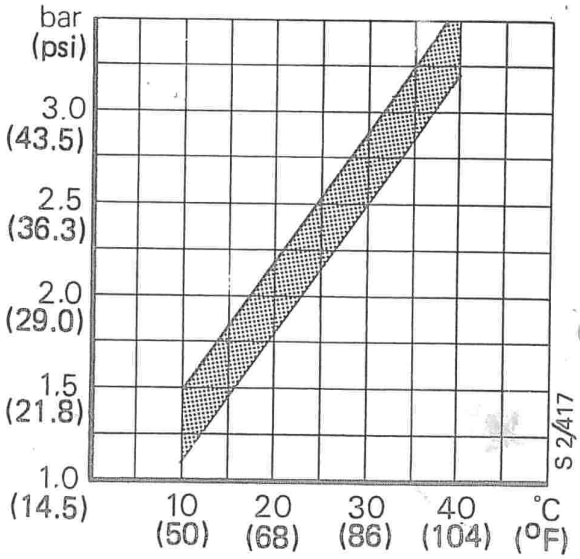


Bosch No. 0438140084



Bosch No. 0438140084: 020
085
111
070
102





Bosch No. 0438140: 084 (with green colour code)
136

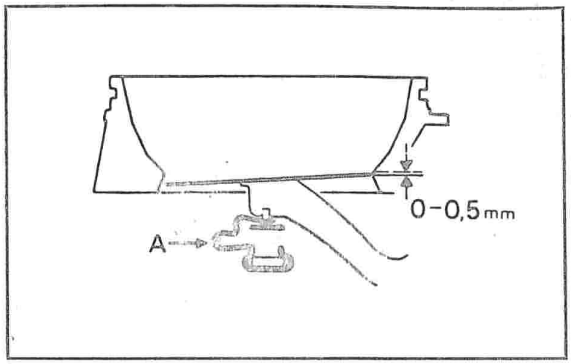
Injectors

Opening pressure	bar (psi)	3.0-4.1 (44-60)	3.7 (53.7)
Tightness test*	bar (psi)	2.4 (35)	2.7 (39.2)
Bosch No.		0437502012	0437502056

*) No leakage is permissible at this pressure during a 15-second period.
The test should be carried out at the residual pressure.

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Mass air flow sensor



Sensor plate in rest position.
The ignition must be switched off during the test.

Tightening torques

Stop bracket retaining bolts	Nm (lbf ft)	4.7-5.3 (3.5-3.9)
Counterweight retaining screw	Nm (lbf ft)	4.7-5.3 (3.5-3.9)
Sensor plate retaining bolt	Nm (lbf ft)	5.0-5.5 (3.7-4.1)
Fuel-flow meter retaining screws	Nm (lbf ft)	3.2-3.8 (2.3-2.8)
Screw plug for line pressure regulator	Nm (lbf ft)	13-15 (9.6-11.0)
M8 bolts	Nm (lbf ft)	10-12 (7.4-8.9)
M10 bolts	Nm (lbf ft)	13-15 (9.6-11.0)
M12 bolts	Nm (lbf ft)	20-24 (14.8-17.7)
M14 bolts	Nm (lbf ft)	15-20 (11.0-14.8)
M12 cap nuts	Nm (lbf ft)	15-20 (11.0-14.8)
M14 cap nuts	Nm (lbf ft)	25-30 (18.5-22.0)

Fuel booster

Type		Boost-pressure influenced full-load enrichment
Simulated boost pressure when drop in control pressure occurs	bar (psi)	0.33-0.40 (4.8-5.8)
Reduced control pressure (at boost pressure in excess of 0.4 bar)	bar (psi)	2.4-2.8 (3.5-4.0)
CO value at idling speed with simulated boost pressure in excess of 0.4 bar	%CO	approx. 4-6

Fuel tank

Total capacity, model year -1989	litres (qts)	63 (66)
1990-	litres (qts)	68 (71)
Capacity when fuel level warning lamp lights up -1989	litres (qts)	approx. 7 (7.4)
Capacity when fuel level warning lamp lights up 1990-	litres (qts)	approx. 10 (10.6)

Fuel pump

Capacity - measured in return pipe	$cm^3(in^3)$/30s	min 900 (54.9)

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Fuel system, B202 engine

Pressure regulator - checking values

	Turbo -1986	Turbo 1987-	B202i 1986-
System pressure, bar (psi)	2.5 (36)	2.8 (40)	3.0 (43)
+0.2 (+2.9)	2.7 (39)	3.0 (43)	3.2 (46)
+0.4 (5.8)	2.9 (42)	3.2 (46)	3.4 (49)
+0.6 (8.6)	3.1 (45)	3.4 (49)	3.6 (52)
atm bar (psi)	2.5 (36)	2.8 (40)	3.0 (43)
-0.6 (8.6)	1.9 (28)	2.2 (32)	2.4 (35)
-0.4 (5.8)	2.1 (30)	2.4 (35)	2.4 (35)
-0.2 (2.9)	2.3 (33)	2.6 (37)	2.8 (40)

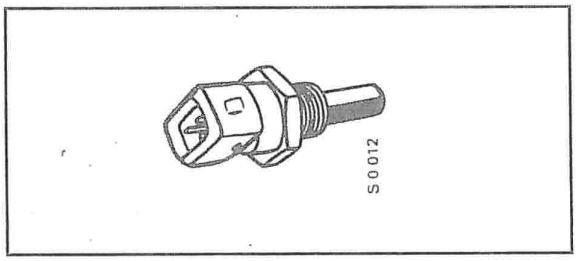
Tolerance range:

2.5 + 0.25/-0.15 bar (36 + 3.6/-2.3 psi)

2.8 + 0.25/-0.15 bar (40 + 3.6/-2.3 psi)

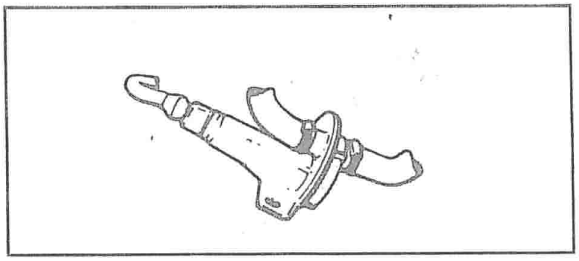
3.0 + 0.25/-0.15 bar (43 + 3.6/-2.3 psi)

Permitted tolerances when the test is carried out using workshop equipment and taking into account the temperature, fuel grade and the tolerance and calibration of the instrument: +5%.



Temperature sensor

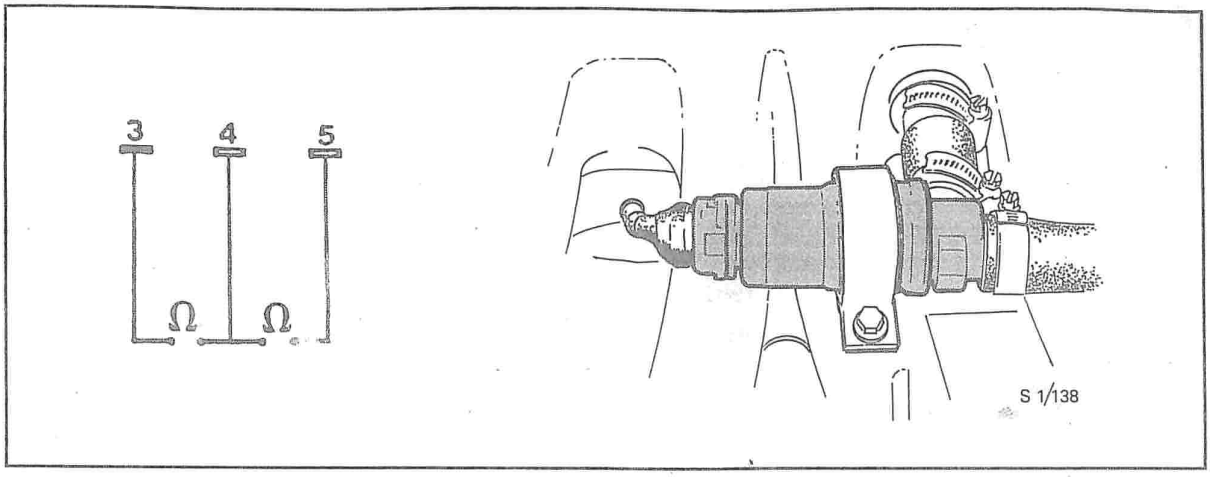
Designation		9357021 (Bosch 0280130026)
Resistance at 0°C (32°F	ohms	5800
20°C (68°F)	ohms	2600
80°C (176°F)	ohms	320
Designation		7485006 (Lucas 73355)
Resistance at -10°C ±1° (14°F)	ohms	7000-11600
20°C ±1° (68°F)	ohms	2100-2900
80°C ±1° (176°F)	ohms	270-390



Auxiliary air valve, 1985

Resistance at 20°C (68°F)	ohms	40-60

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Idle air control valve (IAC), 1986-

Resistance at 20°C (68 °F), LH2.2	ohms	20 ± 5
LH2.4	ohms	7 ± 5
LH2.4.2 (M91-)	ohms	12 ± 3

Full-load enrichment

Throttle switch (LH 2.2, 2.4) (butterfly angle when switch is closed)	degrees (°)	approx. 72
CO value under simulated full-load conditions	%	1-2
Throttle potentiometer, LH2.4.2. Ignition on, voltage across pins 2 and 3		
Idling	V	0.25
Full load	V	4.0

Lambda sensor

Signal voltage 0-1 V when system in operation. Pre-heater resistance 4 ± 2 ohms.

Lambda sensor for Lucas fuel injection system: Signal voltage 0-1 V when system in operation. Pre-heater resistance <10 ohms.

Injectors

Flow capacity

Fuel pressure regulator opening pressure (bar)	min (ml/30 s)
2.5 (turbo, not cat. 84.5-86 and turbo cat. 85-)	104
2.8 (turbo not cat. 86-89)	110
3.0 (i)	90
3.0 (Lucas)	145

Check that all injectors have the same flow capacity.

These values apply at room temperature (20± 1°C).

Injector opening times are proportional to engine load; higher engine load = longer injector opening time.

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Fuel pump

Capacity	$cm^3(in^3)$ /30s	min. 900 (54.9)

Fuel tank

Total capacity, model year -1989		litres (qts)	63 (66)
model year 1990-		litres (qts)	68 (71)
Capacity when fuel level warning lamp lights up	-1989	litres (qts)	approx. 7 (7.4)
	1990-	litres (qts)	approx. 10 (10.6)

Summary of LH components

To facilitate the handling of LH components, we have compiled a clear and simple summary of all those in existence.

The summary covers Saab 900 models and is divided into two tables. Table A covers cars **with** a catalytic converter and table B cars **without** a catalytic converter.

Table A. Specifications, fuel injection system Cars with a catalytic converter

Version	Model year	Engine	LH	Pressure regulator			HLM		Injectors		LH module	
				Bar	Bosch	SAAB	Bosch	SAAB	Bosch	SAAB	Bosch	SAAB
900iM, iA	86	B202	2.2	3.0	-256	7564123	1)-005	9375643	-711	7560162	-514	7525140
-"-	87	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-
-"-	88	-"-	2.4	-"-	-"-	-"-	2)-013	7538655	-"-	-"-	-536	7538689
-"-	88B	-"-	2.4	-"-	-"-	-"-	-"-	-"-	-760	7487028	-564	7487135
-"-	89	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-564	7487135
-"-	90	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-580	9119447
-"-	91	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-
-"-	92–	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-
-"-	91	B212	2.4.2	-"-	-706	748692	3)-019	9113838	-008	8788523	-901	8788507
-"-	92–	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-944	9128117
900 LM, LA	85	B202	2.2	2.5	-214	7501646	1)-005	9375643	-706	7509862	-515	7525595
-"-	86	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"- *	-537	7532146
-"-	87	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-712	7560170	-538	7536709
-"-	88	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-
-"-	88B	-"-	2.4	-"-	-"-	-"-	2)-013	7538655	-761	7487010	-570	8978348
-"-	89	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-
-"-	90	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-58[illegible]	[illegible]9454
-"-A)	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-582	9119462
900 LM, LA	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-585	9119454
-"-A)	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-582	9119462
900 LM, LA	92–	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-585	9119454

1)HLM 1, alum., 100°
2)HLM 2/4.7, plastic, 120°
3)HLM 2/4.7, plastic, 155°
A)EGR (US/Cal)
*) also 7560170

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Table B. Specifications, fuel injection system
Cars without a catalytic converter

Version	Model year	Engine	LH	Pressure regulator			HLM		Injectors		LH module	
				Bar	Bosch	SAAB	Bosch	SAAB	Bosch	SAAB	Bosch	SAAB
900iM	-89	B202	2.2	3.0	-256	7564123	[1]-017	8978280	-760	7487028	-573	9114703
900 iA	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-568	8975443
900 iM	90	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-573	9114703
900 iA	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-568	8975443
900 iM	91	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-573	9114703
900 iA	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-568	8975443
900 iM	92-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-573	9114703
900 iA	92-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-568	8975443
900 LM	84.5	-"-	-"-	2.5	-214	7501646	[2]-005	9375643	-706	7509862	-517	7514904
900 LM, LA	85	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-521	7526114
900 LM	86	-"-	-"-	-"-	-255	7564131	-"-	-"-	-"-	-"- *	-533	7529092
-"-	87	-"-	-"-	2.8	-264	7568041	-"-	-"-	-712	7560170	-547	7536683
-"-	88	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-
-"-	89	-"-	-"-	-"-	-"-	-"-	[1]-017	8978280	-761	7487010	-569	7487119

[1]HLM 2/4.7, plastic, 120°
[2]HLM 1, alum., 100°
[3]Lucas
*) also 7560170

Other LH components

Component	LH system			Car versions	Bosch	Saab
	2.2	2.4	2.4.2			
Temperature sensor	x	x	x	All	-026	9357021
Lambda sensor	x			Cat. cars -85	-009	7525603
Lambda sensor	x	x	x	Cat. cars 86-	-028	9392762
Knock sensor[1]	x			84.5-86 to engine No. G122318, inclusive	-001	9358037
Knock sensor[1]	x	x	x	87- all from engine No. G122319, inclusive	-006	7568801
Throttle switch, DKS	x	x		All except 2.4.2	-300	7501612
Throttle potentiom., DKG			x	2.4.2 M91-	-001	8857195
Idle air control valve, ZWD2	x			Cat. cars	-502	7516792
Idle air contr. valve, EWD		x			-516	7586019
Idle air control valve, ZWD3			x		-505	8857179
Auxiliary air valve	x			900 LA 85 EU 1	-153	7518673
Auxiliary air valve	x			900 LM, 900 iM EU 1	-107	8357832
Auxiliary air valve	x			900 iA EU 1	-122	9313909
Cold-start valve, KSV		x	x	900i B202, B212 Market EU 2	-432	7486129
Evaporative emission canister, complete	x			Cat. cars. Market ME	-	7532054
Evaporative emission canister, excl. TEV		x	x	All	-	7539216
Tank breather valve, TEV		x	x	All	-157	7539257
By-pass valve	x	x	x	All turbo	-103	9390022

[1]Part of APC and ignition system

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Lucas components

Cars with a catalytic converter

Version	Model year	Engine	CU	Pressure regulator			Mass air flow sensor		Injectors		Control module	
				Bar	Lucas	SAAB	Lucas	SAAB	Lucas	SAAB	Lucas	SAAB
900 SM, SA	90	B202	14.0	3.0	73358[1)]	7485030	73350	8977621	73356	7485022	80105	8789661
-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	84905	8977639
-"-	91	-"-	14.1	-"-	-"-	-"-	-"-	-"-	D1152 EA	7872351	80147	7872336
-"-	92-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-
900 LM, LA	90	-"-	14.0	-"-	-"-	-"-	-"-	-"-	73356	7485022	84905	8977639
900 LM, LA	91	-"-	14.1	-"-	-"-	-"-	-"-	-"-	D1152 EA	7872351	80147	7872336
-"-	92-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-

1) Of Pierburg manufacture

Cars without a catalytic converter

Version	Model year	Engine	CU	Pressure regulator			Mass air flow sensor		Injectors		Control module	
				Bar	Lucas	SAAB	Lucas	SAAB	Lucas	SAAB	Lucas	SAAB
900 LM	90	B202	14.0	3.0	73358[1)]	7485030	73350	8977621	73356	7485022	84940	9117789
-"-	91	-"-	14.1	-"-	-"-	-"-	-"-	-"-	D1152 EA	7872351	80146	7872328
-"-	92-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-	-"-

1) Of Pierburg manufacture

Other Lucas components

Component	CU		Car versions	Lucas	Saab
	14.0	14.1			
Compensating resistor	x	x		73360	7485642
Lambda sensor	x	x	Cat. cars	73367	7485600
Idle air control valve	x	x		73357	7485634
Temperature sensor	x	x		73355	7485006
Throttle potentiometer	x	x		78161	7486723
Knock sensor	x	x	900 LM, LA	Bosch -006	7568801

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Setting of idling speed

CO values and idling speeds, engine at operating temperature (not cat.)

Engine	Model year	Market	CO% at test rpm	Test rpm	CO value at idling speed	Idling speed ±50 rpm
Normally aspirated	1981	Sweden	1.0-2.0	2000	max. 4.5%	875
		Others	0.5-2.5	850	—	875
	1982-	Sweden	0.5-1.5	850	max. 4.5%	850
		Others	0.5-1.5	850	—	850
Turbo (B201)	1981	Sweden	1.0-2.0	850	max. 4.5%	850
		Europe	0.5-2.5	850	—	850
	1982-	Sweden	0.2-1.0	850	max. 4.5%	850
		Others	0.2-1.0	850	—	850
Turbo (B202)	1985-	Sweden	0.9-1.6	850	max. 4.5%	850
		Others	0.9-1.6	850	—	850

Pulse ratio/rpm (cat.)

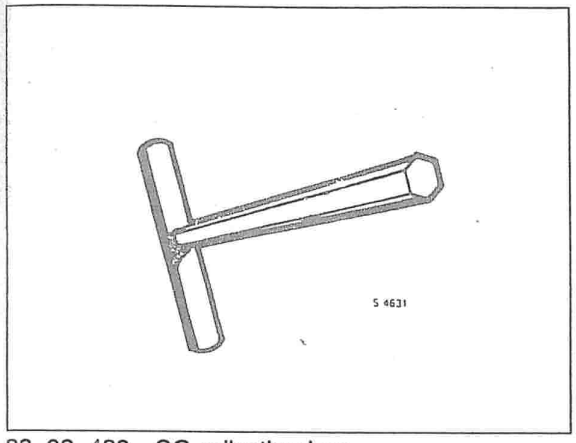
Model year	Pulse ratio*)	Rpm	Remarks
1981	55-65	875	
1982-	45-55	875	
1981		850	CA, not turbo
1982-83		850	CA
1984	45-45	875	CA

**) Measured with pulse-ratio gauge*

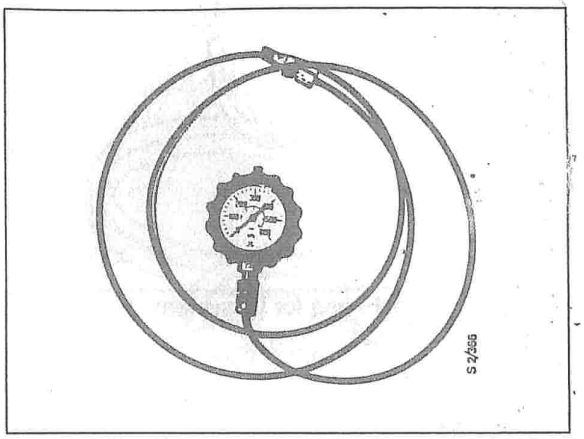
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Special tools



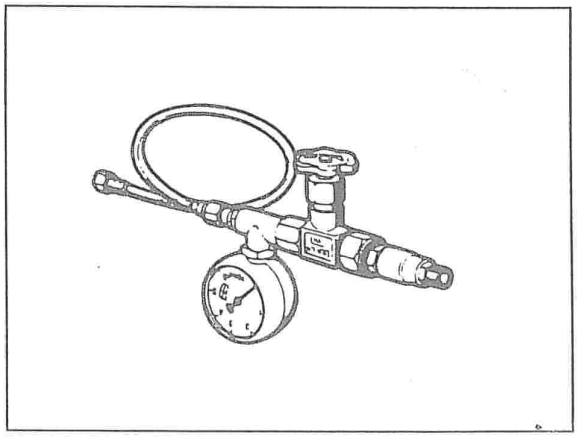
83 92 482 CO adjusting key



83 93 852 Pressure gauge set for measuring fuel pressure in the LH system

83 93 860 Spare set of hoses for gauge set 83 92 852

83 93 878 Connector (spare part for gauge set 83 93 852)

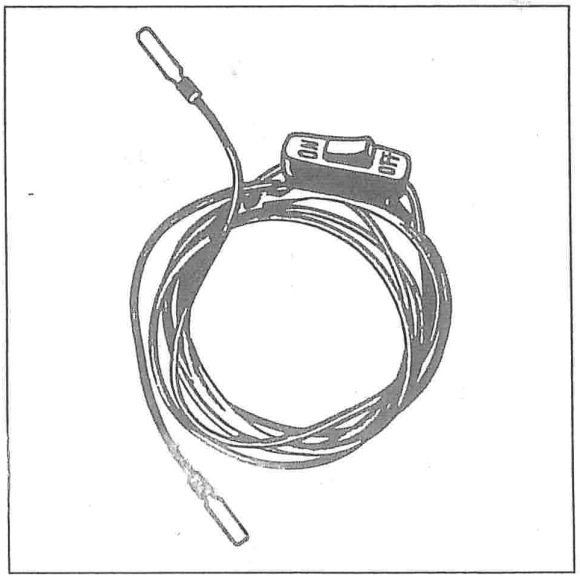


83 92 516 Fuel pressure gauge set (complete) for CI system

83 92 607 Hose

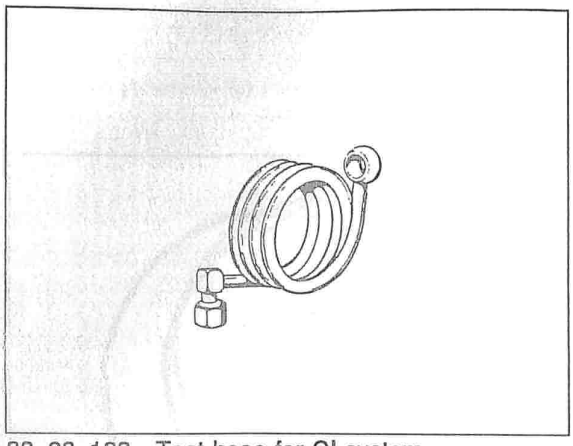
83 92 615 Fitting

83 94 389 Adapter for connection to B201 Turbo, from model year 1987 inclusive

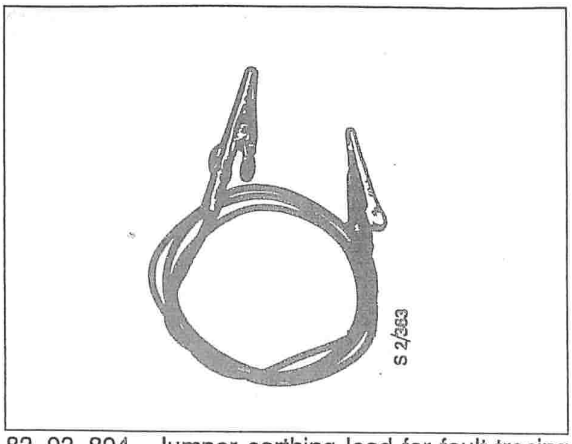


83 93 886 Jumper lead for forced operation of fuel pump during LH system fault diagnosis (-M1989)

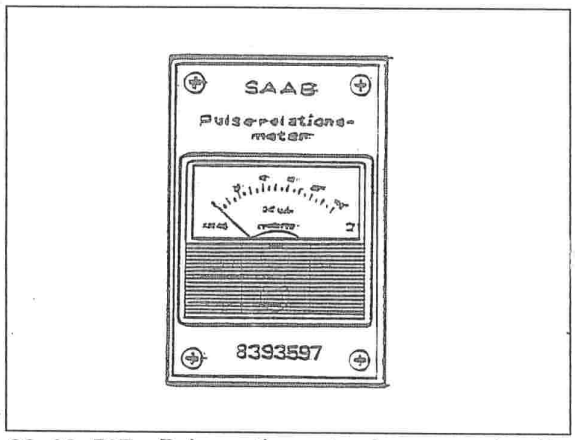
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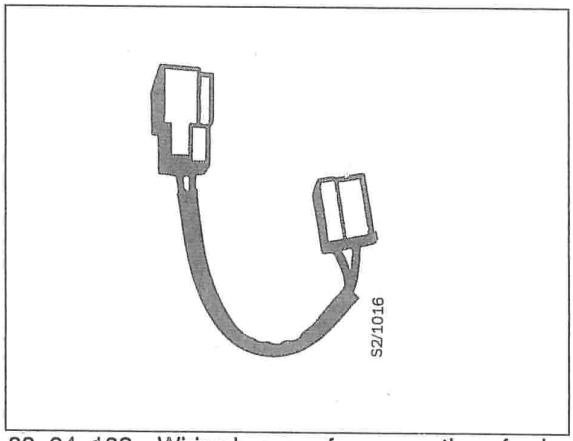
83 93 183 Test hose for CI system



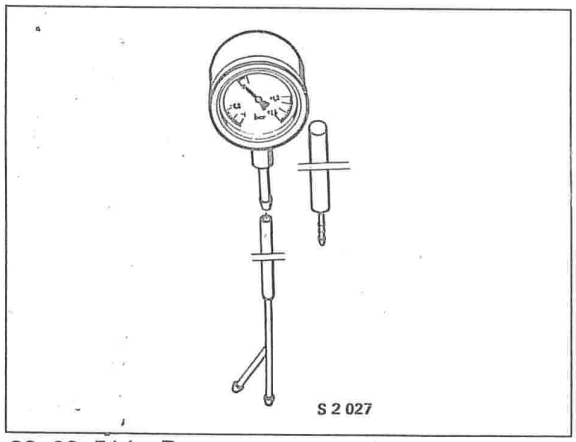
83 93 894 Jumper earthing lead for fault-tracing in the LH system



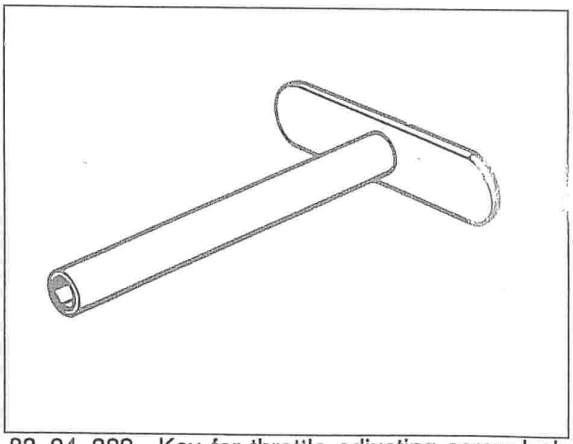
83 93 597 Pulse ratio meter for measuring the pulse ratio of the modulating valve on cars with the Lambda system (certain markets only)



83 94 132 Wiring harness for connection of pulse ratio meter

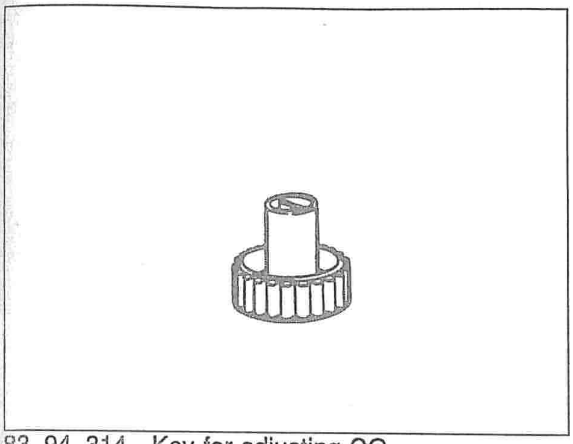


83 93 514 Pressure gauge set

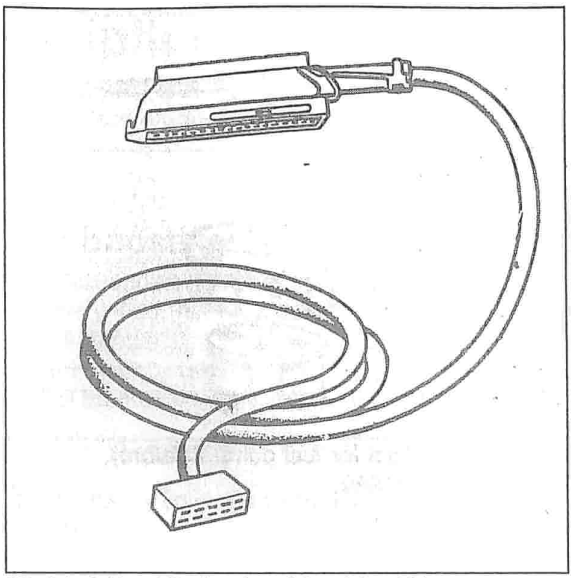


83 94 322 Key for throttle adjusting screw locknut

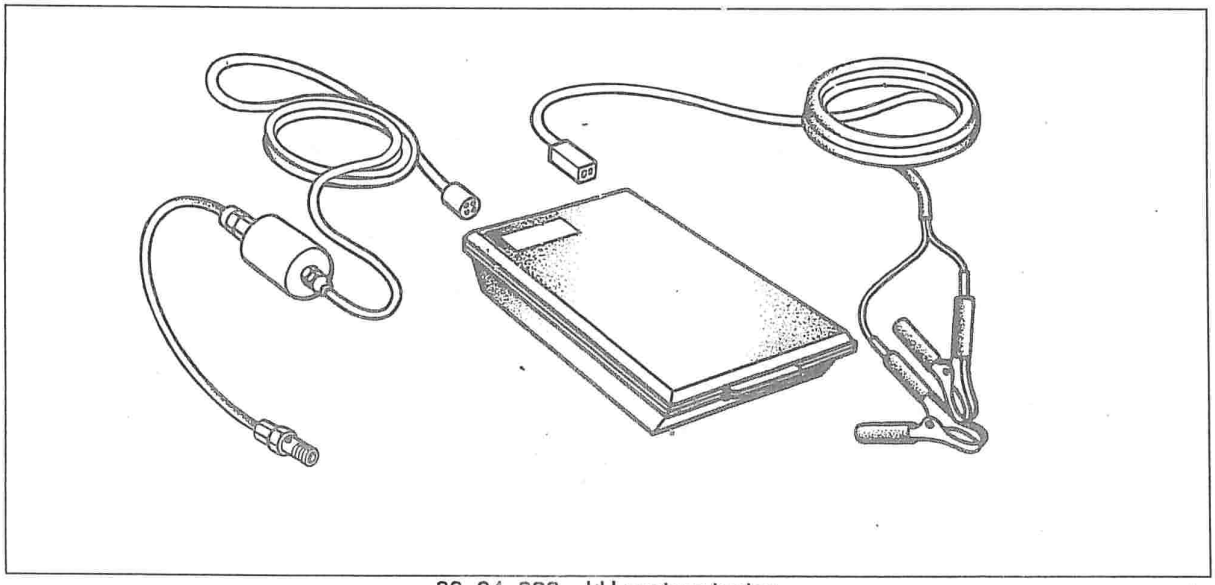
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83 94 314 Key for adjusting CO

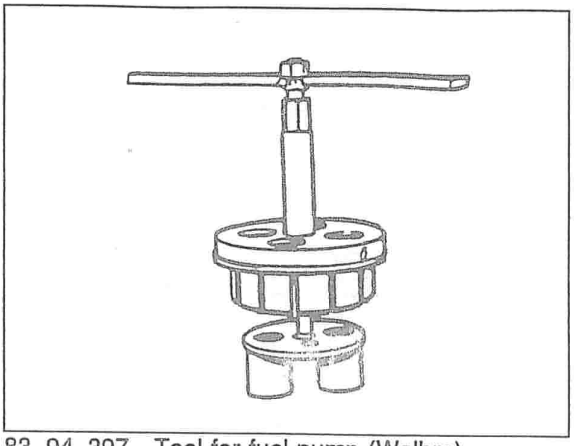


83 94 348 35-pin signal lead for LH 2.4
83 94 405 Test hose for checking fuel flow

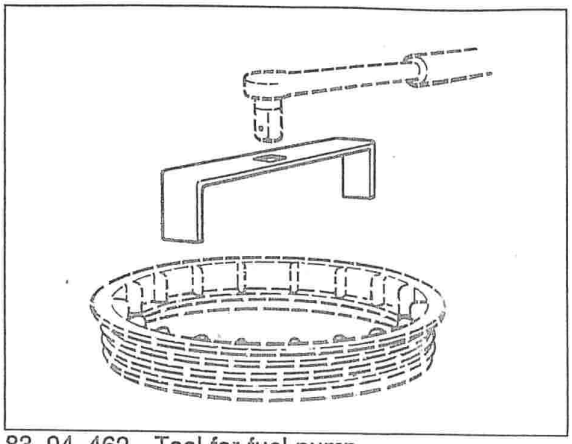


83 94 223 LH system tester

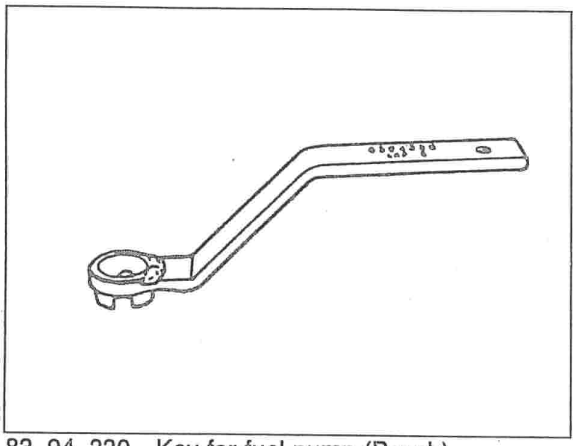
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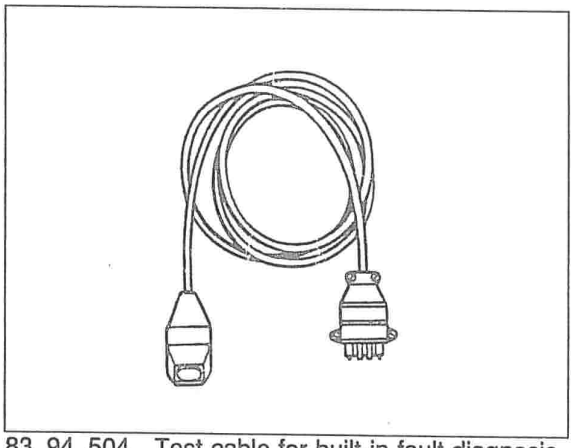
83 94 397 Tool for fuel pump (Walbro), M1989



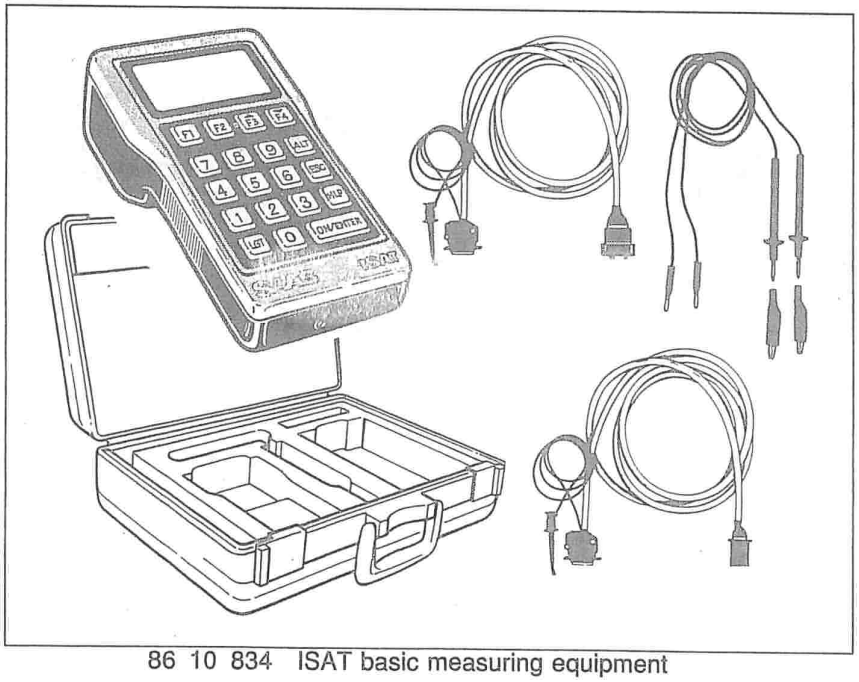
83 94 462 Tool for fuel pump (Bosch), M1990-



83 94 330 Key for fuel pump (Bosch), -M1988



83 94 504 Test cable for built-in fault diagnosis system, M1990-



86 10 834 ISAT basic measuring equipment

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Technical description

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B201 injection engine 200-3

LH multiport fuel injection system
B202 injection engine 200-35

CI fuel injection system B201 engine

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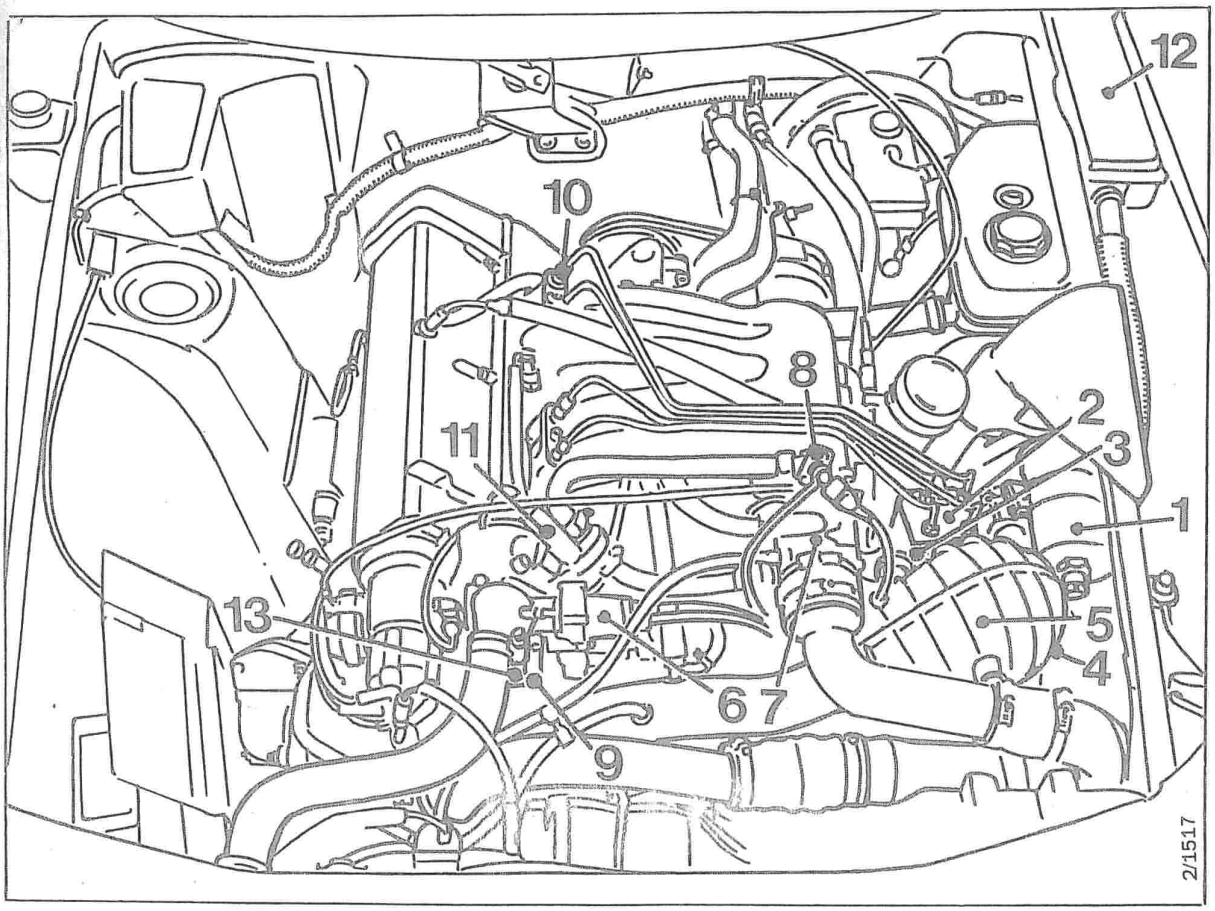
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Fuel system, B201 injection engine

General

The fuel injection system for the engine is the Bosch CI (Continuous Injection) system.

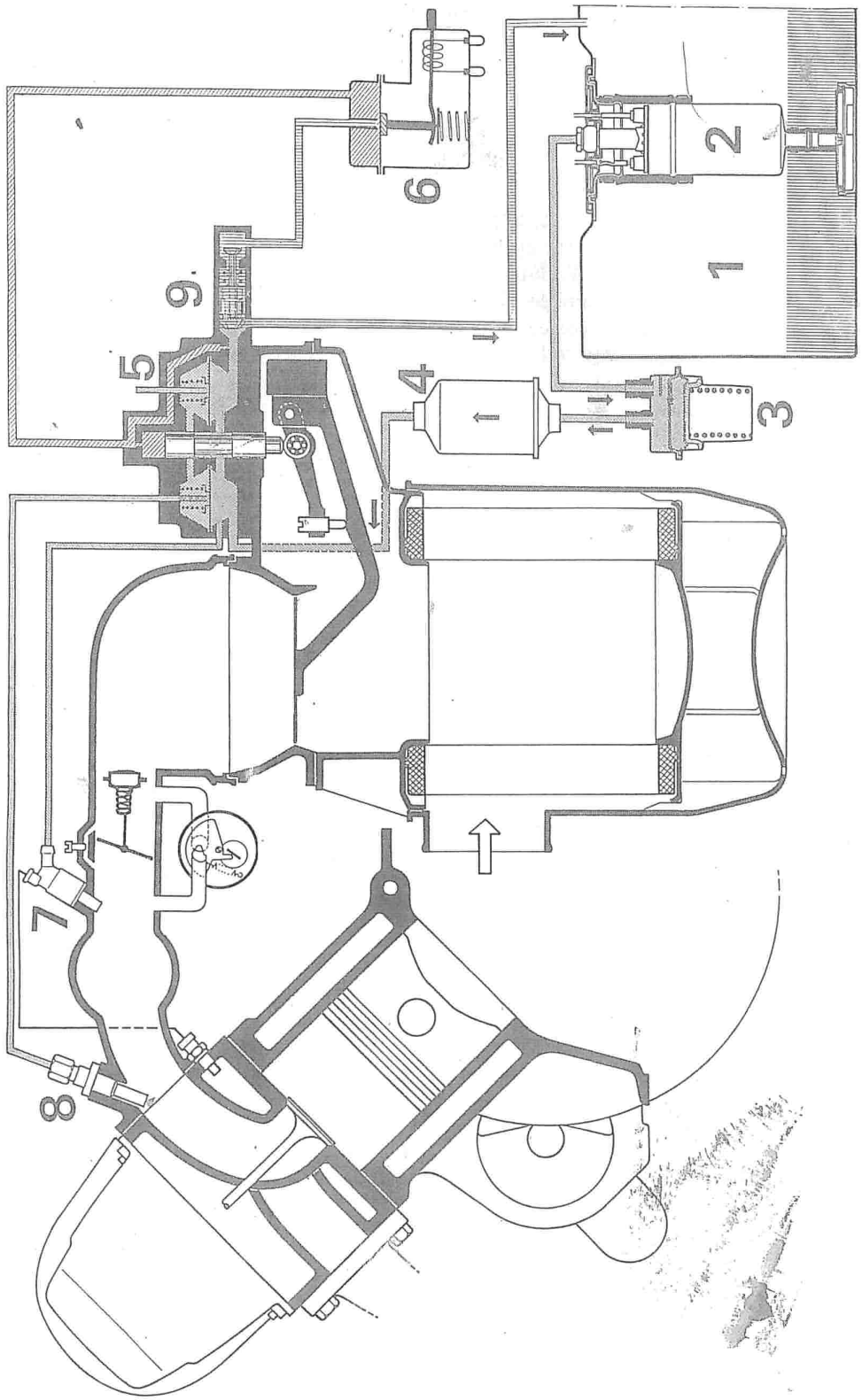
An electric fuel pump delivers fuel at constant pressure to the fuel distributor. The mass air flow sensor, which measures the mass of air drawn into the engine, acts mechanically on the fuel distributor and so ensures that the correct amount of fuel is metered to the four injectors. The fuel is injected continuously into the intake pipe immediately upstream of the inlet valves.



Injection engine

1 Fuel filter
2 Fuel distributor
3 Mass air flow sensor
4 Air cleaner
5 Rubber duct connector
6 Warm-up regulator
7 Throttle body
8 Cold-start valve
9 Thermostatic switch
10 Injectors
11 Auxiliary air valve
12 Main fuse box
13 Thermostatic time switch

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Fuel system (not US spec.)

Line pressure
Line pressure -0.1 bar (-1.5 psi)
Injection pressure
Control pressure
Return, no pressure

1 Fuel tank
2 Fuel pump
3 Fuel accumulator
4 Fuel filter
5 Fuel distributor
6 Warm-up regulator
7 Cold-start valve
8 Injectors
9 Line pressure regulator

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Fuel tank and fuel pump

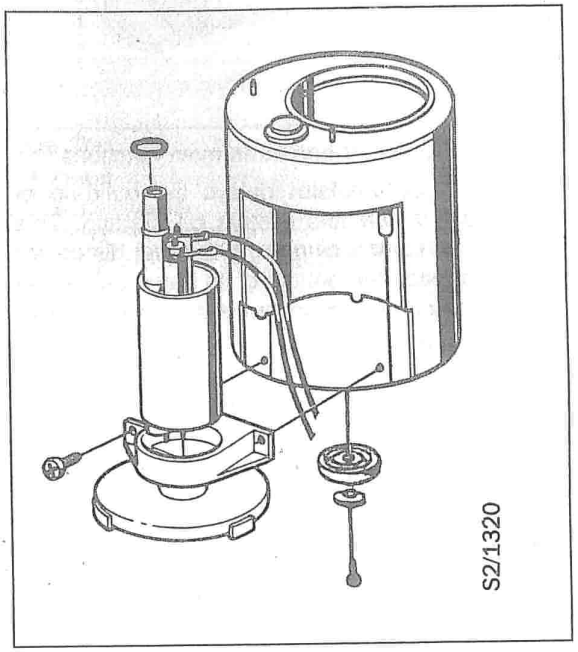
The fuel pump is an electric rotary pump mounted inside the tank. The pump and motor are totally enclosed and cannot be dismantled for repair. The relief valve is fitted to the fuel pump and is actuated when the pressure is excessive. A non- return valve in the fuel pump outlet prevents the line pressure from dropping to zero as soon as the pump stops.

Fuel tank with pressurized receiver (cars with catalytic converter)

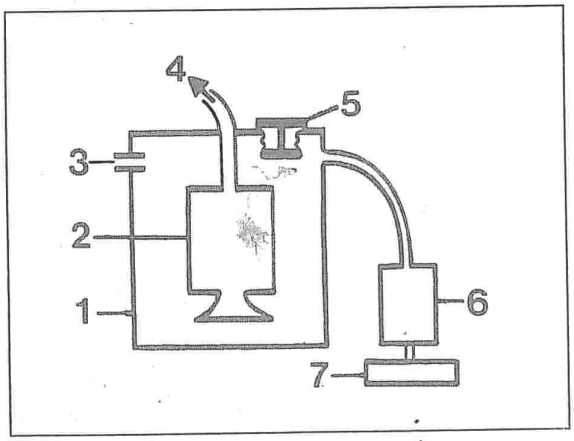
A feed pump and pressurized receiver were introduced on 1983 models.

The function of the pressurized receiver is to maintain pressure on the suction side of the fuel pump to prevent vaporization of the fuel.

This system supersedes the earlier design in which the entire fuel tank was pressurized.



The system consists of a feed pump, a main pump and a pressurized receiver. The feed pump delivers fuel from the tank to the receiver in which the main pump is mounted. When the receiver is full, pressure builds up in it and the main pump is supplied with fuel under pressure.

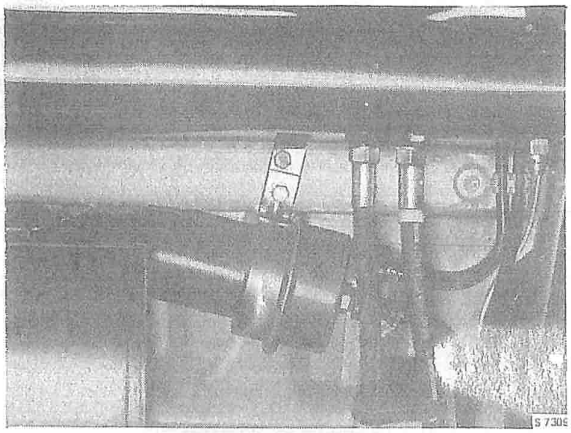


1 Pressurized receiver
2 Main pump
3 Return fuel
4 To fuel accumulator
5 Safety valve
6 Feed pump
7 Filter

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Fuel accumulator

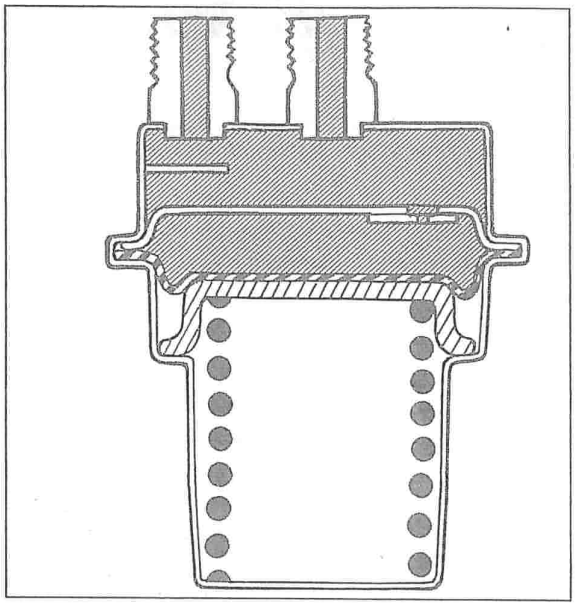
The fuel accumulator is connected to the fuel line from the fuel pump and is situated underneath the floor in front of the fuel tank.



The fuel accumulator has three main functions.

1 The fuel accumulator delays the build-up of pressure in the fuel system on starting. This gives the control plunger in the fuel distributor time to reach the bottom of its travel before the injectors open and so prevents too much fuel from being injected.

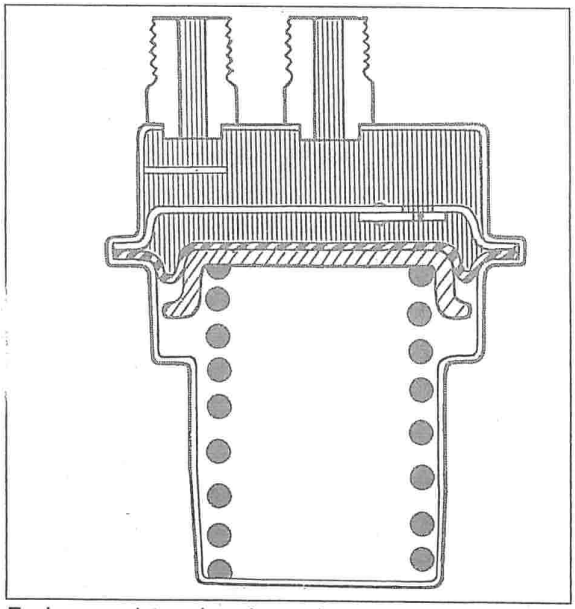
2 The accumulator absorbs any pressure fluctuations or surges occurring in the system.



Fuel accumulator with fuel pump in operation

Line pressure

3 After the engine has been switched off, the pressure in the fuel system drops to about 2 bar (29 psi) and is held at this pressure by the quantity of fuel contained in the accumulator. As a result, the fuel system remains pressurized while the engine cools down, preventing the formation of air locks due to vaporization of the fuel and possible starting difficulties when the engine is hot.



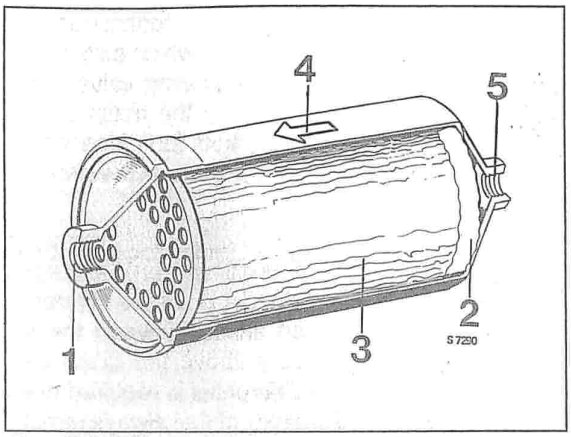
Fuel accumulator when the engine has been switched off.

Shut-off pressure

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Fuel filter

The fuel filter is fitted in the circuit between the fuel accumulator and the fuel distributor. The filter contains a paper filter cartridge and a nylon strainer

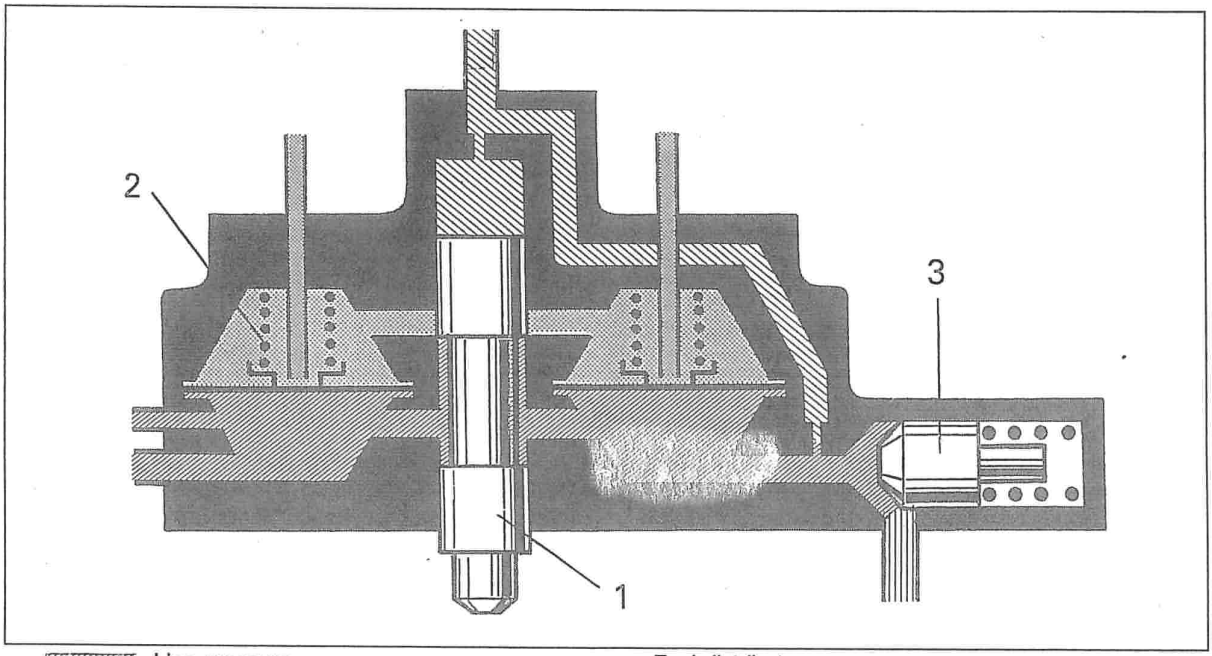


Fuel filter

1 Outlet
2 Nylon strainer
3 Paper filter cartridge
4 Arrow indicating flow direction
5 Inlet

Fuel distributor

The fuel distributor distributes the fuel to the injectors and consists of a fuel control unit and four pressure regulating valves (two of which are shown), one for each cylinder.



Line pressure
Line pressure -0.1 bar (-1.5 psi)
Injection pressure
Control pressure
Return, no pressure

Fuel distributor

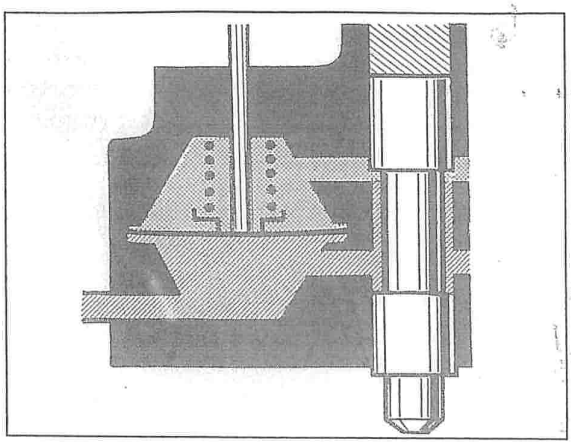
1 Control plunger
2 Pressure regulating valve
3 Line pressure regulator

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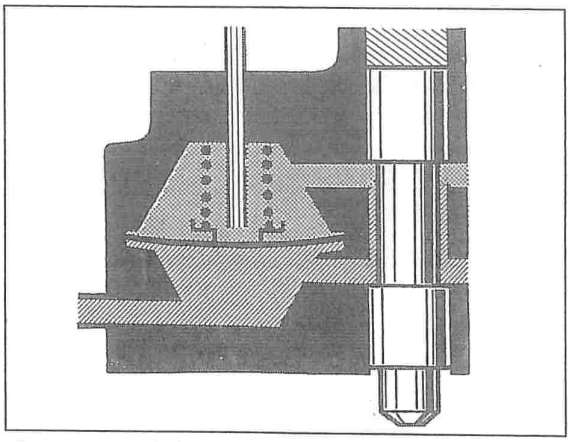
The skirt of the control plunger is in continuous communication with the line pressure which also acts on the bottom of the pressure regulating valve. When the control plunger is raised by the mass air flow sensor's lever, four metering slots (one for each cylinder) which feed the fuel to the top of the pressure regulating valves, will open.

The pressure above the spring-loaded diaphragm acts on the latter, deflecting it downwards and opening the outlet to the injectors. A pressure differential of 0.1 bar (1.5 psi) then arises between the line pressure and the pressure above the diaphragm. This constant pressure differential is required to ensure that the injected quantity of fuel always remains proportional to the open area of the metering slots and is the same for all four cylinders.

The fuel distributor also contains a line pressure regulator, passages for the control pressure, and fuel inlets and outlets.



Pressure regulating valve, partial load



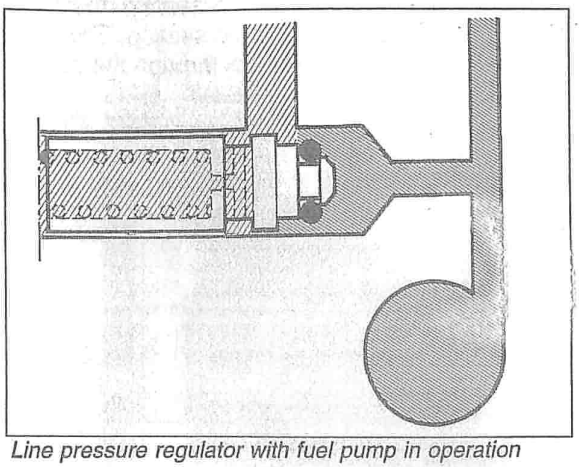
Pressure regulating valve, full load

Line pressure
Line pressure -0.1 bar (-1.5 psi)
Injection pressure
Control pressure

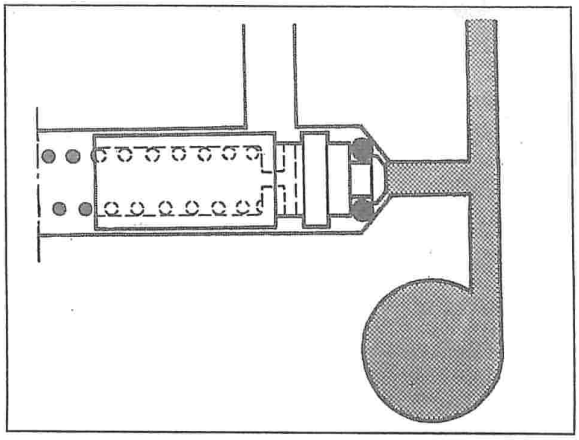
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Line pressure regulator

The line pressure regulator ensures that the pressure in the circuit remains constant when the fuel pump is in operation and also controls the recirculation of fuel to the tank. When the fuel pump is switched off, the regulator closes the return line at a pressure of about 2.5 bar (36 psi) - the rest pressure - which is maintained by means of an O-ring and the quantity of fuel in the fuel accumulator. The purpose of the rest pressure is to prevent the fuel from vaporizing in the circuit when the engine is warm, which would make restarting difficult.



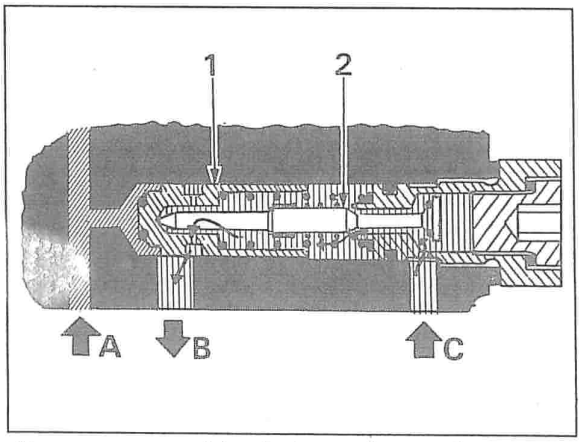
Line pressure regulator with fuel pump in operation



Line pressure regulator, engine switched off

Line pressure
Return, no pressure
Rest pressure

The line pressure regulator forms an integral unit with a shut-off valve to which the return fuel line from the control pressure regulator is connected. When the fuel pump is in operation, the shut-off valve is actuated mechanically by the line pressure regulator so that the return fuel from a control pressure regulator can by-pass the shut-off valve to the return line.



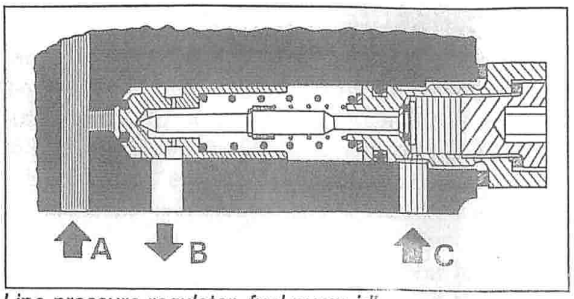
Line pressure regulator, fuel pump in operation

Line pressure regulator
Shut-off valve

A Line pressure
B Return line
C Control pressure return

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When the fuel pump stops and the line pressure regulator valve is pressed into its seating, the shut-off valve is also pressed into its seating. This prevents the fuel from flowing back through the control pressure return line.



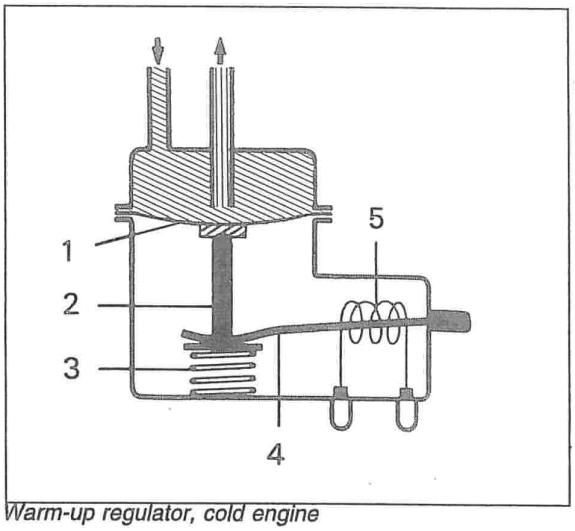
Line pressure regulator, fuel pump idle

A Line pressure
B Return line
C Control pressure return

Warm-up regulator

When the engine is warm, the warm-up regulator (a spring- loaded diaphragm valve) maintains a constant control pressure above the control plunger. When the engine is cold and requires a richer fuel-air mixture, the control pressure is reduced. This allows the control plunger in the fuel distributor to rise so that more fuel can be supplied to the injectors. The warm-up regulator consists of a diaphragm valve which is actuated by a compression spring.

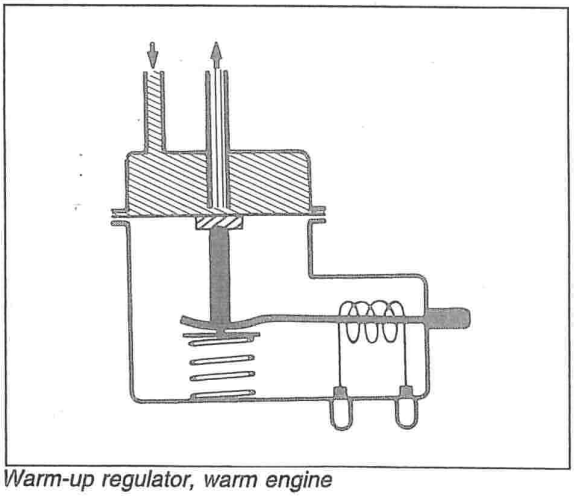
When the engine is cold, a bi-metal strip presses against the compression spring and reduces the force of the spring acting on the diaphragm. The diaphragm then opens and exposes the return line to the fuel tank, thus reducing the control pressure. When the engine is running, current flows through the heating coil surrounding the bi-metal strip.As the bi-metal strip heats up it bends away from the spring and so causes the pressure on the diaphragm, and also the control pressure, to increase. When a warm engine is started, no reduction in the control pressure takes place as the bi- metal strip is then affected by the engine temperature.



Warm-up regulator, cold engine

Control pressure
Return, no pressure

1 Diaphragm
2 Plunger
3 Compression spring
4 Bi-metal strip
5 Heating coil



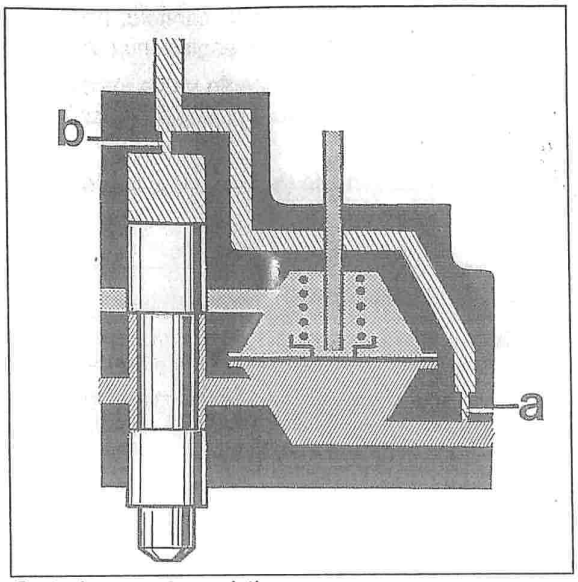
Warm-up regulator, warm engine

Line pressure
Return, no pressure

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Regulation of control pressure

Fuel under control pressure is removed from the system via an orifice (a) in the fuel distributor. The control pressure is reduced to 3.7 bar (54 psi) and 0.5-3.7 bar (7.2-54 psi) during the warm-up period due to the pressure drop across the orifice (a), which is determined by the amount of fuel flowing through the orifice and the warm-up regulator. An additional orifice (b), located between the control pressure passage and the top of the control plunger, is designed to eliminate rapid oscillation of the mass air flow sensor lever.

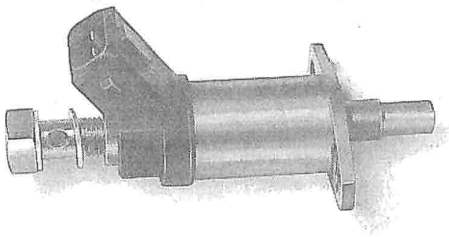


Control pressure regulation

Line pressure
Line pressure -0.1 bar (-1.5 psi)
Injection pressure
Control pressure

Fuel booster (cold start) valve

The cold-start valve, located inside the throttle body, is in communication with line pressure. Actuated by a solenoid, the valve is controlled by a thermostatic time switch that senses engine temperature. The fuel booster valve is actuated when the starter motor is engaged or the fuel booster pressure switch contacts are energized. At a temperature of -20°C (- 4°F) or below, the valve can inject fuel for a maximum period of 9.5 seconds. At higher engine temperatures the injection time becomes progressively shorter and the valve ceases to operate at a temperature of about 45°C (113°F).



Fuel booster (cold start) valve

Thermostatic time switch

When the engine is cold and has a temperature below 45°C (113°F), the switch will close and allow current to flow for some time (depending on the actual temperature) while the starter motor is engaged.

Check that the switch closes when the starter motor is engaged by connecting a test lamp in series with the terminals of the cold-start valve's connector.
It is not possible to make a more accurate check of the temperature or of the time the switch remains closed. If in doubt, fit a new switch.

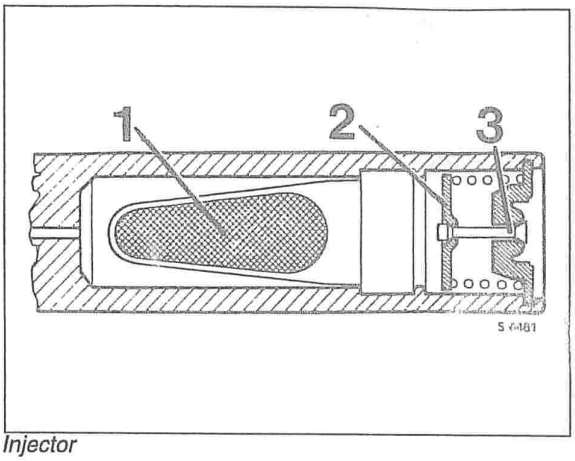
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Injectors

The injectors, fitted in the inlet manifold, inject fuel continuously upstream of the engine inlet valves.

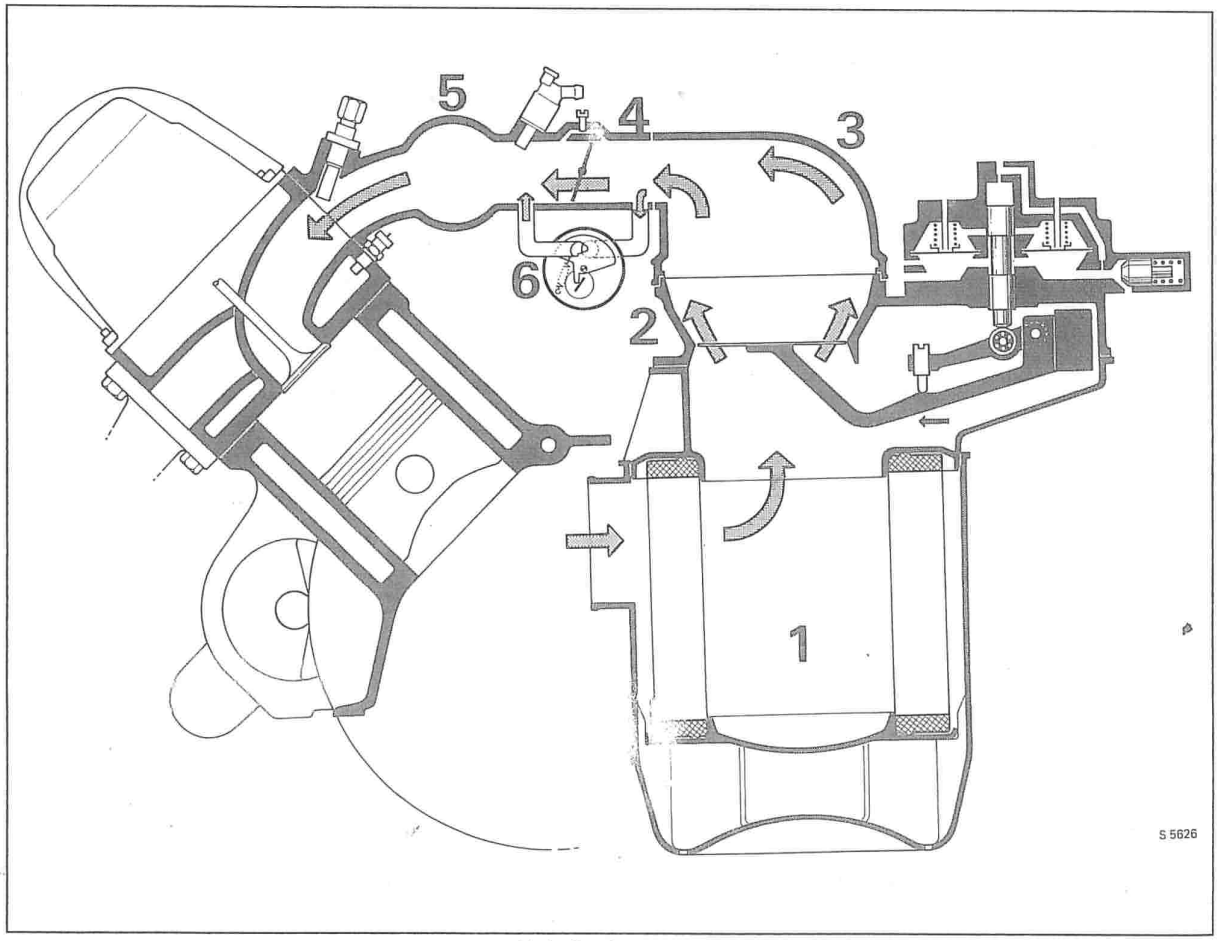
A spring-loaded disc and needle valve inside each injector open when the fuel pressure reaches approx. 3.3 bar (47 psi).

Also incorporated inside the valve is a fuel strainer.



Injector

1 Fuel strainer
2 Valve disc
3 Needle valve



Air induction system

1 Air cleaner
2 Mass air flow sensor
3 Rubber duct connector
4 Throttle body
5 Inlet manifold
6 Auxiliary air valve

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Air cleaner

The air cleaner, which contains a folded paper element, is fitted to a bracket on the front of the LH wheel arch. The air flows through the inlet pipe into the air cleaner, through the air filter and upwards to the mass air flow sensor, which is bolted to the top of the air cleaner.

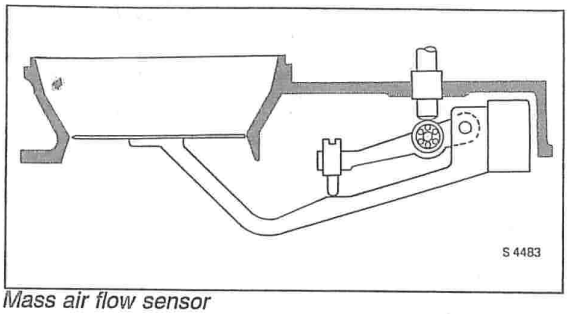
Mass air flow sensor

The mass air flow sensor consists of an air venturi tube inside which an air flow sensor plate moves. The air flowing into the venturi from the air cleaner underneath lifts the air flow sensor plate, allowing the air to flow past it at the sides. The greater the flow of air, the higher the sensor plate is raised.

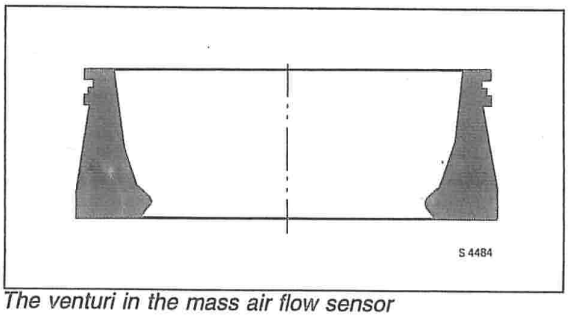
The air flow sensor plate is connected to a lever which is balanced by a counterweight. The lever acts on the control plunger in the fuel distributor, which is pressed down by the control pressure and so counteracts the lifting force of the air flow sensor plate.

The fuel distributor's control plunger is actuated by the levervia a link fitted with a needle bearing at the contact point. The basic fuel setting, and with it the CO setting, is adjusted by means of the adjustment screw on the link. This adjustment is made by means of a special tool and access to the screw can be gained through a hole in the mass air flow sensor between the air venturi and the fuel distributor.

The fuel-air mixture varies with the load. The inclination of the venturi walls therefore varies in stages in order to provide the correct fuel-air mixture under all load conditions. This results in a somewhat richer mixture being obtained at full load.



Mass air flow sensor



The venturi in the mass air flow sensor

Rubber duct connector

The rubber duct connects the mass air flow sensor to the throttle body.

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Throttle body

The throttle body is connected to the intake pipe and, in addition to the throttle butterfly, contains the idling air passage with idling adjustment screw, connections for the auxiliary air valve hoses and for the cold start valve, and the vacuum outlet for ignition advance.

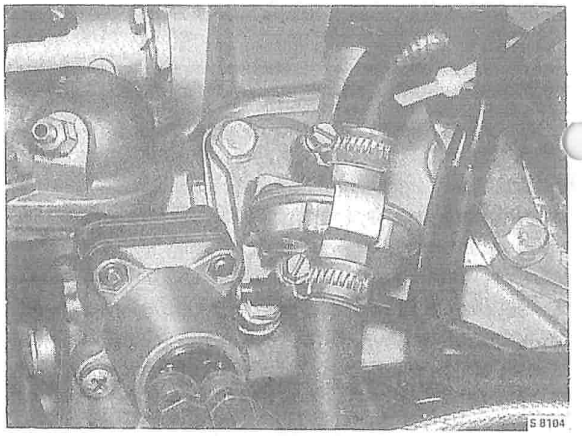
Inlet manifold

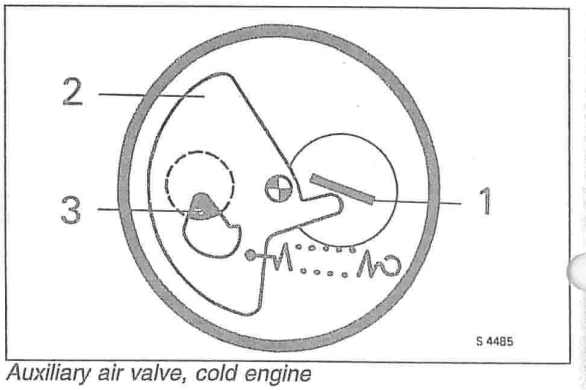
The injectors, mounted in the inlet manifold, inject the fuel into the inlet passages at the joint between the inlet manifold and the cylinder head. A thermostatic time switch or simple thermostatic switch is fitted inside the inlet manifold, which also incorporates outlets for vacuum lines to the brake servo unit and for crankcase ventilation.

Auxiliary air valve

The function of the auxiliary air valve, together with the warm-up regulator, is to compensate for losses due to friction and condensation in the inlet manifold and combustion chamber on cold starting, so that the required idling speed will be obtained.

The valve is located in a passage which by-passes the throttle butterfly. Since the air flowing through the auxiliary air valve has also passed through the mass air flow sensor, the quantity of fuel obtained corresponds to the air flow.



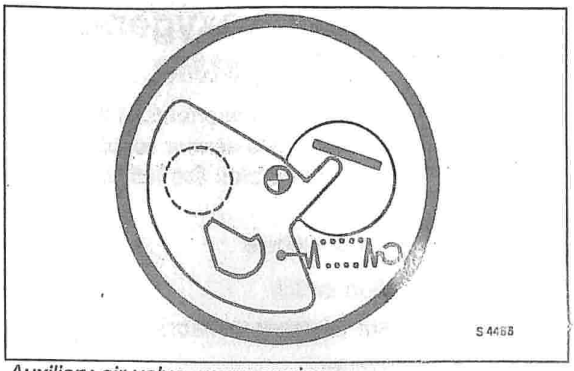


Auxiliary air valve, cold engine

1 Bi-metal strip with heating coil
2 Valve
3 Auxiliary air port

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The valve is actuated by a bi-metal strip which opens the valve completely when the engine is cold. When the engine is started, current flows through a coil and heats up the bi- metal strip, gradually closing the valve. When a hot engine is to be started, the engine temperature acts on the bi-metal strip and the valve remains closed.



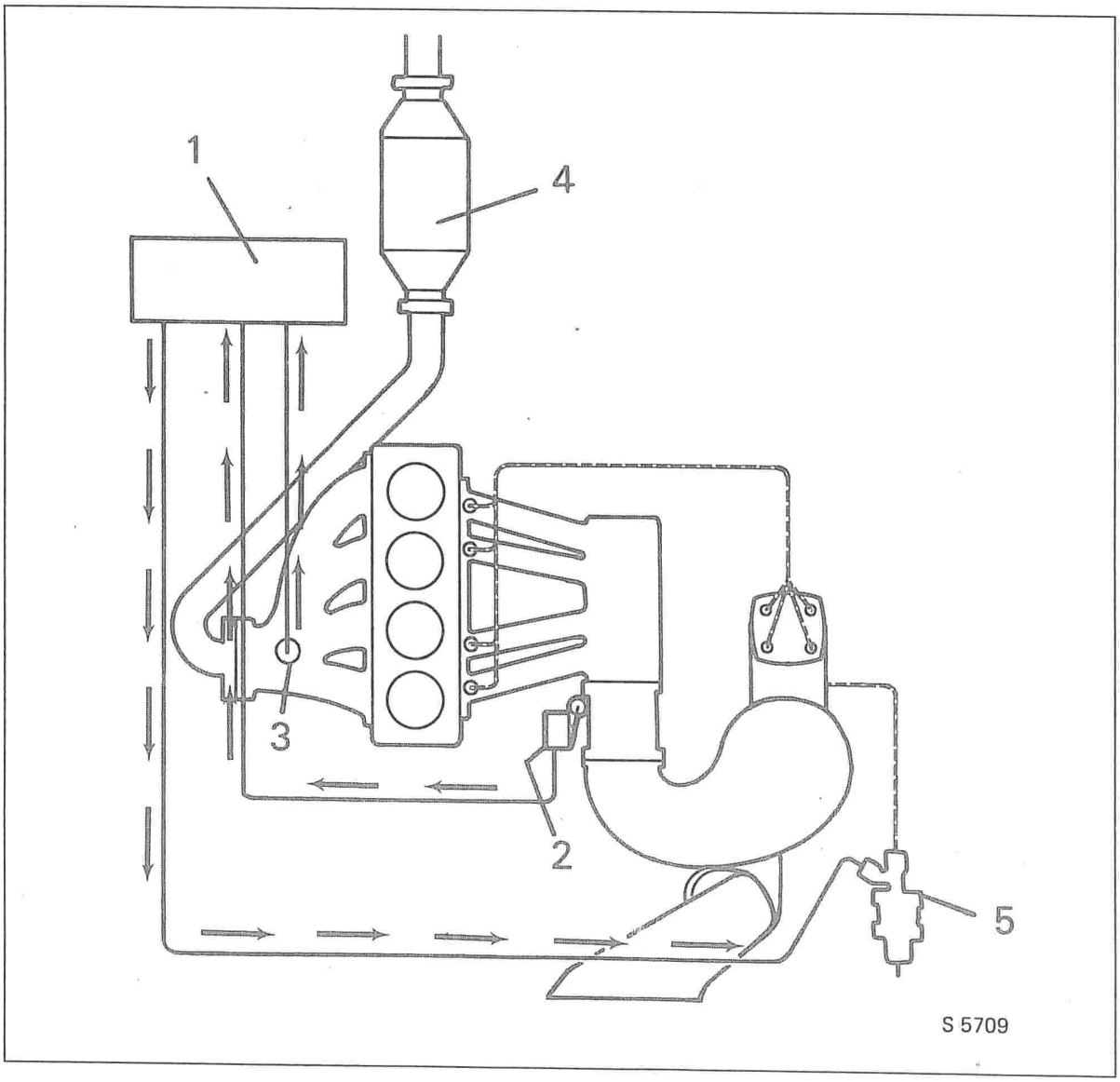
Auxiliary air valve, warm engine

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Lambda-sensor (oxygen-sensor) regulated fuel system

In addition to the standard components of the CI fuel injection system, the lambda-sensor regulated (oxygen) system also incorporates the following components:

1 Electronic control module
2 Throttle position switch
3 Oxygen sensor (Lambda sensor)
4 Catalytic converter
5 Modulating valve

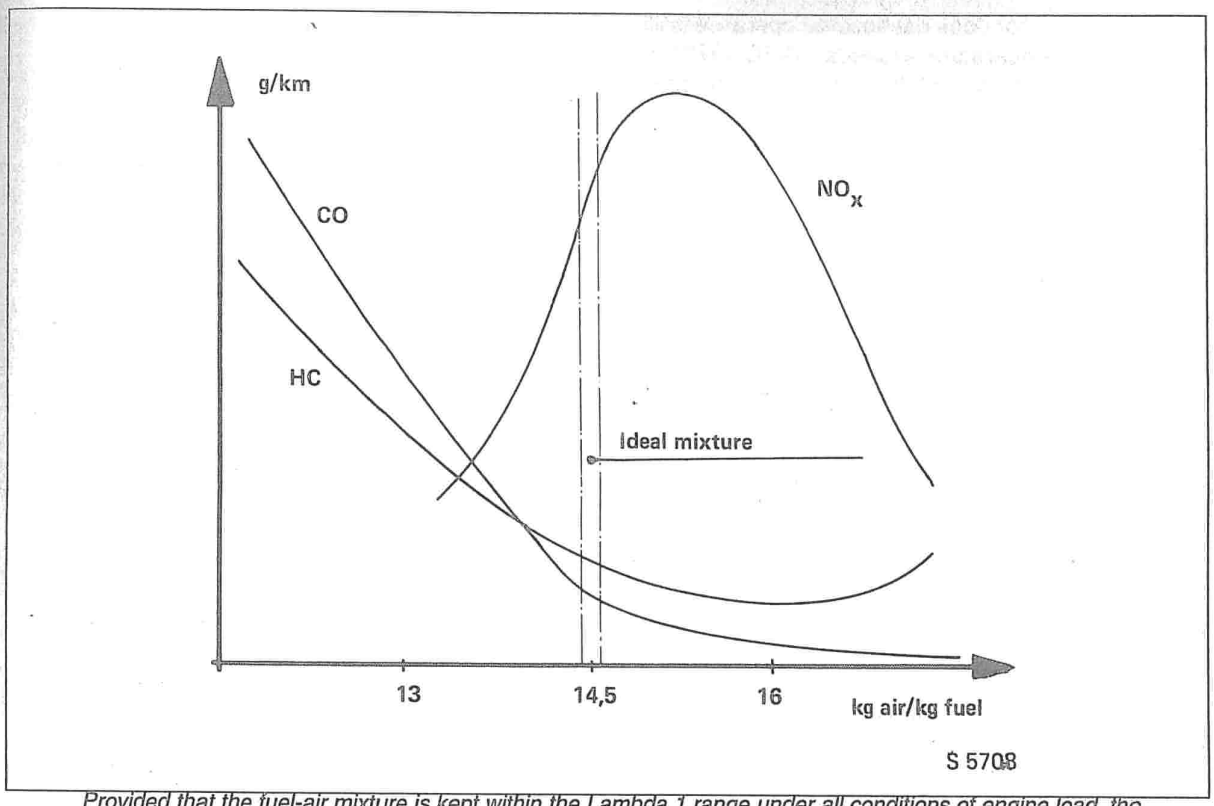


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The oxygen sensor, fitted in the exhaust manifold, senses the amount of oxygen in the exhaust gases and sends this information to the control module.

Via the modulating valve, the electronic control module regulates the pressure difference in the fuel distributor to keep the fuel-air mixture within the Lambda 1 range.

Lambda 1 is the optimum fuel-air mixture for complete combustion. Lambda, the Greek letter, denotes the ratio between the actual (delivered) and theoretical fuel-air mixture.



Provided that the fuel-air mixture is kept within the Lambda 1 range under all conditions of engine load, the harmful gases (CO, HC and NO_x) in the exhaust can be converted by chemical processes in the catalytic converter so that emissions will remain within the prescribed limits.

Lambda sensor (oxygen sensor)

Outwardly, the oxygen sensor is reminiscent of a spark plug but consists of a primary cell and a solid electrolyte. The electrolyte is a ceramic material—(zirconium oxide)—which has been temperature stabilized by the addition of a small amount of yttrium oxide.

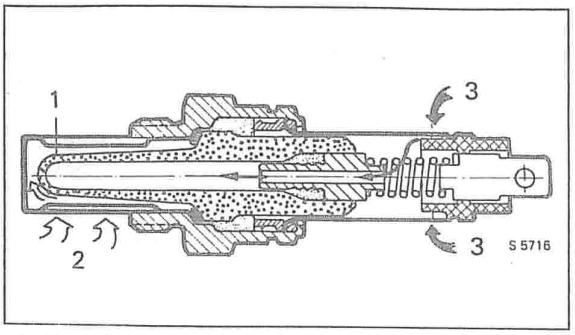
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It is tubular in shape, with one of the ends blanked off, and its surface has a platinum coating to make it electrically conductive.

The outside of the electrolyte is in contact with the exhaust gases and the inside in communication with the ambient air. When there is a difference in the partial oxygen pressure between the inside and outside of the tube, the signal voltage from the Lambda sensor rises.

When the sensor signals a high level of oxygen (lean mixture) to the control module, the control module compensates by changing the pulse ratio of the modulating valve to enrich the mixture or vice versa when the sensor signals a low level of oxygen (rich mixture).

The oxygen sensor does not become operative until the working temperature exceeds 300°C (570°F). Because the accuracy of the sensor deteriorates with age, it must be replaced at 40,000 km (25,000 mile) intervals. This does not apply to electrically heated sensors.



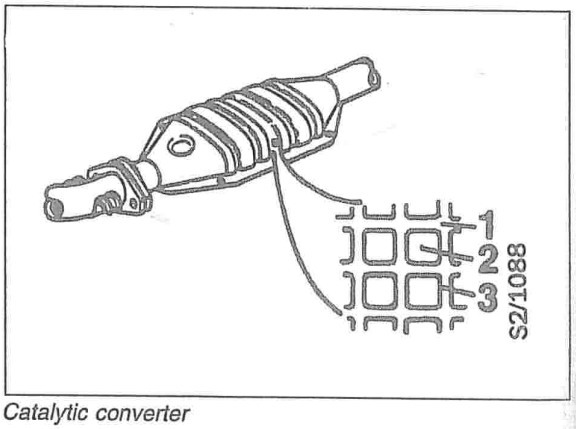
1 Electrolyte
2 Exhaust gases
3 Ambient air

Catalytic converter

The final phase of exhaust emission control consists of a catalytic converter located in the front section of the exhaust pipe.

It consists of a honeycomb ceramic insert, the walls of which are coated with catalytic material (platinum and rhodium).

Cars equipped with a catalytic converter must never be run on anything but unleaded petrol as lead destroys the active constituents of the catalyst and is also detrimental to the oxygen sensor.



Catalytic converter

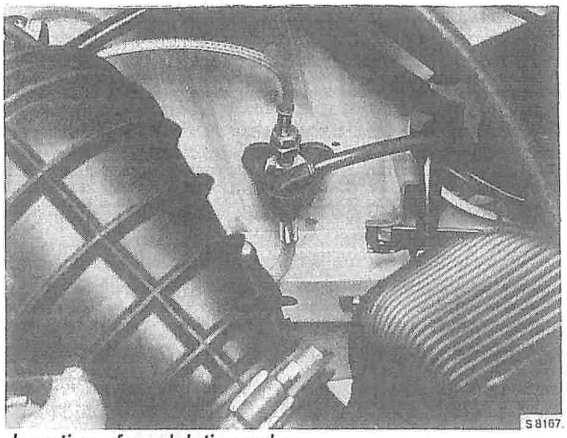
1 Ceramic insert
2 Passages
3 Catalytic coating

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Modulating valve

The modulating valve is a solenoid valve which opens and closes at a constant frequency (70 Hz) as soon as the engine has started.

How long the valve remains open and closed is determined by the pulse ratio.

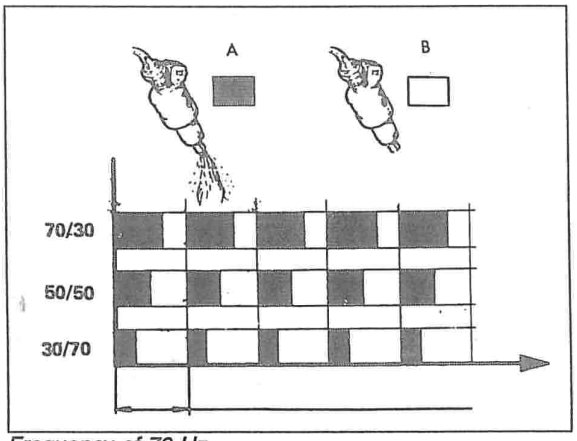


Location of modulating valve

A long opening time (e.g. a 70/30 pulse ratio) results in a rich mixture and a short opening time (e.g. a 30/70 pulse ratio) a lean mixture.

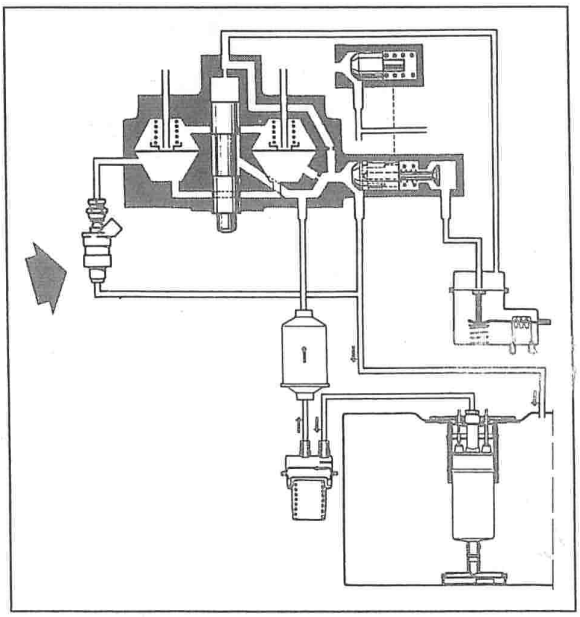
A pulse ratio of 70/30 is known as a 70%ratio and means that the modulating valve is open for 70 per cent and closed for 30 per cent of the time.

Stepless adjustment of the pulse ratio of the modulating valve is made continuously by the control module to provide the fine-tuning of the mixture required in cars equipped with a catalytic converter.



