

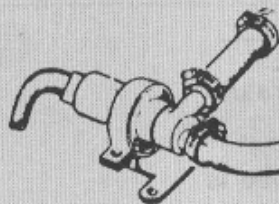
Temperature sensor

	°C	(°F)		(± 10%)
Resistance at	-20	(-4)	Ohm	14000
	-10	(14)	Ohm	9000
	0	(32)	Ohm	5800
	10	(50)	Ohm	3800
	15	(58)	Ohm	3000
	20	(68)	Ohm	2600
	25	(76)	Ohm	2000
	30	(86)	Ohm	1700
	80	(176)	Ohm	320



Auxiliary air valve

Resistance	Ohm	40-60
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AIC valve

Resistance, LH 2.2	Ohm	20 ± 5
LH 2.4	Ohm	7 ± 5

Fuel system, B202 engine

Pressure regulator

Bosch No.	Pressure
0 280 160 225	
227	
257	
214	2.5 + 0.25/-0.15 bar
215	(2.3-2.8)*
213	
226	
235	3.0 + 0.25/-0.15 bar
256	(2.8-3.3)*
258	
264	2.8 + 0.25/-0.15 bar
265	(2.6-3.1)*

* 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.

Pressures	Turbo	Other engines
System pressure (at atmospheric pressure in the intake manifold)		
-1986 bar (psi)	2.5 ± 0.05 (36)	3.0 (43) above pressure
1987- bar (psi)	2.8 ± 0.05 (41)	intake manifold
Residual pressure (engine switched off) bar (psi)	2.3 (33)	2.8 (39)

Pressure regulator - checking values

Turbo, up to and including 1986

Vacuum	System pressure
0 bar	2.5 bar (36 psi)
-0.2 bar (-2.9 psi)	2.3 bar (33 psi)
-0.4 bar (-5.8 psi)	2.1 bar (30 psi)
-0.6 bar (-8.6 psi)	1.9 bar (28 psi)

Pressure	System pressure
0 bar	2.5 bar (36 psi)
+ 0.2 bar (2.9 psi)	2.7 bar (39 psi)
+ 0.4 bar (5.8 psi)	2.9 bar (42 psi)
+ 0.6 bar (8.6 psi)	3.1 bar (45 psi)

Turbo, as from 1987

Vacuum	System pressure
0 bar	2.8 bar (40 psi)
-0.2 bar (-2.9 psi)	2.6 bar (37 psi)
-0.4 bar (-5.8 psi)	2.4 bar (35 psi)
-0.6 bar (-8.6 psi)	2.2 bar (32 psi)

Pressure	System pressure
0 bar	2.8 bar (40 psi)
+ 0.2 bar (2.9 psi)	3.0 bar (43 psi)
+ 0.4 bar (5.8 psi)	3.2 bar (46 psi)
+ 0.6 bar (8.6 psi)	3.4 bar (49 psi)

B202i, as from 1986

Vacuum	System pressure
0 bar	3.0 bar (43 psi)
-0.2 bar (-2.9 psi)	2.8 bar (40 psi)
-0.4 bar (-5.8 psi)	2.6 bar (37 psi)
-0.6 bar (-8.6 psi)	2.4 bar (35 psi)

Technical description

CI Fuel injection system

B201 injection engine 200-2

CI Fuel injection system, B201 engine

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LH Fuel injection system

B202 injection engine 200-30

Fuel boosting system

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. 200-33

LH fuel-injection system - B202 engine

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Components

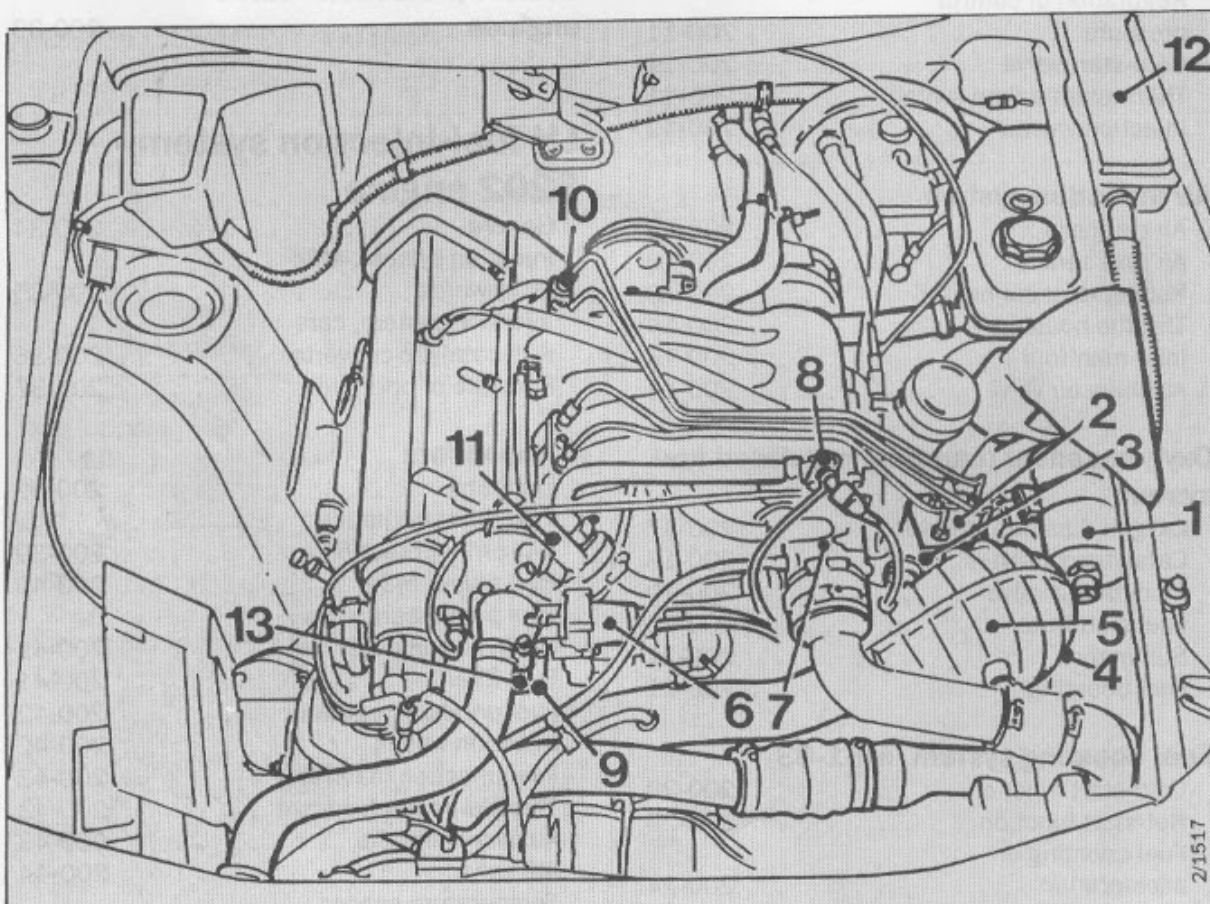
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Fuel system, B201 injection engine

General

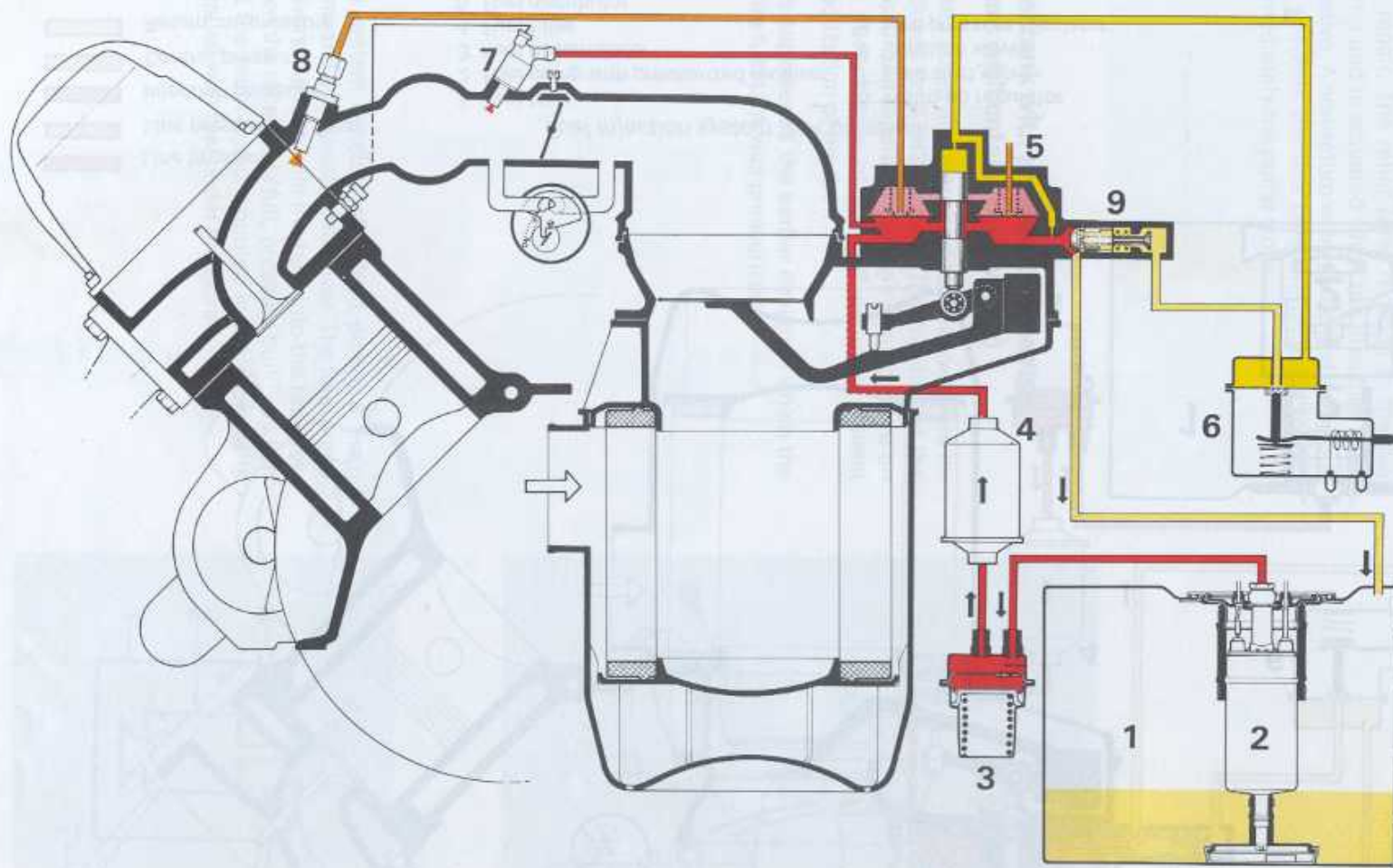
The injection system for the engine is the Bosch CI (Continuous Injection) system.

An electric fuel pump delivers fuel at constant pressure to the fuel distributor. The air flow sensor, which measures the flow of air to the engine, acts mechanically on the fuel distributor, thereby ensuring that the correct amount of fuel is metered to the four injection valves. The fuel is injected continuously into the inlet manifold immediately upstream of the inlet valves.



Injection engine

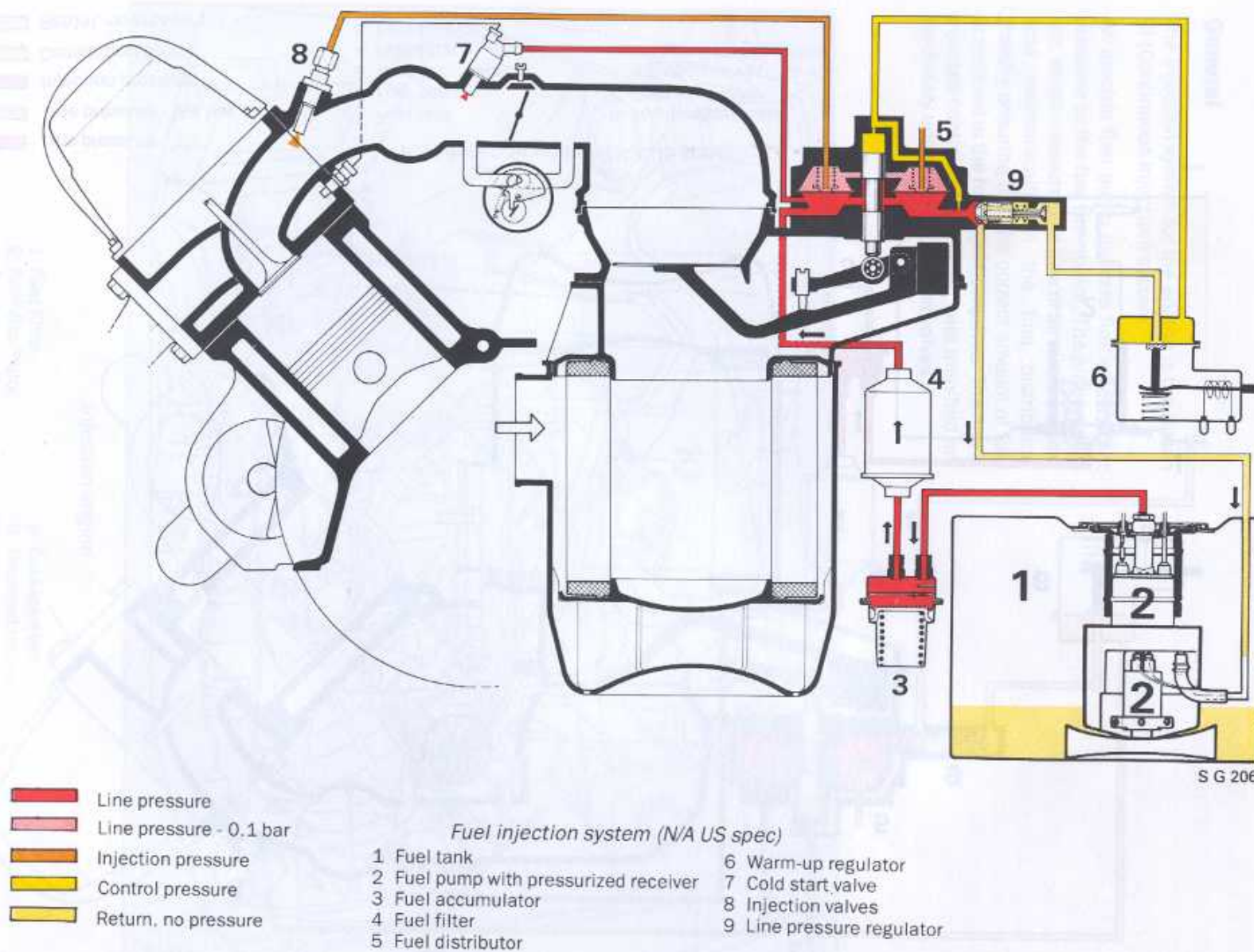
- | | |
|-------------------------|-----------------------------|
| 1 Fuel filter | 8 Cold-start valve |
| 2 Fuel distributor | 9 Thermostatic switch |
| 3 Air flow sensor | 10 Injection valves |
| 4 Air cleaner | 11 Auxiliary air valve |
| 5 Rubber duct connector | 12 Power distribution panel |
| 6 Warm-up regulator | 13 Thermostatic time switch |
| 7 Throttle housing | |



- Line pressure
- Line pressure - 0.1 bar
- Injection pressure
- Control pressure
- Return, no pressure

Fuel injection system (N/A US spec)

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



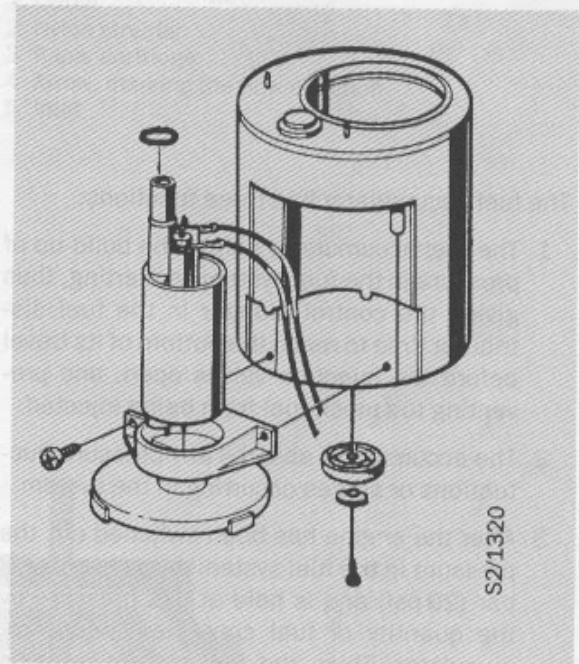
Fuel tank and fuel pump

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 dropping to zero immediately the pump stops.

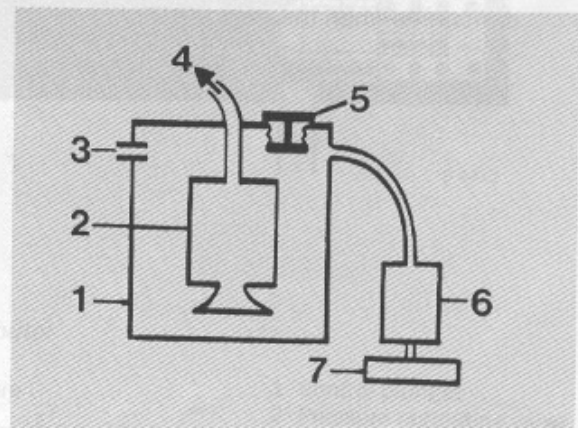
Fuel tank with pressurized receiver (Cars with catalytic converter)

A feed pump and a 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 supersedes the earlier design in which the entire fuel tank was pressurized.



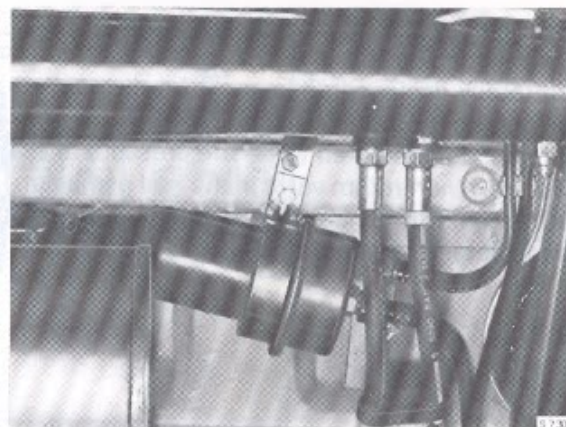
The system consists of a feed pump, a main pump and a pressurized receiver. The feed pump delivers the fuel from the tank into the receiver. When the receiver is full, pressure builds up in it and the main pump mounted in the receiver is supplied with fuel under pressure.



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

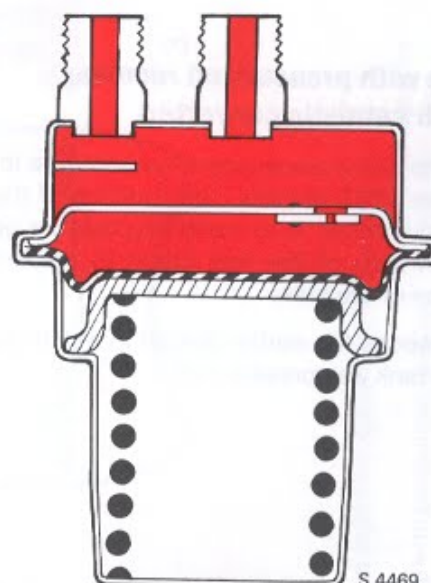
Fuel accumulator

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.



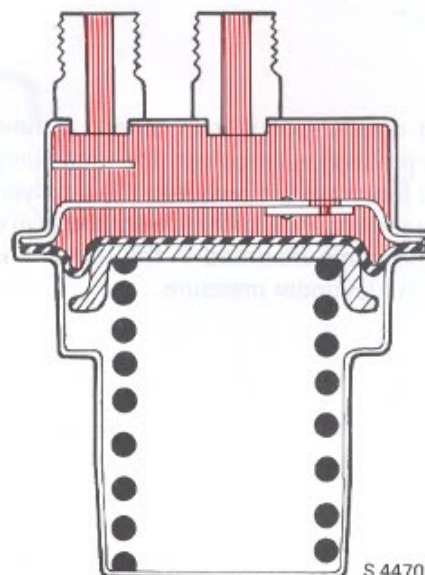
The fuel accumulator has three functions:

- 1 The fuel accumulator delays the build-up of pressure in the fuel system on starting, thus giving the control plunger in the fuel distributor time to reach the bottom of its travel before the injection valves open, and preventing too much fuel from being injected.
- 2 The accumulator absorbs any pressure fluctuations or surges occurring in the system.
- 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. Thus, the fuel system remains pressurized while the engine is cooling, preventing the formation of air bubbles due to vaporization of the fuel and possible starting difficulties when the engine is hot.



Fuel accumulator with fuel pump in operation

Line pressure

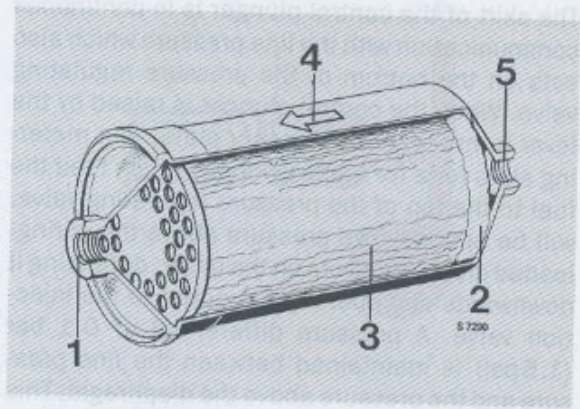


Fuel accumulator on shut-off of engine

Shut-off pressure.

Fuel filter

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

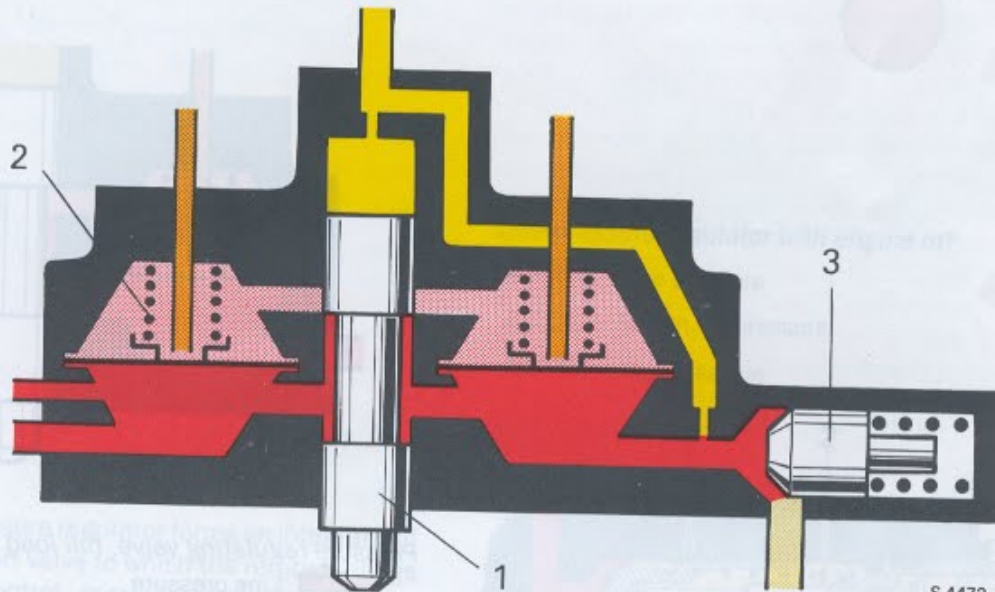


Fuel filter

- 1 Outlet
- 2 Nylon strainer
- 3 Paper cartridge
- 4 Arrow, marking the flow direction
- 5 Inlet

Fuel distributor

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



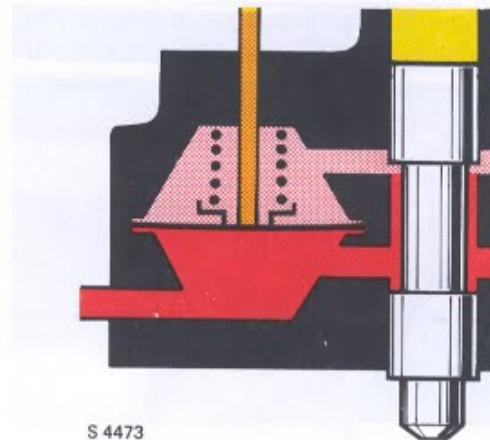
Fuel distributor

- | | |
|--|-----------------------------|
| Line pressure | 1 Control plunger |
| Line pressure - 0.1 bar (1.5 psi) | 2 Pressure regulating valve |
| Injection pressure | 3 Line pressure regulator |
| Control pressure | |
| Return, no pressure | |

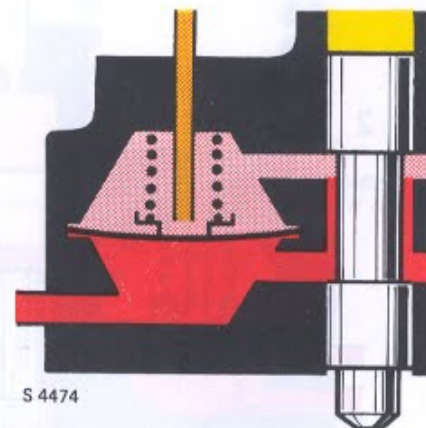
200-8 Technical description

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 lever from the air flow sensor plate, four metering slots (one for each cylinder), which feed the fuel to the top of the pressure regulating valve, will be opened. The pressure above the spring-loaded diaphragm acts on the latter, deflecting it downwards and opening the outlet to the injection valve. A pressure differential of 0.1 bar (1.5 psi) is maintained 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 that this 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

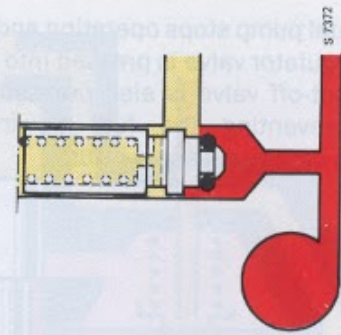


Pressure regulating valve, full load

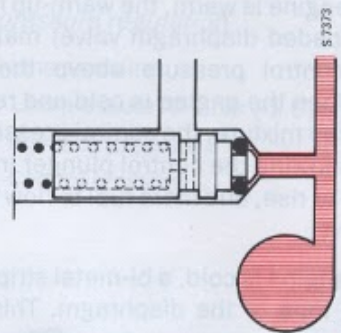
-  Line pressure
-  Line pressure - 0.1 bar (-1.5 psi)
-  Injection pressure
-  Line pressure

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, there is a rapid drop in pressure to approx. 2.5 bar (36 psi), at which pressure (the rest pressure) the regulator closes the return line and the rest pressure is maintained by means of the 'O' ring seal and the quantity of fuel contained 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, making restarting difficult.

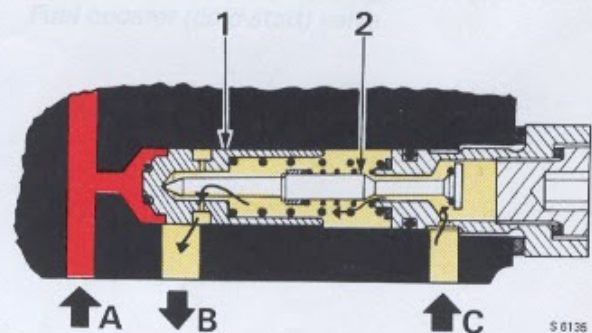


Line pressure regulator with fuel pump in operation



Line pressure regulator with engine off

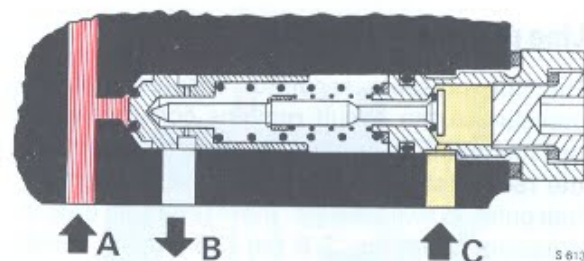
- Line pressure
- Return, no pressure
- Rest pressure



Line pressure regulator, fuel pump operating

- 1 Line pressure regulator
- 2 Shut-off valve
- A Line pressure
- B Return line
- C Control pressure return

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



S 6136

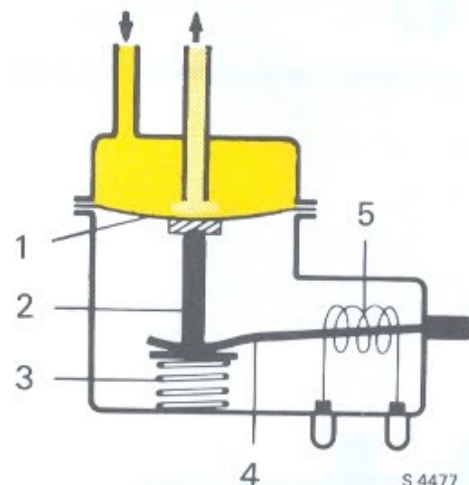
Line pressure regulator, fuel pump idle

- 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 decreased, allowing the control plunger in the fuel distributor to rise, and more fuel to flow to the injection valve.

When the engine is cold, a bi-metal strip reduces the spring load of the diaphragm. This causes the diaphragm to open and more fuel to flow through the recirculation line to the fuel tank, thus reducing the control pressure. When the engine is running, current flows through the coil which surrounds the bi-metal strip. As the bi-metal strip heats up, it bends away from the spring, and the pressure on the diaphragm, and thus the control pressure, increases. When a warm engine is started, there is no reduction in the control pressure, as the bi-metal strip is then affected by the engine temperature.

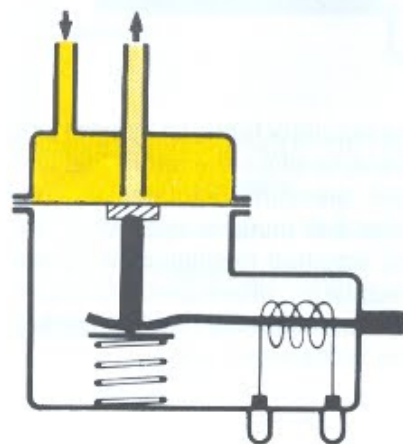


S 4477

Warm-up regulator, cold engine

- Control pressure
- Return, no pressure

- 1 Diaphragm
- 2 Push rod
- 3 Pressure spring
- 4 Bi-metal strip
- 5 Heating coil



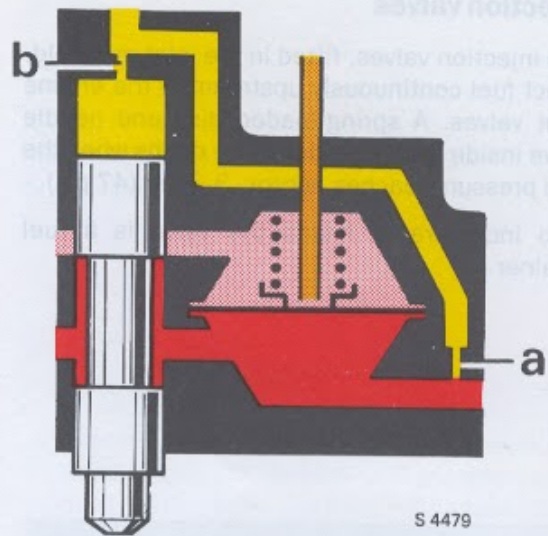
S 4478

Warm-up regulator, warm engine

- Line pressure
- Return, no pressure

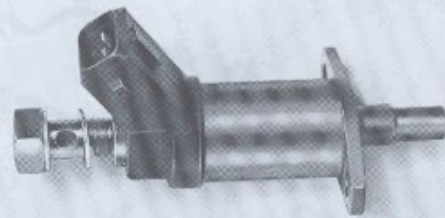
Regulation of control pressure

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 (7-54 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 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

Fuel booster (cold-start) valve

The cold-start valve, located inside the throttle housing, 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 running or the fuel booster pressure switch contacts are energized. At temperatures of -20°C (-4°F) or below, the valve can inject fuel for a maximum period of 9.5 s. At higher engine temperatures the injection time becomes progressively shorter and the valve ceases to operate at a temperature of approx. 45°C (113°F).

Thermostatic time switch

When the engine is cold, with a temperature below 45°C (113°F), the switch should close allowing current to flow for some time (depending on the actual temperature) when the starter motor is running.

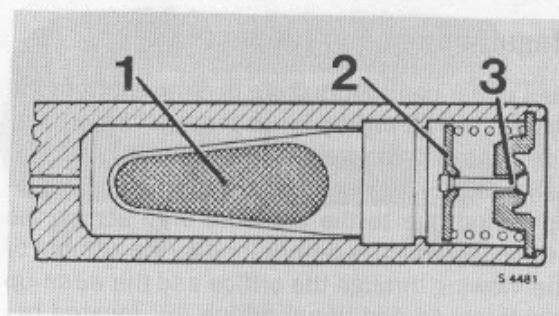
Check that the switch closes when the starter motor is running by connecting a test lamp across the terminals of the unplugged connector.

Because it is not possible to make a more accurate check of the time the switch is closed or of the temperature, if in doubt, fit a new switch.

Injection valves

The injection valves, fitted in the inlet manifold, inject fuel continuously upstream of the engine inlet valves. A spring-loaded disc and needle valve inside each injection valve opens when the fuel pressure reaches approx. 3.3 bar (47 psi).

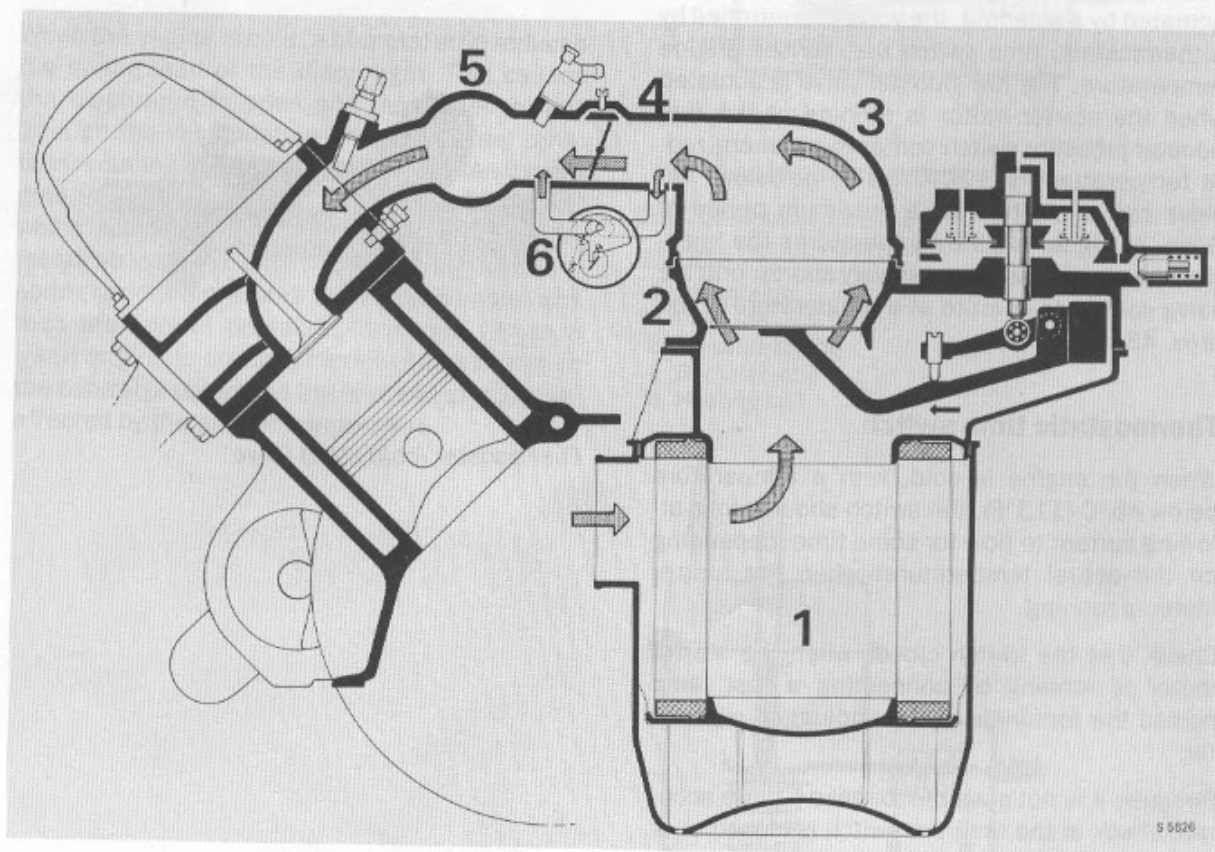
Also incorporated inside the valve is a fuel strainer.



Injection valve

- 1 Fuel strainer
- 2 Valve disc
- 3 Needle valve

Air induction system



Air induction system

- 1 Air cleaner
- 2 Air flow sensor
- 3 Rubber bellows
- 4 Throttle housing
- 5 Inlet manifold
- 6 Auxiliary air valve

Air cleaner

The air cleaner, which contains a 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 air flow sensor, which is bolted to the top of the air cleaner.

Air flow sensor

The 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 lifts the air flow sensor plate, allowing the air to flow through. The greater the flow of air, the higher the sensor plate is raised.

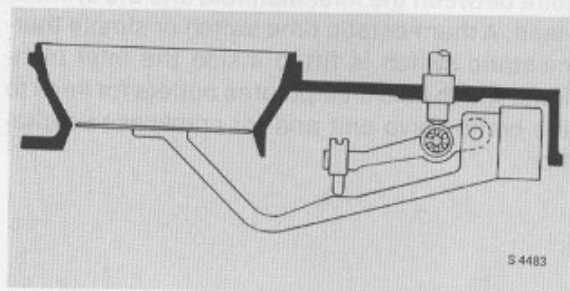
The air flow sensor plate is fitted to a lever which is compensated by a counter-weight. The lever acts on the control plunger in the fuel distributor, which is pressed down by the control pressure, thus counteracting the lifting force of the air flow sensor plate.

The lever acts on the control plunger in the fuel distributor by means of an adjustable link with a needle bearing at the contact point. The basic fuel setting, and thus 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 air flow sensor between the air venturi and the fuel distributor.

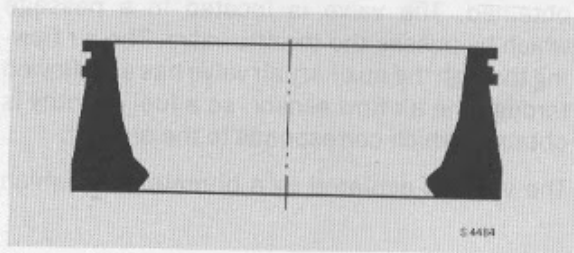
The air/fuel mixture varies with the load. The inclination of the venturi walls therefore varies in stages in order to provide a correct fuel/air mixture at all loads. Thus, the mixture is enriched at full load.

Rubber duct connector

The rubber duct connects the air flow sensor to the throttle housing.



Air flow sensor



The venturi in the air flow sensor

Throttle housing

The throttle housing is connected to the inlet manifold and, in addition to the throttle valve, it contains the idling air passage and the idling adjustment screw, connections for the hoses to the auxiliary air valve and for the cold start valve, and the vacuum outlet for ignition advance.

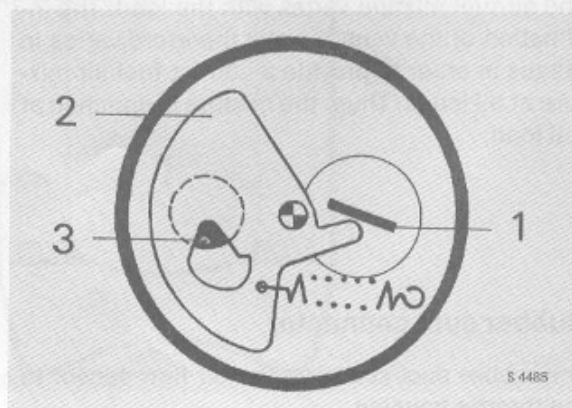
Inlet manifold

The injection valves, 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 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 valve. The air flowing through the auxiliary air valve has also flowed through the air flow sensor, so a fuel quantity is obtained which corresponds to the air flow.

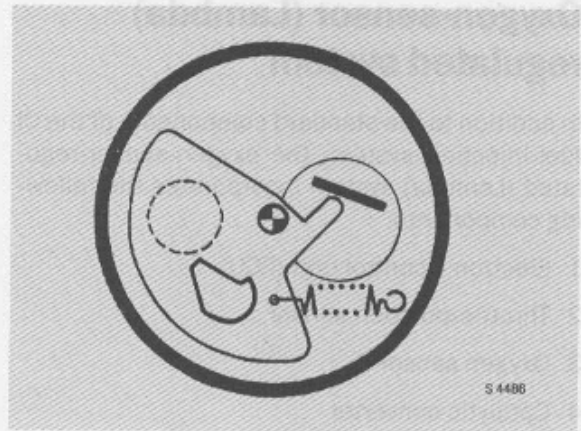
The valve is actuated by a bi-metal strip which



Auxiliary air valve, cold engine

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

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.

