GROUP 04

FUEL SYSTEM

INDEX

BACKGROUND BEAT (DUE TO INBALANCE)	TEST D

TEST STEPS	RESULTS	REMEDY
D1 CHECK CASTING OF MAIN AND ROD BEARINGS – Check: • main and rod bearings for traces of overheating, flaking etc. • crankshaft journals for damage	OK ▶ ~~OK~~ ▶	Carry out step D2 Replace crankshaft. Wash engine block lubricating system and overhaul or replace oil pump if necessary.
D2 CHECK CONNECTING ROD AND BACKGROUND BEATING – Check: • clearances between rod big end and crankshaft journals and relevant bearings • tightening torques of main bearings and rod big end are within prescribed limits.	OK ▶ ~~OK~~ ▶	Carry out step D3 Replace crankshaft and/or affected rod. Tighten to prescribed torque
D3 CHECK CRANKSHAFT BEATING – Check that crankshaft axial play is within the specified limits	OK ▶ ~~OK~~ ▶	Carry out step D4 Replace the thrust half rings

(CONTINUES)

BACKGROUND BEAT (DUE TO INBALANCE)	TEST D

TEST STEPS	RESULTS	REMEDY
D4 CHECK PISTON BINDING BEATING – Visually check the mating surfaces of the cylinder liners and pistons for overheating, binding, scoring etc. and that the piston rings move freely in the relative grooves on the piston	OK ▶ ~~OK~~ ▶	Carry out step B Replace cylinder liner and piston of affected cylinder

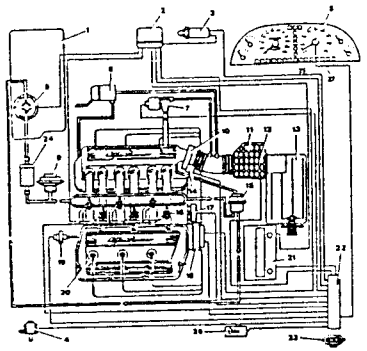
End of test D

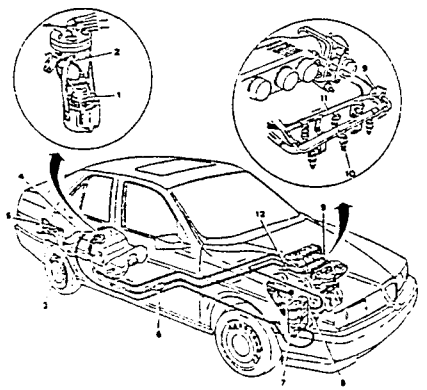
IMPORTANT NOTE:
For any anomalies which interfere with the correct operation of the engine **refer to FAULT RECTIFICATION included in Group 04.**

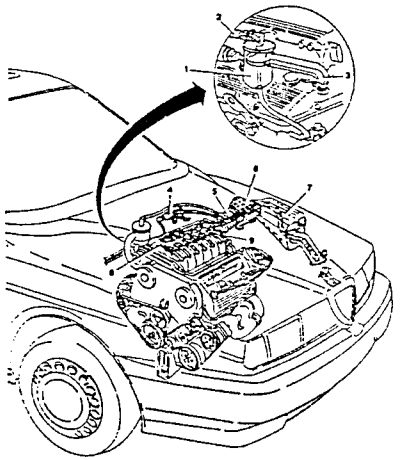
For example

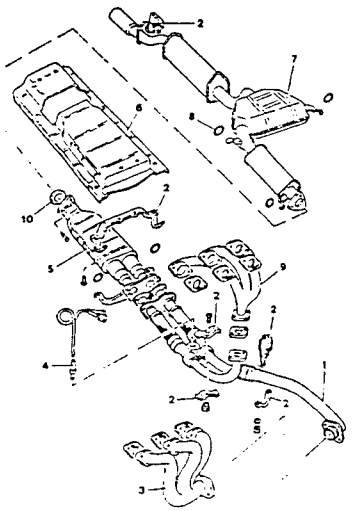
- engine does not start
- engine stumbles
- irregular engine idle speed
- excessive fuel consumption
- excessive percentage of CO
- etc.

ILLUSTRATED INDEX









BOSCH MOTRONIC M1.7 INJECTION - IGNITION SYSTEM

GENERAL DESCRIPTION

An electronic control system defines and controls all the parameters of the engine, optimizing performance and consumption through a real time response to the differing operating conditions.

A single control unit governs both ignition and injection: the point at which the engine catches is identified via special sensors and, as a consequence, the actuators carrying out the following functions are activated:

- regulation of injection times;
- ignition;
- control of cold starting;
- control of enrichment during acceleration;
- fuel cut-off during deceleration;
- control of constant idle speed;
- limitiation of maximum r.p.m.;
- combustion control - Lambda probe;
- fuel vapour recovery;
- connection to air conditioning compressor (only for models with automatic heating/ventilation with air conditioner).
- connection with the Alfa Romeo CODE system

The system is also equipped with a self-diagnosis function which memorizes any anomalies and facilitates their identification and correction.

MOTRONIC M1.7

In comparison to previous models this new 1.7 system employs a control unit of a more technically up-to-date design and is therefore more reliable. Various possibilities of operating particular functions are also included.

A "static distribution" system of electronic ignition has also been adopted (semiconductors without distributor). The arrangement greatly increases reliability and makes it possible to eliminate rotating components and as a result, reduces noise. In addition sparks are not produced externally and this reduces the risk of interference; it also reduces the number of high voltage cables and connections.

The sensor controlling the throttle valve is also of a new design: the two microswitches signalling minimum (throttle valve closed) and maximum (throttle valve open) have been replaced by a potentiometer which sends a signal proportional to the angle of the throttle valve.

The idle speed regulation device is also slightly different and increases the speed of regulation.

The characteristic and innovative feature of this system is the "autoadaptation" function: it is in fact able to recognize the changes which occur in the engine (internal attrition, settling of the engine with time etc.) so that adjustments can be made as a consequence.

This autoadaptation function makes it possible to compensate for the inevitable differences (due to production tollerances) of any replaced components. This enables optimal results to be attained on all vehicles without necessitating particular adjustments or inspections.

NOTE: **Because of this, it is important that after any type of intervention, the engine is left to run for a few minutes so that the control unit can "memorize" any changes which have taken place and adapt itself to them.**

Identification of the catch point:

the point at which the engine catches is identified by two sensors: the r.p.m. and timing sensor supplies the control unit with the speed and angular position of the crankshaft and the air flow meter supplies the instantaneous volumetric output of the engine (relation between actual volume of air entering the cylinders and the volume of the cylinders themselves).

Regulation of injection times:

the control unit controls the injectors at great speed and with great precision, calculating the opening times on the basis of engine loading (r.p.m. and air delivery) also taking battery voltage and engine temperature into account.
Injection is simultaneous; all the injectors are opened at the same time during each revolution permitting the cylinders to be supplied with the correct amount of fuel and improving operation during the transient states.

Ignition:

ignition is of the static type and is controlled directly by the control unit which regulates the advance on the basis of engine loading (r.p.m. and air flow).
For information regarding the static ignition system, reference should be made to **GROUP 05**.

Control of cold starting:

during the cold starting phase, the control unit uses the advance and injection time values.
During starting the control unit also controls the injection at each ignition impulse and not at each revolution of the crankshaft as happens during normal operation. When a certain temperature/engine r.p.m. ratio is reached, the control unit returns the system to normal operation.

Control of enrichment during acceleration:

upon acceleration the control unit increases injection in order to reach the required loading as quickly as possible.
This function is carried out by the potentiometer located on the throttle valve which instantaneously alerts the the control unit that maximum power has been requested, anticipating the signal coming from the air flow meter which shows a great increase in air flow and in this way an immediate response is obtained.

Fuel cut-off during deceleration:

with the throlttle valve closed and the number of revolutions exceeding a threshold value (approx. **1200 r.p.m.**), the control unit interrupts fuel inection; in this way the number of revolutions decreases rapidly towards idle speed and fuel consumption, controlled to a greater degree, is as a consequence, greatly decreased. The threshold value of the cut varies in relation to the temperature of the engine.

Control of idle speed:

the regulation of idle speed is carried out through an actuator which acts on the by-pass of the throttle valve. This acts as an additional air chamber and as a regulator for the operation of the various functions (e.g. air conditioning compressor): with the throttle valve at the stop limit the actuator regulates the by-pass clearance compensating for the power requested by the functions in order to guarantee an idle speed which is as far as possible constant around prescribed value.
The actuator employed in this version guarantees high speed regulation as the opening and closing of the by-pass are both closed by magnetic windings.
Idle speed adustment, for small variations, is already carried out by the ignition advance after which it is regulated by the by-pass.

NOTE: **The automatic adaptation function of the system makes it possible to avoid regulating the idle r.p.m. which recognizes the "throttle valve in the stop limit position" by way of the throttle valve potentiometer, making it possible to "trace" any wearing which may influence the closed position of the throttle valve.**

Limitation of maximum r.p.m.:

once a certain threshold has been exceeded (around **6400 r.p.m.**) the control unit automatically interrupts the fuel injection in order to avoid overloading the engine and to protect it when the revs are excessively high.

Combustion control - lambda probe:

the oxygen probe (or "Lambda" probe) informs the control unit of the quantity of oxygen present during exhaust and therefore of the correct air-fuel metering.
The optimal mixture is obtained by the Lambda coefficient = 1 (intake air = theroetical quantity of air required for combustion). The electrical signal that the probe sends to the control unit undergoes an abrupt variation when the composition of the mixture deviates from lambda = 1. When the mixture is "lean", the control unit increases the quantity of fuel, when the mixture is "rich" the fuel is decreased: in this way the engine functions as near as possible to the ideal lambda value.
The signal from the Lambda probe is processed inside the control unit by an integrator which prevents abrupt swings.
The probe is heated by an electrical resistance in order to be able to to reach the correct operating temperature (approx. **300°C**) as quickly as possible.
This probe therefore makes it possible to regulate the supply of fuel to the engine both retroactively and with precision.
This also permits operation within the limits dictated by the laws regarding vehicle emissions.
In addition, this mechanism makes it possible to compensate for altitude as the variations in air density, via the Lambda probe, adjust the delivery by the injectors separately from the air flow meter which detects variations more slowly.
For information regarding the Lambda probe refer to the relative paragraph in this group.

Fuel vapour recovery:

the petrol vapours, originating from the petrol tank are collected in a fuel vapour filter (canister) by the opening of a solenoid valve and are then sent to the intake to be burned.
This solenoid valve is opened by the control unit only when the petrol vapours are in fact present in the canister and only when the engine is under loading conditions.
This makes it possible to to convey the vapours to the engine intake without disturbing the operation of the engine.
The control unit compensates for this extra quantity of petrol with a reduction in the fuel supplied to the inectors.
Refer to the relative paragraph in this group for information regarding fuel vapour recovery.

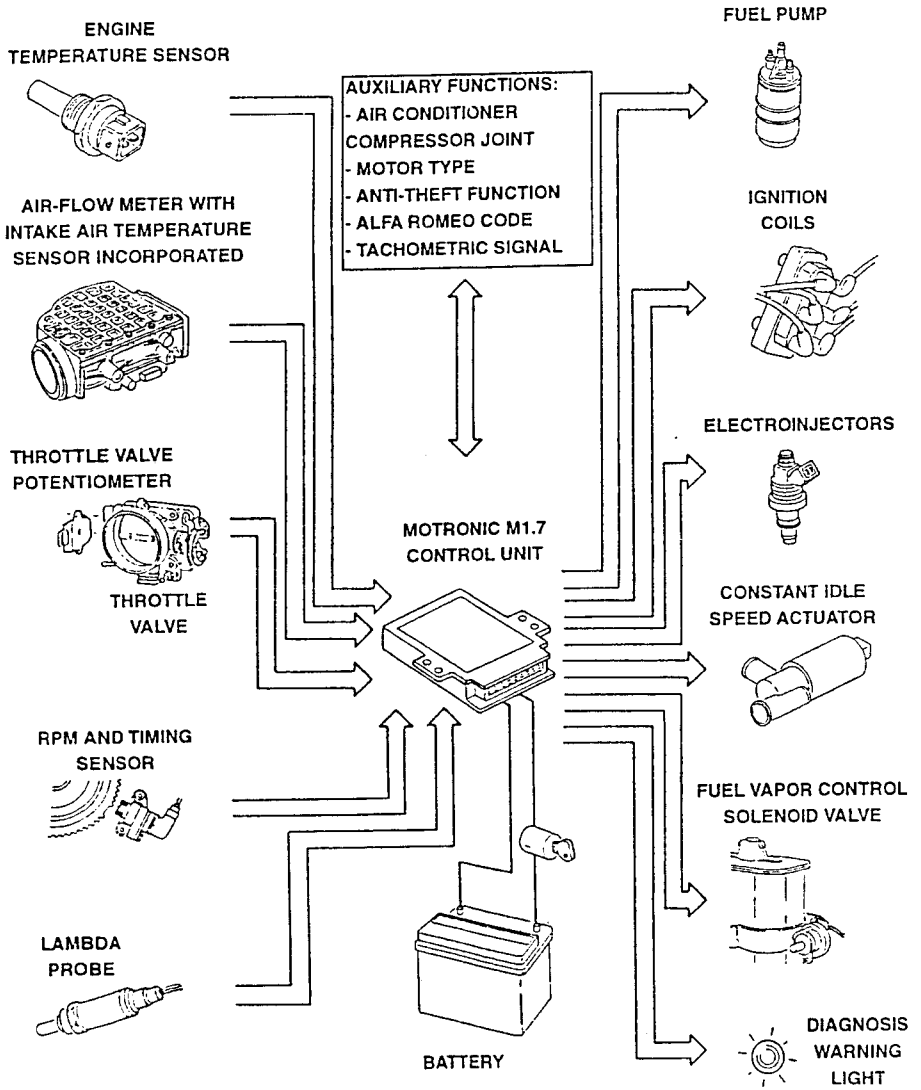
Conection to the air-conditioning compressor:

the control unit is connected to the air conditioning system so that the idle r.p.m. can be adusted to the increased power which occurs each time the compressor cuts in.
When increased engine performance is requested (hard acceleration), the control unit momentarily interrupts the supply to the compressor (7-10 seconds).

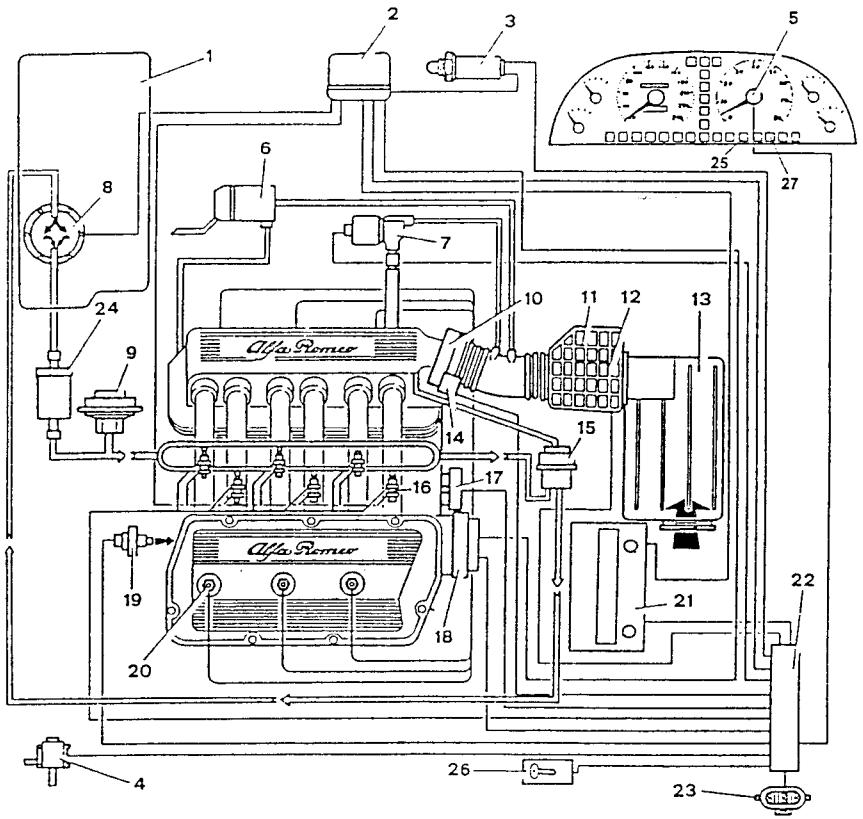
Connection with the Alfa Romeo CODE system:

on cars fitted with the Alfa Romeo CODE system, as soon as the Motronic control unit receives the signal that the key has been turned to MARCIA, it "asks" the above-mentioned system for consent to start the engine: this consent is given only if the Alfa Romeo CODE control unit recognizes the code of the key engaged in the ignition switch as correct.
This dialogue between the control units takes place on diagnosis line K already used for the Alfa Romeo Tester (see specific paragraph).
N.B.: Before doing any work on the system it is advisable to read the corresponding chapter.

The system functions and the relative sensors and actuators are illustrated below:



COMPONENTS OF THE SYSTEM



1. *Fuel tank*
2. *Relay group*
3. *Lambda probe*
4. *Evaporation solenoid valve*
5. *Rev counter*
6. *Oil vapour tank*
7. *Constant idle speed actuator*
8. *Electric fuel pump*
9. *Impulse dashpot*
10. *Throttle body*
11. *Air flow meter*
12. *Intake air temperature sensor*
13. *Air cleaner*
14. *Throttle valve potentiometer*
15. *Fuel pressure regulator*
16. *Electroinjectors*
17. *Thermostat with engine coolant temperature sensor (NTC)*
18. *Ignition coil*
19. *Engine r.p.m. amd timing sensor*
20. *Spark plugs*
21. *Battery*
22. *Ignition and injection control unit*
23. *Socket for system diagnosis (Fiat Tester)*
24. *Fuel filter*
25. *Alfa Romeo CODE system warning light*
26. *Electronic key*
27. *Diagnosis warning light*

NOTE: The individual devices will be illustrated in the paragraphs relative to the systems of which they form part (fuel supply, air supply etc.).

NOTES REGARDING INTERVENTIONS TO BE CARRIED OUT ON THE THE ELECTRONIC SYSTEM

- Remove the electronic control unit before painting in ovens with a temperature exceeding 80°C or when welding the vehicle body.
- When fitting accessories to the vehicle the electronic control unit should be disconnected and the functioning of the accessories checked before reconnection.
The wiring relative to the control unit should under no circumstances be shunted.
- Before carrying out interventions on the different components of the system ensure that connectors have not been disconnected, clamps loosened, hoses cut or blocked etc..
- Never connect or disconnect the the plug relative to the cables of the electronic control unit when the ignition is engaged.
- Never test earth the high or low voltage cables.
- Never start the engine with the battery disconnected.

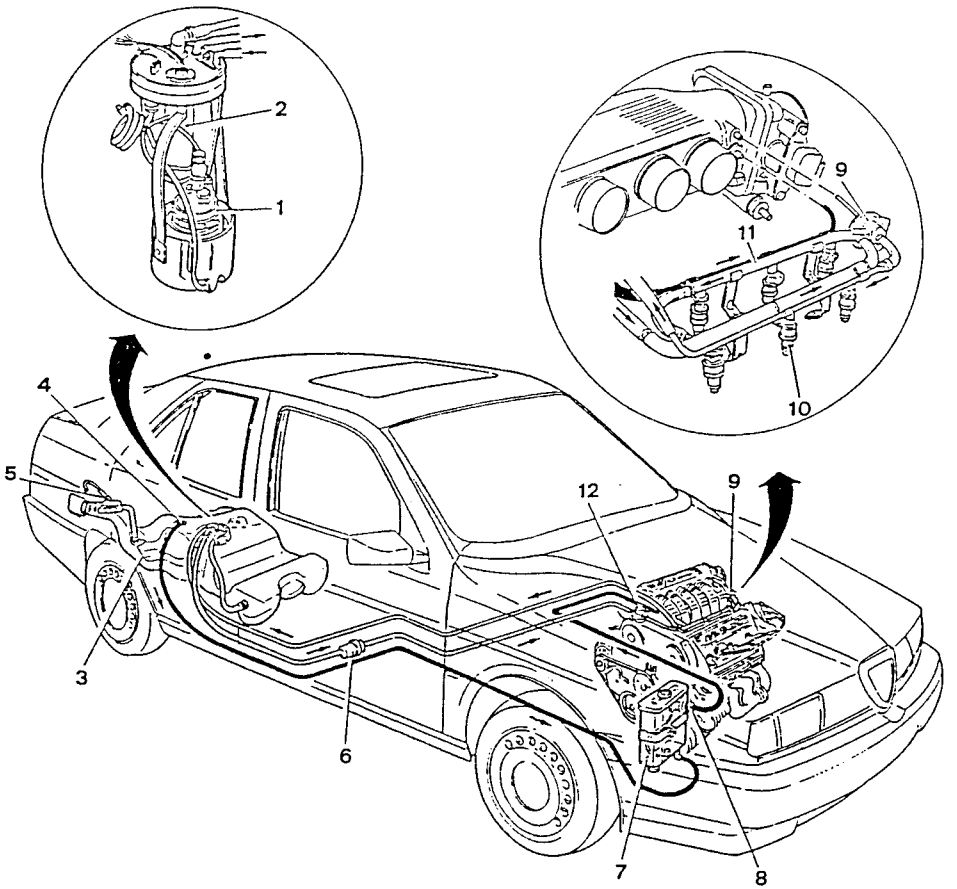
CAUTION

The electronic system of ignition and injection is equipped with a self-diagnosis function which permits a rapid identification of operating anomalies enabling quick and precise repair interventions to be carried out. For greated detail refer to the ELECTRIC - ELECTRONIC DIAGNOSIS manual.

NOTE: Before carrying out the fault diagnosis tests illustrated in the diagnosis manual, a visual check should first be made of the main components and connections of the system checking for damage, correct arrangement, electrical connections, leaks etc.

CAUTION:
Before carrying out repairs to the components of the fuel supply system proceed as follow to avoid dangerous leakage:
- disconnect the fuel pump supply fuse;
- run the engine until it stops.

FUEL SUPPLY AND VAPOUR RECOVERY SYSTEM



1. *Elevctric fuel pump*
2. *Fuel level meter*
3. *Fuel tank*
4. *Multifunction valve*
5. *Safety valve*
6. *Fuel filter*
7. *Fuel vapour separator*
8. *Fuel vapour solenoid valve*
9. *Fuel pressure regulator*
10. *Electroinectors*
11. *Fuel supply manifold*
12. *Impulse dashpot*

DESCRIPTION OF FUEL SUPPLY SYSTEM

The fuel supply circuit is formed by an electronic pump located in the tank which sends the fuel, through the filter, to the impulse dashpot and from there to the thrugh the supply manifold to the electroinectors.

A pressure regulator controlled by vacuum withdrawn through a hose from the air intake box is located on the hose returning the excess fuel to the tank.

Notes on serviceable fuels:

To be able to operate correctly the engine must run on lead free petrol (95 R.O.N.) as the presence of lead would bring about a rapid consumption of the catalytic converter of the exhaust system.

For information regarding the individual components of the system refer to the following paragraphs.

DESCRIPTION OF THE FUEL VAPOUR RECOVERY SYSTEM

The fuel contained in the tank produces a large quantity of vapour which would pollute the atmosphere if released.

The system of control and recovery of these vapours makes it possible to recuperate them and burn them in the engine.

When the vapours inside the fuel tank reach a pressure of 0.038 to 0.053 bars, they are sent through a multifunction valve to the canister containing the fuel vapour filter. Here the vapours are absorbed and stored by the activated carbon contained in the canister.

A solenoid valve is located between the fuel vapour filter and the intake box. When the solenoid valve is not activated the connection to the intake box is closed and the fuel vapours accumulate inside the cannister in the activated carbon.

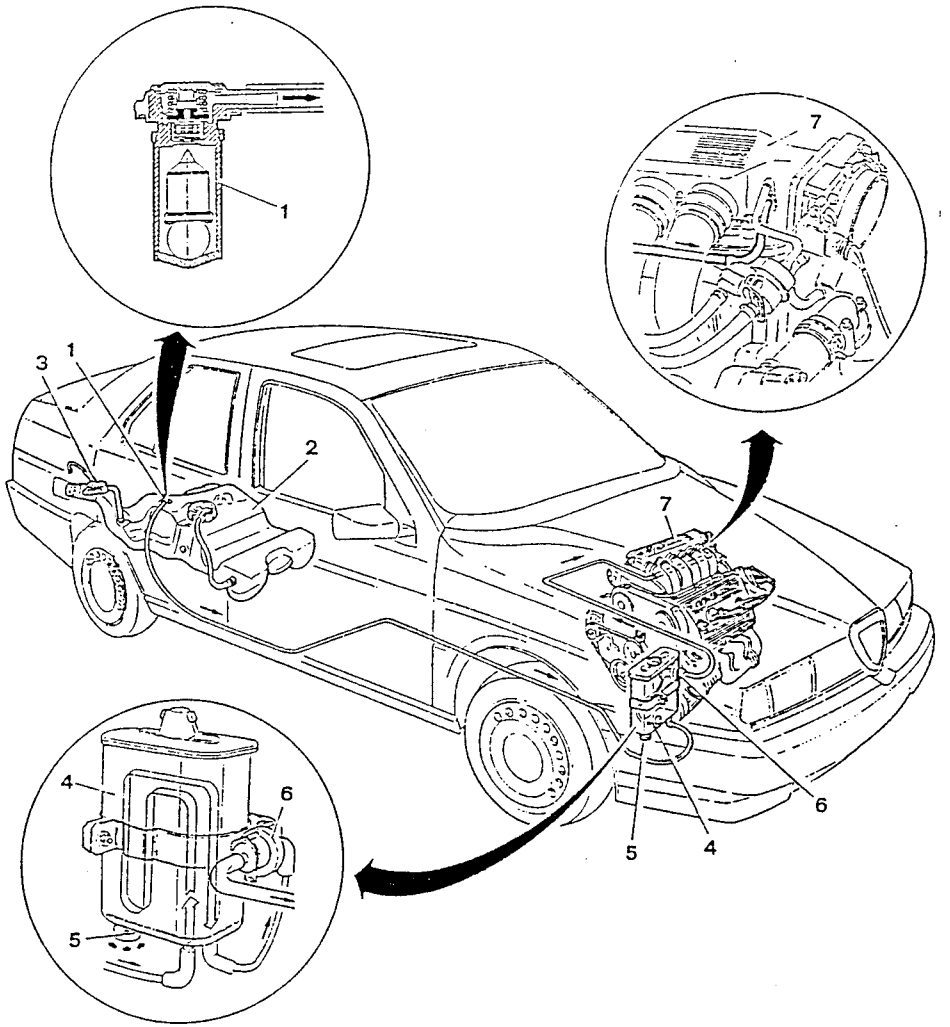
The Motronic control unit, under certain loading conditions, controls the opening of the solenoid valve allowing any fuel vapours to be sucked into the canister.

This situation also applys during exhaust if the Lambda probe detects a reduction in the level of oxygen due to an excessive quantity of fuel in the combustion chamber and signals the control unit which decreases the flow from the electroinectors so that the engine is always supplied normally.

If on the other hand the Lambda probe detects an increase in oxygen due to a lack of fuel vapours in the canister which leads the canister to suck in air, the control unit is signalled and the solenoid valve closes blocking the connection between the canister and the intake box.

For information regarding the individual components of the system refer to the following paragraphs.

FUEL VAPOUR RECOVERY SYSTEM - SIMPLIFIED DIAGRAM



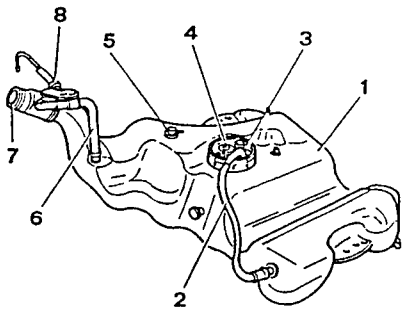
1. *Multifunction valve*
2. *Tank*
3. *Safety valve*
4. *Fuel vapour filter (canister)*
5. *Washing hole*
6. *Electro. ive*
7. *Intake box*

CAUTION:
Before operating on components of the supply system the following indications should be closely followed.
- Ensure that the workshop is equipped with the necessary safety equipment (fire extinguishers etc.).
- Disconnect the earth lead from the battery in order to avoid accidental contact between high voltage cables and the bodywork which may lead to sparks and as a consequence cause fires.
- Place the drained fuel into a suitable container fitted with a safety lid.
- Do not smoke or use naked flame around the work area.

FUEL TANK

The tank is made of plastic and has a capacity of 63 litres, including a reserve of approximately 7 litres.
The fuel filler neck is integrated with the main part of the tank and it is fitted with a filler cap of the most recent type.
A mechanism inside the cap ensures that it is tightened to the correct torque of 15 to 18 Nm; over-tightening, above the stated value, is avoided as the cap will click past the resistance offered by the teeth.
The tank is fixed to the body on a level with the luggage platform and the rear seat and is shaped so that it does not interfere with the tubular frame of the rear suspension.

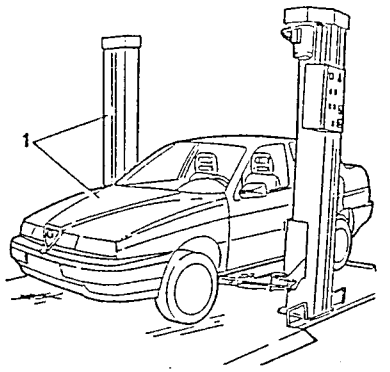
Due to the particular shape of the tank a pipe has been fitted which permits the passage of air to the upper part during filling of the tank.
The corrugated pipe on the filler neck prevents the fuel from splashing out.
A two-way safety valve is also fitted to the filler neck.
An opening is located on the upper part of the tank for the housing of the pump-fuel level meter group and for the multifunction valve.



1. *Tank*
2. *Breather pipe connecting the lower and upper areas of the tank.*
3. *Fuel pump*
4. *Fuel level meter*
5. *Multifunction valve*
6. *Anti-bubbling tube*
7. *Filler neck*
8. *Safety valve*

REMOVAL/REFITTING

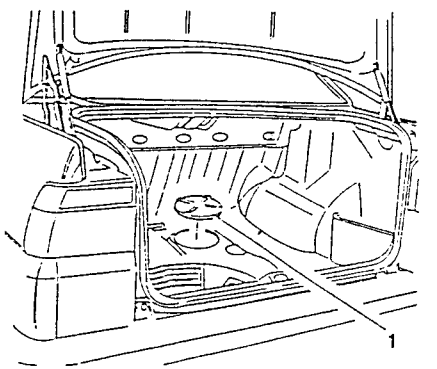
1. Place the vehicle on a lift.



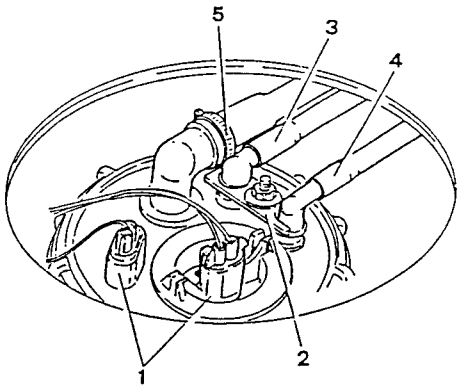
- Disconnect the negative cable from the battery
- Release the pressure within the tank by loosening the filler cap.
- Empty the tank by sucking the fuel out through the filler neck with a suitable pump.

CAUTION:
Place the fuel removed from the vehicle into a suitable container.

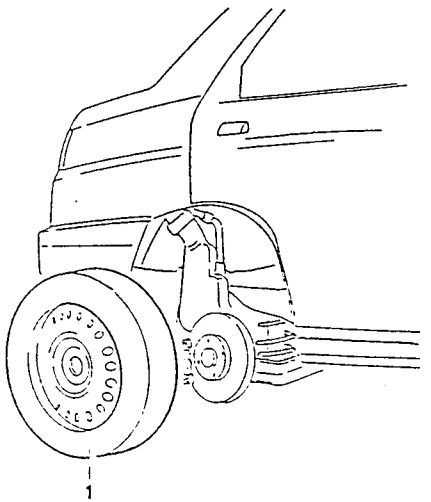
1. Operating from the luggage compartment, remove the lower covering and remove the cover to gain access to the pump and the fuel level meter.



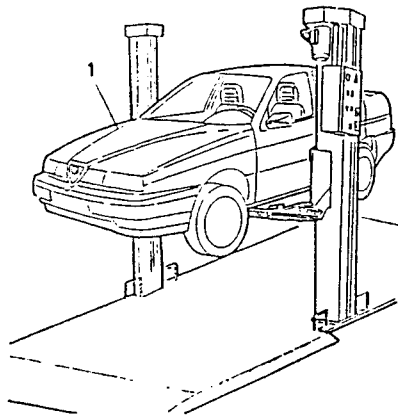
1. Disconnect the electrical connections from the pump and the fuel level meter.
2. Remove the safety plate.
3. Disconnect the fuel delivery pipe from the pump (white connection).
4. Disconnect the fuel return pipe from the pump (black connection).
5. Disconnect the breather pipe connecting the lower and upper parts of the tank.



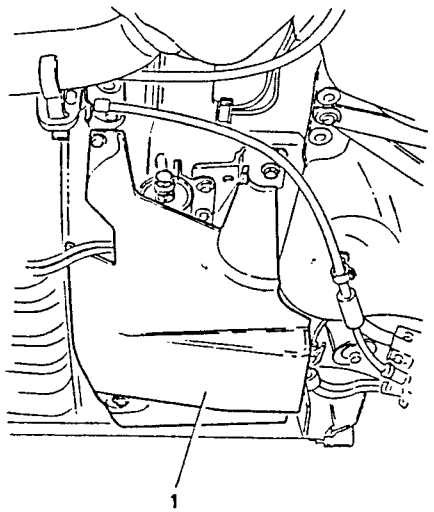
1. Remove the right-hand rear wheel.