Frequency of 70 Hz

A Open
B Closed

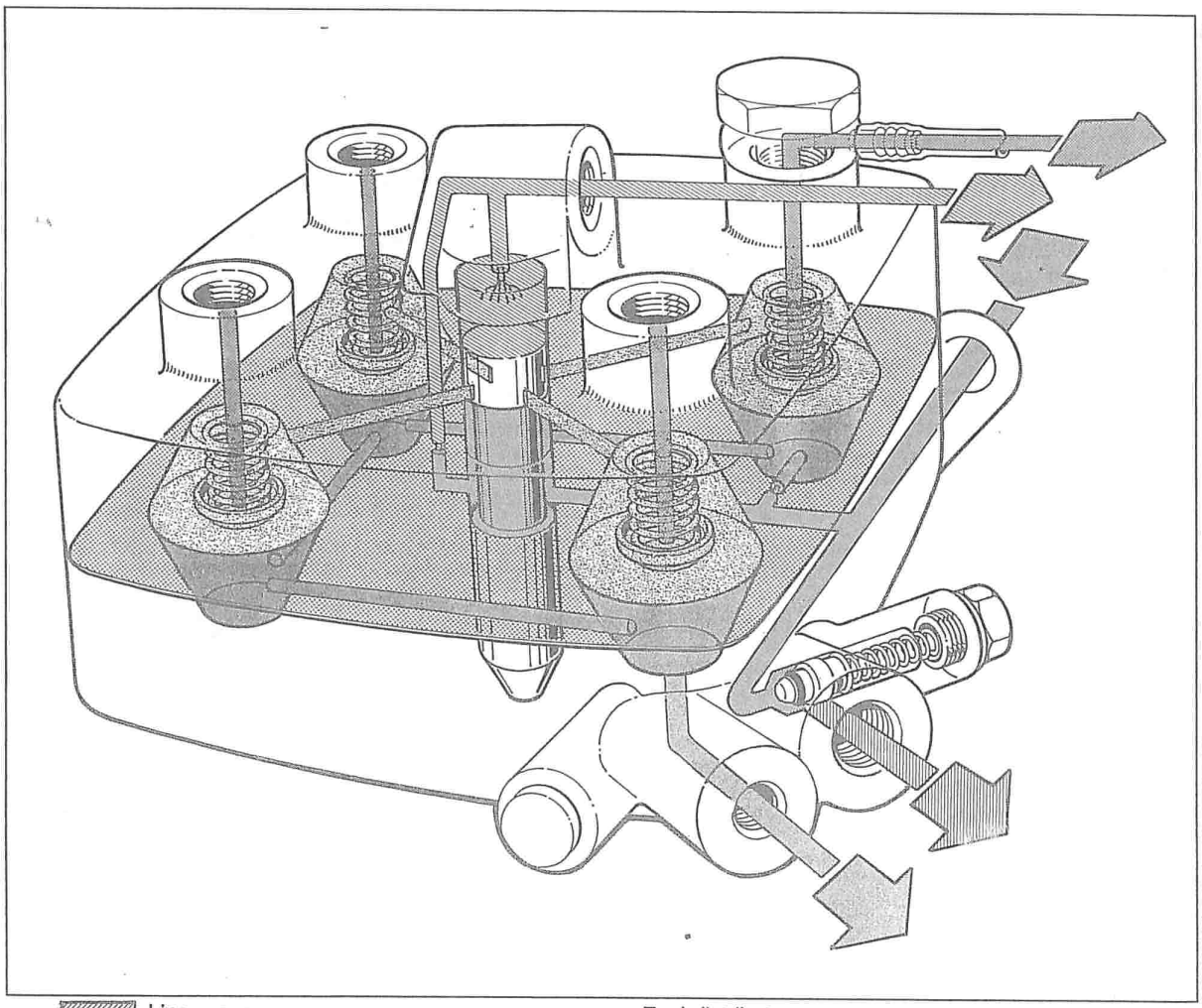


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Fuel distributor

When the pulse ratio of the modulating valve is high, a larger quantity of fuel will flow from the chamber below the steel diaphragm in the pressure-regulating valves, thereby momentarily reducing the pressure below the diaphragm by about 0.2 bar (2.9 psi). This pressure drop increases the flow of fuel through the pressure-regulating valves and, since the opening of the metering slots remains constant, a richer mixture is delivered to the engine.

If the oxygen sensor signals a low oxygen level (rich mixture), the opening phases will be shorter and a smaller quantity of fuel will be drawn from the chamber below the diaphragm in the pressure-regulating valve. This results in a reduction of the pressure difference and fuel flow, resulting in a weakening of the mixture.



Line pressure
Upper chamber pressure
Lower chamber pressure
Injection pressure
Control pressure
Return, no pressure

Fuel distributor

1 Injector
2 Control pressure regulator
3 Inlet
4 Return line
5 Modulating valve

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Summary

The pressure difference across the diaphragm in the pressure- regulating valves is controlled by variation of the pulse ratio. Variations in the pressure difference give rise to a richer or weaker mixture. The magnitude of the rise or fall in pressure is governed by the signal voltage from the Lambda sensor.

Since the Lambda sensor does not become operative below a temperature of 300°C, enrichment to >92%(via terminal 11 of the control module) will always be obtained while the starter motor is engaged and for three seconds after starting. At engine temperatures <19°C the pulse ratio will be 60%for the first three seconds after starting. Following this, the mixture will be enriched via the cold- start valve (temperatures below 45°C) or via P11 (above 45°C).

A ratio of 50/50 is that prevailing under normal conditions of engine load. If the Lambda sensor should fail to emit a signal for any reason, the system will revert automatically to this ratio.

Fuel enrichment

The following types of fuel enrichment occur:

- Cold-start enrichment (via the cold-start valve or via P11, depending on temperature)
- Acceleration enrichment (via the fuel booster pressure switch for 140 ± 20 seconds after starting)
- Rpm-governed enrichment (via the speed relay (138) at engine speed >3800 rpm (4600 rpm on model year 1988 and later cars). Provides a fixed pulse ratio of 85%. Applicable to Turbo cars only)
- Full-load enrichment (via the throttle position switch).

  Model year 1987 and earlier Turbo cars: a throttle butterfly angle >72° gives a fixed pulse ratio >92%, or rpm >3800 (4600 rpm on model year 1988 and later cars) gives a fixed pulse ratio >85%.
- Pressure-governed full-load enrichment, model year 1988 and later

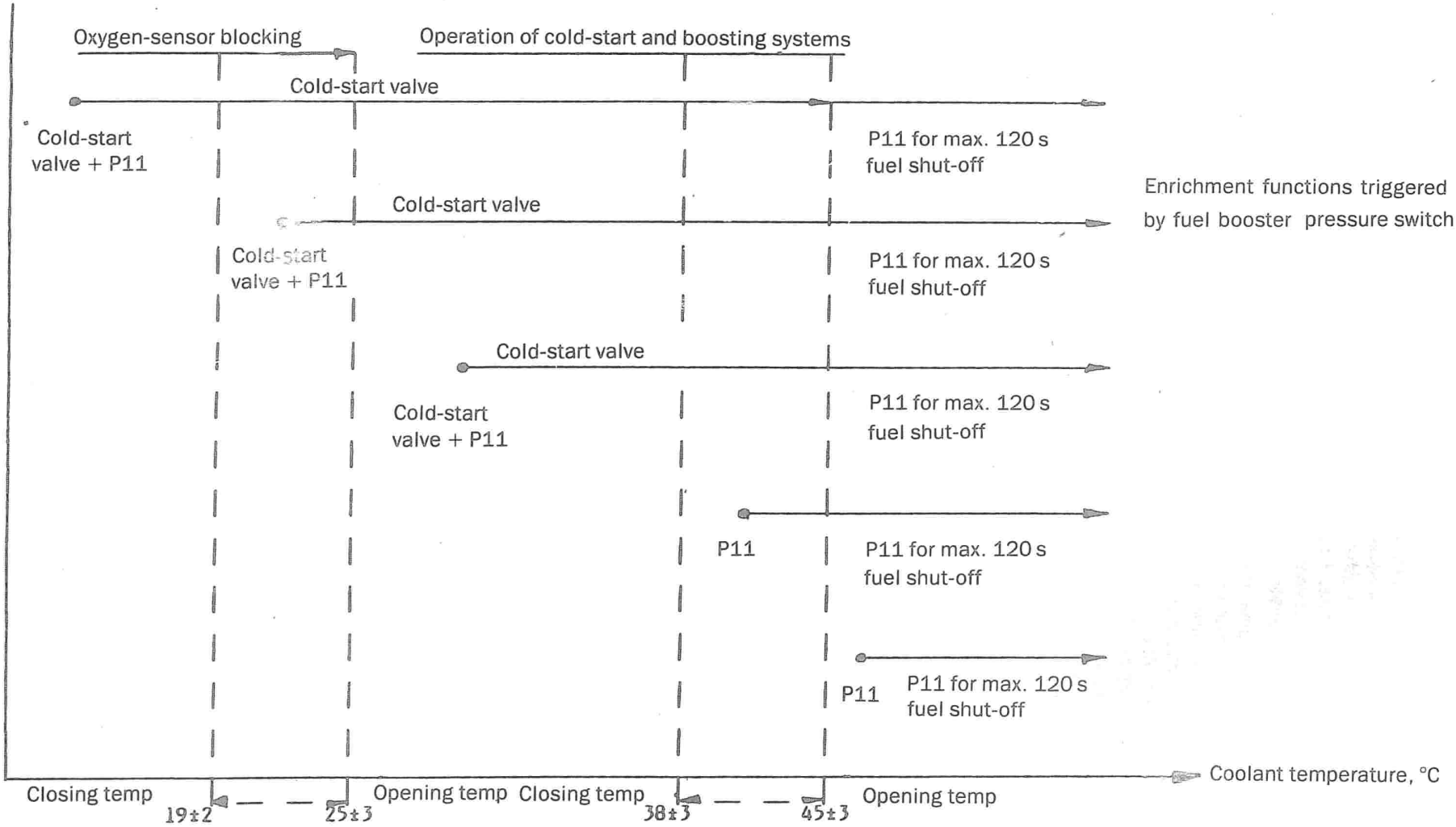
  At an inlet manifold pressure of 0.25-0.30 bar a pressure switch is actuated to effect full-load enrichment (fixed pulse ratio of 85%).

  Normally aspirated engines in model year 1987 and later cars do not have full-load enrichment.

Fuel enrichment is provided to improve drivability during the warm-up period and on acceleration. On Turbo engines it is also designed to ensure sufficient internal cooling of the engine under maximum load conditions and at speeds above 3800 rpm (4600 rpm on model year 1988 and later cars). Full-load and rpm enrichment, Turbo only.

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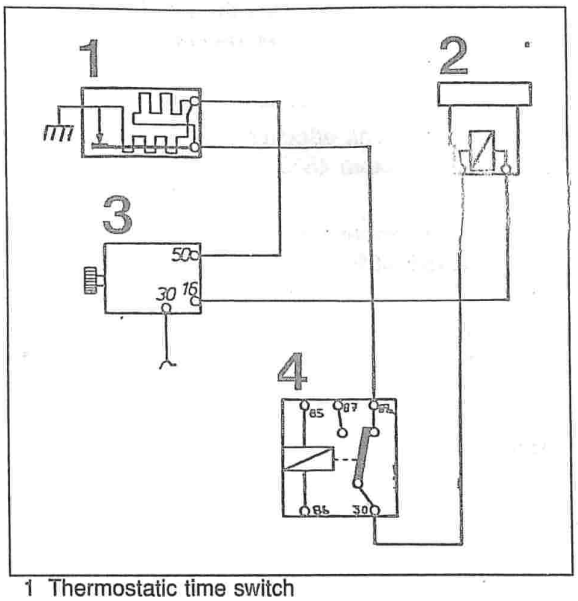


- Regardless of temperature, P11 boosting (pulse ratio 92% minimum) always takes place while the starter motor is running and for three seconds after starting.
- Pulsed signal (0.10 s open and 0.3 s closed) to cold-start valve occurs after starter motor has been running for 1.4 s. This function is operative when the 45 °C thermostatic switch and/or TTK is/are open.
- Oxygen-sensor blocking (P12) results in a fixed pulse ratio of 60% (also that obtaining during fuel shut-off).

Fuel enrichment system, 1981-83

A Cold-start function

The cold-start valve can open only when the starter motor is engaged. The time the valve remains open, injecting fuel, is governed by the thermostatic time switch which senses engine temperature. The maximum injection time of approx. 9.5 seconds occurs at temperatures below -20°C (-4°F). At higher engine temperatures the injection time becomes progressively shorter and the cold-start valve ceases to operate at temperatures above 45°C (113°F).

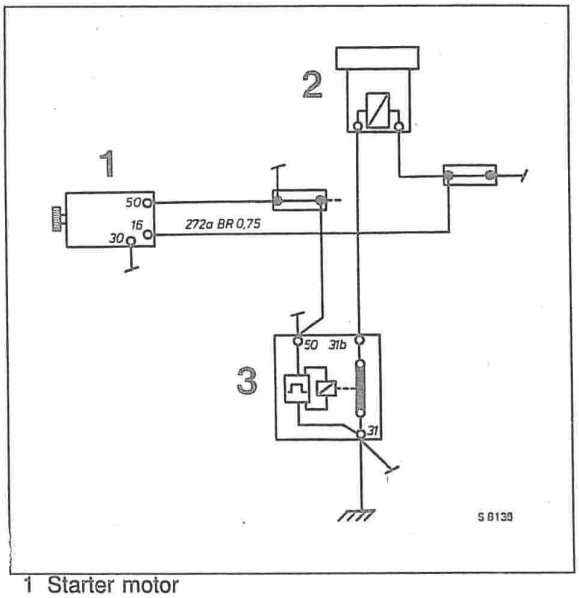


1 Thermostatic time switch
2 Cold-start valve
3 Starter motor
4 Cold-start/hot-start relay

B Hot-start function

If the engine is slow to start when hot because of vapour in the fuel lines, the cold-start valve will be controlled by pulses from a hot-start relay. The engine will then start on fuel provided by the cold-start valve and faster purging of the vapour in the fuel lines is obtained.

If the engine fails to start after 1.4 seconds, injection pulses lasting 0.4 seconds will be obtained at 0.3-second intervals.



1 Starter motor
2 Cold-start valve
3 Hot-start relay

to cold-start valve occurs after starter motor during fuel shut-off).

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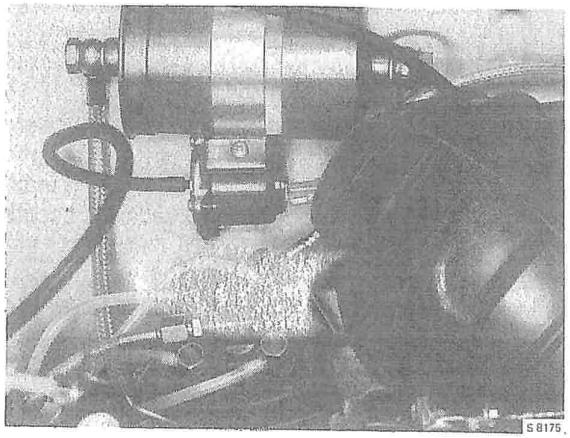
C Acceleration enrichment

This function provides better drivability after starting.

Acceleration enrichment, which is brought about by a fuel booster pressure switch and the cold-start valve, takes place when the load on the engine increases.

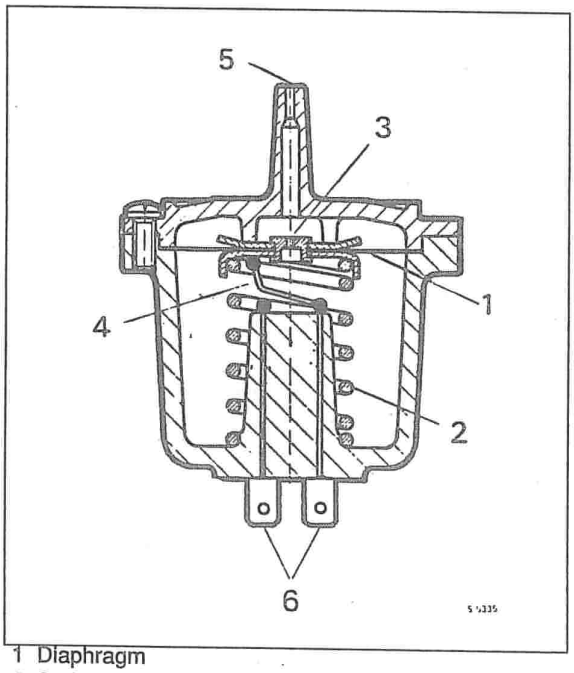
Engine cold
Enrichment remains effective until the engine temperature rises above 45°C (113°F).

Engine hot
Enrichment for about 100 seconds if the engine has been switched off for more than 30 minutes.



Fuel booster pressure switch

When the car is travelling at a constant speed, the negative pressure is the same on either side of the diaphragm. On acceleration, the negative pressure diminishes. The change in pressure will be delayed below the diaphragm on account of the constriction. The "absolute" pressure above the diaphragm then increases momentarily, forcing the diaphragm down and so activating the contact arm which closes the switch contacts.

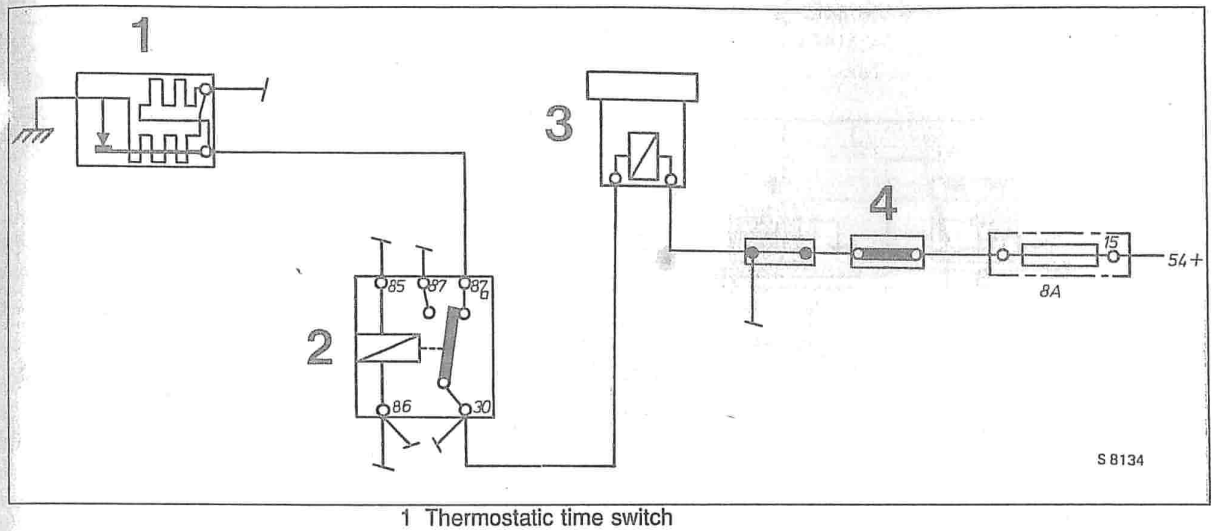


1 Diaphragm
2 Spring
3 Constriction
4 Spring contact arm
5 Vacuum connection
6 Electrical terminals

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Electrical functions: engine cold

The cold-start valve is energized when the fuel booster pressure switch closes. The circuit is grounded via terminals 30 and 87a of the cold-start/ hot-start relay and the thermostatic time switch.



1 Thermostatic time switch
2 Cold-start/hot-start relay
3 Cold-start valve
4 Fuel booster pressure switch

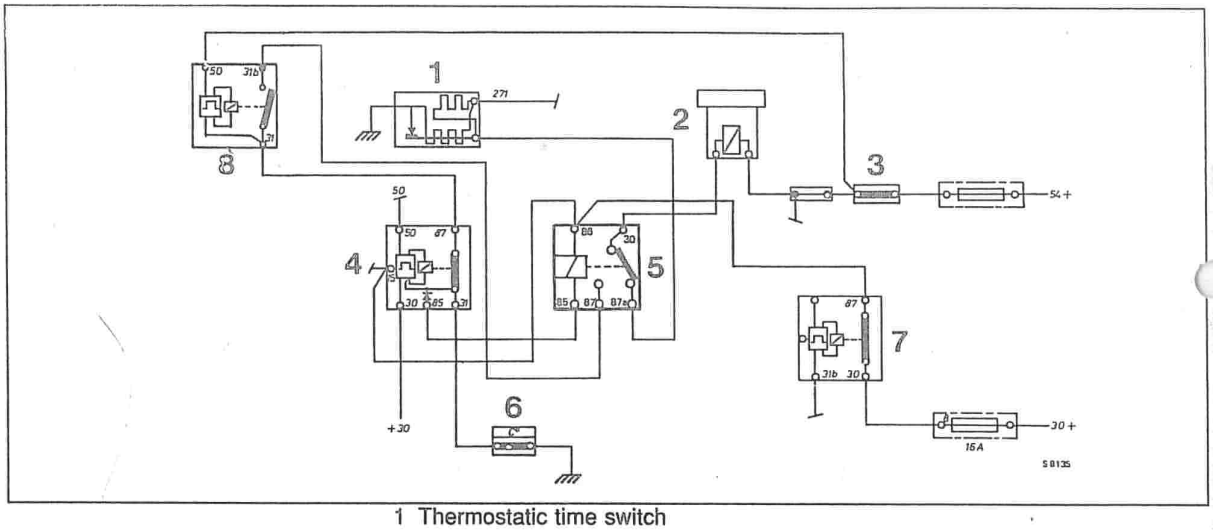
Electrical functions: engine hot

Enrichment for 100 seconds will be obtained when engine temperature exceeds +45°C (113°F) (thermostatic switch on thermostat body closed) and if the engine has been switched off for more than about 30 or 10 minutes. Current from the fuel pump relay passes through the coil and terminal 85 in the cold-start/hot-start relay, through the diode and terminal 31 to ground via the thermostatic switch. The cold- start/hot-start relay is activated.

If the time relay has not been energized for 30 or 10 minutes, the contact in the relay will be closed. The cold- start valve will then be grounded via terminals 30 and 87 of the cold-start/hot-start relay, terminals 87 and 31 of the time relay, and the thermostatic switch.

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In model year 1981 Turbo cars and model year 1982 Turbo cars with automatic transmission, this system would deliver an excessive quantity of fuel. These cars are therefore fitted with an additional relay to restrict the flow of fuel by pulse modulation of the cold-start valve. The relay is activated by the fuel booster pressure switch and is connected in circuit between the time relay and the cold- start/hot-start relay.



1 Thermostatic time switch
2 Cold-start valve
3 Fuel booster pressure switch
4 Time relay
5 Cold-start/hot-start relay
6 Thermostatic switch
7 Fuel pump relay
8 Pulse relay

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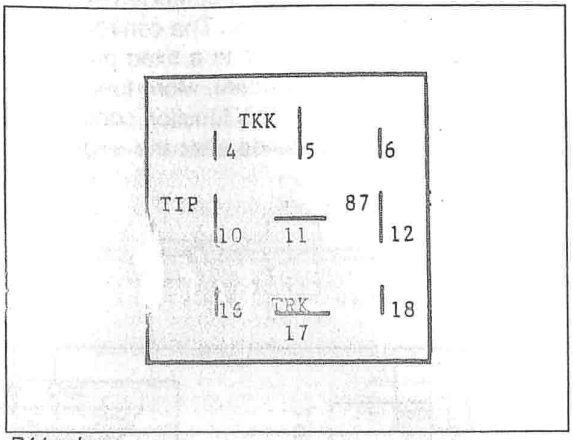
Fuel enrichment system, 1984-

A new fuel enrichment system was introduced was introduced on model year 1984 cars.

The system is controlled by a P11 relay. This relay replaces the time relay, the cold-start/hot-start relay and the pulse relay incorporated in the earlier system.

The system consists of two main functions:

A Starting system
B Acceleration system



P11 relay

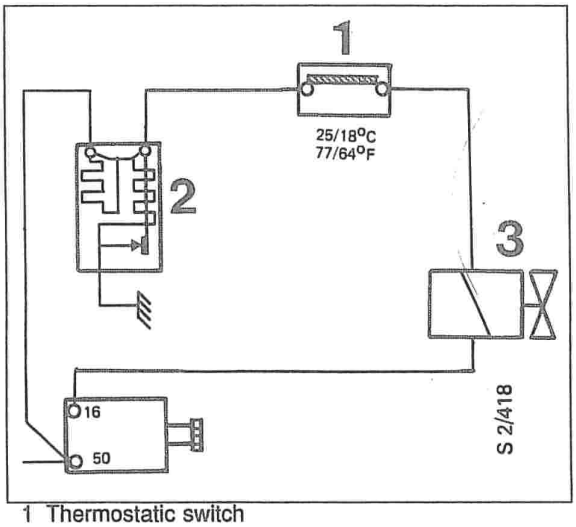
A Starting system

1 Cold starting, engine temperature below +18°C (+65°F)

a. When the starter motor is engaged the cold-start valve provides fuel enrichment.

Operation of the cold-start valve is controlled by the thermostatic switch and the thermostatic time switch.

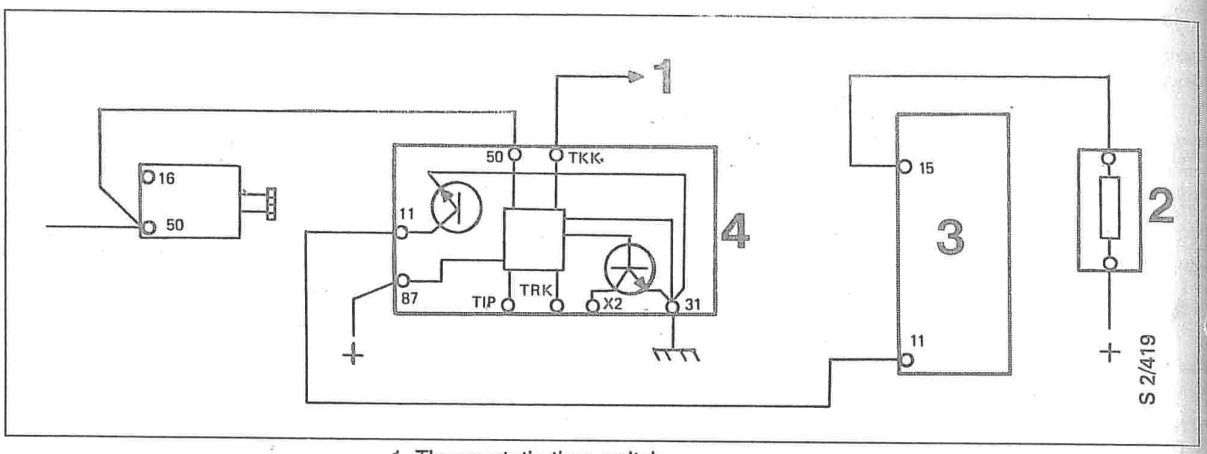
The maximum injection time is about 9.5 seconds, which is obtained at an engine temperature of -20°C (-4°F). At higher engine temperatures the injection time is progressively shorter.



1 Thermostatic switch
2 Thermostatic time switch
3 Cold-start valve

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b. When the starter motor is engaged, the P11 relay also receives a signal and grounds terminal 11 of the Lambda control module. The control module sets the modulating valve to a fixed pulse ratio greater than 92%(fully open). More fuel is delivered via the injectors. This function continues to operate for three seconds after the engine has started.

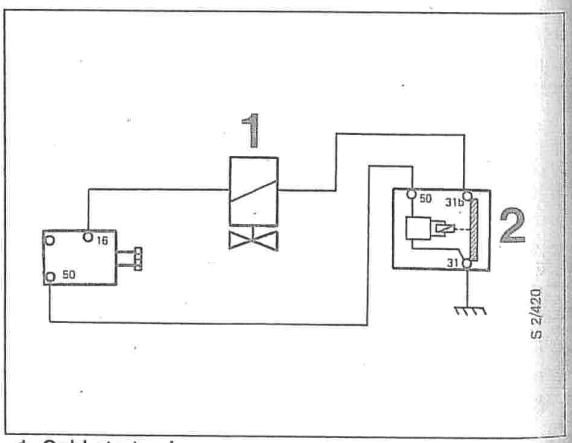


1 Thermostatic time switch
2 Modulating valve
3 Lambda control module
4 P11 relay

2 Hot starting, engine temperature above 25°C (77°F)

a. In the same way as when the engine is started from cold, the P11 relay receives a signal from the starter motor. The modulating valve opens fully and enrichment takes place via the injectors, which deliver a boost of fuel. This function continues to operate for three seconds after the engine has started.

b. If the engine fails to start after 1.4 seconds, the hot-start relay is energized. This relay is a pulse relay and enrichment takes place via the cold-start valve in the form of fuel injection pulses having a duration of 0.1 seconds.



1 Cold-start valve
2 Hot-start relay

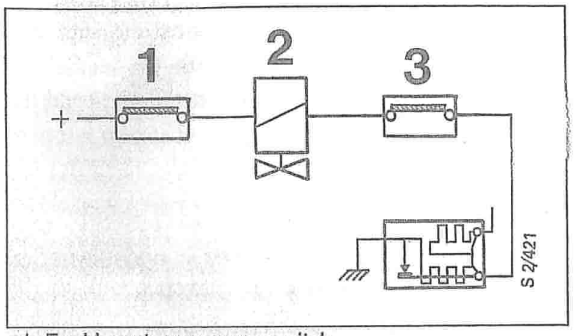
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B Acceleration system

This system of fuel enrichment improves the drivability of the car after starting. It is controlled by a fuel booster pressure switch which senses pressure changes in the intake pipe.

Driving with a cold engine, below +18°C (+65°F)

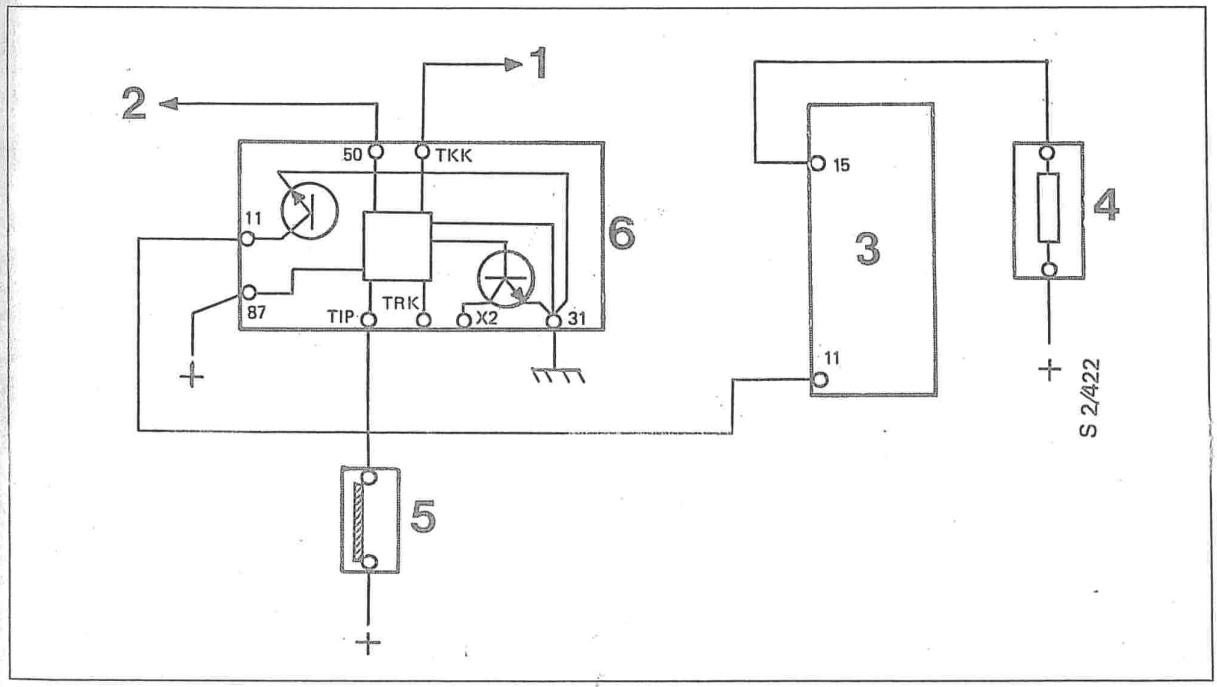
Fuel enrichment takes place via the cold-start valve. When the fuel booster pressure switch closes, power is supplied to the cold-start valve. This valve is grounded via the thermostatic switch and the thermostatic time switch. Enrichment ceases when the engine temperature reaches +25°C, at which temperature the thermostatic switch breaks the circuit. If engine temperature reaches +25°C (77°F) within two minutes of starting, the P11 relay will operate. The modulating valve then opens fully so that additional fuel is delivered to the engine through the injectors.



1 Fuel booster pressure switch
2 Cold-start valve
3 Thermostatic switch

Driving with a hot engine, above +25°C (+77°F)

Each time the fuel booster pressure switch closes, a signal is sent to the P11 relay which senses that the thermostatic switch is open and no enrichment can be provided via the cold-start valve. The P11 relay therefore grounds terminal 11 of the Lambda control module. The modulating valve opens fully and enrichment takes place as a boost of fuel is delivered via the injectors. This cycle is repeated every time the fuel booster pressure switch closes, but not after two minutes has elapsed from starting.



1 Thermostatic time switch
2 Starter motor
3 Lambda control module
4 Modulating valve
5 Fuel booster pressure switch
6 P11 relay

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Connecting pins on the P11 relay

The relay has eight connecting pins, as follows:

87 = Feed to relay

31 = Relay grounding point

11 = Connecting pin for control of Lambda control module. Each time pin 11 is grounded, the modulating valve opens fully and provides full-load enrichment.

50 = Signal from starter motor. This signal initiates the time function of 140 ± 20 seconds, during which time full-load enrichment takes place.

TKK = Thermostatic switch
Through this pin the relay senses whether the switch is open or closed.

TIP = Fuel booster pressure switch
Through this pin the relay receives a signal from the starter motor (pin 16), which initiates fuel enrichment each time the starter motor is engaged. Enrichment continues for three seconds after the engine has started.

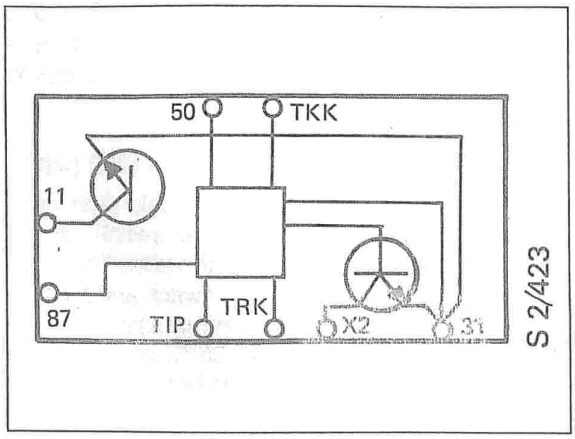
Through this pin the relay also receives a signal when the fuel booster pressure switch closes (acceleration boost).

Cars with a manual gearbox also have:

TRK = Throttle position switch
Senses whether the throttle is open or closed.

X2 = Signal to fuel shut-off relay, which prevents fuel shut-off when the engine is cold.

Together with the throttle position switch, this function inhibits enrichment through the P11 relay during deceleration (overrun).



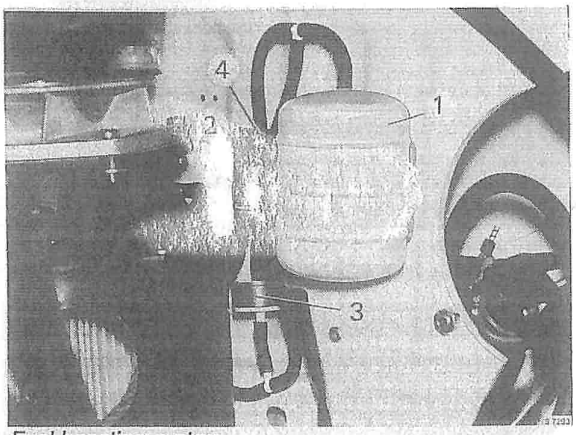
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Fuel boosting system

Turbo engines without BPC (-1982)

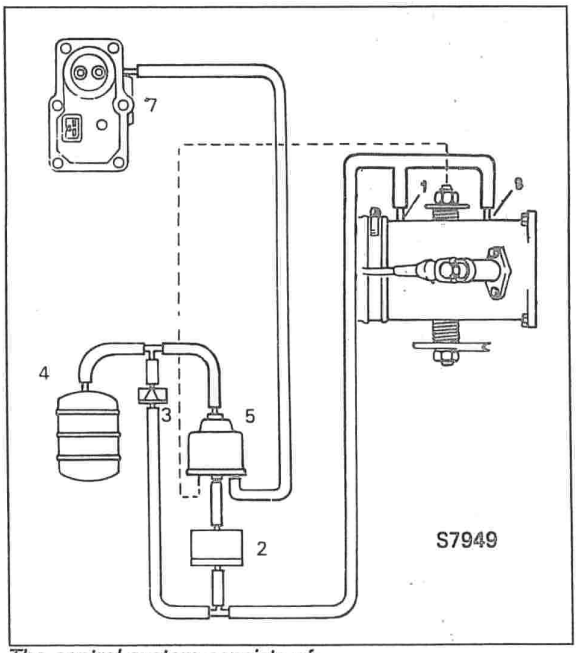
The fuel boosting system performs two functions: it assists in the internal cooling of the engine when it is subjected to sustained periods of load and it also provides the extra fuel required for rapid acceleration.

Fuel boosting is achieved by means of a special warm-up regulator which is actuated by the compressor pressure via a control system.



Fuel boosting system

1 Pressure vessel
2 Electric control valve
3 Delay valve (6 s) (manual gearbox cars only)
4 Non-return valve



The control system consists of:

1 Pressure outlet in the throttle body (upstream of the butterfly)
2 Delay valve (6 s) (manual gearbox cars only)
3 Non-return valve
4 Pressure vessel
5 Electric control valve
6 Throttle position sensor (62° throttle opening)
7 Warm-up regulator with pressure control function
8 ConstrictionØ 2 mm (automatic transmission cars only)

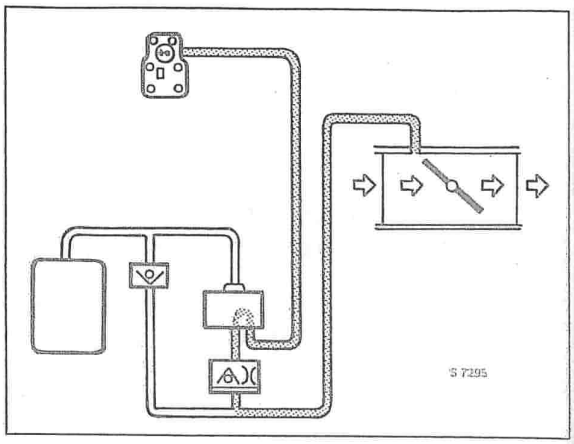
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The control system has the following two functions:

I Heavy load (not full throttle)

Air from the compressor flows via the delay valve through the electric control valve which, in its normal position, allows the pressurized air to pass to the warm-up regulator so that enrichment takes place.

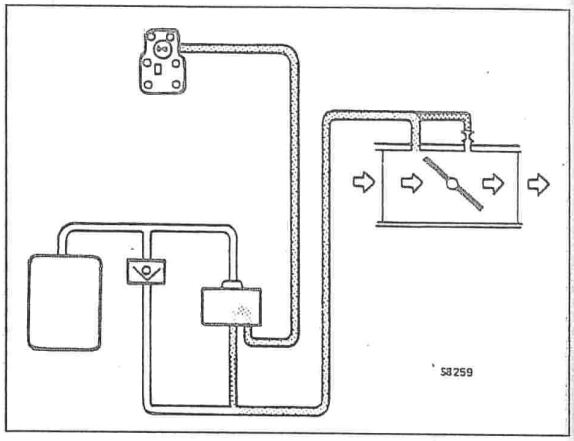
The delay valve ensures that the fuel boosting system is not activated for temporary increases in load which would otherwise result in unnecessarily high petrol consumption and unnecessary hydrocarbon emissions.



Deviations, cars with automatic transmission (Double connections to the throttle body)

Under load, cars with automatic transmission produce a more powerful signal in front of the throttle butterfly. This signal is reduced to the desired level by a constriction inside the throttle.

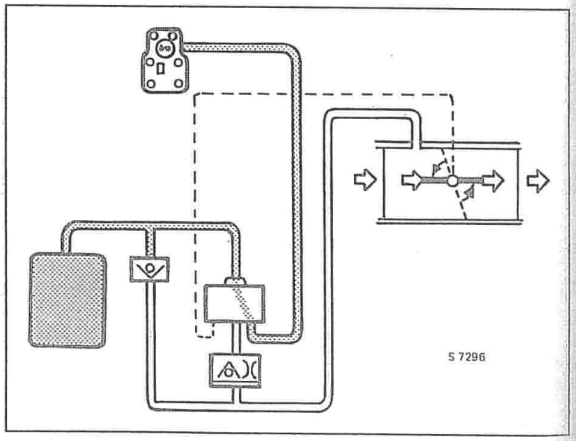
Cars with automatic transmission are not equipped with a delay valve because temporary load increases (pressure surges) do not occur to the same extent as on cars with a manual gearbox.



II Full throttle

Via the non-return valve, the pressure vessel is in communication with the pressure generated by the compressor, thereby increasing the residual pressure enough to maintain the same level over a long period.

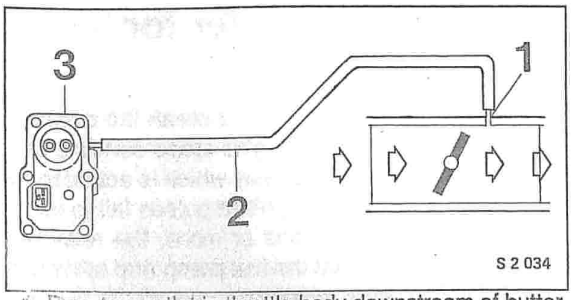
When the throttle is fully open, the electric control valve is activated via the throttle position sensor, resulting in immediate regulation of the control pressure and corresponding fuel enrichment due to the "residual pressure" in the pressure vessel.



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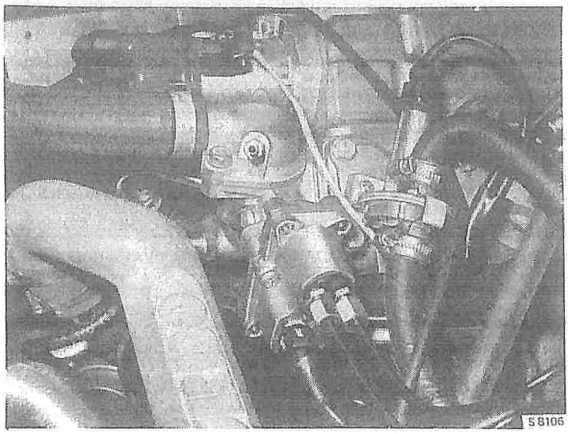
Turbo engines with BPC, 1982

On model year 1982 and later cars equipped with Turbo BPC, the warm-up regulator is connected directly to the intake pipe.



1 Pressure outlet in throttle body downstream of butterfly
2 Hose
3 Warm-up regulator

The special warm-up regulator on Turbo engines incorporates a steel diaphragm valve. The pressure of the spring in the valve is influenced not only by a bi-metal regulator but also by a rubber diaphragm which responds to the pressure generated by the compressor. At a charging pressure of approx. 0.4 bar (5.8 psi), the spring pressure on the steel diaphragm is reduced and there is a consequent drop in the control pressure.



Full-load enrichment, 1988 (CI fuel injection system, B201 with catalytic converter)

Turbo

Pressure-controlled full-load enrichment supplements the speed-controlled full-load enrichment function and also the enrichment that is controlled by the throttle butterfly via the throttle position switch.

A pressure switch in parallel with the speed relay senses the pressure in the inlet manifold. At pressures between 0.25 and 0.30 bar, pin 7 of the control module is grounded via the pressure switch and full-load enrichment takes place (fixed pulse ratio 85%).

The engine speed at which the speed relay operates and activates the full-load enrichment function has been changed from 3800 rpm to 4600 rpm (pin 7 of the control module is grounded via the relay). Activation of the enrichment function takes place only at throttle angles less than 72°.

At full throttle (throttle angle greater than 72°), pin 11 of the control module is grounded and a fixed pulse ratio of 92%is then obtained.

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Over-revving limiter for Turbo engines

The safety function designed to break the circuit to the fuel pump when the engine stops consists of a pulse sensor in the pump relay which is actuated by the ignition pulses. If the ignition pulses fail to occur for a period of one second or more, the relay will break the circuit so that the fuel pump and other fuel system components receive no current.

The relay incorporates an over-revving limiter which breaks the circuit to the fuel pump at approx. 6000 rpm.

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LH fuel injection system, B202 injection engine

General

The Bosch LH-Jetronic L uftmassenmesser H itzdraht) fuel injection system, comprising a mass air flow sensor incorporating a filament (hot-wire sensor), combines the best features of different fuel injection systems with **measurement of the air mass**, i.e. the density of the induction air is taken into account - unlike earlier fuel injection systems.

In the LH-Jetronic system, the **air mass** consumed by the engine is measured, which means that allowance is made for the composition of the air (temperature, pressure and humidity). Measurement of the air mass is performed by the mass air flow sensor with the hot- wire sensor, which measure the air upstream of the inlet manifold.

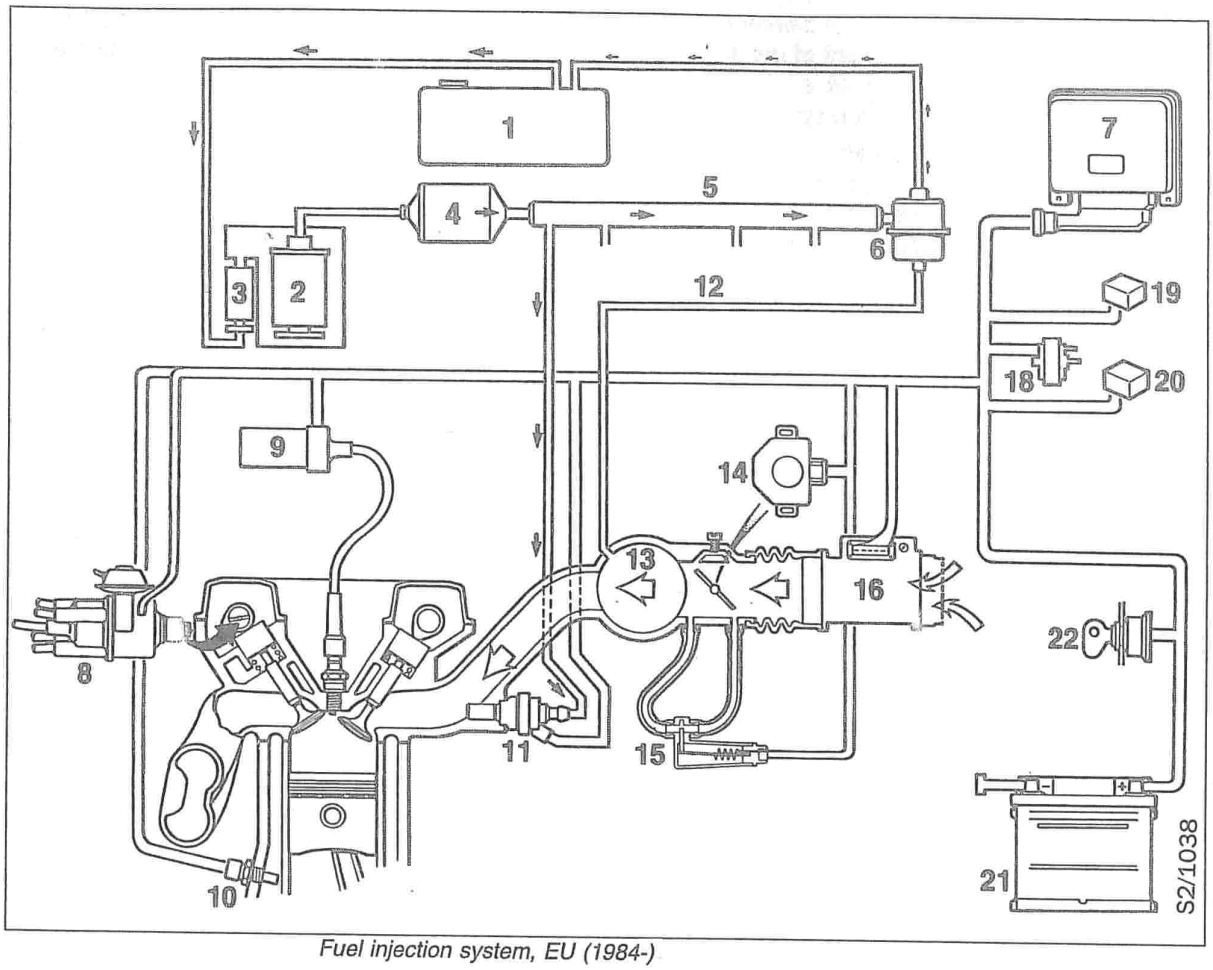
This method provides a more exact measure of the quantity of oxygen supplied to the engine by the air mass, which determines the quantity of fuel required for efficient combustion.

In all previous fuel injection systems, only the air volume (quantity of air) and/or the atmospheric pressure has been taken into account.
The LH system has the following advantages over earlier types of fuel injection:

- Compensation for temperature variations.
- Adjusts the quantity of fuel to the quantity of oxygen at high altitudes.
- Fewer components.
- Lighter.
- Fewer moving parts.
- Wider scope for adapting the quantity of fuel to actual needs (warm-up period/acceleration phase).

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Fuel injection system, EU (1984-)

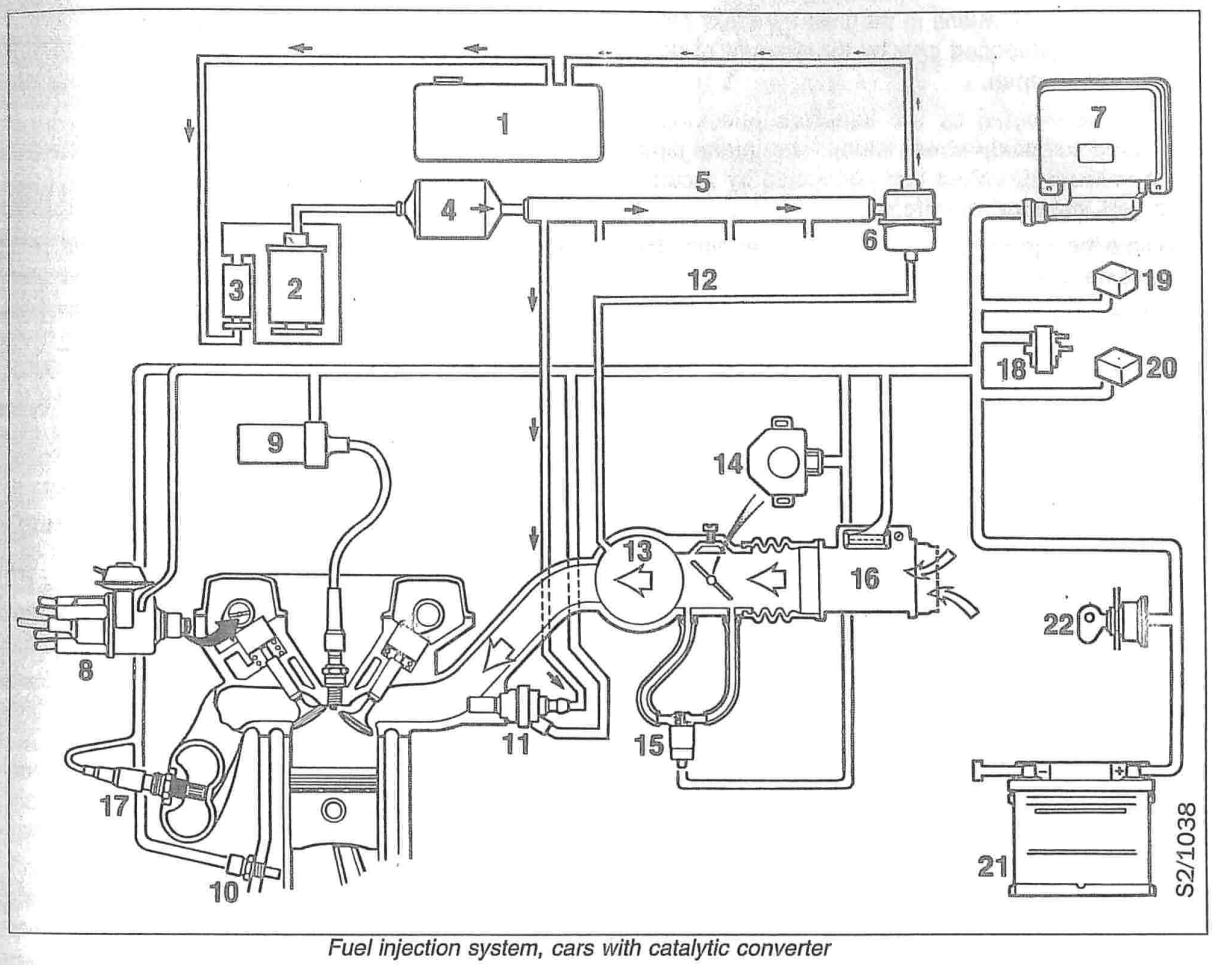


Fuel injection system, EU (1984-)

1 Fuel tank
2 Fuel pump
3 Feed pump
4 Fuel filter
5 Fuel injection manifold
6 Fuel pressure regulator
7 Control module
8 Distributor
9 Ignition coil
10 Coolant temperature sensor
11 Injector
12 Vacuum line
13 Intake pipe
14 Throttle position sensor
15 Auxiliary air valve
16 Mass air flow sensor
17 Pressure switch
18 Main relay
19 Fuel pump relay
20 Battery
21 Ignition switch

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Fuel injection system, cars with catalytic converter



Fuel injection system, cars with catalytic converter

1 Fuel tank
2 Fuel pump
3 Feed pump
4 Fuel filter
5 Fuel injection manifold
6 Fuel pressure regulator
7 Control module
8 Distributor
9 Ignition coil
10 Coolant temperature sensor
11 Injector
12 Vacuum line
13 Intake pipe
14 Throttle position sensor
15 Auxiliary air valve
16 Mass air flow sensor
17 Oxygen sensor
18 Pressure switch (Turbo only)
19 Main relay
20 Fuel pump relay
21 Battery
22 Ignition switch

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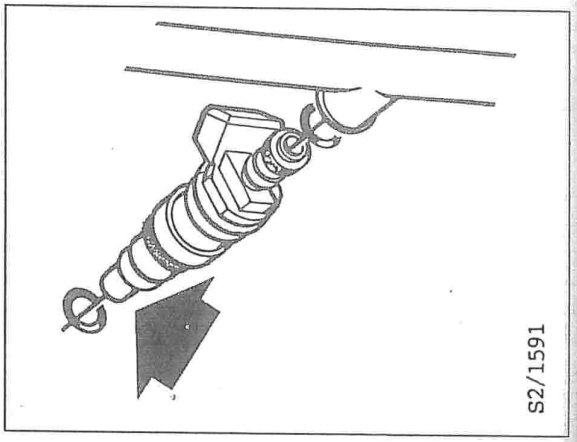
Principle of operation

The operating principle of the system is as follows. An electric **fuel pump** pumps fuel from **the fuel tank,** building up pressure in the fuel system. The level of the pressure is governed by **the pressure regulator** , which maintains a constant ratio between the fuel pressure and the pressure in the intake pipe. As a result, the quantity of injected fuel is unaffected by variations in the inlet manifold pressure and is influenced only by the amount of time the injector is open.

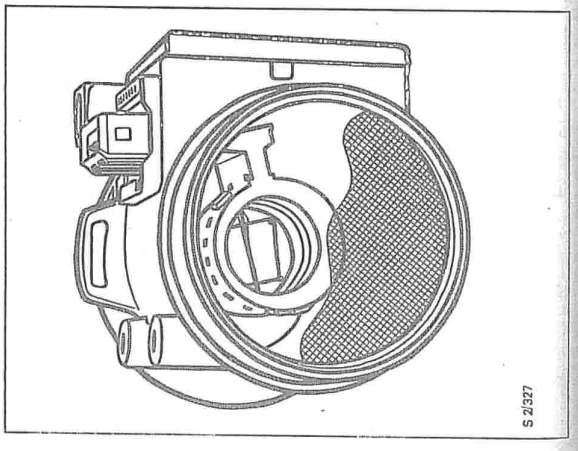
The fuel is injected by **the injectors** (electrically controlled solenoid valves) fitted in the intake pipe close to the inlet valves and connected by a common **fuel injection manifold** .

The time the injectors remain open is determined by the engine load.

On M1989 and later cars the injectors are fitted with a plastic sleeve. A nozzle of new design improves the long-term characteristics.



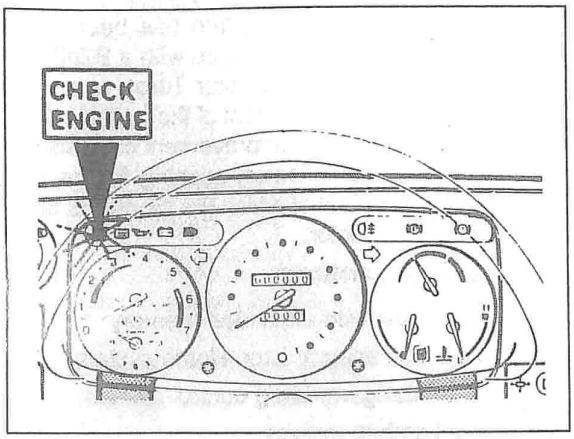
The mass air flow sensor consists of an aluminium housing enclosing an air duct. On M1989 and later Saab 900 Turbo models with catalytic converter (LH2.4), the mass air flow sensor housing is made of plastic. Located in the centre of the duct is a tube which houses the platinum filament (hot wire). The temperature of the hot wire is maintained at approx. 100°C (212°F) above the temperature of the inlet air, regardless of the composition of the air or the air flow.



The device for controlling the current required to maintain the hot wire at a constant temperature consists of a bridge circuit and a detector resistor, the voltage variation across which is directly proportional to the magnitude of the inlet air mass.
The electrical components are located in a module on the mass air flow sensor housing. Since the hot wire is sited inside the inlet duct it can become coated with dirt which reduces its sensitivity and affects the results of measurement. To keep the hot wire free from dirt, it is heated to a temperature of about 1000°C (1830°F) for one second. This takes place four seconds after the engine has been switched off.

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In the event of a break in the signal from the mass air flow sensor (MAF sensor)caused by a broken hot wire, for instance, an emergency system built into the control module and known as the "Limp- Home" mode will take over, enabling the car to be driven with impaired performance. When the Limp-Home mode is in operation, the CHECK ENGINE lamp on the instrument panel will light up.



The electric signals from the temperature sensor and throttle position sensor (two positions), the ignition pulses from the ignition system and the signal from the mass air flow sensor are all fed into **the control module's** microprocessor which then processes the information and determines the time that the injectors remain open. The hot wire burn-off function is also controlled by the control module's microprocessor.

Other functions stored in the control module include full- load enrichment at different engine speeds, extra acceleration enrichment when the engine is cold, and idling control on cars equipped with IAC.

The temperature sensor is of NTC (Negative Temperature Coefficient) type and it sends a continuous engine temperature signal direct to the control module. If there is a break in the signal from the temperature sensor, a signal is simulated by the control module and the system functions on the assumption that engine temperature is +20°C (68°F).

The throttle position switch tells the control module whetherthe throttle butterfly is in the fully open or idling position.

On M1991 and later cars with a B212 engine, the throttle position switch has been replaced by a **throttle position sensor** which continuously and steplessly informs the control module of the current throttle butterfly angle.

The auxiliary air valve compensates for losses due to friction when the engine is started from cold by allowing air to bypass the throttle butterfly.

On cars equipped with a catalytic converter, the auxiliary valve has been replaced by an **idle air control (IAC) valve** which also compensates for momentary increases in the load when the engine is idling. On M1991 and later cars with a B212 engine, this valve is of new design, see under "Components".

S2/1591

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LH 2.4 fuel injection system

The LH 2.4 fuel injection system has been introduced on all M1988 and later cars with a B202i engine and on all M1998B and later Turbo cars. This system is a further development of the earlier LH 2.2 fuel injection system. The improvement consists primarily of an expanded memory capacity for the control module, as a result of which the module is fitted with a 35-pin connector.

Special LH 2.4 functions:

- Control module with expanded memory
- IAC valve with integral Limp-Home system
- Adaptive (intelligent) idling control system
- Adaptive Lambda system
- Integral deceleration function (fuel shut-off)
- Improved function for shift-up indication
- New CP valve
- Integrated fault-diagnosis system
- Pressure-switch function integrated in control module

M1990 and later cars have additional LH 2.4 functions:

- Wider scope for diagnosis with the integrated fault- diagnosis system
- new control module
- Possibility of carrying out fault diagnosis and fault tracing using an ISAT (I ntelligent SA ab T ester)

On M1991 and later cars a number of new diagnostic trouble codes, which can be read on an ISAT, have been included in the fault diagnosis system.

LH 2.4.2 fuel injection system

The LH 2.4.2 fuel injection system was introduced on M1991 cars with all versions of the B212 engine. The most important changes are the wider scope for fault diagnosis made possible by a new control module and the substitution of a throttle position sensor for the throttle position switch.

The IAC valve is also of new design.

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Components

Fuel tank

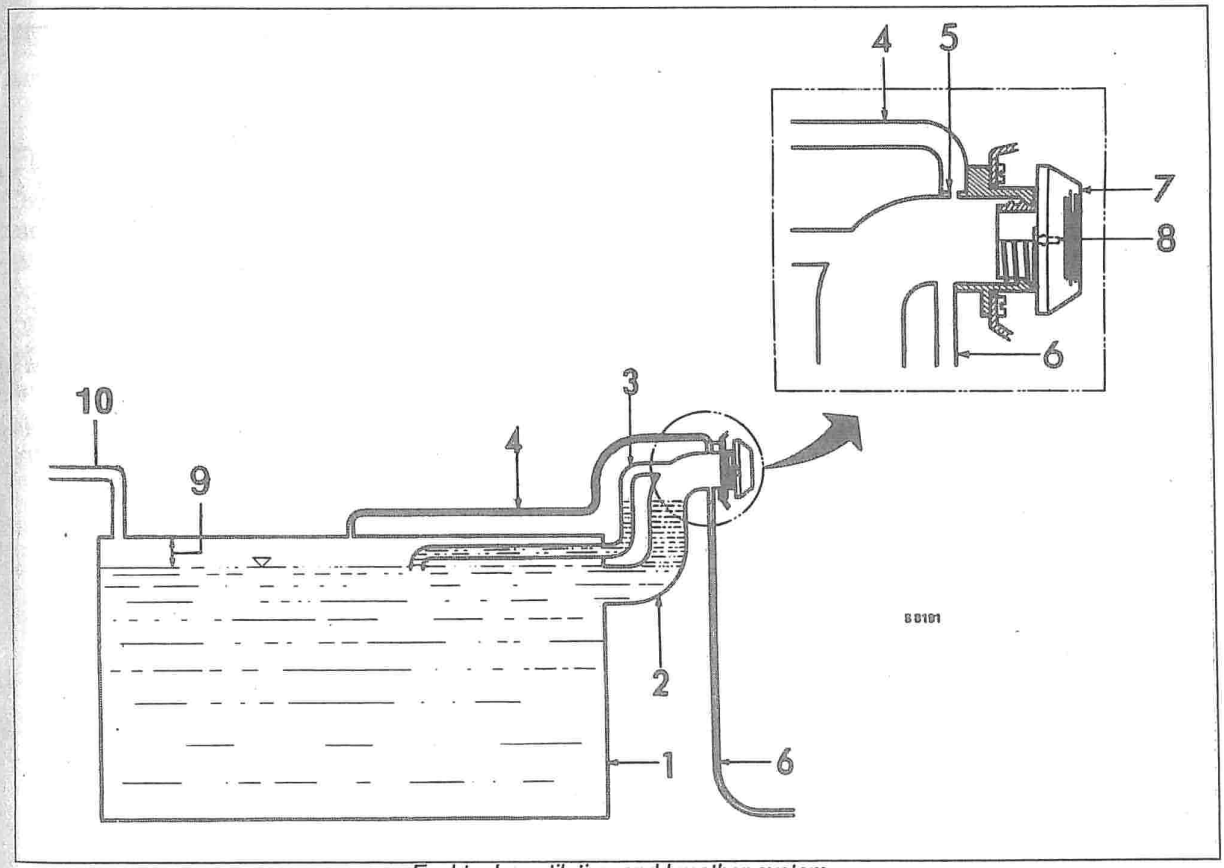
The fuel tank is made of injection-moulded plastic and houses the fuel level transmitter, the pump inlet line and a connection for the fuel return line.

The tank is equipped with a breather system and overfill protection, which allows for expansion of the fuel inside the tank.

Fuel tank venting and overfill protection

When fuel is added to the tank air is evacuated partially through the breather pipe (3).

An air cushion is formed at the top of the tank when the level of fuel reaches the lower opening of the breather pipe (3), owing to the action of a constriction (5) positioned in the breather hose (4) for the upper section of the tank. The constriction inhibits rapid changes in volume when the car is being refuelled but does not affect gradual changes in volume occasioned by temperature variations or the movement of the car when it is being driven.

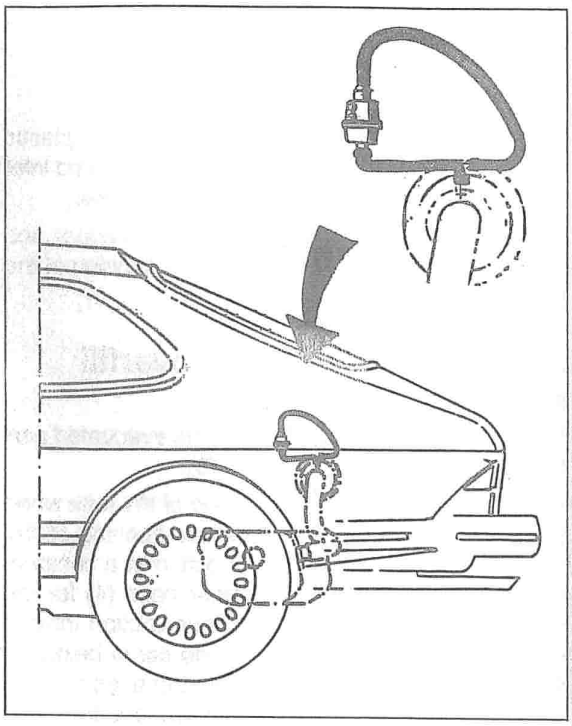


Fuel tank ventilation and breather system

1 Fuel tank
2 Filler pipe
3 Breather pipe
4 Breather hose
5 Constriction
6 Vent hose
7 Filler cap
8 Vacuum valve
9 Expansion space
10 Return fuel line

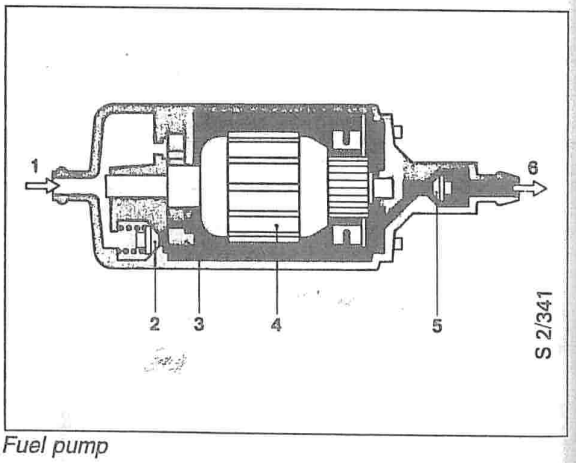
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The tank is vented externally through the vent hose (6) which runs from the filler pipe up the rear corner pillar and along the roof (above the headlining) down through the left front corner pillar and into the engine bay. On late-production model year 1985 and later cars the vent hose is connected to a spigot on the outer end of the filler pipe.
Under normal conditions, the filler cap makes a tight seal with the filler pipe. However, the cap incorporates a vacuum valve which will prevent the fuel tank from collapsing as a result of the pressure difference that could arise if the ventilation system should become blocked.



Fuel pump, EU (1984-)

The electric fuel pump is fitted inside the fuel tank and a filter is connected to the pump inlet. The pump and motor form an integral unit and cannot therefore be repaired. The pump is fitted with a relief valve which opens if the fuel pressure becomes excessive for any reason.
A non-return valve in the pressure line from the pump prevents the pressure in the fuel line from dropping immediately after the pump stops running.



Fuel pump

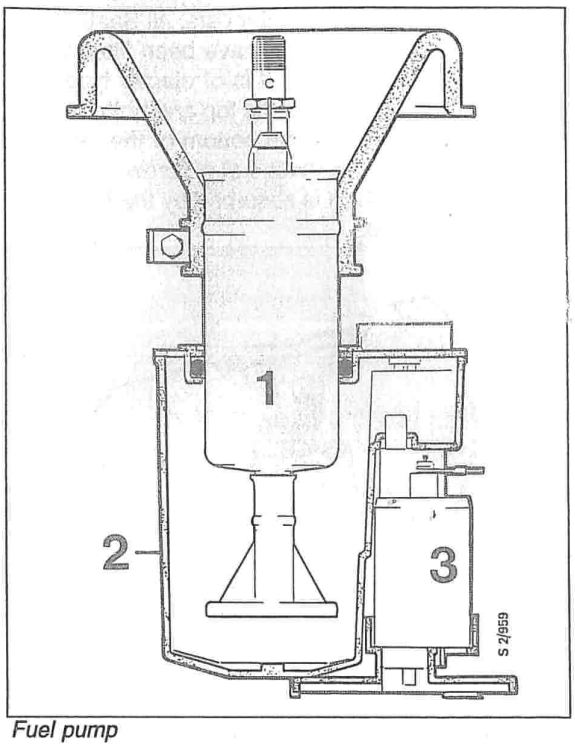
1 Inlet
2 Relief valve (safety pressure)
3 Pump unit
4 Rotor
5 Non-return valve
6 Outlet

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Fuel pump, cars with a catalytic converter (-1988)

The fuel pump (1), housed in a container (2) inside the fuel tank, is an electric rotary pump. The pump and rotor are factory-sealed and cannot be dismantled for overhaul or repair. The pump incorporates a relief valve which opens if the pressure exceeds a preset limit,. A non-return valve in the feed line from the pump prevents the pressure from dropping immediately after the pump has stopped running.

An electric feed pump (3) supplies the container with fuel from the tank. The container acts as a pressure vessel and, since the main fuel pump is always supplied with fuel under pressure, this prevents the formation of vapour locks.



Fuel pump

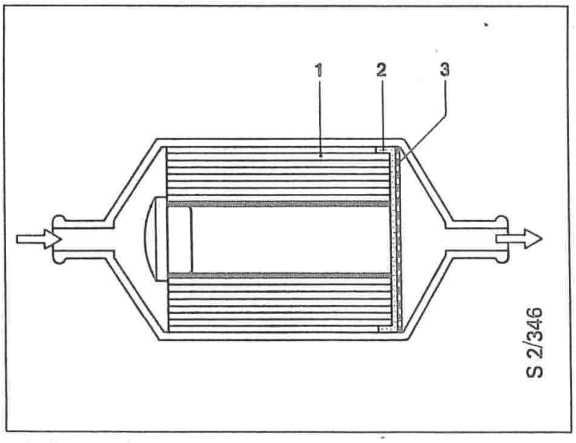
1 Fuel pump
2 Container (pressure vessel)
3 Feed pump

Fuel filter

On model year 1985 and earlier cars the fuel filter is mounted on the left-hand wheel arch, in the pressure line between the fuel pump and the fuel injection manifold.

On model year 1986 and later cars the fuel filter is mounted underneath the car on the right-hand side forward of the fuel tank.

The filter consists of an aluminium housing holding a nylon filter and a paper element.

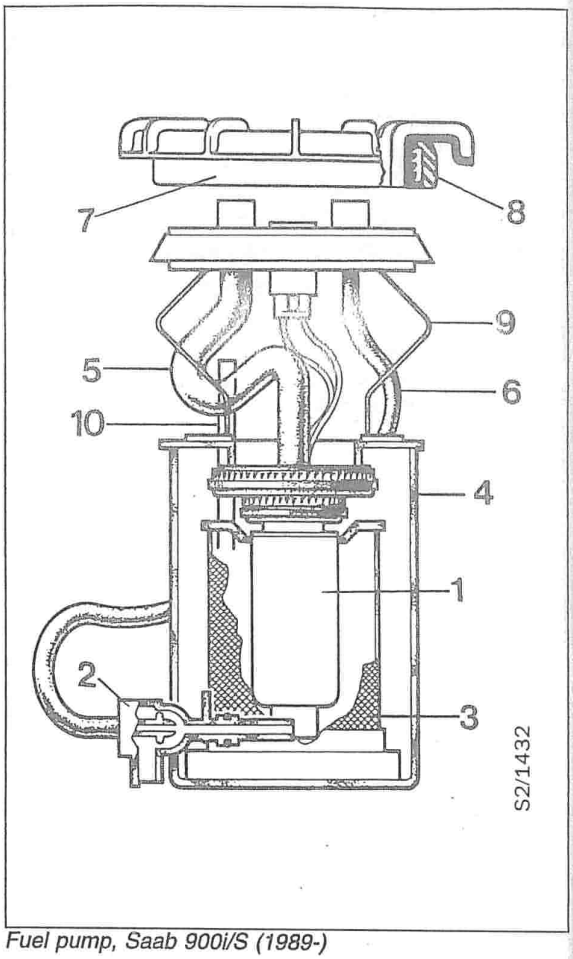


1 Paper element
2 Filter
3 Nylon strainer

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Fuel pump, 900i/S16 (1989-)

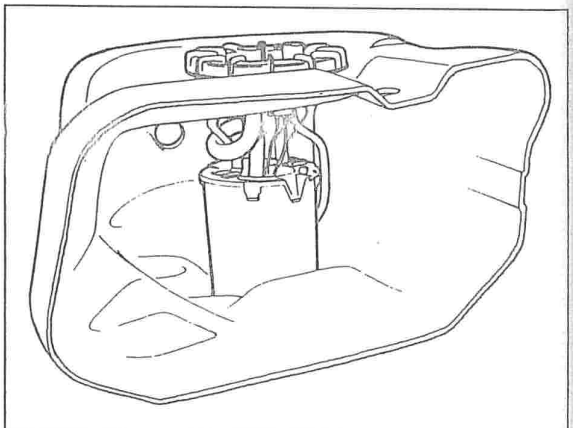
On model year 1989 and later cars, all Saab 900i/S models with a B202 engine have been fitted with a fuel pump of new design. It is of ejector type. The pump is clamped between the top and bottom of the tank, located by ribs on the bottom of the tank and secured at the top by means of a screw top (7).
Any flexing of the tank is absorbed by the fuel pump spring element (9).



Fuel pump, Saab 900i/S (1989-)

1 Main pump
2 Ejector pump
3 Filter
4 Reservoir
5 Pump delivery line
6 Return line
7 Screw top
8 Seal
9 Spring
10 Breather pipe, filter

The design of the tank has been modified to accommodate the new pump.
The pump cannot be fitted in fuel tanks of earlier pattern.



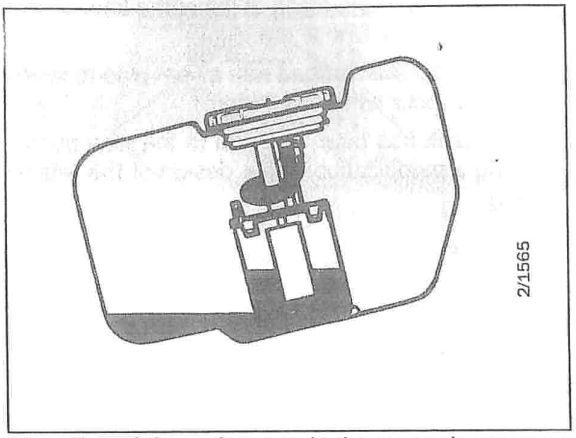
Modified design of tank to accommodate the new fuel pump.

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The principle of operation of the pump is basically the same as in earlier pumps having a main pump and a feed pump. However, in the new fuel pump the feed pump has been replaced by an ejector pump which is driven by the flow of return fuel.

The function of the ejector pump is to ensure the main pump with a supply of fuel. Owing to the location of the main pump in the reservoir, the supply of fuel to the engine is maintained during cornering and acceleration, even when only a small quantity of fuel remains in the tank.

The pump unit, with the ejector pump at the bottom, is seated in a sump in the bottom of the tank. This ensures that the ejector pump will not run dry, even when only a small amount of fuel remains in the tank and when the car leans over heavily.



The siting of the main pump in the reservoir ensures a continuous supply of fuel to the engine.

When the fuel system is completely drained and the tank is empty, at least five litres of fuel must be poured into the tank before any of it can run into the reservoir.

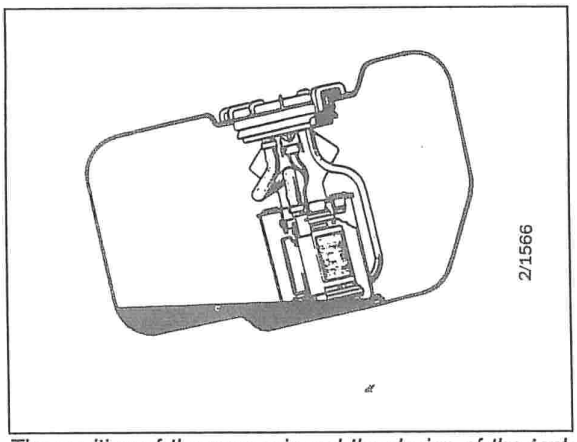
The engine is always supplied with fuel in the following situations:

1 The car is tilted 10%to the front and 10%to the left. Quantity of fuel at least five litres.

2 The car is tilted 10%to the right. Quantity of fuel at least 13 litres.

3 The car is standing on a level surface. Quantity of fuel 2.6 litres.

4 When the car is tilted to the left, the space where the pump is located fills with fuel so the engine can be supplied with fuel until the tank is as good as empty.



The position of the reservoir and the design of the tank combine to ensure a continuous supply of fuel to the engine in most situations.

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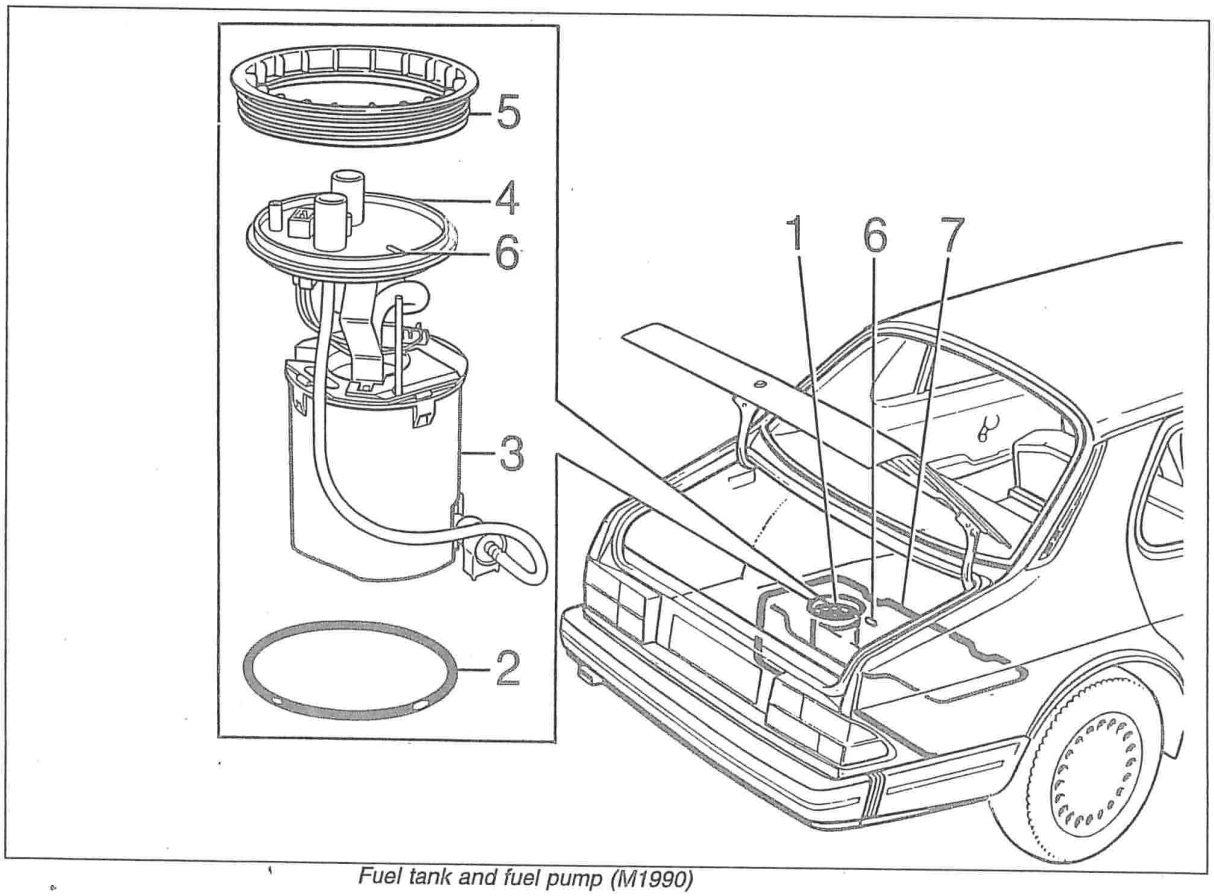
Fuel tank and fuel pump, 900 Turbo (1990-)

The pump is of the same type as earlier with an ejector pump feeding the main pump, but with a number of modifications.

Mounting in the tank has been simplified by the introduction of a new screw top and a new type of rubber seal. This means that a simpler tool can be used for removal and fitting at the same time as the risk of leakage is further reduced.

The fuel pump filter is fitted with a vent pipe to evacuate any vapour which might form.

The fuel tank has been adapted to the new pump, including a modification of the design of the retaining ring.



Fuel tank and fuel pump (M1990)

1 Reinforcement ring
2 Sealing ring
3 Fuel pump
4 pump cover
5 Screw top
6 Alignment marks
7 Fuel tank

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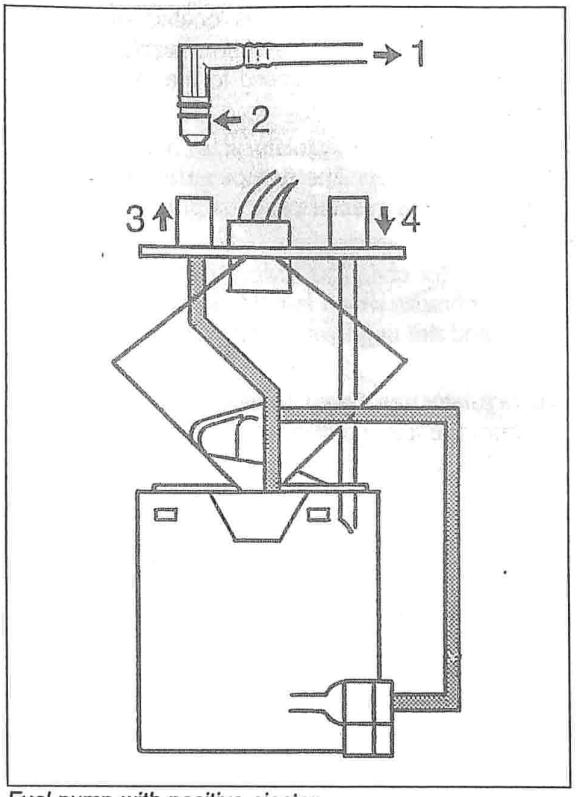
Fuel pump (introduced in 1990)

Earlier fuel pumps have been replaced by a fuel pump with a line pressure ejector (positive ejector) with effect from the following chassis numbers:

- AL 3007857
- AL 5003012
- AL 7021651

This fuel pump is also a replacement pump for 900i cars with a B202 engine (M1989-) and all 900 cars with a B202 engine (M1990-)

The fuel pump's ejector is connected across the line pressure side and the non-return valve is positioned in the fuel pump's feed line. In other respects it is similar to the fuel pump that was introduced before the above chassis numbers.



Fuel pump with positive ejector

1 To fuel filter
2 Non-return valve
3 Feed line
4 Return line

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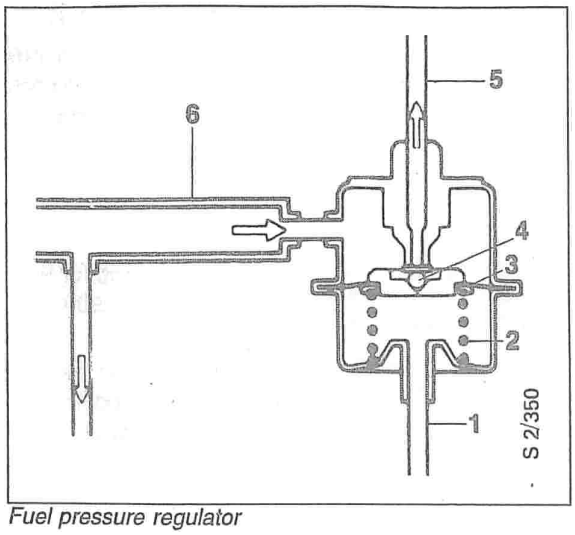
Fuel pressure regulator

The fuel pressure regulator is located immediately adjacent to the fuel injection manifold and is mounted on a bracket bolted to the inlet manifold and cylinder head.

The purpose of the regulator is to maintain a constant ratio between the fuel pressure immediately upstream of the injectors and the pressure in the inlet manifold.

The regulator comprises two chambers, separated by a diaphragm which is held against a valve by a spring and the negative pressure in the inlet manifold.

The regulator has three connections: one for the fuel line from the fuel injection manifold, one for the return fuel line to the tank, and one to the inlet manifold.



Fuel pressure regulator

1 To inlet manifold
2 Spring
3 Diaphragm
4 Valve
5 Return fuel
6 Fuel injection manifold

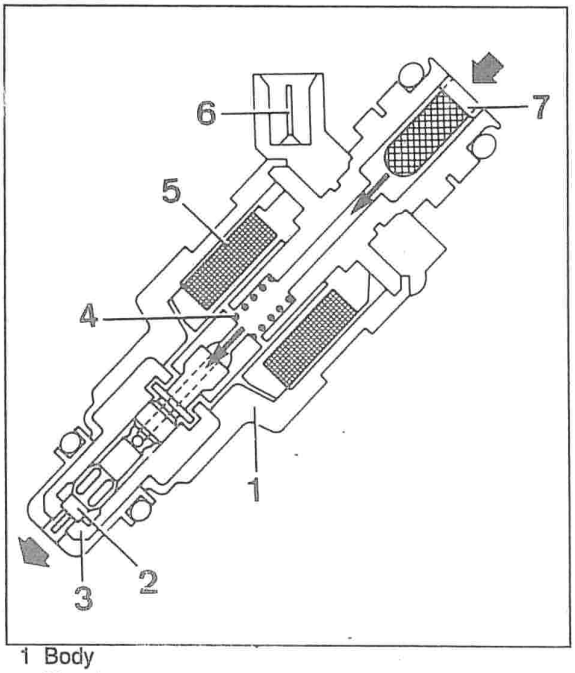
Injectors

The injectors are of solenoid type and the quantity of fuel that is injected, i.e the opening duration of the valves, is determined by the control module. The injectors all open and close simultaneously.

When the engine is running they open once each for revolution of the engine, when starting from cold they open twice for each engine revolution.

The injectors are fitted in the inlet manifold, one for each cylinder, and inject the fuel immediately above the mating surfaces of the inlet manifold and cylinder head.

The opening duration of the valves is regulated within very tight limits: 2-12 milliseconds (1 millisecond = 1/1000th of a second).

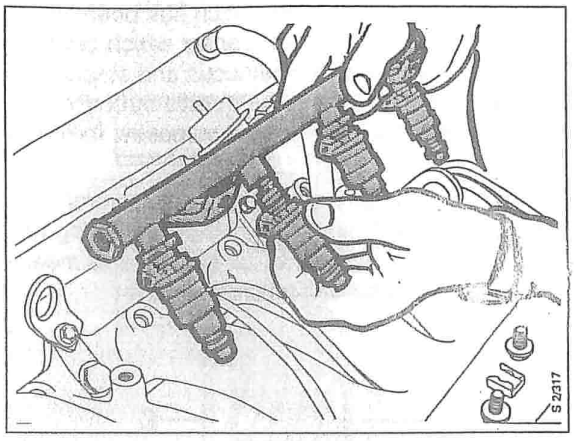


1 Body
2 Nozzle
3 Insulation
4 Spring
5 Coil
6 Electrical terminal
7 Filter

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Fuel injection manifold

The fuel injection manifold is in direct communication with the injectors. Also connected to the fuel injection manifold are the fuel line and fuel pressure regulator.



Throttle position switch

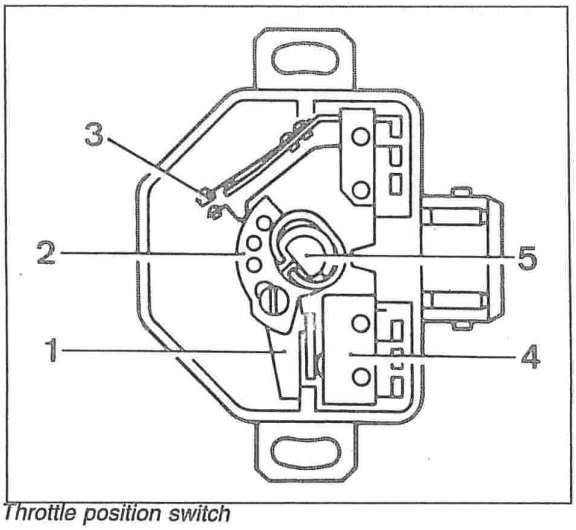
The throttle body is bolted to the inlet manifold and accommodates the throttle butterfly, the idling air passage with idling adjustment screw, connections for the auxiliary air valve hoses and an outlet for the vacuum control unit on the distributor.

The throttle position switch is screwed to the throttle body and consists of a casing incorporating a terminal for the connection of the built-in contacts which send signals on the position of the throttle butterfly to the control module.

Inside the casing is a cam plate that is linked to the throttle butterfly spindle and acts on the contacts.

On idling, the throttle butterfly is in the position for idling and the idling contacts are closed by the actuator.

At full throttle, the butterfly is in the full throttle position and the cam plate closes the full throttle contacts and the engine receives extra full-load fuel enrichment.



Throttle position switch

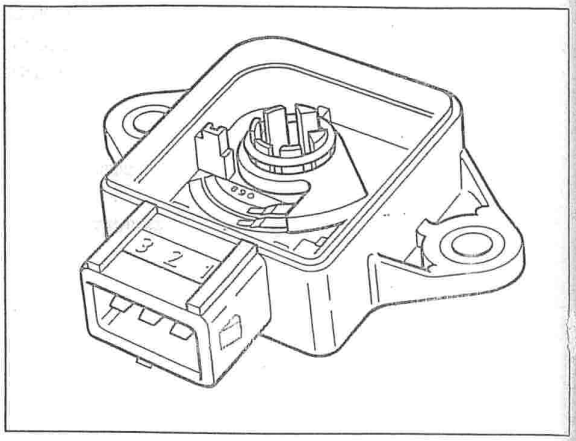
1 Actuator
2 Cam plate
3 Full throttle contacts
4 Microswitch (butterfly closed)
5 Butterfly spindle

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Throttle position sensor (1991-)

The earlier throttle position switch has been superseded by a throttle position sensor which provides the control module with continuous and stepless information on the angle of the throttle butterfly. This information is used for various purposes, including fuel shut-off.

The throttle function is adaptive, i.e. the control module "learns" which signal corresponds to idling and which signal corresponds to full throttle. This means that manual adjustment is unnecessary.



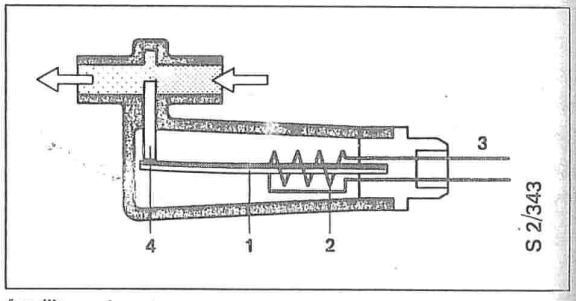
Auxiliary air valve

The auxiliary air valve is mounted on the engine's thermostat housing and acts as a by-pass passage enabling air to flow past the butterfly in the throttle body when the engine is cold.

The auxiliary air valve consists of an aluminium body with a connector for the internal heating coil and spigots for the hoses from the throttle body.Running through the aluminium body is an air passage which is opened and closed by a valve disc operated by the bi- metallic strip.

When the engine is cold, the air passage is fully open. When the engine is started, the heating coil is energized and heats the bi-metallic strip which then gradually closes the valve.

If the engine is hot when started, the heat given off by it acts on the bi-metallic strip and the valve remains almost closed, opening only very slightly.



Auxiliary air valve

1 Bi-metallic strip
2 Coil
3 Electric terminals
4 Valve disc

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Idle air control (IAC) valve (LH 2.2)

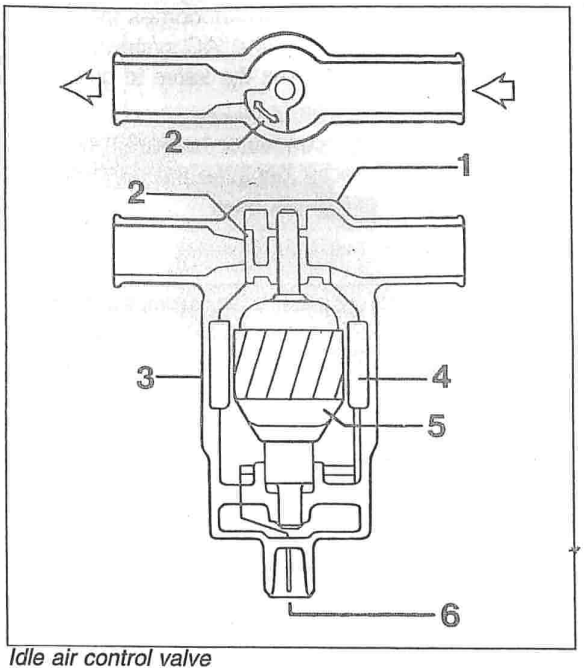
The idle air control valve allows a controlled volume of air to by-pass the throttle butterfly. The volume of air is determined by the degree of opening of the idle air control valve, which is controlled by signals from the LH control module.

The idle air control valve is a rotary slotted valve with a built-in two-stage motor that maintains a continuous reciprocating action, turning the valve through a maximum angle of 90°.

