# ALFA ROMEO 155

## 16V SUPPLEMENT

[SMS PART No Z6015]

THIS MANUAL CONTAINS THE FOLLOWING UPDATES

| DESCRIPTION | PRINT No |
|---|---|
| MAIN MANUAL | 49780016V000 |
| SUPPLEMENT | 49780016V001 |
| SUPPLEMENT | 49780016V002 |

155

REPAIR MANUAL

SUPPLEMENT FOR

155 T.SPARK 16V

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

**PA49780016V002**
**(60494598)**

Alfa Romeo

(PAGE NOT TO BE INSERTED IN THE VOLUME)

# 155

REPAIR
MANUAL

SUPPLEMENT
FOR

155 T.SPARK 16V

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

**PA49780016V001**
**(60494512)**

Alfa Romeo

(PAGE NOT TO BE INSERTED IN THE VOLUME)


# 155

# REPAIR MANUAL

## SUPPLEMENT
## FOR

155 T.SPARK 16V

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

Alfa Romeo



PA49780016V

12-1994

# UPDATES CARD

155 REPAIR MANUAL

SUPPLEMENT FOR

155 T.SPARK 16V

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

| UPDATES CARD | | | |
|---|---|---|---|
| UPDATE (DATE) | SECTION | PAGE | |
| | | REMPLACED | ADDED |
| 2(12/1995) | | Division of Manual | |
| 2(12/1995) | Introduction | V | |
| | Engine (PA 4978D116V000) | | |
| 2(12/1995) | | Divisor | |
| 1(1/1995) | | 01-1 | |
| 2(12/1995) | | 01-1 | |
| 1(1/1995) | | | 01-1/1 - 01-1/24 |
| 2(12/1995) | | 01-1/6 | |
| 2(12/1995) | | 01-1/14 | |
| 2(12/1995) | | 01-1/20 - 01-1/22 | |
| 1(1/1995) | | 01-2 | |
| 2(12/1995) | | 01-2 | |
| 1(1/1995) | | 01-10 | |
| 2(12/1995) | | 01-10 | |
| 2(12/1995) | | | 01-11 - 01 25 |
| 1(1/1995) | | 04-1 | |
| 2(12/1995) | | 04-1 - 04-1/1 | |
| 1(1/1995) | | | 04-1/1 - 04-1/2 |
| 2(12/1995) | | 04-2 | |
| 2(12/1995) | | 04-6 | |
| 2(12/1995) | | | 04-8/1 - 04-8/6 |
| 1(1/1995) | | | 04-9 - 04-34 |
| 2(12/1995) | | 04-10 | |
| 2(12/1995) | | | 04-10/1 - 04-10/2 |
| 2(12/1995) | | | 04-14/1 - 04-14/2 |
| 2(12/1995) | | 04-27 | |
| 2(12/1995) | | | 04-28/1 - 04-28/2 |
| 2(12/1995) | | 04-29 - 04-30 | |
| 2(12/1995) | | 04-33 - 04-34 | |
| 1(1/1995) | | 05-1 | |
| 2(12/1995) | | 05-1 | |
| 1(1/1995) | | | 05-2 - 05-13 |
| 2(12/1995) | | 05-13 | |
| 1(1/1995) | | 07-1 | |
| 1(1/1995) | | | 07-2 - 07-15 |
| 2(12/1995) | | 07-1 - 07-4 | |
| 2(12/1995) | | 07-7 - 07-8 | |
| 2(12/1995) | | | 07-8/1 - 07-8/2 |
| 2(12/1995) | | 07-10 | |
| 2(12/1995) | | 07-12 - 07-15 | |

| UPDATES CARD | | | |
|---|---|---|---|
| UPDATE (DATE) | SECTION | PAGE | |
| | | REMPLACED | ADDED |
| | Mechanical units (PA4978C116V000) | | |
| 1(1/1995) | | 12-1 - 12-3 | |
| 1(1/1995) | | | 12-4 - 12-6 |
| 1(1/1995) | | 13-1 - 13-5 | |
| 1(1/1995) | | | 13-6 - 13-10 |
| 2(12/1995) | | 13-7 | |
| 1(1/1995) | | 17-1 - 17-2 | |
| 2(12/1995) | | 17-1 | |
| 2(12/1995) | | | 17-2/1 - 17-2/2 |
| 1(1/1995) | | | 17-3 |
| 2(12/1995) | | 17-3 | |
| 1(1/1995) | | 21-1 | |
| 1(1/1995) | | 21-3 - 21-4 | |
| 1(1/1995) | | | 21-5 - 21-7 |
| 2(12/1995) | | 21-3 - 21-5 | |
| 1(1/1995) | | 22-1 | |
| 1(1/1995) | | 23-1 - 23-3 | |
| 1(1/1995) | | | 23-4 - 23-5 |
| 1(1/1995) | | 25-1 | |
| 1(1/1995) | | 25-3 | |
| 2(12/1995) | | 25-3 | |
| 1(1/1995) | | | 25-4 |
| 1(1/1995) | | 28-1 | |
| | Bodywork (PA4978D116V000) | | |
| 1(1/1995) | | 40-1 | |
| 1(1/1995) | | 40-4 | |
| 2(12/1995) | | 40-3 - 40-5 | |
| 1(1/1995) | | | 40-6 |
| 1(1/1995) | | 80-1 | |
| 2(12/1995) | | 80-8 | |
| 1(1/1995) | | 80-9 - 80-11 | |
| 1(1/1995) | | | 80-12 - 80-17 |



| UPDATES CARD | | | |
|---|---|---|---|
| UPDATE (DATE) | SECTION | PAGE | |
| | | REMPLACED | ADDED |
| | Electrical & Electronic Diagnosis (PA4978E116V000) | | |
| 2(12/1995) | Index | I - II | |
| 2(12/1995) | Introduction | VIII | |
| 2(12/1995) | | 2-4 | |
| 2(12/1995) | | 2-6 - 2-7 | |
| 2(12/1995) | | 2-11 - 2-12 | |
| 2(12/1995) | | 3-3 - 3-4 | |
| 2(12/1995) | | 13-4 | |
| 2(12/1995) | | 13-10 | |
| 1(1/1995) | | 13-13 | |
| 1(1/1995) | | 13-16 - 13-17 | |
| 2(12/1995) | | 13-17 | |
| 2(12/1995) | | 14-4 | |
| 2(12/1995) | | 14-6 | |
| 2(12/1995) | | 14-9 | |
| 1(1/1995) | | 14-12 - 14-13 | |
| 1(1/1995) | | 19-5 | |
| 2(12/1995) | | 21-2 | |
| 2(12/1995) | | 21A-2 - 21A-3 | |
| 2(12/1995) | | 21A-9 | |
| 2(12/1995) | | 21A-20 | |
| 2(12/1995) | | 22-1 - 22-6 | |
| 2(12/1995) | | | 22-7 |
| 2(12/1995) | | 26-7 - 26-8 | |
| 2(12/1995) | | 26-16 - 26-19 | |
| 2(12/1995) | | 26-21 | |
| 2(12/1995) | | 26-23 | |
| 1(1/1995) | | 26-24 | |
| 2(12/1995) | | 26-25 | |
| 2(12/1995) | | 28-1 - 28-5 | |
| 2(12/1995) | | 29A-7 - 29A-9 | |
| 1(1/1995) | | 29A-13 | |
| 2(12/1995) | | 29A-14 - 29A-15 | |
| 2(12/1995) | | 29B-1 - 29B4 | |
| 2(12/1995) | | 29B-6 | |
| 1(1/1995) | | 29B-7 | |
| 1(1/1995) | | 29B-11 | |
| 2(12/1995) | | | 29C-1 - 29C-12 |

| UPDATES CARD | | | |
|---|---|---|---|
| UPDATE (DATE) | SECTION | PAGE | |
| | | REMPLACED | ADDED |
| | Components and connectors | | |
| 2(12/1995) | | 3 - 7 | |
| 2(12/1995) | | 9 | |
| 2(12/1995) | | 13 - 16 | |
| 2(12/1995) | | 18 | |
| 2(12/1995) | | 20 - 21 | |
| 2(12/1995) | | 23 - 26 | |
| 2(12/1995) | | 28 | |
| 2(12/1995) | | | 28/1 - 28/2 |
| 2(12/1995) | | 29 | |
| 2(12/1995) | | 31 - 33 | |
| 2(12/1995) | | 36 - 39 | |
| 2(12/1995) | | 41 - 42 | |
| 2(12/1995) | | 46 - 56 | |

# UPDATE CHART

| UPDATE CHART | | | |
|---|---|---|---|
| UPDATE (DATE) | ENGINE | PAGE | |
| | | SUBSTITUTED | ADDED |
| | Engines (pages PA4978B116V001) | | |
| 1 (1/1995) | | 01-1 | |
| 1 (1/1995) | | | 01-1/1 to 01-1/24 |
| 1 (1/1995) | | 01-2 | |
| 1 (1/1995) | | 01-10 | |
| 1 (1/1995) | | 04-1 | |
| 1 (1/1995) | | | 04-1/1 to 04-1/2 |
| 1 (1/1995) | | | 04-9 to 04-34 |
| 1 (1/1995) | | 05-1 | |
| 1 (1/1995) | | | 05-2 to 05-13 |
| 1 (1/1995) | | 07-1 | |
| 1 (1/1995) | | | 07-2 to 07-15 |
| | Mechanical units (pages PA4978C116V001) | | |
| 1 (1/1995) | | 12-1 to 12-3 | |
| 1 (1/1995) | | | 12-4 to 12-6 |
| 1 (1/1995) | | 13-1 to 13-5 | |
| 1 (1/1995) | | | 13-6 to 13-10 |
| 1 (1/1995) | | 17-1 to 17-2 | |
| 1 (1/1995) | | | 3 |
| 1 (1/1995) | | 21-1 | |
| 1 (1/1995) | | 21-3 to 21-4 | |
| 1 (1/1995) | | | 21-5 to 21-7 |
| 1 (1/1995) | | 22-1 | |
| 1 (1/1995) | | 23-1 to 23-3 | |
| 1 (1/1995) | | | 23-4 to 23-5 |
| 1 (1/1995) | | 25-1 | |
| 1 (1/1995) | | 25-3 | |
| 1 (1/1995) | | | 25-4 |
| 1 (1/1995) | | 28-1 | |
| | Body (pages PA4978D116V001) | | |
| 1 (1/1995) | | 40-1 | |
| 1 (1/1995) | | 40-4 | |
| 1 (1/1995) | | | 40-6 |
| 1 (1/1995) | | 80-1 | |
| 1 (1/1995) | | 80-9 to 80-11 | |
| 1 (1/1995) | | | 80-12 to 80-17 |
| | Electric-Electronic Diagnosis (pages PA4978E116V001) | | |
| 1 (1/1995) | | 13-13 | |
| 1 (1/1995) | | 13-16 to 13-17 | |
| 1 (1/1995) | | 14-12 to 14-13 | |
| 1 (1/1995) | | 19-5 | |
| 1 (1/1995) | | 26-24 | |
| 1 (1/1995) | | 29A-13 | |
| 1 (1/1995) | | 29B-7 | |
| 1 (1/1995) | | 29B-11 | |



# 155

REPAIR MANUAL

SUPPLEMENT FOR

**155 T.SPARK 16V**

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

# NOTICE

This manual "155 - REPAIR MANUAL - SUPPLEMENT FOR 155 T.SPARK 16V" comprises the following subjects:

- Engine
- Mechanical units
- Body
- Electrical & electronic diagnosis

The subjects relative to:

- Vehicle characteristics and maintenance

are described also for the "155 T.SPARK 16V" in the volume "155 - VEHICLE CHARACTERISTICS AND MAINTENANCE.

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.

# INTRODUCTION

This publication provides the information necessary for the maintenance and repair operations regarding the **155 TSPARK 16v.** 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.

In the sections of "ENGINES", "MECHANICAL UNITS" and "BODY", 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.

For overhauling engines and mechanical groups refere to the following manuals:

- PA493600000000 REPAIR INSTRUCTIONS - ENGINE OVERHAUL.
- PA494200000000 REPAIR INSTRUCTIONS - OVERHAULING MECHANICAL GROUPS.

For information relative to the electrical systems of the vehicle the ELECTRICAL - ELECTRONIC DIAGNOSIS section should be consulted. This section gives the electrical diagrams and the descriptions of each function, the tables of the connectors and the location of the relative components.

## How to use this manual

**(In the sections of "ENGINES", "MECHANICAL UNITS" and "BODY").**

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.

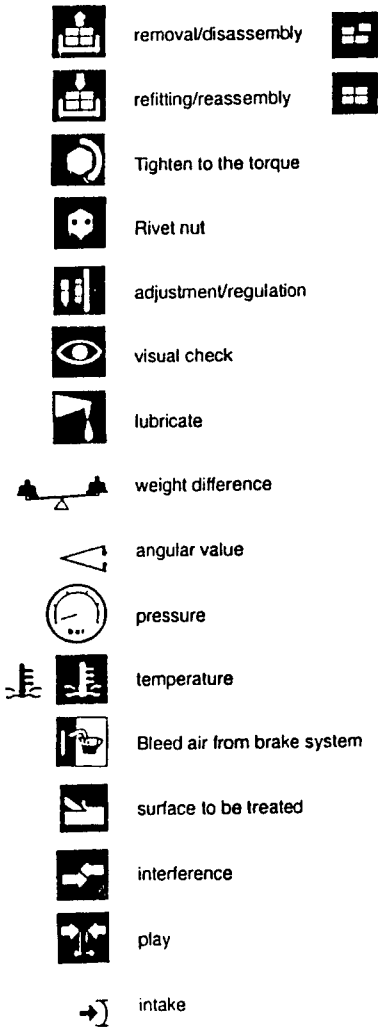


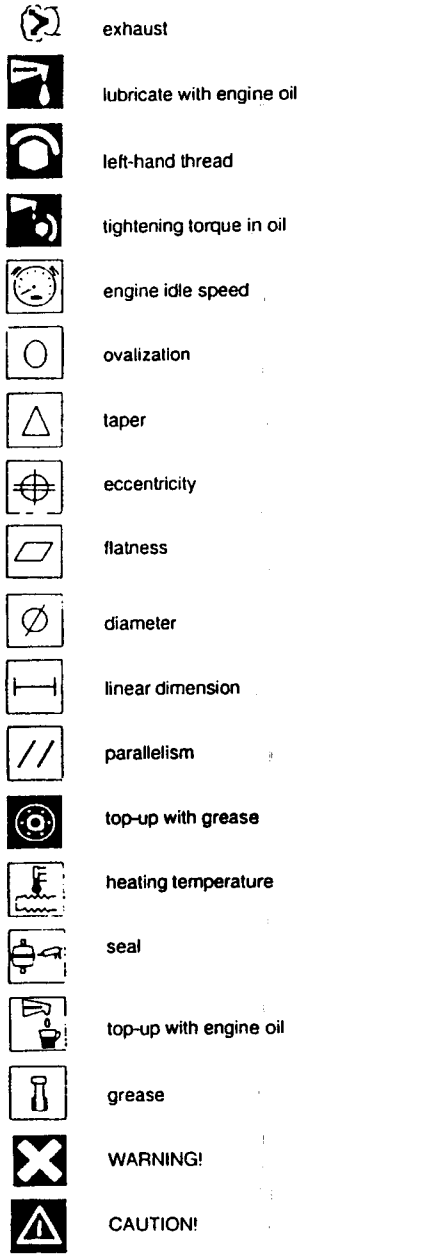


## Symbols

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.



## 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:**
**is used when lack of care may cause damage 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.

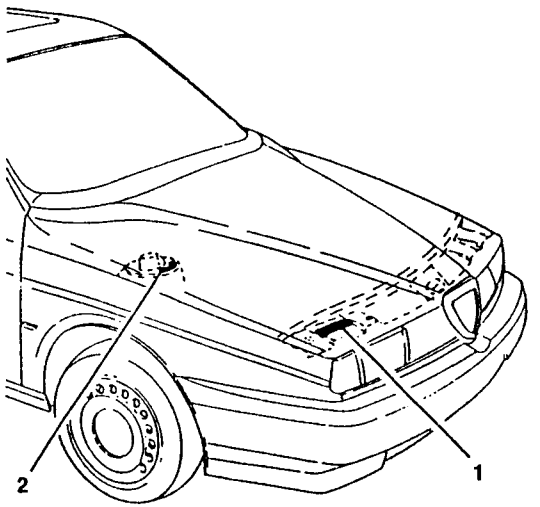
**NOTE:**
It is possible that some subjects have not been covered in time for publication.
In the indexes to the individual groups these subjects are indicated however and are accompanied by the words "Due for publication".
The Technical Assistance will provide documentation relative to these subjects in the form of up-date sheets or in "Technical Bulletins" which will promptly be sent to the Alfa Romeo Assistance Network.

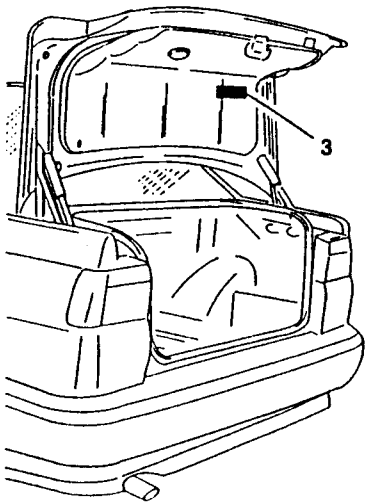


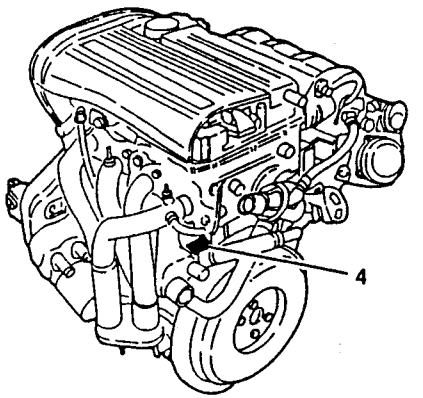


# VEHICLE IDENTIFICATION

## IDENTIFICATION PLATES




1. *Data plate*
2. *Body code*
3. *Paint identification plate*
4. *Engine code*

## MODELS IDENTIFICATION LABEL

| Version | | 155 | 155 | 155 |
|---|---|---|---|---|
| Model | | 2.0 T. SPARK 16V | 1.6 T. SPARK 16V | 1.8 T. SPARK 16V |
| Cylinder displacement | | 1970 $cm^3$ | 1598 $cm^3$ | 1747 $cm^3$ |
| Trim level | | 4-door saloon | | |
| Drive | | LH + RH | | |
| Car model no. | on identification label | 167A2G | 167A6 | 167A4N |
| | on upper part of RH side panel, engine compartment | 167000 | 167000 | 167000 |
| N° chassis serial number (on two assembly lines) | | 121000<br>1022000 | (*) | (*) |
| N° engine type and serial number (intermittent) | | AR67204<br>from<br>3259 | AR67601<br>from<br>(*) | AR67106<br>from<br>(*) |

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

DIVISION OF
"REPAIR MANUAL"

Models 155

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

155 REPAIR MANUAL
• VEHICLE CHARACTERISTICS AND MAINTENANCE

- 155 T.SPARK V6 - PA4655A1000000: GROUP 00
- 155 ⊠ - PA4655A24x4000: GROUP 00
- 155 TD - PA4655A3TD0000: GROUP 00
- 155 TD 2.5 - PA4655A4TD2500: GROUP 00
- 155 T. SPARK 16V - PA4655A516V000: GROUP 00

155 REPAIR MANUAL
• ENGINES

- PA4655B1000000: T. SPARK ENGINE
- PA4655B2000000: V6 ENGINE

155 REPAIR MANUAL
• MECHANICAL UNITS
• BODY

- PA4655C1000000: MECHANICAL UNITS
- PA4655D1000000: Electrical components, Bodywork, Trim, Heating and Ventilation

155 REPAIR MANUAL
• ELETRICAL & ELECTRONIC DIAGNOSIS

- PA4655E1000000: Wiring diagrams and Troubleshooting

N.B. THE UPDATE OF THIS CARD IS SHOWN BY ONLY DATE, WHILE THE PUBLICATION NUMBER REMAINS THE BASIC ONE.

continues →



155 REPAIR MANUAL
SUPPLEMENT FOR 155 ⊠
• ENGINES
• MECHANICAL UNITS
• BODY
• ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4736B14x4000: ENGINE
- PA4736C14x4000: MECHANICAL UNITS
- PA4736D14x4000: Electrical components, Bodywork, Trim, Heating and Ventilation
- PA4736E14x4000: Wiring diagrams and troubleshooting

155 REPAIR MANUAL
SUPPLEMENT FOR 155 TD
• ENGINES
• MECHANICAL UNITS
• BODY
• ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4805B1TD0000: ENGINE
- PA4805C1TD0000: MECHANICAL UNITS
- PA4805D1TD0000: Electrical components, Bodywork, Trim, Heating and Ventilation
- PA4805E1TD0000: Wiring diagrams and troubleshooting

155 REPAIR MANUAL
SUPPLEMENT FOR 155 TD 2.5
• ENGINES
• MECHANICAL UNITS
• BODY
• ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4830B1TD2500: ENGINE
- PA4830C1TD2500: MECHANICAL UNITS
- PA4830D1TD2500: Electrical components, Bodywork, Trim, Heating and Ventilation
- PA4830E1TD2500: Wiring diagrams and troubleshooting

155 REPAIR MANUAL
SUPPLEMENT FOR 155 T.SPARK 16V
• ENGINES
• MECHANICAL UNITS
• BODY
• ELECTRICAL & ELECTRONIC DIAGNOSIS

- PA4978B116V000: ENGINE
- PA4978C116V000: MECHANICAL UNITS
- PA4978D116V000: Electrical components, Bodywork, Trim, Heating and Ventilation
- PA4978E116V000: Wiring diagrams and troubleshooting

# 155
# T.SPARK 16V

# REPAIR MANUAL

## ● ENGINES

(▲) GROUP 01 - ENGINE MAIN MECHANICAL UNIT

GROUP 04 - FUEL SYSTEM

GROUP 05 - ENGINE IGNITION, STARTING AND RECHARGING

GROUP 07 - ENGINE COOLING SYSTEM

**(▲): For overhauling the engine on the bench see manual "ENGINE OVERHAULING" PA493600000000.**

PA4978B116V002

12 - 1995

GROUP 01

# ENGINE MAIN MECHANICAL UNIT

## INDEX

### (1970) (AR67204) engine


REMOVING/REFITTING ENGINE... 01 - 1/2
- Removal..... 01 - 1/2
- Refitting ..... 01-1/12

ENGINE OVERHAULING ON THE BENCH (SEE MANUAL "ENGINE OVERHAULING" PA493600000001)

ON-VEHICLE OPERATIONS..... 01-1/12
- Removing/Refitting cylinder head.. 01-1/12
- Removal/Refitting of oil sump .... 01-1/17
- Changing the crankshaft front oil seal ..... 01-1/19
- Changing the counter-rotating shaft seals ..... 01-1/21
- Changing the camshaft oil seals ..... 01-1/22
- Changing the flexible bushing of the engine stay rod anchor bracket ..... 01-1/23
- Changing the rear crankcase cover (with oil seal) ..... 01-1/23

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS ..... 01 - 2
- Engine technical characteristics..... 01 - 2
- Complete crankcase..... 01 - 2
- Connecting rod - piston assembly .. 01 - 4
- Cylinder head ..... 01 - 5
- Angles of actual timing diagram .... 01 - 7
- Fluids and lubricants..... 01 - 8
- Sealants and adhesives ..... 01 - 8
- Abrasives ..... 01 - 8
- Tightening torques ..... 01 - 9

SPECIAL TOOLS ..... 01-10

**Service News 10-09.96** ... 01-10/1
- Guard under engine ..... 01-10/1
  - Removing/Refitting..... 01-10/1
- Wheel house guards..... 01-10/1
  - Removing/Refitting..... 01-10/1






### (1598) (AR67601) and (1747) (AR67106) engines

**For these engines only the differences with respect to the 1970 cm$^3$ - AR67204 engine are given. Therefore refer to the above-mentioned engine for the items not mentioned here.**


REMOVING/REFITTING ENGINE.... 01-11
- Removal..... 01-11
- Refitting ..... 01-12

ENGINE OVERHAULING ON THE BENCH (SEE MANUAL "ENGINE OVERHAULING" PA493600000004)

ON-VEHICLE OPERATIONS..... 01-13
- Removing/Refitting cylinder head .. 01-13
- Removal/Refitting of oil sump ..... 01-14
- Changing the crankshaft front oil seal ..... 01-14

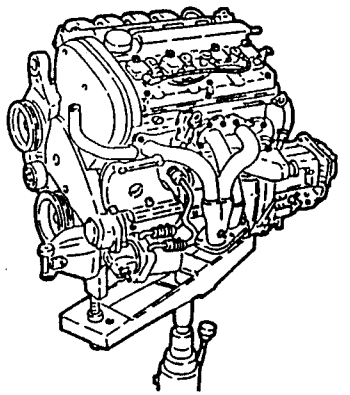
TECHNICAL CHARACTERISTICS AND SPECIFICATIONS ..... 01-17
- Engine technical characteristics..... 01-17
- Complete crankcase..... 01-17
- Connecting rod - piston assembly .. 01-19
- Cylinder head ..... 01-20
- Angles of actual timing diagram .... 01-22
- Fluids et lubricants ..... 01-23
- Sealants and adhesives ..... 01-23
- Abrasives ..... 01-23
- Tightening torques ..... 01-24

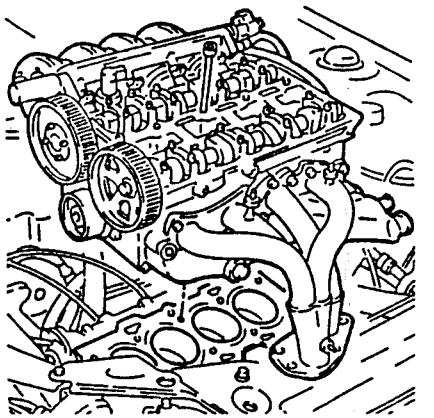
SPECIAL TOOLS ..... 01-25


## ILLUSTRATED INDEX


REMOVING/REFITTING ENGINE Pag. 01-1/2

ON-VEHICLE OPERATIONS Pag. 01-1/12

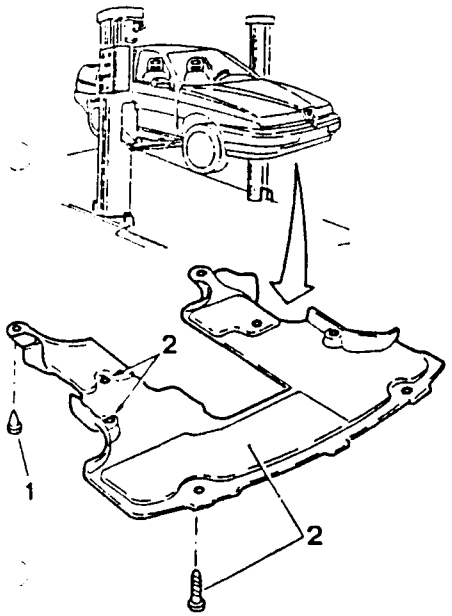


## GUARD UNDER ENGINE (excluding version 1.6 T.S. 16V)

### REMOVING/REFITTING

- Set the car on a lift and raise it.

1. Remove the two plastic buttons fastening the guard under the engine to the body.
2. Slacken the six fastening screws and remove the guard under the engine.



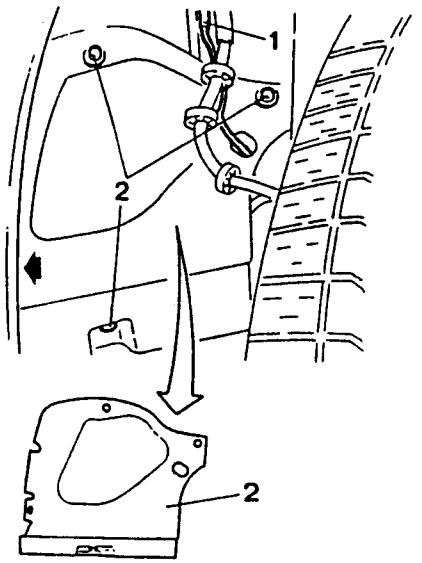

## WHEEL HOUSE GUARDS (Excluding version 1.6 T.S. 16V)

### REMOVING/REFITTING

- Set the car on a lift and raise it.
- Turn the wheel just enough to gain access to the left guard.

1. Disconnect the electrical connection of the brake pad wear signalling cable and remove the latter from the hole on the left guard.
2. Slacken the fastenings and remove the left wheel house guard.

- Carry out the same procedure for removing/refitting the right wheel house guard.








GROUP 01

# ENGINE MAIN MECHANICAL UNIT

## INDEX

### (AR67204) engine

REMOVING/REFITTING ENGINE... 01 - 1/2
– Removal ... 01 - 1/2
– Refitting ... 01-1/12
ENGINE OVERHAULING ON THE BENCH (SEE MANUAL "ENGINE OVERHAULING" PA493600000001)
ON-VEHICLE OPERATIONS ... 01-1/12
– Removing/Refitting cylinder head .. 01-1/12
– Removal/Refitting of oil sump .... 01-1/17
– Changing the crankshaft front oil seal ... 01-1/19
– Changing the counter-rotating shaft seals ... 01-1/21
– Changing the camshaft oil seals ... 01-1/22
– Changing the flexible bushing of the engine stay rod anchor bracket ... 01-1/23
– Changing the rear crankcase cover (with oil seal) ... 01-1/23
TECHNICAL CHARACTERISTICS AND SPECIFICATIONS ... 01 - 2
– Engine technical characteristics ... 01 - 2
– Complete crankcase ... 01 - 2
– Connecting rod - piston assembly .. 01 - 4
– Cylinder head ... 01 - 5
– Angles of actual timing diagram .... 01 - 7
– Fluids and lubricants ... 01 - 8
– Sealants and adhesives ... 01 - 8
– Abrasives ... 01 - 8
– Tightening torques ... 01 - 9
SPECIAL TOOLS ... 01-10

### (AR67601) and (AR67106) engines

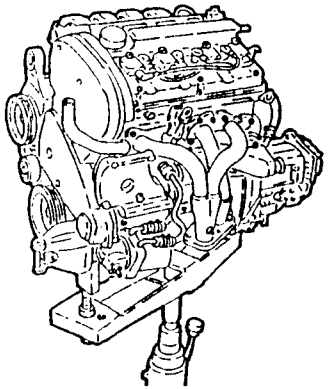
**For these engines only the differences with respect to the 1970 cm³ - AR67204 engine are given. Therefore refer to the above-mentioned engine for the items not mentioned here.**

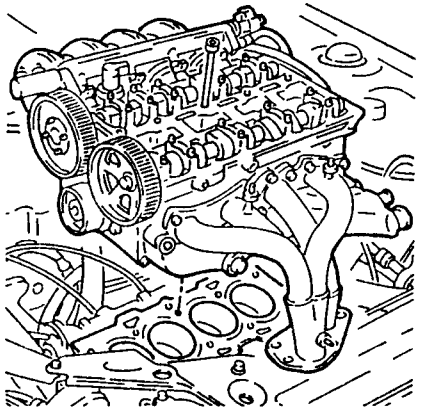
REMOVING/REFITTING ENGINE.... 01-11
– Removal ... 01-11
– Refitting ... 01-12
ENGINE OVERHAULING ON THE BENCH (SEE MANUAL "ENGINE OVERHAULING" PA493600000004)
ON-VEHICLE OPERATIONS ... 01-13
– Removing/Refitting cylinder head .. 01-13
– Removal/Refitting of oil sump ..... 01-14
– Changing the crankshaft front oil seal ... 01-14
TECHNICAL CHARACTERISTICS AND SPECIFICATIONS ... 01-17
– Engine technical characteristics ... 01-17
– Complete crankcase ... 01-17
– Connecting rod - piston assembly .. 01-19
– Cylinder head ... 01-20
– Angles of actual timing diagram .... 01-22
– Fluids et lubricants ... 01-23
– Sealants and adhesives ... 01-23
– Abrasives ... 01-23
– Tightening torques ... 01-24
SPECIAL TOOLS ... 01-25

# ILLUSTRATED INDEX

REMOVING/REFITTING ENGINE Pag. 01-1/2

ON-VEHICLE OPERATIONS Pag. 01-1/12





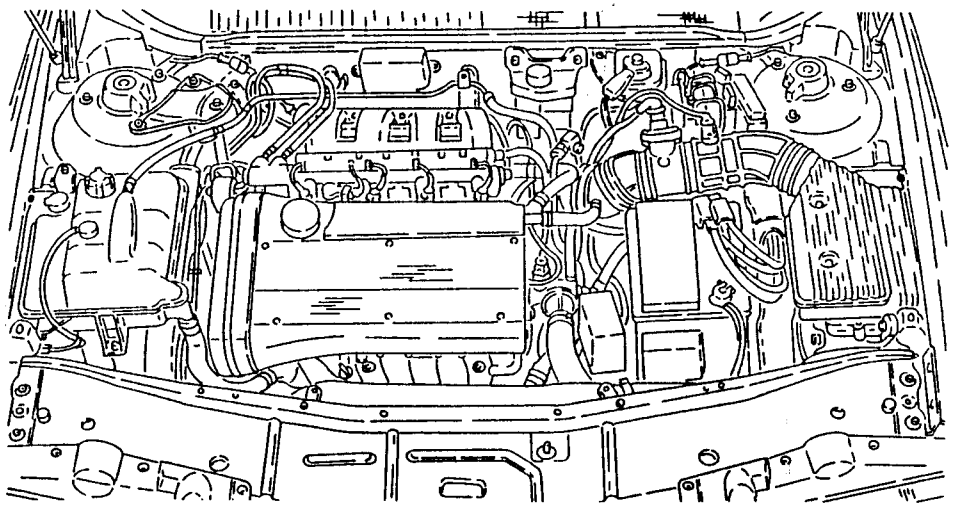




# REMOVING/REFITTING ENGINE

The information and illustrations given below enable the rapid removal of the engine assembly from its housing in the engine compartment and its subsequent refitting.

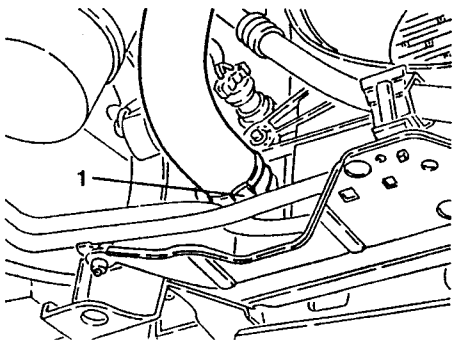
Dis-assembly of the single components on the bench is described in the volume "ENGINE OVERHAULING".
This is to be considered a single, complete procedure with the possibility of adopting only parts of it according to necessity.
For further information and details, see the chapters referring to the specific components or groups.



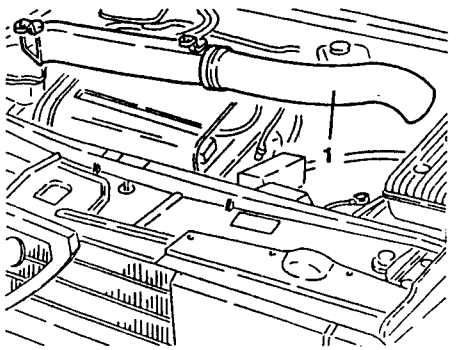
## REMOVAL

- Set the car on a 2 column lift.
- Remove the battery.
- Remove the front wheels and mud flaps.

1. Raise the car and drain the engine coolant fluid disconnecting the radiator outlet sleeve.

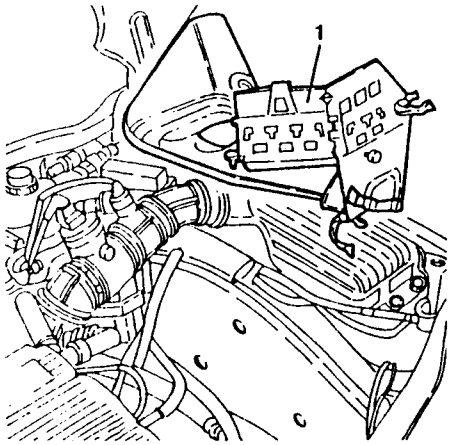



1. Slacken the fastening screws and remove the air inlet pipe from the crossmember.

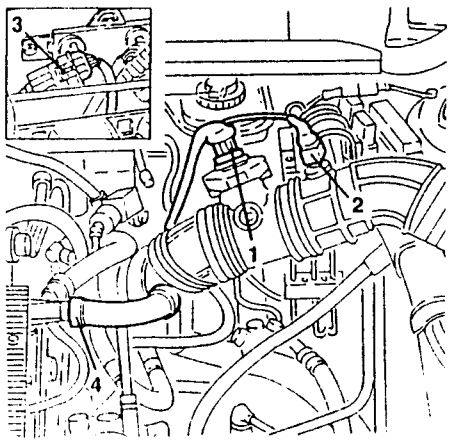



- Remove the relays from the battery support and set them to one side together with their wirings so that they do not hinder the following operations.