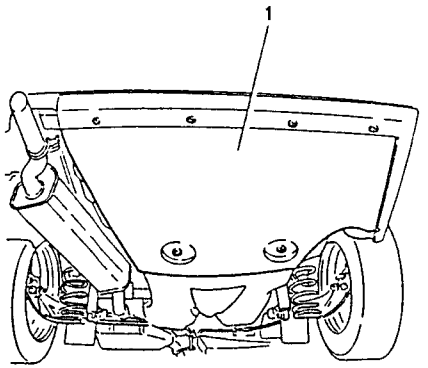
1. Raise the vehicle.



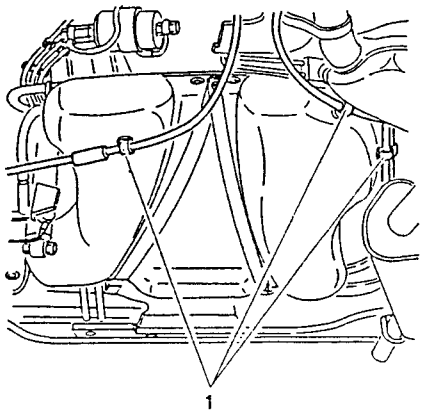
1. Remove the protection from the fuel filter.



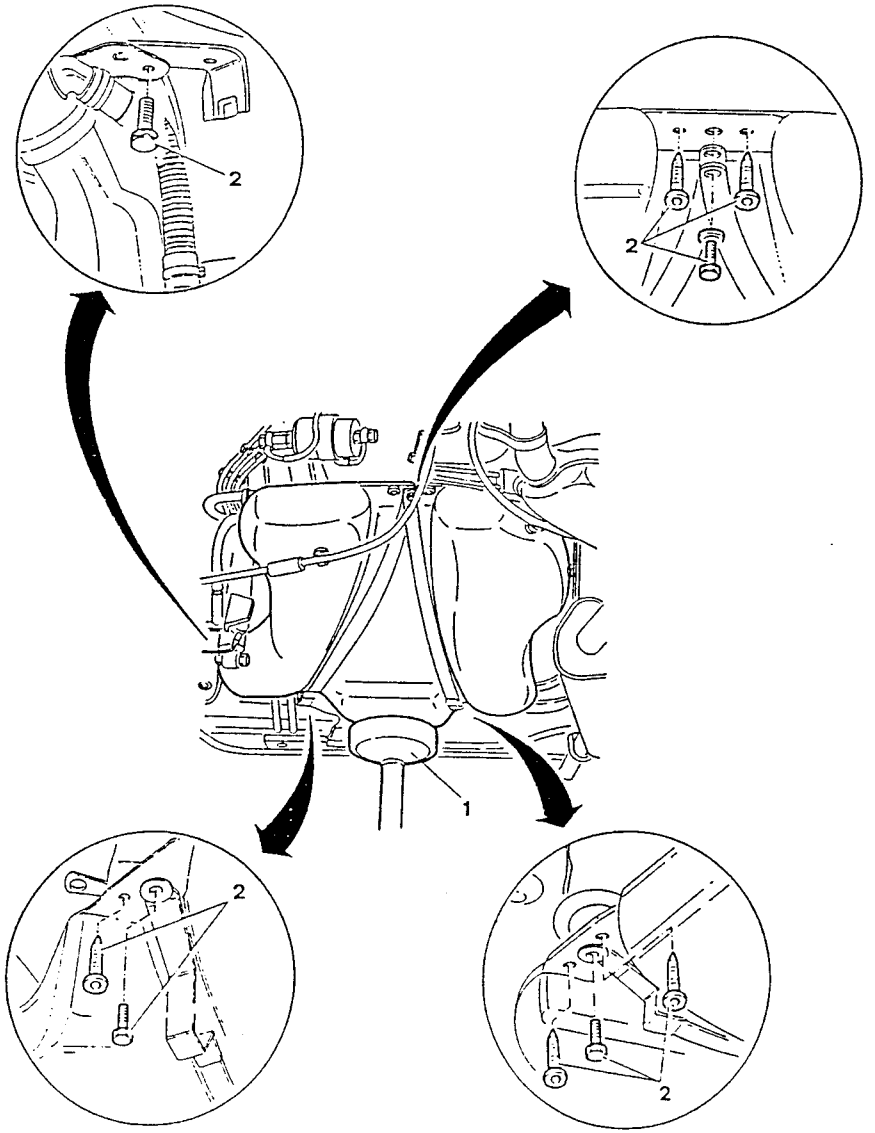
1. Remove the protection from beneath the fuel tank.



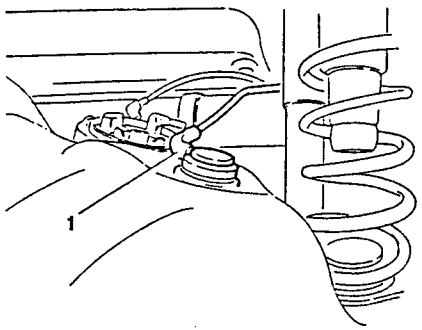
1. Free the handbrake cables and the brake lines from the brackets on the tank.



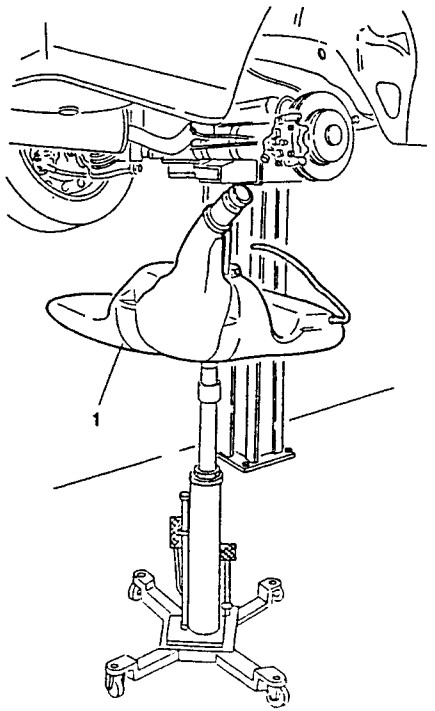
1. Prop up the tank with a hydraulic jack.
2. Remove all the plastic screws and nails holding the tank to the body.



1. Slightly lower the tank withdrawing the filler neck from the rubber protection and then disconnect the fuel vapour delivery pipe from the multifunction valve.



1. Lower the column lift and remove the entire fuel tank.



CHECKS AND INSPECTIONS

- Check that the tank is not deformed or cracked and replace if necessary.

MULTIFUNCTION VALVE

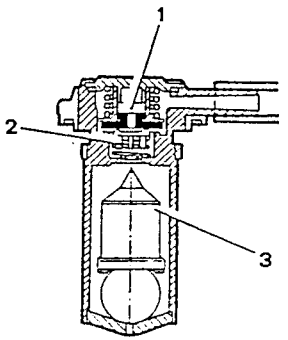
This valve:

- Sends fuel vapours to the canister
- Ventilates the tank
- Prevents fuel spillage

When the pressure of the fuel vapours in the tank reaches **0.038 to 0.053 bars**, a diaphragm held by a spring permits the vapours to flow to the canister. To ventilate the tank when the pressure is below **0.020 bars**, a central bowl acting on the diaphragm opposed by a spring permits air to enter the tank.

A ball of suitable weight is located in a conical housing is fitted in the lower part of the body. This ball rolled on the housing by centrifugal force transmitted to it by the vehicle, raises and closes a needle valve which prevents petrol spillage when the vehicle rocks or is parked on a longitudinal or transversal slope.

The needle valve also serves as an anti-capsizing valve.



1. *Fuel vapours to canister breather pipe valve*
2. *Tank ventilation valve*
3. *Needle valve*

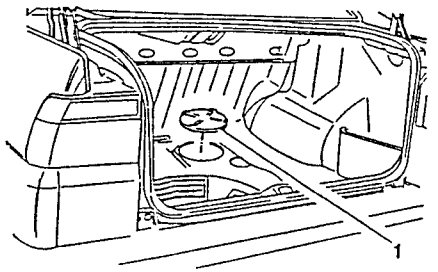
FUEL LEVEL METER

This device is of the axial floating type fixed to the suction device by a bayonette type coupling.

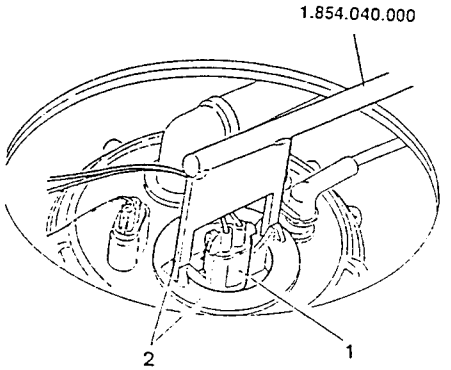
REMOVAL/REFITTING

- Disconnect the negative cable from the battery.

1. Operating from the luggage compartment, remove the lower covering and remove the cover to gain access to the pump and the fuel level meter.



1. Disconnect the connection from the fuel level meter.
2. Remove the fuel level meter using tool N° 1.854.040.000.



CHECKS AND INSPECTIONS

For a complete functional check refer to the ELECTRONIC - ELECTRICAL DIAGNOSIS manual; to check the settings, in accordance with the table given below, use suitable equipment.

Height (mm)	Indicator reading	Resistance (Ω)
51.5	4/4	0 to 7
115.5	3/4	59 to 69
163.5	1/2	116 to 126
199.5	1/4	186 to 201
216.5 ± 3	Max reserve	262
231	0	295 to 315

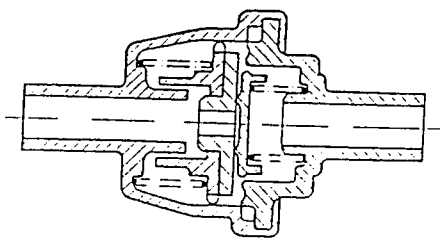
SAFETY VALVE

This valve:

- ventilates the tank
- draws off the fuel vapours

The vacuum in the tank, which could arise when fuel is drawn off is mainly prevented by the ventilation valve set at **0 to 0.020 bars**.

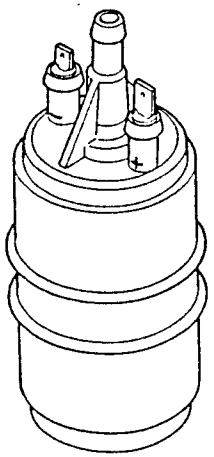
If the pressure in the tank exceeds **0.07 to 0.085 bars**, the valve will open and for safety reasons a part of the fuel vapour pressure will be discharged to the atmosphere.

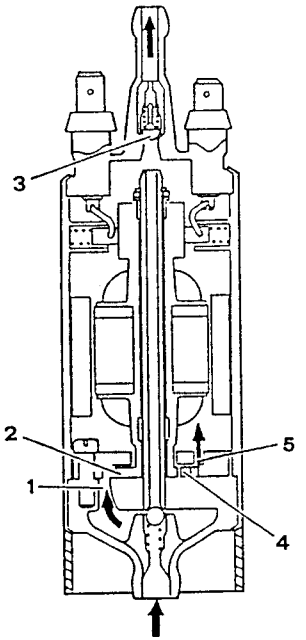


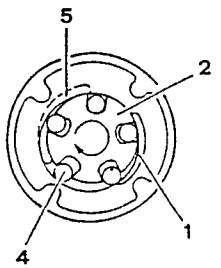
FUEL PUMP

The electric fuel pump is of the volumetric roller type with brush motor excited by permanent magnets submerged in the fuel.
The rotor, turned by the electric motor creates volumes which are moved from the inlet port to the delivery port. These volumes are defined by rollers which adhere to the outer ring during rotation of the motor.
The pump is equipped with two valves: one is a non-return valve to prevent the fuel circuit from draining when the pump is not in operation and the other is a pressure release valve which short circuits delivery by suction when pressures exceeding 5 bars are produced thus avoiding overheating of the electric motor.

NOTE: **The fuel pump is actuated only when the ignition key is engaged and the engine is running. This avoids petrol loss from holes or broken pipes which might otherwise present a fire hazard in the event of an accident.**



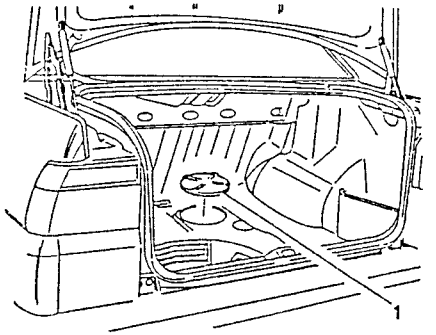




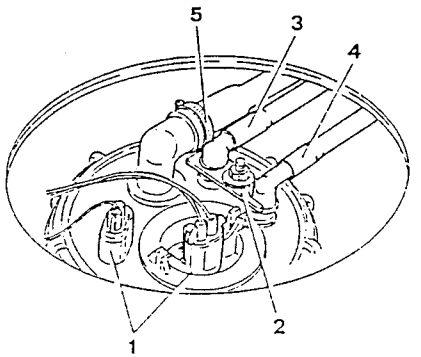
1. *Inlet port*
2. *Rotor*
3. *Non-return valve*
4. *Rollers*
5. *Delivery port*

REMOVAL/REFITTING

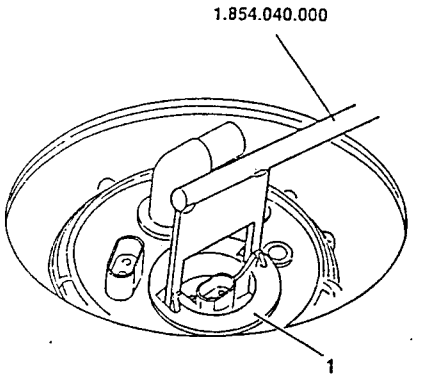
– Disconnect the negative cable from the battery.
1. Operating from the luggage compartment, remove the lower covering and remove the cover in order to gain access to the pump and the fuel level meter.



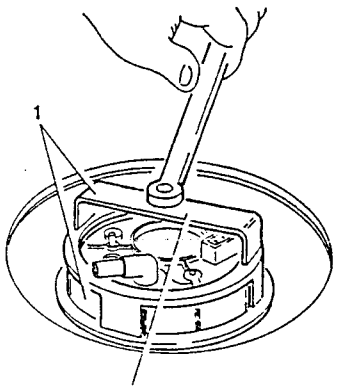
1. Disconnect the electrical connections from the pump and the fuel level meter.
2. Remove the safety plate.
3. Disconnect the pipe conveying fuel from the pump (white connection).
4. Disconnect the pipe conveying fuel to the pump (black connection).
5. Disconnect the breather pipe connecting the lower and upper parts of the tank.



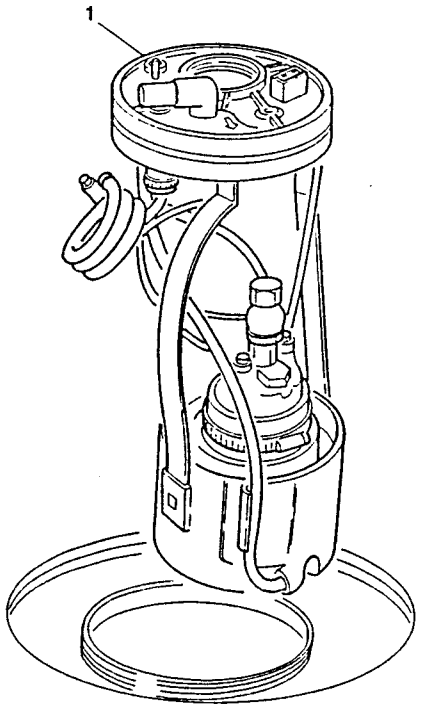
1. Remove the fuel level meter using tool N° 1.854.040.000.



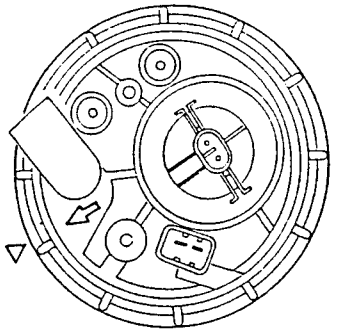
1. Remove the ring nut securing the fuel pump using tool N° 1.821.167.000 (A.3.0631).



1. Withdraw the fuel pump assembly from the tank.

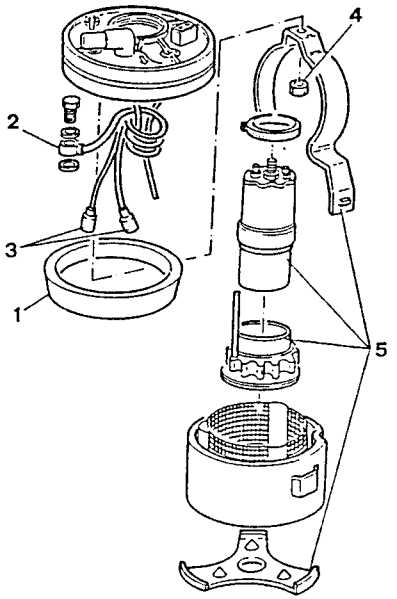


Install the pump assembly in the tank taking care to ensure that the gasket fits perfectly and that the mounting position is correct as indicated by the collimation of the arrows present on the tank and on the pump cover.



DISASSEMBLY AND REASSEMBLY

1. Remove the gasket from the pump cover.
2. Disconnect the delivery connection from the pump along with the nut and washers.
3. Disconnect the supply cables from the pump.
4. Remove the nut securing the spring to the cover and remove the cover along with the hoses.
5. Separate the spring, pump body, support, filter and anti- vibration ring from the reservoir.



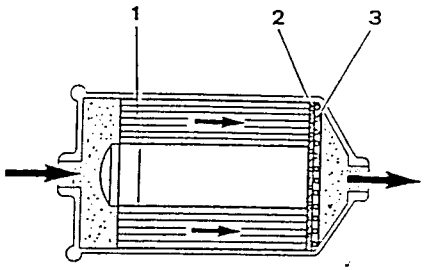
CHECKS AND INSPECTIONS

Thoroughly clean the gauze filter.
Water in the filter is particularly damaging to the pump as it provokes internal oxidation. Carefully check the operation of the pump if the fuel is polluted with water.
Also check the efficiency of the pump power supply contacts as any oxidation could cause a drop in voltage at the tips reducing supply and leading to the formation of air bubbles and a reduction in injected fuel.

ATTENTION:
When substituting the pump remember that it should come filled with protective oil and with the connections closed by suitable plugs. During installation it is not necessary to drain the pump as the oil in it will be burned by the engine.
If the pump is drained of its protective oil it must be installed within two weeks in order to prevent a film of dried oil forming on the manifold of the motor which would render it inoperative through lack of electrical continuity.

FUEL FILTER

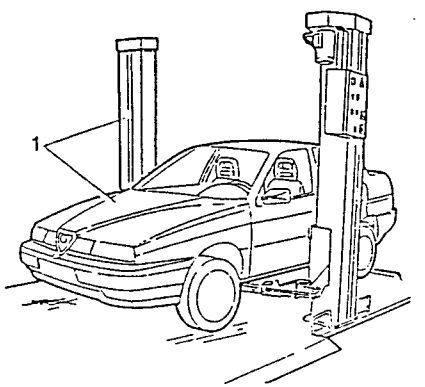
The fuel filter is located under the platform in front of the fuel tank. It is of the paper tuype with a high degree of filtering power, an indispensible quality given the sensitivity of the electroinjectors to foreign matter. On the outer casing of the filter is an arrow which indicates the direction in which the fuel flows and therefore the correct assembly position.



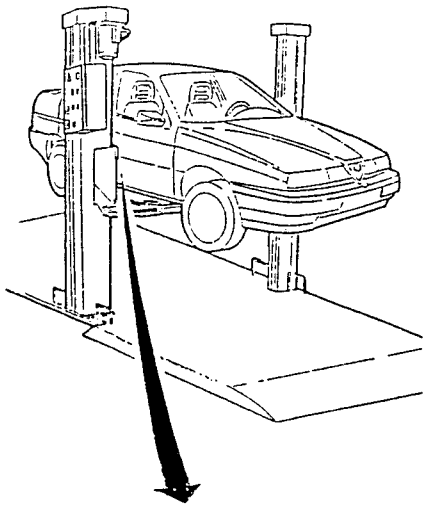
1. *Paper filter*
2. *Cloth filter*
3. *Gauze*

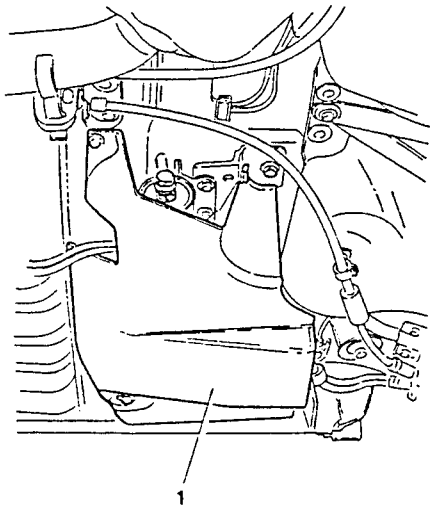
SUBSTITUTION

1. Place the vehicle on a lift.

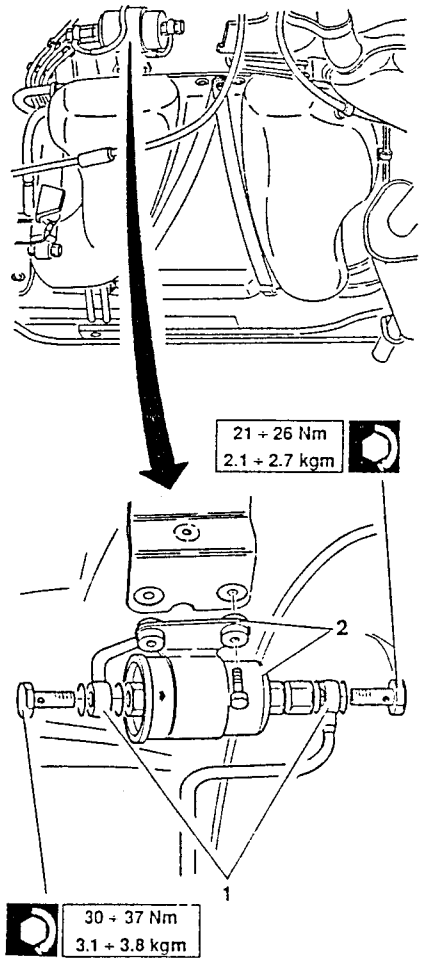


1. Raise the vehicle and remove the fuel filter protection.

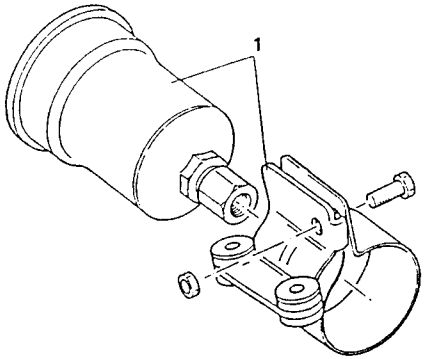




1. Unscrew the fuel inlet and outlet connections from the filter.
– Collect the fuel which leaks out during this operation in a suitable container and plug the ends of the connections without bending or twisting the rigid pipes.
2. Remove the fuel filter together with its supporting clamp.



1. On a bench, seperate the fuel filter from the clamp.



– Fit the new filter by reversing the removal procedure remembering to:
  • replace the copper gaskets on the connections;
  • fit the filter so that the arrow stamped on it points in the direction in which fuel will flow.

FUEL PIPING

REMOVAL/REFITTING

NOTE: Only remove the pipes from the fuel supply system when it is strictly necessary.

– Place the vehicle on a lift.
– Loosen the clamps securing the ends of the pipes to be removed.

CAUTION:
During disassembly block off the ends of the rigid and flexible pipes to prevent dust and dirt from entering.

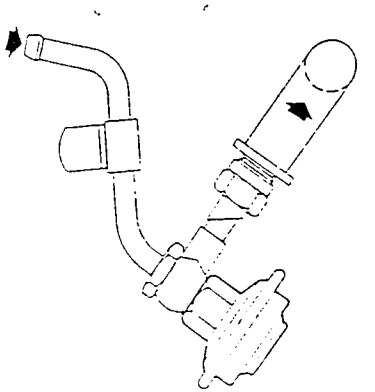
• Carefully refit the clamps on the joints of the system. To avoid damaging the pipes, do not over tighten the clamps.
• Do not bend or twist the rigid pipes when refitting them to the vehicle.
• Start the engine and check that the joints do not leak.

CHECKS AND INSPECTIONS

– Ensure that the flexible hoses are not porous and show no sign of deterioration. Replace any damaged hoses.
– Check that the rigid pipes are not oxidized, blocked or dented.
– Special attention should be given to the piping located near to heat sources as the overheated material is easily deformed and deteriorates rapidly.

IMPULSE DASHPOT

The impulse dashpot is located at the entry of the fuel separator pipe and its function is to suppress the noise from the pulsations which may arise especially when the revs are low.
The pulsations are generated by pressure peaking of the fuel arising from the opening and closing of the electroinjectors or pressure regulator.



FUEL PRESSURE REGULATOR

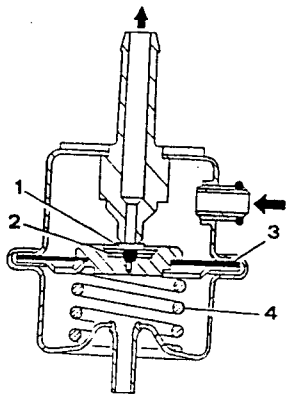
The fuel pressure regulator keeps the difference in fuel pressure and the pressure in the intake manifold at a constant level. In this way it is possible to meter the amount of fuel on the basis of the opening times of the electroinjectors only.

The pressure regulator is mounted at one end of the fuel separator pipe. It is a limiting regulator controlled by a diaphragm which regulates the fuel pressure to 3 bars.

When the pressure of the fuel exceeds the maximum value the diaphragm acts on a valve which opens the return piping through which the excess fuel is returned to the tank.

A small pipe connects the regulator spring chamber to the intake box downstream of the throttle valves.

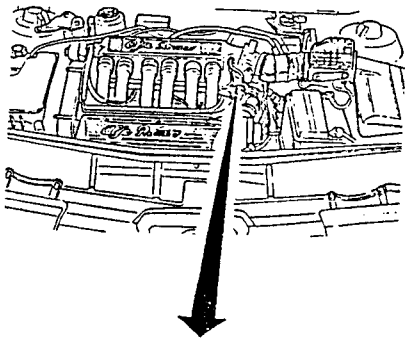
An interdependence is created by this tube between the pressure in the fuel system and the pressure in the intake box so that the pressure between inlet and outlet of the electroinjectors when open, is always the same.

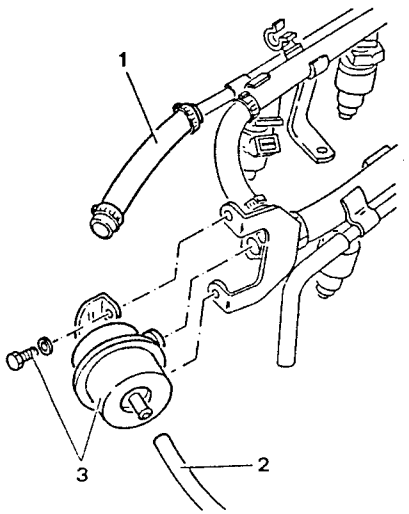


1. *Valve*
2. *Body holding valve*
3. *Diaphragm*
4. *Spring*

REMOVAL/REFITTING

1. Disconnect the fuel return pipe from the pressure regulator.
2. Disconnect the vacuum intake pipe from the from the regulator.
3. Unscrew the two retaining screws and remove the regulator from the supply manifold.





ELECTROINJECTORS

The electroinjectors are electronically controlled and inject a precisely dosed quantity of fuel into the single cylinder intake pipes upstream of the intake valve.

The electroinjectors inject simultaneously at each rotation of the crankshaft, i.e. twice for each engine cycle.

The injected fuel is collected above the intake valve and is sucked, together with air, into the combustion chamber when the intake valve opens.

The opening time of the electroinjectors is calculated by the control unit on the basis of the engine running conditions.

An electroinjector is basically composed of a coil, a plunger and a needle with a disc stop. The core of the magnet is integral with the needle which is pressed by a spring on the seating of the body of the electroinjector.

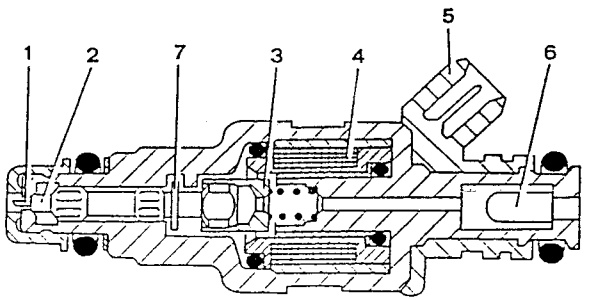
The needle is actuated by the magnetic field created by the coil upon command of the control unit.

CHECK FOR CORRECT OPENING OF ELECTROINJECTORS

- Measure the percentage of exhaust CO.
- One at a time disconnect the electroinjectors. Each time measure the percentage of exhaust CO and check that the value remains constant at each check.
- If it does not remain constant, locate and replace the faulty electroinjector. A visual check of electroinjector efficiency can be made by comparing the electrodes on the sparkplugs:
  - a mixture which is too rich will be associated with a dark colour;
  - a mixture which is too lean will be associated with a light colour.

CHECK SEALING OF ELECTROINJECTORS

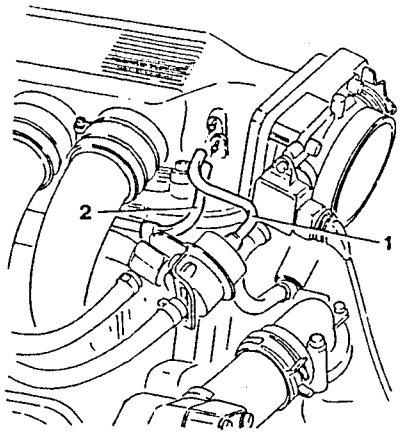
- Remove the electroinjector group and fuel manifold without disconnecting the fuel supply circuit.
- Disconnect the connectors from the electroinjectors.
- Turn the starter motor and check that there is no leakage of fuel from the electroinjectors. If there is leakage replace the faulty injector.



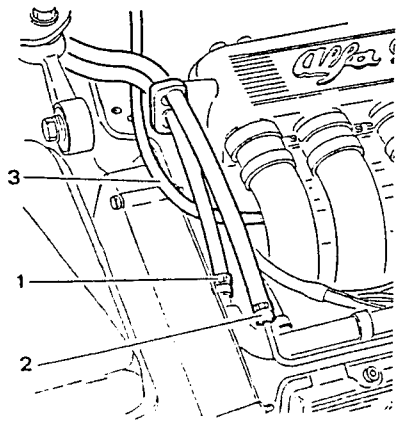
1. *Spray pin*
2. *Needle*
3. *Magnetic armature*
4. *Magnetic winding*
5. *Supply connector*
6. *Filter*
7. *Disc stop*

REMOVAL/REFITTING

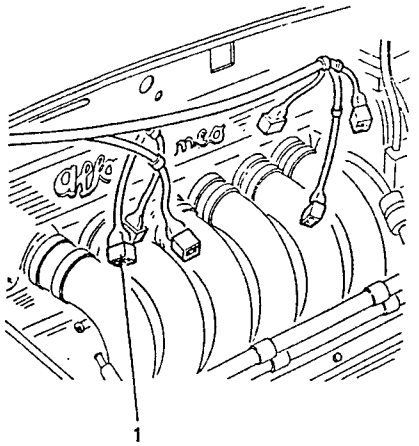
– Disconnect the negative cable from the battery.
1. Disconnect the pressure regulator vacuum intake hose from the intake box.
2. Disconnect the fuel vapour recirculation hose from the intake box.



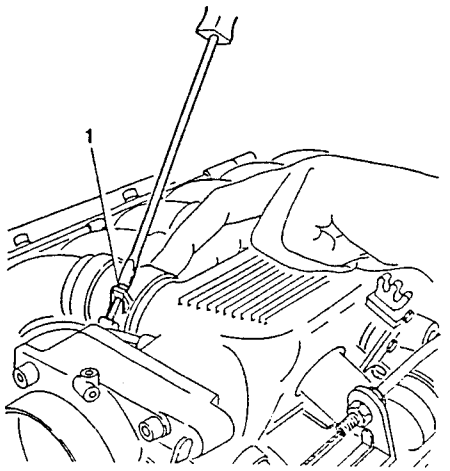
1. Disconnect the fuel delivery hose from the manifold.
2. Disconnect the fuel return hose from the manifold.
3. Disconnect the fuel vapour recirculation hose from the manifold.