Together with the mass air flow sensor system, automatic idle control has been introduced to give:

- steadier engine speed
- better cold-starting and warm-up performance
- increased idling speed on engagement of the air conditioning system
- compensation for reduced engine speed due to a heavier load from the steering servo pump and alternator charging and when the car is driven at high altitudes
- a deceleration function.

For a description and fault diagnosis, see section 254 in Service Manual 2:4.



Idle air control valve

1 Valve body
2 Valve
3 Casing
4 Solenoid
5 Electric motor casing
6 Three-pin connector

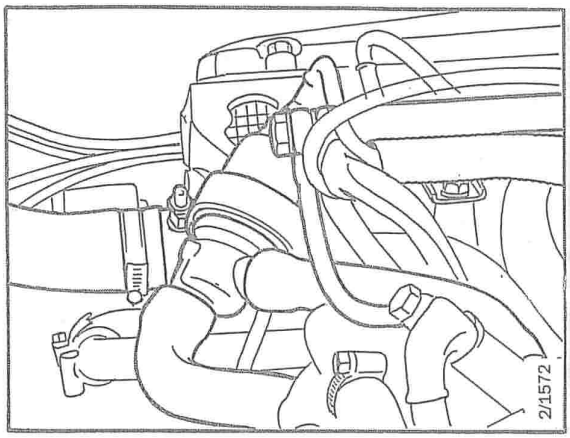
S 2/343

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IAC valve with integral Limp-Home function (LH 2.4)

The Limp-Home function, which comes into operation when a fault occurs in the IAC system, such as a loose connection, causes the valve to give a fast idling speed of 1200 rpm.

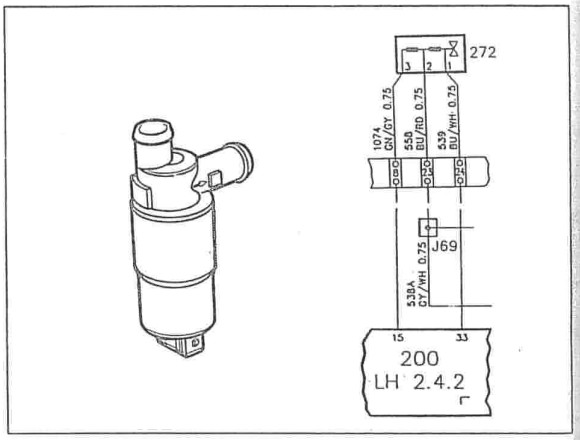
The earlier three-pin connector has been replaced by a two- pin connector because the connector on the IAC valve is of two-pin type.



IAC valve, LH 2.4.2 (M1991-)

As distinct from earlier versions, the IAC valve now has two windings which correspond to each other in the event of a voltage drop, such as occurs when the AC system is engaged.

Whenever necessary, a spring in the valve sets it in Limp- Home mode with a small opening which gives an engine speed of about 850 rpm when there is no load on the valve.



Adaptive idling control system (LH 2.4)

The adaptive (intelligent) idling control system varies the idling speed and IAC setting continuously and automatically compensates for all normal variations.

The microprocessor "remembers" the opening the IAC valve had the last time the engine was run at idling speed. This system reduces the need for service and the setting is constantly maintained at a high level.

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Temperature sensor (NTC resistor)

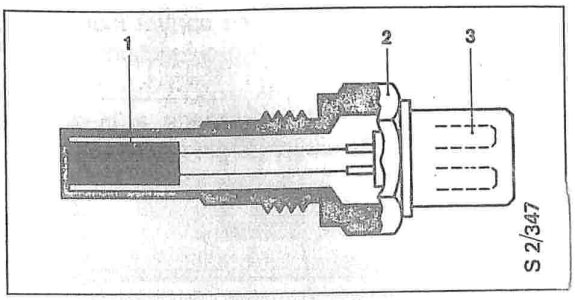
The temperature sensor is screwed into the inlet manifold flange. Its function is to provide the control module with information about the temperature of the engine. The control module then regulates the quantity of fuel injected according to the temperature.

When starting from cold and during the first part of the warm-up period, the engine requires a much richer fuel-air mixture on account of the losses due to condensation in the combustion chambers and intake pipe.

As the temperature of the engine rises, the quantity of fuel injected is decreased proportionately.

The temperature sensor consists of a brass body which holds a resistor of NTC type. NTC (Negative Temperature Coefficient) resistors have a low resistance at high temperatures and a high resistance at low temperatures. The temperature sensor sends a continuous signal to the control module.

If the signal from the temperature sensor is interrupted, a signal will be simulated in the control module which gives a function on the assumption that engine temperature is +20°C (68°F).



Temperature sensor (NTC resistor)

1 Resistor
2 Body
3 Connector

LH control module (LH 2.2)

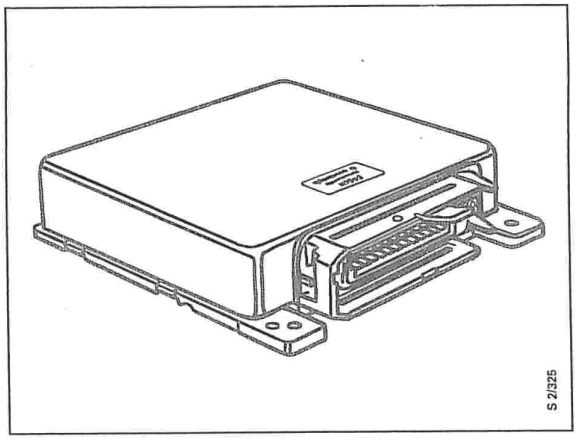
The LH control module is located inside the cabin on the right-hand side underneath the dash panel.

All necessary reference data, such as maximum rpm, full-load enrichment, hot wire burn-off, etc., is stored in the control module's memory.

A microprocessor processes the signals from the mass air flow sensor and other sensors, as well as the data from the memory, and calculates the opening duration of the injectors.

The LH control module also contains auxiliary functions for emitting fixed signals in the event of a break in the signals from the mass air flow sensor or temperature sensor.:

- Mass air flow sensor: the Limp-Home function.
- Temperature sensor: a simulated signal for an assumed engine temperature of 20°C (68°F).

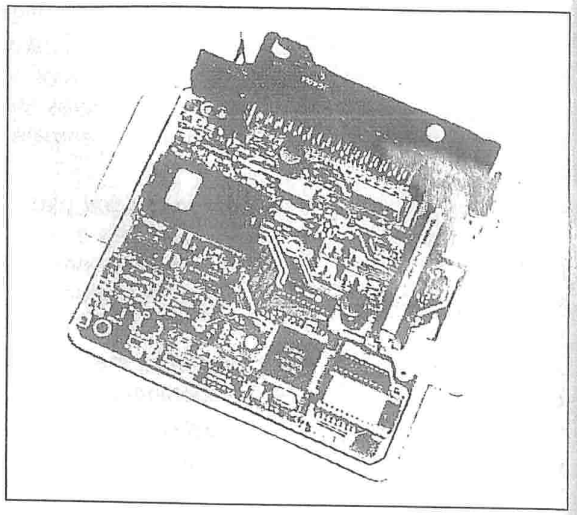


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Control module with expanded memory (LH 2.4)

The expanded memory of the control module enables new monitoring and control functions to be incorporated in it.

To accommodate the new functions, a 35-pin connector replaces the earlier 25-pin connector.

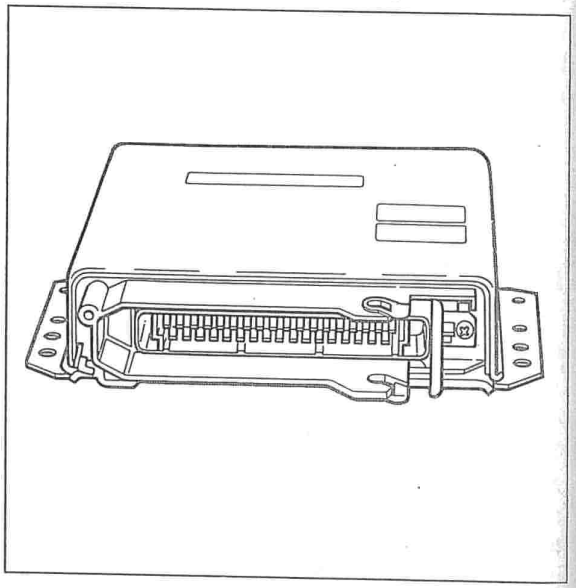


Control module (LH 2.4.2)

The LH 2.4.2 control module is adapted to system changes resulting from changed components but also contains software changes which affect other additional functions.

Engagement of the Lambda sensor when the engine is started from cold is a function of time instead of temperature as it was before. This means that the theoretical limit at which control can start is reduced from 16°C to 0°C.

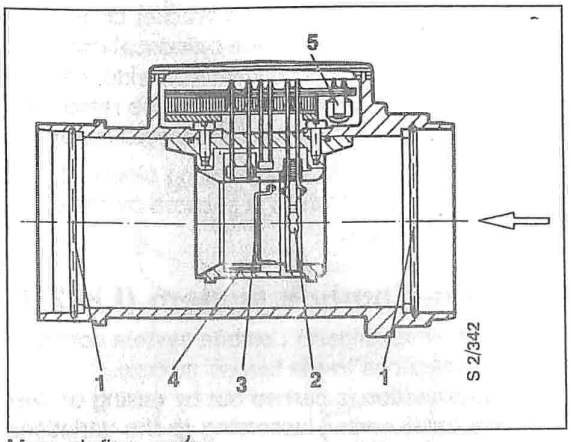
AC engagement is governed by the LH control module.
The AC relay is discontinued.



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Mass air flow sensor

The mass air flow sensor is fitted between the air filter and the intake pipe.
It consists of an aluminium body (plastic with effect- from 1989) enclosing an air duct. Centred inside the air duct is an inner tube incorporating a platinum filament (hot-wire sensor). On both the inlet and outlet sides the hot wire is protected by a fine-mesh filter.



Mass air flow sensor

1 Fine-mesh filter
2 Detector resistor
3 Hot wire (filament)
4 Inner tube
5 CO adjusting screw

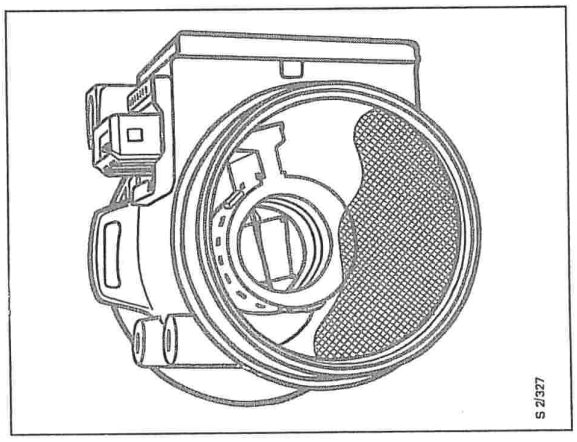
The temperature of the hot wire is maintained at a constant level of approximately 100°C (212°F) above the temperature of the inlet air, regardless of the composition of the air or the air flow.
Since the hot wire is sited inside the inlet duct it can become coated with dirt which reduces its sensitivity and affects the results of measurement. To keep the hot wire free from dirt, it is heated to a temperature of about 1000°C (1830°F) for one second. This takes place four seconds after the engine has been switched off.

The main relay releases after filament burn-off.

The device for controlling the current required to maintain the hot wire at a constant temperature consists of a bridge circuit and a detector resistor, the voltage variation across which is directly proportional to the magnitude of the inlet air mass.

The electrical components are integrated in the mass air flow sensor housing which also contains a potentiometer, accessible from the outside, for adjusting the CO content at idling speed. This adjusting screw was discontinued on the LH 2.4 system with effect from 1989 since the function is incorporated in the new LH control module. The plug which previously covered the hole for the CO adjusting screw has therefore also been discontinued.

In the event of a break in the signal from the mass air flow sensor caused by a broken hot wire, for instance, an emergency system built into the control module and known as the "Limp-Home" mode will take over, enabling the car to be driven but with impaired performance.



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Air cleaner

The air cleaner, mounted on a bracket on the left-hand wheel arch, consists of a cylindrical container to which an air intake is connected. Inside the container is a folded paper element and the removable cover is secured by means of four toggle fasteners.

The cover incorporates a connecting sleeve for the mass air flow sensor which is secured by means of two toggle fasteners.

Adaptive Lambda system (LH 2.4)

The adaptive (intelligent) Lambda system compensates for variations in the fuel-air mixture.
This compensation is carried out by raising or lowering the basic setting according to the variations occurring in the system, which can be caused by air leaks, fluctuations in the quality of the fuel or normal wear and tear.

No basic setting or adjustment of the Lambda system is necessary.

Integrated deceleration function (LH 2.4)

The deceleration function shuts off the supply of fuel during engine overrun. The system supersedes the throttle dashpot function and results in reduced fuel consumption and cleaner exhaust emissions.

The mechanical throttle butterfly damper has been discontinued.

Shift-up indication

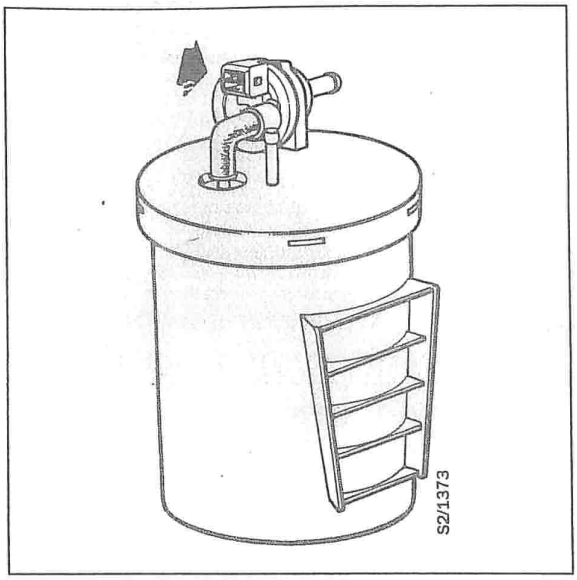
Now that shift-up indication is built into the new control module, the relay and all sensors and switches that were previously incorporated in earlier shift-up indication systems have been discontinued.

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Evaporative-loss control device (LH 2.4)

Gaseous hydrocarbons from the fuel tank are trapped in the charcoal canister. They subsequently pass through the canister purge valve into the engine where they are burnt.

The purge valve on the charcoal canister is activated by signals from the control module. The purging function is dependent on engine load conditions and engine speed.



Integrated fault-diagnosis system

The integrated fault-diagnosis system facilitates and improves fault diagnosis. The system displays a fault code by flashing the CHECK ENGINE warning lamp a varying number of times and with varying duration. By consulting the list of fault codes, the location of the fault can be narrowed down or pinpointed. See also "Fault diagnosis system LH 2.4".

Integrated pressure sensor

Should a fault arise in the Turbo pressure regulating system, the LH control module will interrupt the signals to the injectors.

The earlier pressure switch has been discontinued.

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Air induction system

Preheating 232-1
Function check of preheater valve (-1985) 232-3

Air cleaner

The air cleaner, mounted on the LH wheel arch, has two functions: in addition to cleaning the induction air it also dampens the noise made by the air being drawn in. The filter element, made of special paper, must not be washed or moistened.

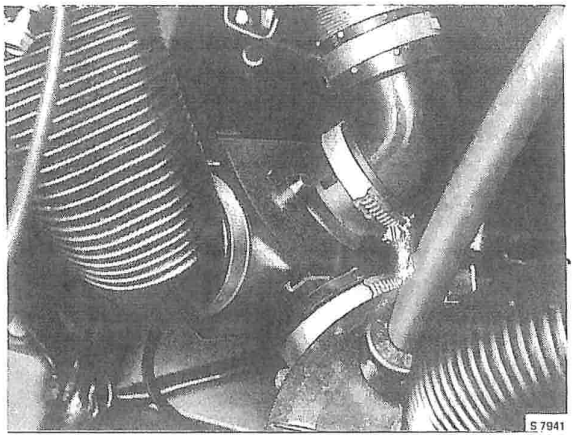
The mass air flow sensor is mounted on top of the air cleaner.

Preheating

The following applies to all cars equipped with CI fuel injection and a catalytic converter (US, EU), to B201 engines with CI on 1984 and earlier models and to Turbo B201 engines on 1985 and earlier models.

Inside the air cleaner intake is a thermostatic valve which regulates the temperature of the induction air.

The valve housing has two inlets, one for cold air and one for preheated air. The preheated air flows through an insulated hose from a hot spot on the exhaust manifold.

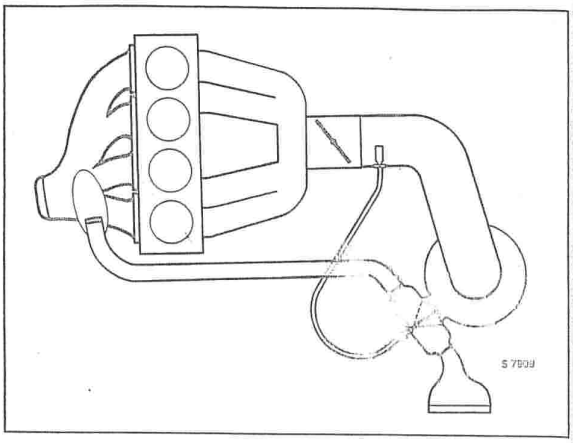


Note:

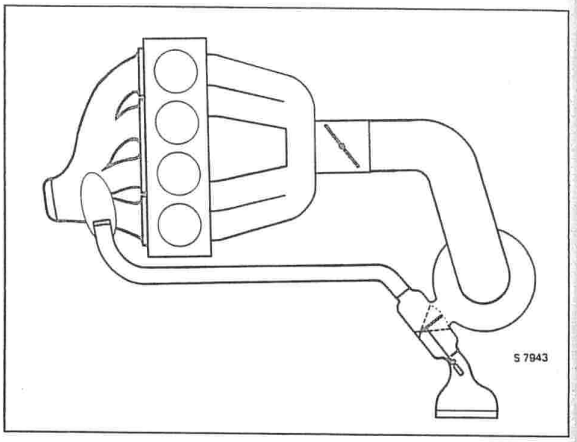
The preheater hose must be tied or clipped to the wastegate valve on Turbo engines to keep it clear of the battery.

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On normally aspirated engines the valve is actuated by means of a cable attached to the body of a thermostat fitted upstream of the throttle housing. The thermostat senses the temperature of the blended induction air, which is maintained at a temperature of between 23°C and 37°C (73-98°F) by the valve butterfly, which oscillates continually between the cold air and preheated air inlets.



On Turbo engines the thermostat body is fitted inside the preheater valve and senses the temperature of the ambient air. The valve maintains an air temperature of between -5°C (23°F) and +5°C (41°F).



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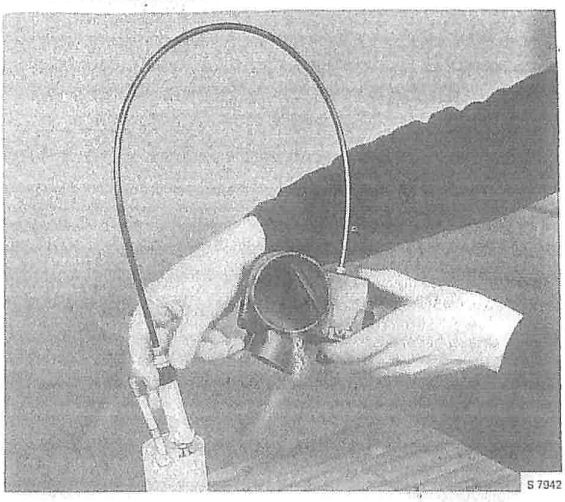
Preheater valve function check (-1985)

A rough check of the valve operation can be made by noting its movement with the cold air intake removed.
For a more accurate check, remove the valve complete with cable (not on Turbo engines) and thermostat. Immerse the thermostat in water at the appropriate temperature (see below) and check the position of the butterfly.

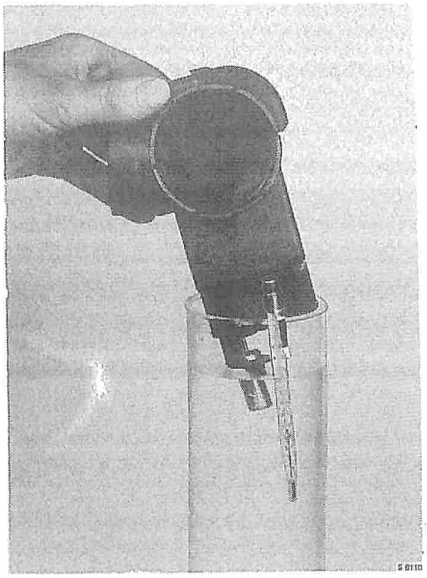
Note:

When performing this check, make sure that the cable adopts roughly the same position as it has in the car.

For Turbo engines:
-5°C (23°F)—preheated air only.
+5°C (41°F)—cold air only.
Normally aspirated engines:
23°C (73°F)—preheated air only.
37°C (98°F)—cold air only.



Checking the preheater valve (normally aspirated engine).



Checking the preheater valve (Turbo engines).

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Fuel system

Feed pump function check 233-1
Changing the fuel pump (with feed pump), -M1988 233-3
Changing the fuel pump (without feed pump). 233-7
Fuel pump, 900/S16 (1989-) 233-10
Fuel pump, Turbo (1990-) 233-30

Feed pump function check (-1988)

CAUTION

There is an acute danger of fire due to fuel atomization when carrying out this test. Do not smoke. Make sure that the area is well ventilated.

Note:

Make sure that the tank is at least 3/4 full before starting this test.

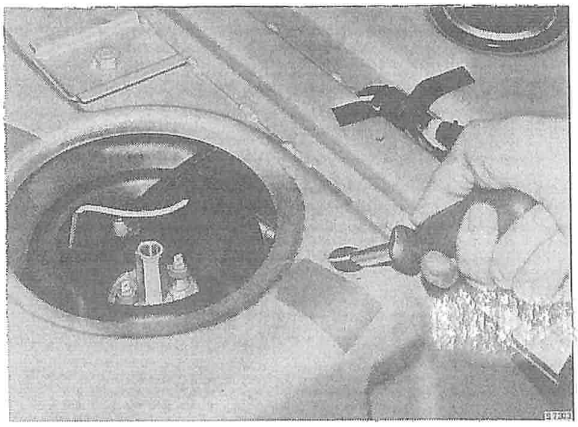
1 Remove the luggage compartment floor and floor panel and also the cover over the fuel pump.

2 Disconnect the electric leads from the main pump.

Note:

Take care to prevent the leads from touching each other or any metalwork.

3 Slacken the clip on the pump using a flexible socket driver.



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4 Cars with LH injection system (cars with CI injection system, see point 5):

Remove fuse No. 30. Connect test lead with switch 83 93 886 between the input of fuse position No. 30 and fuse No. 27, 28 or 29 to supply the fuel pump with power.

Note:

Make sure that the switch is set to OFF.

5 Cars with CI injection system:

Remove the fuel pump relay. Connect test lead with switch 83 93 886 between terminals 30 and 87 to supply the fuel pump with power.

Note:

Make sure that the switch is set to OFF.

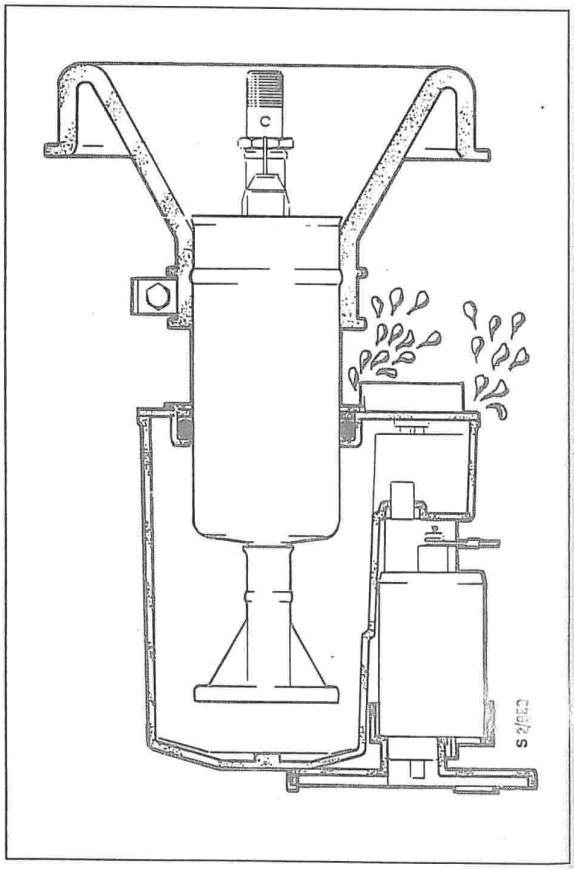
6 Start the feed pump by setting the switch to ON.

7 Carefully raise the edge of the rubber collar and check that fuel is discharged through the safety valve on top of the receiver.

CAUTION

Since a large volume of fuel may be discharged, take precautions to prevent it from getting into the luggage compartment. If fuel does get into the luggage compartment, make sure that all petrol fumes are expelled.

8 If no fuel is discharged through the safety valve when the feed pump is running, fit a new feed pump. If the feed pump does not work, check the electric leads connected to it.



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Note:

Always turn off the pump's power supply by setting the switch to OFF before connecting any test instrument.

9 Fit in reverse order.

Note:

Make sure that the area round the hole for the cover over the fuel tank is clean and perfectly dry before securing the clip on the fuel pump collar.

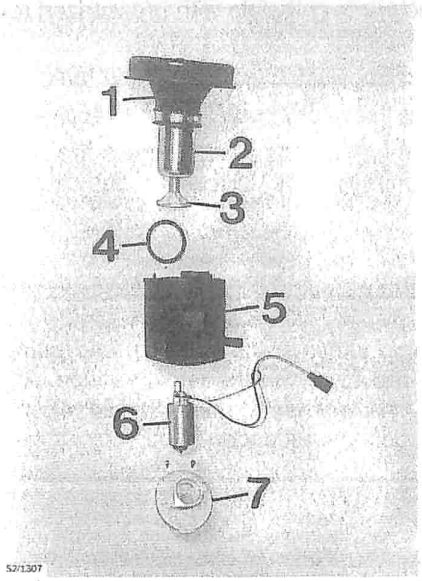
Changing the fuel pump (with feed pump), -1988

To remove

1 Disconnect the battery cables.

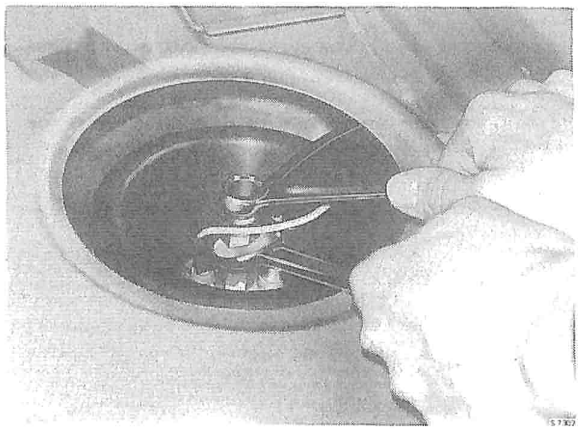
2 Remove the luggage compartment floor and floor panel and also the circular cover over the fuel pump.

3 Disconnect the electric leads from the fuel pump.



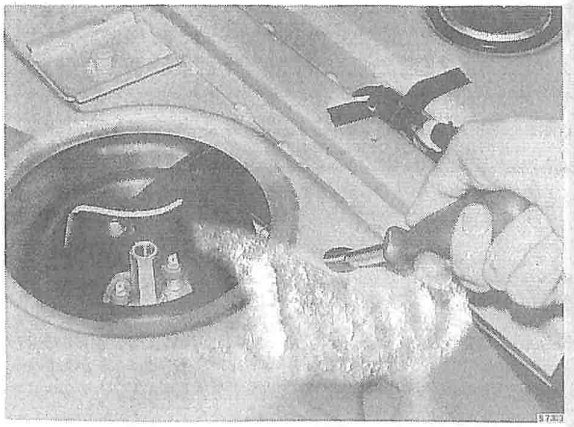
1 Rubber collar
2 Main pump
3 Filter
4 O-ring
5 Receiver
6 Feed pump
7 Filter

4 Disconnect the fuel lines from the pump. When undoing the banjo fittings, use a spanner to stop the pump from turning.



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5 Slacken the clip on the pump using a flexible socket driver.



6 Lift out the pump complete with pressurized receiver.

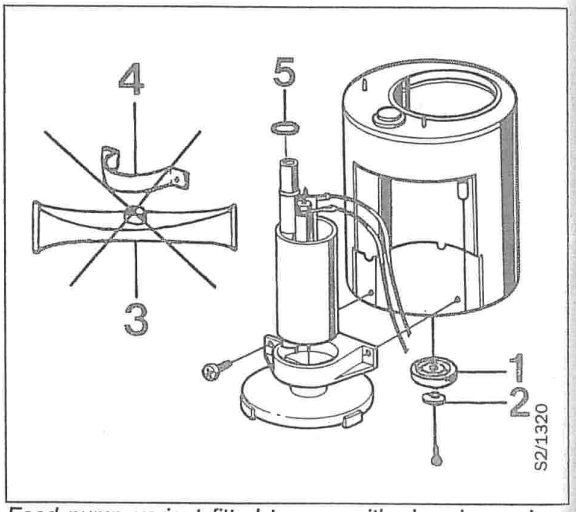
7 Disconnect the electric leads from the tank.

8 Disconnect the return hose from the receiver.

9 Withdraw the main pump and remove the feed pump retaining screws. Disconnect the electric leads.

Note:

On earlier pump variants, the existing feed pump filter must be replaced with the latest version. Accordingly, plug (1), washer (2), filter (3), clip (4) and O-ring (5) will become redundant.



Feed pump variant fitted to cars with chassis numbers from AE1021336 and AE2009858, inclusive.

Earlier feed pump variant

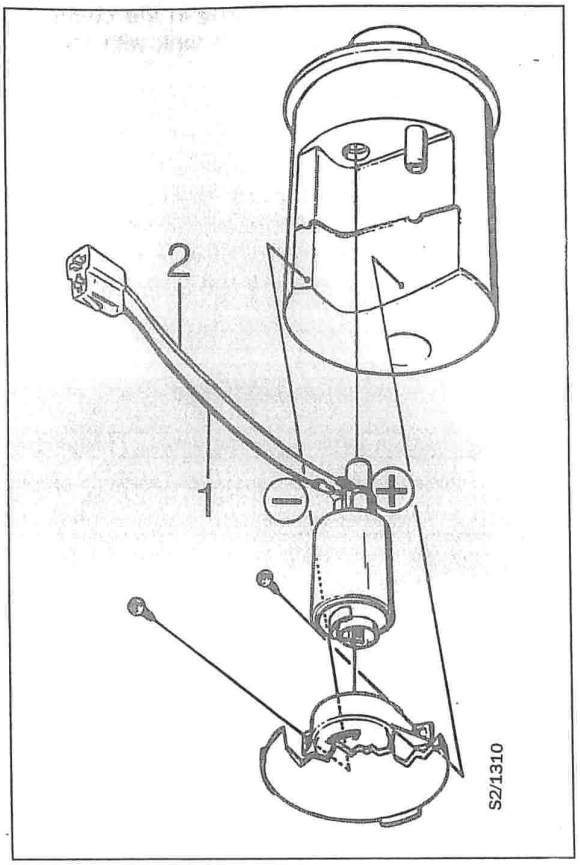
1 Plug
2 Washer
3 Filter
4 Clip
5 O-ring

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To fit

1 Connect the electric leads to the feed pump: white lead to the positive (+) terminal and black lead to the negative (-) terminal.

2 Fit the feed pump and press it right up against the stop.
1 Black
2 White



3 Scribe a mark on the new main pump, A mm from the end.

On cars with CI injection, dimension A = 46 ± 2 mm

(1.81 ± 0.08 in)

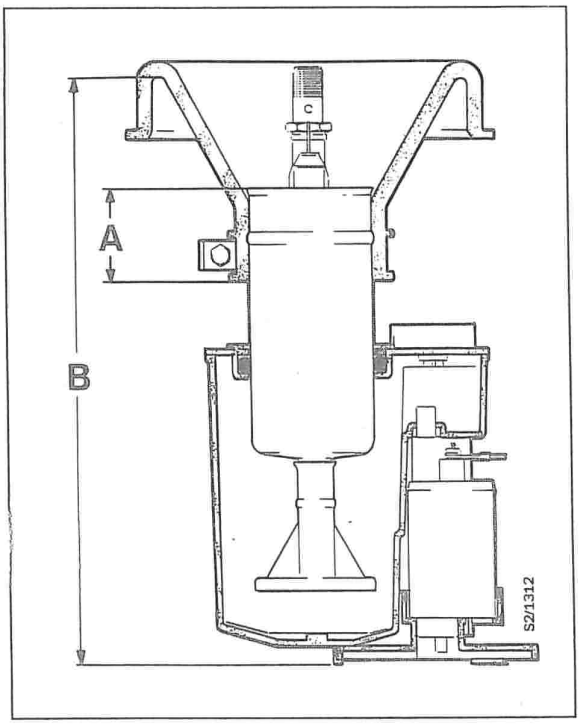
On cars with LH injection, dimensions A = 42 ± 2 mm

(1.65 ± 0.08 in)

Dimension B = 222 mm (8.74 in)

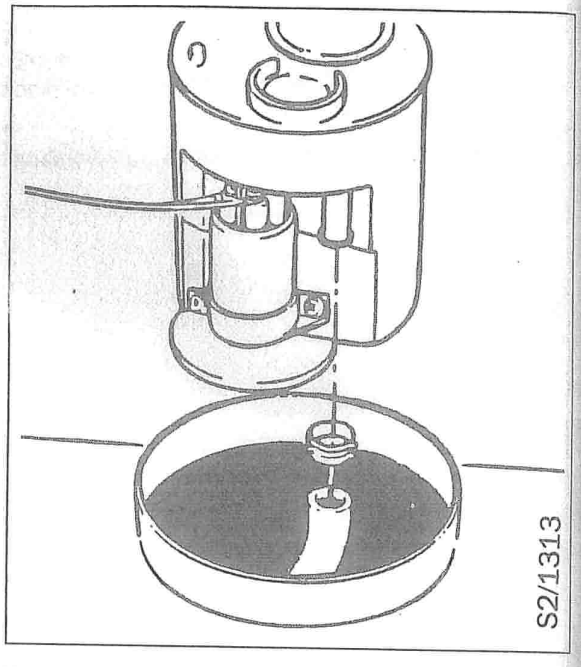
4 Slide the rubber collar up to the scribed mark and tighten the clip.

5 Fit the pump in the receiver and position it according to measurement B. Turn the pump so that the positive (+) terminal is towards the front of the car.



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6 Fit the return hose and plug in the connector. Lower the receiver into the tank with the feed pump facing rearwards.

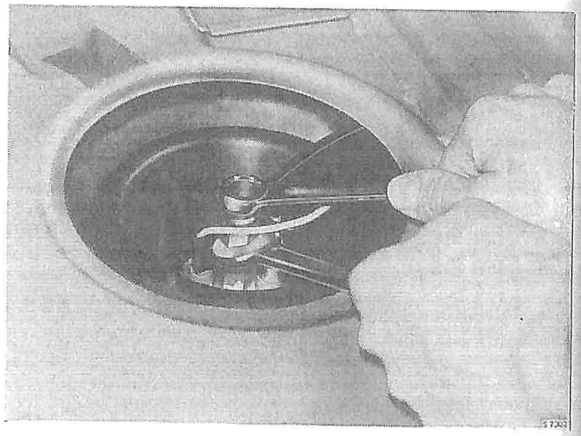


7 Connect the electric leads.

8 Connect the fuel line. Use a spanner to prevent the pump from turning when tightening the banjo fitting. On cars with an LH injection system, use spanner 83 94 330

9 Refit the cover over the fuel pump and replace the floor panel and luggage compartment floor.

10 Connect the battery cables.



Changing the non-return valve for the fuel pump

1 Disconnect the negative battery cable.

2 Remove the luggage compartment floor and floor panel and also the circular cover over the fuel pump.

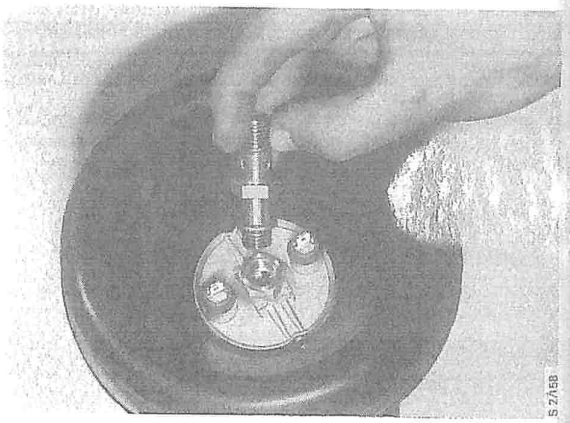
3 Disconnect the electric leads from the fuel pump.

4 Use a spanner to hold the fuel pump steady and remove the cap nut. Lift off the banjo fitting.

5 Remove the banjo fitting with integral non-return valve.

Use a spanner to hold the fuel pump steady.

Fit in reverse order.



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Fuel pump, without feed pump (not catalytic converter cars)

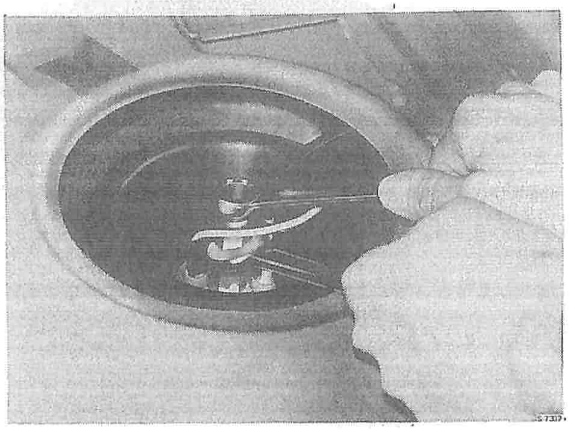
To remove

1 Disconnect the negative battery cable.

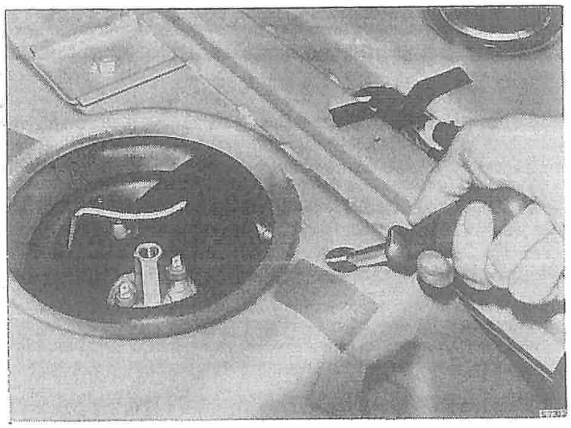
2 Remove the luggage compartment floor and floor panel and also the circular cover over the fuel pump.

3 Disconnect the electric leads from the fuel pump.

4 Use a spanner to hold the fuel pump steady and remove the cap nut. Lift off the banjo fitting.



5 Using a flexible socket driver, slåcken the clip on the pump mounting.



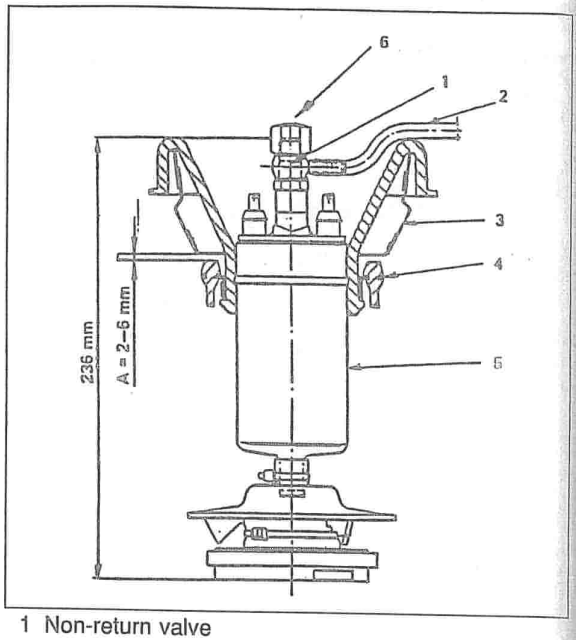
6 Lift up the fuel pump assembly.

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To fit

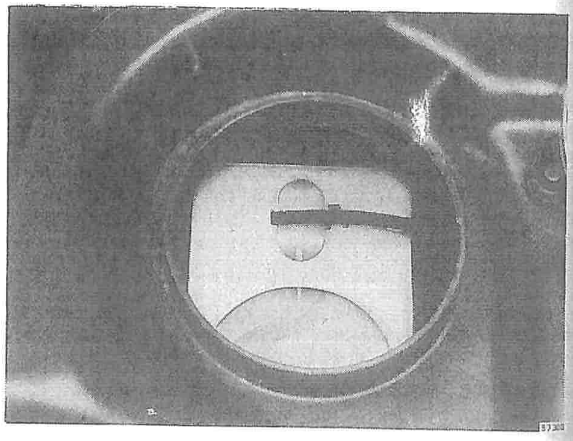
1 Fit the pump to the mounting so that the distance between the base of the suction strainer and the upper edge of the rubber mounting is 236 mm (9.2913 in).

Later version fuel pumps have a new type of pump bracket and clamp to eliminate noise from the pump. On refitting these parts, dimension "A" should be 2-6 mm (0.0787-0.2362 in).



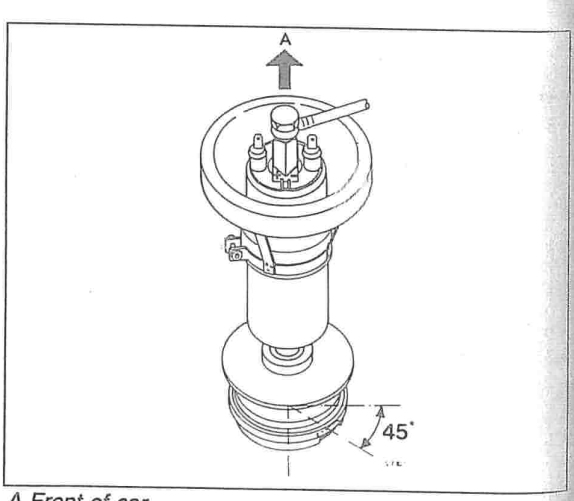
1 Non-return valve
2 Fuel pipe
3 Pump bracket
4 Clip
5 Pump
6 Cap nut

2 Check that the fuel return line is mounted on the splash guard holder at the bottom of the fuel tank.



3 Install the pump assembly in the tank as follows:

- Hold the pump with the positive (+) terminal facing the left- hand side of the car
- Align the suction strainer inlet diagonally rearwards at an angle of 45° towards the right-hand side of the car.



A Front of car

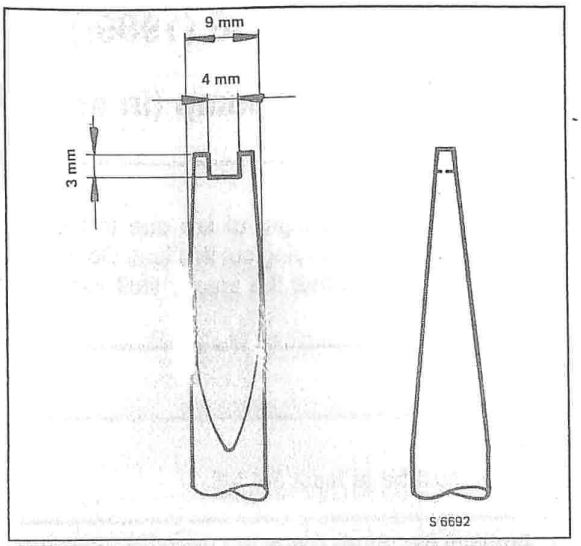
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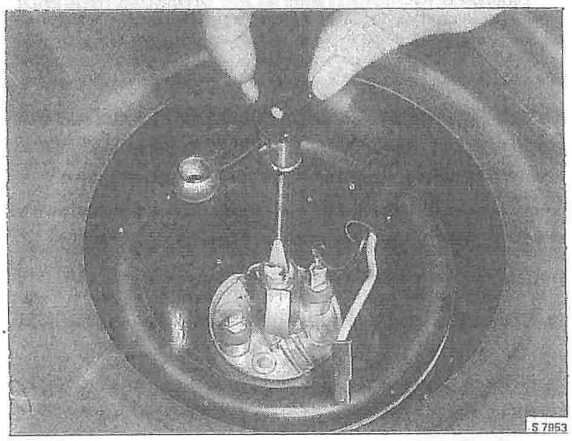
To change the non-return valve

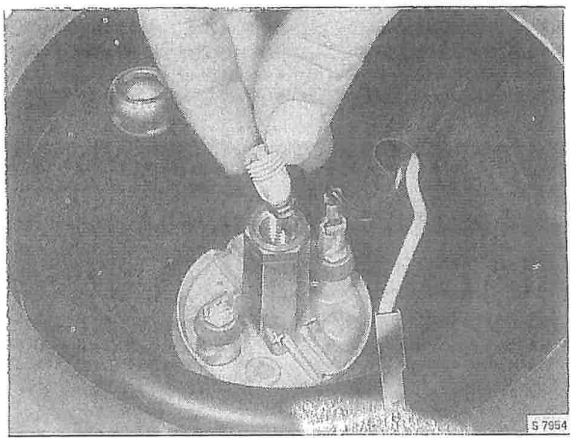
The non-return valve in the outlet from the fuel pump can be removed by means of a specially shaped screwdriver, see Fig.

Avoid gripping the valve too tightly, as this may damage it.

Tightening torque 0.4-0.6 Nm (0.30-0.44 lbf ft)







On model year 1982 and later cars, the non-return valve is incorporated in the banjo coupling

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Fuel pump 900/S16 (1989-)

Checking the fuel pump (in situ)

CAUTION

There is an acute danger of fire due to fuel atomization when carrying out this test. Do not smoke. Make sure that the area is well ventilated.

Note:

The tank must be at least 3/4 full.

1 Remove the return line of the pressure regulator and fit in its place a section of fuel hose about 1 metre long.

2 Remove fuse No. 30 and connect a test cable with switch between fuse position 30 and fuse No. 27.

Check that the switch is set to OFF.

3 Connect a multimeter to measure the voltage across the fuel pump connecting pins.

4 Insert the end of the fuel hose into a 2-litre measuring glass.

5 Start the pump and note the time it takes to fill the measuring glass with 1 litre of fuel. Maximum time 40 seconds.

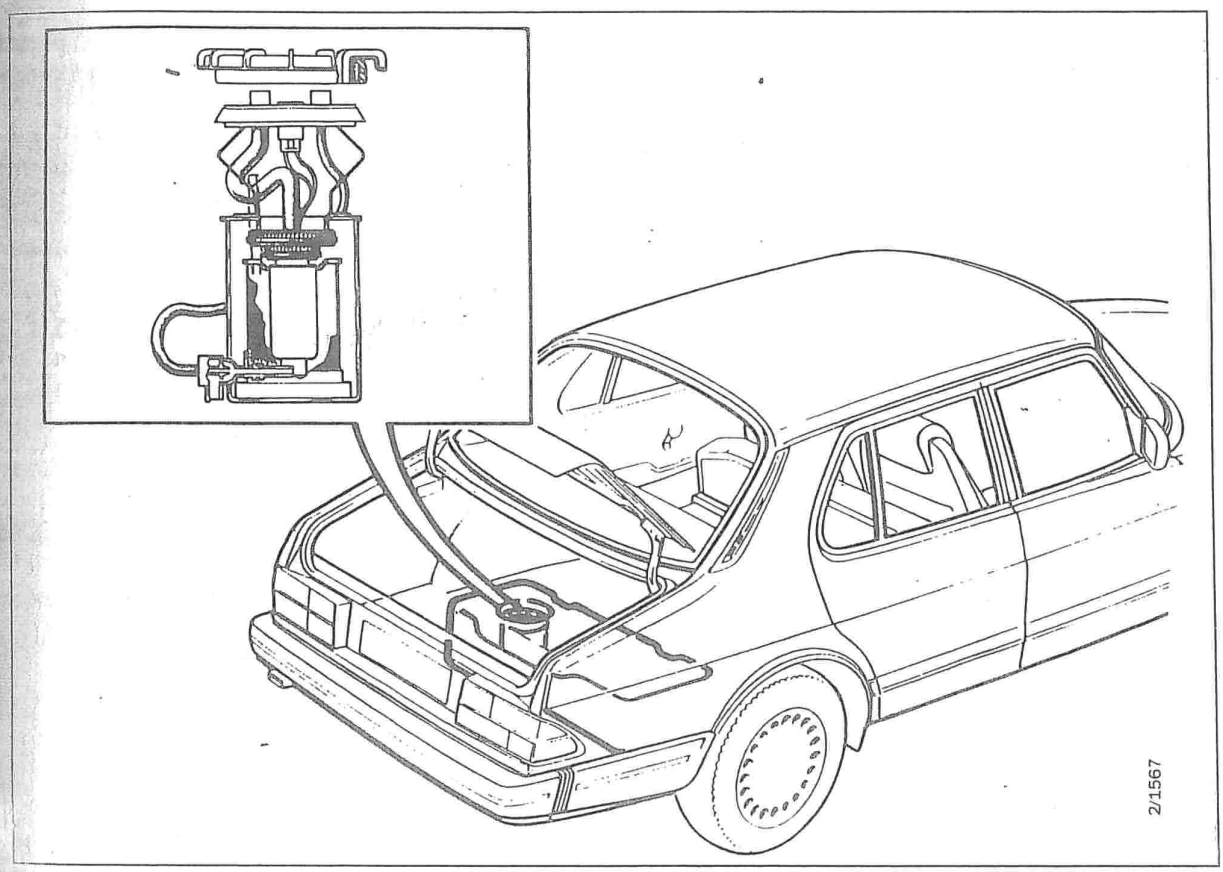
At the same time, check the voltage at the pump. It should be between 11 and 13 V. Other voltages result in an incorrect flow rate.

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Changing the fuel pump

To remove

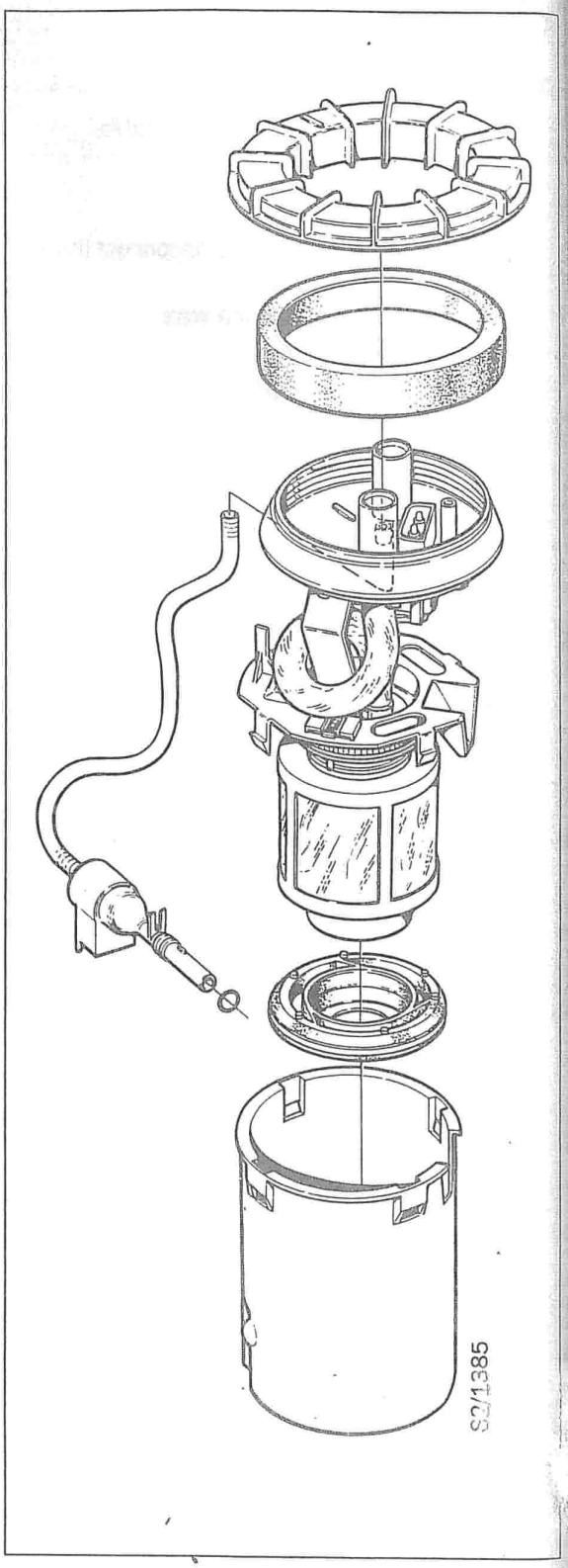
1 Disconnect the negative battery cable.
2 Depressurize the fuel system.
3 Expose the fuel pump.
4 Remove the locking clamp, disconnect the electric leads and fuel lines.
5 Tie the fuel lines out of the way.
6 Apply tool 83 94 397.
7 Remove the screw top.
8 Lift up the pump.



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To fit

9 Place the pump in the tank.
10 Fit a new rubber seal.
11 Refit the screw top.
12 Apply the tool and tighten the top.
13 Reconnect the fuel lines.
14 Reconnect the electric leads and refit the locking clamp.
15 Reconnect the negative battery cable.
16 Check the operation of the pump.
17 Refit the cover and the luggage compartment floor.



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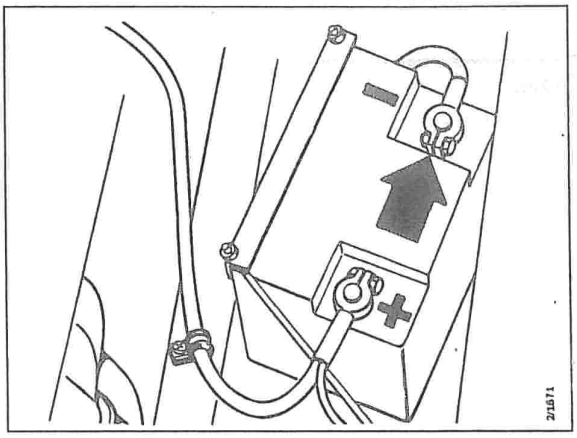
Fuel pump, removal and fitting

CAUTION

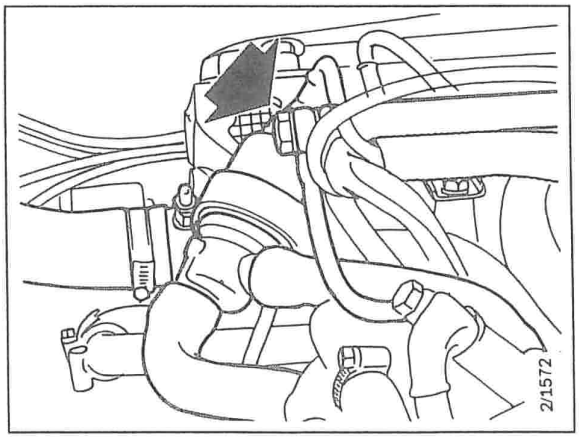
When carrying out any work on the fuel tank, such as replacing the fuel pump or fuel level transmitter, make sure that the area is well ventilated.
If approved extraction equipment for petrol fumes is provided, make use of it.
Wear suitable gloves, as prolonged contact with fuel can cause dermatitis.

To remove

1 Disconnect the negative battery cable.

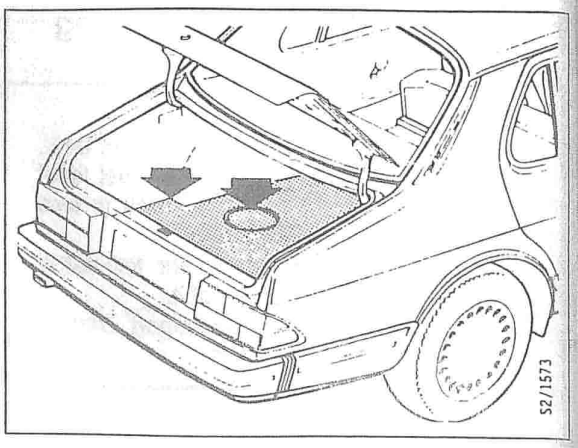


2 Depressurize the fuel system by undoing the nipple on the fuel distribution pipe. Retighten the nipple afterwards.



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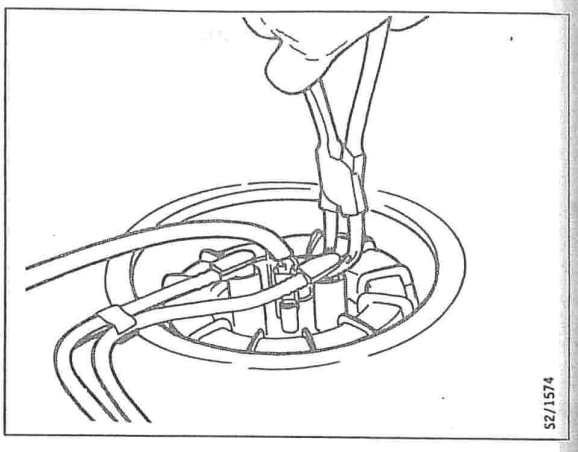
3 To gain access to the fuel pump, remove the luggage compartment floor panel and the cover over the fuel pump.



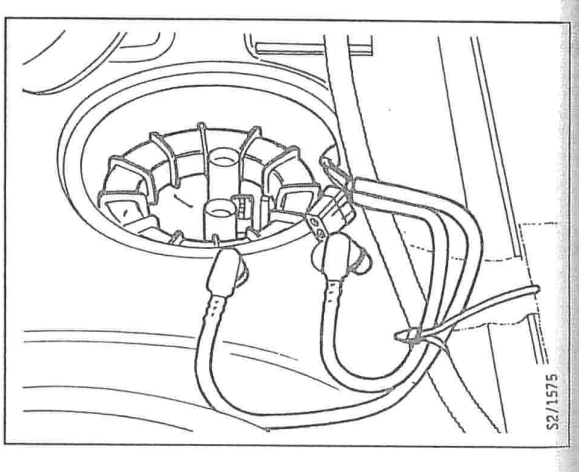
4 Remove the clamp and disconnect the pump's electric leads and the fuel lines.

Note:

Although the fuel system has been depressurized, a small amount of fuel will still escape from the connections,



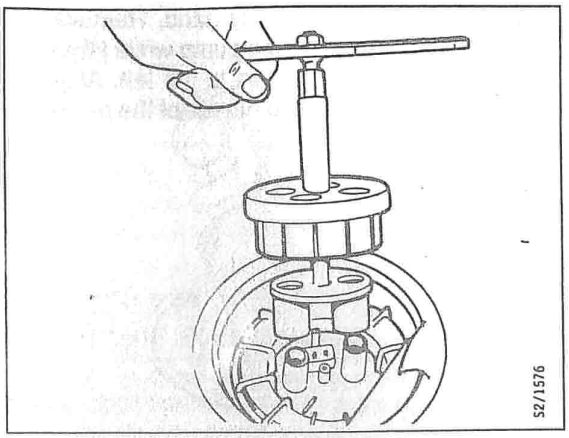
5 Move the fuel lines aside and secure them by means of a cable tie to the rear wiring harness.



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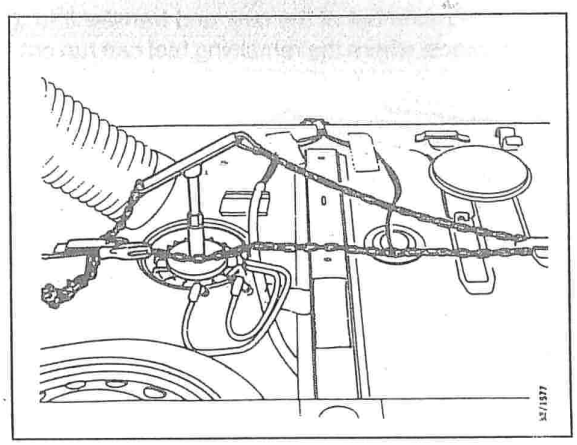


6 Apply tool 83 94 397 as shown in the Fig.



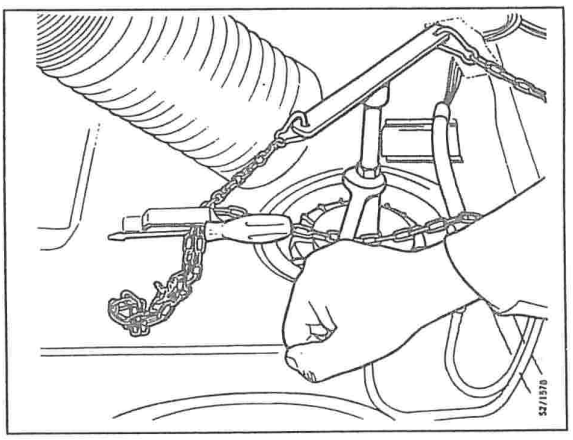


Pass the chain through the load-securing brackets on the luggage compartment floor. Secure the chain by means of a screwdriver as shown in the Fig.



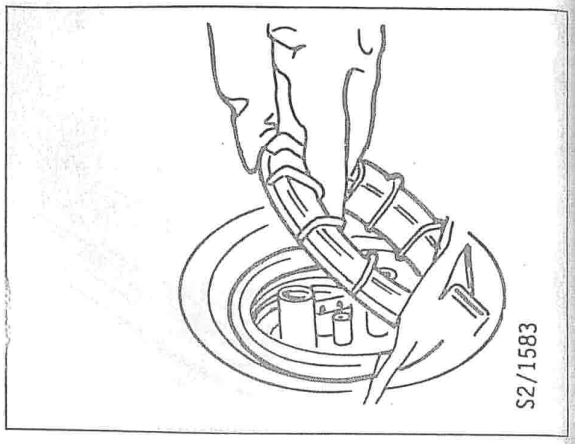


7 Loosen the screw top and put the tool aside.

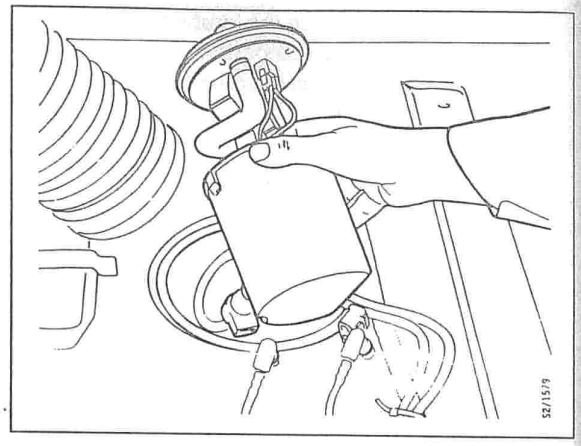


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Unscrew the screw top by hand. Remove the rubber seal and lift up the pump while tilting the top part of it forwards and to the left. Allow as much fuel as possible to run out of the pump before lifting it up.



8 Lift the pump out of the tank and transfer it to a receptacle where the remaining fuel can run out.

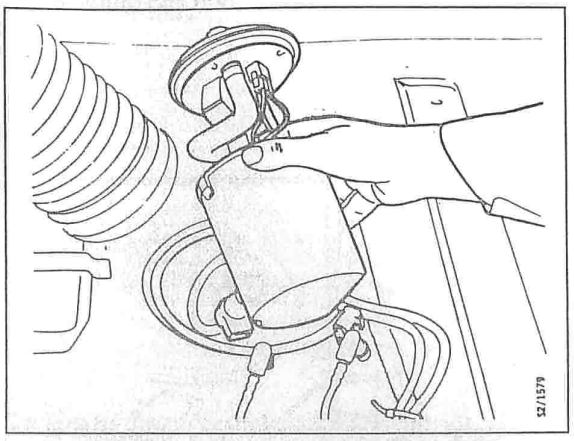


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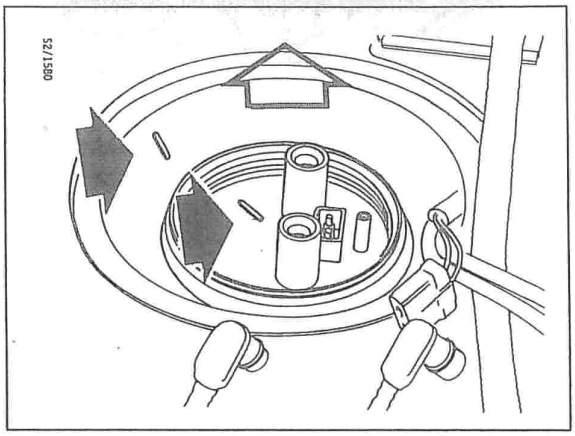
To fit

1 Position the pump before placing it in the tank so that the pressure and return lines are in alignment with the longitudinal axis of the car. Tilt the pump assembly so that the ejector part is introduced into the tank first.

Position the pump inside the tank. Make sure that it is centred between the ribs on the bottom of the tank



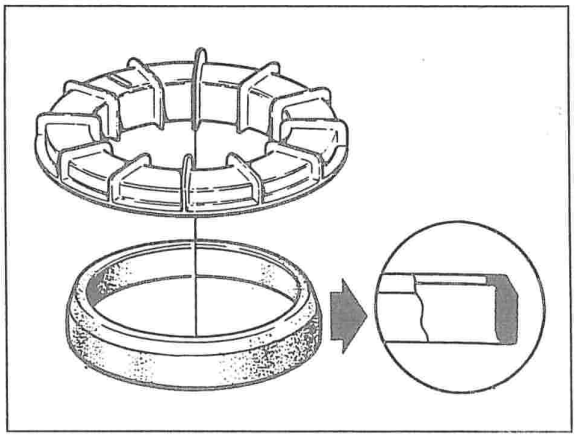
and so that the mark on the top of the pump lines up with the mark on the tank.



2 Smear a new seal with acid-free petroleum jelly (Vaseline) and fit it inside the screw top as shown in the Fig.

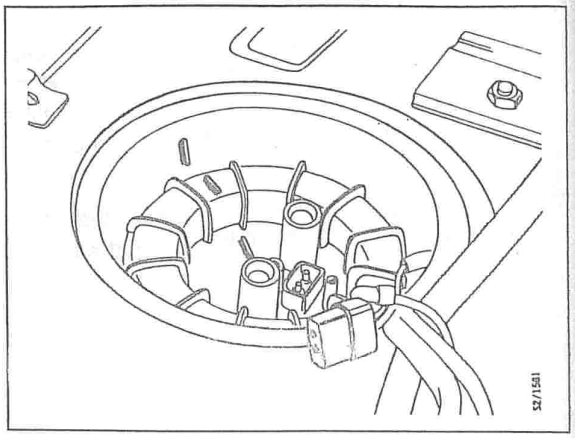
The seal can also be fitted on the top of the pump if great care is taken to ensure that it is accurately positioned.

New rubber seal fitted inside the screw top.

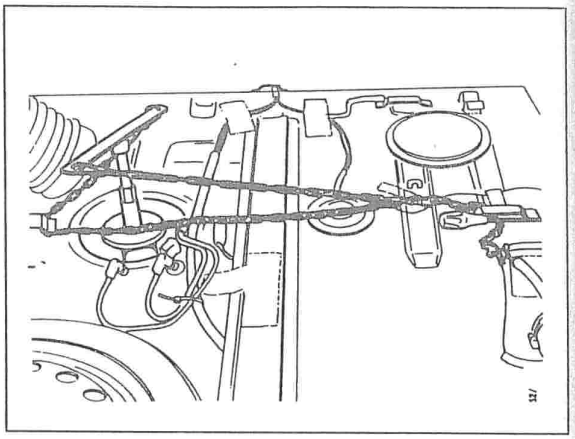


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3 Position the screw top so that the markings are in alignment. Press down hard and rotate the top half a turn.

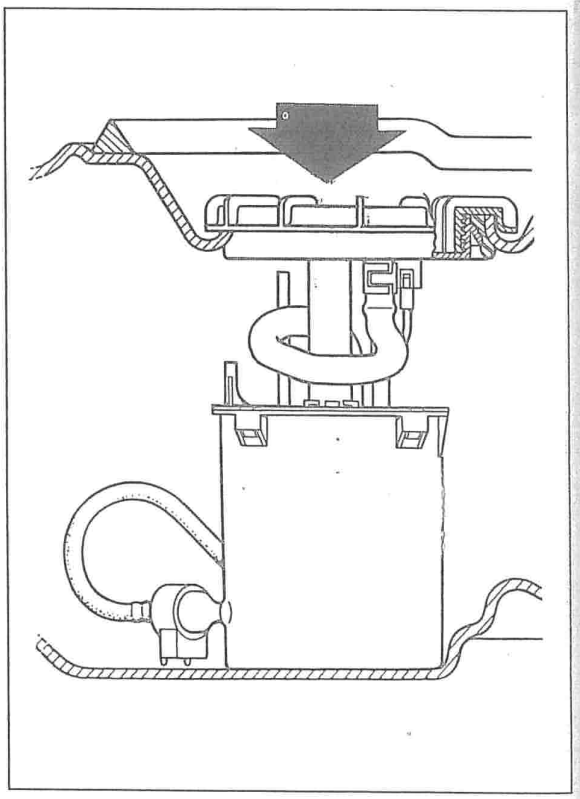


4 Change the chain attachment points so that the chain is correctly positioned for tightening.



Apply the tool and press down on it so that the screw top is brought into contact with the flange of the tank opening.

Press down on the tool to bring the screw top into contact with the tank.



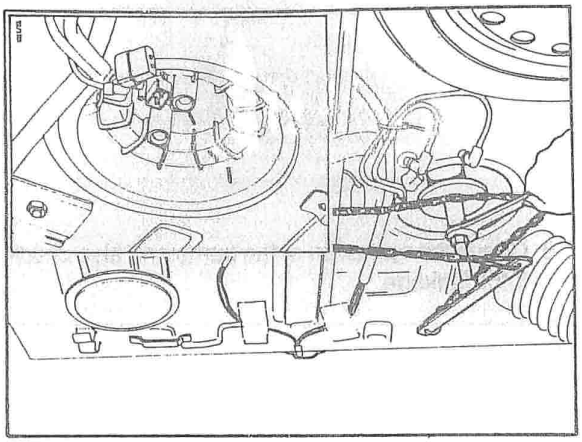
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Note:

To prevent the ejector pump from being damaged, the pump must be correctly positioned and **not allowed to turn** when the screw top is tightened.

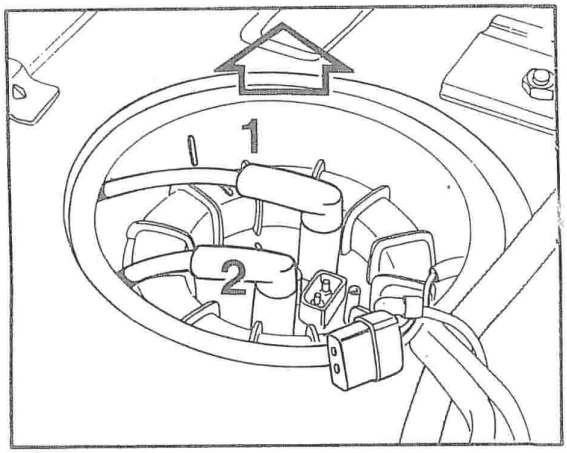
Tighten it as far as it will go.

The position of the pump must not deviate by more than ±30° from the alignment marks.

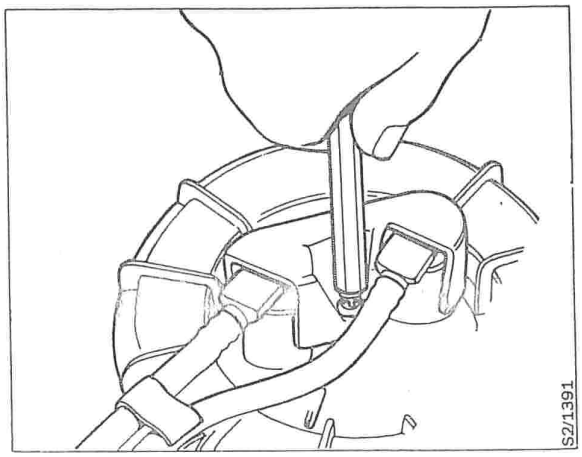


5 Connect the fuel lines and fit the couplings with new O- rings.

The return line (1) incorporating a non-return valve in the fitting is connected to the outlet nearest the front of the car and the pump line (2) to the outlet nearest the rear of the car.

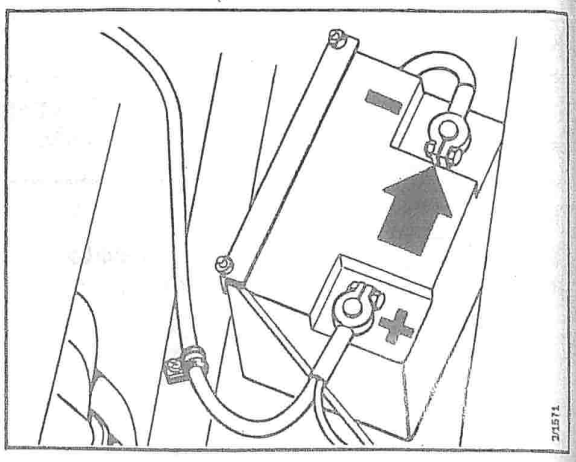


6 Connect the electric leads and fit the locking clamp.

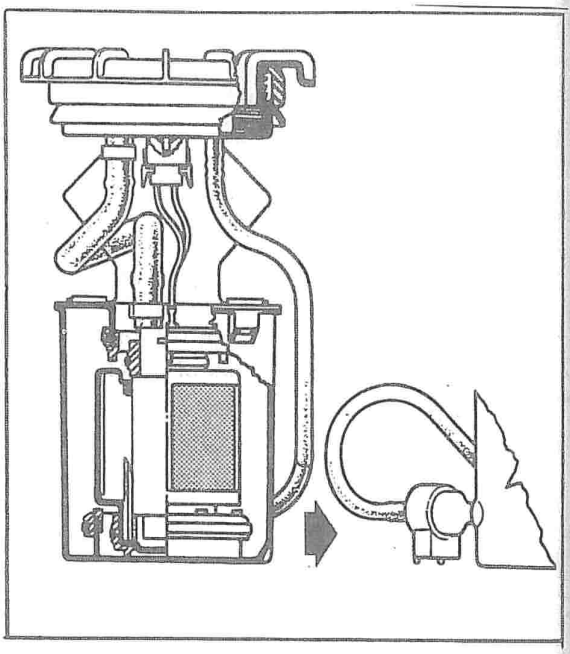


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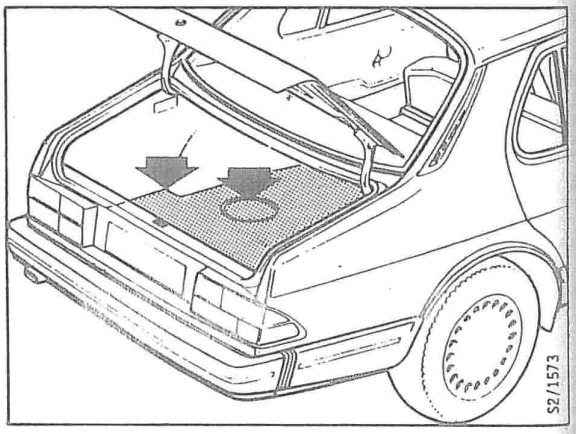
7 Connect the negative battery cable.



8 Check the operation of the pump and also check it for leakage.



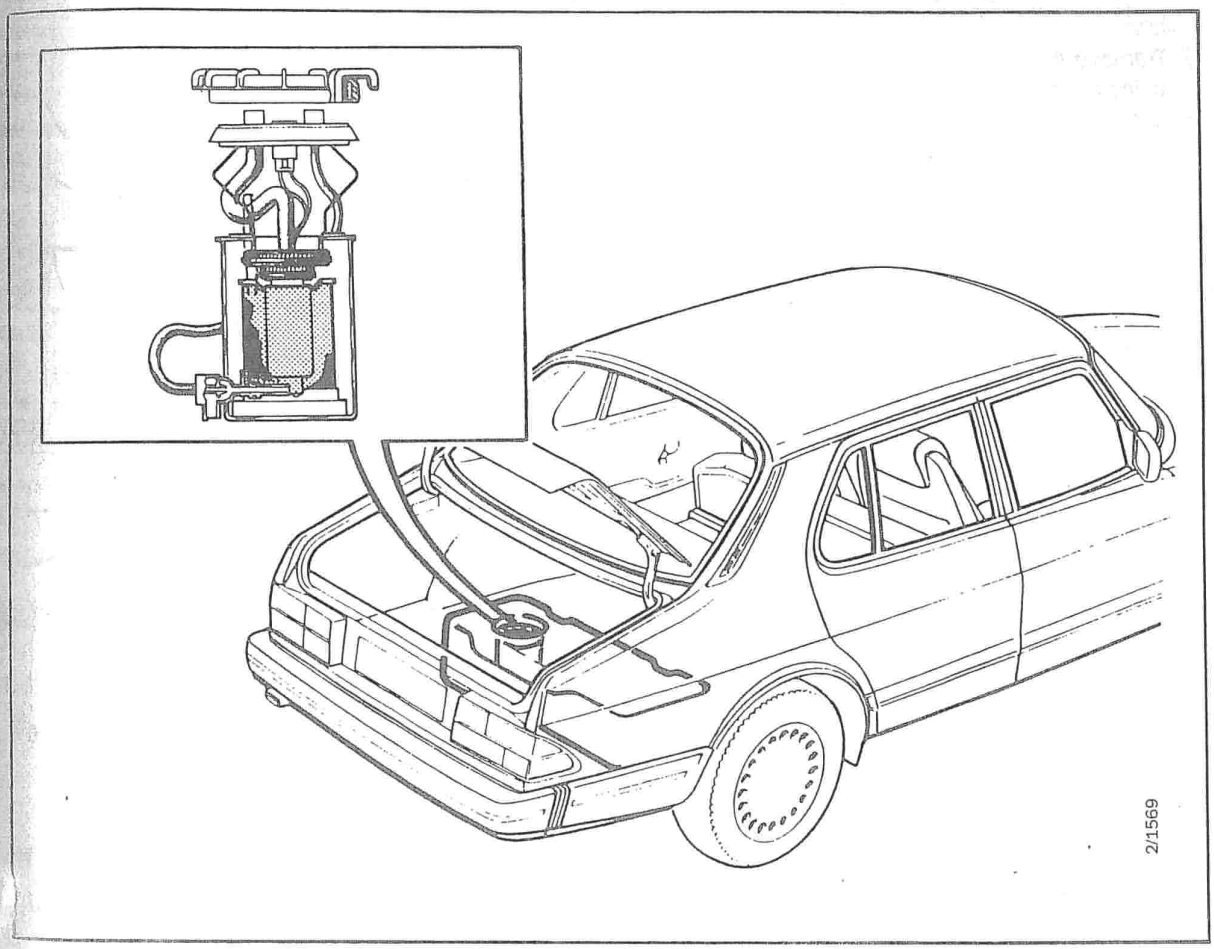
9 Refit the circular cover and the luggage compartment floor panel.



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To replace the fuel pump filter

1 Remove the fuel pump, see page 11.
2 Remove the ejector pump.
3 Separate the reservoir and filter unit from the top section.
4 Fit a new reservoir with filter and O-ring.
5 Fit the ejector pump with a new O-ring.
6 Fit the fuel pump, see page 12.



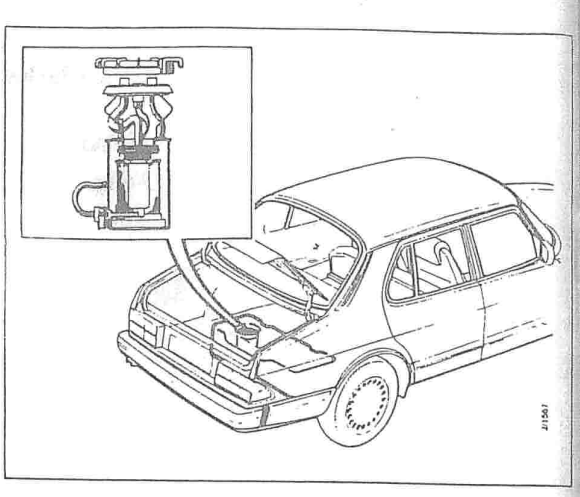
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Fuel pump filter

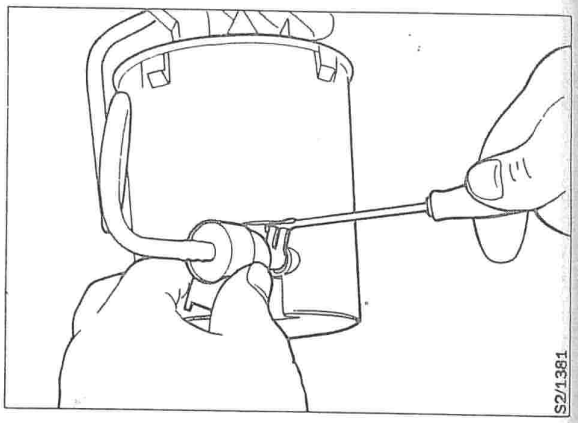
To replace

The filter and reservoir are an integral unit and cannot be replaced individually.

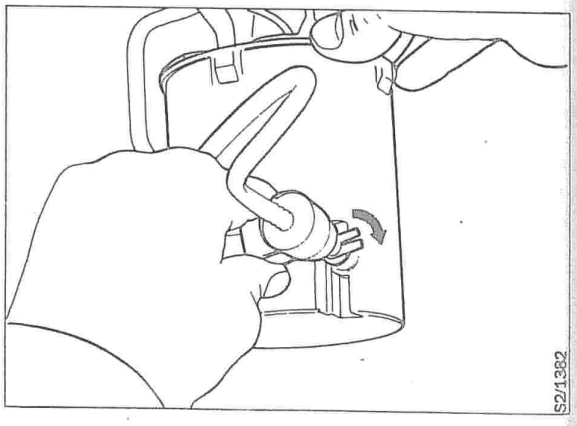
1 Remove the pump, see "Fuel pump, removal and fitting" on page 13.



2 Remove the ejector pump from the reservoir by using a screwdriver to ease back the prongs that prevent the ejector pump from turning.

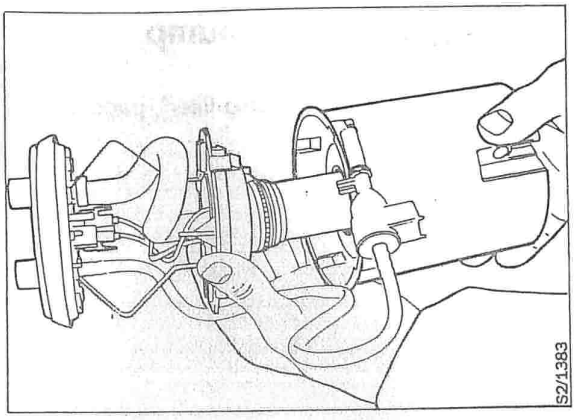


Rotate the ejector pump a quarter-turn and withdraw it.

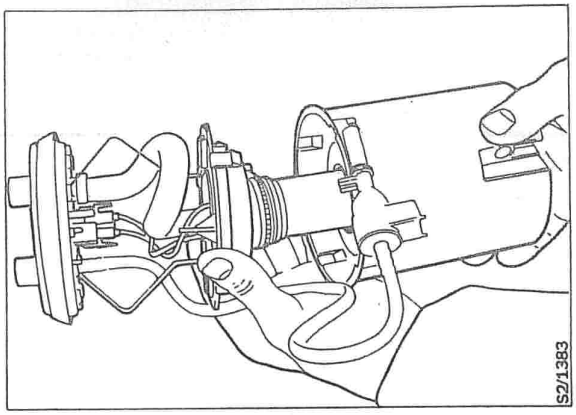


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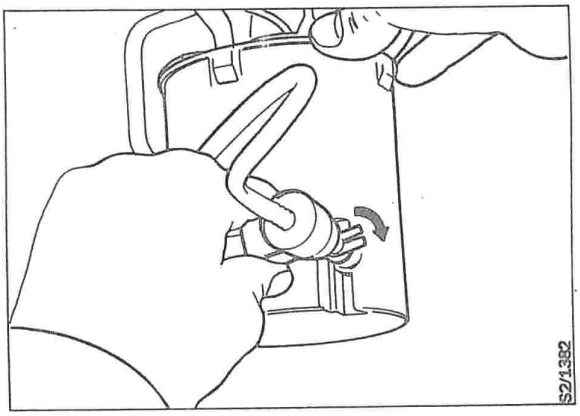
3 Separate the reservoir with filter from the top section.



4 Fit a new reservoir complete with filter unit and O-ring to the pump assembly.

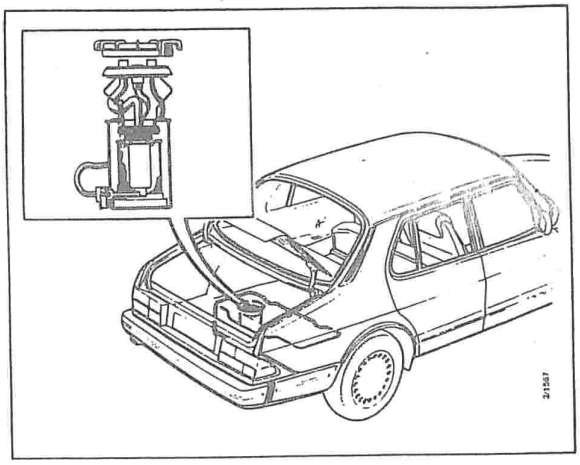


5 Fit the ejector pump with a new O-ring. Insert the pump with the lugs facing outwards and then rotate it a quarter-turn so that the prongs engage the "pimple" on the reservoir.



S2/1381

6 Fit the pump, see "Fuel pump, removal and fitting" on page 17.

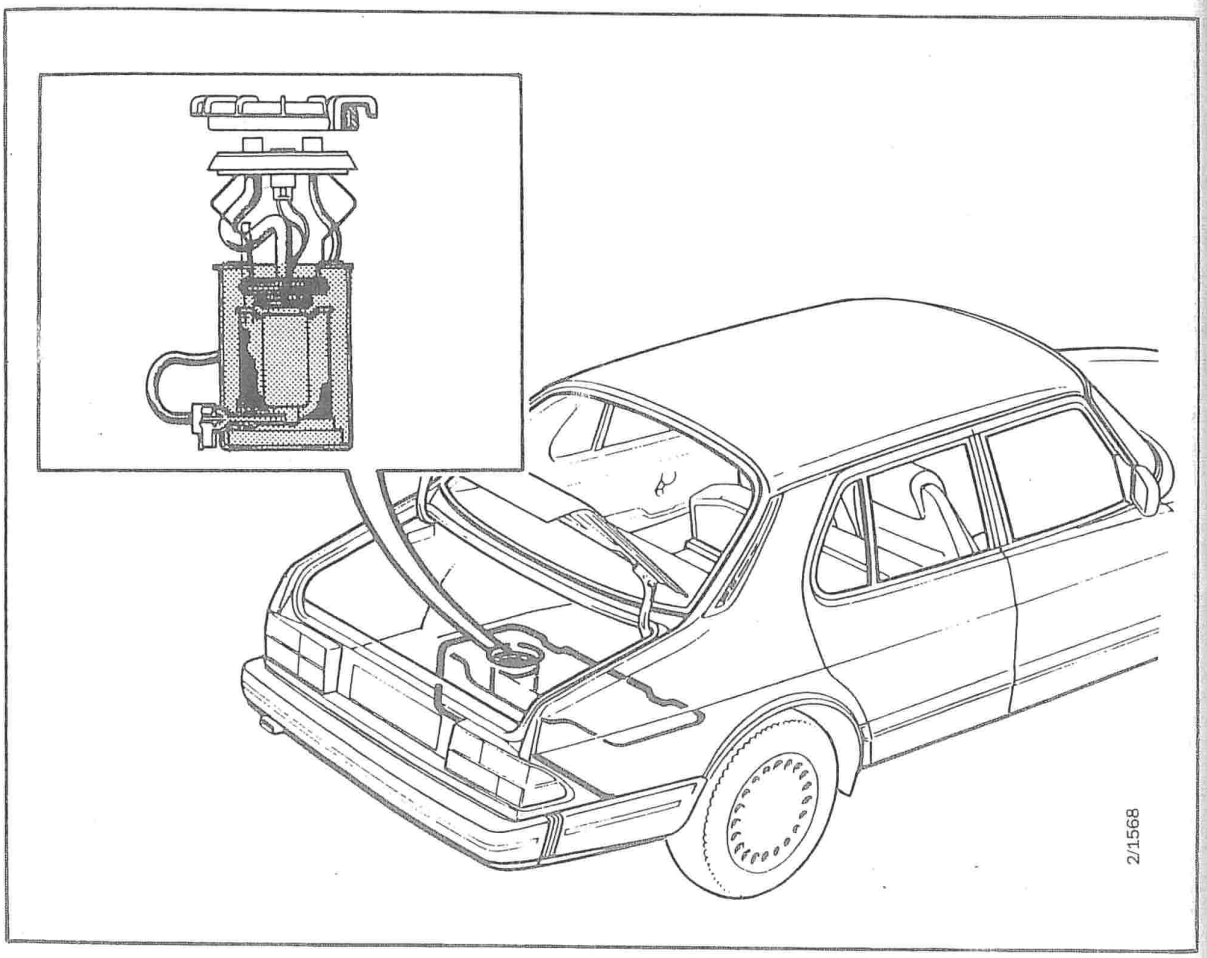


S2/1382

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To replace the fuel pump reservoir

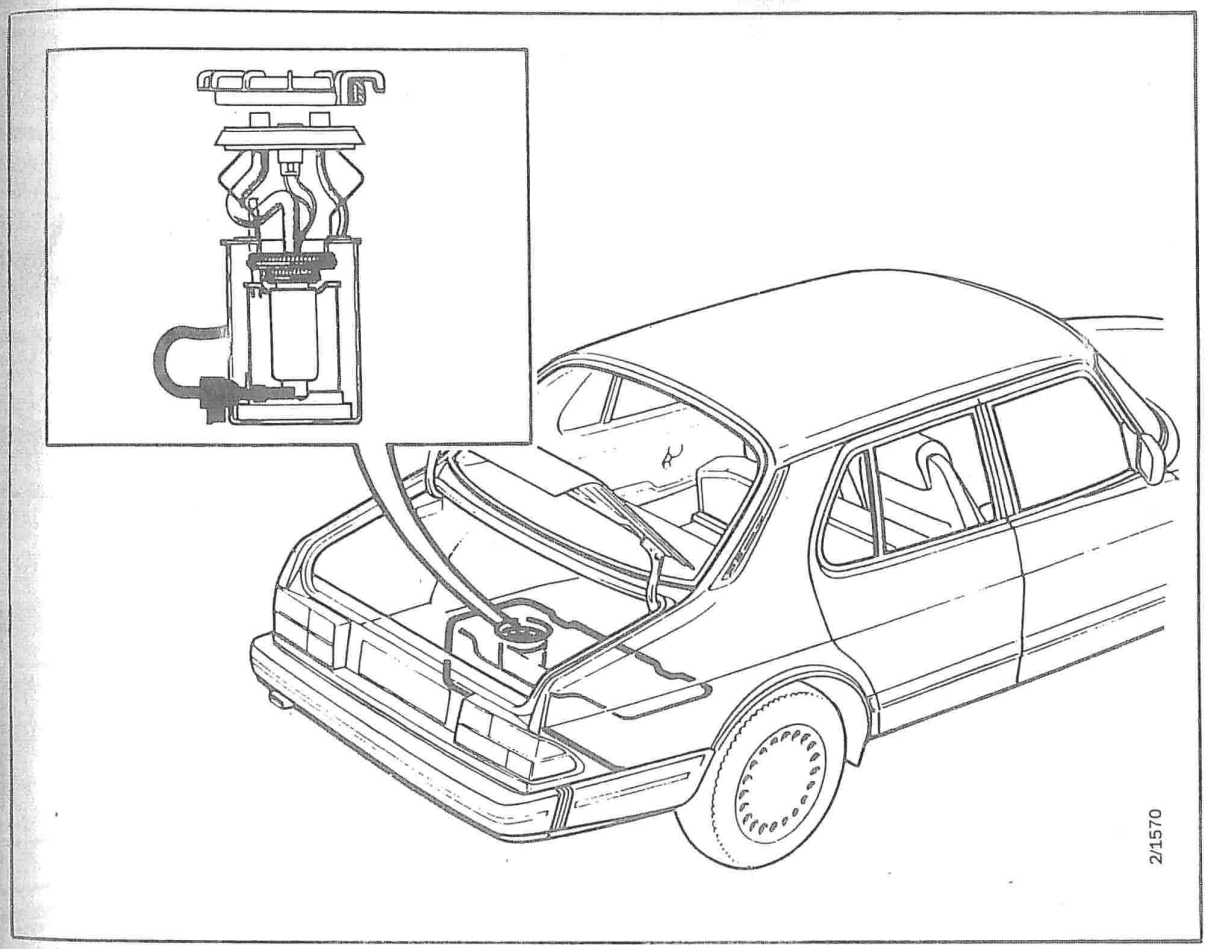
See "To replace the fuel pump filter", page 21.



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To replace the ejector pump

1 Remove the fuel pump, see page 11.
2 Remove the ejector pump, see page 22.
3 Disconnect the return line from the top section.
4 Connect the return line of the new ejector pump.
5 Fit the ejector pump, see page 23.
6 Fit the fuel pump, see page 12.