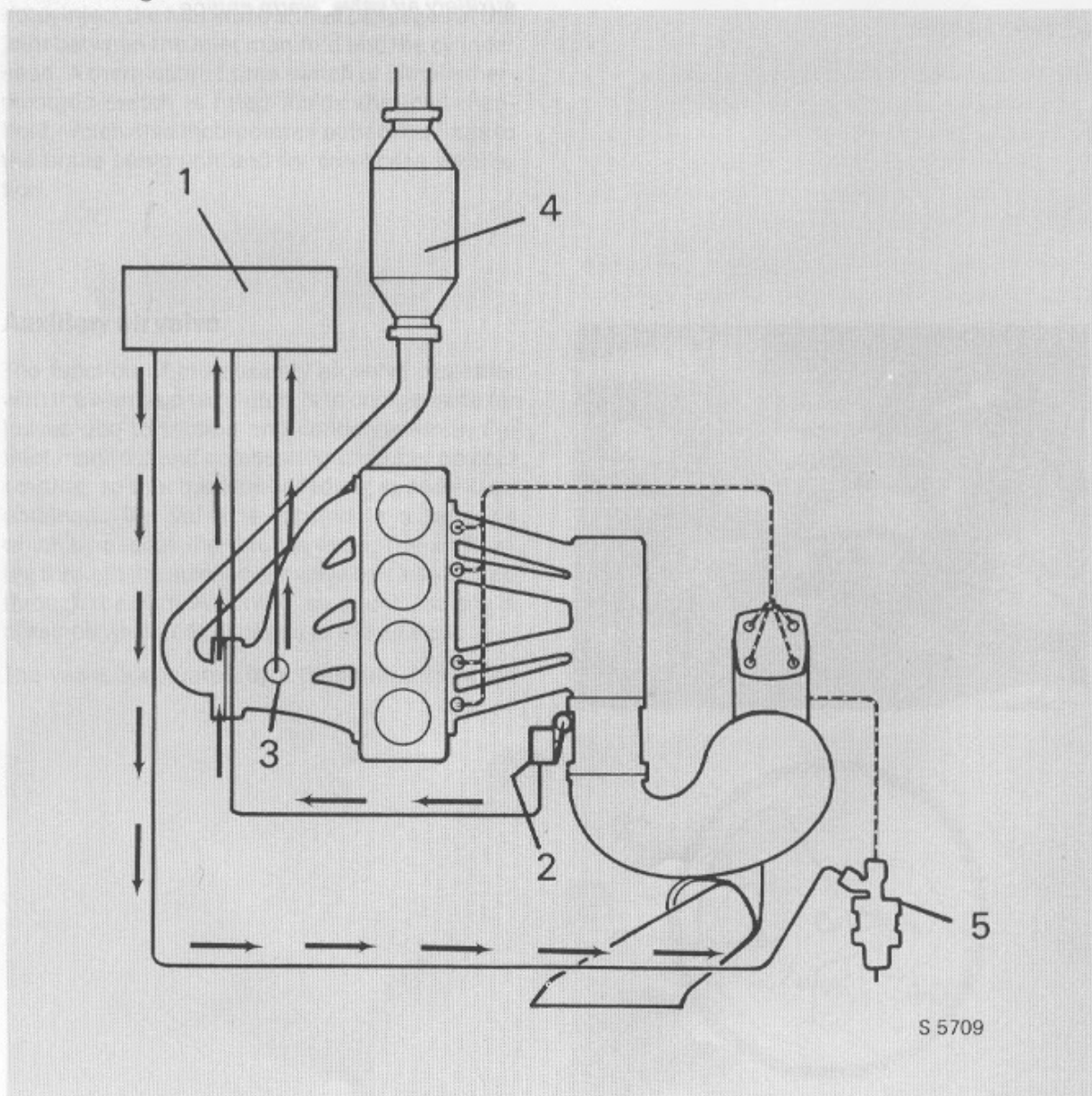


Auxiliary air valve, warm engine

Oxygen-sensor (Lambda) regulated system

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

- 1 Electronic control unit (ECU)
- 2 Throttle-position sensor
- 3 Oxygen sensor
- 4 Catalytic converter
- 5 Modulating valve

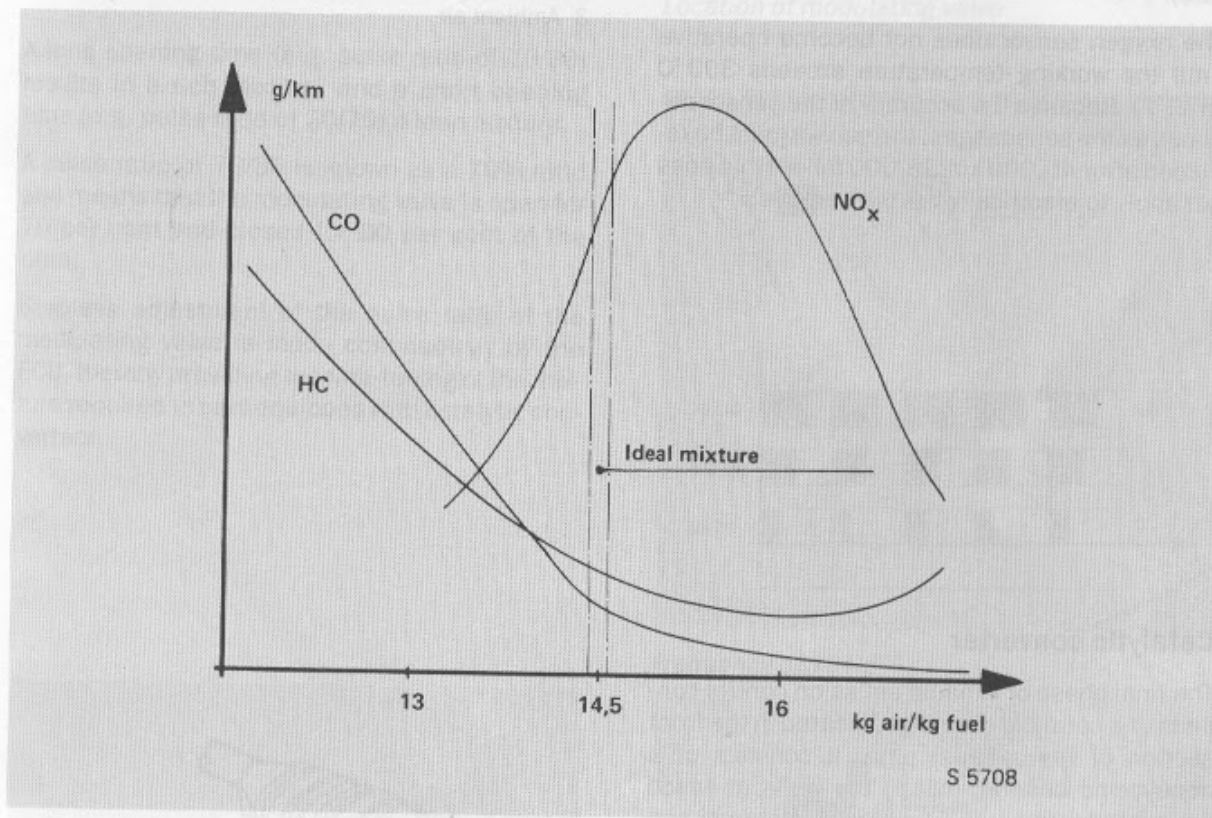


S 5709

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

The ECU, via the modulating valve, controls the pressure difference in the fuel distributor to keep the air/fuel mixture within the Lambda 1 range.

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



Provided that the air/fuel mixture is kept within the Lambda 1 range under all conditions of engine load, the harmful substances (CO, HC and NOx) in the exhaust will undergo chemical reaction in the catalytic converter, keeping emissions inside the prescribed limits.

Oxygen sensor

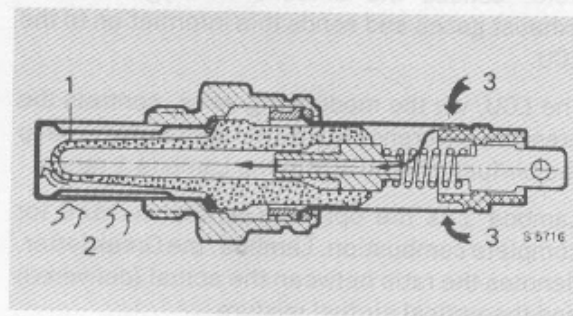
The oxygen sensor, whose outward appearance is reminiscent of a sparking plug, consists of a primary cell and a solid electrolyte. The electrolyte is a ceramic material (zirconium oxide) and has been temperature stabilized by the addition of a small amount of yttrium oxide.

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 oxygen sensor rises.

When the sensor signals a high level of oxygen (lean mixture) to the ECU, the ECU 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 (572 °F). Because the accuracy of the sensor declines as the sensor ages, the sensor must be replaced after 40,000 km/25,000 miles (this does not apply to electrically heated sensors).

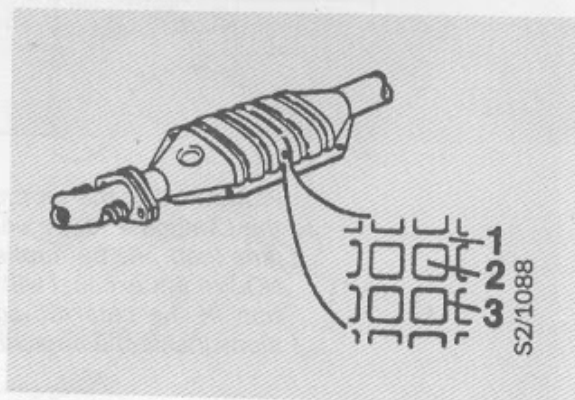


- 1 Electrolyte
- 2 Exhaust gases
- 3 Ambient air

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 catalytic converters must never be run on anything other than unleaded petrol, because 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

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.

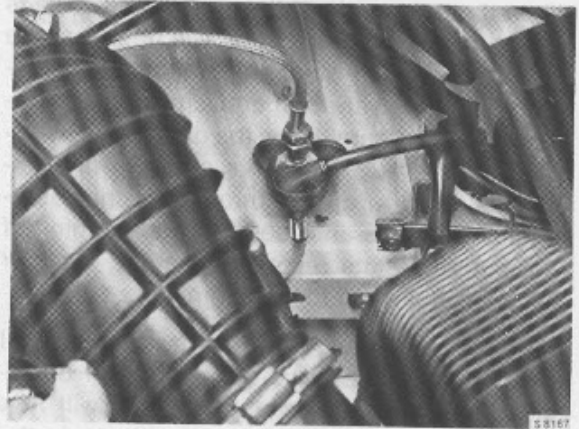
How long the valve remains open and closed is determined by the pulse ratio.

As soon as the oxygen sensor first becomes operative at a temperature of 300 °C (572 °F), while the starter motor is running and for a period of three seconds after starting, the pulse ratio will be raised to at least 92% (ECU terminal 13). If the engine temperature is below 19 °C (66 °F), the pulse ratio will be 62% for the first three seconds after starting.

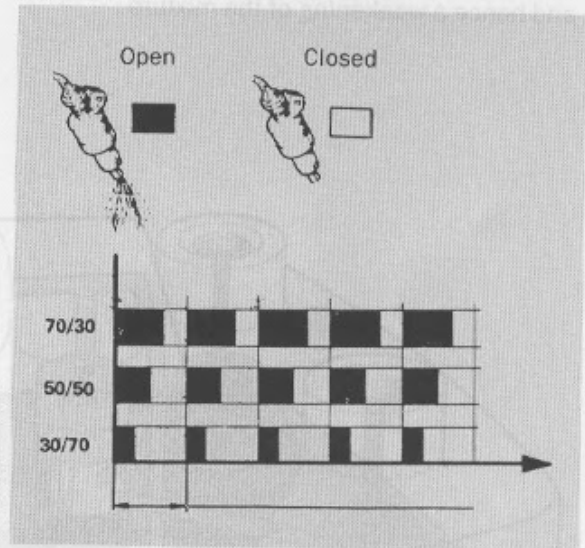
A long opening time (e.g. pulse ratio of 70/30) results in a rich mixture, and a short opening time (e.g. pulse ratio of 30/70) a lean mixture.

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.

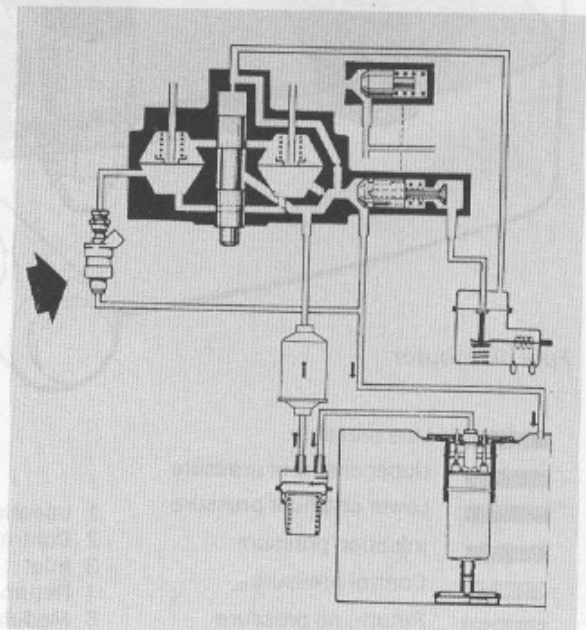
Stepless adjustment of the pulse ratio of the modulating valve is made continuously by the ECU, thereby providing the fine-tuning of the mixture required in cars equipped with catalytic converters.



Location of modulating valve



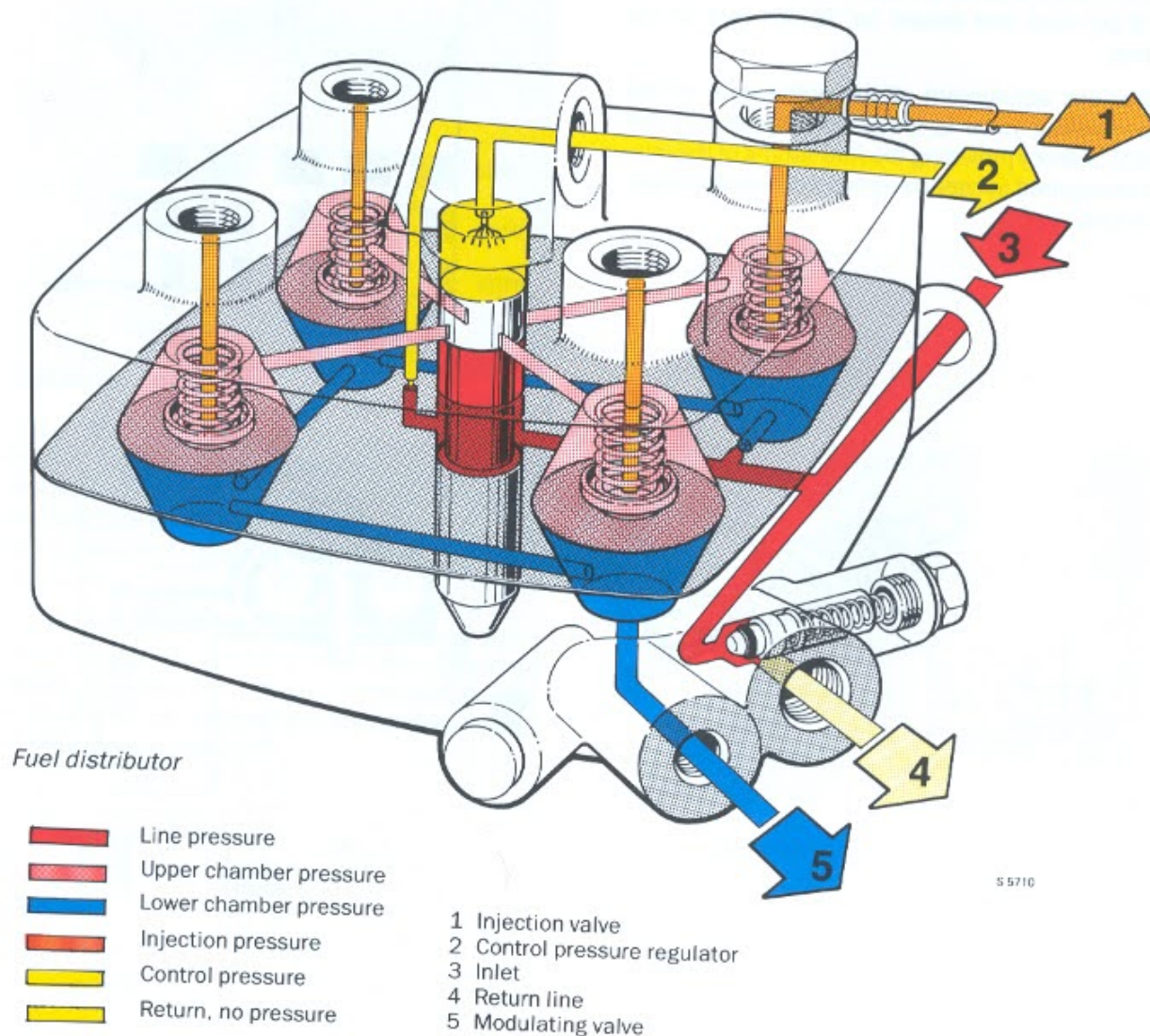
Frequency of 70 Hz



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 approx. 0.2 bar (2.9 psi). This pressure drop increases the flow of fuel through the pressure-regulating valves and, because 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 valve-open time will be reduced and a smaller quantity of fuel will flow from the chamber below the diaphragm in the pressure-regulating valves. This results in a reduction in the pressure difference and fuel flow, and hence a weakening of the mixture.



S 5710

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 oxygen sensor.

Because the oxygen sensor first becomes operative at a temperature of 300 °C (572 °F), while the starter motor is running and for a period of three seconds after starting, the pulse ratio will be raised to at least 92% (via ECU terminal 11). If the engine temperature is below 19 °C (66 °F), the pulse ratio will be 60% for the first three seconds after starting, after which the mixture will be enriched via the cold-start valve (temperatures below 45 °C/113 °F) or via relay P11 (temperatures 45 °C/113 °F or above).

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

Fuel boosting

There are four types of fuel boosting:

- Cold-start boosting (via the cold-start valve or relay P11 depending on temperature)
- Boosting during acceleration (via fuel booster pressure switch for 140 20 s after starting)
- Rpm-governed boosting (via the speed relay (138) at engine speeds above 3800 rpm (M88 onwards: 4600 rpm). Provides a fixed pulse ratio of 85%. Applicable to Turbo cars only).
- Full-load boosting (via the throttle-position sensor)

Turbo cars M87 and earlier: minimum pulse ratio of 92% when throttle butterfly angle > 72°

or

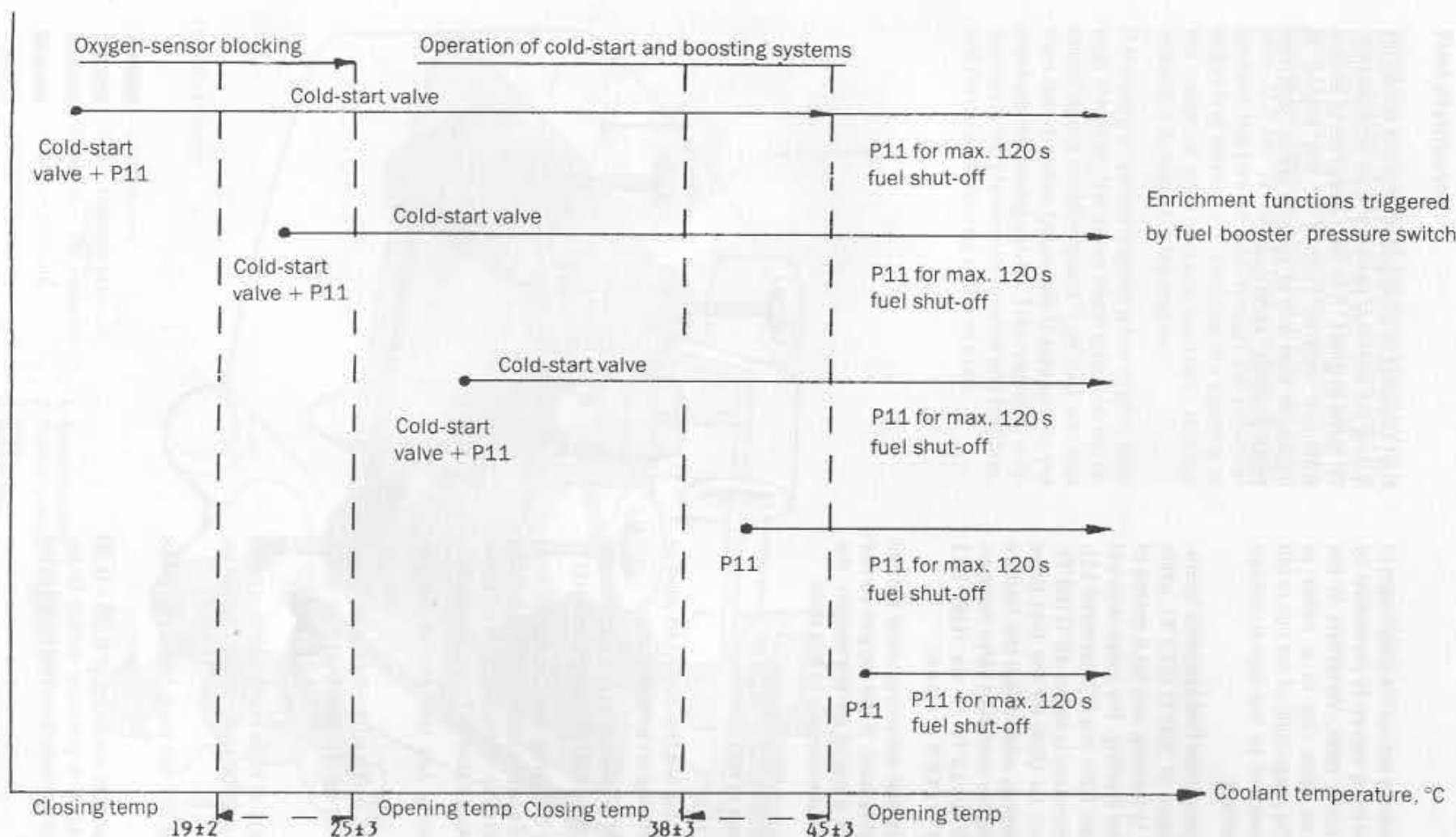
Fixed pulse ratio of 85% minimum at speeds greater than 3800 rpm (M88 onwards: < 4600 rpm).

- Pressure-governed full-load boosting (M88 onwards).

At an inlet manifold pressure of 0.25 - 0.30 bar (3.6 - 4.4 psi) a pressure switch is actuated to effect full-load boosting (fixed pulse ratio of 85%).

Full-load boosting is not fitted to normally aspirated engines in M87 cars onwards.

Fuel boosting 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 at maximum load and at speeds above 3800 rpm (M88 onwards: 4600 rpm).



- 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

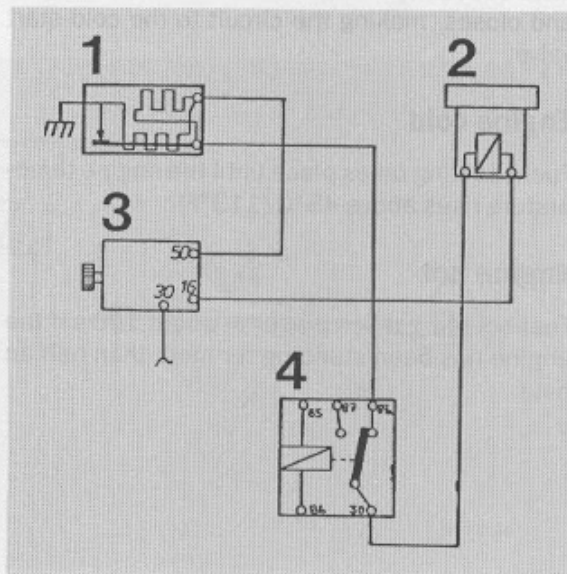
has been running for 1.4 s. This function is operative when the 45°C thermostatic switch and/or TTK is/are open.

- Oxygen-sensor blocking (P12) results in a fixed pulse ratio of 60% (also that obtaining during fuel shut-off).

Fuel-boosting system M81-83 incl.

A Cold-start function

The cold-start valve can open only when the starter motor is running. 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 s 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).

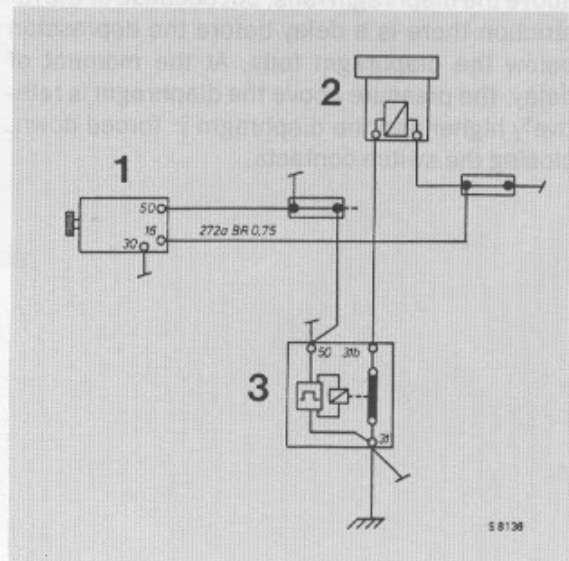


- 1 Thermostatic time switch
- 2 Cold-start valve
- 3 Starter motor
- 4 Cold-start/hot-start relay

B Hot-start function

If, when hot, the engine is slow to start because of vapour in the fuel lines, the cold-start valve will be energized by current supplied by a hot-start relay. Thus, the fuel required by the engine for starting is provided by the cold-start valve and more-rapid purging of the vapour in the fuel lines is obtained.

If the engine fails to start after 1.4 s, injection pulses lasting 0.4 s will occur at 0.3-s intervals.



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

C Fuel boosting on acceleration

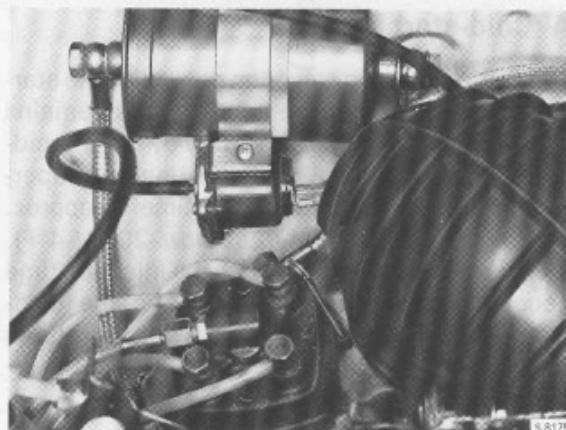
This function provides better drivability after starting. During acceleration, the fuel booster pressure switch responds to the pressure difference caused by the increased load on the engine and closes, making the circuit to the cold-start valve.

Engine cold

Fuel boosting takes place until the engine temperature rises above 45 °C (113 °F).

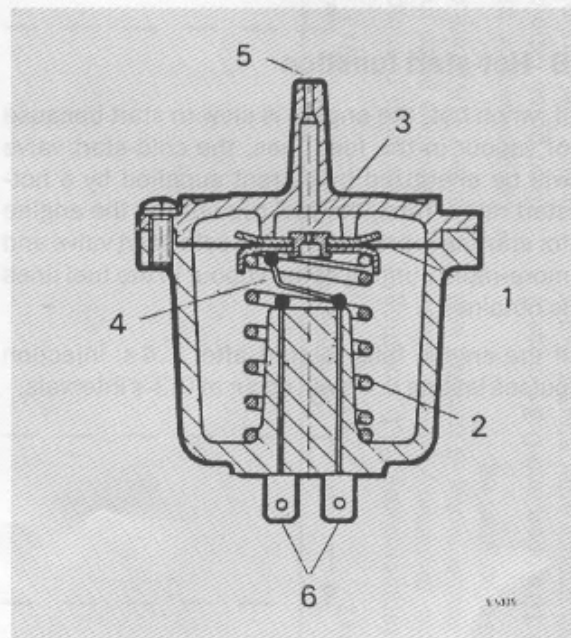
Engine hot

Fuel boosting takes place for about 100 s if the engine has been standing for more than half an hour.



Fuel booster pressure switch

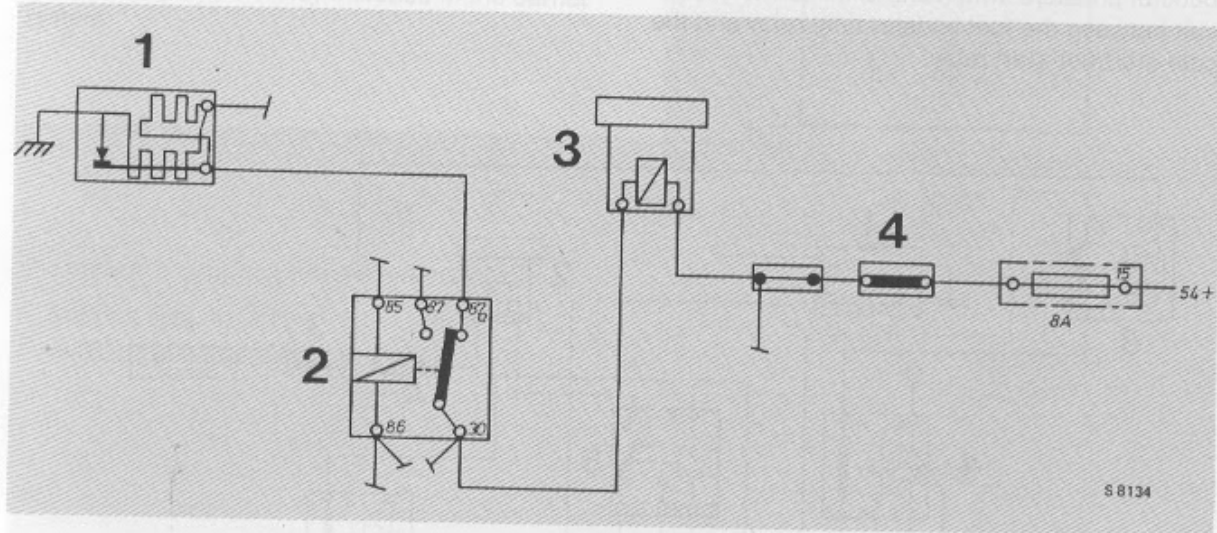
When the car is travelling at a constant speed, the depression is the same on either side of the diaphragm. On acceleration, the depression above the diaphragm falls, but because of the restriction there is a delay before the depression below the diaphragm falls. At the moment of delay, the pressure above the diaphragm is relatively higher and the diaphragm is forced down, closing the switch contacts.



- | | |
|---------------|------------------------|
| 1 Diaphragm | 4 Spring contact arm |
| 2 Spring | 5 Vacuum connection |
| 3 Restriction | 6 Electrical terminals |

Electrical functions: engine cold

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



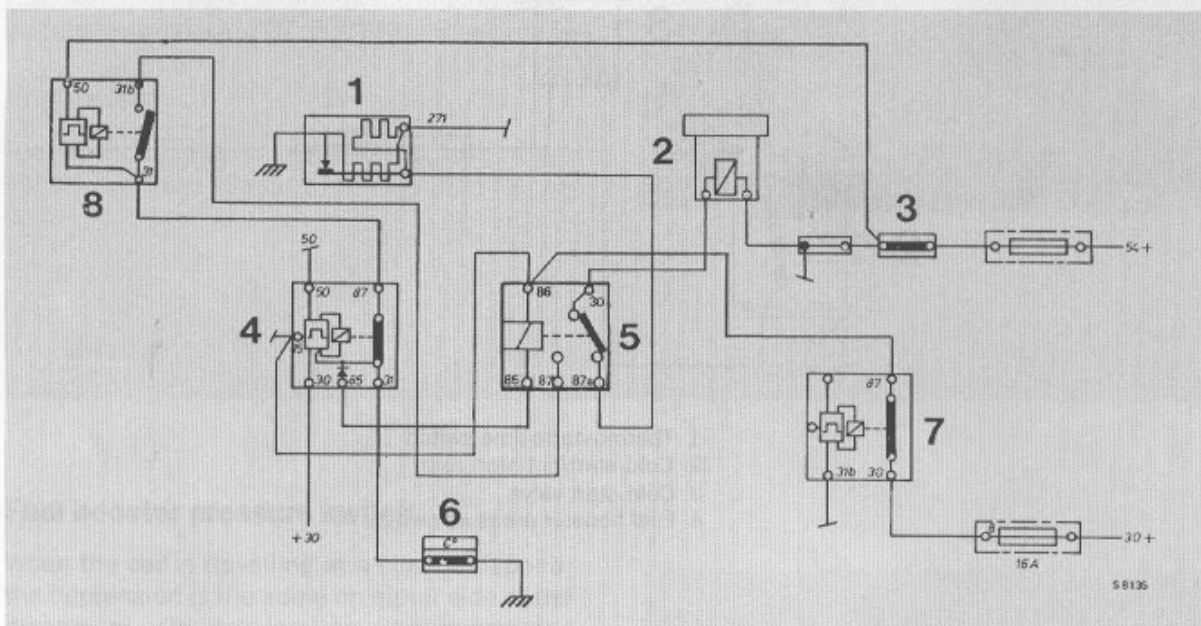
- 1 Thermostatic time switch
- 2 Cold-start/hot-start relay
- 3 Cold-start valve
- 4 Fuel booster pressure switch

Electrical functions: engine hot

If the engine has been switched off for more than about 30 minutes (10 minutes) but the engine temperature is above 45°C (113°F), and the thermostatic switch on the throttle housing is therefore closed, fuel boosting will take place for 100 s after starting. Current flows from the fuel pump relay through the coil and terminal 85 in the cold-start/hot-start relay, through diode 85 and terminal 31 in the fuel booster time relay and to earth via the thermostatic switch, thereby operating the cold-start/hot-start relay.

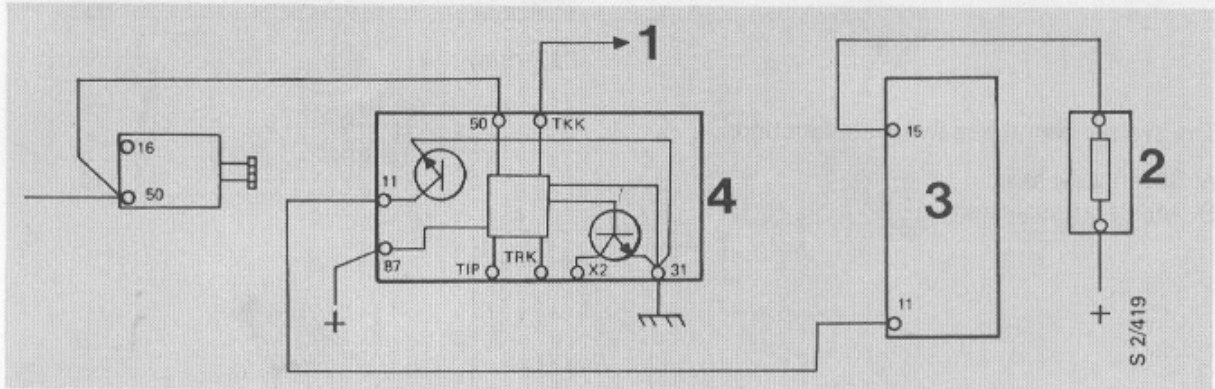
If the time relay has not been energized for 30 minutes (10 min.), the contacts in the relay will be closed. The cold-start valve will then be earthed via terminals 30 and 87 in the cold-start/hot-start relay, terminals 87 and 31 in the time relay and the thermostatic switch.

In 1981-model Turbo cars and 1982-model Turbos with automatic transmission, this system would deliver an excessive quantity of fuel, for which reason an additional relay is fitted to restrict the flow of fuel by modulation of the cold-start valve. The relay is operated by the fuel booster pressure switch and is wired into the circuit between the fuel booster 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 operation relay

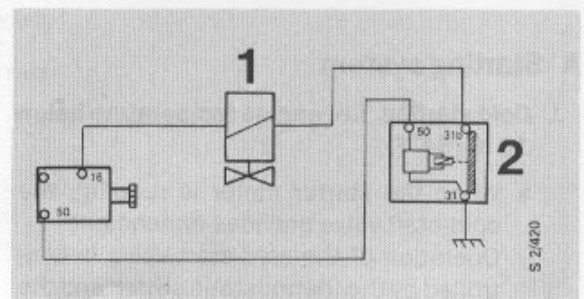
- b When the starter motor is running, relay P11 also receives a signal and connects pin 11 in the Lambda control unit to earth. The control unit sets the modulating valve to a fixed pulse ratio greater than 92%, causing the valve to remain open and the injection valves to provide a boost of fuel. This function continues to operate for three seconds after the engine has started.



- 1 Thermostatic switch
- 2 Modulating valve
- 3 Lambda control unit
- 4 P11 relay

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

- a As is the case when the engine is started from cold, the P11 relay receives a signal when the starter motor is running. The modulating valve opens wide and the injection valves deliver a boost of fuel. This function continues to operate for three seconds after the engine has started.
- b If the engine has failed to start after 1.4 s, the hot-start relay, which is a pulse-operation relay, operates and the cold-start valve boosts the supply of fuel in injection pulses of 0.1 s.



- 1 Cold-start valve
- 2 Pulse-operation relay (hot starting)

B Acceleration system

This system improves the drivability of the car after starting. It is controlled by the fuel booster pressure switch which senses changes in the depression in the inlet manifold.

Driving with the engine cold, i.e. engine temperature below 18 °C (65 °F).

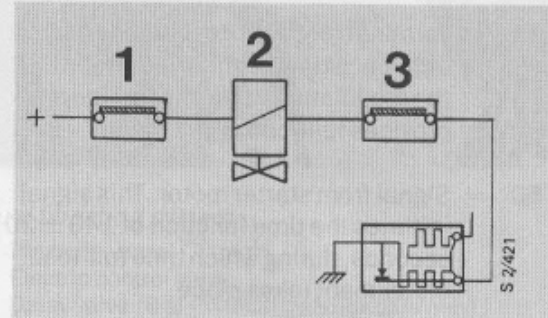
Fuel boosting is provided by the cold-start valve. When the fuel booster pressure switch closes, current flows to the cold-start valve, which is earthed via the thermostatic switch and the thermostatic time switch. When the engine temperature reaches 25 °C (77 °F) the thermostatic switch breaks the circuit, and fuel boosting ceases.

If the engine temperature reaches 25 °C (77 °F) within two minutes of starting, the P11 relay operates, the modulating valve opens fully and additional fuel is injected by the injection valves.

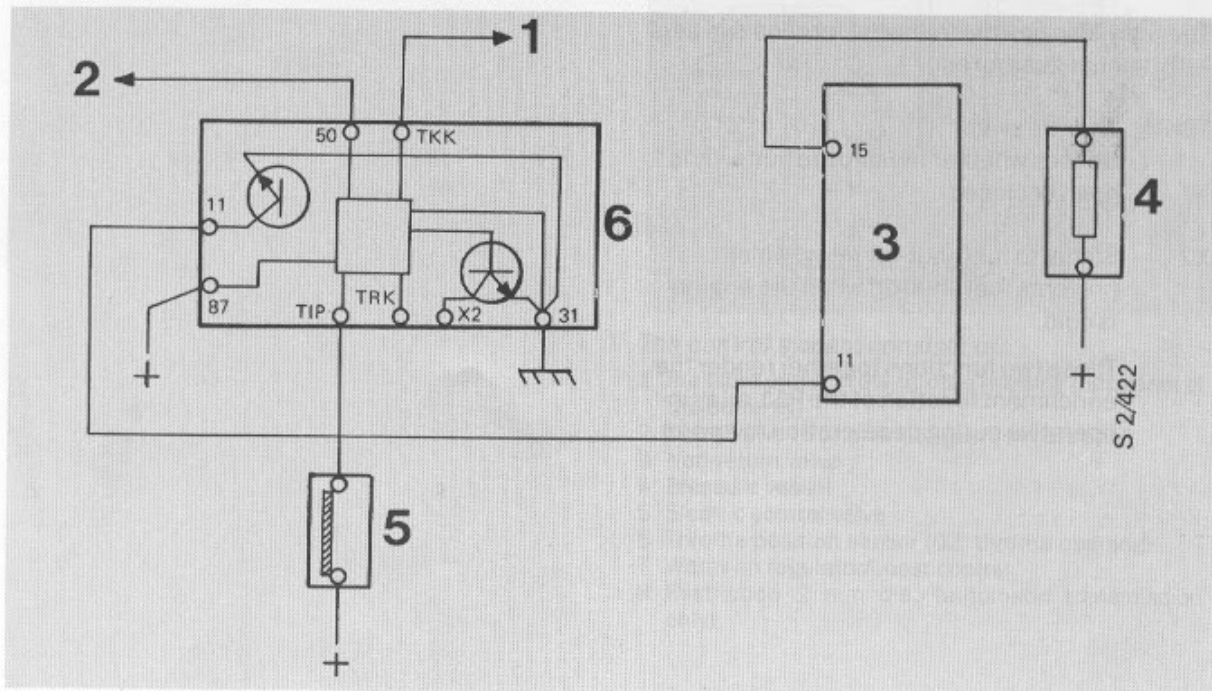
Driving with the engine hot, i.e. engine temperature above 25 °C (77 °F)

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 fuel boosting can be provided by the cold-start valve. The P11 relay then earths pin 11 in the Lambda control unit, the modulating valve opens wide and a boost of fuel is delivered by the

injection valves. This cycle is repeated every time the pressure switch makes, within a maximum period of two minutes from starting.