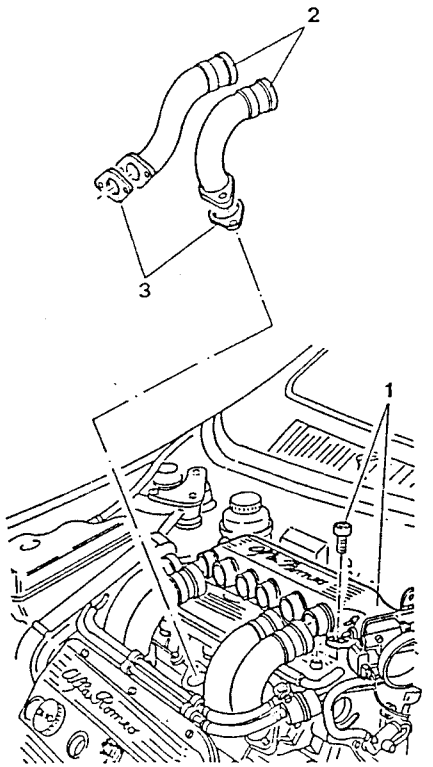
1. Disconnect the electrical connections from the electroinjectors.



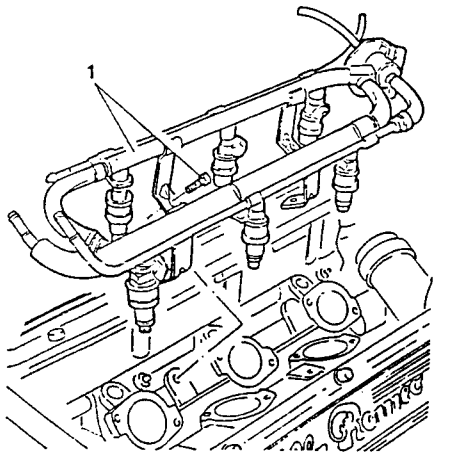
1. Loosen the clamps securing the intake stub pipes to the intake box.



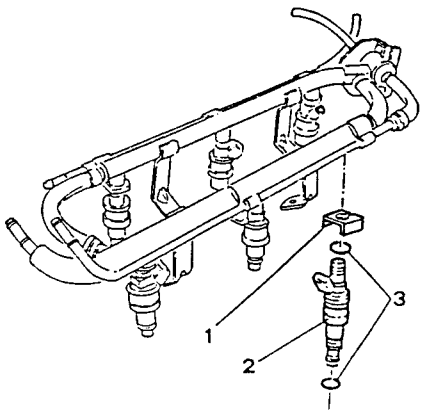
1. Unscrew the screws securing the intake box and move it backwards to enable the intake stub pipes to be removed.
2. Remove the intake stub pipes.
3. Remove the gaskets.



1. Remove the fuel supply manifold together with the electroinjectors by unscrewing the four retaining screws.



For each electroinjector:
1. Withdraw the clip securing the electroinjector to the fuel manifold.
2. Remove the electroinjector.
3. Remove the seal rings.

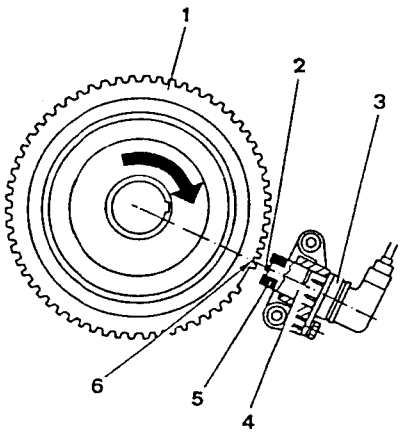


CHECKS AND INSPECTIONS

To check the functioning of the single injectors refer to the ELECTRICAL - ELECTRONIC DIAGNOSIS manual

ENGINE R.P.M. AND TIMING SENSOR

The sensor for the detection of the r.p.m. and timing of the engine is of the inductance type, that is, it functions through the variations in the magnetic field generated by the passing of the teeth on a toothed wheel (phonic wheel) machined onto the crankshaft.
The teeth passing in front of the magnetic field generator vary the air gap between pulley and sensor. The flow which varies as a consequence induces an alternating voltage which in turn establishes the r.p.m..
There is a reference mark on the phonic wheel made by removing two teeth. This enables engine timing to be established.

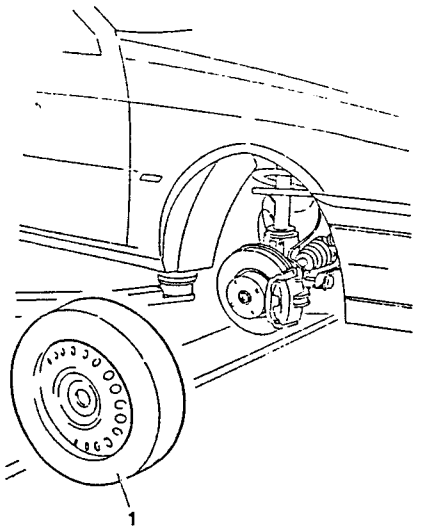


1. *Engine pulley toothed wheel (phonic wheel)*
2. *Core*
3. *Engine timing and r.p.m. sensor*
4. *Permanent magnet*
5. *Winding*
6. *Timing reference*

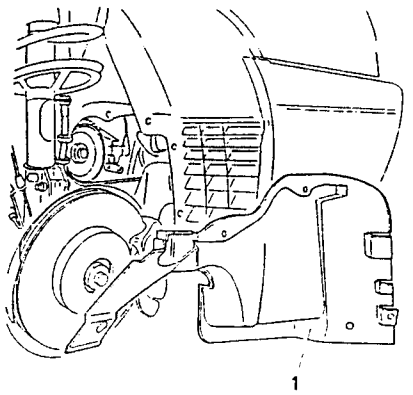
CHECKING R.P.M. AND TIMING SENSOR AIR GAP

- Place the vehicle on a lift.

1. Remove the right-hand front wheel.

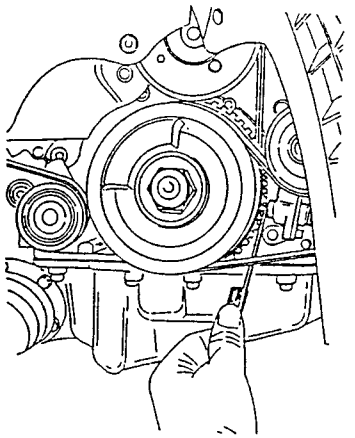


1. Remove the dust guard.



- Using a feeler gauge check that the gap between sensor and phonic wheel is with the specified limits.

Air gap between r.p.m. and timing sensor and phonic wheel
T = 0.5 to 1.5 mm



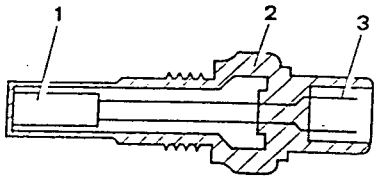
CHECKS AND INSPECTIONS

- To check the functioning of the r.p.m. and timing sensor refer to the electrical - electronic DIAGNOSIS manual.

ENGINE COOLANT TEMPERATURE SENSOR (NTC)

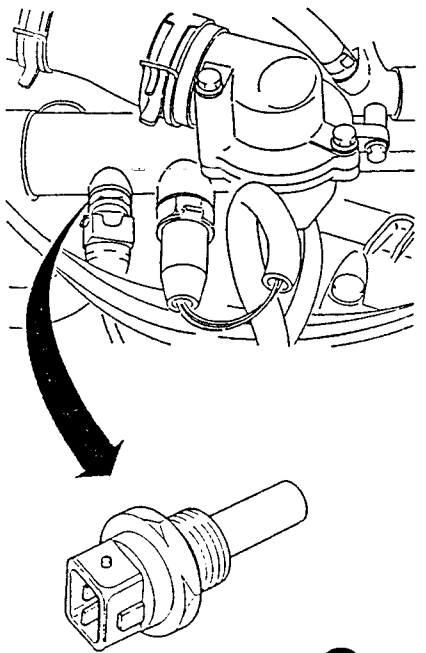
The temperature sensor is of the electronic type. The sensitive part is formed by a NTC resistance with a negative resistance coefficient able to diminish its resistance (supplied with a constant voltage by the control unit) as the temperature rises.
The sensitive part is in contact with the engine coolant

The voltage passing the resistance, measured by the control unit, is therefore proportional to the temperature of the engine.



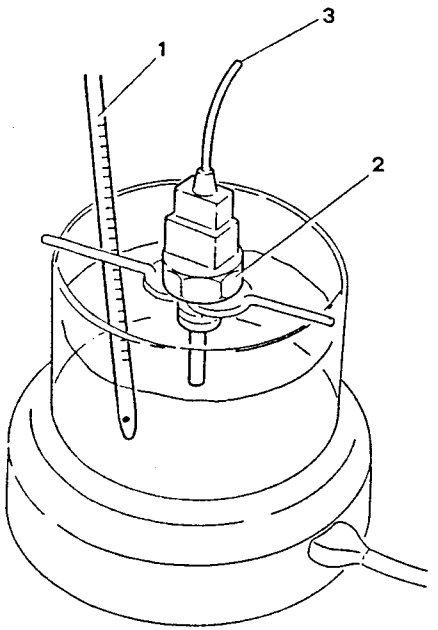
1. *NTC resistance*
2. *Body*
3. *Connectors*

The sensor is housed in a thermostatic cup located in an easily accessible position.



CHECKS AND INSPECTIONS

Immerging the sensor in a suitable container full of water, check that the setting of the engine coolant temperature sensor is within the prescribed limits using a manometer and a Multimeter. If it is not within the prescribed limits replace the sensor.

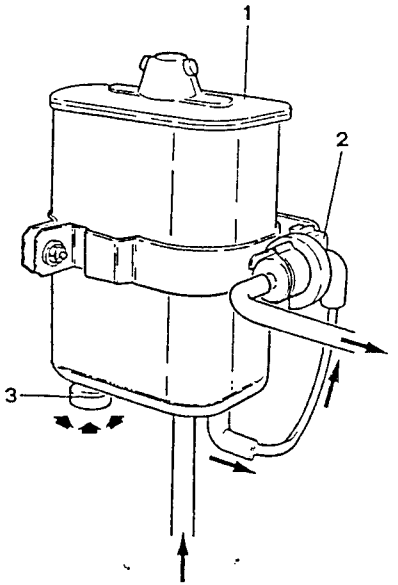


1. *Thermometer*
2. *Engine coolant temperature sensor*
3. *Multimeter*

Temperature (°C)	Resistance (kΩ)
20	~ 2.5

FUEL VAPOUR FILTER

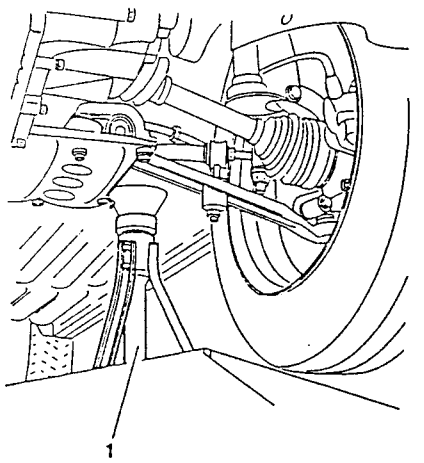
The filter element is composed of activated carbon enclosed in a plastic casing and absorbs the fuel vapours reaching it from the fuel tank.
A single-acting valve allows outside air to enter during vapour intake in order to clean the activated carbon.



1. *Fuel vapour filter*
2. *Solenoid valve*
3. *Washing hole*

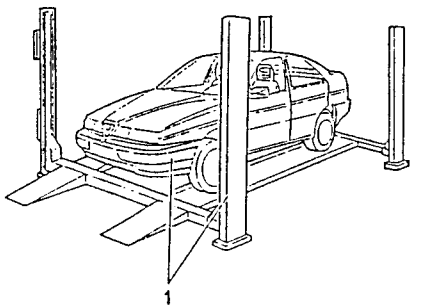
FUEL VAPOUR FILTER SOLENOID VALVE

This valve, controlled by the Motronic control unit, sends the vapours stored in the canister for intake by the engine.
The valve closed in the body is composed of a mobile part or shutter fixed to a leaf spring. The fixed part is formed by a metal cylinder with an inner hole on which the coil is wound.
Overall it is structured so that when the coil is powered, the shutter, which replaces the fixed part of the valve, is attracted to the cylinder and closes the valve.

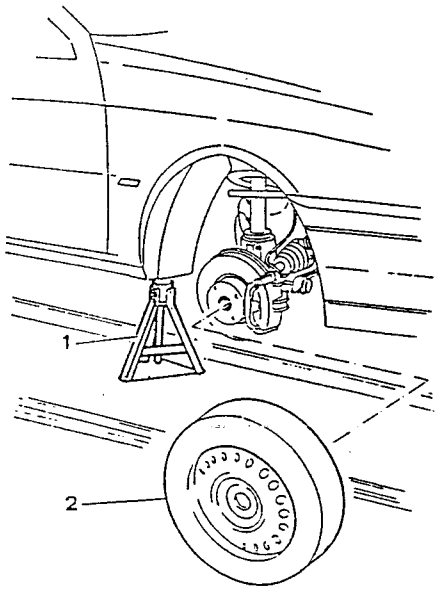


REMOVAL/REFITTING

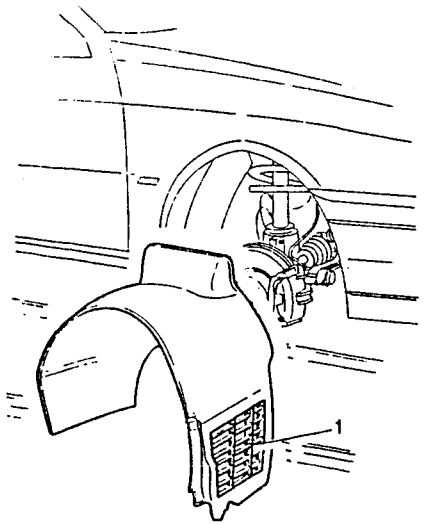
1. Place the vehicle on a lift.
– Disconnect the negative cable from the battery.



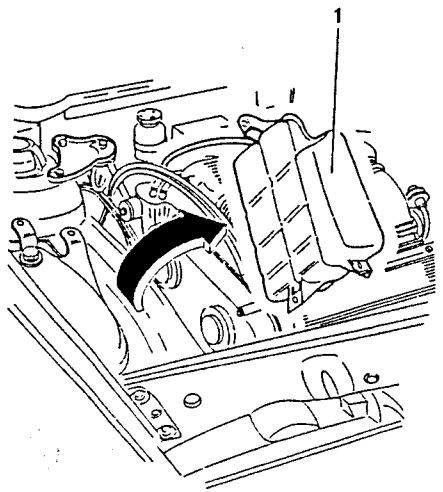
1. Place suitable safety jacks under the forward part of the vehicle.
2. Remove the front right-hand wheel.



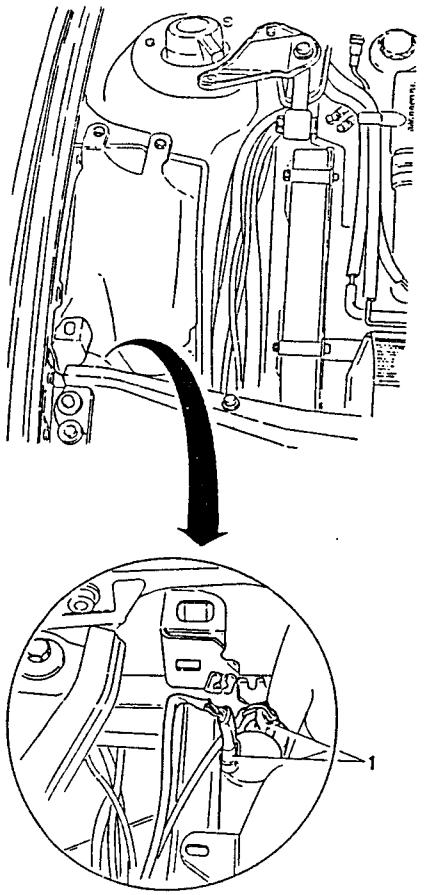
1. Remove the front right-hand wheelhousing.



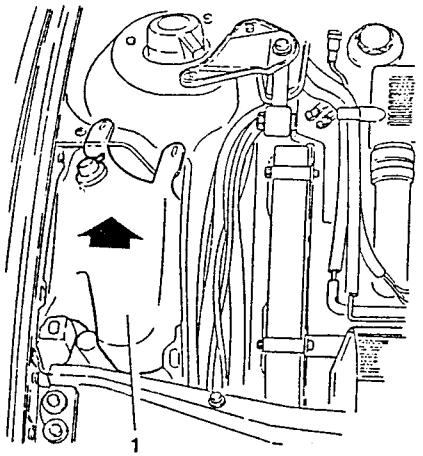
1. Unscrew the screws securing the expansion tank and, without disconnecting the hoses, move it to one side.



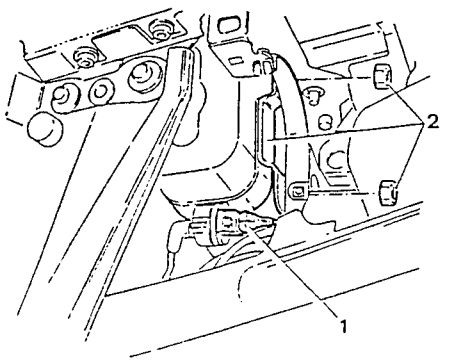
1. Disconnect the electrical connections from the windscreen and headlight washer motors.



1. Unscrew the two screws securing the windscreen/headlight washer fluid reservoir and move it backwards.

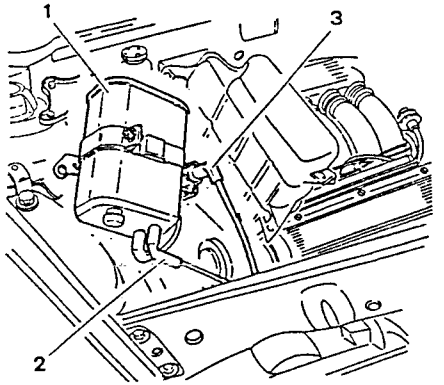


1. Disconnect the electrical connections from the fuel vapour solenoid valve.
2. Unscrew the two nuts securing the canister support clamp to the body.

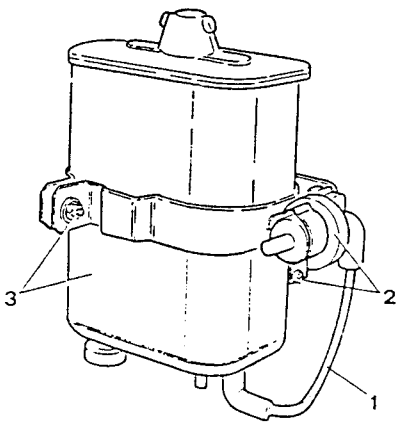


1. Raise the canister and solenoid valve just enough to gain access to the piping.
2. Disconnect the pipe carrying the vapours to the canister.
3. Disconnect the pipe carrying the vapours to the intake.

– Remove the canister together with the solenoid valve and clamp.

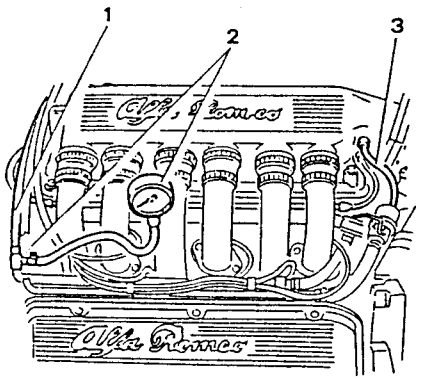


1. On a bench, remove the pipe carrying the vapours from the filter to the solenoid valve.
2. Loosen the screw securing the solenoid valve and remove it.
3. Loosen the screw securing the clamp to the fuel vapour filter and separate them.



CHECKING PRESSURE AND SEALING OF THE FUEL CIRCUIT

1. Disconnect the fuel delivery pipe from the fuel supply manifold.
2. Connect a pressure gauge and a "T" union to the extremities of the previously disconnected inlet pipe.
3. Disconnect the vacuum intake pipe for the pressure regulator connected to the intake box so that variation in engine r.p.m. does not interfere with the reading.



- Start the engine and run at idle speed. Check that the fuel pressure is at the specified value.

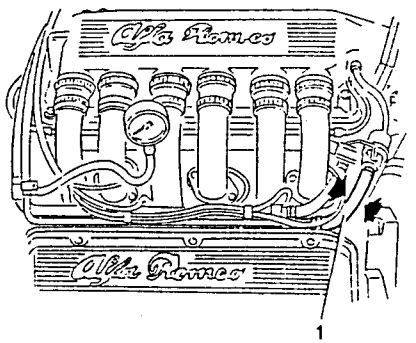
Fuel pressure at idle speed
2.8 to 3.2 bar (2.9 to 3.3 kg/cm^2)

- Reconnect the pipe connecting the vacuum intake to the air intake box. At idle speed the pressure should decrease by 0.5 bar and then increase when the throttle valve opens. If this is not the case check for leaks from the fuel pressure regulator vacuum intake piping.

NOTE: **If there is visible fuel leakage or a persistent smell of petrol, carry out the fuel circuit sealing test.**

WARNING:
Keep a fire extinguisher handy if there are fuel leaks.
Do not smoke.

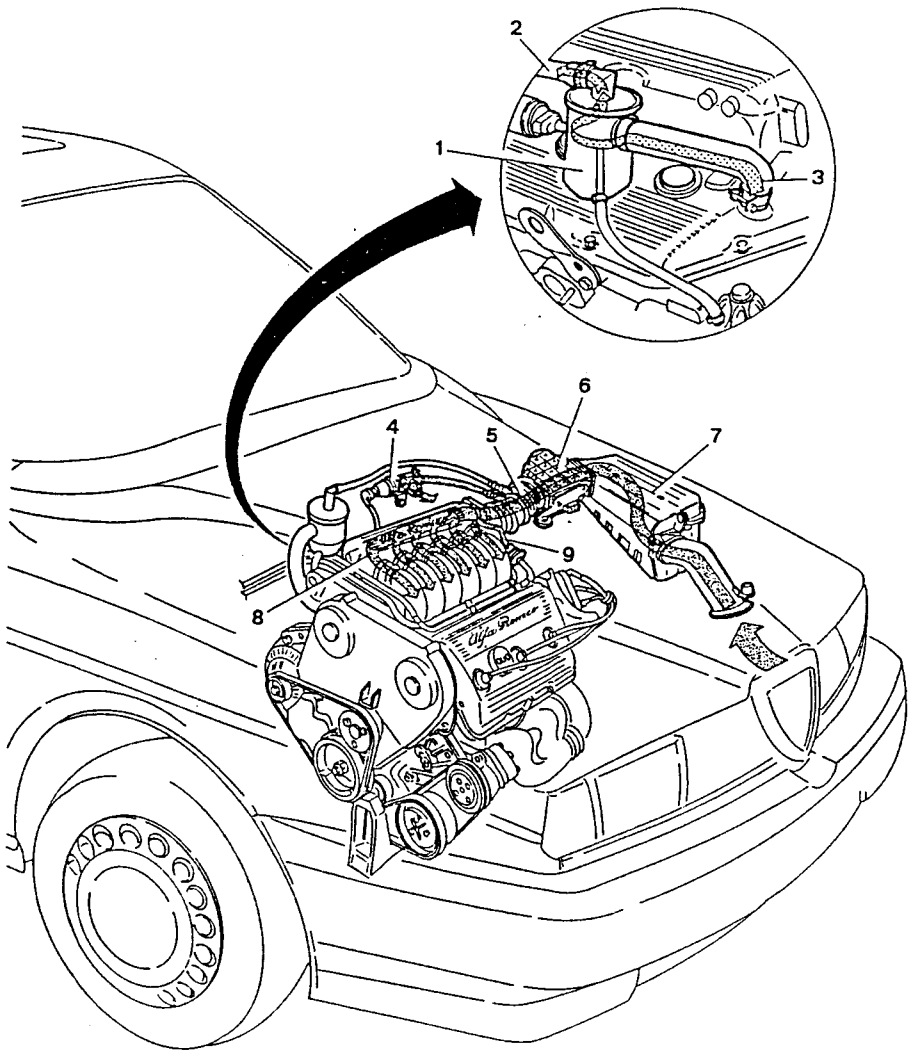
1. With the pressure gauge connected and the engine running at idle speed, pinch the pipe just after the fuel pressure regulator and check that the pressure increases to approximately 4 bar.
   Ensure that the pressure does not exceed this value.



CHECKING SEALING OF THE FUEL VAPOUR RECOVERY SYSTEM

DUE FOR PUBLICATION

AIR SUPPLY SYSTEM



1. *Oil vapour separator*
2. *Oil vapour recirculation nose*
3. *Oil vapour recovery hose*
4. *Constant idle speed actuator*
5. *Corrugated sleeve*
6. *Air flow meter*
7. *Air cleaner*
8. *Air intake box*
9. *Fuel pressure regulator air intake pipe*

DESCRIPTION

The air sucked through a dynamic inlet is filtered by a cartridge filter element and reaches the air flow meter which measures the quantity and temperature. A throttle valve, controlled by the accelerator cable regulates the quantity of air sucked into the air intake box. An electromagnetic valve for additional air by-passes the throttle valve enabling the idle r.p.m. to be kept constant under particular engine conditions. Fuel and oil vapours flow to the air supply system and, through the air intake box, are sucked into the combustion chamber in order to limit the toxic emissions.

The vacuum intake pipe for the fuel pressure regulator and the vacuum intake pipe for the servo brake are also connected to the air intake box.

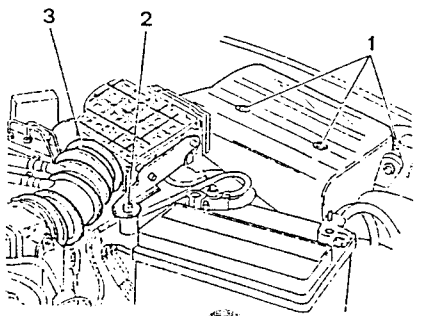
For information regarding the single components of the system refer to the paragraphs below.

AIR CLEANER

The cleaner is of the cartridge type with an easily replaceable filter element which traps the dust and dirt particles present in the air sucked in by the engine.It also acts as an "intake silencer".

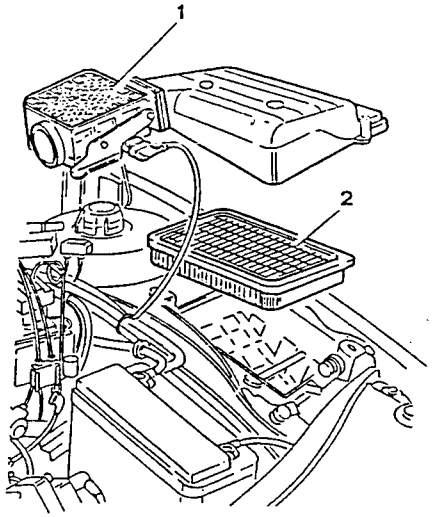
REPLACING THE FILTER ELEMENT

1. Slacken the screws securing the air cleaner cover.
2. Slacken the screw securing the air flow meter support bracket.
3. Disconnect the corrugated sleeve from the air flow meter after loosening the relative clamp.



PA4655B2000000

1. Raise the filter cover-air flow meter assembly without disconnecting the electrical connection.
2. Remove the filter element.



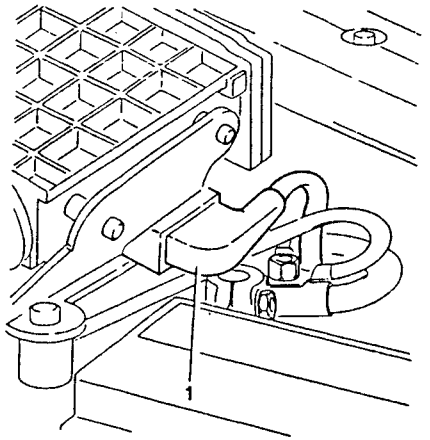
CAUTION:
Any attempt to clean the filter will damage it compromising the correct functioning of the engine supply system.

- Carefully clean the container housing the filter element.
- Position the new filter element.
- Refit the air filter cover and air flow meter assembly by reversing the procedure followed for their removal.

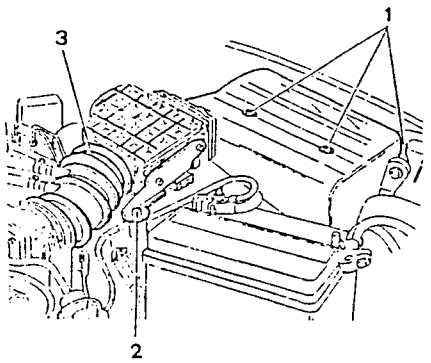
NOTE: **If the filter shows signs of oil contamination, check the entire air circuit for possible infiltration.**

REMOVAL/REFITTING

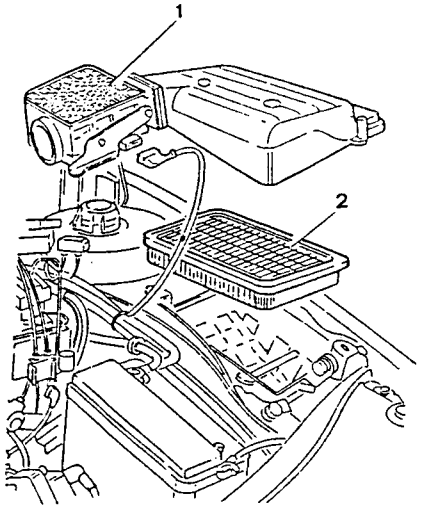
– Disconnect the negative cable from the battery.
1. Disconnect the connection from the air flow meter.



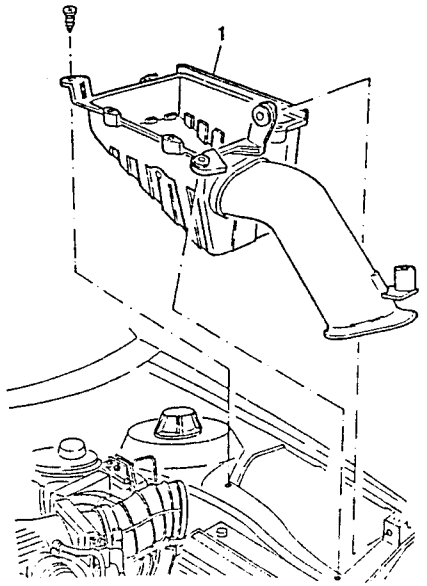
1. Unscrew the secrews securing the the air filter cover.
2. Unscrew the screw securing the air flow meter support bracket.
3. Disconnect the corrugated sleeve from the air flow meter after loosening the relative clamp.



1. Remove the air filter cover-air flow meter assembly.
2. Remove the filter element.



1. Remove the air cleaner box.

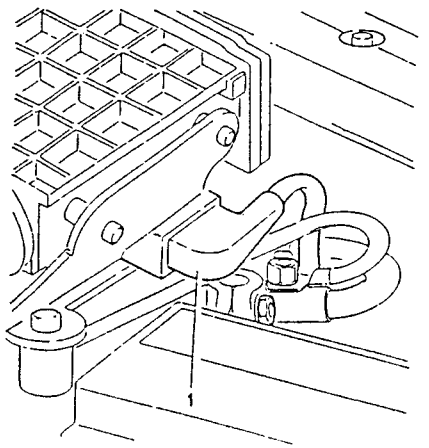


AIR FLOW METER

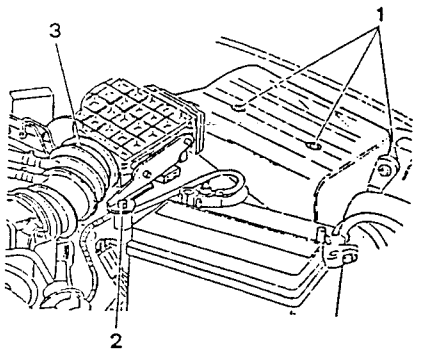
The air flow meter quantifies the flow of air taken in by the engine through the throttle valve controlled by the accelerator cable and sends a signal to the control unit on the basis of which the fuel injection time is determined.
The air flow meter functions according to the principle of the fluctuating throttle valve: a spiral spring acts as an acting force on the throttle valve itself so that, with a certain quantity of air, a precise angular position will be obtained. Compensation for the pressure oscillations arising from the piston strokes is carried out by a compensation throttle valve closely connected to the measuring throttle valve. The electric signal is generated by the trailing of a potentiometer fixed to the shaft of the fluctuating throttle valve.
The intake air temperature sensor is located inside the air flow meter and is realized with a negative resistance coefficient (NTC) (i.e. able to reduce its resistance in proportion to the rise in temperature) connected to the control unit.
This sensor enables the control unit to take into account the variations in air density during the injection phase.

REMOVAL/REFITTING

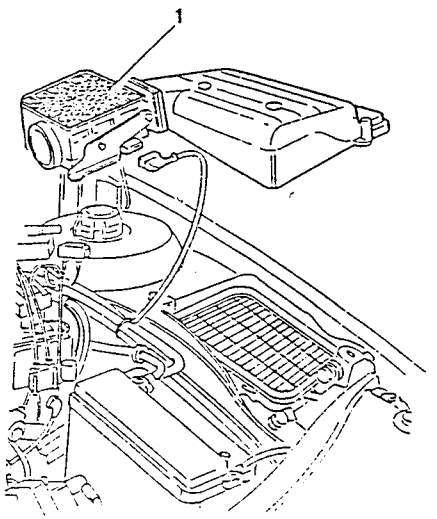
– Disconnect the negative cable from the battery.
1. Disconnect the electrical connection from the air flow meter.



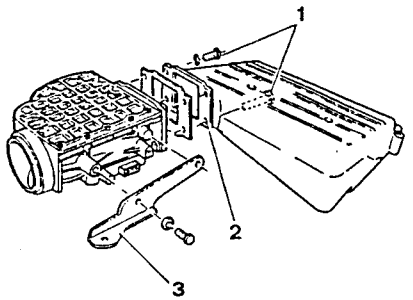
1. Unscrew the screws securing the air cleaner cover.
2. Unscrew the screw securing the air flow meter support bracket.
3. Disconnect the corrugated sleeve from the air flow meter after loosening the relative clamp.