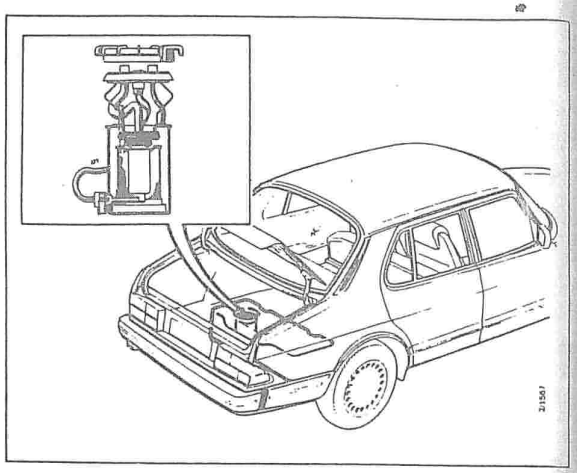


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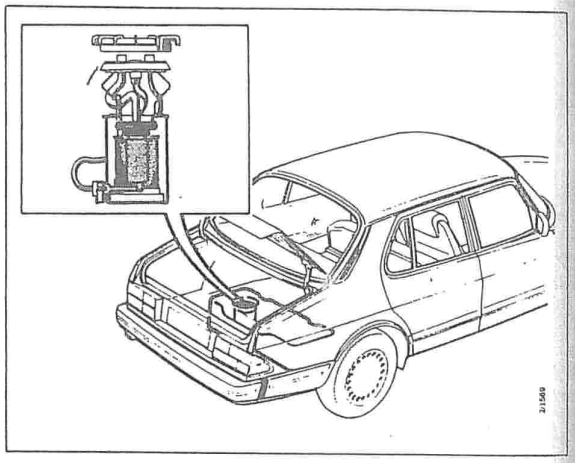
Ejector pump

To replace

1 Remove the fuel pump, see "Fuel pump, removal and fitting" on page 13.

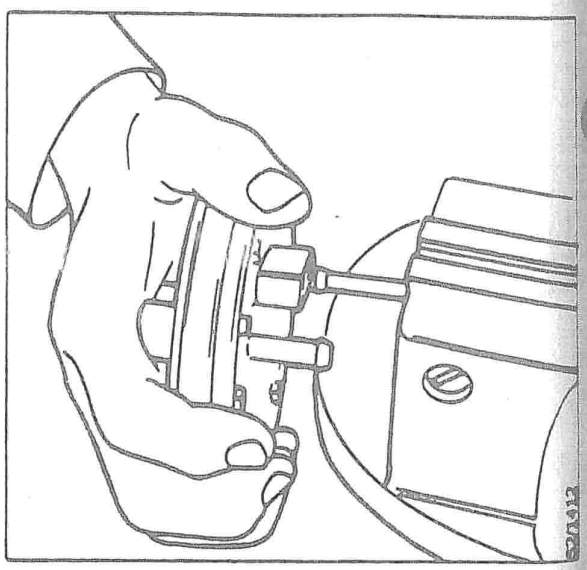


2 Remove the ejector pump, see "To replace the fuel pump filter", page 22.



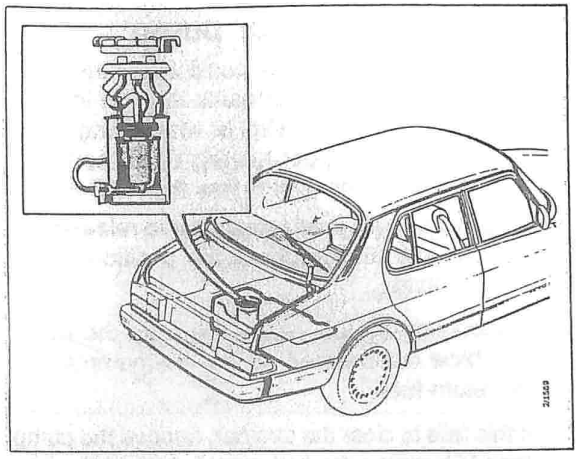
3 Disconnect the return line from the top section. Take care not to damage the knurls on the fitting if you have to use a knife or other tool.

4 Connect the new ejector pump's return line by clamping it in a vice and then pressing the fitting (on the top section of the pump assembly) into it.

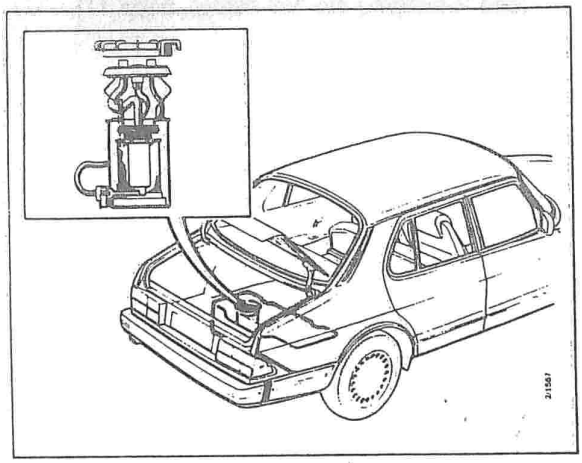


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5 Fit the ejector pump, see "To replace the fuel pump filter", page 23.



6 Fit the fuel pump, see "Fuel pump, removal and fitting" on page 17.



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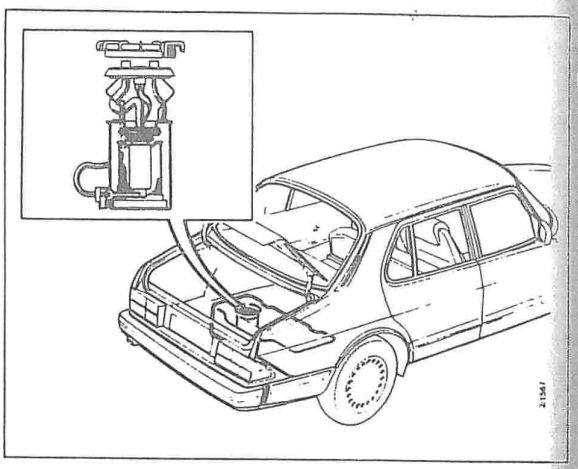
Cleaning the ejector pump

It is possible for the ejector pump inlet strainer to become clogged by contaminants that get into the fuel tank either with the petrol or when filling.
Signs of this include poor running on cornering or accelerating when the tank is less than half full.

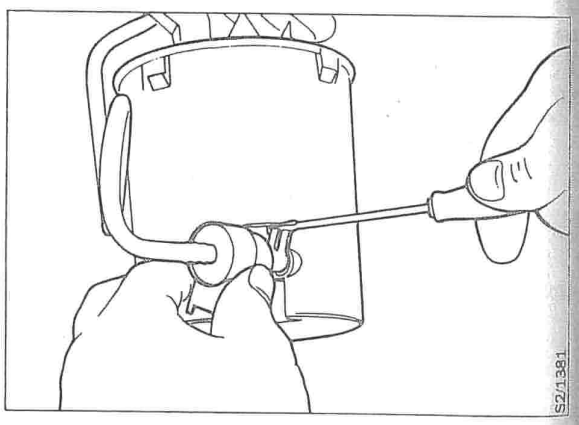
1 Remove the fuel level transmitter to release any air pressure and to check the position of the ejector pump.

Disconnect the fuel return line from the pump and blow compressed air into the pump's inlet for return fuel.

If this fails to clear the strainer, remove the pump (see "Changing the fuel pump", page 11).

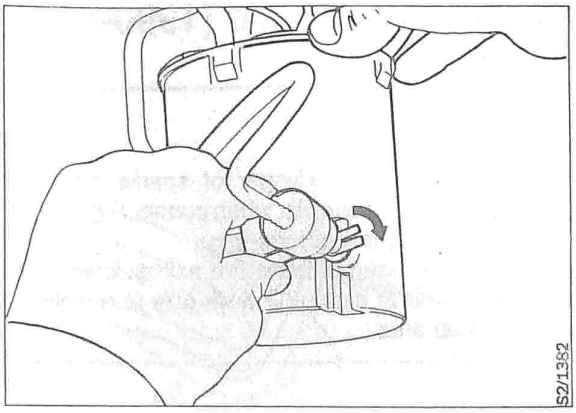


2 Remove the ejector pump from the reservoir by using a screwdriver to ease back the prongs that prevent the ejector pump from turning.



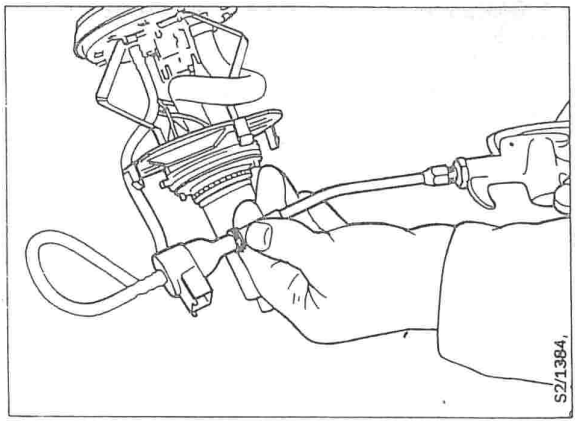
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Rotate the ejector pump a quarter-turn and withdraw it.



3 Blow compressed air into the nozzle to remove any dirt or other foreign bodies.

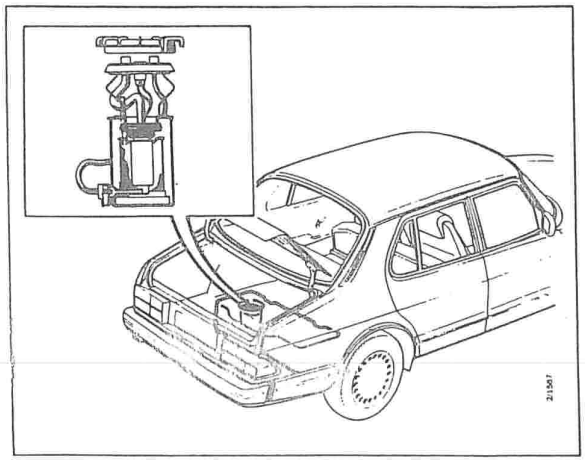
Inspect the filter for the main pump and, if necessary, fit a new filter and reservoir unit.



Note:

Always fit new O-rings.

4 Assemble and refit the pump, see page 17. Check that it is in proper working order.



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Fuel pump, Turbo (1990-)

CAUTION

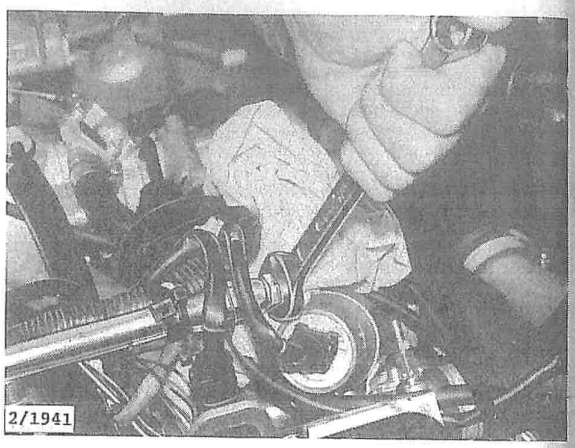
Do not smoke.
Be mindful of the danger of sparks being caused by short circuits, when connecting and disconnecting live circuits, etc.
Make sure that a suitable fire extinguisher is always near at hand and work only in a well-ventilated area.

To remove

1 Disconnect the negative battery cable.

2 Undo the nipple on the fuel distribution pipe to reduce the pressure in the fuel system. Use paper or a cloth to absorb the fuel that runs out.

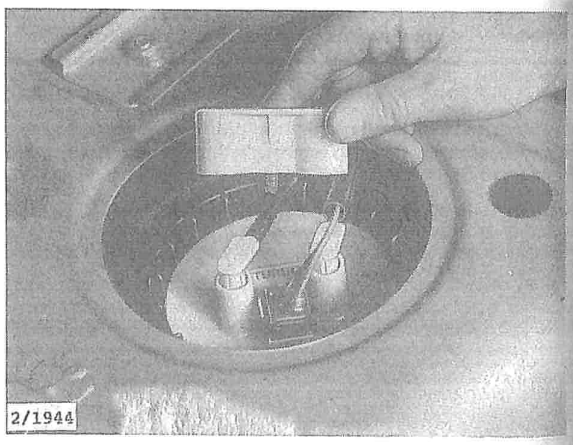
Retighten the nipple.



3 Remove the luggage compartment floor panel.

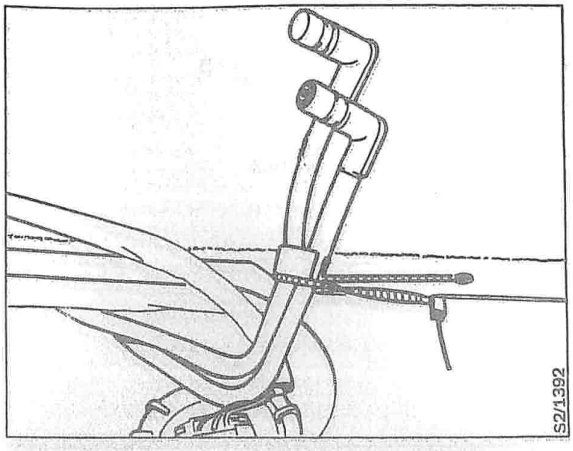
4 Undo and bend aside the cover over the pump.

5 Remove the locking clamp and unplug the connector.

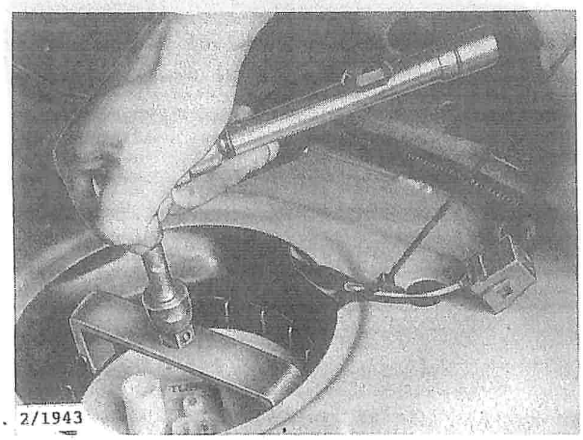


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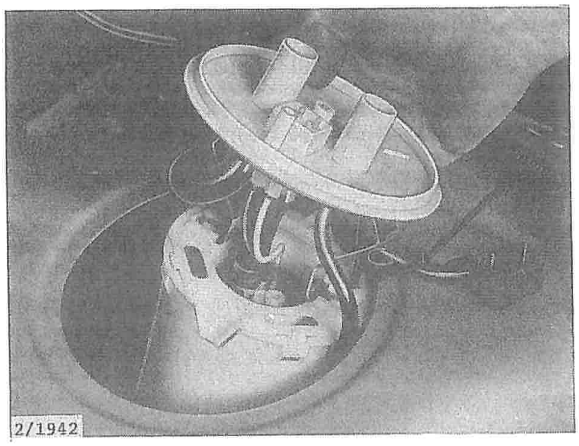
6 Disconnect the fuel lines from the pump. Move them out of the way and secure them by means of a cable tie.



7 Remove the screw top, using special tool 83 94 462.



8 Lift out the pump. Hold paper or a cloth ready to catch surplus fuel.

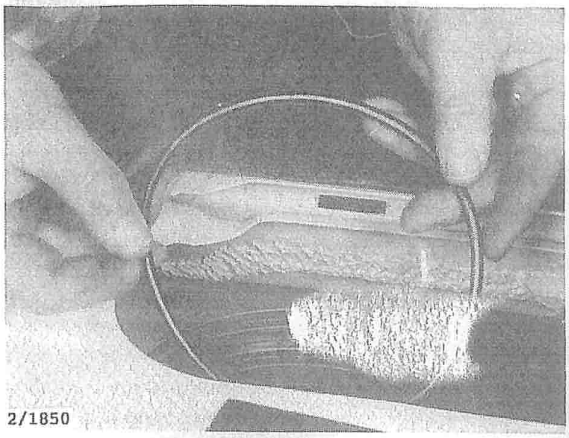


9 Transfer the pump to a suitable receptacle and pour out the fuel.

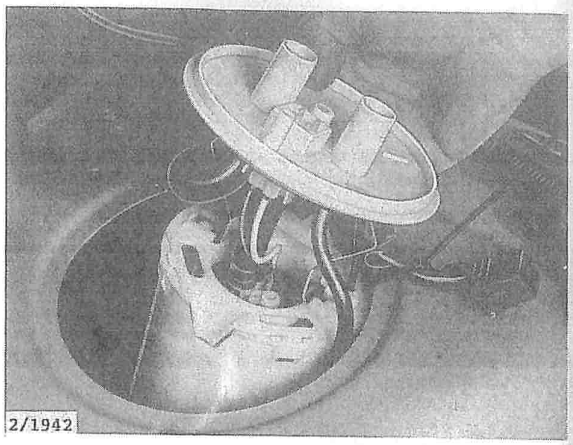
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To fit

1 Fit a new O-ring on the pump.


2/1850

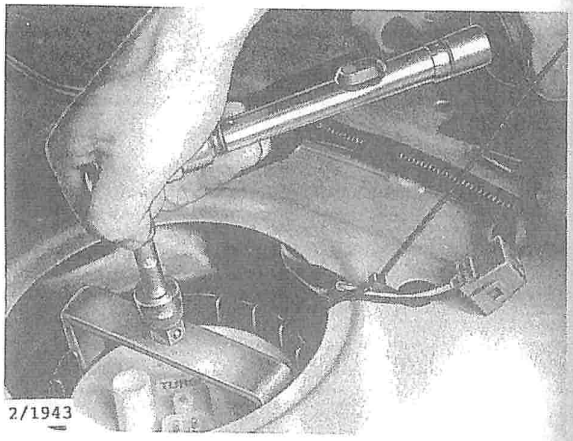
2 Place the pump assembly in the tank and line up the positioning marks.


2/1942

3 Fit the screw top and tighten it with tool 83 94 462 and a torque wrench.

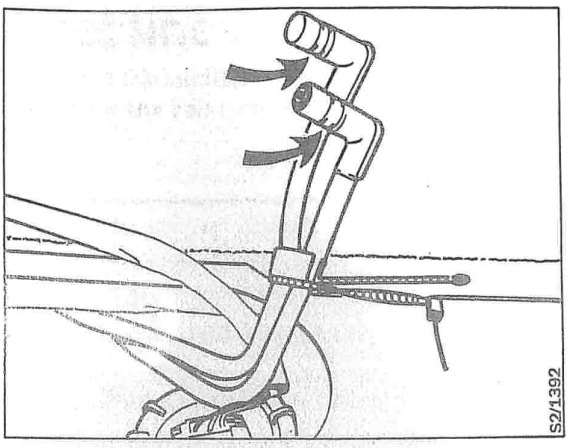
Tightening torque 75 Nm (55 lbf ft).

Make sure that the positioning marks are still in alignment.

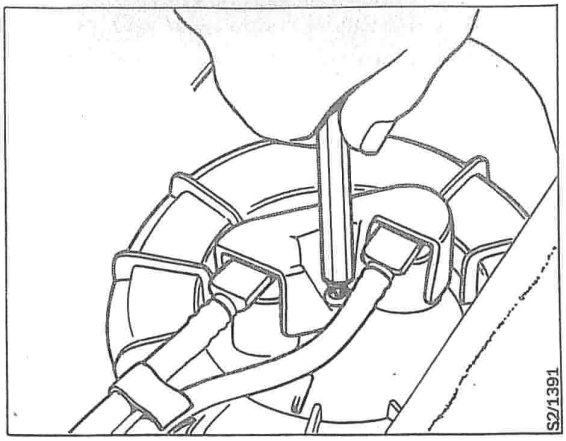

2/1943

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4 Fit new O-rings on the fuel line fittings and connect them to the pump.



5 Plug in the connector and fit the locking clamp.



6 Connect the negative battery cable.

Check the operation of the pump and also check it for leakage.

7 Refit the cover and the luggage compartment floor panel.

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Fuel tank and fuel lines

Removal of tank 234-1
Fitting of tank 234-3
Fuel lines 234-4
Replacing fuel lines inside car 234-5
Fuel level transmitter 234-7
Replacing the roll-over valve 234-8

CAUTION

Do not smoke. Be mindful of the danger of sparks being caused by short circuits, when connecting and disconnecting live circuits, etc.

Make sure that a suitable fire extinguisher is always near at hand.

Work only in a well-ventilated area.

The fuel tank has no drain plug. When work on the fuel system requires the tank to be drained, this can be done with a separate tank draining unit or by using the car's fuel pump.

To remove

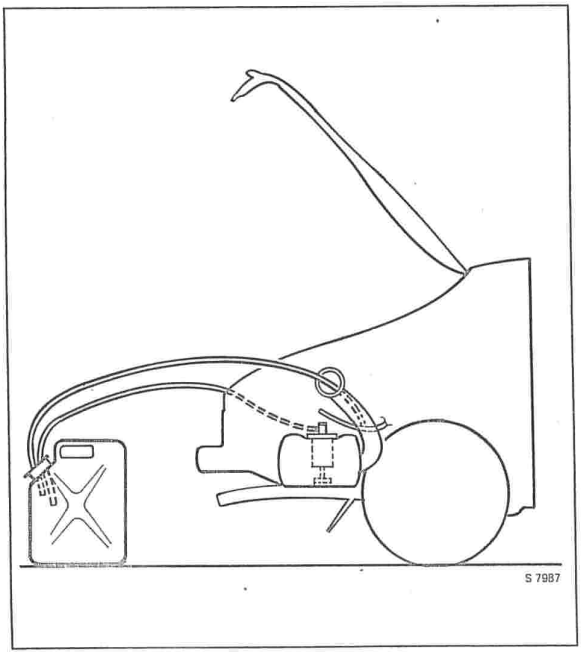
1 Remove the luggage compartment floor, floor panel and cover over the fuel pump.

2 Use the fuel pump to drain the fuel tank. To prevent the emission of hydrocarbons into the workshop, use a closed system.

Disconnect the fuel line from the fuel pump, connect a special line to the pump and fit the other end to a suitable receptacle. The receptacle should be closed and equipped with a vent hose, which should be run back into the fuel filler pipe.

Note:

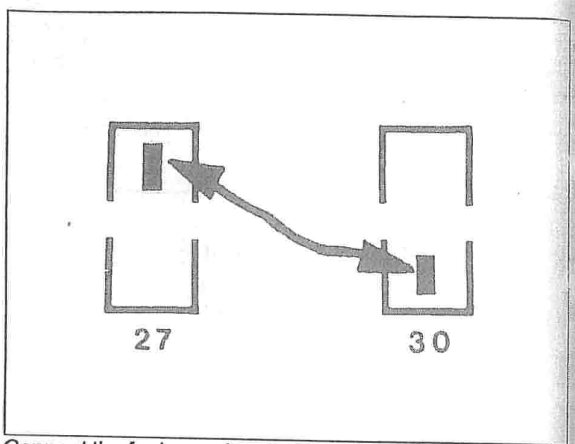
Do not run the fuel pump without any fuel in the tank.



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Remove the fuel pump relay and run the pump by connecting it to terminal No. 30/-87 (CI) until the tank is empty.

For cars with an LH system, see the Fig.



Connect the fuel pump's switched jumper lead 83 93 886 across fuses 27 and 30.

3 Disconnect the negative battery cable.
4 Remove the cover from the fuel level transmitter.
5 Disconnect all electrical leads from the tank.
6 Raise the rear of the car.
7 Remove the filler pipe and breather tubes from the fuel tank.

   Disconnect the pressure and return fuel lines from the fuel accumulator and tank and undo the fuel line clips.
8 Remove the securing strap nuts under the tank.
9 Lower the tank.

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To fit

1 Make sure that all seals are correctly fitted on the tank.

2 Check that the straps are correctly fitted and blank off the ends of the filler pipe and breather tubes with masking tape.

3 Lift the tank into position and support it by the two straps.

4 Adjust the lateral position of the tank and tighten the straps. Remove the masking tape from the filler pipe and breather tubes.

5 Reconnect the fuel lines, filler pipe and breather tubes.

6 Reconnect the leads for the fuel level transmitter and fuel pump and refit the cover over the fuel pump.

7 Lower the car.

8 Reconnect the negative battery cable.

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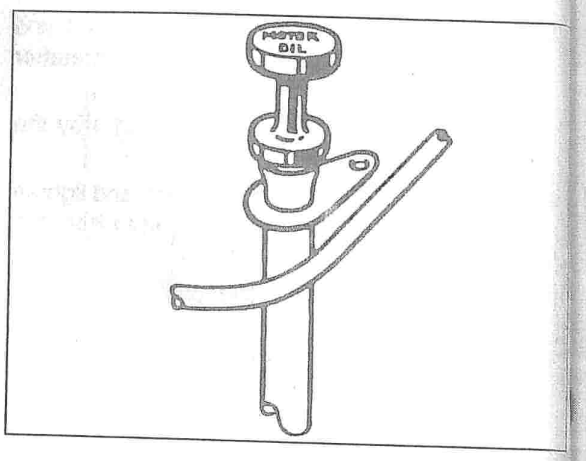
Fuel lines

Fuel line runs

Fuel lines must not be run where there is a risk of chafing.

The danger is particularly great where pipes run adjacent to plastic components subject to engine vibration (e.g. other fuel lines, the dipstick tube, throttle cable, etc.).

When working inside the engine bay, lift the fuel lines well clear to prevent chafing and sheath the pipes with PVC sleeves if contact is unavoidable.



Checking the fuel lines

Follow the pipe runs and check for signs of chafing. Pay special attention to places where the lines chafe or are in contact with nearby plastic components. Wall thickness, fuel pipes:

Pipes to
injectors: 2 mm (0.079 in)
Other pipes: 1 mm (0.039 in)

Re-route the pipes and fit PVC sleeves if chafing is detected. If the wear is greater than half the thickness of the pipe wall, fit a new pipe.

Checking fuel line connections

Check all fuel line connections and joints for leaks. Always fit new sealing washers each time a joint is undone.

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Replacing fuel lines inside the car

The fuel lines from the tank to the engine bay run along the left-hand sill inside the car.

To remove

1 Remove the scuff plates and turn back the carpet from the sill.

2 Remove the tape holding the fuel lines.

3 Remove the insulation felt from the bulkhead.

4 Disconnect the fuel lines in the engine bay, press out the grommets and pull the lines into the cabin.

Disconnect the return fuel line from the fuel flow meter and the pressure line from the fuel filter.

5 Undo the clips and disconnect the fuel lines from the fuel tank. Disconnect the pressure line from the fuel accumulator and release the clips on the fuel tank.

To fit

1 Clean the fuel lines by blowing compressed air through them. Blank off the ends of the lines with masking tape.

2 Insert the fuel lines through the holes in the bulkhead and the spring link bracket and connect the lines in the engine bay.

3 Fit the rubber grommets in the holes in the bulkhead and in the front holes in the spring link bracket.

4 Feed the fuel lines through the cabin, connect them to the lead-through adapters at the rear and secure them with tape at two points along the sill.

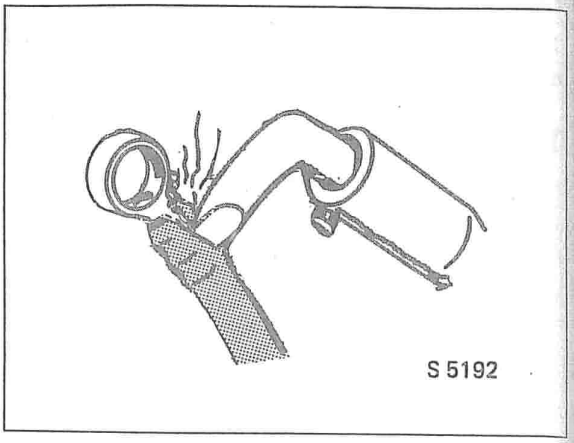
5 Fit the insulating felt to the bulkhead and replace the carpeting and sill scuff plates.

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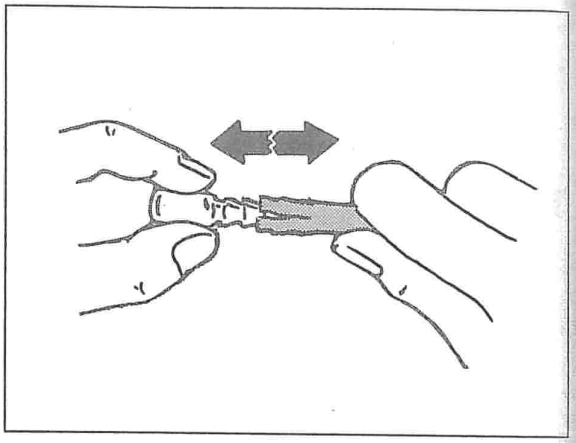
Replacing banjo fitting on fuel line

To remove

1 Burn through the old fuel line with a soldering iron.



2 Withdraw the fuel line from the banjo fitting. Do not use a knife to cut the fuel line and this could damage the fitting and cause leakage.

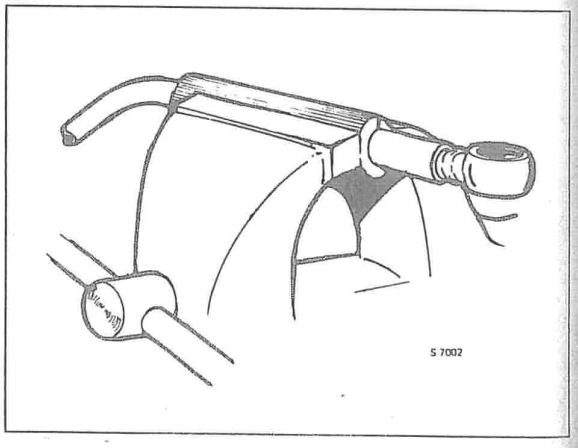


To fit

1 Use a knife to cut off a short section of the fuel line. Cut off as short a length as possible.

2 Slide a piece of thick rubber hose with a slit in it onto the fuel line and clamp it in a vice. Allow the free end of the fuel line to protrude the length of the fitting plus 2 mm.

3 Use a hammer to drive the fitting home. Hold the line to prevent the fitting from twisting.



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Making a fuel line fitting tool

Materials:

- One pair of pliers
- One valve guide

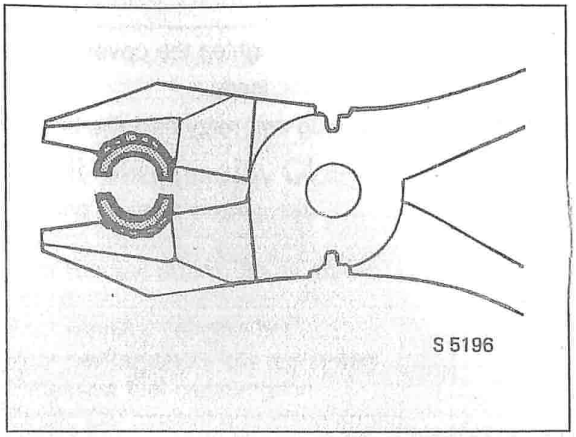
1 Cut the valve guide to a length of 25 mm (0.984 in).

2 Split the valve guide so that two semicircular halves are obtained.

3 Carefully deburr all edges.

4 Solder the two halves to the pliers with the parting line running along the centre line of the pliers.

Hold the halves in place while soldering them by gripping an old valve between them.


S 5196

Fuel level transmitter

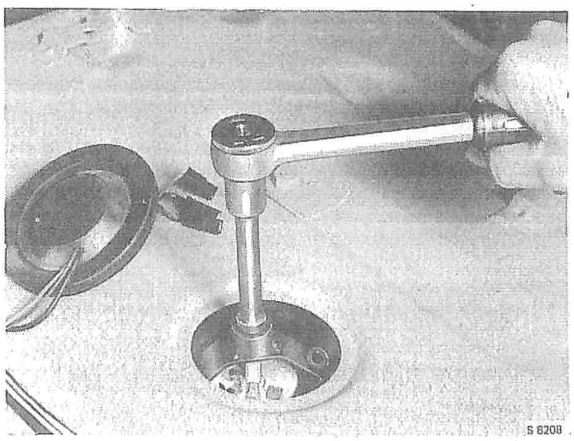
Different versions of the fuel level transmitter are in use - for 1981-1982 cars and for 1983 and later model year cars. The different versions are not interchangeable. Since the different transmitters have a different resistance, fitting the wrong version will cause the gauge to give faulty readings.

To change the fuel level transmitter

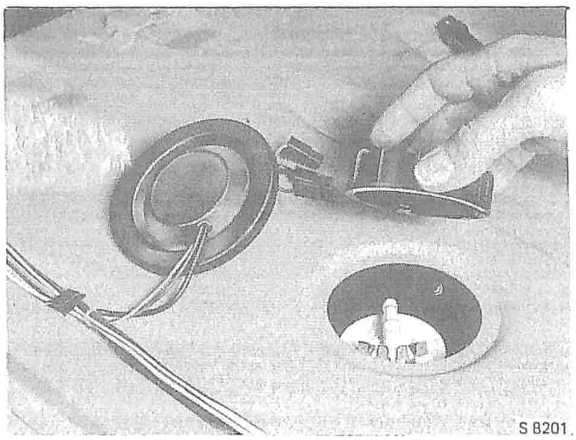
1 Disconnect the negative battery cable.

2 Remove the rubber plug from the transmitter and disconnect the electric leads.

3 Undo the cover using special tool 83 93 365.


S 8208

4 Unscrew the cover and lift out the transmitter.

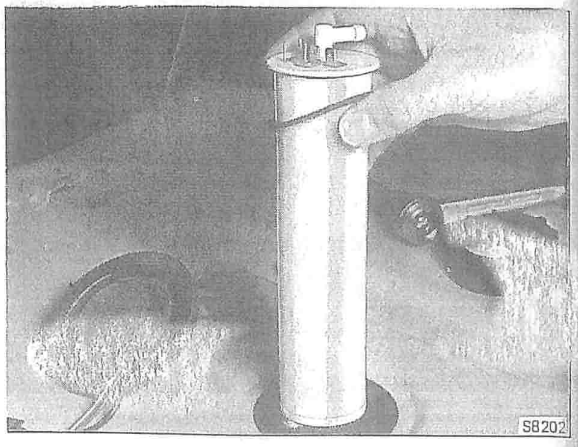

S 8201

Note:

Transmitters intended for model year 1981 and 1982 cars cannot be fitted in model year 1983 and later cars, and vice versa.

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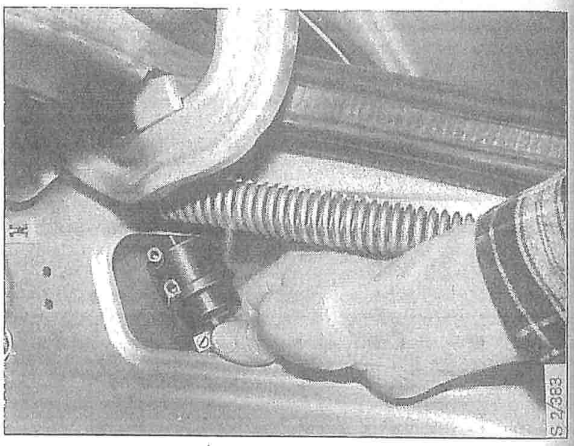
5 Remove the transit safety from the new transmitter (as from 1983 models).
6 Inspect the rubber seal.
7 Fit the transmitter and tighten the cover.
8 Reconnect the electric leads.
9 Refit the rubber plug and reconnect the battery cable.



Replacing the roll-over valve

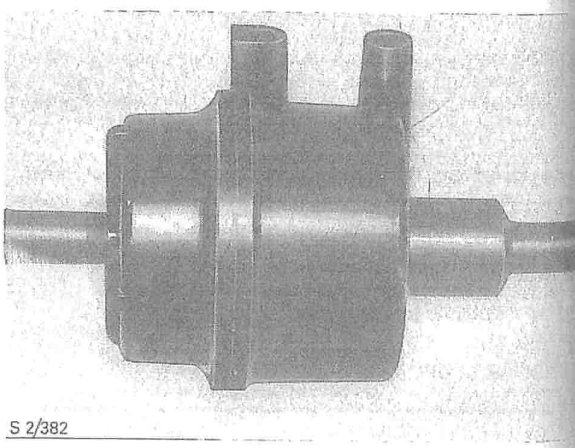
To remove

1 Remove the trim on the right-hand side of the luggage compartment.
2 Remove the screws and withdraw the valve.
3 Disconnect the valve from the hose.



To fit

1 Attach the valve to the vent hose (with the long outlet at the top). Make sure that the lugs on the valve are in line with the screw holes in the body panel.
2 Screw the valve in place and refit the trim in the luggage compartment.



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Fuel injection system

Fuel injection system, CI 240-1
Fuel injection system, LH 240-61





Fuel injection system, CI

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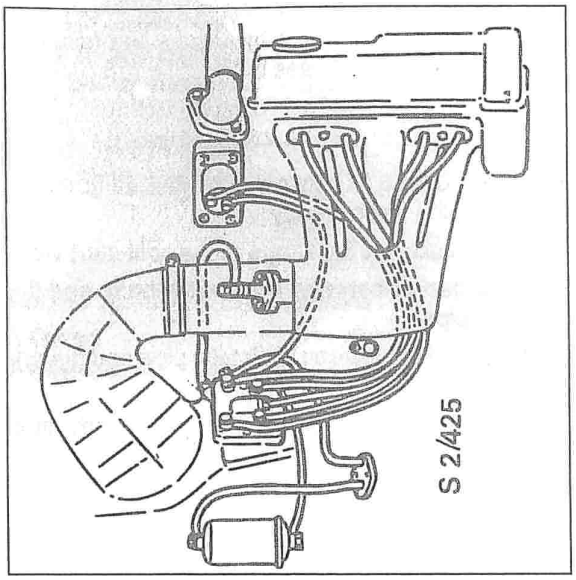
Checking/adjustments

General

Before testing and fault tracing of the CI system is started, it must first be established that there are no mechanical faults in the engine and that the ignition system is in proper working order. Scrupulous cleanliness must be observed while work is carried out on the system. The surrounding area should be thoroughly cleaned before any lines are disconnected.

CAUTION

There is an acute danger of fire due to fuel atomization in this test. Make sure that the area is well ventilated and that nobody is smoking.



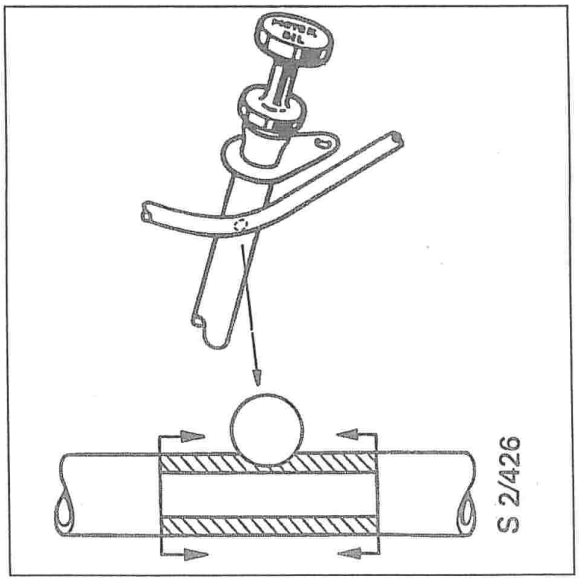
Fuel leakage

Check that there is no leakage at connections and in the fuel lines. Check around the fuel tank, inside the cabin and in the engine bay.

Fit new seals to any leaky connections. Damaged fuel lines should be replaced.

Check that fuel lines do not chafe against other objects (particularly those made of plastic).

Continuous chafing (e.g. against the dipstick tube, other fuel lines or the throttle cable) can result in damage to the fuel line.



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Air leakage

Check for leakage in the induction system between the mass air flow sensor and the engine.

Air leaking into the system may result in poor engine performance since it by-passes the mass air flow sensor and so causes the mixture to be excessively lean.

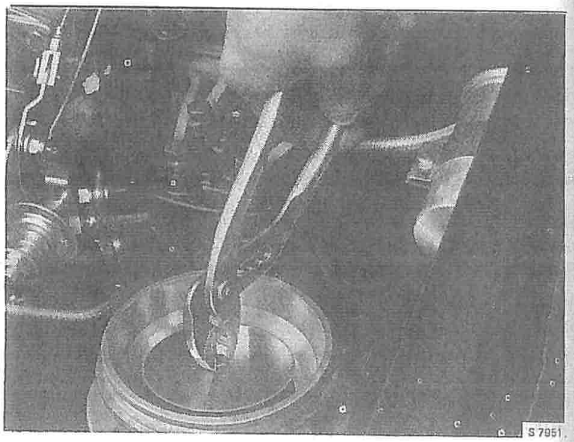
Leakage can occur int he following places:

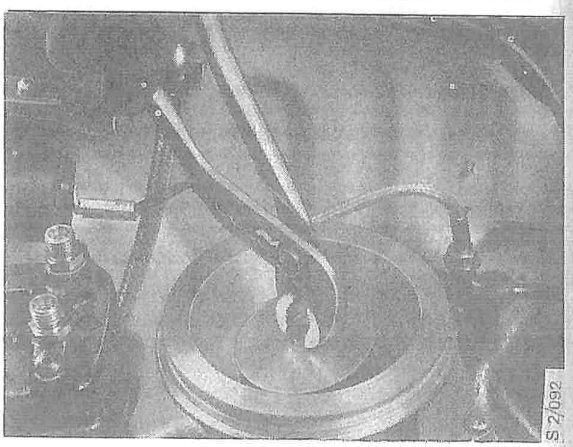
- At the rubber duct between the mass air flow sensor and the throttle body
- At the gasket on the flange of the cost-start valve
- At the gasket between the throttle body and the intake pipe
- At the gasket between the intake pipe and the cylinder head
- At the hose connections on the throttle body, auxiliary air valve and intake pipe

Unwanted air can also be inducted via the crankcase ventilation hose, the oil filler cap, dipstick tube or camshaft cover gasket.

Mass air flow sensor lever mounting

Remove the rubber ducts and check the movement of the lever in the mass air flow sensor. As the lever is lifted, steady resistance should be felt as a result of the damping action of the control plunger. No resistance should be felt when the lever is suddenly pushed down away from the plunger. If the mass air flow sensor has not been removed, use a pair of pliers or a magnet to lift the lever. If any binding is felt, the mass air flow sensor must be repaired.

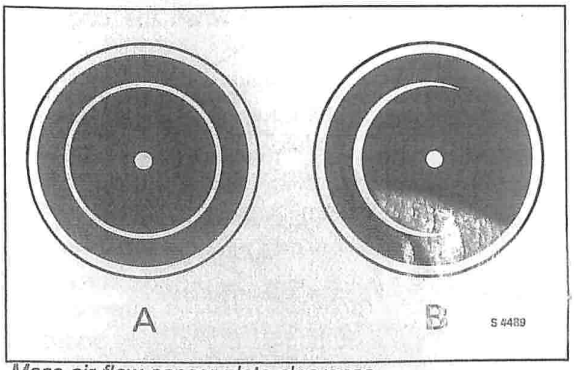




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Mass air flow sensor plate clearance

Check that the clearance between the edge of the mass air flow sensor plate and the air venturi is uniform.

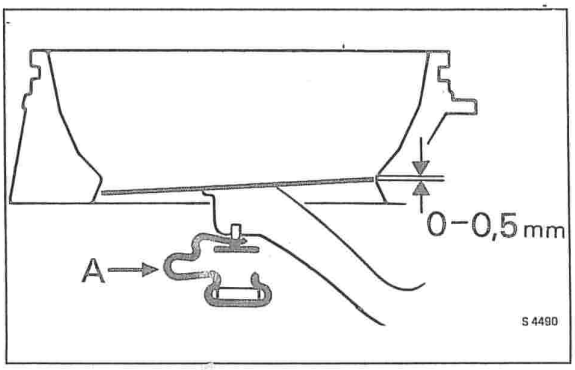


Mass air flow sensor plate clearance

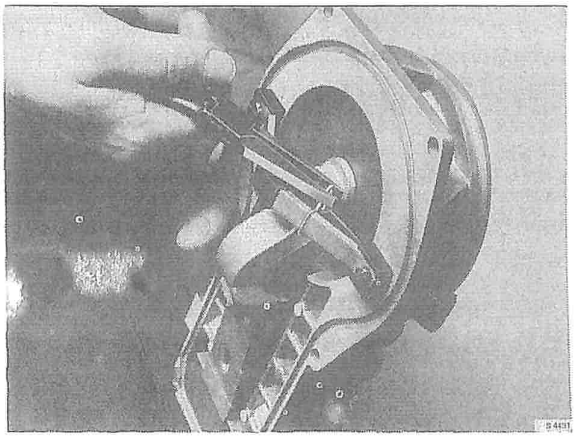
A Correct
B Incorrect

Mass air flow sensor plate rest position

Check the rest position of the mass air flow sensor plate with the ignition switched off (fuel pump not working). This prevents fuel from being injected into the cylinders when the sensor plate is lifted from its rest position. The upper edge of the sensor plate should be level with the bottom edge of the air venturi. This is the highest permissible position for the sensor plate. A position slightly beneath the lower edge of the venturi, max. 0.5 mm (0.0197 in), is permissible. The measurements should be taken from the middle of the lever.



The rest position can be adjusted by bending the clip (A) for the spring-loaded arm on the underside of the mass air flow sensor. The mass air flow sensor must first be removed.



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Auxiliary air valve

(Checking can only be done when the engine is cold.)

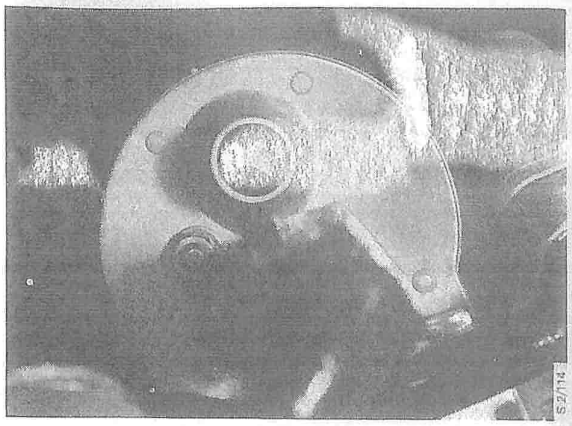
If a check of the control pressure with the engine cold is later to be carried out, disconnect the leads from the warm- up regulator to prevent the bi-metal strip from heating up.

Using an inspection lamp and a mirror, check that the orifice in the auxiliary air valve is elliptical.

Remove the fuel pump relay. To provide current for the pump and the CI system, connect a jumper lead between terminals 30 and 87 of the relay board.

The aperture in the auxiliary air valve should be completely closed in about five minutes.

If the auxiliary air valve has not closed, check whether it is supplied with current. If it is, measure the resistance across its terminals, which should be about 40 ohms. If the valve is defective, fit a new one.



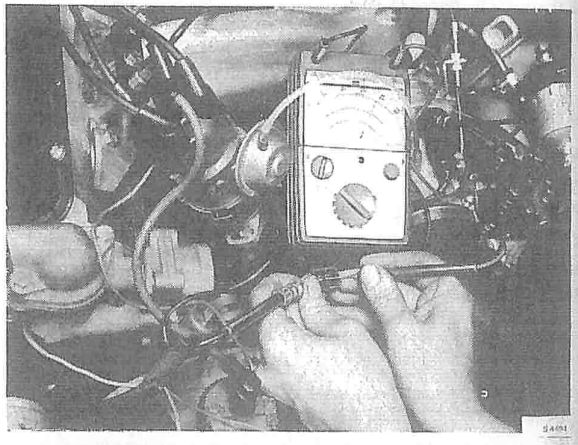
Warm-up regulator

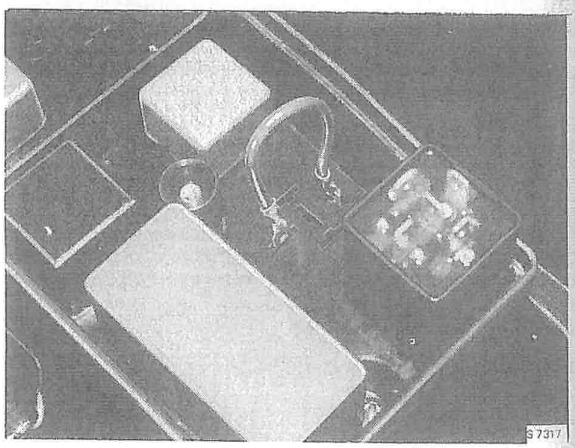
Check the electrical leads running to the warm-up regulator as follows:

Unplug the connector on the warm-up regulator and connect a multimeter across the connector pins.

Remove the fuel pump relay and connect a jumper lead between terminals 30 and 87 on the relay board to supply the fuel pump (and the rest of the CI system) with power. Read off the voltage at the connector, which should not be below 11.5 V.

- Check the continuity of the warm-up regulator coil by connecting a multimeter in series with it. If there is an open-circuit in the heating coil, fit a new warm-up regulator.





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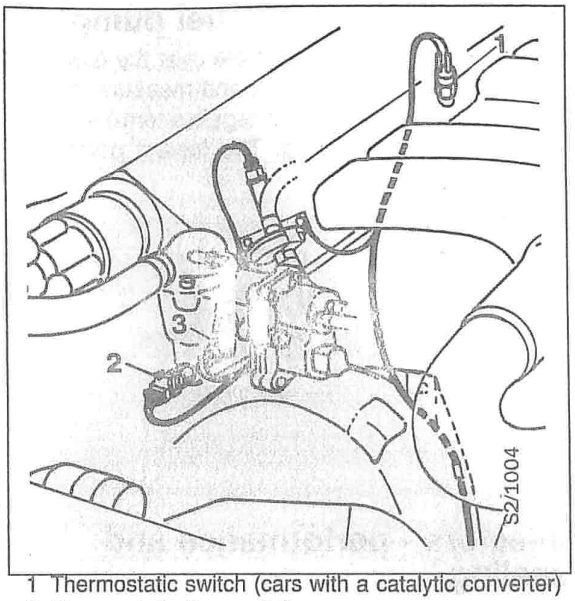
Thermostatic time switch

When the engine is cold, with a temperature below 45°C (113°F), the thermostatic time switch should close for a shorter or longer period (depending on the temperature) to allow current to flow while the starter motor is engaged.

Using a test lamp connected in series across the pins in the connector of the cold-start valve, check that the switch closes when the starter motor is engaged.

It is not possible to carry out a more accurate check of the time the switch is closed or of the temperature. If in any doubt, fit a new switch.

On model year 1986 and later cars the thermostatic time switch is fitted on the thermostat housing.

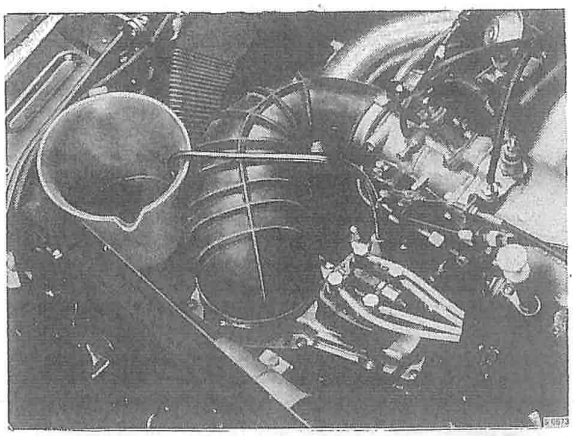


1 Thermostatic switch (cars with a catalytic converter)
2 Thermostatic time switch
3 Auxiliary thermostatic switch

Fuel pump capacity

The capacity of the fuel pump can be checked by measuring the return fuel flow as described in the following, provided that the fuel filter is not clogged and that the battery is fully charged.

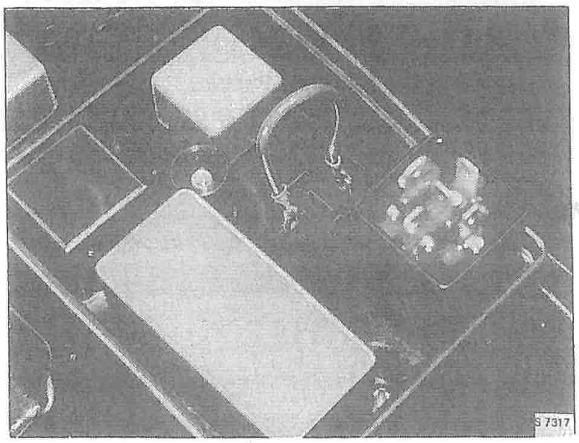
Attach a length of hose to the fuel return connection on the fuel distributor. Place the other end of the hose in a suitable receptacle.



Remove the fuel pump relay and connect a jumper lead between terminals 30 and 87 on the relay board to supply the fuel pump (and the rest of the CI system) with power.
Run the pump for 30 seconds, measure the amount of fuel collected and check it against the minimum quantity specified in the "Technical Data" section

If the amount of fuel collected is below that specified, the following possible causes should be investigated:

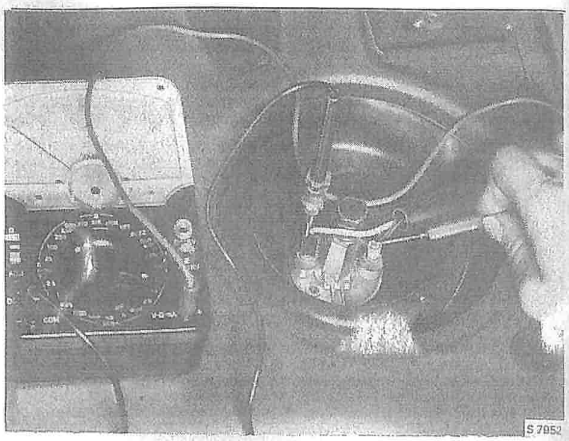
- Defective fuel pump
- Voltage drop in power supply to pump
- Clogged filter or blockage in fuel lines



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Voltage across the fuel pump

Remove the circular cover plate over the fuel pump in the luggage compartment and measure the voltage across the positive and negative terminals of the pump while it is running. The lowest permissible voltage is 11.5 V.

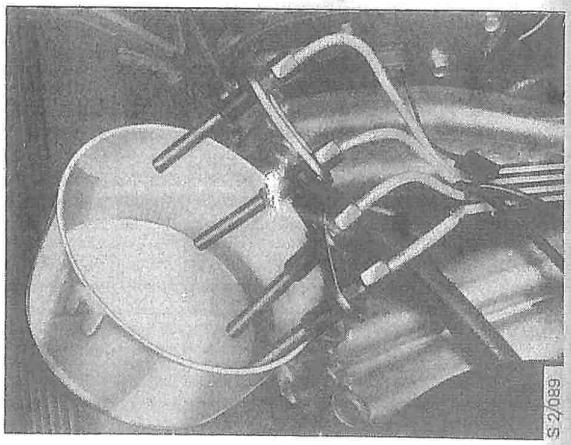


Injectors - performance and sealing

Check the injectors as follows:

1 Remove the rubber duct from the mass air flow sensor.

2 Remove the injectors from the inlet manifold and place them in a suitable receptacle. The fuel lines should remain connected.



3 Remove the fuel pump relay and connect a jumper lead between terminals 30 and 87 on the relay board to supply the fuel pump (and the rest of the CI system) with power.

4 Fuel atomization: Raise the mass air flow sensor lever and observe the spray patterns of the injectors. If atomization is poor, refer to the "Injectors - to clean" section.

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CAUTION

There is an acute danger of fire due to fuel atomization in this test. Make sure that the area is well ventilated and that nobody is smoking.

5 Valve sealing: Switch off the ignition. The fuel system is now under shut-off pressure. Wipe the injector nozzles dry, lift the mass air flow sensor lever and check to see whether any leaks occur. It should take at least 15 seconds for a drop of fuel to form on the tip of the injector. In the case of excessive leakage, refer to the "Injectors - to clean" section.

Cold-start valve - performance and sealing

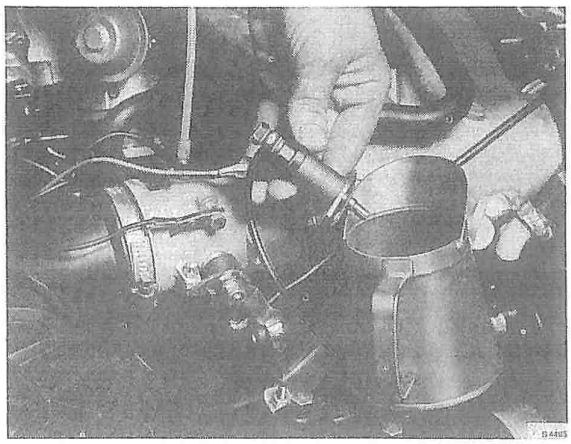
Unplug the connector from the cold-start valve, leave the fuel line connected and unscrew the valve from the throttle body.

Plug the connector on one end of a test cable (fabricate) into the cold-start valve and connect the other ends of the test cable leads to the full beam terminal of a headlamp and to ground.

Remove the fuel pump relay and connect a jumper lead between terminals 30 and 87 on the relay board to supply the fuel pump (and the rest of the CI system) with power.

Place the cold-start valve in a receptacle and get an assistant to switch the headlamps on full beam for a short time (not more than 30 seconds). Fuel should spray out of the valve during this period.

Wipe the cold-start valve nozzle dry and run the fuel pump for a further 60 seconds. No fuel should emerge from the valve during this time.



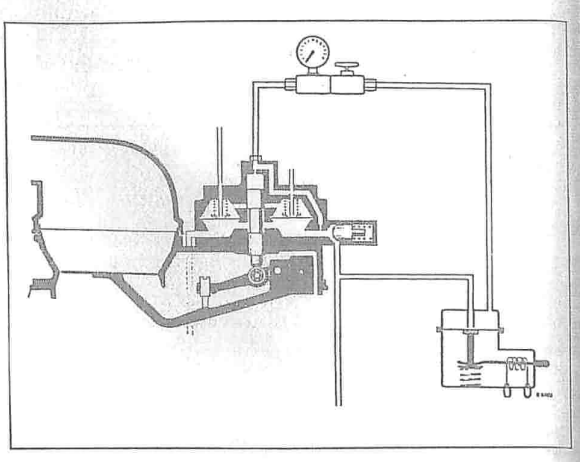
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Checking pressures

General

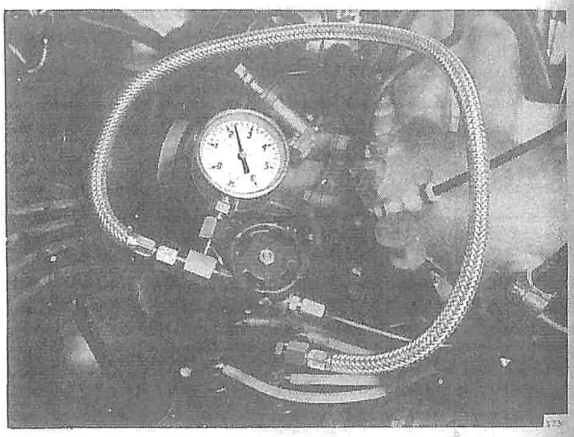
Connect pressure gauge 83 92 516 as follows:

Disconnect the control pressure line from the fuel distributor and connect the pressure gauge between the fuel distributor and the line running to the warm-up regulator.



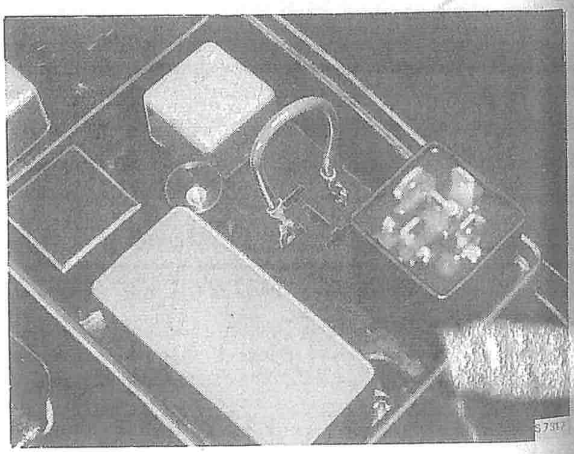
Note:

The safety device for running the fuel pump is controlled by a pulse sensor in the pump relay which is actuated by the ignition pulses.



Remove the fuel pump relay and connect a jumper lead between terminals 30 and 87 on the relay board to supply the fuel pump (and the rest of the CI system) with power.

Bleed the pressure gauge by repeatedly opening and closing its valve with the fuel pump running while pointing the pressure gauge downwards.



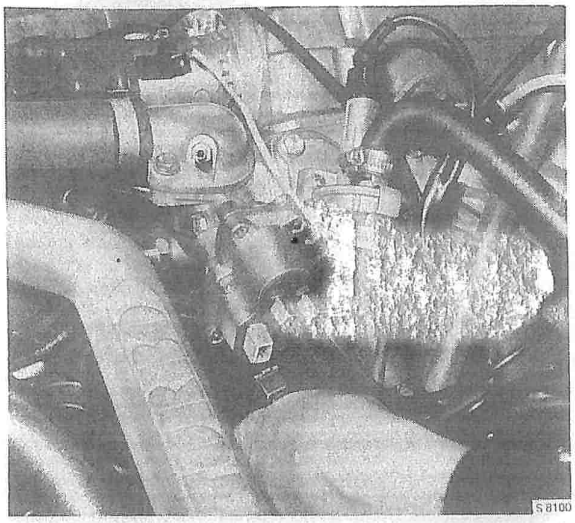
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Control pressure: engine cold

This test is to be carried out in the event of complaints about poor cold starting performance and poor running performance during the warm-up period. The test must be carried out with the engine cold. Do not run the engine immediately prior to the test and make sure that it has been left standing for several hours beforehand (preferably overnight) so that it is at ambient temperature before the test is started. Open the pressure gauge valve, unplug the connector from the warm-up regulator and switch on the ignition.

Compare the pressure gauge reading with the recommended pressure given in the temperature/ pressure graph. See "Technical data", section 022.

If the pressure differs, fit a new warm-up regulator.



Control pressure: engine hot

Carry out this test if poor performance has been experienced when driving the car with the engine at normal operating temperature.

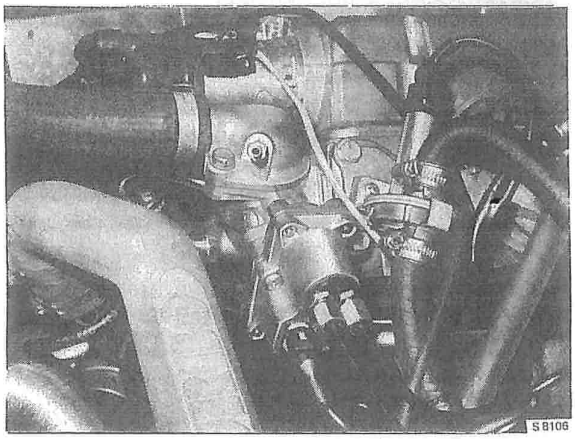
Open the pressure gauge valve.

Plug in the warm-up regulator's connector.

Leave the ignition switched on until the pressure has stabilized.

Consult "Technical data", section 022.

If the figures differ, fit a new warm-up regulator.



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Line pressure

Close the pressure gauge valve.

Run the fuel pump.

Refer to the test figures in "Technical data", section 022.

If the line pressure differs from the recommended figures, this may be due to one or more of the following:

In the case of insufficient line pressure:

- Insufficient pressure from the fuel pump
- Clogged filter in the tank
- leakage in the fuel line
- Faulty line pressure regulator

In the case of excessive line pressure:

- Blocked return line
- Faulty line pressure regulator
  To adjust the line pressure, see "Adjusting the line pressure" below.

Leakage tests on the whole system

This test should be performed in the event of complaints about starting trouble when the engine is hot.

If the engine is cold, the bi-metal strip in the warm-up regulator must be heated and kept hot throughout the test. Unplug the connector from the warm-up regulator and connect a fabricated test cable between the warm-up regulator and the battery.

Open the pressure gauge valve. Run the fuel pump until a reading equal to that for "Control pressure: engine at normal operating temperature" (Technical data section) is reached and then disconnect the pump.

Note any drop in pressure on the pressure gauge. A leak will generally become evident within 3-4 minutes. When in doubt, maintain the system under pressure for 20 minutes (see "Technical data", section 022). If the pressure drops too rapidly, the fault can be located by performing the test with the pressure gauge valve shut.

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If the figures obtained in this test are correct, then the shut-off valve in the warm-up regulator is defective.

If the pressure drop is still excessive, the following components could be the faulty:

- The fuel pump non-return valve
- The fuel distributor
- The cold-start valve

Leakage can occur if the O-ring in the line pressure regulator is damaged. To replace the O-ring, see the "Fuel distributor" and "Line pressure regulator" sections.

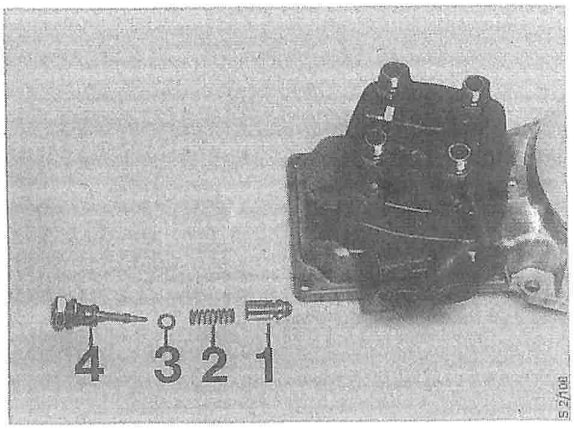
Adjusting the line pressure

After replacement of the O-ring in the line pressure regulator, the line pressure much be checked and adjusted, if necessary.

The pressure can be increased by fitting additional shims and decreased by removing shims. Shims are available in thicknesses of 0.1 and 0.5 mm. A 0.1 mm shim brings about a change in pressure of 0.15 bar (2.2 psi).

When measuring and adjusting the line pressure it is assumed that the fuel pump capacity is correct.

Tightening torque for the valve screw plug: 13-15 Nm (9.6- 11.1 lbf ft)



Line pressure regulator

1 Piston with O-ring
2 Spring
3 Shims
4 Screw plug with O-ring and sealing washer (contains a shut- off valve for the return fuel from the control pressure circuit)

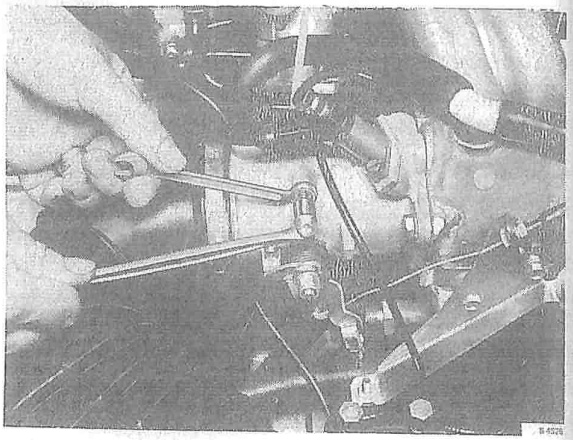
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Idling adjustment (engine speed and CO content)

Run the engine until it reaches normal operating temperature and then connect the CO meter and tachometer.

Setting idling speed

Adjust the idling speed by means of the adjusting screw for the by-pass passage in the throttle body.



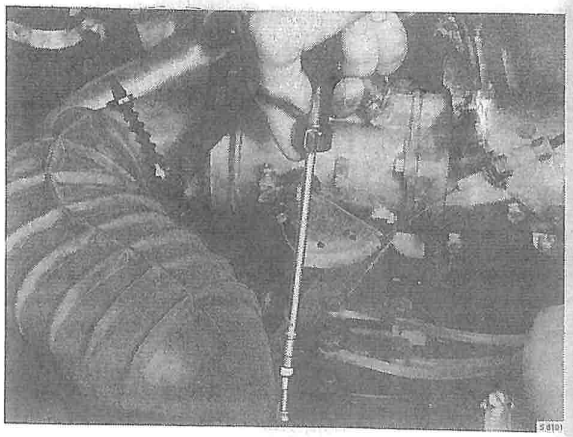
Note:

If rough idling or difficulty in reducing the idling speed is experienced, check the setting of the deceleration valve.

See section 254 in Service Manual 2:4.

Adjusting the CO content

The adjusting orifice in the fuel distributor is sealed by means of an anti-tamper plug which must be removed (and consequently destroyed) before adjustment can be carried out.
A suitable tool can be made by brazing a 5 mm (0.2 in) self- tapping screw onto a screwdriver. Grind a fine point on the screw and use the tool as an extractor.

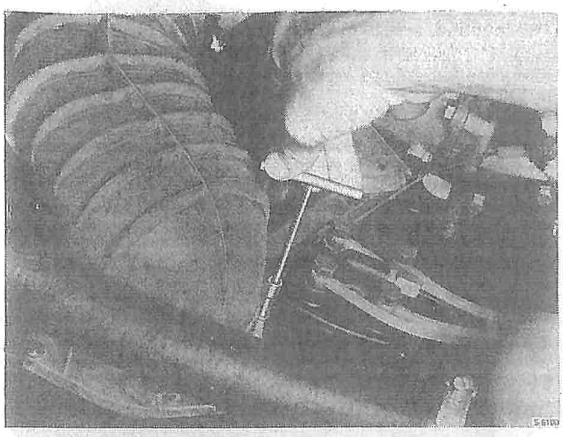


CAUTION

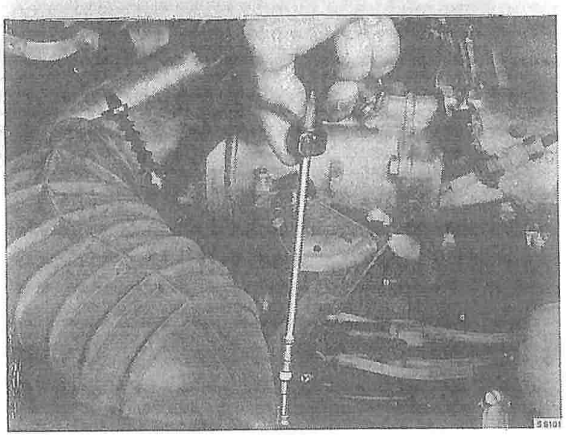
Remove the Allen key from the adjusting screw after each adjustment. If the key is left in place when the engine is revved up, the lever could be damaged.

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Turning clockwise—richer mixture
Turning anticlockwise—leaner mixture



After adjustment, seal the orifice by means of a new plug.

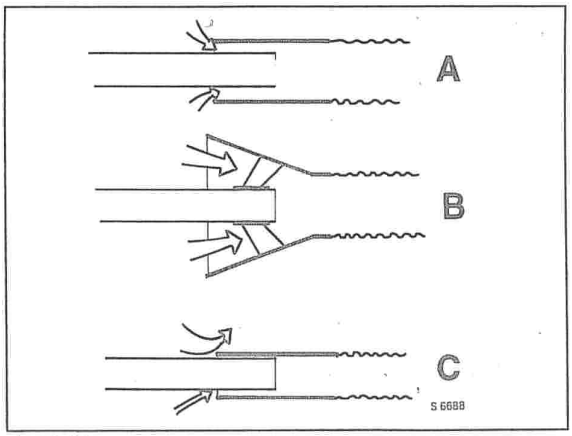


Connection of exhaust extraction equipment

When using exhaust extraction equipment in the workshop, avoid excessive depressurization of the car's exhaust system as this could affect the results of CO measurement.

If excessively powerful exhaust extraction equipment is connected to a Turbo car, oil may escape through the seals in the turbo unit.

This will result in the exhaust system becoming saturated with oil and blue smoke will be emitted in the exhaust for some considerable time afterwards. **To avoid excessively powerful exhaust extraction, connect an extract hose with an open coupling.**



A Right
B Right
C Wrong

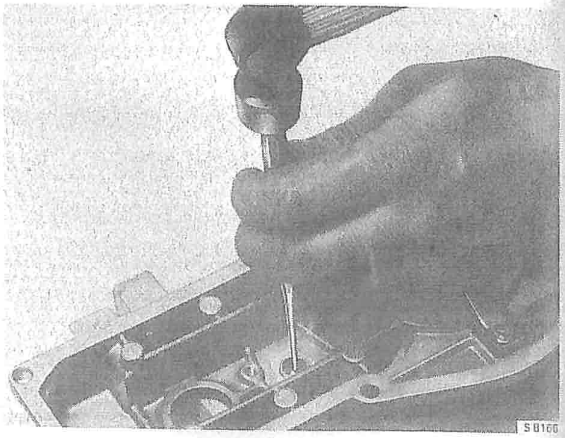
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Setting the fuel-air mixture, cars with a catalytic converter

General

The mass air flow sensor adjusting screw is sealed by a metal plug to prevent inadvertent alteration of the setting. The mixture screw is preset at the factory and should not normally require adjustment until a new mass air flow sensor has been fitted.

It may of course be necessary to reset the mixture in conjunction with repairing the mass air flow sensor or if the mixture is found to be incorrect during the course of fault diagnosis.



Setting a new mass air flow sensor

To gain access to the adjusting screw, remove the mass air flow sensor and sensor plate lever to enable the metal plug to be removed. See the relevant section under "Repairing the mass air flow sensor".

1 Warm up the engine to normal operating temperature and then connect the pulse ratio meter.

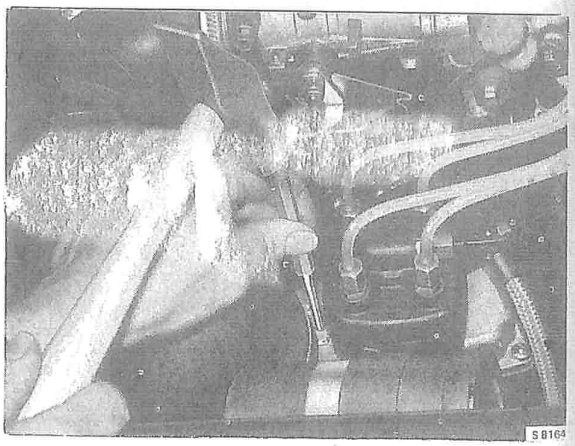
2 Adjust idling speed to 875 ± 75 rpm.

3 Set the specified pulse ratio by means of the mass air flow sensor's adjusting screw (use tool 83 92 482). Rev up the engine and allow the idling speed to stabilize before each reading of the pulse ratio meter.

The specified pulse ratio is given in the "Technical data" section



On completion, refit the metal plug in the mass air flow sensor using a punch to drive it home.



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Checking fuel enrichment Turbo, -1982 (not BPC)

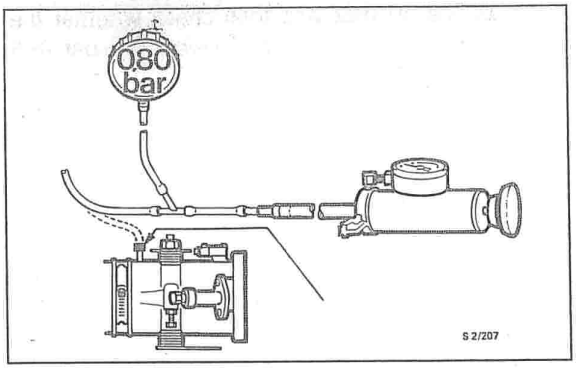
A Heavy load (not full throttle)

1 Run the engine at idling speed with the CO meter connected (engine at normal operating temperature)

2 Disconnect the pressure hose from the throttle body and connect gauge 83 93 514 (pressure gauge for checking charging pressure) and a cooling-system tester to the hose. Plug the end of the spigot on the throttle body.

3 Pump up the pressure to 0.8 bar (11.6 psi) (owing to the action of the delay valve, keep checking the reading on the gauge until the pressure has stabilized).

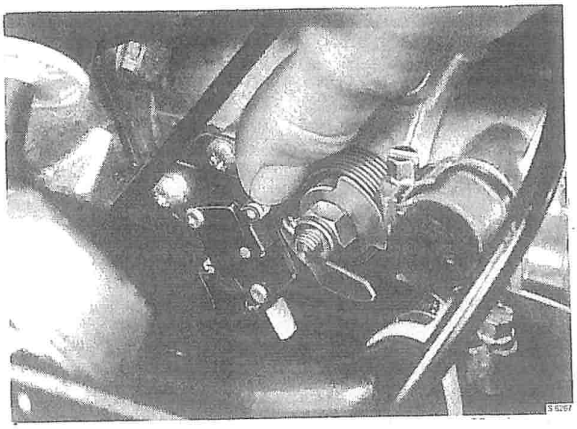
4 Check that the CO reading has risen to about 4-6%.



B Full throttle

5 Disconnect the pump and check to see whether the CO reading on the gauge returns to what it was before.

6 Push in the throttle position switch lever.



7 Check to see whether the CO reading increases to 4-6%.

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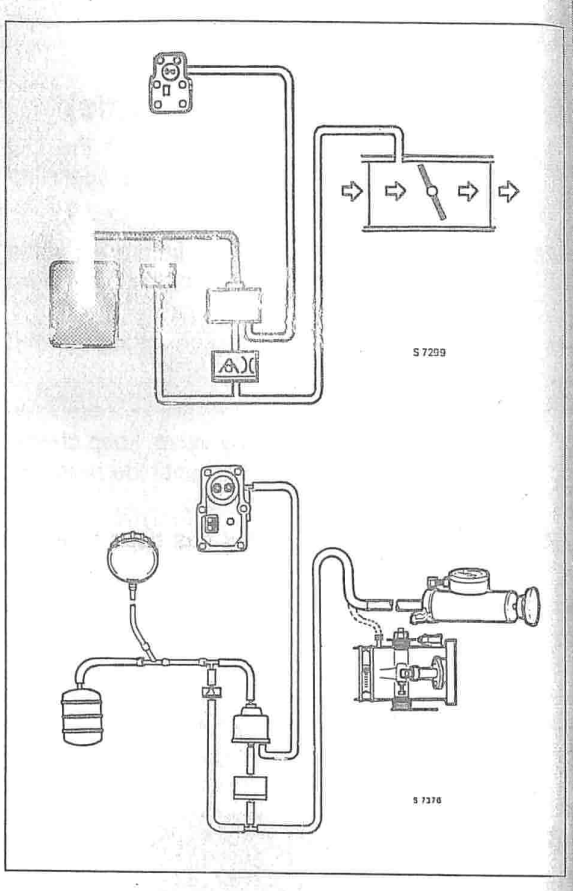
Checking the residual pressure

If acceleration enrichment is to be obtained during the initial phase of acceleration, the pressure vessel and its connections must be tightly sealed. In the event of extensive leakage, fuel enrichment will not take place until charging pressure has built up.

1 Connect pressure gauge 83 93 514 (for checking charging pressure) between the non-return valve and the pressure vessel.

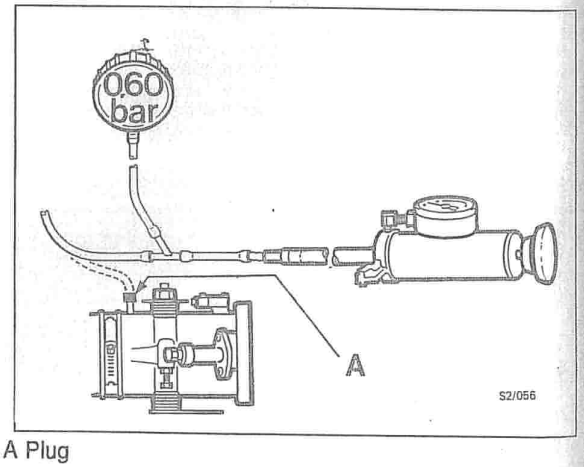
2 Connect a cooling system tester upstream of the non-return valve and pump up the pressure to 0.8 bar (11.6 psi).

3 Wait five minutes and then check whether the pressure has not dropped below 0.6 bar (8.6 psi).



Checking fuel enrichment, Turbo BPC (1982)

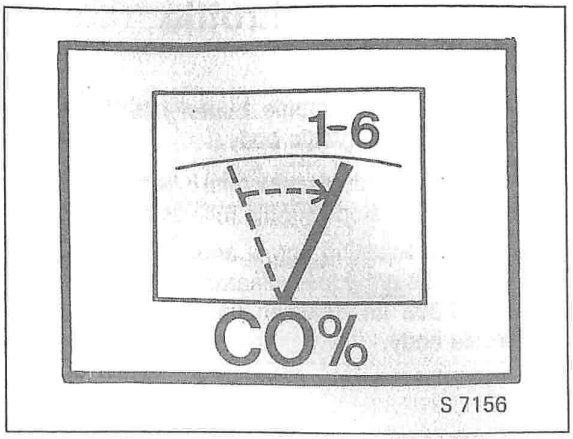
- Run the engine at idling speed with the CO meter connected (motor at normal operating temperature).
- Disconnect the pressure hose from the throttle body and connect gauge 83 93 514 (pressure gauge for checking charging pressure) and a cooling-system tester (air pump) to the hose. Plug the end of the spigot on the throttle body.
- Pump up the pressure to 0.6 bar (8.6 psi).



A Plug

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- Check that the CO content increases to about 1-6%.

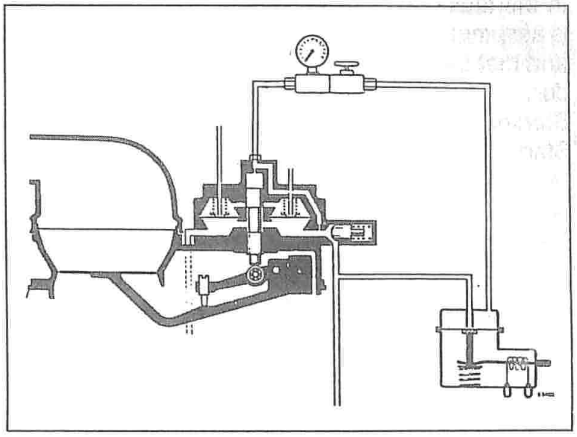


Checking the operation of the warm-up regulator

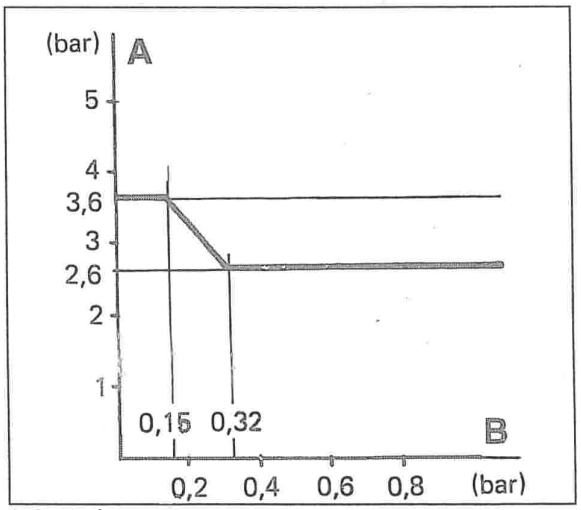
Connect pressure gauge 83 92 516 as follows:

Disconnect the control pressure line from the fuel distributor and connect the pressure gauge between the fuel distributor and the line running to the warm-up regulator.

- Disconnect the pressure hose from the throttle body and connect gauge 83 93 514 (pressure gauge for checking charging pressure) and a cooling-system tester (air pump) to the hose. Plug the end of the spigot on the throttle body.



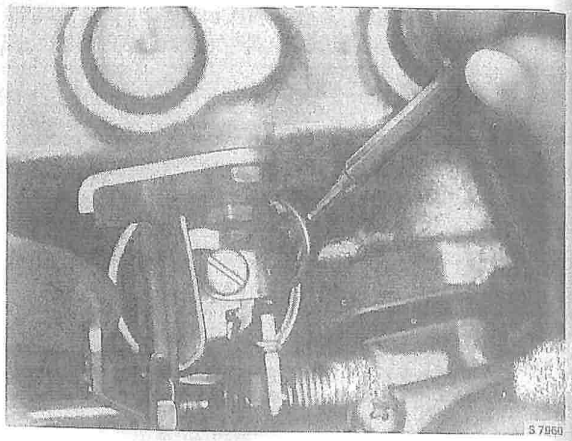
- Start the engine and run it until it reaches normal operating temperature.
- Pump up the pressure to 0.6 bar (8.6 psi).
- Check that the control pressure drops, see graph.



A Control pressure
B Boost pressure

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Adjusting the throttle butterfly stop



1 Check that the throttle butterfly is accurately centred in the throttle body.

2 Turn the adjusting screw until it just makes contact with the stop (throttle fully closed).

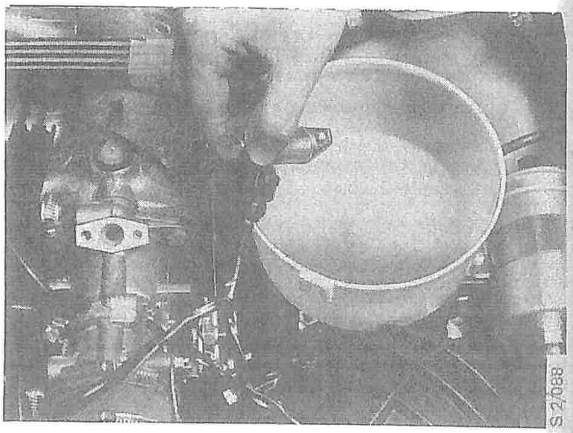
3 Turn the adjusting screw another 1/3 turn and lock it. This provides a clearance of approx. 0.05 mm (0.002 in) between the butterfly and the throttle body.

Fault diagnosis, CI system

In the fault diagnosis procedure described below it is assumed that the engine has no mechanical faults and that the ignition system is in proper working order.

Starting trouble: engine cold.....240-20
Starting trouble: engine hot 240-21
Poor running during warm-up period 240-23
Poor running, engine hot.....240-24
Poor performance, low top speed 240-25
Excessive fuel consumption 240-27
Erratic CO content and idling speed hard to adjust.....240-28

Starting trouble: engine cold



1 Check the operation of the cold-start valve. Remove the valve and place it in a receptacle. Fuel should spray out when the starter motor is turned on if engine temperature is below 45°C (118°F). Injection duration depends on the temperature.

In the event of a fault, check:

The cold-start valve

The thermostatic time switch

The electrical system

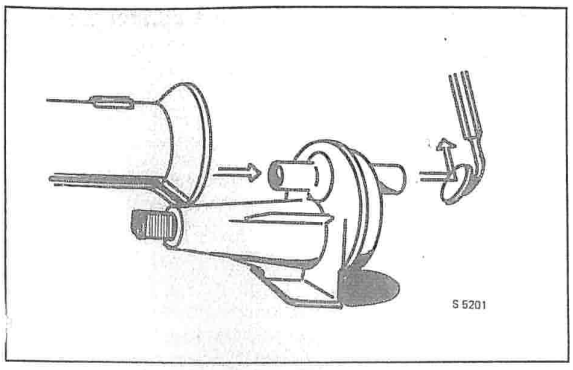
2 Measure the control pressure with the engine cold.

See the "Technical data" section for the correct pressure.

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3 Check that the auxiliary air valve is open when the engine is cold.

4 a Check the CO content (engine hot)



S 7060

b Check the pulse ratio, see the relevant section in Service Manual 2:4 (US specification).

5 Check for air leakage between the mass air flow sensor and the engine.

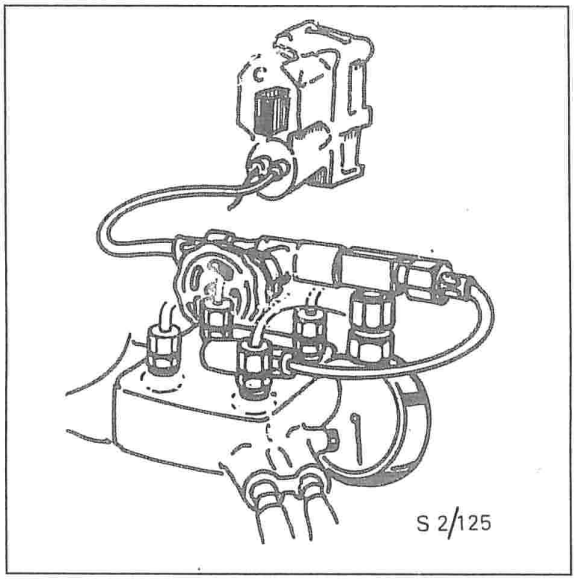
Starting trouble: engine hot

If the pressure in the injection lines drops too low while the engine is still hot, vapour locks will form in the system. This will give rise to starting trouble because the vapour locks are difficult to evacuate.

1 a First check whether the connections on the injectors and fuel injection lines are tight.

b Perform a leakage test.

First check with the pressure gauge valve open. If leakage is detected, perform the test with the valve closed (warm-up regulator disconnected).



S 2/088

Possible leakage points:

Fuel pump non-return valve

Line pressure valve O-ring

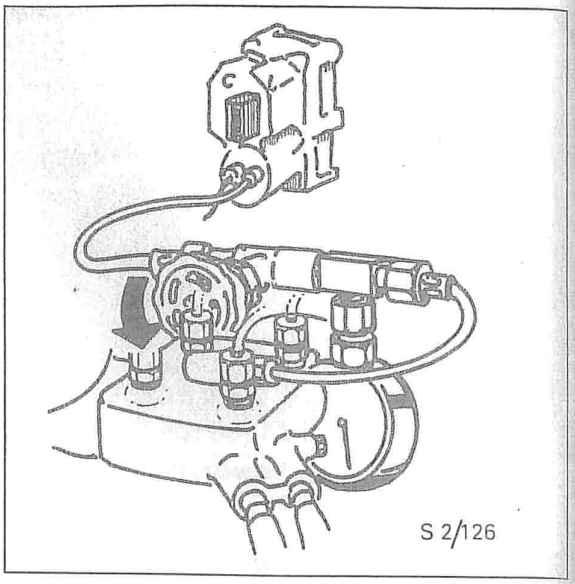
Cold-start valve

External leakage

Shut-off valve for return fuel from warm-up regulator

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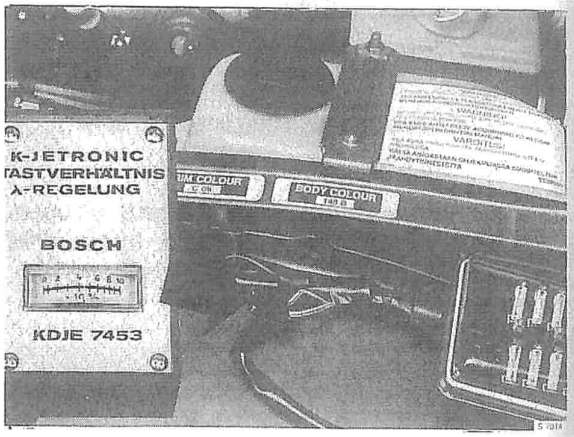
2 Open the valve and check the control pressure (engine hot).



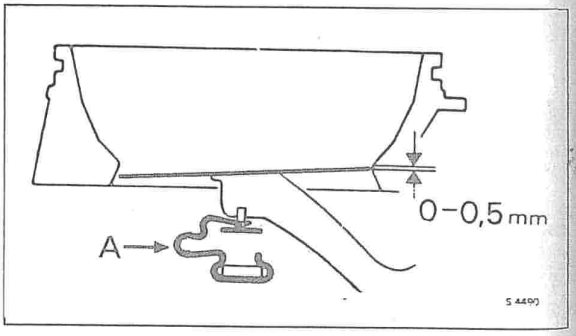
3 a Check the CO content (engine hot).

b Check the pulse ratio, see section 254, Service Manual 2:4 (US specification)

Check the hot-start relay, see "Cold-start valve - performance and sealing" on page 240-9.



4 Check the rest position of the mass air flow sensor plate in the mass air flow sensor. (The top of the sensor plate should be level with the lower edge of the air venturi or slightly below it, max. 0.5 mm.) Adjust by means of the spring slip (A).



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Poor running during the warm-up period

1 Check the control pressure with the engine cold.

Excessive control pressure during the warm-up period results in a fuel-air mixture that is too lean.

Measure the control pressure with the engine cold.

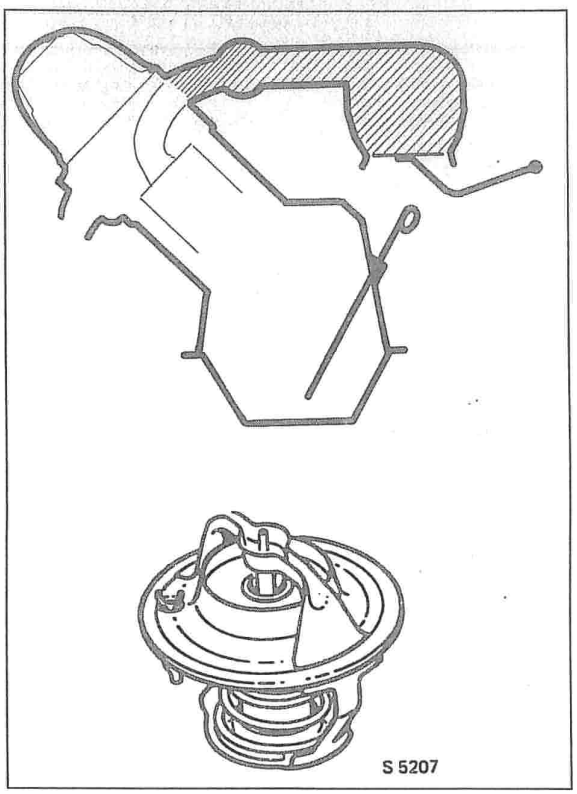
2 a Check the CO content (engine hot).

b Check the pulse ratio, see section 254 of Service Manual 2:4 (US specification).

Check the hot-start relay, see "Cold-start valve - performance and sealing" on page 240-9.

3 Check that no air leakage occurs between the mass air flow sensor and the engine.

4 Check that the engine warm-up period is normal. An abnormally long warm-up period may be due to a faulty thermostat.



5 Check the fuel enrichment system, see "Cold-start valve - performance and sealing" on page 240-9

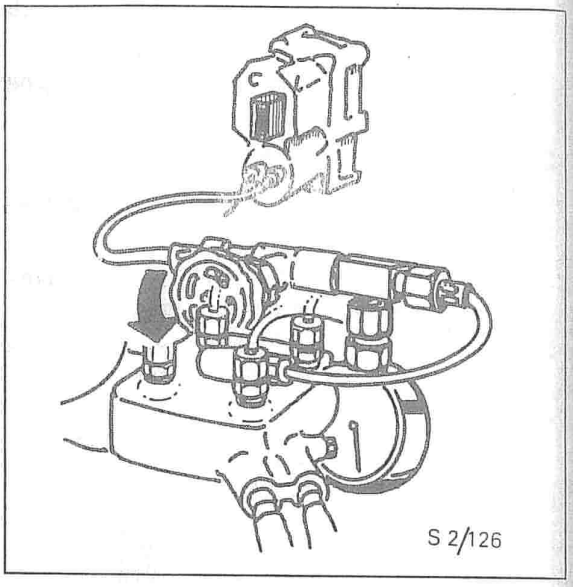
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Poor running, engine hot

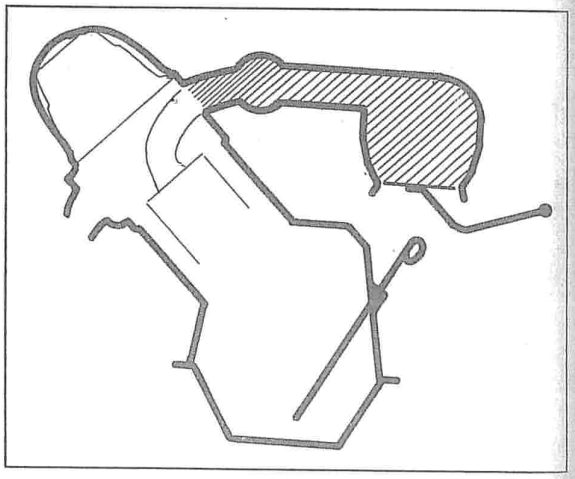
1 Check the CO content (engine hot).