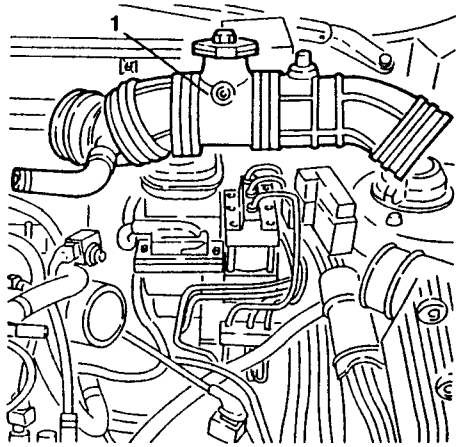
1. Slacken the fastening screws, then remove the battery support after removing it from the rear cable support bracket.



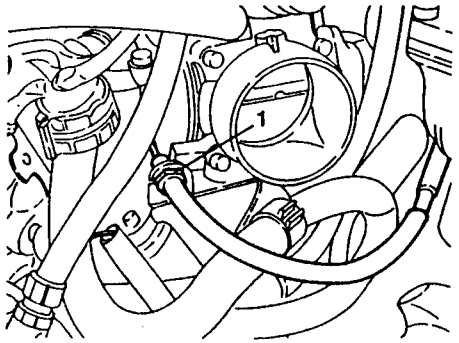

1. Disconnect the electrical connection from the air-flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor (NTC).
3. Disconnect the electrical connection of the lambda probe.
4. Slacken the fastening clamp and disconnect the oil recirculation pipe from the cylinder head.



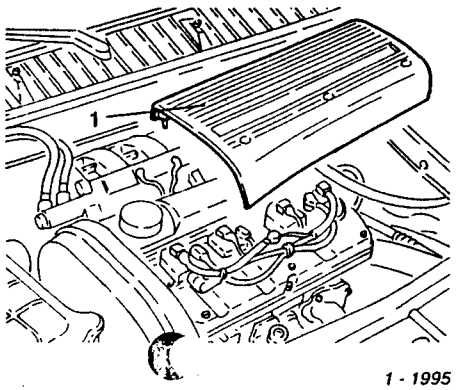

1. Slacken the fastening clamps and remove the corrugated sleeve complete.




1. Disconnect the accelerator cable from the throttle body.



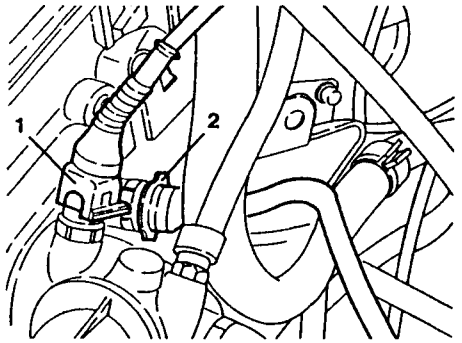

1. Slacken the fastening screws and remove the ignition coils cover.



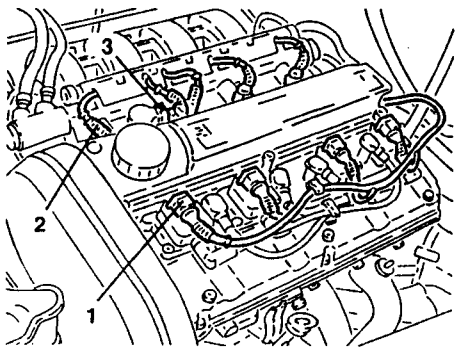





1. Disconnect the electrical connection from the engine coolant fluid temperature sensor (NTC).
2. Disconnect the electrical connection from the engine coolant temperature warning light transmitter, then move aside the wiring.

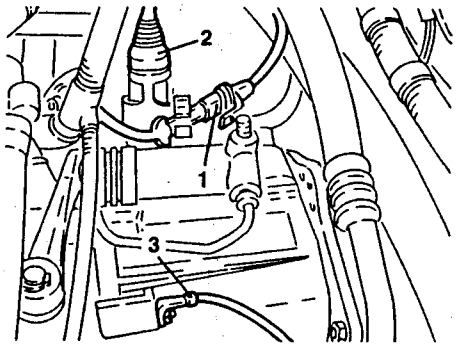



1. Disconnect the electrical connections ignition coils.
2. Disconnect the electrical connections from the electroinjectors.
3. Disconnect the electrical connection from the timing variator solenoid.
- Disconnect the earth cable from the cylinder head.

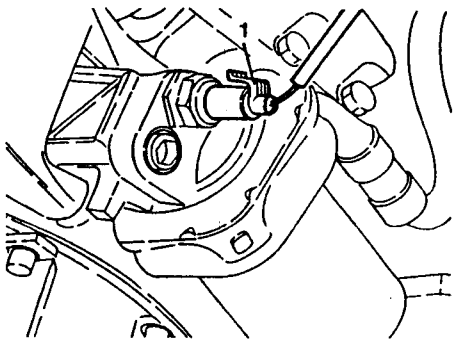



1. Disconnect the electrical connection of the reversing sensor.
2. Disconnect the electrical connection of the tachometric sensor.

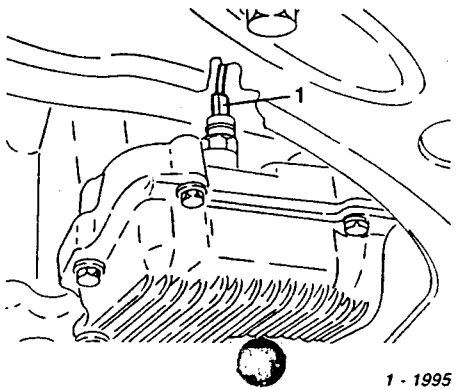
3. Disconnect the earth cable from the gearbox.



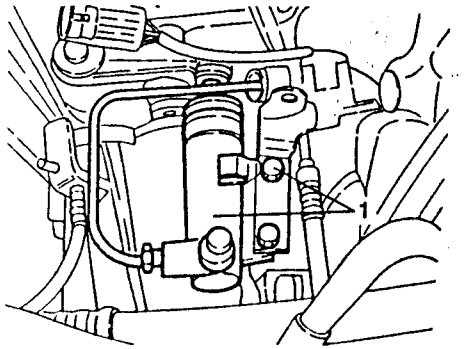

1. Raise the car and disconnect the electrical connection from the minimum engine oil pressure sensor.



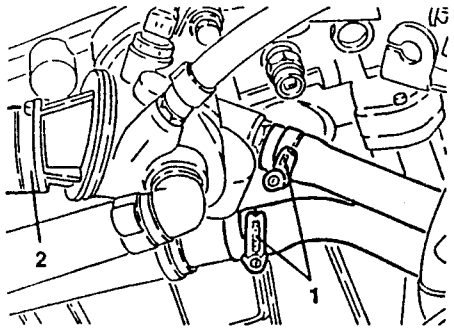

1. Disconnect the electrical connection of the engine oil temperature sensor.
- Disconnect the electrical connection of the engine oil level sensor.



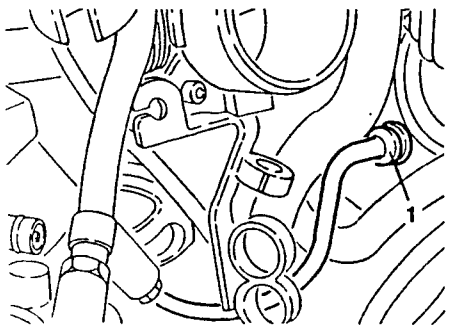
1. Lower the car and slacken the fastening screws, the move the clutch control cylinder without disconnecting the pipes.



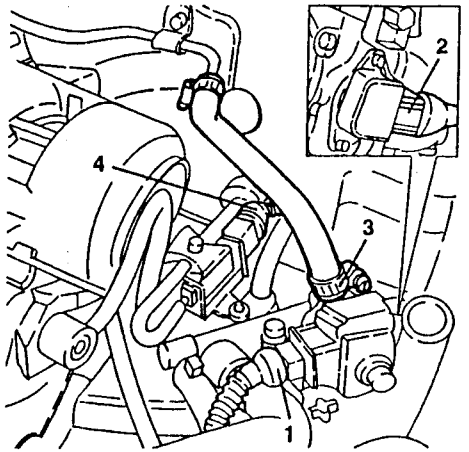

1. Disconnect the coolant fluid delivery and return pipes from the thermostatic cup to the climate control system heater and release them from the bracket.
2. Disconnect the coolant fluid delivery pipe to the radiator from the thermostatic cup.



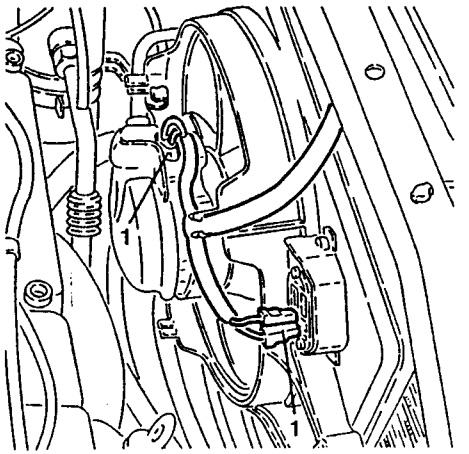

1. Disconnect the vacuum takeoff pipe from the servobrake.




1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection from the throttle potentiometer.
3. Disconnect the the coolant delivery pipe to the header tank from the throttle body.
4. Disconnect the electrical connection from the E.G.R. modulation solenoid valve.



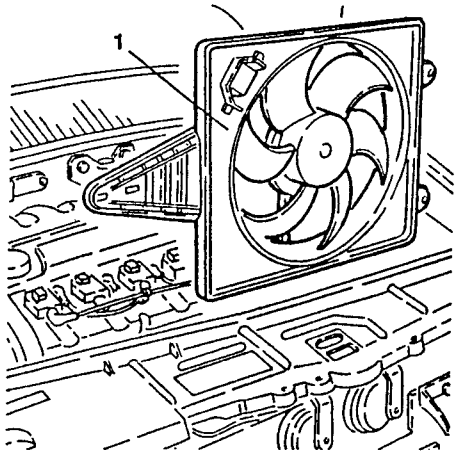

1. Disconnect the electrical connections from the cooling fan.



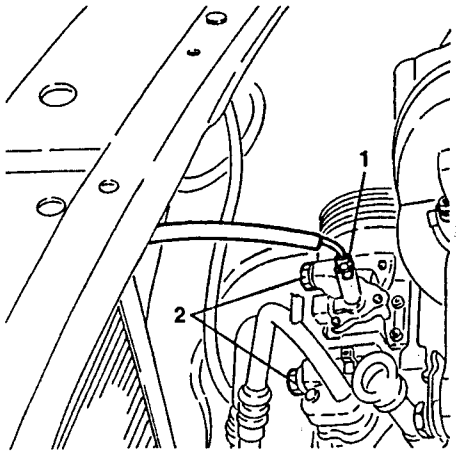




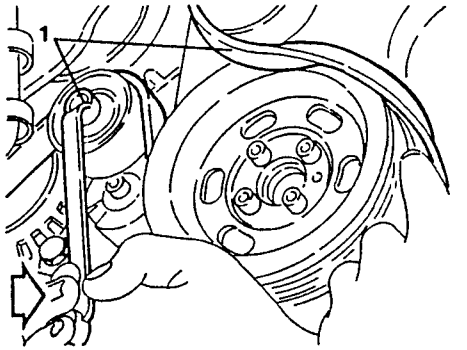

1. Slacken the fastening screws and remove the cooling fan.



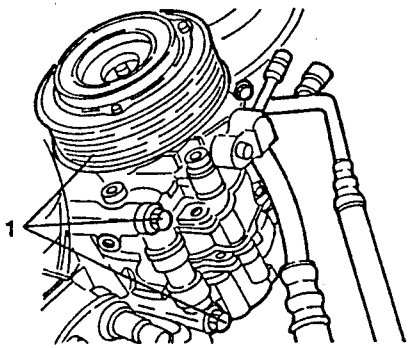

1. Disconnect the electrical connection supplying the conditioner compressor.
2. Slacken the two upper screws fastening the conditioner compressor.



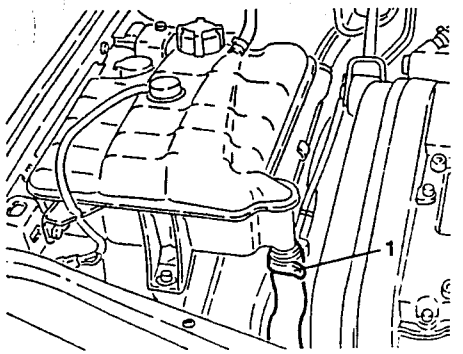

1. Raise the car and working as illustrated on the guide pulley, loosen the tension of the auxiliary components drive belt and remove it.



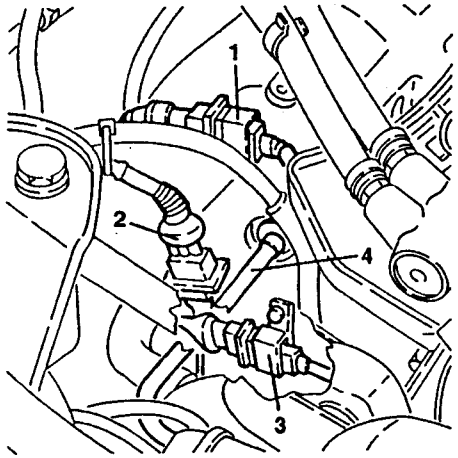

1. Slacken the two lower screws fastening the conditioner compressor, then, without disconnecting the piping, fasten it to one side to prevent hindrance in the following operations.



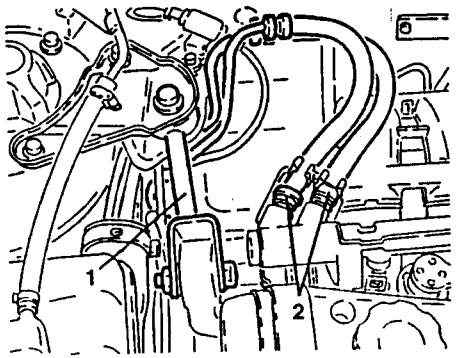

1. Lower the car and disconnect the system supply pipe from the header tank.



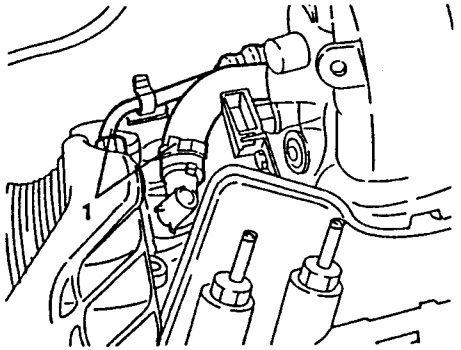
1. Disconnect the electrical connection of the timing sensor.
2. Disconnect the electrical connection pinging sensor.
3. Disconnect the electrical connection timing and rpm sensor.
4. Disconnect the fuel vapour recirculation pipes from the air intake box.



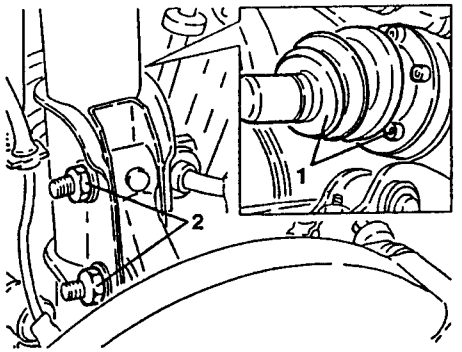

1. Slacken the fastening screws and remove the engine stay connecting rod.
2. Disconnect the fuel inlet and outlet pipes from the distributor manifold.



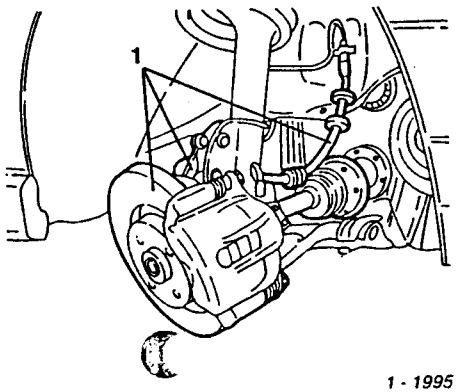

- Using a suitable syringe, drain the oil from the power steering tank.
1. Disconnect the oil inlet and delivery pipes from the power steering pump.




- Remove the alternator (see specific paragraph).
1. Raise the car, slacken the fastening bolts and disconnect the axle shafts.
2. Slacken the two bolts fastening the uprights to the shock absorbers, then remove only the upper bolt.



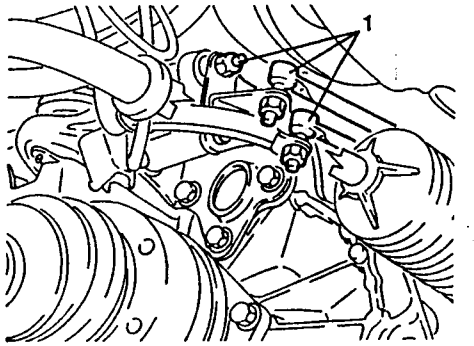

1. Release the brake pipes and A.B.S. sensor cables from their clamps, then turn the wheel hubs forwards as far as possible to move the axle shafts forwards.



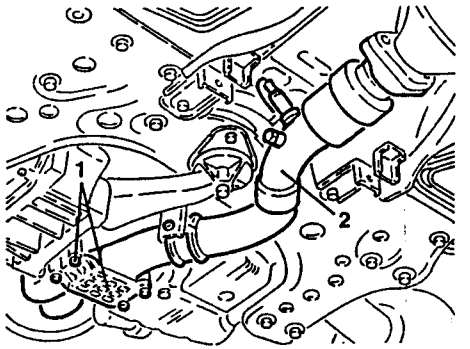




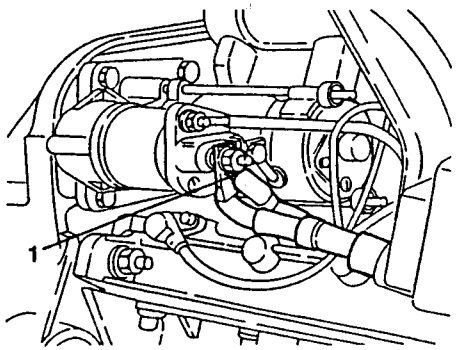

1. Working from the wheelhouse, slacken the fastening nuts and disconnect the gearshift control rods.



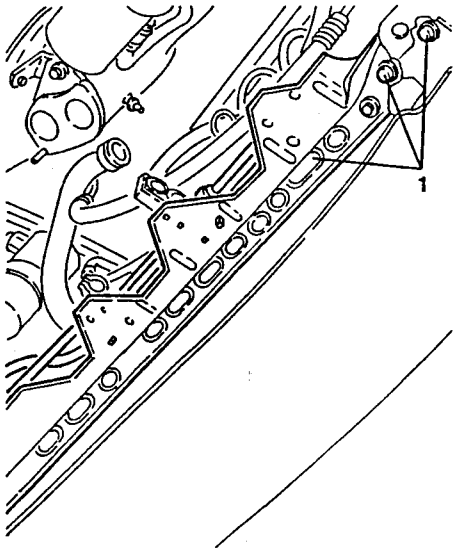

1. Slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda probe after slackening their fastenings.



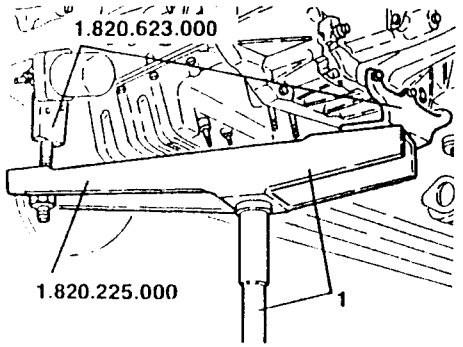

1. Disconnect the electrical connections from the starter motor.



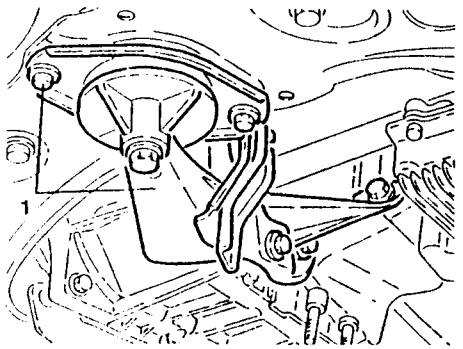

1. From the lower crossmember prise the power steering pipes, then slacken the fastening screws and remove them.



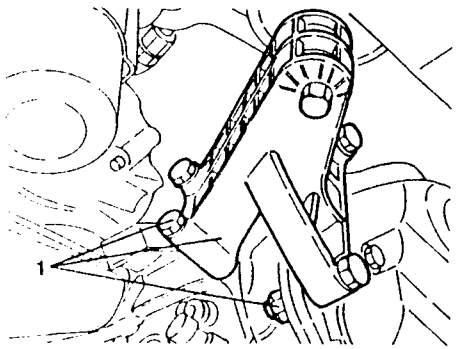
1. Position a hydraulic jack complete with tools no. 1.820.225.000 and no. 1.820.623.000 as illustrated.



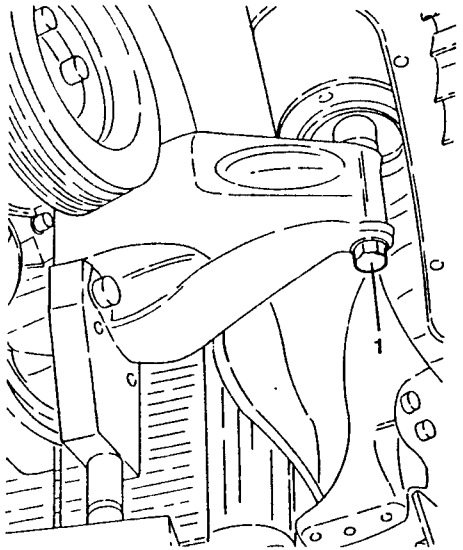

1. Slacken the fastening screws and remove the rear power unit support.




1. Slacken the fastening screws and bolts and remove the gearbox side power unit support.

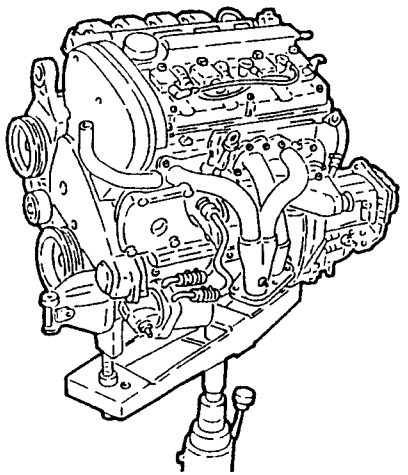



1. Slacken the screw fastening the camshaft side power unit support.




- Lower the hydraulic jack and remove the power unit from the engine compartment.

**WARNING:**
**The hydraulic jack must have a capacity of at least 1000 kg.**



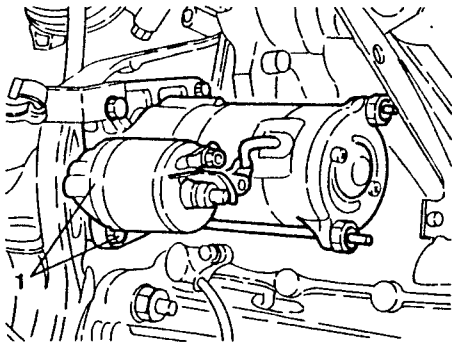




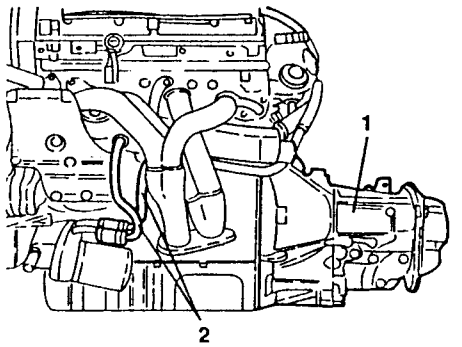
- Support the power unit with a hydraulic hoist besides the hydraulic jack used for removal.

**WARNING:**
**For moving the power unit, use a hydraulic hoist after freeing it from the hydraulic jack.**

- Release the power unit from the support tools then position it on a suitable workbench.
1. Slacken the fastening screws and remove the starter motor.

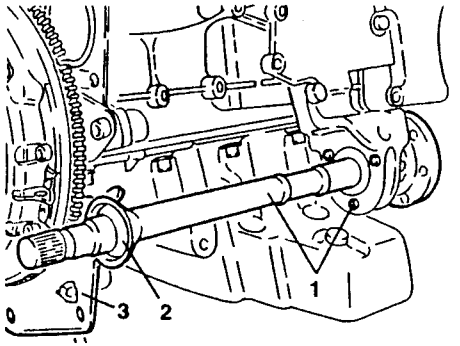



1. Slacken the fastening screws and nuts and remove the gearbox and differential unit.
2. Remove the two heat exchanger coolant delivery and return pipes.

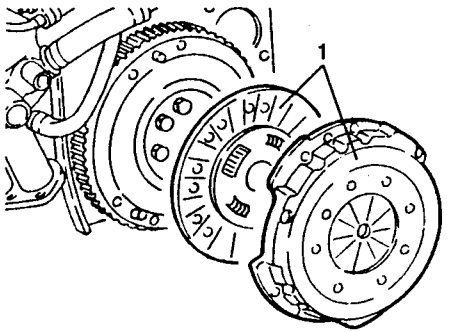



1. Slacken the three fastening screws and remove the lay shaft.

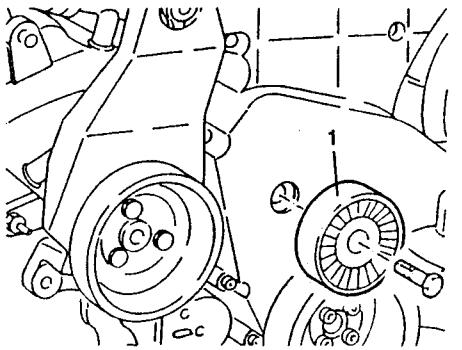
2. Remove the dust guard ring.
3. Remove the lower flywheel cover.



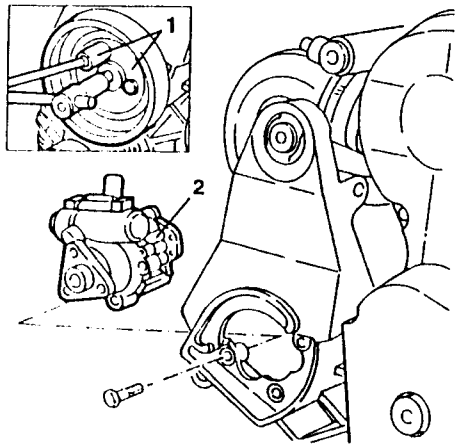

1. Slacken the fastening screws and remove the pressure plate body and clutch plate.



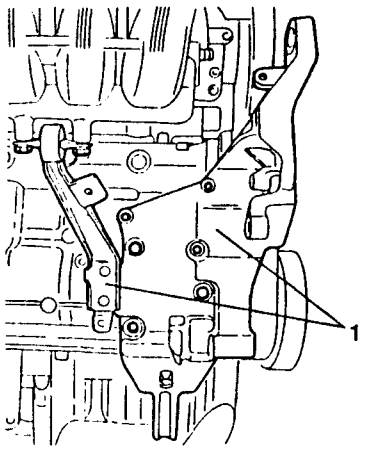

1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.



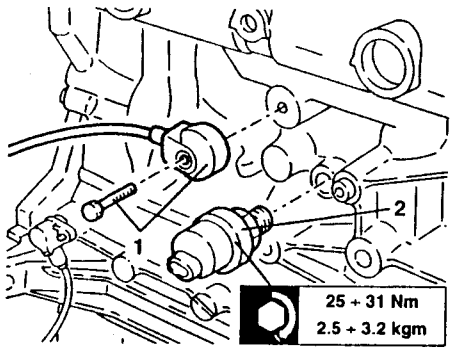
1. Using a 3/8" Allen wrench as counter torque, slacken the three fastening screws and remove the power steering pump pulley.
2. Slacken the three fastening screws and remove the power steering pump.



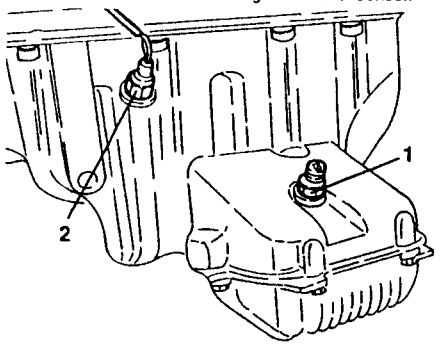

1. Slacken the fastening screws and remove the power steering pump support and alternator complete with intake box support.



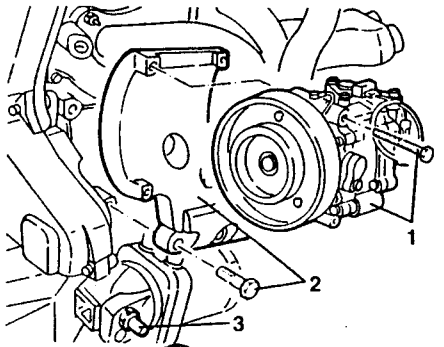

1. Slacken the fastening screw and remove the pinging sensor from the crankcase.
2. Slacken and remove the engine oil pressure meter.




1. Slacken and remove the engine oil temperature sensor.
2. Slacken and remove the engine oil level sensor.




1. Slacken the four fastening screws and remove the conditioner compressor.
2. Slacken the four fastening screws and remove the conditioner compressor support.
3. Slacken and remove the minimum engine oil pressure sensor.








## REFITTING

Reverse the sequence of the operations followed for removal, observing the following instructions:
- Prepare the engine compartment to accommodate the power unit, arranging all the electric cables, pipes, etc. so that they do not interfere with refitting operations.

**WARNING:**
**Make sure that the power unit supporting points have been fastened correctly.**

- After assembly, check the correct tensioning of the belts, fill the various systems as specified (see GROUP 00).
- Carry out all the necessary checks and operations (see GROUP 00).

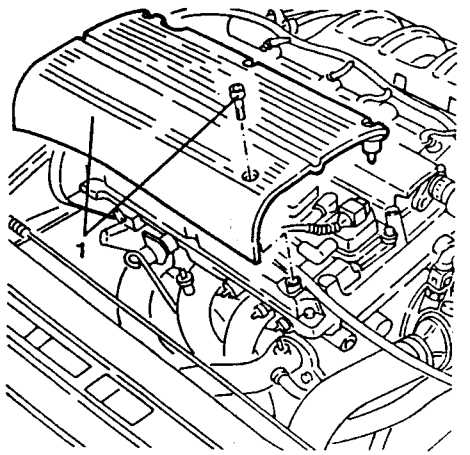
# ON-VEHICLE OPERATIONS

The previous chapter described and illustrated the removal and refitting of the power unit.
However some operations may be carried out on the vehicle without necessarily having to remove the engine.
Among the more frequent operations, the following are possible directly on the vehicle **cylinder head removal/refitting, oil pump removal/refitting** etc.

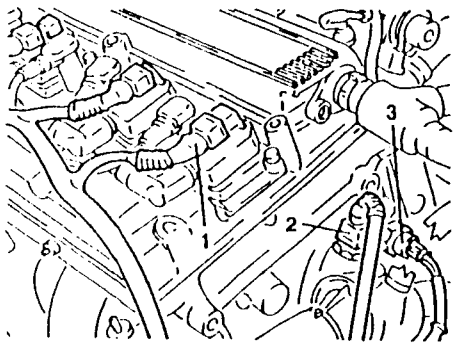
**NOTE:**
**Reference should be made to GROUP 00 for the more frequent servicing operations which are described starting from the engine installed on the vehicle.**

## REMOVING/REFITTING CYLINDER HEAD

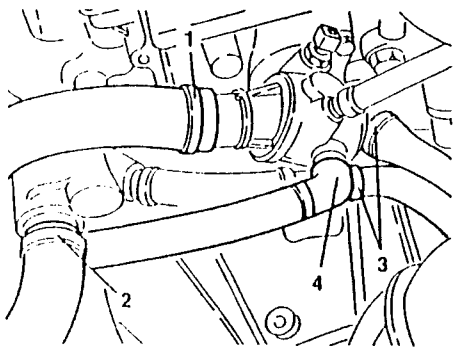
**- Follow the first steps of the procedure "REMOVING/REFITTING ENGINE" up to removal of the corrugated sleeve.**
1. Slacken the fastening screws and remove the ignition coils cover.



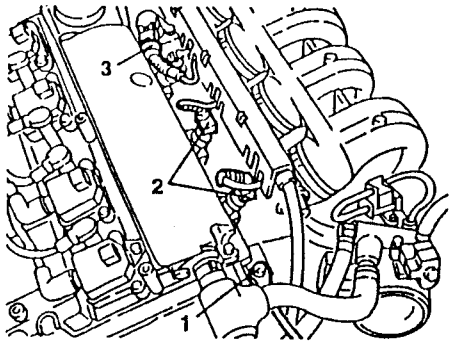
1. Disconnect the electrical connections from the ignition coils.
2. Disconnect the electrical connection from the coolant temperature sensor.
3. Disconnect the electrical connection from the engine coolant temperature gauge transmitter and maximum temperature warning light contact.



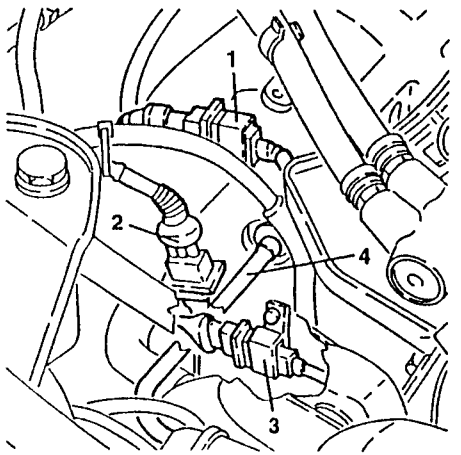
1. Disconnect the coolant delivery sleeve to the radiator from the thermostatic cup.
2. From the coolant return duct to the pump, disconnect the return sleeve from the radiator.
3. Disconnect the two climate control heater coolant return and delivery pipes.
4. From the thermostatic cup disconnect the coolant delivery pipe to the heat exchanger for the engine lubrication circuit.
- Disconnect the system supply pipe from the header tank.



1. Disconnect the earth cable from the cylinder head.
2. Disconnect the electrical connections from the injectors.
3. Disconnect the electrical connection from the timing variator and move the associated wiring to one side.



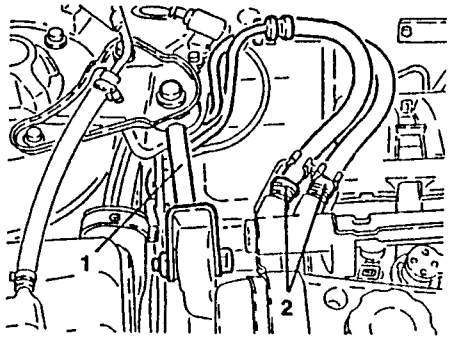
1. Disconnect the electrical connection of the timing sensor.
2. Disconnect the electrical connection pinging sensor.
3. Disconnect the electrical connection timing and rpm sensor.
4. Disconnect the fuel vapour recirculation pipes from the air intake box.



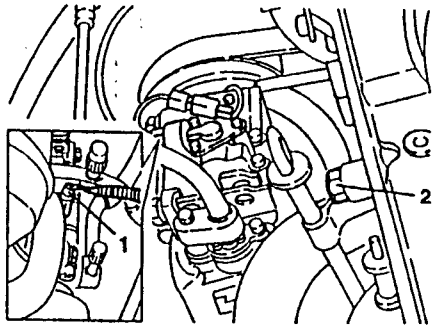




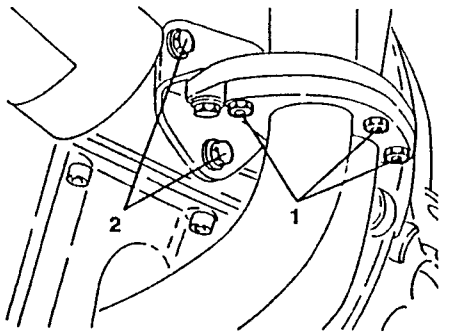
1. Slacken the fastening screws and remove the engine stay connecting rod.
2. Disconnect the fuel inlet and outlet pipes from the distributor manifold.



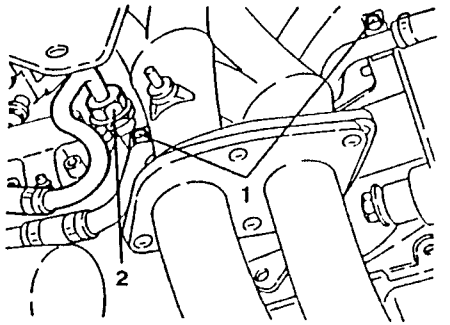
1. Disconnect the intermediate electrical connection from the air conditioning system compressor.
2. Slacken the engine oil dipstick fastening screw.



