

ALFA ROMEO 155

VOLUME 2 (ENGINES)

[SMS PART No Z6017]

THIS MANUAL CONTAINS THE FOLLOWING
UPDATES

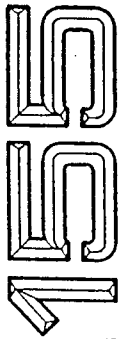
DESCRIPTION	PRINT No
MAIN MANUAL	4655***00000
SUPPLEMENT	4655***00001
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SUPPLEMENT	4655***00005
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155

REPAIR MANUAL

● ENGINES





DIVISION OF

"REPAIR MANUAL"

Models

The documentation published by the Alfa Romeo Assistance Service for the "155" vehicle is composed of the following publications:

155
REPAIR MANUAL
SUPPLEMENT FOR **155**

- ENGINES
- MECHANICAL UNITS
- BODY
- ELECTRICAL & ELECTRONIC DIAGNOSIS

155 T.SPARK V6
- PA4655A1000000: GROUP 00

155
- PA4655A244000: GROUP 00

155 TD
- PA4655A3TD0000: GROUP 00

155 TD 2.5
- PA4655A4TD2500: GROUP 00

155 T.SPARK 16V
- PA4655A516V000: GROUP 00

• VEHICLE CHARACTERISTICS AND MAINTENANCE

155
REPAIR MANUAL
SUPPLEMENT FOR **155** TD 2.5

- ENGINES
- MECHANICAL UNITS
- BODY
- ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4655B1000000: GROUPS 01, 04, 05, 07
Engine 1995 cm³ (code AR 67202)
Engine 1773 cm³ (code AR 67102)
Engine 1749 cm³ (code AR 67103)

- PA4655B2000000: GROUPS 01, 04, 05, 07
Engine 2492 cm³ (code AR 67301)

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SUPPLEMENT FOR **155** T.SPARK 16V

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- MECHANICAL UNITS
- BODY
- ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4655C1000000: MECHANICAL UNITS

- PA4655D1000000: Electrical components, Bodywork, Trim, Heating and Ventilation

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REPAIR MANUAL
SUPPLEMENT FOR **155** T.SPARK 16V

- ENGINES
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- PA4655E1000000: Wiring diagrams and Troubleshooting

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REPAIR MANUAL
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- PA4736B14x4000: GROUPS 01, 04, 05, 07
Engine 1995 cm³ TURBO (code AR 67203)

- PA4736C14x4000: MECHANICAL UNITS

- PA4736D14x4000: Electrical components, Bodywork, Trim, Heating and Ventilation

- PA4736E14x4000: Wiring diagrams and Troubleshooting

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REPAIR MANUAL
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- ENGINES
- MECHANICAL UNITS
- BODY
- ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4805B1TD0000: GROUPS 01, 04, 05, 07
Engine 1929 cm³ TURBO DIESEL (code AR 67502)

- PA4805C1TD0000: MECHANICAL UNITS

- PA4805D1TD0000: Electrical components, Bodywork, Trim, Heating and Ventilation

- PA4805E1TD0000: Wiring diagrams and Troubleshooting

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SUPPLEMENT FOR **155** TD 2.5

- ENGINES
- MECHANICAL UNITS
- BODY
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- PA4830B1TD2500: GROUPS 01, 04, 05, 07
Engine 2.498 cm³ TURBO DIESEL (code VM07B)

- PA4830C1TD2500: MECHANICAL UNITS

- PA4830D1TD2500: Electrical components, Bodywork, Trim, Heating and Ventilation

- PA4830E1TD2500: Wiring diagrams and Troubleshooting

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SUPPLEMENT FOR **155** T.SPARK 16V

- ENGINES
- MECHANICAL UNITS
- BODY
- ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4978B116V000: GROUPS 01, 04, 05, 07
Engine T.SPARK 16v (code AR 67204)

- PA4978C116V000: MECHANICAL UNITS

- PA4978D116V000: Electrical components, Bodywork, Trim, Heating and Ventilation

- PA4978E116V000: Wiring diagrams and Troubleshooting



REPAIR MANUAL

• ENGINES

UPDATE CARD

UPDATE (DATE)	SECTION	PAGE	
		SUBSTITUTED	ADDED
1 (12/1994)	Introduction Engines (pages with PA-4655B1000001)	Division of manual	VI
1 (12/1994)		04-4	
1 (12/1994)		04-5	
1 (12/1994)		04-7	
1 (12/1994)	Engines (pages with PA-4655B2000001)	04-8	
1 (12/1994)		04-4	
1 (12/1994)		04-6	
1 (12/1994)		04-7	
1 (12/1994)		04-8	

INTRODUCTION

This publication provides the information necessary for the maintenance and repair operations regarding the 155 for the models listed in the "vehicle identification" table. The aim of this publication is to provide the Alfa Romeo Service staff with a tool which can be used to rapidly identify any faults and help to render the intervention precise and efficient.

The manual shows the procedures relative to the removal and refitting operations, disassembly and checks regarding the various groups which form the vehicle. The procedures are illustrated in detail as is the use of any necessary tools. A system of symbols combined with the basic technical data given to one side of each drawing facilitate a rapid and complete consultation of the manual.

Particular attention has been given to the fault diagnosis procedures which can be found at the end of each group. These combine with the irreplaceable experience of the operator and help to correctly identify and rectify the fault starting from the malfunction which the operator himself has detected and carrying out a series of tests on the system affected by the fault.

For the information relative to the vehicle's electrical system the "155 - Repair Manual - Electrical-Electronics Diagnosis" manual should be consulted.

All the information contained in this manual is accurate to the date of publication.

Alfa Romeo reserves the right to carry out any modifications to its products considered necessary without warning, though the technical information and up-dates regarding this manual will be promptly published.

How to use this manual

This manual is divided into chapters (GROUPS) relative to each of the assemblies which make up the vehicle.

To rapidly identify the group required, refer to the initial index.

Each group is accompanied by an analytic index and an illustrated index in order to facilitate the search for the required subject.

A brief description of the "removal/refitting", "disassembly/reassembly" and "checking and adjustment" procedures follows.

















The procedures show the complete disassembly of the components and should be carried out alone only when strictly necessary. The "reassembly" and "refitting" procedures are normally a simple reversal of the "disassembly" and "removal" procedures and only the reassembly procedures which are significantly different are illustrated.




















The technical data, specific tools and fault diagnosis procedures follow the procedures mentioned above.

Symbols

This manual employs a series of symbols in order for the main technical information provided to be easily located.

The list of the symbols follows.

-  removal/disassembly
-  refitting/reassembly
-  Tighten to the torque
-  Rivet nut
-  adjustment/regulation
-  visual check
-  lubricate
-  weight difference
-  angular value
-  pressure
-  temperature
-  Bleed air from brake system
-  surface to be treated
-  interference
-  play
-  intake

-  exhaust
-  lubricate with engine oil
-  left-hand thread
-  tightening torque in oil
-  engine idle speed
-  ovalization
-  taper
-  eccentricity
-  flatness
-  diameter
-  linear dimension
-  parallelism
-  top-up with grease
-  heating temperature
-  seal
-  top-up with engine oil
-  grease
-  WARNING!
-  CAUTION!

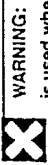
Indications for the operators

All the operations must be carried out with the greatest care in order to avoid damaging vehicles and persons.

- For some procedures the use of the Alfa Romeo specific tools is indicated. The use of these tools is indispensable to the safety of the operation and to avoid damage to the parts involved in the procedure.
- To detach adhering parts, lightly tap with an aluminium or lead mallet; for parts in metal and a wooden or resin mallet for parts in light alloy.
- When disassembling check that the necessary parts have been marked.
- If necessary when refitting, lubricate the parts to prevent seizing or binding during the initial stages of operation.
- Using adhesive tape or clean rags, protect the parts which, after disassembly may allow dust or foreign particles to enter the engine.
- When refitting it is vital that the tightening torques and regulation settings are respected.
- During removal substitute the seal rings, oil seals, flexible washers, safety plates, self locking nuts and any other part showing signs of wear.
- Avoid marking the fittings inside the vehicle.

Assemblies or detached parts must only be replaced by original spare parts as only in this way can the suitability of the part and its perfect operation be guaranteed.

- **CAUTION** and **WARNING** indicate those procedures which must be carried out with particular care in order to prevent personal injury or damage to the vehicles.



WARNING:
is used when lack of care may cause personal injury.



CAUTION:
to the vehicle or parts of it.

- Obey the current safety regulations regarding operation in the workshop. Where necessary specific precautions have been given in the manual in order to prevent dangerous situations from arising.

NOTE:

It is possible that some subjects have not been covered in time for publication. In the indexes to the individual groups these subjects are indicated however and are accompanied by the words "Due for publication".

The Technical Assistance will provide documentation relative to these subjects in the form of up-date sheets or in "Technical Bulletins" which will promptly be sent to the Alfa Romeo Assistance Network.

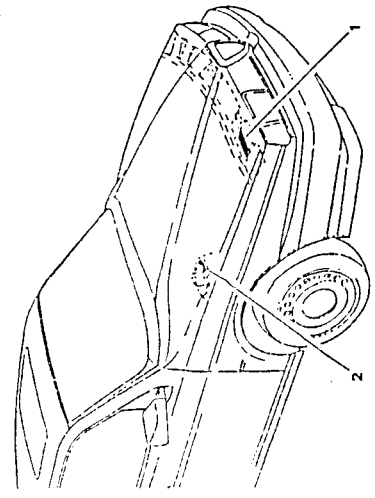
NOTE:

It should be pointed out that inside this manual the "155" vehicle may also be indicated with the "167" vehicle code.

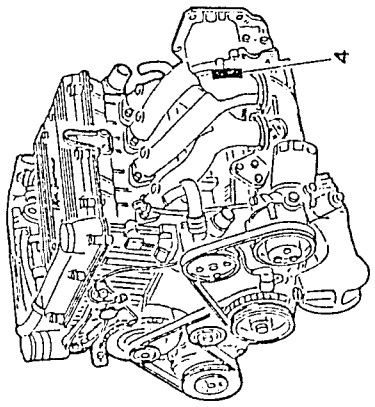
MODEL IDENTIFICATION

Vehicle	155			
Model	T. SPARK 1.8	T. SPARK 1.8	T. SPARK 2.0	V6
Cylinder displacement	1.749 cm ³	1.773 cm ³	1.995 cm ³	2.492 cm ³
Trim level	4-door saloon			
Drive	LH + RH	LH + RH	LH + RH	LH + RH
Car model no.	167A4B	167A4A	167A2A	167A1
	167000	167000	167000	167000
Engine type and serial no.	AR67103 from 000001	AR67102 from 000001	AR67202 from 000001	AR67301 from 000001

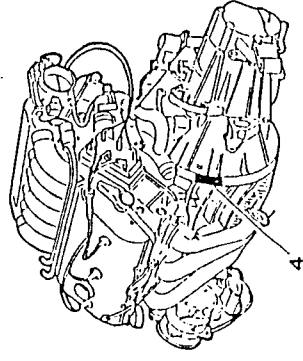
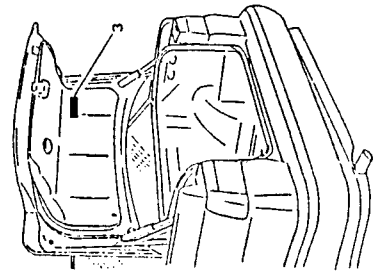
VEHICLE IDENTIFICATION IDENTIFICATION LABELS



TWIN SPARK ENGINES



V6 ENGINE



- 1 Label carrying identification data
- 2 Body label
- 3 Body paint identification label
- 4 Engine label

MODEL IDENTIFICATION ('95 Versions)

Vehicle	155										
Model	1.7 T. SPARK					1.8 T. SPARK					V6
Cylinder displacement	1.749 cm ³					1.773 cm ³					2.492 cm ³
Trim level	4-door saloon										
Drive	LH + RH			LH + RH			LH + RH			LH + RH	
Car model no. on identification label on upper part of RH side panel, engine compartment	167A4H	167A4G	167A4L	167A4E	167A4M	167A4H	167A4E	167A4M	167A4E	167A4M	
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
Engine type and serial no.	167000			167000			167000			167000	
	AR 67105	AR 67103	AR 67105	AR 67102	AR 67202	AR 67105	AR 67102	AR 67202	AR 67303	AR 67303	
	from (*)	from (*)	from (*)	from (*)	from (*)	from (*)	from (*)	from (*)	from (*)	from (*)	

(*) . Engine no. not available at time of going to press

(□) Only for certain markets

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REPAIR MANUAL

● ENGINES

- Engine 1995 cm³ (code AR 67202)- Engine 1773 cm³ (code AR 67102)- Engine 1749 cm³ (code AR 67103)

GROUP 01 - ENGINE MAIN MECHANICAL UNIT



GROUP 04 - FUEL SYSTEM



GROUP 05 - ENGINE IGNITION, STARTING AND CHARGING



GROUP 07 - ENGINE COOLING SYSTEM



GROUP 01

ENGINE

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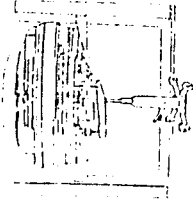
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ENGINE REMOVAL/REFITTING

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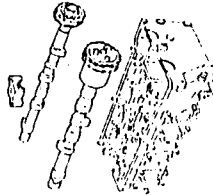
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CYLINDER HEAD CHECKS AND INSPECTIONS

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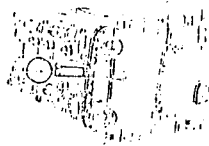
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"ON VEHICLE" OPERATIONS

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ENGINE

The cylinder liners are supplied already coupled with their relative pistons and are divided into three dimensional classes.

GENERALITIES

The engine is of the 4 cylinder in line type in light alloy with a double on-head camshaft, timing variator and double static ignition and injection controlled by a single BOSCH MOTRONIC M1.7 control unit.

The clutch - gearbox - differential group is connected behind the engine and forms an integral part of the engine unit.

The engine itself is front mounted and set transversally with a 13° inclination forwards.

It is installed on the frame by suspension type mounts and fixed by two elastic damping supports. A third support of the compass type secures it to the suspension crossmember.

A rod between the engine and the body prevents excessive shaking of the engine.

The engines described below conform to the "USA 83" exhaust emissions regulations.

STRUCTURE

Engine block:

this is a single block in light aluminium and silicon with a high mechanical resistance and heat dissipation.

The crankshaft is supported by five main supports.

Grooving in the walls of the engine block permit the circulation of engine coolant and lubricating oil.

For AR67202 (1995 cc.) engines only, oil spray jets which cool the pistons are located at the base of the cylinders.

Cylinder liners:

these are in cast iron and are of the low resting type and directly lapped on the outside by the cooling liquid for a more rational heat dissipation (wet).

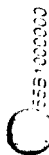
The size of the cam is such that it is not deformed and is thus able to contain the gasses

Cylinder head:

this is of the monolith type, compact and chill-cast in aluminium and silicon alloy with a double camshaft with direct action valves arranged in a "V" of 46°. There are two ignition spark plugs for each cylinder. The configuration of the combustion chambers is optimal due to the position of the valves; at the same time the rectilinear intake ducts have a contained loading loss and permit maximum exploitation of the resonance, a distinct advantage with regard to volumetric performance.

Oil sump:

this is a structural part of the engine with mechanical functions in addition to that of containing the engine oil. It is made of die-cast aluminium with liquid silicone sealing.



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MOVING PARTS

Crankshaft:

this is forged in high resistance bonded steel is soft nitrided. This treatment decreases wear and increases reliability (resistance to fatigue).
It rests on five main supports and shoulders on the central main support.
Eight counterweights arranged through 180° accurately balance the rotating masses.
A channel runs inside the shaft for the lubrication of the main and rod journals.

Main and rod bearing halves:

these are of the three-metal, thin shell type are divided into three dimensional classes to contain the radial play. There are two holes and a circumference groove for the passage of oil located on the front, central and rear main bearing halves.

Flywheel:

this is in cast iron, balanced, and with a ring gear in tempered steel.

Pistons - rods:

the pistons are in silicon-aluminium alloy with self-heating inserts and are divided into three dimensional classes. To ensure correct installation an arrow is stamped onto the piston ceiling which indicates the direction of rotation of the engine.
The rods are in hardened and tempered alloy, with a bushing in copper alloy inserted for the coupling with the gudgeon pin of the piston.
The piston - rod assembly has been lightened to reduce the moving masses.

AUXILIARY ORGANS

Timing:

direct drive by double chain with cemented and tempered on-head camshafts in steel alloy. A reference notch for correct timing has been engraved onto the central journal of the camshaft and relative cap.
The lightweight tappets, of the mechanical type, are composed of a valve cup in alloy steel in contact with the cam.
The control of the valve cup is transmitted to the valve by a cap, in tempered carbonitrided steel, used to regulate the valve clearance.
Particularly important is the introduction of sodium into the exhaust valve which improves the dissipation of the heat to which they are subjected.
The valve seats are sintered in material suitable for operation with unleaded petrol.

Timing variator:

This is of the simplified type which ensures great precision of timing, rapid intervention and high mechanical reliability.
In order to reduce the size of the engine, the actuation valve has been included in the intake manifold with suitable channeling, also present on the cylinder head, which regulates the flow of oil to the variator.

This device varies the intake valve timing on the basis of engine loading. This parameter is received and processed by the MOTRONIC control unit in the form of an electric signal sent by the air-flow meter as a command, to the solenoid, by way of a relay.

When the quantity of air taken in by the engine is lower than a pre-set value, the solenoid (1) is deactivated and the valve box (2) pushed by the counter-spring (3) is lifted up allowing the passage of oil from the channeling (A) to reach the variator.
In this case the timing of the intake valves is not changed.

If the quantity of intake air exceeds the pre-set value, the solenoid (1) is activated and pushes the valve box (2) downwards. In this position the oil arriving from the channeling (A) enters the piston chamber (B) and passes through a hole into the internal channel (C) in the piston.

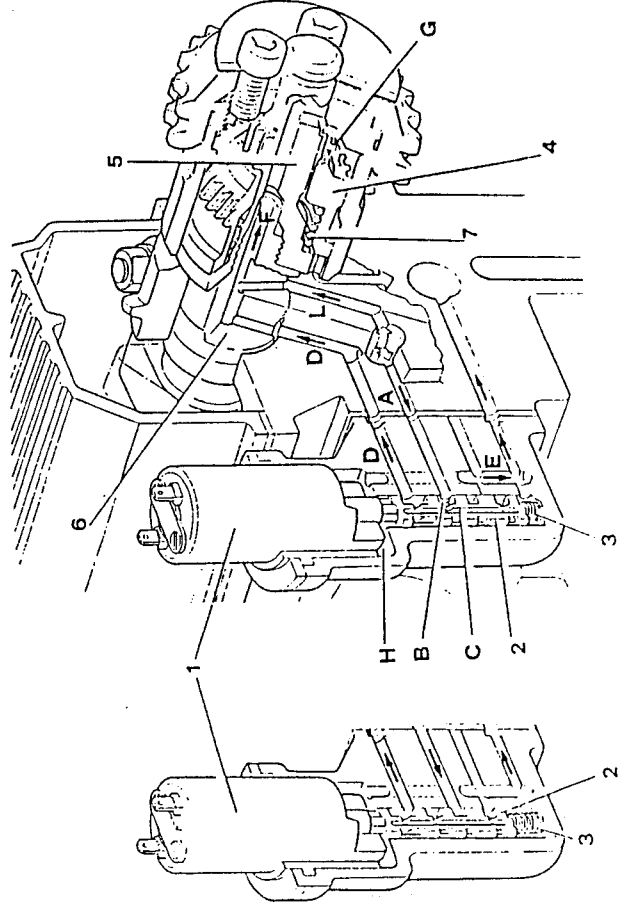
The oil can only exit this channel through the upper hole (leading to the oil-to-variator delivery duct (D)) as the lower hole no longer opens onto the exhaust duct (E) as the valve box (2) is lowered.
The oil passes through the channeling (D) and (F) and reaches the chamber (G) moving the piston (4) axially towards the engine.

The piston is externally equipped with helical teeth and as a result of the axial movement is forced to rotate clockwise (as seen from the timing side). This rotation is transmitted to the pinion through a straight-toothed grooved profile. The pinion (5) which is rotated by the threaded lug of the camshaft (6) transmits the rotation to the shaft, and in this way the timing of the intake valves is varied by 30°.

When the solenoid is deactivated, the valve box (2) returns to the initial position, interrupting the flow of pressurized oil to the piston (4) but, permitting the return of the oil to the outlet due to the thrust from the counter spring (7).

The channeling (L) enables the camshaft journal to be lubricated under the various operating conditions.

The oil which leaks into the solenoid chamber (H) is discharged through the drainage hole (E).



LUBRICATION

The pump located on the front cover of the engine block is actuated directly by the crankshaft through a coupling. The oil, taken from the sump by the pump, is filtered on intake by the gauze filter and then sent under pressure through the channeling to the total flow cartridge oil filter. The filter is equipped with a safety by-pass valve which permits the oil to pass if the filter becomes clogged.

The maximum lubrication pressure is regulated by a relief valve installed on the pump.

After being filtered, the oil passes into the main lubrication ducts, which run longitudinally along the engine block and into the vertical ducts which run along both the engine block and the cylinder head.

From the main ducts, passing through the three transversal ducts, the oil is sent to the lubrication channeling of the crankshaft main and rod supports.

From the vertical ducts, the oil is sent to two ducts located longitudinally on the head and these lubricate the camshaft supports and valve cups.

On the lubrication duct relative to the camshaft, intake side, there are two channels which permit the passage of oil to actuate the timing variator.

The recovery circuit is composed of two ducts located longitudinally on the cylinder head. These collect the oil originating from the outlets located under each valve cup

and from the rear sumps, and discharge it from the head, by gravity, into the sump. The gears of the timing chain in the engine block are in this way lubricated.

A recirculation system with vapour separator permits the recovery of the oil vapours coming from the oil sump. The lubrication pressure is indicated by a pressure gauge located on the instrument panel.

A warning lamp alerts the driver to an excessively low oil pressure. The pressure signals are supplied by a sender and a thermocontact located in the engine block. The oil temperature is indicated on the instrument panel and receives the signal from a sender installed on the oil filter support.

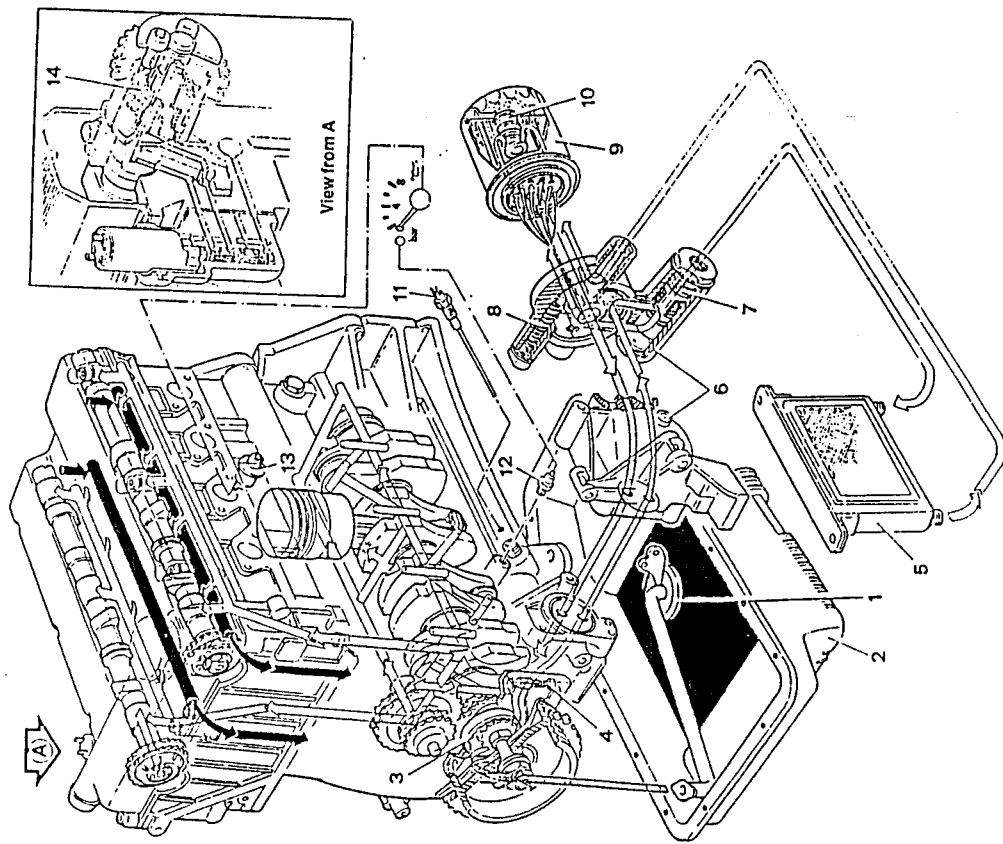
An oil level sensor located to one side of the oil dipstick supplies the input signal for the illumination of a warning light on the instrument panel which comes on if the oil falls below a certain level.

Only for AR67202 engine:

- The lubrication system is equipped with an oil cooling radiator and a thermostat valve located in the filter support. When the temperature falls below $78 \pm 2^\circ\text{C}$ the oil is sent directly to the cartridge filter from where it returns to the engine. When the temperature exceeds 83.5°C the thermostat valve opens to permit the oil to pass to the oil cooling radiator in order to reduce the temperature.

- In order to cool the piston skirt more efficiently, jets are located in the engine block. These jets incorporate a ball valve which opens at a pressure of 1.25 to 1.75 bar.

LUBRICATION CIRCUIT



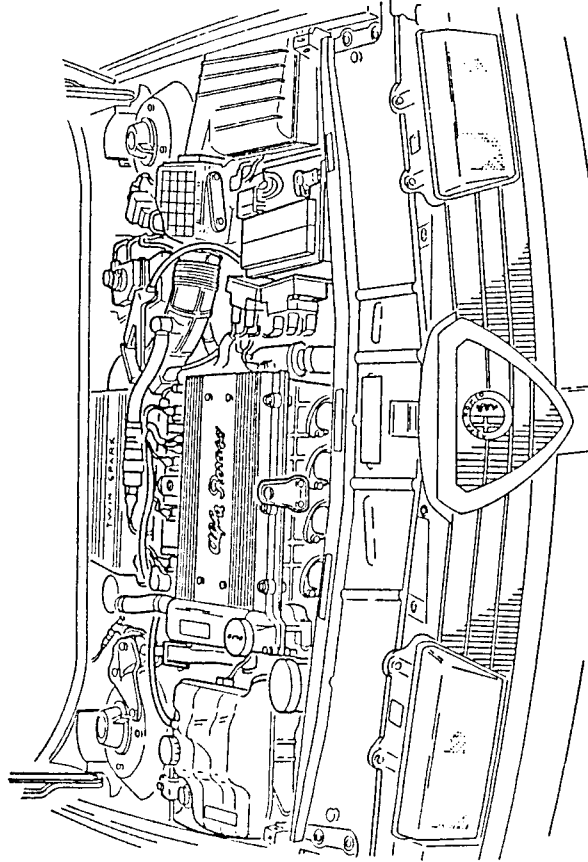
1. Suction device
2. Oil sump
3. Oil pump
4. Pressure relief valve
5. Oil recirculator
6. Oil filter support
7. Thermostat valve

8. Oil pressure relief valve
9. Oil filter
10. By-pass valve
11. Minimum oil level sensor
12. Minimum engine oil pressure warning light sensor
13. Engine oil pressure sender
14. Timing variator

ENGINE REMOVAL/REFITTING

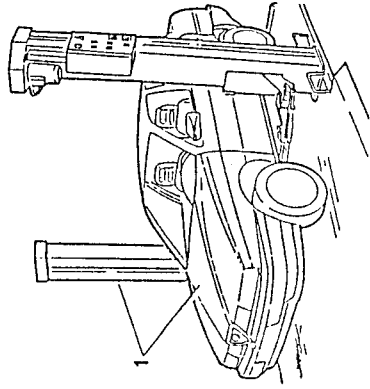
The information and illustrations given below permit the rapid removal of the engine from its housing in the engine compartment and its successive refitting.

The bench disassembly of the single components is described in a separate chapter.
This chapter should be taken as a single, complete procedure though parts may be used as required.
For further information and details refer to the chapters relative to the components or specific groups.



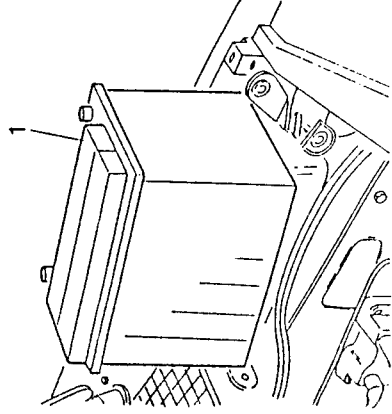
REMOVAL

1. Place the vehicle on a two column lift and release the pressure in the fuel supply system as follows:
 - disconnect the fuel pump supply fuse;
 - start the engine and run until it stops.

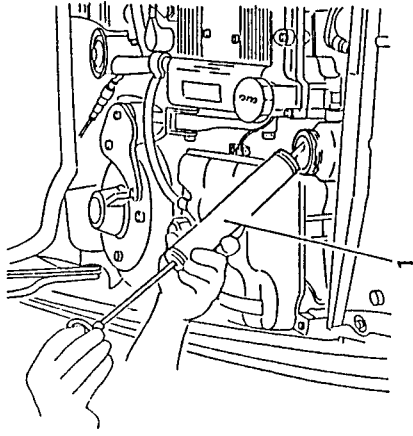


- Drain off the freon from the air conditioning system in accordance with the current regulations (see GROUP 80).

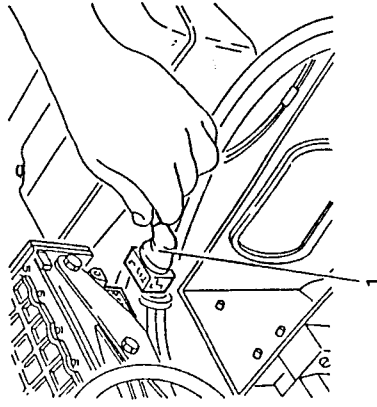
1. Remove the battery after first disconnecting the negative clamp (-) and then the positive (+).



1. Empty the power steering fluid reservoir using a suitable syringe.

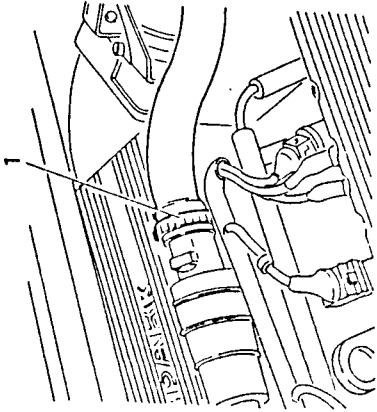


1. Disconnect the electrical connection from the air flow meter.

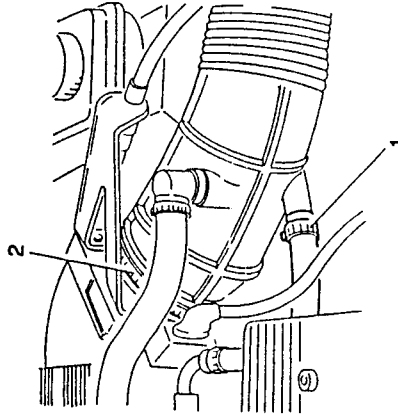




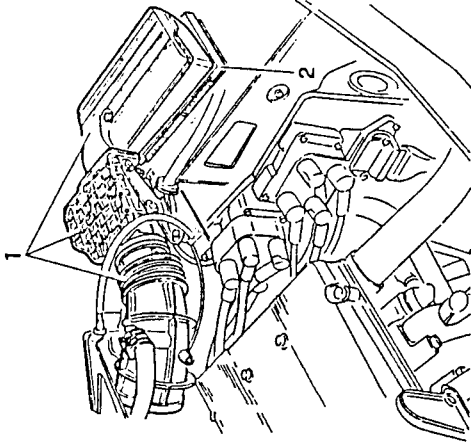
1. Disconnect the air intake pipe from the constant idle speed actuator.



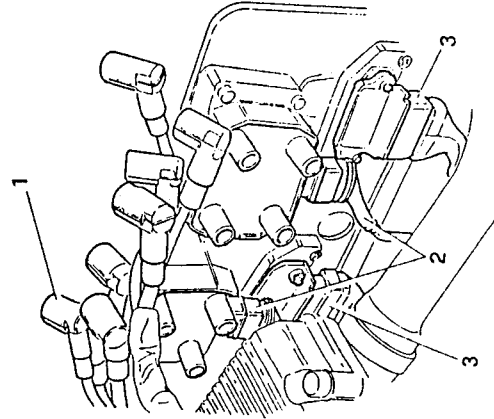
1. Disconnect the oil vapour recirculation hose from the corrugated sleeve.
2. Loosen the clamp and separate the corrugated sleeve from the air intake box.



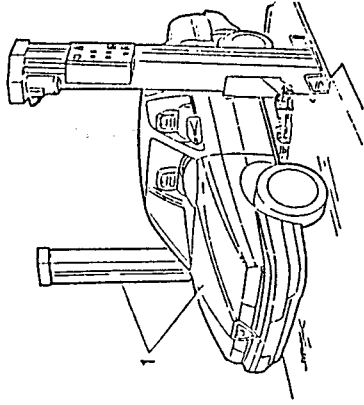
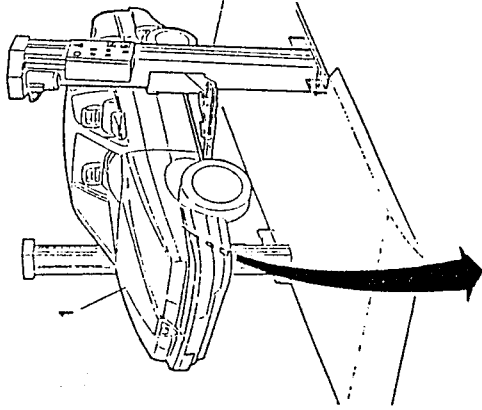
1. Remove the air cleaner cover, air flow meter and corrugated sleeve assembly.
2. If necessary remove the filter element.



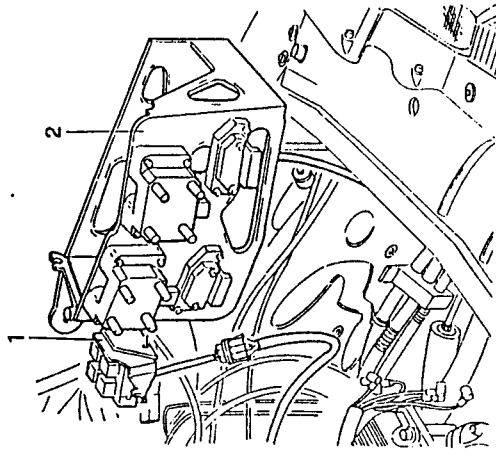
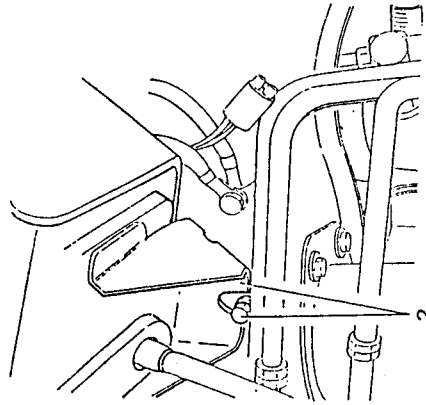
1. Disconnect the spark plug cables from the two ignition coils.
2. Disconnect the electrical connections supplying the ignition coils.
3. Disconnect the electrical connections from the two ignition modules.



1. Raise the vehicle on the lift.
2. Loosen the lower screw securing the battery support to the vehicle body.



- Unscrew the remaining screws securing the battery support to the body and raise it slightly.
1. Remove the relay box bracket from the battery by unscrewing the two screws.
 2. Remove the battery support together with the coils and ignition modules.

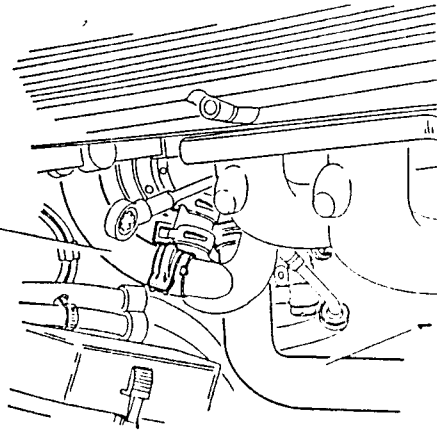
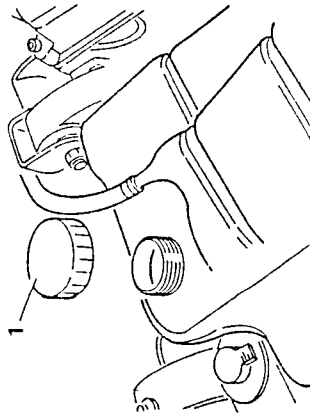


1. Remove the cap from the expansion tank, disconnect the coolant inlet sleeve from the pump and drain the engine coolant into a suitable container.

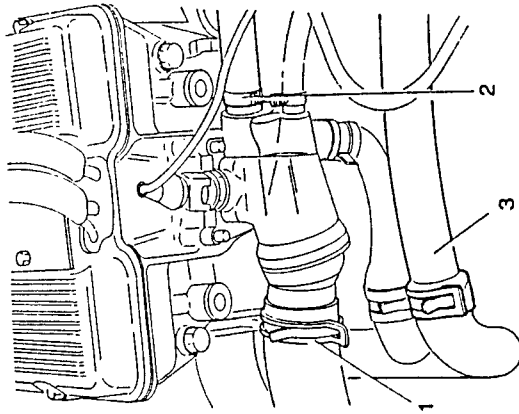
**CAUTION**

The antifreeze mixture used as an engine coolant damages paint: avoid all contact with painted surfaces.

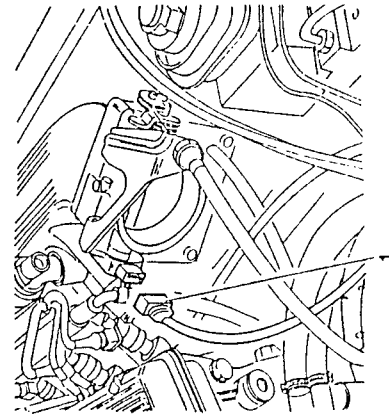
2. Disconnect the engine coolant delivery sleeve from the expansion tank.



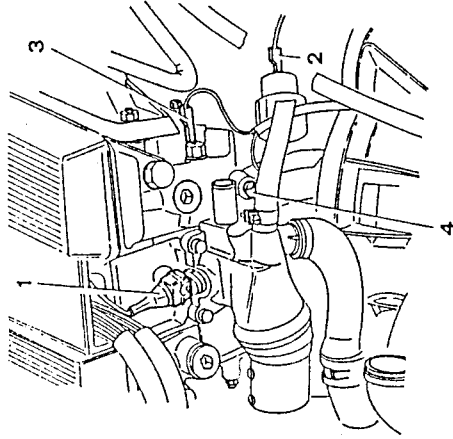
1. Disconnect the engine to coolant delivery sleeve from the thermostatic cup.
2. Disconnect the engine coolant to heater delivery sleeve from the thermostatic cup.
3. Disconnect the engine coolant return sleeve from the heater.



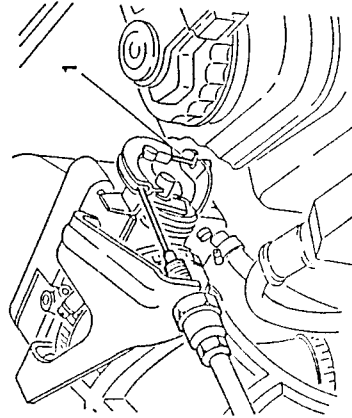
1. Disconnect the engine coolant to expansion tank delivery sleeve from the throttle valve.
2. Disconnect the electrical connection from the throttle valve potentiometer.



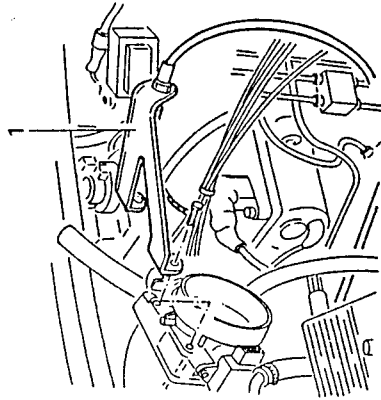
1. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).
2. Disconnect the electrical connection from the engine oil pressure meter.
3. Disconnect the electrical connection from the engine coolant maximum temperature warning light sensor.
4. Disconnect the electrical connection from the engine coolant temperature sender.



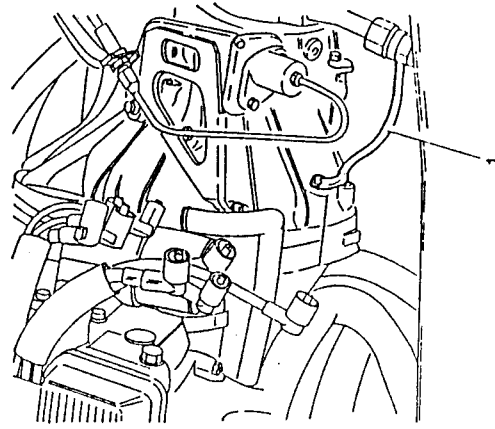
1. Disconnect the accelerator cable from the throttle body.



1. Remove accelerator cable support bracket and move it to the left-hand side of the engine compartment.

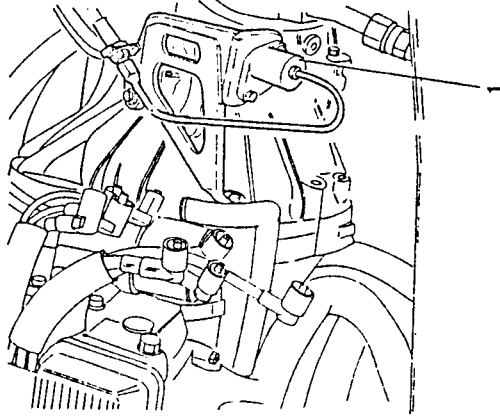


1. Disconnect the earth point from the negative (-) terminal of the battery.

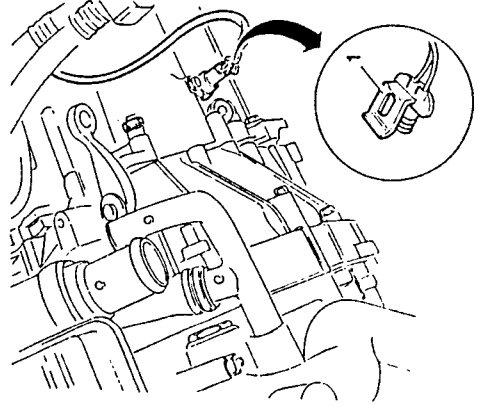




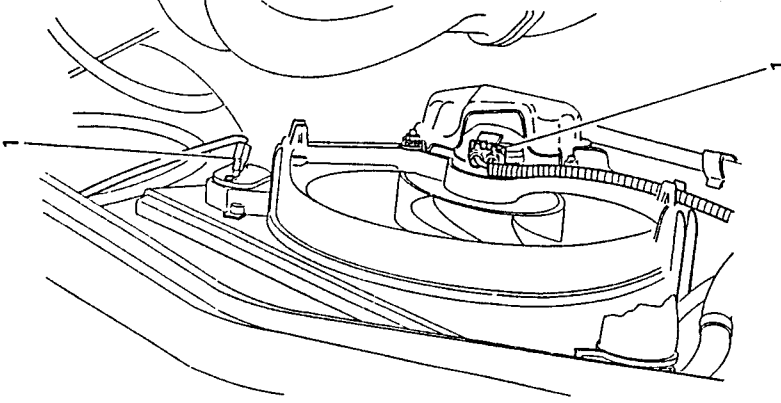
1. Unscrew the screws, and move the bracket to one side together with the hydraulic clutch control without disconnecting the oil inlet pipe.



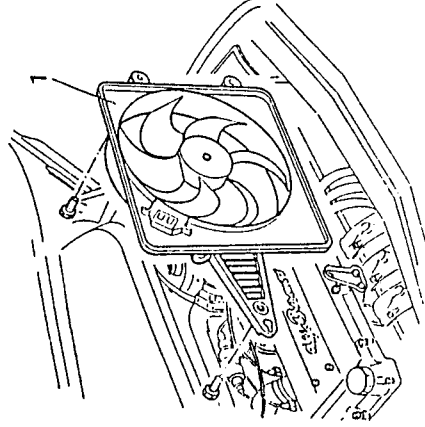
1. Disconnect the electrical connection from the reversing light switch.



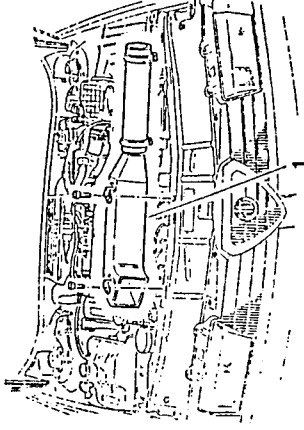
1. Disconnect the two electrical connections from the engine cooling fan.



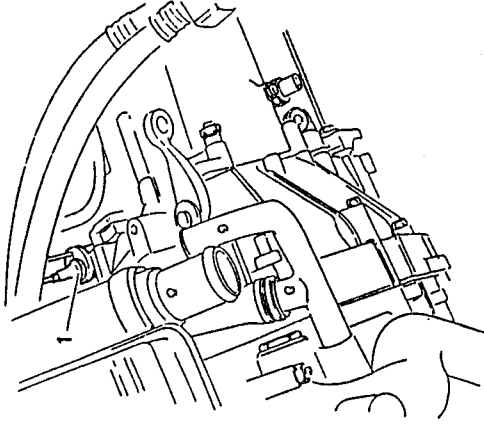
1. Remove the engine cooling fan.



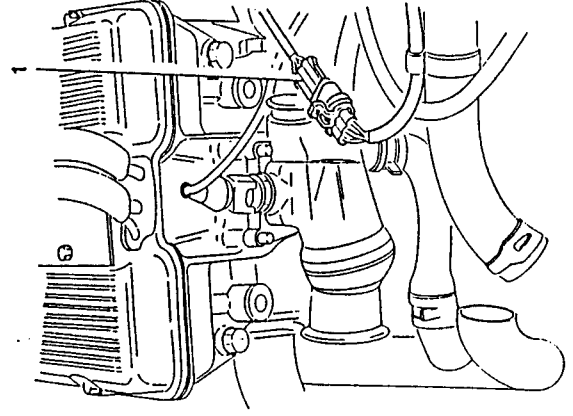
1. Remove the air intake duct from the cleaner together with the brackets.



