# Bravo/Brava

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## TECHNICAL SERVICE MANUAL COMPOSITION

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| | **55** | 1 ÷ 36 | Wiring diagrams-Connector blocks |
| **506.670/07** (VI/1996) | **00** | 1 ÷ 11 | Technical data - 1910 TD & 1581 automatic transmission |
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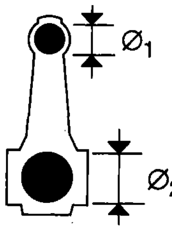
This manual contains the main instructions for repairing and maintaining the **Fiat Bravo and Fiat Brava.**

The manual is divided into sections distinguished by two digit numbers which appear in the parts microfiches and the flat rate manual.
The section **INTRODUCTION AND TECHNICAL DATA (00.)** has a dual function of introducing the model and supporting the remaining part of the manual. This section includes the tables of technical data and specific information relating to the sections in the remaining part of the man.

**The remaining sections (10. - 18. etc.)** include descriptions of the repair operations.

This manual contains graphic representations and symbols in place of descriptions for mechanical components, operations and repair methods.

For example:




Small end diameter

Big end bearing housing

Tighten to torque

**ENGINES** *Section 10 contains illustrations of the operations of removing-refitting the power units, operations on vehicle and the various fuel, lubrication and cooling systems.*
*The procedures for overhauling the individual engines are described in other booklets which have the following print nos.:*

| Engine | Print No. | Part No. |
|---|---|---|
| **1370 12V** | **504.589/19** | **604.89.774** |
| **1581 16V** | **504.589/20** | **604.89.781** |
| **1747 16V** | **504.589/18** | **604.89.192** |
| **1998 20V** | **504.589/22** | **604.89.788** |
| **1929 D** | **504.593/11** | **604.89.841** |
| **1910 TD** | **504.593/13** | **604.44.220** |

*The first 4 booklets are inserted in the Overhauling Petrol Engines Manual 3rd volume, whilst the last ones are inserted in the Overhauling Diesel Engines Manual 2nd volume.*

**GEARBOXES** *Section 21-27 contains illustrations of the operations of removing and refitting the various gearboxes. The procedures for overhauling the various manual gearboxes at the bench are published in separate booklets which have the following print nos.:*

*505.023/08 Inserted in the Overhauling gearboxes manual*
*505.023/03 Inserted in the Overhauling gearboxes manual*
*505.023/18 Inserted in the Overhauling gearboxes manual 2nd volume*

**THIS PUBLICATION HAS BEEN PRODUCED IN A LOOSE LEAF FORMAT TO FACILITATE THE OPERATION OF UPDATING THE MODEL.**

*When using chemical products stick closely to the instructions in the safety chart which the supplier must give to the consumer (for Italy in accordance with D.M. no. 46/1992)*

The **Fiat Bravo** is a 2 box, 3 door vehicle with a load carrying structure, transversely mounted engine and front wheel drive

It is produced with 6 different engine types.

The engines have 4 or 5 cylinders in line with clockwise rotation and are mounted transversely at the front.

According to the trim level, the following engines are fitted:

**1370 cc** four cylinders in line, 12 valves running on unleaded petrol and developing a power output of 59 kW (80 CV) at 6000 rpm.

**1581 cc** four cylinders in line, 16 valves running on unleaded petrol and developing a power output of 76 kW (103 CV) at 5700 rpm.

**1747 cc** four cylinders in line, 16 valves running on unleaded petrol and developing a power output of 83 kW (113 CV) at 5800 rpm.

**1998 cc** five cylinders in line, 20 valves running on unleaded petrol and developing a power output of 108 kW (147 CV) at 6100 rpm.

**1929 D cc** four cylinders in line, 8 valves, indirect injection running on diesel fuel and developing a power output of 48 kW (65 CV) at 4600 rpm.

**1910 TD cc** four cylinders in line, 8 valves, indirect injection running on diesel fuel and developing a power output of 74 kW (100 CV) at 4200 rpm.

The **Fiat Brava** is a three box vehicle, with 5 doors, a load carrying structure, transversely mounted engine and front wheel drive

It is produced with 5 different engine types.

The engines are the same as those fitted on the **Fiat Bravo** with the exception of the 1998 cc.

III-96 - Cancels and replaces

Print no. 506.670/06

Introduction & Tech Data

Introduction & Tech Data 1998 20

Introduction & Tech Data 1998 16

Introduction & Tech Data 1998

> The Planned Maintenance Programme whose operations are described later on is the one in force at the time of printing and replaces and cancels the one in volume 1 of the Manual

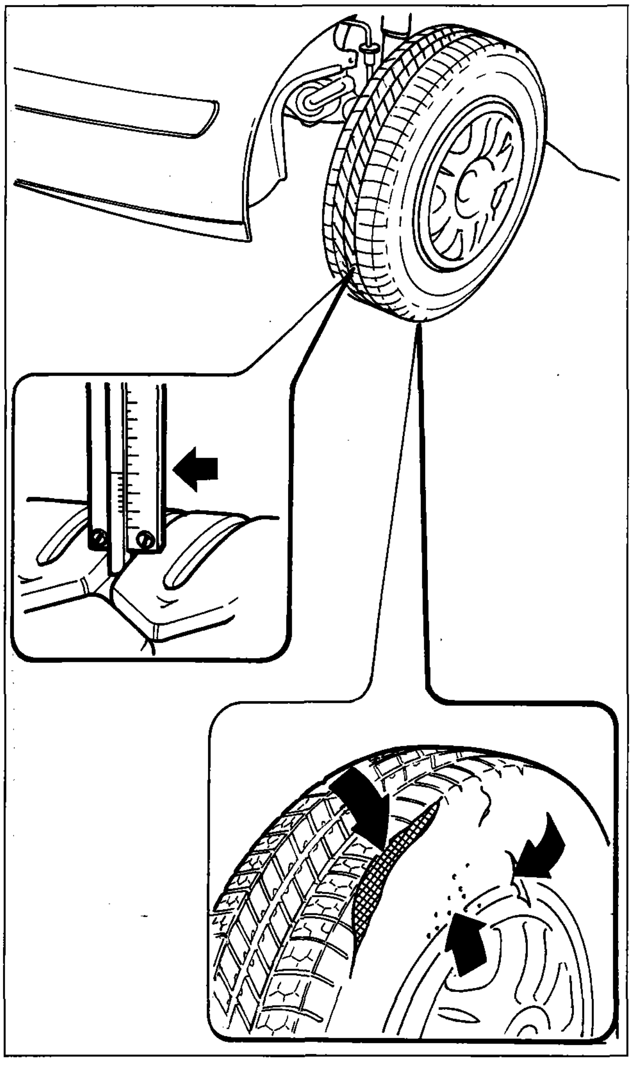
## PLANNED MAINTENANCE PROGRAMME

| N° | OPERATION | THOUSANDS OF KM | | | | | | | | | PAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | |
| 1 | Check tyre condition and wear | ● | ● | ● | ● | ● | ● | ● | ● | ● | 1 |
| 2 | Check operation of front disc brake pad wear sensor | ● | ● | ● | ● | ● | ● | ● | ● | ● | 2 |
| 3 | Check condition of rear disc brake pads (Bravo 1998 20v) | | ● | | ● | | ● | | ● | | 2 |
| 4 | Check rear drum brake linings condition and wear | | | ● | | | ● | | | ● | 2 |
| 5 | Visually inspect condition of: underbody exterior and protection, pipes (exhaust, fuel system, braking system), rubber elements (boots, hoses, bushes, etc.) | ● | ● | ● | ● | ● | ● | ● | ● | ● | 3 |
| 6 | Check tension and, if necessary, adjust various drive belts (excluding engines equipped with automatic tensioners) | ● | | | | | | | | | 3 |
| 7 | Visually inspect condition of trapezoid belts and/or various Poly-V drive belts | | ● | | ● | | ● | | ● | | 6 |
| 8 | Check/adjust clutch pedal travel or height (excluding hydraulically operated version) | | ● | | ● | | ● | | ● | | 7 |
| 9 | Check/adjust handbrake lever travel | | ● | | ● | | ● | | ● | | 8 |
| 10 | Check/adjust tappet clearance (1910 TD diesel version) | ● | ● | | ● | | ● | | ● | | 8 |
| 11 | Check/adjust tappet clearance (1929 D diesel version) | ● | | ● | | ● | | ● | | ● | 9 |
| 12 | *Checking exhaust gas emissions/diesel fumes* | | ● | | ● | | ● | | ● | | 10 |
| 13 | Check operation of anti-evaporation system | | | | ● | | | | ● | | 13 |
| 14 | Replace fuel filter (petrol engines) | | ● | | ● | | ● | | ● | | 13 |
| 15 | Replace fuel filter (diesel engines) | ● | ● | ● | ● | ● | ● | ● | ● | ● | 14 |
| 16 | Replace air filter cartridge (petrol engines) | | ● | | ● | | ● | | ● | | 15 |
| 17 | Replace air filter cartridge (diesel engines) | ● | ● | ● | ● | ● | ● | ● | ● | ● | 15 |
| 18 | Check/top up fluid levels (engine cooling, braking system, power steering, windscreen washer, battery, etc.) | ● | ● | ● | ● | ● | ● | ● | ● | ● | 16 |
| 19 | Replace timing belt | | | | | | ● | | | | 20 |
| 20 | Replace spark plugs, check leads | | ● | | ● | | ● | | ● | | 43 |
| 21 | Check operation of engine control systems (using diagnostic socket) | | ● | | ● | | ● | | ● | | 45 |
| 22 | Check gearbox and differential oil level (only for version with manual gearbox) | | | | ● | | | | ● | | 46 |
| 23 | Checking automatic gearbox oil level | ● | ● | ● | ● | ● | ● | ● | ● | ● | 46 |
| 24 | Changing engine oil (or every 18 months) (every 10,000 Km for diesel engines) | ● | ● | ● | ● | ● | ● | ● | ● | ● | 47 |
| 25 | Replace engine oil filter (every 10,000 km for diesel engines) | ● | ● | ● | ● | ● | ● | ● | ● | ● | 47 |
| 26 | Change brake fluid (or every 24 months) | | | ● | | | ● | | | ● | 48 |
| 27 | Replace pollen filter (or every 12 months) | ● | ● | ● | ● | ● | ● | ● | ● | ● | 50 |

### Foreword

The maintenance operations consist of checking and restoring the efficiency of certain vehicle components subject to wear which may deteriorate during normal usage conditions.
This section describes the operations which should be carriedout on the vehicle at the intervals set out in the Planned Maintenance Programme (on the previous page). Each operation is described independently on account of which there is no pre-defined ideal operating cycle to be repeated at each interval.
It is therefore necessary to ensure that those operations which require the same components to be dismantled are carried out at the same intervals in order to maximize the efficiency of the repair times.
If, when carrying out each operation, the need arises to carry out additional replacements or further repairs not envisaged in the Planned Maintenance Programme, prior approval must be obtained first from the Customer.

### PLANNED MAINTENANCE OPERATIONS



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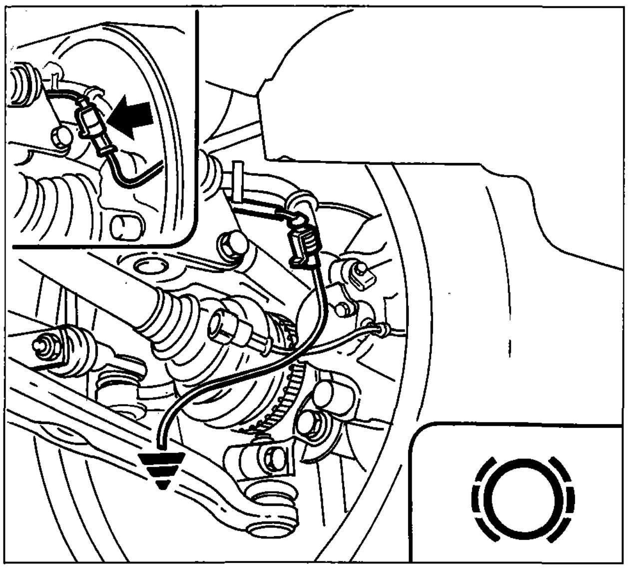
#### 1 CHECK CONDITION OF TYRES AND WEAR

Check the condition of the tyres making sure, in particular, that there are no signs of ageing on the tread and the tyre walls, that the tyres are not excessively/unevenly worn and that there are no abrasions/burrs, porousness or cuts.

Check the depth of the tread using a special gauge, taking the measurement at the intersection between the transverse and longitudinal splining (at several points on the circumference). The minimum permissible depth is 1.6mm. The difference between the depths of tread on the same tyre should not exceed 2 mm. The difference between the depths of tread on different tyres on the same axle should not exceed 5 mm.

If the tread wear is uneven, check the tyre inflation pressure and inform the Customer of the possible need to balance the wheels.



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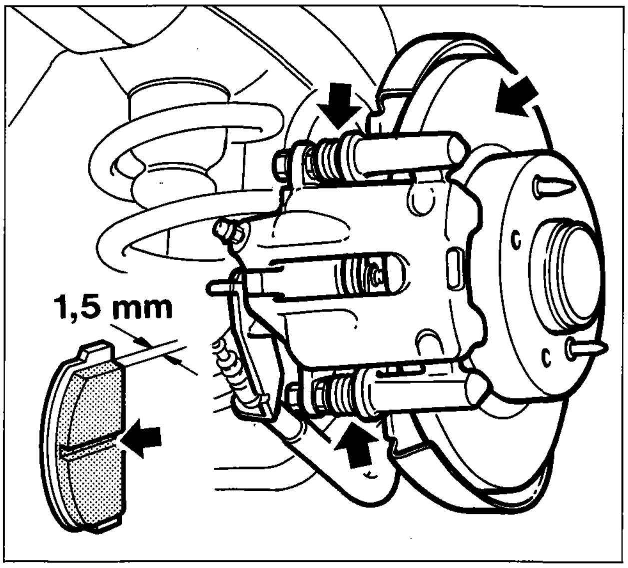


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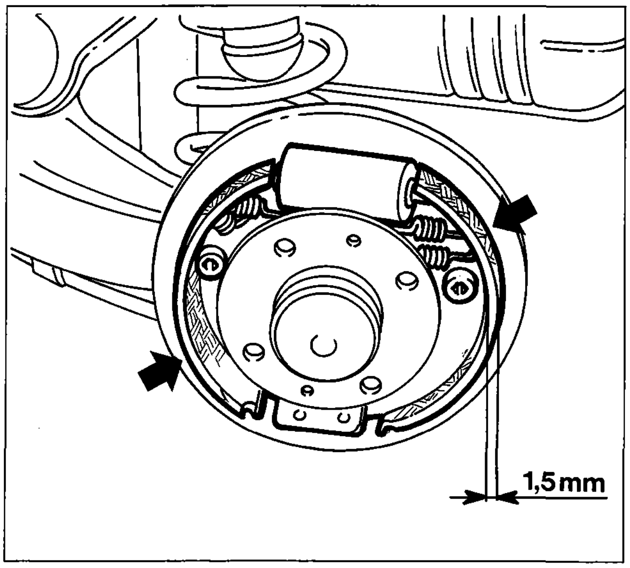


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## 2 CHECK OPERATION OF FRONT DISC BRAKE PAD WEAR SENSOR

Disconnect the connector for the front disc brake pad wear sensor, place the terminal for the wiring side coupling to earth and check that the relevant warning light in the instrument panel comes on.

## 3 CHECK CONDITION OF REAR DISC BRAKE PADS (Bravo 1998 20v)

Remove one of the rear wheels and check the thickness of the friction material through the slit in the brake caliper; the minimum permissible thickness if 1.5 mm. Check that the wear of the pads is even. Visually inspect the condition of the brake caliper dust boots. Check the condition of the brake disc work surfaces (for wear or deep grooves). Notify the Customer of the need to replace or regrind (in the case of a brake pad) one of the components which has been checked.

## 4 CHECK CONDITION AND WEAR OF REAR DRUM BRAKES

With one of the rear wheels removed, remove the brake drum. Check the thickness of the brake linings: the minimum permissible thickness is 1.5 mm. Also check that there is no fouling from oil or grease. Check the efficiency of the shoe return device and the automatic recovery of the clearance between the drum and the shoes. Check the efficiency of the wheel cylinders (sliding of pistons, condition of dust boots). Check the condition of the drum work surfaces (for wear or grooves). Notify the Customer of the need to replace or skim (in the case of brake drums) one of the components which has been checked.
If there is an inspection window in the brake drum it is possible to check the thickness of the brake linings without having to remove the actual drum.


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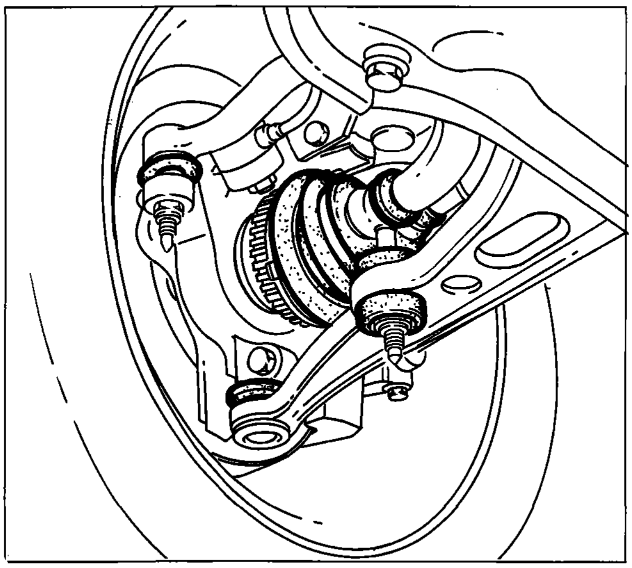

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## 5 VISUALLY INSPECT CONDITION OF: PIPES, RUBBER ELEMENTS, FLEXIBLE PIPES FOR BRAKING SYSTEM AND FUEL SYSTEM

Position the vehicle on a lift. Visually inspect:

- for the presence of any fluid leaks from the following systems: lubrication, fuel, engine cooling, braking and power assisted steering;
- the condition of the rubber elements: bushes, flexible (support) mountings and (protective) boots; check that the collars retaining the pipes and bushes have not loosened.

Check that the wires and cables for the retaining brackets in the engine compartment are correctly positioned.

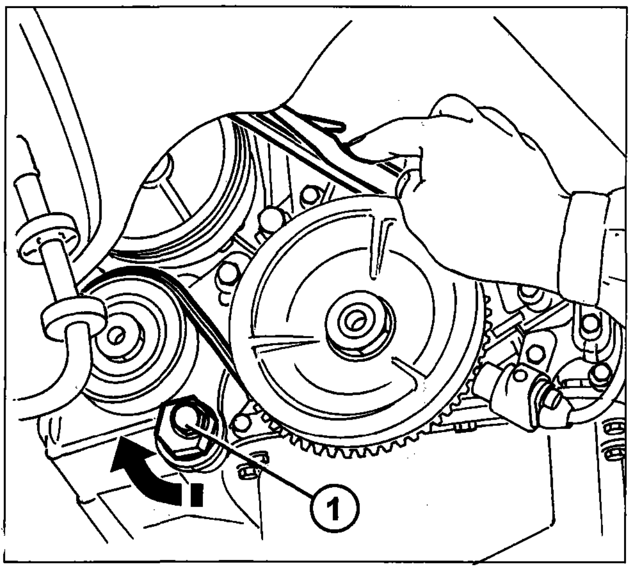
Also check for possible interference of the flexible brake pipes in maximum steering conditions.

## 6 CHECK CONDITION AND TENSION OF VARIOUS DRIVE BELTS AND ADJUST, IF NECESSARY

The tension of the various drive belts is checked using tool 1895762000. Engines equipped with automatic tensioners are exempt from this check.

**Bravo-Brava 1581 16v**

Check that alternator drive belt and power assisted steering drive belt tension, measured using the special equipment, are within the recommended values given in the table at the bottom of this paragraph. If the tension values are not correct, loosen the bolt (1), and rotate the tensioner further working on the hexagonal opening, then tighten the bolt once again and check the tension of the alternator belt. To adjust the power assisted steering pump belt, act on the adjustment screw and the lock nut (2).

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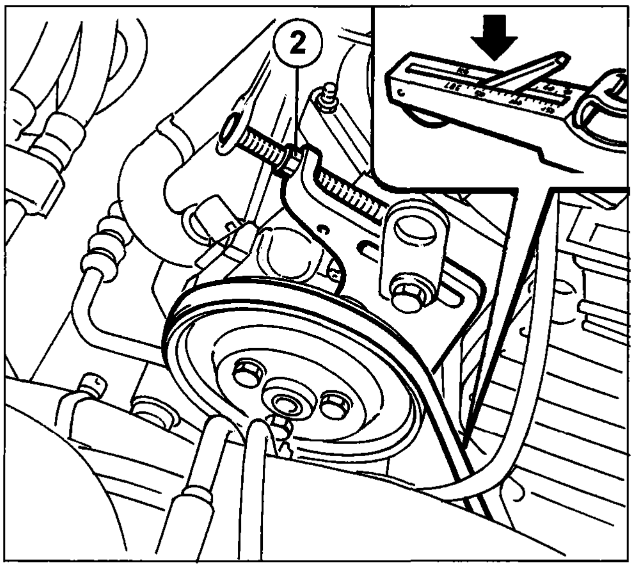


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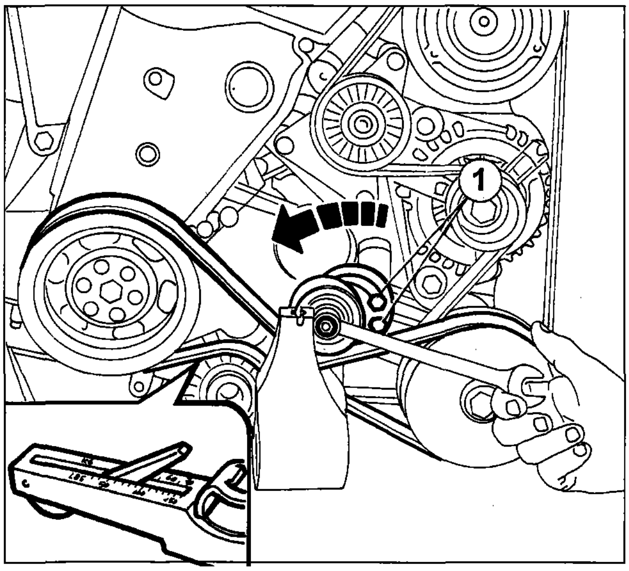


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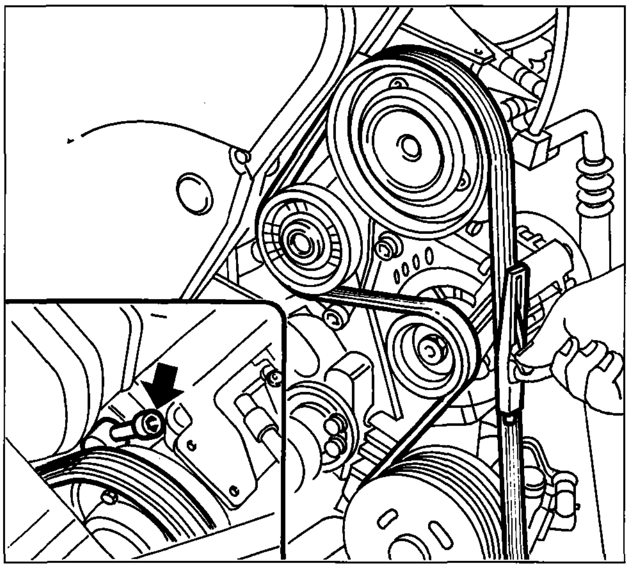
**Bravo 1998 20v**

Check that the tension values for the alternator/air conditioning compressor drive belt and the power assisted steering drive belt, measured using the special equipment, correspond to the recommended figures, given in the table overleaf. If the tension values are not correct, act on the centre tensioner screw to adjust the power assisted steering belt tension, with the fixing bolts (1) slack, tension and lock the bolts (1).



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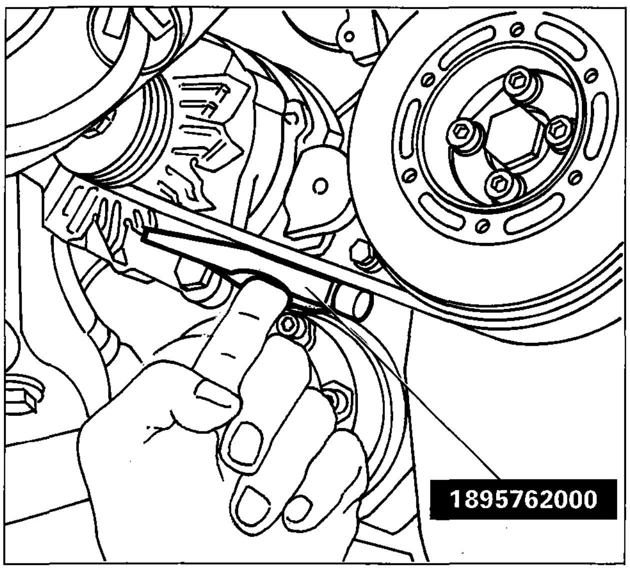
To adjust the tension of the alternator/air conditioning cmopressor belt tension, act on the special adjustment screw removing the compressor cover, if necessary.

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**Bravo-Brava 1929 D**

Check that the tension values measured using the special tool, correspond to the recommended figures, given in the table overleaf. If the tension values are not correct, act on the bolts fixing the alternator and the screw for adjusting the drive belt tension and the special micrometeric screw and bolts fixing the pump to correct the tension of the power assisted steering pump drive belt tension.



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**Tension values for used belts**

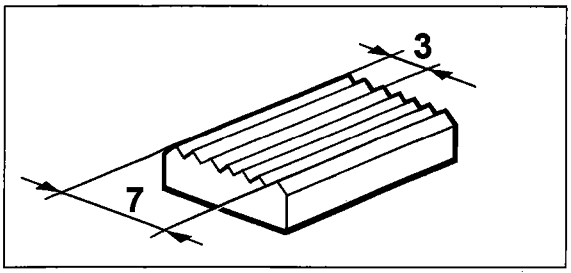
| BELT SECTION | | | TENSION daN |
|---|---|---|---|
| AV 10 | TYPE A | Not pre-run in | 20 ÷ 29 |
| | TYPES B and C | Not pre-run in | 25 ÷ 35 |
| AV 11 | TYPES B and C | Not pre-run in | 25 ÷ 35 |
| AV 13 | TYPE A | Not pre-run in | 30 ÷ 40 |
| | TYPES B and C | Not pre-run in | 32 ÷ 43 |
| POLY-V | 3 ribs | | 23 ÷ 30 |
| | 4 ribs | | 30 ÷ 41 |
| | 5 ribs | | 38 ÷ 53 |
| | 6 ribs | | 45 ÷ 62 |
| | 7 ribs | | 54 ÷ 74 |

**Tension figures for new belts**

| BELT SECTION | | TENSION daN |
|---|---|---|
| AV 10 | TYPE A | 30 ÷ 40 |
| | TYPE B and C | 40 ÷ 55 |
| AV 11 | TYPE B and C | 40 ÷ 55 |
| AV 13 | TYPE A | 45 ÷ 55 |
| | TYPE B and C | 50 ÷ 65 |
| POLY-V | 3 ribs | 36 ÷ 45 |
| | 4 ribs | 48 ÷ 60 |
| | 5 ribs | 60 ÷ 75 |
| | 6 ribs | 72 ÷ 90 |
| | 7 ribs | 84 ÷ 105 |

**Poly-V type belts**

In order to determine the number of ribs on the poly-v belt in question it is necessary to count the number of teeth (or points) from 3 - 7 on the actual belt, as illustrated in the diagram below.

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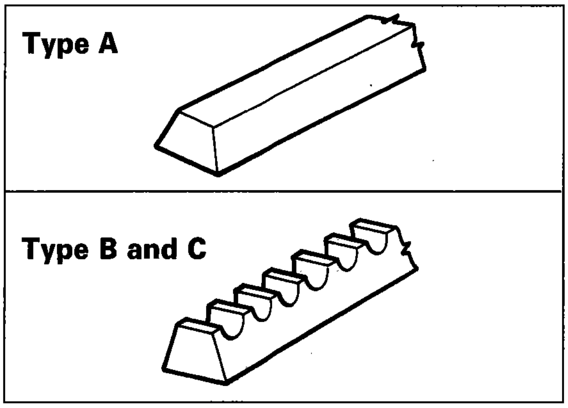
**Trapezoid type belts**

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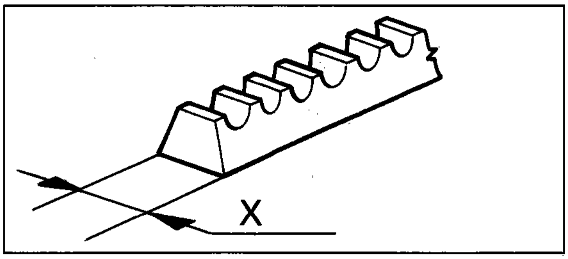
In order to determine whether the trapezoid belt in question is type AV 10 - AV 11 - etc., it is necessary to measure the distance "X" on the back of the belt; if the figure is 10 mm then the blet is a type AV10, if it is 11 mm then it is type AV 11 and so on.

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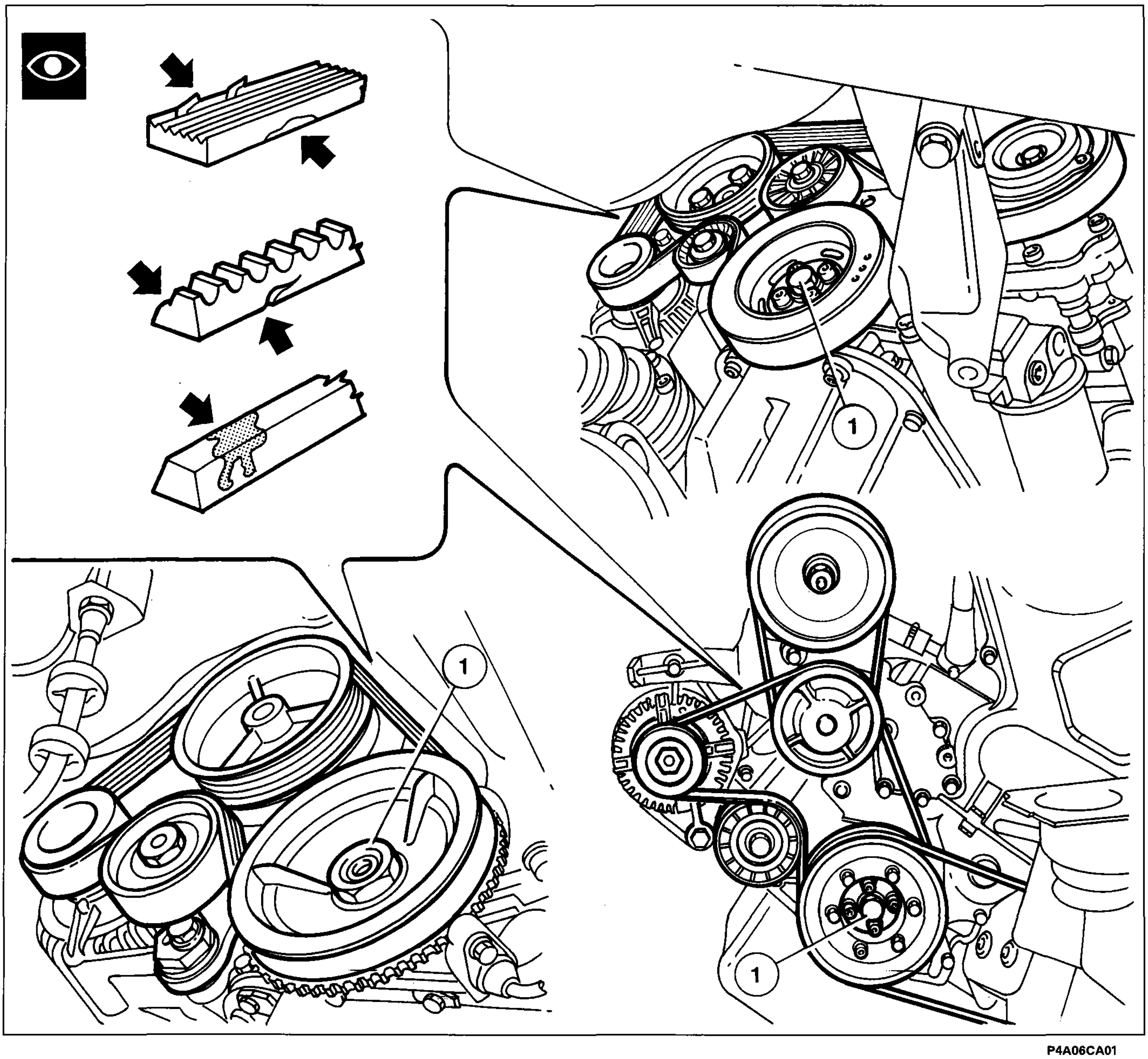
## 7 VISUALLY INSPECT CONDITION OF VARIOUS TRAPEZOID AND/OR POLY-V DRIVE BELTS

- Disconnect the negative battery lead, remove the right front wheel, then remove the wheel arch lining to gain access to the auxiliary shaft drive belts.
- Insert a spanner in the nut (or bolt) fixing the damper flywheel (1), rotate the crankshaft and check the condition of the auxiliary shaft drive belts along the entire perimeter.

*Check the condition of the belts, checkin in particular that there are no: cracks, cuts, surface wear of the material (which would appear smooth and shiny), dry or hard sections with a consequent loss of grip.*
*Also check that the belts have not come into contactwith oil or solvents which could adversely affect the elasticity of the rubber or the adhesion properties.*
*If one of the above faults is found, inform the Customerof the need to replace the belts.*

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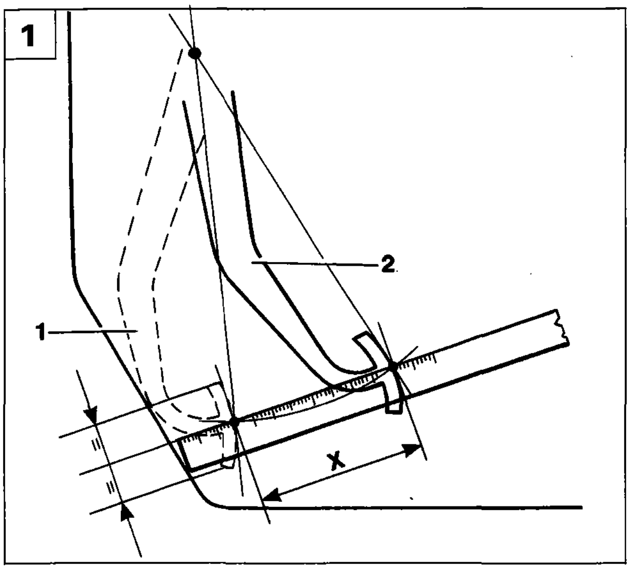


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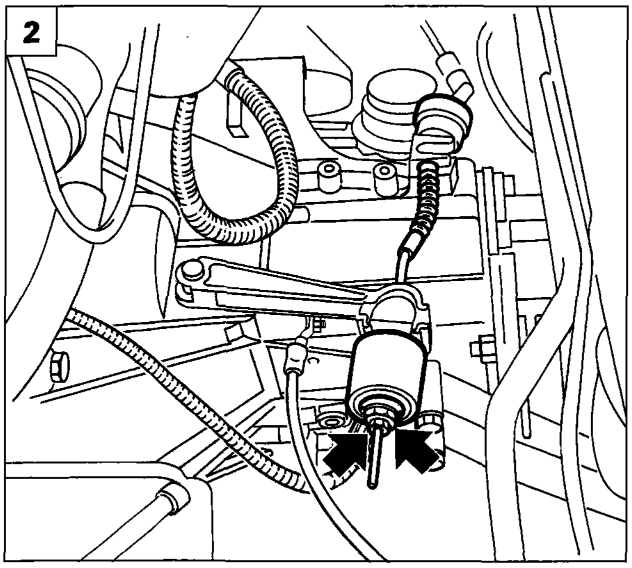

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## 8 CHECK, ADJUST CLUTCH PEDAL TRAVEL OR HEIGHT

The check should only be carried out on vehicles with mechanical release devices (1370 12v - 1581 16v - 1747 16v - 1910 TD - 1929 D). The 1998 20v engine type has a hydraulic release device.

1. Measure the clutch pedal travel:
   1. Pedal in end of travel position
   2. Pedal in rest position

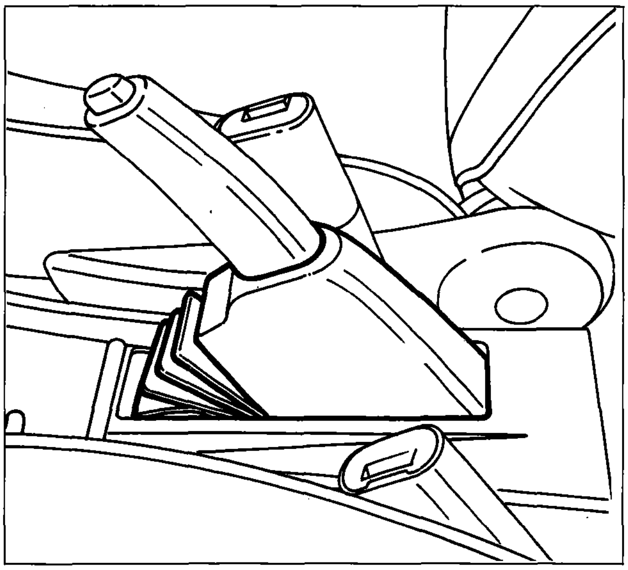
   X. Pedal travel:

   155 ± 10 mm (1370 12v)

   170 ± 10 mm (1581 16v - 1747 16v - 1910 TD - 1929 D)

2. In order to adjust the clutch pedal in the rest position it is necessary:
   - to let the clutch operating mechanism bed in by fully depressing the pedal 2 or 3 times;
   - to check that the travel "X" corresponds to the recommended figure. The travel is measured using a rule corresponding to the pedal centre line and is equivalent to the distance between the pedal in the end of travel position (pedal in contact with the bodyshell) and the pedal in the rest position.
   - any adjustments to the travel are carried out via the nut and lock nut for the clutch cable, gearbox side.

**NOTE** *There should be no obstructions in the area under the pedals preventing the total travel of the pedals: take care, in particular, that any mats are lying flat and not interfering with the pedals.*



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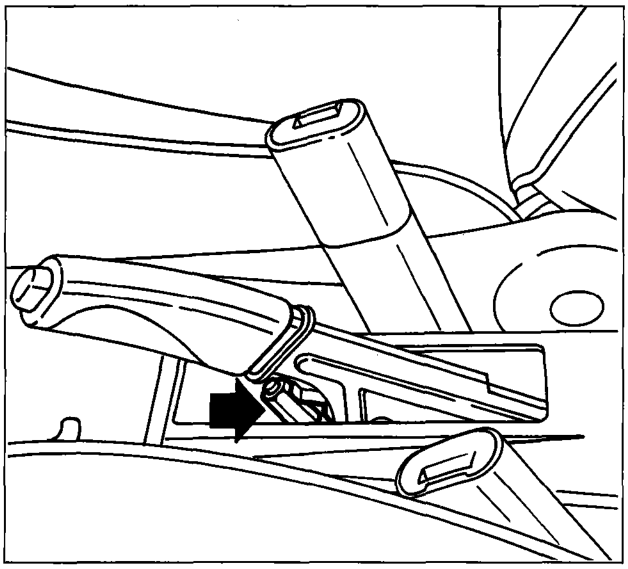

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## 9 CHECK/ADJUST HANDBRAKE LEVER TRAVEL

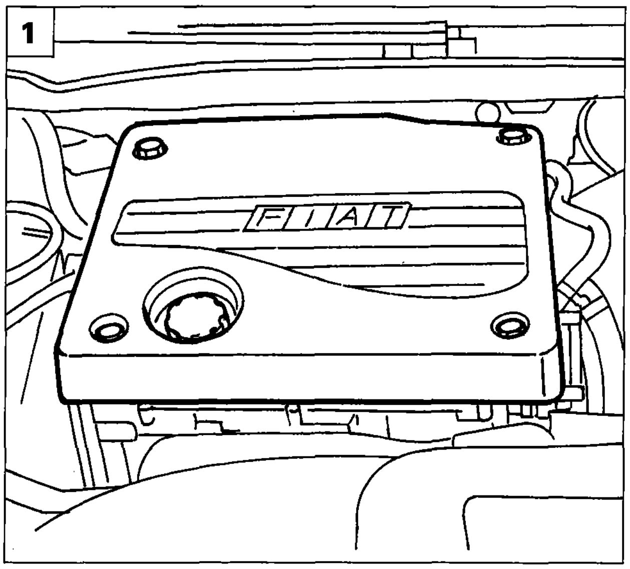
Operate the handbrake lever several times and check that the travel of the toothed sector is 5 notches.

If this is not the case, proceed with the adjustment as follows:

- remove the protective boot for the control lever;
- act on the adjustment nut shown, tightening or loosening it in order to increase or decrease the handbrake lever cable travel;
- check that the lever travel is equal to 5 notches on the toothed sector.

*When the adjustment has been carried out, the control lever travel should not exceed 5 notches on the toothed sector.*

*With the handbrake lever in the rest position the rear wheels should rotate freely; if this is not the case, repeat the adjustment.*

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## 10 11 CHECK/ADJUST TAPPET CLEARANCE

The following components must be removed in order to check and, if necessary, adjust the tappet clearance.

**Bravo-Brava 1910 TD**

1. Remove the upper engine protection.



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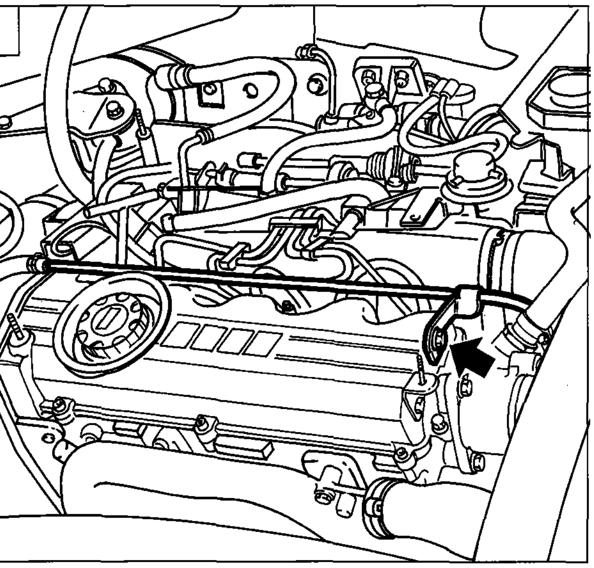
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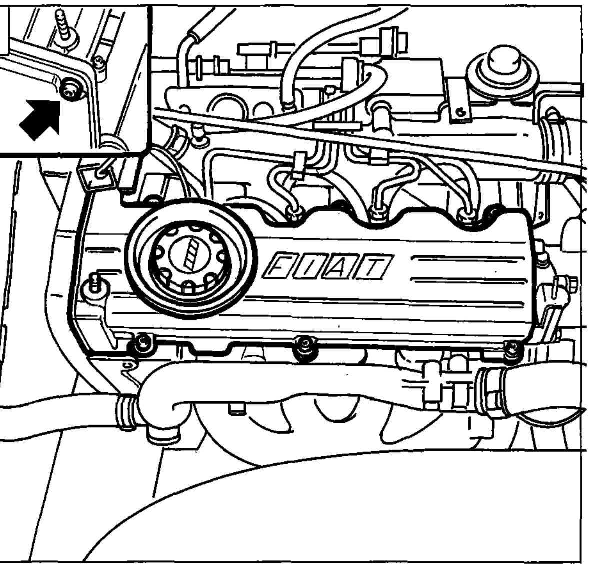
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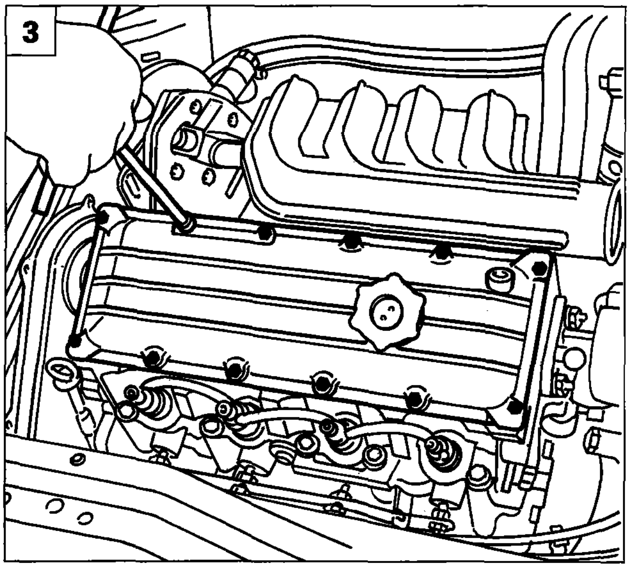
1. Disconnect the rigid engine coolant pipe using tool 1860967000 to undo the connector on the cylinder head; also undo the bolt shown and position the pipe at the side.
2. Undo the bolts fixing the tappet cover and remove it taking care to disconnect the oil vapour recovery pipe and the bolt shown-in the inset fixing the timing belt cover to the tappet cover. Then proceed with checking the tappet clearance.

3

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### Bravo-Brava 1929 D

3. Undo the bolts fixing the tappet cover, disconnect the brackets connected to it and remove it. Then proceed with checking the tappet clearance.

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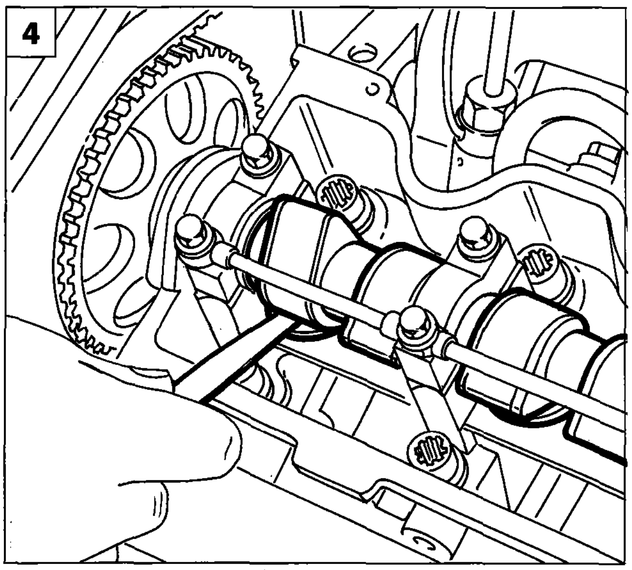
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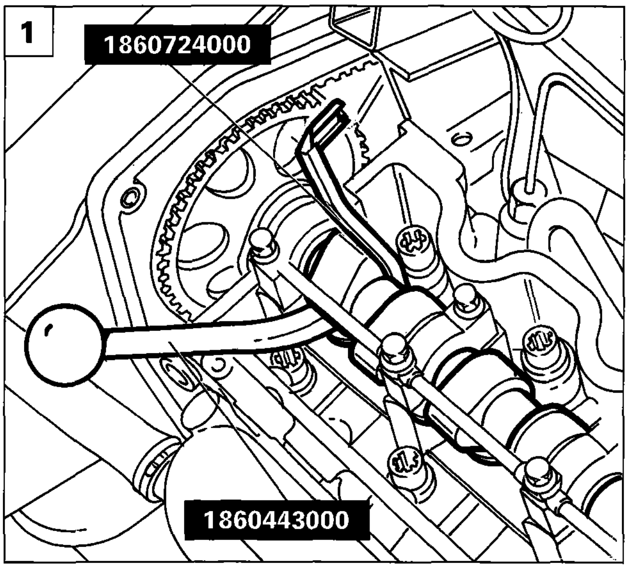
### Checking tappet clearance and, if necessary, adjusting

4. Rotate the camshaft so that the inlet and exhaust valves are in the closed position. With the engine cold, check the clearance between the cam recess radius and the tappet is within the recommended values using a feeler gauge.

| Engine type | 1910 TD | 1929 D |
|---|---|---|
| Inlet | 0.35 mm | 0.30 mm |
| Exhaust | 0.35 mm | 0.35 mm |

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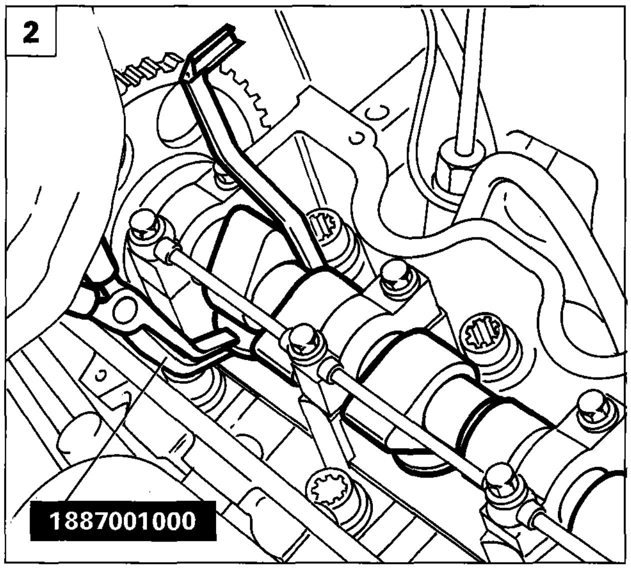


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If the tappet clearance does not correspond to the recommended figures, proceed as follows:

1. Using pressure lever 1860443000, lower the cup for the tappet concerned and insert tool 1860724000 for retaining tappets positioning the notches in the edge of the tappet in such a way as to facilitate the subsequent extraction of the shim to be replaced.

2. Lift up the shim to be replaced, working as appropriate, then remove it using pliers 1887001000.

**NOTE** *Replace the shim removed with another one of the appropriate size to restore the correct valve clearance. Carry out the same operation for the other shim for the pair of valves being adjusted.*

## 12 CHECK EXHAUST GAS EMISSIOSN (petrol engines)

The electronic injection/ignition systems used are capableof automatically controlling the advance, the carbon monoxide (CO) content and the idle air flow rate, therefore no manual adjustment operations are required. However, a check on the content of the exhaust gases downstream of the catalyzer can provide useful indications on the injection/ignition system operating conditions and the engine and catalyzer parameters.

The concentration of carbon monoxide (CO), unburnt hydrocarbons (HC) and the value $\lambda$, is measured with the catalyzer at operating temperature (300 - 350 °C) (we recommend driving hard along a section of road for around 5 to 10 minutes to ensure that the catalyzer reaches operating temperature), the insert a suitably calibrated tester sensor at least 30 cm into the end of the exhaust pipe as shown in the diagram overleaf.

If the shape of the end section of the exhaust pipe is such that the sensor cannot be fully introduced, add a special extension pipe ensuring the seal in the join area.

1. Check that the concentration of CO and the value $\lambda$ during idling and accelerated idle, correspond to the values recommended in the government circular:

**Engine measurement during idling: CO limit $\leqslant$0.5% vol.**

**Measurement for accelerated idle (2000 - 2500 rpm): CO limit $\leqslant$0.3% vol.**

**Lambda = 1 ± 0.03**



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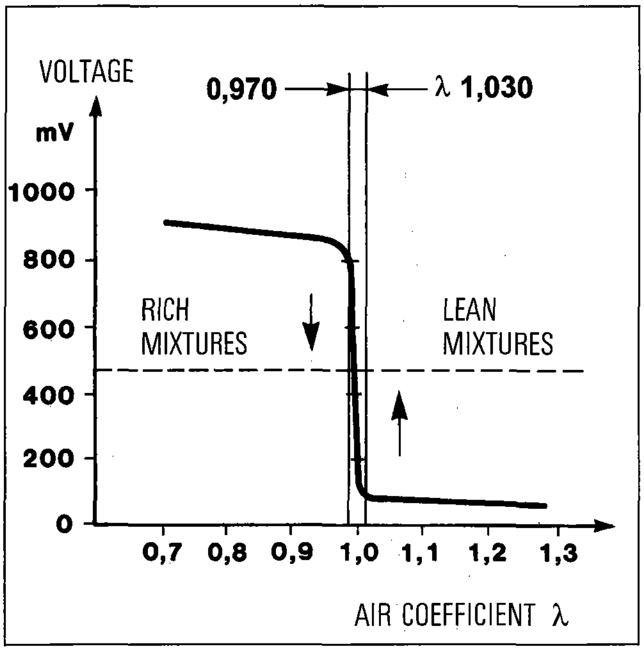
If the values are not within the limits set out in the government circular, the Customer must be notified of the need to check:
- that the Lambda sensor is working properly using the Fiat/Lancia tester;
- for the presence of air penetration in the area surrounding the Lambda sensor housing;
- the injection system, particularly the wear of the spark plugs.

2. If the HC figure is more than 90 p.p.m., the cause of the problem should be sought in the engine timing or the decreased efficiency of the catalyzer.

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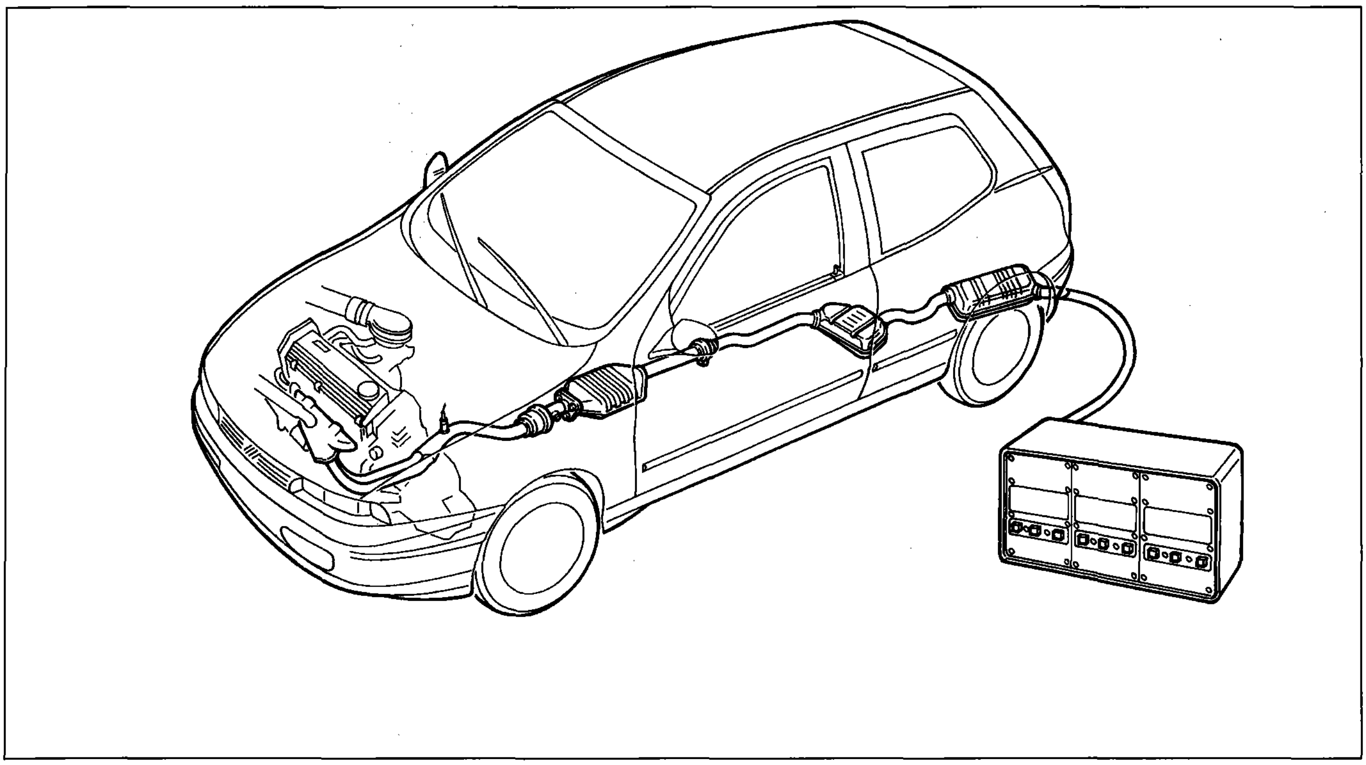
Factor λ is obtained from the ratio between the quantity of intake air and the theoretical quantity of air required to burn all the fuel injected.

To achieve an optimum mixture the quantity of fuel injected must be as close as possible to the theoretical quantity required to be completely burnt in relation to the quantity of air drawn in by the engine. In this case the Lambda factor is equal to 1 (ideal mixture) and the CO content is within the legal limits. With $\lambda \geqslant 1$ (lean mixture), excess air, the CO tends to assume low values: with $\lambda \leqslant 1$ (rich mixture), lack of air, the CO values tend to be high.



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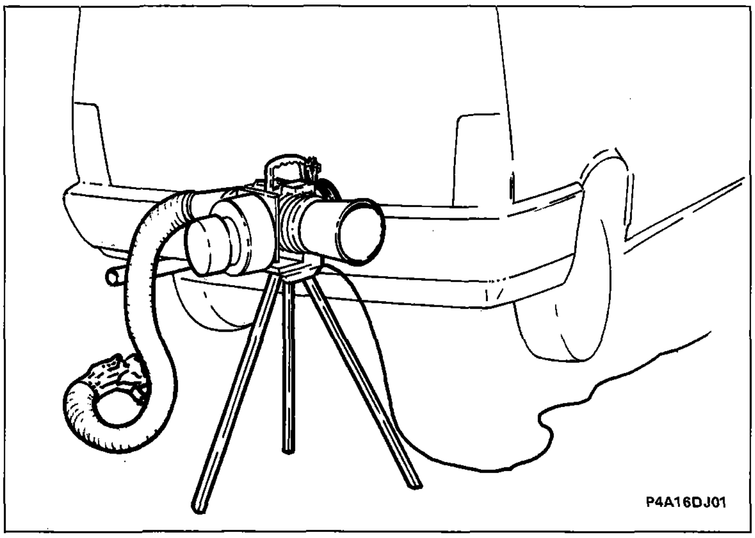
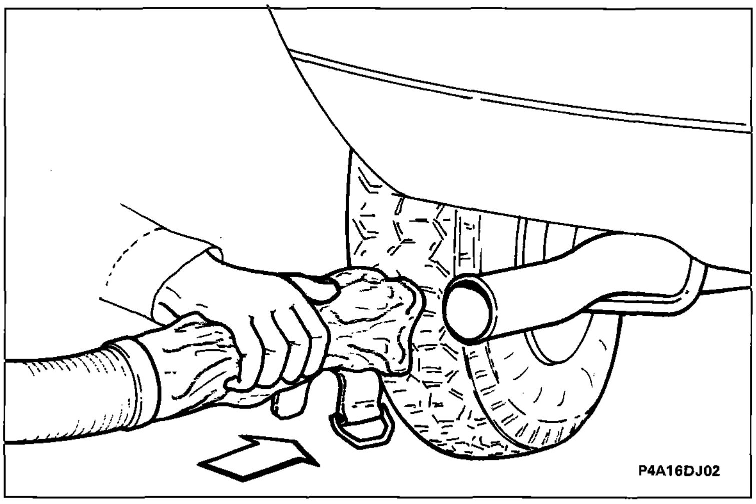


P4A16DJ01

### 12 CHECK EXHAUST GAS EMISSIONS (diesel engines using opacity meter)

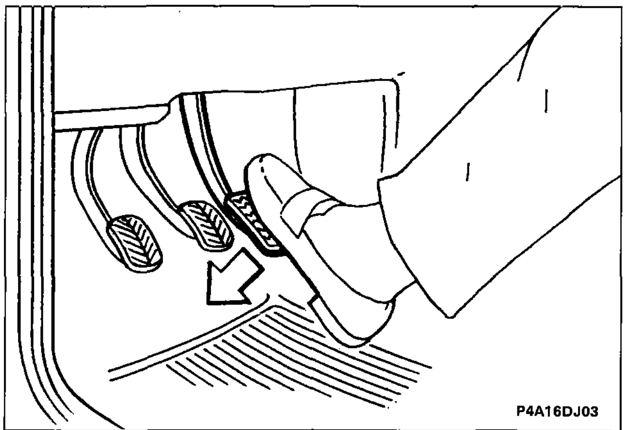
Start up the engine and let it reach operating temperature (radiator cooling fan comes on twice).
Place the opacity metering measuring unit in a stable position near the vehicle exhaust pipe (the opacity meter exhaust must be positioned against the wind).



P4A16DJ02

Connect the measuring unit flexible pipe with the vehicle exhaust pipe.
Carry out the equipment connections and adjustments in accordance with the Manufacturers' instructions.

Fully depress the accelerator pedal three times in quick succession so that the engine revs limiter speed is reached.
Carry out measurements for five subsequent full accelerations.
Make a note of the maximum values reached.
To obtain the figure for the test, calculate the arithmetical average of the three closest values.
If there is more than one suitable trio, select theone which gives the highest average value.



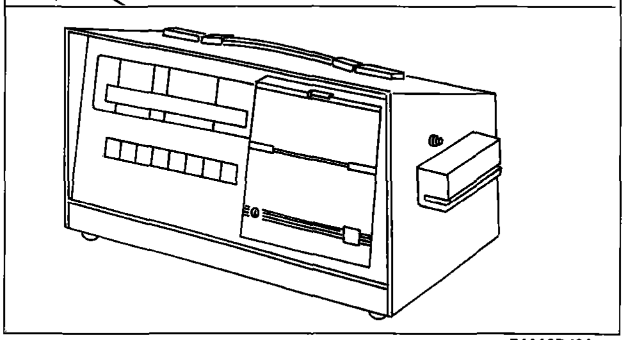
P4A16DJ03

Compare the values with the limit given on the plate on the vehicle conforming with the EEC directive.

Where figures are not available, apply the following limits from directive 92/55/EEC:

**Naturally aspirated diesel engine:**
**K = 2,5 m$^{-1}$**

**Diesel engine with turbocharger:**
**K = 3 m$^{-1}$**



P4A16DJ04

*If the figure for the exhaust fumes is more than 70%, notify the Customer of the need to carry out a series of tests on: the condition of the air filter, injection pump timing and flow rate, valve clearance and timing, injector calibration and cleanliness, compression ratio.*



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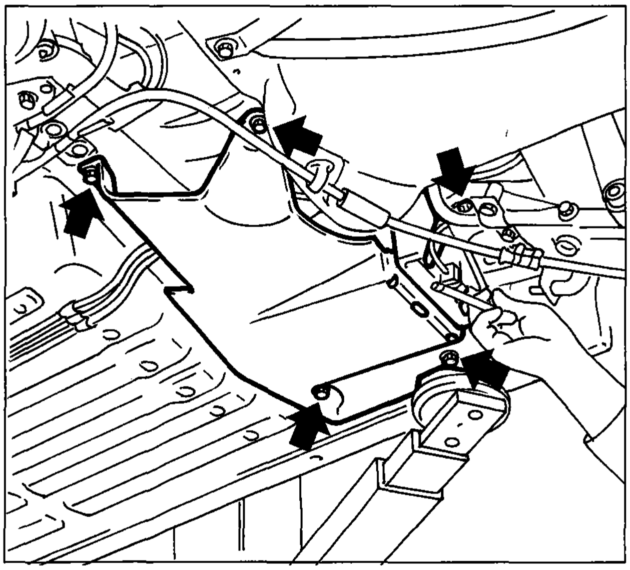
## 13 CHECK ANTI-EVAPORATION SYSTEM

The anti-evaporation system prevents the petrol vapours, which form in the tank and the fuel system, from being discharged into the atmosphere and consequently releasing the light hydrocarbons (HC) which they contain, producing a pollutant effect.

It is therefore necessary to check that the anti-evaporatin system pipes are correctly positioned in the engine compartment; also check their condition, making sure that there are no signs of cracks, cuts or leaks and that they are correctly fixed and not interfering with other components. Check the condition of the active charcoal filter. Position the vehicle on a lift and check the condition of the pipes under the floo of the vehicle.

## 14 REPLACE FUEL FILTER (petrol engines)



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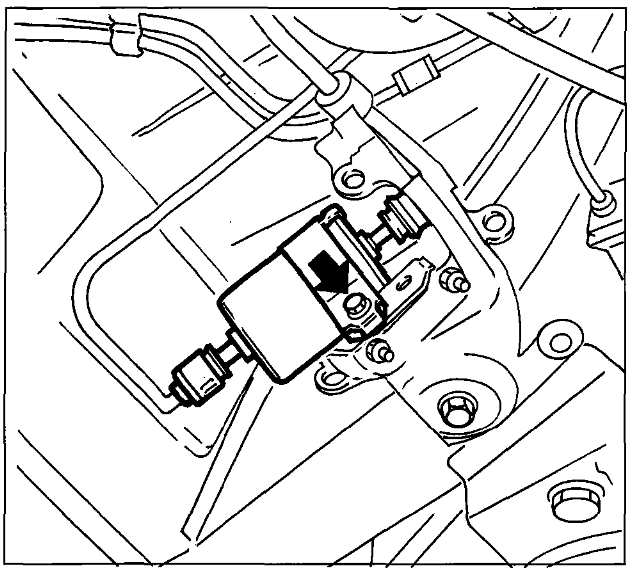

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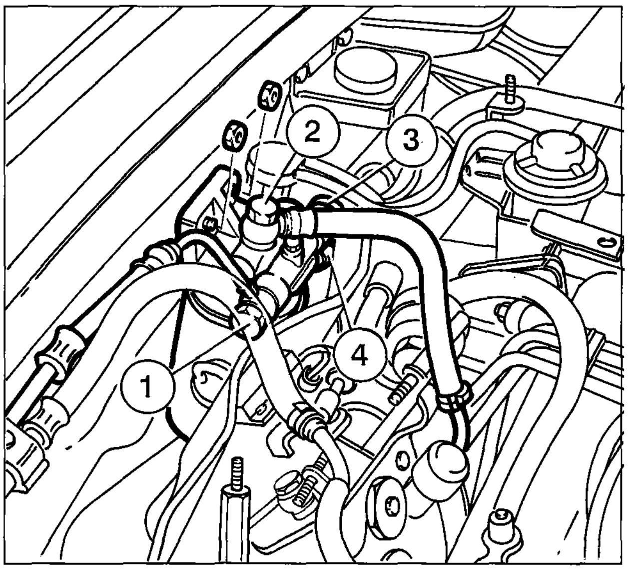
Proceed with removing the fuel filter by carrying out the following operations:

- Raise the vehicle;
- undo the bolts shown in the diagram and remove the protective shield.
- disconnect the rapid fue inlet and outlet connectors from the filter, collecting the fuel which comes out during the operation in a suitable container.
- undo the fixing bolt and remove the filter.

**NOTE** *The filter should NEVER BE FITTED THE WRONG WAY ROUND, or else it has to be replaced (even after working in the wrong position for a short period). The arrow on the outer casing indicates the direction in which the fuel should flow.*
*After replacing the filter, start up the engine and check that there are no leaks of fuel from the seals.*

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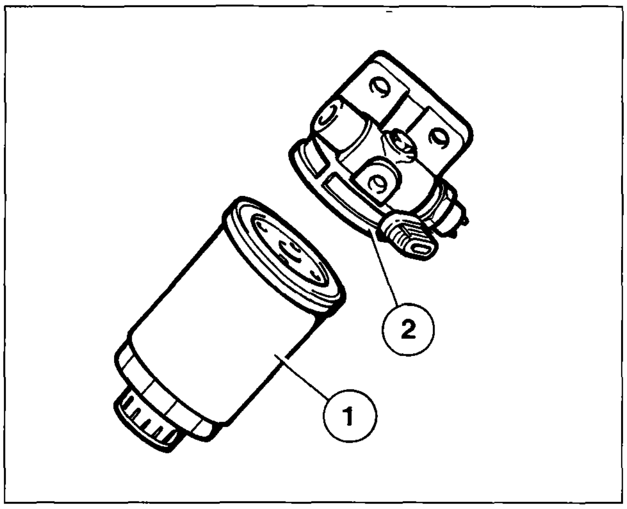


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### 15 REPLACE FUEL FILTER (diesel engines)

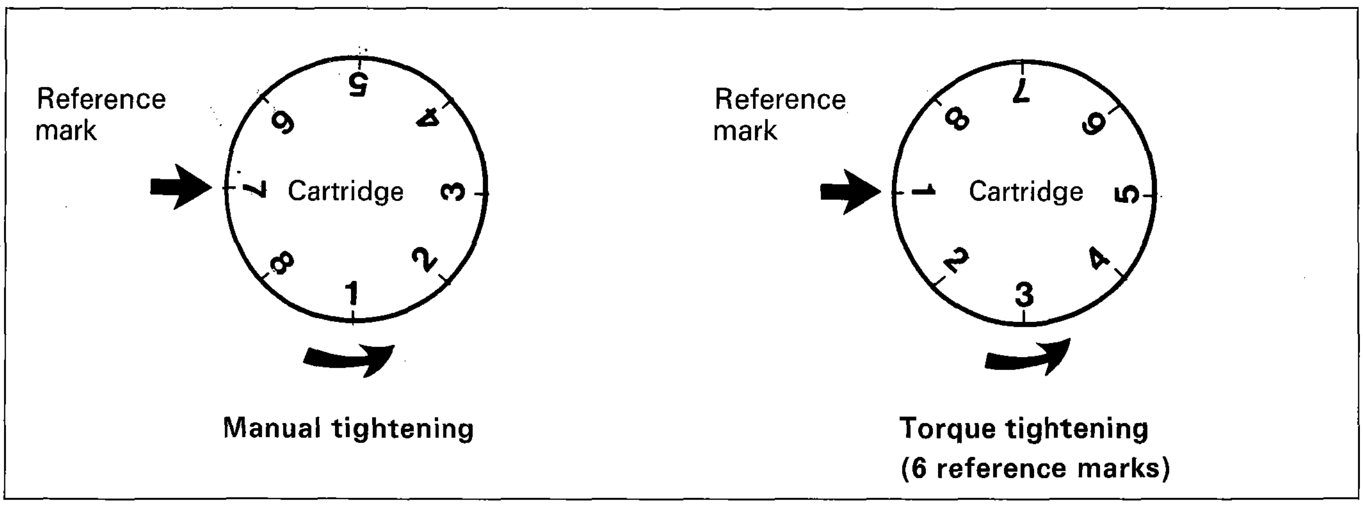
To replace the fuel filter, after having disconnected the negative battery lead, proceed as follows:

- Disconnect the connector (1) for the fuel supply pipe from the tank from the filter;
- Disconnect the connector (2) for the fuel supply pipe to the injection pump from the filter;
- Disconnect the electrical connection (3) from the fuel pre-heating device sensor;
- Disconnect the electrical connection (4) supplying the fuel pre-heating device;
- Undo the two nuts fixing the partition between the passenger and engine compartments and remove the complete fuel filter.
- At the bench, undo the fuel filter (1) with the seal from the support (2).

When refitting the fuel filter, proceed as follows:

- lubricate the rubber seal for the cartridge;
- fill the filter cartridge with diesel fuel (in order to shorten the self-bleeding time);
- tighten the cartridge in contact with the support;
- close the cartridge by 3/4 of a turn (to achieve a tightening torque of 1.3 - 1.6 daNm).

For the 1929 D version, which is equipped with a Lucas pump, this is achieved by means of the numbered references on the cartridge. For example, when the cartridge is in contact with the support a mark must be made on the support corresponding to one of the references on the filter, then the filter must be tightened counting 6 reference marks after that reference.

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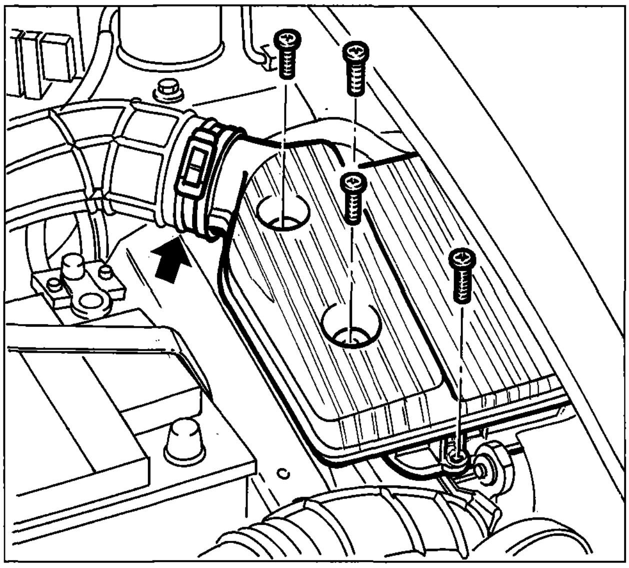

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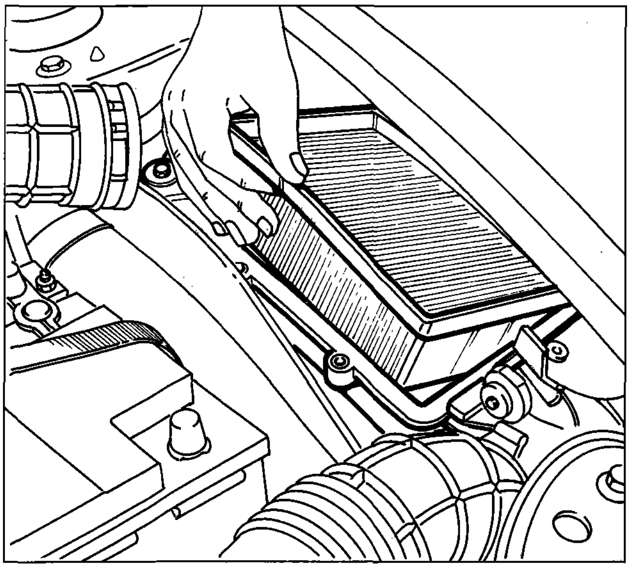

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### 16 17 REPLACE AIR FILTER CARTRIDGE

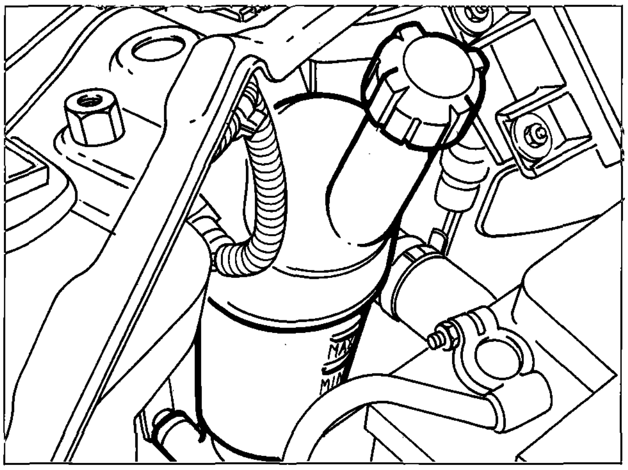
Undo the bolts fixing the air filter cover. Lift up the cover and extract the filter element; to facilitate this last operation, release the retaining band for the connecting hose to the butterfly casing.

*Any cleaning operation could damage the filter and risk adversely affecting the operation of the engine fuel system.*

Clean the air filter cartridge container carefully, replace the filter, then refit the cover and fix it using the appropriate bolts.

*If there are traces of oil on the filter, check for possible penetration throughout the entire air circut.*

**NOTE** *If the vehicle is used on dusty roads replace the air filter more often.*
*If they ask, the Customer should be provided with suitable information on the optimum maintenance frequencies depending on the specific usage of the vehicle.*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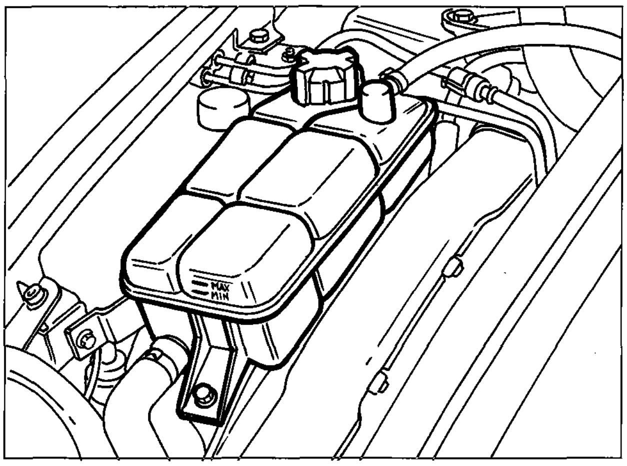
**1370 12v - 1581 16v**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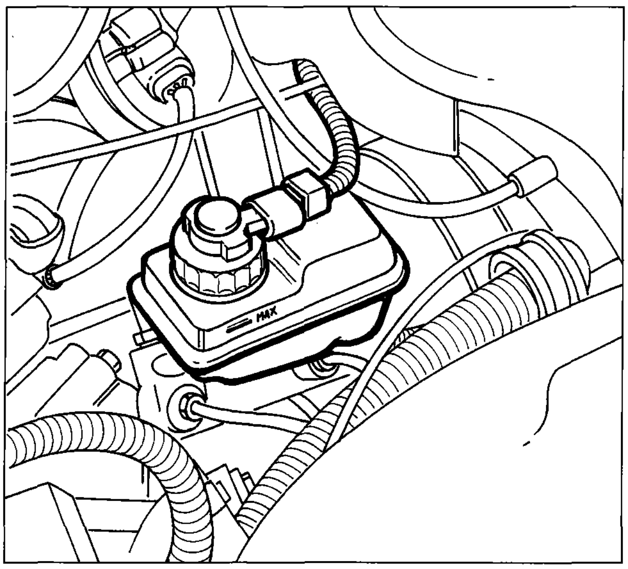
**1747 16v - 1998 20v - 1910 TD - 1929 D**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## 18 TOP UP FLUID LEVELS

### Engine coolant

*Do not remove the radiator cap when the engine is very hot as there is a danger of being scalded.*

The fluid level should checked with the engine cold and it should not be below the MIN level on the tank.

If the level is too low, slowly pour a mixture of 50% distilled water and Fiat Lubrificanti Paraflu 11 through the filler.

**NOTE** *The addition of "Paraflu Formula Europa" to Paraflu 11 used originally means that it is not possible to check the efficiency of the anti-freeze using the regular test equipment. "Paraflu Formula Europa" is already mixed which means that water does not have to be added.*

### Brake fluid level

The brake fluid level is checked with the vehicle on a flat surface.

Check that the level of the fluid in the tank corresponds to the MAX reference on the tank.

It is normal for the brake fluid level to decrease over a period of time because this indicates that the brake pads are working properly.

The level of the brake fluid should not exceedthe MAX level in the tank.

Check the operationof the warning light in the instrument panel: when the cover of the tank is pressed (with the ignition in the ON position) the warning light (!) should come on.


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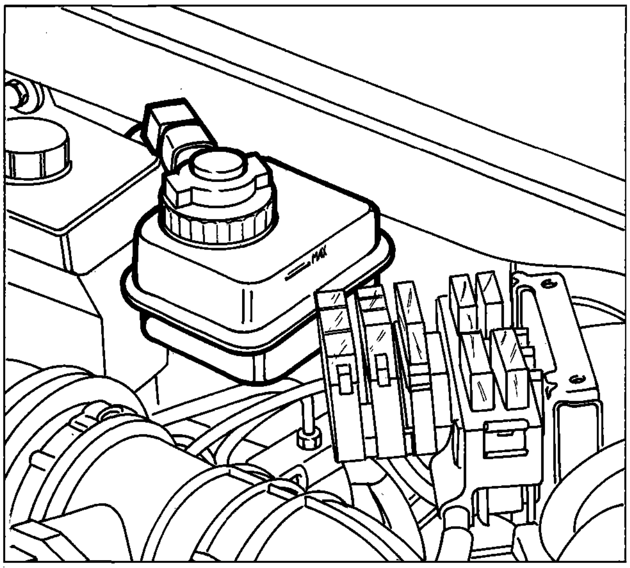
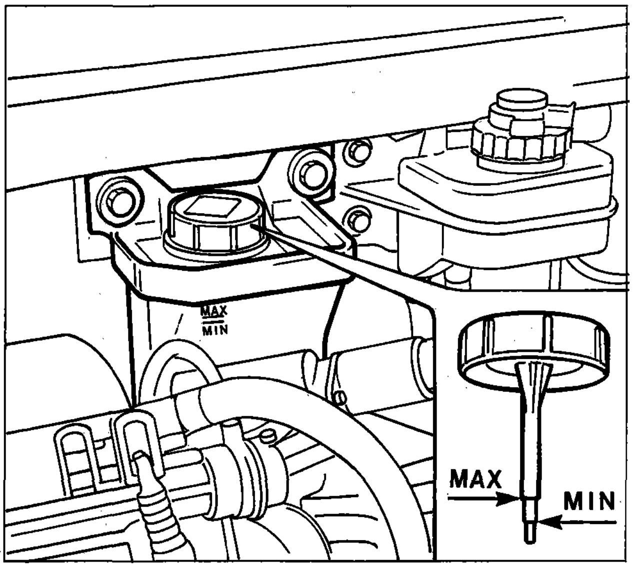


P4A17CA01

If fluid has to be added, only use DOT4 classification. Tutela TOP 4 270°C, which is used initially, is particularly recommended.

*Avoid the brake fluid, which is particularly corrosive, from coming into contact with the paintwork. If it does, wash immediately with cold water.*

*The symbol ⓪, on the container, identifies synthetic type brake fluids, distinguishing them from mineral types. The use of mineral type fluids irreparably damages the rubber seals in the braking system.*




P4A17CA02

### Power steering fluid level

Check that, with the vehicle on a flat surface and the engine cold, the fluid level is between the MIN and MAX references on the dip stick in the tank cap or on the actual tank.

In order to carry out the check, clean the dip stick, fully tighten the cap, undo it and check the level.

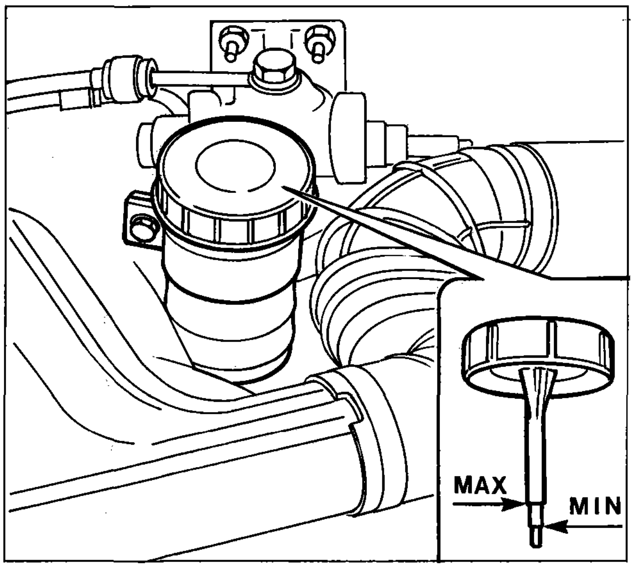
When the fluid is hot it may exceed the MAX level.

If necessary, add fluid, making sure that it has the same characteristics as the fluid already present in the system.

Start up the engine and wait until the level of the fluid in the tank stabilizes.

With the engine running and the vehicle stationary,turn the steering wheel completely to the right and to the left several times.

Top up until the level corresponds to the MAX reference, then retighten the cap.

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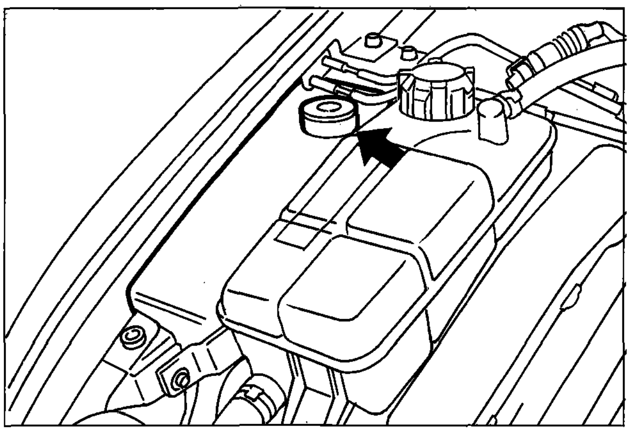
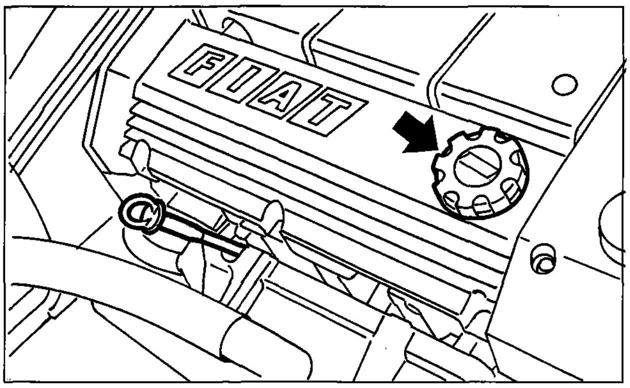
*Avoid power steering fluid coming into contact with the hot parts of the engine as it is inflammable.*



Bravo-Brava 1370 12v



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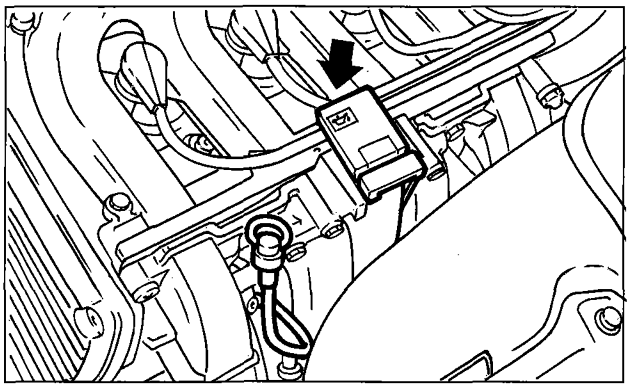
Bravo-Brava 1581 16v



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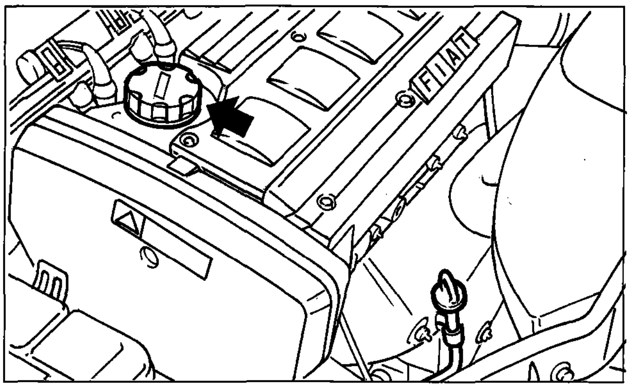
Bravo-Brava 1747 16v



P4A18CA04

### Windscreen/rearscreen and headlamp washer fluid level

In order to add fluid, lift up the cap, lift up the filter and pour a mixture of water and Arexons DP1 fluid in the following percentages:

- 30% Arexons DP1 and 70% water in summer;
- 50% Arexons DP1 and 50% water in winter.

In the case of temperatures below -20 °C, use undiluted Arexons DP1.

Versions with headlamp washers are fitted with a dip stick indicating the amount of fluid in the windscreen washer reservoir.

### Engine oil level

The engine oil level is checked with the vehicle on a flat surface and the engine cold, or around 10 minutes after the engine has been switched off.

The oil level should be between the MIN and MAX marks on the dip stick. The gap between the MIN and MAX levels corresponds to around 1 litre of oil.

If the level of the oil is close to or actually below the MIN reference, add oil through the filler until the MAX reference is reached.

*The level of the oil should never exceed the MAX reference.*

*When topping up with oil take great care to avoid accidentally spilling engine oil in the alternator ventilation slits which could cause serious damage to the alternator and also represents a fire hazard.*

*Do not add oil with different characteristics from those of the oil used in the engine. Only the use of semi-synthetic oil guarantees the planned maintenance intervals.*

After having added oil, before checking the level, let the engine run for a few seconds and wait for several minutes after it has been switched off.



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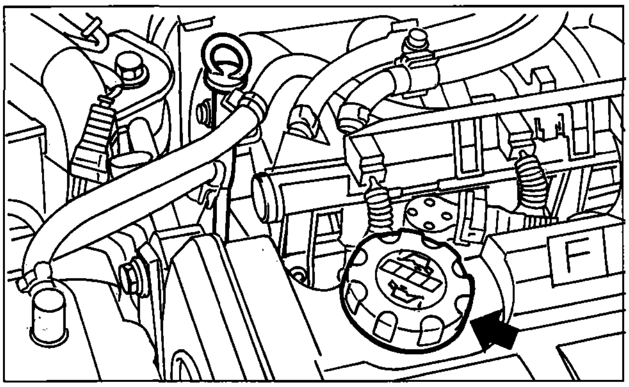
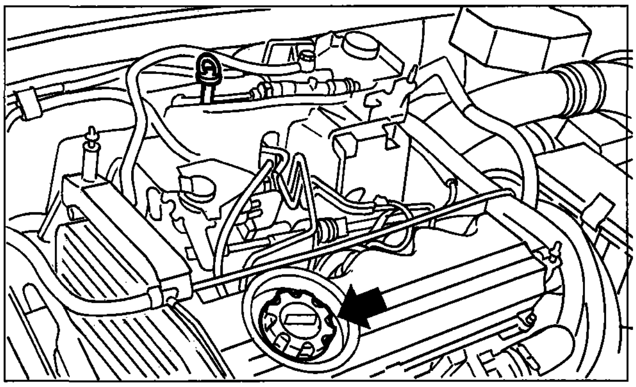
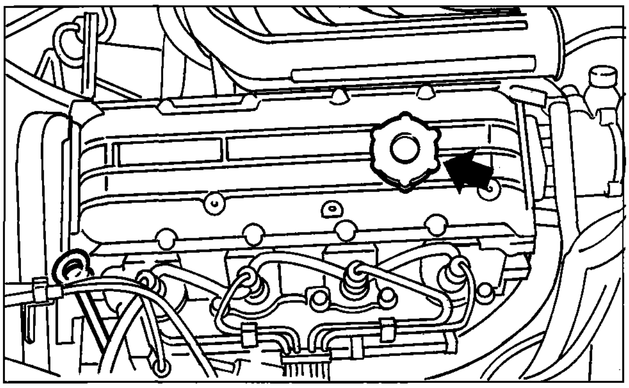


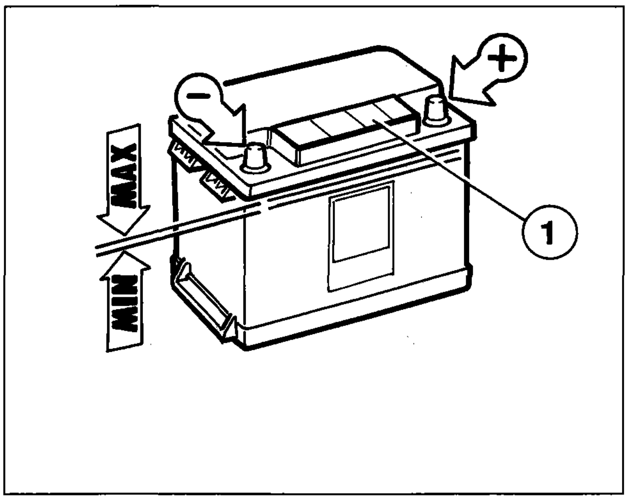

**Bravo 1998 20v**




**Bravo-Brava 1910 TD**




**Bravo-Brava 1929 D**



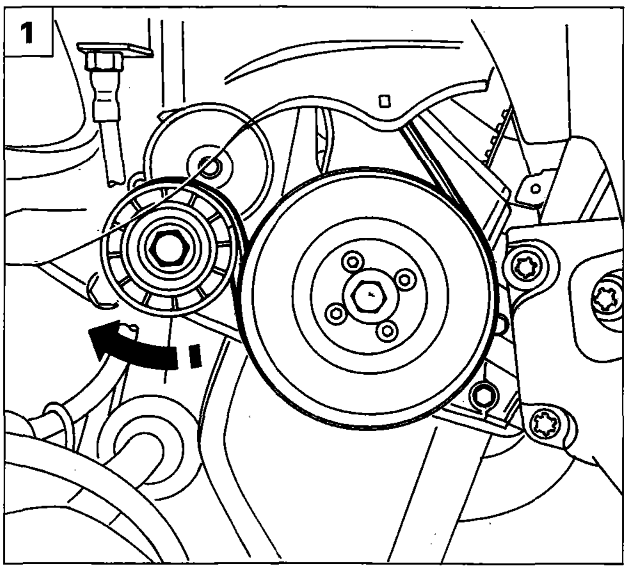

**Battery fluid level**

The battery is the "reduced maintenance" type: in normal usage conditions it does not need topping up with distilled water.

The level of the battery fluid (electrolyte), withthe vehicle on a flat surface, should be between the references on the battery. If the level is below the MIN mark, lift up the protective cover (1) and top up using distilled water.

*The fluid contained in the battery is poisonous and corrosive. Avoid contact with the skin and eyes. Keep naked flames and possible sources of sparks away from the battery as there is a danger of explosion and fire.*

*The state of charge of the battery should be checked, preferably at the beginning of the cold season, to avoid the possibility of the electrolyte freezing.*
*This check should be carried out more often if the vehicle is mainly used for short journies or if it is equipped with consumers which absorb power permanently with the ignition switched off, particularly if they have been fitted in the after market.*

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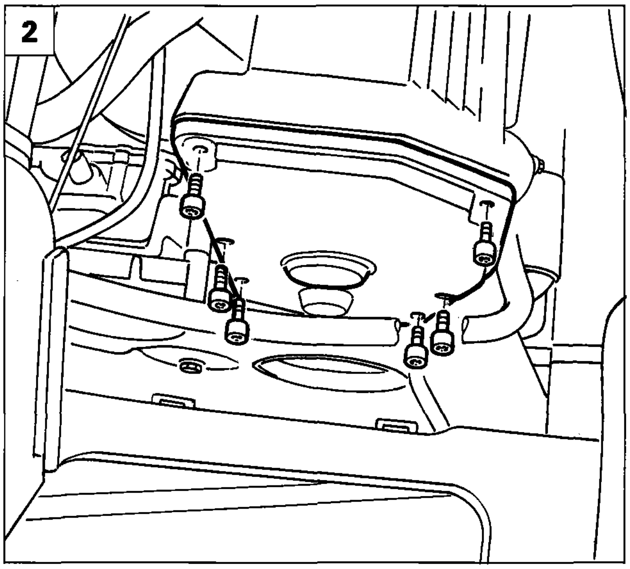
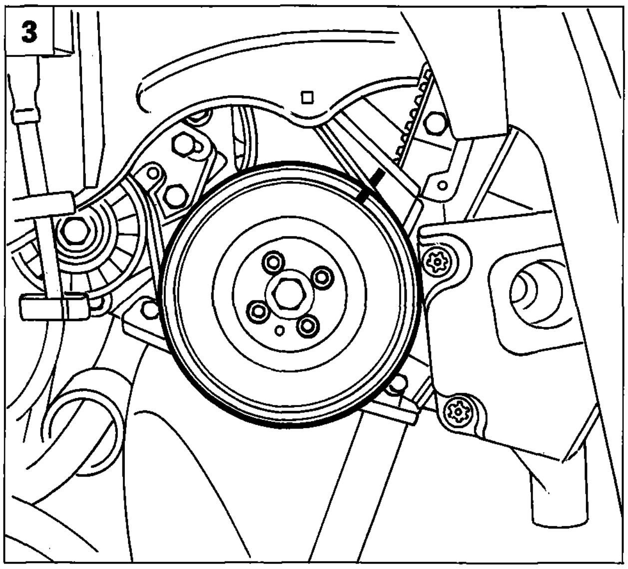



P4A12AX02

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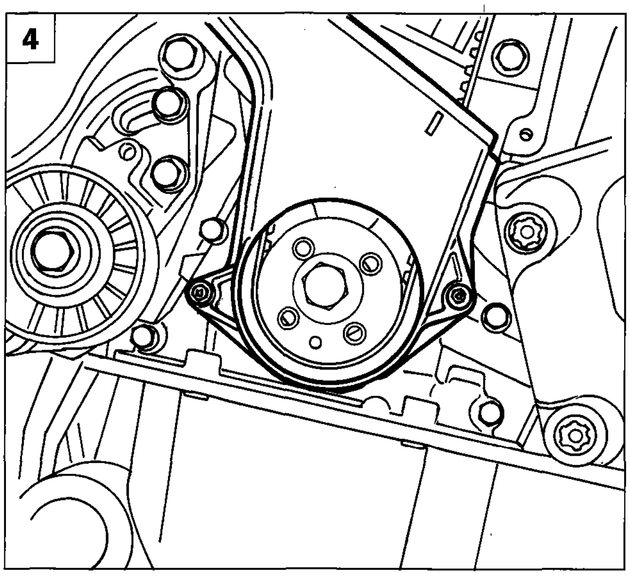


P4A12AX04

## 19 REPLACE TIMING BELT

**Bravo-Brava 1370 12v**

Position the vehicle on a lift, then:

- disconnect the negative battery lead;
- remove the right front wheel;
- remove the right wheel arch liner to gain access to the auxiliary shaft drive belt.

1. Loosen the auxiliary shaft drive belt tension acting on the centre nut for the automatic tensioning device to release the spring inside the actual device. Then remove the actual belt from the damper flywheel leaving it fitted on the power steering pump pulley; it is not necessary to remove the upper shield for the power assisted steering pump.

2. Remove the upper shield for the timing drive belt after having removed the support for the coolant pipe.

3. Loosen the bolts fixing the damper flywheel, then rotate the latter until the reference on it coincides with the reference on the shield underneath. Then, remove the damper flywheel.

4. Remove the lower timing belt lower shield.


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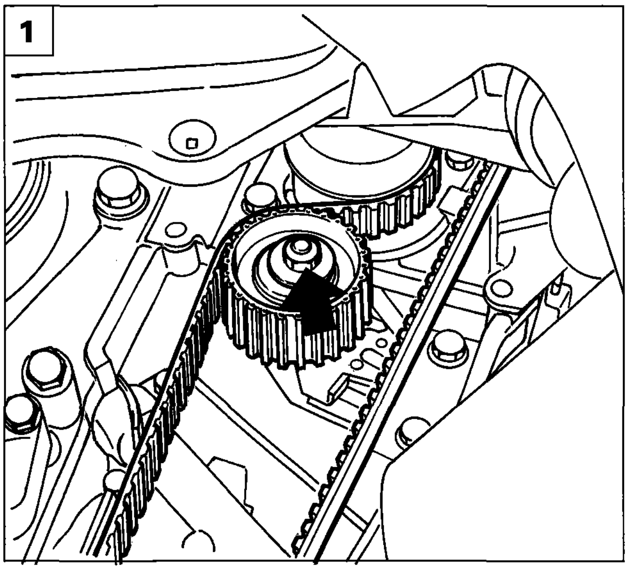

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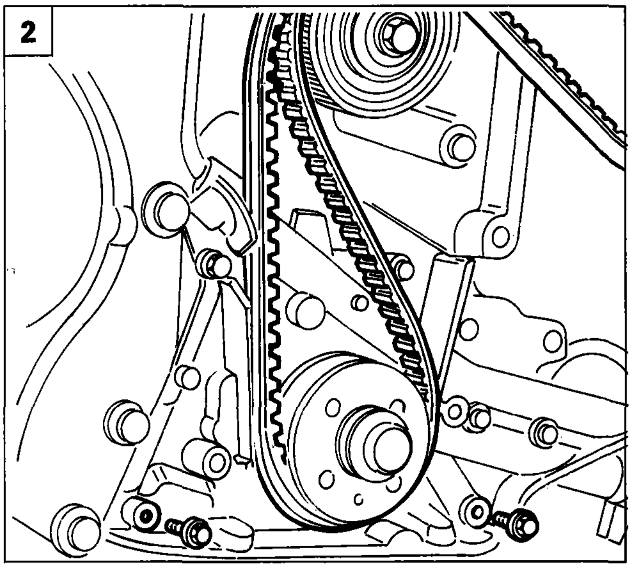

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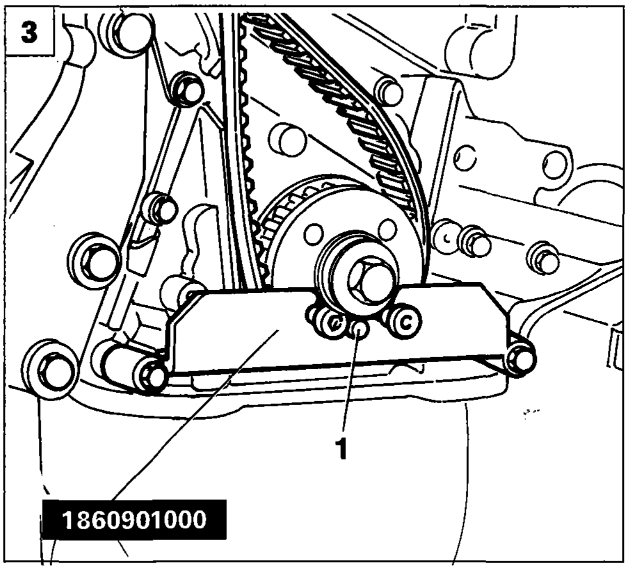


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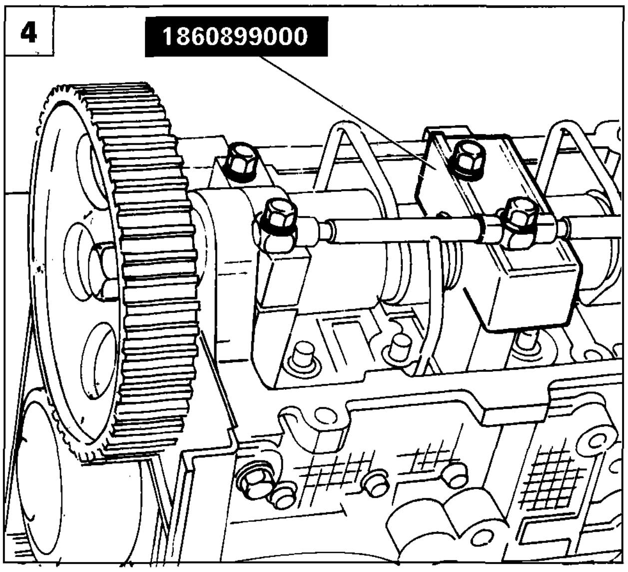



P4A31AX01

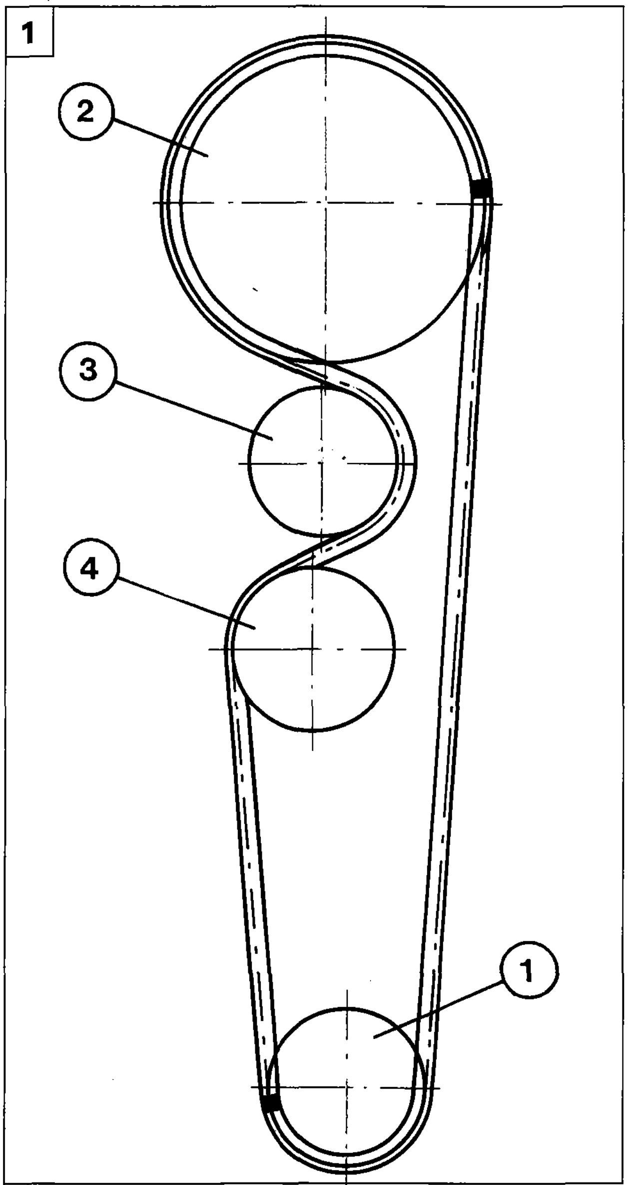
1. Loosen the automatic tensioner bolt, releasing the belt tension, then remove it.

**Fitting timing drive belt**

2. After having removed the tappet cover, loosen the bolt fixing the camshaft drive pulley using spanner 1860831000; fit the toothed belt on the crankshaft gear and remove the two bolts illustrated fixing the oil pump to the crankcase.
3. Place tool 1860901000 in position, ensuring that the opening (1) in the tool coincides with the dowel on the crankshaft gear; in this position cylinder no. 1° is at T.D.C.
4. Remove the bolts fixing the 1st - 2nd - 3rd and 4th timing caps, exhaust side, loosen the inlet side ones, raise the lubrication duct, remove the 2nd cap and place tool 1860899000 for timing the camshaft in the housing, then tighten all the caps to a pre-torque of 1 daNm.

*Work with due care when raising the lubrication duct to avoid the duct being distorted or broken.*

1

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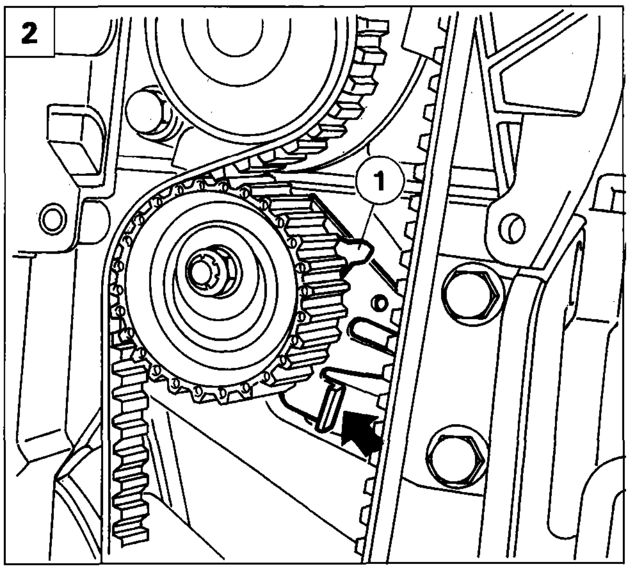
2



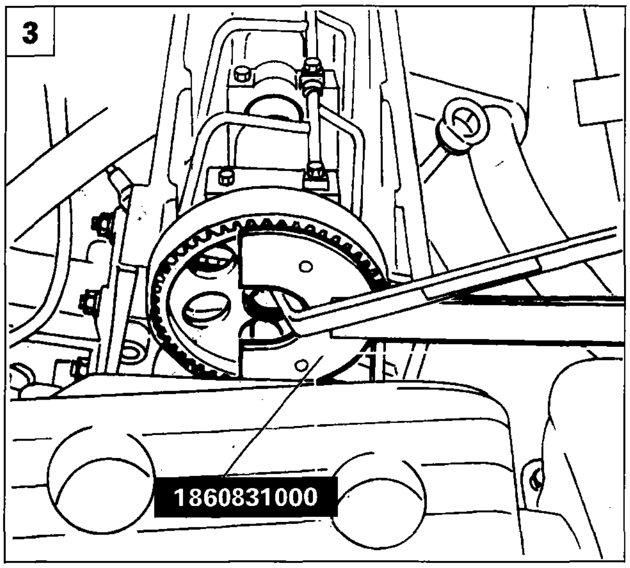

P4A14AX03

1. Complete the refitting of the belt observing the following order:

   - crankshaft drive pinion (1);
   - camshaft drive pulley (2);
   - water pump pulley (3);
   - automatic tensioner (4).

**NOTE** *The belt should be fitted avoiding bending it at acute angles in order not to adversely affect the structure of the actual belt.*
*The belt should also be fitted with the arrows on it facing in the direction of rotation of the engine.*

3




P4A32AX01

**Tensioning timing drive belt**

2. Using tool 1860443000, act at the point shown by the arrow and place the moving index (1) on the tensioner in the maximum tension position, then lock the nut fixing the tensioner.

3. Tighten the fixing bolt for the camshaft drive pulley to a torque of 11.3 daNm using spanner 1860831000.



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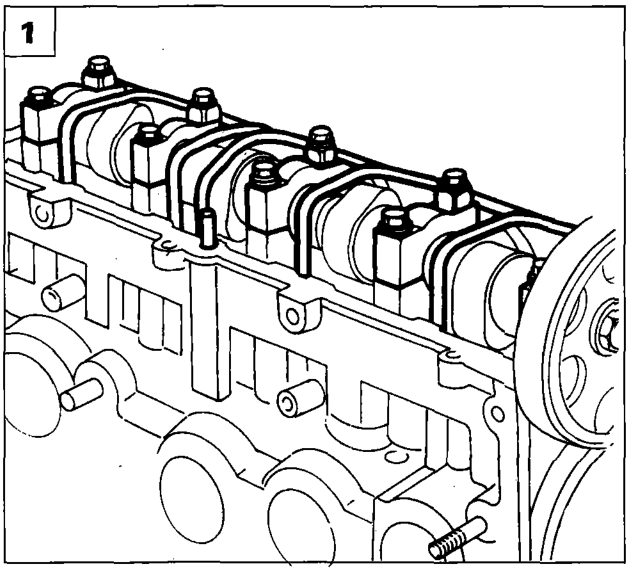
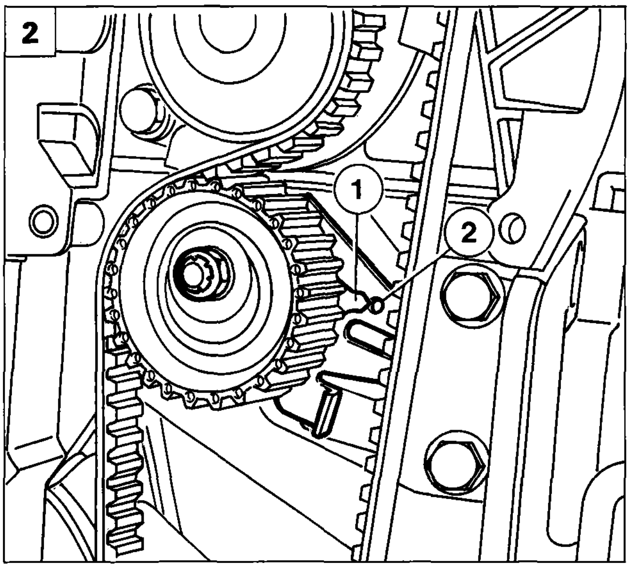



P4A32AX02

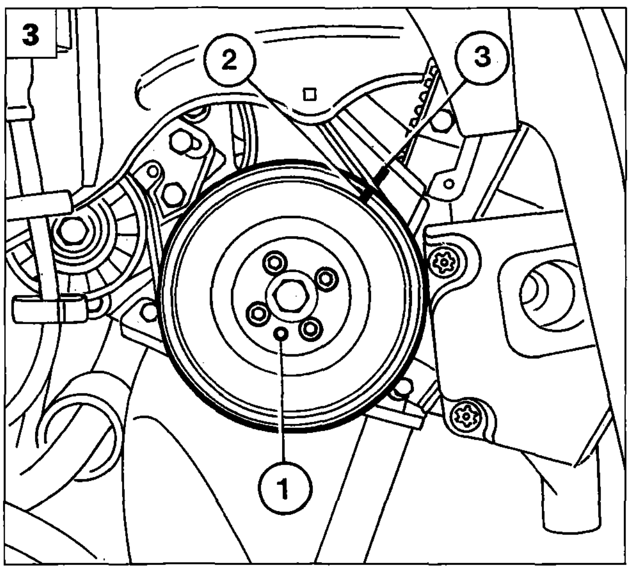
1. Remove tool 1860899000 and refit the 2nd cap.
   In order to carry out this operation it is necessary to remove the bolts fixing the 1st - 2nd - 3rd and 4th caps, exhaust side, loosen the inlet ones, slightly raise the lubrication duct, remove the tool and position the cap, tightening the cap fixing bolts to the recommended torque.

*Work with due care when raising the lubrication duct to avoid the duct from being distorted or broken.*



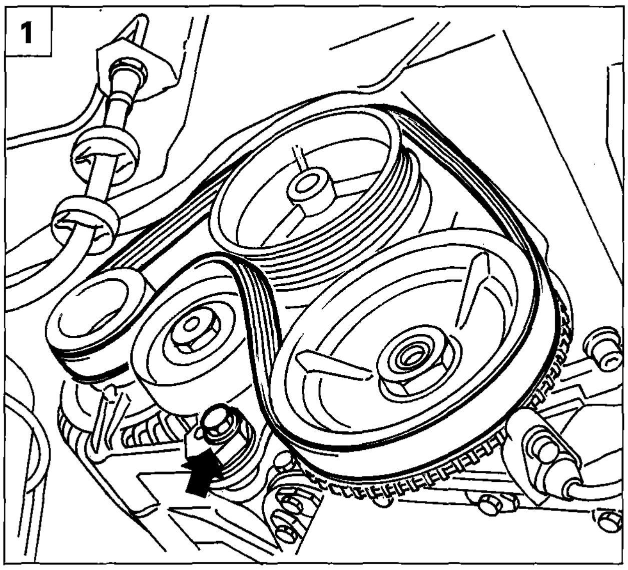

P4A15AX01

2. Remove tool 1860901000 placed previously on the timing gear and rotate the crankshaft through two revolutions in its direction of rotation. Loosen the tensioner fixing nut, make sure that the moving index (1) coincides with the fixed reference (2), then lock the nut fixing the tensioner and tighten it to the recommended torque.

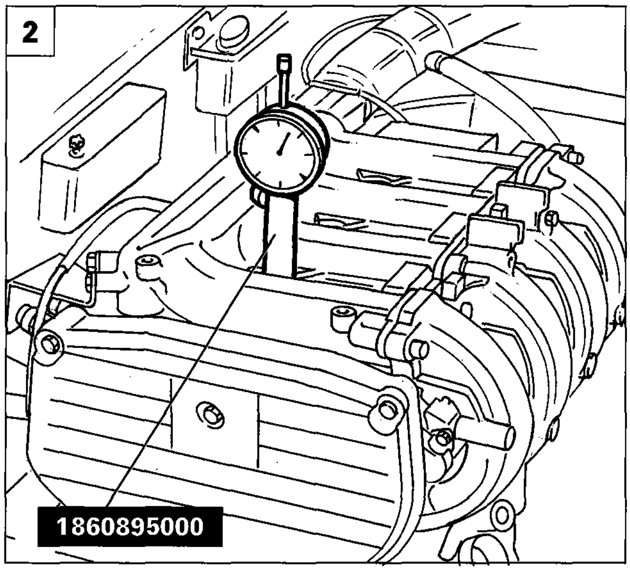



P4A15AX02

3. Refit the previously removed components, taking care to refit the auxiliary shaft drive pulley with the opening in the actual pulley engaged with the dowel (1) on the crankshaft pinion and also checking the engine timing ensuring that the reference (2) on the pulley corresponds with the reference (3) on the timing belt shield.

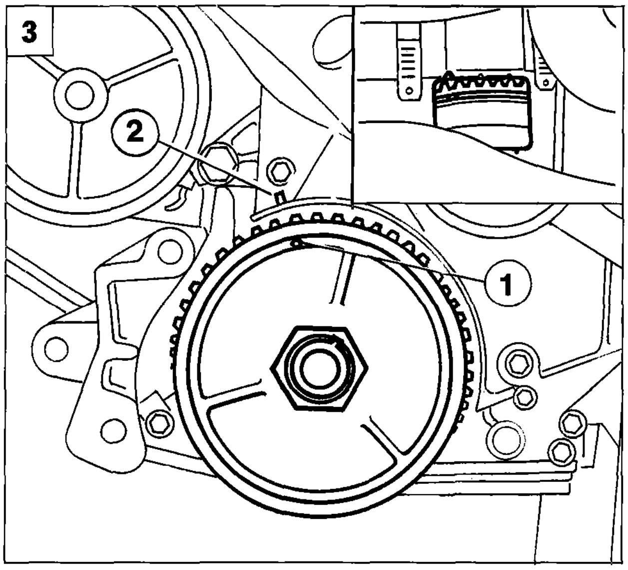



P4A09CX03

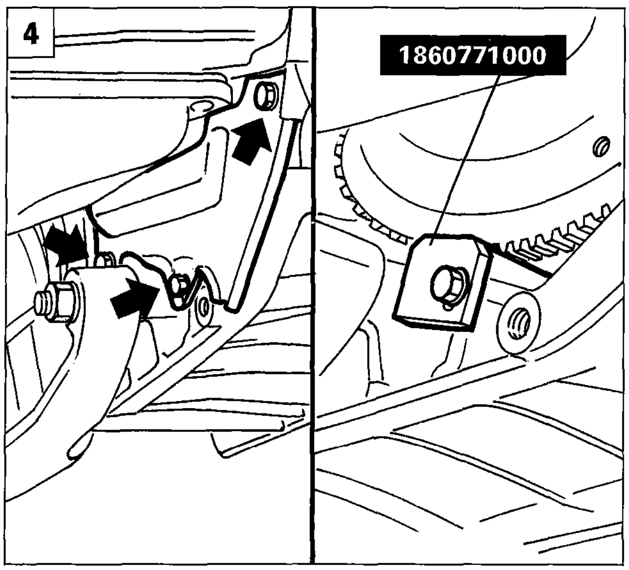



P4A11CX03

P4A11CX05




P4A11CX04




P4A12CX01

**Bravo-Brava 1581 16v**

Position the vehicle on a lift, then:
- disconnect the negative battery lead;
- remove the right front wheel;
- remove the right wheel arch liner.

1. To gain access to the timing belt it is necessary to remove the alternator drive belt from the damper flywheel. In order to do so, act on the tensioner fixing bolt shown in the diagram.
2. After having removed the air intake pipe near the upper part of the timing belt shield, remove the spark plugs and position the dial gauge by cylinder no. 1 using support 1860895000; rotate the crankshaft until T.D.C. is found.
3. Check that the reference (1) on the damper flywheel is aligned with the reference (2) on the timing belt lower shield. Also check that the reference on the flywheel coincides with the reference on the bell housing, as shown in the inset.
4. Remove the lower protective casing for the flywheel from the bell housing, then place flywheel lock 1860771000 in position and remove the damper flywheel. Then undo the upper and lower bolts fixing the timing belt shield and remove it.



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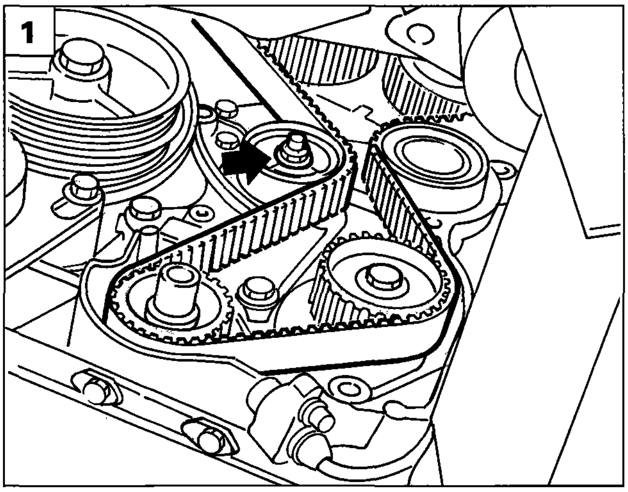
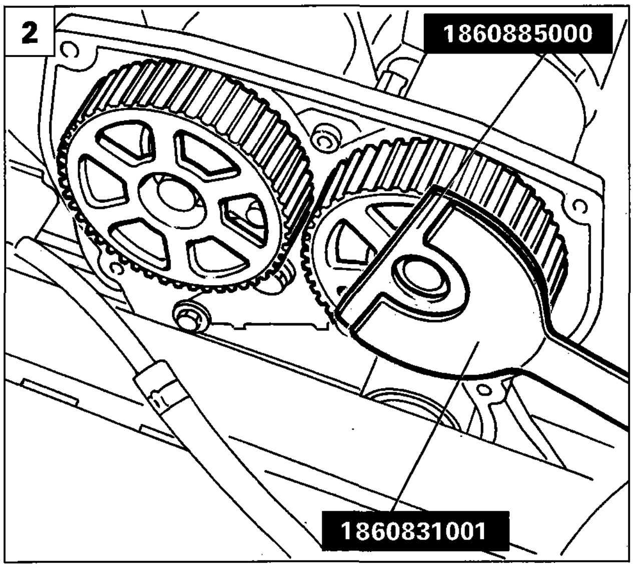



P4A12CX04

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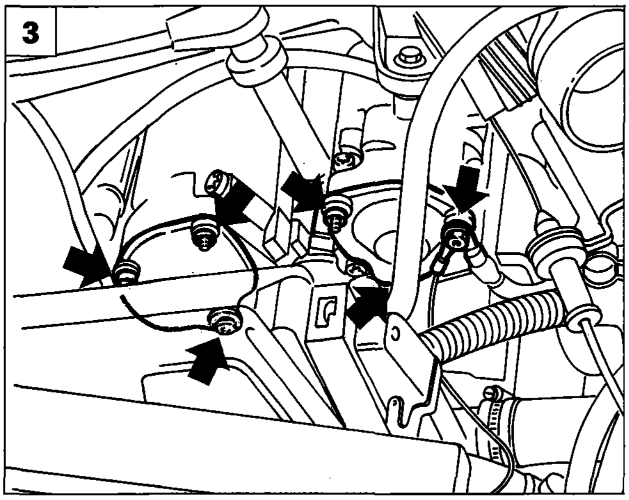
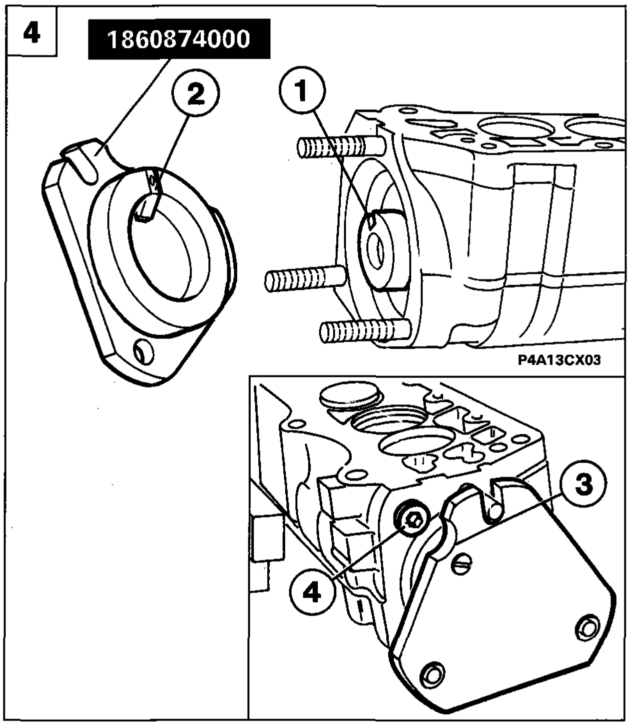



P4A13CX04

1. Loosen the nut fixing the automatic belt tensioner in order to discharge the belt tension, then remove the actual belt.

**Timing at "0"**

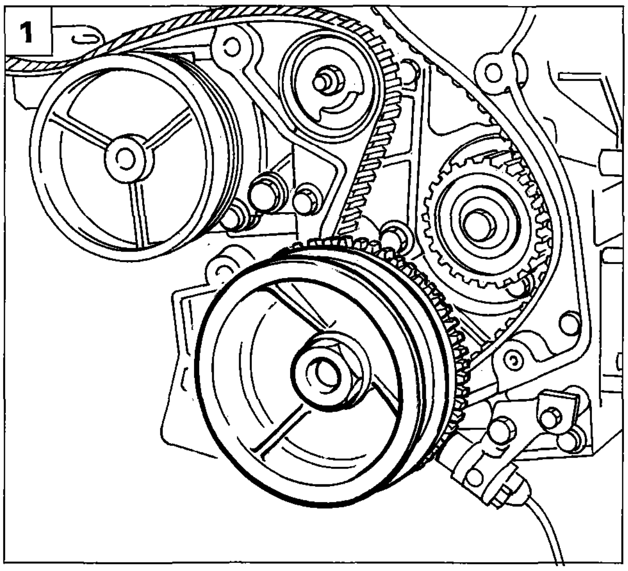
2. Loosen the bolts fixing the camshaft pulleys using tool 1860885000 fitted on support 1860831001.

3. Remove the ignition coils acting on the mounting bracket fixing nuts, after having disconnected the appropriate supply connections. Then remove the camshaft rear covers, as shown in the diagram.

4. Position tools 1860874000 for timing the camshafts, making sure that the housing (1) for the shaft coincides with the element (2) on the tools; engage the element in the housing and fix the tool to the camshaft housing by the covers which were removed previously. Repeat this operation both the camshaft inlet shaft and the exhaust one.

⚠ *If the tools do not fit perfectly and it is necessary to rotate the camshafts, align the pistons so that none of them are at T.D.C. thereby avoiding the valves from being incorrectly positioned.*

⚠ *Tools 1860874000 for timing the shafts differ only in terms of the reference housing (3) in the angle at the bottom which should correspond to the plug (4) in the camshaft housing.*



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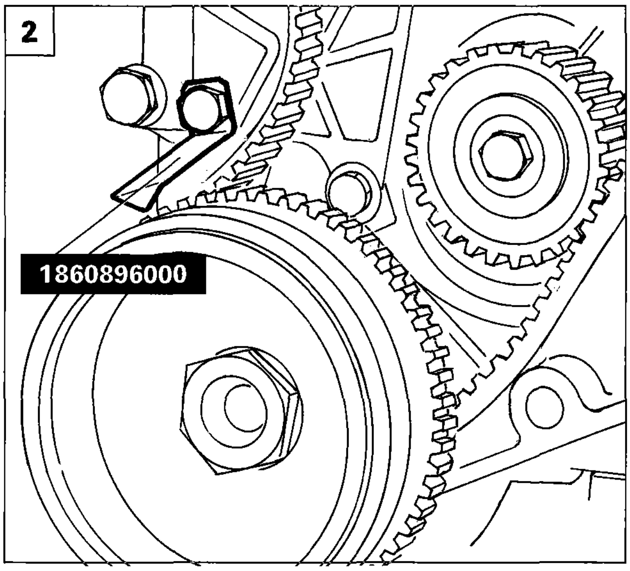

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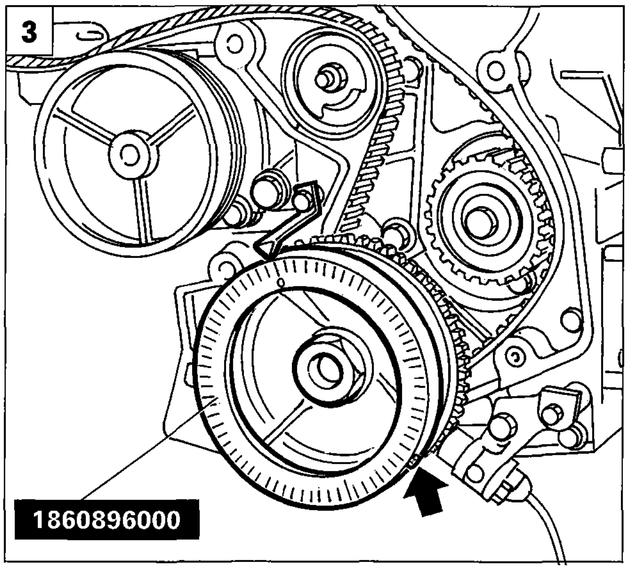

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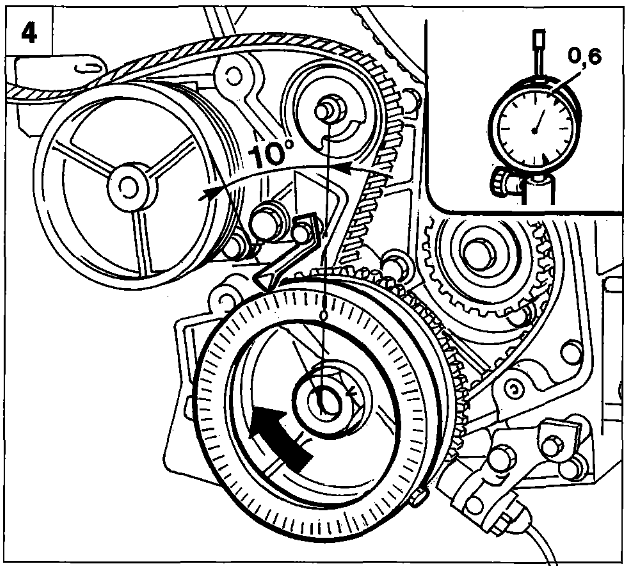

P4A15CX02

1. Only fit the timing drive belt on the crankshaft pinion. With flywheel lock 1860771000 fitted, fit the damper flywheel and tighten the fixing nut to a torque of 22 daNm, then remove the flywheel lock.

2. Remove the auxiliary shaft belt tensioning device acting on the fixings in order to allow the tool to be positioned for timing at "0". Use a dial gauge to recheck that cylinder no. 1 is at T.D.C. then, using the fixing bolt for the timing belt shield, fix the fixed reference shown in the diagram in the housing of the bolt used.

3. Fit the support base for the graduated disc 1860896000 on the auxiliary shaft drive pulley and fix it to the pulley using a bolt. Then fit the graduated disc on the support base ensuring that the "0" on the disc coincides with the fixed reference positioned previously.

4. Rotate the crankshaft through around 10° in its normal direction of rotation using a special spanner on the damper flywheel fixing nut; take a reading of the axial movement of the piston from the dial gauge (for example 0.6 mm).



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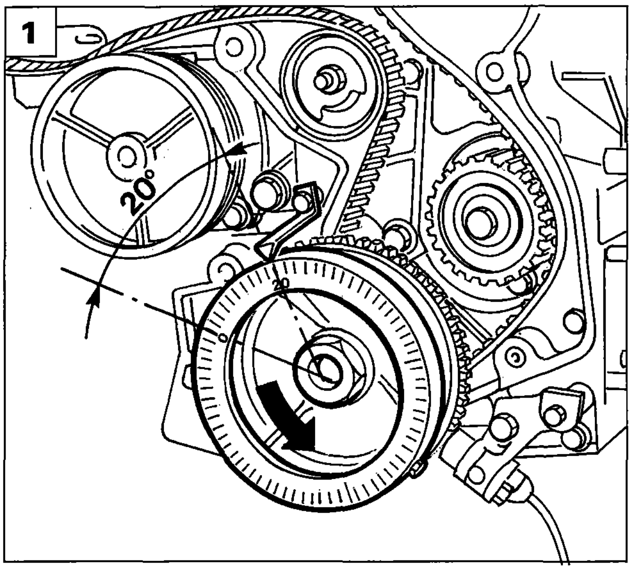


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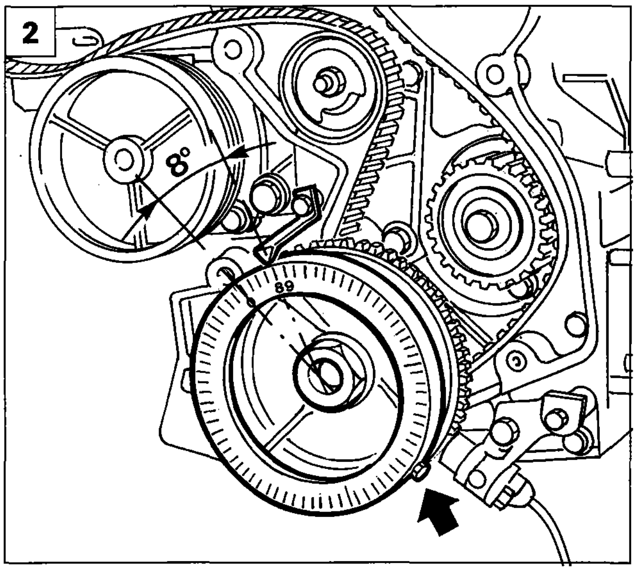


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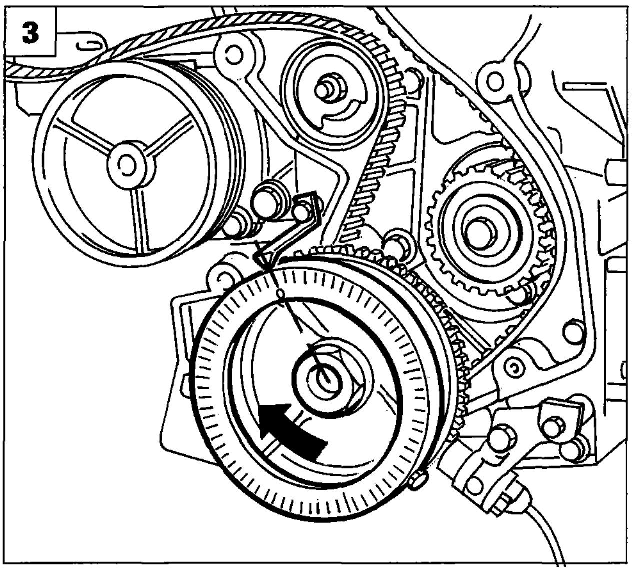


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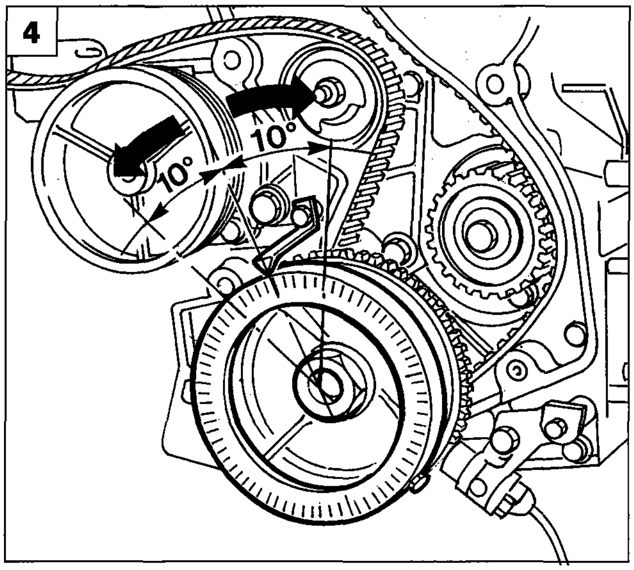
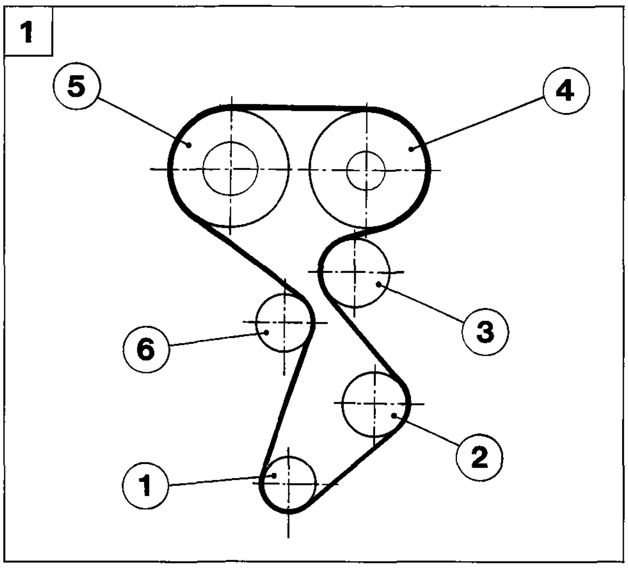



P4A16CX02

1. Rotate the crankshaft in the opposite direction to the normal direction of rotation through 20° in relation to the fixed reference. Rotate the crankshaft once again in its normal direction of rotation until the same axial movement value which appeared previously on the dial gauge (0.6 mm) appears.
2. Read the angular value on the graduated disc corresponding to the previous axial movement (for example 8°). Take the arithmetical average of the angular value of the crankshaft set at the beginning of the procedure (10°) and the current value (8°), then release the graduated disc from the base, position it in relation to the fixed reference, without rotating the crankshaft, at the value which is the arithmetical average (for example 9° = the average of 10° and 8°), then lock the graduated disc once again.
3. Rotate the crankshaft pulley in a clockwise direction until the "0'" on the graduated disc coincides with the fixed reference.
4. Rotate the crankshaft through 10° in a clockwise direction and an anti-clockwise direction checking that the reading on the dial gauge during the clockwise rotation of the crankshaft is the same as that for the anti-clockwise rotation.

*If the readings on the dial gauge after the check carried out for point 4 are not the same, repeat the procedure described on the previous pages.*

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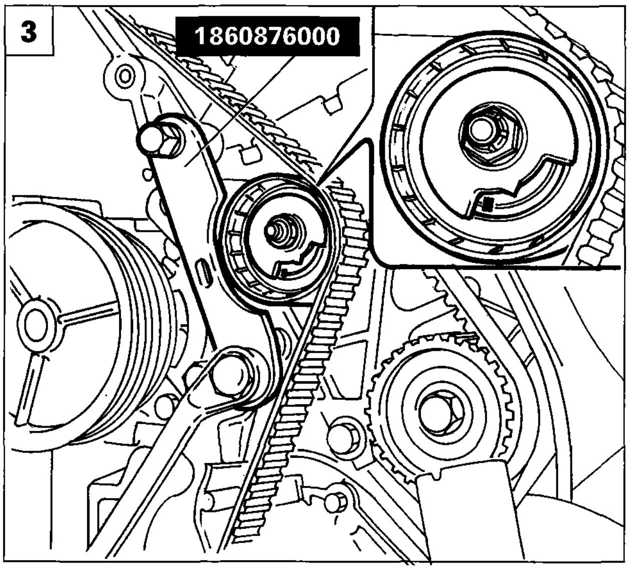


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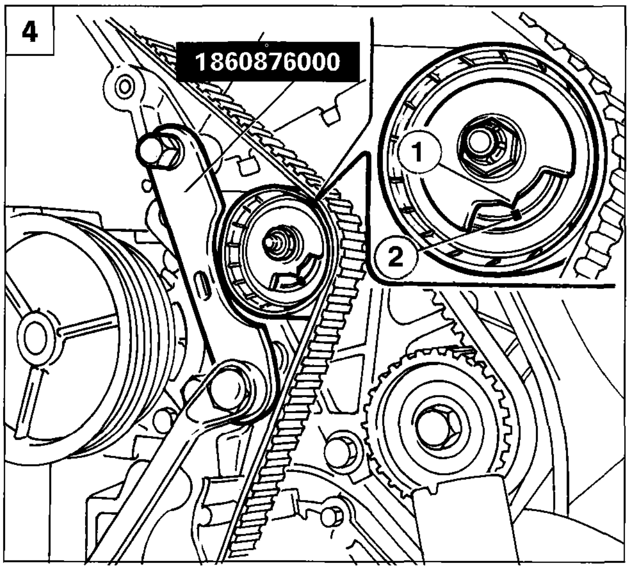


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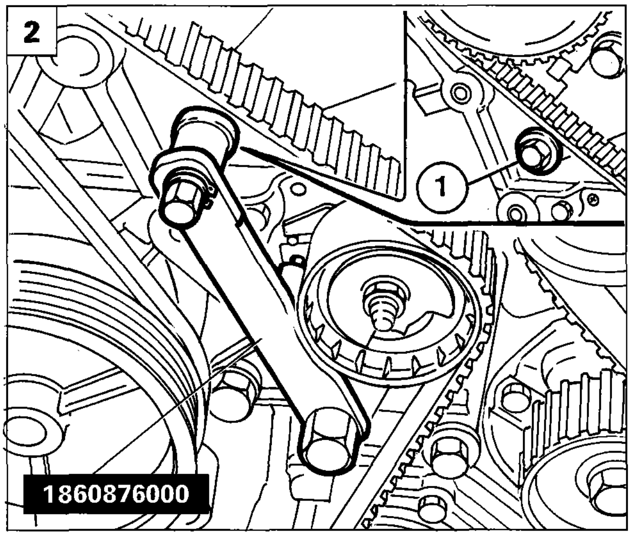


**Tensionamento cinghia distribuzione**

1. Complete the fitting of the belt in the following order: 1. Crankshaft gear (already fitted) - 2. Oil pump gear - 3. Fixed pulley - 4. Timing pulley, inlet side - 5. Timing pulley, exhaust side -
   6. Automatic tensioner.

*Fit the belt with the camshaft pullies facing towards the right in order to recover any necessary clearance for fitting the belt perfectly on the actual pullies, ensuring the correct tension in the section of the belt already fitted.*

2. Remove the bolt (1) to allow tool 1860876000 for tensioning the timing belt to be positioned.
3. Acting on tool 1860876000, place the belt tensioner in the maximum tension position, then lock the tensioner nut. Remove the dial gauge and tighten the camshaft pullies to a torque of 11.5 daNm using tool 1860885000 on support 1860831001.
4. Remove tools 1860874000; rotate the crankshaft through two revolutions in the direction of rotation, loosen the nut locking the tensioner and, using a special spanner on the belt tensioner, position reference (1) in line with reference (2), then tighten the belt tensioner lock nut to a torque of 2.3 daNm.
   As a further check, refit the dial gauge, detect T.D.C. and check that tools 1860874000 fit on the camshafts, then refit the components removed previously.


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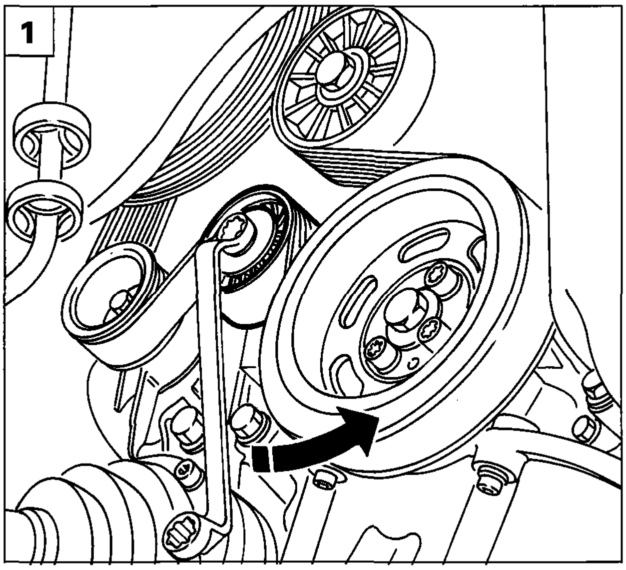


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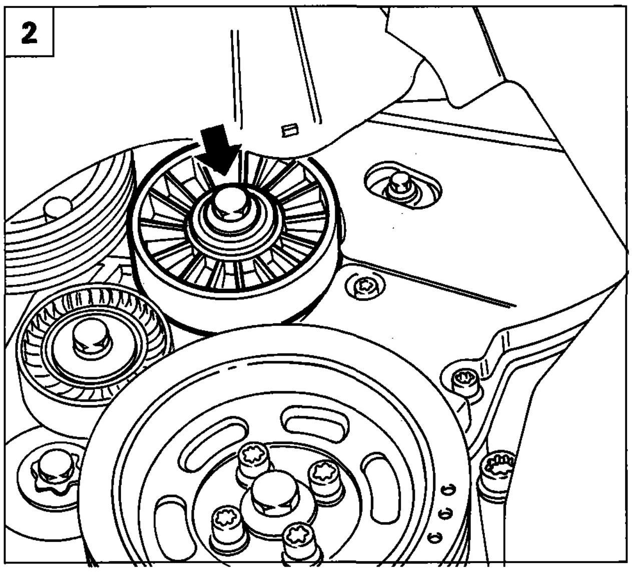


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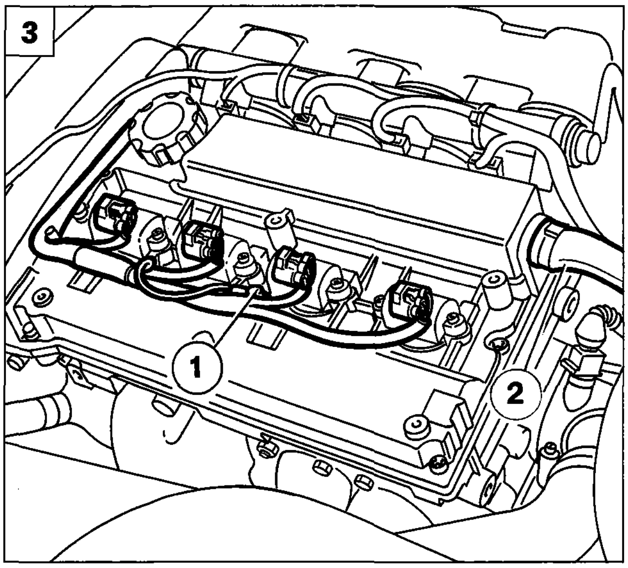


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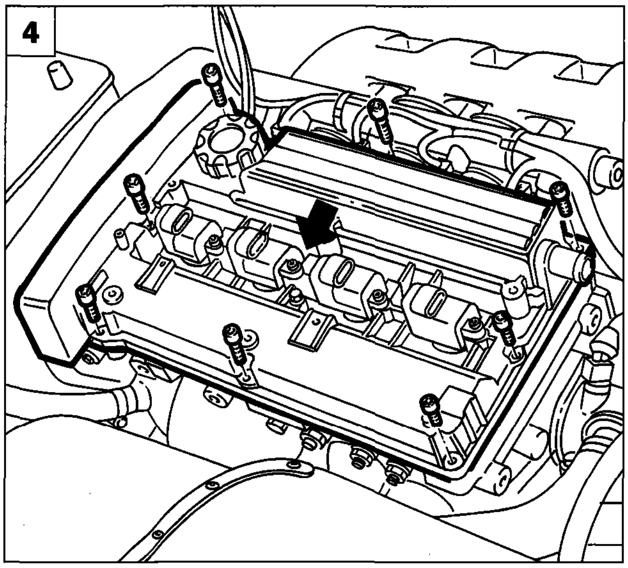


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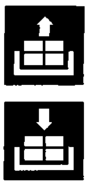


**Bravo-Brava 1747 16v**

Position the vehicle on a lift, then:

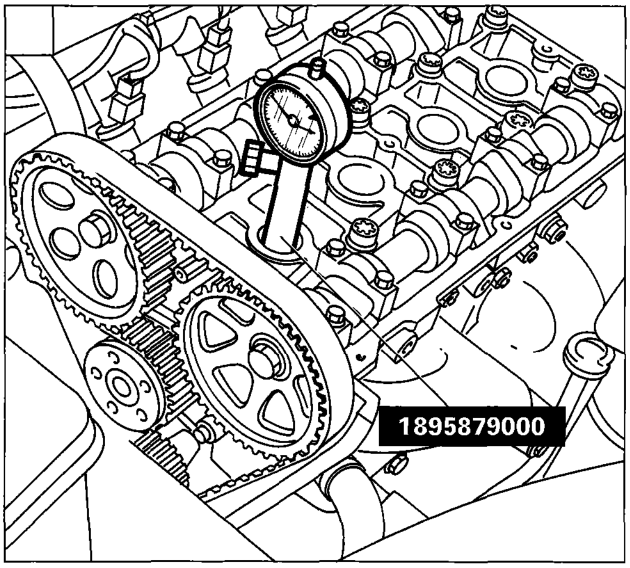
- disconnect the negative battery lead;
- remove the right front wheel;
- remove the right wheel arch liner.