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



- 1 Thermostatic switch
- 2 Starter motor
- 3 Lambda control unit
- 4 Modulating valve
- 5 Pressure switch
- 6 P11-relay

Terminal pins on relay P11

The relay has eight terminal pins as follows:

87 = Feed to relay

31 = Relay earthing point

11 = Terminal for control of Lambda control unit. Each time terminal 11 is earthed, the modulating valve opens wide 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 terminal the relay senses if the switch is closed or open.

TIP = Pressure switch.
Through this terminal the relay receives a signal from the starter motor (terminal 16). This initiates fuel boosting each time the starter is operated, which continues for three seconds after the engine has started.

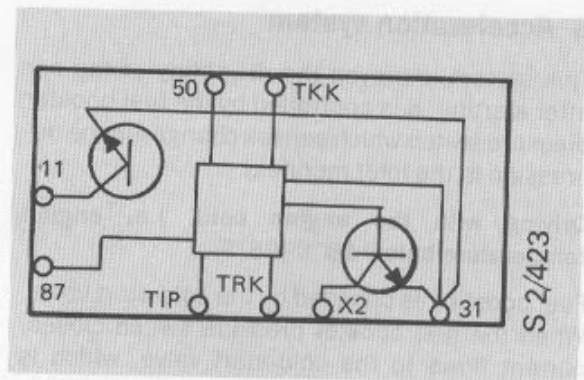
Through this terminal the relay also receives a signal when the pressure switch closes (acceleration boost).

The relay also has the following terminals in cars with manual gearboxes:

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

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

These two functions together render the enrichment function of the P11 relay inoperative during deceleration (overrun).

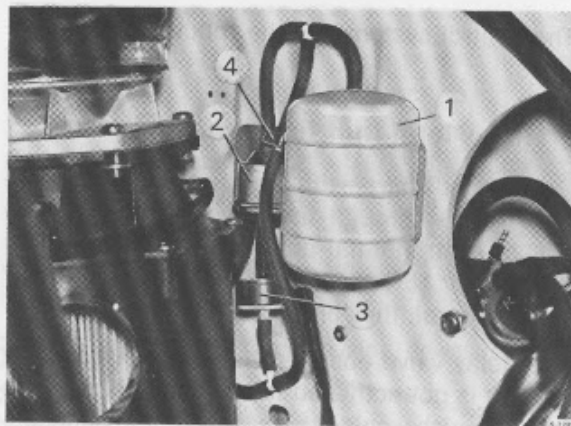


Fuel boosting system

Turbo models without APC M82 and earlier

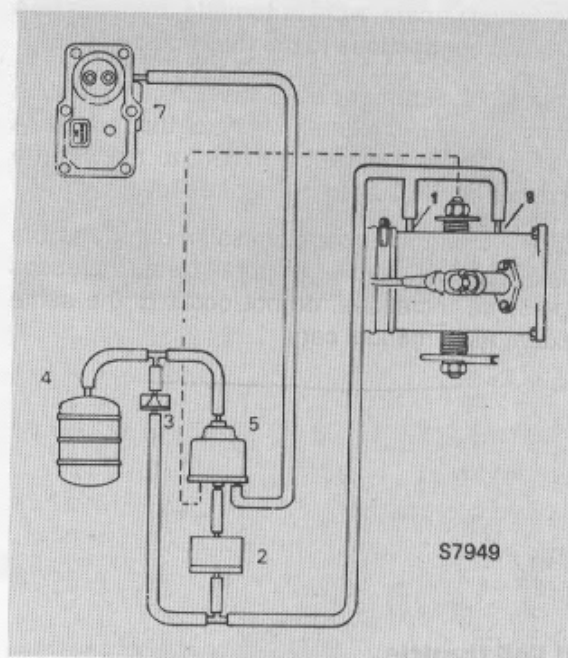
The fuel boosting system performs two functions: it assists in the internal cooling of the engine when it is subjected to sustained periods of load and it also provides the extra fuel required for rapid acceleration.

Fuel boosting is achieved using a special warm-up regulator/boost control which is regulated by the compressor pressure through 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 housing (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/boost control
- 8 Restriction 2 mm dia. (automatic transmission only)

The control system has the following two functions:

I Heavy load (not full throttle)

Pressurized 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/boost control, thus providing fuel boosting.

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 unwarranted hydrocarbon emissions.

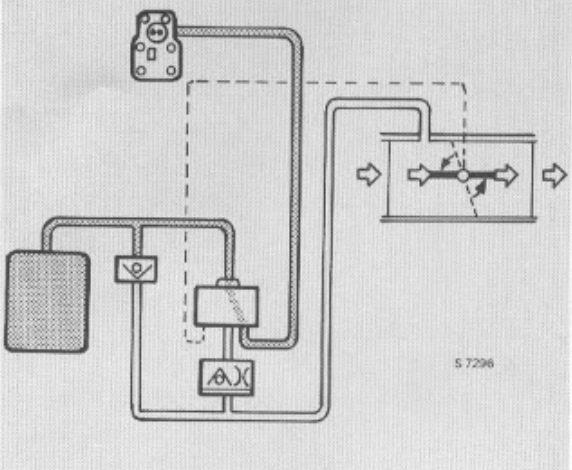
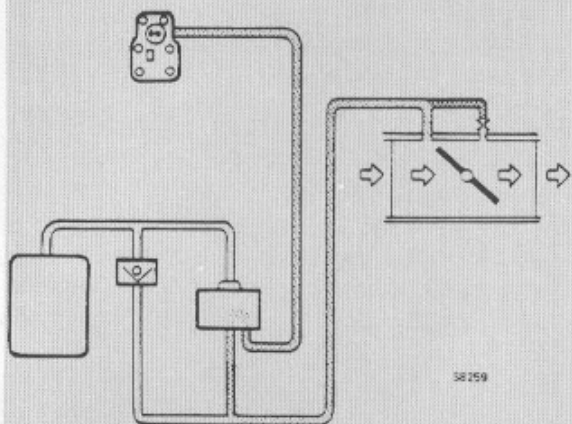
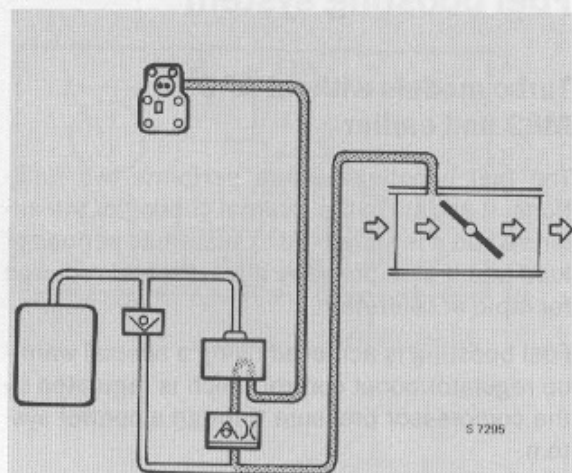
Deviations, cars with automatic transmission (Double connections to the throttle housing)

Under load automatic transmission cars produce a more powerful signal in front of the throttle. A restriction immediately adjacent to the throttle reduces this signal to the desired level.

Cars with automatic transmission do not have a delay valve because temporary load increases (pressure increases) do not occur to the same extent as in manual cars.

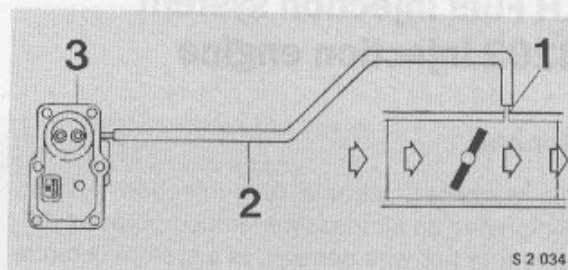
II Full throttle

The pressure vessel is connected to the pressure generated by the compressor via the non-return valve, 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 which immediately regulates the line pressure and boosts the fuel accordingly. This is possible due to the residual pressure in the pressure vessel.



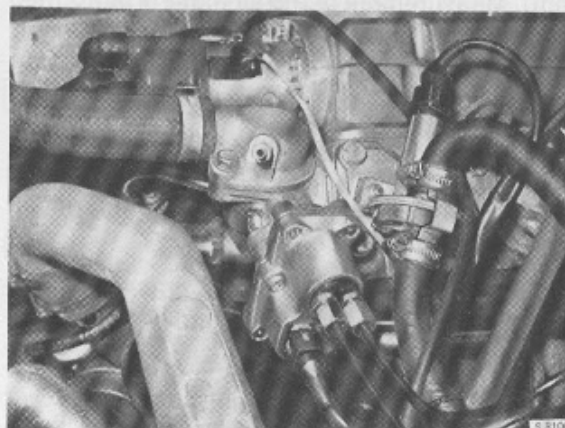
Turbo cars with APC M82 onwards

As from 1982 models, the warm-up regulator/boost control in Turbo cars equipped with APC is connected direct to the inlet manifold.



- 1 Pressure outlet in throttle housing, downstream of butterfly
- 2 Hose
- 3 Warm-up regulator/boost control

The special warm-up regulator on turbocharged engines incorporates a steel diaphragm valve. The pressure of the spring in the valve is influenced by a bi-metal regulator and 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.



Overrev 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 and current will cease to flow to the fuel pump and other components in the fuel system.

The relay incorporates an overrev limiter which breaks the power to the fuel pump at approx. 6000 r/min.

Temperature sensor (NTC resistor)

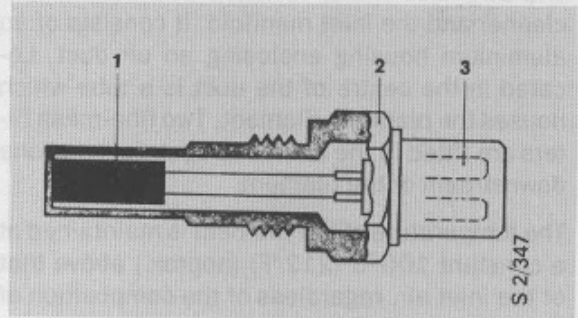
The temperature sensor is screwed into the inlet manifold flange. Its function is to provide information to the electronic control unit about the temperature of the engine. The control unit then regulates the quantity of fuel injected according to the temperature.

When starting from cold and during the first part of the warm-up period, the engine requires a much richer fuel/air mixture, owing to the losses due to condensation in the combustion chamber and inlet manifold.

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 an NTC resistor. NTC resistors have a low resistance value at high temperatures and a high resistance value at low temperatures. The temperature sensor sends a continuous signal to the electronic control unit.

If the signal from the temperature sensor is interrupted, the signal will be simulated by the electronic control unit, and the system will function assuming an engine temperature of 20°C (68°F).



Temperature sensor (NTC resistor)

- 1 Resistor
- 2 Body
- 3 Terminals

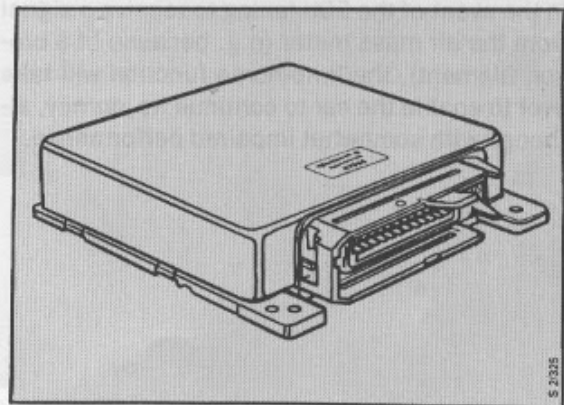
LH-system ECU

The ECU for the LH-system is located inside the car, on the RH side underneath the dash panel.

Inside the ECU is a microprocessor containing all the necessary preprogrammed data, for, e.g., maximum rpm, full-load enrichment, filament burn-off function, etc.

The electronic control unit processes the signals from the air mass meter and from the other sensors, and using the information contained in its memory calculates and controls the opening duration of the injection valves. It also contains a number of auxiliary functions for emitting fixed signals in the event of a break in the signals from the air mass meter or temperature sensor:

- Air mass meter: the limp-home function.
- Temperature sensor: a simulated signal for an engine temperature of 20°C (68°F).



N.B.

Always switch off the power to the pump (switch in OFF position) before connecting any instruments.

Refit in the reverse order.

N.B.

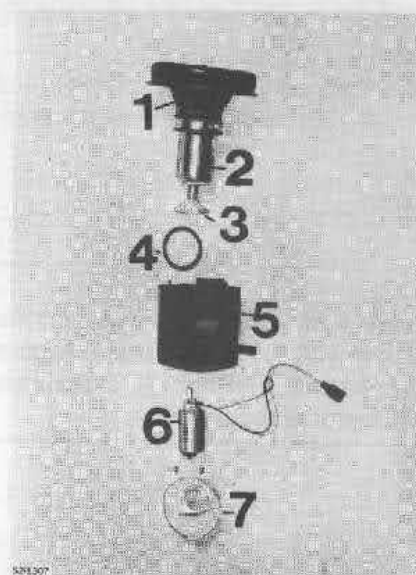
Make sure that the area around the aperture for the fuel tank is perfectly dry before securing the clip on the fuel pump collar.

Changing the fuel pump (with feed pump)

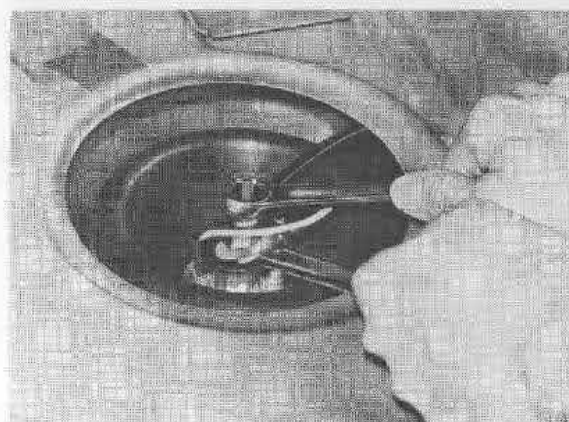
To remove

- 1 Disconnect the battery leads.
- 2 Remove the luggage compartment floor and floor panel and the circular cover over the fuel pump.
- 3 Disconnect the electrical leads from the fuel pump.

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

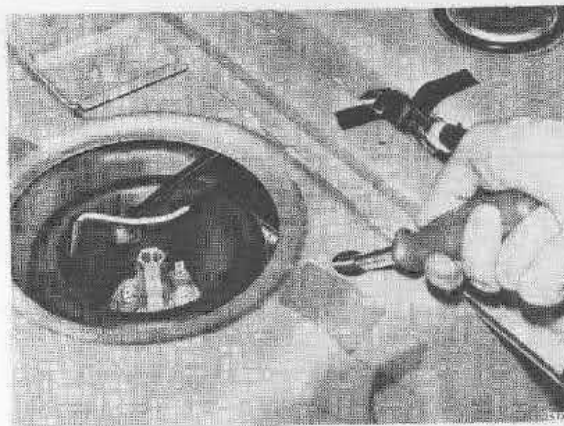


- 1 Rubber collar
- 2 Main pump
- 3 Filter
- 4 'O' ring
- 5 Receiver
- 6 Feed pump
- 7 Filter



233-4 Fuel system

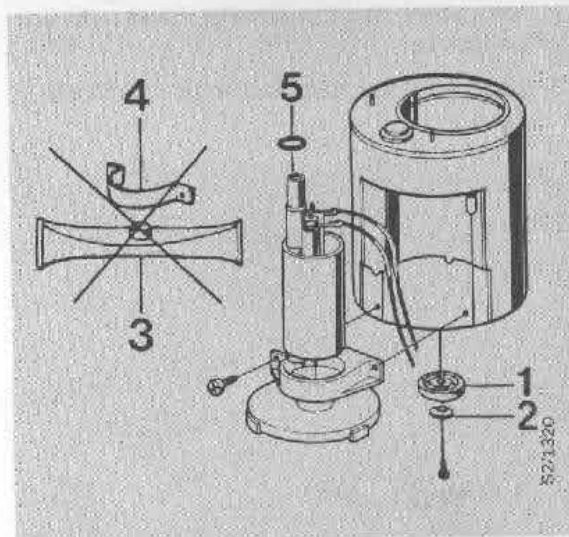
- 5 Using a flexible socket driver, slacken the clip on the collar.



- 6 Lift the pump complete with pressurized receiver.
- 7 Disconnect the electrical leads from the tank.
- 8 Disconnect the return fuel line from the receiver.
- 9 Lift out the main pump and remove the feed pump securing screws. Disconnect the electrical leads.

N.B.

If the pump is an early variant, the existing filter must be replaced with the latest variant. Accordingly, plug (1), washer (2), filter (3), clip (4) and 'O' ring (5) will become redundant.



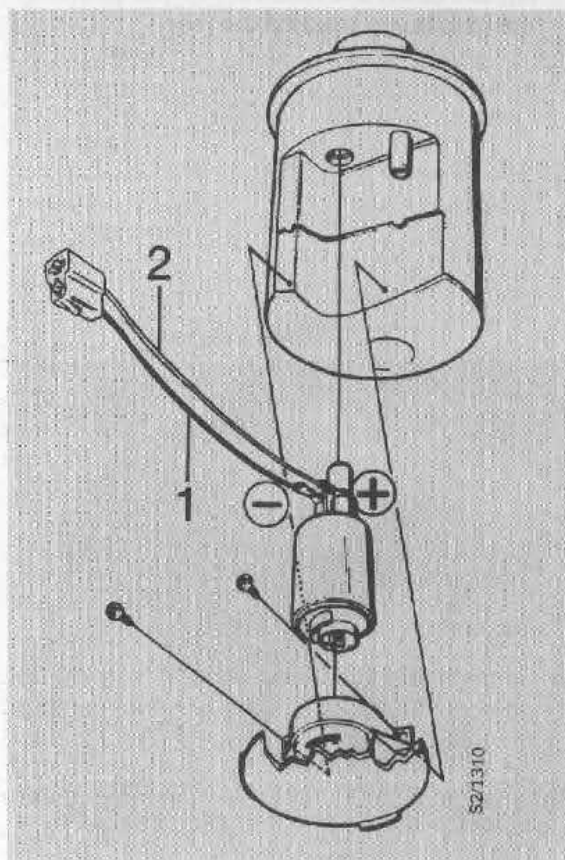
Feed pump variant fitted to cars with chassis nos. as from AE1021336 and AE2009858.

Feed pump, early variant

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

To fit

- 1 Connect the electrical leads to the feed pump: white lead to the positive (+) terminal and the black lead to the negative (-) terminal.
- 2 Fit the feed pump and press it up against the stop.



- 1 Black
- 2 White

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

Cars with CI injection:

Dimension A = 46 ± 2 mm (1.81 ± 0.08 in)

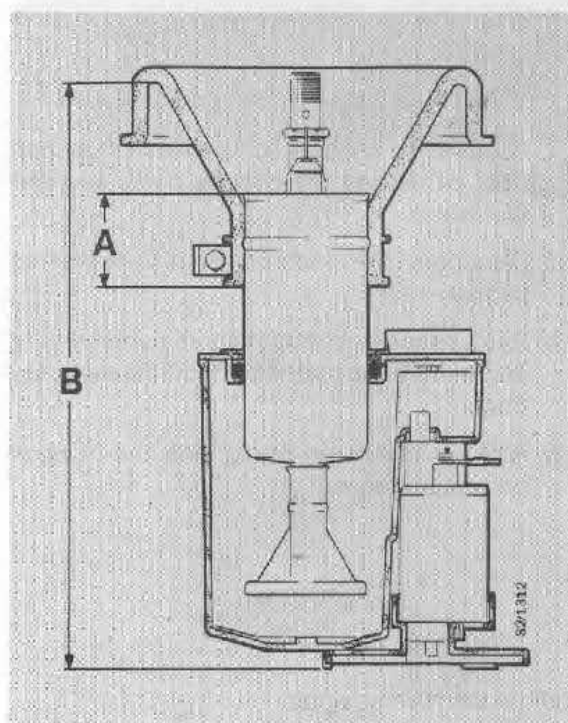
Cars with LH injection:

Dimension A = 42 ± 2 mm (1.65 ± 0.08 in)

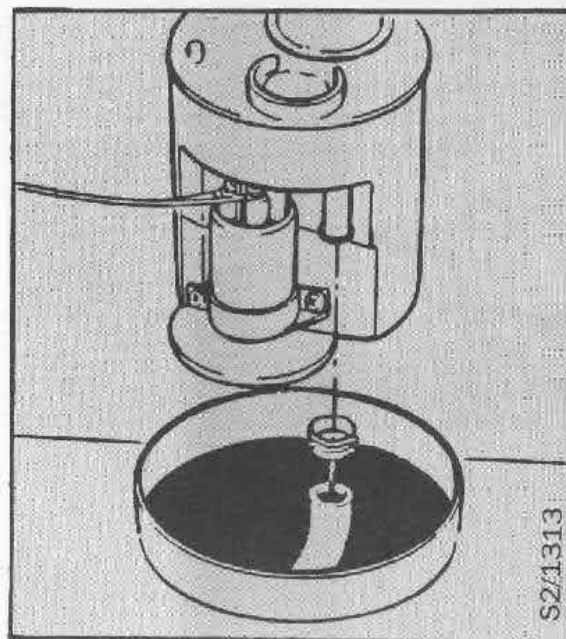
Dimension B = 222 mm (8.75 in)

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

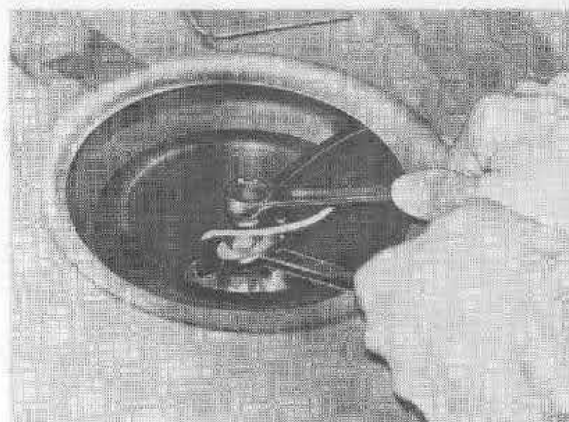
- 5 Fit the pump in the receiver and position it according to measurement B. Turn the pump such that the positive (+) terminal is towards the front of the car.



- 6 Connect the return hose and plug on the connector. Lower the receiver into the tank with the feed pump towards the rear.

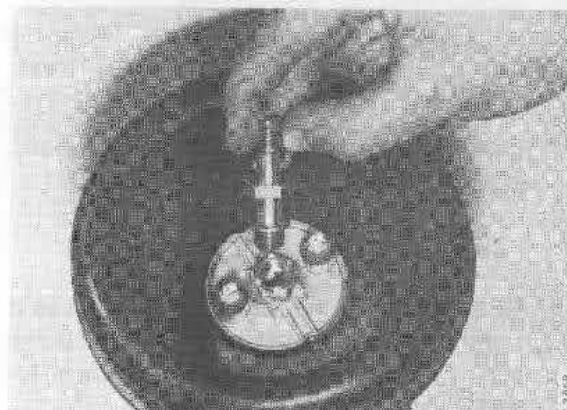


- 7 Connect the electrical leads.
- 8 Connect the fuel line, using a spanner to prevent the pump turning when tightening the banjo fitting.
- 9 Fit the cover over the fuel pump and replace the floor panel and luggage compartment floor.
- 10 Reconnect the battery leads.



Changing the non-return valve for the fuel pump

- 1 Disconnect the negative (-) battery lead.
- 2 Remove the luggage compartment floor and floor panel and the circular cover over the fuel pump.
- 3 Disconnect the electrical leads from the fuel pump.
- 4 Use a spanner to stop the fuel pump turning and remove the cap nut. Lift off the banjo fitting.
- 5 Remove the banjo fitting with the integral non-return valve.



Refit in the reverse order.

CI Fuel injection system

CI Fuel injection system 240-1

LH Injection system 240-58

Fuel injection system

Checking and adjustments

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Checking the fuel-boosting function

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Checking and 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 functioning properly. Scrupulous cleanliness must be observed during work on the fuel system. The surrounding area should be thoroughly cleaned before any lines are disconnected.

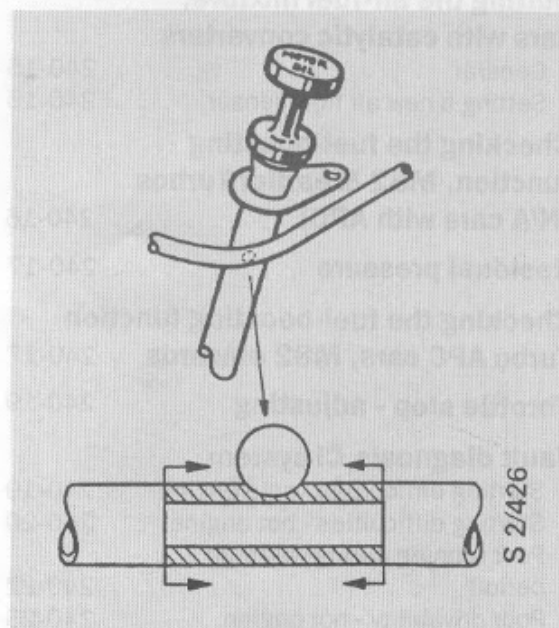
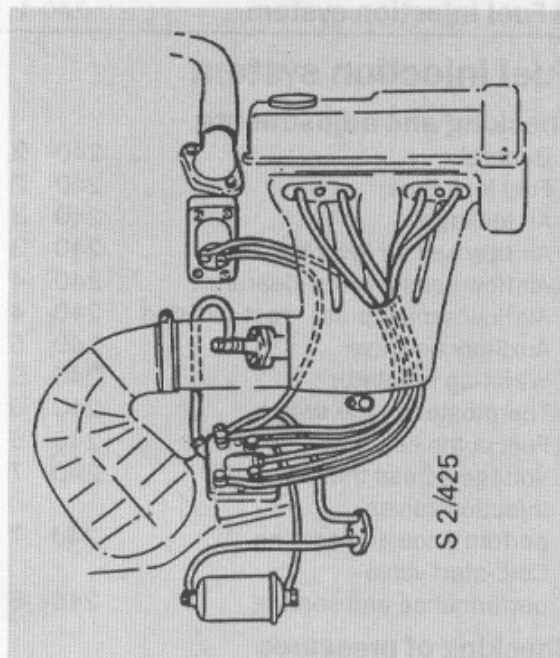
Danger of fire

There is an acute danger of fire because of fuel atomization in this test. Make sure that there is good ventilation and that nobody is smoking.

Fuel leakages

Check that there are no leakages at the connections and in the fuel lines. Check around the fuel tank, in the passenger compartment and in the engine compartment. New seals should be fitted to any leaking connections. Damaged fuel lines should be replaced.

Check that fuel pipes do not chafe against other objects (particularly of plastic). **Continuous chafing** against e.g. the dipstick tube, other fuel pipes or the throttle cable can result in damage to the fuel pipe.



Air leakages

Check for leakage in the induction system between the air flow sensor and the engine. Air leaking into the system may result in poor engine performance, owing to the fact that it by-passes the air flow sensor, causing a lean mixture.

Leakage can occur in the following places:

At the rubber duct between the air flow sensor and the throttle housing.

At the gasket on the flange of the cold-start valve.

At the gasket between the throttle housing and the inlet manifold.

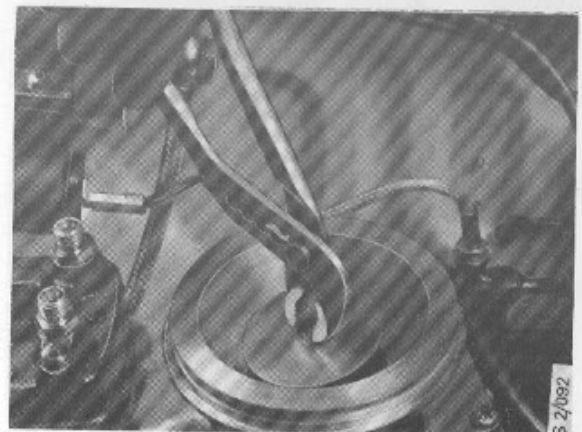
At the gasket between the inlet manifold and the cylinder head.

At the hose connections to the throttle housing, auxiliary air valve and inlet manifold.

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

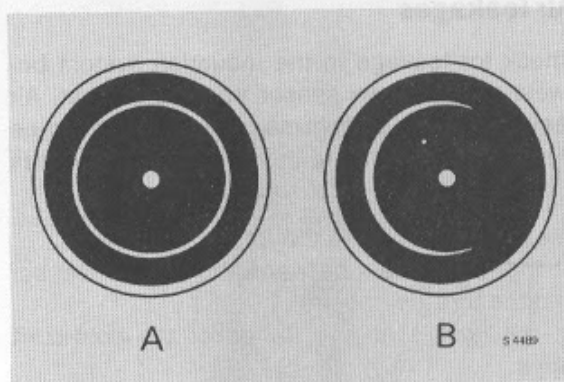
Air flow sensor lever mounting

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



Air flow sensor plate clearance

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

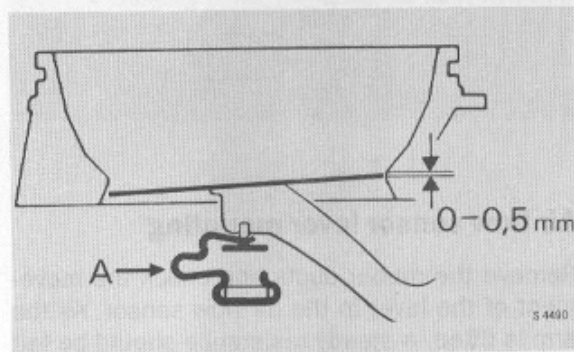


Sensor plate clearance

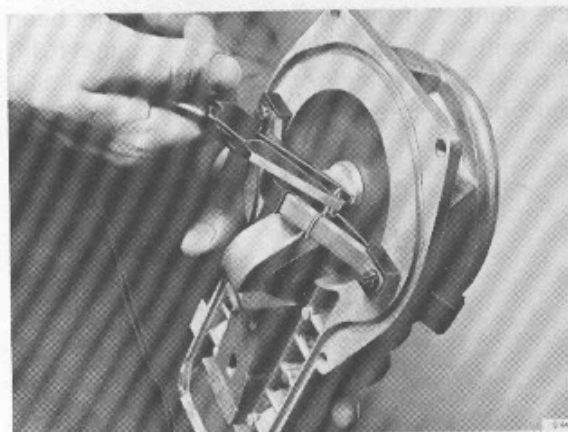
A Right
B Wrong

Air flow sensor plate - rest position

Check the rest position of the air flow sensor plate with the ignition switched off (fuel pump not working). This prevents fuel 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 (0.02 in., 0.5 mm max.) 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 air flow sensor. The air flow sensor must first be removed.



Auxiliary air valve

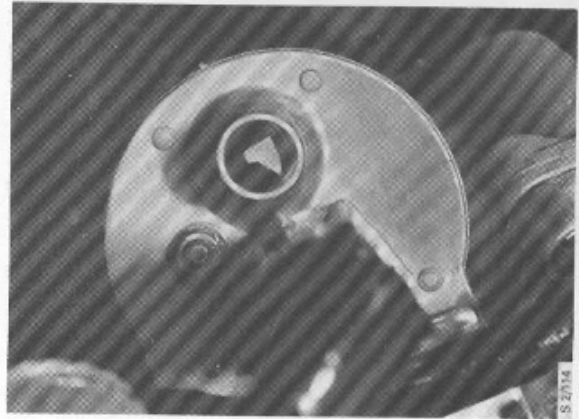
(Must be carried out with the engine cold.)

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

With the aid of a light and a mirror, check that the orifice in the auxiliary air valve is elliptical.

Remove the fuel pump relay. To provide current to the pump and the CI system, connect a jump lead between terminals 30 and 87 in the relay holder. The aperture in the auxiliary air valve should be completely closed after about five minutes.

If the auxiliary air valve has not closed check the electrical supply. If voltage is present, measure the resistance of the heating coil across the terminal pins on the auxiliary air valve, which should be approx. 40 ohm. If the valve is defective, fit a new one.



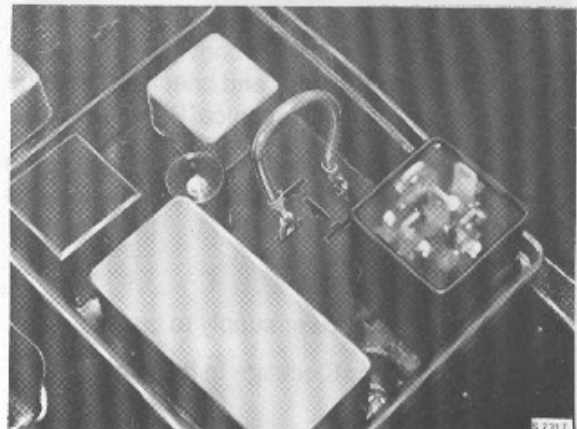
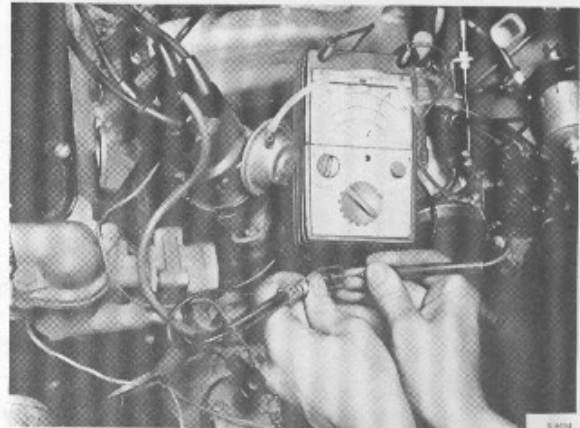
Warm-up regulator

Check the electrical leads to the warm-up regulator as follows.

Unplug the connector from 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 in the relay holder, to provide power to the fuel pump and CI system. Read off the voltage, which must not be below 11.5 V.

Check the continuity of the warm-up regulator coil by connecting a multimeter in series with the coil. If a continuity break is found, fit a new warm-up regulator.



240-6 Fuel injection system

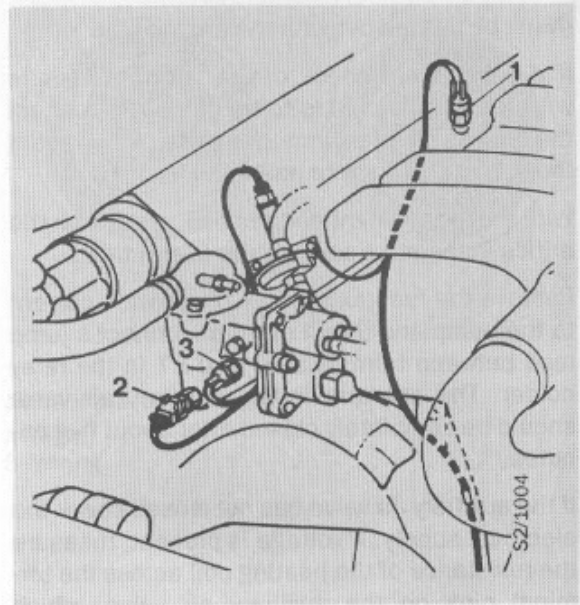
Thermostatic time switch

When the engine is cold, with a temperature below 45°C (113°F), the switch should close allowing current to flow for some time (depending on the actual temperature) when the starter motor is running.

Check that the switch closes when the starter motor is running by connecting a test lamp across the terminals of the unplugged connector.

Because it is not possible to make a more accurate check of the time the switch is closed or of the temperature, if in doubt, fit a new switch.

As from 1986 models, the thermostatic time switch is fitted on the thermostat housing.

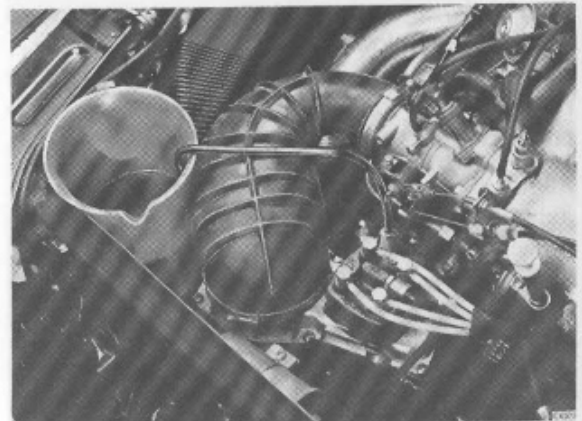


- 1 Thermostatic switch (cars with catalytic converter only)
- 2 Thermostatic time switch
- 3 Auxiliary thermostatic switch

Fuel pump capacity

The fuel pump capacity can be checked by measuring the return fuel flow as follows, provided that the fuel filter is not blocked and that the battery is well charged.

Attach a hose to the fuel return connection at the air flow meter. Place the other end of the hose in a jar or suitable container.

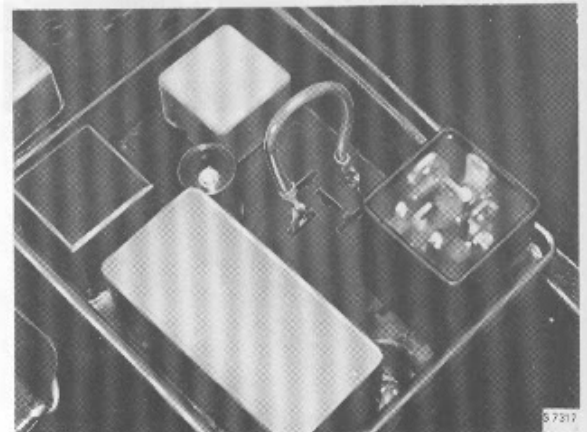


Remove the fuel pump relay. To provide current to the pump and the CI system, connect a jumper lead between terminals 30 and 87 in the relay holder.

Run the pump for 30 seconds, measure the amount of fuel collected, and check against the figure specified in the "Technical Data" Section.

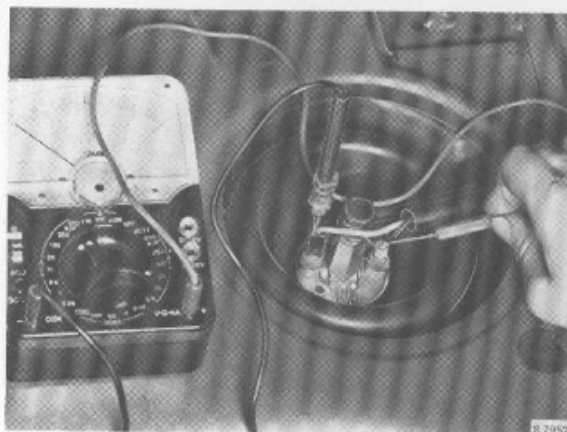
If the amount of fuel collected is below the specified value, the following possible causes should be investigated:

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



Voltage across the fuel pump

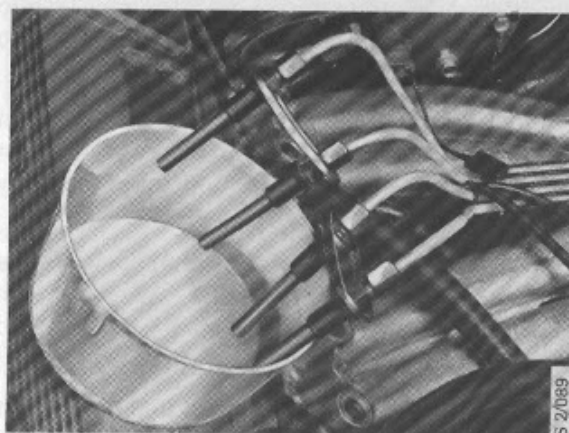
Remove the round cover plate from above the fuel pump in the luggage compartment and measure the voltage across the positive and negative terminals of the pump while it is running. The lowest permissible voltage is 11.5 V.



Injection valves - performance and sealing

Check the injection valves as follows.

- 1 Remove the rubber duct from the air flow sensor.
- 2 Remove the injection valves from the inlet manifold and place them in a suitable container. The fuel pipes should remain connected.



- 3 Remove the fuel pump relay. To provide current to the pump and the CI system, connect a jumper lead between terminals 30 and 87 in the relay holder.
- 4 Fuel atomization: Raise the air flow sensor lever and check the spray patterns of the injection valves. If atomization is poor refer to "Injection valves - to clean".

Danger of fire

There is an acute danger of fire because of fuel atomization in this test. Make sure that there is good ventilation and that nobody is smoking.