1. Remove the air cleaner cover-air flow meter assembly.



1. Unscrew the retaining screws and separate the air cleaner cover from the air flow meter.
2. Remove the gasket.
3. Remove the relative support bracket from the air flow meter.



CHECKS AND INSPECTIONS

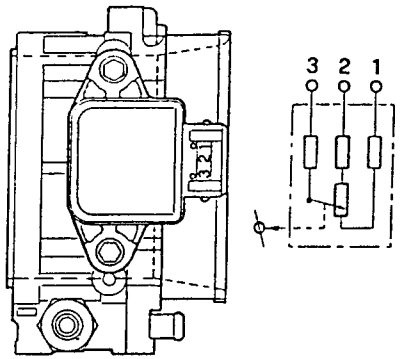
- Press on the shutter of the air flow meter and check that it rotates easily, that there are no friction points up to the stop limit and that it is not scored or or dirty.
- If necessary clean the internal surfaces of the air flow meter with a clean, fibreless cloth.
- For a functional check of the electrical components (potentiometer, sensors etc.) refer to the ELECTRICAL - ELECTRONIC DIAGNOSIS manual.

NOTE: **Never operate the air flow meter unless it is connected to the control unit.**

THROTTLE BODY - THROTTLE POTENTIOMETER

The throttle body regulates the quantity of air sent to the air intake box in relation to the position of the accelerator pedal. The accelerator cable acts on a pulley sector locked onto the rotation pin of the throttle valve.

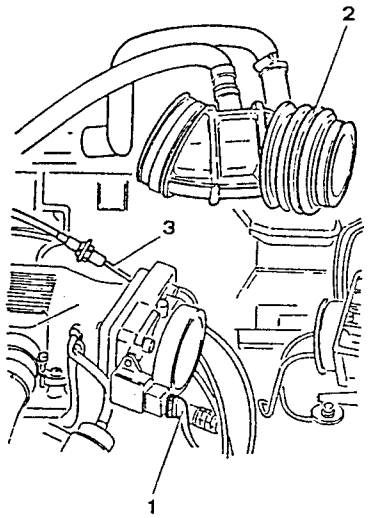
A spiral spring permits the return of the throttle valve to the closed position.



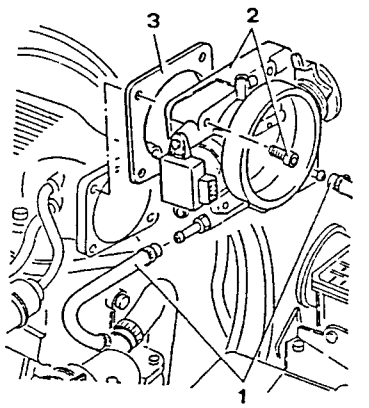
The throttle potentiometer is located to one side and is fixed to the rotation pin of the throttle.
It is composed of a potentiometer of which the mobile part is controlled directly by the shaft of the throttle valve.
During operation, the control unit supplies the potentiometer with **5 volts**
applied to pins (1) and (2).
A voltage collects on pin (3) which is inversely proportional to the position of the throttle valve. On the basis of the voltage sent by pin (3), the control unit recognizes the degree to which the valve has opened and corrects the mixture accordingly.
When the throttle valve is closed, an electric signal of ~ **0.5 Volts** reaches the control unit which recognizes the idle and cut-off states (distinguished on the basis of engine r.p.m.).
The potentiometer automatically recognizes the stop limit of the throttle when it is at idle speed by way of a "self-adaptation" function. This eliminates the operations of regulation carried out on the potentiometer and over a period of time makes it possible to detect any wear affecting the closed position of the throttle valve.

REMOVAL/REFITTING

- Disconnect the negative cable from the battery.
1. Disconnect the connection from the throttle valve potentiometer.
2. Remove the corrugated sleeve together with the air intake pipe, constant idle speed actuator and oil vapour recirculation hose.
3. Disconnect the accelerator cable from the throttle valve.

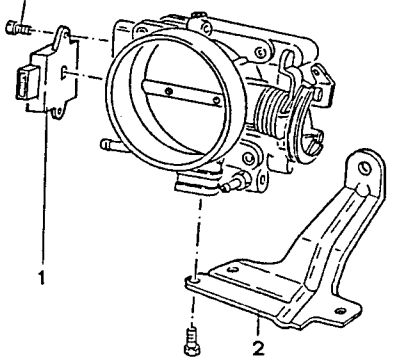


1. Disconnect the throttle body coolant inlet and outlet pipes.
2. Unscrew the retaining screws and remove the entire throttle body.
3. Remove the gasket.



1. Remove the potentiometer from the throttle body.
2. Remove the accelerator cable support bracket from the throttle body.

17.1 ÷ 18.9 Nm
1.74 ÷ 1.92 kgm



- Check that radial and axial play of the throttle shaft are within the specified limits.

	RADIAL PLAY	AXIAL PLAY
at refitting	≤ 0.06 mm	≤ 0.6 mm
at overhaul	≤ 0.08 mm	≤ 0.6 mm

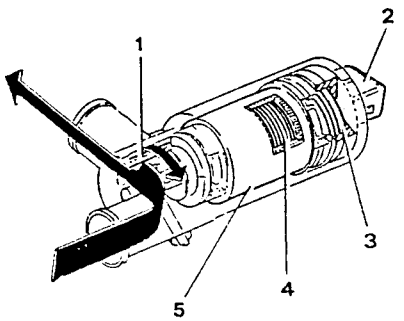
CONSTANT IDLE SPEED ACTUATOR

The control of the r.p.m. at idle speed is carried out by an actuator which regulates the quantity of air taken in by the engine when the throttle valve is at the stop limit. This makes it possible to compensate the request for power by the various functions (air conditioning compressor, power steering, alternator etc.) so that the engine r.p.m. does not change.

A double electromagnetic circuit ensures that the commands for opening and closing are separate, an advantage with regard to the speed of regulation.

The actuator is also "self adapting" which enables it to follow and recognize the changes which are occuring in the engine (different degrees of internal attrition coupled to different temperatures, settling of the engine over a period of time etc.) so that the engine r.p.m. is kept constant under all running conditions.

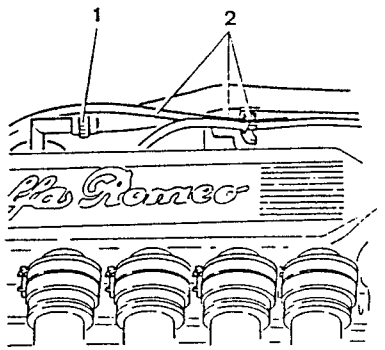
In the event of a fault, a spring opens the actuator to an intermediate position so that the vehicle is able to reach a service station.



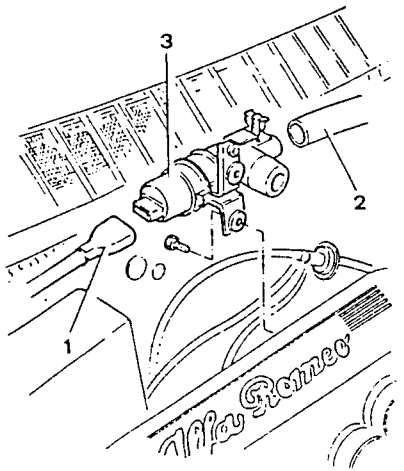
1. *Rotating box*
2. *Connector*
3. *Counter spring*
4. *Armature*
5. *Permanent magnet*

REMOVAL/REFITTING

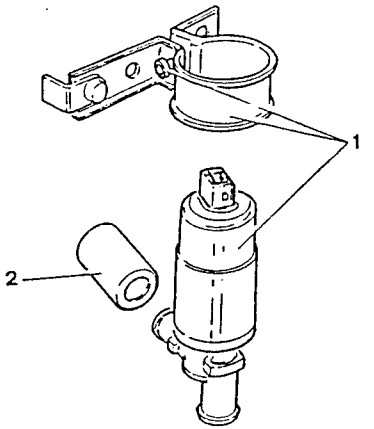
- Disconnect the negative cable from the battery.
1. Disconnect the oil vapour recovery hose from the separator.
2. Withdraw the spark plug cables from the wiring clamps.



1. Disconnect the connections from the constant idle speed actuator.
2. Disconnect the constant idle speed actuator from the air intake pipe leading to the corrugated sleeve.
3. Unscrew the two retaining screws and remove the constant idle speed actuator.



1. On a bench loosen the clamp and remove it from the constant idle speed actuator.
2. Remove the gasket.



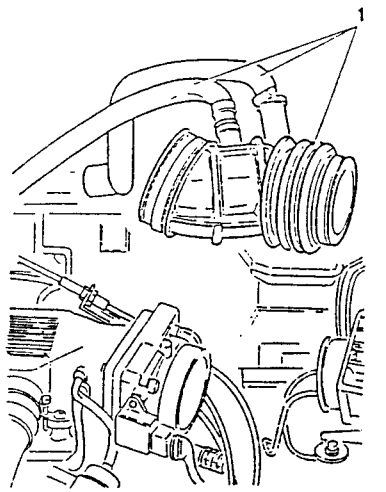
CHECKS AND INSPECTIONS

For a functional check of the electromagnetic part, refer to the ELECTRICAL - ELECTRONIC DIAGNOSIS manual.

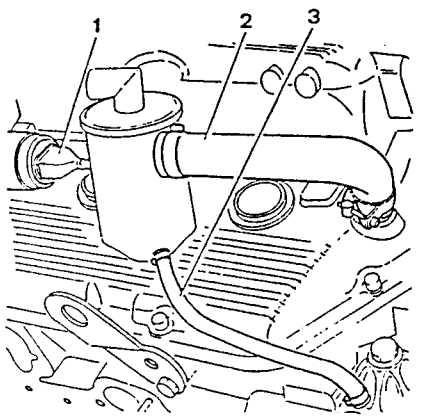
AIR INTAKE BOX

REMOVAL/REFITTING

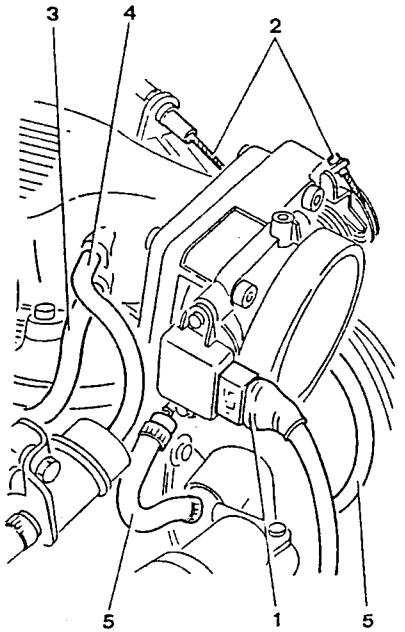
- Disconnect the negative cable from the battery.
1. Remove the corrugated sleeve together with constant idle speed actuator air intake pipe and oil vapour recirculation hose.



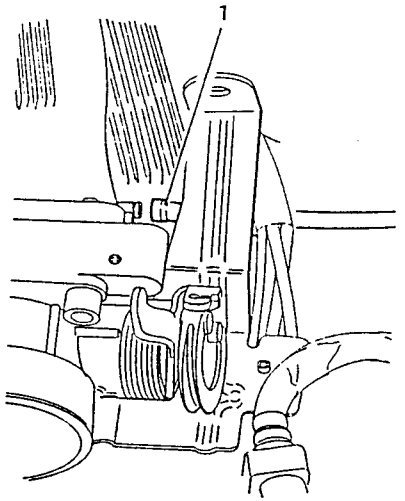
1. Disconnect the connection from the constant idle speed actuator.
2. Disconnect the oil vapour recovery hose from the separator.
3. Disconnect the oil vapour recovery hose.



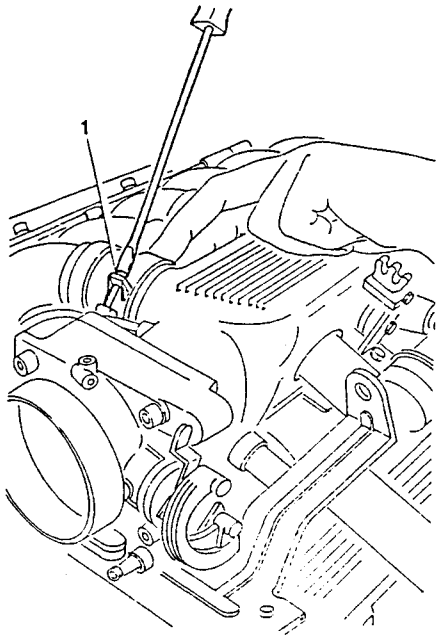
1. Disconnect the electrical connection from the throttle valve potentiometer.
2. Disconnect the accelerator cable from the throttle valve.
3. Disconnect the fuel pressure regulator vacuum intake pipe from the air intake box.
4. Disconnect the fuel vapour recirculation hose from the air intake box.
5. Disconnect the engine coolant inlet and outlet hoses from the throttle body.



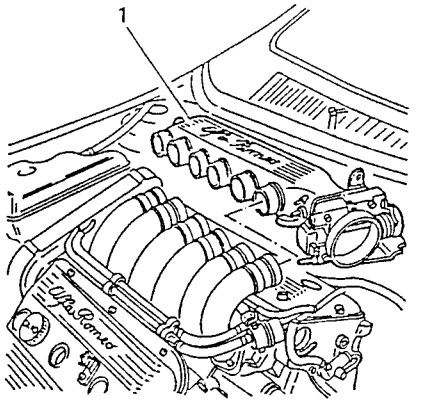
1. Disconnect the servo brake vacuum intake hose from the air intake box.

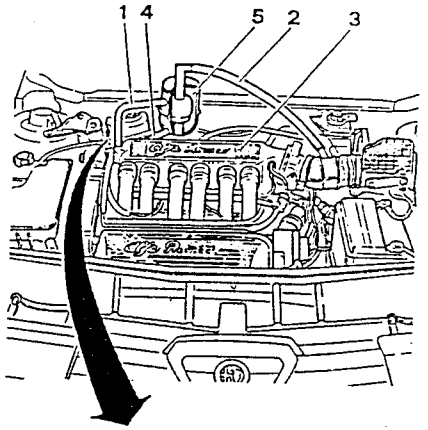


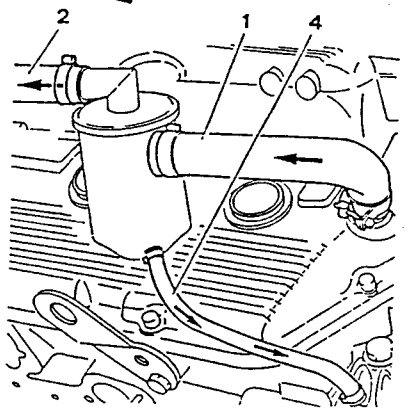
1. Loosen the clamps securing the intake stub pipes to the air intake box.



1. Unscrew the retaining screws and remove the air intake box after having freed the cables and hoses from the clamps fixed to it.







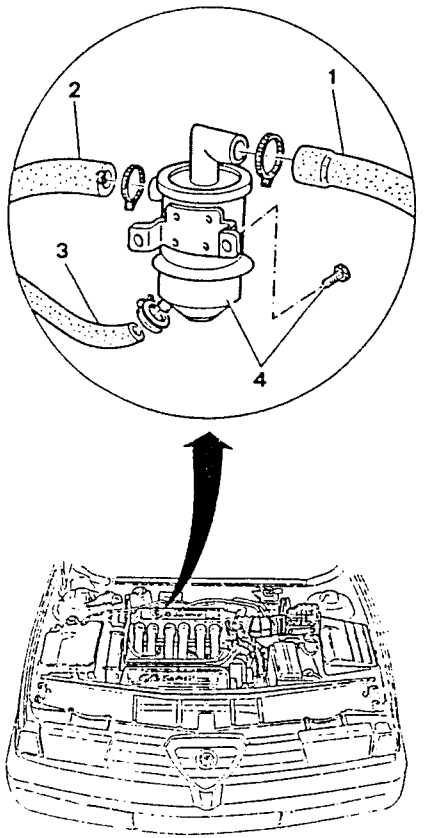
OIL VAPOUR RECOVERY SYSTEM

The control of oil vapour emission is carried out by a separator which collects the vapours released in the right-hand cylinder heads. A partial condensation takes place due to the lower temperature in the separator.
The condensed oil returns to the sump through piping while the vapours are sent on to be aspirated through the corrugated sleeve upstream of the throttle valve and then burned in the engine.

1. *Oil vapour recovery hose*
2. *Oil vapour recirculation hose*
3. *Air intake box*
4. *Oil recovery hose*
5. *Oil vapour separator*

REMOVAL/REFITTING OIL VAPOUR SEPARATOR

1. Disconnect the oil vapour recirculation hose from the separator.
2. Disconnect the oil vapour recovery hose from the separator.
3. Disconnect the oil recovery hose from the separator.
4. Remove the oil vapour separator from the air intake box.



THROTTLE VALVE CALIBRATION CHECK (FLOW)

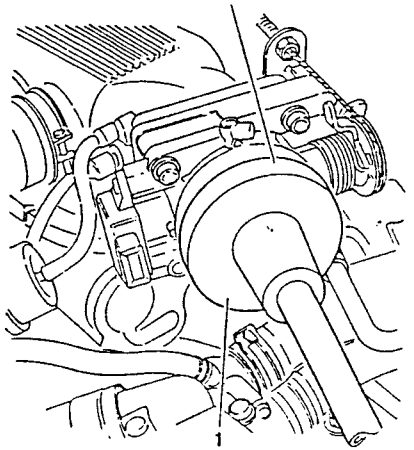
- Remove the air cleaner cover - air flow meter - corrugated sleeve assembly.

1. Ensure that the throttle valve is in the closed position. Rest flow meter tap N° 1.824.011.000 (C.2.0056) on the valve body inlet and check that the flow of air through the valve is within the specified limits.

- If the flow does not correspond to the specified limit, act on the regulation screw until a correct value is obtained.

Air flow through throttle valve in closed position (SOLEX flowmeter)
290 ± 10 on N scale

1.824.011.000
(C.2.0056)

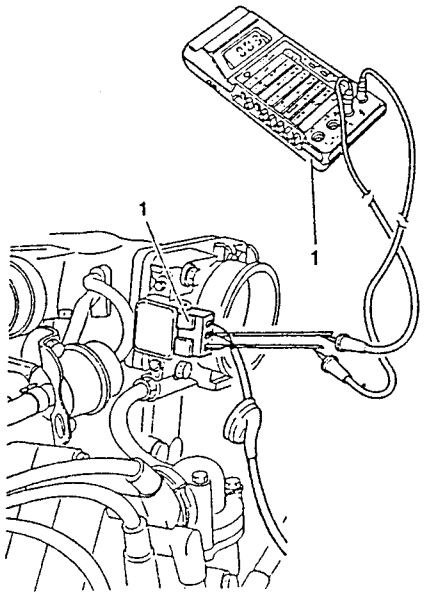


CHECKING FUNCTIONING OF THROTTLE VALVE POTENTIOMETER

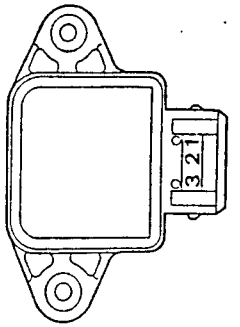
- Check the operation of the throttle valve potentiometer by operating as follows:
- Turn the ignition key to the MARCIA position.

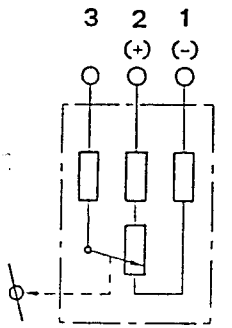
1. Connect a multimeter (20 V end of scale) to terminals 1 and 2 of the throttle valve potentiometer.

NOTE: **When connecting the multimeter the potentiometer must remain connected to its cables. Use needles or similar devices to ensure this.**



- Read approximately 5 Volts.
- Connect a multimeter (20 V end of scale) to terminals 1 and 3 of the throttle valve potentiometer.
- Rotate the valve slowly until it reaches the stop limit and check for a CONSTANT variation between 0.4 to 0.5 Volts and 4.2 to 4.5 Volts.
- If the above conditions are not met, replace the throttle valve potentiometer.





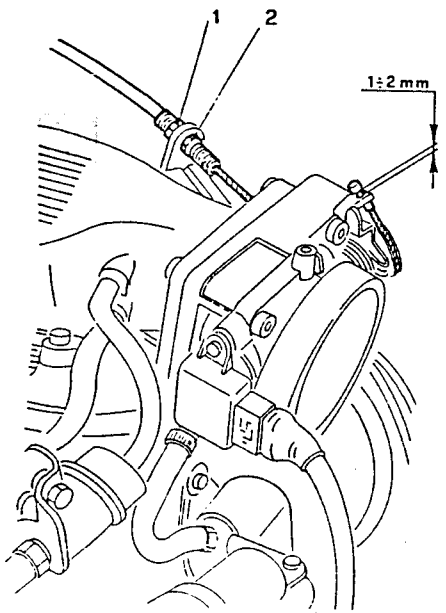
CHECKING AND SETTING ACCELERATOR CABLE

- Check that the accelerator cable runs freely in its sheath.
- With the pedal raised, check that the accelerator cable on the control lever has an axial play of 1 to 2 mm.

1. To calibrate the cable, unscrew the checknut.
2. Act on the nut to obtain the correct axial play.

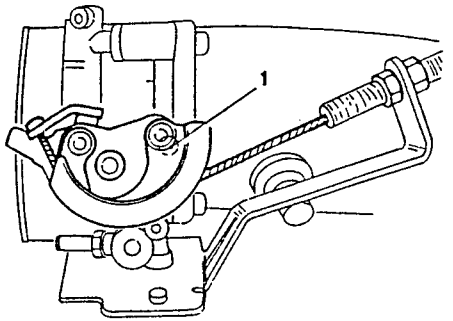
- Lock the check nut in position.

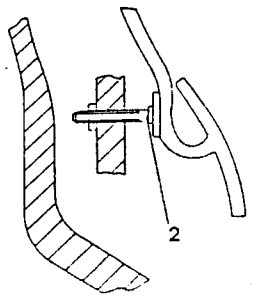
Accelerator cable axial play (with pedal released)
1 to 2 mm



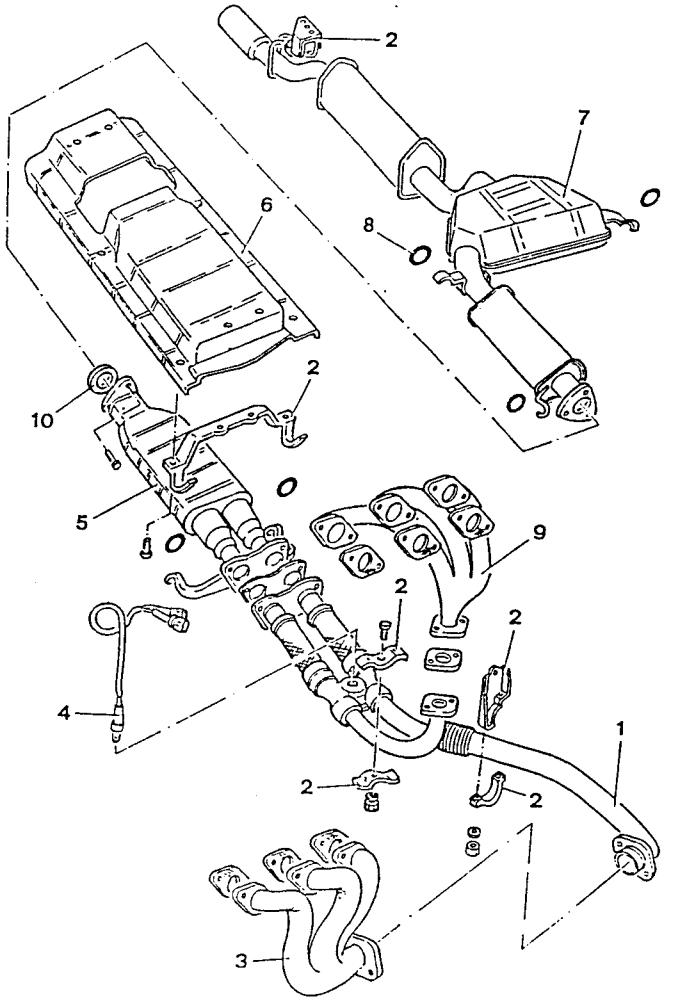
1. With the pedal fully depressed check that the stop limit of the throttle valve is 1 to 2 mm away from the relative stop.
2. Otherwise act on the stop limit buffer located under the accelerator pedal.

Play between throttle valve stop limit and relative stop (with pedal fully depressed).
1 to 2 mm





EXHAUST SYSTEM



1. *Forward section*
2. *Supports*
3. *Exhaust manifold - LH side*
4. *Lambda probe*
5. *Catalytic converter*
6. *Heat shield*
7. *Rear section - silencers*
8. *Elastic rings*
9. *Exhaust manifold - RH side*
10. *Seal ring*

DESCRIPTION

The exhaust gasses flow into two triple manifolds (one for each head) and then through two exhaust pipes to the the three way catalytic converter where most of the pollutants are removed.
The Lambda probe is located on the forward section of the exhaust pipes and this device informs the Motronic control unit of the amount of oxygen present in the exhaust gasses enabling the injection times to be adjusted to keep the stoicheiometric ratio (air-fuel) at an optimum level.
The exhaust gasses exit the catalytic converter and pass on to the three silencers.
Heat dissipation to the car body, very high due to the catalytic converter, is limited by a system of thermal insulation.
For information regarding the individual components of the system, refer to the paragraphs below.

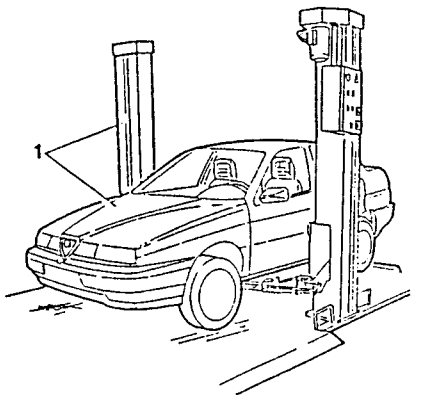
CAUTION:
During engine operation all the exhaust pipes, and in particular the catalytic converter, heat up considerably.
Before attempting any work the system should be left to cool with the engine switched off.
DO NOT TOUCH THE CATALYTIC CONVERTER WITHOUT ADEQUATE PROTECTION SUCH AS GLOVES ETC.
DO NOT ALLOW EASILY INFLAMMABLE MATERIAL TO COME IN CONTACT WITH THE CATALYTIC CONVERTER.

EXHAUST, FORWARD SECTION

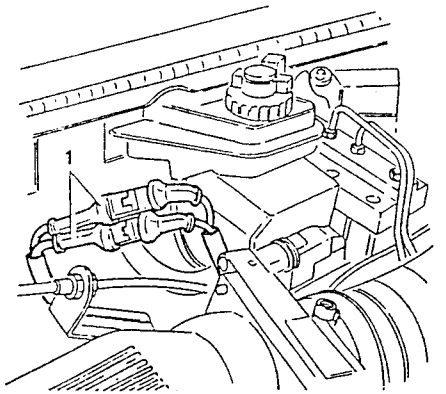
From the two exhaust manifolds, one for each cylinder head, two pipes collect the exhaust gasses and pass them to the catalytic converter.
The connection to the right-hand manifold and to the catalytic converter is accomplished by a flange and gaskets while the left-hand manifold employs a flange with a spherical collar.
To compensate for the heat deformation and vibration transmitted by the engine, bellows type flexible stretches are inserted along the forward section.
At the centre, the two pipes are connected by a covering at the centre of which is the seating for the Lambda probe.

REMOVAL/REFITTING

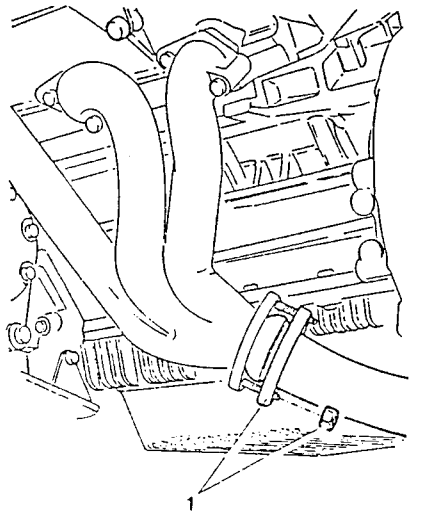
1. Place the vehicle on a lift.

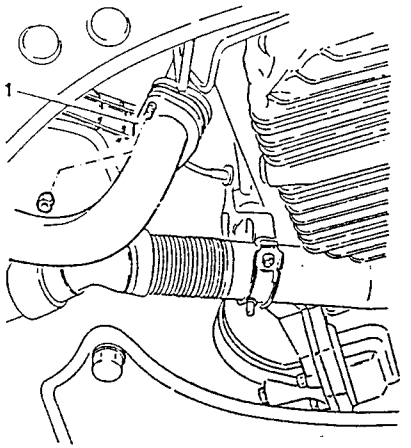


– Disconnect the negative cable from the battery.
1. Disconnect the two lambda probe connections.

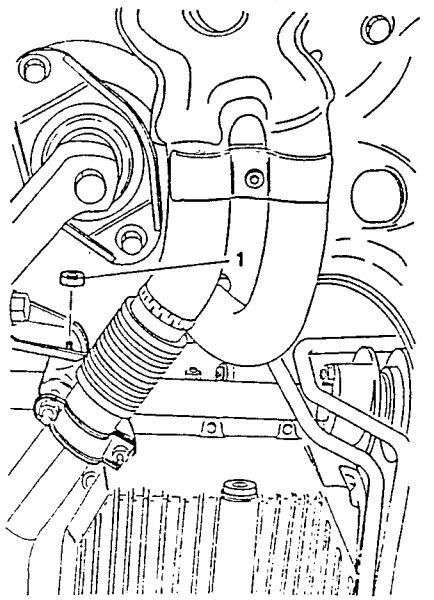


– Raise the vehicle
1. Disconnect the two flanges connected to the exhaust manifold.

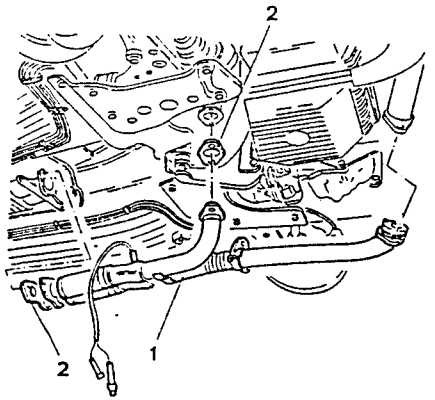




1. Slacken and remove the bolt securing the intermediate bracket.



1. Disconnect the flange connected to the catalytic converter and remove the forward section of the exhaust pipe.
2. Remove the gaskets.

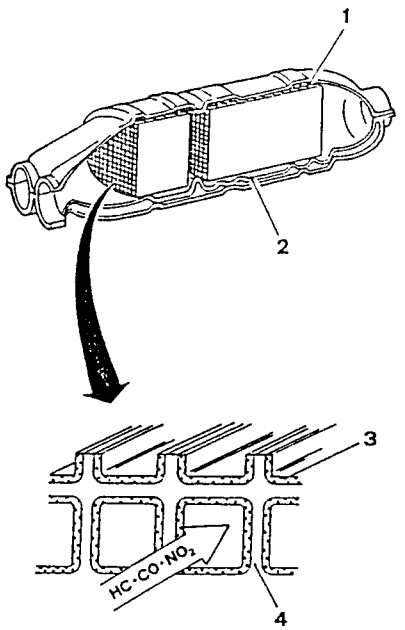


CATALYTIC CONVERTER

Fuel combustion generates harmful gasses such as:
- carbon monoxides (CO);
- unburnt hydrocarbons (HC);
- nitrogen oxides (NOX).

These substances are changed into non-polluting substances normally present in the atmosphere by chemical reaction inside the catalytic converter :
- carbon dioxide (CO_2);
- water vapour (H_2O);
- inert nitrogen (N_2).

The inner part of the catalytic converter is composed of a heat resistant ceramic support containing channels through which the exhaust gasses pass. The channels are coated on the inside with small quantities of noble metals such as platinum, radium and palladium. These activate and accelerate the chemical processes which transform the polluting substances.



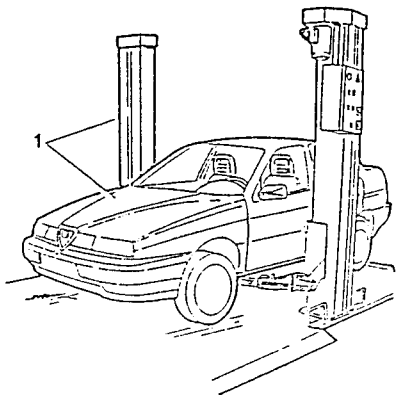
1. *Insulation*
2. *Ceramic support*
3. *Coating of platinum, radium and palladium*
4. *Ceramic layer*

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

The performance of the catalytic converter is greatly influenced by:
- **temperature of exhaust gasses:**
  The chemical reactions which take place in the catalytic converter are of the oxygen reducing type a process occuring normally in nature at temperatures around 1000 to 1200°C. The presence of noble metals allow these reactions to take place at lower temperatures (250 to 300°C).
  These temperatures are reached by the exhaust gasses with the engine running at normal speed.
- **engine air-fuel ratio:**
  Overall the pollutants present in the exhaust gasses are at a lower level when the air-fuel ratio of the mixture burned by the engine is approximately equal to the theroretical stoicheiometric ratio (14.7:1).
  Under these conditions the catalytic converter is able to reduce the concentrations of the polluting substances contained in the exhaust gasses by 80%. It is for this reason that the Lambda probe is used.