1. Loosen the tension for the auxiliary shaft drive belt acting in an anti-clockwise direction on the centre nut for the automatic tensioning device to release the spring inside the actual device; then fit the belt.

2. Remove the fixed pulley for the auxiliary shaft drive belt, then undo the upper and lower bolts fixing the timing belt shield and remove it.

3. Remove the cover for the ignition coils, disconnect the connections from the coils, the earth cable (1) and the oil vapour recovery pipe from the cylinder head cover.

4. Disconnect the connector from the air conditioning compressor, release the cable and remove the cylinder head cover acting on the fixing bolts shown in the diagram.

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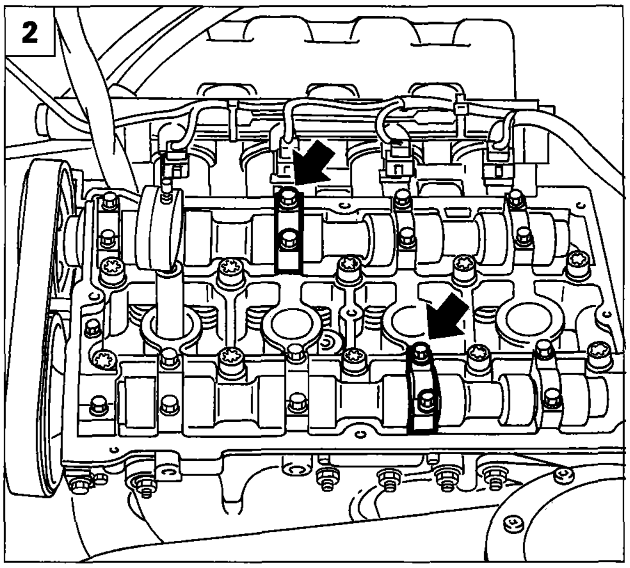


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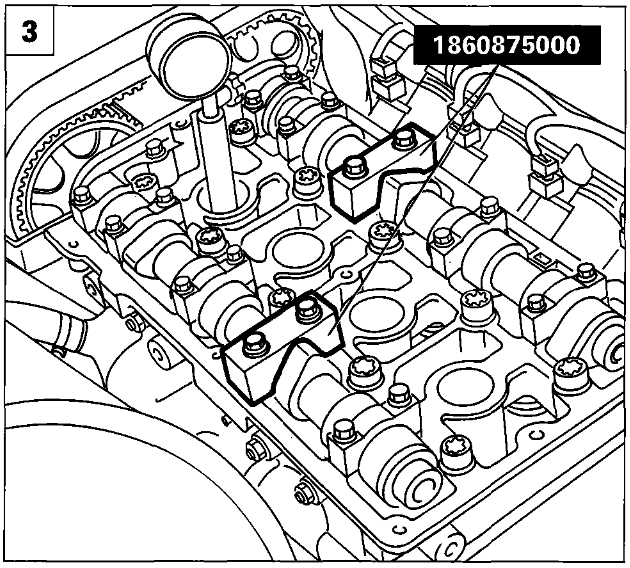


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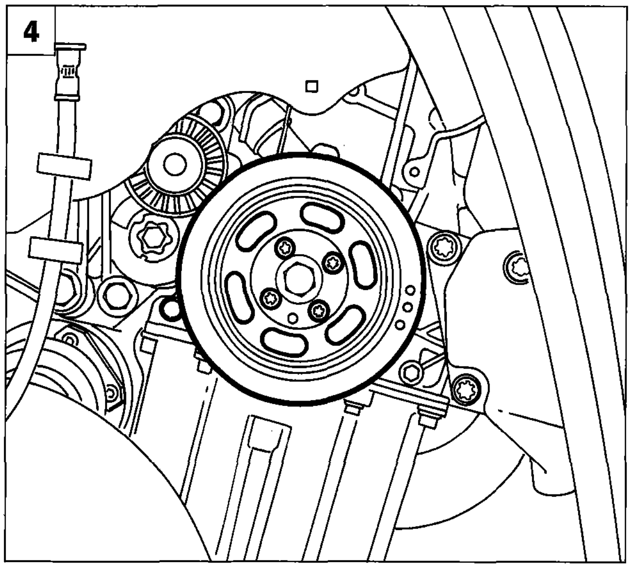


P4A14BX02

1. Remove the spark plugs using a special spanner. Position the dial gauge by cylinder no. 1 using support 1895879000, rotate the crankshaft until T.D.C. is detected.

2. Remove the 2nd cap fixing the inlet side camshaft and the 3rd cap fixing the exhaust side camshaft, as shown in the diagram.

*When the camshaft caps are removed, they must be marked so that they can be refitted in the correct position. If this is not the case, there could be problems with the reliability of the camshafts.*

3. Position and fix the pair of tools 1860875000 by the previously removed caps.

*The pair of tools 1860875000 should exact follow the profile of the camshaft cams.*

4. Remove the lower gearbox protective cover and place flywheel lock 1860898000 in position. Then remove the damper flywheel (auxiliary shaft drive pulley).



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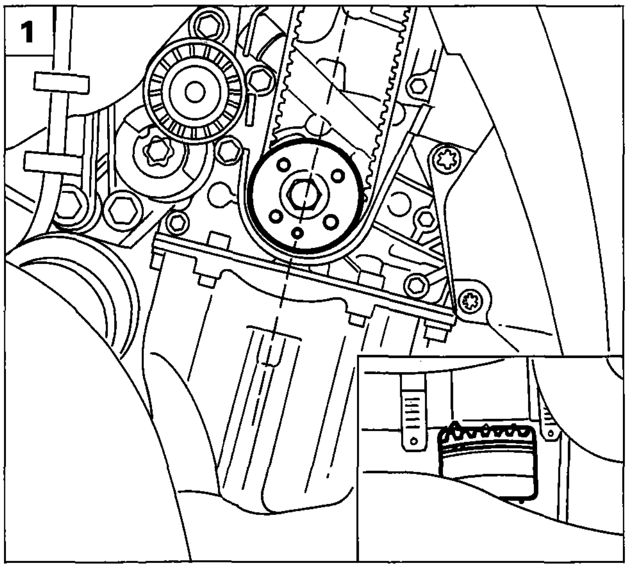


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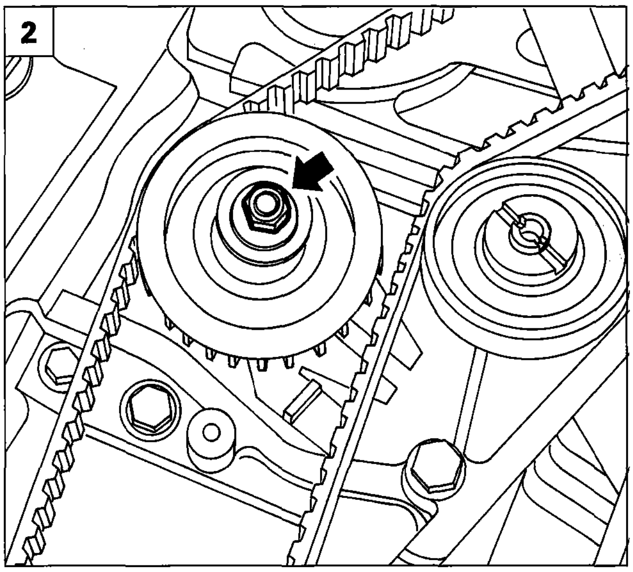


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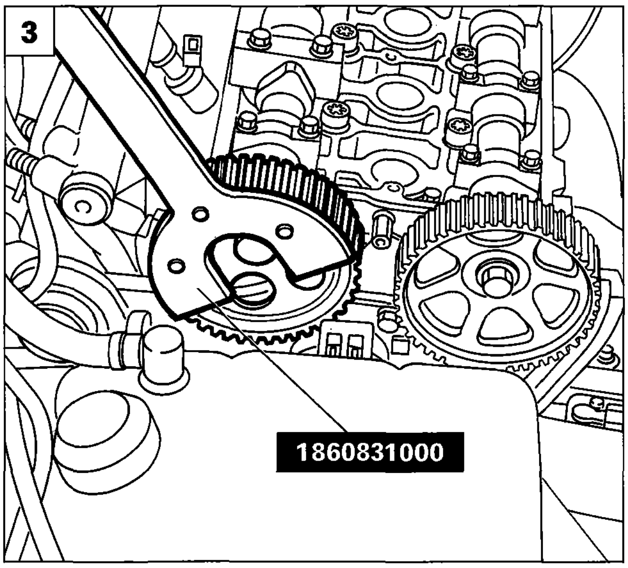


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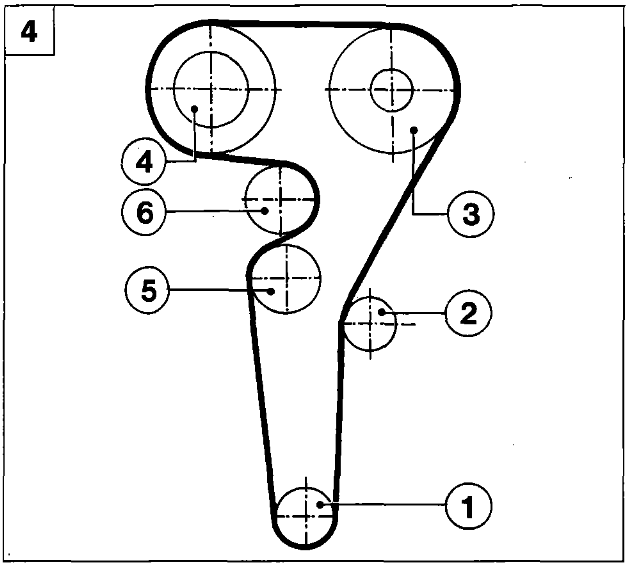



P4A31CA01

1. Check that the centering dowel on the timing drive gear is in line with the engine. Also remove the inspection cover on the bell housing and check that the reference on the flywheel coincides with the reference on the actual bell housing.
2. Loosen the timing belt tension acting on the nut shown in the diagram, then remove the actual belt.

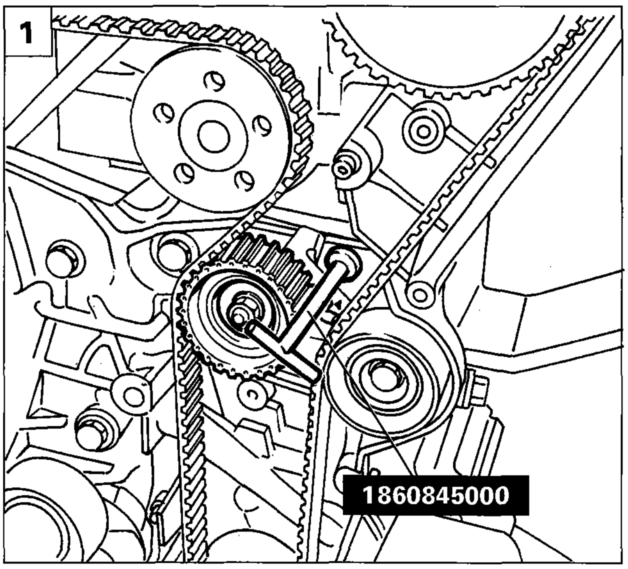
**Fitting the timing belt**

3. To facilitate the positioning of the timing belt, loosen the bolt fixing the inlet side camshaft pulley and the exhaust side pulley, using tool 1860831000. These pullies have slots, allowing the correct matching of the belt-pulley.

4. Fit the belt observing the following order: 1. Crankshaft drive pinion - 2. Fixed pulley - 3. Camshaft pulley, exhaust side - 4. Camshaft pulley, inlet side - 5. Automatic tensioner pulley - 6. Water pump pulley.

**NOTE** *The belt should be fitted avoiding any bends at acute angles in not to adversely affect the structure of the actual belt.*

*Fit the belt so that the arrow is pointing in the direction of rotation of the engine. There are three reference markes on the belt for fitting during production.*

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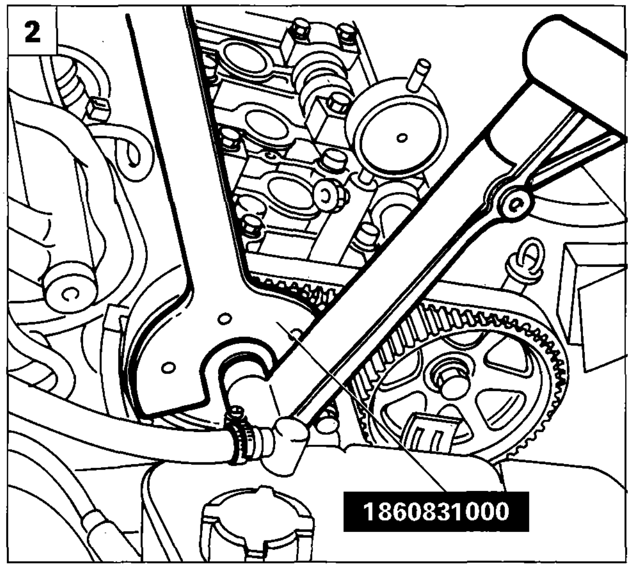


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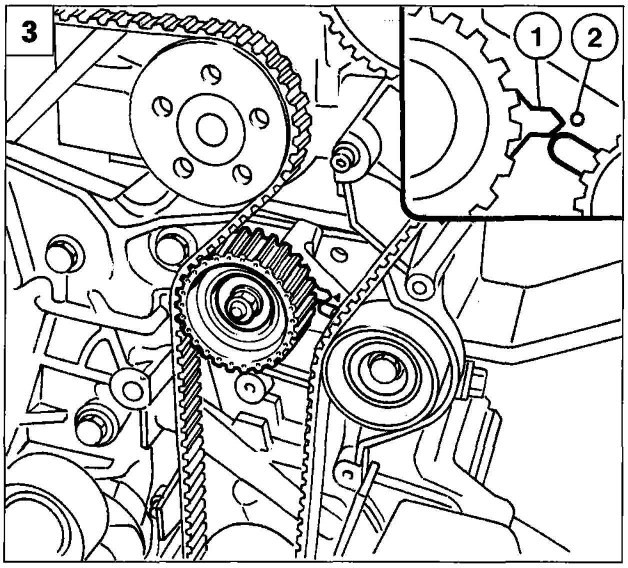


P4A16BX03

**Tensioning the timing belt**

1. Introduce tool 1860845000 in the opening in the automatic tensioner support; rotate the tool to exert force on the automatic tensioner until it is in the maximum tension position, then tighten the nut fixing the tensioner to the support.
2. Tighten the bolts fixing the inlet side and exhaust side camshaft pulley to a torque of 11.8 daNm using tool 1860831000.
3. Remove the pair of tools 1860875000 and return the camshaft caps (marked during the dismantling) to their correct position and tighten them to a torque of 1.5 daNm. Remove the flywheel lock 1860898000, then rotate the crankshaft through two revolutions in its direction of rotation.

Loosen the belt tensioner fixing nut and, using tool 1860845000, make sure that the moving reference (1) for the belt tensioner coincides with the fixed reference (2) on the crankcase. Tighten the nut fixing the belt tensioner to a torque of 2.5 daNm and proceed with refitting the components removed previously.


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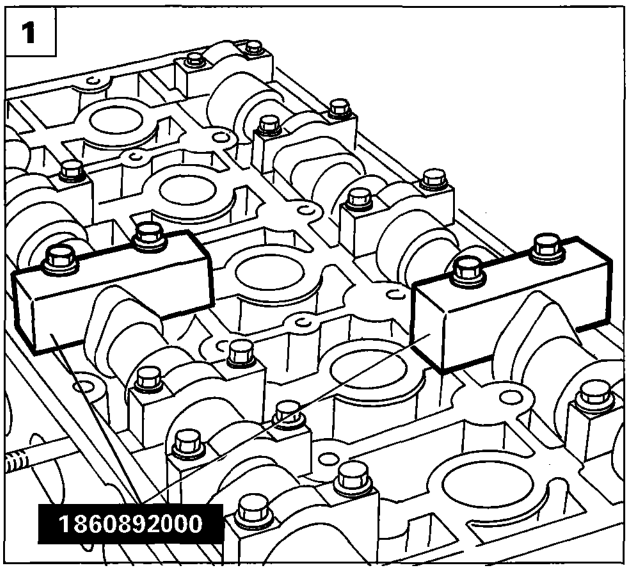


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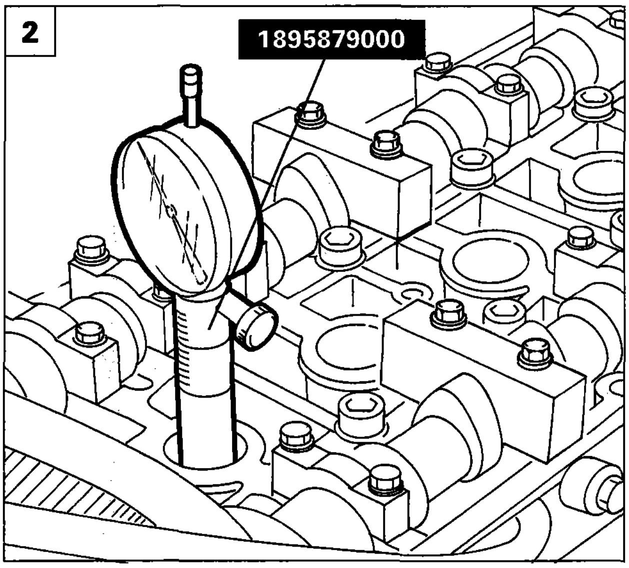


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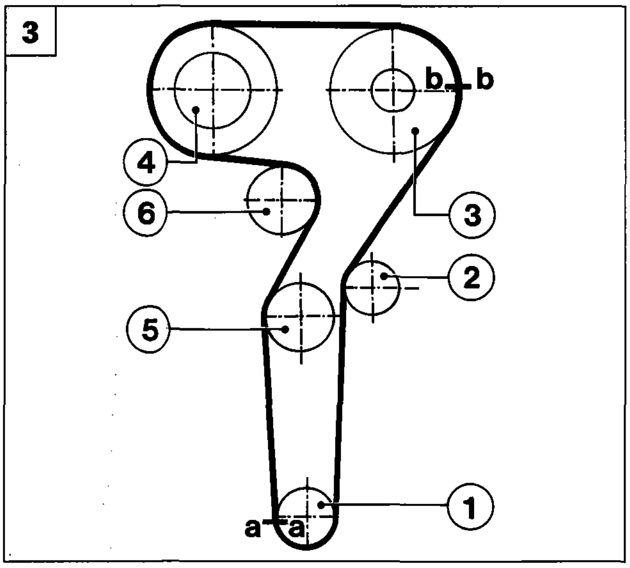



P4A33CA03

**Bravo 1998 20v**

The removing-refitting of the timing drive belt cannot be carried out on the vehicle as there is insufficient space between the timing belt cover and the bodyshell to do so. It must be replaced with the engine at the bench; for more details on the procedure, refer to the instructions in the manual for overhauling this engine type.

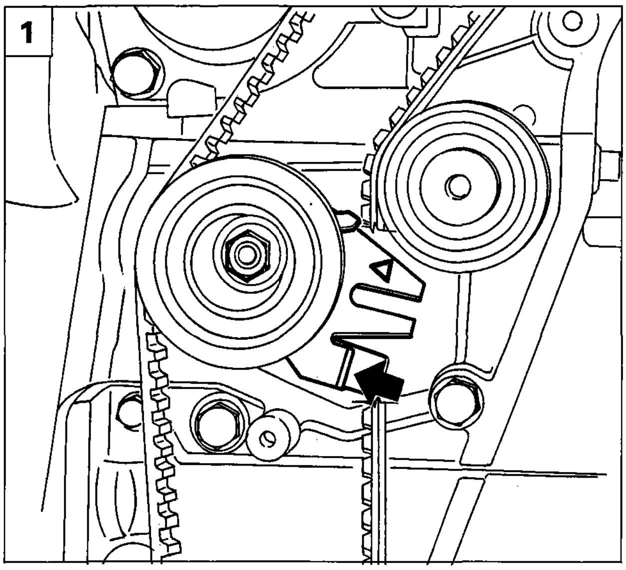
1. The camshafts are timed by positioning tools 1860892000 in place of the cap for the 2nd cylinder, exhaust side and the cap-for the 3rd cylinder, inlet side.

**NOTE** *The letters "A" and "S" on tools 1860892000 indicate "Aspirazione" and "Scarico" (inlet and exhaust). Make sure when refitting, that the profile on the tools is perfectly in line with the profile of the camshaft caps.*

2. To determine T.D.C. for cylinder n° 1, position a dial gauge with tool 1895879000 for support, tightened in place of the spark plug for the first cylinder. Rotate the crankshaft until T.D.C. is reached shown by the dial gauge. Under these circumstances the reference on the crankshaft gear should coincide with the reference on the oil pump cover.

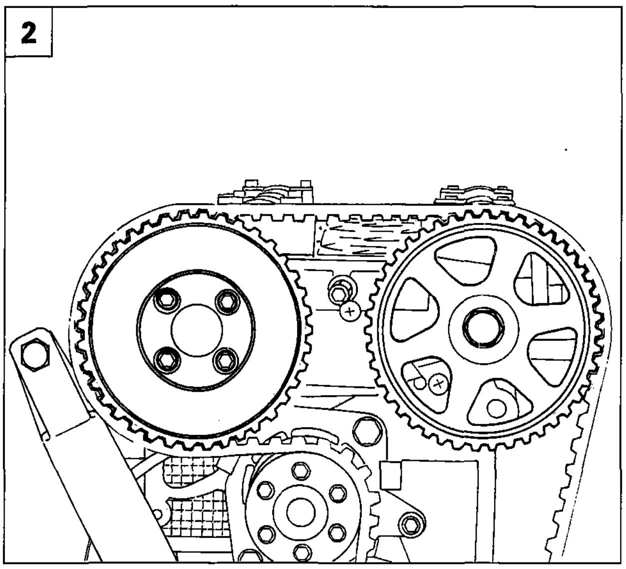
3. With the camshaft pullies slack, fit the belt observing the following order: 1. Crankshaft gear - 2. Fixed pulley - 3. - Camshaft pulley, exhaust side - 4. - Camshaft pulley, inlet side - 5. Automatic tensioner - 6. Water pump.

*There is an arrow on the belt which indicates the direction of rotation of the engine. There are also references used in production for fitting.*



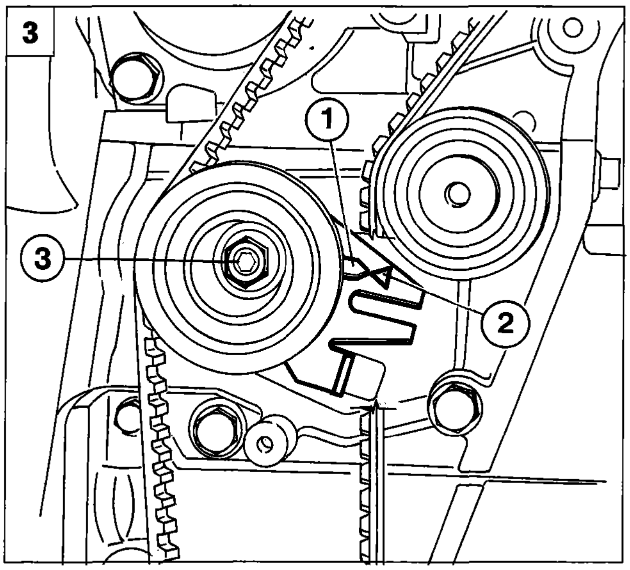

P4A34CA01

1. Using a screwdriver, apply force to the automatic tensioner tab so that the tensioner is in the maximum tension position, then tighten the nut fixing the tensioner to the support.




P4A34CA02

2. Using spanner 1860831000, torque tighten the inlet and exhaust side pullies to the recommended figures.
Remove the tools positioned for timing and locking the camshafts and rotate the crankshaft through two revolutions in its direction of rotation.

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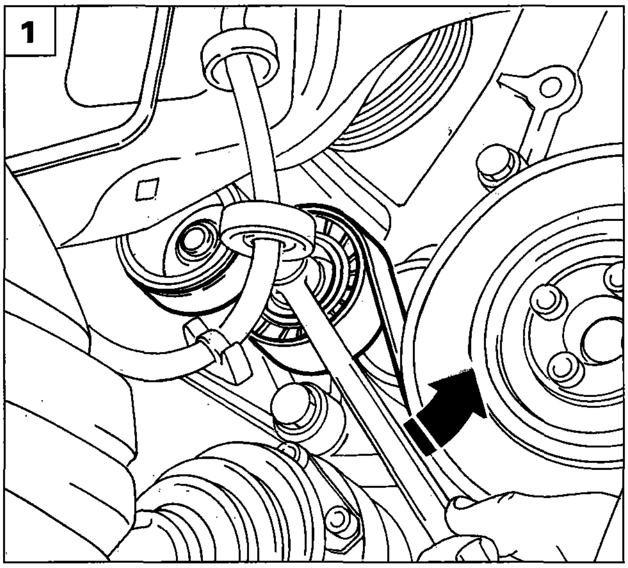
3. Loosen the nut fixing the tensioner and ensure that the moving reference on the tensioner (1) coincides with the fixed reference (2), then tighten the nut fixing the tensioner to torque and proceed with the refitting of the components removed previously.

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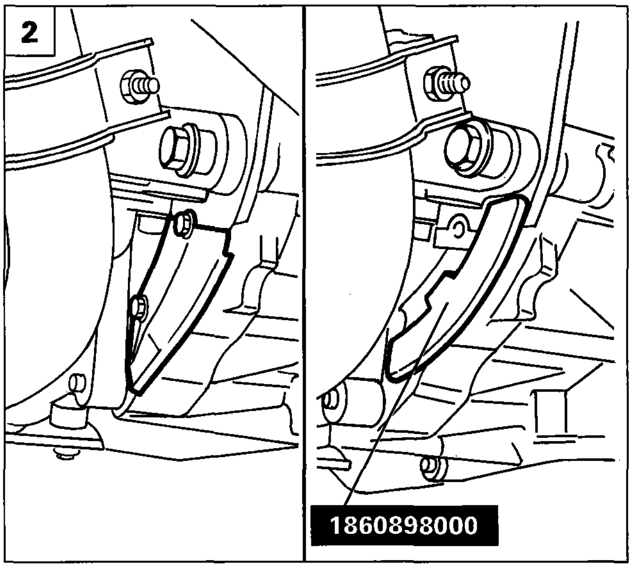


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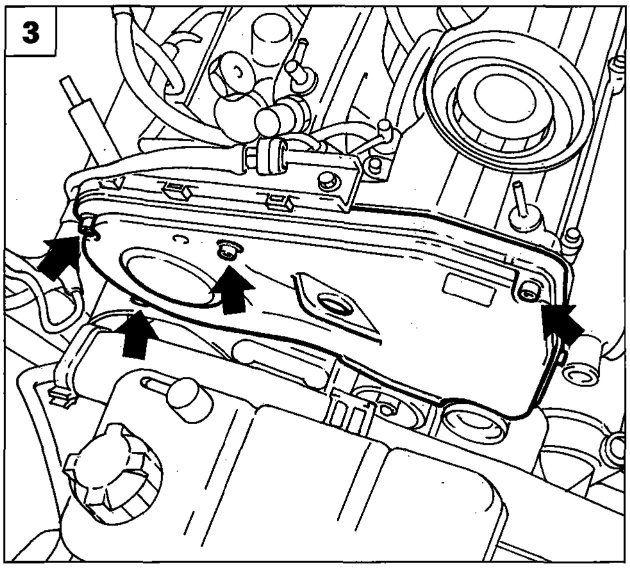


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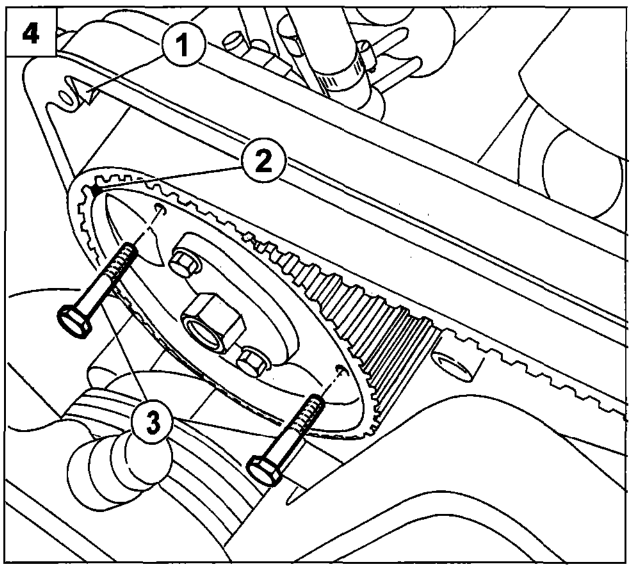


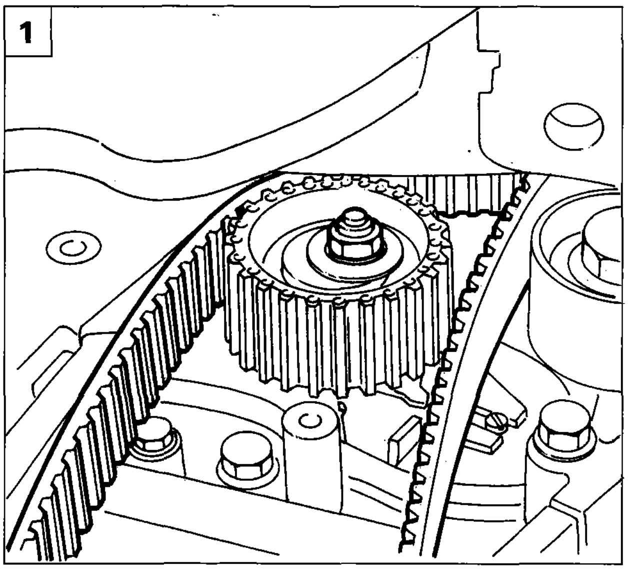

P4A35CA05

**Bravo-Brava 1910 TD 75 e 100**

Position the vehicle on a lift, then:

- disconnect the negative battery lead;
- remove the right front wheel;
- remove the right wheel arch liner.

1. Rotate the device tensioning the auxiliary shaft drive belt in the direction shown by the arrow, slacken the belt tension and remove it.
2. Remove the lower shield for the engine compartment, undo the bolts for the gearbox shield and position the flywheel lock 1860898000. Then remove the damper flywheel (auxiliary shaft drive pulley).
3. Remove the lower shield for the timing belt; remove the reaction connecting rod complete with mounting bracket near the upper timing belt shield, then remove the latter as well.
4. For the 1910 TD 75 version, check that the injection pump timing is correct by making sure that references (1) and (2) illustrated are in line, then lock the pulley in position using the service bolts (3) inserted in the special housings in the actual pulley.

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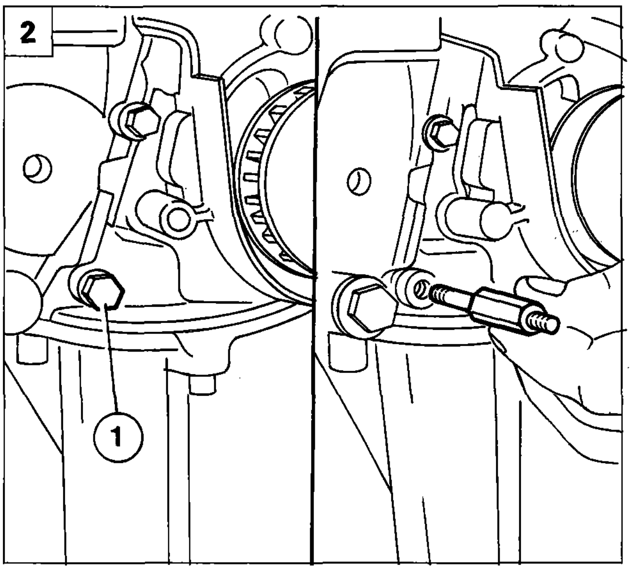


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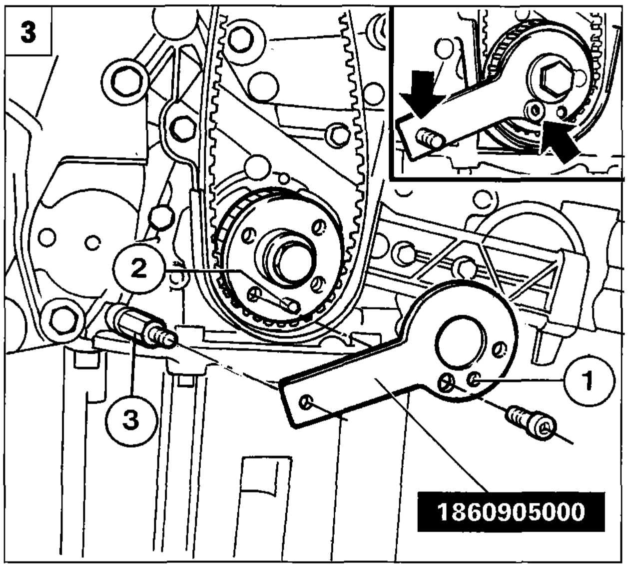


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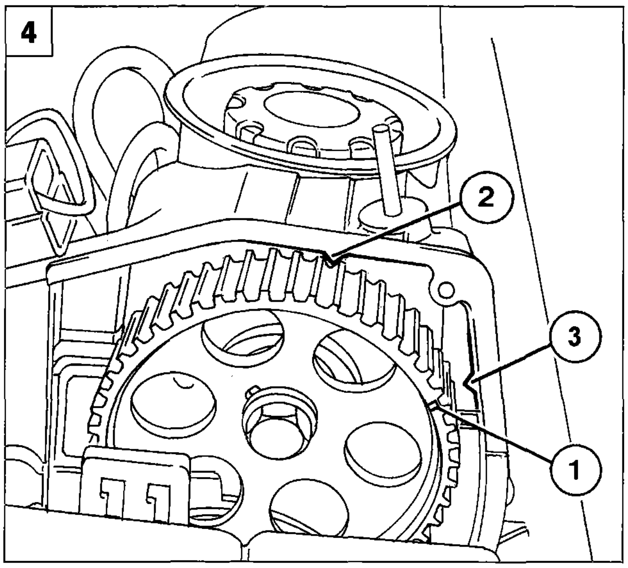



P4A13GX04

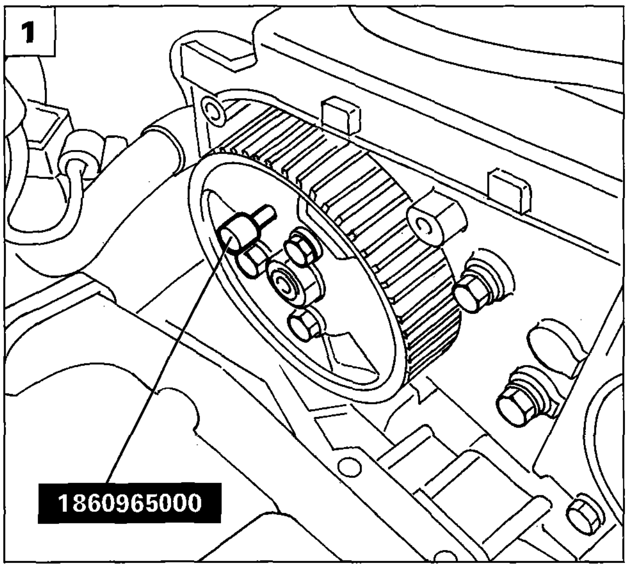
1. Loosen the nut illustrated for the tensioning device, release the belt tension, then remove it.

**Refitting and tensioning the timing belt**

2. Remove the bolt (1) illustrated fixing the oil pump; place the pin for tool 1860905000 in place of the bolt. Then fit the timing belt on the crankshaft gear only.
3. Position tool 1860905000 on the crankshaft gear and on the pin (3); rotate the crankshaft using small movements until the dowel (2) is matched up with the opening (1). In this position cylinder no. 1 is at T.D.C.
4. Using tool 1860831000, rotate the camshaft pulley until the following alignments are achieved:
   - up to engine n° 416499
     the reference (1) on the pulley should have moved 7 teeth (in a clockwise direction) in relation to the reference (2) on the tappet cover.
   - from engine n° 416450
     the reference (1) on the pulley should be aligned with the reference (3) on the tappet cover.

**NOTE** *The timing is correct when, with piston n° 1 at T.D.C., the reference (1) is in the position shown in the diagram (for engines up to n° 416449 the exact position of the reference can vary ± 3° engine or ½ point).*


*Print no. 506.670/09*



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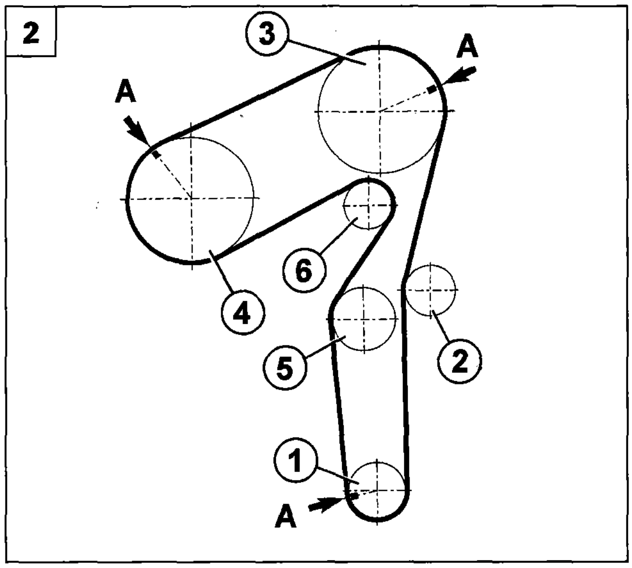

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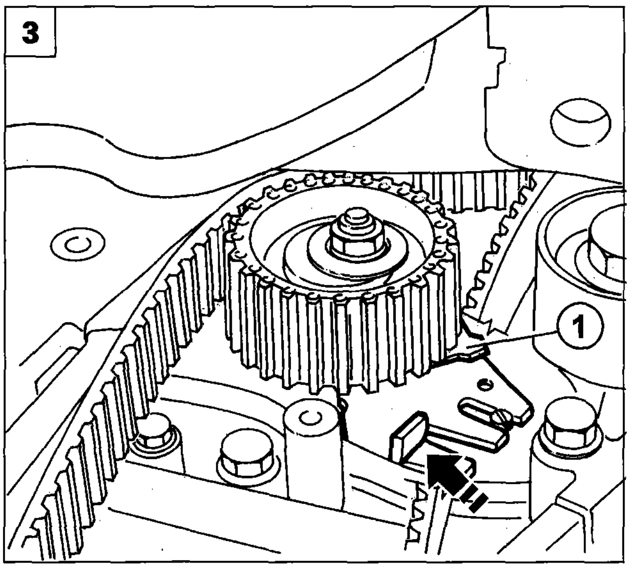

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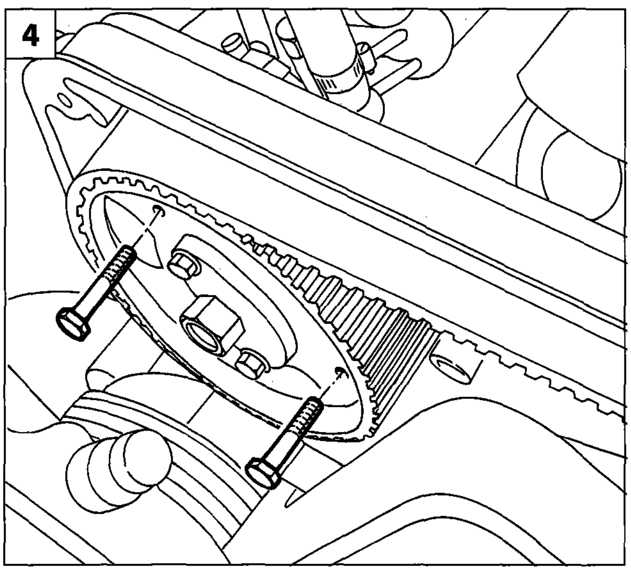


P4A14GX03

1. For the 1910 TD 100 version, loosen the bolts fixing the injection pump pulley and rotate it until pin 1860965000 can be inserted at the point shown.

2. Complete the fitting of the timing belt observing the following order:

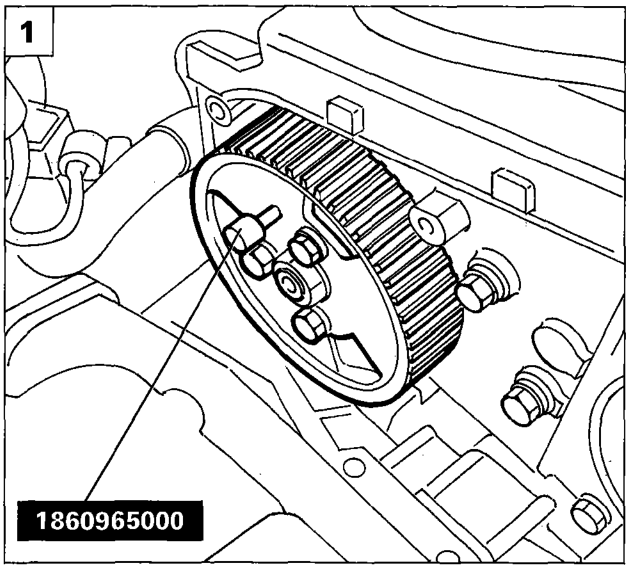
   1. Crankshaft gear
   2. Fixed pulley
   3. Timing pulley
   4. Injection pump pulley
   5. Automatic tensioner
   6. Water pump

For all the pre and post modification engines the new belt can be fitted and timed by following the alignment of the transverse references (A) on the back of the timing belt and the references on the pullies.

**NOTE** *Fit the belt so that the arrow is pointing in the direction of rotation of the engine.*

3. Exert force at the point shown on the automatic tensioner placing the tensioner moving reference (1) in the maximum tension position, then lock the belt tensioner fixing nut.

4. For the 1910 TD 75 version, release the injection pump drive pulley by undoing the three bolts positioned previously.

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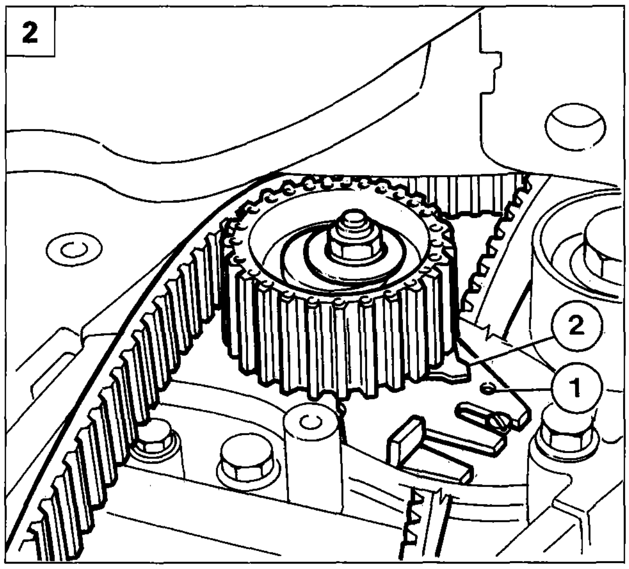
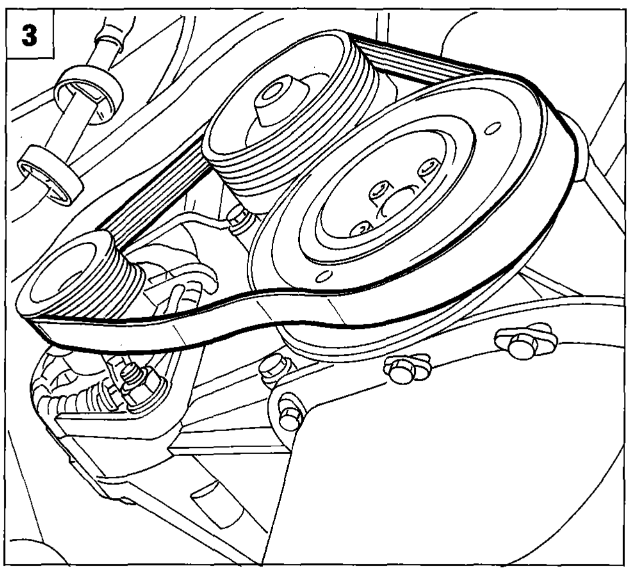



P4A38CA02

1. For the 1910 TD 100 version, fix the injection pump pulley tightening the fixing bolts to the recommended torque and removing pin 1860965000 from the housing.

2. Rotate the crankshaft through two revolutions in its normal direction of rotation, release the nut fixing the tensioner and make sure that the fixed reference (1) on the tensioner support coincides with the moving reference (2) for the belt tensioner. Lock the tensioner fixing nut and then tighten it to the recommended torque. Proceed with refitting the components previously removed reversing the order of the operations described previously.




P4A10EX02

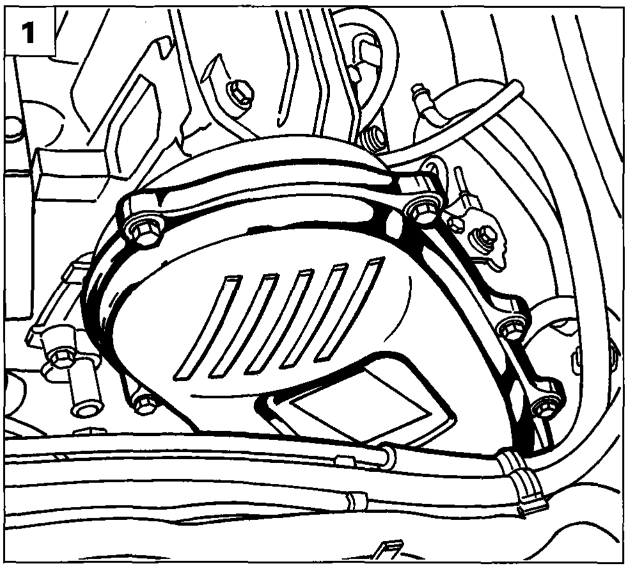
**Bravo-Brava 1929 D**

Position the vehicle on a lift, then:

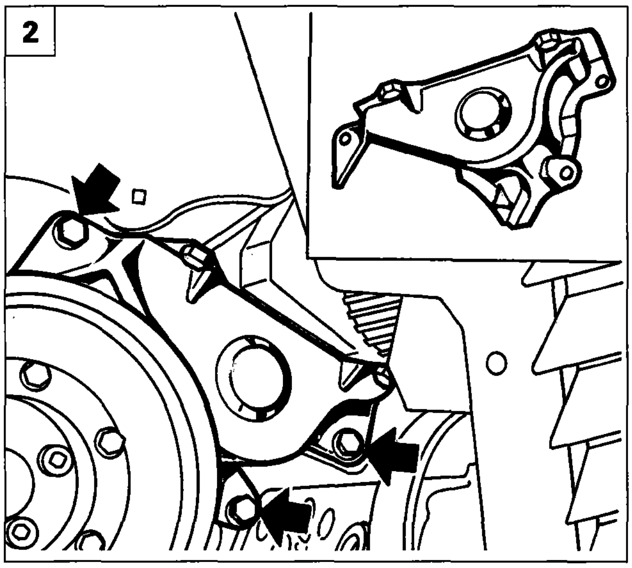
- disconnect the negative battery lead;
- remove the right front wheel;
- remove the right wheel arch liner.

3. Remove alternator drive belt acting on the fixing bolts and the adjustment screw. If the vehicle is equipped with air conditioning, remove the air conditioning compressor drive belt from the damper flywheel.

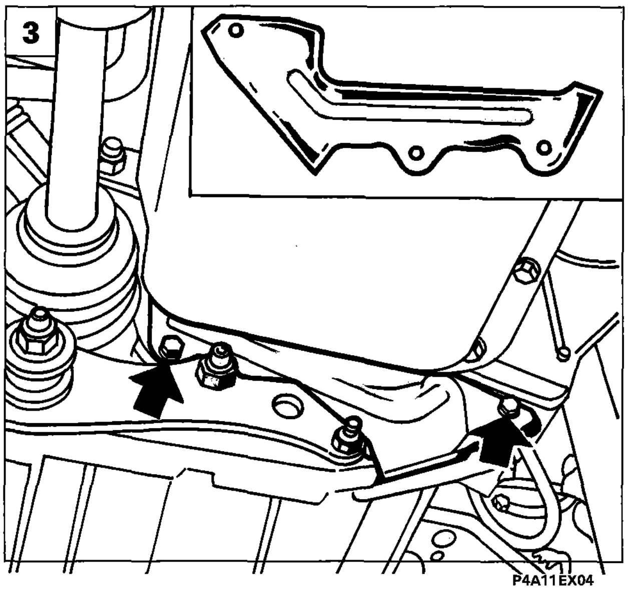

*Print no. 506.670/09*




P4A11EX01

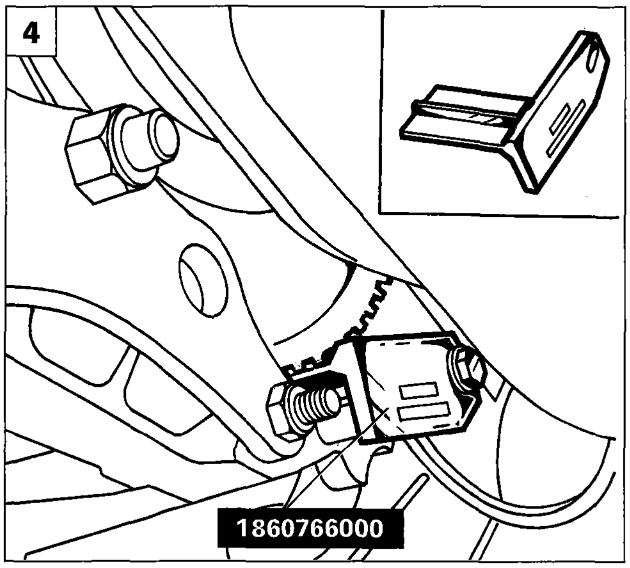



P4A11EX03

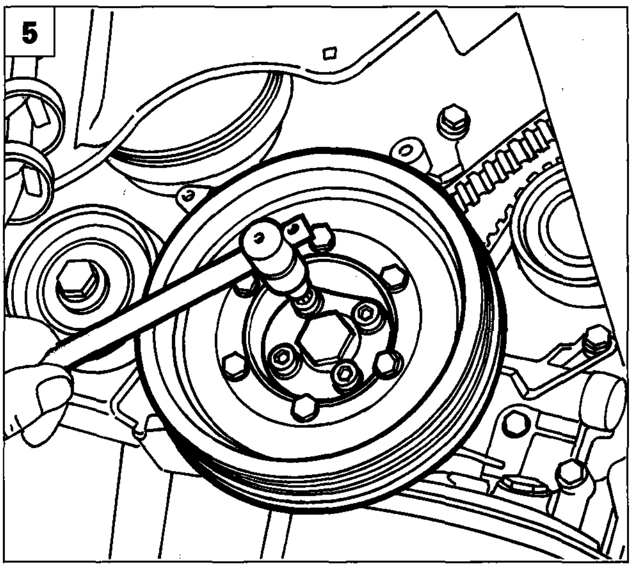



P4A11EX04

1. Remove the upper protective cover for the timing drive belt; if necessary, release the mounting brackets for the engine cooling system pipes.
2. Remove the lower timing belt cover.
3. Remove the lower flywheel shield from the bell housing.
4. Place flywheel lock 1860766000 in position to prevent the rotation of the crankshaft.
5. Remove the damper flywheel, then remove the flywheel lock 1860766000.




P4A12EX03

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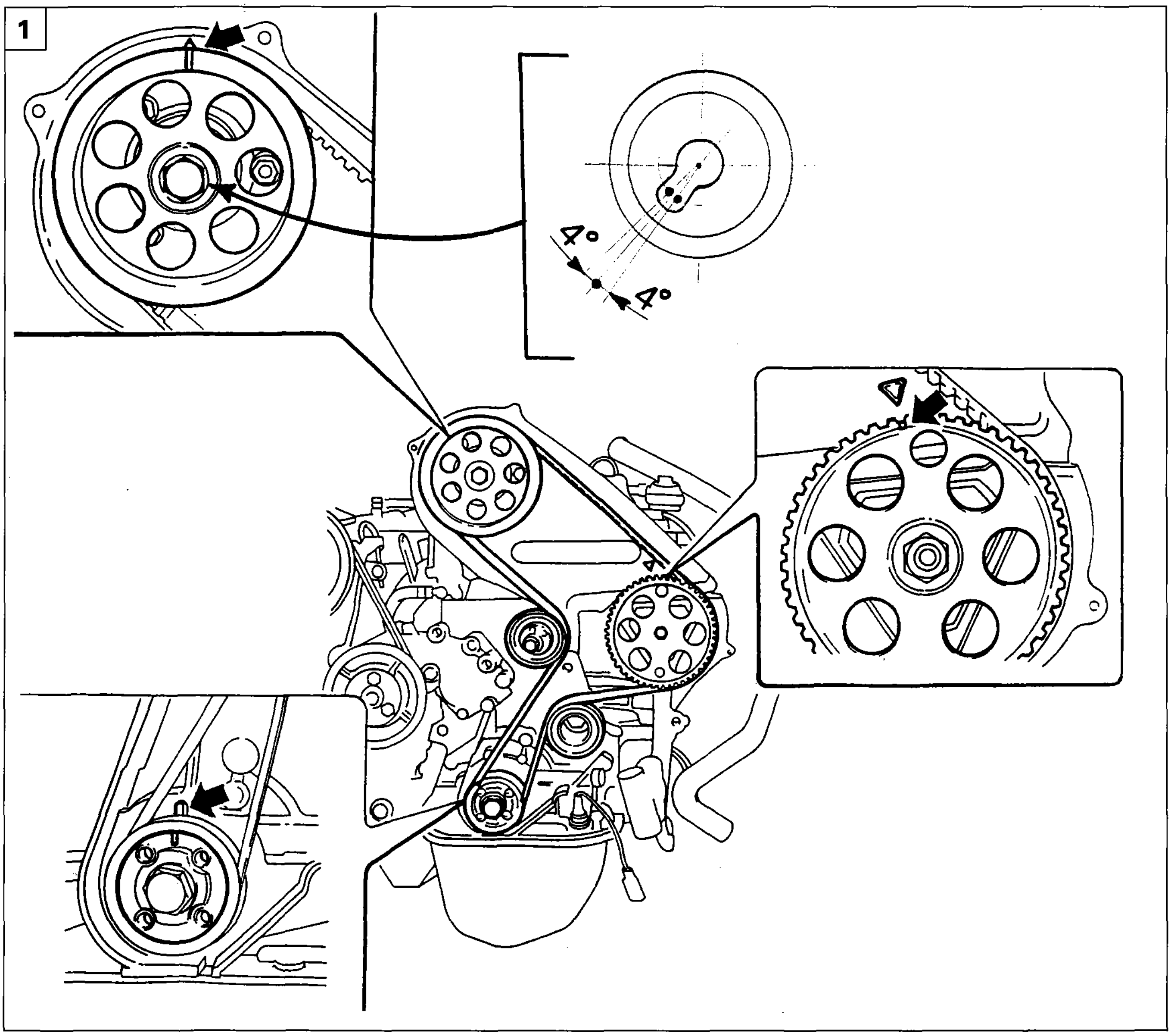


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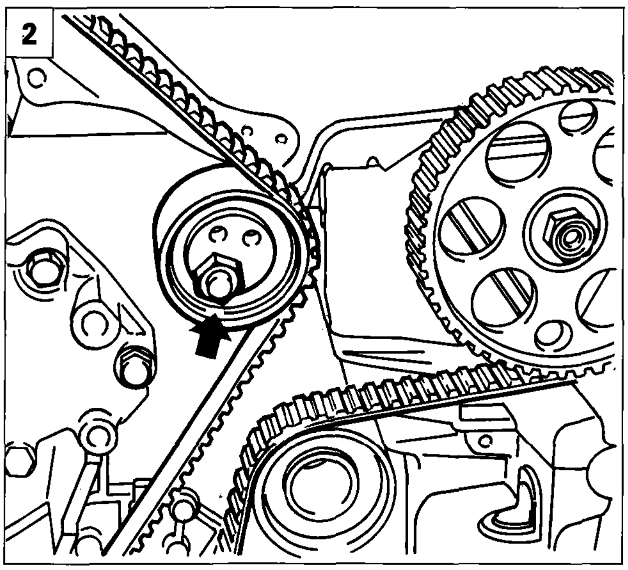
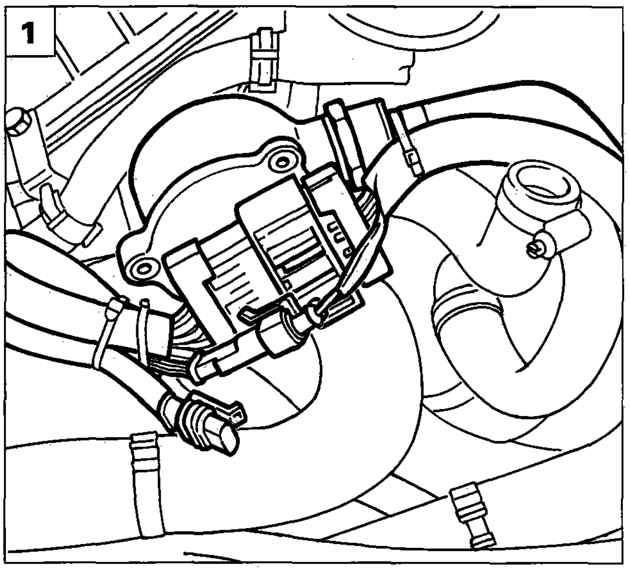



P4A40CA02

1. Rotate the crankshaft in its normal direction of rotation until the references on the crankshaft pulley and the injection pump drive pulley are in line with the fixed references on the engine. Cylinder no. 1 will be at T.D.C., under these circumstances and the camshaft will be timed for the explosion stroke in cylinder no. 1.

**NOTE** *The fixing opening for the camshaft drive pulley has a slot on account of which under these circumstances the reference on it should not coincide exactly with the fixed reference on the cover.*

2. Loosen the belt tensioner nut, then remove the timing drive belt.

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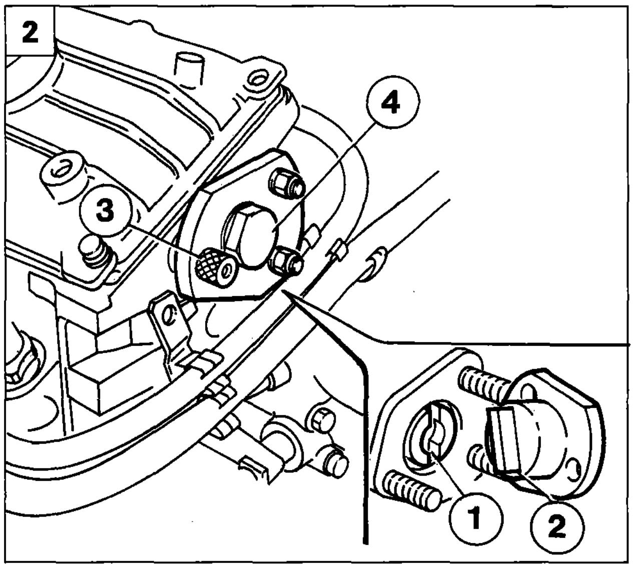


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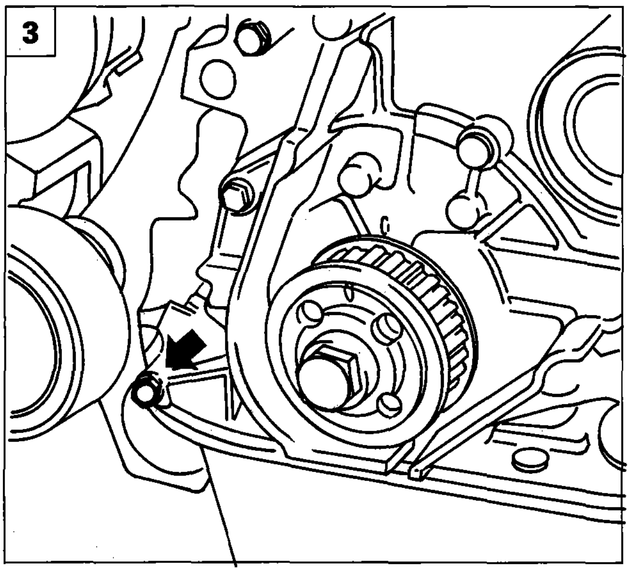


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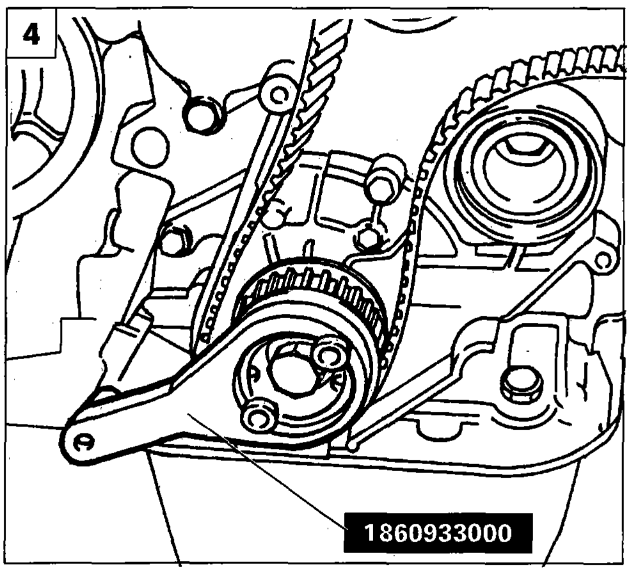
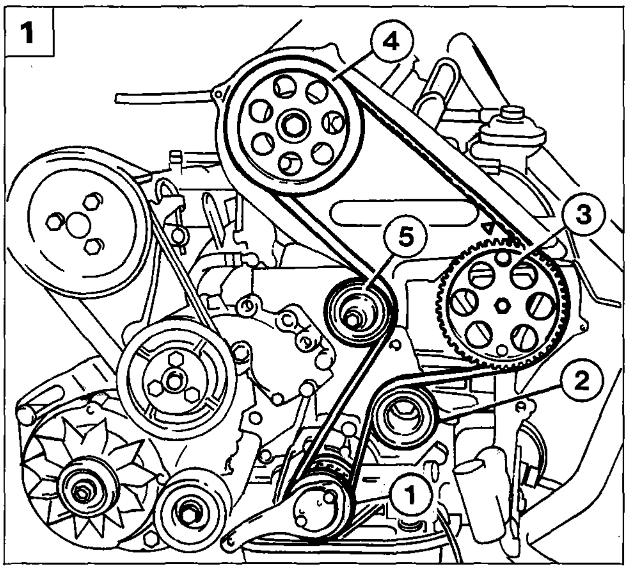



P4A41CA04

1. Move the connections and the cables shown in the diagram aside, then undo the nuts fixing the brake servo vacuum pump to the cylinder head and remove it.
2. Position tool 1860934000 for timing the camshaft, matching the splining (1) for the camshaft with the projection (2) on the tool.
   Fix the tool to the cylinder head placing the centering dowel (3) as illustrated in the diagram. The dowel should be perfectly centered on the tool; if it is not, use a spanner (4) to centre the dowel on the tool using extremely small movements.
3. Remove the bolt shown in the diagram which fixes the front cover to the crankcase. Then fit the timing drive belton the crankshaft drive gear only.
4. Position tool 1860933000 for accurately determining T.D.C. for cylinder no. 1. The tool should be perfectly fixed to the crankshaft drive gear using two bolts and using another bolt to the crankshaft front cover (for the bolt removed previously).
   Then loosen the bolt fixing the camshaft drive pulley using tools 1860831000 and 1860848000.

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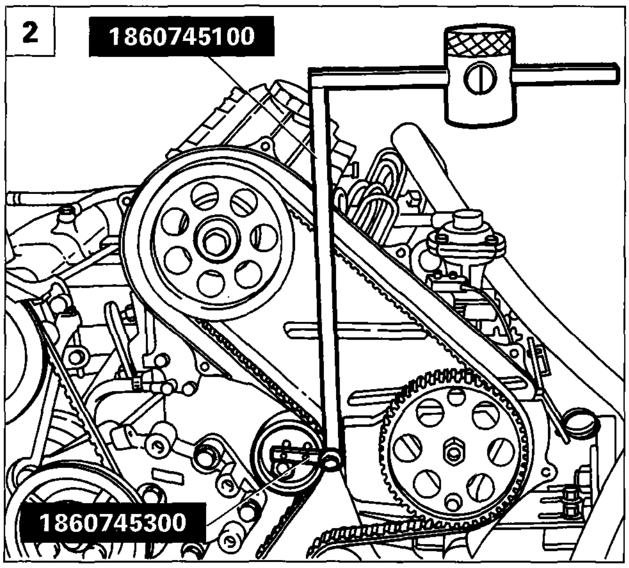


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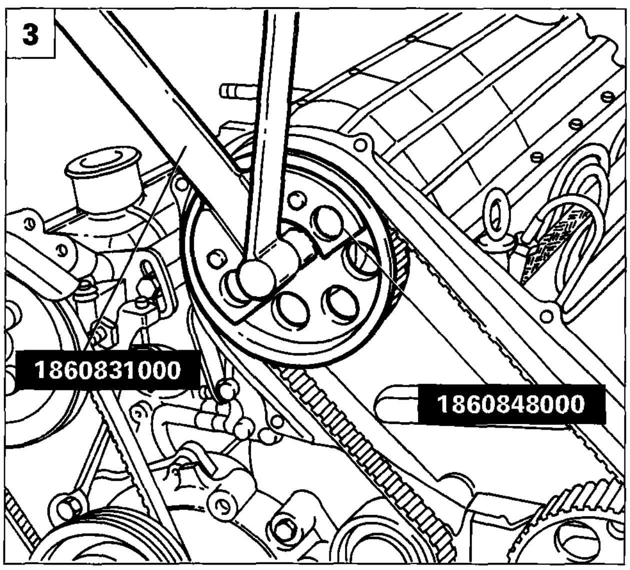


P4A42CA03

**Fitting and tensioning the timing drive belt**

1. Complete the fitting of the timing belt observing the following order:
   - Crankshaft gear;
   - fixed pulley;
   - injection pump pulley;
   - timing pulley;
   - belt tensioner.

⚠ *Check that the reference on the injection pump corresponds with the fixed reference on the rear cover.*

2. Fit part 1860745300 on tool 1860745100, the position the weight with the knurled part 120 mm away on the millimetric rod and lock it in place.
   Fit the tool produced in this way on the belt tensioner as illustrated in the diagram and, acting on the joint, position the millimetric rod on the horizontal plane and lock the joint fixing bolt.

3. Tighten the bolt fixing the camshaft drive pulley to the recommended torque. Remove the tools positioned previously for determining the timing and T.D.C. and the flywheel lock.
   Let the belt bed in by rotating the crankshaft through two revolutions in its direction of rotation and tighten the nut fixing the belt tensioner to torque, then remove the tools used for the tensioning.

**NOTE** *During this last phase the millimetric rod may move away from the horizontal plane; if this is the case, the joint must be adjusted again and the operation repeated.*

Refit the previously removed components reversing the procedure described for the removal.



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## 20 REPLACE SPARK PLUGS AND CHECK LEADS

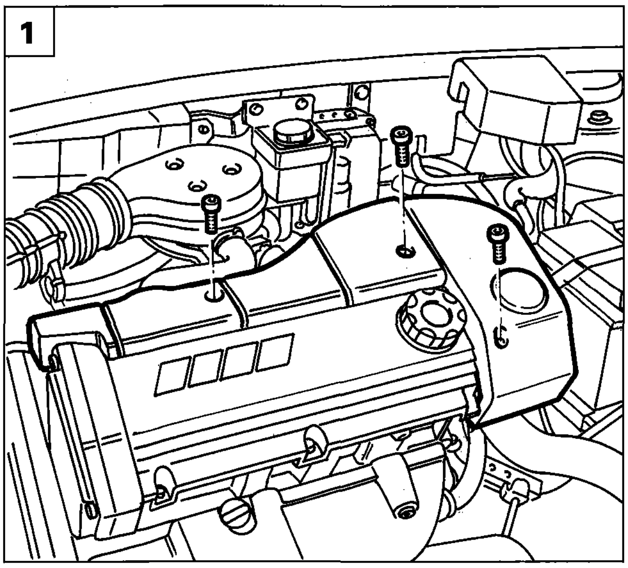
The cleanliness and condition of the spark plugs are critical for the efficiency of the engine and containing pollutant emissions. The following types of spark plug are fitted:

| | Spark plug type |
|---|---|
| 1370 12v<br>1581 16v | Champion RC8BYC<br>Golden Lodge 2HLDR<br>NGK BKR6EKC |
| 1747 16v | Fiat 7GBMSR<br>Champion RC7BMC<br>Champion RC8BYC<br>Golden Lodge 2HLDR<br>NGK BKR6EKC |
| 1998 20v | Fiat 7GBMSR<br>Champion RC7BMC |

*Only use recommended type spark plugs: if the heat rating is insufficient or not guaranteed for the correct period, problems can arise.*

Also check the condition of the supply cables making sure that there are no cuts, cracks or restrictions along the entire length.

**NOTE** *Carry out the following operations with the engine cold.*

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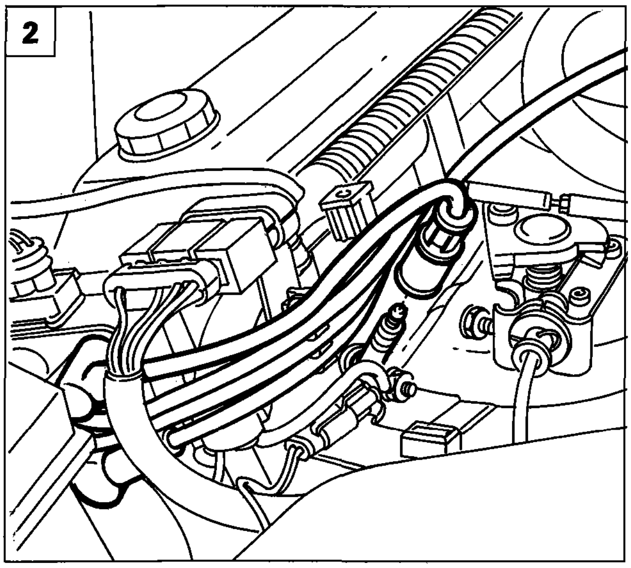
**Bravo-Brava 1370 12v**

1. Remove the cylinder head shield shown in the diagram.

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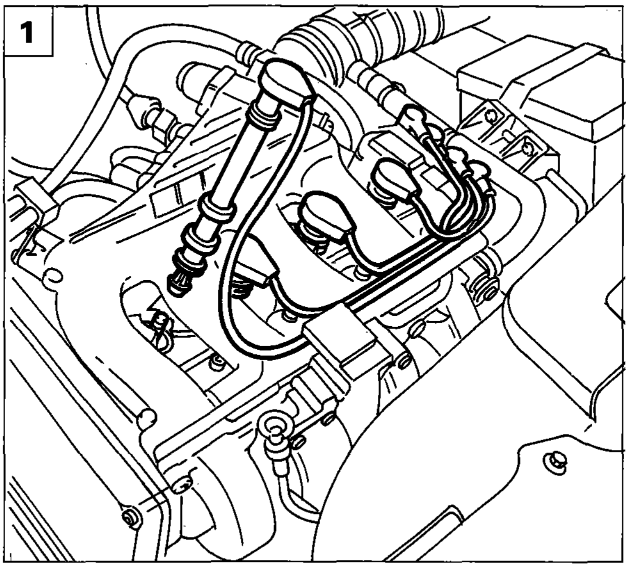
2. Disconnect the H.T. leads from the spark plugs taking great care when extracting the boots and remove and replace the spark plugs using an appropriate spanner.

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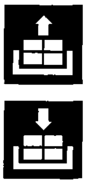

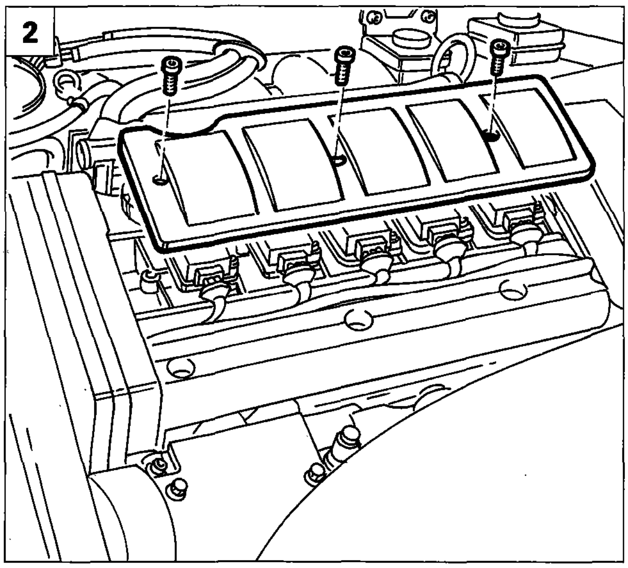


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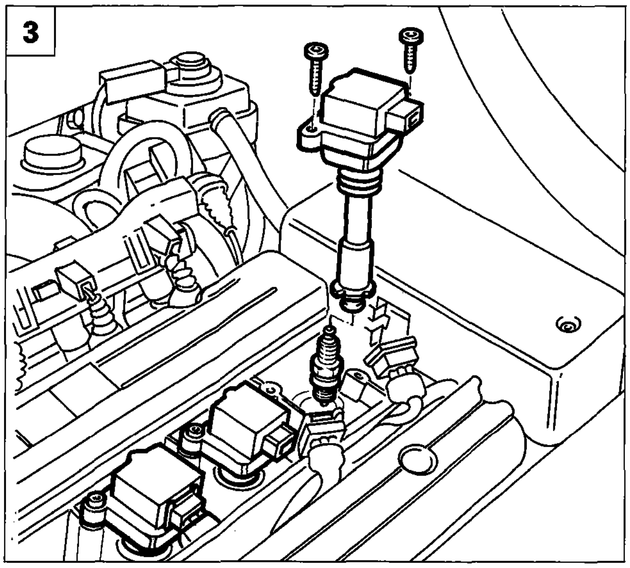


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**Bravo-Brava 1581 16v**

1. Disconnect the H.T. leads from the spark plugs taking great care when extracting the boots and remove and replace the spark plugs using an appropriate spanner.

**Bravo-Brava 1747 16v - 1998 20v**

2. Remove the cover for the ignition coils, then disconnect the supply connectors.

3. Remove the ignition coils acting on the fixing bolts; undo the spark plugs using a special spanner and proceed with replacing them.



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## 21 CHECK OPERATION OF ENGINE CONTROL SYSTEMS (using the autodiagnostic socket)

A complete electronic fault diagnosis of the injection/ignition system can be carried out by connecting the Fiat/Lancia Tester or the SDC or Examiner stations to the diagnostic socket.

The system is also equipped with an autodiagnostic function which recognizes, memorizes and signals any failures.

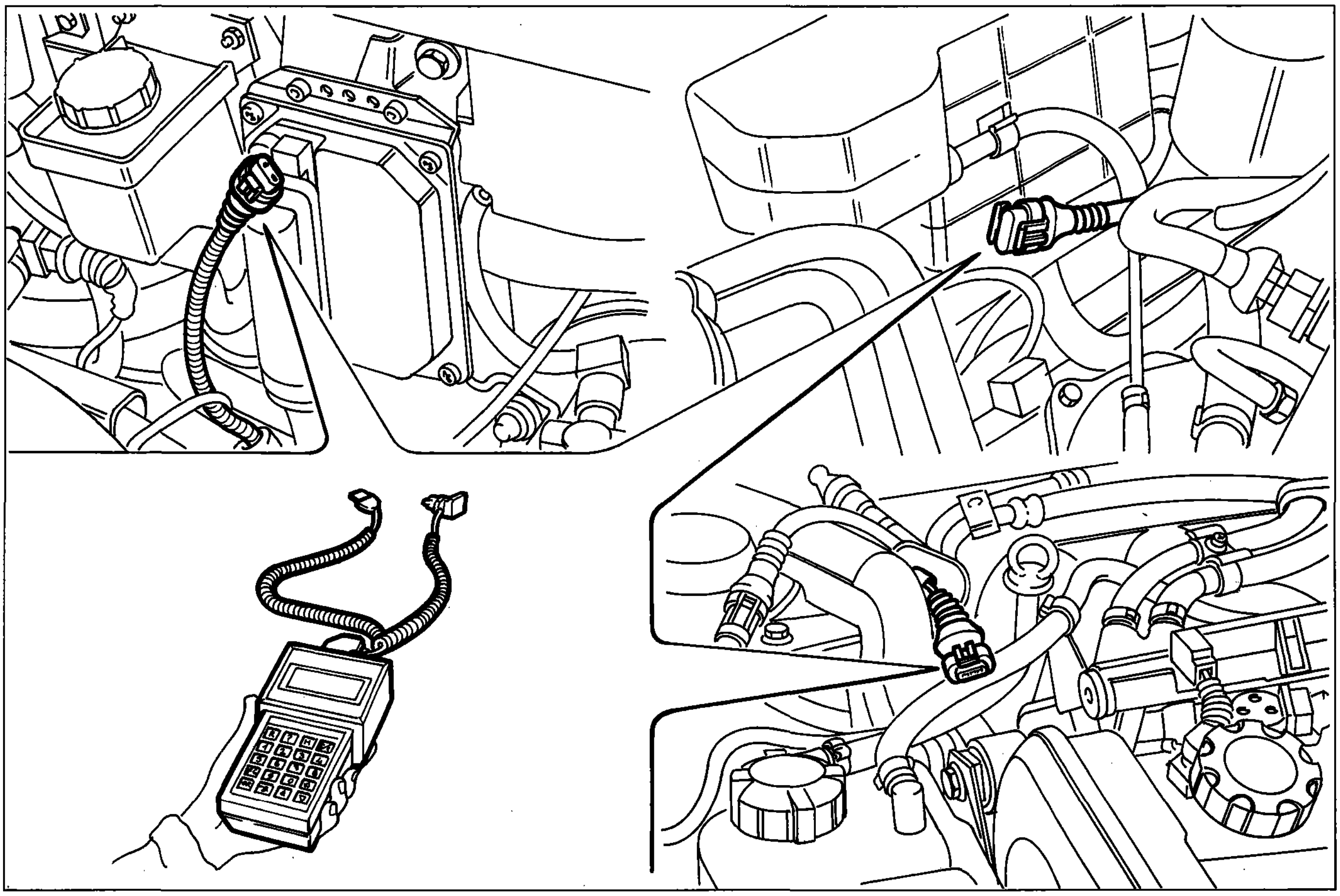
If a fault is detected and confirmed it is permanently memorized and the relevant sensor is excluded from the system until it is repaired.

When a fault is detected and confirmed the warning light in the dashboard usually comes on: when the fault is repaired the light goes out.

Working with the Fiat/Lancia Tester or the SDC or the Examiner it is possible to carry out a complete system fault diagnosis which consists of three stages:

1. display of a series of functional parameters;
2. display of the errors or their cancellinge;
3. activation of certain actuators (active diagnosis).

Unlike the Fiat/Lancia Tester, the SDC and Examiner equipment use a "touch screen" type display which is easy to use and can display several parameters simultaneously; a single CD ROM, which can be periodically updated, makes it possible to carry out fault diagnosis for electronic systems on all Group vehicle models. Also, if connected to a printer, the results of the fault diagnosis can be certified. In addition to the diagnostic functions these pieces of equipment have powerful integrated measuring instruments.



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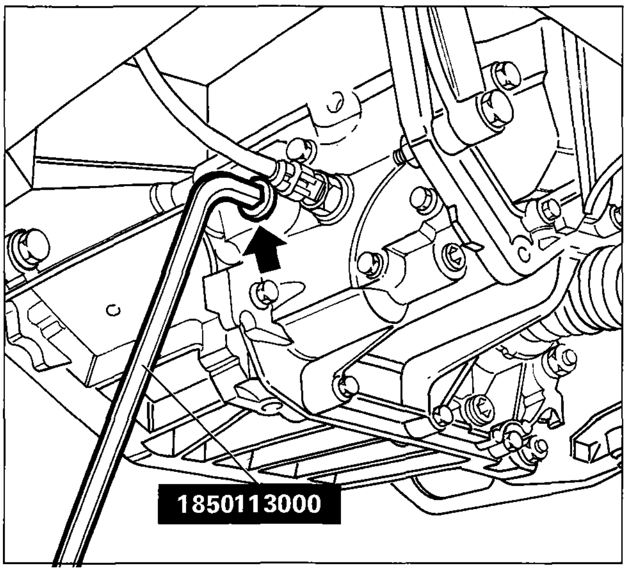


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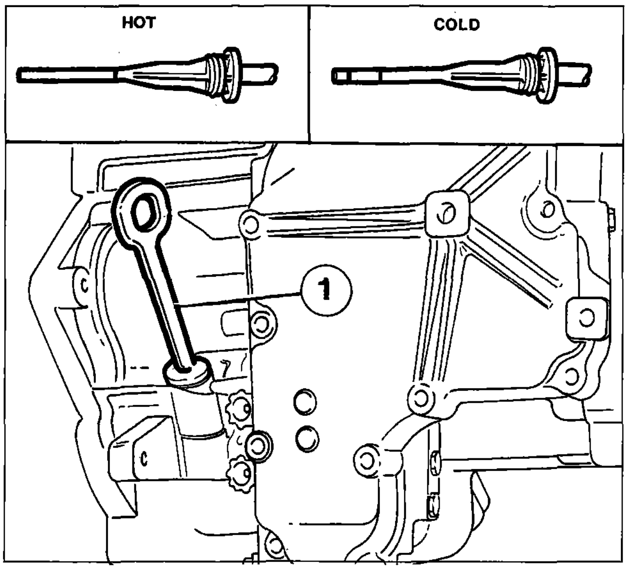
### 22 CHECK GEARBOX/DIFFERENTIAL OIL LEVEL

Position the vehicle on a lift. Undo the filler plug and check that the level of the oil is below the lower edge of the opening.

If necessary, top up until the correct level is restored.
Retighten the filler plug tightening it to a torque of 4.6 daNm.

### 23 CHECK AUTOMATIC GEARBOX OIL LEVEL (Bravo-Brava 1581 16v)

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**NOTE** *The gearbox oil level should be checked with the engine and the gearbox at normal operating temperature (gearbox oil temperature: 70 - 80°C), on account of which the vehicle must be driven for a suitable length of time before the check.*

Proceed with checking the gearbox oil level by carrying out the following operations:

- park the vehicle on a flat surface and apply the handbrake;
- with the engine idling, gently move the selector lever from position P to position 1, then return it to P;
- extract the oil dip stick (1) and clean it again;
- completely insert the dip stick in its housing;
- extract the dip stick once again and check the the level of the oil is between the two reference on the side of the rod marked HOT.

*If the check takes place with the temperature of the gearbox oil low, check that the level of the oil is between the reference on the side of the dip stick marked COLD. If possible, check the level again with the oil at the correct temperature (70 - 80 °C).*



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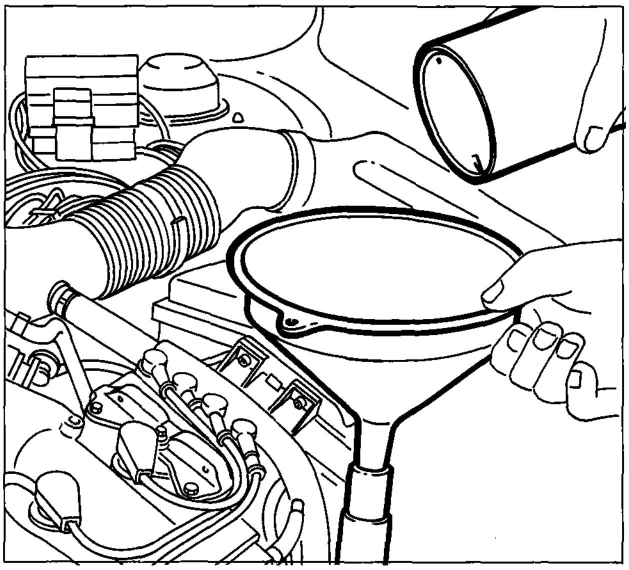

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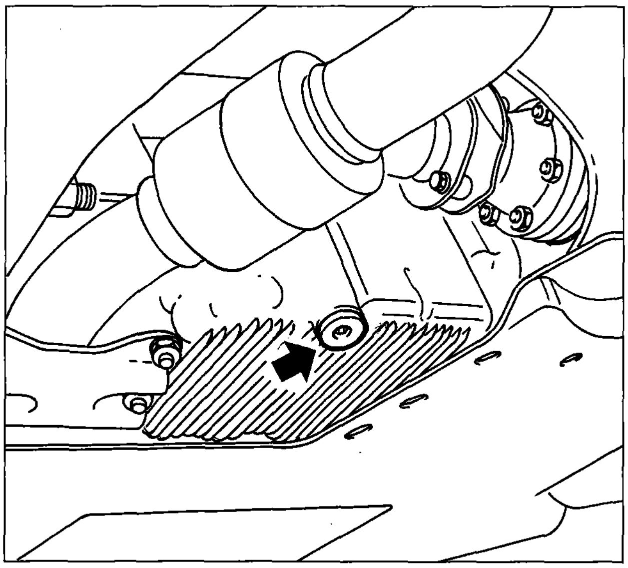

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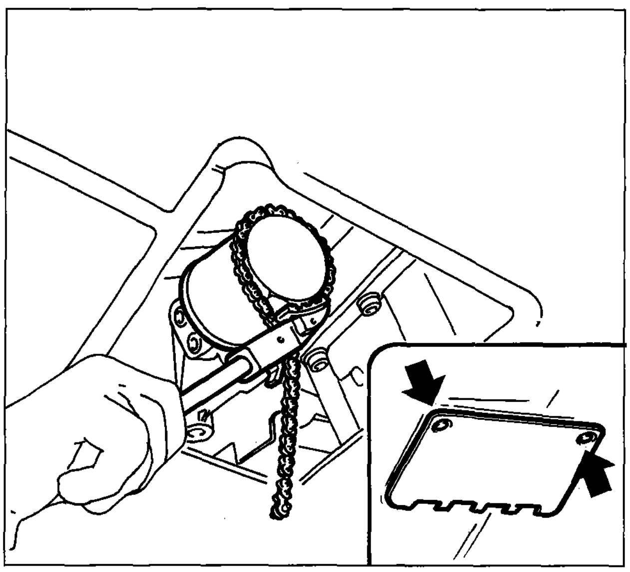

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If the oil level is low, notify the Customer of any leaks or seepage and the need to solve the problem. If refillingis necessary, extract the dip stick and, using a clean container in order not to contaminate the oil, pour in the necessary quantity of gearbox oil. Then recheck the level using the dip stick and check that there are no leaks from the drain plug.

**Recommended gearbox oil: TUTELA GI/2**

**Periodic replacement: 3 litres (2.7 kg)**

### 24 25 CHANGE ENGINE OIL AND FILTER

- With the engine hot remove oil filler plug;
- remove the engine oil dip stick.

*With the engine warm, work very carefully inside the engine compartment because there is a dnager of being scalded. Remember that, with the engine hot, the fan may start working with the danger of injury.*

- Raise the vehicle, remove the engine compartment lower shield and undo the drain plug and completely drain the oil into a suitable container.

*Work very carefully whilst removing the drain plug because the oil could be very hot.*

- Working from underneath the vehicle using the appropriate equipment, release the oil filter and remove it;

**NOTE** *For the 1747 16v and 1998 20v versions, the engine compartment lower shield does not have to be removed because the drain plug is accessible from the rear of the engine and the oil filter can be reached by removing the special flap on the actual shield.*

- clean the drain plug and tighten it, with the appropriate seal, to the recommended torque;
- lubricate the seal for the new filter with oil and tighten fully by hand.

- lower the vehicle, introduce the correct quantity of recommended oil;
- check that the oil level is correct using the dip stick;
- reposition the oil filler plug, let the engine idle for around 2 minutes, switch off the engine and wait for several minutes, then check the level of the oil and make sure there are no leaks.

**NOTE**

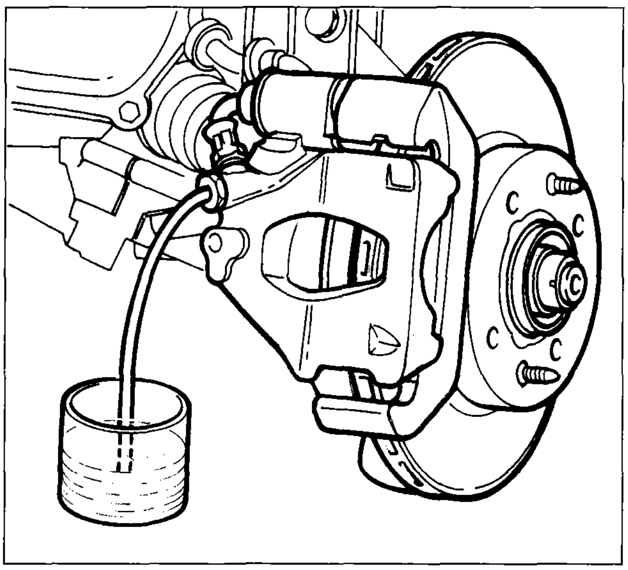
If the vehicle is mainly used in one of the following particularly harsh conditions:

- towing a trailer or caravan
- dusty roads
- short, repeated journies (less than 7-8 km) at sub-zero temperatures
- engine often idling or driving long distances at low speeds

notify the Customer of the need to change the oil more often than indicated in the Planned Maintenance Programme.

*The engine oil used and the oil filter replaced contain substances which are dangerous to the environment. The used oil and the filters should be deposited in special containers and then disposed of in accordance with the laws in force.*

## 26 CHANGE BRAKE FLUID



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The brake fluid is hygroscopic, i.e. it absorbs humidity. To avoid problems with braking, the brake fluid should be changed every two years, irrespective of the mileage.

- Raise the vehicle and, if necessary, remove the wheels;
- connect a flexible pipe to the bleed screws on the brake calipers (for rear drum brakes to the bleed screws on the wheel cylinders), loosen them and, acting on the control pedal, drain the fluid into a suitable container.
- remove the plug from the brake fluid reservoir and (simultaneously to the operation of draining the old fluid) introduce the recommended fluid into the system. Continue to introduce the new fluid until it starts to come out of the bleed screws, then tighten them.

*Avoid the brake fluid, which is extremely corrosive, coming into contact with the paintwork. If it does, wash immediately with water.*

*The symbol ⓒ, present on the container, identifies a synthetic type of brake fluid, distinguishing it from mineral kinds. The use of mineral type fluids irreparably damages the special rubber seals in the braking system.*



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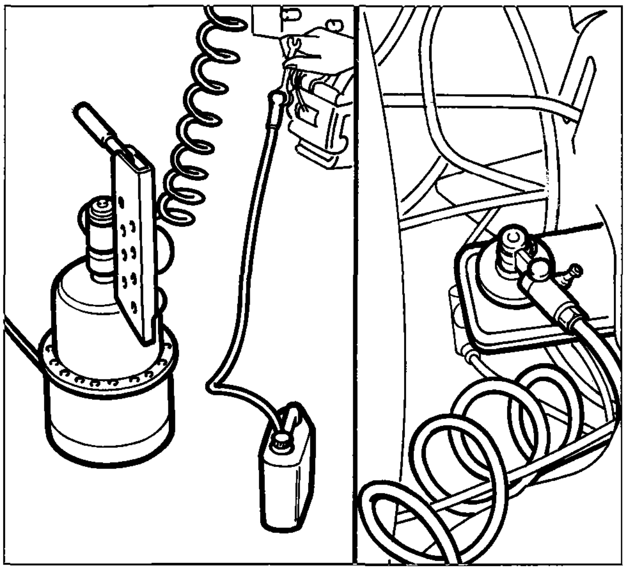
- Bleed the system keeping the flexible pipe connected to the bleed screw and the opposite end immersed in a transparent container filled with the same fluid as the circuit;
- loosen the bleed screw and, at the same time, press the brake pedal letting it return slowly; repeat this operation until any air bubbles finish coming out;
- with the pedal fully depressed, tighten the bleed screw and remove the pipe. Carry out this operation separately for each wheel starting at the rear (the furthest from the brake fluid reservoir).

*During the bleeding operation keep the level of the fluid in the reservoir above the MIN reference.*
*Do not reuse the hydraulic fluid drained during the bleeding procedure.*

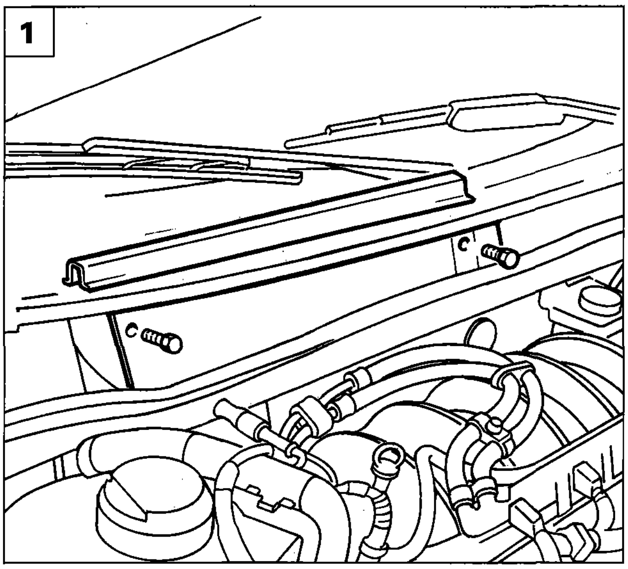
- Restore the level of the fluid in the reservoir and refit the cap;
- check the efficiency of the braking system.

**NOTE** *For versions with hydraulic clutches (Bravo 1998 20v) the fluid in the circuit must be drained by connecting a flexible pipe to the clutch operating cylinder bleed screw, loosening it and acting on the pedal to drain the fluid into a suitable container. Proceed with bleeding the hydraulic clutch circuit in the same way as described for the braking circuit, using the clutch pedal this time.*

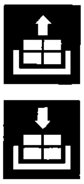

P4A49CA01

The bleeding operation can also be carried out using the "Jollyfren" equipment. This equipment allows the hydraulic system to be bled quickly. The bleeding action is carried out simultaneously for both wheels by a single operator representing a considerable time saving.

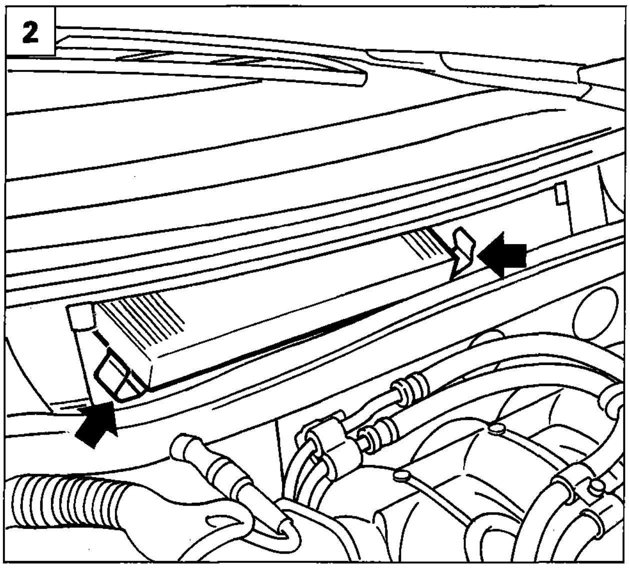
## 27 REPLACE POLLEN FILTER




P4A50CA01



1. To gain access to the pollen filter it is necessary to raise the seal shown in the diagram and then undo the bolts shown and remove the access flap for the pollen filter.




P4A50CA02

2. Release the side retaining springs in the pollen filter housing, extract it and proceed with replacing it.

**NOTE** *Failure to replace the filter can considerably reduce the efficiency of the climate control system.*
*If the vehicle is often used in dusty or strongly polluted areas, advise the Customer of the need to replace the filter element more often; it should especially be replaced if a decrease in the flow rate of the air introduced into the passenger compartment is noticed.*



Print no. 506.670/09

Engine 1910 TD

Engine 1910 TD 100

Engine 98 1242 16v

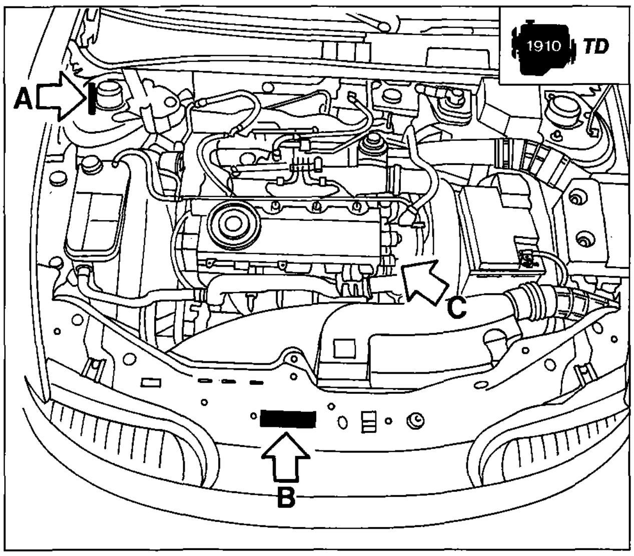
Engine 98 1998 20v

Engine 98 1910 JTD

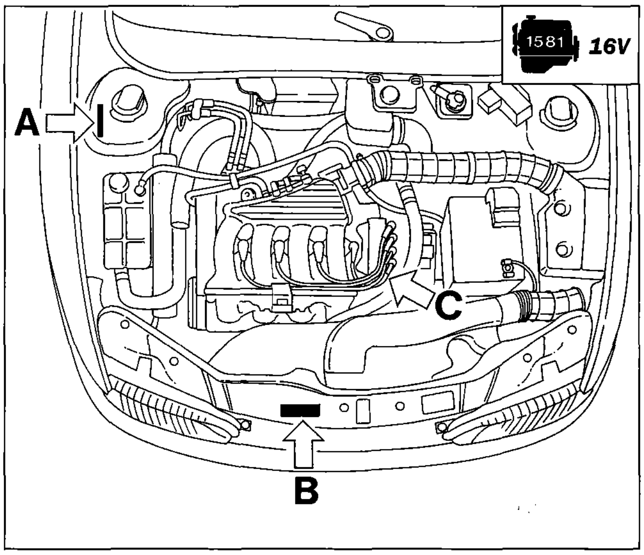
N.D. Data not available at the time of printing

| | CHASSIS | ENGINE | VERSION | BRAVO | BRAVA | GEARBOX (manual 5-speed) | GEARBOX (automatic) |
|---|---|---|---|---|---|---|---|
| 1581 16V | ZFA 182 000 | 182 A4.000 | 182 AB 1AA 01 | ● | | ● | |
| | | | 182 AB 1AA 018 (▲) | ● | | | |
| | | | 182 BB 1AA 11 | | | | |
| | | | 182 BB 1AA 11B (▲) | | ● | | |
| | | | 182 AB 11A 02 | ● | | | ● |
| | | | 182 BB 11A 12 | | ● | | |
| | | 182 A6.000 (*) | 182 AH 1AA 08 (*) | ● | | ● | |
| | | | 182 BH 1AA 17 (*) | | ● | | |
| 1910 TD 100 CV | | 182 A7.000 | 182 AF 1AA 06 | ● | | ● | |
| | | | 182 BF 1AA 15 | | ● | | |
| 1910 TD 75 CV | | 182 A8.000 | 182 AI 1AA 09 | ● | | ● | |
| | | | 182 BI 1AA 18 | | ● | | |

(*) Versions for specific markets (Germany)
(▲) Voluntary - Germany




P4A003A04




P4A002A02

**A. Vehicle type identification code and chassis manufacture number**
**B. V.I.N. Plate (EEC regulations)**
**C. Engine type and number.**

**WEIGHTS** (in kg)

| ENGINE TYPE | | 1581 16V | 1581 16V (●) | 1910 TD 100 CV | 1910 TD 75 CV |
|---|---|---|---|---|---|
| | 3 door | 1050 | 1090 | 1155 | 1145 |
| | 5 door | 1090 | 1120 | 1180 | 1170 |
| +500 = 150 (▲) | 3 door | 1550 | 1590 | 1665 | 1655 |
| | 5 door | 1630 | 1660 | 1720 | 1710 |
| Maximum permissible loads on the axles ■ (front) | 3 door | 850 | 850 | 920 | 920 |
| | 5 door | 850 | 850 | 920 | 920 |
| Maximum permissible loads on the axles ■ (rear) | 3 door | 850 | 850 | 900 | 900 |
| | 5 door | 850 | 850 | 900 | 900 |
| Maximum permissible load on the roof | | 80 | 80 | 80 | 80 |
| Load on the tow hook (trailer with braking system) | Minimum | - | - | - | - |
| | Maximum | 70 | 70 | 70 | 70 |
| | Without braking system | 400 | 400 | 400 | 400 |
| | With braking system | 1100 | 1100 | 1300 | 1300 |

■ Loads which must never be exceeded

(▲) 510 for Bravo 1910 TD - 540 for Brava

(●) With automatic transmission

**NOTE FOR VERSIONS WITH ACCESSORIES:** If special equipment is fitted (non standard air conditioner, sun roof, trailer towing device), the empty weight increases and therefore the carrying capacity may decrease, in relation to the maximum permissible loads.

The fuel consumption figures according to the 80/1268/EEC standards given overleaf have been defined in the course of official tests and in accordance with procedures laid down by EEC regulations. In particular, the bench tests measure simulated urban cycle figures whilst consumption at constant speeds of 90 and 120 kph are measured directly on a flat, dry road and in equivalent bench tests. The fuel consumption figures according tothe 93/116E standards have been defined in the course of homologation tests involving:

- an urban cycle which included cold starting followed by a varied urban cycle simulation.
- an extra-urban cycle which includes frequent acceleration in all gears simulating normal extra-urban usage of the vehicle. The speed varies between 0 and 120 kph.
- The average combined consumption is obtained from 37% of the urban cycle and 63% of the extra-urban cycle.
  The type of journey, traffic conditions, driving styles, atmospheric conditions, trim level/equipment/accessories, whether a roof rack is fitted, the presence of special equipment and the general state of the vehicle can lead to fuel consumption figures which differ from those obtained through the above mentioned procedures.
  The $CO_2$ exhaust emissions (in g/km) are obtained from the average combined cycle


VII-97 - Cancels and replaces
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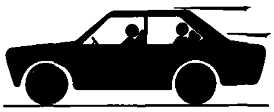
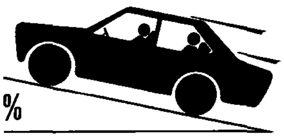
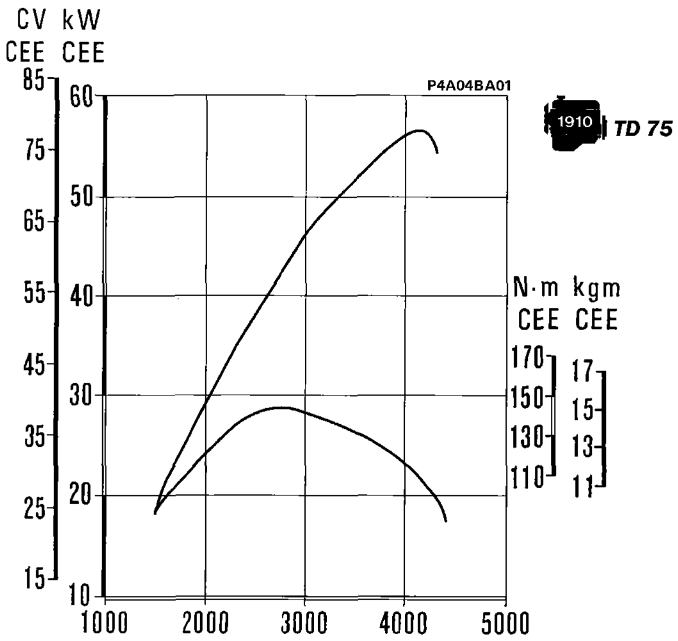
| ENGINE TYPE | | 1581 16V | 1581 16V (▲) | 1910 TD 100 CV | 1910 TD 75 CV |
|---|---|---|---|---|---|
| Speed kph (average load)  | 1 | 52 | – | 36 | 34 |
| | 2 | 90 | – | 63 | 59 |
| | 3 | 132 | 184<br>180 | 97 | 92 |
| | 4 | 175 | – | 137 | 128 |
| | 5 | 184 (180 ●)<br>180 (177 ●) | – | 182<br>180 | 165 |
| | R | 53 | – | 36 | 34 |
|  % Maximum climable gradient | | 37 | 31<br>30 | 41<br>40 | 38<br>37 |
| Fuel consumption according to 80/1268/CEE standards (litres/100 km) (*)  | Urban cycle (A) | 9,3 | 11,2 | 7,5 | 7,7 |
| | Constant speed 90 kph (B) | 5,5 | 5,8<br>5,9 | 4,6<br>4,7 | 4.5 |
| | Constant speed 120 kph (C) | 7,5 | 7,6<br>7,7 | 6,5<br>6,6 | 6,4<br>6,5 |
| | Av. consumption (CCMC proposal) $\frac{A+B+C}{3}$ | 7,4 | 8,2<br>8,3 | 6,2<br>6,3 | 6,2<br>6,23 |
| Fuel consumption according to 93/116/CE standards (litres/100km) (*) | Urban | 11,0<br>11,3 | 13,8<br>13,8 | 8,5<br>8,7 | 8,5<br>8,6 |
| | Extra-urband | 6,5<br>6,6 | 8,3<br>8,3 | 5,2<br>5,3 | 5,1<br>5,2 |
| | Combined | 8,2<br>8,3 | 10,3<br>10,3 | 6,4<br>6,5 | 6,3<br>6,4 |
| $CO_2$ exhaust emissions (g/km) | | 194<br>197 | 246<br>246 | 171<br>173 | 168<br>171 |

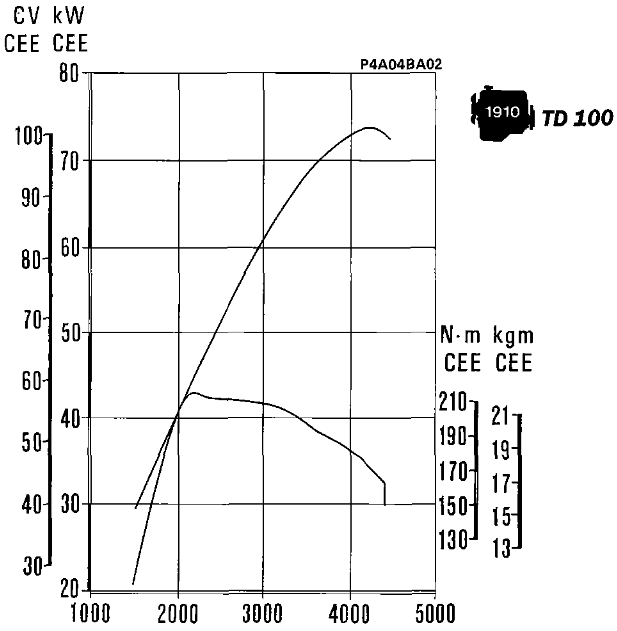
(*) See specification on previous page
(●) Versions for specific markets (Germany)
(▲) With automatic transmission

**NOTE** *The figures with the shaded background refer to the Fiat Brava*

| Capacities | Unit | | Quantity dm³(l) | Quantity (kg) |
|---|---|---|---|---|
| Petrol ⩾ O.R. 95 Unleaded | | 1581 | 50 | – |
| Diesel | | 1910 TD | 60 | – |
| 50% + $H_2O$ (▲) Paraflu FIAT 11 | Total capacity of cooling system | 1581 | 7 (6,4 ■) | – |
| | | 1910 TD 75 | 6,55 (6,8 ■) | – |
| | | 1910 TD 100 | 6,3 (6,55 ■) | – |
| **Petrol engines:** SELENIA 20 K (SAE 10 W/40) | Total capacity | 1581 | 4,5 | 4 |
| | | 1910 TD 75<br>1910 TD 100 | 5 | 4,35 |
| **Diesel engines** SELENIA Turbo Diesel (SAE 15 W/40) | Partial capacity (periodic replacement) | 1581 | 3,8 (3,5 ●) | 3,4 (3,1 ●) |
| | | 1910 TD 75<br>1910 TD 100 | 4,5 (4,2 ●) | 4 (3,7 ●) |
| a = TUTELA ZC 75 Synth | | a | 1,98 | 1,8 |
| b = TUTELA GI/2 | | b | 6 (4,3 *) | 5,4 (3,9 *) |

(▲) Distilled water
(●) Engine sump only
(■) For versions with air conditioning
(*) Periodic replacement




### Engine power curves obtained by EEC method

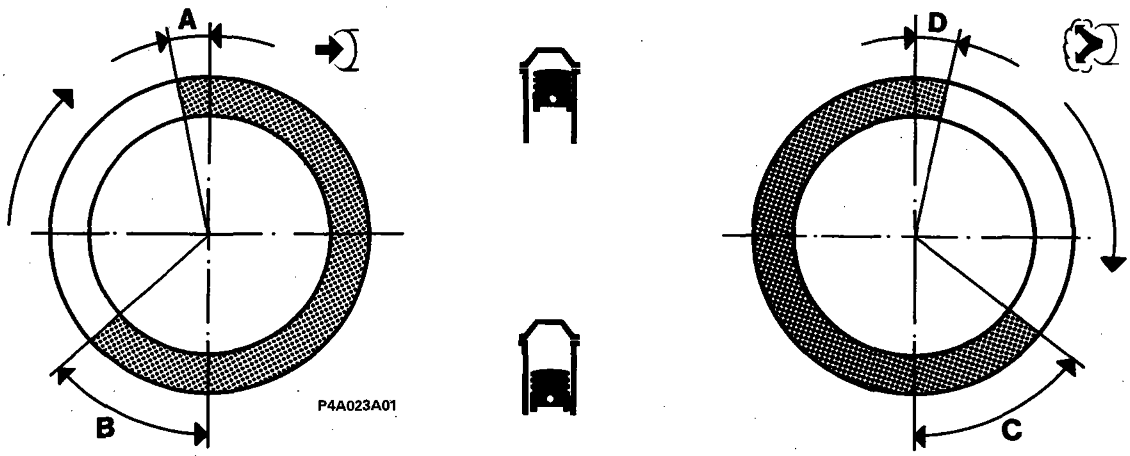
The power curves illustrated can be obtained with the engine overhauled and run in, without a fan and with a silencer and air filter fitted at sea level.

**CHARACTERISTICS**

| | | | 1910 *TD 100 CV* | 1910 *TD 75 CV* |
|---|---|---|---|---|
| Cycle | | | DIESEL 4 stroke | |
| Timing | | | single overhead camshaft | |
| Type of fuel system | | | Indirect mechanical injection | |
| Number of cylinders | | | 4 | |
| Cylinder liner (bore) | | mm | 82 | |
| Stroke | | mm | 90,4 | |
| Capacity | | cc | 1910 | |
| Compression ratio | | | 20,7 ± 0,5 | |
| Total volume of combustion chamber | | cc | 24,6 | |
| Max power EEC | | kW (CV) | 74 (100) | 55 (75) |
| | | rpm | 4200 | 4200 |
| Max torque EEC | | daNm (kgm) | 20 (20,4) | 14,7 (15, ) |
| | | rpm | 2250 | 2750 |

| DESCRIPTION | | | 1910 TD 100 CV | 1910 TD 75 CV |
|---|---|---|---|---|
| | | | Values in mm | |
| 17 | Cam lift | | 8,5 | 8,5 |
| | | | 8,5 | 8,5 |
| 17-20 | clearance for timing check | | 0,50 | |
| | | | 0,50 | |
| | operational clearance | | 0,35 ± 0,05 | |
| | | | 0,35 ± 0,05 | |

### TIMING DIAGRAMS




**Timing angles**

| | | | | |
|---|---|---|---|---|
| A | Inlet | opens before TDC | 6° | 6° |
| B | | closes after BDC | 26° | 26° |
| C | Exhaust | opens before BDC | 26° | 26° |
| D | | closes after TDC | 6° | 6° |



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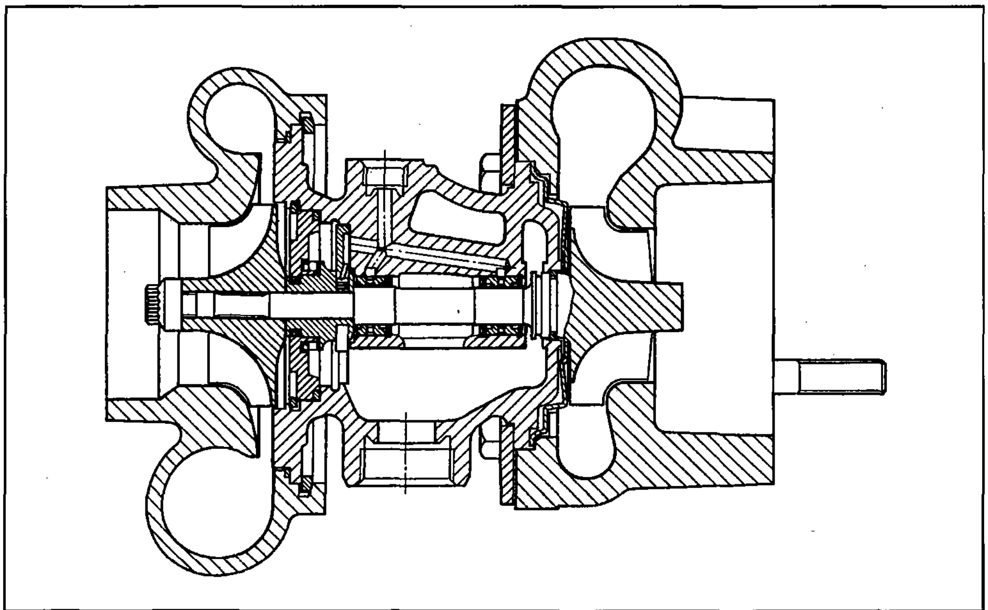
## SPECIFICATIONS

| | 1910 TD 100 BHP | 1910 TD 75 BHP |
|---|---|---|
| Firing order | 1-3-4-2 | |
| Injection pump | LUCAS DPC-FT09, electronic | BOSCH, mechanical VER-679 |
| Injector | LUCAS | BOSCH |
| Nozzle holder | LCD 011R02AA1 (*) LCR 6705344 | BOSCH KCA 30S41 |
| Nozzle | LUCAS RND 05DC6897 | BOSCH DN 0 SD 321 |
| Injector setting pressure | 143-150 bar | 150-158 bar |
| Injection pump timing adjustment: pump piston travel with cylinder no.1 at TDC (compression stage) | Electronic adjustment | 0.92 mm |
| Engine idle speed | 870-930/min | 830-870/min |
| Top engine speed with no load | 4920-5020/min | 5000-5100/min |

(*) Signal injector installed on cylinder no. 1

**TURBOCHARGING** Turbocharger operated by exhaust gases with waste-gate pressure valve and air/air heat exchanger (intercooler)

| | | |
|---|---|---|
| Turbocharger: type | Garrett GT 15 | |
| Maximum turbo boost pressure | < 1.05 bar | 0.950 bar |



4A007A02

**Cross section through turbocharger**

# 00.10

## TEST DATA FOR BOSCH INJECTION PUMP, type VE R 679

**GENERAL TEST CONDITIONS**

- Test oil: ISO 4113
- Test fluid temperature: 45° ± 1°C (reflux
- outlet ●)
- Pump intake pressure: 0.35 bars
- Clockwise rotation

**SPECIFIC TEST CONDITIONS**

- Bosch 1.688.901.022 Injectors
- Nozzles: Bosch 1.688.901.922 (DNO SD 1510) set to 130 - 133 bar
- Pipes: 2x6x450 mm.

| Check type | | Regulator lever position | Rotation speed rpm | Advance check mm | Transfer pressure bar | Output per element mm/cycle | Max. deviation between individual strokesmm/cycle | Stroke reduction Total mm |
|---|---|---|---|---|---|---|---|---|
| Max | 1 | Max | 1000 | 2.4-3.8 | 5.4-6.4 | - | - | - |
| | 2 | Max | 1500 | 5.1-6.3 | 6.8-7.8 | - | - | - |
| | 3 | Max | 2100 | 8.2-9.6 | 8.3-9-3 | - | - | - |
| Output | 4 | Max | 600 | - | - | 39.3-43.9 | - | - |
| | 5 | Max | 1000 | - | - | 40.3-44.9 | - | - |
| | 6 | Max | 1500 | - | - | 41-45 | ≤2.5 | - |
| | 7 | Max | 2100 | - | - | 41.3-45.9 | - | - |
| | 8 | Max | 2400 | - | - | 26.2-36.2 | - | - |
| | 9 | Max | 2600 | - | - | 8.4-18.4 | - | - |
| | 10 | Max | 2800 | - | - | ≤3 | - | - |
| Ignition (enrichment) | 11 | Max | 100 | - | - | 50-80 | - | - |
| Elimination of enrichment | 12 | Max | 400 | - | - | 52-72 | - | - |
| | 13 | Max | 525 | - | - | 55-65 | - | - |
| Reflux output (●) | 14 | Max | 600 | - | - | 15-31 l/h | | - |
| | 15 | Max | 2100 | - | - | 20-50 l/h | - | - |
| Idle | 16 | Min | 425 | - | - | 10.5-18.3 | ≤2.5 | - |
| Residual flow | 17 | Min | 500 | - | - | ≤3 | - | - |
| Arrest (●●) | 18 | Min | 425 | - | - | ≤3 | - | - |
| Delay device (LFB) | 19 | 1500 | - | - | P. MAX (0.2±0.1) | Q. MAX (10±1) | - | - |
| | 20 | 1500 | - | - | - | - | - | 0.7-09 |

**Fixed installation advance = 0.92 mm**
**Electric arrest control: minimum operating voltage 8V. Operating voltage11-13V**
**Maximum engine speed with no load: 5050 ± 50/min.**
**Engine idle speed: 850±20/min.**
(●) Fuel return from pump to tank
(●●) Carry out with electric arrest control turned off.

## DATA FOR CHECKING LUCAS FT09 INJECTION PUMP FOR 1910 TD 100 ENGINE

**GENERAL TEST CONDITIONS**
- Test oil: ISO 4113 (SHELL S-9365)
- Temperature of test oil: 40° ± 1°C
- Injectors ISO 9008-025A
- Injector setting 130÷133 bar
- Injectors RDNOSDC 6876
- Supply pressure: 0,1 bar
- Direction of rotation: clockwise (seen from control side)
- Injection piping: 2,5×6×330 mm
- Max engine free running speed: 5000±50 rpm
- Engine idle speed 850±20 rpm
- Fitting: 0±1° with cyl. n° 1 at TDC

| Type of check or adjustment | Op. N° | Adjust. lever pos. | Rotation speed rpm | Av. capacity per cyl. mm³/-cycle | Advance α° | Max. discr. btwn flow rates mm³/cycle | Ops. or checks to be carried out |
|---|---|---|---|---|---|---|---|
| **Filling and bleeding** | 1 | Max | 0 | – | – | – | Fill pump with test fluid through filler on cover |
| **Electrical supply** | 2 | Max | 0 | – | – | – | With supplier stabilized at 11V the control unit is the interface |
| **Advance instrument setting** | 3 | Max | 0 | – | 0 | – | Adjust acting on the potentiometer on the reader |
| **Check hydraulic continuity** | 4 | Max | 1000 | – | – | – | Let the pump run for 3 minutes checking that there is no air in the fluid |
| **Let oil temp. warm up** | 5 | Max | 2000 | – | – | – | Stabilize the temperature at 40÷40,5 °C (pump outlet) |
| **Dynamic fitting** | 6 | Max | 1500 | – | 6° | – | Supercharging pressure 1 bar<br>Act on the variable pick-up |
| **Max no load check** | 7 | Max | 2530 | 19±4 | – | 4 | Supercharging pressure 1 bar |
| **Regulator intervention check** | 8 | Max | 2330 | 405±4 | – | 4 | Supercharging pressure 1 bar |
| **Max capacity check** | 9 | Max | 2100 | 56,5±2 | 7,5±0,5 | 4 | Supercharging pressure 1 bar |
| **Max capacity check** | 10 | Max | 1250 | 55,4±2 | 4,5±0,5 | 4 | Supercharging pressure 1 bar |
| **Start of superharging intervention** | 11 | Max | 750 | 40,2±2,5 | 1,5±0,5 | 4 | Supply pressure 0,15 bar |
| **Supercharging device gradient** | 12 | Max | 750 | Q12-Q11 =11±2 | 0 | 4 | Supercharging pressure 0,45 bar |

| Type of check or adjustment | Op. N° | Adjust. lever pos. | Rotation speed rpm | Av. cap. per cyl. mm³/cycle | Advance $\alpha°$ | Max. discr. btwn flow rates mm³/cycle | Ops. or checks to be carried out |
|---|---|---|---|---|---|---|---|
| **Max capacity check** | 13 | Max | 750 | 55,0±3 | 0 | – | Supercharging pressure 1 bar |
| **Max capacity check** | 14 | Max | 450 | 35,0±4 | 0 | – | Supercharging pressure 0 bar |
| **Max capacity check** | 15 | Max | 100 | 42,0±8 | 0 | – | Supercharging pressure 0 bar |
| **Idle setting** | 16 | Min | 450 | 6,5±2 | 0 | 4 | Pull the specific levers |
| **Idle check when cold** | 17 | Min | 450 | 12,0±2 | 0 | 4 | Release the specific levers |
| **Regulator state** | 18 | Min | 400 | (Q16+9)±4 | 0 | 4 | Lever drawn |
| **Anti-stall capacity** | 19 | Min | 450 | 4,5±1,3 | 0 | 4 | Pull the STOP lever |
| **Recirculation flow rate** | 20 | Max | 2100 | 10÷40 l/h | 0 | – | Supercharging pressure 1 bar |
| **Supply stop** | 21 | Max | 400 | ⩽3,0 | 0 | – | Remove the supply to the electrostop |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| | | 1910 TD 75 | 1910 TD 100 |
|---|---|---|---|
| | | 1 3 5 / 2 4 R | |
| | Type | C 510.5.17 | |

**GEARBOX**

| | | | |
|---|---|---|---|
| Synchronizers | spring ring (Porsche type) | – | |
| | baulk ring type | 1 3 5 / 2 4 | |
| Gears | straight toothed | R | |
| | helical toothed | 1 3 5 / 2 4 | |
| Gear ratios | 1 | 3,909 | 3,909 |
| | 2 | 2,238 | 2,238 |
| | 3 | 1,444 | 1,444 |
| | 4 | 1,029 | 1,029 |
| | 5 | 0,815 | 0,767 |
| | R | 3,909 | 3,909 |

**DIFFERENTIAL**

| | | 1910 TD 75 | 1910 TD 100 |
|---|---|---|---|
| Ratio crown wheel & pinion reduction | | 17/57 (3,352) | 20/63 (3,15) |
| Ratio at the wheels | 1 | 13,102 | 12,313 |
| | 2 | 7,501 | 7,049 |
| | 3 | 4,840 | 4,548 |
| | 4 | 3,449 | 3,241 |
| | 5 | 2,731 | 2,416 |
| | R | 13,102 | 12,313 |
| Differential internal casing bearing | | conical roller bearings | |
| Adjustment of bearing pre-loading | | by shims | |
| Thickness of shims | FIAT mm 0,07 | 1,70÷2,89 | |
| Interference to obtain exact bearing pre-loading | mm | Bearings not pre-loaded = 0,12<br>bearings pre-loaded (350 daN) = 0,08 | |
| Clearance btwn planet and sat. gears | mm | ≤ 0,10 | |
| Adjustment of clrnce btwn planet/sat. gears | | no adjustment is carried out | |



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**AISIN AUTOMATIC GEARBOX**

| ENGINE TYPE | 1581 16v |
|---|---|
| Gears | 1 2 3 4 R |
| Gear ratios 1 | 2,807 |
| Gear ratios 2 | 1,479 |
| Gear ratios 3 | 1,0 |
| Gear ratios 4 | 0,735 |
| Gear ratios R | 2,769 |
| Idler ratio | 1,019 (54/53) |
| Torque converter ∅ mm | 216 |
| Ratio (multiplication) for engine torque | 2,150 |
| Quantity of oil Gl/2 – total, with gearbox converter, radiator and pipes empty | 6 litres (5,4 kg) |
| Quantity of oil Gl/2 – replacement only | 4,3 litres (3,9 kg) |

**DIFFERENTIAL**

| | |
|---|---|
| Crown wheel and pinion reduction | 3,565 (82/23) |
| Final ratio | 3,633 (54/53 × 82/23) |
| Ratio at the wheels 1 | 10,197 |
| Ratio at the wheels 2 | 5,373 |
| Ratio at the wheels 3 | 3,633 |
| Ratio at the wheels 4 | 2,670 |
| Ratio at the wheels R | 10,059 |

**Front suspension** independent, Mac Pherson type with steel track control arms anchored to an auxiliary cross member. Offset coil springs and double acting telescopic shock absorbers. Anti-roll torsion bar.

### Coil springs

| ENGINE TYPE | | | 1581 16V | | |
|---|---|---|---|---|---|
| **VERSION** | | | **A** | **B** | **C** |
| Diameter of wire | | mm | 12,3±0,05 | 12,5 ± 0,05 | 12,7 ± 0,05 |
| Number of turns | | | 3,75 | 3,75 | 3,75 |
| Direction of coil | | | clockwise | clockwise | clockwise |
| Height of spring released | | mm | 461 | 461 | 454 |
| Height of spring under a load of: | 320,5 ÷ 346,5 | mm | 192 | – | – |
| | 340 ÷ 368 | mm | – | 192 | – |
| | 352 ÷ 382 | mm | – | – | 192 |
| The springs are subdivided into two categories, identifiable by a mark | | | | | |
| yellow (1) for those under a load of: | 333,5 | height of mm | >192 | – | – |
| | 354 | height of mm | – | >192 | – |
| | 367 | height of mm | – | – | >192 |
| green (1) for those under a load of: | 333,5 | height of mm | ⩽192 | – | – |
| | 354 | height of mm | – | ⩽192 | – |
| | 367 | height of mm | – | – | ⩽192 |

(1) Springs of the same category must be fitted.
A. With automatic transmission
B. With automatic transmission and climate control
C. With auto. trans., climate control and ABS.

### Shock absorbers

| | | | |
|---|---|---|---|
| Type: telescopic, double acting (low pressure gas) | | WAY-ASSAUTO | |
| Open (start of damping action) | mm | 518 ± 2,5 | 511 ± 2,5 |
| Closed (metal against metal) | mm | 361 ± 2,5 | 354 ± 2,5 |
| Travel | mm | 157 | 157 |

### Stabilizer bar

| | | | |
|---|---|---|---|
| Diameter of stabilizer bar | mm | 22 | 23 |



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SPORT PACK

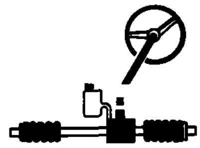
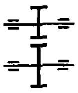
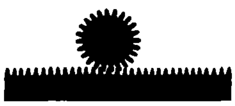
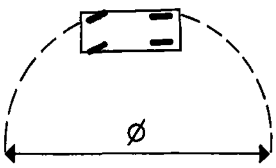
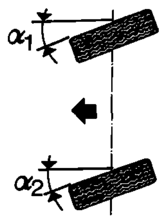
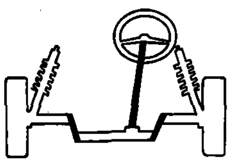
A "SPORT PACK" option is available for the Bravo 1998 20v HGT which makes its behaviour on the road even more sporty.

With this option the vehicle is equipped with special suspension and larger tyres which improve road holding, agility and driving precision.
In pratice it involves personalizing the vehicle aimed at more demanding customers with a passion for sports driving.

The technical contents of the "SPORT PACK" are as follows:

- **flexible suspension elements** which are more rigid to restrict rolling and pitching
- **height from the ground reduced at the front by 20 mm** in order to lower the centre of gravity, improve the aerodynamic coefficient (CX) and minimize the front aerodynamic ligtening at high speeds
- **special front wheel steering knuckles,** with **specific steering geometry** for a high level of responsiveness and to minimize understeer round tight bends; this geometry allows the front wheels to "work" optimally, with consequent improvements to the driving as well;
- **special power assisted steering**, which features a direct steering ratio (60 mm/turn, or 2 and 1/4 turns lock to lock) which makes the steering responsive and precise; this direct steering associated with the specific variation in the toe in which the front wheels undergo during rolling (which improves stability when entering bends) ensures complete control of the vehicle during more decided variations in trajectory;
- **special pressurized Sachs Boge shock absorbers**, which improve the handling of the vehicle and at the same time guarantee a high level of comfort over unmade roads;
- **larger 205/50 R15 tyres**, which ensure road holding which is more appropriate to the driving characteristics and the demands of Customers who love sporty driving.

**NOTE** *The variation in the geometry and larger tyres mean that snow chains cannot be used.*

| | | |
|---|---|---|
| Type | |  rack and pinion power assisted |
|  Ratio |  no. of turns lock to lock | 2.3 |
| |  rack travel | 128 ±1,5 mm |
|  | Turning circle | 12 m |
|  Steering angle | outer wheel $\alpha_1$ | 26° ± 30′ |
| | inner wheel $\alpha_2$ | 34° ± 30′ |
|  | Steering col. |  with 2 universal joints |


*Print no. 506.670/06*

**Front suspension** independent, Mac Pherson type with steel track control arms anchored to an auxiliary cross member. Offset coil springs and double acting, telescopic shock absorbers. Torsion anti-roll bar.

**Coil springs**

| | | | |
|---|---|---|---|
| Diameter of wire | | mm | 13,5±0,05 |
| Number of turns | | | 4 |
| Direction of coil | | | clockwise |
| Height of spring released | | mm | 355 |
| Height of spring under a load of: | 340÷360 daN (358÷388 daN)* | mm | 170 |
| The springs are subdivided into two categories, identifiable by a mark | | | |
| yellow (1) for those under a load of: | 350 daN (373 daN)* | height of mm | >170 |
| green (1) for those under a load of: | 350 daN (373 daN)* | height of mm | ≤170 |

(1) Springs of the same category must be fitted.
(*) For vehicles with air conditioning

**Shock absorbers**

| | | |
|---|---|---|
| Type: telescopic, double acting (low pressure gas) | | BOGE |
| Open (start of damping action) | mm | 458,5 ± 2 |
| Closed (metal against metal) | mm | 291,5 ± 2,5 |
| Travel | mm | 167 |

**Stabilizer bar**

| | | |
|---|---|---|
| Diameter of stabilizer bar | mm | 23 |

# 00.44

**Rear suspension** independent with cast iron track control arms. Coil springs and shock absorbers with vulcanized bushes. Torsion anti-roll bar. Rigid H auxiliary frame made up of transverse tubular element and two pressed side members connected to it.

## Coil spring

| | | | |
|---|---|---|---|
| Diameter of wire | | mm | 11,8±0,05 |
| Number of turns | | | 4,5 |
| Direction of coil | | | clockwise |
| Height of spring released | | mm | 296,8 |
| Height of spring under a load of: | 275÷303 daN | mm | 194 |
| The springs are subdivided into two categories, identifiable by a mark | | | |
| yellow (1) for those under a load of: | 289 daN | height of mm | >194 |
| green (1) for those under a load of: | 289 daN | height of mm | ⩽194 |

(1) Springs of the same category must be fitted.

## Shock absorbers

| | | |
|---|---|---|
| Type: telescopic, double acting (low pressure gas) | | BOGE |
| Open (start of damping action) | mm | 317 ± 3 |
| Closed (metal against metal) | mm | 220,5 ± 3 |
| Travel | mm | 96,5 |

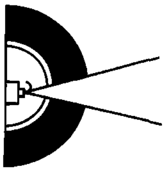
## Stabilizer bar

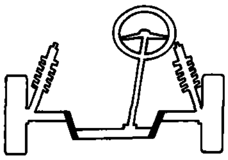
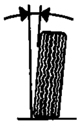
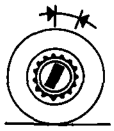
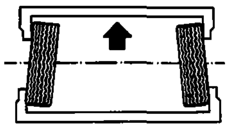
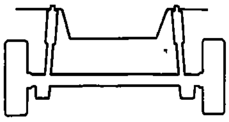
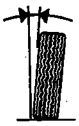
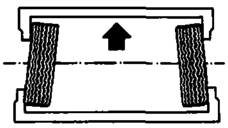
| | | |
|---|---|---|
| Diameter of stabilizer bar | mm | 17 |



Print no. 506.670/06

**WHEEL GEOMETRY**



| | | |  unladen car (■) |
|---|---|---|---|
|  Front suspension | camber (**) |  | -1′± 30′ |
| | caster (**) |  | 2°20′ ± 30′ |
| | toe in |  | -1 ÷ 1 mm |
| | front wheel offset ▲ | | 0° |
|  Rear suspension | camber (**) |  | –45′ ± 30′ |
| | toe in (**) |  | 1 ÷ 5 mm |
| | rear wheel thrust angle ▲ | | 0° |

(**) Angles cannot be adjusted
(■) With tyres inflated to the correct pressure and vehicle in running order with 5 litres of fuel

(▲) Angular values, which cannot be adjusted, used for the correct alignement of the vehicle

| **ENGINE** | **Pressed steel wheel rim type** | **Radial, tubeless tyre** | **Tyre inflation pressure in bar** | | | |
|---|---|---|---|---|---|---|
| | | | Front | | Rear | |
| | | | average load | heavy load | average load | heavy load |
| | 6J×15"– 49 | 205/50 ZR 15 P700Z (●) | 2,5 | 2,7 | 2,2 | 2,5 |
| SPARE WHEEL (*) | 4B×15"– 35 | 115/70 R15 90M | 4,2 | | | |

(●) Not to be used with snow chains because they could interfere with the wheel arch



Print no. 506.670/06

# Contents

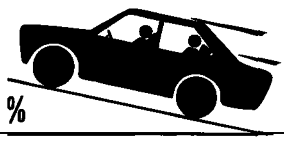


This section contains data relating to cars fitted with a 1581 16v STEP A engine.
For further information, refer to data in section 00 of the first and third volume.

| | CHASSIS | ENGINE | VERSION | Bravo | Brava | GEARBOX |
|---|---|---|---|---|---|---|
| 1581 16V | ZFA 182.000 | 182 A4.000 | 182 AB 1AA 01C | ● | | ● |
| | | | 182 AB 1AA 11B 01D (▲) | ● | | |
| | | | 182 BB 1AA 11C | | ● | |
| | | | 182 BB 1AA 11B 01D (▲) | | ● | |

(▲) Versions for specific markets (Germany)

| | | |
|---|---|---|
| Speed km/h (average load) | 1 | 50 |
| | 2 | 87 |
| | 3 | 135 |
| | 4 | 184 (180) |
| | 5 | 178 |
| | R | 50 |



| | |
|---|---|
| % Gradient when fully laden | 37 |

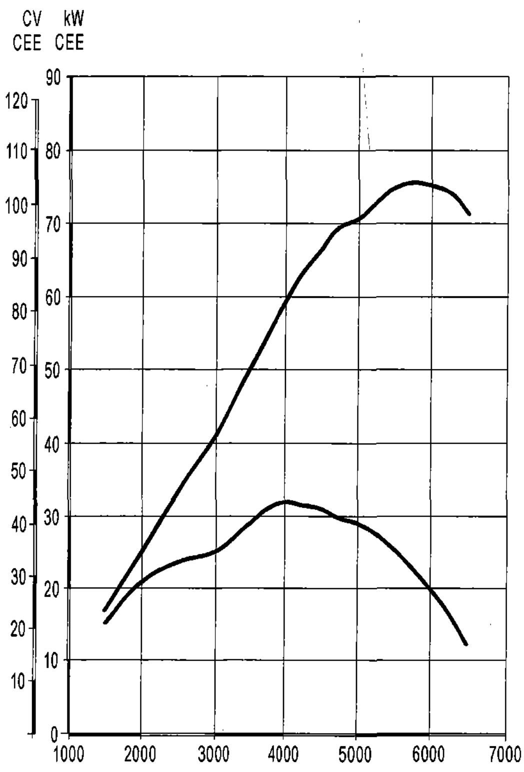
| | | |
|---|---|---|
| Fuel consumption as per 93/116/EC (litres/100 km) (*) | Urban | 10.6 (10.8) |
| | Out-of-town | 6.0 (6.1) |
| | Combined | 7.7 (7.8) |
| Exhaust $CO_2$ emissions (g/km) | | 183 (186) |

**NOTE:** Values shown in brackets refer to the Fiat Brava.
(*) 93/116/EC fuel consumption figures were determined during homologation tests:
- an urban cycle, i.e. a cold start followed by a simulated varied urban route
- out-of-town cycle, i.e. frequent accelerations in all gears to simulate normal out-of-town vehicle use, with speed between 0 and 120 km/h.
- Average combined fuel consumption is assumed to be 37% of the urban cycle and 63% of the extraurban cycle.

Type of route, traffic situations, driving style, weather conditions, version/equipment/accessory level, presence of a roof rack, presence of special equipment and vehicle condition in general may lead to fuel consumption figures other than those measured as above.
Exhaust $CO_2$ emissions (in g/km) are measured over an average combined cycle.

## SPECIFICATIONS

| | | 1581 16v |
|---|---|---|
| Compression ratio | | 10.5 ± 0.15 |
| Maximum power EC | kW (BHP) | 75.8 (103.1) |
| | rpm | 5750 |
| Maximum torque EC | daNm (kgm) | 14.2 (14.5) |
| | rpm | 4000 |



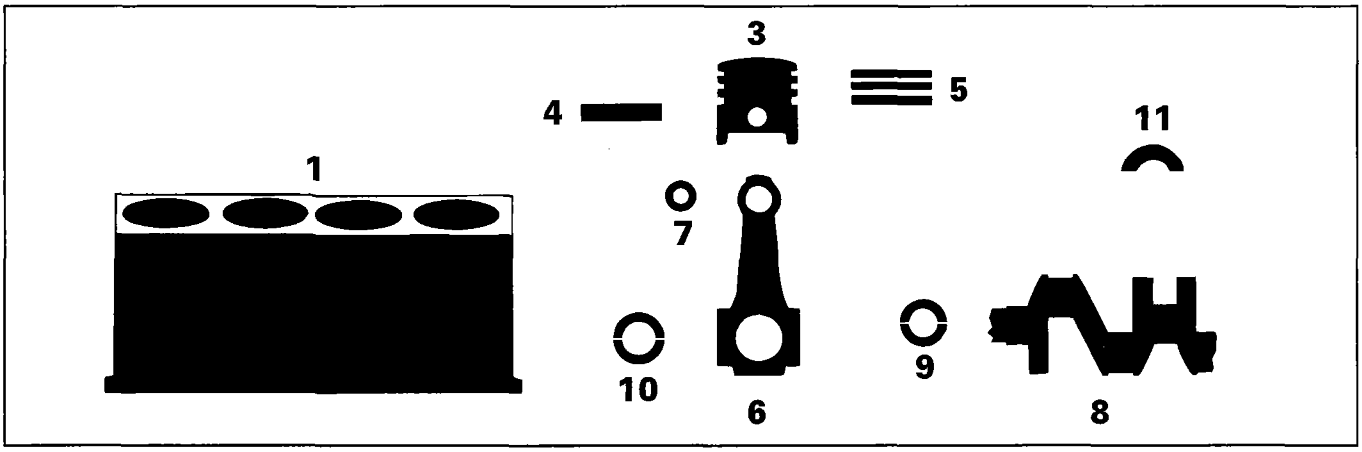
P4A02GA01

1581 16v

**Typical engine curves measured by EEC method**

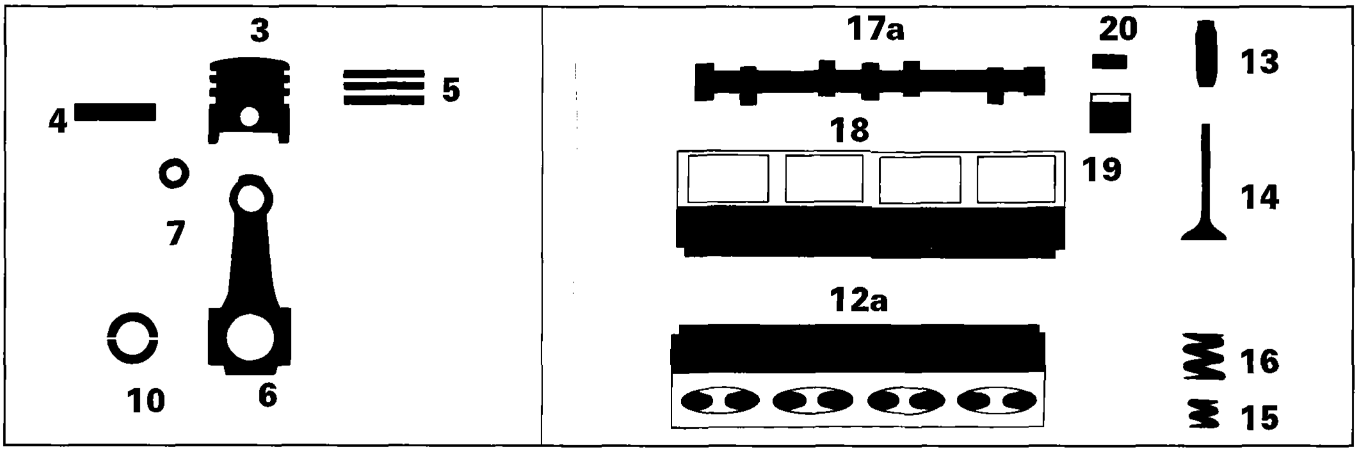
The power curves illustrated can be obtained with the engine overhauled and run in, without a fan and with a silencer and air cleaner fitted at sea level.

