GENERAL DESCRIPTION

An electronic control system supervises and governs all the engine parameters, optimising performance and consumption levels through response in real time to the different operating conditions.

It is the M 2.10.3 version of the tested and proven BOSCH MOTRONIC system.

Compared with the previous versions, this new M2.10.3 system adopts a control unit which is more advanced in design and structure and possesses a considerable number of possibilities for inserting special functions.

SYSTEM FUNCTIONS

Sequential and timed injection (S.E.F.I.)

The type of fuel injection with this control unit is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake ducts by the opening of the injectors is not simultaneous for all the cylinders.
It takes place for each cylinder in correspondence of the optimal injection point, calculated by the control unit following special maps according to engine load, speed and temperature).

NOTE: the instant considered in the design of the maps is that of the start of injection.

Static ignition

Electronic ignition has been adopted with "static distribution" (with semiconductors, without distributor.
This solution makes it possible to eliminate rotating components; it does not produce external sparks and reduces the risk of interferences; it also reduces the number of high voltage cables and connections.

Static ignition is made with a double coil, according to the so-called "lost spark" logic: this solution exploits the different conditions of pressure and environment existing contemporaneously in a pair of cylinders: when one of the cylinders is approaching the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas.
The voltage necessary to strike the arc between the spark plug electrodes is high (appr. 10 kW) in the cylinder in the bursting stroke, whereas in the cylinder in the exhaust stroke, it is extremely low (appr. 500 V).

The instant in which the control unit does not send the signal to one of the power stages, the passage of current in one of the primary circuits of the winding of the coil is cut off, generating by induction an increase of voltage (up to 30 kV loadless) on the secondary winding.

While the high voltage rises, one side of the coil secondary circuit is closed towards earth by the "lost spark" which strikes with about 500 V on the spark plug in the cylinder which is in the exhaust stroke.
This makes it possible to raise the voltage on the spark plug connected to the other side of the secondary circuit which is in contact with the mixture in the cylinder, thereby causing combustion.

Metering the air flow

The air flow meter is new in conception and design. It is of the "heated film type": the operating principle is based on a heated plate which is inserted in the intake duct through which the air that enters the engine flows.

The film plate is maintained at a constant temperature (appr. 120°C) by a heating coil in contact with it.

The mass of air that crosses the duct tends to subtract heat from the plate: therefore, in order to keep its temperature constant, a certain current must flow through the heating coil: this current is measured by a suitable Wheatstone bridge.

Thus, the current measured is proportionate with the mass of air flowing in the duct.

N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port") thereby eliminating problems of temperature, altitude, pressure, etc.

This new air flow meter does not incorporate the intake air temperature sensor, which is separate and is located just downstream of the flow meter itself.

Cylinder detection

Due to the different timed and sequential injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the compression stroke when the engine is started in order to start the correct injection sequence.

This sensor is a Hall effect device by which the voltage signal sent to the control unit "lowers" sharply when the tooth machined on the camshaft pulley passes in front of the it: a signal is sent every two turns of the crankshaft.

Fuel pump

The complex control logic of the fuel pump brought about by the control unit ensures that as soon as the engine stops, the supply to the pump is cut off immediately.
Moreover, the pump will not work with the engine stopped and the ignition key engaged.

In order to provide higher standards of safety, this logic, on this car, is integrated by the inertial switch device: this is an electromechanical switch which opens in the event of heavy impact, cutting off the circuit that connects the fuel pump to earth.
This way the pump stops instantaneously.
This device is particularly important, integrating the safety offered by the logic of the control unit, especially when the car is hit from behind or in other accidents that do not cause the engine to stop immediately.

OPERATING LOGIC

- Determination of the "operating point":
the engine "operating point" is detected by two sensors: the rpm sensor informs the control unit of the engine rotation speed; the air flow meter provides the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

- Adjustment of injection times (quantity of fuel):
The control unit commands the injectors extremely quickly and accurately calculating their opening time on the basis of the engine load (rpm and air flow rate), also taking account of the battery voltage and of the engine temperature. Injection is "sequential", i.e. the injectors are opened during the exhaust stroke of the corresponding cylinder.

- Ignition adjustment (calculation of spark advances):
the control unit calculates the advance on the basis of the engine load (rpm and air flow rate); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

- Cold starting control:
during cold starts the control unit utilizes special advance and injection time values.
When a determinate temperature/engine rpm ratio is reached, the control unit brings operation back to normal conditions.

- Control of enrichment during acceleration:
upon acceleration the control unit increases injection in order to reach the load required as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously signals the control unit of the need for "full power".

- Fuel cut off during deceleration:
with the throttle closed and engine rpm above a certain threshold, the control unit deactivates the injection of fuel; this way the rpms decrease rapidly towards idle speed and fuel consumption, controlled to a greater degree, is considerably reduced.
The threshold varies according to the temperature of the engine and of the speed of the car.

- Idle speed control:
the idle speed is adjusted via the special actuator which acts on the throttle by-pass.
This also serves as an additional air box and regulator for turning on the various services (eg. conditioner compressor): with the throttle at the stop limit, in fact the actuator adjusts the by-pass gap compensating the powers required by the services to ensure that the idle speed remains as constant as possible.

- Maximum rpm limiting:
once a certain threshold has been exceeded, the control unit automatically stops the injection of fuel in order to avoid overloading the engine and to protect it from "over- revving".

- Combustion control-lambda sensor:
the oxygen sensor (or "lambda" sensor) informs the control unit of the amount of oxygen contained in the exhaust, thus the correct air - fuel metering.
The optimal mixture is obtained with lambda coefficient = 1 (fuel injected = theoretic amount of fuel that can be burnt). The electric signal that the sensor sends to the control unit undergoes a sudden change exactly when the composition of the mixture departs from lambda = 1.
When the mixture is "lean" the control unit increases the amount of fuel, when the mixture is "fat" it decreases it: this way the engine operates as much as possible around the ideal lambda rating.
The lambda sensor signal is processed inside the control unit by a special integrator which prevents sharp "oscillations".

The sensor is heated with an electric coil so that it can quickly reach the correct operating temperature (appr.300°C).
This sensor therefore makes it possible to adjust the engine carburetion accurately.
This also enables operation within the limits specified by emission standards.

- Fuel vapour recovery:
the fuel vapours collected in various points of the supply circuit are collected in a special active carbon canister from which they are directed towards the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is under loading conditions that make correct combustion possible without adversely affecting engine operation: in fact the control unit compensates this quantity of fuel by reducing the delivery rate at the injectors.

- Connection with the conditioner compressor:
the control unit is connected with the conditioning system and operates the cutting in of the compressor in relation to engine operation.
Since this service absorbs a considerable amount of power, the control unit:

- adapts the idle rpm to the increased power each time the compressor cuts in; if the engine speed falls below 700 rpm, the compressor is turned off;

- in the case of a high request for power (high speed - over 6000 rpm - or full load - max. throttle opening), the control unit momentaneously cuts out the compressor.

- when the engine is being started it does not allow the compressor to cut in until normal operating conditions have been reached.

- Connection with the anti-theft device:
if the car is fitted with the electronic anti-theft system, the Motronic control unit receives the consent to operate from the anti-theft control unit via a special signal: if this signal is "low" - earth - the control unit operates normally. If the signal becomes "high" - voltage 0 or a.c. - the control unit is deactivated and the engine will not start at all.

SELF-DIAGNOSIS

The control unit is fitted with a self-diagnosis system which continuously checks the signals from the various sensors for plausibility comparing them with the limits allowed: if such limits are exceeded, the system detects a fault and stores it in the memory.

For certain parameters, in the event of a failure the abnormal parameters are replaced by suitable mean values to make it possible to take the car to a point of the Service Network.
These values, known as "recovery", depend on the other signals which are operating normally and they are defined individually by the operating logic of the control unit.
The self-diagnosis system also enables quick and effective fault finding connecting with the ALFA ROMEO Tester (See GROUP 55 "DIAGNOSIS OF THE ELECTRICAL SYSTEM"), through which it is possible to "read" all the errors stored.
It is also possible to check the operating parameters recorded by the control unit and operate the turning on of the single actuators to check whether they are working properly.

ERROR STORAGE:
Once an error has been found through suitable plausibility tests, it is stored in the "Error Memory" of the control unit.
Each error is associated with a CODE that can be "read" by the ALFA ROMEO TESTER.
If an error is "present" (recorded continuously and not sporadically) concerning operation of the engine, a warning light on the instrument cluster will turn on immediately.

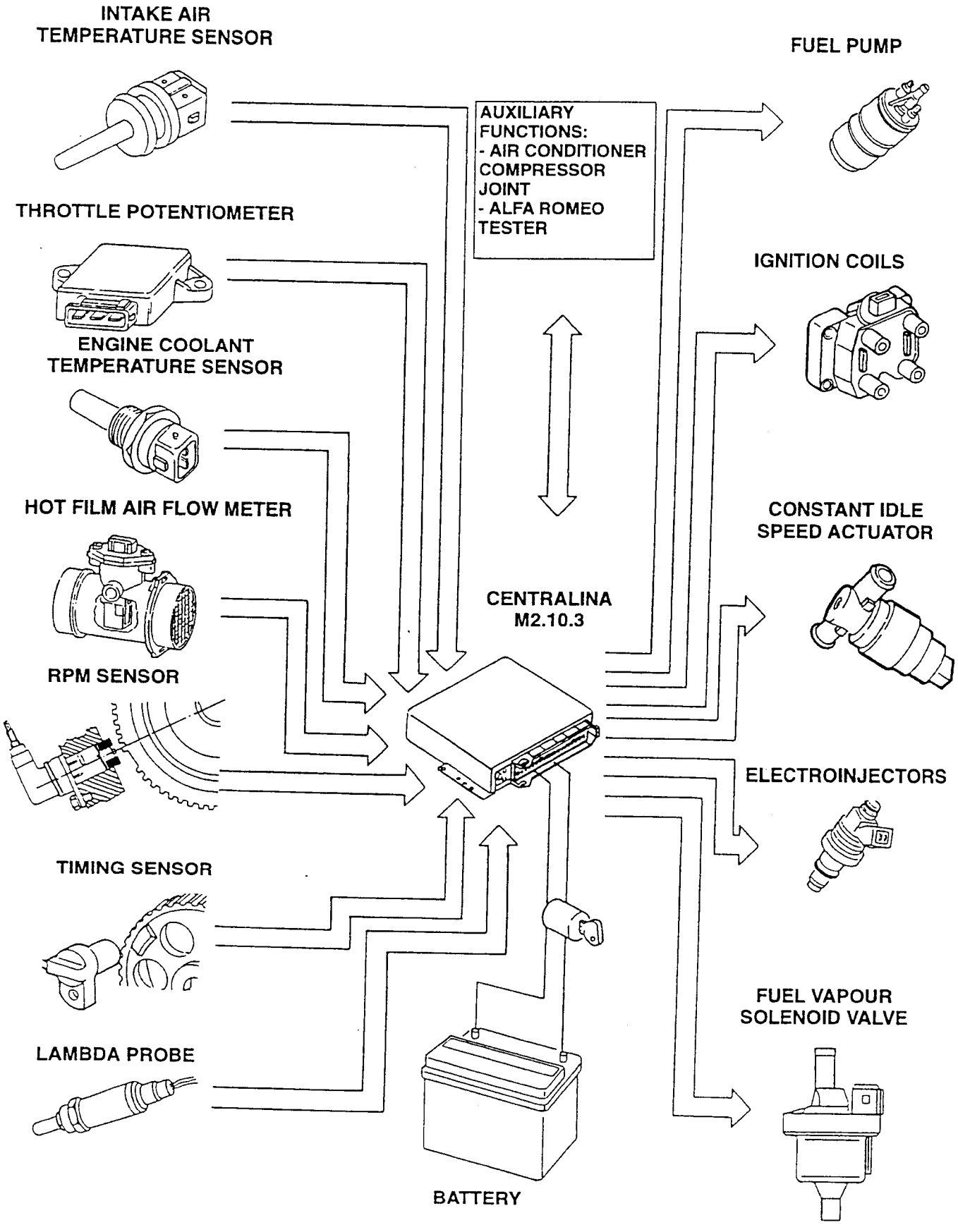
ERROR CANCELLING:
The errors stored in the control unit may be cancelled:

- after 10 times the engine is started without the error repeating.

- through the ALFA ROMEO TESTER

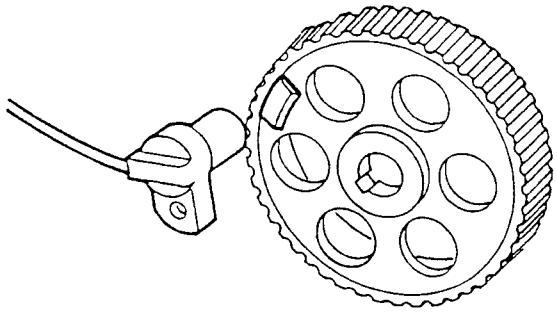
- disconnecting the power supply (battery) for a certain length of time.

OPERATING LAYOUT



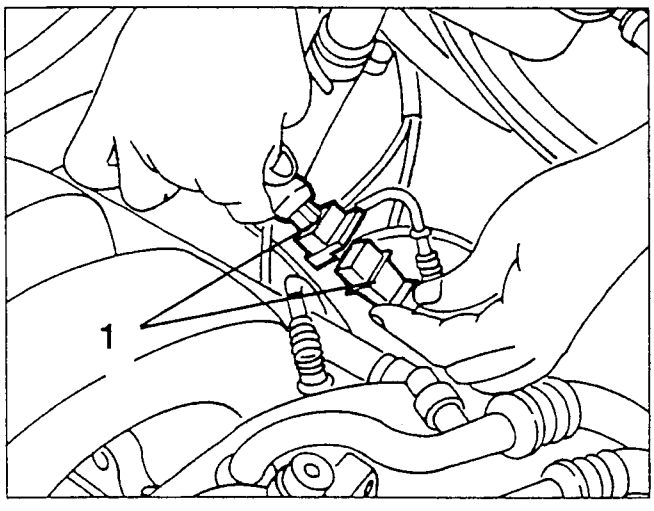
TIMING SENSOR

The timing sensor (cam angle sensor) comprises a Hall effect device.
The voltage signal "lowers" sharply when the tooth machined on the camshaft drive pulley opposite the sensor passes in front of it.

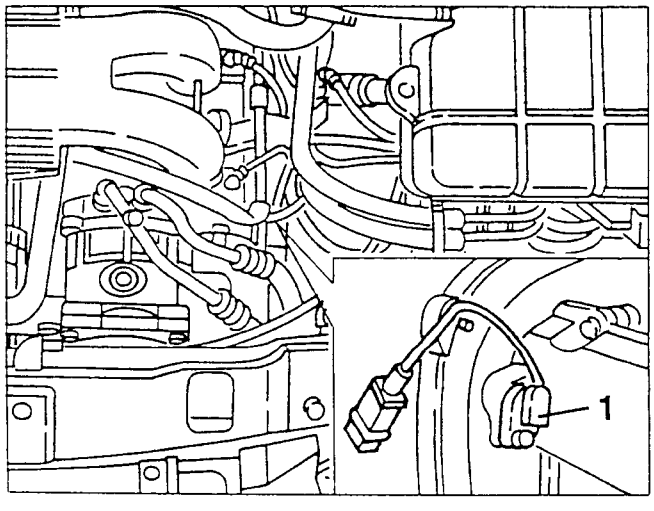


REMOVAL/REFITTING

1. Disconnect the electrical connection of the timing sensor.

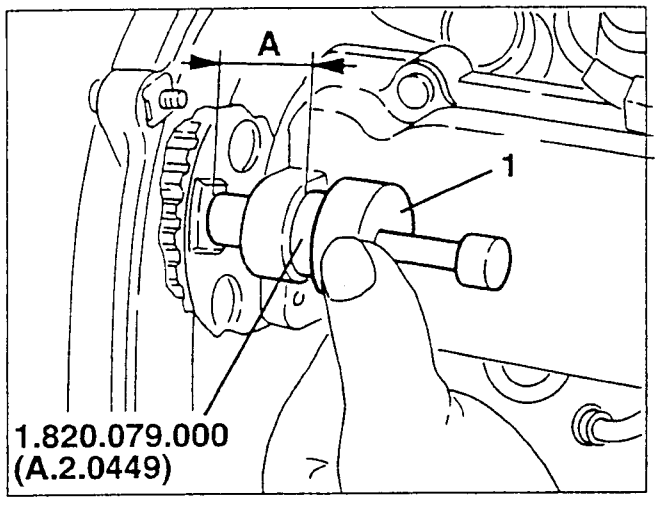


1. Slacken the fastening screw and remove the timing sensor releasing the wiring from the fastening clamps.

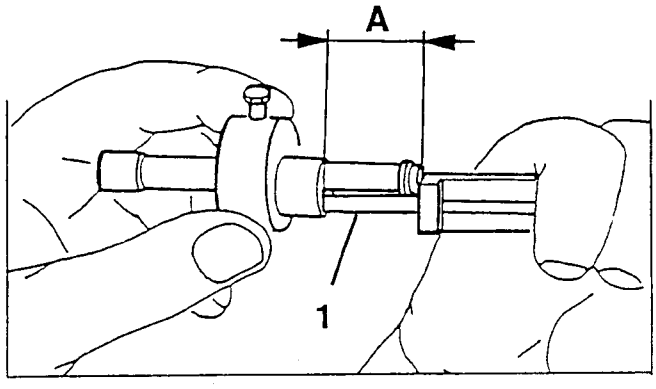


CHECKING THE AIR GAP

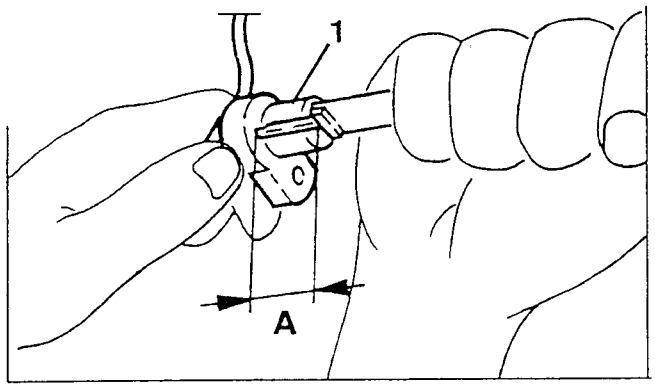
- Remove the timing sensor (see specific procedure).
1. Using tool N° 1.820.079.000 (A.2.0449), measure dimension "A".



1. Using a gauge measure dimension "A" .



1. With a dial gauge check the value of "B" on the sensor.



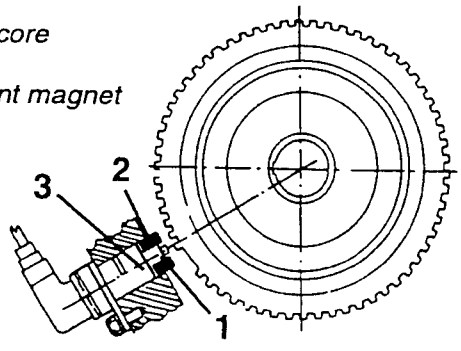
- Calculate the air gap of the timing sensor and check that it is within the specified limits.

A - B = 1.5 mm

RPM SENSOR

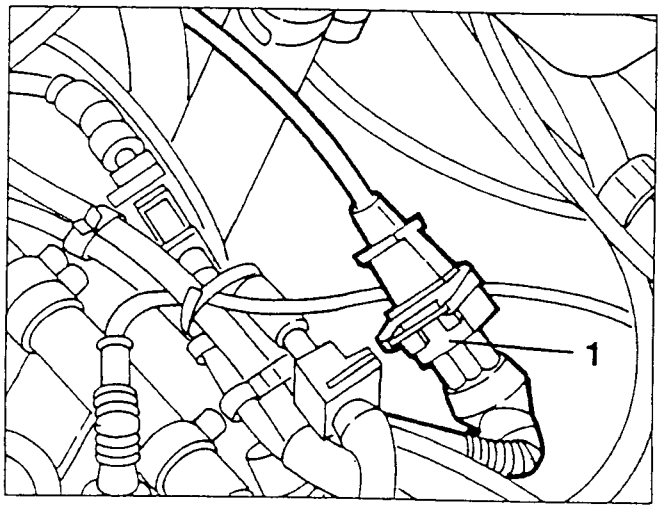
The sensor for detecting the rpm is of the inductive type which operates through the change of a magnetic field generated by the passage of the teeth of a toothed pulley (phonic wheel) fitted on the flywheel. The teeth which pass in front of the magnetic field generator change the gap between the pulley and the sensor; therefore, the dispersed flux, which consequently varies, induces an alternate sinusoidal voltage in the coils of the sensor, the amplitude of which depends on the peripheral speed of the phonic wheel, the gap between the tooth and the sensor,the shape of the teeth, the magnetic characteristics of the sensor and on the support system.
The output signal which varies in relation to the rpm is processed by the control unit to obtain a signal at each passage through zero and a constant rectangular oscillation of amplitude to enable the control of the digital circuits inside the control unit.
The interval between the start of one tooth and another is 6° with the exception of the reference mark which is made by eliminating two of the 60 teeth of the pulley.
The hollow due to the lack of two teeth gives the control unit a reference point of the crankshaft and each subsequent tooth of the phonic wheel informs the control unit of an increase in its angular position.

1. *Soft iron core*
2. *Winding*
3. *Permanent magnet*

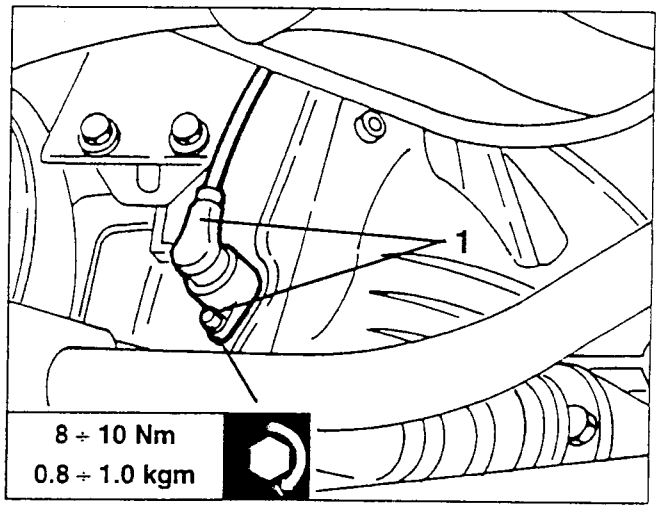


REMOVAL/REFITTING

1. Disconnect the connection of the timing sensor.

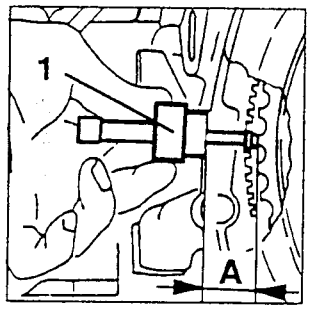


1. Slacken the fastening screw and remove the sensor.

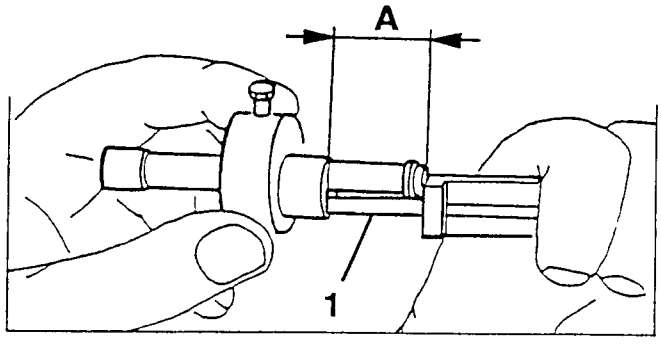


CHECKING THE AIR GAP

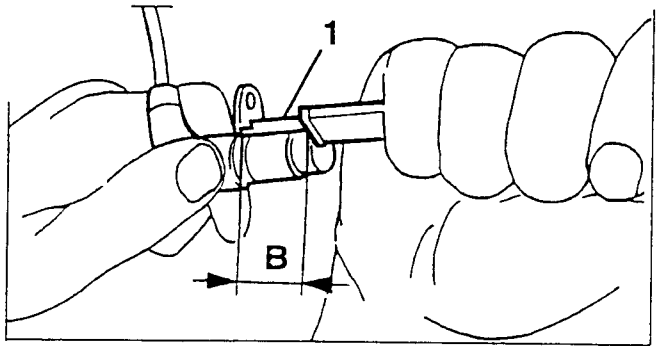
- Remove the rpm sensor (see specific procedure).
1. Using tool N° 1.820.079.000 (A.2.0449), measure dimension "A".



1. Using a gauge measure dimension "A".



1. With a dial gauge check the value of "B" on the sensor.

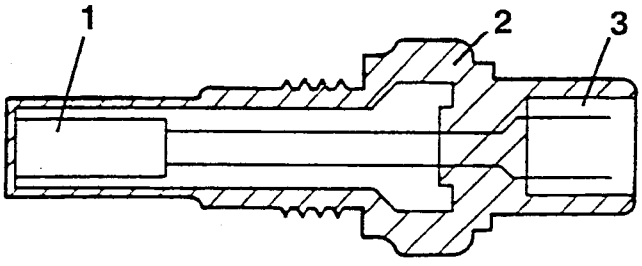


- Calculate the rpm sensor gap and check that it is within the specified limits.

A - B = 0.7 ± 0.1 mm

ENGINE COOLANT TEMPERATURE SENSOR (NTC)

This sensor detects the engine coolant temperature on the intake body through a thermistor (NTC) with a negative resistance coefficent, i.e. capable of lowering its resistance as the temperature increases.
The electric signal obtained reaches the electronic control unit where it is used to correct the air-fuel mixture.

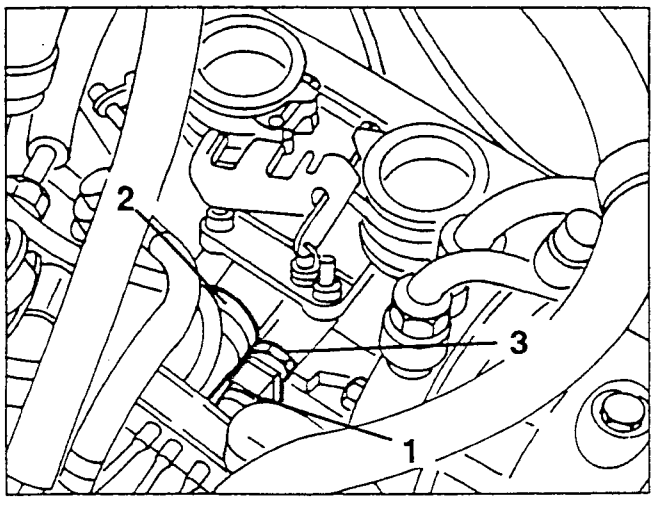


1. NTC resistance *2. Body* *3. Connector*

REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the coolant fluid.
- Remove the intake box and the throttle control shaft (see specific paragraphs).

1. Disconnect the electrical connection from the engine coolant temperature (NTC).
2. Disconnect the engine coolant pipe from the intake body.
3. Slacken and remove the engine coolant temperature sensor (NTC).



CHECKS AND INSPECTIONS

See GROUP 55 - "ELECTRIC SYSTEM DIAGNOSIS".

INERTIAL SWITCH

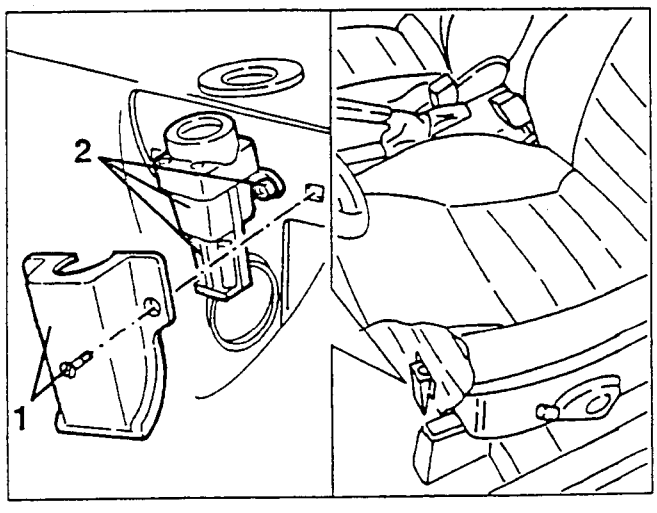
Under the driver's seat there is a safety switch which is triggered in the case of an impact, cutting off the fuel pump connection to earth, thereby also the supply to the injection system.
A steel ball fitted in a taper housing is normally held in place by the force of attraction of an adjacent magnet.
Under specific acceleration loads the ball releases itself from the magnetic force and gradually moves out of the taper support rising upwards following the angle of the taper.
A quick snap connection is fitted above the ball which forms the normally closed electric circuit.
When the mechanism is struck by the ball it changes position from a normally closed circuit to a normally open circuit interrupting the electric fuel pump earth circuit.
In the event of impact in any one of the three orthogonal directions, the switch will be triggered above 12 g peak equivalent to a speed of 25 kph.
The switch can be reset pressing the pushbutton protected by a flexible cover (this also protects against foreign particles which might prevent the switch from operating or reprogramme it.

NOTE: If after even a light crash, there is the smell of petrol or leaks are noted from the fuel supply system, do not reset the switch, but firstly seek the failure and repair it to prevent the hazard of fire.
Conversely, if there are no leaks and the car can be restarted, press the pushbutton to reactivate the fuel pump.

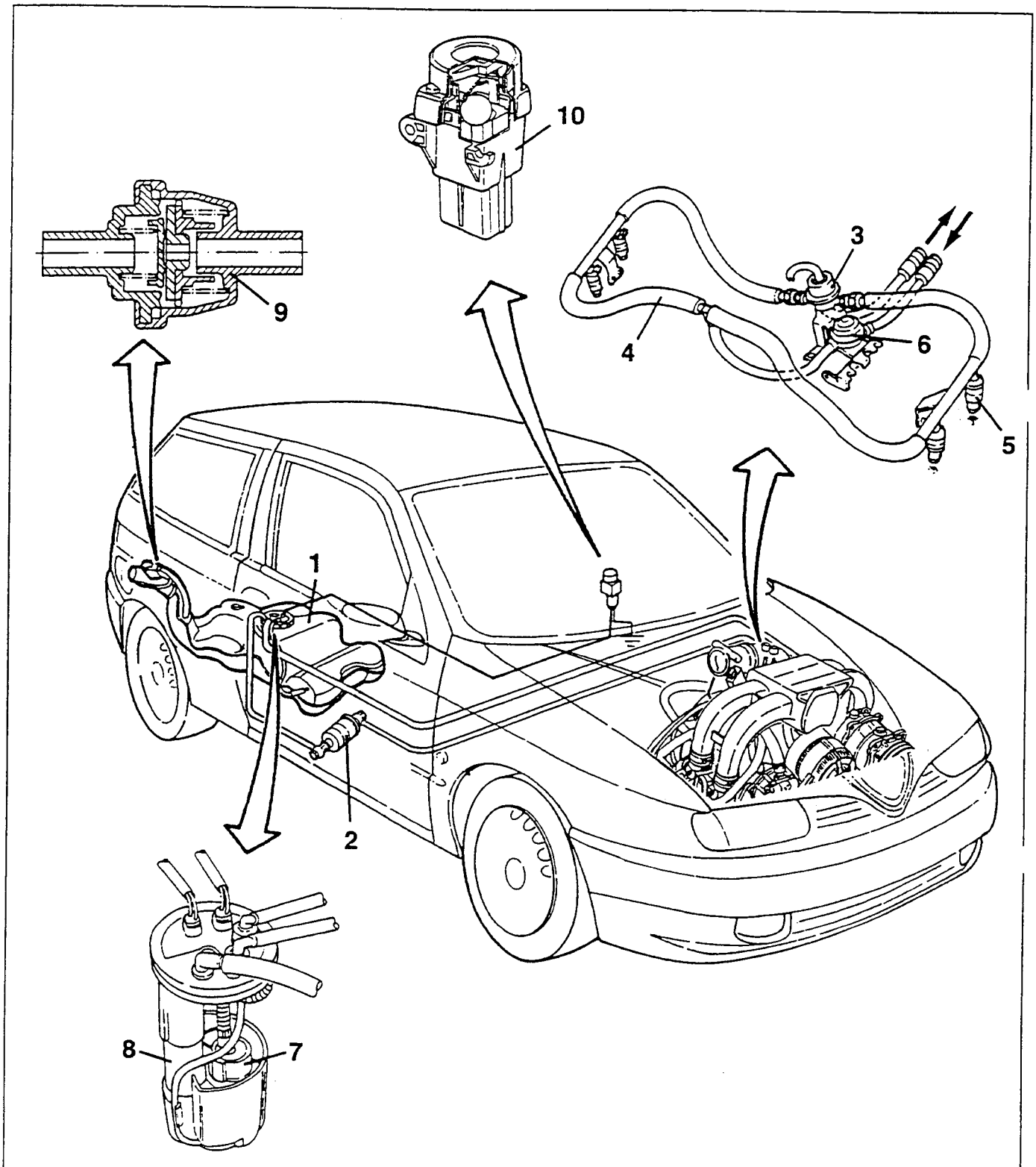
REMOVAL/REFITTING

- Disconnect the negative cable from the battery.