- 5 Valve sealing: Switch off the ignition. The fuel system is now under shut-off pressure. Wipe dry the injection valve nozzles, lift the air flow sensor lever and check if leaks occur. It should take at least 15 seconds for a drop of fuel to form on the tip of the injection valve. If this is not the case refer to "Injection valves - to clean".

Cold-start valve - performance and sealing

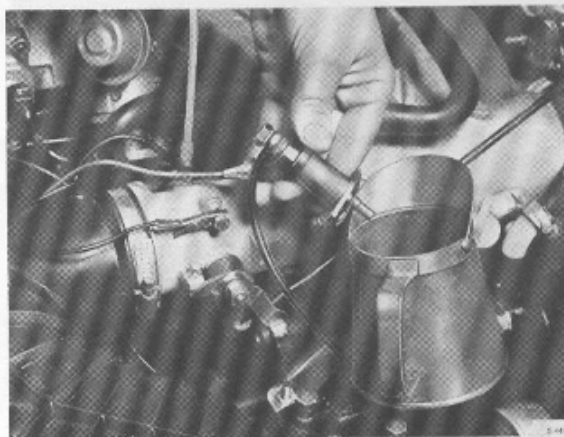
Unplug the connector from the cold-start valve, leave the fuel pipe connected and unscrew the valve from the throttle housing.

Connect the plug on one end of a test loom to the cold-start valve and the other end of each lead to the main beam terminal of a headlamp and to earth, respectively.

Remove the fuel pump relay. To provide current to the pump and the CI system, connect a jumper lead between terminals 30 and 87 in the relay holder.

Place the cold start valve in a container and have an assistant switch the headlights to main beam for a short time (30 seconds max.). Fuel should spray out of the valve during this period.

Dry the valve nozzle and run the fuel pump for a further minute. No fuel must come out of the valve during this time.

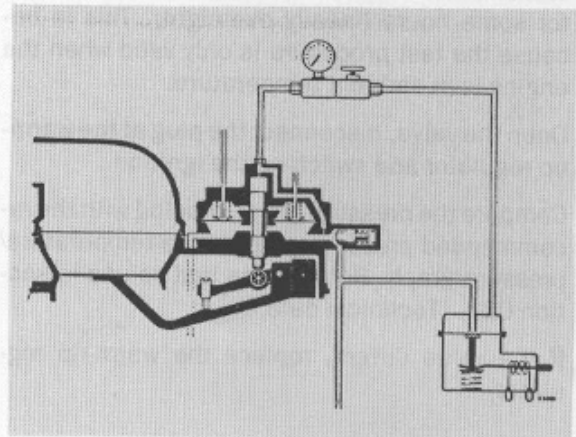


Checking of pressures

General

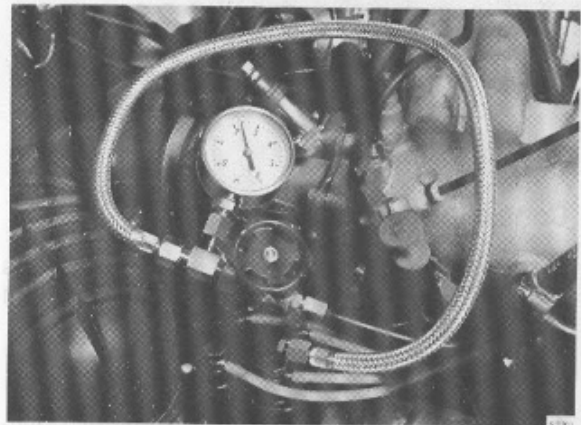
Connect pressure gauge 83 92 516 as follows:

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



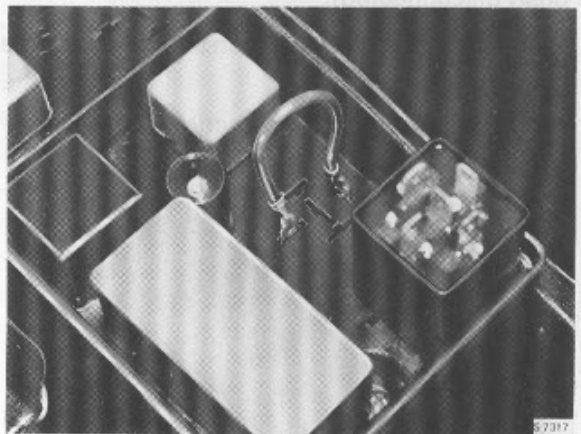
N.B.

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. To provide current to the pump and the CI system, connect a jumper lead between terminals 30 and 87 in the relay holder.

Bleed the pressure gauge by repeated opening and closing of the valve with the pressure gauge pointing downwards and the fuel pump running.



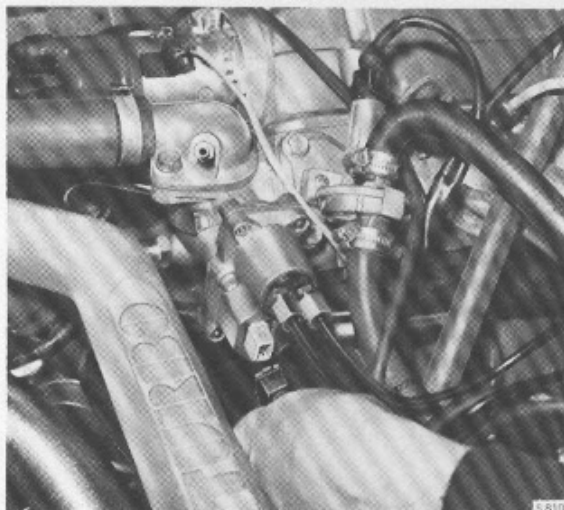
Control pressure: engine cold

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 some hours (ideally overnight). This is because the test procedure is only valid when the engine is at ambient temperature.

Open the valve, disconnect the plug at the warm-up regulator and switch on the ignition.

Compare the pressure gauge reading with the recommended pressure given in the temperature/pressure graph. Refer to the test values in section 022, "Technical data".

If the value differs, replace the warm-up regulator.



Control pressure: engine hot

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

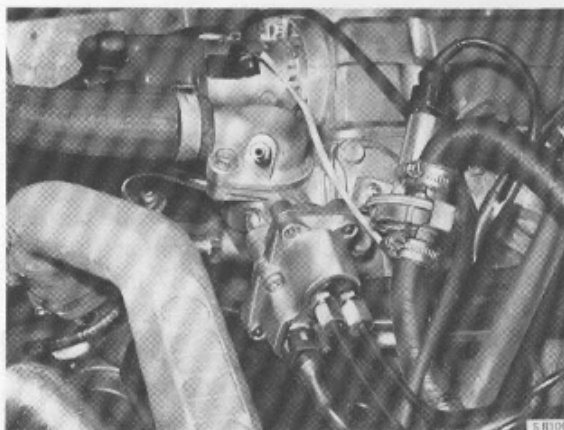
Open the valve.

Connect the warm-up regulator plug (if previously disconnected).

Leave the ignition switched on until the pressure has stabilized.

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

If the value differs, replace the warm-up regulator.



Line pressure

Close the pressure gauge valve.

Run the fuel pump.

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

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
- Blocked filter in the tank
- Leak in the fuel pipe
- Faulty line pressure regulator

In the case of excessive line pressure:

- Blocked return pipe
- 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 when starting difficulties have been experienced when the engine is hot.

If the engine is cold, the bi-metal strip in the warm-up regulator must be heated and kept warm during the test. Unplug the connector from the warm-up regulator and connect a test loom direct 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: normal engine temp." (Technical data section) is reached, and then disconnect the pump.

Note any drop on pressure on the pressure gauge. Generally a leak becomes evident within 3-4 minutes. When in doubt maintain the system under pressure for 20 minutes (see section 022, "Technical data"). If the pressure falls too rapidly, the fault can be located by performing

240-12 Fuel injection system

the test with the pressure gauge valve shut.

If the figures obtained from 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 faulty:

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

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

Adjusting the line pressure

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

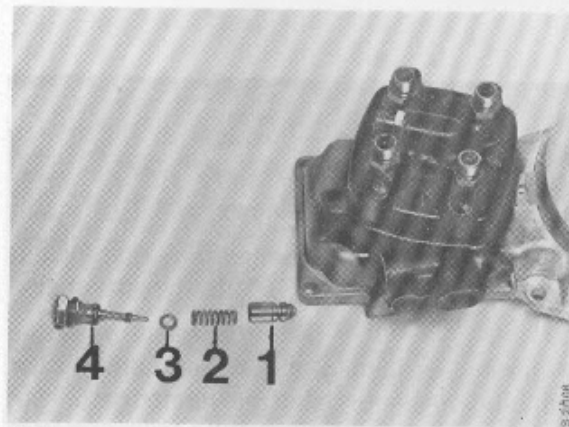
The pressure can be increased by fitting additional shims and decreased by removing shims.

Shims are available in thicknesses of 0.1 and 0.5 mm. A 0.1-mm shim produces a change in pressure of 0.15 bar (2.2 psi).

A prerequisite for measuring and adjusting the line pressure is that the fuel pump capacity is correct.

Screw plug tightening torque:

13 - 15 Nm (9.6 - 11.1 lbf ft)



Line pressure regulator

- 1 Piston with "O" ring
- 2 Spring
- 3 Adjusting washers
- 4 Screw plug with "O" ring and sealing washer (contains a stop valve for the fuel return from the warm-up regulator/boost control circuit)

Idling adjustment (engine speed and CO value)

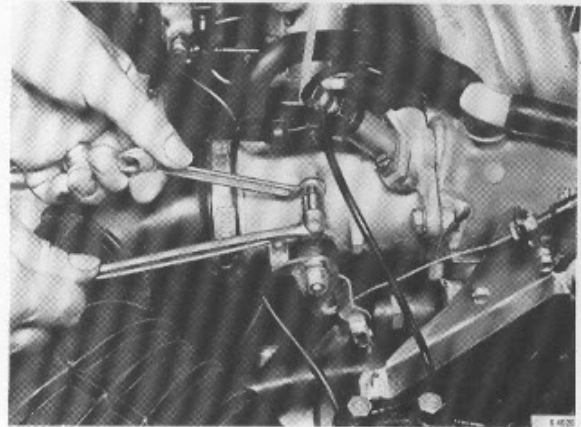
Run the engine to normal temperature and then connect the CO meter and the tachometer.

Speed setting

Adjust the idling speed by means of the adjustment screw located on the by-pass passage in the throttle housing.

N.B.

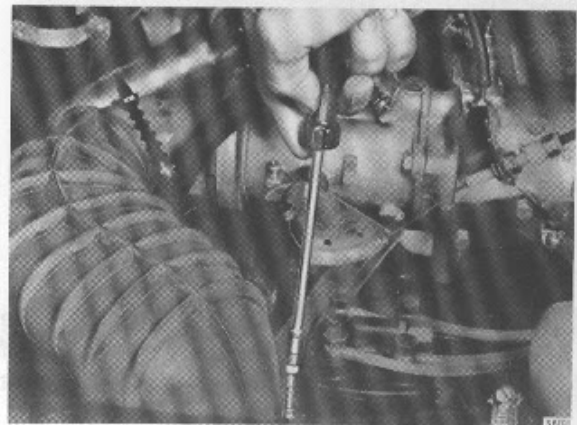
If rough idling or difficulty in reducing the idling speed is encountered, check the setting of the deceleration valve (see section 254).



Adjusting the CO value

The orifice in the fuel distributor is sealed by means of an anti-tamper plug which must be removed (and thereby destroyed) before adjustment can be carried out.

A suitable tool can be made by brazing a 5 mm (0.20 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 adjustment screw after each adjustment. If the key is left in the screw and the engine revved up, the lever can be damaged.

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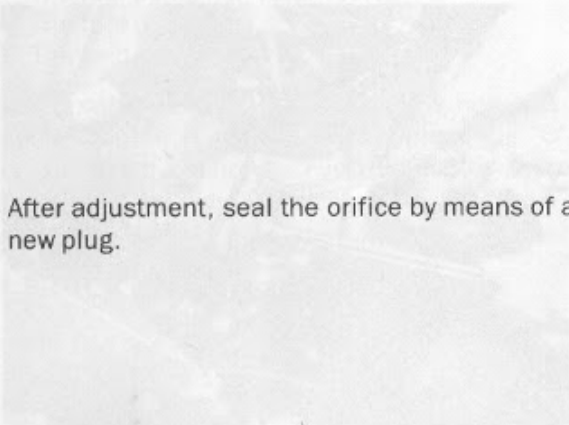
Turning clockwise = richer mixture.

Turning anticlockwise = leaner mixture.

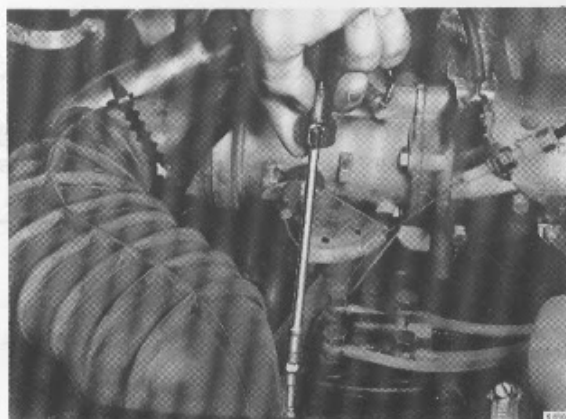
Adjust the shut-off valve in the warm-up regulator if the pressure drop is still excessive.

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

• The fuel pump non-return valve



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



Adjusting the idle pressure

After replacement of the CO valve

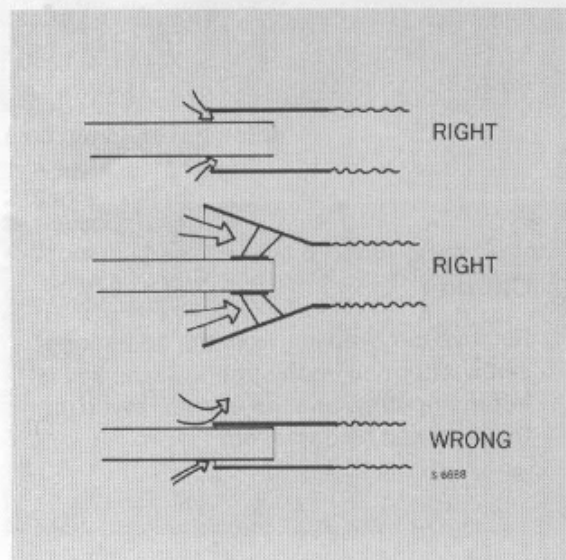


Connection of exhaust extraction equipment

When using exhaust extraction equipment in the workshop, avoid excessive depressurization of the car's exhaust system, as this may affect readings, e.g. of the CO content.

If excessively powerful exhaust extraction equipment is connected to turbo cars, oil may escape through the seals in the turbo unit, resulting in the exhaust system becoming saturated with oil, and blue smoke being emitted in the exhaust for some considerable time afterwards.

To avoid excessively powerful exhaust extraction, connect a hose with an open coupling.



Setting the fuel-air mixture Cars with catalytic converter

General

The 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 require resetting unless** a new air flow sensor has been fitted.

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

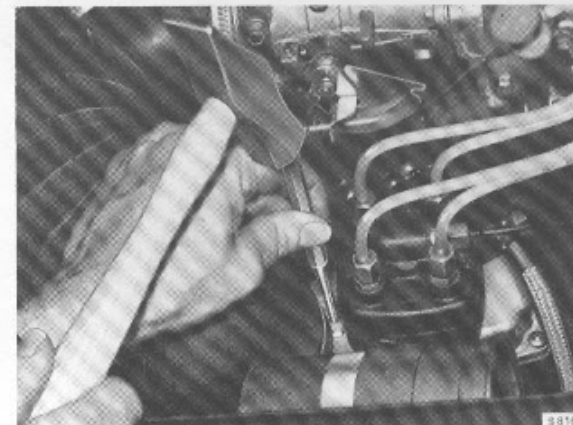
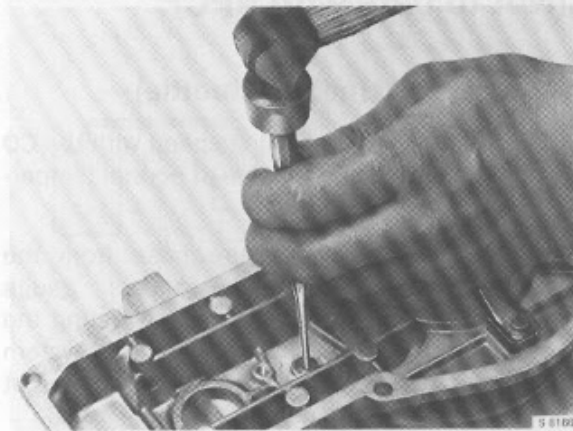
Setting a new air flow sensor

To gain access to the adjusting screw, remove the air flow sensor and sensor plate arm to enable the metal plug to be removed from over the adjusting screw.

- 1 Run the engine to normal temperature and then connect the pulse ratio meter.
- 2 Set the engine idling speed to 875 ± 75 r/min.
- 3 Set the specified pulse ratio using special key 83 92 482. Rev the engine and allow the idling speed to stabilize before each reading.

The specified pulse ratio is given in the "Technical Data" section.

After completion, refit the plug using a drift to drive it home.



Checking the fuel-boosting function, Turbo cars, 1982 models and earlier (N/A to cars with APC)

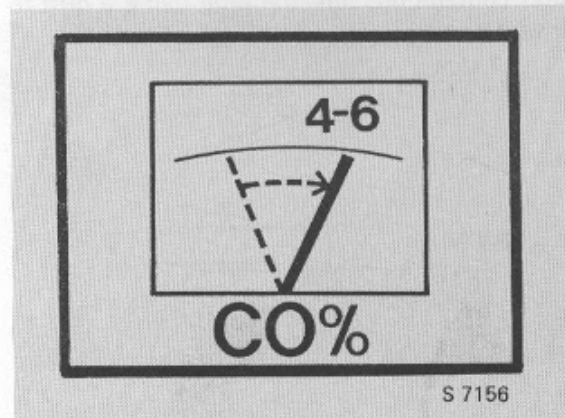
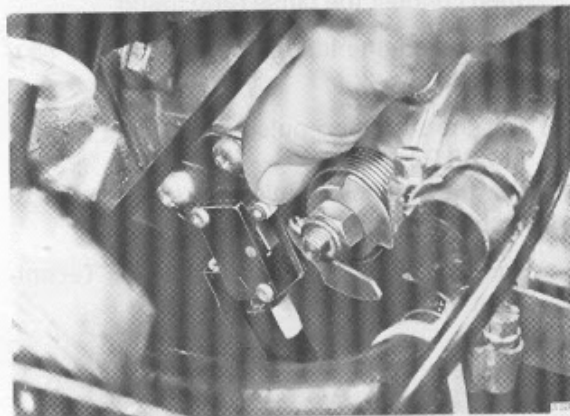
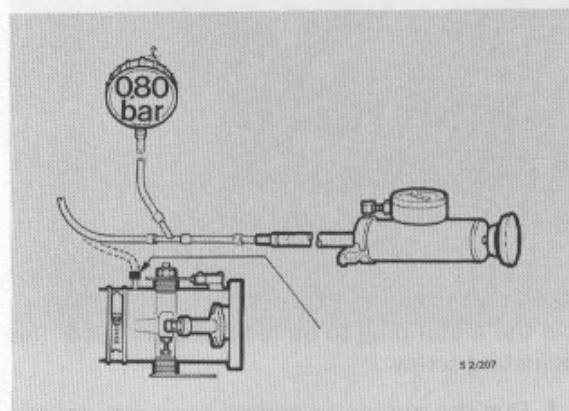
A Heavy load (not full throttle)

- 1 Run the engine at idling speed with the CO meter connected (engine at normal temperature).
- 2 Disconnect the pressure hose from the throttle housing and connect gauge 83 93 514 (pressure gauge for testing the charging pressure) and a cooling-system tester to the hose. Plug the end of the spigot on the throttle housing.
- 3 Raise the pressure to 0.80 bar (11.6 psi) - because of the influence of the delay valve, keep checking the reading on the gauge until the pressure has stabilized.
- 4 Check that the CO reading has now risen to 4 - 6%.

B Full throttle

- 5 Disconnect the pump (cooling-system tester) and check that the CO reading returns to its original value.
- 6 Push in the throttle-switch actuator.

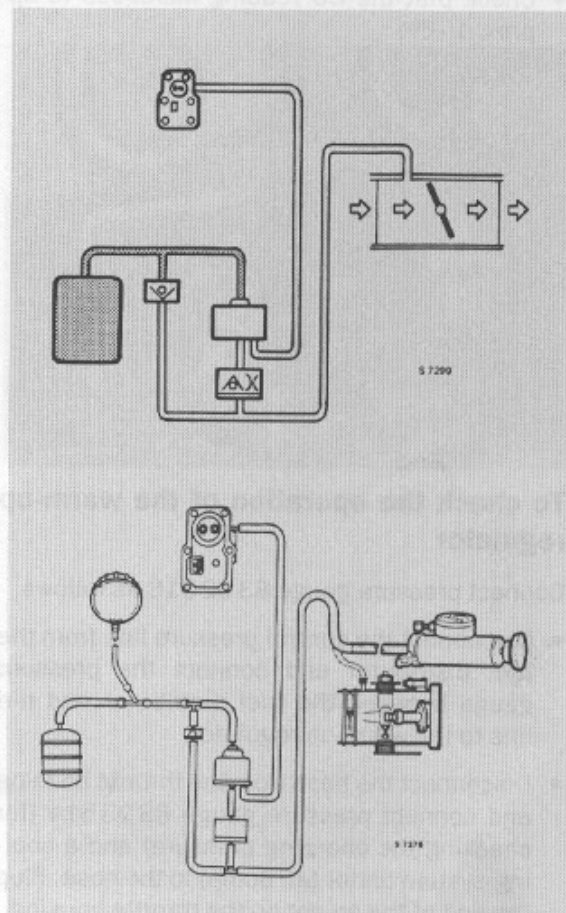
- 7 Check that the CO reading increases to 4 - 6%.



Checking the residual pressure

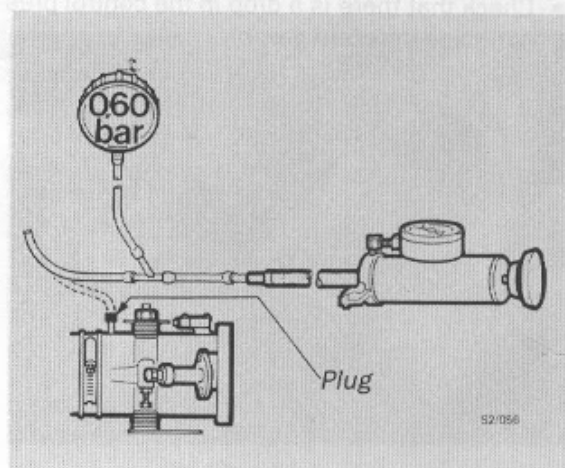
If fuel boosting on acceleration is to be initiated without delay, the pressure vessel and connections must be tightly sealed. In the event of extensive leakage, fuel boosting will not take place until the charging pressure has built up.

- 1 Connect gauge 8393 514 (for checking the charging pressure) between the non-return valve and the pressure vessel.
- 2 Connect a cooling-system tester upstream of the non-return valve and raise the pressure to 0.8 bar (11.6 psi).
- 3 Wait five minutes and then check that the pressure has not fallen below 0.6 bar (8.6 psi).



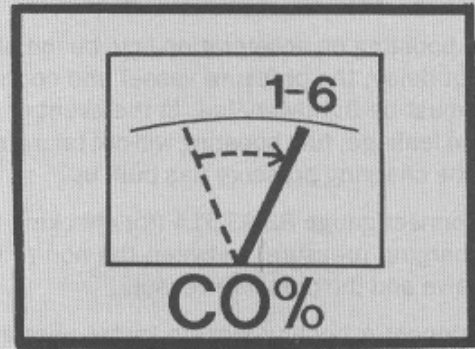
Checking the fuel-boosting function Turbo APC cars, M82 onwards

- Run the engine at idling speed with the CO meter connected (engine at normal temperature).
- Disconnect the pressure hose from the throttle housing and connect gauge 8393 514 (pressure gauge for testing the charging pressure) and a cooling-system tester to the hose. Plug the end of the spigot on the throttle housing.
- Raise the pressure to 0.6 bar (8.6 psi).



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- Check that the CO reading increases to approx. 1 - 6%.

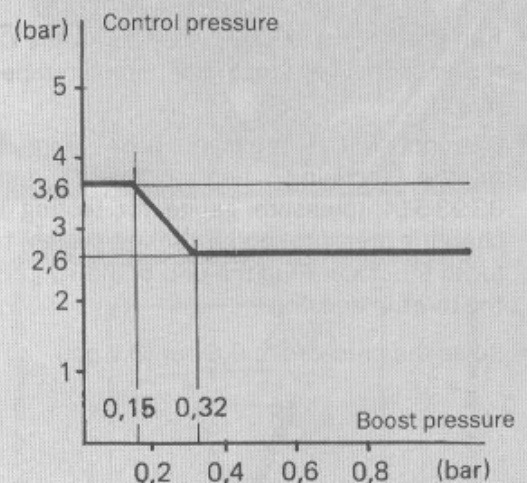
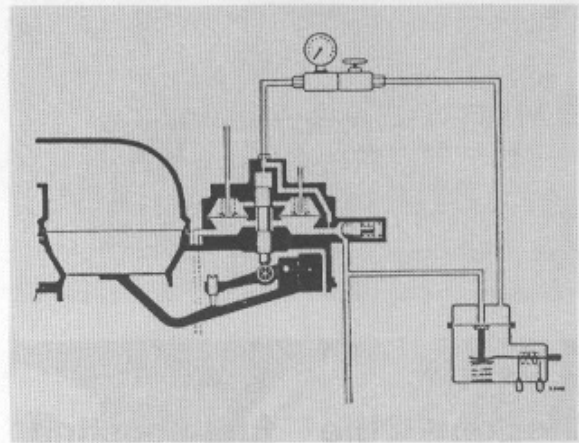


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To check the operation of the warm-up regulator

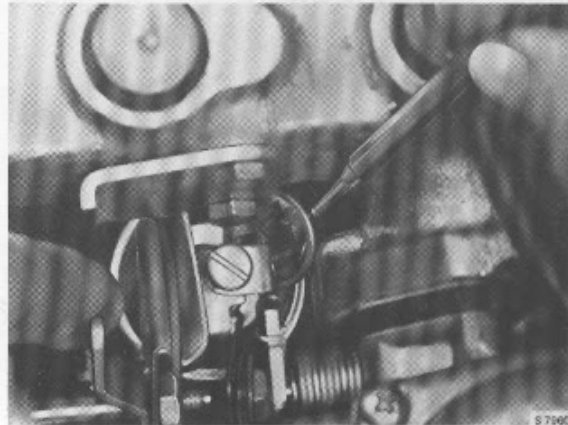
Connect pressure gauge 83 92 516 as follows:

- Disconnect the control pressure line from the fuel distributor and connect the pressure gauge between the fuel distributor and the line to the warm-up regulator.
- Disconnect the hose from the throttle housing and connect pressure gauge 83 93 514 (for checking the charging pressure) and a cooling-system tester (air pump) to the hose. Plug the end of the spigot on the throttle housing.
- Start the engine and run it until it reaches normal temperature.
- Raise the pressure to 0.6 bar (8.6 psi).
- Check that there is a drop in the control pressure (see adjacent graph).



Adjusting the throttle stop

- 1 Check that the throttle butterfly is in the centre of the housing.
- 2 Turn the adjusting screw until it just makes contact with the stop (throttle completely closed).
- 3 Turn the adjusting screw another 1/3 turn and lock it. This provides a clearance of 0.05 mm (0.002 in) approx., between the butterfly and the housing.



Fault diagnosis

In the fault-diagnosis procedure described below it is assumed that the engine does not have any mechanical faults and that the ignition system is working properly.

Starting difficulties: cold engine	240-19
Starting difficulties: hot engine	240-20
Poor drivability during warm-up period	240-22
Poor drivability - engine at normal temperature	240-23
Poor performance/low top speed	240-24
Excessive fuel consumption	240-26
Erratic CO value and idling speed, difficulty in adjusting	240-27

Starting difficulties: cold engine

- 1 Check the operation of the cold-start valve. Remove the valve and place it in a container. Fuel should be ejected from the valve when the starter motor is switched on with the engine colder than 45 °C (118 °F). The injection time depends on the temperature.

In the event of failure, check:
 The cold-start valve
 The thermostatic time switch
 The electrical system



- 2 Measure the line pressure with the engine cold. See section "Technical data" for correct value.

240-20 Fuel injection system

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

- 4 a Check the CO-value (engine at normal temperature).
- b Check the pulse ratio (see section 2:4, subsection 254, of the Service Manual for US-spec. cars).

To check the operation of the warm-up regulator

Connect pressure gauge 8392 536 as follows:

- Disconnect the vacuum pressure line from the warm-up regulator and connect the pressure

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

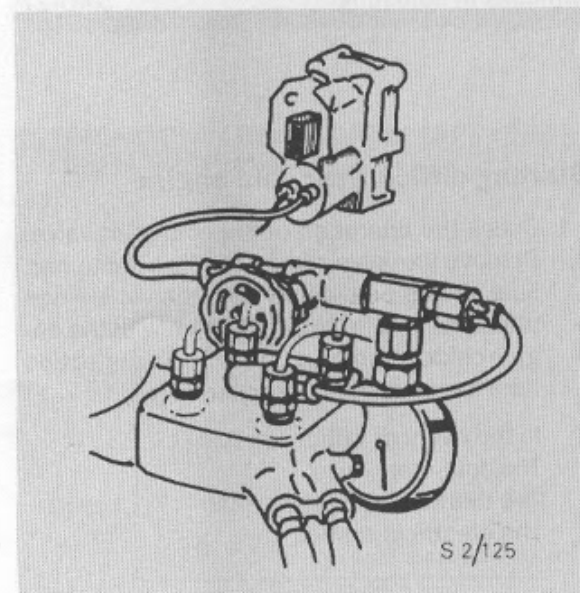
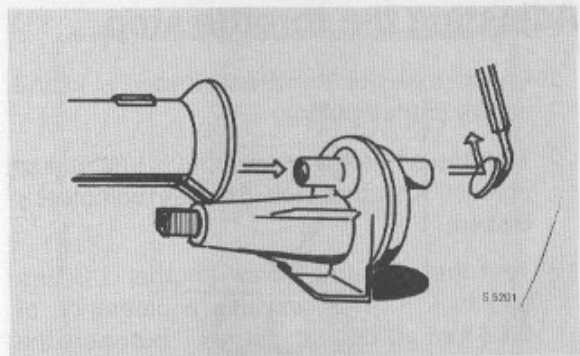
- Disconnect the hose from the throttle housing and connect pressure gauge 8392 536 (for checking the charging pressure) and a fuel line system tester (all quick) to the hose. Plug the end of the sleeve of the throttle housing.

Starting difficulties: hot engine

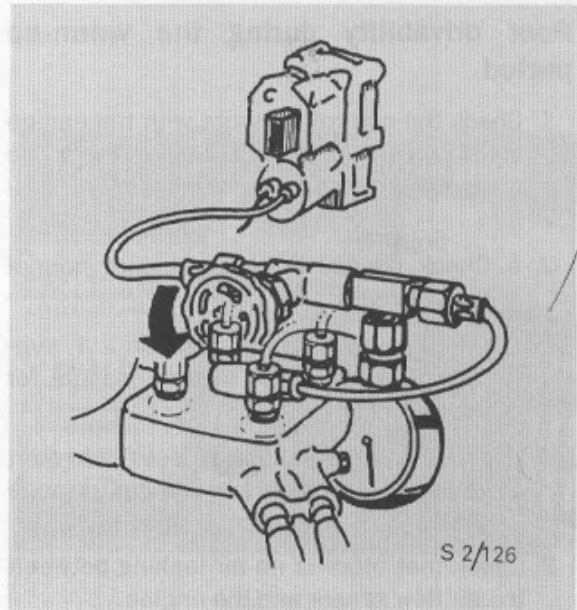
If the pressure in the injection lines falls too low while the engine is still hot, vapour bubbles can form in the system, causing starting problems.

- 1 a First check that the connections on the injection valves and fuel lines are tight.
- b Perform the leakage test. First check with the pressure gauge valve open. If leaks are detected perform the test with the valve shut (warm-up regulator disconnected).

Possible leakage points:
Fuel pump non-return valve
Warm-up regulator "O" ring
Cold start valve
External leakage
Stop valve for fuel return from the warm-up regulator



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

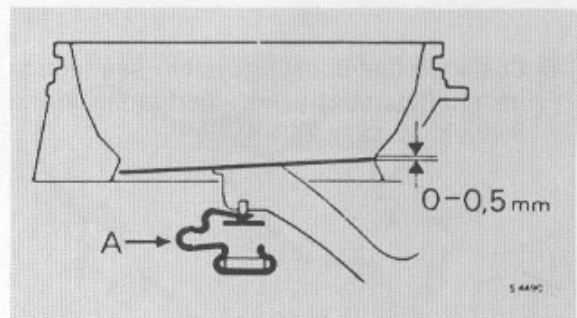


- 3 a Check the CO-valve (engine hot).
- b Check the pulse ratio (Section 2:4, sub-section 254, of the Service Manual for US-spec. cars).

Check the hot-start relay (see "Cold-start valve - performance and sealing" on page 240-8).



- 4 Check the rest position of the air flow sensor plate in the air flow sensor. (The top of the sensor plate should be level with or slightly lower than max. 0.5 mm; 0.02 in the lower edge of the air venturi.) Adjust by means of the spring (A).

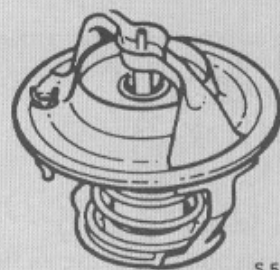
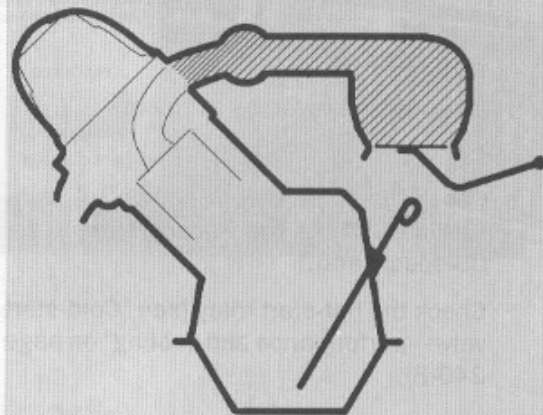


Poor drivability during the warm-up period

- 1 Check the control pressure with the engine cold. Excessive control pressure during the warm-up period produces a lean fuel-air mixture.
- 2 a Check the CO-value (engine at normal temperature).
b Check the pulse ratio (Section 2:4, subsection 254, of the Service Manual for US-spec. cars).
Check the hot-start relay (see "Cold-start valve - performance and sealing" on page 240-8).
- 3 Check that there is no air leaking between the air flow sensor and the engine.

- 4 Check that the warm-up period for the engine is normal by observing the temperature gauge. An abnormally long warm-up period may be caused by a faulty thermostat.

- 5 Check the fuel-boosting system (see section under "Cold-start valve - performance and sealing" on page 240-8).



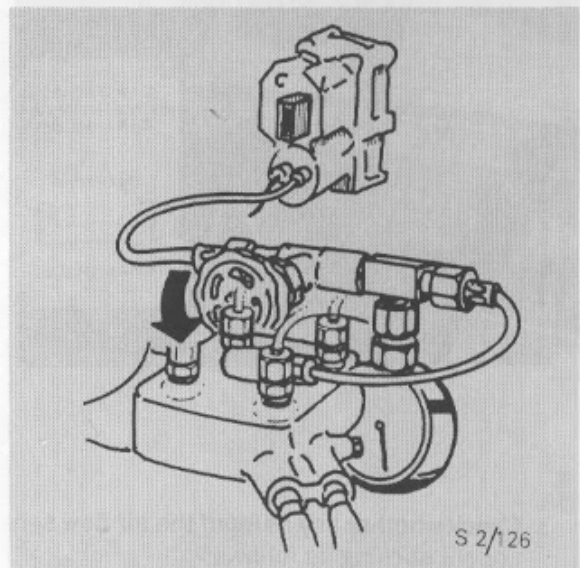
S 5207

Poor drivability - engine at normal temperature

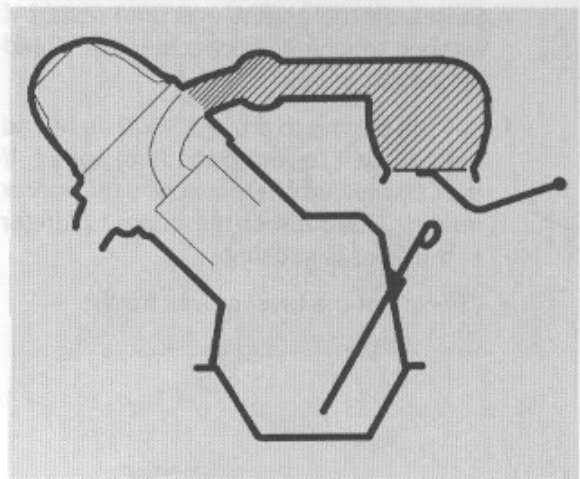
- 1 a Check the CO-value (engine at normal temperature).
- b Check the pulse ratio (engine at normal temperature) as described in Section 2:4, subsection 254, of the Service Manual for US-spec. cars.



- 2 With the valve open, check the control pressure (engine at normal temperature).

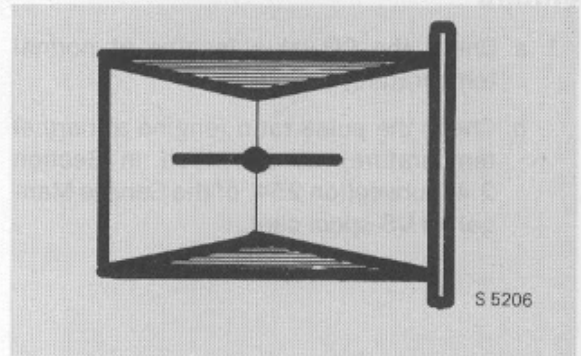


- 3 Check that there is no air leaking between the air flow sensor and the engine.

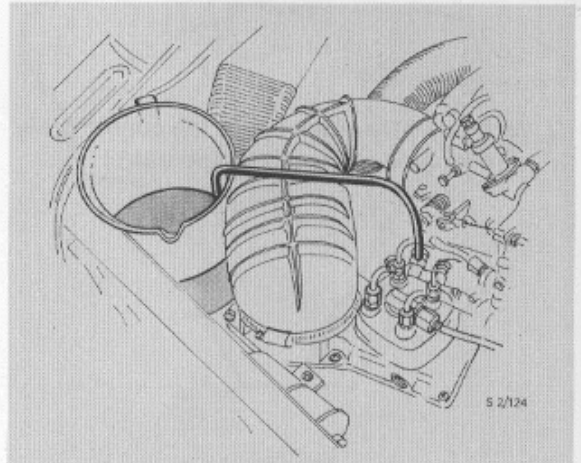


Poor performance/low top speed

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

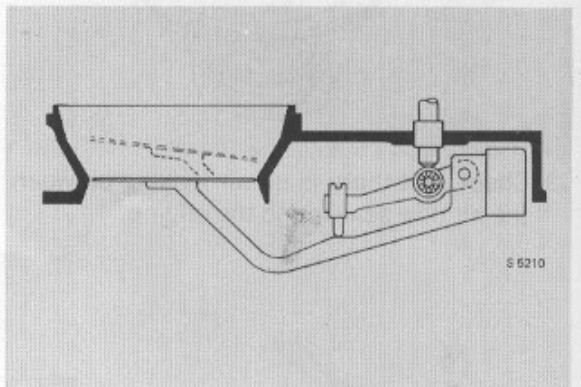


- 2 Check that the fuel flow is sufficient by measuring the quantity of return fuel flowing during a 30-second period. See under "Fuel pump capacity", page 240-6.

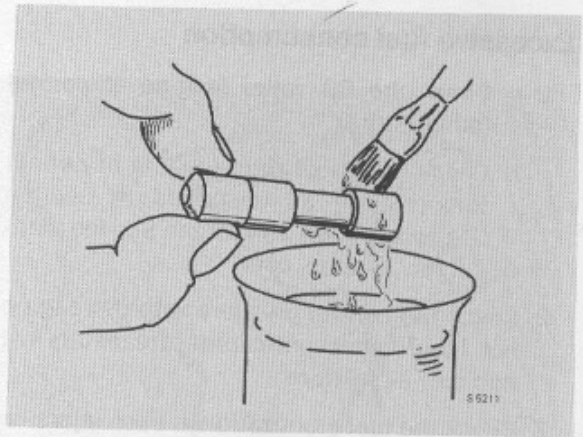


- 3 Check whether any parts of the air flow sensor are sticking as follows:

- Run the engine to normal temperature and then connect a CO meter.
- Switch off the engine and then restart it without touching the accelerator. Read off the CO value.
- Rev the engine to around 3000 r/min and then allow it to return to idling speed. If the CO value is different now to the earlier reading, then either the control plunger or the lever is sticking.
- Check that the lever moves freely.