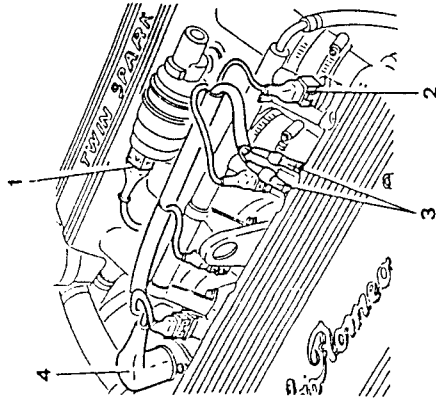
1. Disconnect the cable from the odometer sensor.



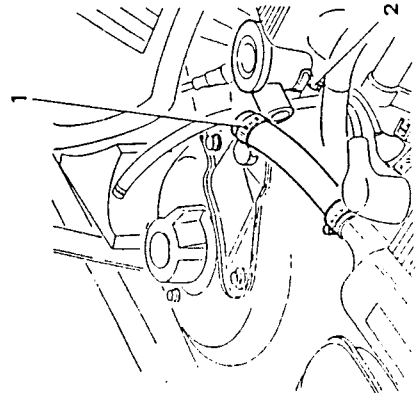
1. Disconnect the electrical connection from odometer sensor.



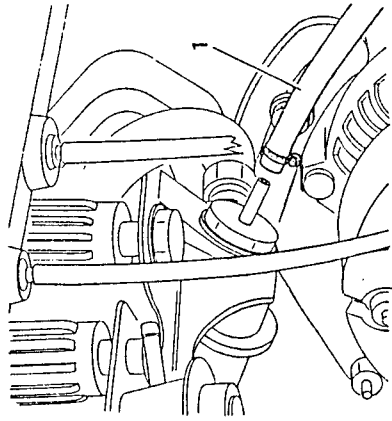
1. Disconnect the electrical connection from the con-start idle speed actuator.
2. Disconnect the electrical connections from the elec-troinjectors
3. Remove the earth cables from the timing cover.
4. Disconnect the electrical connection from the timing variator.



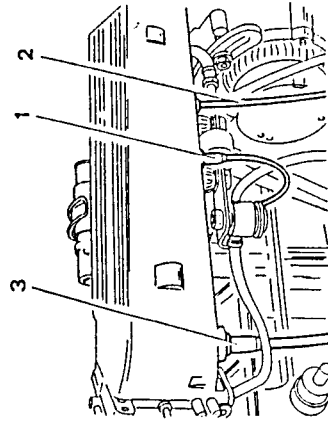
1. Disconnect the oil vapour recovery hose from the oil vapour separator.
2. Unscrew the two screws securing oil vapour separator to the air intake box and move it to one side.



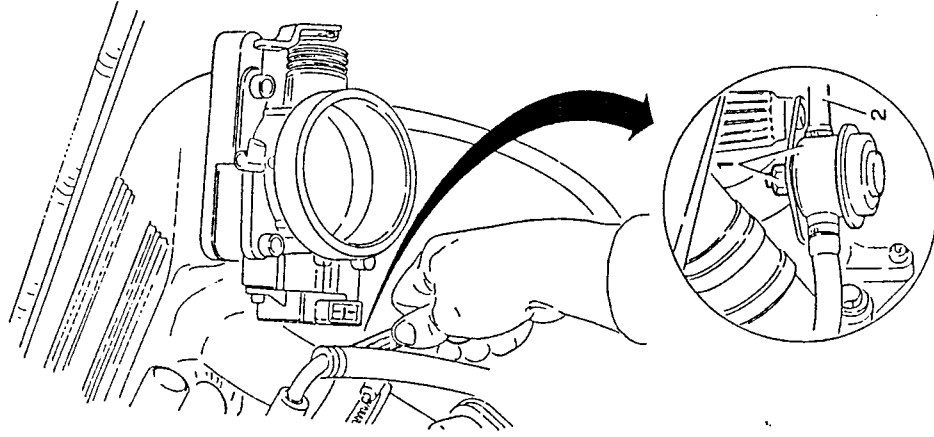
1. Disconnect the excess fuel to tank return hose from the pressure regulator.



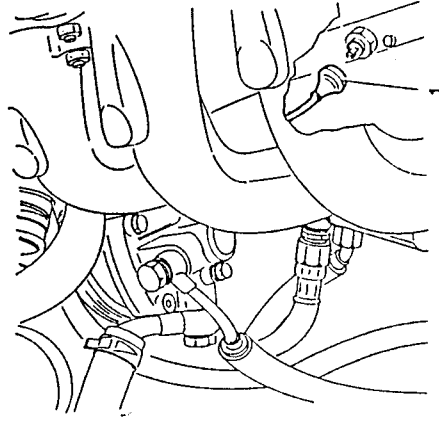
1. Disconnect the fuel pressure regulator vacuum intake hose from the air intake box.
2. Disconnect fuel vapour recirculation hose from the air intake box.
3. Disconnect the servo brake vacuum intake hose from the air intake box.



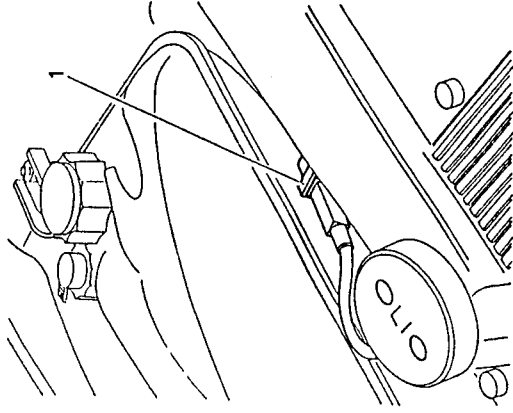
1. Unscrew the nut securing the impulse dashpot the support bracket.
2. Disconnect the fuel delivery hose from the impulse dashpot.



1. Disconnect the electrical connection from the engine oil minimum pressure warning light sensor.

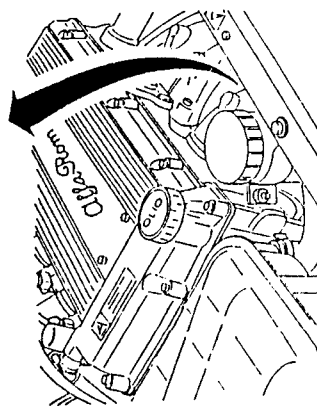
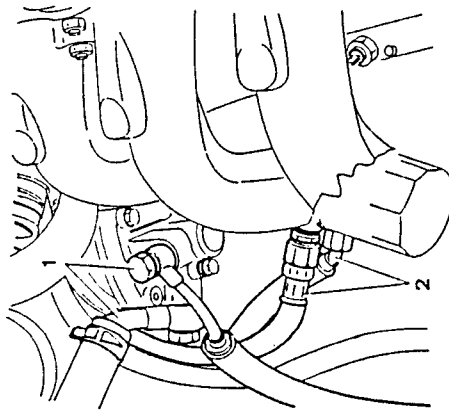


1. Disconnect the electrical connection from the r.p.m. and timing sensor.

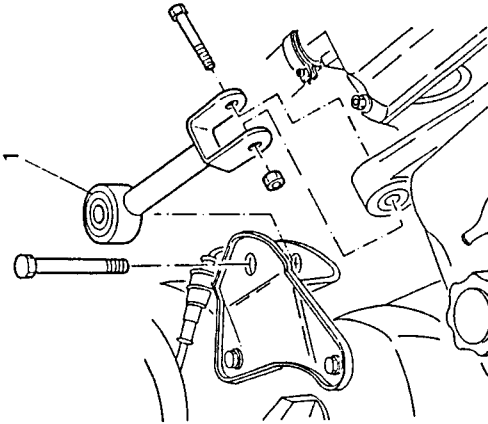




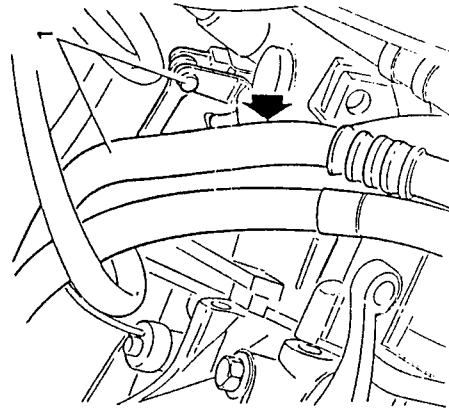
- 1 Disconnect the oil to power steering pump intake and delivery unions.
- Drain off the engine oil (see GROUP 00).
2. Specific procedure for A#67202 (1995 c.c.) engines. Disconnect the engine oil to relative cooling radiator intake and delivery unions from the oil filter support.



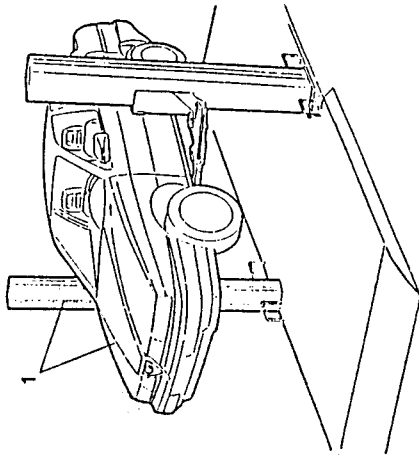
1. Remove the engine damping rod.



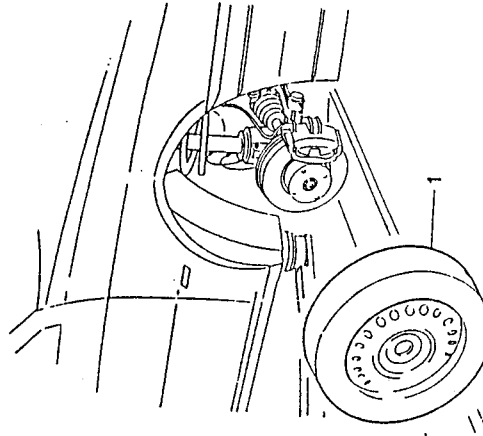
1. Move the air conditioning hoses in order to disconnect the upper gears selection rod.



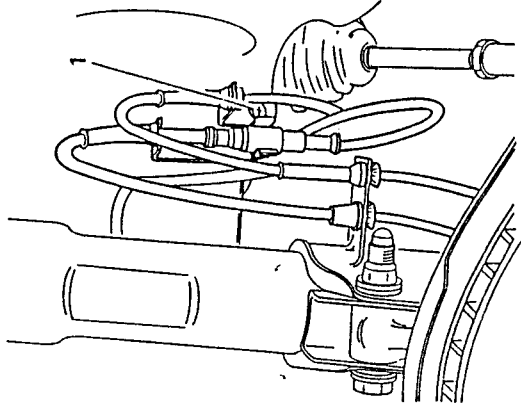
1. Raise the vehicle on the lift.



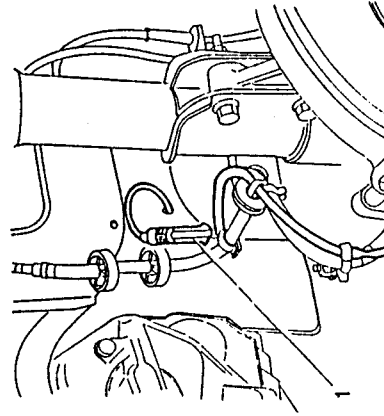
1. Remove the front wheels.



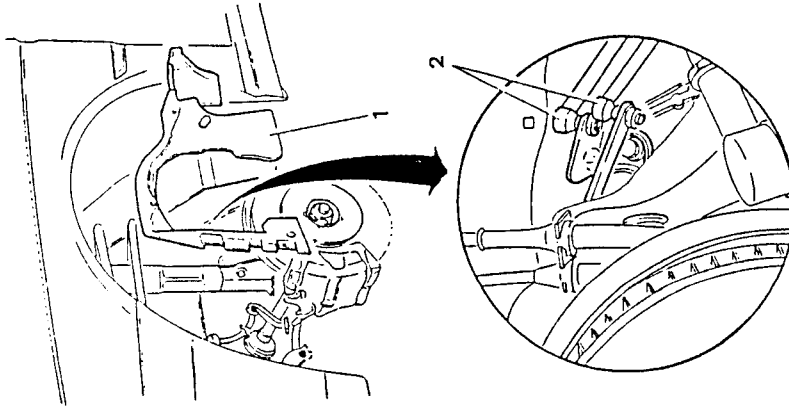
1. Working from the front left wheel arch, remove the bracket supporting the intelligent suspension and ABS sensors without disconnecting them.



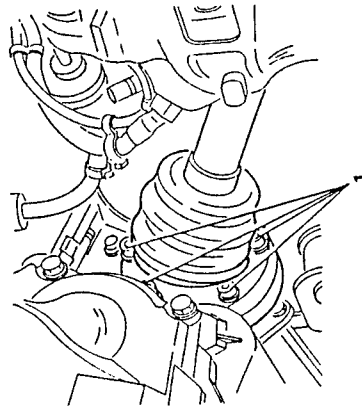
1. Disconnect brake pad wear sensor connection.



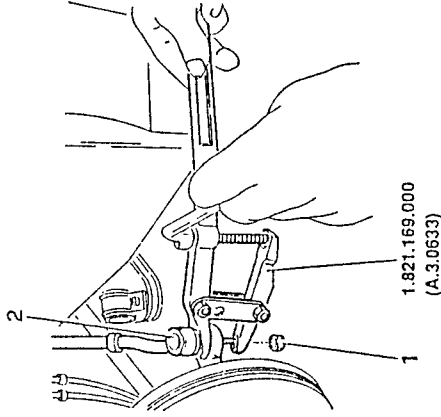
1. Remove the central engine protection cover from the left-hand wheelhousing.
2. Disconnect the two remaining gear selection rods.



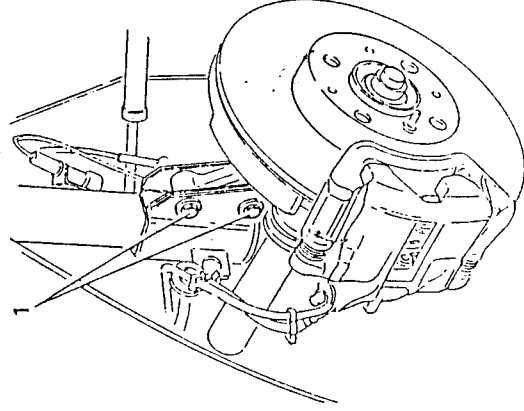
1. Unscrew the relative screws and disconnect the left-hand axle-shaft.



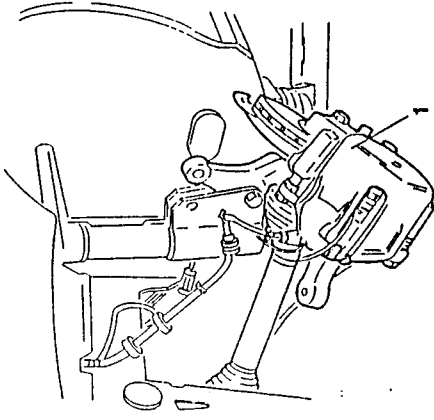
1. Unscrew the nut securing the articulated joint pin of the side steering tie-rod - left-hand side.
2. Remove the steering tie-rod from the control lever on the support using tool N° 1.821.169.000 (A.3.0633).



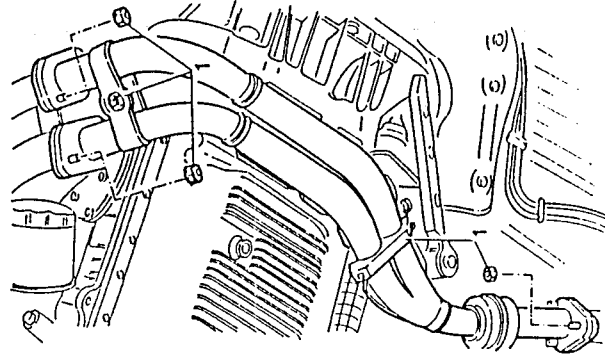
1. Loosen the two bolts securing the support to the front right shock absorber and remove only the upper bolt.



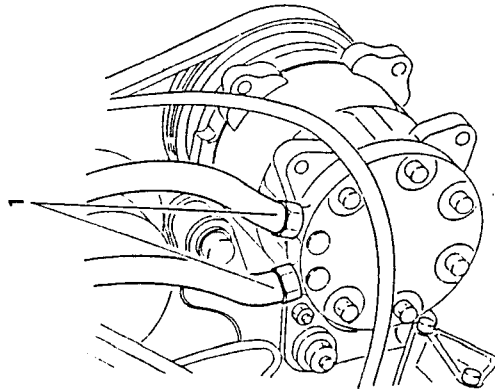
1. Tip the wheel hub as far forward as possible which will also move the axleshaft forward.



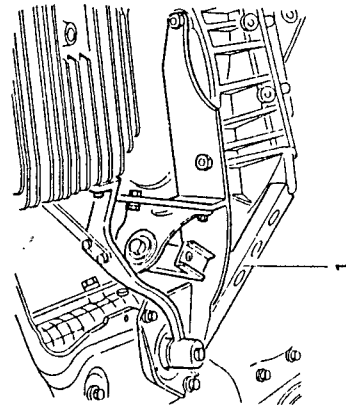
- Operate on the right-hand side as for the left to move the axleshaft forward from its support.
1. Remove the forward section of the exhaust pipe (see GROUP 04).



- Disconnect the electrical connections from the starter motor and alternator.
- 1. Disconnect the intake and delivery unions from the air conditioning compressor.



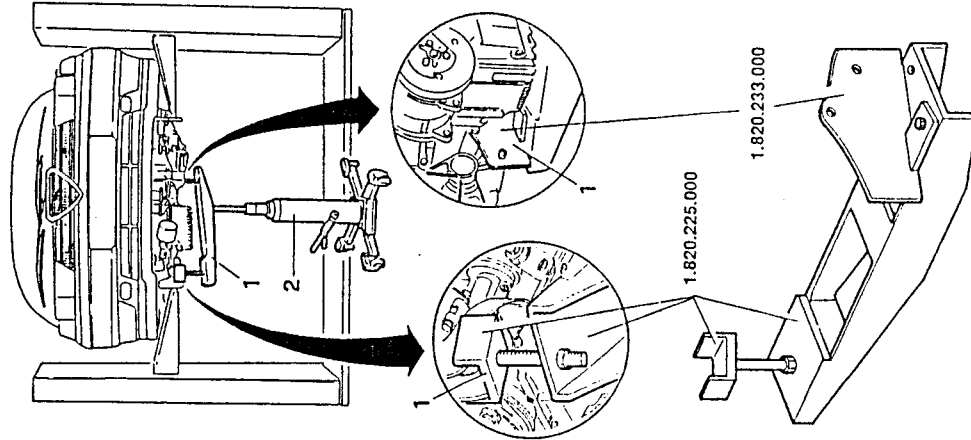
1. Remove the engine support bracket.



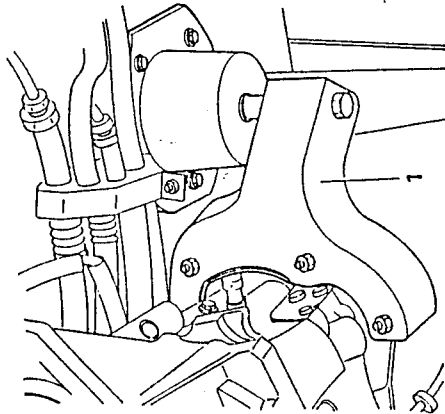
1. Install support tools N° 1.820.225.000 and N° 1.820.233.000 to remove the engine from the vehicle and position them as shown in the illustration.
2. Position a hydraulic jack under the engine support tools.


CAUTION

The hydraulic jack must be able to support a minimum of 1000 kg.



1. Remove the gearbox side engine support.


CAUTION

Disconnect the electrical cables from any clamps and move them away from the engine to avoid damaging them when the engine is removed.

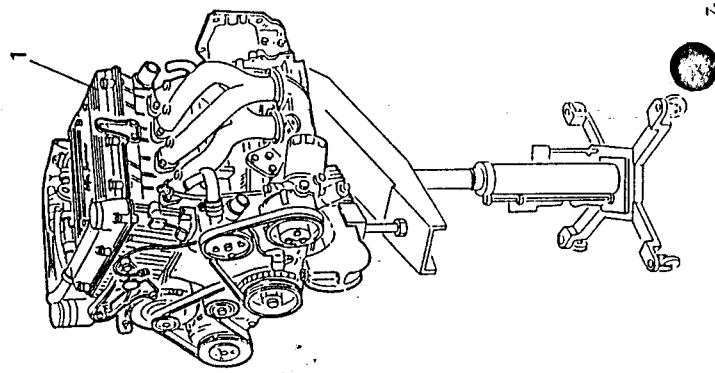
1. Lower the jack and remove the engine from the engine compartment.


CAUTION

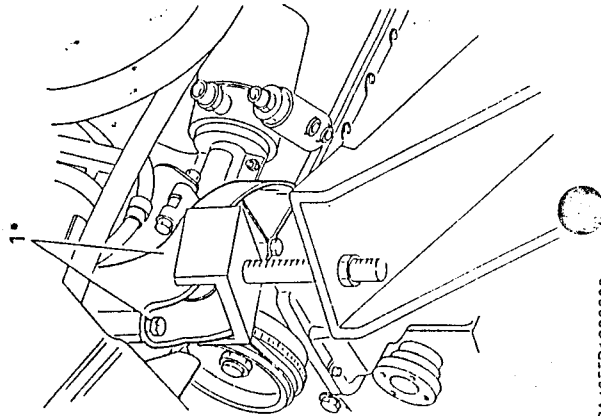
When lowering the jack check that no hoses or cables are still attached to the vehicle.


CAUTION

Pay close attention to avoid damaging components.



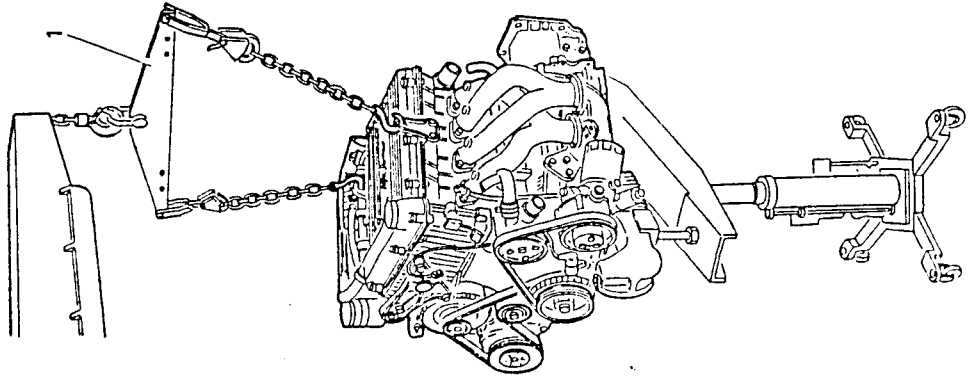
1. Remove the screw securing the engine front support.



1. Support the engine with a hydraulic crane in addition to the hydraulic jack used for its removal.

**CAUTION**

When moving the engine use a hydraulic crane after disengaging the engine from the supporting hydraulic jack.

**REFITTING**

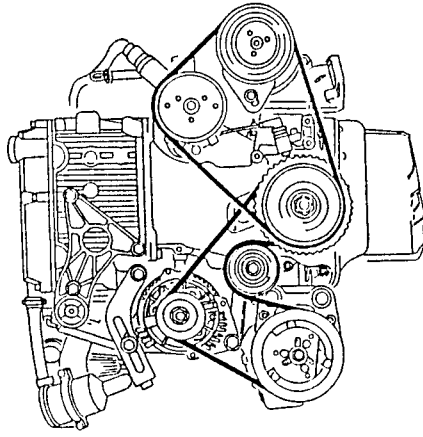
Repeat the above operations in the reverse order and note the following:

- Prepare the engine compartment for the insertion of the engine ensuring that the hoses and electrical cables etc. will not get caught in the engine when it is installed.
- Caution must be exercised when installing the engine, to ensure that no individual components are damaged.

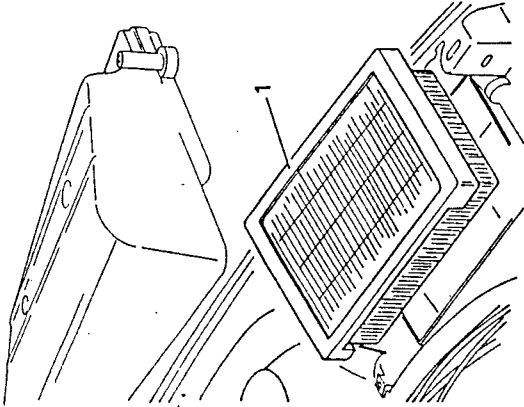
**CAUTION**

Ensure that the engine support points are correctly secured.

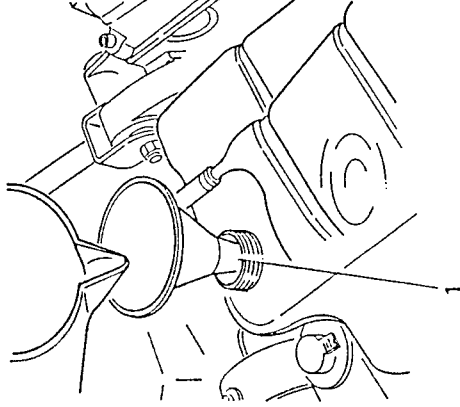
After installation check belt tensioning (see GROUP 00).



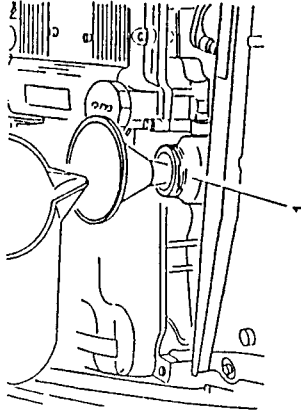
1. Refit the air cleaner ensuring that it is positioned as shown in the illustration.



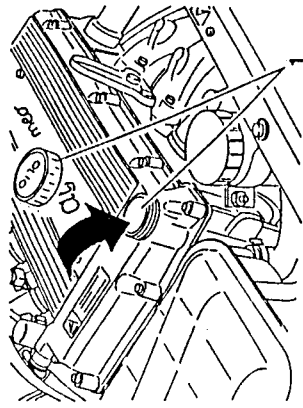
1. Fill the cooling system with the necessary fluid (see GROUP 00).



1. Fill the power steering system with the necessary fluid (see GROUP 00).



1. Fill the lubrication system with the necessary oil (see GROUP 00)



- Fill the air conditioning system (see GROUP 80)
- Check the levels of all the other fluids.
- Carry out all the checks and interventions indicated in GROUP 00.

ENGINE BENCH OVERHAUL

The instructions given in the following paragraphs refer to the complete overhaul of the engine on a bench after removal from the vehicle.

The instructions are divided as follows:

- Disassembly and reassembly of engine: removal (and successive refitting) of the gearbox, accessories etc. from the engine and disassembly of the engine into its main component parts.
- Disassembly and overhaul of cylinder heads: complete overhaul of all the components of the cylinder heads.
- Engine block checks and Inspections: complete overhaul of the components of the crank mechanisms.

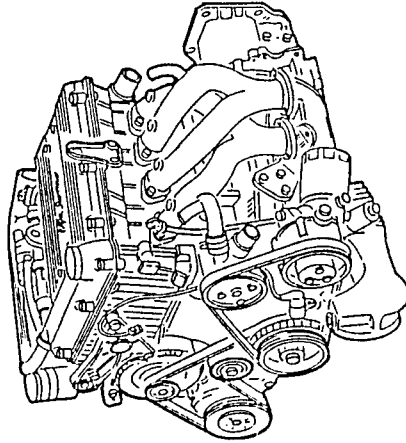
- Precautions for refitting: comprising the refit operations where they differ from the disassembly instructions.



All the disassembly instructions described in the following parts, when carried out in the reverse order, are also valid for refitting purposes unless indicated otherwise.

- Checks and inspections of the electrical components: Checks and inspections of the electrical components relative to the engine.

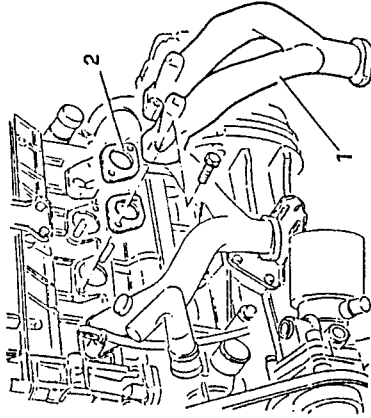
The procedures which follow refer to the complete overhaul of the complete engine unit: it is however possible to use individual parts of these instructions when dealing with specific components.



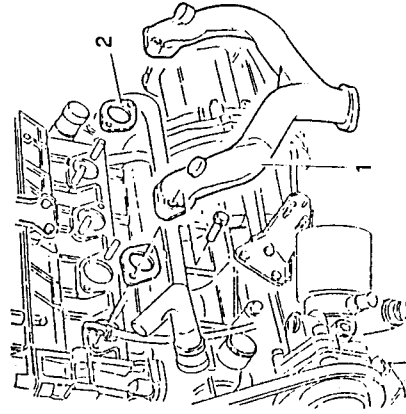
ENGINE DISASSEMBLY AND REASSEMBLY

REMOVAL OF LEFT-SIDE COMPONENTS

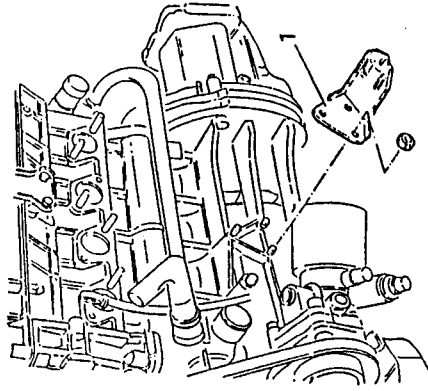
1. Remove the exhaust manifolds from the second and third cylinders.
2. Remove the gaskets.



1. Remove the exhaust manifolds from the first and fourth cylinders.
2. Remove the gaskets.

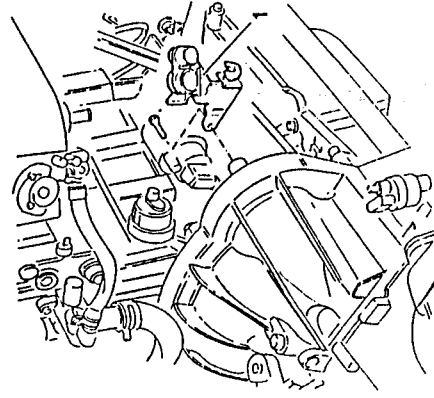


1. Remove the exhaust pipe forward section support bracket.

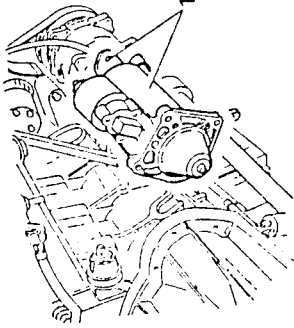


REMOVAL OF RIGHT-SIDE COMPONENTS

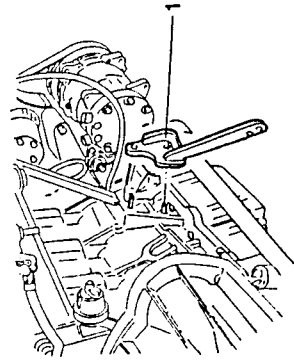
1. Remove the bracket supporting the freon to compressor delivery and return hoses and the starter motor electric supply cables.



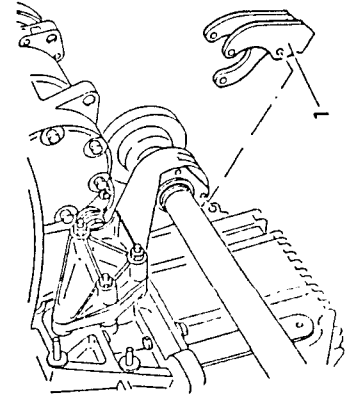
1. Remove the stator motor together with the rear support bracket.



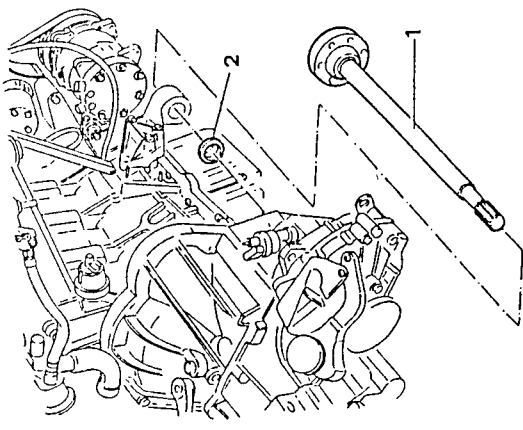
1. Remove the engine support bracket.



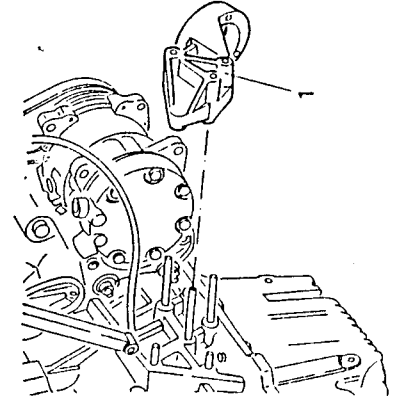
1. Remove the bracket securing the intermediate shaft to the support.



1. Withdraw the intermediate shaft.
2. Remove the dustband.

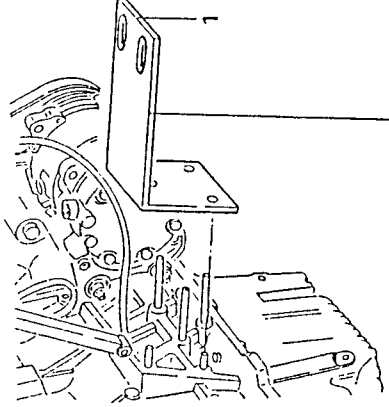


1. Remove the intermediate shaft support.

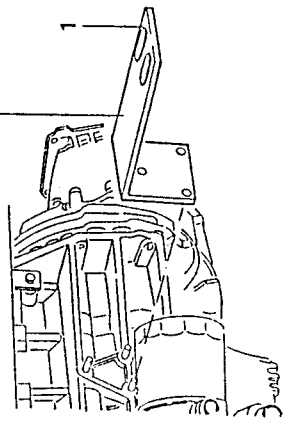


REMOVAL OF GEARBOX-DIFFERENTIAL GROUP

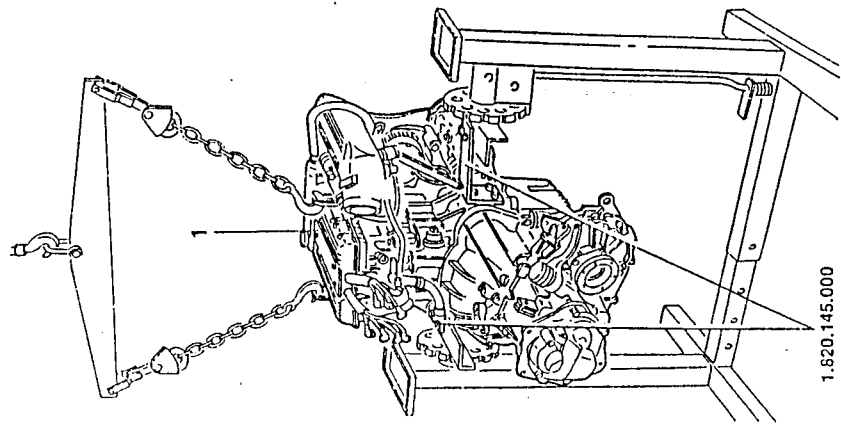
1. Install the two brackets N° 1.820.145.000 (R.4.0178) onto the engine block ready for positioning the over-haul stand.



1.820.145.000
(R.4.0178)



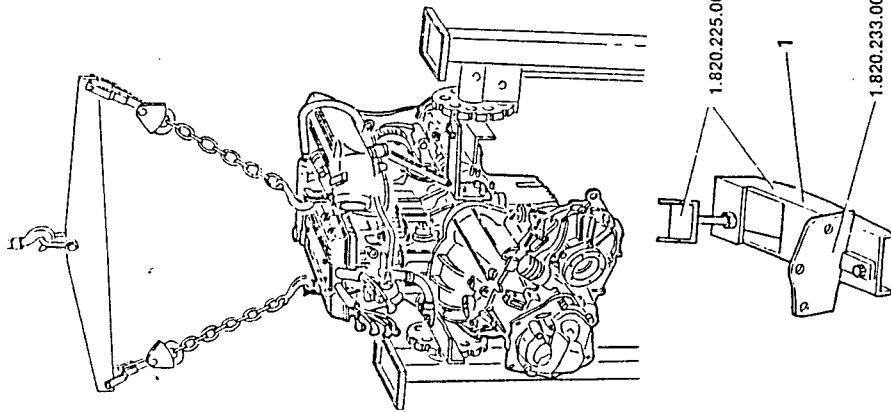
1. Raise the engine using a hydraulic lift and releasing it from the supporting jack. Place it on a rotary over-haul stand and secure it using brackets N° 1.820.145.000 (R.4.0178).



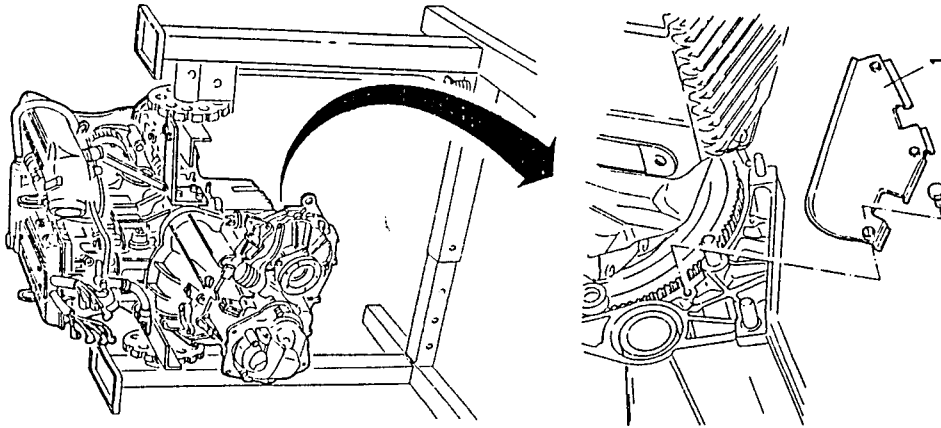
1.820.145.000
(R.4.0178)



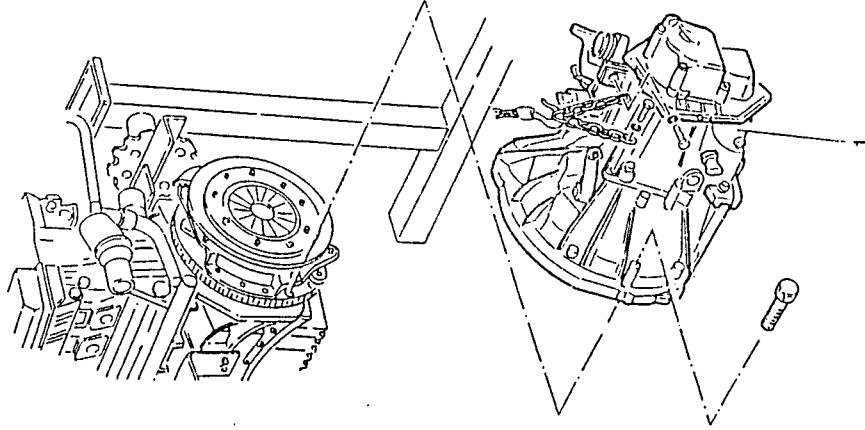
1. Remove tools N° 1.820.225.000 and N° 1.820.233.000 used to remove the engine from the engine compartment.



1. Remove the flywheel cover.



1. Using a hydraulic crane remove the gearbox-differential group from the engine.

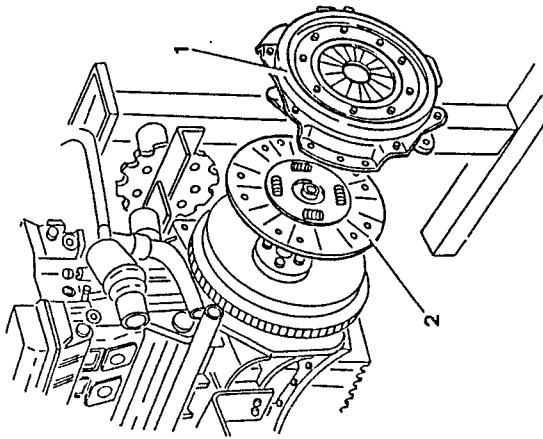


NOTE: For the complete overhaul of the gearbox refer to GROUP 13.



CLUTCH PLATE REMOVAL

1. Remove the disk pressure plate body.
2. Remove the clutch disk.

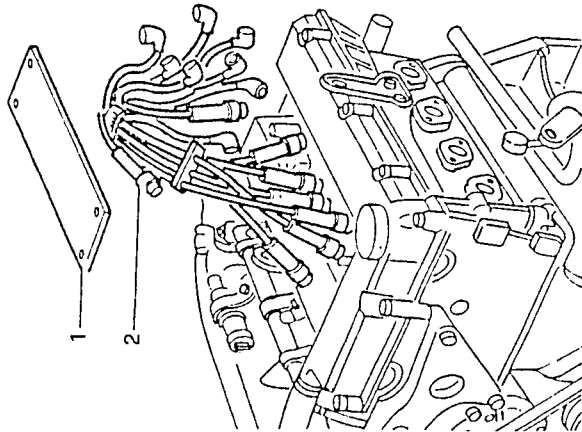


NOTE: For further details regarding the clutch and its components refer to GROUP 12.

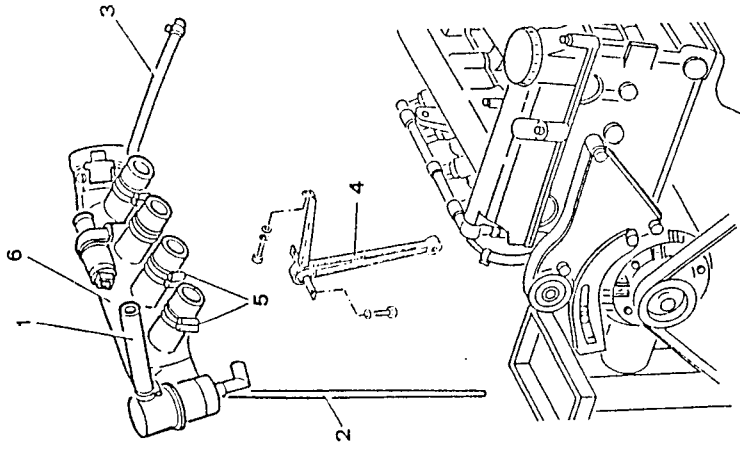
REMOVAL OF AIR INTAKE BOX

NOTE: For additional disassembly and inspections regarding the fuel supply system refer to GROUP 04.

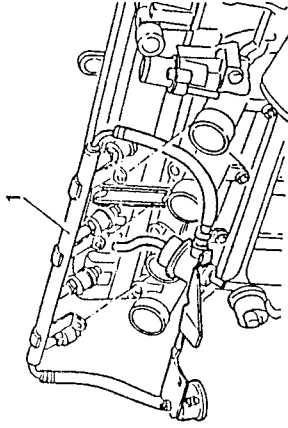
1. Remove the spark plug cover.
2. Disconnect the leads from the spark plugs and remove them together with their clamps.



1. Disconnect the oil vapour hose from the cylinder head cover.
2. Disconnect the oil recirculation hose from the engine block.
3. Disconnect the water to throttle body delivery hose from the thermostatic cup.
4. Remove the strut supporting the air intake box.
5. Loosen the clamps holding the sleeves connecting the intake box to the cylinder head.
6. Remove the complete air intake box.

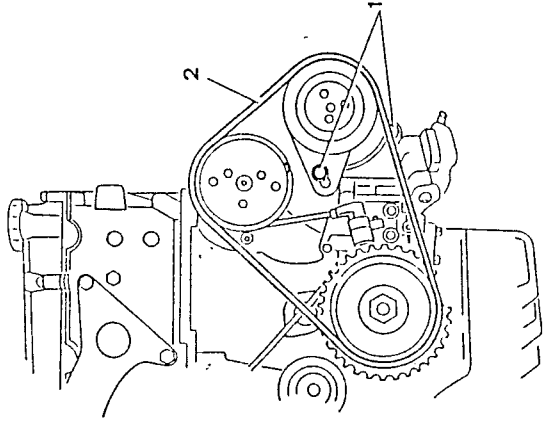


1. Remove the fuel supply manifold complete with injectors and supporting bracket with fuel pressure regulator and impulse dashpot.