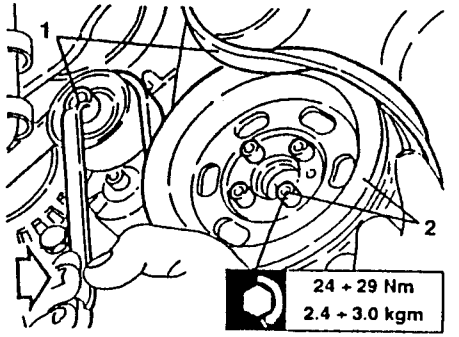
1. Raise the car and slacken the bolts fastening the front section of the exhaust pipe to the manifolds.
2. Slacken the screws fastening the exhaust manifold support bracket to the crankcase.



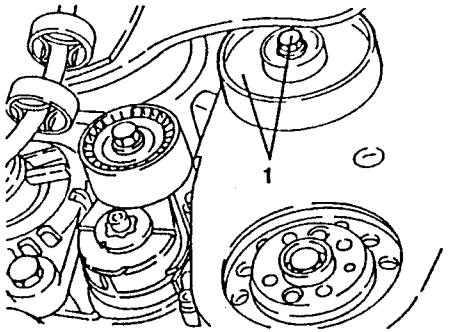
1. Slacken the two screws fastening the coolant delivery pipe to the heat exchanger.
2. Disconnect the coolant outlet pipe from the heat exchanger.



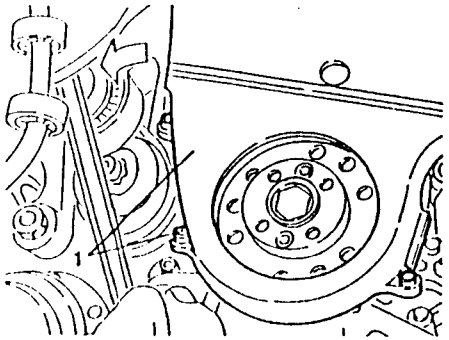
1. Working as illustrated on the guide pulley, loosen the tension of the auxiliary components drive belt and prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.



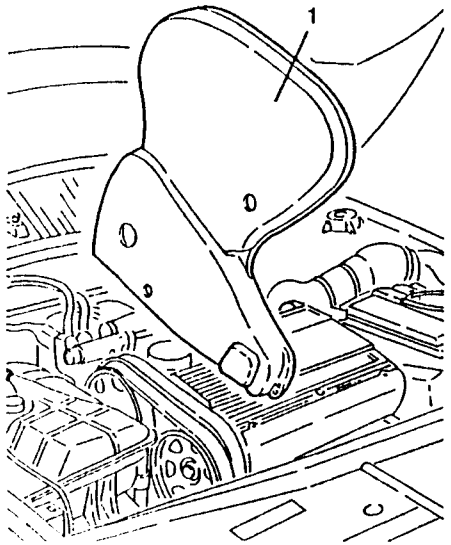

1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.



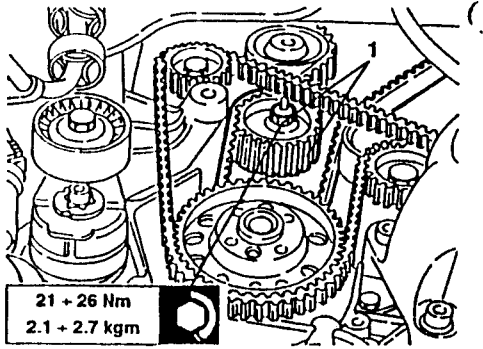
1. Slacken the fastening screws and remove the lower cover of the timing belts and counter-rotating shafts.
**NOTE: To gain access to the rear screw, turn the belt tensioner as illustrated.**



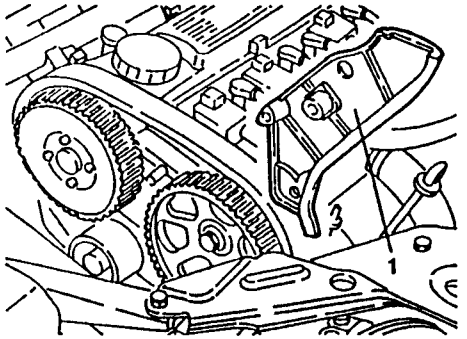

- Slacken the lower screws of the upper cover for the timing gear and counter-rotating shafts drive belts.
1. Lower the car, slacken the remaining fastening screws and remove the upper cover.



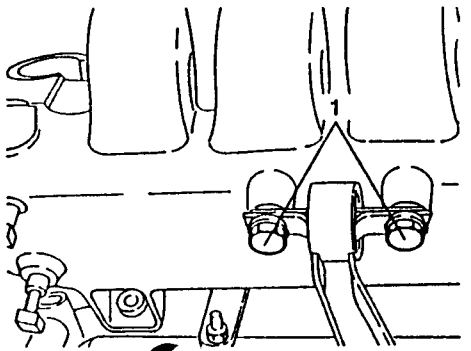

1. Working on the timing gear belt tensioner, loosen the tension of the belt, then prise it off the camshaft driving pulleys




1. Slacken the fastening screws and remove the two timing gear belt side covers.



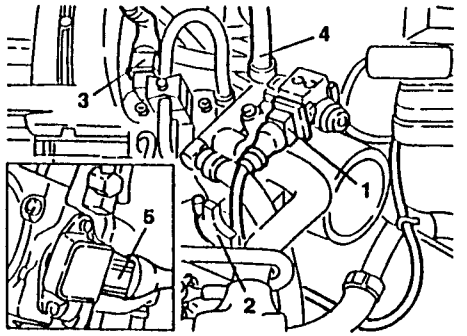

- Remove the bracket connecting the cylinder head to the engine stay rod support.
1. Raise the car and slacken the two screws fastening the support to the intake box.



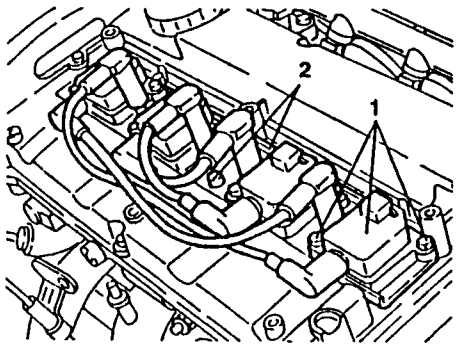




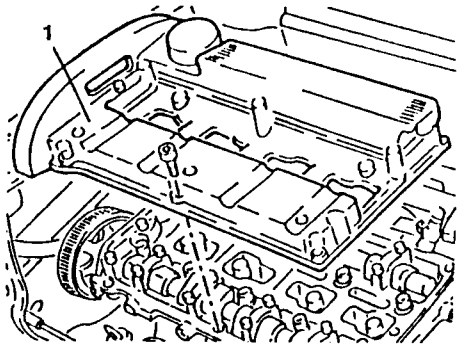

- Disconnect the vacuum takeoff pipe from the servobrake.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the accelerator cable from the throttle body.
3. Disconnect the electrical connection from the E.G.R. modulation solenoid valve.
4. Disconnect the coolant fluid delivery pipe to the header tank from the throttle body.
5. Disconnect the electrical connexion from the throttle potentiometer.



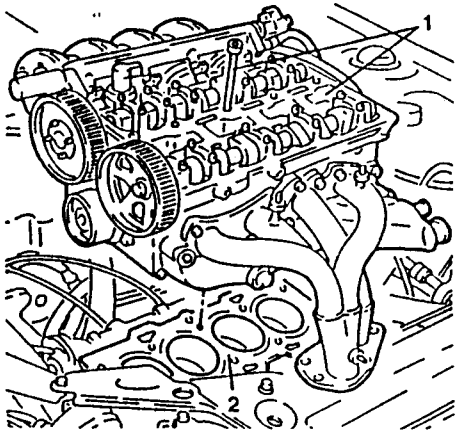

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.




- Disconnect the oil vapour recovery pipe from the cylinder head.
1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.




1. Slacken the cylinder head fastening screws and remove it.
2. Remove the gasket.



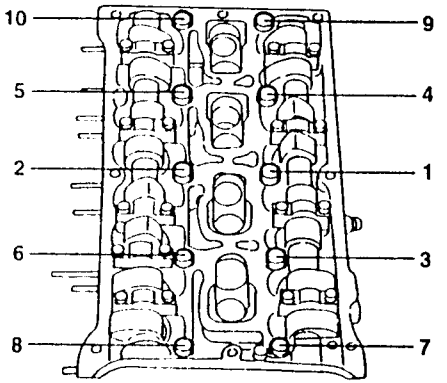

- Strip down the cylinder head and overhaul as described in the volume "Overhauling - Engines".

**Re-assemble the cylinder head reversing the sequence described for removal and following the instructions given below.**
- Turn the crankshaft to move the pistons of the 1st and 4th cylinder to the T.D.C.
- Position a new gasket on the cylinder head.

**NOTE: The cylinder head gasket is in aramidic fibre and cylinder head retightening is unnecessary throughout the life of the engine.**

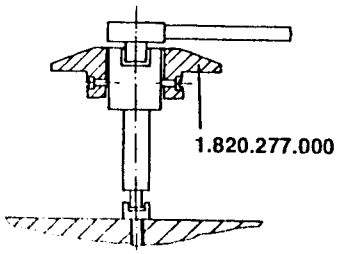
**WARNING: Before assembly, accurately clean the cylinder head and crankcase surfaces.**

- Assemble the complete cylinder head on the crankcase
- Tighten the cylinder head fastening screws as described below and bearing in mind that, for each step, the tightening sequence is the one illustrated.




| Tightening procedure | |
|---|---|
| Set in all the screws to a torque of: | 20 Nm (2.0 kgm) |
| Tighten the screws to the preliminary torque of: | 40 Nm (4.1 kgm) |
| Turn all the screws with an angle of: | 90° + 90° + 90° |

For angle tightening use graduated disk no. 1.820.277.000 as illustrated.

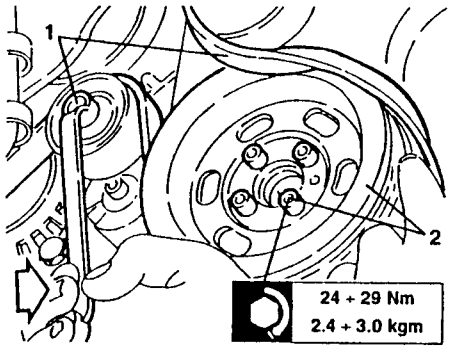



For re-assembly of the timing gear drive belt and timing and for assembly of the auxiliary components drive belt see GROUP 00.

## REMOVAL/REFITTING OF OIL SUMP

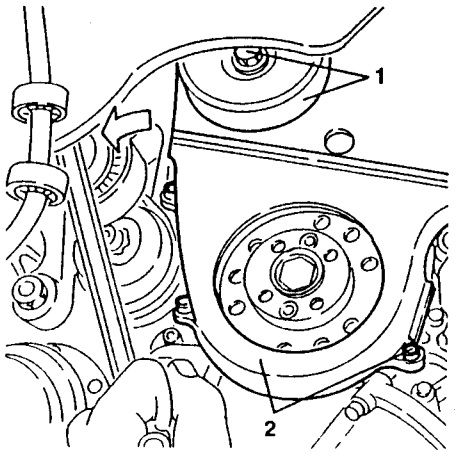
- Set the car on a lift.
- Drain the engine oil (see GROUP 00).
- Remove the right front wheel and mud flap.

1. Raise the car and working as illustrated on the belt tensioner, loosen the tension of the auxiliary components drive belt prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.




1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.
2. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft belts.

**NOTE: To gain access to the rear screw, turn the belt tensioner as illustrated.**

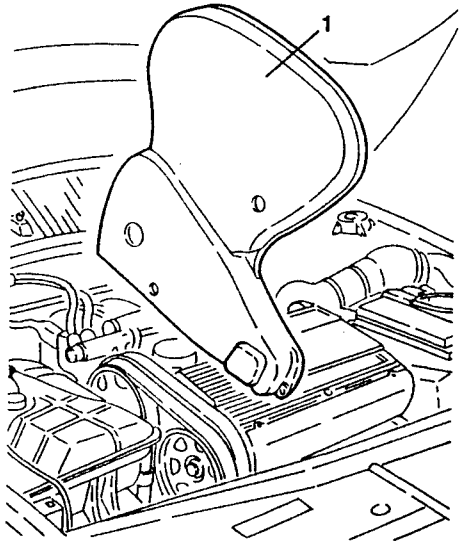






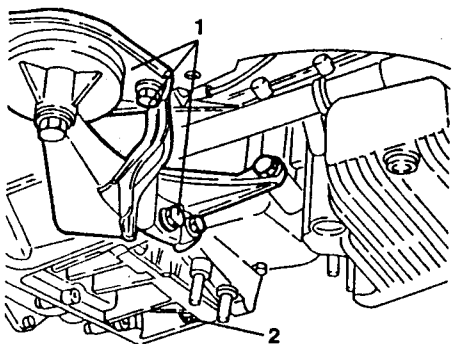

- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft belts.

1. Lower the car, slacken the remaining fastening screws and remove the upper cover.

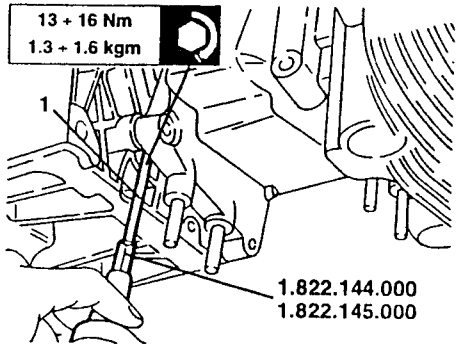



- Remove the front section of the exhaust pipe.
- Position a hydraulic jack under the gearbox.

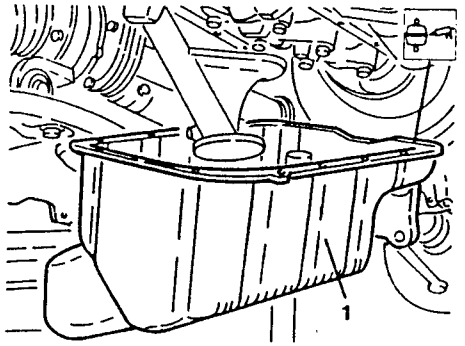
1. Slacken the fastening screws and remove the power unit rear support.
2. Slacken the screws fastening the gearbox to the oil sump.



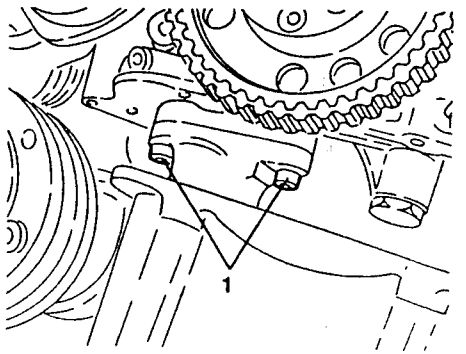

1. Slacken the oil sump fastening screws using tool no. 1.822.144.000 and no. 1.822.145.000 for those to which access is not possible.



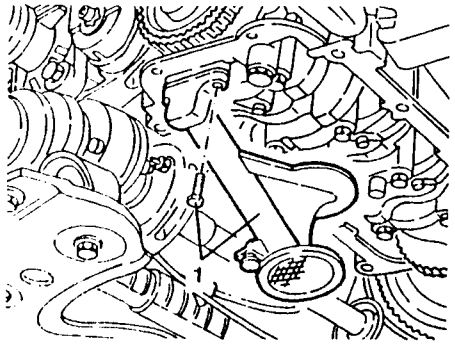

1. Lower the hydraulic jack as required and remove the oil sump.




**NOTE: if difficulty is encountered in removing the oil sump, slacken the fastening screws (1) of the suction device.**

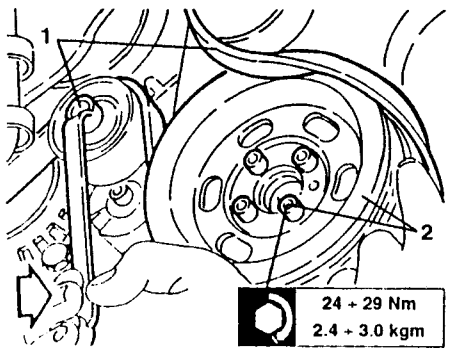


1. Slacken the fastening screws and remove the suction device.
- Remove the seal.



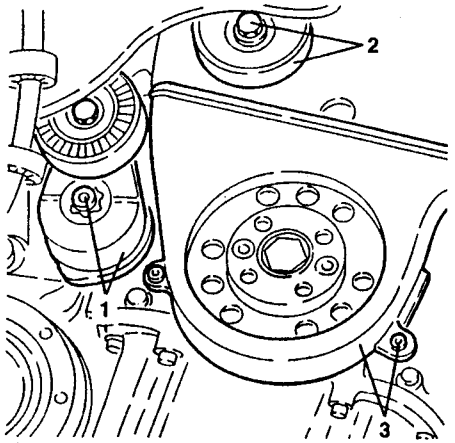

## CHANGING THE CRANKSHAFT FRONT OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.
1. Raise the car and working as illustrated on the belt tensioner, loosen the tension of the auxiliary components drive belt prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.

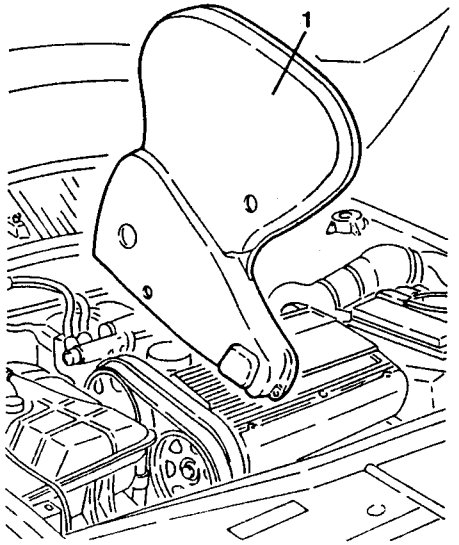



1 Slacken the fastening screw and remove the belt tensioner.
2 Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.

3. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft drive belts.



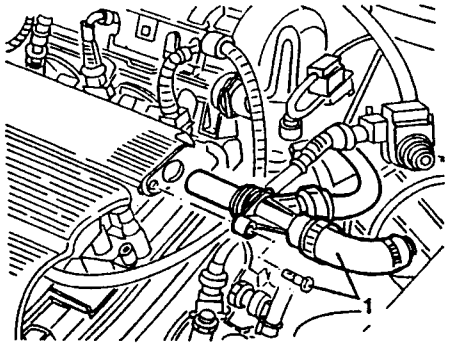

- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft drive belts.
1. Lower the car, slacken the fastening screws and remove the upper cover.



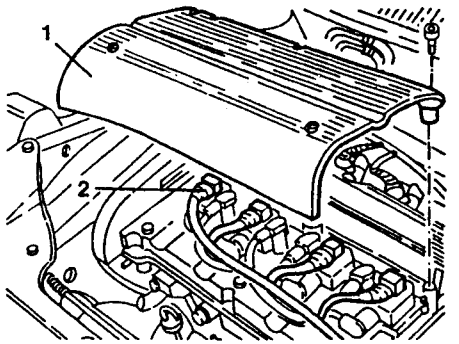




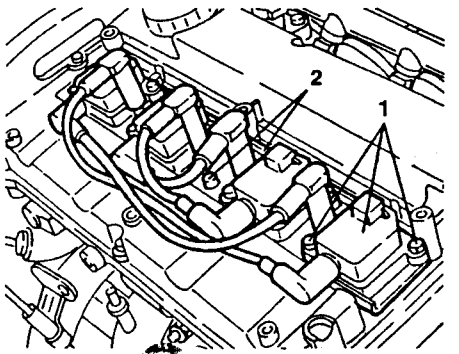

1. Slacken the fastening screw and remove the socket for the oil vapour recovery pipe.



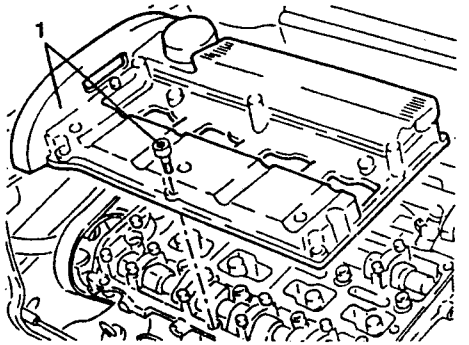

1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



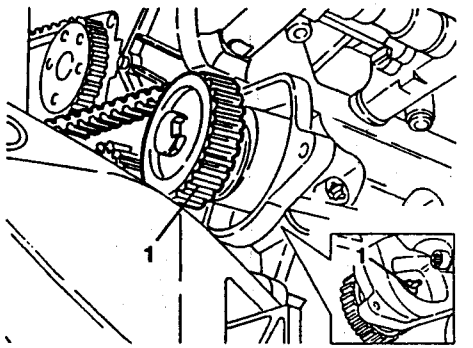

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



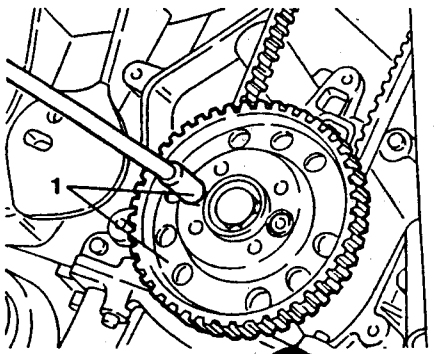

1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.



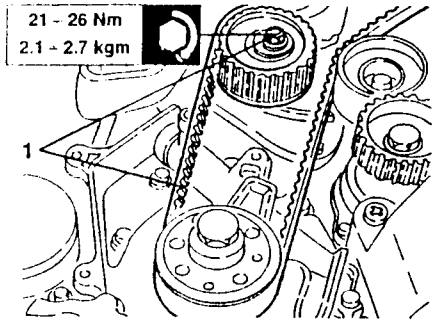

1. Loosen the tension of the counter-rotating shaft belt slackening the fastening nut of the corresponding belt tensioner, then prise and remove the belt.




1. Slacken the two fastening screws and remove the counter-rotating shaft belt driving pulley.

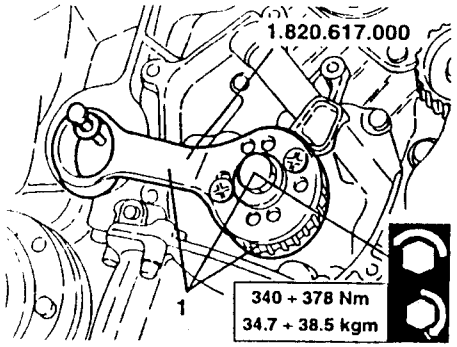


1. Working on the timing gear belt tensioner, loosen the tension of the belt, then prise it off.




**Solution for engines before change**

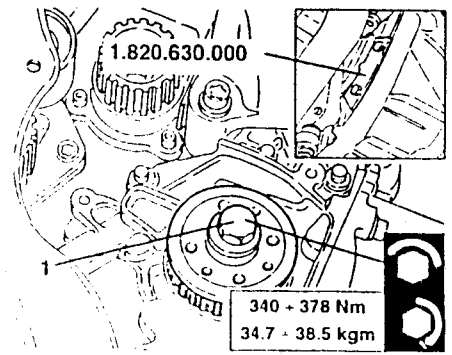
1. Using tool no. 1.820.617.000 slacken the screw (left-hand) fastening the timing gear belt drive pulley, then remove the pulley.



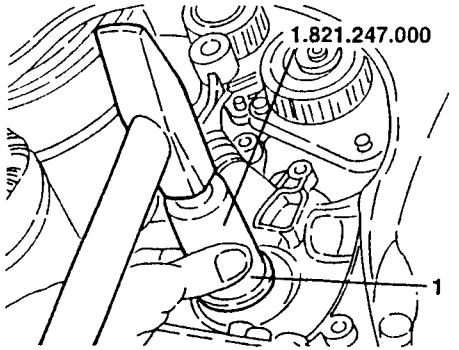

**Solution for engines after change**

- Slacken and remove the flywheel cover.

1. Install the flywheel stopper tool no. 1.820.630.000 as illustrated, slacken the screw (left-handed), then remove the timing gear drive pulley.




1. Remove the oil seal and install a new one using tool no. 1.821.247.000.



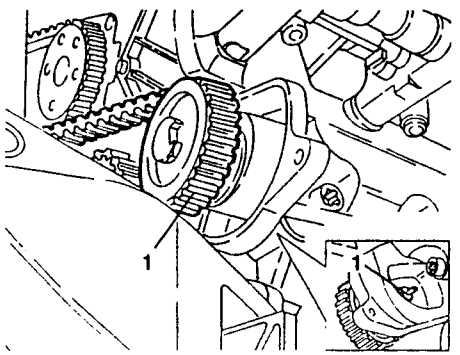

**- Re-assemble reversing the sequence followed for removal.**

**Refer to GROUP 00 for re-assembly of the timing gear belts, counter-rotating shaft belts and their timing and for assembly of the auxiliary components drive belt.**

## CHANGING THE COUNTER-ROTATING SHAFT SEALS

**- Proceed as described in the procedure for "Changing the crankshaft front oil seal" up to removal of the upper cover for the timing gear and counter-rotating shaft belts.**

1. Loosen the tension of the counter-rotating shaft belt slackening the nut fastening the corresponding belt tensioner, then prise and remove the belt.

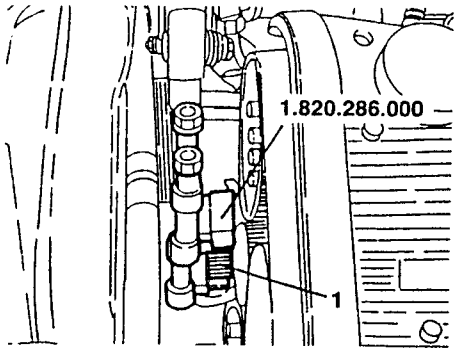




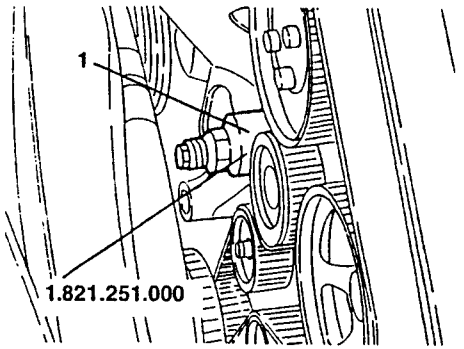



- Slacken the screws and move the header tank to one side without disconnecting the piping.

1. Using tool no. 1.820.286.000 slacken the screw fastening the counter-rotating shaft pulley and remove it.




1. Remove the oil seal and install a new one using tool no. 1.821.251.000.



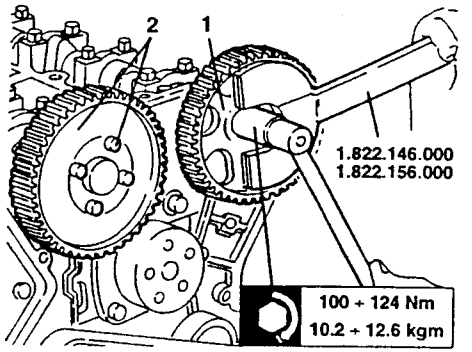

**- Carry out re-assembly reversing the sequence described for removal referring to GROUP 00 for assembly of the counter- rotating shaft belt and for assembly of the auxiliary components drive belt.**

## CHANGING THE CAMSHAFT OIL SEALS

**- Proceed as described n the procedure "Changing the crankshaft front oil seal" up to removing the timing gear drive belt.**

1. Using tool no. 1.822.146.000 complete with tool no. 1.822.156.000 slacken the screw fastening the camshaft pulley on the exhaust side and remove it.

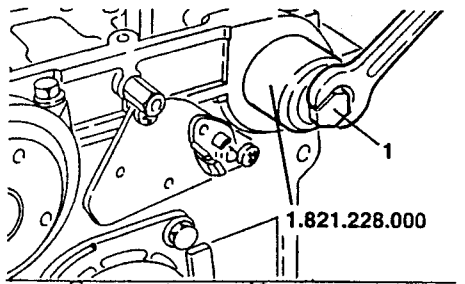
2. Slacken the four screws and remove the camshaft drive pulley on the intake side.

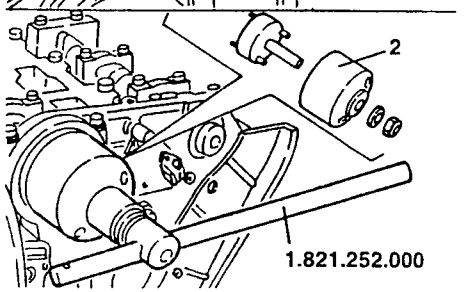



- Remove the camshaft oil seals.

1. Install a new camshaft front oil seal on the exhaust side using tool no. 1.821.228.000.

2. Install a new camshaft front oil seal on the intake side using tool no. 1.821.252.000.



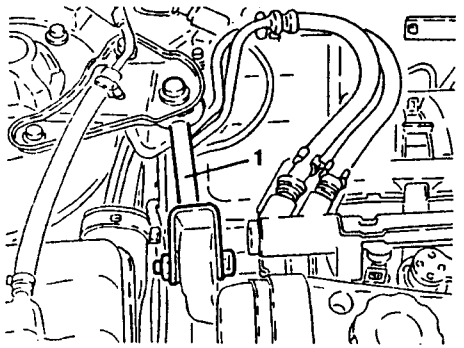



- Carry out re-assembly reversing the sequence described for removal

Refer to GROUP 00 for assembly of the timing gear and counter- rotating shaft belts and for assembly of the auxiliary components drive belt.

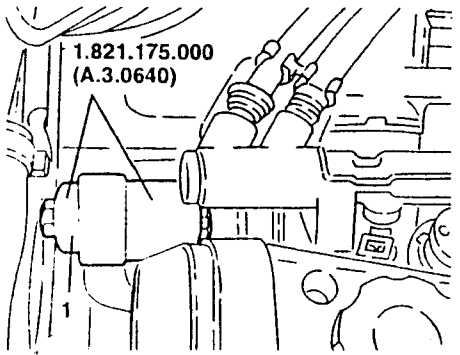
## CHANGING THE FLEXIBLE BUSHING OF THE ENGINE STAY ROD ANCHOR BRACKET

1. Slacken the fastening screws and remove the engine stay rod.



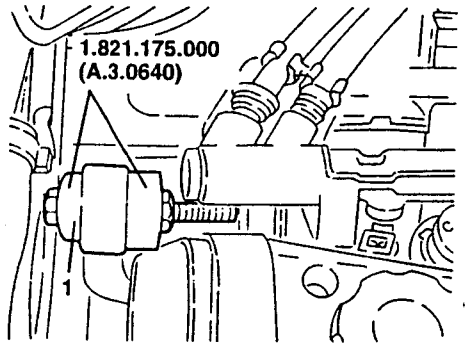

- Slacken the fastening screws and move the header tank to one side without disconnecting the piping.

1. Using tool no. 1.821.175.000 (A.3.0640) as illustrated remove the flexible bushing from the engine stay rod anchor bracket.




1. Refit a new flexible bushing still using tool no. 1.821.175.000 (A.3.0640) as illustrated.

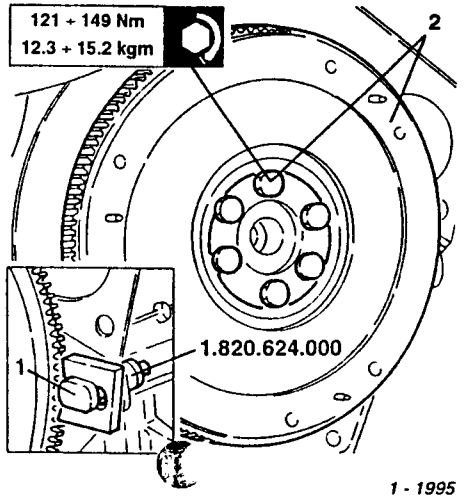
- Complete re-assembly reversing the sequence followed for removal.




## CHANGING THE REAR CRANKCASE COVER (with oil seal)

- Remove the gearbox (see specific paragraph).
- Remove the clutch (see specific paragraph).

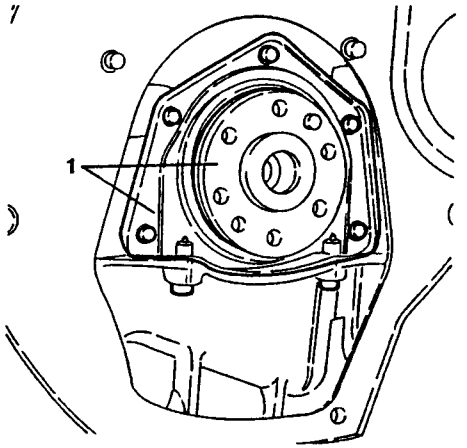
1. Fit flywheel stopper tool no. 1.820.624.000.
2. Slacken the fastening screws and remove the flywheel.



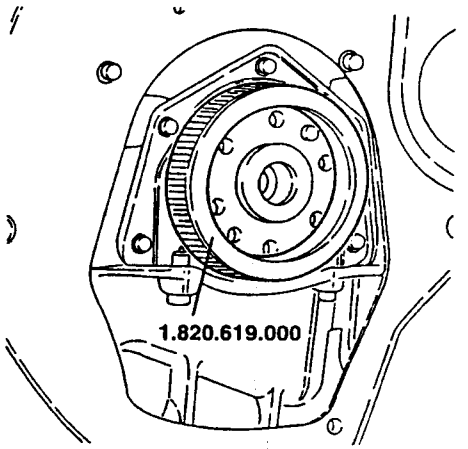





1. Slacken the screws fastening the oil sump to the crankcase, then remove the rear crankcase cover with integrated oil seal ring.




- Refit the rear cover proceeding as follows:
- Fit tool no. 1.820.619.000 on the oil seal of the rear crankcase cover.
- Assemble the tool - rear cover assembly and tighten the screws fastening the crankcase and the oil sump.
- Remove the centering tool no. 1.820.619.000.