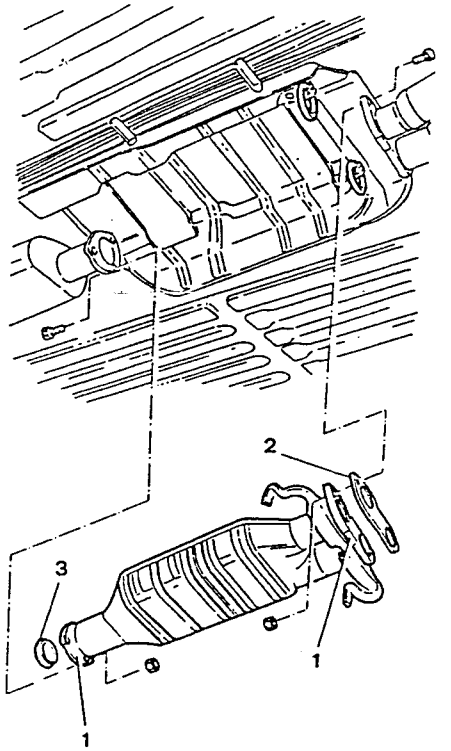
REMOVAL/REFITTING

1. Place the vehicle on a lift.



- Raise the vehicle.

1. Unscrew the bolts securing the forward and rear flanges to the catalytic converter and, after disconnecting the flexible support rings, remove the converter.
2. Remove the gasket.
3. Remove the seal ring.



CAUTION:
Even if the outside of the catalytic converter is cool after removal, the inside may still be hot. For this reason DO NOT PLACE THE CONVERTER ON INFLAMMABLE MATERIALS.

CAUTION:
High temperature of catalytic converter.
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 materials forming the converter itself.
In the event of this situation arising consult the diagnosis section at the end of this chapter.

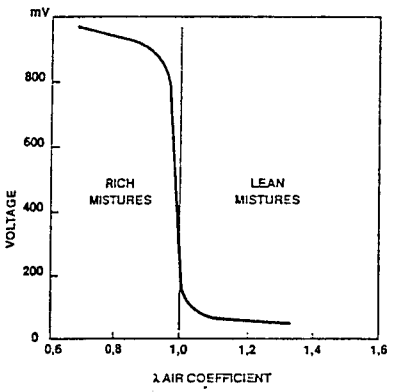
LAMBDA PROBE

The lambda probe informs the MOTRONIC system control unit as to the state of combustion of the air-fuel mixture (see the functions of the MOTRONIC M1.7 system at the beginning of this paragraph) and permits the system to keep the stoicheiometric ratio of the mixture as near as possible to the theoretical value.
In order to obtain an optimim mixture, it is necessary for the quantity of air taken in by the engine to equal the theroretical amount required to burn all the injected fuel.
In this case the lambda factor (λ) is equal to 1:

$$\lambda = \frac{\text{QUANTITY OF INTAKE AIR}}{\text{THEORETICAL QUANTITY OF AIR REQUIRED TO BURN ALL THE INJECTED FUEL}}$$

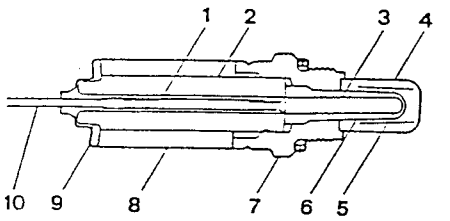
Therefore:
$\lambda = 1$ Ideal mixture
$\lambda < 1$ Lean mixture
$\lambda > 1$ Rich mixture

The lambda probe, in contact with the exhaust gasses generates an electrical signal which varies in voltage depending on the quantity of oxygen present in the gasses. This voltage is characterized by an abrupt variation when the composition of the mixture is moved from $\lambda = 1$.



The lambda probe is composed of a capsule of ceramic material which acts as a support for two platinum electrodes, one in contact with the exhaust gas and the other in contact with the atmosphere. To avoid corrosion by the exhaust gasses the platinum on the electrode is covered by a layer of porous ceramic and by a metallic capsule which protects it from collision with solid particles present in the gasses.
One electrode is connected to earth while the other is connected electrically to the control unit.
At high temperatures (above 300°C) this ceramic layer becomes porous and allows the oxygen ions contained in the exhaust gasses. To be deposited on the platinum electrode.
Oxygen ions present in the atmosphere are deposited on the electrode which is in contact with the atmosphere and create a difference in potential of around a hundred Mv, a voltage which indicates whether the mixture is lean or rich.
In order for the lambda probe to quickly reach the correct operating temperature of 300°C a heating resistance, supplied when the engine is cold, is located on the inside of the probe.

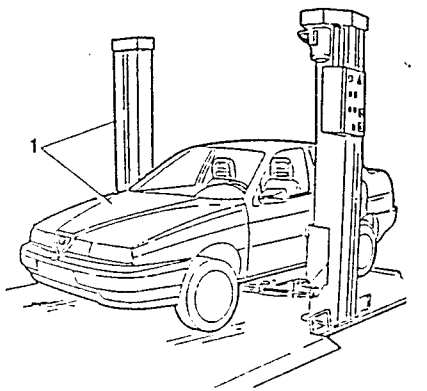
CAUTION
The internal platinum electrodes are subject to chemical attack by lead.
FOR THIS REASON PETROL CONTAINING LEAD MUST NOT BE USED AS THIS WOULD CAUSE RAPID AND IRREVERSIBLE DAMAGE TO THE PROBE.
NEVER USE PETROL CONTAINING LEAD EVEN IN AN EMERGENCY OR FOR SHORT PERIODS.



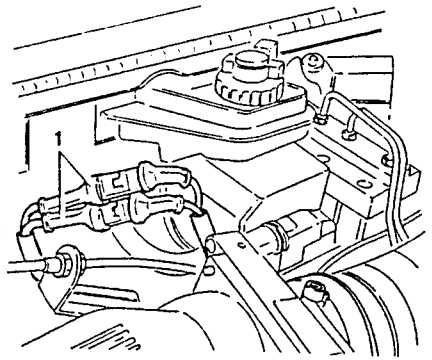
1. *Contact*
2. *Ceramic support*
3. *Ceramics of the probe*
4. *Protective tube*
5. *Electrode (+)*
6. *Electrode (-)*
7. *Shell*
8. *Protective sheath*
9. *Cup spring*
10. *Electrical connection*

REMOVAL/REFITTING

1. Place the vehicle on a lift.
– Disconnect the negative cable from the battery.

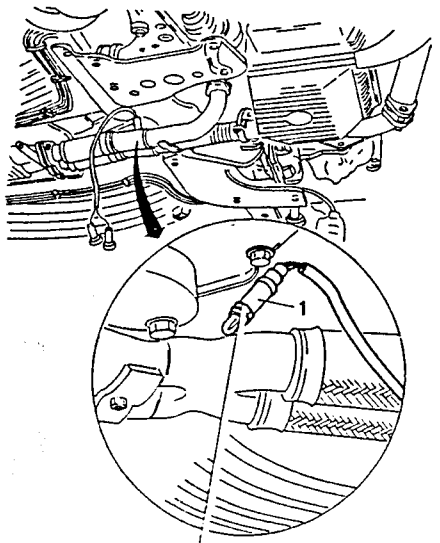


1. Disconnect the two electrical connections from the lambda probe.



– Raise the vehicle.

1. Remove the lambda probe from the forward section of the exhaust pipe.



50 ÷ 60 Nm
5.1 ÷ 6.1 kgm

CHECKS AND INSPECTIONS

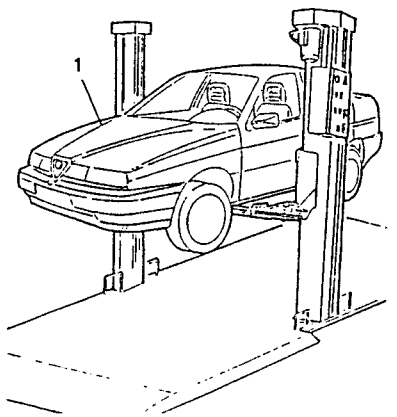
To check the operation of the lambda probe and of the heating resistance, refer to the ELECTRICAL - ELECTRONIC DIAGNOSIS manual.

EXHAUST - REAR SECTION

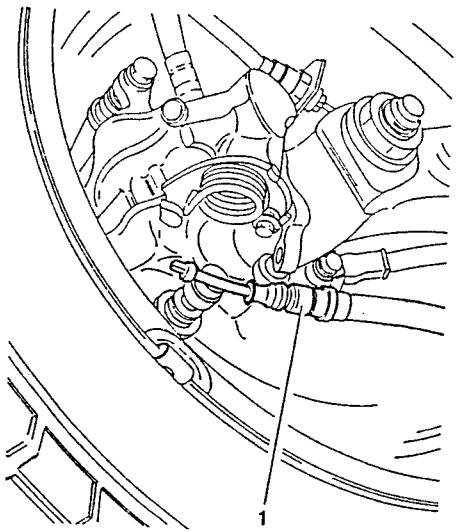
The rear section of the exhaust is composed of three silencers connected by a pipe and supported by the underbody by flexible rings.
The connection to the catalytic converter is obtained by a flange and seal ring.

REMOVAL/REFITTING

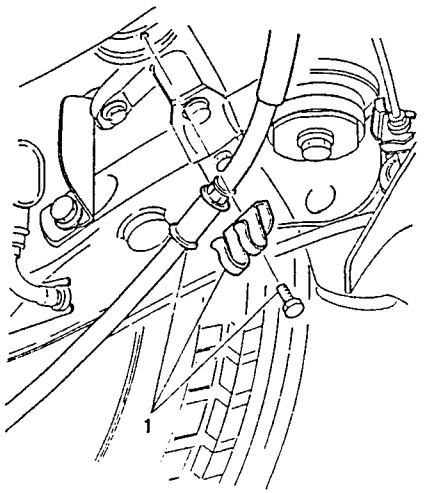
1. Place the vehicle on a lift and raise it.



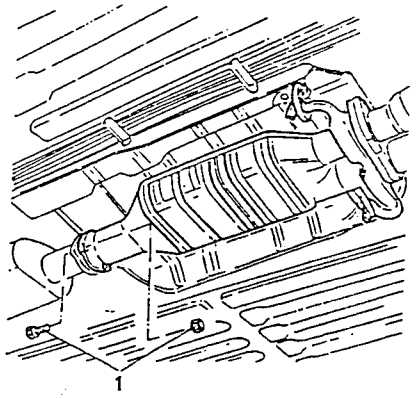
1. Disconnect the handbrake cable from the rear left-hand brake caliper.



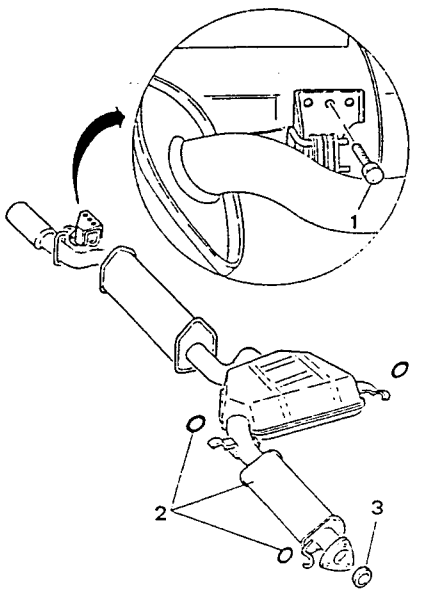
1. Unscrew the screw securing the brake line support brackets and handbrake cable and remove the handbrake cable from the bracket.



1. Unscrew the screws securing the flange connecting the catalytic converter to the rear section of the exhaust pipe.



1. Unscrew the screw securing the rear flexible support to the car body.
2. Remove the rear section of the exhaust pipe withdrawing it from the flexible support rings.
3. Remove the seal rings.



CHECKING EXHAUST EMISSIONS

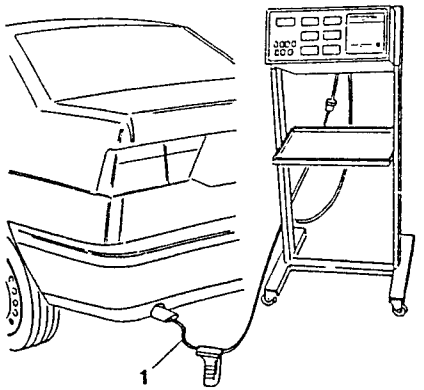
CAUTION:
The exhaust emissions must be checked in the open air or in another suitable area equipped in accordance with the current laws.

NOTE: **The checks must be carried out when the engine is at normal running temperature (i.e. after the electric fan has cut out) and at idle speed.**
If the idle speed value is not within the specified limits check for the correct functioning of the constant idle speed actuator.

- Check that the engine oil level is correct and that the air cleaner filter is clean.
- Start the engine and run at idle speed.

1. Introduce the probe into the end of the exhaust pipe and check that the percentage of CO and HC is within the specified limits.

Idle speed		750 ± 50 r.p.m.
Exhaust CO	% in vol.	≤ 0.5
Exhaust HC	p.p.m.	≤ 50



If the results of the test are not within the specified limits, consult the fault diagnosis at the end of this chapter and refer to the diagnosis procedure with the correct instrument described in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual.

NOTE: **DO NOT ATTEMPT TO ADJUST THE PERCENTAGE OF CO!**
If the percentage is not within the specified limits it is necessary to operate on the faulty components.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

GENERAL SPECIFICATIONS

FUEL

Fuel without lead	R.O.N. ≥ 95

FUEL TANK

Total capacity	63 litres
Reserve	7 litres

CHECKS AND INSPECTIONS

FUEL LEVEL GAUGE CALIBRATION CHECK

Level (mm)	Indicator reading	Resistance (Ω)
51.5	4/4	0 ÷ 7
115.5	3/4	59 ÷ 69
163.5	1/2	116 ÷ 126
199.5	1/4	186 ÷ 201
216.5 ± 3	Max reserve	262
231	0	295 ÷ 315

R.P.M. AND TIMING SENSOR AIR GAP CHECK

Air gap between r.p.m. and timing sensor and crankshaft pulley (phonic wheel)	0.5 ÷ 1.5 mm

ENGINE COOLANT TEMPERATURE SENSOR (NTC) CALIBRATION CHECK

Temperature (°C)	Resistance (kΩ)
20	~ 2.5

FUEL SUPPLY PRESSURE CHECK

Fuel pressure at idle speed	2.8 ÷ 3.2 bar (2.9 ÷ 3.3 kg/cm^2)
Maximum pressure (with pressure regulator engaged)	4 bar (4.1 kg/cm^2)

THROTTLE VALVE SHAFT PLAY CHECK

	Radial play	Axial play
On installation	≤ 0.06 mm	≤ 0.6 mm
At revision	≤ 0.08 mm	≤ 0.6 mm

THROTTLE VALVE SETTING CHECK

Air leakage from accelerator throttle valve in closed position (Solex flowmeter)	240 ÷ 260 on N scale

IDLE SPEED AND EXHAUST EMISSIONS CHECK

Idle speed		750 ± 50 r.p.m.
Exhaust CO at idle speed	% vol.	≤ 0.5
Exhaust HC at idle speed	p.p.m.	≤ 50

TIGHTENING TORQUES

PART	Nm	kgm
Fuel from filter outlet connection	21 ÷ 26	2.1 ÷ 2.7
Fuel to filter inlet connection	30 ÷ 37	3.1 ÷ 3.8
Throttle valve potentiometer retaining screws	17.1 ÷ 18.9	1.74 ÷ 1.92
Lambda probe (λ)	50 ÷ 60	5.1 ÷ 6.1

SPECIFIC TOOLS

1.824.011.000 (C.2.0056)	Pad for checking throttle valve setting
1.854.040.000	Spanner for removing fuel level gauge
1.821.167.000 (A.3.0631)	Spanner for removing fuel pump

FAULT DIAGNOSIS AND CORRECTIVE INTERVENTIONS

FAULTS AND SYMPTOMS	CHECK	TEST REFERENCE
THE ENGINE DOES NOT START (UNDER ANY CIRCUMSTANCES)	– Nothing happens when the ignition key is rotated. Check for problems relating to the IGNITION SWITCH.	See ELECTRICAL - ELECTRONIC DIAGNOSIS manual
	– When the ignition key is turned, the lights on the instrument panel come on but the STARTER MOTOR makes no noise. Check for fault in STARTER MOTOR.	See ELECTRICAL - ELECTRONIC DIAGNOSIS manual
	– When the ignition key is rotated the lights on the instrument panel come on, the starter motor turns normally but the engine does not start.	A (ignition) and then B (supply)
THE ENGINE DOES NOT START WHEN COLD	– When the ignition key is rotated the lights on the dashboard come on, the starter motor turns normally but the engine does not start WHEN COLD. **NOTE: When the engine is warm it starts normally.**	C
THE ENGINE DOES NOT START WHEN HOT	– When the ignition key is rotated the lights on the dashboard come on, the starter motor turns normally but the engine does not start JUST AFTER BEING SWITCHED OFF OR WHEN HOT.	D

(CONTINUES)

FAULT DIAGNOSIS AND CORRECTIVE INTERVENTIONS

FAULTS AND SYMPTOMS	CHECK	TEST REFERENCE
THE ENGINE STARTS WITH DIFFICULTY AFTER MANY ATTEMPTS HAVE BEEN MADE	– When the ignition key is rotated the lights on the instrument panel come on, the starter motor turns normally but the engine starts only AFTER SEVERAL ATTEMPTS HAVE BEEN MADE.	E
THE ENGINE STARTS BUT STOPS IMMEDIATELY	– When the ignition key is rotated the engine starts immediately (or almost) but after a short time it STOPS ABBRUPTLY.	F
IRREGULAR IDLE SPEED **If the anomaly is present when the engine is hot, see test D**	– The idle speed does not conform to the requested value and does not remain constant and regular.	G If the test is not passed carry out test A
THE ENGINE IS RUNNING IRREGULARY (under all conditions)	– Under all conditions (at all speeds and/or loading conditions) the engine runs irregularly and is hesitant. Running irregularly: lean mixture leading to short but obvious oscillations. This can be cyclic or irregular and appear at any speed and under any loading conditions, generally when the speed is constant. Hesitation: temporary lack of initial response after acceleration (begins with a dead point)	H

(CONTINUES)

FAULT DIAGNOSIS AND CORRECTIVE INTERVENTIONS

FAULTS AND SYMPTOMS	CHECK	TEST REFERENCE
ENGINE STUMBLES	– The engine runs irregularly or stumbles. Acceleration is not smooth. Stumbling: Brief but obvious reduction in acceleration	I
ENGINE DOES NOT REACH MAXIMUM PERFORMANCE	– The vehicle functions normally at medium/low speed but does not reach maximum performance (in terms of speed or thrust).	J
EXCESSIVE FUEL CONSUMPTION NOTE: It is obvious that the fuel consumption increases greatly when the vehicle is driven in the wrong manner, i.e. incorrect use of gears, acceleration when in neutral etc.	– Check to see whether the consumption is excessive with regard to the specified values or observed during the car's life.	K
HIGH LEVEL OF EXHAUST CO AND HC	– Check the percentage of CO and HC at idle speed.	L

(CONTINUES)

FAULT DIAGNOSIS AND CORRECTIVE INTERVENTIONS

FAULTS AND SYMPTOMS	CHECK	TEST REFERENCE
LOW CO PERCENTAGE (High NO_x value)	– Check the percentage of CO: a value which is too low* leads to a high NO_x value (NO_x = Nitrogen Oxide) (*) value too low: if the tester reads 00.00	M

ATTENTION:

The IGNITION system functions at dangerous voltages (high or low).
Pay great attention and always disconnect the system before carrying out any operations on it.
Do not smoke while operating on the SUPPLY SYSTEM and ensure that all safety equipment (fire extinguishers etc.) is near at hand.

THE ENGINE DOES NOT START - FAULT IN IGNITION	TEST A

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
A1 CHECK BATTERY SUPPLY – Check to see if the anomalous condition is caused by the battery – See ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase A2 Follow the indications given in the ELECTRICAL-ELECTRONIC DIAGNOSIS manual
A2 CHECK CAR ALARM – Check for correct functioning of car theft alarm - ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase A3 Follow the indications given in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
CAUTION: **The ignition system functions using dangerous voltage levels (high and low) and it is therefore necessary to exercise the utmost caution and to disconnect the system before working on it.**		
A3 CHECK SPARK PLUGS – Check that: • the spark plugs are not dirty and do not show traces of burning • the spark plugs discharge normally: remove the cover, connect to earth and check the plug	OK ▶ ~~OK~~ ▶	Proceed to phase A4 Clean or replace the faulty spark plugs

(CONTINUES)

THE ENGINE DOES NOT START - FAULT IN IGNITION	TEST A

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
A4 CHECK HIGH VOLTAGE AND EARTH CABLES – Check: • that the high voltage cables (from the ignition coils to the spark plugs) are not damaged • that there is no electrical resistance preventing dissipation • that the earth braids are correctly tightened and are not oxidized	OK ▶ ~~OK~~ ▶	Proceed to phase A5 Replace the high voltage cables or the earth braids. Correctly tighten the earth braids.
A5 CHECK ENGINE R.P.M. AND TIMING SENSOR – Check: • the connections between the sensor and the control unit • the distance between the sensor and the pulley - see GROUP 04 - R.P.M. AND TIMING SENSOR	~~OK~~ ▶	Restore the connection or move the sensor to the correct position

End of test A

THE ENGINE DOES NOT START - FAULT IN INJECTION	TEST B

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
CAUTION: **When working on the fuel system do not smoke and ensure that safety equipment is near at hand.**		
B1 CHECK FUEL – Check that there is petrol in the tank (the low level warning lamp may be broken), check that there are no traces of water or other polluting liquid in the petrol and ensure that there is not dirt inside the fuel tank.	OK ▶ ~~OK~~ ▶	Proceed to phase B2 Clean the tank if necessary. Fill the system with the recommended type of petrol.
B2 CHECK FUEL PUMP RELAY – Check that the fuel pump relay is working properly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase B3 Move on to the procedure given in the LELECTRICAL - ELECTRONIC DIAGNOSIS manual
B3 CHECK AIR FLOW METER – Check that the tabs move freely without bending. Check that the inside is clean and that it does not show signs of rubbing.	OK ▶ ~~OK~~ ▶	Proceed to phase B4 Replace or clean the meter

(CONTINUES)

THE ENGINE DOES NOT START - FAULT IN INJECTION	TEST B

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
B4 CHECK ELECTROINJECTORS – It is possible to feel the movement of the needles when touching the injectors. Check the resistance of the injectors.	OK ▶ ~~OK~~ ▶	Proceed to phase B5 Replace the injectors
B5 CHECK FUEL PRESSURE – Carry out sealing and pressure checks of the fuel supply system - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to phase B6 Check that the fuel filter, pump and pressure regulator are working correctly and replace any faults parts
B6 CHECK CONTROL UNIT – Check that the MOTRONIC M1.7 control unit is functioning correctly (checking the vehicle by using another control unit)	OK ▶ ~~OK~~ ▶	Replace the control unit Connect the old control unit and pass on to phase B7
B7 CHECK DISTRIBUTION TIMING – Check that the timing is correct - see GROUP 00 - TIMING CHECK	~~OK~~ ▶	Restore correct timing

End of test B

THE ENGINE DOES NOT START WHEN COLD — TEST C

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
C1 FAULT IN BATTERY – Check that the battery voltage is correct. MINIMUM VOLTAGE: 12 V Voltage sufficient to start the engine may not be enough for the MOTRONIC M1.7 control unit	OK ▶ ~~OK~~ ▶	Proceed to **phase C2** Charge or replace the battery
C2 CHECK ENGINE COOLANT TEMPERATURE SENSOR (NTC) – Check that the sensor is working properly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to **phase C3** Carry out the procedure given in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
C3 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to **phase C4** Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
C4 CHECK CONTROL UNIT – Check that the MOTRONIC control unit is working properly (by checking the vehicle using another control unit) as the air enrichment when cold could be faulty.	~~OK~~ ▶	Replace the control unit

End of test C

THE ENGINE DOES NOT START WHEN HOT — TEST D

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
D1 CHECK ENGINE COOLANT TEMPERATURE SENSOR (NTC) – Check that the sensor works correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to **phase D2** Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual - then proceed to phase D2
D2 CHECK AIR-FLOW METER – Check that the tab moves freely without bending. Check that the inside is clean and that it does not show signs of rubbing.	OK ▶ ~~OK~~ ▶	Proceed to **phase D3** Replace or clean the meter
D3 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to **phase D4** Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts

(CONTINUES)

THE ENGINE DOES NOT START WHEN HOT	TEST D

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
D4 CHECK VAPOUR LOCK		
– Check that there are no vapour locks in the fuel supply circuit. Turn the starter motor for a short while so that the fuel pump can bleed the circuit and recycle the fuel NOTE: the phenomenon disappears if the engine is left to cool down	~~OK~~ ▶	Replace faulty components

End of test D

THE ENGINE STARTS WITH DIFFICULTY	TEST E

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
E1 CHECK IDLE SPEED ACTUATOR		
– Check that the idle speed actuator functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase E2 Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
E2 CHECK FOR LEAKAGE OF AIR		
– Check: • that air is not escaping from the circuit. Cover the connections along the pipes downstream of the air-flow meter with soap solution. With the engine at idle speed check that the solution is not sucked in by the engine	OK ▶ ~~OK~~ ▶	Proceed to phase E3 Replace the faulty components
E3 CHECK FUEL PRESSURE		
– Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to phase E4 Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts

(CONTINUES)

THE ENGINE STARTS WITH DIFFICULTY — TEST E

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
E4 CHECK THE CYLINDER HEAD GASKETS		
– Check that the cylinder head gaskets are not leaking water - see GROUP 01 - CYLINDER HEADS	OK ▶	Proceed to phase E5
	~~OK~~ ▶	Replace the cylinder head gaskets
E5 CHECK THE IDLE SPEED ACTUATOR AND THROTTLE VALVE		
– Strip the throttle body and check that there are no signs of oil or dirt. Carry out the same check on the idle speed actuator.	OK ▶	Proceed to phase E6
	~~OK~~ ▶	Clean the affected parts
E6 CHECK CONTROL UNIT		
– Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)	~~OK~~ ▶	Replace the control unit

End of test E

THE ENGINE STARTS BUT STOPS IMMEDIATELY — TEST F

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
F1 CHECK IDLE SPEED ACTUATOR		
– Check that the idle speed actuator works correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶	Proceed to phase F2
	~~OK~~ ▶	Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
F2 CHECK AIR FLOW METER		
– Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK ▶	Proceed to phase F3
	~~OK~~ ▶	Replace or clean the meter
F3 CHECK FUEL PRESSURE		
– Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶	Proceed to phase F4
	~~OK~~ ▶	Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
F4 CHECK ALTERNATOR		
– Check that the alternator is working correctly and in particular the voltage regulator: The alternator must not be overloaded. See ELECTRICAL - ELECTRONIC DIAGNOSIS manual	~~OK~~ ▶	Replace the voltage regulator or alternator if faulty

End of test F

IRREGULAR ENGINE IDLE SPEED	TEST G

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
G1 CHECK IDLE SPEED ACTUATOR – Check that the idle speed actuator is working correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to **phase G2** Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
G2 CHECK THROTTLE VALVE POTENTIOMETER – Check that the potentiometer is working correctly - see GROUP 04 - CHECKING FUNCTION OF THROTTLE VALVE POTENTIOMETER	OK ▶ ~~OK~~ ▶	Proceed to **phase G3** Replace the potentiometer
G3 CHECK AIR-FLOW METER – Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK ▶ ~~OK~~ ▶	Proceed to **phase G4** Replace or clean the meter
G4 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to **phase G5** Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts

(CONTINUES)

IRREGULAR ENGINE IDLE SPEED	TEST G

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
G5 CHECK FOR LEAKAGE OF AIR – Check: • that air is not escaping from the circuit. Cover the connections along the pipes downstream of the air-flow meter with soap solution. With the engine at idle speed check that the solution is not sucked in by the engine	OK ▶ ~~OK~~ ▶	Proceed to **phase G6** Replace the faulty components
G6 CHECK CYLINDER COMPRESSION – Check cylinder compression - see GROUP 00 - CHECKING CYLINDER COMPRESSION	OK ▶ ~~OK~~ ▶	Proceed to **phase G7** Clean the affected parts
G7 CHECK CONTROL UNIT – Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit) as the idle speed control logic could by faulty	~~OK~~ ▶	Replace the control unit

End of test G

THE ENGINE RUNS IRREGULARLY	TEST H

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
H1 CHECK FUEL – Check that there is petrol in the tank (the low level warning lamp may be broken), check that there are no traces of water or other polluting liquid in the petrol and ensure that there is no dirt inside the fuel tank	OK ▶ ~~OK~~ ▶	Proceed to phase H2 Clean the tank if necessary. Fill the system with the specified fuel type
H2 CHECK SPARK PLUGS – Check that: • the spark plugs are not dirty and do not show traces of burning • the spark plugs discharge normally: remove the cover, connect it to earth and check the plug	OK ▶ ~~OK~~ ▶	Proceed to phase H3 Clean or replace the faulty spark plugs
H3 CHECK HIGH VOLTAGE AND EARTH CABLES – Check: • that the high voltage cables (from the ignition coils to the spark plugs) are not damaged • that there is no electrical resistance preventing dissipation • that the earth braids are correctly tightened and are not oxidized	OK ▶ ~~OK~~ ▶	Proceed to phase H4 Replace the high voltage cables or the earth braids. Correctly tighten the braids

(CONTINUES)

THE ENGINE RUNS IRREGULARLY	TEST H

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
H4 CHECK ALTERNATOR – Check that the alternator is working correctly and in particular the voltage regulator. The alternator must not be overloaded. See ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase H5 Replace the voltage regulator or alternator if faulty
H5 CHECK FOR LEAKAGE OF AIR – Check: • that air is not escaping from the circuit. Cover the connections along the pipes downstream of the air-flow meter with soap solution. With the engine at idle speed check that the solution is not sucked in by the engine • the correct air flow: see GROUP 04 - CHECKING THROTTLE VALVE CALIBRATION	OK ▶ ~~OK~~ ▶	Proceed to phase H6 Replace the faulty components
H6 CHECK AIR-FLOW METER – Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK ▶ ~~OK~~ ▶	Proceed to phase H7 Replace (or clean) the meter
H7 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to phase H8 Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts

(CONTINUES)

THE ENGINE RUNS IRREGULARLY — TEST H

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
H8 CHECK CYLINDER COMPRESSION		
– Check cylinder compression - see GROUP 00 - CHECKING CYLINDER COMPRESSION	OK ▶	Proceed to **phase H9**
	~~OK~~ ▶	Restore the cylinders to the correct compression
H9 CHECK CRANKSHAFT PULLEY		
– Check that the crankshaft pulley is tightened to the correct torque - see GROUP 01 (An incorrect torque will cause the r.p.m. and timing sensor to malfunction)	OK ▶	Proceed to **phase H10**
	~~OK~~ ▶	Tighten to the correct torque
H10 CHECK CONTROL UNIT		
– Check that the.MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)	~~OK~~ ▶	Replace the control unit

End of test H

THE ENGINE STUMBLES — TEST I

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
I1 CHECK AIR-FLOW METER		
– Check that the air-flow meter is working correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶	Proceed to **phase I2**
	~~OK~~ ▶	Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
I2 CHECK THROTTLE VALVE POTENTIOMETER		
– Check that the throttle valve potentiometer is working correctly - see GROUP 04 - CHECKING FUNCTIONING OF THROTTLE VALVE POTENTIOMETER	OK ▶	Proceed to **phase I3**
	~~OK~~ ▶	Replace the potentiometer
I3 CHECK FOR AIR LEAKAGE		
– Check: • that air is not escaping from the circuit. Cover the connections along the pipes downstream of the air-flow meter with soap solution. With the engine at idle speed check that the solution is not sucked in by the engine	OK ▶	Proceed to **phase I4**
	~~OK~~ ▶	Replace the faulty components

(CONTINUES)

THE ENGINE STUMBLES — TEST I

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
I4 CHECK HIGH VOLTAGE AND EARTH CABLES – Check: • that the high voltage cables (from the ignition coils to the spark plugs) are not damaged • that there is no electrical resistance preventing dissipation • that the earth braids are correctly tightened and are not oxidized	OK ▶ ~~OK~~ ▶	Proceed to phase I5 Replace the high voltage or earth cables. Correctly tighten the earth braids
I5 CHECK ACCELERATOR CABLE – Check that the accelerator cable runs freely and check play - see GROUP 04 - ACCELERATOR CABLE ADJUSTMENT	OK ▶ ~~OK~~ ▶	Proceed to phase I6 Adjust the cable
I6 CHECK CONTROL UNIT – Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit) as full load air enrichment could be faulty	~~OK~~ ▶	Replace the control unit

End of test I

THE ENGINE DOES NOT REACH MAXIMUM PERFORMANCE — TEST J

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
J1 CHECK AIR-FLOW METER – Check that the air-flow meter functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase J2 Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
J2 CHECK THROTTLE VALVE POTENTIOMETER – Check that the throttle valve potentiometer is working correctly - see GROUP 04 - CHECKING FUNCTIONING OF THROTTLE VALVE POTENTIOMETER	OK ▶ ~~OK~~ ▶	Proceed to phase J3 Replace the potentiometer
J3 CHECK AIR-FLOW METER – Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK ▶ ~~OK~~ ▶	Proceed to phase J4 Replace or clean the meter
J4 CHECK ELECTROINJECTORS – It is possible to feel the needles when the injectors are touched. Check the resistance of the injectors.	OK ▶ ~~OK~~ ▶	Proceed to phase J5 Replace the electroinjectors