1. Loosen the two screws and remove the plastic cover.
2. Loosen the two screws and remove the inertial switch after disconnecting the relative connection.



FUEL SUPPLY SYSTEM DESCRIPTION



1. *Fuel tank*
2. *Filter*
3. *Pressure regulator*
4. *Distributor manifold*
5. *Electroinjectors*
6. *Pulse damper*
7. *Electric pump*
8. *Level gauge*
9. *Safet valve*
10. *Inertial safety switch*

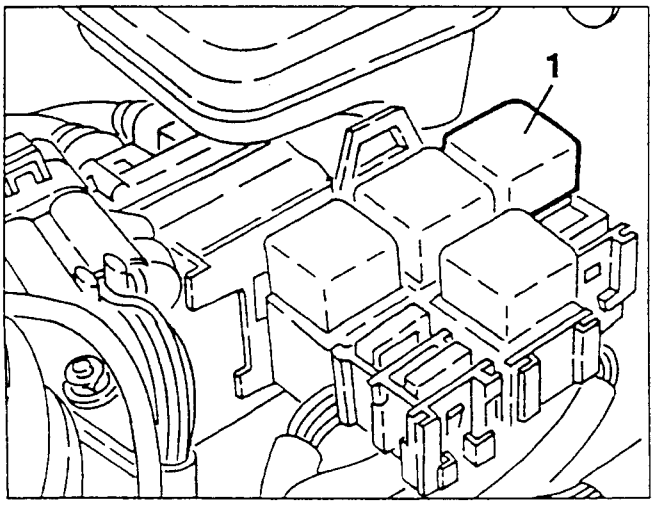
The fuel supply circuit comprises an electric pump located in the fuel tank which sends the fuel under pressure through a special hose to the filter.
From the filter the fuel is sent to the pulse damper and from this to the distribution manifold which distributes it to the injectors.
The fuel in excess returns to the tank via a special hose through the pressure regulator (controlled by the vacuum withdrawn by the idle speed air distributor).
The amount of fuel injected depends solely on the injection time which is controlled by the control unit.
The fuel supply system is fitted with an inertial switch under the driver's seat which is triggered in the event of of a crash, cutting off the connection to earth of the fuel pump thereby also the injection system supply.

Notes on serviceable fuels:
correct operation of the engine requires the use of unleaded fuels (95 R.O.N.) as the presence of lead would quickly bring about consumption of the catalytic converter at the exhaust.

WARNING

Before doing any work on components of the fuel supply system, in order to prevent any dangerous leaks, proceed as follows:
- Disconnect the fuel pump supply relay located in the injection-ignition control unit container.
- Run the engine until it cuts-out.

NOTE: On some vehicles the fuel pump relay (1) is located in the engine bay as shown in the diagram.



FUEL PIPE CONNECTION FITTINGS ("JOHN GUEST" TYPE)

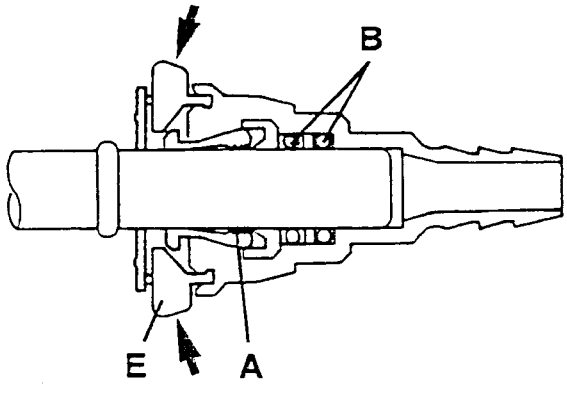
Cleaning for disconnection

Preferably use one of the following systems described in order of effectiveness.
a) Jet of warm water (max. 50°C) on the fitting and drying with jets of compressed air to prevent residual water in the interstices getting into the pipe after disconnection.
b) Jet of cold water and drying with compressed air.
c) Jet of hot water with neutral soap.
d) Jet of cold water with neutral soap.

Never use solvents and/or materials that are not compatible with the pipes in general and, for the fitting in particular, not compatible with nylon and acetolic resin.

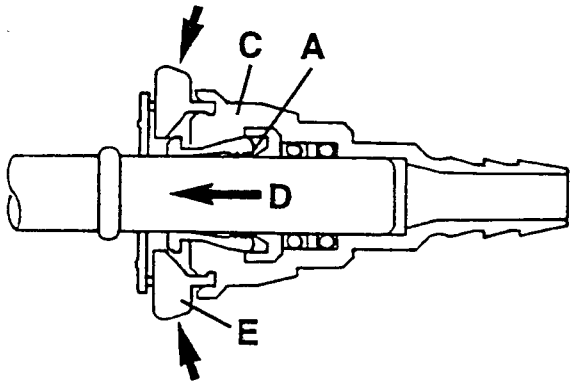
Disconnection operations

When installed, the fitting tends to act as follows for a certain length of time:
- pincer "A" grips the tang with its steel teeth. If they are in plastic the teeth might mark the tang slightly without adversely affecting tightness.
- the seals (O'Rings) "B" tend to stick to the surface of the tang in time whether it is of plastic or metal, as a result of this the coupling seems to be seized and impossible to release by only pressing the fins "E" and pulling the coupling.



Therefore, to disconnect proceed as follows:
- Turn 1/4 ÷ 1/2 of a turn to right and left several times (at least five) body "C" of the fitting in relation to the tang in order to eliminate friction of the seals on the tang and at the same time push the fitting towards the arrow "D" to loosen the grip of the pincers "A".
- Press with the fingers on the release buttons "E".
- Pull the fitting to disconnect it.

If disconnecting is still difficult, repeat these operations firstly checking that the pipe fitting is clean and that there is no mud or dirt in the interstices hindering the movement of the release mechanisms.



NOTE:
Never use pliers, screwdrivers, etc.. for disconnecting. If the coupling has not been tampered with and the above operations are correctly carried out, no tools are necessary.

FUEL PIPE CONNECTION FITTINGS ("HURON" TYPE)

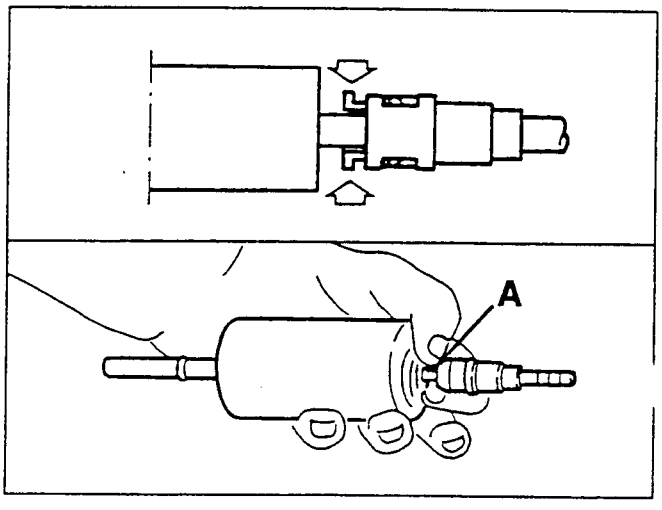
Operations to be carried out before disconnection

- Thouroughly clean the connector area with a jet of cold water (or hot, max 50°C) and dry with compressed air.
- A jet of water (hot or cold) may also be used with neutral soap.

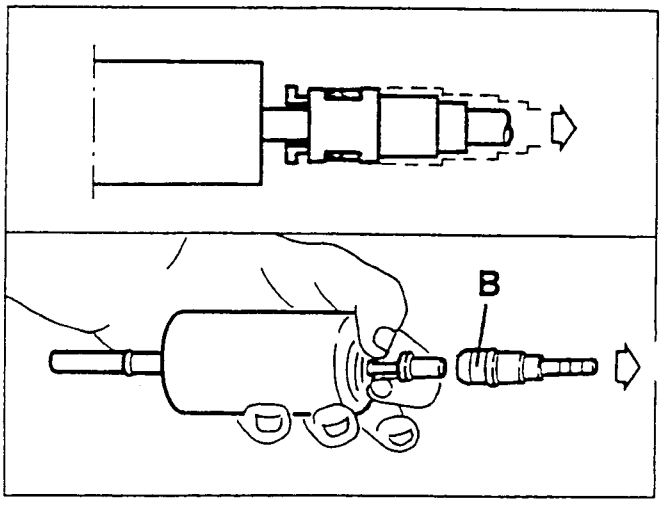
Never use solvents and/or materials that are not compatible with the pipes in general and for the connector in particular, not compatible with nylon and acetalic resin.

Operations for disconnection/connection

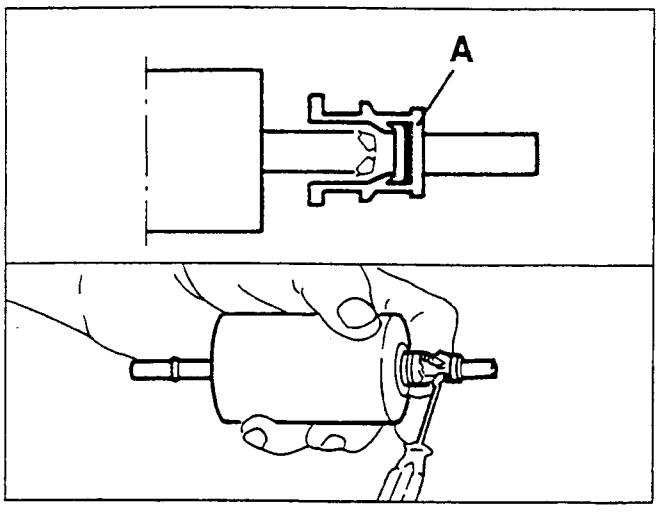
- Pinch the white transparent insert "A" between the thumb and forefinger and keep it pressed.



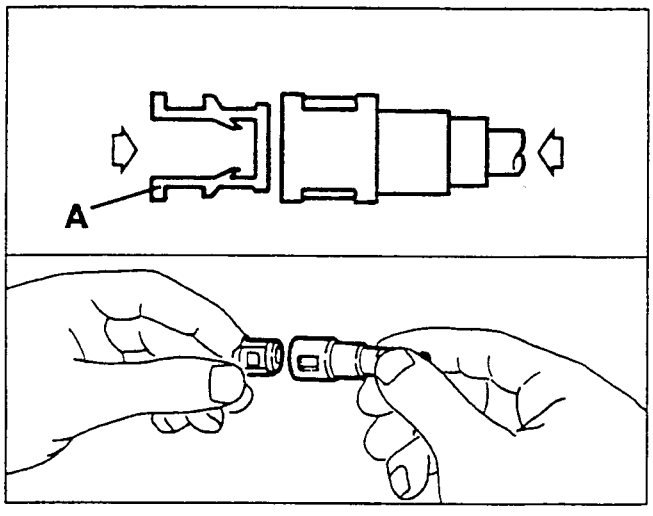
- With the other hand, grip the body "B" of the connector and pull in the direction of release.



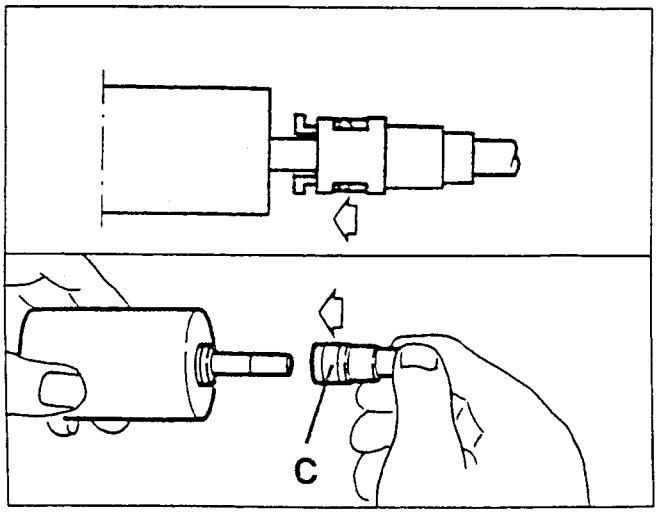
- Using a fine-tipped screwdriver in the points shown by the arrows, remove and retrieve the insert "A" taking care not to damage it.



- Refit insert "A" on the body of the quick coupling, fitted on the pipe, until it clicks meaning that it has been fitted correctly.

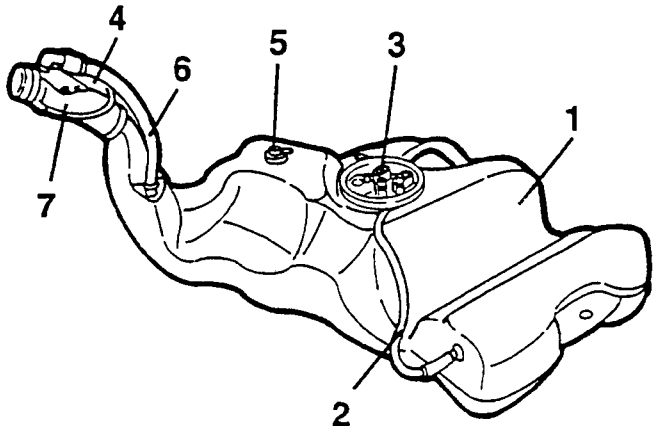


- Then connect the pipe with the quick coupling "C" pushing it until it clicks.
Try to remove the coupling to make sure that it has been installed correctly.



FUEL TANK

The fuel tank is made of plastic and has a capacity of appr. 51 litres, including a reserve of appr. 5 ÷ 8 litres.
The fuel filler neck is integrated with the main part of the tank and it is fitted with a new type of filler cap.
A mechanism inside the cap ensures that it is only tightened to the correct torque; over-tightening beyond the specified value is avoided as the cap will click past the resistance offered by the teeth.
The tank is fastened to the body on level with the luggage compartment floor and rear seat and it is shaped so that it does not interfere with the tubular frame of the rear suspension.
Due to the particular shape of the tank a pipe has been added to release the air to the upper section when filling with fuel.
The corrugated pipe on the filler prevents the fuel from splashing out.
On the filler there is also a two-way safety valve.
An opening is located in the upper section of the tank to house the pump-fuel level gauge assembly and for the multi-purpose valve.

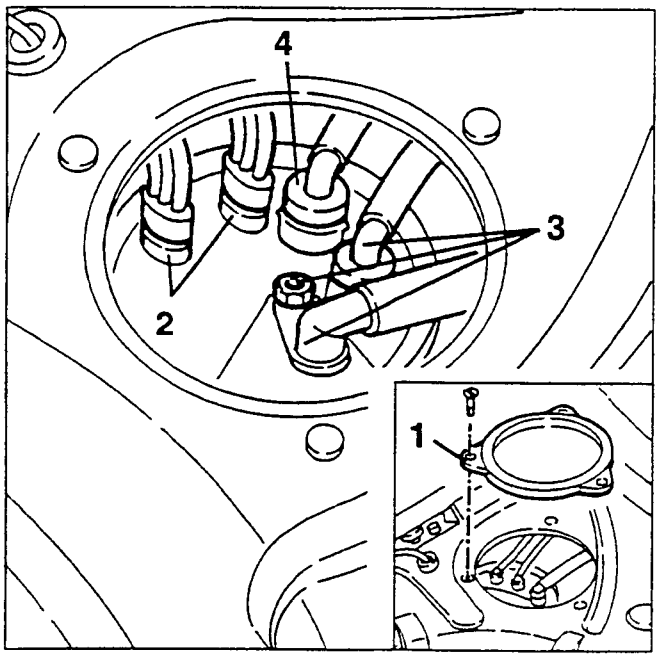


1. Fuel tank
2. Breather pipe
3. Fuel level meter pump assembly
4. Safety valve
5. Multi-purpose valve
6. Anti-bubbling tube
7. Filler neck

REMOVAL/REFITTING

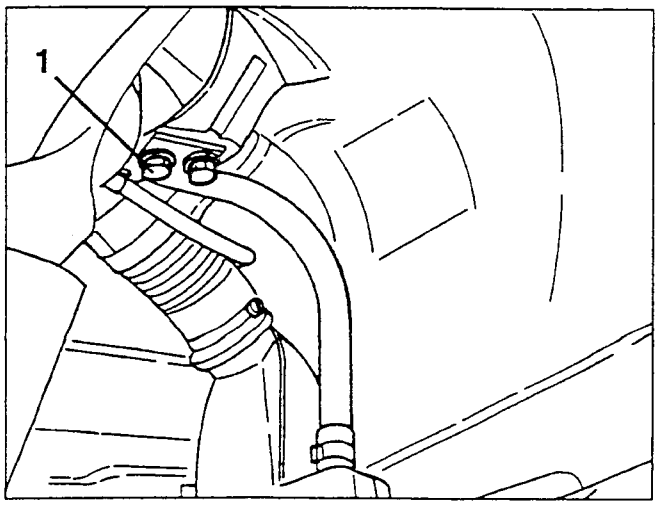
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Empty the tank by siphoning off the fuel through the filler neck using a special pump.
- Remove the right rear wheel.

1. Working in the luggage compartment tip back the covering and remove the pump access cover and fuel level meter.
2. Disconnect the two electrical connections from the pump-fuel level meter assembly.
3. Unscrew the nut on the safety plate and disconnect the connections from the fuel delivery and return hoses.
4. Unscrew the nut anf disconnect the air breather hose connecting the lower and upper parts of the tank.

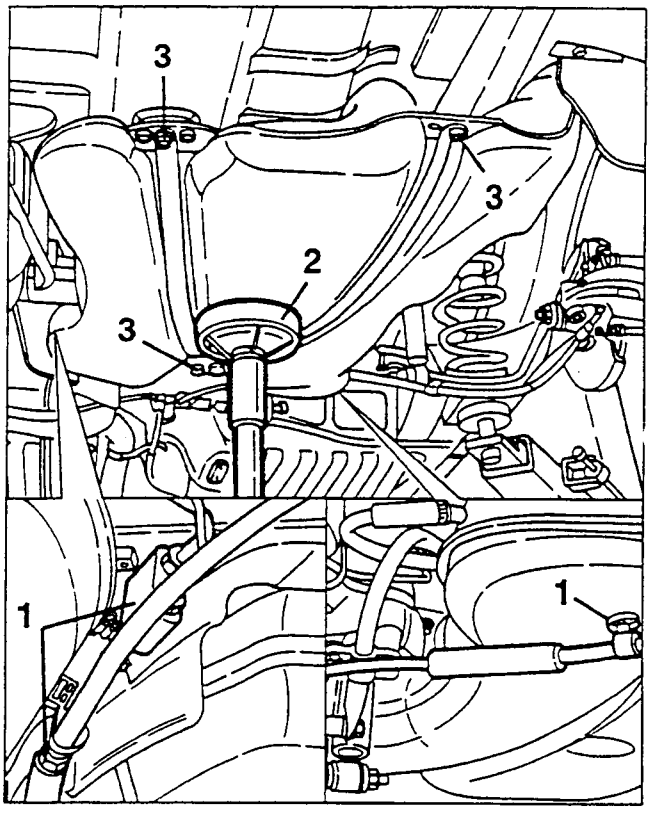


- Raise the car.

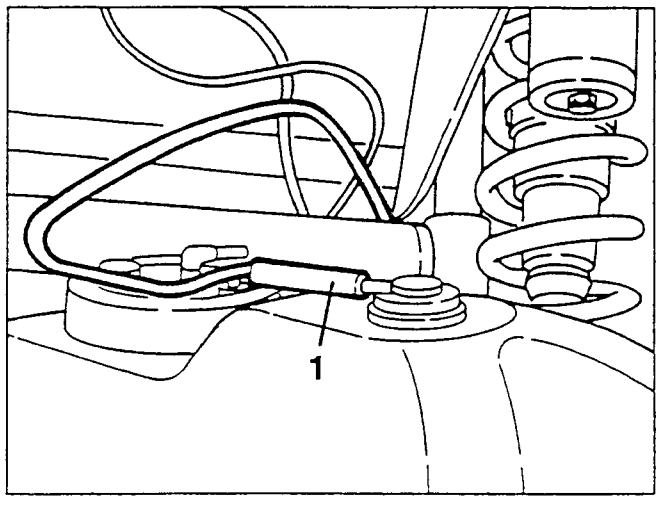
1. Working from the wheel arch, slacken the two screws fastening the filler neck.



1. Disconnect the handbrake cables and rear brake cables from their fastenings on the fuel tank.
2. Position a hydraulic jack under the tank.
3. Remove the plastic buttons and slacken the fuel tank fastening screws.

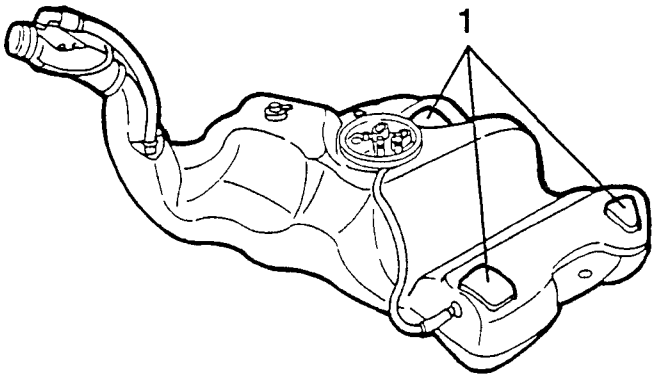


1. Lower the fuel tank using the hydraulic jack just enough to disconnect the fuel vapour breather valve from the multi-purpose valve.



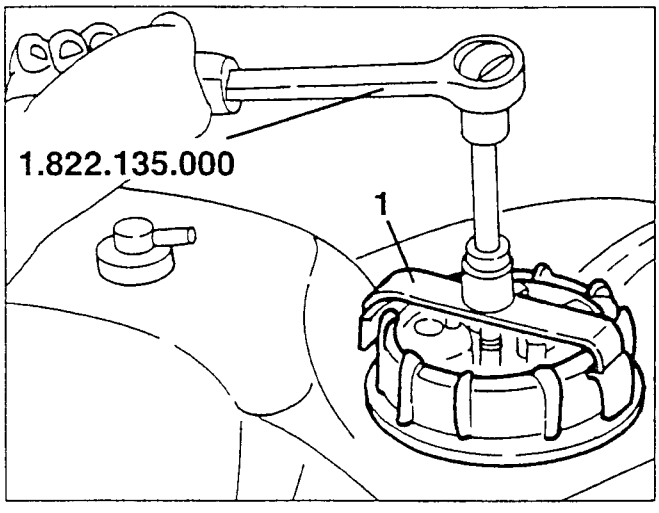
- Completely lower the hydraulic jack and remove the fuel tank.

When refitting the fuel tank check the presence of the rubber pads (1).

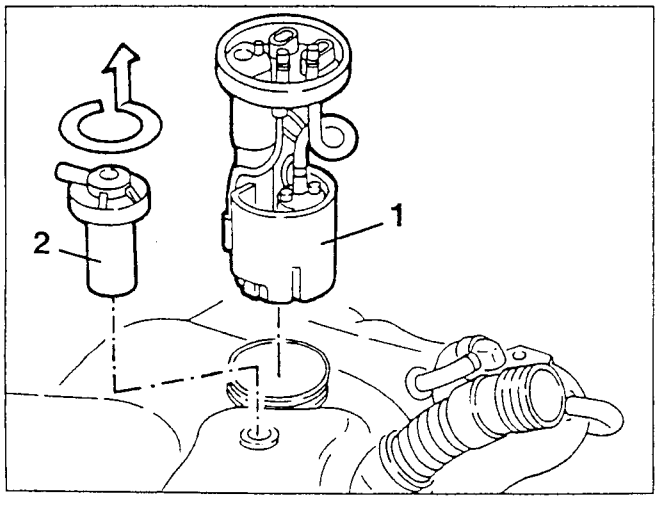


DIS-ASSEMBLY/REASSEMBLY

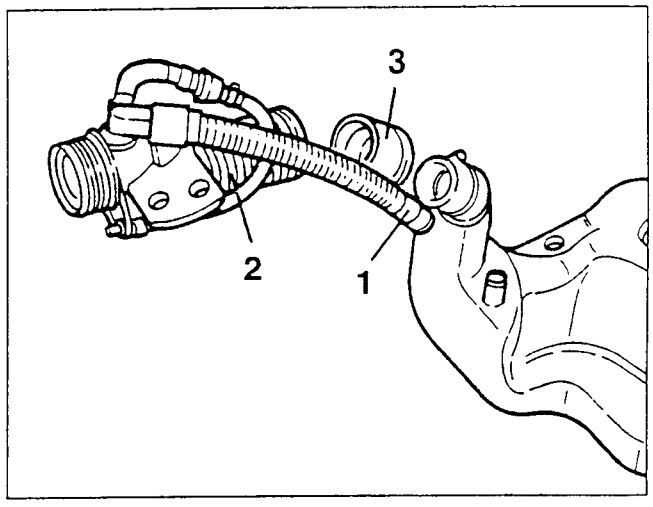
1. Remove the ringnut fastening the pump unit and fuel level gauge using tool N° 1.822.135.000.



1. Remove the fuel pump unit from the fuel tank.
2. Remove the multi-purpose valve from the fuel tank.



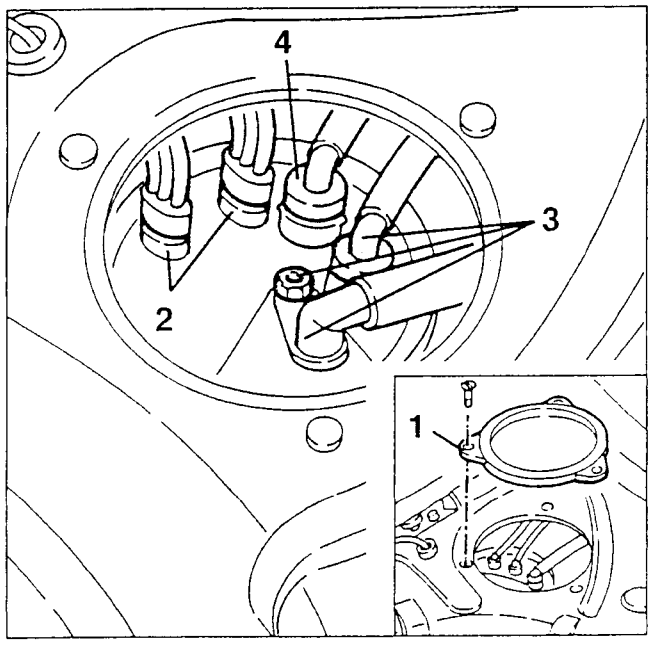
1. Disconnect the anti-bubbling pipe from the fuel tank.
2. Slacken the clamp and remove the fuel filler neck complete.
3. Remove the seal.



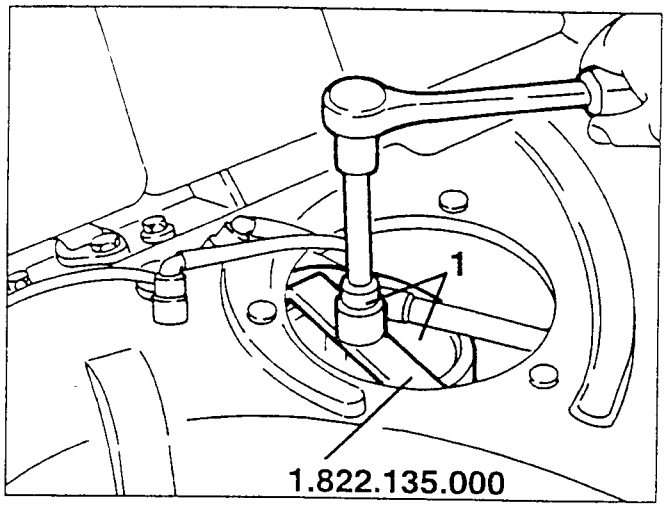
FUEL LEVEL METER-PUMP ASSEMBLY

REMOVAL/REFITTING

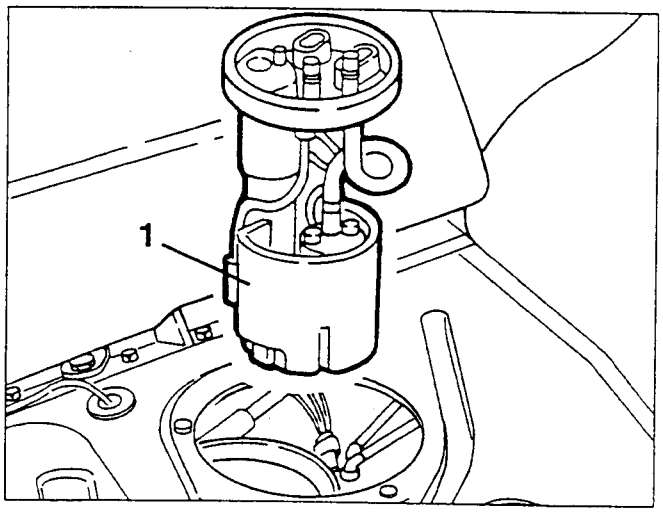
- Disconnect the negative cable from the battery.
1. Working in the luggage compartment tip the covering back and remove the fuel pump assembly access cover.
2. Disconnect the two electrical connections from the pump - fuel level meter assembly.
3. Disconnect the unions from the fuel delivery and return hoses.
4. Unscrew the nut and disconnect the air breather hose connecting the upper and lower parts of the fuel tank.



1. Remove the ring nut securing the fuel pump using tool 1.822.135.000.

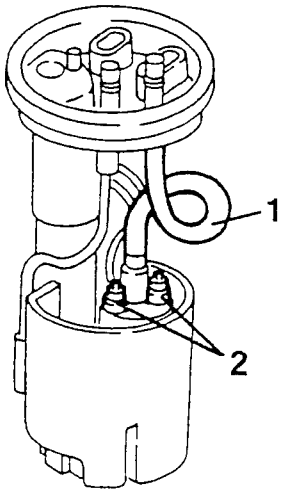


1. Withdraw the pump-fuel level meter assembly from the tank together with the gasket.

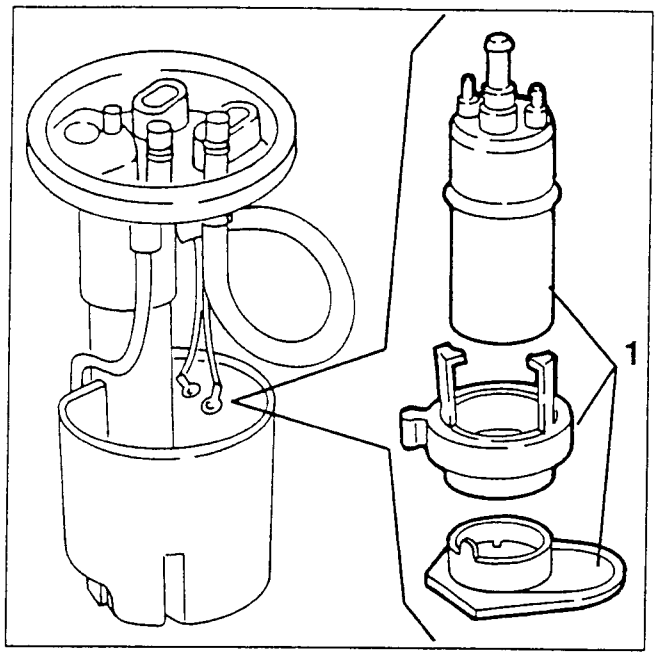


REMOVAL/REFITTING

1. Disconnect the fuel delivery hose from the electric pump.
2. Disconnect the two electrical connections from the electric pump.