**NOTE** *The data and curve shown on this page refer to the 1581 16v engine with order number 46474405*

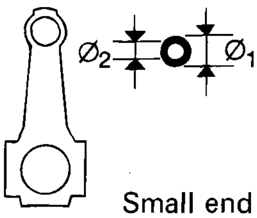
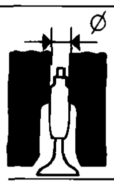
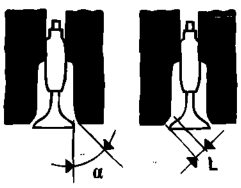
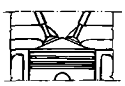
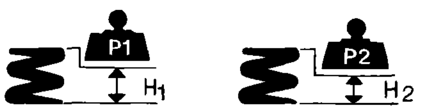



16v

| DESCRIPTION | | Values in mm |
|---|---|---|
| **3** Piston | X | 10.2 |
| | Ø A | 86.352 - 86.362 |
| | Ø B | 86.359 - 86.371 |
| | Ø C | 86.368 - 86.378 |
| | Ø FIAT > | 0.4 |
| **3** Piston ring grooves | 1 | 1.520 - 1.540 |
| | 2 | 1.510 - 1.530 |
| | 3 | 3.010 - 3.030 |
| **5** Piston rings | L 1 | 1.470 - 1.490 |
| | L 2 | 1.470 - 1.490 |
| | L 3 | 3.000 |
| | Ø FIAT > | 0.4 |
| **5-3** Piston rings Piston ring grooves | 1 | 0.035 - 0.075 |
| | 2 | 0.020 - 0.060 |
| | 3 | 0.010 - 0.030 |

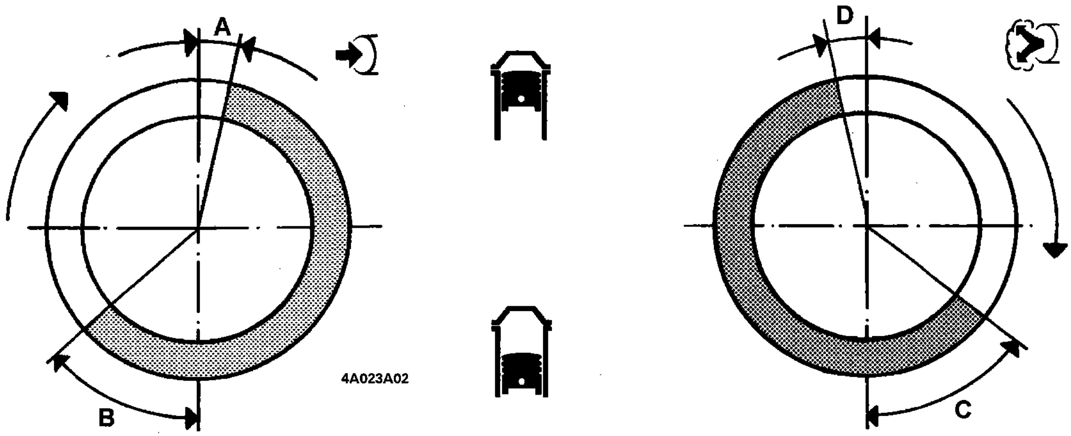



| | 1581 16v |
|---|---|

| DESCRIPTION | | | Values in mm |
|---|---|---|---|
| 7 |   | Ø1 | 24.016-24.041 |
| | Small end bush | Ø2 | 22.004-22.009 |
| 4-7 | Piston pin<br>Small end bush | | 0.009-0.019 |
| |   Valve guide seat on cylinder head | Ø | 12.950-12.977 |
| 12a |   Valve seat | α (intake) | 45°±20′ |
| | | α (exhaust) | 45°±20′ |
| | | L | about 2 |
| |  Volume of combustion chamber in cylinder head | $cm^3$ | 33.35 |
| 15 |   | $P_1$ | 8.3-9.3 daN |
| | | $H_1$ | 27.5 |
| | | $P_2$ | 17.6-19.6 daN |
| | Internal valve spring | $H_2$ | 18.5 |

| | | 1581 16v |
|---|---|---|
| **DESCRIPTION** | | Values in mm |
| 16 Outer valve spring | $P_1$ | 23.4 - 25.6 daN |
| | $H_1$ | 33.5 |
| | $P_2$ | 46 - 50 daN |
| | $H_2$ | 24.5 |
| 17a 17b Cam lift | Intake | 8.5 |
| | Exhaust | 8 |
| 12a Tappet housings | Ø | 33.000 - 33.025 |

## TIMING DIAGRAMS




### Timing angles

| | | | 1581 16v |
|---|---|---|---|
| A | Intake | Begins after TDC | 4° |
| B | | Ends after BDC | 38° |
| C | Exhaust | Ends before BDC | 28° |
| D | | Ends before TDC | 4° |

| **INTEGRATED ELECTRONIC INJECTION/IGNITION SYSTEM COMPONENTS** | | 1581 16V |
|---|---|---|
| Electronic control unit | Versions with manual gearbox | I.A.W. 49 F.B4 |
| | Versions with automatic transmission | I.A.W. 49 F.L2 |
| Intake air pressure and temperature sensor | | M. Marelli TPRT 03 |
| Fuel vapour solenoid valve | | SIEMENS EC1 |
| Throttle body | | M. Marelli 46 SX F2 |
| Idle adjustment actuator | | M. Marelli IB/02 |
| Injector | | M. Marelli IWP 064 |
| Fuel pressure regulator | | M. Marelli RPM 84 |
| Coolant temperature sending unit | | SYLEA 402.183.01<br>ELTH 2690350 |
| Top Dead Centre and rpm sensor | | JAEGER CVM 02 |
| Throttle position sensor (potentiometer) | | M. Marelli IPF 2C |
| Dual relay for electric fuel pump and injection-ignition control unit | | BITRON |
| Electric fuel pump | | MARWALL ESS 291 |
| Lambda sensor | | NTK OZA 334-A1 |
| Fuel filter | | MARWALL FA 5325 IN |
| Knock sensor | | NTK KNE 03 |
| Ignition coil | | COOPER BAE 920 A |


MI.99 Supersedes previous version
*Print n° 506.670/21*

| | 1581 16v |
|---|---|
| | 1 3 5 2 4 R |
| Type | **C.513.514.26** |

**GEARBOX**

| | | |
|---|---|---|
| Synchronizers | ring type (Porsche) | – |
| | free ring | 1 3 5 2 4 |
| Gears | spur toothed | R |
| | helical toothed | 1 3 5 2 4 |
| Gear ratios | 1 | 3.909 |
| | 2 | 2.238 |
| | 3 | 1.444 |
| | 4 | 1.029 |
| | 5 | 0.816 |
| | R | 3.909 |

# 00.21-27

**DIFFERENTIAL**

| | | 1581 16v |
|---|---|---|
| Ratio spur gear and pinion set | | 3.353 (17/57) |
| Ratio at the wheels | 1st | 13.107 |
| | 2nd | 7.504 |
| | 3rd | 4.842 |
| | 4th | 3.450 |
| | 5th | 2.736 |
| | R | 13.107 |
| Differential internal casing bearing | | taper roller type |
| Bearing preload adjustment | | by shims |
| Thickness of shims | mm 0.05 | 1.70-2.60 |
| | 0.10 | – |
| Interference to obtain exact bearing pre-loading | mm | bearings not pre-loaded = 0.12<br>bearings pre-loaded (350 dan) = 0.08 |
| Differential-planet gear backlash | mm | ⩽ 0.10 |
| Adjusting differential-planet gear backlash | | by shims |
| Thickness of shims | (0.05) mm | 0.80 - 1.25 |

1581 16v

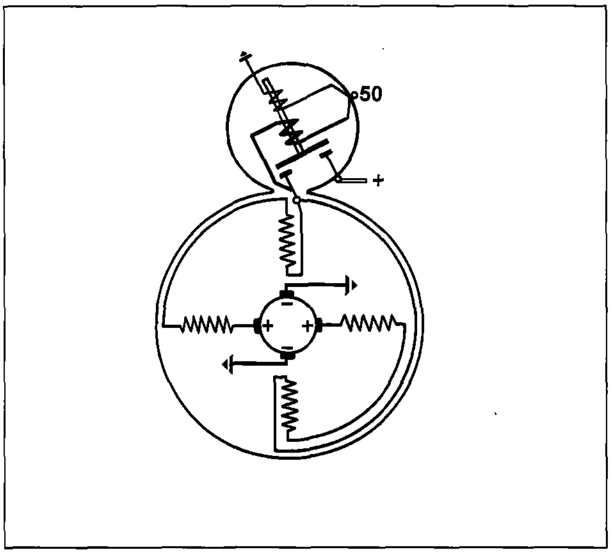
### STARTER MOTOR

| | | |
|---|---|---|
| Type | | M. Marelli<br>M70R-12V-1,3 kW (with reduction unit) |
| Voltage | V | 12 |
| Rated power | kW | 1.3 |
| Rotation, pinion side | | clockwise |
| No. of poles | | 4 |
| Field coil | | series-parallel winding |
| Engagement | | free wheel |
| Control | | electromagnetic |
| End float of armature shaft | mm | 0.15 - 0.45 |
| **Data for bench test** | | |
| Operating test (*): | | |
| current | A | 360 - 380 |
| speed | rpm | 1150 |
| voltage | V | 8.15 |
| torque developed | daNm | 1.30 |
| Engagement test (*): | | |
| current | A | 680 - 700 |
| voltage | V | 4.9 |
| torque developed | daNm | 3.11 |
| Free running test (*): | | |
| current | A | 60 - 80 |
| voltage | V | 11.1 |
| speed | rpm | 4040 |
| **Relay** | | |
| Winding resistance (*) | pull in Ω | 0.33 - 0.37 |
| | hold in Ω | 1.13 - 1.27 |
| **Lubrication** | | |
| Internal splines and shaft bushes | | VS+ SAE 10 W |
| Engagement sleeve and intermediate plate | | TUTELA MR3 |

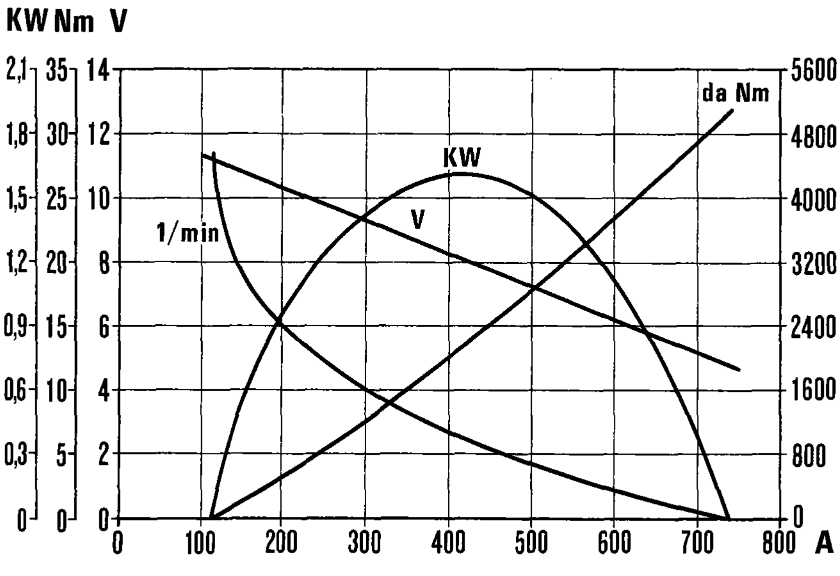
(*) Data measured at environmental temperature of 20°C.

**NOTE** *During service, the insulation between commutator bars need not be lowered*

## STARTER MOTOR - WIRING DIAGRAM AND TYPICAL CURVES




**Wiring diagram of M. Marelli M70R-1.3/12 starter motor**




**Typical curves for starter motor M. Marelli M70R-1.3/12 (with epicyclic reduction gear)**

## ALTERNATOR

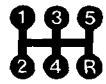
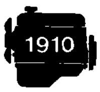
| | 1581 16V | 1581 16V with air conditioner | 1581 16V ** | 1581 16V ** |
|---|---|---|---|---|
| Make | M.Marelli A115I-14V-40/75A | M.Marelli A127IR-14V-40/85A | Bosch KCB1-14V-45/80A | Bosch KCB2-14V-50/90A Bosch● KCB2-14V-55/105A |
| Rated system voltage V | 14V | | | |
| Maximum current A | 75 | 85 | 80 | 90A (105)● |
| Nominal current at 1800 rpm rpm | 40 | 50 | 45 | 50 (55)● |
| Nominal current at 6000 rpm A | 75 | 85 | 80 | 90 (105)● |
| Field winding resistance between the two slip rings (*) Ω | 25.87 - 2.613 | | 2.16 - 2.64 | 2.34 - 2.86 (1.8 - 2.2)● |
| Direction of rotation (seen from control side) | Clockwise | | | |
| Diode power rectifiers | Bridge | | | |

(*) Data obtained at an ambient temperature of 20°C.
(●) For cars with air conditioner destined for ISRAEL
(**) Alternators without cooling system fitted from chassis no. 4788901.

| VOLTAGE REGULATOR | Built in electronic | |
|---|---|---|
| Make | RTM 151 B | BR1 |
| Alternator speed for test rpm | 7000 | 7000 |
| Thermal stabilisation current A | - | - |
| Test current A | - | - |
| Regulation voltage (*) V | 14.3 - 14.6 | 14.3 - 14.6 |

(*) Data obtained at an ambient temperature of 23°C.

## Contents

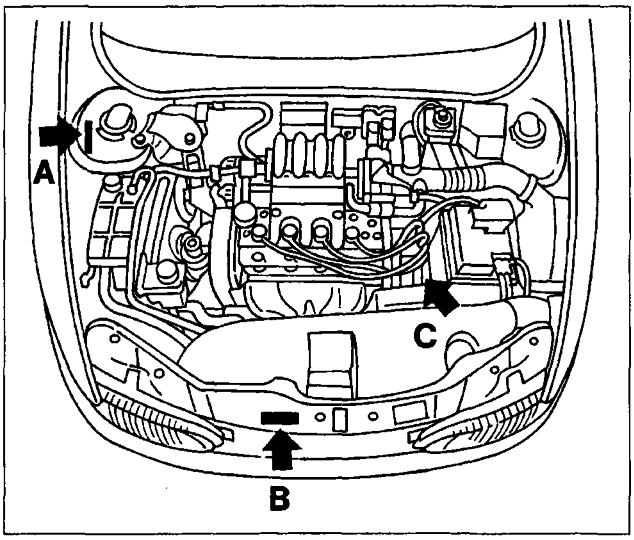
| | CHASSIS | ENGINE | VERSION | 3 Doors | 5 Doors | GEARBOX  |
|---|---|---|---|---|---|---|
|  *16v* | ZFA 182 000 | 182 B2.000 | 182 AP 1AA | ● | – | ● |
| | | | 182 BP 1AA | – | ● | |
|  *20v* | | 182 B3.000 | 182 AQ 1AA | ● | – | ● |
|  *JTD* | | 182 B4.000 | 182 AR 1AA | ● | – | ● |
| | | | 182 BR 1AA | – | ● | |

**NOTE**

This section deals with the new engine versions in the 1998 range.
For the remaining engine versions, refer to the Bravo-Brava manual, publication no. 506.670, and subsequent updates.

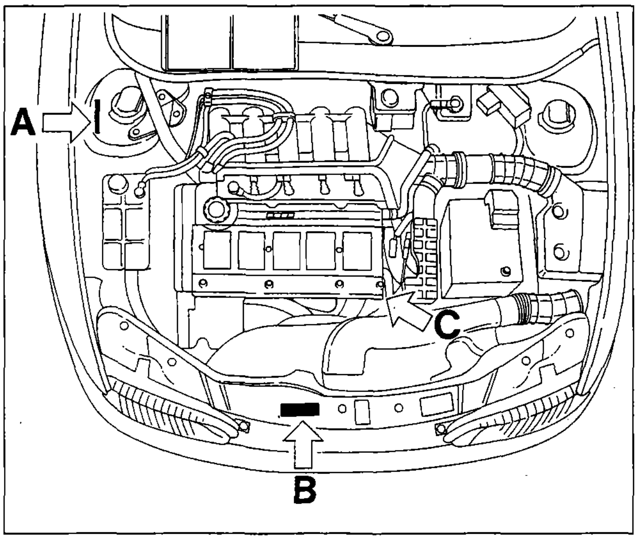
# 00.0

1242 *16v*




P4A02HA01

1998 *20v*

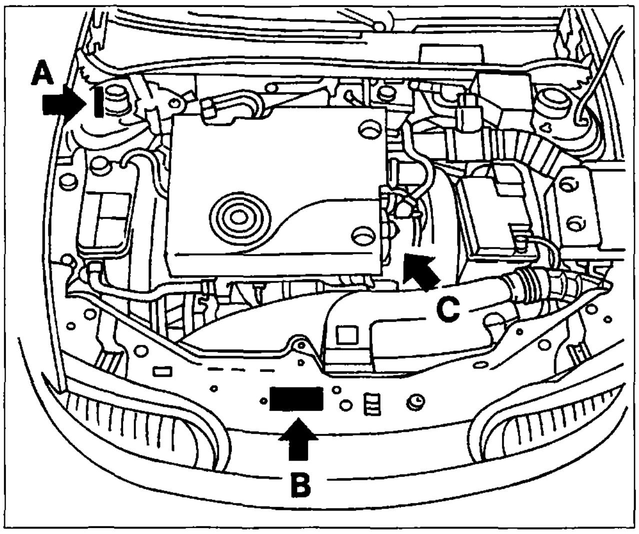



P4A003A02

**1. Vehicle type identification code and chassis manufacture number**

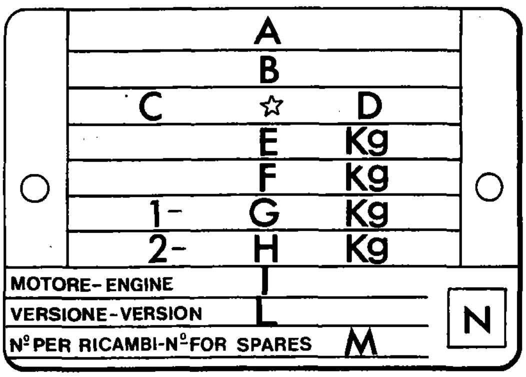
**2. Engine type and number.**

1910 *JTD*




P4A02HA02

**3. Marking summary plate**
(EEC regulation.)




F4A003A01

A. Name of manufacturer
B. Homologation number
C. Vehicle type identification code
D. Chassis manufacture number

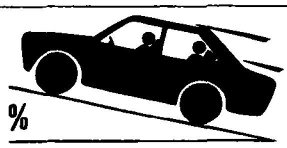
E. Maximum authorized weight of vehicle fully laden
F. Maximum authorized weight of vehicle fully laden plus trailer.
G. Maximum authorized weight on first axle (front)
H. Maximum authorized weight on second axle (rear)
I. Engine type
L. Bodywork version code
M. Parts number
N. Corrected smoke absorption factor (only for diesel engines)

**WEIGHTS**
(values expressed in kg)

| ENGINE | | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| | 3 doors | 1010 | 1190 | 1170 |
| | 5 doors | 1040 | – | 1195 |
| +500 = 150 | 3 doors | 1510 | 1690 | 1680 |
| | 5 doors | 1570 | – | 1735 |
| Maximum permitted loads on axles ■ | 3 doors | 850 | 970 | 920 |
| | 5 doors | 850 | – | 920 |
| | 3 doors | 850 | 900 | 920 |
| | 5 doors | 850 | – | 920 |
| Maximum load permitted on roof | | 80 | 80 | 80 |
| Load on tow hook ball (trailer with braking system) | Minimum | – | – | – |
| | Maximum | 70 | 70 | 70 |
| | Without braking system | 400 | 400 | 400 |
| | With braking system | 1000 | 1300 | 1300 |

■ Loads that should never be exceeded

**NOTE FOR VERSIONS WITH ACCESSORIES:** With special equipment fitted (non-standard air conditioner, sun--roof, trailer tow hook), the unladen weight increases and maximum carrying capacity may decrease.

| ENGINE | | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| Speed km/h (average load)  | 1 | 42 | 59 | 36 |
| | 2 | 76 | 94 | 63 |
| | 3 | 121<br>110* | 139 | 97 |
| | 4 | 167<br>145* | 182 | 136 |
| | 5 | 173 | 213 | 187<br>185* |
| | R | 43 | 54 | 36 |
|  % Gradient when laden | | 37 | | |
| Fuel consumption as per EC standards 93/116 (litres/100 km)  | Urban cycle | 9.4<br>9.5* | 13.1 | 7.2<br>7.3* |
| | Out of town cycle | 5.3<br>5.4* | 7.2 | 4.4<br>4.5* |
| | Combined cycle | 6.8<br>6.9* | 9.4 | 5.4<br>5.5* |
| Exhaust emissions $CO_2$ (g/km) | | 162<br>164* | 222 | 143<br>146* |

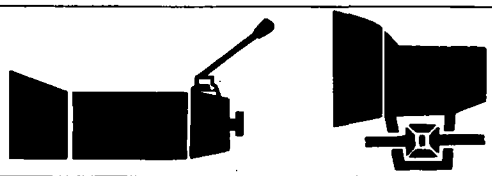
Fuel consumption as per EC standards 93/116 was determined during the following official tests:

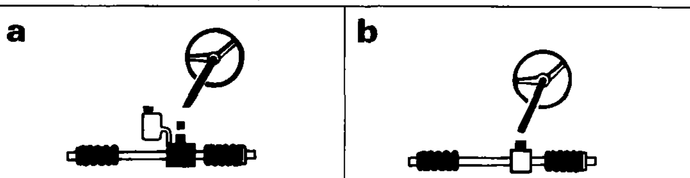
- an urban cycle, i.e. a cold start followed by a simulated varied urban route
- urban cycle, i.e. frequent accelerations in all gears to simulate normal out-of-town vehicle use, with speed between 0 and 120 km/h.
- The average combined fuel consumption test involves 37% of the urban cycle and 63% of the extraurban cycle.

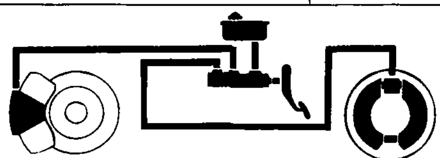
Type of route, traffic situations, driving style, weather conditions, version/equipment/accessory level, presence of a roof rack, presence of special equipment and vehicle condition in general may lead to fuel consumption figures other than those measured as above.
Exhaust $CO_2$ emissions (in g/km) were measured over an average combined cycle.

(*) 5D version (Brava)

| Capacities | Unit | | Amount dm³(l) | Amount (kg) |
|---|---|---|---|---|
| Petrol ⩾ N.O. 95 Unleaded | | 1242 16v | 50 | – |
| | | 1998 STEP A | 60 | – |
| Diesel | | 1910 JTD | 60 | – |
| 50% Paraflu 11 + H₂O (▲) | Total cooling system capacity | 1242 16v | 5.3 (6.4■) | – |
| | | 1998 STEP A | 7.4 (7.2■) | – |
| | | 1910 JTD | 6.3 (6.5■) | – |
| **Petrol engines:** SELENIA 20K (SAE 10 W/40) | Total capacity | 1242 16v | 3.1 | 2.8 |
| | | 1998 STEP A | 5.5 | 4.9 |
| | | 1910 JTD | 5.4 | 4.7 |
| **Diesel engines** SELENIA Turbo Diesel (SAE 10 W/40) | Partial capacity (periodic changes) | 1242 16v | 2.8 (2.5●) | 2.55 (2.25●) |
| | | 1998 STEP A | 4.8 (4.5●) | 4.3 (4.0●) |
| | | 1910 JTD | 4.9 (4.3●) | 4.23 (3.75●) |
| **a** = TUTELA ZC 75 SINT | | 1242 16v **a** | 1.7 | 1.5 |
| | | 1998 STEP A 1910 JTD **a** | 2 | 1.8 |
| **b** = TUTELA GI/A | | **b** | – | – |
| **a** = TUTELA GI/A | **a** | **a** | – | 1.1 |
| **b** = K 854 | **b** | **b** | – | 0.8 |
| TUTELA TOP 4 (270°C) | Total capacity | without abs | 0.38** 0.40 | – |
| | | with abs | 0.45 (0.54)* | – |
| H₂O + DP1 AREXONS | ✳ 3%; ☼ ~ - 10°C 50%; ~ - 20°C 100% | + | 5 (6.4 with headlamp washer) | – |







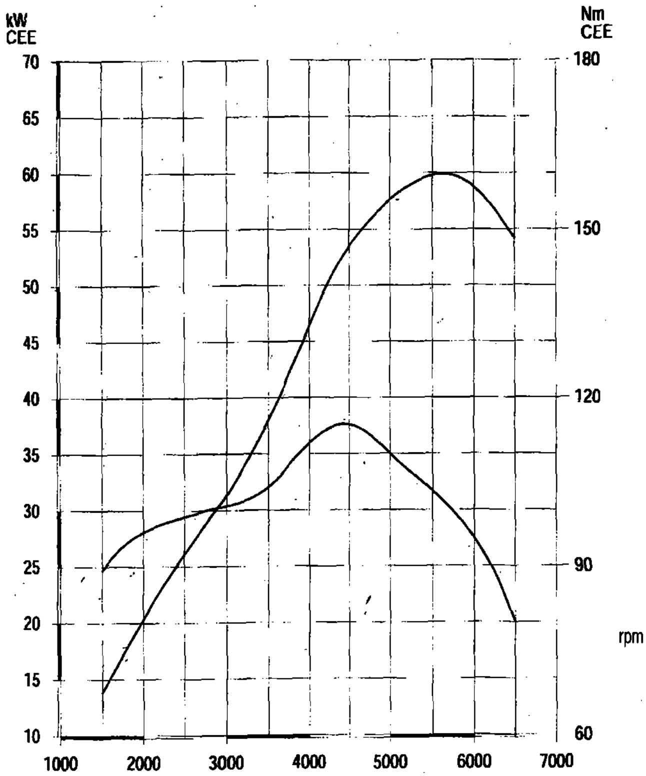
(▲) Distilled water
(●) Only engine sump
(■) For versions with air conditioner
(*) For versions 1998 20v
(**) For versions 1242 16v

| Name product | | Description International designation | Usage |
|---|---|---|---|
| **SELENIA** | **SAE 15 W/40** | Semisynthetic multigrade engine oil. Meets specifications API SH, CCMC-G5 and UNI 20153 | Temperature - 25°C - 40°C |
| **SELENIA Turbo Diesel** | **SAE 10 W/40** | Semisynthetic multigrade engine oil. Meets specifications API CD, ACEA B3-96 | Temperature - 15°C - 40°C |
| **TUTELA ZC 75 SINT** | | SAE 75W/90EP fluid. Meets specifications MIL-L-2105D and API GL5 | Manual gearboxes and differentials |
| **TUTELA GI/A** | | Automatic transmission fluid - "DEXRON II". | Automatic transmissions Power assisted steering |
| **TUTELA TOP 4 (270 °C)** | | Synthetic fluid, F.M.V.S.S. n° 116 DOT 4 ISO 4925, CUNA NC 956-01 | Hydraulic brakes and hydraulic clutches |
| **K 854** | | Lithium-based grease, consistency NLGI = 000, containing molybdenum disulphide | Rack and pinion steering boxes |
| **Arexons DP1** | | Mixture of alcohol, water and tensio-active agents CUNA NC 956-11 | Use neat or diluted in windscreen washer systems |
| **Paraflu[11]** | | Mono-ethylene glycol based anti-freeze for cooling system inhibited mono-ethylene glycol, CUNA NC 596 - 16 | Cooling circuits Percentage to be used 50% up to - 35°C |
| **Diesel Mix Arexons** | | Additive for diesel fuel with protective action for diesel engines | To be mixed with diesel (25 cc for 10 litres) |

## CHARACTERISTICS

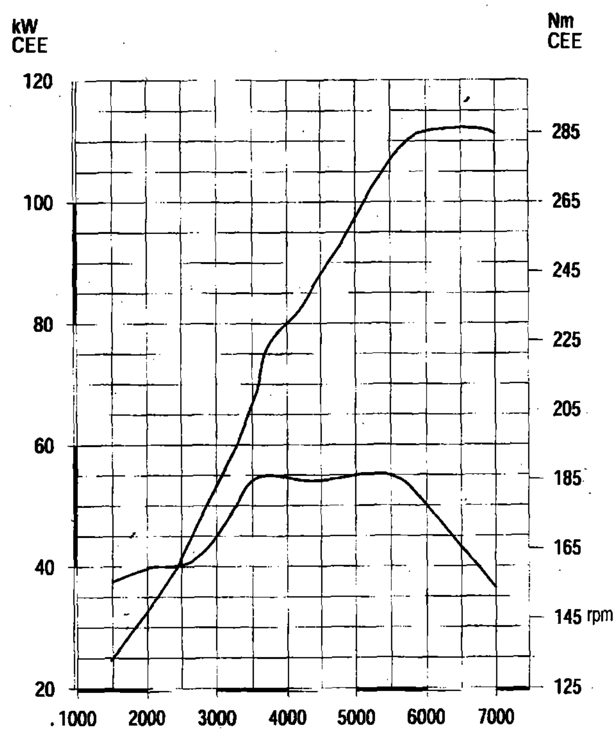
| | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|
| Cycle | | OTTO, 4-STROKE | |
| Timing gear | | twin overhead camshaft | |
| Fuel system type | | Integrated electronic injection-ignition | |
| | | BOSCH M 1.5.5 | MPI BOSCH ME 3.1 |
| Number of cylinders | | 4 | 5 |
| Cylinder liner (bore) | mm | 70.80 | 82 |
| Stroke | mm | 78.86 | 75.65 |
| Capacity | cm³ | 1242 | 1998 |
| Compression ratio | | 10.2 | 10.7 ±0.15 |
| Maximum power EC | kW (PS) | 60 (82) | 113 (155) |
| | rpm | 5500 | 6500 |
| Maximum torque EC | daNm (kgm) | 11.3 (11.5) | 18.6 (19) |
| | rpm | 4250 | 3750 |

1242 *16v*




P4A08HA01

1998 *20v*




P4A08HA02

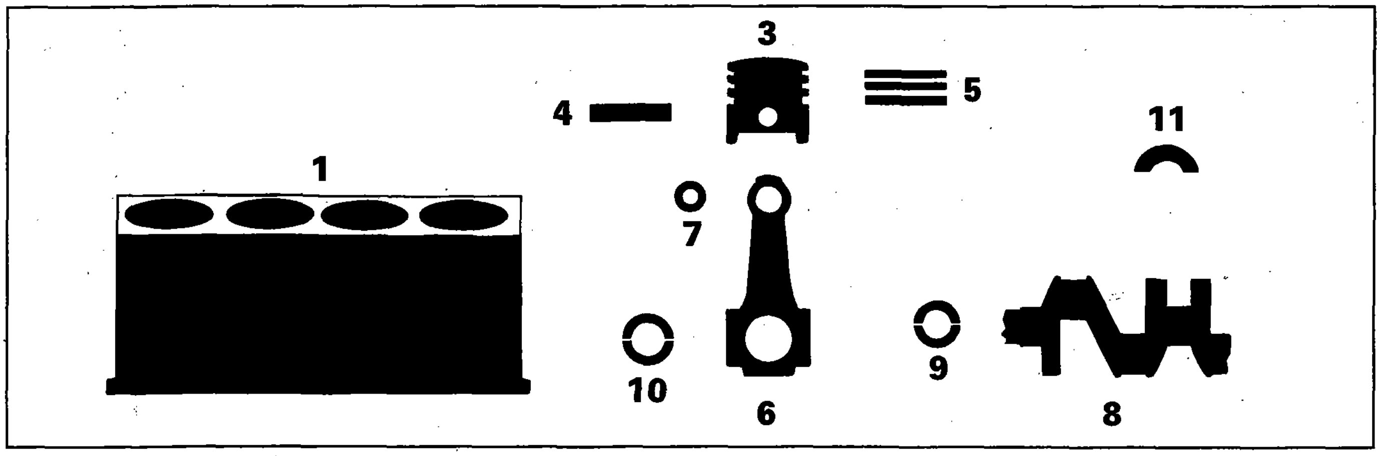
| Speed when laden (rpm) | Time in minutes | Load at brake |
|---|---|---|
| 800-1000 | 10′ | no load |
| 1500 | 10′ | no load |
| 2000 | 10′ | no load |

**Bench test cycles for overhauled engines**

When bench-testing serviced engines, it is not advisable to run the engine at top speed but observe the specifications in the table; finish running in the engine on the car.

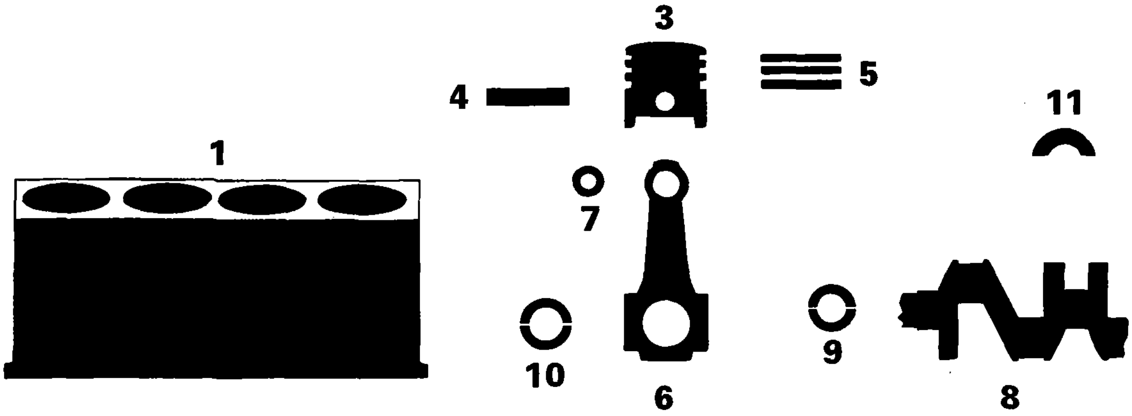
**Engine power curves obtained by eec method**

The power curves illustrated can be obtained with the engine overhauled and run in, without a fan and with a silencer and air filter fitted at sea level.

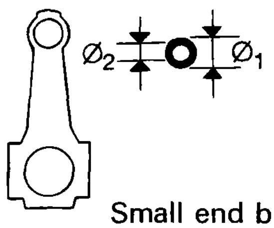


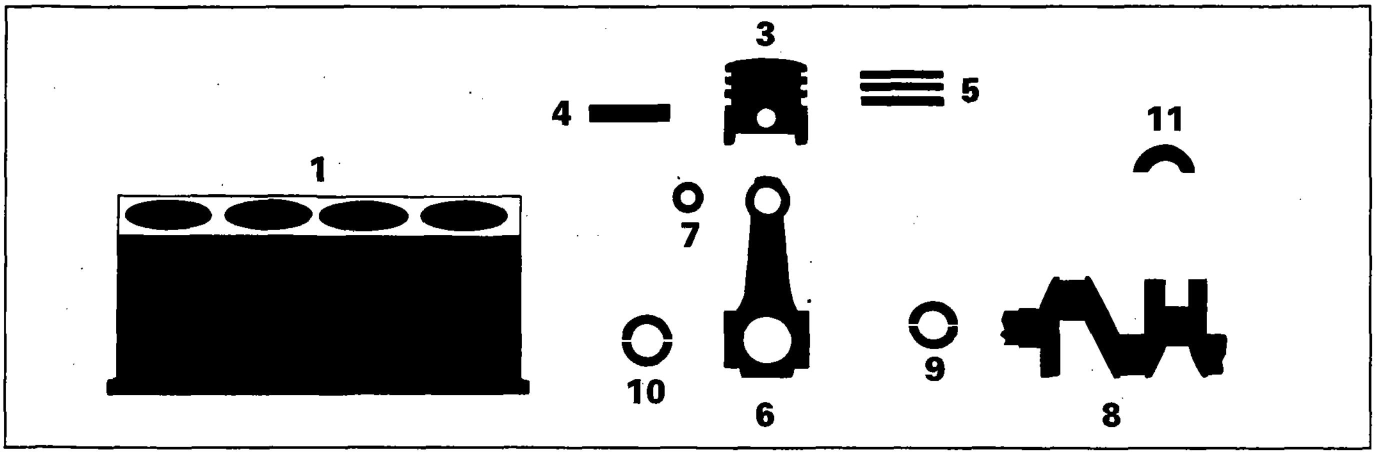

| DESCRIPTION | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|
| | | Values in mm | |
| 1 Main bearing supports | L | 19.14-19.20 | 21.72-21.80 |
| | Ø 1 | 51.705-51.709 | 63.705-63.718 |
| | Ø 2 | 51.709-51.713 | |
| | Ø 3 | 51.713-51.717 | |
| 1 Cylinder bore | Ø A | 70.800-70.810 | 82.000-82.010 |
| | Ø B | 70.810-70.820 | 82.010-82.020 |
| | Ø C | 70.820-70.830 | 82.020-82.030 |
| 3 Piston | X | 6 | 12.5 |
| | Ø A | 70.760-70.770 | 81.952-81.962 |
| | Ø B | 70.770-70.780 | 81.959-81.971 |
| | Ø C | 70.780-70.790 | 81.968-81.978 |
| | Ø FIAT > | 0.4 | |
| 3 weight difference between pistons | | ± 5 g | |
| 3-1 Piston Cylinder liner | Ø A | 0.030 - 0.050 | 0.038-0.058 |
| | Ø B | | 0.039-0.061 |
| | Ø C | | 0.042-0.062 |

| | DESCRIPTION | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|
| | | | Values in mm | |
| 3 | Piston pin seat | Ø | 17.982 - 17.986 | 20.002 - 20.007 |
| 4 | Piston pin | Ø | 17.970 - 17.974 | 19.996 - 20.000 |
| | | Ø FIAT > | 0.2 | |
| 4-3 | Piston pin - Housing | | 0.008 - 0.016 | 0.002 - 0.011 |
| 3 | Piston ring grooves | 1 | 1.190 - 1.230 | 1.220 - 1.240 |
| | | 2 | 1.190 - 1.230 | 1.210 - 1.230 |
| | | 3 | 2.490 - 2.530 | 2.010 - 2.030 |
| 5 | Piston rings (Ø, L) | L 1 | 1.170 - 1.190 | 1.180 - 1.160 |
| | | L 2 | 1.175 - 1.190 | 1.190 - 1.170 |
| | | L 3 | 2.475 - 2.490 | 1.990 - 1.970 |
| | | Ø FIAT > | 0.4 | |
| 5-3 | Piston rings<br>Piston ring grooves | 1 | 0 - 0.06 | 0.040 - 0.080 |
| | | 2 | 0 - 0.055 | 0.020 - 0.050 |
| | | 3 | 0 - 0.055 | 0.020 - 0.060 |
| 5-1 | Piston ring end opening in cylinder liner | 1 | 0.200 - 0.400 | 0.200 - 0.350 |
| | | 2 | 0.250 - 0.450 | 0.250 - 0.500 |
| | | 3 | 0.200 - 0.450 | 0.250 - 0.500 |
| 6 | Bush housing or small end seat | $Ø_1$ | 17.939 - 17.956 | 22.939 - 22.972 |
| | Connecting rod bearing seat | $Ø_2$ | 45.128 - 45.138 | 51.354 - 51.366 |

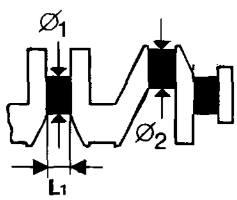
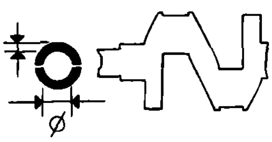
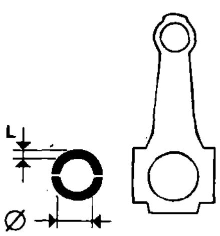



**DESCRIPTION**

| | 1242 16v | 1998 20v STEP A |
|---|---|---|
| | Values in mm | |
| **4** | 0.014 - 0.035 | – |
| **7**  Ø1 | – | 23.007 - 23.027 |
| Small end bush Ø2 | – | 20.006 - 20.012 |
| **4-7** Gudgeon pin<br>Small end bush | – | 0.006 - 0.020 |
| **7-6** Small end bush<br>Bush housing | – | 0.035 - 0.088 |




**DESCRIPTION**

| | | | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|---|
| | | | | Values in mm | |
| 8 |  | Main journals Ø1 | 1 | 47.982-47.988 | 59.994-60.000 |
| | | | 2 | 47.988-47.994 | 59.988-59.99 |
| | | | 3 | 47.994-48.000 | 59.982-59.98 |
| | | Crank pins Ø2 | A | 41.990-42.008 | 48.238-48.24 |
| | | | B | – | 48.232-48.23 |
| | | | C | – | 48.226-48.23 |
| | | | L1 | 23.975-24.025 | 26.575-26.625 |
| 9 |  | Crankshaft bearings L | 1 | 1.836 - 1.840 | 1.836 - 1.840 |
| | | | 2 | 1.843 - 1.847 | 1.839 - 1.843 |
| | | | 3 | 1.848 - 1.852 | 1.842 - 1.846 |
| | | Ø FIAT < | | 0.254 - 0.508 | |
| 9-8 |  | Main bearings - Journals | | 0.025 - 0.040 | 0.025 - 0.052 |
| 10 |  | Connecting rod bearings | L | 1.544 - 1.548 | 1.536 - 1.540 |
| | | | | | 1.539 - 1.543 |
| | | | | | 1.542 - 1.546 |
| | | Ø FIAT < | | 0.254 - 0.508 | |

**DESCRIPTION**

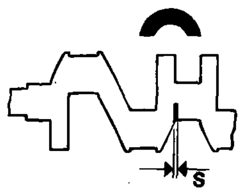
| | | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|
| | | | Values in mm | |
| **10-8** | Connecting rod bearings - Pins | A | 0.024 - 0.060 | 0.030 - 0.056 |
| | | B | – | |
| | | C | – | |
| **11**  | Thrust half-rings | S | 2.310 - 2.360 | 2.342 - 2.358 |
| | S FIAT > | | 0.127 | |
| **11-8** | Crankshaft end float | | 0.055 - 0.265 | 0.059 - 0.161 |

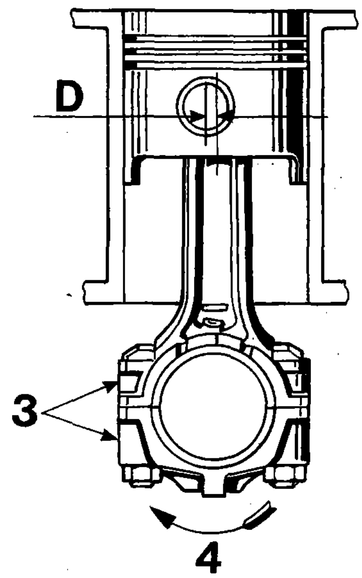
**Diagram showing connecting rod- piston assembly *and direction of rotation in engine***

3. Area where matching cylinder liner number is stamped
4. Engine direction of rotation
   (The arrow shows the direction of rotation of the engine as seen from the timing side)

**Value (in mm ) of offset between connecting rod axis and piston axis**

**D= 0.85 - 1.15 (for 1242 16v)**

**D= 0.10 - 0.60 (for 1998 20v STEP A)**

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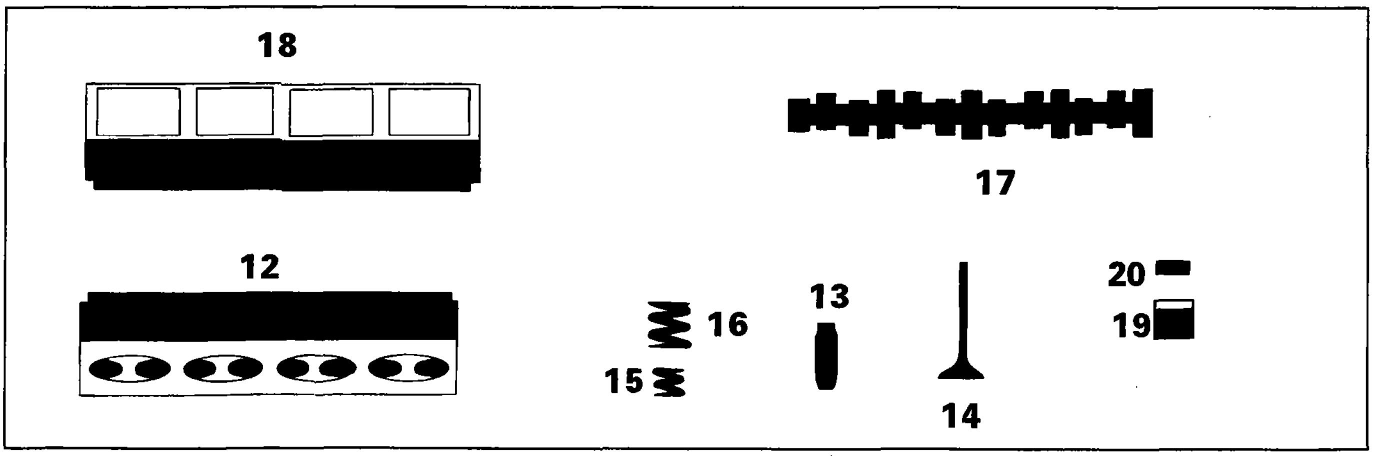
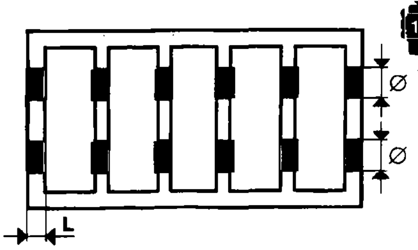
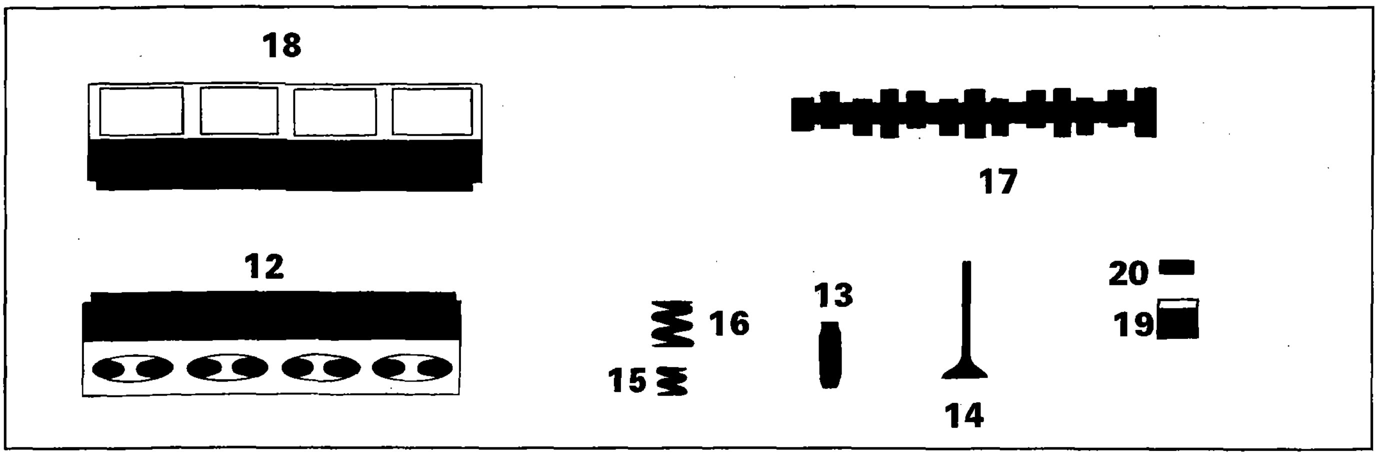
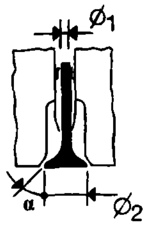
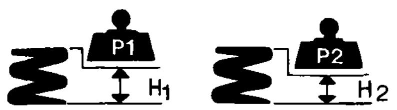
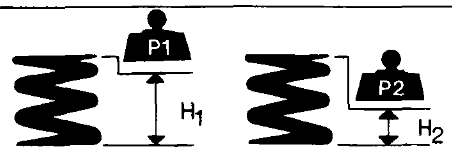
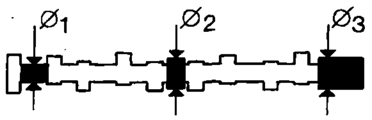
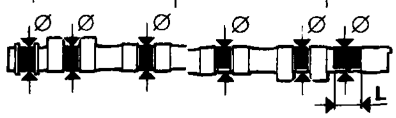
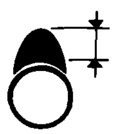


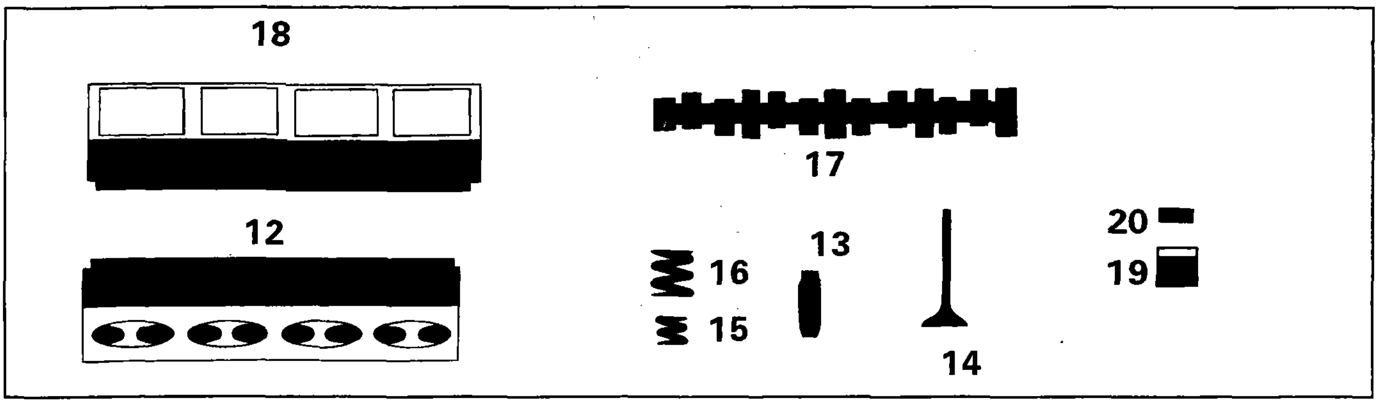

| DESCRIPTION | | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|
| | | | Values in mm | |
| 12 | Camshaft supports on cylinder head  1998 20v STEP A | Ø | - | 26.045-26.070 |
| | | L(*) | - | 19.100-19.150 |



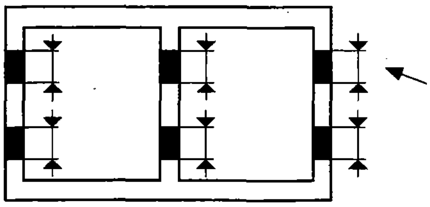
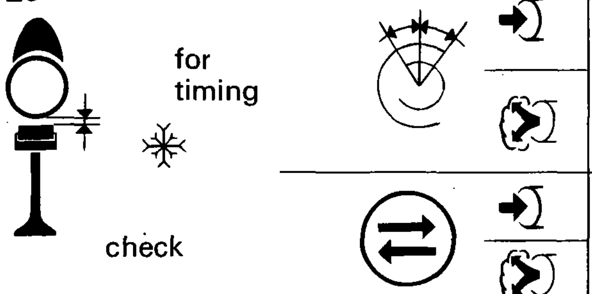

| DESCRIPTION | | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|
| | | | Values in mm | |
| 12 | Valve guide bore in cylinder head | Ø | 9.959 - 9.989 | 12.950 - 12.977 |
| | Valve seat | α | 45° ± 20′ | 45° ± 5′ |
| | | α | 45° ± 20′ | 45° ± 5′ |
| | | L | 1.5 | about 2 |
| | Volume of combustion chamber in cylinder head | $cm^3$ | 12.28 | 38.2 |
| 13 | Valve guide | $Ø_1$ | 6.022 - 6.040 | 7.022 - 7.040 |
| | | $Ø_2$ | 10.010 - 10.030 | 13.010 - 13.030 |
| | | $Ø_2$ FIAT > | – | 0.05-0.10-0.25 |
| 13-12 | Valve guide Bore in cylinder head | | 0.049 - 0.051 | 0.033 - 0.080 |
| 12 | Tappet housing on cylinder head | Ø | – | 33.000 - 33.025 |

DESCRIPTION

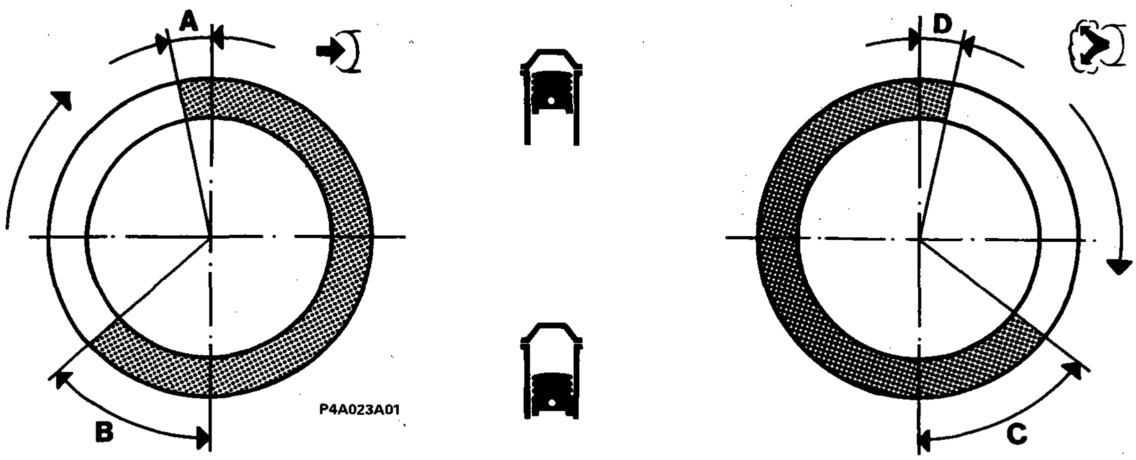
| Ref. | Description | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|
| | | | Values in mm | |
| 14 |  Valve | Ø1 | 5.974 - 5.992 | 6.975 - 6.930 |
| | | Ø2 | 22.250 - 22.550 | 29.900 - 30.200 |
| | | α | – | 45° 30′ ± 5′ |
| | | Ø1 | 5.974 - 5.992 | 6.960 - 6.975 |
| | | Ø2 | 22.250 - 22.550 | 25.900 - 26.200 |
| | | α | – | 45° 30′ ± 5′ |
| 14-13 | Valve / Valve guide | | 0.030 - 0.066 | 0.032 - 0.065 |
| | | | | 0.047 - 0.080 |
| 15 |  Internal valve spring | P1 | – | 11.08 - 12.07daN |
| | | H1 | – | 29.5 |
| | | P2 | – | 21.58 - 23.54 daN |
| | | H2 | – | 20 |
| 16 |  External valve spring | P1 | 22.5 daN | 27.7 - 29.43 daN |
| | | H1 | 31 | 34 |
| | | P2 | 42.3 | 48.46 - 52.38 daN |
| | | H2 | 23 | 24.5 |
| 17a | Camshaft bearings  | Ø1 | 35.000 - 35.015 | – |
| | | Ø2 | 48.000 - 48.015 | – |
| | | Ø3 | 49.000 - 49.015 | – |
| 17b |  | Ø | – | 26.000 - 26.015 |
| | | L | – | 19.250 - 19.330 |
| |  Cam lift | | 7.5 | 9 |
| | | | 7.5 | 9 |
| 12-17a | Camshaft journals / Cylinder head mounts | Ø1 | 0.030-0.070 | – |
| | | Ø2 | 0.030-0.070 | |
| | | Ø3 | 0.030-0.070 | |
| 12-17b | | radial | – | 0.030 - 0.070 |
| | | axial | – | 0.100 - 0.230 |




## DESCRIPTION

| Ref. | Description | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|
| | | | Values in mm | |
| 18 |  Camshaft bearings in camshaft housing | Ø1 | 35.045-35.070 | – |
| | | Ø2 | 48.045-48.070 | – |
| | | Ø3 | 49.045-49.070 | – |
| 18 | Tappet housings | Ø | 28.400 - 28.421 | – |
| 19 | Tappet | Ø | 28.354-28.370 | 32.959-32.975 |
| 19-12 | Tappet Bore in cylinder head | | – | 0.025-0.066 |
| 19-18 | Tappet - Bore in cylinder head extension | | 0.046 - 0.051 | – |
| 17-20 |  for timing | | 0.45 | |
| | check | | Hydraulic tappets | |

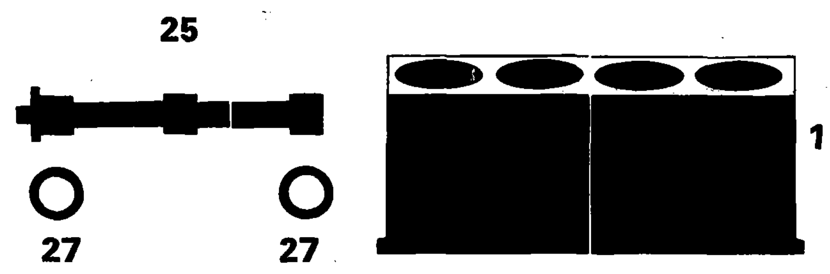
### TIMING DIAGRAMS



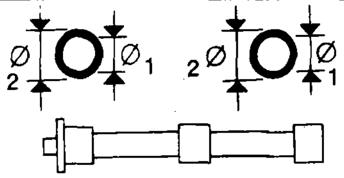
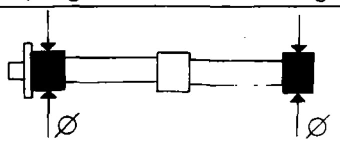
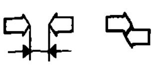
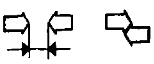

**Timing angles**

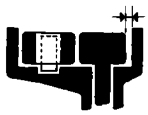
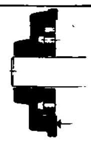
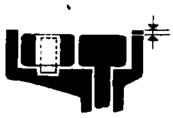
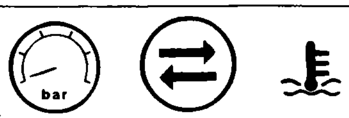
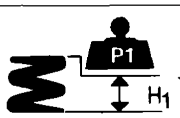
| | | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|---|
| A | Inlet | start before TDC | 0° | 9° (*) after TDC |
| B | Inlet | end after BDC | 32° 42′ | 49° (**) |
| C | Exhaust | start before BDC | 32° 42′ | 40° |
| D | Exhaust | end after TDC | 0° | 0° |

(*) With variable valve timing beginning 9° BTDC
(**) With variable valve timing ending 31° after BDC

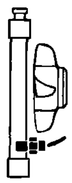



## DESCRIPTION

| Description |   16v |   20v STEP A |
|---|---|---|
| | Values in mm | |
| **25** Counter-rotating shaft drive | – | via oil pump driven gear |
| **27**  Ball bearings for counter-rotating shaft — Ø1 | – | 19.900 - 20.000 |
| Ø2 | – | 46.989 - 47.000 |
| **25**  Counter-rotating shaft journals — Ø | – | 19.980 - 19.993 |
| **1** Bearing seats in crankcase — Ø | – | 46.975 - 47.000 |
| **27-1**  Ball bearings / Cylinder block seats | – | +0.011 - – 0.025 |
| **25-27**  Shaft journals / Ball bearings | – | +0.020 - – 0.003 |

| LUBRICATION |  *16v* |  *20v STEP A* |
|---|---|---|
| | Values in mm | |
| Engine lubrication system | forced circulation, via lobe gear pump with cartridge filter in line | forced circulation, via gear pump with in-line cartridge oil filter |
| Oil pump | lobe gear | gear, located in the front crankshaft cover |
| Pump operated | via crankshaft | via chain driven by the crankshaft |
| Oil pressure relief valve | incorporated in crankshaft front cover | |
| Full flow filter | – | cartridge |
| Insufficient oil pressure sender unit | – | electrical |
|  between pump housing and driven gear | 0.100 - 0.210 | – |
|  between gear edges and pump case | – | 0.110 - 0.180 |
|  between gear edges and pump cover | 0.025 - 0.070 | – |
|  | – | 0.016 - 0.086 |
| Full flow filter | cartridge | |
| Insufficient oil pressure sender unit | electrical | |
|  between drive and driven gears | 0.30 | |
|  Operating pressure at temperature of 100°C — when idling | 1 bar | |
| Operating pressure at temperature of 100°C — at 4000 rpm | 4 bar | |
|  Oil pressure relief valve spring — $P_1$ | 11.73 - 12.51 | |
| Oil pressure relief valve spring — $H_1$ | 35 | |

## COOLING

| | | 1242 16v | 1998 20v STEP A |
|---|---|---|---|
| Cooling circuit | | coolant circulation via centrifugal pump, radiator, expansion tank and fan operated by thermal switch | |
| coolant pump drive | | via belt | |
|  Thermal switch forfan activation (on) | stage 1 | 90° - 94°C | |
| | stage 2 | 95° - 99°C (■) | |
| (stop) | stage 1 | 85° - 89°C | |
| | stage 2 | 90° - 94°C (■) | |
| Engine coolant thermostat | opening starts | 81° - 85°C | |
| | max opening | 103°C | 101°C-105°C |
| | valve travel | 9.5 mm | |
| Fitting clearance between vanes and pump casing | | – | |
| Pressure for checking system water tightness | | 0.98 bar | |
| Checking exhaust valve on supplementary expansion tank | | 0.98 bar | |

(■) Versions with climate control

## FUEL SYSTEM

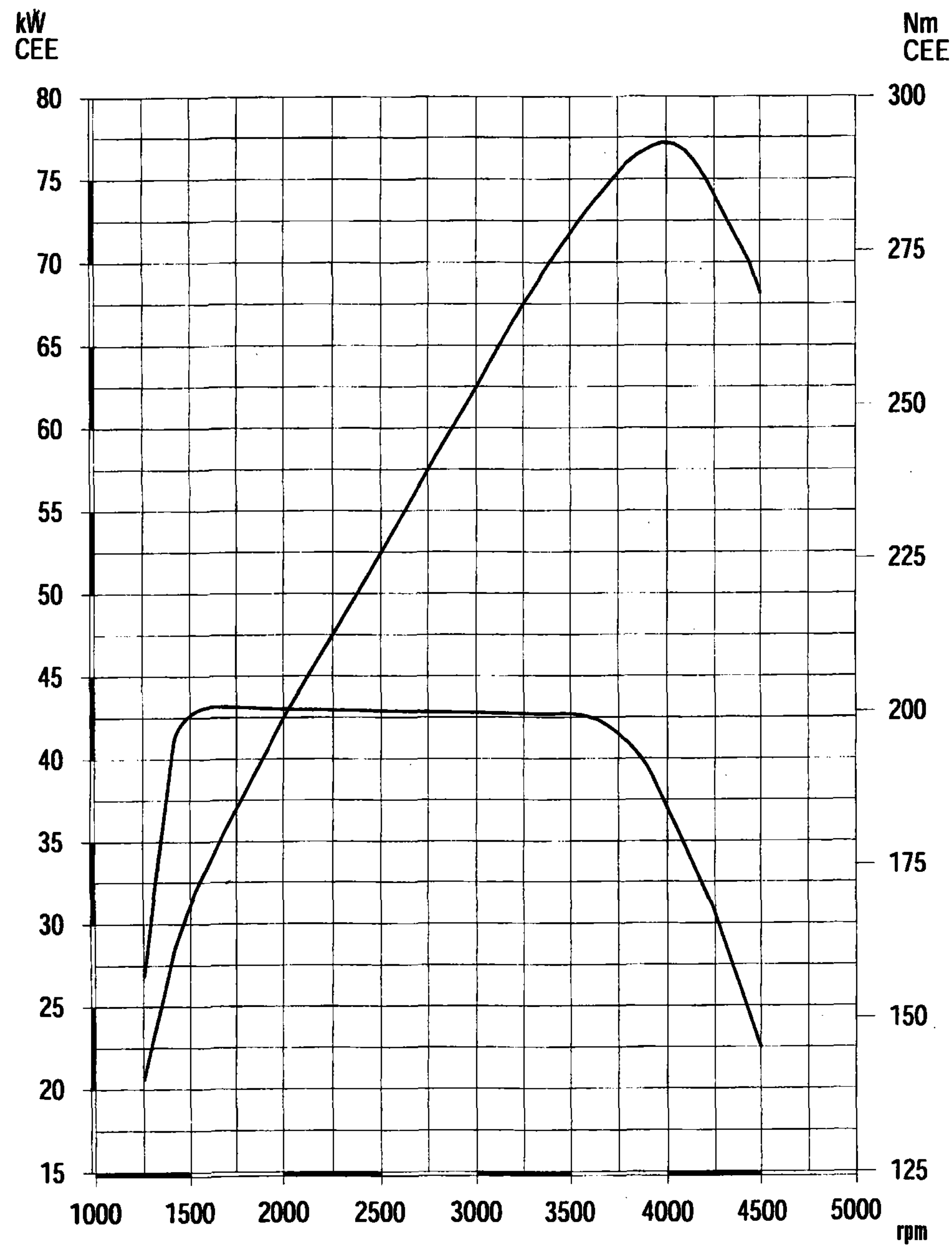
| | 1242 16v | 1998 20v STEP A |
|---|---|---|
| Make | Integrated electronic injection - ignition injection/ignition | Integrated electronic injection - ignition injection/ignition |
| Pump | electrical, submerged in tank | |
| Output | ⩾ 110 l/h | ⩾120 l/h |
| Fuel pressure regulator setting | 3.5 bar | |

| **Checking idle concentration of pollutant emissions** | CO (%) | HC (p.p.m.) | $CO_2$ (%) |
|---|---|---|---|
| Upstream of the catalytic converter | 0.4 – 1 | ⩽ 600 | ⩾ 12 |
| Downstream of the catalytic converter | ⩽ 0.35 | ⩽ 90 | ⩾ 13 |

| INTEGRATED ELECTRONIC INJECTION/IGNITION SYSTEM COMPONENTS | 1242 16V | 1998 20v STEP A |
|---|---|---|
| Injection system electronic control unit | Bosch 0.261.204.578 | Bosch 0.261.204.271 |
| Throttle body | Bosch 0.280.750.013 | - |
| Motorized throttle body | - | Bosch 0.250.003.052 |
| Absolute pressure sensor | Bosch 0.261.230.013 | - |
| Injector | Bosch 0.280.155.816 | Bosch 0.280.155.770 |
| Electric fuel pump | Bosch 0.580.313.011 | |
| Air flow meter | - | Bosch 0.281.002.199 |
| Engine coolant temperature sensor | ELTH 2690350 – SYLEA 402.183.01 | |
| Lambda sensor | Bosch 0.258.006.071 | Bosch 0.258.006.072 |
| Fuel vapour solenoid valve | Bosch 0.280.142.330 | Bosch 0.280.142.340 |
| Knock sensor | Bosch 0.261.231.007 | Bosch 0.261.231.131 |
| Hall effect injection timing sensor | - | Bosch 0.232.101.036 |
| TDC and rpm sensor | Bosch 0.281.210.124 | Bosch 0.261.210.160 |

## CHARACTERISTICS

| | | 1910 JTD |
|---|---|---|
| Cycle | | DIESEL, 4 STROKE |
| Timing gear | | single overhead cam |
| Fuel system type | | Direct - Bosch Common Rail EDC-15C |
| Number of cylinders | | 4 |
| Cylinder liner (bore) | mm | 82 |
| Stroke | mm | 90.4 |
| Capacity | cm³ | 1910 |
| Compression ratio | | 18.45 ± 0.5 |
| Total combustion chamber volume | cm³ | 27.35 |
| Max power eec | kW (BHP) | 77 (105) |
| | rpm | 4000 |
| Max EC torque | daNm (kgm) | 20.0 (20.4) |
| | rpm | 1500 |




P4A24HA01

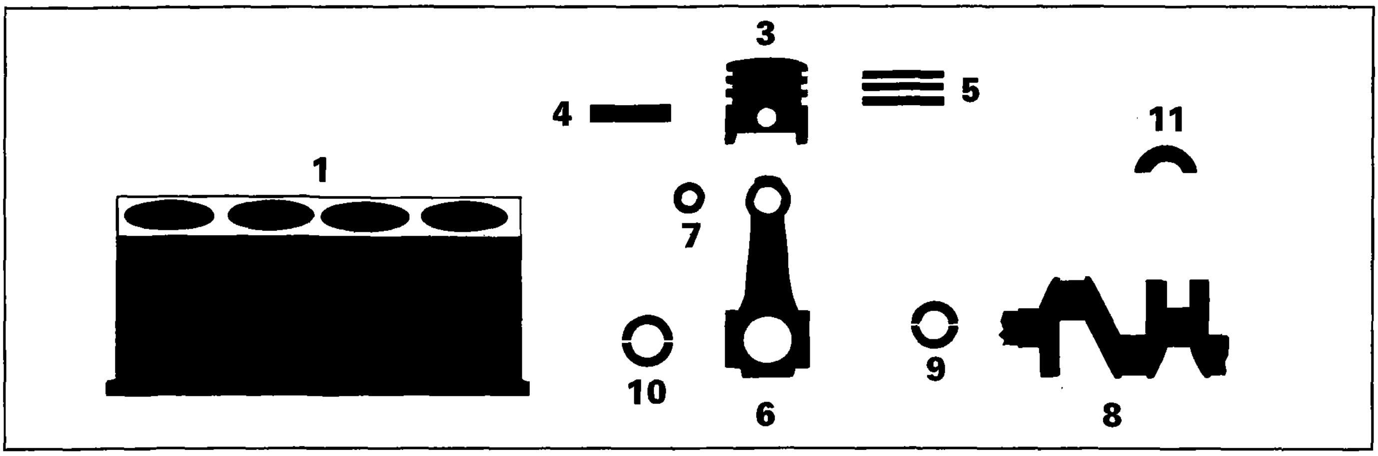
| Test speed (rpm) | Time in minutes | Load at brake |
|---|---|---|
| 800-1000 | 10' | no load |
| 1500 | 10' | no load |
| 2000 | 10' | no load |

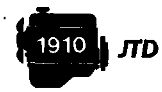
**Bench test cycles for overhauled engines**

When bench-testing serviced engines, it is not advisable to run the engine at top speed but observe the specifications in the table; finish running in the engine on the car.

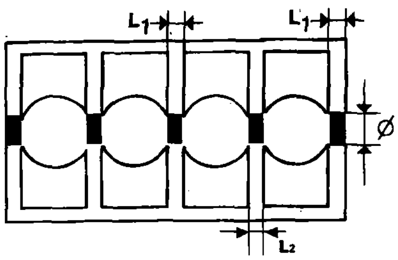
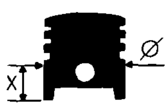
**Engine power curves obtained by EC method**

The power curves illustrated can be obtained with the engine overhauled and run in, without a fan and with a silencer and air filter fitted at sea level.



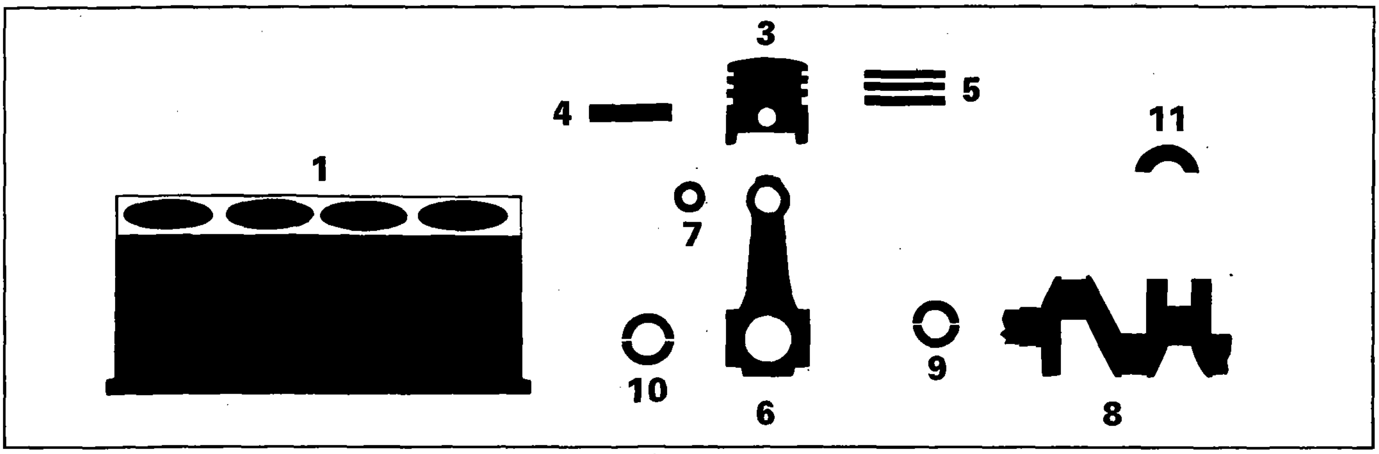

**DESCRIPTION**

| | Description | | Values in mm |
|---|---|---|---|
| 1 |  Main bearing supports | L | 21.75 - 22.25 |
| | | L1 | 22.30 - 22.70 |
| | | L2 | 21.75 - 22.25 |
| | | Ø | 63.691 - 63.732 |
| | Cylinder bore Ø | A | 82.000 - 82.010 |
| | | B | 82.010 - 82.020 |
| | | C | 82.020 - 82.030 |
| 3 |  Piston | X | 8 |
| | Ø | A | 81.920 - 81.930 |
| | | B | 81.930 - 81.940 |
| | | C | 81.940 - 81.950 |
| | Ø FIAT | > | 0.4 |
| 3-1 | Piston projection | | 0.845 - 1.105 |
| 3 | Weight difference between pistons | | ± 5 g |
| 3-1 | Piston Cylinder bore | | 0.070 - 0.090 |

1910 JTD

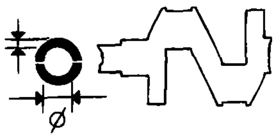
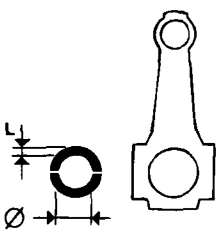
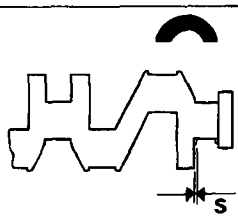
| DESCRIPTION | | | Values in mm |
|---|---|---|---|
| 3 | Piston pin seat | Ø | 25.999 - 26.004 |
| 3 | Piston ring grooves | 1 | 2.685 - 2.715 (*) |
| | | 2 | 2.020 - 2.040 |
| | | 3 | 3.020 - 3.040 |
| 4 | Piston pin | Ø | 25.982 - 25.988 |
| | | Ø FIAT > | – |
| 4-3 | Piston pin - Housing | | 0.004 - 0.014 |
| 5 | Piston rings | L 1 | 2.568 - 2.597 (**) |
| | | L 2 | 1.970 - 1.995 |
| | | L 3 | 2.970 - 2.990 |
| | | Ø FIAT > | 0.4 - 0.6 |
| 5-3 | Piston rings / Piston ring grooves | 1 | 0.088 - 0.147 |
| | | 2 | 0.025 - 0.070 |
| | | 3 | 0.030 - 0.070 |
| 5-1 | Piston ring end opening cylinder liner | 1 | 0.250- 0.400 |
| | | 2 | 0.250 - 0.500 |
| | | 3 | 0.250 - 0.500 |

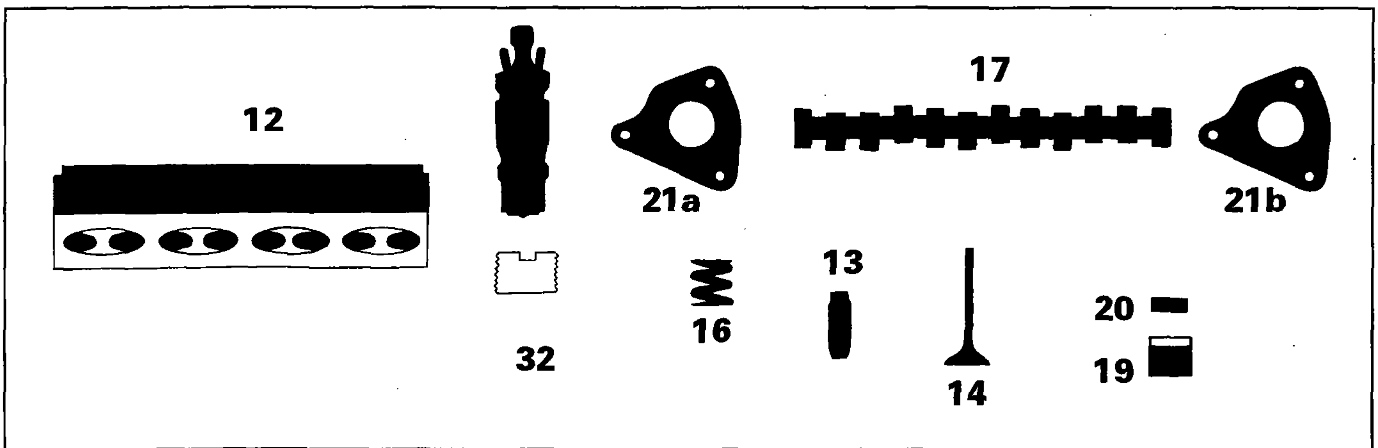
(*) Measured on diameter of 73.8 mm (**) Measured 1.5 mm from outer edge





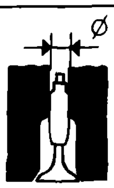
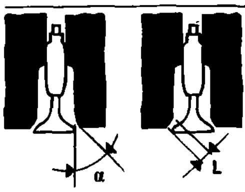
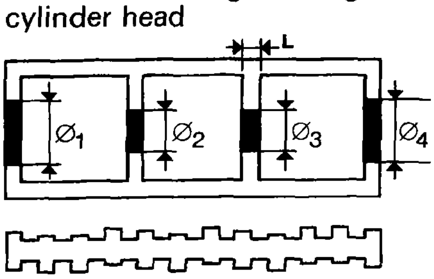
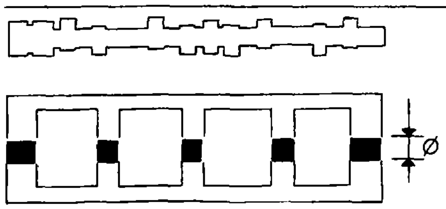
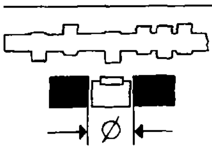
| DESCRIPTION | | | Values in mm |
|---|---|---|---|
| 6 | Bush or small end pin seat | Ø1 | 28.939 - 28.972 |
| | Connecting rod bearing seat | Ø2 | 53.897 - 53.909 |
| 6 | Difference in weight between con rods | | ± 2.5 g |
| 7 | | Ø1 | 29.018 - 29.038 |
| | Small end bush | Ø2 | 26.006 - 26.012 |
| 4-7 | Piston pin<br>Small end bush | | 0.018 - 0.030 |
| 7-6 | Small end bush<br>Bush housing | | 0.046 - 0.099 |
| 8 | Main journals | Ø1 1 | 59.994 - 60.000 |
| | | Ø1 2 | 59.988 - 59.994 |
| | | Ø1 3 | 59.982 - 59.988 |
| | Crank pins | Ø2 A | 50.799 - 50.805 |
| | | Ø2 B | 50.793 - 50.799 |
| | | Ø2 C | 50.787 - 50.793 |
| | | L | 26.80 - 27.20 |
| | | L1 | 25.90 - 26.10 |


| No. | DESCRIPTION | | Values in mm |
|---|---|---|---|
| 9 | Crankshaft bearings  | L 1 | 1.836 - 1.840 |
| | | L 2 | 1.839 - 1.843 |
| | | L 3 | 1.842 - 1.846 |
| | | Ø FIAT < | 0.254 - 0.508 |
| 9-8 | Crankshaft bearings–Main journals | | 0.011 - 0.071 |
| 10 | Connecting rod bearings  | L A | 1.527 - 1.531 |
| | | L B | 1.530 - 1.534 |
| | | L C | 1.533 - 1.537 |
| | | Ø FIAT < | 0.254 - 0.508 |
| 10-8 | Big end bearings–Main journals | | 0.030 - 0.056 |
| 11 | Thrust half-rings  | S | 2.469 - 2.485 |
| | | S FIAT > | 0.127 |
| 11-8 | Crankshaft end float | | 0.049 - 0.211 |

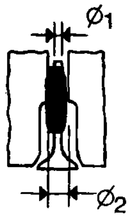
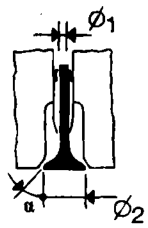
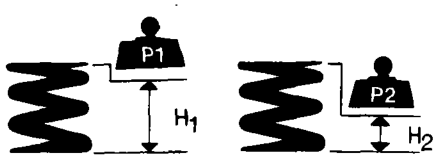
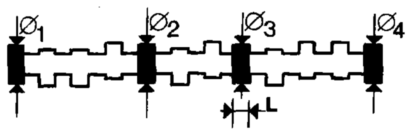
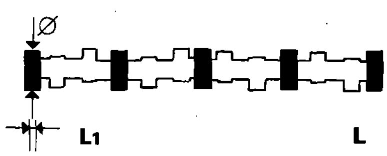


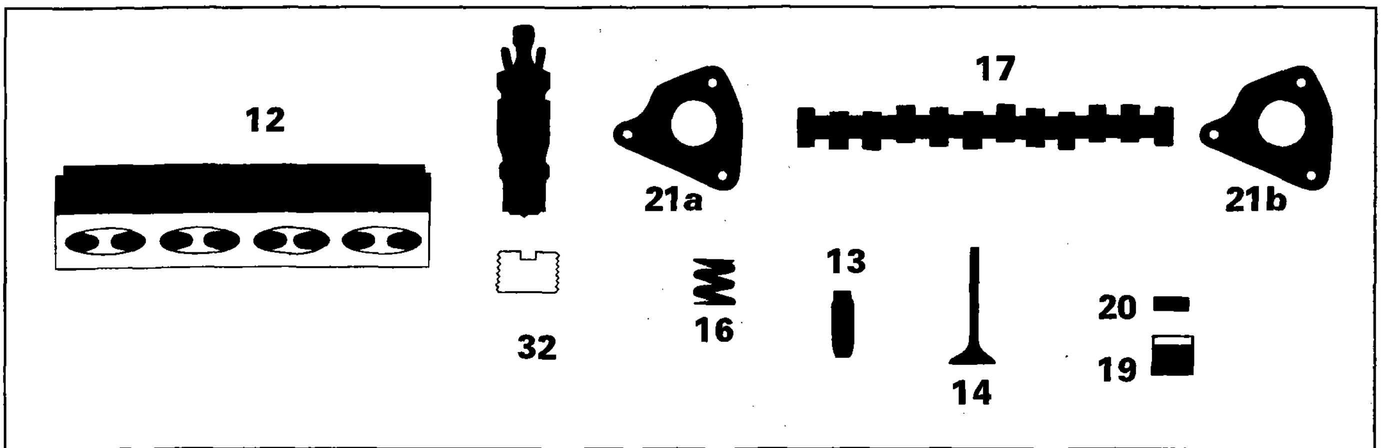


**DESCRIPTION**

| | | | Values in mm |
|---|---|---|---|
| |  Valve guide bore in cylinder head | Ø | 13.950 - 13.977 |
| |  Valve seats | α (intake) | 45° ± 20′ |
| | | α (exhaust) | 45° ± 20′ |
| | | L | about 2.7 |
| 12 | Camshaft bearing housings in cylinder head  | $Ø_1$ | – |
| | | $Ø_2$ | – |
| | | $Ø_3$ | – |
| | | $Ø_4$ | – |
| | | L* | – |
| |  L Camshaft supports | Ø | 26.045 - 26.070 |
| | | L* | 19.100 - 19.150 |
| |  Tappet housing | Ø | 37.000 - 37.025 |

(*) Cap size

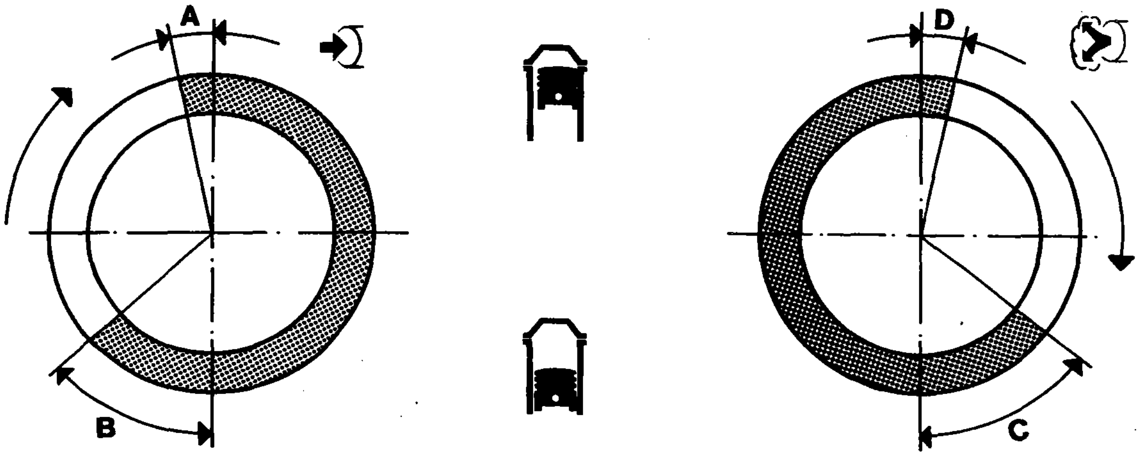
| | | | 1910 JTD |
|---|---|---|---|
| **DESCRIPTION** | | | Values in mm |
| **13**  | Valve guide | Ø1 | 8.022 - 8.040 |
| | | Ø2 | 14.010 - 14.030 |
| | | Ø2 FIAT > | 0.05 - 0.10 - 0.25 |
| **13-12** | Valve guide<br>Bore in cylinder head | | 0.033 - 0.080 |
| **14**  | Valve | Ø1 | 7.974 - 7.992 |
| | | Ø2 | 35.40 - 35.60 |
| | | α | 45°30′ ± 15′ |
| | | Ø1 | 7.974 - 7.992 |
| | | Ø2 | 34.40 - 34.60 |
| | | α | 45°30′ ± 5′ |
| **14-13** | Valve - Valve guide | | 0.030 - 0.066 |
| **16**  | Valve spring | P1 | 36.69 - 39.63 daN |
| | | H1 | 36 |
| | | P2 | 55.91 - 60.82 daN |
| | | H2 | 26.5 |
| **17**  | Camshaft journals | Ø1 | – |
| | | Ø2 | – |
| | | Ø3 | – |
| | | Ø4 | – |
| | | L | – |
|  | | Ø | 26.000 - 26.015 |
| | | L | 23.10 - 23.70 |
| | | L1 | 19.25 - 19.30 |




1910 JTD

| DESCRIPTION | | Values in mm |
|---|---|---|
| **17-12** | radial | 0.030 - 0.070 |
| | axial | 0.100 - 0.230 |
| **17** Cam lift | | 8.5 |
| | | 8.5 |
| **19** Tappet | Ø | 36.975 - 36.995 |
| **19-12** Tappet - Cylinder head | | 0.005 - 0.050 |
| **20** Shim | S (0.05) | 3.25 - 4.90 |
| **17-20** for timing | | 0.50 |
| | | 0.50 |
| check | | 0.30 ± 0.05 |
| | | 0.35 ± 0.05 |

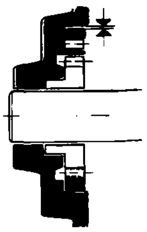
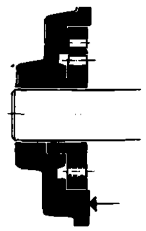
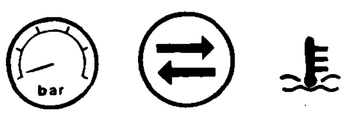
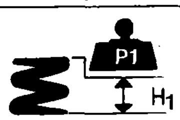
### TIMING DIAGRAMS



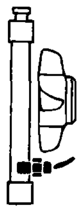

P4A023A01

**Timing angles**

| | | | |
|---|---|---|---|
| **A** | Inlet | start before TDC | 0° |
| **B** | Inlet | end after BDC | 32° |
| **C** | Exhaust | start before BDC | 32° |
| **D** | Exhaust | end after TDC | 0° |

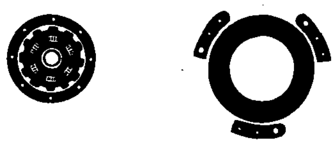
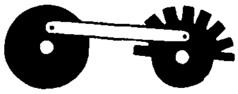
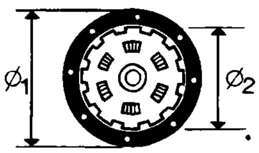
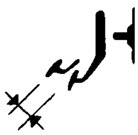

| LUBRICATION | Values in mm |
|---|---|
| Engine lubrication system | forced circulation, via lobe pump with in-line cartridge filter |
| Oil pump | lobe gears |
| Pump driven | by crankshaft |
| Oil pressure relief valve | built into front crankshaft cover |
|  between pump housing and driven gear | 0.080 - 0.186 |
|  between the upper side of the gears and the pump cover | 0.025 - 0.056 |
| Full flow filter | cartridge |
| Insufficient oil pressure sender unit | electrical |
|   Operating pressure at temperature of 100°C | 3.43 - 4.9 bar |
|   $P_1$ | 6.27 - 7.06 daN |
| Oil pressure relief valve spring $H_1$ | 36 |

## COOLING SYSTEM

| | | 1910 JTD | |
|---|---|---|---|
| Cooling circuit | | coolant circulation via centrifugal pump, radiator and two speed electrical fan controlled by engine management control unit | |
| Water pump operation | | via belt | |
|  thermal switch for fan activation | | 1st speed | 2nd speed |
| | ⇄ | 93.5°C | 99°°C |
| | stop | 97°C | 102.5°C |
| Engine coolant thermostat | opening begins | 86° - 90°C | |
| | max opening | 101° - 105°C | |
| | valve travel | ⩾9.5 mm | |
| Installation fit between blades of impeller and pump case | | 0.40 - 0.75 mm | |
| Radiator tightness test pressure | | 1 bar | |
| Checking setting of outlet spring on supplementary expansion tank | | 0.9 - 1.1 bar | |

| COMPONENTS OF BOSCH COMMON RAIL ELECTRONIC FUEL SYSTEM | 1910 JTD |
| --- | --- |
| Control unit | Bosch 0.281.001.928 |
| Debimeter | Bosch 0.281.002.199 |
| Coolant temperature sensor | Jaeger 402.183.01 |
| Diesel temperature sensor | Bosch 0.281.002.209 |
| Rpm sensor | Bosch 0.281.002.214 |
| Timing sensor | Bosch 0.281.002.213 |
| Turbocharger pressure sensor | Bosch 0.281.002.215 |
| Fuel pressure sensor | Bosch 0.281.002.210 |
| Injector | Bosch 0.445.110.002 |
| Preheating control unit | Bosch 0.281.003.215 |
| Glow plug | Bosch 0.250.202.028 |
| EGR solenoid | 46419651 |

# 00.18

| | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|
| | Values in mm | | |
| Type |  dry, single plate with bearing | | |
|  Operating mechanism |  diaphragm spring | | |
| Spring loading daN | 400 | 485 | 500 |
|  Lining Ø1 | 190 | 230 | 230 |
| Lining Ø2 | 134 | 155 | 155 |
|  Distance between pedal in end of travel position and rest position | 155 ±10 | 140 ±5 | |
| Clutch release | mechanical | hydraulic | |

## GEARBOX

| | | 1242 12v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| | Gears: 1 3 5 / 2 4 R | | | |
| | Type | C.514.5.13 | C.510.5.21 | C.510.5.17 |
| Synchronizers | elastic ring (Porsche type) | – | | |
| Synchronizers | ring | 1 3 5 / 2 4 | | |
| Gears | with narrow teeth | R | | |
| Gears | with helical teeth | 1 3 5 / 2 4 | | |
| Gear ratios | 1 | 3.909 | 3.545 | 3.909 |
| | 2 | 2.158 | 2.238 | 2.238 |
| | 3 | 1.345<br>1.480* | 1.520 | 1.444 |
| | 4 | 0.974<br>1.121* | 1.156 | 1.029 |
| | 5 | 0.829<br>0.891* | 0.970 | 0.767 |
| | R | 3.818 | 3.909 | 3.909 |

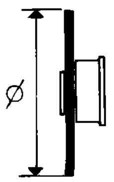
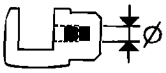
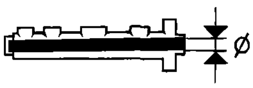
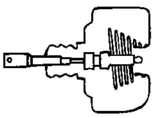
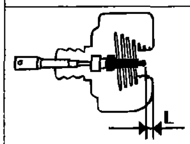
(*) 5D version (Brava)

**DIFFERENTIAL**

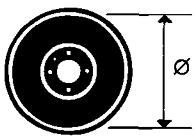
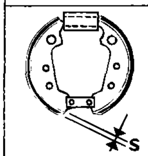
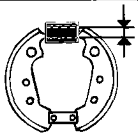
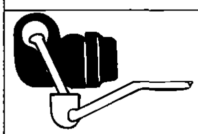
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| Spur gear and pinion set ratio | | 3.887 (15/58) | 3.353 (17/57) | 3.053 (19/58) |
| Final drive ratio | 1 | 15.115 | 11.886 | 11.933 |
| | 2 | 8.344 | 7.504 | 6.832 |
| | 3 | 5.200<br>5.753* | 5.096 | 4.408 |
| | 4 | 3.766<br>4.357* | 3.876 | 3.141 |
| | 5 | 3.205<br>3.463* | 3.252 | 2.341 |
| | R | 14.763 | 13.107 | 11.933 |
| Differential internal casing bearing | | taper roller bearings | | |
| Adjustment of bearing pre-load | | using shims | | |
| Thickness of shims FIAT (mm) | 0.05 | - | 1.70 - 2.60 | |
| | 0.10 | 2.00 - 3.00 | - | |
| Interference to obtain exact bearing pre-loading | mm | bearings not pre-loaded = 0.12<br>bearings pre-loaded (350 dan) = 0.08 | | |
| Differential-planet gear backlash | mm | ⩽ 0.10 | | |
| Adjusting differential-planet gear backlash | | no adjustment necessary | | using shims |
| Thickness of shims FIAT (0.05) | mm | - | | 0.80 - 1.25 |

(*) 5D version (Brava)

### FRONT BRAKES

| | | | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| | | | Values in mm | | |
|  | Disc | ∅ | 257 | 283.8 - 284.2 | 257 |
| | | S | 11.80 - 12.10 | 21.90 - 22.10 | 19.80 - 20.10 |
| | | S (worn) | 11.10 | 20.55 | 18.55 |
| | | S < Allowed | 10.20 | 20.20 | 18.20 |
|  | Brake pads | S < Allowed | 1.5 | | |
|  | Caliper | ∅ | 54 | | |
|  | Master cylinder (pump) | ∅ | 22.225 (7/8") | 23.81 (15/15") | 22.225 (7/8") |
|  | Brake servo | | Iso-Vac 8" vacuum servo acting on all four wheels | ISO-VAC 8"+7" vacuum servo acting on all four wheels | Iso-Vac 8" vacuum servo acting on all four wheels |
|  | Distance of hydraulic piston push rod from master cylinder support plate | L | 22.45 - 22.65 | | |

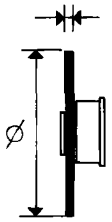
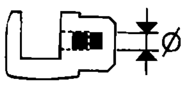
### REAR BRAKES

| | | | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
|  | Drum | S (∅) | 203.10-203.40<br>180.00-180.25 (*) | - | 203.10-203.40 |
| | | S (worn) | 180.95 | - | 204.10 |
| | | S > allowed | 181.35 | - | 204.70 |
|  | Shoes | S < allowed | - | 1.5 | - |
|  | Cylinders | Ø | 22.00 | - | 22.00 |
|  | Load proportioning valve | | acting on rear wheels | - | acting on rear wheels |
| | Ratio (reduction) | | 0.36 | - | 0.36 |

(*) Version without ABS

| | 1242 *16v* | 1998 *20v* *STEP A* | 1910 *JTD* |
|---|---|---|---|
| | Values in mm | | |

**REAR BRAKES**

| | | | | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|---|
|  | Disc | | Ø | - | 240 | - |
| | | S | | - | 10.80 - 11.10 | - |
| | | S | | - | 10.10 | - |
| | | S | < Allowed | - | 9.20 | - |
|  | Brake pads | S | < Allowed | - | 1.5 | - |
|  | Caliper | | Ø | - | 34 | - |

**LOAD PROPORTIONING VALVE**
**Adjustment figures**

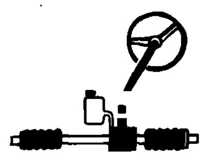
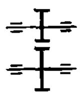
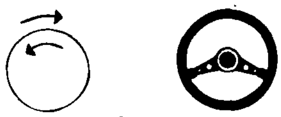
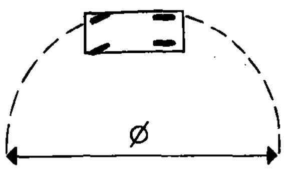
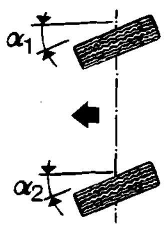
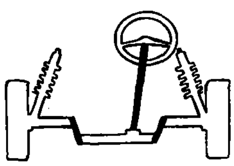
| Vehicle | Engine type | Weight in luggage compartment | Load to be applied |
|---|---|---|---|
| | | kg | daN |
| ***Bravo*** | 1242 *16v* 1581 *16v* | 94<br>85.5* | 5.5 |
| ***Brava*** | 1242 *16v* 1581 *16v* | 64<br>55* | 5.5 |
| ***Bravo*** | 1747 *16v* | 85.5<br>75* | 5.5 |
| ***Brava*** | 1747 *16v* | 55<br>46* | 5.5 |
| ***Bravo*** | 1910 *TD75 ; TD100 ; JTD* | 85.5<br>66* ● | 5.5 |
| ***Brava*** | 1910 *TD75 ; TD100 ; JTD* | 64<br>46* ● | 5.5 |
| ***Bravo*** | 1998 *20v* | 85.5<br>75* | 4 |

(*) Weight to be applied for vehicles complete with all accessories
(●) Weights referring to 1910 TD 100 and 1910 JTD versions only



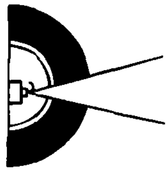
II-98 – Cancels and replaces

*Print n° 506.670/19*

| ENGINE | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|
| Type |  rack and pinion power assisted | | |
|  Ratio —  no. of turns lock to lock | 3 | | |
| Ratio —  rack travel | 142 ±1.5 mm | | |
|  Turning circle | 10.4 m | | |
|  Steering angle — offside wheel $\alpha_1$ | 31° 30′ ±30′ | | |
| Steering angle — nearside wheel $\alpha_2$ | 38° 15′ ± 30′ | | |
|  Steering column |  with 2 universal joints | | |

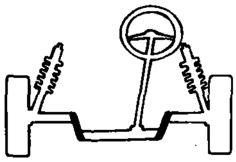
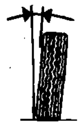
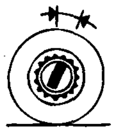
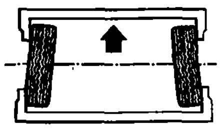
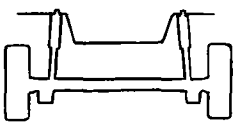
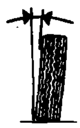
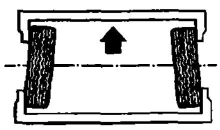
| ENGINE | | Wheel rim type | Tubeless tyre radial tread, type | Tyre pressure in bars | | | |
|---|---|---|---|---|---|---|---|
| | | | | Front | | Rear | |
| | | | | average load | full load | average load | full load |
| 1242 *16v* | ***Brava*** | 5½J×14" -37<br>6J×14" -43<br>6J×15" -40 | 175/65 R14 82T<br>175/65 R14 82H<br>185/55 R14 81H | 2.2 | 2.3 | 2.2 | 2.5 |
| | ***Bravo*** | 5½J×14" -37 | 175/65 R14 82H | | | | |
| 1998 *20v* *STEP A* | ***Bravo*** | 6J×15" -49<br>6J×15" -49 | 195/55 R15 84V<br>205/50 ZR15 (■) | 2.5 | 2.7 | 2.2 | 2.4 |
| 1910 *JTD* | ***Brava*** | 6J×15" -40<br>5½J×14" -37<br>6J×14" -43 | 185/55 R15 81H<br>185/60 R14 82H<br>185/60 R14 82H | 2.3 | 2.3 | 2.2 | 2.5 |
| | ***Bravo*** | 6J×15" -40<br>6J×14" -43 | 185/55 R15 81H<br>185/60 R14 82H | | | | |
| SPARE WHEEL (*) | | 4B×14" -43<br>4B×15" -35 | 105/70 R14 84M<br>115/70 R15 90M | 4,2 | | | |

(*) Speed limit: 80 km/h
(■) Do not fit chains because they could foul against the wheel arch



unladen car (■)

**WHEEL GEOMETRY**

| | | |
|---|---|---|
|  Front suspension | camber (**)  | -7′± 30′<br>-33′± 30′ (only for Bravo 1998) |
| | caster (**)  | 2°50′ ± 30′ |
| | toe-in  | -1 - 1 mm |
| | front wheel offset ▲ | 0° |
|  Rear suspension | camber (**)  | – 0°46′ ± 30′ |
| | toe-in (**)  | 0 - 4 |
| | rear wheel thrust angle ▲ | 0° |

(**) Angles cannot be adjusted
(■) With tyres inflated to the correct pressure and vehicle in running order with 5 litres of fuel
(▲) Non-adjustable angles, used for correct vehicle alignment

# 00.44

**Front suspension** independent wheel, MacPherson type with forged steel wishbones anchored to a subframe. Offset coil springs and double-acting telescopic dampers. Anti-roll torsion bar.

### Coil springs

| ENGINE | | | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Diameter of wire | | mm | 12.2±0.05 | 13.2 ± 0.05 | 12.7 ± 0.05 (12.9 ±0.05)* |
| Number of turns | | | 3.75 | | |
| Direction of coil | | | clockwise | | |
| Height of spring released | | mm | 449.2 (461)* | 404.5 (419.6)* | 454 (449)* |
| Spring height under a load of: | 303 - 335 daN (320.5 - 346.5 daN)* | mm | 192 | – | – |
| | 340 - 368 daN (352 - 382 daN)* | mm | – | – | – |
| | 344 daN (369 daN)* | mm | – | 192 | – |
| | 352 ±382 daN (366 ±396 daN)* | mm | – | – | 192 |
| The springs are subdivided into two categories, identifiable by a mark: | | | | | |
| yellow (1) springs loaded to: | 319 daN (333.5 daN)* | a height of mm | >192 | – | – |
| | 354 daN (367 daN)* | a height of mm | – | – | – |
| | 344 daN (369.2 daN)* | a height of mm | – | >192 | – |
| | 367 daN (381 daN)* | height of mm | – | – | >192 |
| green (1) springs loaded to: | 319 daN (333.5 daN)* | a height of mm | ≤192 | – | – |
| | 354 daN (367 daN)* | a height of mm | – | – | – |
| | 344 daN (369 daN)* | a height of mm | – | ≤192 | – |
| | 367 daN (381 daN)* | height of mm | – | – | ≤192 |

(1) Springs of the same category must be fitted together.
(*) For vehicles with air conditioner.

### Shock absorbers

| | | |
|---|---|---|
| Type: telescopic, double-acting (low pressure gas type) | | WAY-ASSAUTO |
| Open (damping starts) | mm | 518 ± 2.5 |
| Closed (steel against steel) | mm | 361 ± 2.5 |
| Stroke | mm | 157 |

### Stabilizer bar

| | | |
|---|---|---|
| Diameter of stabilizer bar | mm | 23 |

**Rear suspension** independent with ductile cast iron tie rods. Coil springs and dampers with vulcanised bushes. Anti-roll torsion bar. Rigid H-shaped subframe consisting of one transverse tubular element and two moulded rails fastened to it.

### Coil spring

| VERSIONS | | BRAVO<br>1242 16v, 1910 JTD | BRAVO<br>1998 20v | BRAVA<br>1242 16v, 1910 JTD |
|---|---|---|---|---|
| Diameter of wire | mm | 11. 5±0.05<br>(11.9±0.05)* | 11.8±0.05 | 11.9±0.05 |
| Number of turns | | 4.75(5)* | 4.5 | 5 |
| Direction of coil | | clockwise | | |
| Height of spring released | mm | 311 (309)* | 297 | 309 |
| Spring height under load of: 270 - 298 daN (286- 316 daN)* | mm | 194 | - | - |
| Spring height under load of: 275 - 303 daN | mm | - | 194 | |
| Spring height under load of: 286 - 316 daN | mm | - | - | 194 |
| The springs are subdivided into two categories, identifiable by a mark: | | | | |
| yellow (1) springs loaded to: 284 daN (301 daN)* | height of mm | >194 | - | - |
| yellow (1) springs loaded to: 289 daN | height of mm | - | >194 | - |
| yellow (1) springs loaded to: 301 daN | height of mm | - | - | >194 |
| green (1) springs loaded to: 284 daN (301 daN)* | height of mm | ⩽194 | - | - |
| green (1) springs loaded to: 289 daN | height of mm | - | ⩽194 | - |
| green (1) springs loaded to: 301 daN | height of mm | - | - | ⩽194 |

(1) Springs of the same category must be fitted together
(*) For 1910 JTD cars with air conditioning.

### Shock absorbers

| | | | | |
|---|---|---|---|---|
| Type: telescopic, double-acting (low pressure gas type) | | WAY-ASSAUTO | | |
| Open (damping starts) | mm | 322.5 ± 2 | 312 ± 2 | 322.5 ± 2 |
| Closed (steel against steel) | mm | 223 ± 2 | 223 ± 2 | 223 ± 2 |
| Stroke | mm | 99.5 | 89 | 99.5 |

### Stabilizer bar

| | | |
|---|---|---|
| Diameter of stabilizer bar | mm | 17 |

| | 1242 16v | 1998 20v STEP A |
|---|---|---|
| **STARTER MOTOR** | M. Marelli E80E-12V-0,9KW | M. Marelli<br>M70R-12V-1,4kW<br>(with reduction unit) |
| **ALTERNATOR** | M. Marelli<br>A115I-14V-38/65A<br>M. Marelli<br>A115IM-14V-50/90A (●) | M. Marelli<br>A127IR-14V-50/80A<br>M. Marelli<br>A127IR-14V-55/100A (●) |
| **VOLTAGE REGULATOR** | BUILT IN ELECTRONIC | |
| **BATTERY** | 12V-40Ah-200A<br>12V-50Ah-250A* | 12V-50Ah-250A |
| **IGNITION SYSTEM** | Built-in electronic<br>injection-ignition<br>MPI Bosch M 1.5.5 | Built-in electronic<br>injection-ignition<br>MPI Bosch Motronic ME 3.1 |
| **IGNITION COIL** | Bosch<br>0.221.503.407 | Bosch<br>0.221.504.014 |
| **SPARK PLUGS** | NGK RDCPR 8EKC<br>CHAMPION RA4HCX | CHAMPION RC8BY |

(●) For vehicles with air conditioner
(*) For cars equipped with alarm system

| | 1910 JTD |
|---|---|
| **STARTER MOTOR** | BOSCH DIAM 78,5 - 12V - 2,0 kW<br>M. Marelli M70R - 12V - 1.8 kW<br>(with reduction unit) |
| **ALTERNATOR** | M. Marelli<br>A 127IR - 14V - 55/100A |
| **VOLTAGE REGULATOR** | Built in electronic |
| **BATTERY** | 12V - 60 Ah - 380A |
| **PRE-HEATING ELECTRONIC CONTROL UNIT** | BOSCH 0.281.003.215 |
| **ELECTRONIC CONTROL UNIT ENGINE FUEL SYSTEM CONTROL** | N.D. |
| **GLOW PLUGS** | BOSCH 0.250.202.028 |

**STARTER MOTOR**

| | | 1242 16v | 1998 20v STEP A | 1910 JTD | |
|---|---|---|---|---|---|
| Type | | M. Marelli E80-12V-0.9 kW | M. Marelli M70R-12V-1.4 kW (with reduction unit) | BOSCH DIAM 78.5 - 12V - 2.0 kW (with reduction unit) | M. Marelli M70R-12V-1.8 kW (with gearing) |
| Voltage | V | 12 | | | |
| Power rating | kW | 0.9 | 1.4 | 2.0 | 1.8 |
| Rotation, pinion side | | clockwise | | | |
| No. of poles | | 4 | | 6 | 4 |
| Field coil | | in line | | permanent magnets | in-line-parallel |
| Engagement | | free wheel | | | |
| Operation | | solenoid | | | |
| End float of armature shaft | mm | 0.1 - 0.5 | | | |
| **Data for bench test** | | | | | |
| Operating test (*): | | | | | |
| current | A | 180 (200) | 360 . 380 | 500 | 400 |
| speed | rpm | 1720 (2200) | 1150 | 1950 | 1400 |
| voltage | V | 9.5 (9.8-10) | 8.15 | 7.30 | 9.60 |
| torque developed | daNm | 0.37 (0.38) | 1.30 | 1.30 | 1.40 |
| Engagement test (*): | | | | | |
| current | A | 324 (440) | 680 - 700 | 1200 | 1100-1150 |
| voltage | V | 7.1 (7.6) | 4.9 | 5.5 | 4.4 - 4.6 |
| torque developed | daNm | ⩾0.97 (⩾1.25) | 3.11 | 3.0 | 5.0 |
| Free running test (*): | | | | | |
| current | A | 40 (44-48) | 60 - 80 | 70 - 80 | 120 - 140 |
| Voltage | V | 11.4 (11.4-11.5) | 4.9 | 11.5 | 11 |
| speed | rpm | 8500 - 9000 (11400-12300) | 4040 | 5450 - 5750 | 4750 - 5000 |
| **Relay** | | | | | |
| Winding resistance (*) | pull in Ω | 0.30-0.32 (0.32) | 0.33 - 0.37 | 0.4 | 0.30-0.37 |
| | hold in Ω | 1.2-1.3 (1.09) | 1.13 - 1.27 | 1.7 | 1.2-1.3 |
| **Lubrication** | | | | | |
| Internal splines and shaft bushes | | VS⁺ SAE 10 W | | | |
| Sleeve and intermediate disc | | TUTELA MR3 | | | |

(*) Data measured at environmental temperature of 20°C.

**NOTE** *The insulation between commutator segments need not be lowered during service.*

## ALTERNATOR

| | | 1242 16v | 1242 16v (●) | 1998 20v STEP A | 1998 20v STEP A (●) / 1910 JTD |
|---|---|---|---|---|---|
| Type | | M.Marelli A115I-14V-38/65A | M.Marelli A115IM - 14V-50/90A | M. Marelli A127IR - 14V-50/85A | M. Marelli A127IR - 14V-55/100A |
| Voltage rating | V | 14 | | | |
| Maximum current | A | 65 | 93 | 85 | 105 |
| Current rating at 1800 rpm | rpm | 38 | 50 | 50 | 55 |
| Current rating at 6000 rpm | A | 65 | 93 | 85 | 105 |
| Field winding resistance between the slip rings (*) | Ω | 2.4 | 2.23 | 2,6 | |
| Direction of rotation (seen from drive side) | | clockwise | | | |
| Diode rectifiers | | preconstituted bridge | | | |

(*) Data measured at environmental temperature of 20°C.
(●) For vehicles with air conditioner

## VOLTAGE REGULATOR

| | | Built in electronic | |
|---|---|---|---|
| Type | | RTM 151 A | RTM 151 B |
| Alternator speed for test | rpm | 6000 | |
| Thermal stabilization current | A | - | |
| Test current | A | - | |
| Regulation voltage (*) | V | 14.05 - 14.35 | |

(*) Data measured at environmental temperature of 23°C.

| INTEGRATED ELECTRONIC INJECTION-IGNITION CONTROL MODULE | 1242 16v |
|---|---|
| Type | Bosch 0.261.204.578 |
| Firing order | 1 – 3 – 4 – 2 |

### COIL WITH 4 HIGH TENSION OUTLETS

| | |
|---|---|
| Type | Bosch |
| Code | 0.221.503.407 |
| Ohmic resistance of primary winding at 20°C Ω | 0.45 - 0.55 |
| Ohmic resistance of secondary winding at 20°C Ω | 12000 - 14600 |

### TOP DEAD CENTRE AND RPM SENSOR

| | |
|---|---|
| make and type | Bosch 0.281.210.124 |
| Sensor winding resistance at 20° C Ω | 486 - 594 |
| Distance (gap) between sensor and tooth of crankshaft pulley mm | 0.8 - 1.5 |

### ADVANCE ON ENGINE

| | |
|---|---|
| With engine idling (850 ± 50 rpm) | N.A. |

### SPARK PLUGS

| | |
|---|---|
| Make and type | NGK RDCPR8EKC<br>CHAMPION RA4HCX |
| Thread | M 14×1.25 |
| Electrode gap mm | 0.8 |

| | 1998 20v STEP A |
|---|---|

### INTEGRATED ELECTRONIC INJECTION - IGNITION SYSTEM

| | | |
|---|---|---|
| Type | | Bosch 0.261.204.271 |
| Firing order | | 1 – 2 – 4 – 5 - 3 |

### IGNITION COIL (1 FOR SPARK PLUG)

| | | |
|---|---|---|
| Type | | Bosch |
| Code | | 0.221.504.014 |
| Ohmic resistance of primary winding at 20°C | Ω | 0,4 |
| Ohmic resistance of secondary winding at 20°C | Ω | 8500 |

### TOP DEAD CENTRE AND RPM SENSOR

| | | |
|---|---|---|
| Make and type | | Bosch 0.261.210.160 |
| Sensor winding resistance at 20 °C | Ω | 774 - 946 |
| Gap between sensor and crankshaft pulley teeth | mm | 0.8 - 1.5 |

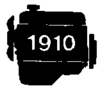
### KNOCK SENSOR

| | | |
|---|---|---|
| Type | | Bosch |
| Code | | 0.261.231.131 |

### SPARK PLUGS

| | | |
|---|---|---|
| Make and type | | CHAMPION RC8BY |
| Thread | | M 14×1.25 |
| Electrode gap | mm | 0.8 |

### BOSCH COMMON RAIL ELECTRONIC FUEL SYSTEM

| |  JTD |
|---|---|
| Type | Bosch EDC15C |
| Spontaneous firing order | 1 – 3 – 4 – 2 |

### PREHEATING CONTROL UNIT

| | |
|---|---|
| Type | Bosch |
| Code | 0.281.003.215 |

### TOP DEAD CENTRE AND RPM SENSOR

| | | |
|---|---|---|
| Make and type | | Bosch 0.281.002.214 |
| Sensor winding resistance at 20 °C | Ω | 774 - 946 |
| Gap between sensor and crankshaft pulley teeth | mm | 0.8 - 1.5 |

### TIMING SENSOR

| | |
|---|---|
| Type | Bosch |
| Code | 0.281.002.213 |

### GLOW PLUGS

| | | |
|---|---|---|
| Make and type | | Bosch 0.250.202.028 |
| Engine attachment thread | | M 12 × 1.25 |
| Electrical resistant at 20°C | mΩ | 700 |

| Tool number | TOOL DESCRIPTION | ENGINE | | |
|---|---|---|---|---|
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |

**ENGINE**

| | | | | |
|---|---|---|---|---|
| **1806149001** | Fuel consumption tester | ● | | |
| **1820225000** | Stand for removing and refitting power unit | ● | | |
| **1822144000** | Oil sump removal wrench | | | ● |
| **1822145000** | Oil sump removal wrench | | | ● |
| **1850132000** | Wrench (13 mm) with 1/2" fitting for removing intake manifold fastenings | | ● | |
| **1850184000** | Wrench for removing/refitting spark plugs | | ● | |
| **1850193000** | Spark plug wrench | ● | | |
| **1852154000** | Wrench, with 1/2" fitting, for cylinder head bolts | | ● | ● |
| **1852159000** | Wrench for removing/refitting belt tensioner | | ● | |
| **1852161000** | Wrench for variable valve timing | | ● | |
| **1852162000** | Alternator pulley wrench | | ● | |
| **1860183000** | Pliers (Ø 75-110) for removing and refitting piston rings | ● | ● | ● |
| **1860313000** | Installer for fitting oil seal to valve guide | ● | ● | |
| **1860313002** | Drift for press-fitting oil seal to valve guide | | | ● |
| **1860395000** | Drift for valve guide removal | ● | ● | |
| **1860395001** | Drift for removing valve guide | | | ● |
| **1860443000** | Pressure lever | | | ● |

# 00.A

| Tool number | TOOL DESCRIPTION | ENGINE 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| **1860470000** | Tool for retaining cylinder head during overhaul | ● | ● | ● |
| **1860490000** | Fixture to retain valve tightness test device 1895868000 (to be used with 1860470000)) | ● | | |
| **1860592000** | Universal hook, power plant lifting and handling | ● | | |
| **1860644000** | Extractor for half-cones, cups, springs and valves | | | ● |
| **1860700000** | Collar (∅ 60-125 mm) for fitting normal and oversized pistons in cylinders | ● | ● | |
| **1860724000** | Tool to hold tappets for replacing plates while adjusting valve clearance (to be used with 1860443000) | | | ● |
| **1860744000** | Tool for turning crankshaft (at bench) | ● | | |
| **1860790000** | Tool for removing springs, cups, half-cones and valves (use with 1860786000 - 1860787000 - 1860788000 and 1860877000) | ● | | |
| **1860812000** | Tool for fitting valve guide | | ● | ● |
| **1860813000** | Guide for fitting oil seal to valve guide | | ● | ● |
| **1860814000** | Installer for applying oil seal to valve guide | | | ● |
| **1860815000** | Adaptor for turning crankshaft | ● | ● | ● |
| **1860816000** | Drift for fitting oil pump gasket | | ● | ● |
| **1860817000** | Tool for locating cover gasket on crankshaft | | ● | |
| **1860818000** | Camshaft timing tools | | ● | |
| **1860821000** | Tool for removing small end bush | | ● | |
| **1860821000** | Tool for removing/fitting small end bush | | | ● |

| Tool number | TOOL DESCRIPTION | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|
| **1860822000** | Oil pump timing adjustment tool | | ● | |
| **1860824000** | Tool for fitting camshaft seal | | ● | |
| **1860831000** | Wrench for timing pulley | ● | | |
| **1860833000** | Hexagonal, splined wrench for removing-refitting oil sump | | ● | |
| **1860834000** | Hexagonal, splined wrench for removing-refitting oil sump | ● | ● | |
| **1860835000** | Extractor for removing oil seal on valve guide | | ● | |
| **1860836000** | Tool for preventing crankshaft from turning | | ● | |
| **1860846000** | Tool to hold flywheel (operations at bench) | ● | | ● |
| **1860854000** | Pressure pump pulley extractor | | | ● |
| **1860859000** | Adaptor for removing-refitting power unit (use with 1860859000 and 1860860000) | | ● | |
| **1860860000** | Support for removing-refitting power unit | | ● | |
| **1860877000** | Tool for dismantling and reassembling half-cones, cups, springs and valves | ● | | |
| **1860879000** | Universal handle | ● | | |
| **1860881000** | Tool for fitting rear crankshaft cover | ● | | |
| **1860893000** | Fuel pump cover wrench | ● | ● | ● |
| **1860898000** | Flywheel retainer (on vehicle) | | ● | |
| **1860905000** | Tool for measuring T.D.C. | | | ● |

# 00.A

| Tool number | TOOL DENOMINATION | ENGINE | | |
|---|---|---|---|---|
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |
| **1860942000** | Angle wrench | ● | | ● |
| **1860955000** | Equipment for testing fuel supply circuit | ● | | |
| **1860961000** | Template for camshaft timing adjustment | | ● | |
| **1860985000** | Tools for timing and securing camshafts | ● | | |
| **1860986000** | Tool for removing nad fitting piston pin | ● | | |
| **1860987000** | Timing belt tensioning tool | ● | | |
| **1860988000** | Tappet retaining tool | ● | | |
| **1860989000** | Extractor for valve guide oil seal | | | ● |
| **1860990000** | Two-way installer for fitting crankshaft and camshaft front cover oil seals | ● | | |
| **1860992000** | Tools for positioning pistons in line | ● | | |
| **1860993000** | Tool for fitting valve guide oil seals | ● | | |
| **1860994000** | Tool for removing and refitting valve guide | ● | | |
| **1861001032** | Bracket to secure engine (distribution side) on rotating stand 1861000000 | ● | | |
| **1861001034** | Bracket to secure engine (flywheel side) on rotating stand 1861000000 | ● | | |
| **1861001039** | Pair of brackets for fastening engine to rotary stand | | ● | ● |
| **1867029000** | Tool to hold flywheel | | ● | |
| **1870404000** | Stand for dial gauge used to measure cylinder liner depth or protrusion | | ● | ● |

| Tool number | TOOL DESCRIPTION | ENGINE | | |
|---|---|---|---|---|
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |
| **1870718000** | Blade for removing oil sump | | | ● |
| **1890385000** | Valve guide bore reamer | | ● | |
| **1895615000** | Tool to check piston pin unseating load (to be used with 1895884000) | ● | | |
| **1895762000** | Torque wrench for checking auxiliary drive belts | ● | ● | |
| **1895868000** | Valve tightness tester | ● | ● | |
| **1895881000** | Dial gauge | ● | | |
| **1895890000** | Pressure gauge for measuring electric pump supply pressure | | ● | |
| **1895897000** | Graduated disc for cylinder head bolt angular tightening | | ● | |

### CLUTCH

| | | | | |
|---|---|---|---|---|
| **1875086000** | Clutch disk centering pin | ● | ● | |

### GEARBOX-DIFFERENTIAL

| | | | | |
|---|---|---|---|---|
| **1842133000** | Tool for dismantling differential bearing and gearbox gears | ● | | |
| **1842134000** | Tool for dismantling gearbox gears and hubs | ● | | |
| **1845028000** | Reaction block for removing differential bearings | ● | | |
| **1845057000** | Tool for removing layshaft 5th speed gear bush | ● | | |
| **1845062000** | Tool to remove front axle shaft constant velocity joint (to be used with 1847017001) | | ● | |

# 00.A

| Tool number | TOOL DESCRIPTION | ENGINE | | |
|---|---|---|---|---|
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |
| **1847017001** | Striker (use with 1860889000) | ● | ● | ● |
| **1847017004** | Plate for removing flanged shaft from differential gear (use with 1847017001) | | ● | |
| **1847056000** | Extractor for differential output shafts | ● | | |
| **1850132000** | Wrench for differential housing seal cover retaining bolts | | ● | |
| **1850113000** | Wrench (12 mm), oil sump draining plug | ● | ● | |
| **1855035000** | Wrench (19 mm) for removing and refitting gearbox | ● | ● | |
| **1860691000** | Drift for removing and refitting gear stiffening ball plug | ● | | |
| **1860851000** | Beam for removing-refitting gearbox | ● | ● | ● |
| **1860851001** | Adaptor for beam used to remove-refit gearbox (use with 1860851000) | ● | ● | ● |
| **1860873000** | Bracket for removing-refitting gearbox | ● | ● | |
| **1860889000** | Two-way fitting for striker (use with 1847017001) | ● | ● | ● |
| **1870007000** | Universal handle | ● | ● | |
| **1870152000** | Drift for fitting hubs and gears to main shaft and lay shaft | ● | | |
| **1870419000** | Part for fitting main shaft seal to gearbox bell housing (use with 1870007000) | ● | ● | |
| **1870448000** | Tool for fitting front bearng inner race | | ● | |
| **1870469000** | Part for fitting differential bearing (use with 1870007000) | ● | | |
| **1870478000** | Tool for fitting 4th speed gear bush and rear bearing | | ● | |

| Tool number | TOOL DENOMINATION | ENGINE | | |
|---|---|---|---|---|
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |
| **1870629000** | Drift for fitting differential casing cover gasket (use with 1870007000) | ● | | |
| **1870630000** | Drift for fitting differential casing gasket (use with 1870007000) | ● | | |
| **1870631000** | Drift for fitting main and layshaft bearing and gears | ● | | |
| **1870632000** | Drift for fitting bearings | ● | | |
| **1874541000** | Tool for fitting differential bearing outer race | | ● | |
| **1875016000** | Drift to fit gasket on axle shaft flange | | ● | |
| **1875017000** | Tool to remove and refit differential bearing rings (to be used with 1840005003) | | ● | |
| **1875088000** | Drift for fitting main and layshaft bearings | ● | | |
| **1881124000** | Pliers for main and layshaft rear bearing retaining rings | ● | | |
| **1895655000** | Tool to select differential bearing adjusting shims (to be used with 1895884000) | ● | | |

**BRAKING SYSTEM**

| | | | | |
|---|---|---|---|---|
| **1856132000** | Wrench (10-11 mm) for brake line unions | ● | ● | ● |
| **1856133000** | Wrench for handling rear brake caliper self-adjusting device | | ● | |
| **1872273000** | Set of tools to hold cylinder pistons when installing brake shoes | ● | | ● |
| **1895901000** | Tool for adjusting load proportioning valve position | ● | ● | |

**STEERING**

| | | | | |
|---|---|---|---|---|
| **1847035000** | Puller for steering rod ball pins | ● | ● | ● |

| Tool number | TOOL DESCRIPTION | ENGINE | | |
|---|---|---|---|---|
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |

**SUSPENSION SYSTEM**

| Tool number | TOOL DESCRIPTION | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| **1845028000** | Tool for removing front hub bearing inner race from flange (to be used with 1840005003, 1840005302 and 1840005400) | ● | ● | ● |
| **1847014000** | Puller, wheel hub cap | ● | ● | ● |
| **1874551000** | Tool for retaining front damper rod while manoeuvring retaining nut | ● | ● | ● |
| **1874555000** | Pneumatic tool for compressing suspension springs whe removing dampers | ● | ● | ● |
| **1875055000** | Drift to fit front wheel hub bearings (to be used with 1870007000) | ● | ● | ● |
| **1875059000** | Installer, rear wheel hub caps | ● | ● | ● |

**ELECTRICAL EQUIPMENT**

| Tool number | TOOL DESCRIPTION | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| **1860893000** | Tool for removing fuel level gauge ring nut | ● | ● | ● |
| **1860897000** | Tool for removing radio | ● | ● | ● |

**BODYWORK**

| Tool number | TOOL DESCRIPTION | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|
| **1860890000** | Wrench for removing-refitting door hinges | ● | ● | ● |
| **1878034000** | Remover, window regulator handles | ● | ● | ● |
| **1878077000** | Tool to remove door trim panels or plastic buttons | ● | ● | ● |
| **1878080000** | Fixture for positioning door stop rod during assembly of retaining pin (to be used in conjunction with 1878081000) | ● | ● | ● |
| **1878081000** | Pliers for removing/refitting door stop link retaining pin (use with 1878080000 during assembly) | ● | ● | ● |

| Tool number | TOOL DESCRIPTION | ENGINE | | |
|---|---|---|---|---|
| | | 1242 16v | 1998 20v STEP A | 1910 JTD |

**GENERAL-PURPOSE TOOLS**

| | | | | |
|---|---|---|---|---|
| **1840005000** | Puller, universal | ● | ● | ● |
| **1840206000** | Percussion extractor (use with special parts) | ● | ● | ● |
| **1846017000** | Base for puller half-rings | ● | ● | ● |
| **1847017001** | Percussion extractor (use with special parts) | ● | ● | ● |
| **1861000000** | Rotary stand for engine overhaul (used also for gearbox and differential) | ● | ● | ● |
| **1861000001** | Pair of sections for brackets supporting the engine on rotating stand 1861000000 1861000000 | ● | ● | ● |
| **1870007000** | Universal handle | ● | ● | ● |
| **1870404000** | Support for measuring depth and protrusion (use with 1895881000) | ● | ● | ● |
| **1871000000** | Rotary column for servicing gearboxes and differential | ● | ● | ● |
| **1876048000** | Mini Hylok Contact terminal extractor (MHF) dia. 2.15 mm | ● | ● | ● |
| **1881138000** | Adjustable pliers for pipe retaining collars and tabs | ● | ● | ● |
| **1882002010** | Tool panel to be fixed to wall or stand 1882003000 (with hooks) | ● | ● | ● |
| **1882003000** | Stand to hold two tool panels | ● | ● | ● |
| **1882011000** | Set of additional hooks (50) for tool panel | ● | ● | ● |
| **1895113000** | Feeler gauge (0.05-0.10...0.80 mm) for checking valve clearance | ● | ● | ● |
| **1895881000** | Centesimal gauge for special tools (10 mm capacity; stem length 16.7 mm) mm 10; | ● | ● | ● |
| **1895882000** | Centesimal gauge for special tools (10 mm capacity; stem length 88 mm) | ● | ● | ● |
| **1895884000** | Centesimal gauge for special tools (10 mm capacity; stem length 16.7 mm) | ● | ● | ● |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|

**ENGINE**

| PART | Thread | Tightening torques daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining main bearing caps to crankcase | M10×1.25 | 4 + 90° | ● | | |
| | M12 | 2 + 100° | | ● | ● |
| Bolt, cylinder head to engine block | M9 | 3 + 90° + 90° | ● | | |
| | M10 | 4 + 90°+90°+90° | | ● | |
| | M10 | 6.5 + 90°+90°+90° | | | ● |
| Nut retaining connecting rod cap | M8 | 4.1 | ● | | |
| Bolt retaining connecting rod cap | M8 | 2 + 60° | | ● | ● |
| Bolt, flywheel to crankshaft | M8 | 4.4 | ● | | |
| | M12x1.25 | 16 | | ● | ● |
| Bolt retaining drive shaft to crankshaft | M16x1.5 left (*) | 2 + 90° | ● | | |
| | M16 left (*) | 36 | | ● | ● |
| Bolt retaining flywheel and timing end cover | M6 | 0.9 | | ● | ● |
| Bolt retaining timing belt guards | M6 | 0.9 | | ● | ● |
| Bolt retaining camshaft driven gear and rear camshaft gears | M12x1.25 | 12 | ● | ● | ● |
| Screw, camshaft caps | M7 | 1.5 | ● | ● | ● |
| Belt tensioner retaining bolt | M8x1.25 | 2.5 | ● | | |
| Bolt retaining coolant intake pipe to pump | M6 | 1 | ● | | |
| Bolt retaining coolant intake pipe to cylinder head | M6 | 0.9 | | ● | |
| | M10 | 5 | | ● | |
| Coolant pump retaining bolt | M8 | 2.5 | | ● | ● |
| Bolt retaining thermostat to cylinder head | M8 | 2.5 | | ● | ● |

(*) The bolt need not be greased

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining plate to oil pump case | M6 | 0.7 | ● | | |
| Screw, cylinder head to engine block | M9 | 0.9 | | ● | ● |
| Bolt retaining oil sump to crankcase | M6 | 1 | ● | | |
| | M8 | 2.5 | | ● | ● |
| Nut retaining oil sump to covers | M6 | 0,5 | ● | | |
| Sump drain plug | M18 | 2 | | ● | ● |
| Oil dipstick pump retaining bolt and nut | M6 | 0.9 | | ● | ● |
| Bolt retaining alternator to crankcase, used also for adjustment | M10x1.25 | 5 | ● | | |
| Bolt retaining engine to crankcase | M8 | 2.2 | ● | | |
| | M10 | 5 | | ● | |
| Bolt retaining bracket to engine mount | M8 | 2.5 | | ● | |
| | M10x1.25 | 5 | | ● | |
| Bolt retaining alternator to slot | M10x1.25 | 5 | ● | | |
| Nut retaining lower bracket to alternator mount and fastening | M12 | 7 | | ● | ● |
| Bolt retaining compressor to support | M8 | 2.5 | | ● | |
| | M10 | 5 | | ● | ● |
| Power steering pump retaining bolt | M10x1.25 | 5 | ● | | |
| Bolt retaining pulley to power steering pump | M10x1.25 | 5 | ● | | |
| Spark plugs | M12x1.25 | 2.7 | ● | ● | |
| Oil pressure switch | M14x1.5 | 3.2 | ● | | |
| | M14x1.5 | 2.2 | | ● | ● |
| Coolant temperature sender unit | M16x1.5 tapered | 3.4 | ● | | |
| | M16x1.5 tapered | 2.5 | | ● | ● |

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| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Coolant temperature sender unit for i.e. system | M12x1.5 | 2 | | ● | ● |
| Bolt retaining sensors to crankcase and cylinder head | M6 | 0.9 | | ● | ● |
| Bolt retaining phonic wheel to crankshaft | M6 | 0.9 | | ● | |
| Bolt retaining knock sensor to crankcase | M8 | 2.5 | | ● | |
| Oil temperature sender unit on sump | M14x1.5 | 2.2 | | ● | |
| Oil level sending unit | M12x1.25 | 2 | | ● | ● |
| Bolt retaining auxiliary pulley | M8 | 2.2 | ● | | |
| | M8 | 2.5 | | | ● |
| Bolt retaining pulley to power steering pump | M10x1.25 | 5 | ● | | |
| Flanged bolt retaining auxiliary component fixed belt tensioner | M8 | 2.5 | | | ● |
| Bolt retaining automatic belt tensioner to alternator mount | M8 | 2.5 | | ● | ● |
| | M10 | 7 | | ● | ● |
| Bolt retaining fixed belt tensioner to alternator mount and auxiliary parts | M8 | 2.5 | | ● | ● |
| Bolt retaining fixed belt tensioner to air conditioner compressor mount | M10x1.25 | 5 | | ● | ● |
| Bolt retaining tensioner bracket to engine mount(for a/c versions) | M10x1.25 | 5 | | ● | |
| Bolt retaining belt tensioner to engine mount | M8 | 2.5 | | ● | |
| | M10 | 5 | | ● | |
| Bolt retaining reinforcement between front bracket and rear bracket | M10x1.25 | 5 | ● | | |
| Bolt retaining alternator/compressor rear mount to crankcase | M10x1.25 | 5 | ● | | |
| Bolt securing power steering mount to crankcase | M10x1.25 | 5 | ● | | |
| Bolt retaining power steering pump plate | M8 | 2.2 | ● | | |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Power steering pump retaining bolt | M6 | 2.5 | | | ● |
| Bolt retaining pulley to power steering pump | M8 | 2.5 | | ● | ● |
| Compressor tensioner retaining bolt | M10x1.25 | 5 | ● | | |
| Nut retaining compressor pivot | M10x1.25 | 5 | ● | | |
| Screw retaining compressor to support | M8 | 2.2 | ● | | |
| Alternator retaining bolt | M10x1.25 | 5 | ● | | |
| | M10x1.25 | 8 | | | |
| Bolt retaining rear tensioner to compressor | M10x1.25 | 5 | ● | | |
| Nut securing rear compressor/alternator mount to engine block | M10x1.25 | 5 | ● | | |
| Power steering guard retaining bolt | M6 | 0.7 | ● | | |
| Alternator retaining/tensioning bolt | M8 | 2.2 | ● | | |
| Bolt retaining plate to engine block | M10x1.25 | 5 | ● | | |
| Nut retaining cam cover to cylinder head | M6 | 0.9 | | ● | ● |
| Bolt retaining cylinder head extension to cylinder head | M7 | 1.5 | ● | | |
| Nut retaining rear cover to cylinder head extension | M6 | 0.9 | ● | | |
| Nut retaining intake manifold to cylinder head | M7 | 1.5 | ● | | |
| | M8 | 2.5 | | | ● |
| Nut retaining exhaust manifold to cylinder head | M8x1.25 | 2.7 | ● | | |
| | M8x1.25 | 2.5 | | ● | ● |
| Bolt retaining coils to rear cover | M4 | 0.2 | ● | | |
| Coil retaining bolt | M6 | 0.9 | | ● | |

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| PART | Thread | Tightening torques daNm | ENGINE | | |
|---|---|---|---|---|---|
| | | | 1242 16v | 1998 20v STEP A | 1910 JTD |
| Coil cover retaining bolt | M6 | 0.9 | | ● | |
| Nut retaining upper part of intake manifold to lower part | M6 | 0.9 | ● | | |
| Adjustment screw for securing intake manifold | M6 | 0.9 | ● | | |
| Plug sealing channels for bolts securing head extension to cylinder head | M16 | 1.5 | ● | | |
| Tapered plug for tightening oil channel to cylinder head extension | M14x1.5 | 1.5 | ● | | |
| Nut for retaining front cover | M6 | 0.9 | ● | | |
| Tapered plug for sealing oil channel on head extension (timing end) | M20x1.5 | 3 | ● | | |
| Plugs sealing camshaft timing studs | M16x1.5 | 1.5 | ● | | |
| Bolts retaining belt guard to steel bushes | M6 | 0.9 | ● | | |
| Plug on head extension with resonator retaining seat | M18 | 3 | ● | | |
| Stud with screw for securing resonator | M8x1.25 | 2.5 | ● | | |
| Bolts retaining cable channels | M6 | 0.9 | ● | | |
| Heat shield retaining nuts | M6 | 0.9 | ● | | |
| Hexagonal, splined bolt retaining dust shield | M6 | 0.9 | | ● | ● |
| Half-axle mount retaining bolt | M10 | 5 | | ● | |
| Bolt retaining connector beneath cam cover | M6 | 0.9 | | ● | |
| Bolt retaining reaction bracket to duct and half-axle mount | M8 | 2.5 | | ● | |
| Nut retaining intake manifold bracket and wiring channel | M8 | 2.5 | | ● | |

| PART | Thread | Tightening torques daNm | ENGINE: 1242 16v | ENGINE: 1998 20v STEP A | ENGINE: 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining damping flywheel to gear | M8 | 2.5 | ● | | |
| Timing belt tensioner retaining bolt | M10 | 5 | ● | ● | |
| Bolt retaining intake gear to variable valve timing | M6 | 0.9 | ● | | |
| Bolt retaining oil pump casing to cap | M6 | 0.9 | ● | | |
| Bolt for heat exchanger connection | M20 | 3 | ● | | |
| Bolt retaining coolant return line from heater to cylinder head | M10x1.25 | 5 | ● | | |
| Bolt retaining coolant delivery line to crankcase | M8x1.25 | 2.5 | ● | | |
| Air conditioner shield retaining bolt | M6 | 0.9 | ● | | |
| Adjustment bolt retaining nut | M10 | 5 | ● | | |
| Bolt, reaction bracket to half-axle | M10x1.25 | 5 | | ● | ● |
| Nut for bolt between sump and half-axle mount | M8 | 2.5 | | ● | ● |
| Bolt retaining power steering pump to rod mount | M8 | 2.5 | | ● | |
| Bolt retaining power steering pulley to shaft | M16 | 10 | | ● | |
| Nut retaining oil vapour separator to intake duct | M6 | 0.9 | | | ● |
| Flanged bolt retaining auxiliary mount to crankcase | M8 | 2.5 | | | ● |
| | M10 | 5 | | | ● |
| Injector retaining bracket tightening nut | M8 | 3.2 | | | ● |
| | M32x1.5 | 11.8 | | | |
| Fastening, exhaust manifold reaction bracket to crankcase | M8 | 2.5 | | | ● |
| Bolt retaining injection pump to mount, crankcase end | M8 | 3.2 | | | ● |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining injection pump to intake manifold end mount | M8 | 2.6 | | | ● |
| Injection pump gear retaining nut | M14 | 5 | | | ● |
| Fuel temperature sensor | M12 | 1.6 | | | ● |
| Nut retaining fuel filter to intake manifold | M8 | 2.5 | | | ● |
| Nut retaining turbocharger to exhaust manifold | M8 | 2.5 | | | ● |
| Nut retaining manifold to turbocharger | M8 | 2.5 | | | ● |
| Union retaining oil delivery pipe to turbocharger | M10<br>M12 | 1.5 | | | ● |
| Heat exchanger valve retaining fitting | M20 | 6.5 | | | ● |
| Bolt retaining nozzle assembly to crankcase | M6 | 0.9 | | | ● |
| Bolt retaining front coolant intake union to cylinder head | M6 | 0.9 | | | ● |
| Nut retaining thermostat to coolant outlet union to cylinder head | M7 | 1.5 | | | ● |
| Upper and lower alternator reaction bracket retaining bolt | M10x1.25 | 5 | | | ● |
| Bolt retaining vacuum pump to cylinder head | M8 | 2.5 | | | ● |
| Nut retaining valve to exhaust manifold | M8 | 2.5 | | | ● |
| Bolt retaining pipe to valve | M8 | 2.5 | | | ● |
| Air pressure sensor | M6 | 0.9 | | | ● |
| Preheating glow plugs | M12 | 1.5 | | | ● |
| Lines from fuel manifold to injectors - injector end | M12 | 2.3 | | | ● |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Injector fuel manifold lines , manifold end | M14 | 3.2 | | | ● |
| Lines from pressure pump to fuel manifold - pump end | M14 | 3.2 | | | ● |
| Lines from pressure pump to fuel manifold - manifold end | M14 | 3.2 | | | ● |

### EXHAUST

| PART | Thread | Tightening torques daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Front bolt retaining exhaust pipe to differential end bracket | M8 | 1.8 | | ● | |
| Self-locking nut retaining flange to exhaust manifold | M8 | 3 | ● | | |
| Bolt retaining first exhaust pipe section to manifold | M8 | 3.2 | ● | | |
| Nut retaining front section to catalytic converter | M8 | 3 | ● | | |
| Bolt for collar retaining rear section to catalytic converter | M10 | 5 | ● | | |
| Flanged bolt retaining brackets with side and rail nut | M8 | 2.8 | ● | ● | ● |
| Flanged bolt retaining front pipe to turbine fitting | M8 | 2.4 | | | ● |
| Front section bracket retaining bolt | M8 | 2.4 | | | ● |
| Front bracket retaining bolt | M8 | 2.4 | | | ● |
| Bolt retaining front exhaust pipe half-bracket connection bracket to bracket anchored to differential mount | M8 | 2.5 | | ● | |
| Bolt with safety washer retaining front section to catalytic converter | M8 | 2.5 | | ● | |
| Bolt for retaining bracket with block to differential end mount | M8 | 2.5 | | ● | |
| Nut retaining front exhaust pipe flange to manifold | M8 | 2.8 | | ● | |
| Self-locking nut with metal insert retaining front exhaust half-bracket | M8 | 2.5 | | ● | |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Self-locking nut with tapered safety washer retaining bracket to crankcase | M8 | 2.5 | | ● | |
| Nut joining rear pipe to catalytic converter | M10x1.25 | 4 | | ● | |
| Lambda probe | M18x1.5 | 3.6 | ● | ● | ● |
| Nut retaining anti-flex bracket to oil sump | M10 | 3 | | ● | |

**POWER UNIT MOUNTING**

| | | | | | |
|---|---|---|---|---|---|
| Bolt retaining mount to gearbox-differential end | M12x1.25 | 8.5 | ● | ● | ● |
| Bolt retaining engine to body, engine and gearbox end | M8 | 3.2 | ● | ● | ● |
| Bolt retaining bracket to gearbox-differential end | M10x1.25 | 4.5 | ● | | |
| Bolt retaining bracket to gearbox-differential end | M12x1.25 | 9 | ● | | |
| Bolt retaining connecting rod mount to body | M8 | 3.8 | | ● | |
| Tapered bolt retaining connecting rod mount to body | M8 | 2.8 | | ● | |
| Fastener, bracket to block and body - engine end | M10x1.25 | 5 | ● | | |
| Fastener - engine mount to body - engine end | M8 | 3.2 | ● | | |
| Nut retaining block to engine end mount | M12x1.25 | 8 | | ● | |
| Flanged bolt retaining mount to gearbox | M10x1.25 | 5 | ● | | |
| Nut retaining differential mount to gearbox | M12x1.25 | 8 | | ● | ● |
| Screw, reaction link to bracket and to engine mount | M10x1.25 | 5 | | ● | |
| Bolt retaining reaction link to body | M8<br>M8 | 2.8<br>3.8 | ● | | |
| Bolt retaining mount to engine sump, differential end | M12x1.25 | 8 | | ● | |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining brace to differential end mount | M12x1.25 | 8 | | ● | |
| Bolt retaining differential end flexible block to beam | M8 | 3.6 | ● | ● | ● |
| Bolt retaining bracket to gearbox - gearbox end | M10x1.25 | 5 | | ● | |
| Power unit reaction link retaining bolt | M10 | 5 | ● | | |

**PEDAL UNIT**

| | | | | | |
|---|---|---|---|---|---|
| Nut retaining accelerator pedal to pedal unit | M6 | 0.5 | ● | ● | ● |
| Flanged nut retaining brake and clutch pedal unit mount to body | M8 | 1.5 | ● | ● | ● |
| Broad-flanged bolt for automatic fittings retaining pedal unit to dashboard | M8 | 2.6 | ● | ● | ● |
| Self-locking nut for retaining and adjusting clutch control cable on gearbox | M6 | 0.44 | ● | ● | ● |
| Self-locking nut retaining brake and clutch pedal pivot pin to pedal unit | M8 | 3 | ● | ● | ● |

**EXTERNAL GEARBOX LINKAGE**

| | | | | | |
|---|---|---|---|---|---|
| Bolt retaining gear lever mount to floor pan | M6 | 0.74 | ● | ● | ● |
| Screw retaining bottom selection and engagement rod to gear lever | M8 | 2.8 | ● | ● | ● |
| Nut retaining intermediate return pin | M8 | 1.5 | ● | ● | ● |
| Nut retaining ball heads to levers | M8 | 1.5 | ● | ● | ● |
| Nut for bolt retaining selection idler to gearbox | M8 | 1.5 | ● | ● | ● |
| Bolt retaining reverse pipe to gearbox | M8 | 2.4 | ● | ● | ● |
| Nut retaining ball heads to selection lever | M8 | 1.5 | ● | ● | ● |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining reaction bracket to gearbox | M8 | 2.4 | ● | ● | ● |
| Nut retaining gearbox linkage to mount | M6 | 0.74 | ● | ● | ● |

**GEARBOX AND DIFFERENTIAL**

| PART | Thread | Tightening torques daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Nut retaining spring in speed rod position | M14x1.4 | 3 | ● | ● | ● |
| Screw retaining plate to gear case | M8 | 2.5 | ● | ● | ● |
| Screw retaining gear case cover and plate | M8 | 2.5 | ● | ● | ● |
| Screw retaining cover to bell housing | M8 | 2.5 | ● | ● | ● |
| Screw retaining gear case to bell housing | M6<br>M8 | 1<br>2.5 | ● | ● | ● |
| Screw retaining reversing shaft | M8 | 3.4 | ● | ● | ● |
| Lock ring, main and layshaft, 5th speed gear | M20x1.5 | 11.8 | ● | ● | ● |
| Screw retaining gear control forks | M6 | 1.8 | ● | ● | ● |
| Bolt retaining speed selection and engagement shaft lever | M8 | 2.5 | ● | ● | ● |
| Reverse lever support retaining screw | M6 | 1 | ● | ● | ● |
| Screw retaining bush for gear shaft | M6 | 1 | ● | ● | ● |
| Screw retaining front drive axle ring gear | M10x1.25 | 8.8 | ● | ● | ● |
| Screw retaining differential case retaining flange to gear case | M10x1.25<br>M8 | 4.9<br>2.5 | ● | ● | ● |
| Screw retaining speedometer support | M6 | 1.2 | ● | ● | ● |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Tapered, thread | M22x1.5 | 4.6 | ● | ● | ● |
| Tapered threaded plug for filling gear case with oil | M22x1.5 | 4.6 | ● | ● | ● |
| Screw retaining differential right shaft support | M6 | 1 | ● | ● | ● |
| Tapered threaded plug for 1st-2nd speed rod seat on gear case | M18x1.5 | 2 | ● | ● | ● |
| Gear selection lever support retaining screw | M8 | 1.5 | ● | ● | ● |
| Reversing light switch | M14x1.25 | 3 | ● | ● | ● |

**BRAKING SYSTEM**

| | | | | | |
|---|---|---|---|---|---|
| Screw with split safety washer retaining brake carrier plate to suspension arm | M8 | 2.4 | ● | ● | ● |
| Bolt retaining front brake caliper | M10x1.25 | 5.7 | ● | ● | ● |
| Bolt with tapered safety washer retaining front brake calipers to pillar | M12x1.25 | 10.5 | | ● | |
| Bolt retaining front brake disc, rear brake disc, rear brake drum (with wheel centring function) | M8 | 1.2 | ● | ● | ● |
| Bolt with tapered safety washer retaining bracket assembly for braking system | M8 | 2.5 | ● | ● | ● |
| Fitting connecting hose to front brake caliper | M10x1 | 1.4 | ● | ● | ● |
| Bleed screw on front and rear brake caliper | M8 | 0.6 | ● | ● | ● |
| Fitting connecting hose to rear brake caliper | M10x1 | 1.4 | | ● | |
| Bolt retaining cylinder to rear brake carrier plate | M6 | 0.8 | ● | | ● |
| Bleed screw on rear drum brake cylinder ⌀180 | M8 | 0.65 | ● | | |
| Brake pump restriction fitting (ABS version) | M10 | 1.4 | ● | ● | ● |

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| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | ENGINE 1998 20v STEP A | ENGINE 1910 JTD |
|---|---|---|---|---|---|
| Male fitting for flared hoses fastening rigid pipe to rear drum brake cylinder | M10x1 | 1.4 | ● | ● | ● |
| Flanged nut retaining load proportioning valve to bracket | M6 | 0.76 | ● | ● | ● |
| Self-locking nut with polyamide ring for bolt retaining EBD spring bracket to rear antiroll bar | M6 | 0.6 | ● | ● | ● |
| Bolt for square load proportioning valve adjustment lever | M8 | 1.8 | ● | ● | ● |

**POWER ASSISTED STEERING AND STEERING**

| PART | Thread | Tightening torques daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Power steering retaining nuts and bolts | M6 | 0.5 | ● | ● | ● |
| | M8 | 1.5 | | | |
| Union for return fitting from power steering to tank | M12x1.25 | 2 | ● | ● | ● |
| Flanged bolt retaining box to beam | M10x1.25 | 7 | ● | ● | ● |
| Union for pump/power steering outlet fitting on power steering | M14x1.5 | 3 | ● | ● | ● |
| Self-locking nut retaining box link to pillar | M10x1.25 | 3.4 | ● | ● | ● |
| Union for pump/power steering outlet fitting on pump | M12 | 3.6 | ● | ● | ● |
| Bolt with tapered safety washer retaining fork and universal joint | M8 | 2 | ● | ● | ● |
| Nut retaining steering wheel to steering column | M16x1.5 | 5 | ● | ● | ● |
| Bolt with tapered end with safety washer for steering column mount fastener | M8 | 2,2 | ● | ● | ● |
| Bolt with safety washer retaining airbag module to steering wheel | M6 | 0.8 | ● | ● | ● |
| Bolt with tapered end and safety washer retaining strut to column mount | M8 | 2.2 | ● | ● | ● |
| Nut retaining reinforcement strut to pedal unit | M8 | 2.2 | ● | ● | ● |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|

**FRONT SUSPENSION**

| PART | Thread | daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining front and rear of front beam to body | M10x1.25 | 8 | ● | ● | ● |
| | M12x1.25 | 10.8 | | | |
| Broad-flanged bolt retaining front of front beam to body | M12x1.25 | 10.8 | ● | ● | ● |
| Flanged nut for nut fastening rear of front beam to body | M10x1.25 | 8 | ● | ● | ● |
| Screw with flat and tapered washer retaining front and rear outside of plates joining wishbone to beam | M10x1.25 | 6.9 | ● | ● | ● |
| Screw with flat and tapered washer retaining front and rear interior of plate jointing wishbone to beam | M10x1.25 | 6.9 | ● | ● | ● |
| Flanged nut fastening top of damper to block | M12×1.25 | 10 | ● | ● | ● |
| Screw with broad flange retaining top damper block to body | M8 | 3.2 | ● | ● | ● |
| Self-locking nut retaining damper to pillar | M10×1.25 | 7 | ● | ● | ● |
| | M12×1.25 | 10 | | | |
| Self-locking nut for bolt retaining wishbone pivot head to pillar | M10×1.25 | 7 | ● | ● | ● |
| Screw with tapered and flat safety washer retaining anti-roll bar support plate to beam | M8 | 4 | ● | ● | ● |
| Self-locking nut retaining end of anti-roll bar to connecting rod | M10×1.25 | 7 | ● | ● | ● |
| Self-locking nut retaining bar to front suspension arm | M10×1.25 | 3.1 | ● | ● | ● |
| Nut retaining front wheel hub to coupling | M22×1.5 | 7+55° | ● | ● | ● |
| | M24×1.5 | 7+62° | | | |
| Wheel stud | M12×1.25 | 8.6 | ● | ● | ● |

| PART | Thread | Tightening torques | ENGINE | | |
|---|---|---|---|---|---|
| | | daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |

**REAR SUSPENSION**

| | | | | | |
|---|---|---|---|---|---|
| Screw with broad flange retaining front flexible block to rear subframe | M12×1.25 | 10.8 | ● | ● | ● |
| Screw with broad flange retaining rear flexible block to body | M12×1.25 | 10.8 | ● | ● | ● |
| Nut for stud retaining rear swinging arm to subframe | M16×1.5 | 15 | ● | ● | ● |
| Nut for screw retaining lower damper to suspension | M12×1.25 | 8.8 | ● | ● | ● |
| Screw retaining top of damper to mount | M10×1.25 | 6 | ● | ● | ● |
| Nut for pivot pin retaining rear hub | M22×1.5 | 28 | ● | ● | ● |
| Bolt retaining stabilizer bar to rear suspension arm | M10×1.25 | 5.6 | ● | ● | ● |
| Bolt retaining stabilizer bar support plates to rear suspension arm | M8 | 2.8 | ● | ● | ● |
| Wheel stud | M12×1.25 | 8.6 | ● | ● | ● |
| Nut for bolt retaining square lever to wishbone | M8 | 1.5 | ● | ● | ● |

**AIR CONDITIONER**

| | | | | | |
|---|---|---|---|---|---|
| Bolt retaining dehydrating filter inlet and outlet ducts | M6 | 0.55 | ● | ● | ● |
| Bolt retaining evaporator pipe to compressor | M6 | 0.55 | ● | ● | ● |
| Three-stage pressure switch fastener | M10x1 | 0.8 | ● | ● | ● |

**ELECTRICAL EQUIPMENT**

| | | | | | |
|---|---|---|---|---|---|
| Nut retaining i.e. control unit | M6 | 0.55 | ● | ● | ● |
| Bolts and nuts retaining i.e. control unit. | M6 | 0.55 | ● | ● | ● |

| PART | Thread | Tightening torques daNm | ENGINE 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Headlamp retaining nuts and bolts | M6 | 0.55 | ● | ● | ● |
| Third brake light retaining bolt | M5 | 0.2 | ● | ● | ● |
| Bolt retaining earth to body | M8 | 2.4 | ● | ● | ● |

**BODYWORK**

| PART | Thread | Tightening torques daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Bolt with hexagonal splined groove retaining luggage compartment catch | M8 | 2 | ● | ● | ● |
| Bolt with tapered washer retaining side door lock | M6 | 0.75 | ● | ● | ● |
| Hexagonal socket screw retaining fixed side door hinge | M10×1.25 | 4.5 | ● | ● | ● |
| Bolt retaining front bumpers | M6 | 0.4 | ● | ● | ● |
| Bolt retaining brackets to pretensioner | M6 | 4-6 | ● | ● | ● |

**AIR BAG SYSTEM**

| PART | Thread | Tightening torques daNm | 1242 16v | 1998 20v STEP A | 1910 JTD |
|---|---|---|---|---|---|
| Bolt retaining air bag control unit | M6 | 0.8 | ● | ● | ● |
| Bolt retaining driver module to steering wheel | M6 | 0.8 | ● | ● | ● |
| Bolt retaining passenger module to facia beam | M6 | 0.7 | ● | ● | ● |

page

**FUEL SYSTEM**

## FUEL SYSTEM WITH LUCAS FT09 PUMP

### INTRODUCTION

The devices making up the injection system are collectively responsible for introducing fuel into each cylinder and ensuring the required quantity is provided to provide even, effective combustion.