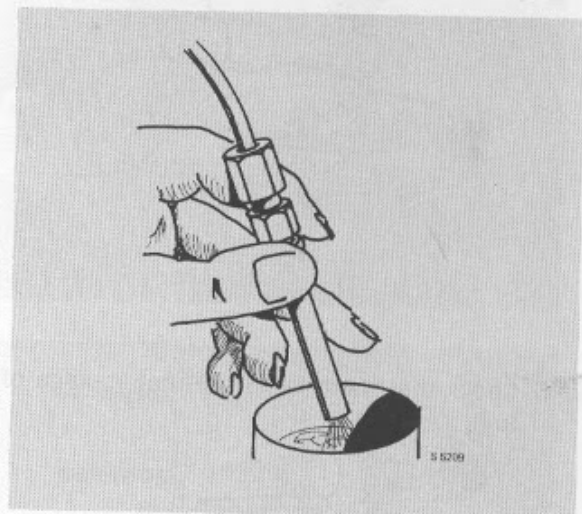
If the control plunger is binding, separate the fuel distributor from the air flow sensor, ensuring that the control plunger does not fall out. Extract and inspect the control plunger (avoid handling the sealing surfaces). Clean the plunger in petrol, install it and refit the fuel distributor. Never dismantle the fuel distributor any further.



- 4 a Check the CO value (engine at normal temperature).
- b Check the pulse ratio (see Section 2:4, subsection 254, of the Service Manual for US-spec. cars).

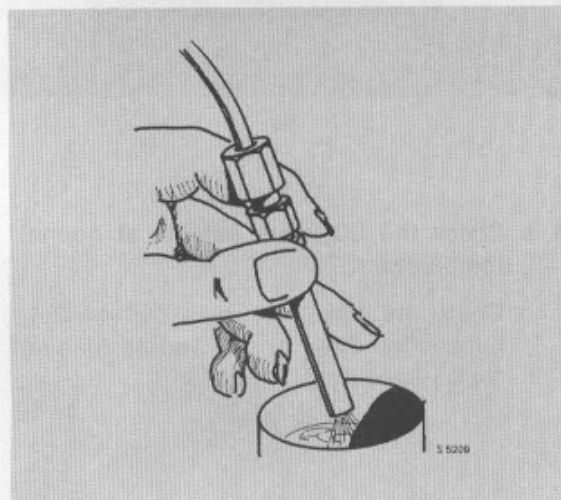


- 5 Check the fuel atomization at each injection valve. The deposits on the spark plugs can give an indication of poor atomization.

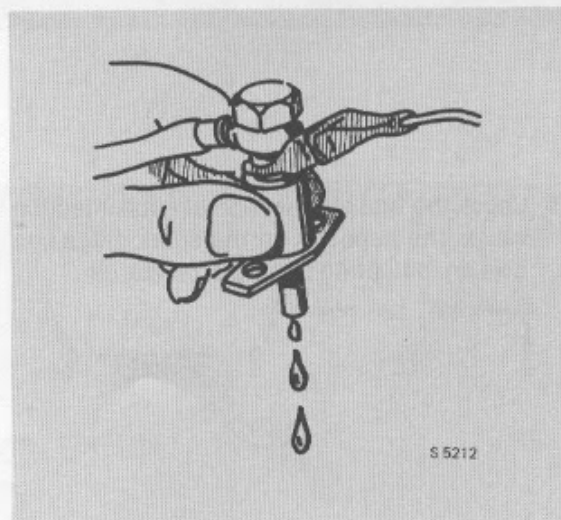


Excessive fuel consumption

- 1 a Check the CO value (engine at normal temperature).
- b Check the pulse ratio (engine at normal temperature) as described in Section 2:4, subsection 254, of the Service Manual for US-spec. cars.
- 2 Check the control pressure with the engine hot. Insufficient control pressure results in a rich fuel-air mixture.
- 3 Check the fuel atomization at each injection valve. The deposits on the spark plugs can give an indication of poor fuel atomization.



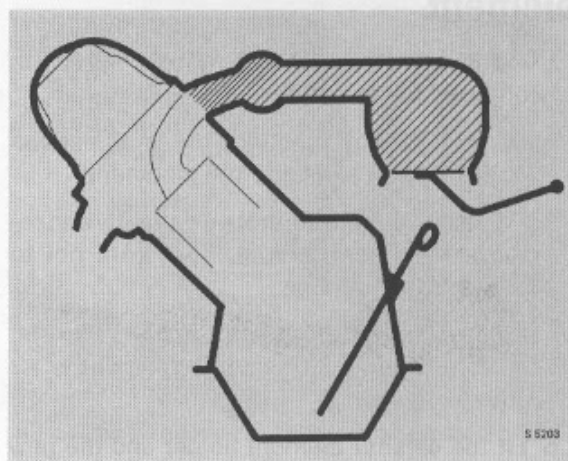
- 4 Check that the cold-start valve is not leaking.



- 5 Check that there is no external leakage of fuel.

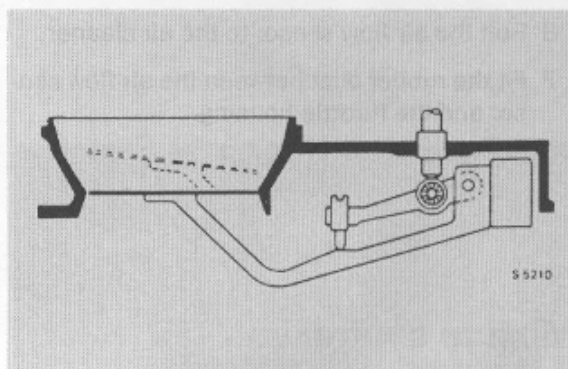
Erratic CO value and idling speed, difficulty in adjusting

- 1 Check that no air is leaking between the air flow sensor and the engine.

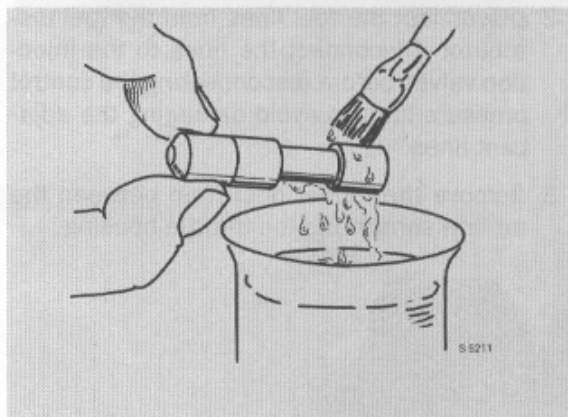


- 2 Check whether any parts of the air flow sensor are sticking, as follows:

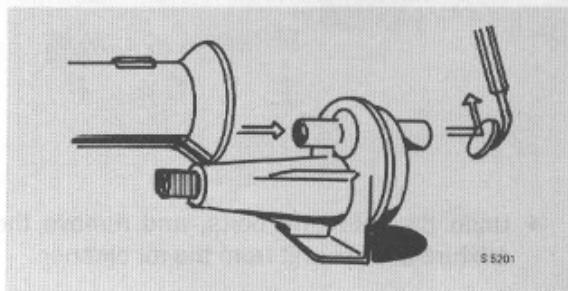
- Run the engine to normal temperature and then connect a CO-meter.
- Switch off the engine and then restart it without touching the accelerator. Read off the CO value.
- Rev the engine to around 3000 r/min and then allow it to return to idling speed. If the CO value is different now to the earlier reading, then either the control plunger or the lever is sticking.
- Check that the lever moves freely.



If the control plunger is binding, separate the fuel distributor from the air flow sensor, ensuring that the control plunger does not fall out. Extract and inspect the control plunger (avoid handling the sealing surfaces). Clean the plunger in petrol, install it and refit the fuel distributor. Never dismantle the fuel distributor any further.

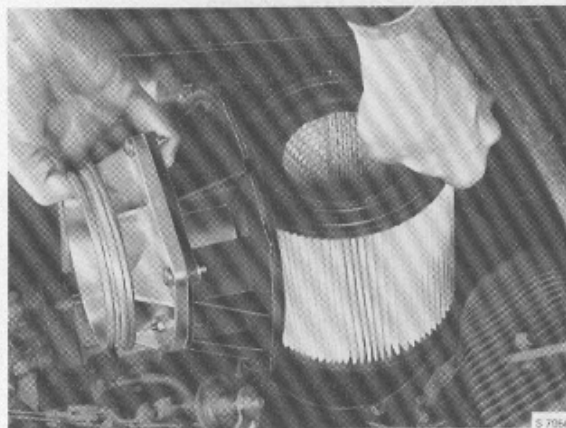


- 3 Check that the disc in the auxiliary air valve is not sticking.



Replacing the air cleaner filter element

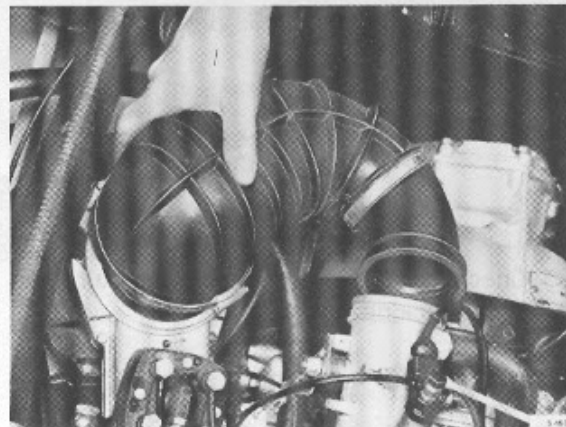
- 1 Remove the rubber duct from between the air flow sensor and the throttle housing.
- 2 Remove the bolts securing the lower section of the air flow sensor to the air cleaner.
- 3 Raise the mixture control unit slightly and remove the filter element. Take care not to damage the fuel line.
- 4 Remove 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 air flow sensor to the air cleaner.
- 7 Fit the rubber duct between the air flow sensor and the throttle housing.



Mixture control unit

Removal

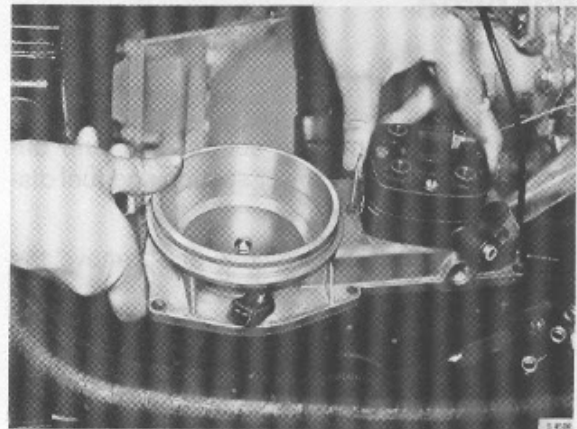
- 1 Thoroughly clean the area around the fuel connections on the fuel distributor.
- 2 Disconnect the fuel lines from the fuel distributor. Disconnect the lines to the injection valves before disconnecting the control pressure line, to avoid damaging the adjacent lines.
- 3 Remove the rubber duct from between the air flow sensor and the throttle housing.



- 4 Undo the retaining bolts, and remove the mixture control unit from the air cleaner.

Assembly

- 1 Make sure that the air cleaner element is in the correct position and then bolt the mixture control unit to the air cleaner.
- 2 Connect the fuel line to the fuel distributor.
- 3 Fit the rubber duct between the air flow sensor and the throttle housing.



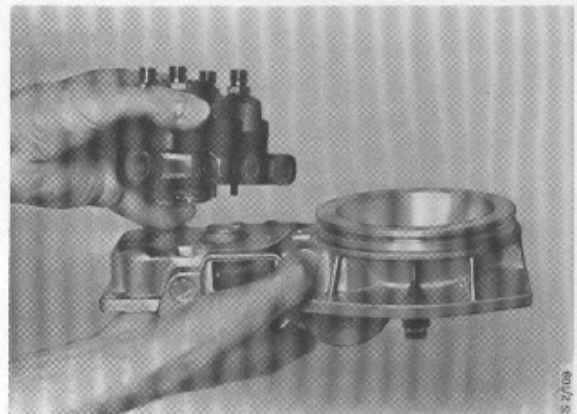
Fuel distributor

The fuel distributor must not be dismantled but should be replaced when faulty.

When separating the fuel distributor from the air flow sensor, ensure that the control plunger does not fall out.

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

When assembling the fuel distributor, ensure 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).

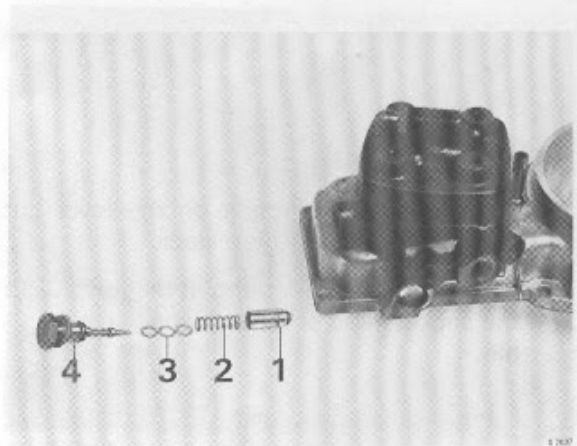


Line pressure regulator

The line pressure regulator is located inside the screw plug at the return line and return connection from the warm-up regulator/boost control circuit.

The regulator comprises the following:

- 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/boost control circuit when the fuel pump is not operating. The socket head screw in the plug should not normally be removed.)



Lever adjustment arm and sensor plate

To remove

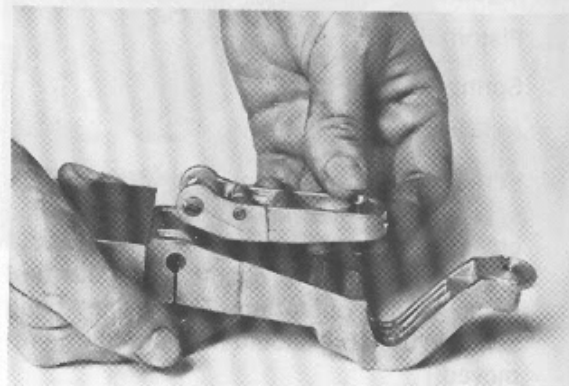
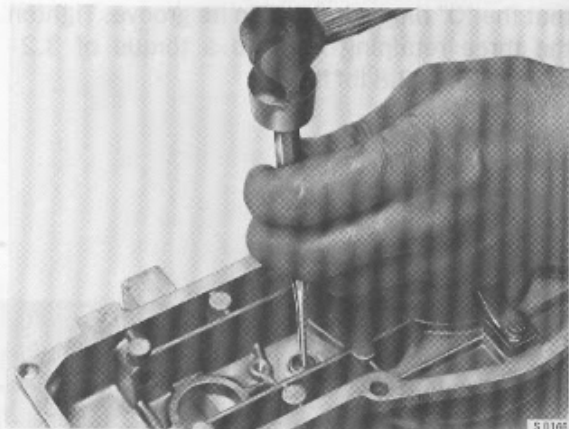
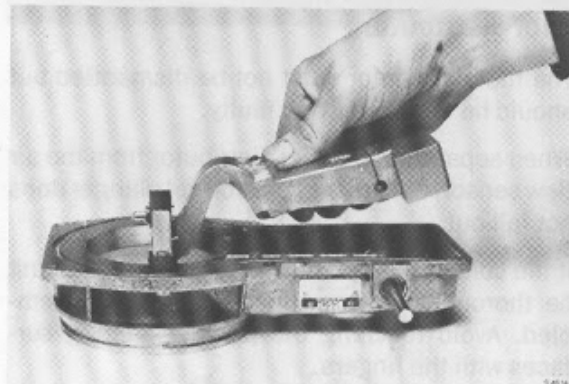
- 1 Remove the mixture control unit and unscrew the plastic lower section and fuel distributor.
- 2 Undo the retaining screw and remove the sensor plate.
- 3 Remove the circlips from the lever pivot, followed by the shims, seals, spring (fitted on one side only) and the balls.
- 4 Undo the counterweight retaining screw and press out the spindle.
- 5 Remove the lever, counterweight and adjustment arm.

- 6 Tap out the plug over the adjusting screw - remember to refit it after setting the fuel/air mixture.

Refer to page 240-15 for setting of the fuel/air mixture.

To refit

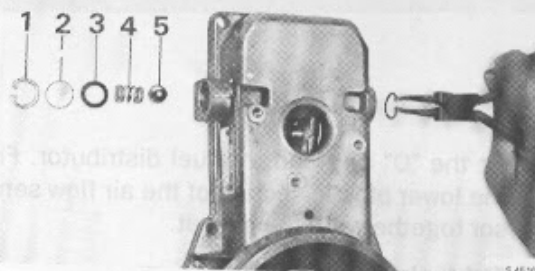
- 1 Place the counterweight on the lever but leave the retaining screw slack.
- 2 Place the adjustment arm in the lever, with the socket head of the adjusting screw visible.



- 3 Grease both bearings using Bosch Ft2v2 silicon grease or the equivalent.
- 4 Place the lever assembly in the air flow sensor housing and fit the spindle.
- 5 Grease the balls with silicon grease and fit them, followed by the spring (in the longer bearing seating), the seals, the shims and the circlips.

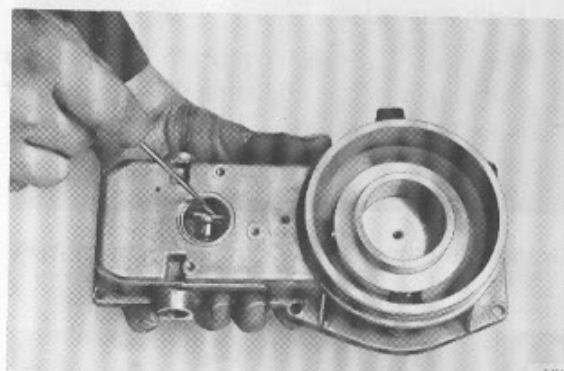
N.B.

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



- 1 Circlip
- 2 Shim
- 3 Seal
- 4 Spring
- 5 Ball

- 6 Mount 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)

- 7 Fit the sensor plate retaining screw and tighten it. Check that the lever moves freely, without resistance.

Tightening torque:

5.0 - 5.5 Nm (3.7 - 4.1 lbf ft)



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

240-32 Fuel injection system

- 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 dimension should be 18 - 19 mm (0.71 - 0.75 in). To adjust the dimension, turn 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 air flow sensor together with the gasket.

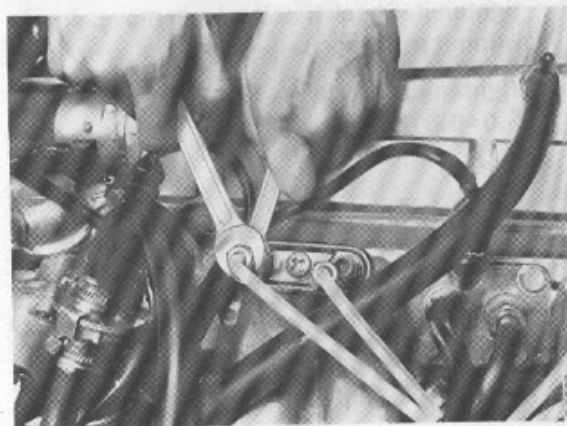
**Tightening torque,
Fuel distributor screws**
3.2 - 3.8 Nm (2.4 - 2.8 lbf ft)

- 11 Fit the mixture control unit in the car. Fine adjustment of the basic fuel flow is made by means of a CO gauge after the engine has been warmed up.

Fine-tune the fuel/air mixture and replace the plug over the adjusting screw in the air flow meter (see page 240-15).

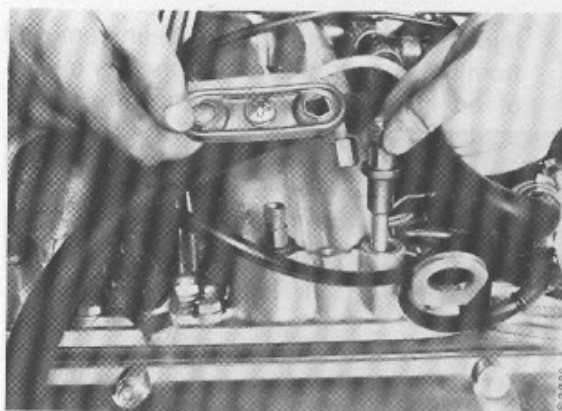
Replacing injection valves

- 1 Clean the area around the injection valve and its connection.
- 2 Disconnect the fuel line from the valve. To prevent the valve turning, hold the hexagon with a spanner.



- 3 Remove the retaining plate.
- 4 Withdraw the injection valve and pull off the rubber seal.

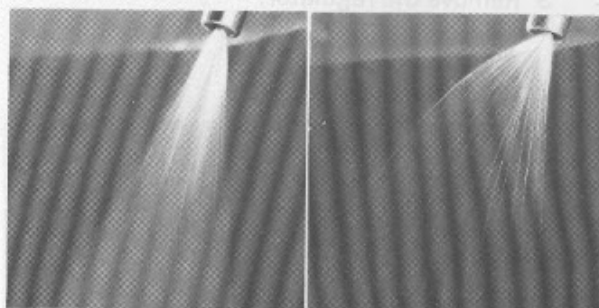
Refit in the reverse order.



Injection valves - to clean

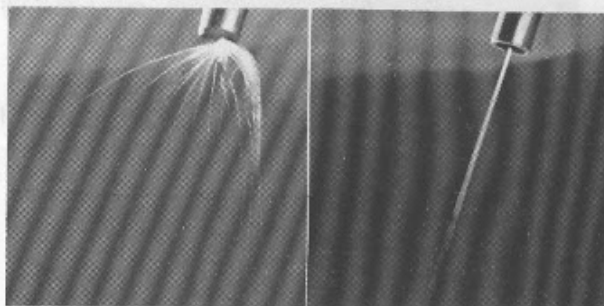
If an injection valve is atomizing the fuel improperly or if it is leaking under opening or closing pressure the cause can be small particles of dirt in the valve seat. It is sometimes possible to remove the particles by forced flushing of the valve as follows:

- 1 Disconnect the rubber ducts from the air flow sensor.
- 2 Remove the injection valve from the inlet manifold and place it in a suitable container. Do not disconnect the fuel line.
- 3 Remove the pump relay and use a jumper lead across terminals 30 and 87 in the relay holder to provide power to the fuel pump.
- 4 Raise the air flow sensor lever a few times to its highest position, thereby force-flushing the injection valve.



Perfect atomization

Acceptable atomization

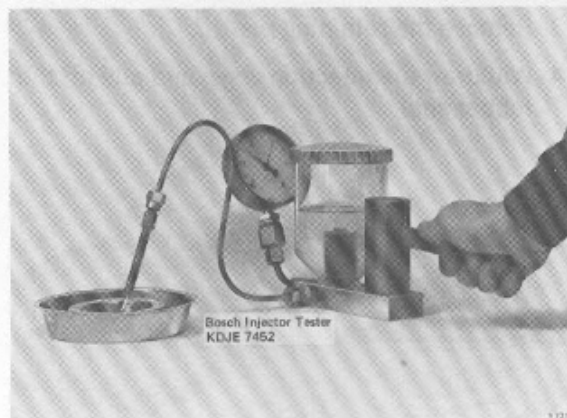


Examples of poor atomization

240-34 Fuel injection system

Injection valves that have been removed from the car can also be cleaned by means of an injector tester designed for diesel equipment (e.g. Bosch KDJE P400 or KDJE 7452). Cleaning with compressed air is not recommended.

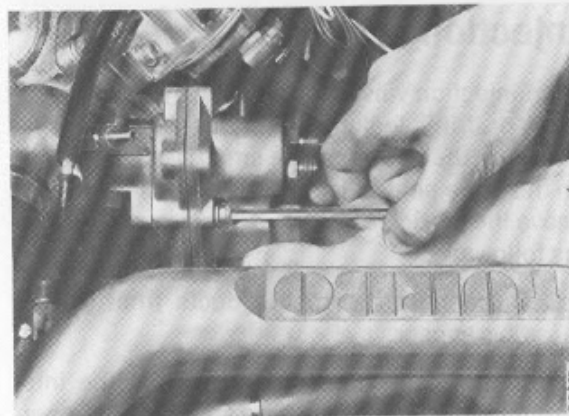
If the fault persists, fit a new injection valve.



Replacing the warm-up regulator

- 1 Clean the area round the warm-up regulator and its connections.
- 2 Disconnect the electrical leads and both fuel pipes from the regulator.
- 3 Remove the regulator.

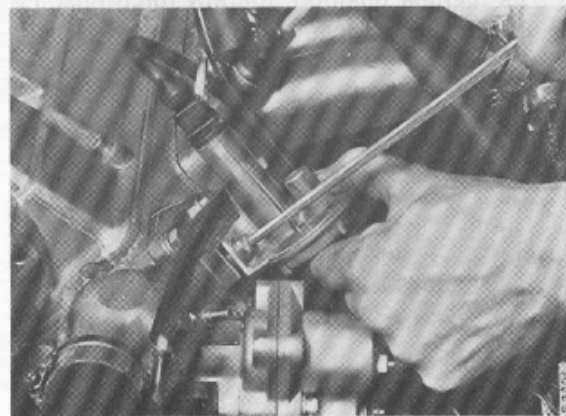
Refit in the reverse order.



Replacing the auxiliary air valve

- 1 Pull off the hoses and unplug the electrical lead.
- 2 Unscrew the auxiliary air valve.

Refit in the reverse order.



Fuel accumulator

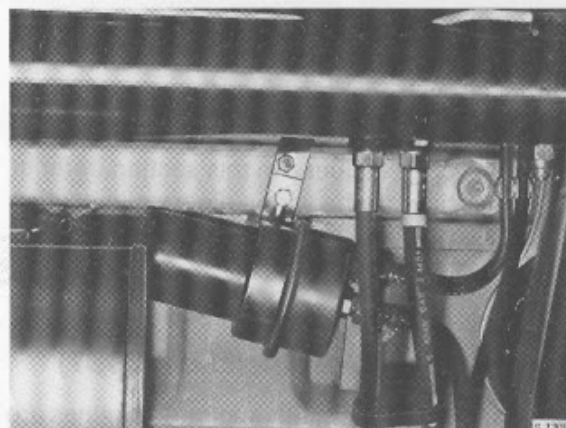
To remove

- 1 Clean the area around the fuel connections.
- 2 Undo the connections and remove the fuel accumulator.

To refit

- 1 Mount the accumulator on the bracket on the fuel tank.
- 2 Connect the fuel lines. The line from the fuel pump should be fitted to the connection nearest to the edge of the fuel accumulator.

Make sure that the fuel line from the pump cannot chafe against the body.

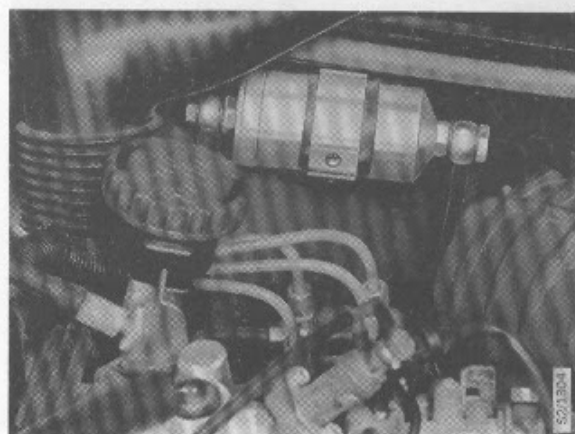


Replacing the fuel filter

- 1 Clean the area around the two connections.
- 2 Hold the filter by means of the hexagons on the filter and fitting and disconnect the fuel lines. Remove the filter.

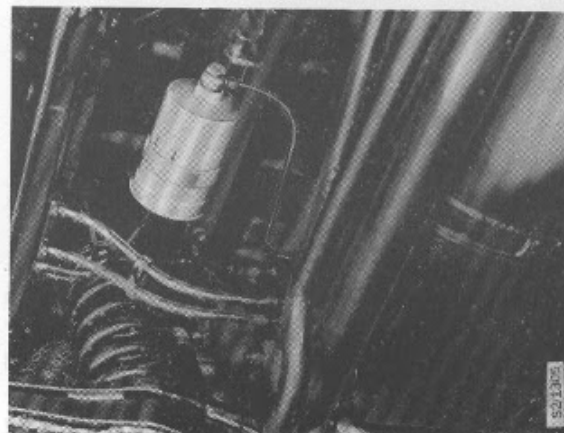
N.B.

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

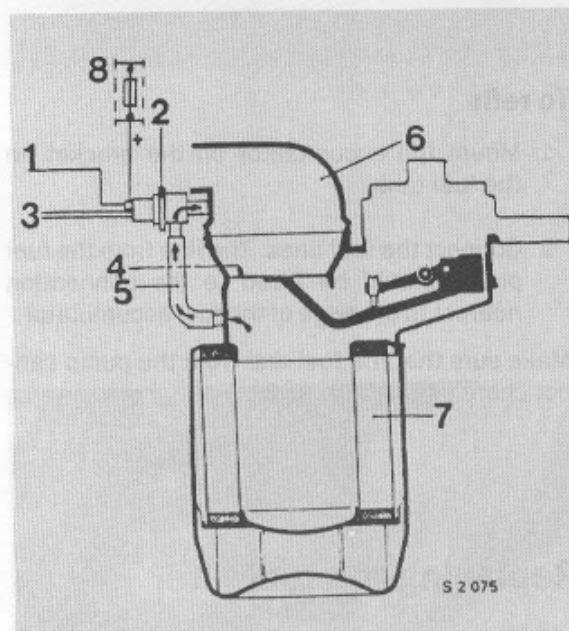
CI fuel injection system, Lambda (EU & US specs)

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

When using the component locations or fault-diagnosis chart included in this section, refer at the same time to the wiring diagram in section 3:2 of the Manual.

Fuel shut-off on deceleration (1987)

Manual cars with normally aspirated engines are equipped with a system that shuts off fuel injection during engine overrun. The system is provided to reduce fuel consumption and also the content of unburned hydrocarbons (HC) in the exhaust. The system comprises a vacuum valve and a deceleration relay.

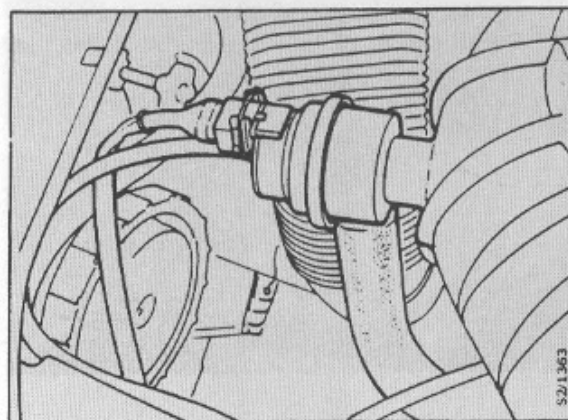


Air cleaner and fuel distributor

- 1 From deceleration relay
- 2 Vacuum valve
- 3 From inlet manifold
- 4 Sensor plate in home position
- 5 Bypass line
- 6 Rubber socket connector
- 7 Filter
- 8 Fuse

Principle of operation

The deceleration system causes the induction air that normally flows across the air flow sensor plate to bypass the sensor plate via a hose and vacuum valve, resulting in the sensor plate remaining in its home position and hence shutting off the flow of fuel to the cylinders.



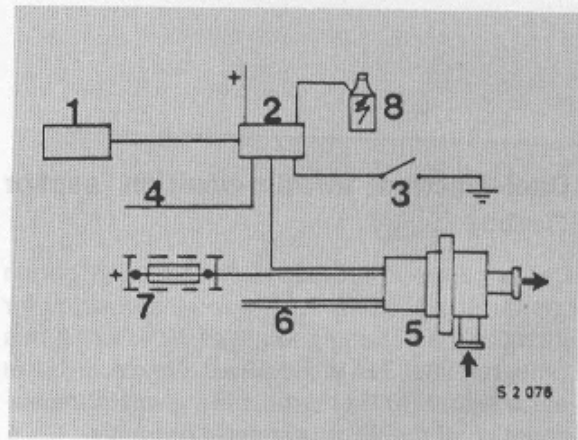
Thus, the vacuum valve acts as a bypass line when the deceleration system is operating. Because the relay is operating, the ECU selects a fixed pulse ratio of 60%.

The deceleration relay operates when:

- the thermostatic switch is closed (coolant temperature above 45 °C/113 °F)
- the time relay (P11) is not operating (relay in de-energized position)
- the engine speed is higher than 1575 ± 175 rpm.
- the throttle-position sensor is making the circuit

The deceleration system shuts off the supply of fuel as soon as the set of contacts in the throttle-position sensor close (foot off accelerator).

Fuel supply is resumed once the engine speed has fallen below 1375 ± 75 rpm.

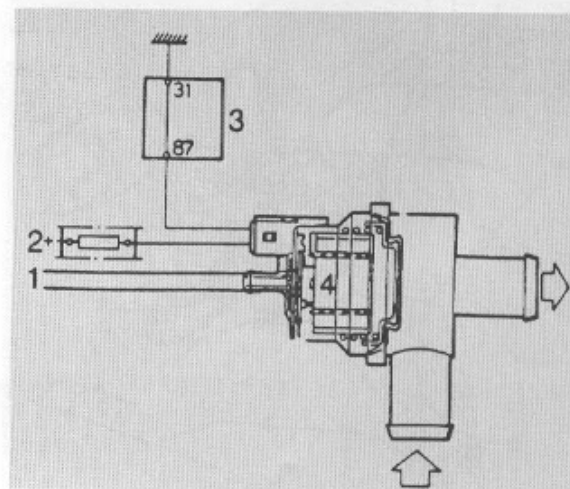


Principle of operation of fuel shut-off system

- 1 Time relay for boost during acceleration
- 2 Deceleration relay (manual cars)
- 3 Throttle-position sensor
- 4 Lambda ECU
- 5 Vacuum valve
- 6 Hose from inlet manifold
- 7 Fuse
- 8 Ignition coil

Vacuum valve mode of operation

When current flows through the vacuum valve solenoid (4) from power distribution panel (2) via the deceleration relay (3) to earth, the depression in the inlet manifold acts on the diaphragm in the valve, opening the bypass port.



Vacuum valve

Single-function throttle-position sensor (normally aspirated engines)

Contact is made between terminals 1 and 2 only when the butterfly is in the position for idling.

When the circuit is made, terminal 30 in the deceleration relay and terminal TRK in the time relay receive an earth signal (further details are given in the description of the relay operation).

Once the throttle butterfly has opened beyond 72°, contact is made between terminals 2 and 3, an earth signal is received from terminal TK in the AC relay (156) and the electromagnetic clutch on the AC compressor is disengaged (cars with AC only).

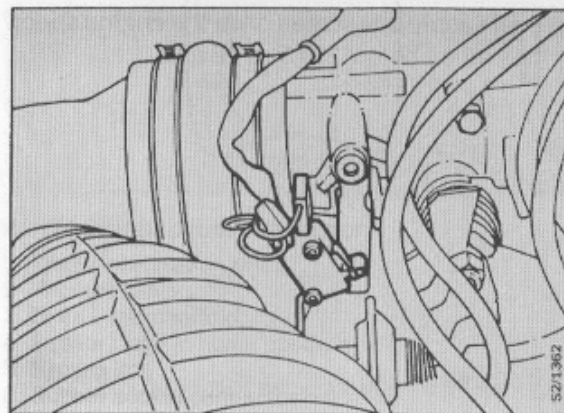


Throttle-position sensor on normally aspirated engine

Dual-function throttle-position sensor (Turbo)

Contact is made between terminals 1 and 2 when the throttle butterfly is between the position for idling and an opening angle of 72°. During this time, terminal 31A in the speed relay receives an earth signal (further details are given in the description of the TIP relay operation).

After the throttle butterfly has moved beyond the 72° opening angle, contact is made between terminals 2 and 3. This makes the earthing circuit to terminal TK in the AC relay (156) (releasing the electromagnetic clutch on the AC compressor), to terminal 11 in the deceleration relay (106) and thence to terminal 11 in the Lambda ECU, thereby providing a pulse ratio of 92% minimum.

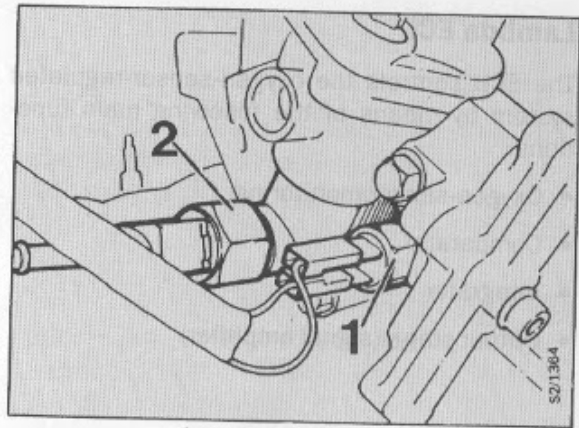


Throttle-position sensor, Turbo

Thermostatic switch (45/38 °C) and thermostatic time switch

The thermostatic switch is closed at temperatures below 45 °C (113 °F). If the temperature has been higher than this, the switch will not close until the temperature has fallen to 38 °C (100 °F). The thermostatic switch is connected in series with the thermostatic time switch (92).

Thus, no earthing is available for the cold-start valve or terminal TTK in the time relay (106) at temperatures above 45 °C (113 °F).



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

Thermostatic switch (25/18 °C)

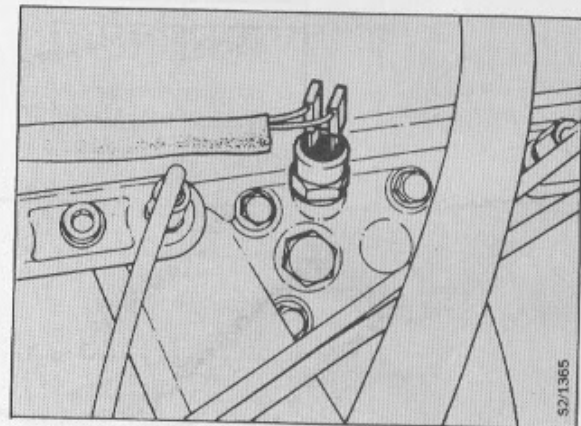
The thermostatic switch is closed at temperatures below 25 °C (77 °F). If the temperature has been higher than this, the switch will not close until the temperature has fallen to 19 °C (66 °F).

Normally aspirated engines

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

At temperatures below 25 °C (77 °F), an earthing signal is available to terminal 12 in the Lambda ECU and a pulse ratio of 60% is selected (the same as during fuel shut-off via P12).

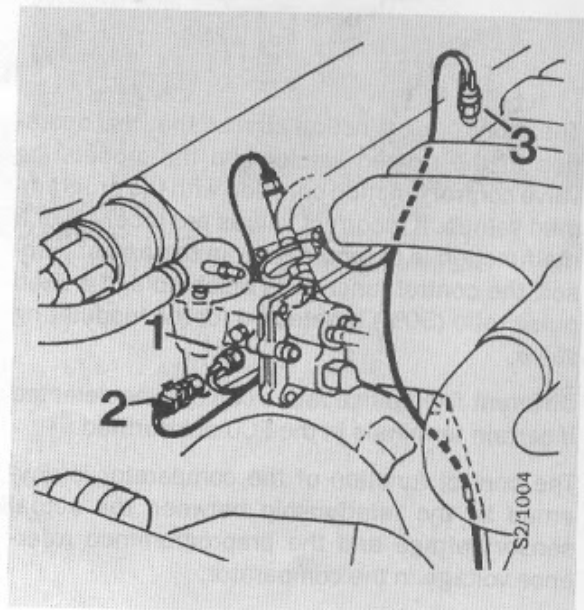
At temperatures above 25 °C (77 °F), the thermostatic switch is open and the preset pulse ratio is not selected.