(CONTINUES)

THE ENGINE DOES NOT REACH MAXIMUM PERFORMACE	TEST J

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
J5 CHECK SPARK PLUGS – Check: • that the spark plugs are not dirty and do not show signs of burning • the spark plugs discharge normally: remove the cap, connect to earth and check the plug	OK ▶ ~~OK~~ ▶	Proceed to **phase J6** Clean or replace the faulty spark plugs
J6 CHECK HIGH VOLTAGE AND EARTH CABLES – Check: • that the high voltage cables (from the ignition coils to the spark plugs) are not damaged • that there is no electrical resistance preventing dissipation • that the earth br.. s are correctly tightened and are not oxidized	OK ▶ ~~OK~~ ▶	Proceed to **phase J7** Replace the high voltage or earth cables. Correctly tighten the braids
J7 CHECK THROTTLE VALVE – Check that the throttle valve moves freely without bending or irregularity: The furthest point to which it must open should be the stop limit – Check for correct play on control shaft - see GROUP 04 - THROTTLE VALVE BODY - THROTTLE VALVE POTENTIOMETER	OK ▶ ~~OK~~ ▶	Proceed to **phase J8** Replace the throttle valve

(CONTINUES)

THE ENGINE DOES NOT REACH MAXIMUM PERFORMANCE	TEST J

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
J8 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to **phase J9** Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
J9 CHECK VALVE CLEARANCE – Check the valve clearance - see GROUP 01 - CHECKING AND ADJUSTMENT OF VALVE CLEARANCE (and also GROUP 00)	OK ▶ ~~OK~~ ▶	Proceed to **phase J10** Adjust valve clearance
J10 CHECK CYLINDER COMPRESSION – Check cylinder compression - see GROUP 00 - CHECKING CYLINDER COMPRESSION	OK ▶ ~~OK~~ ▶	Proceed to **phase J11** Restore the cylinders to the correct compression
J11 CHECK CONTROL UNIT – Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)	~~OK~~ ▶	Replace the control unit

End of test J

EXCESSIVE FUEL CONSUMPTION	TEST K

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
K1 CHECK TYRES – Check the pressure and degree of wear of the tyres (see GROUP 28)	OK ▶ ~~OK~~ ▶	Proceed to phase K2 Inflate or replace the tyres
K2 CHECK AIR CLEANER – Check that the filter element is clean (see GROUP 04 - AIR CLEANER)	OK ▶ ~~OK~~ ▶	Proceed to phase K3 Replace the filter
K3 CHECK THROTTLE VALVE POTENTIOMETER – Check that the throttle valve potentiometer functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase K6 Follow the procedure described in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual

(CONTINUES)

EXCESSIVE FUEL CONSUMPTION	TEST K

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
K4 CHECK AIR-FLOW METER – Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK ▶ ~~OK~~ ▶	Proceed to phase K5 Replace or clean the meter
K5 CHECK ELECTROINJECTORS – It is possible to feel the needles move when the injector is touched. Check the resistance of the injectors	OK ▶ ~~OK~~ ▶	Proceed to phase K6 Replace the faulty electroinjectors
K6 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to phase K7 Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
K7 CHECK CONTROL UNIT – Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)	~~OK~~ ▶	Replace the control unit

End of test K

HIGH PERCENTAGE OF EXHAUST CO AND HC	TEST L

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
L1 CHECK AIR CLEANER – Check that the filter element is clean (see GROUP 04 - AIR CLEANER)	OK ▶ ~~OK~~ ▶	Proceed to **phase L2** Replace the filter
L2 CHECK LAMBDA PROBE – Check that the lambda probe functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to **phase L3** Follow the procedure described in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
L3 CHECK AIR-FLOW METER – Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK ▶ ~~OK~~ ▶	Proceed to **phase L4** Replace or clean the meter
L4 CHECK CATALYTIC CONVERTER – Check that the catalytic converter functions correctly. Take samples of exhaust fumes from downstream of the catalyzer and analyze them. The correct functioning of the catalyzer is indicated by a decrease in the CO and HC levels (see GROUP 04 - CATALYTIC CONVERTER)	OK ▶ ~~OK~~ ▶	Proceed to **phase L5** Replace the catalytic converter

(CONTINUES)

HIGH PERCENTAGE OF EXHAUST CO AND HC	TEST L

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
L5 CHECK ELECTROINJECTORS – Check: • operation of the electroinjectors: it is possible to feel the movement of the needles when the injectors are touched • resistance of the electroinjectors • the sealing of the injectors: fuel leaks are not permitted	OK ▶ ~~OK~~ ▶	Proceed to phase L6 Replace the faulty electroinjectors
L6 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to phase L7 Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
L7 CHECK CONTROL UNIT – Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit) as the CO control logic could be faulty	~~OK~~ ▶	Replace the control unit

End of test L

LOW PERCENTAGE OF EXHAUST CO	TEST M

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
M1 CHECK AIR-FLOW METER – Check that the air-flow meter functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK ▶ ~~OK~~ ▶	Proceed to phase K6 Follow the procedure described in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
M2 CHECK AIR-FLOW METER – Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK ▶ ~~OK~~ ▶	Proceed to **phase M3** Replace or clean the meter
M3 CHECK ELECTROINJECTORS – It is possible to feel the movement of the needles when the injectors are touched. Check the resistance of the injectors	OK ▶ ~~OK~~ ▶	Proceed to phase M4 Replace the faulty electroinjectors

(CONTINUES)

LOW PERCENTAGE OF EXHAUST CO	TEST M

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
M4 CHECK FOR AIR LEAKAGE – Check: • that air is not escaping from the circuit. Cover the connections along the pipes downstream of the air-flow meter with soap solution. With the engine at idle speed check that the solution is not sucked in by the engine • To set the flow correctly see GROUP 04 - CHECKING THROTTLE VALVE CALIBRATION	OK ▶ ~~OK~~ ▶	Proceed to **phase M5** Replace the faulty components
M5 CHECK FUEL PRESSURE – Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK ▶ ~~OK~~ ▶	Proceed to **phase M6** Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
M6 CHECK CONTROL UNIT – Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit) as the CO control function could be faulty	~~OK~~ ▶	Replace the control unit

End of test M

GROUP 05

ENGINE IGNITION, STARTING AND CHARGING

INDEX

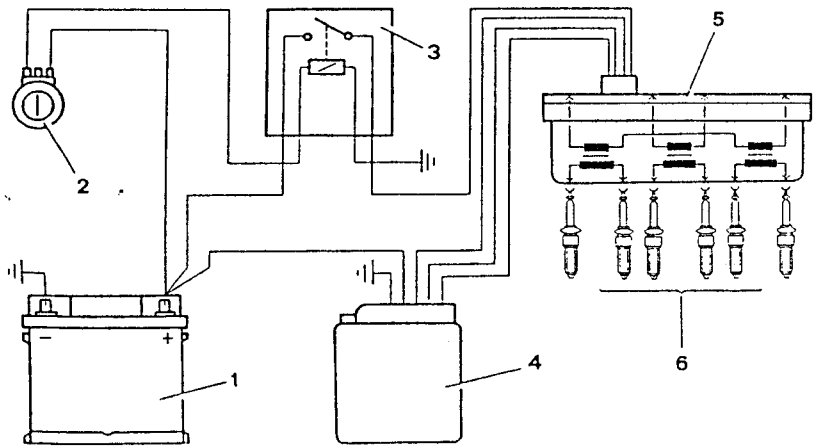
ILLUSTRATED INDEX

IGNITION SYSTEM

The ignition system, of the static type, is integrated with the injection system within the MOTRONIC system.
Static ignition does not require a distributor to supply the high volatge to the spark plugs but employs three coils each of which controls two spark plugs (lost spark static distribution system)
The most important advantages are:

- greater sparking power
- reliability
- reduction in radio disturbance
- small size

The control unit recognizes the angular position and the speed of the crankshaft through the r.p.m. and timing sensor.
Processing the signal relative to the temperature and engine loading, it calculates the ignition advance and pilots the relative coil by way of the power modules within the control unit.
This solution exploits the different environmental and pressure conditions existing simultaneously in the three pairs of cylinders 1-5, 2-6, 3-4.
When one of the cylinders nears the firing stage in the presence of air-fuel mixture, the corresponding cylinder is at the end of the exhaust phase in the presence of exhaust gas.
Examining the voltage necessary to strike the arch between the electrodes of the spark plugs, it can be noted that in a cylinder during compression this voltage is elevated (around 10 kV), while the voltage during the exhaust phase is greatly reduced (around 500 V).
At the moment in which the Motronic control unit releases control from one of the power phases, the flow of electricity in the main circuit of the relevant coil is interrupted, generating by induction, an increase in voltage on the secondary circuit (up to 30 kV empty).
During the increase in high voltage, one side of the secondary circuit of the coil is closed towards earth by the lost spark which, with a charge of approximately 500 V, strikes the spark plug located in the cylinder during the exhaust phase.
This permits a voltage increase on the spark plug connected to the other side of the secondary circuit, which is in contact with the mixture present in the cylinder, and provokes combustion.

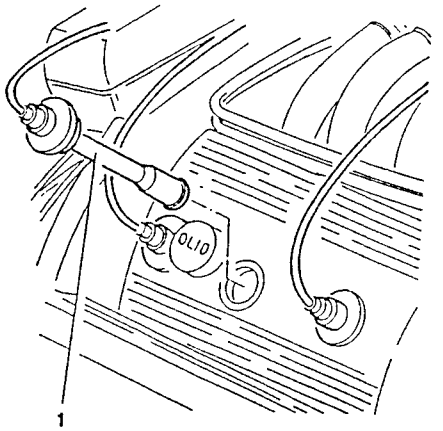


1. *Battery*
2. *Ignition block*
3. *Key operated service relay*
4. *MOTRONIC M1.7 control unit*
5. *Ignition coil*
6. *Spark plugs*

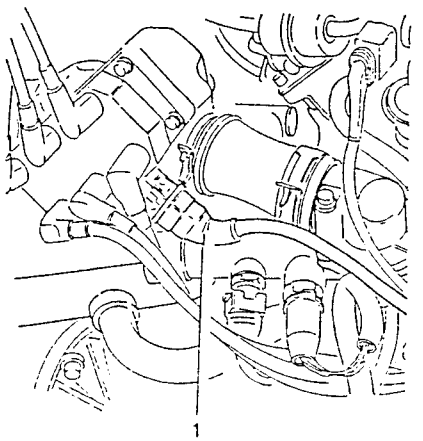
IGNITION COIL

REMOVAL/REFITTING

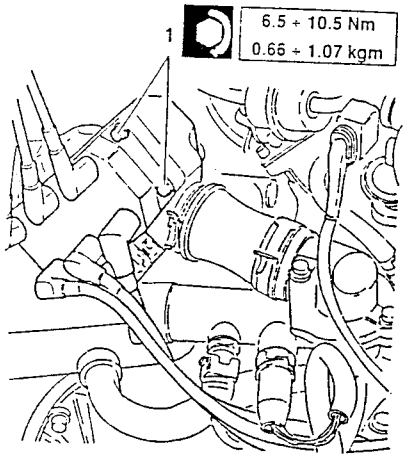
– Disconnect the negative cable from the battery.
1. Disconnect the high voltage cables from the spark plugs.



1. Disconnect the electrical connection from the ignition coil.

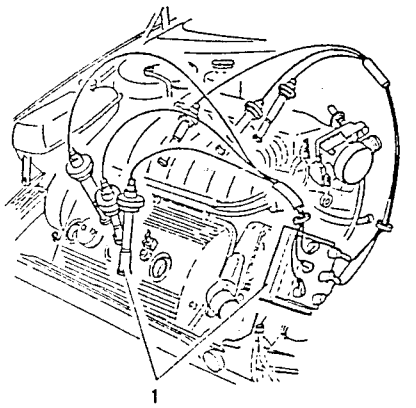


1. Unscrew the screws securing the ignition coil to its support.



1. Remove the ignition coil together with the spark plug cables.

– If necessary separate the spark plug cables from the ignition coil on a bench.



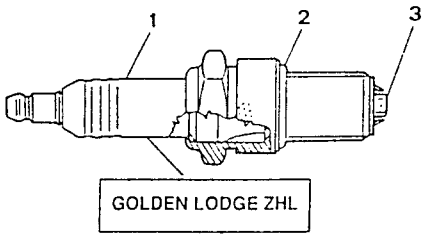
SPARK PLUGS

CAUTION
Do not use spark plugs of a type or size different from those specified as this may cause damage to the engine and alter the level of toxic exhaust fumes.
A dirty or burnt out spark plug is often symptomatic of a malfunction in the engine's supply system.
For example:
- **Traces of carbon powder: incorrect mixture, air cleaner very dirty;**
- **Oil stains: infiltration of oil from the piston rings;**
- **Ash formation: presence of aluminium material especially in oil;**
- **Melted electrodes: overheating due to unsuitable combustion, valve defects;**
- **Fast wearing electrodes: damaging additives present in the fuel or oil, pinging, overheating;**
- **Etc.**

For greater detail regarding these problems refer to the fault diagnosis contained in GROUPS 01 and 04.

The spark plugs installed on the vehicle are of the surface discharge type with four peripheral points and a central electrode.
The distance between electrodes does not need to be adjusted on this type of spark plug.

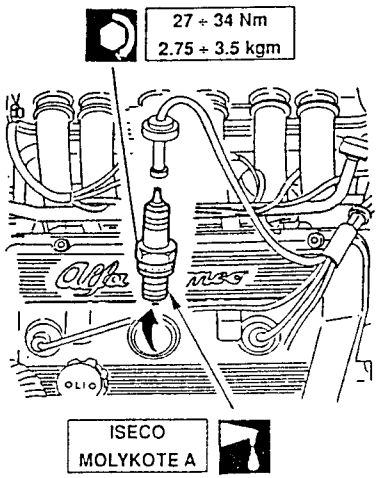
Firing order	1 - 4 - 2 - 5 - 3 - 6



1. *Ceramic*
2. *Gasket*
3. *Electrode*

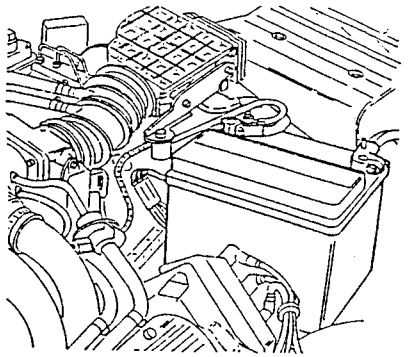
MAINTENANCE

Periodically check to see if the electrode is dirty.
Also check to see if it is worn or the ceramic insulation broken.
Replace the spark plug if these faults are detected.
When refitting, lubricate the threads using the specified oil and tighten to the correct torque.



BATTERY

The battery is located in the left-hand part of the engine compartment.

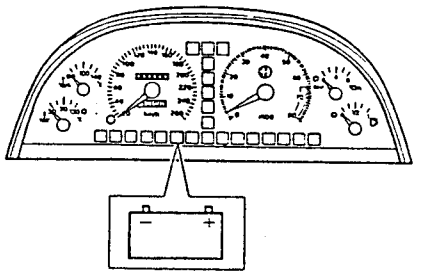


It has been designed following criteria which permit the engine to be started in the shortest possible time.
Towards this aim a high torque and a fixed number of minimum revolutions are necessary. This is guaranteed by the optimal size of the 6 elements contained within the battery each of which emits approximately 2 V (12V in total).
The battery adopted does not require maintenance.
It is on the whole similar to a normal battery, it maintains its charge longer and also contains diluted sulphuric acid, for this reason it is necessary to keep it in the upright position even when it is not installed on the vehicle. The body of the battery is equipped with small ventilation holes so that the build up of gasses inside the battery during charging is kept to a minimum. Due to the reduction in the volume of gas produced there is no corrosion and good contact at the terminals is ensured.

The advantages of this battery are:
- reduced consumption of water due to the new type of alloy used in the manufacture of the grills and plates for which reason it is not necessary to periodically top-up the battery;
- exceptional suitability to long term storage (up to seven months at temperatures below 28°C) due to its excellent starting capacity, a result of reduced discharging.

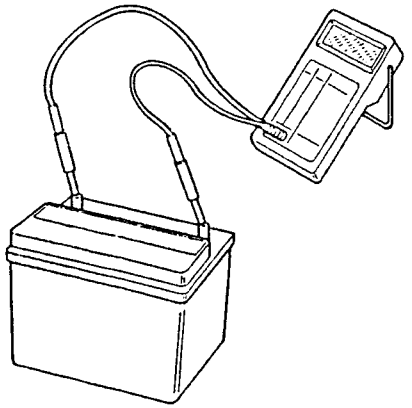
CHARGING

When the vehicle is travelling the alternator recharges the battery. Whenever the charge is insufficient or or the connection between the the alternator and battery is interrupted, a warning lamp located on the instrument panel comes on to signal the malfunction.



If the battery appears to be flat, check the charge by measuring the volatge across the disconnected terminals using a voltmeter.

If the voltage is lower than 12.30 V it is only half charged, if it reaches 12.48 V it is three-quarters charged and at 12.66 V it is fully charged.



CAUTION
If the electrolyte level in one of the cells of the battery should fall below the mimimum level notch on the side of the plastic container, carefully open the cap cover and add de-ionized distilled water as with ordinary batteries.

NOTE: **Do not recharge the battery at a voltage of above 15.5 V with a strong flow of current. Use instead a normal 12 V battery charger connecting the positive cable (red) to the (+) terminal of the battery and the negative cable (black) to the (-) terminal of the battery.**
In case the battery of the vehicle is connected temporarily to an external battery connect the positive terminal to the positive terminal and the negative terminal to the negative.

CAUTION
- Do not connect or disconnect the battery to or from the electrical system of the vehicle when the engine is running.
- Do not invert the terminal connections (even for a few moments) as this would damage the alternator rectifyer.
- When connecting the battery charger to the battery, first establish the connections and then start the charger.
- If it becomes necessary to start the engine with temporary cables and with an auxillary battery, the voltage of the external battery must not exceed 12 V.
- Before charging the battery it is necessary to remove the clamp from the negative terminal.
- When recharging check that the temperature of the electrolyte does not exceed 45°C.

CAUTION
- Do not touch the negative and positive termanals at the same time.
- Keep all naked flames away from the vehicle during recharging of the battery.

When replacing the battery follow the directions for use. If the charge of the replacement battery is potentially higher than the old one the higher voltage could cause the fusion of the starter motor induction coil or damage the pinion or crown.

MAINTENANCE

The capacity of the battery to start the engine depends on the charge within it and it is therefore necessary to regularly check it and to carry out any maintenance operations required, especially during the winter when the battery may be affected due to both the greater loading required by the starter motor and the reduced battery capacity at low temperatures.
Clean the surfaces of the battery, the terminals and clamps with a solution of water and sodium bicarbonate. Before reconnecting the clamps cover them with a layer of grease.

CAUTION
Do not let any of the fluid used for cleaning to enter the battery as it will react with the electrolyte.

CAUTION
The electrolyte fluid is an acid and therefore dangerous for eyes, hands and clothes.

NOTE: **Batteries stored in a warehouse or istalled on a vehicle but unused for long periods will slowly lose their charge so it will be necessary to recharge them before use.**

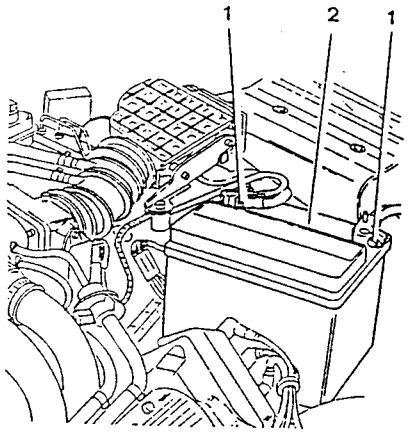
REMOVAL/REFITTING

1. Unscrew the screw securing the clamps to the terminals of the battery and disconnect the negative (-) cable first and then the positive (+) cable.

CAUTION
When disconnecting the cables from the battery ensure that the engine is not running as this would damage the alternator.

2. Remove the battery ensuring that it is kept in an upright position.

– When refitting reverse the procedure and clean and grease the clamps and terminals of the battery.

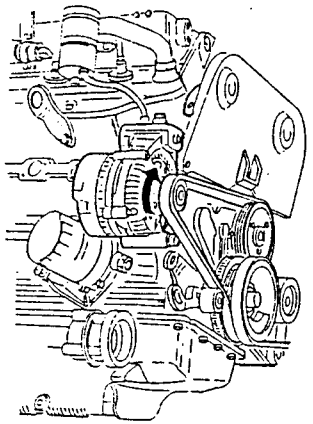


CHECKS AND INSPECTIONS

Check that the electrolyte container is not cracked and that the level of the electrolyte covers the electrodes by approximately 5 mm. Also check that the upper surface of the battery is clean and that the contacts are not oxidized.
Check that the cable clamps are well tightened onto the terminals so that an efficient contact is established.

ALTERNATOR

The alternator provides electrical energy to the electronic control units and the varoious vehicle functions when the engine is running.
It also supplies current to the accumulator (battery) in order for it to be able to supply current when the engine is stationary.



The electrical current is generated by a rotor which "cuts" a magnetic field generated by a fixed coil (stator).
The rotor is integrated with a pulley which is directly actuated by the crankshaft by way of a belt.
The contact brushes supply the rotor with the excitation current.
The alternating voltage generated by the alternator and rectifyer is regulated by diodes and by the voltage regulator located on the body of the alternator.
The electronic voltage regulator used is wear free and small in size and guarantees that a constant voltage is supplied to all the fields of operation of the engine whatever the difference in loading and r.p.m..
A cooling fan turns together with the pulley and enables the alternator to avoid reaching dangerous temperatures which would affect its operation.

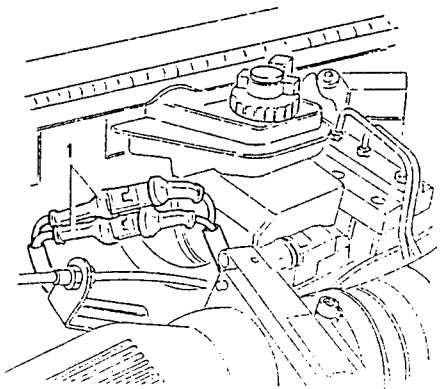
The alternator installed on the vehicle is of the claw terminal type with collecting rings: it is light and compact. It is fixed to the engine by brackets of which the lower is isolated to facilitate tensioning of the drive belt (see GROUP 00).

CAUTION
The fan will correctly cool the alternator if it turns in a certain direction:
CORRECT ROTATION OF THE ALTERNATOR: CLOCKWISE (SEEN FROM PULLEY SIDE).

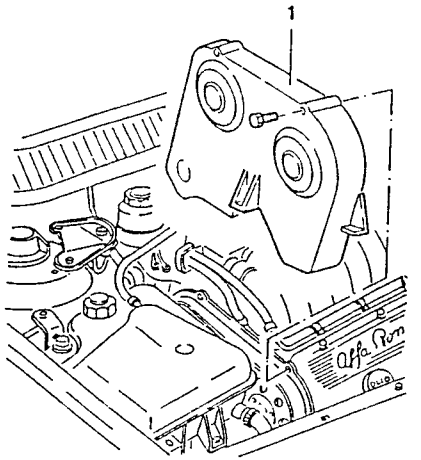
REMOVAL/REFITTING

- Place the vehicle on a lift.
- Disconnect the negative cable from the battery.

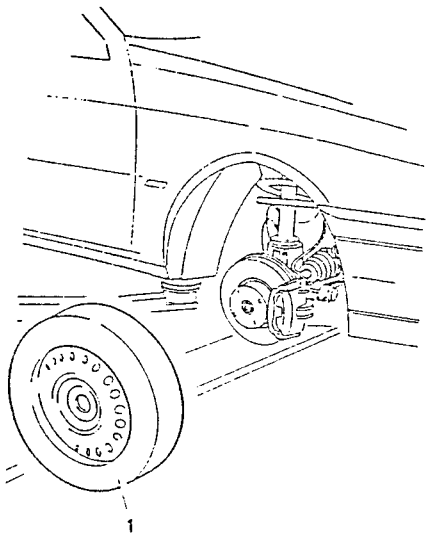
1. Disconnect the electrical connections from the lambda probe.



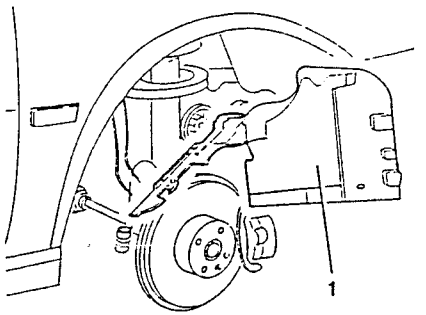
1. Remove the front cover from the timing belt.



1. Remove the front wheels.

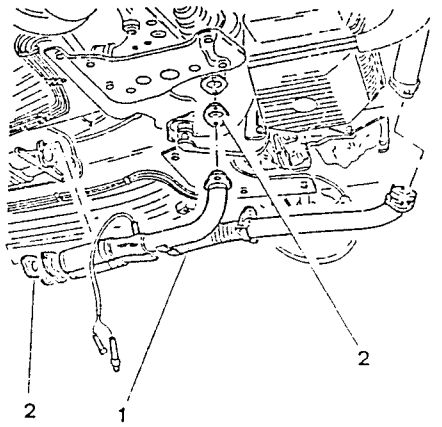


1. Remove the dust cover from the front right-hand wheel housing.

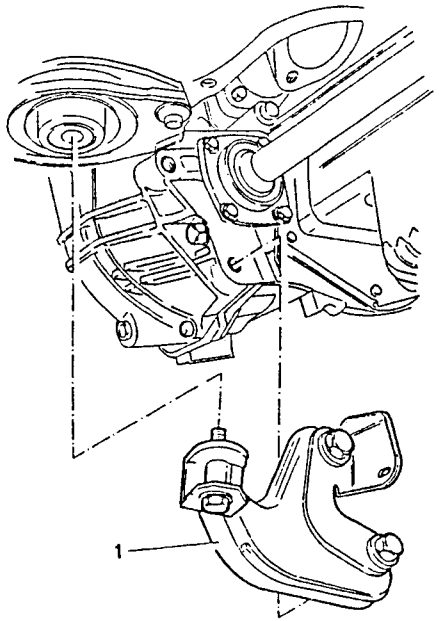


- Raise the vhicle.

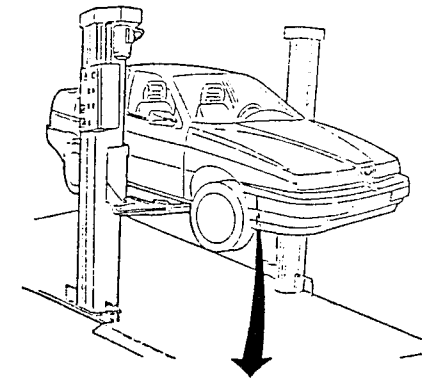
1. Remove the forward section of the exhaust pipe.
2. Remove the gaskets.

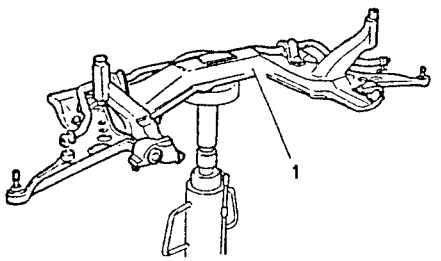


1. Remove the rear engine support.

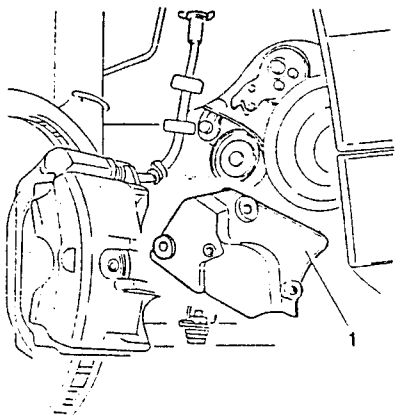


1. Remove the crossmember together with oscillating arms (see GROUP 21).

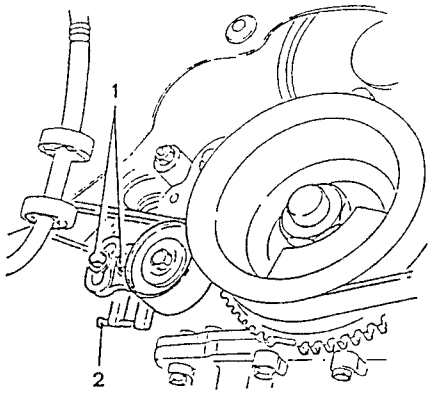




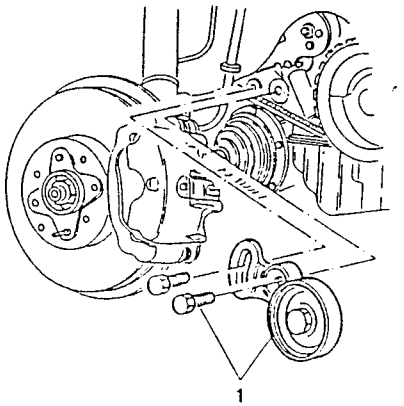
1. Remove the protective cover from the hydraulic belt tensioner.



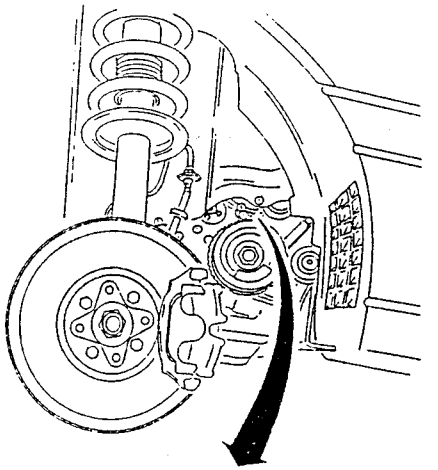
1. Loosen the two screws securing the water pump alternator drive belt tensioner guide pulley.
2. Act on the screw of the micrometeric tensioner in order to reduce the tension on the belt.

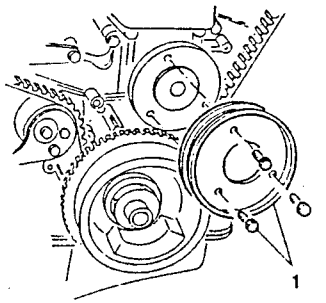


1. Completely unscrew the two screws and remove the guide pulley.

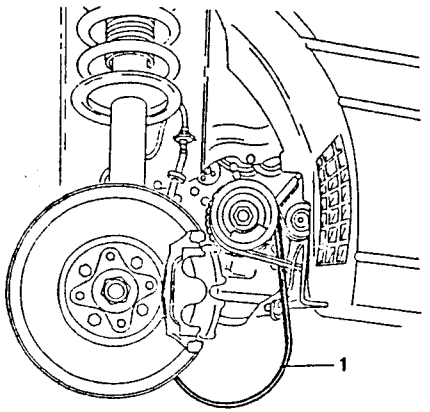


1. Unscrew the three screws and remove the water pump pulley.

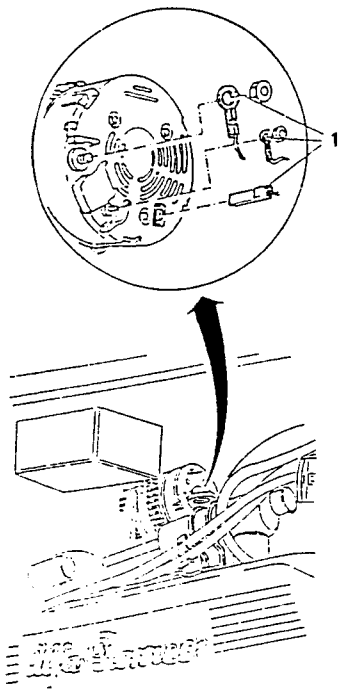




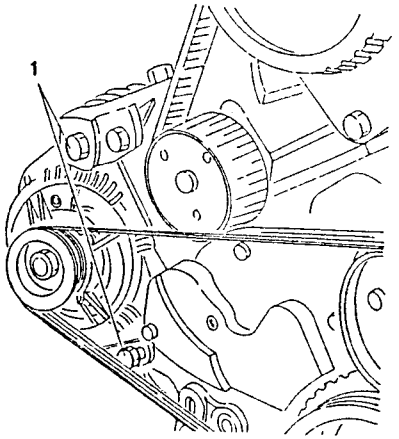
1. Withdraw the belt from the alternator without removing it from the crankshaft pulley.