Efficient engine operation depends largely on precise injection.
The following essential conditions must be satisfied:

- each cylinder must be provided with the amount of fuel required by the engine during each cycle as dictated by rpm and load. In practice, this involves metering the fuel;
- the fuel must be introduced at the most effective moment and the beginning of injection must always be repeated at the same point in the cycle. This point is chosen to bring conditions as close as possible to the ideal engine operation cycle. It must be possible to alter this moment as the rpm changes;
- the fuel must be nebulised into tiny droplets to facilitate ignition;
- the droplets must possess sufficient kinetic energy to penetrate the mass of compressed air;
- the fuel particles must be diffused as evenly as possible in all directions so that as much of the air in the cylinder as possible can be used for combustion

The main features of the 1910 TD indirect injection system are as follows:

- fuel injection advance managed by an electronic control unit (ECU);
- turbocharged by a turbocharger and intercooler
- cross flow intake/exhaust ducts;
- Exhaust gas recirculation system for removal of NOx (controlled by the electronic control unit);
- Crankcase case reciculation system (Blow-by).

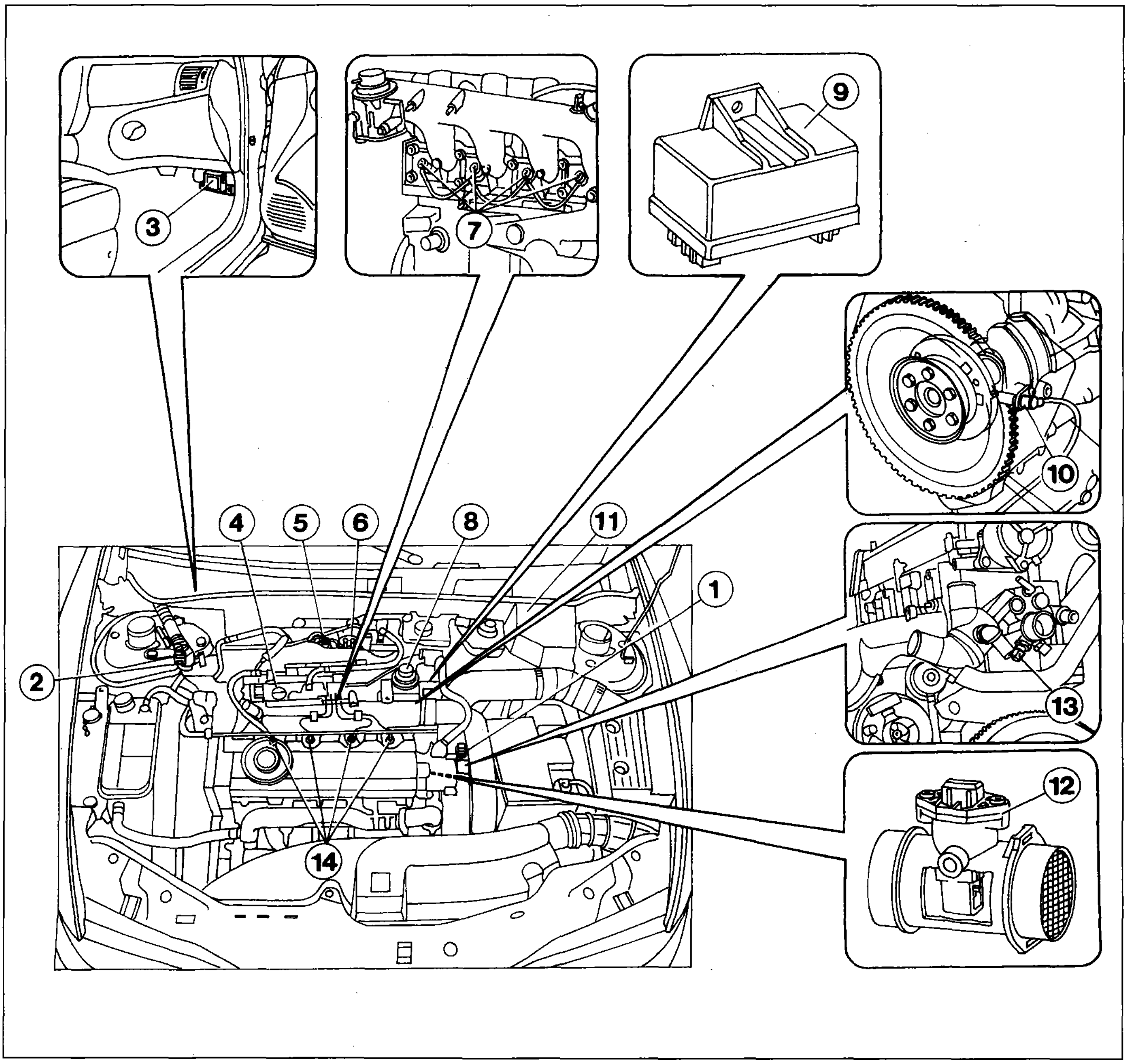
These devices ensure that this version meets EC F2 emission requirements while also allowing better fuel returns, lower noise levels and better handling.

### FUEL SYSTEM COMPONENTS

The fuel system is made up of the following main subsystems:

- Air intake circuit
- Fuel supply circuit
- Electric/electronic circuit
- Circuit for recirculating vapours from the crankcase (blow-by gases)
- Exhaust gas recirculation circuit (E.G.R.)

## LOCATION OF FUEL SYSTEM COMPONENTS




P4A02EJ01

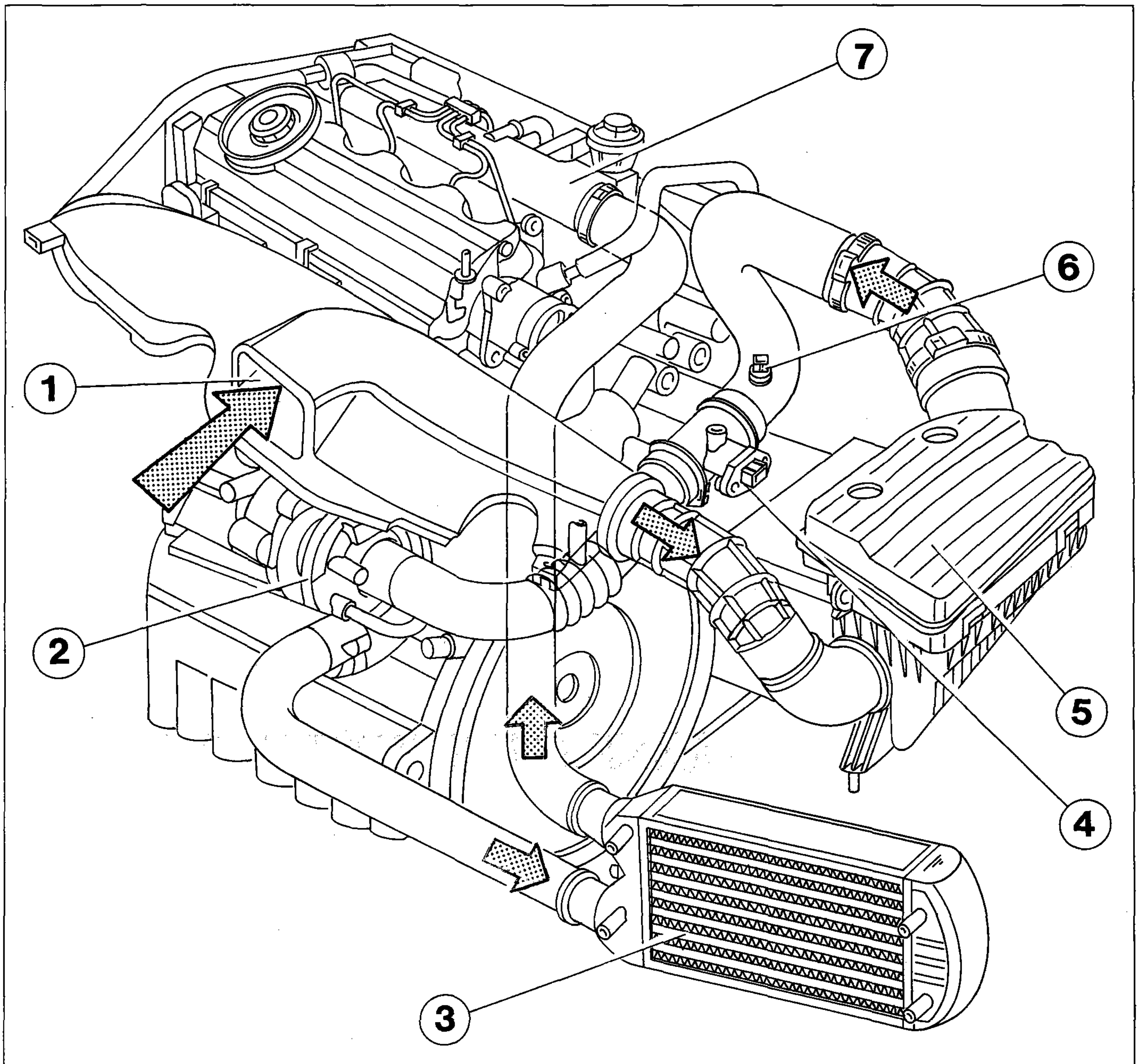
1. Air temperature sensor
2. Diagnostic socket
3. Electronic control unit
4. Injection pump
5. Fast idle valve
6. Borg Warner modulator valve
7. Heater plugs
8. E.G.R. valve. (Mitsubishi)
9. Pre-heating control unit
10. Rpm sensor
11. Preheating control unit fuse
12. Air flow meter (debimeter)
13. Coolant temperature sensor
14. Injectors

## AIR INTAKE CIRCUIT

The air intake circuit is turbocharged by means of a Garrett GT15 turbocharger with waste-gate.

Air is taken in through intake (1) and flows through filter (5) before compression in exhaust gas-driven turbocharger (2). Air then flows through the heat exchanger (intercooler) (3).

The air assumes optimal temperature and density properties and then flows to the intake manifold (7) for distribution to the cylinders.




P4A03EJ01

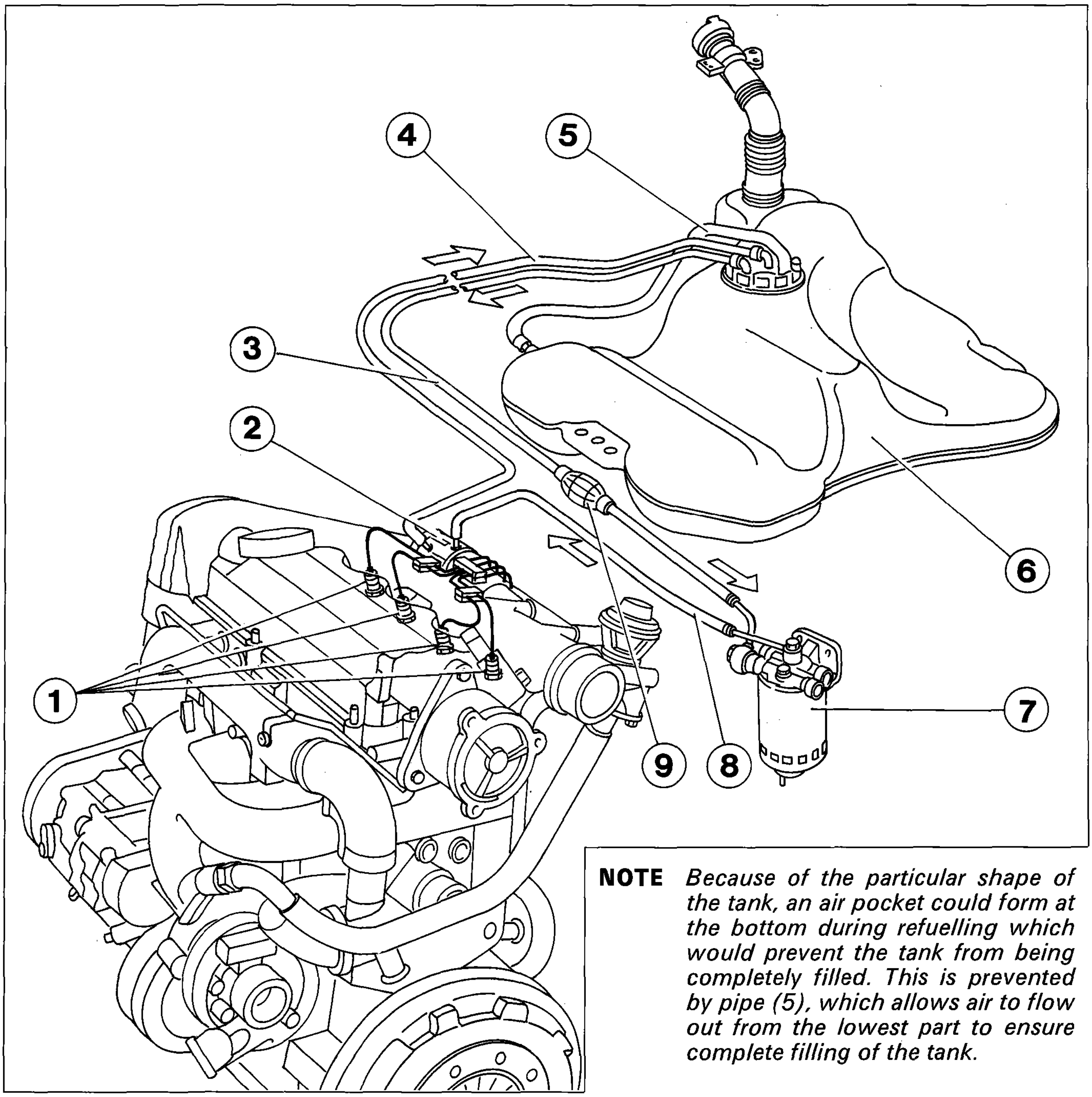
1. Inlet fitting
2. Turbocharger
3. Heat exchanger (intercooler)
4. Air flow meter (debimeter)
5. Air cleaner
6. Air temperature sensor
7. Inlet manifold

# 10.

### FUEL FEED CIRCUIT

The main components of the fuel system are as follows: tank, filter, injection pump and injectors. Fuel flows from tank (6) to injection pump (2) through filter (7). A pump (9) is fitted upstream from filter (7) to prime the fuel if necessary (e.g., after replacing the fuel filter).

Rotary injection pump (2) ensures injectors (1) are properly supplied with fuel in the firing order 1-3-4-2.




**NOTE** *Because of the particular shape of the tank, an air pocket could form at the bottom during refuelling which would prevent the tank from being completely filled. This is prevented by pipe (5), which allows air to flow out from the lowest part to ensure complete filling of the tank.*

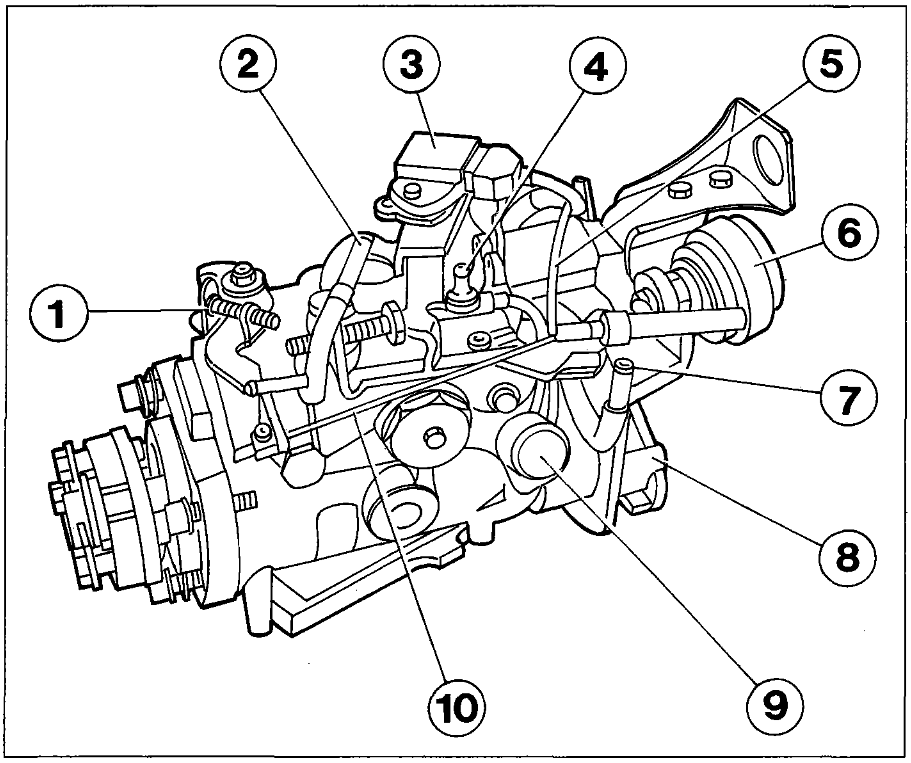
1. Injectors
2. Injection pump
3. Delivery line from tank to filter
4. Return line (recirculation)
5. Vent pipe
6. Reservoir
7. Fuel filter
8. Fuel outlet line from filter to injection pump
9. Hand-operated priming pump

**Injection pump**

The Lucas FT09 injection pump is designed specifically for indirect injection diesel pumps. New innovative features optimise engine service characteristics under all operating conditions. More specifically, the pump reduces fuel consumption, harmful emissions and noise levels.

The pump is rotary and its main characteristics are as follows:

- Injection advance altered by an electronic control unit.
- Centrifugal mass maximum flow regulator fitted to the pump shaft.
- Pump is lubricated by the fuel used to drive the pump.
- Extra fuel under conditions of fuel engine load or when full power is required.
- Coded, electronic fuel flow stop device built into the immobiliser system (Fiat CODE).




P4A05EJ01

1. Idle speed adjustment screw
2. Fitting for diesel return line to tank
3. Throttle lever position sensor.
4. Accelerator control lever
5. Engine stop solenoid protective cover
6. Fast idle actuator control device
7. Fitting for diesel delivery line from filter
8. Diesel delivery fitting to injectors
9. Advance actuator
10. Fast idle cable

# 10.

**Principle of operation**

Fuel taken up from tank (11) and filtered by filter (12), flows to feed pump (7) which increases fuel pressure.

Under the effect of the feed pump pressure regulator valve (2), the pressure increases in more or less linear fashion as engine rpm rises.

Valve (2) also by-passes the feed pump (7) during priming.

Fuel flows from the feed pump to metering device (6), which calculates the amount of fuel to be sent to pumping element (4) and thus the effective output of the injectors.

The position of metering device (6)is controlled by speed regulator (13) on the basis of accelerator pedal position.

The pumping element consists of two opposing plungers which slide radially in the rotor and are operated by the profile of a ring with cams via rollers and sliding pads.

The plungers lack return springs because they are pressed outward by centrifugal force and the pressure of the fuel entering during the supply stage.

The rollers which drive the plungers come into contact with the cam profile at different points according to the length of travel during the fuel supply stage.

This travel is dependent upon the amount of fuel entering the pumping chamber, regulated by the metering device, and upon plunger expansion time determined by pump rotating speed.

During the injection stage, the plunger control rollers come into contact with the cams and the plungers are pushed inward to raise the pressure and bring about injection.

At the end of the injection stage, the plungers are pushed outward to lower the pressure. Fuel delivery stops and valve (5) seals off the outlet pipe.

Valve (5) not only closes the delivery pipe but also instantaneously lowers the pressure in the pipe leading to injector (10). This quickly shuts off injection to prevent the injector dripping.

The maximum quantity of fuel which may be fed into the pumping element (4) during each cycle is determined by a maximum flow regulator.

Pressure inside pumping element (4) is maintained at a constant level by pressurisation valve (9).

Turbocharging control valve (1) increases the fuel flow. Increased turbocharging pressure compresses a membrane located inside the valve to move a piston which transfers feed pressure to the sliding pad actuator located inside pumping element (4). The sliding pads move to alter plunger travel and thus also the quantity of fuel injected.

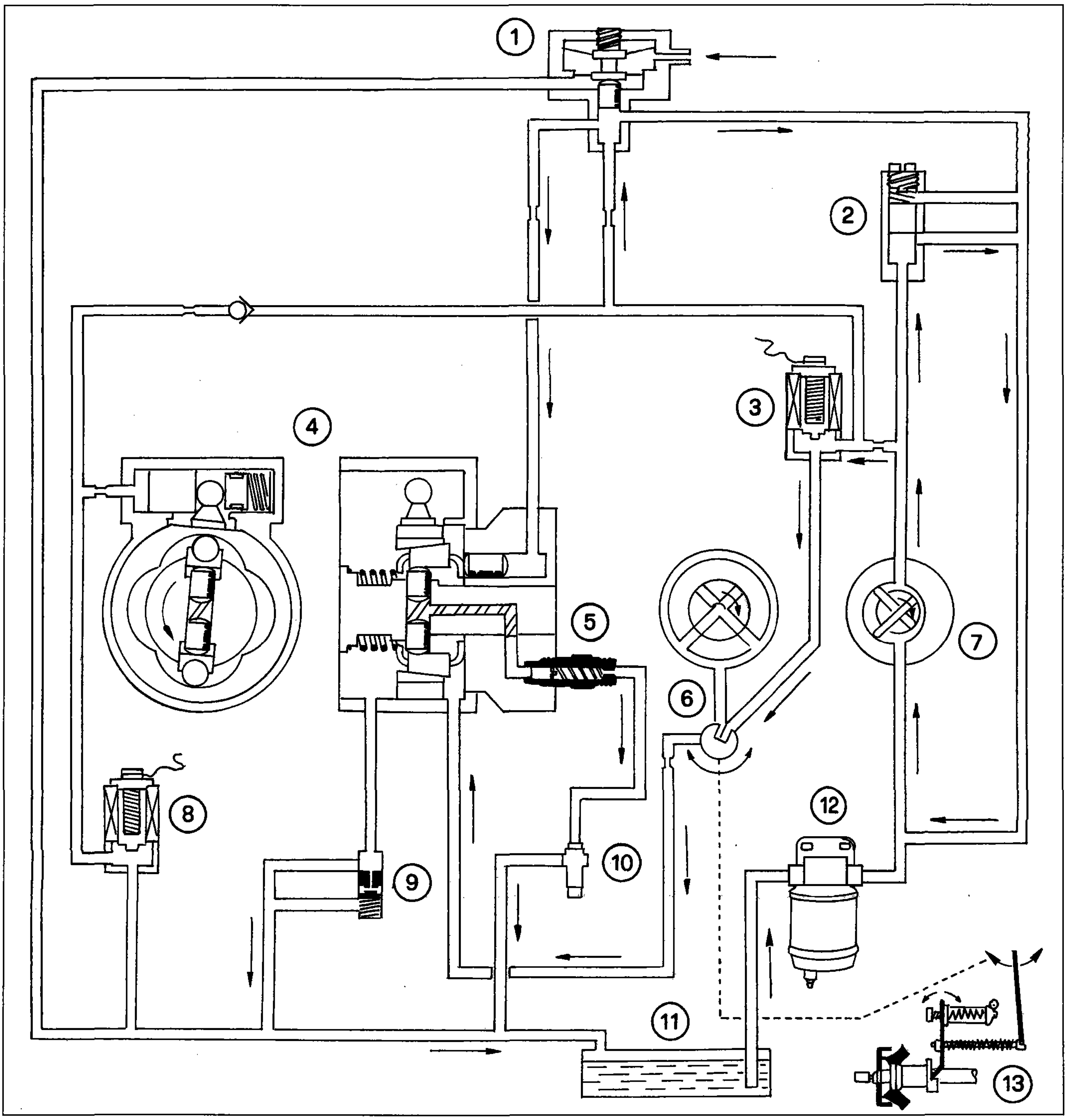
Solenoid (8), controlled by a electronic control unit, alters the pump delivery advance to bring about an increase when engine load exceeds a given threshold.

The engine stop solenoid (3) is protected by a tamper-proof cover.

During engine operation, the solenoid remains active so that fuel may flow from feed pump (7) to the intake duct.

When the key is turned to switch off the engine, the solenoid is deactivated to shut off the fuel flow. The metering device feed chamber is no longer supplied with fuel and the engine stops.

## FUEL CIRCUIT DIAGRAM



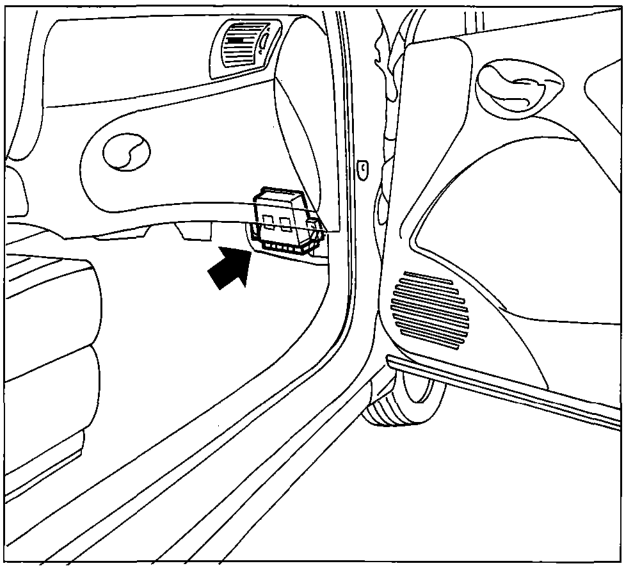

1. Turbocharging control valve
2. Feed pressure regulator valve
3. Engine stop solenoid
4. Pumping element
5. Outlet valve
6. Metering device
7. Feed pump
8. Advance actuator control solenoid
9. Pressurisation valve
10. Injectors
11. Tank
12. Filter
13. Speed regulator

# 10.

## ELECTRIC-ELECTRONIC SYSTEM

The fuel system electric - electronic circuit comprises a wiring circuit, an electronic unit (control unit) and the following sensors and actuators:

- Rpm sensor
- Coolant temperature sensor
- Air flow meter (debimeter)
- Intake air temperature sensor
- Injector with controls
- Accelerator lever position sensor
- Fast idle control solenoid
- Preheating control unit

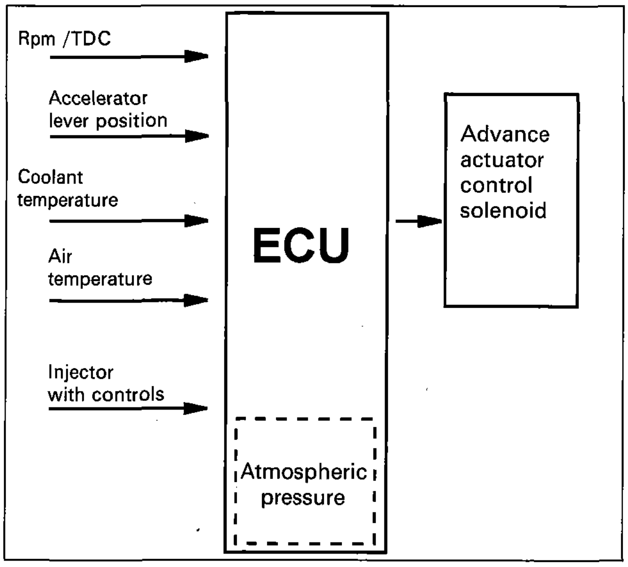


P4A08EJ01

### Electronic control unit

The electronic control unit (ECU) is located beneath the glove compartment (right hand side) and is connected to the wiring by a 25 pin connector. This receives all the data on engine service conditions transmitted by the various sensors in addition to atmospheric pressure information obtained by a sensor located inside the control unit. The control unit uses this data in conjunction with specific programs to implement the following operating strategies:

- injection advance control
- fast idle control
- exhaust gas recirculation
- glow plug pre/post heating control
- air conditioning system control

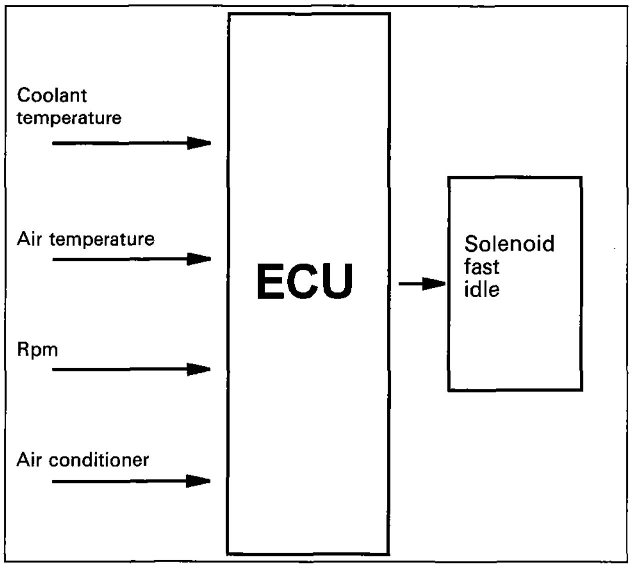



P4A08EJ03

## INJECTION ADVANCE CONTROL

The electronic control unit uses data on engine rpm/TDC, accelerator lever position, air and coolant temperature and atmospheric pressure to calculate the optimal injection advance. It compares this with the actual value transmitted by the injector with controls and adjusts the advance actuator control solenoid when required.

## FAST IDLE MANAGEMENT

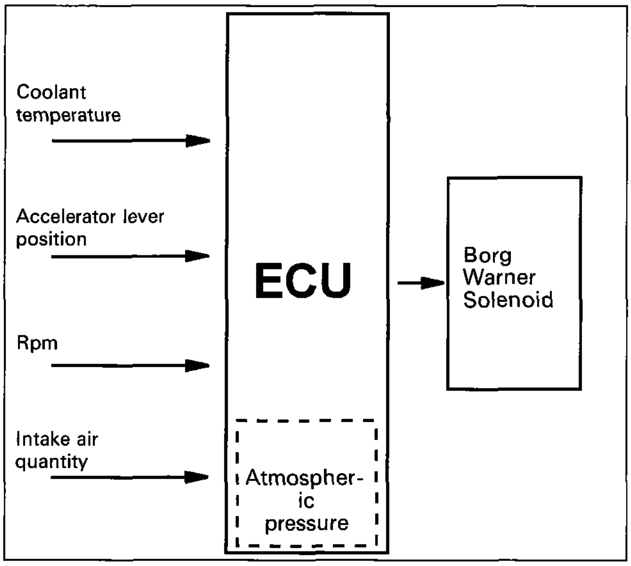



P4A09EJ01

The control unit activates the fast idle when at least one of the following conditions occurs:

1. Intake air temperature less than 25° C and coolant temperature less than 55° C.
2. Air conditioner compressor on.
3. Engine speed less than 750 rpm.

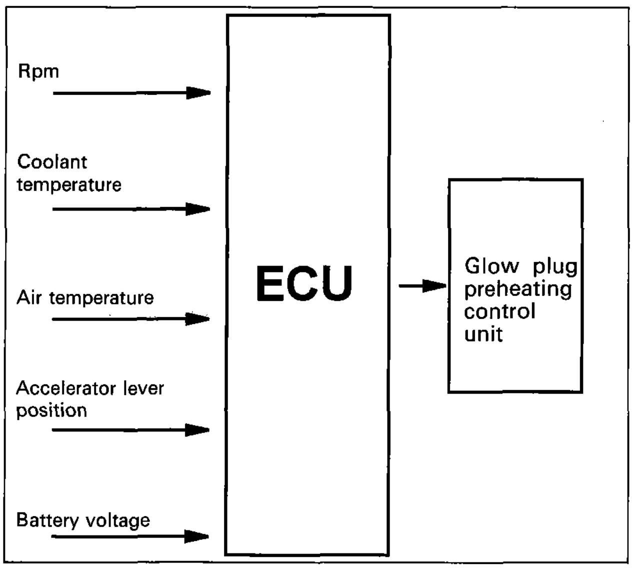
## EXHAUST GAS RECIRCULATION CONTROL




P4A09EJ02

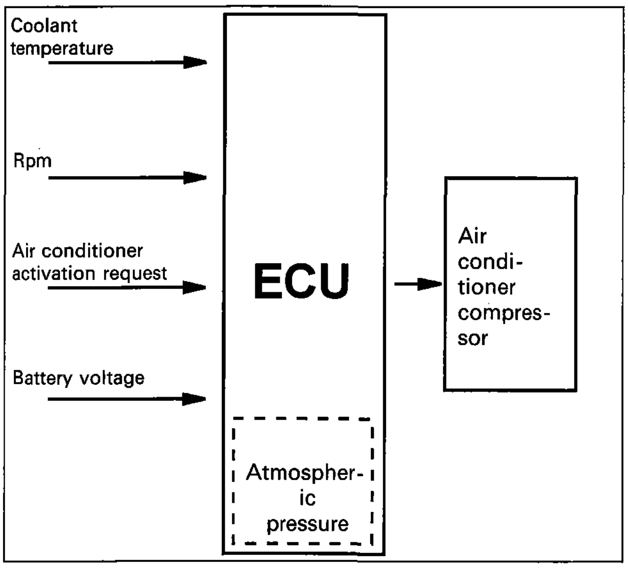
The control unit calculates the weight ratio between "clean" air taken in and the quantity of burnt gases which may be returned to the intake. On the basis of engine load, coolant temperature and intake air quantity, the control unit controls the Borg Warner modulator valve which in turn activates the EGR valve via a vacuum signal in order to recirculate the exhaust gas.

## GLOW PLUG PRE/POST HEATING MANAGEMENT




P4A09EJ03

The electronic control unit (ECU) controls the glow plug preheating control unit directly to manage pre and post heating times, mainly on the basis of coolant and intake air temperature. When calculating post-heating times, the control unit also takes into account accelerator lever positin and rpm. Heating times are reduced when there is a high demand for engine power.




P4A10EJ01

## AIR CONDITIONING SYSTEM CONTROL

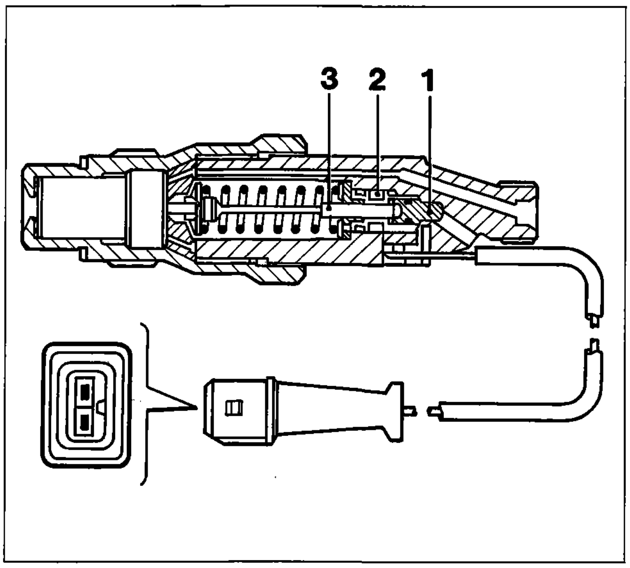
When the air conditioner is turned on, the compressor absorbs power from the engine, which tends to stall when only idling. The control unit activates the fast idle function described previously to prevent this problem occurring.
The control unit also deactivates the compressor if one of the following conditions occurs:

1. Coolant temperature greater than 110 °C.
2. A given rpm threshold is exceeded (about 4500).
3. High engine power demand (high acceleration).

Under conditions 1 and 2 the compressor is reactivated when coolant temperature or rpm drop below the intervention threshold.
Under condition 3, power is cut off only temporarily and automatically restored after a few seconds even if the power requirement is still high.

### Injector with controls

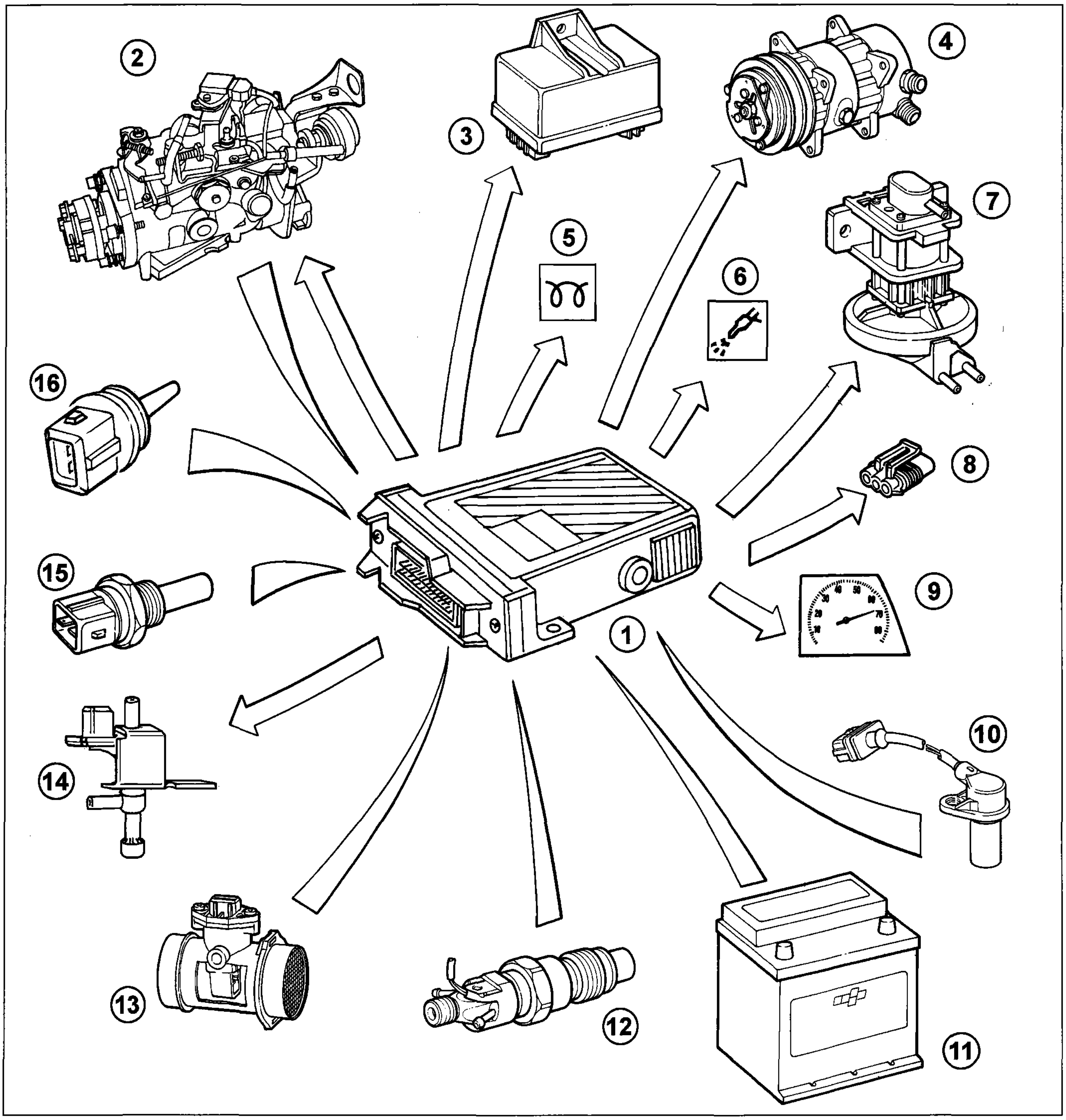
The injector with controls informs the electronic control unit of the true injection advance (beginning of injection stage, i.e. when the needle valve begins to move).




P4A08EJ02

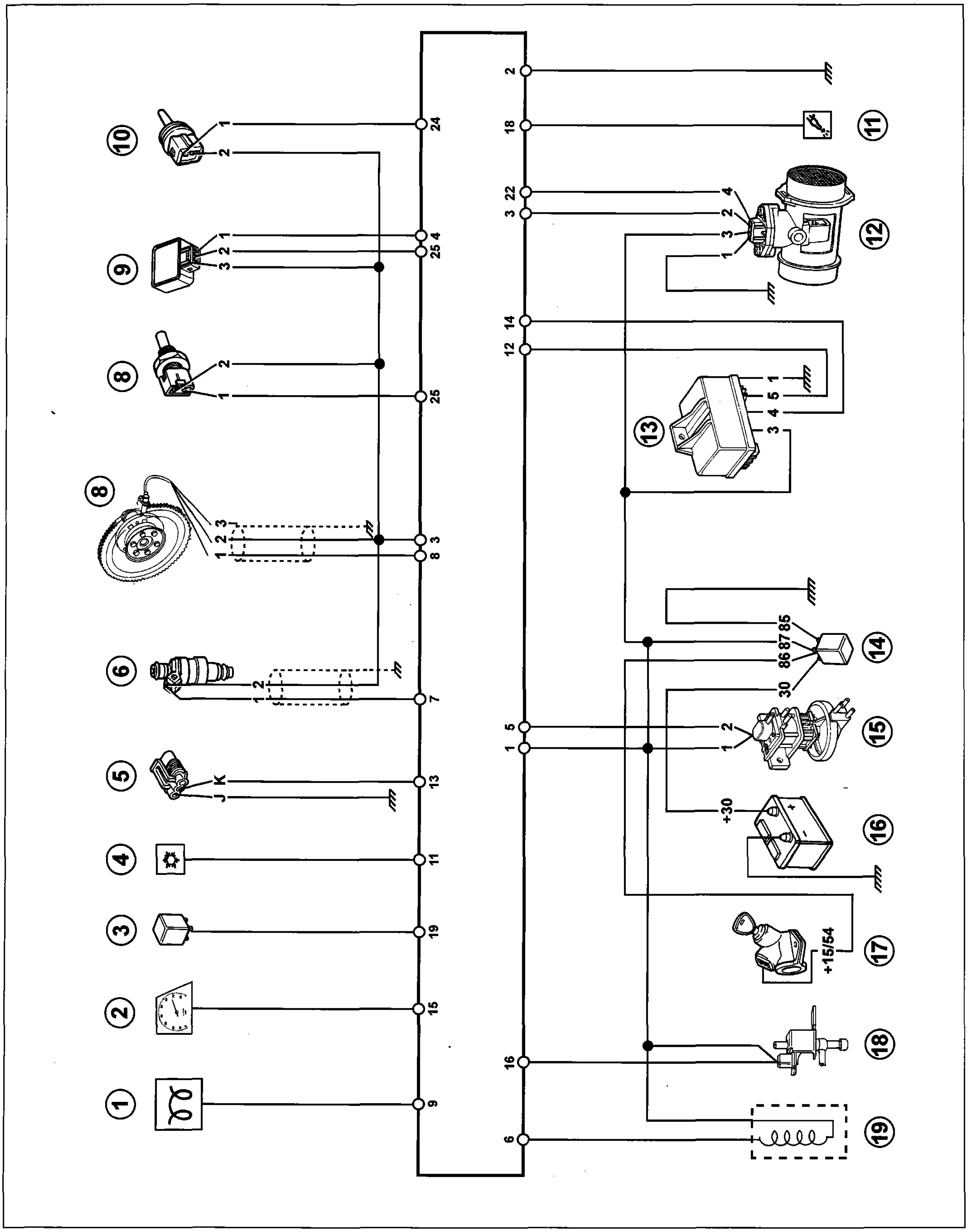
On the basis of the signal, the control unit corrects the advance set by the injector actuator until the rated value is reachede.
The injector is fitted to cylinder (1) and equipped with a device to identify the exact moment at which the injection stage begins and wiring to send a signal to the electronic control unit.
The injector contains a coil (2), a needle valve (3) and an adjustment pin (1). The coil is electrically activated and generates a magnetic flow which affects the needle valve (3). When the needle valve begins to open the nozzle for fuel injection, the magnetic flow alters in coil (2). The control unit identifies this as the moment when injection begins and bases its advance adjustment strategy on this reading.

## INPUT AND OUTPUT SIGNALS BETWEEN ECU/SENSORS AND ACTUATORS




1. Electronic control unit
2. Injection pump
3. Glow plug control unit
4. Heating/ventilation system
5. Glow plug warning light
6. Injection system failure warning light
7. Borg Warner solenoid
8. Diagnostic socket
9. Rev counter
10. Rpm sensor
11. Battery
12. Injector with controls
13. Air flow meter (debimeter)
14. Fast idle valve
15. Coolant temperature sensor
16. Air temperature sensor

## WIRING DIAGRAM

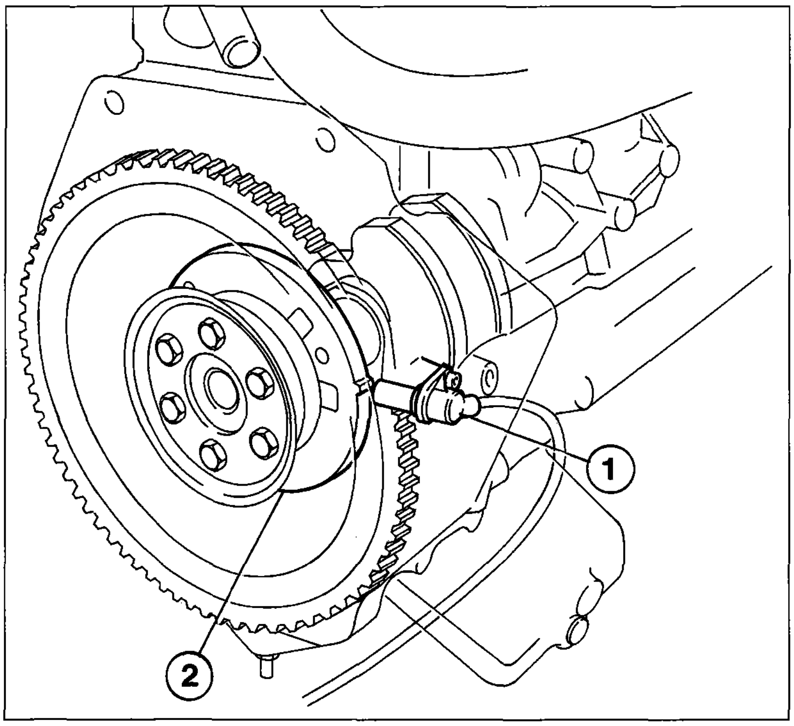


P4A10EJ02

**Key to wiring diagram**

1. Heater plugs warning light
2. Rev counter signal
3. Air conditioner relay
4. Air conditioner activation button
5. Fiat/Lancia Tester fault diagnosis point
6. Injector with controls
7. Rpm and TDC sensor
8. Coolant temperature sensor
9. Accelerator lever position sensor
10. Intake air temperature sensor
11. Injection system failure warning light
12. Debimeter
13. Preheating control unit
14. System relay
15. Borg Warner solenoid (E.G.R)
16. Battery
17. Ignition switch
18. Fast idle valve
19. Solenoid for advance adjustment device

**Rpm and phonic wheel sensor**



P4A13EJ03

**Specifications:**

Gap
0.8 - 1.5 mm

Winding resistance
860 ohm ± 10% at 20°C

1. Rpm sensor
2. Phonic wheel

The rpm sensor is fitted on the crankcase and faces a phonic wheel located inside the crankcase and fastened to the crankshaft.

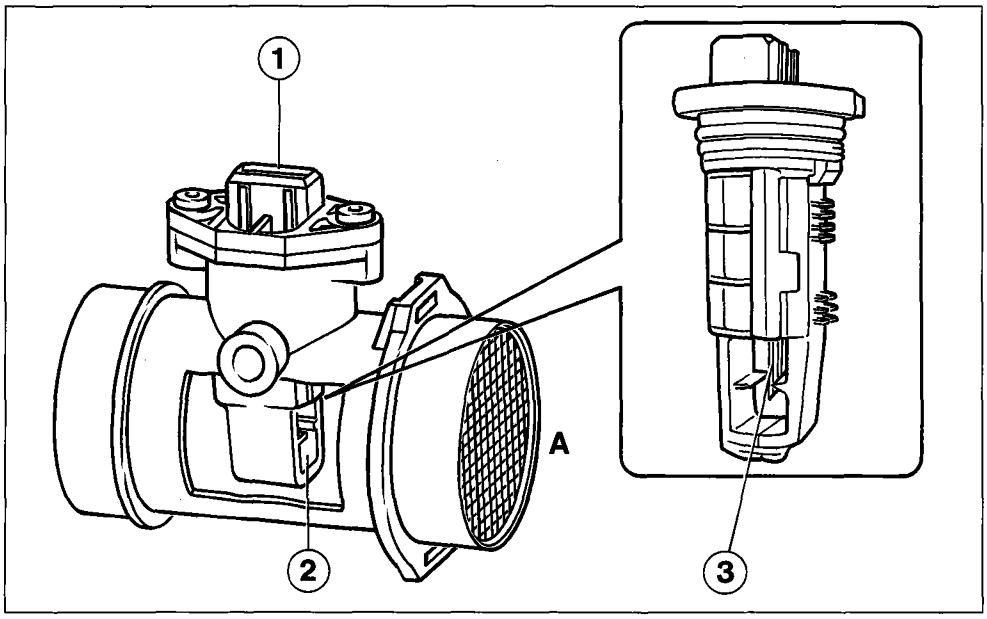
The steel phonic wheel is fitted with two reference dowels on the outer part of the circumferenc, each one located 10° after top dead centre.

When these dowels or teeth pass beneath the sensor, the gap brings about a change in the magnetic flux which in turn induces a current in the sensor coil windings.

This signal provides the control unit with information on engine rpm.

### Air flow meter (Debimeter)

The air flow meter (Debimeter) is hot film type. In this system, a heated membrane is placed in a measurement channel through which air is taken into the engine.
The film membrane is maintained at a constant temperature ( ~120°C above air temperature) by an adjacent heating coil.
The mass of air flowing through the measurement channel tends to remove heat from the membrane. To keep the membrane at constant temperature, a certain current must therefore flow through the heating coil. This current is measured by means of a Wheatstone bridge.
The measured current is therefore proportional to the flowing air mass.




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

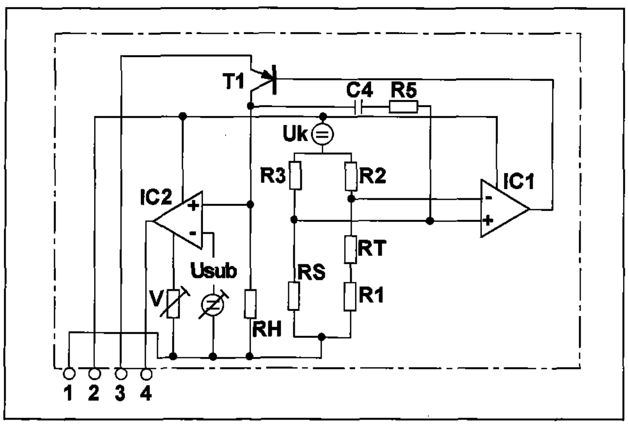
A= Air intake

P4A31FJ01

**NOTE** *This debimeter measures air mass directly (not volume) and thus eliminates problems of temperature, altitude, pressure etc.*

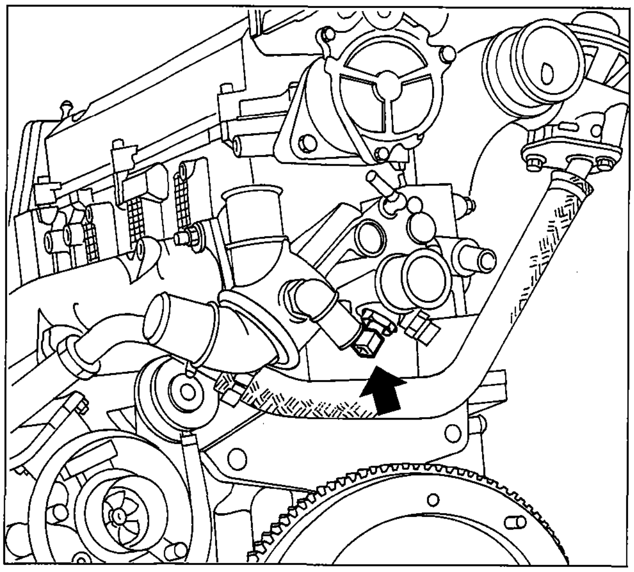
### Operating description

The Wheatstone bridge (R3, R2, Rs, Rt+R1 format) is in equilibrium when Rs is about 120°C more than air temperature.
The air flowing through the membrane removes heat from Rs, and the bridge becomes imbalanced. This sitaution is deteced by the circuit connected to IC1, which controls transistor T1 to an extent proportional to bridge imbalance. T1 then sends more current through Rh to heat Rs and thus restore the bridge to equilibrium.
Circuit IC2 measures the current flowing through Rh. This current maintains the bridge in equilibrium and is thus proportional to the mass of air flowing through the air meter.




**Wiring diagram of air flow meter**

P4A31FJ02

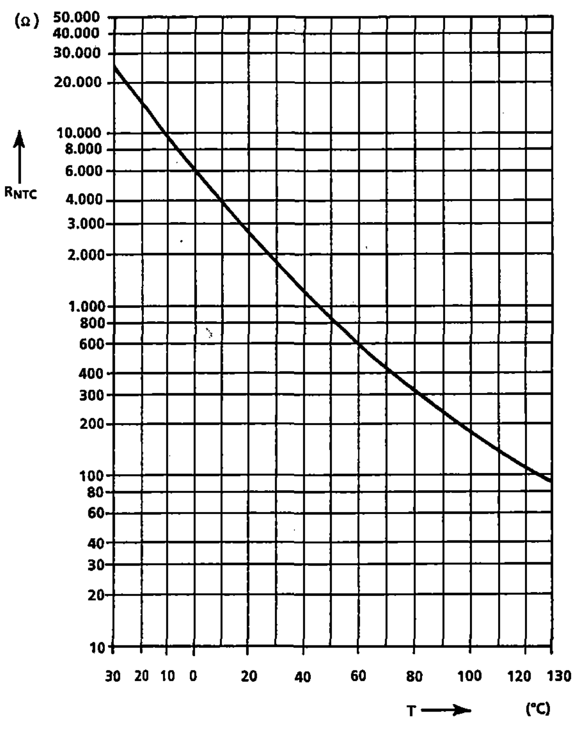


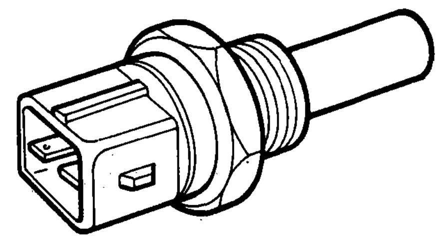
P4A13EJ01

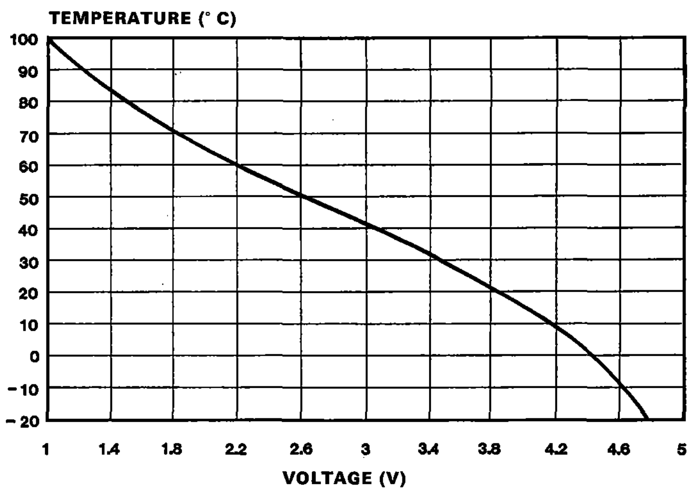
### Coolant temperature sensor

Coolant temperature is measured by a sensor containing an NTC resistance, which alters resistance in inverse proportion to temperature as shown in the diagram.

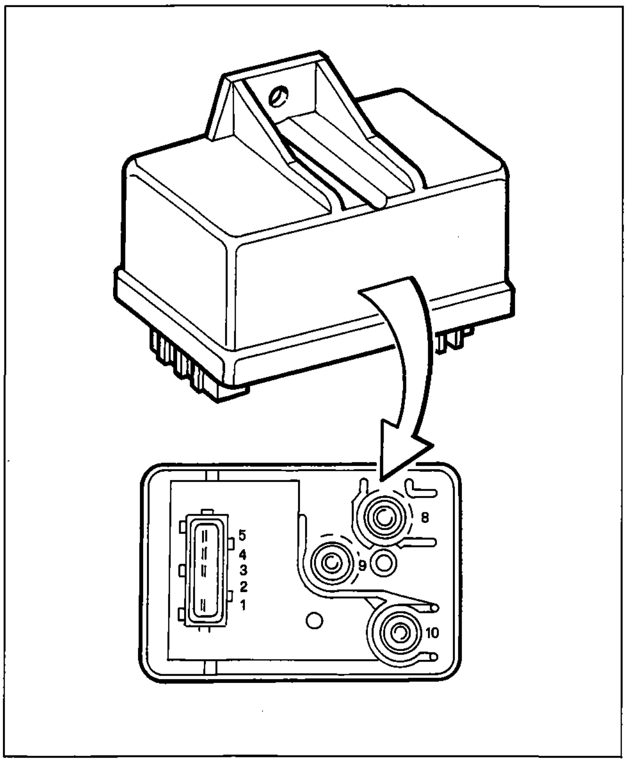
The control unit records a voltage change proportional to the current intensity flowing through the sensor.
When fitting the sensor, take care not to tighten to more than 15 Nm






P4A13EJ02




P4A14EJ01

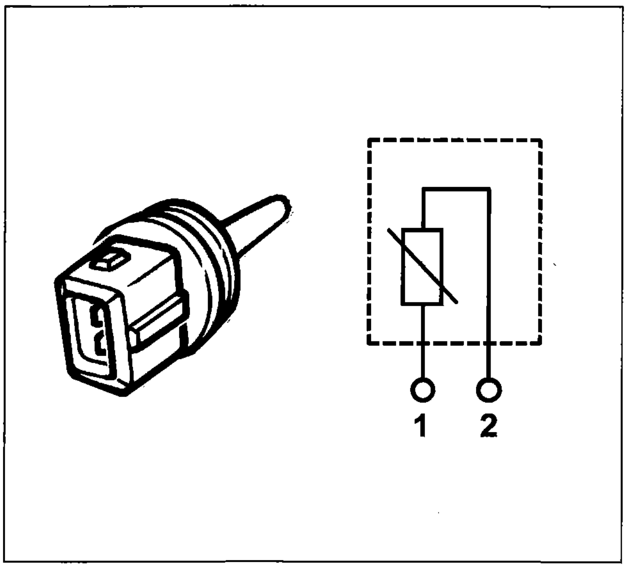
**Preheating control unit**

The glow plugs are controlled by the preheating control unit under the direct control of the electronic control unit.
The unit contains a smart relay which sends feedback to the electronic control unit in order to inform it of faults in the preheating unit or short-circuits in the glow plugs.

The figure shows the connectors located on the base of the preheating control unit and the pin-outs.

*Connections*

1. Vehicle earth
2. Not connected
3. Ignition switch (+15)
4. Electronic control unit (pre-postheating activation)
5. Electronic control unit (fault diagnosis)
8. Battery positive
9. Glow plugs
10. Glow plugs

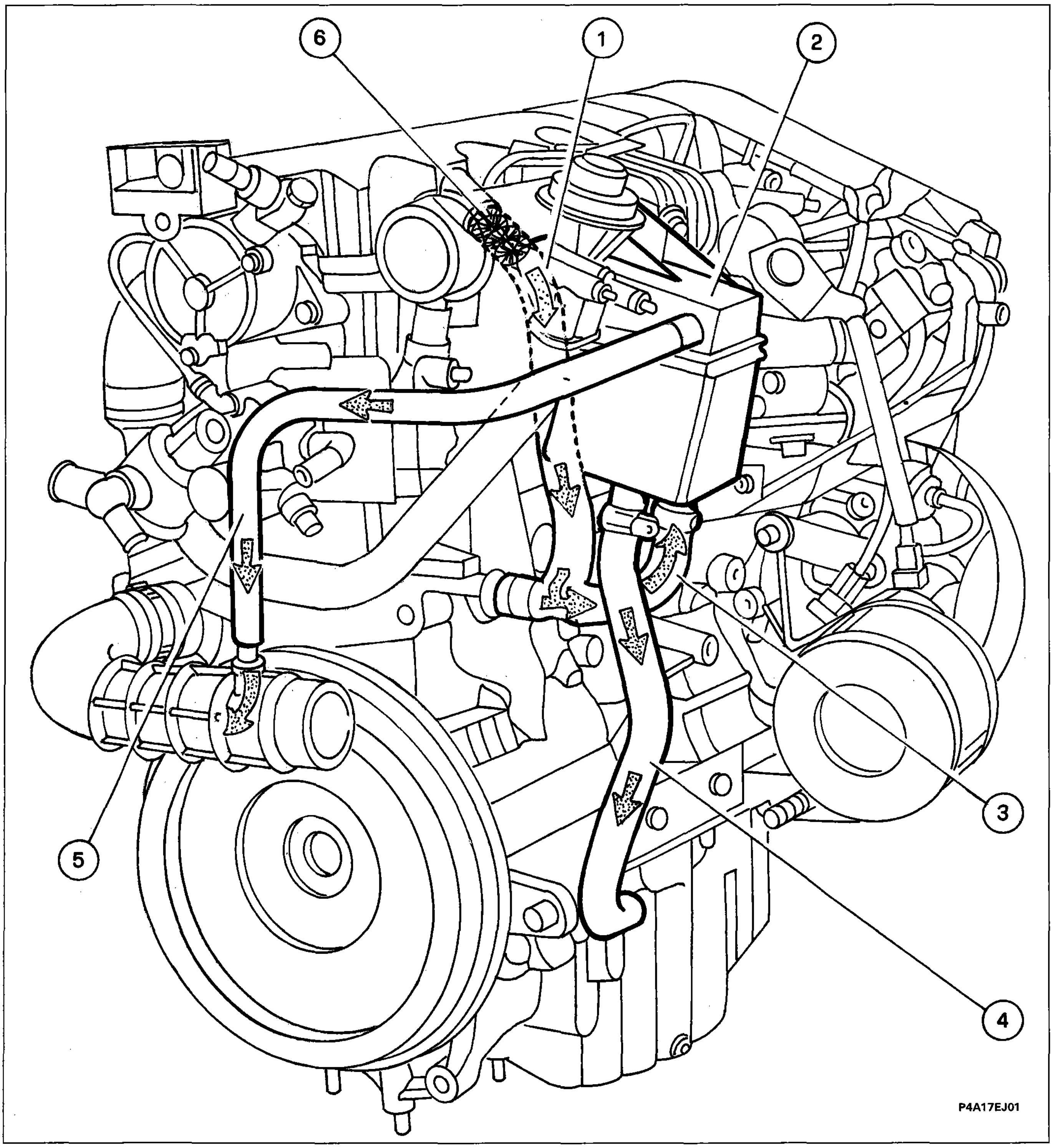



P4A30FJ01

**Air temperature sensor**

The intake air temperature sensor is separate from the air flow meter in this version. It is a normal Negative Temperature Coefficient (NTC) sensor: its electric resistance drops as temperature increases.
Because the control unit input circuit is designed as a voltage divider, this voltage is distributed between a resistance in the control unit and the sensor NTC resistance.
The control unit is therefore able to assess sensor resistance changes through voltage changes and obtain temperature information.

**BLOW-BY GAS RECIRCULATION DIAGRAM)**




Crankcase emissions are made up of a mixture of air, diesel and burnt gases which leak through the piston rings, in addition to lubrication oil vapour.
This mixture is defined "blow-by" or "vent" gas.
Vent gases from the crankcase and cylinder head flow through pipe (3) to separator (2) where they lose part of their oil content in the vortex. This falls back to the sump through pipe (4) in the form of droplets (4).
The remaining gases flow through pipe (5) and are directed to the intake circuit.
Cylinder head gas outlet pipe (1) contains a flap trap (6) to prevent the pipe catching fire due to flame flash-back.

# 10.

### EXHAUST GAS RECIRCULATION SYSTEM (E.G.R.))

This system directs a proportion of the exhaust gases to the intake under certain engine operating conditions.

The process dilutes the fuel mixture with inert gases to lower the temperature peak in the combustion chamber. This reduces the formation of nitrogen oxides to bring about a 30-50 % reduction in emissions.

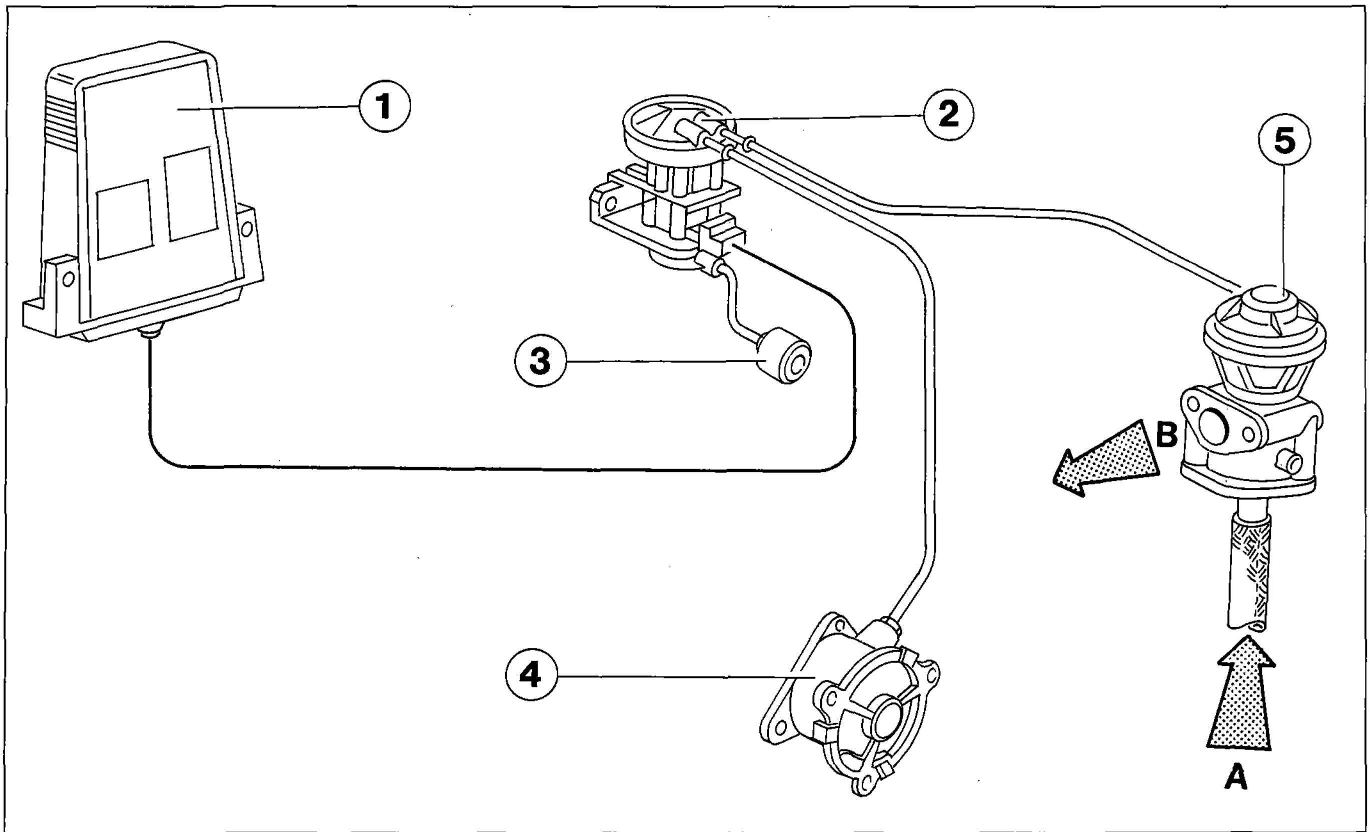
Exhaust gas recirculation is allowed only at medium-low loads, when the air - fuel ratio is very high and engine operation is not impaired by the presence of inert gases instead of air.

The recirculation system is controlled by electronic control unit (1), which receives input signals from a potentiometer on the accelerator lever (on the injection pump) and from the rpm and coolant temperature sensors. It produces an output signal which controls the Borg Warner modulator solenoid and hence the E.G.R. (2).

The E.G.R. is connected to the atmosphere through filter (3). According to an input signal, the valve directs a higher or lower vacuum from the brake servo vacuum pump (4) to the Pierburg EGR valve (5).

If the vacuum is sufficient, this valve opens to bring the exhaust manifold into communication with the intake manifold.

The amount of gas recirculated can therefore be altered by adjusting Pierburg E.G.R. valve opening continuously on the basis of maps saved in the ECU memory and the degree of opening, which is in turn dependent on signals received.

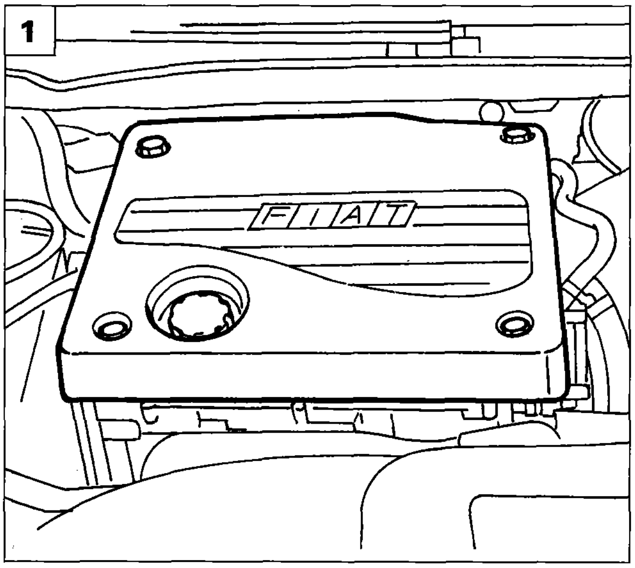



P4A16EJ01

1. Electronic control unit
2. Borg Warner modulator solenoid controlling EGR.
3. Atmospheric intake filter
4. Vacuum pump for brake servo
5. E.G.R. valve.

A. Gas from the exhaust manifold
B. Gas sent to intake

page

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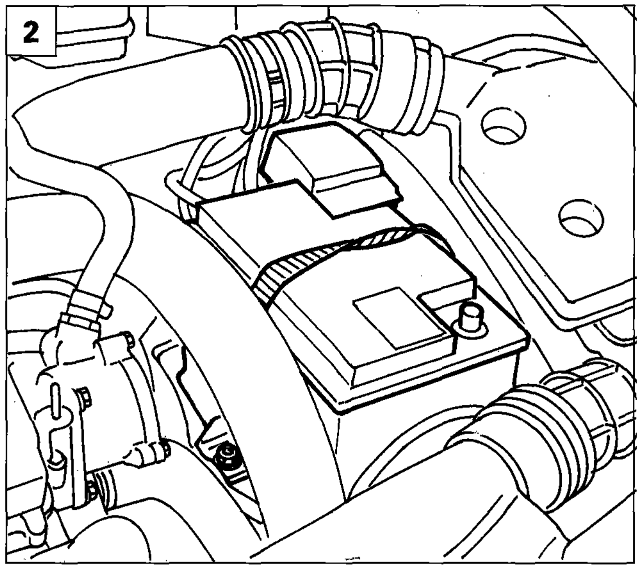


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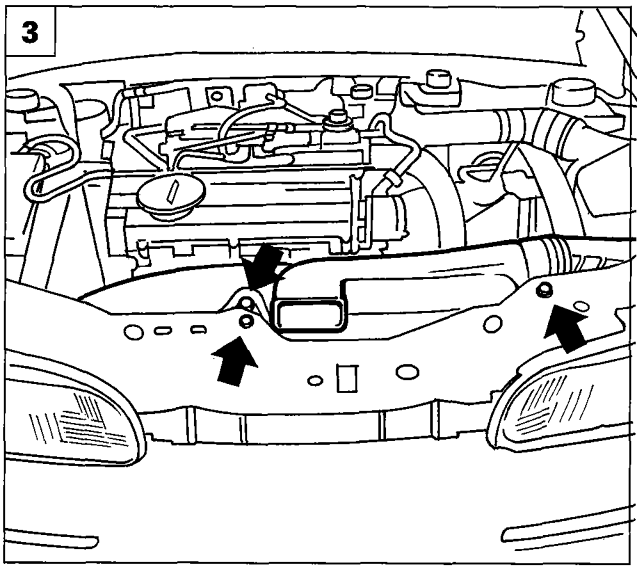


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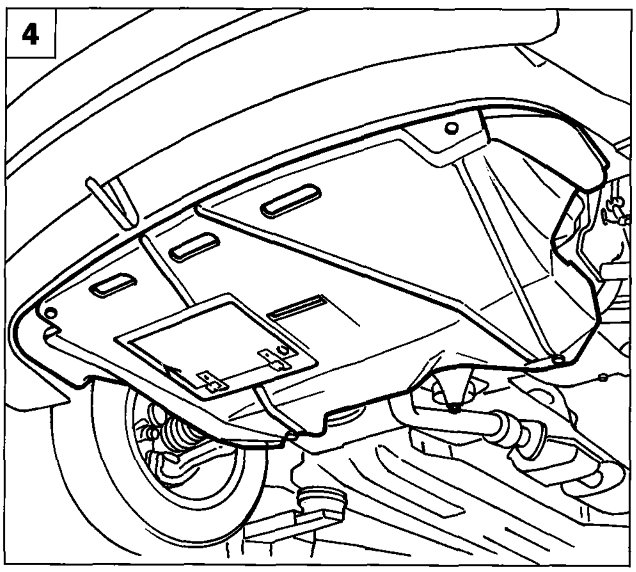


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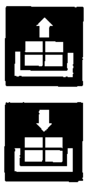
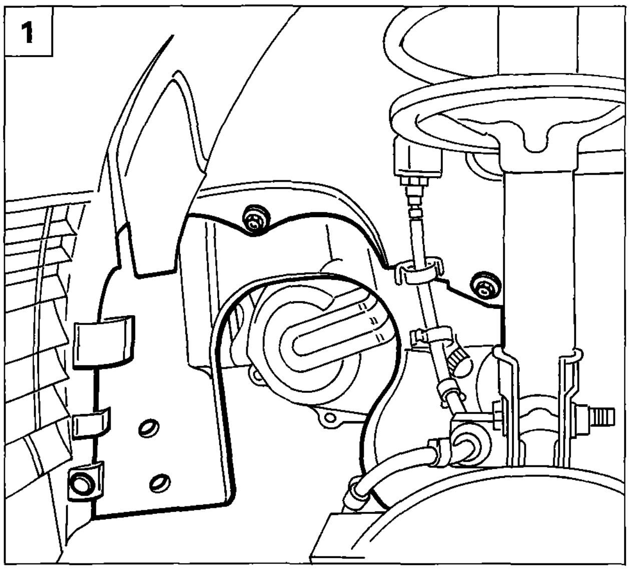


## REMOVING - REFITTING

Position the vehicle on a lift, remove the front wheels and disconnect the battery negative terminal. Then proceed as follows.

1. Remove the upper engine guard.
2. Disconnect the battery positive terminal, unscrew the nut securing the battery to its cradle and remove from the engine bay.
3. Unscrew the retaining bolts shown and remove the air shroud shown in the figure.
4. Raise the lift and remove the lower engine bay guard.

# 10.

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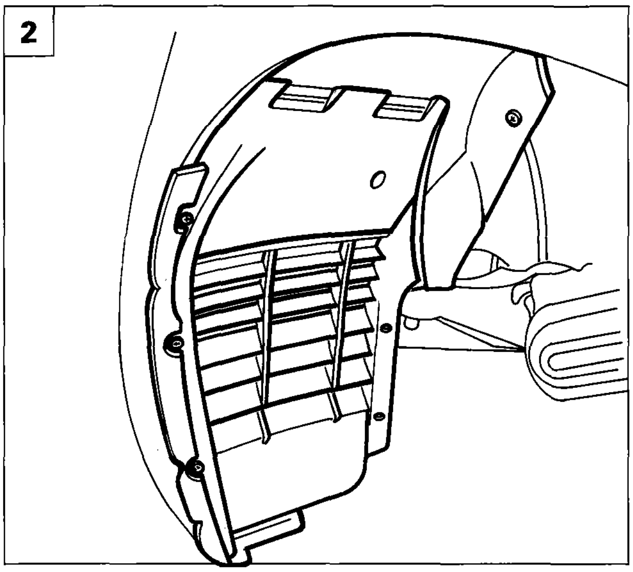


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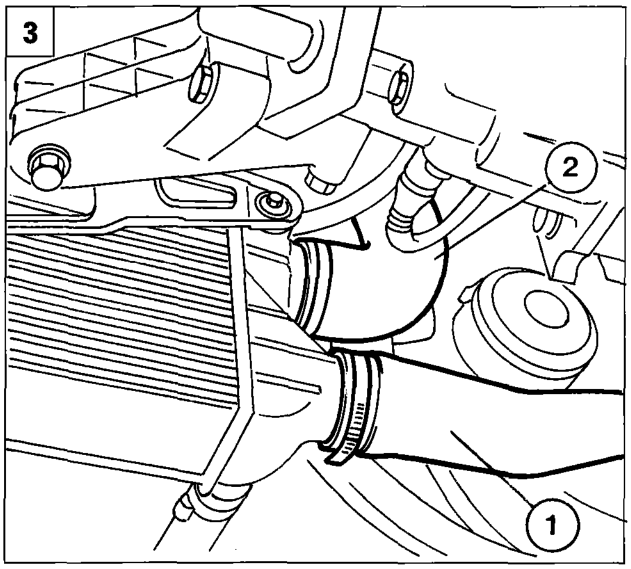
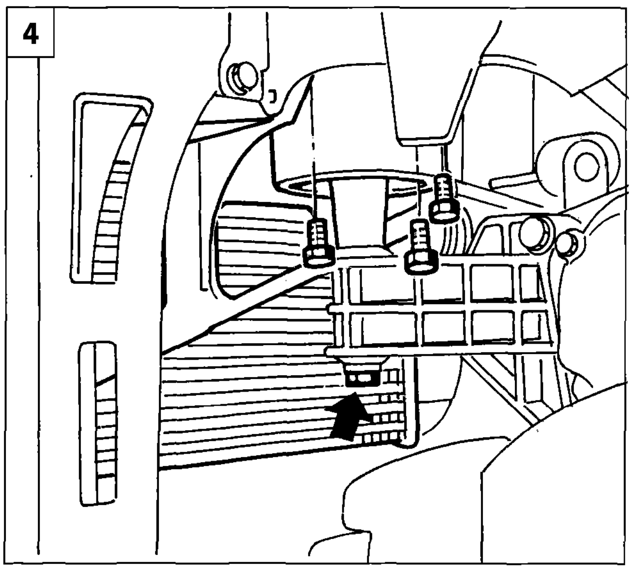



P4A02FX03

1. Use tool 1878077000 to undo the stud, unscrew the bolts and release the dust guard from its seat.
2. Remove the wheel arch guard shown.
3. Disconnect sleeve (1) connecting turbine - intercooler and air outlet sleeve (2) from intercooler to intake manifold.
4. Position the hydraulic jack to support the power unit and remove the engine mount on the body. Lower the engine and remove the intercooler with bracket. Reposition the engine mount when the operation is complete.
5. Position a container to recover the engine coolant, then disconnect the coolant intake sleeve from the radiator.

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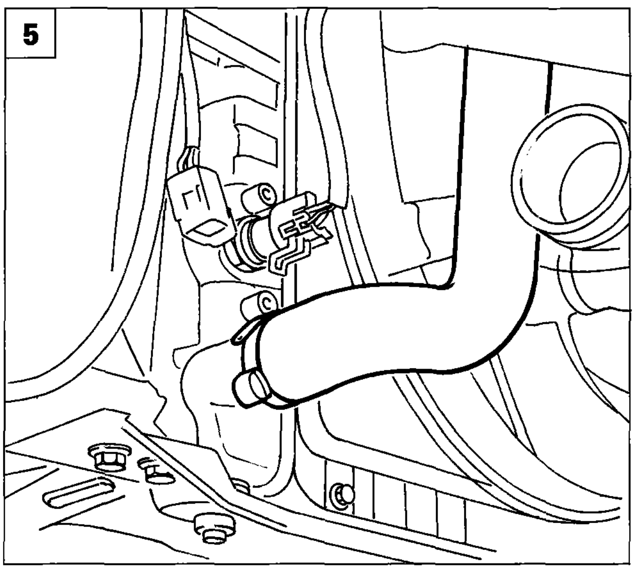


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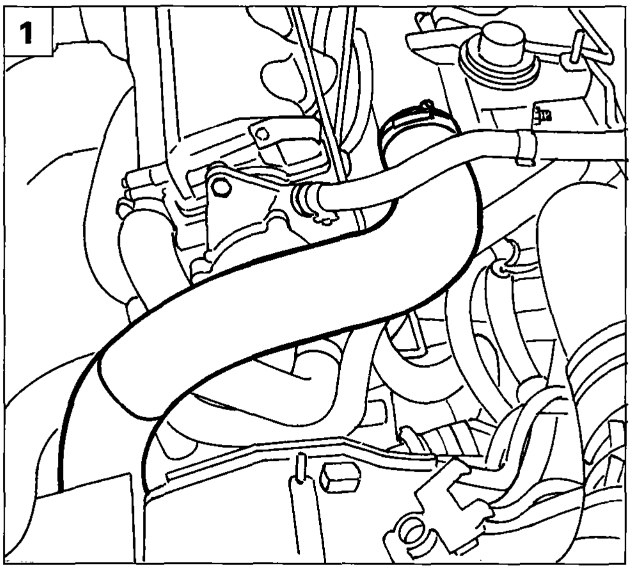

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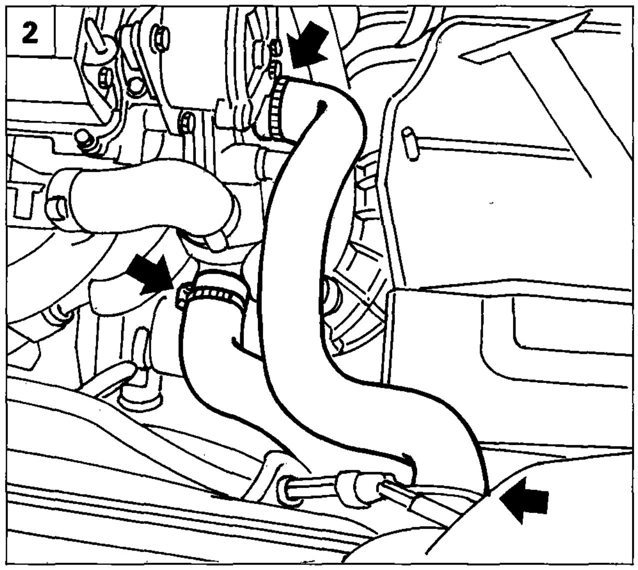

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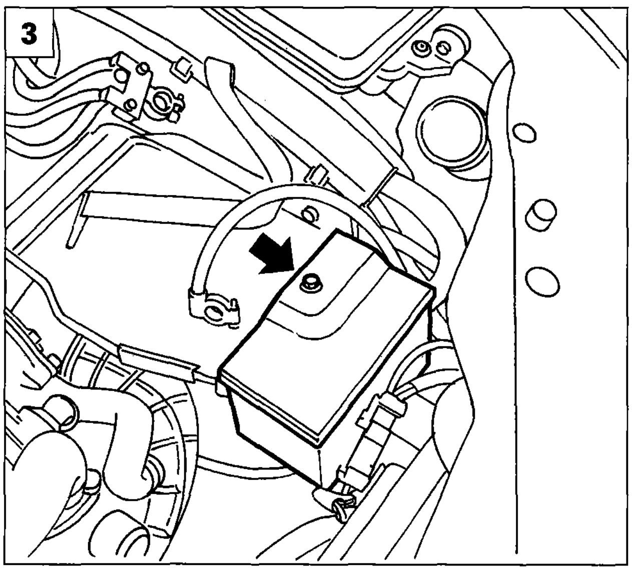
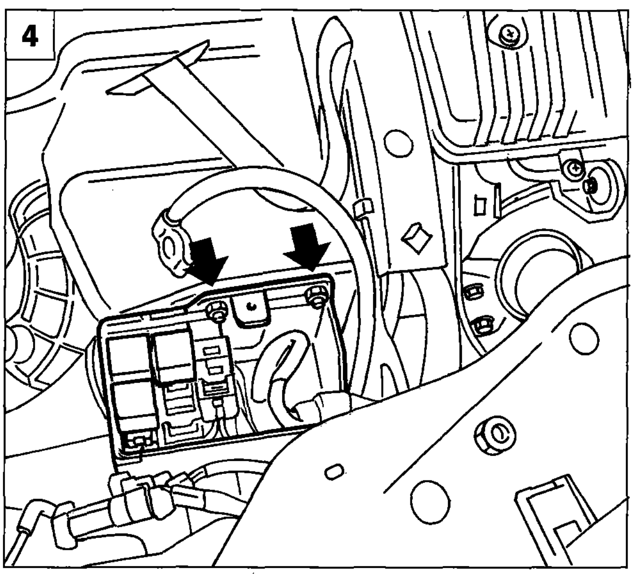


P4A03FX03

1. Remove the pipe indicated by disconnecting from the clip located on the intake manifold.
2. Remove the coolant intake and outlet pipes from the points shown.
3. Unscrew the relay case cover bolt shown in the figure.
4. Unscrew the nuts illustrated and place the relay box to one side in the engine bay
5. Unscrew bolts (1), loosen bolt (2) and then remove the battery cradle.



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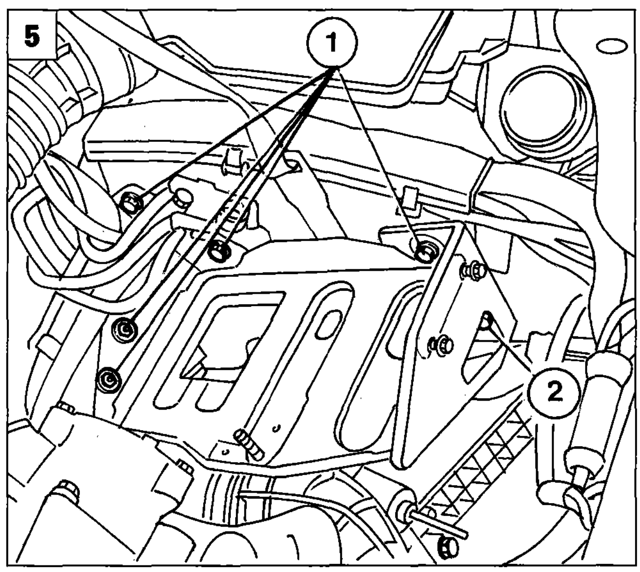

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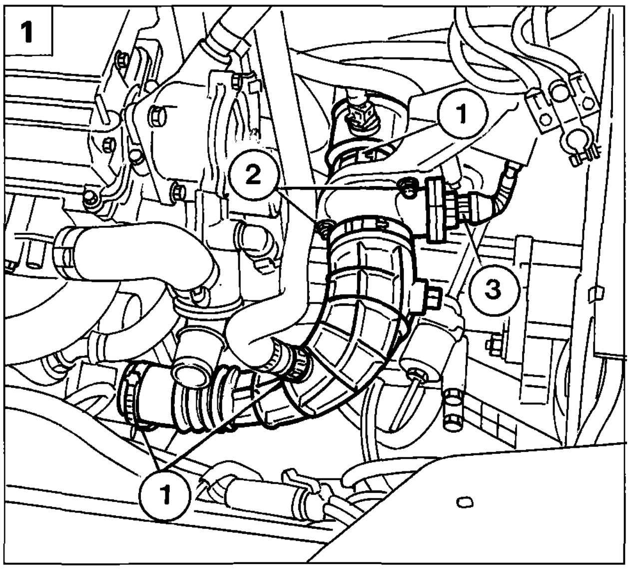


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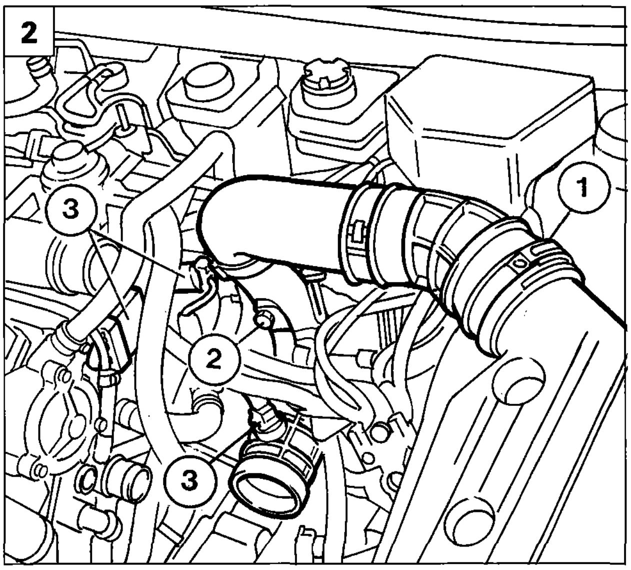


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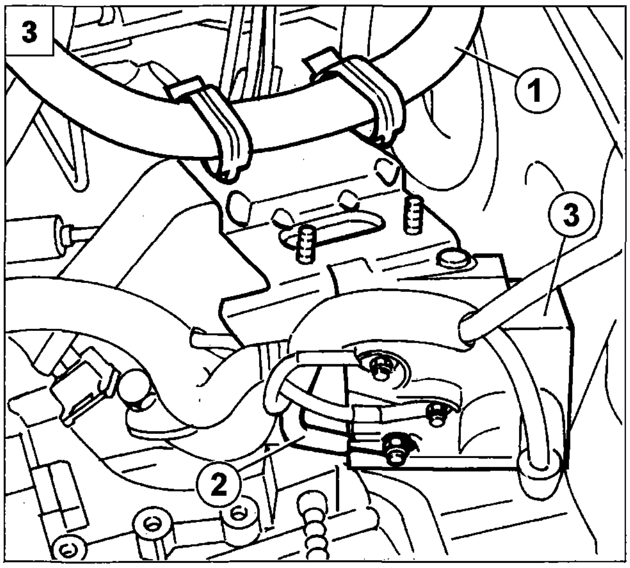
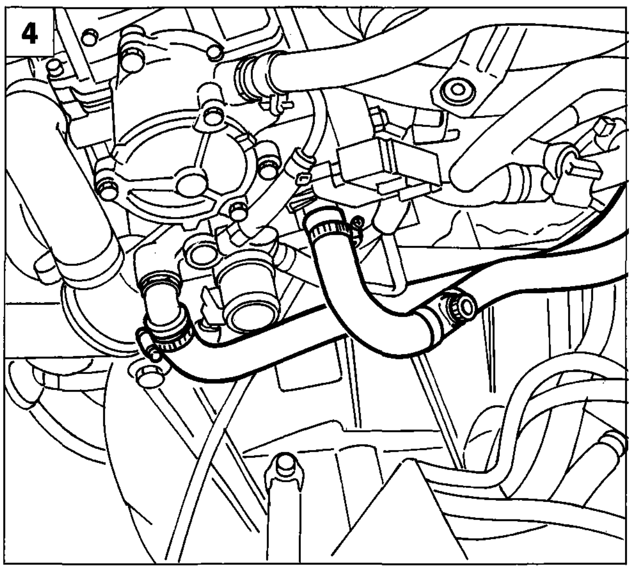



P4A04FX03

1. Loosen clips (1), unscrew bolts (2), disconnect connection (3) and then disconnect the first section of the air intake pipe complete with debimeter.
2. Loosen clip (1), unscrew screw (2) disconnect electrical connections (3) and then disconnect the second section of the air intake pipe.
3. Open both clips and release cable (1), disconnect cable (2) and then move glow plug ECU (3) with its bracket to one side.
4. Disconnect the two pipes leading from the heater unit from the thermostat.
5. Disconnect both fan electrical connections.

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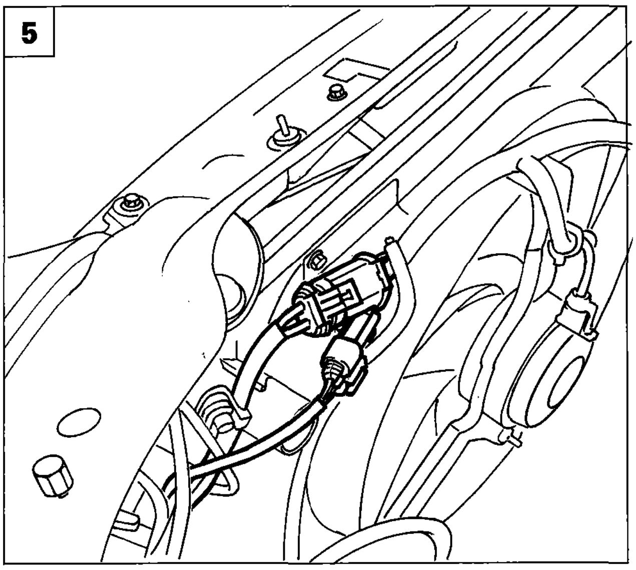


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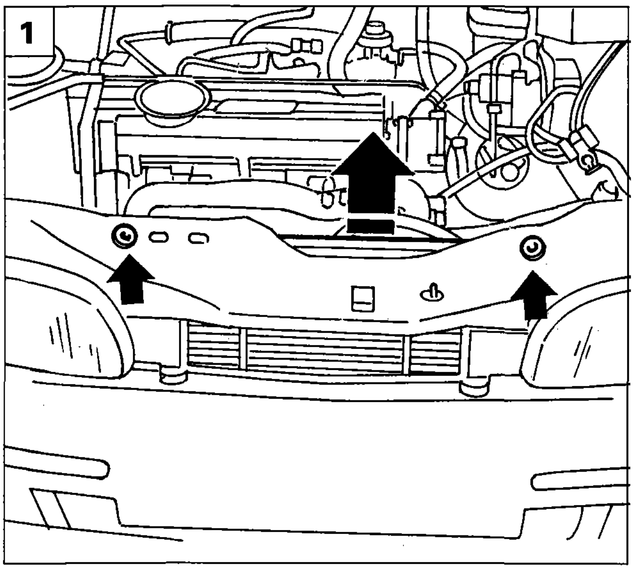


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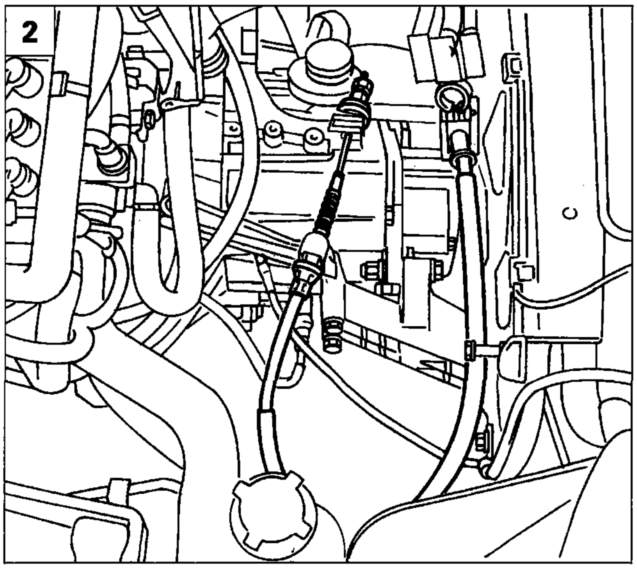


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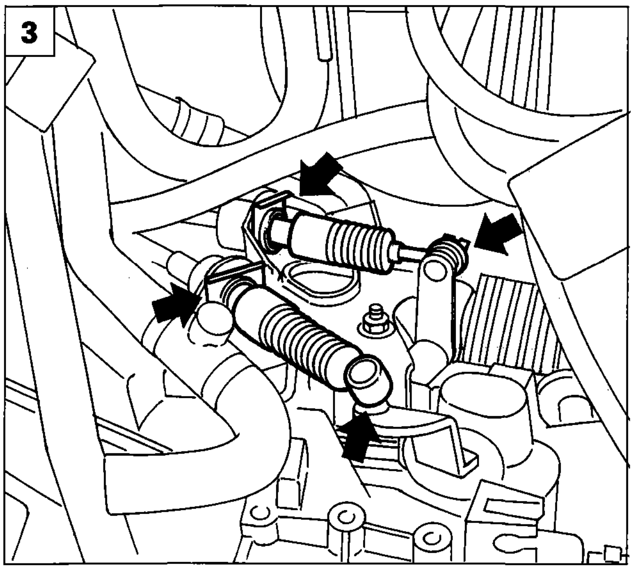
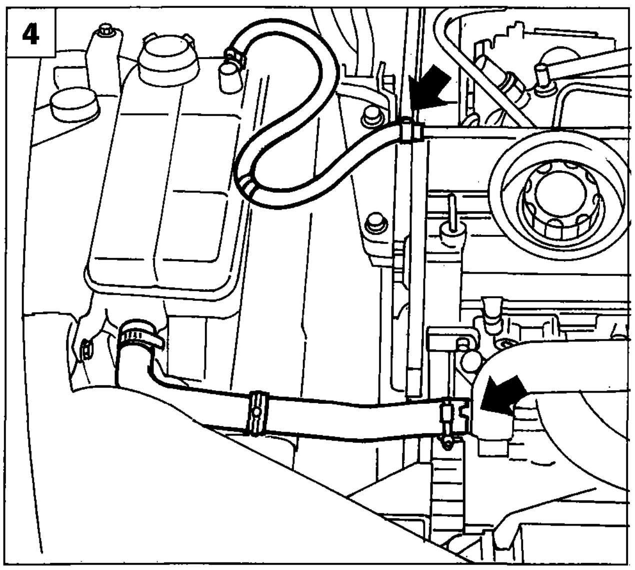



P4A05FX03

1. Unscrew both bolts retaining the radiator to the body, then remove the radiator - fan assembly.
2. Disconnect the clutch release cable from the anchorages on the gearbox.
3. Disconnect the gear selection and engagement cables from the points indicated, taking care not to damage the cables as the head is removed.
4. Disconnect both expansion tank pipes from the points indciated.
5. Disconnect fuel outlet and inlet lines (1) and (2) and pipe (3) carrying fuel from the diesel filter to the injection pump.

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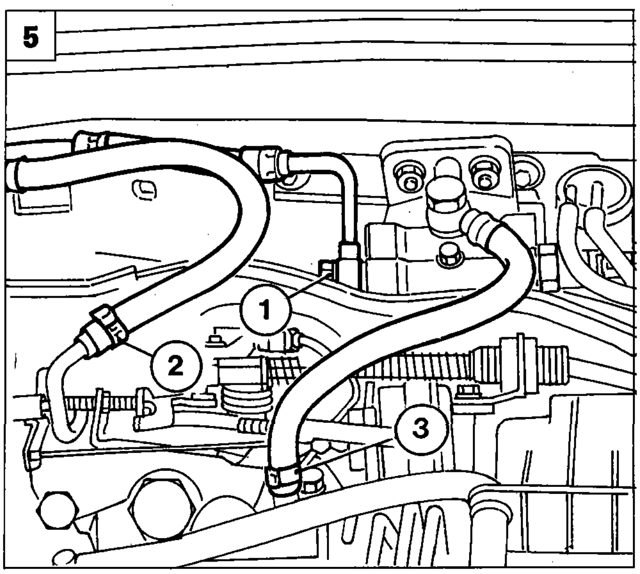


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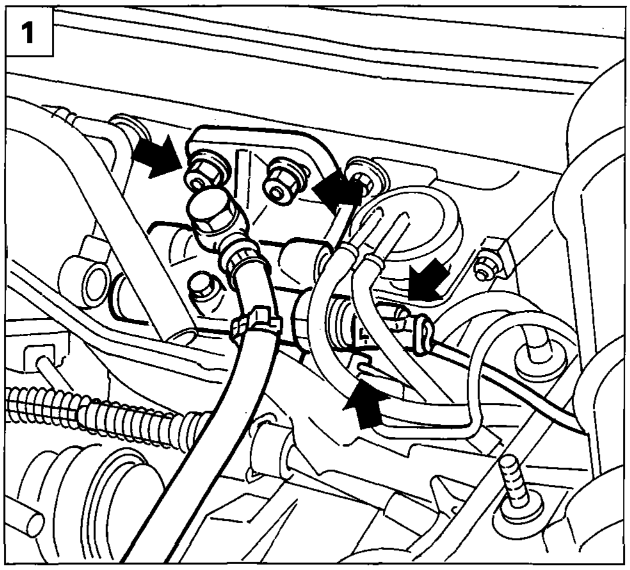


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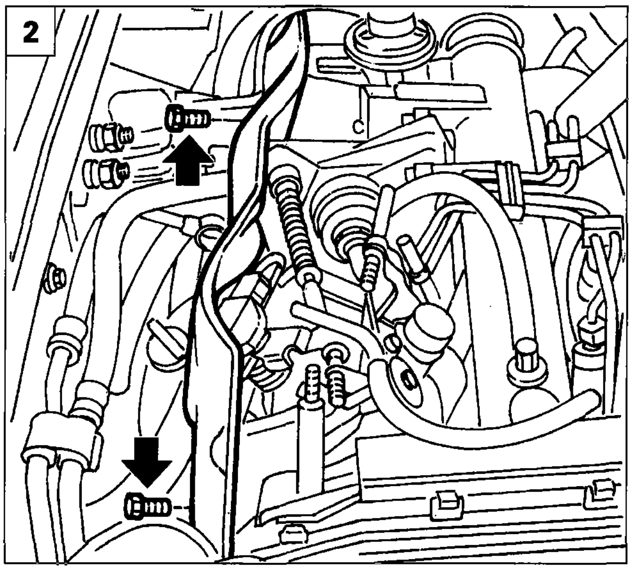


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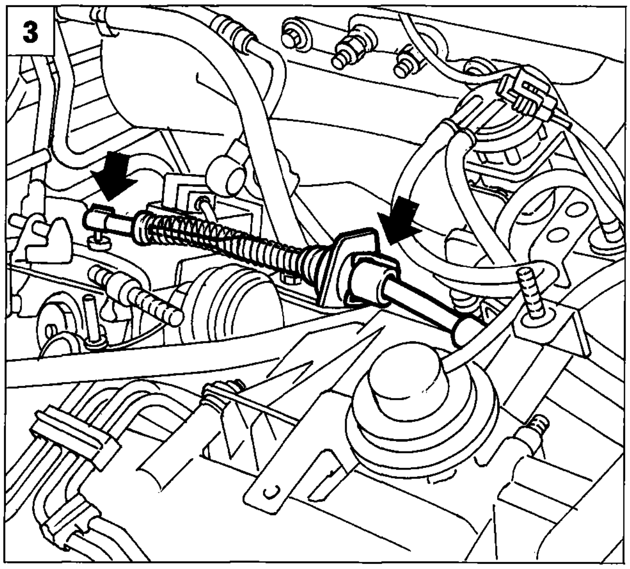
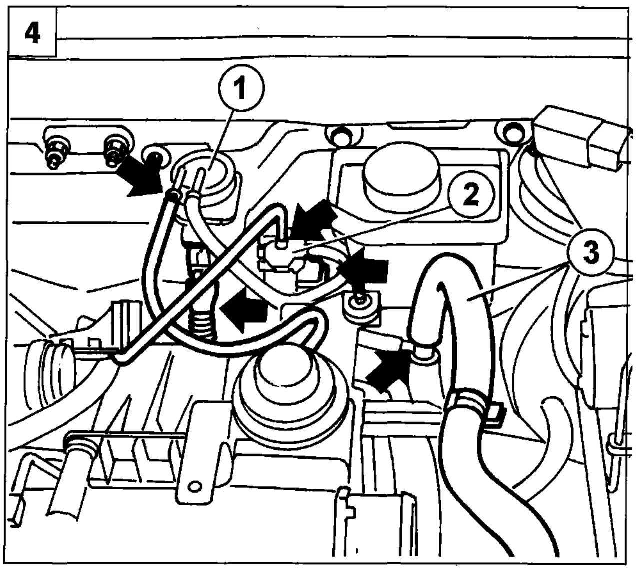



P4A06FX03

1. Unscrew the nuts, disconnect both electrical connections shown and then remove the diesel filter.
2. Remove the rear sound-proofed guard by unscrewing the bolts shown.
3. Disconnect the accelerator cable from the points shown.
4. Disconnect the pipe from modulator valve (1), the pipe from fast idle valve (2) and then disconnect the electrical connections shown and the vacuum pump sleeve for brake servo (3) from the point shown.
5. Remove the reaction bracket complete with mount by unscrewing the retaining bolts shown.

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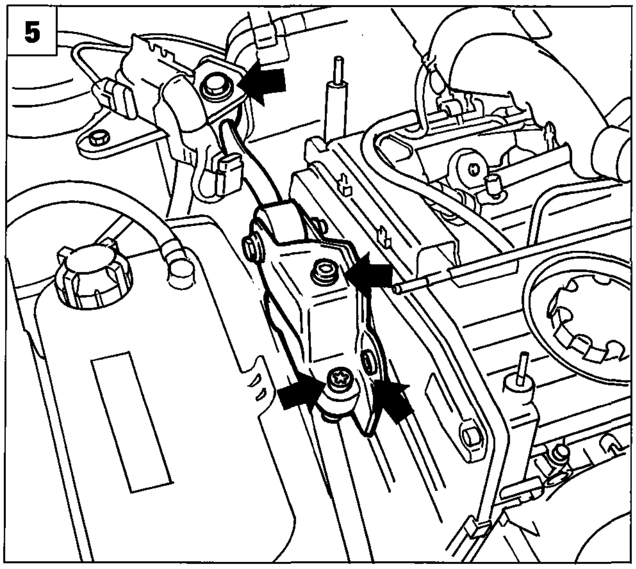


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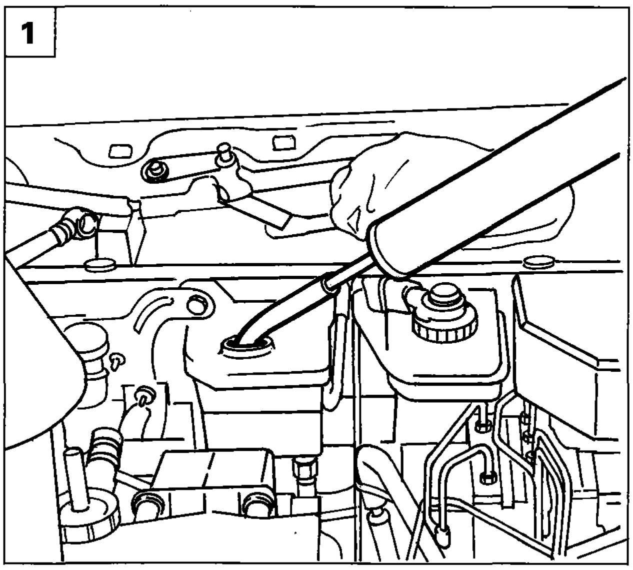

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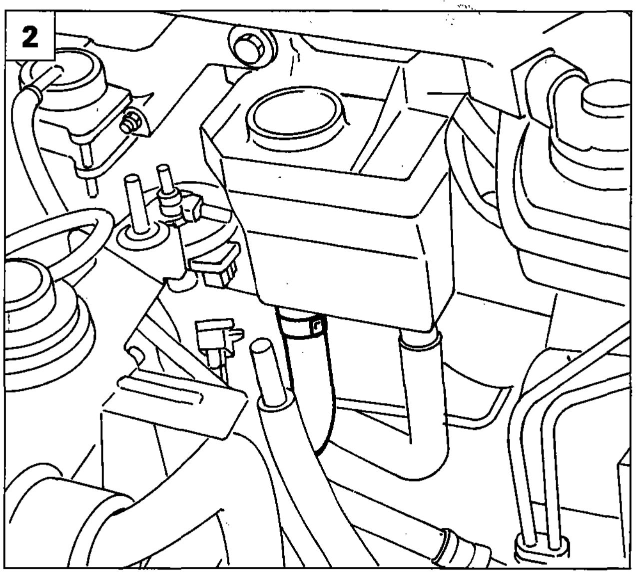

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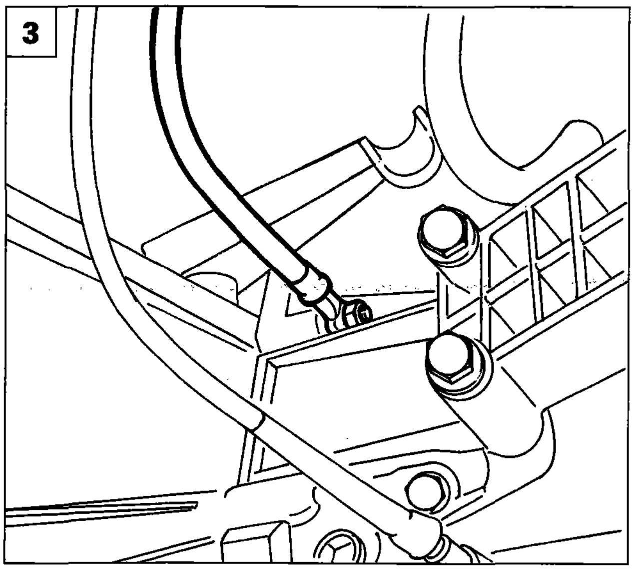
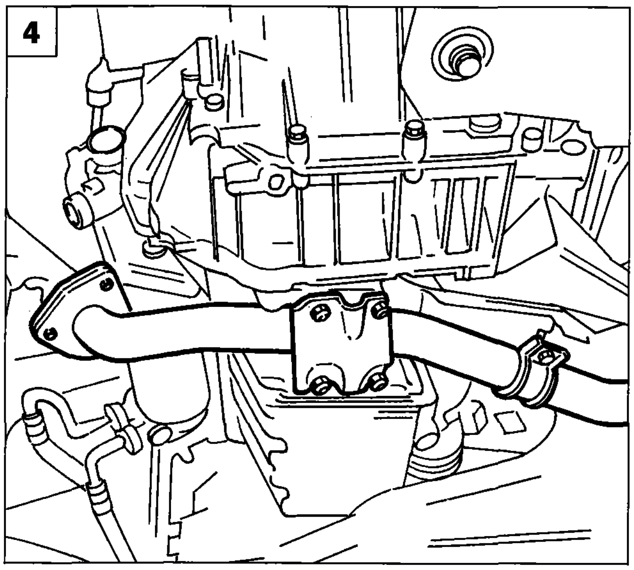


P4A07FX03

1. Drain the power steering pump fluid and use an appropriate container to collect the fluid.
2. Disconnect the pipe carrying fluid to the power steering pump from the reservoir.
3. Disconnect the earth lead from the gearbox
4. Remove the front section of the exhaust pipe from the connector and from both vibration-resistant brackets.
5. Disconnect the front section of the exhaust pipe from the catalytic converter, then remove from the vehicle.



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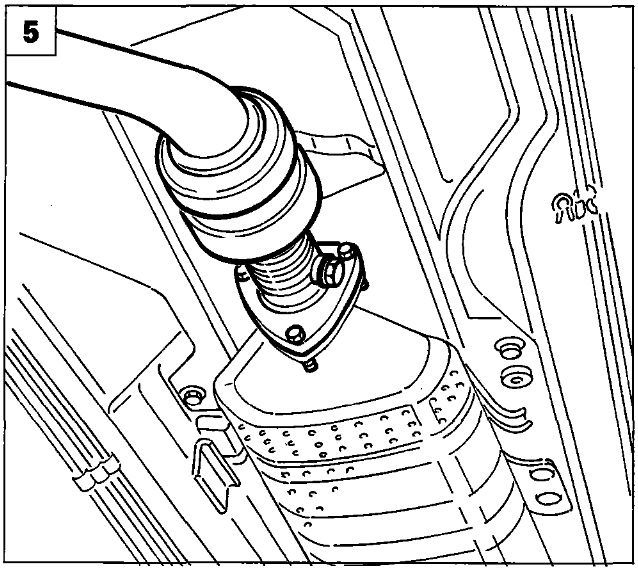

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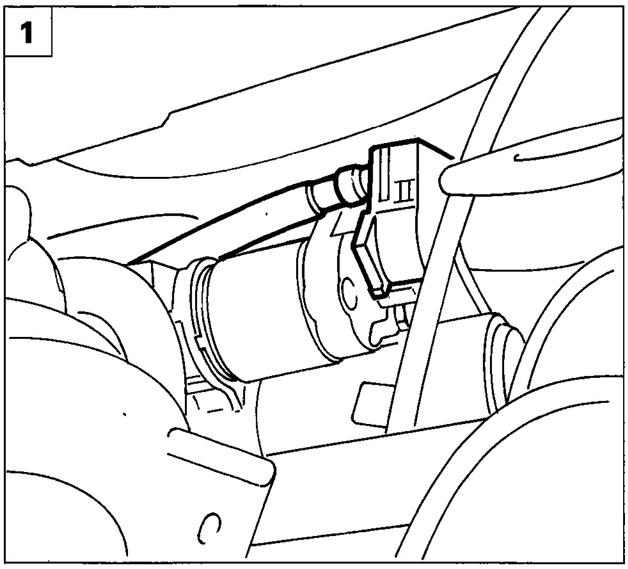


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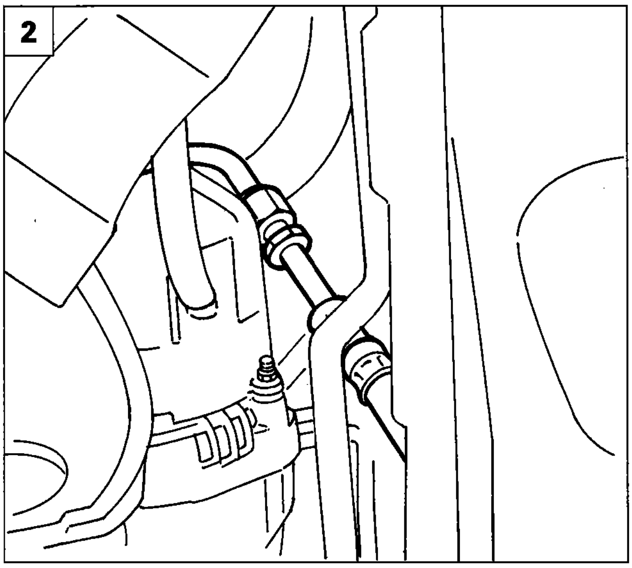


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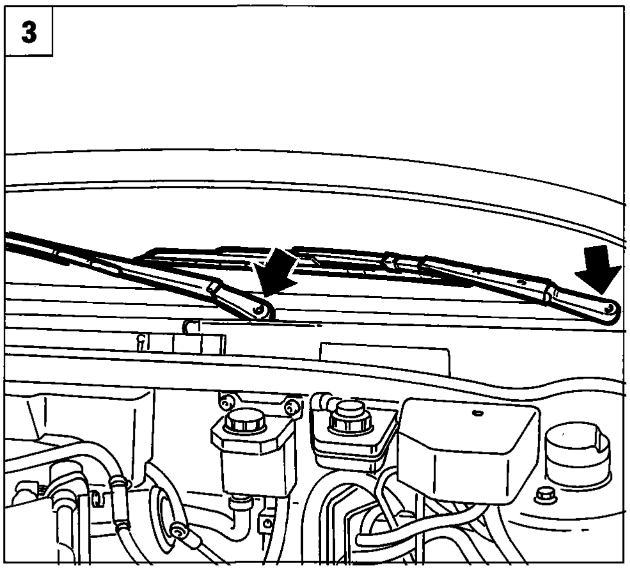
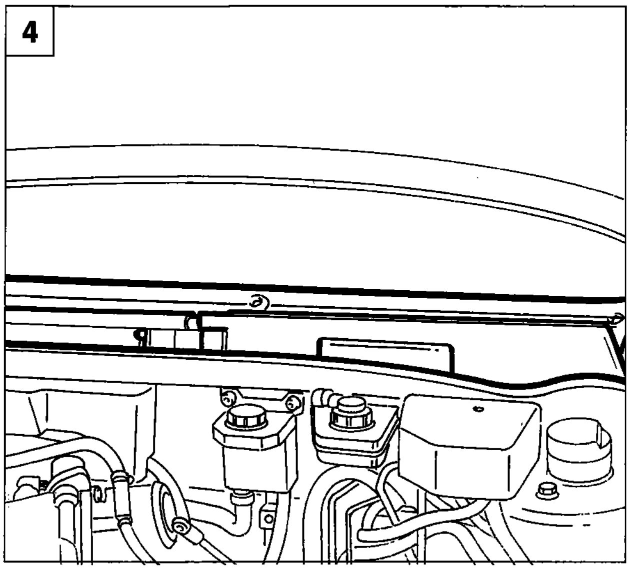



P4A08FX03

1. Disconnect the supply lead from the starter motor.
2. Disconnect the return fitting from the power steering pump.
3. Remove the wiper arms by prising up the plastic protection and unscrewing the underlying nut.
4. Remove the pollen filter plastic protection.
5. Undo the nuts retaining the engine wiring mount bracket to the body.

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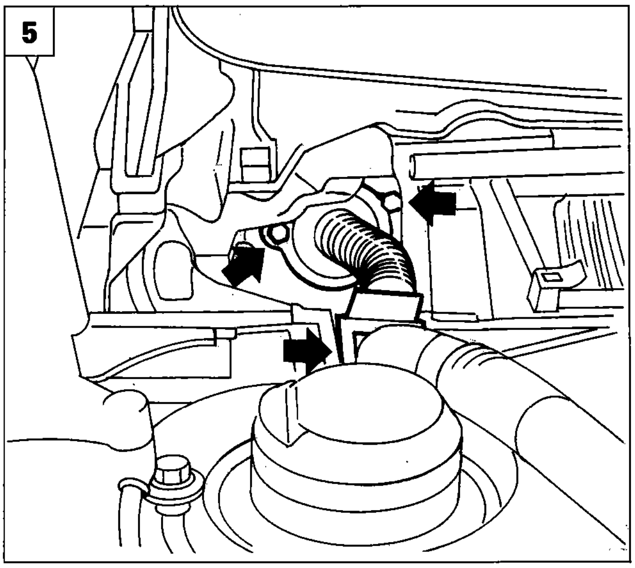


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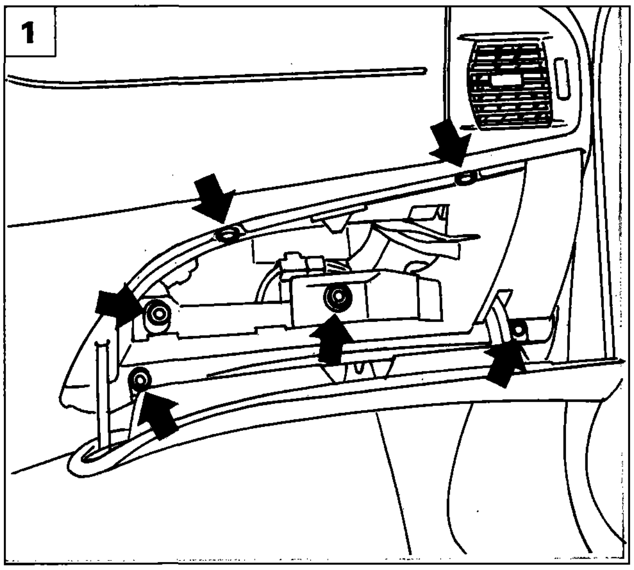


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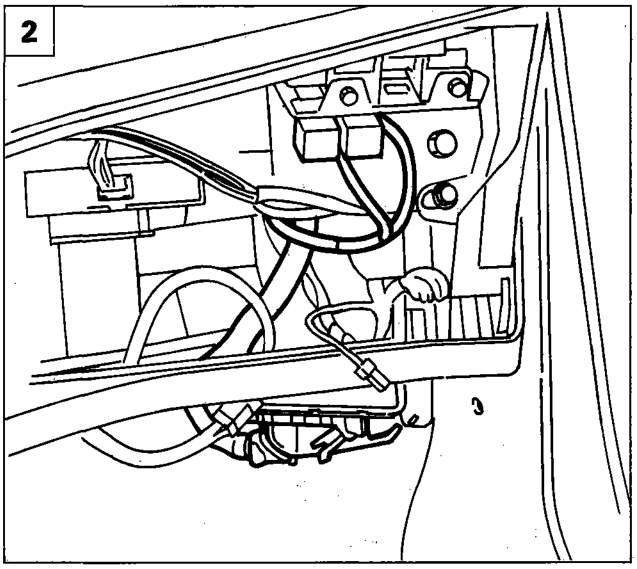


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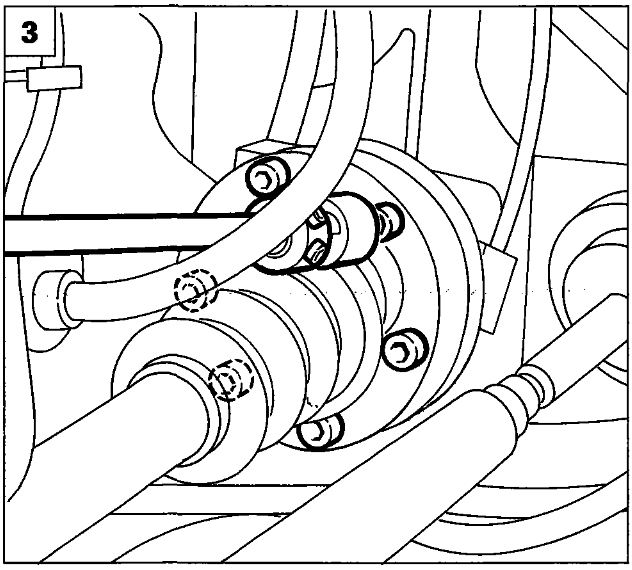


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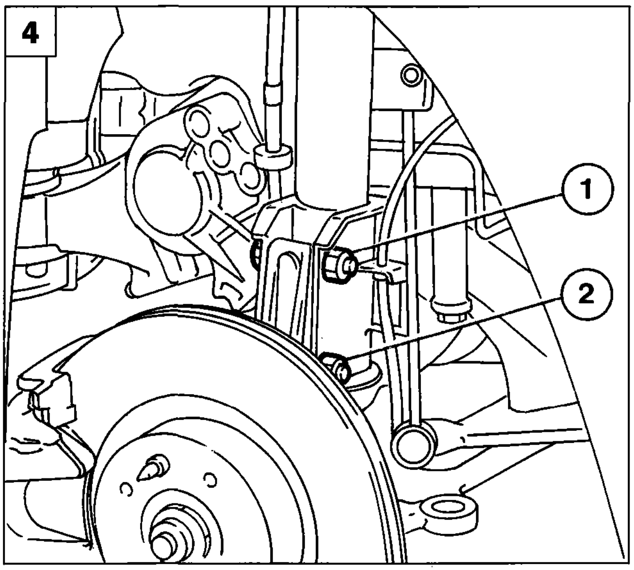
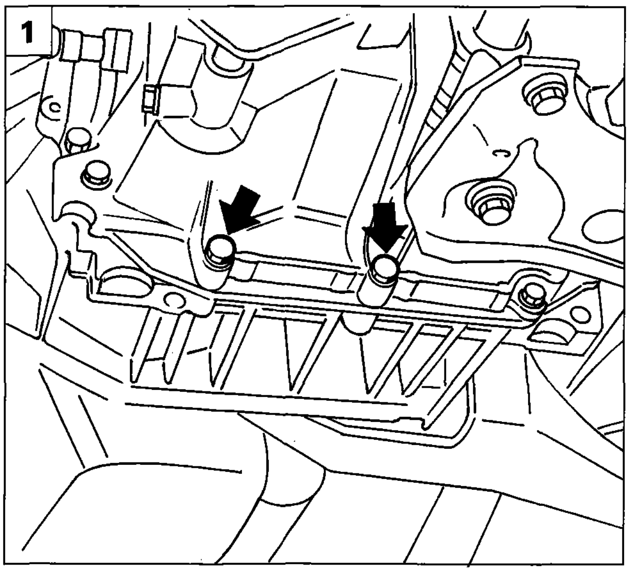



P4A09FX04

1. Working from inside the vehicle, remove the glove compartment by unscrewing the retaining bolts shown.
2. Disconnect connector from the i.e. control unit and withdraw the relay from its bracket. Then withdraw the engine wiring assembly and attach to the power unit.
3. Disconnect the half-axles by undoing the bolts securing the constant velocity joints to the gearbox flange.
4. Unscrew bolt (1) and loosen bolt (2) retaining the suspension pillar. Then turn the pillar outward to release the drive shaft from its attachment on the differential.

# 10.

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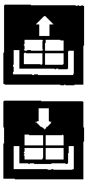
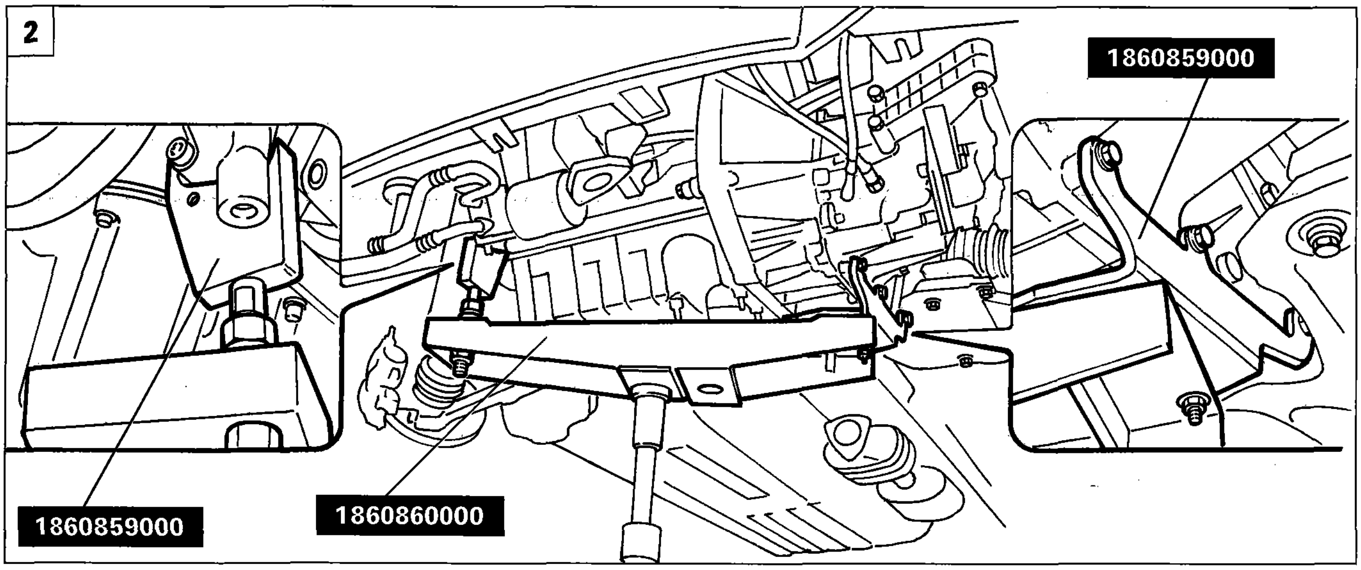


1. Remove the bolts indicated from the bell housing in order to position the tool used to remove the power unit.

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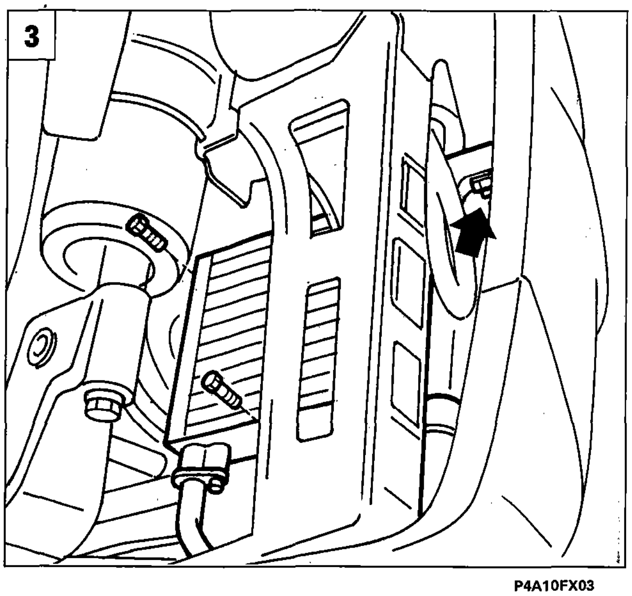
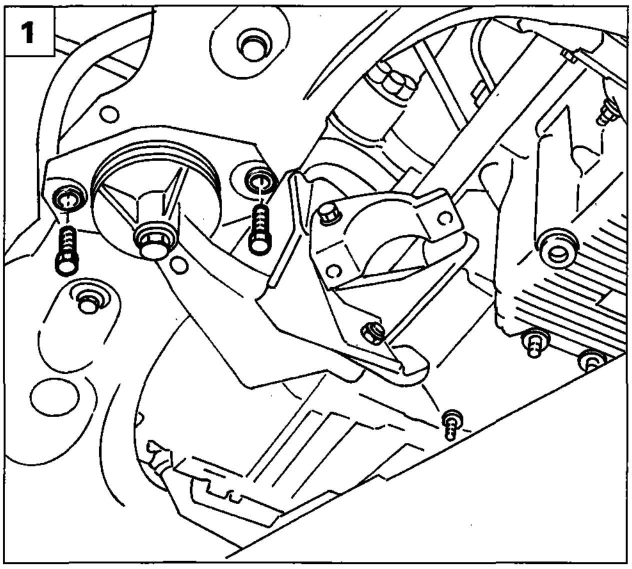



P4A10FX03

2. Position tool 1860860000 used to mount the power unit on the hydraulic jack and fasten to the power unit using the tools shown.

> *The hydraulic jack must have a capacity of at least 1000 kg and it must be sufficiently high to allow the power unit to be removed from below. When calculating the height, consider the maximum height setting of the lift and the minimum height setting of the hydraulic jack.*

3. Remove the engine oil heat exchanger from the fastenings shown, then secure to the power unit.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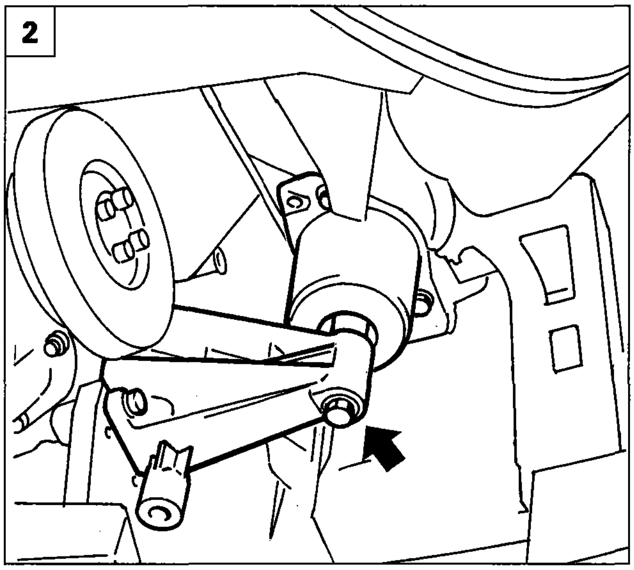
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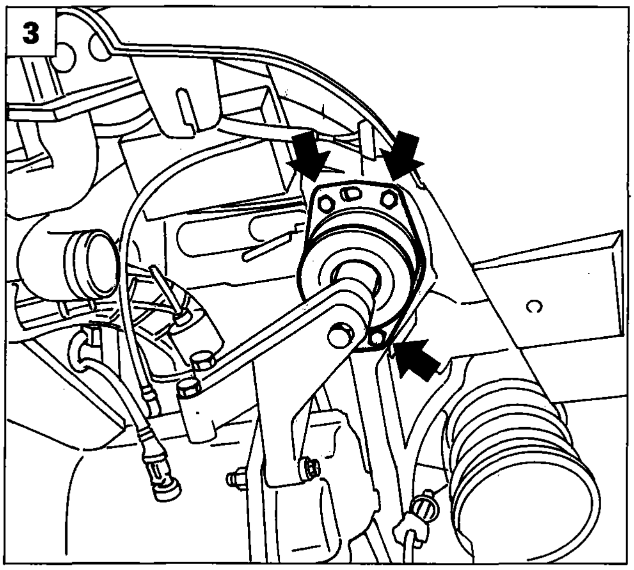
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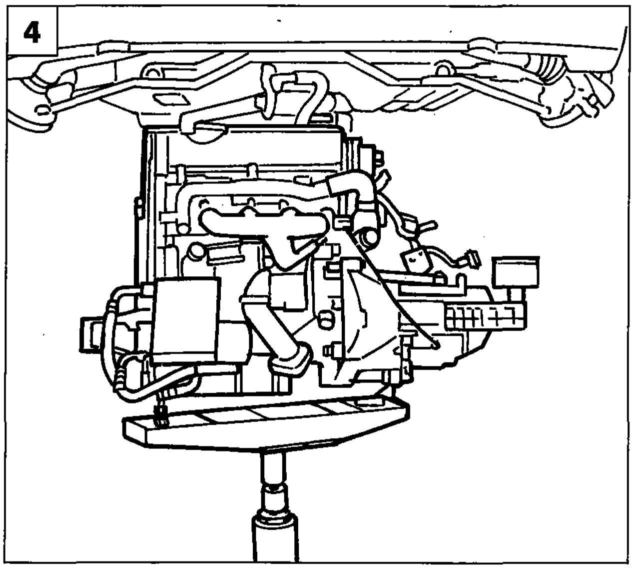

P4A11FX04

1. Remove the central power unit mount by unscrewing the bolts retaining it to the body.
2. Remove the timing end engine mount by unscrewing the central bolt.
3. Disconnect the gearbox end engine mount by unscrewing the retaining bolts shown.
4. Lower the hydraulic jack and remove the power unit from below the vehicle.