1. Withdraw the electric pump with the intake filter and the support ring and if necessary separate them.



CHECKS AND INSPECTIONS

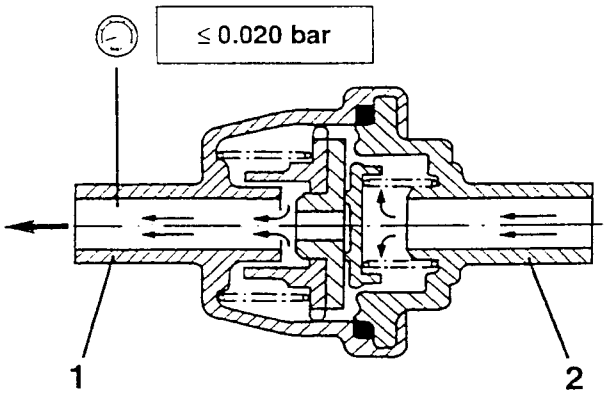
Clean the gauze filter thoroughly.
The presence of water in the fuel is particularly damaging to the pump as it causes internal rust. Carefully check the operation of the pump if the fuel is contaminated with water.
Also check the efficiency of the pump power supply contacts as any oxidation would cause a drop in voltage at the leads, resulting in the formation of bubbles and a reduction of the fuel injected.

WARNING:
When changing the pump, remember that it is supplied filled with protective oil and with the fittings suitably plugged. When assembling on the car it is not necessary to empty the oil from the pump as it is burnt immediately by the engine. If the protective oil is emptied fom the pump, it must be put into service within two weeks in order to prevent the formation of a film of dry oil on the motor collector which would make it unserviceable due to lack of electrical continuity.

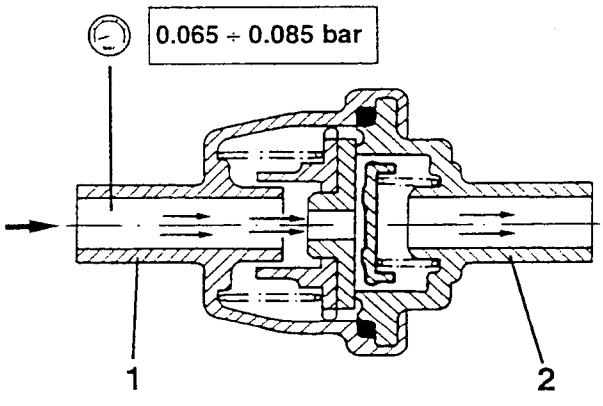
SAFETY VALVE

The purposes of this valve are the following:
- Ventilation of the fuel tank (together with the multi-purpose valve of the fuel vapour recirculation system)
- Fuel vapour release (only if the multi-purpose valve fails to operate).

The vacuum in the fuel tank determined by the withdrawal of fuel is countered by the opening of the safety valve set at ≤ 0.020 bar.



If the pressure inside the fuel tank exceeds 0.065 ÷ 0.085 bar, the valve opens to relieve part of the fuel vapour pressure to the atmosphere.

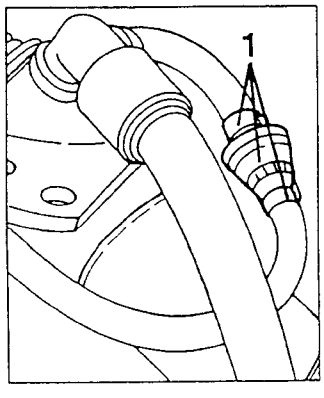


1. Fuel tank side 2. Atmosphere side

REMOVAL/REFITTING

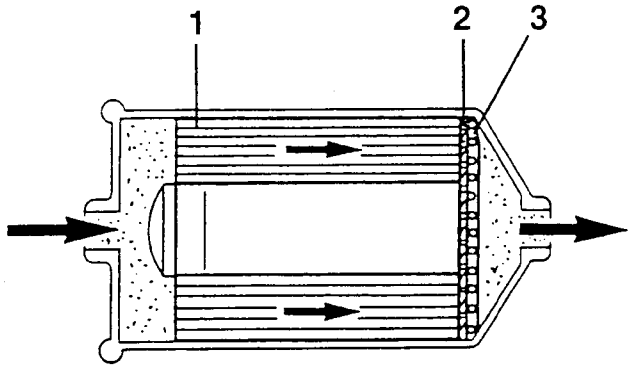
- Remove the right rear wheel.

1. Working from the right rear wheel arch, slacken the fastening clamps and remove the safety valve.



FUEL FILTER

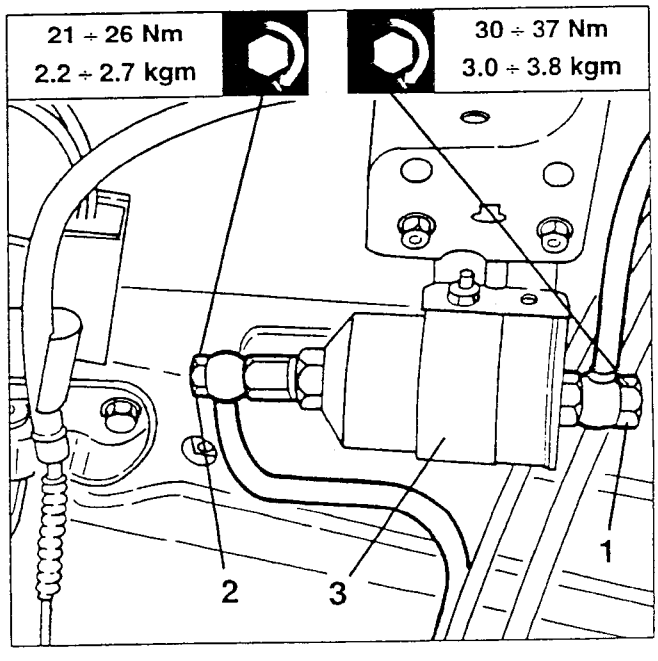
The filte is inserted in the fuel delivery pipe to the injectors, under the car floor, next to the fuel tank.
It is formed of an outer aluminium cover and an inner polyurethane support which carries a paper element with a high filtering power (~ 5 mm) and a surface of appr. 1400 cm^2.
Fuel filtering is indispensible to ensure correct operation of the electronjectors, given their sensitivity to foreign particles contained in the fuel circuit.
There is an arrow on the outer filter cover which indicates the direction in which the fuel flows and therefore the correct assembly position.



1. Paper filter 2. Fabric filter 3. Mesh

REPLACEMENT

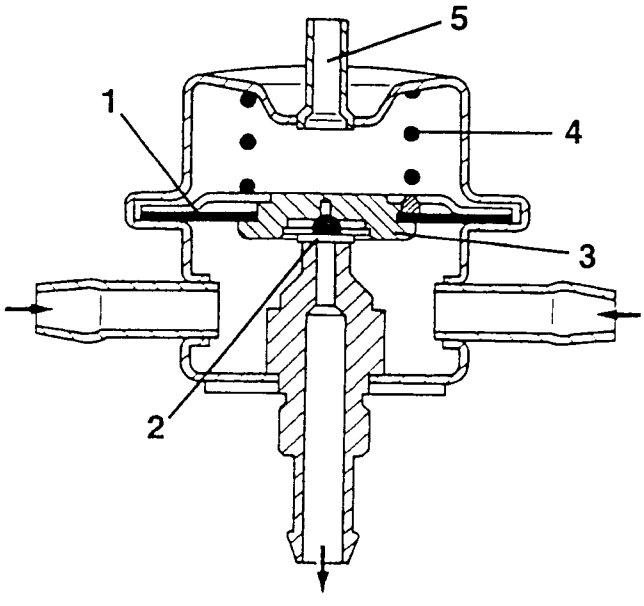
1. Disconnect the fuel inlet pipe fitting from the filter.
2. Disconnect the fuel outlet pipe fitting from the filter.
3. Slacken the fastening clamp and remove the fuel filter.



- Fit a new filter reversing the sequence described for removal and adhering to the following instructions:
• change the copper fitting seals;
• install the filter with the arrow stamped on it pointing in the direction of the flow of the fuel.

FUEL PRESSURE REGULATOR

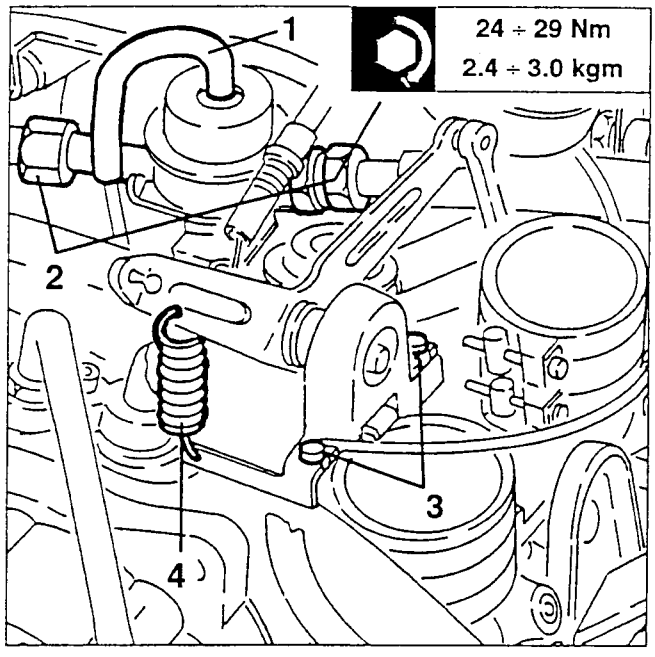
The task of the fuel pressure regulator is to keep the difference between the pressure of the fuel and the pressure in the intake manifold constant.
This way it is possible to meter the amount of fuel solely on the basis of the injector opening time.
The pressure regulator is fitted downstream of the fuel distributor manifold.
It is a limiting regulator controlled by a diaphragm which regulates the fuel pressure to 3 bar.
When the fuel pressure exceeds the maximum rating, the diaphragm acts on a valve which opens the return pipe, through which the excess fuel is returned to the fuel tank.
A tube connects the regulator spring chamber to the idle speed air distributor.
An interdependence is created by this tube between the pressure in the fuel system and the pressure in the intake manifold, so that the pressure between the inlet and outlet of the electroinjectors is always the same.



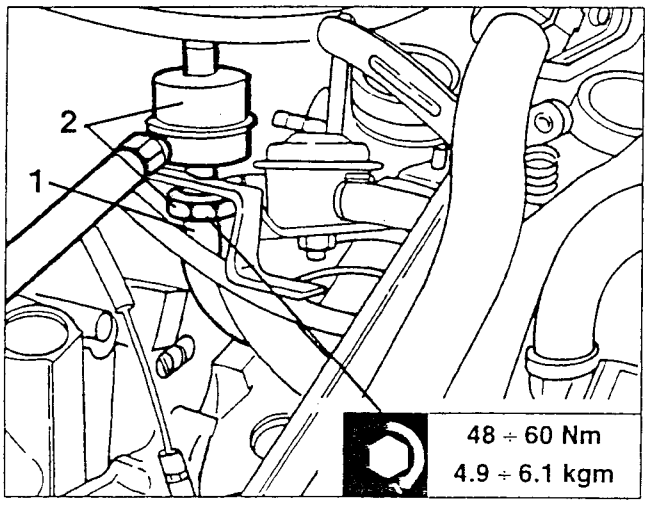
1. Diaphragm
2. Valve
3. Valve holder
4. Compression spring
5. Connection for vacuum takeoff

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the intake box (see specific paragraph).
1. Disconnect the vacuum takeoff pipe from the fuel pressure regulator.
2. Disconnect the fuel distributor fittings from the fuel pressure regulator.
3. Slacken the two nuts fastening the fuel pressure regulator and pulse damper support bracket.
4. Disconnect the throttle control shaft return spring.

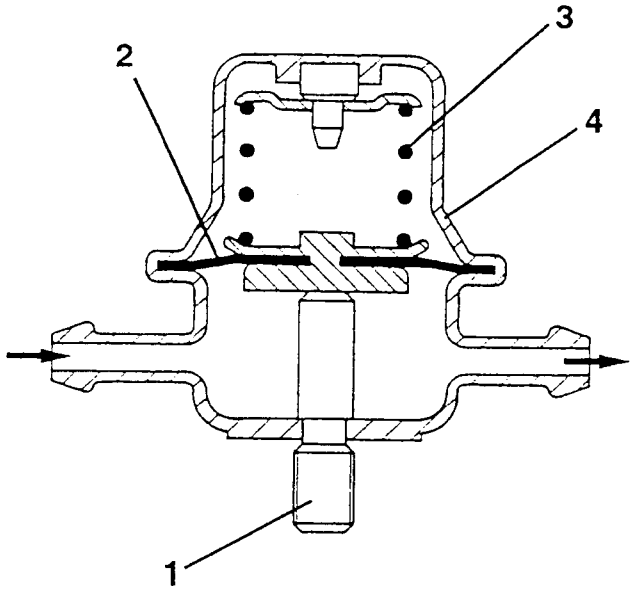


1. Raise the support bracket just enough to disconnect the excess fuel return pipe to the tank from the regulator.
2. Loosen the nut and remove the fuel pressure regulator.



PULSE DAMPER

The pulse damper is connected upstream of the fuel distributor and it serves to suppress the pulsing noises that can occur at low engine rpm.
The pulsing is generated by pressure differences of the fuel arising from the opening and closing of the electroinjectors or of the pressure regulator.

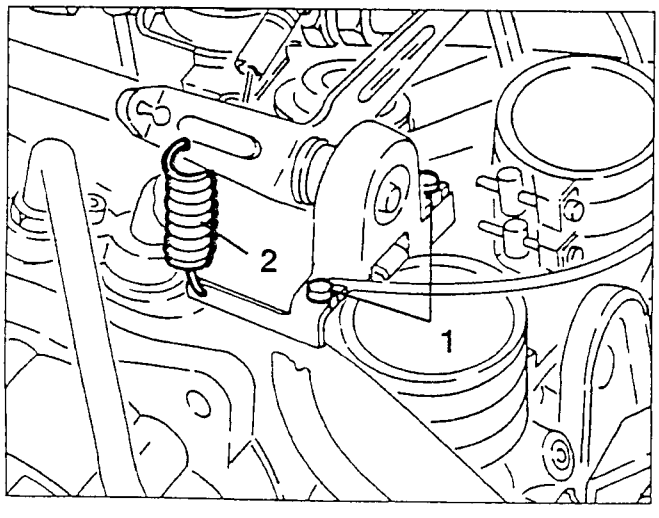


1. Fastening pin
2. Diaphragm
3. Spring
4. Covering

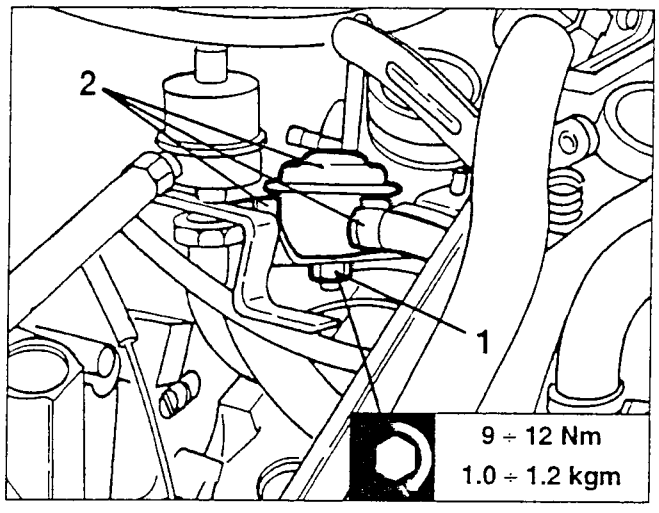
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Remove the intake box (see specific paragraph).

1. Slacken the two nuts fastening the pulse damper and fuel pressure regulator support bracket.
2. Disconnect the throttle control shaft return spring.

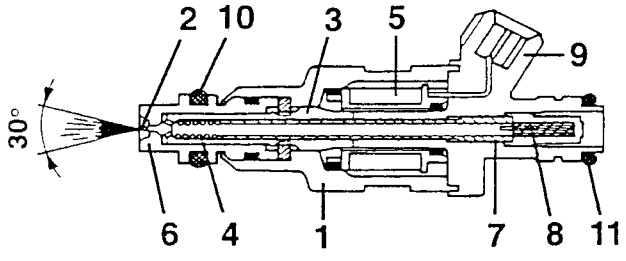


1. Turn the support bracket just enough to slacken the pulse damper fastening nut.
2. Raise the damper, disconnect the two fuel pipes and remove it.



ELECTROINJECTORS

The electroinjectors are installed on the bodies, immediately upstream of the intake valves.
The injector nozzle is formed so that the jet of fuel atomizes into a 30° cone.
The injectors are locked by the fuel distributor which presses them into their housings.
The injectors are also anchored to the fuel distributor by "safety catches".



1. Injector body
2. Needle
3. Magnetic core
4. Coil spring
5. Winding
6. Injector nose
7. Adjustable spring plate
8. Filter
9. Electrical connector
10. Vacuum seal ring
11. Fuel seal ring

Two O-rings ensure tightness on the intake bodies and on the fuel distributor manifold.
The electroinjectors have the task of metering the amount of fuel needed by the engine.
They are "all or nothing" devices i.e. they only have two possible conditions, either open or closed.
They will let the fuel pass when they are "open" and prevent it from being delivered when they are "closed".

They basically comprise a nozzle or ring controlled by an electromagnet and by a return spring.
In the rest position, the needle, which forms one piece with the core, is pushed by the spring onto the electroinjector nose to close the hole and ensure that unwanted fuel is unable to come out.
As soon as the winding is energized, the core is attracted, it compresses the spring opening the nozzle hole, thereby allowing the fuel to flow out.
Considering the physical characteristics of the fuel (viscosity, density) and the pressure difference (pressure regulator) constant, the amount of fuel injected depends on the injector opening time only.
The winding energizing time is normally called the "injection time".
Lastly, on the injector body there is a two-pin socket for electrical connection to the system.

CHECKING FOR CORRECT OPENING OF ELECTROINJECTORS

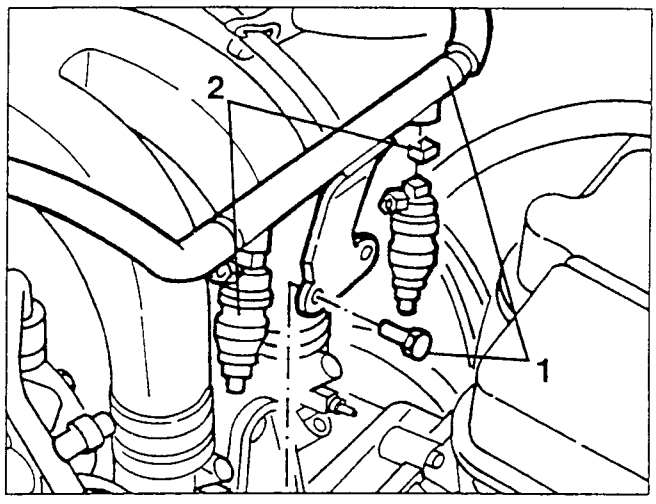
- Measure the percentage of CO at the exhaust.
- Disconnect the electroinjector connectors one by one; each time measure for a reduction of the CO percentage at the exhaust and check that this value remains constant at each check.
- If not, locate and replace the faulty electroinjector;
The efficiency of the electroinjectors can be checked visually by comparing the spark plug electrodes:
• a mixture which is too rich will be associated with a black colour.
• a mixture which is too lean will be associated with a light colour.

CHECKING THE SEALING OF ELECTROINJECTORS

- Remove the electroinjectors complete with fuel distributor manifold, keeping the fuel supply circuit connected.
- Disconnect the connectors from the electroinjectors.
- Operate the starter motor and check that there are no leaks of fuel from the electroinjectors; if so, replace the faulty injector.

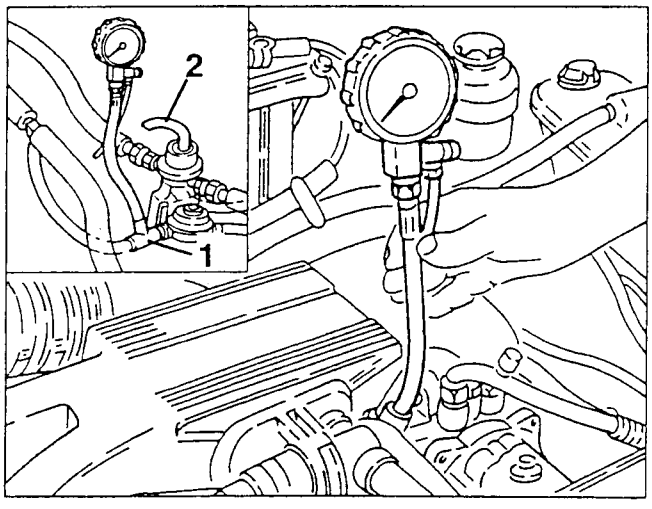
REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
- Disconnect the electrical connections from the electroinjectors.
1. Slacken the screws fastening the fuel distributor manifold and remove it.
2. Remove the fastening clips and remove the electroinjectors.



CHECKING THE PRESSURE AND TIGHTNESS OF THE FUEL CIRCUIT

- Remove the intake box (see specific paragraph).
1. Disconnect the fuel outlet pipe from the pulse damper, then connect a pressure gauge using a T adapter between the damper and the disconnected pipe.
2. Disconnect the vacuum takeoff pipe from the pressure regulator to avoid any irregularities in the rotation speed from causing abnormal readings.
- Refit the intake box, start the engine and at idle speed, check that the fuel pressure is within the specified limits.

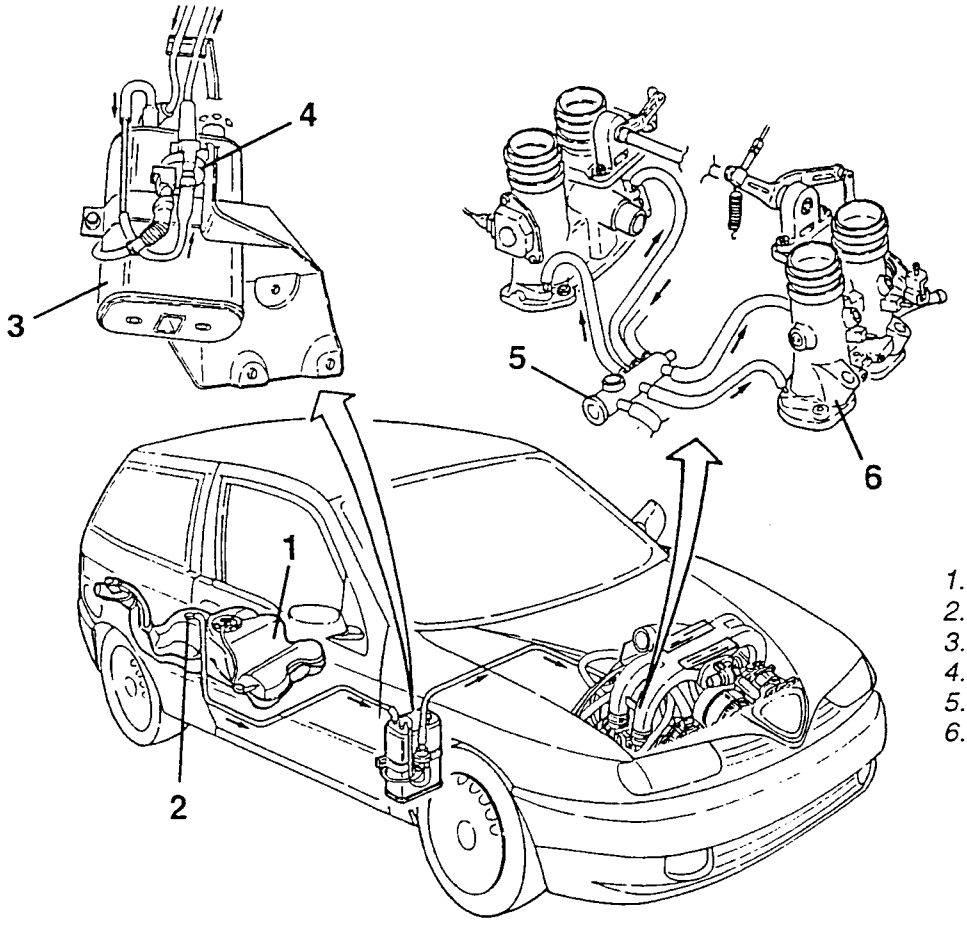


Fuel pressure at idle speed
2.8 ÷ 3.2 bar

- Reconnect the vacuum takeoff pipe to the pressure regulator and check that the fuel pressure falls by 0.5 bar and then rises again when the throttle valve is opened. If this fails to take place, look for leaks on the vacuum takeoff pipe.

- Keeping the vacuum takeoff pipe connected to the regulator and with the engine running at idle speed, choke the fuel outlet pipe from the regulator measuring the pressure increase up to 4 bar (avoid letting the pressure exceed this value).
- If the pressure fails to reach the above value and there are no leaks, check the fuel filter and/or the operation of the pump.

DESCRIPTION FUEL VAPOUR RECOVERY SYSTEM



1. *Fuel tank*
2. *Multi-purpose valve*
3. *Vapour filter (canister)*
4. *Solenoid valve*
5. *Idle speed air distributor*
6. *Intake bodies*

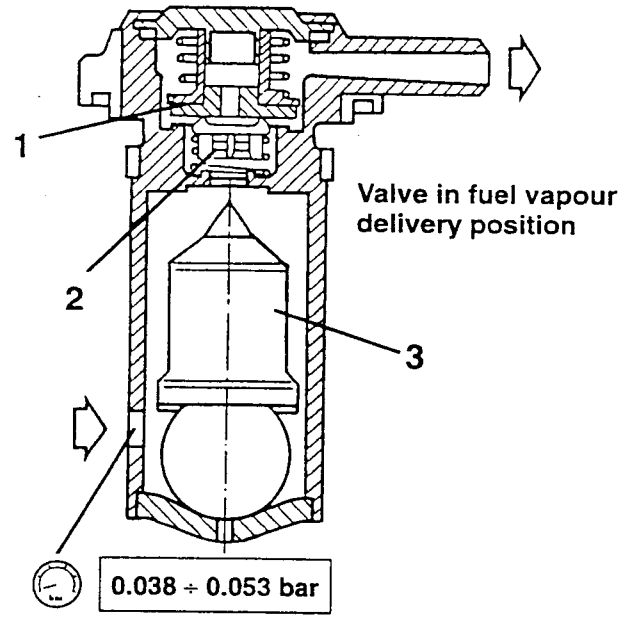
The fuel contained in the tank produces a considerable amount of vapours, which would pollute the environment if released.
The vapour control and recovery system gathers these vapours and burns them in the engine.
When the vapours inside the fuel tank reach a pressure of 0.038 ÷ 0.053 bar, they are sent through a multi- purpose valve to the fuel vapour filter canister where they are absorbed and stored by the active carbon contained in the filter.
There is a solenoid valve between the fuel vapour filter and the engine intake. When the solenoid valve is not activated the connection with the intake is closed and the fuel vapours are collected in the canister in the active carbon.
Under certain load conditions the control unit controls the opening of the solenoid valve allowing any fuel vapours in the canister to be withdrawn.

This condition remains even if at the exhaust the lambda sensor detects a reduction of oxygen which, due to the presence of too much fuel in the combustion chamber, is signalled to the control unit which delivers less fuel to the injectors so that the engine is always supplied normally.
Vice-versa, if the lambda sensor detects an increase of the oxygen, due to the lack of fuel vapours in the canister which leads the canister to draw in air, the control unit is signalled.
In this case the control unit closes the solenoid valve thus preventing the connection of the canister with the intake.

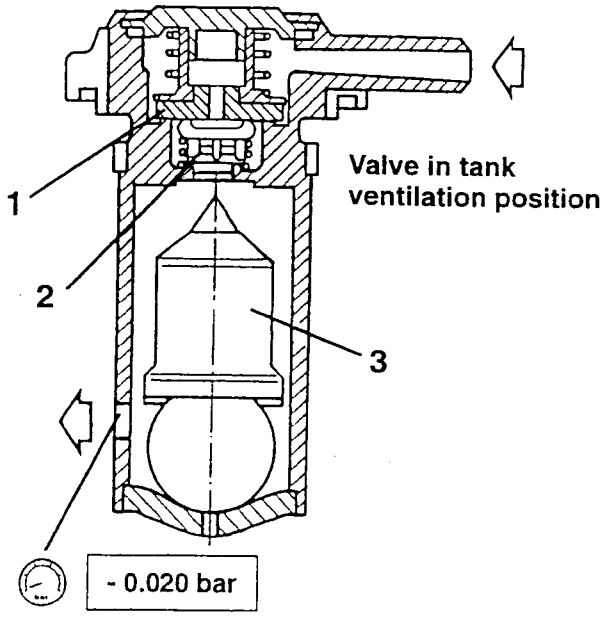
MULTI-PURPOSE VALVE

The purposes of this valve are:
- To send the fuel vapours to the canister
- Ventilate the fuel tank
- Prevent the fuel from spilling

When the pressure of the vapours in the tank reaches 0.038 ÷ 0.053 bar, a diaphragm countered by a spring allows them to be released to the canister.

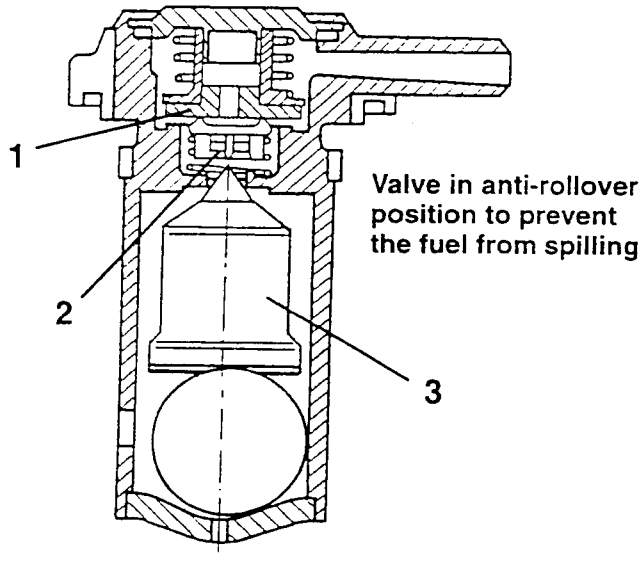


To ventilate the tank with vacuum ratings below -0.020 bar, a centre cup acts on the above-mentioned diaphragm countered by another spring and lets air into the tank.



1. Fuel vapour relief valve to canister
2. Tank ventilation valve
3. Needle valve

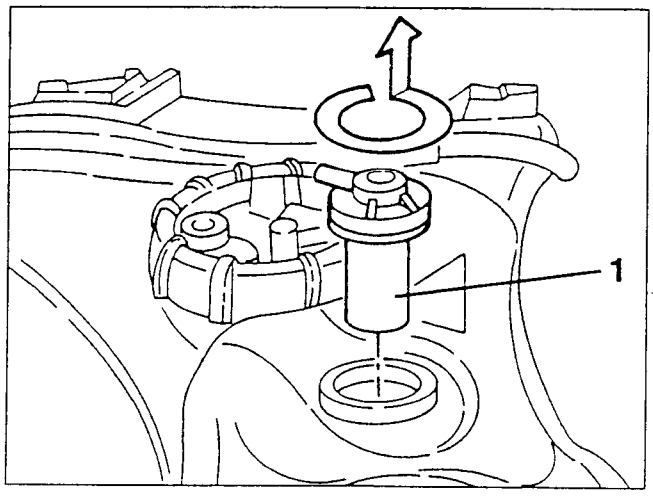
In the lower part of the body there is a taper housing on which a ball of suitable weight is housed. This ball rolls on its housing and under the centrifugal thrust received from the car, it raises and closes a needle valve to prevent the fuel from spilling when the car sways and when it is parked on sloping ground.
The needle valve also acts as an anti-rollover valve.