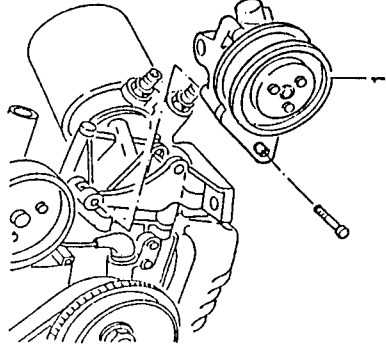


REMOVAL OF POWER STEERING PUMP

1. Loosen the two bolts securing the power steering pump.
2. Remove the water pump/power steering pump drive belt.

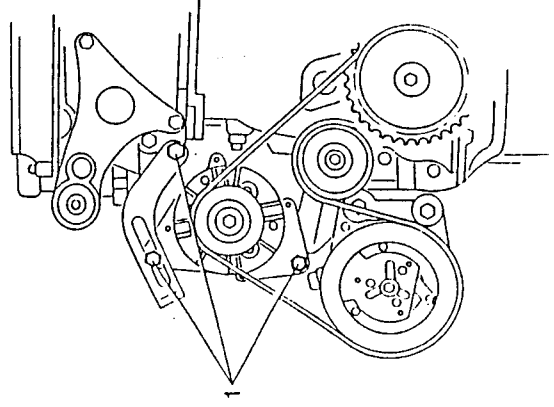


1. Withdraw the bolts and remove the power steering pump.



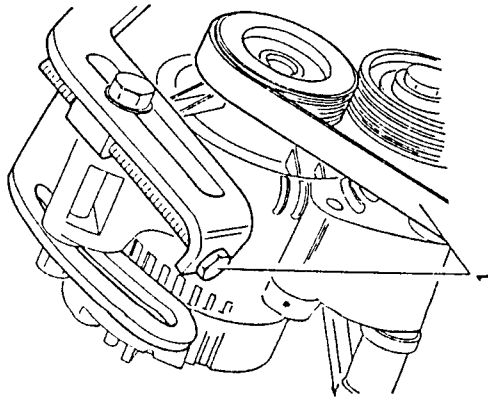
REMOVAL OF ALTERNATOR

1. Loosen the bolts securing the alternator.

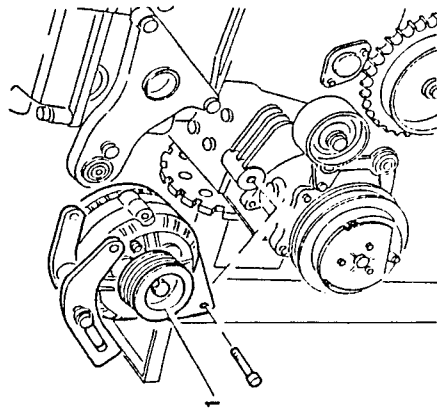




1. Loosen the drive belt by acting on the micrometric tensioner and withdraw it from the alternator pulley.

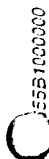
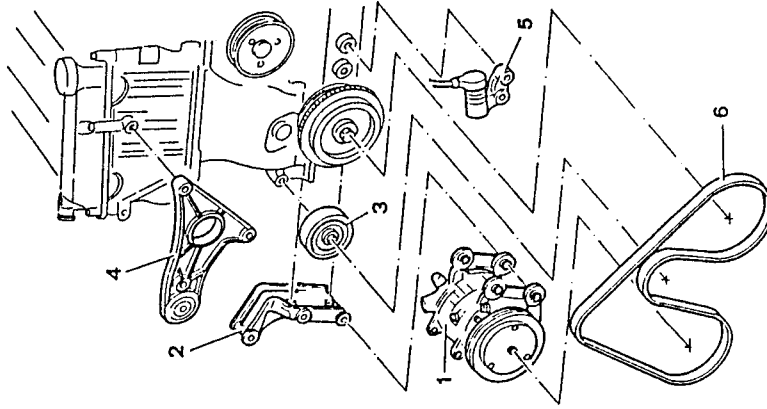


1. Withdraw the pins and remove the alternator together with belt tensioner brackets.



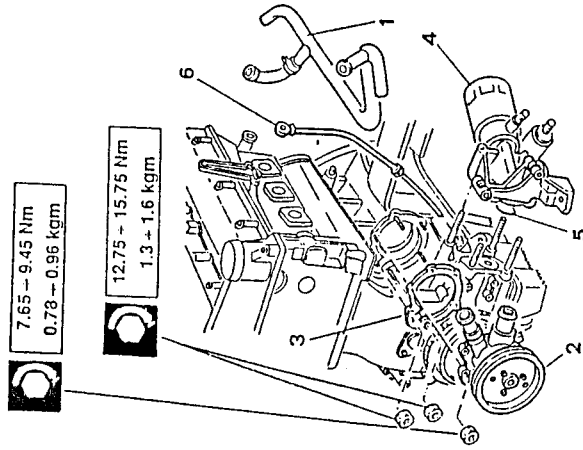
REMOVAL OF AIR CONDITIONING COMPRESSOR

1. Unscrew the two pins and remove the compressor.
2. Remove the alternator and compressor support.
3. Remove the guide pulley.
4. Remove the front engine support bracket.
5. Remove the r.p.m. and timing sensor.
6. Remove the air conditioning compressor - alternator drive belt.

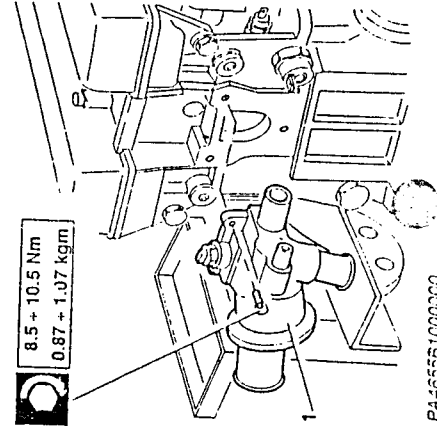


REMOVAL OF WATER PUMP

1. Remove the engine coolant to pump intake hose.
2. Remove the water pump.
3. Remove the water pump gasket.
4. Remove the oil filter support assembly.
5. Remove the O-ring.
6. Remove the oil dipstick.

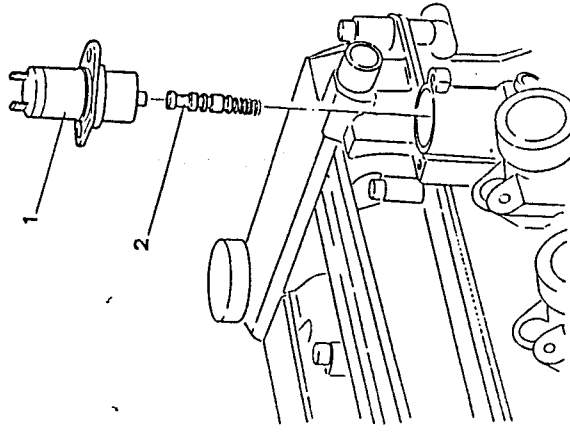


1. Remove the thermostat group.

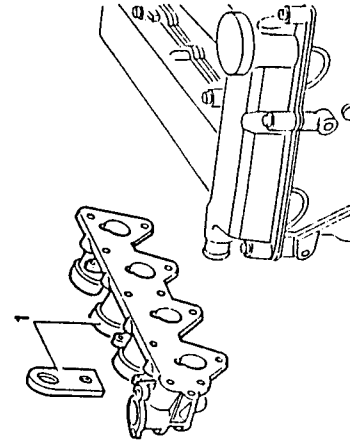


REMOVING CYLINDER HEAD

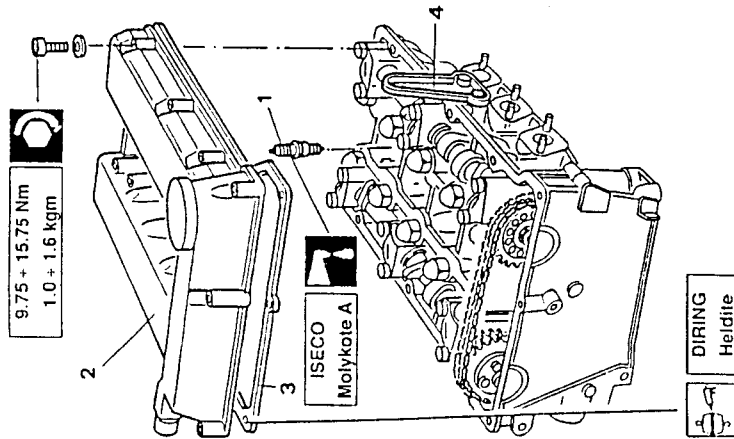
1. Remove the timing variator controlling solenoid.
2. Remove the timing variator control valve and spring.



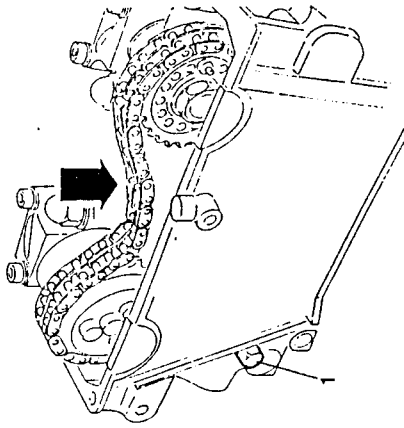
1. Remove the intake manifolds and right-hand engine support bracket.



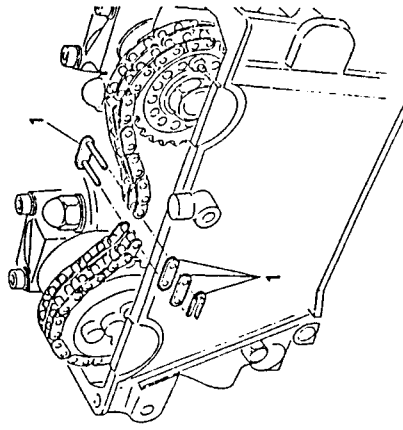
1. Remove the spark plugs.
2. Remove the timing cover.
3. Remove the gasket.
4. Remove the left-hand engine support bracket.



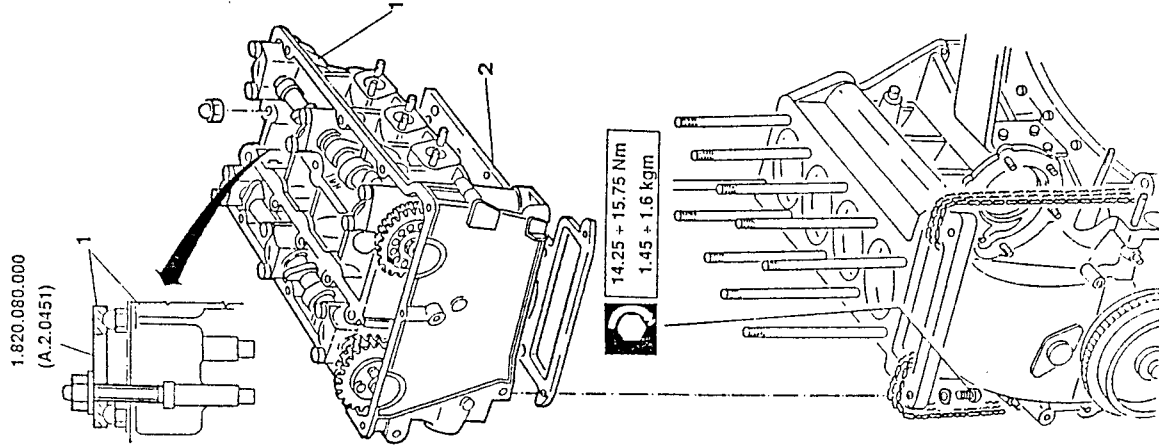
- Rotate the crankshaft until the connecting chain link is at the top.
- 1. Unlock the belt tensioner screw and push the chain downwards. Lock the belt tensioner in this position by re-tightening the relative screw.



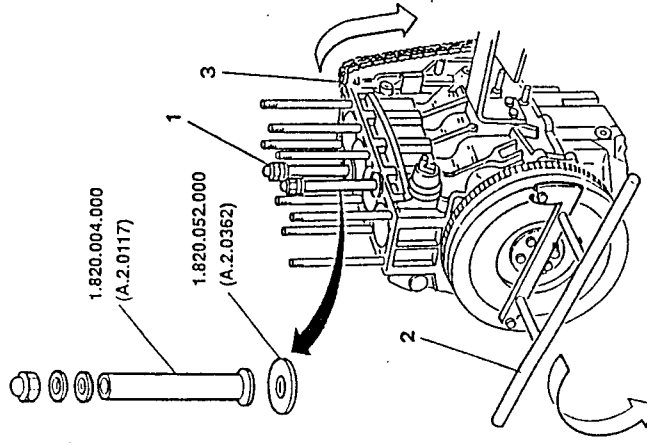
1. Remove the connecting link from the timing chain.



1. Using tool N° 1.820.060.000 (A.2.0451), release the cylinder head and remove it.
2. Remove the gasket.



1. Install the cylinder liner fixing tools N° 1.820.004.000 (A.2.0117) with washers N° 1.820.052.000 (A.2.0362).
2. Install a suitable tool to permit rotation of the crankshaft.
3. Withdraw the timing chain by rotating the crankshaft.

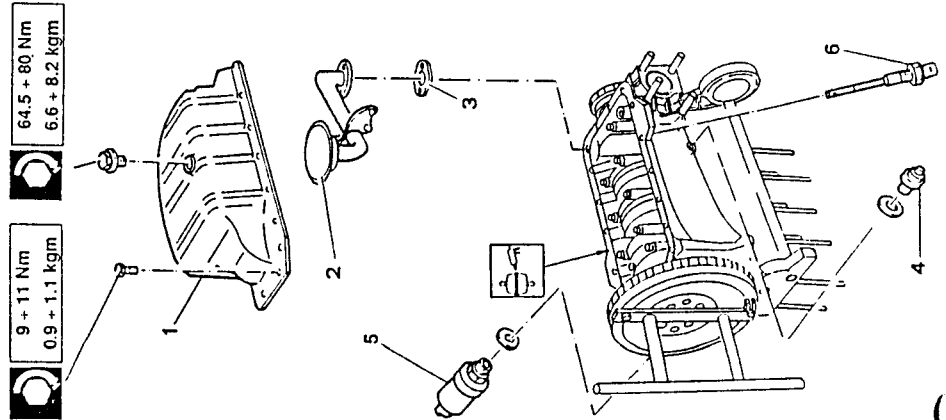


To refit the cylinder head refer to the relevant paragraph.



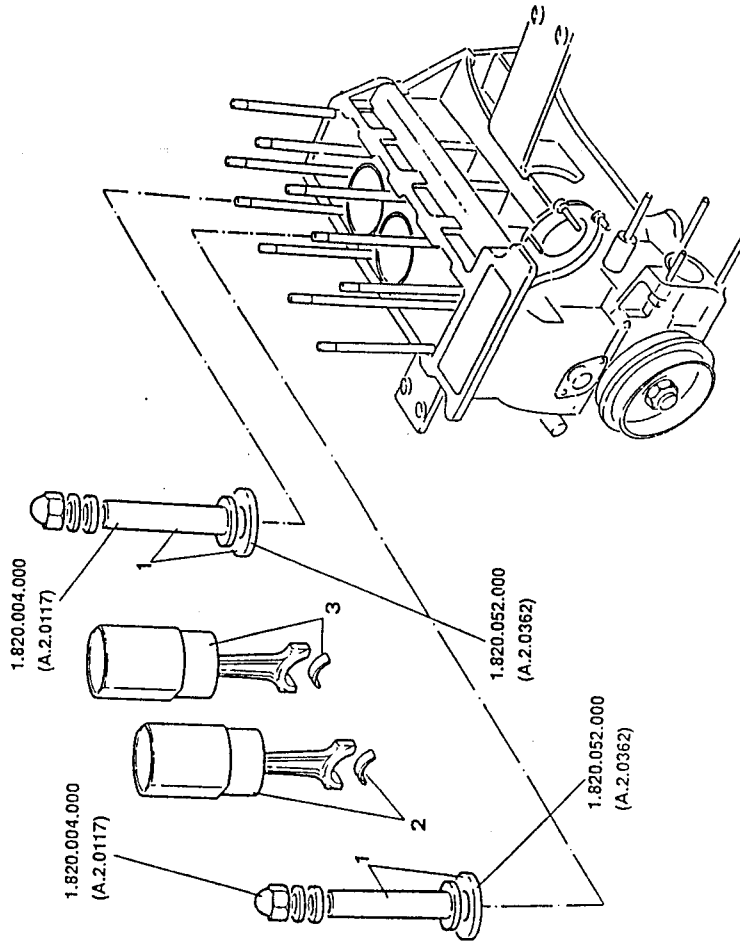
REMOVAL OF COMPONENTS FROM THE ENGINE BLOCK

- Release the rotary stand and rotate the engine block 180°.
- 1. Remove the oil sump.
- 2. Remove the oil pump suction body.
- 3. Remove the gasket.
- 4. Remove the engine oil minimum pressure warning light sensor.
- 5. Remove the engine oil pressure meter.
- 6. Remove the engine oil level sensor.



- Release the rotary stand and rotate engine block 180°.
- 1. Remove the cylinder liner fixing tools N° 1.820.004.000 (A.2.0117) and washers N° 1.820.052.000 (A.2.0362).

- 2. Withdraw the cylinder liner with piston from the first cylinder. Remove the relative rod half-bearing.
- 3. Withdraw the cylinder liner and piston from the fourth cylinder. Remove the relative rod half-bearing.
- Rotate the engine block 180° and proceed in the same way for the second and third cylinders.



1. Withdraw the liner.
2. Remove the O-ring
3. Using a suitable tool, withdraw the seal rings and oil scraper ring from the piston.

CAUTION

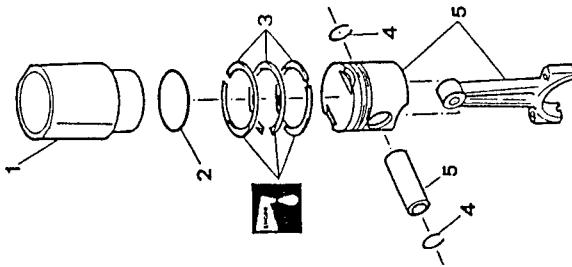
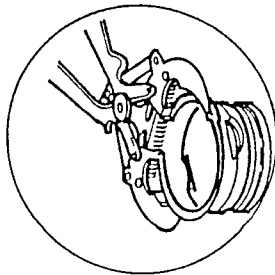
Proceed with care in order to avoid breaking the rings which may otherwise be re-used.



When refitting, install the seal rings so that the word «TOP» stamped onto them faces upwards.

4. Withdraw the two flexible rings securing the gudgeon pin.
5. Withdraw the gudgeon pin and separate the piston from the rod.

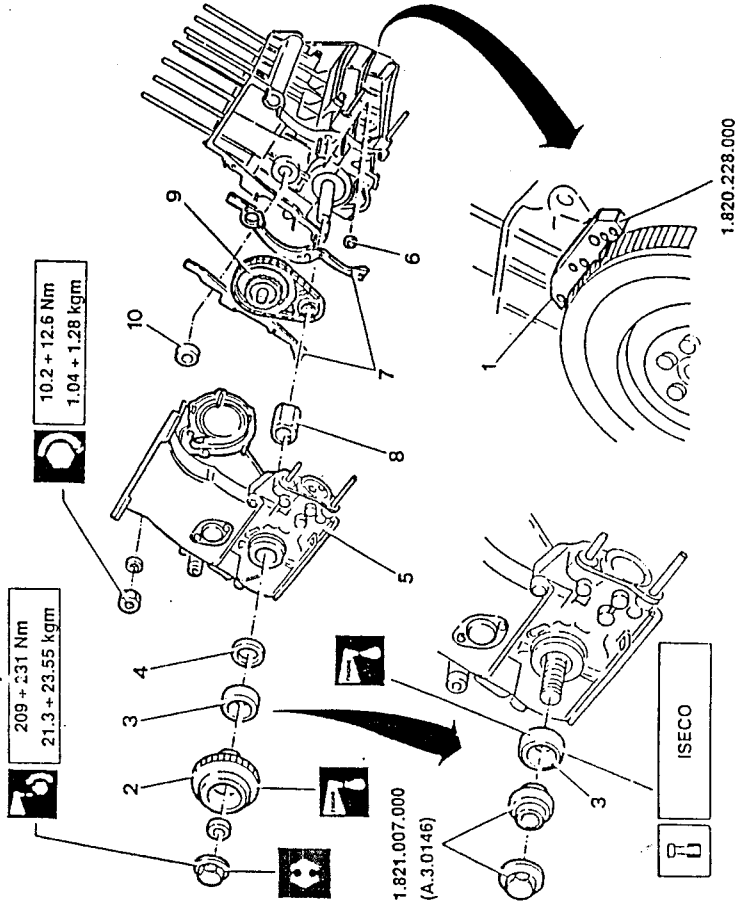
To refit, follow the indications given in the relative paragraph.

**REMOVAL OF COMPONENTS FROM THE ENGINE BLOCK (Continued)**

Remove the previously installed tool for rotating the flywheel.

1. Install tool N° 1.820.228.000 to prevent rotation of the flywheel.
2. Remove the crankshaft pulley.
3. Remove the oil seal ring.
When refitting use inserting tool N° 1.820.007.000 (A.2.0146).

4. Remove the washer.
5. Remove the front cover.
6. Remove the seal ring.
7. Remove the gaskets between the front over and the engine block.
8. Remove the oil pump control pinion.
9. Withdraw the toothed wheels and relative chain.
10. Remove the the shoulder.

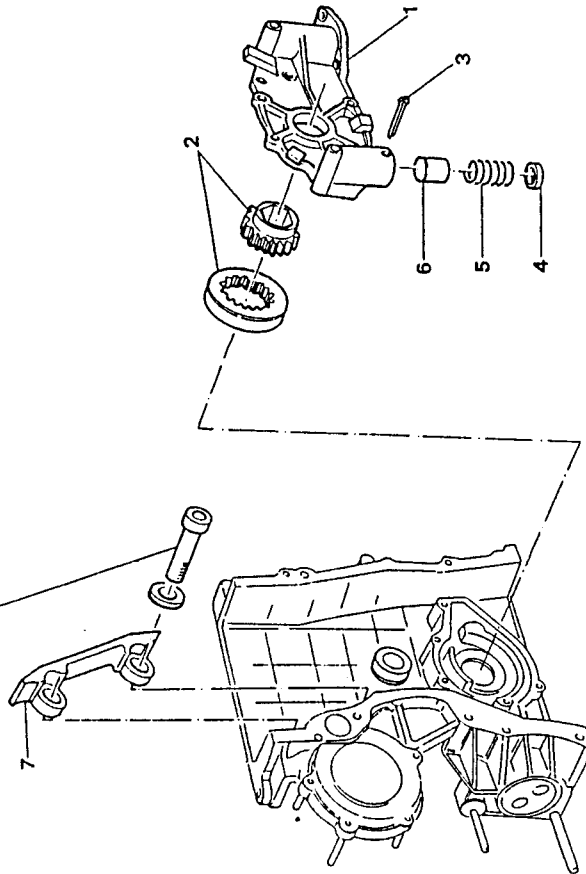




DISASSEMBLY OF OIL PUMP

1. Remove the front cover from the pump body.
2. Remove the toothed wheels.
3. Withdraw the cotter pin.

$6 + 8 \text{ Nm}$
 $0.6 + 0.8 \text{ kgm}$



4. Remove the cap.
5. Remove the spring.
6. Remove the oil pressure relief valve.
7. Remove the timing chain shoe.



REMOVAL OF COMPONENTS FROM ENGINE BLOCK (Continued)

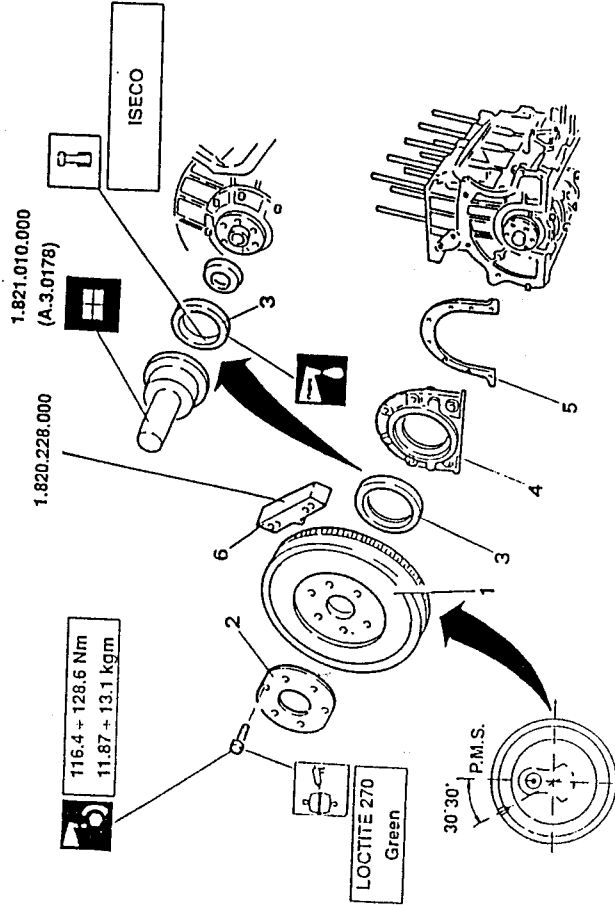
1. Remove the flywheel.



When installing, rotate the crankshaft until the rod journal of the first and fourth cylinder is at T.D.C.; position the flywheel and check that the small hole located on the outer edge is at 31°30' in relation to the vertical.

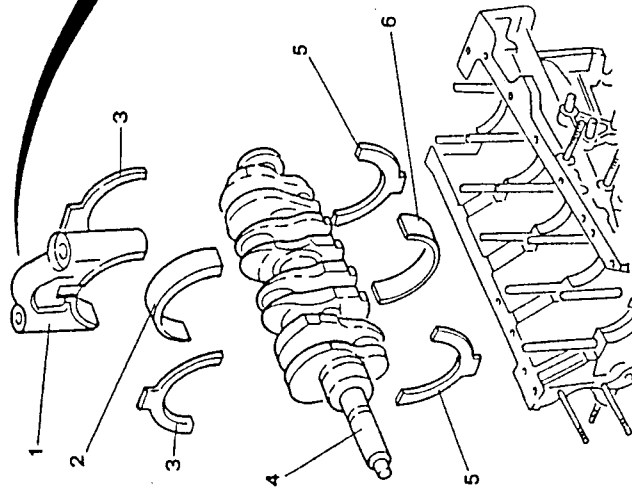
Before applying the specified fixative to the threads of the flywheel retaining screws, remove all traces of the old fixative.

2. Remove the safety washer.
3. Remove the oil seal.
When refitting use inserting tool N° 1.821.010.000 (A.3.0178).
4. Remove the rear cover.
5. Remove the gasket between rear cover and engine block.
6. Remove the tool N° 1.820.228.000 which was previously installed to lock the flywheel.



REMOVING THE CRANKSHAFT

1. Remove the main journal caps using a suitable tool.
2. Remove the the main half-bearings from the main journal caps
3. Remove the lower thrust half-rings.
4. Remove the crankshaft.
5. Remove the upper thrust half-rings.
6. Remove the main half-bearings from the supports.



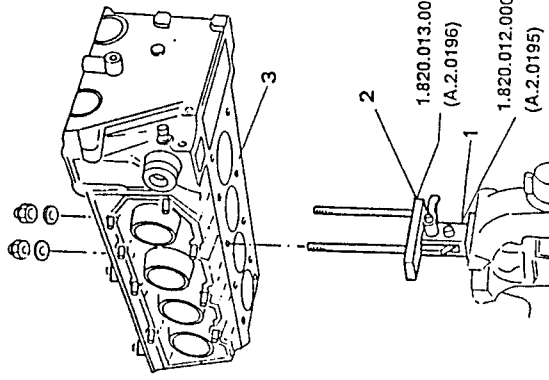
NOTE: Mark the position of the various components in case they are to be reused.



To reit the crankshaft follow the indications given in the relative paragraph.

DISASSEMBLY OF CYLINDER HEADS
HEADS
PRELIMINARY OPERATIONS

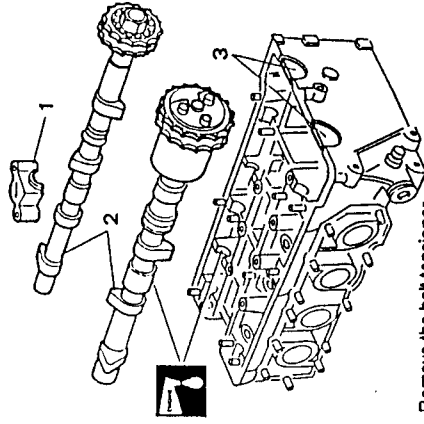
1. Lock the moveable support N° 1.820.012.000 (A.2.0195) into a vice.
2. Install fork N° 1.820.013.000 (A.2.0196) and lock it to the support.
3. Insert the cylinder head onto the rods of the fork and lock it into position.


REMOVING THE CAMSHAFTS

1. Remove the camshaft caps.

NOTE: Arrange the caps in order in case they are to be reused.

2. Remove the camshafts.
3. Remove the rubber pads.

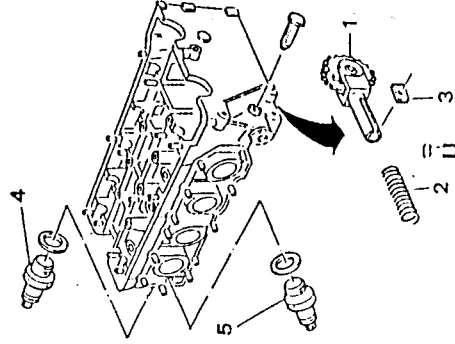


1. Remove the belt tensioner.
2. Remove the spring.
3. Remove retaining plate.


CAUTION

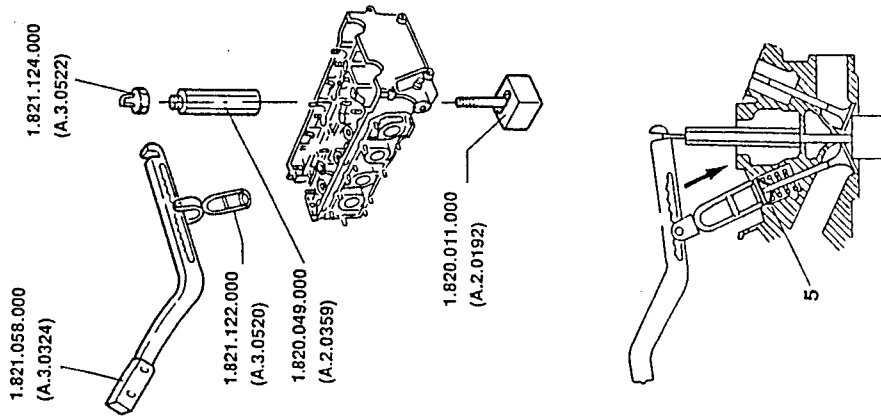
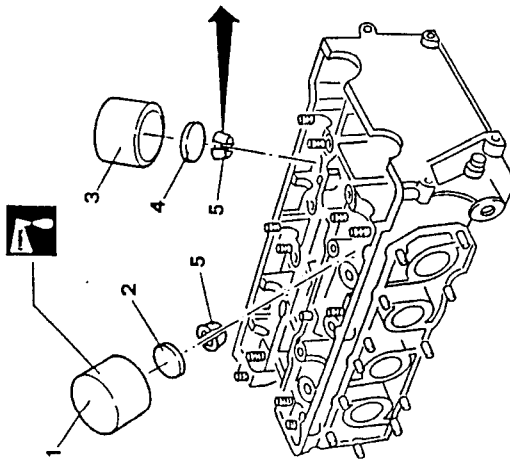
Restrain the belt tensioner when releasing the retaining screw and release the spring.

4. Remove the engine coolant temperature sender.
5. Remove the engine maximum temperature sensor.



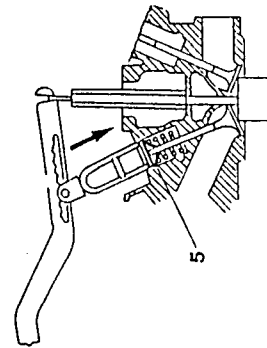
DISASSEMBLY OF VALVES

- Operate on one cylinder at a time.
- 1. Withdraw the valve cup from the intake side.
- 2. Remove the valve clearance adjustment cap - intake side.
- 3. Withdraw the valve cup - exhaust side.
- 4. Remove the valve clearance adjustment cap - exhaust side.



NOTE: Arrange the components in order in case they are to be reused.

- 5. With the tool illustrated below, remove the exhaust and intake side cotters.

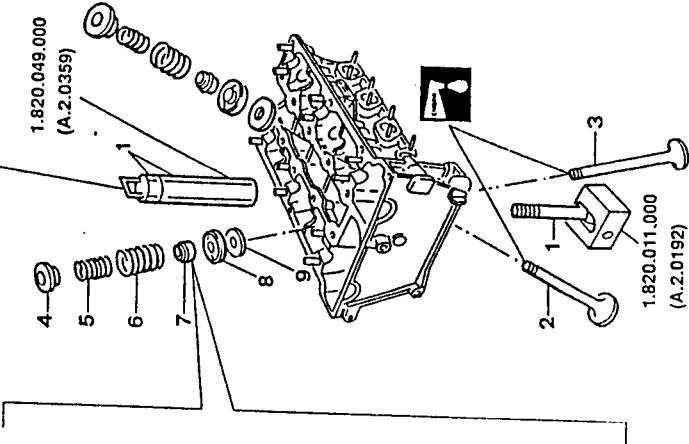
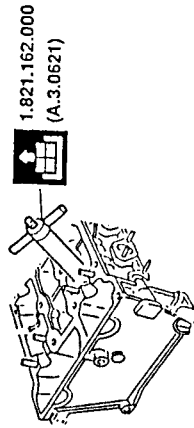


When refitting use Inserting tool N° 1.821.110.000 (A.3.0469).

- 8. Remove the spring retaining ring.
- 9. Remove the lower cap.
- Proceed likewise for the components on the exhaust side.
- Following the same procedure and using the same tools, operate on the other cylinders.

- 1. Remove the previously installed tools.

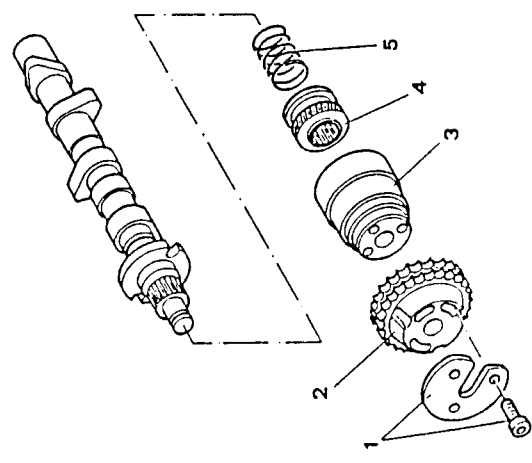
- 2. Withdraw the intake valve.
- 3. Withdraw the exhaust valve.
- Operate on the exhaust side.
- 4. Remove the upper cap.
- 5. Remove the inner spring.
- 6. Remove the outer spring.
- 7. Using puller N° 1.821.162.000 (A.3.0621), remove the oil seal.





DISASSEMBLY OF THE CAMSHAFT - INTAKE SIDE

1. Unscrew the three screws and remove the safety plate.
2. Remove the timing gear.
3. Remove the body.
4. Remove the piston.
5. Remove the piston return spring.



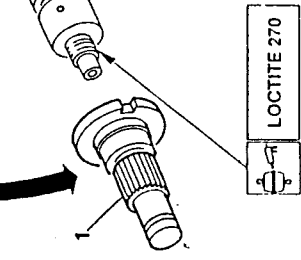
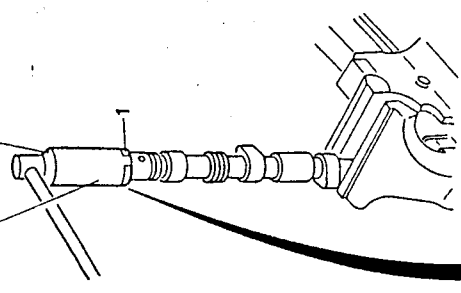
When reassembling:

- ensure that the sealant does not block the oil channels.
- Do not tighten the three retaining screws so that the timing can be adjusted if necessary.
- Wait for approximately two hours before installing the shaft on the cylinder head.

1. Remove the support using tool N° 1.822.110.000.

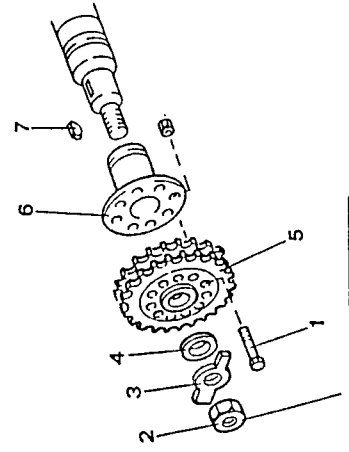
104.5 + 115.5 Nm
10.7 + 11.8 kgm

1.822.110.000



DISASSEMBLY OF CAMSHAFT - EXHAUST SIDE

1. Remove the bolt.
2. Remove the nut.
3. Remove the safety retainer.
4. Remove the washer.
5. Remove the timing gear.
6. Remove the flange.
7. Remove the feather.



51 + 63 Nm
5.2 + 6.4 kgm

CYLINDER HEAD CHECKS AND INSPECTIONS

CHECKING LOWER PLANE OF CYLINDER HEAD

1. Ensure that the lower plane is level and replace if necessary.

	Maximum head lower plane flatness error	0.05 mm
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1. After resurfacing check that the height of the head exceeds the permitted minimum.

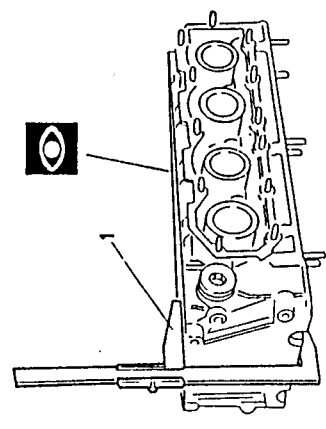


CAUTION
Do not exceed the permitted minimum value as this may cause serious engine malfunction.

- Check that the surfacing of the lower plane of the head is of the required quality.



Minimum permitted height of the head after facing
134.900 mm



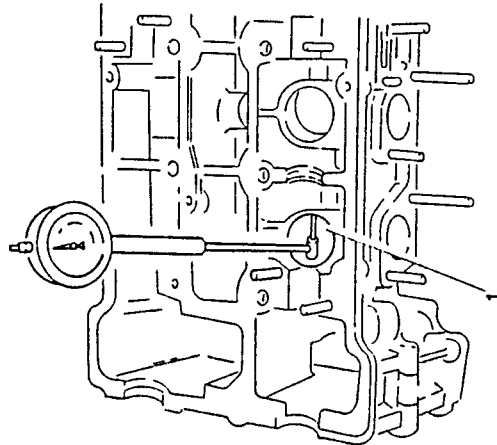


VALVE CUP SEATINGS AND VALVE CUPS

1. Check that the diameter of the valve cup seats is within the specified limits.



Diameter of valve cup seating	
Intake and exhaust	35.000 to 35.025 mm



1. Check that the outer diameter of the valve cups is within the prescribed limits.



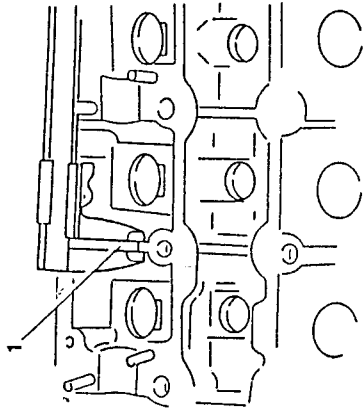
Diameter of valve cup	
Intake and exhaust	34.973 to 34.989 mm



1. Check that the width of the camshaft support shoulder is within the prescribed limits.



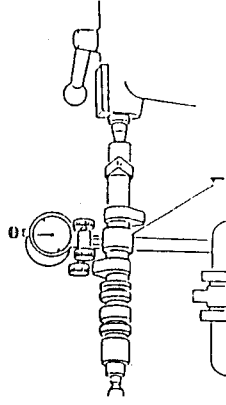
Width of camshaft support shoulder	
	7.988 to 7.920 mm



1. Check that the diameter of the camshaft journals is within the prescribed limits.



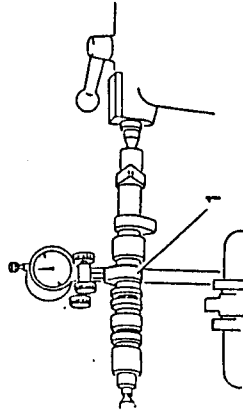
Diameter of camshaft journals	
	26.959 to 26.960 mm



1. Check that the height of the cams exceeds the prescribed minimum



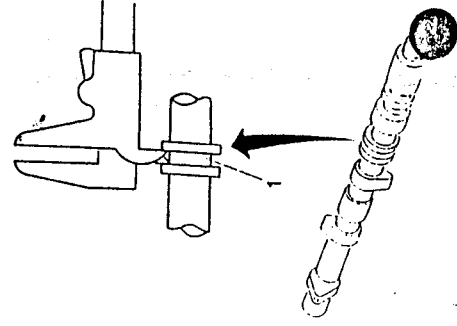
Minimum cam height	
intake	11.5 mm
exhaust	10.1 mm



1. Check that the width of the camshaft shoulders is within the prescribed limits.

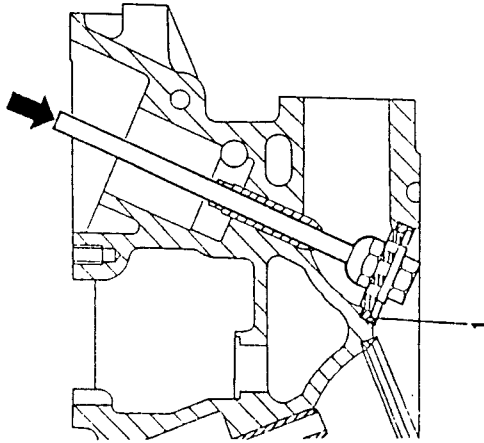


Width of camshaft shoulders	
	8 to 8.022 mm



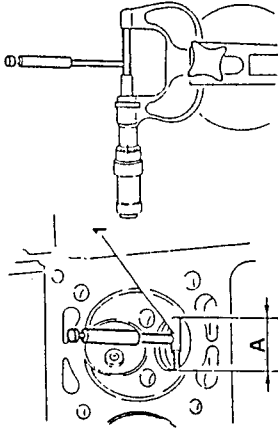
VALVE SEAT REPLACEMENT

1. Extract worn valve seats using suitable equipment.



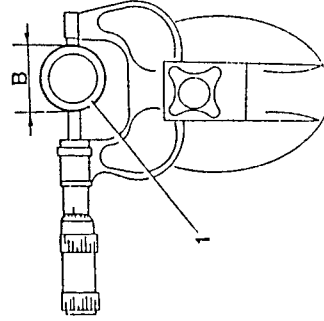
1. Check that the diameter of the valve seat housings is within the prescribed limits.

Valve seat housing diameter «A»	
intake	45.000 to 45.025 mm
Exhaust	39.000 to 39.025 mm



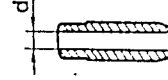
1. Check that the outer diameter of the new valve seat is within the prescribed limits.

Outer diameter of valve seat «B»	
intake	45.100 to 45.116 mm
exhaust	39.095 to 39.111 mm

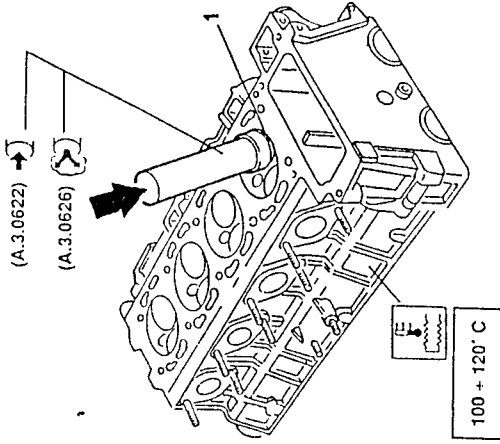

CLEARANCE BETWEEN VALVE GUIDE AND STEM

1. Measure the inner diameter of the valve guide and check that it is within the prescribed limits.

Internal diameter of valve guide «d»	
intake and exhaust	8.000 to 8.015 mm



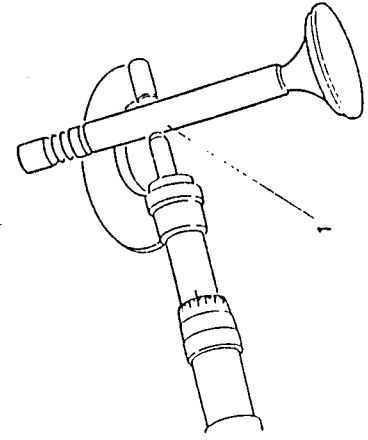
1. Heat the head to a temperature of about 100°C and install the new valve seats using the special inserting tools.



1. Measure the diameter of the valve stem in at least three places and at right-angles to each other. Calculate the clearance and check that it is within the prescribed limits. If not, replace the worn parts.



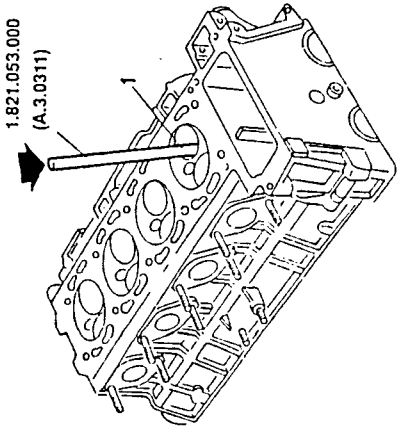
Radial clearance between valve stem and inner diameter of valve guide	
intake	0.015 to 0.045 mm
exhaust	0.040 to 0.070 mm





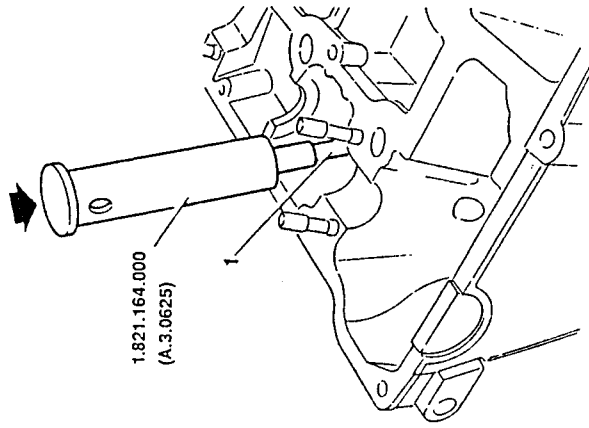
REPLACING VALVE GUIDES

1. Extract the worn valve guides using puller N° 1.821.053.000 (A.3.0311).



Valve guide protrusion	
intake and exhaust	9.850 to 10.150 mm

1. Insert the new valve guides using inserting tool N° 1.821.164.000 (A.3.0625) which will also ensure correct protrusion.



- Measure the diameter of the valve guide seats and the outer diameter of the new valve guide: the installation interference must be within the prescribed tolerances.

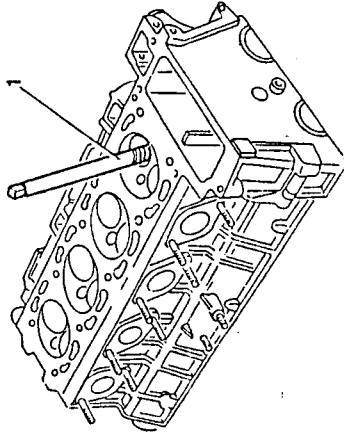
Diameter of valve guide seats	
15.000 to 15.018 mm	

External diameter of valve guides	
intake	15.039 to 15.050 mm
exhaust	15.050 to 15.068 mm

Interference between valve guide and valve guide seat	
intake	0.021 to 0.050 mm
exhaust	0.032 to 0.068 mm

1. Ream the new valve guides to free them from burring and calibrate the holes to the prescribed diameter.

Inner diameter of valve guides	
intake and exhaust	8.000 to 8.015 mm



VALVES

1. Check that the diameter of the stem and the diameter of the head are within the prescribed limits.

Diameter of valve stem «A»	
intake	7.970 to 7.965 mm
exhaust	7.945 to 7.963 mm

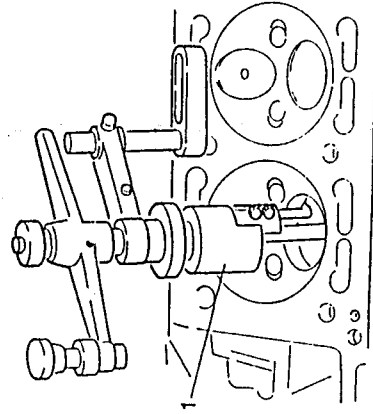
Diameter of valve head «B»	
intake	43.850 to 44.000 mm
exhaust	37.850 to 38.000 mm

TURNING OF VALVE SEATS

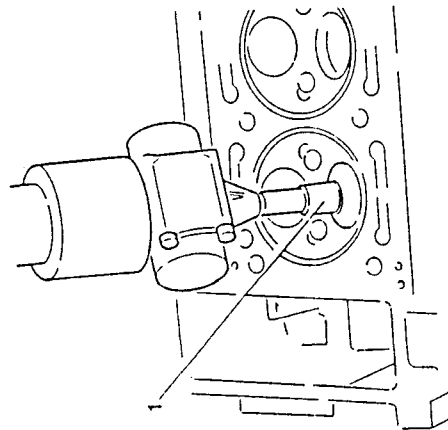
1. If necessary carry out valve seat turning using a suitable tool.