- 3 Thermostatic switch (97)

Turbo engines

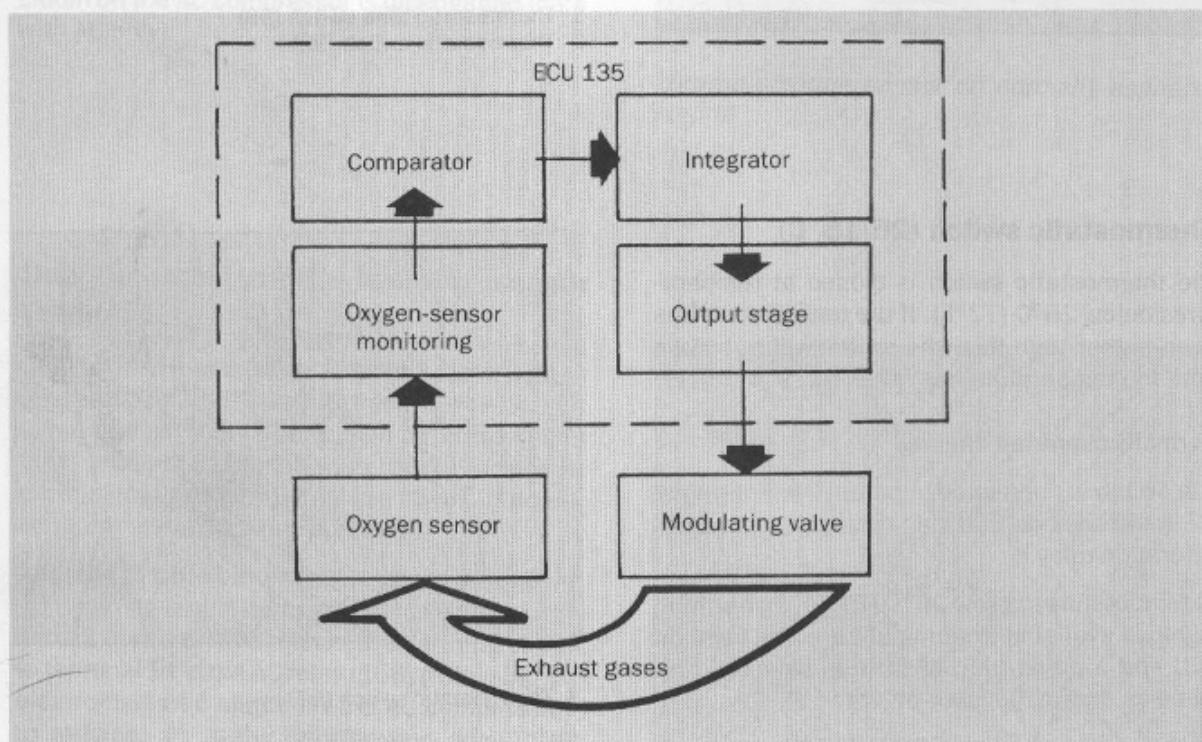
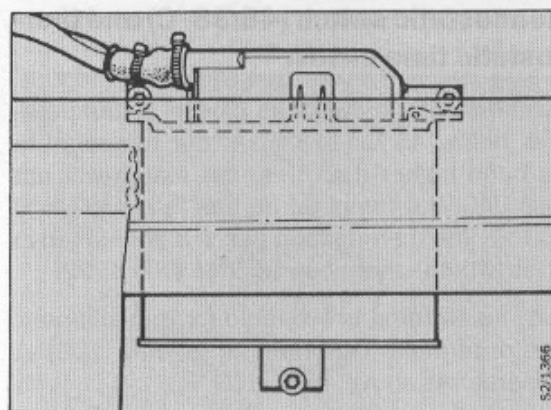
The function is the same except that the thermostatic switch is connected direct only to terminal 12 in the Lambda ECU. A fixed pulse ratio of 60% is selected.



Lambda ECU

The ECU controls the oxygen-sensor-regulated system by means of the following main functions:

- Oxygen-sensor monitoring
- Comparator
- Integrator
- Output stage (signal amplifier)



The monitoring function checks that the operation of the oxygen sensor and the modulating valve control function coincide with the programmed values. If incorrect values are received or a malfunction is detected, e.g. in the oxygen sensor, the control function is disabled and a fixed pulse ratio (50%) is selected for the modulating valve.

Different fixed pulse ratios can also be selected if certain terminals in the ECU are earthed.

The control function of the comparator is governed by the relationship between the actual sensor voltage and the preprogrammed reference voltage in the comparator.

If the mixture is lean, the signal voltage from the oxygen sensor will be lower than the reference voltage and the ECU will then increase the pulse ratio (opening duration) of the modulating valve, thereby enriching the mixture.

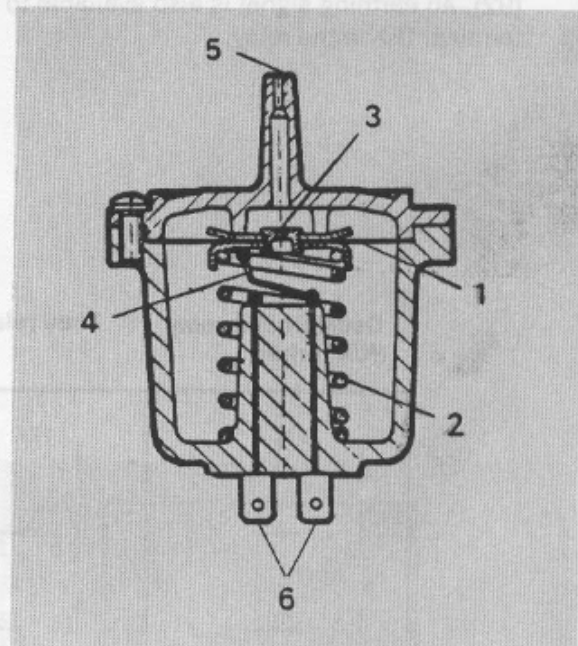
The integrator controls the signal voltage from the output stage at a programmed control speed to enrich or weaken the mixture. The control speed is optimized to provide best possible conversion of the exhaust gases in the catalytic converter, by keeping the Lambda value between very tight limits, as close as possible to $\text{Lambda} = 1$ (ideal mixture).

Lambda ECU terminal pins

Pin 2	Signal from oxygen sensor 136. Green (GN).
Pin 4	Oxygen sensor. Screened braid.
Pin 15	Pulsed earth signal to modulating valve 139. Dependent on pulse ratio. Violet (VL).
Pin 17	+ 12V supply via fuse 8 from terminal + 54 on power distribution panel. Brown/white (BR/VT).
Pin 8	+ 12V supply when fuel pump relay 102 operating. Yellow/red (GL/RD).
Pin 26	Internal jumpering. Yellow (GL).
Pin 7	When earthed, fixed pulse ratio of 85%. Red/white (RD/VT).
Pin 12	When earthed, fixed pulse ratio of 60%. Yellow/red (GL/RD).
Pin 11	When earthed, fixed pulse ratio of 92% minimum. Red (RD).
Pin 16	Earthing point. Black/white (SV/VT).
Pin 5	Earthing point. Brown (BR).

Fuel-booster pressure switch

With the car being driven at a steady speed, the depression on either side of the diaphragm is equal. During acceleration, the depression weakens, and because of the restriction the pressure change below the diaphragm is delayed. The momentary increase in "absolute" pressure acting on top of the diaphragm pushes the diaphragm down, actuating the spring contact and making the circuit.



- | | |
|---------------|------------------------|
| 1 Diaphragm | 4 Spring contact |
| 2 Spring | 5 Vacuum inlet |
| 3 Restriction | 6 Electrical terminals |

Time relay P11**Time function of 3 s**

For a period of three seconds after starting, terminal 11 of the Lambda ECU is earthed, and a fixed pulse ratio of 92% is selected (fuel boost on starting).

Time function of 140 ± 20 s

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

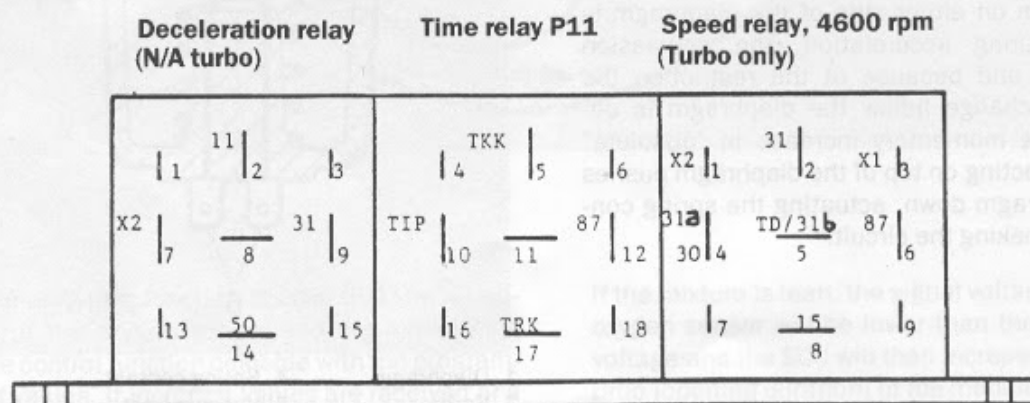
- 2 Cold engine (temperature below 45°C/113°F)

Fuel boosting during acceleration is available when the fuel-booster pressure switch (79) has been operated via the cold-start valve (94), which is earthed via thermostatic switch (97) and thermostatic time switch (92). An earthing signal is also available to terminal TKK in the relay.

- 3 Engine hot (at or above 45°C/113°F)

Fuel boosting during acceleration is available for 140 seconds if the fuel-booster pressure switch (79) has operated. There will be no earthing signal to terminal TKK via thermostatic switch (97) and thermostatic time switch (92).

Terminal TIP is energized, providing an earthing signal to terminal 11 of the Lambda ECU, resulting in a pulse ratio of 92% being selected.

**Relay P11 terminal pins**

Pin 87	+ 12 V supply when fuel pump relay 102 operating.
Pin TIP	+ 12 V supply via terminal + 54 when vacuum switch operating.
Pin TKK	Earthing via cold-start valve 94, thermostatic switch 97 and thermostatic time switch 92.

Pin 50	+ 12 V supply when starter motor running.
Pin 31	Earth
Pin 11	Earthed when above functions operating (period limited to 140 s).
Pin X2	Same as pin 11 (not connected)
Pin TRK	Earthed via throttle-position sensor (not connected).

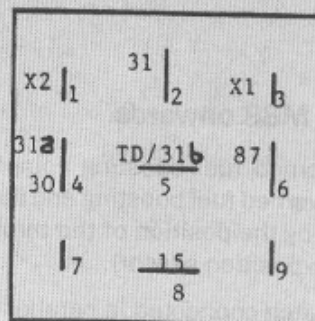
Deceleration relay, normally aspirated engines

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 (113°F) or, alternatively, during a 140-second period after starting.

When the accelerator is released, earthing is made via terminal 1 (idling position) in the throttle-position sensor to terminal 30 in the deceleration relay (105), thereby providing a signal from terminal 87 to the fuel shut-off valve (260). There is also a signal from terminal X1 to terminal 12 in the Lambda ECU, and a pulse ratio of 60% is therefore selected (to compensate for the weaker mixture sensed by the oxygen sensor).

Terminal pins

- Pin 15 +12V supply when fuel pump relay 102 operating.
- Pin TD Ignition pulses from terminal TD-0 in ignition pulse amplifier 147.
- Pin 30 Earthing via terminals X2 and 31 in time relay 106.
- Pin 31 Earth.
- Pin X1 Earths terminal 12 in Lambda ECU subject to above functions operating, 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 once the engine speed has fallen below 1375 rpm.
- Pin 87 Earthing of fuel shut-off valve 260 via terminal X1.
- Pin X2 Earthing via time relay terminals X2 and 11.



Deceleration relay (normally aspirated engine)

Speed relay (speed-governed fuel boosting, Turbo only)

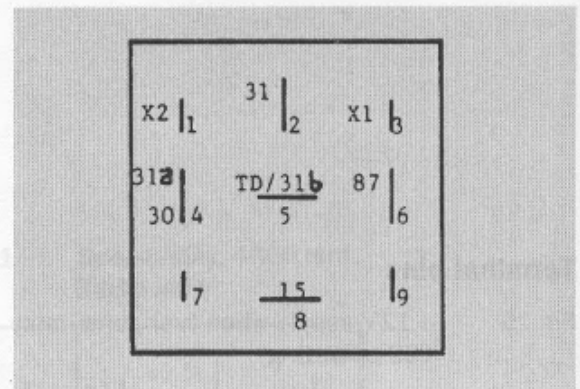
Speed-governed fuel boosting takes place at engine speeds above 3800 rpm (M88 onwards: 4600 rpm). Pulse ratio 85% or 92%.

At engine speeds above 3800 rpm (M88 onwards: 4600 rpm) and before the throttle butterfly has passed the 72° position, there is a signal from terminal 1 in the throttle-position sensor to terminal 31A in the speed relay (138). Thus, terminal 7 in the Lambda ECU is earthed via terminal 87 in the relay, and terminal 31 in the speed relay is earthed via terminal 31 in time relay (106), resulting in a pulse ratio of 85% being selected.

If the throttle butterfly passes the 72° position, the circuit to terminal 31A in the speed relay is broken, terminal 11 in the Lambda ECU is earthed via terminal 3 in the throttle-position sensor (203), terminal TK in the AC relay (156) and terminal 11 in the time relay (106), and a pulse ratio of 92% is selected.

Speed relay (138) terminal pins (Turbo only)

Pin TD	Ignition pulses from terminal TD-0 in ignition pulse amplifier 147.
Pin 15	+12 V supply via terminal +54.
Pin 31A	Earthed via throttle-position sensor 203.
Pin 87	Earth for terminal 7 of Lambda ECU via terminal 31 in time relay 106.

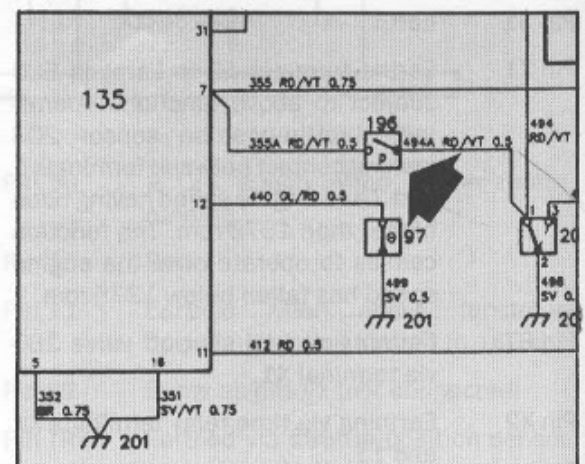


Speed relay 3800 rpm (M88 onwards: 4600 rpm), Turbo only.

Turbo cars, M88 onwards

Pressure-governed fuel boosting complements the speed-governed fuel boosting and the boosting governed by the position of the throttle butterfly (throttle-position sensor).

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 (3.6 and 4.4 psi), the pressure switch closes, earthing ECU pin 7 and providing fuel boosting (fixed pulse ratio of 85%).



Electrical system - principle of operation

CI system

When the ignition key is turned to the starting position, current (+50) flows to the starter motor (4) and thermostatic time switch (92).

If the engine is cold (i.e. coolant temperature below 45°C/113°F), thermostatic time switch (92) makes the circuit. The cold-start valve (94), which receives current from terminal 16 on the starter motor, is then earthed. The valve is thus open and the engine receives a boosted supply of fuel while the starter motor is running (up to a maximum of 9 seconds).

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

Ignition pulses are sent from the ignition pulse amplifier (147) to the fuel pump relay and the Lambda system. If the engine stops the pulses cease, the relay is de-energized and the power supply to the fuel system is cut off.

Oxygen-sensor regulated system (Lambda)

The Lambda system itself incorporates an oxygen sensor (136), which provides continuous data to the ECU (135) on the amount of oxygen in the exhaust gases. On the basis of this and the data the ECU receives from the other sensors and relays, modulating valve (139) regulates the amount of fuel injected. (The modulating valve is operated by earthing of terminal 15.)

ECU (135) and relays (105) and (106) receive power from terminal 87 in relay (102).

During the starting phase, relay (106), which receives control voltage (+50) when the ignition switch (20) is in the start position, boosts the supply of fuel via the ECU and modulating valve (139).

Thermostatic switch (97) senses the engine temperature and opens when the temperature is higher than 25°C (77°F), breaking the circuit to valve (94).

Fuel-booster switch (79) is used to control fuel boosting during acceleration. When the engine is cold, the switch opens the cold-start valve (94). When the engine is hot, a signal is sent instead to time relay (106), which boosts the supply of fuel via the ECU (the relay operates for a maximum of 140 ± 20 s after starting).

Thermostatic switch (97) breaks the circuit to cold-start valve (94) when the engine temperature is higher than 25°C (77°F). The switch is located in the engine compartment.

Socket (45) is connected to the cold-start valve (94) and the cold-start valve (94) is connected to the cold-start valve (94). The cold-start valve (94) is connected to the cold-start valve (94).

144 Pre-accr switch
Being lower dash panel to the left of the steering wheel (behind bumper only)

147 Ignition pulse amplifier
On power distribution panel on LH wing in engine compartment

152A 29-pin connector (white)
152B 29-pin connector (black)

On power distribution panel in engine compartment

154 AC compressor relay
On power distribution panel on LH wing in engine compartment

155 Distribution terminal block, negative (-)
159 Distribution terminal block, positive (+)

160 On power distribution panel on LH wing in engine compartment

201 Engine earthing point
203 Throttle position sensor

On throttle housing

260 Fuel shut-off solenoid valve (Lambda)
On rubber socket connector on top of air cleaner

240-46 Fuel injection system

Speed relay (105), together with the solenoid valve (260) and throttle-position sensor (203), is used for fuel shut-off during engine overrun. When the accelerator pedal is released, the throttle-position sensor earths relay (105). This function is also operative if the engine speed exceeds approx. 1375 rpm. Note that this relay is fitted to manual cars only.

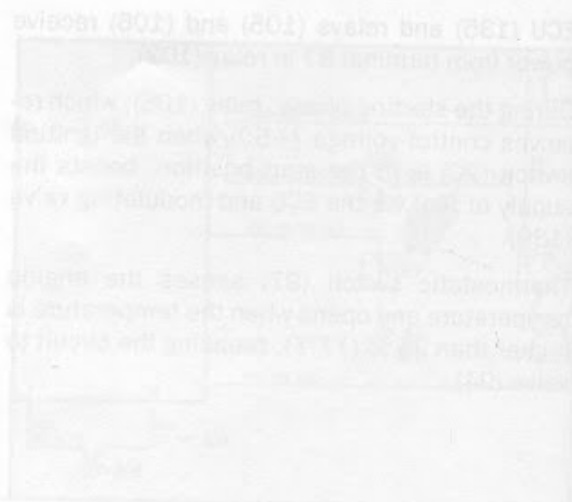
Thermostatic switch (99) breaks at 45°C (113°F) and makes at 38°C (100°F). The switch helps to improve the fuel-boosting function.

Socket (120) is provided for the connection of special measuring instruments and is used when the pulse ratio is being set. The socket receives power when the ignition switch is in the drive position.

Turbo cars, MBE onwards

Pressure-governed fuel boosting supplements the speed-governed fuel boosting and the pressure-governed fuel boosting is controlled by the throttle position sensor (203).

A pressure switch connected in parallel with the speed relay senses the pressure in the fuel line. When the pressure is raised to approx. 0.25 bar (3.6 psi) the pressure switch closes, sending ECU pin 7 and providing fuel-boosting pulse ratio of 85%.



Component locations

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

- 4 Starter motor
On LH (induction) side of engine
- 7 Earthing point on radiator member
- 9 Earthing point in luggage compartment
- 20 Ignition switch
On centre console between front seats
- 22A Fuse holder
On power distribution panel on top of LH wing inside engine compartment
- 59 Two-pin connector
One on power distribution panel on LH wing in engine compartment
One in luggage compartment adjacent to fuel pumps
One socket (120) on LH wing in engine compartment
- 60 Single-pin connector
One on power distribution panel on LH wing in engine compartment
One on RH wing inside engine compartment
- 77 Starter-interlock switch (automatics only)
Underneath centre console, adjacent to selector lever
- 79 Fuel-booster pressure switch
On inside of LH tie-plate adjacent to fuel filter in engine compartment
- 92 Thermostatic time switch
On coolant thermostat
- 94 Cold-start valve
On throttle housing
- 95 Auxiliary air valve
Adjacent to thermostat at front of engine
- 96 Warm-up regulator
Adjacent to thermostat 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
On power distribution panel on LH wing in engine compartment
- 103 Fuel pump
Inside fuel tank under luggage compartment floor
- 105 Deceleration relay (900i only)
Behind trim forward of RH front door

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

- 106 Time relay
Behind trim forward of RH front door
- 135 ECU (Lambda)
On RH side underneath rear seat
- 136 Oxygen sensor
On exhaust manifold
- 138 Speed relay (manual turbos only)
Behind trim forward of RH front door
- 139 Modulating valve (Lambda)
On inside of LH tie-plate in engine compartment
- 144 Pressure switch
Behind lower dash panel to the left of the steering wheel (behind flasher unit)
- 147 Ignition pulse amplifier
On power distribution panel on LH wing in engine compartment
- 152A 29-pin connector (white)
- 152C 29-pin connector (black)
On power distribution panel in engine compartment
- 156 AC compressor relay
On power distribution panel on LH wing in engine compartment
- 158 Distribution terminal block, negative (-)
- 159 Distribution terminal block, positive (+ 15)
On power distribution panel on LH wing in engine compartment
- 201 Engine earthing point
- 203 Throttle-position sensor
On throttle housing
- 260 Fuel shut-off solenoid valve (Lambda)
On rubber socket connector on top of air cleaner

Checking

General

- 1 Connect pulse meter 83 93 597.
- 2 Turn the ignition key to the drive position. The reading on the pulse meter should be 100%. The modulating valve and fuel pump should start and run for a short time.
- 3 Start the engine.
 - a) Cold engine ($< 19^{\circ}\text{C}/66^{\circ}\text{F}$):
The needle on the pulse meter should first indicate 0%, move to 90% and then, after about three seconds, indicate a **steady pulse ratio** of 60%.
 - b) Hot engine:
The needle on the pulse meter should first indicate 0%, move to 90% and then, after about three seconds, indicate a **fluctuating pulse ratio** of approx. 50%.
- 4 Checking the fuel boosting at full load: (Turbo cars):
 - a) Rev the engine up to a speed exceeding 3850 rpm and check that the reading on the pulse meter is 85%.
 - b) Actuate the throttle-position sensor (move butterfly). The pulse meter should now indicate 92%.

Checking the Lambda system

- 1 Connect pulse meter 83 93 597.
- 2 Let the engine idle.
- 3 Unplug the oxygen-sensor loom from the main wiring loom (on RH wing in engine compartment).
- 4 Earth the signal lead to the ECU. The pulse meter should now indicate 92%.
- 5 Hold the signal lead in your left hand and grip the positive (+) terminal pole on the battery with the other. The reading on the meter should now fall to 0%.

Checking the signal level from the oxygen sensor

Connect a multimeter between the signal lead from the oxygen sensor and earth. If the sensor is sound, the reading on the meter should be between 0.1 and 1.0 V, depending on the temperature and oxygen content in the exhaust.

Component locations

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

4	Starter motor
5	On LH production side of engine
7	Earthing point on radiator manifold
9	Earthing point in luggage compartment
20	Ignition switch
	On centre console between front seats
32A	Fuse holder
	On power distribution panel on top of LH
	Wing inside engine compartment
35	Two-pin connector
	On power distribution panel on LH
	Wing in engine compartment
	One in luggage compartment adjacent to fuel pump
	One socket (120) on LH wing in engine compartment
60	Single-pin connector
	On power distribution panel on LH
	Wing in engine compartment
	One on RH wing inside engine compartment
77	Starter-interlock switch (automatic only)
	Underneath centre console, adjacent to selector lever
78	Fuel booster pressure switch
	On inside of LH tie-plate adjacent to fuel filter in engine compartment
82	Thermostatic time switch
	On coolant thermostat
84	Cold-start valve
	On throttle housing
85	Auxiliary air valve
	Adjacent to thermostat at front of engine
86	Warm-up regulator
	Adjacent to thermostat at front of engine
87	Thermostatic switch, 48°C (Lambda)
	On inlet manifold
88	Thermostatic switch, 35°C (Lambda)
	On thermostat housing
100	Diode (Lambda)
	Adjacent to deceleration relay (105) and time relay (106)
102	Fuel pump relay
	On power distribution panel on LH wing in engine compartment
103	Fuel pump
	Inside fuel tank under luggage compartment floor
105	Deceleration relay (800 only)
	Behind trim forward of RH front foot

Fault diagnosis using the LH-system tester

Make absolutely certain that you refer to the appropriate wiring diagram for the variant concerned, i.e. (900/9000, model year and LH-system generation (2.2/2.4)).

The tester uses the following error codes for the LH 2.2 (25-pin connector)

Error Code	Pin No.	Malfunction indicated	Action - see page
E001	1	Ignition pulse at pin 1 absent	28
E101	1	Starter motor revs too low	28
E002	2	Temperature sensor signal absent	28
E102	2	Temperature sensor circuit shorting out	28
E003	3	Idling contacts constantly open	29
E103	3	Idling contacts constantly closed	29
E005	5	ECU pin 5 not earthing	29
E006	6	Air mass meter not earthing	30
E007	7	Air mass meter signal absent	30
E107	7	Air mass meter signal too high	30
E207	7	Air mass meter signal too low	30
E008	8	Air mass meter burn-off function absent	31
E108	8	Air mass meter burn-off function constantly energized	31
E009	9	System relay 12 V supply absent	31
E109	9	System relay 12 V supply too low	31
E010	10	Signal from AIC valve pin 10 absent	32
E011	11	ECU pin 11 not earthing	32
E012	12	Full-throttle contacts constantly open	32
E112	12	Full-throttle contacts constantly closed	33
E013	13	Injection pulses absent	33
E113	13	Injection pulses erratic	33
E014	14	Air mass meter: break in CO-adjusting circuit	34
E017	17	Pump relay control circuit faulty	34
E018	18	15 V supply absent	34
E020	20	Oxygen (Lambda) sensor signal absent	35
E120	20	Oxygen (Lambda) sensor signal too low	35
E220	20	Oxygen (Lambda) sensor signal too high	36
E021	21	System relay control circuit faulty	36
E023	23	Signal from AIC valve pin 23 absent	37
AIC0	23	AIC valve pulse ratio faulty	37
E024	24	Load signal absent	37
E025	25	ECU pin 25 not earthing	37

The following codes may also appear on the display:

GLOU	(Glow) Air mass meter filament burn-off function operating
C1	Turbo
C2	Turbo with AIC
C3	Turbo with AIC and catalytic converter
C4	Turbo with AIC and Saab DI
C5	Non-turbo with AIC
FPU	Fuel pump relay and system relay operating
FUEL	Fuel mode
OFF	Starting point for injection valve test
FIn	Injection valves open
MON	Monitor mode

Fault diagnosis

Prior to starting work

Many so-called fuel injection faults can be traced to other unrelated engine or electrical faults. Before starting fault diagnosis work on the LH system, check the following first:

- Battery condition
- Charging system
- Ignition system (timing, plugs, HT leads, distributor cap and rotor, etc.)
- Battery connections and earthing points
- Engine condition (compression, inlet manifold vacuum, etc.)
- Air leaks in the turbo/induction system

It is often advisable to perform a quick check on the system and pump relays as follows:

- 1 Unplug the connectors from the LH-system ECU and the air mass meter.
- 2 Remove the cover from the connector on the loom to the LH ECU.
- 3 Connect pins 17 and 21 to earth via pin 25.
- 4 Check that voltage is reaching the following:
Pins 9 and 13 (loom connector for LH ECU)
Pin 2 or 5 (loom connector for air mass meter - 9000i M88)
Fuse 14 (fuel pump relay)

General procedure for fault-diagnosis work

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/short circuiting.

Be alert to the possibility of interference from components connected to the wiring concerned and check that the wiring is in good condition and not causing defective earthing.

Make absolutely certain that you refer to the appropriate wiring diagram for the variant concerned, i.e. 900/9000, model year and LH-system generation (2.2/2.4).

Error codes given in brackets on the fault-diagnosis charts denote that the faults concerned are attributable to the primary fault.

Fault-diagnosis chart: LH 2.2

Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction indicated	Action
E001 (E010) (E017)	1	Ignition pulse absent	A Check ignition system. B Check the wiring between ECU pin 1 and: M85 onwards: pin 1 of ignition coil (5) M86 onwards (Turbo): pin TD-0 on ignition pulse amplifier (147) M88 onwards, 9000i/9000S: pin 17 of ECU for EZK (176) M88 (Turbo): pin 7 of amplifier (147) C Fit a new ECU for the LH system
E101		Starter motor revs too low N.B. engine temp > 10°C	A Check the battery voltage and capacity B Check the lead between the positive (+) pole of the battery and terminal 30 on the starter motor, and between the negative (-) pole of the battery and earthing point 7 and the earthing point on the engine C Check the starter motor
E002	2	Temperature sensor (NTC) signal absent	A Check the wiring between pin 2 of the ECU (200) and pin 1 of the temperature sensor (202), and between pin 2 of the temperature sensor (202) and earthing point (201) B Check for good earth connection at earthing point 201 C Check the temperature sensor (202) D Fit a new LH ECU
E102	2	Temperature sensor (NTC) circuit shorting out	See E002

Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction indicated	Action
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 damper (dashpot) - C Check setting and operation of throttle-position sensor - D Check the wiring between pin 3 of the ECU (200) and pin 1 of the throttle-position sensor - E Check the wiring between pin 2 on the throttle-position sensor (203) and earthing point 201 - F Check for good earth through engine earthing point (201)
E103	3	Throttle-position sensor (203) contacts constantly closed (when revs increased from idling to 2500 rpm)	- A Check the setting and operation of the throttle position sensor - B Check the wiring between pin 3 of the ECU (200) and pin 1 of the throttle position sensor (203) - C 900i/900S: Check the wiring between pin 3 of the ECU (200) and pin 7 of the EZK ECU (176) via connector 57 - D Check the EZK ignition system
E005	5	Pin 5 of ECU (200) not earthing	- A Check the wiring between pin 5 of the ECU (200) and earthing point 201 - B Check for good earth through engine earthing point (201)

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Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction indicated	Action
E006	6	Air mass meter (205) not earthing	A Check the wiring between pin 3 of the air mass meter (205) and: M88 onwards (non-Turbo): pin 2 and earthing point 201 B Check the wiring between pin 4 on the air mass meter (205) and engine earthing point 201. Check for good earth at earthing point C Fit a new air mass meter (205)
E007	7	Air mass meter (205) signal absent	A Check the wiring between pin 7 of the ECU (200) and pin 5 on the air mass meter (205) B Check the wiring between engine earthing point 201 and pin 4 on the ECU (200) C Fit a new air mass meter (205)
E107	7	Air mass meter (205) signal too high	A Check the wiring between pin 7 of the ECU (200) and pin 5 (M88 9000i onwards: pin 3) on the air mass meter (205) B Check by eye that filament burn-off function takes place C Fit a new air mass meter (205)
E207	7	Air mass meter (205) signal too low	See E107

Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction indicated	Action
E008	8	Air mass meter (205) burn-off function absent	A Repeat the test. Rev the engine above 2500 rpm for at least two seconds (SET 2500 RPM) B Check the wiring between pin 8 on the ECU (200) and pin 1 on the air mass meter (205) C Fit a new LH ECU (200)
E108	8	Air mass meter (205) burn-off function constantly energized	A Check the wiring between pin 8 of the ECU (200) and pin 1 (M88 onwards: pin 4) of the air mass meter (205) B Fit a new LH ECU (200)
E009	9	System relay 12 V supply absent	A Check for 12 V supply at +30 terminal on power distribution panel 230 B Check the wiring between +30 terminal on the power distribution panel (230) and pin 30 of system relay 229 C Check the wiring between pin 87 on the system relay (229) and pin 9 of the ECU (200) D Check the wiring between pins 30 and 86 on the system relay (229) E Fit a new system relay (229)
E109	9	System relay 12 V supply too low	A Check that battery voltage at connector 75 is at least 10 V B Check the wiring between connector 75 and pin 30 on the system relay (229) C Check the wiring between pin 87 on the system relay (229) and pin 9 on the ECU (200) D Fit a new system relay (229)

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Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction indicated	Action
E010	10	Signal from AIC valve pin 10 absent	A Check the wiring between pin 1 on the AIC valve (272) and pin 10 on the ECU (200) B Check for 12 V supply at pin 2 on the AIC valve (272) (with ignition switched on) C Check the wiring between pin 2 on the AIC valve (272) and pin 87 on the pump relay (102) D Check the wiring between pin 30 on the pump relay (102) and the +30 supply terminal (230) E Fit a new pump relay F Fit a new AIC valve (272) G Fit a new ECU
E011	11	LH ECU (200) not earthing	A Check the wiring between pin 11 on the ECU (200) and earthing point 201 B Check for good earth at earthing point (201) on engine
E012	12	Throttle-position sensor (203) full-throttle contacts constantly open	A Check function by flooring accelerator on command from LH-system tester. Check display to see whether butterfly open B Check setting and operation of throttle-position sensor C Check wiring between pin 12 on the ECU (200) and pin 3 on the throttle-position sensor (203) D Check the wiring between pin 2 on the throttle-position sensor (203) and earthing point 201 E Check for good earth at earthing point on engine (201)

Error Code	Continuity break or shorting in circuit to ECU 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 Cars with AIC: Check the wiring between pin 12 on the ECU (200) and pin 3 on the throttle-position sensor (203) D Check for good earth at connector 60 E Check the wiring between connector 60 and pin 12 on the ECU (200) F Check the wiring between pin 12 of the ECU (200) and terminal TK on the AC relay (156) H Check that the AC relay (156) is not earthing
E013	13	Pulses to injection valves (206) absent	A Check the wiring between pin 13 on the ECU (200) and pin 2 on the injection valves (206) B Check the wiring between pin 1 on the injection valves (206) and pin 87 on the pump relay (102) C Check that 12 V supply is present at pin 30 on the pump relay (102) D Fit a new pump relay (102) E Fit a new LH ECU
E113	13	Injection pulses erratic	See E013

Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction indicated	Action
E014	14	Air mass meter: break in CO-adjusting circuit	A Check the wiring between pin 14 on the ECU (200) and pin 6 on the air mass meter (205) B Fit a new air mass meter (205)
E017	17	Pump relay (102) control circuit faulty	A Check the wiring between pin 17 on the ECU (200) and pin 85 on the pump relay (102) B Check the wiring between pin 86 on the pump relay (102) and pin 87 on the system relay (229) (Turbo: via pressure switch 144) C Check the wiring between pin 30 on the system relay (229) and the +30 supply terminal (230) D Fit a new fuel pump relay (102) E Fit a new system relay (229) F Fit a new LH ECU
E018	18	15 V supply absent	A Check the wiring between pin 18 on the ECU (200) and the power distribution panel (159) B Check that 12 V supply is available at the power distribution panel (159) when the ignition is on
E020	20	Oxygen (Lambda) sensor (136) signal absent	A Check the wiring between pin 20 on the ECU (200) and connector 60 B Check the wiring between pin 5 on the ECU (200) and the braid on the signal lead C Fit a new oxygen (Lambda) sensor

Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction Indicated	Action
E120	20	Oxygen (Lambda) sensor (136) signal too low	- A Set the Lambda system to the correct value - B Check the voltage across the oxygen sensor between connector 60 and earth - C Check that 12 V supply is present between pins 1 and 2 on connector 59 - D Check the wiring between pin 5 on the ECU (200) and the braid on the signal lead - E Check the oxygen sensor preheating (136) - F Check the fuel pressure (line pressure) - G Check for air leakage in the induction system - H Check for air leaks in the exhaust system between the engine and the oxygen sensor - I Check the operation and delivery flow of the injection valves - J Fit a new oxygen sensor - K Fit a new LH ECU (200)
E220	20	Oxygen (Lambda) sensor (136) signal too high	- A Set the Lambda system to the correct value - B Check the voltage across the oxygen sensor between connector 60 and earth - C Check that 12 V supply is present between pins 1 and 2 on connector 59 - D Check the oxygen sensor preheating (136) - E Check the fuel pressure (line pressure) - G Check the operation and delivery flow of the injection valves - H Fit a new oxygen sensor - I Fit a new LH ECU (200)
E021	21	System relay (229) control circuit faulty	- A Check that battery voltage (12 V) is present at terminal +30 on the power distribution panel (230) - B Check the wiring between terminal +30 on the power distribution panel (230) and pin 86 on the system relay (229) - C Check the wiring between pin 85 on the system relay (229) and pin 21 on the ECU (200) - D Fit a new system relay (229) - E Fit a new LH ECU

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Error Code	Continuity break or shorting in circuit to ECU pin no.:	Malfunction indicated	Action
E023	23	Signal from AIC valve pin 23 absent	A Check the wiring between pin 3 on the AIC valve (272) and pin 23 on the ECU (200) B Check that battery voltage (12 V) is present at pin 2 on the AIC valve (with ignition on) C Check the wiring between pin 2 on the AIC valve (272) and pin 87 on the pump relay (102) D Check the wiring between pin 30 on the pump relay (102) and terminal +30 on the power distribution panel (230) E Fit a new pump relay F Fit a new AIC valve (204) G Fit a new LH ECU
AIC0	23	AIC valve pulse ratio faulty	A Set the AIC system to the correct value
E024	24	Engine load signal to EZK absent (non-Turbo)	A Check the wiring between pin 24 on the LH ECU (200) and pin 8 on the EZK ECU (176) B Fit a new LH ECU (200)
E025	25	ECU pin 25 not earthing	A Check the wiring between pin 25 on the ECU (200) and earthing point 201 B Check for good earth at engine earthing point (201)

Fault diagnosis

Key to quick-reference table

To replace

E1	= System relay	See page 240-113
E2	= Pump relay	See page 240-113
E3	= Pressure switch	
E4	= Temperature sensor (NTC resistor)	See page 240-113
E5	= Throttle-position sensor	See page 240-114
E6	= Injection valves	See page 240-114
E7	= Air mass meter	See page 240-116
E7A	= Filament, air mass meter	
E7B	= Filament burn-off	
E7C	= CO content, %	
E7D	= Fuel system basic setting (cars with catalytic converter)	
E8	= Electronic control unit (ECU)	See page 240-113
E8A	= Input signals to ECU	
E8B	= Signals from ECU to injection valves	
E8C	= Fuel shut-off on starting	
E8D	= Enrichment	
E8E	= Warm-up period	
E9	= AC compressor	
E10	= Oxygen (Lambda) sensor	
B1	= Fuel system	Fuel injection manifold: see page 240-114 Fuel filter: see page 240-116
B1A	= System pressure	
B1B	= Fuel pressure regulator	See page 240-117
B1C	= Residual pressure	
B1D	= Delivery pressure of fuel pump	
B1E	= Delivery flow of fuel pump	
I1	= Leakage in the induction system	
I2	= Auxiliary air valve	See page 240-117
M1	= Basic setting of throttle butterfly	
M1A	= Setting the idling speed (N/A cars with catalytic converter)	
M1B	= Setting the idling speed (cars with catalytic converter)	
E	= Electrical	
B	= Fuel	
I	= Induction	
M	= Mechanical: removal and fitting of components	

Fault symptom

- 1 Engine fails to start
- 2 Engine starts but stops immediately
- 3 Erratic idling
- 4 Poor response on acceleration
- 5 Engine erratic in all speed ranges
- 6 Excessive fuel consumption
- 7 Engine fails to rev up (no power)
- 8 CO content too low
- 9 CO content too high

N.B.

Before starting to trace possible faults in the LH system, check that the engine, ignition and electrical system are adjusted in accordance with the specifications.

Example of "Test procedure": E1 = check the system relay, and so on.

Fault symptom	Possible cause	Check/Remedy	Test procedure
1 2 5	System relay or pump relay defective	Check the voltage	E1, E2
1	Fuel pump not running	Check the fuse for the fuel pump, the power supply the fuel relay and the pressure switch (Turbo)	B1, E1, E2, E3
1 2 3	Auxiliary air valve defective	Check operation of valve	I2
3	EGR valve defective	Check operation of the valve	
2 6	Defective throttle-position sensor/-enrichment function	Check by connecting an ohmmeter across terminals 3 and 18 on the throttle position sensor	E5
3 4 5 6 7 9	Air mass meter (HLM)	Check the filament, the burn-off function and that all 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, the filter, the fuel lines and the 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 for a pinched hose. Check the pressure regulator.	B1
4 5 7 8	Fuel capacity too low	Check capacity of fuel pump	B1D, B1E

N.B.

Faults that can be traced to items 4 and 5 may also be attributable to the limp-home function.

Fault symptom	Possible cause	Check/Remedy	Test procedure
1 2 3 4 5 6 7 8 9	Temperature sensor (NTC resistor)	Check using an ohm-meter	E4
6 7	Throttle butterfly failing to open/close completely	Check the throttle housing, the throttle-position sensor, spindle and cable	E5
1 2 3 4 5 6 7 8 9	Poor earthing or earth connection or connection wrongly wired	Check the earthing of the engine and battery	E8A
1 2 3 4 5 6 7 8 9	Broken cable or connector	Check the wiring and terminals and remedy as necessary	E8A
2 3 4 8	CO content too low	Check the idling speed and CO value as per specification. Check the resistance (ohm reading) of the air mass meter	E7C
2 3 4 6 9	CO content too high	Check the idling speed and CO value as per specification Check the resistance (ohm reading) of the air mass meter	E7C
1 2 3 4 5 6 7 8 9	Electronic control unit or input signals	Check all input signals and connections of the electronic control unit	E8A

1 Engine fails to start

System or component	Possible cause	Remedy
a. Electrical system	a. Low voltage, break in wiring, poor connection, faulty relay, pressure switch.	a. Check the battery voltage: minimum acceptable value, 11.5 V. Check system relay and pump relay E1, E2. Check for breaks, poor connections or corrosion in the wiring and terminals E8. Check the pressure switch (Turbo) E3.
b. Fuel pump	b. Fuel pump not working or poor capacity.	b. Check fuel pump operation: pressure capacity and flow. B1D, B1E.
c. Fuel system	c. Leakage, faulty fuel pressure regulator, blockage in return line.	c. Check for leakage in the fuel system B1. Check the line pressure B1. Check the fuel pressure regulator B1B.
d. Induction system	d. Air leakage	d. Check for air leakage in the induction system: downstream of throttle butterfly housing using pressure testing equipment; and visually between the air mass meter and the butterfly. I1.
e. Injection valves	e. Opening duration, leakage	e. Check the opening duration of the injection valves using a multimeter E6, E8B.
f. Temperature sensor (NTC resistor)	f. Not functioning, break in wiring, poor connection.	f. Check the temperature sensor using a multimeter E4.
g. Electronic control unit	g. Poor contact, no input signals, not functioning.	g. Check all input signals using a multimeter, E8 A.
h. Auxiliary air valve	h. Malfunction, leakage.	h. Check the auxiliary air using a multimeter I2.