REMOVAL/REFITTING

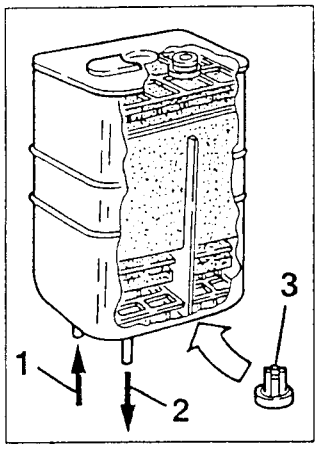
- Remove the fuel tank (see specific paragraph).

1. Remove the multi-purpose valve from the fuel tank.



FUEL VAPOUR FILTER (CANISTER)

The filtering element comprises active carbons enclosed in a plastic container which absorb the fuel vapours leading from the fuel tank.

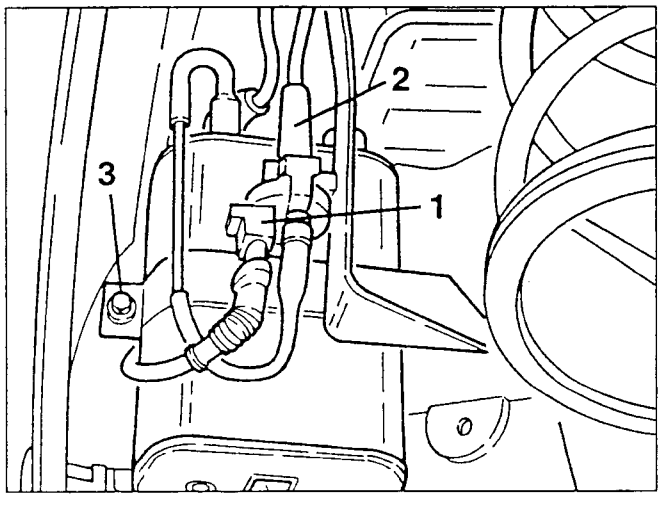


A one-way valve admits outside air when the vapours are sucked in. This is to carry out a washing action on the active carbon.
It is possible to test the tightness of the system connecting as described in the specific procedure to the housing of the one-way valve after removing the valve.

1. From the multi-purpose valve
2. To the solenoid valve
3. One-way washing valve

REMOVAL/REFITTING

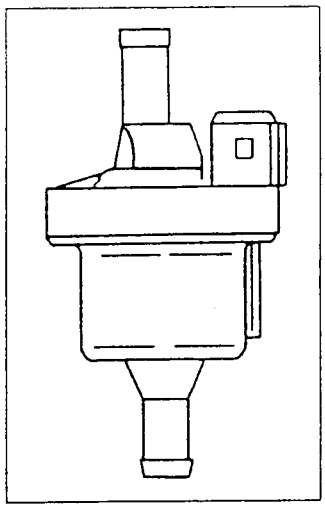
- Remove the right front wheel and wheel arch (see GROUP 70).
1. Disconnect the electrical connection from the fuel vapour solenoid valve.
2. Disconnect the vapour delivery pipe to the engine intake from fuel vapour solenoid valve.
3. Slacken the screw of the fuel vapour filter fastening clamp.



- Lower the fuel vapour filter just enough to disconnect the fuel vapour inlet pipe, then remove the filter.
- On the bench, separate the solenoid valve complete with connection pipe from the fuel vapour filter.

FUEL VAPOUR SOLENOID VALVE

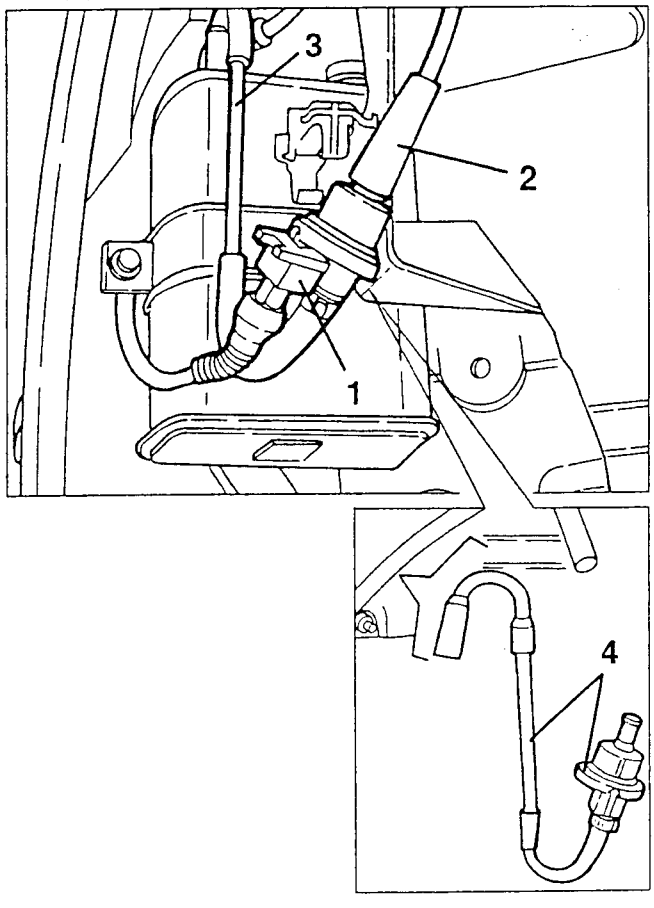
This valve is controlled by the Motronic control unit and its purpose is to let the fuel vapours stored in the canister pass through to send them to the engine intake.



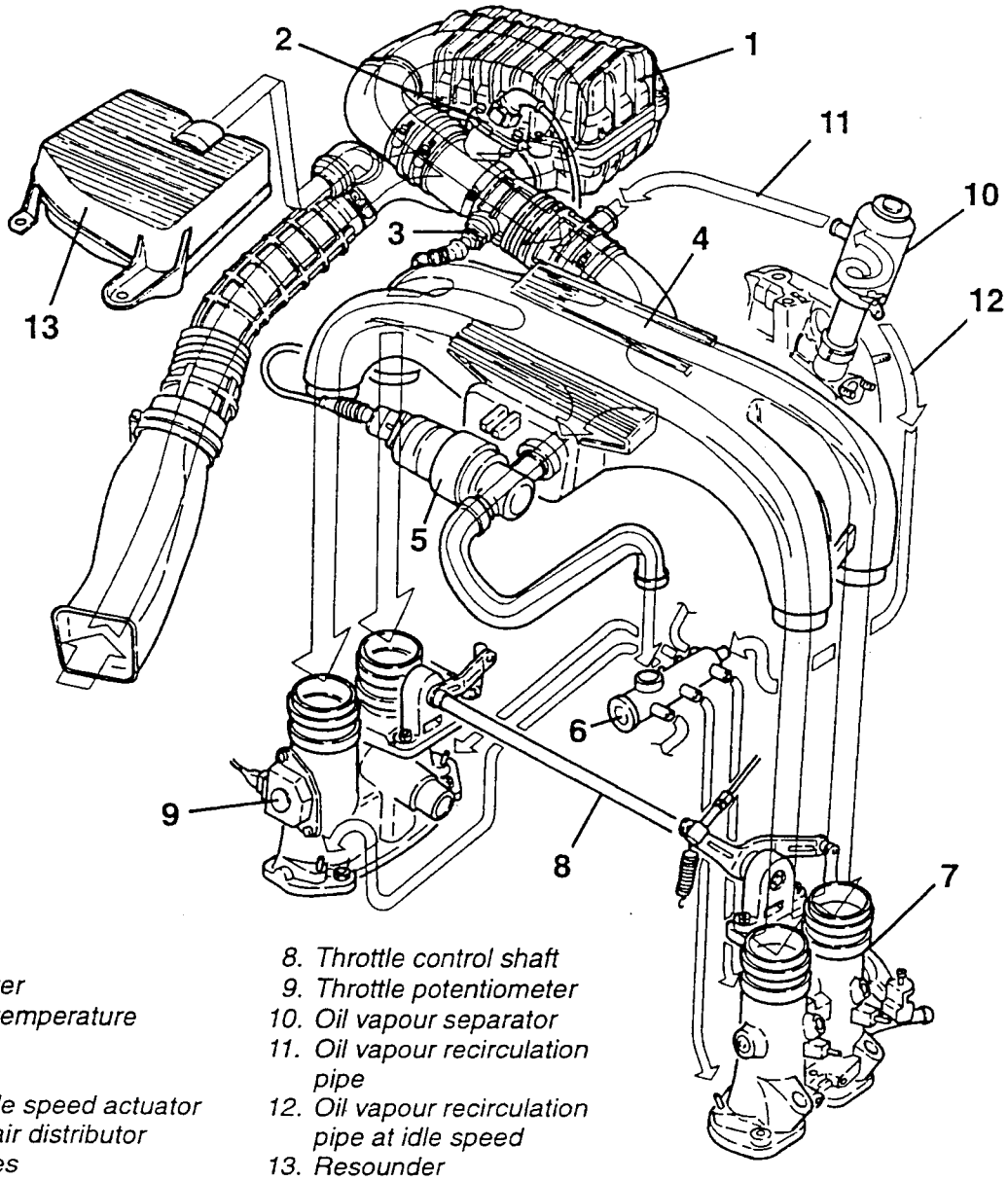
The valve enclosed in the casing comprises a mobile part or shutter, constrained to a plate spring; the fixed part is formed of a metal cylinder perforated inside on which the coil is wound.
The device is structured so that when the coil is supplied, the shutter is attracted against the cylinder, which replaces the fixed part of the valve and closes it.

REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and wheel arch (see GROUP 70).
1. Release the solenoid valve from the support bracket and disconnect the electrical connection.
2. Disconnect the fuel vapour delivery pipe to the engine intake from the solenoid valve.
3. Disconnect the solenoid valve connection pipe from the fuel vapour filter.
4. Remove the fuel vapour solenoid valve complete with pipe and separate them on the bench.



AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM



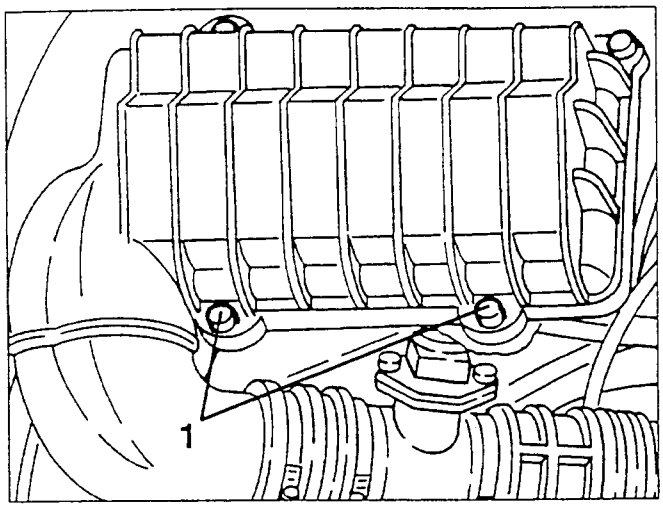
1. *Air filter*
2. *Air flow meter*
3. *Intaken air temperature sensor*
4. *Intake box*
5. *Constant idle speed actuator*
6. *Idle speed air distributor*
7. *Intake bodies*
8. *Throttle control shaft*
9. *Throttle potentiometer*
10. *Oil vapour separator*
11. *Oil vapour recirculation pipe*
12. *Oil vapour recirculation pipe at idle speed*
13. *Resounder*

The air taken in through a dynamic inlet is put into communication with a resonance capacity to dampen the noise fitted above the corrugated air intake sleeve.
After being filtered through a cartridge element, the air passes into the corugated sleeve where the hot film flow meter and intaken air temperature sensor are to be found.
From the corrugated sleeve the air enters the intake box from which it is sent to the bodies which are fitted with throttles controlled by the shaft connected to the accelerator cable and adjust the amount of air taken in by the engine.
There is an additional air electromagnetic valve on the intake box which py-passes the throttle valves with a series of pipes to keep the engine idle speed constant under particular conditions of the engine.

The fuel vapours and oil vapours (see specific paragraph) are ducted to the air supply system.
The oil vapours are developed when the engine is running and they are collected in the separator.
From the separator, the condensed oil falls back into the crankcase while the remaining vapours are sent to the engine through two pipes.
When the engine is running at idle speed, the oil vapours are ducted to the throttles through the connection to the idle speed air distributor.
At higher loads, the vapours are taken in by the engine upstream of the intake box through the connection to the corrugated sleeve.

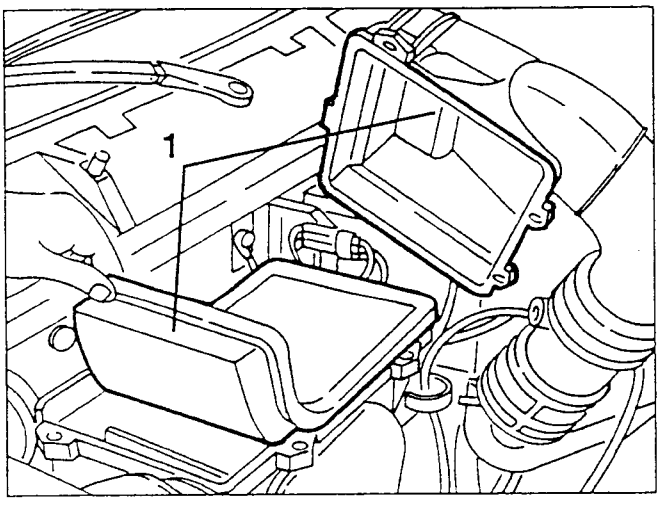
CHANGING THE AIR CLEANER CARTRIDGE

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



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

WARNING:
Any cleaning operation on the filter might damage it and risk compromising the correct operation of the engine supply system.

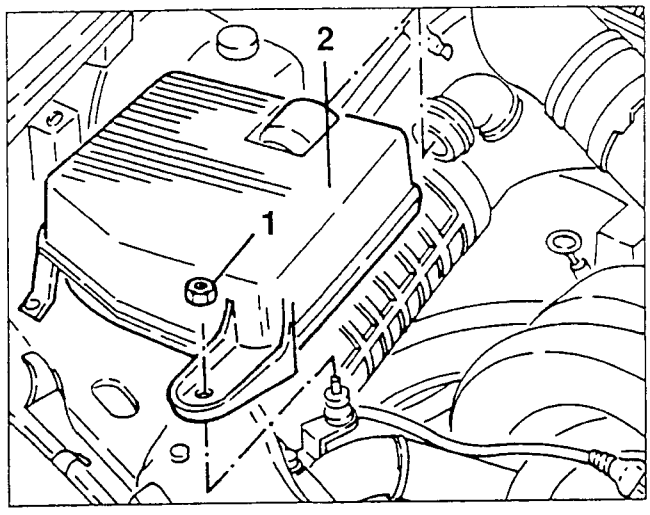


If the air cleaner shows traces of oil, check for any leaks in the whole circuit.

RESOUNDER

REMOVAL/REFITTING

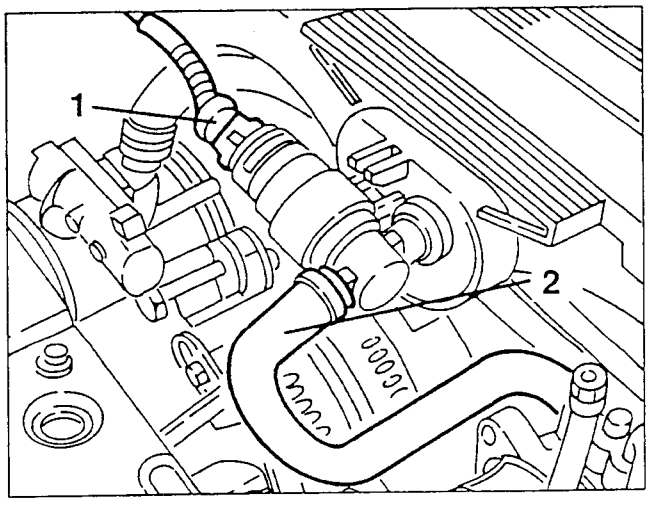
1. Slacken the two nuts fastening the resounder to the support brackets.
2. Remove the resounder disconnecting the air intake hose connection from the elbow.



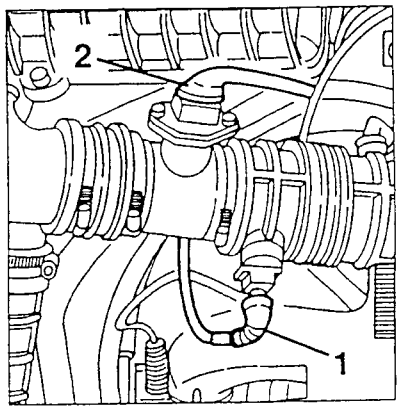
AIR INTAKE BOX

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the air intake pipe from the constant idle speed actuator.

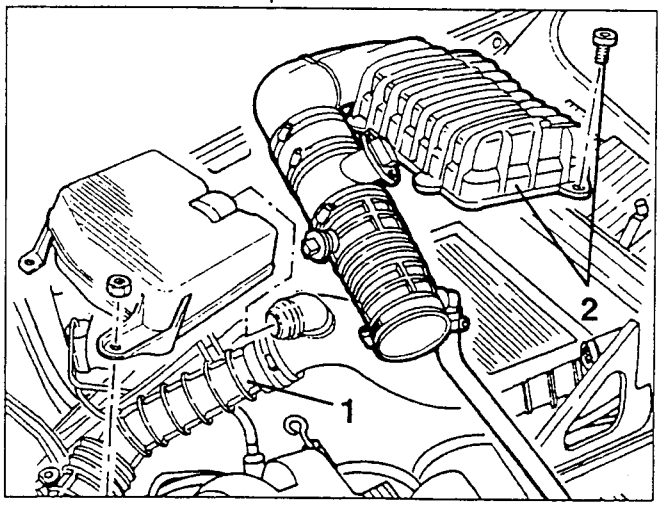


- Remove the resounder (see specific paragraph).
1. Disconnect the electrical connection from the intaken air temperature sensor.
2. Disconnect the electrical connection from the air flow meter.

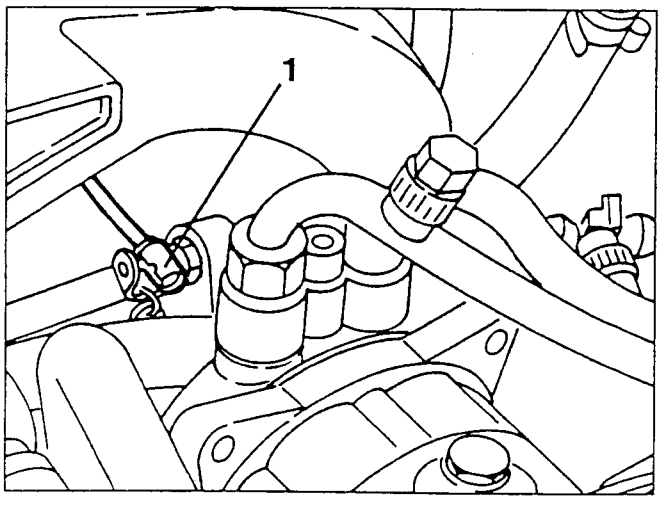


- Disconnect the oil vapour recovery pipe.
- Disconnect the corrugated sleeve from the intake box.

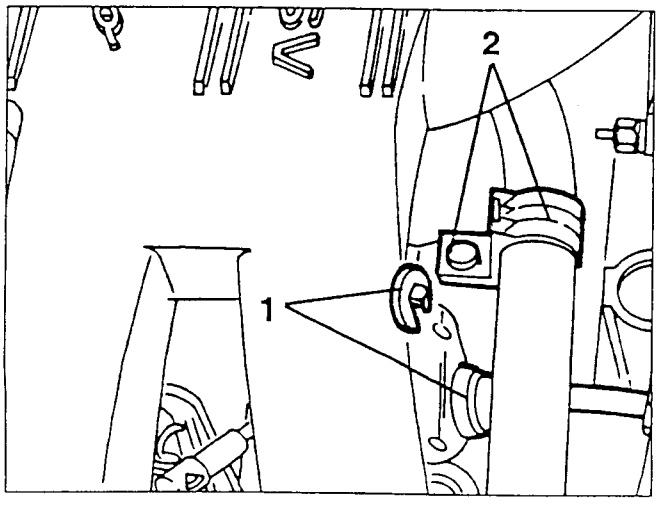
1. Remove the resounder.
2. Slacken the four fastening screws and remove the air cleaner cover complete with sleeves.



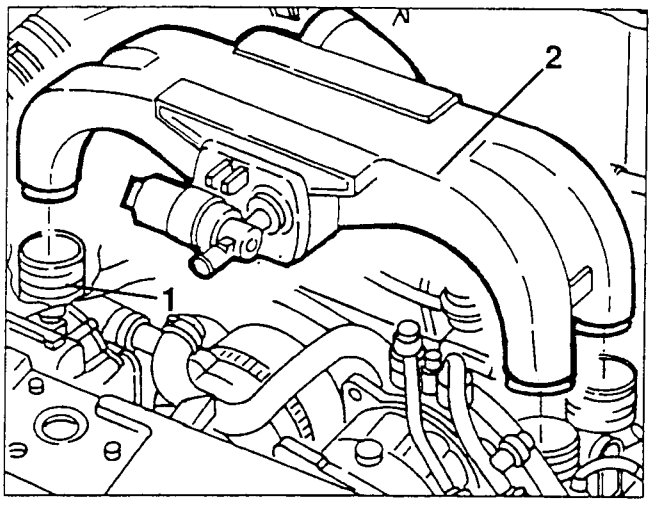
1. Disconnect the accelerator cable from the throttle control shaft.



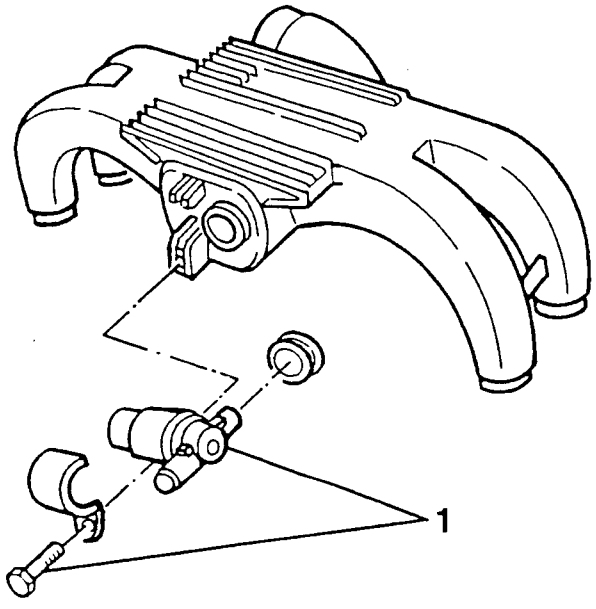
1. Remove the stop and withdraw the accelerator cable from the support bracket.
2. Slacken the power steering pipe support clamp fastening screw from the intake box.



1. Slacken the clamps fastening the air intake box to the sleeves of the bodies.
2. Raise the intake box just enough to disconnect the fuel distributor from the fastening clamp, then remove it.



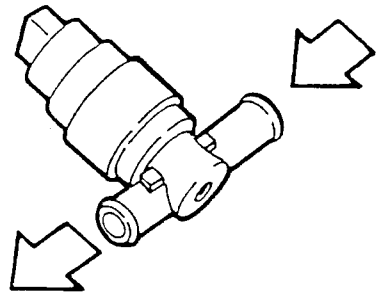
1. On the bench, slacken the fastening clamp screw and remove the constant idle speed actuator from the intake box.



CONSTANT IDLE SPEED ACTUATOR

A hose by-passes the throttle valve and connects with an idle speed actuator to be found on the intake box. The cross-section of the actuator determines the flow of air when the throttle valve is closed.
The cross-section may be adjusted through a rotating slider. To control idle speed a rotary actuator with double winding is used.
One of the windings moves the slider in the "opening" direction while the other turns it in the "closing" direction.

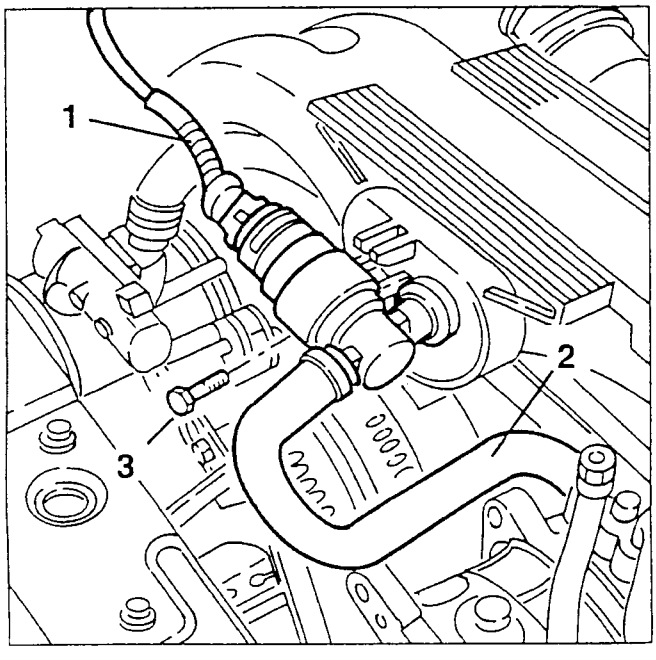
The two actuator windings, for idle speed, are supplied with two complementary duty-cycle signals i.e. they receive voltage and produce opposite forces on the rotor.



A determinate number of pulses, with the battery voltage and winding temperature constant, correspond to a well-defined angular position of the rotary valve and, therefore, a precise opening section of the by-pass. The idle speed regulator is controlled by a part of programme stored in the control unit.
The constant idle speed actuator is mainly used to determine the exact amount of air when starting and for maintaining an ideal idle speed condition under all engine conditions.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the air intake pipe from the constant idle speed actuator.
3. Slacken the clamp fastening screw and remove the constant idle speed actuator.

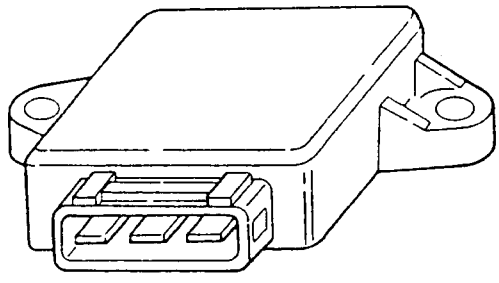


CHECKS AND INSPECTIONS

For checking the operation of the electromagnetic part of the actuator see GROUP 55 - "ELECTRIC SYSTEM DIAGNOSIS".

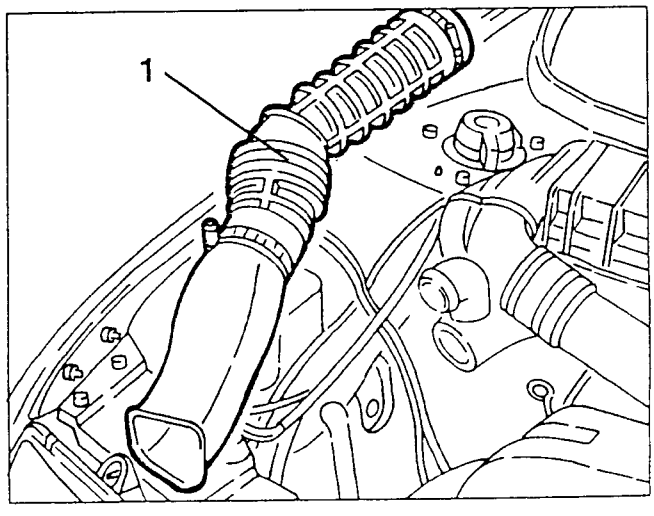
THROTTLE POTENTIOMETER

This is a potentiometer, the mobile part of which is controlled directly by the throttle valve shaft.
The potentiometer informs the control unit instantly when there is the need for "full power", anticipating the signal from the air flow meter which records a considerable increase of the air flow thereby obtaining an immediate response.
The potentiometer automatically detects the throttle contact position by a "self-adapting" function.
This dispenses with the need to adjust the potentiometer and makes it possible to follow any wear occurring on the throttle closed position over the course of time.

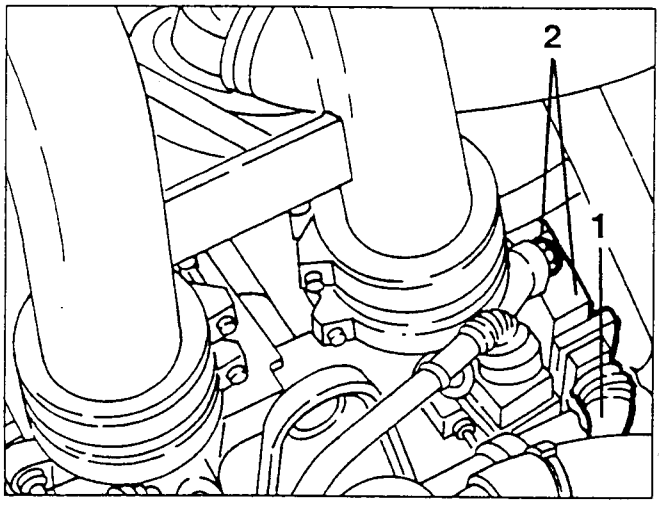


REMOVAL/REFITTING

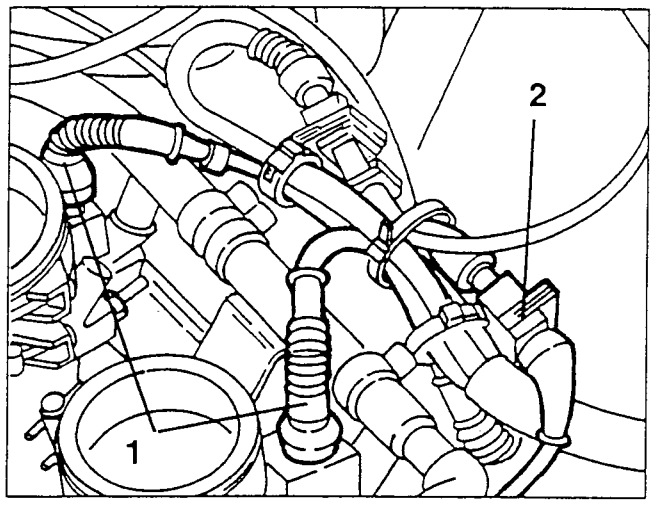
- Disconnect the battery (-) terminal.
- Remove the resounder (see specific paragraph).
1. Slacken the clamp fastening to the air cleaner box, slacken the front fastening bolt and remove the air intake duct.



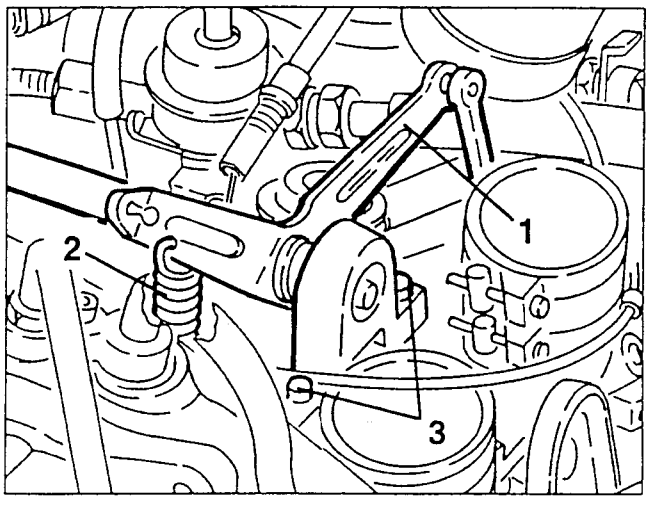
1. Disconnect the electrical connection from the throttle potentiometer.
2. Slacken the two fastening screws and remove the throttle potentiometer.