NOTE: Taper "C" can be obtained by positioning the hand lathe tool at an angle of 45°.

Valve seat taper - intake and exhaust	
C = 90° ± 20'	



1. After turning, grind each valve in its relative seat as follows:
 - spread the stop limit surfaces of the valves and seats with abrasive paste (SIPAL AREXONS Carbosilicium for valve).
 - Lubricate the valve stem with engine oil.
 - Fix the lower surface of the valve head to the suction cup of a pneumatic lap.
 - insert the valve into the relative guide and grind.
 - After grinding, thoroughly clean both the valves and their seats.



VALVE SPRINGS

- Check that the length of the "free" springs is within the prescribed limits.

NOTE: The terminal planes must be parallel to each other and perpendicular to the axis of the spring with a maximum error of 2°.

1. Using a dynamometer check that the characteristic data of the springs are within the prescribed limits.

Length of free spring

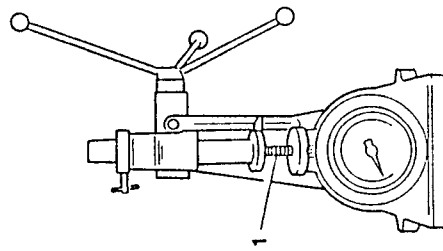
outer spring	La	48.7 mm
inner spring	Lb	46.2 mm

Outer spring

Length of the spring	mm	Control loading N(kg)
Valve A closed	36.5	212 to 220 (21.6 to 22.4)
Valve A open	25.5	452 to 470 (46.1 to 47.9)

Inner spring

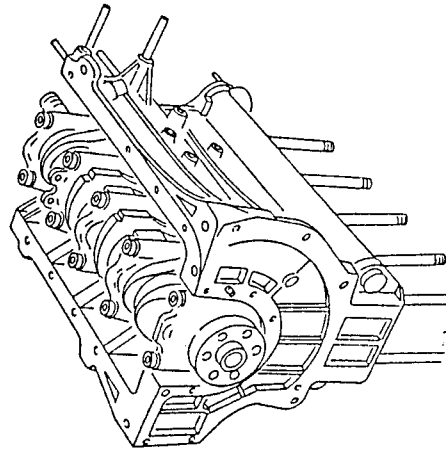
Length of the spring	mm	Control loading N(kg)
Valve A closed	34.5	115 to 120 (11.8 to 12.2)
Valve A open	23.5	244 to 252 (24.9 to 25.7)



ENGINE BLOCK

CHECKS AND INSPECTIONS

- Visibly check the engine block for signs of cracking and excessive wear of the sliding surfaces: check that the threads are all intact.
- Remove the caps from the main engine lubrication and coolant channel and clean with a suitable detergent. Blow off with compressed air and install new caps.
- Thoroughly clean the engine block faces of all traces of old gasket.



MAIN BEARING CAPS

1. Install the main bearing caps in the position and direction identified by the numbering on the caps themselves.
2. Tighten the lubricated nuts to the correct torque and check that the diameter of the main supports is within the prescribed limits.
3. Check that the length "S" of the central main support shoulder is within the prescribed limits.



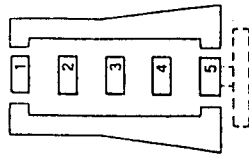
Diameter of main supports

53.652 to 63.664 mm

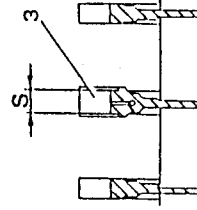
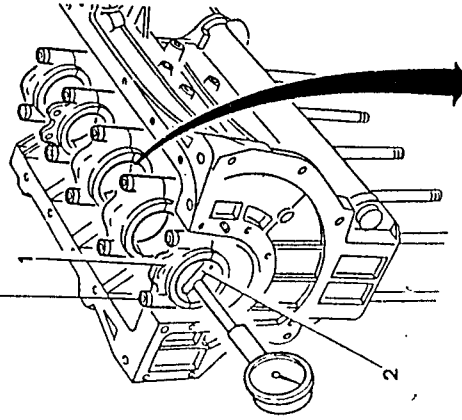


Length of central main support shoulder "S"

25.15 to 25.20 mm



20 Nm + 115°
2.04 kgm + 115°



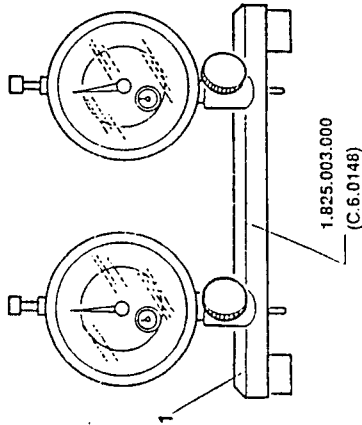


CYLINDER LINER PROTRUSION

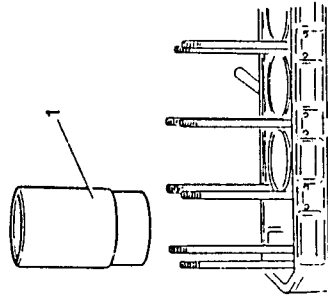
Carry out the check without the seal rings

NOTE: Procedure to be followed during the bench overhaul as a preliminary check of the correct coupling of the cylinder liners and engine block.

1. Apply two centesimal dial gauges to tool N° 1.825.003.000 (C.6.0148) and reset them on a surface plane.



1. Introduce the cylinder liners into the engine block without the seal rings.

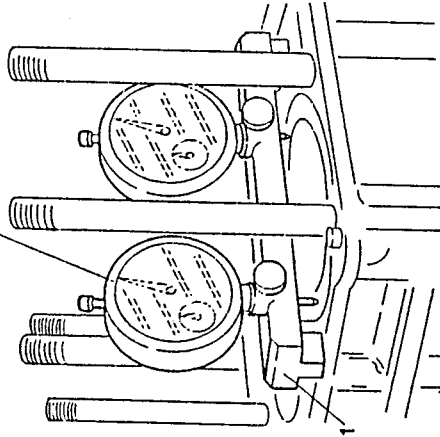


1. Place tool N° 1.825.003.000 (C.6.0148) on the engine block so that the probes rest on the edge of the cylinder liner, then check that the protrusion is within the prescribed tolerances.



Cylinder liner protrusion from engine block	0.01 to 0.06 mm
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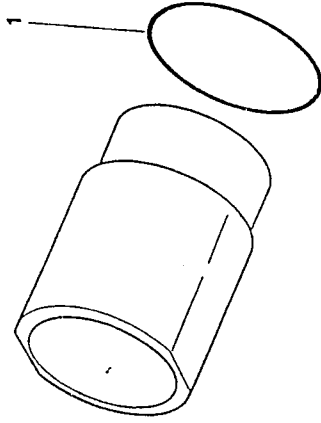
1.825.003.000 (C.6.0148)



Check with seal rings

NOTE: Procedure to be carried out when refitting.

1. Insert the seal rings in the cylinder liners.



Insert the cylinder liners into the engine block.

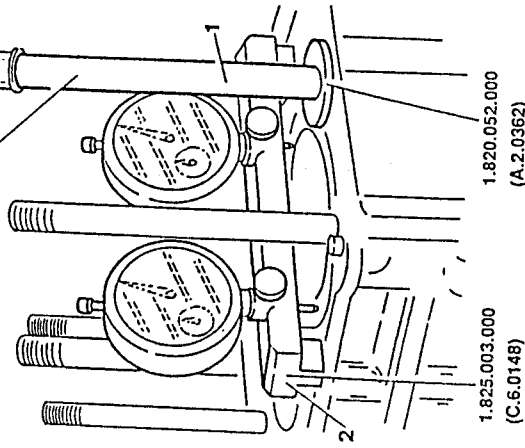
1. Lock the cylinder liners using cylinder liner fixing tools N° 1.820.004.000 (A.2.0117) and washers N° 1.820.052.000 (A.2.0362) and tightening the nuts to the prescribed torque.
2. Place tool N° 1.825.003.000 (C.6.0148) on the engine block so that the probes rest on the edge of the cylinder liners and check that the protrusion is within the prescribed tolerances.



Cylinder liner protrusion from engine block	0.01 to 0.06 mm
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76 + 84 Nm 7.75 + 8.56 kgm

1.820.004.000 (A.2.0117)



1.825.003.000 (C.6.0148)

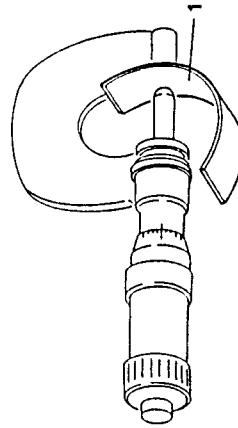
1.820.052.000 (A.2.0362)

MAIN AND ROD BEARING HALVES AND THRUST HALF-RINGS

- The main and rod bearing halves and the crankshaft must be coupled by matching the parts of the same dimensional class, identified by dots of the same colour on the side of the bearing half and on the relevant crankshaft journal.

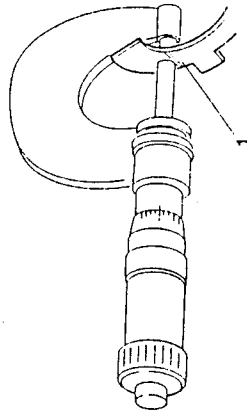
1. Check that the thickness of the bearing halves is within the prescribed limits.

Class	Thickness of bearing halves
A RED	1.830 to 1.835 mm
B BLUE	Main 1.835 to 1.839 mm
C YELLOW	1.839 to 1.844 mm
A RED	1.832 to 1.836 mm
B BLUE	Rod 1.836 to 1.841 mm
C YELLOW	1.841 to 1.845 mm



1. Check that the thickness of the thrust ring halves is within the prescribed limits.

Thickness of thrust half-rings	2.311 to 2.362 mm
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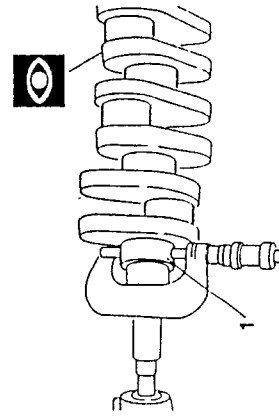
CRANKSHAFT Main and rod journals

- The crankshaft journals are divided in to two classes and marked with a blob of paint: RED, BLUE or YELLOW depending on the manufacturing tolerances.

1. Check that the diameter of the main and rod journals is within the prescribed limits.

Diameter of main journals	
RED	59.970 to 59.976 mm
BLUE	59.963 to 59.970 mm
YELLOW	59.956 to 59.963 mm

Diameter of rod journals	
RED	49.992 to 49.998 mm
BLUE	49.985 to 49.992 mm
YELLOW	49.978 to 49.985 mm

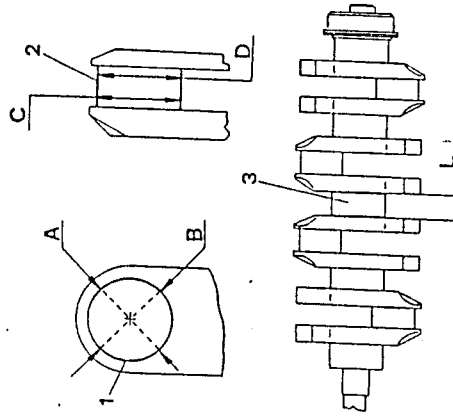


1. Check that the ovalization of the main and rod journals is within the prescribed limits.
2. Check that the taper of the rod and main journals is within the prescribed limits.
3. Check that the length of the central main journal is within the prescribed limits.

Main and rod journals maximum ovalization error	0.007 mm
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Main and rod journals maximum taper error	0.010 mm
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Length of central main journal	30.000 to 30.035 mm
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- Check eccentricity between main journals.

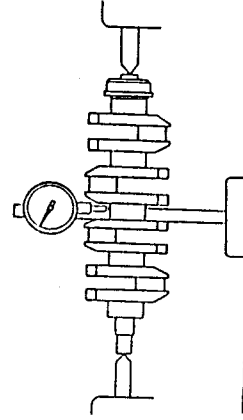
Main journals maximum eccentricity	0.040 mm
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- Check parallelism between main and rod journals

Maximum parallelism error between main and rod journals	0.015 mm
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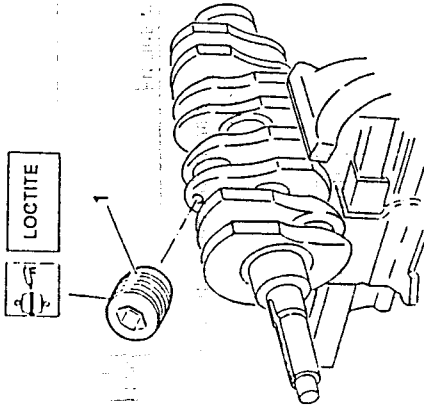
- Check the deviation between the axes of the two pairs of rod journals and the axes of the main journals.

Maximum derivation between the shaft of the two pairs of rod journals and the shaft of the main journals	0.300 mm
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Cleaning lubrication channels

1. Unscrew the cylindrical caps closing the ends of the lubrication channels.



- Thoroughly clean the lubrication channels using warm diesel oil and blow-off.
- Close the holes of the lubrication channels with new caps.

CYLINDER LINERS

- The cylinder liners are selected according to their inner diameter and are divided into three categories - A, B and C. These categories are identified by BLUE, PINK and GREEN dots located on the outer surface.
- 1. Check that the inner diameter, taper and ovalization of the cylinder liners are within the prescribed limits.


Diameter of cylinder liners (d)

Class A (Blue)	83.985 to 83.994 mm (1) 83.385 to 83.394 mm (2)
Class B (Pink)	83.995 to 84.004 mm (1) 83.395 to 83.404 mm (2)
Class C (Green)	84.005 to 84.014 mm (1) 83.405 to 83.414 mm (2)

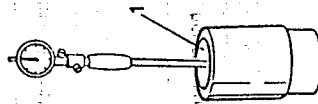
- (1) For AR67102 and AR67202 engines
- (2) For engine AR67103


Maximum taper (M - N)

0.01 mm
83.985 to 84.004 mm (1) 83.385 to 83.394 mm (2)


Maximum ovalization (X - Y)

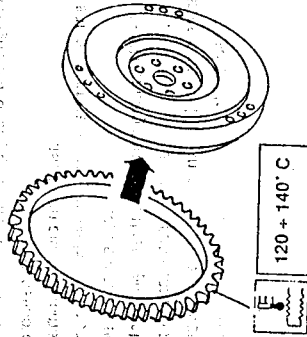
0.01 mm
83.985 to 84.004 mm (1) 83.385 to 83.394 mm (2)



H = area for dimensional control

REPLACING THE ENGINE FLYWHEEL RING GEAR

- When replacing the ring gear of the engine flywheel, proceed as follows:
 - remove the old ring gear,
 - thoroughly clean the mating surfaces of the new ring gear and the flywheel.
 - Uniformly heat the new ring gear to 120 - 140° C and fit it to the engine flywheel.
 - leave the parts to cool naturally to ambient temperature; do not force the cooling of the parts.


Outer diameter «a» (3)

Class A (Blue)	83.935 to 83.945 mm (1) 83.345 to 83.355 mm (2)
Class B (Pink)	83.945 to 83.955 mm (1) 83.355 to 83.365 mm (2)
Class C (Green)	83.955 to 83.965 mm (1) 83.365 to 83.375 mm (2)

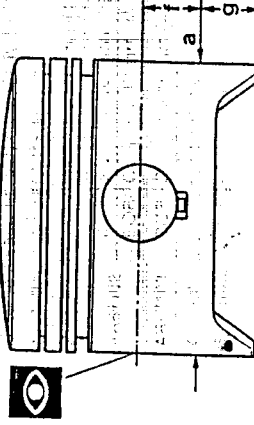
- (1) For AR67102 and AR67202 engines
- (2) For engine AR67103

- (3) to be measured perpendicularly to the gudgeon pin hole at a distance of:

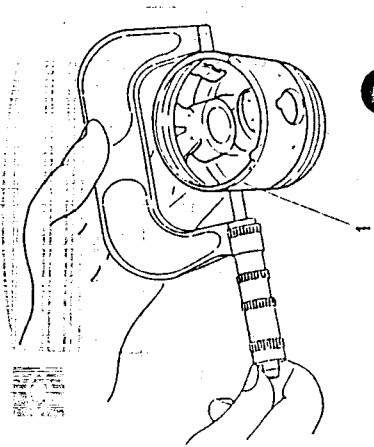
AR67202	MONDIAL	g = 10.3 mm (4)
AR67102	MONDIAL	f = 16.5 mm (5)
AR67103	BORG	g = 17 mm (4)
AR67103	BORG	g = 15 mm (4)

(4) = from the lower edge of the skirt

(5) = from the gudgeon pin shaft


PISTONS AND GUDGEON PINS

- Like the cylinder liners, the pistons are divided into three classes according to their manufacturing tolerances. These classes are identified by the letters A, B and C and are differentiated by dots located on the piston ceiling.
- 1. Check that the outer diameter of the piston is within the prescribed limits.

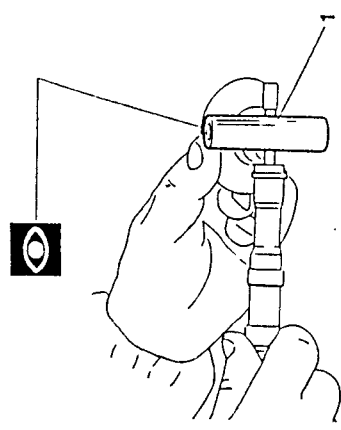


- Both the gudgeon pins and relative mating holes on the piston are divided into two classes according to the manufacturing tolerances. These classes are identified by BLACK or WHITE dots on the inner surface of the pins and on the outer surface of the piston hub.

1. Check that the outer diameter of the gudgeon pin is within the prescribed limits.



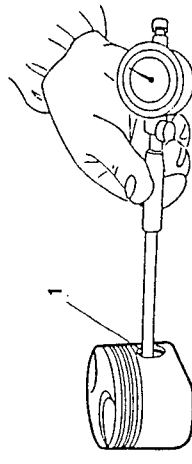
Outer diameter of gudgeon pin	
Black	21.994 to 21.997 mm
White	21.997 to 22.000 mm



1. Check that the diameter of the mating hole on the piston is within the prescribed limits.



Diameter of the gudgeon pin mating hole on the piston	
Black	22.000 to 22.002 mm
White	22.002 to 22.005 mm

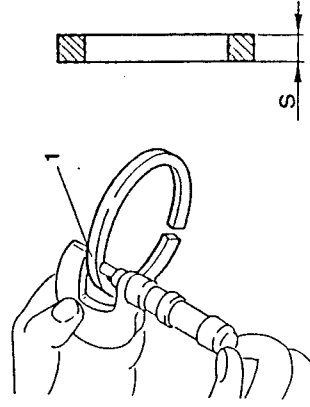


PISTON RINGS AND OIL SCRAPER RING

1. Check that the thickness "S" of the piston rings and the oil scraper ring is within the prescribed limits.



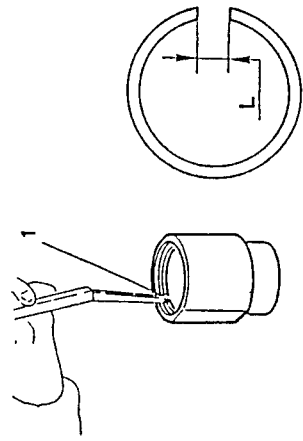
Thickness rings «S»		
First ring	1.478 to 1.490 mm	
Second ring	Goetze	1.475 to 1.490 mm
	Borgo	1.478 to 1.490 mm
Oil scraper ring	Goetze	3.475 to 3.490 mm
	Borgo	3.478 to 3.490 mm



1. Insert the rings in the control ring or in the cylinder liner and check that gap "L" is within the prescribed limits.



Gap «L»		
First ring	0.30 to 0.50 mm	
Second ring	0.30 to 0.50 mm	
Oil scraper ring	Borgo	0.25 to 0.40 mm
	Goetze	0.25 to 0.50 mm

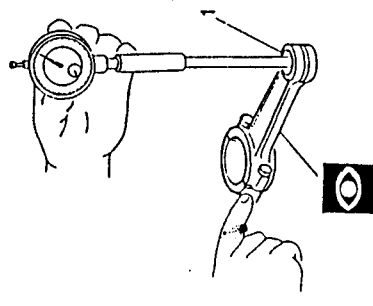


RODS

1. Check that the diameter of the bushing of the rod small end is within the prescribed limits.



Diameter of the rod small end bushing hole	
	22.005 to 22.015 mm



1. Check that the axial play between the piston rings and oil scraper ring with their relative seatings on the piston is within the prescribed limits.



Axial play between oil rings and seating		
First ring	0.035 to 0.067 mm	
Second ring	Borgo	0.035 to 0.067 mm
	Goetze	0.035 to 0.070 mm
Oil scraper ring	Borgo	0.025 to 0.057 mm
	Goetze	0.025 to 0.060 mm

1. Install the rod caps and tighten the lubricated nuts to the prescribed torque. Check that the diameter of the rod big end is within the prescribed limits.

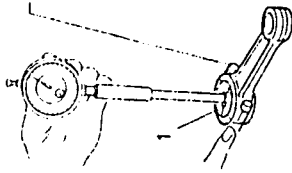


Inner diameter of rod big end

53 655 to 53 706 mm

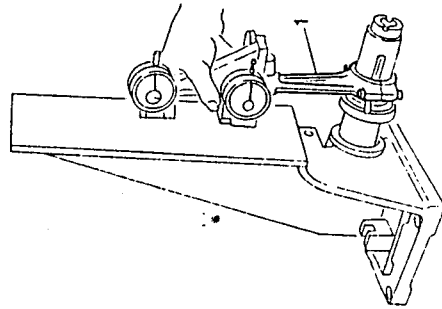
53 695 to 53 705 mm (*)

(*) For engine AR67202



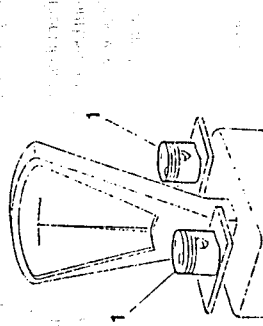
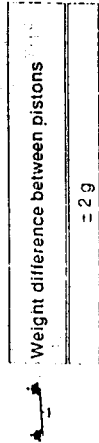
 49 + 54 Nm
 5 + 5.5 kgm

1. Check that the rods are perpendicular.

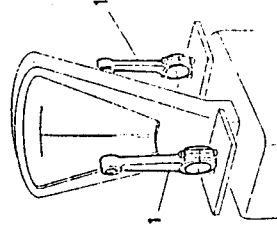
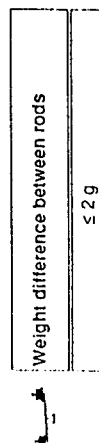


CHECKING WEIGHT DIFFERENCE BETWEEN THE SINGLE PISTONS AND THE SINGLE RODS

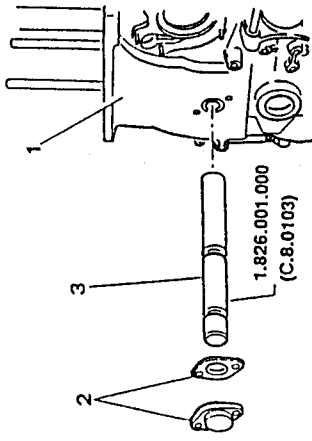
1. Group the gudgeon pins and pistons according to the dimensional class (BLACK or WHITE). Insert the gudgeon pins in the pistons and lock them with the flexible rings. Install the piston rings and the oil scraper ring. Check that the difference in weight between the pistons is within the prescribed limits.



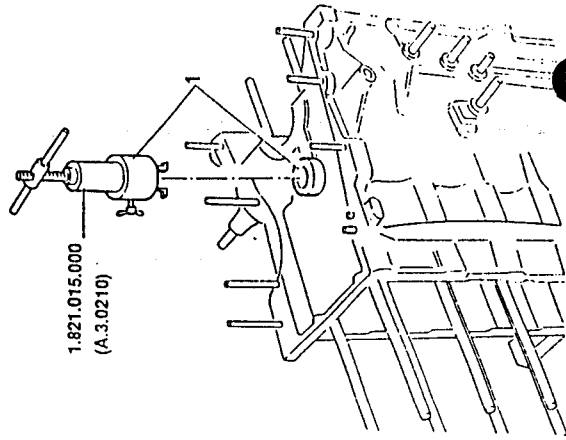
1. Similarly check that the difference in weight between the rods, together with the bearing halves, caps and bolts is within the prescribed limits.



1. Temporarily install the front cover.
2. Remove the cover and relative gasket.
3. Using tool N° 1.826.001.000 (C.8.0103), check the alignment of the two bushings.

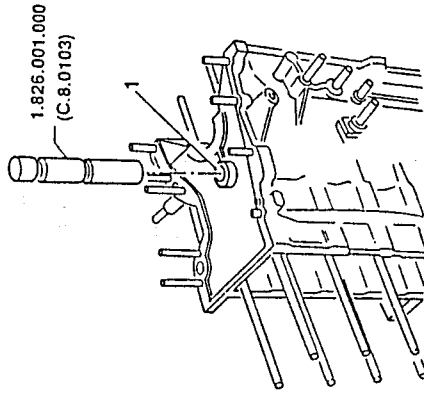


- If the two bushings are excessively worn, replace them proceeding as follows:
 1. Remove the engine block bushing using tool N° 1.821.015.000 (A.3.0210).

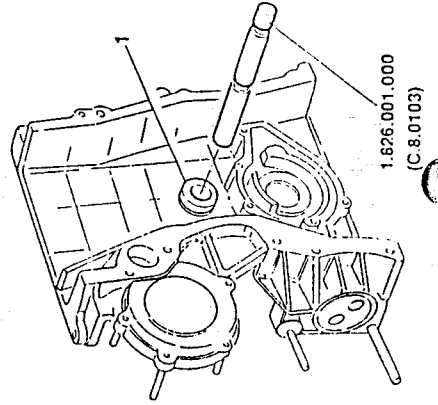


TIMING SYSTEM IDLE GEAR BUSHING

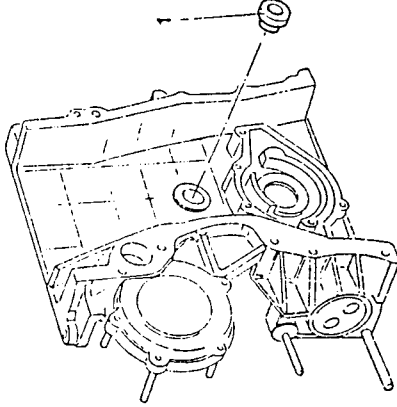
1. Using a plug gauge (passes doesn't pass) N° 1.826.001.000 (C.8.0103), check the inner wear of the limiting control idle shaft housing bush.



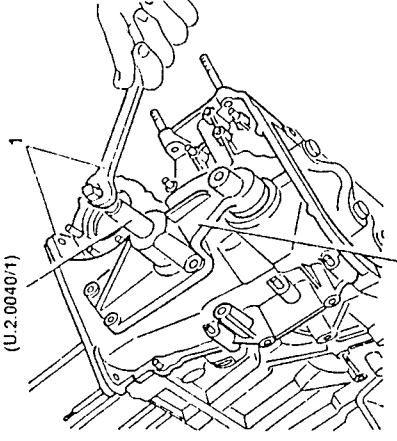
1. Also check the corresponding bushing on the front cover.



- Install a new bushing using a suitable inserting tool
- 1. Remove the bushing on the front cover and install a new one using suitable tools



1.828.001/2.000
(U.2.0040/1)



1.820.114.000
(A.4.0172)

- Remove the tools and using plug gauge N° 1.826.001.000 (C.8.0103) check that the inner diameter of the two bushings is correct.



When replacing one bushing, the other must also be replaced.

1. Temporarily install the front cover onto the engine block and ream the two bushings at the same time, using guide tool N° 1.820.114.000 (A.4.0172) and reaming tool N° 1.828.001/2.000 (U.2.0040/1).

REASSEMBLING CAMSHAFTS, ADJUSTING VALVE CLEARANCE



Locking the nuts of the camshaft caps when the timing marks do not correspond means that the valves overlap and strike each other leading to irreparable damage. It is therefore necessary to scrupulously follow the refitting procedure given below.

1. Position the camshafts.
- Position the caps and turn them in accordance with the numbering marked on them.
2. Tighten the lubricated camshaft cap nuts on the intake side to the prescribed torque.

INDICATIONS FOR REASSEMBLY

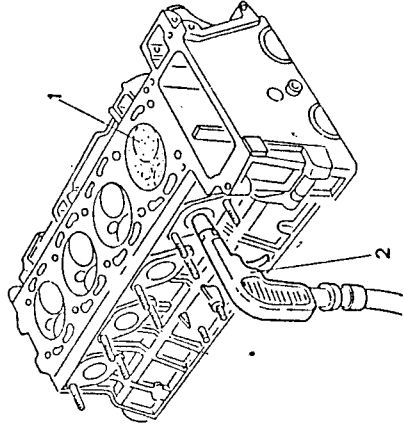


For the reassembly operations, follow the procedure used for disassembly in the reverse order unless otherwise indicated below.

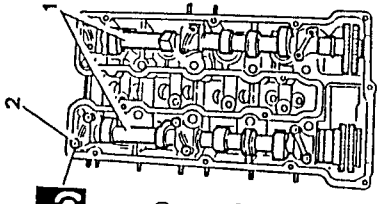
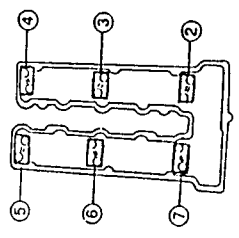
CHECKING VALVE LEAKAGE

- Insert the spark plugs in their sealings.

 1. Pour a small quantity of fuel in one of the combustion chambers so that it just covers the valve heads.
 2. Blow low pressure air into the intake and exhaust ports and check that no bubbles form. If there are bubbles check for correct assembly and grind the valve seats again if necessary (see specific procedure).



20 + 22 Nm
2.04 + 2.24 kgm



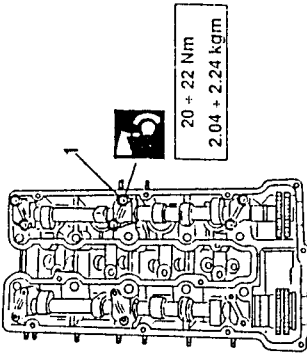
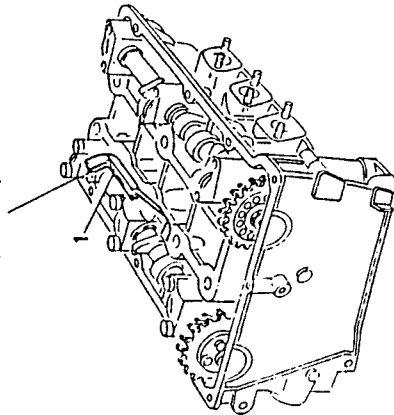


- 1 Check that the clearance between the cam heel radius and corresponding valve cup is within the prescribed limits. Otherwise replace the intake valve caps with others of a suitable thickness.



Intake side valve clearance
0.380 to 0.450 mm

1.825.018.000
(C.6.0197)



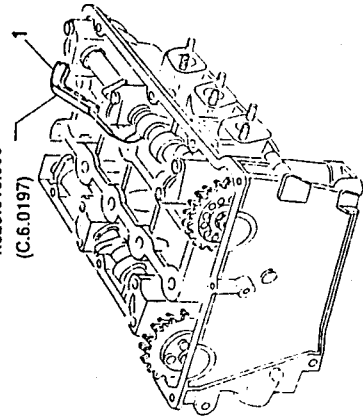
20 + 22 Nm
2.04 + 2.24 kgm

1. Check that the clearance between the cam heel radius and corresponding cup is within the prescribed limits, otherwise replace the exhaust valve caps with others of a suitable thickness.



Exhaust side valve clearance
0.430 to 0.500 mm

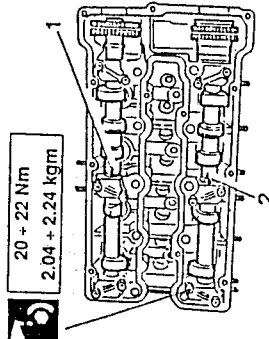
1.825.018.000
(C.6.0197)



- Unlock and remove the intake side camshaft cap nuts
- 1 Tighten the lubricated exhaust side cap nuts to the correct torque.



1. Rotate the exhaust side camshaft until the cam of the first cylinder faces outwards and the timing mark corresponds with that on the central cap (first cylinder in firing phase).
2. Rotate the intake side camshaft until the cam of the first cylinder faces outwards and the reference notches are staggered by 3 to 4 mm in advance so that the marks will be perfectly aligned after the timing chain has been tensioned.



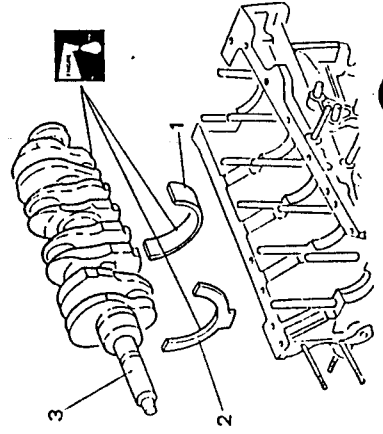
20 + 22 Nm
2.04 + 2.24 kgm

REFITTING CRANKSHAFT

1. Set the main bearing halves onto the relative supports.

NOTE: The assembly onto the crankshaft must be carried out by matching the parts of the same dimensional class marked with colored dots on the side of the bearing half and relative crankshaft journal.

2. Install thrust ring halves into their seatings and ensure that the lubrication grooves face the crankshaft shoulders.
3. Position the crankshaft after abundantly lubricating the main bearing halves.



CHECKING AXIAL PLAY OF THE CAMSHAFTS

1. Apply a centesimal dial gauge and measure the axial play of the camshafts. Check that the value is within the prescribed tolerances.

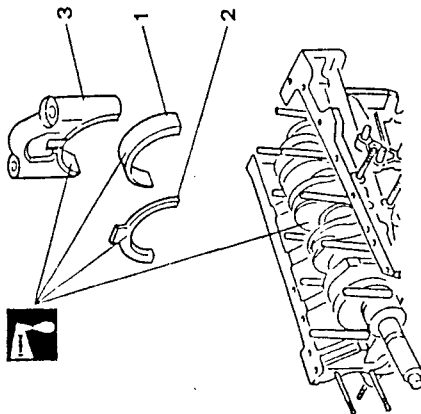


CAUTION
Do not rotate the camshafts: the valves which are overlapping may strike each other and cause irreparable damage.



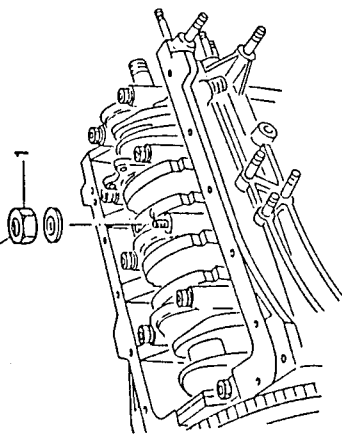
Camshaft axial play
0.080 to 0.124 mm

1. Set the main bearing halves into the main bearing caps.
 2. Set the thrust ring halves onto the central main cap.
 3. Install the central main caps setting them in accordance with the numbering marked on them (the safety mark must be on the same side as the corresponding mark on the engine block); tighten but do not lock the retaining nuts.
- In the same way install the remaining main caps without locking the nuts.



1. In two or three operations starting from the central main cap, tighten the lubricated nuts securing the main caps.

20 Nm + 115°
2,04 kgm + 115°

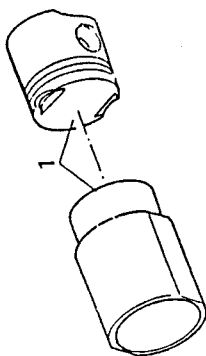


CHECKING CRANKSHAFT AXIAL PLAY

1. Using a centesimal dial gauge mounted on a magnetic platform, check that the axial play of the crankshaft is within the prescribed limits.



Crankshaft axial play
0.076 to 0.263 mm



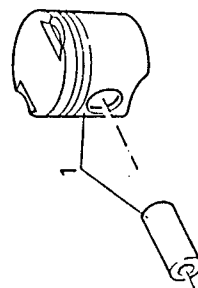
Clearance between cylinder liner and piston
0.040 to 0.059 mm

MATCHING OF PISTONS AND GUDGEON PINS

1. Match parts of the same dimensional class, identified by dots of the same colour: BLACK or WHITE on the inside of the gudgeon pins and on the outside of the relative piston hub.



Clearance between piston hole and gudgeon pin	
Black	0.003 to 0.008 mm
White	0.002 to 0.008 mm



REFITTING CYLINDER LINERS, PISTONS, RODS, COUPLING OF RODS AND PISTONS

1. Coupling must be carried out by matching the parts of the same dimensional class marked with paint of the same colour: A (Blue), B (Pink) or C (Green), onto the piston ceiling and on the outside of the cylinder liner.



MATCHING OF PISTONS, RODS AND CRANKSHAFT

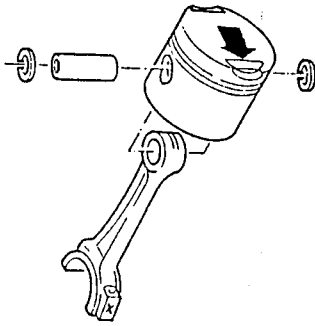
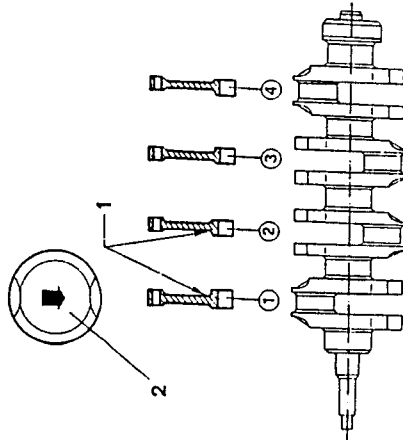
1. The rods must be set with the offset turned towards the crankshaft intermediate supports.
2. The pistons must be positioned so that the arrow stamped onto the ceiling points in the direction of engine rotation.



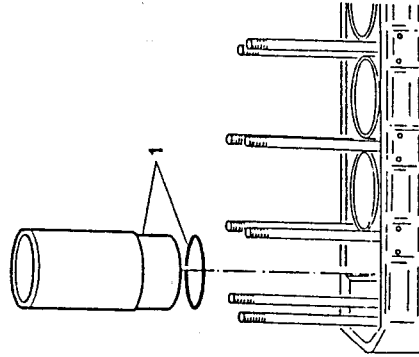
Each rod has the cylinder number to which it refers stamped onto the big end.



Clearance between rod small end bushing and gudgeon pin	
Black	0.008 to 0.021 mm
White	0.005 to 0.018 mm



1. Install the cylinder liners and seal rings onto the engine block.
- Check the cylinder liner protrusion as described in the relative paragraph.



- Rotate the crankshaft until the position corresponding to the B.D.C. of the first and fourth cylinders is reached.

1. Set the bearing halves onto the rod big ends.

NOTE: The assembly onto the crankshaft must be carried out by matching the parts of the same dimensional class indicated by blobs of colour, RED or BLUE on the side of the bearing half and RED and LIGHT BLUE on the relative crankshaft journal.

2. Place the piston rings on the pistons with the gaps staggered by 120°
3. Using a suitable tool, install the pistons and rods into the first and fourth cylinders.

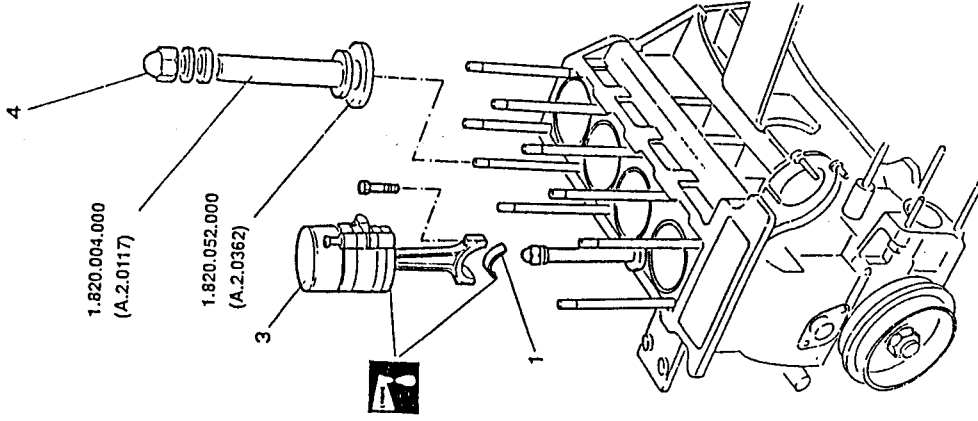
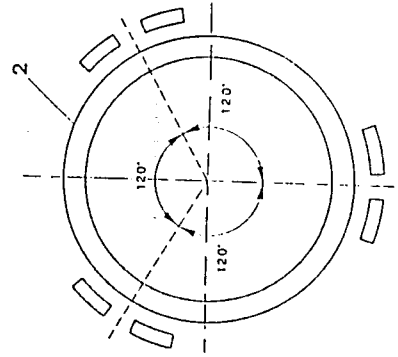


CAUTION

The arrows stamped onto the piston ceiling should indicate the direction of rotation.

Position the rods with the offset facing the crankshaft intermediate supports.

4. Install the cylinder liner fixing tools N° 1.820.004.000 (A.2.0117) and supplementary washers N° 1.820.052.000 (A.2.0362).

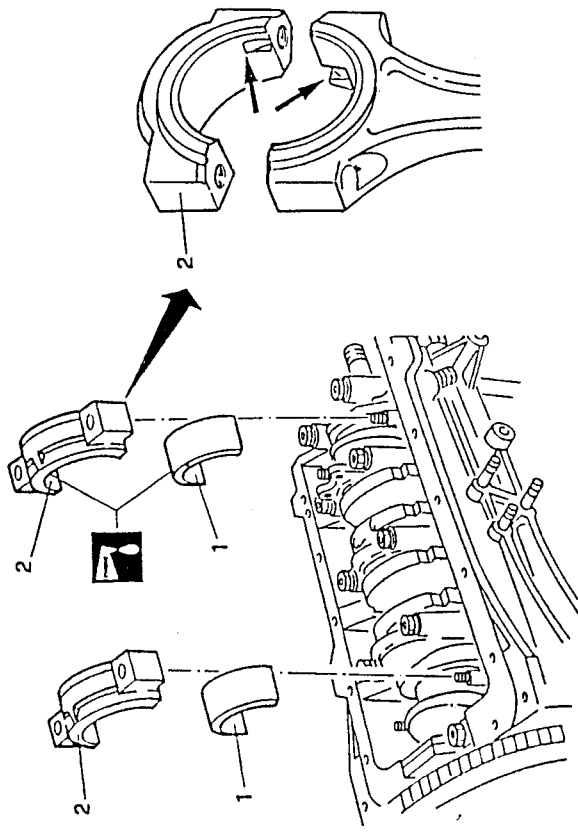


- Rotate the engine block 180°.
 - 1. Set the rod bearing halves onto the rod caps.
- NOTE:** The assembly onto the crankshaft must be carried out by matching the parts of the same dimensional class indicated by blobs of colour, RED or BLUE on the side of the bearing halves and RED or LIGHT BLUE on the relative crankshaft journal.

**CAUTION**

The number of the cylinder to which the rod caps refer is stamped onto the side of the caps.

- 2. Install the rod caps of the first and fourth cylinders and set the safety notches so that they are facing the corresponding notches on the rod big end. Lubricate but do not tighten the retaining bolts.



- In the same way, refit the pistons and rods of the second and third cylinder.
- 1. Before locking the bolts of the rod caps, use a thickness gauge to check that the axial play between crankshaft shoulder and rod-cap profile are within the prescribed limits.

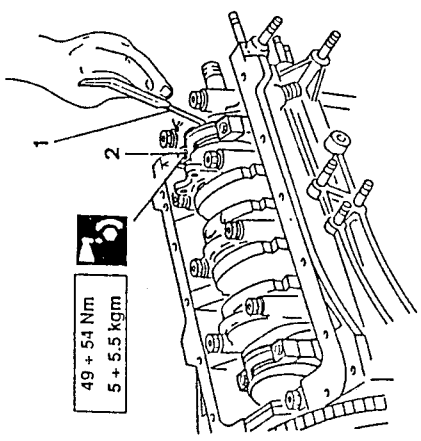


Axial play between crankshaft shoulder and rod-cap profile

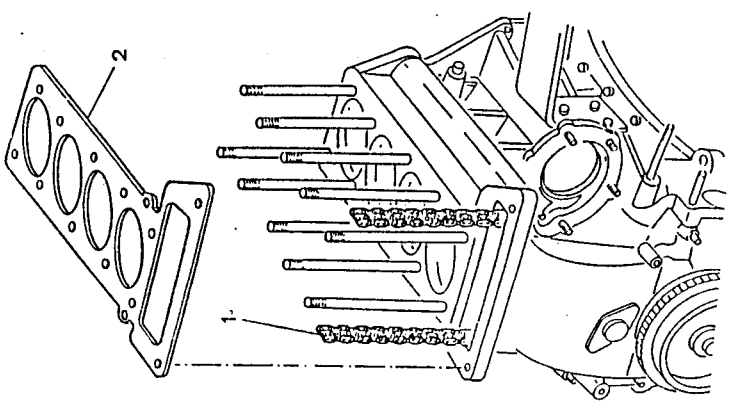
0.2 to 0.3 mm

- 2. Tighten the lubricated rod cap bolts to the correct torque.

49 + 54 Nm
5 + 5.5 kgm

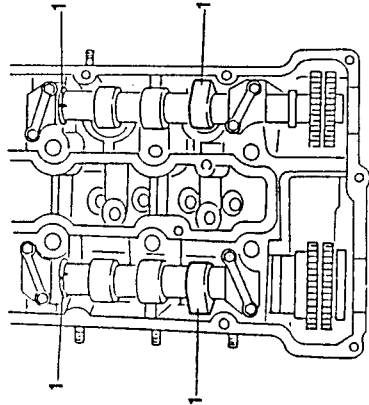
**REFITTING THE CYLINDER HEAD**

- 1. Position the timing chain.
 - Rotate the crankshaft until the piston of the first and fourth cylinders is at T.D.C.
- 2. Position the cylinder head gasket.

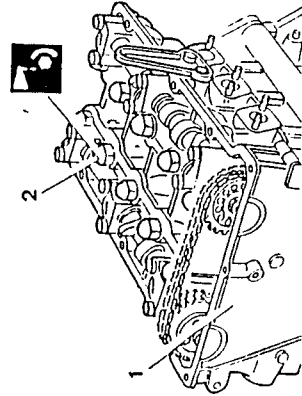




1. Ensure that the cams of the first cylinder face the outside and that the timing marks on the camshaft (exhaust side) are aligned and on the intake side, staggered by 3 to 4 mm in advance.