2 Engine starts but stops immediately

System or component	Possible cause	Remedy
a. Electrical system	a. Low voltage, break in wiring, poor connection, faulty relay, pressure switch.	a. Check the battery voltage: minimum acceptable value, 11.5 V. Check the system relay and pump relay E1, E2. Check wiring and terminals E8. Check the pressure switch (Turbo) E3.
b. Temperature sensor (NTC resistor)	b. Not functioning, break in wiring, poor connection.	b. Check the temperature sensor using a multimeter E4.
c. Induction system	c. Air leakage	c. Check for air leakage in the induction system: downstream of throttle butterfly using pressure testing equipment; and visually between the air mass meter and the throttle butterfly I1.
d. Electronic control unit	d. Poor contact, no input signals.	d. Check all input signals using a multimeter E8A.
e. Auxiliary air valve	e. Malfunction, leakage.	e. Use a multimeter to check the auxiliary air valve/idling-control valve I2.
f. CO content too low or too high	f. Incorrect setting	f. Check the idling speed and CO content as per specification and check the resistance of the air mass meter E7C.
g. Idling system (cars with catalytic converter)	g. Incorrect setting	g. Check idling speed and pulse ratio against spec. Check resistance of air mass meter (E7D).
h. Throttle-position sensor	h. Incorrect setting or defective.	h. Refer to the section on checking of the throttle-position sensor E5.

3 Erratic idling

System or component	Possible cause	Remedy
a. Temperature sensor (NTC resistor)	a. Not functioning, break in wiring, poor connection.	a. Check the temperature sensor using multimeter E4.
b. Air mass meter/CO content	b. CO content set too high or too low. Broken filament.	b. Check the air mass meter - for insufficient or excessive CO content. Check that the filament is sound E7C.
c. Idling system (cars with catalytic	c. Incorrect setting	c. Check idling speed and pulse ratio against spec. Check resistance of air mass meter E7D
d. Induction system	d. Leakage	d. Check for air leakage in the induction system: using pressure testing equipment. Vacuum should be between -0.4 and -0.8 bar (1).
e. Injection valves	e. Opening duration, leakage	e. Check the opening duration and resistance of the injection valves using a multimeter E6, E8B.
f. Fuel system	f. Insufficient pressure.	f. Check fuel system line pressure and pressure-regulator function B1.
g. Electronic control unit	g. Poor connection, no input signals	g. Check all input signals using a multimeter E8A.
h. Auxiliary air valve	h. Malfunction, leakage	h. Check the auxiliary air valve I2.
i. Electrical system	i. Broken wiring or faulty connectors. Poor earthing.	i. Check the wiring and connections E8. Check the earth connections on the engine and battery.
j. EGR valve	j. Not functioning. Valve binding.	j. Check the EGR system (see Section 2:4, subsection 254, of the Service Manual).
k. Oxygen (Lambda) sensor	k. Poor contact. Resistance incorrect	k. Check the oxygen sensor E10

5 Engine runs erratically at all speeds

System or component	Possible cause	Remedy
a. Electronic control unit	a. Defective connection in connector.	a. Check terminals 9, 11, 13, 17 and 25 in the control unit for defective connections E8.
b. Electrical system	b. Alternator. Low voltage. Poor earthing.	b. Check the operation of the alternator (see section on electrical system) and the battery voltage E1, E2, E8.
c. Injection valves	c. Opening duration	c. Check the opening duration of the injection valves using a multimeter E6, E8B.
d. Turbo/APC	d. Malfunction	d. Check the operation of the Turbo (see Turbo section). Check the operation of the APC (see APC section).
e. Throttle-position sensor	e. Incorrectly adjusted, butterfly binding	e. Check the throttle-position sensor using a multimeter, that the microswitch is correctly adjusted and the butterfly is not sticking E5.
f. Airmass meter	f. Burn-off function not working, broken filament.	f. Check the filament and that the burn-off function is working E7.
g. Induction system	g. Air leakage.	g. Check for air leakage in the induction system: downstream of throttle butterfly using pressure testing equipment; and visually between the air mass meter and throttle butterfly.
h. Fuel system	h. Insufficient or no fuel pressure. Poor capacity.	h. Check the line pressure in the fuel system B1.
i. Temperature sensor (NTC resistor)	i. Not functioning, break in wiring, poor connection.	i. Check the temperature sensor using a multimeter E4.
j. Oxygen (Lambda) sensor	j. Poor contact. Resistance incorrect	j. Check the oxygen sensor E10

7 Engine fails to rev up (no power)

System or component	Possible cause	Remedy
a. Induction system	a. Leakage	a. Check for air leakage in the induction system using pressure testing equipment I1.
b. Throttle butterfly	b. Incorrectly adjusted	b. Check that the butterfly opens fully E5.
c. Fuel system	c. Insufficient flow/low voltage	c. Check the flow from the fuel pump B1E. Check pump power supply (11.5V minimum) B1E.
d. Injection valves	d. Malfunctioning	d. Check the injection valves by disconnecting the leads, one at a time, which should cause the engine speed to drop noticeably E6, E8B.
e. Air mass meter	e. Burn-off function not working. Broken filament.	e. Check the filament and that the burn-off function is working E7.
f. Turbo/APC	f. Malfunctioning.	f. Check the operation of the Turbo (see Turbo section). Check the operation of the APC (see APC section).
g. Temperature sensor (NTC resistor)	g. Not functioning, break in wiring, poor connection.	g. Check the temperature sensor using a multimeter E4.
h. Electrical system	h. Broken wires or connections. Poor earthing or earth contacts.	h. Check the wiring and connections E8. Check the earth connections on the engine and battery.
i. Electronic control unit	i. Poor connections, no input signals or signals weak.	i. Check all input signals using a multimeter E8.

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8 & 9 CO content too low or too high

System or component	Possible cause	Remedy
a. Induction system	a. Leakage	a. Check for air leakage in the induction system using pressure testing equipment I1.
b. Fuel system	b. Leakage, defective fuel pressure regulator, blockage in return line/insufficient flow.	b. Check the line pressure B1. Check the fuel pressure regulator by slowly pinching the return line B1B. Check the flow B1D, B1E.
c. Air mass meter	c. Burn-off function not working, broken filament.	c. Check the filament and that the burn-off function is working E7.
d. Temperature sensor (NTCresistor)	d. Not functioning	d. Check the temperature sensor using a multimeter E4.
e. Electrical system	e. Broken wires or connections. Poor earthing or earth contacts.	e. Check the wiring and connections E8. Check the earth connections on the engine and battery.
f. Electronic control unit	f. Poor connections, no input signals or signals weak.	f. Check all input signals using a multimeter E8.
g. EGR valve	g. Not functioning. Valve binding.	g. Check the EGR system (see Section 2:4, subsection 254, of the Service Manual).

Checking/fault diagnosis LH injection system

A special tester unit for the LH system that appreciably simplifies servicing and fault-diagnosis work is available:

LH-system tester	83 94 223
Service Manual supplement	40 17 11 (GB) 40 17 78 (US)

For fault diagnosis using the LH-system tester, see page 240-60.

B1 Checking the fuel system

Tools: LH fuel pressure gauge equipment 83 93 852
Test hose for return flow
Graduated beaker, 2 l (0.5 USgal)
Jumper lead with switch 83 93 886
Cooling system pressure tester and hose
Vacuum pump
Pressure gauge 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 and switch between fuse No. 30 and fuse No. 27, 28 or 29, to provide current to the fuel pump.

Make sure 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 the specified value (see Section 0, Technical data).

Line pressure too high:

Stop the fuel pump by moving the switch to **OFF**. Disconnect the return line from the fuel

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pressure regulator and blow through the line.

If the line is open:

Change the fuel pressure regulator.

If the line is blocked:

Unblock it or fit a new return line. Check the one-way valve at the tank.

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 next section).

B1B Checking the fuel pressure regulator

- 1 Connect pressure gauge 8393514 to the inlet and outlet on the fuel pressure regulator. Tie up the pressure gauge so that it hangs vertically to obviate reading errors. Connect either the cooling system pressure tester or the vacuum pump to the pressure gauge (8393514).
- 2 Start the fuel pump by moving the switch to **ON**. The line pressure should now rise to the specified value (see Section 0, Technical data).

Use a vacuum pump to raise a vacuum in the fuel pressure regulator. The amount by which the line pressure drops should now correspond to the movement of the needle on the pressure gauge (see Section 0).

Use the cooling system tester to raise the pressure in the fuel pressure regulator. The amount by which the line pressure rises should now correspond to the movement of the needle on the pressure gauge (see Section 0).

B1C Checking the residual pressure

Start the fuel pump by setting the switch to **ON**. Read off the line pressure. For correct value, see Section 0, Technical data.

Stop the fuel pump by setting the switch to **OFF**. The pressure should immediately drop by 0.1-0.2 bar (1.5-2.9 psi). If the drop in the residual pressure during 10 minutes is greater than this, check for leakage in the pressure regulator and the fuel pump non-return valve. Check the pressure and flow delivered by the fuel pump.

B1D Checking the fuel pump delivery pressure

Start the pump by setting the switch to **ON**. Pinch closed the return line momentarily.

Caution

The pressure must not exceed 6.0 bar (83 psi).

There should be an immediate, marked rise in the line pressure.

Insufficient delivery pressure:

- Check that the voltage across the fuel pump terminals is at least 11.5 V.

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- Check for pinched or blocked fuel lines.
- Check that the fuel filter is not clogged.

N.B.

If the fuel filter has been fitted the wrong way round, it cannot be refitted but must be replaced by a new one.

- Check the relief valve in the pump. If defective, fit a new pump.

B1E Checking the delivery flow from the fuel pump

- 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 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 (this should be at least 0.9 l 0.95 liq qt).
- 4 If the pressure drops by more than 0.1-0.2 bar (1.5-2.9 psi) and the delivery flow is adequate, fit a new fuel pressure regulator.
- 5 If the delivery pressure from the fuel pump is incorrect, perform the checks detailed in section B1D.

Checking the electrical system

Quick check of the system relay E1 and fuel pump relay E2

- 1 Unplug the electronic control unit and the air mass meter connectors.
- 2 Connect terminals 17 and 21 of the control unit connector to earth.
- 3 Check that current is present at:
 - The test socket
 - Pin 9 of the ECU connector
 - Pin 2 of the air mass meter connector
 - Fuse 14

If current is present in these components, the system relay, fuel pump relay and associated circuitry are sound.

If not, follow the steps detailed in Sections E1 and E2.

To remove the system relay/fuel pump relay

The relay is located on the right-hand wheel arch.

- 1 Unscrew and remove the sill scuff plate.
- 2 Remove the weatherstrip from the front door pillar. Unscrew the anchor plate for the carpet from 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.

E1 Checking the system relay

Tools: Multimeter

Jumper lead with crocodile clips
8393894

- 1 Unplug the ECU and the air mass meter connectors. Peel back the cover from the ECU connector. All readings should be made at the back of the connector. Check that pin 11 of the connector is earthed.
- 2 Switch on the ignition.
- 3 Use the jumper lead to connect pin 21 (yellow/white; GL/VT) on the ECU connector to earth. Check that the relay is operating by checking for current between pin 9 (brown/white; BR/VT) and pin 11 (black; SV) on the ECU connector.

If no voltage is present, gain access to the relay by removing the sill scuff plate, the weatherstrip and the carpet.

Check for voltage across pin 30 (red; RD) on the relay and earth and across pin 86 (red; RD) and earth.

If not, check the leads 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 the jumper lead to connect pin 85 (yellow/white; GL/VT) to earth. Check that voltage is present at relay pin 87 (brown/white; BR/VT) and 87B (brown/white; BR/VT). If no voltage is present, fit a new relay.

If voltage is present, using the jumper lead check the brown/white (BR/VT) lead from relay pin 87 to ECU connector pin 9, the black (SV) lead from ECU pin 11 to earth, and the yellow/white (GL/VT) lead from ECU pin 21 to relay pin 85.

Check for voltage at pin 2 (brown/white; BR/VT) on the air mass meter. If dead, check the lead from pin 87B of the system relay.

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 no. 30. Connect jumper lead 83 93 886 between fuse no. 30 and fuse no. 27, 28 or 29, to supply power to the fuel pump. Make sure that the switch is set to **OFF**.

- 1 Unplug the connectors from the ECU, air mass meter and auxiliary air valve.
 - 2 Connect jumper lead 83 93 894 between pins 17 and 25 of the ECU connector.
 - 3 Check whether the relay is operating by checking for voltage between the grey/red (GR/RD) Limp-home pin on the connector (by the wiring loom on the RH wheel arch) and earth.
- If not, fold back the carpeting and remove the relay.

Check for voltage between relay terminal 30 (red; RD) and earth and between relay terminal 86 (brown/white; BR/VT) and earth.

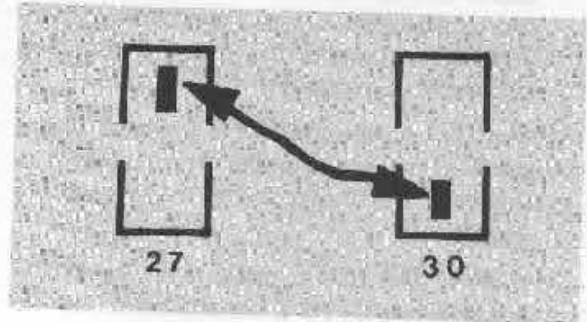
If dead, check the red (RD) lead between terminal 30 and the positive terminal, and the brown/white (BR/VT) lead between terminal 86 and system relay terminal 87 (Turbo pressure switch).

If voltage is present, connect terminal 85 (violet; VL) to earth using jumper lead 83 93 894.

Check for voltage at relay terminal 87 (blue/red; BL/RD) and terminal 87B (grey/red; GR/RD).

If dead, fit a new relay.

If voltage is present, check the grey/red (GR/RD) lead between the Limp-home connector and relay terminal 87B.



Switched jumper lead (83 93 886) for power feed to fuel pump. Connect between fuses 27 and 30.

E3 Checking the pressure switch (Turbo cars only)

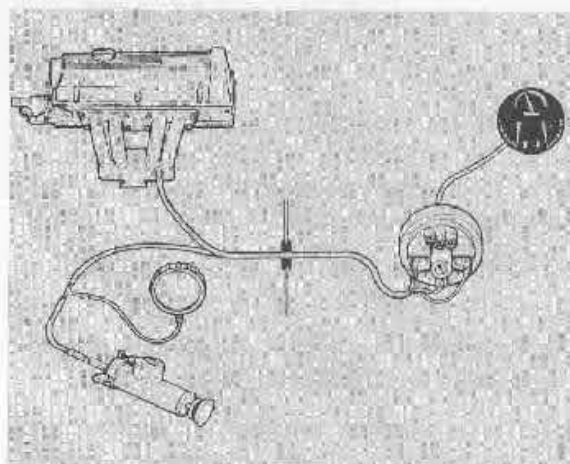
Tools: Multimeter
Pressure gauge 83 93 514
Cooling-system tester

- 1 Connect pressure gauge 83 93 514 to the outlet on the inlet manifold for the hose to the pressure switch, and connect the cooling-system tester to the branch connection on the pressure gauge.
- 2 Start the engine. Raise the pressure to the value at which the pressure switch breaks the circuit, whereupon the engine should stall.

If the engine fails to stall, check the breaking pressure of the pressure switch as follows:

Connect the multimeter between terminal 87 on the system relay and terminal 86 on the fuel pump relay.

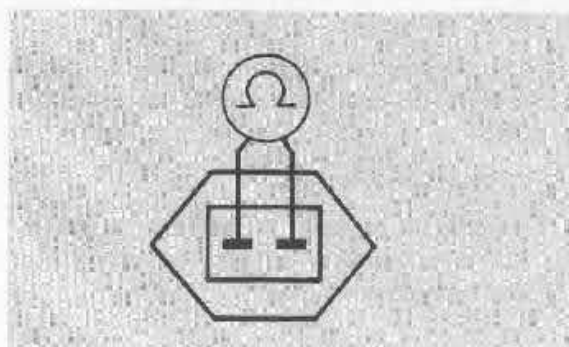
- 3 Raise the pressure. The power supply circuit should be broken when the opening pressure for the switch is reached (see Section 2:4, Technical data). If not, replace the pressure switch.



E4 Checking the temperature sensor (NTC resistor)

Tools: Multimeter

- 1 Unplug the connector for the ECU and remove the cover.
- 2 Measure the resistance of the NTC resistor: connect the multimeter across ECU connector pins no. 2 (yellow; GL) and no. 11 (black; SV); or, alternatively, unplug the temperature sensor connector and measure the resistance across the pins direct.



The resistance varies with the coolant temperature as follows:

0 °C (32 °F)	=	5800 ohm
20 °C (68 °F)	=	2600 ohm
100 °C (212 °F)	=	180 ohm

- 3 If incorrect readings are obtained, disconnect the leads to the NTC resistor. Connect the multimeter across the terminals of the

NTC resistor, and check the values again. If the readings are still incorrect, fit a new sensor. If the NTC resistor is found to be sound, check the lead between terminal 11 on the electronic control unit and earth (black; SV) and between the NTC resistor and earth.

E5 Checking and adjusting the throttle-position sensor

Tools: Multimeter

- 1 Unplug the connector from the electronic control unit and remove the cover.
- 2 Connect the multimeter between pins 3 (grey; GR) and 11 (black; SV) on the ECU connector. Check that the circuit is closed.

If there is a break in the circuit, check the grey (GR) lead from pin 3 on the connector to the throttle-position sensor, the black (SV) lead from pin 11 on the connector to earth, and the black/white (SV/VT) lead from the sensor to earth.

- 3 Move the throttle butterfly and check the reading on the multimeter. If the sensor is operating properly, the circuit should be broken the moment the butterfly leaves its home position (position for idling). If not, adjust the position of the throttle butterfly (M1, Basic setting of throttle butterfly).

240-90 Fuel injection system

Slacken the nut and setscrew and then screw in the setscrew until it touches the butterfly stop.

Turn the setscrew 1/3-turn more, and lock it with the nut.

To adjust the throttle-position sensor, undo the screws securing it to the throttle housing and turn the sensor until it butts against the integral stop for idling position. Retighten the securing screws.

Check that the circuit between ECU connector pin 3 (grey; GR) and 11 (black; SV) is broken the moment the throttle butterfly leaves the stop for idling speed.

- 4 Connect the multimeter across pins 11 (black; SV) and 12 (green/red; GN/RD). If the sensor is functioning properly, the circuit should be closed when the butterfly angle is 72° (just before full throttle).

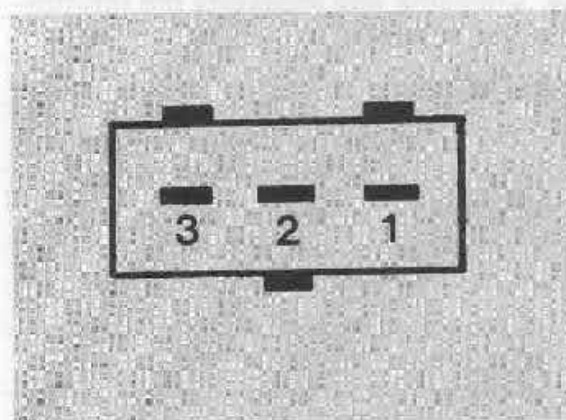
If the circuit is not closed, check the green/red (GN/RD) lead between pin 12 on the connector and pin 3 on the throttle-position sensor; the black lead between ECU connector pin 11 and earth, and the black lead between pin 2 on the throttle-position sensor and earth.

If the wiring is found to be good but the sensor is not functioning properly, fit a new throttle-position sensor.

Throttle-position sensor connector pins

No Should be connected to:

- 3 ECU connector pin 12 (green/red; GN/RD)
- 2 Earthing point on the engine (black/white; SV/VT)
- 1 ECU connector pin 3 (grey; GR)



E6 Checking the injection valves

Tools: Multimeter

Before starting any checks on the injection valves, unplug the connectors for the electronic control unit and the air mass meter.

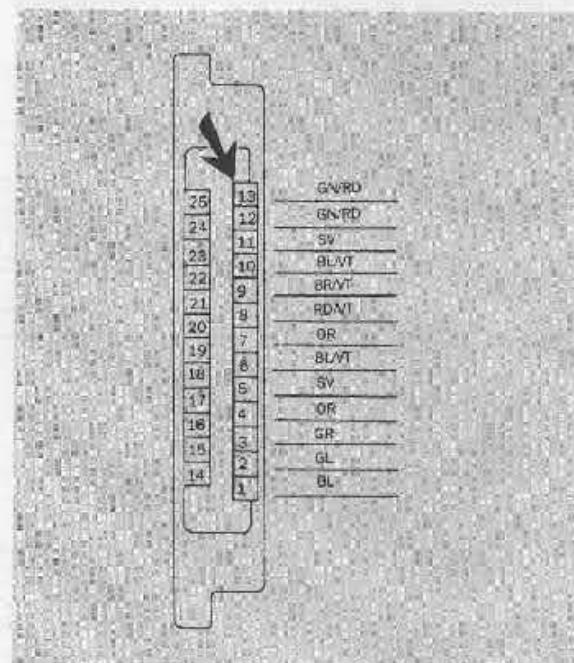
N.B.

The measurements must be made at the back of the connector for the electronic control unit, with the cover removed.

- 1 Unplug the connectors on the electronic control unit and the air mass meter and remove the cover from the ECU connector.
- 2 Measure the resistance across terminal 13 (green/red; GN/RD) on the ECU connector and terminal 87 on the fuel pump relay. The reading should be 4 ohm. If not, proceed as follows:
- 3 Unplug the connector on the injection valve. Connect the multimeter across the connector on the injection valve and read-off the resistance.

The reading for a sound injection valve should be 16 ohm at 20 °C (68 °F). If this reading is not obtained, fit a new valve.

- 4 If the correct reading is obtained, check the wiring loom from pin 13 (green/red; GN/RD) on the ECU connector to the connectors on the injection valves (via the connection block). Slide back the rubber gaiters and connect the meter between the injection valves (via the connection block) and the back of the ECU connector and also between the injection valves and the blue/red (BL/RD) lead from terminal 87 on the fuel pump relay



E7A Checking the air mass meter

Tools: Multimeter

Start the engine and let it run at idling speed. Check the CO value. If the reading is higher than 6%, it cannot be adjusted using the CO adjusting screw. Switch off the engine.

- 1 Disconnect the air mass meter from the air filter.

Check that the filament is not broken.

If broken:

Change the air mass meter.

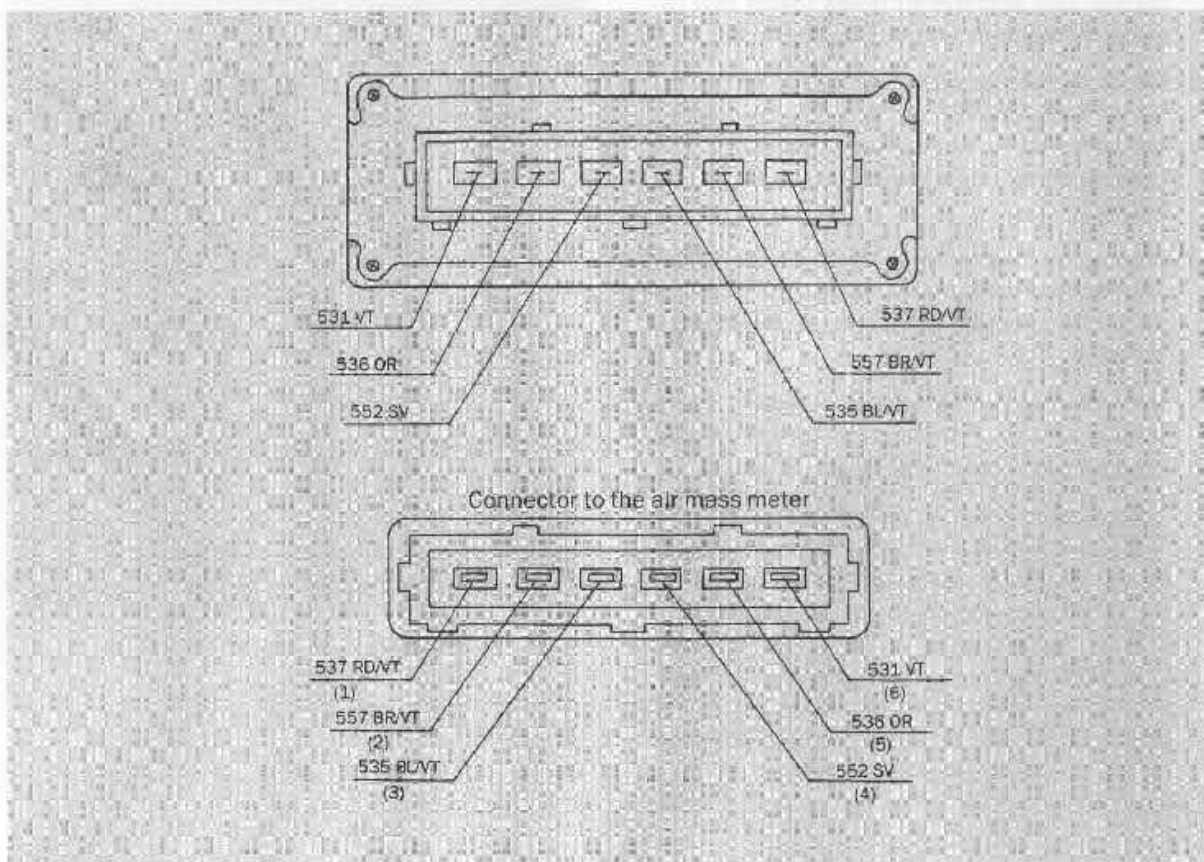
If not broken:

Check the air mass meter connector and wiring loom as follows:

- Unplug the air mass meter and ECU connectors and lift the cover on the ECU connector.

- Check that wiring and connectors are sound.
- If the wiring is good, plug on the ECU connector.

- 2 Check the burn-off function for the filament E7B.



Air mass meter connector

Pin	To component no.
1	ECU connector pin 8 (red/white; RD/VT)
2	System relay terminal 87B (brown/white; BR/VT)
3	ECU connector pin 6 (blue/white; BL/VT)
4	Engine earthing point 552 (black; SV)
5	ECU connector pin 7 (orange; OR)
6	ECU connector pin 14 (white; VT)

E7B Checking the filament burn-off function

- 1 Detach the air mass meter from the air cleaner and check the filament.
- 2 Start the engine and run it until it reaches a temperature of at least 65°C (149°F) and then let it idle. Rev the engine to 2500 r/min, release the throttle and allow the engine to return to idling speed.
- 3 Switch off the ignition; after about four seconds, the filament should glow brightly for about one second. If nothing happens, check the wiring E7A.
- 4 Start the engine and rev it up to 2500 r/min. Connect the probes to pins 1 and 4 of the air mass meter connector. Switch off the engine. After four seconds, the voltage should rise to 4 V for a duration of approx. one second.

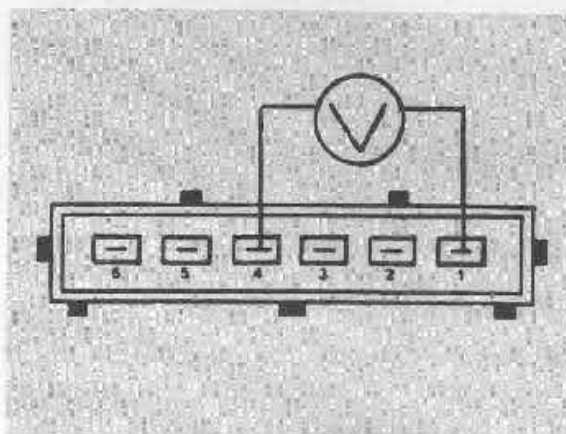
- 5 If not, check the red/white (RD/WT) lead between pin 1 on the air mass meter connector and pin 8 on the ECU connector, and the black (SV) lead between pin 4 on the air mass meter connector and one of the earthing points on the block.

If the leads are found to be sound, test the system using a new ECU.

- 6 Start the engine and repeat the test procedure. If a correct voltage reading is obtained but the burn-off function fails to operate, fit a new air mass meter.

N.B

The limp-home function takes over automatically if the filament is broken.



E7C Checking and adjusting the CO content

Tools: CO meter
Tachometer
Exhaust extraction equipment
Multimeter

- 1 Connect the CO meter, exhaust extraction equipment and tachometer.
- 2 Start the engine and run it until it reaches normal operating temperature. Check the CO reading against the specifications (Section O).

If the reading is different to the specified value, turn the adjusting screw:

- clockwise if the value is too low
- anti-clockwise if the value is too high.

- 3 If the CO reading is higher than 6% and therefore cannot be adjusted by use of the adjusting screw, switch off the engine, unplug the air mass meter connector and connect the multimeter across pins 3 and 6 of the air mass meter connector.

Turn the adjusting screw until the reading is 380 ohm.

If you cannot obtain this reading, fit a new air mass meter. If the correct reading of 380 ohm is obtained, plug in the air mass meter connector. Start the engine and run it until it reaches normal operating temperature. Recheck the CO reading, and adjust the CO content until the correct value is obtained. If the correct value still cannot be obtained, check the air mass meter wiring loom and connectors (see E7A).

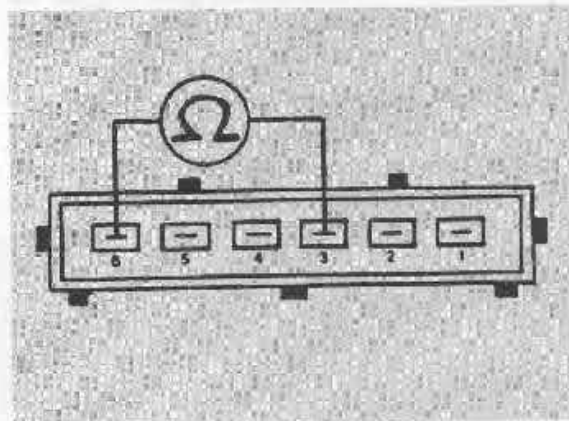
- 4 If the wiring loom is sound and the CO value still cannot be adjusted, try fitting a new electronic control unit.

E7D Checking the basic setting of the fuel injection system (cars with catalytic converter)

N.B

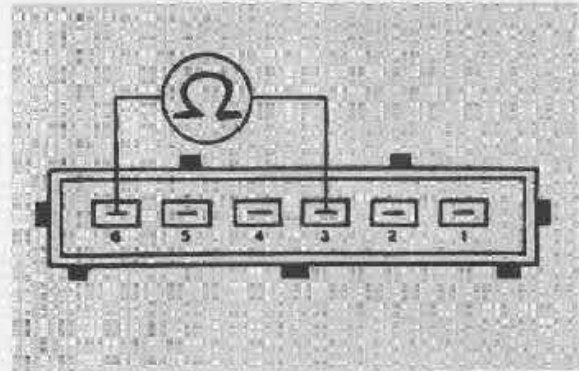
There are no specified intervals at which the fuel system basic setting should be checked or adjusted.

This setting establishes a reference point for the LH system and does not affect vehicle performance. Recalibration should be carried out **only** when engine function has been disturbed by major work such as replacement of the ECU temperature sensor or air mass meter, or after



extensive work such as an engine overhaul, cylinder head work or timing chain replacement.

- 1 Remove the plug from the potentiometer screw located on the side of the air mass meter.
- 2 Unplug the loom connector from the air mass meter.
- 3 Connect the multimeter (2 kilo-ohm scale) between pins 3 and 6 as shown. The reading should be 380 ohm; adjust as necessary by turning the potentiometer screw. This is the first step in the basic-setting procedure.



- 4 Reconnect the air mass meter wiring loom.
- 5 Connect pulse ratio meter 83 93 597 to the test point adjacent to the evaporator housing using adaptor loom 83 94 132.
- 6 Start the engine and let it run until the fan cuts in.
- 7 If the basic setting is correct the meter will oscillate between the ends of the scale.

N.B

The needle will not oscillate or hunt rapidly across the scale and there may be a pause between needle movements.

- 8 If adjustment is necessary, turn the potentiometer screw as follows:
 - a If the needle locks at the top of the scale or settles largely on the high side, turn the screw anticlockwise until the needle spends an equal amount of time at either end.
 - b If the needle settles largely on the low side of the scale, turn the screw clockwise until the needle spends an equal amount of time at either end.
- 9 Refit the plug for the potentiometer screw.

E8 Checking the ECU

Tools: Multimeter

Jumper lead with crocodile clips

83 93 894

Test lamp

Before performing any checks on the ECU, unplug the connectors on the ECU and the air mass meter and unplug the connector between the ignition system and the distributor.

N.B

The measurements must be made at the back of the ECU connector, with the cover removed.

E8A Checking the input signals to the ECU

- 1 Unplug the connector for the ECU and remove the cover. Disconnect the lead to the Hall generator.

- 2 Switch on the ignition.

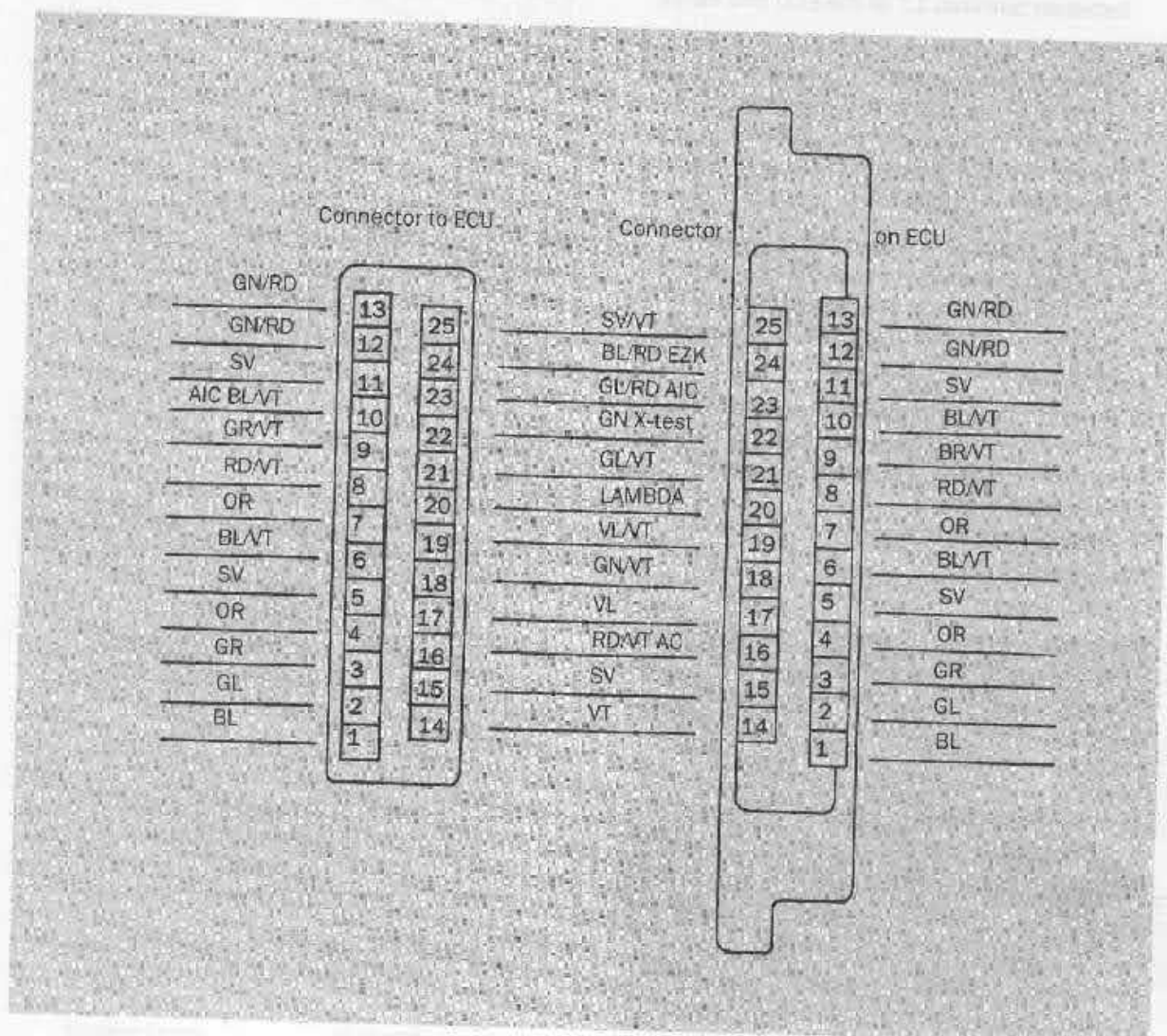
Check that voltage is reaching pin 18 (green/white; GN/VT) on the ECU connector.

If not, trace and check the lead from the pin back to the fuse panel, via the 6-pin loom connector and terminal block. Also check the fuse.

- 3 Connect the jumper lead with crocodile clips between terminal 21 of the ECU and earth. Check that current is available at terminal 9 of the ECU. If not, check the yellow/white (GL/VT) lead between terminal 21 of the ECU and terminal 85 (brown/white; BR/VT) of the system relay, and the brown/white (BR/VT) lead between terminal 9 of the ECU and terminal 87 of the system relay.

- 4 With the ignition on, check that current is available between terminals 18 and 11 of the ECU. If not, check the black (SV) lead between terminal 11 of the ECU and an earthing point on the block.

Key to the terminals on the electronic control unit



Terminal For: No.

- | | | | |
|----|---|----|---|
| 1 | Ignition pulse to terminal 1 (blue; BL) of the coil | 11 | Earthing point on engine (black; SV) |
| 2 | Temperature sensor (NTC resistor), terminal 2 (yellow; GL) | 12 | Throttle-position sensor, terminal 3 (green/red; GN/RD) |
| 3 | Throttle-position sensor, terminal 1 (grey; GR) | 13 | Control signal to injection valves (green/red; GN/RD) |
| 4 | Idling increase switch, automatic transmission (orange; OR) | 14 | Air mass meter, terminal 6 (white; VT) |
| 5 | Earthing point, engine (black; SV) | 15 | Earthing point, engine (black; SV) |
| 6 | Air mass meter, terminal 3 (blue/white; BL/VT) | 16 | AC, (red/white; RD/VT) |
| 7 | Air mass meter, terminal 5 (orange; OR) | 17 | Pump relay, terminal 85 (violet; VL) |
| 8 | Air mass meter, terminal 1 (red/white; RD/VT) | 18 | Ignition switch, terminal + 15 (green/white; GN/VT) |
| 9 | System relay, terminal 87 (brown/white; BR/VT) | 19 | Limp-home function (violet/white; VL/VT) |
| 10 | AIC valve | 20 | Lambda |
| | | 21 | System relay, terminal 85 |
| | | 22 | Lambda test, (green; GN) |
| | | 23 | AIC valve, (yellow/red; GL/RD) |
| | | 24 | EZK (blue/red; BL/RD) |
| | | 25 | Earthing point on engine (black/white; SV/VT) |

- 5 Connect the jumper lead with crocodile clips between terminal 17 of the ECU and earth.

With the ignition on, check that current is reaching terminals 87 and 87B of the fuel pump relay (or listen to hear if the pump is running). If not, check the violet (VL) lead between terminal 17 of the ECU and terminal 85 of the fuel pump relay.

- 6 With the ignition on, check that current is available between terminals 18 and 25 of the ECU. If not, check the black/white (SV/VT) lead between terminal 25 of the ECU and its earthing point on the block.
- 7 Plug in the distributor connector. Check for an ignition pulse from terminal 1 of the ECU by connecting the test lamp between the terminal and earth.

Switch on the ignition:

1985 and earlier models: the test lamp should glow weakly for about a second and then become brighter. If not, check the blue (BL) lead between ECU connector pin 1 and terminal 1 on the ignition coil.

1986 models onwards: the test lamp should now come on. If not, check the blue (BL) lead between ECU connector pin 1 and terminal TD-O of the ignition pulse amplifier.

- 8 Use the multimeter to check the other leads in the loom from the ECU (check for broken wires or corroded terminals).

E8B Checking the signals from the electronic control unit to the injection valves

Tools: Screwdriver or stethoscope
Multimeter
Tachometer

- 1 If unplugged, reconnect the connectors for the ECU, air mass meter and the lead between the Hall generator and the distributor. Connect the tachometer.
- 2 Lift up the gaiter on the connector on one of the injection valves.

N.B

Do not use a test lamp to check the signals from the ECU to the injection valves.

- 3 Connect the multimeter probes to the injection valve terminals.

N.B

Polarity: Red (+) probe to the blue/red (BL/RD) lead and the black (-) probe to the green/red (GN/RD) lead.