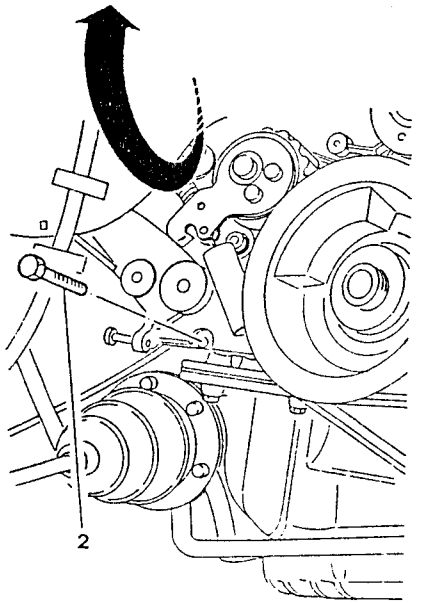


1. Disconnect the electrical connections from the alternator.

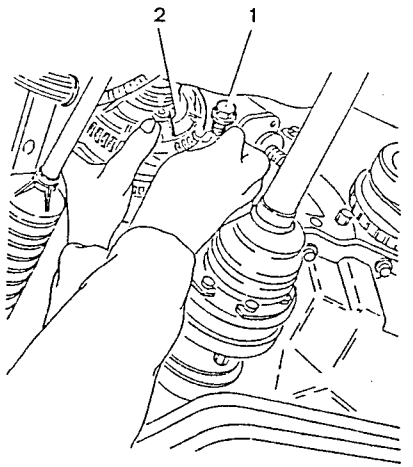


1. Loosen the two bolts securing the alternator, and remove only the upper one.
2. Unscrew the screw securing the bracket to the alternator support micrometric tensioner.





1. Bend the lower alternator support bracket without disconnecting it from the hydraulic belt tensioner. Withdraw the lower bolt securing the alternator.
2. Remove the alternator.



DISASSEMBLY/REASSEMBLY

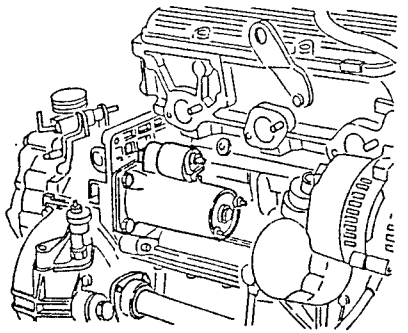
DUE FOR PUBLICATION

CHECKS AND INSPECTIONS

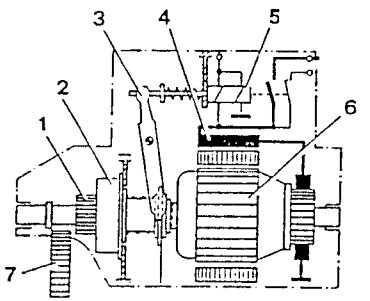
DUE FOR PUBLICATION

STARTER MOTOR

The starter motor, overcoming inertia and friction, cranks the engine to a set number of revolutions in order to begin the formation of the air-fuel mixture necessary for combustion and subsequent autonomous movement of the engine.



The movement is transmitted by a direct current electric motor powered by battery voltage through a drive pinion which rotates the ring gear on the engine flywheel.



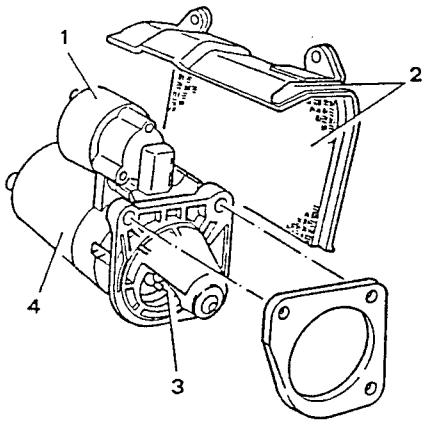
1. *Pinion*
2. *Roller type Freewheel*
3. *Coupling lever*
4. *Excitation coil*
5. *Relay*
6. *Induction*
7. *Ring gear flywheel*

Due to a free-wheel coupling the pinion disengages when the main engine unit rotates at a greater speed than the motor.

A relay, excited by the current from the motor, engages the pinion by way of a fork.

The starter motor installed on the vehicle is of the translating, screw pinion type with the relay loaceted directly above the starter motor.

The starter is fixed to the engine by a bracket and a metalic shield protects it from excessive heat

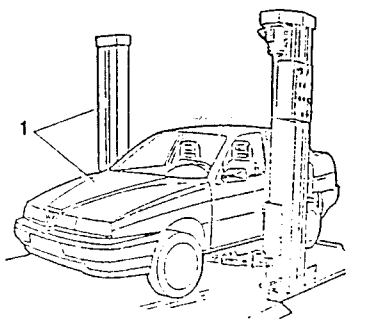


1. *Relay*
2. *Heat shielding*
3. *Pinion*
4. *Motor*

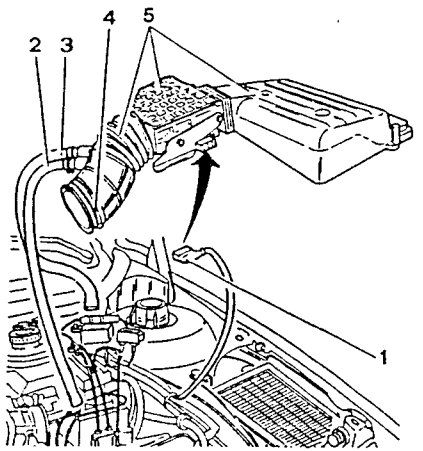
REMOVAL/REFITTING

1. Place the vehicle on a lift.

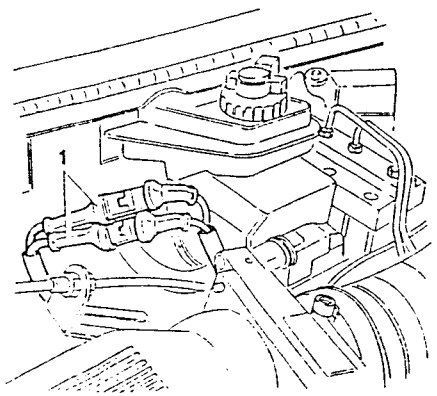
– Disconnect the negative cable from the battery.



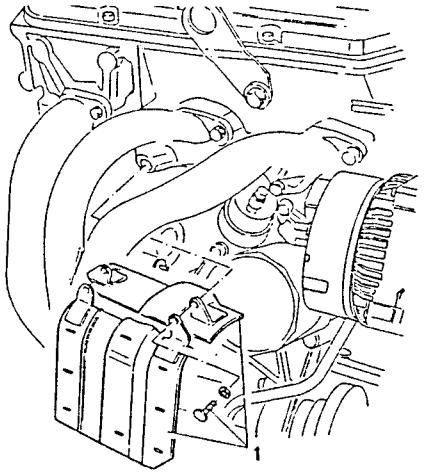
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect oil vapour recirculation pipe from the oil vapour separator.
3. Disconnect the air intake box intake hose from the constant idle speed actuator.
4. Slacken the clamp securing the corrugated sleeve to the air intake box.
5. Remove air cleaner cover, air flow meter and corrugated sleeve assembly.



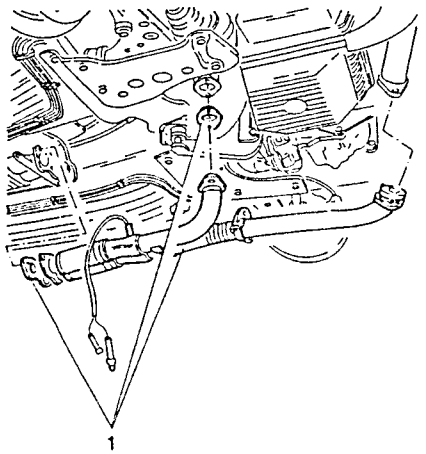
1. Disconnect the two electrical connections from the lambda probe.



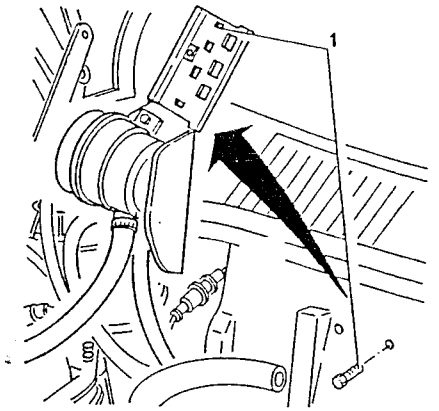
1. Operating from the engine compartment, unscrew the two screws securing the heat shielding of the starter motor.



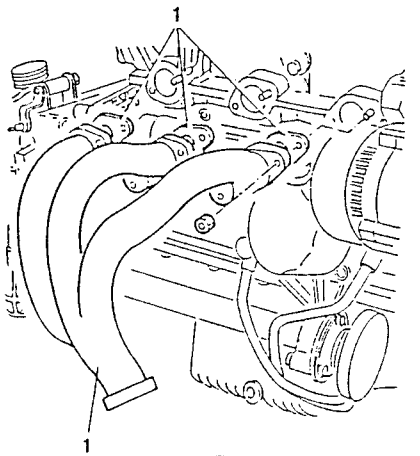
- Raise the vehicle.
1. Disconnect the forward section of the exhaust pipe and remove it together with the relative gaskets.



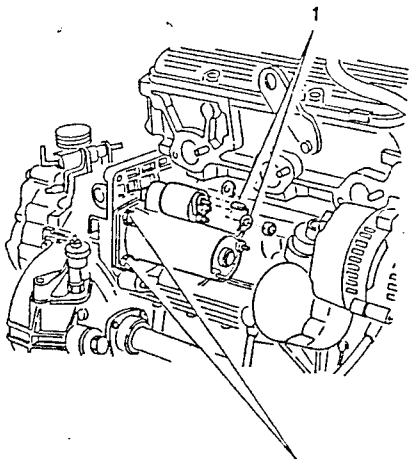
- Operating from beneath the vehicle remove the previously loosened heat shielding.
- Lower the vehicle.
- Remove the relay box plastic bracket protection.
1. Unscrew the screws securing the relay box bracket and power steering fluid reservoir support and move everything to one side after disconnecting the relay from the supporting bracket.



1. Remove the right-hand exhaust manifolds and the relative gaskets.



- Raise the vehicle.
1. Disconnect the electrical connections from the starter motor.
2. Unscrew the three screws securing the starter motor to the gearbox.
- Lower the vehicle and remove the starter motor through the engine compartment.



17.9 ÷ 22 Nm
1.8 ÷ 2.2 kgm

DISASSEMBLY/REASSSEMBLY

DUE FOR PUBLICATION

CHECKS AND INSPECTIONS

DUE FOR PUBLICATION

FAULT DIAGNOSIS AND CORRECTIVE INTERVENTIONS

For the fault diagnosis and corrective interventions refer to GROUP 04 which also deals with the components of the ignition system.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

BATTERY

Nominal output	12 V
Discharge voltage (at -18°C)	320 A
Capacity (20 hours)	60 Ah

ALTERNATOR

Nominal output		14 V
Power supply	Nominal output	80 A
	Minimum speed	1000 r.p.m.
	Speed at 40 A	~ 1600 r.p.m.
	Speed at nominal output	6000 r.p.m.

STARTER MOTOR

Nominal output		12 V
Nominal power		1.4 kW
Full load test	Voltage	9 V
	Current	≤ 350 A
	Speed	≥ 1500 r.p.m.
	Torque	8.5 Nm
Short circuit test	Voltage	4 V
	Current	≤ 750 A
	Torque	≥ 15 Nm
Flywheel overrunning torque		0.12 ÷ 0.18 Nm
Pinion teeth module		2.1167 mm

IGNITION COILS

Primary winding resistance	0.5 Ω
Secondary winding resistance	13.3 kΩ

SPARK PLUGS

Type	GOLDEN LODGE 2HL

FLUIDS AND LUBRICANTS

Application	Type	Name	Quantity
Battery leads	GREASE	Reinach E10 TAC	-
Spark plug threads	OIL	ISECO Molykote A	-

TIGHTENING TORQUES

PART	Nm	kgm
Spark plugs	27 ÷ 34	2.75 ÷ 3.5
Ignition coil retaining screws	6.5 ÷ 10.5	0.66 ÷ 1.07
Starter motor retaining screws	17.9 ÷ 22	1.8 ÷ 2.2

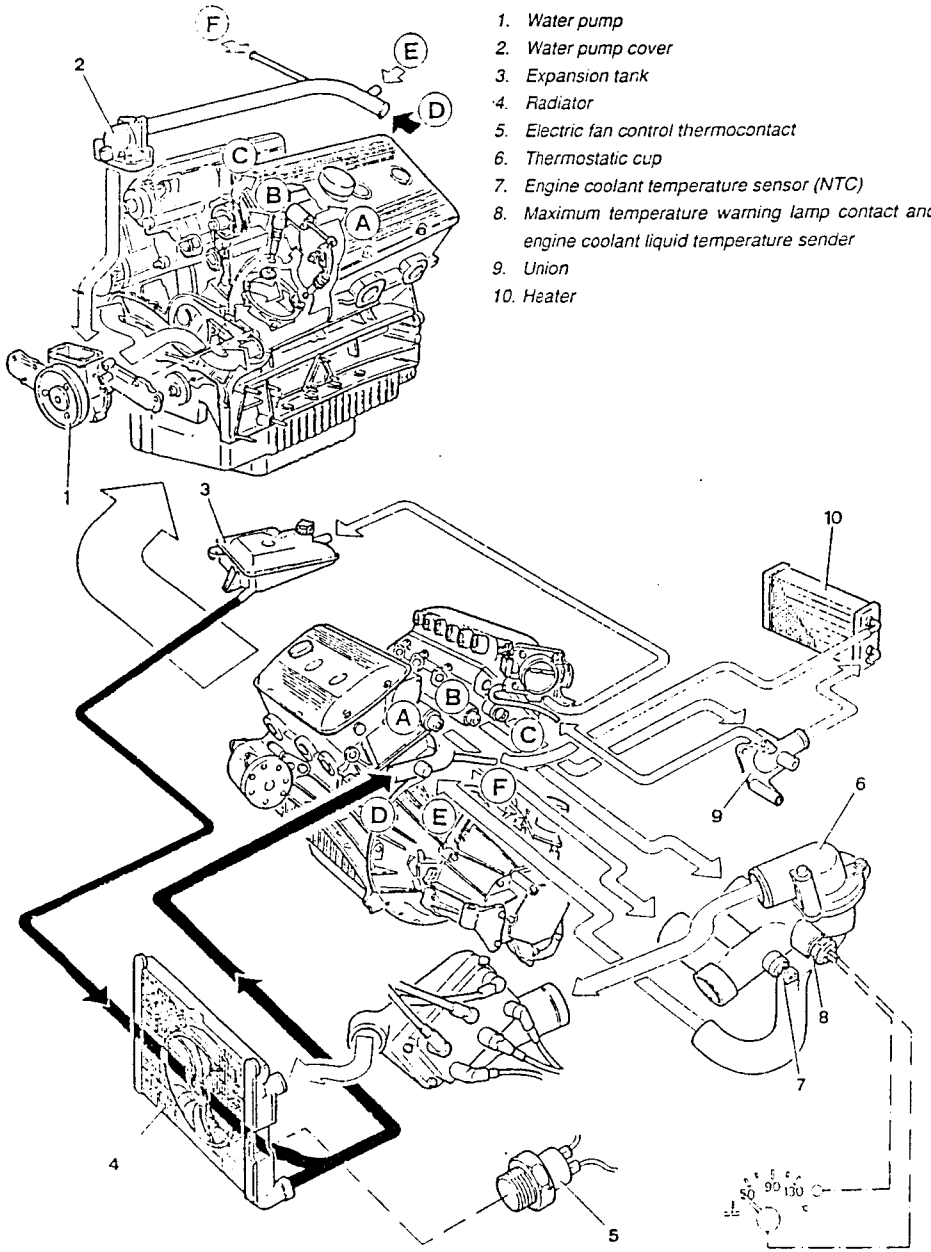
GROUP 07

ENGINE COOLING SYSTEM

INDEX

ILLUSTRATED INDEX

COOLING SYSTEM



1. *Water pump*
2. *Water pump cover*
3. *Expansion tank*
4. *Radiator*
5. *Electric fan control thermocontact*
6. *Thermostatic cup*
7. *Engine coolant temperature sensor (NTC)*
8. *Maximum temperature warning lamp contact and engine coolant liquid temperature sender*
9. *Union*
10. *Heater*

DESCRIPTION

The system is of the sealed type. The flow of coolant is forced by a centrifugal pump driven by the crankshaft through a V-type belt.

A thermostatic valve located on the rear side of the engine keeps the engine temperature at an optimum level. The thermostat opens when the coolant reaches a temperature of 87°C.

The radiator cools the liquid in the engine by dynamic air and by a two-speed cooling fan controlled by a thermal switch located on the radiator. An additional resistance and a relay select the higher fan speed if the temperature gets too high.

The expansion tank tops-up the cooling system if the coolant level falls and absorbs the changes in the volume of the coolant due to changes in temperature. The expansion tank also ensures that air is bled from the system. The cooling system also includes an engine coolant temperature sender for the indicator and a maximum temperature thermal switch for the warning lamp which comes on when the temperature of the liquid exceeds ~ 112°C.

SYSTEM OPERATION

After the liquid has cooled the engine it reaches the the thermostat group through the cylinder heads. If the temperature is below 87°C it is then directed to the pump through the engine coolant return longitudinal manifold located between the two cylinder heads. If the temperature is higher than this value, it is directed to the radiator through the opening in the thermostat.

After being cooled in the radiator, the coolant returns once again through the longitudinal manifold to the pump which channels it to the engine.

A union on the right-hand cylinder head receives the coolant through a supplementary channel and directs it to the heater by a main artery pipe.

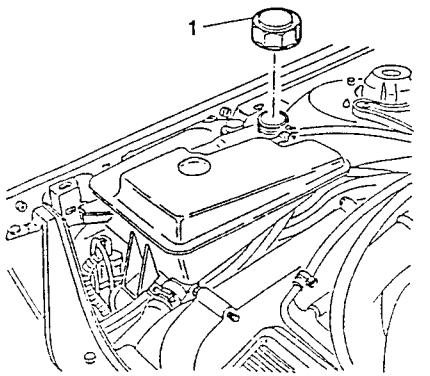
A secondary pipe branches off from here and passes through the throttle valve body in order to heat it. It also serves to bleed off any air in the system thorough the expansion tank.

CAUTION
The anti-freeze mixture is harmful to paintwork. All contact with painted surfaces should be avoided.

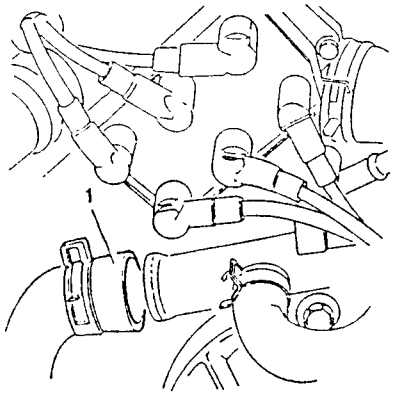
DRAINING THE HYDRAULIC SYSTEM

1. Unscrew and remove the cap from the expansion tank.

CAUTION
Never remove the cap from the expansion tank when the engine is warm!



1. Loosen the clamp securing the radiator outlet sleeve and disconnect the sleeve from the radiator. Drain off and collect the coolant in a suitable container placed under the vehicle.

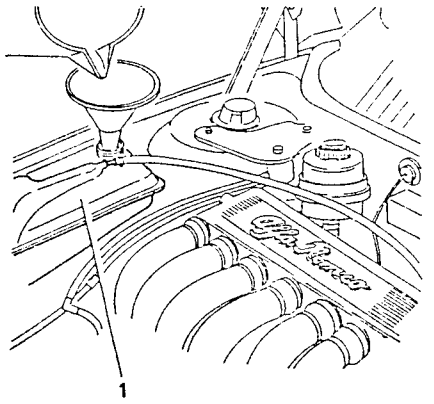


SERVICING THE HYDRAULIC SYSTEM

- Re-connect the sleeve to the radiator along with any other hoses which were previously disconnected. Check that all the clamps are correctly tightened.

1. Service until the level of the liquid reaches the MAX mark on the expansion tank.
   The quality and approximate quantity of the coolant are given in the table below:

Minumum temperature		-40°C
Concentrated antifreeze	Alfa Romeo Antifreeze	5.0 litres (55%)
Distilled water		4.2 litres (45%)
Antifreeze ready for use	Alfa Romeo Climafluid Permanent -40°C	9.2 litres



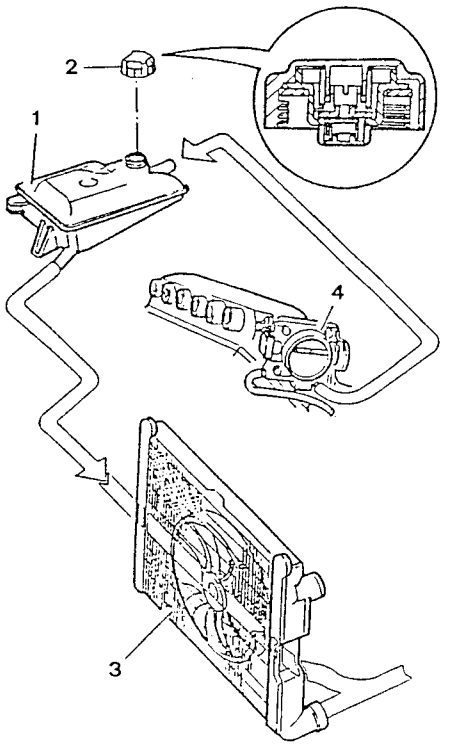
- Start the engine and run to normal operating temperature so that the opening of the thermostat will vent any air trapped in the circuit.
- When the engine is cold, top-up to the MAX level marked on the expansion tank.
- Screw on and tighten the expansion tank pressurized cap.

CAUTION

Do not mix different makes of antifreeze! Do not use rust-proofing additives as they may not be compatible with the antifreeze used in the system!

EXPANSION TANK

The expansion tank supplies the circuit and absorbs the variations in coolant volume due to the changes in engine temperature.
The tank also allows air, collected through the pipe coming from the throttle body, to bleed from the system by way of a calibrated valve in the pressurized cap.
This valve also acts as a washing function enabling outside air to enter the system to compensate for the vacuum created as the system cools.

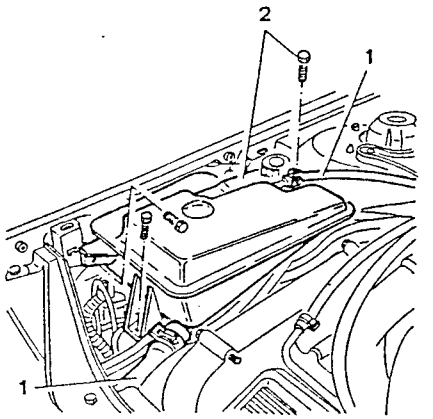


1. *Expansion tank*
2. *Pressure cap*
3. *Radiator*
4. *Throttle valve body*

REMOVAL/REFITTING

- Drain the engine cooling system (see relative paragraph).

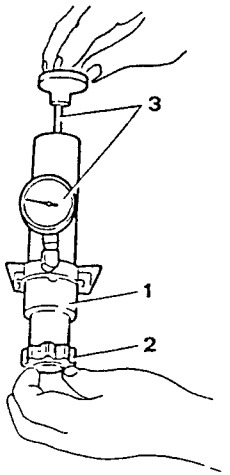
1. Loosen the two clamps and disconnect the coolant delivery and return hoses from the expansion tank.
2. Unscrew the three screws and remove the expansion tank.



PRESSURIZED CAP SEALING TEST

- Perform the test using a seal test tool.

1. Screw the fitting to the lower end of the test tool.
2. Install the expansion tank pressurized cap onto the fitting of the test tool.
3. Manually operate the piston of the test tool and pressurize the cap. Check that the valve opens at the specified pressure read from the manometer.

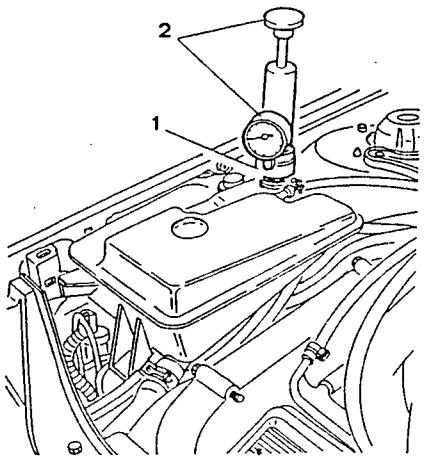


Pressurized cap setting
0.98 ± 0.1 bars (1 ± 0.1 kg/cm^2)

HYDRAULIC SYSTEM PROOF TEST

- Unscrew and remove the pressurized cap from the expansion tank.

1. Screw the hydraulic system proof testing tool and relevant fitting onto the expansion tank filler neck.
2. Manually pressurize the circuit and check that the pressure is maintained at the specified value. If the pressure is incorrect, check that there are no leaks in the radiator or sleeves.



Hydraulic system test pressure
1.08 bars (1.1 kg/cm^2)

CAUTION
For safety reasons never let the pressure rise above 1.38 bars (1.4 kg/cm^2) when testing with the testing tool.

WATER PUMP

The water pump is of the centrifugal blade type.
The pump body is made of aluminium alloy and the impeller of phenolic resin.
The pump is fixed to the engine block and actuated through a Poly-V drive belt by the crankshaft. A gasket seals the joint between the engine block and the pump.
The water pump operates constantly thus guaranteeing the continual circulation of the coolant.

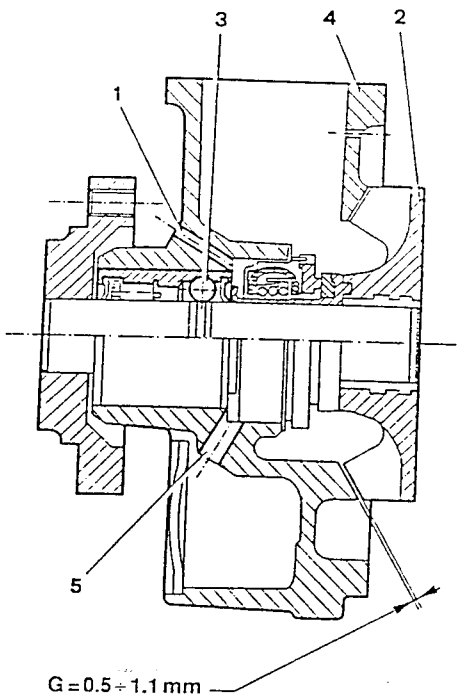
REMOVAL/REFITTING

- For the removal/refitting of the water pump refer to GROUP 01.

CHECKS AND INSPECTIONS

- Check that the pump body and impeller are in good condition and that there are no signs of oxidation or corrosion.
- Check that the clearance between the pump body and the impeller is within the prescribed limits.
- Check that the front gasket of the pump is in good condition and without leaks.
  NOTE: small leaks from the drainage hole of the pump are normal;
- check that the bearing does not show signs of wearing on the races, balls or rollers:

If any of these defects are detected, replace the entire pump.



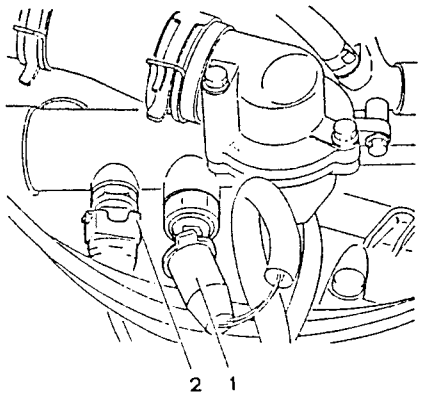
1. *Aeration hole*
2. *Impeller*
3. *Bearing*
4. *Pump body*
5. *Drainage hole*

THERMOSTAT UNIT

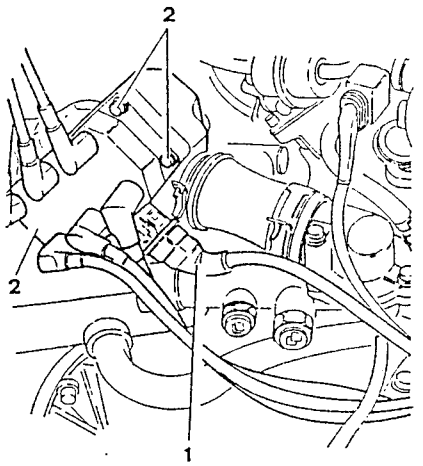
The thermostat unit is installed on the rear side of the cylinder heads.
It ensures that the engine does not exceed the optimal temperture. Until the temperature of the coolant reaches 87 ± 2°C, the thermostat valve deviates the liquid directly to the pump: at temperatures above this value the opening of the thermostat valve conveys the liquid to the radiator.
The thermostat is provided with a sensor (NTC) which measures the temperature of the coolant and sends it to the Motronic control unit, Also present is an engine coolant temperature sender and a maximum temperature warning lamp contact connected to the instrument panel.

REMOVAL/REFITTING

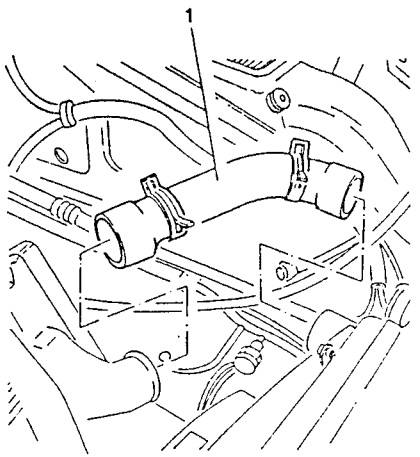
– Remove the battery.
1. Disconnect the electrical connection from the engine coolant temperature sender and maximum temperature warning lamp contact.
2. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).



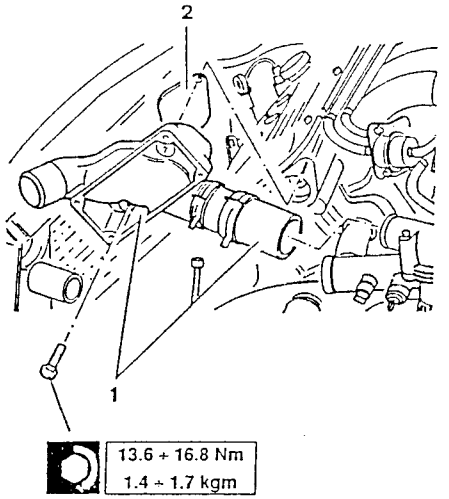
1. Disconnect the electrical connection supplying the ignition coil
2. Unscrew the four screws and remove the coil without disconnecting it from the spark plug cables and place it on the engine.



– Drain the engine coolant system (see relative paragraph).
1. Remove sleeve connecting the radiator and ignition coil support.

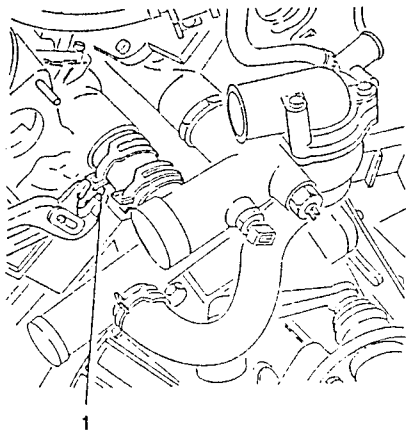


1. Remove the ignition coil support together with the sleeve connecting it to the thermostatic cup.
2. Remove the gasket.

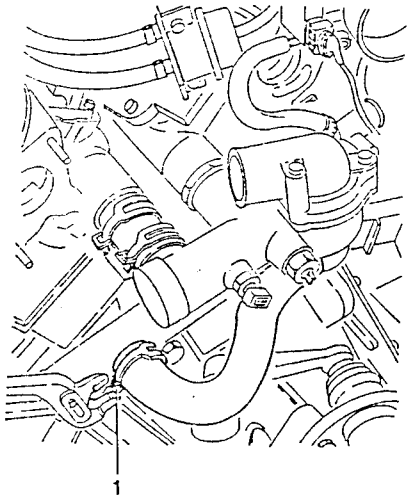


13.6 ÷ 16.8 Nm
1.4 ÷ 1.7 kgm

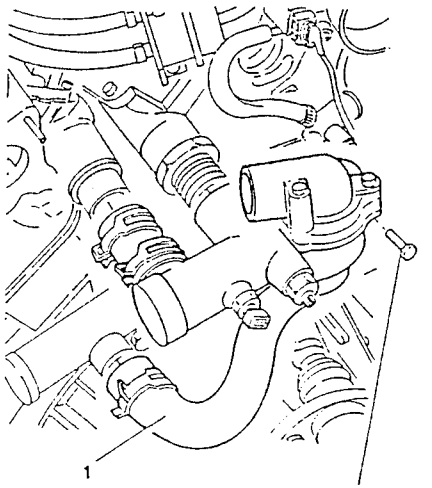
1. Disconnect the sleeve connecting the thermostatic cup and the left-hand cylinder head.



1. Disconnect the engine coolant to pump sleeve.



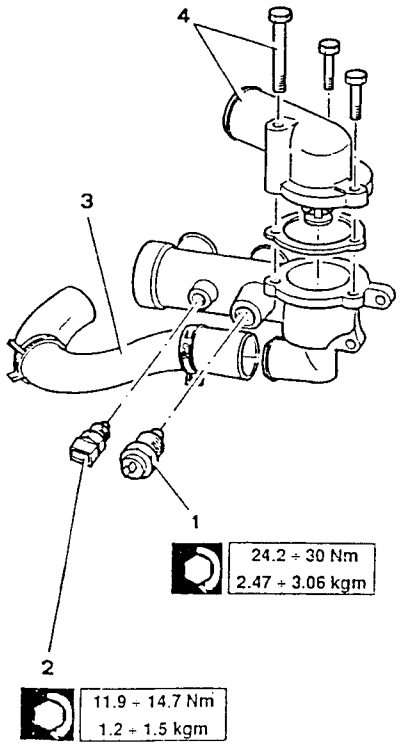
1. Remove the thermostatic unit complete with sleeves.