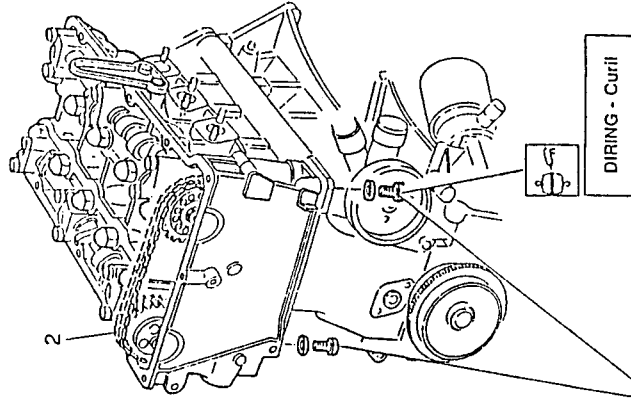
1. Install the cylinder head on the engine block.
2. Lubricate the threads, nuts and washers with engine oil and tighten, in two or three operations, the ten nuts securing the cylinder head. Follow the order shown in the table.



	<p>When retightening torque gradually following the sequence indicated:</p>	<p>76 to 84 Nm 7.75 to 8.56 kgm</p>
	<p>After bench testing and trials when the engine is cool loosen the nuts by one turn following the sequence indicated; lubricate with engine oil and tighten to the correct:</p>	<p>82.65 to 91.35 Nm 8.43 to 9.3 kgm</p>



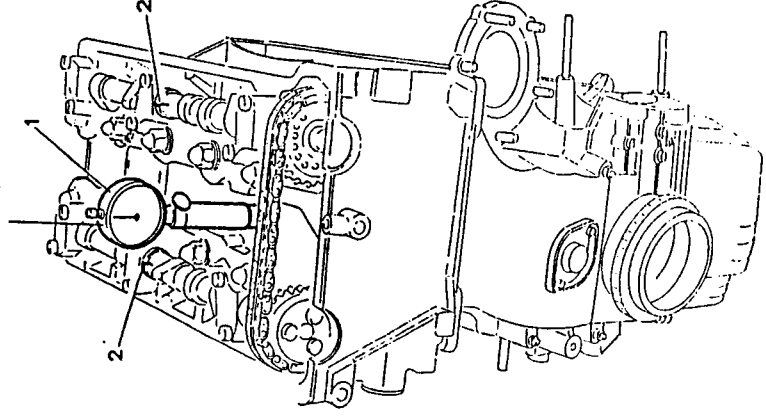
1. Tighten and lock the two screws securing the lower side of the cylinder head.
2. Install the timing chain and tension it.



1.825.013.000
(C.6.0183)

CHECKING ENGINE TIMING

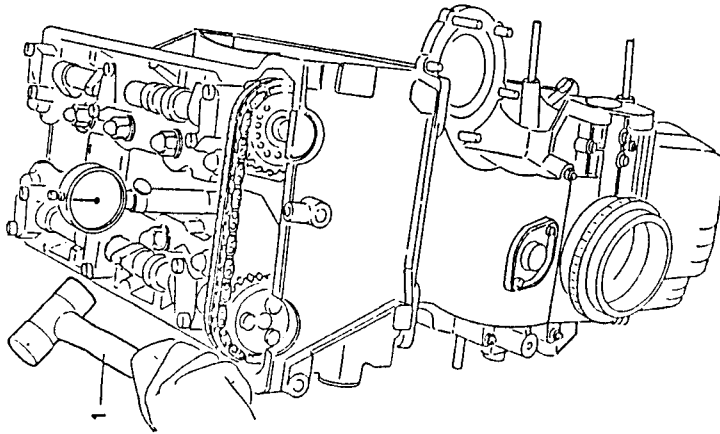
1. Install probe N° 1.825.013.000 (C.6.0183) with dial gauge into the spark plug seat of the first cylinder.
 - Rotate the crankshaft until the piston of the first cylinder is at T.D.C. in the firing phase.
2. Check that the marks engraved on the camshafts are aligned to those of the relative central caps.
 - If the marks on the camshafts are not aligned with the relative caps, operate as described below.



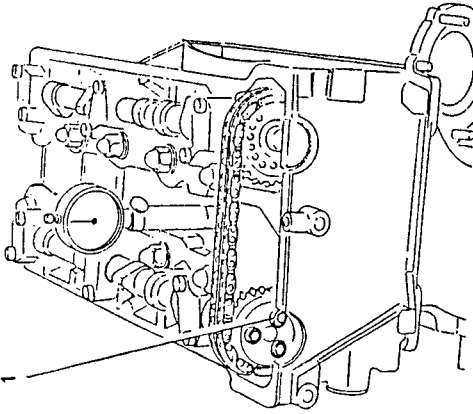
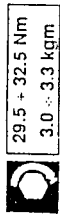
Intake side camshaft

- Using a plastic mallet, rotate the camshaft until the reference notches are aligned.

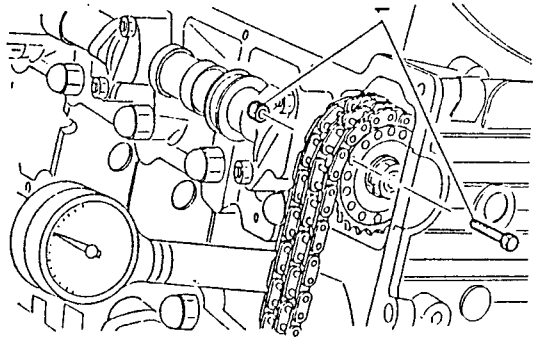
NOTE: The rotation of the camshaft is permitted by the slotted holes present on the toothed wheel and by having left the three retaining screws untightened when refitting.



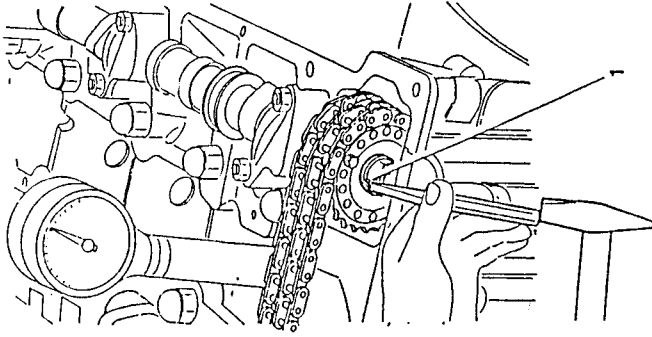
- Tighten the three screws of the timing variator.

**Exhaust side camshaft**

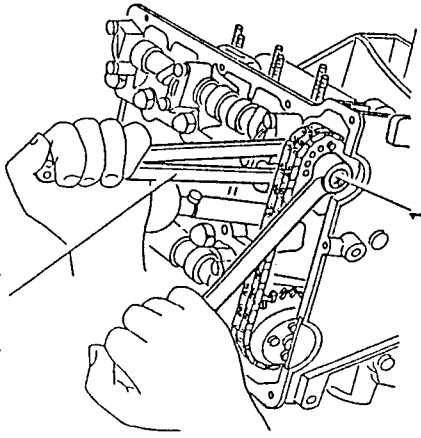
- Remove the bolt securing the toothed wheel to the flange.



- Raise the edge of the nut retainer.



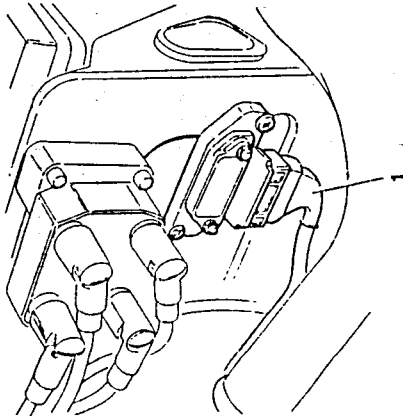
1.822.001.000
(A.5.0103)



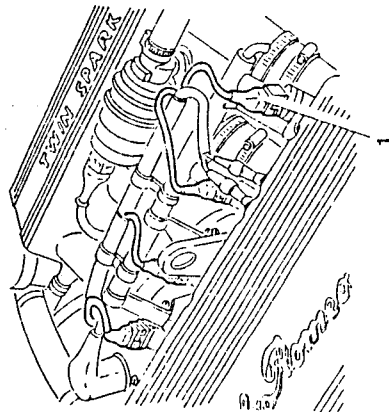
- Using tool N° 1.822.001.000 (A.5.0103), rotate the shaft without moving the chain, until the timing marks are aligned.
- Refit the bolt securing the toothed wheel to the flange and ensuring that the hole in the toothed wheel coincides with the hole in the flange.
- Using tool N° 1.822.001.000 (A.5.0103), lock the nut securing the toothed wheel and bend the edge of the safety retainer back down.

CYLINDER COMPRESSION TEST

- Start the engine and let it run until it reaches normal operating temperature.
 - Remove the spark plug cover.
 - Disconnect the high voltage cables from one spark plug per cylinder and and remove the disconnected spark plug.
1. Disconnect the electrical connections from the power modules



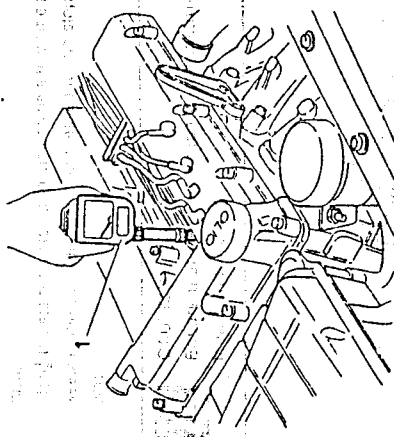
1. Disconnect the electrical connections from the electroinjectors.



1. Insert the test instrument into the seat of a spark plug.
- Using the starter motor, turn the engine a few times keeping the accelerator pedal pressed to the stop limit.


CAUTION:

Ensure that the connection to the instrument is not leaking.



- Repeat the test on the other cylinders ensuring that the instrument is reset each time.

NOTE: If the pressure values measured in the cylinder differ greatly, the cause should be looked for by checking for leaks in the valve, flexible rings and pistons.



AFTER INSTALLATION OF THE ENGINE A CYLINDER COMPRESSION TEST should be carried out in addition to the normal maintenance checks and inspections (see GROUP 00) and the checks regarding the fuel supply system (see GROUP 04) and the engine cooling system (see GROUP 07).

CHECKING ELECTRICAL COMPONENTS (located in the engine compartment)

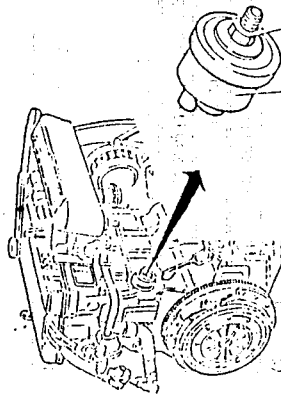
- Engine oil pressure meter.
 - Engine oil temperature sensor.
 - Minimum engine oil pressure warning light.
 - Minimum engine oil level warning light sensor.
- For the other sensors and electrical components located in the engine compartment refer to the specific groups where they are dealt with in detail.

ENGINE OIL PRESSURE METER

1. Check the setting of the engine oil pressure meter. If the values are incorrect, replace the meter.

Pressure	Resistance
bar (kg/cm ²)	Ω
0	290 to 320
0.39 (0.4)	255 to 285 (1)
3.9 (4)	270 to 300 (2)
	103 to 133
7.8 (8)	0 to 40 (1)
	0 to 25 (2)

(1) Jeger (2) Sicea



8.5 + 10.5 Nm
0.87 + 1.07 kgm

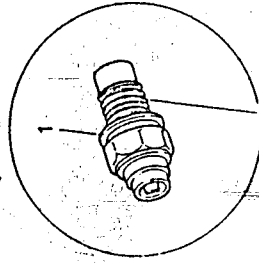
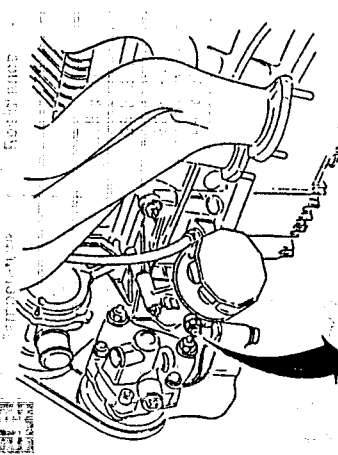
ENGINE OIL TEMPERATURE SENSOR

1. Check the setting of the engine oil temperature sensor. If the values are incorrect, replace the meter.



Temperature	Resistance
°C	Ω
60 ± 0.5	525 to 605
ENGINE OPERATING TEMPERATURE	195 to 215
120 ± 0.5	82 to 94
140 ± 0.5	49 to 55

1. Check the setting of the engine oil temperature sensor. If the values are incorrect, replace the meter.



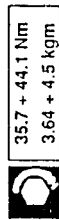
21.3 + 26.3 Nm
2.2 + 2.7 kgm

MINIMUM ENGINE OIL PRESSURE WARNING LIGHT SENSOR

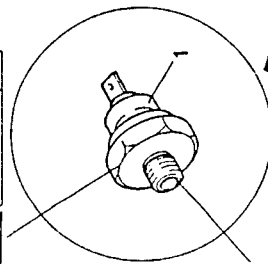
1. Check the setting of the minimum engine oil pressure warning light sensor. If the values are incorrect, replace the sensor.



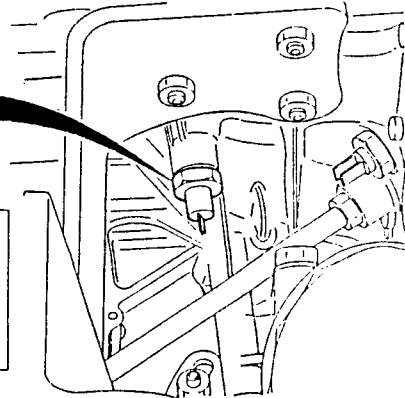
Pressure	bar (kg/cm ²)
Contact opening	0.147 to 0.44 (0.15 to 0.45)
admissible	5.88 (6)
admissible point with cold starting	9.8 (10)



35.7 + 44.1 Nm
3.64 + 4.5 kgm



Mastic S - ME4



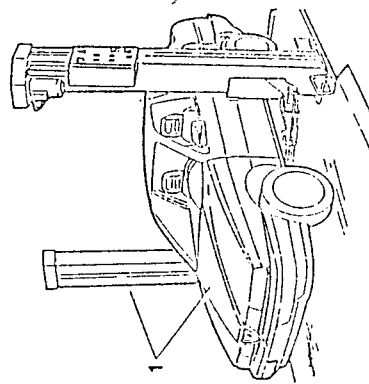
"ON VEHICLE" OPERATIONS

The preceding chapter described and illustrated the complete engine bench overhaul. Some of these operations can be carried out with the engine installed without necessitating its removal from the engine compartment. Among the most frequent operations, it is possible to remove and refit the oil sump and engine pulley by following the indications given below.

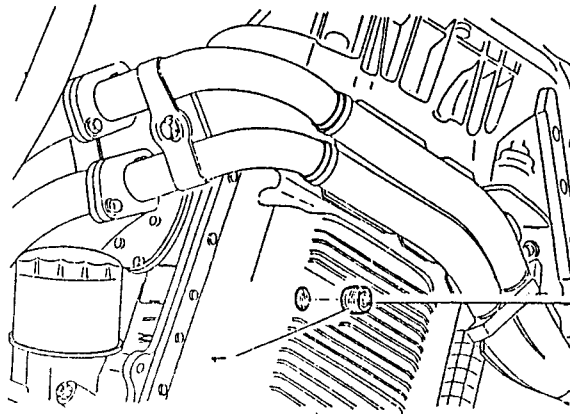
NOTE: Refer to GROUP 00 for the most frequent maintenance operations carried out with the engine installed on the vehicle.

REMOVAL/REFITTING OF OIL SUMP

1. Place the vehicle on a lift.

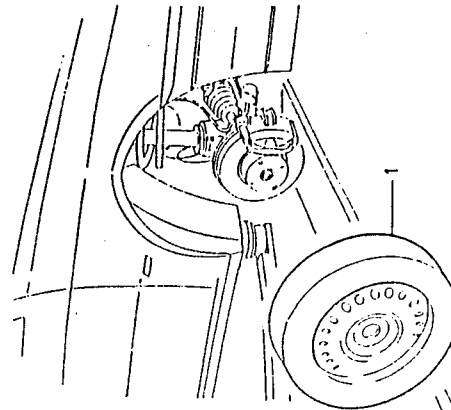


1. Drain off the engine oil by unscrewing the cap on the oil sump.



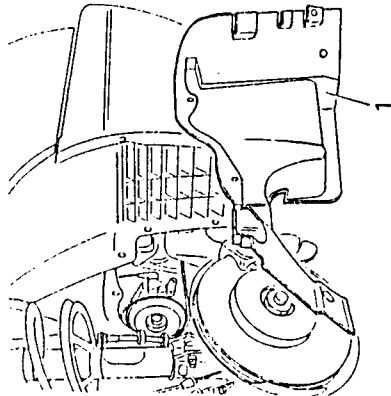
64.5 + 80 Nm
6.6 + 8.2 kgm

1. Remove the front right-hand wheel.

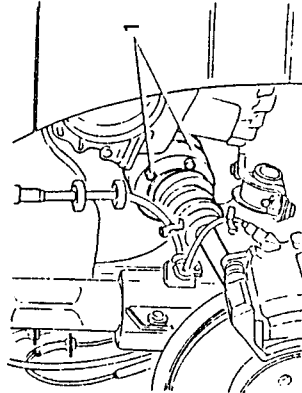




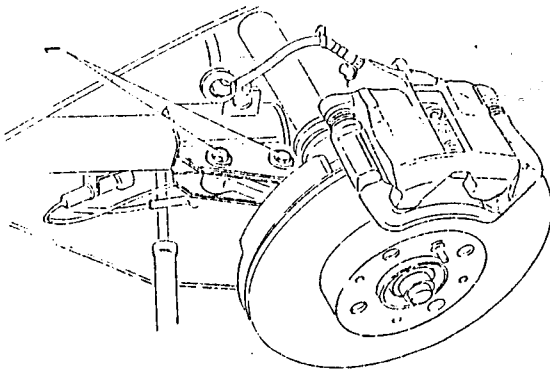
1. Remove the central engine protection cover from the right-hand wheel arch.



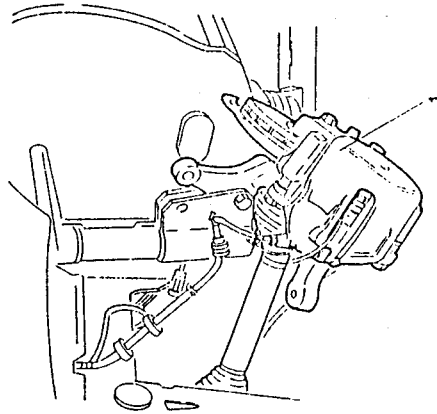
1. Disconnect the right-hand half-shaft from the intermediate transmission shaft by unscrewing the relative screws.



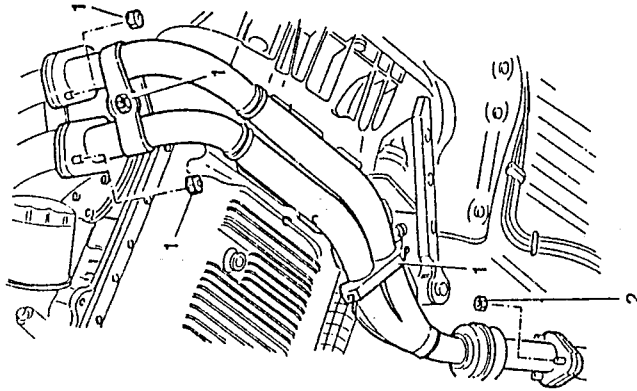
1. Loosen the two bolts securing the right-hand support to the shock absorber and remove only the upper bolt.



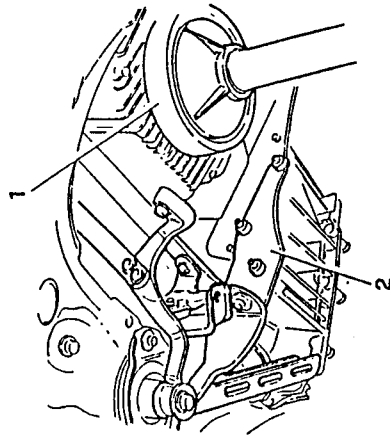
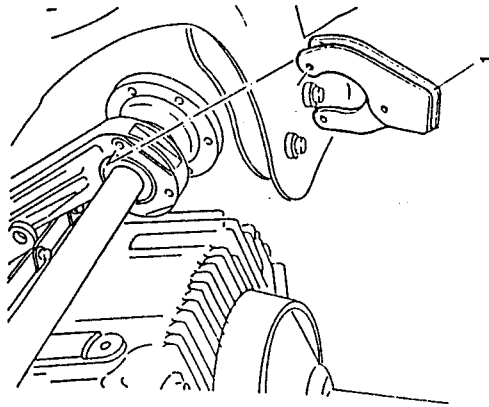
1. As far as possible, tip the wheel hub forwards to advance the half-shaft.



1. Disconnect the forward section of the exhaust pipe from the manifolds by unscrewing the relative nuts and intermediate supports.
2. Disconnect the flange securing the forward section of the catalytic converter and remove it.

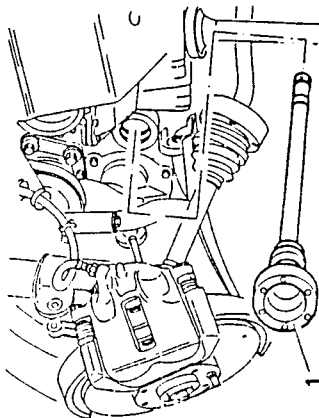


1. Remove bracket locking the intermediate shaft to the support.

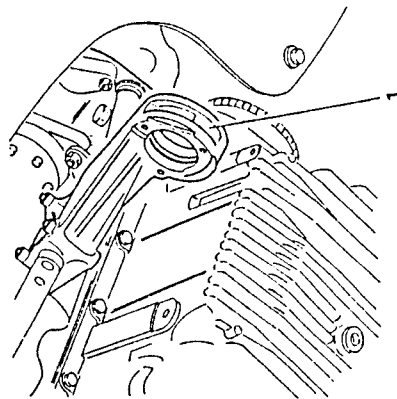


1. Place a suitable column lift under the oil sump.
2. Remove the engine support bracket.

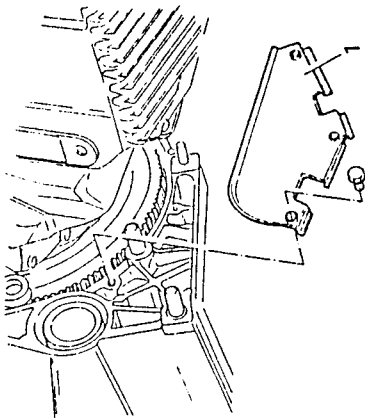
1. Withdraw the intermediate shaft and the dust ring.



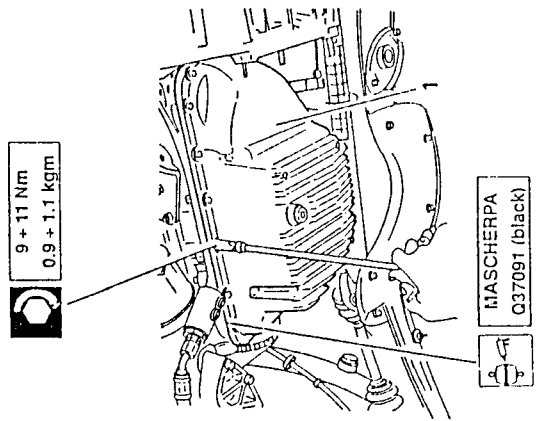
1. Remove the intermediate transmission shaft.



1. Remove the flywheel protection cover.

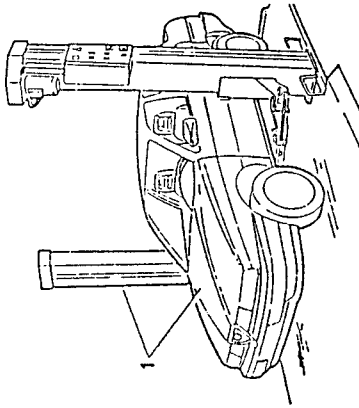


1. Unscrew the screws and bolts and remove the oil sump.

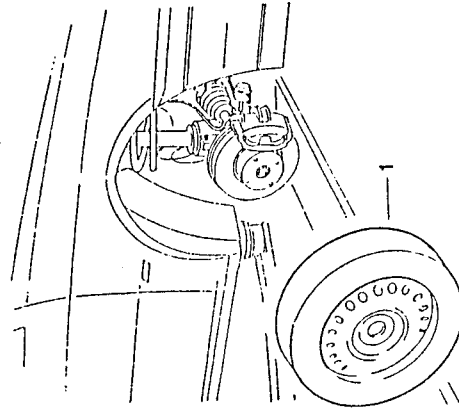


REMOVAL/REFITTING OF THE ENGINE PULLEY

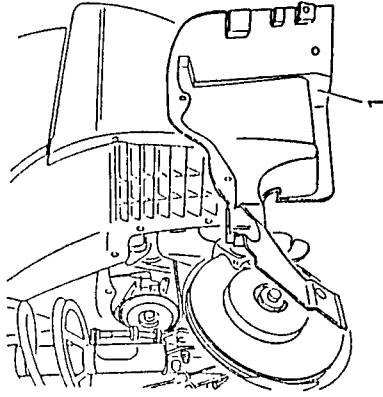
1. Place the vehicle on a lift.



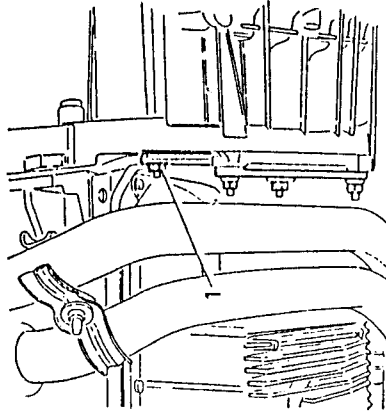
1. Remove the front right-hand wheel.



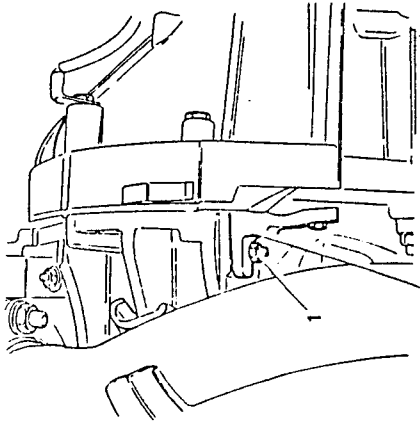
1. Remove the central engine protection cover from the right-hand wheel arch.



1. Remove the front screw securing the flywheel cover to the gearbox.

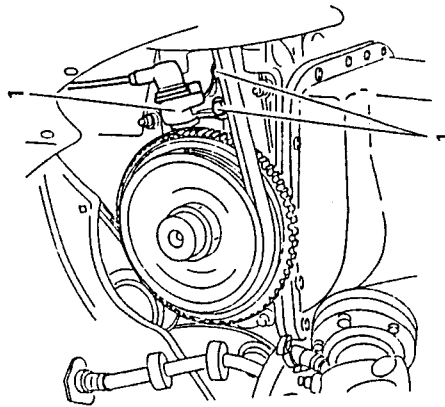


1. Install flywheel locking tool N° 1.820.240.000.

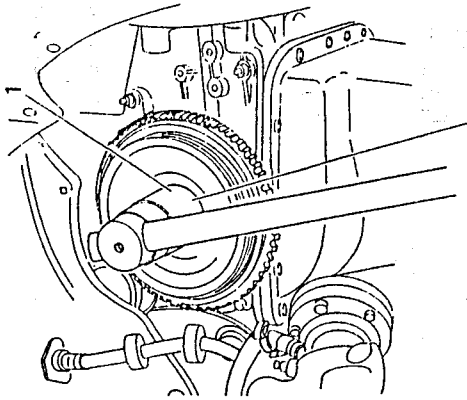


1.820.240.000

1. Unscrew the screws securing the r.p.m. and timing sensor and move it to one side without disconnecting the electrical connections.



- Remove the water pump, power steering pump and alternator drive belts (see GROUP 00)
1. Unscrew the nut and remove the crankshaft pulley



209 + 231 Nm
21,3 + 23,55 kgm



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

The same information has been included in the description of the repair procedure presented earlier.
The information below has been synthetically enlarged with other data useful for the complete inspection of the engine and its parts.

The order in which the components are presented is the same as that for the reassembly of overhauled engines.

All technical dimensional checks and inspections relative to the AR67102, AR67202 and AR67103 engines are presented below.

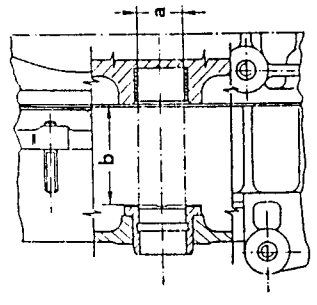
TECHNICAL CHARACTERISTICS OF THE ENGINE

Engine	AR 67103	AR 67102	AR 67202
Cycle	eight cycles, four stroke		
Fuel supply	electronic injection		
Displacement	1749	1773	1995
Number of cylinders	4 in a line		
Bore	83.4	84	84
Stroke	80	80	90
Maximum Power	(*)	129 (93) 6000	143 (104) 6000
Maximum torque	(*)	17 (165) 5000	19.3 (186.8) 5000
Compression ratio	(*)	10	10
Engine oil pressure	kPa (bars: kg/cm ²)		
- at idle speed	100 (1; 1.02)		
- at 4000 r.p.m.	500 (5; 5.1)		

(*) Values not available at time of going to press.

COMPLETE ENGINE BLOCK

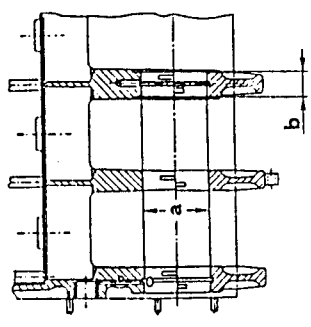
Engine block



	Unit: mm
Internal diameter of timing belt idle shaft housing bushings (1)	20.667 + 20.698
Width of shoulder between the two timing belt idle shaft housing bushings (2)	44.320 + 44.420

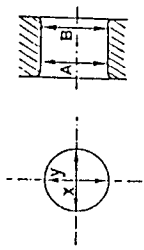
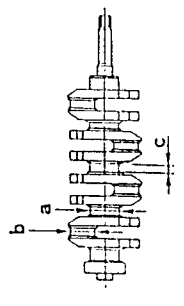
(1) During interventions both bushings must be replaced.
 (2) Measurement must be carried out with the cover locked and the relative gasket installed.

Main supports



	Unit: mm
Diameter of main supports	63.652 + 63.664
Length of central main support shoulder	25.15 + 25.20

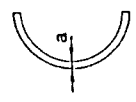
Crankshaft



(1) Ovalization X:Y
 (2) Taper A:B

	Unit: mm	
Diameter of main supports (a)	A - Red	59.970 + 59.976
	B - Blue	59.963 + 59.970
	C - Yellow	59.956 + 59.963
Diameter of rod journal (b)	A - Red	49.992 + 49.998
	B - Blue	49.985 + 49.992
	C - Yellow	49.978 + 49.985
Length of central main journal (c)		30.000 + 30.035
Maximum ovalization of main and rod journal (1)		0.007
Maximum taper of main and rod journals (2)		0.010
Maximum error of parallelism between main and rod journals		0.015
Maximum eccentricity between main journals		0.040
Maximum deviation between centre lines of handle and main journals		0.300

Main half bearings



	Unit: mm	
Thickness of main half bearings (a)	A - Red	1.830 + 1.835
	B - Blue	1.835 + 1.839
	C - Yellow	1.839 + 1.844
Radial play between main pin and bearing	A - Red	0.006 + 0.034
	B - Blue	0.004 + 0.031
	C - Yellow	0.001 + 0.030

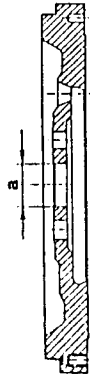
Thrust half rings



	Unit: mm
Thickness of thrust half rings (a)	2.311 + 2.362
Crankshaft axial play	0.076 + 0.263

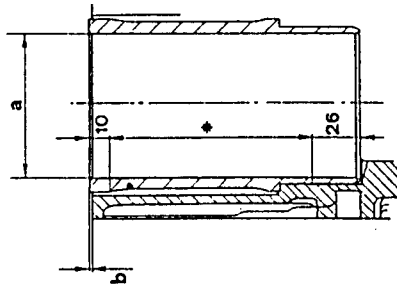


Flywheel



Internal diameter of central bushing (bore) (a)	32.000 + 32.025 mm
Heating temperature of ring gear for installation on engine flywheel	120 + 140° C

Cylinder liner



	Unit: mm		
	AR67102	AR67202	
Diameter of cylinder liner (a)	A - Blue	83.385 + 83.394	83.985 + 83.994
	B - Pink	83.395 + 83.404	83.995 + 84.004
	C - Green	83.405 + 83.414	84.005 + 84.014
Protuberance of cylinder liner from engine block (b)	0.01 + 0.06		
Limit of ovalization and cylinder liner taper	0.01		
Cylindrical and circular limit of cylinder liner	0.01		

(*) Area for dimensional control



ROD-PISTON ASSEMBLY

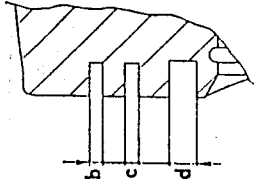
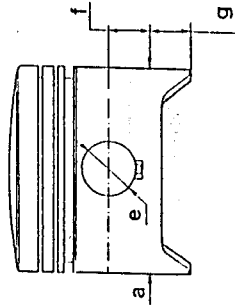
Piston

Unit: mm

	AR67102		AR67202	
Piston diameter (1)	A - Blue	83.345 + 83.355	83.935 + 83.945	
	B - Pink	83.355 + 83.365	83.945 + 83.955	
	C - Green	83.365 + 83.375	83.955 + 83.965	
Height of first seal ring seating (b)	1.525 + 1.545			
Height of second seal ring seating (c)	1.525 + 1.545			
Height of oil scraper ring seating (d)	3.515 + 3.535			
Diameter of gudgeon pin hole in piston (e)	Black	22.000 + 22.002	22.000 + 22.002	
	White	22.002 + 22.005	21.999 + 22.002*	
Clearance between cylinder liner and piston	0.030 + 0.049		0.040 + 0.059	
Weight difference between pistons	± 2 g			

* Value only relative to AR67202 engine

(1) To be measured perpendicular to the gudgeon pin hole at a distance of:

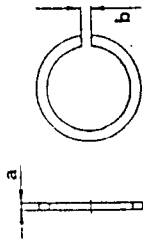


from the lower edge of skirt	g = 10.3 mm	AR67202 (MONDIAL)
from the gudgeon pin axis	f = 16.5 mm	AR67102 (MONDIAL)
from lower edge of skirt	g = 17 mm	AR67102 (BORGO)
from lower edge of skirt	f = 15 mm	AR67103 (BORGO)

Piston rings

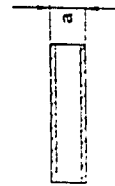
		Unit: mm
Thickness of rings (a)	First ring	1.478 + 1.490
	Second ring	1.478 + 1.490 (2)
	Oil scraper ring	1.475 + 1.490 (3)
Ring gap (1) (b)	First ring	3.478 + 3.490 (2)
	Second ring	3.475 + 3.490 (3)
	Oil scraper ring	0.30 + 0.50
Axial play between piston rings and sealings	First ring	0.30 + 0.50
	Second ring	0.25 + 0.40 (2)
	Oil scraper ring	0.25 + 0.50 (3)
Axial play between piston rings and sealings	First ring	0.035 + 0.067
	Second ring	0.035 + 0.067 (2)
	Oil scraper ring	0.035 + 0.070 (3)
Oil scraper ring	First ring	0.025 + 0.057 (2)
	Second ring	0.025 + 0.060 (3)

(1) To be measured in the checking ring nut or in the cylinder liner
 (2) Borgo (3) Goetze


Gudgeon pin

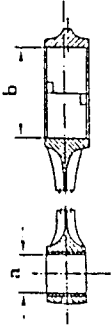
		Unit: mm
Outer diameter of gudgeon pin (a)	Black	21.994 + 21.997
	White	21.991 + 21.994 (*)
Clearance between piston hole and gudgeon pin	Black	21.997 + 22.000
	White	21.994 + 21.997 (*)
Clearance between piston hole and gudgeon pin	Black	0.003 + 0.008
	White	0.005 + 0.011 (*)
Clearance between piston hole and gudgeon pin	Black	0.002 + 0.008
	White	0.005 + 0.011 (*)

(*) Only relative to AR67202 engine


Rod

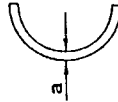
		Unit: mm
Diameter of rod small end bushing bore	(a)	22.005 + 22.015
	(b)	53.695 + 53.708
Inner diameter of rod big end	(a)	53.695 + 53.708
	(b)	53.695 + 53.705 (*)
Weight difference between rods	Black	≤ 2 g
	White	0.008 + 0.021
Clearance between rod small end bushing and gudgeon pin	Black	0.009 + 0.024 (*)
	White	0.005 + 0.018
		0.008 + 0.021 (*)

(*) Only relative to AR67202 engine


Rod bearing halves

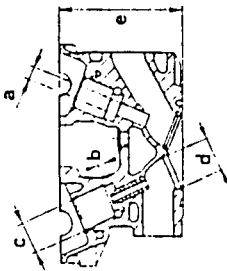
		Unit: mm
Thickness of rod half bearing (a)	A - Red	1.832 + 1.836
	B - Blue	1.836 + 1.841
	C - Yellow	1.841 + 1.845
Radial play between pins and rod bearings	A - Red	0.025 + 0.052
	B - Blue	0.025 + 0.049 (*)
	C - Yellow	0.021 + 0.051
Axial play of rod head	A - Red	0.021 + 0.048 (*)
	B - Blue	0.020 + 0.048
	C - Yellow	0.020 + 0.045 (*)
		0.2 + 0.3

(*) Only relative to AR67202 engine



CYLINDER HEADS

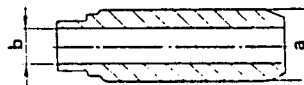
Heads



	Unit: mm	
Diameter of valve guide seating	(a)	15.000 + 15.018
Valve guide protrusion	(b)	9.850 + 10.150
Diameter of valve cup seating	(c)	35.000 + 35.025
Diameter of valve seat housing	Intake (d)	45.000 + 45.025
	Exhaust	39.000 + 39.025
Minimum permissible height of the head after facing	(e)	134.900
Maximum error of parallelism between head planes		0.087
Maximum error of flatness of head lower plane		0.05

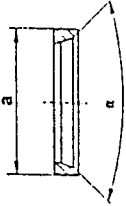


Valve guides



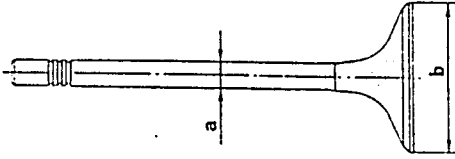
	Unit: mm	
Outer diameter of valve guide	Intake (a)	15.039 + 15.050
	Exhaust	15.050 + 15.068
Inner diameter of valve guide (bore) (b)		8.000 + 8.015
Interference between valve guide and seating	Intake	0.021 + 0.050
	Exhaust	0.032 + 0.068

Valve seatings



	Unit: mm	
Outer diameter of valve seat	Intake (a)	45.100 + 45.116
	Exhaust	39.095 + 39.111
Valve seat taper	(α)	90° ± 20°
Interference between valve seat and housing	Intake	0.075 + 0.116
	Exhaust	0.070 + 0.111
Cylinder head shrink-fit temperature for installation of valve seatings		100 + 120°C

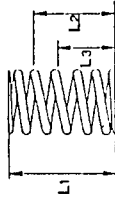
Valve



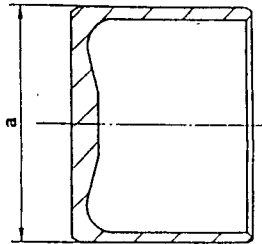
	Unit: mm	
Diameter of valve stem	Intake (a)	7.970 + 7.985
	Exhaust	7.945 + 7.960
Diameter of valve head	Intake (b)	43.850 + 44.000
	Exhaust	37.850 + 38.000
Radial play between valve stem and guide	Intake	0.015 + 0.045
	Exhaust	0.040 + 0.070

Valve springs

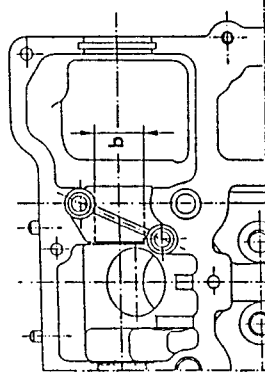
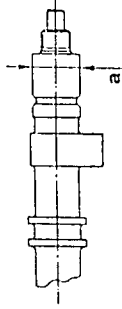
		Unit: mm
Length of valve spring at rest (L ₁)	Outer spring	48.7
	Inner spring	46.2
Length of closed valve spring (L ₂)	Outer spring	36.5
	Inner spring	34.5
Length of spring with open valve (L ₃)	Outer spring	25.5
	Inner spring	23.5
Load corresponding to spring length with valve closed	Outer spring	212 + 220 N (21.6 + 22.4 kg)
	Inner spring	115 + 120 N (11.8 + 12.2 kg)
Load corresponding to spring length with valve open	Outer spring	452 + 470 N (46.1 + 47.9 kg)
	Inner spring	244 + 252 N (24.9 + 25.7 kg)


Valve cups

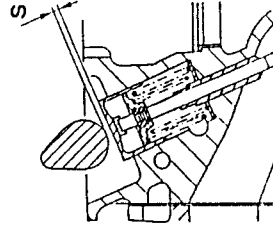
		Unit: mm
Diameter of valve cups	(a)	34.973 + 34.989
Radial play between valve cups and seating		0.011 + 0.052


Camshaft

		Unit: mm
Diameter of camshaft journal	(a)	26.959 + 26.980
Diameter of camshaft journal seating	(b)	27.000 + 27.033
Radial play between weight and camshaft seating		0.020 + 0.074
Camshaft axial play		0.080 + 0.124

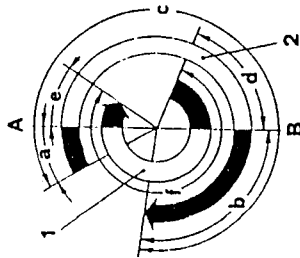

Valve clearance

		Unit: mm
Valve clearance (cold engine)	(s) Intake	0.380 + 0.450
	Exhaust	0.430 + 0.500
Nominal height	Intake	11.5
	Exhaust	9.6
Angular value of timing reference marks on caps	Intake	5°30'
	Exhaust	13°15'





ANGULAR VALUES OF ACTUAL TIMING DIAGRAM



Clockwise rotation of crankshaft seen from front side

(1) Exhaust (2) Intake
(A) TDC (B) BDC

Intake	Opening (before TDC)	(a)	30°	60° (*)
	Closing (after BDC)	(b)	98°	68° (*)
Exhaust	Intake angular value	(c)	308°	
	Opening (before BDC)	(d)	67°50'	
	Closing (after TDC)	(e)	34°	
	Intake angular value	(f)	281°50'	

(*) Values measured with timing variator engaged.