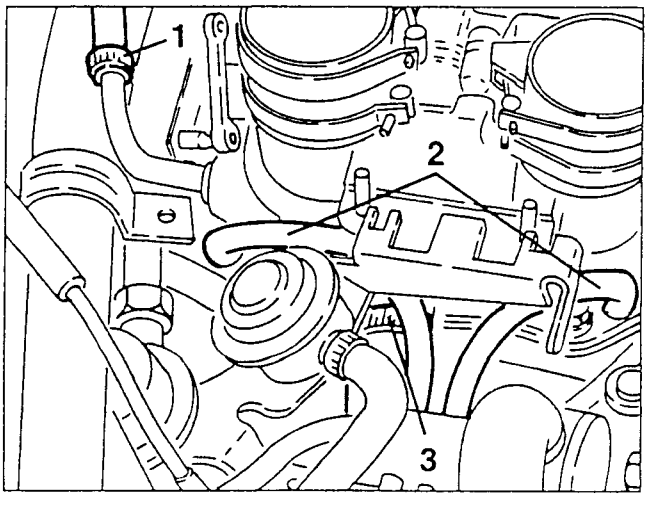
2. Disconnect the connection of the engine coolant temperature sensor (NTC).



1. Disconnect the tierods from the throttle control shaft
2. Disconnect the spring.
3. Slacken the fastening nuts and remove the throttle control shaft, retrieving the spacers.



1. Disconnect the servobrake vacuum takeoff pipe.
2. Disconnect the two evaporative pipes from the body.
3. Disconnect the engine coolant sleeve from the body.

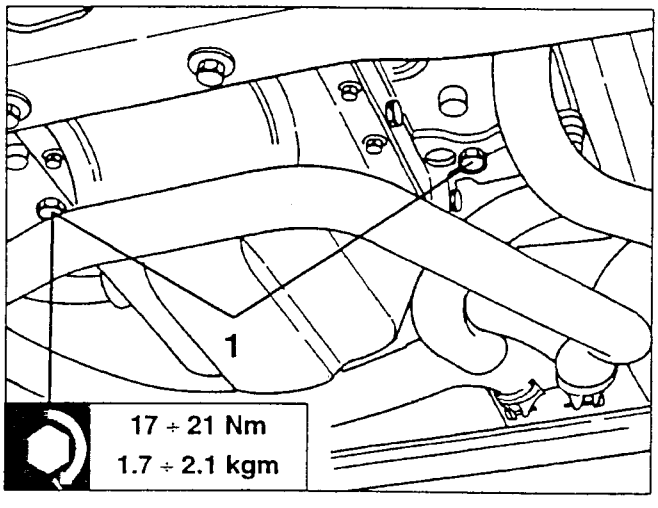


BODIES

REMOVAL/REFITTING

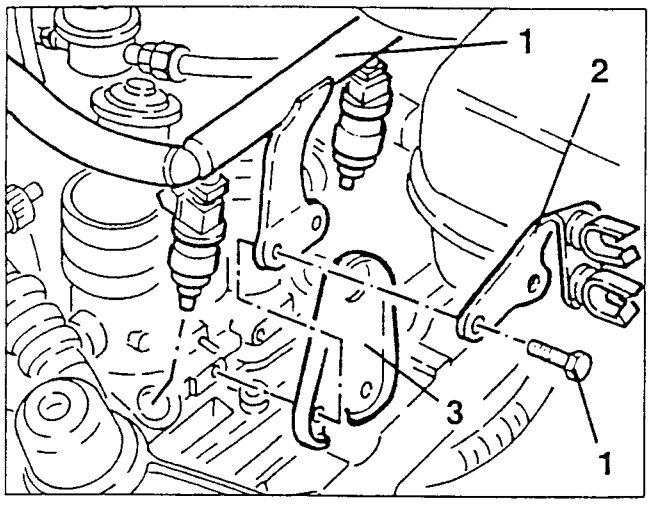
The following procedure describes the sequence for removing/refitting the left-hand body.
However, this procedure may be used for the right-hand body adapting it suitably owing to the different location of certain components.

1. Slacken the two plugs under the crankcase and drain the coolant fluid into a suitable recipient.

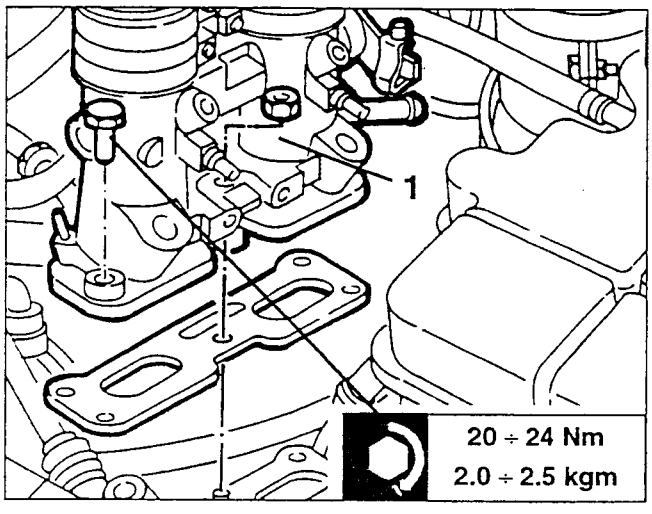


- Remove the air intake box (see specific paragraph).
1. Disconnect the electrical connections from the electroinjectors.

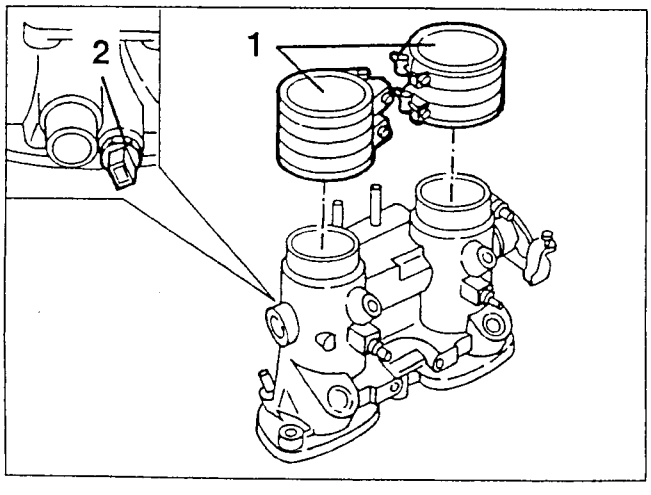
1. Slacken the two screws fastening the fuel distributor manifold and raise it removing the injectors from their housings.
2. Retrieve the cable support bracket.
3. Retrieve the engine lifting bracket.



1. Slacken the four screws and the nut fastening the body, then remove it.

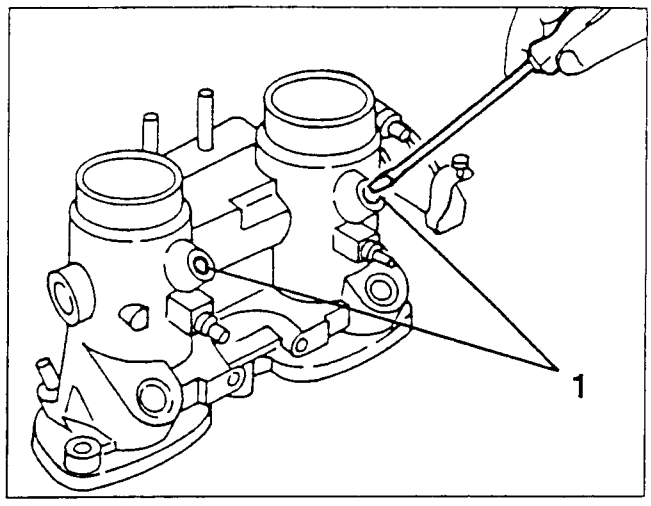


1. On the bench, slacken the fastening clamps and remove the sleeves from the body.
2. Slacken and remove the engine coolant temperature sensor (NTC).

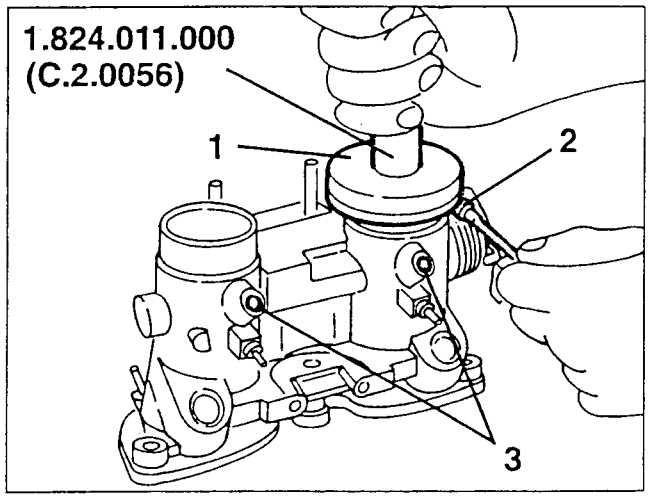


FLUX TEST ON THE BENCH

1. Remove the seals and unscrew the by-pass screws completely.



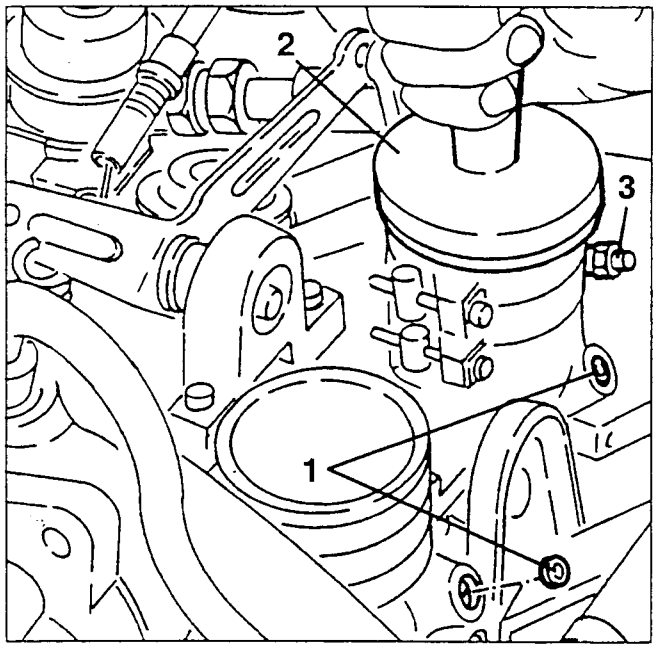
1. Set the flow meter to scale "K" and take the reading on each of the body tubes using tool N° 1.824.011.000 (C.2.0056) checking that the flow rate is 120 ÷ 130.
2. If not, turn the throttle adjustment screw until the specified value is obtained.
3. With the throttles adjusted, open the by-passes (unscrew) until a flow rate of 185 is obtained with the flow meter on scale "N".



FLUXING TEST ON THE CAR

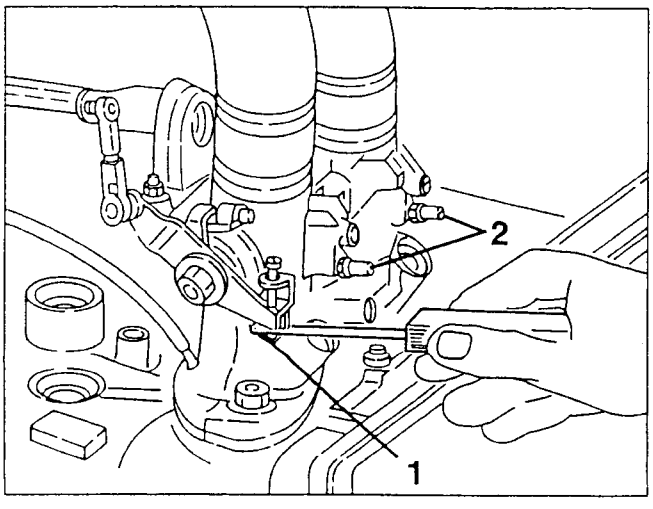
- Remove the air intake box complete with connection sleeves to the bodies (see specific paragraph).
- Set the flow meter to scale "N" and take the reading on each tube of the bodies using tool N° 1.824.011.000 (C.2.0056), checking that the flow rate is 185.
- If not, proceed as described below.

1. Remove the seals and tighten the by-pass screws completely.
2. Set the flow meter to scale "K" and take the reading on each of the body tubes checking that the flow rate is 120 ÷ 130.
3. If not, turn the throttle adjustment screw until the specified value is obtained.
- With the throttles adjusted, open the by-passes (unscrew) until a flow rate of 185 is obtained with the flow meter on scale "N".

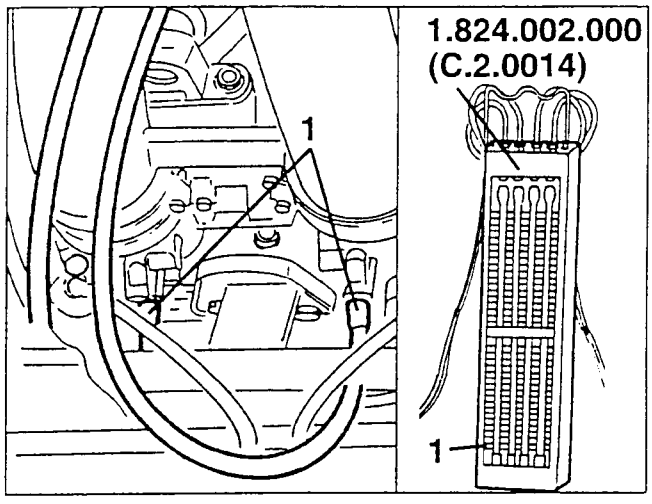


ALIGNING AND SYNCHRONISING THE INTAKE BODIES

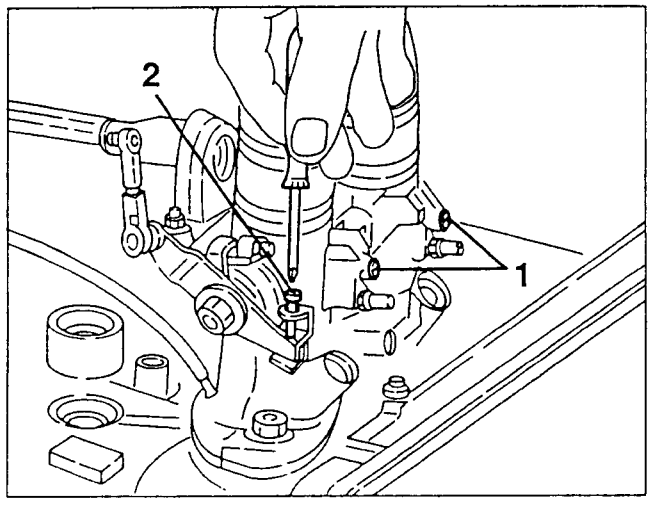
1. Check that the play on the two"loosened levers" of the throttles on the bodies is within the specified value of 1 mm.
2. Slacken the vacuum inlets.



1. Connect the sockets of vacuum gauge N° 1.824.002.003 (C.2.0014) to the vacuum takeoffs on the bodies.



1. Start the engine and at idle speed check that the difference between the cylinders does not exceed 25 mmHg, if it does adjust the by-pass screws.
- If the difference between the cylinders of the same head exceeds 25 mmHg despite adjustment, the body needs changing.
2. Accelerate slightly a few times and see that the pressure gauge columns move simultaneously; if synchronism is lacking, adjust the screws of the "loosened levers".

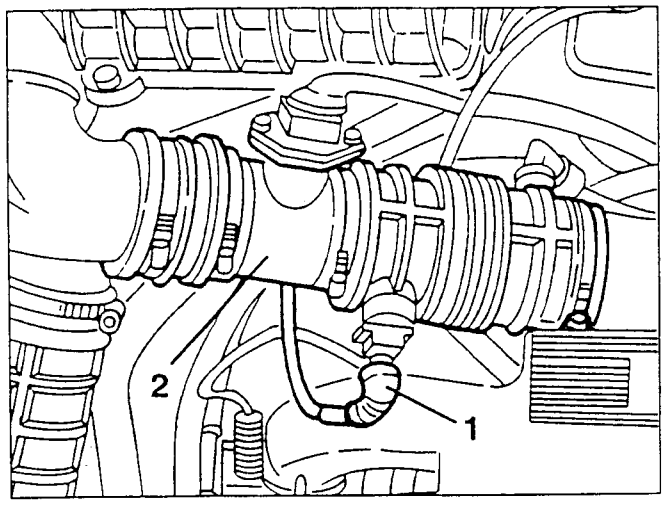


INTAKEN AIR TEMPERATURE SENSOR (NTC)

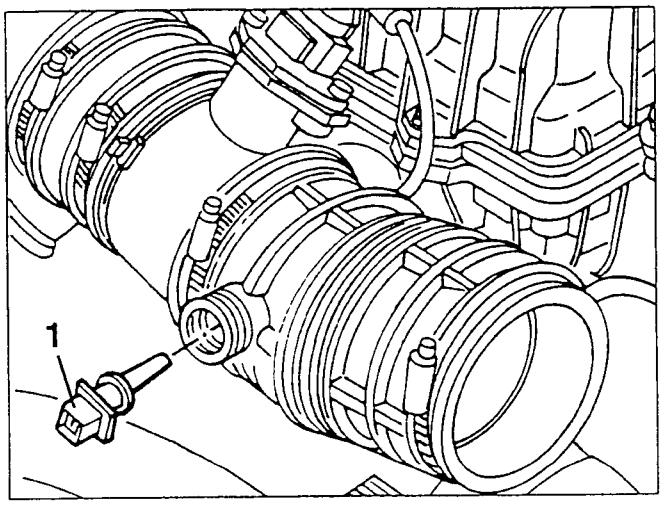
The intaken air temperature sensor is located on the corrugated air intake sleeve and it detects the air temperature through an NTC thermistor with a negative resistance coefficient, i.e. capable of lowering its resistance as the temperature increases.
The electrical signal obtained reaches the control unit where it is used to calculate the density of the air.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the intaken air temperature sensor.
2. Slacken the clamp and disconnect the corrugated sleeve from the intake box.

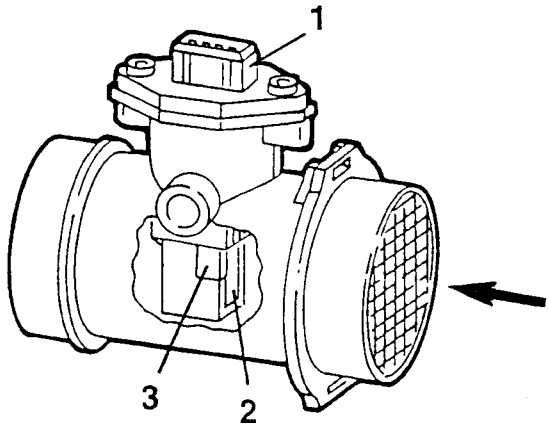


1. Remove the fastening clamp and withdraw the sensor from the corrugated sleeve.



AIR FLOW METER

The air flow meter is of the "heated film" type. Its operating principle is based on a heated diaphragm which is interposed in a measuring channel through which the engine intake air flows.
The hot film diaphragm is kept at a constant temperature (~ 120°C) by the heating coil in contact with it.
The mass of air that crosses the measuring channel tends to withdraw heat from the diaphragm, therefore to keep the temperature constant, a certain current needs to flow through the resistance.
This current is measured by a suitable Wheatstone bridge.
Therefore the current measured is proportionate with the mass of air flowing through.

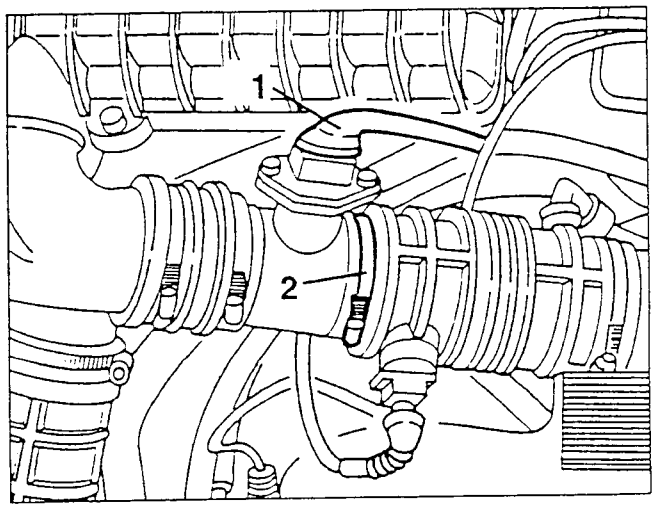


1. Connector
2. Measuring channel
3. Hot film sensor

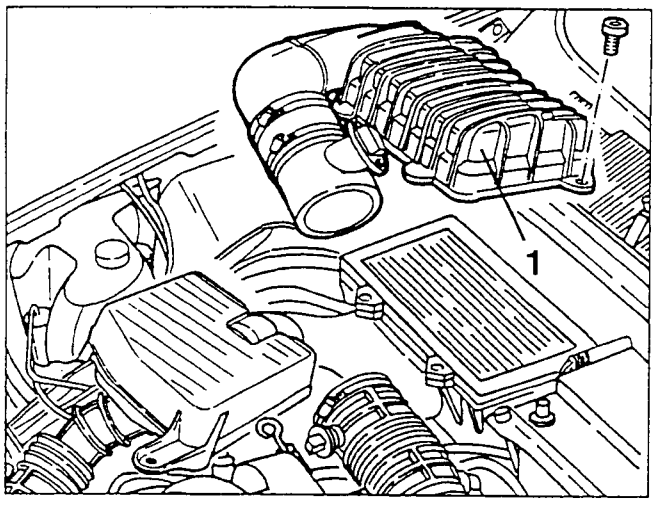
NOTE: This air flow meter measures directly the mass of air (and not the volume) thereby eliminating problems of temperature, altitude, pressure, etc.
The correct operation of the air flow meter depends on the conditions of the air cleaner which must therefore be checked often.

REMOVAL/REFITTING

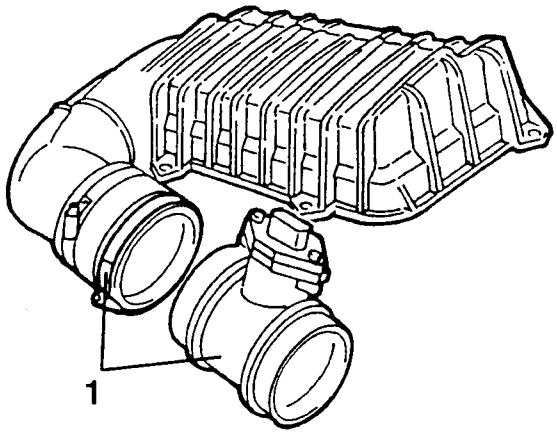
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the air flow meter.
2. Slacken the clamp fastening the corrugated sleeve to the air flow meter.



1. Slacken the four screws fastening the air cleaner cover and remove it complete with air flow meter.



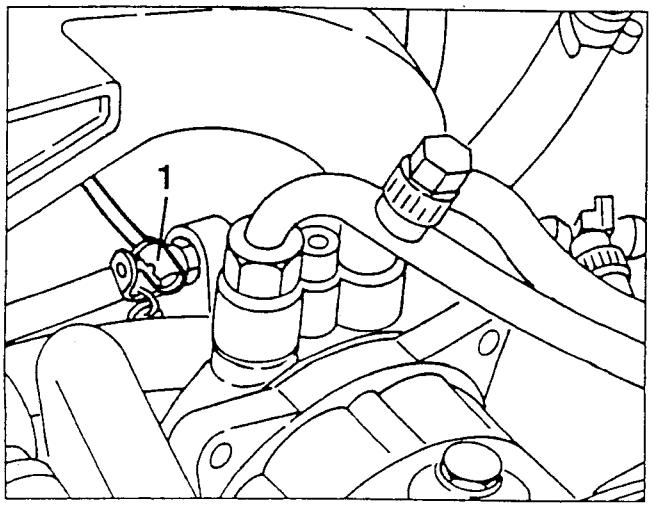
1. On the bench, slacken the fastening clamp and separate the air flow meter from the air cleaner cover.



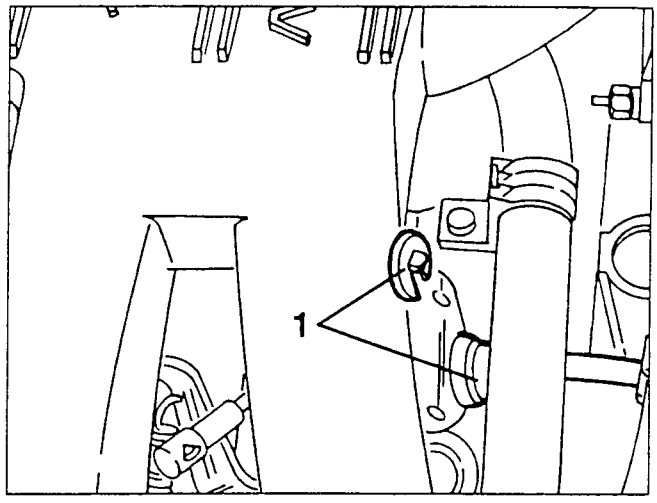
ACCELERATOR CABLE

REMOVAL/REFITTING

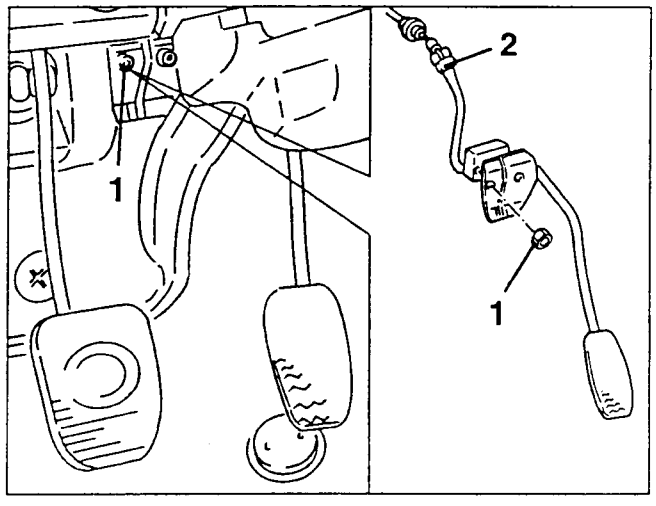
1. Move back the safety catch and disconnect the accelerator control cable from the throttle control shaft.



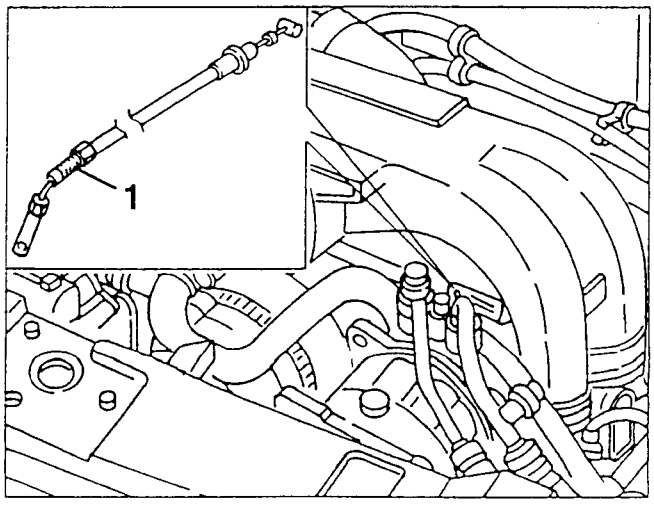
1. Remove the catch and remove the accelerator cable from the support bracket on the intake box.



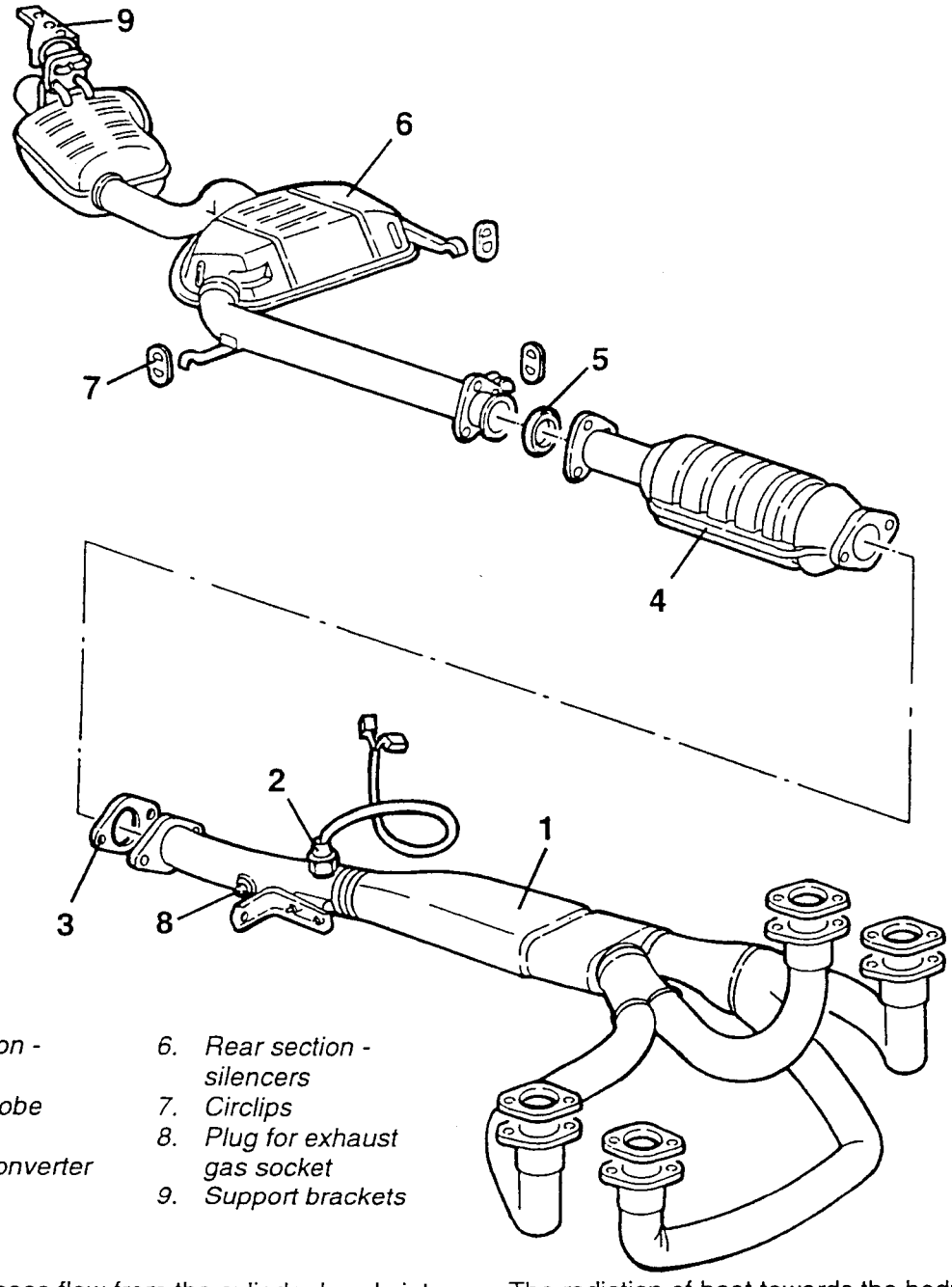
1. Working from the passenger compartment, slacken the two nuts fastening the accelerator pedal fastening bracket.
2. Move the pedal just enough to disconnect the accelerator cable from the fork on the pedal.