*Lower the hydraulic jack gradually and check that the power unit is correctly positioned and balanced on the mounting tool.*

- Position the power unit on a stand using a hydraulic hoist.

*Use a hydraulic hoist to move the power unit, once it has been released from the mounting tool.*

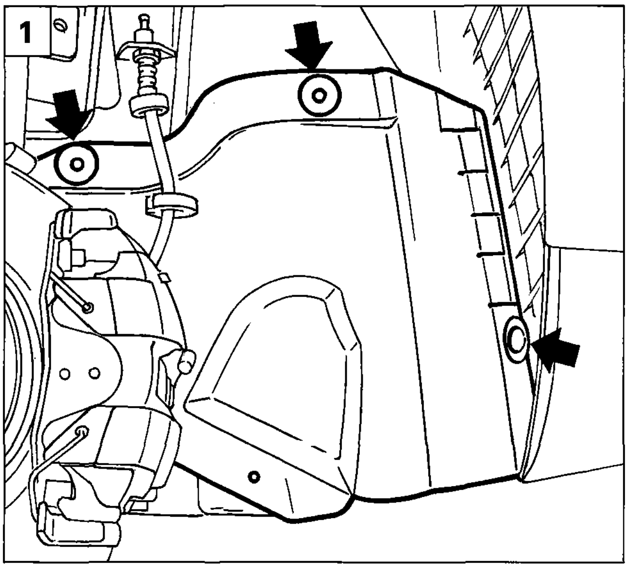
**NOTE** *To refit the power unit, carry out removal operations in reverse order.*

- *Prepare the engine bay to fit the power unit. Take care to arrange all electrical leads, pipes etc. so that they do not get in the way when the engine is refitted;*

- *Take great care not to damage individual components when the power unit is fitted*
- *When fitting the coolant lines, align groove on rubber hose with ridge on associated rigid sleeve. When filling the cooling system, refer to section on "Removing-refitting radiator".*

*Ensure that the power unit mounting points are properly secured.*

*Clutch pedal height.*



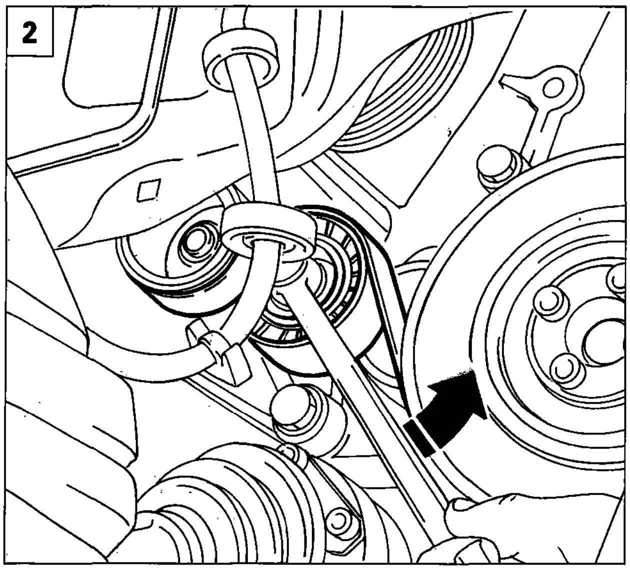

P4A12FX01

### REMOVING - REFITTING ALTERNATOR DRIVE BELT AND POWER STEERING PUMP

#### Removing

Position the vehicle on a lift, remove the right front wheel, disconnect the battery negative terminal and then proceed as follows.

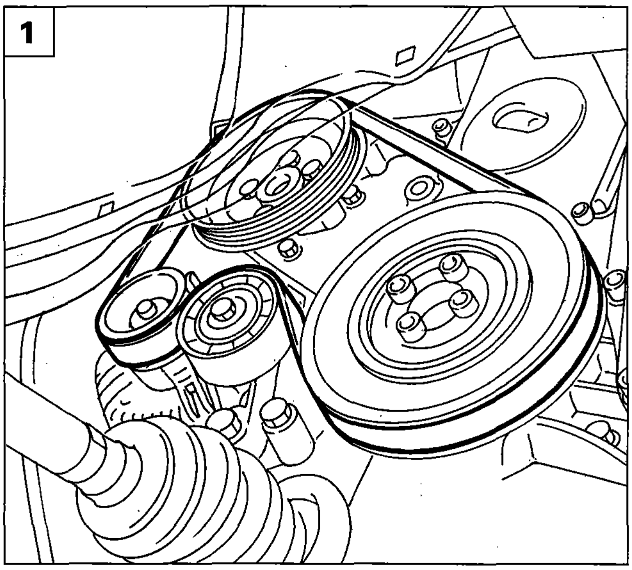
1. Remove the wheel arch guard by unscrewing the retaining bolts shown. Use tool 1870077000 to prise up the stud shown.



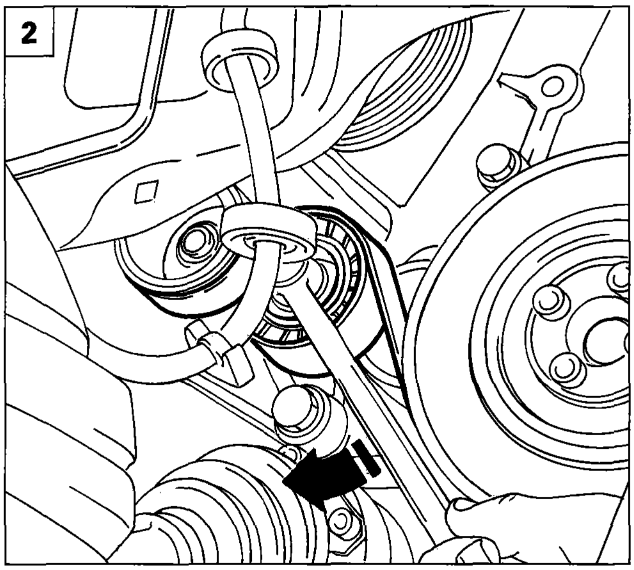

P4A12FX02

2. Turn the tensioning device in the arrowed direction and release belt tension before removing.

*Check the condition of the drive belt. In particular, check for cracks, tears, surface wear (smooth or shiny in appearance) and dry or hard parts with consequent loss of grip. Replace belt if even one of the above defects is present.*




P4A13FX01

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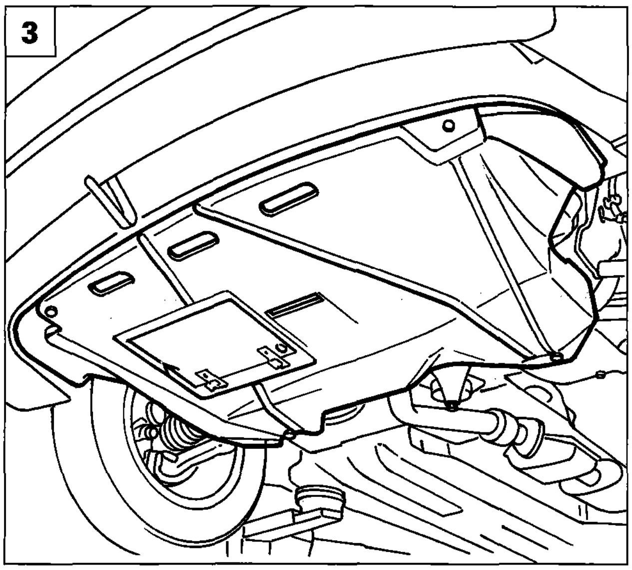
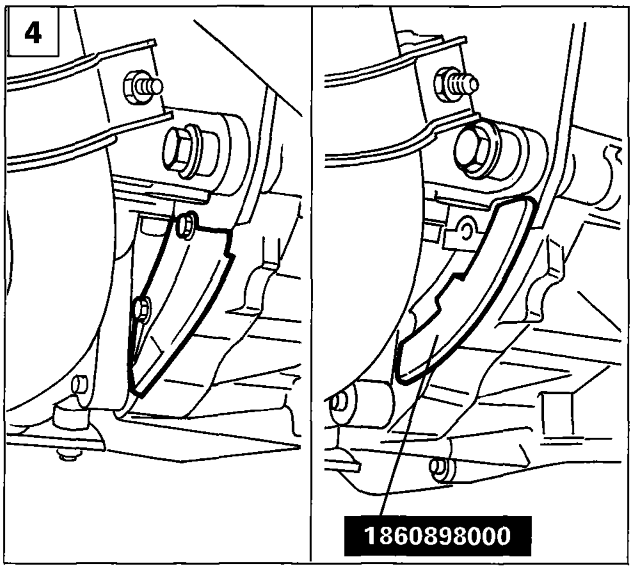



P4A01FX04




P4A13FX03 P4A13FX04

**Refitting**

1. Fit the new belt as shown in the figure.

*Prevent the belt coming into contact with oil or solvents which could affect the elasticity of the rubber with consequent loss in grip.*

2. Return the tensioning device to the position shown in the figure. The preloaded tensioner spring will ensure the belt is correctly tensioned after the crankshaft has been turned a few times.

**REMOVING TIMING BELT**

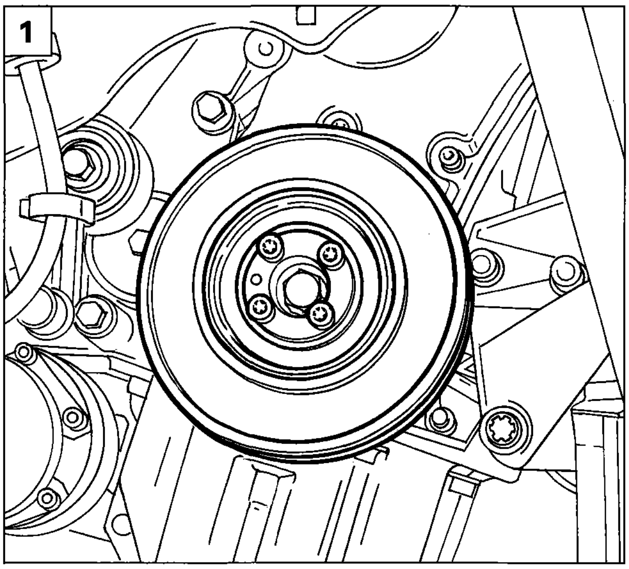
*Before removing the timing belt, the auxiliary belt must be removed as described previously.*

3. Remove the lower power unit guard.

4. Remove the gearbox guard by unscrewing the retaining bolts shown and position flywheel retainer 1860898000 to secure the flywheel in position.

# 10.

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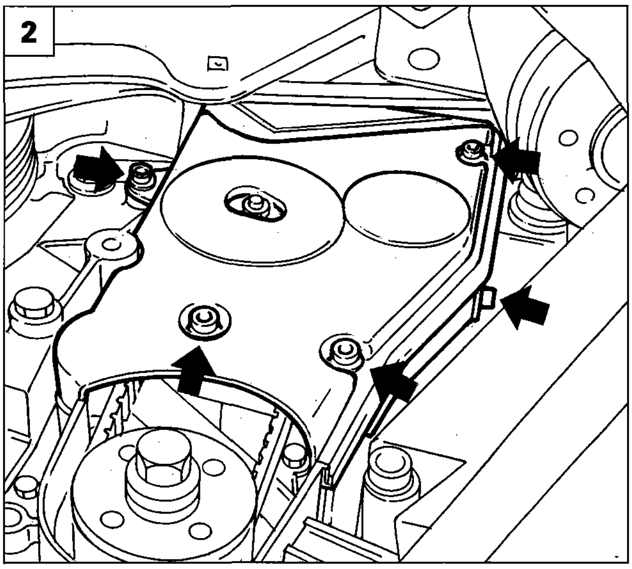


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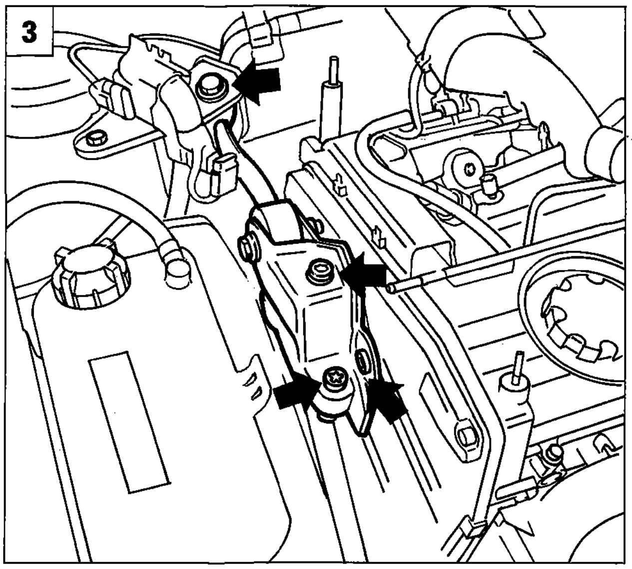
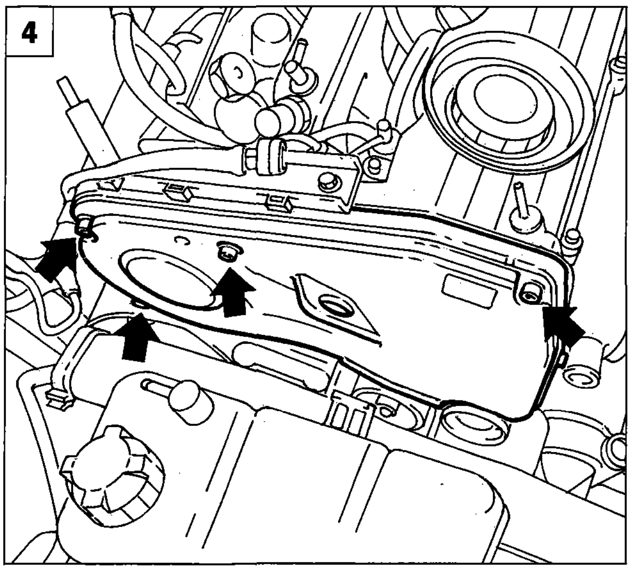



P4A06FX05

1. Remove the auxiliary drive pulley and the flywheel retainer described previously.
2. Remove the lower timing belt guard.
3. Unscrew the retaining bolts shown and remove the reaction rod complete with mounting bracket.
4. Remove the lower timing belt guard.
5. Loosen the tensioner nut, release belt tension and then remove.

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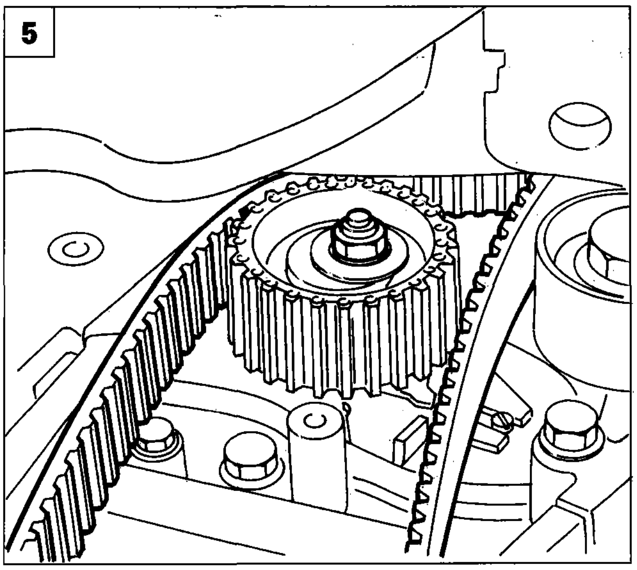


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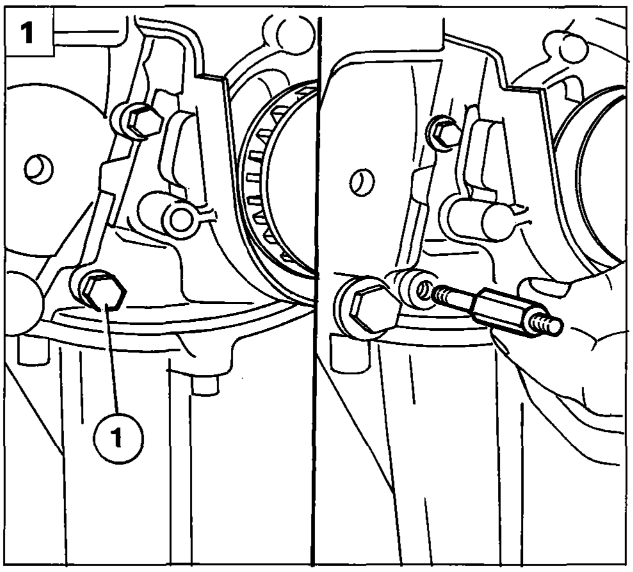

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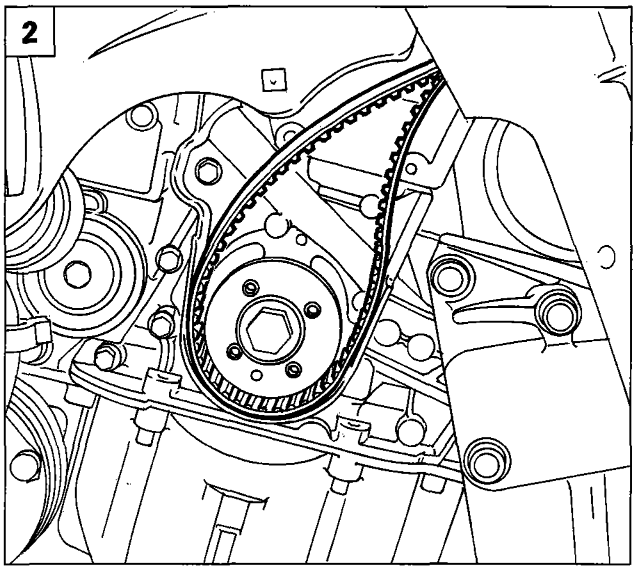

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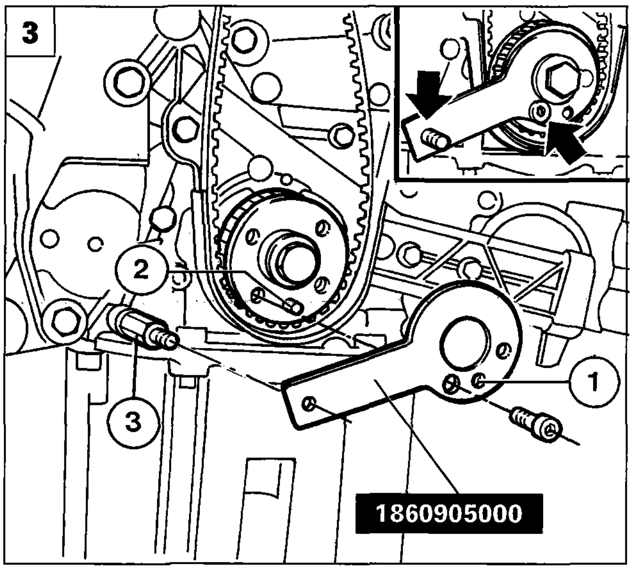

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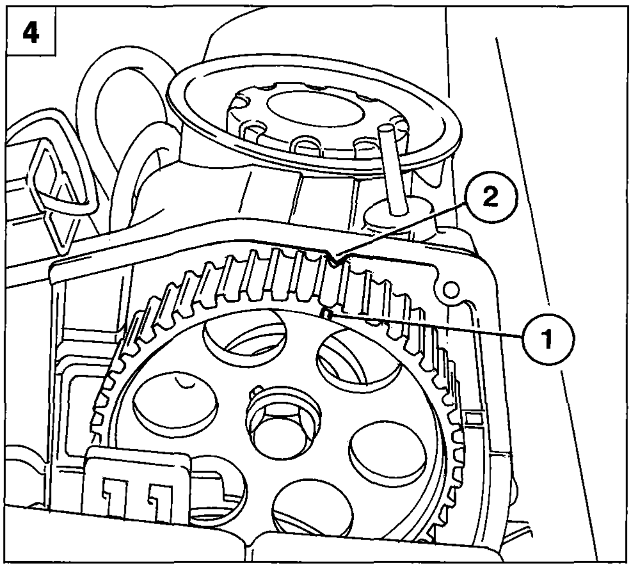


P4A15FX04

## REFITTING AND TENSIONING TIMING BELT

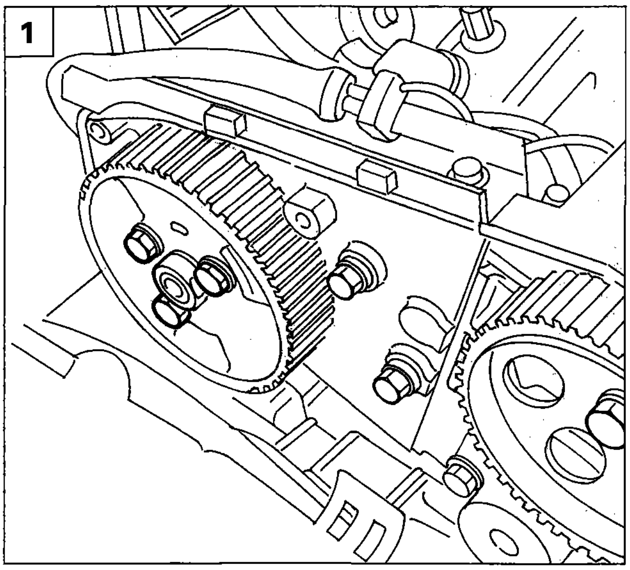
1. Remove bolt (1) retaining the oil pump and replace the bolt with the pin of tool 1860905000.

2. Fit the timing belt onto the crankshaft gear.

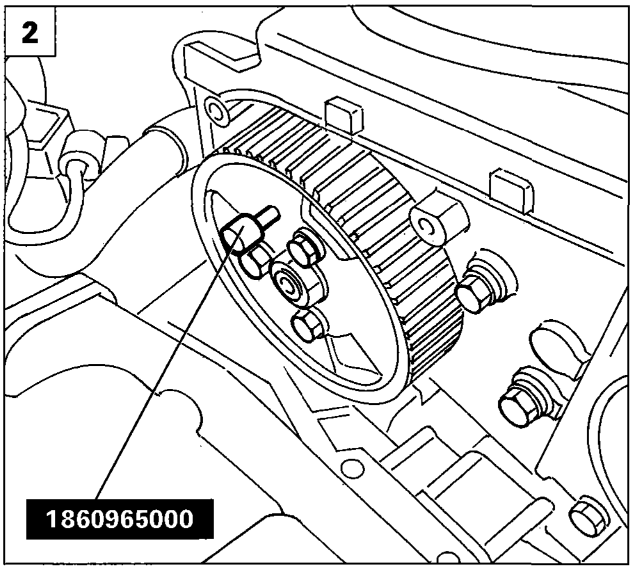
3. Position tool 1860905000 on the crankshaft gear and pin (3); turn the crankshaft through small movements until dowel (2) fits into hole (1). The first cylinder is set to T.D.C. in this position.

4. Use tool 1860831000 to turn the timing belt pulley until notch (1) on the pulley is aligned with notch (2) on the cam cover.

## 10.




P4A16FX01

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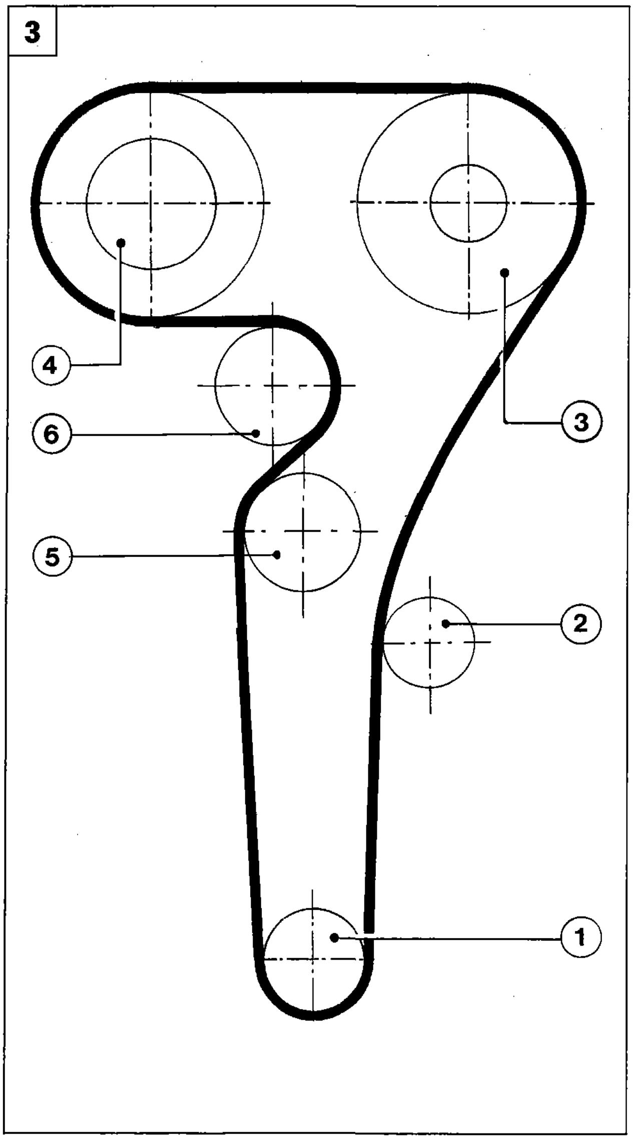


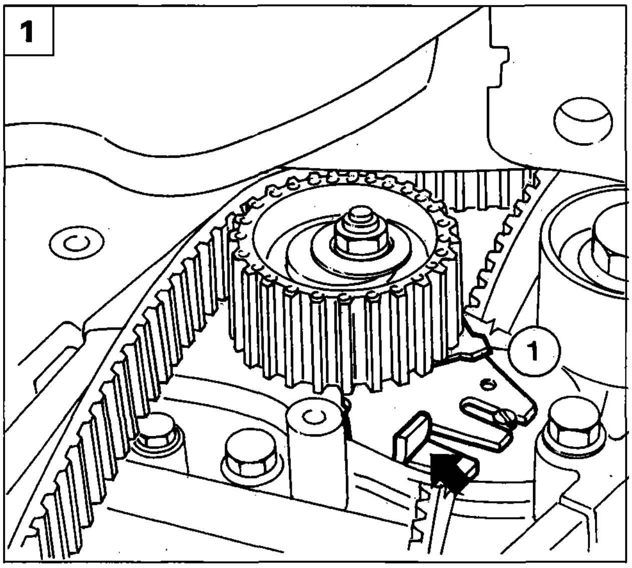

P4A16FX03

1. Loosen the three injection pump pulley retaining bolts.

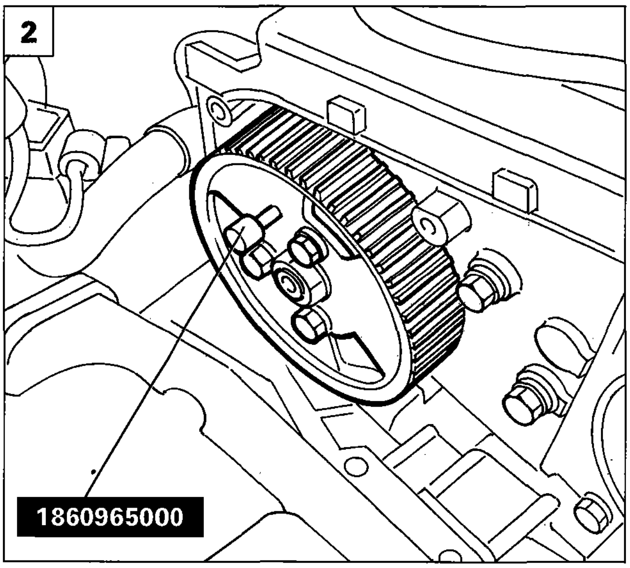
2. Turn the injection pump pulley until pin 1860965000 fits into the point shown.

3. Finish fitting the timing belt by assembling components in the following order:

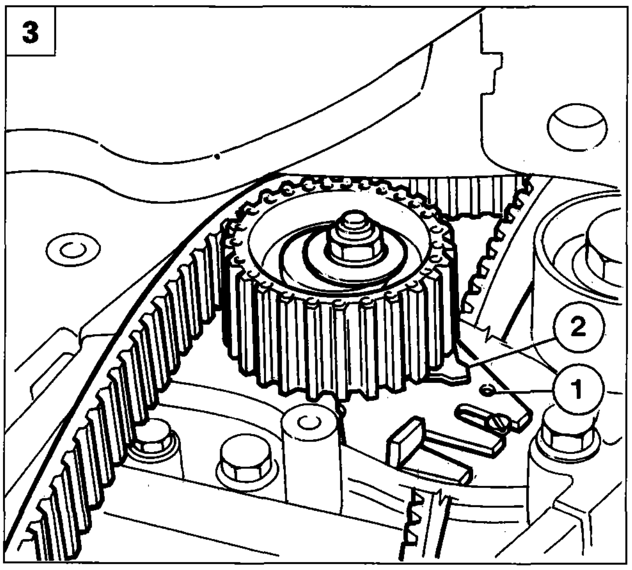
   1. Crankshaft gear
   2. Fixed guide pulley
   3. Timing pulley
   4. Injection pump pulley
   5. Automatic tensioner
   6. Coolant pump



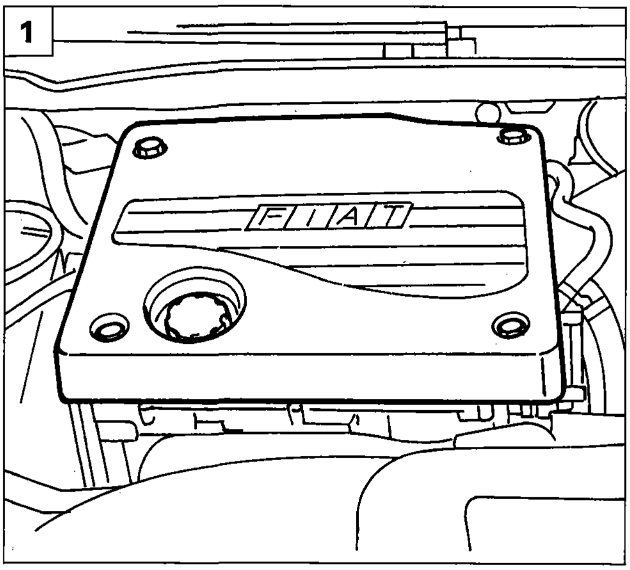

1. Apply a force at the point indicated on the automatic tensioner and move the tensioner mobile pointer to the position of greatest tension. Then lock the belt tensioner retaining nut.




2. Fasten the injection pump pulley by tightening the retaining bolts to the specified tightening torque and remove pin 1860965000 from its housing.




3. Turn the crankshaft through two turns in its normal direction of rotation, release the belt tensioner retaining nut and align fixed indicator (1) on the tensioner mount with the belt tensioner mobile indicator. Secure the tensioner nut and then tighten to the specified torque. Refit parts removed previously by carrying removal operations in reverse order.



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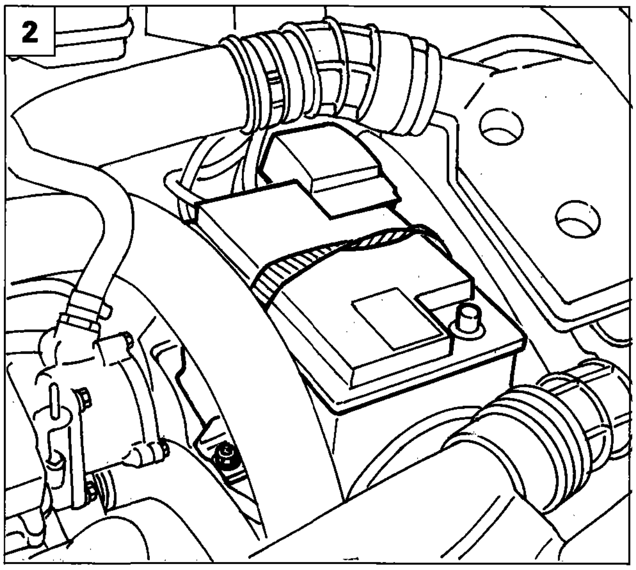

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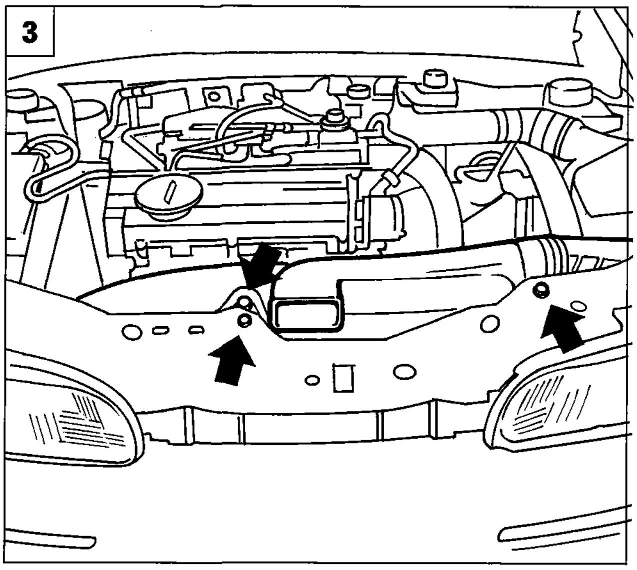

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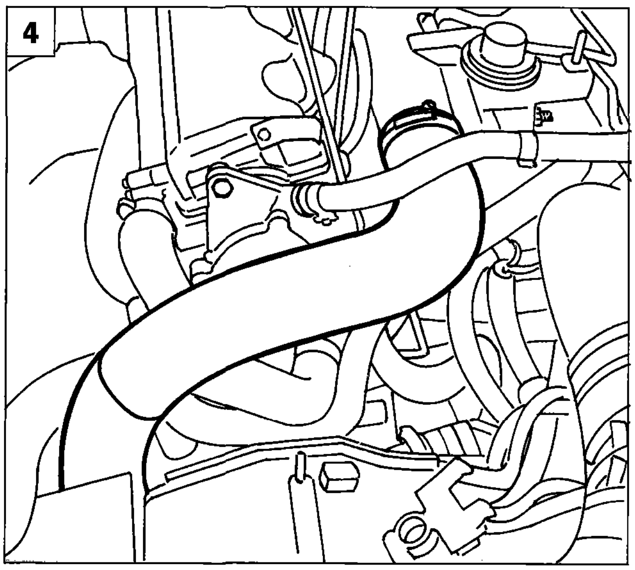


P4A03FX01

## REMOVING CYLINDER HEAD

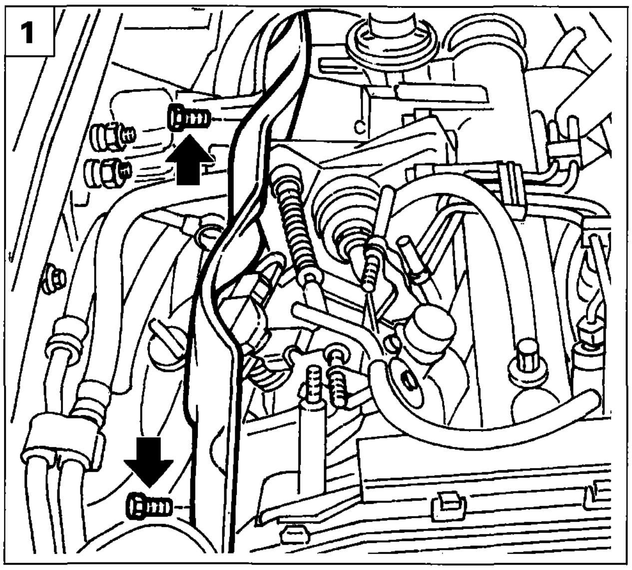
Place the vehicle on a lift, remove the front wheels, disconnect the battery negative terminal and then proceed as follows.

1. Remove the upper cylinder head protection by unscrewing the retaining nuts.

2. Disconnect the battery positive terminal (1), unscrew nut (2), raise bracket (3) and then remove the battery.

3. Unscrew the retaining bolts indicated to remove the air intake shown.

4. Loosen the clip shown and disconnect the air intake sleeve from the inlet manifold.

1

P4A06FX02

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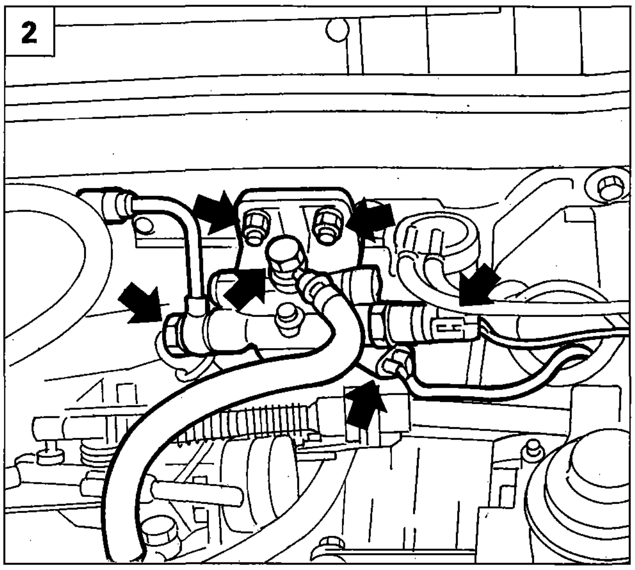
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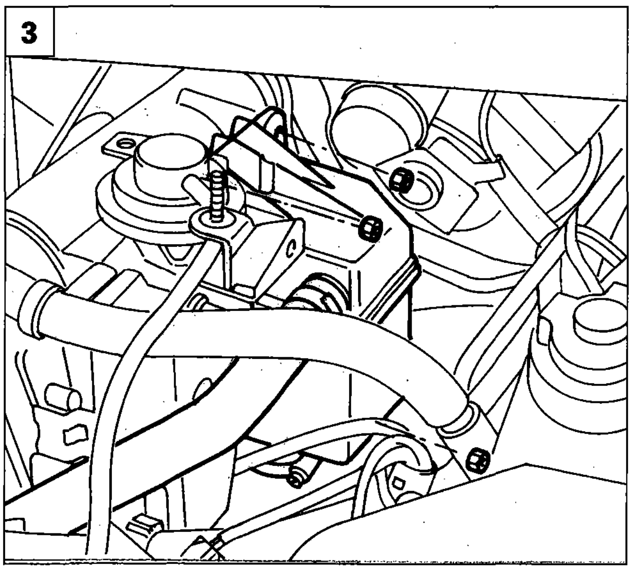
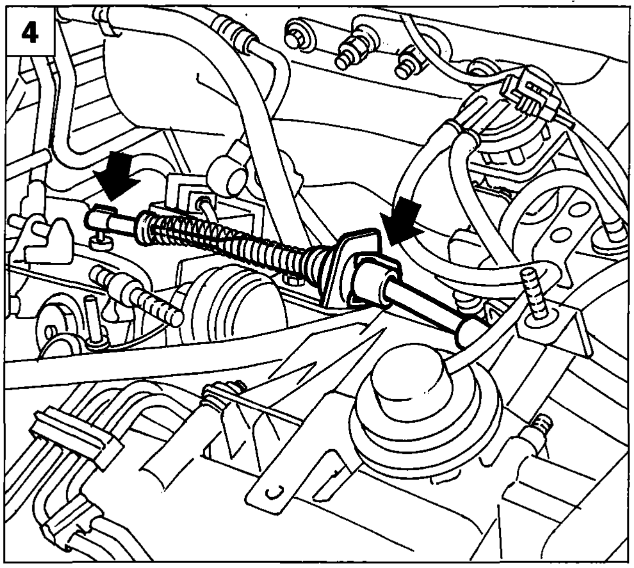

P4A19FX02

1. Unscrew both retaining screws and remove the partition shown.
2. Disconnect both electrical connections shown, unscrew the nuts, disconnect both fuel fittings and then remove the diesel filter.
3. Loosen the clip and disconnect the pipe shown, then unscrew the retaining nuts shown in order to position the oil vapour separator to one side in the engine bay.
4. Disconnect the accelerator cable from the points indicated.
5. Disconnect the air pipe to the brake servo from the vacuum pump.

4

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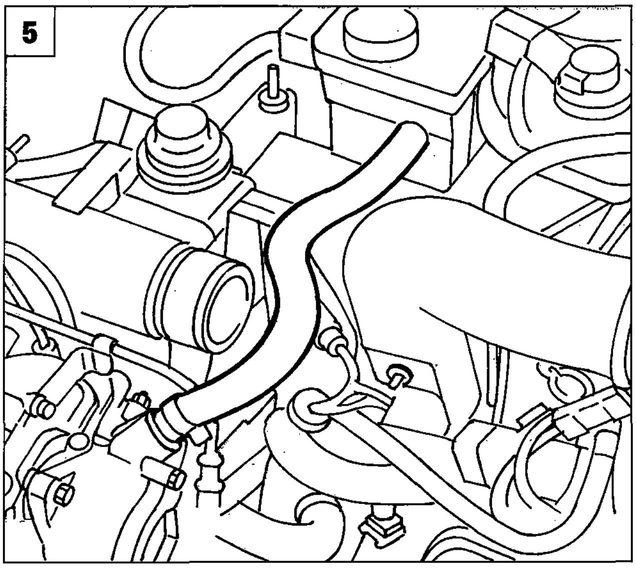
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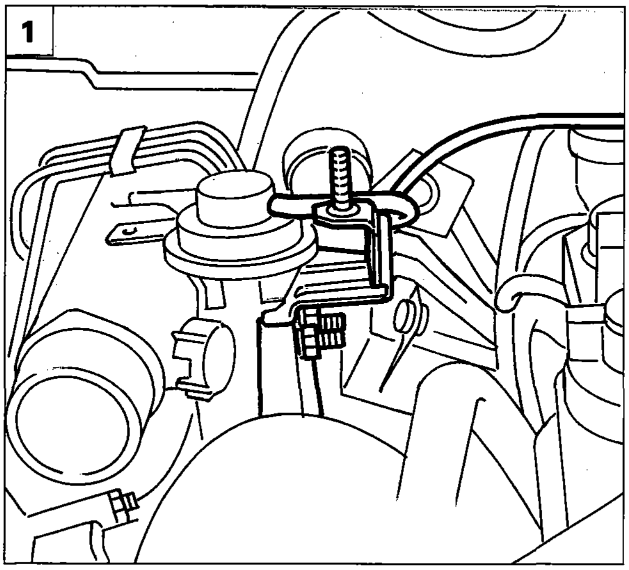
# 10.



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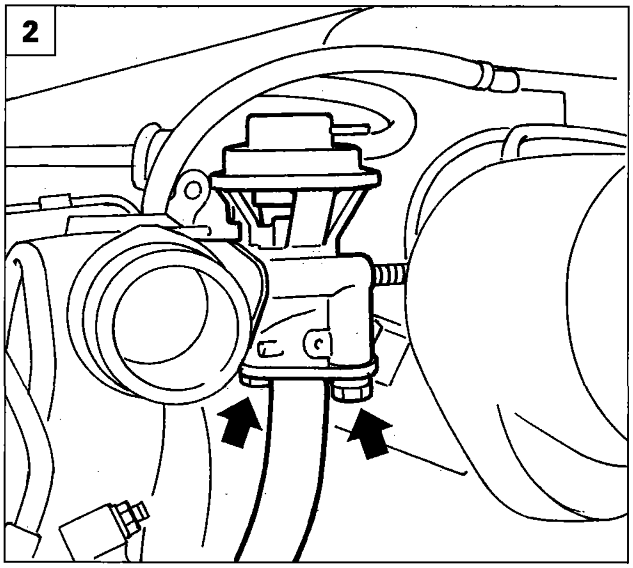

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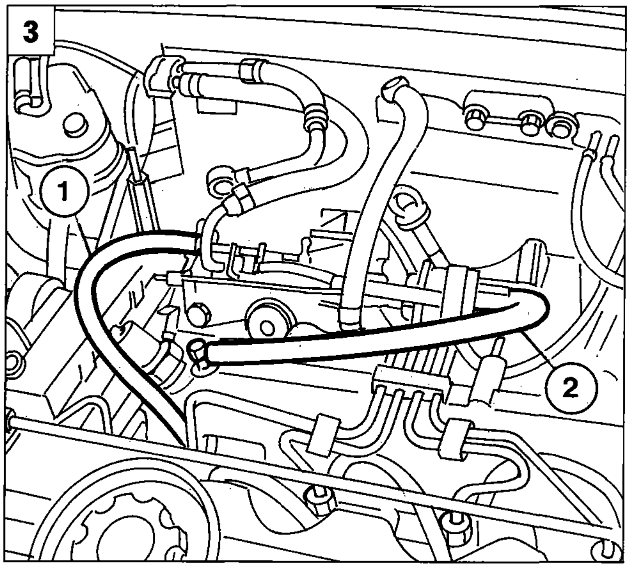
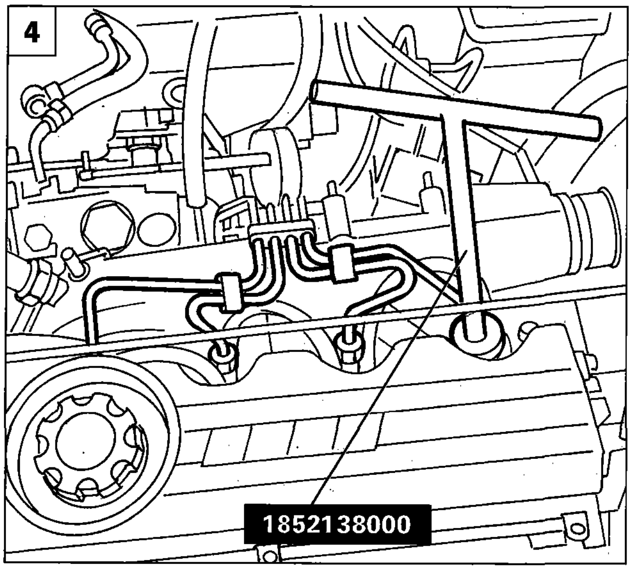
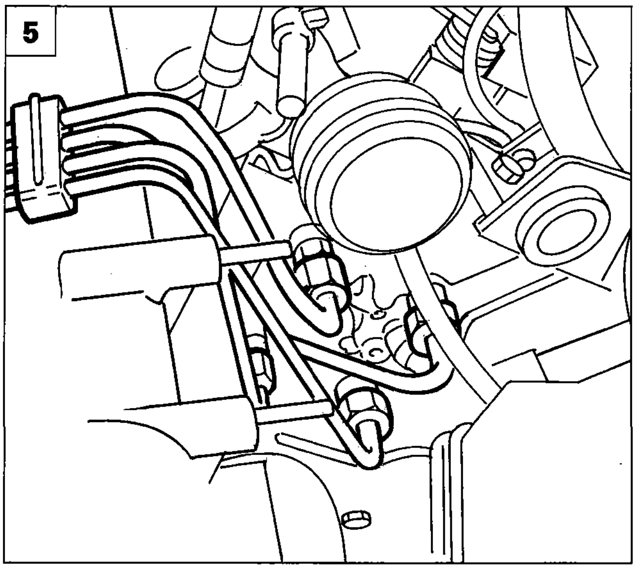


P4A20FX03

1. Disconnect the fuel vapour cut-off solenoid from the EGR by unscrewing the nuts indicated and remove the bracket shown.
2. Unscrew the bolts indicated, separate the EGR valve from the pipe and then remove.
3. Disconnect the fuel recovery line (1) from the fuel return sleeve and pipe (2) from the intake manifold.
4. Use wrench 1852138000 to unscrew the fittings of the diesel supply lines on the injectors.
5. Unscrew the diesel supply line fittings from the injection pump and then remove the pipes themselves.



P4A20FX04



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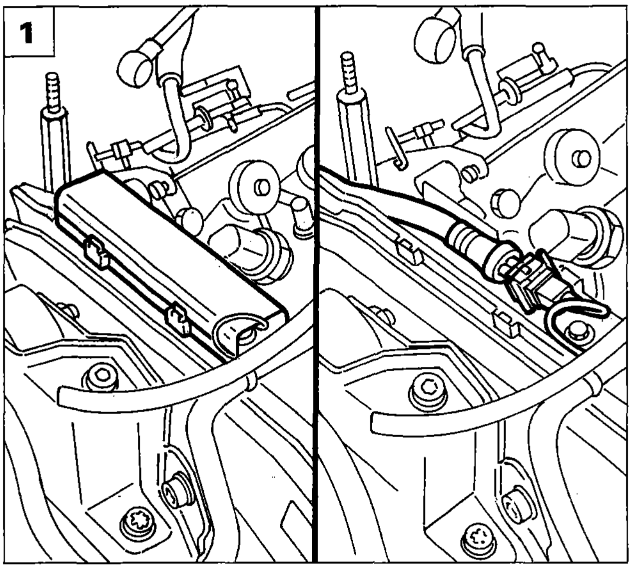


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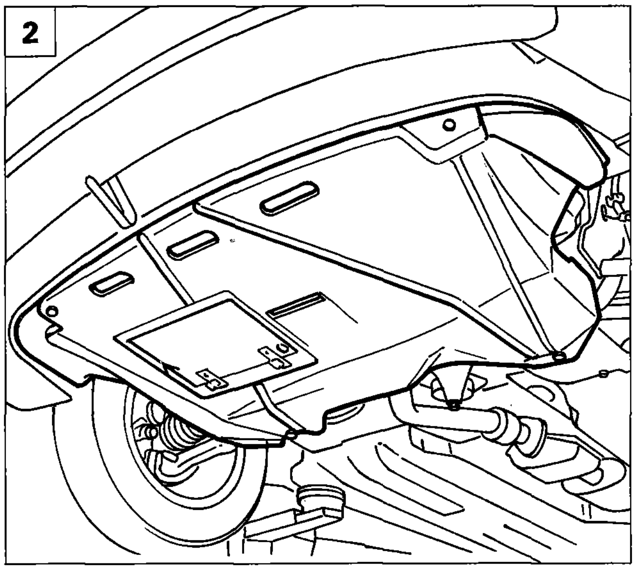
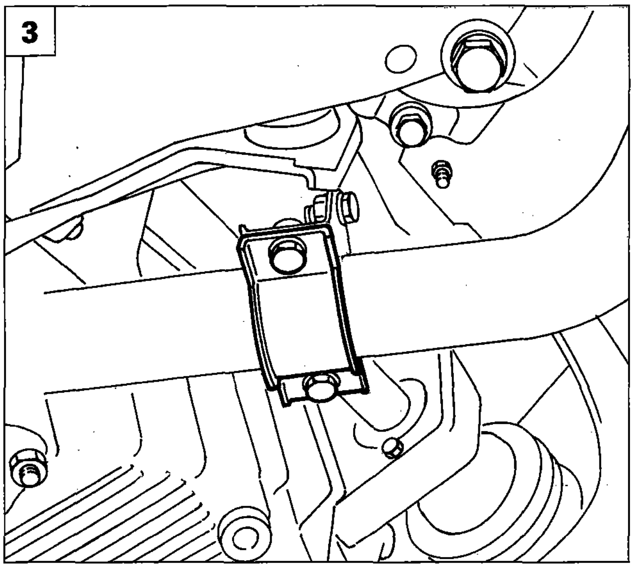


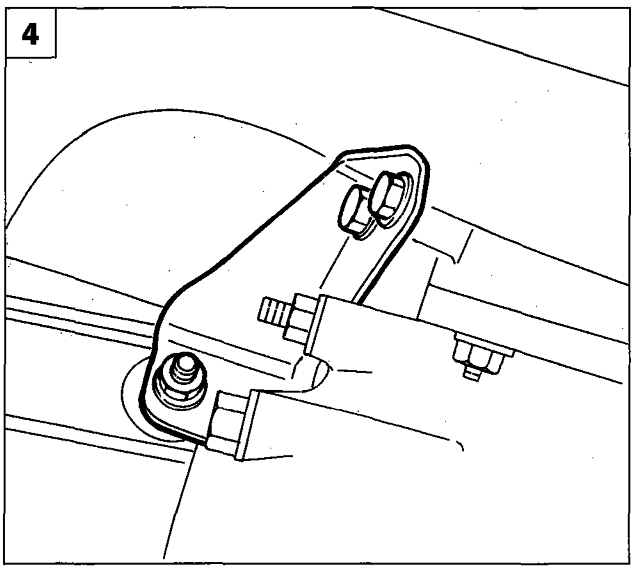

P4A21FX02

1. Open the wiring guard shown and disconnect the electrical connection of the pulse injector.

2. Raise the lift and remove the lower engine bay guard.

3. Unscrew the retaining bolts shown and release the exhaust pipe from the vibration-res stant bracket shown.

4.5. Remove both brackets holding the turbine to the engine block.

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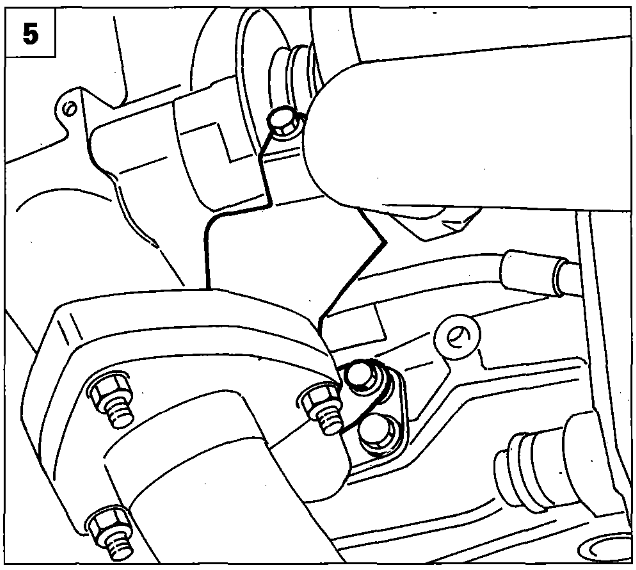


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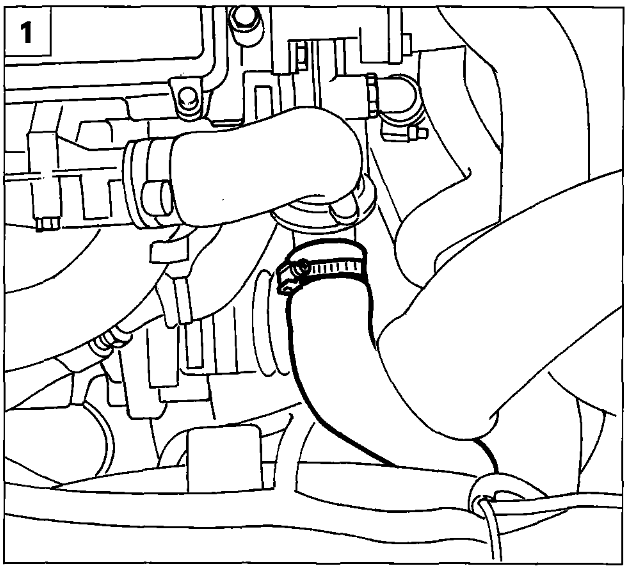


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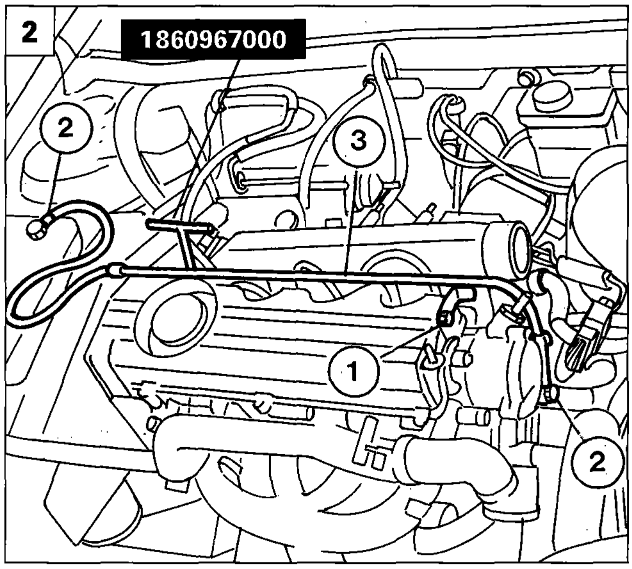


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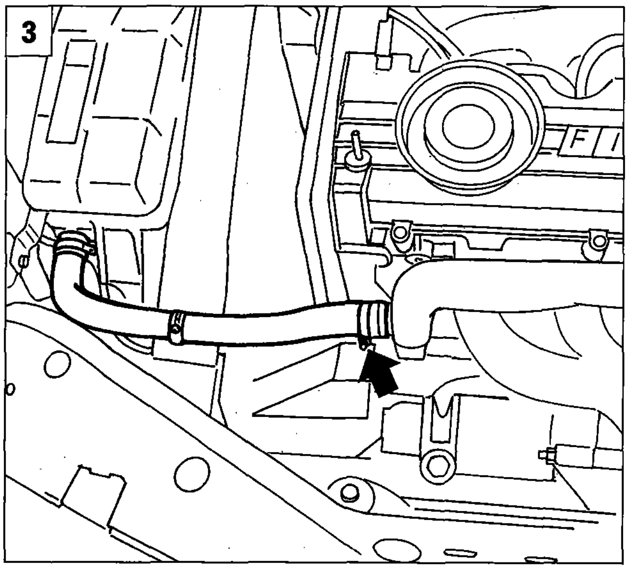
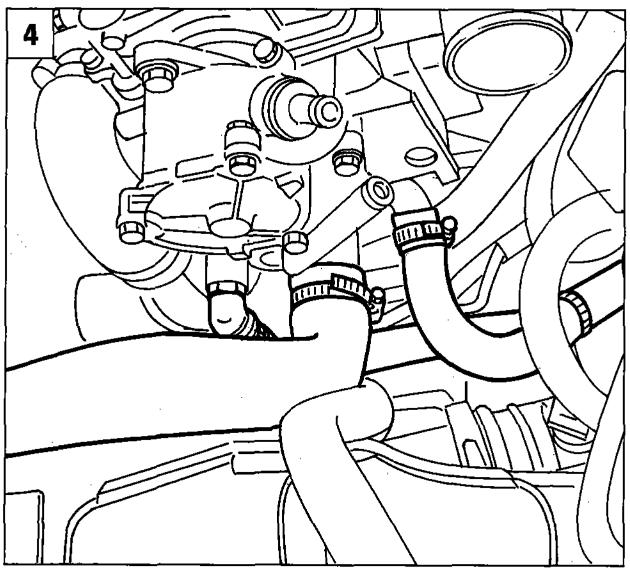



P4A22FX03

1. Position a suitable container to collect the coolant, then disconnect the pipe shown and drain the coolant.
2. Use tool 1860967000 to unscrew the fitting on the head, unscrew bolt (1), disconnect clips (2) and remove coolant pipe (3) from the cylinder head.
3. Disconnect the pipe shown from the cylinder head.
4. Disconnect the pipes shown from the thermostat.
5. Disconnect the sensor and coolant temperature sending unit electrical connections.

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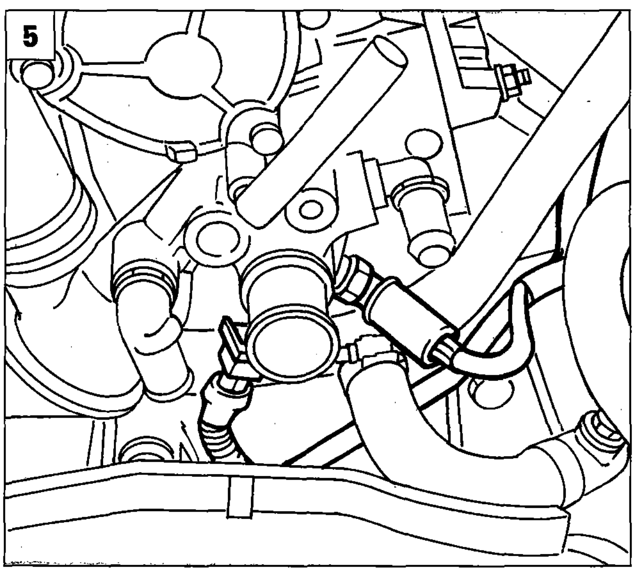


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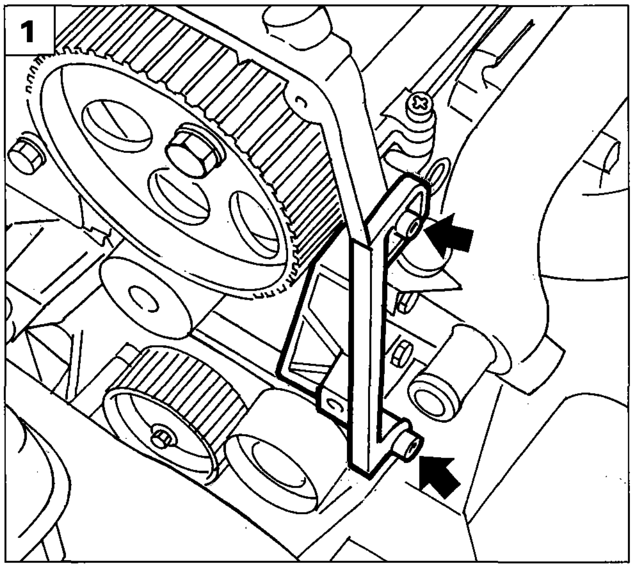


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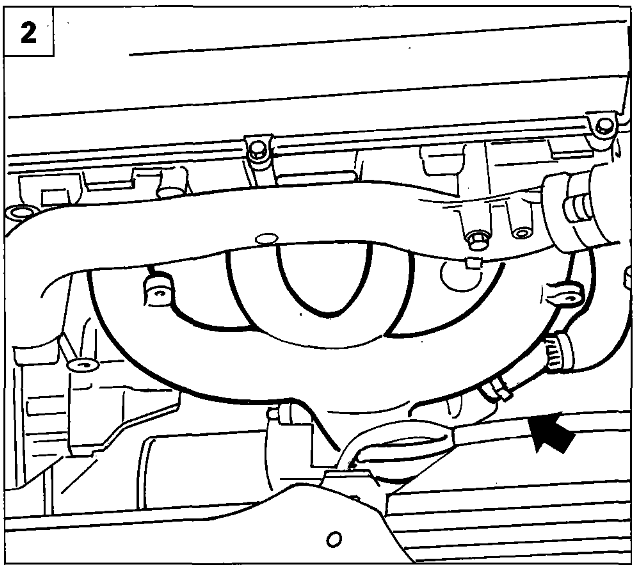


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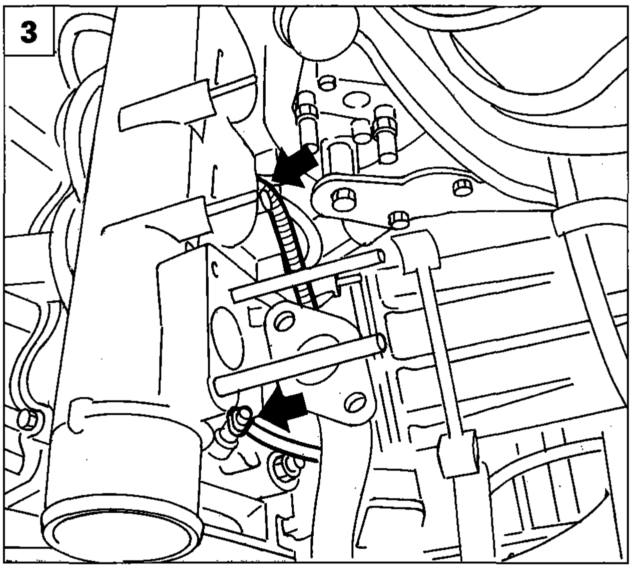


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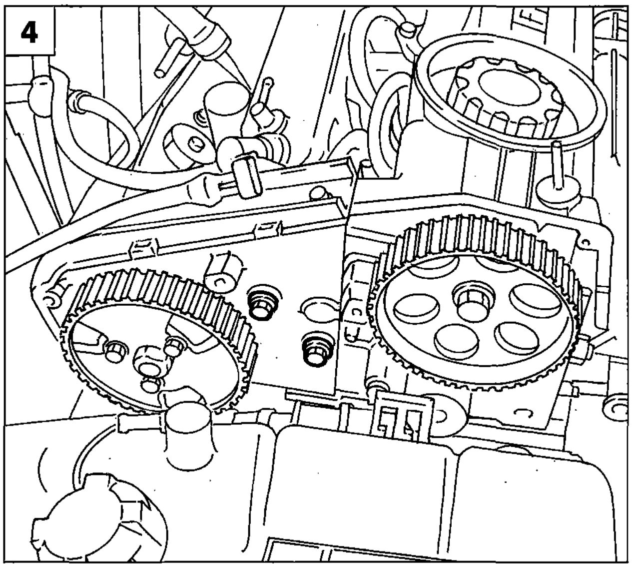
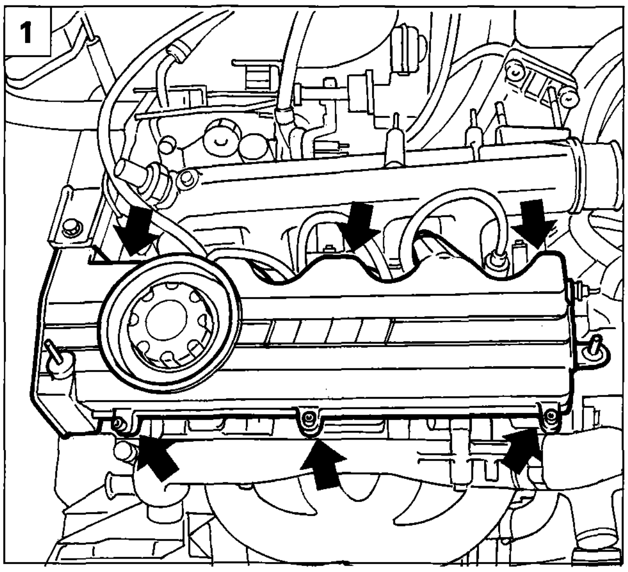


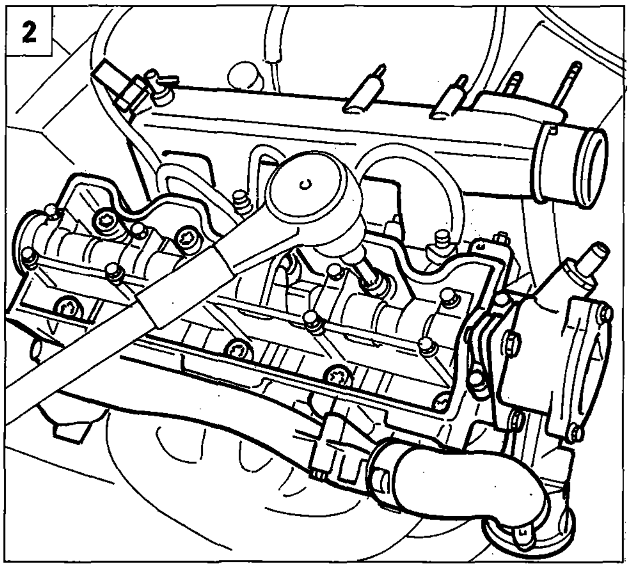

P4A23FX04

*Remove the auxiliary belt and the timing belt as described previously.*

1. Unscrew the retaining bolts shown and remove the timing belt side cover.
2. Unscrew the bolts retaining the exhaust manifold to the cylinder head, unscrew the nut shown and prise the EGR valve rigid pipe from the manifold, then release the exhaust manifold from the pins.
3. Unscrew the nuts shown and disconnect the glow plug supply leads.
4. Unscrew the bolts retaining the intake manifold to the injection pump mount bracket.




P4A24FX01

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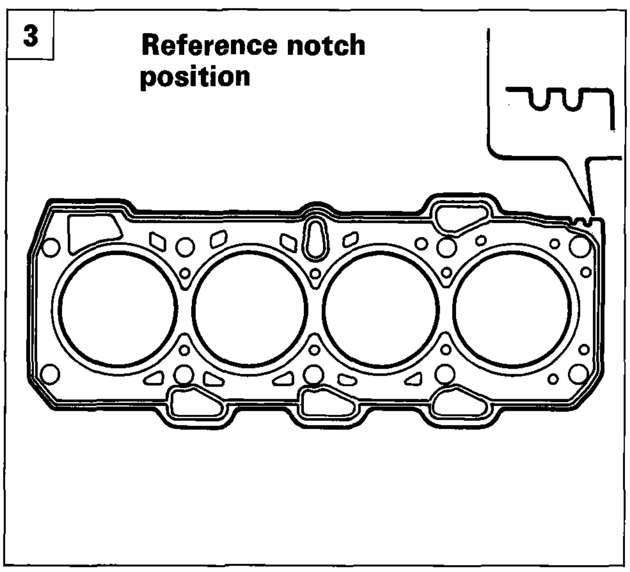



P4A24FX03

1. Remove the cam cover.

2. Use wrench 1852152000 to unscrew the bolts retaining the cylinder head to the engine block, then remove together with the intake manifold.

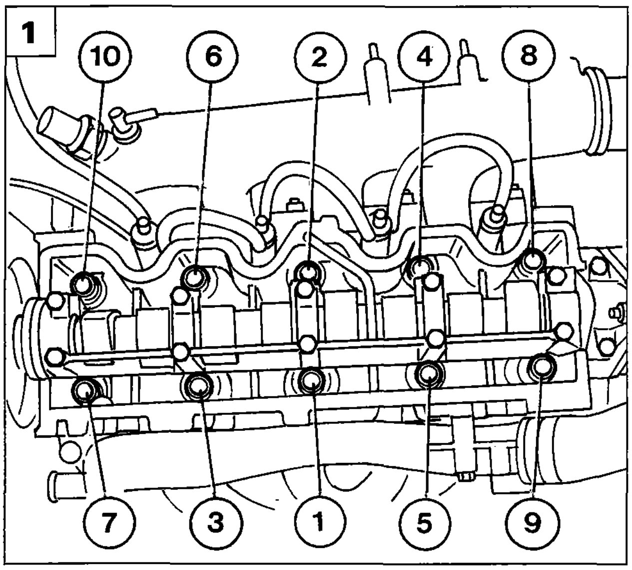
## FITTING CYLINDER HEAD GASKET

3. Check the amount by which the piston protrudes from the upper surface of the engine block and fit a cylinder head gasket of the thickness shown in the table in order to ensure the compression ratio remains as specified. Fit the gasket to the engine block by inserting the locating pins and ensure that the wording "ALTO" [TOP] is facing the operator.

| Average piston protrusion | Cylinder head gasket thickness | No. of notches |
|---|---|---|
| up to 0.80 mm | 1.6 mm | - |
| 0.80 to 0.90 mm | 1.7 mm | 1 |
| more than 0.90 mm | 1.8 mm | 2 |

*The cylinder head gasket is ASTADUR type. This type of gasket is made from a special material which undergoes a process of polymerisation while the engine is running and therefore hardens considerably during use. The following conditions must be satisfied in order to ensure polymerisation occurs:*

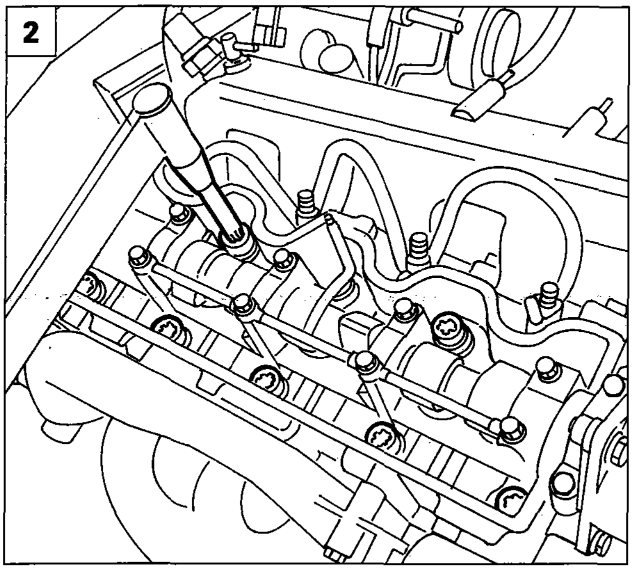
- *keep the gasket sealed in its plastic bag;*
- *take out only shortly before fitting;*
- *do not oil the gasket or contaminate with oil. Ensure cylinder head and crankcase surfaces are thoroughly clean.*




P4A25FX01

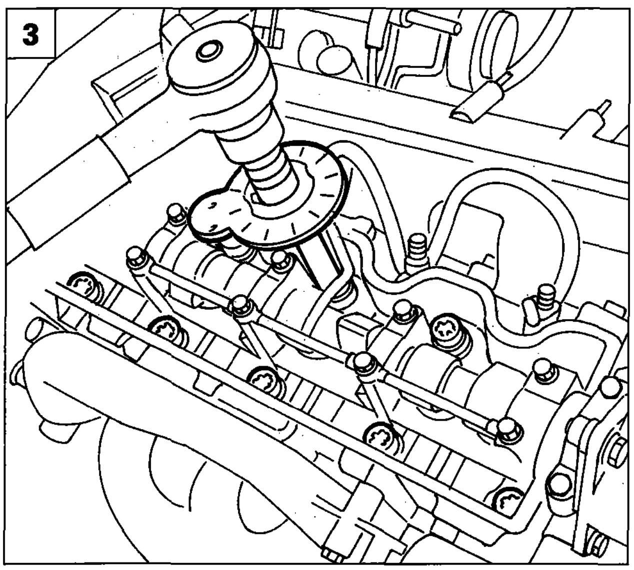
**REFITTING AND TIGHTENING CYLINDER HEAD**

1. Position the cylinder head on the engine block, then tighten the retaining bolts to torque. Ensure that the tightening order shown in the figure is followed for each tightening stage.




P4A25FX02

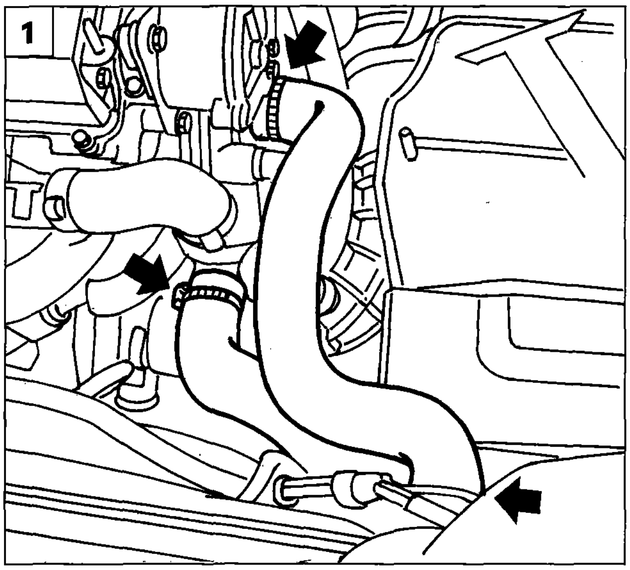
2. Oil screws and washers and leave to drain for at least 30 minutes; screw in bolts to a torque of 2 daNm, then carry out final tightening to a torque of 6.5 daNm using wrench 1852154000.




P4A25FX03

3. Tighten bolts through an angle of 270° in three different stages (90°+90°+90°) using wrench 1852154000 applied to tool 1860942000.

# 10.

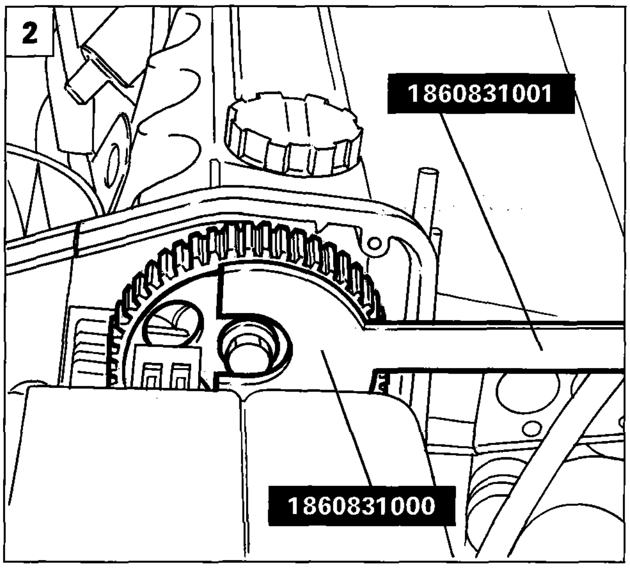



P4A03FX02

## REPLACING COOLANT PUMP

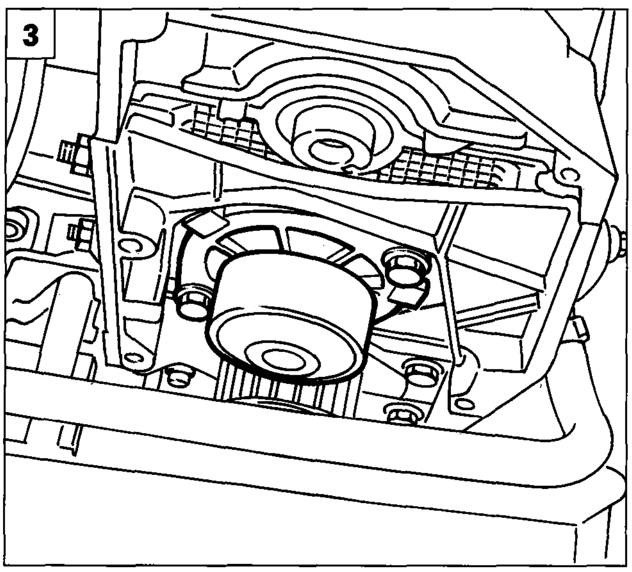
*Before removing the coolant pump, take off the auxiliary belt and the timing belt as described previously.*

1. Position a suitable container to collect the coolant and disconnect the coolant sleeves shown from the points illustrated.




P4A26FX01

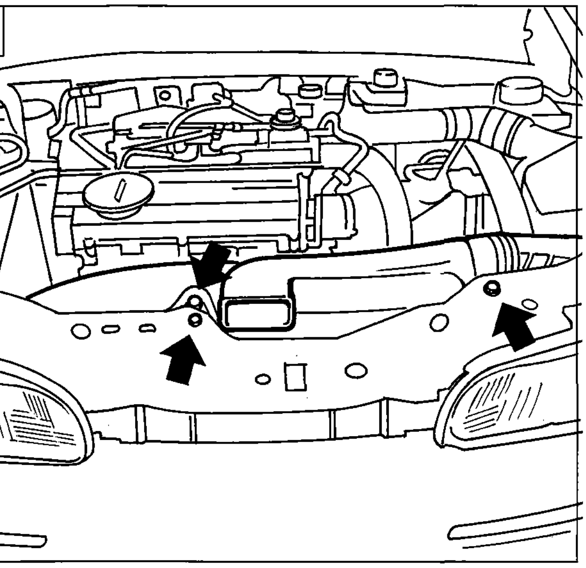
2. Use tools 1860831001 and 1860831000 to unscrew the camshaft pulley retaining nut.




P4A26FX02

3. Remove the coolant pump from the cylinder head.

1



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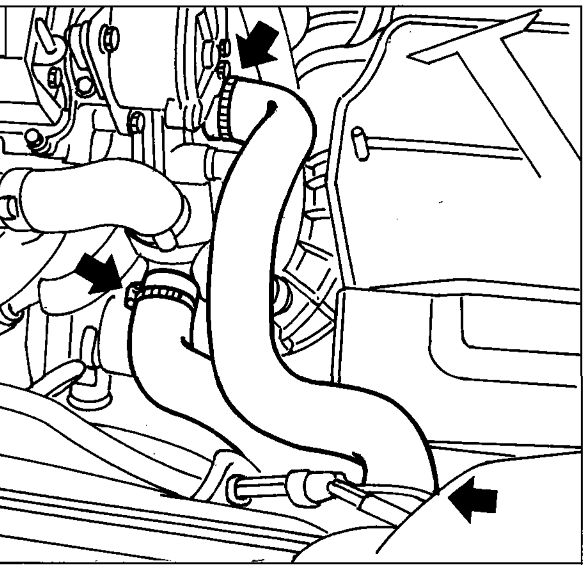
2



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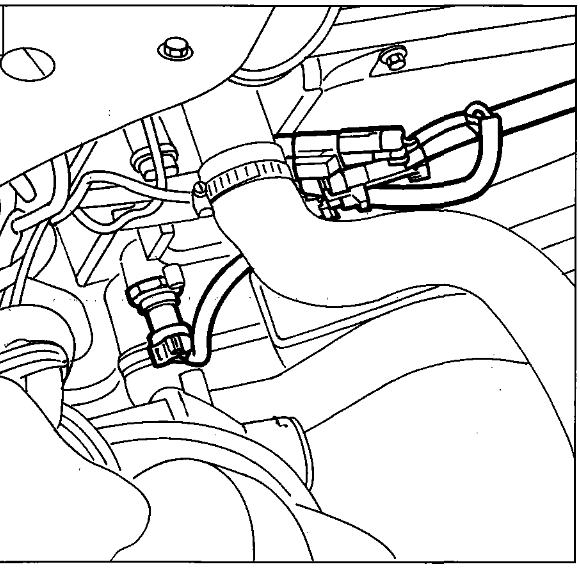
3



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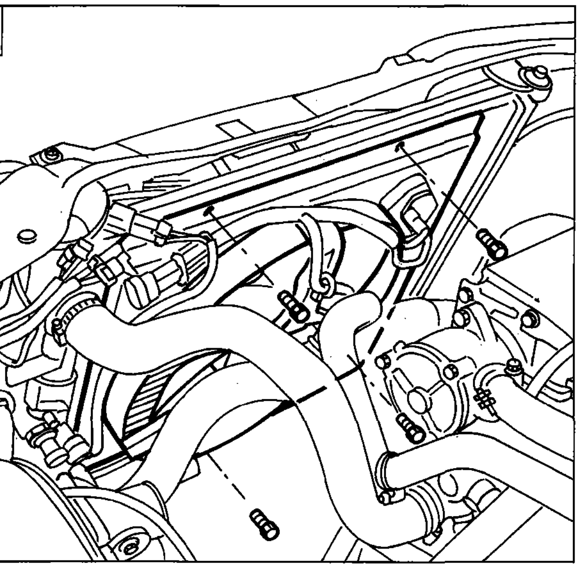
4



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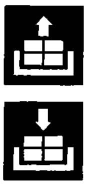


## REMOVING - REFITTING RADIATOR

Place the vehicle on a lift, remove the front wheels, disconnect the battery negative terminal and then proceed as follows.

1. Unscrew the retaining bolts shown and remove the air intake illustrated.

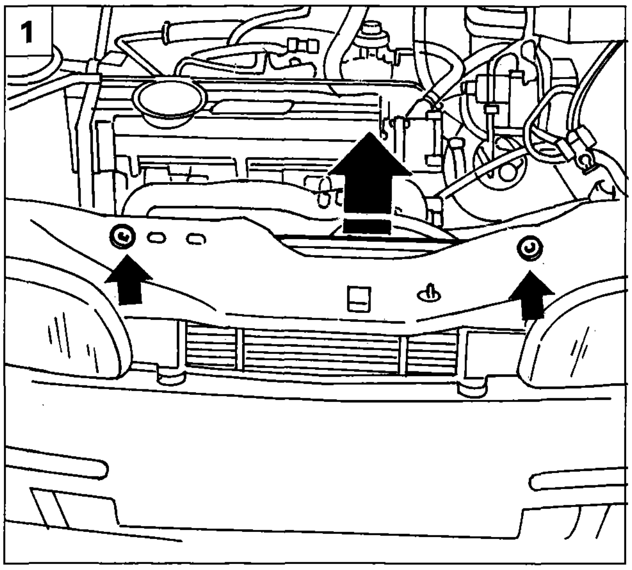
2. Position a container to collect the coolant and then disconnect the pipes shown to drain the coolant.

3. Disconnect the fan and thermostatic switch electrical connections.

4. Unscrew the bolts retaining the fan to the radiator (indicated in figure) and then remove the fan.

# 10.

1



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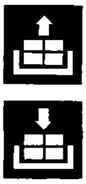


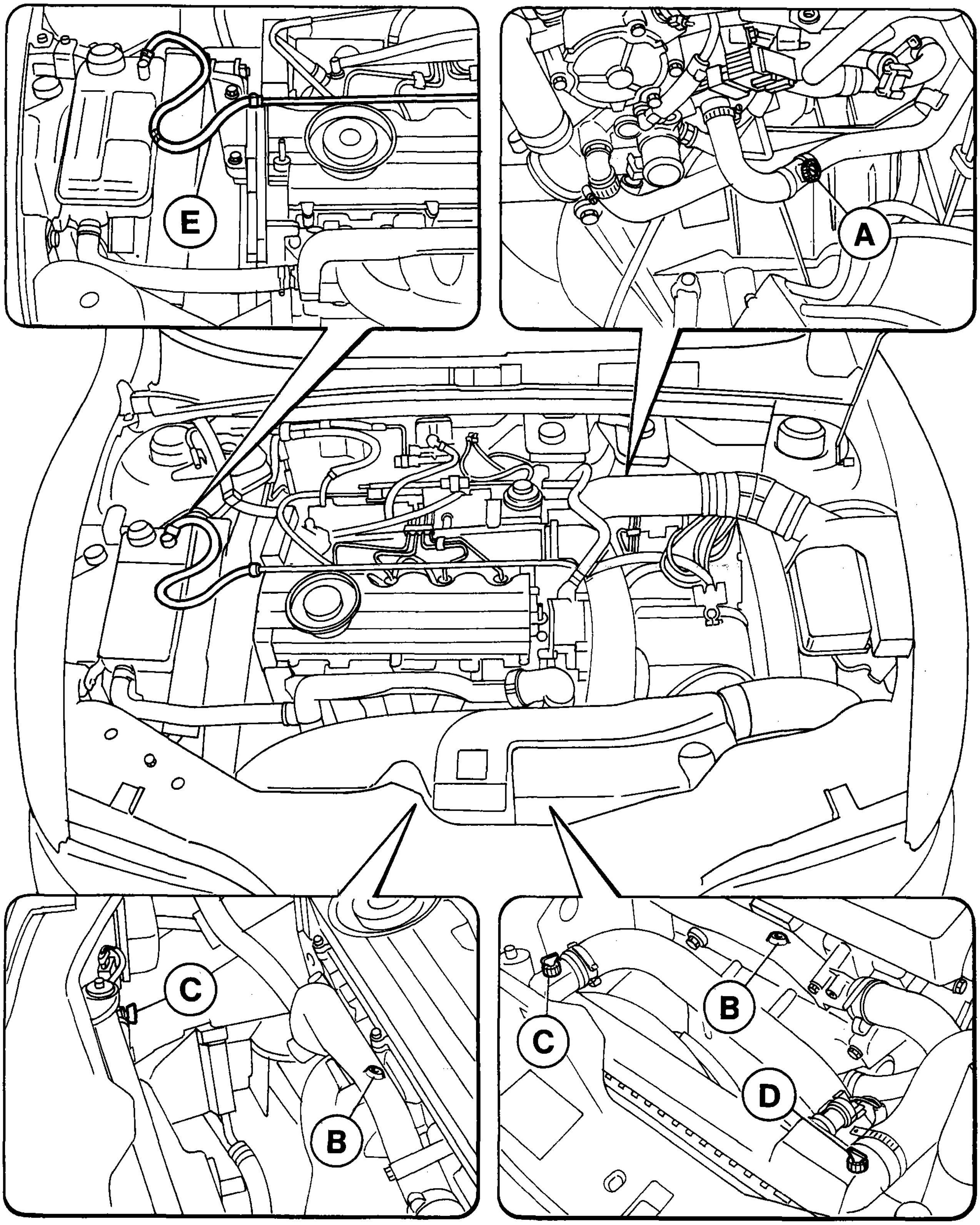
1. Unscrew the bolts retaining the radiator to the body, release from the lower pins and then remove from the upper part of the engine bay.

**COOLING SYSTEM FILLING PROCEDURE (Heated and air conditioned version with 75 bhp and 100 bhp engines)**

- Ensure all cooling system components (engine, heater, radiator etc.) are completely empty.
- Open bleed fitting (A) on the heater outlet sleeve, open bleed fitting (B) on the cylinder head rigid cooling pipe, and open bleed fitting (C) on the radiator. For versions with air conditioner, also open bleed fitting (D) on the radiator.
- Disconnect sleeve (E) connecting expansion tank/thermostat from the point indicated, blow compressed air into the sleeve to empty the pipe. Re-connect when this operation has been carried out.
- Slowly pour in coolant (mixture of 50% water and 50% paraflù) to fill the system until fluid emerges from bleed fitting (A) on the heater outlet sleeve, then close the bleed fitting.
- Carry on pouring in coolant until fluid emerges from bleed fitting (B) on the rigid pipe, then close the bleed fitting.
- Continue filling until fluid emerges from bleed fitting (C) on the radiator, then close. Close bleed fitting (D) at the same time as fitting (C) for air conditioned versions.
- Complete the operation by filling until the fluid reaches the level of the MAX notch on the expansion tank.
- Start the engine and allow to idle for about 2 or 3 minutes.
- Then pump the accelerator at regular intervals to increase the revs to about 3000 rpm. Add coolant to the expansion tank if necessary, but do not exceed the level of the MAX notch.
- Wait until the fan has come on at least twice and then turn off the engine.
- Allow the engine to cool and top up, if necessary, to a level between the MIN and MAX notches on the expansion tank.

**NOTE** *If fluid boils while the engine is running as described above, interrupt the procedure in order to find the defective component responsible for the problem, and replace it. Then repeat the filling procedure.*

**Location of engine cooling circuit bleed fittings for 75 bhp and 100 bhp engines (heated and air conditioned version)**




**Heated version** **Version with a/c**

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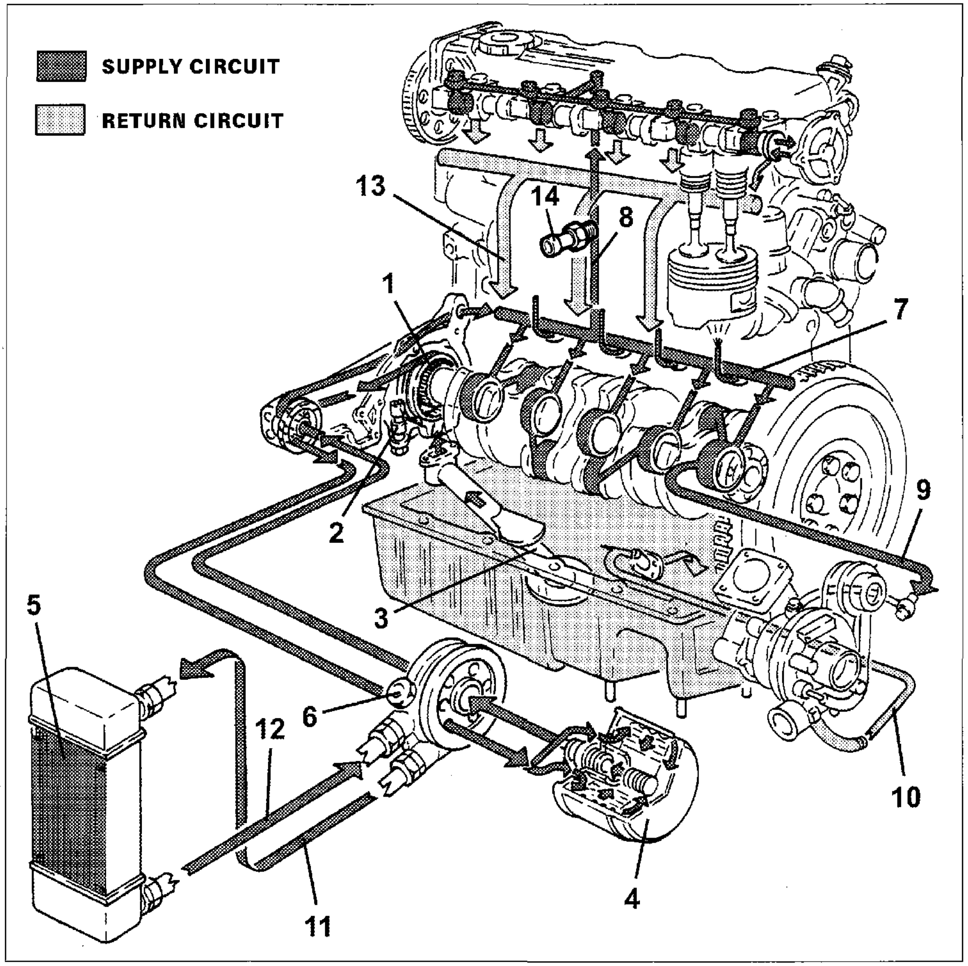
## DIAGRAM SHOWING ENGINE LUBRICATION SYSTEM




1. Oil pump
2. Oil pressure relief valve
3. Float with gauze filter
4. Oil filter cartridge
5. Engine oil cooling radiator
6. Thermostatic valve
7. Main longitudinal duct
8. Supply duct to the camshaft
9. Supply pipe to the turbocharger
10. Oil return pipe to the sump from the turbocharger
11. Oil supply pipe from the thermostatic valve to the radiator
12. Oil return pipe from the radiator to the thermostatic valve
13. Oil return to the sump
14. Engine oil pressure warning light switch

**Operation**

The engine lubrication system is pressurized through a geared pump incorporated in the crankcase front cover and operated directly by the crankshaft.
A relief valve controls the system pressure.

During the intake, the oil is filterd through a gauze filter and later by a replaceable cartridge on the supply line.

A thermostatic valve fitted on the oil filter mounting has the following function:
- at a temperature of $\leq$ 75°C, the oil passes directly into the oil filter cartridge and then to the engine;
- at a temperature of $\geq$ 90°C, the thermostatic valve is open and allows the oil to pass into the cooling radiator to lower the temperature and ensure better lubrication.

A main longitudinal duct in the cylinder block-/crankcase allows the lubrication of the crankshaft, the pistons and the connecting rods.

A duct allows the lubrication of the cylinder head and all the engine timing system components.

Two special pipes allow the lubrication of the turbocharger.

4A31FX

The information contained in this publication is supplied as a guide and may no longer be up to date as a result of modifications made by the Manufacturer at any time for reasons of a technical or commercial nature or to meet legal requirements in different countries.

**Fiat Auto S.p.A.**
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## BOSCH 1.5.5 INTEGRATED INJECTION/IGNITION SYSTEM

### Introduction

The BOSCH 1.5.5 system fitted on the 1242 16v ie engine belongs to the category of static advance, digital, electronic ignition systems integrated with phased, intermittent type electronic fuel injection systems.
The integrated system can be divided into the following sub systems:

ELECTRICAL/ELECTRONIC CIRCUIT
AIR INTAKE CIRCUIT
FUEL SUPPLY CIRCUIT
EMISSION CONTROL DEVICES

The system is capable of detecting the following parameters by means of appropriate sensors:
- the engine rotation speed;
- the correct sequence of TDC in the explosion stroke for the cylinders (injection timing);
- the absolute pressure in the inlet manifold;
- the intake air temperature;
- the position and the variation speed of the accelerator butterfly;
- the temperature of the engine coolant;
- the possible presence of detonation;
- the speed of the vehicle;
- the battery voltage;
- the possible engagement of the air conditioning;
- the possible end of travel of the power assisted steering.

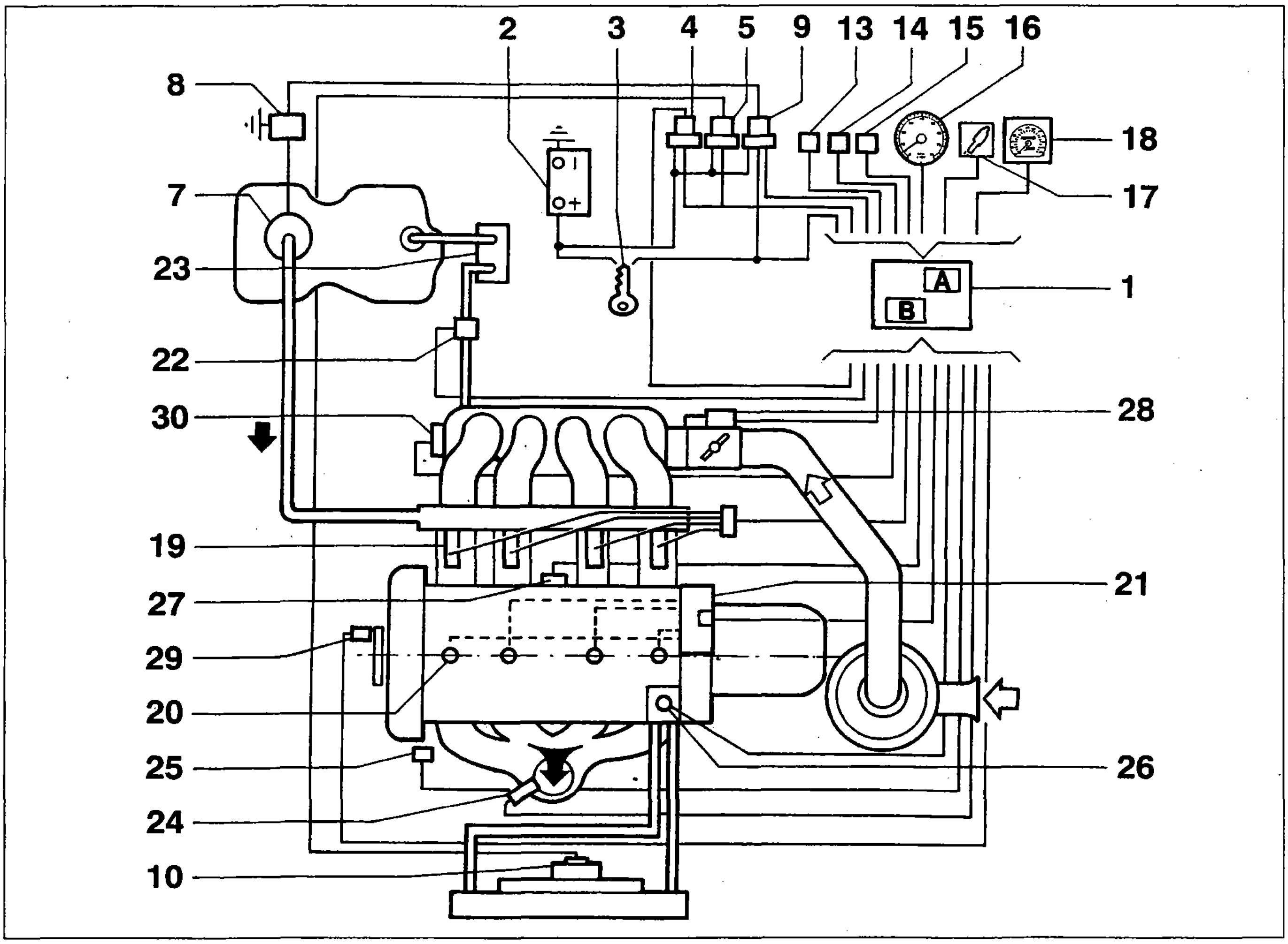
This information, usually in analogue format, is converted into digital signals by analogue/digital (A/D) converters so that they can be used by the control unit.
The management programme (software) is stored in the control unit memory and consists of a series of strategies, each of which manages a precisely defined system control function.
Through the use of the information (input) listed earlier, each strategy processes a series of parameters using data maps stored in special areas of the control unit memory and then operates the system actuators (output), which consist of devices which allow the engine to operate, such as:
- injectors;
- ignition coil;
- relay feeds;
- implementation solenoid valves;
- interface with the vehicle (diagnostic warning light, diagnostic instrument, etc.).

**NOTE** *The BOSCH 1.5.5 injection/ignition system does not require any adjustment as it is the self-adjusting type.*

**NOTE** *In the drawings and diagrams, the numbers indicate the corresponding engine control unit pins (number/A for connector A, number/B for connector B).*

# 10.

### BOSCH 1.5.5 INJECTION/IGNITION SYSTEM FUNCTIONAL DIAGRAM




P4A02JJ01

1. Engine control unit
2. Battery
3. Ignition switch
4. Engine control system relay
5. Electric fuel pump relay
7. Drip tray (including: electric pump, pressure regulator, filter, gauge)
8. Inertia switch
9. Radiator fan relay(s)
10. Radiator fan
13. Climate control connection
14. CODE connection
15. Diagnostic equipment connection
16. Rev counter
17. System failure light
18. Speedometer
19. Injectors
20. Spark plugs
21. Ignition
22. Charcoal filter solenoid valve
24. Lambda sensor
25. Power assisted steering sensor
26. Coolant temperature sensor
27. Detonation sensor
28. Engine idle adjustment actuator and butterfly position sensor
29. Engine rpm and TDC sensor
30. Absolute pressure and air temperature sensor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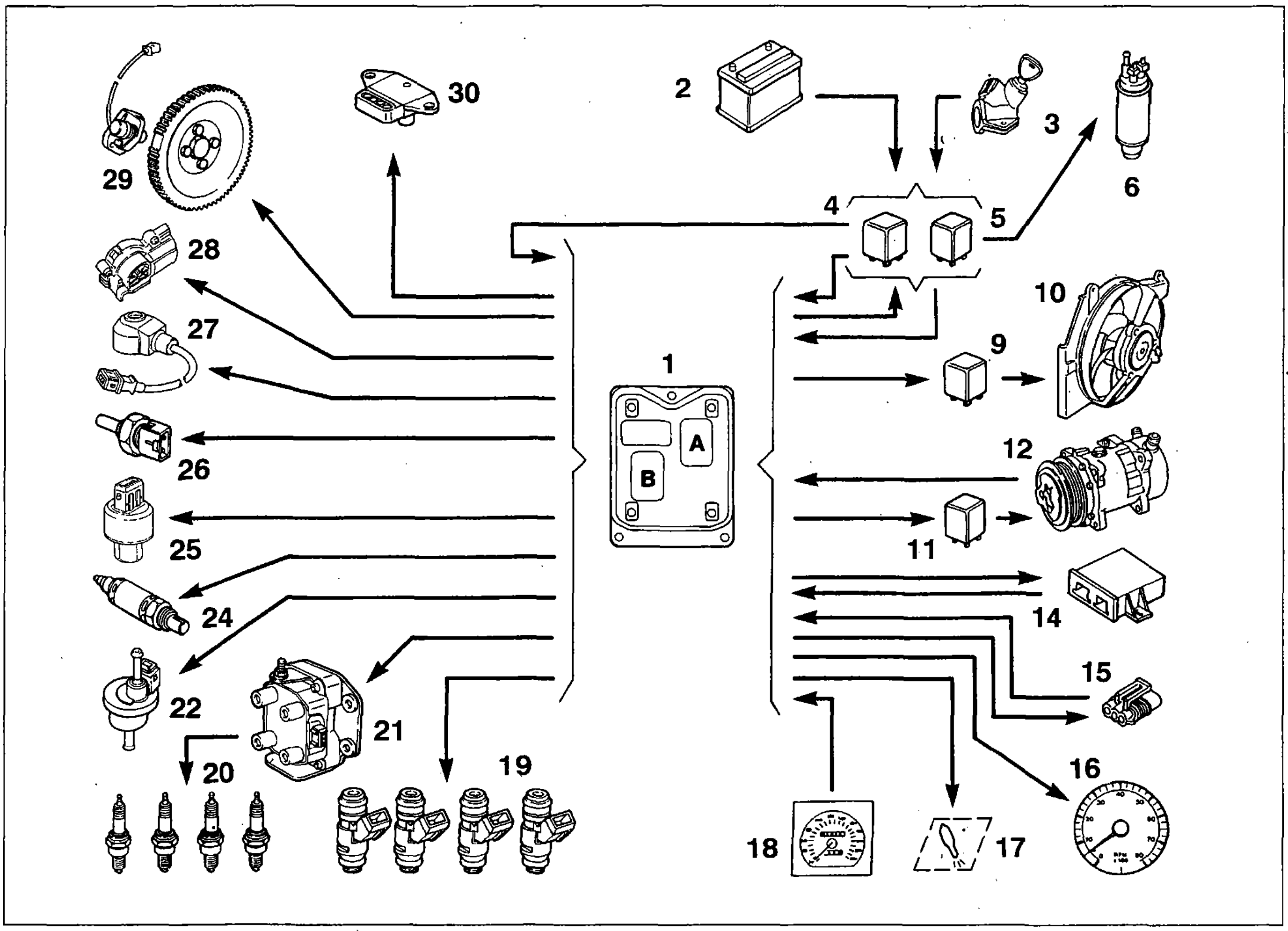
## DIAGRAM SHOWING INFORMATION ENTERING/LEAVING THE CONTROL UNIT AND BOSCH 1.5.5 INJECTION/IGNITION SYSTEM COMPONENTS

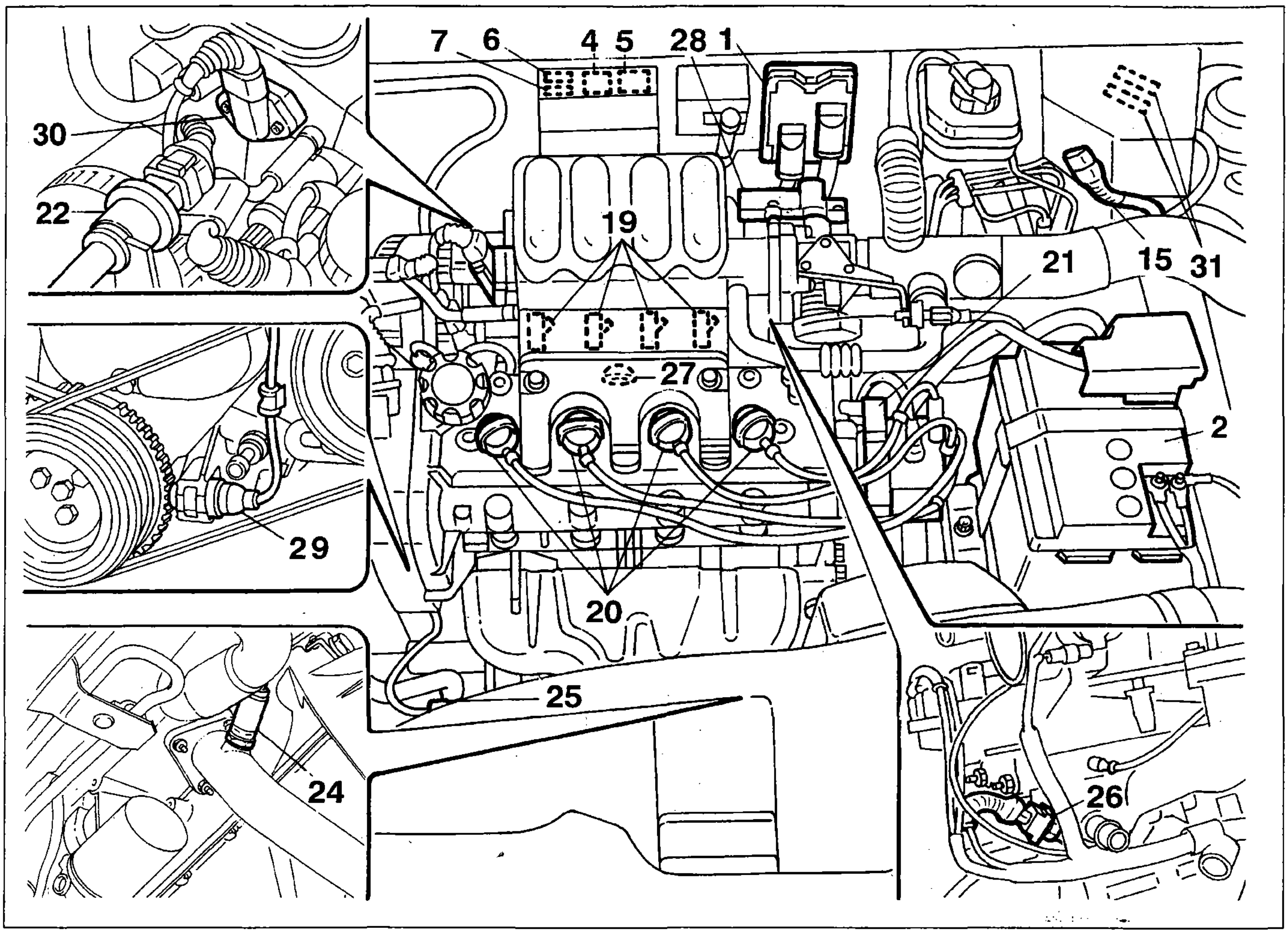



P4A03JJ01

1. Engine control unit
2. Battery
3. Ignition switch
4. Engine control system relay
5. Electric fuel pump relay
6. Electric fuel pump
9. Radiator fan relay(s)
10. Radiator fan
11. Compressor engagement relay
12. Compressor
14. CODE control unit
15. Diagnostic equipment connection
16. Rev counter
17. System failure light
18. Speedometer
19. Injectors
20. Spark plugs
21. Ignition
22. Charcoal filter solenoid valve
24. Lambda sensor
25. Power assisted steering sensor
26. Coolant temperature sensor
27. Detonation sensor
28. Engine idle adjustment actuator and butterfly position sensor
29. Engine rpm and TDC sensor
30. Absolute pressure and air temperature sensor

# 10.

## LOCATION OF BOSCH 1.5.5 INJECTION/IGNITION SYSTEM COMPONENTS IN THE ENGINE COMPARTMENT




1. Engine control unit
2. Battery
4. Engine control system relay
5. Electric fuel pump relay
6. System fuse
7. Electric pump fuse
15. Diagnostic equipment connection
19. Injectors
20. Spark plugs
21. Ignition
22. Charcoal filter solenoid valve
24. Lambda sensor
25. Power assisted steering sensor
26. Coolant temperature sensor
27. Detonation sensor
28. Engine idle adjustment actuator and butterfly position sensor
29. Engine rpm and TDC sensor
30. Absolute pressure and air temperature sensor
31. Main fuses (maxi-fuse)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## SYSTEM MANAGEMENT STRATEGIES
### Operating principle

Any engine operating point is identified by two parameters;
- rotation speed;
- engine load.

If these parameters are known by means of appropriate processing it is possible to calculate and then implement the injection (quantity of fuel supplied and timing with explosion stroke TDC), the ignition (correct ignition advance) and any other functions for each engine operating point.

In the BOSCH 1.5.5 system the rotation speed is measured directly via the relevant sensor whilst the engine load is determined indirectly, calculating "factor tl" (representing the actual engine load) accordint to the absolute pressure and the temperature of the air, both measured in the inlet manifold.
Special maps are experimentally determined for the engine and the vehicle for the injection and the ignition, which (for a certain number of speed-load parameter pairs) contain the ignition advance and injection timing values required for the correct operation of the engine.
For any engine operating point not exactly included in those stored in the maps, the values are determined through mathematical interpolation from these figures.

The injection time values calcluated are also corrected according to the signal coming from the Lambda sensor which, on the basis of suitable operating strategies, ensures that the mixture strength is constantly around the stoichiometric value.
The system is known as the "speed-density-Lambda" type because the injection time is basically determined from these three parameters.

All the particular operating situations which require adjustments to the ignition advance and injection timing values calculated are managed by the engine control unit on the basis of the signals coming from the various system sensors.

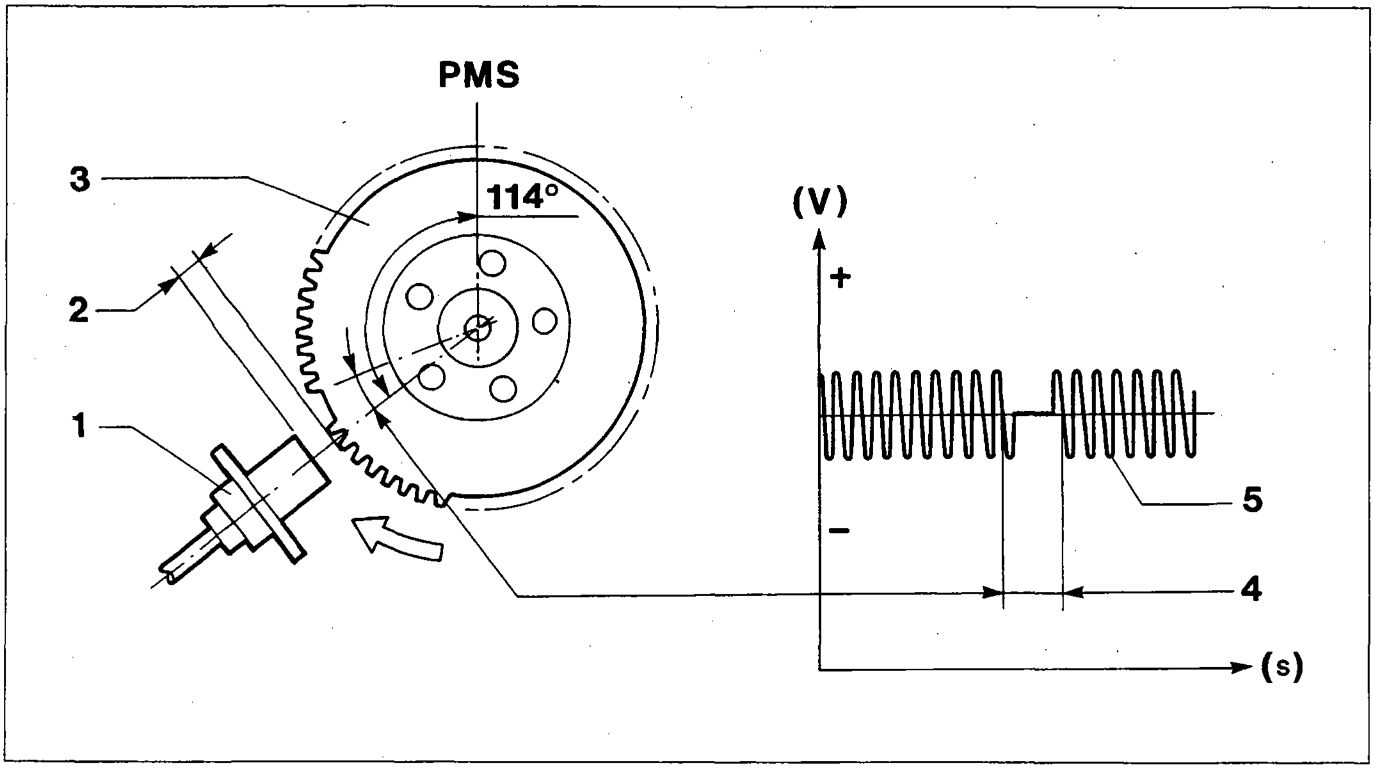
### Management of the signals

**NOTE** *These signals refer to the collection of signals coming from the sensor on the crankshaft which are characterized by a precise sequence which the control unit is capable of recognizing.*

During starting, the control unit recognizes the ignition and the injection timing which are vital for the subsequent operation of all the strategies.
This recognition takes place in two successive stages:
- by interpreting the succession of signals coming from the flywheel sensor, on the crankshaft, the control unit recognizes TDC for the pair of cylinders 1-4.
- using a particular strategy the control unit, by failing to operate a particular injector, is capable, by evaluating the consequent variation in speed (not perceptible to the driver) of recognizing which cylinder the injector which is not operated belongs to and therefore of determining the correct cylinder sequence (software timing).

# 10.

In particular, the signal is composed as follows.
There are sixty teeth on the flywheel, two of which have been removed to create discontinuity: the angle between the two consecutive teeth is therefore 6°:
The synchronism point is recognized at the end of the first tooth following the two missing teeth: the flywheel is fitted so that as the engine passes this tooth cylinders 1 and 4 are 17 teeth before TDC.




P4A06JJ01

1. Engine rpm and TDC sensor
2. Gap
3. Flywheel 60-2 teeth
4. Signal corresponding to two missing teeth
5. Flywheel signal (engine speed sensor)

## MANAGEMENT OF THE INJECTION

The injection management strategies are designed to provide the engine with the correct quantity of fuel at the desired moment according to the engine operating conditions.

The management of the injection basically consists of calculating the injection time, determining the injection phase and then the implementation by operating the injector.
The "basic" injection time is calculated by means of mathematical interpolation of the speed-load map: the figures contained in the map, which have been obtained experimentally, also depend on the characteristics of the injector.
The "final" injection time "is determined by means of a calculation algorhythm in which the "basic" injection time is corrected by a series of coefficients which take into account the different engine operating conditions which are highlighted by the various system sensors.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### Controlling the mixture strength

**NOTE** *The mixture strength is defined and the ratio is indicatd by the greek letter α (alfa).*

$$\frac{\textbf{quantity of air drawn in by the engine}}{\textbf{quantity of fuel injected}}$$

*The stoichiometric ratio is defined and the ratio is indicated by αst.*

$$\frac{\textbf{theoretical quantity of air required to burn all the fuel injected}}{\textbf{quantity of fuel injected}}$$

*The mixture strength is defined and the ratio is indicated by the greek letter λ (lambda):*

$$\frac{\textbf{quantity of air drawn in by the engine}}{\textbf{theoretical quantity of air required to burn all the fuel injected}}$$

It can easily be deduced that $\alpha st = \lambda$.
The stoichiometric ratio depends on the type of fuel: for current unleaded petrol it is about 14.7 - 14.8 and corresponds to a Lambda of 1:
A mixture is called *rich* when the quantity of air is lower than the stoichiometric figure and in that case the Lambda is $\lambda < 1$:
A mixture is called *poor* (or *lean*) when the quantity of air is higher than the stoichiometric figure and in that case the Lambda is $\lambda > 1$.

The strategy is designed to correct the "basic" injection times so that the mixture strength constantly oscillates at a high Hertz frequency:

**NOTE** *1 Hz = 1 oscillation per second*

In
- cut-off conditions,

or
- in full load engine conditions,

or
- with the engine cold (coolant and air temperature below around 20 °C)

the strategy is disabled.

### Self-adjustment

The control unit is equipped with a self-adjustment function which has the task of memorizing any differences between the basic map and the corrections set by the Lambda sensor which occur repeatedly during operation. These differences (due to the ageing of the system and engine components) are permanently stored in the memory, allowing the adjustment of the system operation to the gradual alterationsin the engine and components compared to when they were new.
The strategy is disabled during the opening of the charcoal filter solenoid valve.
If the control unit is replaced, a road test must be carried out which allows the engine to reach operating temperature and the control unit to intervene (especially during stops whilst idling) imposing the self--adjustment function.

### Starting and operation when cold

During cold starting the management of the injection is simultaneous (full-group), i.e. not phased: this situation persists until the coolant reaches a certain temperature (about 0°C), after which the management becomes phased.

Whist the starter motor is working the injection time is determined by a special map and depends on the temperature of the coolant: once the engine has been startedup, the regular speed-load map is used for the calculations.

During operation when cold, since the mixture is naturally weakened as a result of the reduced evaporation and the strong condensation of the fuel on the internal walls of the inlet manifold, the "basic" injection time "is increased by a multiplication coefficient which depends on the engine temperature and speed.

### Operation in full load conditions

The strategy is enabled when the butterfly exceeds a certain level, which, in turn, depends on the engine speed.

In this situation the injection time is determined by a special map which depends on the engine load and speed conditions.

### Operation in acceleration and deceleration conditions

The acceleration and deceleration conditions are interpreted by the system as a trasition stage between two conditions, setting off and arriving: this transition can be positive (acceleration) or negative (deceleration).

The transition management strategy is very complex, having to take a large number of factors into account.

In general, the injection time is increased for positive transitions and reduced for negative ones.

The extent of the correct basically depends on the variation in the engine load: however, other factors such as the speed of movement of the butterfly, the engine speed, the gear engaged (obtained from the ratio between the engine speed and the vehicle speed), the temperature of the engine (coolant and intake air) which are interconnected also have an impact.

The "basic" injection time is multiplied by a coefficient which is, in turn, the sum of two coefficients: the first takes into account the temperature of the engine and opening speed of the accelerator butterfly; the second depends on the engine rotation speed.

In particular, if the increase in the injection time is feasible at an injector which has just closed, the control unit reopens the injector (extra pulse), in order to compensate for the mixture strength extremely quickly: the subsequent injections are already increased on the basis of the coefficients mentioned previously.

### Operation in cut off conditions

The control unit enables the cut-off strategy when the temperature of the engine exceeds a certain level.

The cut-off strategy is implemented when the control unit recognizes that the butterfly is in the minimum position (signal from the butterfly potentiometer): it is disabled when the engine is cold to avoid driveability problems.

The engine supply is re-enabled when the butterfly is recognized to be in a non closed position or when the engine speed goes below a level which depends on the coolant temperature.


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**Rotation speed restricter**

This strategy restricts the maximum speed which can be reached by the engine enabling the cut-off. There are two different cut-off thresholds:
- static restriction (the engine speed approaches the level slowly): maximum speed = 6670 [rpm];
- dynamic restriction (the speed approaches the level rapidly): maximum speed = 6500 [rpm];

**Operation of electric fuel pump**

The electric fuel pump is operated by the engine control unit by means of a relay.
The pump is stopped:
- if the engine speed goes below 50 [rpm]
- after a certain time (about 5 seconds) if the ignition key is in the ON position and the engine has not been started up (timed inhibition);
- if the inertia switch has intervened.

**Operation of injectors**

The operation of the injectors is the sequential, phased type. However, during cold starting, the injectors are operated in parallel up to a certain temperature.
The timing of the injectors varies according to the engine speed.

## MANAGEMENT OF THE FIAT CODE ANTI-THEFT FUNCTION

The system is equipped with an anti-theft function. This function is achieved through the presence of a special (FIAT CODE) control unit, capable of conversing with the engine control unit, and an electronic key equipped with a special transmitter for sending a recognition code.

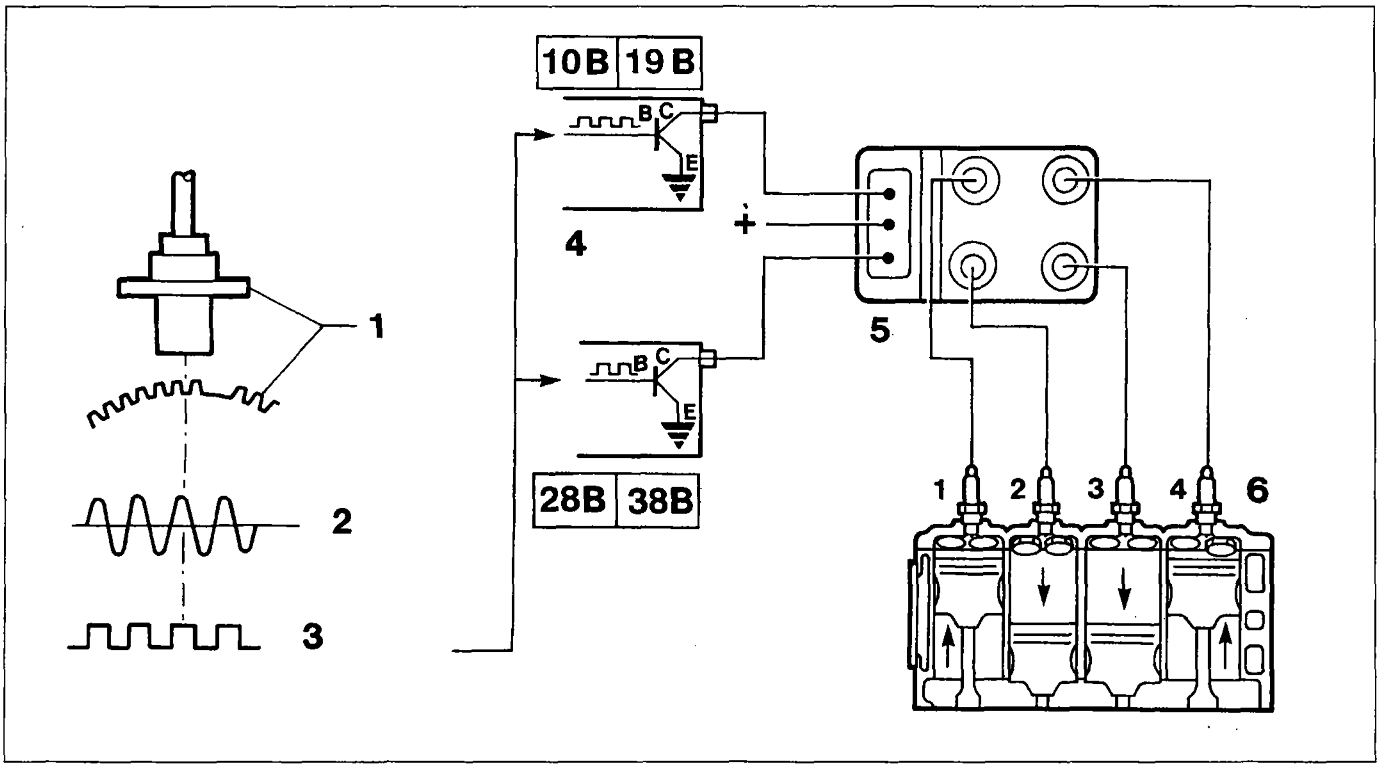
Each time the key is turned to the OFF position, the Fiat CODE system completely deactivates the engine control unit.

When the key is turned to the ON position the following operations take place in order:
1. the engine control unit (whose memory contains a secret code) sends the FIAT CODE control unit a request to send the secret code to deactivate the immobilization of the functions;
2. the Fiat CODE control unit responds by only sending the secret code after having, in turn, received the recognition code transmitted by the ignition key;
3. the recognition of the secret code allows the immobilization of the engine control unit to be deactivated and normal operation resumed.

**NOTE** *If a FIAT CODE anti-theft system is fitted, during the fault diagnosis, DO NOT CARRY OUT the test using another engine control unit. In such a case, the Fiat CODE control unit would transfer the (unrecognized) recognition code to the test control unit which could then no longer be used on other vehicles.*

**MANAGEMENT OF THE IGNITION**

The management of the ignition basically consists of determining the desired ignition advance according to the engine operating conditions and its implementation through the operation of the power transistor located inside the control unit.
The "basic" advance value, calculated on the basis of the engine load and speed conditions, is then corrected according to the different engine operating conditions.
The primary winding for each coil receives the battery voltage via the relay and is connected to the power transistor incorporated in the engine control unit, whose transmitter is connected to earth, whilst base receives the operating voltage from the control unit.
According to the engine rotation speed and the ignition advance to be implemented, the engine control unit establishes the moment for the start of the condution of the primary winding, in such a way as to reach the desired current intensity (saturation) in the primary winding immediately before this current is interrupted.
This moment obviously varies in terms of the angle in relation to TDC for the explosion stroke for each cylinder and the greater the advance, the greater the engine rotation speed because the time required to saturate the current in the coil primary winding is more or less constant: it is determined using suitable coefficient stored in the memory (dwell management).
The moement for the start of conduction is also corrected on the basis of the battery voltage.
The engine control unit therefore determines the moment the current in the primary coil is interrupted transforming the advance degrees into the time required by the engine to cover this angle: this time constitutes the advance in relation to TDC for the explosion stroke with which the current is interrupted at the base of the transistor.
The moment the current at the base of the power transistor is interrupted, the connection to earth for the primary coil is interrupted and consequently there is a high tension discharge at the secondary winding.




P4A11JJ01

1. Engine rpm and TDC sensor and flywheel
2. Control unit input signal
3: Signal converter in the control unit (square wave)
4. Internal power module
5. Coil
6. Spark plugs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**Starting**

During starting the normal management of the advance is not possible on account of the considerable fluctuations in the rotation speed which do not allow the dwell and the advance to be calculated correctly.
The control unit implements a fixed advance for the entire time the engine is driven by the starter motor.

**Operation at high temperatures**

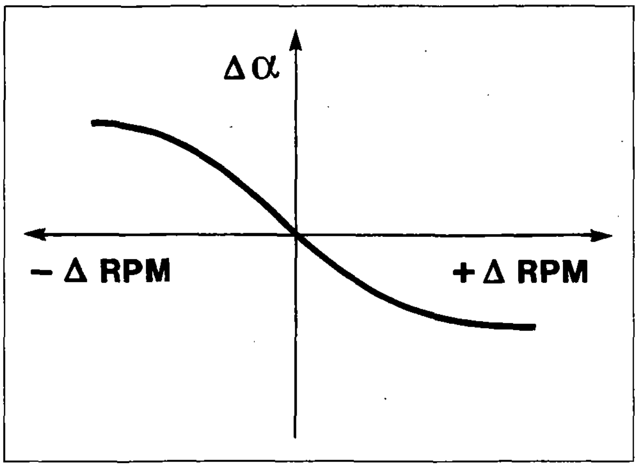
This strategy is enabled when the intake air temperature exceeds a certain level.
The "basic" advance value is reduced according to this temperature.

**Operation in cut off conditions**

The injection advance is reduced on entry into cut-off: from the moment the supply of fuel is restored, the advance gradually returns to the "basic" value.

**Operation during take-off**

This strategy is designed to reduce the advance when the vehicle moves off from a stationary position.




P4A12JJ01

**Operation with the engine idling**

When the engine is idling, the management of the advance is implemented independently of the "basic" advance.

The advance value during idling is corrected in a manner which is inversely proporational to the variation in the speed in relation to the pre-set speed which, in turn, depends on the temperature of the coolant.

In particular, the advance is increased if the speed decreases and is decreased if the speed increases, in order to ensure the stability of the actual speed.

$\Delta\alpha$: correction of the ignition advance during idling
+ΔRPM: the speed during idling is higher than the nominal speed
-ΔRPM: the speed during idling is lower than the nominal speed

**Control of the detonation**

This strategy has the task of detecting the presence of the phenomenon of detonation, by processing the signal coming from the relevant sensor. The strategy continuously compares the signal coming from the sensor with a threshold, which is, in turn, constantly updated, to take into account background noise and the ageing of the engine.

If the system recognizes the presence of detonation, the strategy reduces the ignition advance, in steps of 3° up to a maximum of 9° until the phenomenon disappears. Later on, the advance is gradually restored either until the basic value is reached or until the phenomenon occurs again.

The strategy also has a self-adjustment function which memorizes the reductions in the advance which are continuously repeated to adapt the advance to the different conditions in which the engine finds itself (for example, the use of a low octane rating fuel). The strategy is capable of restoring the advance to the map value if the conditions which caused the reduction no longer exist.

## MANAGEMENT OF THE ENGINE IDLE SPEED

The general objective of this strategy is to keep the engine speed around the value memorized (engine warm: 800 [rpm]) the position assumed by the butterfly depends on the engine speed and the vehicle speed.

- Starting.

When the key is inserted, the butterfly assumes a position which depends on the temperature of the engine and the battery voltage (open-loop position).

- Engine running and accelerator pedal released.

The engine speed varies according to the temperature of the engine and is kept constant close to this value by altering the position of the butterfly to compensate for any fluctuations in the speed.

This takes place, in particular, when external loads are applied (power assisted steering, heated rear windscreen, etc).

If the air conditioning and the fans, both managed by the control unit, are switched on and the power assisted steering is in the end of travel position, which is signalled by a switch, the strategy manages the butterfly in advance of the engagement of the load.

- Normal driving.

Under these circumstances, the actuator is in the open-loop position.

- Deceleration.

In deceleration conditions outside of idling, the control unit controls the position of the butterfly through a special (dash-pot) curve, in other words it slows down the return of the butterfly towards the closed position; this produces a reduction in the braking effect of the engine.

In addition, if the vehicle is in deceleration conditions, the information concerning its speed correlated to the engine speed, makes it possible to manage the dash-pot effect in an optimum manner by adpating it to the gear engaged.

## MANAGEMENT OF THE ACTIVE CHARCOAL FILTER SCAVENGING

This strategy controls the position of the active charcoal filter solenoid valve in the following way:
- during starting, the solenoid valve remains closed, preventing the fuel vapours from enriching the mixture;
- after cold starting, the solenoid valve remains closed for the entire time the engine is warmin up;
- with the engine warm, the control unit operates the solenoid valve in duty-cycle to control the quantity of fuel vapours sent to the inlet (scavenging of the charcoal filter), according to the engine speed and load conditions. In particular, the system alternates scavenging and non-scavenging periods: the self-adjustment function is activated during the latter, but disabled during the scavening stage.
- in cut-off conditions, the solenoid valve remains closed.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## MANAGEMENT OF THE CLIMATE CONTROL SYSTEM

The injection/ignition control unit is connected to the climate control system, because:
1. it receives the request to switch on the compressor and operate the appropriate interventions (additional air);
2. it gives the go ahead to switch on the compressor when the conditions required by the strategies have been verified;
3. it receives information on the state of the four stage pressure switch and operates the appropriate interventions (operation of the radiator fan).

As far as point 1 is concerned, if the engine is idling, the control unit increases the air flow rate, altering the position of the butterfly in advance of the engagement of the compressor and conversely it returns the butterfly to its normal position after the compressor is switched off.
The engine idle speed is also increased the entire time the compressor is activated (engine warm: 900 [rpm].

As far as point 2 is concerned, the control unit automatically operates the disengagement of the compressor:

- for several seconds (timed disengagement):
  - in conditions where the engine power requirements are high (strong acceleration);
  - during vehicle take-off;
- as long as the following critical conditions persist:
  - temperature of the engine coolant above a certain level (engine overheating);
  - engine speed below 700 rpm.

## MANAGEMENT OF THE RADIATOR FAN

**NOTE** *Since the coolant temperature is detected by the appropriate sensor there is no longer a thermal contact on the radiator.*

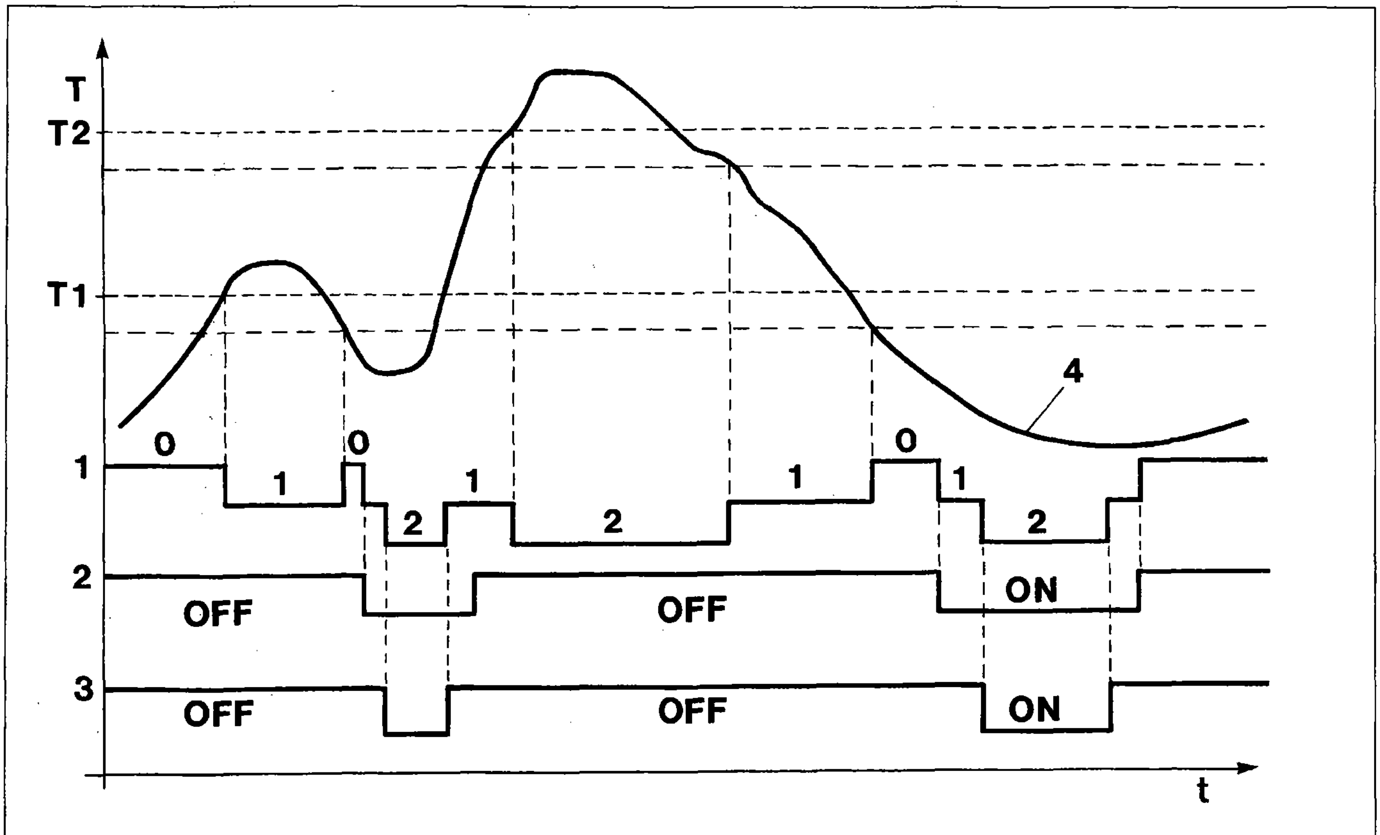
The engine control unit operates the engagement of the radiator fan according to the temperature of the coolant andwhether or not there is a climate control system.

In the case of versions with climate control, there are two fan operating speeds, managed according to different logics, entirely independent of one another.
- According to the coolant temperature.

Low speed: this is switched on when the temperature of the coolant reaches $T_1$ = 96.5 °C;
high speed: this is switched on when the temperature of the coolant reaches $T_2$ = 102 °C.

The fan is switched off with a temperature hysteresis of around 3 °C.
- According to the condition of the four stage pressure switch.

Low speed: this is switched on when stage II of the pressure switch is triggered;
high speed: this is switched on when stage III of the pressure switch is reached.




P4A14JJ01

$T_1$ = 96.5 °C
$T_2$ = 102 °C

ON: pressure switch activated
OFF: pressure switch deactivated

1. Fan state. 0 = off
   1 = low speed
   2 = high speed
2. Four stage pressure switch level II
3. Four stage pressure switch level III
4. Engine coolant temperature progress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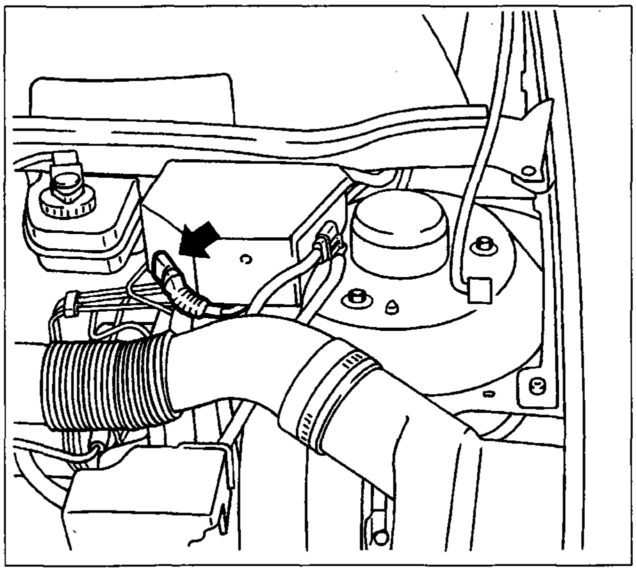
## DIAGNOSTICA

The system is equipped with an autodiagnostic function which is designed to verify an irregular state for the following components:

**Actuators**
injectors
coils
charcoal filter solenoid valve
engine idle adjustment actuator
electric fuel pump relay
climate control relays (if fitted)

**Sensors**
engine speed sensor
vehicle speed sensor
Lambda sensor
butterfly position sensor
coolant temperature sensor
detonation sensor

### Location of diagnostic connector



P4A15JJ01

If a fault is detected and confirmed, it is permanently stored in the memory and the relevant sensor is excluded from the system until normal operation has been restored.

The detection of a confirmed fault usually involves the warning light in the dashboard coming on: it goes out when the fault conditions no longer exist.

**NOTE** *During starting, the warning light is:*
- *on for about 4 seconds,*
- *off for 0.1 seconds;*
- *kept on/off permanently according to whether or not "permanent" errors are present.*

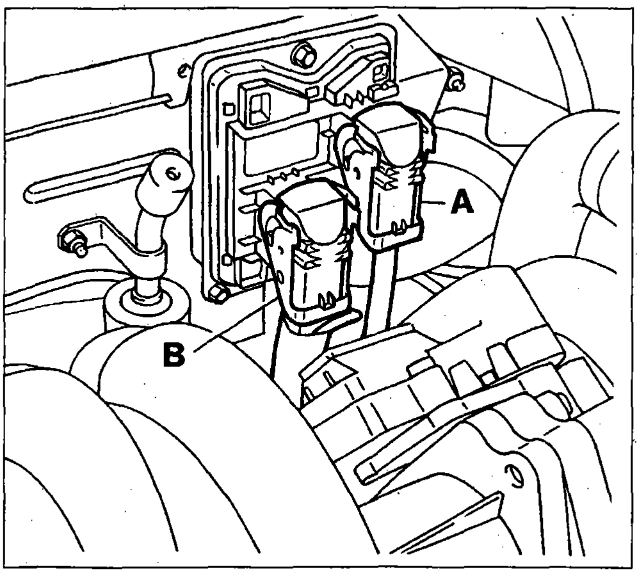
Working with the diagnostic equipment, it is possible to carry out a complete fault diagnosis of the system, which consists of three stages:
- display of a series of functional parameters (with the engine switched off or running);
- display of the errors and their cancelling;
- activation of certain actuators (active diagnosis).

### Recovery strategy

If a fault is detected with the sensors/actuators, the control unit, where possible, replaces the missing information, reconstructing it using software (recovery) to allow the opertion of the engine.

# 10.

## ELECTRICAL/ELECTRONIC CIRCUIT



P4A16JJ01

### Wiring

The system has two distinct sets of wiring for the control unit connectors: the engine side wiring (B) which connects the components fitted on the engine to the engine control unit and the vehicle side wiring (A) which connects the other components to the control unit and constitutes the interface with the vehicle wiring.