FLUIDS AND LUBRICANTS

Application	Type	Classification	Name	Q.ty litres
Engine oil	Oil	API SG CCMC G5 SAE 10W/40	SELENIA SPECIAL FORMULA ALFA ROMEO 10W/40	5.5; 6° 5
- Total capacity				
- Partial capacity (filter and pan) for routine changes				
- Filter				0.5
- Camshaft sumps				0.5
Cylinder head stud bolts				-
Intake and exhaust valve cups				-
Camshaft supports				-
Oil pump shaft				-
Outer surface of crankshaft oil seals				-
Crankshaft oil seal lip	Grease		ISECO	-
Spark plug threads	Oil		ISECO Molykote A	-

(*) Only for AR 67202 engine

SEALANTS AND FIXATIVES

Application	Type	Name	Q.ty
Cylinder head screws (lower side)	Mastic	DIRING Curit	-
Upper head cover plane	Mastic	DIRING Heldite	-
Timing variator solenoid support flange	Mastic	DIRING Heldite	-
Screws securing flywheel to crankshaft	Mastic	Loctite 270 (green)	-
Camshaft shank for installation of timing variator	Mastic	DIRING Heldite	-
Gasket between flexible support pads and supply manifold	Mastic	DOW CORNING Hermetite	-
Contact surfaces between oil sump and engine block	Mastic	MASCHERPA Q37091 (black)	-

ABRASIVES

Application	Type	Name	Q.ty
Grinding of valve seats	Abrasive	SIPAL AREXONS Carbosilicium for valves	-

TIGHTEN TORQUES
Engine block

Part	Nm	kgm
Nuts securing main caps to support block (in oil)	20 + 115*	2.04 + 115*
Screws securing flywheel to crankshaft (with fixative)	116.4 + 128.6	11.87 + 13.1
Nut securing crankshaft pulley (in oil)	209 + 231	21.3 + 23.55
Screws securing belt tensioner shoe to front cover	6 + 8	0.6 + 0.8
Nuts securing front cover to engine block	10.2 + 12.6	1.04 + 1.28
Nuts securing water pump to front cover	7.65 + 9.45	0.78 + 0.96
Nuts securing water pump to engine block	12.75 + 15.75	1.3 + 1.6
Screws securing thermostat unit to cylinder head	8.5 + 10.5	0.87 + 1.07
Nuts securing rod caps	49 + 54	5 + 5.5
Oil sump drainage cap	64.5 + 80	6.6 + 8.2
Screws and nuts securing oil sump	9 + 11	0.9 + 1.1

Cylinder head

Part	Nm	kgm
Screws securing timing cover	9.75 + 15.75	1.0 + 1.6
Screws securing cylinder head to front cover	14.25 + 15.75	1.45 + 1.6
Nuts securing camshaft caps (in oil)	20 + 22	2.04 + 2.24
Spark plug tightening (in ISECO Molykote A oil)	28 + 34.65	2.85 + 3.53
Engine coolant temperature sender	40 + 49.4	4.1 + 5.0
Engine minimum oil pressure sensor	35.7 + 44.1	3.64 + 4.5
Engine oil pressure motor	8.5 + 10.5	0.87 + 1.07
Nut securing exhaust side timing gear	51 + 63	5.2 + 6.4
Engine coolant maximum temperature warning light sensor	3.8 + 4.7	0.39 + 0.48
Support securing timing variator to camshaft (with fixative)	104.5 + 115.5	10.7 + 11.8
Screws securing timing gear to timing variator	29.5 + 32.5	3.0 + 3.3
Engine oil temperature sensor	21.3 + 26.3	2.2 + 2.7
Engine oil minimum level warning light sensor	25	2.5

Tightening nuts securing cylinder head to engine block

Tightening sequence	Phase	Nm	kgm
	When refitting: Gradually tighten following the indicated sequence	76 + 84	7.75 + 8.56
	After trials and bench testing: With engine cold, loosen the nuts by one turn following the sequence indicated, smear with engine oil and tighten in the sequence shown	82.65 + 91.35	8.43 + 9.3



SPECIAL TOOLS

1.820.004.000 (A.2.0117)	Tool for locking cylinder liners
1.820.011.000 (A.2.0192)	Valve support tool
1.820.012.000 (A.2.0155)	Base for cylinder head support tool
1.820.013.000 (A.2.0196)	Cylinder head support yoke
1.820.049.000 (A.2.0359)	Special nut for valve support tool
1.820.052.000 (A.2.0362)	Tool for locking cylinder lines
1.820.080.000 (A.2.0451)	Tool for removing head from engine block
1.820.114.000 (A.42.0172)	Guide for reaming front cover and engine block bushings
1.820.145.000 (R.4.0178)	Engine support bracket
1.820.225.000	Support for removal/refitting engine group
1.820.228.000	Tool for locking flywheel
1.820.233.000	Bracket for removing/refitting engine group
1.820.240.000	Tool for locking flywheel
1.821.007.000 (A.3.0146)	Crankshaft front oil seal inserting tool
1.821.010.000 (A.3.0178)	Crankshaft rear oil seal inserting tool
1.821.015.000 (A.3.0210)	Tool for removal of bushing on engine block


(CONTINUES)



(CONTINUED)

1.821.053.000 (A.3.0311)	Valve guide puller
1.821.056.000 (A.3.0324)	Lever for valve disassembly/assembly
1.821.110.000 (A.3.0469)	Inserting tool for valve guide pads
1.821.122.000 (A.3.0520)	Cage for valve disassembly/assembly
1.821.124.000 (A.3.0522)	Support for valve disassembly/assembly
1.821.162.000 (A.3.0621)	Puller for valve guide seal cover (intake and exhaust)
1.821.164.000 (A.3.0625)	Inserting tool for valve guides (intake and exhaust)
1.822.001.000 (A.5.0103)	Spanner for rotation of camshaft
1.822.110.000	Tool for disassembly/reassembly and greasing of camshaft timing variator - intake side
1.825.003.000 (C.6.0148)	Tool for checking cylinder liner or piston protrusion from engine block
1.825.013.000 (C.6.0183)	Tool for checking TDC
1.825.018.000 (C.6.00197)	Feeler gauge for checking valve clearance
1.825.001.000 (C.8.0103)	Plug gauge for checking alignment of return gear bushings
1.828.001.000 (U.2.0040)	Tool for reaming front cover and engine block bushings
1.828.002.000 (U.2.0041)	Tool for reaming front cover and engine block bushings
(A.3.0527)	Inserting tool for intake valve seatings
(A.3.0528)	Inserting tool for exhaust valve seatings



PROCEDURE FOR FAULT RECTIFICATION		
ENGINE - LUBRIFICATION		
FAULTS AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
OIL LEAKS	Visual detection of oil leaks causing drips or soiling of the engine	A
LOSS OF OIL PRESSURE	The pressure gauge on the instrument panel indicates a decrease (sudden or gradual) of engine oil pressure: at very low pressure the relevant warning lamp comes on. NOTE: It is advisable to first ascertain that the pressure gauge on the instrument panel, pressure meter and minimum pressure sensor are operational, checking the actual engine oil pressure with a pressure gauge - refer to WIRING DIAGRAMS AND ELECTRICAL DIAGNOSIS manual - INSTRUMENT PANEL	B
EXCESSIVE OIL CONSUMPTION	Oil consumption will increase notably in relation to the stated values and those noted during the life of the vehicle. NOTE: High oil consumption during the first 8000 miles must not be considered abnormal as this is due to the engine settling.	C
 ATTENTION: <ul style="list-style-type: none"> Engine oil is harmful to the skin: reduce all contact, stains or drops of oil on your skin to a minimum: wash off oil with soap and water. Do not dispose of used oil in the environment: find out where used oil is collected in your area. 		

OIL LOSS		TEST A
TEST STEPS	RESULTS	REMEDY
FOREWORD: It is absolutely necessary to accurately identify the engine component or area causing the leak. If the cause cannot be visually identified, it is advisable to wash the engine with water, dry it, and then start it on a level surface or perform a short test cycle and wait until the leaks become evident. Following this, act on the affected component and tackle the other components at a later date.		
A1 CHECK DRAIN PLUG - Check drain plug for correct torque and for absence of damage	OK OK	Carry out step A2 Torque or replace plug if necessary
A2 CHECK OIL SUMP - Check: • the oil sump for damage, distortion or micro-cracks • sealing of gasket between sump and engine block • screws securing sump for correct torque	OK OK	Carry out Step A3 Replace sump or restore gasket if necessary. Tighten the sump screws to the correct torque
A3 CHECK OIL FILTER - Check for absence of leaks in the oil filter area; check that the seal is tight	OK OK	Carry out step A4 Replace seal and tighten filter to the correct torque



OIL LOSS

TEST A

TEST STEPS		RESULTS	REMEDY
A4	CHECK OIL SEALS	OK	Carry out step A5
	- Remove the covers in order to gain access to the crankshaft and camshaft oil seals; check for leaks in these areas	OK	Replace defective oil seals
A5	CHECK MISCELLANEOUS COMPONENTS	OK	Replace defective components
	- Check for leaks from any other component not listed in the previous test steps. Correct the fault on the basis of the remedies mentioned above.		

End of test A



LOSS OF OIL PRESSURE

TEST B

TEST STEPS		RESULTS	REMEDY
B1	CHECK OIL LEVEL	OK	Carry out step B2
	- Using the dipstick, check that the oil level is correct	OK	Top-up oil level
B2	CHECK QUALITY OF OIL AND FILTER	OK	Carry out step B3
	- Check that: <ul style="list-style-type: none"> the engine oil is of the prescribed type the oil filter is of the prescribed type and correctly installed 	OK	Service with the prescribed oil to the proper level. If necessary replace the filter
B3	CHECK OIL PUMP	OK	Carry out step B4
	- Check oil pump for traces of binding, overheating of its components.	OK	Replace defective parts

(Continued)



LOSS OF OIL PRESSURE		TEST B
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TEST STEPS	RESULTS	REMEDY
B4 CHECK PRESSURE RELIEF VALVE - Check: • pressure relief valve for correct seal, integrity and cleanliness • the valve spring for yielding or breakage	(OK) ▲ (OK) ▲	Carry out step B5 Replace defective components
B5 CHECK OIL PASSAGES Only relevant to complete engine overhaul: - Check the passages in the engine block and cylinder heads for obstructions caused by oil residues or foreign matter. - Check plugs on crankshaft for sealing and integrity.	(OK) ▲	Thoroughly clean affected parts and replace them if necessary.

End of test B

EXCESSIVE OIL CONSUMPTION		TEST C
---------------------------	--	--------

TEST STEPS	RESULTS	REMEDY
FOREWORD: Check that excessive oil consumption is not caused by leakage. Refer to Test A.		
C1 CHECK FOR SEEPAGE THROUGH VALVES - Remove the cylinder heads and check for traces of oil in the combustion chambers. In this case check: • Dimensions and clearances between the valve stem and the relevant valve guide, and between the valve guide and the valve guide seats in the cylinder head; • the integrity of the seal pad located on the valve stem • the valve stem for traces of binding or scoring.	(OK) ▲ (OK) ▲	Carry out step C2 Replace defective parts
C2 CHECK FOR SEEPAGE THROUGH PISTON RINGS - Check for seepage through piston rings. If this is discovered check the piston rings for: • breakage or damage; • correct installation (TOP mark facing upwards); • correct distribution of clearance around the circumference (gaps located at three different angles); • binding in their seats or excessive wear.	(OK) ▲ (OK) ▲	Carry out step C3 Replace the faulty rings
C3 CHECK CYLINDER LINERS - Check: • the roughness of the cylinder liners (excessive wear could cause excessively smooth surface); • that the main dimensions are within limits.	(OK) ▲	Replace the faulty cylinder liners if necessary

End of test C



PROCEDURE FOR FAULT RECTIFICATION ENGINE - NOISY OPERATION

FOREWORD:

Discover if the noises are really caused by the engine and not by other components like:

- Coolant pump
- Alternator
- Power steering pump
- Air conditioning compressor

Note whether the noise is mainly present when the engine is cool or at normal running temperature, when engine is at idle speed or if the noise increases as the revs increase.

Noise is produced by the engine if:

- noise is present when the vehicle is at rest and during travel
- noise is present when the clutch is engaged and disengaged

FAULTS AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
BEATING WHEN THE ENGINE IS IDLING	More or less constant noise is present when the engine is at idle speed, at normal running temperature; noise comes from the timing system cover area.	A
BEATING WHEN THE ENGINE IS COLD	Continuous beating of varying intensity coming from one or more of the cylinders. NOTE: Beating disappears when the engine is at normal running temperature. The affected cylinder can easily be identified by disconnecting the spark plugs one at a time.	B
INTENSE AND INCONSTANT BEATING	Very intense beating which can be heard during clutch engagement and disengagement and during sudden acceleration.	C



PROCEDURE FOR FAULT RECTIFICATION ENGINE - NOISY OPERATION

FAULTS AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
BACKGROUND BEATING (DUE TO IMBALANCE)	A background beat that can be heard when the engine is under load or noise coming from the rod-crankshaft and piston-cylinder liner couplings	D

NOTE: Before performing the tests indicated below, check the oil level, grade of oil and oil filter. If necessary change engine oil and filter using the prescribed quantities and grades.



BEATING WHEN ENGINE IS AT IDLE		TEST A
TEST STEPS	RESULTS	REMEDY
A1 CHECK VALVE CLEARANCE - Check that the clearance between the cam heel radius and the top of the valve cup is within the specified limits.	OK OK	Carry out step A2 Adjust clearance
A2 VISUALLY CHECK CAMS AND CUPS - Visually check the cuspid of the cams and the top of the cups for wear, scoring, binding etc.	OK OK	Carry out step A3 Replace defective items
A3 CHECK AXIAL PLAY - Check that camshaft axial play is within the specified limits.	OK OK	Carry out step A4 Replace defective camshaft
A4 CHECK CUPS AND SEATINGS - Check the outer diameter of the cups and the diameter of the relevant seatings; also check for scroing, binding etc.	OK	Replace affected cups and/or relevant cylinder head

End of test A

BEATING WITH ENGINE COLD		TEST B
TEST STEPS	RESULTS	REMEDY
B1 CHECK PISTON-CYLINDER LINER COUPLING - Check that the clearance between cylinder liner and piston is within the prescribed limits.	OK OK	Carry out step B2 Replace affected cylinder liner and piston
B2 CHECK GUDGEON PIN - Check that clearances between piston hole and gudgeon pin, and between rod small end bushing hole and gudgeon pin are within the specified limits.	OK	Replace affected items

End of test B



INTENSE AND INCONSTANT BEATING		TEST C
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TEST STEPS		RESULTS	REMEDY
C1	CHECK CRANKSHAFT PULLEY ATTACHMENT - Check that the nut securing the crankshaft pulley is not loose.	<p>OK ▲</p> <p>OK ▲</p>	<p>Carry out step C2</p> <p>Tighten the nut to the correct torque or replace if faults</p>
C2	CHECK FLYWHEEL ATTACHMENT - Check that the screws securing the flywheel to the crankshaft are not loose.	<p>OK ▲</p>	<p>Tighten screws to the specified torque or replace if damaged. Use locking compound LOCTITE 270</p>



End of test C

BACKGROUND BEAT (DUE TO INBALANCE)		TEST D
------------------------------------	--	--------

TEST STEPS		RESULTS	REMEDY
D1	CHECK CASTING OF MAIN AND ROD BEARINGS - Check: <ul style="list-style-type: none"> main and rod bearings for traces of overheating, flaking etc. crankshaft journals for damage 	<p>OK ▲</p> <p>OK ▲</p>	<p>Carry out step D2</p> <p>Replace crankshaft. Wash engine block lubricating system and overhaul or replace oil pump if necessary.</p>
D2	CHECK CONNECTING ROD AND BACKGROUND BEATING - Check: <ul style="list-style-type: none"> clearances between rod big end and crankshaft journals and relevant bearings tightening torques of main bearings and rod big end are within prescribed limits. 	<p>OK ▲</p> <p>OK ▲</p>	<p>Carry out step D3</p> <p>Replace crankshaft and/or affected rod. Tighten to prescribed torque</p>
D3	CHECK CRANKSHAFT BEATING - Check that crankshaft axial play is within the specified limits	<p>OK ▲</p> <p>OK ▲</p>	<p>Carry out step D4</p> <p>Replace the thrust half rings</p>



(CONTINUES)



BACKGROUND BEAT (DUE TO INBALANCE)	TEST D
------------------------------------	--------

TEST STEPS	RESULTS	REMEDY
<p>D4 CHECK PISTON BINDING BEATING</p> <p>- 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</p>		<p>Carry out step B</p> <p>Replace cylinder liner and piston of affected cylinder</p>

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.



GROUP 04

FUEL SYSTEM

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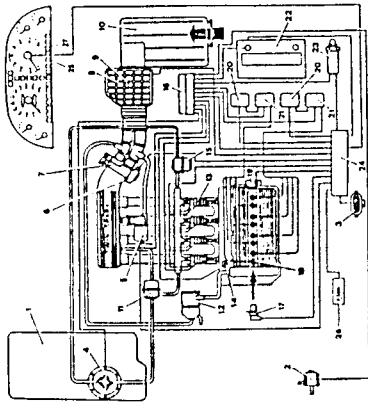




ILLUSTRATED INDEX

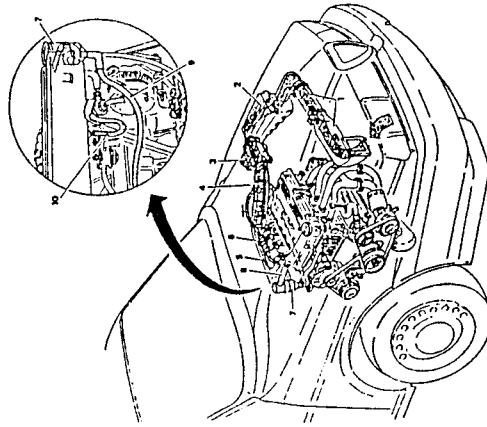
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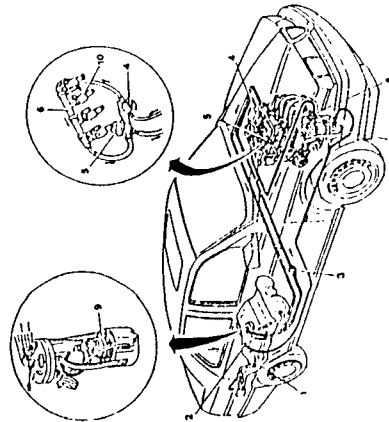
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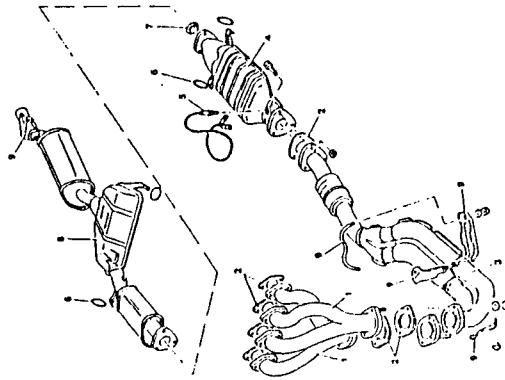
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BOSCH MOTRONIC M1.7 INJECTION - IGNITION SYSTEM

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 by 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;
- limitation of maximum r.p.m.;
- Timing variator control
- 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). This 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, setting 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 manufacturing tolerances) 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 (quantity of fuel):**

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, refer 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 which 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 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 throttle valve closed and the number of revolutions exceeding a threshold value (approx. 1200 r.p.m.), the control unit interrupts fuel injection; 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 the prescribed value.

The actuator employed in this version guarantees high speed regulation as the opening and closing of the by-pass are both controlled by magnetic windings. Idle speed adjustment, 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 body sensor, making it possible to "trace" any wearing which may influence the closed position of the throttle valve.



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 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 injectors. Refer to the relative paragraph in this group for information regarding fuel vapour recovery.

Connection to the air-conditioning compressor:

the control unit is connected to the air conditioning system so that the idle r.p.m. can be adjusted 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.

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.

Timing Variator:

the TWIN SPARK engines are equipped with an electro-mechanic-hydraulic timing variator which, connected to the camshaft, controls and regulates the intake timing on the basis of the engine loading and r.p.m. This mechanism is activated by the control unit when engine r.p.m. exceeds 1600 r.p.m. with a loading which is greater than 30%.

For information relevant to the timing variator, refer to GROUP 01.

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 = theoretical 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.

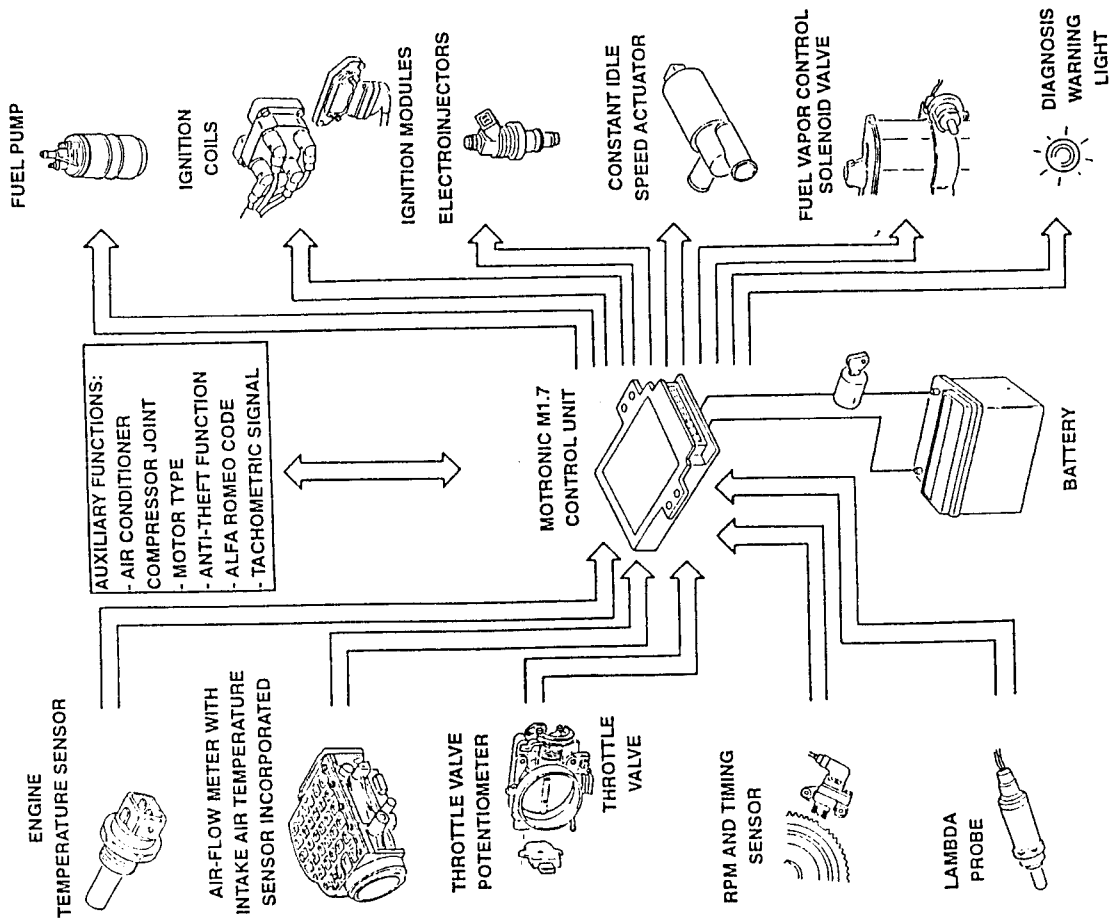
The probe is heated by an electrical resistance in order to be able to reach the correct operating temperature (approx. 300°C) as quickly as possible.

This probe therefore makes it possible to regulate the supply of fuel to the engine both retroactively and with precision.

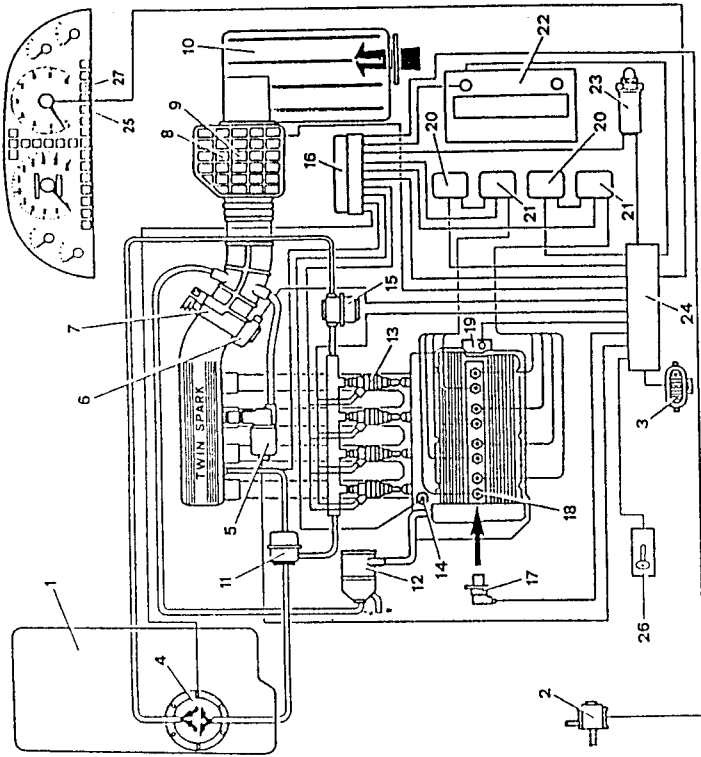
This also permits operation within the limits dictated by the laws regarding vehicle emissions.

In addition, this mechanism makes it possible to compensate for altitude as the variations in air density, via

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



COMPONENTS OF THE SYSTEM



- | | |
|---|---|
| 1. Fuel tank | 15. Impulse dashpot |
| 2. Evaporation solenoid valve | 16. Relay group |
| 3. Socket for system diagnosis | 17. R.P.M. and timing sensor |
| 4. Fuel pump | 18. Spark plugs |
| 5. Constant idle speed actuator | 19. Thermostat with engine coolant sensor |
| 6. Throttle valve opening position sensor | 20. Ignition modules |
| 7. Single throttle body | 21. Ignition coil |
| 8. Air-flow meter | 22. Battery |
| 9. Intake air temperature sensor | 23. Lambda probe |
| 10. Air cleaner | 24. Ignition and injection control unit |
| 11. Fuel pressure regulator | 25. Alfa Romeo CODE system warning light |
| 12. Oil separator | 26. Electronic key |
| 13. Electroinjectors | 27. Diagnosis warning light |
| 14. Timing vanator | |



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 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 greater 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.

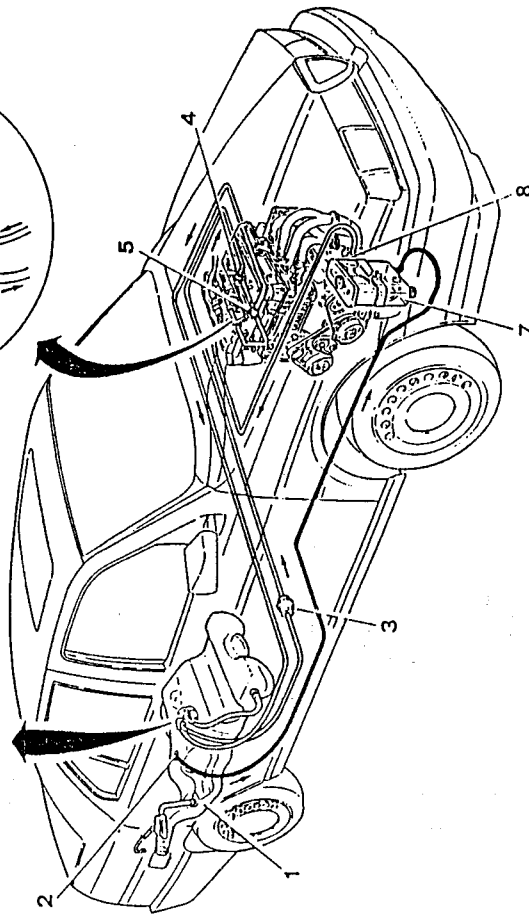
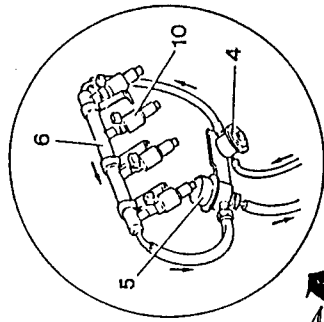
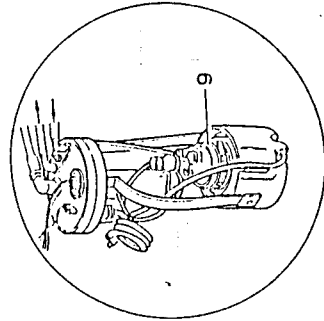


CAUTION:
Before carrying out repairs to the components of the fuel supply system proceed as follows to avoid dangerous leakage:

- disconnect the fuel pump supply fuse;
- run the engine until it stops.



FUEL SUPPLY AND VAPOUR RECOVERY SYSTEM



- | | |
|------------------------|----------------------------------|
| 1. Fuel tank | 6. Supply manifold |
| 2. Multifunction valve | 7. Fuel vapour filter (canister) |
| 3. Fuel filter | 8. Fuel vapour solenoid valve |
| 4. Impulse dashpot | 9. Electric fuel pump |
| 5. Pressure regulator | 10. Electroinjectors |

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 through the supply manifold to the electroinjectors.

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

When the outside temperature is high and when the exhaust pipe is hot, the fuel contained in the tank heats up and 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 canister in the activated carbon.

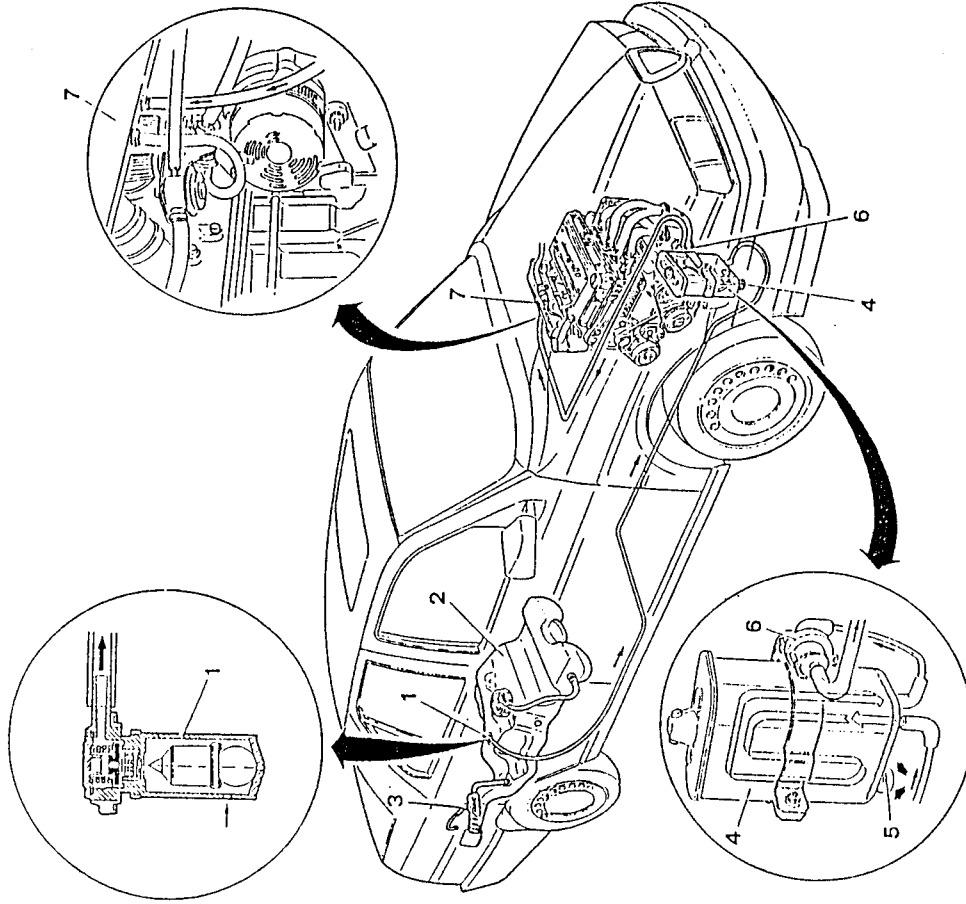
The Motronic control unit, when the engine is subject to loading, controls the opening of the solenoid valve allowing any fuel vapours to be sucked into the canister.

This situation also applies 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 electroinjectors 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 note
- 6. Electrovalve
- 7. Intake box



CAUTION:

Before operating on components of the supply system the following indications should be closely followed.

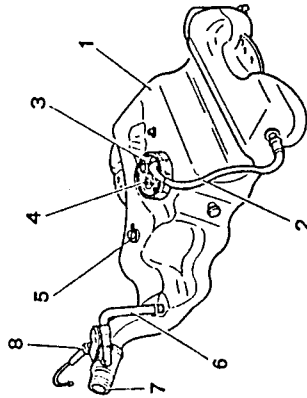
- Ensure that the workshop is equipped with the necessary safety equipment (fire extinguishers etc.).
- Disconnect the earth lead from the battery in order to avoid accidental contact between high voltage cables and the body-work which may lead to sparks and as a consequence cause fires.
- Place the drained fuel into a suitable container fitted with a safety lid.
- Do not smoke or use naked flame around the work area.

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

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.

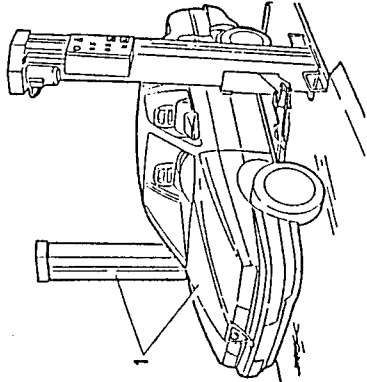
A mechanism inside the cap ensures that it is tightened to the correct torque of 15 to 18 Nm: over-tightening, above the stated value, is avoided as the cap will click past the resistance offered by the teeth.

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.



REMOVAL/REFITTING

1. Place the vehicle on a lift.

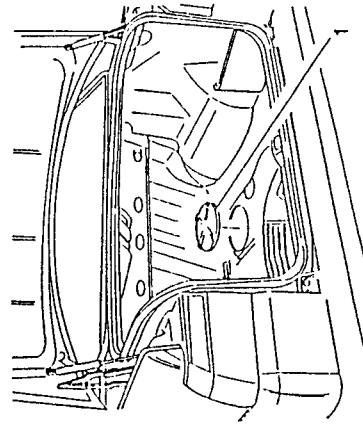


- Disconnect the negative cable from the battery
- Release the pressure within the tank by loosening the filler cap.
- Empty the tank by sucking the fuel out through the filler neck with a suitable pump.

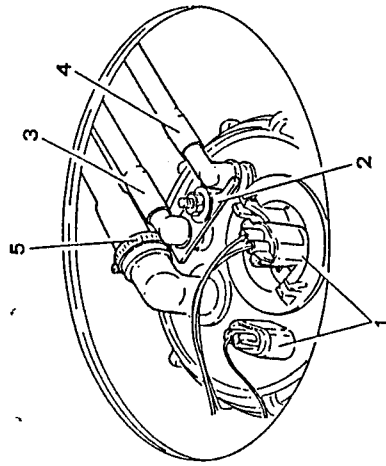


CAUTION:
Place the fuel removed from the vehicle into a suitable container.

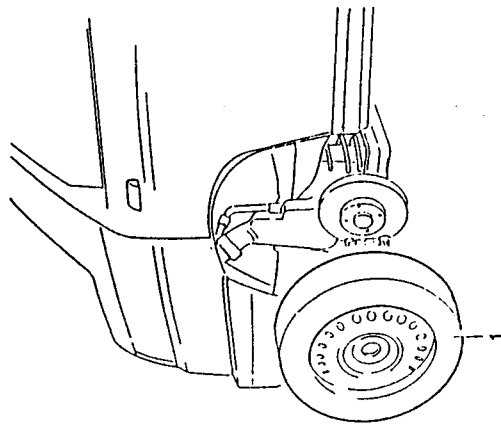
1. Operating from the luggage compartment, remove the lower covering and remove the cover to gain access to the pump and the fuel level meter.



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.

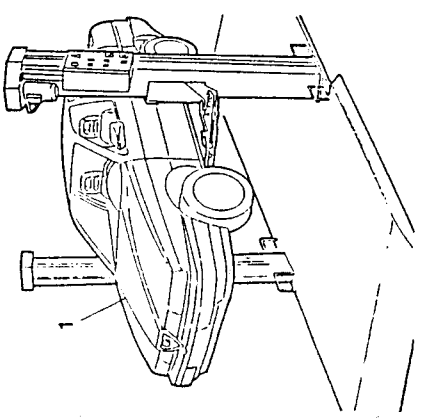


1. Remove the right-hand rear wheel.

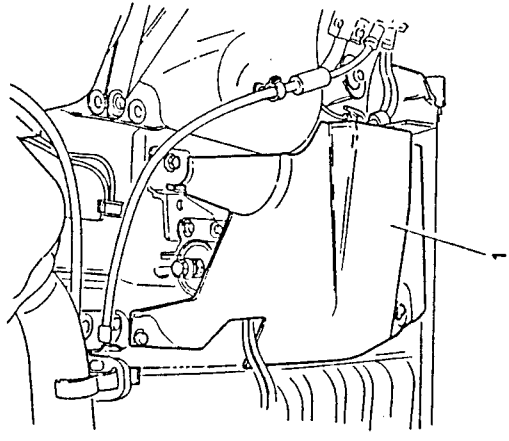




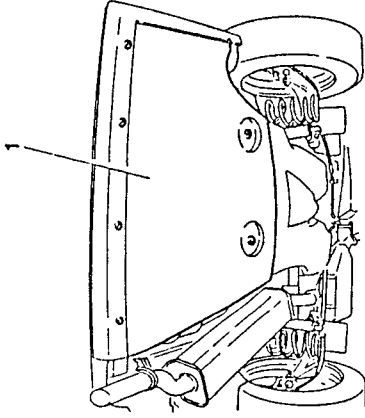
1. Raise the vehicle.



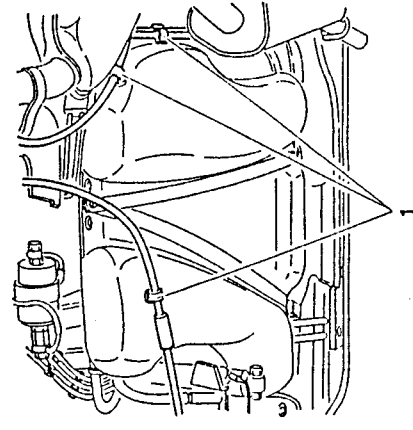
1. Remove the protection from the fuel filter.



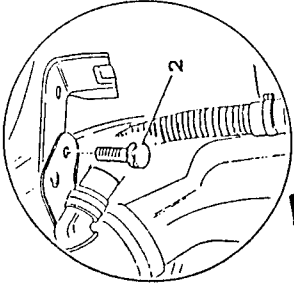
1. Remove the protection from beneath the fuel tank.



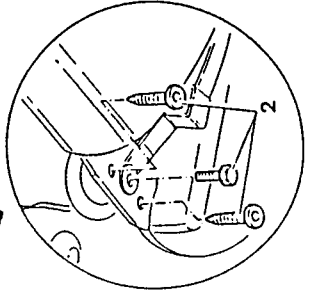
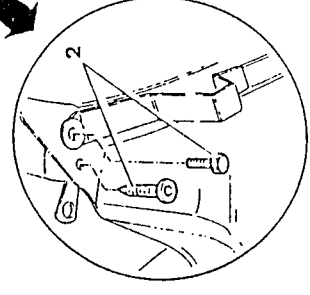
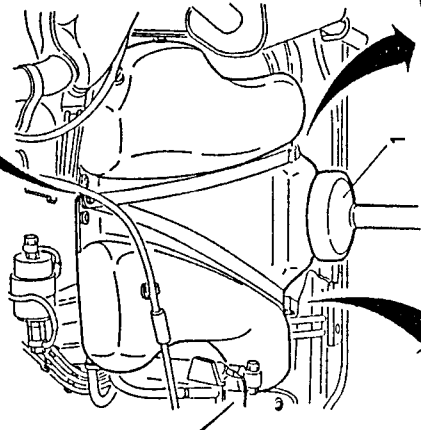
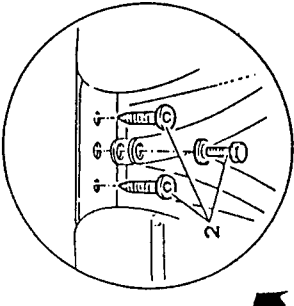
1. Free the handbrake cables and the brake lines from the brackets on the tank.



1. Prop up the tank with a hydraulic jack.

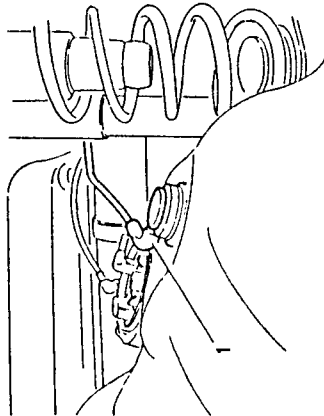


2. Remove all the plastic screws and nails holding the tank to the body.

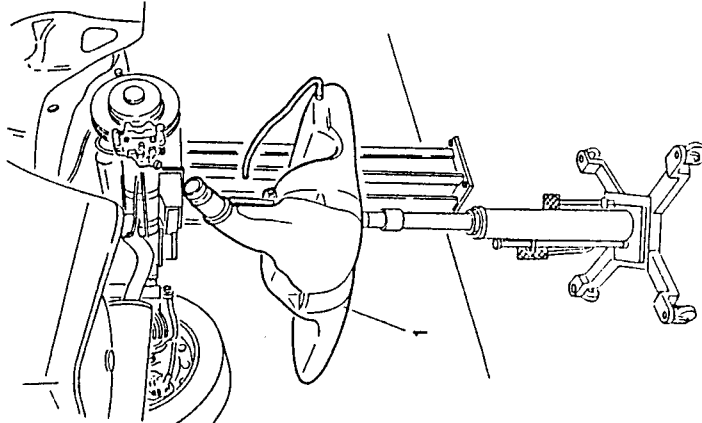




1. Slightly lower the tank withdrawing the filler neck from the rubber protection and then disconnect the fuel vapour delivery pipe from the multifunction valve.



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

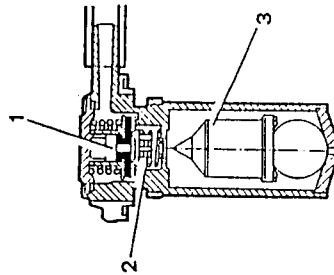
This valve:

- 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

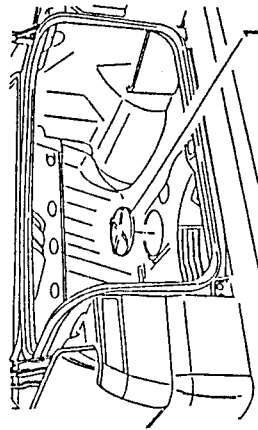


FUEL LEVEL METER

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

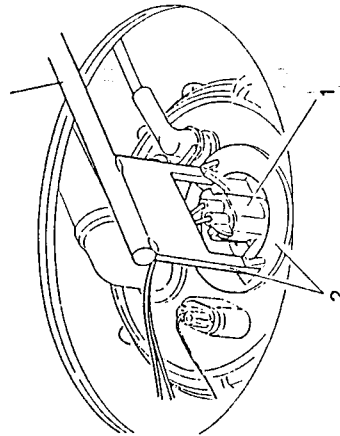
REMOVAL/REFITTING

- 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.

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

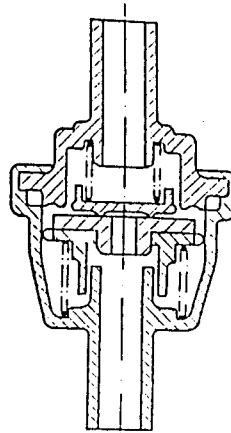
SAFETY VALVE

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.





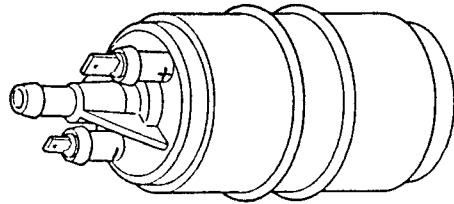
FUEL PUMP

The electric fuel pump is of the volumetric roller type with brush motor excited by permanent magnets submerged in the fuel.

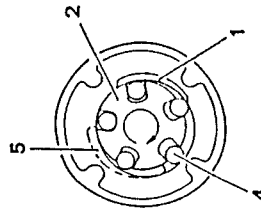
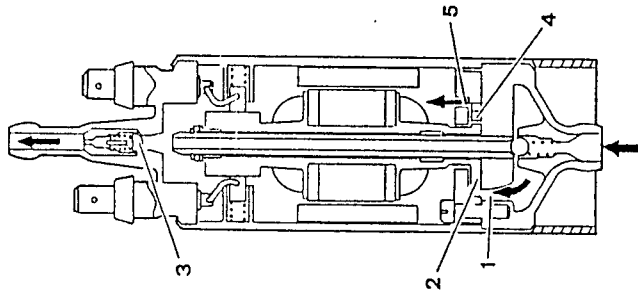
The rotor, turned by the electric motor creates volumes which are moved from the inlet port to the delivery port. These volumes are defined by rollers which adhere to the outer ring during rotation of the motor.

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.

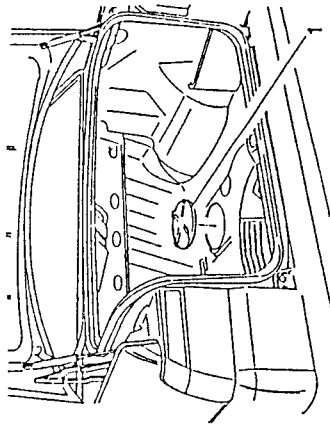


- 1. Inlet port
- 2. Rotor
- 3. Non-return valve
- 4. Rollers
- 5. Delivery port

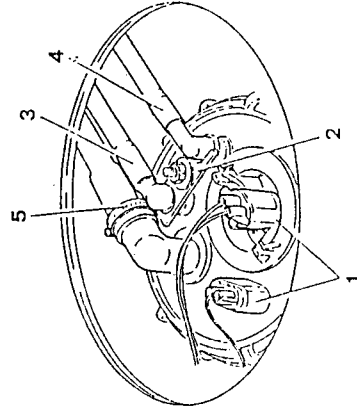


REMOVAL/REFITTING

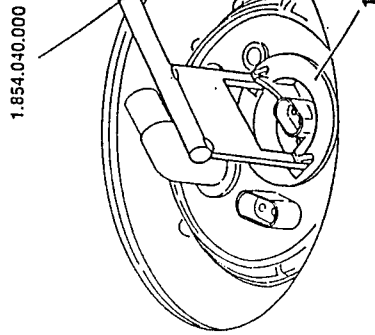
- Disconnect the negative cable from the battery.
- 1. Operating from the luggage compartment, remove the lower covering and remove the cover in order to gain access to the pump and the fuel level meter.



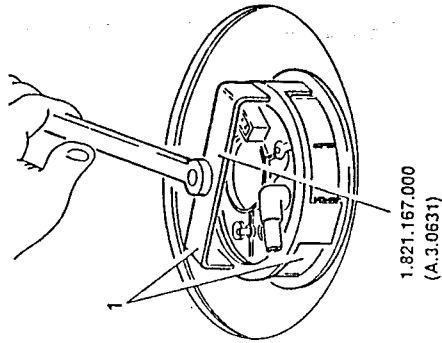
- 1. Disconnect the electrical connections from the pump and the fuel level meter.
- 2. Remove the safety plate.
- 3. Disconnect the pipe conveying fuel from the pump (white connection).
- 4. Disconnect the pipe conveying fuel to the pump (black connection).
- 5. Disconnect the breather pipe connecting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



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

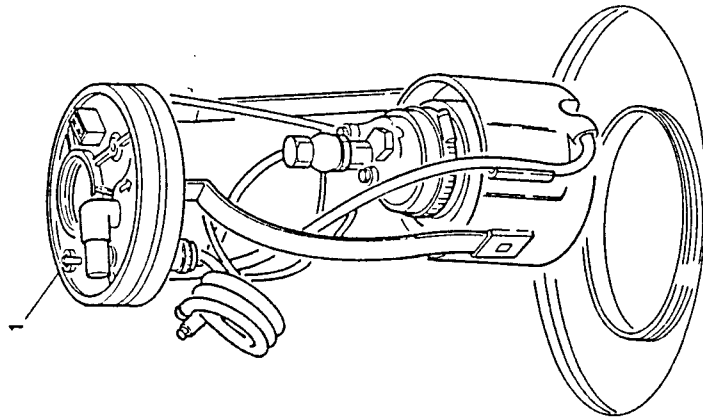


- 1. Remove the ring nut securing the fuel pump using tool N° 1.821.167.000 (A.3.0631).





1. Withdraw the fuel pump assembly from the tank.

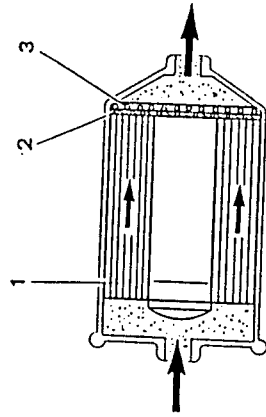


Install the pump assembly in the tank taking care to ensure that the gasket fits perfectly and that the mounting position is correct as indicated by the collimation of the arrows present on the tank and on the pump cover.



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.



1. Paper filter
2. Cloth filter
3. Gauze

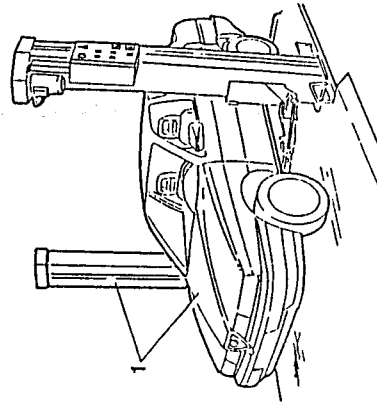
ATTENTION:

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 type with a high degree of filtering power, an indispensable 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.