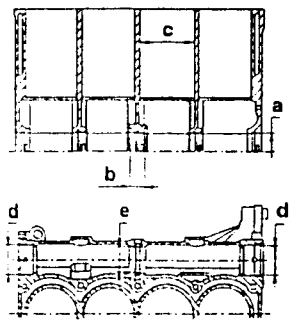
# TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

## ENGINE TECHNICAL CHARACTERISTICS

| | | | |
|---|---|---|---|
| Engine | | AR 67204 | |
| Cycle | | Otto 4-stroke | |
| Fuel system / Ignition | | Multi-Point Motronic M 2.10.3 ('95 version) | Multi-Point Motronic M 2.10.4 ('96 version) |
| Firing order | | 1 - 3 - 4 - 2 | |
| Displacement | $cm^3$ | 1970 | |
| Number of cylinders | | 4 in line | |
| Bore | mm | 83 | |
| Stroke | mm | 91 | |
| Maximum power | CV EEC (kW EEC) | 150 (110) | |
| | rpm | 6200 | |
| Maximum torque | kgm EEC (Nm EEC) | 19 (187) | |
| | rpm | 4000 | |
| Compression ratio | | 10 : 1 | |
| Engine oil pressure - At idle speed | bar | ≥ 1.5 | |
| - At 4000 rpm | bar | ≥ 4.5 | |
| Idle speed | rpm | 840 ± 50 | 800 ± 50 |

## COMPLETE CRANKCASE

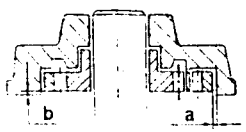
### Crankcase




Unit: mm

| | | |
|---|---|---|
| Diameter of main journals "a" | | 56.705 ÷ 56.718 |
| Length of centre main bearing shoulder "b" | | 21.720 ÷ 21.800 |
| Diameter of cylinders "c" | Class A - Blue | 83.000 ÷ 83.010 |
| | Class B - Pink | 83.010 ÷ 83.020 |
| | Class C - Green | 83.020 ÷ 83.030 |
| | Oversize 0.1 | |
| Diameter of counter-rotating shafts journals | Front and rear "d" | 46.975 ÷ 47.000 |
| | Centre "e" | 39.979 ÷ 40.009 |

### Oil pump



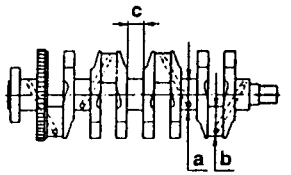

Unit: mm

| | | |
|---|---|---|
| Clearance between pump casing seat and driven gear "a" | | 0.08 ÷ 0.186 |
| Clearance between pump cover rest surface and upper side of gears "b" | | 0.025 ÷ 0.070 |
| Engine oil pressure limiting valve | Control load | 6.8 kg |
| | Length of spring | 36 |





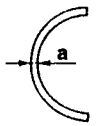
### Crankshaft




Unit: mm

| | | |
|---|---|---|
| Diameter of main bearing journals "a" | Class A - Red | 52.994 ÷ 53.000 |
| | Class B - Blue | 52.988 ÷ 52.994 |
| | Class C - Yellow | 52.982 ÷ 52.988 |
| | Undersize 0.127 | |
| Diameter of connecting rod pins "b" | Class A - Red | 50.799 ÷ 50.805 |
| | Class B - Blue | 50.793 ÷ 50.799 |
| | Class C - Yellow | 50.787 ÷ 50.793 |
| | Undersize 0.127 | |
| Length of centre bearing journal "c" | | 26.575 ÷ 26.625 |
| Maximum taper of main and connecting rod journals | | 0.0045 |
| Maximum error of concentricity between main journals and connecting rod journals | | 0.003 |

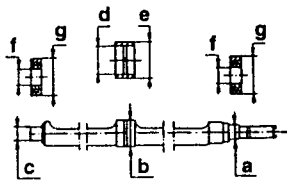
### Main half bearings




Unit: mm

| | | |
|---|---|---|
| Thickness of main half bearings "a" | Class A - Red | 1.836 ÷ 1.840 |
| | Class B - Blue | 1.839 ÷ 1.843 |
| | Class C - Yellow | 1.842 ÷ 1.846 |
| | Undersize 0.127 | |
| Operating clearance between main journals and half bearings | | 0.025 ÷ 0.052 |

### Counter-rotating shafts




Unit: mm

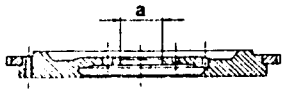
| | | |
|---|---|---|
| Diameter of counter-rotating shaft pins | Front "a" | 19.980 ÷ 19.993 |
| | Centre "b" | 36.945 ÷ 36.960 |
| | Rear "c" | 19.990 ÷ 20.010 |
| Diameter of centre bushes | Inside "d" | 37.020 ÷ 37.040 |
| | Outside "e" | 40.065 ÷ 40.090 |
| Diameter of ball bearings | Inside "f" | 19.990 ÷ 20.000 |
| | Outside "g" | 46.989 ÷ 47.000 |
| Interference between centre bushes and their seats on crankcase | | 0.056 ÷ 0.111 |
| Radial clearance between bushes and centre journals | | 0.060 ÷ 0.095 |
| Clearance / Interference between ball bearings and their seats on crankcase | | +0.011 ÷ -0.025 |
| Clearance / Interference between ball bearings and counter-rotating shaft pins | Front | +0.020 ÷ -0.003 |
| | Rear | + 0.010 ÷ -0.020 |

### Half thrust rings


Unit: mm

| | |
|---|---|
| Thickness of half thrust rings "a" | 2.342 ÷ 2.358 |
| | Oversize 0.127 |
| Crankshaft end float | 0.059 ÷ 0.221 |

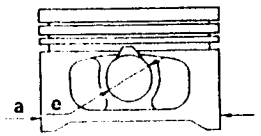
### Engine flywheel

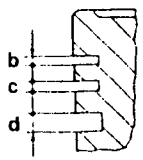



| | |
|---|---|
| Inside diameter of centre bush (bore) "a" | 47.010 ÷ 47.035 mm |
| Heating temperature of ring gear for assembly on flywheel | 80° ÷ 100°C |

## CONNECTING ROD - PISTON ASSEMBLY

### Piston



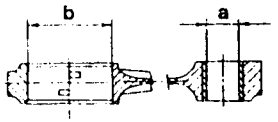




Unit: mm

| | | |
|---|---|---|
| Diameter of pistons "a" (1) | Class A - Blue | 82.952 ÷ 82.962 |
| | Class B - Pink | 82.959 ÷ 82.971 |
| | Class C - Green | 82.968 ÷ 82.978 |
| Height of first seal ring seats "b" | | 1.220 ÷ 1.240 |
| Height of second seal ring seats "c" | | 1.510 ÷ 1.530 |
| Height of oil scraper ring seats "d" | | 3.010 ÷ 3.030 |
| Diameter of gudgeon pin holes in pistons "e" | | 20.002 ÷ 20.007 |
| Clearance between cylinders and pistons | | 0.038 ÷ 0,062 |
| Difference in weight between pistons | | ± 5 g |

(1) To be measured perpendicular to the gudgeon pin hole at a distance of 12.5 mm from lower edge of skirt.

### Connecting rods



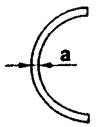

Unit: mm

| | |
|---|---|
| Diameter of small end bushing bore "a" | 20.006 ÷ 20.012 |
| Inside diameter of rod big ends "b" | 53.897 ÷ 53.909 |
| Difference in weight between rods | ≤ 5 g |
| Clearance between small end bushings and pins | 0.006 ÷ 0.016 |
| Small end end float | 0.25 ÷ 0.6 |





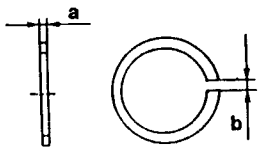
### Connecting rod half bearings




Unit: mm

| | | |
|---|---|---|
| Thickness of connecting rod half bearings "a" | Class A - Red | 1.527 ÷ 1.531 |
| | Class B - Blue | 1.530 ÷ 1.534 |
| | Class C - Yellow | 1.533 ÷ 1.537 |
| | Undersize 0.127 | |
| Operating clearance connecting rod pins and their half bearings | Class A - Red | 0.03 ÷ 0.056 |
| | Class B - Blue | |
| | Class C - Yellow | |

### Seal rings

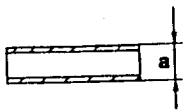



Unit: mm

| | | |
|---|---|---|
| Thickness of rings "a" | First ring | 1.170 ÷ 1.190 |
| | | Oversize 0.1 |
| | Second ring | 1.475 ÷ 1.490 |
| | | Oversize 0.1 |
| | Oil scraper ring | 2.975 ÷ 2.990 |
| | | Oversize 0.1 |
| Ring gap "b" (1) | First ring | 0.25 ÷ 0.50 |
| | Second ring | 0.30 ÷ 0.50 |
| | Oil scraper ring | 0.25 ÷ 0.45 |
| Axial play between seal rings and seats | First ring | 0.030 ÷ 0.070 |
| | Second ring | 0.020 ÷ 0.055 |
| | Oil scraper ring | 0.020 ÷ 0.055 |

(1) To be measured in the checking ring nut or in the cylinder

### Gudgeon pins

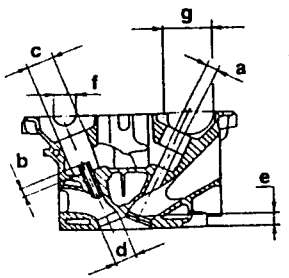



Unit: mm

| | |
|---|---|
| Outside diameter of gudgeon pins "a" | 19.996 ÷ 20.000 |
| Clearance between gudgeon pins and their seats on pistons | 0.002 ÷ 0.011 |

## CYLINDER HEAD

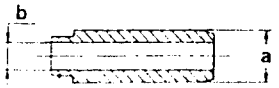
### Head




Unit: mm

| | | |
|---|---|---|
| Diameter of sedi valve guide seats "a" | | 12.950 ÷ 12.977 |
| Valve guide protrusion "b" | | 11.25 ÷ 11.75 |
| Diameter of valve cup seats "c" | | 33.000 ÷ 33.025 |
| Diameter of valve seat housing "d" | Intake | 34.989 ÷ 35.014 |
| | Exhaust | 28.991 ÷ 29.012 |
| Minimum depth of combustion chamber "e" | | 13 ± 0.2 |
| Maximum error of flatness of head lower surface | | 0.1 |
| Diameter of camshaft supports "f" | | 26.045 ÷ 26.070 |
| Diameter of timing variator support "g" | | 55.990 ÷ 56.015 |

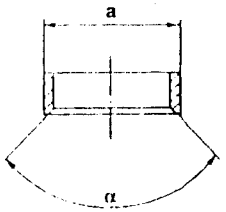
## Valve guides




Unit: mm

| | |
|---|---|
| Outside diameter of valve guides "a" | 13.010 ÷ 13.030 |
| | Oversize 0.20 |
| Inside diameter of valve guides (bore) "b" | 7.022 ÷ 7.040 |
| Interference between valve guides and their seats | 0.033 ÷ 0.080 |

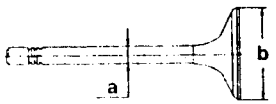
## Valve seats




Unit: mm

| | | |
|---|---|---|
| Outside diameter of valve seats "a" | Intake | 35.135 ÷ 35.150 |
| | Exhaust | 29.142 ÷ 29.157 |
| Valve contact area taper "α" | | 90° ± 10' |
| Interference between valve seats and their housings | Intake | 0.121 ÷ 0.146 |
| | Exhaust | 0.130 ÷ 0.166 |
| Cylinder head heating temperature for fitting valve seats | | 80 °C |

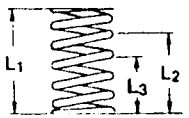
## Valves




Unit: mm

| | | |
|---|---|---|
| Diameter of valve stems "a" | Intake | 6.975 ÷ 6.990 |
| | Exhaust | 6.960 ÷ 6.975 |
| Diameter of valve mushrooms "b" | Intake | 33.4 ÷ 33.7 |
| | Exhaust | 27.9 ÷ 28.2 |
| Radial clearance between valve stem and guide | Intake | 0.032 ÷ 0.065 |
| | Exhaust | 0.047 ÷ 0.080 |

## Valve springs




| | Outer spring | Inner spring |
|---|---|---|
| Free length "$L_1$" | 46 mm | 39 mm |
| Length with valves closed "$L_2$" | 34 mm | 29.5 mm |
| Corresponding load at "$L_2$" | 271 ÷ 294 N (27.6 ÷ 30 kg) | 96 ÷ 106 N (9.8 ÷ 10.8 kg) |
| Length with valves open "$L_3$" | 24,5 mm | 20 mm |
| Corresponding load at "$L_3$" | 485 ÷ 524 N (49.4 ÷ 53.4 kg) | 201 ÷ 221 N (20.5 ÷ 22.5 kg) |

## Hydraulic tappets

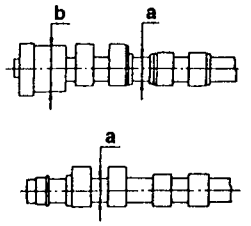

Unit: mm

| | |
|---|---|
| Outside diameter of hydraulic tappets "a" | 32.959 ÷ 32.975 |
| Radial clearance between hydraulic tappets and their seats | 0.025 ÷ 0.066 |





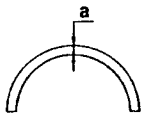
## Camshafts




Unit: mm

| | | |
|---|---|---|
| Diameter of camshaft journals "a" | | 26.000 ÷ 26.015 |
| Diameter of timing variator journal "b" | | 49.985 ÷ 50.000 |
| Nominal cam lift | Intake | 9.50 |
| | Exhaust | 9.50 |
| Clearance between camshaft journals and their seats | | 0.03 ÷ 0.07 |
| Camshaft end float | | 0.10 ÷ 0.23 |

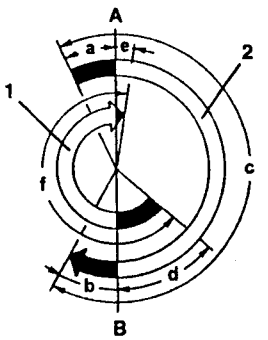
## Timing variator half bearings




Unit: mm

| | |
|---|---|
| Thickness of timing variator half bearings "a" | 2.992 ÷ 2.998 |
| Clearance between timing variator and bearings | 0.034 ÷ 0.086 |

## ANGLES OF ACTUAL TIMING DIAGRAM




| | | | |
|---|---|---|---|
| Intake | Opens (before T.D.C.) | "a" | 0° 25°(*) |
| | Closes (after B.D.C.) | "b" | 55° 30°(*) |
| | Intake angle | "c" | 235° |
| Exhaust | Opens (before B.D.C.) | "d" | 50° |
| | Closes (after T.D.C.) | "e" | 8° |
| | Exhaust angle | "f" | 238° |

(*): Values obtained with timing variator engaged.

(1) Exhaust (2) Intake
(A) T.D.C. (B) B.D.C.

## FLUIDS AND LUBRICANTS

| Application | Type | Specified classification | Name | Q.ty litres |
|---|---|---|---|---|
| Engine (Refilling) | Oil | API SG<br>CCMG5<br>SAE 10W/40 | SELENIA SPECIAL FORMULA ALFA ROMEO 10W/40 (*) | 5 (1)<br>4.4 (2) |

(*): For decidedly sportive use of the car fully synthetic **SELENIA Racing 10W/60** engine oil is recommended

(1): Total capacity

(2): Sump + filter (for periodical replacement)

## SEALANTS AND ADHESIVES

| Application | Type | Name | Q.ty |
|---|---|---|---|
| Oil sump - crankcase | Silicone Q3 | Mascherpa - 7091<br>RHONE PULENC - CAF 5552 | - |
| Timing variator | Sealant | Loctite 270 | - |

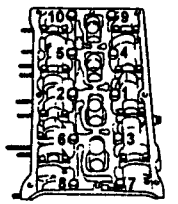
## ABRASIVES

| Application | Type | Name | Q.ty |
|---|---|---|---|
| Valve seat grinding | Abrasive | SIPAL AREXONS<br>Carbosilicium for valves | - |





## TIGHTENING TORQUES

| Part | | Nm | kgm |
|---|---|---|---|
| Screws fastening main bearing caps (in oil) | | 96 ÷ 119 | 9.8 ÷ 12.1 |
| Screws fastening flywheel | | 121 ÷ 149 | 12.3 ÷ 15.2 |
| Screws fastening connecting rod caps (in oil) | | 44 ÷ 53 | 4.5 ÷ 5.4 |
| Screws fastening auxiliary components drive belt pulley | | 24 ÷ 29 | 2.4 ÷ 3.0 |
| Screw fastening timing gear belt drive pulley (left-handed) | | 340 ÷ 378 | 34.7 ÷ 38.5 |
| Screws fastening water pump | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Engine oil minimum pressure warning light sensor | | 25 ÷ 31 | 2.5 ÷ 3.2 |
| Screws fastening counter-rotating shaft front covers | | 6 ÷ 7 | 0.6 ÷ 0.7 |
| Screws fastening oil sump | | 13 ÷ 16 | 1.3 ÷ 1.6 |
| Oil sump drain plug | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screws fastening oil pump | | 6 ÷ 8 | 0.6 ÷ 0.8 |
| Screws fastening E.G.R. valve | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Nuts fastening intake box to cylinder head | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screw fastening exhaust side timing gear pulley | | 100 ÷ 124 | 10.2 ÷ 12.6 |
| Nut fastening timing gear belt tensioner | | 21 ÷ 26 | 2.1 ÷ 2.6 |
| Nuts fastening exhaust manifold to cylinder head | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screws fastening thermostatic cup to cylinder head | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screws fastening camshaft caps (in oil) | | 13 ÷ 16 | 1.3 ÷ 1.6 |
| Spark plugs | Centre large | 25 ÷ 35 | 2.5 ÷ 3.6 |
| | Side small | 10 ÷ 12 | 1.0 ÷ 1.2 |
| Engine coolant temperature gauge sender and max. temperature warning light contact | | 25 ÷ 31 | 2.5 ÷ 3.2 |
| Engine coolant temperature sensor (NTC) | | 12 ÷ 15 | 1.2 ÷ 1.5 |
| Cylinder head tightening | | | |
| Set all the screws to a torque of: |  | 20 | 2.0 |
| Tighten the screws to a preliminary torque of: | | 40 | 4.1 |
| Turn all the screws by an angle of: | | 90° + 90° + 90° | |

# SPECIAL TOOLS

| | |
|---|---|
| 1.820.011.000 (A.2.0192) | Valve support tool |
| 1.820.012.000 (A.2.0195) | Support for cylinder head support tool |
| 1.820.049.000 (A.2.0359) | Nut for valve support tool |
| 1.820.145.000 (R.4.0178) | Engine support brackets for assembly on overhauling stand |
| 1.820.225.000 | Support for removing/refitting the power unit |
| 1.820.258.000 | Cylinder head support |
| 1.820.267.000 | Spacer for valve disassembly/re-assembly |
| 1.820.277.000 | Graduated disk for angle torque tightening |
| 1.820.286.000 | Counter-torque for counter-rotating shaft pulleys |
| 1.820.617.000 | Crankshaft pulley counter-torque (for engines before change) |
| 1.820.618.000 | Adaptater for turning crankshaft |
| 1.820.619.000 | Disk for centering crankshaft rear oil seal |
| 1.820.623.000 | Supports for removing/refitting the power unit |
| 1.820.624.000 | Flywheel stopper tool (to be used on the bench) |
| 1.820.626.000 | Fitting for mallet |
| 1.820.630.000 | Flywheel stopper (for engines after change) |
| 1.821.058.000 (A.3.0324) | Lever for valve disassembly/re-assembly |
| 1.821.124.000 (A.3.0522) | Support for valve disassembly/re-assembly |
| 1.821.161.000 (A.3.0617) | Mallet |
| 1.821.171.000 (A.3.0635) | Support grip for installing tools |
| 1.821.175.000 (A.3.0640) | Puller/installing tool for engine stay connecting rod silent-block |
| 1.821.176.000 (A.3.0641) | Puller tool for valve guides |
| 1.821.203.000 | Installing tool for counter-rotating shaft front oil seals (to be used on the bench) |
| 1.821.205.000 | Cage for per valve disassembly/re-assembly |
| 1.821.206.000 | Installing tool for valve guide oil seal |
| 1.821.208.000 | Puller tool for valve guide oil seal |
| 1.821.228.000 | Installing tool for exhaust side camshaft oil seal |
| 1.821.247.000 | Installing tool for crankshaft front oil seal |
| 1.821.251.000 | Installing for balance shaft oil seal |
| 1.821.252.000 | Installing tool for intake side camshaft oil seal |
| 1.821.253.000 | Puller tool for counter-rotating shaft front bearings |
| 1.821.254.000 | Installing tool for valve guides |
| 1.822.144.000 | Hexagon grooved wrench for removing/refitting oil sump |
| 1.822.145.000 | Hexagon grooved wrench for removing/refitting oil sump |
| 1.822.146.000 | Support for pulley wrenches |
| 1.822.147.000 | Wrench for timing variator |
| 1.822.149.000 | Wrench for tensioning timing belts |
| 1.822.154.000 | Wrench for tensioning counter-rotating shaft belt |
| 1.822.155.000 | Wrench for timing gear pulley intake side |
| 1.822.156.000 | Wrench for timing gear pulley exhaust side |
| 1.822.160.000 | Wrench for removing/refitting engine oil pressure sensor |
| 1.825.013.000 (C.6.0183) | Tool for checking T.D.C. |
| 1.825.041.000 | Templates for timing camshafts |



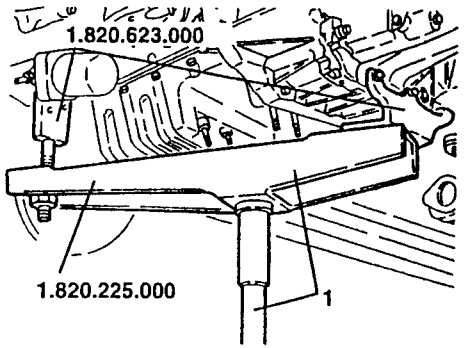


# REMOVING/REFITTING ENGINE

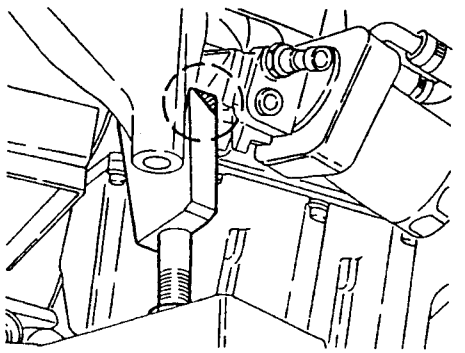
## REMOVAL

**Proceed as described for removing the 1970 engine with the exception of the following.**

1. Position a hydraulic jack complete with tools no. 1.820.225.000 and no. 1.820.623.000 as illustrated.




**NOTE: the part of the timing gear side engine support of tool no. 1.820.623.000, is to be relieved in the area illustrated to prevent interference with the oil filter support.**

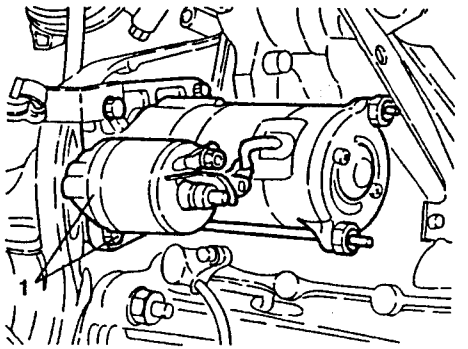


**Complete removal of the engine from the car as described for the 1970 engine.**

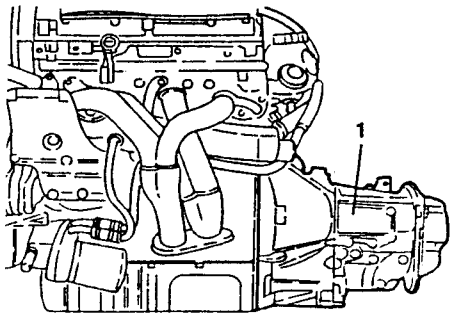
**Then, on the bench, remove the components as described below to enable positioning of the engine on the overhauling stand.**

- Release the power unit from the support tools then position it on a suitable workbench.

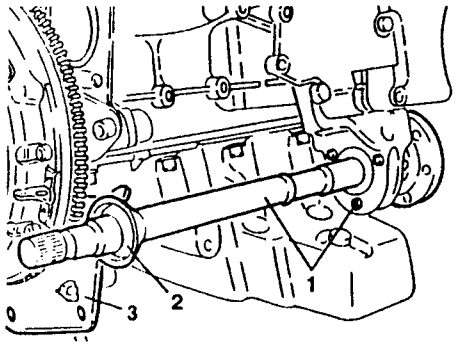
1. Slacken the fastening screws and remove the starter motor.



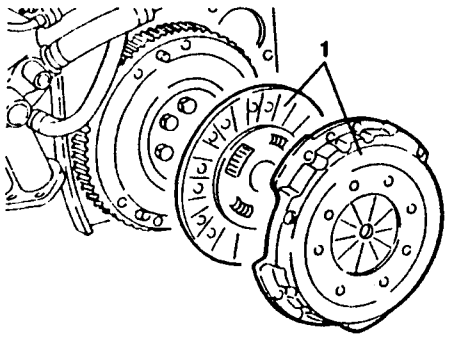

1. Slacken the fastening nuts and remove the gearbox and differential unit.



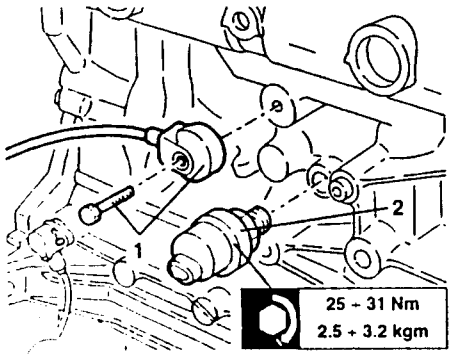
1. Slacken the three fastening screws and remove the lay shaft.
2. Remove the dust guard ring.
3. Remove the lower flywheel cover.



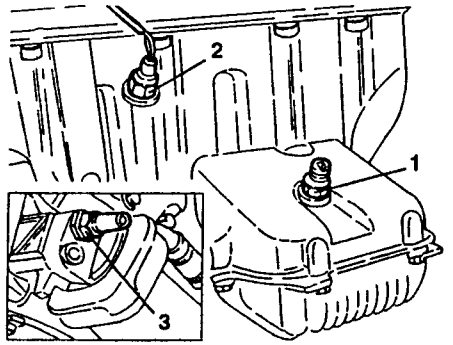

1. Slacken the fastening screws and remove the pressure plate body and clutch plate.



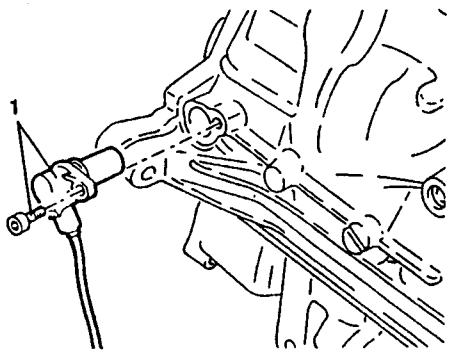

1. Slacken the fastening screw and remove the pinging sensor from the crankcase.
2. Slacken and remove the engine oil pressure meter.




1. Slacken and remove the engine oil temperature sensor.
2. Slacken and remove the engine oil minimum level sensor.
3. Slacken and remove the engine oil minimum pressure sensor.




1. Slacken the fastening screw and remove the rpm sensor.




## REFITTING

**Proceed as described for the 1970 engine.**





# ON-VEHICLE OPERATIONS

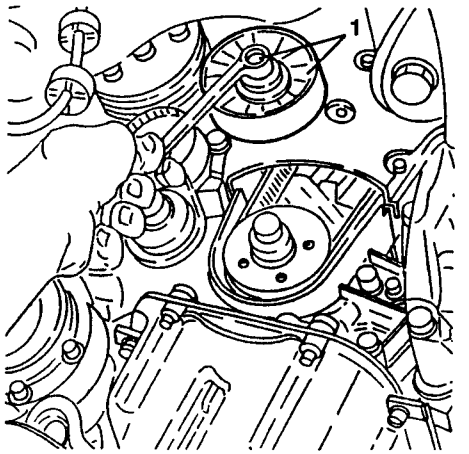
**Below only the procedures which differ from the 1970 engine are given.**

**Refer to the 1970 engine for the items not mentioned below.**

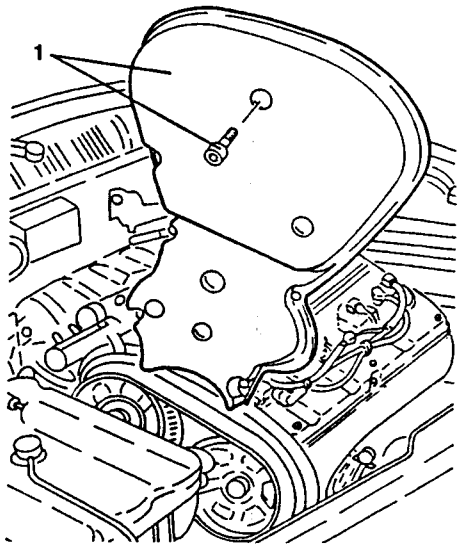
## REMOVING/REFITTING CYLINDER HEAD

**Proceed as described for the 1970 engine up to and including removing the auxiliary components drive pulley.**

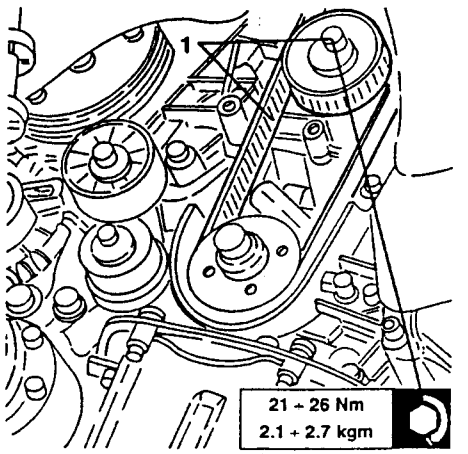
1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.




- Slacken the lower screws of the cover for the timing gear drive belts.
1. Lower the car, slacken the remaining fastening screws and remove the cover for the timing gear drive belts.




1. Working on the timing gear belt tensioner, loosen the tension of the belt, then prise it off the camshaft driving pulleys.

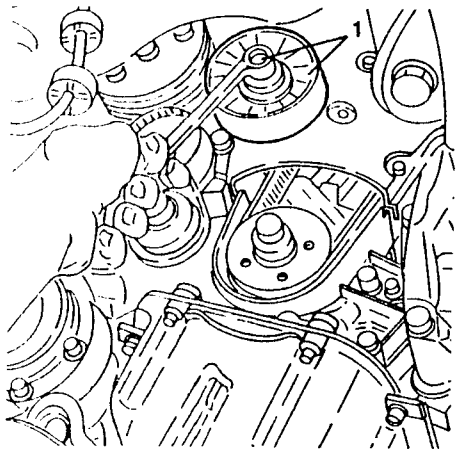



**Complete the cylinder head removing/refitting procedure as described for the 1970 engine.**

## REMOVAL/REFITTING OF OIL SUMP

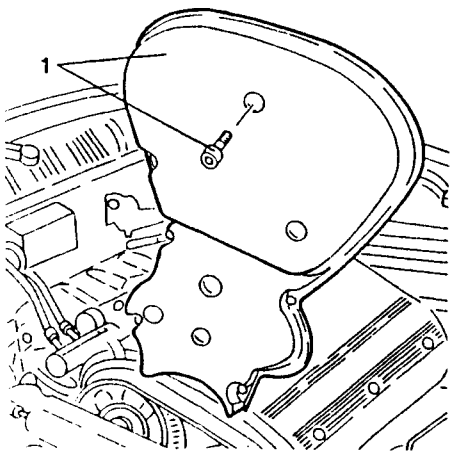
**Proceed as described for the 1970 engine up to and including removing the auxiliary components drive pulley.**

1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.




- Slacken the lower screws of the cover for the timing gear drive belts.

1. Lower the car, slacken the remaining fastening screws and remove the cover for the timing gear drive belts.

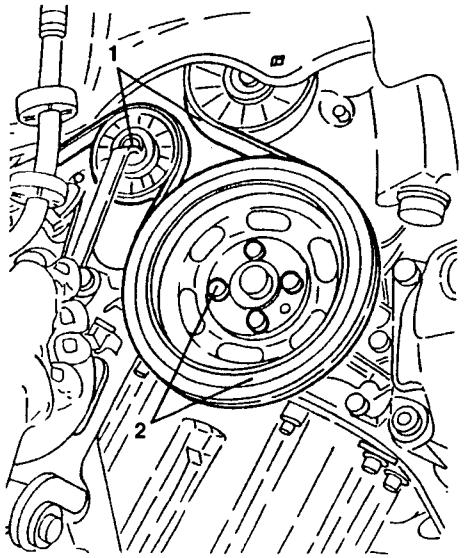



**Complete the oil sump removing/refitting procedure as described for the 1970 engine.**

## CHANGING THE CRANKSHAFT FRONT OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

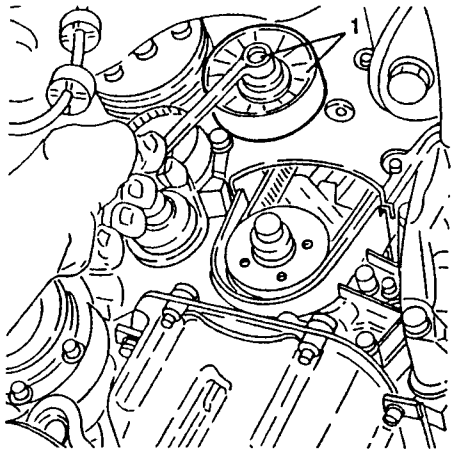
1. Raise the car and working as illustrated on the belt tensioner, loosen the tension of the auxiliary components drive belt prise it off.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.





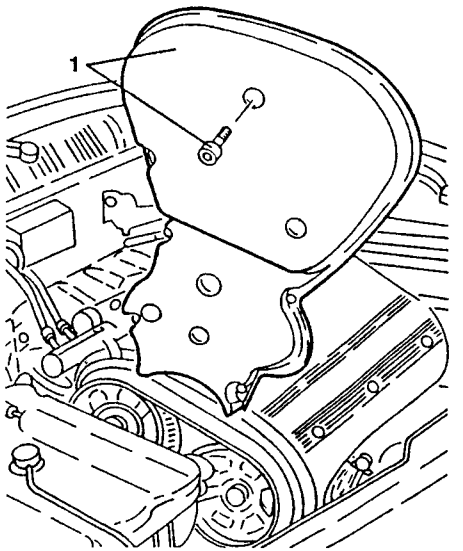



1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.

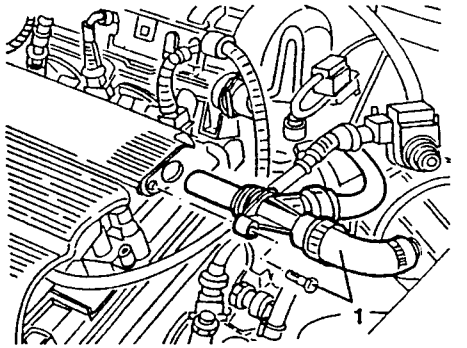



- Slacken the lower screws of the cover for the timing gear drive belts.

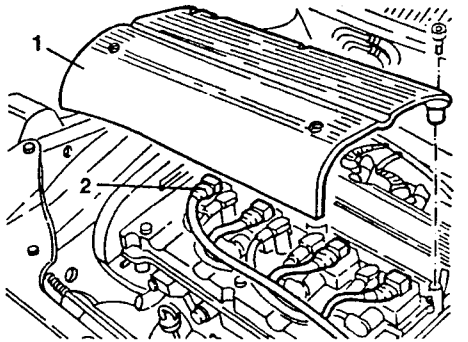
1. Lower the car, slacken the remaining fastening screws and remove the cover for the timing gear drive belts.



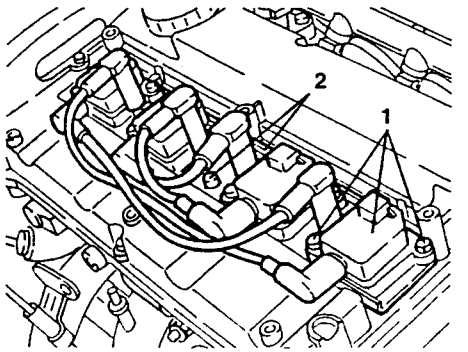

1. Slacken the fastening screw and remove the socket for the oil vapour recovery pipe.



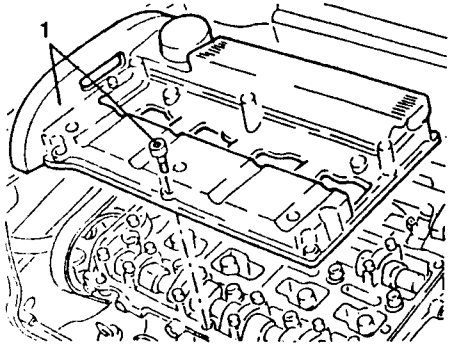

1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



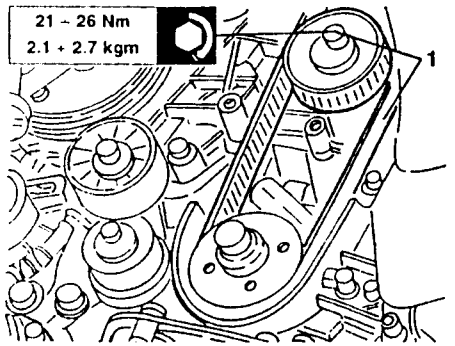

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



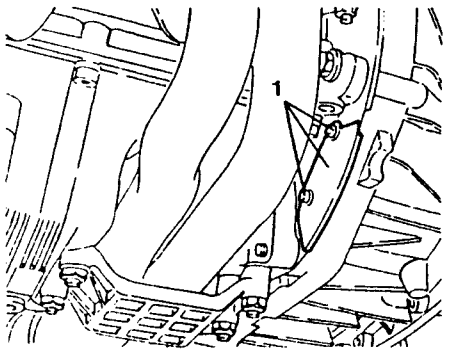
1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.