*vehicle side wiring (A)*

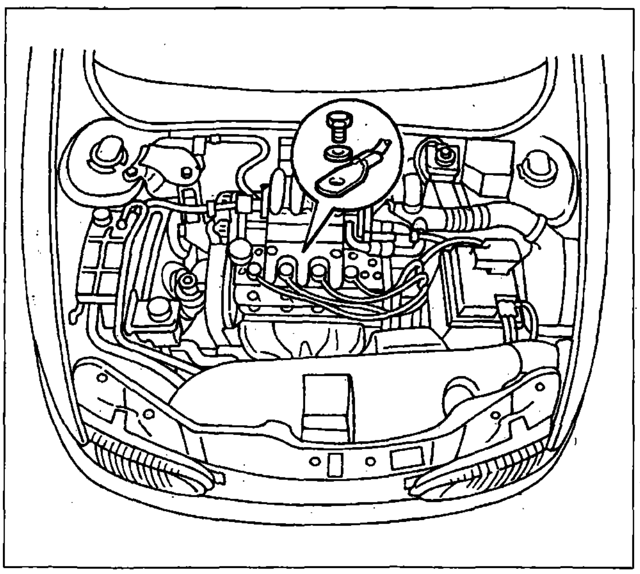
supply from the battery
supply from the ignition switch
fuses
system relay feeds
radiator fan relay(s)
climate control compressor relay (if fitted)

CODE control unit connection
control panel connection
diagnostic equipment

*engine side wiring (B)*

engine speed sensor
absolute pressure and air temperature sensor
coolant temperature sensor
detonation sensor
Lambda sensor
power assisted steering end of travel sensor
injectors
idle speed actuator/butterfly position sensor

ignition
charcoal filter solenoid valve


P4A16JJ02

### Layout of system earth points

In order to increase electro-magnetic compatibility and operational reliability, special care has been taken over the number and the location of the earth points, as can be seen the diagram:
- main earth directly on the battery negative;
- engine control system earth on the cylinder block/crankcase near the detonation sensor.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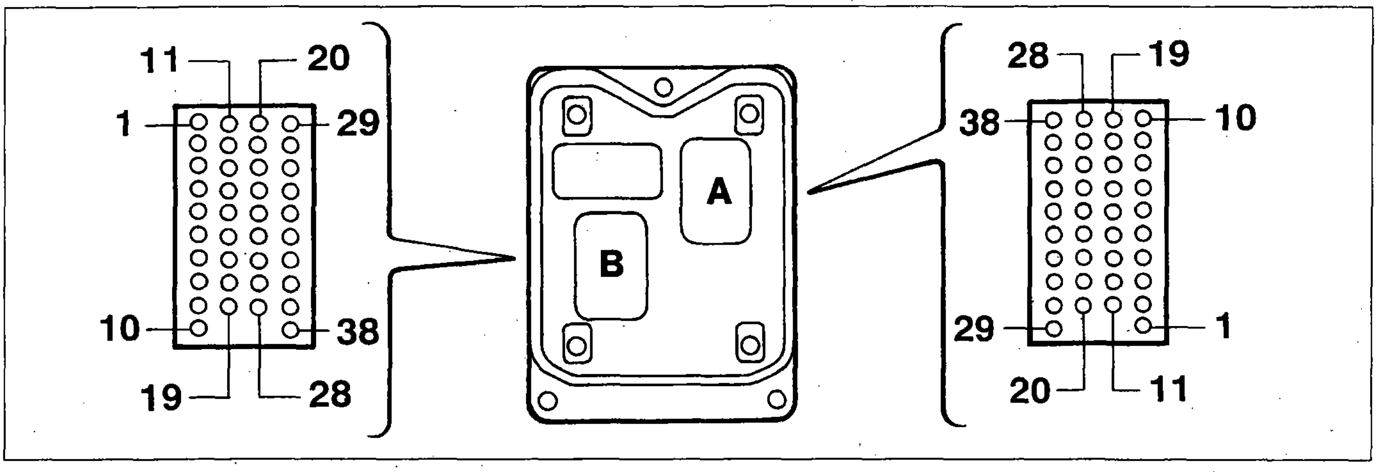
## BOSCH 1.5.5 SYSTEM CONTROL UNIT PIN-OUT




P4A17JJ01

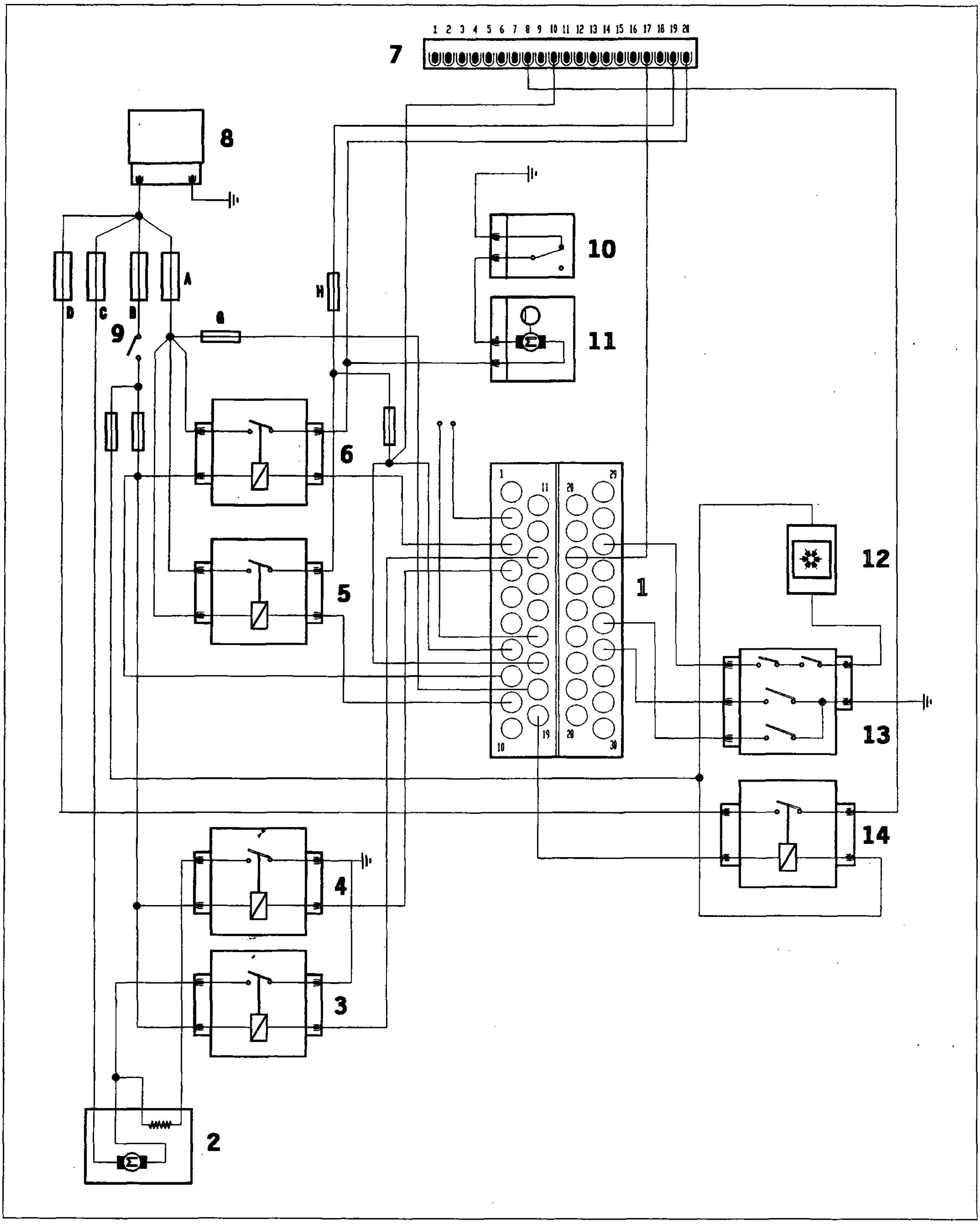
### Connector B (engine side)

1 Sensors earth
2 Detonation sensor signal
3 Intake air temperature sensor signal
4 Butterfly position sensor signal
5 Coolant temperature sensor signal
6 Operation of injector for cylinder 1
7 Operation of injector for cylinder 4
8 Operation of Lanbda sensor heater
9 N.c.
10 Operation of coil for cylinders 2/3
11 Detonation sensor earth
12 Absolute pressure sensor signal
13 Butterfly position sensor signal
14 N.c.
15 N.c.
16 Operation of injector for cylinder 3
17 Operation of injector for cylinder 2
18 N.c.
19 Operation of coil for cylinders 2/3
20 N.c.
21 Lambda sensor earth
22 Engine speed sensor positive
23 N.c.
24 N.c.
25 N.c.
26 Operation of idle speed actuator
27 N.c.
28 Operation of coil for cylinders 1/4
29 Sensor supply
30 Lambda sensor signal
31 N.c.
32 Engine speed sensor negative
33 N.c.
34 Operation of charcoal filter solenoid valve
35 Operation of idle speed actuator
36 N.c.
37 N.c.
38 Operation of coil for cylinders 1/4

### Connector A (vehicle side)

1 N.c.
2 Operation of rev counter
3 Operation of fuel pump relay
4 Operation of high speed fan relay
5 N.c.
6 N.c.
7 Control unit supply from relay (+30)
8 Engine started signal (from ignition switch)
9 Operation of engine control system relay
10 N.c.
11 Line K
12 Operation of system failure light
13 Operation of low speed fan relay
14 N.c.
15 N.c.
16 CODE connection
17 Control unit supply from relay (+30)
18 Control unit supply (+30)
19 Operation of compressor relay (if fitted)
20 N.c.
21 N.c.
22 Power assisted steering sensor signal
23 N.c.
24 N.c.
25 N.c.
26 N.c.
27 Vehicle speed sensor signal
28 N.c.
29 N.c.
30 N.c.
31 Operation of compressor engagement
32 N.c.
33 N.c.
34 Four stage thermostat signal (if fitted)
35 Four stage thermostat signal (if fitted)
36 N.c.
37 N.c.
38 N.c.

## BOSCH 1.5.5 SYSTEM WIRING DIAGRAM
### Connector A (vehicle side)




P4A18JJ01



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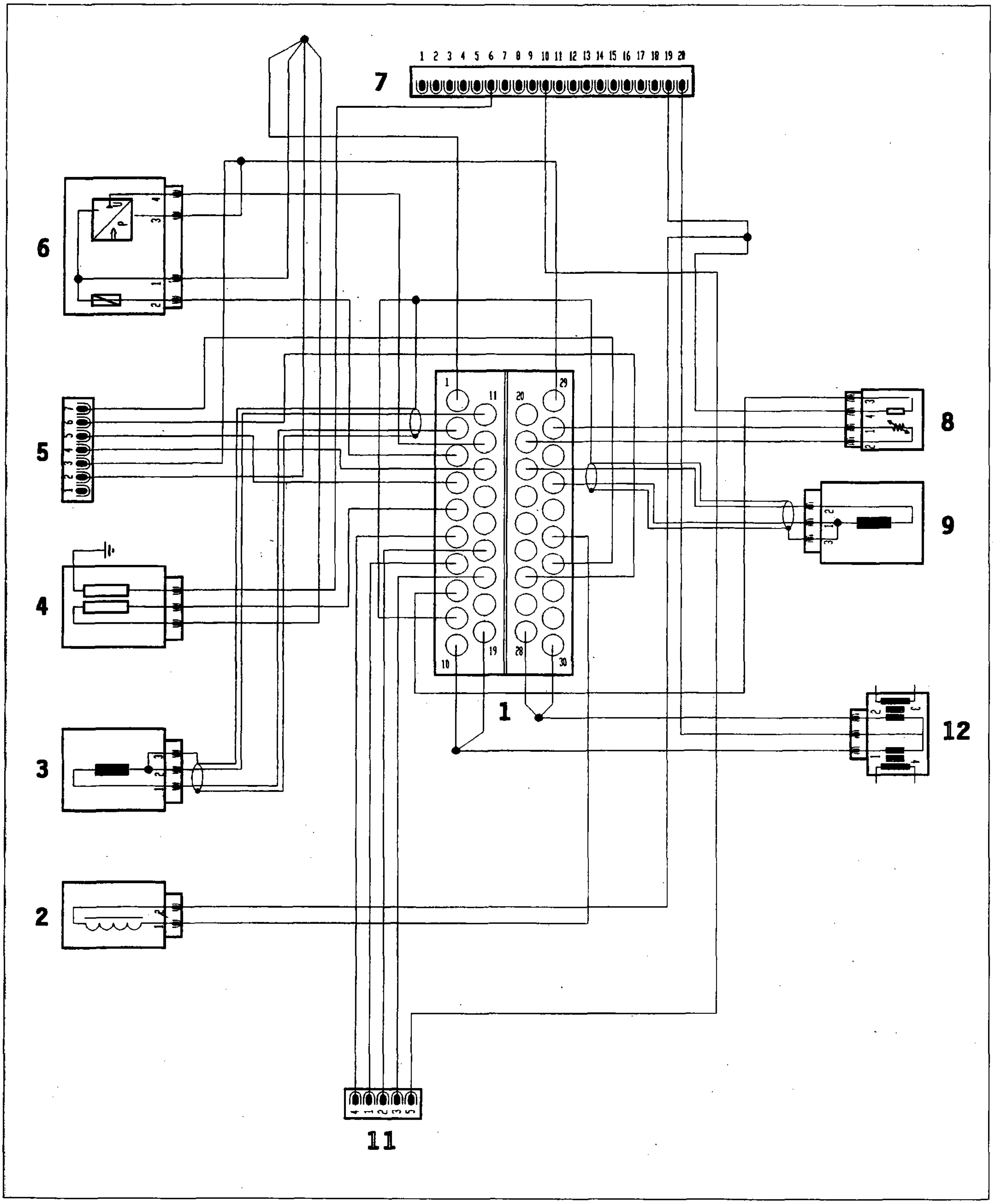
**Bosch 1.5.5 system wiring diagram key**
**Connector A (vehicle side)**

1. Control unit
2. Radiator fan
3. Electric fan high speed relay
4. Electric fan low speed relay
5. Engine control system relay
6. Fuel pump relay
7. Front cable connection
8. Battery
9. Ignition switch
10. Inertia switch
11. Electric fuel pump
12. Air conditioning control unit (on button)
13. Four stage pressure switch
14. Compressor relay

A. 30A fuse
B. 40A fuse
C. 40A fuse
D. 7.5A fuse
E. 7.5A fuse
F. 7.5A fuse
G. 7.5A fuse
H. 15A fuse
L. 15A fuse

## BOSCH 1.5.5 SYSTEM WIRING DIAGRAM
### Connector B (engine side)

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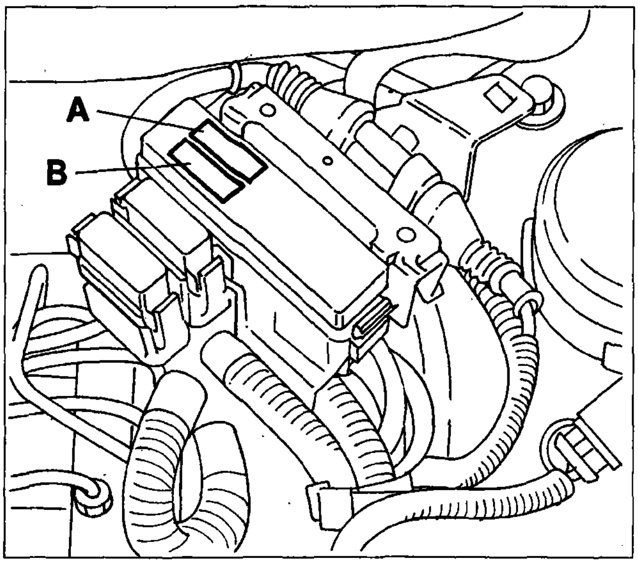
**Bosch 1.5.5 system wiring diagram key**
***Connector B (engine side)***

1. Control unit
2. Active charcoal filter solenoid valve
3. Detonation sensor
4. Coolant temperature sensor
5. Engine idle adjustment actuator/butterfly position sensor
6. Absolute pressure and air temperature sensor
7. Front cable connection
8. Lambda sensor
9. Engine speed sensor
10. Coil
11. Injector section

# 10.




P4A22JJ01

## LOCATION OF FUSES AND RELAYS

**NOTE** *For more information, see Group 55-Electrical equipment*

### Main fuses (maxi-fuse)

A. System fuse
B. Fuse controlled by the ignition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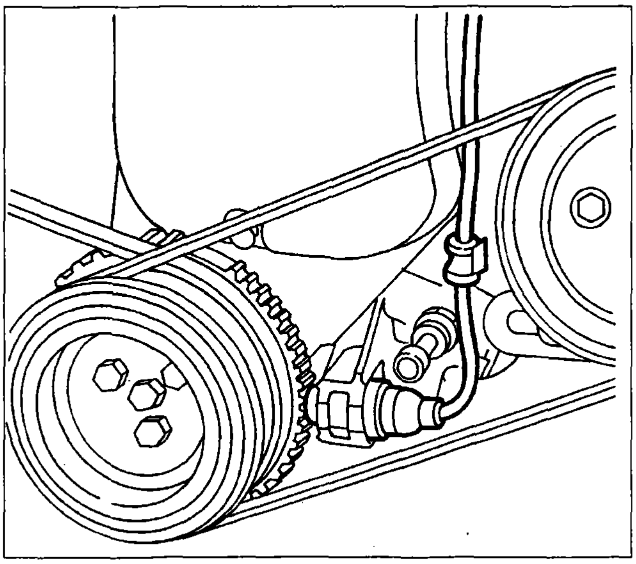
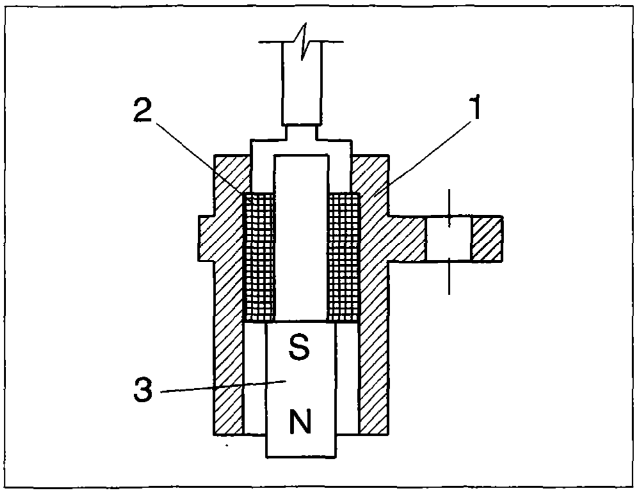

P4A54JJ01

## ENGINE RPM AND TDC SENSOR

The engine rpm and TDC sensor (1) is fixed to the cylinder block/crankcase and is facing the flywheel on the crankshaft pulley.

**Operating principle**

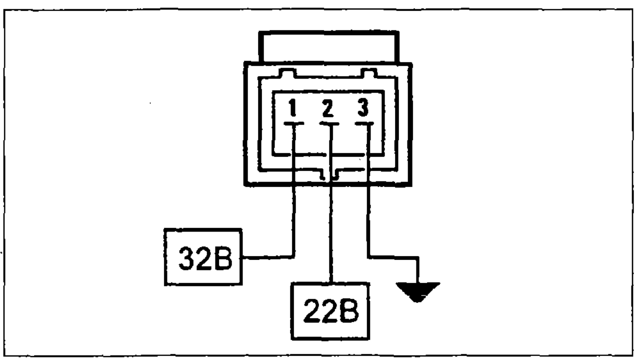


P4A29IJ02

The sensor consists of a tubular casing (1) containing a permanent magnet (3) and an electrical winding (2). As a result of passing the flywheel teeth, the magnetic flow produced by the magnet (3) oscillations according to the variation in the gap.

These oscillations create an electro-motive force in the winding (2) producing an alternately positive voltage (tooth facing the sensor) and negative voltage (gap facing the sensor). The peak sensor output voltage depends, all other factors being equal, on the distance between the sensor and the tooth (gap).

**Wiring connector**



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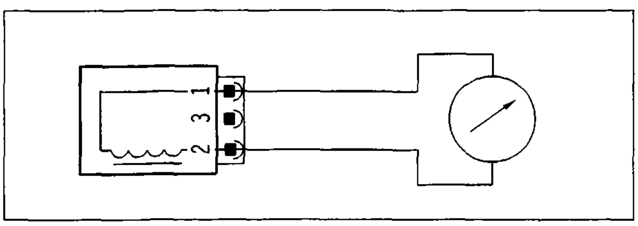
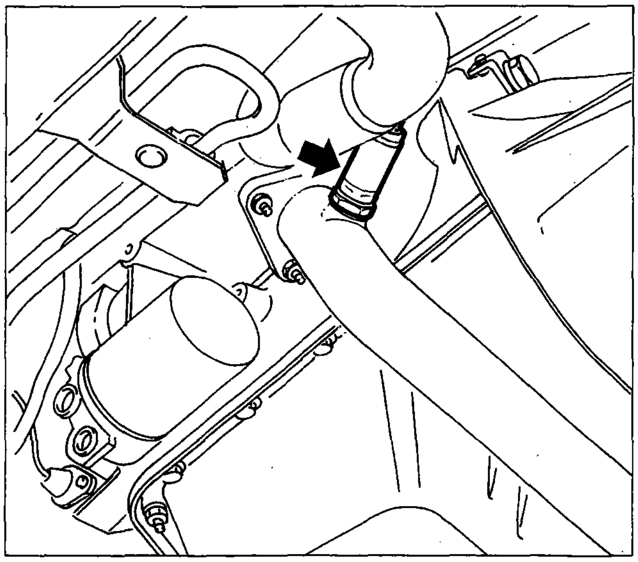


P4A30IJ03

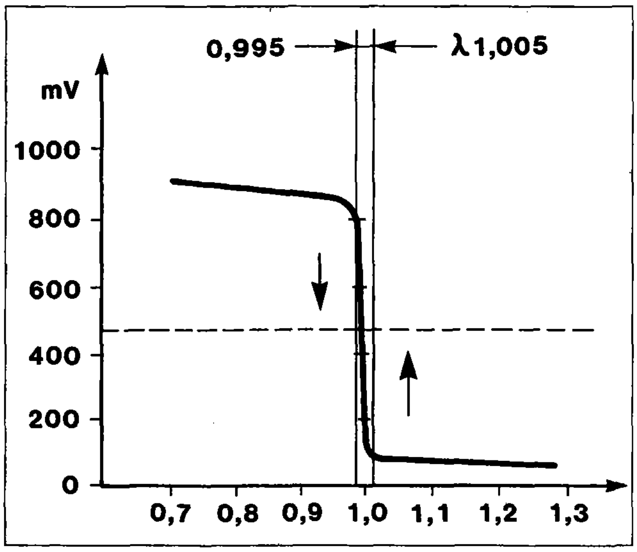
The sensor resistance can be measured by disconnecting the connector and connecting and ohmmeter to the sensor.

**Resistance: 9600+10% ohm at 20 °C**

# 10.



P4A24JJ01



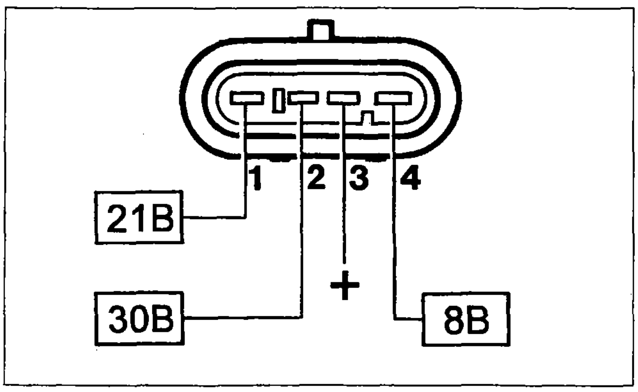

P4A24JJ02

$\lambda$=1 Ideal mixture (stoichiometric)
$\lambda$ 1 Lean mixture

Excess air; the CO values tend to be low
$\lambda$ 1 Rich mixture

Lack of air; the CO values tend to be high

**Wiring connector**




P4A24JJ03

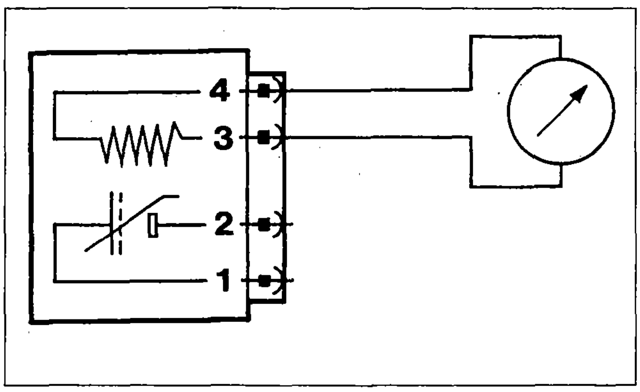
## LAMBDA SENSOR

The Lambda sensor measures the oxygen content in the exhaust gases: it is fitted on the exhaust pipe upstream of the catalytic silencer.
The sensor output signal is sent to the control unit for fee-back correction of the mixture strength.
When the sensor provides a low signal (voltage below 200 mV), the control unit recognizes a lean mixture and increases the injection time; later, when the sensor signal is high (voltage above 800 mV), the control unit recognizes a rich mixture and decreases the injection time.
This sequence is repeated at a frequency in order of tens of Hertz so that the engine constantly operates with a mixture strength close to the stoichiometric ratio.
For temperatures below 300 °C, the ceramic material is not activated, therefore the sensor does not send plausible signals: to ensure rapid heating during starting and maintain the temperature during idling, the sensor is fitted with a heater with the electrical resistance always switched on.

*The sensor can rapidly be put out of action by the presence of even slight amounts of lead in the fuel.*

The sensor heater resistance can be measured by disconnecting the connector and connecting an ohmmeter as shown in the diagram.

**Resistance: 4.5+0.5 ohm at 20 °C**




P4A24JJ04



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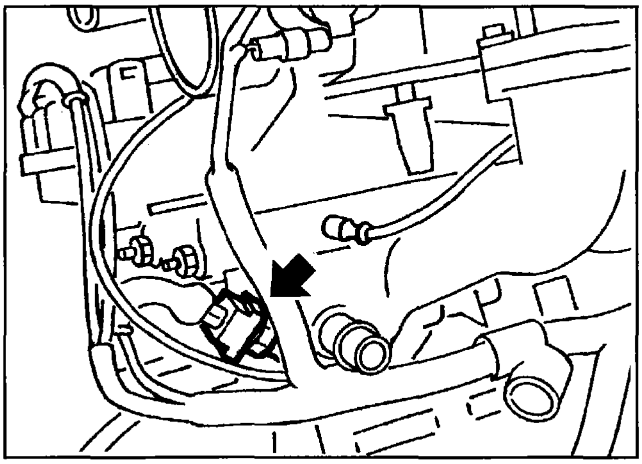


4A25JJ01

## ENGINE COOLANT TEMPERATURE SENSOR

This sensor is fitted on the thermostat.
It is made up of brass casing which affords protection for the actual resistive elements consisting of two NTC (Negative Temperature Coefficient) type thermistors whose electrical resistance decreases as the temperature increases).
The two thermistors are separate and provide information concerning the temperature to the instrument panel (A) and the engine management control unit (B), respectively.
The reference voltage for the latter is 5 Volt: since the control unit intake circuit is designed as a voltage divider, the reference voltage is shared between a resistance in the control unit and the actual sensor.
As a result, the control unit is capable of evaluating the variations in the sensor resistance through the changes in voltage, thereby obtaining information concerning the temperature.

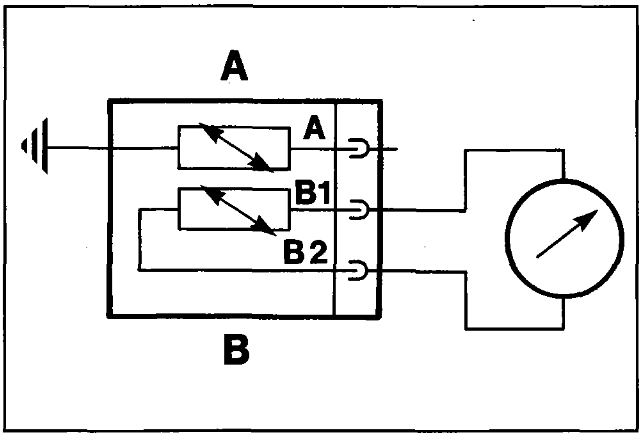
The table shows the progress of the sensor, which can be measured by disconnecting the connector and connecting an ohmmeter as illustrated in the diagram.

**INJECTION NTC**

| °C | Ω | °C | Ω |
|---|---|---|---|
| -20 | 15970 | 40 | 1150 |
| -10 | 9620 | 50 | 807 |
| 0 | 5975 | 60 | 576 |
| 10 | 3816 | 70 | 418 |
| 20 | 2500 | 80 | 309 |
| 25 | 2044 | 90 | 231 |
| 30 | 1679 | 100 | 176 |

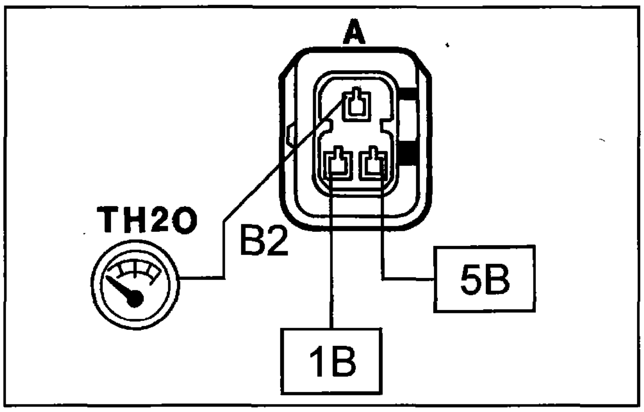
**NTC INSTRUMENT**

| °C | Ω |
|---|---|
| 80 | 300.8-313.2 |
| 90 | 226.3-234.1 |
| 100 | 172-177 |
| 110 | 132.9-136.1 |
| 120 | 103.6-106.6 |



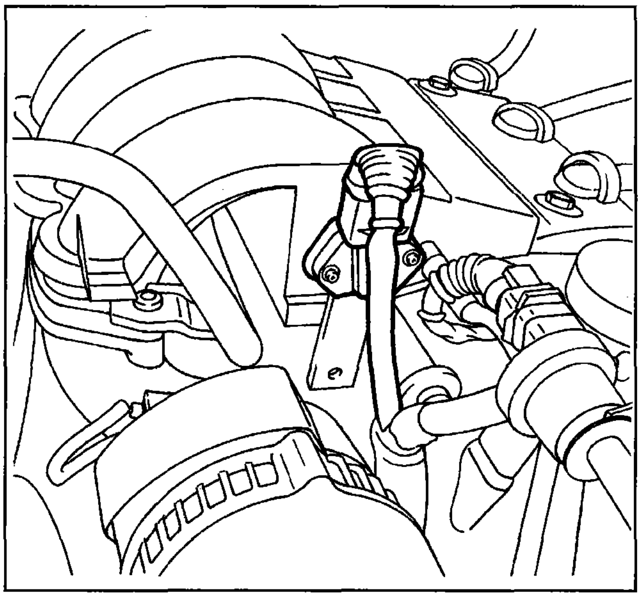

4A25JJ02

**Connector wiring**




4A25JJ03

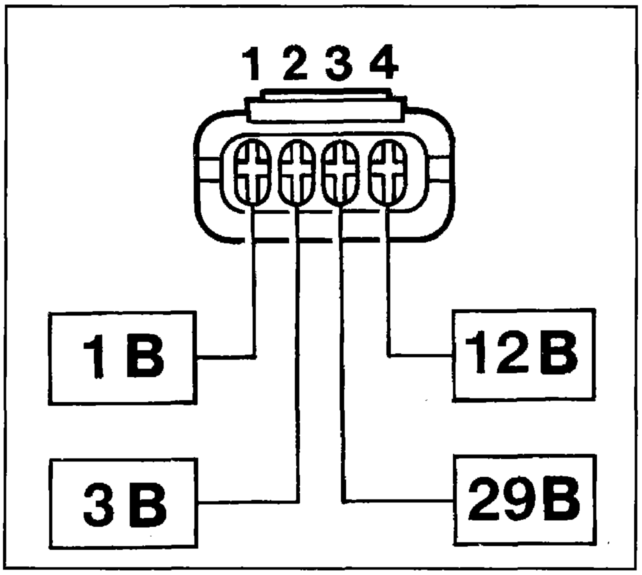
## 10.



4A27JJ01

### INTAKE AIR PRESSURE AND TEMPERATURE SENSOR

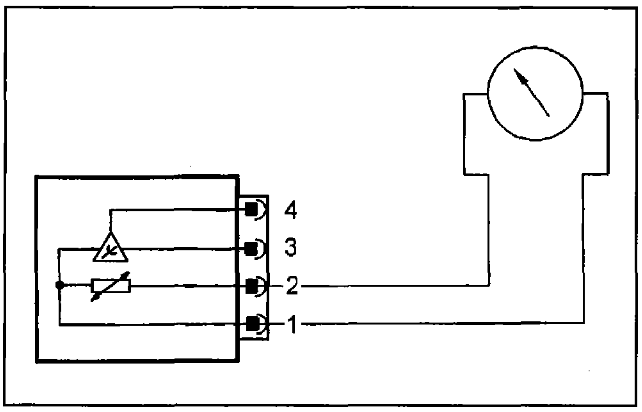
The intake air pressure and temperature sensor is an integrated component that measures pressure and temperature inside the inlet manifold. The injection control unit uses both items of information to define the amount of air taken in by the engine. This information is then used to compute injection time and ignition point. The sensor is fitted on the intake manifold.




4A26JJ01

| Temperature (°C) | Resistance (M) |
|---|---|
| -40 | 52600-38700 |
| -20 | 17500-13500 |
| 0 | 6500-5300 |
| 10 | 4200-3400 |
| 20 | 2700-2300 |
| 30 | 1850-1550 |
| 40 | 1300-1050 |
| 50 | 920-750 |
| 60 | 650-530 |
| 80 | 360-290 |
| 100 | 210-160 |

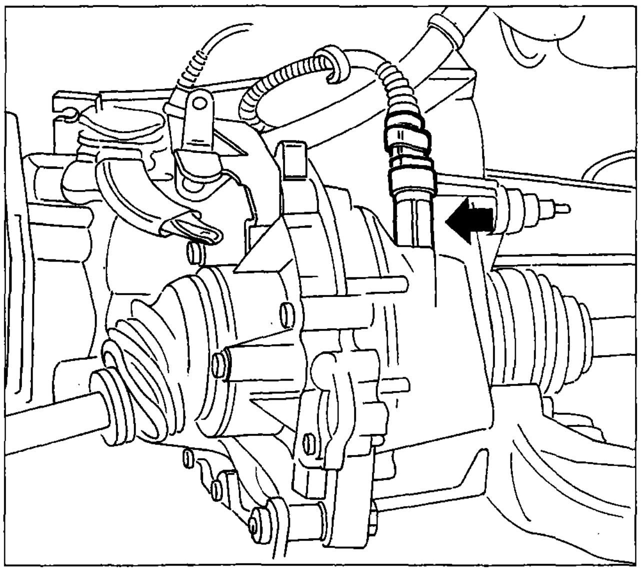
**Connector wiring**




4A26JJ02

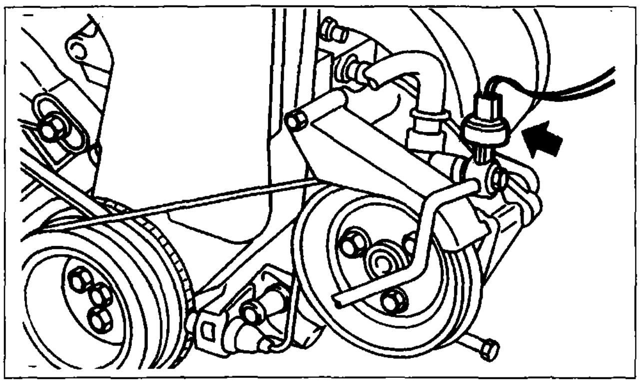
**Checking the resistance**

The table shows resistance values that the temperature sensor (NTC thermistor) may assume as temperature changes. These values may be measured by connecting an ohmmeter as shown in the diagram.


P4A43IJ01

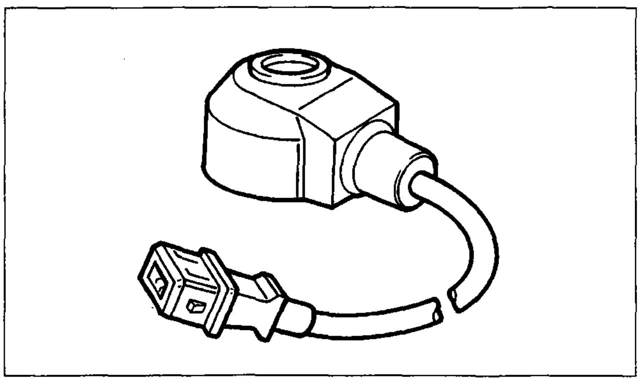
## VEHICLE SPEED SENSOR

This sensor is positioned at the differential output, by the left driveshaft coupling and transmits information concerning the vehicle speed to the speedometer: the signal is then sent to the engine control unit.
The sensor is the Hall effect type and is calibrated so that a given distance corresponds to each impulse: it is therefore possible to determine the speed of the vehicle on the basis of the frequency of the impulses.


P4A27JJ02

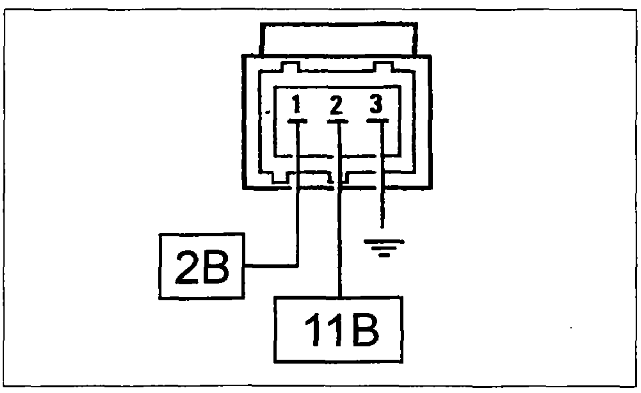
## POWER ASSISTED STEERING SENSOR

This sensor, fitted on the pump outlet high pressure pipe, consists of a pressure switch which closes when the hydraulic pressure exceeds a set value corresponding to the steering in the end of travel position: the information is used to managing the idle speed control actuator in advance of the absorption of power due to the steering.


P4A27JJ03

## DETONATION SENSOR

This is a piezoelectric type sensor fitted on the cylinder block/crankcase, symmetrical in relation to the pairs of cylinders 1-2 and 3-4. This position is determined by the need to detect the onset of detonation in the same way in all cylinders.
When the engine is knocking, vibrations of a particular frequency are produced in the cylinder block/crankcase which are transformed, by the sensor, into a voltage signal which is proportional to their intensity.



P4A27JJ04

**Wiring connector**

# 10.

## IGNITION COILS

The ignition circuit is the inductive discharge, static advance type where the high tension is provided from two twin outlet coils fitted at the side of the cylinder head.

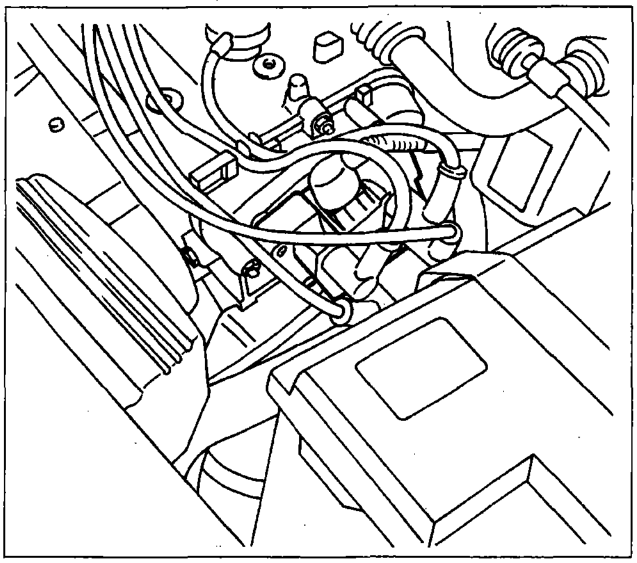
The coils used are the closed magnetic circuit type with the windings in a plastic container immersed in epoxide resin. Each coil is connected to the two spark plugs by means of high tension leads with dielectric properties.

In this type of coil the current in the secondary winding (discharge current) always has the same polarity: therefore one end of the circuit has a positive potential and the other a negative potential.

This implies that the discharge current in the secondary winding always flows in the same direction and therefore the sparks for the two cylinders connected to the coil strike in the opposite way:
- in the spark plug with the positive centre electrode the spark strikes from the earth electrode towards the centre one;
- in the spark plug with the negative centre electrode the spark strikes from the centre electrode towards the earth one.

As a result the wear of the electrodes between the two spark plugs in question is different.

Since the intensity of the spark depends on the resistance between the electrodes (dielectric), whilst the spark in the cylinder in the cross-over stage is weak (lost spark), at alsmot atmospheric pressure in the cylinder at the end of the compression stroke, the spark is intense (working spark) by virtue of the high pressure in the chamber.



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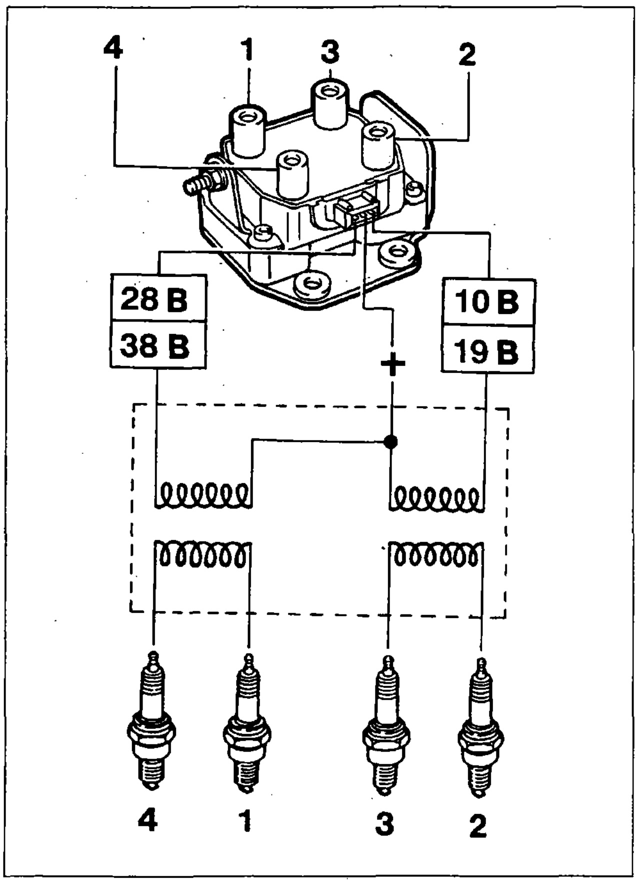
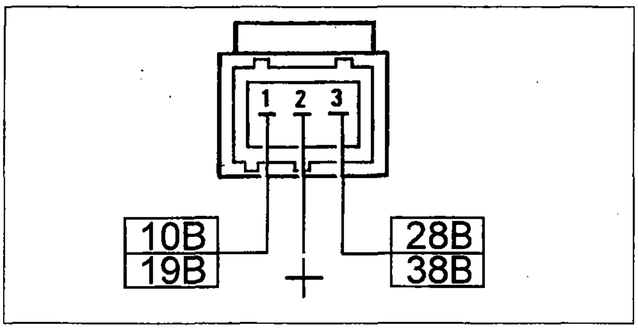



P4A28JJ02




P4A28JJ03

**Wiring connector**



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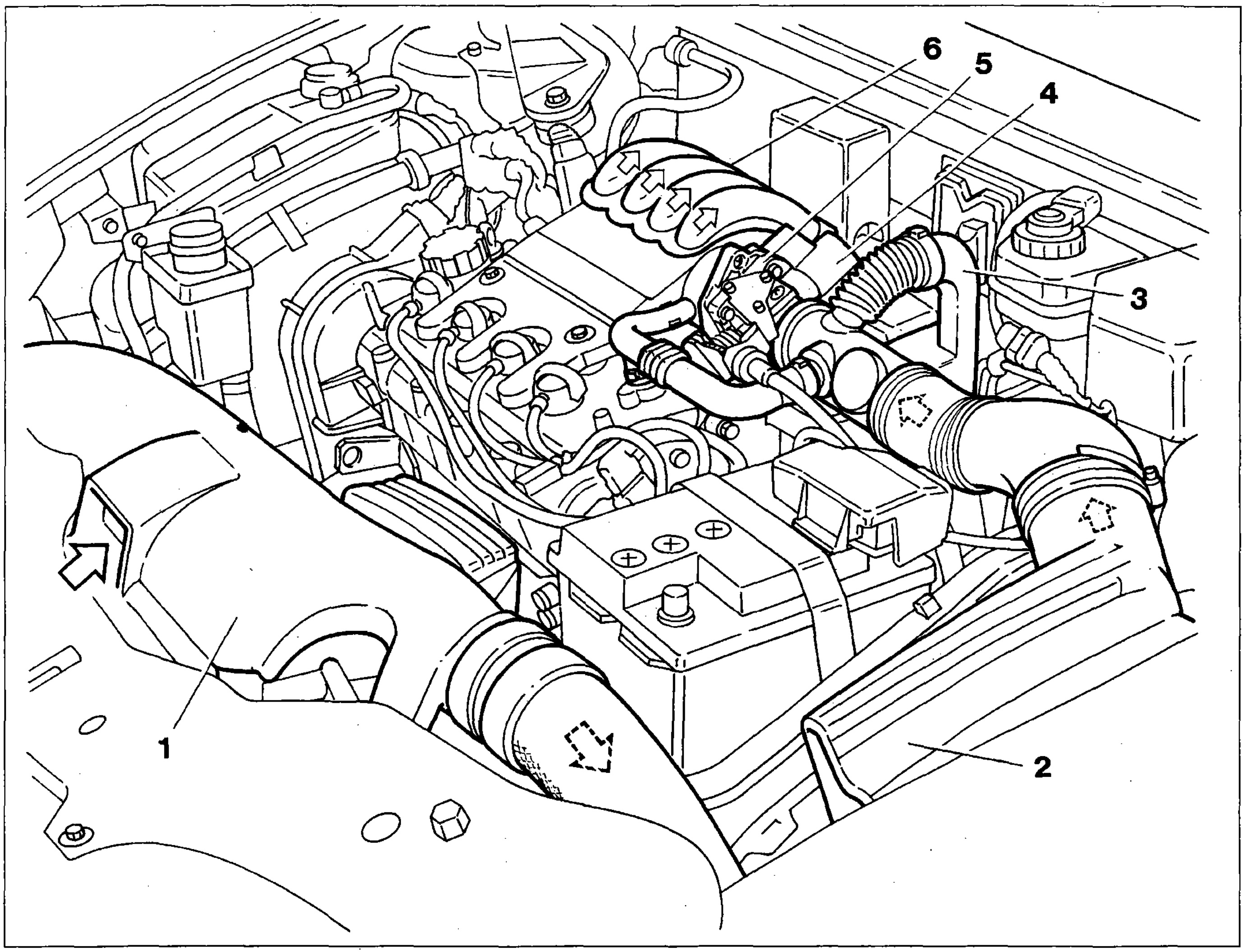
### INTAKE CIRCUIT

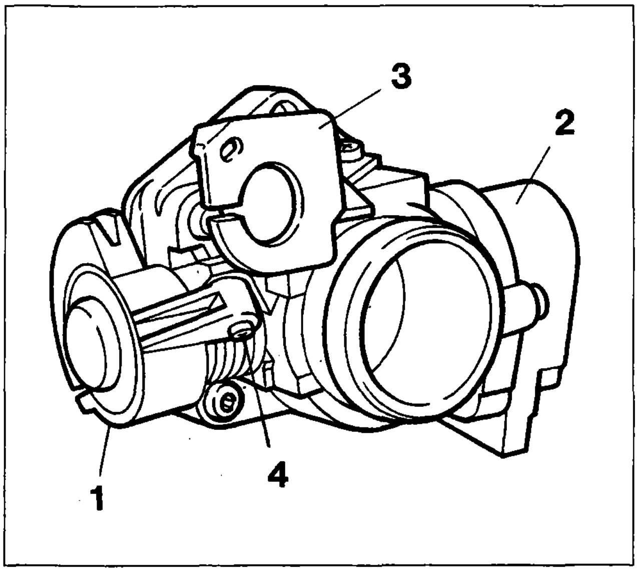
This consists of the various components which ensure that the air flow rate required by the engine is correctly directed in different operating conditions.




P4A29JJ01

1. Inlet vent
2. Air filter
3. Resonator
4. Engine idle speed adjustment actuator and butterfly position sensor
5. Butterfly casing
6. Inlet manifold

# 10.




P4A30JJ01

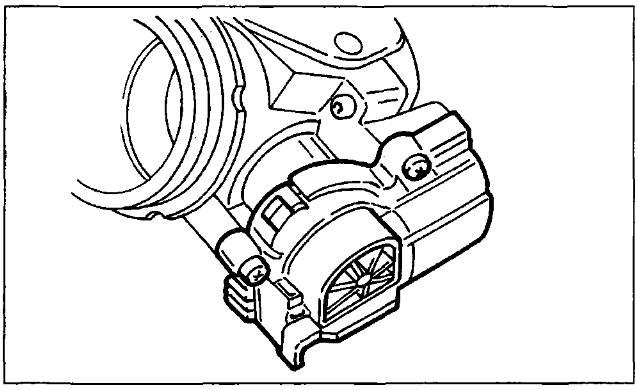
1. accelerator control lever
2. idle speed adjustment actuator and butterfly position sensor
3. accelerator cable adjustment bracket
4. anti-tamper screw

## BUTTERFLY CASING

The butterfly casing has the task of metering the quantity of air drawn in by the engine (and consequently the power developed) according to the driver's request via the accelerator.

The butterfly casing is fixed to the inlet manifold: the butterfly is opened by means of a lever which has a gradual opeing law (small butterfly opening angles for a good part of the accelerator pedal travel and greater angles in the last part of the travel.

With the pedal completely released (engine decelerating or idling) the position of the butterfly is regulated by the engine idle adjustment actuator in order to be able to supply the additional air required according to the engine conditions. The actuator also includes the butterfly position sensor.



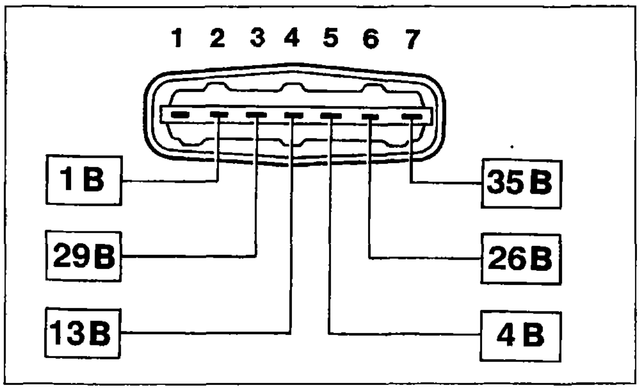
P4A30JJ02

## ENGINE IDLE SPEED ACTUATOR AAAND BUTTERFLY POSITION SENSOR

The actuator, fitted on the butterfly casing, consists of a direct current motor operated by a circuit inside the engine control unit which regulates the position of the butterfly: it has the task of ensuring the additional air for the engine with the accelerator pedal released, under all circumstances when necessary (idling, deceleration, external loads applied).

The maximum actuator opening angle is around 30°.

The actuator contains a twin track potentiometer:
- the first track goes from the closed position to 30° and is used to control the butterfly with the accelerator pedal released;
- the second track goes from the closed position to the maximum butterfly opening position and is used for the normal engine management.




P4A30JJ03

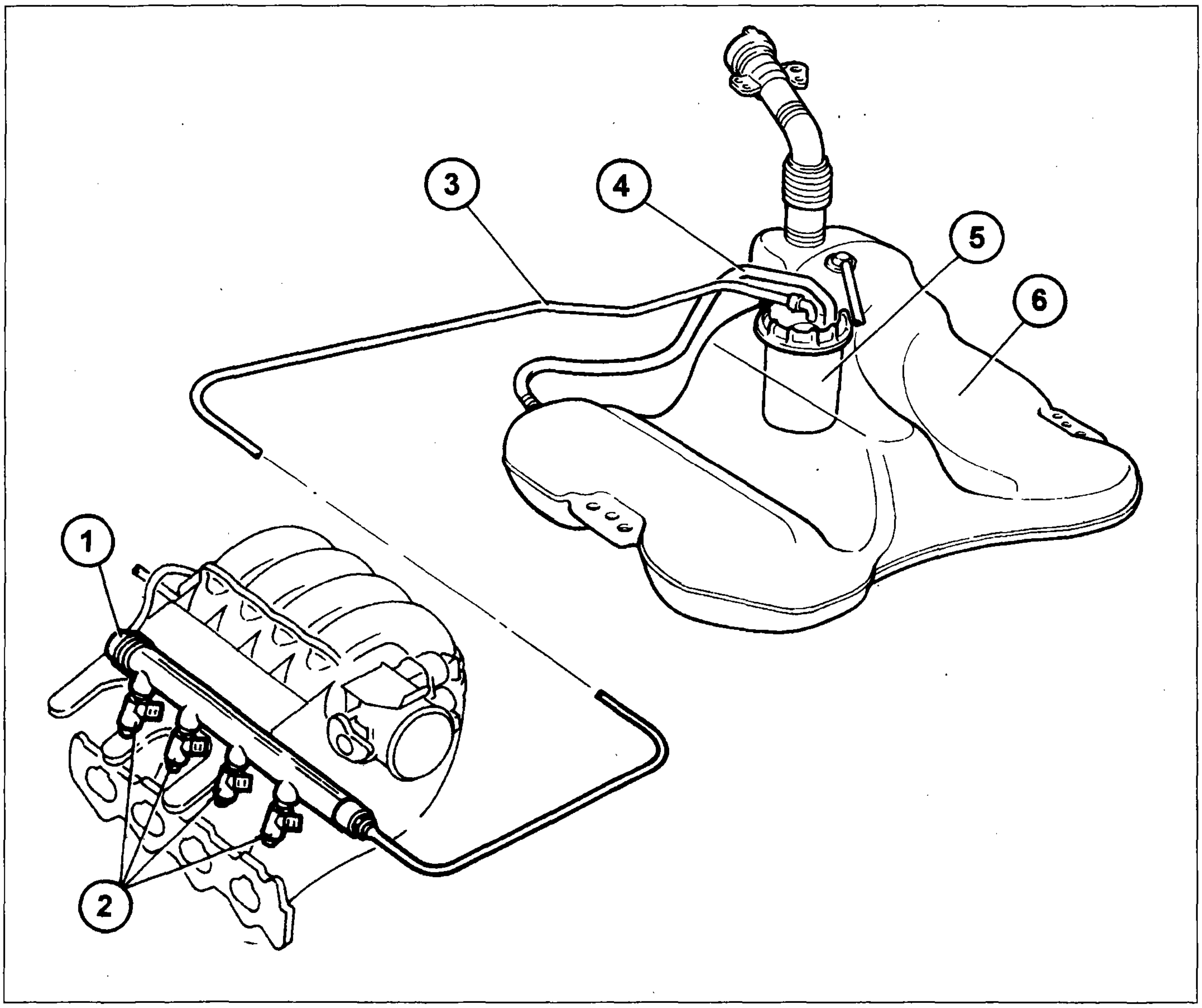
**Wiring connector**


Print no. 506.670/16

## FUEL SUPPLY CIRCUIT

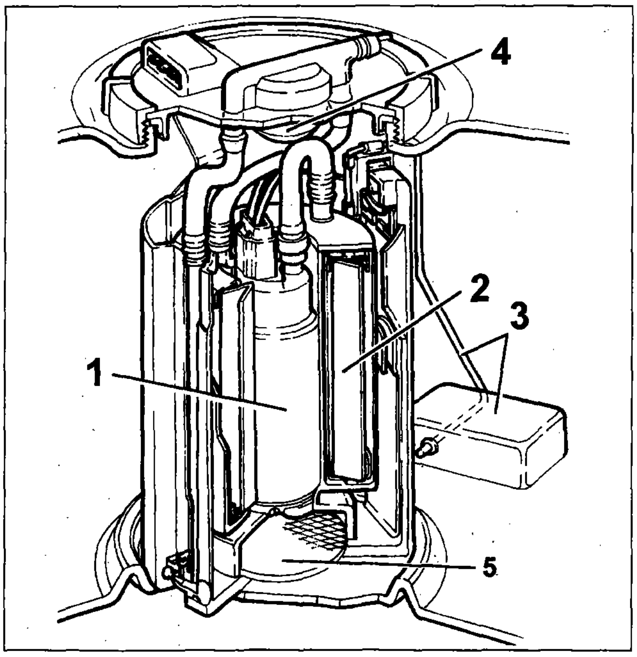
This circuit consists of the following components:
- Fuel tank
- Drip tray complete with pump, filter, pressure regulator and gauge
- Supply pipe
- Returnless type fuel manifold complete with injectors

## FUEL CIRCUIT DIAGRAM




P4A31JJ01

1. Air bleed connector
2. Injectors connector
3. Supply pipe
4. Tank filler pipe
5. Drip tray complete with pump, filter, pressure regulator and gauge
6. Fuel tank




1. Electric fuel pump
2. Fuel filter
3. Fuel gauge with float
4. Pressure regulator
5. Gauze pre-filter

## FUEL DRIP TRAY ASSEMBLY

### Electric fuel pump

The pump is housed insde the fuel tank on a special drip tray which also supports the fuel gauge and it has a filter on the pump inlet.

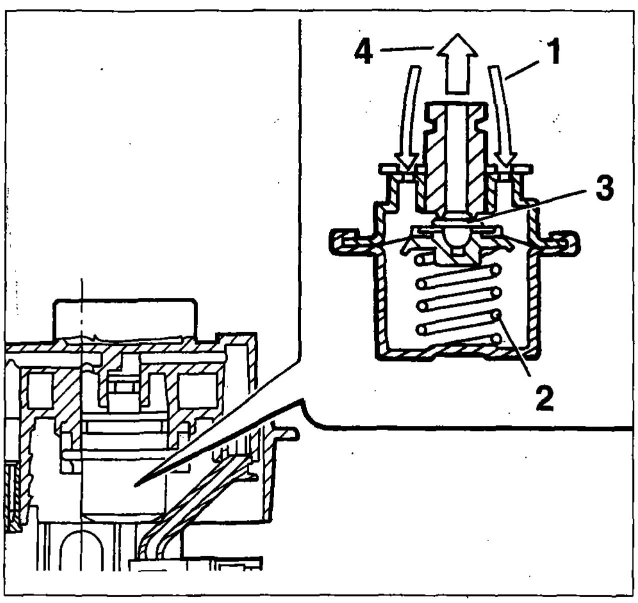
The pressure regulator is fitted on the pump supply.

The pump is the single stage peripheral flow type and is designed to run on unleaded fuel.

The rotor is moved by a d.c. electric motor supplied by a relay and controlled by the control unit to ensure:
- that the pump cuts out if the engine speed goes below a minimum level;
- timed operation (about 5 seconds) each time the ignition key is turned to the ON psition, even if the engine is not started up;
- operation with the engine started up.

The pump is fitted with an excess pressure valve which short circuits the supply with the inlet if the pressure in the supply circuit exceeds around 5 bar to prevent the electric motor from overheating.

In addition, a one-way valve in the supply, prevents the entire fuel circuit from being drained when the pump is not working.



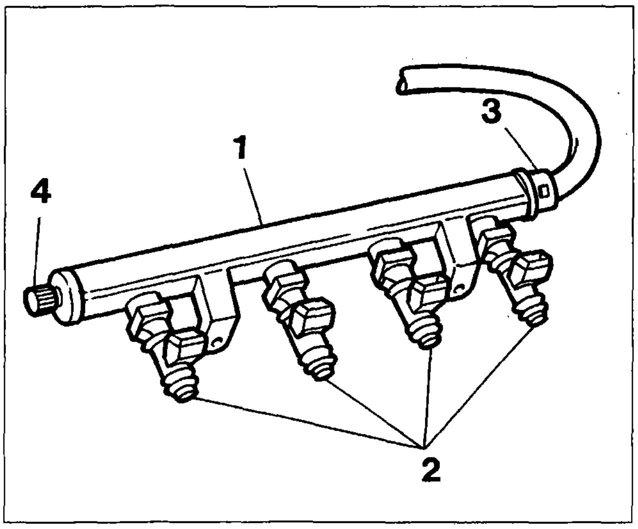

### Fuel filter

The fuel filter is in the housing surrounding the pump and does not require periodic replacement.

### Fuel pressure regulator

This is a differential, diaphragm device, adjusted during manufacture to a pressure of $3.50 \pm 0.05$ bar and located in the top part of the drip tray.
The fuel, under pressure (1), coming from the pump, exerts force on the valve (3), opposed by the calibrated spring (2). When the set pressure is overcome, the valve opens and the excess fuel (4) returns to the tank, thereby stabilizing the pressure in the circuit.


*Print no. 506.670/16*

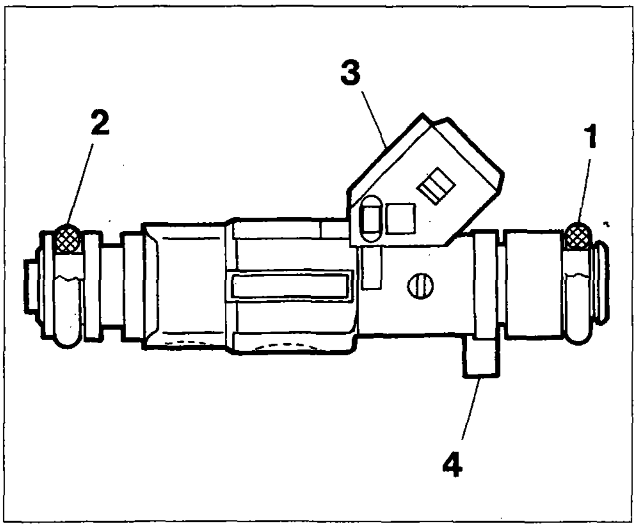



P4A33JJ01

## FUEL MANIFOLD

The fuel manifold, which has the task of distributing the fuel to the injectors, is made from die-cast aluminium and incorporates the housings for the injectors and the air bleed valve.
The fuel inlet has a rapid attachment. Since the system is the returnless type, there is no recirculation pipe.

1. Fuel manifold
2. Injectors
3. Fuel supply connector
4. Bleed valve



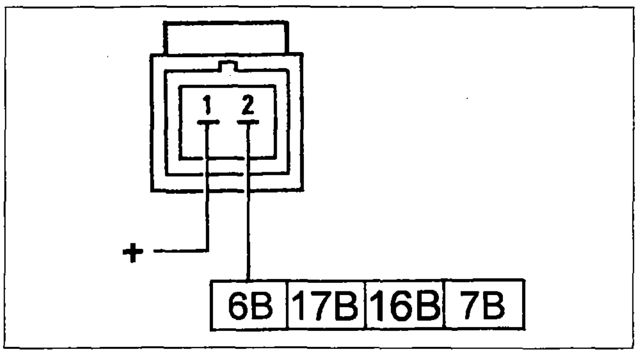

P4A33JJ02

## INJECTORS

The injectors have the task of supplying the amount of fuel required for the operation of the engine: the fuel is injected into the inlet duct, immediately upstream of the inlet valve.

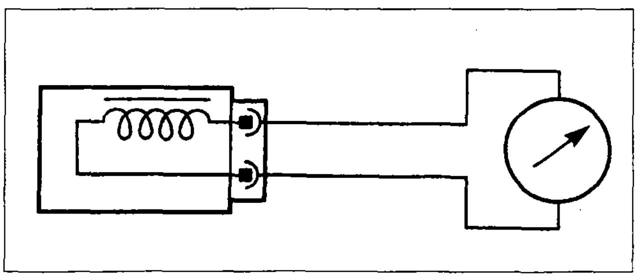
The injectors are the top-feed type and there is an electrical winding connected to the connector (3) terminals.

When the current passes through the winding, the magnetic field which is created attracts the shutter causing the opening of the injector and the flow of fuel.
There are two seals on the fuel manifold side (1) and the inlet manifold side (2).
A reference (4) determines the angular position of the injector and the correct position of the jets in relation to the inlet valves.




P4A33JJ03

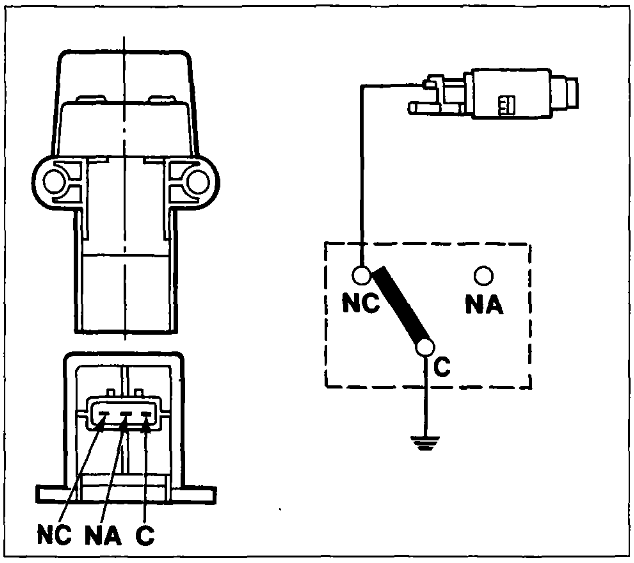
**Wiring connector**
The injector resistance can be measured by disconnecting the connector and connecting an ohmmeter as shown in the diagram.



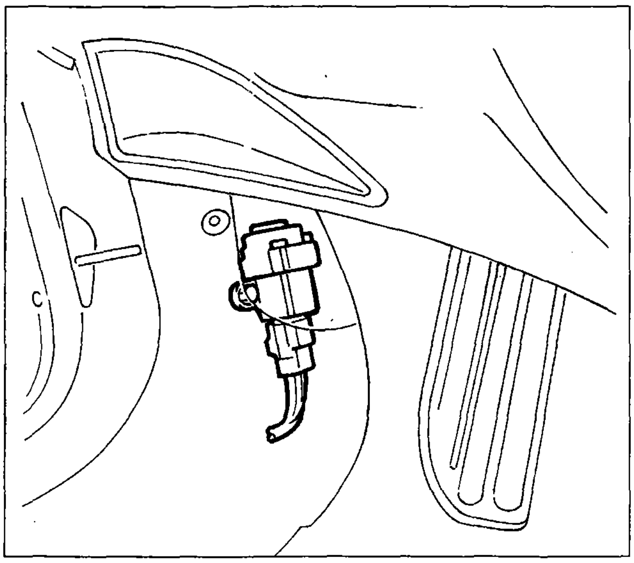
P4A33JJ04

**Resistance value: 14.5±5% ohm.**

# 10.




P4A34JJ01




P4A34JJ02

## INERTIA SAFETY SWITCH

The inertia switch has the task of interrupting the electrical supply for the electric fuel pump if the vehicle is subject to violent deceleration (an impact) to prevent the fuel from coming out and causing the vehicle to catch fire in case the fuel manifold or the supply pipe is damaged.

The switch consists of a steel ball in a conical shaped housing which is kept in position by the attraction force of a permanent magnet.

The ball can be released from the magnetic clip, due to the action of the acceleration from the inertia forces, and gradually come out of the conical housing with an upwards movement which depends on the angle of the cone.

There is a rapid release mechanism which forms a normally closed (NC) circuit. When it is struck by the ball, the mechanism changes position into a normally open (NA) circuit, thereby interrupting the electrical supply to the electricpump and causing it to cut out.

The calibration of the switch causes it to intervene at acceleration above 1.2 g (approx 11.7 m/s2, corresponding to an impact at a speed of around 25 kph).

To restore the connection to earth for the auxiliary electric pump, move the seat backwards and press the switch until the click is heard.

*After even an apparently slight impact, if there is a smell of fuel or there are noticeable leaks from the fuel system, do not turn the switch back on, but search for the cause of the problem and eliminate it to avoid fire hazards.*

*If this is not the case and there are no leaks and the vehicle is ready to be driven again, press the button to reactivate the electric pump.*


*Print no. 506.670/16*

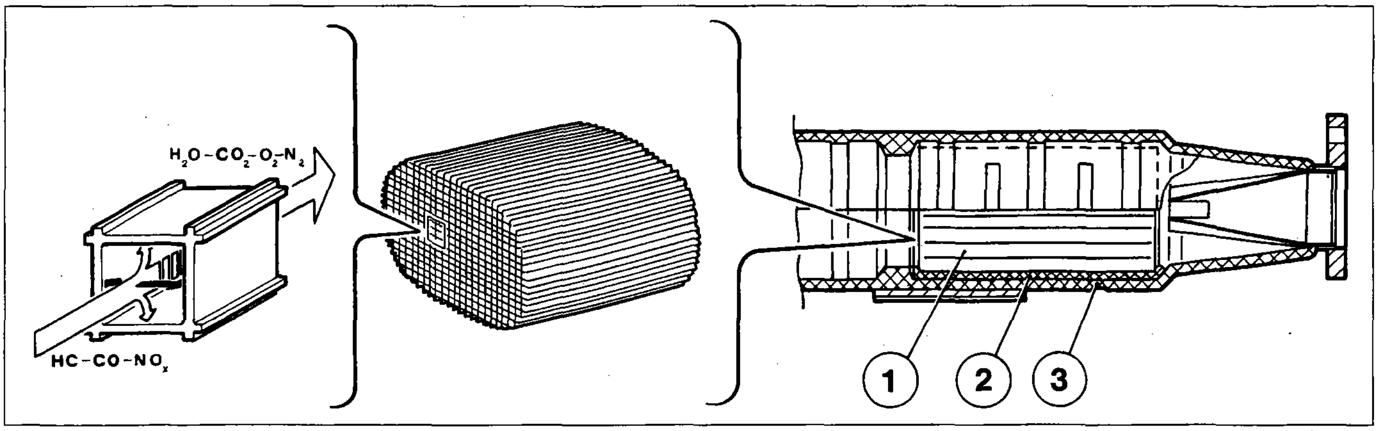
## EMISSION CONTROL DEVICES

The devices used for this purpose have two aims:
- to keep down the levels of pollutant substances in the exhaust, through the catalytic silencer;
- to eliminate the dispersion towards the outside of unburnt hydrocarbons, through the (fuel) anti-evaporation system and the (lubricant) oil vapour recirculation system.

## CATALYTIC SILENCER

The catalytic silencer is a device which makes it possible to simultaneously keep down the levels of the three main pollutants in the exhaust: unburnt hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx).
Two types of chemical reaction take place inside the catalyzer:
- oxidation of the CO and the HC, converted into carbon dioxide ($CO_2$) and water ($H_2O$);
- reduction of the NOx, converted into Nitrogen ($N_2$).

These reactions can take place extremely quickly thanks to the presence, inside the catalyzer structure (ceramic support), of a layer of active substances (platinum and rhodium) which greatly accelerate the conversion speed of the harmful substances.
The effectiveness of this conversion process is, however, affected by the fact that the mixture strength with which the engine is operating is constantly oscillating around the stoichiometric value, which is achieved thanks to the feed-back control carried out by the control unit on the basis of the Lambda sensor.
Lastly, the conversion processes are activated at temperatures in excess of 300-350 °C: it is therefore vital for the catalyzer to reach this temperature as quickly as possible in order to work properly.




P4A35JJ01

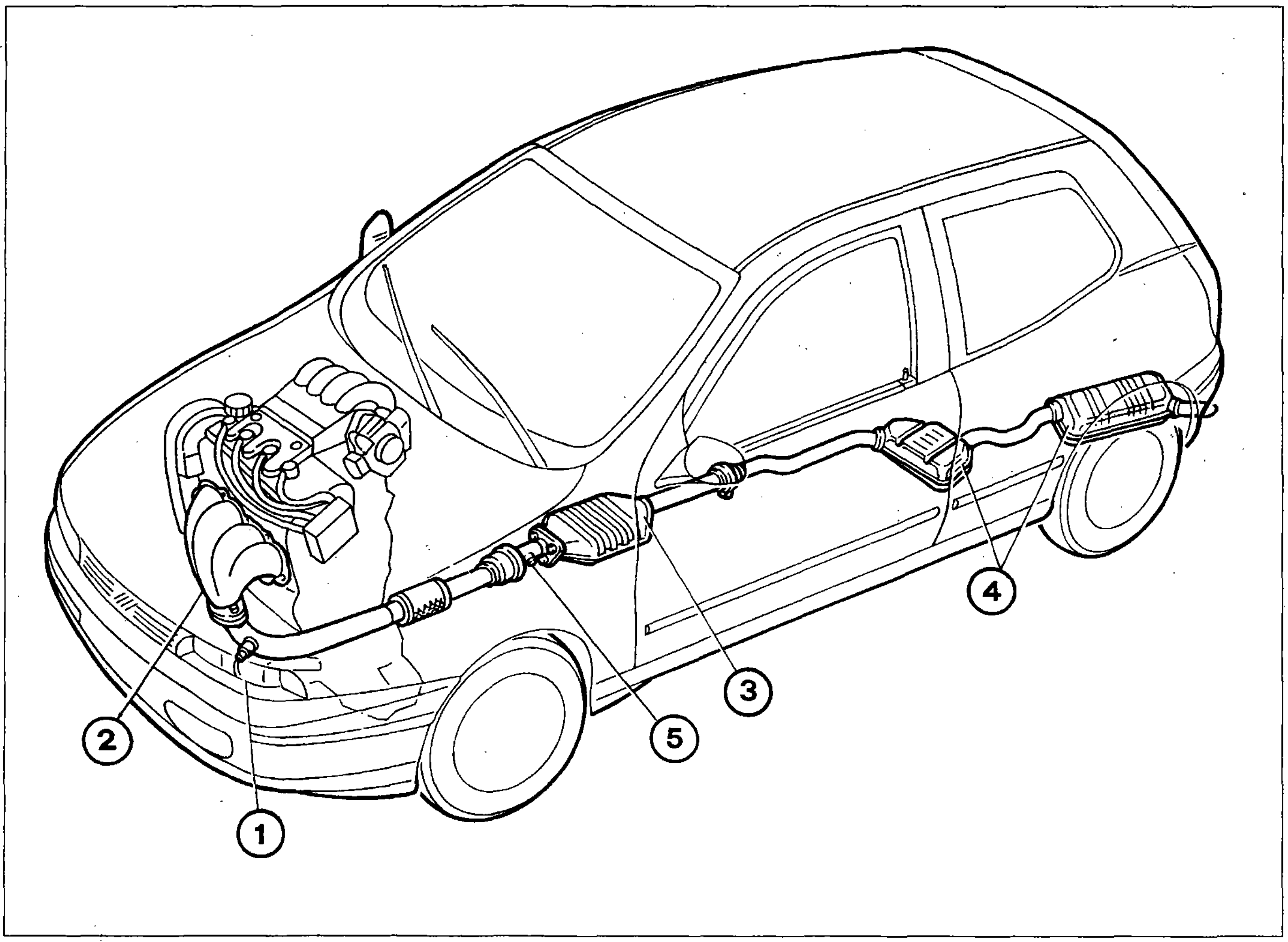
1. Ceramic monolith
2. Metal support
3. Steel outer casing

⚠ *When work has to done near the catalytic silencer, the vehicle should be left to rest for some time because the operating temperature (inside) the catalyzer is between 500 and 850 °C.*

⚠ *There are basically two things which destroy the inside of the catalyzer:*
- *the presence of lead in the fuel, which lowers the degree of conversion to practically nil ("lead poisoning") and also irreparably damages the Lambda sensor;*
- *the presence of completely unburnt fuel in the exhaust gases, due to failed ignition, which causes an increase in temperature which melts the ceramic support. Consequently, the hight tension leads should not be disconnected with the engine running for any reason: in the case of tests, the silencer should be replaced with an equivalent section of pipe.*

# 10.

## ENGINE EXHAUST ASSEMBLY DIAGRAM




P4A36JJ01

**Key**

1. Lambda sensor
2. Exhaust manifold
3. Catalytic silencer
4. Silencer
5. CO intake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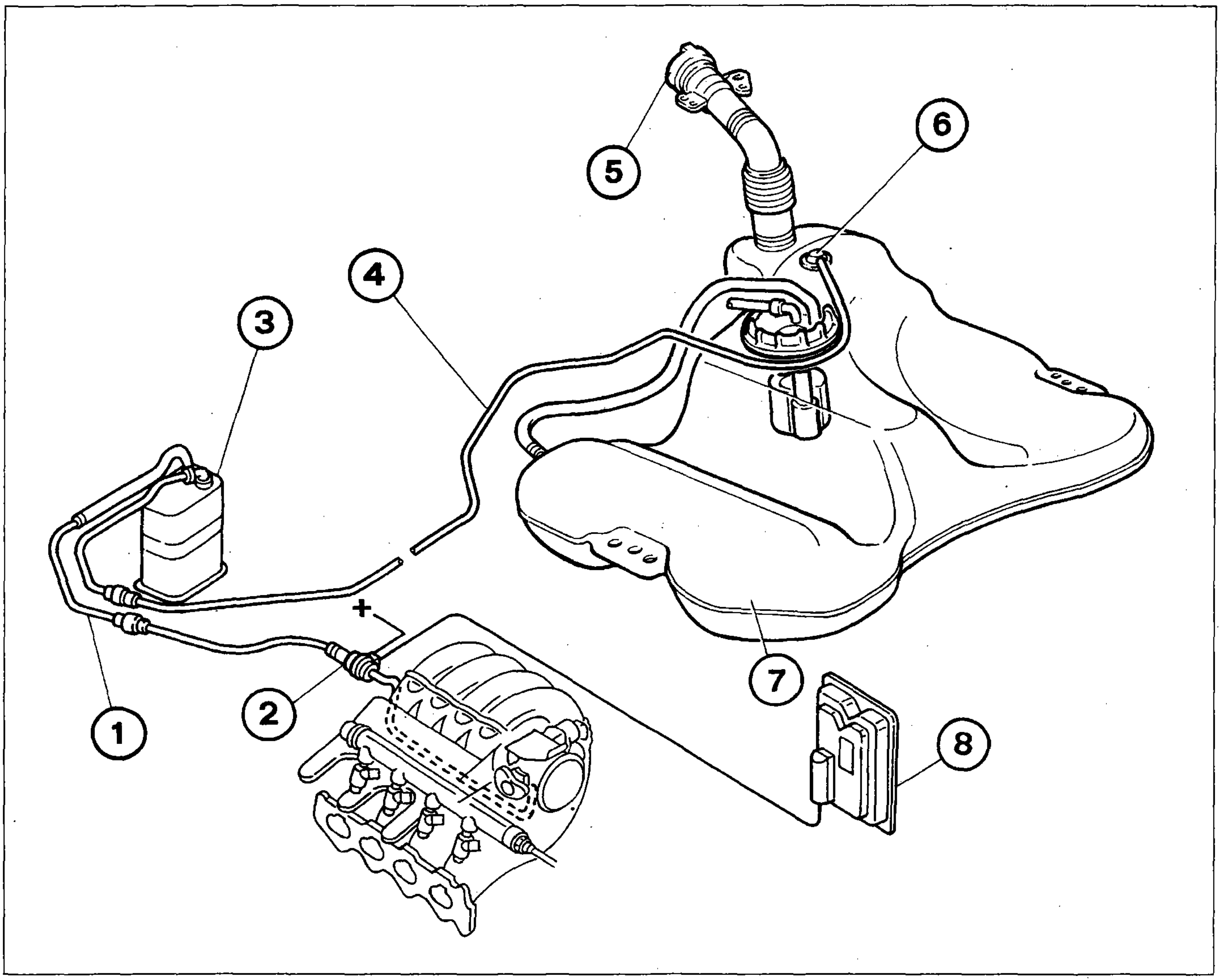
## DIAGRAM SHOWING ANTI-EVAPORATION CIRCUIT




P4A37JJ01

The anti-evaporation system is designed to prevent the fuel vapours, consisting of the lightest particles of hydrocarbons which form in the tank from being discharged into the atmosphere.

1. vapour supply pipe to the butterfly casing
2. Charcoal filter solenoid valve
3. Charcoal filter
4. Vapour supply pipe from the tank to the charcoal filter
5. Safety and ventilation valve
6. Multi-purpose valve
7. Tank
8. Injection/ignition control unit

# 10.

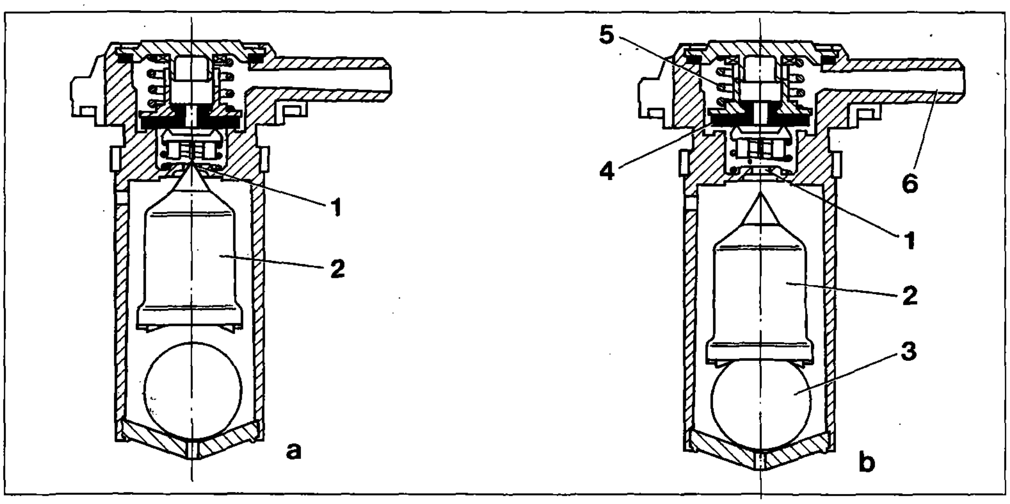
## ANTI-EVAPORATION SYSTEM COMPONENTS

**Multi-purpose valve**
This valve is used to carry out various functions, namely:
- to prevent the flow of liquid fuel if the tank is too full or if the vehicle overturns in the case of an accident.
- to allow the breathing of the fuel vapours towards the active charcoal filter;
- to allow the ventilation of the tank if there is a vacuum inside.

The valve consists of a float body (2), a heavy ball (3), a plate thrust against the valve body by a spring (5) and a shim (8) thrust against the plate (4) by the spring (9). The operation of the multi-purpose valve can be summed up in the following cases, depending on how full the fuel tank is:

a. if the tank is full, the float (2) shutters the port (1) preventing the liquid fuel from reaching the active charcoal filter preventing it from being damaged;

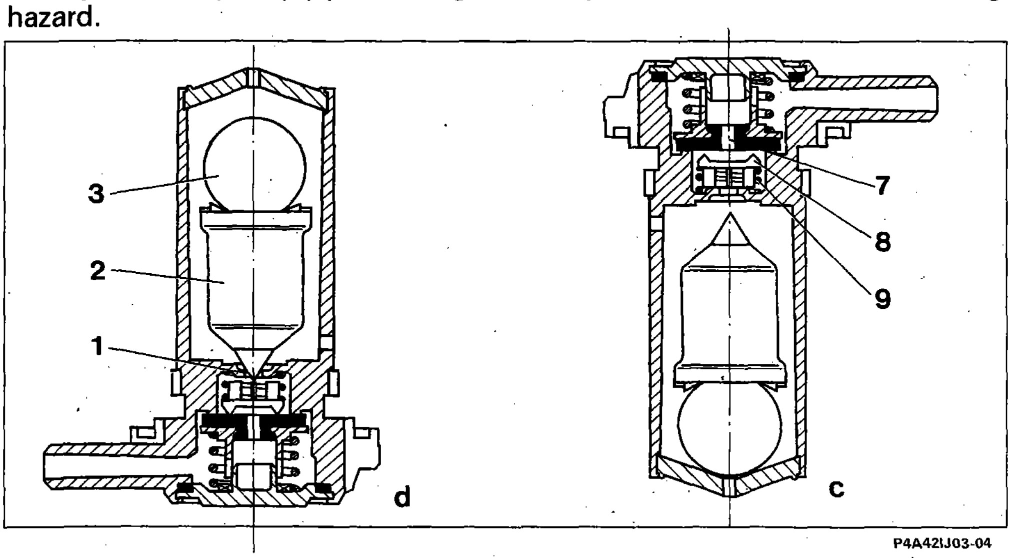
b. if the level of the fuel in the tank decreases, the float (2) goes down and rests on the ball (3) opening the port (1); when the pressure exerted by the fuel vapours on the plate (4) overcomes the spring (5) loading, a ring section opens between the actual plate and the valve body, allowing the fuel vapours to come out of the duct (6) and reach the active charcoal filter;




P4A42IJ01-02

c. if the level of the fuel in the tank decreases to such an extent as to produce a vacuum inside the tank, this acts on the shim (8) and, overcoming the spring (9) loading, recalls it downwards allowing the ventilation of the tank through the port (7).

d. if the vehicle overturns, irrespective of how full the tank is, the ball (3), weighing down on the float (2), pushes it against the port (1) preventing the escape of fuel which would be dangerous and create a fire hazard.

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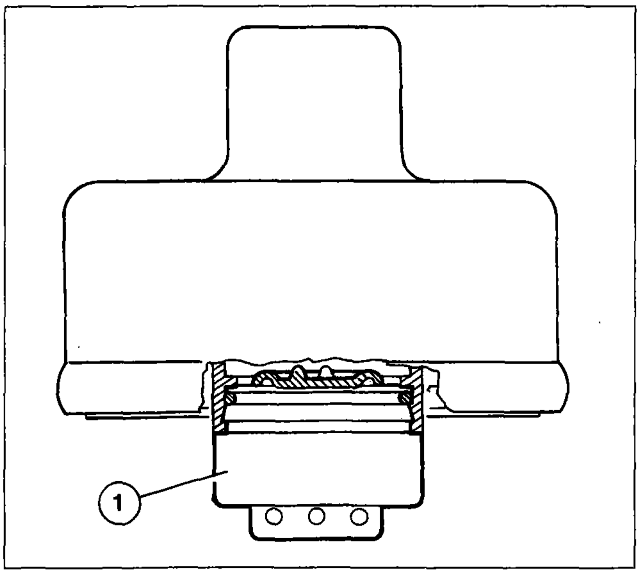
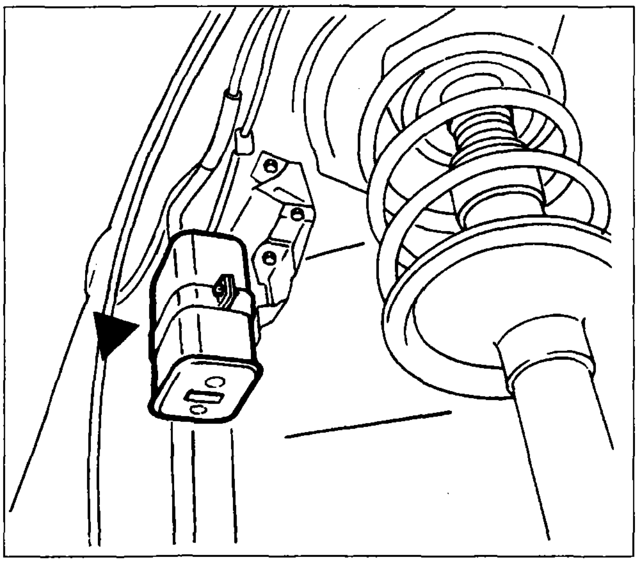



P4A43IJ03

## Safety and ventilation valve

This valve is located in the fuel filler cap and, depending on the pressure in the tank, carries out the following functions:

- When the pressure inside the fuel tank exceeds 0.13 - 0.18 bar, it allows the excess vapours to be discharged outwards (safety function).
- If, conversely, there is a vacuum of 0.020 - 0.030 bar in the tank, it allows the intake of air (ventilation function).



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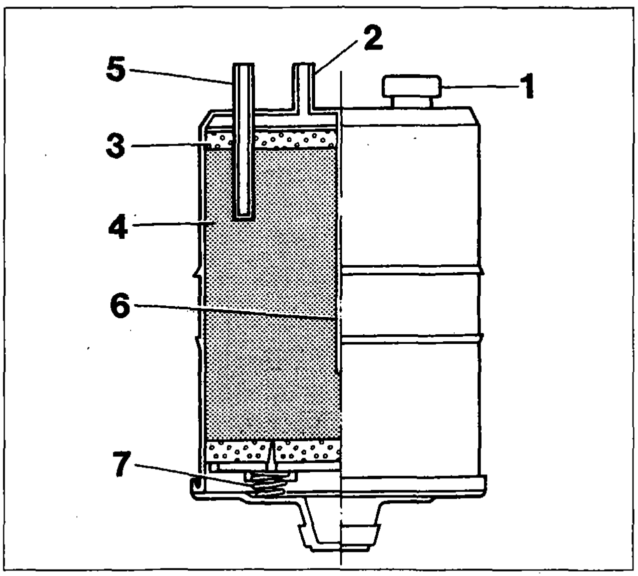



P4A43CJ02

## Charcoal filter

The charcoal filter is located in the right wheel arch; to gain access to it, remove the rear part of the right front wheel arch liner.

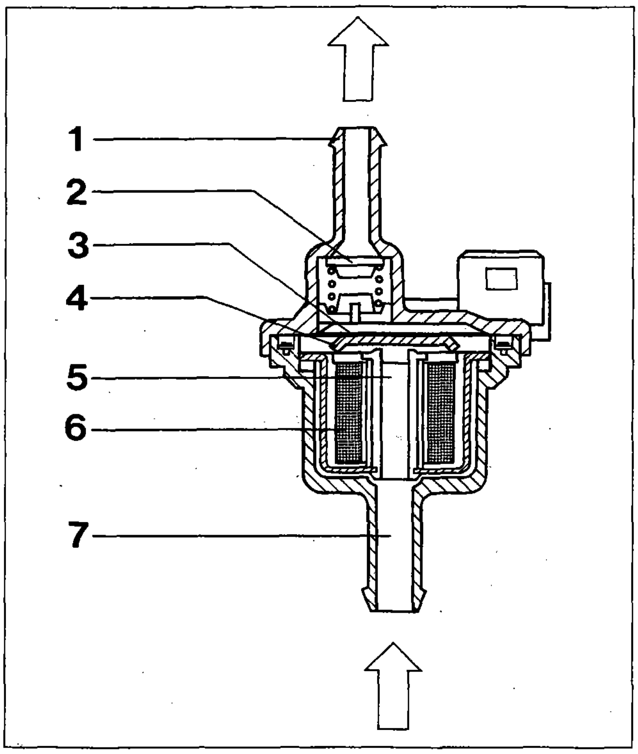
It consists of granules of charcoal (4) which trap the petrol vapours entering through the intake (5).

The scavenging air which enters through the intake (1), through the paper filter (3), comes into contact with the granules and directs them towards the outlet (2) and from there towards the cut-out valve.

The air, having entered through the intake (5), can also be recalled by the vacuum in the tank to ventilate the actual tank. The partition (6) ensures that the air drawn in comes into contact with all the granules of charcoal assisting the release of petrol vapours towards the inlet manifold.

There are also two springs (7) which allow the mass of granules to expand when the pressure increases.

# 10.



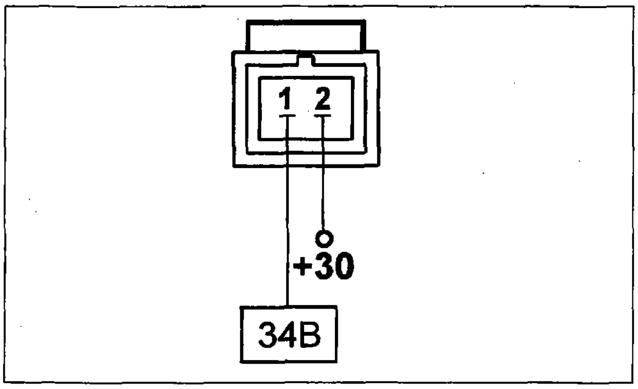

P4A36FJ03

## Charcoal filter solenoid valve

The function of this valve is to control the quantity of fuel vapours drawn in by the active charcoal filter and directed to the inlet manifold by means of the injection/ignition electronic control unit.

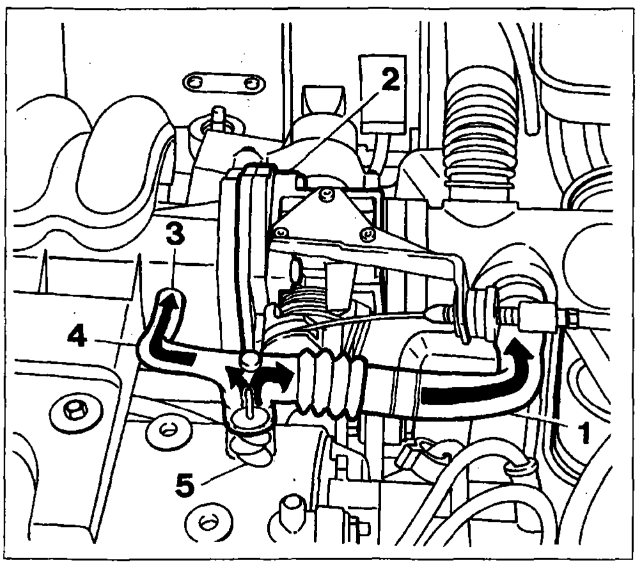
If this valve has no supply, it is closed, preventing the fuel vapours from excessively enriching the mixture.

1. Inlet connector
2. One-way valve
3. Spring
4. Shutter
5. Outlet opening
6. Solenoid valve
7. Outlet connector




P4A40JJ02

## Wiring connector




P4A40JJ01

## DIAGRAM SHOWING RECIRCULATION OF GASES COMING FROM THE ENGINE CRANKCASE (BLOW-BY)

This system controls the emission, from the cylinder block/crankcase, of the breather gases made up of air/petrol mixtures and burnt gases which escape through the piston ring seals, in addition to the lubricant oil vapours, recirculating them to the inlet.
With the accelerator butterfly open, the gases from the upper cover reach the main air intake pipe through the pipe (1) which contains a spark-out (5) to prevent combustion due to flame returns from the butterfly casing (2).
With the accelerator butterfly closed (engine idling), the vacuum in the inlet manifold draws in the gases (in limited quantities) directly through the small pipe (4) and the calibrated port (3).


Print no. 506.670/16

## CHECKS, ADJUSTMENTS AND REPAIR OPERATIONS ON THE BOSCH 1.5.5 SYSTEM

*The following precautions should be observed when working on a vehicle equipped with the Bosch 1.5.5 system:*
- *do not start up the engine when the electrical connectot terminals are badly connected or slack at the battery poles;*
- *do not use a rapid battery charger to start the engine;*
- *never disconnect the battery from the electrical system with the engine running;*
- *in order to charge the battery it must be disconnected first from the electrical equipment;*
- *if the vehicle goes in a drying oven after painting at temperatures in excess of 80 °C, it is necessary to remove the engien control unit from the vehicle;*
- *do not connect/disconnect the control unit multiple connectors with the ignition switch in the ON position;*
- *always disconnect the negative battery lead before carrying out electrical welding on the vehicle.*

*The system has a memory which is directly supplied by the battery, even with the ignition switched off, where the self-adjustment values are stored. Disconnecting the battery will involve the loss of this information which can only be learnt once again after a certain period: this operation should therefore be limited as far as possible.*

## CHECKING EMISSIONS CONCENTRATION

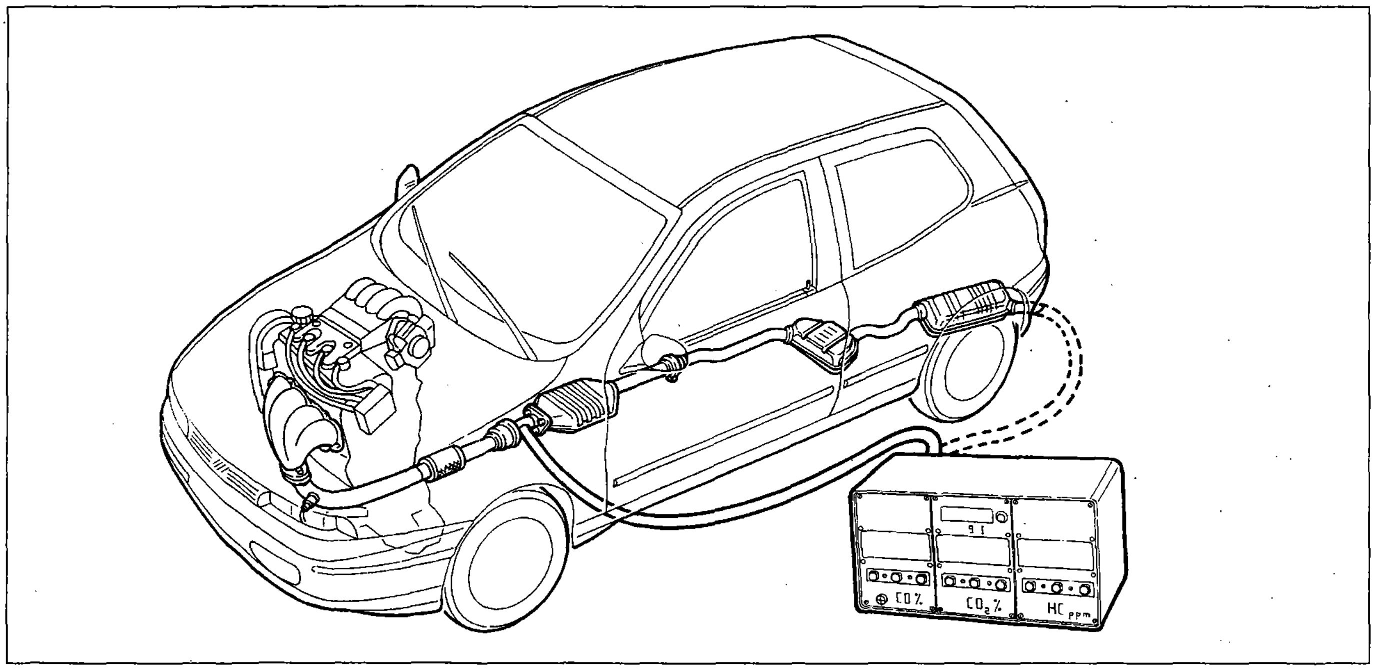
This system manages the advance, the carbon monoxide (CO) content and the idle air flow rate with no possibility for manual adjustment. However, a check on the content of the exhaust gases upstream and downstream of the catalyzer can provide useful indications on the injection/ignition system operating conditions, the engine parameters or the catalyzer.

### Checking idle concentration of CO and HC upstream of the catalytic silencer

To check the concentration of carbon monoxide (CO) and unburnt hydrocarbons (HC) upstream of the catalyzer, proceed as follows:

1. Undo the cap located on the exhaust pipe, upstream of the catalyzer, and tighten the tool in its pla ce.
2. Connect a suitably calibrated CO-tester to the tool.
3. Start up the engine and let it reach operating temperature.
4. Check that the engine speed is correct.
5. Check that the idle concentration of CO is within the recommended values (see table); if this is not the case, check:
   - that the Lambda sensor is working properly, using the diagnostic equipment;
   - for the presence of air penetration in the area surrounding the Lambda sensor housing;
   - the injection and ignition system **(in particular the state of wear of the spark plugs).**
6. In the same conditions, check that the HC concentration is below 500 p.p.m.
7. If these values are not found, tune the engine, paying particular attention to:
   - the valve gear timing;
   - the engine compression.

# 10.




P4A42JJ01

**Table summarizing pollutant emission tolerance values**

| | CO (%) | HC (p.p.m.) | $CO_2$ (%) |
|---|---|---|---|
| Upstream of the catalyzer | 0,4 ÷ 1 | ⩽ 500 | ⩾ 12 |
| Downstream of the catalyzer | ⩽ 0,35 | ⩽ 90 | ⩾ 13 |

**Checking concentration of CO and HC at the exhaust**

The exhaust concentration of carbon monoxide (CO) and unburnt hydrocarbons (HC) is measured by inserting a suitably calibrated tester sensor at least 30 cm into the end of the exhaust pipe.

1. Check that the idle CO and HC concentrations correspond to the recommended figures (see table).
2. If the HC value is outside of the recommended limit, whilst that measured previously upstream of the catalyzer was correct, the engine parameters are correct and the cause of the problem should therefore be sought in the decreased efficiency of the catalyzer.

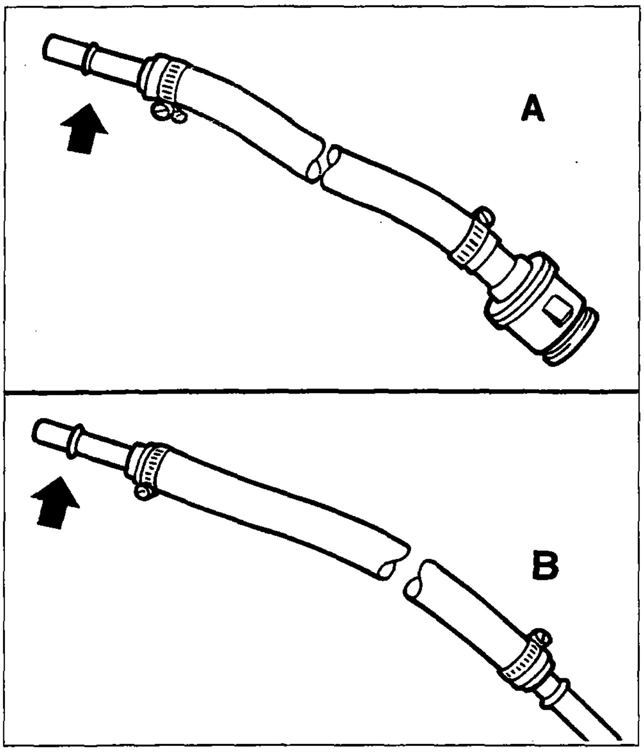
## CHECKING ENGINE IDLE SPEED

If the engine idle speed does not correspond with the one recommended, as the system is the self-adjusting type no adjustments can be carried out. It is therefore necessary to check that the accelerator linkage is correctly adjusted and the cause of the problem should be sought by carrying out a complete fault diagnosis using the diagnostic equipment.

## IGNITION ADVANCE CHECK

The diagnostic equipment must be used to check the ignition advance angles at the different speed.


Print no. 506.670/16

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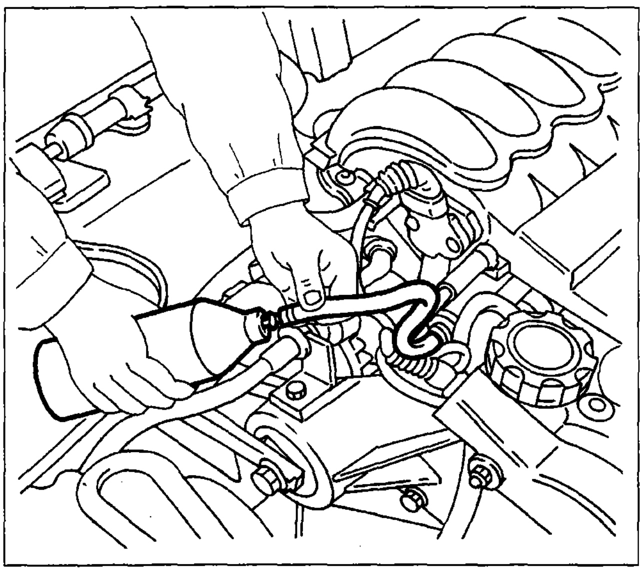


P4A43JJ0

## CHECKS ON THE FUEL SUPPLY CIRCUIT

*THESE OPERATIONS SHOULD BE CARRIED OUT IN THE PRESENCE OF A SUITABLE VAPOUR PURIFICATION AND EXHAUST SYSTEM.*

**Checking the fuel supply circuit pressure**

Check the supply pressure and the seal of the fuel supply system following the instructions given below using equipment 1860955000, fitted with two adaptors which should be made as described below:

- adaptor (A): use a new type rapid attachment female terminal and a length of pipe contained in Kit no. 1860955003 and an old type rapid attachment male terminal contained in Kit no. 1860955001;
- adaptor (B): use a new type rapid attachment male terminal and a length of pipe contained in Kit no. 1860955003 and an old type rapid attachment male terminal contained in Kit no. 1860955001;

Configure the adaptors as illustrated in the diagram.

*The arrow indicates the the side to insert in the test equipment 1860955000 (pressure gauge)*

**Discharging the fuel pressure in the supply circuit**

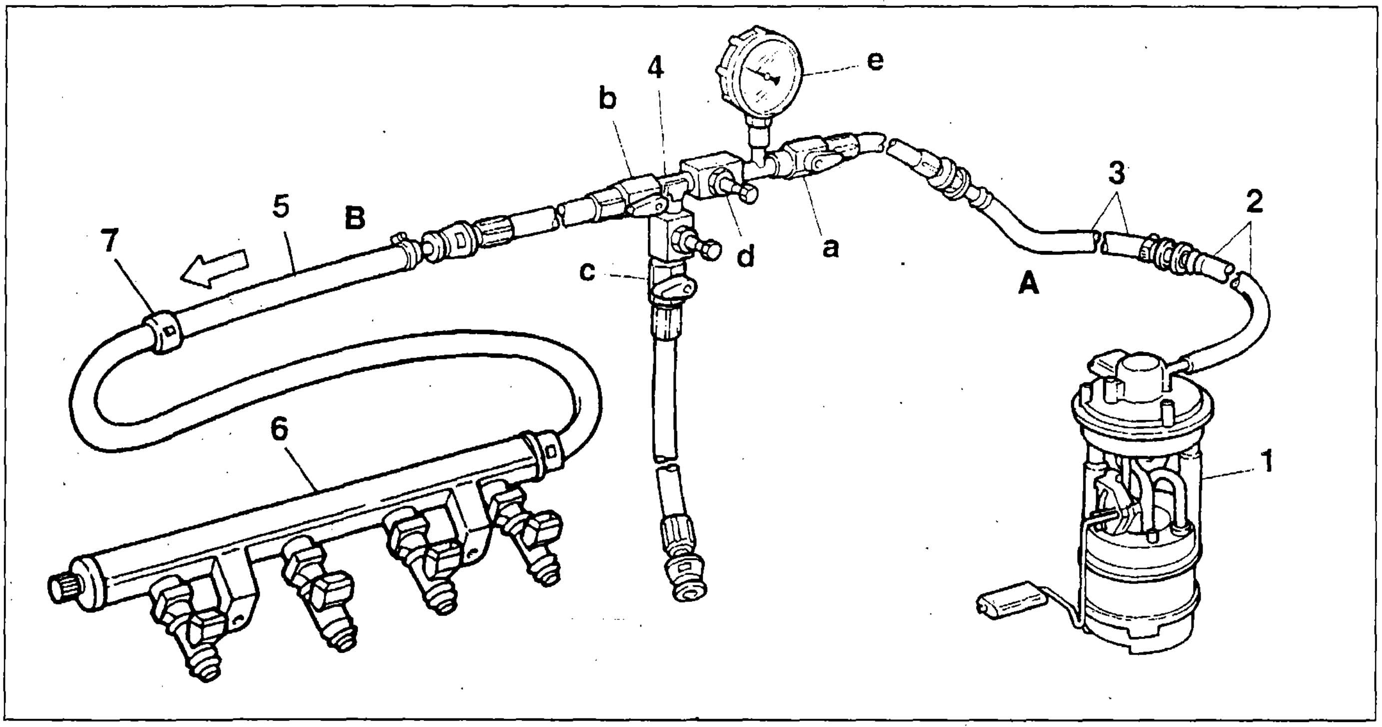
The fuel supply circuit is kept at a constant pressure of about 3.2 bar even with the engine switched off; therefore before carrying out any operations on the supply pipe, the pressure in the system must be discharged, using adaptor no. 1870684000 and a special container to collect the excess fuel in.

Proceed as described below:
- Remove the protective cover from the attachment on the fuel manifold;
- introduce the male end of the adaptor into the container and fitthe rapid connector on the attachment on the fuel manifold, as illustrated in the diagram; in this way the small amount of excess fuel, which creates pressure, is discharged into the container and it is therefore possible to carry out the checks on the fuel supply system;
- disconnect the adaptor from the attachment and refit the protective cover.

# 10.

### Checking fuel supply circuit pressure

Prepare the test equipment 1860955000 using the adaptors produced previously and fitted as illustrated in the diagram below placing the ball valves (a), (b) and (d) in the maximum open position and valve (c) in a closed position.




1. Complete electric fuel pump
2. Fuel supply pipe
3. Adaptor (A)
4. Test equipment no. 1860955000
5. Adaptor (B)
6. Fuel manifold
7. Rapid attachment connector

After having discharged the pressure, remove the end of the fuel supply pipe (2) from the rapid connector (7), following the instructions on the previous pages, connect it to the female connector of the adaptor (A), connect the new male end of the adaptor (B) to the rapid connector (7) and check that the connectors are correctly fitted.
Turn the ignition key to the ON position and observe whether the pressure on the gauge (e), after increasing to about 3.5 bar, settles down at around 3.2 bar (the fall in pressure is due to the fact that after operating for several seconds the pump is deactivated if the engine is not started up).
If there is a fall in pressure to below the values mentioned above, check the seal of the section of the system Upstream of the fuel manifold and check the seal of the injectors following the instructions given below.

### Fuel supply pipe leakage test

Keep the test equipment in the position described in the previous paragraph, close valve (b), keeping valve (c) closed and valve (a) in the maximum open position.
Turn the ignition key to the ON position and observe whether, after increasing to around 3.5 bar, the pressure on the gauge (e) settles down at around 3.2 bar (the decrease in pressure is due to the fact that after the pump has been working for several seconds it is deactivated if the engine is not started up).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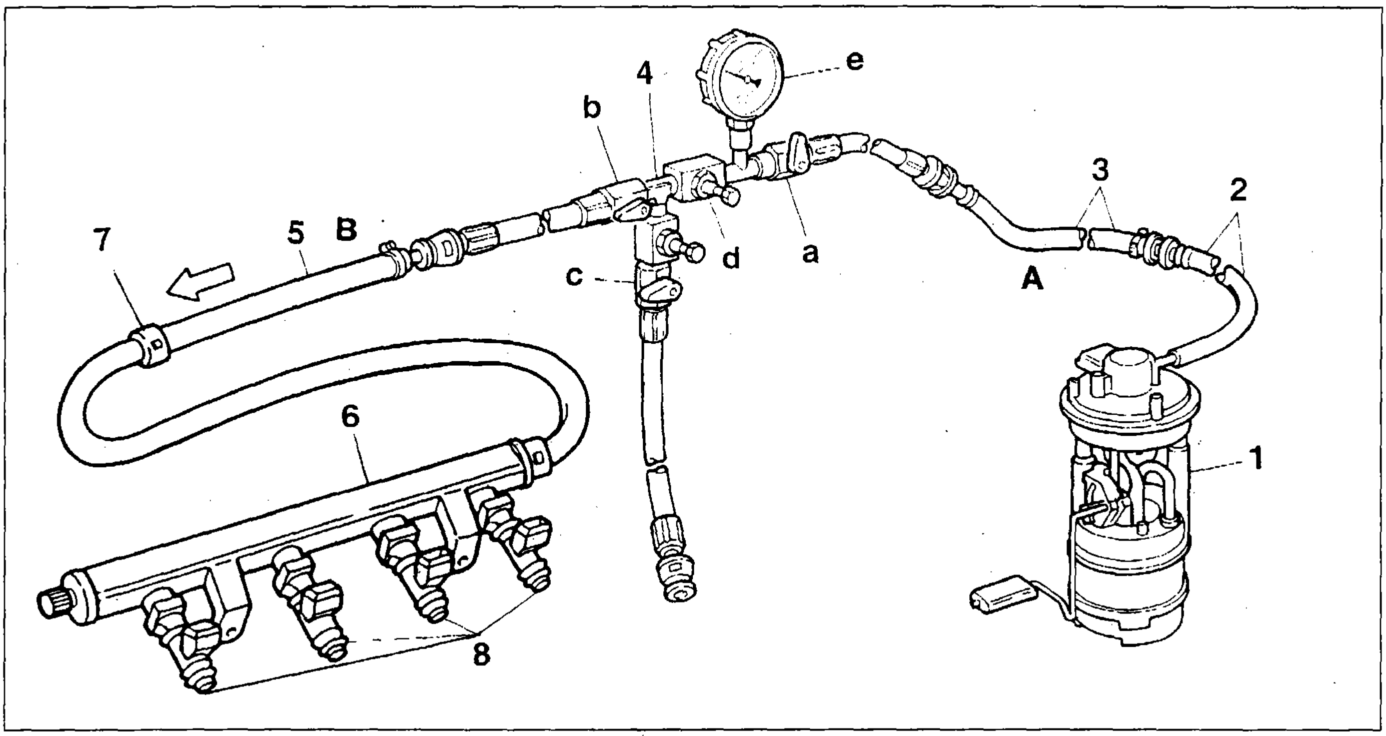
If there is a decrease in pressure to below the values mentioned above, check the section of the system upstream of the manifold and if there are no leaks or damage to the fuel supply pipe, replace the electric fuel pump drip tray assembly because the pressure regulator is housed in the actual unit and CANNOT be replaced.
If, after repeating the check, the pressure exceeds the recommended figure and is considerably higher, replace the electric fuel pump beucase there are operating problems with the pressure regulator housed in it.
If the pressure corresponds to the recommended figure, check the seal of the fuel manifold and the injectors following the procedure described in the paragraph below.

**Injector leakage test**




P4A45JJ01

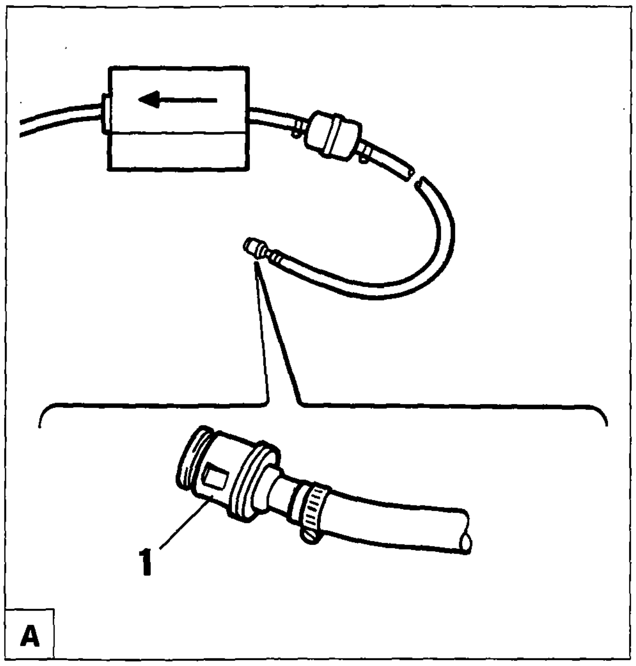
1. Complete electric fuel pump
2. Fuel supply pipe
3. Adaptor (A)
4. Test equipment No. 1860955000
5. Adaptor (B)
6. Fuel manifold
7. Rapid attachment connector
8. Injectors

Keep the test equipment in the same position as described in the previous paragraph, place valve (b) in the maximum open position, keeping valve (c) closed and valve (a) in the maximum open position.
Turn the ignition switch to the ON position and observe whether, after increasing to around 3.5 bar, the pressure on the gauge (e) settles down at a pressure of about 3.2 bar, then close valve (a) and check that the pressure remains constant for at least a minute; if this is not the case, there is a leak from one or more injectors.

# 10.

### Removing the test equipment

Remove the test equipment 1860955000 with the key in the OFF position, following these instructions:
- introduce the end of the pipe connected to the valve (c) into a suitable container;
- open the valve (c) and drain the excess fuel into the container;
- keep the pipe in the container and disconnect the end of the supply pipe from the female connector for the adaptor (A) keeping the connection upwards;
- let the fuel in the pipes flow into the container;
- disconnect the end of the adaptor (B) from the rapid connector and let the residual fuel flow from the pipes into the container;
- reconnect the fuel supply pipe.



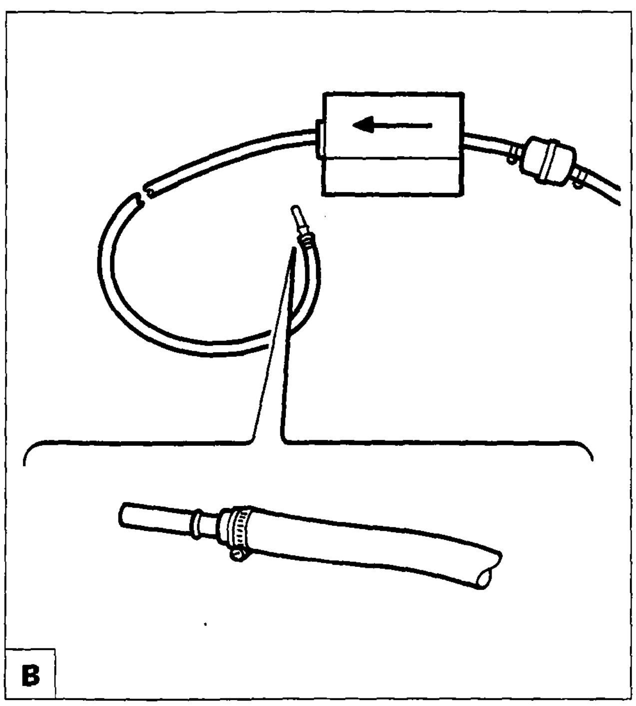

P4A46JJ01

### Checking fuel consumption using FLOWTRONIC equipment 1866149001

To carry out the check, the equipment should be configured with the connectors shown in the diagrams:

A. supply pipe side
B. fuel manifold side

If this has not been done, make the adjustment following the instructions given below:
- cut the end of the FLOWTRONIC equipment inlet pipe and replace it with a female rapid connector (1), contained in the Kit No. 1860955003, as illustrated in figure A;




P4A46JJ02

- cut the end of the FLOWTRONIC equipment outlet pipe and replace it with a male connector (2), contained in the Kit No. 1860955003, as illustrated in figure B.

*The connectors removed should be recovered and kept for any future connections.*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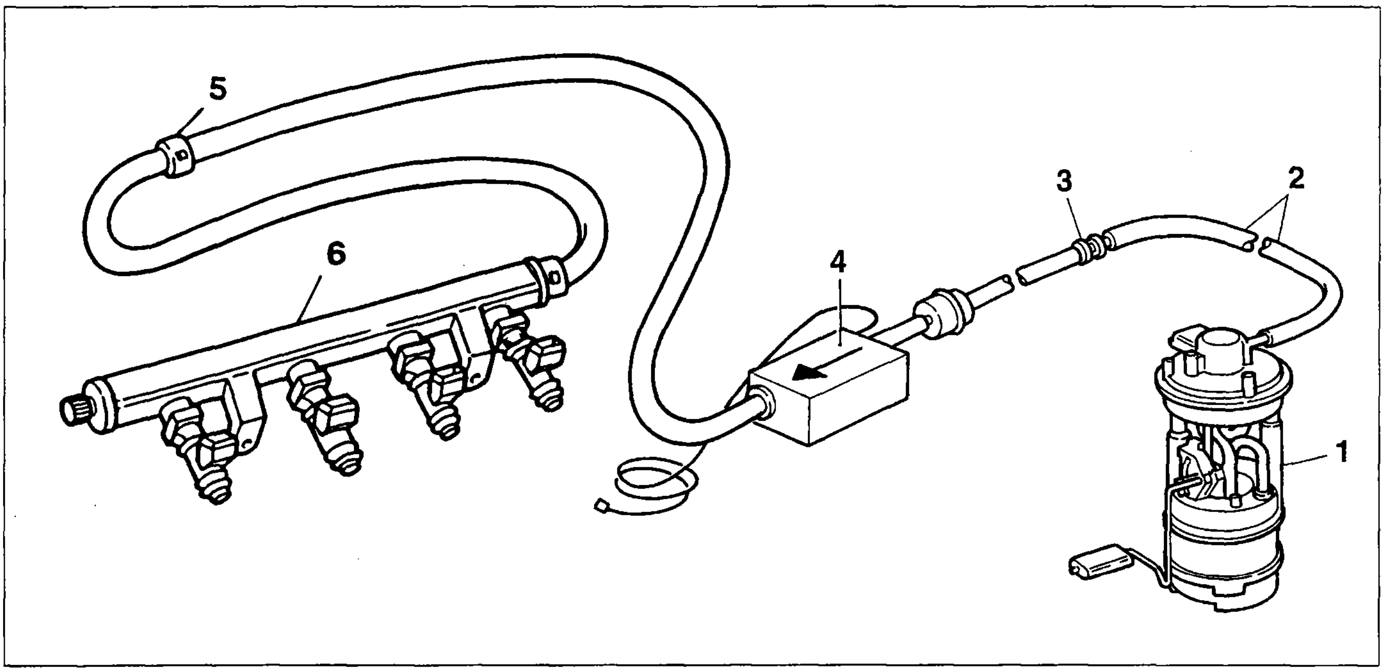
- discharge the fuel pressure inside the supply pipe and disconnect the pipe from the rapid connector, following the instructions in the previous paragraphs;
- attach the end of the supply pipe to the female rapid connector for the FLOWTRONIC equipment and the male connector to the rapid connector;
- position the equipment in the engine compartment, place the connecting electrical cable inside the vehicle and connect the actual equipment as described in the instructions which come with the equipment;
- proceed with the fuel consumption test in accordance with regulation 93/116 CE and check that the figures correspond with those given in section 00 - Technical data.



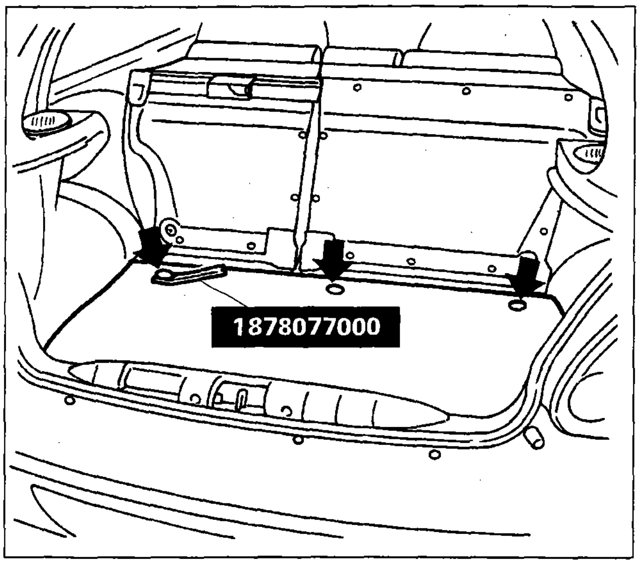

P4A47JJ01

1. Complete electric fuel pump
2. Fuel supply pipe
3. Female rapid connector
4. FLOWTRONIC equipment
5. Rapid connector
6. Fuel manifold

- carry out the fuel consumption road test in accordance with directive 93/116 CE (litres per 100 km):
  URBAN CYCLE - this includes a cold start, followed by a simulated urban journey;
  EXTRA-URBAN CYCLE - this includes frequent acceleration, in all the gears, simulating normal out of town usage; the speed varies between 0 and 120 kph;
  AVERAGE COMBINED CONSUMPTION - this involves 33% of the urban cycle and 67% of the extra-urban cycle;
  check that the figures measured correspond to those in the section "Introduction and technical data".

**NOTE** *Traffic conditions, driving styles, atmospheric conditions, trim levels / accessories, whether a roof rack is fitted, the presence of special equipment and the general state of the vehicle, can lead to fuel consumption figures which differ from those obtained using the procedures described above.*

# 10.




P4A48JJ01

## FUEL DRIP TRAY ASSEMBLY

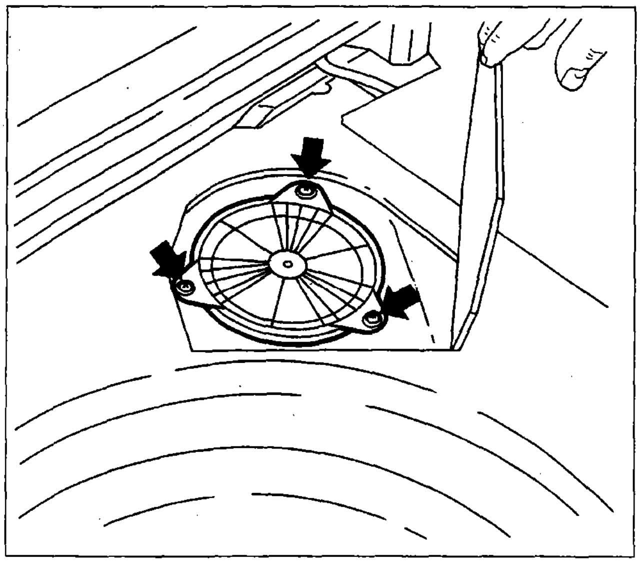
**NOTE** *In order to extract the assembly from the tank, the fuel should not be higher than the halfway mark.*

### Removing-refitting

Proceed with removing the fuel drip tray assembly as follows:

- remove the buttons (arrow) fixing the luggage compartment lining using tool 187807700 and remove it, then lift up panel cover to gain access to the dust cover;
- undo the bolts (arrow) and remove the dust cover;
- disconnect the supply pipe (1), the breather pipe (2) and the electrical connector (3);
- using tool 1860893000 remove the ring nut securing the drip tray and extract the drip tray from the tank, taking care not to damage the seal.

When refitting, repeat the operations carried out for the removal in the reverse order; at the end, make sure that there are no fuel leaks.



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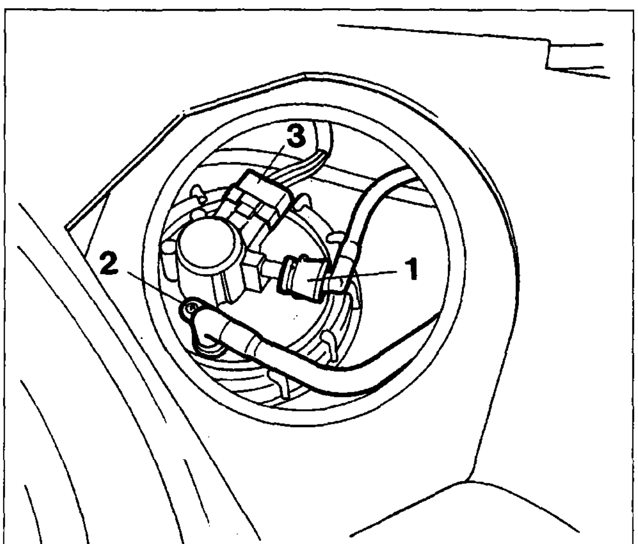


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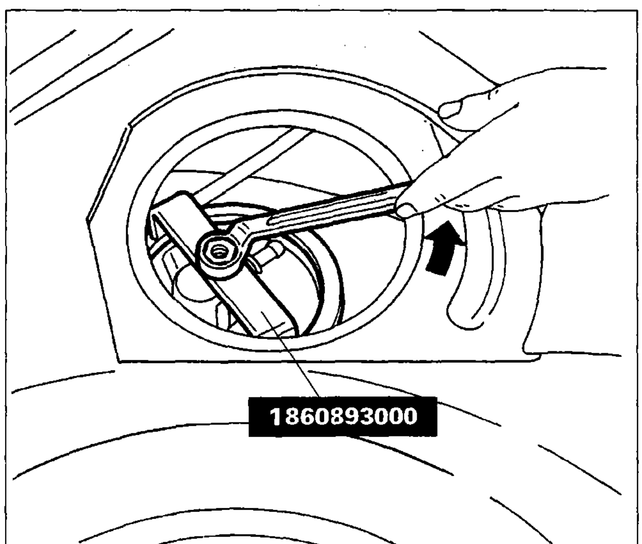


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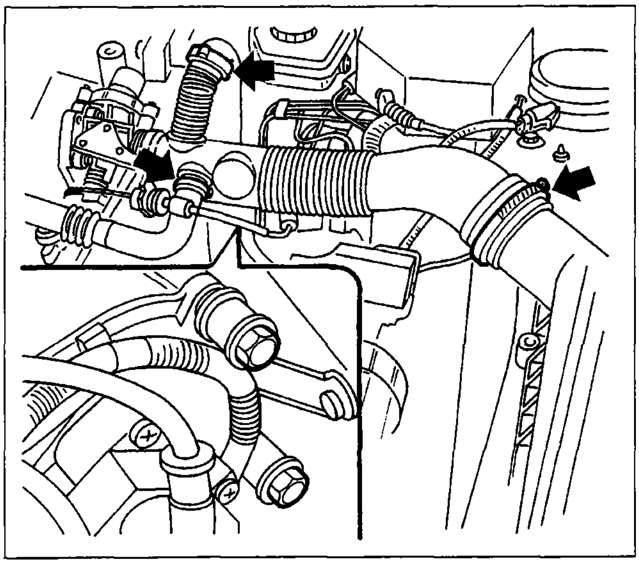

P4A49JJ01

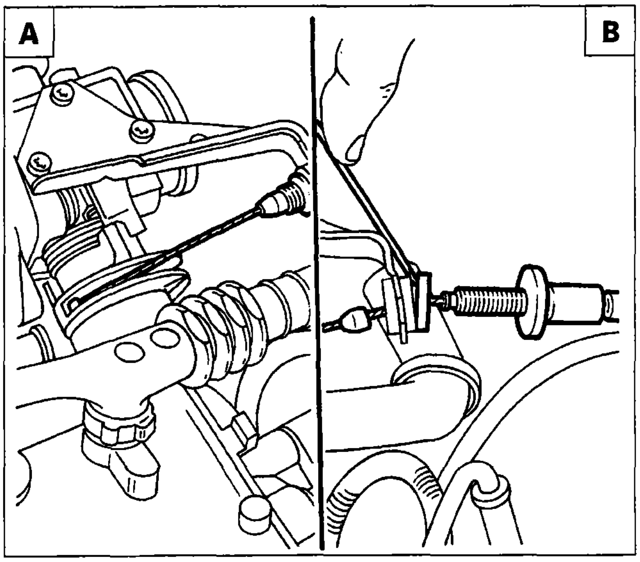
## FUEL MANIFOLD AND INJECTORS

**NOTE** *Before removing the manifold, discharge the pressure inside following the instructions given at the start of this chapter.*

**Removing-refitting fuel manifold**

Proceed with removing the manifold as follows:

- remove the bands shown (arrow); then, undo the two bolts (detail) and remove the inlet hose complete with resonator;

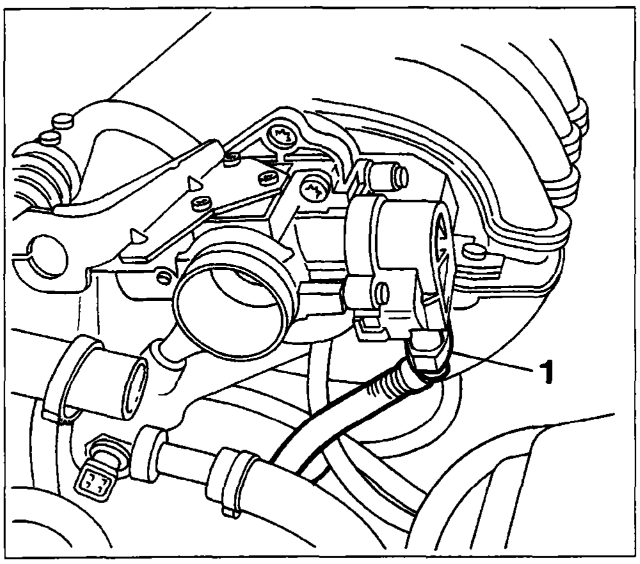


P4A49JJ02

- rotating the accelerator lever, release the end of the accelerator cable from the lever (A) then remove the adjuster from the bracket (B) and move the accelerator cable away;

- disconnect the engine idle speed actuator connector (1);

- undo the bolts (arrow) fixing the upper half of the manifold and remove the vapour recirculation pipe (2).



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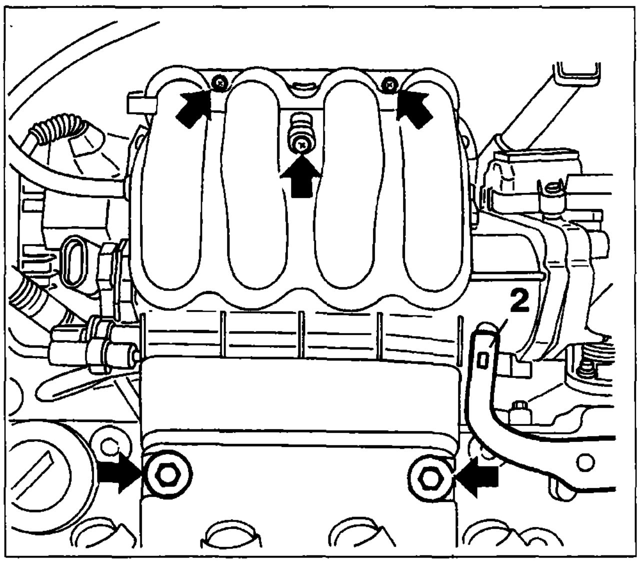

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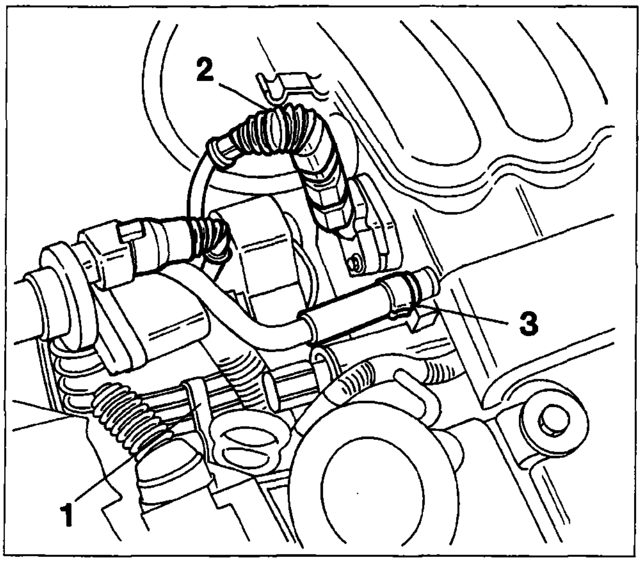


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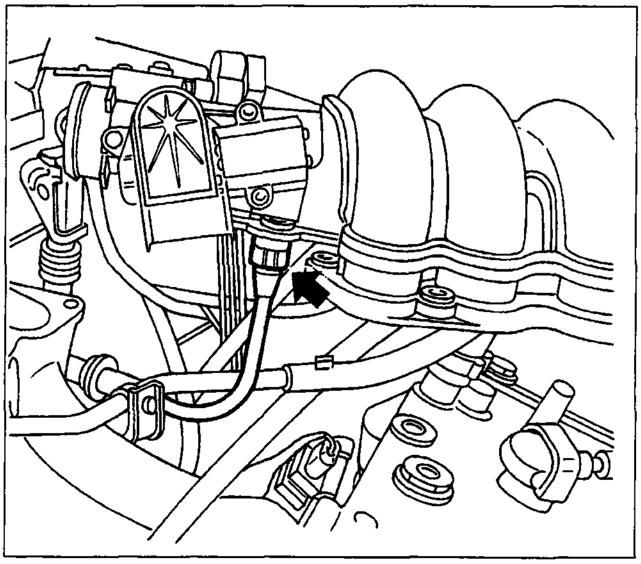

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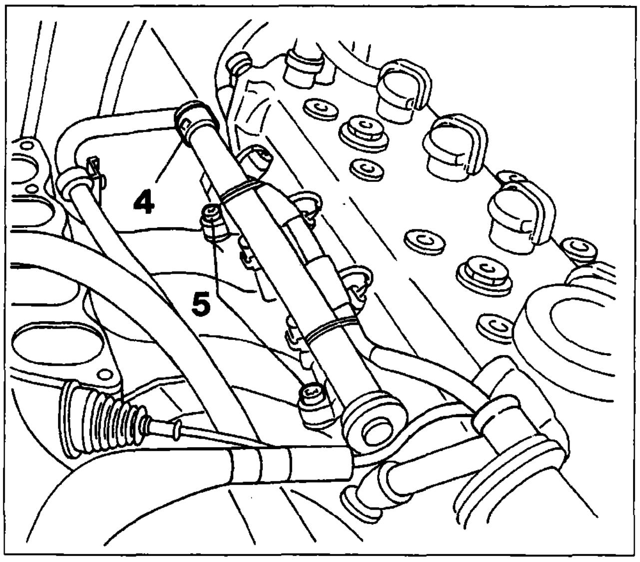
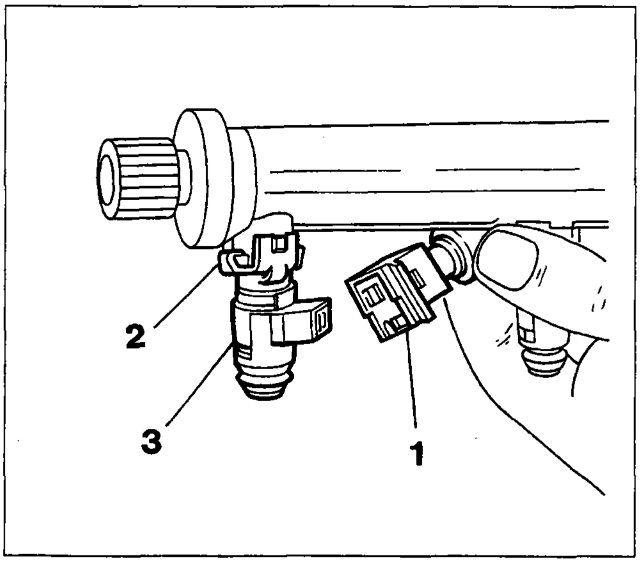



P4A50JJ03

- disconnect the air temperature and pressure sensor connector (2) and the injectors cable connector (1) and remove the charcoal filter intake pipe (3);
- partly raise the half-manifold and remove the brake servo vacuum inlet pipe (arrow);
- disconnect the rapid connector (4), undo the fixing bolts (5) then remove the complete fuel manifold.

When refitting, repeat the operations described for the removal in the reverse order.




P4A50JJ04

**Removing-refitting injectors**

To remove the injectors, proceed as follows:
- Disconnect the electrical connection (1).
- Remove the safety clip (2).
- Remove the injector (3) which is a press fit.

*Never act on the electrical connector to remove the injector.*
*Before refitting, check the condition of the seals.*



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## THROTTLE BODY

### Removing-refitting

Proceed as follows to remove the throttle body:

- remove the collars indicated (arrowed), then unscrew both bolts (detail) and remove the intake sleeve with resonator;

- release the accelerator cable terminal from lever (A), then remove the adjustment block from bracket (B) and place the accelerator cable aside;

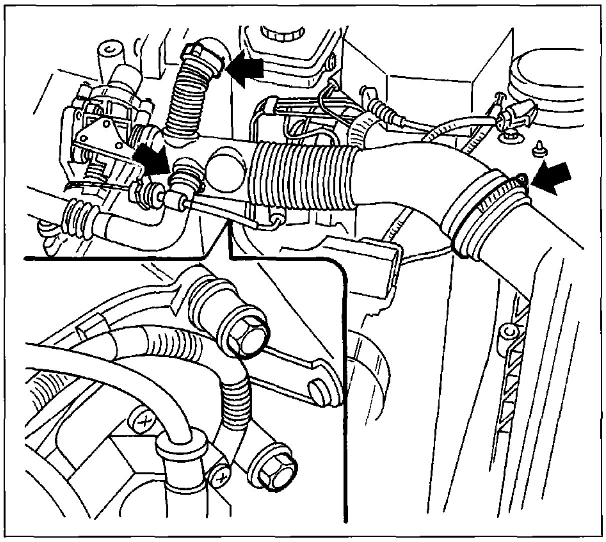
- disconnect the engine idle speed actuator connector (1);

- unscrew the four retaining bolts (arrowed) and remove the throttle body.

Reverse removal instructions to refit.

Adjust the accelerator cable as described in the following paragraph.

**NOTE** *If the throttle body is replaced, connect a tester (Examiner) to the tester connection and run the required procedure to zero and self-learn engine idle adjustment actuator (M.D.S.) data*



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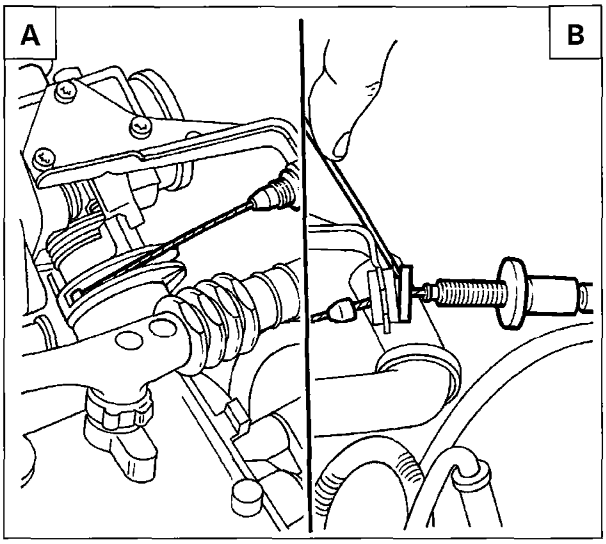


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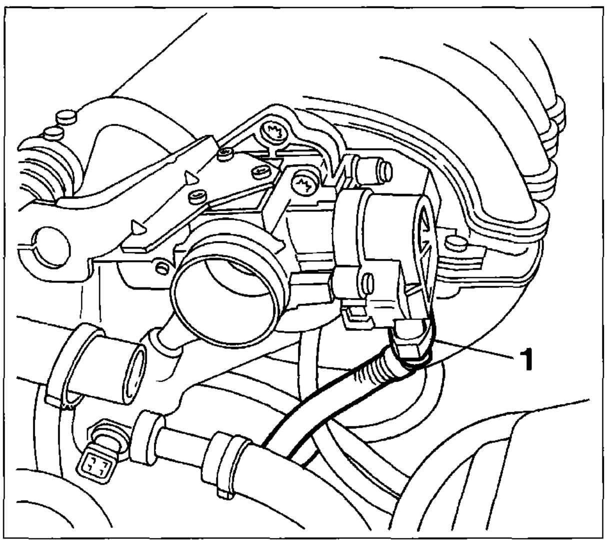


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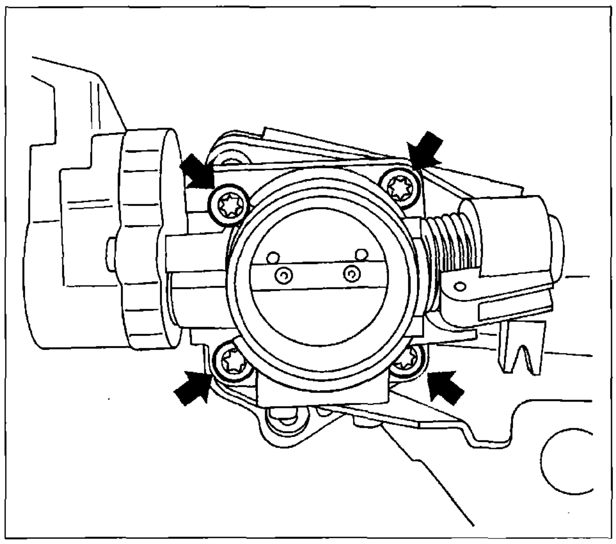


4F051PJ01

# 10.

### Zeroing

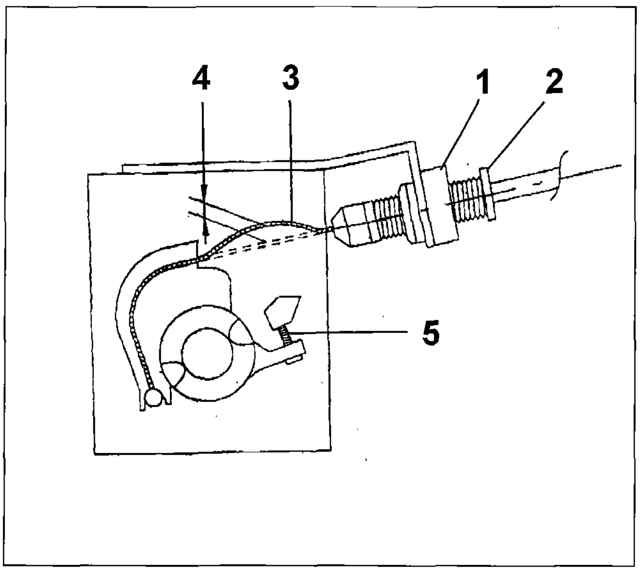
- Ensure the ignition key is turned off.
- Check that the climate control system is off, the accelerator pedal is not depressed and the accelerator cable is correctly adjusted (see next paragraph).
- Connect switch MPX 97 (tool 1806365000) to the tester connection and move the handle to position 3.
- Connect a tester (Examiner).
- Set the Examiner to "Control Unit Test" mode.
- Turn the ignition key on.
- Set the Examiner to "active test" mode, then select "Reset self-adaptive parameters" and "Idle actuator".
- Confirm reset and wait for the "Executed" message.
- Turn the ignition off and wait for 30 seconds.

### Self-learning

- Turn the ignition on and wait for 30 seconds.
- Use the Examiner to re-establish communication with the engine control system.
- Set the Examiner to "Parameters" mode and select "Idle identification test - executed" and "Idle identification signals - synchronised" from the "Selection" menu.

**NOTE** *If at least one of the parameters is not as specified, turn the ignition off and repeat the procedure. If the parameter is still not as specified, check the test lead is connected properly and the equipment working properly.*

- Turn the ignition off and wait for 30 seconds.
- Start the engine without operating the accelerator pedal and wait for the fan to come on.
- Disconnect the tester.
- Carry out a test run for a few kilometres, then ensure idle speed is as specified when the engine is warm.




4F052PJ01

### ACCELERATOR CONTROL CABLE

#### Adjustment

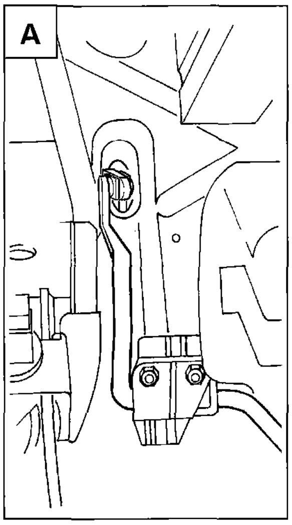
- slacken lock nut (1);
- adjust nut (2) to alter the clearance of accelerator cable (3) to achieve complete throttle closure (adjustment screw 5 in contact) and a cable clearance (4) of 5 mm with the pedal released.