2 Check the pulse ratio (engine hot), see section 254 of Service Manual 2:4 (US specification).

3 With the valve open, check the control pressure (engine hot).



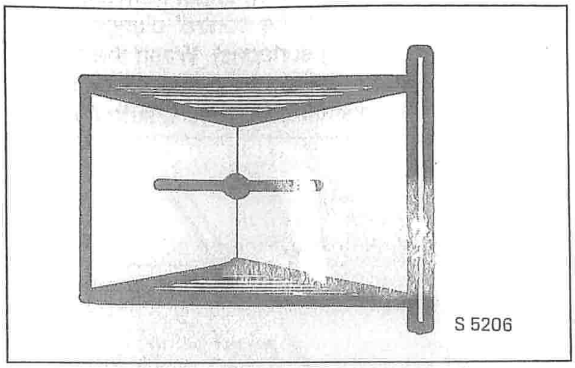
4 Check that no air leakage occurs between the mass air flow sensor and the engine.



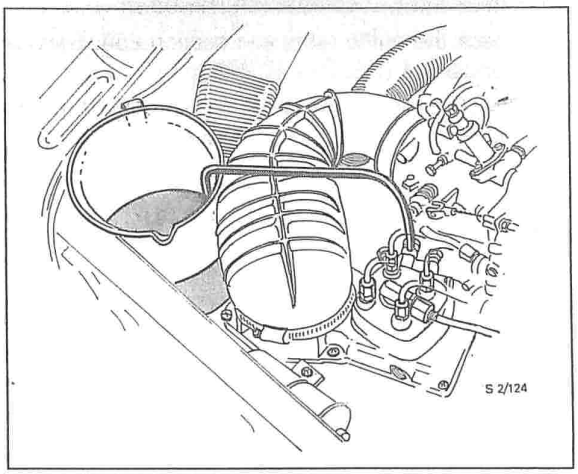
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Poor performance, low top speed

1 Check that the throttle butterfly opens fully when the accelerator is fully depressed.

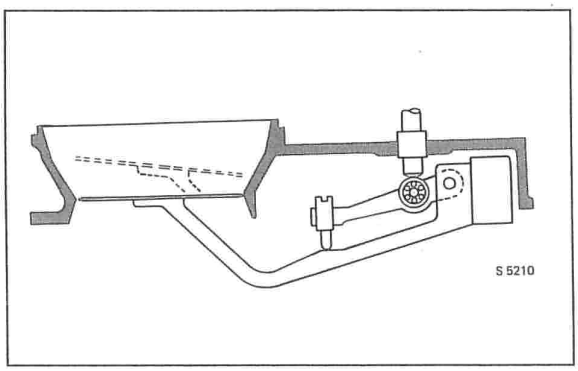


2 Check that the fuel flow rate is sufficient by measuring the quantity of return fuel obtained during a 30-second period. See "Fuel pump capacity", page 240-7.



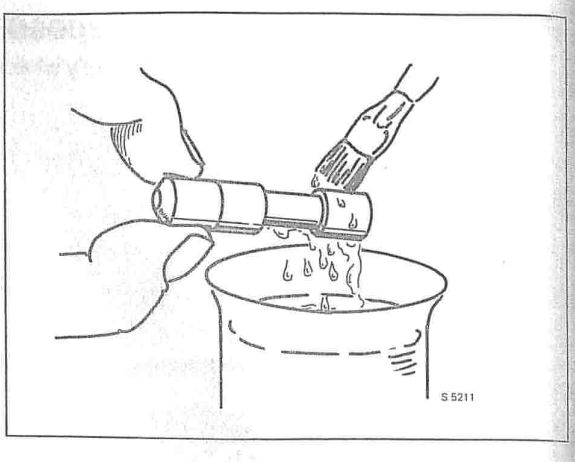
3 Check whether binding occurs in the mass air flow sensor as follows:

- Run the engine until it reaches normal operating temperature and then connect a CO meter.
- Switch off the engine and start it again without touching the accelerator. Read off the CO content.
- Rev up the engine to about 3000 rpm and then allow it to return to idling speed. If the CO content is now different to the earlier reading, then either the control plunger or the lever is sticking.
- Check that the lever moves freely.



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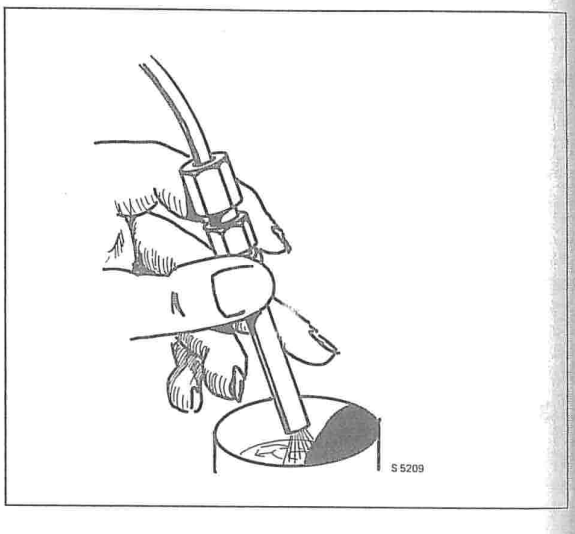
- If the control plunger is sticking, separate the fuel distributor from the mass air flow sensor, taking care to prevent the control plunger from falling out. Remove and inspect the control plunger (avoid touching the sealing surfaces). Wash the plunger in clean petrol, refit it and also refit the fuel distributor. Do not dismantle the fuel distributor more than this.



4 Check the CO content (engine hot).

5 Check the pulse ratio, see section 254, Service Manual 2:4 (US specification).

6 Check the fuel atomization of each injector. The deposits on the spark plugs can give an indication of poor atomization by any injector.



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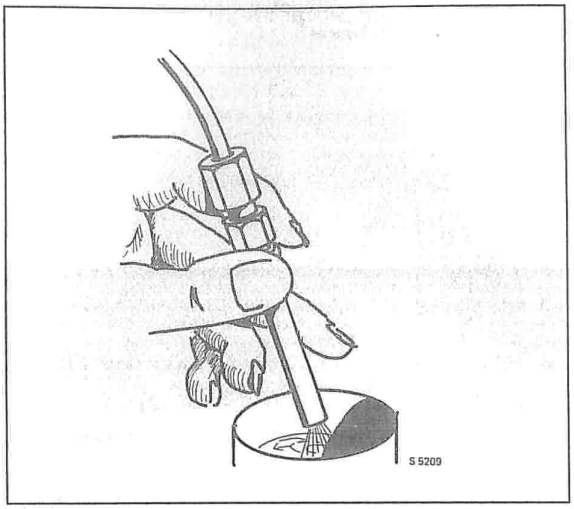
Excessive fuel consumption

1 Check the CO content (engine hot).

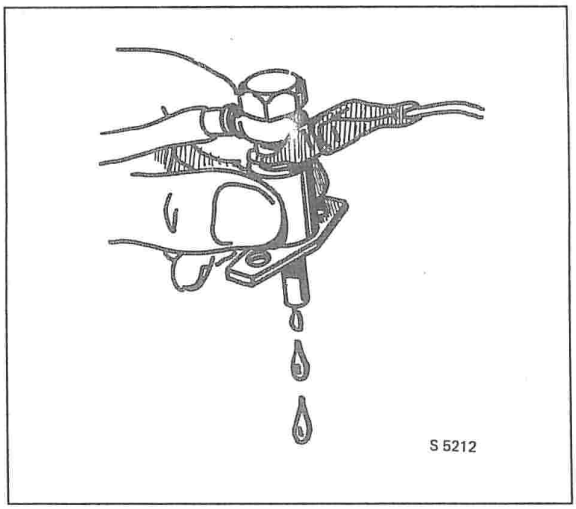
2 Check the pulse ratio (engine hot), see section 254, Service Manual 2:4 (US specification).

3 Check the control pressure with the engine hot. Insufficient control pressure results in a rich fuel-air mixture.

4 Check the fuel atomization of each injector. The deposits on the spark plugs can give an indication of poor atomization by any injector.



5 Check that the cold-start valve does not leak.

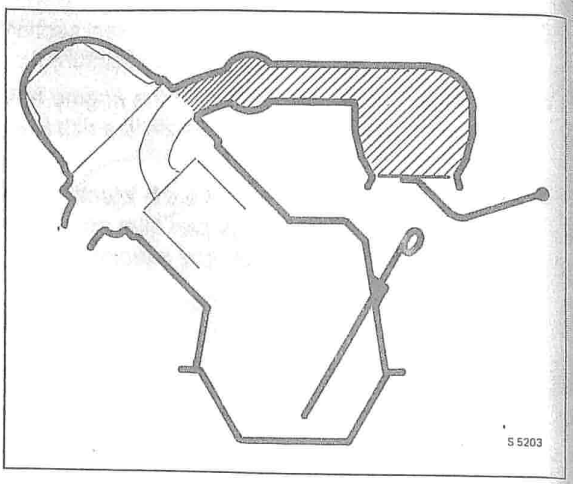


6 Check that there is no external leakage of fuel.

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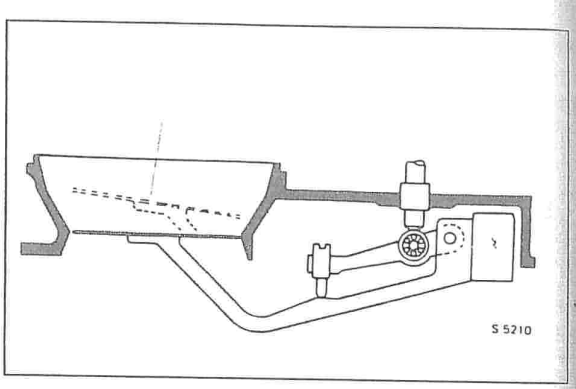
Erratic CO content and idling speed, hard to adjust

1 Check that no air leakage occurs between the mass air flow sensor and the engine.

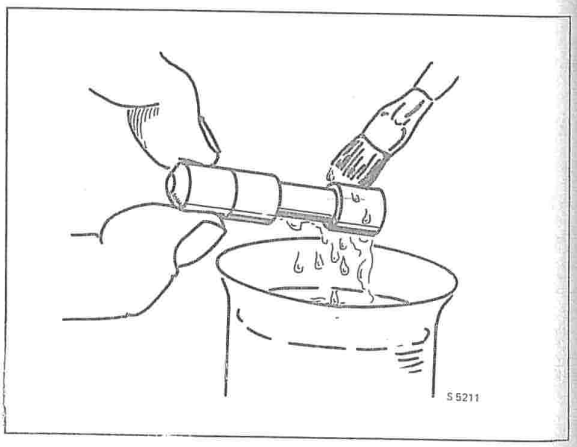


2 Check whether any parts of the mass air flow sensor are sticking, as follows:

- Run the engine to normal operating temperature and then connect a CO meter.
- Switch off the engine and start it again without touching the accelerator. Read off the CO content.
- Rev up the engine to about 3000 rpm and then allow it to return to idling speed. If the CO content is now different to the earlier reading, then either the control plunger or the lever is sticking.
- Check that the lever moves freely.

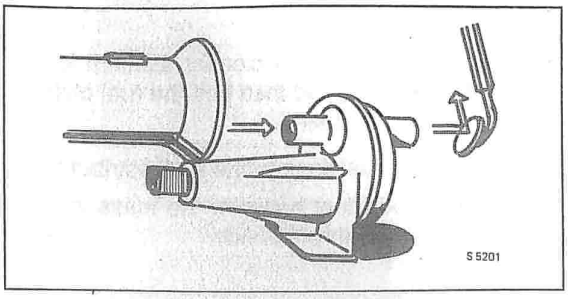


If the control plunger is sticking, separate the fuel distributor from the mass air flow sensor, taking care to prevent the control plunger from falling out. Remove and inspect the control plunger (avoid touching the sealing surfaces). Wash the plunger in clean petrol, refit it and also refit the fuel distributor. Do not dismantle the fuel distributor more than this.



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3 Check that the disc in the auxiliary air valve is not sticking.



Replacing the air cleaner filter element

1 Remove the rubber duct between the mass air flow sensor and the throttle body.

2 Remove the bolts securing the lower section of the mass air flow sensor to the air cleaner.

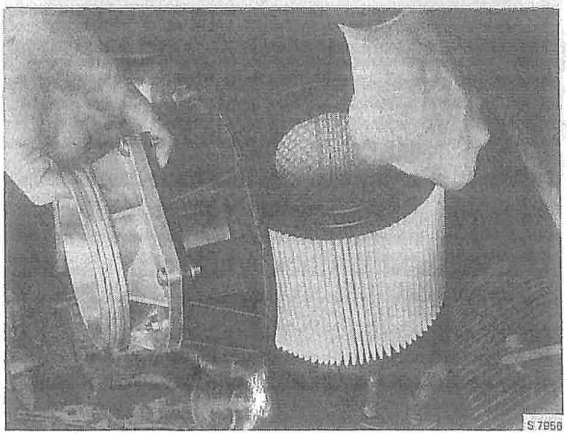
3 Raise the fuel distributor slightly and remove the filter. Take care not to damage the fuel lines.

4 Remove the filter element holder from the bottom of the air cleaner and clean the air cleaner casing.

5 Fit the cleaner element holder and the new element.

6 Bolt the mass air flow sensor to the air cleaner.

7 Fit the rubber duct between the mass air flow sensor and the throttle body.



Mixture control unit

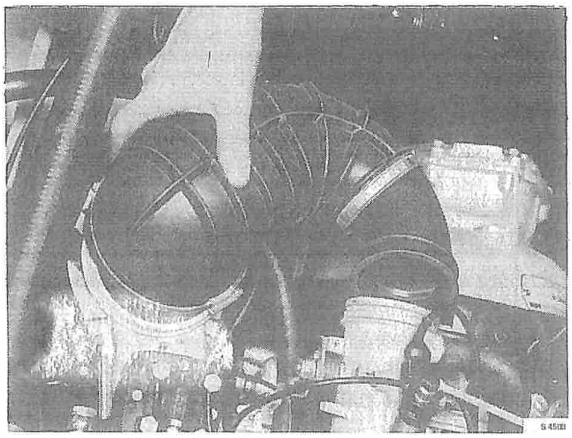
To remove

1 Thoroughly clean the area round the fuel connections on the fuel distributor.

2 Disconnect the fuel lines from the fuel distributor. Disconnect the lines to the injectors before disconnecting the control pressure line to avoid damaging adjacent lines when the control pressure line is removed.

3 Remove the rubber duct between the mass air flow sensor and the throttle body.

4 Undo the retaining bolts and remove the fuel distributor from the air cleaner.



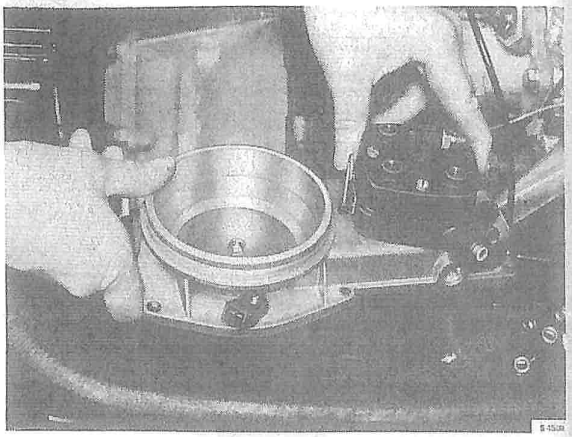
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To fit

1 Make sure that the air cleaner element is correctly positioned and then bolt the fuel distributor to the air cleaner.

2 Connect the fuel lines to the fuel distributor.

3 Fit the rubber duct between the mass air flow sensor and the throttle body.



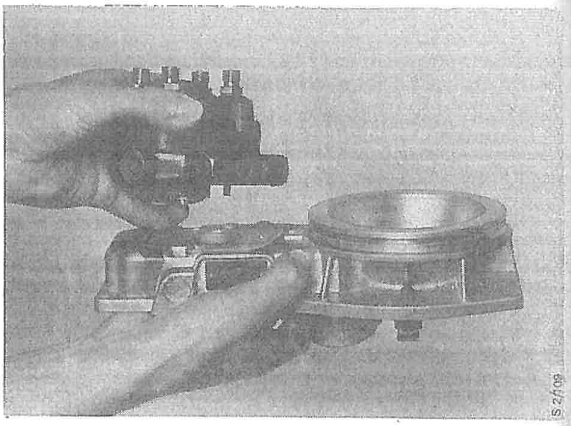
Fuel distributor

The fuel distributor must not be dismantled for repair but should be replaced if it is faulty.

When separating the fuel distributor from the mass air flow sensor, take care to prevent the control plunger from falling out.

If the control plunger has been removed, it must be cleaned thoroughly in petrol and reassembled. Avoid touching the plunger sealing surfaces.

When fitting the fuel distributor, make sure that the O-ring is located in its groove. Tighten the three retaining bolts to a torque of 3.2-3.8 Nm (2.4-2.8 lbf ft).



Line pressure regulator

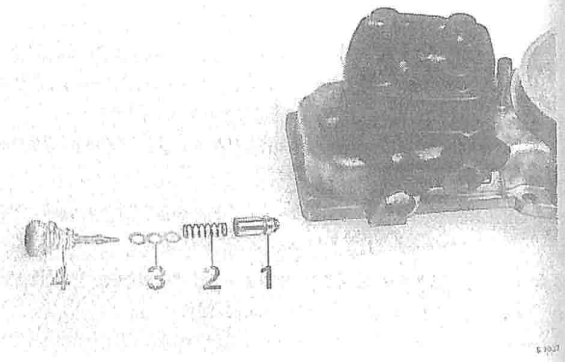
The line pressure regulator is located inside the screw plug by the return line and return connection from the warm-up regulator.
The regulator consists of:

1 Piston with O-ring

2 Spring

3 Shims

4 Screw plug with O-ring and washer. (The screw plug contains a shut-off valve which closes the return line from the warm-up regulator when the fuel pump is not operating. The socket head screw in the plug should not normally be removed.)



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Lever, adjustment arm and sensor plate

To remove

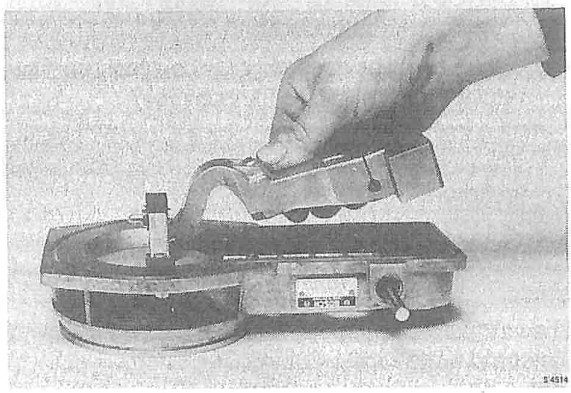
1 Remove the mixture control unit and unscrewthe plastic lower sectionand fuel distributor.

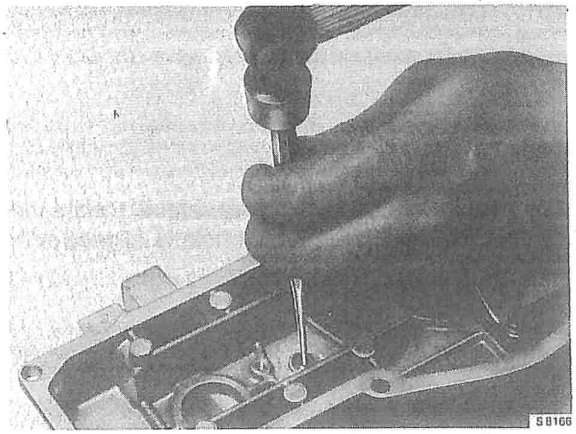
2 Undo the retaining screw and remove the sensor plate.

3 Remove the circlips from the lever pivot, followed by the shims, rubber seals, spring (one side) and balls.

4 Undo the counterweight retaining screw and press out the spindle.

5 Remove the lever, counterweight and adjustment arm.





6 Tap out the plug over the adjusting screw. The plug must be refitted when the fuel-air mixture has been set.

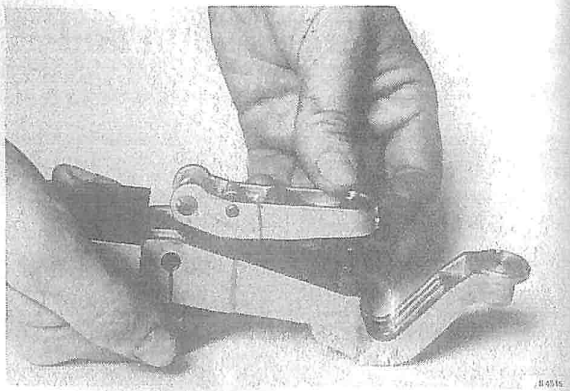
See "Setting the fuel-air mixture" on page 240-16.

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To fit

1 Place the counterweight on the lever but do not tighten the screw fully.

2 Place the adjustment arm in the lever so that the socket head of the adjusting screw is visible.



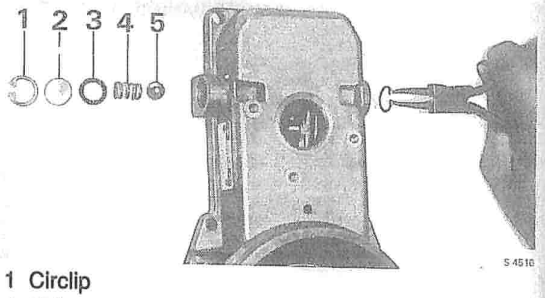
3 Pack both bearings with Bosch Ft2v2 silicon grease or the equivalent.

4 Place the lever assembly in the mass air flow sensor housing and fit the spindle.

5 Coat the balls with silicon grease and fit them in place, followed by the springs, seals, shims and circlips.

Note:

The circlips are stamped out and must be fitted with the sharp edge facing outwards.

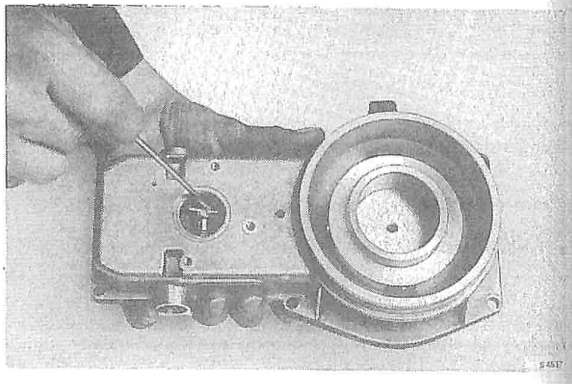


1 Circlip
2 Shim
3 Seal
4 Spring
5 Ball

6 Fit the sensor plate in the air venturi. Centre the lever so that the threaded hole is aligned with the hole in the sensor plate.

Tighten the counterweight screw.

Tightening torque: 4.7-5.2 Nm (3.5-3.8 lbf ft)



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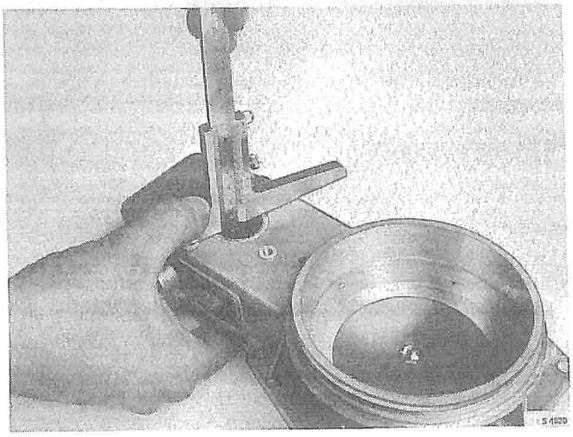
7 Fit the sensor plate retaining screw and tighten it. Check that the lever can move freely, completely without resistance.

Tightening torque: 5.0-5.5 Nm (3.7-4.1 lbf ft)



8 Adjust the rest position of the sensor plate by bending the spring clip on the stop bracket underneath the mass air flow sensor.

9 Preset the position of the adjustment arm. Using a depth gauge, measure the distance between the joint surface of the fuel distributor (across the screw holes) and the needle bearing roller. The distance should be 18-19 mm (0.71-0.75 in). Adjust by turning the mixture adjusting screw by means of an Allen key.



10 Fit the O-ring and the fuel distributor. Fit the lower plastic section of the mass air flow sensor together with the gasket.

Tightening torque, fuel distributor screws: 3.2-3.8 Nm (2.4- 2.8 lbf ft)

11 Fit the mixture control unit in the car. Carry out fine adjustment of the basic fuel flow by means of a CO meter after warming up the engine.

Fine-tune the fuel-air mixture and refit the plug over the adjusting screw in the mass air flow sensor.

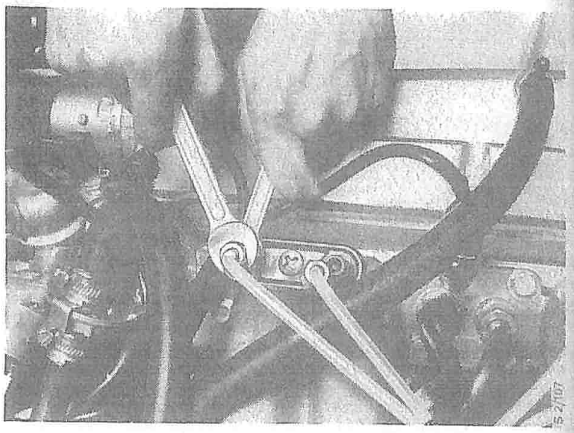
See "Setting the fuel-air mixture", page 240-16.

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Injectors - to replace

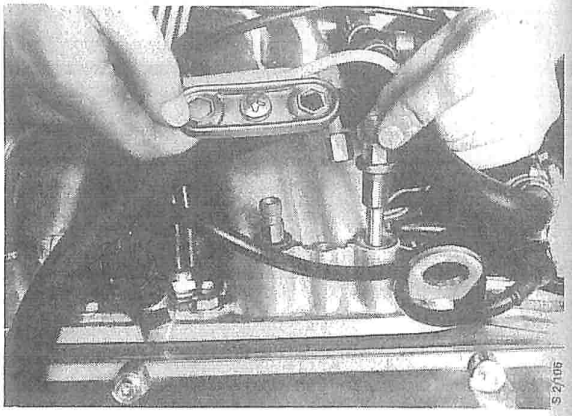
1 Clean the area round the injector and its connection.

2 Disconnect the fuel line from the injector. Prevent the injector from turning by holding it with a spanner.



3 Remove the retaining plate.

4 Withdraw the injector and pull off the rubber seal.



Fit in reverse order.

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Injectors - to clean

If an injector atomizes the fuel imperfectly or if it leaks under opening or closing pressure, the cause of this could be small particles of dirt having fastened in the valve seat. It is sometimes possible to remove such particles by forced flushing of the injector, asfollows:

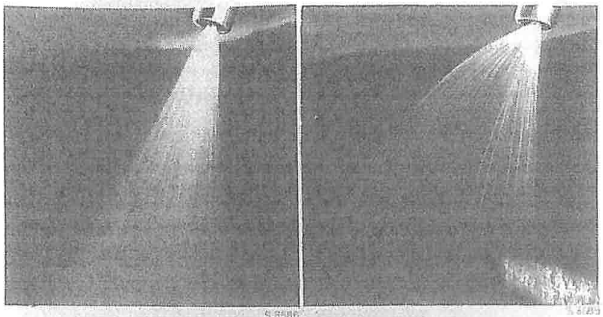
1 Disconnect the rubber duct from the mass air flow sensor.

2 Remove the injectors from the inlet manifold and place them in a suitable receptacle. Do not disconnect the fuel lines.

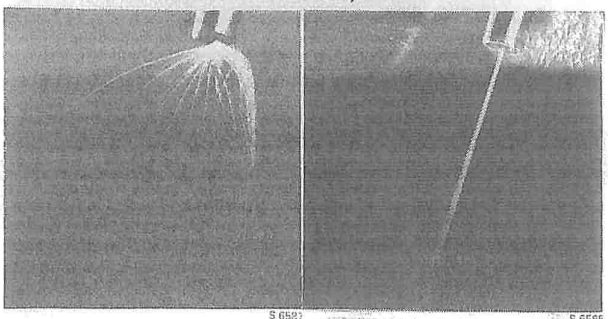
3 Remove the pump relay and connect a jumper cable across terminals 30 and 87 on the relay holder to supply power to the fuel pump.

4 Raise the mass air flow sensor lever a few times to its highest position. This will have the effect of force-flushing the injector.

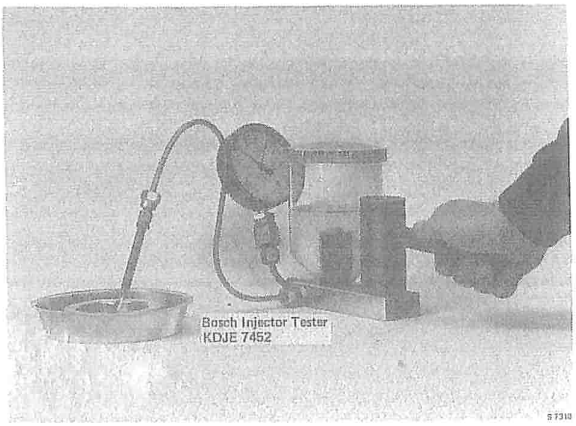
Injectors that have been removed from the engine can also be cleaned by means of an injector tester such as the Bosch KDJE P400 (KDJE 7452). Cleaning with compressed air is not recommended. If the fault persists, fit a new injector.



Perfect atomization *Acceptable atomization*



Examples of poor atomization



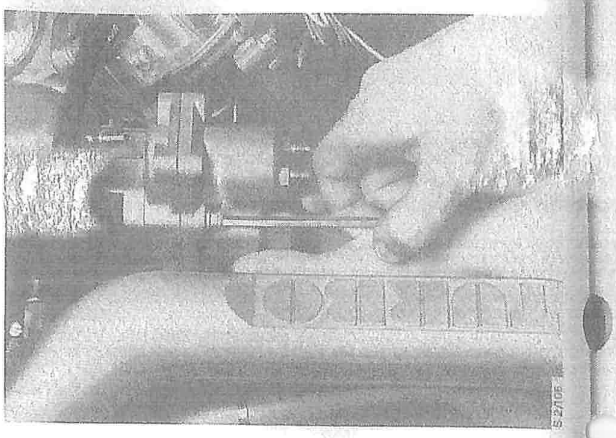
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Warm-up regulator - to replace

1 Clean the area round the warm-up regulator and its connections.

2 Disconnect the electrical leads and both fuel lines from the regulator.

3 Remove the regulator.

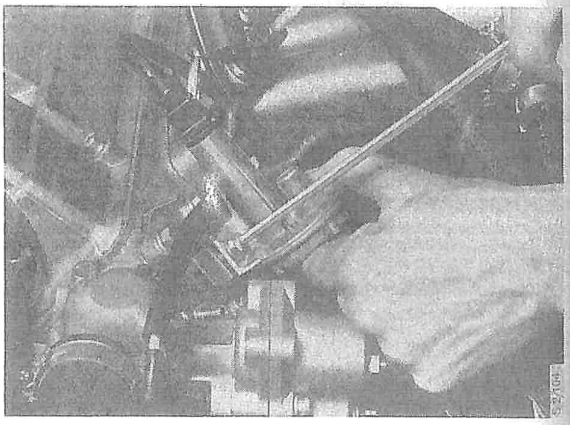


Fit in reverse order.

Auxiliary air valve - to replace

1 Pull off the hoses and unplug the electrical connector.

2 Unscrew the auxiliary air valve.



Fit in reverse order.

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Fuel accumulator

To remove

1 Clean the area round the fuel connections.

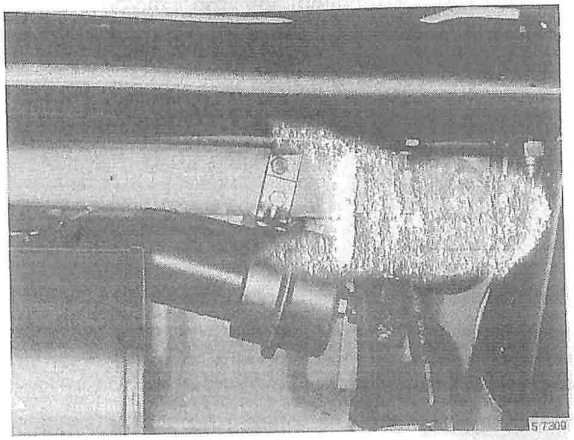
2 Undo the connections and remove the fuel accumulator.

To fit

1 Mount the fuel accumulator on the bracket.

2 Connect the fuel lines. The line from the fuel pump should be fitted to the connection nearest the edge of the fuel accumulator.

Position the fuel line from the pump so that it cannot chafe against the car body.



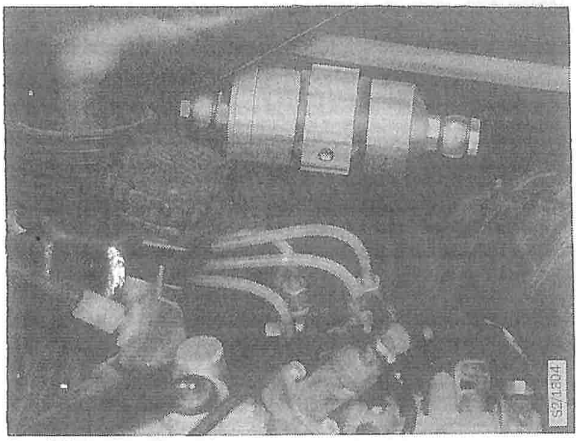
Fuel filter - to replace

1 Clean the area round the two connections.

2 Prevent the filter from turning by holding it with a spanner applied to the flats. Disconnect the fuel lines and remove the filer.

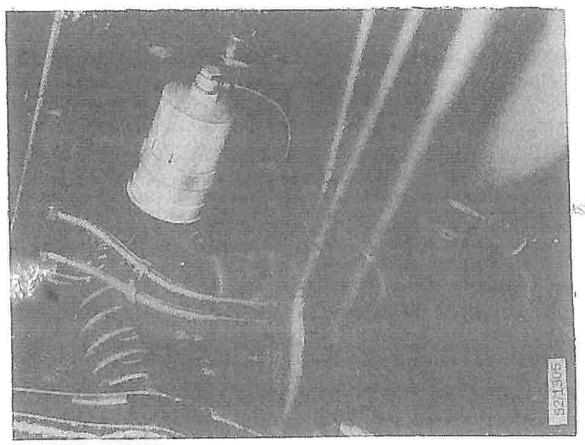
Note:

Avoid loosening the fitting on the outlet side to prevent aluminium swarf from the threads entering the system.



Fuel filter, B201 engine

3 Fit the new filter with the arrow pointing in the direction of flow and connect the fuel lines.



Fuel filter, B202 engine

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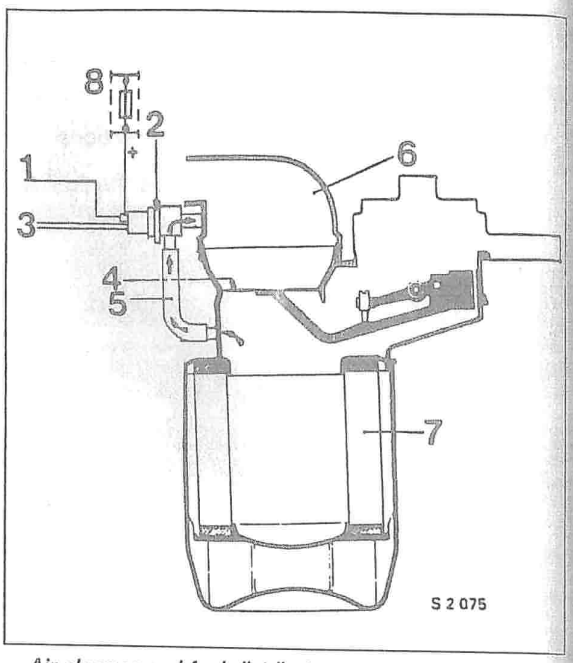
CI fuel injection systemλ, EU (US specification)

A general description of the oxygen-sensor (Lambda) system fitted to cars with a catalytic converter is given on page 200-16.

When reading the component descriptions and fault-diagnosis chart included in this section, refer at the same time to the corresponding wiring diagram in Service Manual 3:2.

Fuel shut-off on deceleration (1987)

Non-Turbo cars having a manual gearbox are fitted with a system which shuts off fuel injection during engine overrun. That is done to reduce fuel consumption and also the content of unburned hydrocarbons (HC) in the exhaust. The system consists of a vacuum valve and a deceleration relay.

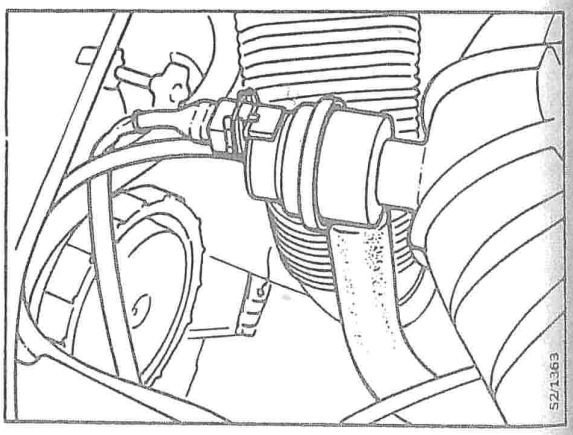


Air cleaner and fuel distributor

1 From deceleration relay
2 Vacuum valve
3 From inlet manifold
4 Sensor plate in rest position
5 By-pass line
6 Rubber duct
7 Filter
8 Fuse

Principle of operation

The deceleration system causes the induction air that normally passes the mass air flow sensor plate to by-pass the plate via a hose and vacuum valve. As a result, the sensor plate remains in its rest position and so shuts off the supply of fuel to the cylinders.



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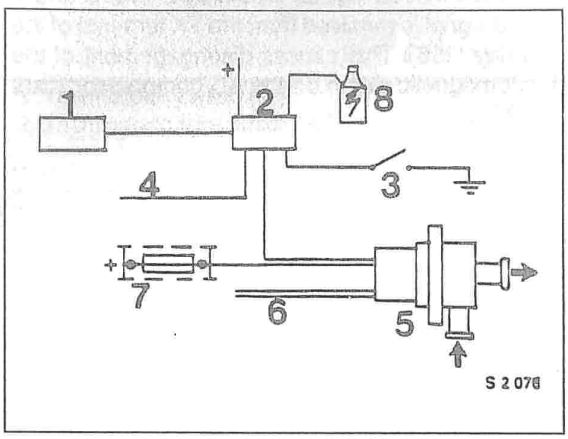
The vacuum valve acts as a by-pass when the deceleration system is engaged. When the relay is activated, the control module selects a fixed pulse ratio of 60%.

The deceleration relay is activated when:

- the thermostatic switch is closed (coolant temperature above 45°C)
- the time relay (P11) is not activated (relay in rest position)
- engine speed is higher than 1575 ± 175 rpm
- the throttle position switch is closed.

The deceleration system shuts off the supply of fuel as soon as the throttle position switch closes (foot off accelerator).

The supply of fuel is resumed once engine speed has dropped below 1375 ± 75 rpm.

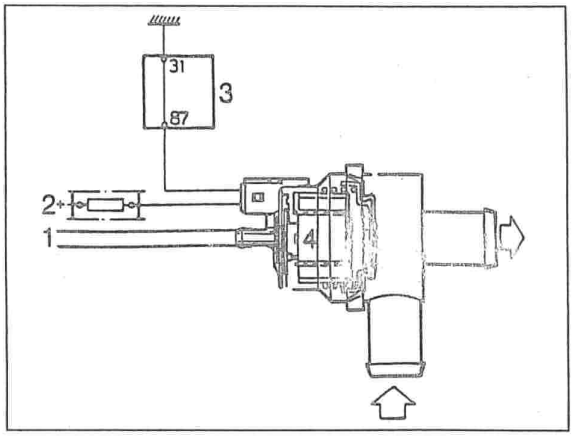


Fuel shut-off system, principle of operation

1 Time relay for acceleration enrichment
2 Deceleration relay (manual gearbox cars)
3 Throttle position sensor
4 Lambda control module
5 Vacuum valve
6 Hose from inlet manifold
7 Fuse
8 Ignition coil

Vacuum valve - principle of operation

When current flows through the vacuum valve solenoid (4) from the fuse board (2) via the deceleration relay (3) to ground, the pressure in the inlet manifold acts on the diaphragm in the valve, thus opening a by-pass port.



Vacuum valve

S2/1363

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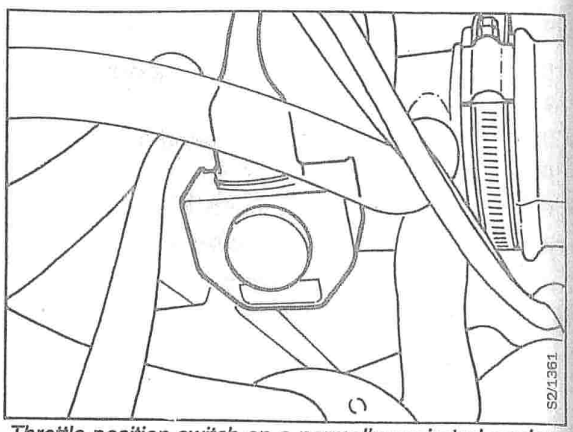
Throttle position switch, normally aspirated engines

Closing function

The throttle position switch is closed across terminals 1 and 2 only in the idling position.

As a result, terminal 30 of the deceleration relay and the TRK terminal of the time relay receive a ground signal (see the description of the relevant relay function for further details).

Once the throttle butterfly has opened beyond 72°, the switch closes across terminals 2 and 3 and a ground signal is received from the TK terminal of the AC relay (156). This causes disengagement of the electromagnetic clutch on the AC compressor (cars with AC).



Throttle position switch on a normally aspirated engine

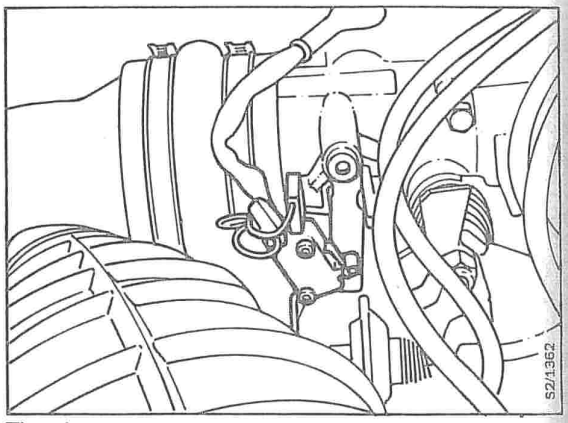
Throttle position switch (Turbo)

Dual function

The throttle position switch is closed across terminals 1 and 2 from the idling position until the butterfly opening angle is greater than 72°.

During this time, terminal 31A of the speed relay receives a ground signal (see the description of the TIP relay function for further details).

When the butterfly opening angle passes 72°, the throttle position switch changes over and a connection is made across terminals 2 and 3. As a result, a ground signal is received on terminal TK of the AC relay (156) (disengaging the electromagnetic clutch of the AC compressor), terminal 11 of the deceleration relay (106) and terminal 11 of the Lambda control module, which produces a pulse ratio of more than 92%.



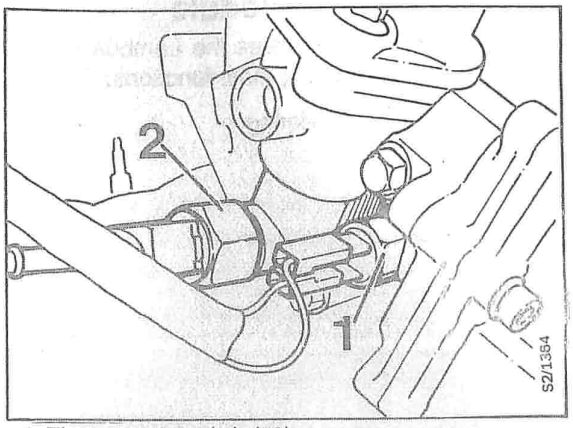
Throttle position switch on a Turbo engine

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Thermostatic switch 45/38°C and thermostatic time switch

The thermostatic switch closes at temperatures below 45°C (112°F). If the temperature has been higher than this, the switch will not close until the temperature has dropped to 38°C (100°F). The thermostatic switch is connected in series with the thermostatic time switch (92).

Consequently, no grounding is available for the cold-start valve or terminal TKK of the time relay (106) at temperatures above 45°C (112°F).



1 Thermostatic switch (99)
2 Thermostatic time switch (92)

Thermostatic switch 25/18

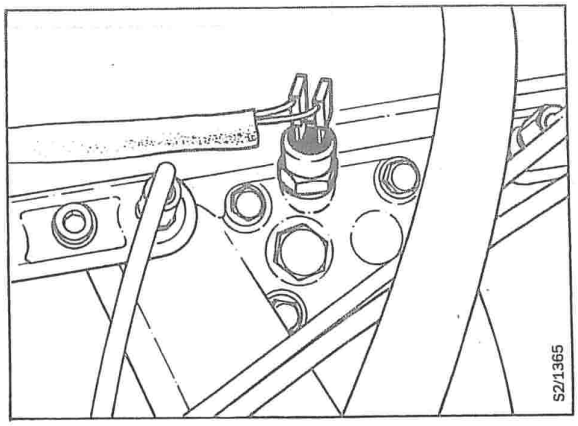
The thermostatic switch closes at temperature below 25°C (77°F). If the temperature has been higher than this, the switch will not close until the temperature has dropped to 19°C (66°F).

Normally aspirated engines

The switch is connected in parallel with terminal 12 of the Lambda control module via terminal X1 of the deceleration relay.

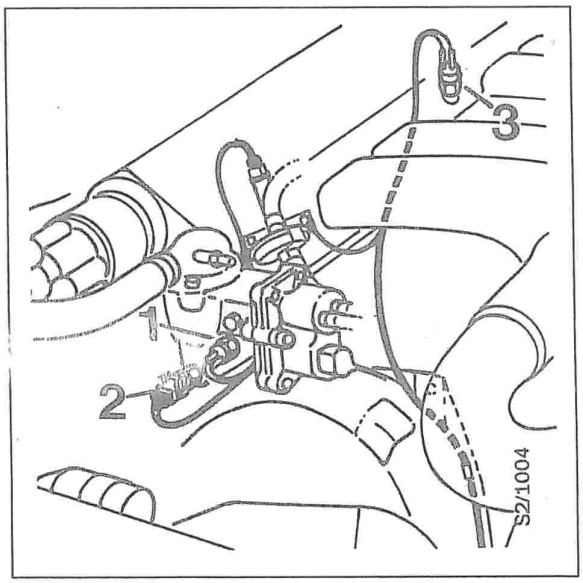
At temperatures below 25°C (77°F), an grounding signal is applied to terminal 12 of the Lambda control module and a pulse ratio of 60%is obtained (the same as during fuel shut- off via P12).

At temperatures above 25°C (77°F) the thermostatic switch is open and the preset pulse ratio is not selected.



Turbo engines

The function is the same except that the thermostatic switch is connected directly to terminal 12 of the Lambda control module. A fixed pulse ratio of 60%is obtained.



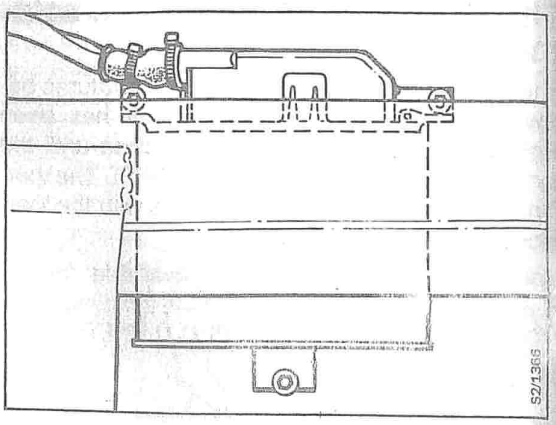
3 Thermostatic switch 97

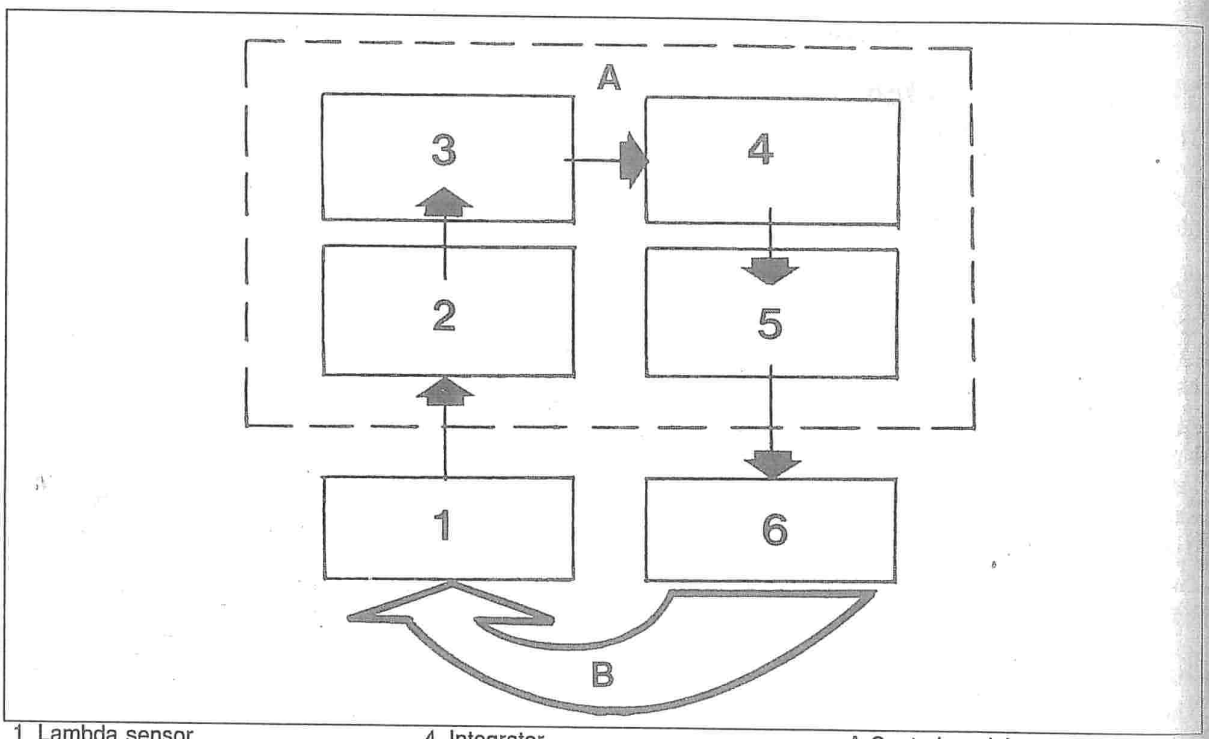
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Lambda control module

The control module regulates the Lambda system by means of the following main functions:

- Lambda sensor monitoring
- comparator
- integrator
- output stage





1 Lambda sensor
2 Lambda sensor monitoring
3 Comparator
4 Integrator
5 Output stage
6 Modulating valve
A Control module 135
B Exhaust gases

The monitoring function checks that the operation of the Lambda sensor and the regulating function of the modulating valve coincide within given parameters. If incorrect values are received or a malfunction is detected in the Lambda sensor, for instance, the regulating function is disabled and a fixed pulse ratio of 50% is selected for the modulating valve.
Different fixed pulse ratios can also be obtained by grounding certain terminals of the control module.
The control function of the comparator is governed by the relationship between the actual sensor voltage and the reference voltage programmed in the comparator.
If the fuel-air mixture is lean, the sensor voltage will be lower than the reference voltage and cause the opening duration of the modulating valve to increase, thereby enriching the mixture.
At a preprogrammed control speed, the integrator controls the signal voltage from the output stage to enrich or weaken the fuel-air mixture.
The control speed is optimized to provide the best possible conversion of the exhaust gases in the catalytic converter. The Lambda value is kept within extremely narrow limits and as close to λ as possible.

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Terminal pins - Lambda control module

Pin 2 Lambda sensor 136 signal. Green (GN).

Pin 4 Lambda sensor, screened. Braided.

Pin 15 Modulating valve 139. Pulsed ground connection, depending on pulse ratio. Violet (VL).

Pin 17 +12 V via fuse 8, main fuse box +54 supply. Brown/White (BR/VT).

Pin 8 +12 V when fuel pump relay 102 activated. Yellow/Red (GL/RD)

Pin 26 Internal jumper connection. Yellow (GL).

Pin 7 When grounded, fixed pulse ratio of 85%. Red/White (RD/VT).

Pin 12 When grounded, fixed pulse ratio of 60%. Yellow/Red (GL/RD).

Pin 11 When grounded, fixed pulse ratio above 92%. Red (RD).

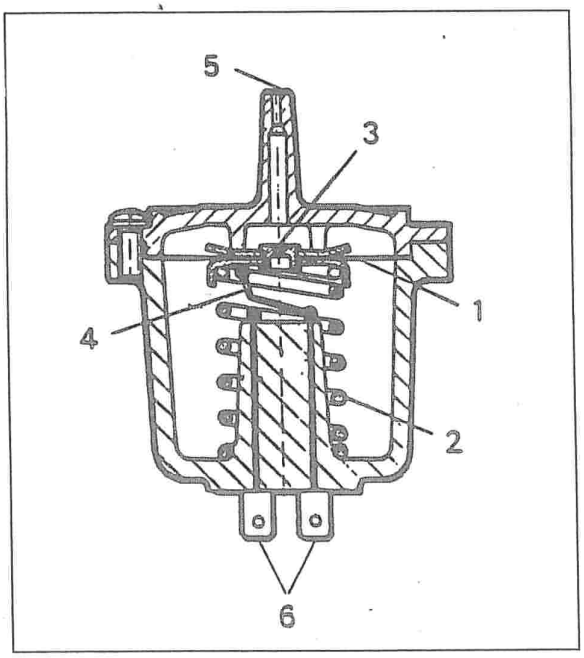
Pin 16 Grounding point. Black/White (SV/VT).

Pin 5 Grounding point. Brown (BR).

S2/1366

Fuel booster pressure switch

When the car is travelling at a constant speed, the negative pressure is the same on either side of the diaphragm. On acceleration, the negative pressure diminishes. The change in pressure will be delayed below the diaphragm on account of the constriction. The "absolute" pressure above the diaphragm then increases momentarily, forcing the diaphragm down and so activating the contact arm which closes the switch contacts.



1 Diaphragm
2 Spring
3 Constriction
4 Spring contact arm
5 Vacuum connection
6 Electrical terminals

tor
to

est
at-
nin
si-

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Time relay P11

Time function - 3 seconds

For a period of three seconds after starting, terminal 11 of the Lambda control module is grounded and a fixed pulse ratio of 92%is selected (starting enrichment).

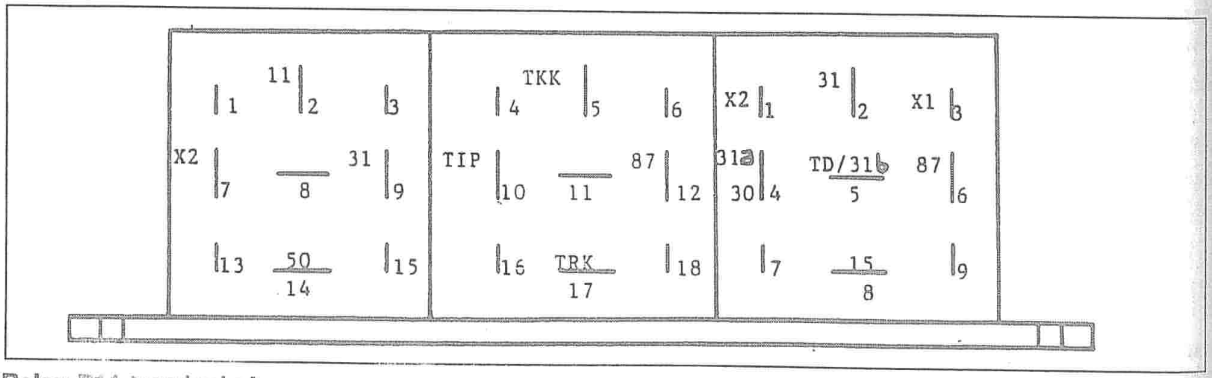
Time function - 140 ± 20 seconds

1 For a period of 140 seconds after starting, the fuel shut- off function during deceleration is disabled (no grounding via terminal X2 of the relay). This applies to non-Turbo cars with a manual gearbox only.

2 Cold engine (below 45°C)
Acceleration enrichment is available when the fuel booster pressure switch (79) has been activated via the cold-start valve (94), which is grounded via the thermostatic switch (97) and thermostatic time switch (92). A grounding signal is also applied to the TKK terminal of the relay at the same time

3 Hot engine (above 45°C)
Acceleration enrichment is available for 140 seconds if the fuel booster pressure switch (79) has been activated. There will be no grounding signal applied to the TKK terminal via the thermostatic switch (97) and the thermostatic time switch (92). Terminal TIP is activated and applies a grounding signal to terminal 11 of the Lambda control module, resulting in a pulse ratio of 92%being selected.

Deceleration relay (non-Turbo engine) | Time relay P11 | Speed relay, 4600 rpm (Turbo)



Relay P11 terminal pins

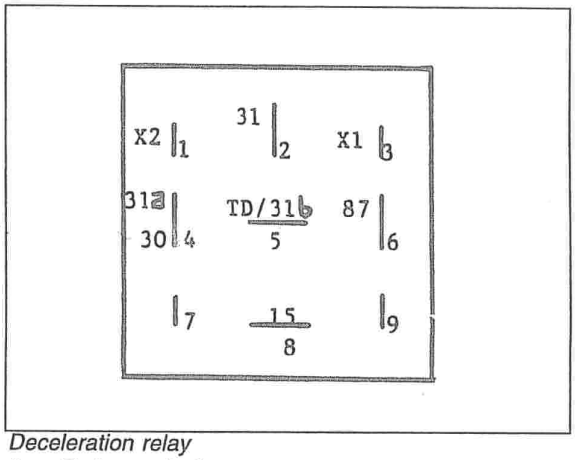
pin 87	+12 V supply when fuel pump relay 102 activated
pin TIP	+12 V supply +54 when vacuum switch activated
pin TKK	Ground via cold-start valve 94, thermostatic switch 97 and thermostatic time switch 92
pin 50	+12 V supply when starter motor engaged
pin 31	Ground
pin 11	Grounded when above functions activated (for 140 seconds only)
pin X2	Same as pin 11, not connected
pin TRK	Grounded via throttle position switch, not connected

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Deceleration relay, normally aspirated engines

The deceleration function shuts off the supply of fuel when the accelerator is released at engine speeds above 1575 rpm and at engine temperatures above 45°C or, alternatively, during a 140-second period after starting.

When the accelerator is released, grounding takes place via terminal 1 (idling position) of the throttle position sensor to terminal 30 of the deceleration relay (105), and a signal from terminal 87 is applied to the fuel shut-off valve (260). Further, a signal from terminal X1 is applied to terminal 12 of the Lambda sensor and a pulse ratio of 60%is then obtained (to compensate for the weaker mixture sensed by the Lambda sensor).



Deceleration relay (non-Turbo engine)

Terminal pins

pin 15	+12 V supply when fuel pump relay 102 activated.
pin TD	Ignition pulses from terminal TF-0 of ignition pulse amplifier 147.
pin 30	Grounding via terminals X2 and 31 of time relay 106.
pin 31	Ground.
pin X1	Grounds terminal 12 of the Lambda control module subject to the above functions having been activated, throttle position sensor 203 making contact between terminals 1 and 2, and engine speed having been higher than 1575 rpm. The function ceases to operate when engine speed drops below 1375 rpm.
pin 87	Grounding of fuel shut-off valve 260 via terminal X1.
pin X2	Grounding via terminals X2 and 11 of the time relay.

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Speed relay (speed-dependent enrichment, Turbo only)

Speed-dependent fuel enrichment takes place at engine speeds above 3800 rpm (model year 1987 and earlier) or above 4600 rpm (model year 1988 and later). Pulse ratio 85%or 92%.

At engine speeds above 3800 rpm (model year 1987 and earlier) or above 4600 rpm (model year 1988 and later) and before the throttle butterfly has passed the 72° position, a signal from terminal 1 of the throttle position switch is applied to terminal 31A of the speed relay (138). As a result, terminal 7 of the Lambda control module is grounded via terminal 87 of the relay and terminal 31 of the time relay (106), which gives a pulse ratio of 85%.

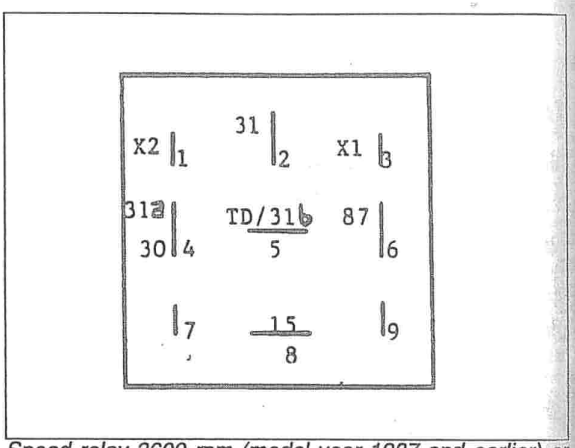
If the throttle butterfly passes the 72° position, the circuit to terminal 31A of the speed relay will be broken, terminal 11 of the Lambda control module will be grounded via terminal 3 of the throttle position switch (203), terminal TK of the AC relay (156) and terminal 11 of the time relay (106), which gives a pulse ratio of 92%.

Speed relay (138) terminal pins (Turbo only)

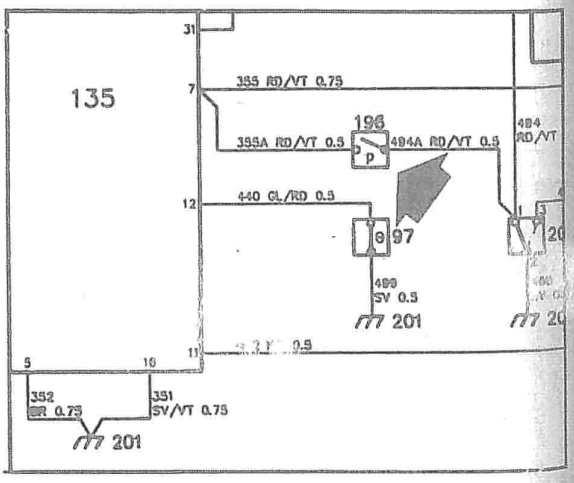
pin TD	Ignition pulses from terminal TD-0 of TD amplifier 147. TD-0
pin 15	+12V via +54
pin 31A	Ground via throttle position switch 203.
pin 87	Ground for terminal 7 of the Lambda control module via terminal 31 and ground of time relay 106.

Turbo cars, model year 1988 and later

Pressure-controlled full-load enrichment supplements speed- dependent full-load enrichment and also the enrichment that is controlled by the throttle butterfly via the throttle position switch.
A pressure switch connected in parallel with the speed relay senses the pressure in the inlet manifold. When the pressure is between 0.25 and 0.30 bar, the pressure switch grounds pin 7 of the control module and so causes full-load enrichment to take place (fixed pulse ratio 85%).



Speed relay 3600 rpm (model year 1987 and earlier) or above 4600 rpm (model year 1988 and later). Turbo engines only.



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Electrical system - principle of operation

CI system

When the ignition switch is turned to the Start position, the starter motor (4) and the thermostatic time switch (92) are supplied with current (+50 supply).

If the engine is cold (temperature below 45°C), the thermostatic time switch (92) will be closed. The cold-start valve (94), which is supplied with current from terminal 16 of the starter motor (4), is then grounded. This causes the valve to open and the engine receives extra fuel (for up to a maximum of nine seconds) while the starter motor is engaged.

When the ignition switch is in the Start/Drive position, the fuel pump relay receives current (+15 supply) via fuse 22. Relay 102 operates and the fuel pump (103), which receives current via fuse 30, starts to run. Current is also supplied to the heating coils in the auxiliary air valve (95) and the warm-up regulator (96).

The fuel pump relay and the Lambda system receive ignition pulses from the ignition pulse amplifier (147). If the engine stops, the pulses cease to be emitted, causing the relay to release and the supply of current for the fuel system components is cut off.

Lambda

The Lambda system itself incorporates a Lambda sensor (136) which continuously supplies the control module (135) with data on the oxygen content of the exhaust gases. On the basis of this data and the signals received from the Lambda system's various sensors and relays, the control module regulates the amount of fuel injected via the modulating valve (139). (The valve is controlled by grounding of terminal 15.)

The control unit (135) and relays 105 and 106 are supplied with current from terminal 87 of relay 102.

The time relay (106), which is supplied with control current (+50 supply) when the ignition switch (20) is in the Start position, is used during the starting phase. This relay increases the supply of fuel via the control module and the modulating valve (139).

The thermostatic switch (97) senses the engine temperature and opens when the temperature is above +25°C, thus breaking the circuit to the cold-start valve (94).

The fuel booster pressure switch (79) is used to control fuel enrichment during acceleration. When the engine is cold, the switch opens the cold-start valve (94). When the engine is hot, a signal goes instead to the time relay (106), which increases the supply of fuel via terminal 11 of the control module (active for a maximum of 140 ± 20 seconds after starting).

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The speed relay (105) is used in conjunction with the solenoid valve (260) and throttle position switch (203) to shut off the fuel during engine overrun. When the accelerator is released, the throttle position switch grounds relay 105. This function is also operative if engine speed exceeds approx. 1375 rpm. Note that this relay is fitted only on cars with a manual gearbox.

The thermostatic switch (99) opens at +45°C and closes at +38°C. One of the purposes of this switch is to improve the fuel enrichment function.

Socket 120 is provided for the connection a special measuring instrument and is used in connection with setting the pulse ratio. The socket is live when the ignition switch is in the Drive position.

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Component locations

The component locations are the same for 8-valve engines with CI fuel injection and the Lambda system (EU), fuel injection engines and Turbo engines.

For further details of component locations, see Service Manual 3:2.

4 Starter motor on LH (induction) side of engine
7 Grounding point on radiator member
9 Grounding point in luggage compartment
20 Ignition switch on centre console between front seats
22A Fuse holder in main fuse box in engine bay on LH wheel arch
59 Two-pin connectors
one in main fuse box in engine bay on LH wheel arch, one in luggage compartment adjacent to fuel pumps
one socket (120) in engine bay on LH wheel arch
60 Single-pin connectors
one in main fuse box in engine bay on LH wheel arch
one in engine bay on RH wheel arch
77 Starter interlock switch (automatic transmission) under centre console adjacent to selector lever
79 Fuel booster pressure switch in engine bay on inside of LH tie-plate adjacent to fuel filter
92 Thermostatic time switch on coolant thermostat housing
94 Cold-start valve above throttle body
95 Auxiliary air valve adjacent to thermostat housing at front of engine
96 Warm-up regulator on thermostat housing at front of engine
97 Thermostatic switch, 45°C (Lambda), on inlet manifold
99 Thermostatic switch, 25°C (Lambda), on thermostat housing
100 Diode (Lambda), adjacent to deceleration relay 105 and time relay 106
102 Fuel pump relay in main fuse box in engine bay on LH wheel arch
103 Fuel pump in fuel tank under luggage compartment floor
105 Deceleration relay, injection engines only, behind trim forward of RH front door
106 Time relay behind trim forward of RH front door
135 Control module (Lambda) on RH side under rear seat
136 Lambda sensor on exhaust manifold
138 Speed relay (manual gearbox Turbo cars only) behind trim forward of RH front door
139 Modulating valve (Lambda) in engine bay on inside of LH tie plate
144 Pressure switch under dash to left of steering wheel behind knee shield (behind flasher relay holder)
147 Ignition pulse amplifier in main fuse box in engine bay on LH wheel arch
152A 29-pin connector (white)
152C 29-pin connector (black) in main fuse box in engine bay
156 AC compressor relay in main fuse box in engine bay on LH wheel arch
158 Distribution terminal block, negative
159 Distribution terminal block, positive 15, in main fuse box in engine bay on LH wheel arch
201 Grounding point, engine
203 Throttle position switch on throttle body
260 Fuel shut-off solenoid valve (Lambda) on rubber duct above air cleaner

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Checking

General

1 Connect pulse meter 83 93 597.

2 Turn the ignition key to the Drive position. The pulse meter should indicate 100%. The modulating valve and fuel pump should start and run for a short time.

3 Start the engine.

a) Cold engine (below 19°C):
The pulse meter first indicates 0%, then 90%and after three seconds **a steady pulse ratio of** 60%.

b) Hot engine:
The pulse meter first indicates 0%, then 90%and after three seconds **a fluctuating pulse ratio** of around 50%.

4 Checking full-load enrichment (Turbo)

a) Rev up the engine to more than 3850 rpm. The pulse meter should indicate 85%.

b) Actuate (close) the throttle position switch. The pulse meter should indicate 92%.

Checking the Lambda system

1 Connect pulse meter 83 93 597.

2 Run the engine at idling speed.

3 Unplug the Lambda sensor connector from the main wiring harness (located on the RH inner wheel arch in the engine bay).

4 Ground the signal lead to the control module. The pulse meter should now indicate 92%.

5 Hold the signal lead in your left hand and grip the positive battery terminal with your right hand. The pulse meter should now drop to a reading of 0%.

Checking the Lambda sensor's signal level

Connect a multimeter between the Lambda sensor's signal lead and ground. If the Lambda sensor is OK, a reading of between 0.1 and 1.0 V should be obtained on the meter, depending on the temperature and oxygen content of the exhaust.

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Fault diagnosis chart, CI systemλ(EU)

Fault symptoms

1 Starting difficulty (engine cold): see checking/ fault diagnosis

"A Starting with cold engine, below 45°C".

2 Erratic idling/poor response during the warm-up period: see checking/fault diagnosis "D Enrichment during the warm-up period, below 45°C".

3 Poor acceleration in first few minutes after starting/backfiring in inlet manifold: see checking/fault diagnosis "C Enrichment via the cold-start valve, below 45°C".

4 Stalling on overrun: see checking/fault diagnosis

F "Deceleration function".

5 Fuel starvation/backfiring above 3800 rpm— or at full throttle: see checking/fault diagnosis

"G Enrichment at engine speeds above 3800 rpm".

A Starting with cold engine, below 45°C

Enrichment via cold-start valve:

When the starter motor is engaged, fuel enrichment is provided by the cold-start valve which injects additional fuel. The cold-start valve is controlled by the thermostatic time switch (92) and the thermostatic switch (97). Maximum injection time is 9.5 seconds at -20°C (-4°F).

Checking

1 Connect a test lamps between the cold-start valve's brown (BR) lead and ground. The lamp should light up when the starter motor is engaged.

2 Remove the fuel pump relay (102). Connect the test lamp between +12 V and the cold-start valve's (94) green (GN) lead. The lamp should light up.

Note:

The thermostatic switch (97) must be closed (temperature below 38°C).

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3 Connect the test lamp between +12 V and the green (GN) lead of the thermostatic time switch (92).

Note:

The connector must be plugged in during this test.

If the engine temperature is below 45°C (113°F) the lamp should be on. When the starter motor is engaged, the lamp should go out for a few seconds. This indicates that the thermostatic time switch has interrupted the ground circuit and is thus working properly.

4 To check the operation of the cold-start valve, see Service Manual 2:3, section 240.

B Fuel enrichment via the cold-start valve and control module (92%pulse ratio)

Mode of operation

The cold-start valve continues to inject fuel as long as the starter motor is engaged. At the same time, a signal is applied to time relay P11 (106) which grounds terminal 11 of the control module (135). The control module adjusts the frequency of the modulating valve to a steady pulse ratio of more than 92%(fully open). This function remains in operation for three seconds.

Checking

1 Connect pulse meter 83 93 597 to the test socket. Remove the ignition switch relays (E) from the main fuse box and connect a jumper lead between pins 3 and 4.

2 When the starter motor is engaged the pulse ratio should be 92 ± 10%.

3 After three seconds the pulse ratio should change to 60%(cold engine, temperature below 25°C) or 50%(engine temperature above 25°C).

Fault diagnosis (Electrical testing)

1 Remove time relay P11 (106) and connect one lead of a test lamp to +12 V.

2 Normally aspirated engine:

a) Connect the other test lamp lead to pin 31. The lamp should light up (connection to ground).

b) Connect the other test lamp lead to the TRK pin. The lamp should light up only when the throttle butterfly is fully closed.

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3 Connect one of the test lamp leads to ground (-).

a) Connect the other test lamp lead to pin 50. The lamp should light up when the starter motor is engaged (Turbo).

b) Connect the other test lamp lead to the TIP pin. The test lamp should light up briefly when the fuel booster pressure switch (79) closes and then opens again. Connect a vacuum pump to the fuel booster pressure switch (79), switch on the ignition and raise a vacuum. When the vacuum is eliminated, the fuel booster pressure switch closes briefly, during which period the test lamp should light up.

c) Connect the other test lamp lead to pin 87. The test lamp should light up when the engine is running.

d) Connect a jumper lead between pin 11 and ground. With the engine idling, the pulse ratio should be 92 ± 10%.

4 Use a multimeter to check for circuit continuity between:

a) Pin X2 of time relay P11 (106) and pin X2 of the deceleration relay (105) (not on cars with automatic transmission).

b) The TKK pin on time relay P11 (106) and the 45° thermostatic switch (97) and between the thermostatic switch 45° (97) and the thermostatic time switch (92).

C Fuel enrichment via the cold-start valve (engine temperature below 45°C)

Normally aspirated engine:
The fuel enrichment system improves engine performance immediately after starting. The system is controlled by vacuum, temperature and time.

Mode of operation

Fuel enrichment is effected by the cold-start valve (94) and controlled by a 45°C thermostatic switch (97), a thermostatic time switch (92) and a pressure switch (79).

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Checking

1 Connect a test lamp to the brown (BR) lead of the cold-start valve (94) and ground and connect pulse meter 83 93 597. Start the engine.

2 Cold engine (below 45°C)

When the throttle is opened rapidly the test lamp should light up briefly. Pulse ratio 60%.

3 Engine cold on starting, warms up during the test.

When the throttle is opened rapidly the test lamp should light up. When the 45°C thermostatic switch (97) opens, the lamp should go out. Each time the throttle is opened rapidly the pulse ratio should change to 92%. This function continues in operation for a period of 140 seconds after starting.

4 Hot engine (above 45°C)

When the throttle is opened rapidly, the pulse ratio should change to 92%. This continues for 140 seconds after starting. The test lamp should not light up.

Fault diagnosis (electrical testing)

1 Check whether the red/white (RD/VT) and white (VT) leads of the fuel booster pressure switch (79) are live.

2 Check whether a voltage pulse is applied to the brown (BR) lead of the fuel booster pressure switch (79) when the throttle is opened rapidly.

3 With the engine running, ground pin 11 of time relay P11 (101). The pulse meter should give a reading of 92%.

D Fuel enrichment during the warm-up period, below 45°C (pulse ratio 60%)

Mode of operation

900 Turbo:
the 25°C thermostatic switch (99) grounds terminal 12 of the control module and fixes the pulse ratio at 60%.

900i:
the 25°C thermostatic switch (99) grounds terminal 12 of the control module (via terminal X1 of the speed relay (105) on cars with a manual gearbox) and fixes the pulse ratio at 60%.

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Checking

1 Cold engine

Run the engine at idling speed. After three seconds the pulse ratio should be 60%and remain steady at this figure until the temperature rises above 25°C. The pulse meter should then begin to fluctuate.

2 Hot engine

Disconnect the red/yellow (RD/GL) lead from the thermostatic switch (99) and connect it to ground.

The pulse ratio should be fixed at 60%.

Fault diagnosis (electrical testing)

1 Remove the speed relay/deceleration relay (138/105) and start the engine.

900i:

connect terminal X1 of the relay (105) to ground. The pulse ratio should change to 60%.

900 Turbo:

connect the thermostatic switch (99) to ground. The pulse ratio should change to 60%.

2 Connect terminal 12 of the control module to ground. The pulse ratio should change to 60%.

3 Check the thermostatic switch (99), including all the wiring and connections.

E Fuel enrichment up to 140 seconds after starting, engine temperature above +45°C (not Turbo engines)

Mode of operation

A signal applied across the fuel booster pressure switch (79) to the TIP terminal of the time relay (106) fixes the pulse ratio at 92%via terminal 11 of the control module.

Checking

Check whether fuel enrichment continues for more than 140 seconds.

Note:

The 45°C thermostatic switch (97) and the 25°C thermostatic time switch (99) must be open and three seconds must have elapsed after the engine has been started.

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Fault diagnosis (electrical testing)

1 Remove time relay P11 (106).

2 Connect one of the leads of a test lamp to +12 V.

3 Connect the other lead to:

pin 31 - the test lamp lights up

the TRK pin - the test lamp lights up when the throttle position switch closes

F Deceleration (fuel shut-off) function (900i cars with manual gearbox only)

Mode of operation

Fuel shut-off cannot take place when the thermostatic switch (94) is closed or while fuel enrichment is in progress (140 seconds).

When the vacuum valve (260) opens, the pressure difference between each side of the mass air flow sensor plate is equalized. The sensor plate assumes its rest position and fuel injection into the fuel distributor via the control plunger ceases. A fixed pulse ratio of 60%is selected.

Checking

1 Start the engine and run it for 140 seconds.

2 Connect a test lamp to the red lead of the fuel booster pressure switch (79) and ground, and connect pulse meter 83 93 597.

3 Slowly increase engine speed to 1600 rpm.

4 Close the throttle rapidly.

The test lamp should light up until the engine reaches a speed of about 1375 rpm. The pulse meter should first indicate 60%and then 50%.

Note:

The fuel shut-off function will not operate during the first 140 seconds after starting.

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Fault diagnosis (electrical testing)

1 Run the engine at idling speed.

2 Connect one of the test lamp leads to +12 V.

3 Connect the other lead in turn to the following pins of the deceleration relay (105):

31:

the test lamp should light up

30:

the test lamp should light up when the throttle position switch is closed

X2:

the test lamp should light up after 140 seconds.

4 Connect one of the test lamp leads to ground.

5 Connect the other lead in turn to the following pins of the deceleration relay (105):

31b:

the lamp should flash (ignition pulses)

15

the lamp should light up (+12 V)

X1:

the pulse ratio should be 60%

87:

Fuel shut-off should take place (on deceleration).

Fault diagnosis	Component possibly defective					
	Deceleration relay	Acceleration enrichment time relay	Throttle position switch	Fuel shut-off valve	Modulating valve	Lambda control module
Fuel shut-off function inoperative	|b5	|b5	|b5	|b5		
Incorrect pulse ratio when the system is in operation	|b5	|b5	|b5		|b5	|b5

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G Enrichment at engine speeds above 3800 rpm (4600 rpm on model year 1988 and later cars) (Turbo)

Mode of operation

The speed signal goes from terminal 1 of the ignition coil via the ignition pulse amplifier (147) to the TD pin of the speed relay (138).

A signal then goes from pin 87 of the relay (138) to terminal 7 of the control module, which fixes the pulse ratio at 85%.

Checking

Connect pin 7 of the control module to ground. The pulse ratio should increase to 85%.

Fault diagnosis (electrical testing)

Check circuit continuity between:

a. pins 1 and 2 of the throttle position switch

b. pin 2 of the throttle position switch and pin 31A of the speed relay (138)

c. pin 87 of the speed relay (138) and pin 7 of the control module (135).

H Fuel enrichment governed by pulse ratio (throttle butterfly open more than 72°)

Mode of operation

Pin 3 of the throttle position switch (203) grounds pin 11 of time relay P11 (106), which governs fuel enrichment via terminal 11 of the control module (when the throttle butterfly is open at least 72° and engine temperature is above 45°C).

Checking

When the throttle butterfly closes, the pulse ratio should rise to 92%.

Fault diagnosis (electrical testing)

1 Remove time relay P11 (106).

2 Connect one lead of a test lamp to +12 V.

Connect the other lead to pin 11 of the P11 relay. The lamp should light up when the throttle butterfly is open more than 72°.

3 Connect one of the test lamp leads to ground and the other to terminal 11 of time relay P11. The pulse ratio should rise to 92%(engine running).

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I Setting the fuel-air mixture (pulse ratio)

General

The adjusting screw on the mass air flow sensor is sealed by a metal plug to prevent inadvertent adjustment. The mixture is preset at the factory and **should not normally require readjustment until replacement of the mass air flow sensor becomes necessary.**

Readjustment of the mixture may be necessary, however, if the mass air flow sensor has been repaired or if fault diagnosis shows that the mixture setting is incorrect.

Setting a new mass air flow sensor

Remove the mass air flow sensor, the sensor plate lever and then the metal plug. See the Service Manual section describing repairs to the mass air flow sensor.

1 Warm up the engine to normal operating temperature and connect the pulse meter.

2 Adjust the idling speed to 875 ± 75 rpm.

3 Set the recommended pulse ratio by means of the mass air flow sensor adjusting screw, using tool 83 92 482. Rev up the engine and allow the idling speed to stabilize each time before taking a meter reading.

4 Refit the metal plug, using a suitable punch. Pulse ratio setting: 45-55%.

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CAUTION

When carrying out any work involving fuel, fuel supply systems or fuel injection, make sure that the area is well ventilated.

If approved extraction equipment for fuel vapour is available, use it.

Wear suitable gloves, as prolonged contact with fuel can cause dermatitis.

No smoking anywhere in the vicinity.

Always make sure a suitable fire extinguisher is nearby.

Safety precautions for the LH system

1 Never start the engine unless the battery is properly connected to the car's electrical system.

2 Under no circumstances should an attempt be made to start the engine using an external power source, such as batteries connected in series (24 V) or a fast-boost charger (16 V), with the battery connected to the car's electrical system.

3 If a fast-boost charger is used, make sure that the battery cables are disconnected.

4 Never disconnect the battery while the engine is running.

5 Make sure that all electric cable connections make good electrical contact.

6 Never plug in or unplug the control module connector with the ignition switched on.

7 Before conducting a compression test, unplug the connector on the output stage of the ignition system.

8 At temperatures above +80°C (176°F), such as occur in connection with stove enamelling and drying of paintwork, the control module must be removed from the car.

9 Always remove the control module before carrying out any electric welding.

10 Take care never to transpose the connections on the fuel pump.

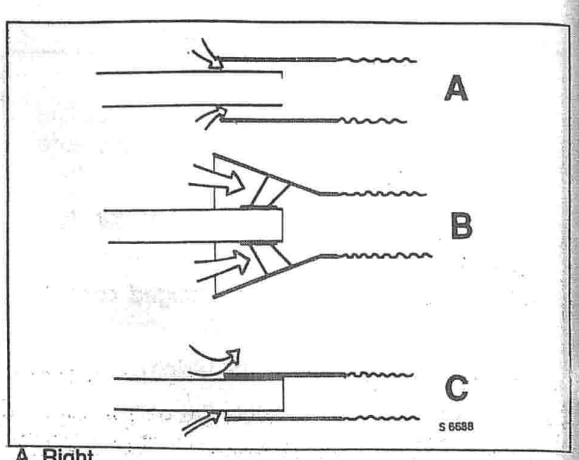
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Connection of exhaust extraction equipment

When using exhaust extraction equipment in the workshop, avoid excessive depressurization of the car's exhaust system as this could affect the results of CO measurement.

If excessively powerful exhaust extraction equipment is connected to a Turbo car, oil may escape through the seals in the turbo unit.

This will result in the exhaust system becoming saturated with oil and blue smoke will be emitted in the exhaust for some considerable time afterwards. **To avoid excessively powerful exhaust extraction, connect an extract hose with an open coupling.**



A Right
B Right
C Wrong

Colour codes

The following colour codes are used in the Service Manual. Colour codes can be used alone or in combination with each other, e.g. BL/RD, GL/VT, etc.

-M1991

BL	blue
BR	brown
GL	yellow
GN	green
GR	grey
OR	orange
RD	red
SV	black
VL	violet
VT	white

M1991-

Code	English
BK	Black
BN	Brown
BU	Blue
GN	Green
GY	Grey
OG	Orange
RD	Red
VT	Violet
WH	White
YE	Yellow
PK	Pink

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Fault diagnosis with LH system tester, LH 2.2 and LH 2.4

When carrying out fault diagnosis, make absolutely certain that you refer to the appropriate wiring diagram for the model year and LH system concerned, see Service Manual 3:2.

Note:

Before starting fault diagnosis with the LH system tester, it is advisable to use the integrated function on LH 2.4 cars for identifying data on any intermittent faults recorded in the control module. See under "Fault diagnosis with integrated fault diagnosis system, LH 2.4".
It is important to do this first, since connection of the LH tester to the control module interrupts the module's power supply, with the result that any fault information stored in its memory will be erased and the opportunity to identify any intermittent faults will be lost.
This will also occur if either of the battery cables is disconnected.

For details of the LH system tester, how to connect it to the car, etc., see "Service Manual LH system tester".

Before starting work

Many faults that are blamed on the fuel injection system can be traced to other unrelated engine or electrical faults. Therefore, before starting any fault diagnosis work, always check the following first:

- Battery condition
- Charging system
- Ignition system (timing, spark plugs, cables (HT leads), distributor cap, rotor, etc.)
- Battery connections and grounding points
- Engine conditions (compression, inlet manifold vacuum, etc.)
- Possible air leaks in the turbo/induction system

It is often advisable to perform a quick check on the main and pump relays, as follows:

1 Unplug the connectors on the LH control module and mass air flow sensor.

2 Remove the cover from the connector for the LH control module.

3 Connect pins 17 and 21 to ground via pin 25.

4 Check whether current is present on:

pins 9 and 13 (LH control module)

Pin 2 or pin 5 (mass air flow sensor, 9000i M 88)

Fuse 14 (fuel pump relay)

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Fault diagnosis work - general procedure

The words "Check the wiring between xx and yy" are used frequently in the fault diagnosis charts. Sometimes the wiring may run through different types of connector and, by implication, these must also be checked for circuit continuity and short circuiting.

Be alert to the possibility of interference from components connected to the wiring concerned. Also check that the wiring is in good condition and not the cause of defective grounding.

Always make absolutely certain that you refer to the correct wiring diagram for the car model, model year and type of LH system concerned.

Note:

Reference values for some of the parameters that are to be checked are preprogrammed in the microprocessor incorporated in the LH system tester.

In some cases the nominal values fall within very narrow limits. Consequently, under certain conditions, a fault may be indicated when, in fact, no fault exists.

This can only happen in extreme situations which are far removed from normal driving conditions.

Examples of spurious faults that may be indicated under such extreme conditions include the following:

LH 2.2	LH 2.4	
E002	E013	Excessive warm-up period, e.g. thermostat fault or prolonged idling in extremely cold weather.
E020	E020	Prolonged engine braking, faulty signal level from Lambda sensor.
E207	E207	Prolonged full-throttle acceleration, HLM voltage abnormally high
E113	E118	Engine overrevved, overrev cut-out triggered, excessive boost pressure

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Fault codes: LH 2.2 (25-pin connector)

Fault code	Pin No.	Malfunction indicated	Action - see page
E001	1	No ignition pulse on pin 1	69
E101	1	Starter motor revs too low	69
E002	2	Temperature sensor, no signal	69
E102	2	Temperature sensor, circuit shorted	69
E003	3	Idling contacts constantly open	69
E103	3	Idling contacts constantly closed	70
E005	5	Control module pin 5 not grounding	70
E006	6	Mass air flow sensor not grounding	70
E007	7	Mass air flow sensor, no signal	70
E107	7	Mass air flow sensor, signal too high	70
E207	7	Mass air flow sensor, signal too low	70
E008	8	Mass air flow sensor, no burn-off function	70
E108	8	Mass air flow sensor, burn-off function constantly activated	71
E009	9	Main relay, no 12 V supply	71
E109	9	Main relay, 12 V supply too low	71
E010	10	IAC valve, no signal from pin 10	71
E011	11	Control module pin 11 not grounding	71
E012	12	Full-throttle contacts constantly open	71
E112	12	Full-throttle contacts constantly closed	72
E013	13	No injection pulses	72
E113	13	Injection pulses erratic	72
E014	14	Mass air flow sensor, break in CO adjusting circuit	72
E017	17	Pump relay control circuit faulty	72
E018	18	No +15 supply	72
E020	20	Lambda sensor, no signal	73
E120	20	Lambda sensor, signal too low	73
E220	20	Lambda sensor, signal too high	73
E021	21	Main relay control circuit faulty	73
E023	23	IAC valve, no signal from pin 23	74
AIC	23	IAC valve, pulse ratio faulty	74
E024	24	No load signal	74
E025	25	Control module pin 25 not grounding	74

The following may also appear on the tester display:

"GLOU "	Mass air flow meter filament (hot-wire) burn-off function
"C 1"	Turbo
"C 2"	Turbo with IAC
"C 3"	Turbo with IAC and catalytic converter
"C 4"	Turbo with IAC and Saab EI
"C 5"	Non-turbo engines with IAC
"F PU"	Fuel pump relay and main relay operated
"FUEL"	Fuel mode
"OFF"	Starting point for injector test
"F IN"	Injectors open
"MON"	Monitor mode

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Fault codes: LH 2.4 (35-pin connector)

The following fault codes are used for the LH 2.4

Fault code	Pin No.	Malfunction indicated	Action - see page
E001	1	No ignition pulse on pin 1	75
E101	1	Starter motor revs too low	75
E002	2	Idling contacts constantly open	75
E102	2	Idling contacts constantly closed	75
E003	3	Throttle position switch contacts constantly open	75
E103	3	Throttle position switch contacts constantly closed	76
E005	5	Control module pin 5 not grounding	76
E006	6	Mass air flow sensor not grounding	76
E007	7	Mass air flow sensor, no signal	76
E107	7	Mass air flow sensor signal too high	76
E207	7	Mass air flow meter signal too low	76
E008	8	Mass air flow sensor, no burn-off function	76
E108	8	Mass air flow sensor, burn-off function constantly activated	77
E009	9	Main relay, no 12 V supply	77
E109	9	Main relay, 12 V supply too low	77
E018	18	No injection pulses	77
E118	13	Injection pulses erratic	77
E020	20	Pump relay control circuit faulty	77
E021	21	Main relay control circuit faulty	78
E024	24	Lambda sensor, no signal	78
E124	24	Lambda sensor signal too high	78
E224	24	Lambda sensor signal too low	78
E025	25	No load signal	79
E033	33	IAC valve, no signal from pin 33	79
E035	35	No +15 supply	79

The following may also appear on the tester display:

"GLOU"	Mass air flow meter filament (hot-wire) burn-off function
"C 6"	Non-turbo engines with IAC and catalytic converter
"F PU"	Fuel pump relay and main relay operated
"FUEL"	Fuel mode
"OFF"	Starting point for injector test
"F IN"	Injectors open
"MON"	Monitor mode

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Fault diagnosis chart: LH 2.2

Fault codes in brackets in the fault-diagnosis charts denote that the faults concerned are attributable to the primary fault.

Fault code	Control module pin No.:	Malfunction indicated	Action
E001 (E010) (E017)	1	No ignition pulse.	A Check ignition system. B Check the wiring between pin 1 of the control module and: M1985- onwards: pin 1 of the ignition coil (5) M1986- onwards (Turbo): pin TD-0 of the ignition pulse amplifier (147) i/S M1988- onwards (Turbo): pin 17 of the EZK control module (176), pin 7 of amplifier (147) (Turbo). C Fit a new LH control module.
E101		Starter motor revs too low. **Note:** Engine temperature above +10°C	A Check battery voltage and capacity. B Check the wiring between the positive terminal of the battery and pin 30 of the starter motor and between the negative terminal of the battery and grounding points 7 and 211. C Check the operation of the starter motor.
E002	2	Shorting in temperature sensor (NTC) circuit.	A Check the wiring between pin 2 of the control module (200) and pin 1 of the temperature sensor (202) and between pin 2 of the temperature sensor (202) and grounding point 201. B Check for good ground at grounding point 201. C Check the temperature sensor (202). D Fit a new LH control module.
E102	2	Shorting in temperature sensor (NTC) circuit.	See E002
E003	3	Throttle position sensor (203) contacts constantly open	A Release the accelerator immediately after starting for at least 20 seconds. B Check operation of throttle butterfly damper (dashpot). C Check setting and operation of throttle position sensor. D Check the wiring between pin 3 of the control module (200) and pin 1 of the throttle position sensor (203) E Check the wiring between pin 2 of the throttle position sensor (203) and grounding point 201. F Check for good ground through engine grounding point (201).

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Fault code	Control module pin No.:	Malfunction indicated	Action
E103	3	Throttle position sensor (203) contacts constantly closed (when engine revs increased from idling to 2500 rpm).	A Check setting and operation of throttle position sensor. B Check the wiring between pin 3 of the control module (200) and pin 1 of the throttle position switch (203). C 900i/900S Check the wiring between pin 3 of the control module (200) and pin 7 of the EZK control module (176) via connector 57. D Check the EZK ignition system.
E005	5	Control module (200) pin 5 not grounding.	A Check the wiring between pin 5 of the control module (200) and grounding point 201. B Check for good ground through the engine grounding point (201).
E006	6	Mass air flow sensor (205), no signal.	A Model year 1988 and later: check the wiring between pin 3 of the mass air flow sensor (205) and pin 2 and grounding point 201 (not Turbo). B Check the wiring between pin 4 of the mass air flow sensor (205) and the engine grounding point (201). Check for good ground at the grounding point. C Fit a new mass air flow sensor (205).
E007	7	Mass air flow sensor (205), no signal.	A Check the wiring between pin 7 of the control module (200) and pin 5 of the mass air flow sensor (205). B Check the wiring between engine grounding point 201 and pin 4 of the control module (200). C Fit a new mass air flow sensor (205).
E107	7	Mass air flow sensor (205), signal too high	A Check the wiring between pin 7 of the control module (200) and pin 5 of the mass air flow sensor (205). B Check by eye that mass air flow sensor hot wire (filament) burn-off takes place. C Fit a new mass air flow sensor (205).
E207	7	Mass air flow sensor (205), signal too low	See E107
E008	8	Mass air flow sensor (205), no hot wire (filament) burn-off function	A Repeat the test. Rev up the engine to 2500 rpm for at least 3 seconds ("SET 2500 RPM"). B Check the wiring between pin 8 of the control module (200) and pin 1 of the mass air flow sensor (205). C Fit a new LH control module (200).