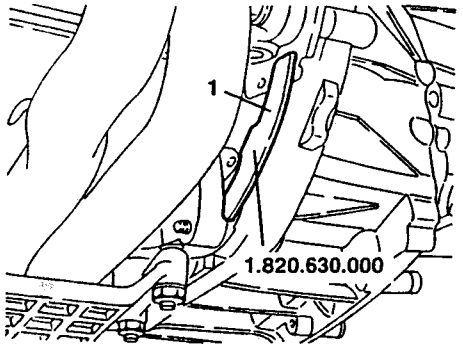

1. Working on the timing gear belt tensioner, loosen the tension of the belt, then prise it off.



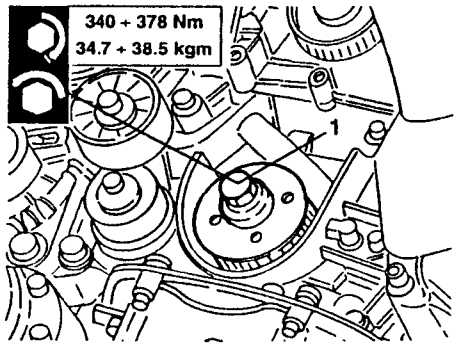

1. Slacken the two fastening nuts and remove the flywheel protection plate.



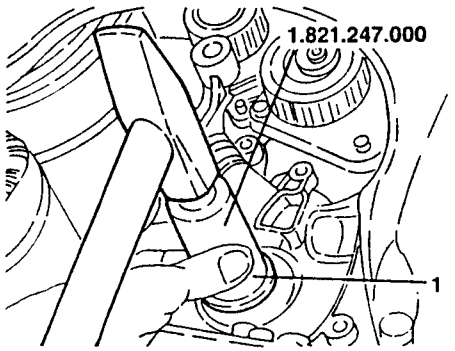

1. Install the flywheel stopper tool no. 1.820.630.000, as illustrated




1. Slacken the fastening screw (left-handed) timing gear belt drive pulley, then remove it.




1. Remove the oil seal and install a new one using tool no. 1.821.247.000.




**- Re-assemble reversing the sequence followed for removal.**

**Refer to GROUP 00 for refitting the timing gear belt and timing operations.**





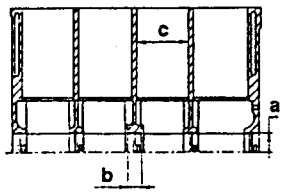
# TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

## ENGINE TECHNICAL CHARACTERISTICS

| | | | |
|---|---|---|---|
| Engine | | AR67601 | AR 67106 |
| Cycle | | Otto 4-stroke | |
| Fuel system / Ignition | | Multi - Point Motronic M 2.10.4 | |
| Firing order | | 1 - 3 - 4 - 2 | |
| Displacement | $cm^3$ | 1598 | 1747 |
| Number of cylinders | | 4 in line | |
| Bore | mm | 82 | 82 |
| Stroke | mm | 75.65 | 82.7 |
| Maximum power | CV EEC (kW EEC) | 120 (88) | 140 (103) |
| | rpm | 6300 | 6300 |
| Maximum torque | kgm EEC (Nm EEC) | 14.7 (144) | 16.8 (165) |
| | rpm | 4500 | 4000 |
| Compression ratio | | 10.3 : 1 | 10.3 : 1 |
| Engine oil pressure | | | |
| - At idle speed | bar | ≥ 1.5 | ≥ 1.5 |
| - At 4000 rpm | | ≥ 4.5 | ≥ 4.5 |
| Idle speed | rpm | 800 ± 50 | 800 ± 50 |

## COMPLETE CRANKCASE

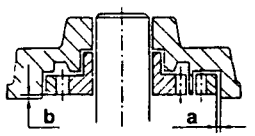
### Crankcase




Unit: mm

| | | |
|---|---|---|
| Diameter of main journals "a" | | 56.705 ÷ 56.718 |
| Length of centre main bearing shoulder "b" | | 21.720 ÷ 21.800 |
| Diameter of cylinders "c" | Class A | 82.000 ÷ 82.010 |
| | Class B | 82.010 ÷ 82.020 |
| | Class C | 82.020 ÷ 82.030 |
| | Oversize 0.1 | |

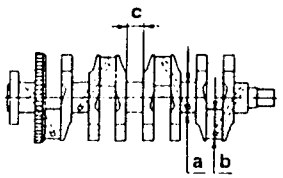
### Oil pump




Unit: mm

| | | |
|---|---|---|
| Clearance between pump casing seat and driven gear "a" | | 0.080 ÷ 0.186 |
| Clearance between pump cover rest surface and upper side of gears "b" | | 0.025 ÷ 0.070 |
| Engine oil pressure limiting valve | Control load | 6.4 ÷ 7.2 kg |
| | Length of spring | 36 |

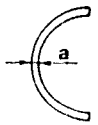
## Crankshaft




Unit: mm

| | | 1594 | 1747 |
|---|---|---|---|
| Diameter of main bearing journals "a" | Class A - Red | 52.994 ÷ 53.000 | |
| | Class B - Blue | 52.988 ÷ 52.994 | |
| | Class C - Yellow | 52.982 ÷ 52.988 | |
| | Undersize 0.127 | | |
| Diameter of connecting rod pins "b" | Class A - Red | 48.238 ÷ 48.244 | 50.799 ÷ 50.805 |
| | Class B - Blue | 48.232 ÷ 48.238 | 50.793 ÷ 50.799 |
| | Class C - Yellow | 48.226 ÷ 48.232 | 50.787 ÷ 50.793 |
| | Undersize 0.127 | | |
| Length of centre bearing journal "c" | | 26.575 ÷ 26.625 | |
| | | Oversize 0.254 | |
| Maximum taper of main and connecting rod journals | | 0.0045 | |
| Maximum error of concentricity between main journals and connecting rod journals | | 0.03 | |

## Main half bearings




Unit: mm

| | | 1594 | 1747 |
|---|---|---|---|
| Side main half bearing shim "a" | Class A - Red | 1.836 ÷ 1.840 | 1.831 ÷ 1.837 |
| | Class B - Blue | 1.839 ÷ 1.843 | 1.836 ÷ 1.844 |
| | Class C - Yellow | 1.842 ÷ 1.846 | 1.843 ÷ 1.849 |
| | Undersize 0.127 | | |
| Centre main half bearing shim "a" | Class A - Red | 1.831 ÷ 1.835 | 1.826 ÷ 1.832 |
| | Class B - Blue | 1.834 ÷ 1.838 | 1.831 ÷ 1.839 |
| | Class C - Yellow | 1.837 ÷ 1.841 | 1.838 ÷ 1.844 |
| | Undersize 0.127 | | |
| Play between pin and main half bearing | Side | 0.025 ÷ 0.052 | 0.019 ÷ 0.062 |
| | Centre | 0.035 ÷ 0.062 | 0.029 ÷ 0.072 |

## Half thrust rings


Unit: mm

| | |
|---|---|
| Thickness of half thrust rings "a" | 2.342 ÷ 2.358 |
| | Oversize 0.127 |
| Crankshaft end float | 0.059 ÷ 0.221 |

## Engine flywheel

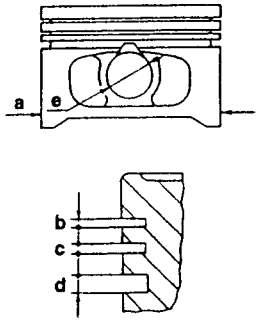

| | |
|---|---|
| Inside diameter of centre bush (bore) "a" | 47.010 ÷ 47.035 mm |
| Heating temperature of ring gear for assembly on flywheel | 80° ÷ 100°C |





# CONNECTING ROD - PISTON ASSEMBLY

## Piston

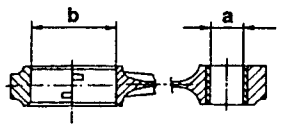



Unit: mm

| | | |
|---|---|---|
| Diameter of pistons "a" (1) | Class A - Blue | 81.952 ÷ 81.962 |
| | Class B - Pink | 81.960 ÷ 81.970 |
| | Class C - Green | 81.968 ÷ 81.978 |
| | Oversize 0.1 | |
| Height of first seal ring seats "b" | | 1.520 ÷ 1.540 |
| Height of second seal ring seats "c" | | 1.510 ÷ 1.530 |
| Height of oil scraper ring seats "d" | | 3.010 ÷ 3.030 |
| Diameter of gudgeon pin holes in pistons "e" | | 20.002 ÷ 20.007 |
| Clearance between cylinders and pistons | | 0.038 ÷ 0.062 |
| Difference in weight between pistons | | ± 5 g |

(1) To be measured perpendicular to the gudgeon pin hole at a distance of 12.5 mm from lower edge of skirt.

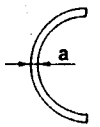
## Connecting rods




Unit: mm

| | 1594 | 1747 |
|---|---|---|
| Diameter of small end bushing bore "a" | 20.006 ÷ 20.012 | |
| Inside diameter of rod big ends "b" | 51.354 ÷ 51.366 | 53.897 ÷ 53.909 |
| Difference in weight between rods | ≤ 5 g | |
| Celarance between small end bushings and pins | 0.006 ÷ 0.016 | |
| Small end end float | 0.25 ÷ 0.6 | |

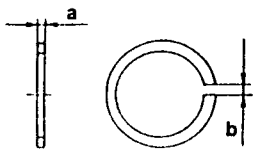
## Connecting rod half bearings




Unit: mm

| | | 1594 | 1747 |
|---|---|---|---|
| Thickness of connecting rod half bearings "a" | Class A - Red | 1.536 ÷ 1.540 | 1.527 ÷ 1.531 |
| | Class B - Blue | 1.539 ÷ 1.543 | 1.531 ÷ 1.535 |
| | Class C - Yellow | 1.542 ÷ 1.546 | 1.535 ÷ 1.539 |
| | Undersize 0.127 | | |
| Play between connecting rod pins and their half bearings | Class A - Red<br>Class B - Blue<br>Class C - Yellow | 0.030 ÷ 0.056 | 0.026 ÷ 0.056 |

## Seal rings

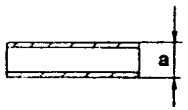



Unit: mm

| | | |
|---|---|---|
| Thickness of rings "a" | First ring | 1.470 ÷ 1.490 |
| | | Oversize 0.1 |
| | Second ring | 1.475 ÷ 1.490 |
| | | Oversize 0.1 |
| | Oil scraper ring | 2.975 ÷ 2.990 |
| | | Oversize 0.1 |
| Ring gap "b" (1) | First ring | 0.25 ÷ 0.50 |
| | Second ring | 0.30 ÷ 0.50 |
| | Oil scraper ring | 0.25 ÷ 0.45 |
| Axial play between seal rings and seats | First ring | 0.030 ÷ 0.070 |
| | Second ring | 0.020 ÷ 0.055 |
| | Oil scraper ring | 0.020 ÷ 0.055 |

(1) To be measured in the checking ring nut or in the cylinder.

## Gudgeon pins

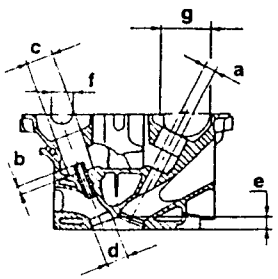



Unit: mm

| | |
|---|---|
| Outside diameter of gudgeon pins "a" | 19.996 ÷ 20.000 |
| Clearance between gudgeon pins and their seats on pistons | 0.002 ÷ 0.011 |

# CYLINDER HEAD

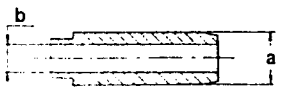
## Head




Unit: mm

| | | |
|---|---|---|
| Diameter of valve guide seats "a" | | 12.950 ÷ 12.977 |
| Valve guide protrusion "b" | | 11.25 ÷ 11.75 |
| Diameter of valve cup seats "c" | | 33.000 ÷ 33.025 |
| Diameter of valve seat housing "d" | Intake | 35.019 ÷ 35.044 |
| | Exhaust | 29.021 ÷ 29.042 |
| Minimum depth of combustion chamber "e" | | 13 ± 0.2 |
| Maximum error of flatness of head lower surface | | 0.1 |
| Diameter of camshaft supports "f" | | 26.045 ÷ 26.070 |
| Diameter of timing variator support "g" | | 55.990 ÷ 56.015 |

## Valve guides



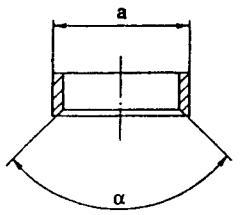

Unit: mm

| | |
|---|---|
| Outside diameter of valve guides "a" | 13.010 ÷ 13.030 |
| | Oversize 0.20 |
| Inside diameter of valve guides (bore) "b" | 7.022 ÷ 7.040 |
| Interference between valve guides and their seats | 0.033 ÷ 0.080 |





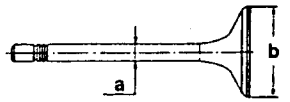
## Valve seats




Unit: mm

| | | |
|---|---|---|
| Outside diameter of valve seats "a" | Intake | 35.135 ÷ 35.150 |
| | Exhaust | 29.142 ÷ 29.157 |
| Valve contact area taper "α" | | 90° ± 10' |
| Interference between valve seats and their housings | Intake | 0.091 ÷ 0.131 |
| | Exhaust | 0.100 ÷ 0.136 |
| Cylinder head heating temperature for fitting valve seats | | 80 °C |

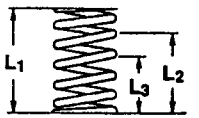
## Valves




Unit: mm

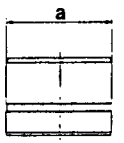
| | | |
|---|---|---|
| Diameter of valve stems "a" | Intake | 6.975 ÷ 6.990 |
| | Exhaust | 6.960 ÷ 6.975 |
| Diameter of valve mushrooms "b" | Intake | 33.4 ÷ 33.7 |
| | Exhaust | 27.9 ÷ 28.2 |
| Radial clearance between valve stem and guide | Intake | 0.032 ÷ 0.065 |
| | Exhaust | 0.047 ÷ 0.080 |

## Valve springs




| | Outer spring | Inner spring |
|---|---|---|
| Free length "$L_1$" | 46 mm | 39 mm |
| Length with valves closed "$L_2$" | 34 mm | 29.5 mm |
| Corresponding load at "$L_2$" | 271 ÷ 294 N (27.6 ÷ 30 kg) | 96 ÷ 106 N (9.8 ÷ 10.8 kg) |
| Length with valves open "$L_3$" | 24,5 mm | 20 mm |
| Corresponding load at "$L_3$" | 485 ÷ 524 N (49.4 ÷ 53.4 kg) | 201 ÷ 221 N (20.5 ÷ 22.5 kg) |

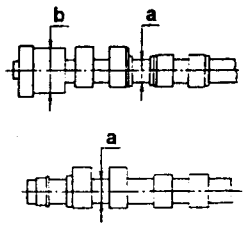
## Hydraulic tappets




Unit: mm

| | |
|---|---|
| Outside diameter of hydraulic tappets "a" | 32.959 ÷ 32.975 |
| Radial clearance between hydraulic tappets and their seats | 0.025 ÷ 0.066 |

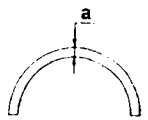
## Camshafts




Unit: mm

| | | 1998 | 1747 |
|---|---|---|---|
| Diameter of camshaft journals "a" | | 26.000 ÷ 26.015 | |
| Diameter of timing variator journal "b" | | 49.985 ÷ 50.000 | |
| Nominal cam lift | Intake | 8.3 | 9.5 |
| | Exhaust | 7.5 | 9.5 |
| Clearance between camshaft journals and their seats | | 0.03 ÷ 0.07 | |
| Camshaft end float | | 0.10 ÷ 0.23 | |

### Timing variator half bearings




Unit: mm

| | |
|---|---|
| Thickness of timing variator half bearings "a" | 2.992 ÷ 2.998 |
| Actual operating play between timing variator and the corresponding bearings | 0.034 ÷ 0.086 |

## ANGLES OF ACTUAL TIMING DIAGRAM (Obtained with control clearance 0.45 mm)

1598

| | | | |
|---|---|---|---|
| Intake | Opens (before T.D.C.) | "a" | -8° 17° (*) |
| | Closes (after B.D.C.) | "b" | 40° 15° (*) |
| | Intake angle | "c" | 212° |
| Exhaust | Opens (before B.D.C.) | "d" | 31° |
| | Closes (after T.D.C.) | "e" | -4° |
| | Exhaust angle | "f" | 207° |

(*): Values obtained with timing variator engaged.

1747

| | | | |
|---|---|---|---|
| Intake | Opens (before T.D.C.) | "a" | -3° 22° (*) |
| | Closes (after B.D.C.) | "b" | 51° 26° (*) |
| | Intake angle | "c" | 228° |
| Exhaust | Opens (before T.D.C.) | "d" | 47° |
| | Closes (after B.D.C.) | "e" | 4° |
| | Exhaust angle | "f" | 231° |

(*): Values obtained with timing variator engaged.





## FLUIDS AND LUBRICANTS

| Application | Type | Specified classification | Name | Q.ty litres |
|---|---|---|---|---|
| Engine (Refilling) | Oil | API SG<br>CCMG5<br>SAE 10W/40 | SELENIA SPECIAL FORMULA ALFA ROMEO 10W/40 (*) | 5 (1)<br>4.4 (2) |

(*): For decidedly sportive use of the car fully synthetic **SELENIA Racing 10W/60** engine oil is recommended
(1): Total capacity
(2): Sump + filter (for periodical replacement)

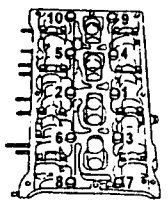
## SEALANTS AND ADHESIVES

| Application | Type | Name | Q.ty |
|---|---|---|---|
| Oil sump - crankcase | Silicone Q3 | Mascherpa - 7091<br>RHONE PULENC - CAF 5552 | - |
| Timing variator | Sealant | Loctite 270 | - |

## ABRASIVES

| Application | Type | Name | Q.ty |
|---|---|---|---|
| Valve seat grinding | Abrasive | SIPAL AREXONS<br>Carbosilicium for valves | - |

## TIGHTENING TORQUES

| Part | | Nm | kgm |
|---|---|---|---|
| Screws fastening main bearing caps (in oil) | | 96 ÷ 119 | 9.8 ÷ 12.1 |
| Screws fastening flywheel | | 121 ÷ 149 | 12.3 ÷ 15.2 |
| Screws fastening connecting rod caps (in oil) | | 44 ÷ 53 | 4.5 ÷ 5.4 |
| Screws fastening auxiliary components drive belt pulley | | 24 ÷ 29 | 2.4 ÷ 3.0 |
| Screw fastening timing gear belt drive pulley (left-handed) | | 340 ÷ 378 | 34.7 ÷ 38.5 |
| Screws fastening water pump | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Engine oil minimum pressure warning light sensor | | 25 ÷ 31 | 2.5 ÷ 3.2 |
| Screws fastening oil sump | | 13 ÷ 16 | 1.3 ÷ 1.6 |
| Oil sump drain plug | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screws fastening oil pump | | 6 ÷ 8 | 0.6 ÷ 0.8 |
| Screws fastening E.G.R. valve | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Nuts fastening intake box to cylinder head | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screw fastening exhaust side timing gear pulley | | 100 ÷ 124 | 10.2 ÷ 12.6 |
| Nut fastening timing gear belt tensioner | | 21 ÷ 26 | 2.1 ÷ 2.6 |
| Nuts fastening exhaust manifold to cylinder head | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screws fastening thermostatic cup to cylinder head | | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screws fastening camshaft caps (in oil) | | 13 ÷ 16 | 1.3 ÷ 1.6 |
| Spark plugs | Centre large | 25 ÷ 35 | 2.5 ÷ 3.6 |
| | Side small | 10 ÷ 12 | 1.0 ÷ 1.2 |
| Engine coolant temperature gauge sender and max. temperature warning light contact | | 25 ÷ 31 | 2.5 ÷ 3.2 |
| Engine coolant temperature sensor (NTC) | | 12 ÷ 15 | 1.2 ÷ 1.5 |
| Cylinder head tightening | | | |
| Set all the screws to a torque of: |  | 20 | 2.0 |
| Tighten the screws to a preliminary torque of: | | 40 | 4.1 |
| Turn all the screws by an angle of: | | 90° + 90° + 90° | |





## SPECIAL TOOLS

| | |
|---|---|
| 1.820.011.000 (A.2.0192) | Valve support tool |
| 1.820.012.000 (A.2.0195) | Support for cylinder head support tool |
| 1.820.049.000 (A.2.0359) | Nut for valve support tool |
| (*) | Engine support brackets for assembly on overhauling stand |
| 1.820.225.000 | Support for removing/refitting the power unit |
| 1.820.258.000 | Cylinder head support |
| 1.820.267.000 | Spacer for valve disassembly/re-assembly |
| 1.820.277.000 | Graduated disk for angle torque tightening |
| 1.820.617.000 | Crankshaft pulley counter-torque |
| 1.820.618.000 | Adaptater for turning crankshaft |
| 1.820.619.000 | Disk for centering crankshaft rear oil seal |
| 1.820.623.000 | Supports for removing/refitting the power unit |
| 1.820.624.000 | Flywheel stopper tool (to be used on the bench) |
| 1.820.626.000 | Fitting for mallet |
| 1.821.058.000 (A.3.0324) | Lever for valve disassembly/re-assembly |
| 1.821.124.000 (A.3.0522) | Support for valve disassembly/re-assembly |
| 1.821.161.000 (A.3.0617) | Mallet |
| 1.821.171.000 (A.3.0635) | Support grip for installing tools |
| 1.821.175.000 (A.3.0640) | Puller/installing tool for engine stay connecting rod silent-block |
| 1.821.176.000 (A.3.0641) | Puller tool for valve guides |
| 1.821.205.000 | Cage for per valve disassembly/re-assembly |
| 1.821.206.000 | Installing tool for valve guide oil seal |
| 1.821.208.000 | Puller tool for valve guide oil seal |
| 1.821.228.000 | Installing tool for exhaust side camshaft oil seal |
| 1.821.247.000 | Installing tool for crankshaft front oil seal |
| 1.821.252.000 | Installing tool for intake side camshaft oil seal |
| 1.821.254.000 | Installing tool for valve guides |
| 1.822.144.000 | Hexagon grooved wrench for removing/refitting oil sump |
| 1.822.145.000 | Hexagon grooved wrench for removing/refitting oil sump |
| 1.822.146.000 | Support for pulley wrenches |
| 1.822.147.000 | Wrench for timing variator |
| 1.822.149.000 | Wrench for tensioning timing belts |
| 1.822.155.000 | Wrench for timing gear pulley intake side |
| 1.822.156.000 | Wrench for timing gear pulley exhaust side |
| 1.822.160.000 | Wrench for removing/refitting engine oil pressure sensor |
| 1.825.013.000 (C.6.0183) | Tool for checking T.D.C. |
| 1.825.041.000 | Templates for timing camshafts (for 1747 engine) |
| 1.825.042.000 | Templates for timing camshafts (for 1598 engine) |

(*): Not available at time of going to press.

# GROUP 04

# FUEL SYSTEM

## INDEX


BOSCH MOTRONIC M 2.10.3 ELECTRONIC INJECTION AND IGNITION SYSTEM ..... 04 - 2
(Specific for 1370 '95 versions)
- General description ..... 04 - 2
  - Functions of the system ..... 04 - 2
  - Operating logic ..... 04 - 4
  - Components of the Motronic M 2.10.3 electronic injection and ignition system ..... 04 - 7
  - Functional layout of Motronic M 2.10.3 injection - ignition system ..... 04 - 8

BOSCH MOTRONIC M 2.10.4 ELECTRONIC INJECTION AND IGNITION SYSTEM
(Specific for 1370 1598 1747 '96 versions) ..... 04-8/1
- General description ..... 04-8/1
  - Functions of the system ..... 04-8/1
  - Operating logic ..... 04-8/3
  - Components of the Motronic M 2.10.4 electronic injection and ignition system ..... 04-8/6
  - Functional layout of Motronic M 2.10.4 injection - ignition system ..... 04-8/7

FUEL SUPPLY SYSTEM ..... 04 - 9
- Description ..... 04 - 9
  - Warnings ..... 04-10
- Fuel pipe connection fittings ("John Guest" type) ..... 04-10
- Fuel pipe connection fittings ("Huron" type) ..... 04-10/1
- Fuel tank ..... (*)
- Fuel level gauge ..... 04-10/2
  - Removal/Refitting ..... 04-10/2
  - Checks and inspections ..... 04-10/2
- Fuel pump ..... (*)
- Fuel filter ..... (*)
- Fuel distributor manifold ..... 04-11
  - Removal/Refitting ..... 04-11
- Electroinjectors ..... 04-11
  - Checking for correct opening of electroinjectors ..... 04-12
  - Checking the sealing of electroinjectors ..... 04-12
  - Removal/Refitting ..... 04-12
- Fuel pressure regulator ..... 04-12
  - Removal/Refitting ..... 04-13
- Checking the pressure and tightness of the fuel circuit ..... 04-13


(*): See INSTRUCTIONS FOR REPAIR - ENGINES - PA4655B1000000






FUEL VAPOUR RECOVERY SYSTEM ..... 04-14
- Description ..... 04-14
- Multi-purpose valve ..... 04-14/1
- Safety valve ..... (*)
- Fuel vapour filter ..... (*)
- Fuel vapour filter solenoid valve ..... (*)

AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM ..... 04-15
- Description ..... 04-15
- Changing the air cleaner cartridge ..... 04-16
- Throttle body ..... 04-16
  - Removal/Refitting ..... 04-16
- Air-flow meter ..... 04-17
  - Removal/Refitting ..... 04-18
- Intake air temperature sensor (NTC) ..... 04-18
  - Removal/Refitting ..... 04-18
- Throttle potentiometer ..... 04-18
  - Removal/Refitting ..... 04-19
- Air intake box ..... 04-19
  - Removal/Refitting ..... 04-19
- Constant idle speed actuator ..... 04-20
  - Removal/Refitting ..... 04-20

EXHAUST GAS RECIRCULATION SYSTEM ..... 04-21
- Description ..... 04-21
- E.G.R. valve ..... 04-22
  - Removal/Refitting ..... 04-22
- E.G.R. modulatin solenoid valve ..... 04-22
  - Removal/Refitting ..... 04-22

EXHAUST SYSTEM ..... 04-23
- Description ..... 04-23
- Catalytic converter ..... 04-24
- Lambda sensor ..... 04-25
  - Removal/Refitting ..... 04-26
- Checking emissions at the exhaust ..... 04-26

ELECTRICAL ELECTRONIC COMPONENTS ..... 04-27
- Timing sensor ..... 04-27
  - Removal/Refitting ..... 04-27
- Speedometer sensor ..... 04-29
  - Removal/Refitting ..... 04-29
- Rpm sensor and timing sensor ..... 04-29
  - Removal/Refitting ..... 04-30
  - Checking the gap ..... 04-30
- Engine coolant temperature sensor (NTC) ..... 04-31
  - Removal/Refitting ..... 04-31
- Knocking sensor ..... 04-31
  - Removal/Refitting ..... 04-31
- Timing variator solenoid ..... 04-32
  - Removal/Refitting ..... 04-32
- Inertial switch ..... 04-32
  - Removal/Refitting ..... 04-32

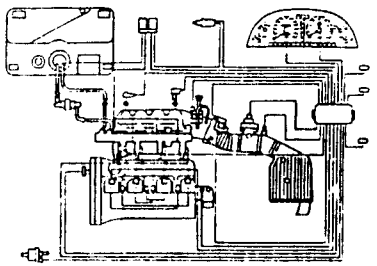
TECHNICAL CHARACTERISTICS AND SPECIFICATIONS ..... 04-33
- Fuel ..... 04-33
- Fuel tank ..... 04-33
- Checking the setting of the fuel level gauge ..... 04-33
- Checking fuel supply pressure ..... 04-33
- Checking emission at the exhaust ..... 04-33
- Rpm and timing sensor gap ..... 04-33
- Idle speed ..... 04-33
- Tightening torques ..... 04-34

SPECIAL TOOLS ..... 04-34

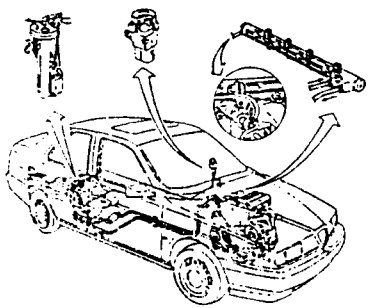

(*): See INSTRUCTIONS FOR REPAIR - ENGINES - PA4655B1000000

# ILLUSTRATED INDEX

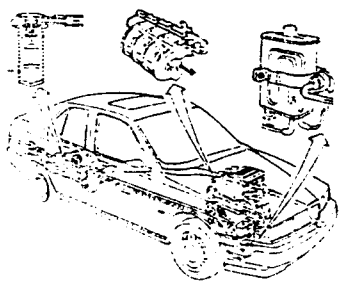
BOSCH MOTRONIC M 2.10.3 ELECTRONIC INJECTION AND IGNITION SYSTEM Pag. 04 - 2



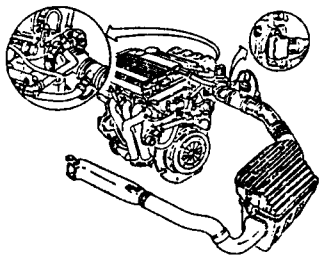
FUEL SUPPLY SYSTEM Pag. 04 - 9



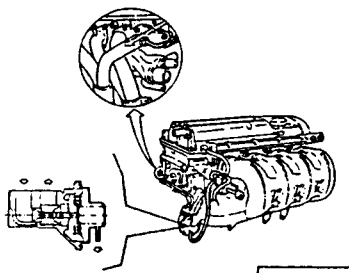
FUEL VAPOUR RECOVERY SYSTEM Pag. 04-14



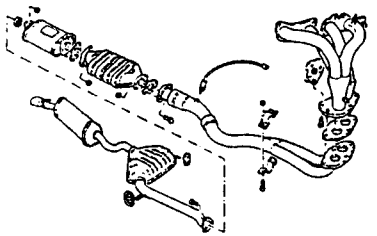
AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM Pag. 04-15



EXHAUST GAS RECIRCULATION SYSTEM Pag. 04-21



EXHAUST SYSTEM Pag. 04-23



ELECTRICAL ELECTRONIC COMPONENTS Pag. 04-27

# BOSCH MOTRONIC M 2.10.3 ELECTRONIC INJECTION AND IGNITION SYSTEM (Specific for 1970 '95 versions)

## GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions: this sophisticated latest generation system consists of a single control unit which controls both ignition (static with lost spark) and injection (timed).

This is the M 2.10.3 version of the proven and reliable BOSCH MOTRONIC system.

Compared with the previous versions this new M 2.10.3 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions.

As a result of the use of new sensors and revision of the control programmes, the system makes it possible to achieve considerable improvements in terms of consumption and emission levels and vehicle handling.

Another feature of this system is self-adaptation, i.e. the capability to recognise the changes that take place in the engine and to compensate them, according to functions which mainly correct:

- the mixture titration
- the caburetion parameters according to the command of the evaporative solenoid valve
- an adaptive programme for idle speed control.

## FUNCTIONS OF THE SYSTEM

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

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

**NOTE:** the instant considered in the design of the maps is that of the start of injection (the cylinder is in the exhaust stroke - intake valve still closed).

### Static ignition

An electronic ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences; lastly it reduces the number of high voltage cables and connectors; as the power modules for controlling the primary windings of the coil are inside the control unit.

Static ignition takes place through four coils, according to the so-called "lost spark" logic: this solution exploits the different pressures and environments existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas. In a 4-cylinder in line engine, the paired cylinders are 1/4 and 2/3.

The solution adopted for this engine (T.SPARK - 16 valves) has required the adoption of a larger "central" spark plug and a smaller "side" spark plug. Each of the four coils supplies the small spark plug of the cylinder below and simultaneously the large one of the paired cylinder.

**NOTE:** This way it is impossible to invert the spark plug cables during servicing operations.





### Metering the air flow rate

The air flow meter adopted is of a more modern design known as the "hot film" type.

Outside, the air-flow meter looks like a part of duct between the intake manifold and the air cleaner. Inside the air-flow meter there is an electronic circuit and a plate that is crossed by the air which passes into the duct. The film plate is kept at a constant temperature (appr. 120°C over the temperature of the incoming air) by a heating resistance placed in contact with it. The mass of air flowing through the manifold tends to withdraw heat from the plate: therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.

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

### Cylinder detection

Following the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence. The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.

Conversely, the rpm sensor sends a reference signal for each turn of the engine and each subsequent tooth of the phonic wheel informs the control unit of an increase of the angular position of the crankshaft, so that injection is sent correctly from the suitable cylinder and the spark to the corresponding pair of cylinders.

### Fuel pump

The control logic of the fuel pump carried out by the control unit (mainly based on the rpm signal) immediately cuts off the supply to the pump as soon as the engine stops.

Moreover, the pump will not operate with the key engaged and the engine not running.

In this car, this logic is integrated - in order to further higher the standards of **safety** - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously. This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents in which the engine does not stop immediately.

### Timing variator

This T.SPARK - 16 valve engine is fitted with an electro- mechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts intake timing (advance) in such a way that a larger amount of air is taken in. This device is activated by the control unit only after exceeding a determinate rpm and engine load to avoid adversely affecting correct operation of the engine at low speeds.

## Percentage of exhaust gas recirculation

Nox (nitnc oxide) is developed at high temperatures in the combustion chambers. To reduce these emissions an E.G.R. (Exhaust Gas Recirculation) system is adopted which by recirculating part of the exhaust gases, lowers the temperature, thus the Nox produced, in the combustion chambers.
In fact, part of the exhaust gas is withdrawn through the special EGR Valve and re-admitted to the intake box where it is mixed with the intaken air and burnt again in the engine. The EGR valve is modulated by a solenoid valve controlled by the injection control unit and, as a result of the type of control, in addition to reducing the amount of Nox, consumption levels are also optimised.
The percentage of exhaust gas to be returned to the engine is established by the control unit taking account of a specific characteristic curve which depends on the load, speed and temperature of the engine.

## OPERATING LOGIC

- **Identification of the "operating point":**

the "point of operation of the engine" is located mainly through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

- **Adjustment of injection times (quantity of fuel):**

the control unit controls the injectors very quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine. Injection is "sequential", i.e. the injectors are opened in correspondence of the exhaust stroke of the corresponding cylinder.

- **Ignition adjustment (calculation of advances):**

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

- **Cold starting control:**

during cold starts the control unit uses special advance values and injection times.
When a determinate temperature/rpm ratio is reached, the control unit resumes normal operating conditions.

- **Control of enrichment during acceleration:**

upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

- **Fuel cut-off during deceleration:**

with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The cut-off threshold value varies according to the temperature of the engine and the speed of the car.





- **Control of idle speed:**

the adjustment of the engine idle speed is carried out through the special actuator fitted directly on the throttle body which acts on the throttle by-pass: in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.

- **Maximum Rpm limiting:**

above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

- **Combustion control -lambda probe-:**

the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.
The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture). The electric signal sent by the probe to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
The signal from the lambda probe is processed inside the control unit by a special integrator which prevents sudden "oscillations".
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).
Through this probe it is therefore possible to adjust engine carburetion precisely. Among other items, this makes it possible to meet emission limit regulations.

- **Timing variator control:**

The electro-mechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts the intake timing according to the load and rpm of the engine. This device is activated by the control unit at higher engine operating speeds (above 1,600 rpm and with load above 30%).

- **Knocking control:**

Through a knock sensor the control unit is informed if any pinging or "knocking" occurs and it corrects the spark advance "delaying" it accordingly; a further correction also takes account of the air temperature, in fact, when the temperature of the intake air is high, pinging is more accentuated.
**N.B.** The intaken air temperature sensor to be found just downstream of the air-flow meter, is not used to calculate the engine load but to control the knocking parameters.

- **Fuel vapour recovery:**

the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

- **E.G.R. valve control**

The percentage of exhaust gas to be returned to the engine is determined by the control unit taking account of a specific characteristic curve which depends on the engine load and speed: recirculation is only activated when the engine speed is between 2500 and 4000 rpm., also in relation to the temperature of the engine (higher recirculation percentage with high temperatures).

- **Connection with the air conditioner compressor:**

the control unit is connected with the air conditioner compressor and it cuts in the compressor in relation to operation of the engine.

See: GR. 80 - "HEATING AND VENTILATION".

- **Connection with ALFA ROMEO CODE system:**

on cars fitted with "electronic key" (ALFA ROMEO CODE), as soon as the Motronic control unit receives the signal that the key has been turned to MARCIA, it "asks" the Alfa Romeo CODE 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 two control units takes place on diagnosis line K already used for the Alfa Romeo Tester (see specific paragraph).

N.B. Before working on the system you are advised to read the corresponding chapter.

- **Self-diagnosis:**

the control unit possesses a **self-diagnosis system**, which continuously monitors the plausibility of the signals from the various sensors and compares them with the limits allowed: if these limits are exceeded, the system detects a fault and turns on the corresponding warning light on the instrument cluster.

The warning light turns on when the engine is started to indicate the initial test of the entire system (appr. 4 seconds), it then turns off if no errors have been memorised: otherwise it stays on.

For certain parameters, the control unit replaces the abnormal values with suitable ones so that the car can "limp" to a point of the Service Network.

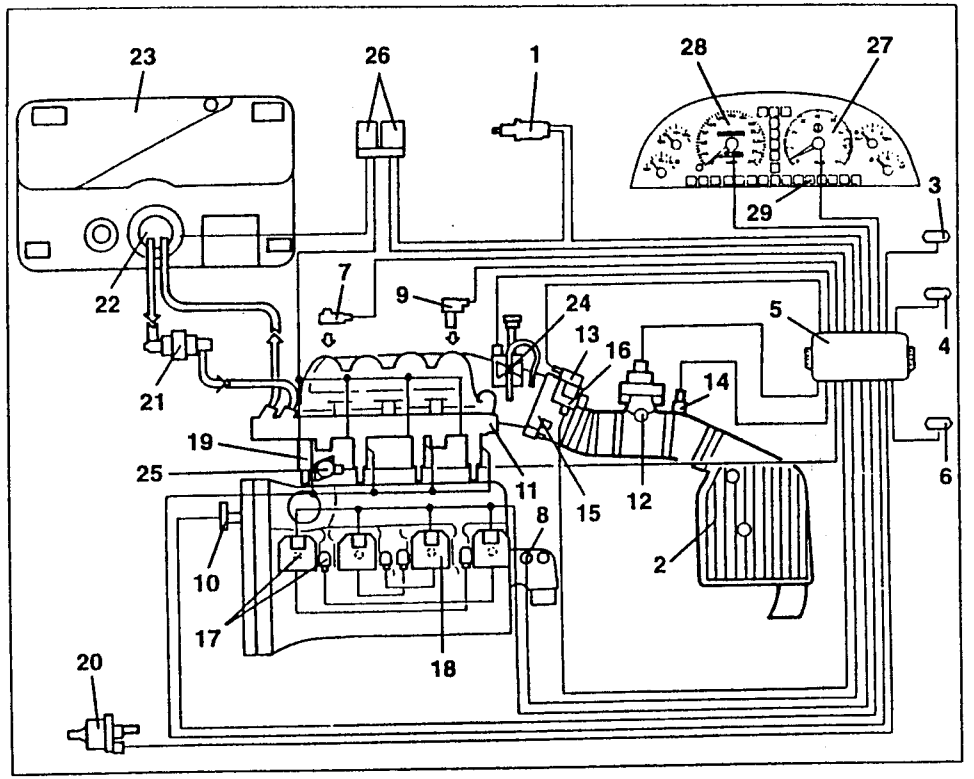
These "recovery" values depend on the other correct signals and they are defined individually by the control unit operating logic.