Proceed as follows:

**tighten** to reduce the clearance
**loosen** to increase the clearance

- tighten the locknut following adjustment

Once the cable has been adjusted to set idle speed, connect the tester to the appropriate connection and check that throttle opening is at least 80° with the pedal fully depressed.

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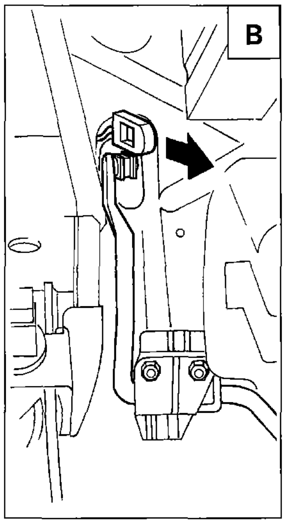


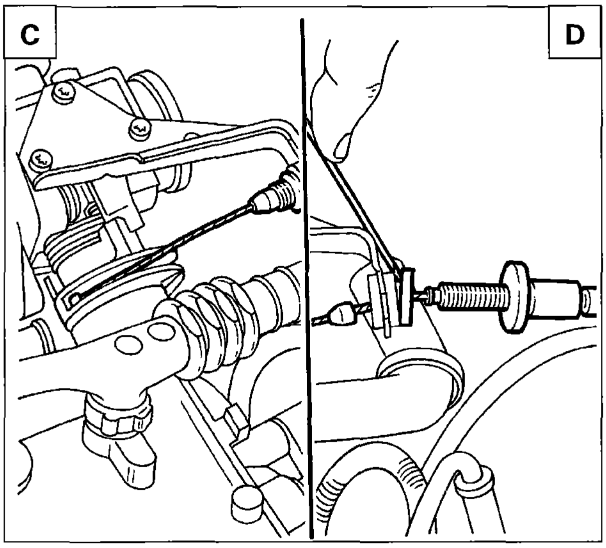

4F052PJ03

### Removing-refitting

Disconnect the accelerator cable as follows:

- working from inside the vehicle (A), disconnect the control cable from its anchorage on accelerator pedal (B);
- turn the accelerator lever to disengage the accelerator cable terminal from lever (C). Then remove the adjustment block from bracket (D) and move the accelerator cable aside.

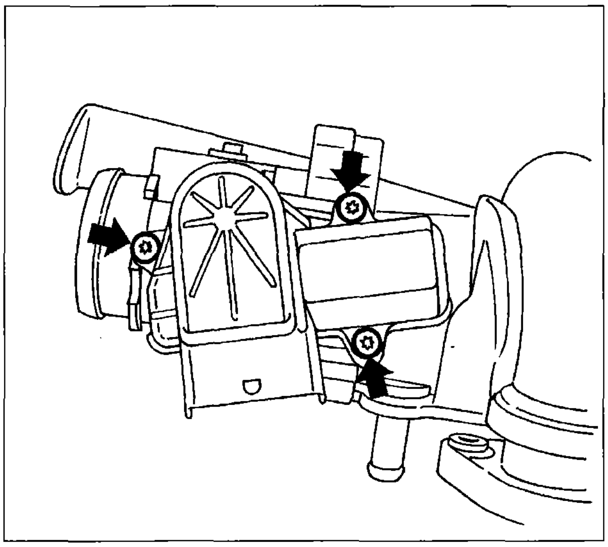
Reverse removal instructions to refit.




4F049PJ02

## ENGINE IDLE ADJUSTMENT ACTUATOR/THROTTLE POSITION SENSOR

**NOTE** *The engine idle adjustment actuator/throttle position sensor should be disconnected from the throttle body only in case of replacement_because removing/refitting causes damage to certain components (e.g. internal sealing rings) and correct component operation cannot be guaranteed once the component is refitted.*



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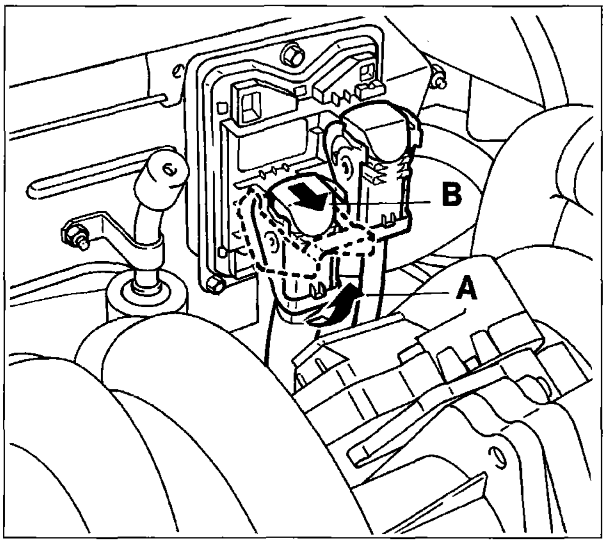
### Removing-refitting

To remove the actuator, disconnect the connector and unscrew the retaining bolts (arrowed).

**NOTE** *It is compulsory to zero and self-learn engine idle adjustment actuator (M.D.S) data as described in the "THROTTLE BODY" paragraph.*

# 10.



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## ENGINE CONTROL UNIT

### Removing - refitting

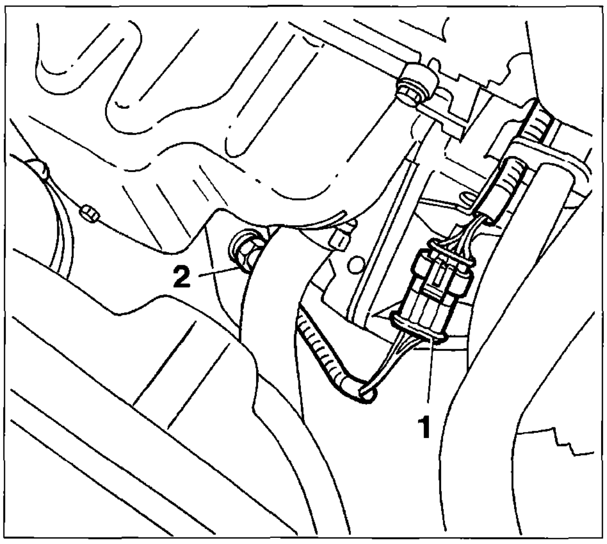
Remove the control unit as follows:

- disconnect both connectors in two stages:
  A) turn the metal hook up to release the connection;
  B) pull away the connection;
- unscrew the control unit retaining bolts and remove.

Proceed as follows to refit the connector:

- move the connector into contact with the control unit;
- turn the metal hook until completely closed.

**NOTE** *If the engine control unit is replaced, connect a tester (EXAMINER) to the tester connection and and run the self-learning procedure for engine idle adjustment actuator (M.D.S) data as described in the "THROTTLE BODY" paragraph.*



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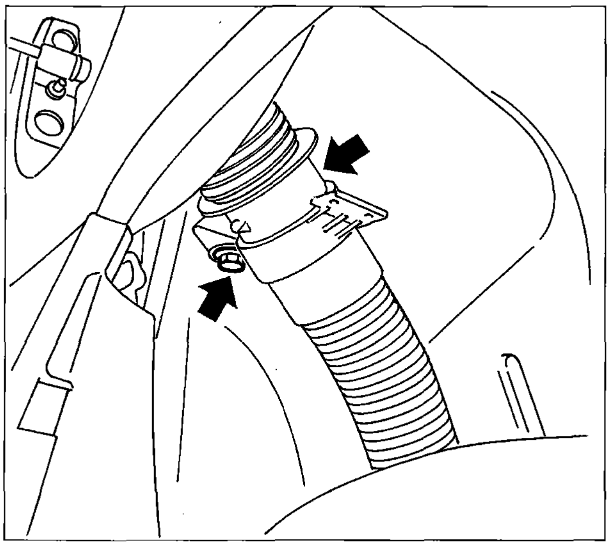
## LAMBDA SENSOR

### Removing - refitting

Disconnect electrical connection (1) and remove sensor (2) from its seat on the exhaust manifold.
When refitting, spread the threading with lubricant grease resistant to high temperature.


4A054PJ01

## Engine RPM and TDC sensor

### Removing-refitting

Disconnect the electrical connection.
Unscrew the retaining bolt and remove the sensor.

### Check the gap

Check the distance between sensor and phonic wheel teeth (gap).

**Gap: 0.5 - 1.5 mm**

**NOTE** *Whenever the sensor mount is serviced (e.g. gap not as specified, sensor not aligned etc.), the sensor must be correctly positioned and aligned with its mount as described in the engine service manual.*

## BOSCH MOTRONIC ME 3.1 M.P.I. INTEGRATED INJECTION/IGNITION SYSTEM

### Introduction

The Bosch Motronic system fitted on the 1998 5 cylinder 20 valve engine belongs to the category of static advance, inductive discharge, digital electronic ignition systems integrated with sequential, phased type electronic fuel injection systems.
This system has only one electronic control unit, a single set of wiring and one set of joint sensors.
Its function is to inject the exact amount of petrol, into the engine inlet manifold, upstream of the inlet valves, designed to mix with the air introduced into the cylinder so that the correct mixture strength is formed.
The Motronic ME 3.1 guarantees efficient operation, ensuring optimum performance and fuel economy and a reduction in harmful emissions through a response in real time to the different engine operating conditions.

### General description of the injection system

There are basically two conditions which must always be satisfied in the preparation of the air/fuel mixture for the smooth running of the engine:

1. the metering (air/fuel ratio) should be kept as constant and as close as possible to the stoichiometric value, to ensure that combustion takes place quickly avoiding unnecessary fuel consumption;
2. the mixture should be composed of petrol vapours dispersed in the air as finely and uniformly as possible.

As far as the optimum metering, on the other hand, is concerned, it is calculated by the control unit after the following measurements have been taken:

- the exact quantity of intake air by the air flow meter;
- the engine rotation speed by the rpm sensor;
- the power request by the accelerator pedal potentiometer;
- the engine coolant temperature by the sensor on the thermostat support;
- the measurement of the oxygen content of the exhaust gases by the Lambda sensor.

This information is processed by a micro-calculator in the injection/ignition electronic control unit which determines the basic injection time through experimentally obtained values which are stored in a special memory in the above mentioned control unit.

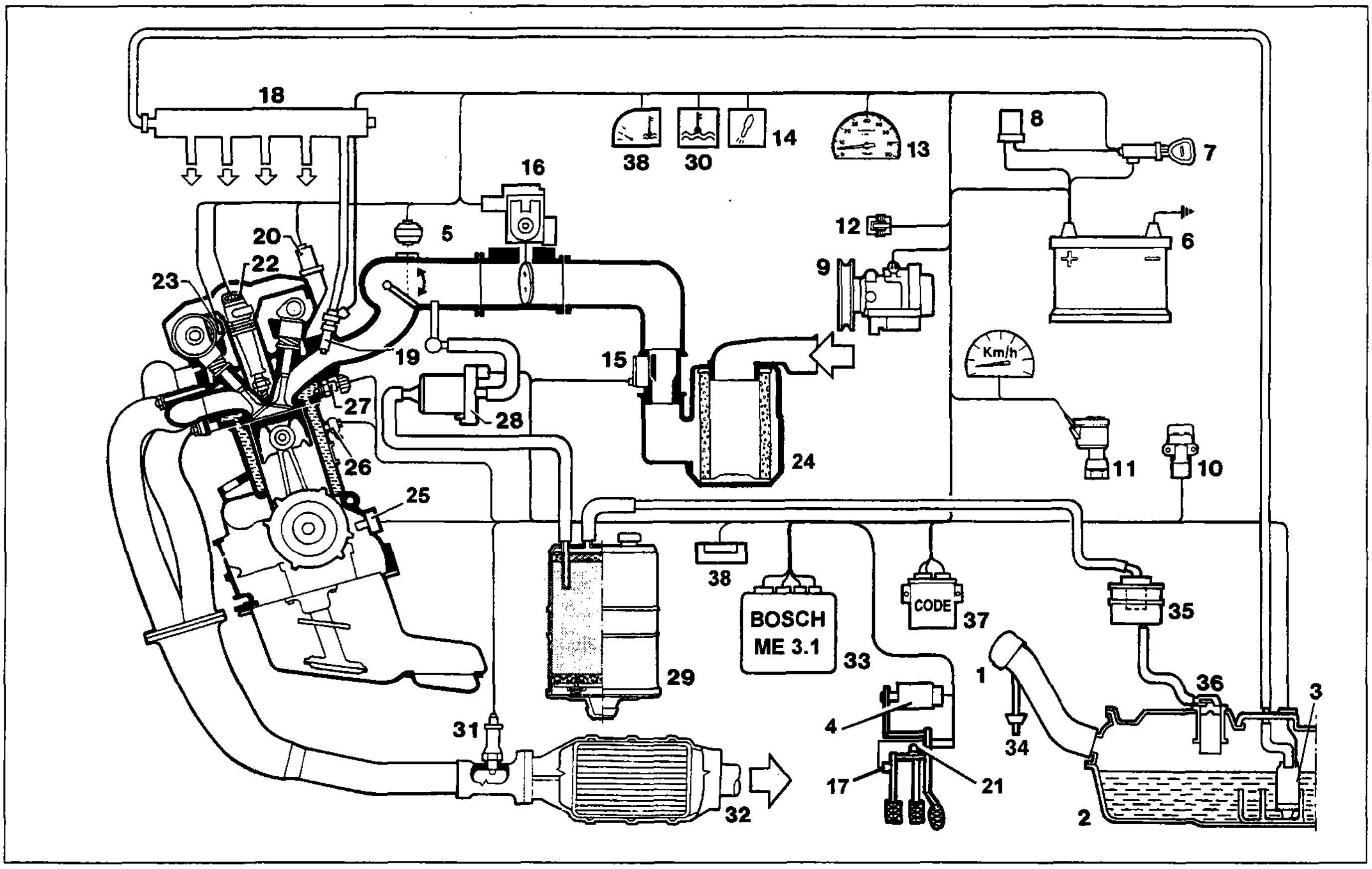
### General description of the ignition system

The ignition system is the static advance, inductive discharge type (i.e. without a high tension distributor) with the power modules insde the electronic control unit.
The system has a single coil for each spark plug; the advantages of this solution are;

- less electrical overloading
- gurantee of constant discharge at each spark plug

The electronic control unit contains a memory where the entire series of optimum advance values which the engine can use for its operating range on the basis of the engine speed and load conditions are stored.
In the case of detonation, it is possible to selectively delay the ignition in the individual cylinder, recognized by the combination of values trasmissted by the detonation and timing sensors.

## INJECTION/IGNITION SYSTEM FUNCTIONAL DIAGRAM




P4A02LJ01

1. Fuel tank filler cap
2. Fuel tank
3. Electric fuel pump with filter and pressure regulator
4. Accelerator pedal potentiometer
5. Variable geometry manifold solenoid valve
6. Battery
7. Ignition switch
8. System relay feed
9. Climate control compressor
10. Inertia switch
11. Vehicle speed sensor
12. Diagnostic socket
13. Rev counter
14. System failure warning light
15. Air flow meter
16. Butterfly casing electronic actuator
17. Clutch pedal switch
18. Fuel manifold
19. Injectors
20. Phase transformer solenoid valve
21. Brake pedal switch
22. Ignition coils
23. Engine timing sensor
24. Air filter
25. Engine rpm sensor
26. Detonation sensors
27. Coolant temperature sensor
28. Fuel vapour solenoid valve
29. Charcoal filter
30. Coolant overheating warning light
31. Lambda sensor
32. Catalytic silencer
33. Injection/ignition control unit
34. Safety valve
35. Fuel vapour separator
36. Multi-purpose valve
37. Fiat CODE control unit
38. Coolant temperature gauge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These values have been obtained experimentally, by means of a long series of practical tests carried out on prototypes at the engine test bench, to identify the advances which give the best compromise between the conflicting requirements of maximum power and a reduction in fuel consumption and harmful exhaust emissions.
These optimum advances have then been memorized in the system control unit. During the operation of the engine, the control unit is constantly informed of the (engine) speed and load conditions and on this basis it "selects" the optimum advance from its memory to strike the spark at the spark plug for the cylinder in the explosion stroke with the optimum advance.

In addition, the control unit corrects this value, depending on other factors such as the engine coolant temperature, intake air temperature, detonation and butterfly valve position, so that the ignition point is always optimum.

The information required by the control unit to operate the single coils is transmitted by means of electrical signals sent by the following sensors:

a. **An rpm sensor** which produces a single phase alternating signal whose frequency indicates the engine speed.

b. **An air flow meter** with a temperature sensor which, on the basis of the quantity/temperature of the air drawn in by the engine, transforms these figures into electrical signals, sending them to the electronic control unit.

c. **Two detonation sensors** which, located in the upper part of the cylinder block/crankcase, one between cylinders 1 and 2 and the other between cylinders 4 and 5, respectively, allow the control unit to recognize the cylinder where detonation (or the onset of detonation) is taking place and only correct the ignition advance for the spark plug of the cylinder concerned.

d. **An accelerator pedal potentiometer** which transforms the angular value of the actual pedal into an electrical signal allowing the control unit to recognize minimum, partial and full load conditions.

### Functions of the injection/ignition system

In addition to electronically controlling the moment of ignitionand the air flow rate during idling, in order to allow the engine to run smoothly when the ambient parameters and loads applied vary, the control unit should control and manage the injection in such a way that the stoichiometric (air/fuel) ratio is always within the optimum value.
The electronic control unit establishes the operating «time» for the injectors using a relatively simple rule which can be summarized as follows.
Taking the physical properties of the fuel (viscosity and density) and the difference in pressure between the pressure of the fuel and the pressure in the inlet manifolds as constant, the quantity of fuel to be injected only depends on the injector «opening time».

The injection/ignition system basically carries out the following functions:

- adjustment of injection time;
- adjustment of ignition advance;
- check on cold starting;
- check on the enrichment during acceleration;
- fuel cut-off during deceleration;
- check on engine idle speed;
- restriction of the maximum engine speed;
- control of combustion through the Lambda sensor;
- fuel vapour recovery;
- control of the detonation;
- control of the phase transformer;
- check on the inlet manifold
- self-adjustment of the system;
- autodiagnosis;
- connection with the engine immobilizer device (Fiat CODE);
- management of the climate control system;
- management of the radiator fans.

## SYSTEM MANAGEMENT STRATEGIES

### Adjustment of the injection time

Digital technology has made it possible to achieve optimum fuel economy and performance using programmed maps, stored inside the electronic control unit memory, dependent of the engine speed and load.
The control unit controls the injectors with great speed and precision, calculating the opening time on the basis of the engine load (speed and air flow rate), also taking into account the battery voltage and the temperature of the engine coolant.
The injection is sequential and phased for each cylinder (the moment of injection is not simultaneous for all the cylinders) and takes place at the optimum injection point.

### Adjustment of ignition advance

Thanks to a map stored in its memory, the control unit is capable of calculating the advance according to the engine load conditions (minimum, partial, full according to the engine speed and air flow rate), the temperature of the intake air and the temperature of the engine coolant.
It is possible to selectively delay the ignition at the cylinders required, recognized by means of the combination of values recorded by the detonation and cam angle sensors.

### Check on the cold starting

Under these circumstances there is a natural weakening of the mixture as a result of the poor turbulence of the particles of fuel at low temperatures, the reduced evaporation and the condensation on the internal walls of the inlet manifold, all of which is exacerbated by the increased viscosity of the lubricant oil.
The electronic control unit recognizes this condition and corrects the injection time on the basis of the signal for the temperature of the coolant, the temperature of the intake air, the battery voltage and the engine speed.
The ignition advance depends exclusively on the engine speed and the temperature of the engine coolant.
During cold starting the control unit controls an initial simultaneous (full-group) injection for all the injectors and after recognition of the reference on the flywheel, it switches to the normal, sequential, phased operation. Starting when warm takes place straightaway in a phased sequential manner.

### Check on the enrichment of the mixture during acceleration

The control unit detects the acceleration request from the signal supplied by the accelerator pedal potentiometer and, as a result, increases the injection times and modifies the opening of the butterfly valve to reach the desired engine speed quickly.
If in response to an acceleration request, the variation in the signal supplied by the air flow meter exceeds a pre-set increase, the control unit not only adapts the injection to the new requirements, but also further increases it for several seconds to improve the responsiveness.

### Fuel cut-off during deceleration

When the accelerator pedal is released and beyond a pre-set engine speed threshold, the injection control unit cuts off the supply to the injectors.
With no supply, the engine speed starts to decrease at a rate which depends on the vehicle driving conditions.
Before reaching the idle speed, the dynamics of the engine speed dcrease are verified.
If they are above a certain value, the fuel supply is partly reactivated on the basis of a logic which involves the "gentle accompaniment" of the engine during idling.


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Having reached this condition, the normal functions for idling and cut-off during deceleration are only reactivated when the fuel cut-off threshold is exceeded to prevent the engine from not running smoothly. The levels for restoring the supply and the cut-off vary according to the engine temperature.
There is another fuel cut-off logic in the control unit which intervenes in partial deceleration conditions, in other words when the engine load is lower.
The function is only activated if the new condition persists for a pre-set time and after the ignition advance angle has been adjusted for the new situation.

**Check on the engine idle speed**

The control unit recognizes the "idle" condition (accelerator pedal released) from the signal supplied by the accelerator pedal potentiometer and according to the signals from the brake and clutch pedal switches and the electrical consumers being switched on (climate control and radiator fan)and operates the butterfly valve motor to produce an idle speed of 700±50 rpm.
The idle is also corrected by varying the ignition angle because it has a quicker effect.
The correct self-learning of the minimum and maximum butterfly opening positions is therefore essential for the effective control of the idle speed; it should be carried out at least once in production and each time the engine control unit or the motorized butterfly casing are replaced.
The self-adjustment function allows the adjustment of the idle, in time, to any variations in the conditions of the components which manage the idle.

**Restriction of the maximum engine speed (protection outside of revs)**

When the engine speed exceeds 6,800 rpm, the electronic control unit reduces the operating times of the injectors to prevent the engine from being overloaded, also protecting it outside of revs.
If the engine idle speed exceeds 7,000 rpm, the control unit activates the fuel cut-off function, restoring the operation of the injectors when the speed goes below a certain level.

**Check on combustion using the Lambda sensor**

The Lambda sensor informs the control unit of the quantity of oxygen present in the exhaust and therefore the correct metering of the air/fuel mixture by means of a voltage signal at two levels corresponding to a lean mixture and a rich mixture, respectively.

To obtain an ideal mixture for the operation of the three-way catalyzer and keep emissions to a minimum, the petrol injected must be kept to a pre-established (stoichimetric) ratio in relation to the intake air, measured from the unit value of the Lambda parameter (=1); in the case of a lean mixture it is >1, in the case of a richmixture it is <1.

The Lambda sensor, in contact with the exhaust gases, produces an electrical signal whose voltage depends on the concentration of oxygen present in the actual gases:
- if the mixture is lean(>1), the sensor provides a low voltage level(<200 mV) and the control unit slightly increases the quantity of petrol injected;
- if the mixture is rich (<1), the sensor provides a high voltage level (>800 mV) and the control unit reduces the quantity of petrol injected.

The closed-loop management of the Lambda sensor allows the control unit to keep the Lambda value very close to the theoretical unitary value, also aided by suitable self-adjustment functions.
The control unit also manages the supply of the Lambda sensor heater. In effect, on the basis of the engine speed and load conditions, the control unit processes a forecast for the temperature of the exhaust gases and consequently controls the heater supply current, restricting it to the actual needs depending on the engine conditions.

### Fuel vapour recovery

The fuel vapours (pollutant according to regulations) are sent to an active charcoal filter and from these to the engine where they are burnt; this takes place by means of a solenoid valve which is only operated by the control unit when the engine load condition is such as to allow correct combustion without the operation of the engine being "disturbed": in effect, the control unit compensates for this quantity of incoming petrol by reducing the supply to the injectors.

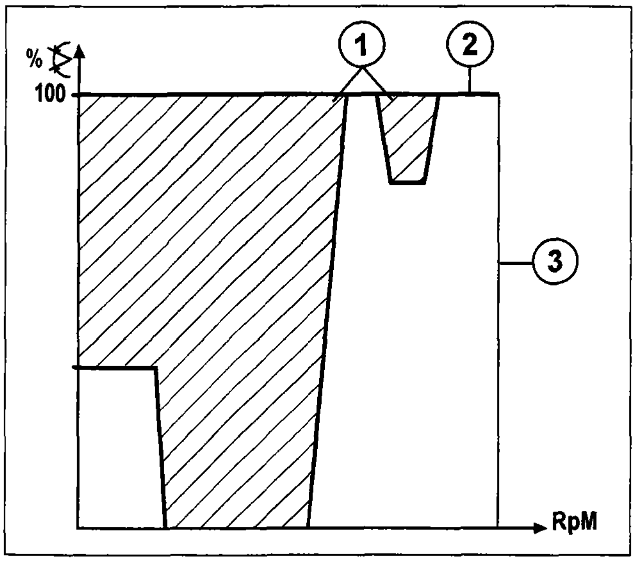
### Control of the detonation

This function is designed to detect the presence of the phenomenon of detonation (engine knock), by processing the signal coming from the appropriate sensors. The control unit continuously compares the signals coming from the sensors with a threshold value which is, in turn, constantly updated to take into account background noise and the ageing of the engine.

The control unit is therefore capable of detecting the presence of detonation (or the onset of detonation) and reduces the ignition advance (by 3° up to a maximum of about 9°), until the phenomenon disappears. Later on, the advance is gradually restored to the basic value.

In acceleration conditions, a higher threshold is used, to take into account the increased engine noise under these circumstances. The detonation control strategy is also equipped with a self-adjustment function which memorizes the reductions in the advance which are continuously repeated to adpat the map to the different conditions in which the engine finds itself.

### Control of the phase transformer




P4A06LJ01

1. Transformer in ON position
2. Accelerator pedal fully depressed
3. Maximum speed limit

The control unit controls the solenoid valve for the phase transformer hydraulic actuator (fitted on the camshaft, inlet side) by means of a relay.

The transformer has two operating positions:

A. OFF position (power, reduced engine loads and idling), corresponding to the normal camshaft value;

B. ON position (torque), corresponding to an 18° crankshaft advance for the camshaft.

The transformer, normally in the OFF position, is switchedto the ON position according to the engine load and rotation speed, as illustrated in the diagram.

In any case, the ON position is only enabled for coolant temperatures above 40°C.

Obviously the control of the phase transformer operates with a hysteresis field, in other words the level at which the solenoid valve is activated is always higher than the level at which is it deactivated; this is designed to avoid balance conditions and too rapid a succession from one timing diagram to another with obvious operating problems.

### Check on the inlet manifold

The control unit controls the geometry of the inlet manifolds to optimize the quantity of air drawn in by the engine.

The control unit selects short ducts for speeds above 4500 RPM and high engine loads.

In other engine operating conditions, the control unit selects a configuration with long ducts.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### Self-adjustment of the system

The control unit is equipped with a self-adjustment function which is designed to recognize the changes which take place in the engine due to the bedding in processes over a period of time and the ageing of both the components and the engine itself.

These changes are memorized in the form of modifications to the basic map and are designed to adapt the operation of the system to the gradual alterations to the engine and components compared with when new.

This adjustment function also makes it possible to compensate for inevitable differences (due to production tolerances) in any components which are replaced. This means that all vehicles can have the best results without special adjustment and control operations.

### Autodiagnosis

The ME 3.1 injection/ignition system is also equipped with an "**autodiagnostic**" function which memorizes any faults in the sensors and actuators, making it easier to identify and correct them. A fault is signalled by the warning light in the instrument panel coming on.

### Connection with the engine immobilizer device (Fiat CODE)

To increase protection against theft attempts, the vehicle has been equipped with an engine immobilizer system (Fiat CODE) which only allows the injection/ignition control unit to be activated by an electronic code.

Each time the key is turned to the OFF position, the FIAT CODE system completely deactivates the injection/ignition control unit.

If the ignition key is turned from OFF to ON, the following operations take place in order:

1. The injection/ignition control unit sends the Fiat CODE control unit a request for a secret code in order to deactivate the immobilizer function.
2. The Fiat CODE control unit responds by only sending the secret code after having, in turn, received the recognition code transmitted by the ignition key, which contains a special transponder.
3. The recognition of the secret code allows the de-activation of the immobilizer function and the injection/ignition control unit can activate the normal system management programme.

A special two-way serial line allows the exchange of data between the injection/ignition control unit and the Fiat CODE control unit.

If there is a fault with the Fiat CODE system, the enginecan be started up using the emergency procedure.

⚠ *Given the presence of the Fiat CODE system* **DO NOT** *carry out tests using another injection/ignition control unit during the fault diagnosis and/or operating checks. In such a case, the Fiat CODE control unit would transfer the (unrecognized) recognition code to the test control unit which could then no longer be used on other vehicles.*

**Management of the climate control system**

The injection/ignition control unit is operationally connected to the climate control system, in that:

1. it receives a request to switch on the compressor from the climate control control unit via pin F6 and carries out the relevant operations (additional air);
2. it gives the go ahead to switch on the compressor via pin F13, when the conditions planned by the strategies are verified;
3. it receives information concerning the state of the four stage pressure switch from pins F9 and F41 and operates the appropriate interventions (operation of the radiator fan).

As far as point 1 is concerned,, if the engine is idling, the control unit increases the flow rate of the air passing through the motorized butterfly casing before the compressor is switched on and conversely it returns the actuator to the normal position after the compressor is switched off.

On the other hand, as far as point 2 is concerned, the control unit switches off the compressor automatically:

- for several seconds (timed disengagement):
  - when the engine power request conditions are high (strong acceleration);
  - during engine take-off;
- as long as the following critical conditions persist:
  - at engine coolant temperatures above a certain value;
  - at engine speeds above or below a certain threshold.

**Management of the radiator fan**

The control unit directly controls the operation of the radiator fan according to the temperature of the engine coolant and the engagement of the climate control system.
The fan is switchedon when the temperature exceeds 98°C (1st speed) and 101°C (2nd speed). It is switched off with a hysteresis of 2°C below the temperature threshold.

**AIR INTAKE CIRCUIT**

The 1998 5 cylinder 20 valve engine is fitted with a special system of air inlet ducts. The manifold consists of two half shells and an internal rocker element (module) which, operated by a special pneumatic actuator, can assume two positions and alter the length of the inlet ducts (variable geometry).

In this way it is possible to produce give long (torque) ducts or five short (power) ducts.

The two different length ducts operate alternately allowing maximum thermal efficiency at different speeds.

By selecting the appropriate length for the inlet duct it is possible to ensure that the fluctuations in the column of gas entering, due to the inlet, are timed with the movement of the valve, to increase the effect of the inertia of the gaseous mass in the cylinder.

It is therefore possible to achieve better thermal efficiency than normal.

The device obviously operates with a hysteresis field, in other words, the changes from a "power" duct and viceversa, do not always take place at the same engine speed

This is to avoid the possible creation of balance conditions and too rapid a succession from one length to another with obvious operating problems.


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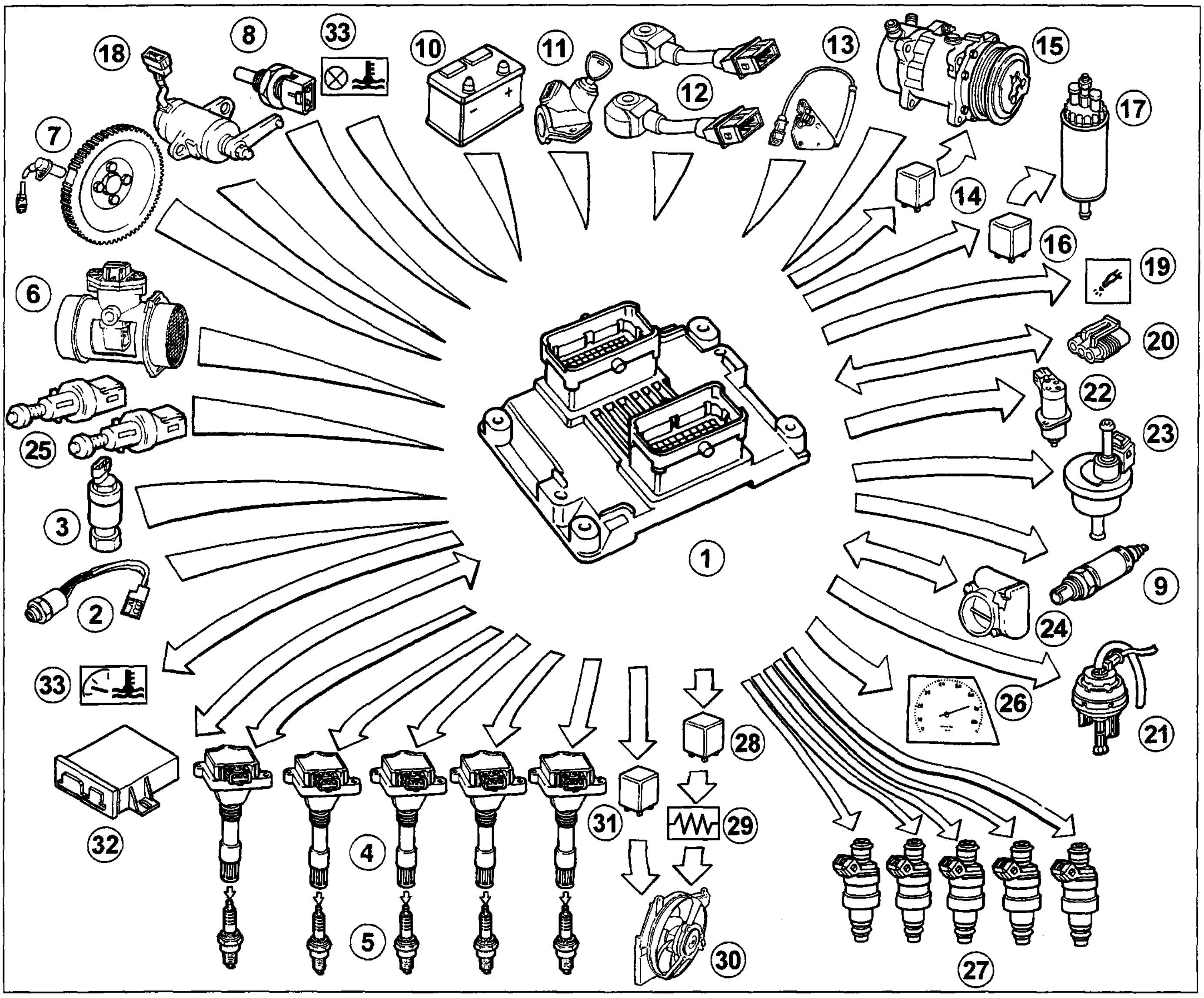
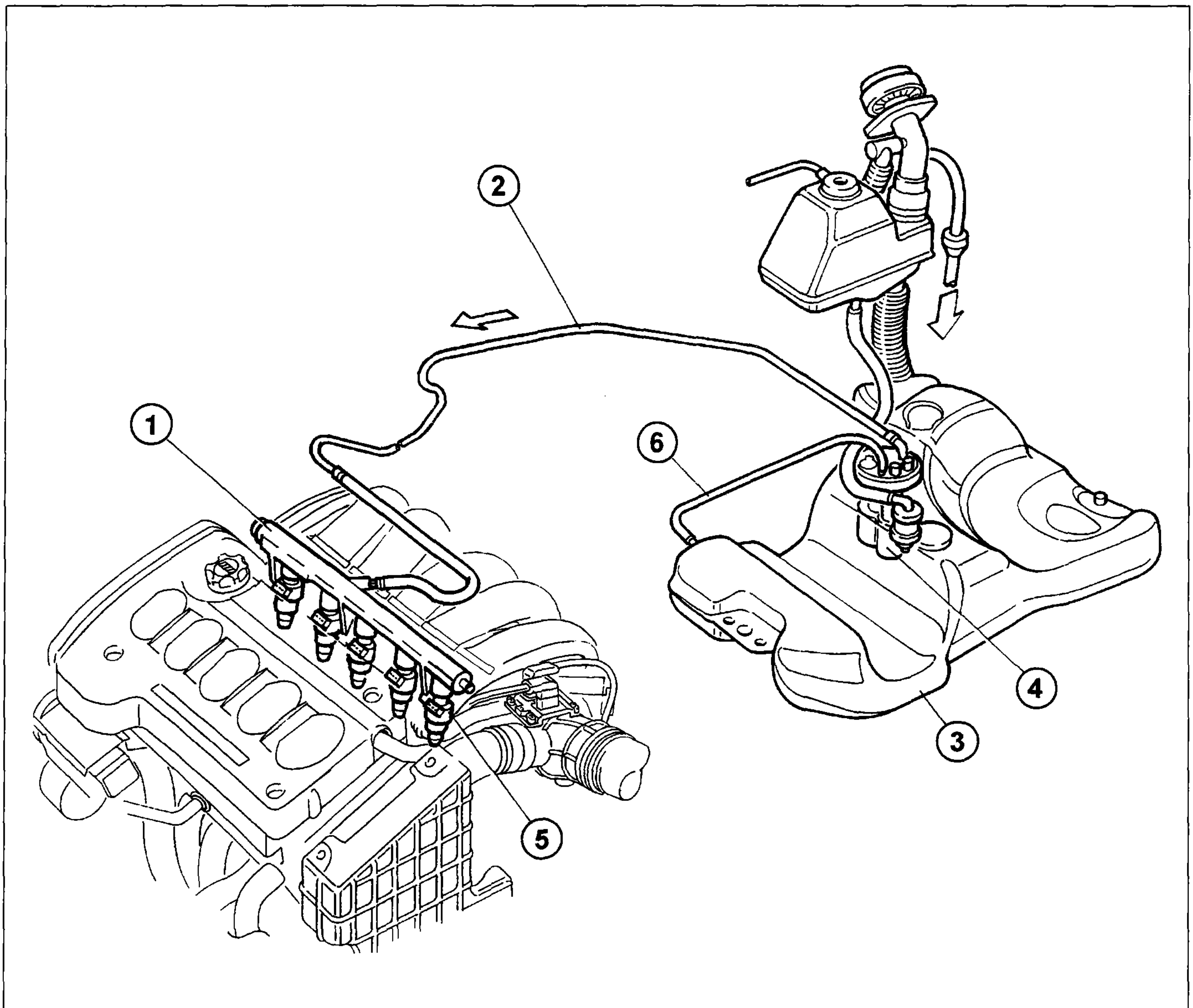
## DIAGRAM SHOWING INFORMATION ENTERING/LEAVING THE INJECTION/IGNITION SYSTEM CONTROL UNIT AND SENSORS/ACTUATORS




1. Electronic control unit
2. Four stage pressure switch
3. Speedometer sensor
4. Coils
5. Spark plugs
6. Flow meter
7. Rpm sensor
8. Coolant temperature sensor
9. Lambda sensor
10. Battery
11. Ignition switch
12. Detonation sensors
13. Timing sensor
14. Air conditioning compressor relay
15. Climate control system
16. Electric fuel pump relay
17. Electric fuel pump
18. Accelerator pedal potentiometer
19. System failure warning light
20. Diagnostic socket
21. Variable geometry inlet manifold solenoid valve
22. Phase transformer solenoid valve
23. Fuel vapour solenoid valve
24. Butterfly casing actuator
25. Brake and clutch pedal switch
26. Rev counter signal
27. Injectors
28. Radiator fan 1st speed relay
29. Radiator fan 1st speed resistance
30. Radiator fan
31. Radiator fan 2nd speed relay
32. Fiat CODE control unit
33. Water temperature gauge

# 10.

## DIAGRAM SHOWING FUEL SUPPLY CIRCUIT




P4A10LJ01

1. Fuel supply manifold
2. Fuel supply pipe to the injectors
3. Tank
4. Electric fuel pump with filter and pressure regulator
5. Injectors
6. Breather pipe

The fuel is supplied by an electric pump immersed in the tank which draws in the fuel and sends it to the filter and from there to the injectors.

The fuel supply system is the returnless type, in other words with one single connecting pipe between the fuel tank and the engine.

This system makes it possible to:

- keep the risk of the vehicle catching fire in the case of an accident to a minimum;
- reduce the emission of fuel vapours in the atmosphere.

The electric fuel pump is enclosed in a casing which also incorporates the fuel pressure regulator, the fuel gauge and the fuel filter.

The system is also fitted witn an inertia switch which interrupts the supply from the electric fuel pump in the case of an impact.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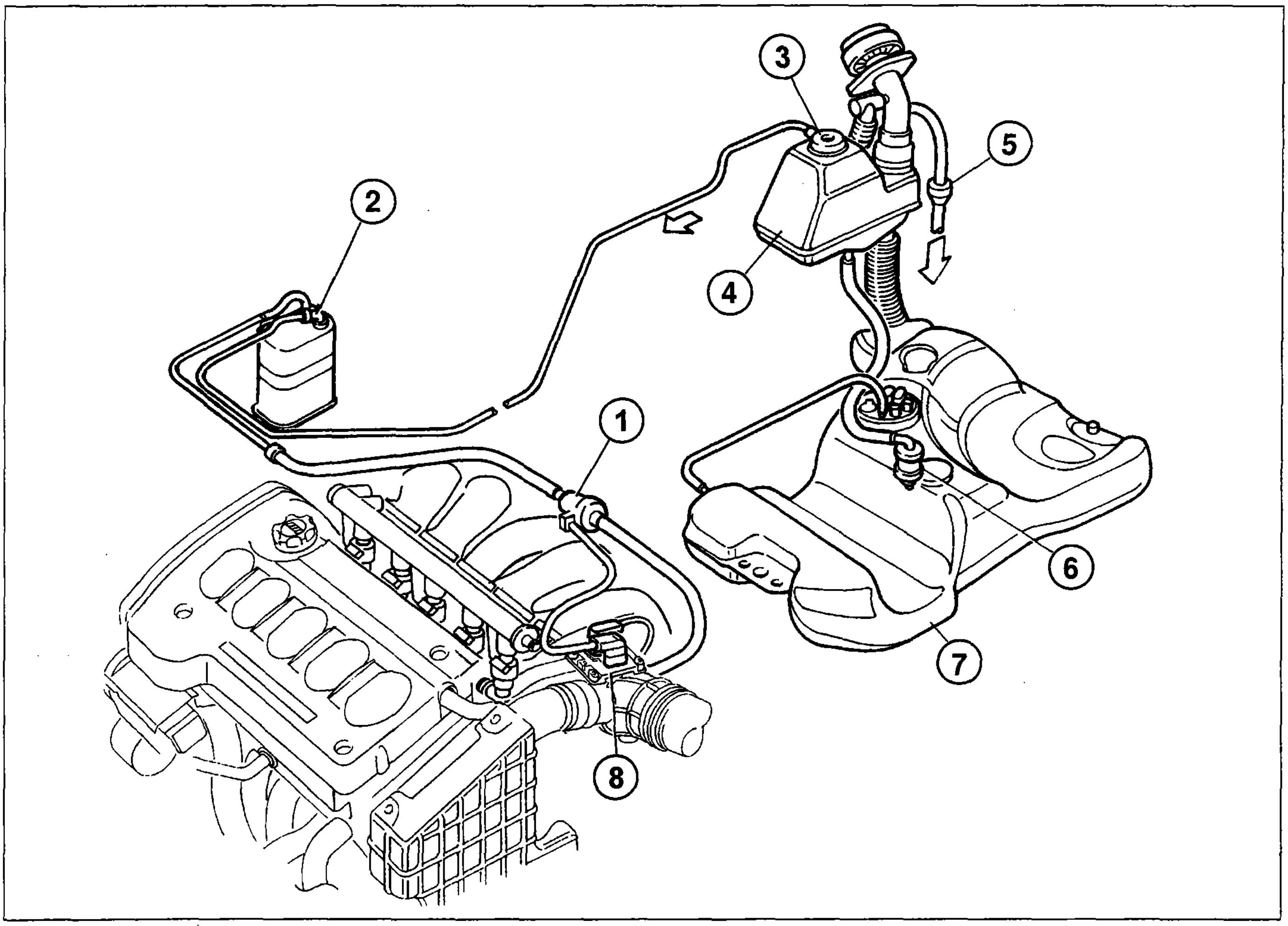
## DIAGRAM SHOWING FUEL ANTI-EVAPORATION CIRCUIT




P4A11LJ01

1. Fuel vapour cut out solenoid valve
2. Charcoal filter
3. Multi-purpose valve
4. Fuel vapour separator
5. Safety and ventilation valve
6. Float valve
7. Tank
8. Injection/ignition control unit

The anti-evaporation system is designed to prevent the fuel vapours, consisting of the lightest particles of hydrocarbons which form in the tank, from being discharged into the atmosphere.
The system works, above all, at high outside temperatures, when the temperature of the fuel increases and consequentlythe tendency towards evaporation increases; in this situation, there is an increase in the pressure inside the tank (7).
In particular, even when the tank (7) is full, when the vehicle is stationary, the float valves (6) remain open, as they are located higher than the breather pipe and therefore they allow the vapours to reach the separator (4), from where, when they condense, they mainly return to the tank (7).
In the case of spillage whilst driving or if the vehicle overturns, the float valves (6) close, preventing fuel from escaping.
When the pressure inside the tank reaches approximately 30-40 mbar, the multi-purpose valve (3) opens and the fuel vapours reach the charcoal filter (2). The valve (3) also allows an intake of air into the tank through the charcoal filter, for example after the level of the fuel decreases with the consequent vacuum created inside the tank.
With the engine running, the control unit (8) controls the fuel vapour cut out solenoid valve (1), which allows the intake of vapours by the engine and the consequent scavenging of the charcoal filter (2).
If, as a result of the malfunction of a component, the pressure inside the tank increases to dangerous levels, the safety valve (5), located near the cap, allows the pressure to be discharged outwards. If necessary, this valve can open in the other direction to ventilate the tank and prevent the vacuum reaching excessive levels.

# 10.

## SYSTEM FOR RECIRCULATING GASES COMING FROM THE ENGINE CRANKCASE (BLOW-BY)

This system controls the emissions, from the cylinder block/crankcase, of the breather gases made up of air/petrol mixtures and burnt gases which escape from the piston seals, in addition to lubricant oil vapours, recirculating them to the inlet.

The breather gases, directed by special partitions, rise by the engine oil filler, then pass throughthe coils (7),under the tappet cover, where they lose some of the oil they contain which goes to the camshafts, through the pipe (6), in the form of droplets.

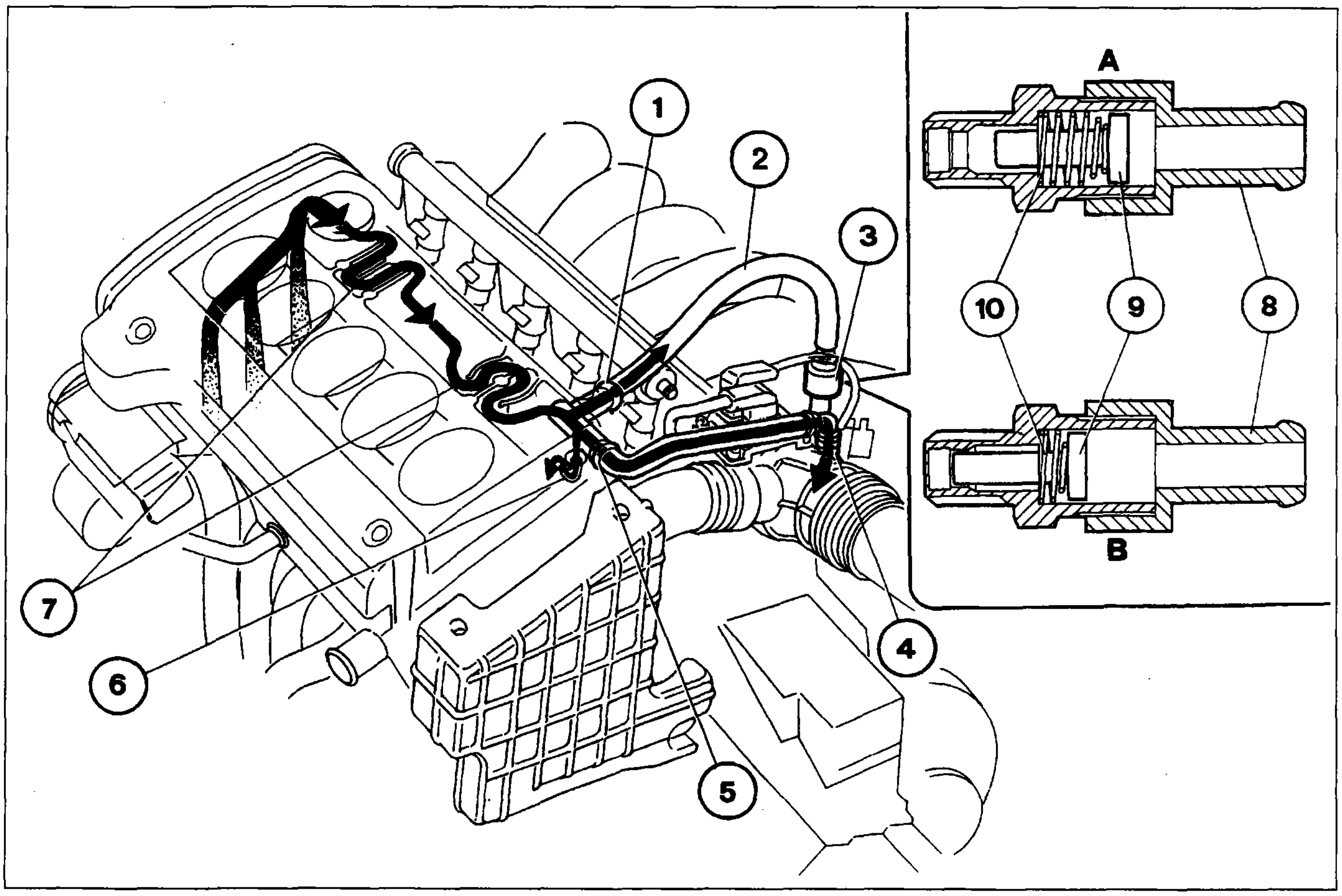
The pipe (6) is shaped like a siphon to prevent the escape of breather gases and only allow the recirculation of drops of oil.

With the butterfly open, the gases come out of the intake (5) and are sent, via the connector (4) on the air hose, upstream of the butterfly valve, to be drawn into the manifold.

With the butterfly closed, the vacuum in the inlet manifold draws in the gases through the intake (1) and they reach the connector (3) on the inlet manifold, via the pipe (2), which contains a PCV (Positive Crank Ventilation) relief valve (8) which shutters the inlet.

The PCV valve can, in effect, be modulated and the quantity of gases which pass through is proportional to the vacuum in the inlet manifold.

When the butterfly valve is completely open (condition A), the vacuum inside the inlet manifold is minimal, the spring (10) is fully extended and the PCV valve allows the maximum flow of breather gases. Conversely, with the butterfly completely closed (condition B), the vacuum inside the manifold is maximum, which causes the movement of the small piston (9) which shutters the section of the flow of breather gases inside the PCV valve thereby limiting the intake of the actual gases into the manifold.




P4A12LJ01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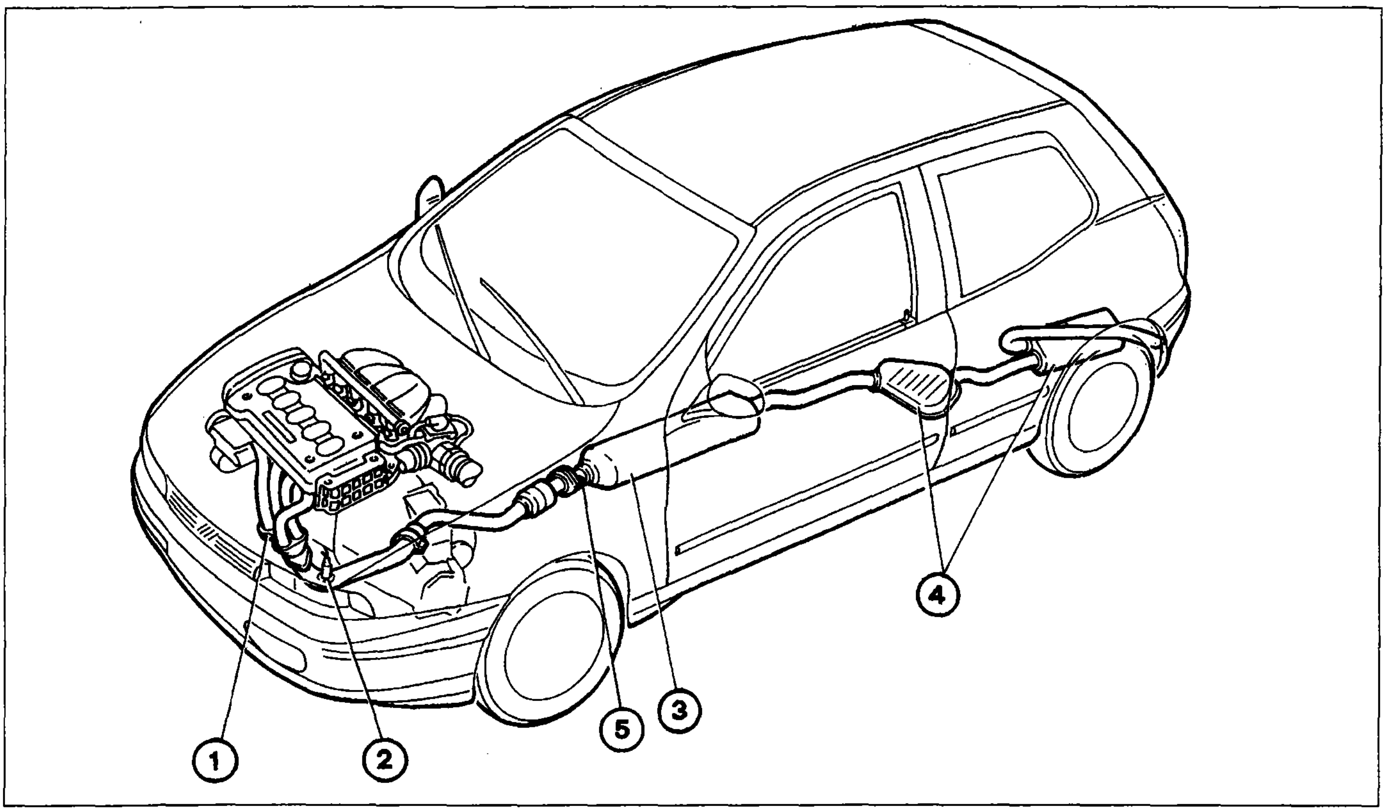
## ENGINE EXHAUST ASSEMBLY DIAGRAM




1. Exhaust manifold
2. Lambda sensor
3. Catalytic silencer
4. Silencers
5. Presa CO

The control of the mixture strength, which is the closed-loop type, is activated by the Lambda sensor which measures the oxygen content of the exhaust gases upstream of the catalytic silencer.

The Lambda sensor measurements allow the electronic control unit to continuously correct the quantity of petrol injected keeping the air/fuel ratio constant.

This ensures the control of the harmful exhaust emissions, a job completed by the three way catalytic converter (catalytic silencer).

The efficient operation of the catalytic silencer and consequently containing the toxicity of the exhaust gases depends on the air/fuel ratio which the engine receives.

The three-way catalytic converter makes it possible to simultaneously keep down the levels of the three pollutant gases present in the exhaust gases: unburnt hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NOx).

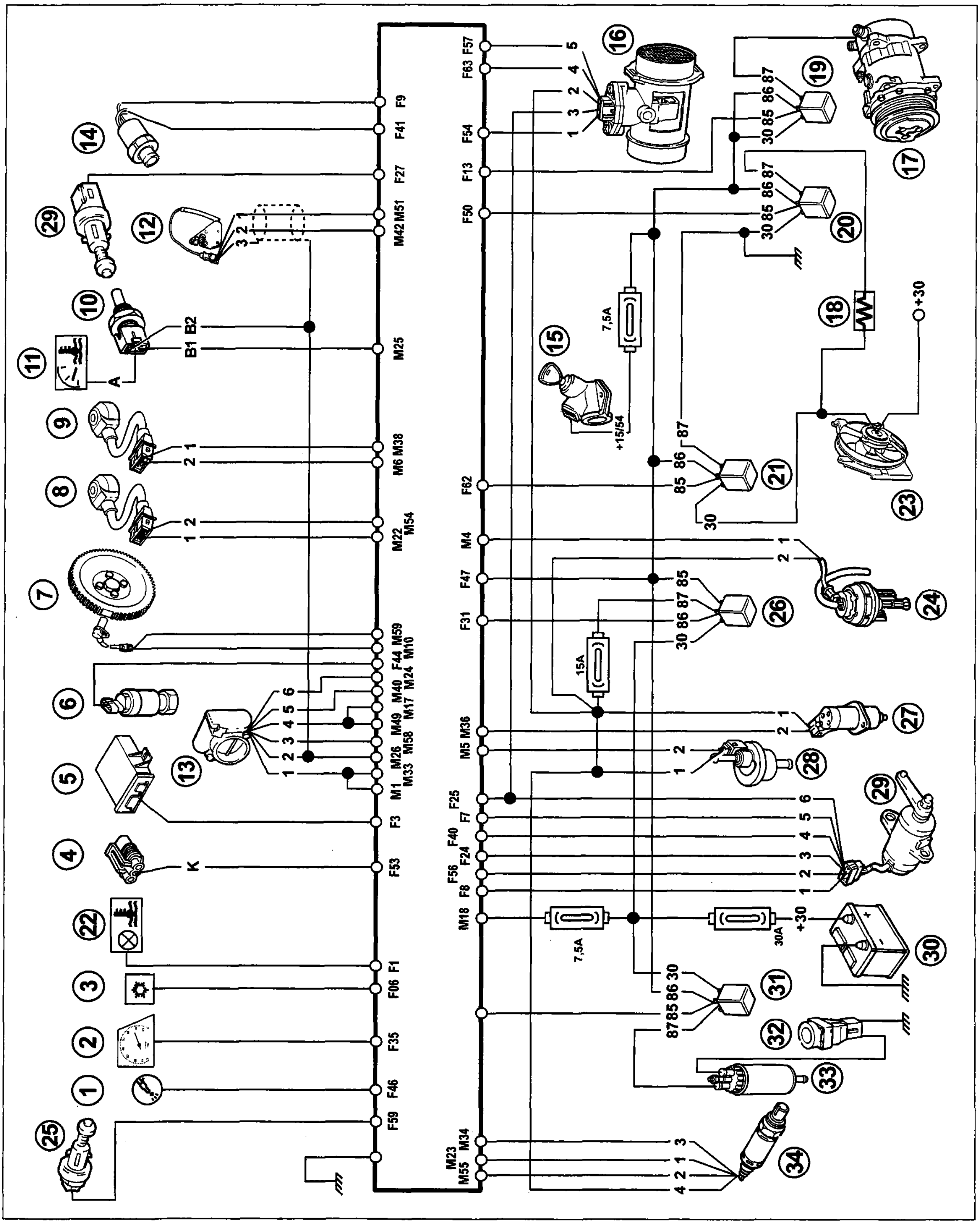
Two types of chemical reaction take place inside the converter:
- oxidation of the CO and the HC, converted into carbon dioxide ($CO_2$) and water ($H_2O$);
- reduction of the NOx, converted into Nitrogen ($N_2$).

The following would put the catalytic converter out of use and make it irreparable:
- the presence of lead in the petrol which lowers the degree of conversion to such levels that the presence of the catalytic converter in the system is useless;
- the presence of unburnt petrol in the converter: in effect, a flow of petrol for 30s in an ambient of 800 °C (temperature inside the silencer) is sufficient to cause the catalyzer to melt and break.

It is vital for the injection/ignitin system to be in perfect working order, therefore **the spark plug leads should never be disconnected with the engine running and, the catalytic converter should be replaced with an equivalent section of pipe in the case of tests.**

# 10.

## INJECTION/IGNITION SYSTEM WIRING DIAGRAM



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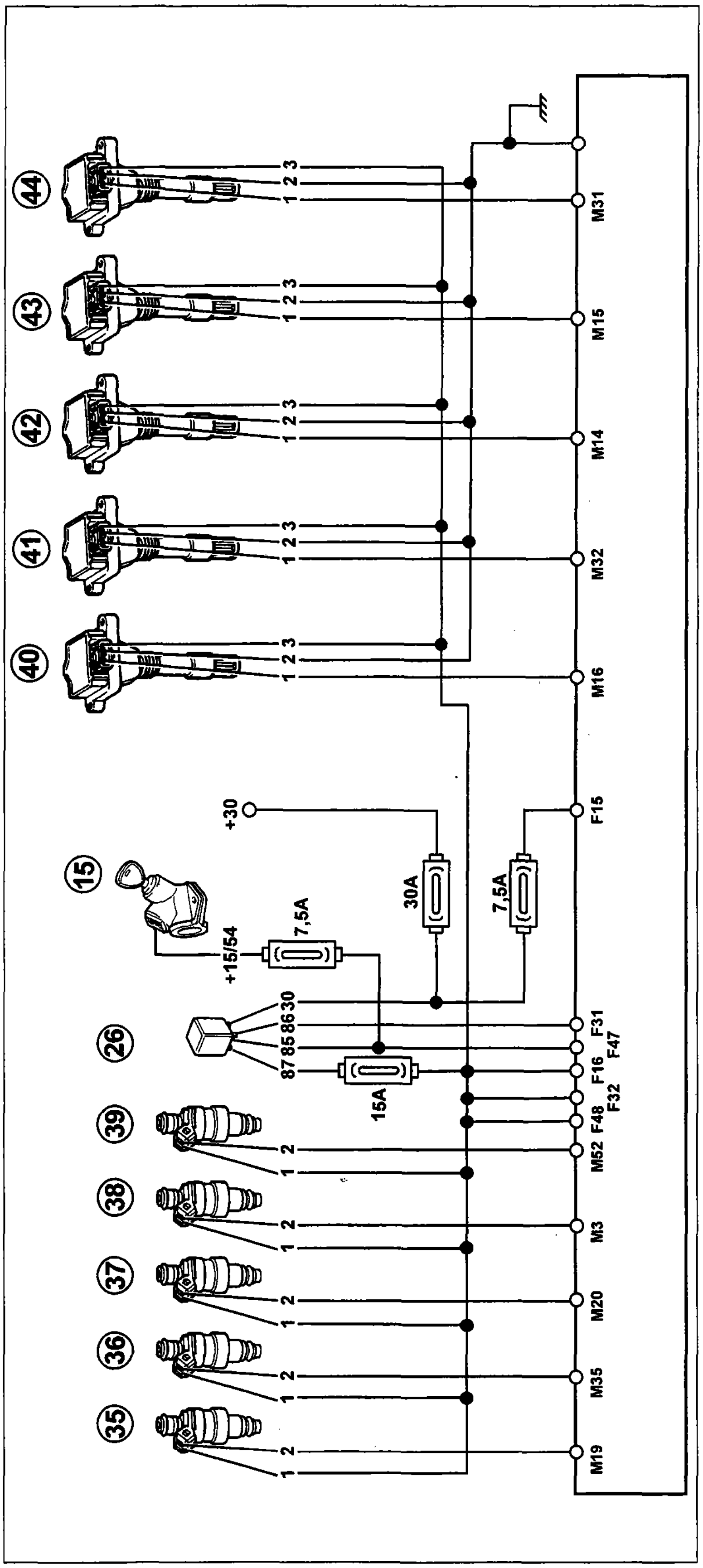
## Connection between control unit/ignition coils and injectors




P4A15LJ01

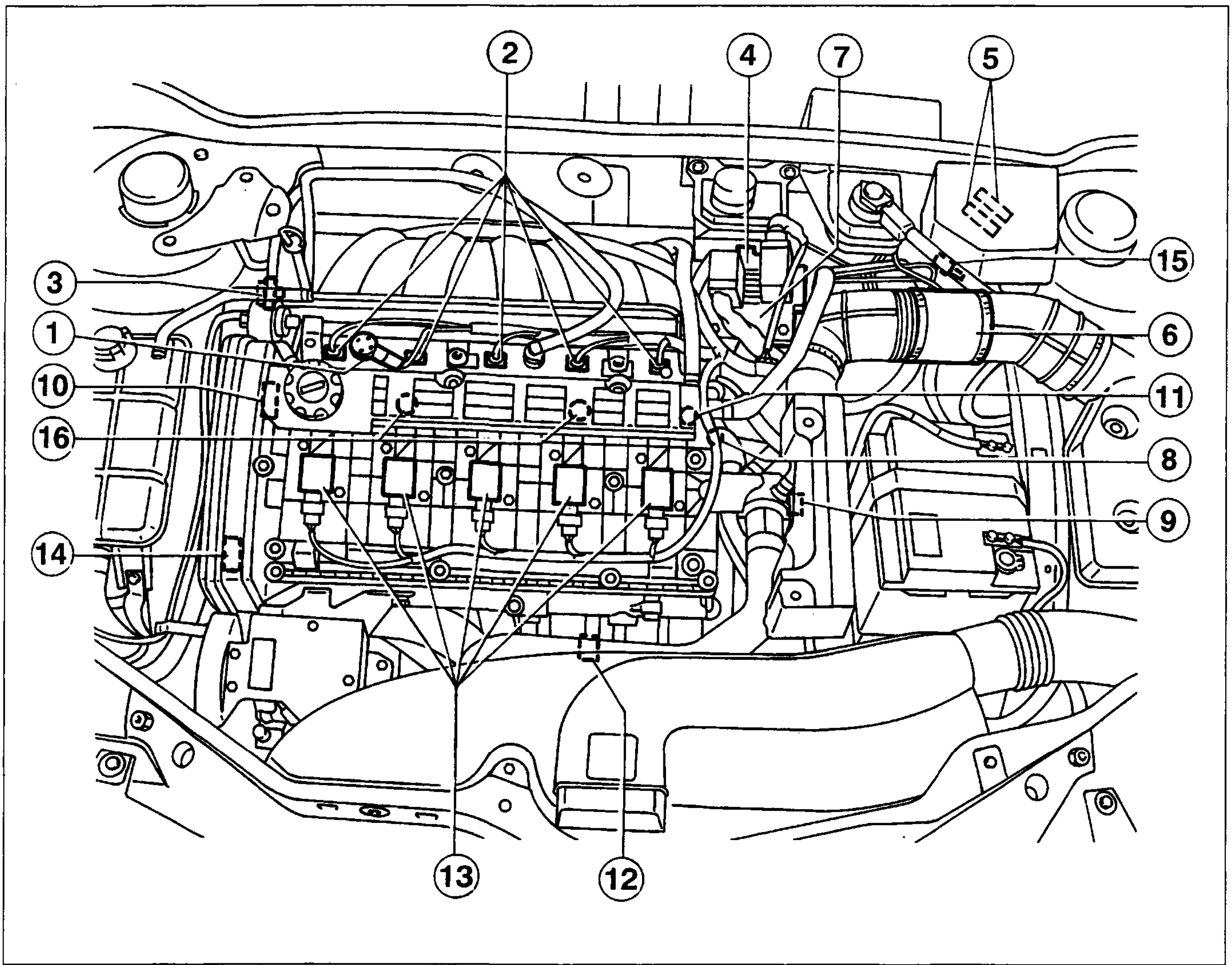
**Key:**

1. Injection/ignition system failure warning light
2. Rev counter signal
3. Engagement of climate control
4. Diagnostic socket
5. Fiat CODE control unit
6. Vehicle speed sensor
7. Rpm and TDC sensor
8. Detonation sensor 1
9. Detonation sensor 2
10. Coolant temperature sensor
11. Engine coolant temperature gauge
12. Timing sensor
13. Butterfly casing actuator
14. Four stage pressure switch
15. Ignition switch
16. Flow meter
17. Air conditioning compressor
18. Radiator fan 1st speed resistance
19. Air conditioning compressor electro-magnet coupling relay
20. Radiator fan 1st speed relay
21. Radiator fan 2nd speed relay
22. Coolant overheating warning light
23. Radiator fan
24. Variable geometry manifold fan
25. Clutch pedal switch
26. Injection/ignition system relay feed
27. Phase transformer solenoid valve
28. Fuel vapour solenoid valve
29. Brake pedal switch
30. Battery
31. Electric fuel pump and Lambda sensor relay
32. Inertia switch
33. Electric fuel pump
34. Lambda sensor

35-39. Injectors N°s 1 to 5
40-44. Ignition coils for cylinders N°s 1 to 5
45. Accelerator pedal potentiometer

# 10.

## LOCATION OF INJECTION/IGNITION SYSTEM COMPONENTS




**Key**

1. Phase transformer solenoid valve
2. Injectors
3. Fuel vapour cut out solenoid valve
4. Injection/ignition control unit
5. General system protective fuse
6. Flow meter/air temperature sensor
7. Motorized butterfly casing
8. Coolant temperature sensor
9. Vehicle speed sensor
10. Variable geometry manifold actuator solenoid valve
11. Rpm sensor
12. Lambda sensor
13. Ignition coils
14. Timing sensor
15. Diagnostic socket
16. Detonation sensors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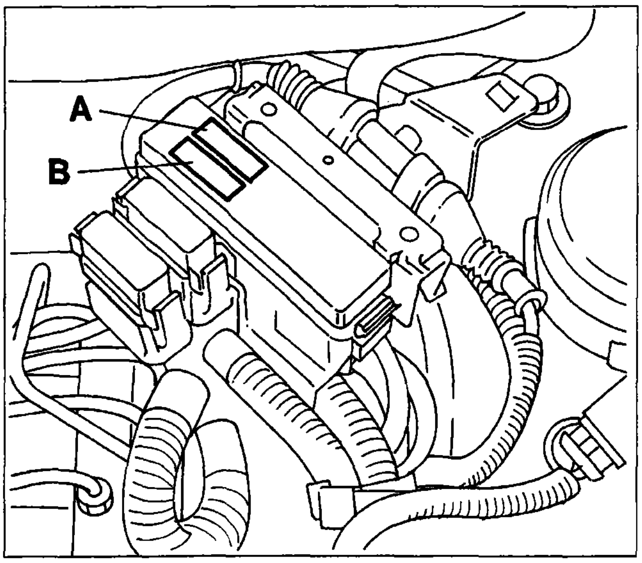


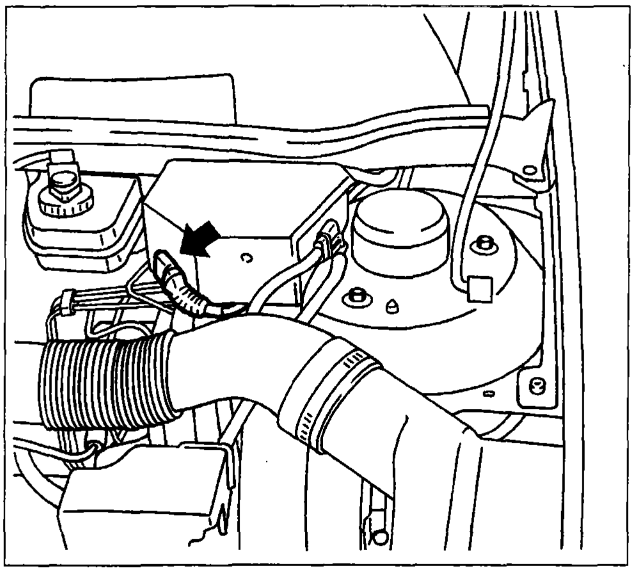

P4A22JJ01

## FUSES AND RELAYS

**NOTE** *For more information, see Group 55-Electrical equipment*

### Main fuses (maxi-fuse)

A. system fuse
B. fuse controlled by the ignition



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## DIAGNOSTIC SOCKET

The exchange of data between the injection/ignition control unit and the diagnostic equipment takes place via a two direction serial line (line K) using the standard Bosch communication protocol.

The transmission is in positive logic and the coding takes place via the NRZ method (Non Return Zero) at a baud rate of 4.8 kbaud (208 µs/bit ±5%)

### Location of diagnostic socket

The arrow in the diagram shows the location of the diagnostic socket.

## INJECTION/IGNITION SYSTEM COMPONENTS

The injection/ignition system basically consists of wiring, an electronic control unit (I.E. control unit) and the following sensors/actuators:

**Sensors**

- Speedometer sensor
- Rpm and T.D.C. sensor
- Detonation sensors
- Coolant temperature sensor
- Timing sensor
- Butterfly valve position sensor (integrated in the butterfly casing actuator)
- Intake air temperature sensor
- Intake air temperature and flow rate sensor (flow meter)
- Lambda sensor
- Accelerator pedal potentiometer
- Brake pedal switch
- Clutch pedal switch

**Actuators**

- Butterfly casing actuator
- Phase transformer solenoid valve
- Fuel vapour cut out solenoid valve
- Variable geometry manifold solenoid valve
- Electric fuel pump (including filter and pressure regulator)
- Injectors
- Ignition coils
- Spark plugs

## INJECTION/IGNITION SYSTEM WIRING

The various system components are connected by two distinct sets of wiring.
The engine side wiring (connector M) connect the components fitted on the engine to the injection control unit; the vehicle side wiring (connector F) connects the other components to the control unit and constitutes the interface with the other vehicle wiring.
The two connectors (M and F) are the same and both have 64 pins, but due to the presence of special keys it is not possible to mix up the control unit connector wiring.

## INJECTION/IGNITION ELECTRONIC CONTROL UNIT

The injection/ignition electronic control unit is located in the engine compartment, fixed to a bracket to the side of the inlet manifold.
The control unit processes the signals coming from the various sensors through the application of software algorhythms and operates the actuators (in particular the injectors and the pressure regulator) in order to ensure the optimum engine operation.
The control unit is the "flash E.P.R.O.M." type which can be reprogrammed from the outside without involving the hardware.


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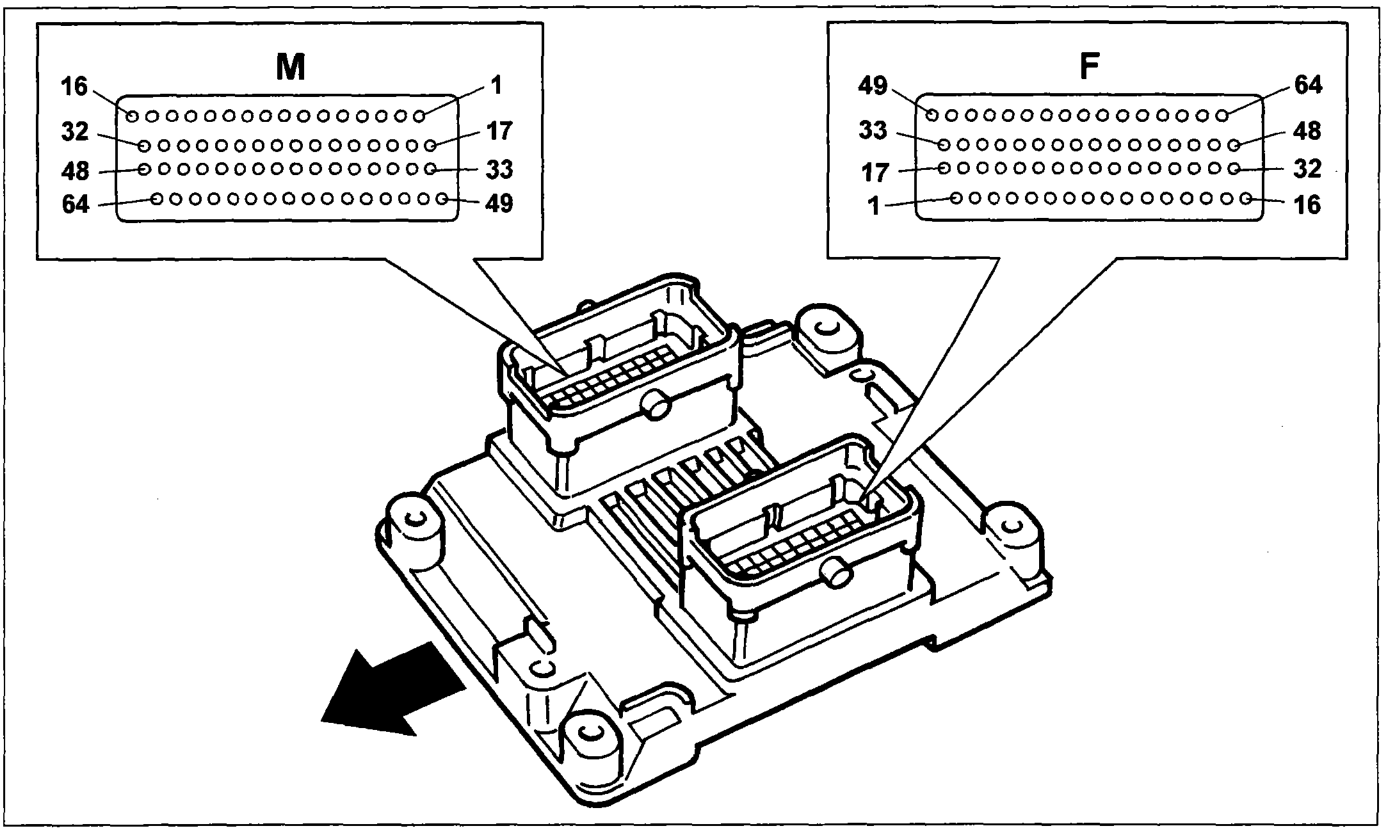
**Identification of the control unit connections (Pin-out)**




**Connector F**

1. Engine coolant overheating warning light
2. Not connected
3. Fiat CODE control unit
4. Not connected
5. Not connected
6. Request to engage climate control system compressor
7. Supply for accelerator pedal potentiometer 1
8. Signal for accelerator pedal potentiometer 1
9. Request to engage radiator fan low speed
10. Not connected
11. Not connected
12. Not connected
13. Engagement of climate control system compressor
14. Not connected
15. Supply from battery
16. Supply from relay
17. Not connected
18. Not connected
19. Not connected
20. Not connected
21. Not connected
22. Not connected
23. Not connected

**Connector M**

1. Butterfly casing motor (-)
2. Not connected
3. Injector for cylinder 4
4. Variable geometry manifold actuator
5. Fuel vapour cut out solenoid valve
6. Reference earth for detonation sensor 2
7. Not connected
8. Not connected
9. Not connected
10. Not connected
11. Not connected
12. Not connected
13. Not connected
14. Ignition coil for cylinder 3
15. Ignition coil for cylinder 4
16. Ignition coil for cylinder 1
17. Butterfly casing motor (+)
18. Not connected
19. Injector for cylinder 1
20. Injector for cylinder 3
21. Not connected
22. Detonation sensor 1 signal
23. Lambda sensor signal

# 10.

**Connector F**

24. Accelerator pedal potentiometer 1 earth
25. Accelerator pedal potentiometer 2 earth and air flow meter
26. Not connected
27. Brake pedal switch
28. Not connected
29. Not connected
30. Electric fuel pump relay
31. Go ahead for fuel system relay
32. Supply from relay
33. Not connected
34. Not connected
35. Rev counter signal
36. Not connected
37. Not connected
38. Not connected
39. Not connected
40. Accelerator pedal potentiometer 2 signal
41. Request to engage radiator fan high speed
42. Not connected
43. Not connected
44. Vehicle speed signal
45. Not connected
46. Injection system failure
47. Supply from ignition switch
48. Supply from relay
49. Not connected
50. Go ahead to engage radiator fan low speed
51. Not connected
52. Not connected
53. Diagnostic socket, line K
54. Intake air temperature signal
55. Not connected
56. Accelerator pedal potentiometer 2 supply
57. Intake air quantity signal
58. Not connected
59. Clutch pedal switch
60. Not connected
61. Not connected
62. Go ahead to engage radiator fan high speed
63. Reference voltage for flow meter
64. Not connected

**Connector M**

24. Butterfly casing potentiometer 1 signal
25. Coolant temperature
26. Butterfly casing, temperature sensor potentiometers 1 and 2 reference earth
27. Not connected
28. Not connected
29. Not connected
30. Not connected
31. Ignition coil for cylinder 5
32. Ignition coil for cylinder 2
33. Butterfly casing motor (-)
34. Lambda sensor heater earth
35. Injector for cylinder 2
36. Phase tranformer solenoid valve
37. Not connected
38. Detonation sensor 2 signal
39. Not connected
40. Butterfly casing potentiometer 2 signal
41. Not connected
42. Timing sensor signal
43. Not connected
44. Not connected
45. Not connected
46. Not connected
47. Not connected
48. Not connected
49. Butterfly casing motor (+)
50. Not connected
51. Timing sensor reference voltage
52. Injector for cylinder 5
53. Not connected
54. Detonation sensor 1 reference earth
55. Lambda sensor reference earth
56. Not connected
57. Not connected
58. Buterfly casing potentiometer 1 and 2 supply
59. Engine rpm sensor
60. Not connected
61. Not connected
62. Not connected
63. Not connected
64. Not connected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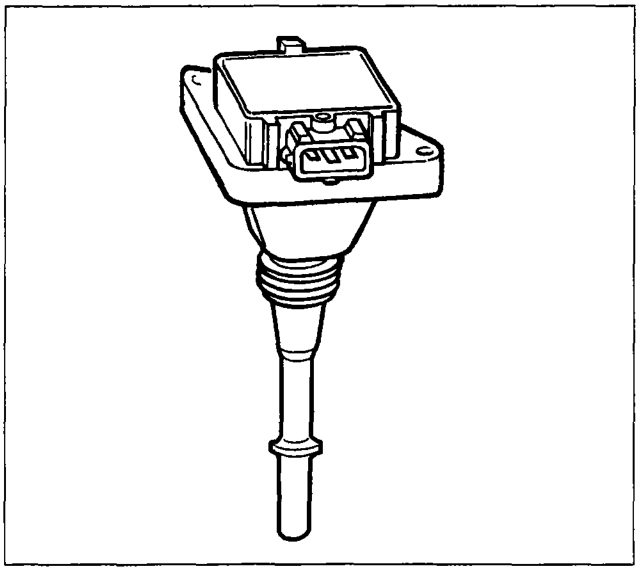
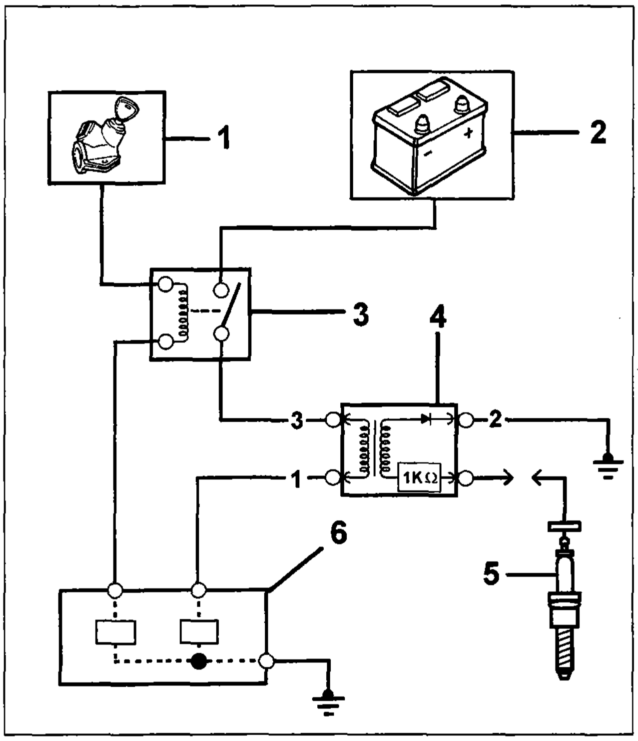


P4A21LJ01

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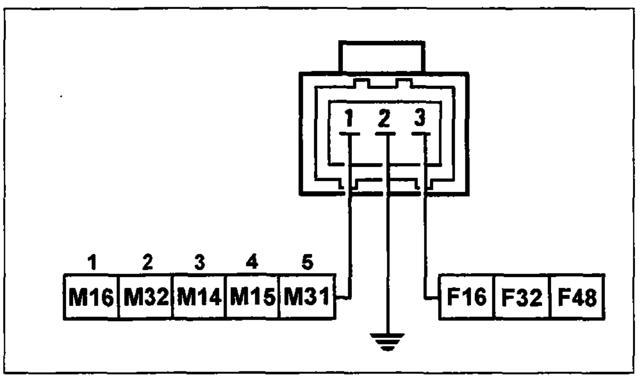



P4A21LJ03

**IGNITION COILS (0.221.504.014)**

The ignition is the static advance eletronic type with a single coil for each spark plug; this solution eliminates the high tension circuit, increasing reliability and safety and decreasing the risk of interference due to high tension leads and connections.

It involves a regular coil which raises the voltage of the impulse sent to the spark plugs: each individual coil, located in the cylinder head, supplies a spark plug directly without intermediate cables.

**Checking ignition coil primary circuit resistance**

The resistance is checked by connecting an ohmmeter to the connector external pins ( 1 and 3):

**Primary winding resistance: 0.73 ohm**

**Electrical specifications**

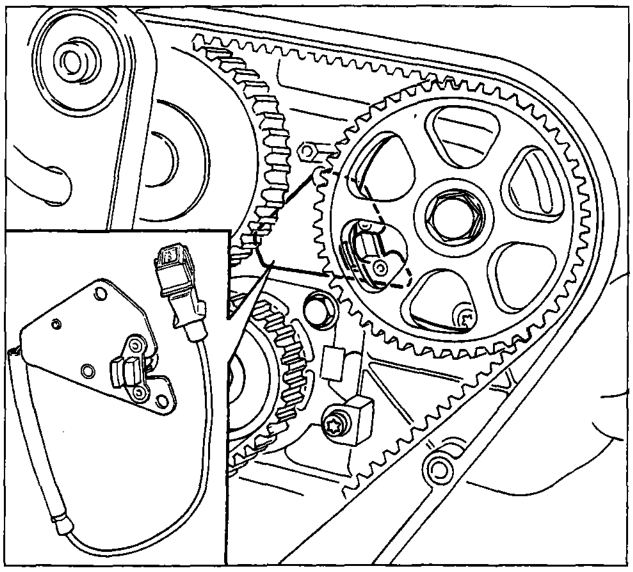
Primary winding inductance............ 2,5 mH
Primary winding resistance................ 0,73 Ω
Anti-interference resistance.................. 1 KΩ

**Diagram showing electrical connections**

A. Control signal
X. Primary winding
Y. Secondary winding
1. Supply from ignition switch
2. Single coil
3. Electronic control unit
4. Spark plug

**Wiring connector**

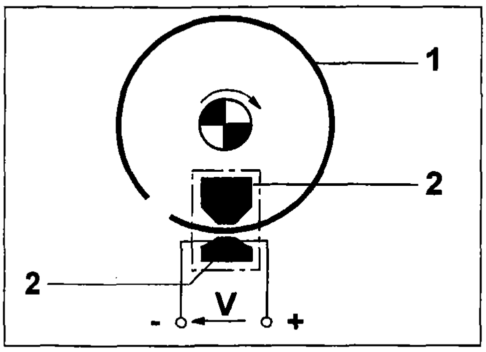
The numbers in the boxes, connected to pin 1, indicate the corresponding control unit pins arranged in the order of the cylinder numbers.



P4A22LJ01

## TIMING SENSOR (0.232.101.026)

In the Bosch Motronic ME 3.1 system the injection is the sequential, phased type, in other words the fuel is injected in sequence for each cylinder during the inlet stroke.
In order to achieve this, in addition to the rpm and TDC signal, the electronic control unit also uses a timing signal to determine the injection point.
The signal sent to the control unit is produced by a Hall effect sensor fitted by the camshaft drive pulley, exhaust side.




P4A22LJ02

1. Deflector (pulley ring)
2. Magnetic material

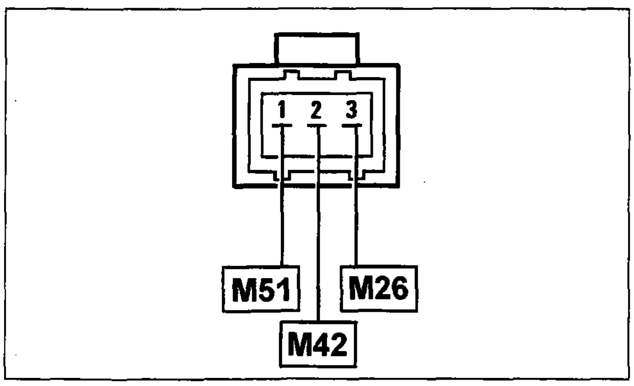
### Operating principle

A semi-conductor layer, which the current passes through, immersed in a normal magnetic field (lines of force perpendicular to the direction of the current) produces a difference in power, known as "HALL" voltage.
If the intensity of the current remains constant, then the voltage produced only depends on the intensity of the magnetic field; the intensity of the magnetic field only needs to vary periodically in order to produce a modulated electrical signal, whose frequency is proportional to the speed at which the magnetic field changes.
To achieve this change, a metal ring (internal part of the pulley) with an opening passes through the sensor. As it moves the metal part of the ring covers the sensor, blocking the magnetic field with a consequent low output signal; conversely, when the opening is present and consequently there is a magnetic field, the sensor produces a high signal.

As a result the high signal alternates with the low signal once for every two revoluations of the engine, namely when cylinder N°1 is 78° before TDC.
This signal, together with the rpm and TDC signal, allows the control unit to recognize the cylinders and determine the injection point. For each engine revolution, the control unit checks that the timing signal is present; if this signal is missing for two consecutive revolutions, the control unit signals a fault (warning light in the instrument panel comes on) and the engine cannot be started up.

### Wiring connector

The numbers indicate the corresponding control unit pins




P4A22LJ03

### Removing-refitting

This operation involves the removal of the toothed belt from the timing drive and the exhaust side camshaft pulley.

When these operations have been carried out:
- disconnect the electrical connector;
- undo the fixing bolts and remove the sensor.

When refitting, reverse the order of the operations, following the instructions for refitting and tensioning the toothed belt.

**NOTE** *The sensor does not require any type of adjustment.*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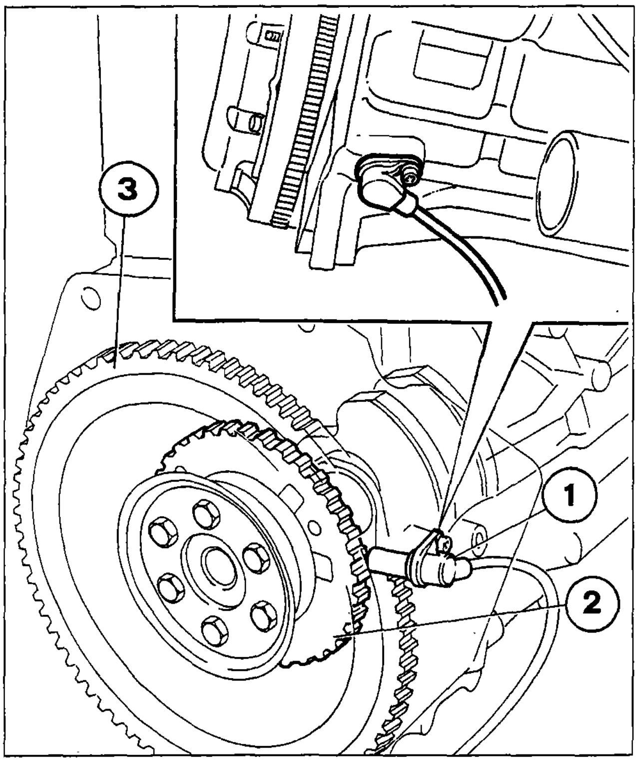
## RPM AND TDC SENSOR (0.261.210.160)

This sensor which detects the engine speed and TDC is the inductive type, i.e. it operates through the variation of the magnetic field produced by the passing of the teeth on a toothed pulley (flywheel) inside the cylinder block/crankcase fixed to the crankshaft rear counter-weight. In this way the sensor is fixed to the cylinder block/crankcase and the gap and the angular position no longer need to be checked or adjusted.

The teeth which pass in front of the sensor alter the gap between the pulley and the sensor; the flow, which varies as a result, produces an alternating voltage whose frequency depends on the number of revs.

The flywheel consists of 58 teeth plus a space equivalent to the size of the two missing teeth.

The reference defined by the space of the two missing teeth constitutes the basis for detecting the synchronism point (TDC).




P4A23LJ01

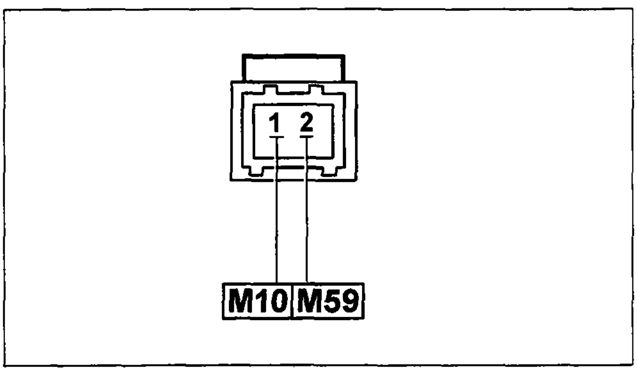
1. Rpm sensor
2. Toothed pulley
3. Engine flywheel

### Removing-refitting

Position the vehicle on a lift, then, working from the lower part of the vehicle:

- disconnect the electrical connector;
- undo the bolt fixing the sensor and remove it from its housing.

### Wiring connector

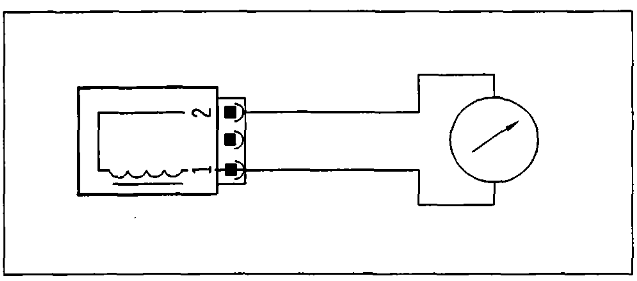



P4A23LJ02

The sensor is connected to the electronic control unit (pins M10 and M59) by twisted cables covered with an anti-interference outer casing.

The numbers indicate the corresponding control unit pins

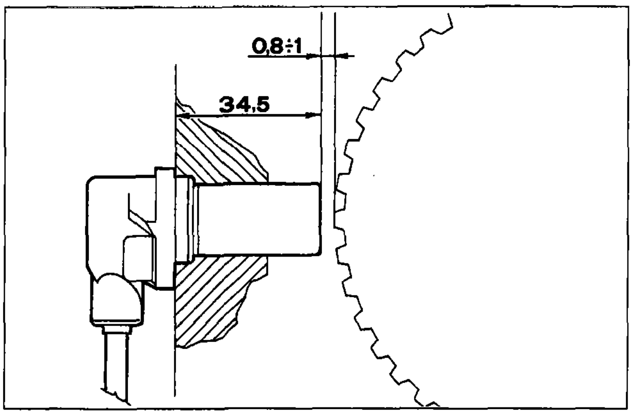
### Checking the resistance




P4A23LJ03

The sensor resistance can be measured by disconnecting the connector and connecting an ohmmeter to the sensor.

**Resistance: 774-946 ohm at 20°C**



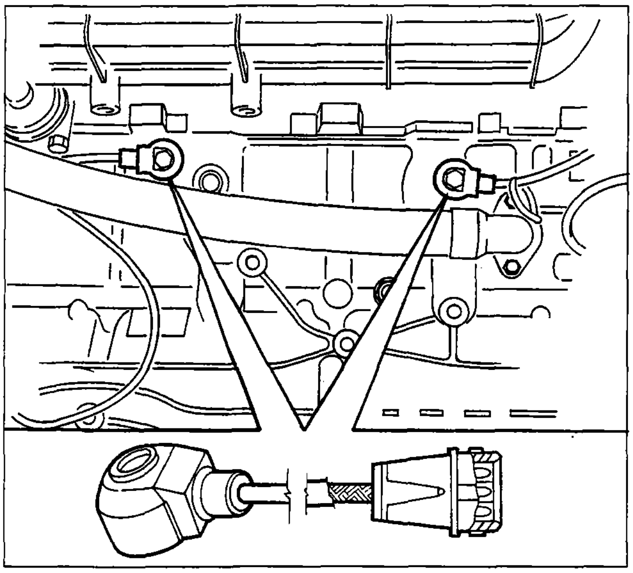

P4A24LJ01

*When measuring the distance, it is vital to be at right angles to the flywheel and corresponding to a tooth and not a gap.*

### Checking the gap

The rpm and TDC sensor is fixed directly to the cylinder block/crankcase and therefore the gap and the angular position do not need adjusting. If a fault is suspected, the gap can be checked as follows:

- remove the rpm and TDC sensor;
- check that the distance between the surface of the sensor and the flywheel tooth corresponds to the total length of the sensor probe (34.5mm) with the gap (0.8 - 1.5 mm).



P4A24LJ02

### DETONATION SENSORS (0.261.231.131)

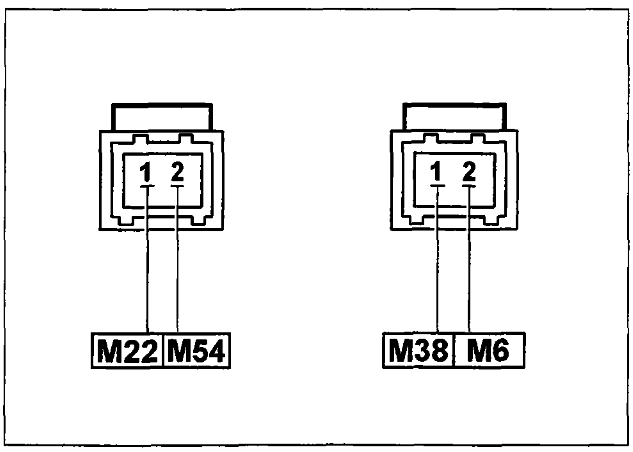
The detonation sensors are located in the monobloc under the inlet manifolds and between cylinders 1-2 and 4-5, respectively.

These sensors have a bush to prevent inappropriate torque tightening.

**If they are replaced, do not place washers or shims between the cylinder block-/crankcase and sensor contact surfaces.**

When the engine is knocking (detonation), vibrations of a certain frequency are produced in the cylinder block/crankcase.

This phenomenon produces a mechanical ripercussion on a piezoelectric crystal which sends a signal to the control unit which, on the basis of this signal, reduces the ignition advance (by 3° up to a maximum of 9.7°) until the phenomenon disappears. Later, the advance is gradually restored to the basic value.




P4A24LJ03

### Wiring connector

The sensors are connected to the electronic control unit (Pins M22/M54 and M38/M6) by twisted cables covered in an anti-interference outer casing.

The numbers indicate the corresponding control unit pins.



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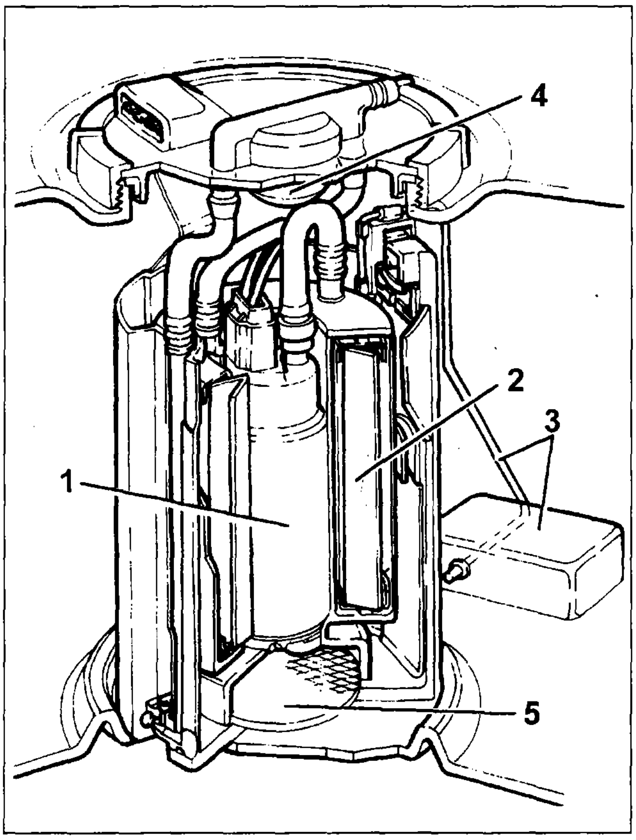


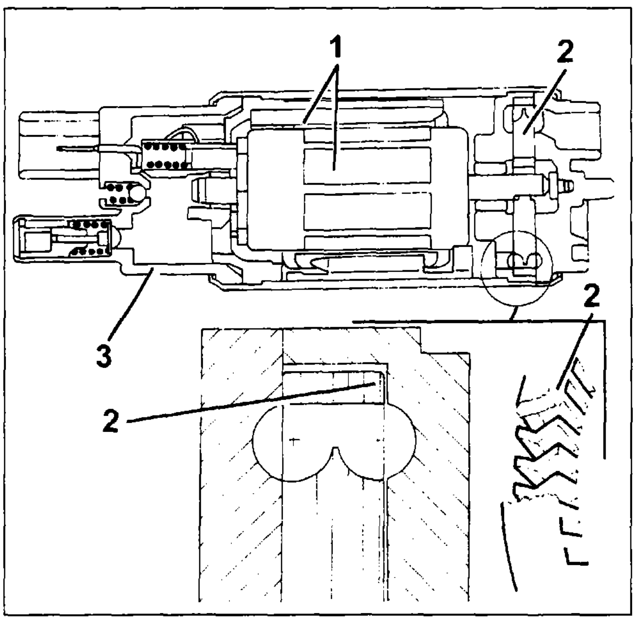
P4A25LJ01

## LECTRIC FUEL PUMP (0.580.313.011)

The electric fuel pump is located inside the fuel tank, in a special housing which also includes:

- the fuel pressure regulator;
- the fuel gauge;
- the fuel filter.

1. Electric fuel pump;
2. Fuel filter;
3. Fuel gauge with float;
4. Pressure regulator;
5. Gauze pre-filter;



P4A25LJ02

The electric fuel pump has an electric motor with a permanent magnet (1), which operates the pump (2) impeller and a support cover (3) which contains the electrical and hydraulic connections.

The electric pump is the single stage type with high performance in low voltage and temperature conditions.

It has the following advantages compared with pumps which operate on the volumetric principle:
- lighter;
- smaller dimensions

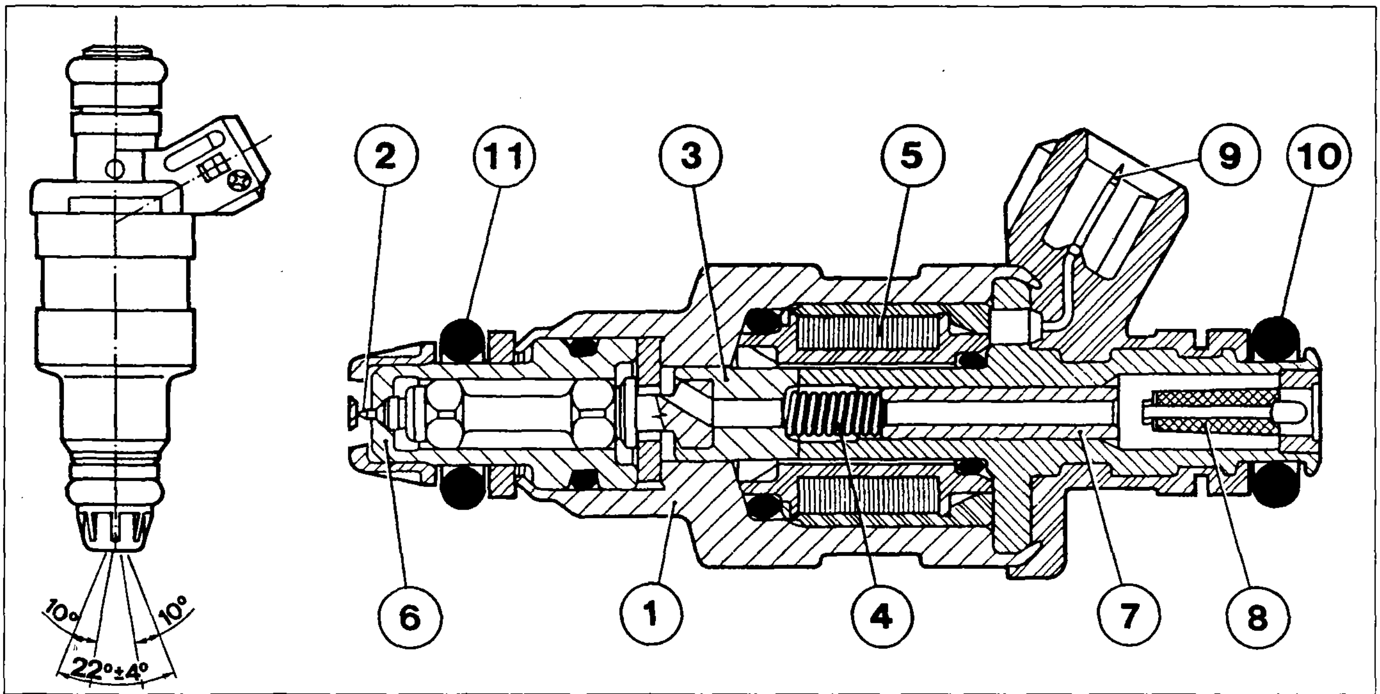
## FUEL SUPPLY MANIFOLD

The fuel manifold is fixed to the inside of the inlet manifold and its function is to send the fuel to the injectors. The fuel manifold is made from die-cast aluminium and incorporates the housings for the injectors. The fuel inlet has a fixing with a bolt with a tapered seal.

# 10.

### INJECTORS (0.280.155.770)

The twin jet type injectors are fitted on the inlet manifolds, immedeiately before the inlet valve.
These injectors have been specially designed for engines with 4 valves per cylinder and allow the jets to be directed towards the two inlet valves.
The fuel jets comes out of the injector at a pressure of 3 bar and are instantly atomized forming two cones of around 10° each.
The operation of the injectors is the «sequential phased» type, i.e. the five injectors are operated according to the engine cylinder inlet sequence, whilst the supply can already start for each cylinder during the expansion stroke until the inlet stroke has already begun.
The injectors are fixed by the fuel manifold, which presses them into their housings in the inlet manifolds. In addition they are secured to the fuel manifold by means of «safety clips». Two rubber seals (10) and (11) ensure the seal on the inlet manifold and the fuel manifold.

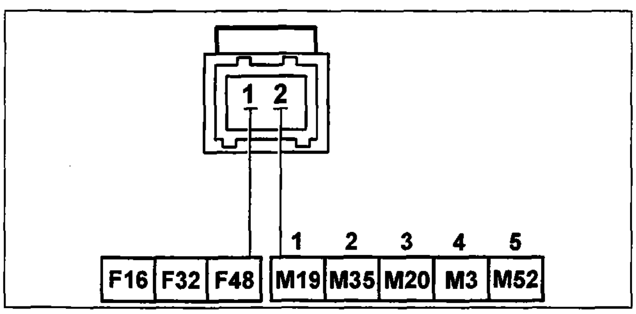



P4A26LJ01

1. Injector body
2. Needle
3. Magnetic core
4. Coil spring
5. Winding
6. Injector nose
7. Adjustable spring
8. Fuel filter
9. Electrical connection socket
10. Fuel seal
11. Vacuum seal

**Wiring connector**

The numbers indicate the corresponding control unit pins arranged in the order of the cylinder numbers.

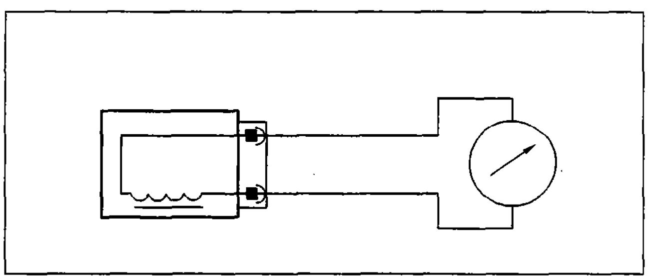



P4A26LJ02

**Checking the resistance**

The injector resistance can be measured by disconnecting the connector and connecting an ohmmeter as shown in the diagram.

**Resistance value 16.2 ohm**



P4A26LJ03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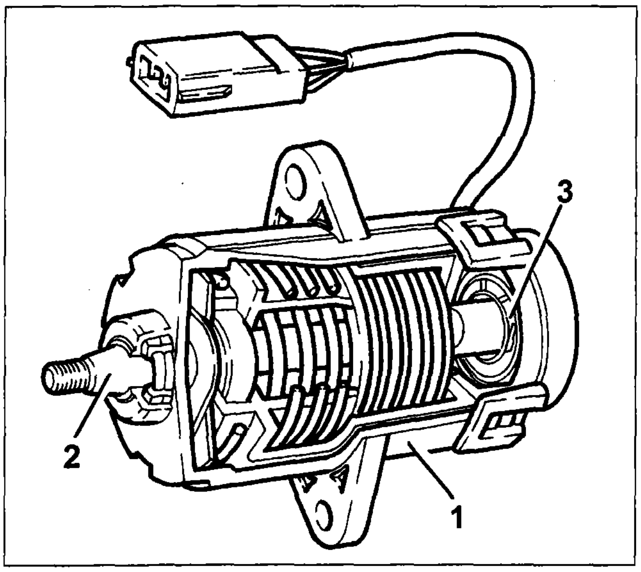
## ACCELERATOR PEDAL POTENTIOMETER (0.281.002.203)




P4A27LJ01

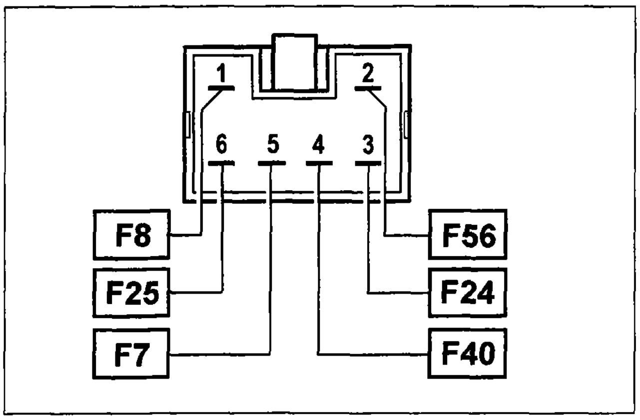
The position of the accelerator pedal is transformed into an electrical voltage signal and sent to the injection control unit by the potentiometer connected to the appropriate pedal.

The accelerator pedal position signal is processed together with the information relating to the engine speed to obtaine the injection times and pressure.

The sensor is made up of a casing (1) fixed to the pedals by a flange, which contains a shaft (2), in an axial position, connected to two potentiometers (3): one main one and one safety one.

A coil spring on the shaft guarantees the correct pressure resistance, whilst a second spring ensures the return on release.

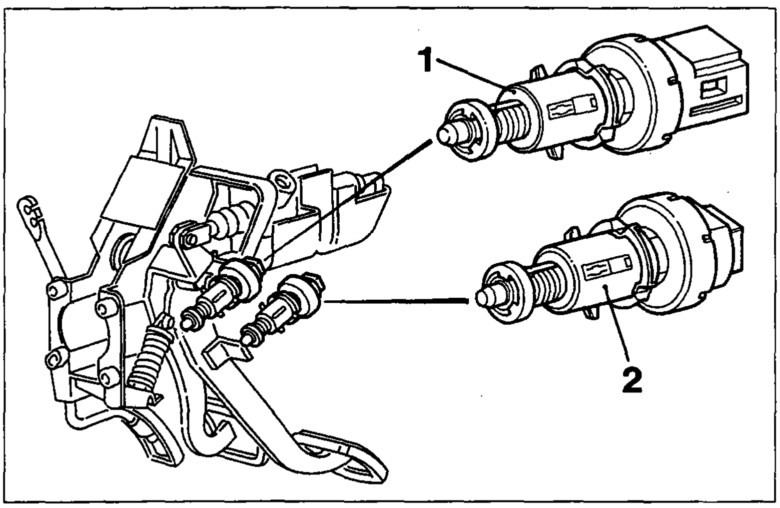
### Wiring connector




P4A27LJ02

The numbers indicate the corresponding control unit pins

## BRAKE PEDAL SWITCH




P4A27LJ03

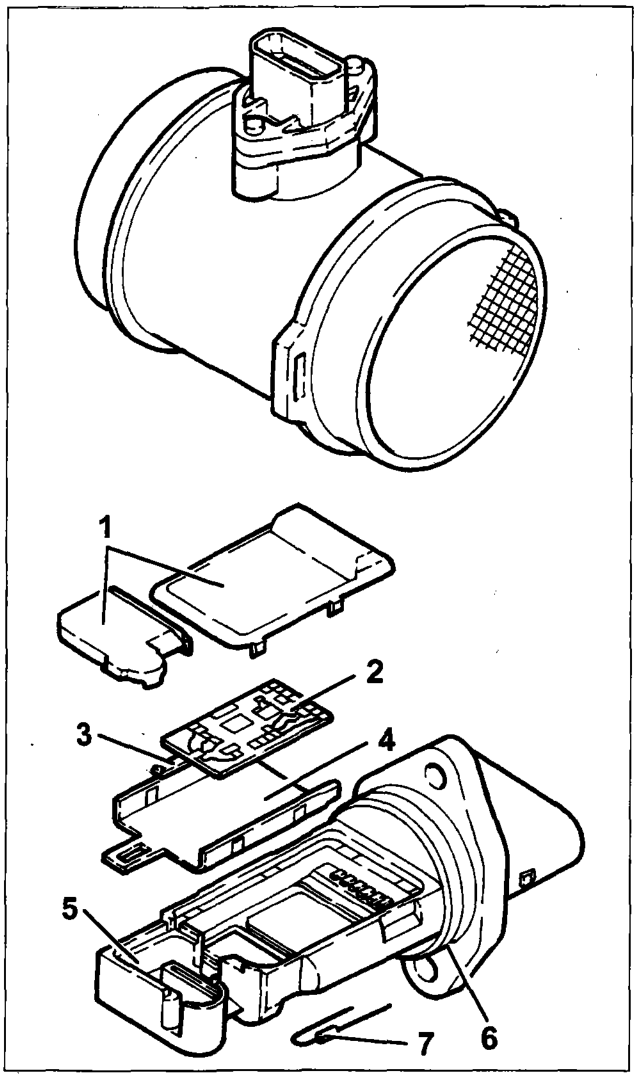
There is a switch (1) on the brake pedal which operates the brake lights; the same switch sends a signal to pin F27 of the injection control unit.

The "brake pedal pressed" signal is used by the control unit for:
- understanding that there is a deceleration situation;
- checking the plausibility of the signal coming from the accelerator potentiometer.

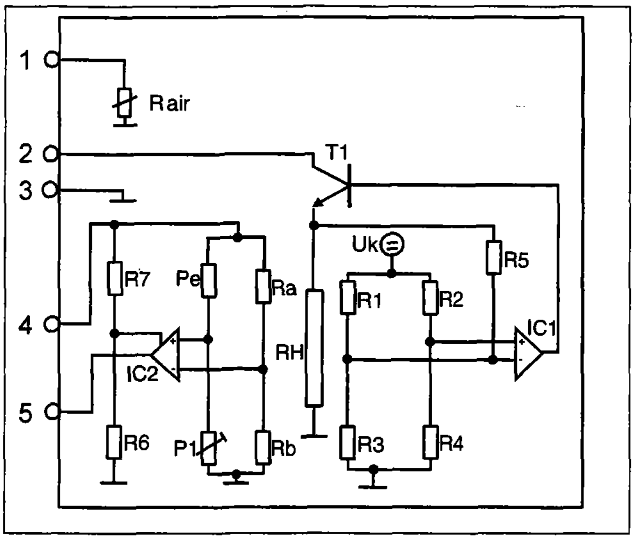
## CLUTCH PEDAL SWITCH

There is a switch (2), on the clutch pedal, connected to pin F59 of the injection control unit.

The "clutch pedal activated" signal is used by the injection control unit to distinguish the gear engaged and gear shift conditions.




P4A28LJ01




P4A28LJ02

1. Air temperature signal
2. Battery voltage
3. Mass
4. Reference voltage (5V)
5. Air flow rate signal

**AIR FLOW METER (0.281.002.199)**

The flow meter is on the air inlet hose and is the "hot film" type.
The intake air temperature sensor is inside the flow meter.
The operation is based on a heated diaphragm placed in a measuring duct through which the intake air entering the engine flows.
The hot film diaphragm is kept at a constant temperature (about 120 °C above the temperature of the intake air) by the heating resistance.
The mass of air passing through the measuring duct tends to remove heat from the diaphragm therefore, in order to keep the latter at a constant temperature, a current has to pass through the resistance.
This current, being proportional to the mass of air flowing to the engine, is measured by a suitable Wheatstone bridge and the signal obtained is sent to the injection control unit.

1. Covers
2. Electronic card
3. Sensor
4. Support plate
5. Support
6. Seal (O-Ring)
7. Temperature sensor

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

**Description of the operation**

The Wheatstone bridge (made up of resistors R1,R2,R3,R4) is balanced when R3 is about 120 °C higher than the temperature of the air.
The air which passes through the diaphragm removes heat from R3, then the bridge is unbalanced.
This situation is detected by the circuit at IC1 which operates the transistor T1, in a manner which is proportional to the bridge imbalance, which then allows more current to pass through Rh in order to heat R3 and restore the bridge balance.
Circuit IC2 measures the current passing through Rh.
This current, allows the equilibrium of the bridge to be maintained and is therefore proportional to the mass of air passing through the air flow meter.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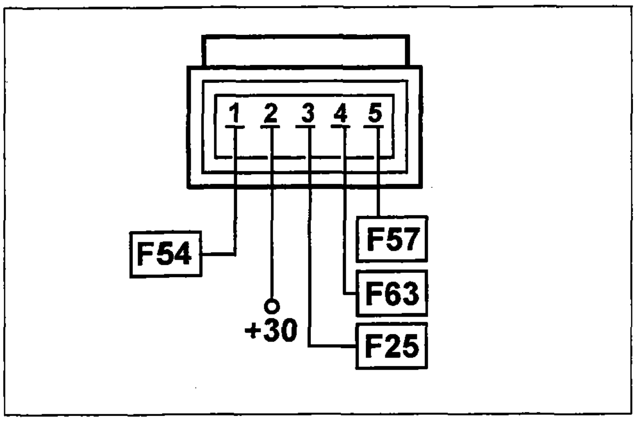
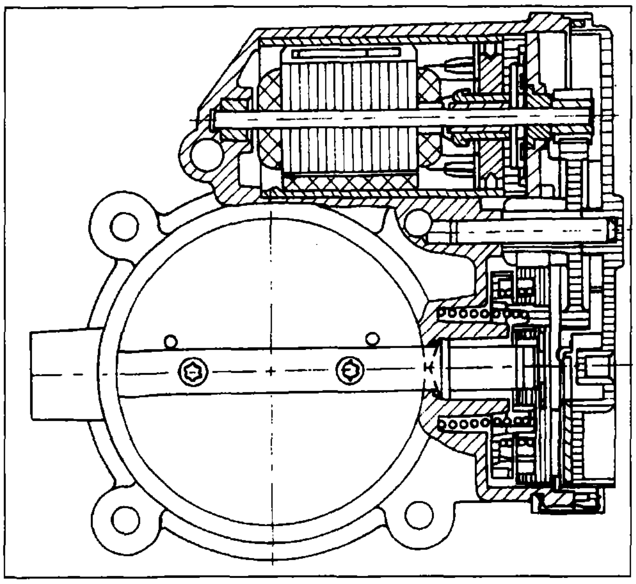



P4A29LJ01

### Wiring connector

The numbers indicate the corresponding control unit pins.

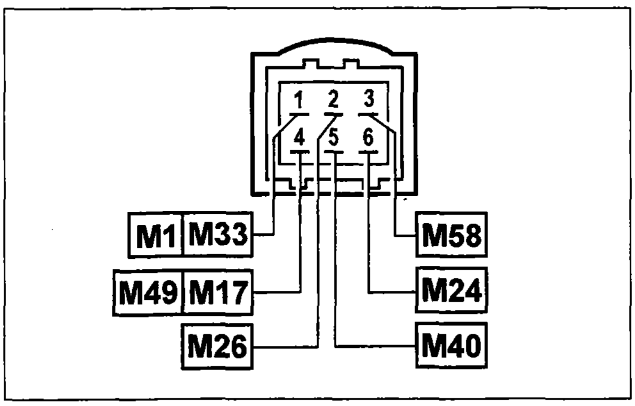


P4A29LJ02

### BUTTERFLY CASING ACTUATOR

The actuator is fixed to the inlet chamber and regulates the quantity of air drawn in by the engine.
According to the signal coming from the accelerator pedal potentiometer, the injection control unit control the opening of the butterfly by means of a direct current motor incorporated in the butterfly casing actuator.
The butterfly casing actuator is fitted with two potentiometers connected in parallel so that one controls the other and viceversa.
If there is a problem with the two potentiometers or if there is no supply, the control unit reduces the engine torque, according to the position of the accelerator pedal.

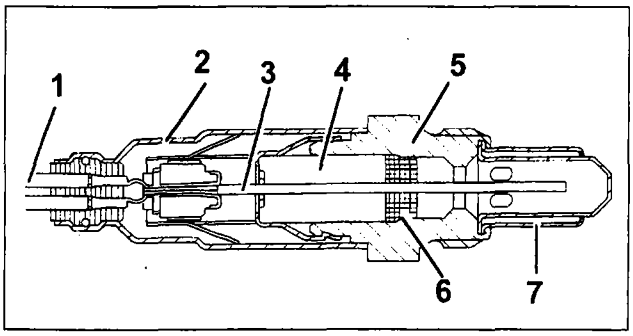
If the butterfly casing actuator or the injection control unit are replaced, the following "self-learning" procedure must be carried out:
- Place the ignition key in the ON position and keep it in this position for 30 secs
- Place the ignition key in the OFF position for 5 secs
- Return the key to the ON position and start up the engine




P4A29LJ03

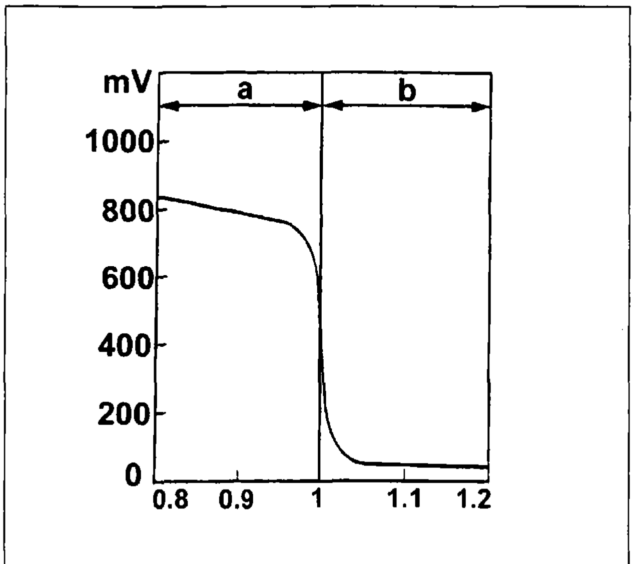
### Wiring connector

The numbers indicate the corresponding control unit pins.



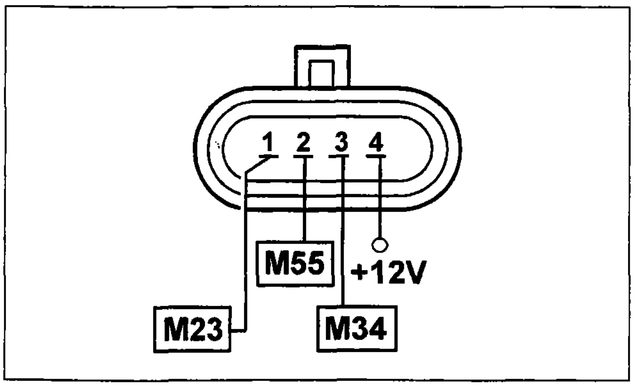

P4A30LJ01

1. Connecting cable
2. Protective sleeve
3. Planar sensor element
4. Ceramic support pipe
5. Sensor housing
6. Ceramic seal
7. Protective pipe




P4A30LJ02

a. Rich mixture (lack of air)
b. Lean mixture (excess air)




P4A30LJ03

## LAMBDA SENSOR (B.258.040.092)

The Lambda sensor is the "planar" type and is fitted on the front section of exhaust pipe and informs the injection control unit of the progress of the combustion (stoichiometric ratio).
To obtain an optimum mixture the quantity of air drawn in by the engine must equal the theoretical quantity for burning all the fuel injected.
In this case the Lambda factor ($\lambda$) i.e. the ratio between the quantity of air drawn in and the theoretical quantity of air (required to burn all the fuel injected) is equal to 1.

Therefore:
$\lambda = 1$ ideal mixture
$\lambda > 1$ lean mixture
$\lambda < 1$ richmixture

The Lambda sensor, in contact with the exhaust gases, produces an electrical signal, whose voltage value depends on the concentration of oxygen present in the actual gases.
This voltage is characterized by a sharp variation when the composition of the mixture moves away from the value $\lambda = 1$.
The heating of the Lambda sensor is managed by the injection control unit proportionallly to the temperature of the exhaust gases.
This prevents thermal shocks to the ceramic casing due to contact with the condensation water, present in the exhaust gases, with the engine cold.

The measuring cell and the heater are incorporated in the "planar" (stratified) ceramic element with the advantage of heating the cell rapidly to allow a closed loop control (=1) within a few seconds of the engine being started up.

### Wiring connector

The numbers indicate the corresponding control unit pins.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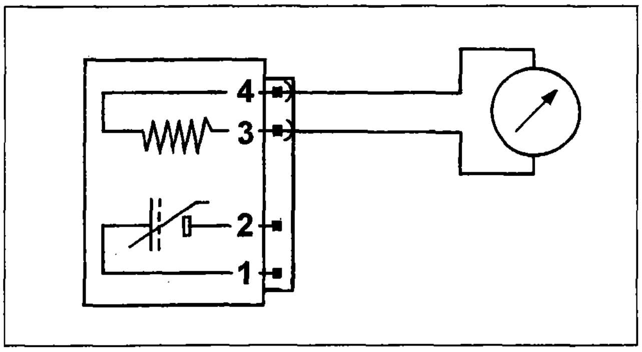
*The sensor can be rapidly put out of action by even small amounts of lead in the fuel.*

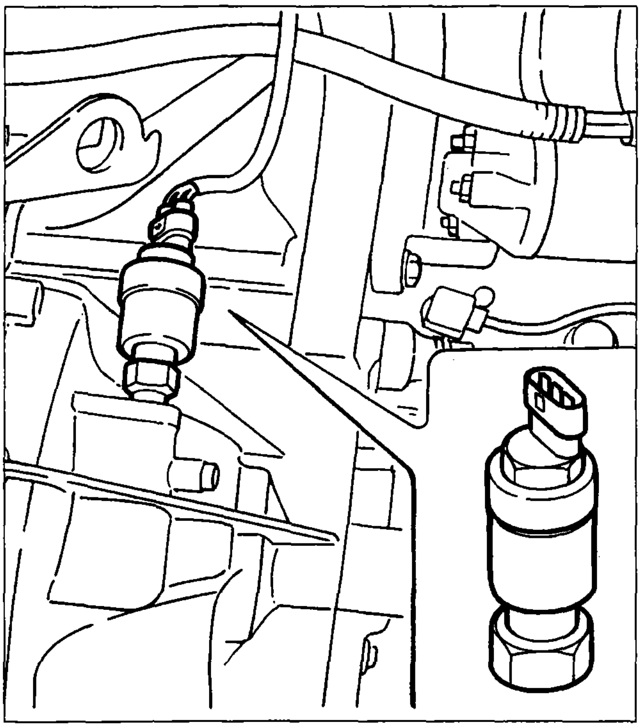



P4A31LJ01

**Checking the resistance**

The resistance of the heater and the sensor can be measured by disconnecting the connector and connecting an ohmmeter as shown in the diagram.

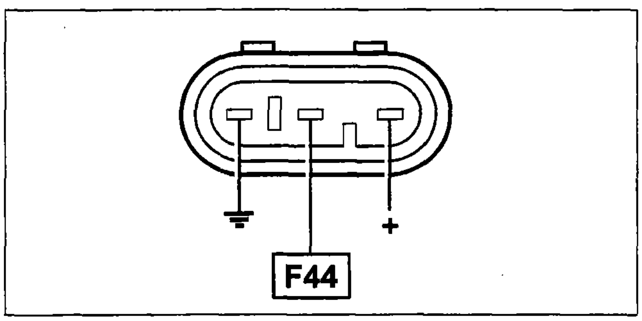
**Resistance = 500-1000 ohm at 20°C**



P4A31LJ02

**SPEEDOMETER SENSOR**

The speedometer sensor (vehicle speed sensor) is positioned at the differential outpur, by the left driveshaft coupling and transmits information concerning the vehicle speed to the control unit: the signal is also used for the operation of the speedometer.
The sensor is the Hall effect type (see paragraph on "engine timing sensor") and is calibrated so that each impulse corresponds to a distance of one metre; it is possible to know the speed of the vehicle from the frequency of the impulses.
The control unit uses this information for improving the management of the engine idle adjustment actuator and for the CUT-OFF strategy.




P4A31LJ03

**Wiring connector**

The numbers indicate the corresponding control unit pins

**PHASE TRANSFORMER**

In order to achieve a good compromise between good performance in terms of power at high speeds and good torque at low speeds, a phase transformer (with electronic operation and hydraulic implementation) has been fitted on this engine for the inlet camshaft.

This device makes it possible to vary the timing diagram (inlet stroke) according to the load required by the engine; this parameter is processed by the MOTRONIC control unit on the basis of the electrical signals received by the air flow meter and the rpm sensor and is sent as a commant to the phase transformer solenoid valve.

The construction of the device involves a main assembly fitted on the inlet camshaft which is designed to alter the angular position of the actual shaft in relation to the drive pulley.

In addition, there is an impelementation valve, operated by a solenoid valve, both on which are on the inlet manifold and are hydraulically connected to the main assembly by means of suitable ducts.

The operating principle is as follows:

- with the temperature of the coolant below 40 °C and when the engine is idling or the speed exceeds a pre-set level, the solenoid valve (1) is de-energized, therefore the valve body (2), thrust by the opposing spring (3), remains raised not allowing the oil, which is arriving from the duct (A), to reach the transformer.
  In this case the timing of the inlet valves remains unaltered.
  With the coolant temperature above 40 °C and the engine speed below a pre-set level with the butterfly angle greater than around 8°, the solenoid valve (1) is energized, thereby pushing the valve body (2) downwards. In this position, the oil, coming from the duct (A), enters the piston chamber (B) and from there flows through a special port into the duct (C) inside the latter.
  The oil can only leave the above mentioned duct through the upper port (in contact with the oil supply duct to the transformer (D)) because the lower port is not in contact with the drainage duct (E) as the valve body (2) is lowered.
  The oil passes through ducts (D) and (F), reaches the chamber (G) moving axially towards the engine and the piston (4), which has helical teeth on the outside, is forced to rotate in a clockwise direction (seen from the timing side) on account of the above mentioned axial movement.
  Its rotation is transmitted, by means of a straight toothed splining, to the pinion (5) which, bolted onto the threaded element of the camshaft (6), transmits the rotation to the shaft, altering the timing of the inlet valves with an advance of 9°.

When the solenoid valve is de-energized, the valve body (2) returns to the initial position, interrupting the flow of oil under pressure to the chamber (G), but allowing the return of oil to the drainage, thanks to the force of the opposing spring (7).

An additiona duct guarantees the lubrication of the camshaft bearing even when the device is not activated.

The oil which reaches chamber (H) of the solenoid valve through seepage, is discharged through the drainage duct (E).

**Recovery**

In the case of a problem with the solenoid valve, the final stage (driver) in the control unit is deactivated.


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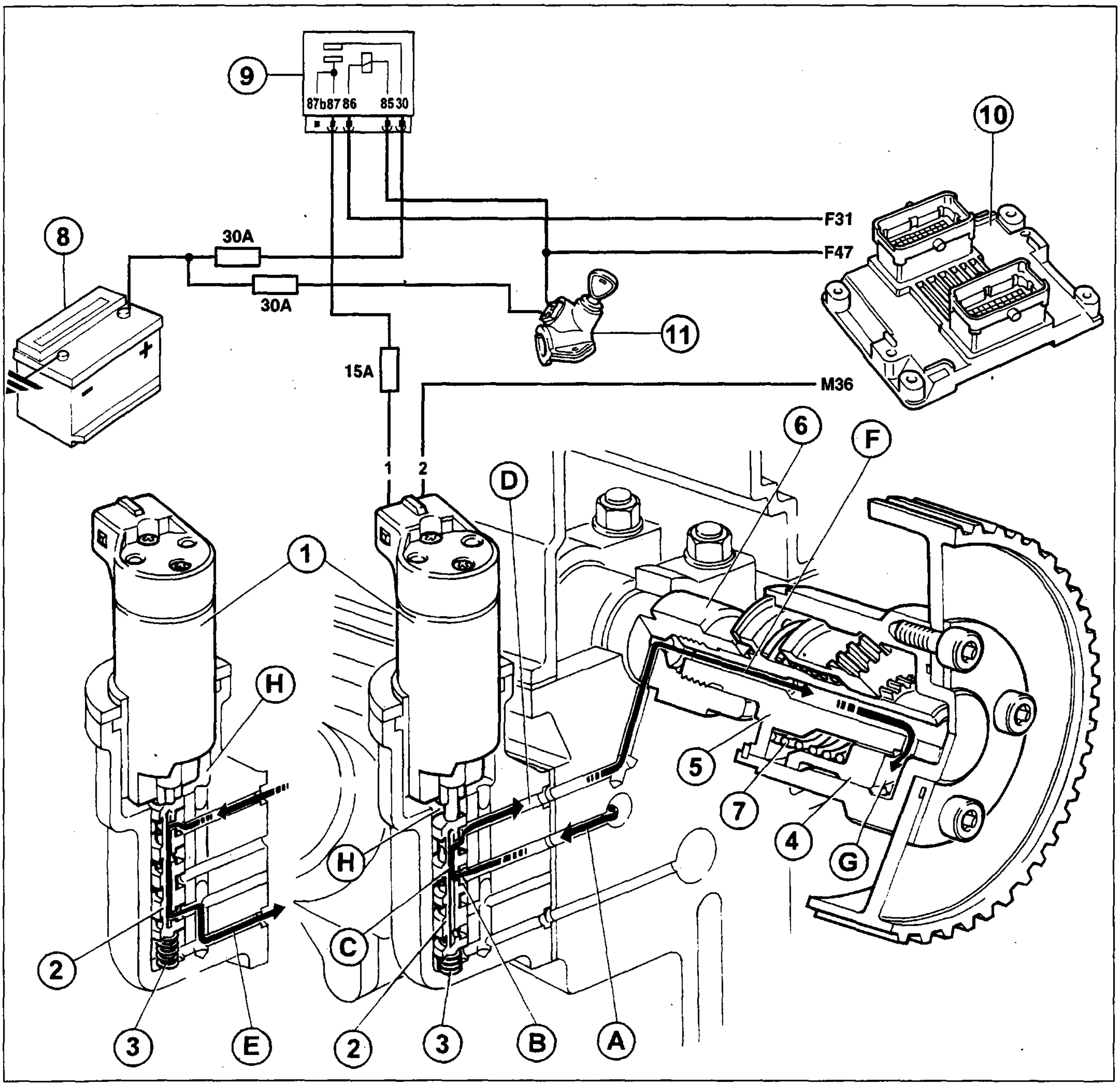
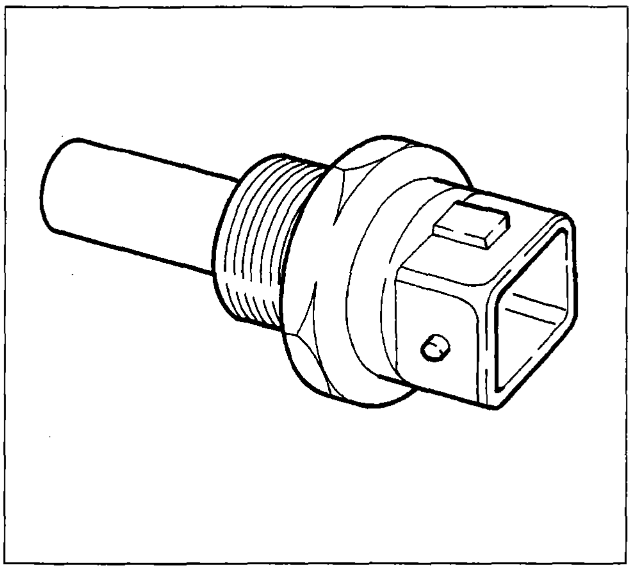
**Diagram showing operation of the phase transformer**




P4A33LJ01

1. Solenoid valve
2. Valve body
3. Valve body spring
4. Piston
5. Pinion
6. Camshaft element
7. Piston spring
8. Battery
9. Injection/ignition system relay
10. Injection/ignition control unit
11. Ignition switch

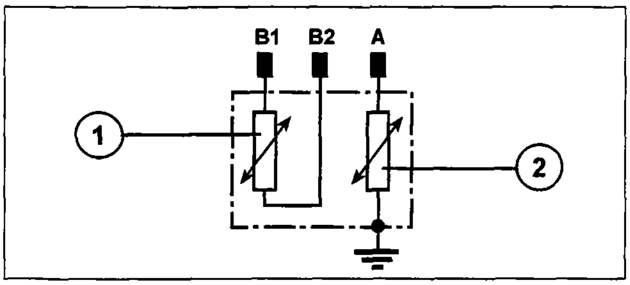


P4A34LJ01

## COOLANT TEMPERATURE SENSOR

**(Jaeger 402.183.01)**
**(Elth 2690350)**

The sensor is fitted on the themostat casing; it is made up of a brass casing which acts as protection against the actual resistive elements made up of two NTC thermistors (Negative Temperature Coefficient, where the electrical resistance of the sensor decreases as the temperature increases). The two NTCs are distinct and provide temperature information to the specific gauge in the Instrument panel and to the injection/ignition control unit. The reference voltage for the NTC element for the injection system is 5 Volt; since the control unit inlet circuit is designed as a voltage divider, this voltage is shared between a resistance in the control unit and the sensor NTC resistance. As a result, the control unit is capable of evaluating the changes in voltage and obtaining temperature information in this way.




P4N34LJ02

1. NTC for injection system
2. NTC for gauge in Instrument panel

**NTC INJECTION**

| | Ω | °C | Ω |
|---|---|---|---|
| -20 | 15970 | 40 | 1150 |
| -10 | 9620 | 50 | 807 |
| 0 | 5975 | 60 | 576 |
| 10 | 3816 | 70 | 418 |
| 20 | 2500 | 80 | 309 |
| 25 | 2044 | 90 | 231 |
| 30 | 1679 | 100 | 176 |

**NTC INSTRUMENT**

| °C | Ω |
|---|---|
| 60 | 512÷602 |
| 90 | 184÷208 |
| 120 | 76÷88 |

### Recovery

The last value detected is taken as valid or a fixed values of 80 °C if the temperature of the intake air is above a given level. The self-adjustment of the mixture strength is inhibited. The radiator fan is activated. The self-adjustment of the idle is inhibited.

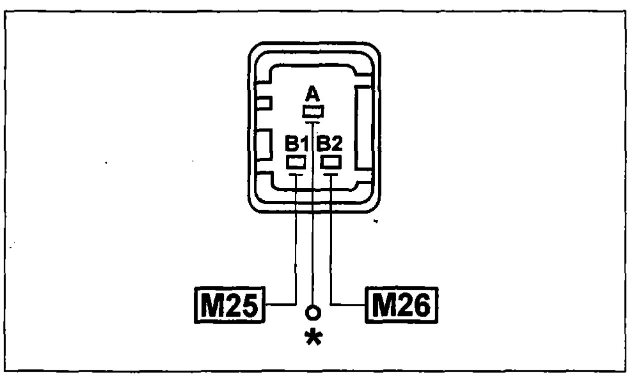
### Checking the resistance

The table at the side contains the resistance values which the NTC elements can assume according to the temperature. These values can be measured by by disconnecting the connector and connecting an ohmmeter to sensor pins.

### Removing-refitting

Disconnect the electrical connection and remove the sensor

**Tightening torque 2.2 da Nm.**




P4A34LJ03

* Connection to the coolant temperature gauge in the Instrument panel

### Wiring connector

The numbers indicate the respective control unit pins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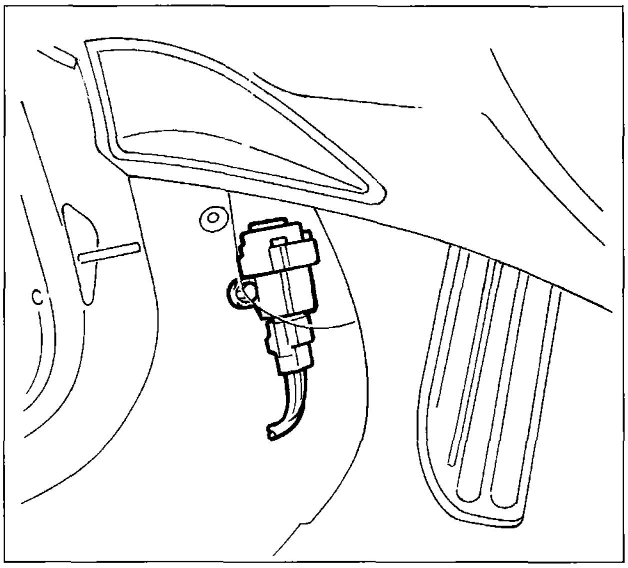


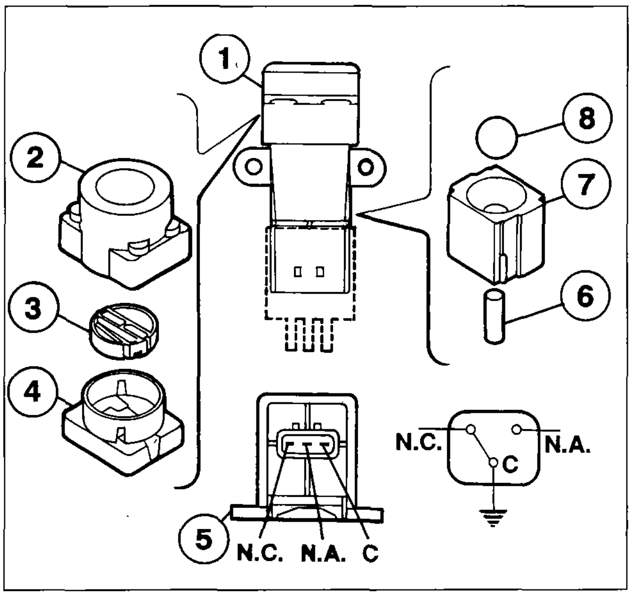
P4A34JJ02

## INERTIA SWITCH

In order to increase the safety of the occupants, in the case of an impact, the vehicle is equipped with an inertia switch located inside the passenger compartment, fixed to the left side panel.
This sensor reduces the risk of fire (as a result of fuel escaping) deactivating the auxiliary electric pump which supplies the injection circuit.
The inertia switch consists of a steel ball fitted in a (tapered) housing and kept in position by the attraction force of a permanent magnet.

If the vehicle is involved in a violent crash, the ball is released from the magnetic clip and opens the normally closed (NC) electrical circuit) interrupting the connection to earth for the electric pump and as a result the supply to the injection system.
To restore the connection to earth for the auxiliary electric pump, the seat must be moved backwards and the switch pressed until it is heard to click.