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Fault code	Control module pin No.:	Malfunction indicated	Action
E108	8	Mass air flow sensor (205), burn-off function constantly activated.	A Check the wiring between pin 8 of the control module (200) and pin 1 (pin 4 on model year 1988 and later cars) of the mass air flow sensor (205). B Fit a new LH control module (200)
E009	9	Main relay, no 12 V supply	A Check for 12 V supply on the +30 distribution terminal (230). B Check the wiring between the +30 distribution terminal (230) and pin 30 of the main relay (229). C Check the wiring between pin 87 of the main relay (229) and pin 9 of the control module (200). D Check the wiring between pins 30 and 86 of the main relay (229). E Fit a new main relay (229).
E109	9	Main relay, 12 V supply too low	A Check battery voltage at distribution block (75)— is at least 10 V. B Check the wiring between the distribution block (75) and pin 30 of the main relay (229). C Check the wiring between pin 87 of the main relay (229) and pin 9 of the control module (200). D Fit a new main relay (229).
E010	10	IAC valve, no signal from pin 10.	A Check the wiring between pin 1 of the IAC valve (272) and pin 10 of the control module (200). B Check whether +12 V battery voltage is applied to pin 2 of the IAC valve (272) (ignition switched on). C Check the wiring between pin 2 of the IAC valve (272) and pin 87 of the pump relay (102). D Check the wiring between pin 30 of the pump relay (102) and the +30 supply terminal (230). E Fit a new pump relay. F Fit a new IAC valve (272). G Fit a new LH control module.
E011	11	LH control module (299) not grounding.	A Check the wiring between pin 11 of the control module (200) and grounding point 201. B Check for good ground at the engine grounding point (201).
E012	12	Throttle position sensor (203), full-throttle contacts constantly open	A Check operation by flooring accelerator on command from LH system tester. Check display to see whether throttle butterfly opens. B Check operation and setting of throttle position sensor. C Check the wiring between pin 12 of the control module (200) and pin 3 of the throttle position sensor (203). D Check the wiring between pin 2 of the throttle position sensor (203) and grounding point 201. E Check for good ground at engine grounding point (201).

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Fault code	Control module pin No.:	Malfunction indicated	Action
E112	12	Throttle position sensor (203), full-throttle contacts constantly closed.	A Release accelerator on starting. B Check setting and operation of throttle position sensor (203). C 900 with AIC: Check the wiring between pin 12 of the control module (200) and pin 3 of the throttle position sensor (203). D Check that the connector (60) is not grounded. E Check the wiring between the connector (60) and pin 12 of the control module (200). F Check the wiring between pin 12 of the control module (200) and the TK pin of the AC relay (156). H Check that the AC relay (156) is not grounded.
E013	13	No pulses to injectors (206)	A Check the wiring between pin 13 of the control module (200) and pin 2 of the injectors (206). B Check the wiring between pin 1 of the injectors (206) and pin 87 of the pump relay (102). C Check whether a +12 V supply is applied to pin 30 of the pump relay (102). D Fit a new fuel pump relay (102). E Fit a new LH control module.
E113	13	Erratic injection pulses.	See E013
E014	14	Mass air flow sensor, break in CO adjusting circuit.	A Check the wiring between pin 14 of the control module (200) and pin 6 of the mass air flow sensor (205). B Fit a new mass air flow sensor (205).
E017	17	Pump relay (102) control circuit faulty.	A Check the wiring between pin 17 of the control module (200) and pin 85 of the pump relay (102). B Check the wiring between pin 86 of the pump relay (102) and pin 87 of the main relay (229) (Turbo: via pressure switch 144). C Check the wiring between pin 30 of the main relay (229) and the +30 distribution terminal (230). D Fit a new fuel pump relay (102). E Fit a new main relay (229). F Fit a new LH control module.
E018	18	No +15 supply.	A Check the wiring between pin 18 of the control module (200) and the distribution terminal (159). B Check whether +12 V battery voltage is applied to the distribution terminal (159) when the ignition is switched on.

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Fault code	Control module pin No.:	Malfunction indicated	Action
E020	20	Lambda sensor (136), no signal.	A Check the wiring between pin 20 of the control module (200) and the connector (60). B Check the wiring between pin 5 of the control module (200) and the braided screening round the signal lead. C Fit a new Lambda sensor.
E120	20	Lambda sensor (136), signal too low.	A Set the Lambda system to the correct value. B Check the voltage across the Lambda sensor between the connector (60) and ground. C Check whether a +12 V supply is present across pins 1 and 2 of the connector (59) D Check the wiring between pin 5 of the control module (200) and the braided screening round the signal lead. E Check the Lambda sensor (136) preheating function. F Check the fuel pressure (line pressure) G Check the induction system for air leakage. H Check for air leaks in the exhaust system between the engine and the Lambda sensor. I Check the operation and delivery flow of the injectors. J Fit a new Lambda sensor. K Fit a new LH control module (200).
E220	20	Lambda sensor (136), signal too high	A Set the Lambda system to the correct value. B Check the voltage across the Lambda sensor between the connector (60) and ground. C Check whether +12 V battery voltage is present across pins 1 and 2 of the connector (59) D Check the Lambda sensor (136) preheating function. E Check the fuel pressure (line pressure). F Check the operation and delivery flow of the injectors. G Fit a new Lambda sensor (136). H Fit a new LH control module (200).
E021	21	Main relay (229) control circuit faulty	A Check for 12 V battery voltage on the +30 distribution terminal (230). B Check the wiring between the +30 distribution terminal (230) and pin 86 of the main relay (229). C Check the wiring between pin 85 of the main relay (229) and pin 21 of the control module (200). D Fit a new main relay (229). E Fit a new LH control module.

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Fault code	Control module pin No.:	Malfunction indicated	Action
E023	23	IAC valve, no signal from pin 23.	A Check the wiring between pin 3 of the IAC valve (272) and pin 23 of the control module (200). B Check whether +12 V battery voltage is applied to pin 2 of the IAC valve (ignition switched on). on). C Check the wiring between pin 2 of the IAC valve (272) and pin 87 of the pump relay (102). D Check the wiring between pin 30 of the pump relay (102) and the +30 supply terminal (230). E Fit a new pump relay. F Fit a new IAC valve (204). G Fit a new LH control module.
AICO	23	IAC valve, pulse ratio faulty	A Adjust the IAC system to the correct setting.
E024	24	No load signal to EZK (not Turbo)	A Check the wiring between pin 24 of the LH control module (200) and pin 8 of the EZK control module (176). B Fit a new LH control module (200).
E025	25	Control module pin 25 not grounding.	A Check the wiring between pin 25 of the control module (200) and grounding point 201. B Check for good ground at engine grounding point 201.

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Fault diagnosis chart: LH 2.4

Fault code	Control module pin No.:	Malfunction indicated	Action
E001	1	No ignition pulse	A Check ignition system. B Check the wiring between pin 1 of the control module and pin 17 of the EZK control module (176). **Note:** If the engine fails to start, the ignition switch must be left in the Drive position for about 20 seconds. If this is not done, the instrument will not be able to detect the fault.
E101		Starter motor revs too low. **Note:** Engine temperature above +10°C	A Check battery voltage and capacity. B Check the wiring between the positive terminal of the battery and pin 30 of the starter motor and between the negative terminal of the battery and grounding points 7 and 211. C Check the operation of the starter motor.
E002	2	Throttle position sensor (203) idling contacts constantly open.	A Release the accelerator immediately after starting and do not touch it for at least 20 seconds. B Check the setting and operation of the throttle position sensor. C Check the wiring between pin 2 of the control module (200) and grounding point 201 via the throttle position sensor (203). D Check for good ground at grounding point 201.
E102	2	Throttle position sensor (203) contacts constantly closed (when engine revs increased from idling to 2500 rpm).	A Check the setting and operation of the throttle position sensor. B Check the wiring between pin 2 of the control module (200) and pin 1 of the throttle position sensor. C Check the wiring between pin 2 of the control module (200) and the EZK control module. D Check the operation of the EZK ignition system.
E003	3	Throttle position sensor (203) full-throttle contacts constantly open	A Check operation by flooring accelerator on command from LH system tester. Check display to see whether throttle butterfly opens. B Check operation and setting of throttle position sensor. C Check the wiring between pin 3 of the control module (200) and grounding point the throttle position sensor (203). D Check for good ground at engine grounding point (201).

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Fault code	Control module pin No.:	Malfunction indicated	Action
E103	3	Throttle position sensor (203), full-throttle contacts constantly closed.	A Release accelerator on starting. B Check operation and setting of throttle position sensor. C Check the wiring between pin 3 of the control module (200) and pin 3 of the throttle position sensor (203) and also between pin 3 of the control module and the TK pin of the AC relay (156). D Check that the TK pin of the AC relay (156) is not grounded.
E005	5	LH control module pin 5 not grounding to grounding point 201.	A Check the wiring between pin 5 of the control module and grounding point 201. B Check for good ground at grounding point 201.
E006	6	No continuity in circuit between LH Control module pin 6 and pin 2 of the mass air flow sensor (205)	A Check the wiring between pin 6 of the control module (200) and pin 2 of the mass air flow sensor (205). B Check the wiring between pin 1 of the mass air flow sensor (205) and the engine grounding point (201). C Fit a new mass air flow sensor (205).
E007	7	No signal between pin 7 of the control module and pin 3 of the mass air flow sensor (205).	A Check the wiring between pin 7 of the control module (200) and pin 3 of the mass air flow sensor (205). B Fit a new mass air flow sensor (205). C Check whether a +12 V supply is present across pins 1 and 5 of the mass air flow sensor (205) D Fit a new LH control module.
E107	7	Signal from pin 3 of the mass air flow sensor (205) to pin 7 of the control module too high.	Same procedure as above.
E207	7	Signal from pin 3 of the mass air flow sensor (205) to pin 7 of the control module too low.	Same procedure as above.
E008	8	Mass air flow sensor (205), no hot wire (filament) burn-off function.	A Repeat the "SET 2500 RPM" test for at least 3 seconds. B Check the wiring between pin 8 of the control module (200) and pin 4 of the mass air flow sensor (205). C Check the wiring between pin 5 of the mass air flow sensor (295) and pin 87 of the main relay (229). D Fit a new LH control module (200).

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Fault code	Control module pin No.:	Malfunction indicated	Action
E108	8	Hot wire (filament) burn-off function constantly activated.	A Check the wiring between pin 8 of the control module (200) and pin 4 of the mass air flow sensor (205). B Fit a new LH control module
E009	9	Main relay (229), no power supply.	A Check whether +12 V battery voltage is present at the +30 distribution terminal (230). B Check the wiring to pin 30 of the main relay (229) and from pin 87 of the main relay to pin 9 of the control module. C Fit a new main relay.
E109	9	Main relay (229), supply voltage too low.	A Check the battery voltage at the +30 distribution terminal (23). B Check the wiring to pin 30 of the main relay (229) and from pin 87 of the main relay to pin 9 of the control module. C Check the alternator and charging system for low charging voltage.
E018	18	No pulses to injectors (206).	A Check the wiring between pin 18 of the control module (200) and pin 2 of the injectors (206). B Check the wiring between each injector and pin 87 of the main relay (229). C Check whether a +12 V supply is present at pin 30 of the main relay (229). D Fit a new main relay (229). E Fit a new LH control module.
E118	18	Pulses to injectors (206) erratic in relation to ignition pulses.	See above.
E020	20	Pump relay (102) control circuit faulty.	A Check the wiring between pin 20 of the control module (200) and pin 85 of the pump relay (102). B Check the wiring between pin 86 of the pump relay (102) and pin 87 of the main relay (229) and between pin 30 of the main relay and the +30 distribution terminal (230). C Fit a new pump relay (102). C Fit a new main relay (229). E Fit a new LH control module (200).

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Fault code	Control module pin No.:	Malfunction indicated	Action
E021	21	Main relay (229) control circuit faulty.	A Check whether a +12 V supply is present at the +30 distribution terminal (230). B Check the wiring to pin 86 of the main relay (229) and from pin 85 of the main relay to pin 21 of the control module (200). C Fit a new main relay. D Fit a new control module.
E024	24	Lambda sensor, no signal.	A Check the wiring between pin 24 of the control module (200) and the connector (60). B Check the wiring between pin 5 of the control module (200) and the braided screening round the signal lead. C Fit a new Lambda sensor (136). D Fit a new LH control module.
E124	24	Lambda sensor, signal too low.	A Check the voltage across the Lambda sensor between connector 60 and ground. B Check whether a +12 V supply is present between pins 1 and 2 of the connector (59). C Check the wiring between pin 5 of the control module and the braided screening round the signal lead. D Check the Lambda sensor preheating function. E Check the wiring between pin 24 of the control module (200) and the connector (60) and between the connector (60) and the Lambda sensor (136). F Check for leakage in the induction system. G Check for air leaks in the exhaust system between the engine and the Lambda sensor. H Check injector operation and delivery flow. I Fit a new Lambda sensor (136).
E224	24	Lambda sensor, signal too high.	A Check the voltage across the Lambda sensor between connector 60 and ground. B Check whether a +12 V supply is present between pins 1 and 2 of the connector (59). C Check the Lambda sensor (136) preheating function. D Check the fuel pressure (line pressure). E Check the Lambda sensor (136) preheating function. F Check injector operation and delivery flow. G Fit a new Lambda sensor.

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Fault code	Control module pin No.:	Malfunction indicated	Action
E025	25	No load signal to EZK (176).	A Check the wiring between pin 25 of the LH control module (200) and pin 8 of the EZK control module (176). B Fit a new LH control module (200).
E033	33	IAC valve, no signal from pin 33.	A Check whether the throttle butterfly is correctly adjusted (as near to the closed position as possible without binding). B Check the operation and setting of the throttle position sensor (203). C Check the wiring between pin 33 of the control module (200) and pin 2 of the IAC valve (272). D Check whether a +12 V supply is present across pin 1 of the IAC valve (272) and ground. E Check the wiring between pin 1 of the IAC valve (272) and pin 87 of the main relay (229). F Check the wiring between pin 30 of the main relay (229) and the +30 distribution terminal (230). G Fit a new main relay (229). H Fit a new IAC valve. I Fit a new LH control module.
E035	35	No supply from the +15 distribution terminal (159).	A Check the wiring between pin 35 of the control module (200) and the +15 distribution terminal (159). B Check whether a +12 V supply is present at the distribution terminal (159) when the ignition is switched on.

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Fault diagnosis using the integrated fault-diagnosis system (LH 2.4), 900S (US)

The fault-diagnosis system has two principal applications:

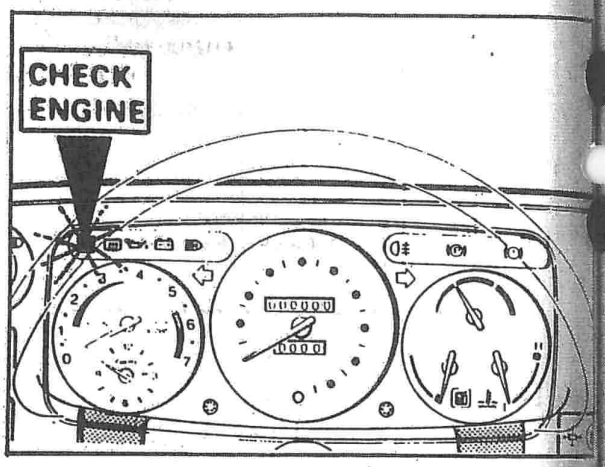
- Fault diagnosis, faults detected and stored in the memory.
- Component and signal testing.

Faults stored in the memory

Faults that occur intermittently are often hard to trace. The LH 2.4 has an integral memory that stores information on such faults so that you can later identify and rectify them.

By following the instructions below which describe how to activate the system's memory facility, the "CHECK ENGINE" lamp on the car's instrument panel will flash and provide information on any faults that have been detected.

A certain combination of short flashes, e.g. 1+2+3+2+2, stands for a particular fault. By consulting the list of fault codes to find out what the fault code 1 2 3 2 2 stands for, you can identify the fault and rectify it. This procedure can be repeated for fault No. 2 and fault No. 3, whereupon the CHECK ENGINE lamp will flash new codes which enable you to identify the faults from the list of fault codes.



Up to three faults can be stored at a time in the control module memory, which can be accessed as described above and provide information on the nature of the fault. Serious faults are given priority, which means that these must first be rectified before the memory can store information on minor faults.

Note:

If a serious fault occurs repeatedly, each occurrence will be recorded in the memory and the "CHECK ENGINE" lamp will light up. Once the fault has been rectified, it may be necessary to clear the memory by erasing all its contents to delete any additional codes for the same fault. In doubtful cases, take the car out on a road test.

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Component and signal testing

This testing can best be carried out in conjunction with diagnosis of stored faults.

Testing incorporates a function check of certain key components in the LH system and a check of important signals from the control module.

In these cases, the "CHECK ENGINE" lamp flashes codes in the same way as for stored faults. However, this time the code is not a fault code but an identification code for the component or signal being tested.

For instance, if the "CHECK ENGINE" lamp flashes code 1 2 4 1 3, reference to the table of identification codes for component and signal testing will show that the CP valve on the charcoal filter is being tested and that you should hear the valve opening and closing.

Note:

All code indication and testing will be aborted when the ignition is switched off.

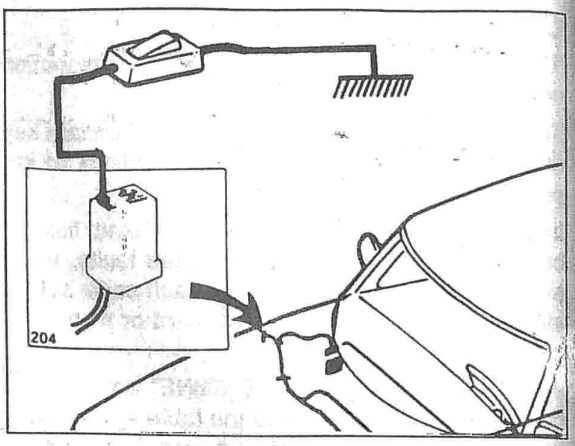
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Fault diagnosis - stored faults

(1) Ground pin No. 3 of the 3-pin test socket in the engine bay on the RH side. Use the jumper cable with switch, part No. 83 93 886.

(2) Read off the fault codes flashed by the "CHECK ENGINE" lamp.

(2*) On model year 1990 and later cars, obtain the flash codes from the ISAT socket under the rear seat on the RH side using the test cable, part No. 83 94 504.



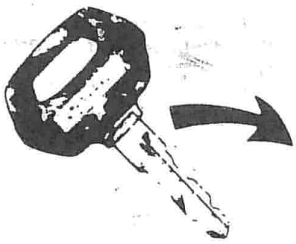
Note:
Read through the entire starting procedure carefully before switching on the ignition.

3 Switch on the ignition.

The "CHECK ENGINE" lamp will light up.

4 Set the switch to "ON" (grounding pin 16 of the control module).

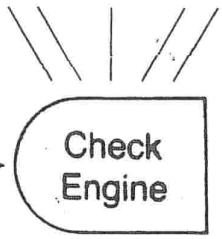
The "CHECK ENGINE" lamp will go out.



(1) uzemnit uzemňovací kolík #3 (ze sady 3-kolík testovací soupravy) na straně RH. Použijte startovací kabel s vspiva čem #ch'lu 83 93 886

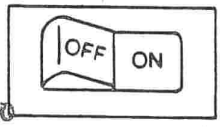
(2) Přečtěte kódy které blikají na kontrole (check engine)

(2*) Na autech v.v. 1990 a starších získejte blikací kódy z ISAT/ socket pod zadním sedadlem na straně RH použijte test kabel - #83 94 504



(3) Zapněte klíček ("Check engine se rozsvítí")

(4) Nastavte vspínač na "ON" (zapnuto) uzemnit kolík 16 na-ze kontrolní modulu



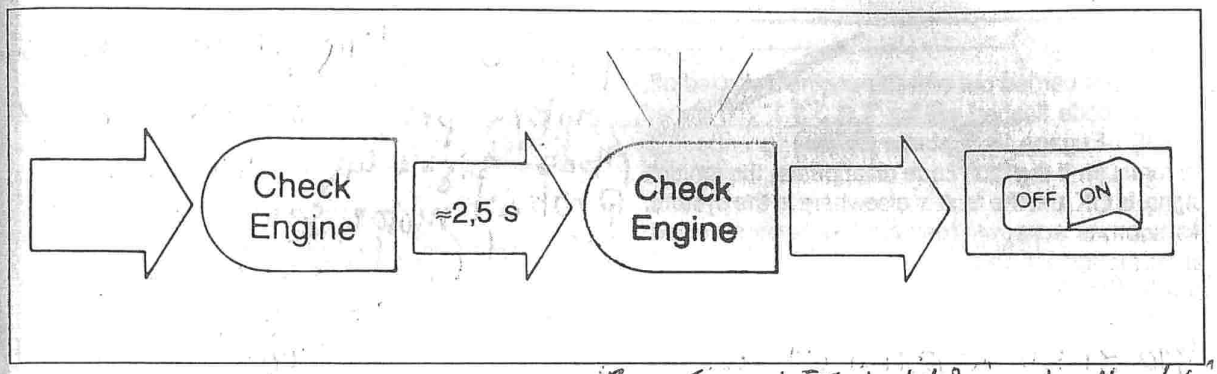
"Check. engine" zhasne

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5 Watch the "CHECK ENGINE" lamp carefully. After about 2.5 seconds it will **flash briefly**, signifying that the first fault code is to be activated.

As soon as the lamp has flashed, set the switch immediately to "OFF".

Check Engine začne blikat za 2.5 sekundy krátce jako znak že první kód bude aktivován.
Po krátkém zablikání vypnout na 'off'



6 The first of three possible fault codes has now been activated and will be displayed by a series of short flashes of the "CHECK ENGINE" lamp.

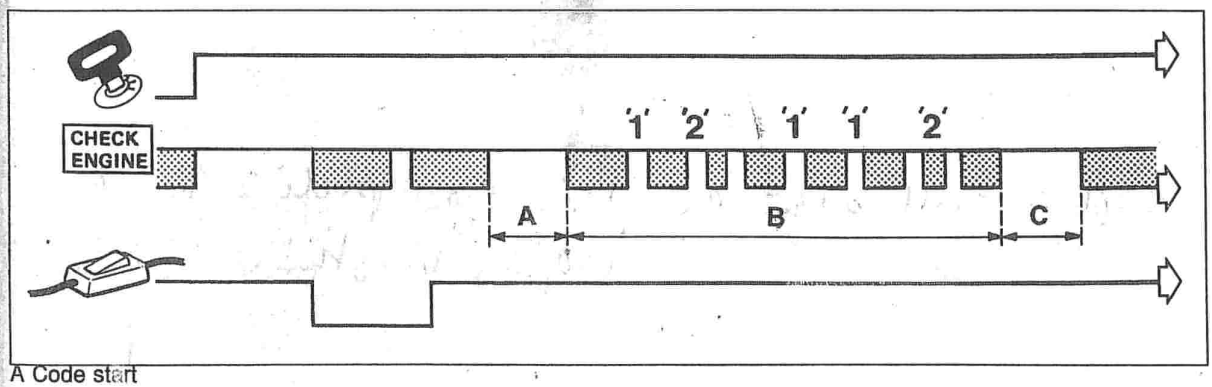
První ze tří kódů je teď aktivován a bude ukázán sérií krátkých bliknutí "check engine"

Note:

The fault codes starts and finishes with a long flash of the "CHECK ENGINE" lamp.

These long flashes have nothing to do with the code itself but serve merely to indicate the beginning and end of the code.

Note: Začátek kódu ~~začíná~~ dlouhým blknutím "check engine"
dlouhé blikmutí nemá nic společného s kódem. Signalizuje pouze začátek a konec tohoto kódu.



A Code start
B Fault code
C Code end

Fault code

The entire sequence takes place as shown in the diagram.

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In the example, the fault code is "1 2 1 1 2". Reference to the table shows that the fuel-air mixture on idling is incorrect.

When the switch is set to "OFF", fault code "1 2 1 1 2" will be flashed repeatedly and the next fault code, if any, in the control module memory will not be activated.

V tomto případě kódu 12112 na tabulce vidíme že je špatná směs při volno běhu případě že vypínač je na OFF

Note:

If testing is carried out with the engine switched off, the first code flashed will be "1 2 2 3 1" (no speed signal). Engage the starter motor for about 5 seconds. If the fault code disappears, the ignition signal is OK and the fault is elsewhere in the system. As soon as acknowledgement has been received, allow the ignition switch to return to the Drive position and testing will continue.

Jestliže testing je při vypnutém motoru první kód bude 12231 (bez signálu rychlosti.) Protočit motor startérem na 5 sekund (jestliže kód zmizí zapalování je v pořádku a chyba je někde jinde - jakmile je toto potvrzeno otočte klíčkem na pozici (drive) a testing bude pokračovat.

Next fault code

Pro zjištění dalších závad

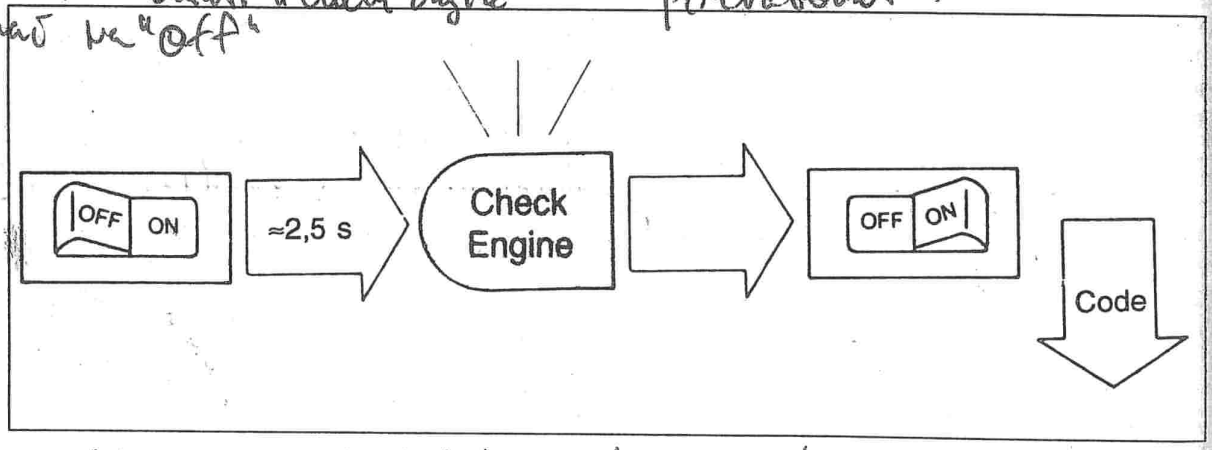
To check whether there are any additional faults in the system, continue as described below.

7 Set the switch to "ON".

Vypínač na

8 After **a short flash of the "CHECK ENGINE" lamp**, set the switch to "OFF".

Po krátkém blikání "Check Engine" vypínač na "off"



Kód 2 bude blikat tak jako u prvního 1 se svojim vlastním kodem

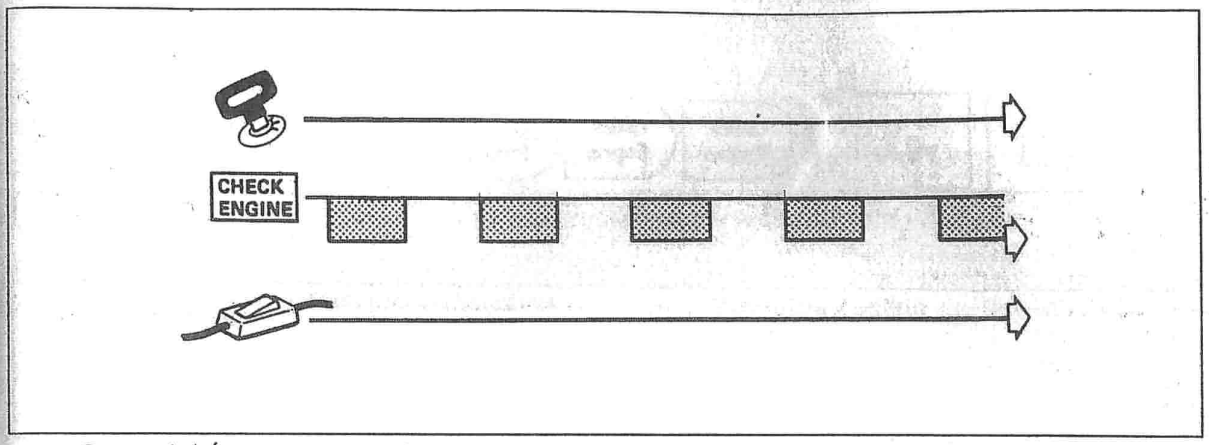
Fault code No. 2 will then be flashed in same way as the first one.

If an additional fault is stored it will be flashed in the same way as the first fault but with its own fault code.

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Stejná procedura pro kód 3. Jestliže kód 3 není uložen a nebo jestliže ostatní kódy byly smazány tak blikání bude sériové ukončeno

9 Follow the same procedure to obtain the fault code for a third stored fault, if any. If no third fault has been stored, or all the faults have been rectified, this will be indicated by a continuous series of long flashes.



znovu testování

To restart the test procedure

If for any reason you want to obtain the fault codes again, starting from the first fault, proceed as follows:

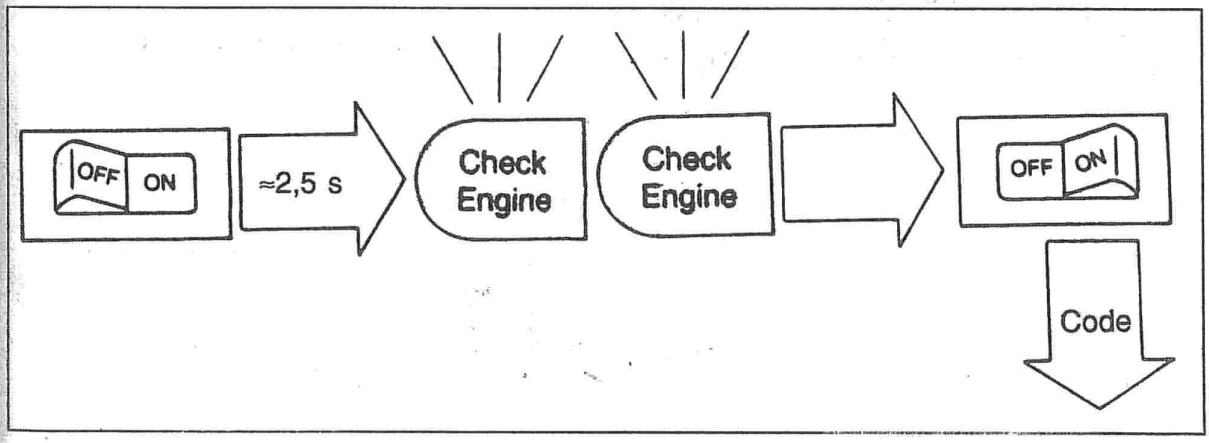
1 Set the switch to "ON".

Vypínač na "ON"

2 After **two short flashes,** set the switch to "OFF" and the code for fault No. 1 will be flashed once again.

po dvou krátkých bliknutích

Vypínač na "off" a kód #1 bude znovu blikat



Set the switch to "OFF" immediately after the second flash of the "CHECK ENGINE" lamp.

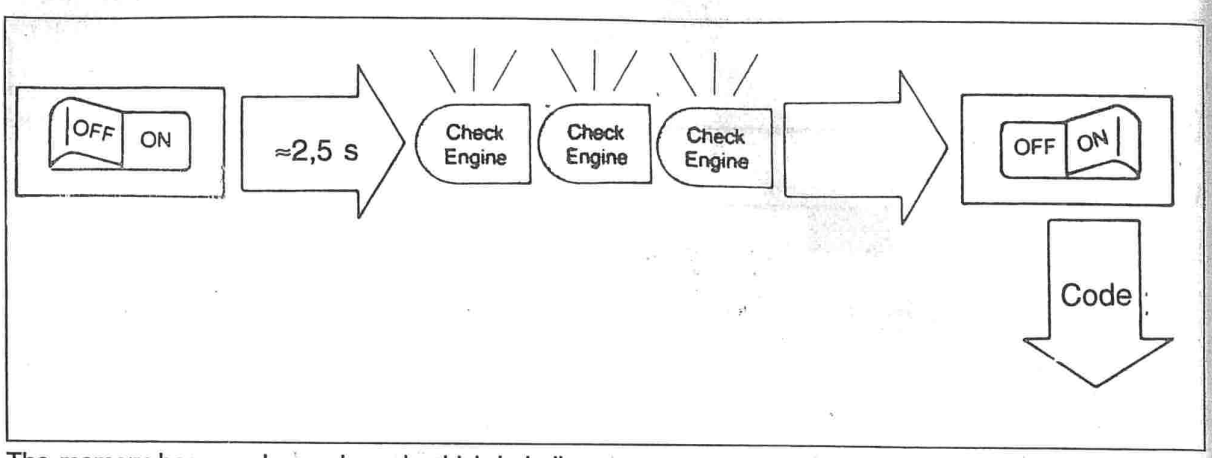
Blik kód

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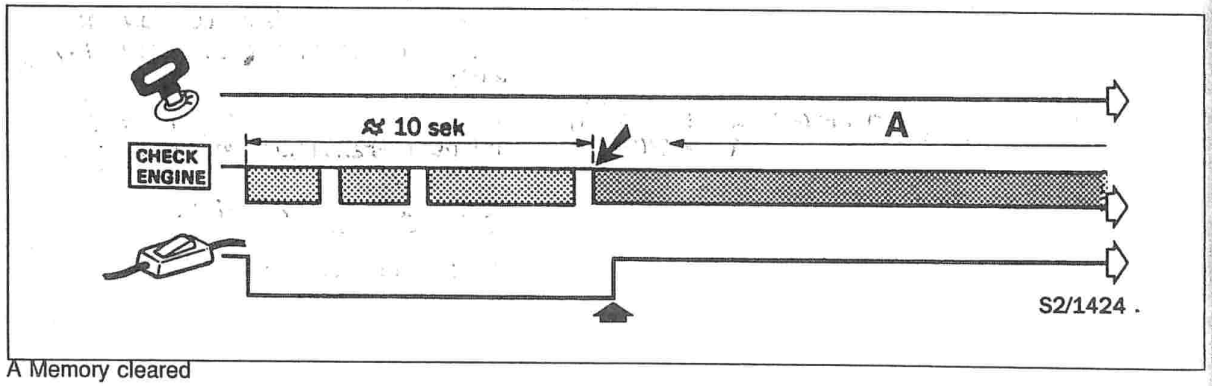
To clear the memory

1 Set the switch to "ON".

2 After **three short flashes,** set the switch to "OFF".



The memory has now been cleared, which is indicated by a continuous series of long flashes of the "CHECK ENGINE" lamp.



A Memory cleared

Note:

The contents of the memory cannot be cleared before code "00000" has been displayed (indicating end of fault codes).

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LH 2.4 fault codes (M1989-)

Note:

The proposed action given in the following table should be regarded primarily as the starting point for further fault diagnosis. The self-diagnosis function incorporated in the LH 2.4 system has two advantages: the ability to store data on occasional (intermittent) faults; and the ability to check the effect of action taken to rectify a fault.

Fault code	CHECK ENGINE	Malfunction indicated	Preliminary action
12231	Off	No ignition signal. Always appears as the first fault code if the engine is switched off. Engage the starter motor for 5 seconds. If the code disappears, the ignition signal is OK and the fault is elsewhere.	Check the input signal on pin 1 of the control module and check the wiring between pin 1 and the ignition system. Check the ignition system.
12221	On	Mass air flow sensor, no signal. Car goes into emergency mode. (Limp-Home).	Check mass air flow sensor connections and wiring. Try a new mass air flow sensor. **Note:** Take care to distinguish between plastic and aluminium mass air flow sensor versions.
12214	On	Temperature sensor signal faulty. (temperatures below -90°C or above +160°C)	Check the resistance of the NTC resistor and the resistance between pin 13 of the control module connector and ground. Correct resistances are 2280-2720 ohms at 20°C or 290-365 ohms at 80°C, measured with the connector unplugged from the control module.
12211	Off	Battery voltage incorrect (below 10 V or above 16 V when engine running).	Check battery condition, charging system, grounding points, etc.
12225	On	Lambda sensor, signal faulty or preheating function inoperative (engine temperature must be above +70°C; M88: +80°C).	Check whether voltage is present across the Lambda sensor connector pins. Check the preheater fuse (M88: also that the line-fuse connections make good contact). Check whether the sensor signal fluctuates between 0 and 1.5 V (sensor hot). Fit a new Lambda sensor. Try a new control module.
12223 12224	On	Fuel-air mixture too lean. Fuel-air mixture too rich.	Check all screws, hoses, hose clips, O-rings, etc. to ensure that they are not loose and that no leakage occurs. Check the induction system for leaks and also that it is in proper working order. See also fault code 12225 above.

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Fault code	CHECK ENGINE	Malfunction indicated	Preliminary action
12232	Off	Memory voltage more than 1 V.	Check that voltage is present on the pins of the control module (even when the ignition is switched off).
12212	Off	Throttle position sensor idling contacts malfunctioning, shorting to ground when the car is being driven.	Check and adjust the throttle position sensor contacts. Check the wiring between the throttle position sensor contacts and the control module for shorting to ground. Try a new throttle position sensor. Try a new control module.
12213	Off	Throttle position sensor full-throttle contacts malfunctioning, shorting to ground on low engine load (idling).	Check and adjust the throttle position sensor. Check the wiring between the throttle position sensor and the control module for shorting to ground. Try a new throttle position sensor. Try a new control module.
12222	Off	Idle air control (IAC) system faulty.	Check the connections and wiring to the IAC valve. Fit a new valve. Try a new control module.
12111	Off	Lambda adaptation fault (fuel-air mixture on idling).	Check the system for air or fuel leaks and the Lambda sensor preheating function. Check the induction system for leaks and also check that it is in proper working order. Try a new control module.
12112	Off	Lambda adaptation fault (fuel-air mixture when car is being driven).	Check the system for air or fuel leaks and the Lambda sensor preheating function. Check the induction system for leaks and also check that it is in proper working order. Try a new control module.
12113	Off	Idle air control adaptation fault, pulse ratio too low.	Check and adjust the throttle butterfly for air leaks. Fit a new IAC valve. Try a new control module.
12114	Off	Idle air control adaptation fault, pulse ratio too high.	Check for sticking IAC valve. Also check for other mechanical defects. Try a new control module.
00000	Off	No more faults or no faults detected	**Note:** Until this code has been displayed the fault memory cannot be cleared.

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LH 2.4 fault codes (M1990-)

Fault code	CHECK	Malfunction indicated	Action
12243	Off	Speed transmitter sensor, no signal (USA-West and LH 2.4.1) (9000)	A With the control module connector plugged in: Check the voltage across pin 34 of the control module and ground. When either of the front wheels is rotated, the voltage should swing between about 1 and 11 V. If not: Check the green lead (GN) between the speed transmitter sensor (132) and pin 34 of the control module. Also check the black lead (SV) from the sensor to grounding point 3 and the green-white lead (GN/VT) to pin 15 of the ignition switch (20). B Try a new speed transmitter sensor. C Try a new control module.
12245	On	EGR function faulty (USA-West)	A With the ignition switch in the Drive position (engine switched off) enter command 555 on an ISAT. Check whether the modulating valve works. If not: Check the yellow-white lead (GL/VT) between pin 19 of the control module and connector 394 and also the white lead (VT) between the connector and the modulating valve (390). Also check the green-white lead (GN/VT) between the modulating valve and the injector distribution block, green-red lead (GN/RD). B Try a new modulating valve. C Check the yellow-white lead (GL/VT) between the thermostatic switch (389) and pin 23 of the control module and the black lead (SV) between the thermostatic switch and grounding point 201. D Try a new thermostatic switch. E Try a new control module.

*) Depending on how serious the fault is.

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When faults arising in the LH 2.4 system can be classed as "adaptation faults", the car must be run for about 10 minutes to prevent the same fault codes recurring after the fault has been rectified. This is because the system always endeavours to compensate for any changes that can affect its performance in one way or another.

When the system compensates for values that are outside the permitted limits, a fault code is generated. After the fault codes have been read and any faults rectified, the fault codes generated by the adaptive function of the system when compensating for the faults will remain in the memory. Such codes cannot be cleared until the system has been re-adapted to new compensation parameters.

It takes the system a certain amount of time to re-adapt to these new compensation parameters, depending on the type of fault concerned. However, driving the car for ten minutes with the engine at normal operating temperature is long enough for the system to re-adapt itself.

The following fault codes are affected by this adaptive function:

12223, 12224 and 12225 (Lambda sensor signal/ preheating)

12111 and 12112 (Lambda adaptation faults)

12113 and 12114 (IAC adaptation faults)

Occasional (intermittent) faults

Intermittent faults of a serious nature will cause the CHECK ENGINE lamp to light up at times when the fault occurs. When the fault disappears temporarily, the CHECK ENGINE lamp will go out but the relevant fault code will remain stored in the memory.

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Component and signal testing

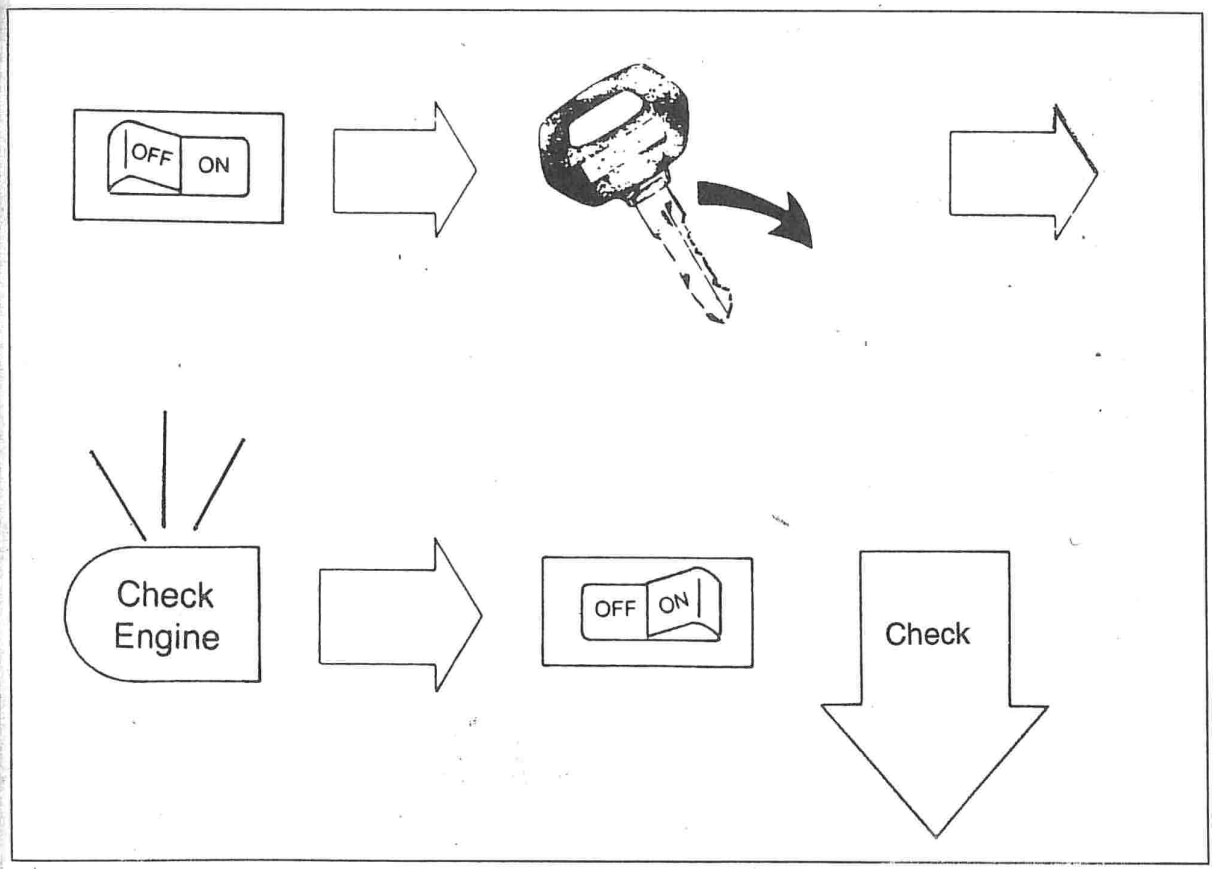
Testing is started at point 1 and runs through all the points up to point 7, see table. Connections are the same as for "Fault diagnosis - stored faults".

Note:

In this testing mode, the switch must be set to "ON" **before** the ignition is switched on.

1 Set the switch to "ON".

2 Switch on the ignition and wait **for a short flash** of the CHECK ENGINE lamp, then immediately set the switch to "OFF".



At the same moment the lamp starts flashing, the fuel pump should start running (unless it is defective). Listen for the sound of the pump or, if necessary, check the fuel pressure.

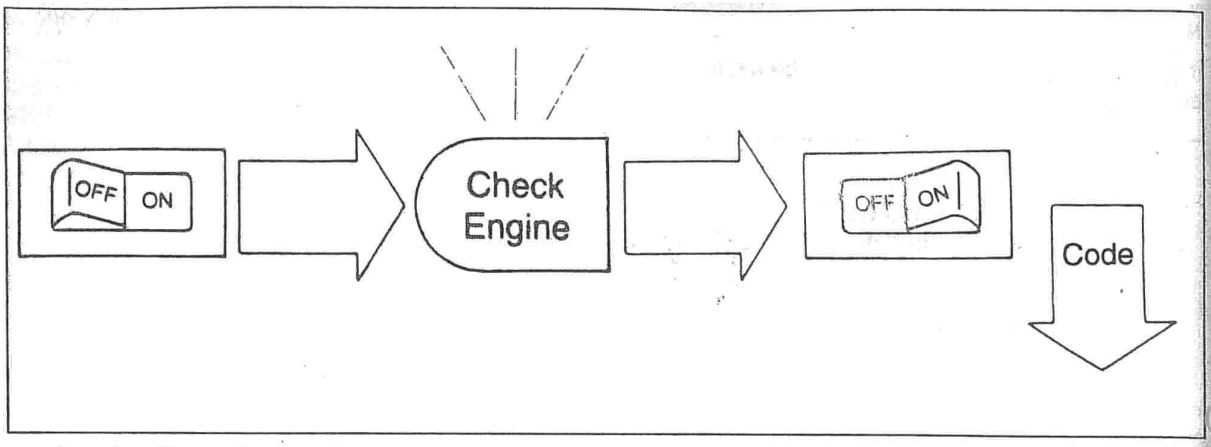
Note:

The fuel pump will run for less than a second. No ID code will be obtained during this test.

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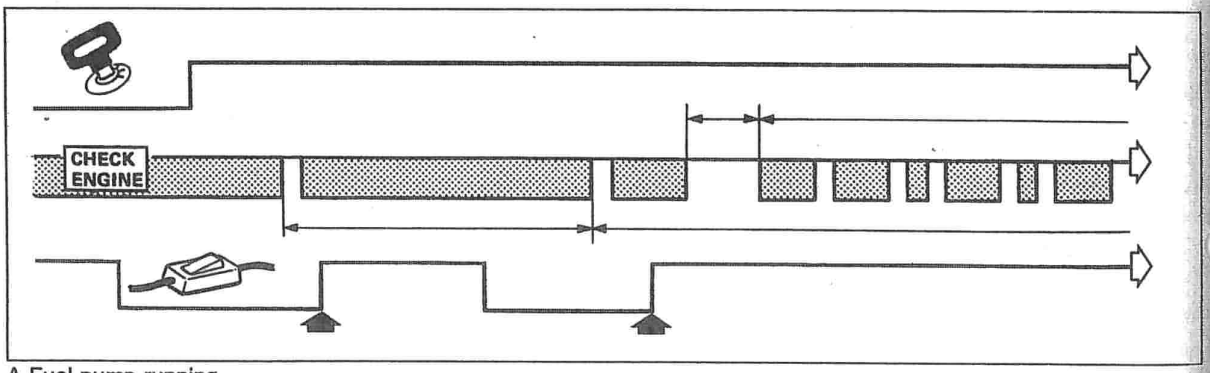
3 To move on to test No. 2 (injectors), set the switch to "ON".

4 After **a short flash,** set the switch to "OFF".



A code will now be displayed in the same way as for "Fault diagnosis - stored faults", i.e. first a long flash to indicate the start of the code, then a series of short flashes comprising the actual fault code, and finally another long flash to indicate the end of the code.

Check by listening for the sound of the injectors working.



A Fuel pump running
B Code start
C Injectors working

5 Run through the remaining points in the table in the same way. Set the switch to "ON", - wait for a short flash - and then set the switch to "OFF".

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Table for component and signal testing

ID code	CHECK ENGINE	Component/Signal	Remarks
———	—	Fuel signal	Listen (pump runs for about 1 second).
12411	—	Injectors	Listen.
12412	—	IAC valve	The valve switches between open and closed positions once a second. Listen.
12413	—	CP valve	The valve switches between open and closed positions once a second. Listen.
12421	—	"Drive" signal, automatic transmission	The lamp stops flashing on shifting from "N" to "D".
12424	—	Throttle position sensor, idling signal	The lamp stops flashing when the accelerator is depressed.
12431	—	Throttle position sensor, full-throttle signal	The lamp stops flashing when the accelerator is floored.

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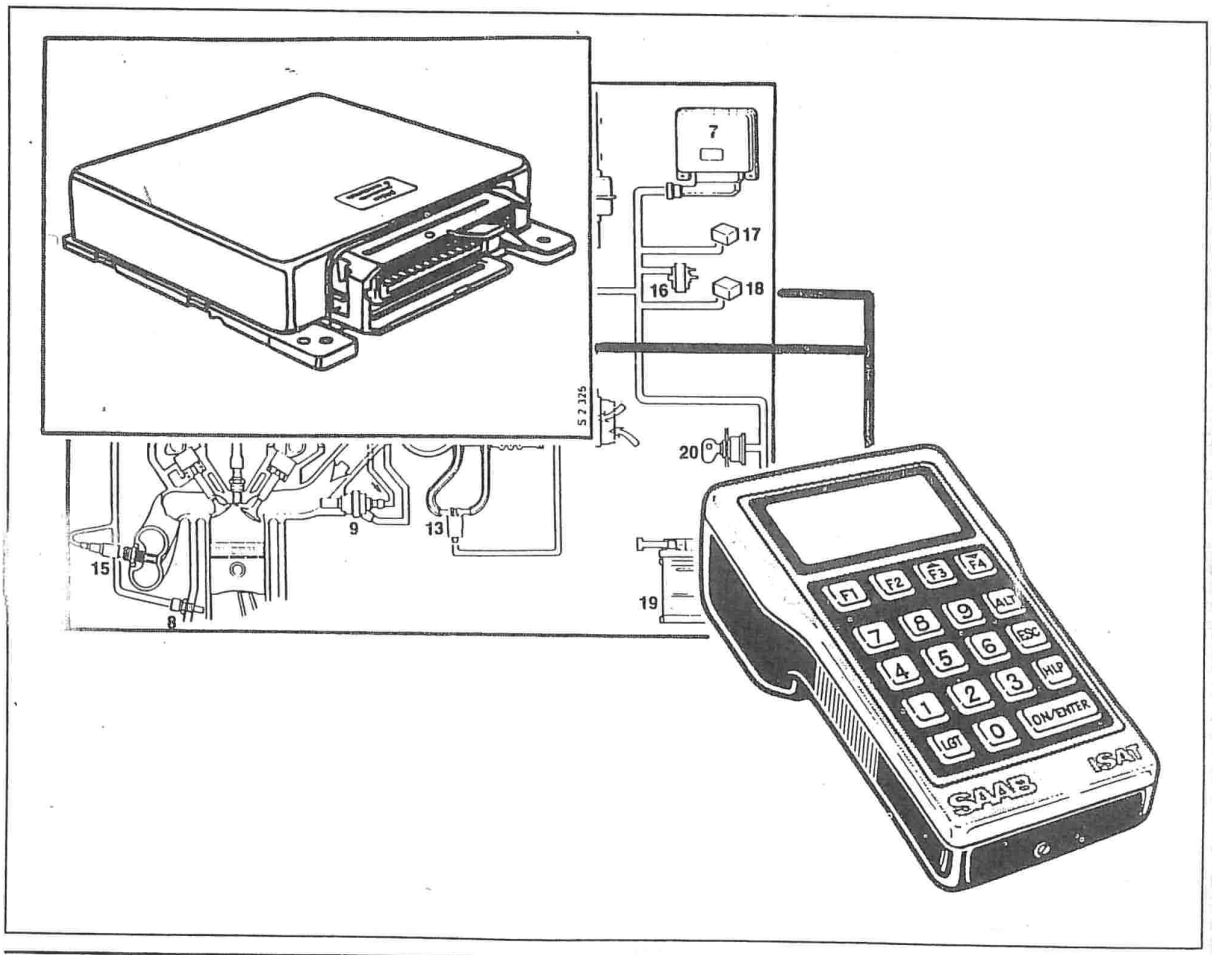
Fault diagnosis with an ISAT, LH 2.4 (M1990-)

Model year 1990 and later cars with a B202 engine and the LH 2.4 fuel injection system have additional diagnostic facilities and are consequently equipped with new control modules. A number of new fault codes have been added to the self-diagnosis function using ENGINE CHECK lamp flashes, and it will also be possible to carry out fault diagnosis by means of an ISAT.

However, use of the ISAT involves the addition of a number of control command codes by means of which the operation and current status of components can be checked.

As before, fault diagnosis can also be carried out by means of an LH system tester.

The fault diagnosis schedule with an ISAT does not include more fault codes than are incorporated in the self-diagnosis function, but will be fully developed for model year 1991 cars.



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Before starting fault diagnosis

Note:

Never unplug the connector from the control module or disconnect any of the battery cables before the contents of the control module memory have been transferred to the ISAT.

Apart from a thorough knowledge of the system, successful fault diagnosis on the LH system also requires the use of Saab's LH system tester or an ISAT diagnostics instrument.

Since the LH system's integrated self-diagnosis function continuously monitors and records the majority of possible faults, both permanent and intermittent, it is extremely easy to use an ISAT to identify the fault, rectify it and afterwards check that the system is in perfect working order.

The system's integrated self-diagnosis functions, combined with the facilities provided by an ISAT, make for faster and above all more accurate fault diagnosis. The risk of replacing good components is reduced while service and repair costs can be kept down.



The ISAT is an invaluable aid for efficient and accurate fault diagnosis.

Is the fault in the LH system?

Sometimes the LH system is suspected of being faulty when the fault really lies in the engine or some other auxiliary system. For this reason, remember to check the following points before starting fault diagnosis on the system.

- Battery condition
- Engine condition
- Charging system
- Other auxiliary systems
- Cable connections
- Grounding points

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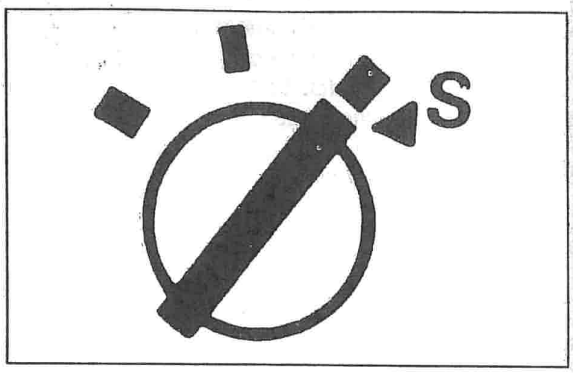
Fault diagnosis using an ISAT

For details of how to use the diagnostics instrument, see Service Manual 1:4 "ISAT".

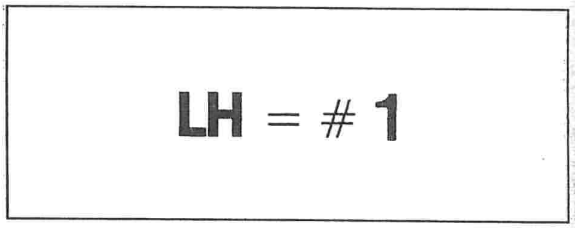
Diagnosis

Observe the following:

- Never unplug the connector from the control module or disconnect any of the battery cables before the contents of the control module memory have been transferred to the ISAT.
- The 10-pin diagnostics socket is located under the rear seat on the RH side. It is protected by a plastic cover.
- Turn the ignition switch to the Drive position.



- The LH system has been assigned system No. 1 in the ISAT.



- If communication between the ISAT and the control module cannot be established, first check the wiring between pins 12 and 16 of the control module and the diagnostics socket (347).

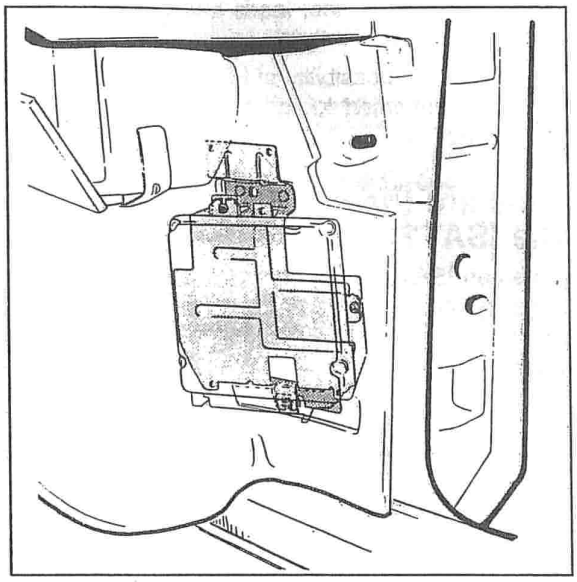
  Also check that power and ground are present at the diagnostics socket and that the pins of the connector are undamaged.
- When the contents of the system's fault memory have been transferred and stored in the ISAT, the actual diagnosis has been completed. The faults are now available in the form of five-digit codes, following which further fault diagnosis work can be continued as described in the "ISAT fault- diagnosis chart", page 100.

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Test readings on the control module connector

Before starting any fault diagnosis work on the LH system, the contact strip in the control module connector must first be exposed. All test readings must subsequently be taken from the side where the leads are connected to the pins in the connector.

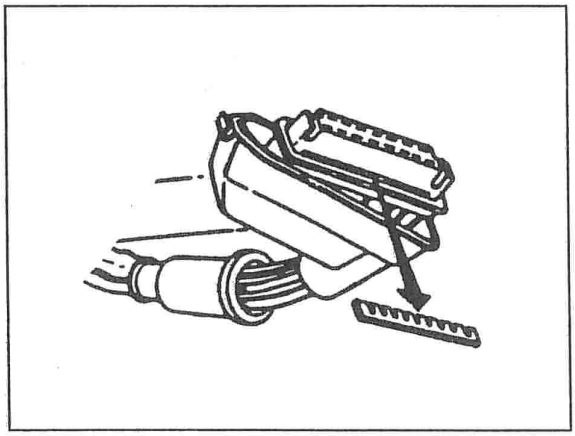
1 Remove the control module, located inside the car on the RH wheel arch.



2 Unplug the connector.

3 Remove the protective cover and rubber dust excluder.

4 Withdraw the rubber gasket and lift up the contact strip.



5 Plug in the connector.

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Checking the wiring

The words "Check the wiring between xx and yy" are used frequently in the fault-diagnosis charts. Sometimes the wiring may run through different types of connector and, by implication, these must also be checked for circuit continuity and shorting.

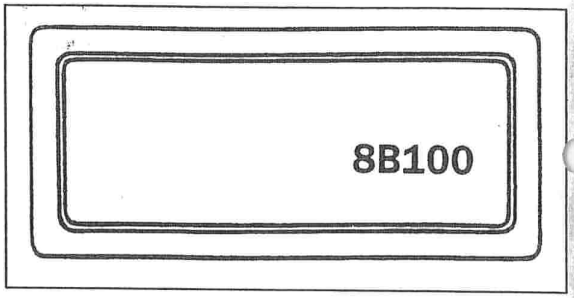
Also check by eye that leads and connectors, etc. are undamaged.

Be alert to the possibility of interference from components connected to, or adjacent to, the wiring concerned.

How are the results displayed on the ISAT?

When an ISAT is used to simulate signals or functions by means of command codes issued to the control module, the results are shown on the display as a combination of numbers and letters (alphanumeric code).

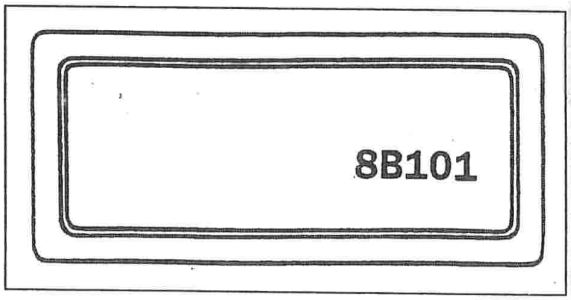
The result is displayed in the form of five characters.



Example 1:

To check the position of the throttle butterfly, we enter the command 201 on the ISAT keypad.'With the engine idling, the five alphanumeric characters appearing on the ISAT's display should be 8B101.

See also "ISAT control commands, LH 2.4 (M1990)" page 105.



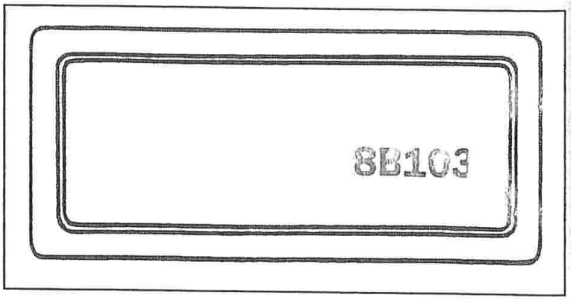
Example 2:

Sometimes we want to check whether a signal is high or low. To check the DRIVE signal, we enter the command 203 on the ISAT keypad.'

If the signal is not activated the display will show 8B000, signifying that the signal is low.If the signal is activated the signal should be high and the ISAT"s display ought to show 8B103.

See also "ISAT control commands, LH 2.4 (M1990)" page 105.

The five characters in the combination of letters and numbers (alphanumeric code) show the result of the entered command.



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Fault codes: LH 2.4 M1990, ISAT

Permanent	Intermittent	Malfunction indicated
67192	-	ROM faulty
45771	25771	Throttle position sensor: idling contacts not breaking circuit on increase of engine revs and load (constantly closed to ground).
45772	25772	Throttle position sensor: full-throttle contacts constantly closed.
46261	26261	Temperature sensor: constant signal.
46271	26271	Temperature sensor: temperature above +160°C (constantly grounded).
46221	26221	Temperature sensor: temperature below -90°C.
42291	22291	Control module pin 4: voltage below 10 V or above 16 V.
42251	22251	Control module pin 4: voltage too low (below 1 V).
58121	38121	Mass air flow sensor: no hot wire (filament) burn-off function.
45691	25691	Mass air flow sensor: signal faulty (too high or too low).
42491	22491	Fuel-air mixture faulty over a lengthy period (idling additive).
42492	22492	Fuel-air mixture faulty over a lengthy period (multiplicative when car being driven).
42450	22450	Fuel-air mixture too lean.
42440	22440	Fuel-air mixture too rich.
42460	22460	Lambda sensor: signal faulty.
58321	38321	IAC valve malfunctioning.
45723	25723	DRIVE signal malfunctioning.
58371	38371	Injectors: injection pulses malfunctioning.

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Fault diagnosis chart, LH 2.4 (M1990), ISAT

Permanent	Intermittent	Malfunction indicated	Action
67192		ROM faulty (control module fault).	Try a new control module.
45771	25771	Throttle position sensor (203): idling contacts not breaking circuit when engine speed increased from idling to 2500 rpm.	A Enter command 201 on the ISAT. Depress the accelerator slowly from idling to full-throttle position. The display should then show 8B101→8B001→8B301. If 8B001 is shown constantly, there is no continuity in the wiring to the throttle position sensor. Continue with points C and D. If 8B103 is shown, codes appear in the wrong place or do not change: Unplug the throttle position sensor connector. 8B001 should now appear on the display. If it does not, continue with point C, D or E. B If 8B001 is shown, try a new throttle position sensor. C If 8B101 is shown, check the wiring between pin 2 of the control module (200) and pin 1 of the throttle position sensor (203) and also between pin 2 of the control module and pin 7 of the EZK control module (176). D If 8B301 is shown, check the wiring between pin 3 of the control module (200) and pin 3 of the throttle position sensor (203) and also the TK pin on the AC relay (156). E If 8B103 is shown, check the wiring as described in points C and D. F Try a new LH control module.
45772	25772	Throttle position sensor (203): full-throttle contacts constantly closed.	See fault code 45771/25771 above.
46261	26261	Temperature sensor (202): signal constantly activated.	A Check the wiring between pin 13 of the control module (200) and pin 1 of the temperature sensor (202). B Check the wiring between pin 2 of the temperature sensor and grounding point 201. C Check for good ground at the grounding point. D Check the temperature sensor. E Try a new LH control module.

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Permanent	Intermittent	Malfunction indicated	Action
46271	26271	Temperature sensor (202): temperature above +160°C.	Check the resistance of the NTC resistor and the resistance between pin 13 of the control module and ground. The resistance should be 2280-2720 ohms at 20°C or 290-365 ohms at 80°C, measured with the connector unplugged from the control module.
46221	26221	Temperature sensor (292): temperature below -90°C.	See fault code 46721/26271 above.
42291	22291	Control module pin 4: voltage below 10 V or above 16 V.	Check the condition of the battery, charging system, grounding points, etc.
42251	22251	Control module pin 4: voltage too low (below 1 V).	Check the condition of the battery, charging system, grounding points, etc.
58121	38121	Mass air flow sensor (205): no hot wire (filament) burn-off function.	A Check the wiring between pin 8 of the control module (200) and pin 4 of the mass air flow sensor (205). B Check the wiring between pin 5 of the mass air flow sensor and pin 87B of the main relay (229). C Try a new mass air flow sensor. D Try a new LH control module.
45691	25691	Mass air flow sensor: signal faulty.	A Check for leakage in the induction system between the mass air flow sensor and the engine. B Check pin 1 (ground) and pin 5 (positive supply) of the mass air flow sensor. C Try a new mass air flow sensor. D Try a new LH control module.

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Permanent	Intermittent	Malfunction indicated	Action
42491	22491	Fuel-air mixture faulty for lengthy period on idling (additive adaptive fault, Lambda system)	A First check the system for air or fuel leakage or, alternatively, the preheating function of the Lambda sensor. B Check the induction system for leaks and also check that it is in proper working order. C Try a new control module.
42492	22492	Fuel-air mixture faulty for lengthy period when car is being driven (multiplicative adaptive fault, Lambda system)	A First check the system for air or fuel leakage or, alternatively, the preheating function of the Lambda sensor. B Check the induction system for leaks and also check that it is in proper working order. C Try a new control module.
42440	22440	Fuel-air mixture too rich.	A Check all screws, hoses, hose clips, O-rings, etc. for leaks and make sure that they are properly tightened. B Check the induction system for leaks and also check that it is in proper working order. C Check whether voltage is present across the pins on the Lambda sensor connector. D Check the fuse for the Lambda sensor preheating function. E Check whether the Lambda sensor fluctuates between 0 and 1.5 V (sensor hot). F Fit a new Lambda sensor. G Try a new control module. Check: enter command 205 on the ISAT. During the engine warm-up period, 8B105 (lean) and 8B305 (rich) should be shown on the display alternately (about 20 seconds each).
42450	22450	Fuel-air mixture too lean.	See fault code 42440/24440 above.
45723	25723	DRIVE signal malfunctioning.	A Check fuse No. 13. B Check whether battery voltage is present on pin 2 of the switch (31) (ignition switch in Drive position). If it is not: check the wiring between the +54 distribution terminal (231) and pin 2 of the switch. C Check the operation of the switch. D Check the wiring between the switch and pin 30 of the control module (200). Check: enter command 203 on the ISAT. Move the selector lever slowly from P to D. On the display, 8B003 (P and N positions) should change to 8B103 (Drive position).

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Permanent	Intermittent	Malfunction indicated	Action
46391	26391	EGR function faulty (USA-West).	A With the ignition switch in the Drive position (engine switched off), enter command 555 on the ISAT. Check that the modulating valve is working. If it is not: Check the yellow-white (GL/VT) lead between pin 19 of the control module and connector 394 and the white (VT) lead between the connector and the modulating valve (390). Also check the green-white (GN/VT) lead between the modulating valve and the injector distribution point, green- red (GN/RD) lead. B Try a new modulating valve. C Check the yellow-white (GL/VT) lead between the thermostatic switch (389) and pin 23 of the control module and the black (SV) lead between the thermostatic switch and grounding point 201. D Try a new thermostatic switch. E Try a new control module.
42460	22460	Lambda sensor (136) signal faulty.	A Check the operation of the Lambda sensor preheating function (check that battery voltage is present across pins 1 and 2 of connector 59). B Check the wiring between pin 24 of the control module (200) and connector 60. C Check the wiring between pin 5 of the control module and the braided screening round the Lambda sensor lead. D Run the engine to warm it up. Disconnect the lead from the Lambda sensor at connector 60 and measure the signal voltage. It should be 0.5 V. E Try a new Lambda sensor. F Try a new LH control module. Check: enter command 205 on the ISAT. Run the engine to warm it up and check that the display alternates between 8B105 (lean) and 8B305 (rich) at 20 second intervals. If the display shows 8B005, then the sensor is not activated.

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Permanent	Intermittent	Malfunction indicated	Action
58321	38321	IAC valve, no signal from pin 33.	A With the ignition switch in the Drive position (engine switched off), enter command 553 on the ISAT: The valve should have a pulse rate of about one per second. B Check that battery voltage is present at the distribution block 75. C Check the wiring between distribution block 75 and pin 30 of the main relay (229). D Check the wiring between pin 87 of the main relay and pin 1 of the IAC valve (272). E Check that battery voltage is present across pin 1 of the IAC valve (272) and ground. F Check the wiring between pin 33 of the control module and pin 2 of the IAC valve. G Check the setting and operation of the throttle position sensor (203). H Check that the throttle butterfly is correctly adjusted (as near as possible to the closed position with binding). I Try a new main relay. J Try a new IAC valve. K Fit a new LH control module.
58371	38371	Injectors (206) - injection pulses malfunctioning	A With the ignition switch in the Drive position (engine switched off), enter command 552 on the ISAT. The injectors should have a pulse rate of about 15 per second. B Check whether battery voltage is present on pin 30 of the main relay (229). C Check the wiring between pin 87 of the main relay and pin 1 of the injectors (206). D Check the wiring between pin 18 of the control module (200) and pin 2 of the injectors. E Try a new main relay. F Try a new LH control module.

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Control commands - LH 2.4 (M1990), ISAT

Code	Function	Display
550	Activates the AC function (0.2 Hz) (LH 2.4.1).	8A550
200	Checks status of AC (not TCS).	8B100 (activated)
201	Checks position of throttle butterfly.	8B101 (idling position) 8B001 (normal position) 8B301 (full-throttle position) 8B103 (idling + full-throttle)
552	Activates injectors (15 Hz and 1.5 ms opening duration) Disconnects the fuel pump.	8A552
553	Activates the IAC valve (1 Hz).	8A553
554	Activates the CP valve (1 Hz).	8A554
202	Checks position of CP valve.	8B002 (open) 8B102 (closed)
555	Activates EGR valve (1 Hz) (USA-West only).	8A555
203	Checks status of DRIVE signal.	8B103 (activated) 8B000 (not activated)
205	Checks status of Lambda sensor.	8B105 (lean) 8B305 (rich) 8B005 (inactive)
900	Clears all fault codes and resets all "adaptive" values to the basic levels.	11111
930	Resets all "adaptive" values to basic level.	11011
100	Transfers all fault codes from the control module memory to the ISAT.	
207	Displays control module identification code (last 4 digits of Bosch spare part number).	At the request of Saab Automobile AB

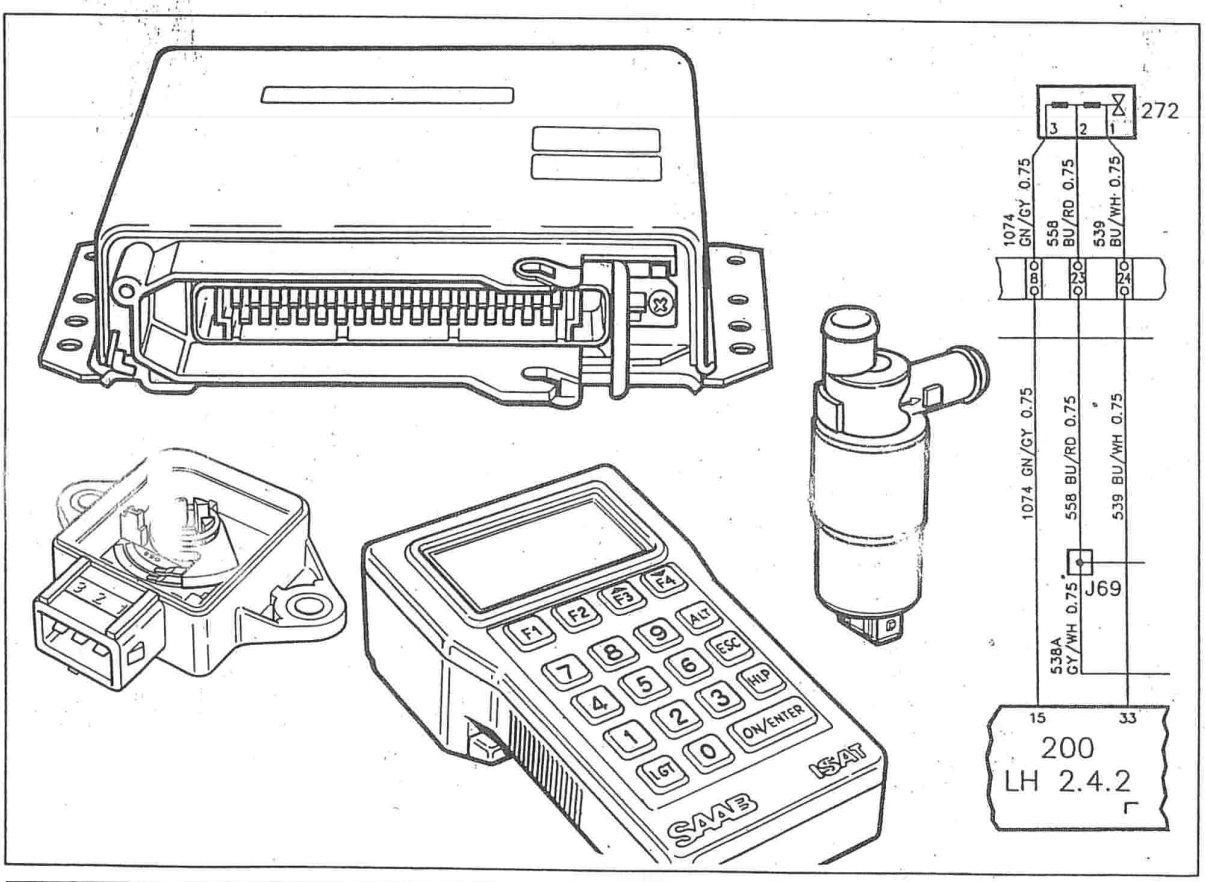
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Fault diagnosis with the ISAT, LH 2.4.2 and LH 2.4 (M1991-)

The LH 2.4.2 fuel injection system is fitted to all variants of the B212 engine.

The most important changes on the new LH 2.4.2 fuel injection system are the fitting of a new control module (providing an expanded fault diagnosis facility when using the ISAT) and the replacement of the throttle position switch by a throttle position sensor.

An IAC valve of new design is also fitted.



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LH 2.4.2 control module connections, test data

Pin	Colour of lead	Component/function	In-put	Out-put	Voltage (V)	Remarks
1	BU	Engine rpm signal from ignition system	x		6.5 >8 V	When starter motor engaged When idling
2	GY	Throttle position sensor 1+ 2.4. idling contact.	x		0.2 4.0 0	Idling Full throttle
3						Not used
4	RD	+30 supply	x		battery voltage	
5	BK	Signal ground			0	Ground connection separate from chassis ground
6	BU/WH	Mass air flow sensor, ground signal	x		0	
7	OG	Mass air flow sensor, signal	x		2	Idling with engine running Full throttle with engine running
8	RD/WH	Mass air flow sensor, hot wire (filament) burn-off		x	4 0	On burn-off In other cases
9	BU/WH	Voltage supply from main relay	x		battery voltage	
10	GN/RD	Throttle position sensor, reference voltage from / (2.4.		x	5	
11	RD/WH	AC relay, control circuit from 2.4.		x	battery voltage 0	AC off AC on
12	BU/WH	Diagnostics lead K (PWM)	x	x		
13	YE	Temperature sensor, engine temperature	x		4-0.5	-20 °C (+80 °C)
14	BU/WH	AC, load signal	x		12 0	AC on AC off
15	GY/RD	IAC, opening control signal		x	7-11	No-load idling and hot engine
16	GY/WH	Diagnostics lead L	x	x		PWM signal
17	BK/WH	Chassis ground			0	
18	GN/RD	Injectors		x		Use the ISAT"s pulse measurement function and check that the frequency increases as the throttle is opened

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Pin	Colour of lead	Component/function	In-put	Out-put	Voltage (V)	Remarks
19	WH	EGR valve		x	battery voltage <battery voltage	not activated activated
20	VT	Fuel pump relay, control circuit		x	1 battery voltage	Activated Ignition on
21	YE/WH	Main relay, control circuit		x	1 battery voltage	ignition on ignition off
22	VT/WH	CHECK ENGINE lamp		x	battery voltage 1	off on
23	YE/WH	EGR, temperature sensor	x		4.5 <4.5 V	EGR closed EGR open
24	GN	Lambda sensor signal	x		0.6-1.0 0-0.4	rich lean
25	BU/RD	Load signal, Tq		x		*)
26	YE	Shift-up lamp (US manual gearbox)		x	battery voltage 0	not activated activated
27	YE/RD	Tank vent valve		x	battery voltage 1	valve open valve closed
28						Not used
29	GY/WH	Coding	x			Not used
30	OG	DRIVE signal	x		battery voltage 0	R, D, 1, 2 and 3 P, N and man vxl
31						Not used
32	BN	Cold-start valve (some variants)		x	battery voltage 0	not activated activated (<-15°C)
33	BU/WH	IAC, closing signal		x	5-11	No-load idling
34	GN	Signal from speed sensor	x		6 0 or 12	Rotating wheel Stationary wheel
35	GN/WH	+15 supply	x		battery voltage	ignition on

*) Use the ISAT"s pulse measuring function and check that pulse duration and frequency change as the throttle is opened.

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Differences in test data, control module connections

The differences are in respect of:

- LH 2.4

LH 2.4 control module connections, test data

Pin	Colour of lead	Component/function	In-put	Out-put	Voltage (V)	Remarks
2	GY	Throttle position sensor, idling contacts			0 battery voltage	at idling speed above idling speed
3	GN/RD	Throttle position sensor, full-throttle contacts			battery voltage 0	at idling speed above idling speed
10						Not used
11						Not used
15	GN/YE	Coding for cold-start valve			12 0	valve fitted valve not fitted
33	BU/WH	IAC, control signal			5-12	
34						Not used

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Fault diagnosis, LH 2.4 and LH 2.4.2

Additional fault codes and command codes

On model year 1991 and later cars, the LH 2.4 and LH 2.4.2 fuel injection systems incorporate a number of additional fault codes that can be retrieved by means of an ISAT.

There are also more command codes, so that the number of usable codes now amounts to more than 20.

Like the table of command codes, the fault code table contains all the codes but those that have been added for model year 1991 are specially marked. All fault codes beginning with 4 or 5 are permanent faults while those beginning with 2 or 3 indicate that the fault is of an occasional or intermittent nature.

Fault diagnosis using the ISAT

Before starting fault diagnosis

Apart from a thorough knowledge of the system, successful fault diagnosis on the LH system also requires the use of an ISAT diagnostics instrument.

Since the LH system's integrated self-diagnosis function continuously monitors and records the majority of possible faults, both permanent and intermittent, it is extremely easy to use an ISAT to identify the fault, rectify it and afterwards check that the system is in perfect working order.

The system's integrated self-diagnosis functions, combined with the facilities provided by an ISAT, make for faster and above all more accurate fault diagnosis. The risk of replacing good components is reduced while service and repair costs can be kept down.

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Is the fault in the LH system?

Sometimes the LH system is suspected of being faulty when the fault really lies in the engine or some other auxiliary system. For this reason, remember to check the following points before starting fault diagnosis on the system.

- battery condition
- engine condition
- charging system
- other auxiliary systems
- cable connections
- grounding points
- ignition system

Some important points to remember:

1 When carrying out fault diagnosis on microprocessor- controlled systems, memory sectors may be corrupted and give unusual symptoms.

To erase all unusual symptoms, switch off the ignition for at least 35 seconds.

2 Read and make a note of all fault codes stored in the memory before disconnecting the battery or control module.

Never disconnect the control module while the ignition is switched on as this will very likely ruin it.

3 When carrying out fault diagnosis on a car's electronic systems, always check first and foremost that the ground connections of the control module concerned are OK and that all supply voltages are correct. This is strongly recommended.

4 Always check the connector connections before starting fault diagnosis in other areas.

Unplug the connectors and check that the pins are undamaged and secured with their barbs.

Plug in the connectors again and clear all fault codes. Start the car and drive it to check whether the fault or faults persist.

5 On first being detected, every fault is assigned a fault code corresponding to a permanent fault. If the fault disappears, it will be assigned an intermittent fault code instead.

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6 Since all signals round the 12 V level are proportional to battery voltage, the levels should only be used as guidance.

7 0 V signals denote ground but readings slightly above 0 V may be obtained on a sensitive multimeter.

8 Readings of the voltage on inputs and outputs must only be taken with the ignition switched on or with the engine running.

9 The black diagnostics socket is located under the rear seat on the RH side.

It is protected by a plastic cover.

10 The ignition switch should always be turned to the Drive position when carrying out diagnosis.

11 The LH system has been assigned system No. 1 in the ISAT.

12 If communication between the ISAT and the control module cannot be established, first check the wiring between pins 12 and 16 of the control module and the diagnostics socket (347).

Also check that power and ground are present at the diagnostics socket and that the pins of the connector are undamaged.

13 When the contents of the system's fault memory have been transferred and stored in the ISAT, the actual diagnosis has been completed. The faults are now available in the form of five-digit codes, following which further fault diagnosis work can be continued in accordance with the fault-diagnosis chart for the system concerned.

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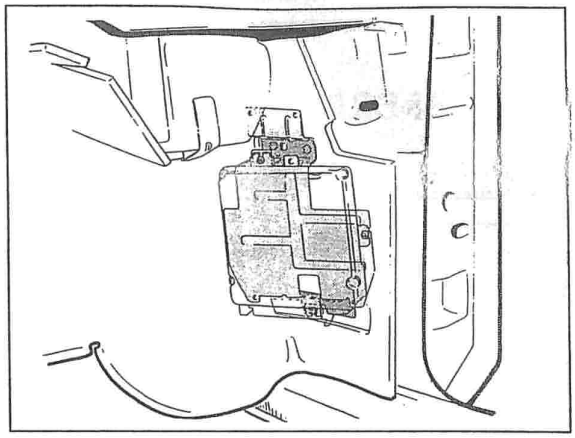
Test readings on the control module connector

Before taking any test readings on the LH system, the contact strip in the control module connector must first be exposed. All test readings must subsequently be taken from the side where the leads are connected to the pins in the connector.

1 Remove the control module, located inside the car on the RH side between the wheel arch and the front door pillar.

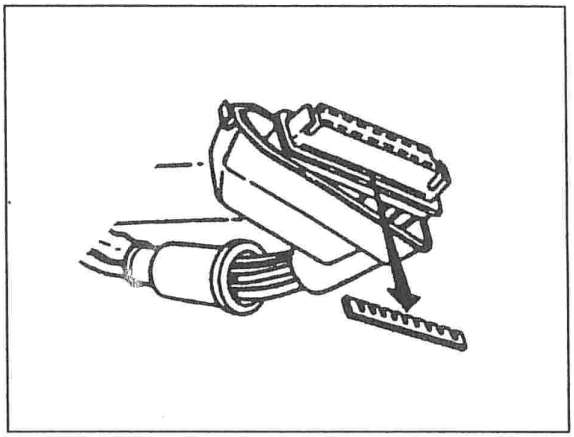
2 Unplug the connector.

3 Remove the protective cover and the rubber dust excluder.



4 Withdraw the rubber gasket and lift up the contact strip.

5 Plug in the connector.



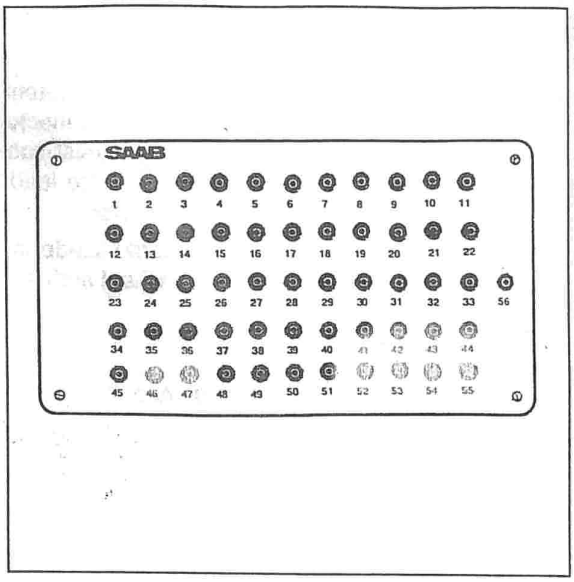
Checking the wiring

The words "Check the wiring between xx and yy" are used frequently in the fault-diagnosis charts.
Sometimes the wiring may run through different types of connector and, by implication, these must also be checked for circuit continuity and shorting.
Also check by eye that leads and connectors, etc. are undamaged.
Be alert to the possibility of interference from components connected to, or adjacent to, the wiring concerned.

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Breakout box

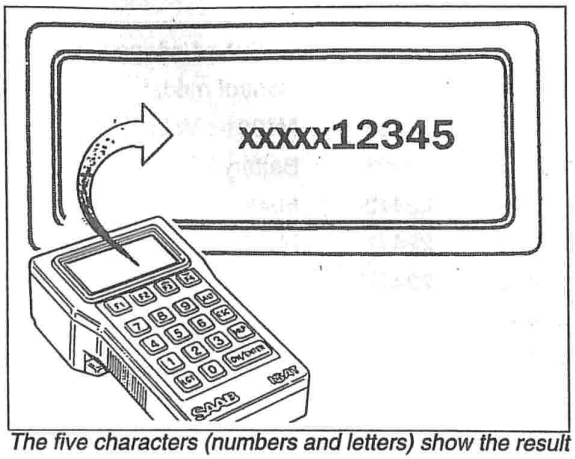
For taking test readings on the control module, primarily in the TC/ABS system, a breakout box is now available to facilitate fault diagnosis. This breakout box, which has part No. 86 11 006, can of course also be used for diagnosing faults in the LH system.



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ISAT command codes

When the ISAT is used for simulating signals or functions by sending command codes to the control module, the results will be shown on the display as a combination of numbers and letters (alphanumeric code)
The result is shown in the form of five characters.



The five characters (numbers and letters) show the result of the entered code.

Example 1:

To check the position of the throttle butterfly we enter command 201 on the ISAT keypad.

With the engine running, the last five characters on the ISAT display should read 8B101.

Example 2:

Sometimes we want to check whether a signal is high or low. To check the DRIVE signal we enter the command 203 on the ISAT keypad.

If the signal is not activated, 8B000 will appear on the display to indicate that the signal is low.

If the signal is activated, it should be high and the ISAT display should show 8B103.

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Fault codes - LH 2.4 and LH 2.4.2

Permanent	Intermittent	Faulty component/signal	Action, see page
42241	22241	M1991-: Voltage too high, above 16 V	119
42251	22251	Control module pin 4, voltage too low (less than 1 V)	119
42252	22252	M1991-: Voltage too low, below 10 V	119
42291	22291	Battery voltage, voltage below 10 V or above 16 V	119
42440	22440	Fuel-air mixture too rich, Lambda sensor unable to act	120
42441	22441	M1991-: Fuel-air mixture too rich when engine idling	120
42442	22442	M1991-: Fuel-air mixture too rich when car being driven	120
42450	22450	Fuel-air mixture too lean, Lambda sensor unable to act	120
42451	22451	M1991-: Fuel-air mixture too lean when engine idling	120
42452	22452	M1991-: Fuel-air mixture too lean when car being driven	120
42460*	22460*	Lambda sensor, signal faulty	120
42491	22491	Fuel-air mixture faulty when engine idling	120
42492	22492	Fuel-air mixture faulty when car being driven	120
44221	24221	M1991-: No speed pulses	123
44261	24261	M1991-: Speed sensor, signal faulty	124
45641*	25641*	M1991-: Mass air flow sensor, signal too high	125
45651*	25651*	M1991-: Mass air flow sensor, signal too low	125
45691*	25691*	Mass air flow sensor, signal faulty (too high or too low)	125
45723	25723	DRIVE signal, function faulty	127
45771*	25771	Throttle position switch/throttle position sensor, indicates idling position when car being driven (idling contacts constantly closed and grounded)	128
45772*	25772	Throttle position switch/throttle position sensor, indicates full throttle and idling positions simultaneously	128
46221*	26221	Temperature sensor, temperature below -90°C (break) when car being driven	132
46271*	26271	Temperature sensor, temperature above +160°C (constantly grounded)	132
–	–	Electronic EGR	134
58121*	38121	Mass air flow sensor, no hot wire (filament) burn-off function	137
58321	38321	IAC valve, function faulty	138
58322*	38322	CP valve, function faulty	142
58371*	38371	Injector faulty	140
58372*	38372	M1991-: CP valve, open circuit/shorting to ground	142
58382*	38382	M1991-: CP valve, shorting to positive supply	142
67192*	-	ROM fault	

*) In connection with these faults, the CHECK ENGINE lamp lights up.

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Command codes
LH 2.4 and LH 2.4.2

Code	Function/signal	Display text/example
22A	Mass air flow sensor, signal	803.6 = 3.6 V 804.7 = 4.7 V
22B	Battery voltage	8010.6 = 10.6 V 8007.3 = 7.3 V
23A	EGR, pulse ratio	80000 = 0 %(valve closed) 80012 = 12 %
100	All fault codes transferred	
200	Checks AC status	8B100 = activated 8B000 = not activated
201	Throttle butterfly position	8B101 (idling position) 8B001 (normal position) 8B301 (full-throttle position) 8B103 (idling + full-throttle)
202	CP valve position	8B002 (open) 8B102 (closed)
203	DRIVE signal status	8B103 = active 8B003 = not active
204	Shift-up indication	8B104 = lamp on 8B004 = lamp off
205	Lambda sensor status	8B105 (lean) 8B305 (rich) 8B005 = not active
206	PRE-IGNition signal*	8B106 = enrichment pre-ignition 8B006 = enrichment knocking
207	Ignition pulses	8B007 (no pulses) 8B107 (pulses present)
239	IAC, pulse ratio	80035 = 35% 80043 = 43%

*) when functioning normally, the ISAT should alternately show 8B006 and 8B106

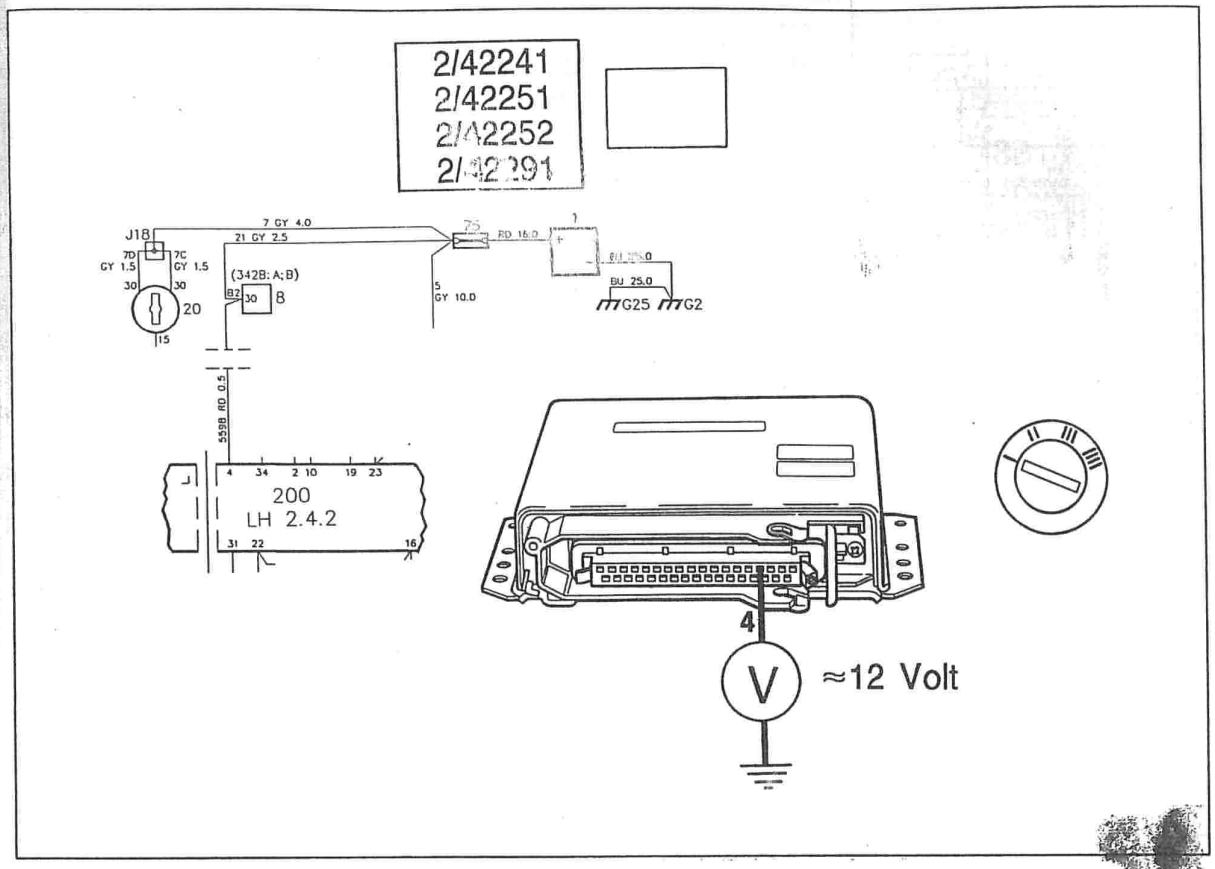
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Code	Function/signal	Display text/example
249	Speed	801000 = 1000 rpm 805500 = 5500 rpm
250	Coolant temperature	800-30 = -30°C 80+130 = +130°C
279	Throttle butterfly angle in degrees (°)	Ex. 80030 = 30°
382	Control module code	(The last four digits of the Bosch spare part No.)
550	Activates the AC function	8A5550 = activated
552	Activates injectors	8A552 (15 Hz and 1.5 ms opening duration)
553	Activates IAC (1 Hz)	8A553
554	Activates CP (1 Hz)	8A554 from control module memory to ISAT
555	Activates EGR (1 Hz)	8A555 = activated (USA-West only)
800	Ends communication	
900	Clears all fault codes and resets all "adaptive" values to basic level	11111
930	Resets adaptive values to basic level	11011

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Fault diagnosis chart, LH 2.4 and LH 2.4.2

Fault codes 2/42241, 2/42251, 2/42252, 2/42291



Malfunction indicated

Incorrect voltage level (below 10 V or above 16 V) applied to pin 4 of the control module.