1. From the engine compartment, withdraw the complete accelerator cable.



EXHAUST SYSTEM DESCRIPTION



1. *Front section - manifolds*
2. *Lambda probe*
3. *Seals*
4. *Catalytic converter*
5. *Seal ring*
6. *Rear section - silencers*
7. *Circlips*
8. *Plug for exhaust gas socket*
9. *Support brackets*

The exhaust gases flow from the cylinder heads into the manifolds of the front section of the exhaust pipe. On the front section of the exhaust pipe the lambda sensor is fitted which informs the control unit of the amount of oxygen contained in the exhaust gas thus enabling the injection times to be adjusted to keep the stoichiometric ratio (air- fuel) at an optimum level. On the front section of the exhaust pipe, there is also the plug for the exhaust gas socket upstream of the catalytic converter. From the front section, the exhaust gases reach the catalytic converter where most of the pollutants are transformed. From the catalytic converter the exhaust gases reach the two silencers of the rear section of the exhaust pipe.
The various sections of the exhaust pipe are connected by flanges with seals and support to the body is made by brackets and circlips.

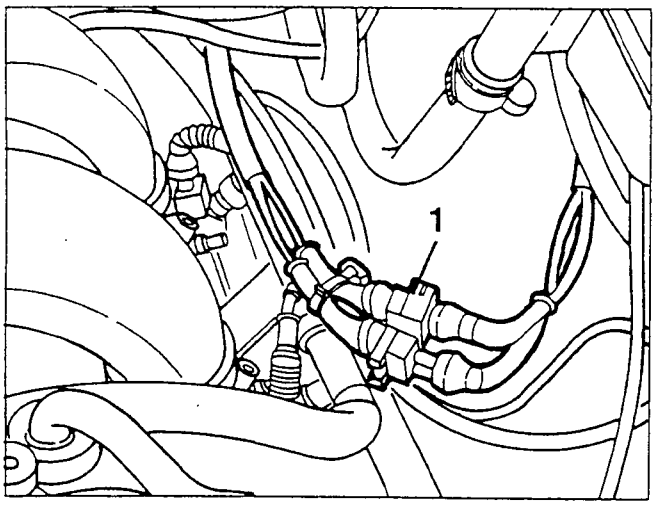
The radiation of heat towards the body, which is very high due to the catalytic converter, is limited by a set of heat shields.

During engine operation all the exhaust pipes and in particular the catalytic converter heat up considerably.
Before attempting any work, the system should be left to cool with the engine switched off.
NEVER TOUCH THE CATALYTIC CONVERTER WITHOUT ADEQUATE PROTECTION SUCH AS GLOVES. ETC.
DO NOT ALLOW EASILY INFLAMMABLE MATERIAL TO COME INTO CONTACT WITH THE CATALYTIC CONVERTER.

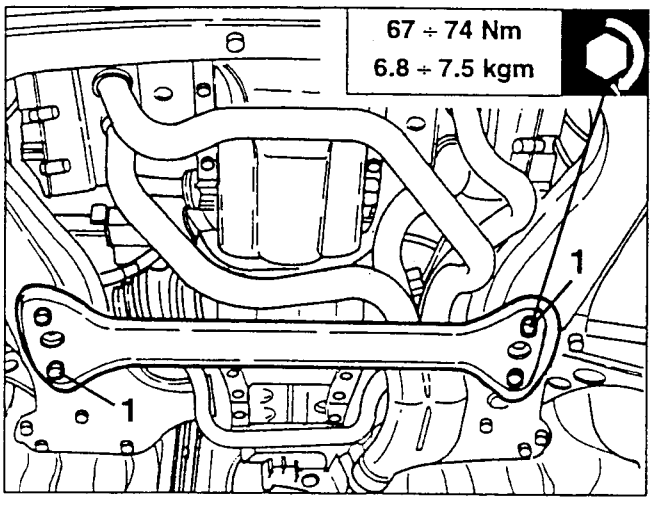
EXHAUST, FRONT SECTION

REMOVAL/REFITTING

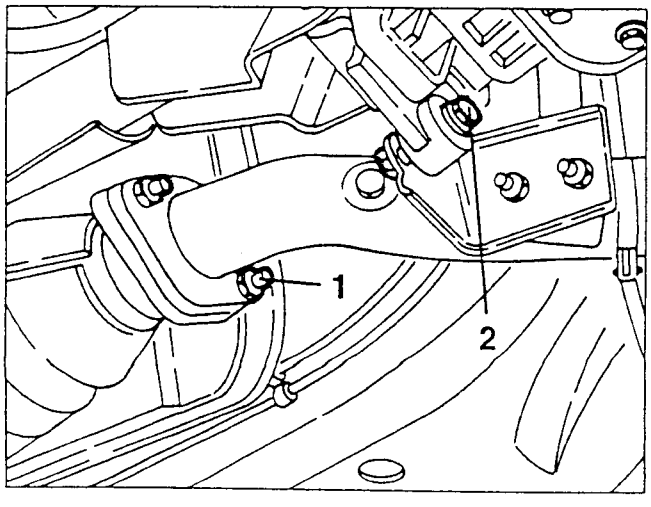
1. Disconnect the two electrical connections of the lambda sensor.



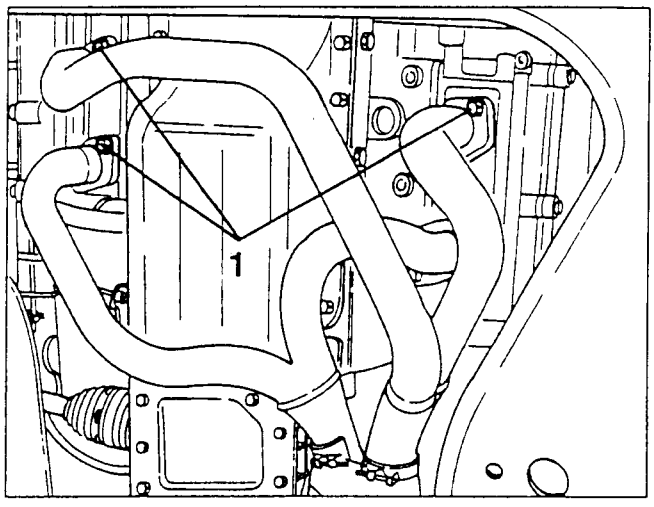
1. Slacken the fastening screws and remove the engine support frame crossmember.



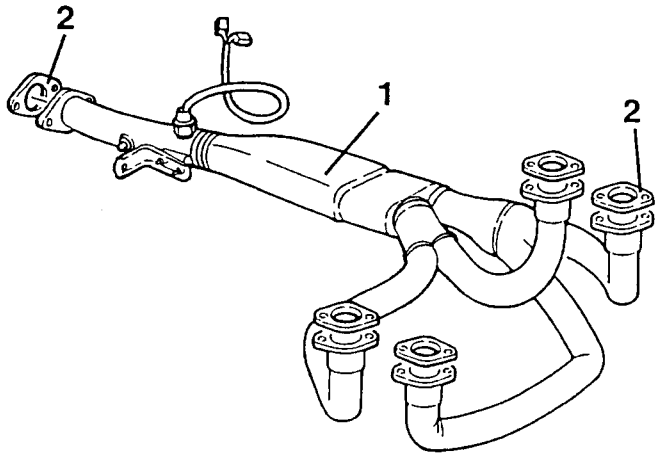
1. Disconnect the flange connecting the front section-catalytic converter.
2. Slacken the bolt fastening the exhaust pipe front section support bracket.



1. Slacken the nuts fastening the front section of the exhaust pipe to the cylinder heads.



1. Remove the front section of the exhaust pipe.
2. Remove the seals.



- Remove the lambda sensor and the support bracket from the front section of the exhaust pipe.

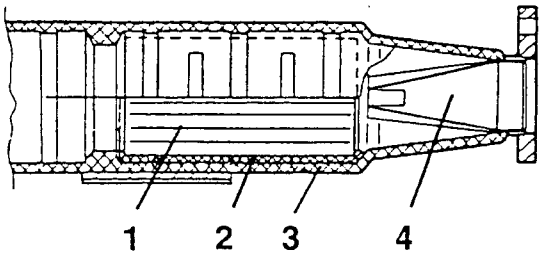
CATALYTIC CONVERTER

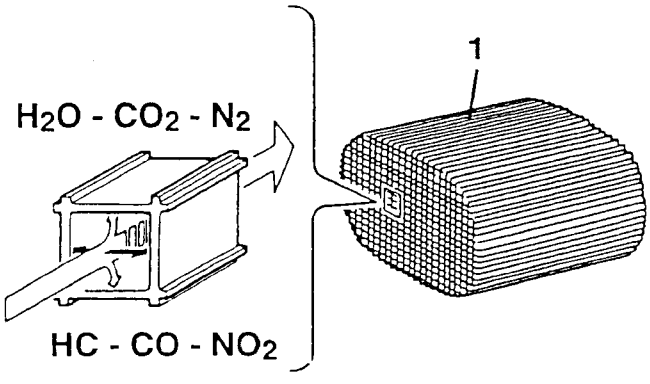
Closed loop mixture titration control is activated by the lambda sensor which detects the amount of oxygen contained in the exhaust gases upstream of the catalyst.
The measurements of the lambda sensor enable the control unit to continuously correct the mixture keeping the air/fuel ratio constant. This way harmful emissions to the exhaust are controlled and this is completed by the trivalent catalytic converter. The efficiency of the catalytic converter and as a result, the reduction of the harmfulness of the exhaust gases therefore depends on the air/fuel ratio with which the engine is supplied.

The trivalent catalytic converter makes it possible to contemporaneously reduce the three pollutants in the exhaust gases:
- unburnt hydrocarbons (HC);
- carbon monoxide (CO);
- nitric oxide (NOx)

Two types of chemical reactions take place inside the converter:
- oxidation of CO and HC, transformed into carbon dioxide (CO_2) and water (H_2O)
- reduction of NOx transformed into Nitrogen (N_2).

The converter comprises a monolith, a metal mesh support to dampen shocks and vibrations and an outer cover resistant to high temperatures and the weather.
The monolith is made with a honeycomb structure formed of ceramic material coated with a very fine layer of catalytically active substances, platinum or rhodium, which accelerate the decomposition of the harmful gases contained in the exhaust gases, which passing through the cells of the heart at temperatures of above 300° ÷ 350°C, activate the catalysts starting the oxidation and reduction reactions.
To optimise the efficiency and life of the catalist, a perforated steel sheet cone improves the diffusion of the exhaust gas in the cells of the ceramic heart.





1. Ceramic monolith 3. Outer cover
2. Metal support 4. Perforated steel sheet cone

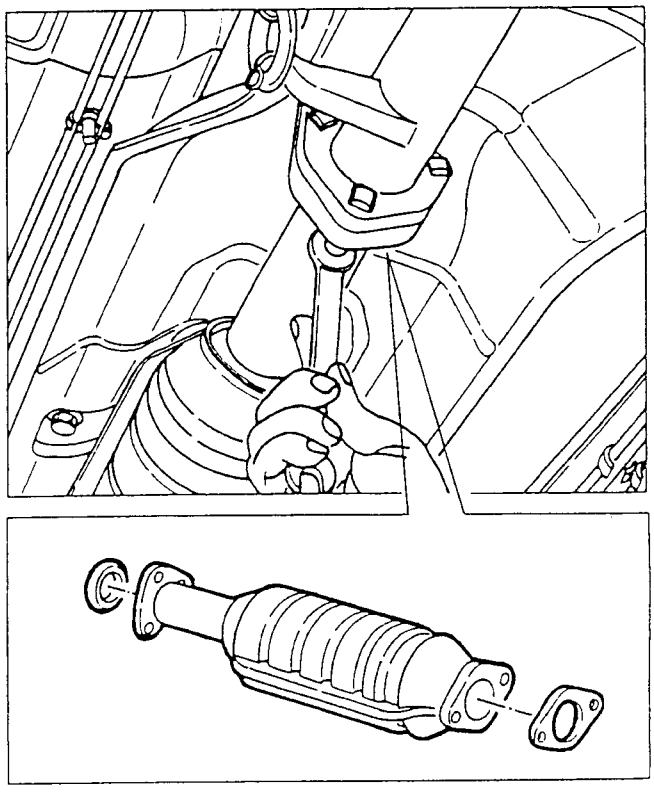
The causes which rapidly and irreversibly damage the catalytic converter are:
- the presence of lead in the fuel, which lowers the degree of conversion to levels that make its presence in the system useless;
- the presence of unburnt fuel in the converter: in fact a flow of petrol for 30 s in an environment at 800°C (inside temperature of the catalyst) is sufficient to melt or break the catalyst.

The ignition system must be in perfect operating conditions, therefore, for no reason at all should the spark plug cables be disconnected with the engine running and, in the event of tests, the silencer should be replaced with an equivalent length of pipe.
If used correctly, the converter will work efficioently for no less than 80.000 km or for at least five years.

WARNING:
The precious metals contained in the catalytic converter, also due to the high temperature, are subject to chemical attack by lead.
FOR THIS REASON, PETROL CONTAINING LEAD MUST NOT BE USED AS THIS WOULD QUICKLY AND IRREVERSIBLY DAMAGE THE CONVERTER. NEVER USE PETROL CONTAINING LEAD EVEN IN AN EMERGENCY OR FOR VERY SHORT PERIODS.

REMOVAL/REFITTING

- Set the car on a lift and raise it.
- Remove the fastening bolts of the connection flanges and remove the catalytic converter.

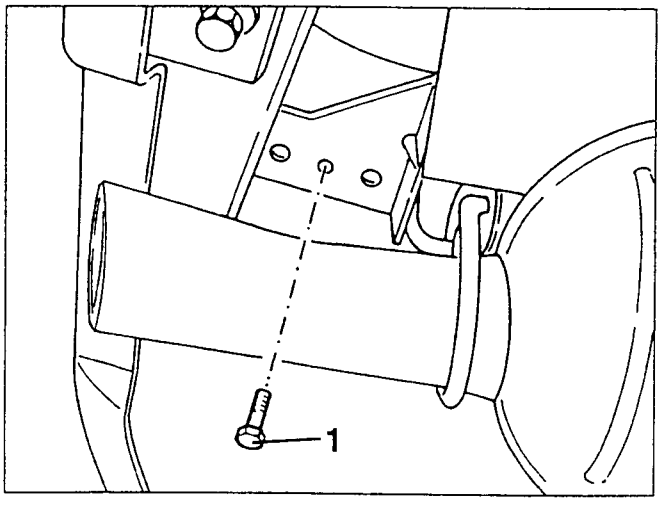


WARNING:
When the catalytic converter is removed, though outside it is cold, inside it might still be hot. For this reason NEVER DISCARD THE OLD CONVERTER ON INFLAMMABLE RUBBISH.
If an excessive temperature is signalled during operation of the catalytic converter it is advisable to immediately identify the cause in order to avoid irreversible damage to the material forming the silencer itself.

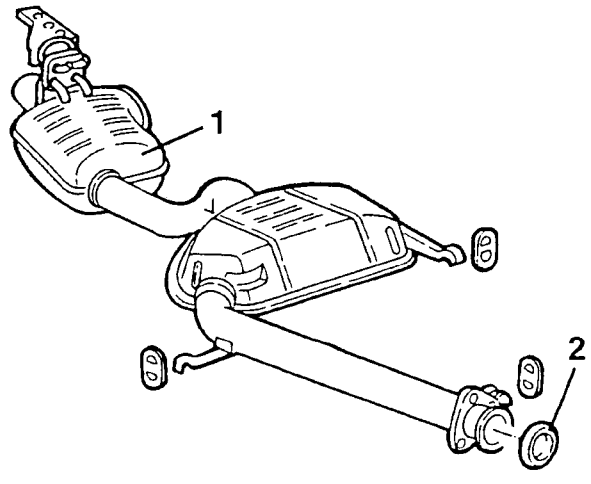
EXHAUST, REAR SECTION

REMOVAL/REFITTING

- Disconnect the handbrake left cable from the fastening clamps.
- Slacken the three bolts fastening the rear section of the exhaust pipe to the catalytic converter.
1. Slacken the exhaust pipe rear support bracket fastening screw.



1. Remove the rear section of the exhaust pipe releasing it from the support circlips.
2. Remove the seal ring.



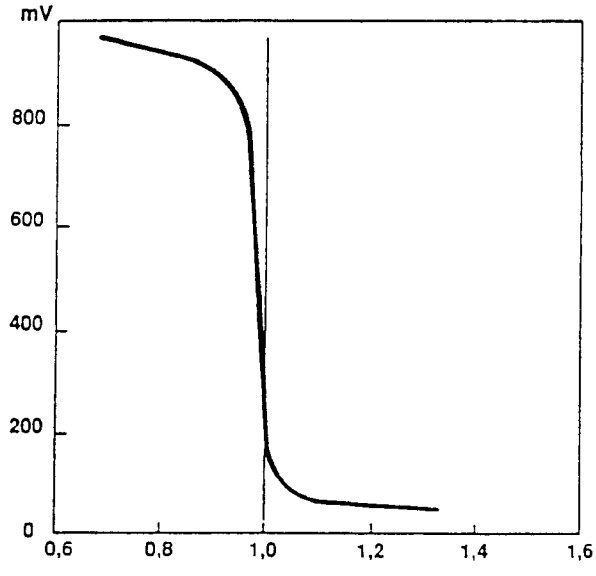
LAMBDA SENSOR

The lambda sensor informs the control unit of the injection and ignition system of the course of combustion of the air - fuel mixture and it enables the system to keep the stoichiometic ratio of the mixture as close as possible to the theoretical value.
Therefore, in order to obtain an optimum mixture, the quantity of air taken in by the engine must be the theoretical quantity required to burn all the fuel injected.
In this case it is said that the lambda factor (λ) is 1, in fact:

$$\lambda = \frac{\text{QUANTITA' DI ARIA ASPIRATA}}{\text{THEORETIC QUANTITY OF AIR THAT SERVES TO BURN ALL THE FUEL INJECTED}}$$

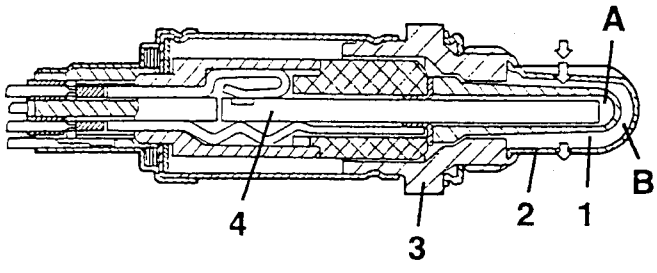
Therefore:
λ = 1 IDEAL MIXTURE;
λ > 1 LEAN MIXTURE;
λ < 1 RICH MIXTURE

The lambda sensor in contact with the exhaust gases generates an electric signal, the voltage of which depends on the concentration of oxygen contained in the gas.
This voltage changes sharply when the composition of the mixture departs from λ = 1.



The lambda sensor comprises a ceramic body based on zirconium dioxide, coated with a fine layer of platinum closed at one end, inserted in a metal tube and housed in a metal body which offers further protection and makes it possible to install it on the exhaust manifolds.
The outer part of the ceramic is exposed to the current of exhaust gas, while the inner part communicates with the environment air.

The operation of the sensor is based on the fact that with temperatures of above 300°C, the ceramic material used becomes a conductor of oxygen ions.
Under these conditions, if the quantity of oxygen at the two sides of the sensor (A and B) is in different percentage, a voltage change is generated between the two ends which is an index of measurement for the difference in the quantity of oxygen in the two environments (environment air side and exhaust gas side) and it alerts the control unit that the oxygen residues in the exhaust gas are not in sufficient percentage to warrant combustion with a low amount of harmful substances.
For temperatures below 300°C the ceramic material is not active, therefore the sensor does not send serviceable signals and a special circuit in the control unit stops loop adjustment of the mixture while the sensor heats up.
To ensure that the sensor quickly reaches its operating temperature it is fitted with an electrical resistance suitably supplied by the battery; this also makes it possible to install the sensor in cooler areas of the exhaust pipe.

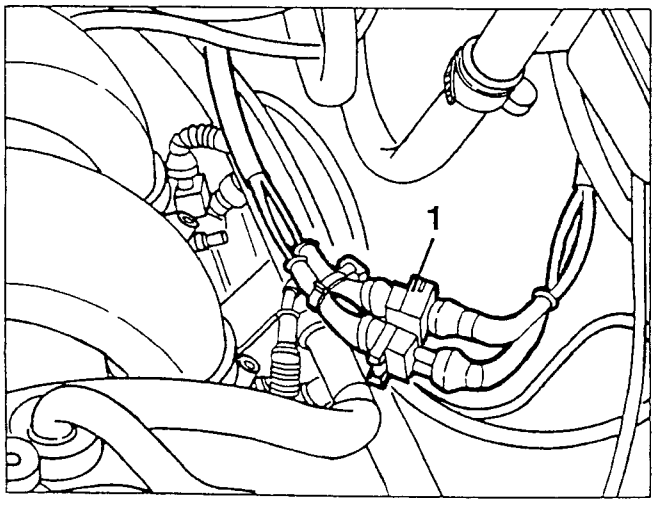


1. *Ceramic body*
2. *Protective tube*
3. *Metal body*
4. *Electric resistance*

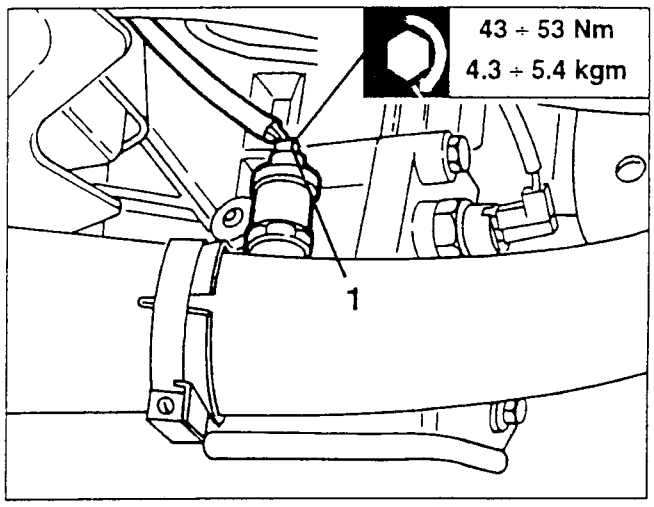
A. Inner ceramic part
B. Outer ceramic part

REMOVAL/REFITTING

1. Disconnect the two electrical connections of the lambda sensor.



1. Slacken and remove the lambda sensor complete with wiring.



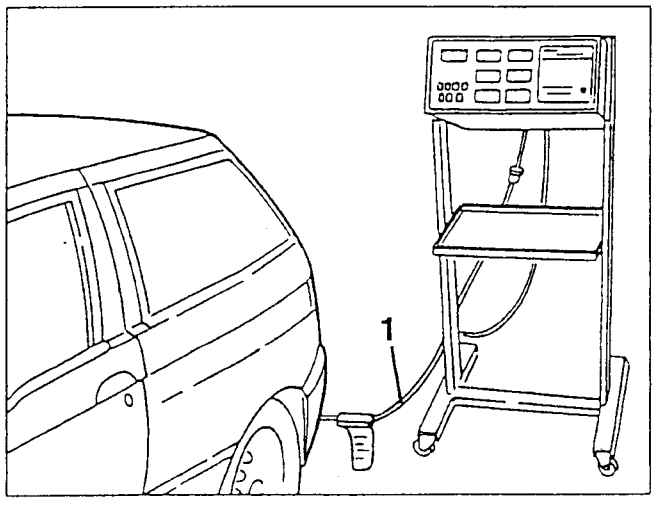
CHECKING EMISSIONS AT THE EXHAUST

The exhaust emissions must be checked in the open or in a suitable area equipped in accordance with current regulations.

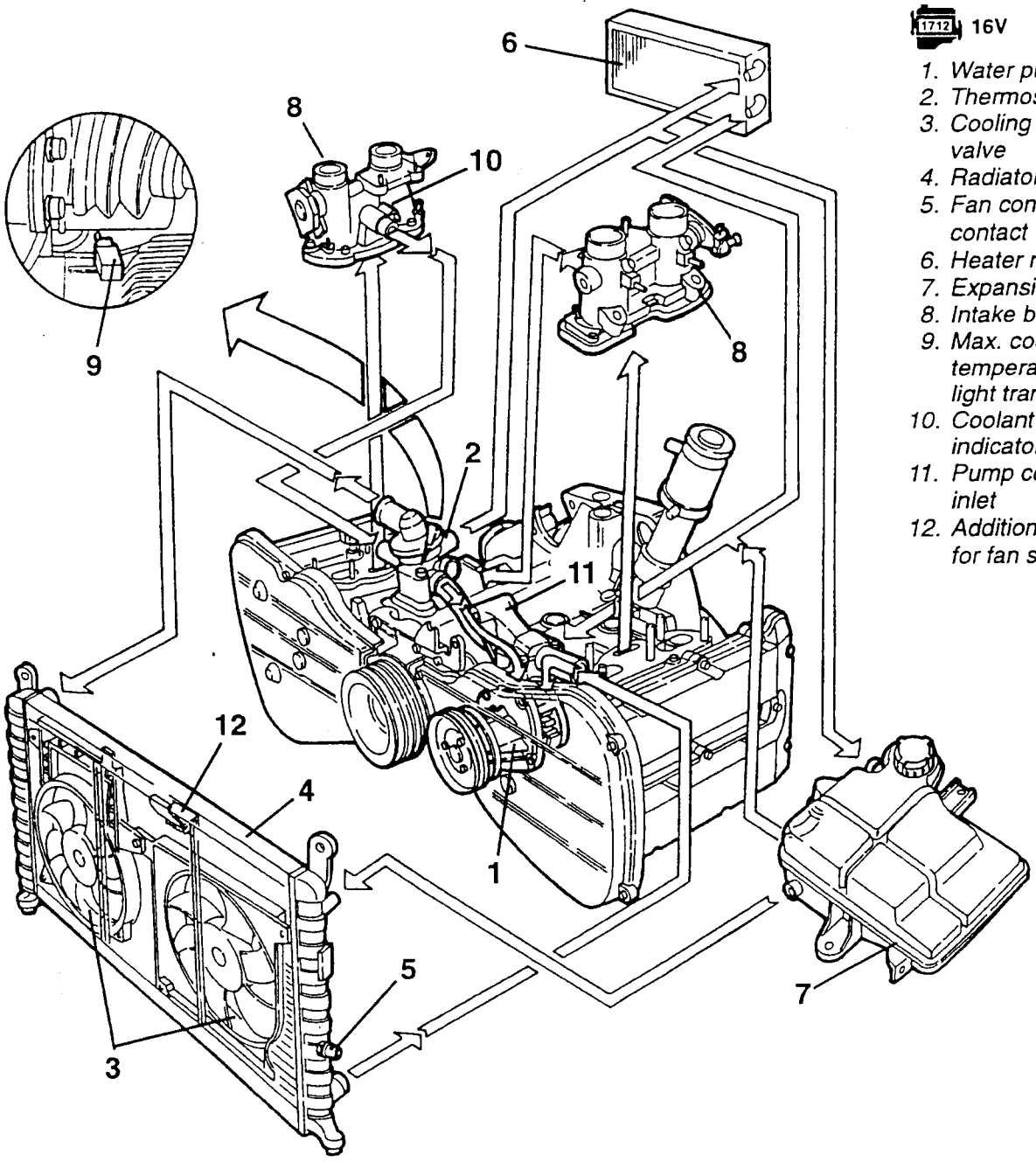
The check must be carried out with the engine at normal operating temperature (i.e. after the fan has turned on and then off) and at idle speed (see: GROUP 00 - "ENGINE TECHNICAL DATA").
If the idle speed is not within the specified limits check that the constant idle speed actuator is working properly.

- Check that the engine oil level is correct and that the air cleaner cartridge is clean.
- Start the engine and run it at idle speed.
1. Insert the probe of the analyzer in the end piece of the exhaust pipe and check that the percentages of CO and HC are within the specified limits.

CO at exhaust	% vol.	≤ 0.2
HC at exhaust	p.p.m.	≤ 50



BOXER ENGINES COOLING SYSTEM DESCRIPTION

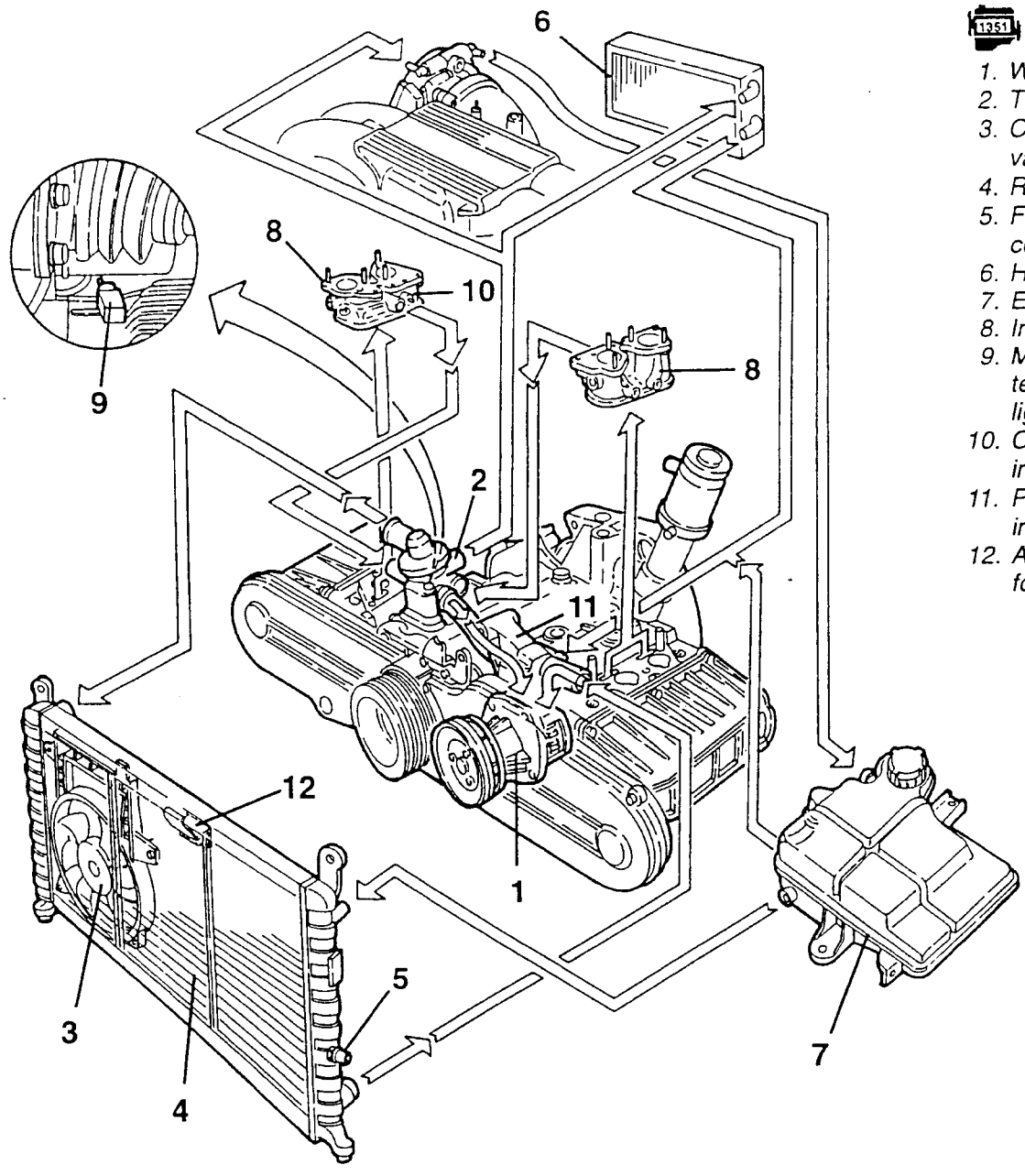


1712 16V

1. *Water pump*
2. *Thermostatic cup*
3. *Cooling solenoid valve*
4. *Radiator*
5. *Fan control thermal contact*
6. *Heater radiator*
7. *Expansion tank*
8. *Intake bodies*
9. *Max. coolant temperature warning light transmitter*
10. *Coolant temperature indicator transmitter*
11. *Pump coolant filter inlet*
12. *Additional resistance for fan speeds*

The cooling system is of the sealed type.
Circulation is forced by centrifugal pump operated by the crankshaft through the Poly-V belt.
A thermostatic valve fitted on the crankcase keeps the engine temperature at an optimum level: it opens when the coolant reaches a temperature of 86° ± 2°C.
The radiator cools the fluid by dynamic air and by a fan (two for versions with air conditioner) which is turned on by a thermal contact on the radiator.
For the air-conditioned versions, the thermal contact has two levels and, with the help of an additional resistance, it operates the fans in parallel at two different speeds.