The self-diagnosis system also enables quick and effective location of faults connecting with the ALFA ROMEO Tester (see "Fault-finding"), through which all the errors memorised can be displayed. It is also possible to check the operating parameters recorded by the control unit and operate the single actuators to check whether they are working properly.



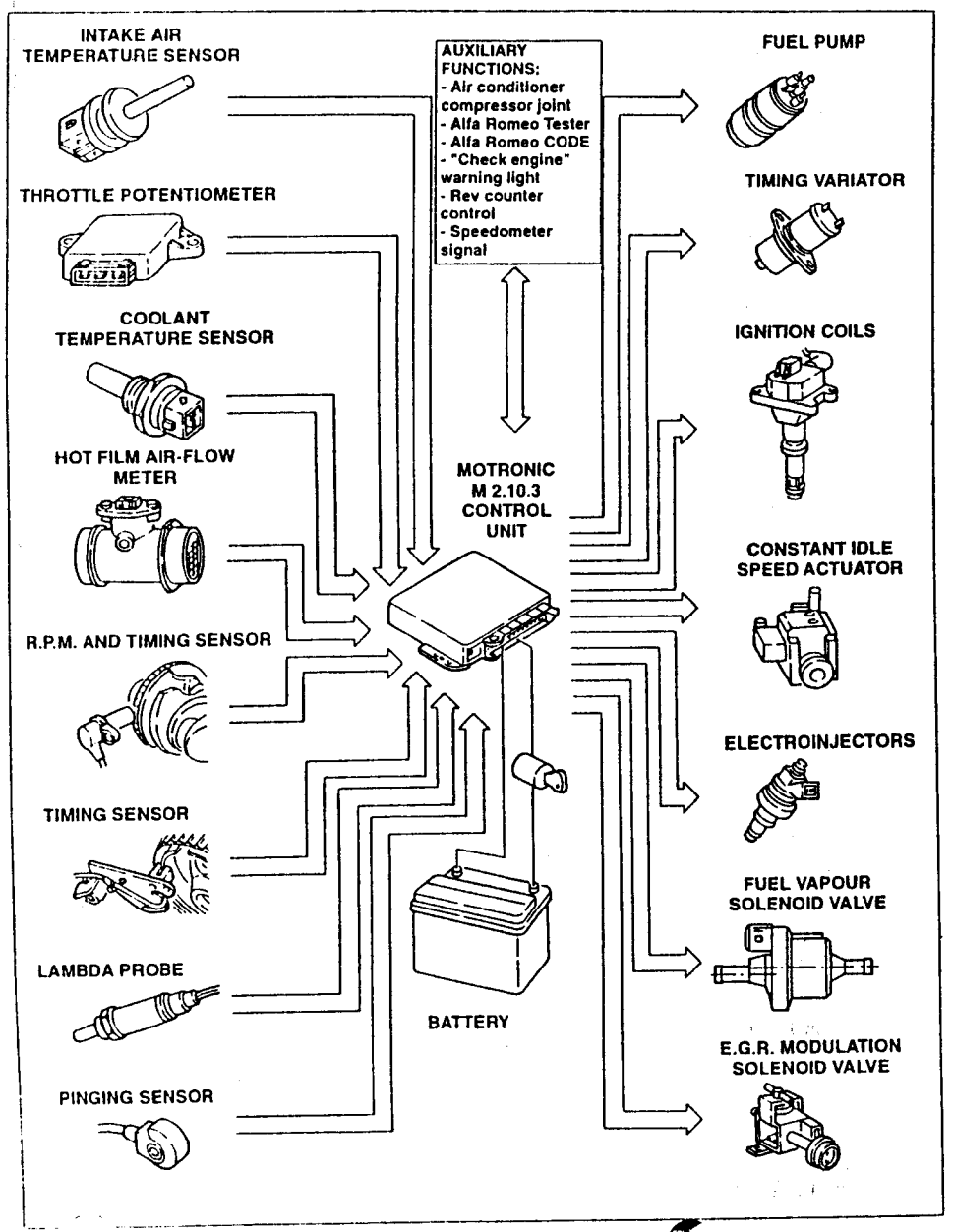


## COMPONENTS OF THE MOTRONIC M 2.10.3 ELECTRONIC INJECTION AND IGNITION SYSTEM




1. *Lambda sensor*
2. *Air cleaner*
3. *Climate control system connector*
4. *Diagnosis socket (Alfa Romeo Tester)*
5. *Injection - ignition control unit*
6. *Alfa Romeo CODE control unit connector*
7. *Pinging sensor*
8. *Coolant temperature sensor (NTC)*
9. *Rpm and timing sensor*
10. *Timing sensor*
11. *Fuel pressure regulator*
12. *Air-flow meter*
13. *Throttle potentiometer*
14. *Intake air temperature sensor (NTC)*
15. *Throttle body*
16. *Constant idle speed actuator*
17. *Spark plugs*
18. *Ignition coils*
19. *Electroinjectors*
20. *Fuel vapour solenoid valve*
21. *Fuel filter*
22. *Electric fuel pump*
23. *Fuel tank*
24. *E.G.R. modulation solenoid valve*
25. *Timing variator*
26. *Set of relays*
27. *Rev counter*
28. *Speedometer*
29. *"Check engine" warning light*

## FUNCTIONAL LAYOUT OF MOTRONIC M 2.10.3 INJECTION - IGNITION SYSTEM








# BOSCH MOTRONIC M 2.10.4 ELECTRONIC INJECTION AND IGNITION SYSTEM (Specific for 1970 1596 1747 '96 versions)

## GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions.
This is the M 2.10.4 version of the proven and reliable BOSCH MOTRONIC system.
Compared with the previous versions this new M 2.10.4 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions engine cooling fan).
Owing to the use of new sensors and updated programmes the system also makes it possible to achieve considerable improvements in terms of consumption, emission levels and vehicle handling.
Another feature of this system is self-adaptation, namely the capability of detecting the changes that take place in the engine and compensate them, according to functions which mainly correct:
- mixture titration;
- carburetion parameters according to the command of the evaporative solenoid valve;
- the adaptation plan for idle speed control.

## FUNCTIONS OF THE SYSTEM

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

With this control unit injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds actuated through the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimum point of injection, calculated by the control unit according to special maps according to the load, speed and temperature of the engine.

### Static ignition

An ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences; lastly it reduces the number of high voltage cables and connectors.
Static ignition takes place through four coils, according to the logic known as "lost spark".
Each of the four coils supplies the spark plug of the cylinder below and simultaneously that of the cylinder paired cylinder but in the same position (central with central, side with side).
NOTE: this way it is impossible to invert the spark plug cables during servicing operations.
This solution exploits the different environment conditions existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the spark is useful, whereas for the corresponding cylinder which is at the end of the exhaust stroke in the presence of exhaust gas, the spark is lost.
This T.SPARK - 16 valve engine requires the adoption of two spark plugs of different size: a "central" larger one and a smaller "side" one.

## Metering the air flow rate

The air flow metering system has been newly designed and it is of the "heated film" type.
Outside the air-flow meter looks like a part of duct between the intake manifold and the air cleaner. Inside the air-flow meter there is an electronic circuit and a plate that is crossed by air which passes into the duct. The film plate is kept at a constant temperature appr. 120°C above the temperature of the incoming air) by a heating resistance placed in contact with it.
The mass of air flowing through the duct tends to withdraw heat from the plate; therefore, to keep its temperature constant. a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.
N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure, etc.)
This air flow meter does not incorporate the intaken air temperature sensor which is separate, to be found just upstream of the air flow meter itself.

## Cylinder detection

Following the adoption of the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence.
The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.
Conversely, the rpm sensor sends a reference signal each turn of the engine and each subsequent tooth of the phonic wheel informs the control unit of an increase in the angular position of the crankshaft, so that the correct injection and ignition are sent to the appropriate cylinder.

## Fuel pump

The complex control logic of the fuel pump carried out by the control unit (chiefly based on the rpm signal) immediately cuts off the supply to the engine as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.
In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously.
This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents which do not cause the engine to stop immediately.

## Timing variator

This T. SPARK 16 valve engine is fitted with an electromechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts the intake timing (advance) so that timing that offers the best performance levels is obtained.
This mechanism is activated by the control unit only after exceeding a determinate engine rpm and load so that correct operation of the engine at low speed is not adversely affected.





## Exhaust gas recirculation

NOx (nitric oxide) is generated at high temperatures in the combustion chamber.
To reduce these emissions an E.G.R. (Exhaust Gas Recirculation) system has been adopted which, by recirculating part of the exhaust gas, lowers the temperature in the actual chamber, thereby also the Nox.
Part of the exhaust gas is withdrawn by the special E.G.R. valve and then re-admitted to the intake box where it is mixed with the intake air and recycled in the engine. The E.G.R. valve is modulated by a control solenoid valve controlled by the control unit and as a result of the type of control, in addition to reducing Nox it is also possible to optimise consumption.
The percentage of exhaust gas to be sent back to the engine is determined by the control unit taking account of a specific characteristic curve which depends on the load, speed and temperature of the engine.

## OPERATING LOGIC

**- Identification of the "operating point":**
the "point of operation of the engine" is located mainly through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

**- Adjustment of injection times (quantity of fuel):**
the control unit controls the injectors very quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine.
Injection is "sequential and timed", i.e. the injectors are opened in correspondence of the exhaust stroke of the associated cylinder.

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

**- Cold starting control:**
during cold starts the control unit uses special advance values and injection times in order to reach the required load more rapidly.

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

**- Fuel cut-off during deceleration:**
with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The cutoff threshold values varies according to the temperature of the engine and the speed of the car.

**- Control of idle speed:**
the adjustment of the engine idle speed is carried out through the special actuator, fitted directly on the throttle body, which acts on the throttle by-pass.
This device acts as a regulator for cutting in the various services (e.g. conditioner compressor): in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.
The system also controls the cutting in of the radiator cooling fan, if necessary, compensating the engine idling speed.

**- Maximum Rpm limiting:**
above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

**- Combustion control -lambda probe-:**
the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.
The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture).
The electric signal sent by the probe to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300°C).
Through this probe it is also possible to adjust engine carburetion precisely. Among other items, this makes it possible to meet emission limit regulations.

**- Timing variator control:**
the electromechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts intake timing depending on the engine load and rpm. This device is activated by the control unit over idle speed (over 1,600 rpm and with load above 30%).

**- Pinging control:**
the control unit is informed about pinging or "knocking" through the pinging sensor and it corrects ignition advance delaying it accordingly.

**- Fuel vapour recovery:**
the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

**- E.G.R. control valve**
the percentage of exhaust gas to be sent back to the engine is determined by the control unit taking account of a specific characteristic curve which depends on the engine load and speed: recirculation is operated only when the engine speed is between 2500 and 4000 rpm, also depending on the temperature of the engine (recirculation percentage higher with high temperatures).





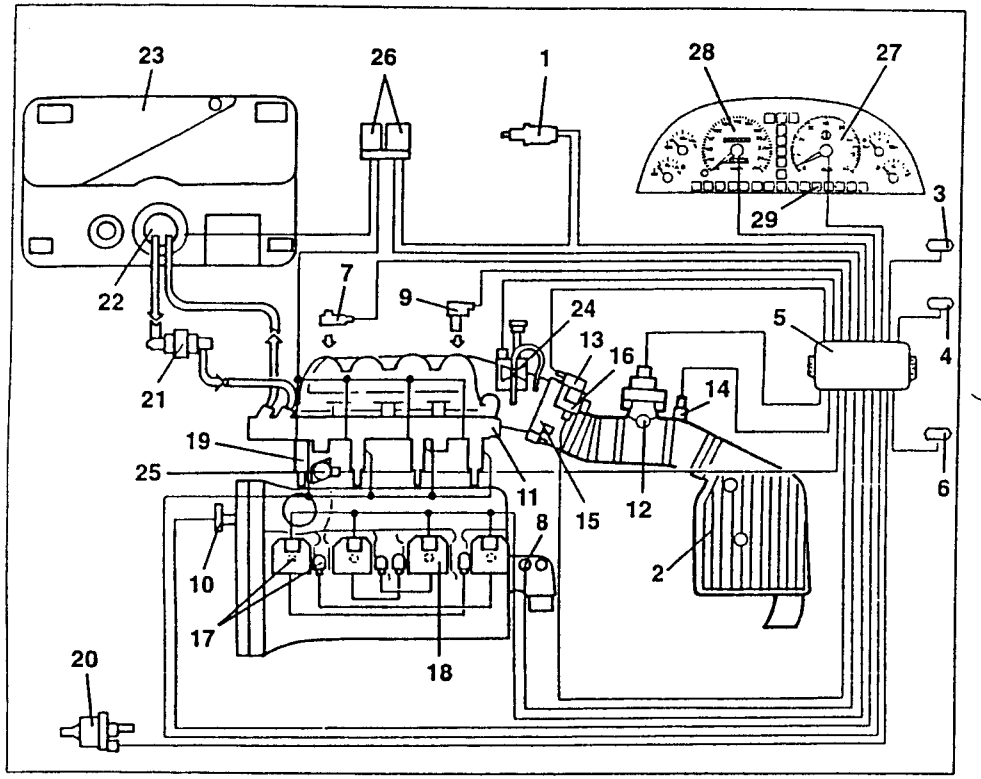
**- Connection with the conditioner compressor:**
the control unit is connected with the air conditioning system and controls the cutting in of the compressor and fan according to the operating conditions of air conditioning system.
See: GR. 80 - "HEATING AND VENTILATION".

**- Connection with the radiator cooling fan:**
in this version the cooling fan control thermal contact on the radiator has been eliminated.
The fan command for the first and second speed is supplied by the injection control unit depending on the temperature measured by the coolant fluid temperature sensor of the MOTRONIC system.

**- Connection with the Alfa Romeo Code system:**
on cars fitted with "electronic key" (Alfa Romeo CODE), as soon as the Motronic control unit receives the "key at MARCIA" signal, it asks the Alfa RomeoCODE system for consent to start the engine: this consent only takes place if the Alfa Romeo CODE control unit recognises the code of the key engaged in the ignition switch as correct. This conversation between the two control units takes place on diagnosis line K already used by the Alfa Romeo Tester (see specific paragraph).
N.B. Before working on the system, you are advised to read the associated chapter.

**- Self-diagnosis:**
The control unit possesses a diagnosis system which continuously monitors the signals leading from the various sensors checking their plausibility and comparing them with the permissible limits: if these limits are exceeded, the system detects a fault and turns on the warning light on the instrument cluster.
The warning light turns on when the engine is started to indicate the initial test of the whole system (appr. 4 seconds), then it goes off if no errors are memorised: otherwise it stays on.
For certain parameters, the control unit replaces the abnormal values with suitable mean ones to enable the car to "limp" to a point of the Service Network. These are known as "recovery" values, they depend on the other correct signals and are defined individually by the control unit operating logic. The system also makes it possible to quickly locate faults by connecting with the Alfa Romeo Tester (see "Fault- finding"), through which all the errors memorised can be displayed.
It is also possible to check the operating parameters recorded by the control unit and command the turning on of the single actuators to check whether they are working properly.

## COMPONENTS OF THE MOTRONIC M 2.10.4 ELECTRONIC INJECTION AND IGNITION SYSTEM

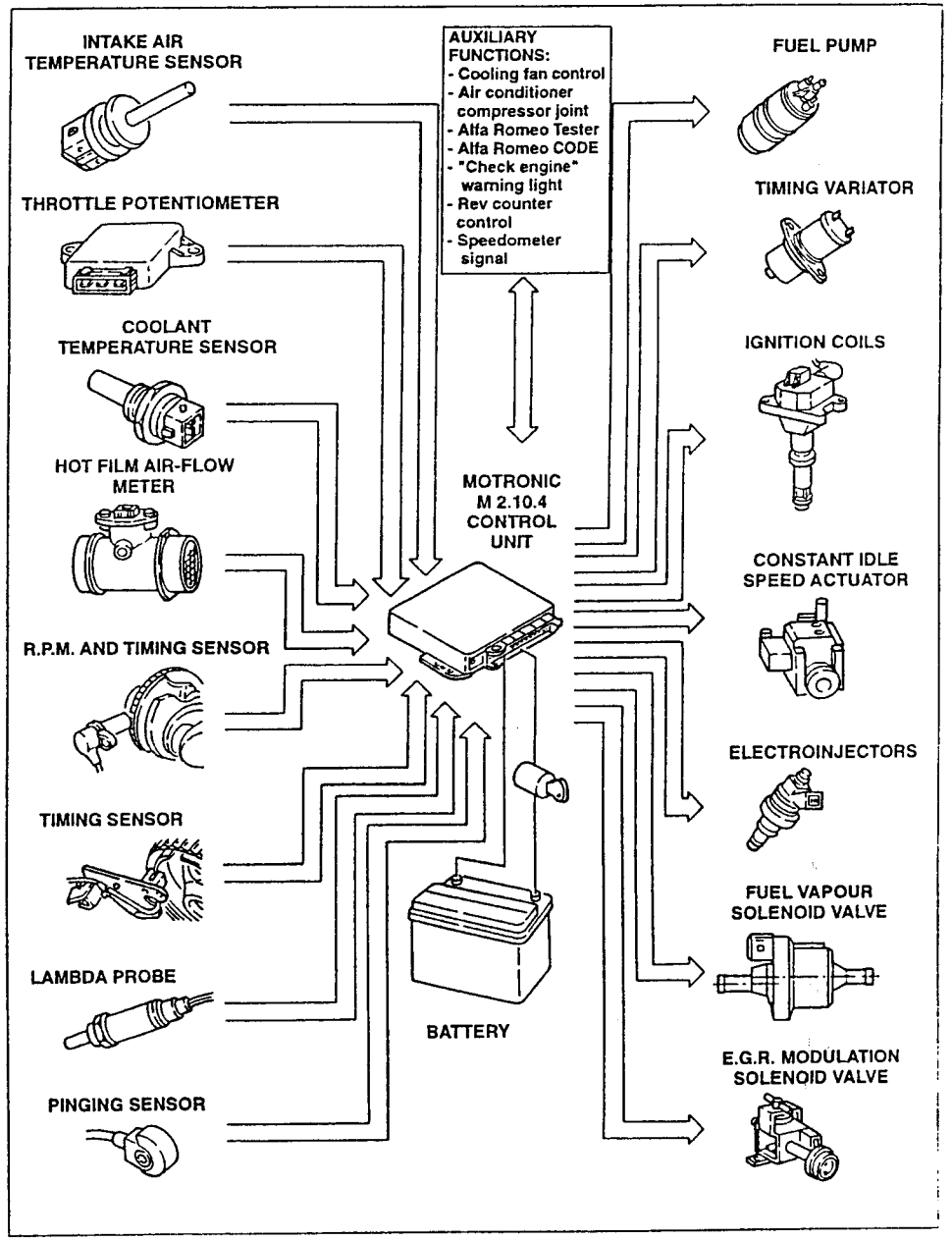



1. *Lambda sensor*
2. *Air cleaner*
3. *Climate control system connector*
4. *Diagnosis socket (Alfa Romeo Tester)*
5. *Injection - ignition control unit*
6. *Alfa Romeo CODE control unit connector*
7. *Pinging sensor*
8. *Coolant temperature sensor (NTC)*
9. *Rpm and timing sensor*
10. *Timing sensor*
11. *Fuel pressure regulator*
12. *Air-flow meter*
13. *Throttle potentiometer*
14. *Intake air temperature sensor (NTC)*
15. *Throttle body*
16. *Constant idle speed actuator*
17. *Spark plugs*
18. *Ignition coils*
19. *Electroinjectors*
20. *Fuel vapour solenoid valve*
21. *Fuel filter*
22. *Electric fuel pump*
23. *Fuel tank*
24. *E.G.R. modulation solenoid valve*
25. *Timing variator*
26. *Set of relays*
27. *Rev counter*
28. *Speedometer*
29. *"Check engine" warning light*





## FUNCTIONAL LAYOUT OF MOTRONIC M 2.10.4 INJECTION - IGNITION SYSTEM

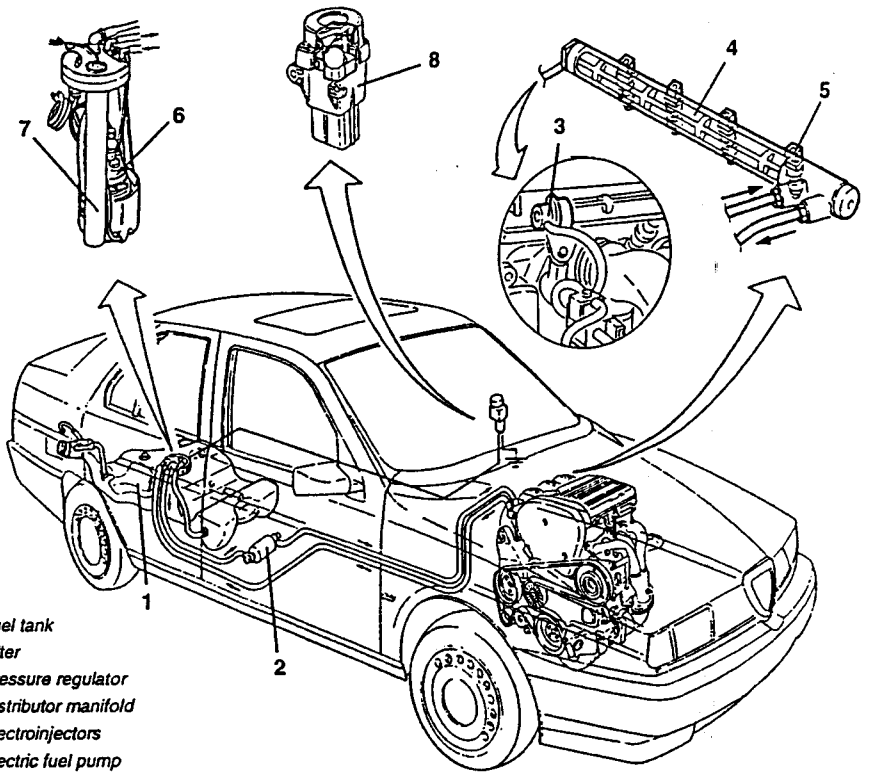


# WHITE





## FUEL SUPPLY SYSTEM




*1. Fuel tank*
*2. Filter*
*3. Pressure regulator*
*4. Distributor manifold*
*5. Electroinjectors*
*6. Electric fuel pump*
*7. Fuel level gauge*
*8. Inertial switch*

## DESCRIPTION

The fuel supply circuit comprises an electric fuel pump (6) located in the fuel tank (1) which sends the fuel under pressure through a special tube to the filter (2).
From here the fuel is sent to the distributor manifold (4) which distributes it to the electroinjectors (5).
The fuel in excess returns to the fuel tank via a special tube, through the pressure regulator (3) fitted directly on the distributor manifold and controlled by the vacuum withdrawn from the intake box.
The amount of fuel injected depends solely on the injection time which is controlled by the control unit.

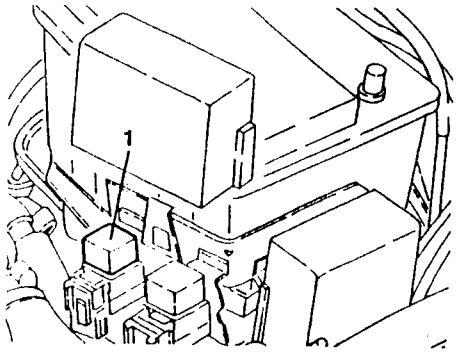
The different sections of the fuel pipes are connected by special connectors (for their disconnection see specific paragraph).
The fuel supply system is fitted with an inertial switch (8) which is triggered in the event of a crash, cutting off the connection to earth of the fuel pump thereby also the injection system supply.

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

## WARNINGS

Before doing any work on components of the fuel supply system, in order to prevent any dangerous leaks, proceed as follows:

- Disconnect the fuel pump supply relay (1).




- Run the engine until it stops.

## FUEL PIPE CONNECTION FITTINGS ("JOHN GUEST" TYPE)

### Cleaning for disconnection

Preferably use one of the following systems described in order of effectiveness.

a) Jet of warm water (max. 50°C) on the fitting and drying with jets of compressed air to prevent residual water in the interstices getting into the pipe after disconnection.

b) Jet of cold water and drying with compressed air.

c) Jet of hot water with neutral soap.

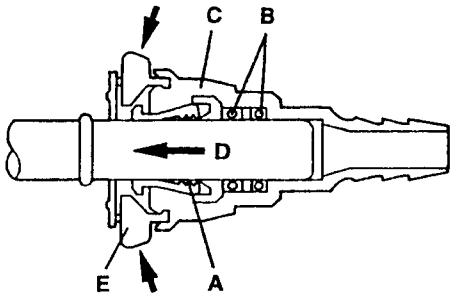
d) Jet of cold water with neutral soap.

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

### Disconnection operations

When installed, the fitting tends to act as follows for a certain length of time:

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




Therefore, to disconnect proceed as follows:

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

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

**NOTE: Do not use pliers, screwdrivers, etc.. for disconnecting.**

**If the coupling has not been tampered with and the above operations are correctly carried out, no tools are necessary.**





## FUEL PIPE CONNECTION FITTINGS ("HURON" TYPE)

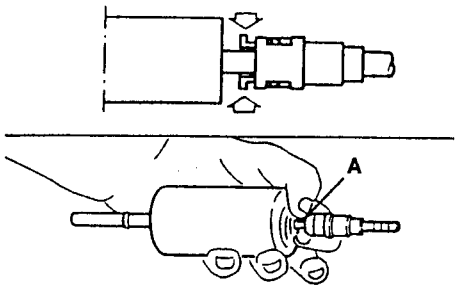
### Operations to be carried out before disconnection

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

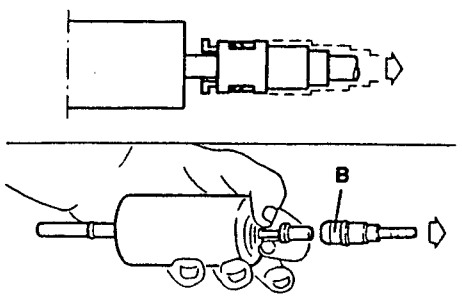
**Never use solvents and/or materials that are not compatible with the pipes in general and for the connector in particular, not compatible with nylon and acetalic resin.**

### Operations for disconnection/connection

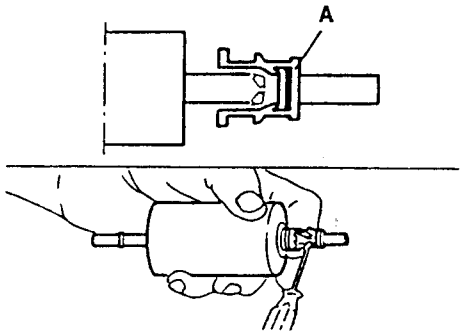
- Pinch the white transparent insert "A" between the thumb and forefinger and keep it pressed.



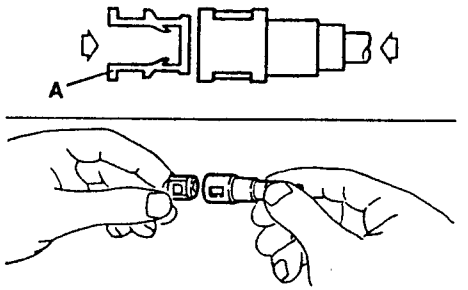

- With the other hand, grip the body "B" of the connector and pull in the direction of release.



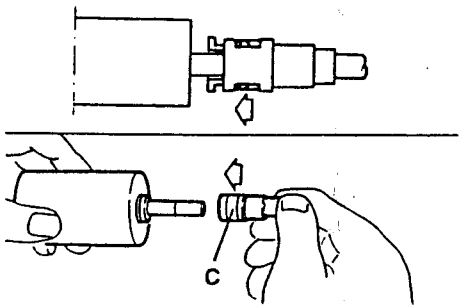

- Using a fine-tipped screwdriver in the points shown by the arrows, remove and retrieve the insert "A" taking care not to damage it.




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

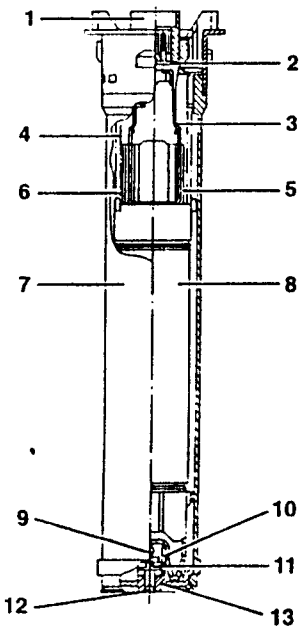



- Then connect the pipe with the quick coupling "C" pushing it until it clicks. Try to remove the coupling to make sure that it has been installed correctly.



## FUEL LEVEL GAUGE

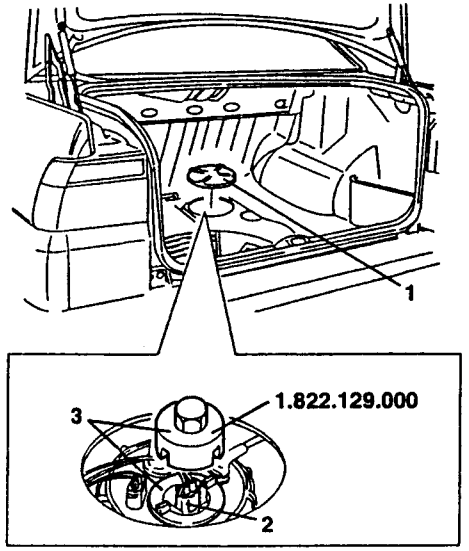
This is of the axial floating type and it is fastened to the tank by a bayonet coupling.
Its main feature is that it prevents the gauge pointer from swaying when cornering and on twisting roads.
This is because the float that runs inside the tube of the level gauge is submerged in the fuel and is therefore only sensitive to the hydrostatic thrust and not to the differences in level due to swaying of the vehicle.




1. *Connector*
2. *O-Ring*
3. *Sliding blade*
4. *Resistance*
5. *Common blade*
6. *Upper spring*
7. *Tube*
8. *Float*
9. *Adjustment pin*
10. *Lower spring*
11. *Cup*
12. *Cap*
13. *Base*

## REMOVAL/REFITTING

- Disconnect the battery (-) cable.
1. Working from the luggage compartment, remove the lower trim and remove the lid for access to the suction device and fuel level gauge.
2. Disconnect the connection from the fuel level gauge.
3. Remove the fuel level gauge using tool no. 1.822.129.000.




## CHECKS AND INSPECTIONS

For a complete functional check. see ELECTRICAL - ELECTRONIC DIAGNOSIS; to check the setting, using special tools, check that the data are within the specified limits.

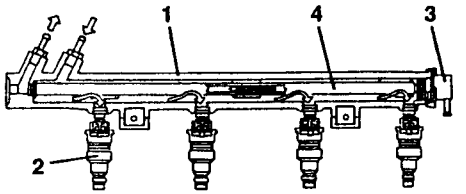
| Level (mm) | Gauge reading | Resistance (Ω) |
|---|---|---|
| 51.5 | 4/4 | 0 ÷ 7 |
| 125 | 3/4 | 56.5 ÷ 71.5 |
| 174 | 1/2 | 111 ÷ 131 |
| 211 | 1/4 | 181 ÷ 206 |
| 228 ± 3 | Max reserve | 262 |
| 238 | 0 | 290 ÷ 320 |





## FUEL DISTRIBUTOR MANIFOLD

This device is die-cast and incorporates the pressure regulator and the injectors fastened on the manifold itself by special catches.
The fuel returns to the tank through a pipe contained inside the manifold connected to the fuel pressure regulator.

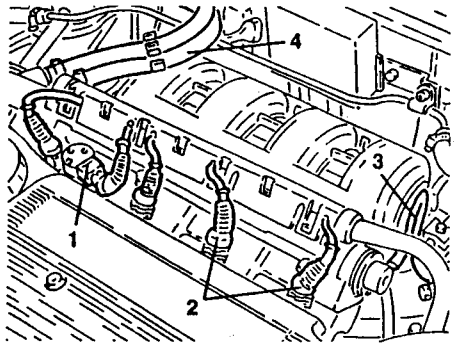



1. *Fuel distributor manifold*
2. *Electroinjectors*
3. *Pressure regulator*
4. *Excess fuel return pipe*

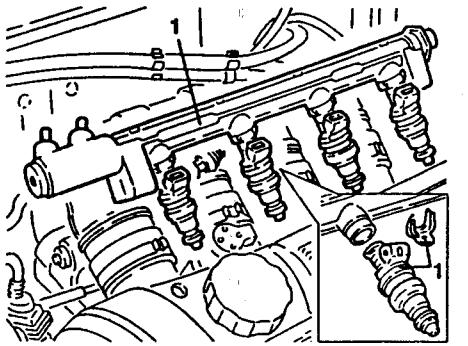
**NOTE: Never wash the fuel distributor manifold with aggressive fluids, this operation may only be carried out on the outside using a brush. Otherwise, damage may occur to the seals (O-rings) and to the return circuit plastic piping.**

## REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the timing variator solenoid.
2. Disconnect the electrical connections from the electroinjectors, then move aside the wiring after removing the guard.
3. Disconnect the vacuum takeoff pipe from the pressure regulator.
4. Disconnect the fuel return and delivery pipes from the distributor manifold.



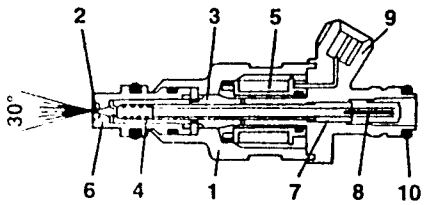

1. Slacken the two fastening screws and remove the fuel distributor manifold complete with injectors and pressure regulator and, if necessary, separate them on the bench.




## ELECTROINJECTORS

The electroinjectors are installed on a new aluminium distributor manifold which on one side incorporates the pressure regulator.
The injector nozzle is formed so that the jet of fuel atomizes into a 30° cone.
The injectors are locked by the fuel distributor which presses them into their housings machined on the intake ducts.
The injectors are also anchored to the fuel distributor by "safety catches" and sealed by two O-Rings.

The electroinjectors have the task of metering the amount of fuel needed by the engine.
They are "ON-OFF" devices i.e. they only have two possible conditions, either open or closed.
They will let the fuel pass when they are "open" and prevent it from being delivered when they are "closed".
They basically comprise a nozzle controlled by an electromagnet and by a return spring.
In the rest position, the needle, which forms one piece with the core, is pushed by the spring onto the electroinjector nose to close the hole and ensure that unwanted fuel is unable to come out.
As soon as the winding is energized, the core is attracted, it compresses the spring opening the nozzle hole, thereby allowing the fuel to flow out.
Considering the physical characteristics of the fuel (viscosity, density) and the pressure difference (pressure regulator) constant, the amount of fuel injected depends on the injector opening time only.
The winding energizing time is normally called the "injection time".




1. *Injector body*
2. *Needle*
3. *Magnetic core*
4. *Helical spring*
5. *Winding*
6. *Injector nose*
7. *Adjustable pressure plate*
8. *Filter*
9. *Electrical connection*
10. *Seal rings*

## CHECKING FOR CORRECT OPENING OF ELECTROINJECTORS

- Measure the quantity of CO at the exhaust.
- Disconnect the electroinjector connectors one by one; each time measure for a reduction of the CO quantity at the exhaust and check that this value remains constant at each check
- If not, locate and replace the faulty electroinjector; in any case a visual index of the efficiency of the electroinjectors is given by the spark plug electrodes:
  - a mixture which is too rich corresponds to a black colour.
  - a mixture which is too lean corresponds to a light colour.

## CHECKING THE SEALING OF ELECTROINJECTORS

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

## REMOVAL/REFITTING

Proceed as described in the procedure "Fuel distributor manifold - Removal/Refitting".