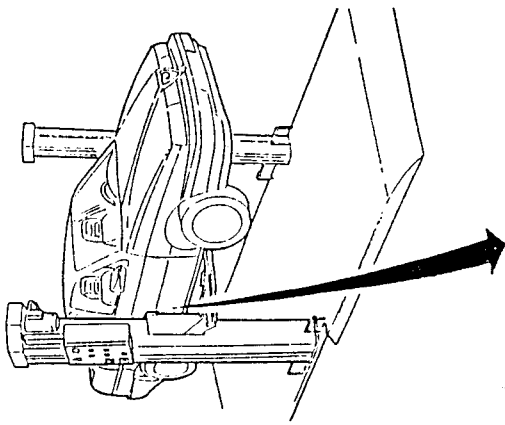


1. Place the vehicle on a lift.

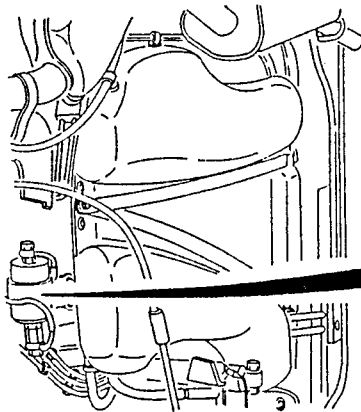
SUBSTITUTION



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

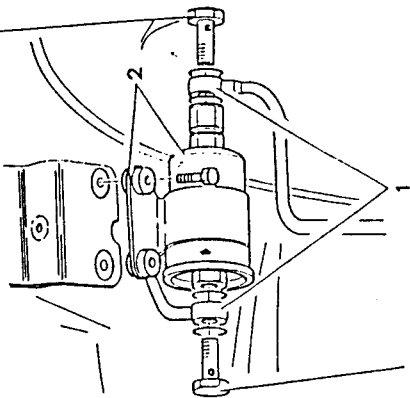


1. Unscrew the fuel inlet and outlet connections from the filter.
 - Collect the fuel which leaks out during this operation in a suitable container and plug the ends of the connections without bending or twisting the rigid pipes.
2. Remove the fuel filter together with its supporting clamp.



$21 \pm 26 \text{ Nm}$

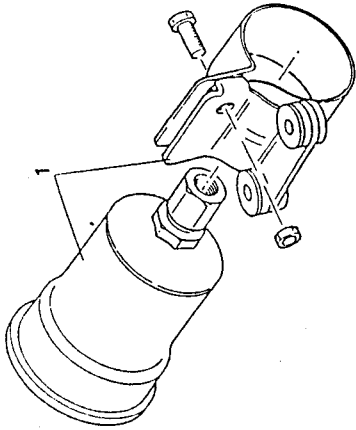
 $2.1 \pm 2.7 \text{ kgm}$



$30 \pm 37 \text{ Nm}$

 $3.1 \pm 3.8 \text{ kgm}$

1. On a bench, separate 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 the 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.

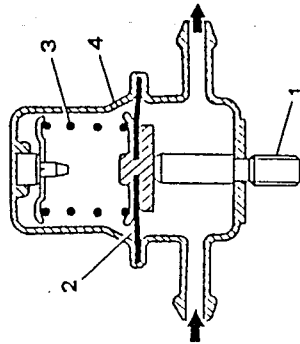
CHECKS AND INSPECTIONS

- 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.

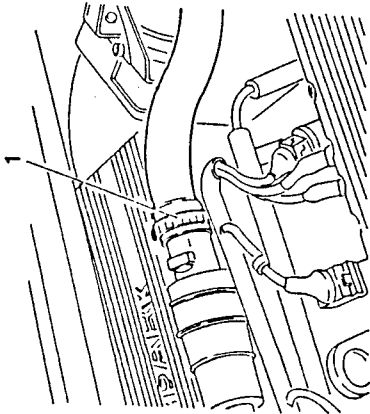


1. Threaded retaining pin
2. Diaphragm
3. Compression spring
4. Covering

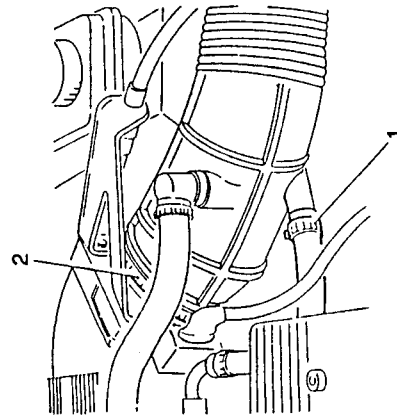


REMOVAL/REFITTING

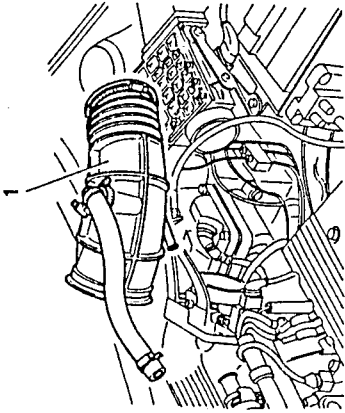
- Disconnect the negative cable from the battery.
- 1. Disconnect the air intake hose from the constant idle speed actuator.



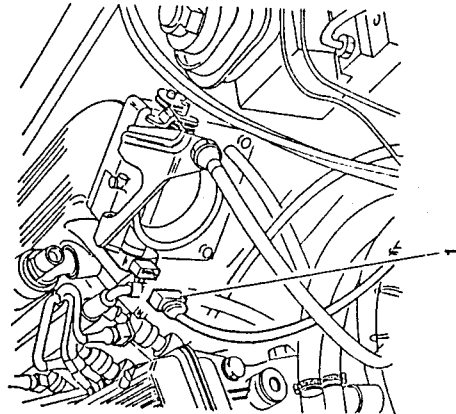
1. Disconnect the oil vapour recirculation hose from the corrugated sleeve.
2. Loosen the two clamps securing the corrugated sleeve to the intake box and air-flow meter.



1. Remove the corrugated sleeve together with the air intake hose for the constant idle speed actuator.



1. Disconnect the electrical connections from the potentiometer.



FUEL PRESSURE REGULATOR

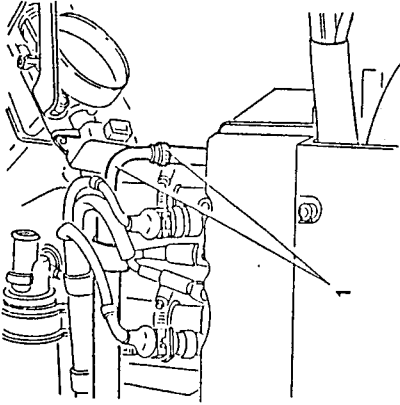
The fuel pressure regulator keeps the difference in fuel pressure and the pressure in the intake manifold at a constant level. In this way it is possible to meter the amount of fuel on the basis of the opening times of the electroinjectors only.

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.

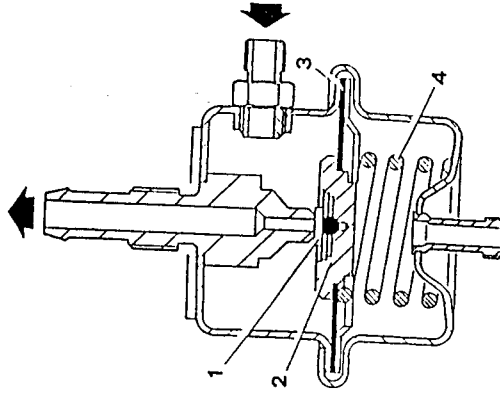
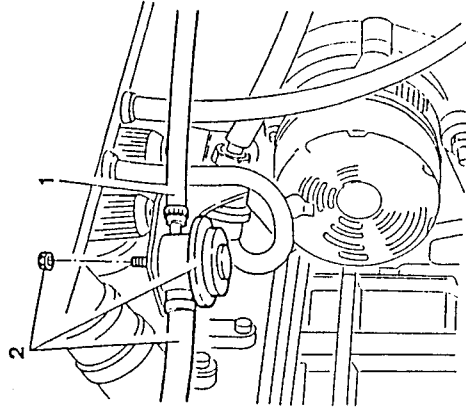
A small pipe connects the regulator spring chamber to the intake box downstream of the throttle valves.

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. Disconnect the impulse dashpot delivery hose from the fuel supply manifold.



1. Disconnect the fuel delivery hose from the impulse dashpot.
2. Unscrew the retaining nut and remove the impulse dashpot together with the hose connecting it to the fuel supply manifold. Separate them on a bench.



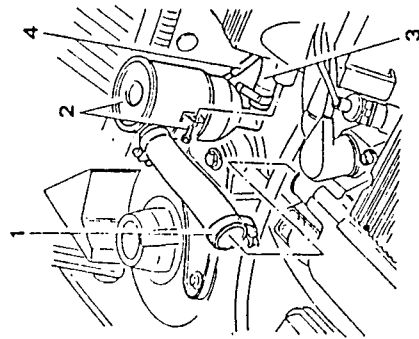
1. Valve
2. Body holding valve
3. Diaphragm
4. Spring



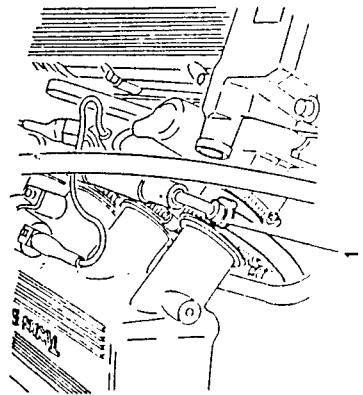


REMOVAL/REFITTING

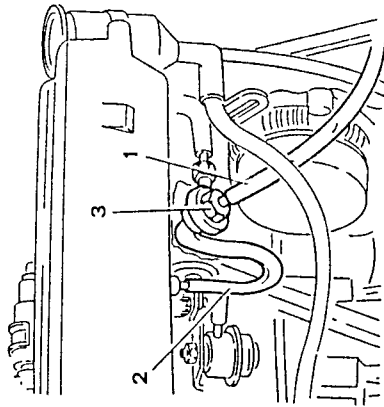
- Disconnect the negative cable from the battery.
- 1. Disconnect the oil vapour recovery hose from the cylinder head.
- 2. Unscrew the two screws securing the oil vapour separator to the air intake box and raise it as far as possible.
- 3. Disconnect the oil vapour recirculation hose from the separator.
- 4. Disconnect the oil recovery hose from the separator and remove the separator.



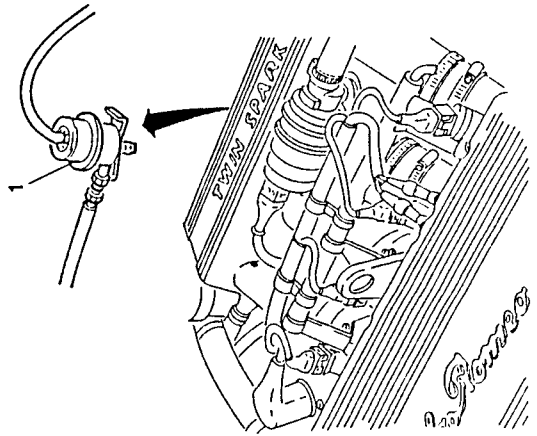
- 1. Disconnect the pressure regulator return hose from the fuel supply manifold.



- 1. Disconnect from the pressure regulator the hose conveying the excess fuel to the tank.
- 2. Disconnect the regulator vacuum intake hose from the air intake box.
- 3. Unscrew the nut securing the support bracket.



- 1. Remove the pressure regulator complete with vacuum intake hose and connection to supply manifold and separate them on a bench.



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.

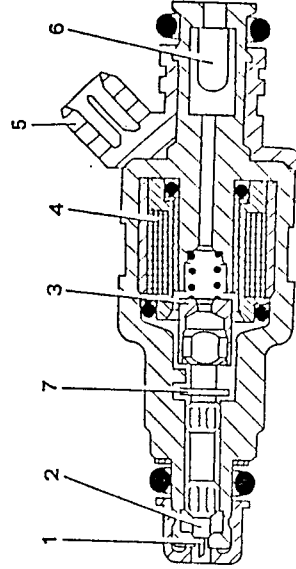
An electroinjector is basically composed of a coil, a plunger and a needle with a disc stop. The core of the magnet is integral with the needle which is pressed by a spring on the seating of the body of the electroinjector. The needle is actuated by the magnetic field created by the coil upon command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

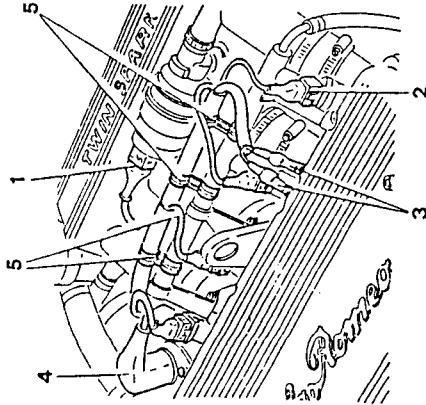


- 1. spray pin
- 2. Needle
- 3. Magnetic armature
- 4. Magnetic winding
- 5. Supply connector
- 6. Filter
- 7. Disc stop

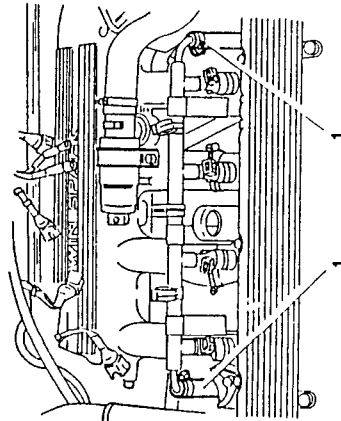


REMOVAL/REFITTING

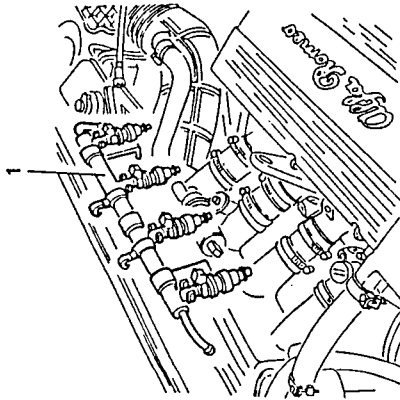
- Disconnect the negative cable from the battery.
- 1. Disconnect the electrical connection from the constant idle speed actuator.
- 2. Disconnect the electrical connections from the electroinjectors.
- 3. Remove the earth cables from the timing cover.
- 4. Disconnect the electrical connection from the timing variator.
- 5. Withdraw the wiring from the clamps and place it on the air intake box.



- 1. Disconnect the inlet and outlet hoses from the fuel supply manifold.

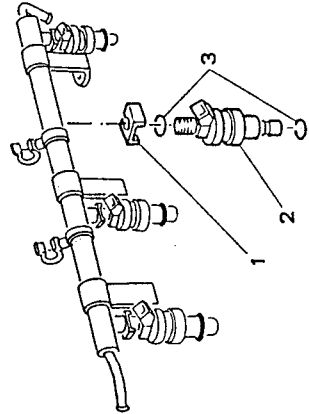


- 1. Remove the fuel supply manifold complete with electroinjectors by unscrewing the three screws securing it to the intake manifolds.



For each injector:

- 1. Unscrew the clip securing the electroinjector to the fuel manifold.
- 2. Remove the electroinjector.
- 3. Remove the seal rings.



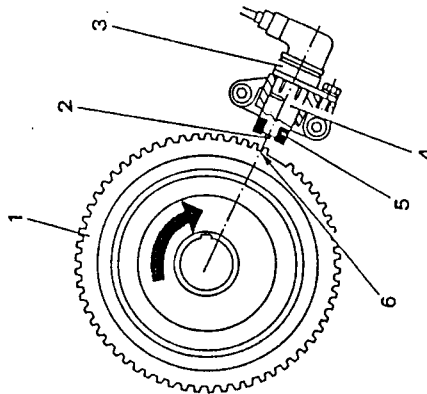
CHECKS AND INSPECTIONS

To carry out a functional check of the single injectors, refer to the ELECTRICAL - ELECTRONIC DIAGNOSIS manual.



ENGINE R.P.M. AND TIMING SENSOR

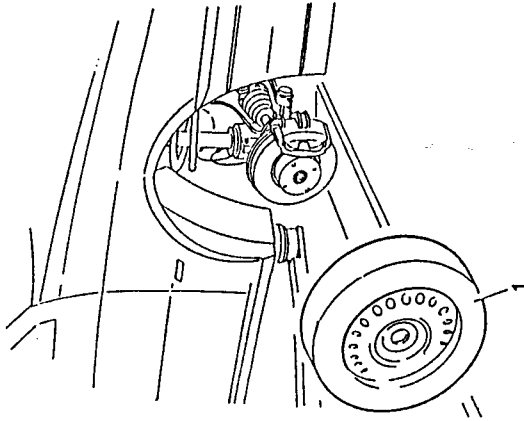
The sensor for the detection of the r.p.m. and timing of the engine is of the inductance type, that is, it functions through the variations in the magnetic field generated by the passing of the teeth on a toothed wheel (phonic wheel) machined onto the crankshaft. The teeth passing in front of the magnetic 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.



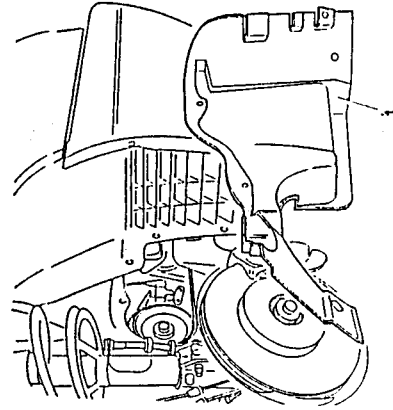
- 1. Engine pulley toothed wheel (phonic wheel)
- 2. Core
- 3. Engine timing and r.o.m. sensor
- 4. Permanent magnet
- 5. Winding
- 6. Timing reference

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

- Place the vehicle on a front lift.
- 1. Remove the front right-hand wheel.



- 1. Remove the dust guard.

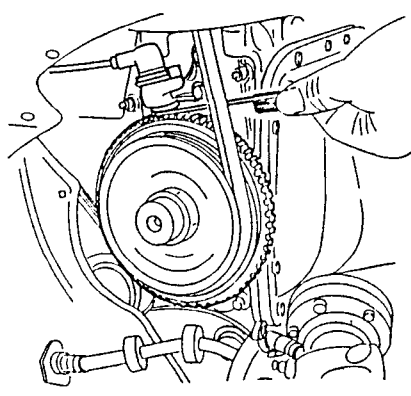


- Using a feeler gauge check that the gap between sensor and phonic wheel is with the specified limits.



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

T = 0.5 to 1.5 mm



CHECKS AND INSPECTIONS

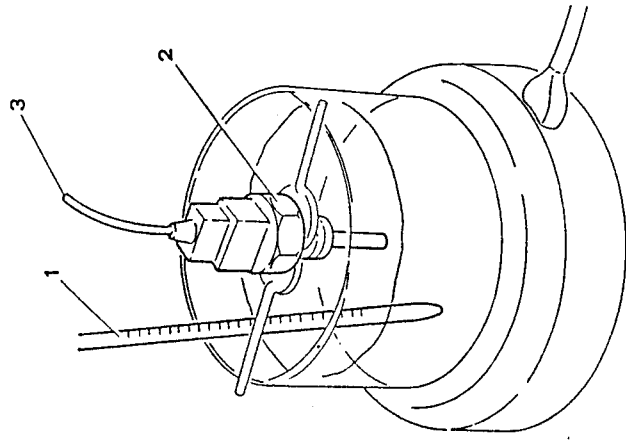
- To check the functioning of the r.p.m. and timing sensor refer to the ELECTRICAL - ELECTRONIC DIAGNOSIS manual.

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.

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 thermometer and a Multimeter. If it is not within the prescribed limits replace the sensor.

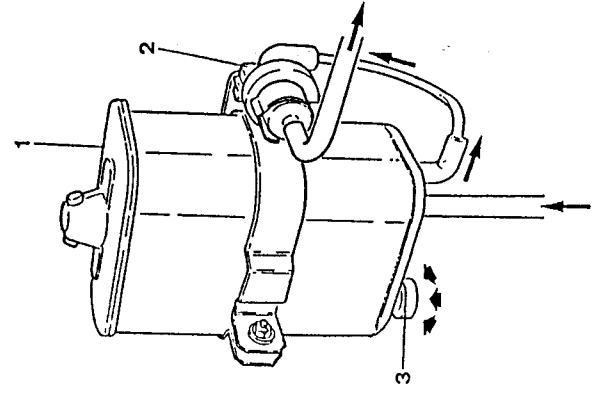


1. Thermometer
2. Engine coolant temperature sensor
3. Multimeter

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 vapour 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

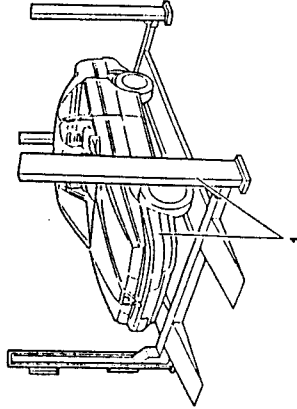
This valve, controlled by the Motronic control unit, sends the vapours stored in the canister for intake by the engine.

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.

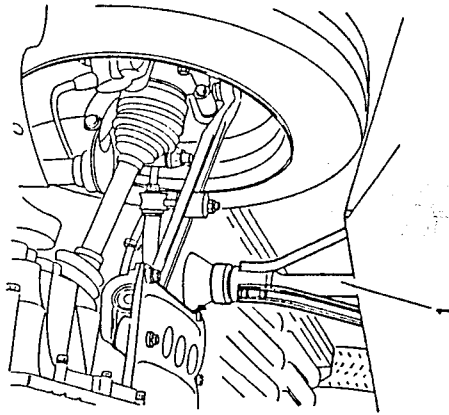
Overall it is structured so that when the coil is powered, the shutter, which replaces the fixed part of the valve, is attracted to the cylinder and closes the valve.

REMOVAL/REFITTING

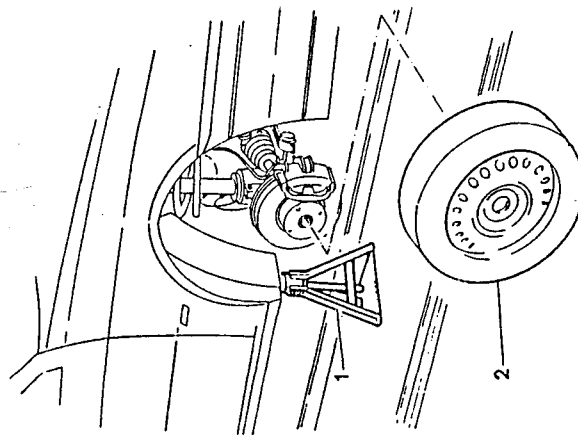
1. Place the vehicle on a lift.
- Disconnect the negative cable from the battery.



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



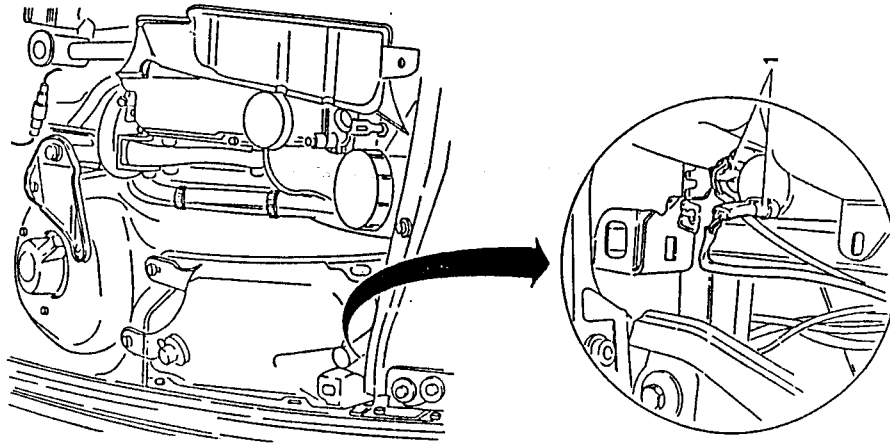
1. Remove the front right-hand wheelhousing.



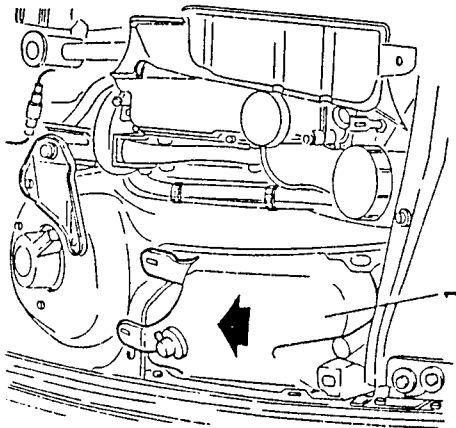
1. Unscrew the screws securing the expansion tank and, without disconnecting the hoses, move it to one side.



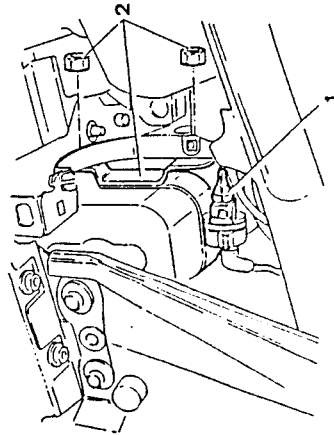
1. Disconnect the electrical connections from the windscreen and headlight washer motors.



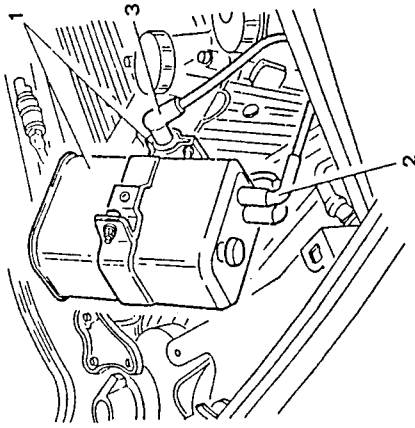
1. Unscrew the two screws securing the windscreen/washer fluid reservoir and move it backwards



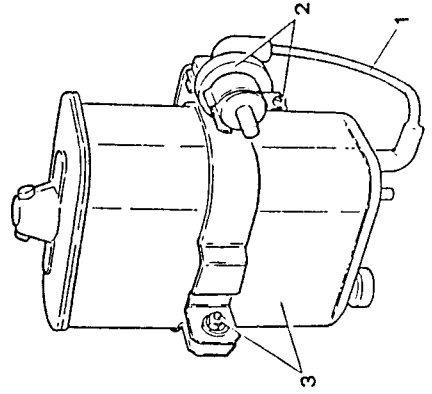
1. Disconnect the electrical connections from the fuel vapour solenoid valve.
2. Unscrew the two nuts securing the canister support clamp to the body.



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.



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



Fuel pressure at idle speed
284.3 to 323.6 kPa (2.8 to 3.2 bar; 2.9 to 3.3 kg/cm ²)

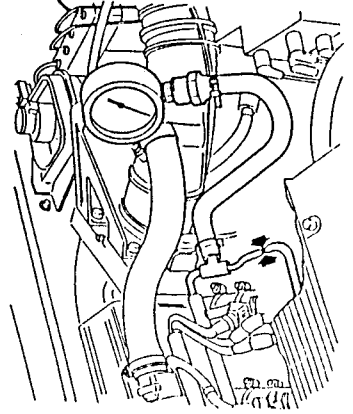
- Reconnect the pipe connecting the vacuum intake to the air intake box. At idle speed the pressure should decrease by 0.5 bar and then increase when the throttle valve opens. If this is not the case check for leaks from the fuel pressure regulator vacuum intake piping.

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



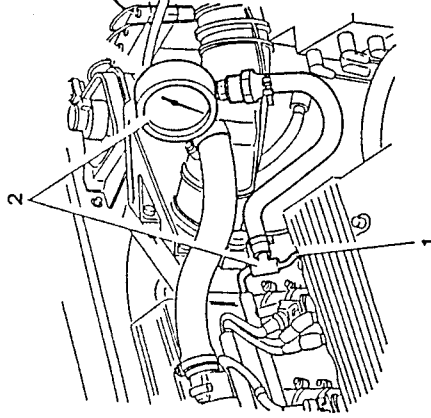
WARNING:
Keep a fire extinguisher handy if there are fuel leaks.
Do not smoke.

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.

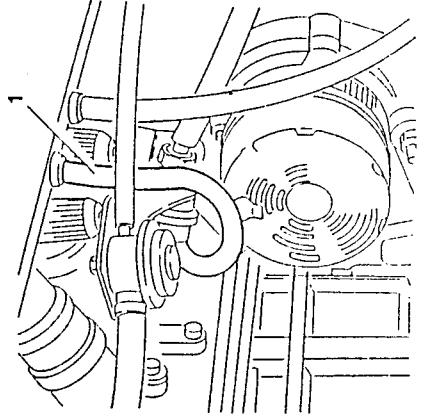


CHECKING PRESSURE AND SEALING OF THE FUEL CIRCUIT

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.



1. 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.

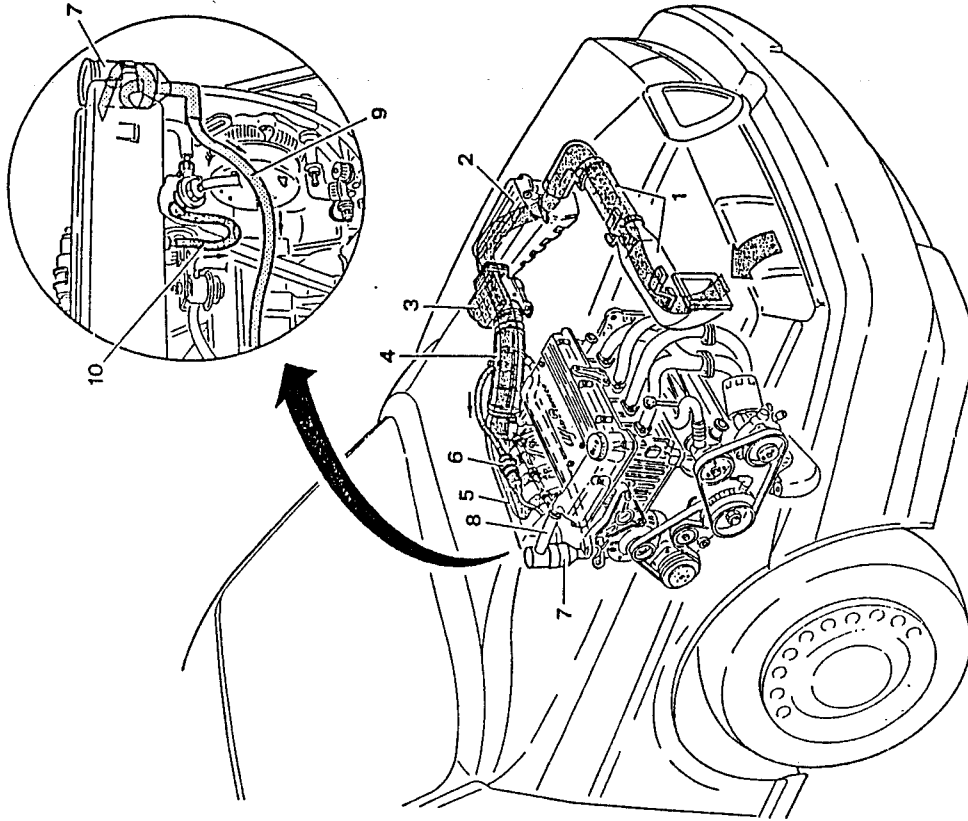




CHECKING SEALING OF THE FUEL
VAPOUR RECOVERY SYSTEM



AIR SUPPLY SYSTEM



DUE FOR PUBLICATION

- 1. Air intake hose
- 2. Air cleaner
- 3. Air-flow meter
- 4. Corrugated sleeve
- 5. Air intake box

- 6. Constant idle speed actuator
- 7. Oil vapour separator
- 8. Oil vapour recovery hose
- 9. Oil vapour recirculation hose
- 10. Vacuum intake hose for fuel pressure regulator



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.

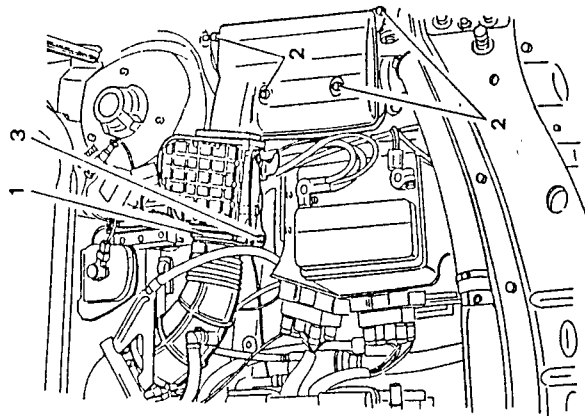
For information regarding the single components of the system refer to the paragraphs below.

AIR CLEANER

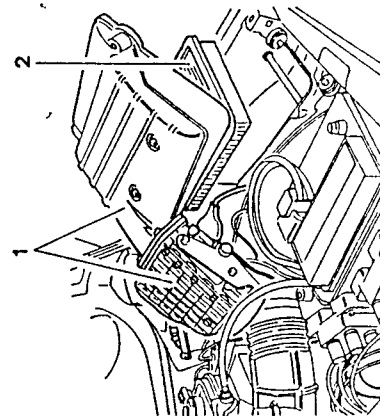
The cleaner is of the cartridge type with an easily replaceable filter element which traps the dust and dirt particles present in the air sucked in by the engine. It also acts as an "intake silencer".

REPLACING THE FILTER ELEMENT

1. Loosen the clamps connecting the corrugated sleeve to the air-flow meter.
2. Unscrew the screws securing the air cleaner cover.
3. Unscrew the screw securing the air-flow meter support bracket.



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



CAUTION:

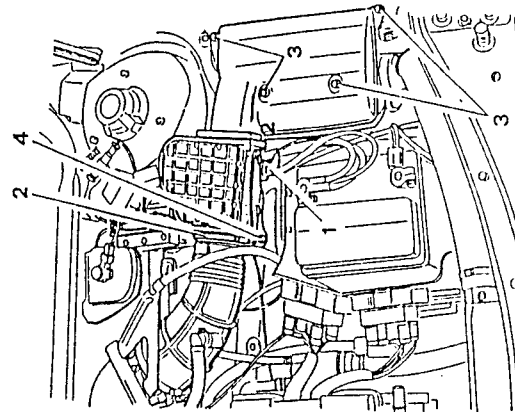
Any attempt to clean the filter will damage it compromising the correct functioning of the engine supply system.

- 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.

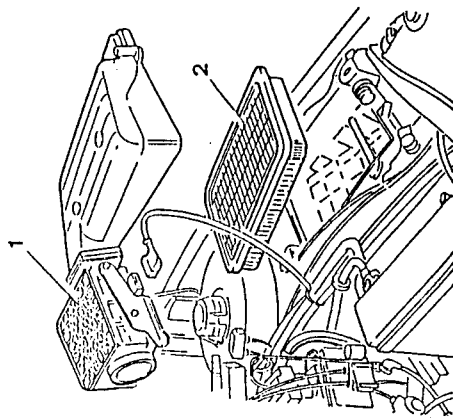
NOTE: If the filter shows signs of oil contamination, check the entire air circuit for possible infiltration.

REMOVAL/REFITTING

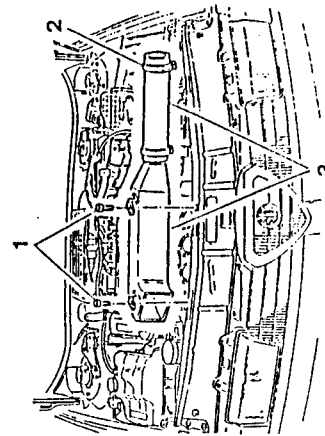
- Disconnect the negative cable from the battery.
1. Disconnect the electrical connection from the air flow meter.
 2. Loosen the clamp connecting the corrugated sleeve to the air-flow meter.
 3. Unscrew the screws securing the air cleaner cover.
 4. Unscrew the screw securing the air-flow meter support bracket.



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

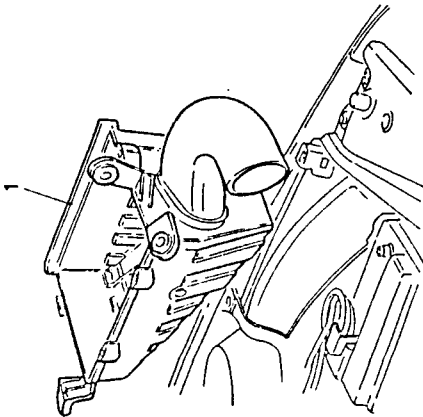


1. Unscrew the two screws securing the air intake duct to the crossmember.
2. Loosen the clamp securing the air intake sleeve to the air cleaner box.
3. Remove the duct - air intake sleeve assembly.



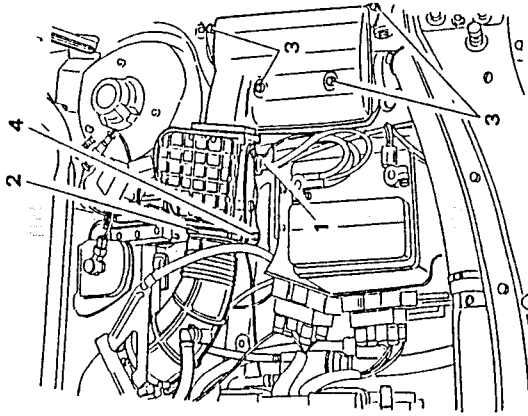


1. Remove the air cleaner box.

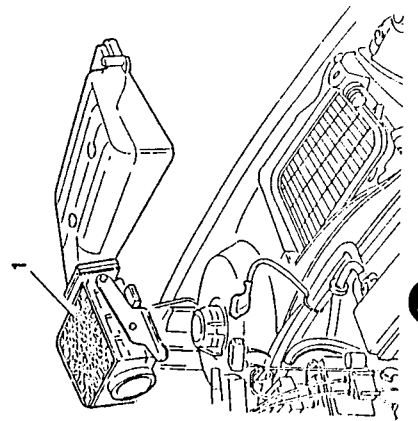


REMOVAL/REFITTING

- Disconnect the negative cable from the battery.
1. Disconnect the electrical connection from the air flow meter.
 2. Loosen the clamps connecting the corrugated sleeve and the air-flow meter.
 3. Unscrew the screws securing the air cleaner cover.
 4. Unscrew the screw securing the air flow meter support bracket.



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



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.

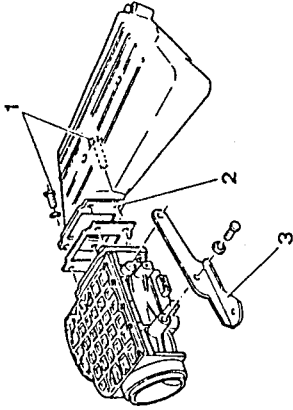
The air flow meter functions according to the principle of the fluctuating throttle valve: a spiral spring acts as an acting force on the throttle valve itself so that, with a certain quantity of air, a precise angular position will be obtained. Compensation for the pressure oscillations arising from 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.



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

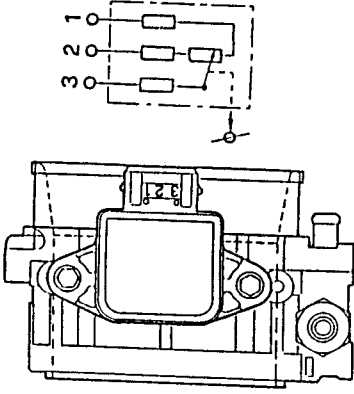
- Press on the shutter of the air flow meter and check that it rotates easily, that there are no friction points up to the stop limit and that it is not scored or dirty.
- If necessary clean the internal surfaces of the air flow meter with a clean, fibreless cloth.
- For a functional check of the electrical 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.

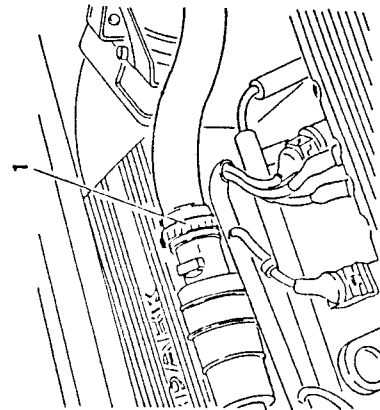
When the throttle valve is closed, an electric signal of ~ 0.5 Volts reaches the control unit which recognizes the idle and cut-off states (distinguished on the basis of engine r.p.m.).

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.

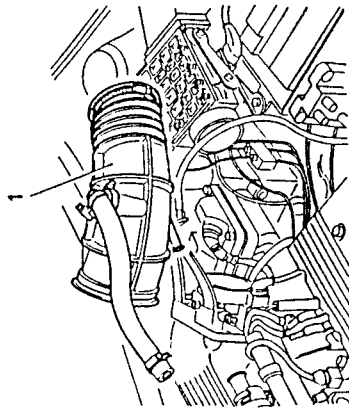


REMOVAL/REFITTING

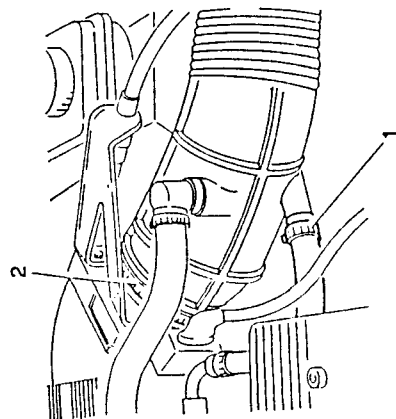
- Disconnect the negative cable from the battery.
- 1. Disconnect the air intake hose from the constant idle speed actuator.



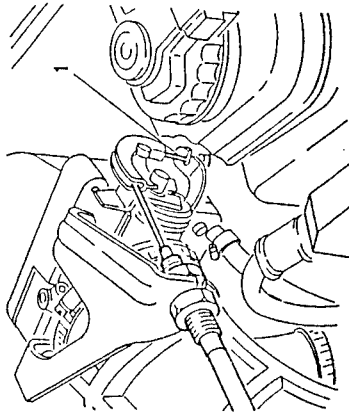
- 1. Remove the corrugated sleeve complete with air intake hose for the constant idle speed actuator.



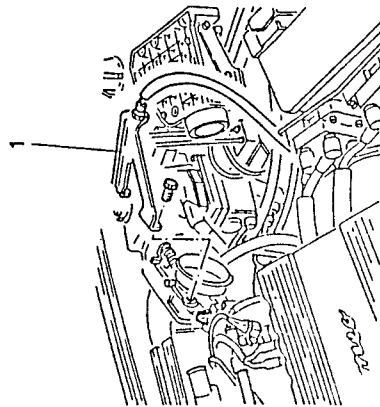
- 1. Disconnect the oil vapour recirculation hose from the corrugated sleeve.
- 2. Loosen the two clamps securing the corrugated sleeve to the air intake box and air-flow meter.



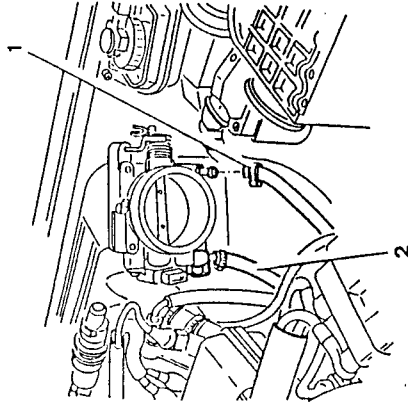
- 1. Disconnect the accelerator cable from the throttle body.



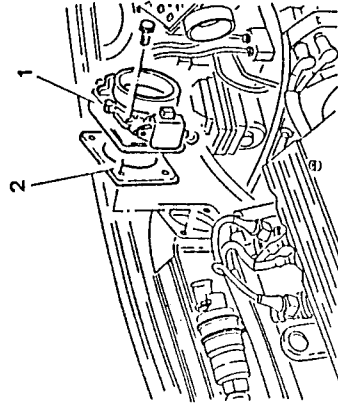
- 1. Remove the accelerator cable support bracket.



- 1. Disconnect the engine coolant delivery hose from the throttle body.
- 2. Disconnect the engine coolant outlet hose from the throttle body.



- 1. Unscrew the screw and remove the complete throttle valve body.
- 2. Remove the gasket.

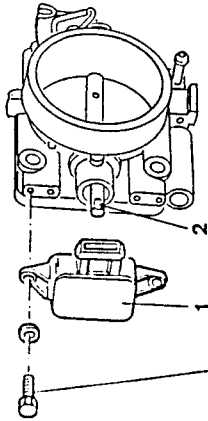




- Remove the potentiometer from the throttle body. Check that radial and axial play of the throttle shaft is within the specified limits



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



17.1 + 18.9 Nm
1.74 + 1.92 kgm

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.

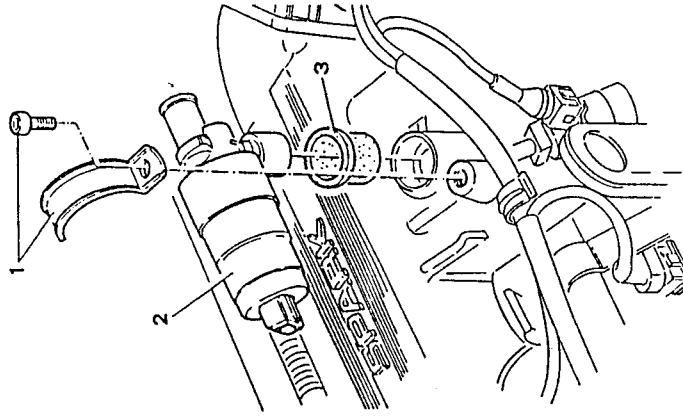
The actuator is also "self adapting" which enables it to follow and recognize the changes which are occurring in the engine (different degrees of internal attrition coupled to different temperatures, settling of the engine over a period of time etc.) so that the engine r.p.m. is kept constant under all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



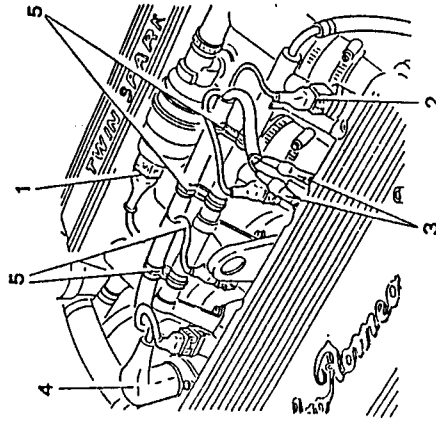
AIR INTAKE BOX

REMOVAL/REFITTING

- Disconnect the negative cable from the battery.
- Disconnect the electrical connection from the constant idle speed actuator.
 - Disconnect the electrical connections from the injectors.
 - Remove the earth cables from the timing cover.
 - Disconnect the electrical connection from the timing variator.
 - Withdraw the wiring from the clamp and place it on the air intake box.



- Unscrew the screw and remove the clamp.
- Remove the constant idle speed actuator.
- Remove the gasket.