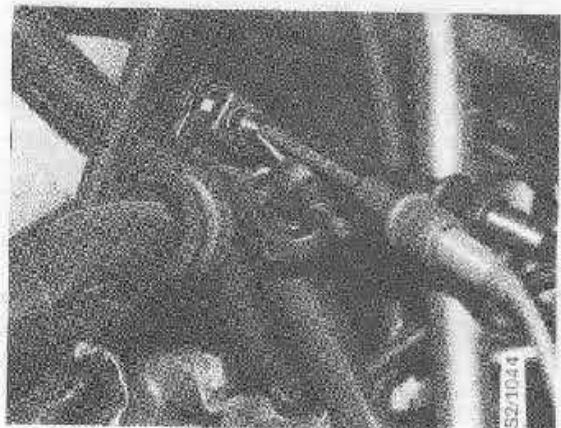
- 4 Start the engine and check the voltage reading against the following tables:

Engine temp	Voltage
0 °C (32 °F)	1 V
20 °C (68 °F)	0.6 V
80 °C (176 °F)	0.3 V

N.B

The above values are only approximate

- 5 If the engine is running erratically, check during the warm-up period that all injection valves are operating properly. This can be done by placing a screwdriver or stethoscope against the black metal part of the valve. A clicking sound should be heard if the valve is operating.



- a If one or more of the valves cannot be heard operating, refer to section E6 on checking of the injection valves.

- b If the injection valves can be heard operating but the engine still runs erratically at idling speed:

Using a small screwdriver to release the tension in the spring clips, unplug the valve connectors, one at a time. This should produce a marked fall in engine speed.

- c If there is no marked fall in the engine speed, make a thorough inspection of the following systems:

- The fuel system
- The injection system
- The electrical system

- 6 When the engine has reached normal running temperature, increase the speed gradually to 3000 r/min. Measure the voltage across the injection valve, which should rise to 0.8 - 0.9 V. Let the engine speed fall to idling speed and then raise it rapidly again to 3000 r/min; the voltage should now rise above 0.8 - 0.9 V momentarily before falling back to 0.8 - 0.9 V again.



E8C Checking the fuel shut-off function on starting

Tools: Multimeter

When the engine is being turned over on the starter motor, the fuel supply will be shut off if the accelerator pedal is fully depressed to the full-throttle position (butterfly turned through 72°).

- 1 Lift up the gaiter on the connector on one of the injection valves. Connect the multimeter probes to the injection valve terminals. Polarity: Red (+) probe to the blue/red (BL/RD) lead and the black (-) probe to the green/red (GN/RD) lead.
- 2 Run the starter motor and check that voltage

is present across the injection valve.

- 3 Fully depress the accelerator pedal.
- 4 The injection valve should now remain de-energized throughout the time the starter motor is running. If not, check the operation of the throttle-position sensor (E5) and replace it if faulty. Check the green/red (GN/RD) lead between terminal 3 on the throttle-position sensor and terminal 12 on the ECU. Check the lead between terminal 2 on the throttle-position sensor and its earthing point on the block.

E8D Checking the full-load enrichment function (N/A cars with catalytic converter)

Tools: CO meter
Multimeter
Jumper lead

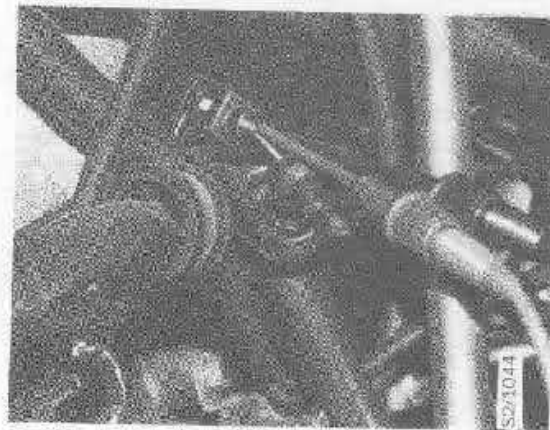
- 1 Connect the CO meter and exhaust extraction equipment.
- 2 Start the engine and run it to normal temperature.
- 3 Slide back the gaiter on the connector on one of the injection valves. Unplug the connector from the throttle-position sensor, peel back the connector rubber and connect a jumper lead between pins 3 and 18.
- 4 Check that the CO value increases by about 1%. If not, connect the multimeter across the terminals of the injection valve.

N.B

Polarity: Red (+) probe to the blue/red (BL/RD) lead and black (-) probe to the green/red (GN/RD) lead.

Check that the voltage rises by approx. 0.1 V.

- 5 If the voltage does not rise, check the leads to the ECU (see E5). If the wiring is sound, try fitting a known good ECU.
- 6 Check and adjust the CO content as described in section E7C.



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 Slide back the gaiter on the connector on one of the injection valves.
- 4 Connect the multimeter probes to the connector pins.

N.B

Polarity: Red (+) probe to the black/red (BL/RD) lead and the black (-) probe to the green/red (GN/RD) lead.

- 5 Check the engine speed during the warm-up period. The engine speed should decrease as the engine temperature rises.
- 6 Measure the voltage across the injection valve and compare the reading with the values given in the following table:

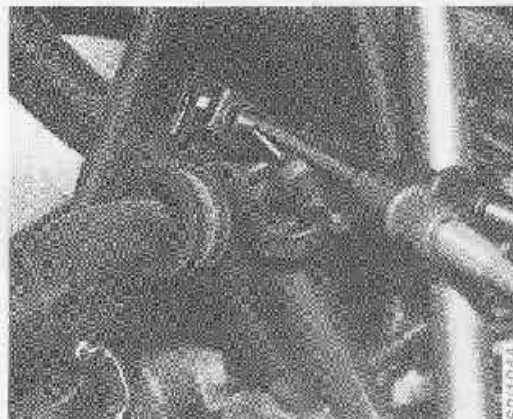
Engine temp	Voltage
0°C (32°F)	1V
20°C (68°F)	0.6V
80°C (176°F)	0.3V

N.B The above values are only approximate

If the readings obtained differ from the above values, check the CO setting E7C, the temperature sensor E4 and the filament burn-off function E7B.

If no fault is found try fitting a known good ECU.

- 7 Check the CO value and adjust as necessary E7C.



E9A Checking for idling-speed increase on cut-in of AC compressor (Cars with auxilliary air valve)

Tools: Multimeter
Tachometer

- 1 Connect the tachometer and exhaust extraction. Start the engine and wait until it reaches normal temperature.
- 2 Press in the AC switch, whereupon a marked drop in the engine speed should occur before it returns to normal idling speed.
- 3 If not:
 - Check that current is available at the AC compressor single-pin connector at the compressor (red; RD).
 - Check the electrical system for the AC unit (supply to the electro-magnetic clutch).
 - Check that current is reaching the AIC valve and that the valve is opening (see Section 8:3, subsection 854, of the Service Manual).
 - Check that current is reaching the AC thermostat (115°C; 239°F). (See Section 8:3, subsection 854, of the Service Manual.)
 - Check the yellow (GL) lead between the AIC valve and the AC thermostat (115°C; 239°F), and the black (SV) lead to the alternator earth.

E9B Checking for idling-speed increase on cut-in of AC compressor (Cars with AIC valve)

Tools: Multimeter
Tachometer

- 1 Connect the tachometer and exhaust extraction. Start the engine and wait until it reaches normal temperature.
- 2 Depress the AC button. There should not be any noticeable change in the engine speed.

3 If the engine speed drops noticeably, check the following:

- The power supply to terminal 16 (red/white; RD/VT) on the ECU.
- If no power is present, check the red/white (RD/VT) lead from terminal 16 on the ECU to terminal 16 on the AC relay and also check that the relay is operating properly.

If voltage is present:

- Check the yellow/red (GL/RD) lead from terminal 3 on the AIC valve to terminal 23 on the ECU connector, and the blue/white (BL/VT) lead from terminal 9 on the AIC valve to terminal 10 on the ECU connector.
- Check the AIC valve I3.
- If the AIC valve is sound, try fitting a known good ECU.

E10 Checking the oxygen (Lambda) sensor

The oxygen sensor provides one of several input signals that the ECU processes to determine the proper air-fuel ratio. Other inputs include engine rpm, engine temperature, throttle position and air mass.

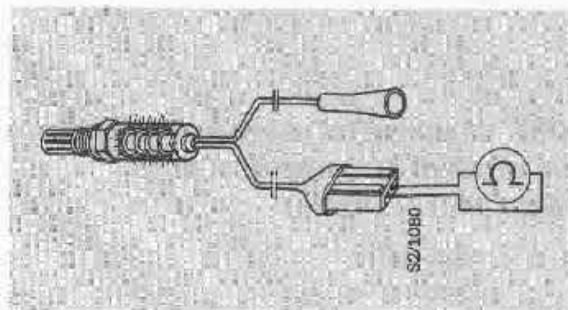
The oxygen sensor used with the LH system has an electric preheating function which enables it to quickly reach a temperature that allows accurate measurement of exhaust gas composition.

- 1 Unplug the two-pin connector from the wiring loom.
- 2 Use the multimeter to check the resistance across the two white terminals on the sensor. The reading should be approx. 4 ohm.

- 3 Using the DCV 2-V scale, connect the multimeter across the oxygen sensor black lead and earth.

Start the engine.

As the sensor comes up to temperature, it starts to generate a low-voltage signal of be-



tween 100 and 900 mV. The actual signal varies with the strength of the mixture: a lean mixture, such as that caused by a slight vacuum leak, will give a Lambda value of 1 and a sensor voltage of about 100 mV.

A rich mixture will give a Lambda value of <1 and a sensor voltage of about 900 mV.

11 Checking the induction system

Tools: Pressure gauge set 83 93 514

There must not be any leakage of air between the air mass meter and the engine.

1 Check the hose connections on:

- the auxiliary air valve
- the brake servo unit
- the vacuum chamber
- the pressure switch
- the EGR thermostatic valve
- the EGR valve
- the fuel pressure regulator

Also check:

- that the butterfly closes
- that the three securing bolts for the throttle housing are tight

2 Check that the injection valves are properly seated in the inlet manifold and that the "O" rings are not damaged.

If after the completion of these checks air leakage is still suspected, carry out further checks as follows:

- 3 Connect pressure gauge 83 93 514 to the inlet manifold, downstream of the throttle butterfly, and hang the pressure gauge on the rear-view mirror inside the car.
- 4 Start the engine and let it run at idling speed (850 50 r/min). Check the vacuum, which, if the system is operating correctly, should be between -0.4 and -0.8 bar (-5.8 and -10.2 psi). If the vacuum is less than -0.4 bar (-5.8 psi), check the system again as detailed in step 1 above.
- 5 Check for air leakage in the induction system, using the pressure gauge to check downstream of the throttle butterfly, and making a visual check between the air mass meter and the butterfly. The vacuum should be above -0.4 bar (-5.8 psi).



- 6 Make a visual check also for air leaks between the throttle housing and pressure pipe, between the pressure pipe and the turbo, between the turbo and the inlet manifold, at the inlet manifold connections for crankcase ventilation and the APC return hose.

Check also the rubber duct connections between the inlet manifold and the air mass meter, and the connections between the air mass meter and the air cleaner, at the air cleaner cover and between the air intake and the air cleaner.

12 Checking the auxillary air valve (When fitted)

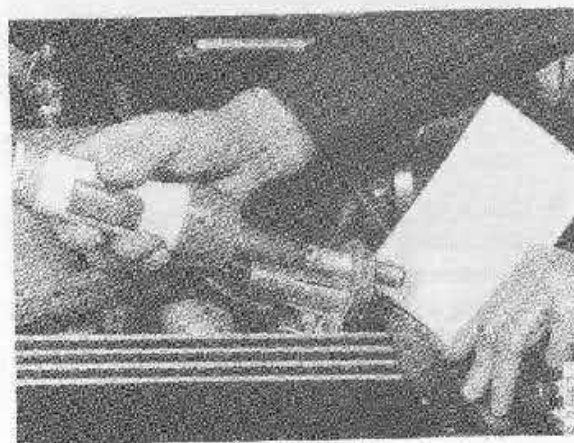
Tools: Multimeter
Torch (flashlight)
Mirror or sheet of white card
Jumper leads

Before performing any checks on the auxiliary air valve, unplug the electronic control unit and auxiliary air valve connectors.

N.B

Checking must only be done when the engine is cold (temperature below 30 °C/86 °F).

- 1 Using two separate jumper leads, connect pin 21 (yellow/white; GL/VT) and pin 17 (violet; VL) on the ECU connector to earth.
- 2 Check that voltage is present across the auxiliary air valve terminals. If not, check that the system relay and pump relay are operating properly E1 and E2 and check the grey and black (GR; 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 a mirror or sheet of white card close to the opening in the other hose spigot. The valve should close fully after about five minutes (depending on the temperature of the engine).
- 4 If not, check the resistance of the auxiliary air valve by connecting the multimeter across the valve terminals. The reading should be 40 - 60 ohm. If the reading obtained is not between these values, fit a new auxiliary air valve.



13 Checking the AIC valve

- Unplug the connector from the AIC valve.

Measure the resistance across pin 3 and pin 2 (the middle pin) on the valve and between pin 2 and pin 1. Refer to the "Technical Data" section for the correct resistance value.

If the correct reading is not obtained, try fitting a new AIC valve.

M1 Basic setting of throttle butterfly

- 1 Check that the butterfly is mounted centrally in the throttle housing.
- 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 lock the screw with the nut. This will set a clearance between the butterfly and the throttle housing of approx. 0.05 mm (0.002 in).
- 4 Check the length of the throttle cable to ensure that it will not prevent the butterfly from reaching the position for idling speed, and that there is no play at the accelerator pedal.
- 5 Check that the butterfly opens fully when the accelerator is depressed to the full-throttle position.

Check and adjust the throttle-position sensor.

M1A Adjusting the idling speed (N/A cars with catalytic converter)

The idling speed is adjusted by means of the adjusting screw on the by-pass passage for the throttle housing. Adjust the idling speed in conjunction with setting the CO value.

Idling speed: 850 ± 75 r/min

N.B

The engine must be at normal temperature.

M1B Setting the idling speed (cars with catalytic converter)

Setting the idling speed involves the use of either a dwell angle tester and tachometer or the LH-system tester.

Before starting work on the AIC system, check the ignition timing and CO setting (Lambda setting on US spec. cars).

Tools

Dwell angle tester and tachometer
or

Digital inductive dwell meter and
tachometer

or

LH-system tester Throttle stop locknut T-wrench
83 94 322

N.B

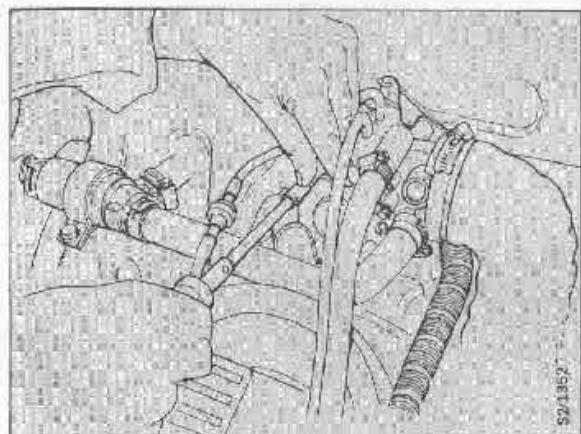
The accuracy of the dwell angle tester and the digital inductive dwell meter should be $\geq \pm 0.5\%$.

- 1 Start the engine and run it up to normal temperature. (It is vital that the gearbox oil be hot.)
- 2 Undo the locknut on the throttle and lower the dashpot clear of the throttle lever.

When using a dwell angle tester:

- 3 a Pull back the rubber on the AIC valve connector and connect the dwell angle tester probes to pins 4 and 5 (valve terminals 2 and 3).

Connect the tachometer.



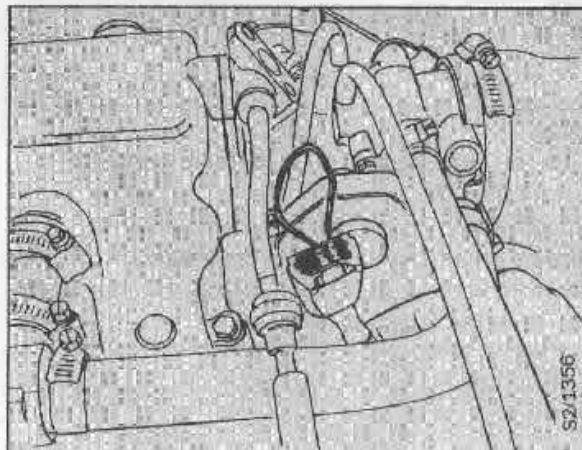
When using a digital inductive dwell meter

- 3 b Pull back the rubber boot on the AIC valve connector. Insert probe into pin 3 (valve terminal 5) and connect lead of dwell meter.

Connect the tachometer.

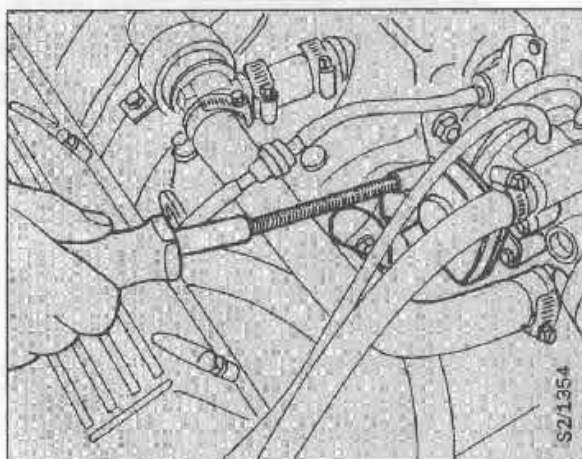
When using the LH-system tester:

- 3 c Undo the LH ECU securing screws and connect the LH-system tester between the ECU and the ECU wiring-loom connector.
- 4 Unplug the connector for the throttle-position sensor and connect a jumper lead between pins 1 and 2 on the back of the connector (terminals 2 and 18 on the throttle-position sensor). This simulates closed contacts for the idling position.



If the setting is made with the contacts open, the value will be incorrect.

- 5 Undo the two retaining screws for the throttle-position sensor and rotate the sensor clear of the throttle butterfly. Make sure that the throttle cable is slack so that it cannot interfere with movement of the butterfly.



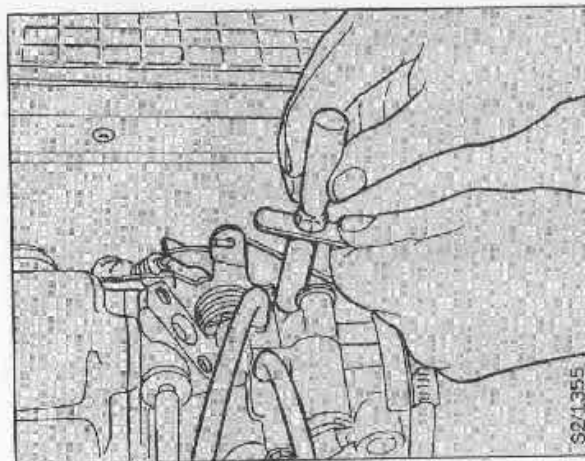
- 6 Start the engine and isolate all possible loads, such as the AC system, headlights, seat heaters, etc.

N.B

Setting must not be carried out when the radiator fan is running.

Cars not fitted with air bleed screw:

- 7 a Slacken the throttle stop screw locknut and turn the adjusting screw anti-clockwise until it no longer touches the throttle linkage.



N.B

The meter reading should increase to a minimum of 34° or 38%.

If difficulty is encountered in obtaining this value, check for air leaks in the induction system downstream of throttle housing or improperly centred throttle butterfly.

Cars fitted with air bleed screw:

- 7 b If necessary (i.e. if the correct setting value for the AIC valve cannot be obtained), adjust the position of the throttle butterfly (it must be properly centred) by slackening the throttle stop screw locknut and turning the adjusting screw until it just touches the linkage (throttle fully closed).

Turn the screw a further 1/3 turn (US spec.: 1/2 - 3/4 turn) and tighten the locknut. This sets a clearance between the butterfly and housing of approx. 0.05 mm (0.0020 in).

Slacken the air bleed screw locknut and turn the air bleed screw in (clockwise) until fully seated.

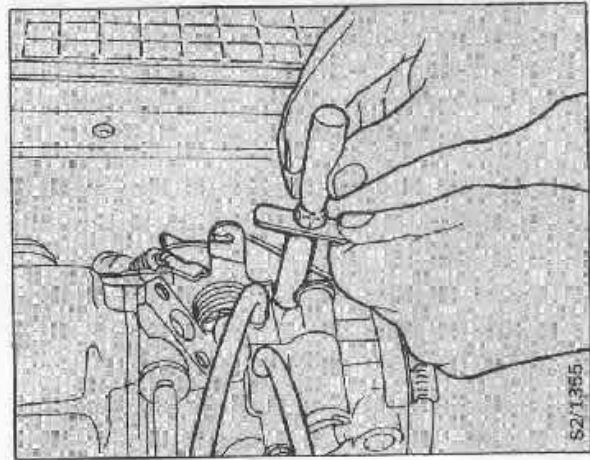
N.B

The meter reading should increase to a minimum of 34° or 38%.

If difficulty is encountered in obtaining this value, check for air leaks in the induction system downstream of throttle housing or improperly centred throttle butterfly.

- 8 Turn the adjusting screw/air bleed screw slowly clockwise so the AIC valve setting decreases.

When the reading shows the correct setting value, the idling speed should be 850 r/min.



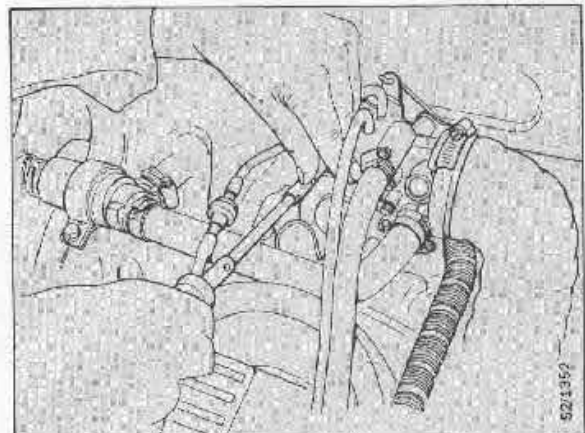
N.B

When using the LH-system tester, make the adjustment slowly to give the tester time to perform the necessary calculations.

AIC-valve setting values

Using dwell angle tester (degrees) °	Using LH-system tester or dwell angle tester with % scale	
32 ± 1	35 ± 1	New cars <1000 miles (1500 km)
30 ± 1	33 ± 1	Cars with mileage >1000 miles (1500 km)

- 9 Tighten the locknut on the adjusting screw/air bleed screw taking care not to alter the setting.
- 10 Switch off the engine.
- 11 Reset the throttle-position sensor (closed in idling position).



Check the setting: move the throttle lever and if the setting is correct a light metallic click should be heard as the sensor switches from the idling position. Do not confuse this with click from upshift switch.

- 12 Set the throttle dashpot to close within a period of 4 ± 1 seconds and then tighten the locknut.
- 13 Remove the jumper lead from the throttle-position sensor connector and plug the connector onto the sensor.
- 14 Remove the probes from the AIC valve connector and push back the rubber boot.

If the LH-system tester has been used, unplug the connector and refit the LH control unit.

- 15 Turn the AC on and ensure that the idling speed increases slightly.

Component replacement

Electronic control unit (ECU)

- 1 Disconnect the negative (-) battery lead.
- 2 Remove the sill scuff plates from the right-hand side of the car. Pull away the lower, leading edge of the door weatherstrip.
- 3 Remove the plate which holds the carpet in position on the wheel arch, and fold back the carpet.
- 4 Unplug the ECU connector by releasing the fastener and lifting the connector diagonally upwards and outwards.
- 5 Remove the screws securing the ECU to the wheel arch.

Refit in the reverse order.

System relay and pump relay

- 1 Remove the securing screws for the air duct and fold it down out of the way.
- 2 Fold back the sound-insulation felt.
- 3 Pull the relays out of their holders.

To check the operation of the relays, detach the relay holders from the wheel arch and pull the relays forward; this will provide much easier access to the electrical connectors.

Refit in reverse order.

Temperature sensor

- 1 Detach 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 connector from the temperature sensor.
- 4 Drain off approx. 4l (4 liq qt) of coolant to prevent liquid running out of the aperture after the sensor has been removed.

- 5 Remove the sensor using a long socket (3/4-inch drive).

Before refitting, clean the mating flanges and sensor body thoroughly. Check the condition of the copper washer.

Refit in the reverse order.

Tightening torque for temperature sensor:
20 Nm (14.8 lbf ft)

N.B

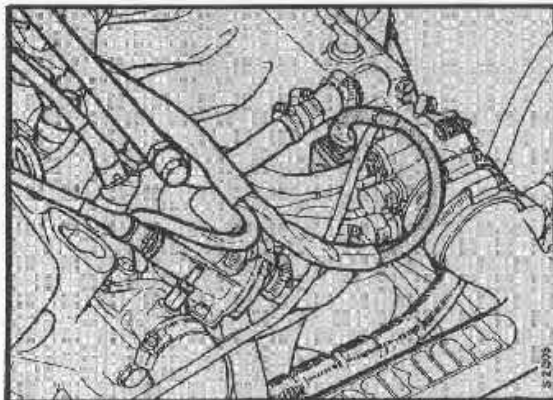
Remember to reconnect the earth leads for the LH injection system when refitting the fuel pressure regulator.

Throttle-position sensor

- 1 Unplug the electrical leads from the sensor.
- 2 Remove the screws securing the sensor to the inlet manifold and lift off the sensor.

Refit in the reverse order.

Adjust the position of the sensor (see section E5).



Fuel injection manifold and injection valves

To remove

N.B

Scrupulous cleanliness must be observed in work on the fuel injection manifold and injection valves. Wash the areas around the injection valves, the fuel injection manifold and the inlet manifold, and blow the areas clean using compressed air.

- 1 Detach the crankcase ventilation hose from the camshaft cover.

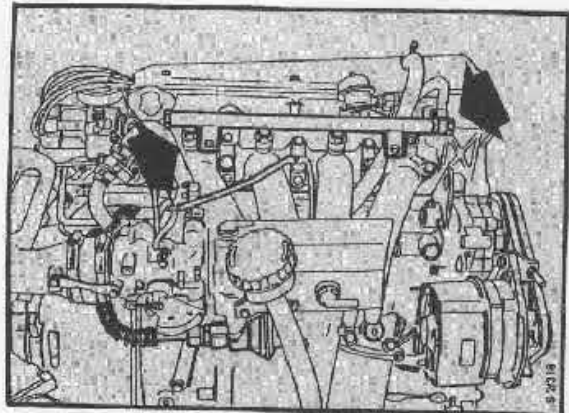
- 2 Unplug the electrical connectors from the injection valves.
- 3 Free the wiring loom by undoing the clip located where the fuel injection manifold is attached to the inlet manifold.
- 4 Disconnect the hose connections (banjo fittings) at either end of the fuel injection manifold.

N.B

Hold the injection manifold steady by means of a spanner on the flats at either end.

Caution

Always wipe dry any leaked fuel.



- 5 Remove the bolts securing the fuel injection manifold to the inlet manifold.
- 6 Lift off the fuel injection manifold complete with injection valves.
- 7 Slide off the clips located between the injection valves and the fuel injection manifold.
- 8 Remove the injection valves from the fuel injection manifold by twisting and then pulling them off.

To refit

Before refitting, check the "O" rings and replace any that are damaged.

To facilitate refitting and to reduce the risk of the "O" rings being damaged, apply petroleum jelly sparingly to the rings.

- 1 Fit the injection valves in the fuel injection manifold.
- 2 Refit the fuel injection manifold complete with valves onto the inlet manifold.

Check that the injection valves are in the correct position and pushed fully home in the inlet manifold, and that the flange of the fuel injection manifold lines up with the groove for the clips for the injection valves. Fit the clips.

Continue in the reverse order of removal.

Air mass meter

- 1 Slacken the hose clip securing the flexible duct to the air mass meter.
- 2 Unplug the electrical connector and release the two toggle fasteners for the air cleaner housing cover.
- 3 Lift the air mass meter clear of the cover and the flexible duct.
- 4 Fit the new air mass meter. Make sure that the ridge in the air mass meter and the recess in the cover line up and then secure the fasteners.
- 5 Fit the flexible duct onto the air mass meter and tighten the hose clip.
- 6 Plug in the electrical connector.

Fuel filter

- 1 Thoroughly clean the areas round the fuel line connections.
- 2 Prevent the filter from twisting by using an open-ended spanner on the hexagons on the filter and banjo fitting, respectively, and disconnect the fuel lines. Remove the filter.

N.B

To prevent swarf from the threads 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.

N.B

If the filter has been fitted the wrong way round, it must not be refitted; fit a new filter.

Fuel pressure regulator

N.B

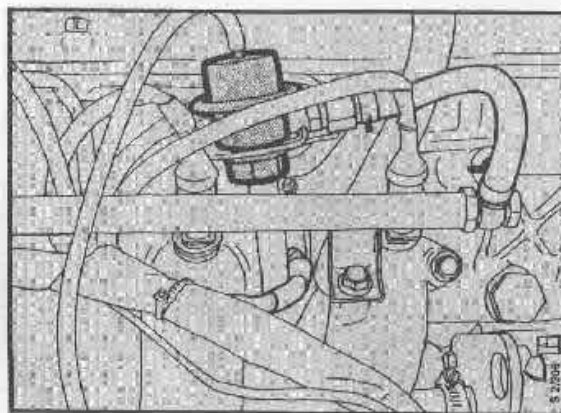
Remember that there is residual pressure in the line. Wipe up any leaked fuel immediately.

- 1 Disconnect the hose from the fuel injection manifold at the nipple on the fuel pressure regulator.
- 2 Disconnect the hose between the inlet manifold and the diaphragm side of the fuel pressure regulator.
- 3 Remove the fuel pressure regulator complete with bracket from the cylinder head.
- 4 Disconnect the return fuel line from the fuel pressure regulator.
- 5 Detach the fuel pressure regulator from the bracket.

Refit in the reverse order.

N.B

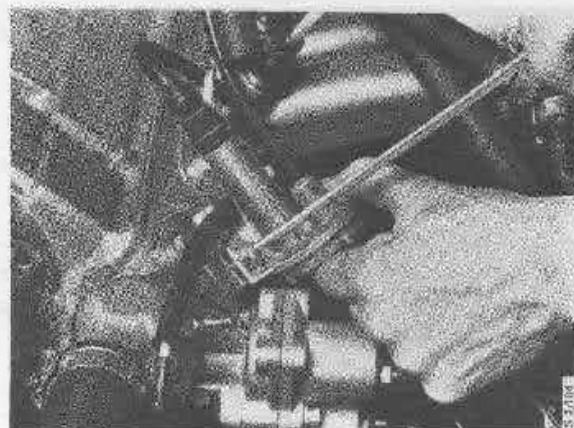
Remember to reconnect the earth leads for the LH system when refitting the fuel pressure regulator.



Auxiliary air valve

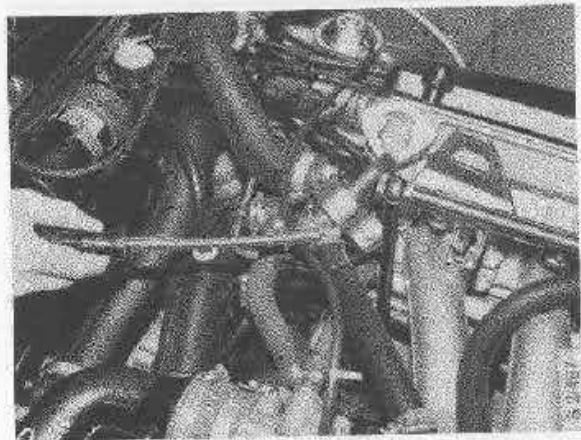
- 1 Slacken the hose clips and detach the hoses.
- 2 Disconnect the electrical leads.
- 3 Unscrew the auxiliary air valve.

Refit in the reverse order.

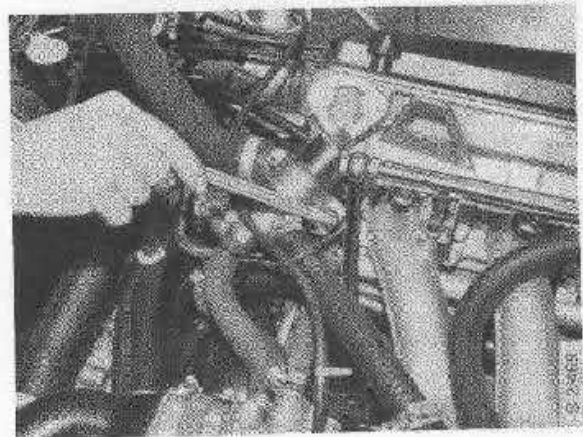


AIC valve

- 1 Unplug the connector.
- 2 Undo the hose clips and detach the hoses.



- 3 Undo the screws and lower the valve out of its mounting.



Refit in the reverse order.

To adjust the setting of the AIC valve, see M1B.

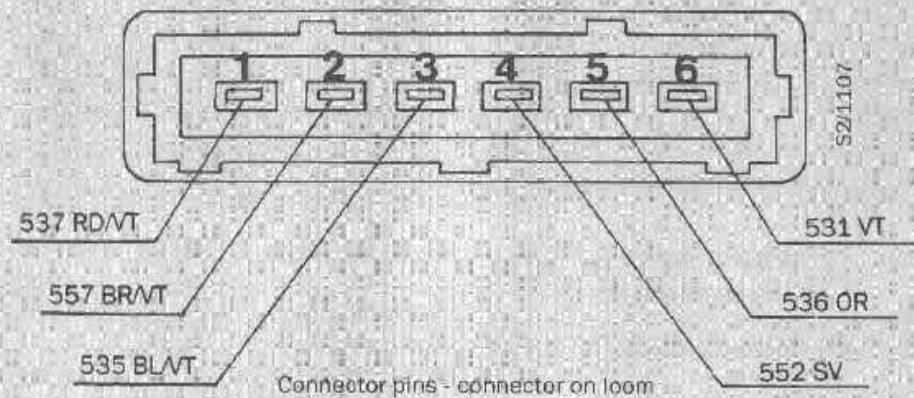
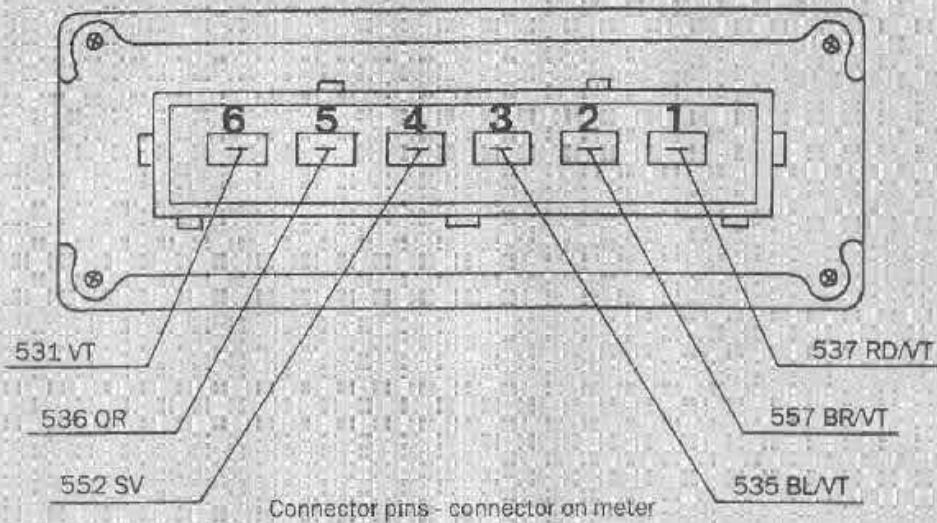
Air cleaner filter element

- 1 Unplug the air mass meter connector and release the two toggle fasteners securing the air cleaner to the air mass meter. Lift the air mass meter and turn it to one side, out of the way.
- 2 Release the four toggle fasteners and lift off the top.
- 3 Lift out the filter element.
- 4 Fit a new filter element, making sure it is properly centred inside the air cleaner.
- 5 Refit the top. Turn the top to line up the fasteners and to bring the spigot for the air mass meter in line with the inlet to the turbo unit. Secure the toggle fasteners.
- 6 Reconnect the air mass meter. Line up the ridge in the air mass meter with the groove in

the air cleaner top and secure the toggle fasteners.

- 7 Plug in the air mass meter connector.

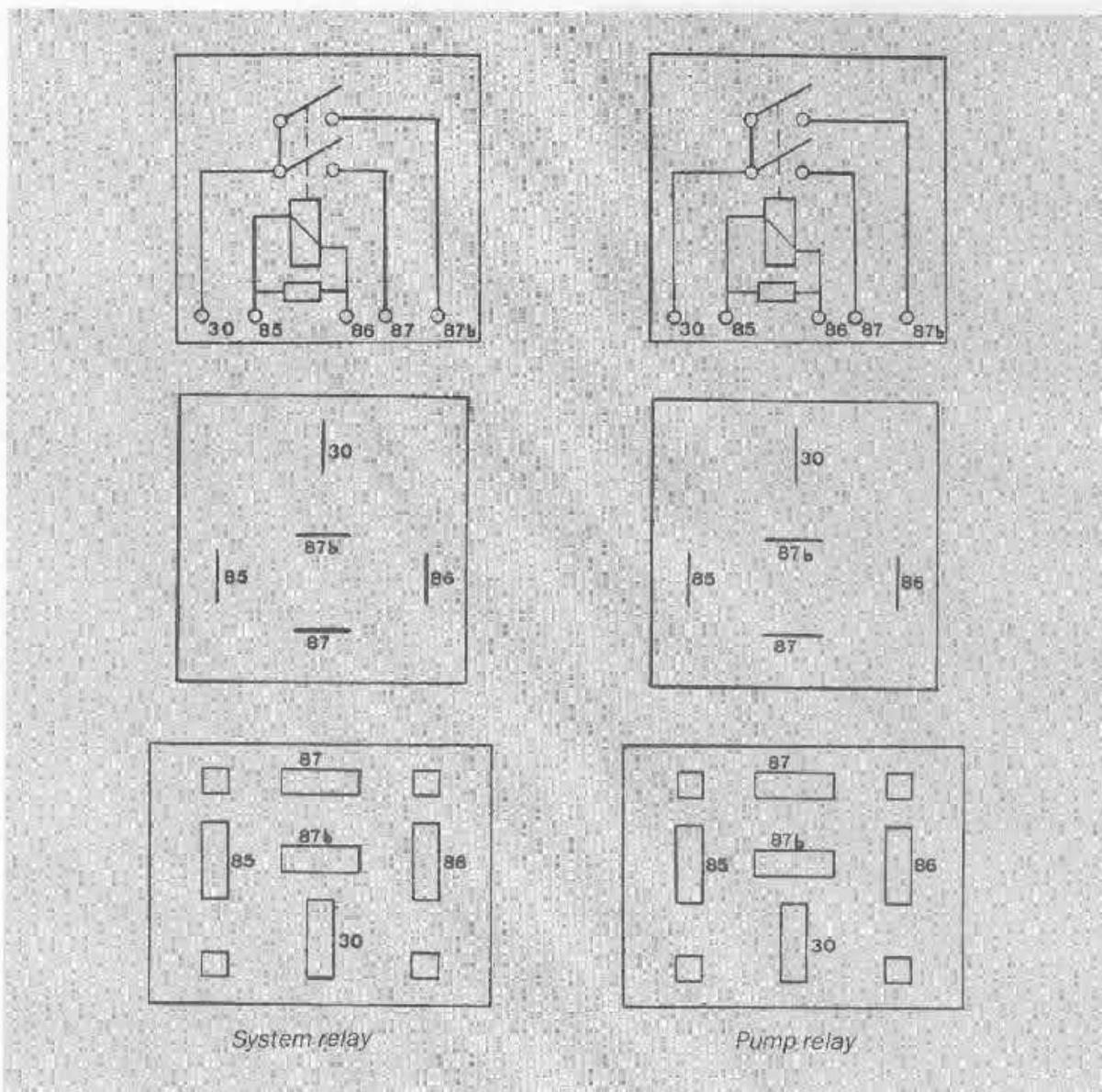
Air mass meter connector pins



Pin functions

Pin	Lead	Goes to:
1	537	Electronic control unit, terminal 8
2	557	System relay, terminal 87B
3	535	Electronic control unit, terminal 6
4	552	Earthing point on engine
5	536	ECU, terminal 7
6	531	ECU, terminal 14

Wiring diagrams for system relay and pump relay



Key to terminals:

Pin	Lead	Component/circuit
30=	559A (RD)	= Battery
85=	548 (GL/VT)	= ECU pin 21
86=	559B (RD)	= Battery
87=	538 (BR/VT)	= ECU pin 9
87B=	557 (BR/VT)	= Filament burn-off

Key to terminals:

Pin	Lead	Component/circuit
30=	559 (RD)	= Battery
85=	545 (VL)	= ECU pin 17
86=	560A (BR/VT)	= Pressure switch pin 15
87=	561 (BL/RD)	= Injection valve
	558 (BL/RD)	= Aux. air or AIC valve
87B=	261A (GR/RD)	= Fuel pump
	564 (GR/RD)	= Limp-home socket