For the versions without air conditioner, the thermal contact has one level and it operates the fan at one speed only.
The purpose of the header tank is to supply the circuit if the level falls and it absorbs the change in volume of the fluid due to changes in the temperature; it also bleeds air from the circuit through the plug with a special setting.
The circuit is fitted with a coolant fluid temperature gauge sender installed on the cylinder head which turns on the warning light on the instrument cluster when the coolant temperature exceeds 117° ± 3°C.



1351 1596

1. *Water pump*
2. *Thermostatic cup*
3. *Cooling solenoid valve*
4. *Radiator*
5. *Fan control thermal contact*
6. *Heater radiator*
7. *Expansion tank*
8. *Inlet manifolds*
9. *Max. coolant temperature warning light transmitter*
10. *Coolant temperature indicator transmitter*
11. *Pump coolant filter inlet*
12. *Additional resistance for fan speeds*

CIRCUIT OPERATION

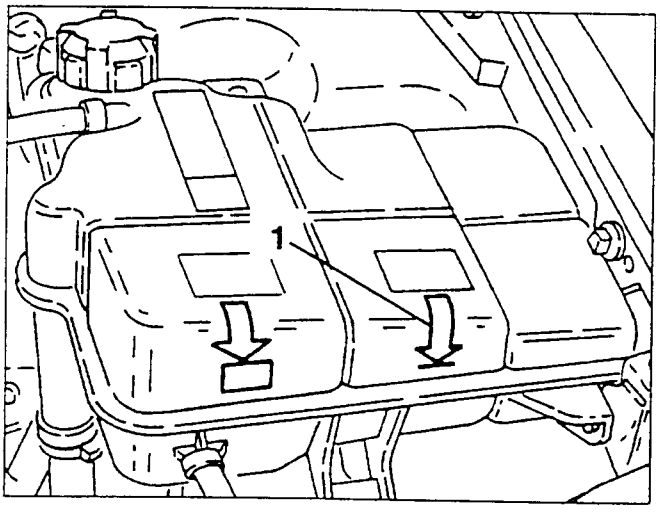
After the fluid has cooled the engine, it comes out of the cylinder head through the intake bodies and reaches the thermostat unit through special hoses.
From here, if the temperature is below 86° ± 2°C it is taken in by the pump through the inlet union.
If the temperature is higher than this value, the thermostat opens and the fluid is sent to the radiator.
After being cooled in the radiator, the fluid returns through a pipe to the inlet union and from this to the pump which ducts it back to the radiator.
A connection pipe is fited on the radiator for coupling with the header tank.

A pipe leading from the thermostatic cup takes the coolant fluid to the passenger compartment heater and, for the 16V versions, it branches with a return pipe to the header tank which also serves to bleed the air from the system.
For the 8V versions, a branch from the heater delivery pipe goes to heat the throttle valve from where it returns directly to the header tank.
A pipe leading from the heater joins the supply pipe leading from the header tank and goes to the pump inlet.

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

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



- Re-tighten the drain plugs and check that all the hose clamps of the cooling system are firmly tightened.
- Fill until the MAX. mark on the header tank is reached.

The type and quantity of the coolant fluid is given in the table below:

Alfa Romeo Climafluid Super Permanent -40°C	6.7 litres

- Start the engine and bring it to normal operating temperature until the thermostat opens and releases the residual air from the circuit. - With the engine cold, top up to reach the level marked on the header tank.
- Re-tighten the pressurized cap on the header tank.

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

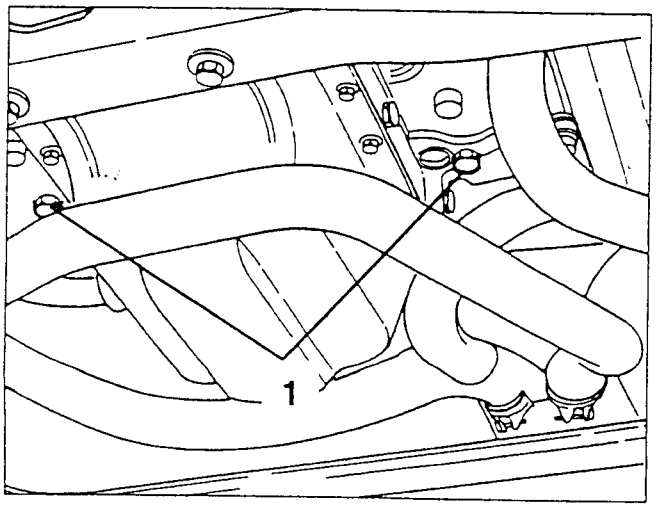
Changing

- Slacken and remove the header tank plug.

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

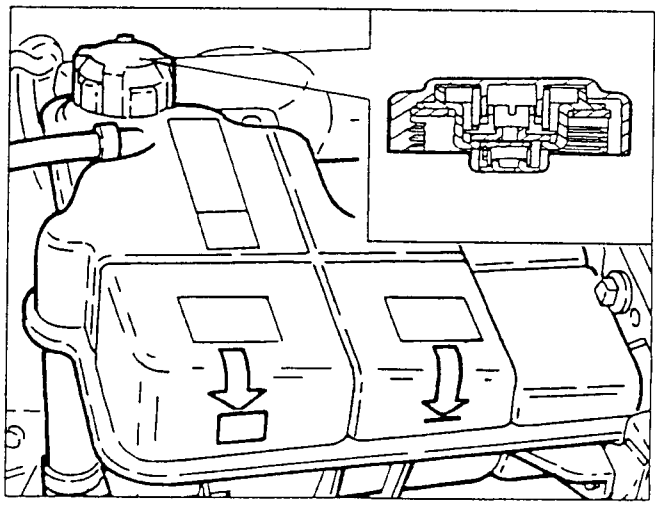
1. Slacken the two plugs under the crankcase and drain off the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can damage the paintwork: avoid touching any painted parts with it.



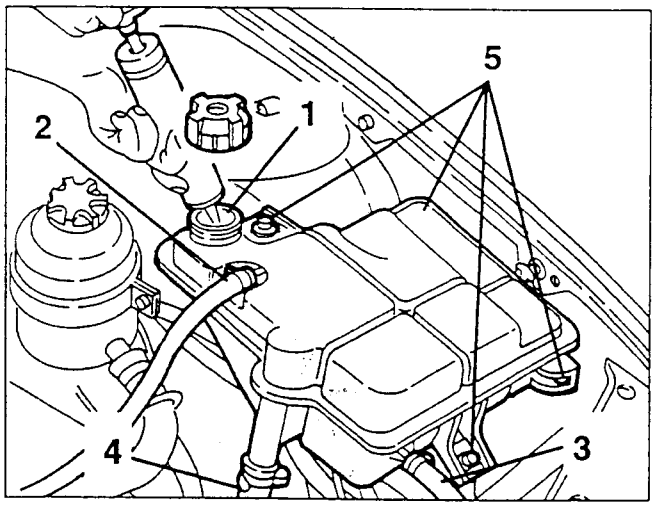
HEADER TANK

The purpose of the header tank is to supply the circuit and absorb the changes in volume of the coolant fluid due to changes in the temperature of the engine.
In addition, a special valve contained in the pressurised cap bleeds the air from the circuit.
This valve also has a washing purpose as it admits outside air when the circuit is under vacuum due to the cooling of the engine.
The level of the coolant in the header tank must be between the MIN and MAX. marks.



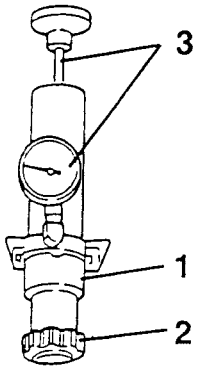
REMOVAL/REFITTING

1. Empty the coolant fluid from the header tank using a suitable syringe.
2. Disconnect the air relief and coolant return pipe from the header tank.
3. Disconnect the radiator connection pipe from the header tank.
4. Disconnect the system supply pipe from the header tank.
5. Slacken the three fastening screws and remove the header tank.



PRESSURIZED CAP SEAL TEST

1. Connect the union on the lower end of the testing device.
2. Fit the header tank pressurized cap on the union.
3. Pressurize working manually on the piston and check that the valve on the cap opens at the specified setting using a pressure gauge.

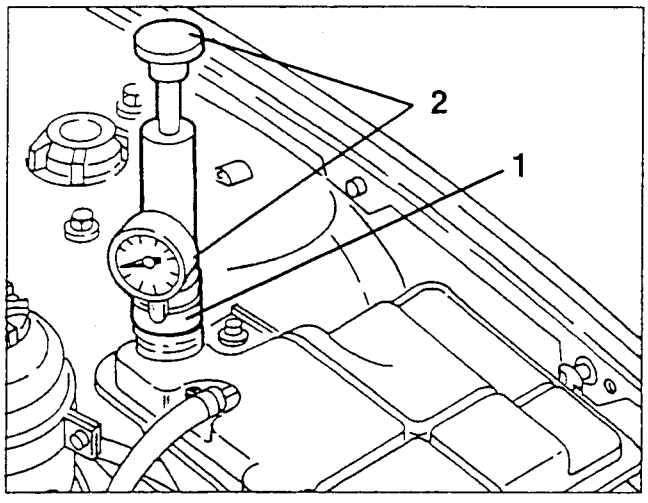


Pressurized cap setting pressure
0.98 ± 0.1 bar (1 ± 0.1 kg/cm^2)

ENGINE COOLING SYSTEM SEAL TEST

- Slacken and remove the pressurized cap from the header tank.

1. Screw the seal test device fitted with special union on the header tank union.
2. Pressurize the circuit manually and check on the test device that the pressure maintains the rating specified, if not, check the sleeves and radiator for leaks.



Hydraulic circuit test pressure
1.08 bar (1.1 kg/cm^2)

WARNING:
For safety reasons, during these tests never allow the pressure to exceed 1.38 bar (1.4 kg/cm^2).

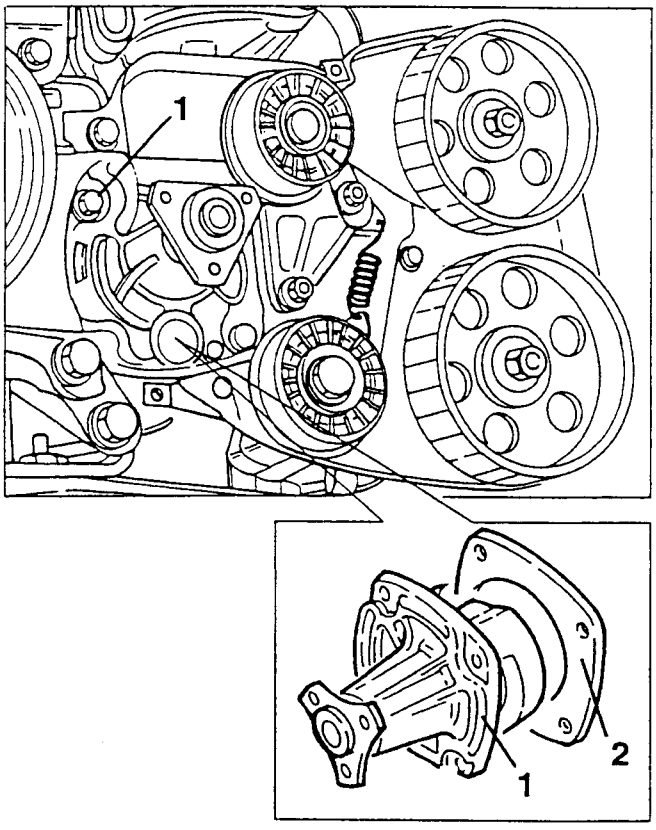
WATER PUMP

The water pump is of the centrifugal blade type. The pump casing is made from aluminium alloy and the impeller is in phenolic resin.
The pump is fastened to the crankcase and operated by a Poly V belt driven by the crankshaft. A gasket seals the joint between the crankcase and the pump.
The water pump operates constantly, thus ensuring continuous circulation of the coolant fluid.

REMOVAL/REFITTING 1712 16V

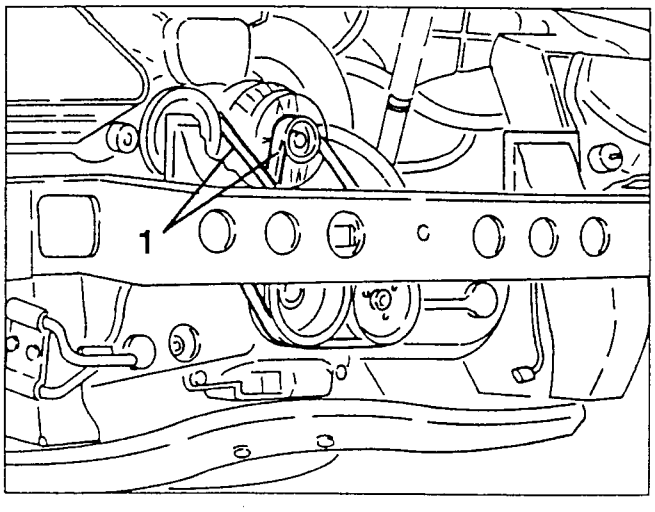
Proceed as described in GROUP 01 "REMOVAL/REFITTING CYLINDER HEADS" up to removal of the left-hand timing belt.

1. Slacken the four fastening screws and remove the water pump.
2. Remove the seals.

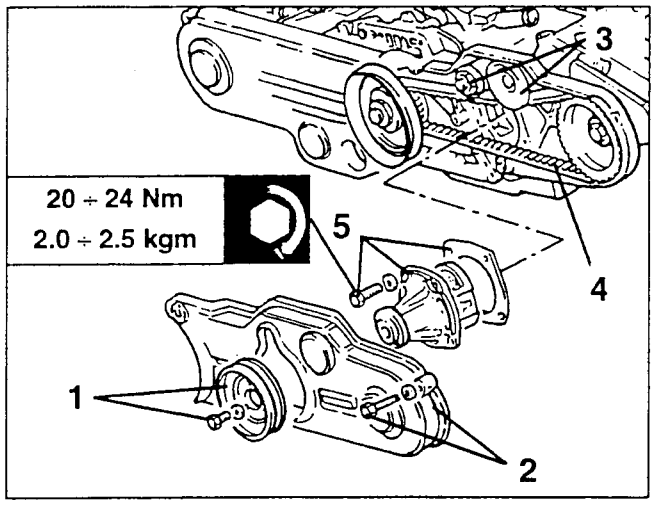


REMOVAL/REFITTING 1351 1596

- Remove the radiator (see specific paragraph).
1. Remove the auxiliary component belts.



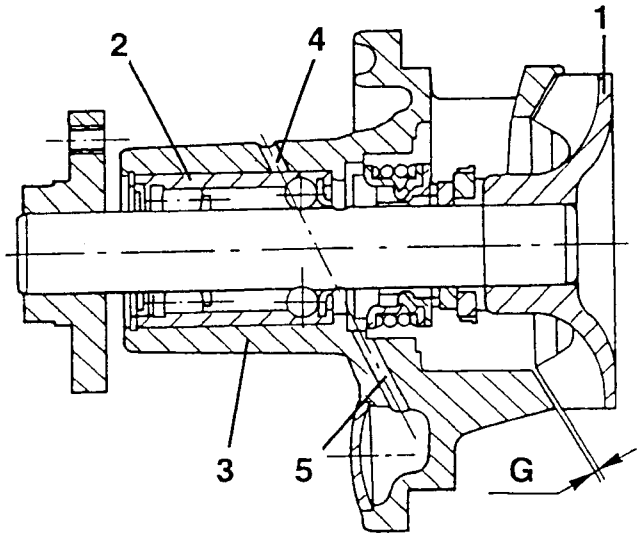
1. Slacken the fastening screws and remove the water pump pulley.
2. Slacken the fastening screws and remove the left-hand timing belt cover.
3. Loosen the nut securing the left-hand belt tensioner, press the belt guide to overcome the force of the spring and lock the nut.
4. Remove the left-hand timing belt from the camshaft drive pulleys.
5. Slacken the fastening screws and remove the water pump with its gasket.



CHECKS AND INSPECTIONS

- Check that the water pump and impeller are in good conditions and that there are no signs of oxidation or corrosion;
- check that the clearance "G" between the impeller and pump casing is with the specified limits;
- check that the front pump gasket is in good conditions and does not allow any leakage;
- check that the bearing shows no signs of wear of the races, balls and rollers;

If one of the above is found, change the whole water pump.

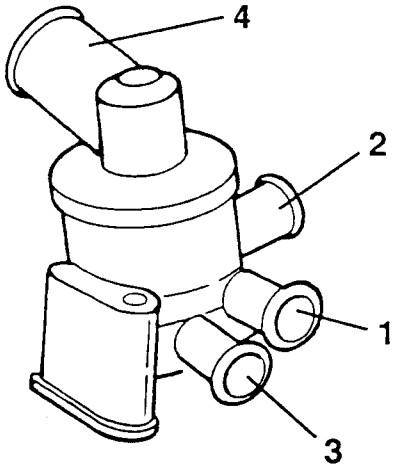


1. Impeller
2. Bearing
3. Pump casing
4. Air relief hole
5. Drain hole

Clearance between impeller and water pump
G = 0.5 ÷ 0.8 mm

THERMOSTAT UNIT

The thermostat unit is fitted on the upper side of the crankcase.
Its purpose is to ensure that the engine does not exceed the optimum temperature: until the coolant temperature reaches 86° ± 2°C, the thermostat valve diverts the fluid directly towards the pump; at higher temperatures the thermostat valve opening allows the fluid to flow towards the radiator.

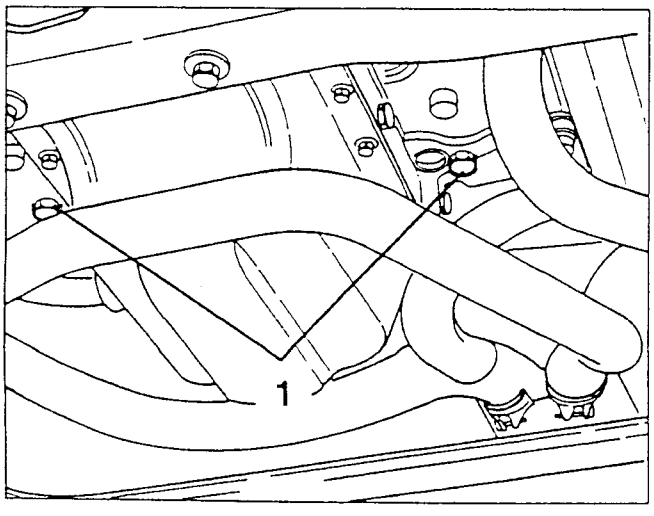


1. Return from bodies
2. Delivery to heater
3. Delivery to pump
4. Delivery to radiator

Total bulb stroke (at 100°C)
≥ 7 mm

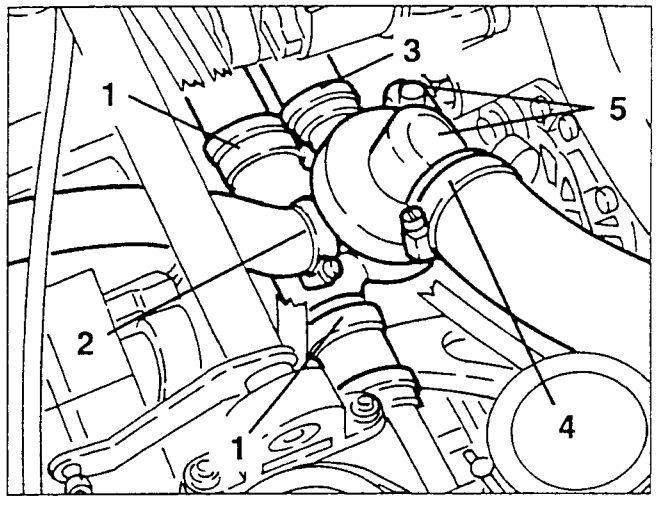
REMOVAL/REFITTING

- Set the car on a lift and raise it.
1. Unscrew the two plugs under the crankcase and drain the coolant into a suitable recipient.



WARNING:
The anti-freeze mixture used as coolant can damage the paintwork: avoid touching any painted parts with it.

- Remove the intake box (see GROUP 10).
1. Disconnect the coolant return sleeves from the thermostatic cup.
2. Disconnect the coolant delivery sleeve to the heater from the thermostatic cup.
3. Disconnect the coolant delivery sleeve to the pump inlet from the thermostatic cup.
4. Disconnect the coolant delivery sleeve to the radiator from the thermostatic cup.
5. Slacken the fastening screw and remove the thermostatic cup.



CHECKS AND INSPECTIONS

Check that the thermostat setting is within the specified limits.

Thermostat setting	
Start of opening temperature	86° ± 2°C
Valve stroke at 100°C	≥ 7 mm

- If the setting is incorrect, change the thermostat.

RADIATOR

The radiator is sized to dissipate the heat produced during operation of the engine.
It comprises a radiator core (front radiating surface 20.3 dm^2) and two side tanks fitted with unions for the inlet and outlet of the coolant fluid; the radiator core pipes and fins are in aluminium and the tanks are in plastic. .

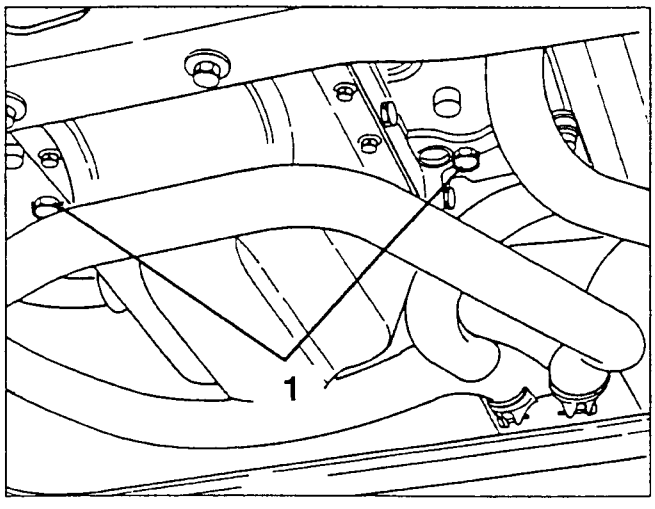
A thermal contact on the radiator controls the cooling fans.

REMOVAL/REFITTING (for versions with conditioner)

- Remove the cooling fans (see specific paragraph).
- Remove the radiator grille and front bumper (see GROUP 70).
- Raise the car.

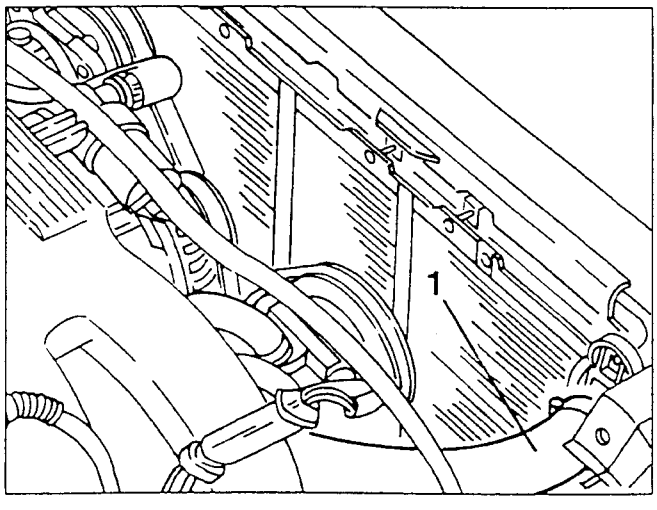
1. Unscrew the two plugs under the crankcase and drain off the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can damage the paintwork: avoid touching any painted parts with it.



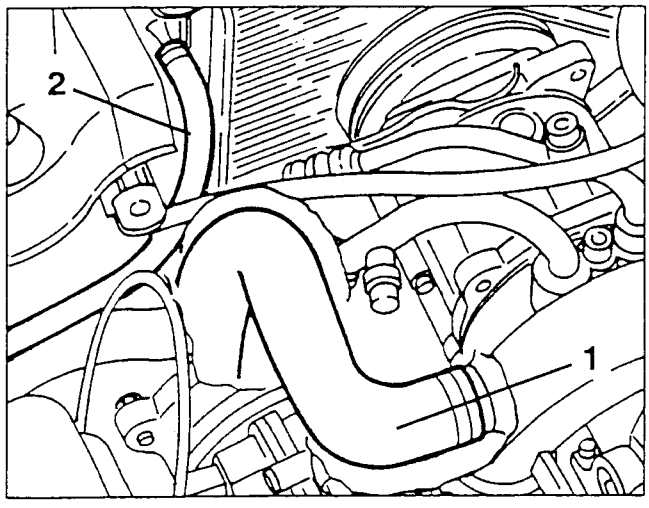
- Lower the car.

1. Disconnect the coolant inlet sleeve from the radiator.



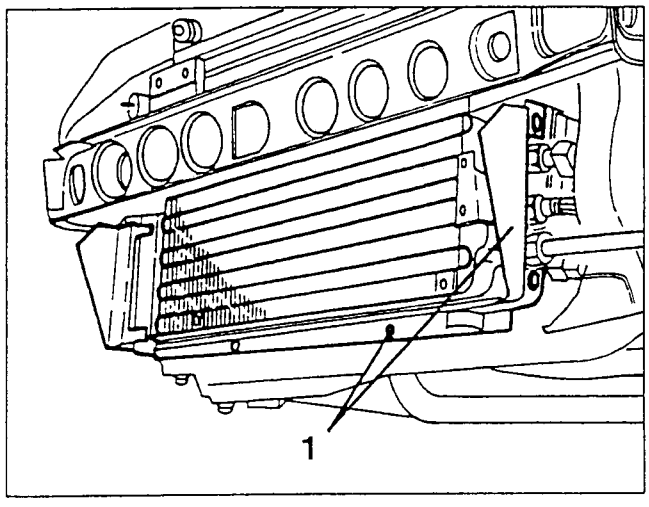
1. Disconnect the radiator coolant outlet sleeve from the union on the crankcase.

2. Disconnect the connection pipe to the header tank from the radiator.

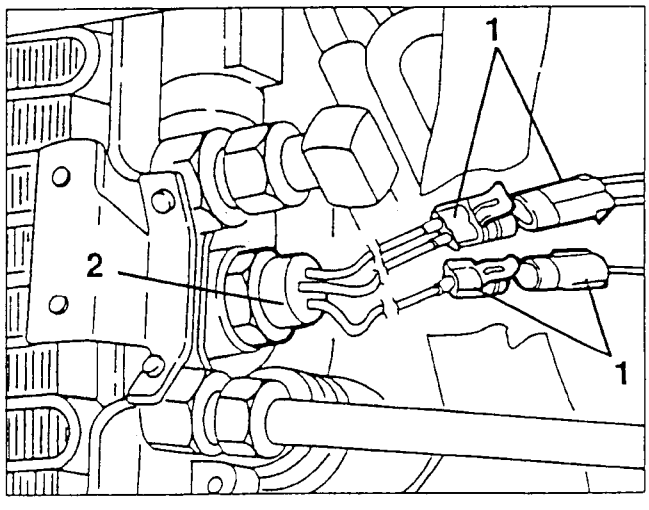


- Raise the car.

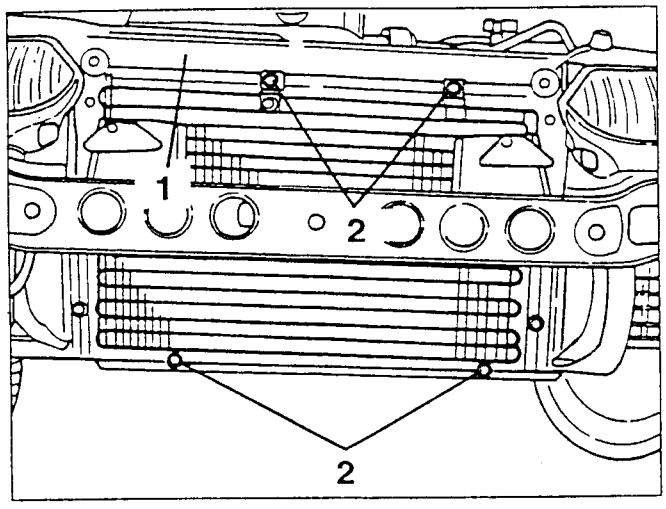
1. Slacken the fastening screws and remove the lower air duct.



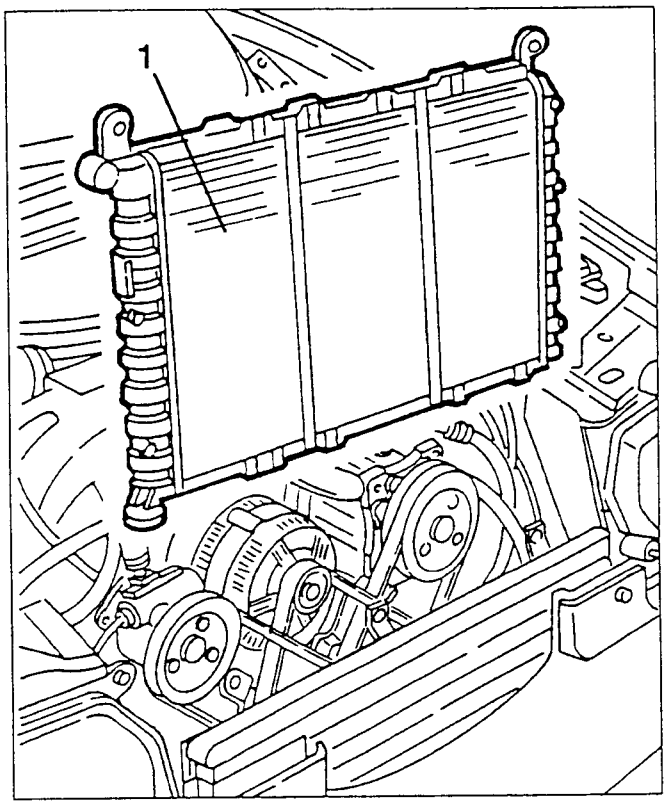
1. Disconnect the electrical connections of the fan control thermal contact.
2. Remove the fan control thermal contact.



1. Slacken the screws fastening the upper air duct to the radiator.
2. Slacken the four screws fastening the condenser to the radiator.



1. Remove the radiator pulling it upwards.

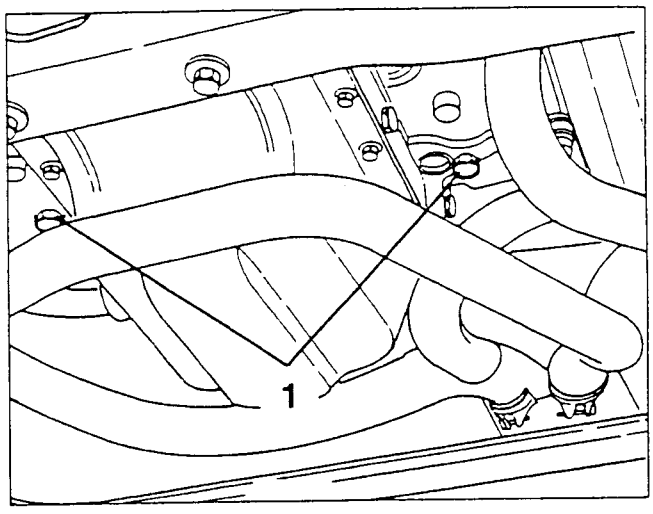


- On the bench remove the coolant outlet sleeve from the radiator.