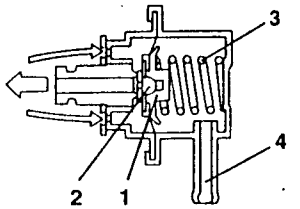
# FUEL PRESSURE REGULATOR

The task of the fuel pressure regulator is to keep the difference between the pressure of the fuel and the pressure in the intake manifold constant.
This way it is possible to meter the amount of fuel solely on the basis of the injector opening time.
The pressure regulator is fitted ddirectly on the fuel distributor manifold.
It is a limiting regulator a diaphragm which regulates the fuel pressure to appr. 3 bar.
When the fuel pressure exceeds the maximum rating, the diaphragm acts on a valve which opens the return pipe, through which the excess fuel is returned to the fuel tank.
A tube connects the regulator spring chamber to the air intake box.





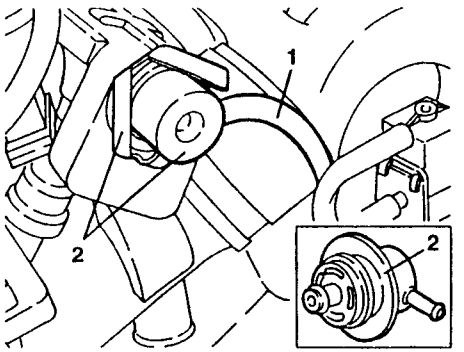
An interdependence is created by this connection between the pressure in the fuel circuit and the pressure in the intake manifold, so that the pressure between the inlet and outlet of the electroinjectors is always the same, when they are open.




1. *Diaphragm*
2. *Flow valve*
3. *Adjustment spring*
4. *Vacuum takeoff*

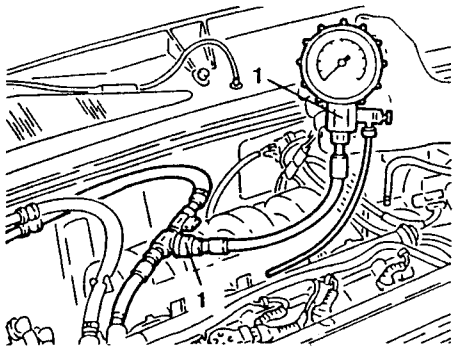
## REMOVAL/REFITTING

1. Disconnect the vacuum takeoff pipe from the fuel pressure regulator.
2. Remove the catch and withdraw the fuel pressure regulator complete with O-Ring from the fuel distributor manifold.




# CHECKING THE PRESSURE AND TIGHTNESS OF THE FUEL CIRCUIT

1. Disconnect the fuel inlet pipe from the distributor manifold, then connect a pressure gauge, through a Tee adapter, between the manifold and the disconnected pipe.

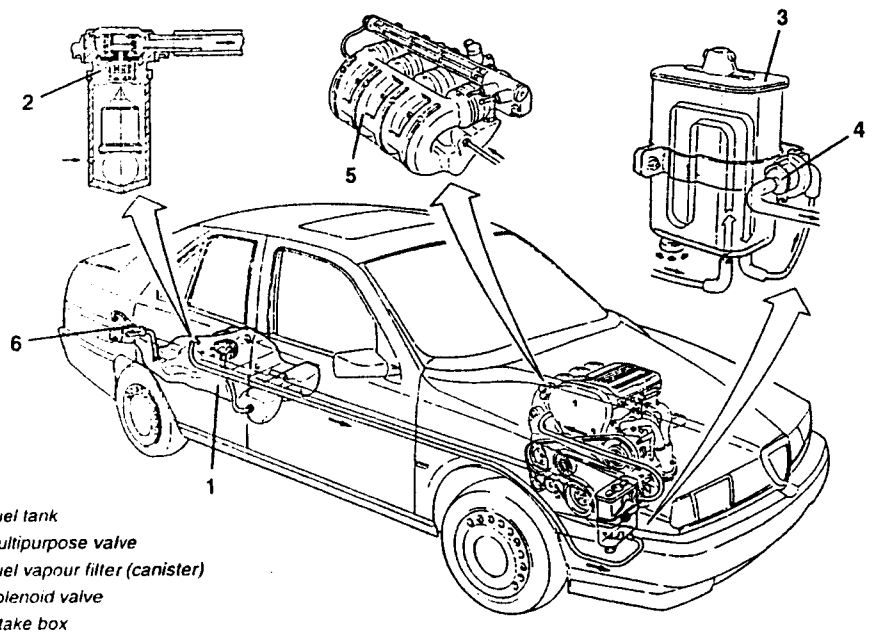



- Disconnect the fuel pressure regulator vacuum takeoff pipe to avoid any irregularities in the rotation speed from causing abnormal readings.
Start the engine and at idle speed check that the fuel pressure is within the specified limits.

| Fuel pressure at idle speed |
|---|
| 2.8 ÷ 3.2 bar |

- Reconnect the vacuum takeoff pipe on the regulator and check that the fuel pressure falls by ~ 0.5 bar and then rises again when the throttle valve opens.
If this fails to occur, look for any leaks in the vacuum takeoff pipe.
- Keeping the vacuum takeoff pipe connected to the regulator and with the engine running at idle speed, choke the distributor manifold outlet pipe noting the increase in pressure up to ~ 4 bar (do not allow the pressure to exceed this rating).
- If the pressure does not reach this rating and no leaks are detected, check the fuel filter and/or that the pump is working properly.

# FUEL VAPOUR RECOVERY SYSTEM




1. *Fuel tank*
2. *Multipurpose valve*
3. *Fuel vapour filter (canister)*
4. *Solenoid valve*
5. *Intake box*
6. *Safety valve*

## DESCRIPTION

The fuel contained in the tank produces a considerable amount of vapours, which would pollute the environment if released.
The vapour control and recovery system gathers these vapours and burns them in the engine.
When the vapours inside the fuel tank reach a pressure of 0.038 ÷ 0.053 bar, they are sent through a multi-purpose valve (7) to the fuel vapour filter canister (3) through a special pipe. The canister absorbs and stores these vapours by the active carbon contained in the filter.
There is a solenoid valve (4) between the fuel vapour filter and the intake box (5); when the solenoid valve is not activated the connection with the intake is closed and the fuel vapours are collected in the canister.

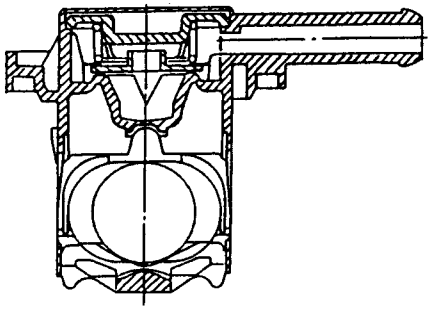
Under certain load conditions the control unit controls the opening of the solenoid valve allowing any fuel vapours in the canister to be withdrawn.
This condition remains even if at the exhaust the lambda sensor detects a reduction of oxygen which, due to the presence of too much fuel in the combustion chamber, is signalled to the control unit which delivers less fuel to the injectors so that the engine is always supplied under optimal conditions.
If there is a lack of fuel vapours in the canister resulting in the withdrawing of air alone, the lambda probe detects this and signals an increase of oxygen to the control unit. In this case the control unit closes the solenoid valve thus preventing the connection of the canister with the intake box, thereby eliminating the excess of air.





## MULTI-PURPOSE VALVE

The functions of this valve are the following:
- Pressurising the fuel tank
- Pressure maintenance
- Tightness in the event of overturning



### TANK PRESSURISING

Tank pressurising is maintained between **30 ÷ 45 mbar** using a fluorosilicone valve, rested on a sealing edge.
The valve is supported with a stainless steel plate countered by a spring.
When the pressure in the tank exceeds the specified limit, it overcomes the resistance of the spring and allows the valve to rise, letting the vapours flow to the canister.
When the pressure is within limits the valve closes again.

### MAINTENANCE

Under particular operating conditions of the vehicle, low temperatures and high engine load, a vacuum may form in the fuel tank.
In this case, the purpose of the valve is to maintain the pressure of the tank by admitting air.
A fault in this function can cause the car to stop or jerk, due to difficulty in supplying the pump.
This function is carried out by the goose-necked valve obtained directly on the fluorosilicone rubber piece.

### SEALING IN THE EVENT OF OVERTURNING (ROLL-OVER)

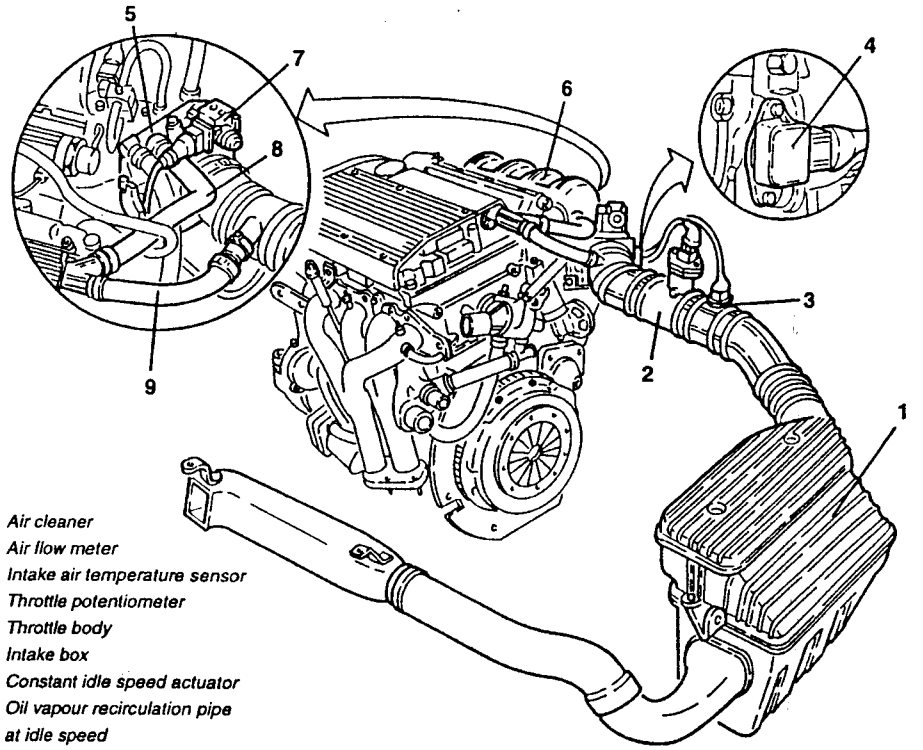
The purpose of the Roll-Over is to prevent fuel from spilling from the tank if the vehicle overturns or is sharply inclined.
During normal operation of the vehicle (bends, accelerating, braking, up-hil driving, etc.) the fuel is swayed causing it to evaporate with the likelihood of overflowing to the canister.
The considerable sensitivity of the Roll-Over valve prevents or limits this.
The closing angle of the Roll-Over valve, for this version, fitted directly on the tank is **< 24°**.

# WHITE





## AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM




1. *Air cleaner*
2. *Air flow meter*
3. *Intake air temperature sensor*
4. *Throttle potentiometer*
5. *Throttle body*
6. *Intake box*
7. *Constant idle speed actuator*
8. *Oil vapour recirculation pipe at idle speed*
9. *Oil vapour recirculation pipe*

### DESCRIPTION

The air, drawn in through a dynamic inlet and filtered by a cartridge element (1), reaches the throttle body (5) through the corrugated sleeve on which the hot film air-flow meter (2) and the intake air temperature sensor (3) are fitted.

The latter, controlled by the accelerator cable, adjusts the amount of air drawn into the box (6).

On one side of the throttle body there is the potentiometer (4) fastened to the pivot pin of the throttle itself which informs the control unit of the position of the throttle.

An additional air solenoid valve (7) on the throttle body by- passes the throttle through a special pipe to keep the idle rpm constant during particular operating conditions of the engine.

The fuel vapours (see specific paragraph) and the oil vapours flow to the air supply system.

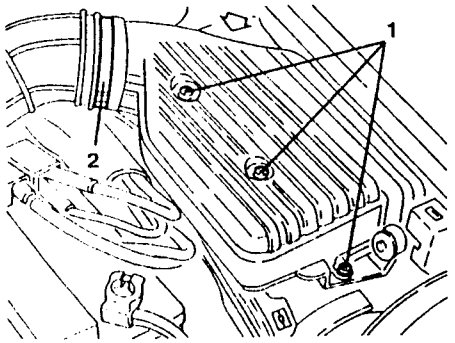
The oil vapours are formed when the engine is running and they are collected in the cylinder head from which the condensed oil returns to the crankcase, while the remaining vapours are sent to the intake through two pipes.

When the engine is running at idle speed the oil vapours are ducted to the throttle body through the special pipe (8).

At higher loads, the vapours are sent upstream of the throttle valve through a pipe (9) connected with the corrugated sleeve and then burnt in the engine.

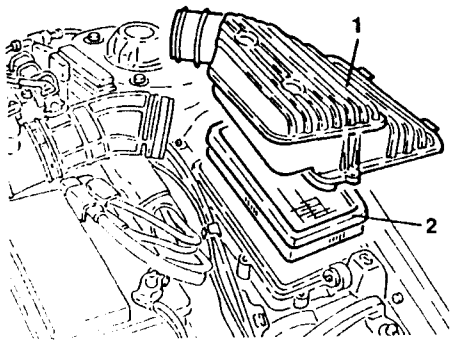
## CHANGING THE AIR CLEANER CARTRIDGE

1. Slacken the four air cleaner cover fastening screws.
2. Slacken the clamp fastening the air claner cover to the corrugated sleeve.




1. Remove the air cleaner cover.
2. Remove the air cleaner cartridge.

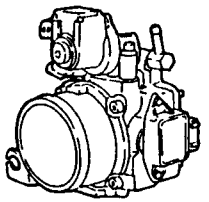
**WARNING:**
**Any filter cleaning operation might damage it, thereby adversely affecting the correct operation of the engine.**




## THROTTLE BODY

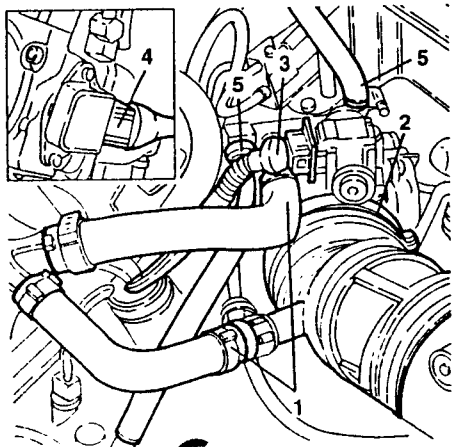
The throttle body adjusts the amount of air sent to the intake box in relation to the position of the accelerator pedal.

In fact, the accelerator acts on a specific sector of pulley locked on the throttle valve pivot pin.
A coil spring allows the throttle to return to the closed position.
To prevent the formation of ice on the throttle valve which would prevent it from closing, the throttle body is heated by the engine coolant fluid.
The constant idle speed actuator is installed directly on the throttle body.



### REMOVAL/REFITTING

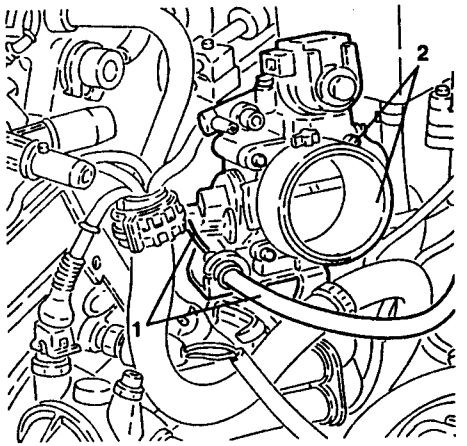
- Disconnect the battery (-) terminal.
1. Disconnect the oil vapour recirculation pipes from the throttle body and from the corrugated sleeve.
2. Slacken the fastening clamp and disconnect the corrugated sleeve from the throttle body.
3. Disconnect the electrical connection from the constant idle speed actuator.
4. Disconnect the electrical connection from the throttle potentiometer.
5. Disconnect the two engine coolant fluid inlet and outlet pipes from the throttle body.








1. Disconnect the accelerator cable from the throttle.
- Release the pipes from the fastenings on the bracket under the throttle body.
2. Slacken the four fastening screws and remove the throttle body complete with potentiometer and constant idle speed actuator and separate them on the bench.
- Remove the throttle body seal.

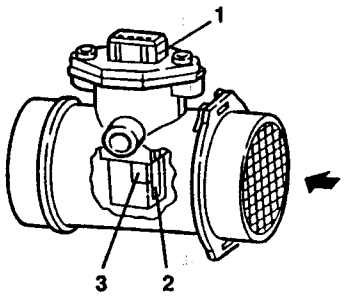



## AIR-FLOW METER

The air flow meter is of the "heated film" type.
Its operating principle is based on a heated diaphragm interposed in a measurement duct through which the air admitted to the engine flows.
The hot film diaphragm is kept at a constant temperature (~ 120°C above the temperature of the incoming air) by the heating resistance in contact with it.
The mass of air crossing the measurement duct tends to withdraw heat from the diaphragm, therefore, in order to keep its temperature constant, a certain amount of current must flow through the resistance.
This current is measured by a suitable Wheatstone bridge.
Thus, the current is proportionate with the mass of flowing air.

**NOTE:**
**This air-flow meter measures directly the mass of air and not the volume) thereby eliminating problems of temperature, altitude, pressure, etc.**

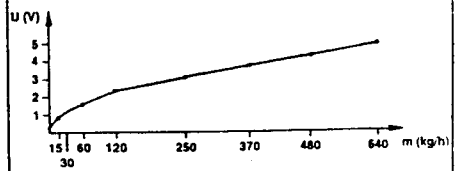
**The correct operation of the air flow meter depends on the condition of the air cleaner, which must therefore be checked often.**




1. *Connector*
2. *Measurement duct*
3. *Hot film sensor*

| TECHNICAL CHARACTERISTICS | |
|---|---|
| Current that crosses the diaphragm: | |
| flow rate (kg/h) | current (A) |
| 0 | ≤ 0.25 |
| 640 | ≤ 0.80 |

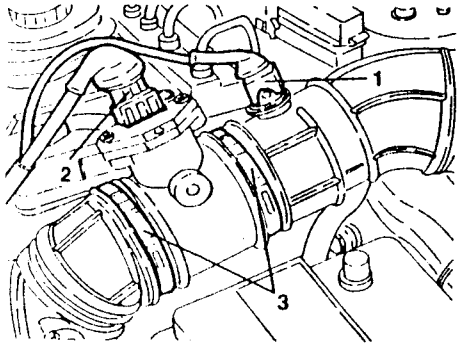
Characteristic curve of sensor



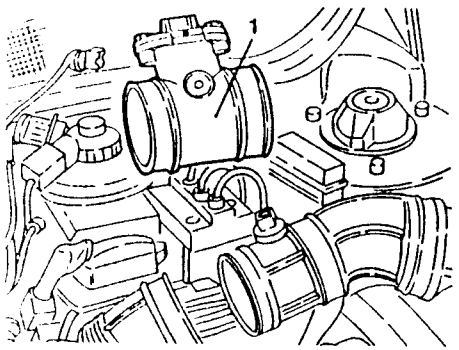

m = flow rate
U = voltage between pins 4 and 2

## REMOVAL/REFITTING

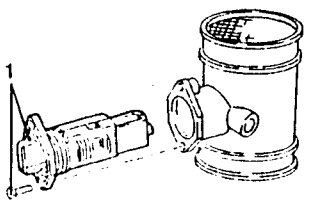
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection of the intake air temperature sensor.
2. Disconnect the electrical connection from the air-flow meter.
3. Slecken the two clamps fastening the corrugated sleeve to the air-flow meter.




1. Withdraw and remove the air-flow meter from the corrugated sleeve.




1. If necessary, slacken the two fastening screws and remove the air flow meter from its support.

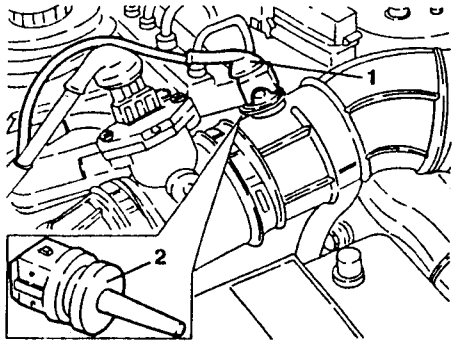



## INTAKE AIR TEMPERATURE SENSOR (NTC)

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

## REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the intake air temperature sensor.
2. Withdraw and remove the intake air temperature sensor from the corrugated sleeve.




## THROTTLE POTENTIOMETER

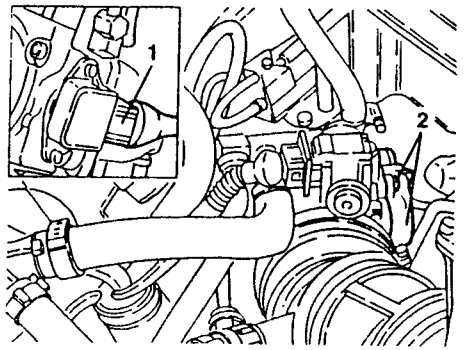
This is a potentiometer the mobile part of which is controlled directly by the throttle valve shaft.
The potentiometer signals the control unit instantaneously when there is the need for "full power", anticipating the signal from the air-flow meter which records a considerable increase of the flow of air, thereby obtaining a more immediate response.
The potentiometer automatically detects the throttle closed position through a "self-adapting" function.
This eliminates the need for potentiometer adjustment operations and makes it possible to follow in time any wear occurring on the throttle closing position.





## REMOVAL/REFITTING

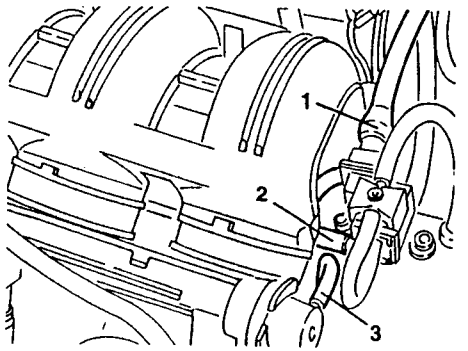
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the throttle potentiometer.
2. Slacken the two fastening screws and remove the throttle potentiometer.




## AIR INTAKE BOX

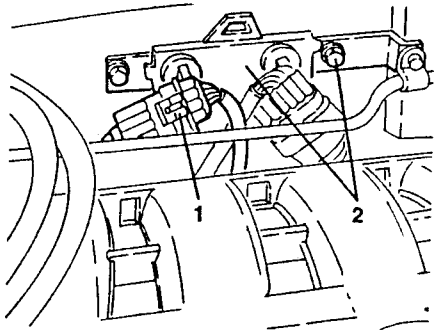
## REMOVAL/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the throttle body (see specific paragraph).
1. Disconnect the electrical connection from the E.G.R. modulation solenoid valve.
2. Disconnect the E.G.R. valve connection pipe from the modulation solenoid valve.
3. Disconnect the vacuum takeoff pipe for the fuel pressure regulator.

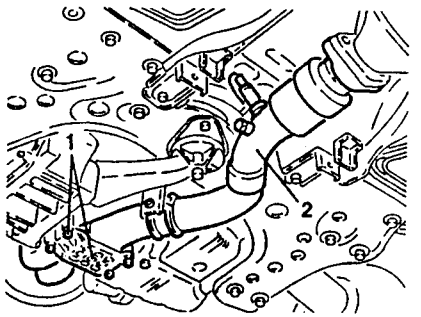



- Disconnect the vauum takeoff pipe from the servobrake.

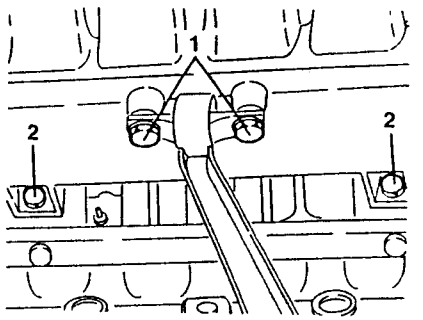
1. Disconnect the lamda probe connector.
2. Slacken the fastening screws and remove the electrical connection support bracket.



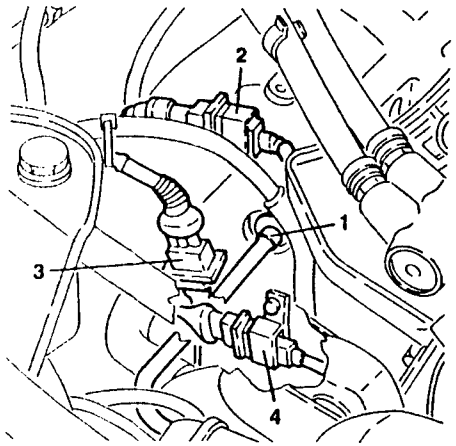

1. Raise the car, slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda probe after slackening the fastenings.



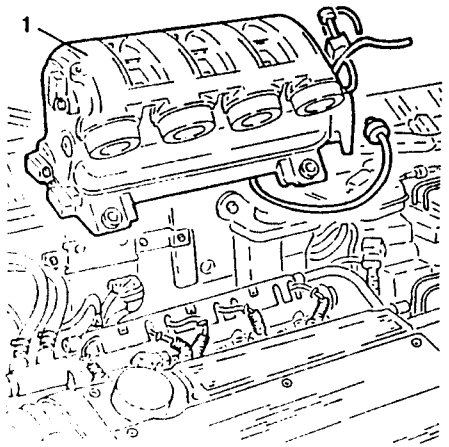

1. Slacken the two screws fastening the support to the intake box.
2. Slacken the two screws fastening the intake box to the cylinder head.



1. Lower the car and disconnect the fuel vapour recirculation pipe from the intake box.
2. Disconnect the electrical connection of the the timing sensor.
3. Disconnect the electrical connection of the pinging sensor.
4. Disconnect the electrical connection of the rpm and timing sensor.




1. Slacken the fastening clamps and remove the intake box pulling it upwards.



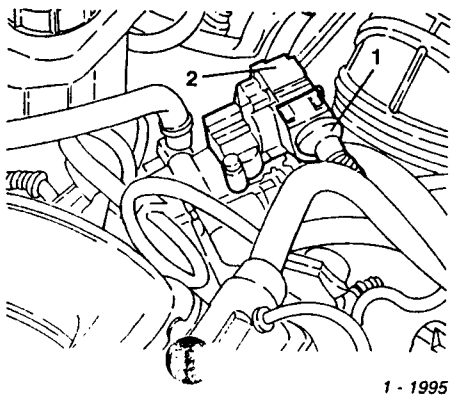

PA19...116V001

## CONSTANT IDLE SPEED ACTUATOR

Idle speed rpm is controlled by an actuator fitted directly on the throttle body, but since it is more compact and can be operated individually, it is on the whole more cost-effective and reliable. The actuator adjusts the amount of air taken in by the engine when the throttle valve is closed. This makes it possible to compensate the power required by the various services (conditioner compressor, power steering, alternator) so that the engine speed remains unaffected.
The opening and closing controls are independent due to a double electromagnetic circuit with considerable advantages in terms of prompt adjustment.
In fact, as the control unit is "self-adaptive", it is necessary to follow and "detect" the changes that occur in the engine (different internal frictions at different temperatures, settling of the engine over the course of time etc.) so that idle speed remains constant under all conditions.
Lastly, in the event of a fault, a spring moves the actuator to an intermediate degree of opening to enable the car to reach an authorised service centre.

### REMOVAL/REFITTING

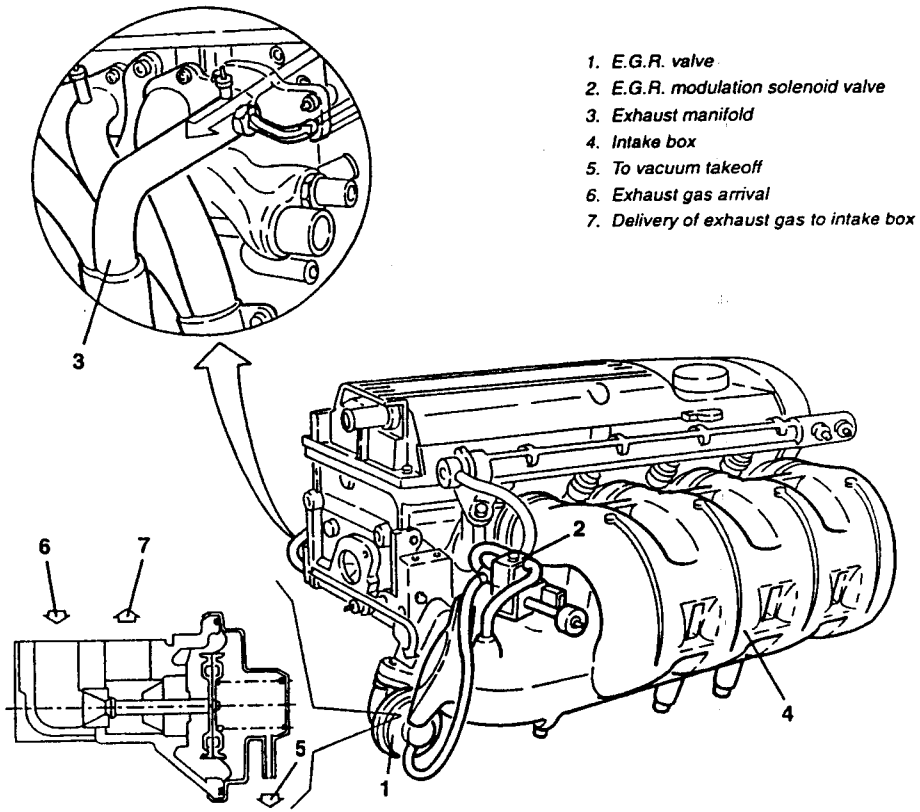
- Disconnect the battery (-) terminal.
1. Disconnect the electrical connection from the constant idle speed actuator.
2. Slacken the two fastening screws and remove the constant idle speed actuator from the throttle body.
- Remove the seal.








# EXHAUST GAS RECIRCULATION SYSTEM




1. *E.G.R. valve*
2. *E.G.R. modulation solenoid valve*
3. *Exhaust manifold*
4. *Intake box*
5. *To vacuum takeoff*
6. *Exhaust gas arrival*
7. *Delivery of exhaust gas to intake box*

## DESCRIPTION

To further reduce emissions of NOx (nitric oxides) the supply system is fitted with an E.G.R. valve (1).
The E.G.R. valve (Exhaust Gas Recirculation) withdraws part of the exhaust gas and returns it to the intake box (4), where it is mixed with the intake air and burnt in the engine.
The E.G.R. valve is operated by the vacuum modulated by the solenoid valve (2) controlled by the MOTRONIC control unit.
The amount of exhaust gas sent to the engine is determined by the MOTRONIC control unit, taking account of the characteristic curve of the E.G.R. control depending on the engine load and speed and on the temperature of the coolant fluid.
Through the MOTRONIC control unit the solenoid valve modulates the vacuum to be sent to the E.G.R. valve for opening.
The E.G.R. valve is not activated at idle speed, in neutral gear and for engine speeds below 2000 rpm. When the engine coolant fluid temperature excedds 60 °C the E.G.R. valve is operational and it it is completely closed at engine speeds in excess of 4600 rpm.

PA4978B116V00...

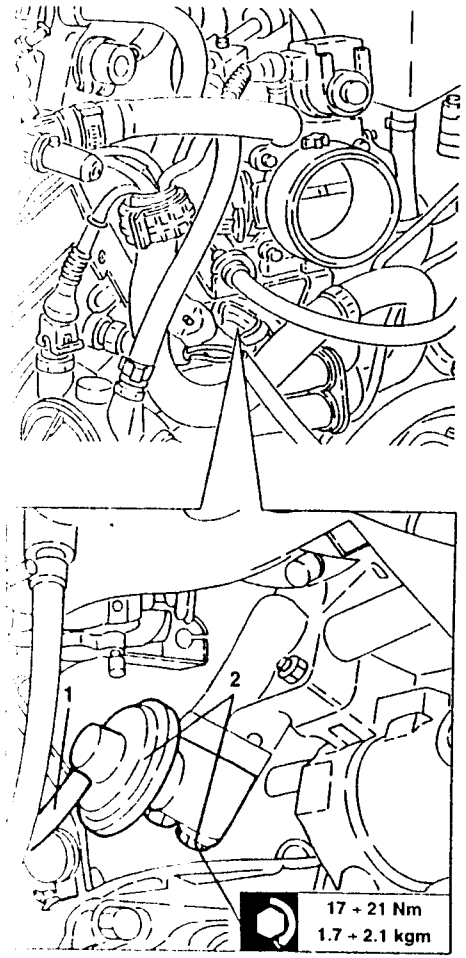
## E.G.R. VALVE

### REMOVAL/REFITTING

- Remove the battery.

Slacken the fastening clamp and disconnect the corrugated sleeve from the throttle body.

1. Disconnect the connection pipe to the modulation solenoid valve from the E.G.R. valve.
2. Slacken the two fastening screws and remove the solenoid valve from the intake box.

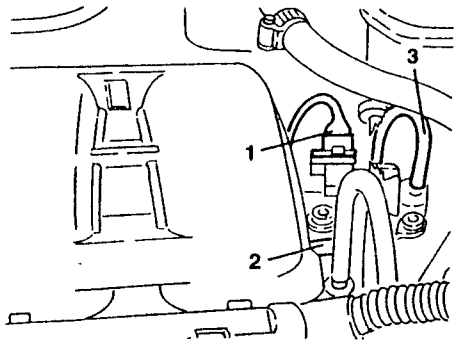



## E.G.R. MODULATING SOLENOID VALVE

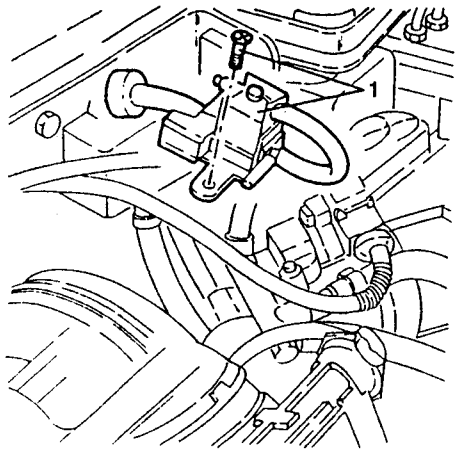
### REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection from the E.G.R. modulating solenoid valve.
2. Disconnect the the connection pipe with the E.G.R. valve from the modulation solenoid valve.
3. Disconnect the vacuum takeoff pipe from the E.G.R. modulation solenoid valve.



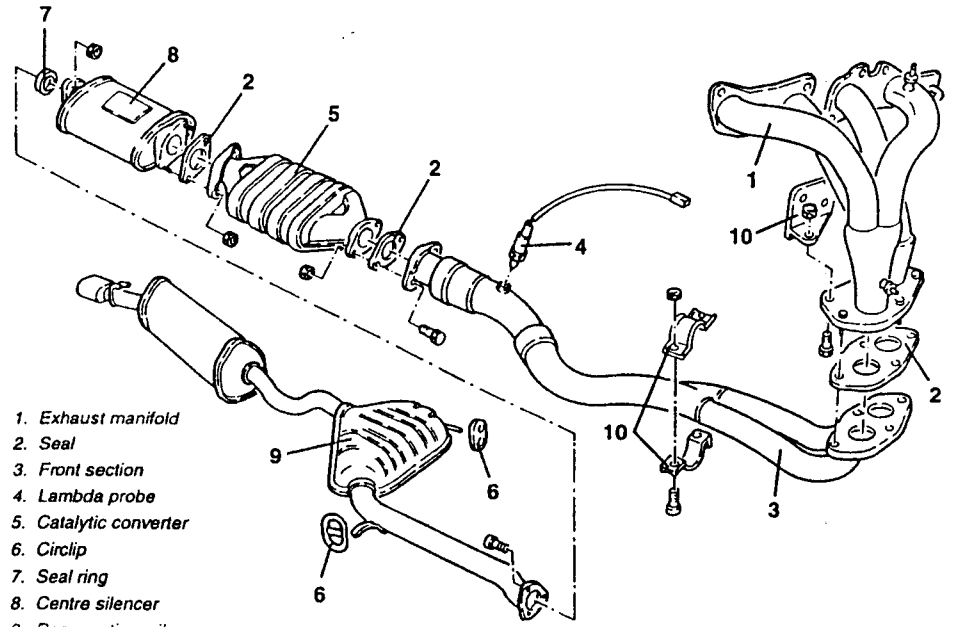

1. Slacken the two fastening screws and remove the E.G.R. modulation solenoid valve.








# EXHAUST SYSTEM




1. *Exhaust manifold*
2. *Seal*
3. *Front section*
4. *Lambda probe*
5. *Catalytic converter*
6. *Circlip*
7. *Seal ring*
8. *Centre silencer*
9. *Rear section, silencer*
10. *Supports*

## DESCRIPTION

The exhaust gases from the cylinder heads, flow in two double manifolds connecting underneath by a single glange. From these, through the front section of the exhaust pipe, they reach the three-way catalyst where most of the polluting substances are transformed.

On the front section of the exhaust pipe there is a flexible element which makes it possible to limit the transmission of vibrations and the exhaust gas takeoff socket downstream of the catalyst.