Fault symptom

Car runs poorly or will not start.

Test procedure

1 Check the battery and also the starting and charging systems.

2 With the ignition switched off, check that battery voltage is present on pin 4 of the control module.

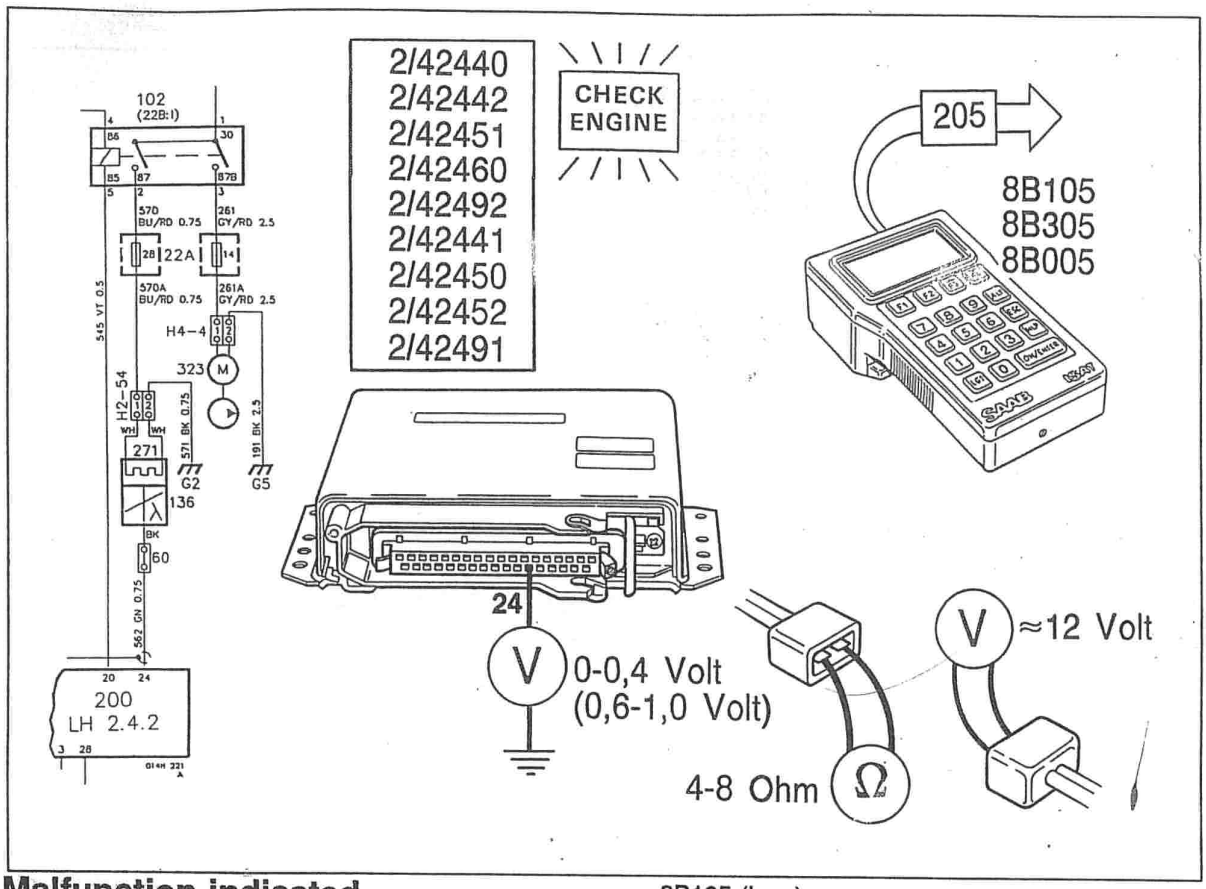
If it is not, check the red lead and yellow lead connected to distribution block 75 adjacent to the battery tray for continuity.

3 Clean and check the connections at the following grounding points:

- battery
- grounding point G2 behind the battery
- grounding point G25 on the gearbox
- grounding point G7 on the engine

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Fault codes 2/42440, 2/42441, 2/42442, 2/42450, 2/42451, 2/42452, 2/42460, 2/42491, 2/42492



Malfunction indicated

Incorrect fuel-air mixture

Fault symptom

Poor drivability because the fuel-air mixture is too rich or too lean.
CHECK ENGINE lamp alight.

Test procedure

Note:

During the car's running-in period (up to 500 km), any of these fault codes may be generated without any fault actually existing.
In these cases, check carefully to see whether the fault code is generated again after it has been cleared.

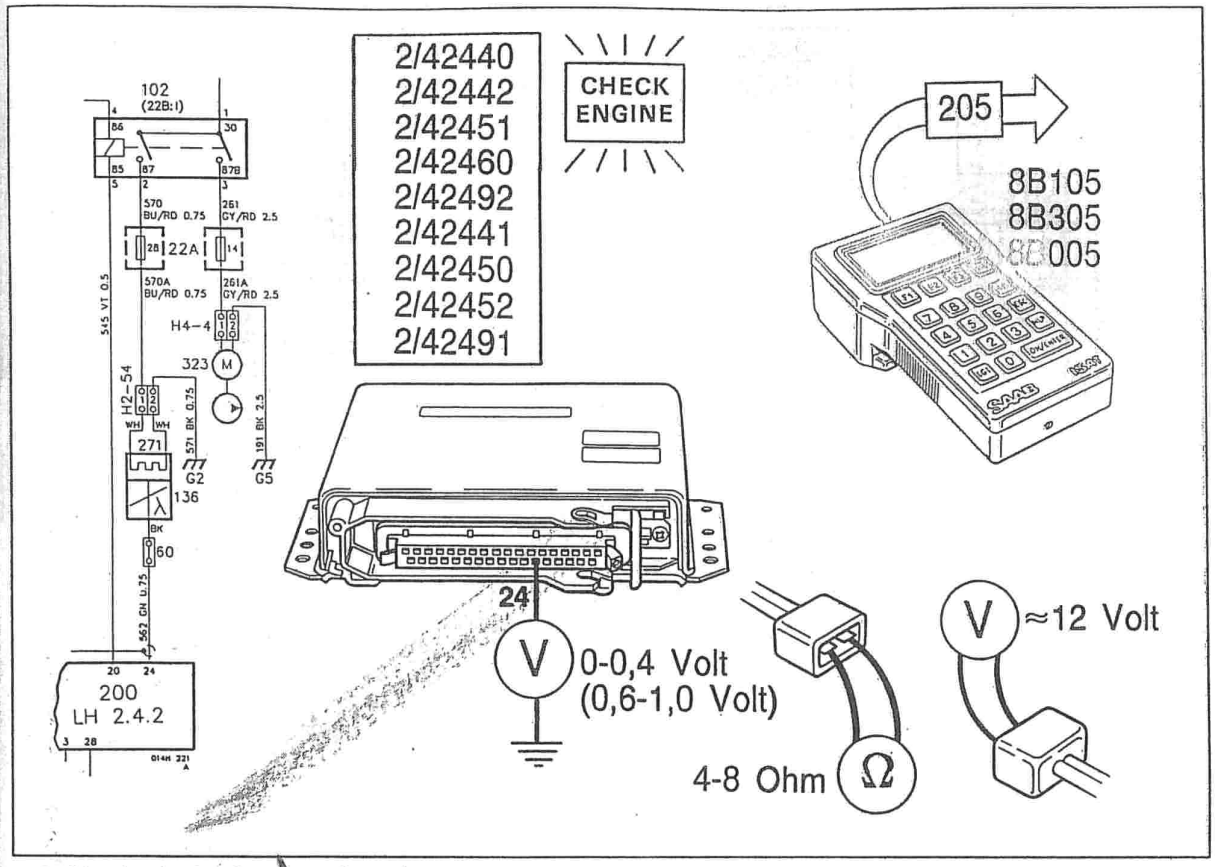
1 With the engine warmed-up, enter command code 205 on the ISAT. The following codes should appear on the display one after the other in a continuous cycle.

- 8B105 (lean)
- 8B305 (rich)
- 8B005 (inactive)

If any of the codes is displayed continuously, it indicates that the Lambda sensor is not working properly.

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Fault codes 2/42440, 2/42441, 2/42442, 2/42450, 2/42451, 2/42452, 2/42460, 2/42491, 2/42492



2 Check whether battery voltage is present across the pins of the Lambda sensor connector.

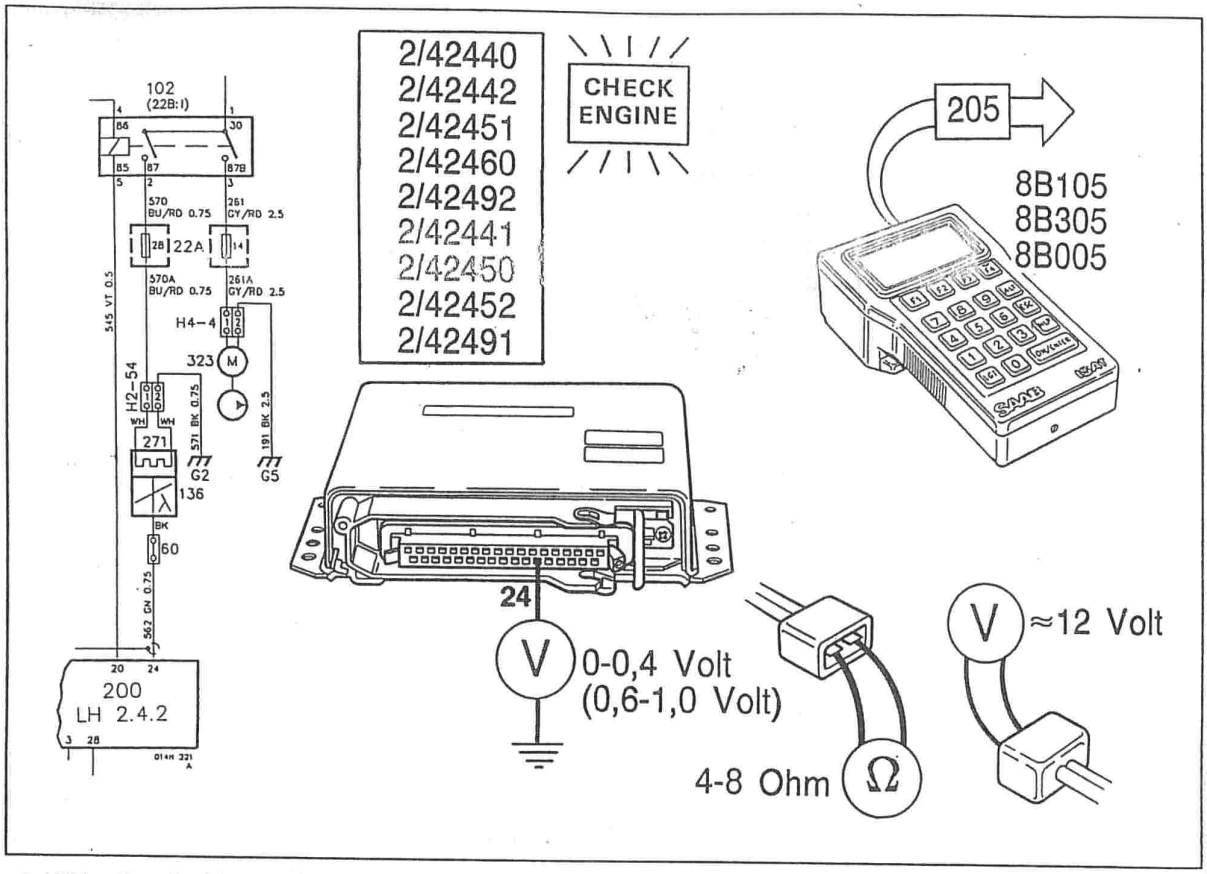
If voltage is present, go to point 3.

If not, check:

- fuse No. 1 of the Lambda sensor.
- the BU/RD lead between pin 1 and fuse No. 1 of the Lambda sensor connector for continuity/ shorting.
- the BK lead between pin 2 of the Lambda sensor connector and ground for continuity/shorting.

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Fault codes 2/42440, 2/42441, 2/42442, 2/42450, 2/42451, 2/42452, 2/42460, 2/42491, 2/42492



3 With the ignition switched off, unplug the Lambda sensor preheating connector and measure the resistance across the sensor connections (WH-WH).

The resistance should be 4-8 ohms.

In the event of an open circuit or high resistance, fit a new Lambda sensor.

4 Check the induction system for leaks by listening for the sound of air escaping.

5 Check the fuel pressure and operation of the fuel pressure regulator.

Relative to the pressure in the inlet manifold, the fuel pressure should be:

- 3.0 bar (all LH 2.4.2)
- 2.5 bar (LH 2.4 Turbo)
- 3.0 bar (LH 2.4 i)

If the fuel pressure is incorrect, fit a new pressure regulator.

6 With the engine idling, measure the sensor signal across pin 24 of the control module and a good grounding point.

The signal should swing between 0 and 0.4 V (lean) and 0.6- 1.0 V (rich) when the engine is hot.

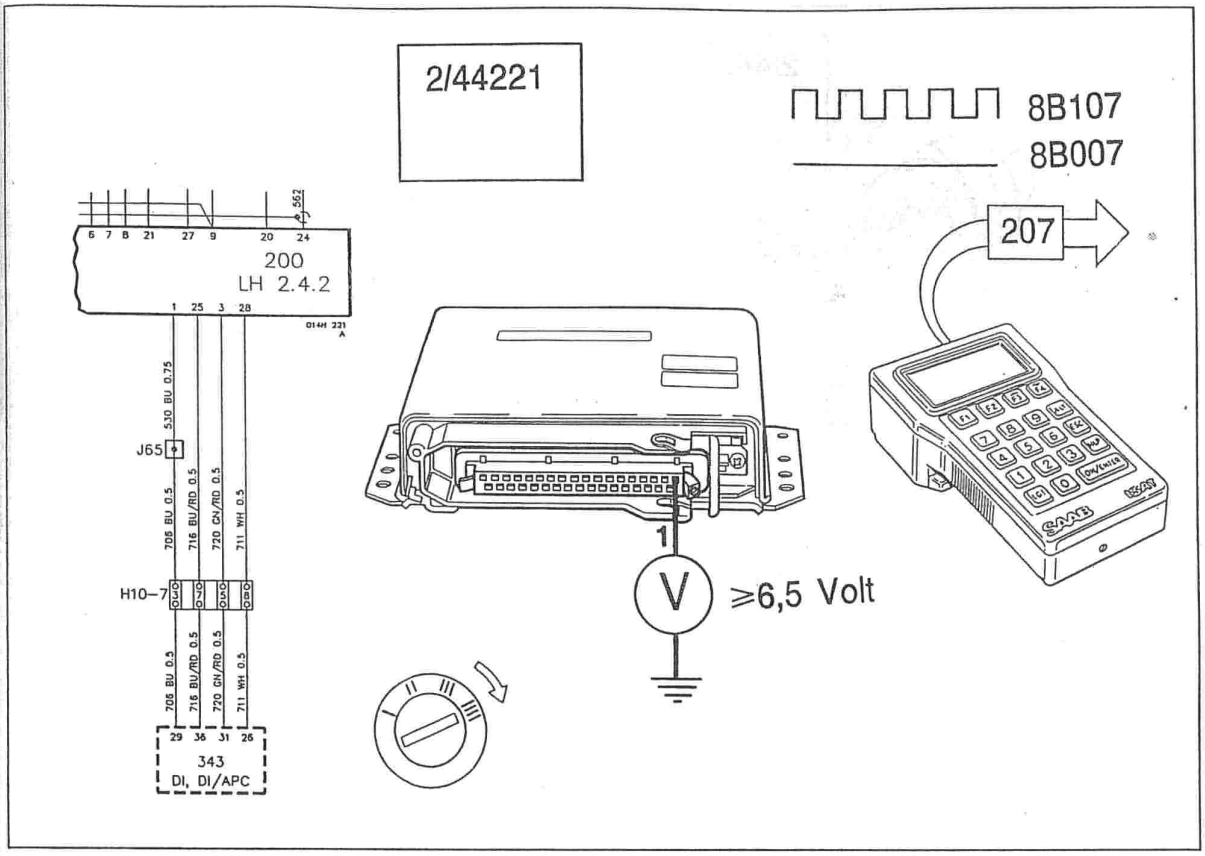
If it does not, check the GN and BK leads between pin 24 of the control module and the Lambda sensor for continuity/shorting.

7 If the fault persists in spite of the above tests, fit a new Lambda sensor and check system operation afresh by entering command code 205 on the ISAT.

8 Try a new control module.

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Fault code 2/44221



Malfunction indicated

No speed signal received by the control module from the ignition system.

Fault symptom

Engine fails to start.

Test procedure

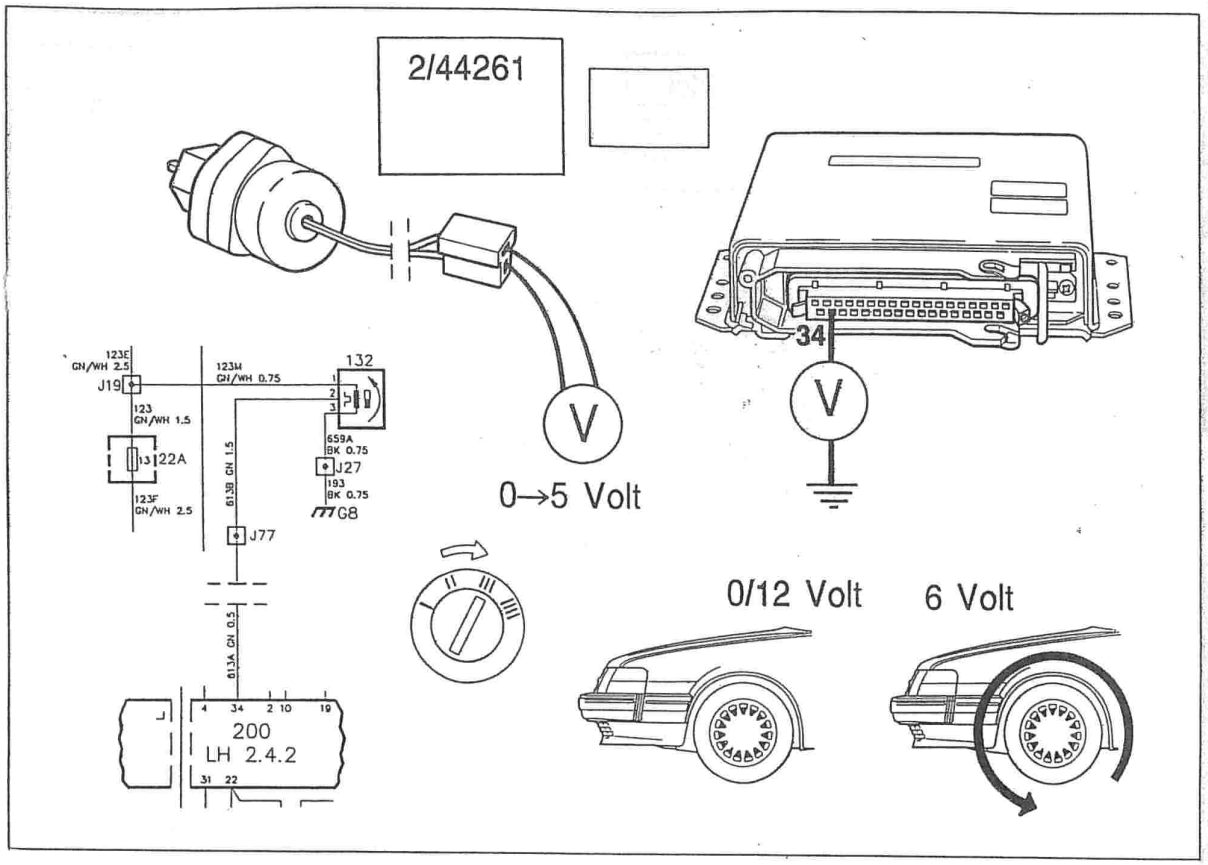
1 Check whether the voltage on pin 1 of the control module is higher than 6.5 V while the starter motor is engaged.

If it is not, check the BU lead between pin 1 of the LH control module and the ignition system for continuity/shorting.

2 If necessary, further fault diagnosis should be carried out as described for the relevant ignition system in Service Manual 3:2.

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Fault code 2/44261



Malfunction indicated

Speed sensor signal faulty or absent.

Fault symptom

Poor idling.

Test procedure

1 Check that the speedometer is working properly.

2 With the control module connector unplugged, measure the voltage across pin 34 of the connector and ground.

The voltage should swing between 0.5 and 5.0 V when either of the front wheels is spun round.

If it does not, check the GN lead between the speed sensor and pin 34 of the connector.

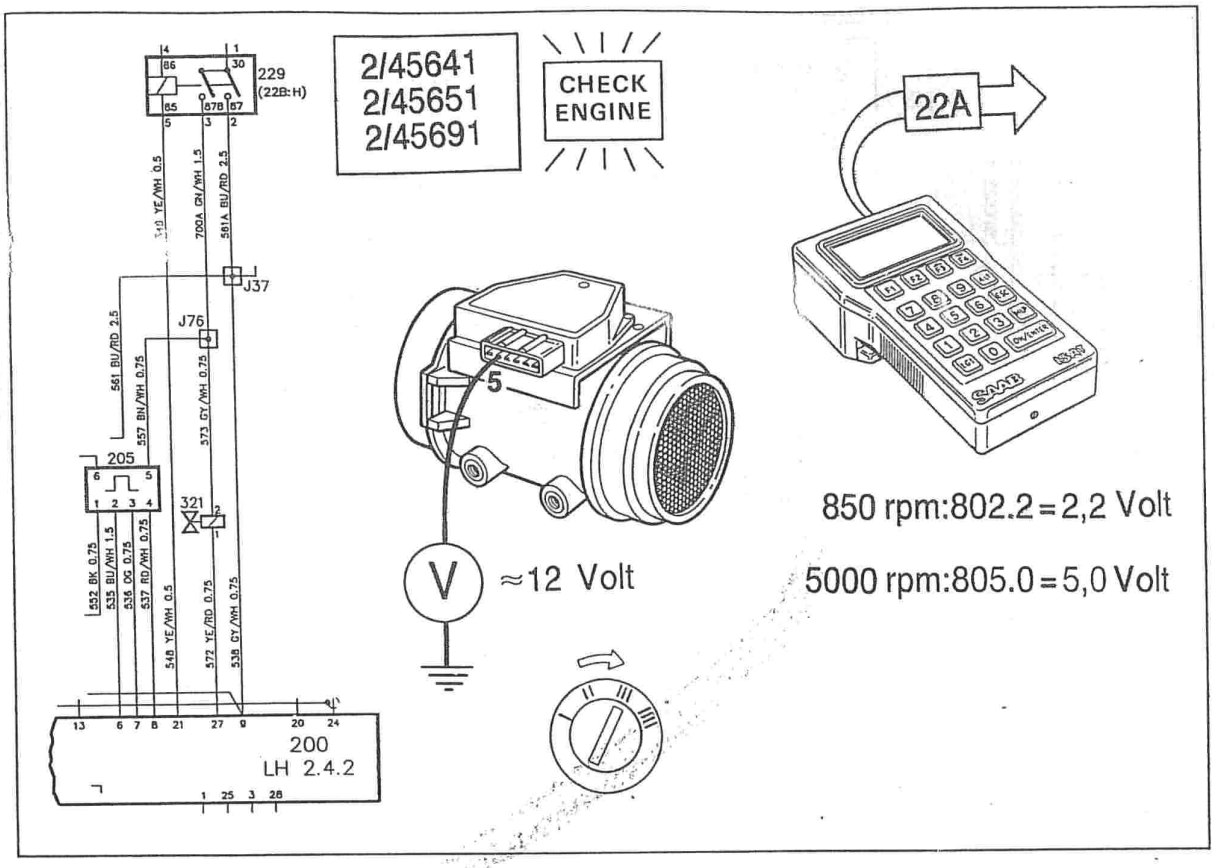
3 Check whether the Cruise Control function (if fitted) works properly (the speed signal is taken from the same sensor in the speedometer).

4 Try a new sensor in the speedometer.

5 Try a new control module.

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Fault codes 2/45641, 2/45651, 2/45691



Malfunction indicated

Signal from mass air flow sensor faulty or absent.

Fault symptom

Poor drivability, starting difficulty and high fuel consumption. Fault code often appears together with other fault codes.
CHECK ENGINE alight.

Test procedure

1 Enter command code 22A on the ISAT and check that the display shows the following:

- 802.0 = 2.0 V on idling
- 805.0 = 5.0 V on full throttle

2 Check the induction system for leaks by pressurizing it and listening for the sound of air escaping.

3 Check that pin 1 of the mass air flow sensor has a good connection to ground.

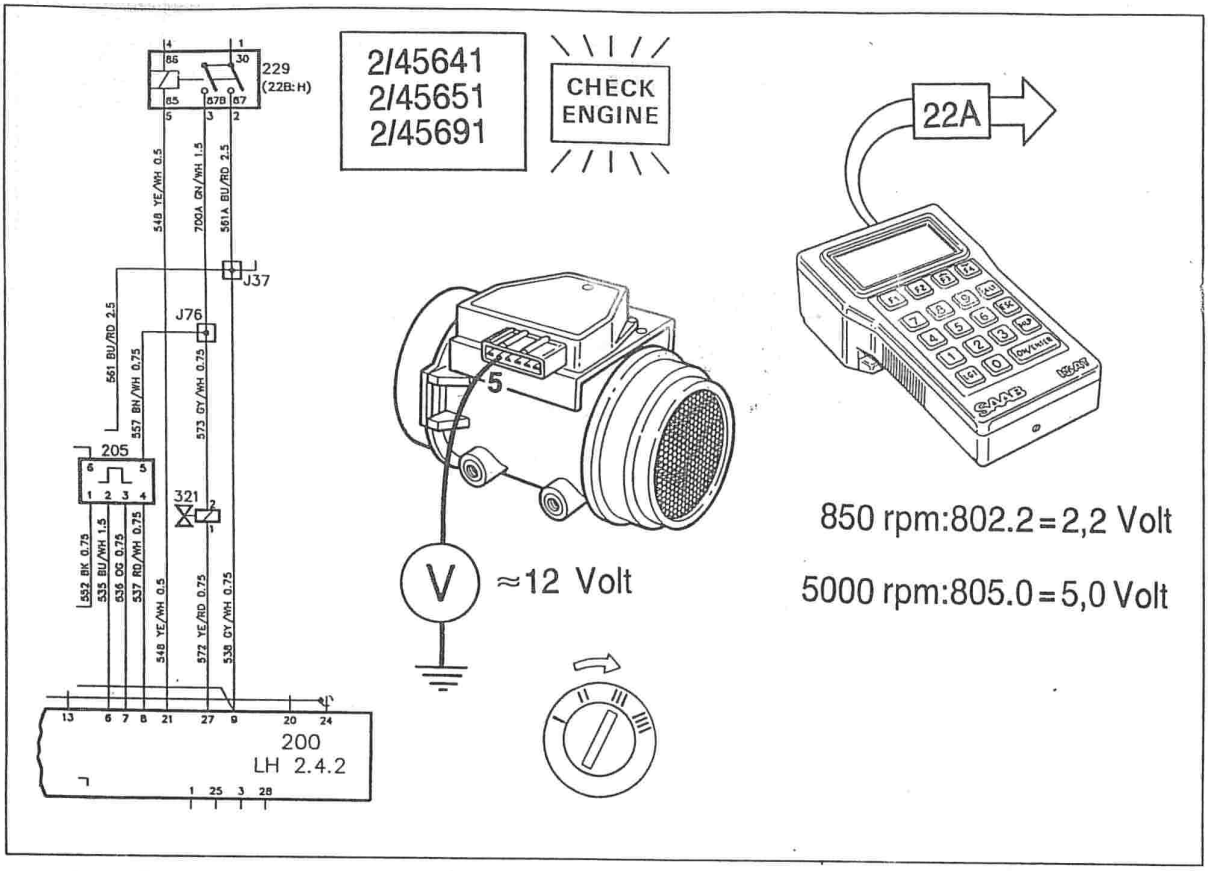
If not, check the BK lead between pin 1 of the mass air flow sensor and ground for continuity/shorting.

4 With the ignition switch in the Drive position, check whether battery voltage is present on pin 5 of the mass air flow sensor.

If it is not, check the BN/WH lead between pin 5 of the mass air flow sensor and pin 87 of the main relay for continuity/shorting.

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Fault codes 2/45641, 2/45651, 2/45691



5 Enter command code 22A on the ISAT and check that the signal varies between 2 and 5 V, depending on the load (the display should show 802.0-805.0).

   If it does not, check the OG lead between pin 7 of the control module and pin 3 of the mass air flow sensor for continuity/shorting.

6 Check that pin 2 of the mass air flow sensor is properly grounded.

   If it is not, check the BU/WH lead between this pin and pin 6 of the control module for continuity/shorting.

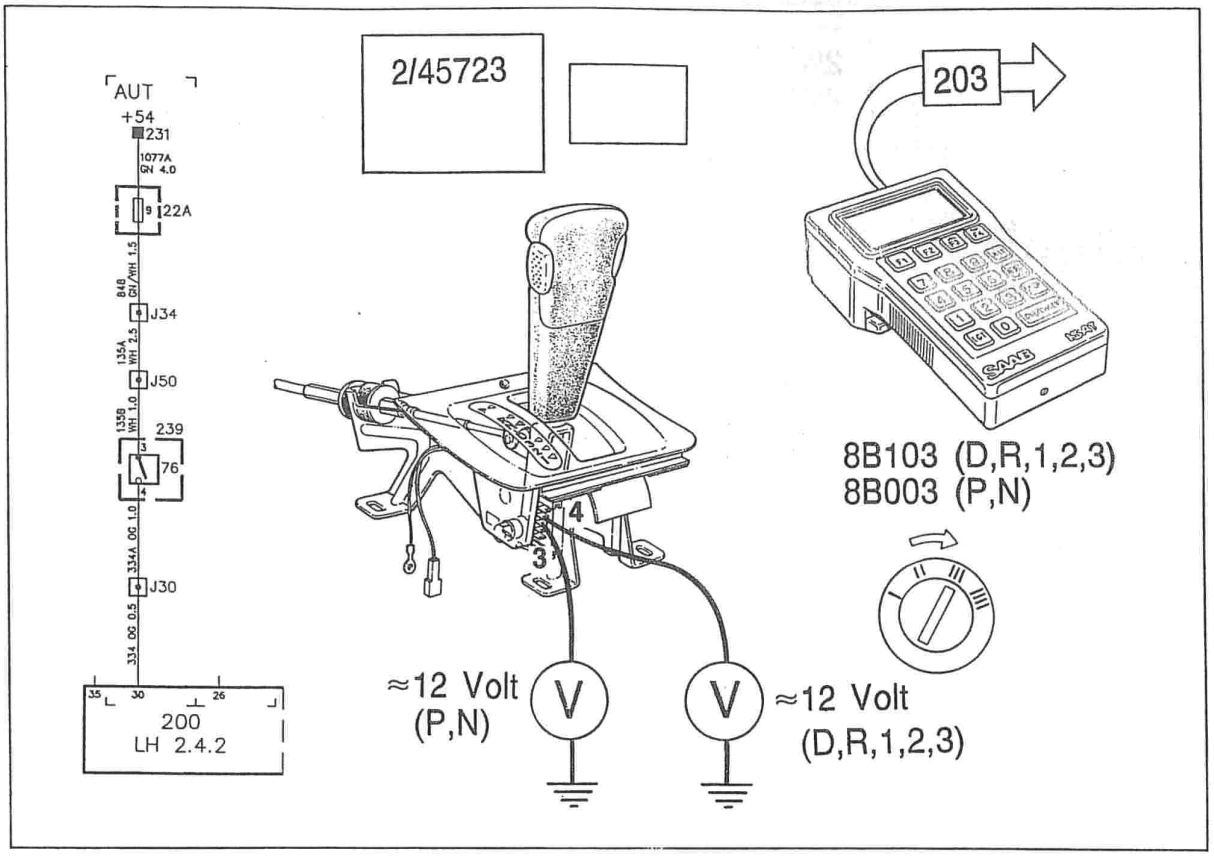
7 If no faults have been found after carrying out the above tests, clear the fault codes and take the car out on a road test. Afterwards check whether the fault codes have been recorded afresh.

8 Fit a new mass air flow sensor and repeat the procedure described in point 6.

9 Try a new LH control module.

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Fault code 2/45723



Malfunction indicated

DRIVE signal absent or faulty.

Fault symptom

No engine rpm increase on selecting D, R, 1, 2 or 3 (cars with automatic transmission).

Test procedure

1 Enter command code 203 on the ISAT and check that the display shows the following:

- With the selector lever in position D: 8B103 (activated)
- with the selector lever in position P or N: 8B003 (not activated)

2 Check fuse No. 13.

3 Check whether battery voltage is present on pin 2 of the selector lever switch contacts (31, 76).

If it is not, check the WH and GN/WH leads between the switch and the fuse and also the GN lead between the fuse and the +54 distribution terminal.

4 With the selector lever in position D, check whether battery voltage is present on pin 1 of the selector lever switch.

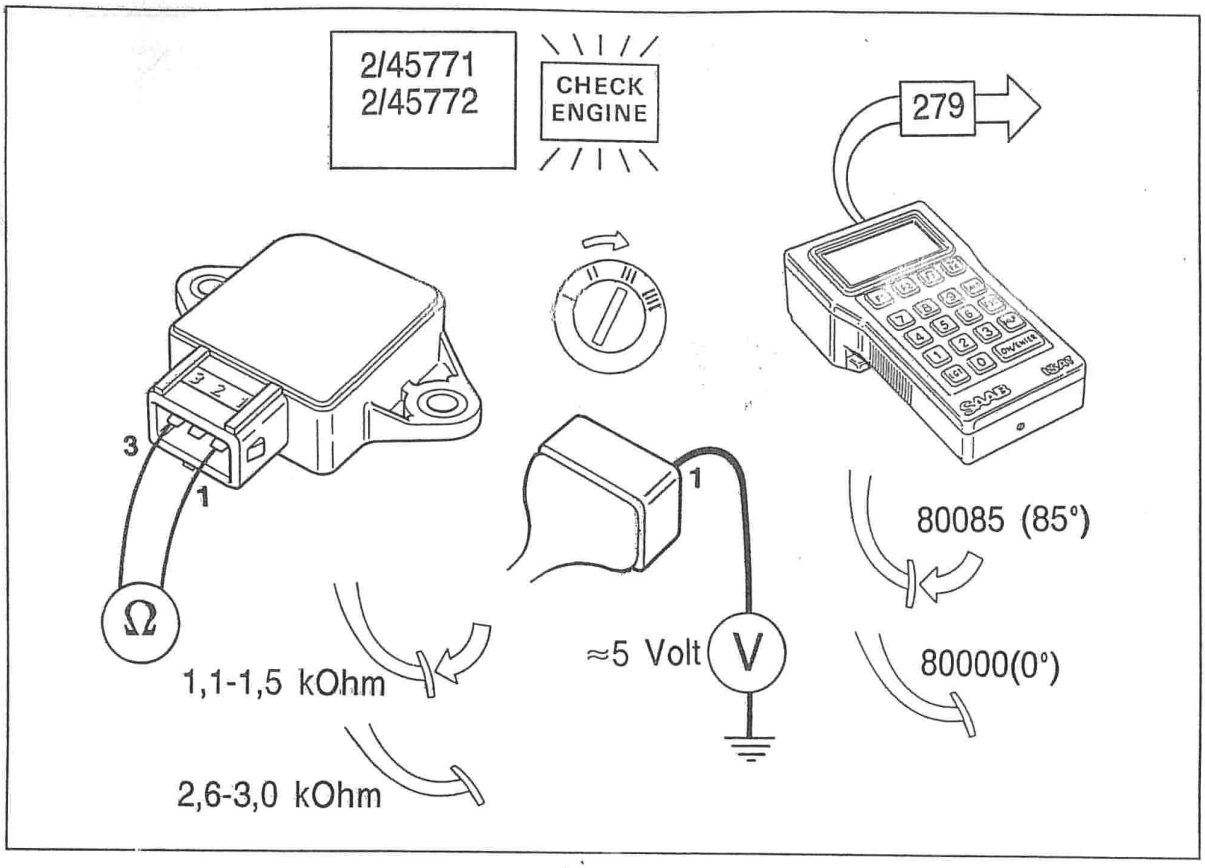
If it is not, but is present on pin 1, fit a new selector lever switch.

5 With the selector lever in position D, check whether battery voltage is present on pin 30 of the control module.

If it is not, check the OG lead between pin 30 of the control module and the selector lever switch for continuity/shorting.

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Fault codes 2/45771, 2/45772



Malfunction indicated

Signal from throttle position sensor (LH 2.4.2) or throttle position switch (2.4) absent or faulty.

Fault symptom

Idle control not working properly.
CHECK ENGINE lamp alight.

Test procedure (LH 2.4.2)

1 With the ignition switch in the Drive position, enter command code 279 on the ISAT.

The following throttle openings should be shown on the display:

- with the accelerator floored: 80085 = approx. 85 degrees (open)
- with the accelerator untouched: 80000 = approx. 0 degrees (closed)

2 Measure the resistance across pins 1 and 3 of the throttle position sensor.

The correct resistance is as follows:

- with the accelerator floored: approx. 1.1-1.5 kohms
- with the accelerator untouched: approx. 2.6-3.0 kohms

If the resistance is not correct, fit a new throttle position sensor.

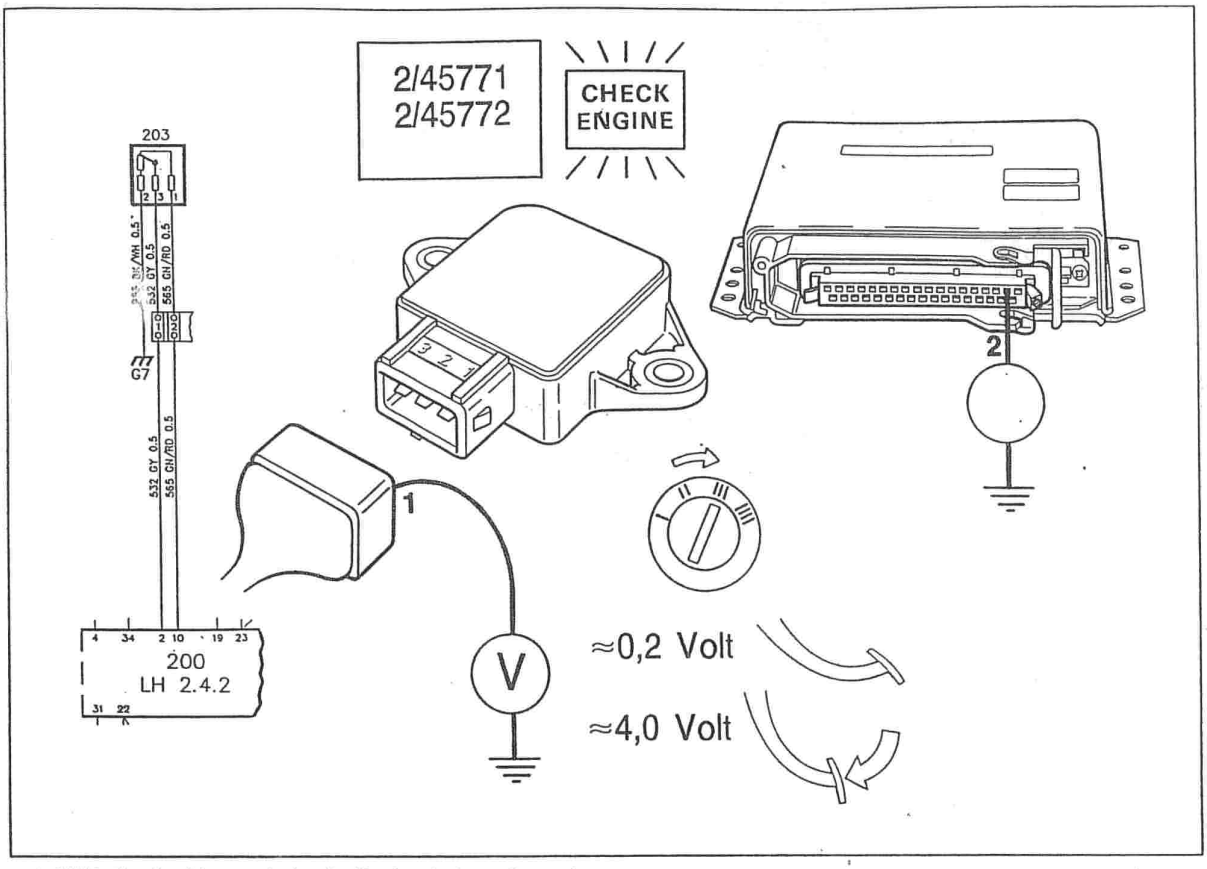
3 With the ignition switch in the Drive position, measure the voltage on pin 1 of the throttle position sensor's connector.

It should be 5 V.

If it is not, check the GN/RD lead between pin 1 of the throttle position sensor's connector and pin 10 of the control module for continuity/shorting.

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Fault codes 2/45771, 2/45772



4 With the ignition switched off, check that pin 2 of the throttle position sensor's connector is properly grounded.

If it is not, check the BK/WH lead between this pin and ground for continuity/shorting.

5 With the control module connected and with the ignition switch in the Drive position, check the voltage across pin 2 of the control module and ground.

It should be:

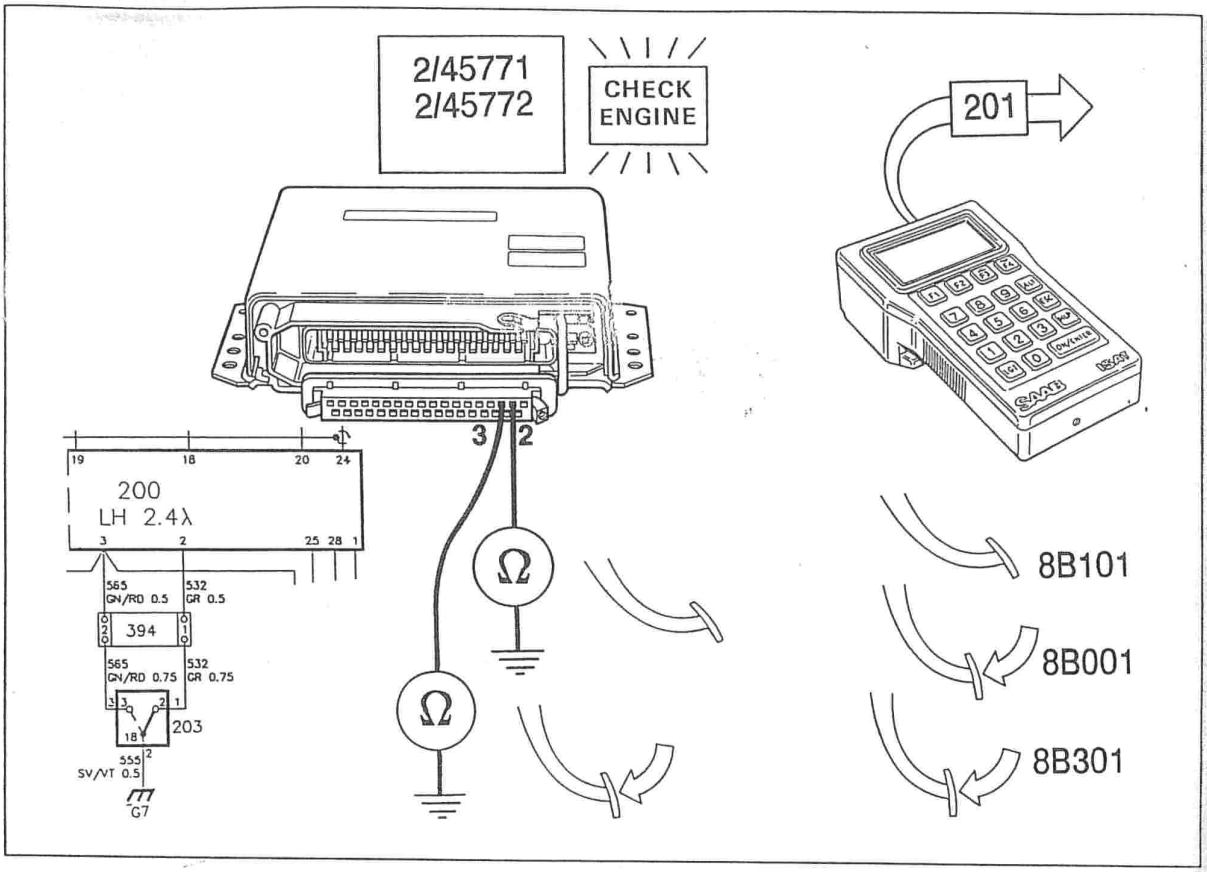
- accelerator untouched (idling): approx. 0.2 V
- accelerator floored: approx. 4 V

If it is not, check the GY lead between pin 3 of the throttle position sensor's connector and pin 2 of the control module for continuity/shorting.

6 Try a new control module.

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Test procedure, LH 2.4



1 With the ignition switch in the Drive position, enter command code 201 on the ISAT.

The following codes should then be shown on the ISAT"s display:

- accelerator untouched (idling): 8B101
- accelerator pressed halfway down: 8B001
- accelerator floored (full throttle): 8B301

If 8B001 is displayed continuously, check the circuit for continuity.

8B103 indicates that the throttle position switch signals idling and full throttle simultaneously. If 8B103 is displayed continuously, unplug the connector. If the display now shows 8B001 instead, fit a new throttle position switch.

If the code does not change from 8B103 to 8B001 when the connector is unplugged, check the circuit wiring for shorting.

Note:

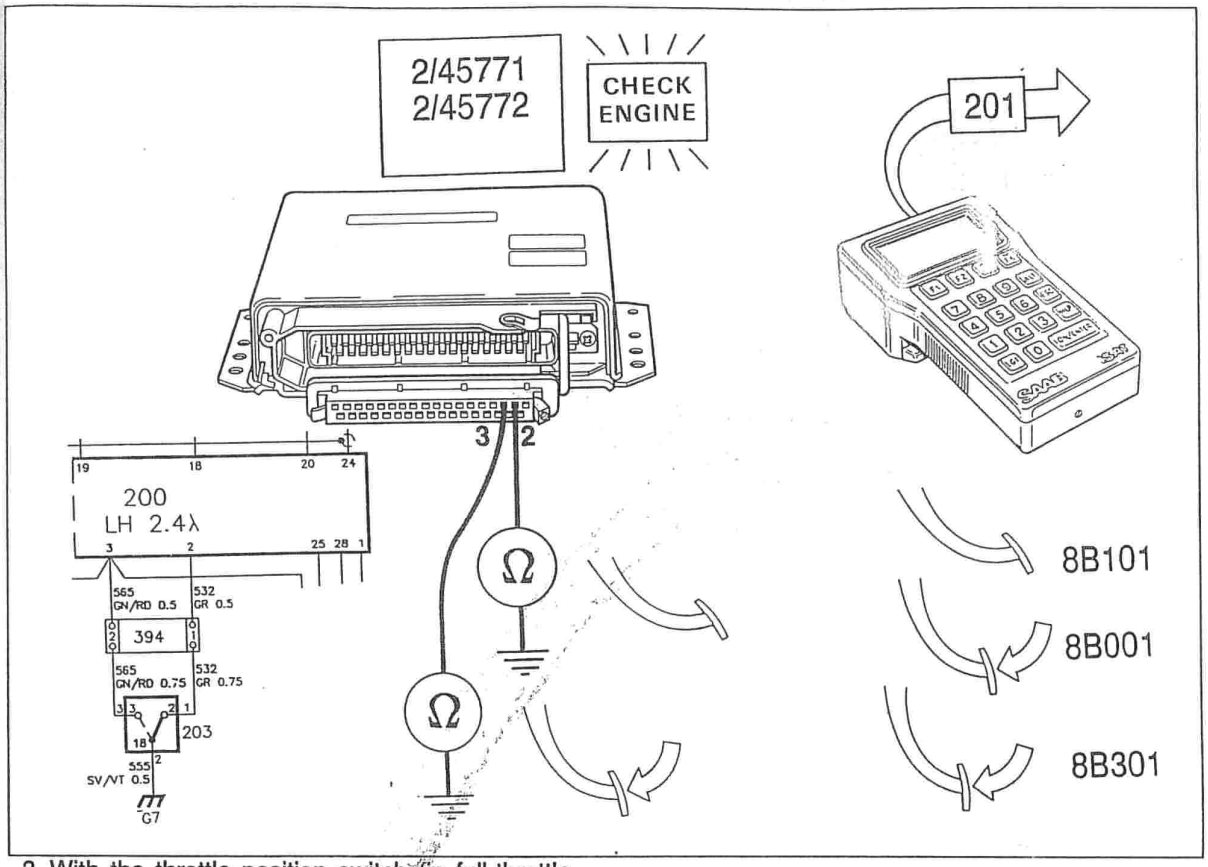
Before continuing with further fault diagnosis, make sure that the throttle position switch is correctly adjusted. With the engine idling, there should be continuity across pins 1 and 2 of the switch.

2 With the throttle position switch (in idling position) connected and with the control module connector unplugged, check that pin 2 of the control module connector is properly grounded.

If it is not, check the GY lead between pin 2 of the control module and pin 1 of the throttle position switch for continuity/shorting.

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Test procedure, LH 2.4



3 With the throttle position switch (in full-throttle position) connected and with the control module unplugged,, check that pin 3 of the control module connector is properly grounded.

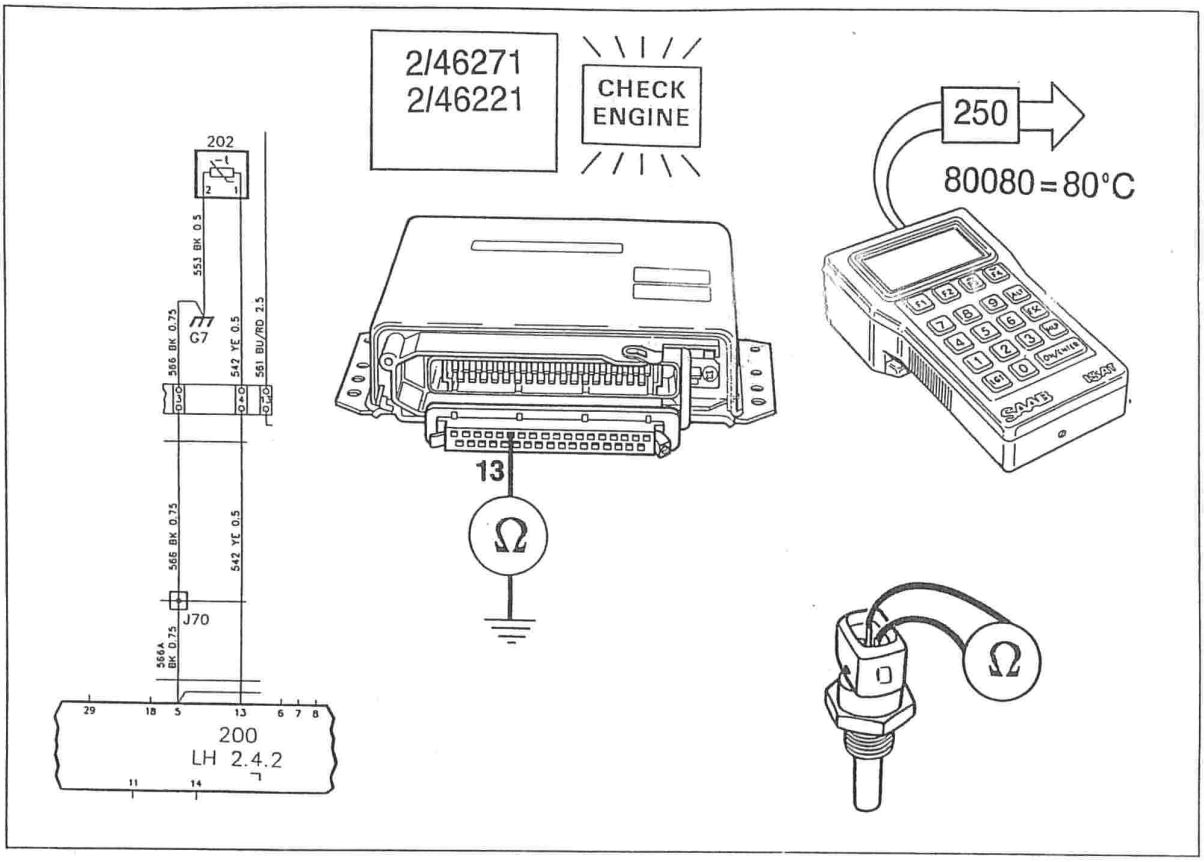
   If it is not, check the GN/RD lead between pin 3 of the control module and pin 3 of the throttle position switch for continuity/shorting.

4 Check that pin 2 of the throttle position switch is properly grounded.

5 Try a new control module.

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Fault codes 2/46221, 2/46271



Malfunction indicated

Temperature sensor, signal faulty or absent

Fault symptom

Poor drivability, CHECK ENGINE lamp alight.

Test procedure

1 Enter command code 250 on the ISAT.

The engine temperature should now be shown on the display, e.g. 80+080 if the temperature is +80°C.

2 With the temperature sensor connector unplugged, measure the resistance of the temperature sensor. See the table on the next page.

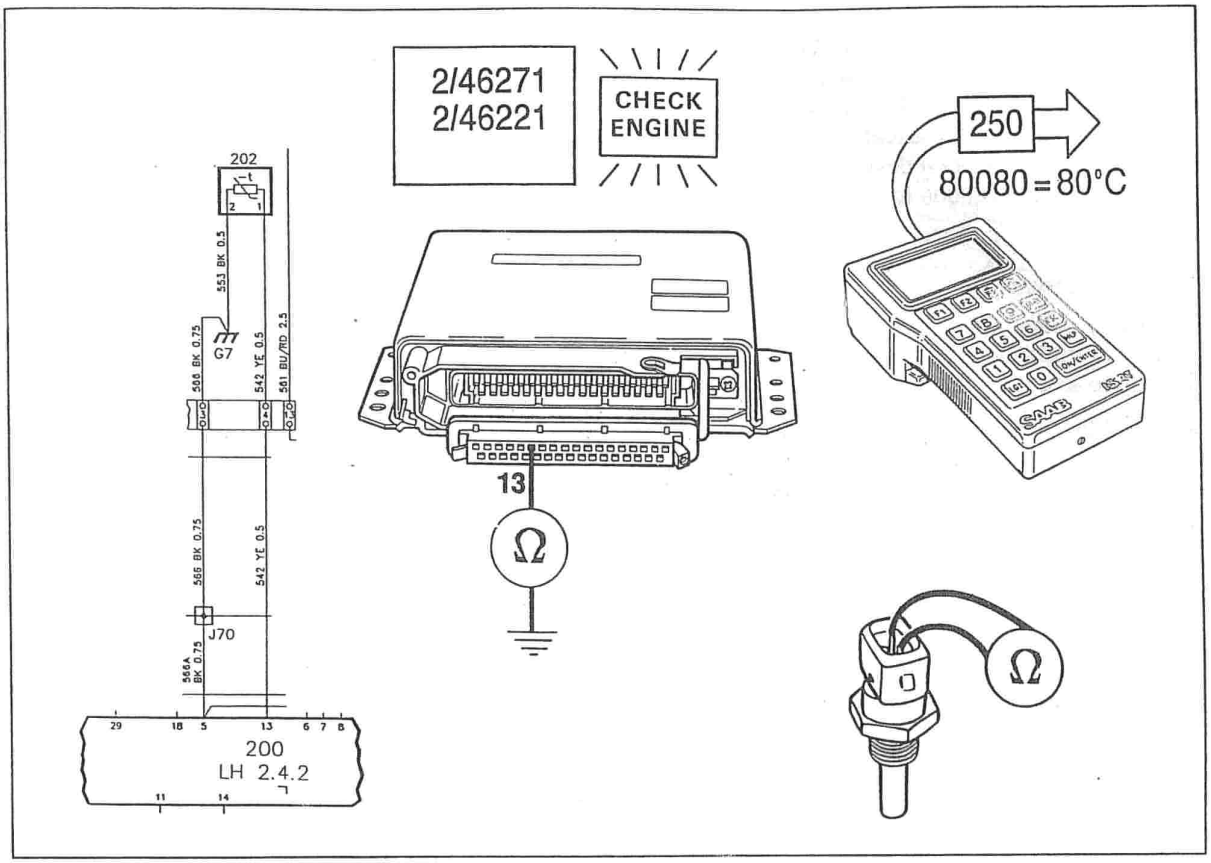
If the resistance is not OK, fit a new temperature sensor.

3 If the resistance is OK, plug in the temperature sensor connector and unplug the control module connector.

Measure the resistance across pin 13 (YE) at the rear of the connector and a good ground.

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Fault codes 2/46221, 2/46271



4 The resistance should be that shown in the table (a few ohms higher is acceptable).

   If it is not, check the YE lead between pin 13 of the connector and pin 1 of the temperature sensor connector for continuity/shorting.

5 Check the BK lead between pin 2 of the temperature sensor connector and the grounding point on the engine for continuity/shorting.

6 Try a new control module.

Table

°C	°F	Ohms (± 10 %)
-20	-4	14000
-10	14	9000
0	32	5800
10	50	3800
15	58	3000
20	68	2600
25	76	2000
30	86	1700
80	176	320

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Electronic EGR

Background

Since component faults have occurred on several EGR systems and in order to comply with the emission control requirements that are met by the electronic EGR system in the cars concerned, an improved solution has been developed which consists primarily of modifications to the LH control module software.

Cars concerned

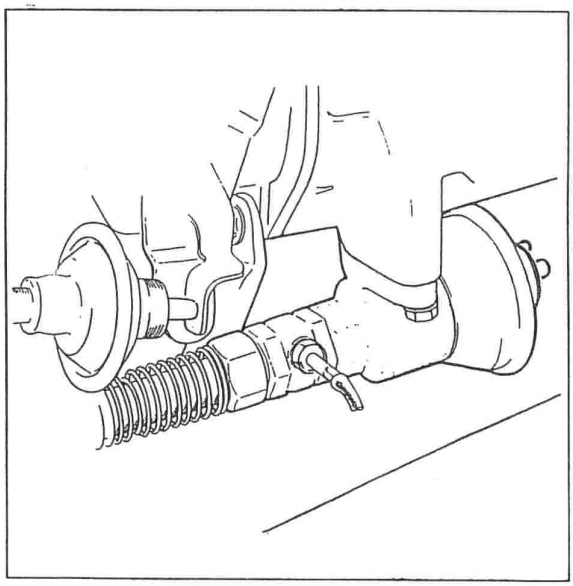
All model year 1990-91 California-specification Saab 900 Turbo cars as well as model year 1992 cars up to and including chassis numbers:

- N2002860 (Trollhättan)
- N7002782 (Uusikaupunki)

Action

Remove the EGR system and fit a new LH control module as follows:

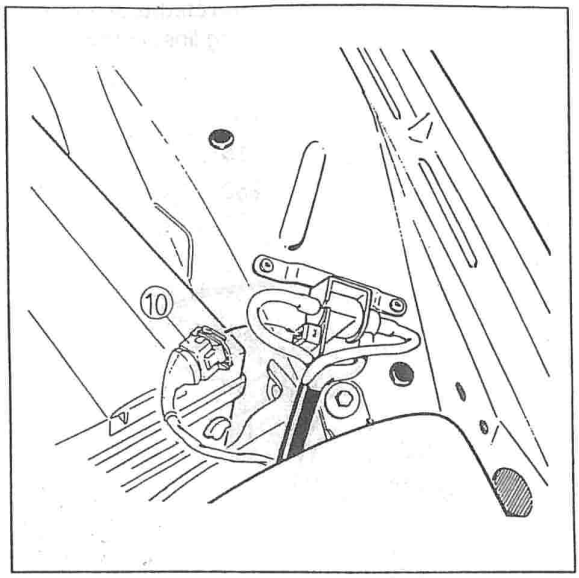
1 Remove the EGR valve retaining screws, remove the EGR pipe from the exhaust manifold and lift away the valve and pipe.



Plug the pipe connection in the exhaust manifold by means of plug 81 23 739 and replace the EGR valve by flange 93 58 177, seal 75 07 973 and two screws 80 19 895.

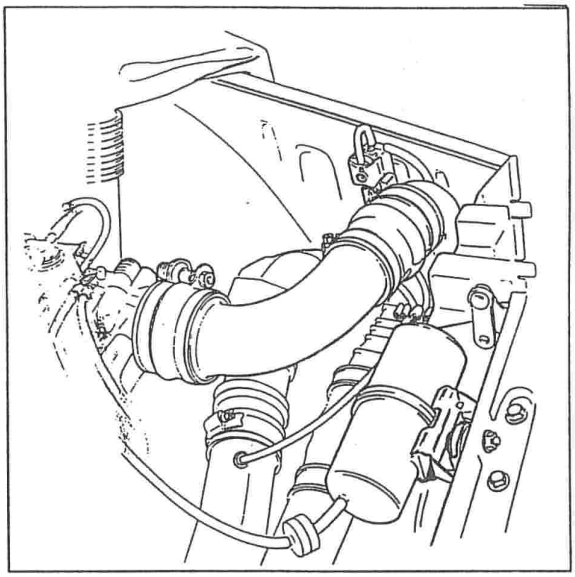
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2 Remove the modulating valve and vacuum hoses.

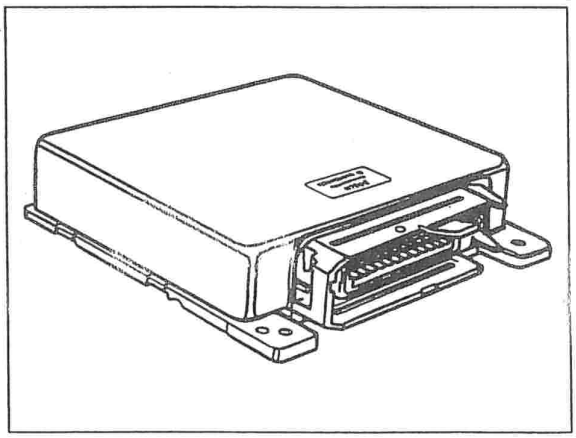


3 Remove the vacuum tank and its vacuum hoses.

Plug the hose outlet on the intake pipe and the outlet on the pressure pipe by means of rubber plug 83 35 614.



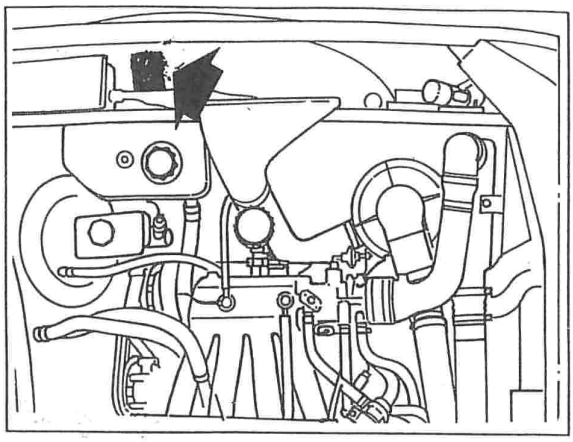
4 Fit an LH control module having part No. 43 00 083.



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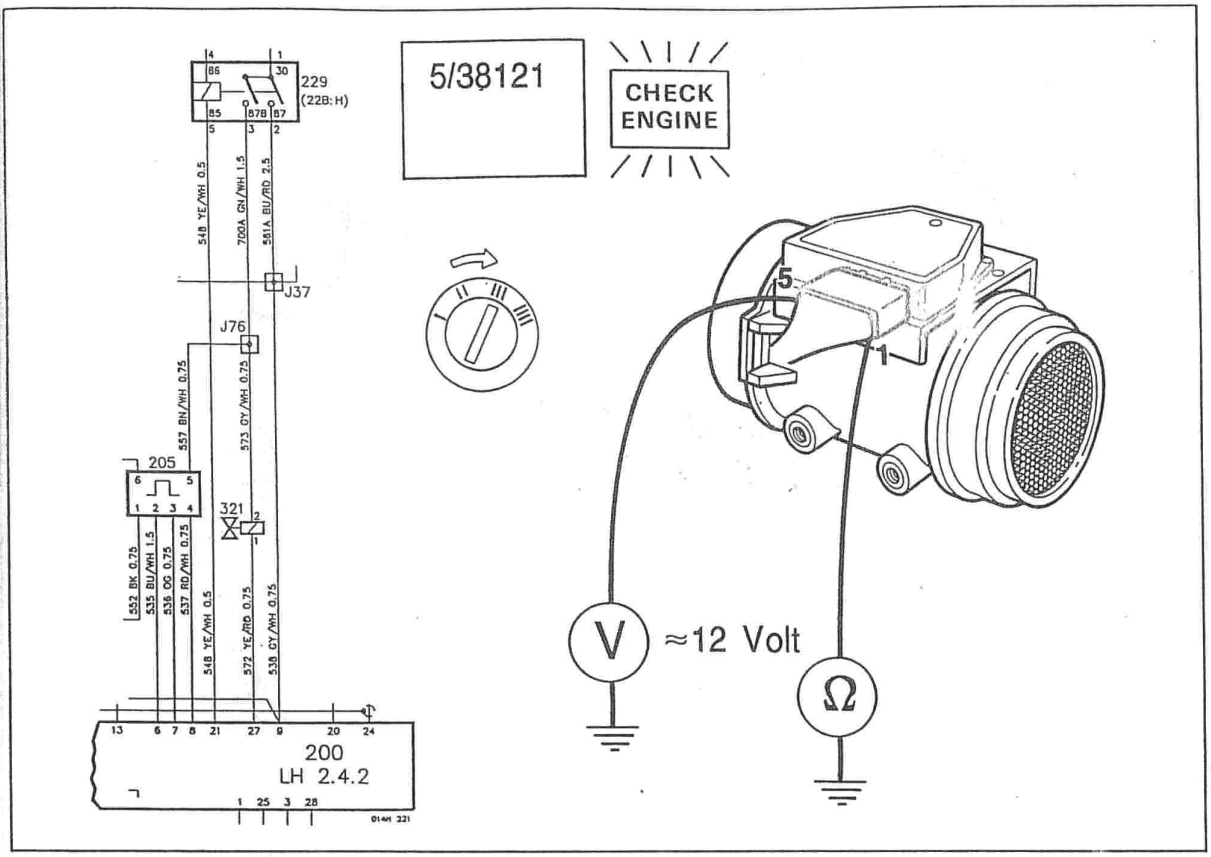
5 Affix a new exhaust emission control label on top of the old one on the LH wing liner in front of the fuse box as follows:

- M1990—label No. 43 92 700
- M1991—label No. 43 92 718
- M1992—label No. 43 74 252



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Fault code 5/38121



Malfunction indicated

Mass air flow sensor, hot wire (filament) burn-off function out of order.

Fault symptom

Starting difficulty, poor drivability and high fuel consumption
CHECK ENGINE lamp alight.

Test procedure

If fault code 2/45691 occurs at the same time, it is advisable to deal with that fault code first.

1 With the connectors unplugged from the control module and mass air flow sensor, check the RD/WH lead between pin 8 of the control module and pin 4 of the mass air flow sensor.

2 With the connectors plugged in and the ignition switch in the Drive position, check that battery voltage is present on pin 5 of the mass air flow sensor and that pin 1 is properly grounded.

If no voltage is present, check the BN/WH and GN/WH leads between pin 5 of the mass air flow meter and pin 87B of the main relay.

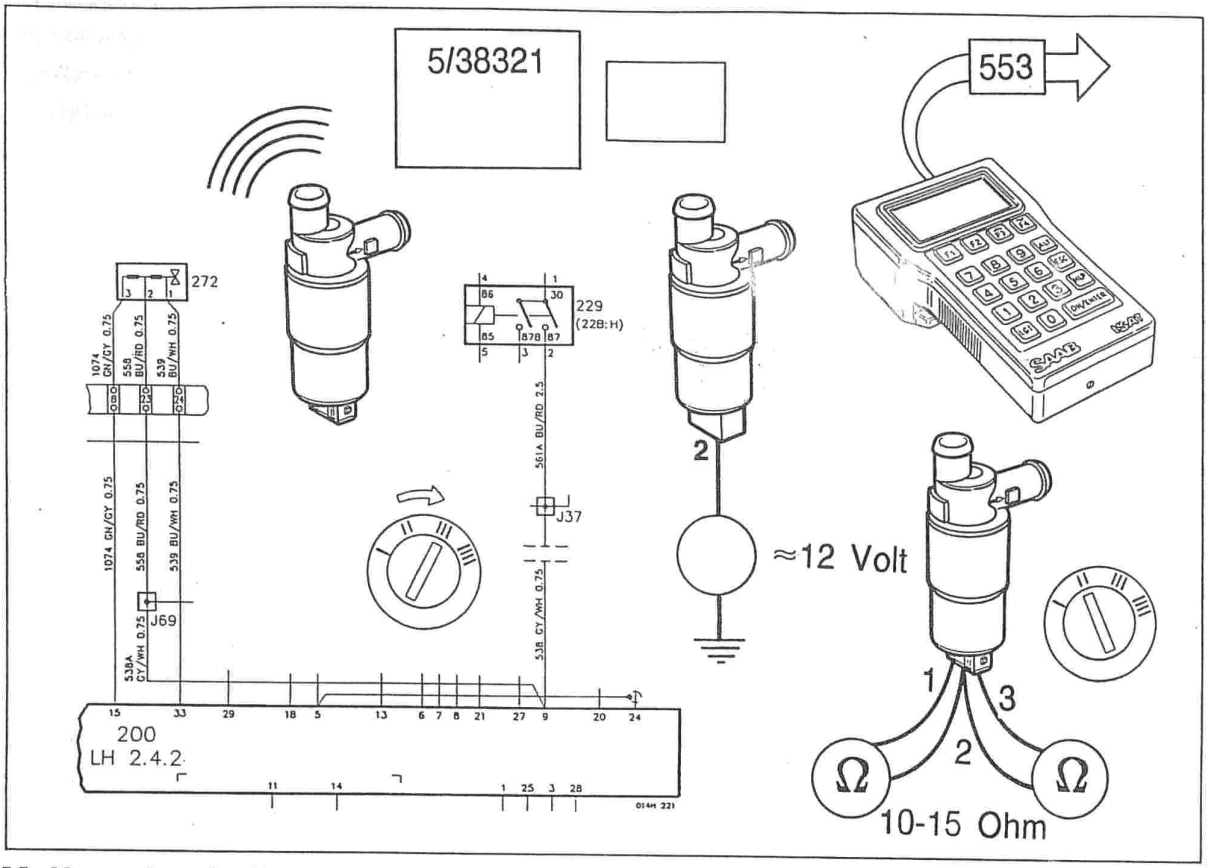
If grounding is not OK, check the BK lead between pin 1 of the mass air flow sensor and grounding point G7 on the intake pipe.

3 If the fault persists, fit a new mass air flow sensor, clear the fault code memory and take the car out on a road test. Afterwards check whether the fault code is generated afresh.

4 If the fault code is generated afresh after fitting a new mass air flow sensor, fit the old one back in place again and try a new LH control module instead.

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Fault code 5/38321



Malfunction indicated

IAC valve malfunctioning

Faulty symptom

Poor running when idling.

Test procedure, LH 2.4.2

1 With the ignition switch in the Drive position, enter command code 553 on the ISAT.

Check whether the IAC valve is working (1 Hz) by listening to it.

2 With the ignition switch in the Drive position, check whether battery voltage is present across pin 2 of the IAC valve connector and a good ground.

If it is not, check the BU/WH+GY/RD lead between pin 2 of the IAC valve and pin 87 of the main relay for continuity/shorting.

3 With the ignition switched off and the IAC valve connector unplugged, measure the resistance of both valve windings across pins 1 and 2 and pins 2 and 3.

The resistance of each winding should be 10-15 ohms.

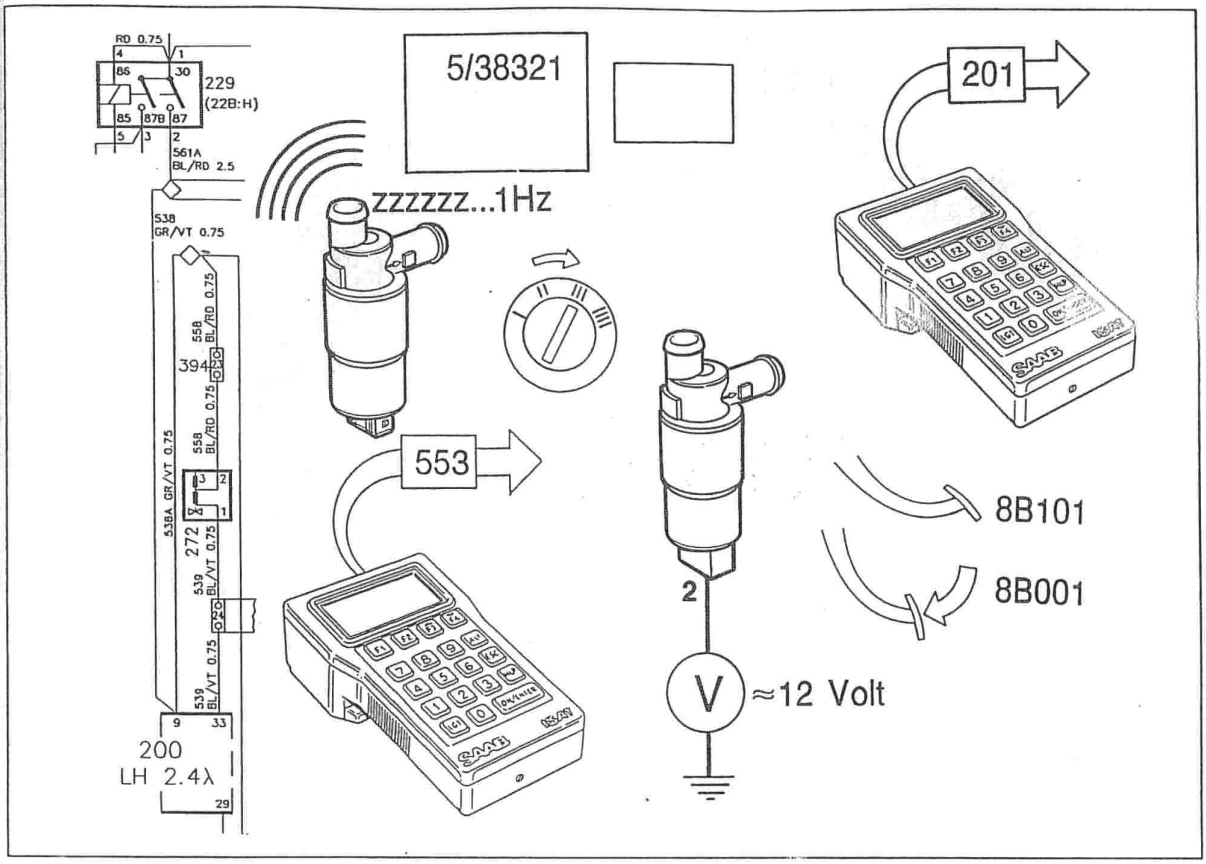
If it is not, fit a new IAC valve.

4 Check the BU/WH lead between pin 33 of the control module and pin 1 of the IAC valve and the GN/GY lead between pin 15 of the control module and pin 3 of the IAC valve for continuity/shorting.

5 Try a new control module.

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Test procedure, LH 2.4



1 With the ignition switch in the Drive position, enter command code 553 on the ISAT. Check whether the IAC valve is working (1 Hz) by listening to it.

2 Check the adjustment of the throttle position switch by entering command code 201 on the ISAT.

With the accelerator untouched the ISAT should show 8B101, which should change to 8B001 when the accelerator is floored (when the idling contacts open).

3 With the ignition switch in the Drive position and the control module connected, check whether battery voltage is present across pin 1 of the IAC valve connector and a good ground.

If it is not, check (with the ignition switched off) the BU/RD+GY/WH lead between pin 2 of the IAC valve and pin 87 of the main relay for continuity/shorting.

4 With the ignition switched off, check the BU/WH lead between pin 2 of the IAC valve and pin 33 of the control module for continuity/shorting.

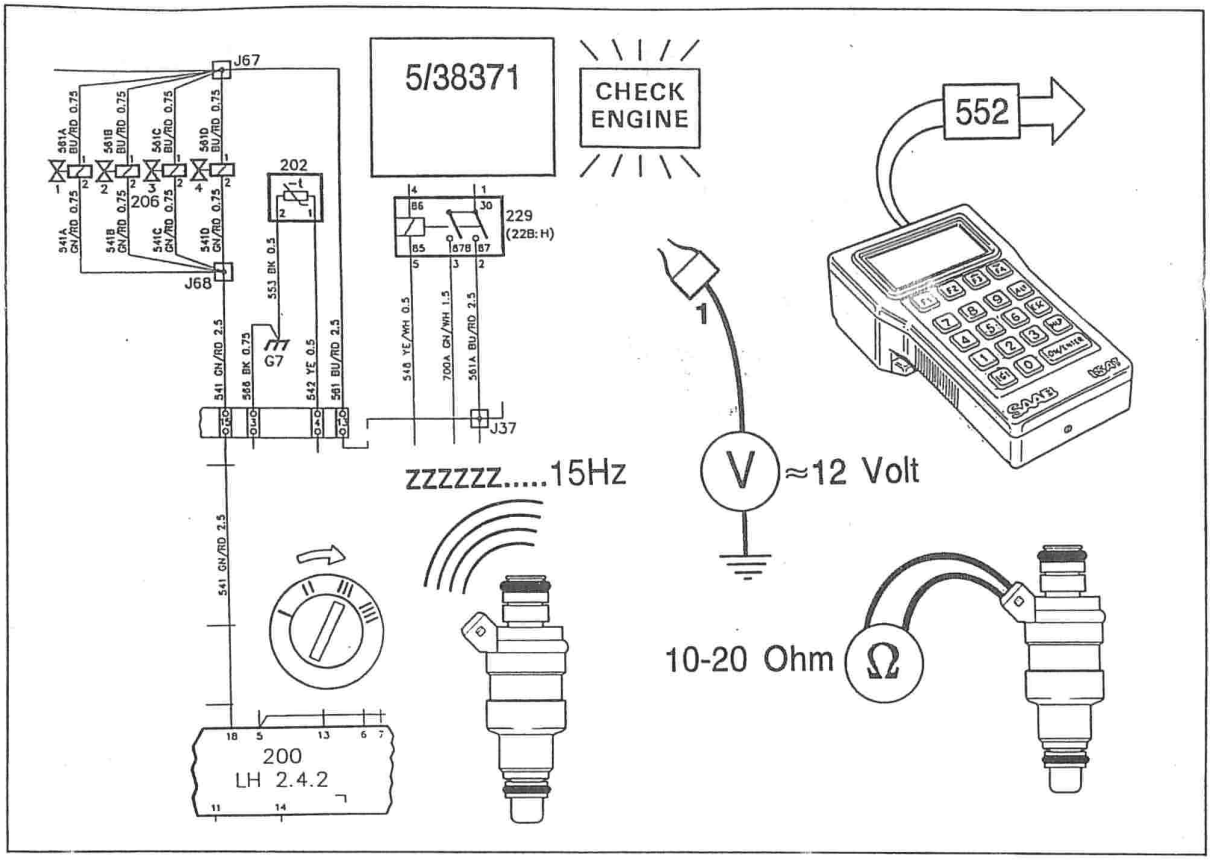
5 If no fault can be found, clear the fault memory and drive the car. Check whether the fault code is generated afresh.

6 Try a new IAC valve and repeat the test as described in point 5.

7 Try a new control module.

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Fault code 5/38371



Malfunction indicated

Injectors malfunctioning

Fault symptom

Poor drivability, engine misfires.
CHECK ENGINE lamp alight.

Test procedure

Note:

The fault may also be due to lack of sparking in one of the cylinders. It may therefore be necessary to carry out fault diagnosis on the ignition system, see the relevant section in the Service Manual.

1 With the ignition switch in the Drive position, enter command code 552 on the iSAT.

Check that all injectors are working (15 Hz) by listening to them.

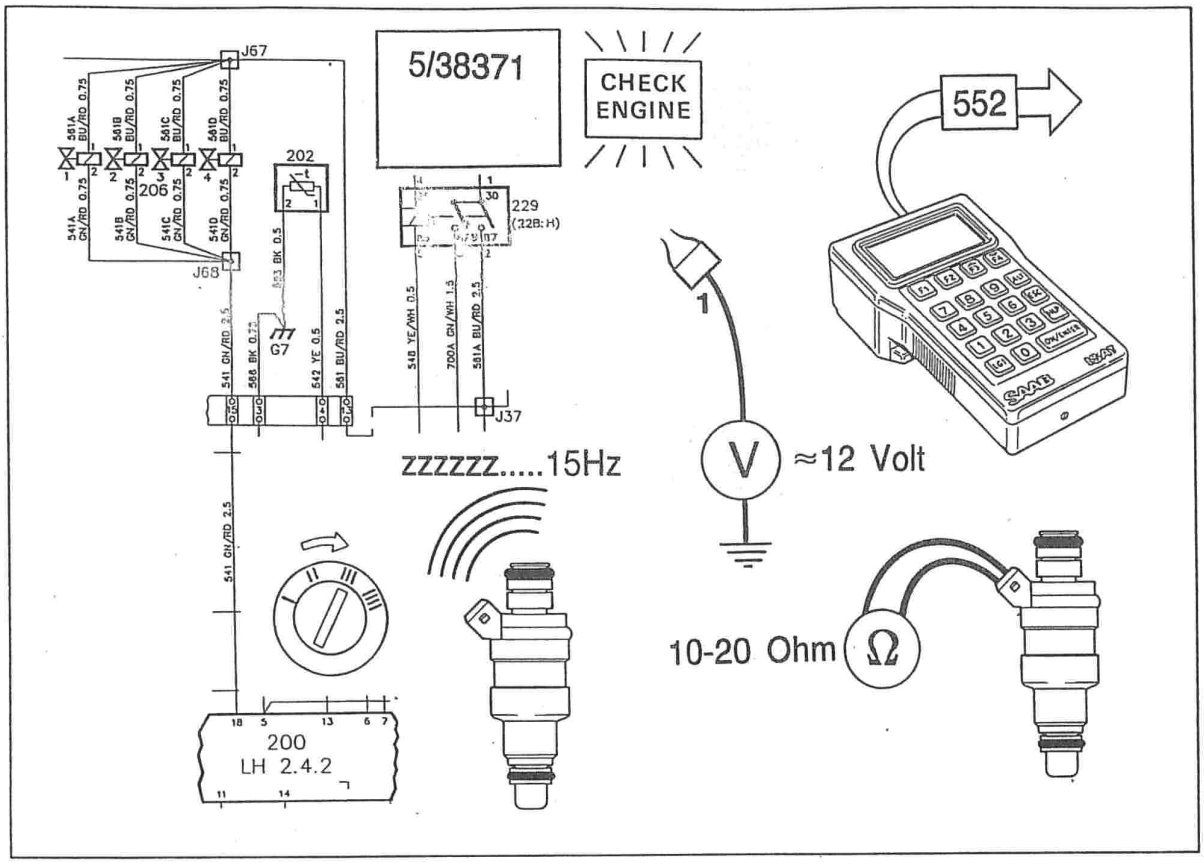
If the injectors are working, continue fault diagnosis but be alert to the possibility of intermittent faults.

2 With the ignition switch in the Drive position, check whether battery voltage is present on pin 1 of each injector connector.

If it is not, check the BU/RD lead between pin 1 of each connector and pin 87 of the main relay for continuity/shorting.

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Fault code 5/38371



3 With the connectors unplugged, measure the resistance across the connecting pins of the injectors.

It should be 10-20 ohms.

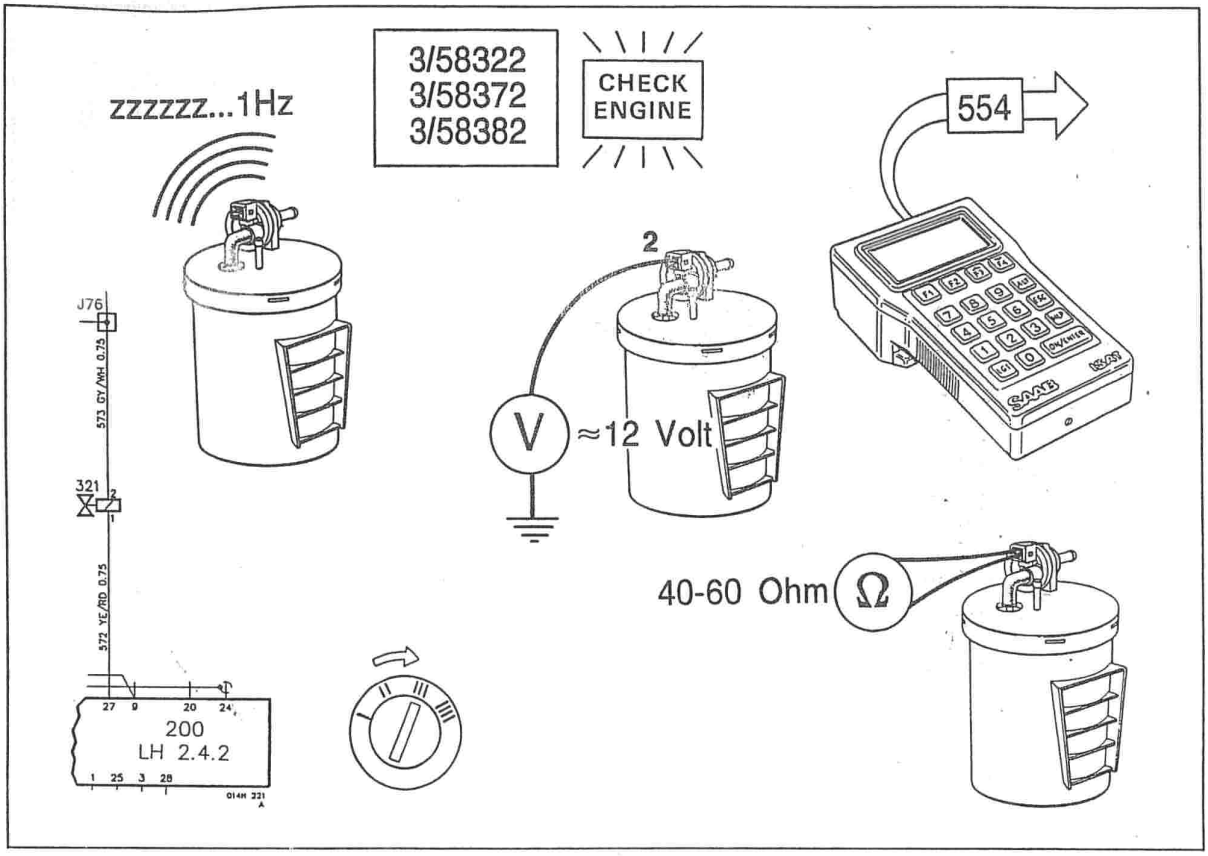
If any of the injectors does not have this resistance, fit a new injector.

4 With the ignition switched off and the control module disconnected, check the GN/RD lead between pin 2 on each injector and pin 18 of the connector for continuity/shorting.

5 If the fault still persists, try a new control module.

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Fault codes 3/58322, 3/58372, 3/58382



Malfunction indicated

Malfunctioning of the evaporative emission canister purge valve (CP).

Fault symptom

Poor drivability and poor idling control.
CHECK ENGINE lamp alight.

Test procedure

1 With the ignition switch in the Drive position, enter command code 554.

Check that the valve is working by listening to it (1 Hz).

2 Check whether battery voltage is present across pin 2 of the valve and a good ground.

If it is not, check the GY/WH lead between pin 2 of the valve connector and pin 87 of the main relay for continuity/shorting.

3 Measure the resistance of the valve across pins 1 and 2.

It should be 40-60 ohms.

If it is not, fit a new valve.

4 With the ignition switched off and the control module and valve connectors unplugged, check the YE/RD lead between pin 1 of the valve connector and pin 27 of the control module connector for continuity/shorting.

5 Try a new control module.

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Fault diagnosis chart for manual diagnosis, LH 2.2

Key to quick-reference chart

E1	=	Main relay	Replacement, see page 240-185
E2	=	Pump relay	Replacement, see page 240-185
E3	=	Pressure switch	
E4	=	Temperature sensor (NTC resistor)	Replacement, see page 240-186
E5	=	Throttle position switch	Replacement, see page 240-186
E6	=	Injectors	Replacement, see page 240-187
E7	=	Mass air flow sensor	Replacement, see page 240-188
E7A	=	Mass air flow sensor, hot wire (filament)	
E7B	=	Burn-off	
E7C	=	CO content, %	
E7D	=	Fuel system basic setting (cars with catalytic converter)	
E8	=	Control module	Replacement, see page 240-185
E8A	=	Control module input signals	
E8B	=	Control module signals to injectors	
E8C	=	Fuel shut-off on starting	
E8D	=	Full-load enrichment	
E8E	=	Warm-up period	
E9	=	AC compressor	
E10	=	Oxygen (Lambda) sensor	
B1	=	Fuel system	Replacement of fuel injection manifold, see page 240-187 Replacement of fuel filter, see page 240-189
B1A	=	Line pressure	
B1B	=	Fuel pressure regulator	Replacement of fuel pressure regulator, see page 240-189
B1C	=	Residual pressure	
B1D	=	Fuel pump delivery pressure	
B1E	=	Fuel pump delivery flow	
I1	=	Leakage in induction system	
I2	=	Auxiliary air valve	Replacement, see page 240-190
M1	=	Basic setting of throttle butterfly	
M1A	=	Adjustment of idling speed (not cars with catalytic converter)	
M1B	=	Adjustment of idling speed (cars with catalytic converter)	
E	=	Electrical	
B	=	Fuel	
I	=	Induction	
M	=	Mechanical: removing and fitting of constituent components	

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Fault symptom

1 Engine will not start.
2 Engine starts but immediately stops.
3 Erratic idling.
4 Poor throttle response.
5 Engine runs unevenly in all speed ranges.
6 High fuel consumption.
7 Maximum revs unobtainable (weak engine).
8 CO content too low.
9 CO content too high.

Note:

Before starting any fault diagnosis work on the LH system, check that the engine, ignition system and electrical system comply with the specifications.

Example of "Test procedure":
E1 = check the main relay, and so on.

									Malfunction indicated/possible cause	Test procedure	Test reference
1	2			5					Main relay or pump relay defective	Check the voltage	E1, E2
1									Fuel pump inoperative	Check the fuse for the fuel pump, power supply, fuel relay and pressure switch (Turbo)	B1, E1, E2, E3
1	2	3							Auxiliary air valve (idling control valve) defective	Check operation of the valve	I2
		3							EGR valve defective	Check operation of the valve	
	2				6				Throttle position switch defective/enrichment	Check by connecting an ammeter across pins 2 and 3 of the throttle position switch	E5
		3	4	5	6	7		9	Mass air flow sensors (HLM)	Check that the hot wire (filament) is intact, that the burn- off function is OK, and that the connections are good	E7A
1	2	3	4	5		7	8		Induction system	Check the vacuum using a vacuum gauge	I1
1		3	4	5		7	8	9	Fuel pressure too low or no fuel pressure	Check the pressure, filter, fuel lines and pressure regulator	B1
					6			9	Fuel pressure too high	Check the intermediate hose and suction hose to the pressure regulator. Check for blockage in the fuel line or a pinched hose. Pressure regulator defective	B1
			4	5		7	8		Fuel delivery flow too low	Check the fuel pump delivery capacity	B1DB1E

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Note:

Fault symptoms that can be traced to points 4 and 5 may also be attributable to the "Limp-Home" function.

										Malfunction indicated/possible cause	Test procedure	Test reference
1	2	3	4	5	6	7	8	9		Temperature sensor (NTC resistor)	Use an ohmmeter to check	E4
					6	7				Throttle butterfly does not open or close fully	Check the throttle body, throttle position switch, spindle and cable	E5
1	2	3	4	5	6	7	8	9		Poor grounding or connection wrongly wired	Check engine and battery grounding or connections	E8A
1	2	3	4	5	6	7	8	9		Electrical leads and connections broken	Check the leads and connections and remedy as necessary	E8A
	2	3	4				8			CO content too low	Check idling speed and CO content as per specifications Check the resistance of the mass air flow sensor	E7C
	2	3	4		6			9		CO content too high	Check idling speed and CO content as per specifications Check the resistance of the mass air flow sensor	E7C
1	2	3	4	5	6	7	8	9		Control module and control module signals	Check all control module input signals, connections	E8A

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1 Engine fails to start

System or component	Malfunction indicated/possible cause	Test procedure
a. Electrical system	a. Low voltage, break in wiring, poor connection, faulty relay, pressure switch.	a. Check battery voltage. Minimum acceptable: 11.5 V. Check the main relay and pump relay (see sections E1, E2). Check the wiring and connections for continuity, good contact, corrosion (see section E8). Check the pressure switch (Turbo) (see section E3).
b. Fuel pump	b. Fuel pump inoperative, poor delivery capacity.	b. Check fuel pump operation, pressure, delivery capacity delivery flow. (See sections B1D, B1E.)
c. Fuel system	c. Leakage, faulty pressure regulator, blockage in return line.	c. Check the fuel system for leakage (see section B1). Check the line pressure (see section B1). Check the pressure regulator (see section B1B).
d. Induction system	d. Air leakage.	d. Check the induction system for air leaks downstream of the throttle butterfly using pressure testing equipment and by eye between the mass air flow sensor and the throttle butterfly. (See section I1.)
e. Injectors	e. Opening duration, leakage.	e. Check the opening duration and resistance of the injectors, using a multimeter. (See sections E6, E8B.)
f. Temperature sensor (NTC resistor)	f. Inoperative, break in wiring, poor connection.	f. Check the temperature sensor, using a multimeter. (See section E4.)
g. Control module	g. Poor contact, no input signals, inoperative.	g. Check all control module input signals, using a multimeter. (See section E8A.)
h. Auxiliary air valve	h. Malfunction, leakage.	h. Check the auxiliary air valve using a multimeter. (See section I2.)