32.3 - 39.9 Nm
3.3 - 4.1 kgm

DISASSEMBLY/REASSEMBLY

1. Remove the engine coolant temperature indicator sender and the maximum temperature warning lamp contact.
2. Remove the engine coolant temperature sensor (NTC).
3. Remove the engine coolant to water pump delivery sleeve from the thermostat unit.
4. Unscrew the retaining screws and remove the cover complete with thermostat.



CHECKS AND INSPECTIONS

Check the setting of the thermostat by operating as follows:

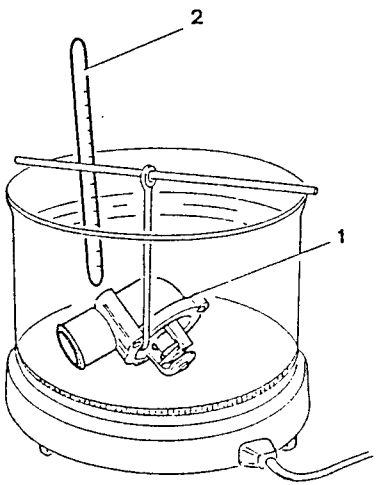
1. Hang the thermostat in a container full of water and heat the water.
2. Using a thermometer check that the temperatures at which opening is initiated and completed correspond to the values indicated in the table.

CAUTION
Neither the thermometer nor the thermostat must touch the bottom of the container.

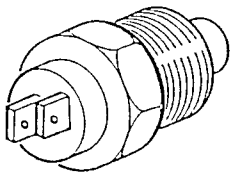
Also check that the total bulb travel is the same as that indicated in the table.

Thermostat setting	
Opening begins·	87 ± 2°C
Fully open	95° C
Total bulb travel	7.5 mm

If the correct values are not obtained replace the thermostat.



- Check the setting of the engine coolant temperature indicator sender and maximum temperature warning lamp contact. If the values are not correct replace the sender.



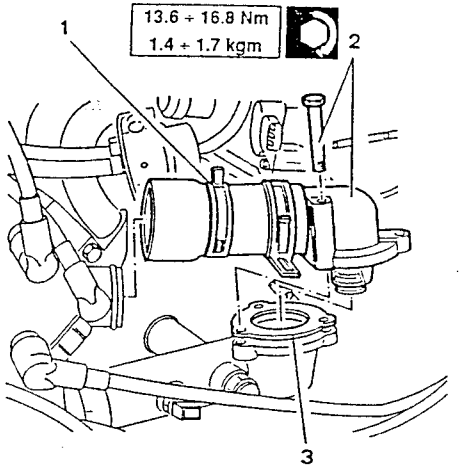
Temperature °C	Resistance of the thermistors Ω
40	900 to 1400
60	470 to 600
80	235 to 300
90	175 to 215
100	135 to 165
120	80 to 100

Closure temperature	115 ± 3°C
Reopening temperature	≥ 102°C

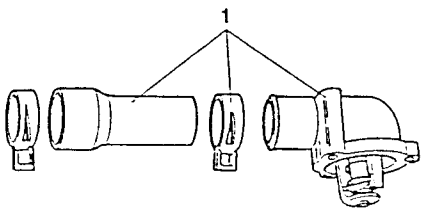
THERMOSTAT REPLACEMENT

- Disconnect the negative cable from the battery.
- Drain the engine cooling system (see relative paragraph).

1. Loosen the sleeve connecting the the thermostat unit to the ignition coil support - coil side.
2. Unscrew the three screws and remove the cover complete with thermostat and sleeve.
3. Remove the gasket.



1. On a bench, separate the cover complete with thermostat from the the sleeve.



RADIATOR

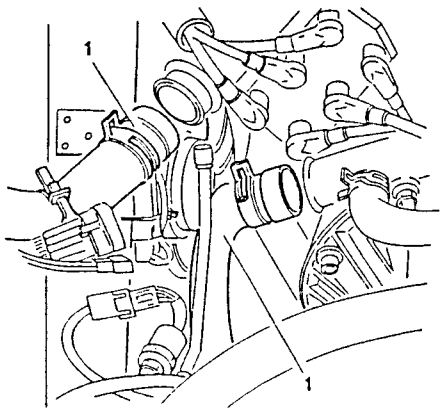
The size of the radiator is such that it can fulfull the requirements of heat dissipation during operation of the engine.
It is composed of a radiator core (radiating frontal surface 18.28 dm^2) and two side tanks provided with fittings for the inlet and outlet of the coolant. The pipes and fins of the radiating core are made of aluminium and the tanks of plastic.

REMOVAL/REFITTING

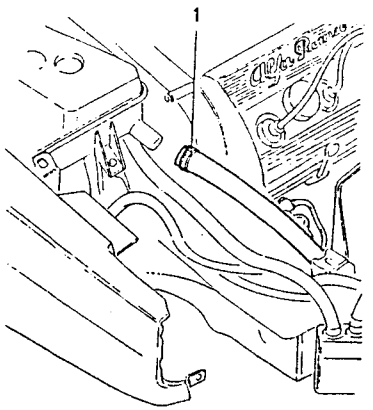
- Place the vehicle on a lift.
- Disconnect the negative cable from the battery.
- Drain off the air conditioning freon in accordance with the current regulations (see GROUP 80).
- Remove the front bumper (see GROUP 75).

1. Drain off the engine coolant by removing the cap from the expansion tank and disconnecting the two inlet and outlet sleeves from the radiator; collect the liquid in a suitable container.

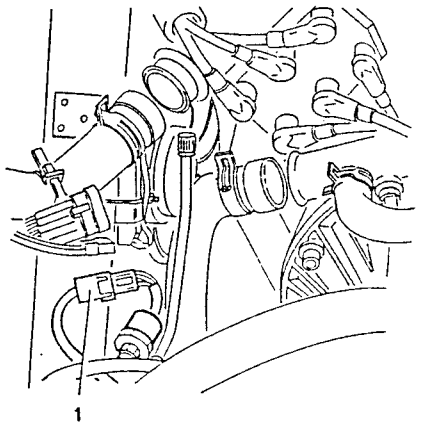
CAUTION
The anti-freeze used as an engine coolant is damaging to paintwork. Avoid all contact with painted parts.



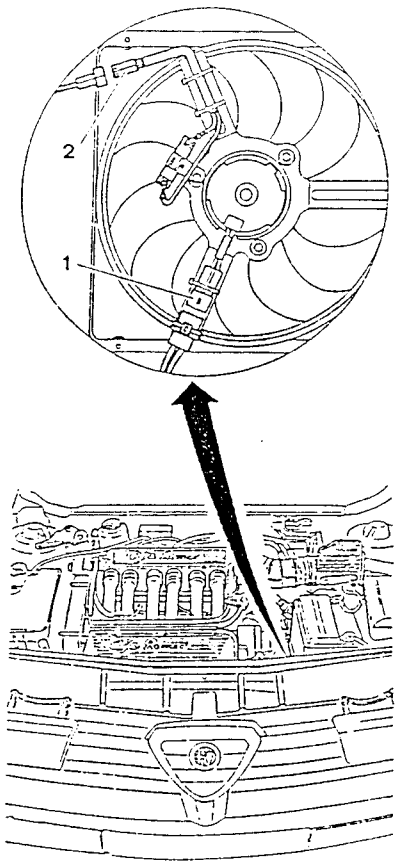
1. Disconnect the engine coolant to radiator sleeve from the expansion tank.



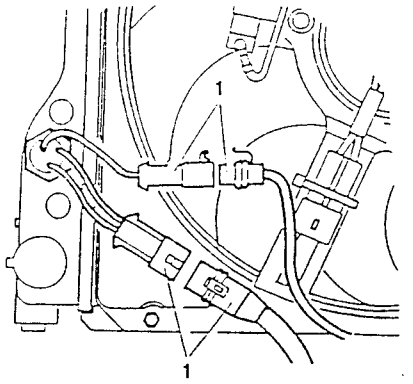
1. Disconnect the pressure switch (trinary) of the air conditioning system.



1. Disconnect the electrical connections of the electric cooling fand.
2. Disconnect the electric fan electrical connection.

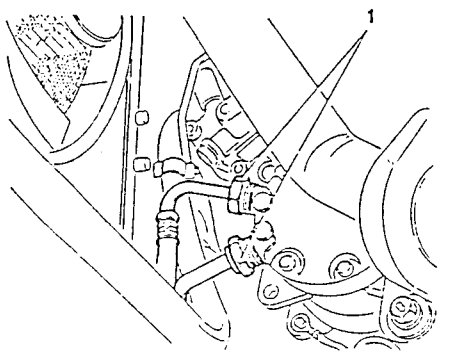


1. Disconnect the two connections of the electric cooling fan thermocontact.

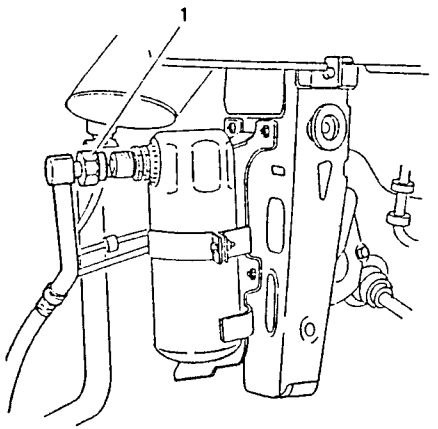


- Raise the vehicle.

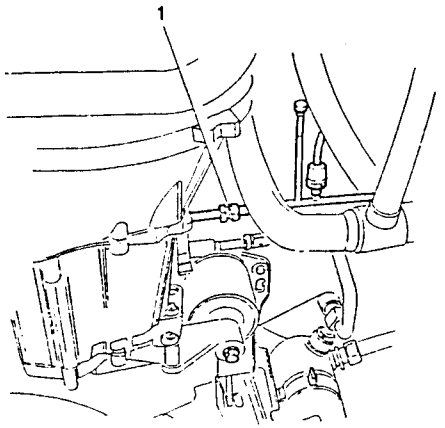
1. Disconnect the intake and delivery unions from the compressor and plug the unions on the compressor.



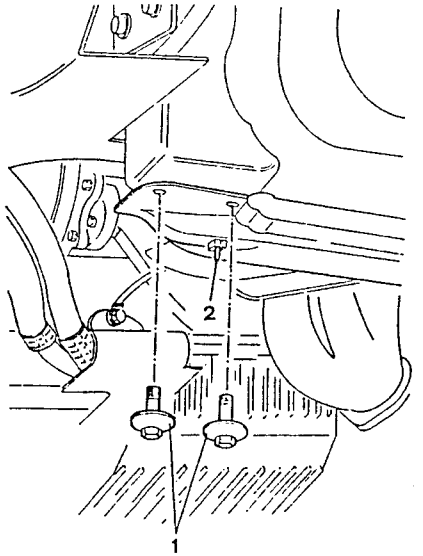
1. Disconnect the freon inlet union from the dehydrating filter of the air conditioning system.



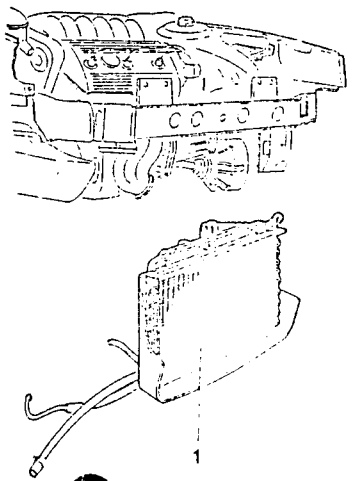
1. Disconnect the air conditioning system intermediate union.



1. Unscrew the screws securing the lower crossmember to the body.
2. Unscrew the screw securing the oil radiator air conveyor to the crossmember.

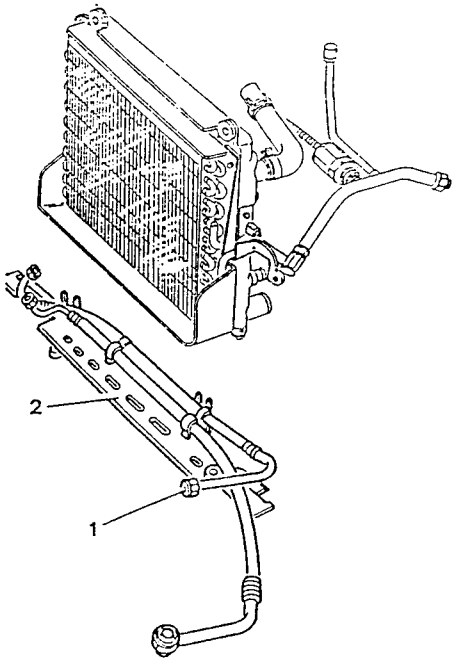


1. Remove the radiator assembly and air conditioning condenser complete with electric fan and pipes.

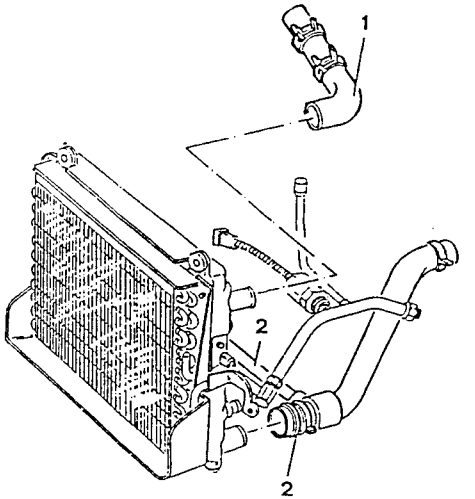


DISASSEMBLY

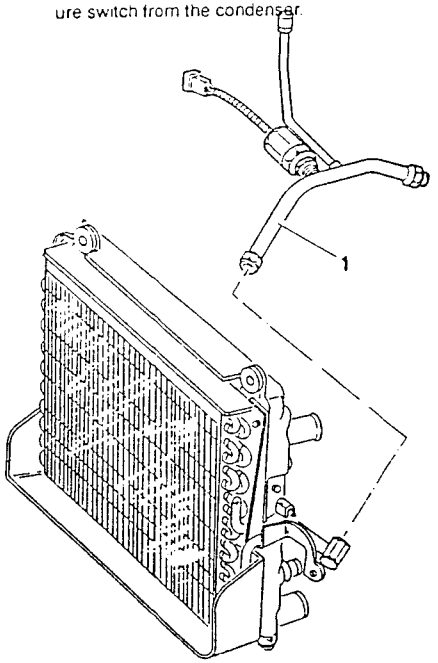
1. Disconnect the freon from conditioning condenser outlet union.
2. Remove the lower cross member complete with freon intake and delivery pipes.



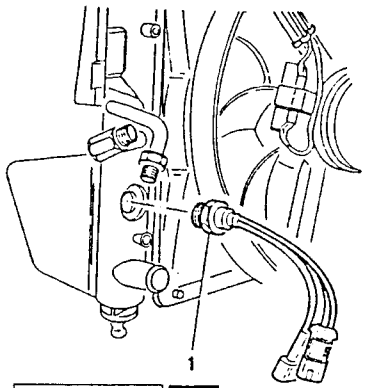
1. Remove the engine coolant inlet sleeve from the radiator.
2. Remove the engine coolant outlet sleeves from the radiator.



1. Remove the freon inlet union complete with pressure switch from the condenser.

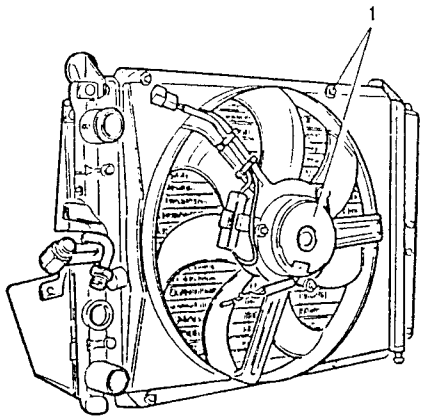


1. Remove the electric fan cut-in thermocontact from the radiator.

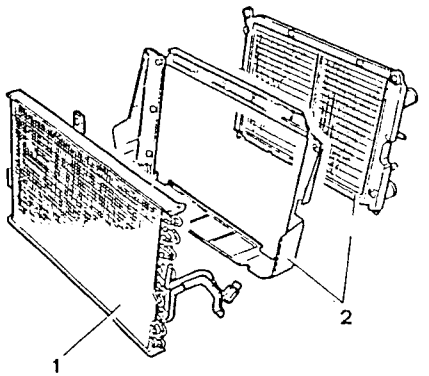


6.5 ÷ 10.5 Nm
0.66 ÷ 1.07 kgm

1. Remove the complete electric fan from the cooling radiator by unscrewing the four retaining screws.



1. Unscrew the retaining screws and remove the air conditioning system condenser.
2. Unscrew the retaining screws and separate the air conveyor from the radiator.

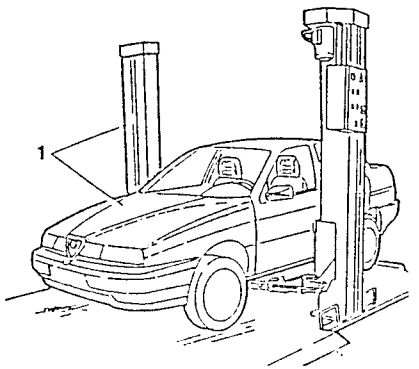


ELECTRIC COOLING FAN

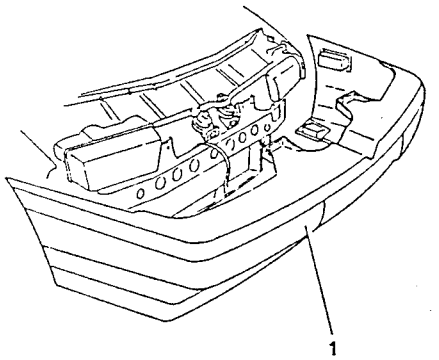
The two-speed electric cooling fan increases the radiator heat exchange capability.
A double threshold thermocontact, the first contact of which is set at 92°Cand the second, by way of an additional resistance at 97°C, activates the fan at the two different speeds.

REMOVAL/REFITTING

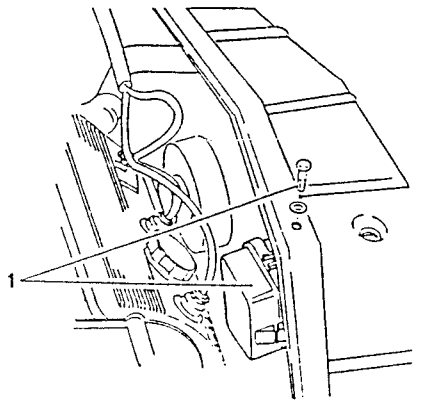
1. Place the vehicle on a lift.
– Disconnect the negative cable from the battery.



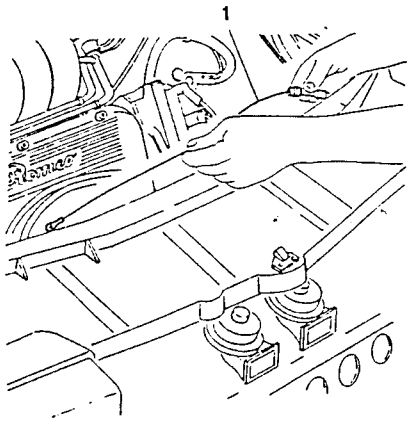
1. Remove the front bumper (see **GROUP 75**).



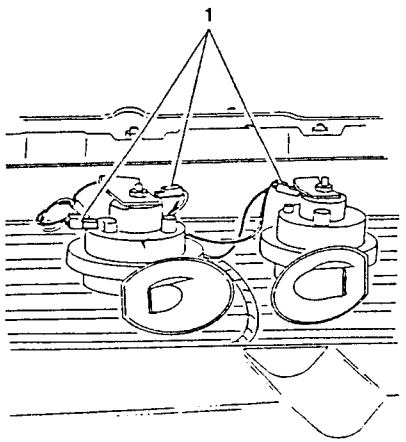
1. Unscrew the screw securing the relay box to the crossmember and temporarily move the box to one side.



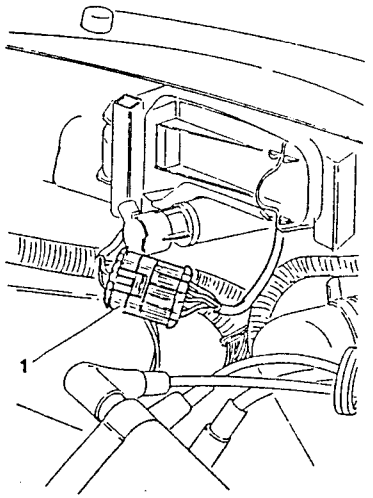
1. Disconnect bonnet release cable from the two catches (see GROUP 56).



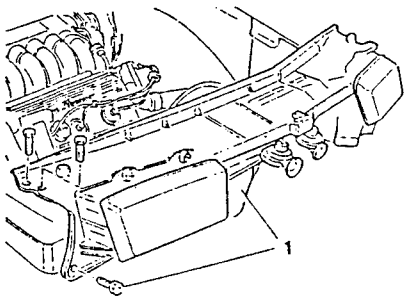
1. Disconnect the electrical connections from the horns.



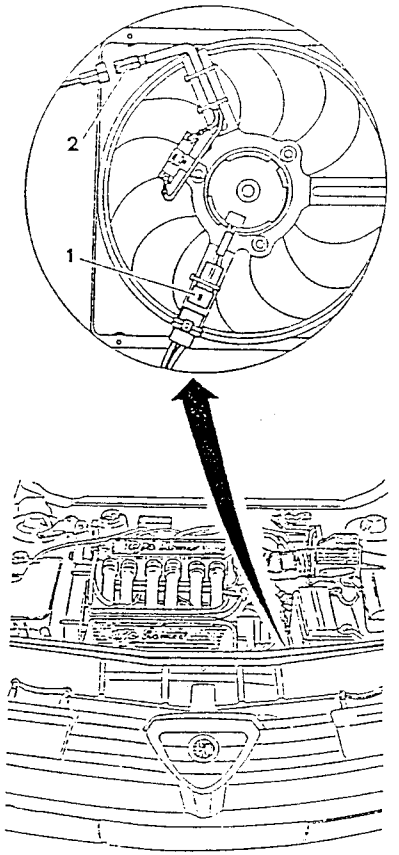
1. Disconnect the electrical connections from the front headlight assemblies.



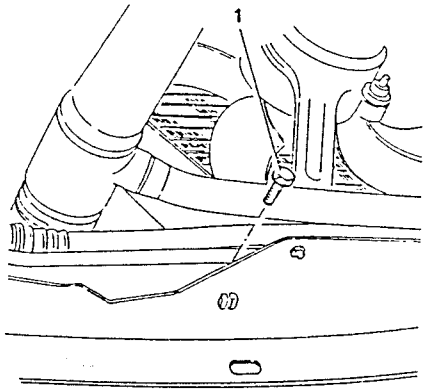
1. Unscrew the screws securing the upper crossmember to the body and remove it together with the headlight assemblies and horns.



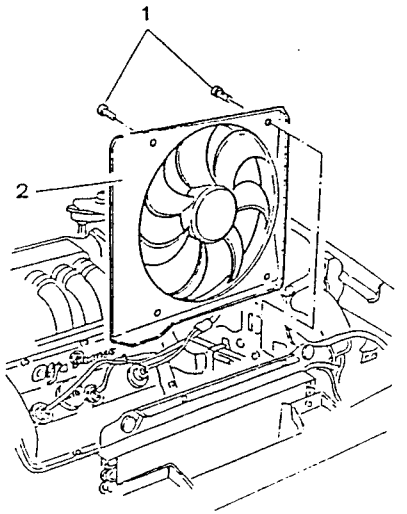
1. Disconnect the electrical connections from the electric cooling fan.
2. Disconnect the electrical connection from the fan resistance.



– Raise the vehicle.
1. Unscrew the lower screws securing the electric fan.

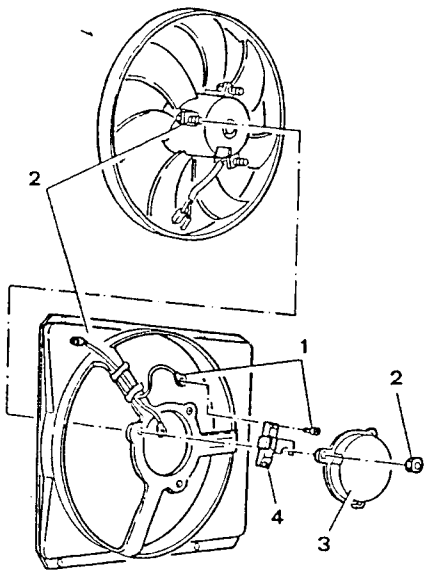


– Lower the vehicle.
1. Unscrew the upper screws securing the fan.
2. Remove the complete fan.



DISASSEMBLY

1. Disconnect the electrical cables from the additional resistance.
2. Unscrew the three nuts and separate the conveyor from the fan.
3. Remove the dustguard.
4. Remove the additional resistance.



ELECTRIC COOLING FAN THERMOCONTACT

Check the setting of the thermocontact by operating as follows:

- Remove the thermocontact from the radiator.

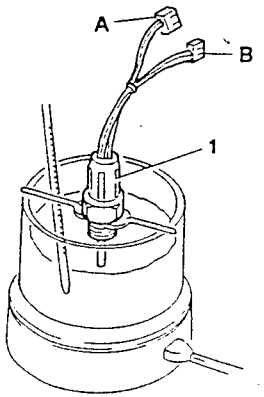
1. Hang the thermocontact in a container full of water and heat the water.

- Using a thermometer and a multimeter, check that thecontact closes on the two pins (of connector A) at the 2nd speed cut-in temperature.
- In the same way check that the thermocontact closes between the pins of connector A and B at the 2nd speed cut-in temperature.

CAUTION
Neither the thermometer or the thermocontact must touch the bottom of the container.

Electric fan cut-in temperature	
1st speed	92 ± 2°C
2nd speed	97 ± 2°C

- If the correct values are not detected, replace the thermocontact.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

COOLING SYSTEM

Hydraulic circuit control pressure	1.08 bars (1.1 kg/cm^2)
Pressure setting of pressurized cap	0.98 ± 0.1 bars (1 ± 0.1kg/cm^2)

THERMOSTAT

Temperature at start of opening	87 ± 2° C
Temperature when fully open	95° C
Total bulb stroke	7.5 mm

ELECTRIC FAN

Temperature of cut-in at 1st speed	92 ± 2° C
Temperature of cut-in at 2nd speed	97 ± 2° C

ENGINE COOLANT TEMPERATURE INDICATOR SENDER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

Temperature (°C)	Resistance of thermistors (Ω)
40	900 ÷ 1400
60	470 ÷ 600
80	235 ÷ 300
90	175 ÷ 215
100	135 ÷ 165
120	800 ÷ 100

Closing temperature	115 ± 3°C
Reopening temperature	≥ 102°C

ENGINE COOLANT

Minimum temperature		-40°C
Concentrated antifreeze	Alfa Romeo Antifreeze	5.0 litres (55%)
Distilled water		3 litres (45%)
Antifreeze ready for use	Alfa Romeo Climafluid Permanent -40°C	9.2 litres

TIGHTENING TORQUES

PART	Nm	kgm
Screws securing water pump to engine block	8.1 ÷ 9.3	0.83 ÷ 0.95
Screws securing water pump pulley	8.5 ÷ 10.5	0.87 ÷ 1.07
Screws securing water pump cover	6.5 ÷ 10.5	0.66 ÷ 1.07
Screws securing thermostat group to support	32.3 ÷ 39.9	3.3 ÷ 4.1
Screws securing thermostat group cover	13.6 ÷ 16.8	1.4 ÷ 1.7
Screws securing ignition coil support	13.6 ÷ 16.8	1.4 ÷ 1.7
Engine coolant temperature indicator sender and maximum temperature warning light contact	24.2 ÷ 30	2.47 ÷ 3.06
Engine coolant temperature sensor (NTC)	11.9 ÷ 14.7	1.2 ÷ 1.5
Electric fan thermocontact	6.5 ÷ 10.5	0.66 ÷ 1.07

FAULT DIAGNOSIS AND CORRECTIVE INTERVENTIONS

FAULTS AND SYMPTOMS	CHECK	TEST REFERENCE
LOSS OF ENGINE COOLANT - (If shown by low level of engine coolant and white-green sediment around the site of the leak)	- If the loss is not evident carry out the "HYDRAULIC CIRCUIT PROOF TEST"	A
ENGINE OVERHEATING	- Start the engine and run it to normal operating temperature. - When the temperature is excessively high the warning light and indicator on the instrument panel will come on. NOTE: In cases where the warning light and temperature indicator are broken, a valve located on the expansion tank will release the high pressure created within the cooling system. CAUTION: Dusty or muddy roads or air containing pollen or small insects may block the front area of the engine cooling device and reduce the cooling capacity leading to overheating of the engine.	B

LOSS OF ENGINE COOLANT	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK CLAMPS – Check that the clamps are not loose, damaged, incorrectly installed or of the wrong size	OK ▶ ~~OK~~ ▶	Proceed to phase A2 Tighten or replace the faulty clamps
A2 CHECK GASKETS, SLEEVES AND PLUGS – Check that the gaskets, sleeves, unions and plugs are not leaking	OK ▶ ~~OK~~ ▶	Proceed to phase A3 Replace the faulty elements
A3 CHECK RADIATOR – Check that the radiator is not leaking	OK ▶ ~~OK~~ ▶	Proceed to phase A4 Replace the radiator
A4 CHECK EXPANSION TANK – Check that the expansion tank is not leaking from around the cap or through the relief valve	OK ▶ ~~OK~~ ▶	Proceed to phase A5 Replace the tank if damaged

(CONTINUES)

LOSS OF ENGINE COOLANT	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A5 CHECK GASKETS – Check tht there are no leaks from around the coolant pump gaskets or from the thermostat group	OK ▶ ~~OK~~ ▶	Proceed to phase A6 Replace the gasket between the pump and the engine or the gaskets between the engine and the thermostat unit
A6 CHECK PUMP AND THERMOSTAT GROUP – Check that there are no cracks or other defects on the water pump or thermostat group	OK ▶ ~~OK~~ ▶	Proceed to phase A7 Replace the faulty parts
A7 CHECK CYLINDER HEADS – Check that the cylinder heads are tightened to the correct torque. If the torque is incorrect, check the condition of the cylinder head gaskets	~~OK~~ ▶	Tighten the screws to the correct torque or replace the gaskets of the cylinder heads. (In this case check that the engine oil has not been contaminated by engine coolant)

End of test A

ENGINE OVERHEATING	TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK WARNING LIGHT AND INDICATOR – Check that the engine coolant temperature warning light and indicator on the instrument panel and the senders on the engine are functioning correctly (see ELECTRICAL - ELECTRONIC DIAGNOSIS)	OK ▶ ~~OK~~ ▶	Proceed to phase B2 Repair or replace the faulty parts
B2 CHECK LEVEL OF ENGINE COOLANT – Check the level of the engine coolant	OK ▶ ~~OK~~ ▶	Procced to phase B3 Top-up the system to the correct level. Check tightness of the circuit
B3 CHECK LEVEL OF ENGINE OIL – Check the level of the engine oil	OK ▶ ~~OK~~ ▶	Proceed to phase B4 Top-up the engine oil to the correct level (see GROUP 00)
B4 CHECK BELT – Check that the water pump drive belt is correctly tensioned and that it is not worn	OK ▶ ~~OK~~ ▶	Proceed to phase B5 Tighten the belt to the correct value or replace it if it is damaged or excessively worn (see GROUP 00)

(CONTINUES)

ENGINE OVERHEATING	TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B5 CHECK ENGINE COOLING FAN – Check functioning of the electric cooling fan (see ELECTRICAL - ELECTRONIC DIAGNOSIS)	OK ▶ ~~OK~~ ▶	Proceed to phase B6 Replace the cooling fan or the faulty elements from the corresponding electrical system
B6 CHECK THERMOCONTACT – Check the setting of the cooling fan thermocontact	OK ▶ ~~OK~~ ▶	Proceed to phase B7 Replace the thermocontact
B7 CHECK DUCTS – Check that there are no obstructions in the coolant ducts: visually check that the sleeves are not squashed or bent	OK ▶ ~~OK~~ ▶	Proceed to phase B8 Restore or renew the affected ducts
B8 CHECK FLOW OF ENGINE COOLANT – Check that the coolant flows freely in the ducts by manually pumping it in the tubes and checking the agitation of the fluid in the expansion tank	OK ▶ ~~OK~~ ▶	Proceed to phase B9 Clean the obstructed duct with specific detergent: ensure that the engine coolant is of the correct type

(CONTINUES)

ENGINE OVERHEATING	TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B9 CHECK RADIATOR		
– Check that the radiator is not encrusted and that it contains no foreign particles	OK ▶	Proceed to **phase B10**
	~~OK~~ ▶	Wash the radiator with specific detergent: ensure that the engine coolant is of the correct type
B10 CHECK COOLANT PUMP		
– Check the condition and correct functioning of the water pump	OK ▶	Proceed to **phase B11**
	~~OK~~ ▶	Replace pump and seal
B11 CHECK THERMOSTAT		
– Run the engine to operating temperature and touch the duct between the thermostat and radiator: check that it gradually heats up	OK ▶	Proceed to **phase B12**
	~~OK~~ ▶	Replace the thermostat unit and relative gasket
B12 CHECK THERMOSTAT		
– Check the correct setting of the thermostat	OK ▶	Proceed to **phase B13**
	~~OK~~ ▶	Replace the thermostat unit and relative gasket

(CONTINUES)

ENGINE OVERHEATING	TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B13 CHECK TIMING		
– Check engine timing	~~OK~~ ▶	Adjust engine timing

End of test B

SERVICE

ASSISTENZA TECNICA

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