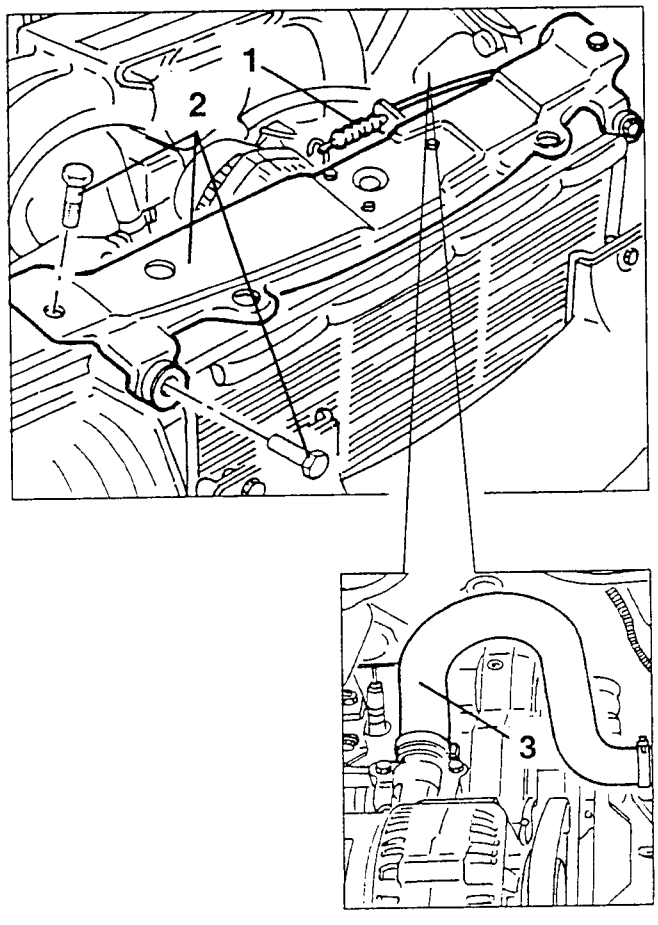
REMOVAL/REFITTING (for versions without conditioner)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Raise the car.

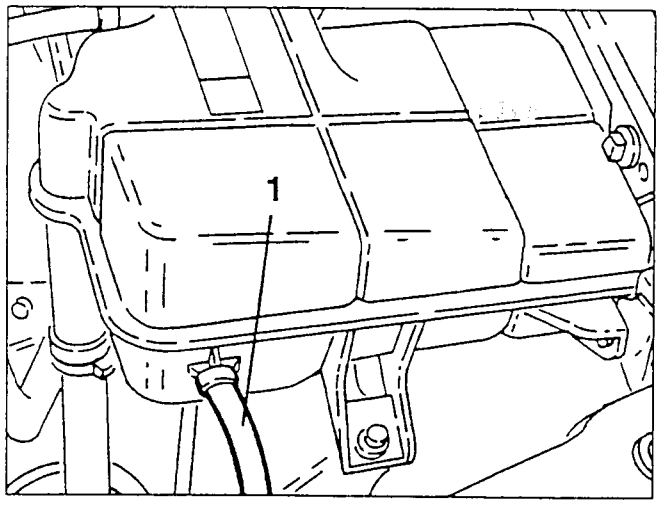
1. Unscrew the two plugs under the crankcase and drain the coolant into a suitable recipient.



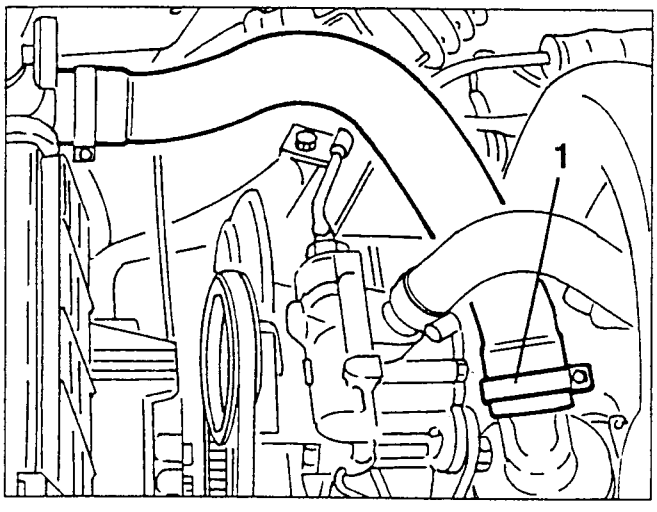
- Lower the car.
- Remove the radiator grille and front bumper (see GROUP 70).
1. Disconnect the bonnet opening cable from the lock.
2. Slacken the crossmember fastening screws and remove it.
- Remove the front bumper (see GROUP 70).
3. Disconnect the radiator outlet hose from the water pump coolant inlet union.



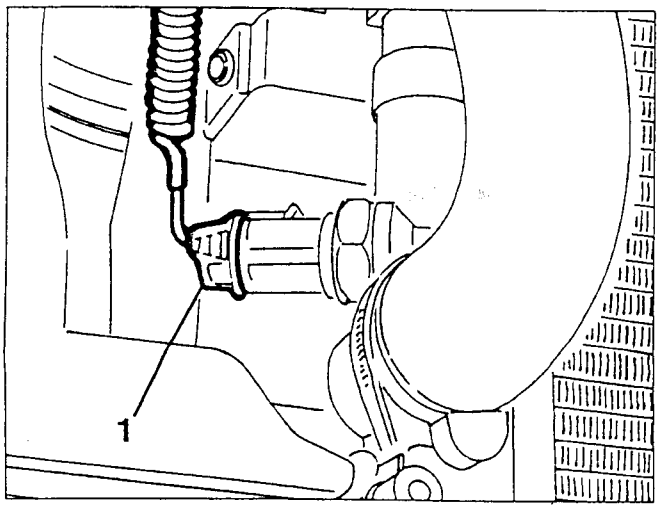
1. Disconnect the radiator connection pipe from the header tank.



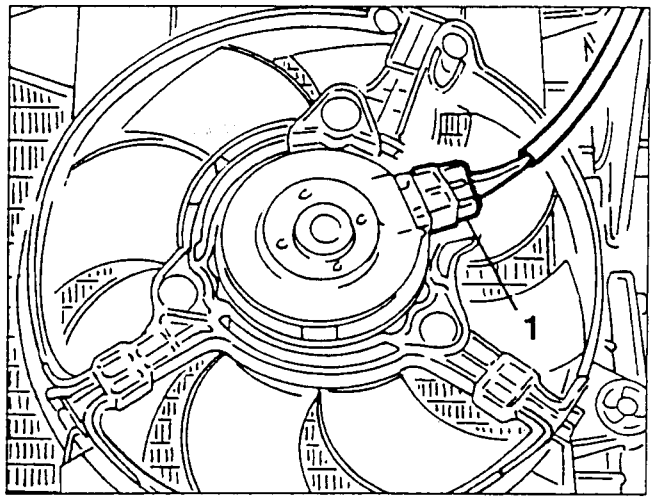
1. Disconnect the radiator coolant delivery sleeve from the thermostatic cup.



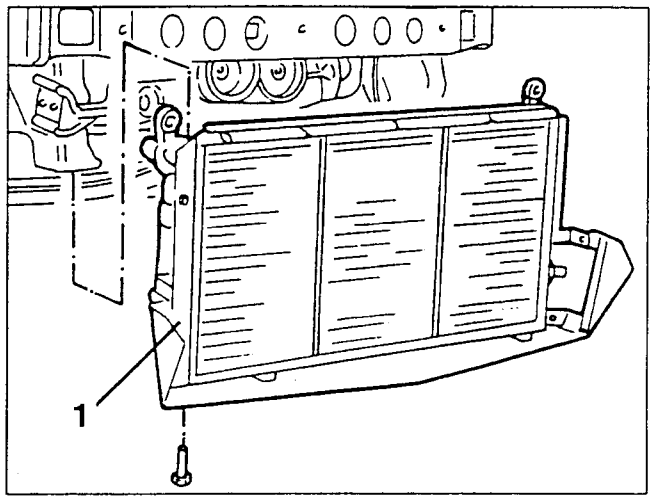
1. Disconnect the electrical connection from the fan control thermal contact.



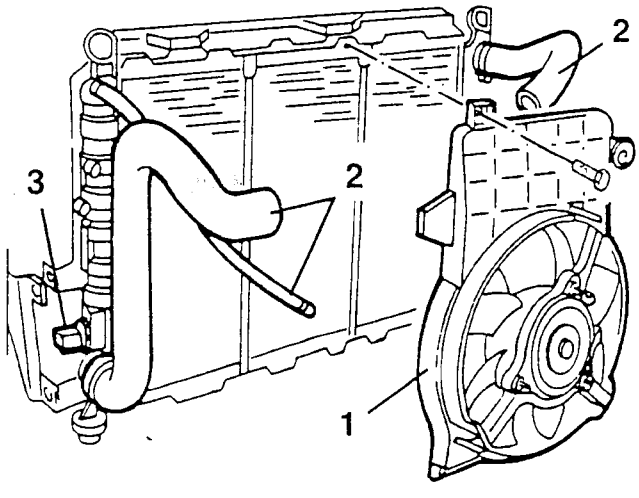
1. Disconnect the electrical connection from the cooling fan.



1. Slacken the two screws fastening the lower crossmember and remove it complete with the radiator and fan.



- Separate the lower crossmember from the radiator.
1. Slacken the four fastening screws and remove the fan from the radiator.
2. Remove the pipes from the radiator.
3. Slacken and remove the fan control thermal contact from the radiator.

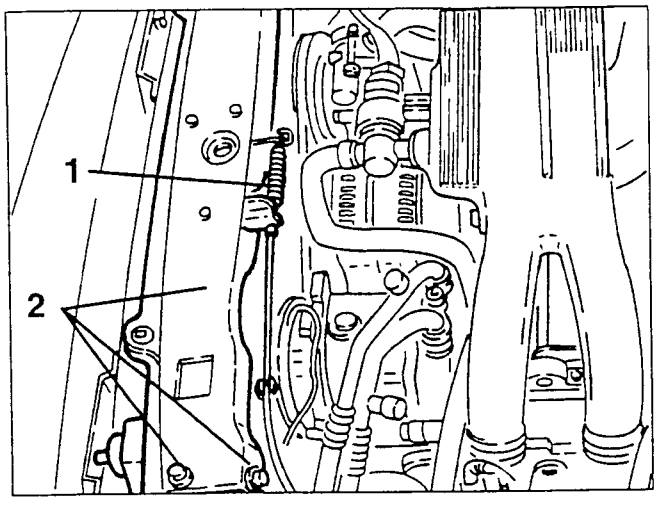


COOLING FANS

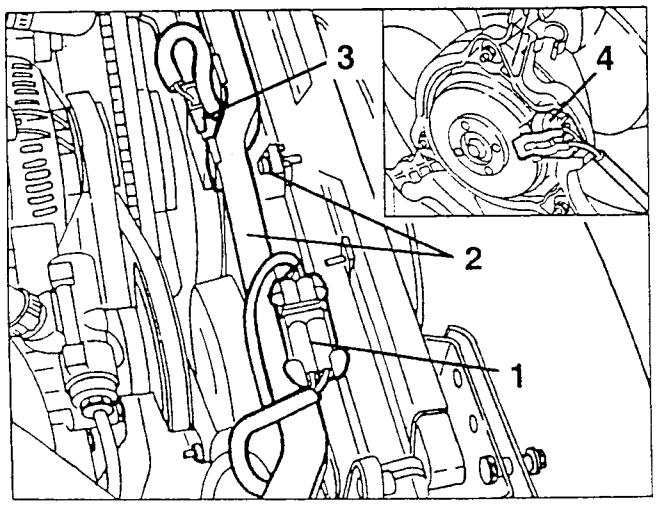
The cooling fan makes it possible to increase the heat dissipating capacity of the radiator.
The cars with air conditioner have two fans with two speeds, while the cars without air conditioner have only one fan with one speed.
The fans are controlled by a thermal contact on the radiator.

REMOVAL/REFITTING (for cars with conditioner)

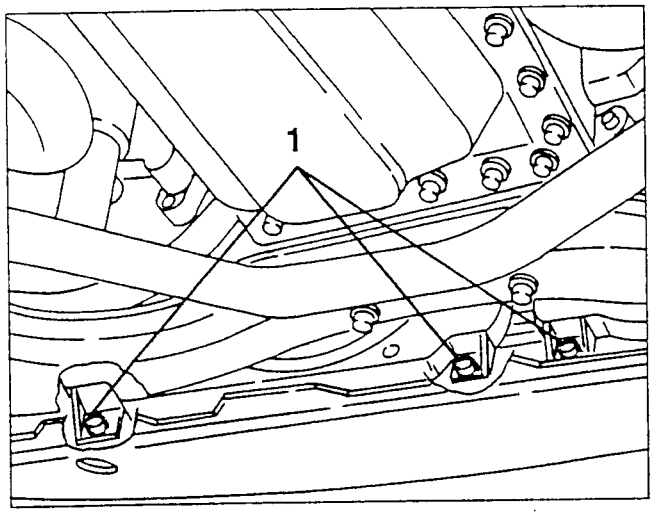
- Remove the radiator grille (GROUP 70).
1. Disconnect the bonnet opening cable.
2. Remove the upper radiator crossmember.



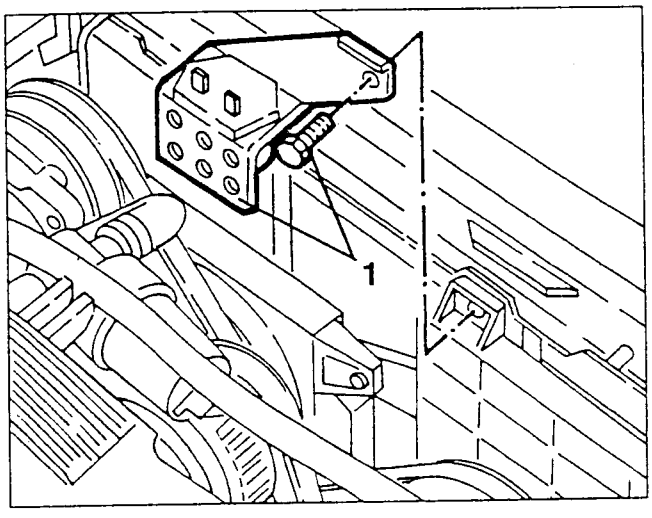
1. Remove the electrical connection without disconnecting it from above the fan.
2. Release the wiring from the groove, slacken the two fastening screws and remove it.
3. Disconnect the two electrical connections from the engine cooling fan additional resistance.
4. Disconnect the electrical connections from the cooling fans.



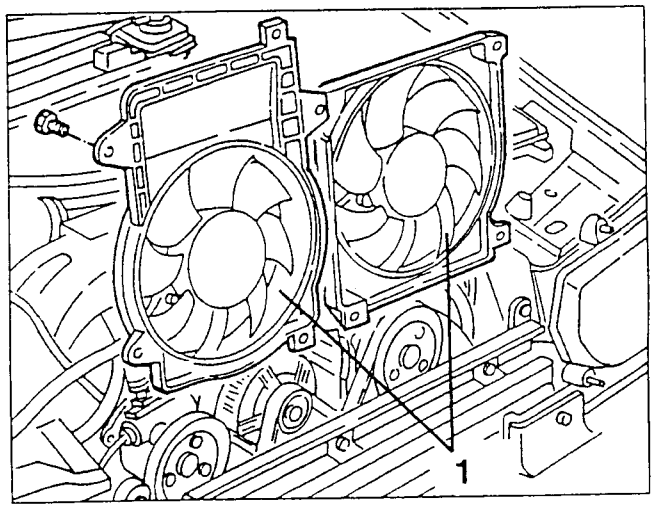
1. Slacken the three lower fastening screws of the cooling fans as illustrated.



- Slacken the remaining lower screw fastening the right fan.
1. Slacken the fan fastening screw illustrated and retrieve the additional resistance.



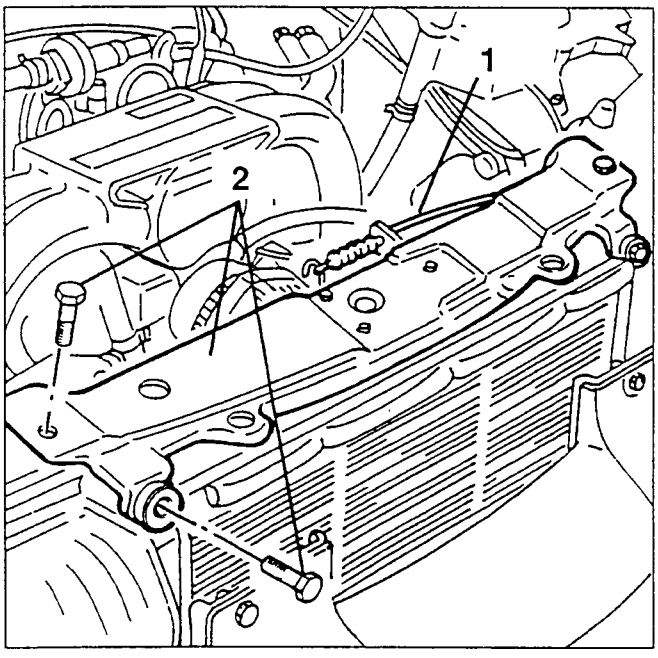
1. Slacken the remaining three upper fan fastening screws then remove the fans pulling them upwards beginning with the right-hand one.



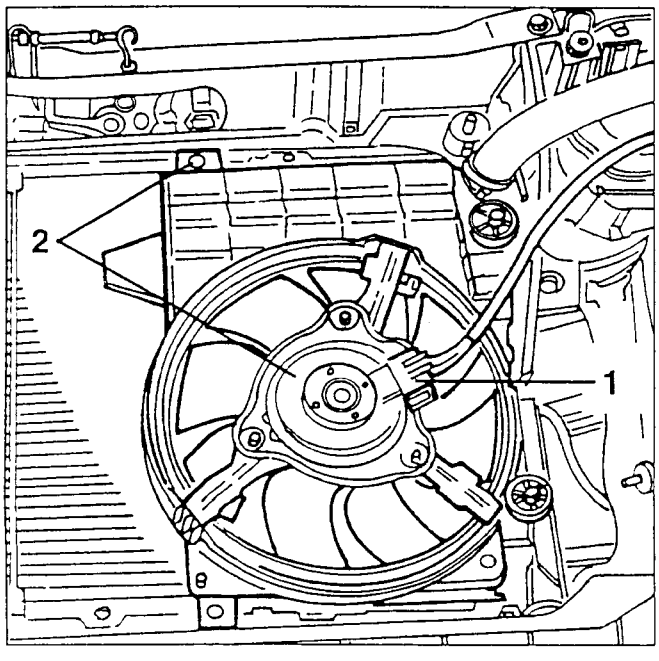
REMOVAL/REFITTING (for versions without conditioner)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the radiator grille (see GROUP 70).

1. Disconnect the bonnet opening cable from the lock.
2. Slacken the crossmember fastening screws and remove it.



1. Disconnect the electrical connection of the fan supply.
2. Slacken the four fastening screws and remove the fan pulling it upwards.



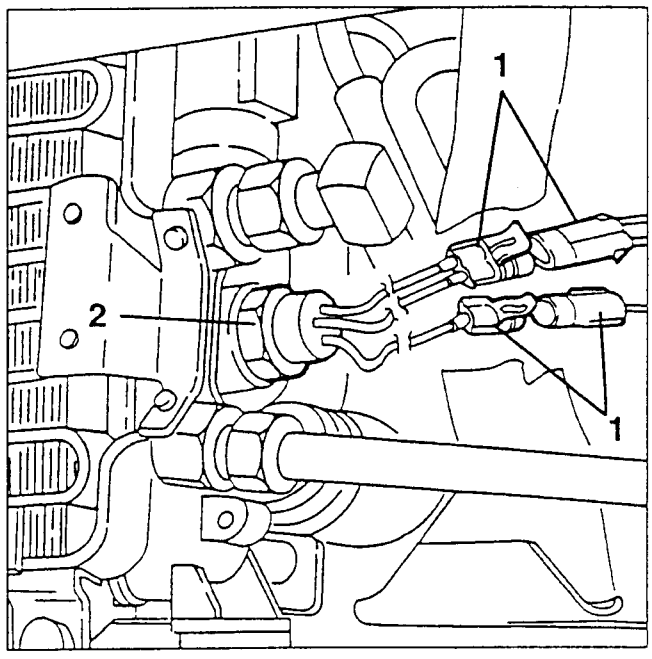
FAN THERMAL CONTACT

REMOVAL/REFITTING

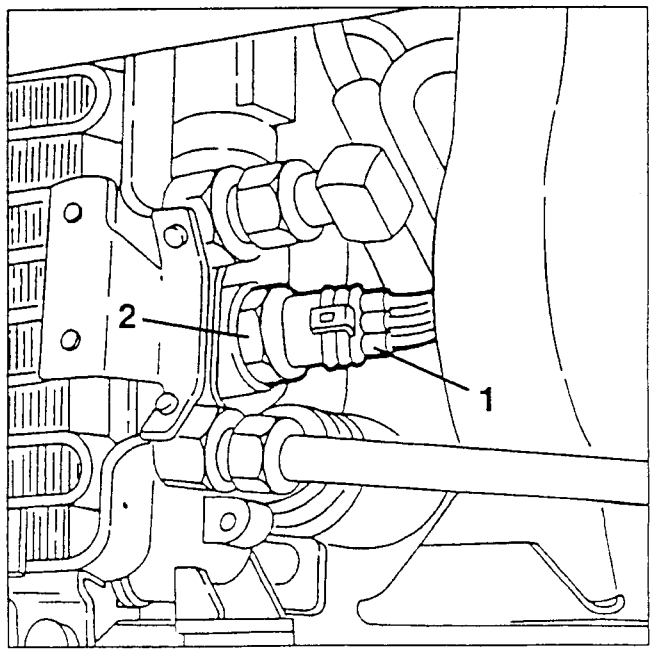
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the radiator grille and front bumper (see GROUP 70).

1. Disconnect the electrical connections of the fan control thermal contact.
2. Remove the fan control thermal contact and recover the coolant that comes out.

WITH CONDITIONER



WITHOUT CONDITIONER



CHECKS AND INSPECTIONS

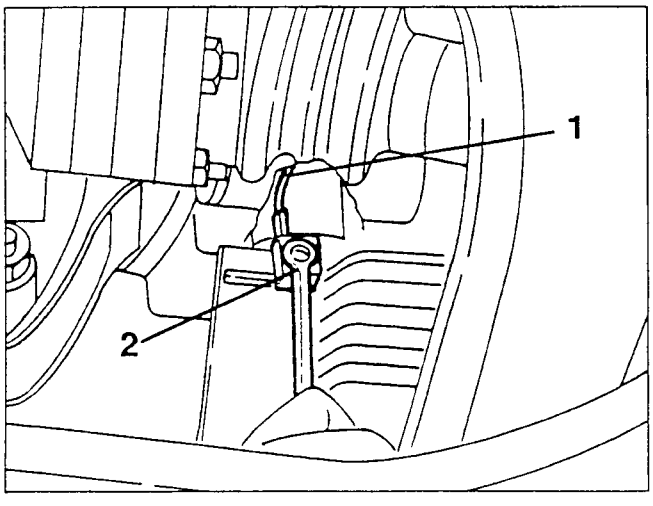
Check the setting of the thermal contact referring to the wiring diagram of the specific manual.

Cooling fan cut-in/cut-out temperatures		
1st speed	Cut in (contacts close)	92° ± 2°C
	Cut out (contacts open	87° ± 2°C
2nd speed (only for versions with conditioner)	Cut in (contacts close)	97° ± 2°C
	Cut out (contacts open)	92° ± 2°C

- If the values are not as specified, change the thermal contact.

MAXIMUM COOLANT TEMPERATURE WARNING LIGHT SENDER

1. Disconnect the electrical connection from the max. coolant temperature warning light sender.
2. Slacken the fastening screw and remove the max. coolant temperature warning light sender from the right-hand cylinder head.

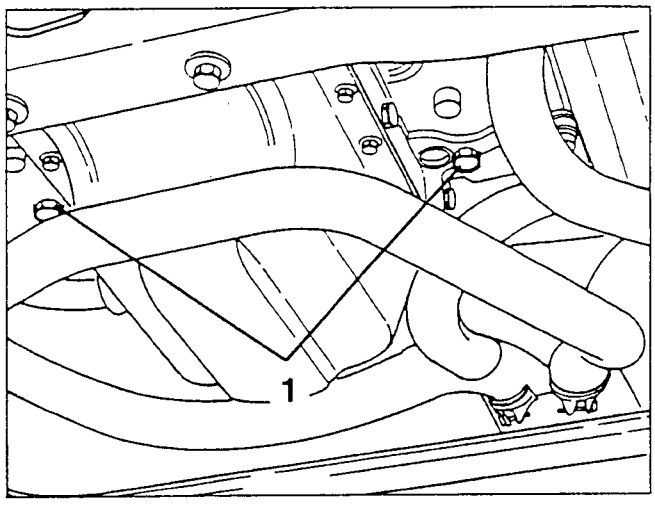


- Check the setting of the max. coolant temperature warning light sender. If the setting is incorrect, change the sender.

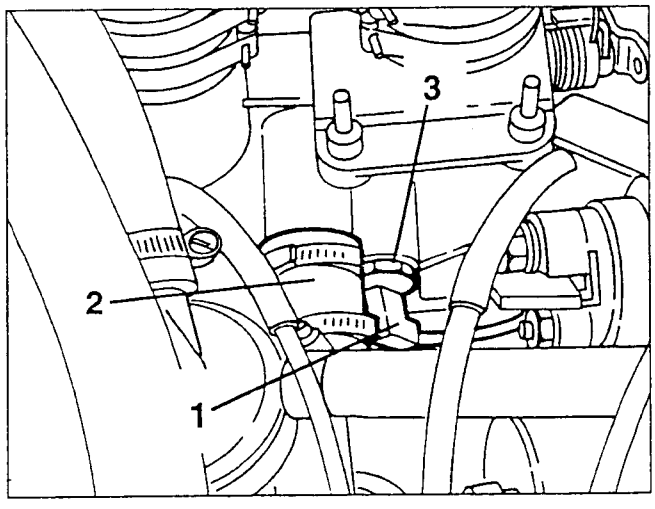
Cut in temperature	117° ± 3°C
Cut out temperature	100° ± 3°C

COOLANT TEMPERATURE GAUGE SENDER

1. Slacken the two plugs under the crankcase and drain the engine coolant fluid into a suitable recipient.



- Lower the car.
- Remove the intake box and the throttle control shaft (see GROUP 10).
1. Disconnect the electrical connection from the coolant temperature gauge sender.
2. Disconnect the coolant outlet sleeve from the right-hand body.
3. Slacken and remove the engine coolant temperature gauge sender.

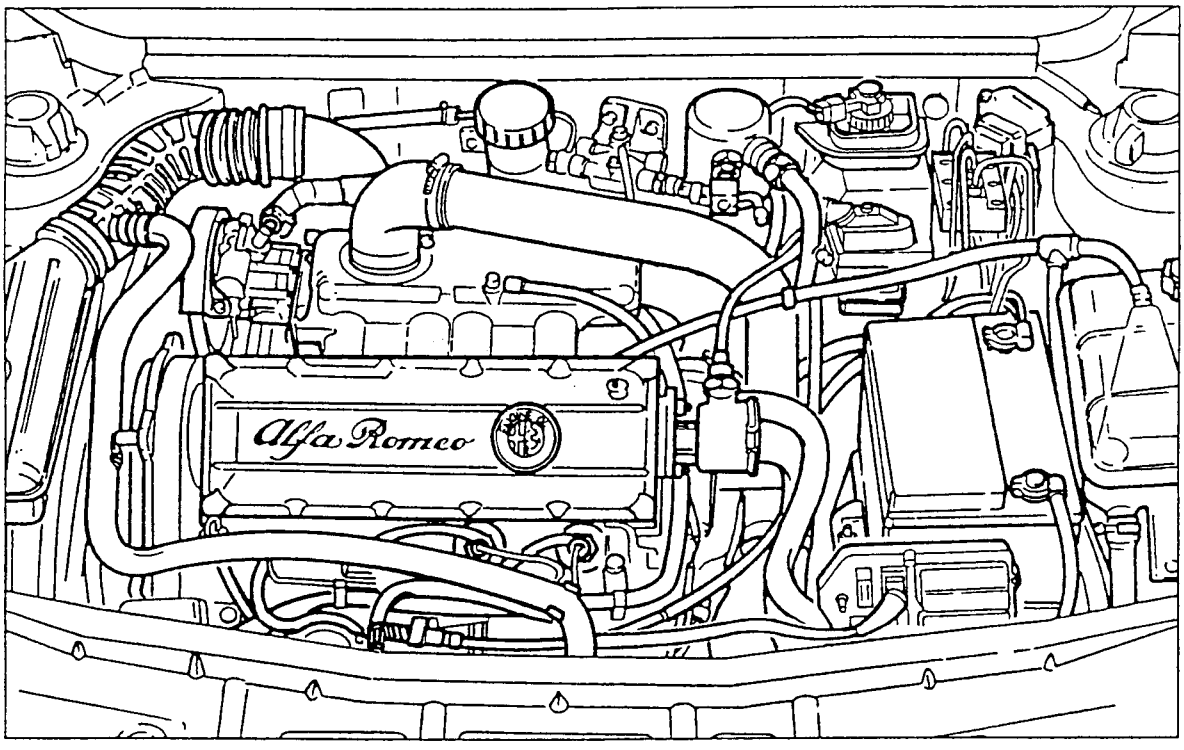


- Check the setting of the engine coolant temperature gauge sender (see: GROUP 55 - "DIAGNOSIS OF THE ELECTRICAL SYSTEM").

DESCRIPTION

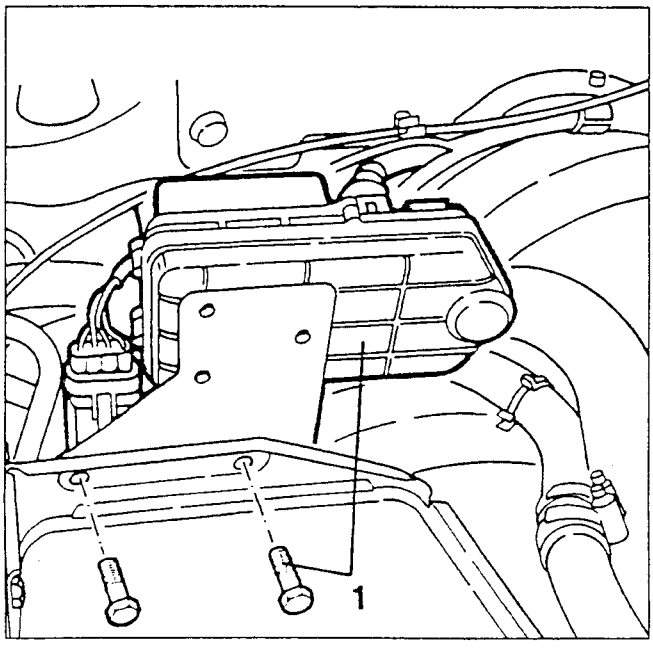
The information and illustrations given below enable the rapid removal of the power unit from its housing and its subsequent refitting.
The bench disassembly of the single components is described in the volume "ENGINE OVERHAULING".

The following procedure may be used only in part according to requirements.
Fur further information and details, refer to the chapters concerning the components or specific groups.



REMOVAL

- Remove the front wheels.
- Remove the radiator grille and front bumper (see GROUP 70).
- Drain off the air conditioning fluid.
1. Loosen the two screws and move the fan relays to one side.



- Remove the conveyor for draining the battery acid.
1. Unscrew the two nuts securing the heater plug control unit bracket support at the battery support.
2. Unscrew the four screws and remove the battery support.