The lambda probe is installed on the front section of the exhaust pipe at the catalyst inlet and informs the control unit of the oxygen content in the exhaust gases, making it possible to adapt the injection time in order to keep the stoichiometric ratio (air-fuel) at an umptimum level.

The exhaust gases leave the catalyst and cross the three special silencers.

The connection between the different sections of the exhaust piping is made through flanges with interposed seals and supporting to the body is with brackets with flexible supports.

The very high heat radiated towards the body by the catalyst is limited by a series of heat shields between the exhaust piping and the body itself.

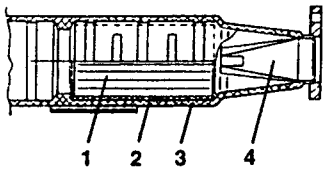
**WARNING:**
**During engine operation all the exhaust pipes and in particular the catalytic converter heat up considerably.**
**Before attempting any work, the system should be left to cool with the engine switched off.**
**Never touch the catalytic converter without adequate protection such as gloves, etc.**
**Do not allow easily inflammable material to come into contact with the catalytic converter.**

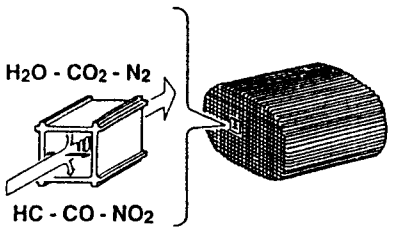
## CATALYTIC CONVERTER

Closed loop mixture titration control is activated by the lambda sensor which detects the amount of oxygen contained in the exhaust gases upstream of the catalyst. The measurements of the lambda sensor enable the control unit to continuously correct the mixture keeping the air/fuel ratio constant. This way harmful emissions to the exhaust are controlled and this is completed by the trivalent catalytic converter. The efficiency of the catalytic converter and as a result, the reduction of the harmfulness of the exhaust gases therefore depends on the air/fuel ratio with which the engine is supplied.
The trivalent catalytic converter makes it possible to contemporaneously reduce the three pollutants in the exhaust gases:
- unburnt hydrocarbons (HC);
- carbon monoxide (CO);
- nitric oxide (NOx)

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

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




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

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

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





**WARNING:**
**The precious metals contained in the catalytic converter, also due to the high temperature, are subject to chemical attack by lead.**
**For this reason, petrol containing lead must not be used as this would quickly and irreversibly damage the converter.**
**Never use petrol containing lead even in an emergency or for very short periods.**

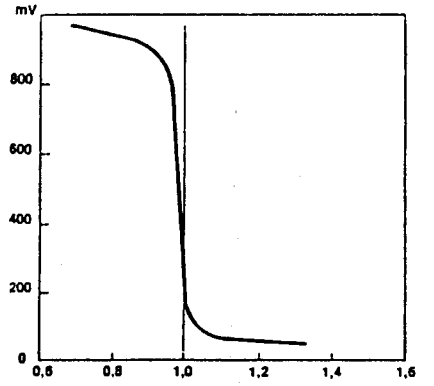
## LAMBDA SENSOR

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

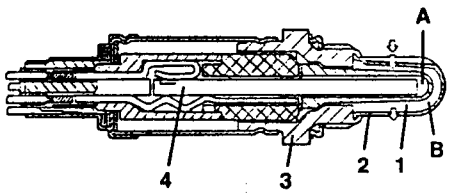
$$\lambda = \frac{\text{INTAKED QUANTITY OF AIR}}{\text{THEORETIC QUANTITY OF AIR THAT SERVES TO BURN ALL THE FUEL INJECTED}}$$

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

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




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




*1. Ceramic body* *A. Inner ceramic part*
*2. Protective tube* *B. Outer ceramic part*
*3. Metal body*
*4. Electric resistance*

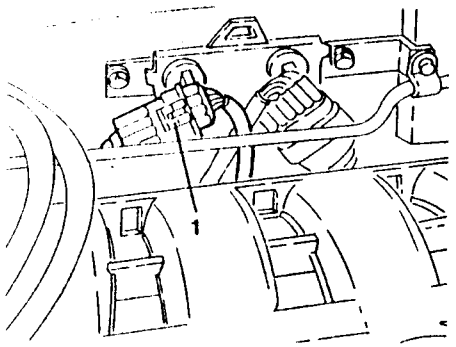
The operation of the sensor is based on the fact that with temperatures of above 300°C, the ceramic material used becomes a conductor of oxygen ions.
Under these conditions, if the quantity of oxygen at the two sides of the sensor (A and B) is in different percentage, a voltage change is generated between the two ends which is an index of measurement for the difference in the quantity of oxygen in the two environments (environment air side and exhaust gas side) and it alerts the control unit that the oxygen residues in the exhaust gas are not in sufficient percentage to warrant combustion with a low amount of harmful substances.

For temperatures below 300°C the ceramic material is not active, therefore the sensor does not send serviceable signals and a special circuit in the control unit stops loop adjustment of the mixture while the sensor heats up.

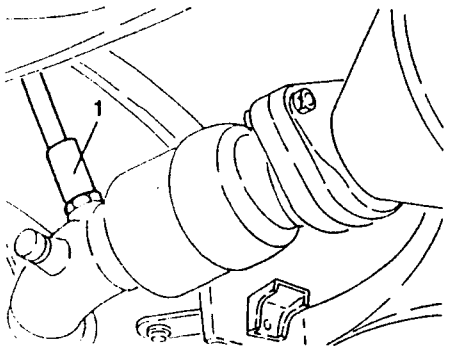
To ensure that the sensor quickly reaches its operating temperature it is fitted with an electrical resistance suitably supplied by the battery; this also makes it possible to install the sensor in cooler areas of the exhaust pipe.

## REMOVAL/REFITTING

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




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




## CHECKING EMISSIONS AT THE EXHAUST

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

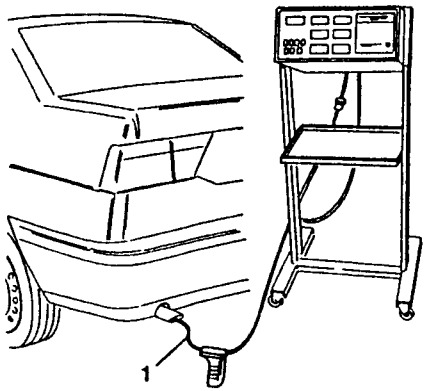
**The check must be carried out with the engine at normal operating temperature (i.e. after the fan has turned on and then off) and at idle speed (see: "TECHNICAL CHARACTERISTICS AND SPECIFICATIONS").**

**If the idle speed is not within the specified limits check that the constant idle speed actuator is working properly.**

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

1. Insert the probe of the analyzer in the end piece of the exhaust pipe and check that the quantities of CO and HC are within the specified limits.

| | |
|---|---|
| CO at exhaust | ≤ 2.2 g x km |
| HC + NOx at exhaust | 0.5 g x km |



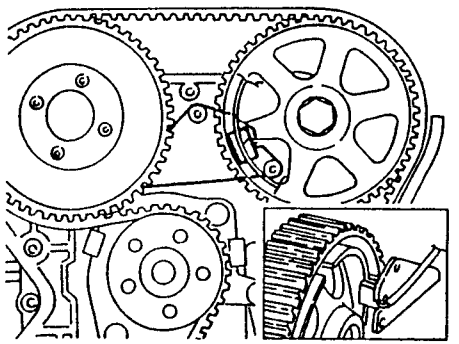





# ELECTRICAL ELECTRONIC COMPONENTS

## TIMING SENSOR

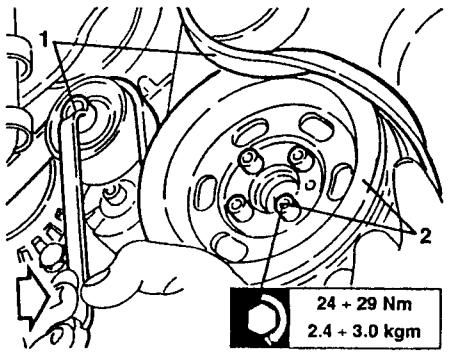
The timing sensor (cam angle sensor) comprises a Hall effect device. The voltage signal "lowers" sharply when the tooth machined on the camshaft drive pulley opposite the sensor passes in front of it.



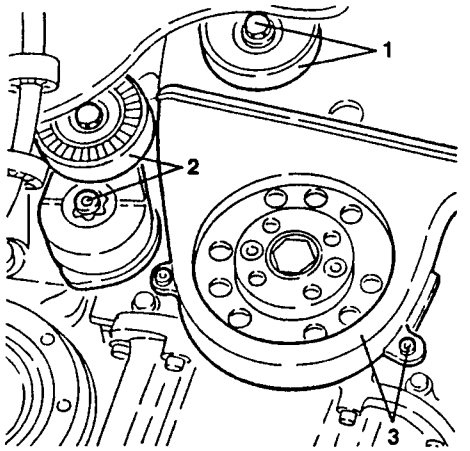
## REMOVAL/REFITTING (For engines with counter-rotating shafts)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.

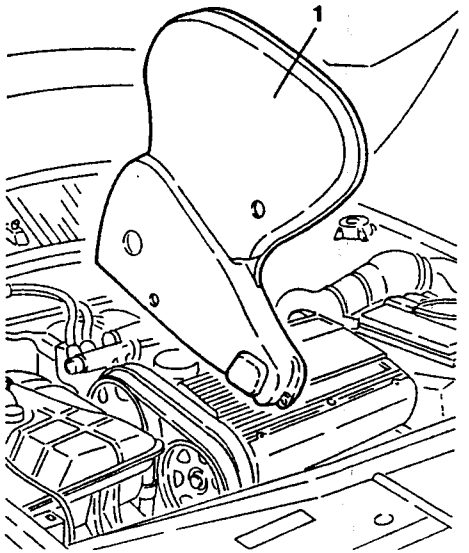



1. Slacken the fastening screw and remove the belt tensioner.
2. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.
3. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft drive belts.

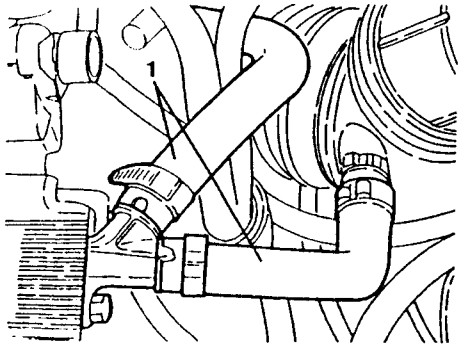



- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft drive belts.

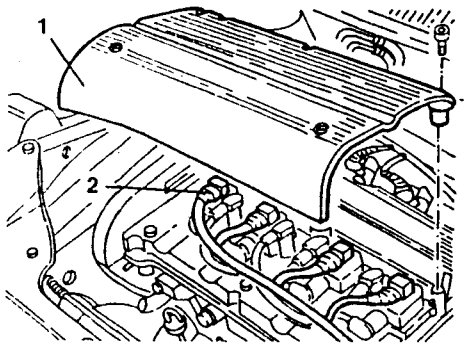
1. Lower the car, slacken the fastening screws and remove the upper cover.



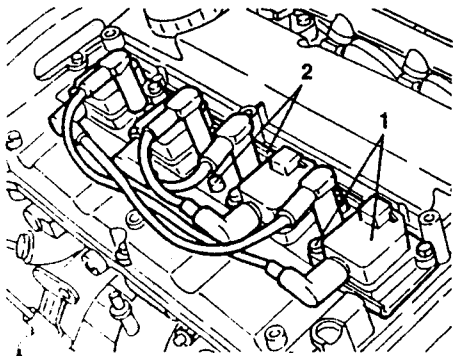
1. Disconnect and remove the oil vapour recovery pipes.



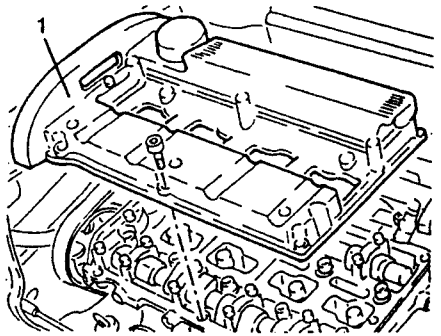

1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



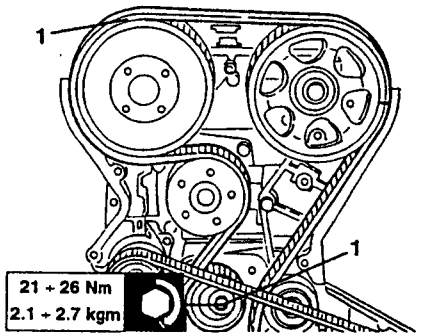

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



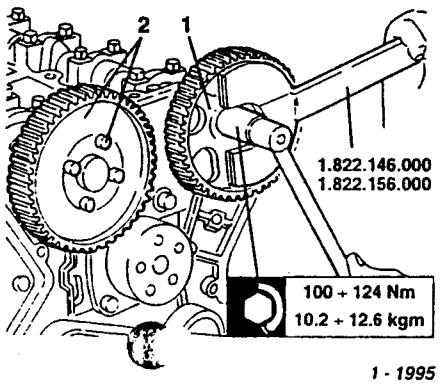

1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.




1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.



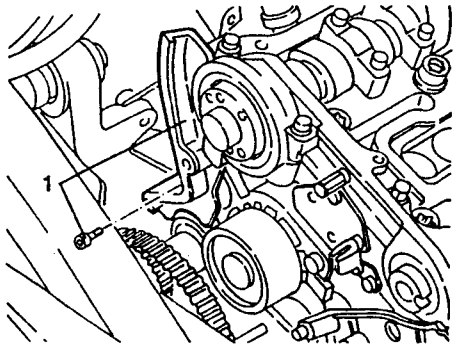

1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear exhaust side drive pulley and remove it.
2. Slacken the four screws fastening the timing gear intake side drive pulley and remove it.



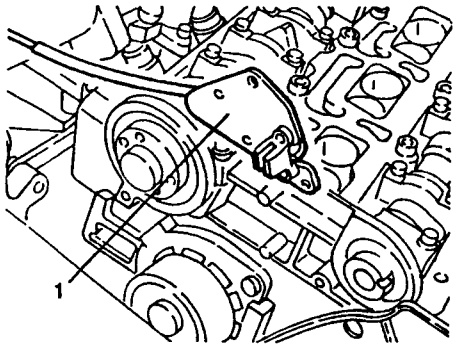





1. Slacken the fastening screws and remove the intake side cover.




1. Disconnect the electrical connection, slacken the two fastening screws and remove the timing sensor complete with support plate.

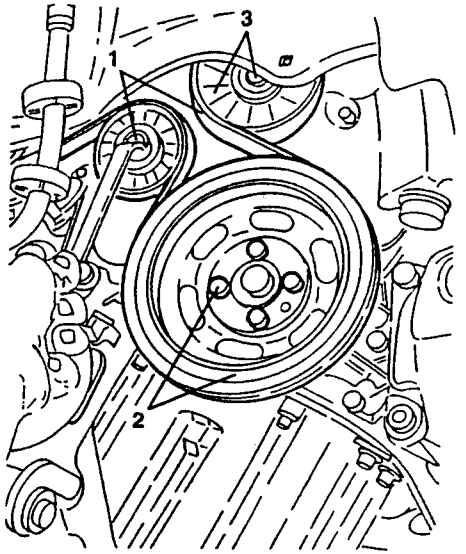



**For re-assembly of the timing gear drive belt, valve gear timing and assembly and tensioning the auxiliary components drive belt see GROUP 00.**

## REMOVAL/REFITTING (For engines without counter-rotating shafts)

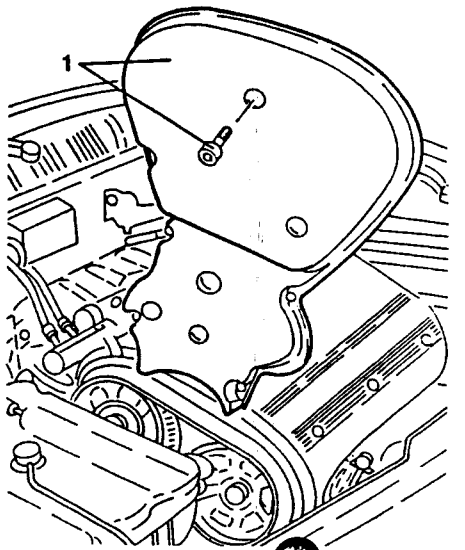
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.
3. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.

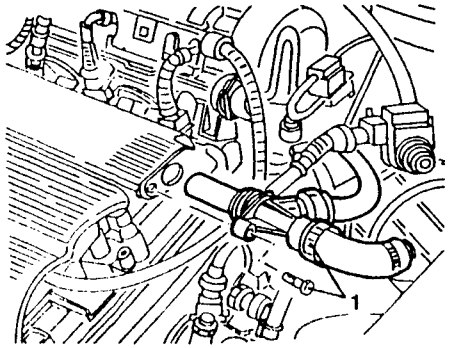



- Slacken the lower screws of the cover of the timing gear drive belt.

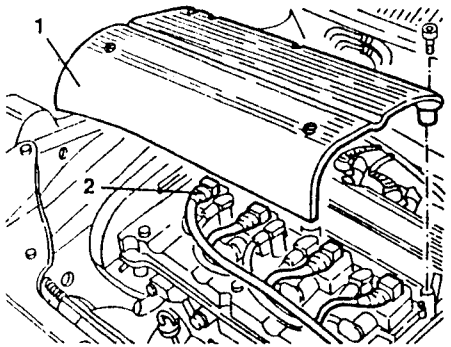
1. Lower the car, slacken the fastening screws and remove the cover of the timing gear drive belt.



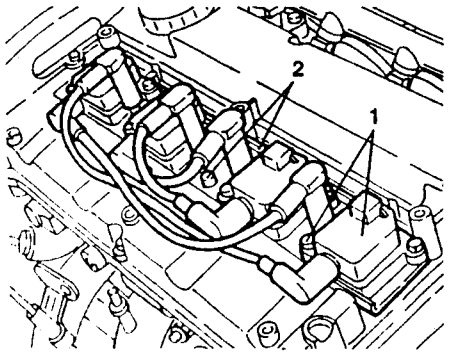
1. Slacken the fastening screw and remove the oil vapour recovery pipes.



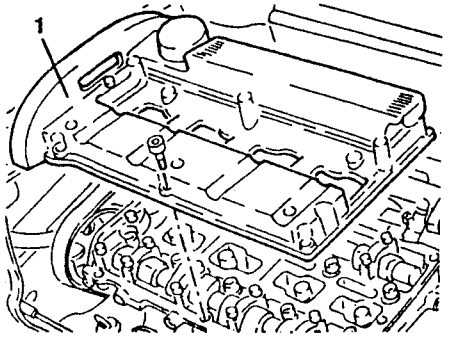

1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



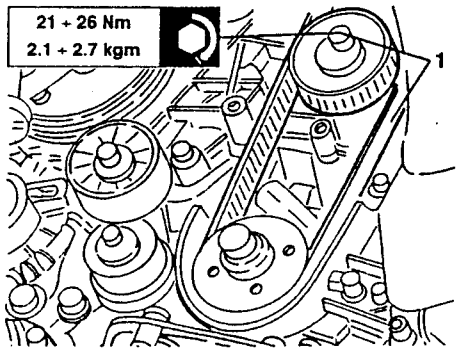

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



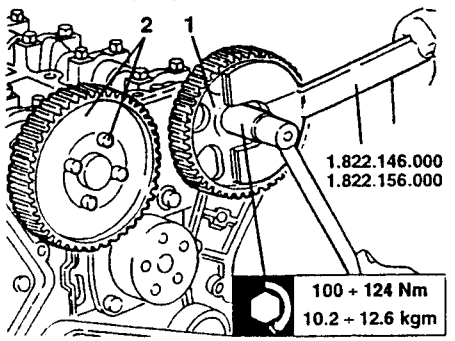

1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.




1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.



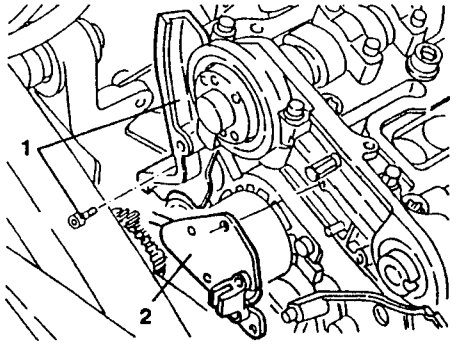

1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear exhaust side drive pulley and remove it.
2. Slacken the four screws fastening the timing gear intake side drive pulley and remove it.








1. Slacken the fastening screws and remove the intake side cover.
2. Disconnect the electrical connection, slacken the two fastening screws and remove the timing sensor complete with support plate.



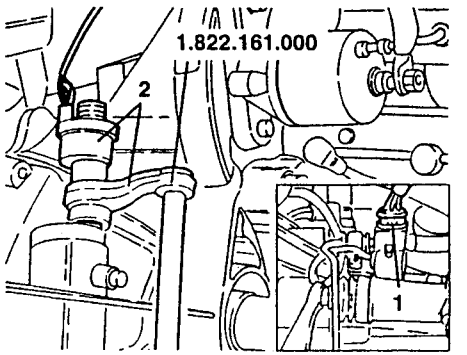

**For re-assembly of the timing gear drive belt, valve gear timing and assembly and tensioning the auxiliary components drive belt see GROUP 00.**

## SPEEDOMETER SENSOR

### REMOVAL/REFITTING

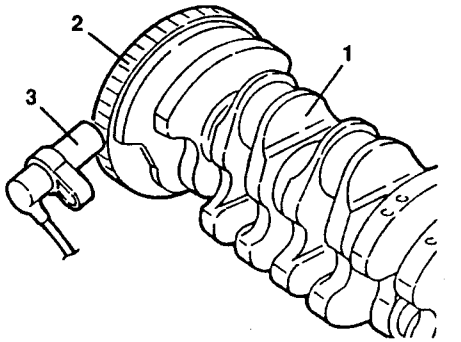
- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection of the speedometer sensor.
2. Raise the car and using wrench no. 1.822.161.000, slacken and remove the speedometer sensor.




## RPM SENSOR AND TIMING SENSOR

The sensor for detecting the rpm and engine timing is of the inductive type which operates through the change of a magnetic field generated by the passage of the teeth of a toothed pulley (phonic wheel) shrunk onto the crankshaft.
The teeth which pass in front of the magnetic field generator change the gap between the pulley and the sensor; therefore, the dispersed flux, which consequently varies, induces an alternate sinusoidal voltage in the coils of the sensor, the amplitude of which depends on the peripheral speed of the phonic wheel, the gap between the tooth and the sensor, the shape of the teeth, the magnetic characteristics of the sensor and on the support system.



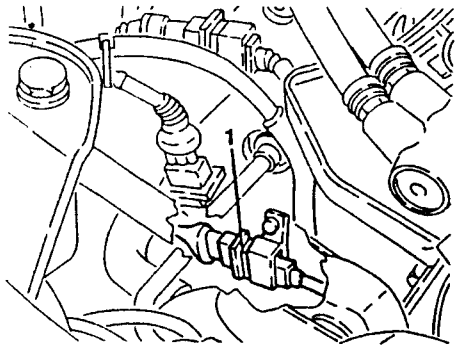

*1. Crankshaft*
*2. Phonic wheel*
*3. Rpm and timing sensor*

The output signal which varies in relation to the rpm is processed by the control unit to obtain a signal at each passage through zero and a constant rectangular oscillation of amplitude to enable the control of the digital circuits inside the control unit.
The interval between the start of one tooth and another is 6° with the exception of the reference mark which is made by eliminating two of the 60 teeth of the pulley.
The hollow due to the lack of two teeth gives the control unit a reference point of the crankshaft and each subsequent tooth of the phonic wheel informs the control unit of an increase in its angular position.

## REMOVAL/REFITTING

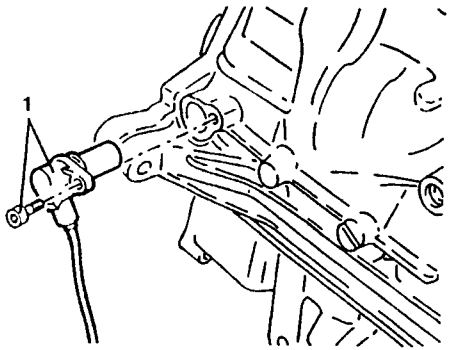
- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Disconnect the rpm and timing sensor electrical connection.




- Raise the car and remove the front section of the exhaust piping.

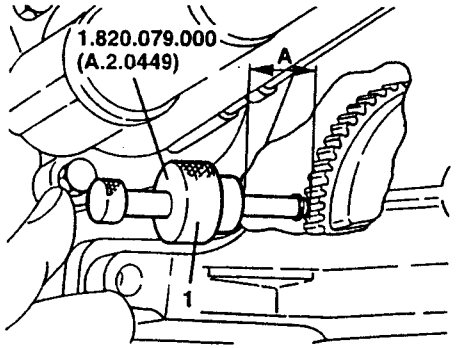
1. Slacken the fastening screw and remove the rpm and timing sensor.



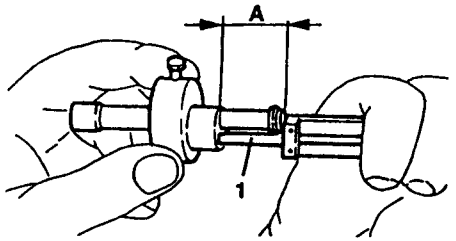

## CHECKING THE GAP

- Set the car on a lift and remove the front section of the exhaust pipe.
- Remove the rpm and timing sensor (see specific procedure).

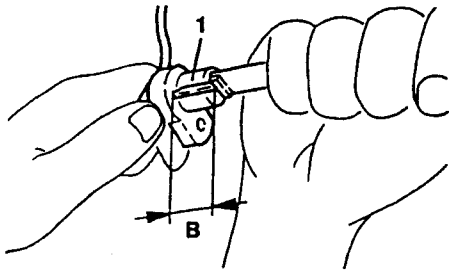
1. Using tool no. 1.820.079.000 (A.2.0449), find dimension "A".




1. Using a gauge measure dimension "A".




1. Using a gauge measure dimension "B" on the sensor.




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

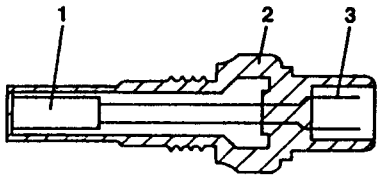
| Rpm and timing sensor gap |
|---|
| A - B = 0.5 ÷ 1.5 mm |





## ENGINE COOLANT TEMPERATURE SENSOR (NTC)

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

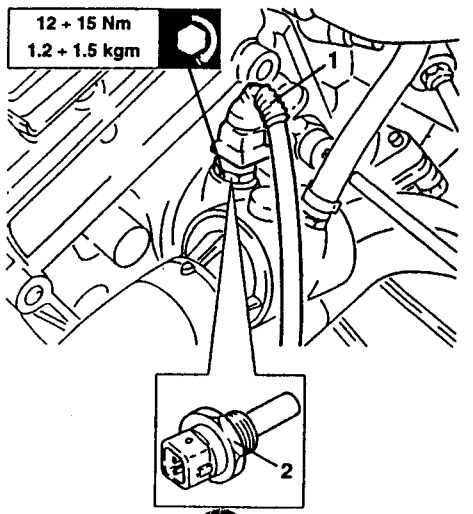



*1. NTC resistance*
*2. Body*
*3. Connector*

## REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).
2. Slacken and remove the engine coolant temperature sensor from the thermostatic cup.





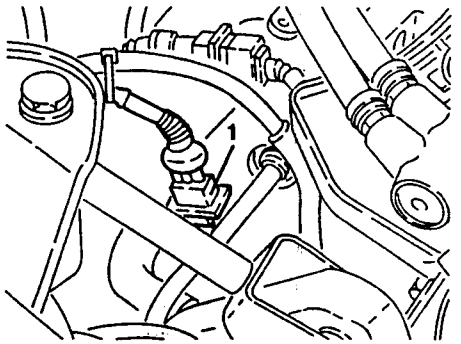

## KNOCKING SENSOR

The knocking sensor detects the intensity of the vibrations (pinging in the cylinder head) caused by knocking in the combustion chamber.
In this condition the control unit increases the amount of fuel and reduces the advance ratings calculated from the special map, in order to eliminate knocking as quickly as possible: in fact the advance curves are reduced by appr. 2°, then if necessary by another 2° etc:, until pinging ceases, after which the normal advance corresponding to the original map is resumed.

## REMOVAL/REFITTING

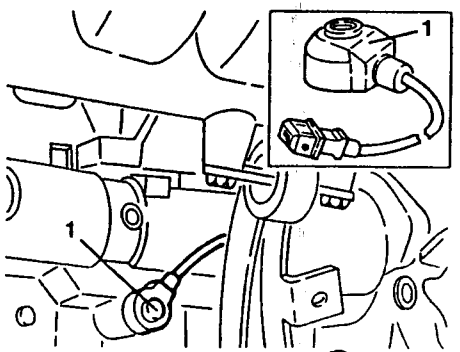
- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection of the pinging sensor.




- Remove the front section of the exhaust pipe.

1. Slacken the fastening screw and remove the pinging sensor.

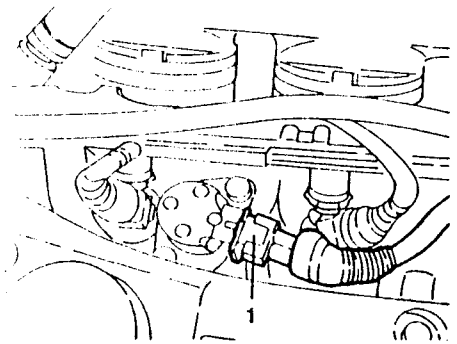


## TIMING VARIATOR SOLENOID

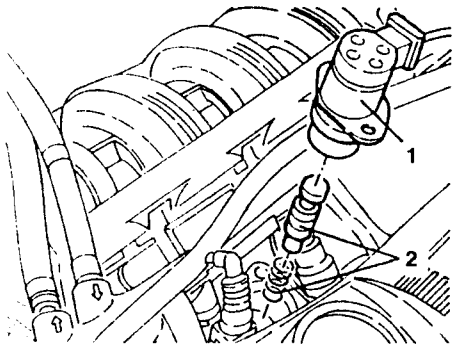
### REMOVAL/REFITTING

Disconnect the battery (-) terminal

1. Disconnect the electrical connection from the timing variator solenoid.



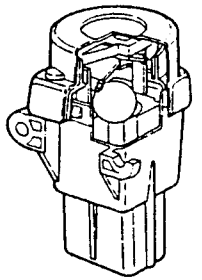

1. Slacken the two fastening screws and remove the timing variator solenoid.
2. Remove the valve complete with the timing variator spring.




## INERTIAL SWITCH

Under the driver's seat there is a safety switch which is triggered in the event of a crash, cutting off the fuel pump earth connection, thereby also the supply to the injection system.

A steel ball fitted in a taper housing is normally held in place by the force of attraction of an adjacent magnet.
Under specific acceleration loads the ball releases itself from the magnetic force and gradually moves out of the taper support rising upwards following the angle of the taper.
A quick snap connection is fitted above the ball which forms the normally closed (N.C.) electric circuit.

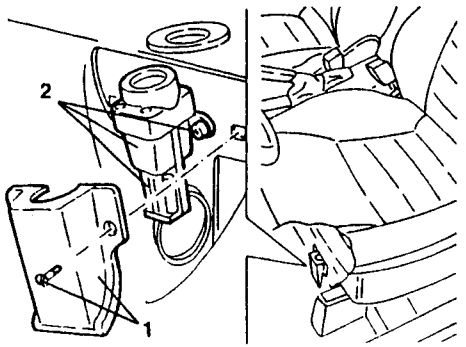


When the mechanism is hit by the ball it changes position, from N.C. circuit to normally open circuit (N.A.), cutting off the fuel pump earth circuit.
In the event of impact in any one of the three orthogonal directions, the switch will be triggered above 12 g peak equivalent to a speed of 25 kph.
The switch can be reset pressing the pushbutton protected by a flexible cover (this also protects against foreign particles which might prevent the switch from operating or reprogramme it).

### REMOVAL/REFITTING

- Disconnect the battery (-) terminal.

1. Slacken the two fastening screws and remove the plastic cover protecting the inertial switch.
2. Slacken the two fastening screws, disconnect the electrical connection and remove the inertial switch.








# TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

## FUEL

| | |
|---|---|
| Unleaded petrol | minimum R.O.N. = 95 |

## FUEL TANK

| | |
|---|---|
| Total capacity | 63 litres |
| Reserve | – 7 litres |

## CHECKING THE SETTING OF THE FUEL LEVEL GAUGE

| Level (mm) | Gauge reading | Resistance (Ω) |
|---|---|---|
| 51.5 | 4/4 | 0 ÷ 7 |
| 125 | 3/4 | 56.5 ÷ 71.5 |
| 174 | 1/2 | 111 ÷ 131 |
| 211 | 1/4 | 181 ÷ 206 |
| 228 ± 3 | Max reserve | 262 |
| 238 | 0 | 290 ÷ 320 |

## CHECKING FUEL SUPPLY PRESSURE

| | |
|---|---|
| Fuel pressure at idle speed | 2.8 ÷ 3.2 bar |
| Maximum control pressure | – 4 bar |

## CHECKING EMISSION AT THE EXHAUST

| | |
|---|---|
| CO at exhaust | ≤ 2.2 g x km |
| HC + NOx at exhaust | 0.5 g x km |

## RPM AND TIMING SENSOR GAP

| |
|---|
| 0.5 ÷ 1.5 mm |

## IDLE SPEED

| 1598 1747 1970 '96 versions (Motronic M2.10.4) | 1970 '95 versions (Motronic M2.10.3) |
|---|---|
| 800 ± 50 rpm | 840 ± 50 rpm |

## TIGHTENING TORQUES

| PART | Nm | kgm |
|---|---|---|
| Screws fastening E.G.R. valve | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Screws fastening auxiliary components drive belt pulley | 24 ÷ 29 | 2.4 ÷ 3.0 |
| Timing gear belt tensioner fastening nut | 21 ÷ 26 | 2.1 ÷ 2.7 |
| Screw fastening exhaust side timing gear pulley | 100 ÷ 124 | 10.2 ÷ 12.6 |
| Engine coolant temperature sensor (NTC) | 12 ÷ 15 | 1.2 ÷ 1.5 |
| Nuts fastening intake box to cylinder head | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Nuts fastening exhaust manifold to cylinder head | 17 ÷ 21 | 1.7 ÷ 2.1 |
| Fuel filter outlet pipe union | 21 ÷ 26 | 2.1 ÷ 2.7 |
| Fuel filter inlet pipe union | 30 ÷ 37 | 3.1 ÷ 3.8 |

## SPECIAL TOOLS

| | |
|---|---|
| 1.820.079.000 (A.2.0449) | Tool for measuring gap |
| 1.821.167.000 (A.3.0631) | Spanner for removing fuel pump |
| 1.822.129.000 | Spanner for removing fuel measuring device |
| 1.822.146.000 | Support for pulley wrenches |
| 1.822.156.000 | Wrench for exhaust side camshaft pulley |
| 1.822.161.000 | Wrench for removing the tachometric sensor |



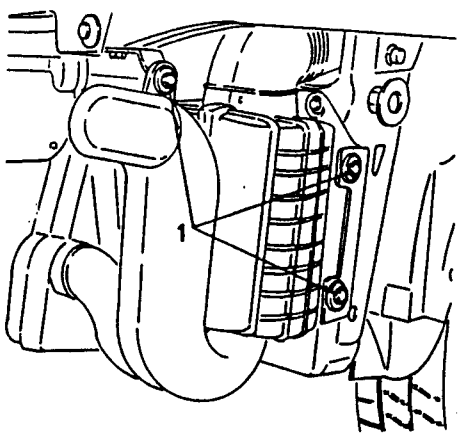


## 'IR INTAKE RESOUNDER

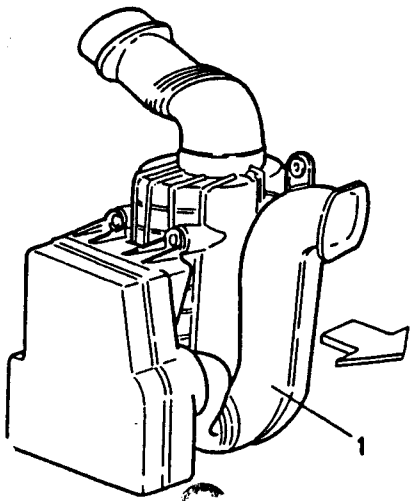
### REMOVING/REFITTING

- Set the car on a lift and raise it.
- Remove the front bumper.

1. Slacken the three screws fastening the air intake resounder.




1. Remove the air intake resounder pulling it forwards.




## REAR SILENCERS

The T. Spark 16V cars are fitted with new rear exhaust silencers.
The rear silencers are connected to the catalytic converter through a "binocular" coupling with a special clamp.