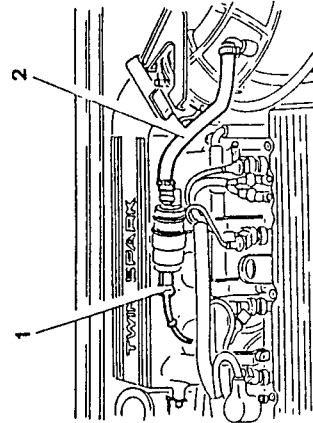


CHECKS AND INSPECTIONS

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

REMOVAL/REFITTING

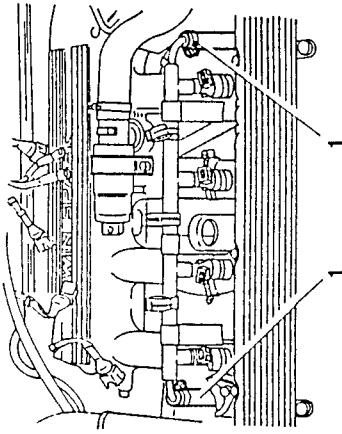
- Disconnect the negative cable from the battery.
- Disconnect the electrical connection from the constant idle speed actuator.
 - Disconnect the air intake hose from the constant idle speed actuator.



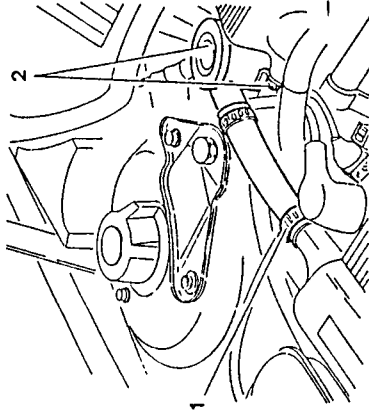
- Rotating box
- Connector
- Counter spring
- Armature
- Permanent magnet



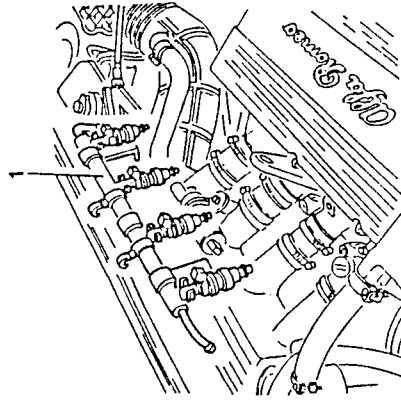
1. Disconnect the inlet and outlet hoses from the fuel supply manifold



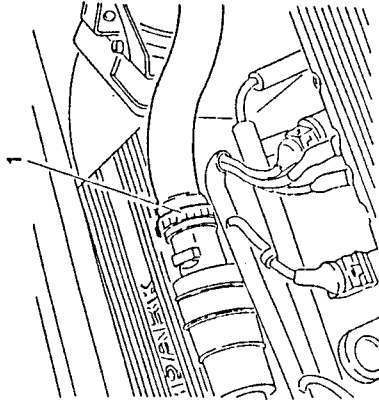
1. Disconnect the oil vapour recovery hose from the cylinder head.
2. Unscrew the two screws securing the separator to the intake box and move it to one side in order to gain access to the pressure regulator.



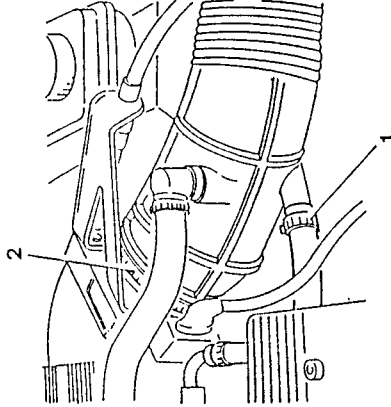
1. Remove the fuel supply manifold complete with electroinjectors by unscrewing the three screws securing it to the intake manifolds.



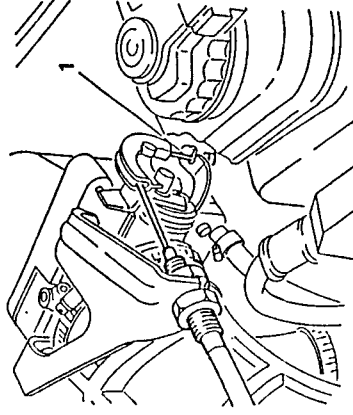
1. Disconnect the air intake hose from the constant idle speed actuator.



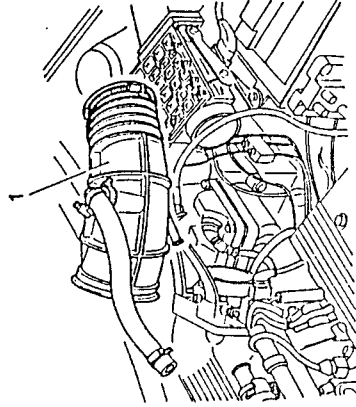
1. Disconnect the oil vapour recirculation hose from the corrugated sleeve.
2. Loosen the two clamps securing the corrugated sleeve to the air intake box and air-flow meter.



1. Disconnect the accelerator cable from the throttle body.

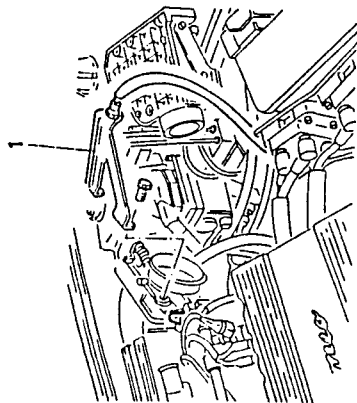


1. Remove the corrugate sleeve along with the vacuum intake hose for the constant idle speed actuator.

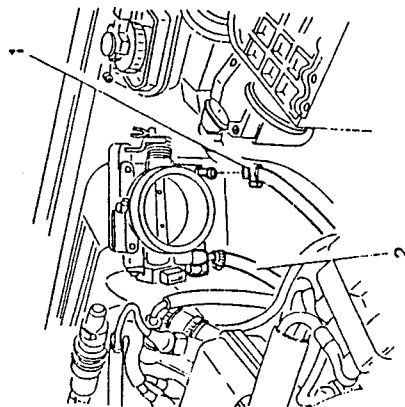




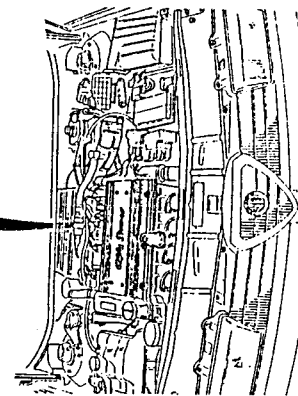
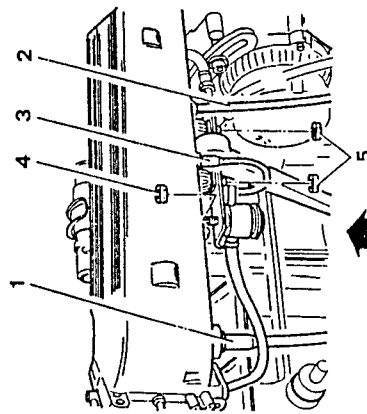
1. Remove the accelerator cable support bracket.



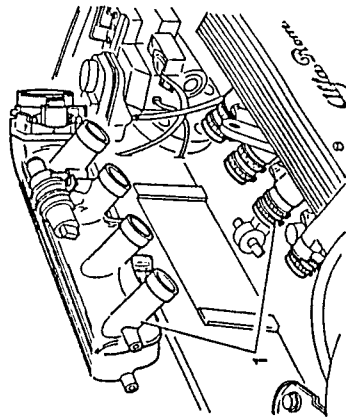
1. Disconnect the engine coolant inlet hose from the throttle body.
2. Disconnect the engine coolant outlet hose from the throttle body.



1. Disconnect the vacuum intake hose (from the servo brake) from the air intake box.
2. Disconnect the fuel vapour recirculation hose from the air intake box.
3. Disconnect the fuel pressure regulator vacuum intake hose from the air intake box.
4. Unscrew the nut securing the impulse dashpot to the bracket without disconnecting the fuel lines.
5. Unscrew the two screws securing the air intake box to the support strut.



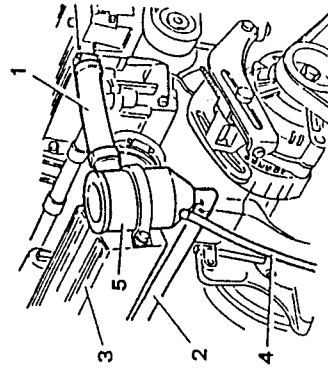
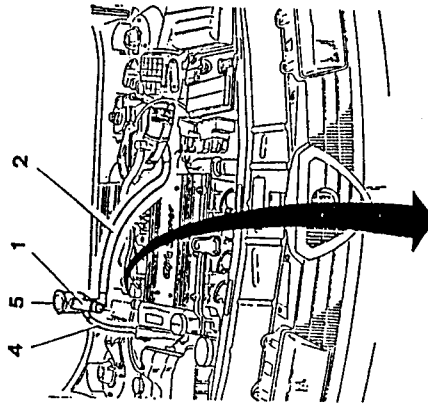
1. Loosen the clamps securing the intake sleeves and remove the air intake box together with the constant idle speed actuator and throttle body.



OIL VAPOUR RECOVERY SYSTEM

The control of oil vapour emission is carried out by a separator which collects the vapours which collect in the cylinder head into the cover. A partial condensation takes place due to the centrifugal force and 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.

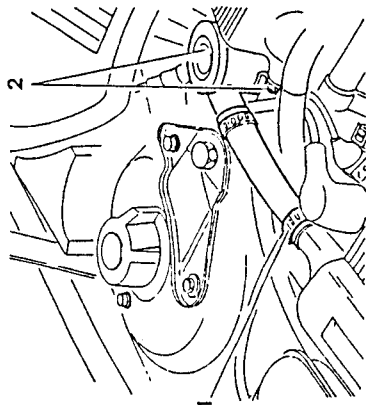


1. Oil vapour recovery hose
2. Oil vapour recirculation hose
3. Air intake box
4. Oil recovery hose
5. Oil vapour separator

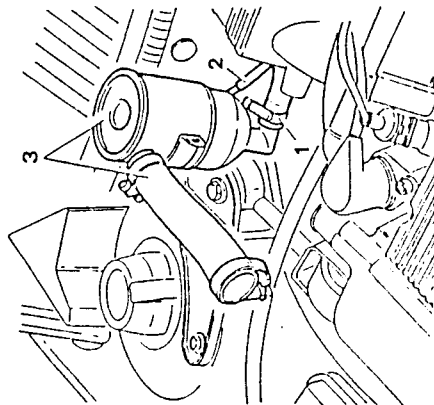


REMOVAL/REFITTING OIL VAPOUR SEPARATOR

- 1. Disconnect the oil vapour recovery hose from the timing cover.
- 2. Unscrew the two screws securing the separator to the air intake box and raise it as far as possible.



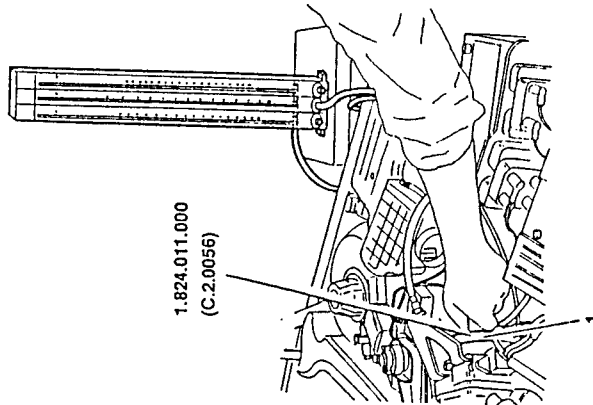
- 1. Disconnect the oil vapour recirculation hose from the separator.
- 2. Disconnect the oil vapour recovery hose from the separator.
- 3. Remove the oil vapour support together with the oil vapour recovery hose and separate them on a bench.



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)
240 to 260 on N scale

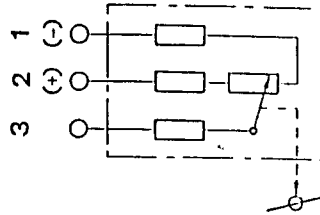
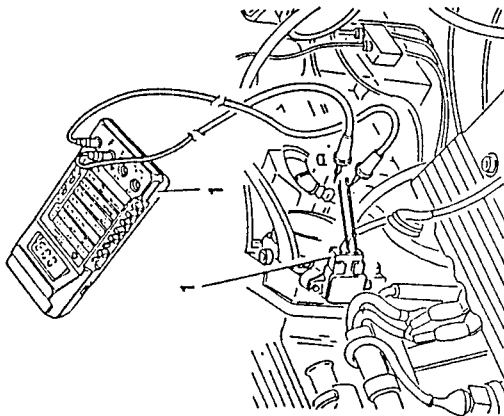
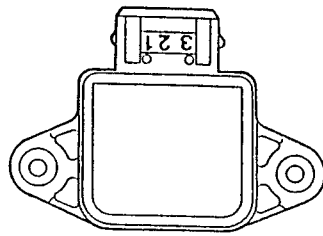


CHECKING FUNCTIONING OF THROTTLE VALVE POTENTIOMETER

- 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.

- 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.





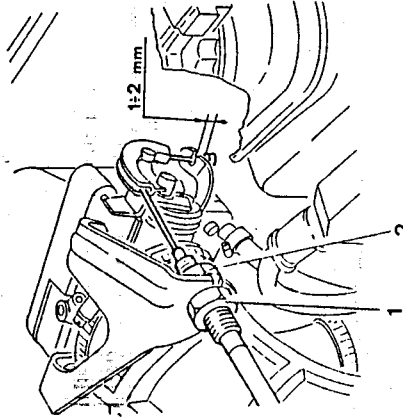
CHECKING AND SETTING ACCELERATOR CABLE

- 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



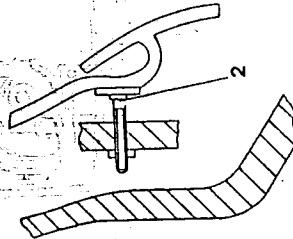
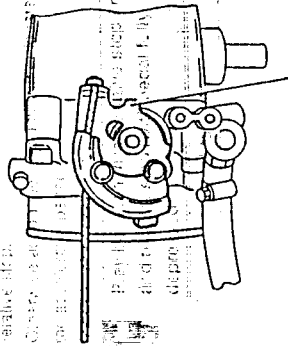
1-2 mm



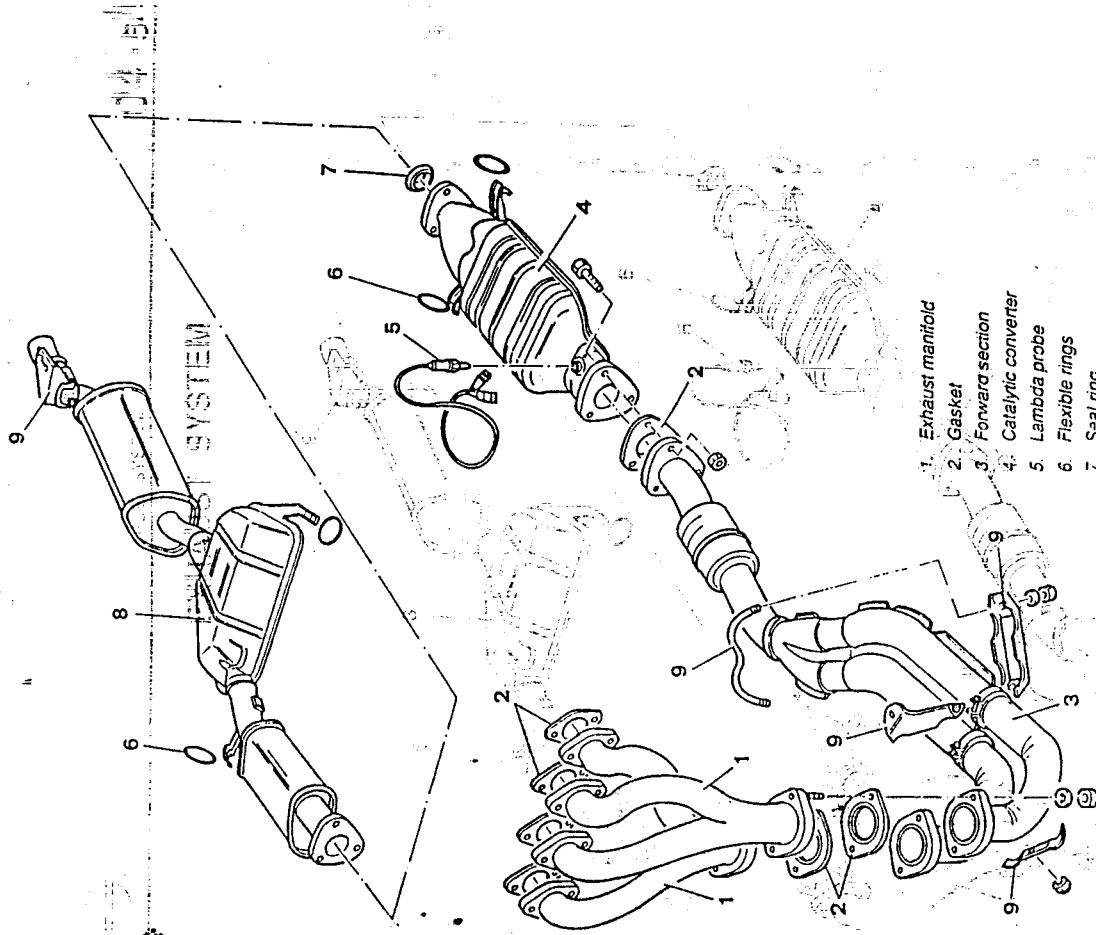
Play between throttle valve stop limit and relative stop (with pedal fully depressed)

1 to 2 mm

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



EXHAUST SYSTEM



1. Exhaust manifold
2. Gasket
3. Forward section
4. Catalytic converter
5. Lambda probe
6. Flexible rings
7. Seal ring
8. Rear section - silencers
9. Supports



DESCRIPTION

The exhaust gasses flow into two double manifolds (one for each head) and then through two exhaust pipes to the three way catalytic converter where most of the pollutants are removed.

A flexible element is located on the forward section of the exhaust pipe and serves to limit the transmission of vibration.

An intake for the measurement of the exhaust gasses is also present in the forward section of the exhaust pipe upstream of the lambda probe.

The Lambda probe is located at the entrance to the catalytic converter. 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 stoichiometric 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.

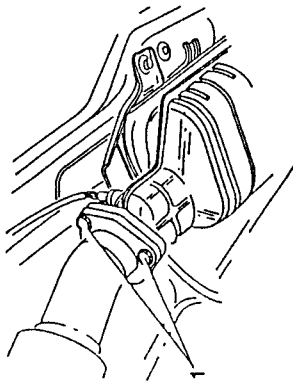
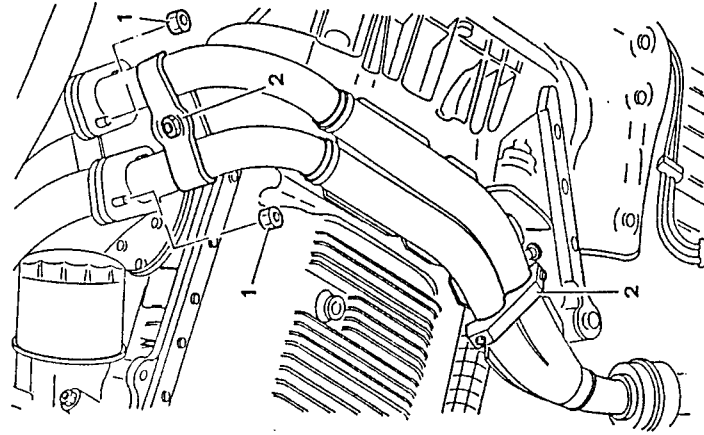
Before attempting any work the system should be left to cool with the engine switched off.

DO NOT TOUCH THE CATALYTIC CONVERTER WITHOUT ADEQUATE PROTECTION SUCH AS GLOVES ETC.

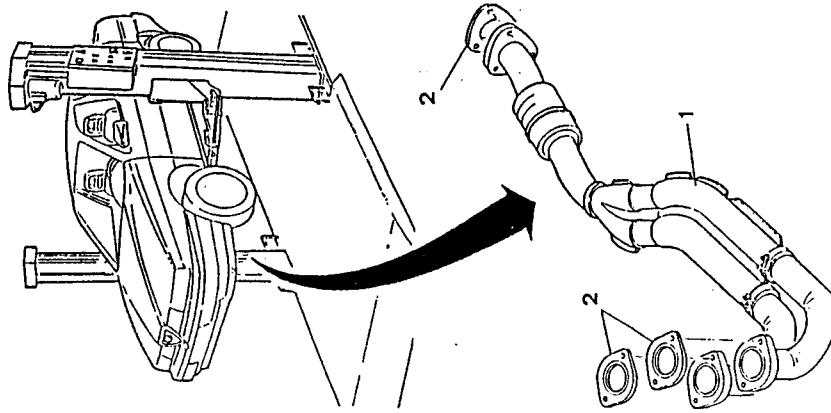
DO NOT ALLOW EASILY INFLAMMABLE MATERIAL TO COME IN CONTACT WITH THE CATALYTIC CONVERTER.



1. Disconnect the flanges connecting the exhaust manifolds.
2. Disconnect the intermediate supports.



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



1. Disconnect the flange connecting the catalytic converter.



CATALYTIC CONVERTER

Fuel combustion generates harmful gasses such as:

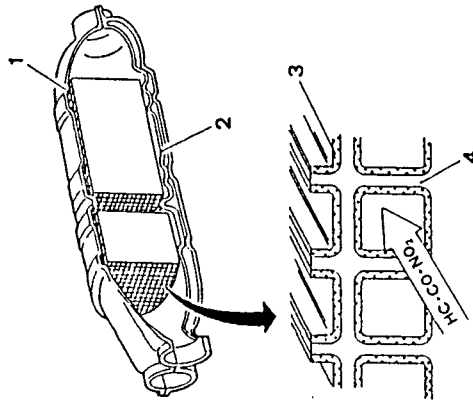
- carbon monoxides (CO);
- unburnt hydrocarbons (HC);
- nitrogen oxides (NOX).

These substances are changed into non-polluting substances normally present in the atmosphere by chemical reaction inside the catalytic converter :

- carbon dioxide (CO₂);
- water vapour (H₂O);
- inert nitrogen (N₂).

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 occurring 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:

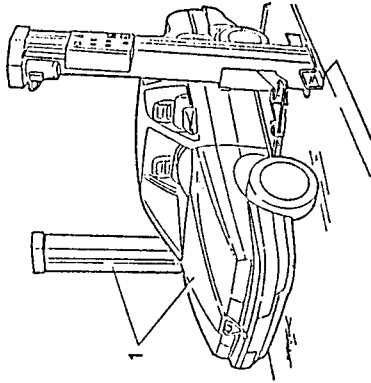
Overall the pollutants present in the exhaust gasses are at a lower level when the air-fuel ratio of the mixture burned by the engine is approximately equal to the theoretical stoichiometric ratio (14.7:1).

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.



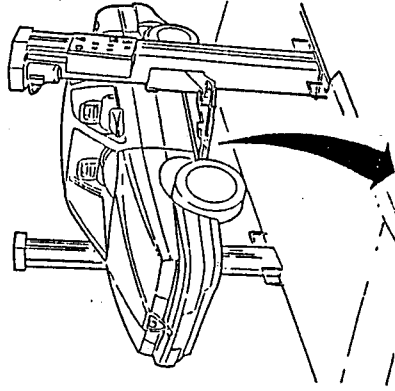
REMOVAL/REFITTING

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



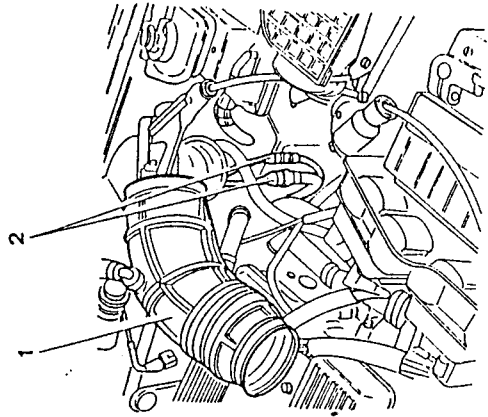
- Raise the vehicle.

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.
4. If necessary remove the lambda probe.



50 + 60 Nm
5.1 + 6.1 kgm

1. Loosen the two clamps securing the corrugated sleeve to the air-flow meter and the throttle body and move it to one side
2. Disconnect the two electrical connections from the lambda probe.





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 stoichiometric ratio of the mixture as near as possible to the theoretical value. In order to obtain an optimum mixture, it is necessary for the quantity of air taken in by the engine to equal the theoretical amount required to burn all the injected fuel. In this case the lambda factor (λ) is equal to 1:

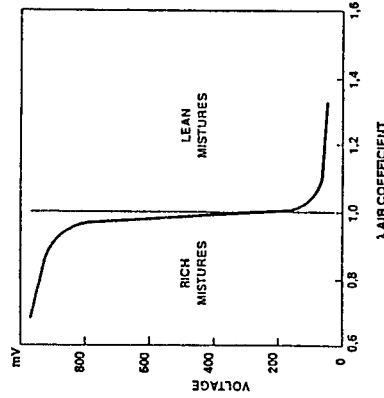
QUANTITY OF INTAKE AIR

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.

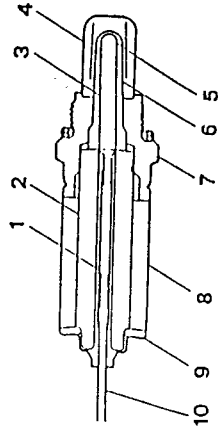
Oxygen ions present in the atmosphere are deposited on the electrode which is in contact with the atmosphere and create a difference in potential of around a hundred mV, a voltage which indicates whether the mixture is lean or rich.

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

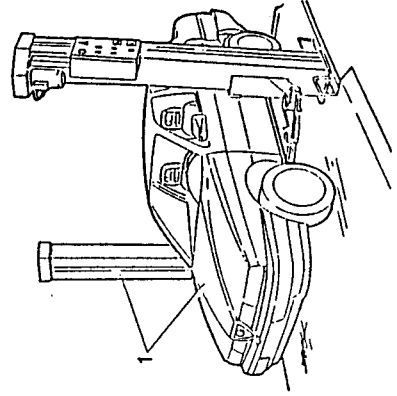
The internal platinum electrodes are subject to chemical attack by lead. FOR THIS REASON PETROL CONTAINING LEAD MUST NOT BE USED AS THIS WOULD CAUSE RAPID AND IRREVERSIBLE DAMAGE TO THE PROBE. NEVER USE PETROL CONTAINING LEAD EVEN IN AN EMERGENCY OR FOR SHORT PERIODS.



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

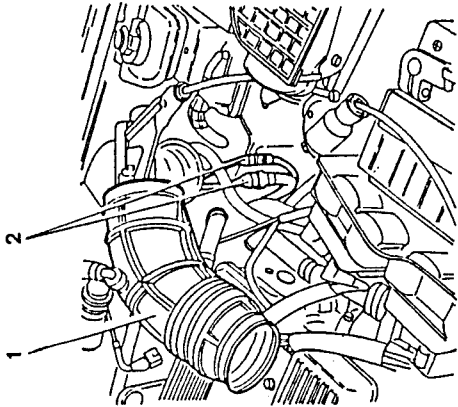
REMOVAL/REFITTING

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





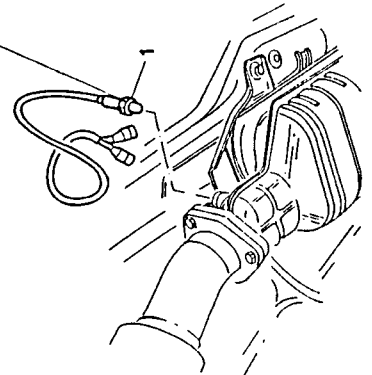
1. Loosen the two clamps securing the corrugated sleeve to the air-flow meter and the throttle body and move it to one side.
2. Disconnect the two electrical connections from the lambda probe.



— Raise the vehicle.

1. Remove the lambda probe from the catalytic converter.

50 + 60 Nm
5.1 + 6.1 kgm



CHECKS AND INSPECTIONS

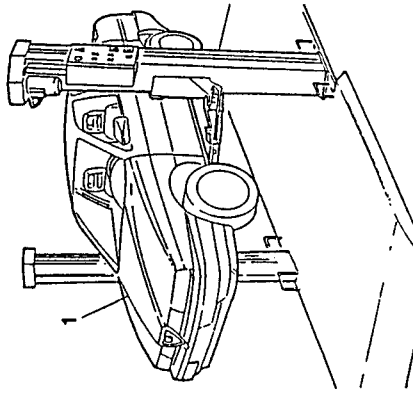
To check the operation of the lambda probe and of the heating resistance, refer to the ELECTRICAL - ELECTRONIC DIAGNOSIS manual.

EXHAUST SYSTEM - REAR SECTION

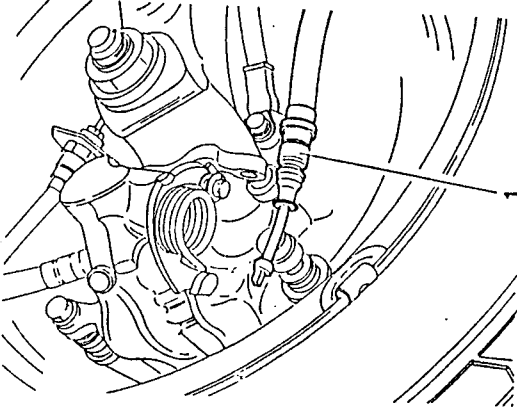
The rear section of the exhaust is composed of three silencers connected by a pipe and supported by the underbody by flexible rings. The connection to the catalytic converter is obtained by a flange with seal ring.

REMOVAL/REFITTING

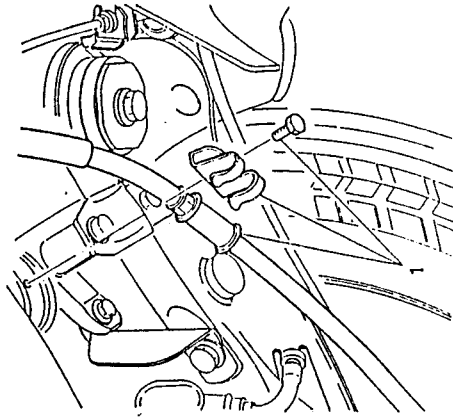
1. Place the vehicle on a lift and raise it.



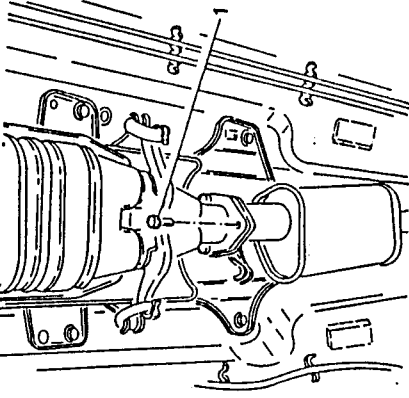
1. Disconnect the handbrake cable from the rear left-hand brake caliper.



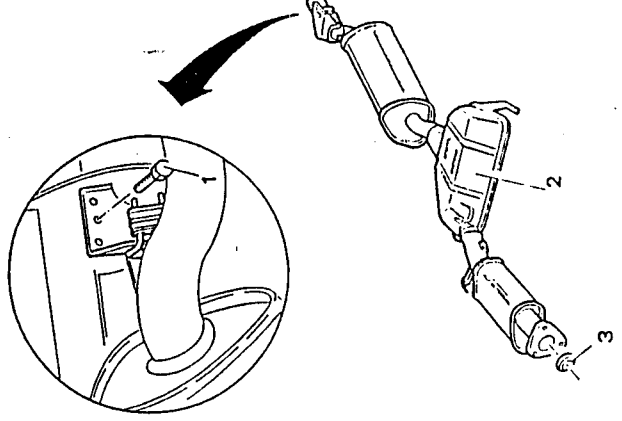
1. Unscrew the screw securing the brake line support brackets and handbrake cable and remove the handbrake cable from the bracket.

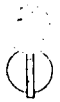


1. Unscrew the screws securing the flange connecting the catalytic converter to the rear section of the exhaust pipe.



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 ring.





CHECKING EXHAUST EMISSIONS



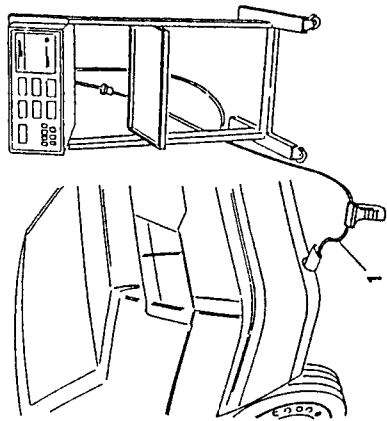
CAUTION:

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	166 + 201
216.5 ± 3	Max reserve	262
231	0	255 + 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



04-65

FUEL SYSTEM

ENGINE COOLANT TEMPERATURE SENSOR (NTC) CALIBRATION CHECK

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

FUEL SUPPLY PRESSURE CHECK

Fuel pressure at idle speed	284.3 + 323.6 kPa (2.8 + 3.2 bar; 2.9 + 3.3 kg/cm ²)
Maximum pressure (with pressure regulator engaged)	4 bars

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
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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



04-66

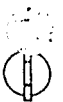
FUEL SYSTEM

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)	<ul style="list-style-type: none"> Nothing happens when the ignition key is rotated. Check for problems relating to the IGNITION SWITCH. 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. 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. 	<p>See ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p> <p>See ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p> <p>A (ignition) and then B (supply)</p>
THE ENGINE DOES NOT START WHEN COLD	<ul style="list-style-type: none"> 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. <p>NOTE: When the engine is warm it starts normally.</p>	C
THE ENGINE DOES NOT START WHEN HOT	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> When the ignition key is rotated the engine starts immediately (or almost) but after a short time it STOPS ABRUPTLY. 	F
IRREGULAR IDLE SPEED If the anomaly is present when the engine is hot, see test D	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> The engine runs irregularly or stumbles. Acceleration is not smooth. Stumbling: Brief but obvious reduction in acceleration 	I
ENGINE DOES NOT REACH MAXIMUM PERFORMANCE	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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
<p>ATTENTION:</p> <p>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.</p> <p>Do not smoke while operating on the SUPPLY SYSTEM and ensure that all safety equipment (fire extinguishers etc.) is near at hand.</p>		






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	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  ▲ </div> <div style="text-align: center;">  ▲ </div> </div>	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	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  ▲ </div> <div style="text-align: center;">  ▲ </div> </div>	Proceed to phase A3 Follow the indications given in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
<p>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.</p>			
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 plug cover, connect to earth and check the plug	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  ▲ </div> <div style="text-align: center;">  ▲ </div> </div>	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	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  ▲ </div> <div style="text-align: center;">  ▲ </div> </div>	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	<div style="text-align: center;">  ▲ </div>	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
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TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
<p>CAUTION: When working on the fuel system do not smoke and ensure that safety equipment is near at hand.</p>		
<p>B1 CHECK FUEL</p> <p>- 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.</p>	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase B2</p> <p>Clean the tank if necessary. Fill the system with the recommended type of petrol.</p>
<p>B2 CHECK FUEL PUMP RELAY</p> <p>- Check that the fuel pump relay is working properly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase B3</p> <p>Move on to the procedure given in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>
<p>B3 CHECK AIR FLOW METER</p> <p>- Check that the tabs move freely without bending. Check that the inside is clean and that it does not show signs of rubbing.</p>	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase B4</p> <p>Replace or clean the meter</p>

(CONTINUES)



THE ENGINE DOES NOT START - FAULT IN INJECTION	TEST B
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TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
<p>B4 CHECK ELECTROINJECTORS</p> <p>- It is possible to feel the movement of the needles when touching the injectors. Check the resistance of the injectors.</p>	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase B5</p> <p>Replace the injectors</p>
<p>B5 CHECK FUEL PRESSURE</p> <p>- Carry out sealing and pressure checks of the fuel supply system - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK</p>	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase B6</p> <p>Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts</p>
<p>B6 CHECK CONTROL UNIT</p> <p>- Check that the MOTRONIC M1.7 control unit is functioning correctly (checking the vehicle by using another control unit)</p>	<p>OK ▲</p> <p>OK ▲</p>	<p>Replace the control unit</p> <p>Connect the old control unit and pass on to phase B7</p>
<p>B7 CHECK DISTRIBUTION TIMING</p> <p>- Check that the timing is correct - see GROUP 00 - TIMING CHECK</p>	<p>OK ▲</p>	<p>Restore correct timing</p>





THE ENGINE DOES NOT START WHEN COLD		TEST C
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TEST PROCEDURE		RESULTS	CORRECTIVE ACTION
C1	FAULT IN BATTERY	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase C2</p> <p>Charge or replace the battery</p>
	<p>Check that the battery voltage is correct.</p> <p>MINIMUM VOLTAGE: 12 V</p> <p>Voltage sufficient to start the engine may not be enough for the MOTRONIC M1.7 control unit</p>		
C2	CHECK ENGINE COOLANT TEMPERATURE SENSOR (NTC)	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase C3</p> <p>Carry out the procedure given in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>
	<p>Check that the sensor is working properly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>		
C3	CHECK FUEL PRESSURE	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase C4</p> <p>Check that the fuel filler, pump and pressure regulator are working correctly and replace any faulty parts</p>
	<p>Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK</p>		
C4	CHECK CONTROL UNIT	<p>OK ▲</p>	<p>Replace the control unit</p>
	<p>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.</p>		

End of test C

THE ENGINE DOES NOT START WHEN HOT		TEST D
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TEST PROCEDURE		RESULTS	CORRECTIVE ACTION
D1	CHECK ENGINE COOLANT TEMPERATURE SENSOR	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase D2</p> <p>Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual - then proceed to phase D2</p>
	<p>Check that the sensor works correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>		
D2	CHECK AIR-FLOW METER	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase D3</p> <p>Replace or clean the meter</p>
	<p>Check that the tab moves freely without bending. Check that the inside is clean and that it does not show signs of rubbing.</p>		
D3	CHECK FUEL PRESSURE	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase D4</p> <p>Check that the fuel filler, pump and pressure regulator are working correctly and replace any faulty parts</p>
	<p>Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK</p>		

(CONTINUES)



THE ENGINE DOES NOT START WHEN HOT

TEST D

TEST PROCEDURE		RESULTS	CORRECTIVE ACTION
D4	CHECK VAPOUR LOCK	OK ▲	Replace faulty components
<p>- 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</p> <p>NOTE: the phenomenon disappears if the engine is left to cool down</p>			



THE ENGINE STARTS WITH DIFFICULTY

TEST E

TEST PROCEDURE		RESULTS	CORRECTIVE ACTION
E1	CHECK IDLE SPEED ACTUATOR	OK OK ▲	Proceed to phase E2 Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
<p>- Check that the idle speed actuator functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>			
E2	CHECK FOR LEAKAGE OF AIR	OK OK ▲	Proceed to phase E3 Replace the faulty components
<p>- 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</p>			
E3	CHECK FUEL PRESSURE	OK OK ▲	Proceed to phase E4 Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
<p>- Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK</p>			



THE ENGINE STARTS WITH DIFFICULTY		TEST E
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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	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase E5</p> <p>Replace the cylinder head gasket</p>
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.	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase E6</p> <p>Clean the affected parts</p>
E6 CHECK CONTROL UNIT - Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)	<p>OK ▲</p>	<p>Replace the control unit</p>

End of test E



THE ENGINE STARTS BUT STOPS IMMEDIATELY		TEST F
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TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
F1 CHECK IDLE SPEED ACTUATOR - Check that the idle speed actuator works correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase F2</p> <p>Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>
F2 CHECK AIR FLOW METER - Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase F3</p> <p>Replace or clean the meter</p>
F3 CHECK FUEL PRESSURE - Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase F4</p> <p>Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts</p>
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	<p>OK ▲</p>	<p>Replace the voltage regulator or alternator if faulty</p>

End of test F



IRREGULAR ENGINE IDLE SPEED	TEST G
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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
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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 Restore the cylinders to the correct compression
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 be faulty	OK	Replace the control unit



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 disipation • 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	OK ▲	Proceed to phase H9
- Check cylinder compression - see GROUP 00 - CHECKING CYLINDER COMPRESSION		OK ▲	Restore the cylinders to the correct compression
H9	CHECK CRANKSHAFT PULLEY	OK ▲	Proceed to phase H10
- 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 ▲	Tighten to the correct torque
H10	CHECK CONTROL UNIT	OK ▲	Replace the control unit
- Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)			

End of test H



THE ENGINE STUMBLES

TEST I

TEST PROCEDURE		RESULTS	CORRECTIVE ACTION
I1	CHECK AIR-FLOW METER	OK ▲	Proceed to phase I2
- Check that the air-flow meter is working correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual		OK ▲	Follow the procedure indicated in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual
I2	CHECK THROTTLE VALVE POTENTIOMETER	OK ▲	Proceed to phase I3
- Check that the throttle valve potentiometer is working correctly - see GROUP 04 - CHECKING FUNCTIONING OF THROTTLE VALVE POTENTIOMETER		OK ▲	Replace the potentiometer
I3	CHECK FOR AIR LEAKAGE	OK ▲	Proceed to phase I4
- Check: <ul style="list-style-type: none"> 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 ▲	Replace the faulty components

(CONTINUES)





THE ENGINE STUMBLES TEST I

TEST PROCEDURE	RESULTS	CORRECTIVE ACTION
<p>14 CHECK HIGH VOLTAGE AND EARTH CABLES</p> <p>- Check:</p> <ul style="list-style-type: none"> 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 	<p>OK</p> <p>OK</p>	<p>Proceed to phase I5</p> <p>Replace the high voltage or earth cables. Correctly tighten the earth braids</p>
<p>15 CHECK ACCELERATOR CABLE</p> <p>- Check that the accelerator cable runs freely and check play - see GROUP 04 - ACCELERATOR CABLE ADJUSTMENT</p>	<p>OK</p> <p>OK</p>	<p>Proceed to phase I6</p> <p>Adjust the cable</p>
<p>16 CHECK CONTROL UNIT</p> <p>- 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</p>	<p>OK</p>	<p>Replace the control unit</p>

End of test I



THE ENGINE DOES NOT REACH MAXIMUM PERFORMANCE TEST J

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

(CONTINUES)



THE ENGINE DOES NOT REACH MAXIMUM PERFORMANCE		TEST J
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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	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase J6</p> <p>Clean or replace the faulty spark plugs</p>
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 disipation • that the earth braids are correctly tightened and are not oxidized	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase J7</p> <p>Replace the high voltage or earth cables. Correctly tighten the braids</p>
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	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase J8</p> <p>Replace the throttle valve</p>

(CONTINUES)



THE ENGINE DOES NOT REACH MAXIMUM PERFORMANCE		TEST J
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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	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase J9</p> <p>Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts</p>
J9	CHECK VALVE CLEARANCE - Check the valve clearance - see GROUP 01 - CHECKING AND ADJUSTMENT OF VALVE CLEARANCE (and also GROUP 00)	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase J10</p> <p>Adjust valve clearance</p>
J10	CHECK CYLINDER COMPRESSION - Check cylinder compression - see GROUP 00 - CHECKING CYLINDER COMPRESSION	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase J11</p> <p>Restore the cylinders to the correct compression</p>
J11	CHECK CONTROL UNIT - Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)	<p>OK ▲</p>	<p>Replace the control unit</p>

End of test J



EXCESSIVE FUEL CONSUMPTION TEST K

TEST PROCEDURE		RESULTS	CORRECTIVE ACTION
K1	CHECK TYRES	OK	Proceed to phase K2
	- Check the pressure and degree of wear of the tyres (see GROUP 28)	OK	Inflate or replace the tyres
K2	CHECK AIR CLEANER	OK	Proceed to phase K3
	- Check that the filter element is clean (see GROUP 04 - AIR CLEANER)	OK	Replace the filter
K3	CHECK THROTTLE VALVE POTENTIOMETER	OK	Proceed to phase K6
	- Check that the throttle valve potentiometer functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	OK	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	OK	Proceed to phase K5
	- Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	OK	Replace or clean the meter
K5	CHECK ELECTROINJECTORS	OK	Proceed to phase K6
	- It is possible to feel the needles move when the injector is touched. Check the resistance of the injectors	OK	Replace the faulty electroinjectors
K6	CHECK FUEL PRESSURE	OK	Proceed to phase K7
	- Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	OK	Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts
K7	CHECK CONTROL UNIT	OK	Replace the control unit
	- Check that the MOTRONIC M1.7 control unit is working properly (by checking the vehicle using another control unit)	OK	

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)	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase L2</p> <p>Replace the filter</p>
L2	CHECK LAMBDA PROBE - Check that the lambda probe functions correctly - see ELECTRICAL - ELECTRONIC DIAGNOSIS manual	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase L3</p> <p>Follow the procedure described in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>
L3	CHECK AIR-FLOW METER - Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase L4</p> <p>Replace or clean the meter</p>
L4	CHECK CATALYTIC CONVERTER - Check that the catalytic converter functions correctly. Take samples of exhaust fumes from upstream and 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 also GROUP 04 - CATALYTIC CONVERTER)	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase L5</p> <p>Replace the catalytic converter</p>

(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	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase L6</p> <p>Replace the faulty electroinjectors</p>
L6	CHECK FUEL PRESSURE - Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase L7</p> <p>Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts</p>
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	<p>OK ▲</p>	<p>Replace the control unit</p>



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	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase K6</p> <p>Follow the procedure described in the ELECTRICAL - ELECTRONIC DIAGNOSIS manual</p>
M2	CHECK AIR-FLOW METER - Check that the tabs move freely without bending. Check that there are no traces of dirt or rubbing inside	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase M3</p> <p>Replace or clean the meter</p>
M3	CHECK ELECTROINJECTORS - it is possible to feel the movement of the needles when the injectors are touched. Check the resistance of the injectors	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase M4</p> <p>Replace the faulty electroinjectors</p>

(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	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase M5</p> <p>Replace the faulty components</p>
M5	CHECK FUEL PRESSURE - Check the pressure and sealing of the fuel supply circuit - see GROUP 04 - FUEL CIRCUIT PRESSURE AND SEALING CHECK	<p>OK ▲</p> <p>OK ▲</p>	<p>Proceed to phase M5</p> <p>Check that the fuel filter, pump and pressure regulator are working correctly and replace any faulty parts</p>
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	<p>OK ▲</p>	<p>Replace the control unit</p>

End of test M



GROUP 05

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STARTING AND RECHARGING**

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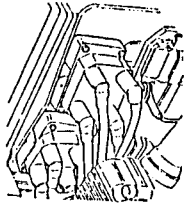
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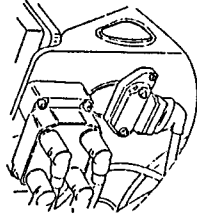
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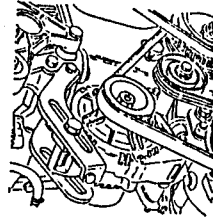
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