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2 Engine starts but stops immediately

System or component	Malfunction indicated/Possible cause	Test procedure
a. Electrical system	a. Low voltage, break in wiring, poor connection, faulty relay, pressure switch.	a. Check the battery voltage. Minimum acceptable: 11,5 V. Check the main relay and pump relay (see sections E1, E2). Check the wiring and connections (see section E8). Check the pressure switch (Turbo) (see section E3).
b. Temperature sensor (NTC resistor)	b. Inoperative, break in wiring, poor connection.	b. Check the temperature sensor using a multimeter. (See section E4.)
c. Induction system	c. Air leakage.	c. Check the induction system for air leaks downstream of the throttle butterfly using pressure testing equipment and by eye between the mass air flow sensor and the throttle butterfly. (See section I1.)
d. Control module	d. Poor contact, no input signals.	d. Check all control module input signals, using a multimeter. (See section E8A.)
e. Auxiliary air valve	e. Malfunction, leakage.	e. Check the auxiliary air valve (idling control valve), using a multimeter. (See section I2.)
f. CO content too low or too high	f. Incorrect setting.	f. Check the idling speed and CO content as per specifications. Check the resistance of the mass air flow sensor. (See section E7C.)
g. Basic setting incorrect (cars with catalytic converter).	g. Incorrect setting.	g. Check the idling speed and pulse ratio as per specifications. Check the resistance of the mass air flow sensor. (See section E7D.)
h. Throttle position switch	h. Incorrectly adjusted or defective.	h. See "Checking the throttle position switch". (See section E5.)

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3 Erratic idling

System or component	Malfunction indicated/possible cause	Test procedure
a. Temperature sensor (NTC resistor)	a. Inoperative, break in wiring, poor connection.	a. Check the temperature sensor using a multimeter. (See section E4.)
b. Mass air flow sensor/CO content	b. CO content too low or too high, hot wire (filament) broken.	b. Check the mass air flow sensor for insufficient or excessive CO content. Check whether the hot wire (filament) is intact. (See section E7C.)
c. Basic setting incorrect (cars with catalytic converter).	c. Incorrect setting.	c. Check the idling speed and pulse ratio as per specifications. Check the resistance of the mass air flow sensor. (See section E7D.)
d. Induction system	d. Leakage.	d. Check for leakage in the induction system using pressure testing equipment. (See section I1.)
e. Injectors	e. Opening duration, leakage	e. Check the opening duration and resistance of the injectors using a multimeter. (See sections E6, E8B.)
f. Fuel system	f. Pressure too low.	f. Check fuel system line pressure and operation of the pressure regulator. (See section B1.)
g. Control module	g. Poor contact, no input signals.	g. Check all control module input signals using a multimeter. (See section E8A.)
h. Auxiliary air valve	h. Malfunction, leakage.	h. Check the auxiliary air valve. (See section I2.)
i. Electrical system	i. Break in wiring or poor connections. Poor grounding.	i. Check the wiring and connections (see section E8). Check the ground connections or engine and battery grounding points.
j. EGR valve	j. Inoperative. Sticking valve.	j. Check the EGR system, see section 254 in the Service Manual.
k. Oxygen (Lambda) sensor	k. Poor contact. Incorrect resistance.	k. Check the oxygen (Lambda) sensor. (See section E10.)

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4 Poor throttle response.

System or component	Malfunction indicated/possible cause	Test procedure
a. Mass air flow sensor/CO content	a. CO content too low or too high, hot wire (filament) broken.	a. Check the mass air flow sensor for insufficient or excessive CO content. Check whether the hot wire (filament) is intact. (See section E7.)
b. Basic setting incorrect (cars with catalytic converter).	b. Incorrect setting.	b. Check the idling speed and pulse ratio as per specifications. Check the resistance of the mass air flow sensor. (See section E7D.)
c. Induction system	c. Leakage.	c. Check for leakage in the induction system using pressure testing equipment. (See section I1.)
d. Injectors	d. Pulse ratio, leakage.	d. Check the pulse ratio and resistance of the injectors. (See sections E6, E8B.)
e. Fuel system	e. Quantity, delivery flow, pressure.	e. Check the fuel system line pressure and delivery flow. (See section B1.)
f. Control module	f. Poor contact, no input signals or signals weak.	f. Use a multimeter to check all control module input signals. (See section E8.)
g. Temperature sensor (NTC resistor)	g. Inoperative, break in wiring, poor connection.	g. Use a multimeter to check the temperature sensor. (See section E4.)
h. Electrical system	h. Broken wiring or connections. Poor grounding or ground connections.	h. Check the wiring and connections (see section E8). Check the grounding and the engine and battery grounding points.
i. Oxygen (Lambda) sensor	i. Poor contact. Incorrect resistance.	i. Check the oxygen (Lambda) sensor (see section E10).

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5 Engine runs erratically at all speeds

Symptom or component	Malfunction indicated/possible cause	Test procedure
a. Control module	a. Defective wiring in the connector.	a. Check that control module pins 9, 11, 13, 17 and 25 make good contact. (See section E8.)
b. Electrical system	b. Alternator. Low voltage, break in wiring, poor grounding.	b. Check the electrical system in regard to operation of the alternator (see the Electrical system section) and check battery voltage E1, E2, E8.
c. Injectors	d. Opening duration.	c. Use a multimeter to check the opening duration of the injectors. (See section E6, E8B.)
d. Turbo/APC	d. Malfunction	d. Check the operation of the turbo. See the Turbo section. Check the operation of the BPC valve. See the BPC section.
e. Throttle position switch.	e. Incorrectly adjusted, throttle butterfly sticks.	e. Check the throttle position switch using a multimeter. Check that the microswitch is correctly adjusted and that the throttle butterfly does not stick. (See section E5.)
f. Mass air flow sensor	f. Hot wire (filament) burn-off function inoperative, broken hot wire (filament).	f. Check the mass air flow sensor to see whether the hot wire (filament) is intact and that the burn-off function is working properly. (see section E7.)
g. Induction system	g. Air leakage.	g. Check the induction system for air leaks downstream of the throttle butterfly using pressure testing equipment and by eye between the mass air flow sensor and the throttle butterfly.
h. Fuel system	h. Fuel pressure too low or too high. Poor capacity.	h. Check the line pressure in the fuel system. (See section B1.)
i. Temperature sensor (NTC resistor)	i. Inoperative, break in wiring, poor connection.	i. Check the temperature sensor using a multimeter. (See section E4.)
j. Oxygen (Lambda) sensor	j. Poor contact. Incorrect resistance.	j. Check the oxygen (Lambda) sensor. (See section E10.)

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6 Excessive fuel consumption.

Symptom or component	Malfunction indicated/possible cause	Test procedure
a. Fuel system	a. Pressure regulator	a. Check the pressure in the fuel system and the fuel pump capacity. (See sections B1, B1B.)
b. Injectors	b. Malfunctioning.	b. Check the injectors by disconnecting the leads one at a time, which should cause a noticeable drop in engine speed. (See sections E6, E8B.)
c. Temperature sensor (NTC resistor)	c. Inoperative.	c. Use a multimeter to check the temperature sensor. (See section E4.)
d. Throttle position sensor	d. Incorrectly adjusted.	d. Check the microswitch in the throttle position sensor. (See section E5.)
e. Mass air flow sensor CO content too high.	e. Hot wire (filament) broken.	e. Check the mass air flow sensor to see whether the hot wire (filament) is intact and that the burn-off function is working properly. (See section E7.)
f. Basic setting incorrect (cars with catalytic converter)	f. Incorrectly adjusted.	f. Check the idling speed and pulse ratio as per specifications. Check the resistance of the mass air flow sensor. (See section E7D.)
g. Electrical system	g. Broken wiring or connections. Poor grounding.	g. Check the wiring and connections. (See section E8.) Check the grounding of engine and battery.
h. Control module	h. Poor contact, no input signals or signals weak.	h. Check all control module input signals, using a multimeter (see section E8).

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7 Engine cannot attain maximum revs (lack of power)

Symptom or component	Malfunction indicated/possible cause	Test procedure
a. Induction system	a. Leakage	a. Check for leakage in the induction system, using pressure testing equipment. (See section I1.)
b. Throttle butterfly	b. Incorrectly adjusted.	b. Check whether the throttle butterfly opens fully. (See section E5.)
c. Fuel system	c. Insufficient flow/low voltage.	c Check the fuel pump delivery flow. (See section B1E.) Check the voltage supplied to the fuel pump. Minimum acceptable: 11.5 V (See section B1E.)
d. Injectors	d. Malfunctioning.	d Check the injectors by disconnecting the leads one at a time, which should cause a noticeable drop in engine speed. (See sections E8B, E6.)
e. Mass air flow sensor.	e. Broken hot wire (filament). Burn-off function inoperative.	e. Check the mass air flow sensor to see whether the hot wire (filament) is intact and that the burn-off function is working properly. (See section E7.)
f. Turbo/APC	f. Malfunctioning.	f. Check the operation of the turbo, see Turbo section. Check the operation of the BPC valve. (See the BPC section.)
g. Temperature sensor (NTC resistor)	g. Inoperative, break in wiring, poor connection.	g. Check the temperature sensor, using a multimeter. (See section E4.)
h. Electrical system	h. Break in wiring or connections. Poor grounding or ground connections.	h. Check the wiring and connections. (See section E8.) Check the grounding and the engine and battery grounding points.
i. Control module	i. Poor contact, no input signals or signals weak.	i. Check all control module input signals, using a multimeter. (See section E8.)

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8, 9 CO content too low or too high

Symptom or component	Malfunction indicated/possible cause	Test procedure
a. Induction system	a. Leakage	a. Check for leakage in the induction system, using pressure testing equipment. (See section I1.)
b. Fuel system	b. Leakage, pressure regulator defective, blockage in return line/delivery flow.	b Check the line pressure. (See section B1.) Check the pressure regulator by slowly squeezing the return line. (See section B1B.) Check the delivery flow. (See sections B1D, B1E.)
c. Mass air flow sensor	c. Broken hot wire (filament), burn-off function inoperative.	c. Check the mass air flow sensor to see whether the hot wire (filament) is intact and that the burn-off function is working properly. (See section E7.)
d. Temperature sensor (NTC resistor)	d. Malfunctioning.	d. Check the temperature sensor, using a multimeter. (See section E4.)
e. Electrical system	e. Broken wiring or connections. Poor grounding.	e. Check the wiring and connections. (See section E8.) Check the grounding of the engine and battery.
f. Control module	f. Poor contact, no input signals or weak signals.	f. Check all control module input signals, using a multimeter. (See section E8.)
g. EGR valve	g. Inoperative. Valve sticking.	g. Check the EGR system. See Service Manual, section 254.

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Checking/fault diagnosis

B1 Checking the fuel system

Tools:

- LH fuel pressure gauge equipment 83 93 852
- Test hose for return flow
- Graduated measuring beaker, 2 litre
- Jumper lead with switch 83 93 886
- Cooling system tester with hose
- Vacuum pump
- Pressure testing equipment No. 83 93 514
- Multimeter

1 Disconnect the banjo coupling at the inlet to the fuel injection manifold and connect the fuel pressure gauge using the existing seals. Tie up the pressure gauge so that it hangs vertically to obviate reading errors.

2 Remove fuse No. 30. Connect the jumper lead with switch between fuse No. 30 and fuse No. 27, 28 or 29 to supply the fuel pump with current.

Check that the switch is set to "OFF".

B1A Checking the line pressure

1 Start the pump by setting the switch to "ON". The line pressure should now rise to that specified in the "Technical data" section.

Line pressure too high:

Stop the fuel pump by setting the switch to "OFF". Disconnect the return line from the fuel pressure regulator and blow through the line.
If the line is clear:
Fit a new fuel pressure regulator.
If the line is blocked:
Unblock it or fit a new return line.

Line pressure too low:

- Check the level of fuel in the tank.
- Check for leaks in the fuel system.
- Check the fuel pressure regulator (see "Checking the fuel pressure regulator").

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B1B Checking the fuel pressure regulator

1 Connect pressure testing equipment 83 93 514 to the inlet and outlet of the fuel pressure regulator. Tie up the pressure gauge so that it hangs vertically to obviate reading errors.

Connect either the cooling system tester or the vacuum pump to testing equipment 83 93 514.

2 Start the fuel pump by setting the switch to "ON". The line pressure should now rise to that specified in "Technical data".

Use the vacuum pump to increase the vacuum in the fuel pressure regulator. The line pressure should now drop by as much as corresponds to the movement of the needle on the pressure gauge, see "Technical data".

Use the cooling system tester to raise the pressure in the fuel pressure regulator. The line pressure should now increase by as much as corresponds to the movement of the needle on the pressure gauge, see "Technical data".

B1C Checking the residual pressure

Start the fuel pump by setting the switch to "ON".

Read off the line pressure. See "Technical data" for the correct pressure.

Stop the fuel pump by setting the switch to "OFF". The pressure should now drop immediately by 0.1-0.2 bar (1.5-2.9 psi). If the residual pressure drops by more than this after about 10 minutes, check for leakage in the fuel pressure regulator and the fuel pump non-return valve.

Check the pressure and flow delivered by the fuel pump.

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B1D Checking the fuel pump delivery pressure

Start the pump by setting the switch to "ON". Pinch the return line closed momentarily.

CAUTION
The pressure must not exceed 6.0 bar (83 psi).

There should be an immediate noticeable rise in the line pressure.

Insufficient delivery pressure:

- Check that the voltage across the fuel pump terminals is at least 11.5 V.
- Check that the fuel lines are not pinched or blocked.
- Check that the fuel filter is not clogged.

Note:
If the fuel filter has been fitted the wrong way round it cannot be refitted but must always be replaced by a new one.

- Check the relief valve in the pump. If it is defective, fit a new pump.

B1E Checking the fuel pump delivery flow

1 Stop the pump by setting the switch to "OFF". Disconnect the return line at the fuel pressure regulator.

2 Connect one end of the return flow test hose to the fuel pressure regulator and place the other end in the 2-litre graduated beaker.

3 Start the fuel pump by setting the switch to "ON". Allow the pump to run for 30 seconds and then read off the volume of fuel in the beaker. It should be at least 0.9 litres (0.96 qts).

4 If the pressure drops by more than 0.1-0.2 bar (1.5-2.9 psi) and the delivery flow is correct, fit a new fuel pressure regulator.

5 If the fuel pump delivery flow is not correct, carry out test procedure B1D.

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Checking the electrical system

Quick check of the main relay and pump relay (E1, E2)

1 Unplug the control module and mass air flow sensor connectors.

2 Connect pins 17 and 21 of the control module connector to ground.

3 Check whether voltage is present at:

- The test socket
- Pin 9 of the control module connector
- Pin 2 of the mass air flow sensor
- Fuse 14

If voltage is present at these points, the main relay and fuel pump relay with their associated wiring are OK.
If it is not, continue as described in sections E1 and E2.

To remove the main relay/fuel pump relay

The relay is mounted in a relay holder on the RH wheel arch.

1 Unscrew and remove the sill scuff plate.

2 Remove the weatherstrip from the front door pillar. Undo the screws retaining the anchor plate for the carpet on the inner wheel arch panel.

3 Unscrew the air duct and fold it down together with the carpet.

4 Unscrew and withdraw the relay holder.

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E1 Checking the main relay

Tools:

- Multimeter

Jumper lead with crocodile clips 83 93 894.

1 Disconnect the control module and the mass air flow sensor. Peel back the cover on the control module connector. All readings should be taken from the rear of the connector.

Check whether pin 11 of the connector is connected to ground.

2 Switch on the ignition.

3 Use the jumper lead with crocodile clips (83 93 894) to connect pin 21 (yellow/white; GL/VT) of the control module connector to ground. Check the operation of the relay by ascertaining whether voltage is present across pins 9 (brown/white; BR/VT) and 11 (black; SV) of the control module connector.

If no voltage is present, gain access to the relay by removing the sill scuff plate, weatherstrip and carpet.

Check for voltage across pin 30 (red; RD) of the relay and ground and across pin 86 (red; RD) of the relay and ground.

If no voltage is present, check the wiring between pin 30 (red; RD) and the positive terminal and between pin 86 (red; RD) and pin 30 (red; RD).

If voltage is present, use jumper lead 83 93 894 to connect pin 85 (yellow/white; GL/VT) to ground. Check for voltage at pin 87 (brown/white; BR/VT) and pin 87b (brown/white; BR/VT) of the relay. If no voltage is present, fit a new relay.

If voltage is present, use jumper lead 83 93 894 to check the brown/white (BR/VT) lead from pin 87 of the relay to pin 9 of the control module, the black (SV) lead from pin 11 of the control module to ground, and the yellow/white (GL/VT) lead from pin 21 of the control module to pin 85 of the relay.

Check for voltage at pin 2 (brown/white; BR/VT) of the mass air flow sensor. If no voltage is present, check the wiring up to pin 87b of the main relay.

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E2 Checking the fuel pump relay

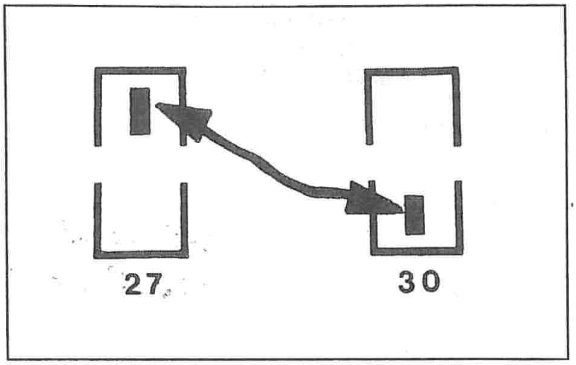
Tools:

- Multimeter
- Jumper lead with crocodile clips 83 93 894
- Jumper lead with switch 83 93 886

Remove fuse 30. Connect the jumper lead with switch (83 93 886) between fuse No. 30 and fuse No. 27, 28 or 29 so that current can be supplied to the fuel pump. Make sure that the switch is set to "OFF".

1 Unplug the control module, mass air flow sensor and auxiliary air valve connectors.

2 Connect jumper lead 83 93 894 between pins 17 and 25 of the control module connector.



Connect the jumper lead with switch (83 93 886) between fuses 27 and 30.

3 Ascertain whether the relay operates by checking for voltage between the Limp-Home connector's grey/red (GR/RD) lead and ground (at the wiring harness on the RH wheel arch).

If no voltage is present, fold back the carpeting and remove the relay.

Check for voltage between relay pin 30 (red; RD) and ground and between relay pin 86 (brown/white; BR/VT) and ground.

If no voltage is present, check the red (RD) lead between pin 30 and the positive terminal, and the brown/white (BR/VT) lead between pin 86 and main relay pin 87 (pressure switch, Turbo).

If voltage is present, use jumper lead 83 93 894 to connect pin 85 (violet; VL) to ground.

Check for voltage on relay pins 87 (blue/red; BL/RD) and 87b (grey-red; GR/RD).

If no voltage is present, fit a new relay.

If voltage is present, check the grey/red (GR/RD) lead from the Limp-Home connector to relay pin 87b.

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E3 Checking the pressure switch (Turbo only)

Tools:

- Multimeter
- Pressure testing equipment 83 93 514
- Cooling system tester

1 Connect the pressure testing equipment to the intake pipe and the cooling system tester to the branch connection on the pressure gauge.

2 Start the engine. Raise the pressure until it corresponds to that at which the switch should open and break the circuit. The engine should now stall.

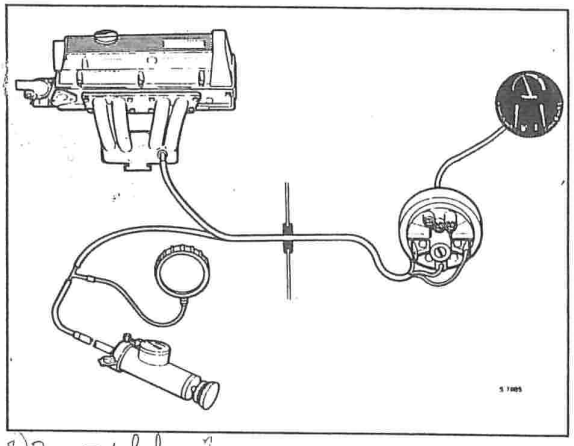
If the engine does not stop, check the breaking pressure of the pressure switch as follows:

Connect the multimeter to pin 87 of the main relay and pin 86 of the fuel pump relay.

3 Raise the pressure. The power supply circuit should be broken when the opening pressure of the pressure switch is reached.

See "Technical data" in Service Manual 2:4 for the correct breaking pressure.

If the pressure switch breaking pressure is incorrect, fit a new pressure switch.



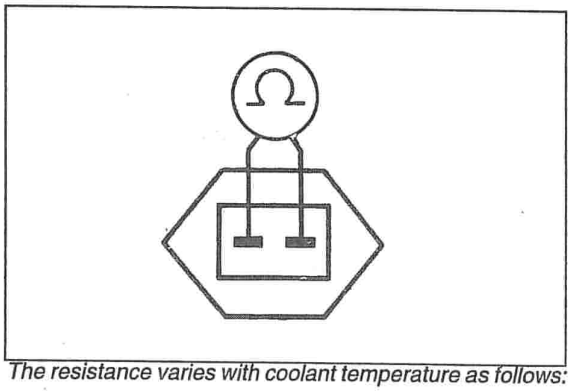
E4 Checking the temperature sensor (NTC resistor)

Tools:

- Multimeter

1 Unplug the control module connector and remove the cover.

2 Measure the resistance of the NTC resistor as shown in the table by connecting the multimeter test prods to the control module connector pins 2 (yellow; GL) and 11 (black; SV). Alternatively, unplug the NTC resistor connector and simply measure the resistance across the pins.



The resistance varies with coolant temperature as follows:

0°C	(32°F)	- * 5800 ohms
20°C	(68°F)	- 2600 ohms
100°C	(212°F)	- 180 ohms

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3 If incorrect readings are obtained, disconnect the NTC resistor leads.

Measure the resistance of the NTC resistor as shown in the table above by connecting the multimeter test prods to the NTC resistor connecting pins.

If the readings obtained are still incorrect, fit a new NTC resistor.

If the NTC resistor is OK, check the wiring between pin 11 (black; SV) of the control module and ground, and between the NTC resistor and ground.

E5 Checking and adjusting the throttle position sensor

Tools:

- Multimeter

1 Unplug the control module connector and remove the cover.

2 Connect the multimeter between control module connector pins 3 (grey; GR) and 11 (black; SV). Check that the circuit is closed.

If there is a break in the circuit, check the grey lead from pin 3 of the connector to the throttle position sensor and the black lead from pin 11 of the connector to ground, and the black/white lead from the throttle position sensor to ground.

3 Move the throttle butterfly and check the reading on the multimeter. If the sensor is in proper working order, the circuit should be broken the moment the butterfly leaves its idlingposition. If it is not, adjust the position of the throttle butterfly (see M1, "Basic setting of throttle butterfly".)

Adjust the throttle position sensor by slackening the screws securing it to the throttle body. Turn the throttle position sensor until it abuts against the integral idling position stop. Tighten the throttle position sensor retaining screws.

Check that the circuit between control module pins 3 (grey; GR) and 11 (black; SV) is broken when the throttle butterfly leaves its idling position stop.

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4 Connect the multimeter across pins 11 (black; SV) and 12 (green/red GN/RD). If the sensor is in proper working order, the circuit should be closed when the throttle butterfly is turned through 72°, i.e. approaching full throttle.

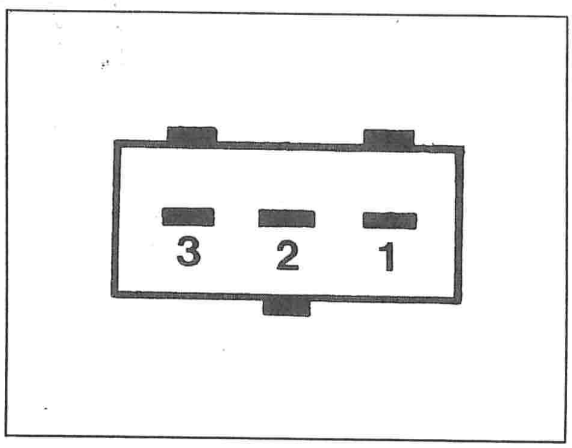
If the circuit is not closed, check the green/red (GN/RD) lead between pin 12 of the connector and pin 3 of the throttle position sensor, the black lead between pin 11 of the control module and ground, and the black lead between pin 2 of the throttle position sensor and ground.

If the wiring is OK but the sensor is not working properly, fit a new throttle position sensor.

Throttle position sensor connections:

No. Should be connected to:

3 Control module connector pin 12 (green/red; GN/RD)
2 Grounding point on engine (black/white; SV/VT)
1 Control module connector pin 3 (grey; GR)



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E6 Checking the injectors

Tools:

- Multimeter

Before starting any checking work on the injectors, unplug the control module and mass air flow sensor connectors.

Note:

Readings must be taken at the rear of the control module connector with its cover removed.

---

1 Unplug the control module and mass air flow sensor connectors. Remove the cover from the control module connector.

2 Measure the resistance across pin 13 (green/red; GN/RD) of the control module and pin 87 of the pump relay. The resistance should be 4 ohms. If it is not, continue as described below.

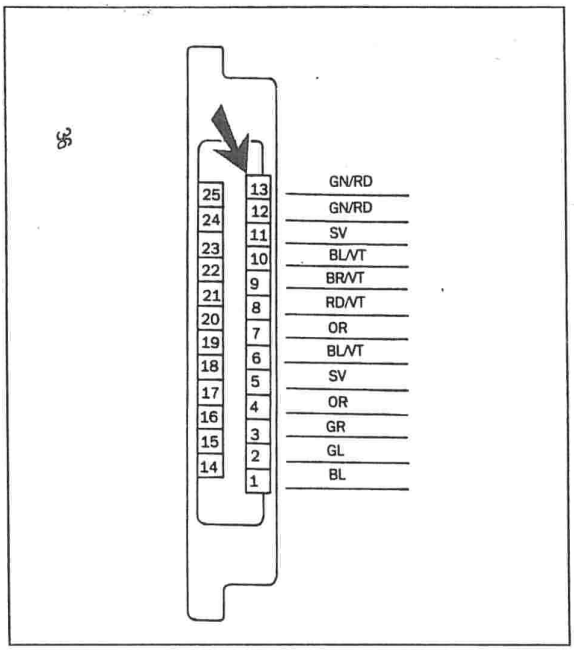
3 Unplug the injector connector.

Measure the resistance of the injector by connecting the multimeter to its connecting pins.

The reading should be 16 ohms at 20°C (68°F) if the injector is OK.

If a correct reading is not obtained, fit a new injector.

4 If the correct reading is obtained, check the wiring between pin 13 (green/red; GN/RD) of the control module and the injectors (via the distribution points). Peel back the rubber dust excluders and, from the rear of the connector, check the blue/red lead between pin 87 of the fuel pump relay and the injectors via the distribution block.



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E7A Checking the mass air flow sensor

Tools:

- Multimeter

Start the engine and let it run at idling speed. Check the CO content. If it is higher than 6%it cannot be adjusted by means of the CO adjusting screw. Switch off the engine.

1 Remove the mass air flow sensor from the air cleaner side. Check whether the hot wire (filament) is intact.

Hot wire (filament) defective:

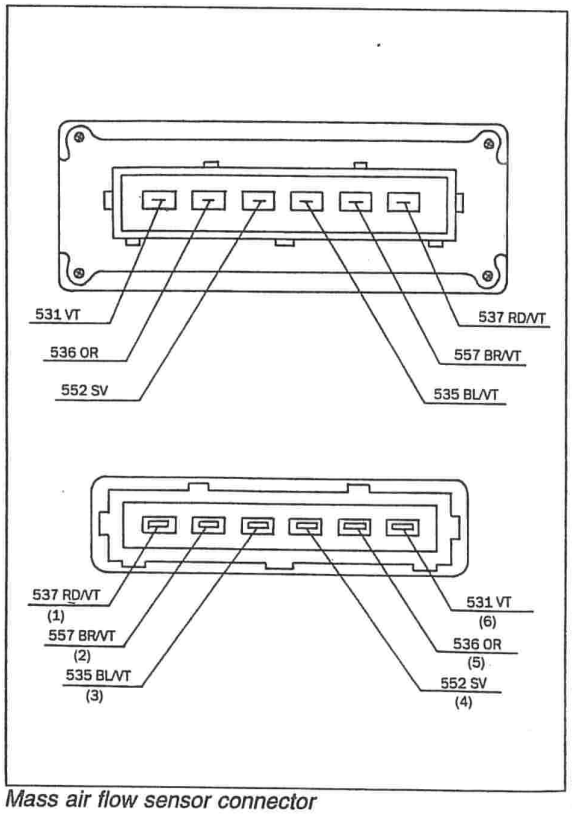
Change the mass air flow sensor.

Hot wire (filament) OK:

Check the mass air flow sensor connector and wiring by:

- Unplugging the mass air flow sensor and control module connectors and removing the cover from the control module connector.
- Check that the wiring and connections are OK.
- If the wiring is OK, plug in the control module connector.

2 Check the hot wire (filament) burn-off function. (See "Checking the hot wire (filament) burn-off function", section E7B.)



Mass air flow sensor connector

Pin No.	To component
1	Control module connector pin 8 (red/white; RD/VT)
2	Main relay pin 87b (brown/white; BR/VT)
3	Control module connector pin 6 (blue/white; BL/VT)
4	Engine grounding point 552 (black; SV)
5	Control module connector pin 7 (orange; OR)
6	Control module connector pin 14 (white; VT)

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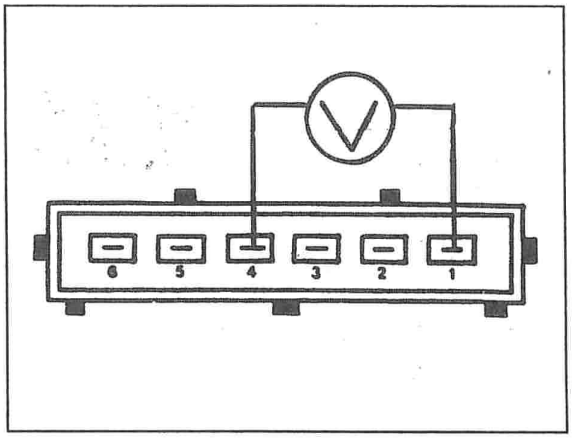
E7B Checking the hot wire (filament) burn-off function

1 Detach the mass air flow sensor from the air cleaner and check whether the hot wire (filament) is OK.

2 Start the engine and warm it up to a temperature of at least 65°C (149°F) and then let it idle. Rev the engine up to 2500 rpm, release the accelerator and let it return to idling speed again.

3 Switch off the ignition. The hot wire (filament) should glow brightly about four seconds afterwards for about a second. If nothing happens, check the wiring (see section E7A).

4 Start the engine and rev it up to 2500 rpm. Connect the test prods to pins 1 and 4 of the mass air flow sensor connector. Switch off the engine. Four seconds later the voltage should rise to 4 V for about one second.



5 If nothing happens, check the red/white (RD/VT) lead between pin 1 of the mass air flow sensor connector and pin 8 of the control module connector, and the black (SV) lead between pin 4 of the mass air flow sensor connector and one of the engine grounding points.

If the wiring is OK, test the system using a different control module.

6 Start the engine and repeat the above test procedure. If the correct voltage is now obtained but the burn-off function does not come into operation, fit a new mass air flow sensor.

Note:

The Limp-Home function takes over automatically if the hot wire (filament) breaks.

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E7C Checking and adjusting the CO content

1 Connect the CO meter, exhaust extraction equipment and tachometer.

2 Start the engine and warm it up. Check the CO content, see "Technical data".

If the CO content is not to specification, turn the adjusting screw:

clockwise—if it is too low

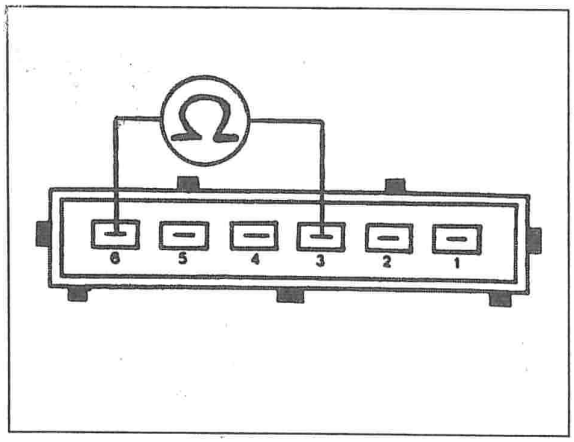
anticlockwise—if it is too high.

3 If the CO content is higher than 6%and cannot therefore be adjusted, switch off the engine. Unplug the mass air flow sensor connector and connect the multimeter across pins 3 and 6 of the mass air flow sensor.

Turn the adjusting screw as many turns as required to obtain a reading of 380 ohms.

If you cannot obtain this reading, fit a new mass air flow sensor. On obtaining the correct reading, 380 ohms, plug in the mass air flow sensor connector. Start the engine and warm it up. Check the CO content again and adjust it further until it is exactly right. If the correct CO content still cannot be obtained, check the mass air flow sensor wiring and connections as described in point E7A.

4 If the wiring is OK and the CO content still cannot be adjusted, try a new control module.



E7D Checking the basic setting of the fuel injection system (cars with catalytic converter)

Note:

There are no specified intervals at which the basic setting of the fuel injection system should be checked or adjusted.

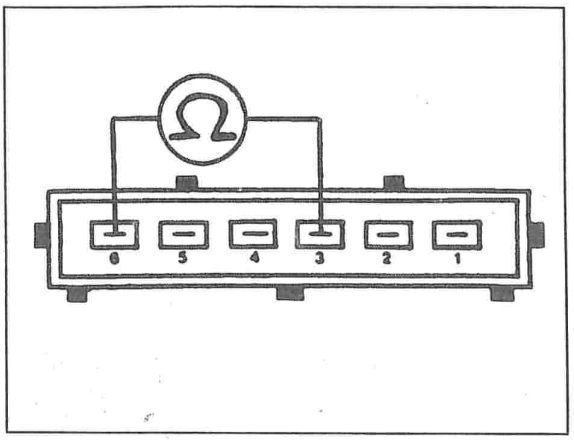
This setting establishes a reference point for the LH system and does not affect vehicle performance. Recalibration is necessary only if the performance of the engine has been disturbed by major work on it, such as replacement of the electronic control module, the NTC resistor or the mass air flow sensor, or by a major overhaul, cylinder head work or timing chain replacement.

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1 Remove the plug from the potentiometer screw on the side of the mass air flow sensor.

2 Unplug the wiring harness connector from the mass air flow sensor.

3 Connect the multimeter to pins 3 and 6 as shown in the figure. The instrument should read 380 ohms. Adjust as necessary by turning the potentiometer screw. This is the first step in checking and adjusting the basic setting.



4 Plug the wiring harness into the mass air flow sensor again.

5 Connect pulse ratio meter 83 93 597 to the test point adjacent to the evaporator housing by means of the adapter lead in 83 94 132.

6 Start the engine and run it until the radiator fan cuts in.

7 If the basic setting is correct, the meter needle will swing back and forth between both ends of the scale.

Note:

The movement of the needle will not be rapid and there may be a pause between each movement.

8 If adjustment is necessary, turn the potentiometer screw in the mass air flow sensor as follows:

a If the needle remains stationary at the higher end of the scale or spends most of its time at this end, turn the screw anticlockwise until the needle stays roughly the same length of time at both ends of the scale.

b If the needle remains stationary on the left-hand side of the scale, turn the potentiometer screw until it stays roughly the same length of time at both ends of the scale.

9 Fit the plug back in the mass air flow sensor.

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E8 Checking the control module input signals

Tools:

- Multimeter
- Jumper lead with crocodile clips 83 93 894

Before carrying out any checking work on the control module, unplug its connector. Also unplug the mass air flow sensor connector and the connector between the ignition system and the distributor.

Note:

Instrument readings must be taken at the rear of the control module connector with the cover removed.

E8A Checking the control module input signals

1 Unplug the control module connector. Remove the cover from the connector. Disconnect the Hall sensor lead.

2 Switch on the ignition.

Check whether voltage is present on pin 18 (green/white; GR/VT) of the control module connector.

If it is not, check the lead running from pin 18 (green/white; GR/VT) of the control module connector to the fuse box via the 6-pin connector and distribution terminal. Also check that the fuse is intact.

3 Connect the jumper lead with crocodile clips between pin 21 of the control module and ground. Check for voltage on pin 9 of the control module. If there is no voltage, check the yellow/white (GL/VT) lead between pin 21 of the control module and pin 85 of the main relay, and the brown/white (BR/VT) lead between pin 9 of the control module and pin 87 of the main relay.

4 With the ignition switched on, check that voltage is present across pins 18 and 11 of the control module. If it is not, check the black (SV) lead running from pin 11 of the control module to one of the engine grounding points.

Před tím než začnete jakoukoli kontrolu, odpojte ~~nežádoucí~~ přebytečné konektory, také odpojte (14) a konektor mezi zážehovým systémem a rozdělovačem.

Poznámka:
Popis přístrojů se vztahuje zpětným ~~jednotlivě~~ zapojením ze zadní strany ~~kontrolního~~ modulu (po odklopení krytu)

Úkony

1) Odpojte konektor ~~kontrolního~~ řídicí jednotky, odstraňte kryt konektoru, odpojte "Hall-sensor" přívod.

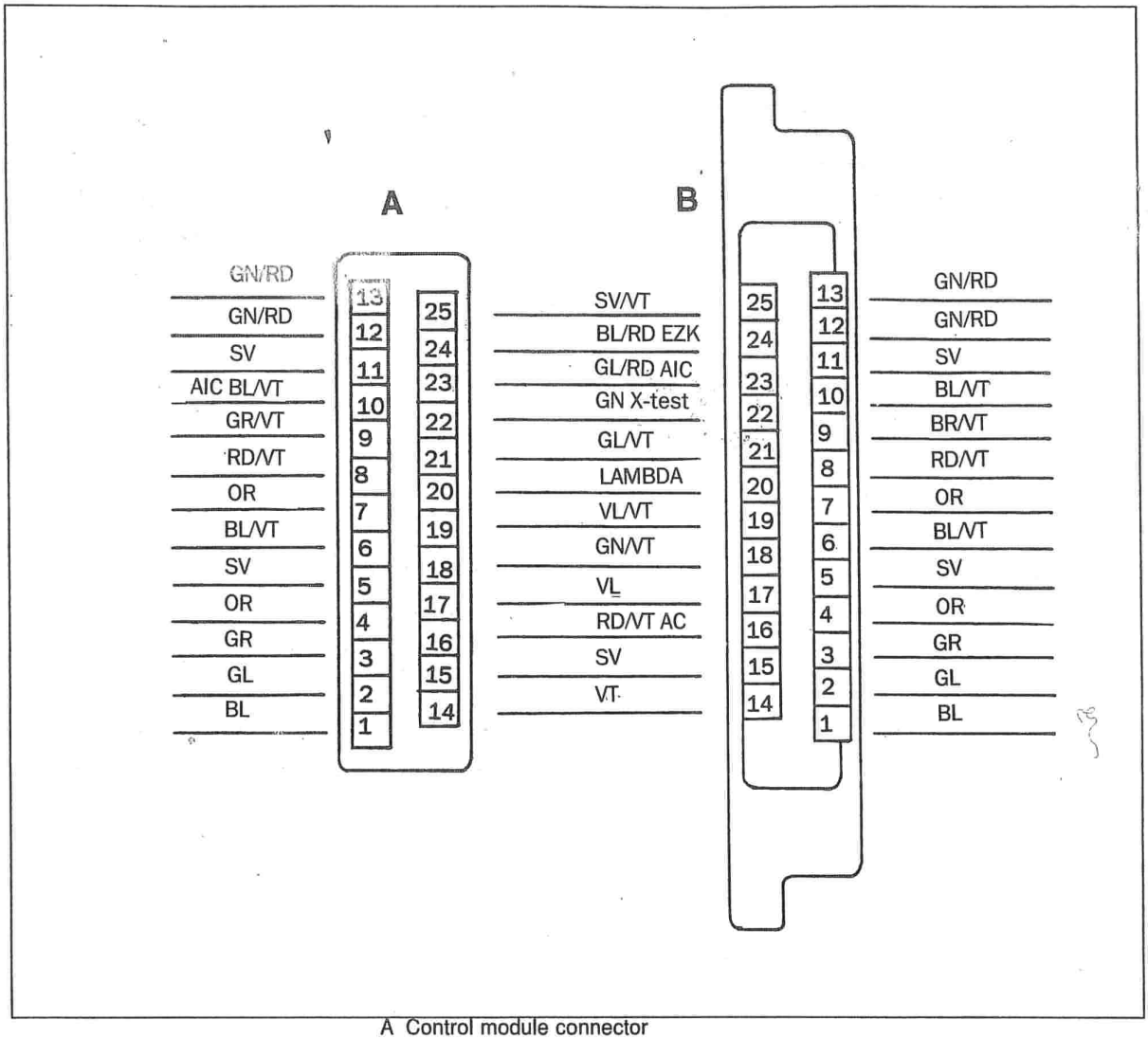
2) Zapněte zapalování, zkontrolujte jestli pin 18 (GR/VT) vykazuje napětí. Jestli-že na zkontrolujte přívod z pin 18 (GR/VT) kontrolního modulu do pojistek ~~pojistkového~~ panelu konektor a do rozdělovače. Také se přesvědčte, že pojistka je v pořádku.

3) Spojkou (klipsou) vedte napětí mezi pin 21 a zemí. zkontrolujte napětí na pin 9. Jestli-že se nevztahuje žádné napětí zkontrolujte (GL/VT) napětí mezi pin 21 a pin 85 na hlavním relé a také (BR/VT) napětí mezi pin 9 a pin 87 na hlavním relé.

4) ~~Vypněte~~ zapalování je zapnuto, zkontrolujte jestli napětí mezi pin 18 a 11 Jestli ne tak zkontrolujte černý (SV) přívod napětí z pin 11 do jednoho z uzemňovacích bodů.

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Control module connections



A Control module connector
B Control module connection

Pin No.	*Component/circuit*
1	Ignition pulse. Ignition coil pin 1, blue (BL)
2	Temperature sensor (NTC resistor) pin 2, yellow (GL)
3	Throttle position sensor pin 1, grey (GR)
4	Idling speed increase switch, automatic transmission, orange (OR)
5	Engine grounding point, black (SV)
6	Mass air flow sensor pin 3, blue/white (BL/VT)
7	Mass air flow sensor pin 5, orange (OR)
8	Mass air flow sensor pin 1, red/white (RD/VT)
9	Main relay pin 87, brown/white (BR/VT)
10	IAC valve
11	Engine grounding point, black (SV)
12	Throttle position sensor pin 3, green/red (GN/RD)

Pin No.	*Component/circuit*
13	Injector control signal, green/red (GR/RD)
14	Mass air flow sensor pin 6, white (VT)
15	Engine grounding point, black (SV)
16	AC, red/white (RD/VT)
17	Pump relay pin 85, violet (VL)
18	Ignition switch, +15 pin, green/white (GR/VT)
19	Limp-Home mode, violet/white (VL/VT)
20	Lambda
21	Main relay pin 85
22	Lambda test, green (GN)
23	IAC valve, yellow/red (GL/RD)
24	EZK, blue/red (BL/RD)
25	Engine grounding point, black/white (SV/VT)

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5 Connect the jumper lead with crocodile clips to pin 17 of the connector and ground.

With the ignition switched on, check for voltage on pins 87 and 87b of the fuel pump relay (or listen for the sound of the pump starting up). If no voltage is present, check the violet (VL) lead between pin 17 of the control module connector and pin 85 of the fuel pump relay.

6 With the ignition switched on, check whether voltage is present between pin 18 of the control module connector and pin 25 of the control module. If it is not, check the l ack/white (SV/VT) lead between pin 25 of the control module and one of the grounding points on the engine.

7 Plug in the distributor connector. Check for an ignition pulse on pin 1 of the control module by connecting a test lamp to ground and pin 1 of the control module connector. Switch on the ignition.

Model year 1985 and earlier cars:

The test lamp should light up weakly for about a second and then shine with a brighter light. If it does not, check the blue (BL) lead between pin 1 of the control module connector and terminal 1 on the ignition coil

Model year 1986 and later cars:

The test lamp should light up. If it does not, check the blue (BL) lead between pin 1 of the control module and the TD-O pin of the ignition pulse amplifier.

8 Use the multimeter to check other wiring functions (broken leads or corrosion) between the connecting pins of the control module.

5/ Spojkou (klipsnou) propojte pin 17 se zemí a vedte mezi nimi napětí. Jestli je spínač zapalování je zapnut zkontrolujte jestli pin 87 a 87b vykazují napětí na kleti čerpadla paliva (nebo poslouchejte čerpadlo při startování), jestli že se neobjeví napětí, zkontrolujte (VL) vedení mezi pin 17 kontrolního modulu a pin 85 na kleti čerpadla paliva.

6/ Jestli že spínač zapalování je zapnut. Zkontrolujte je napětí mezi pin 18 kontrolního modulu a pin 25 kontrolního modulu jestli ne, zkontrolujte černo bílý (SV/VT) vedení mezi pin 25 kontrolního modulu s jedním z uzemňovacích podů motoru.

7/ Zapojte konektor rozdělovače ~~kontrolujte jestli je na zapalovacím~~ impuls k zemi na pin 1 kontrolního modulu i jestli že propojíte zkoušecí lampu se zemí a pinem 1 na konektoru kontrolního panelu (světlo zhasne) zapněte zapalování. Model 1985 a starší

Zkoušecí lampa by měla slabě zasvítit na 1 sec. a pak se rozsvítit silněji jestliže ne zkontrolujte modrý (BL) vedení mezi pin 1 kontrolního panelu a konektorem 4 na zapalovací cívkou

Model 1986 a starší

Zkoušecí lampa by se měla rozsvítit. Jestliže ne zkontrolujte modrý (BL) vedení mezi pin 1 kontrolního modulu a TD-O pin na zapalovacím impulsním zesilovači.

8/ Použijte multimeter na kontrolu el. vedení (spojitost vedení kontrolu) mezi spojovacími piny a kontrolním modulem.

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E8B Checking control module output signals to the injectors

Tools:

- Screwdriver or stethoscope šroubovák nebo stetoskop
- Multimeter
- Tachometer – otáčkoměr

1 Plug in the control module and mass air flow sensor connectors and connect the Hall sensor lead to the distributor (if previously unplugged or disconnected). Connect the tachometer.

2 Pull up the rubber dust excluder over the connector on one of the injectors.

Zapojte kontrolní modul a "mass air flow" snímač a spojte Hall snímač dohromady s rozdělovačem (jestli-že byly v minulosti vypojeny / rozpojeny). Zapojte otáčkoměr.

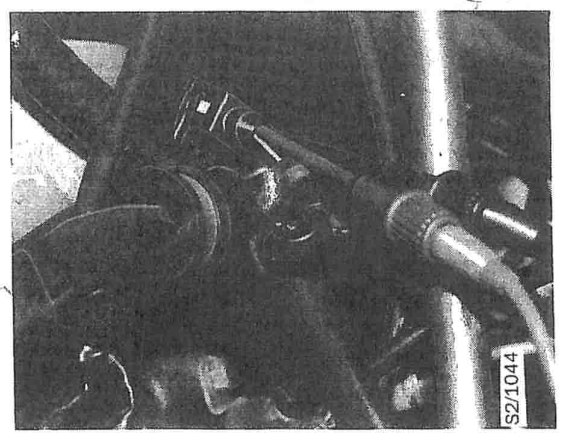
Poznámka:
Nepoužívejte zkušební lampu při kontrole výstupu kontrolního modulu do ustřikovače

Note:

Do not use a test lamp when checking the control module's output signals to the injectors.

3 Connect the multimeter test prods to the injector terminals.

propojte multimeter ke koncovce ustřikovače



Note:

Polarity: Red (+) prod to the blue/red (BL/RD) lead and black (-) test prod—to the green/red (GR/RD) lead. Ohmmeter k modré/červené + černý kondenzátor – v zapojení multimeter

4 Start the engine and check the voltage reading against the table below.

Zapni motor a zkontroluj napětí z tabulky pod ním

Engine temperature	Voltage
0°C (32°F)	1 V
20°C (68°F)	0.6 V NOTE!
80°C (176°F)	0.3 V approx.

5 If the engine runs erratically when idling, check during the warm-up period that all injectors are working properly. This can be done by placing a screwdriver or stethoscope against the black metal part of the injector. A clicking sound should be heard if the injector is working.

5) když motor běží nepravidelně zkontrolujte během zahřívání motoru že všechny ustřikovače správně pracují. To můžete udělat když umístíte šroubovák nebo stetoskop na černou kovovou část ustřikovače. Tikání by se mělo ozvat jestli-že ustřikovač pracuje

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a If no clicking sound can be heard from one or more injectors, refer to section E6 "Checking the injectors".

b If the injectors can be heard clicking but the engine still runs erratically when idling:

Remove one connector at a time from the injectors. Use a small screwdriver to relieve the tension in the spring clips. This should cause engine revs to drop.

c If engine revs do not drop, make a thorough inspection of the following systems:
- The fuel system
- The induction system
- The electrical system

6 When the engine has reached normal operating temperature, rev it up to 3000 rpm. Measure the voltage across the injector, which should rise to 0.8-0.9 V. Let the engine revert to idling speed and then rev it up rapidly to 3000 rpm again. The voltage should now rise above 0.8-0.9 V momentarily before dropping back to 0.8-0.9 V.

a/ Jestli tikání vstřikovačů slyšet
z jednoho nebo více vstřikovačů
Vyhledejte kapitolu E6" kontrola
vstřikovačů"

b/ Jestli vstřikovače tikají ale
motor stále běží normálně
na prázdno
Odstraňujte vždy jeden svorku
ze vstřikovače postupně!
Pružinové upínací sponky
uvolňovat šroubovákem
pružnice. Toby
Se motor



c) Jestli -žádné motor vzpěrače
odpojit, vdělejte kontrolu
následujících -
- palivový systém
- indukční systém
- elektrický systém

6) když motor dosáhne
normální, teplotu provozní
teploty zvyšte otáčky
na 3000 rpm. Změřte
napětí mezi, vstřikovači
které by mělo dosáhnout
0,8 - 0,9 V. Nechte
motor na volnoběh
a pak rychle zvyšte
počet otáček na 3000
rpm. Napětí by se
mělo pohybovat mezi
0,8 - 0,9 V.

E8C Fuel shut-off on starting

When the starter motor is turning the engine over, the fuel supply will be shut off if the accelerator is floored (72° butterfly angle).

1 Lift up the dust excluder on one of the injectors and connect the test prods to the two injector pins.

Polarity: red test prod (+) to the blue/red (BL/RD) lead and black—test prod to the green/red (GR/RD) lead.

2 Engage the starter motor and check for voltage across the injector.

3 Press the accelerator to the floor.

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4 The injectors should remain without current as long as the starter motor is engaged. If not, check the operation of the throttle position sensor, see E5. If the throttle position sensor is defective, fit a new one.

Check the green/red (GN/RD) lead between pin 3 of the throttle position sensor and pin 12 of the control module. Check the lead between pin 2 of the throttle position sensor and one of the engine grounding points.

E8D Checking the full-load enrichment function (not cars with catalytic converter)

Tools:

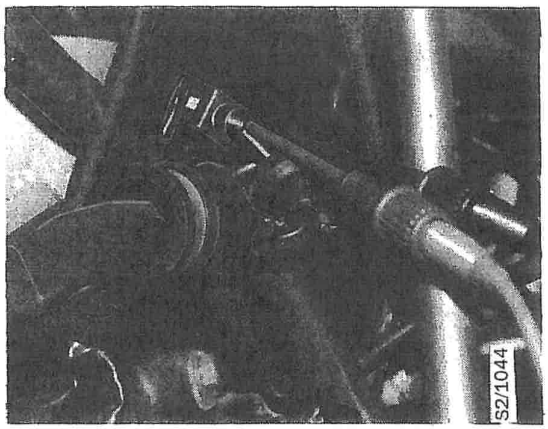
- CO meter
- Multimeter

1 Connect the CO meter and exhaust extraction equipment.

2 Start the engine and warm it up.

3 Peel back the rubber dust excluder on the connector of one of the injectors.

Unplug the throttle position sensor connector and pull up the rubber dust excluder. Connect a jumper lead to pins 3 and 18 of the throttle position sensor connector.



4 Check whether the CO content rises by about 1%. If it does not, connector the multimeter test prods to the injector connecting pins.

Note:

Polarity: Red test prod (+) to the blue/red (BL/RD) lead and black test prod (-) to the green/red (GR/RD) lead.

Check whether the voltage rises by about 0.1 V.

5 If it does not, check the leads running to the control module. See section E5 "Checking the throttle position sensor". If these leads are OK, try another control module.

6 Check and adjust the CO content as described in section E7C.

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E8E Checking the warm-up period

Tools:

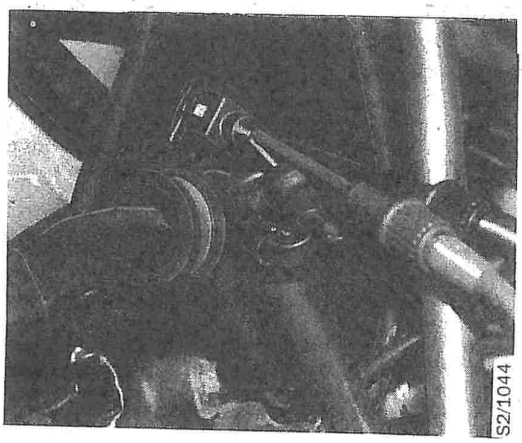
- Multimeter
- CO meter
- Tachometer

1 Connect the tachometer, CO meter and exhaust extraction equipment.

2 Start the engine.

3 Pull up the rubber dust excluder on the connector of one of the injectors.

4 Connect the multimeter test prods to the injector connector pins.



Note:

Polarity: Red test prod (+) to the blue/red (BL/RD) lead and black test prod (-) to the green/red /GR/RD) lead.

5 Check engine speed during the warm-up period. It should decrease as the engine warms up.

6 Measure the voltage across the injectors and compare the readings with the data in the table.

Engine temperature	Voltage
0°C (32°F)	1 V
20°C (68°F)	0.6 V NOTE!
80°C (176°F)	0.3 V approx.

If the readings obtained are incorrect, check the CO setting (see E7C) and temperature sensor (see E4). Also check the hot wire (filament) burn-off function (see E7B).

If these are OK, try another control module.

7 Check the CO content and adjust as necessary as described in E7C.

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E9A Checking the idling-speed increase on cut-in of AC compressor (cars with auxiliary air valve)

Tools:

- Multimeter
- Tachometer

1 Connect the tachometer and exhaust extraction equipment. Start the engine and warm it up.

2 Press the AC button. Engine speed should then drop noticeably and then return to normal idling speed again.

3 If it does not:

- Check whether voltage is present at the AC compressor's single-pole connector at the compressor (red; RD).
- Check the AC unit's electrical system (power supply to the electromagnetic clutch).
- Check whether voltage is present at the IAC valve and whether it opens (see section 854, Service Manual 8:3).
- Check whether voltage is present at the AC unit's 115°C (240°F) thermostat (see section 854, Service Manual 8:3).
- Also check that the yellow (GL) lead between the IAC valve and the AC unit's 115°C (240°F) thermostat and the black (SV) lead to the alternator grounding point are OK.

E9B Checking the idling-speed increase on cut-in of AC compressor (cars with IAC idle air control valve.

1 Connect the tachometer and exhaust extraction equipment. Start the engine and warm it up.

2 Press the AC button. There should not be any noticeable change in engine speed.

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3 If engine speed drops noticeably, check the following:

- The current supply to pin 16 (red/white; RD/VT) on the LH control module.
- If no current is present, check the red/white (RD/VT) lead from pin 16 of the LH control module to pin 16 of the AC relay. Also check the operation of the relay.
- If current is present, check the yellow/red (GL/RD) lead between pin 3 of the IAC valve and pin 23 of the control unit connector, and the blue/white (BL/VT) lead between pin 9 of the IAC valve connector and pin 10 of the control module connector.
- Check the IAC valve as described in point I3.
- If the IAC valve is OK, try a new control module.

Když otáčky motoru značně klesnou testuj:

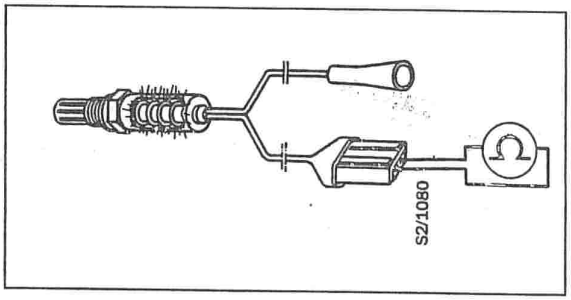
- napětí na pin 16 na LH řídicím modulu,
- přítomnost, vedení RD/VT z pin 16 LH modulu na pin 16 AC relé. Taktéž testuj funkci relé.
- je-li vše v pořádku, kontroluj GL/RD vedení mezi pin 3 IAC ventilu a pin 23 řídicí jednotky a BL/VT vedení mezi pin 9 IAC konekt. ventilu a pin 10 z konektoru řídicího modulu.
- Kontroluj IAC ventil jak popsáno v bodě I3.

E10 Checking the oxygen (Lambda) sensor

The oxygen (Lambda) sensor provides one of several input signals that are processed by the control module to determine the correct fuel-air mixture. Other input signals include engine rpm, engine temperature, accelerator position and air mass.
The oxygen (Lambda) sensor used in the LH system incorporates an electric preheating function which enables the temperature to be raised quickly so that accurate monitoring of the composition of the exhaust gases is ensured.

1 Unplug the two-pin connector from the wiring harness.

2 Use the multimeter to measure the resistance across the two white connections of the oxygen (Lambda) sensor. The correct resistance is about 4 ohms.



1. Odpoj dvou-pinový konektor od vedení.

2. Použij multimetr k měření odporu mezi dvěma bílými svody LAMBDY. Svíný odpor jsou cca 4 ohmy.

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3 Connect the multimeter (2-V DC scale) prods to the black lead of the oxygen (Lambda) sensor and ground.

Start the engine.

As the temperature of the sensor rises, it starts to emit a signal of between 100 and 900 mV. The actual signal will vary with the fuel-air mixture, so that a lean mixture of the kind caused by a slight vacuum leak will give a Lambda value >1 and a signal voltage of about 100 mV.

A rich mixture will give a Lambda value >1 and a signal voltage of about 900 mV.

I1 Checking the induction system

Tools:

- Pressure gauge set 83 93 514

There must be no leakage of air between the mass air flow sensor and the engine.

1 Check the hose connections on:

- the auxiliary valve
- the brake servo unit
- the vacuum tank
- the pressure switch
- the EGR thermostatic valve
- the EGR valve
- the fuel pressure regulator

and also check that the butterfly closes and that the three throttle body retaining bolts are tight.

2 Check that the injectors are properly seated in the inlet manifold and that the O-rings are undamaged.

If air leakage is still suspected after these checks have been carried out, carry out further checking as follows:

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3 Connect pressure gauge 83 93 514 to the inlet manifold downstream of the throttle butterfly and hang the pressure gauge from the rear-view mirror inside the car.

4 Start the engine and let it run at idling speed (850 ± 50 rpm).

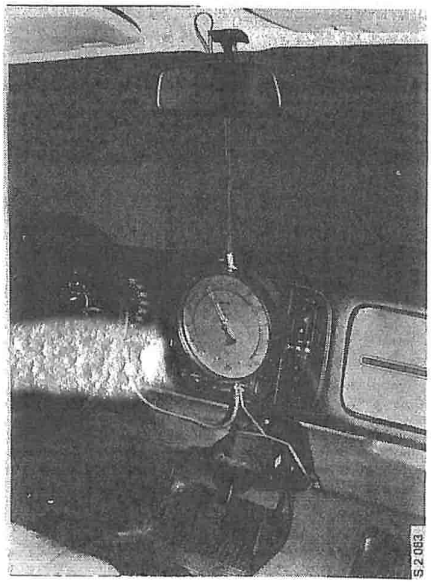
Check the vacuum which, if the system is operating correctly, should be between -0.4 and -0.8 bar (-5.8 to -10.2 psi).

If the vacuum is less than -0.4 bar (-5.8 psi), this indicates a leak in the induction system. Check the system again as described in point 1.

5 Use the pressure gauge to check the induction system for air leakage downstream of the throttle butterfly and check the system by eye between the mass air flow sensor and the throttle butterfly. The vacuum should be above -0.4 bar (- 5.8 psi).

6 Check for leaks by eye between the throttle body and pressure pipe, between the pressure pipe and the turbo, between the turbo and the inlet manifold, or at the inlet manifold connections for crankcase ventilation and the BPC return hose. Also check that no leakage occurs between the inlet manifold connection to the rubber duct and the mass air flow sensor, between the mass air flow sensor and the air cleaner, and at the air cleaner cover.

Also check the connection of the air intake to the air cleaner and its position.



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I2 Checking the auxiliary air valve

Tools:

- Multimeter
- Torch
- Mirror or sheet of white paper

Before starting to check the auxiliary air valve, unplug the control module and auxiliary air valve connectors.

Note:

Checking is to be carried out when the engine is cold (below 30°C/86°F).

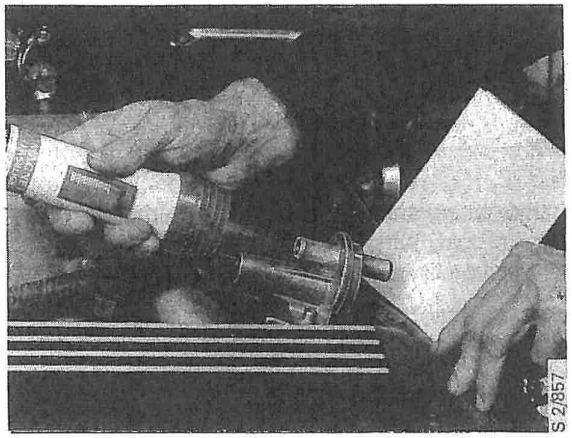
1 Using two separate jumper leads with crocodile clips, connect pin 21 (yellow/white; GL/VT) and pin 17 (violet; VL) of the control module connector to ground.

2 Check that voltage is present across the pins in the auxiliary air valve connector. If it is not, check the operation of the main relay and pump relay, see sections E1 and E2, and the grey and black (GR and SV) leads to the auxiliary air valve.

3 Detach the rubber hoses and plug in the auxiliary air valve connector. Check that the valve opens by shining the torch through one of the hose spigots and holding the mirror or sheet of white paper close to the opposite hose spigot. The valve should close fully after about five minutes (depending on engine temperature).

4 If it does not, check the resistance of the auxiliary air valve by connecting the multimeter test prods to its pins. The resistance should be 40-60 ohms.

If this reading is not obtained, fit a new auxiliary air valve.



I3 Checking the IAC idle air control valve

- Unplug the idle air control valve connector.

Measure the resistance of the IAC valve across pins 3 and 2 (the middle pin) and across pins 2 and 1. See "Technical data" for the correct resistance.

If the correct resistance reading is not obtained, try a new IAC valve.

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M1 Basic setting of throttle butterfly, LH 2.2

1 Make sure that the butterfly is mounted centrally in the throttle body.

2 Screw in the adjusting screw until it touches the stop (butterfly fully closed).

3 Turn the adjusting screw a further 1/3 turn and secure it in this position with a locknut. This will ensure a clearance between butterfly and throttle body of approx. 0.05 mm (0.002 in).

4 Check that the length of the throttle cable does not prevent the butterfly from reaching the idling speed position, and that there is no play at the accelerator pedal.

5 Check that the butterfly opens fully when the accelerator is floored.

Check and adjust the throttle position sensor.

Basic setting of throttle butterfly (LH 2.4)

Basic setting should be carried out:

- after repair work on the engine induction system
- if idling speed is too high (engine cold or at normal operating temperature)

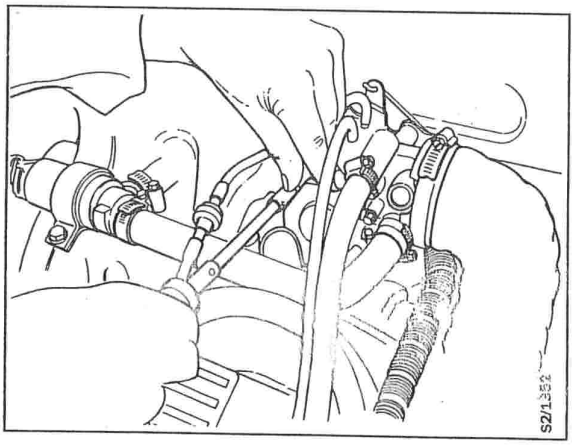
Note:

Basic setting should always be carried out with the engine cold, temperature about 20°C (68°F), and the ignition switched off.

Basic setting cannot be carried out accurately when the engine is hot due to excessive clearance between the throttle butterfly and the throttle body (because the inside diameter of the throttle body increases more than the diameter of the throttle butterfly as the temperature rises).

1 Undo the throttle position sensor retaining screws and rotate the sensor clear of the throttle butterfly'

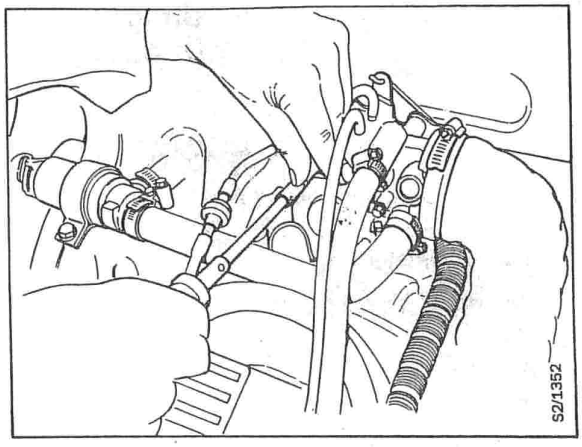
Make sure that the throttle cable is slack.



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2 Undo the butterfly locknut, using nut driver 83 94 332 and turn the adjusting screw until the throttle butterfly is fully closed (abuts firmly against the inner wall of the throttle body).

Then turn the adjusting screw half a turn (180°) clockwise and tighten the locknut, taking care not to alter the setting.



3 Reset the throttle position sensor (closed in the idling position) and tighten the retaining screws.

Check the setting. When the butterfly leaves the idling position a clicking sound should be heard from the sensor.

M1A Adjusting the idling speed (not cars with catalytic converter)

To adjust the idling speed, turn the adjusting screw on the throttle body by-pass passage. Adjust the idling speed in conjunction with setting the CO content.

Idling speed: 850 ± 75 rpm.

Note:

The engine must be at normal operating temperature.

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M1B Adjusting the idling speed (cars with catalytic converter)

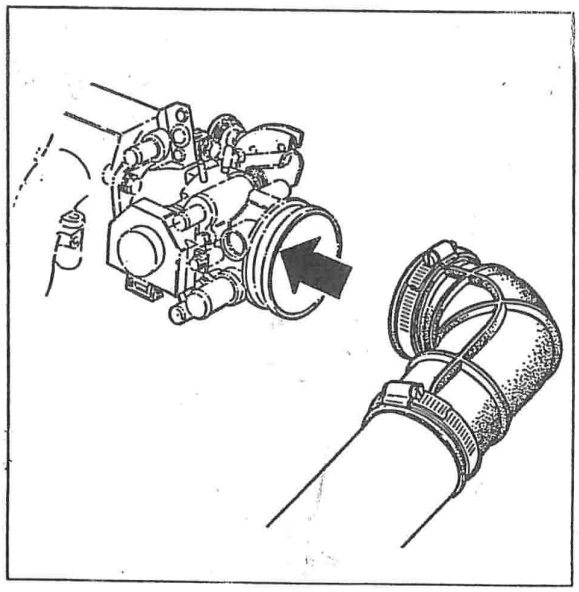
(For cars with the LH 2.2 fuel injection system.)

Tools:

- TSI tachometer
- Nut driver for the butterfly adjusting screw locknut, 83 94 322
- Jumper lead with switch 83 93 886

1 Remove the induction hose from the throttle body.

Open the throttle butterfly fully and wash the inside of the throttle body round the butterfly, using a cloth soaked in benzine or the equivalent.



2 Start the engine and warm it up.

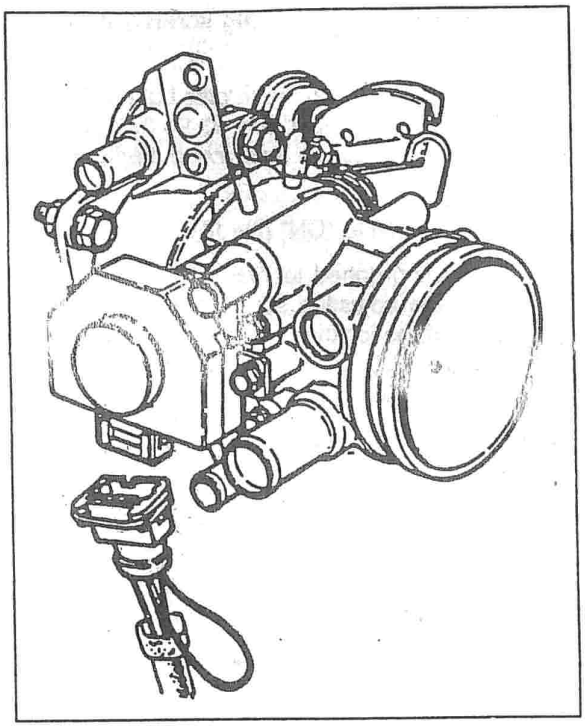
Note:

It is extremely important for the gearbox oil to be at normal operating temperature.

3 Undo the locknut on the throttle and lower the dashpot clear of the throttle lever.

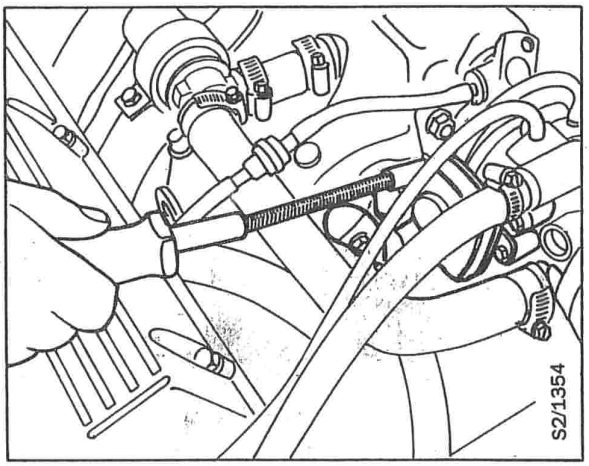
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4 Unplug the throttle position sensor connector and connect a jumper lead across pins 1 and 2 at the rear of the connector. (This sends a signal to the LH control module corresponding to closed contacts for the idling position, which is necessary for obtaining an accurate setting when carrying out adjustment.)



5 Undo the two throttle position sensor retaining screws and rotate the sensor clear of the throttle butterfly.

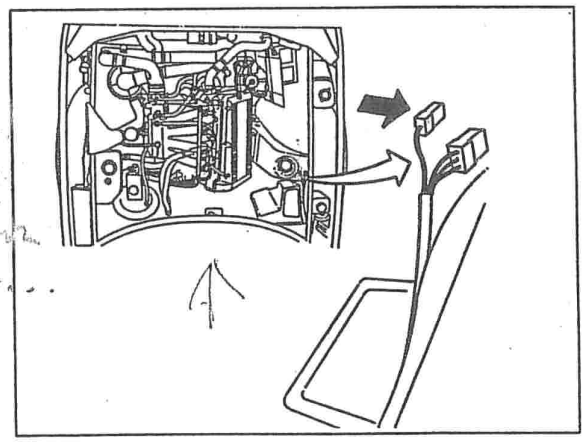
Also make sure that the throttle cable does not interfere with the movement of the throttle butterfly (cable slack).



6 Start the engine and disconnect current-consuming items like the AC, headlamps, seat heating elements, etc.

Note also that adjustment must not be carried out when the radiator fan is running.

7 Connect the jumper lead with switch (83 93 886) to the single-pole test socket located adjacent to the right-hand wheel arch (green/red lead).



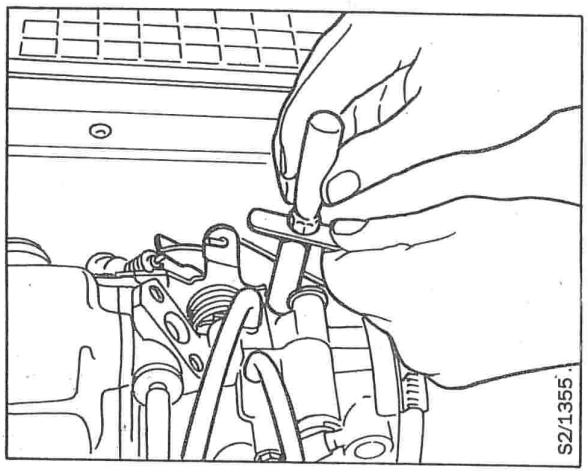
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Cars not fitted with adjusting screw (air bleed screw):

8 Undo the locknut on the throttle butterfly adjusting screw, using nut driver 83 94 322, and turn the adjusting screw until the butterfly is fully closed.

Set the switch to "ON" (the IAC valve closes).

Adjust idling speed to 775 ± 25 rpm and then secure the adjusting screw in this position by means of the locknut.



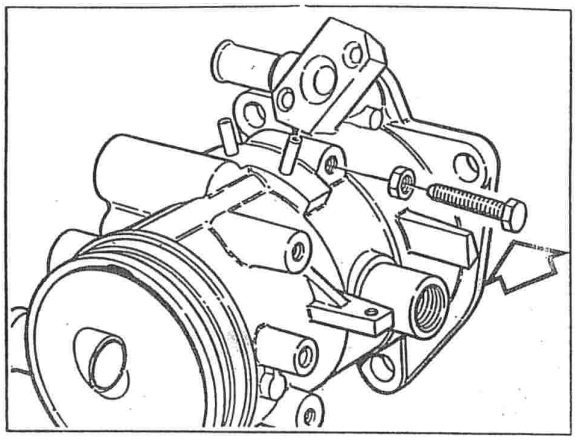
9 Set the switch to "OFF".

Check that engine speed changes and when stabilized settles down to a steady idling speed of 850 ± 75 rpm.

Cars fitted with an adjusting screw (air bleed screw):

Turn the adjusting screw clockwise until it reaches the stop (fully seated) and tighten it by means of the locknut.

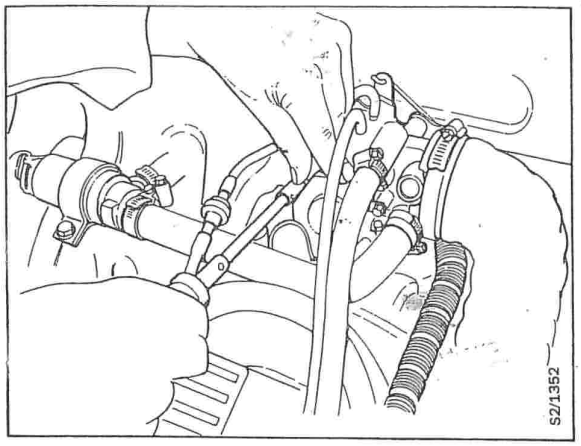
Then continue adjustment as described in point 8.



10 Switch off the engine.

11 Adjust the throttle position sensor to the correct setting (closed in idling position).

Check that the sensor makes a clicking sound when the butterfly lever is moved away from the idling position. Do not confuse this sound with the click produced by the shift- up switch.



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12 Adjust the throttle dashpot so that it closes within a period of 2-3 seconds.

Tighten the locknut.

13 Remove the jumper lead from the throttle position sensor connector and connect it to the sensor.

Component replacement

Control module

1 Disconnect the negative battery cable.

2 Remove the sill scuff plates from the right-hand side of the car.

Pull away the door weatherstrip at bottom front.

3 Remove the plate holding the carpet in place on the wheel arch and fold back the carpet.

4 Unplug the control module connector by releasing the clip and lifting it diagonally upwards and outwards.

5 Remove the control module retaining screws from the wheel arch.
Fit in reverse order.

Main relay and pump relay

1 Remove the air duct retaining screws and move the duct out of the way.

2 Fold the sound insulating felt aside.

3 Pull the relays out of their holders.

To check the operation of the relays, remove the relay holder from the wheel arch and pull the relays forward, providing easier access to the electrical connections.
Fit in reverse order.

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Temperature sensor

1 Remove the clips for the crankcase ventilation hose from the camshaft cover.

2 Remove the fuel pressure regulator complete with bracket from the cylinder head.

3 Unplug the temperature sensor connector.

4 Drain off about 4 litres of coolant so that it will not run out of the aperture when the temperature sensor is removed.

5 Unscrew the temperature sensor and remove it, using a ½" drive long socket..

Before refitting, thoroughly clean the mating surfaces and temperature sensor.

Also check the condition of the copper washer.

Fit in reverse order.

Temperature sensor tightening torque: 20 Nm (14.8 lbf ft).

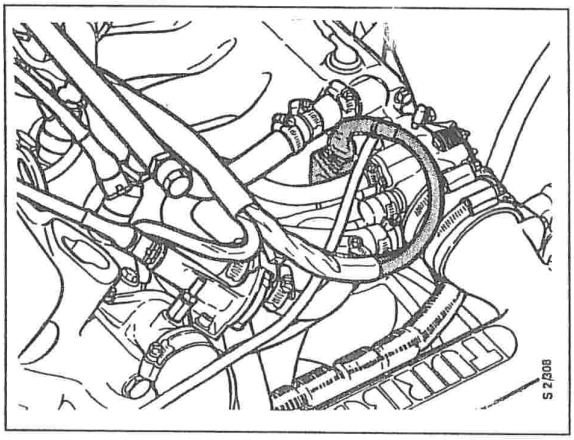
Note:

Do not forget to reconnect the ground leads for the LH injection system at the point where the fuel pressure regulator is fastened to the cylinder head.

Throttle position sensor

1 Unplug the electrical leads from the throttle position sensor.

2 Remove the inlet manifold retaining screws and lift off the throttle position sensor.
Fit in reverse order.
Adjust the throttle position sensor to the correct position, see section E5 "Checking and adjusting the throttle position sensor".



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Fuel injection manifold and injectors

To remove

Note:

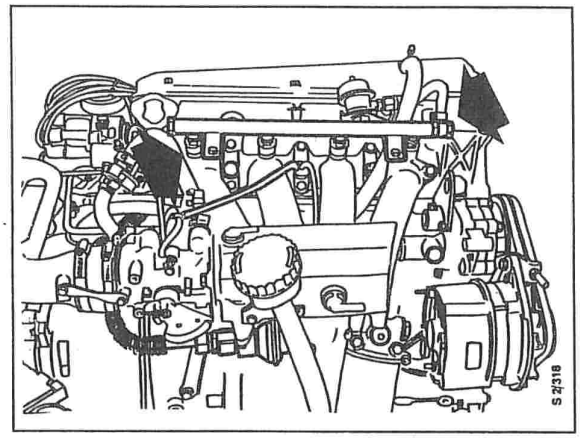
Scrupulous cleanliness must be observed when carrying out work on the fuel injection manifold and injectors.
Wash the areas round the injectors, the fuel injection manifold and the intake manifold. Blow clean and dry with compressed air.

1 Remove the crankcase ventilation hose from the camshaft cover.

2 Unplug the electrical connectors from the injectors.

3 Free the wiring harness by undoing the cable tie at the point where the injection manifold is fastened to the intake manifold.

4 Undo the fuel injection manifold hose connections (banjo fittings) at both ends.



Note:

Use a spanner on the flats at each end to hold the injection manifold steady.

Note:

In the event of fuel leakage, always wipe up the fuel with a cloth or the like.

5 Remove the bolts securing the fuel injection manifold to the intake manifold.

6 Lift up the fuel injection manifold complete with injectors.

7 Remove the clips between the injectors and the injection manifold.

8 Remove the injectors from the injection manifold by twisting and then withdrawing them.

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To fit

Before refitting, inspect the O-rings. If damaged, fit new ones.
To facilitate fitting and reduce the risk of damage, smear the O-rings sparingly with petroleum jelly (Vaseline).

1 Fit the injectors in the fuel injection manifold.

2 Mount the fuel injection manifold complete with injectors on the intake manifold.

Check that the injectors are correctly located and pushed fully home in the intake manifold, and that the flange of the fuel injection manifold lines up with the groove for the clip in the injector. Fit the clips.
Fit in reverse order.

Mass air flow sensor

1 Undo the hose clip securing the rubber duct to the mass air flow sensor.

2 Unplug the connector and the two clips for the air cleaner housing cover.

3 Lift the mass air flow sensor clear of the cover and the rubber duct.

4 Fit the new mass air flow sensor, making sure that the ridge in the sensor lines up with the recess in the cover. Secure the clips.

5 Connect the rubber duct to the mass air flow sensor. Tighten the hose clip.

6 Plug in the connector.

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Fuel filter

1 Thoroughly clean the area round the two fuel line connections.

2 Prevent the filter from turning by applying a spanner to the flats on the filter and banjo fitting and disconnect the fuel lines. Remove the filter.

Note:

To prevent swarf from the threads from getting into the fuel system, do not remove the fitting on the discharge side.

3 Fit the new filter with **the arrow pointing in the direction of flow** and reconnect the fuel lines.

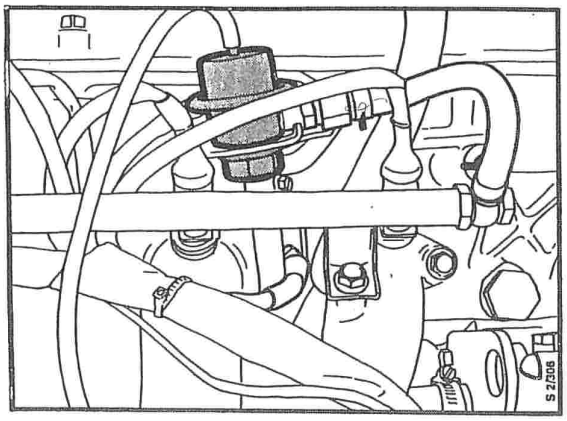
Note:

If the filter has been fitted the wrong way round it must not be refitted. Fit a new one instead.

Fuel pressure regulator

Note:

Fuel still under pressure. Wipe up any escaping fuel with a cloth or the like.



1 Disconnect the hose between the fuel injection manifold and the fuel pressure regulator at the nipple on the pressure regulator.

2 Remove the hose between the intake manifold and the diaphragm side of the pressure regulator.

3 Remove the fuel pressure regulator complete with bracket from the cylinder head.

4 Disconnect the return fuel hose from the pressure regulator.

5 Remove the pressure regulator from the bracket.
Fit in reverse order.

Note:

Do not forget to reconnect the LH injection system ground leads at the point where the pressure regulator is fastened to the cylinder head.

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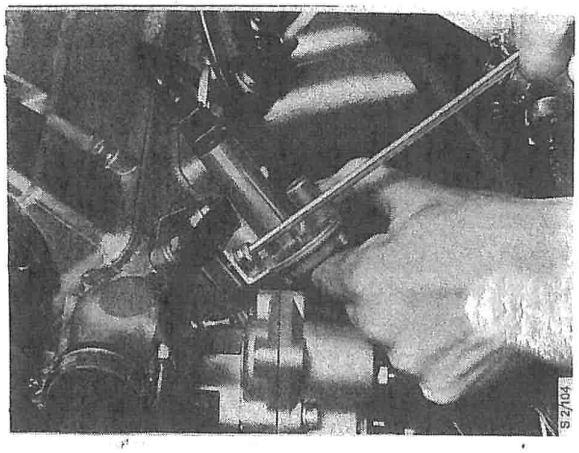
Auxiliary air valve

1 Undo the hose clips and pull off the hoses.

2 Disconnect the electrical leads.

3 Unscrew the auxiliary air valve.

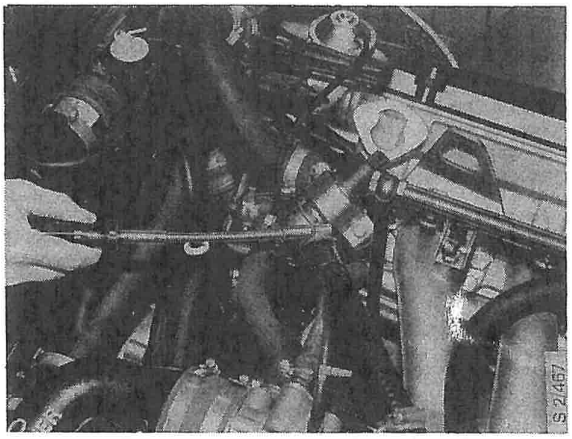
Fit in reverse order.



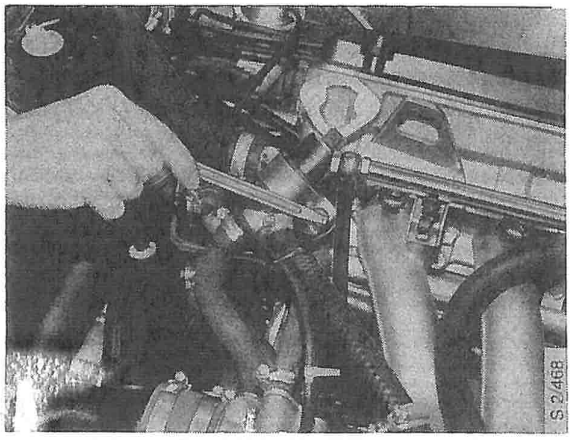
IAC idle air control valve

1 Unplug the connector.

2 Undo the hose clips and pull off the hoses.



3 Undo the valve retaining screws and lower the valve from its holder.



Fit in reverse order.

To adjust the setting of the IAC valve, see section M1B.

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Air cleaner

1 Unplug the mass air flow sensor connector and release the two clips securing the air cleaner housing cover. Withdraw the mass air flow sensor and turn it to one side out of the way.

2 Remove the air cleaner housing cover by undoing the four clips.

3 Lift off the housing cover.

4 Lift out the filter element.

5 Fit a new filter element, making sure it is centred in the air cleaner housing.

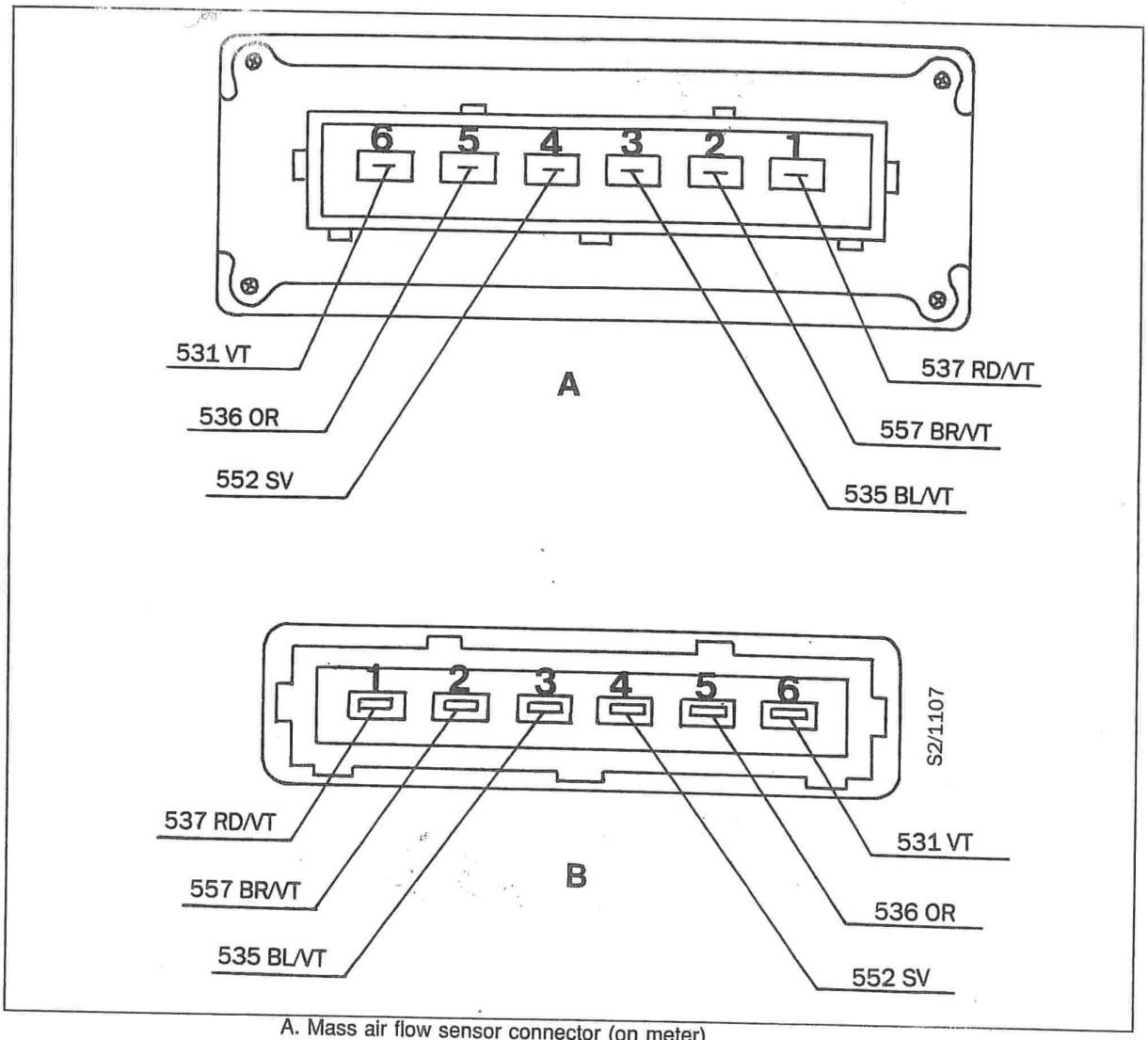
6 Refit the housing over. Turn the cover to line up the clips and to bring the spigot for the mass air flow sensor in line with the inlet to the turbo unit. Fasten the clips.

7 Reconnect the mass air flow sensor, lining up its ridge with the groove in the air cleaner housing cover. Fasten the clips.

8 Plug in the mass air flow sensor connector.

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Mass air flow sensor connector pins

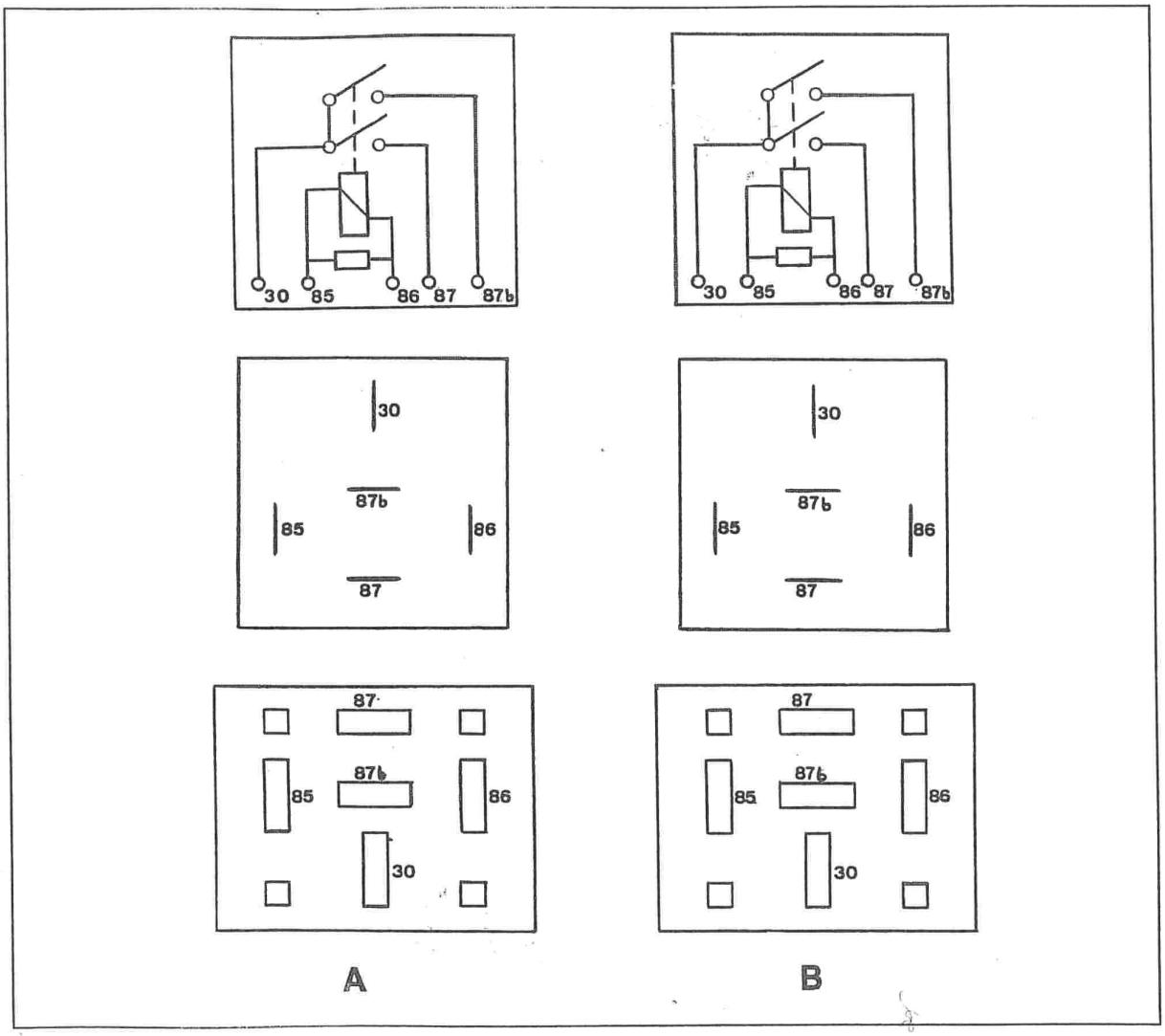


A. Mass air flow sensor connector (on meter)
B. Mass air flow sensor connector (on wiring)

The connections from the mass air flow sensor go to:
531 (1)→Control module pin 14
536 (2)→Control module pin 7
552 (3)→Grounding point on engine
535 (4)→Control module pin 6
557 (5)→Main relay pin 87b
537 (6)→Control module pin 8

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Wiring diagrams for main relay and pump relay



A Main relay
B Pump relay

Key: Main relay

30 = 559a red (RD) = Battery
85 = 548 yellow/white (GL/VT) = To control module pin 21
86 = 559b red (RD) = Battery
87 = 538 brown/white (BR/VT) = To control module pin 9
87b = 557 brown/white (BR/VT) = Hot wire (filament) burn-off function

Key: Pump relay

30 = 559 red (RD) = Battery
85 = 545 violet (VL) = To control module pin 17
86 = 560A brown/white (BR/VT) = To pressure switch pin 15
87 = 561 blue/red (BL/RD) = To injector and

558 blue/red (BL/RD) to auxiliary air valve or idle air control valve
87b = 261a grey/red (GR/RD) = To fuel pump and

564 grey/red (GR/RD) = LIMP-HOME socket

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