*Even after an apparently slight impact, if there is a smell of fuel or there are leaks from the fuel system, do not turn the inertia switch back on, but first search for the cause of the problem and remedy it to prevent the risk of fire.*




P4A35LJ01

**Inertia switch components**

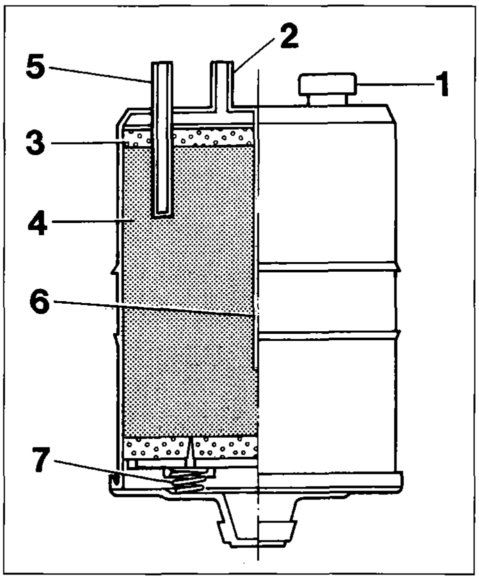
1. Complete inertia sensor
2. Outer casing
3. Button
4. Upper side
5. Engagement side
6. Permanent magnet
7. Permanent magnet housing
8. Steel ball

C. Common terminal
N.C. Normally closed contact
N.A. Normally open contact

## ANTI-EVAPORATION SYSTEM COMPONENTS

### Charcoal filter and fuel vapour cut out solenoid valve

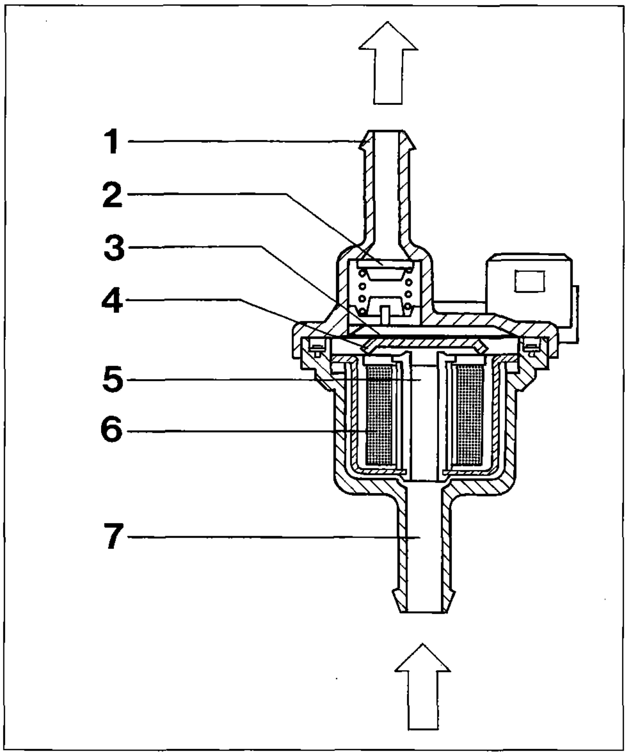
These components form part of the fuel vapour recovery and anti-evaporation system. The charcoal filter is located in the right wheel arch and the rear section of the right front wheel arch liner has to be removed to gain access to it.
The cut out solenoid valve is located in the engine compartment under the inlet manifold.




P4A36LJ01

### Charcoal filter

This consists of charcoal granules (4) which trap the petrol vapours entering through the inlet (5).
The air which enters through the intake (1), passes through the paper filter (3), comes into contact with the charcoal granules removing the petrol vapours and directing them towards the outlet (2) and from there to the cut out solenoid valve.
The air, having entered through the intake (5), can also be recalled by the vacuum in the tank for ventilating it. The partition (6) ensures that the air drawn in comes into contact with all the granules of charcoal assisting the release of the petrol vapours to the inlet manifold.
There are also two springs (7) which allow the expansion of the mass of granules when the pressure increases.




P4A36LJ02

1. Inlet connector
2. One-way valve
3. Spring
4. Shutter
5. Outlet port
6. Electro-magnet
7. Outlet connector

### Vapour cut out solenoid valve (0.280.142.340)

The function of this valve is, by means of the electronic control unit, to control the quantity of petrol vapours drawn in by the charcoal filter and directed to the inlet manifold.
If this valve is not supplied, it is open; by turning the key to the ON position, it closes, in preparation for operation. In effect, if energized the solenoid valve (6) attracts the shutter (4) which, overcoming the spring (3) loading, closes the port (5) preventing the flow of petrol vapours.

The operation is controlled by the electronic control unit in the following way:
- during starting the solenoid valve remains closed, preventing the petrol vapours from excessively enriching the mixture;
- with the engine started up, the electronic control unit sends the solenoid valve a signal which modulates the opening.

In this way the control unit controls the quantity of petrol vapours sent to the inlet, avoiding substantial variations (especially during idling) in the mixture strength.

**NOTE** *The solenoid valve must be fitted in the correct position: the arrow on the casing should be pointing towards the vacuum pick up on the inlet manifold.*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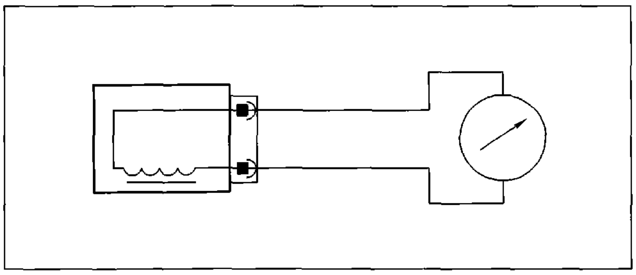
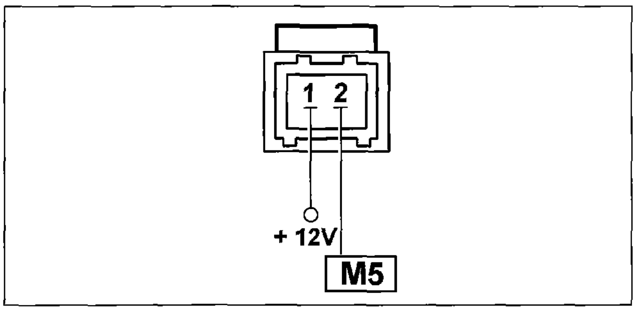


4A37LJ01

## Checking the resistance

The resistance of the solenoid valve can be measured by disconnecting the connector and connecting an ohmmeter as illustrated in the diagram.

**Resistance: 17.5-23.5 ohm at 20 °C**




4A37LJ02

## Wiring connector

The numbers indicate the corresponding control unit pins

## CHECKS - ADJUSTMENTS AND REPAIR OPERATIONS ON THE BOSCH MOTRONIC ME 3.1 INJECTION/IGNITION SYSTEM IN ADDITION TO THE FAULT DIAGNOSIS

*WHEN WORKING ON A VEHICLE EQUIPPED WITH A MOTRONIC INJECTION/IGNITION SYSTEM, OBSERVE THE FOLLOWING PRECAUTIONS:*

- *do not start up the engine with the terminals for the electrical connections not properly connected or slack at the battery poles;*
- *do not use a rapid battery charger to start the engine;*
- *never disconnect the battery from the on board system with the engine running;*
- *when recharging the battery, disconnect it first from the system;*
- *if the vehicle goes into a drying oven after painting, at temperatures in excess of 80 °C, then the injection/ignition electronic control unit must be removed first;*
- *never connect or disconnect the electronic control unit multiple connector with the ignition switch in the ON position;*
- *always disconnect the negative battery lead before carrying out electrical welding on the vehicle.*

*It should be remembered that this system has a memory which is always supplied (stand-by memory) which contains all the self-adjustment figures. If the battery is disconnected then this information is lost and can only be acquired again after a certain length of time so this operation should be carried out as infrequently as possible.*

If the engine control unit or the motorized butterfly casing is being replaced, the self-learning procedure must be carried out for the return spring inside the butterfly casing and maximum/minimum motorized butterfly valve angular positions.

# 10.

### Learning procedure

**NOTE** *During the learning procedure, from the moment the ignition is turned to the ON position until the end of the procedure, do not press the accelerator pedal, the brake pedal or the clutch pedal.*

Manual learning:
- Turn the ignition key to the ON position.
- Wait for 60 seconds; during this period the return spring inside the butterfly casing and the maximum/minimum angular positions of the motorized butterfly valve are checked.
- Turn the ignition key to the OFF position.
- Wait for 10 seconds; during this period the values acquired are recordd in the control unit EEPROM.

Learning with diagnostic equipment signal "learning ended with positive outcome".
- Connect the diagnostic equipment.
- Place the ignition key in the ON position.
- Wait until the diagnostic equipment gives the positive learning outcome signal.
- Turn the ignition key to the OFF position.
- Wait until the diagnostic equipment signals that the procedure is over.

## ENGINE IDLE SPEED CHECK

If the engine idle speed is not 750±50 rpm and the injection/ignition control unit is the self-regulating type, then it is not possible to carry out any adjustments, therefore it is necessary to check that the accelerator linkage is correctly adjusted and the cause of the problem should be sought by carrying out a complete fault diagnosis using the diagnostic equipment.

## CHECKING CONCENTRATION OF POLLUTANT EMISSIONS

Through the self-adjusment of the system, the Motronic ME 3.1 system guarantees a continuous check on the idle speed and CO percentage, thereby making any outside adjustment operations superfluous (there are no adjustment screws). However, a check on the content of the exhaust gases, downstream fo the catalyzer, can provide precious information on the operating conditions of the injection/ignition system, the engine parameters or the catalyzer.

### Checking idle CO and HC concentration upstream of the catalytic silencer

To check the concentration of carbon monoxide (CO) and unburnt hydrocarbons (HC) upstream of the catalyzer, proceed as follows:

1. Undo the cap or nut on the exhaust pipe, upstream of the catalyzer and tighten the tool in its place.
2. Connect a suitably calibrated CO tester probe to the tool.
3. Start up the engine and let it reach operating temperature.
4. Check that the speed corresponds to the recommended figure.
5. Check that the idle CO concentration is within the recommended figures given in the table overleaf; if this is not the case, it is necessary to check:
   - that the Lambda sensor is working properly, using the diagnostic equipment;
   - for the presence of air penetration in the area surrounding the Lambda sensor housing;
   - the injection and ignition system ( **in particular, the wear of the spark plugs**).
6. In the same conditions, check that the concentration of HC is below 600 p.p.m.
7. If these values are not measured, check the engine tuning, paying particular attention to: the ignition advance value - the valve clearances - the valve gear timing - the engine compression.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### Checking exhaust concentration of CO and HC

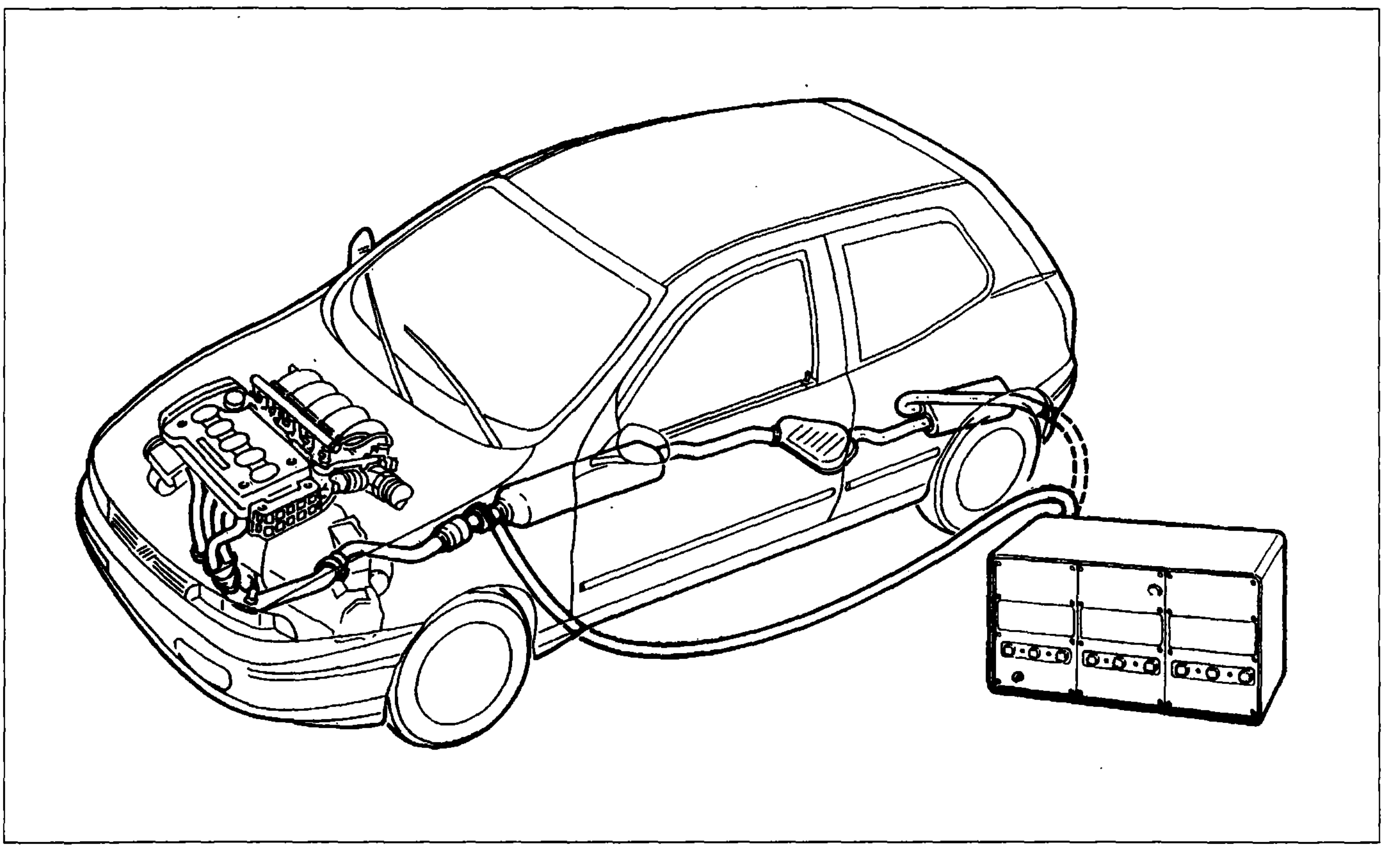
The exhaust concentration of carbon monoxide (CO) and unburnt hydrocarbons (HC) is measured by inserting a suitably calibrated CO tester probe at least 30 cm into the end of the exhaust pipe as shown in the diagram.

If the shape of the end of the exhaust pipe is such that the sensor cannot be fully introduced, a special extension pipe which guarantees the seal in the join area must be added.

1. Check that the idle CO and HC concentrations are the same as those in the table.
2. If the HC value differes from the recommended limit, whilst that measured previously upstream of the catalyzer was correct, the engine parameters are correct and the cause of the problem should therefore be sought in the decreased efficiency of the catalyzer.

### Table summarizing pollutant emission tolerance figures

| | CO (%) | HC (p.p.m.) | $CO_2$ (%) |
|---|---|---|---|
| Upstream of the catalyzer | 0,4 ÷ 1 | 600 | $\geqslant$ 12 |
| Downstream of the catalyzer | $\leqslant$ 0,35 | $\leqslant$ 90 | $\geqslant$ 13 |



P4A39LJ01

## DIAGNOSTICS

The complete fault diagnosis of the system can be carried out through an active dialogue using the diagnostic equipment.
If a fault is detected with the sensors, the electronic control unit replaces the data coming from the faulty sensor with pre-memorized (recovery) data to allow the operation of the engine. If a fault is detected it is permanently stored in the memory and the sensor is excluded from the system until the signal is compatible once again.

The same procedure is applied if the fault involves an actuator or control flap. The detection of a fault and the replacement with recovery data involves the signalling of the fault by the specific warning light in the instrument panel coming on.

The following parameters can, in the case of a failure, be managed by the control unit: flow meter, coolant temperature sensor, butterfly casing actuator, Lambda sensor, air temperature sensor, battery voltage and detonation sensors. In the case of faults in the control unit, the rpm sensor or the electric fuel pump, the system does not identify the fault and the vehicle stops. On request, the operator can read the faults on the control unit using the diagnostic equipment.

### Detecting faults

This is done whilst carrying out the basic function through which the sensor/actuator is managed.

### Memorizing the error and the structure of the errors memory

Errors are memorized in the control unit in the order in which they occur. The location, type of error and environmental conditions (specific for each type of error) are measured the moment the fault is detected for all errors. There is also a frequency counter.

### Classification of the defect

If a defect is recognized for the first time or the error state persists for a time $t > 0.5s$, the defect is memorized as "permanent". If this defect later disappears, it is memorized as "intermittent" and "not present". If it then reappears, it is memorized as "intermittent", but becomes "present".
The classification of a fault as "permanent" activates the recovery functions; when the fault disappears the normal reading or implementation function is resumed.

Several types of fault are classified as "important", i.e. in terma of anti-pollution regulations. The presence of these faults is signalled to the driver by the failure warning light in the instrument panel coming on.

### Frequency counter

Each error is assigned a frequency counter, which is used to determine the moement in which a fault no longer present has been memorized. The first time a fault is detected, the counter is set at 10. If the fault disappears, the counter remains at the current value. If it reappears, it is increased by 1 (with an upper limit 50).
The counter is decreased each time the engine is started up and the fault has not reappeared. If the counter reaches zero, the fault is automatically cancelled from the memory.
If the counter has decreased and the fault reappears, the counter returns to 10 (if it was already above 10, it is not altered).

### Signalling a fault

The failure warning light comes on when a defect is memorized as "present" and "important".
The delay time between detecting the fault and the warning light coming on is 0.1 seconds; the delay time between the fault disappearing from the memory and the warning light going out is 4 seconds.
The warning light comes on each time the ignition key is turned to the ON position. If "important" faults are aleady present, the warning light goes out after 4 seconds.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### Cancelling errors

When the frequency counter reaches 0, the fault and the parameters associated with it are cancelled.

The immediate cancelling of the entire errors memory takes place through the "cancel errors memory" command sent by the diagnostic equipment.

### Connector with the diagnostic equipment

The diagnostic socket to which the diagnostic equipment (Examiner or SDC station) is connected is located at the front of the engine compartment on the right hand side (see diagram on page 18).

The exchange of data between the control unit and the diagnostic equipment takes place via a two-way serial line (line K) using the standard Bosch communication protocol.

The diagnostic equipment can supply the following information:

- display of the errors;
- display of the engine parameters;
- active diagnosis

### List of errors

| Description | Nature of the errors |
|---|---|
| Rpm sensor | Signal loss |
| Air temperature sensor | Implausible signal |
| Coolant temperature sensor | C.A-C.C. |
| Battery | Voltage not plausible |
| Lambda sensor | C.C. |
| Injector | C.A.-C.C |
| Butterfly casing actuator | Potentiometer signal not plausible |
| Petrol vapour solenoid valve | C.C. |
| Relays actuators | C.A.-C.C. |
| Control unit | Faults in the operation of the microprocessor or the control unit memories are signalled. |
| Flow meter | Implausible signal |
| Timing sensor | Implausible signal |
| Detonation sensor | Implausible signal |
| Speedometer sensor | Missing or implausible signal |
| Phase transformer | C.C. |
| Electric fuel pump | C.C. |
| Fiat CODE | Code not recognized or not received |

**Parameters displayed**

Engine rpm
Injection time
Advance
Intake air temperature
Coolant temperature
Butterfly valve opening angle
Battery voltage
Lambda sensor
Self-adjustment
Flow meter
Engine knock (detonation)
Vehicle speed
Petrol vapour cut out solenoid valve
Fiat CODE
Atmospheric pressure

**Active diagnosis**

The following tests can be activated using the diagnostic equipment:
- Phase transformer
- Injector
- Failure warning light
- Petrol vapour solenoid valve
- Air conditioning
- Idle speed actuator
- Cancelling errors.

**Recovery**

If there are faults with the sensors, the control unit replaces the figure transmitted by the sensor with a Recovery value which, depending on the different problems, is either stored in the control unit memory or is constructed specially using the other information available in order to allow the vehicle to reach a Service Centre.

**Permanent memory**

The control unit is equipped with a «permanent» type memory (EEPROM), i.e. it keeps a record of the error even when the cause of the problem no longer exists and if the ignition is switched OFF and a «volatile» memory (RAM) where the information concerning the error is lost as soon as the cause of the problem ceases.
This also allows the more effective identification of error of an occasional nature.
Before ending the fault diagnosis, the contents of the «permanent» memory should be cancelled using the diagnostic equipment in Active diagnosis.

The contents of the «permanent» errors memory can be cancelled in the following ways:

1 - Using the diagnostic equipment in active diagnosis.

If this is not the case, when the diagnostic equipment is reconncted, the errors already examined will be signalled.

2 - If the cause of the error is longer present and the engine has been started up 5 times (running for at least 20 minutes) with an interval of at least 2 minutes between each starting up.

*Disconnecting the control unit from the system, even for very long periods, does not cancel the contents of the «permanent» memory.*


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page

## FUEL SYSTEM

### INTRODUCTION

The Fiat Bravo and Brava 1.9 JTD are equipped with a 4 cylinder in line 1920 cc turbodiesel engine with two valves per cylinder, a counter-balance shaft, an overhead camshaft, supercharged by a turbocharger with an intercooler and with electronic fuel injection.

The fuel system ensures the correct operation of the engine and can be divided into the following circuits:
- fuel supply circuit with common rail type injection;
- air supply circuit;
- exhaust circuit;
- oil vapour recirculation circuit from the crankcase;
- exhaust gas recirculation circuit (EGR).

The optimum operation of the various fuel system "circuits" is achieved through an electronic control system managed by a special control unit.
The main feature of the fuel system is the common rail type injection of the fuel. This is a high pressure electronic injection system for direct injection fast diesel engines.
The main features of the common rail system are:
- availability of high injection pressures (up to 1350 bar);
- possibility of modulating these pressures (from a minimum of 150 bar up to a maximum of 1350 bar) indepedent of the engine rotation speed and load;
- capacity to operate at high engine speeds (up to 6000 rpm);
- precision injection operation (advance and duration of the injection);
- reduction in fuel consumption;
- reduction in emissions.

### FUEL SYSTEM MANAGEMENT STRATEGIES

There is a management programme (software) in the control unit memory which consists of a series of strategies, each of which manages a precise system control function.
By using information supplied by the various sensors (input), each strategy processes a series of parameters, using maps stored in special areas of the control unit memory and then operates the system actuators (output) which are the devices which allow the operation of the engine.

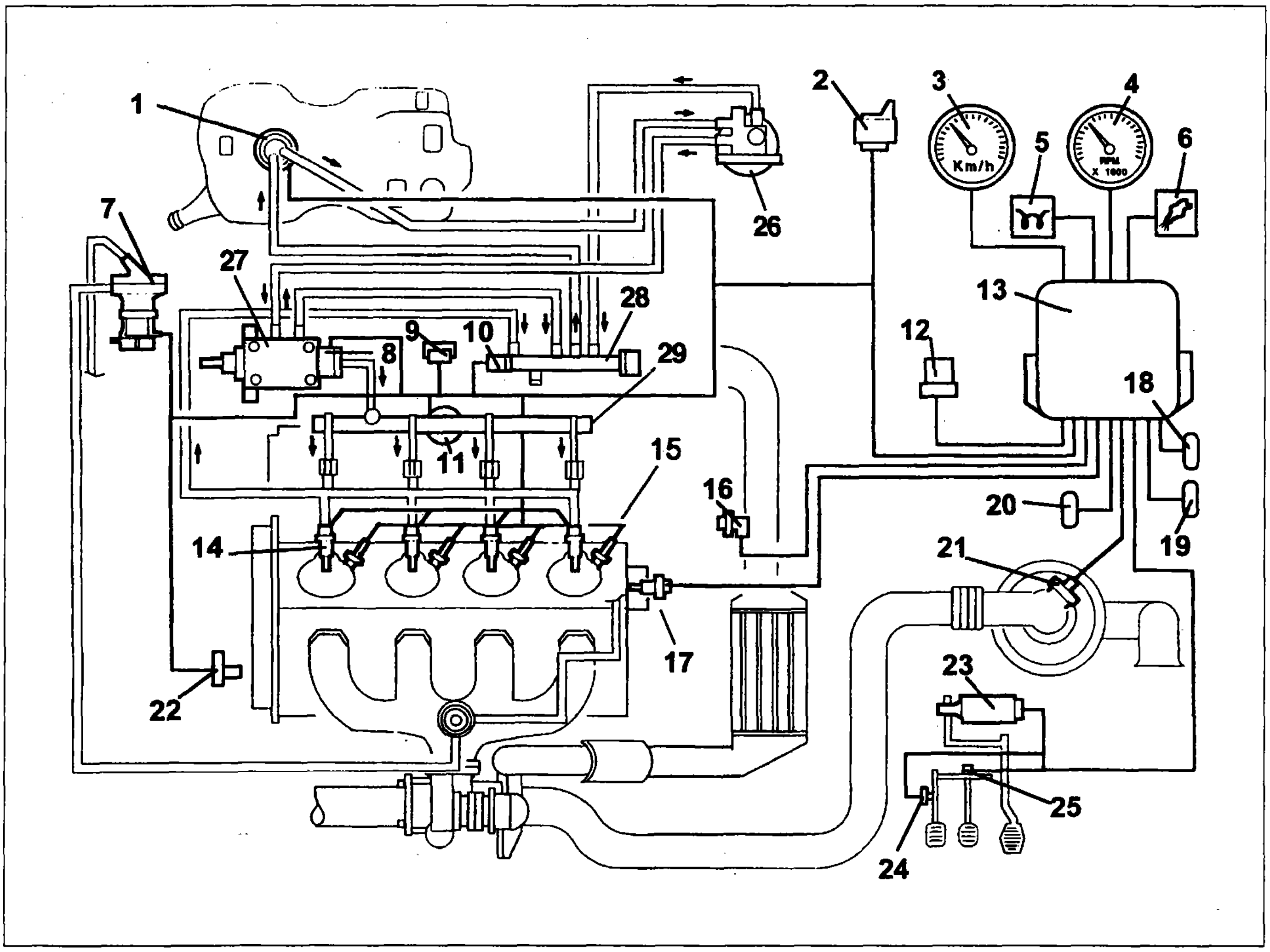
The main aim of the management strategies is to determine the exact quantity of fuel which should be injected into the cylinders at one time (injection advance) and the pressure to achieve the best engine behaviour in terms of power, consumption, fumes, emissions and driveability.

The main system management strategies are, basically, as follows:

- control of quantity of fuel injected;
- control of injection advance;
- control of injection pressure;
- control of auxiliary electric fuel pump;
- control of injection during deceleration (Cut-off);
- control of idle speed;
- control of maximum speed restriction;
- control of maximum torque restriction;
- control of fuel temperature;
- control of engine coolant temperature;
- control of heater plugs;
- control of exhaust fumes;
- control of exhaust gas recirculation (EGR);
- control of engagement of climate control system;
- control of engine immobilizer function (Fiat CODE);
- autodiagnosis.

# 10.

## FUNCTIONAL DIAGRAM SHOWING FUEL SYSTEM




1. Auxiliary electric fuel pump
2. Heater plugs control unit
3. Vehicle speed
4. Rev counter
5. Heater plugs warning light
6. Infocenter (system failure indication)
7. EGR valve modulator
8. Pressure regulator
9. Excess pressure sensor
10. Fuel temperature sensor
11. Fuel pressure sensor
12. Injection system relay
13. Electronic control unit
14. Injectors
15. Heater plugs
16. Rpm sensor
17. Engine coolant temperature sensor
18. Climate control system connector
19. Diagnostic socket
20. Fiat CODE system connector
21. Flow meter
22. Timing sensor
23. Potentiometer on accelerator pedal
24. Switch on clutch pedal
25. Switch on brake pedal
26. Fuel filter
27. Pressure pump
28. Return manifold (low pressure)
29. Supply manifold (high pressure)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**Controlling the quantity of fuel injected**

On the basis of the signals coming from the accelerator pedal potentiometer, the flow meter and the rpm sensor, the control unit operates the fuel pressure regulator and the injectors, as appropriate.
The timing and consequently the injection sequennce, is determined by the starting of the engine using the signals coming from the rpm sensor and the timing sensor (synchronization stage); later, the injection timing is implemented using only the rpm sensor signal and the injection sequence 1-3-4-2.

The control unit inhibits the injection in the following cases:
- fuel pressure value above 1500 bar;
- fuel pressure value below 120 bar;
- engine speed above 6000 rpm.

At operating temperature the maximum duration of the injection (injector opening time) is 1500 ns, whilst during starting it can reach 3000 ns.

**Control of injection advance**

The electronic control unit determines the injection advance mainly on the basis of the quantity of fuel to be injected.
Later on, the injection advance is corrected according to the temperature of the engine coolant and the speed in order to compensate, whilst the engine is warming up, for the increase in the ignition delay due to the low temperatures in the combustion chambers.

**Control of injection pressure**

This check is esepcailly important because the injection pressure affects the following parameters:
- the quantity of fuel introduced into the cylinders for the duration of the injection time;
- the atomization of the fuel injected;
- the penetration of the jet;
- the delay between the electrical operation of the injector and the effective start and end of injection.

The above mentioned parameters have a considerable effecton the behaviour of the engine, especially as far as the power supplied, exhaust emissions, noise and driveability are concerned.
On basis of the engine load, the injection control unit operates the pressure regulator to ensure a line pressure which is always optimum.
With the engine cold, the injection pressure is corrected on the basis of the engine coolant temperature and speed in order to satisfy the engine requirements at different operating temperatures.

**Control of the auxiliary electric fuel pump**

The auxiliary electric fuel pump, immersed in the tank, is supplied by the injection control unit via a relay when the ignition key is in the ON position.

The supply to the electric pump is inhibited when one of the following conditions occurs:
- after the ignition key has been in the ON position for a certain length of time and the engine has not been started up;
- if the inertia switch has been operated.

**Control of injection during deceleration (cut-off)**

The cut-off strategy is implemented when the injection control unit receives the information from the potentiometer that the accelerator pedal is released.
Under these circumstances, the control unit removes the supply to the injectors and reactivates before the idle speed is reached.

### Control of the idle speed

On the basis of the signals coming from the rpm sensor and the engine coolant temperature sensor, the injection control unit controls the pressure regulator and varies the operating times for the injectors to keep the idle speed stable.
Under certain circumstances, in order to control the idle speed, the control unit also takes the battery voltage into account.

### Control of the maximum speed restriction

According to the engine speed, the injection control unit restricts the maximum speed through two types of intervention:
- as the maximum speed is approached, it decreases the quantity of fuel injected, reducing the line pressure;
- when 6000 rpm is exceeded, it inhibits the operation of the injectors.

### Control of the maximum torque restriction

Depending on the engine speed, the injection control unit calculates the torque limit and maximum permissible fumes parameters based on pre-defined maps stored in the memory.
It then corrects the above parameters using engine coolant temperature and vehicle speed data and uses the values obtained in this way for metering the quantity of fuel to be injected involving the pressure regulator and the injectors.

### Control of fuel temperature

The injection control unit is constantly informed of the temperature of the fuel by the sensor on the return manifold.
If the temperature of the fuel exceeds a certain level (about 110 °C), the control unit reduces the line pressure acting on the pressure regulator and leaving the injection times unaltered.

### Control of engine coolant temperature

The injection control unit is constantly informed of the temperature of the engine coolant by the sensor on the thermostat.
If the temperature of the engine coolant exceeds certain values, the control unit implements the following strategies:
- it reduces the quantity of fuel injected acting on the pressure regulator and the injectors (power reduction);
- it operates the engine cooling radiator fan.

### Control of heater plugs

The injection control unit controls the operation of the heater plugs control unit so that the temperature in the combustion chambers is at a level which assists the self-ignition of the fuel and consequently facilitates starting.
In effect the injection control unit controls the operation of the heater plugs control unit for a certain length of time both before starting (pre-heating) and after starting (post-heating) and also controls the coming on of the warning light in the instrument panel.
The pre-heating and post-heating times plus the coming of the heater plugs warning light all vary according to the temperature of the engine coolant.


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**Control of exhaust fumes**

Through this function the injection control unit limits any exhaust fumes which could occur during strong acceleration.
In order to satisfy this requirement, the control unit processes the signals supplied by the accelerator pedal potentiometer, the rpm sensor and the intake air quantity sensor (flow meter) and operates the fuel pressure regulator and the injectors to correctly meter the quantity of fuel to be injected.

**Control of exhaust gas recirculation**

On the basis of the signals supplied by the rpm, intake air quantity, engine coolant temperature and accelerator pedal position sensors, the injection control unit calculates the operating times for the EGR solenoid valve so that the exhaust gases are partly recirculated in certain engine operating conditions.

**Control of engagement of air conditioning system**

The injection control unit manages the operation of the air conditioning system compressor electro--magnet coupling following a logic aimed at preventing operating conditions which would adversely affect engine performance.

When the compressor is switched on, the injection control unit increases the quantity of fuel during idling so that the engine can meet the request for more power and interruptsthe supply to the compressor in the following conditions:
- request for high power for the engine (strong acceleration);
- excessive engine coolant temperature.

**Control of engine immobilizer function**

The system is equipped with an engine immobilizer function. This function is achieved through the presence of a special control unit (Fiat CODE), capable of dialogue with the injection control unit and an electronic key, with a special transmitter for sending a recognition code.
Each time the key is turned to the OFF position, the Fiat CODE system completely deactivates the injection control unit.

When the ignition key is placed in the ON position, the following operations take place in order:
1. the injection control unit (whose memory contains a secret code) sends the Fiat CODE control unit a request for the latter to send the secret code to deactivate the immobilizer function;
2. the Fiat CODE control unit responds by only sending the secret code after having, in turn, received the recognition code transmitted by the ignition key;
3. the recognition of the secret code allows the de-activation of the injection control unit immobilizer function and normal operation to be resumed.

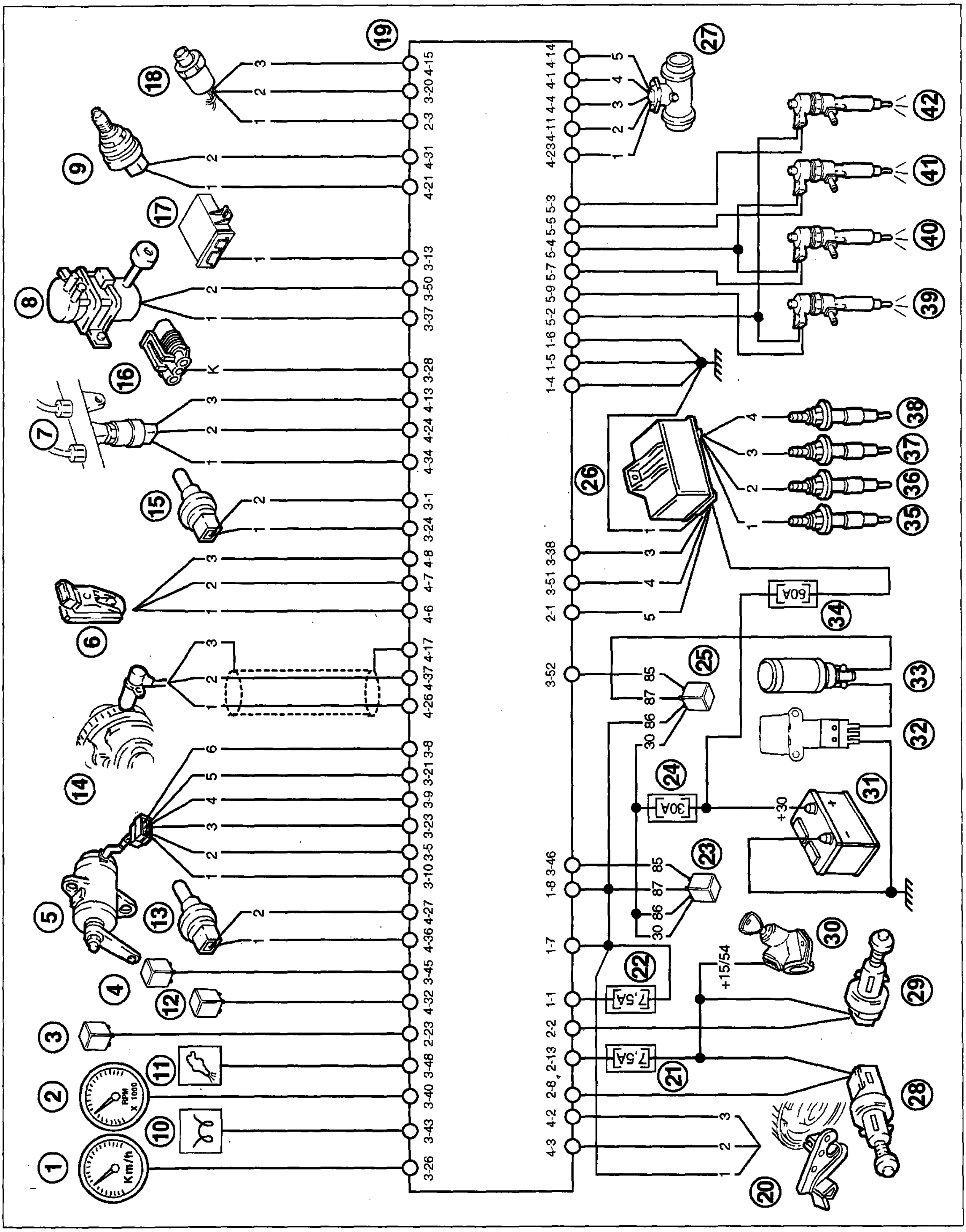
**Autodiagnosis**

The complete electronic fault diagnosis of the injection system can be carried out by connecting the special equipment (EXAMINER or SDC station) to the diagnostic socket.

The system is also equipped with an autodiagnostic function which recognizes, memorizes and signals any failures.

If a fault is detected at the sensors or actuators, the signal reconstruction (recovery) strategies are immediately activated to ensure the operation of the engine at an acceptable level. The vehicle can therefore be driven to a Service Centre to have the appropriate repairs carried out.

## INJECTION SYSTEM WIRING DIAGRAM




P4A06KJ01



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**Key to injection system wiring diagram components**

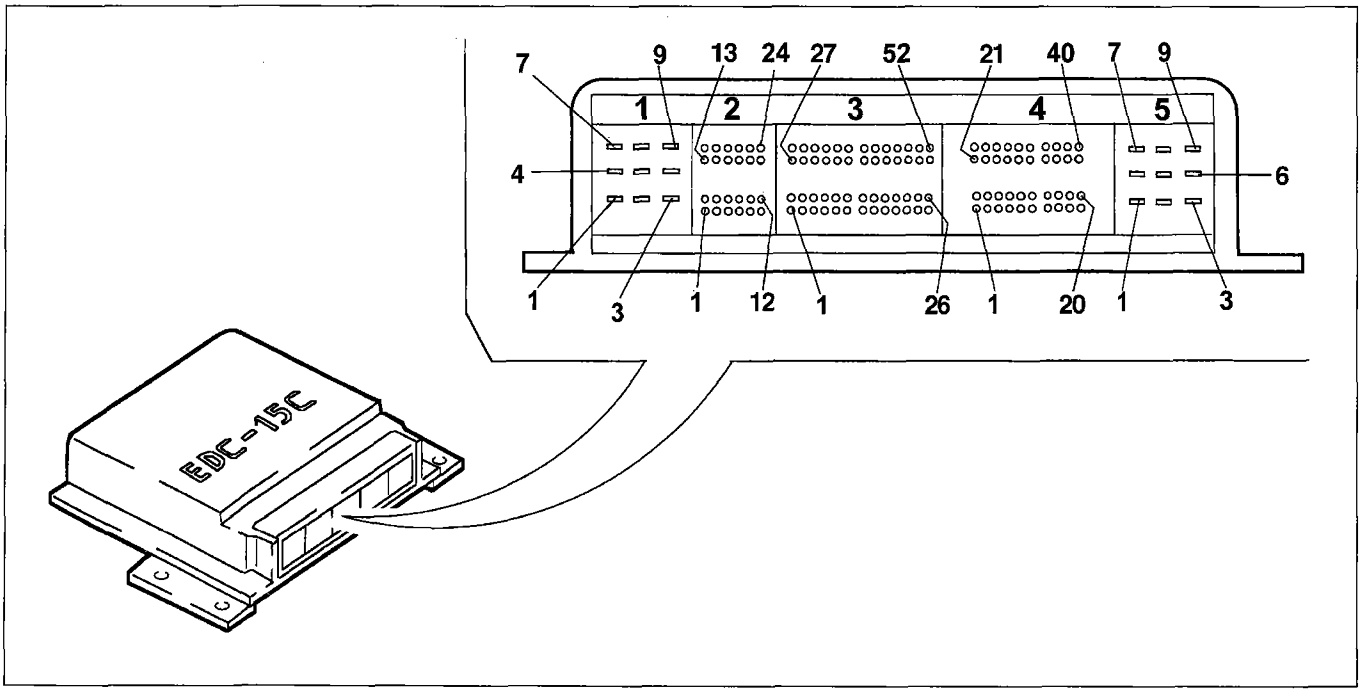
1. Vehicle speed
2. Rev counter
3. Engine cooling fan low speed relay
4. Radiator fan high speed activation relay
5. Potentiometer on accelerator pedal
6. Excess pressure sensor
7. Fuel pressure sensor
8. EGR system modulator solenoid
9. Fuel pressure regulator
10. Glow plug preheating warning light on control panel
11. Injection system failure warning light
12. Air conditioner control relay
13. Coolant temperature sensor
14. RPM sensor
15. Fuel temperature sensor
16. Tester connection
17. Fiat CODE control unit
18. Four stage pressure switch
19. Injection electronic control unit
20. Timing sensor
21. Fuse (7.5A) protecting injection control unit (+15 power supply from ignition switch)
22. Fuse (7.5A) protecting injection control unit (+30 power supply from battery)
23. Injection system main relay
24. 30A fuse protecting injection system
25. Auxiliary fuel pump supply relay
26. Glow plug preheating control unit
27. Intake air flow and temperature sensor (debimeter)
28. Brake pedal switch
29. Clutch pedal switch
30. Ignition switch
31. Battery
32. Inertia switch
33. Auxiliary fuel pump (submerged in tank)
34. 60A fuse protecting glow plug control unit
35. Cylinder no.1 glow plug
36. Cylinder no.2 glow plug
37. Cylinder no.3 glow plug
38. Cylinder no.4 glow plug
39. Cylinder no.1 injector
40. Cylinder no.2 injector
41. Cylinder no.3 injector
42. Cylinder no.4 injector

# 10.

## INJECTION ELECTRONIC CONTROL UNIT

The injection control unit processes signals from the various sensors by applying software algorithms and controls the actuators accordingly (particularly the injectors and pressure regulator) to achieve the best possible engine service conditions.
The control unit is "flash E.P.R.O.M." type, i.e. it can be reprogrammed from outside without andy need to adjust the hardware.
The injection control unit contains a built-in absolute pressure sensor and is connected to the wiring bya 134 pin connector

### Identifying injection control unit connections (pin-out)



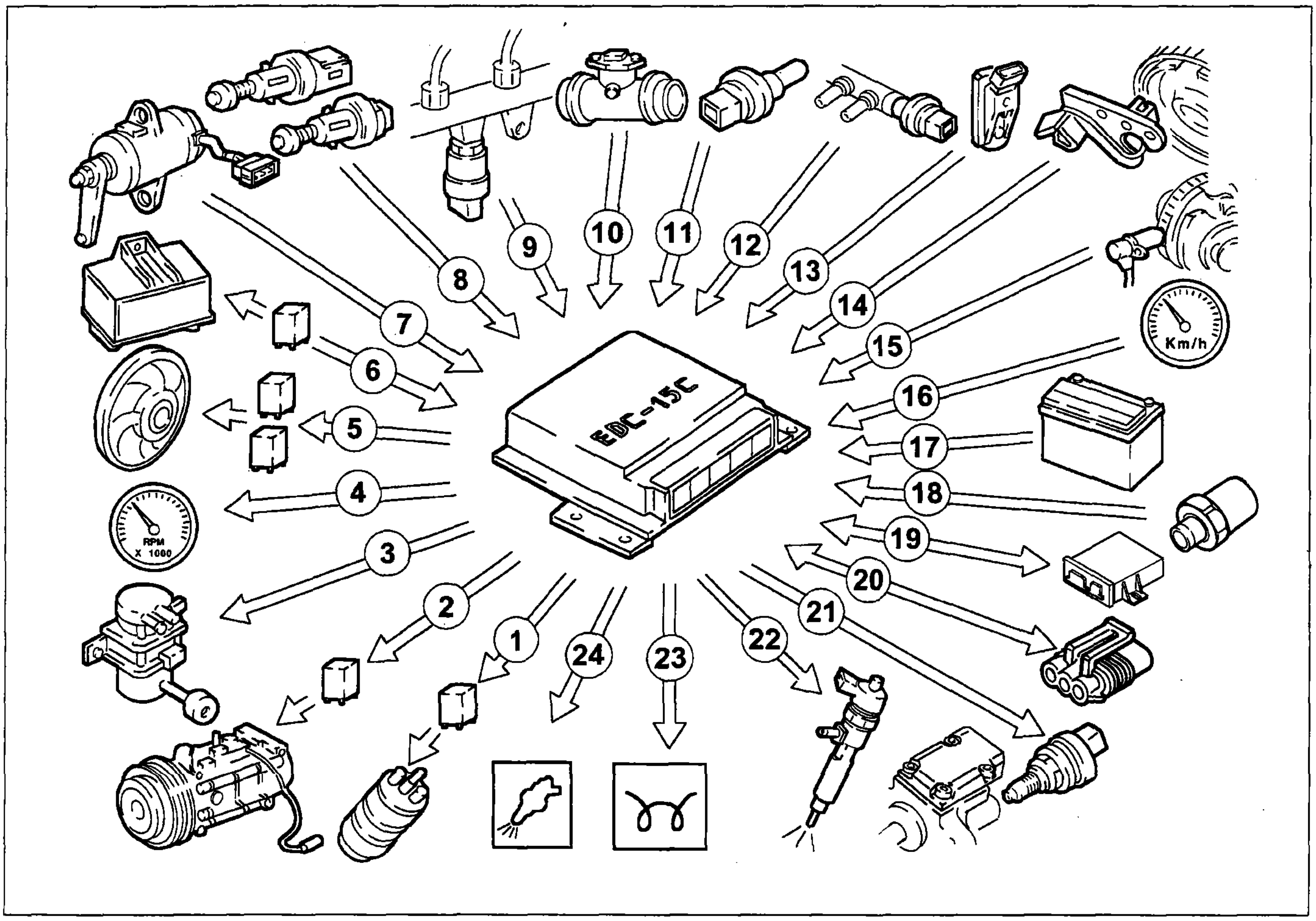

4A08KJ01

1-01 Battery positive (+30) from main relay
1-02 Not connected
1-03 Not connected
1-04 Earth
1-05 Earth
1-06 Earth
1-07 Battery positive (+30) from main relay
1-08 Battery positive (+30) from main relay
1-09 Not connected
2-01 Glow plug timer signal
2-02 Clutch pedal switch
2-03 Climate control system activation request
2-04 Not connected
2-05 Not connected
2-06 Not connected
2-07 Not connected
2-08 Brake pedal switch
2-09 Not connected
2-10 Not connected
2-11 Not connected
2-12 Not connected
2-13 Positive (+15) from ignition switch
2-14 Not connected
2-15 Not connected
2-16 Not connected
2-17 Not connected
2-18 Not connected
2-19 Not connected
2-20 Not connected
2-21 Not connected
2-22 Not connected
2-23 Low radiator fan speed activation request
2-24 Not connected
3-01 Fuel temperature sensor earth
3-02 Not connected
3-03 Not connected

3-04 Not connected
3-05 Accelerator pedal potentiometer 1 supply
3-06 Not connected
3-07 Not connected
3-08 Accelerator pedal potentiometer 2 earth
3-09 Accelerator pedal potentiometer 2 signal
3-10 Accelerator pedal potentiometer 1 signal
3-11 Not connected
3-12 Not connected
3-13 Fiat CODE control unit
3-14 Not connected
3-15 Not connected
3-16 Not connected
3-17 Not connected
3-18 Not connected
3-19 Not connected
3-20 Go ahead to engage climate control from four stage pressure switch
3-21 Accelerator pedal potentiometer 2 supply
3-22 Not connected
3-23 Accelerator pedal potentiometer 1 earth
3-24 Fuel temperature sensor signal
3-25 Not connected
3-26 Vehicle speed signal (from ABS)
3-27 Not connected
3-28 Diagnostic sockect connection (line K)
3-29 Not connected
3-30 Auxiliary electric fuel pump supply (immersed in the tank)
3-31 Not connected
3-32 Not connected
3-33 Not connected
3-34 Not connected
3-35 Not connected
3-36 Not connected
3-37 EGR modulating solenoid valve supply
3-38 Heater plugs timer control
3-39 Not connected
3-40 Rpm signal to the rev counter
3-41 Not connected
3-42 Not connected
3-43 Heater plugs warning light
3-44 Not connected
3-45 Request to engage engine radiator fan high speed
3-46 Main relay go ahead
3-47 Not connected
3-48 Injection system failure
3-49 Not connected
3-50 EGR modulating valve earth
3-51 Heater plugs timer control
3-52 Auxiliary electric pump relay feed go ahead
4-01 Flow meter supply
4-02 Timing sensor earth
4-03 Timing sensor signal
4-04 Flow meter earth
4-05 Not connected
4-06 Excess pressure sensor signal
4-07 Excess pressure sensor earth
4-08 Excess pressure sensor supply
4-09 Not connected
4-10 Not connected
4-11 Flow meter supply
4-12 N.C.
4-13 Fuel pressure sensor supply
4-14 Flow meter signal
4-15 Four stage pressure switch
4-16 Not connected
4-17 Rpm sensor screening
4-18 Not connected
4-19 Not connected
4-20 Not connected
4-21 Fuel pressure regulator
4-22 Not connected
4-23 Air temperature sensor signal
4-24 Fuel pressure sensor signal
4-25 Not connected
4-26 Rpm sensor signal
4-27 Engine coolant temperature sensor earth
4-28 Not connected
4-29 Not connected
4-30 Not connected
4-31 Fuel pressure regulator
4-32 Climate control system relay
4-33 Not connected
4-34 Fuel pressure sensor earth
4-35 Not connected
4-36 Engine coolant temperature sensor signal
4-37 Rpm sensor earth
4-38 Not connected
4-39 Not connected
4-40 Not connected
5-01 N.C.
5-02 Supply for injectors for cylinders 1 and 4
5-03 Operation of injector for cylinder no. 4
5-04 Supply for injectors for cylinders no. 2 and 3
5-05 Operation of injector for cylinder no. 3
5-06 Not connected
5-07 Operation of injector for cylinder no. 2
5-08 N.C.
5-09 Operation of injector for cylinder no. 1

# 10.

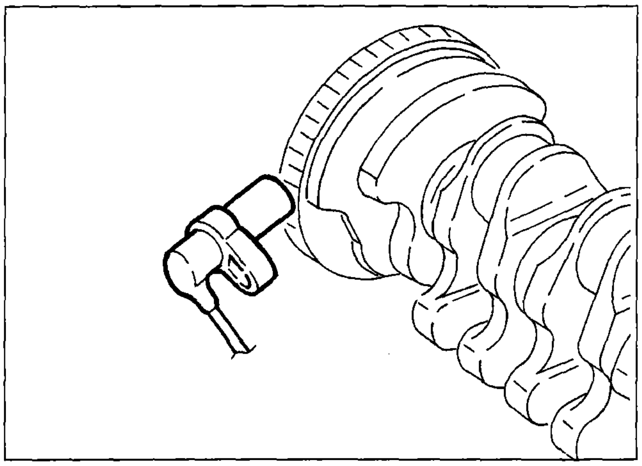
## DIAGRAM SHOWING INFORMATION ENTERING/LEAVING THE INJECTION CONTROL UNIT AND SENSORS/ACTUATORS




P4A10KJ01

1. Auxiliary electric fuel pump
2. Climate control compressor
3. EGR modulating valve
4. Rev counter
5. Engine radiator fans
6. Heater plugs control unit
7. Accelerator pedal potentiometer
8. Brake and clutch pedal switches
9. Fuel pressure sensor
10. Intake air temperature and quantity sensor (flow meter)
11. Engine coolant temperature sensor
12. Fuel temperature sensor
13. Excess pressure sensor
14. Timing sensor
15. Rpm sensor
16. Vehicle speed
17. Battery
18. Four stage pressure switch
19. Fiat CODE control unit
20. Diagnostic socket
21. Fuel pressure regulator
22. Injectors
23. Heater plugs warning light
24. Injection system failure


*Print no. 506.670/16*



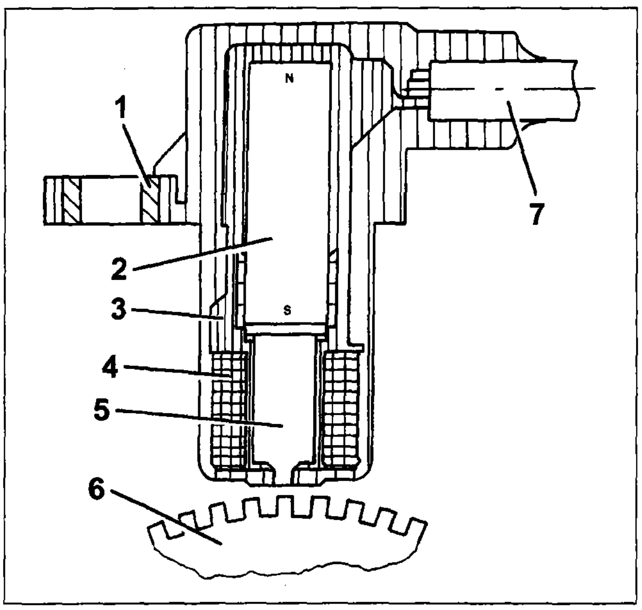
P4A11KJ01

## RPM SENSOR

The rpm sensor is fitted on the cylinder block-/crankcase facing the flywheel on the crankshaft.

The sensor is the inductive type, in other words it operates through the variation in the magnetic field produced by the teeth on the flywheel (60-2 teeth) passing in front of the sensor element.

The injection control unit uses the rpm sensor signal to determine the crankshaft angular position and speed.



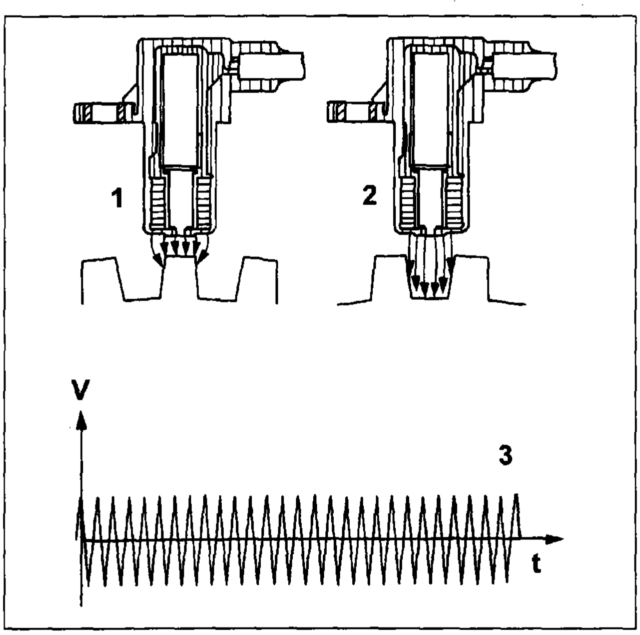

P4A11KJ02

### Operation

The passage from full to empty due to whether or not there is a tooth, determines a variation in the magnetic flow sufficient to produce an alternating voltage from the counting of the teeth on the flywheel.

The peak rpm sensor output voltage depends, all things being equal, on the distance between the sensor and the flywheel teeth.

1. Metal bush
2. Permanent magnet
3. Sensor body
4. Winding
5. Core
6. Flywheel
7. Electrical connection




P4A11KJ03

To obtain the correct signals, the recommended distance between the flywheel and the sensor (gap) should be between 0.8 and 1.5 mm.

This distance cannot be adjusted therefore if the gap is outside of the tolerance, check the condition of the sensor and the flywheel.

**Winding resistance: 860 Ohm ±10% at 20 °C**

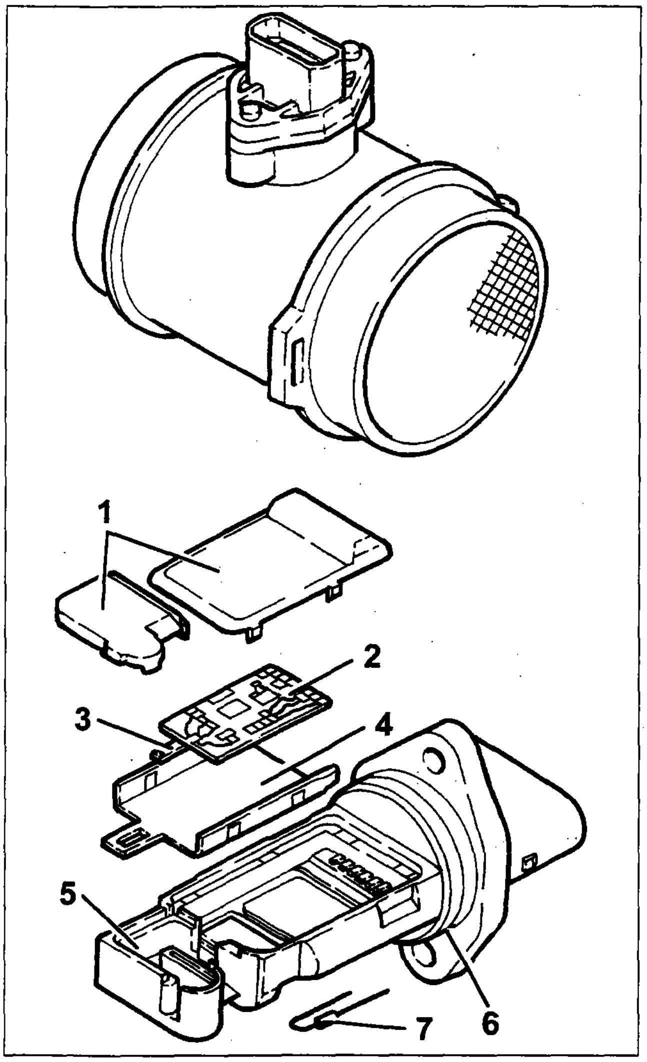
1. Maximum mangetic flow
2. Minimum magnetic flow
3. Alternating voltage

## TIMING SENSOR

This Hall effect type sensor is fitted on the cylinder and is facing the camshaft pulley (exhaust).
There is an opening in the pulley which allows the timing sensor to detect the engine timing position and signal it to the injection control unit.
The injection control unit uses the timing sensor signal to recognize TDC at the end of the compression stroke.

### Operation

A semiconductor layer, through which a current flows, immersed in a normal magnetic field (lines of force perpendicular to the direction of the current), produces a difference in power known as Hall voltage.
If the intensity of the current remains constant, the voltage produced only depends on the intensity of the magnetic field; therefore if the intensity of the magnetic field simply varies periodically this produces a modulated electrical signal, whose frequency is proportional to the speed at which the magnetic field changes.
To produce this change, a metal ring (inner part of the pulley) with an opening passes through the sensor.
As it moves, the metal part of the ring covers the sensor blocking the magnetic field with a consequent low output signal; conversely, by the opening where the magnetic field is present, the sensor produces a high signal.
This signal, together with the signals relating to the rpm and TDC, allow the injection control unit to recognize the position of the pistons and determine the injection point.



P4A12KJ01

## AIR FLOW METER

The flow meter is located on the air inlet hose and is the hot film type.
The intake air temperature sensor is incorporated inside the flow meter.

### Operation

The operating principle is based on a heated diaphragm in a measuring duct through which the intake air which enters the engine flows.
The hot film diaphragm is kept at a constant temperature (about 120 °C higher than the temperature of the inlet air) by the heating resistance.
The mass of air passing through the measuring duct tends to remove heat from the diaphragm therefore, in order to keep the latter at a constant temperature, a current is passed through the resistance.
This current, being proportional to the mass of air which flows to the engine, is measured using a Wheatstone bridge and the signal obtained is sent to the injection control unit.

1. Covers
2. Electronic card
3. Sensor
4. Support plate
5. Support
6. Seal (O-Ring)
7. Temperature sensor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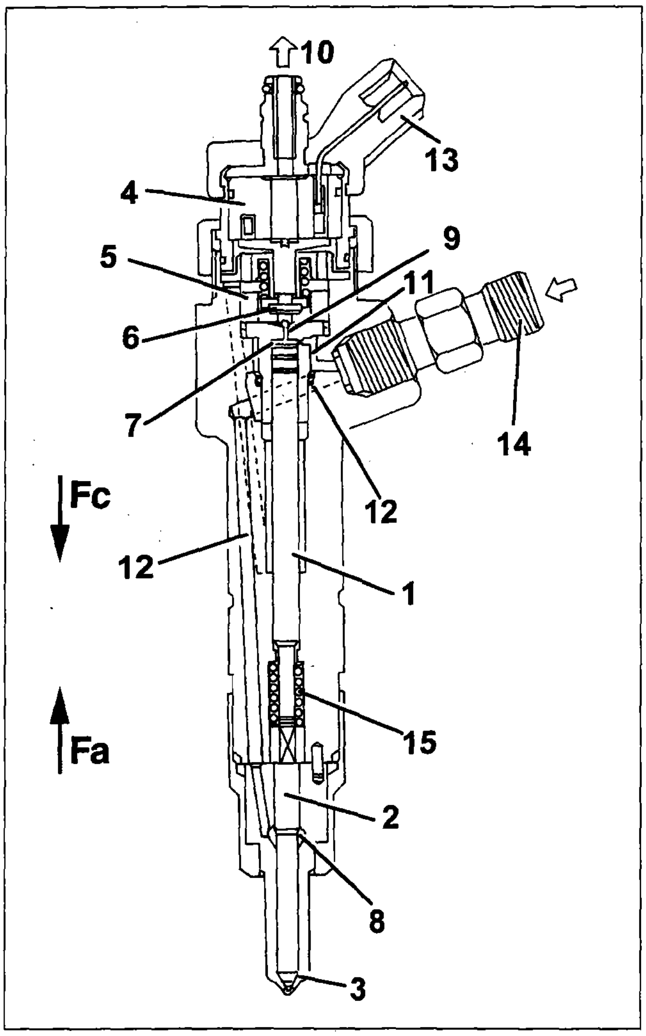



P4A13KJ01

1. Pressure rod
2. Pin
3. Jet
4. Coil
5. Valve
6. Shutter with ball
7. Control area
8. Supply volume
9. Control volume
10. Fuel outlet connector (low pressure)
11. Control manifold
12. Supply manifold
13. Electrical connection
14. Fuel inlet connector (high pressure)
15. Spring

## INJECTORS

The injectors, fitted on the cylinder head, are the electro-magnetic type, operated directly by the injection control unit.
The injectors are equipped with a high pressure supply duct and a recirculation pipe at ambient pressure; the supply duct is connected to the supply manifold (rail) with pipes designed to withstand the high operating pressures.

The injector can be divided into two parts:
- actuator/nozzle consisting of a pressure rod (1), pin (2) and jet (3);
- solenoid valve consisting of a coil (4) and valve (5).

### Operation

The operation of the injectors can be divided into three stages:

*1. rest position*

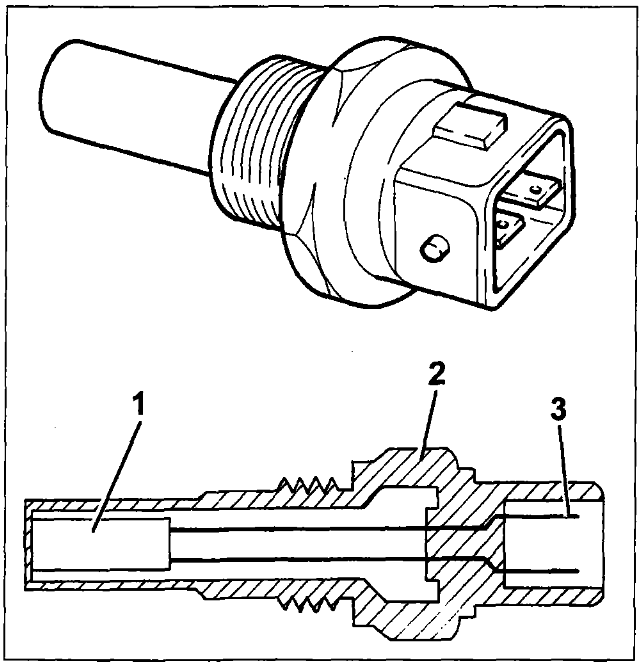
The coil (4) is de-energized and the shutter (6) is in the closed position and does not allow the introduction of fuel into the cylinder: Fc>Fa where Fc is the force produced by the pressure which acts on the control area (7) of the pressure rod (1) and Fa is the force produced by the pressure acting on the supply volume (8).

*2. start of injection*

The coil (4) is energizd and raises the shutter (6). The fuel flows from the control volume (9) to the return manifold causing a decrease in pressure in the control area (7). At the same time, the line pressure through the supply manifold (12) exerts a force Fa>Fc on the supply volume (8) raising the pin (2) with the consequent introduction of fuel into the cylinders.

*3. end of injection*

The coil (4) is de-energized and returns the shutter (6) to the closed position which restores a balance which returns the pin (2) to the closed position and consequently the injection ends.




P4A14KJ01

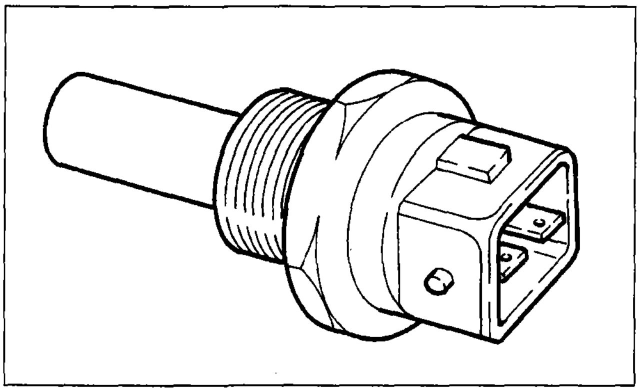
## ENGINE COOLANT TEMPERATURE SENSOR

This sensor is fitted on the thermostat and detects the temperature of the engine coolant by means of an NTC thermistor with a negative resistance coefficient.

The sensor is produced using semiconductor technology, therefore if the temperature of the sensor element increases as the temperature of the coolant increases, the resistance value decreases as a result.

As the variation in the resistance is not linear, the same increase in temperature is greater at lower temperatures than at higher temperatures.

1. NTC resistance
2. Sensor body
3. Electrical connector

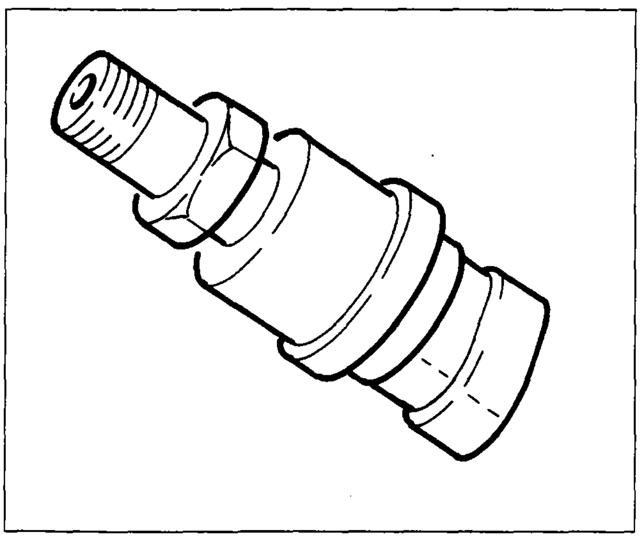


P4A14KJ02

## FUEL TEMPERATURE SENSOR

This sensor is fited on the return manifold and detects the temperature of the fuel through an NTC thermistor which has a negative resistance coefficient.

For the operation of the sensor, refer to the previous description dealing with the coolant temperature sensor.



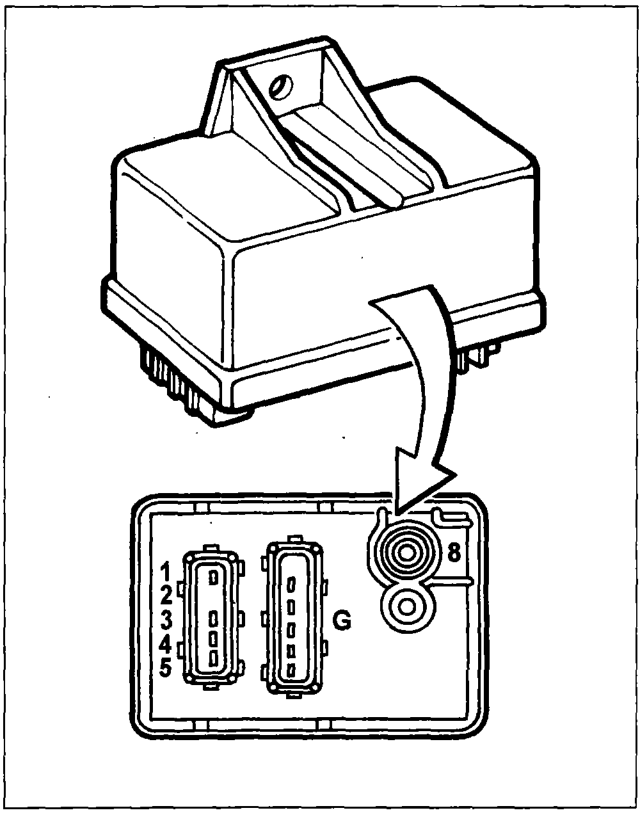
P4A14KJ03

## FUEL PRESSURE SENSOR

This sensor is fitted in the centre of the fuel supply manifold (rail) and has the task of supplying the injection control unit with a return ("feed-back") signal for:

- regulating the injection pressure;
- regulating the duration of the injection.


*Print no. 506.670/16*



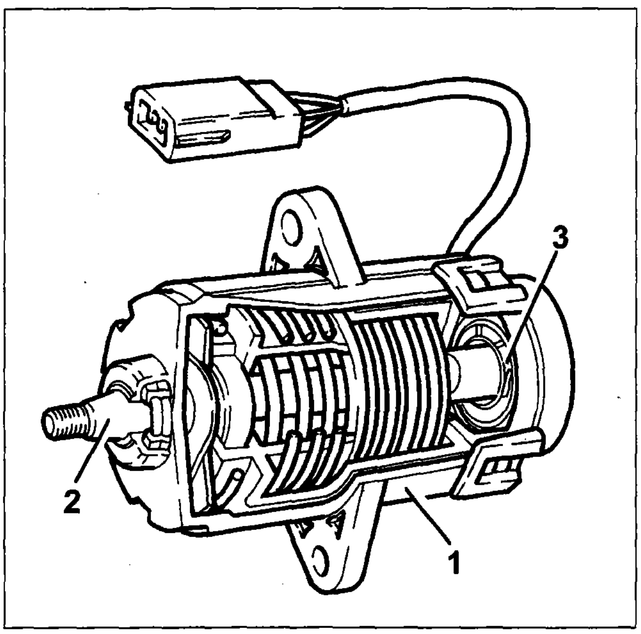

P4A15KJ01

### HEATER PLUGS CONTROL UNIT

The operation of the heater plugs takes place through the heater plugs control unit under the direct control of the injection control unit.
There is an "intelligent" relay inside the heater plugs control unit which sends feed-back to the injection control unit which is thereby informed of any failure in the heater plugs control unit or a short circuit to earth of the heater plugs.

The diagram illustrates the connectors at the base of the heater plugs control unit and the pin-out:

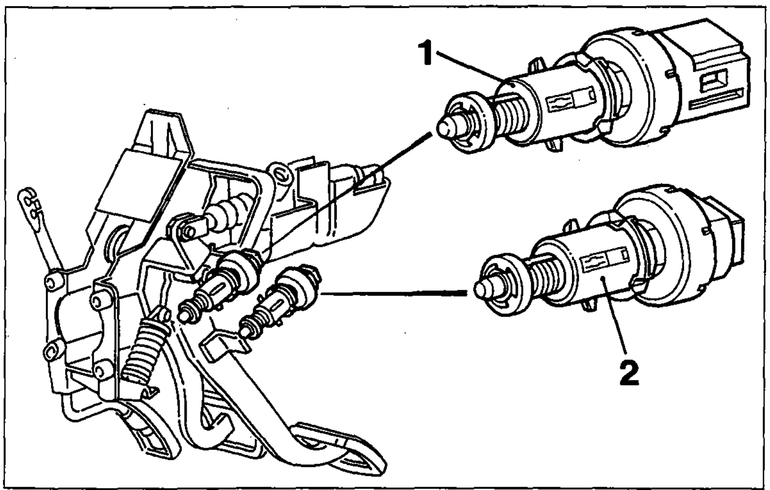
1. Earth
2. Connected to earth
3. Injection control unit (pin 3-38)
4. Injection control unit (pin 3-51)
5. Injection control unit (pin 2-1)
8. Battery positive (+30)
G. Heater plugs (only 4 outlets are used)




P4A15KJ02

### ACCELERATOR PEDAL POTENTIOMETER

The position of the accelerator pedal is transformed into an electrical voltage signal and is sent to the injection control unit by the potentiometer connected to the pedal.
The accelerator pedal position signal is processed together with the information relating to the speed to obtain the injection times and pressure.
The sensor is made up of a casing (1) fixed to the pedals by a flange, which contains a shaft (2), in an axial position, connected to the two potentiometers (3): one main one and one safety one.
There is a coil spring on the shaft which ensures the correct resistance to the pressure, whilst a second spring ensures the return on release.



P4A16KJ01

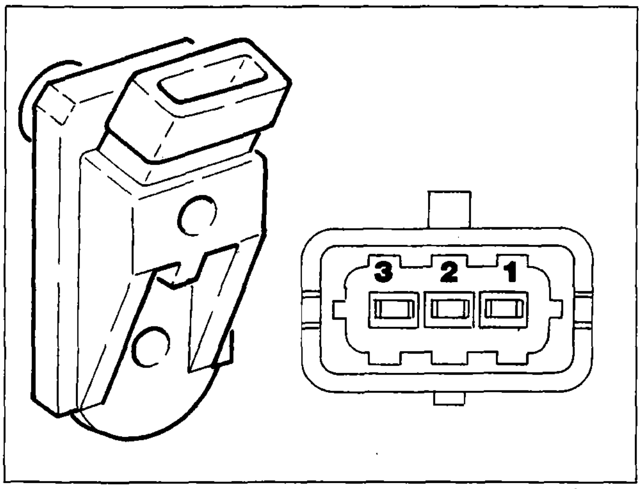
## BRAKE PEDAL SWITCH

There is a switch (1) on the brake pedal which operates the brake lights; the same switch sends a signal to pin 2-8 of the injection control unit.

The "brake pedal pressed" signal is used by the control unit:
- for understanding that there is a deceleration situation;
- for checking the plausibility of the signal coming from the accelerator potentiometer.

## CLUTCH PEDAL SWITCH

There is a switch (2) on the clutch pedal connected to pin 2-2 of the injection control unit.
The "clutch pedal operated" signal is used by the injection control unit to distinguish the gear engaged and gear shift conditions.



P4A16KJ02

## EXCESS PRESSURE SENSOR

This sensor is fitted on the inlet manifold and the signal transmitted to the injection control unit is used for:
- regulating the injection pressure;
- regulating the duration of the injection.

The diagram at the side shows the sensor and the electrical connector with the pin-out:

1. Pressure signal
2. Earth
3. Supply

## ATMOSPHERIC PRESSURE SENSOR

The atmospheric pressure sensor is incorporated inside the injection electronic control unit and has the task of measuring the atmospheric pressure in order to correct the air flow rate value measured and the reference air flow rate for controlling the EGR function.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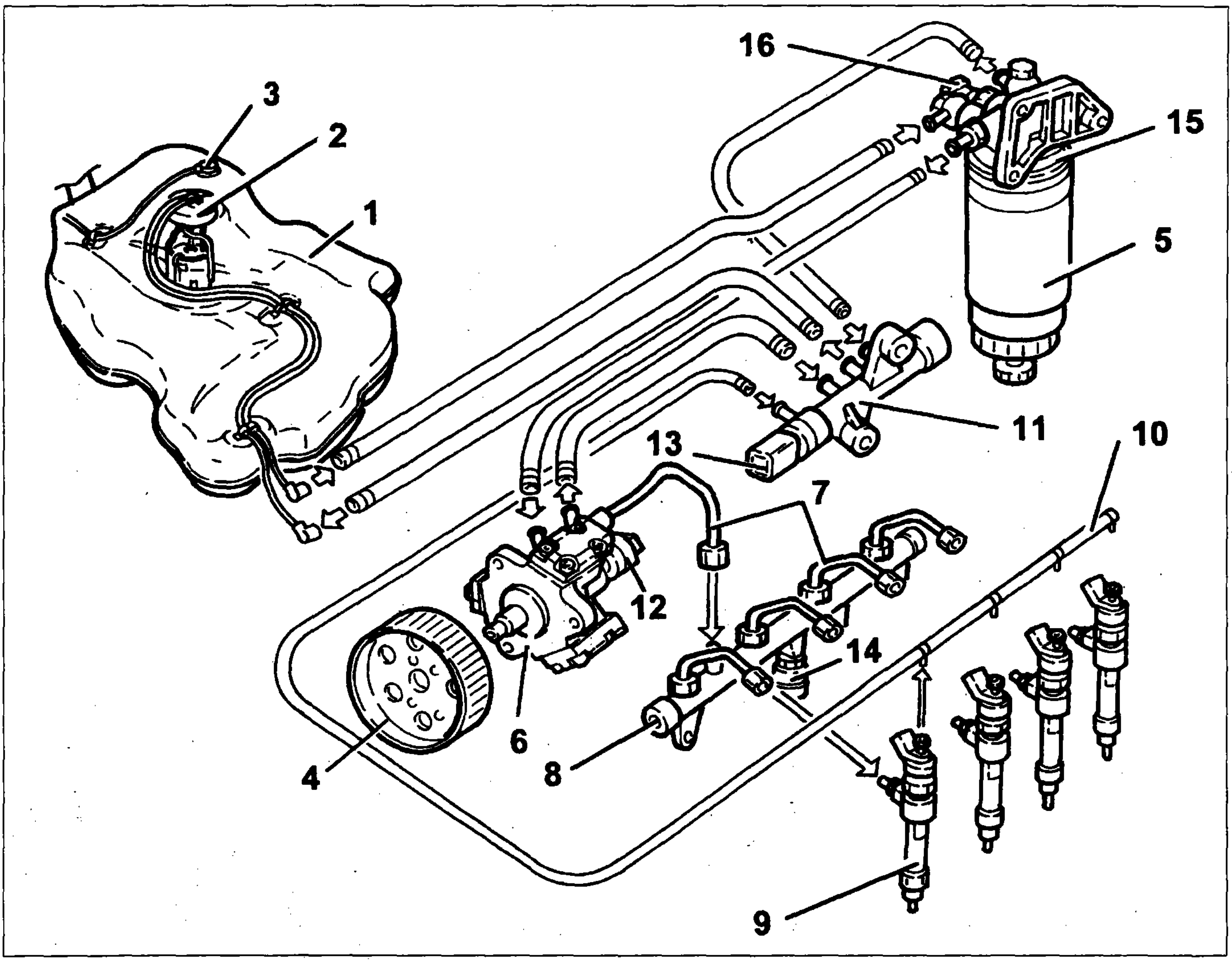
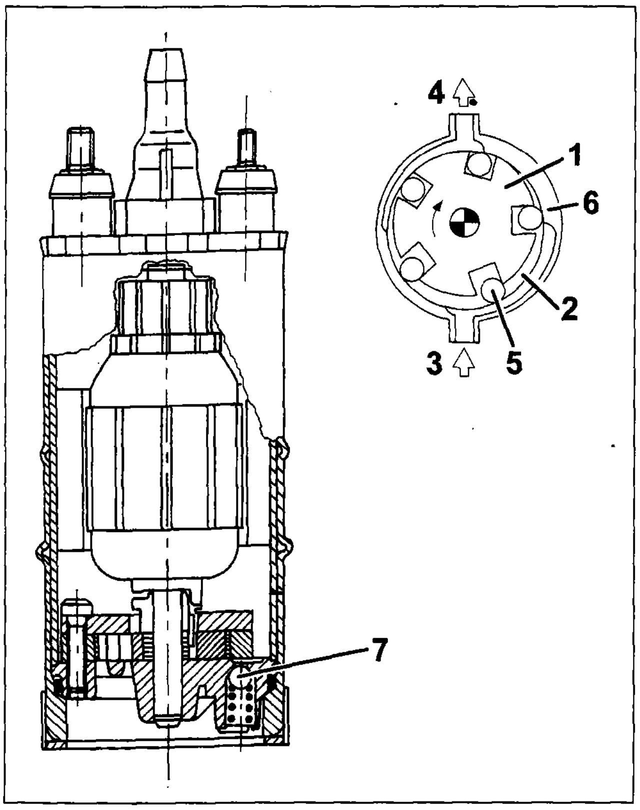
## FUEL SUPPLY CIRCUIT

The fuel supply circuit is operationally divided into a low pressure circuit and a high pressure circuit. The low pressure circuit consists of a tank, multi-purpose valve, auxiliary electric pump immersed in the tank and return manifold.
The high pressure circuit consists of a radialjet pressure pump, supply manifold and injectors.




P4A17KJ01

1. Fuel tank
2. Immersed (auxiliary) electric pump assembly complete with fuel gauge
3. Multi-purpose valve
4. Pressure pump drive pulley
5. Diesel filter cartridge
6. Pressure pump
7. High pressure pipes
8. Supply manifold (rail)
9. Injectors
10. Fuel recirculation pipe (return for the injectors)
11. Return manifold
12. Pressure regulator
13. Fuel temperature sensor
14. Fuel pressure sensor
15. Diesel heater
16. Thermal switch




1. Impeller
2. Volumes
3. Inlet port
4. Supply port
5. Rollers
6. Outer ring
7. Excess pressure valve

## IMMERSED (AUXILIARY) ELECTRIC PUMP AND FUEL GAUGE

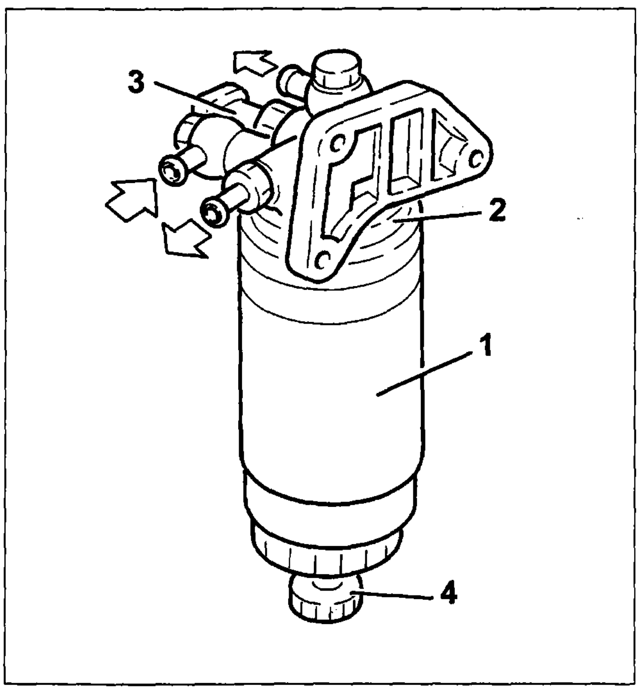
This assembly is basically composed of:
- a roller type electric pump;
- a fuel level gauge;
- a fuel filter

The electric pump immersed in the fuel is the volumetric roller type with a motor with brushes and permanent magnets.

The impeller (1), driven by the electric motor, creates volumes (2) which move from the inlet port (3) to the supply port (4).

These volumes are defined by rollers (5) which, during the rotation of the motor, adhere to the outside ring (6).

The electric pump has two valves: one single-acting valve to preven the fuel circuit from being drained (when the pump is not working); the second excess pressure valve (7) which recirculates the supply with the inlet when the pressure exceeds 5 bar.




## FUEL FILTER

The fuel filter is located in the engine compartment, fixed to the inlet manifold.

The filter is the cartridge type with a filter element (1) made up of a pack of paper discs with a filtering surface area of around 5300 $cm^2$ and a filtering capacity of 4 - 5 mm.

The filter has a fuel pre-heating device (2) controlled by a thermal switch (3) fitted on the actual filter.
When the temperature of the diesel is below 6 °C, an electrical resistance heats it up to a maximum of 15 °C before sending it to the pressure pump.
There is a plug (4) bolted to the base of the fuel filter cartridge for draining the water.

1. Filter cartridge
2. Diesel pre-heating device
3. Thermal switch
4. Water drain plug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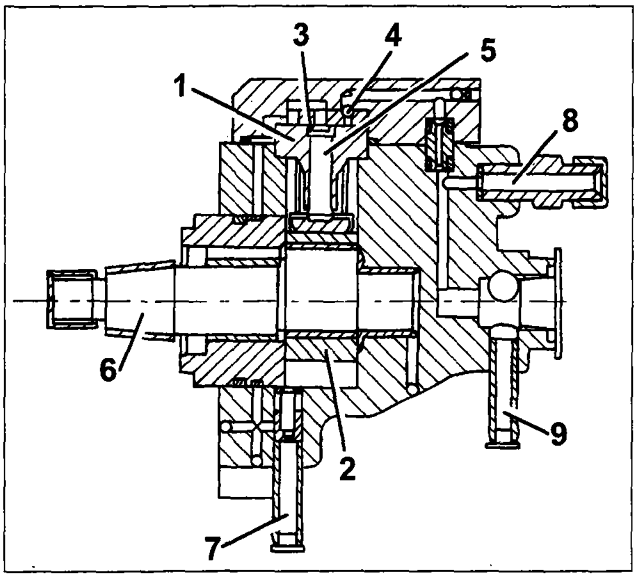


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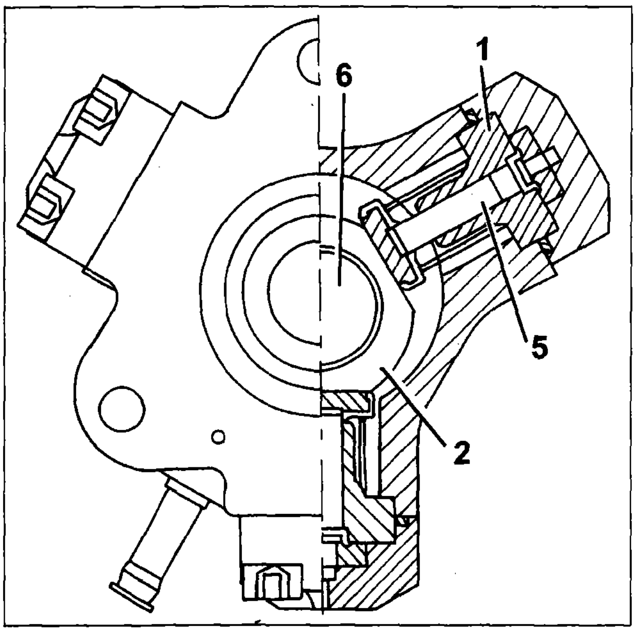


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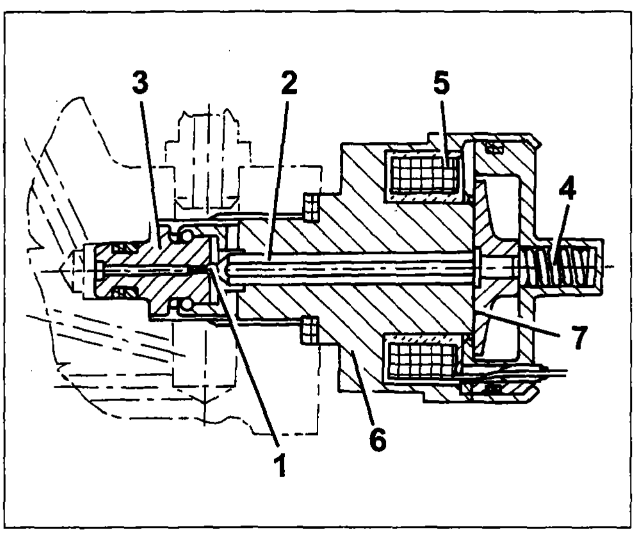



P4A19KJ03

## PRESSURE PUMP

The pressure pump is the radialjet type with three radial pistons (total capacity 0.657 cc) and is operated by the timing belt.

Each pumping unit consists of:
- a piston (5) operated by a cam (2) fixed to the pump (6) shaft;
- an inlet valve with a shim (3);
- a supply ball valve (4).

The pressure pump should receive a pressure of at least 0.5 bar; for this reason, the fuel system is equipped with an auxiliary electric pump immersed in the tank.

The pressure pump is lubricated and cooled by the same diesel fuel through ducts and is capable of supplying a maximum pressure of 1350 bar.

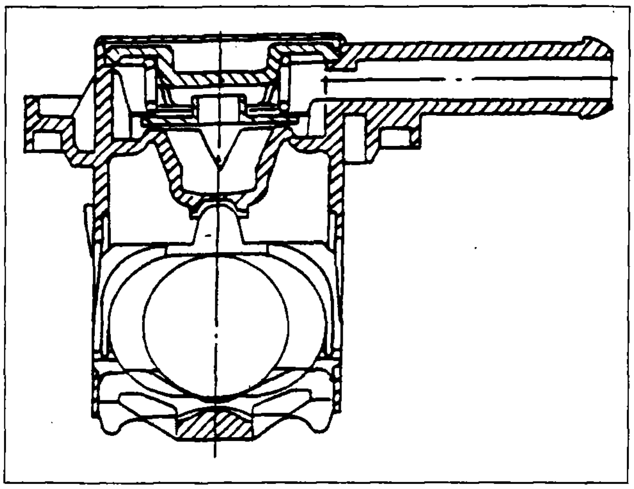
1. Cylinder
2. Cam
3. Inlet valve
4. Supply ball valve
5. Piston
6. Pump shaft
7. Diesel inlet connector - low pressure - from fuel filter
8. Diesel supply connector - high pressure - to manifold (rail)
9. Diesel supply connector - low pressure - recirculation

## FUEL PRESSURE REGULATOR

The fuel pressure sensor is fitted on the pressure pump and, operated directly by the injection control unit, regulates the supply pressure of the fuel to the injectors.

The pressure regulator basically consists of the following components:
1. Shutter with ball
2. Pin
3. Valve
4. Pre-loading spring
5. Coil
6. Casing
7. Keeper

# 10.



P4A20KJ01

## MULTI-PURPOSE VALVE

The multi-purpose valve is located on the fuel tank and carries out the following tasks:
- pressurizing the tank
- ventilation
- seal in case of overturn

**Pressurizing the tank**

The tank pressure is kept at between 55 and 75 mbar through a small valve resting on the edge.

This valve is supported by a steel plate and has an opposing spring.

When the pressure in the tank exceeds the recommended value, it overcomes the resistance of the spring and allows the valve to rise, allowing the flow of vapours.

When the pressure returns to within the limits, the valve closes.

**Ventilation**

In certain operating conditions, a vacuum may be created in the tank due to:

- heat variations;
- fuel consumption.

The function of the valve, in this case, is to restore the pressure inside the tank by drawing in air.

Any irregularity in this function can cause misfiring or the vehicle to come to a halt through problems with the supply of the electric pump.

**Seal in the case of overturning (roll-over)**

The roll-over function is designed to prevent fuel coming out of the tank if the vehicle turns over or is at an angle.
During normal operation (round bends, acceleration, braking, etc.) the fuel splashes around in the tank and could escape.
The extreme sensitivity of this valve to roll-over prevents fuel from escaping.

## SUPPLY MANIFOLD (RAIL)

The supply manifold (rail) is fitted on the cylinder head, inlet side.

It dampens the fuel pressure fluctuations due mainly to the:
- operation of the pressure pump;
- opening of the injectors.

The fuel pressure sensor is fitted in the centre of the supply manifold.
The (high pressure) hydraulic connections are through special steel pipes.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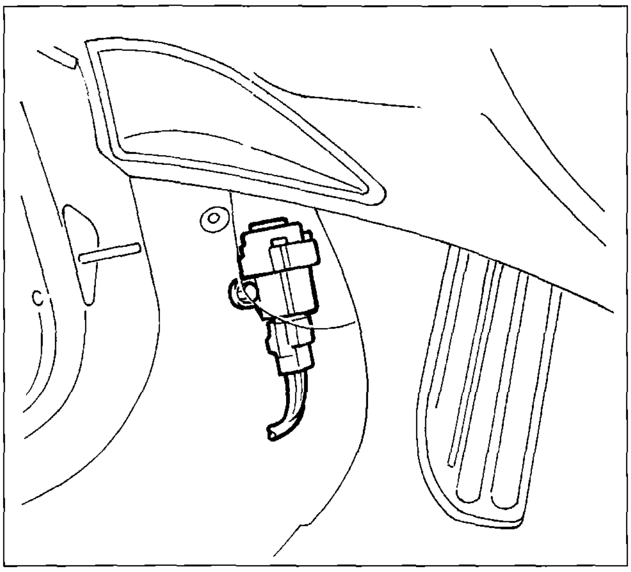


P4A34JJ02

### INERTIA SAFETY SWITCH

In order to increase the safety of the occupants, in the case of an impact, the vehicle is equipped with an inertia switch located inside the passenger compartment, fixed to the left of the side panel.

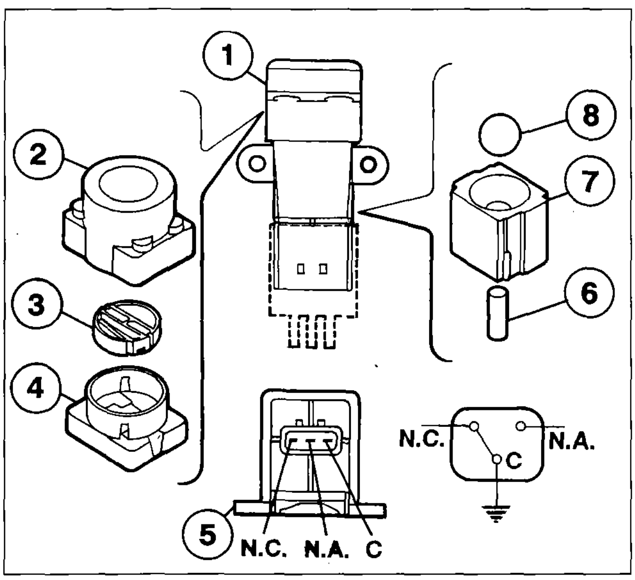
This sensor reduces the risk of fire (as a result of fuel escaping) by deactivating the auxiliary electric pump which supplies the injection circuit.

The inertia switch consists of a steel ball fitted in a (tapered) housing and kept in position by the attraction force of a permanent magnet.

If the vehicle is involved in a violent crash, the ball is released from the magnetic clip and opens the normally closed (N.C.) electrical circuit interrupting the connection to earth for the auxiliary electric pump and, as a result, the supply to the injection system.

To restore the connection to earth for the auxiliary electric pump, the seat must be moved backwards and the switch pressed until it is heard to click.

*Even after an apparently minor impact, if there is a smell of fuel or there are leaks from the fuel system, do not turn the inertia switch back on, but search first for the cause of the problem and remedy it to avoid the risk of fire.*




P4A35LJ01

**Inertia switch components**

1. Complete inertia sensor
2. Outer casing
3. Button
4. Upper side
5. Engagement side
6. Permanent magnet
7. Permanent magnet housing
8. Steel ball

C Common terminal
N.C. Normally closed contact
N.A. Normally open contact

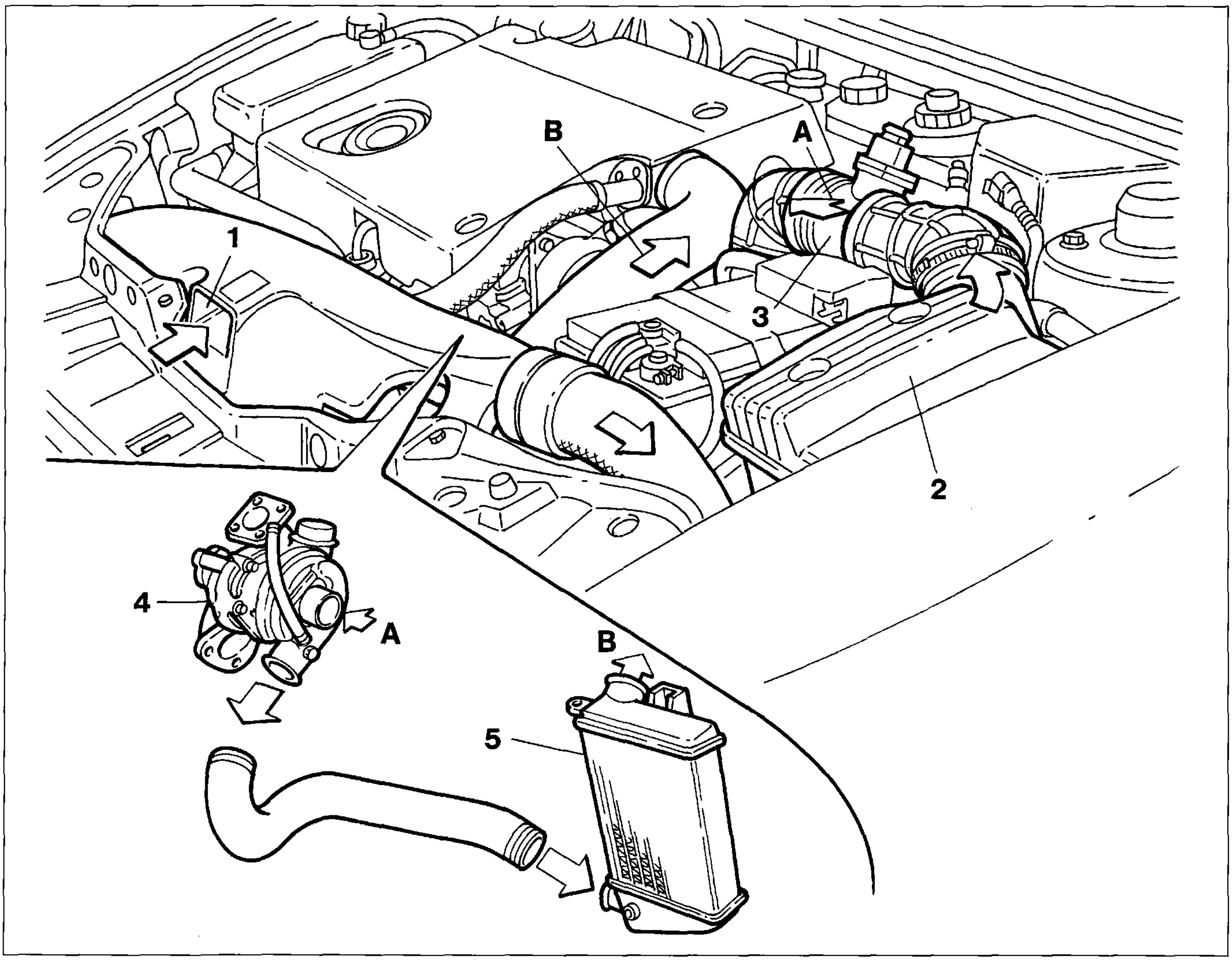
# 10.

## AIR SUPPLY CIRCUIT

The air supply circuit is supercharged by means of a variable geometrye GARRET turbocharger and an intercooler.
The turbocharger is the reduced inertia type, based on a new supercharging concept where the use of the turbocharger is designed to increase the torque in the most frequently used range (e.g. low speeds).

The intake air, after having passed through the filter (1), is compressed by the turbocharger (4) operated by exhaust gases, cooled by the heat exchanger (intercooler) (5) and sent to the inlet manifold (6) from where it is distributed to the cylinders.

**Diagram showing air supply circuit**




P4A22KJ01

1. Inlet vent
2. Air filter
3. Intake air flow meter
4. Turbocharger
5. Air/air heat exchanger (intercooler)
   A. To the turbocharger
   B. To the inlet manifold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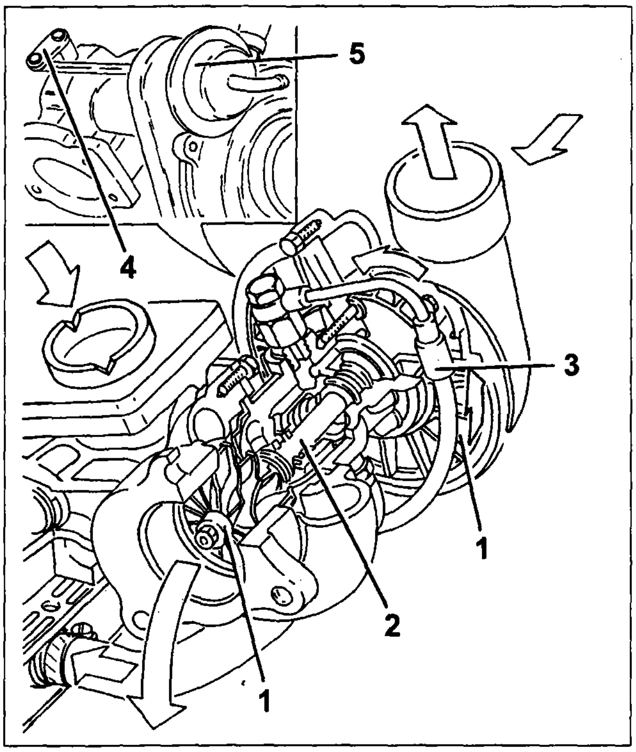



P4A23KJ01

## TURBOCHARGER

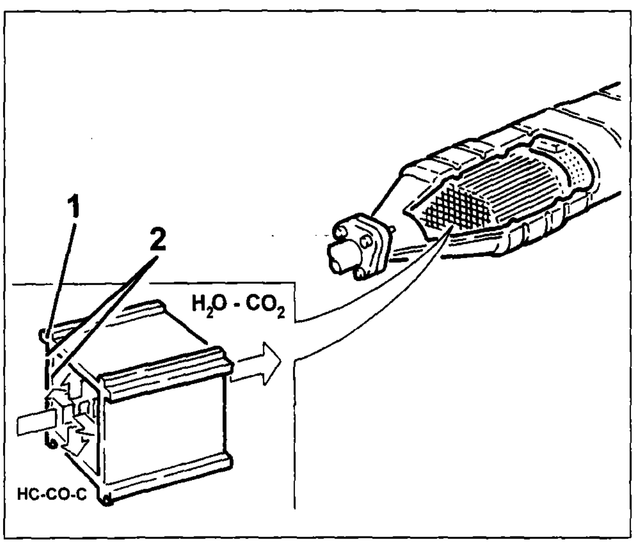
It is basically made up of two impellers (1) fitted on one shaft (2), which rotates on floating bearings lubricated via a duct (3) from the engine lubrication circuit.
The oil used discharges part of the large amount of heat given off by the exhaust gases at the turbine.
There is a waste-gate valve (4), operated by a pneumatic actuator (5), on the turbocharger, which shutters the flow of exhaust gases to the turbine, according to the engine power/torque request.

1. Impellers
2. Shaft
3. Lubrication
4. Waste-gate valve
5. Actuator

## EXHAUST GAS CIRCUIT

The engine exhaust gases flow through the manifold To the turbocharger and, through a pipe, to the oxidizing catalytic converter and then to the silencer.
Special protection limits the heat given off towards the bodyshell.

## EMISSION CONTROL DEVICES

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## CATALYTIC CONVERTER

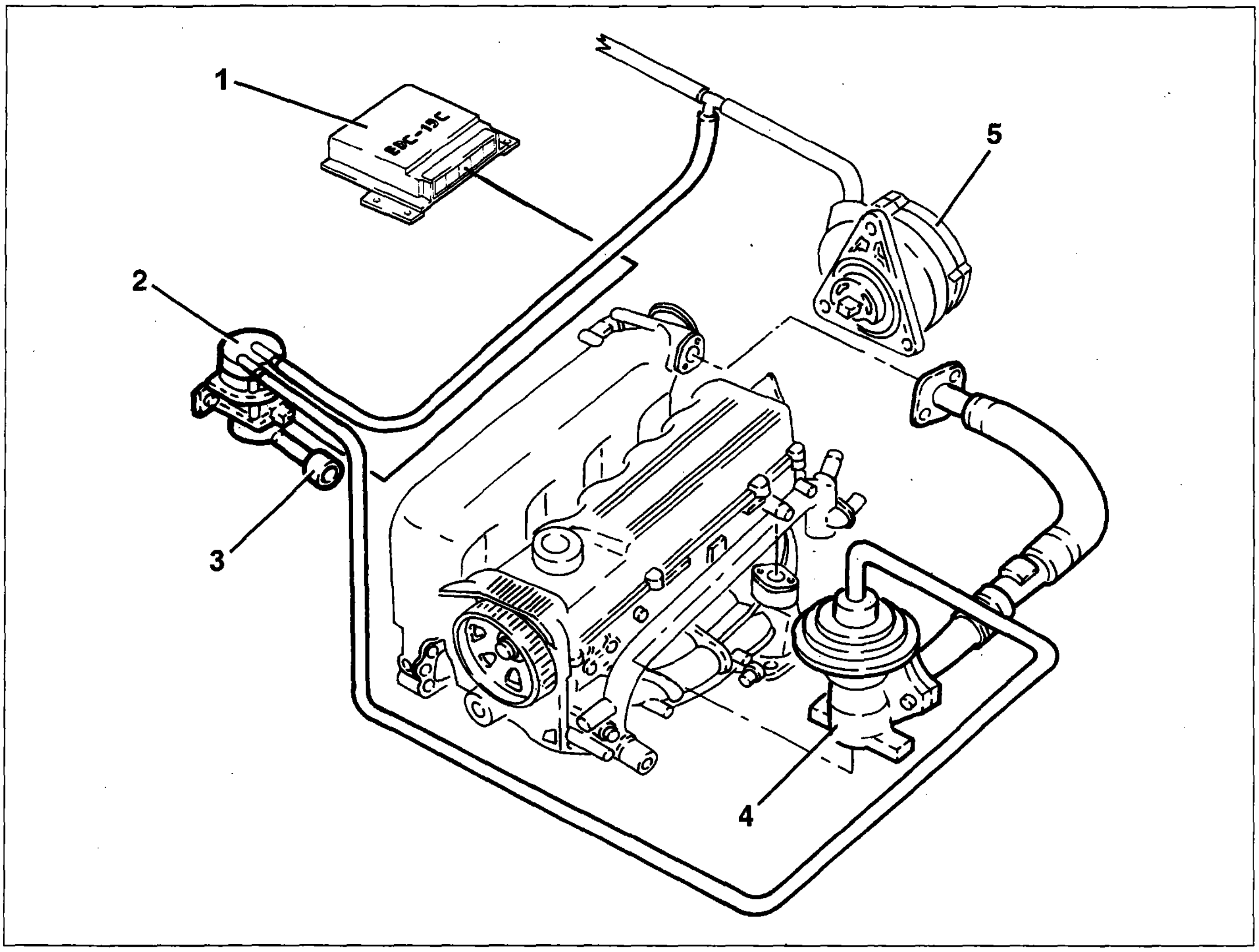
The catalytic converter is a post-treatment device for oxidizing the CO, HC and particle matter, transforming them into carbon dioxide ($CO_2$) and water vapour ($H_2O$).
The catalyzer consists of a ceramic honeycomb structure (1), whose cells are impregnated with platinum (2), which acts as a catlyst for the oxidation reactions.
The exhaust gases which pass through the cells heat the catalyzer, triggering off the conversion of the pollutants into inert compounds.
The chemical reaction of the oxidation of the CO, HC and particle matter is effective at tempeartures of between 200 °C and 350 °C.
Above 350 °C, the sulphur contained in the diesel fuel starts to oxidize, producing sulphur dioxide and sulphur trioxide.

# 10.

## EXHAUST GAS RECIRCULATION CIRCUIT (EGR - Exaust Gas Recirculation)

This system makes it possible to send part of the exhaust gases to the inlet in certain engine operating conditions.
This dilutes the fuel mixture with the inert gases lowering the peak temperature in the combustion chamber; this contains the formation of nitrogen oxides (NOx), giving a reduction of 30-50% at the exhaust.
The recirculation of exhaust gases is only allowed at medium-low loads, when the air/fuel ratio is very high and the operation of the engine is not adversely affected by the presence of inert gases in place of the air.
The recirculation is controlled by the injection control unit (1) which, basically according to the signals from the accelerator pedal potentiometer, the rpm sensor and the engine coolant temperature sensor, supplies an output signal for operating the modulating valve (2).
On the basis of the signal received, the latter, connected to the atmosphere by means of a small filter (3), transmits a lesser or greater vacuum, coming from the brake servo vacuum pump (5), to the EGR valve (4).
If the vacuum is sufficient, the valve (4) opens placing the exhaust manifold in contact with the inlet manifold.

**Diagram showing exhaust gas recirculation**




P4A24KJ01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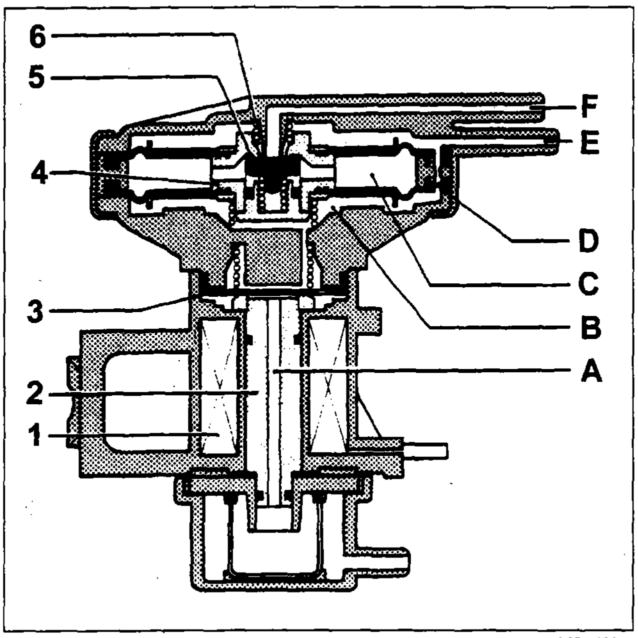
**EGR MODULATING VALVE**

The vacuum coming from the vacuum pump for the brake servo reaches the chamber (E) from the duct (F) (case I), because the force of the spring (6) acts on the moving element (4) and the valve (5) allows its passage.

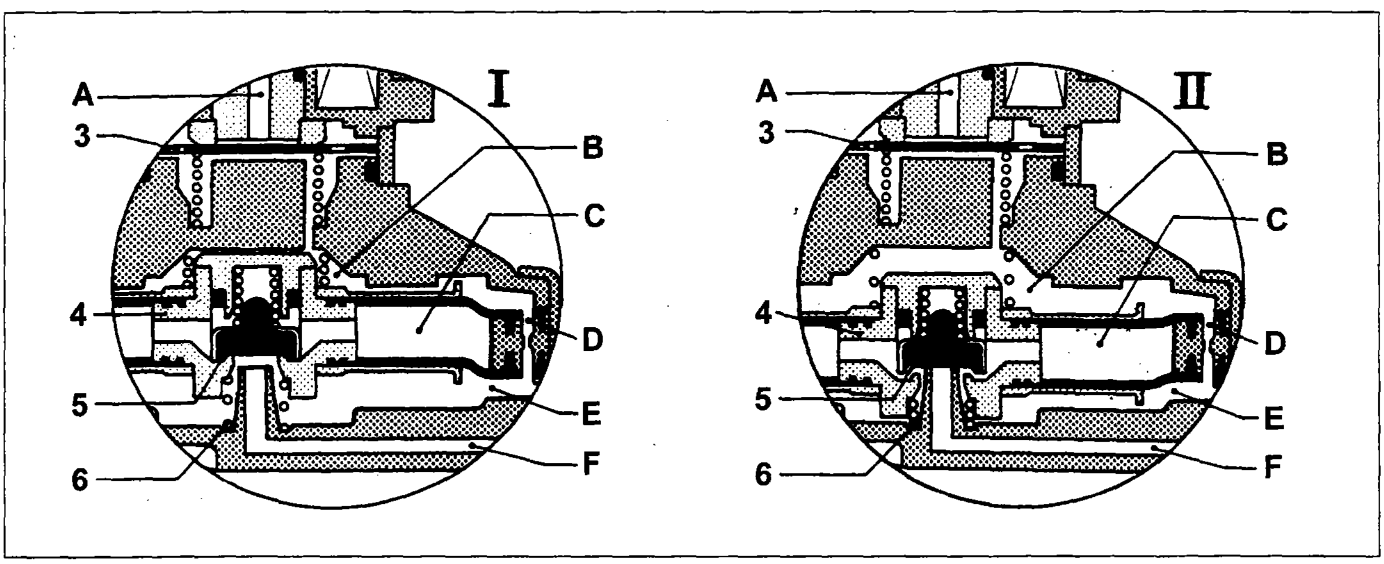
The vacuum then affects the chamber (B), through the compensation port (D) and the surface of the shutter (3).

When the forces acting on the disc (3) are in equilibrium, the atmospheric pressure in the duct (A) enters the chamber (B), moving the moving element downwards (case II), so that the valve (5) shutter closes the duct (F) and places chamber (E) in contact with chamber (C) at atmospheric pressure, decreasing the value of the vacuum in the duct (E).




P4A25KJ01

The decreased vacuum value or the increase in the absolute pressure in the chamber (E) raises the moving element (4) (case I), closing the passage (C) and placing the valve (5) in the ideal condition (E in contact with F) and the cycle is repeated.

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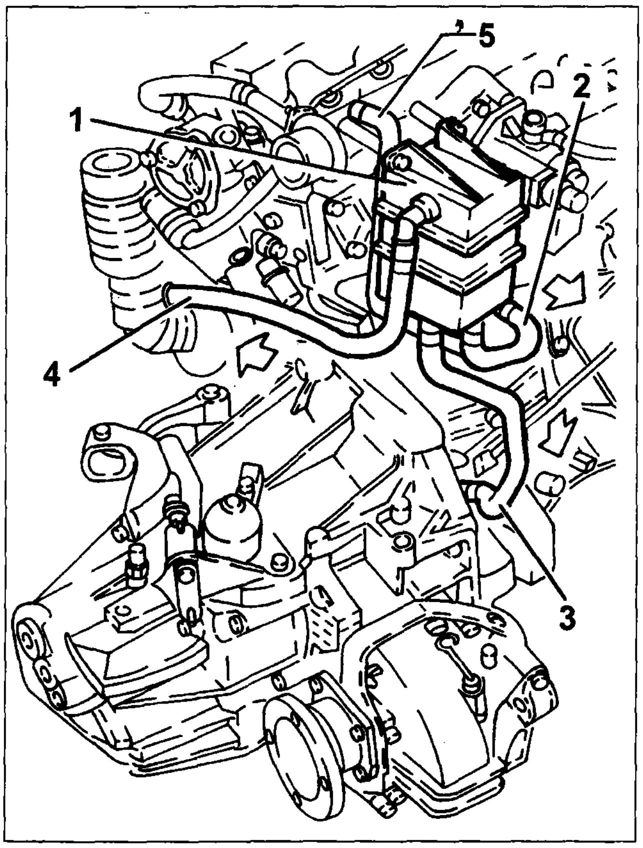


P4A26KJ01

### RECIRCULATION CIRCUIT FOR VAPOURS COMING FROM THE CRANKCASE (BLOW-- BY)

The crankcase emissions are composed of mixtures of air/diesel and exhaust gases which escape from the piston rings, in addition to lubricant oil vapours.

They are defined as blow-by or breather gases.

The breather gases coming from both the crankcase (2) and the cylinder head (5) reach the separator (1).

In the separator (1) the gases lose some of the oil dissolved in them which return to the sump via the pipe (3) in the form of drops.

The remaining gases, on the other hand, are directed, through the pipe (4) to the intake circuit.



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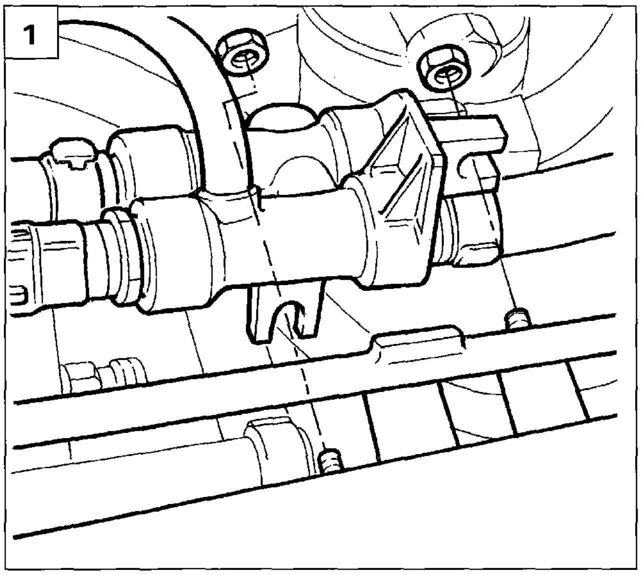
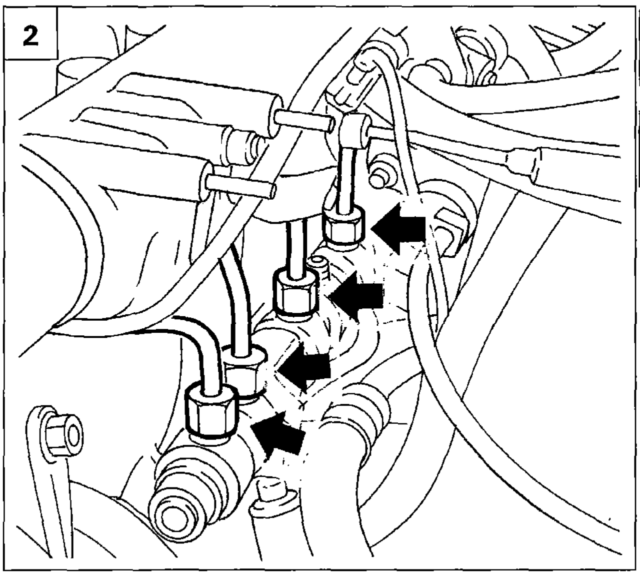


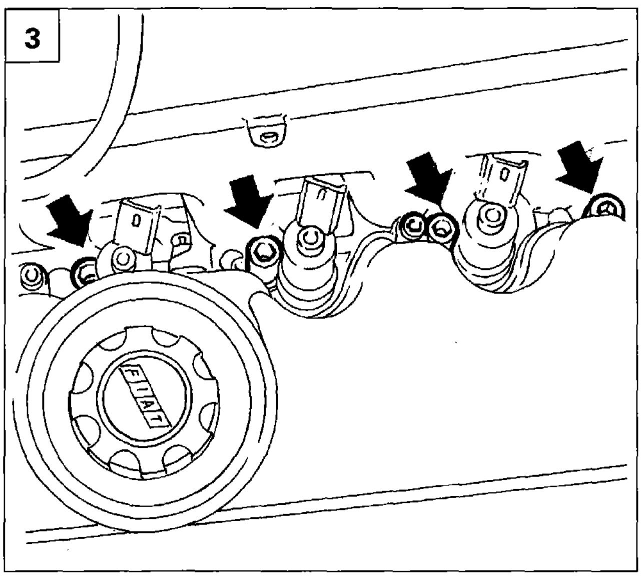

P4A29KJ01

1. Remove the return manifold by loosening both retaining nuts




P4A29KJ02

2. Undo the manifold end pipe fittings from the rail leading to the injectors and remove them



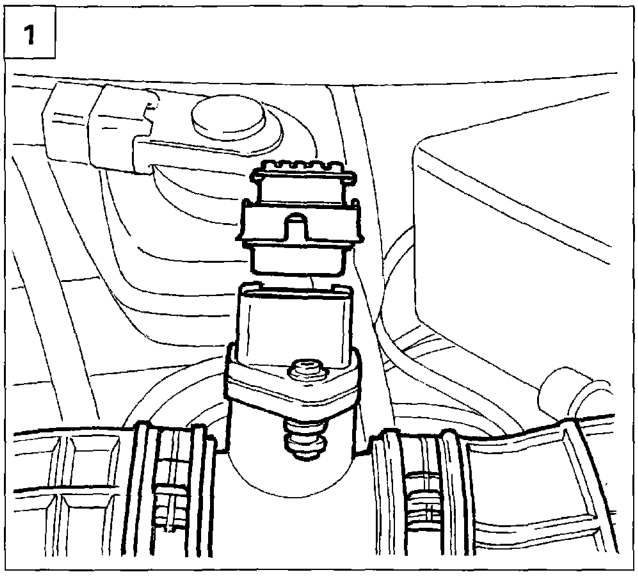

P4A29KJ03

3. Undo the retaining nuts and remove firstly the bracket and then the injectors.

**NOTE** *When refitting, carry out removal procedure in reverse order. Tighten the fittings between return manifold and injectors to the specified torque ofi 2 daNm*

# 10.

## REMOVING-REFITTING RAIL

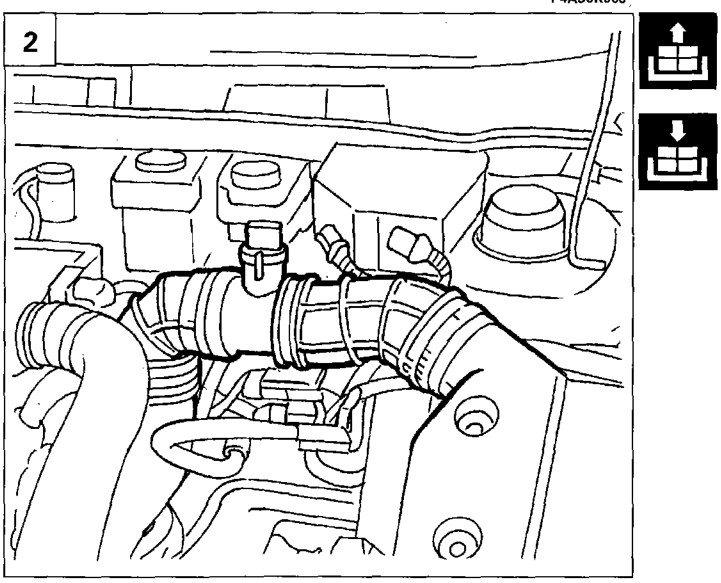



P4A30KJ03

- Disable the alarm (if present) by means of the switch under the junction unit cover.

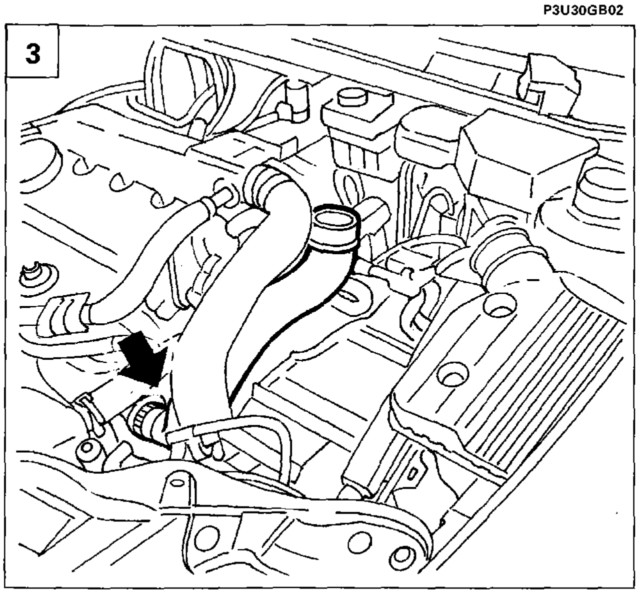
- Disconnect the terminals and remove the battery

1. Disconnect the flow meter electrical connection.



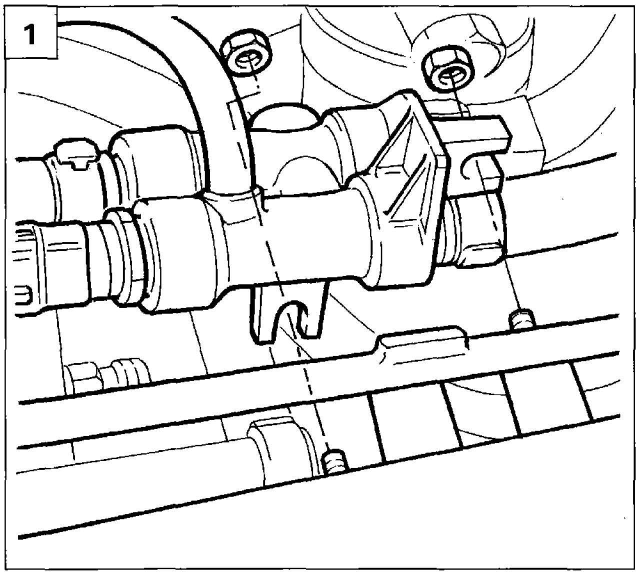

P3U30GB02

2. Loosen the collars and remove the first pipe section between the air filter case and turbocharger.




P3U30GB03

3. Loosen the bands and remove the second pipe section between the air cleaner case and turbocharger.

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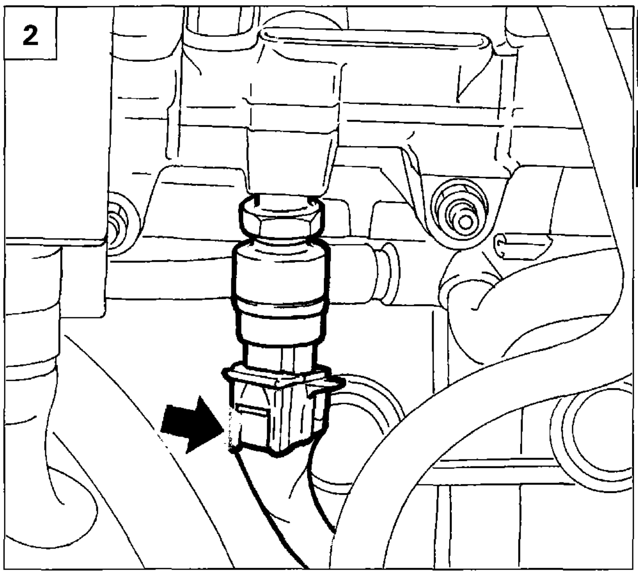


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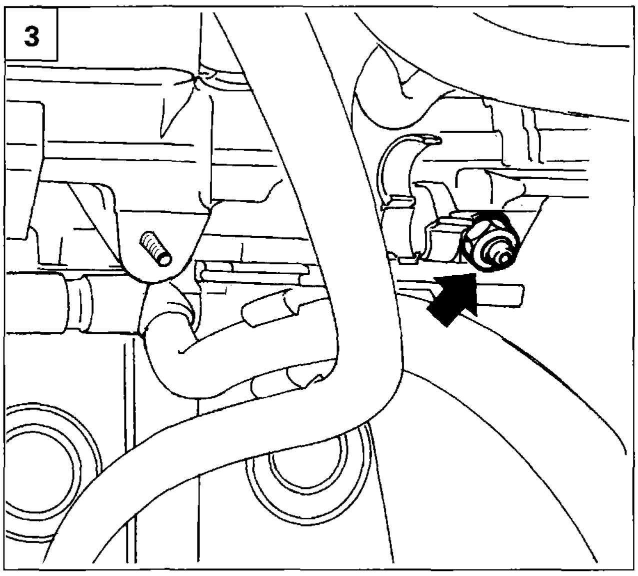


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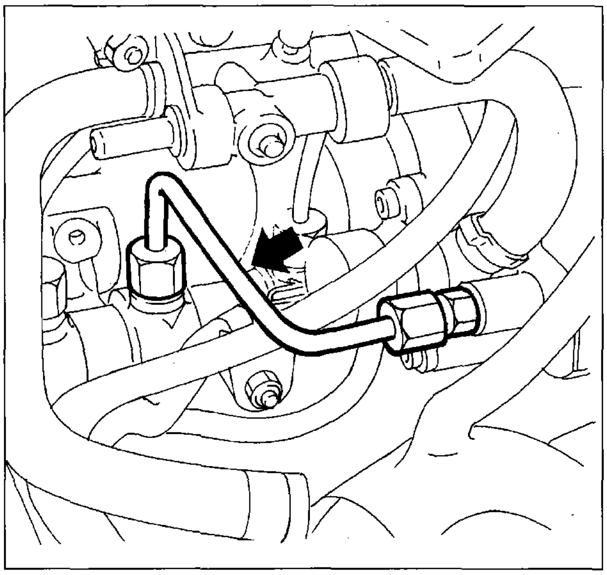
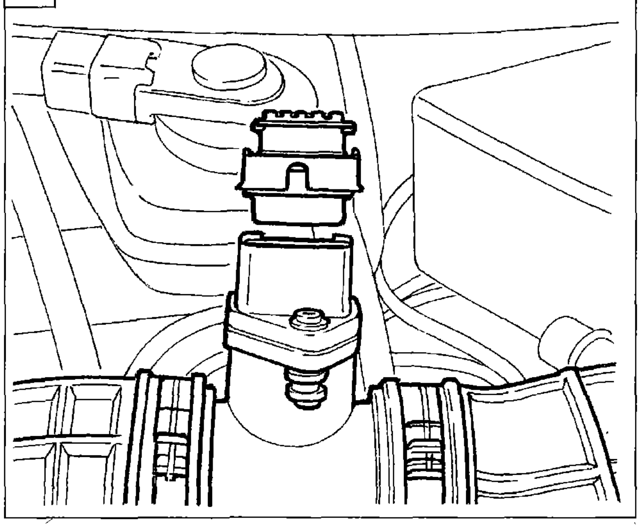


1. Remove the return manifold by loosening both retaining nuts.
2. Remove the fuel delivery pipe from the pressure pump to the rail pipe.
3. Disconnect the electrical connection from the fuel pressure sensor
4. Unscrew the remaining nut securing the rail and remove.

**NOTE** *To refit, carry out removal instructions in reverse order. Tighten the fittings of pipes between return manifold and injectors and of the fuel delivery pipe from the pressure pump to the specified torque of 2 daNm.*

# 10.

1



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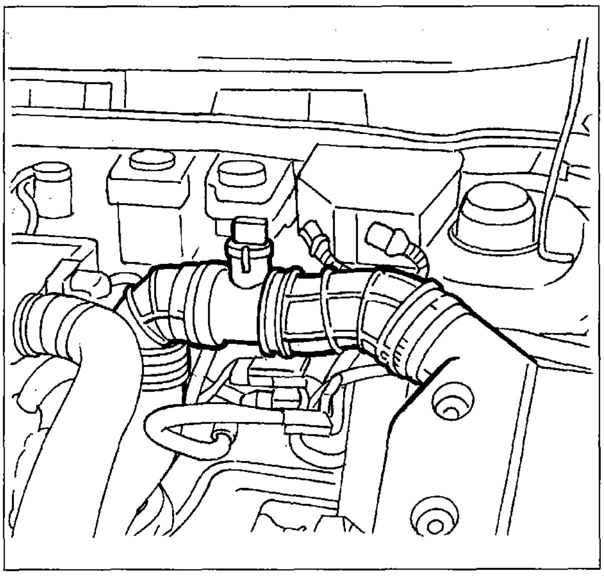

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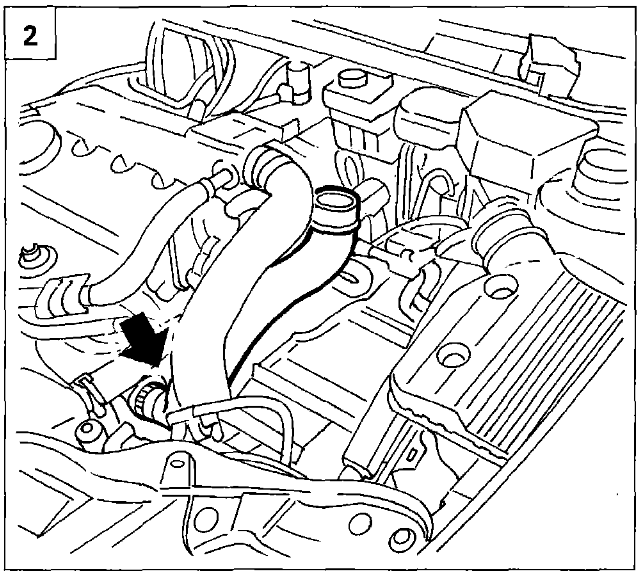
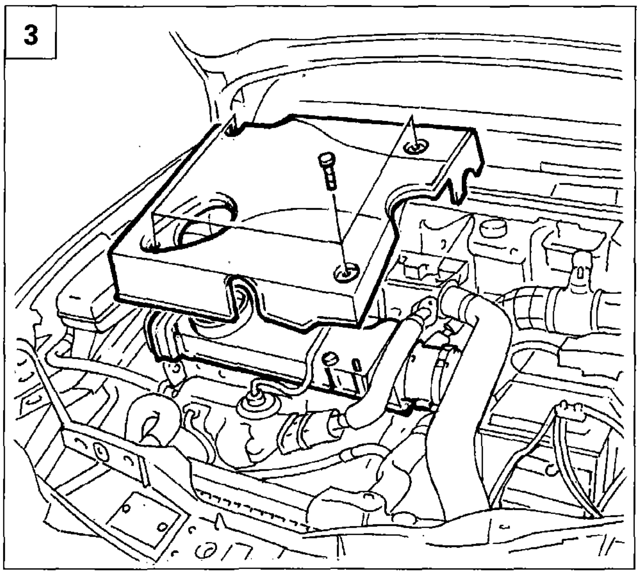
2



P4A30KJ05

3



P4A27KJ01

## REMOVING-REFITTING GLOW PLUGS

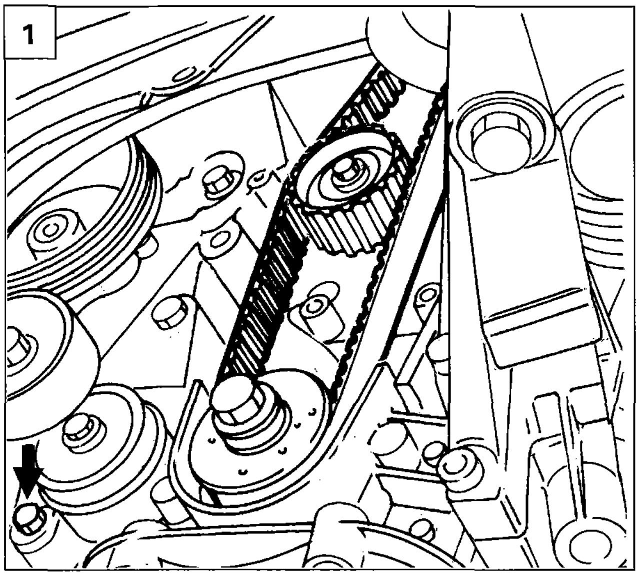
- Disable the alarm (if present) by means of the switch beneath the junction unit cover.
- Disconnect the terminals and remove the battery.

1. Disconnect the electrical connection for the flow meter.

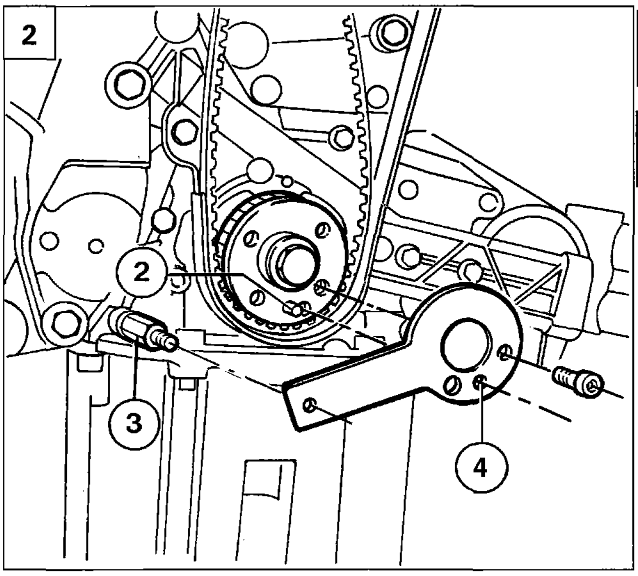
2. Loosen the collars and remove the first section of piping between air cleaner casing and turbocharger.

3. Remove the second section of piping between air cleaner casing and turbocharger.

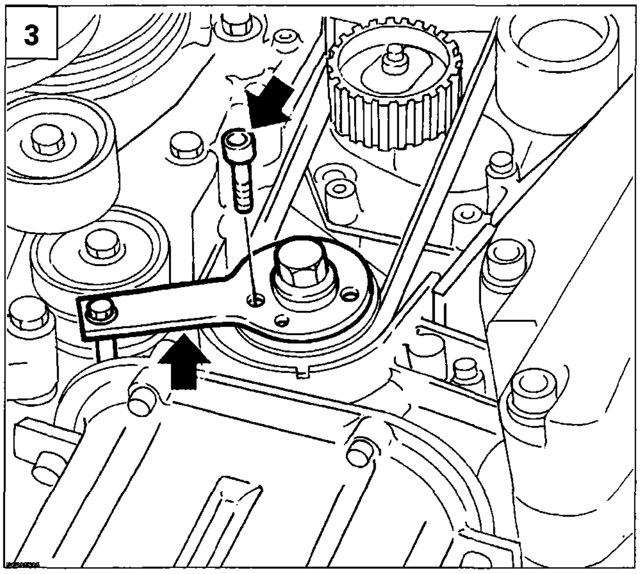
4. Undo the retaining bolts and remove the upper engine protection cover.




P4A41KJ01




P4A41KJ02




P4A41KJ03

### Refitting

Reverse procedure described for removal to the point where the pressure pump is refitted. Then refit and tension the timing belt and auxiliary drivebelt.

*Check that the timing belt and auxiliary drive-belt do not show signs of cracking or wear that could impair operation.*

*Tighten thefittings of the pipes carrying fuel from the pressure pump to the rail to a torque of 2 daNm*

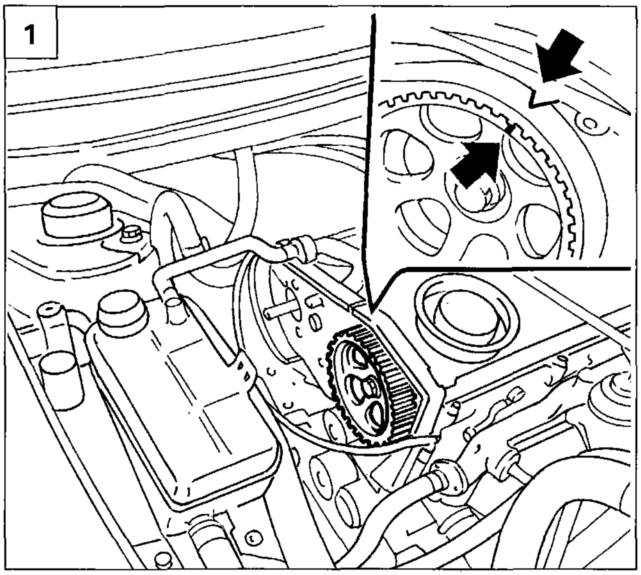
### Fitting and tensioning timing drive belt

1. Fit the timing belt to the crankshaft gear provisionally and remove the bolt indicated from the oil pump.

2. Position tool 1860905000 on the crankshaft drive gear and pin (3); turn the crankshaft through small movements until locating dowel (2) fits into hole (4) on the tool. In this position, cylinder no. 1 is exactly aligned with TDC.

3. Secure the tool to the crankshaft drive gear using the bolt shown.

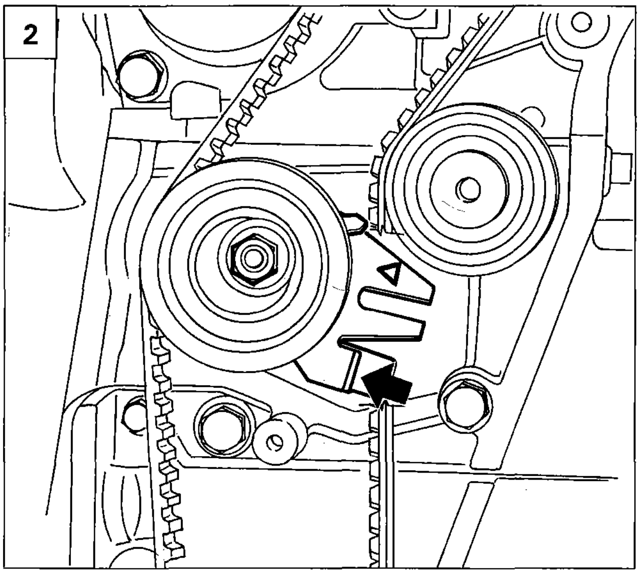
# 10.




P4A30KJ03

Lower the lift

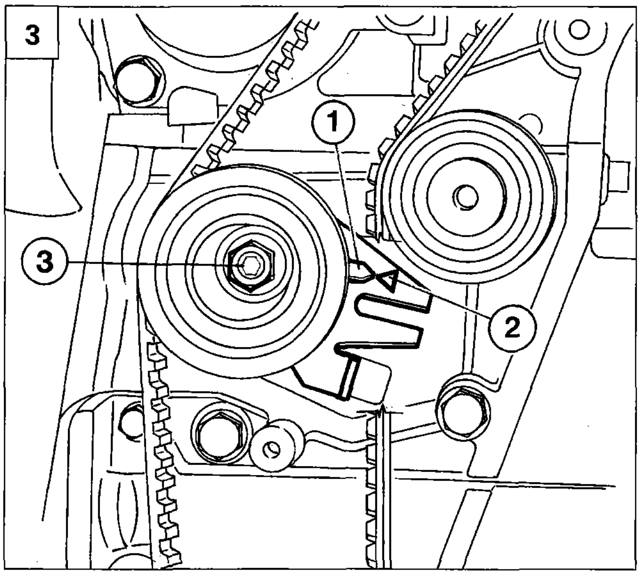
1. Turn the toothed drive pulley to align the timing notches.




P4A30KJ05

Raise the lift and finish fitting the timing belt. Check the timing.

2. Use a screwdriver to apply a force to the automatic tensioner to adjust the tensioner to maximum tension. Then tighten the tensioner bolt to the mount. Remove tool 1860905000 and turn the engine through two revolutions in its normal direction of rotation.

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3. Loosen the nut securing tensioner (3) and apply leverage with a screwdriver so the tensioner does not go completely slack. Then align mobile pointer (1) on the tensioner with fixed reference (2). Then tighten tensioner bolt (3) to the specified torque.


VII-99 - Supersedes previous version

Print n° 506.670/21

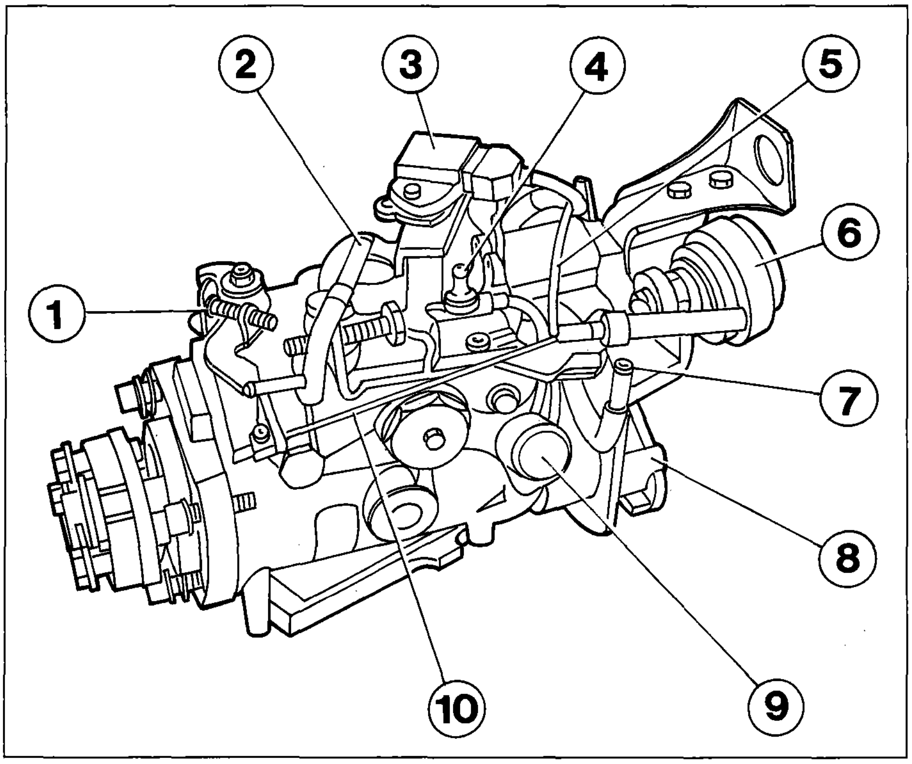
Fuel System 1910 TD 100

Fuel System 98 1581 16v

## FUEL SYSTEM

## INJECTION PUMP

The Lucas FT09 injection pump has been specifically designed for indirect injection diesel engines with special innovative features which ensure optimum engine running in all operating conditions; in particular, it allows a decrease in consumption, harmful emissions and noise levels.
The function of the injection pump is to accurately meter the quantity of fuel and to inject it at high pressure into the combustion chamber for each cylinder at a precise moment in the engine cycle; the quantity of fuel metered is therefore atomized at high pressure by the injector.
It is vital for the injection pump to be working accurately and reliably because the cycle is repeated thousands of times per minute; therefore variations in the injection point (advance) or the quantity of fuel injected (metering) are not permissible for the entire life of the engine.
The injection pump is characterized by being rather small in size; it is the rotary distributor type, compact in structure and does not require any external lubrication because it is lubricated by the filtered diesel fuel with which it is always filled during operation.
The internal pressure prevents penetration of dust, water or other foreign bodies which would be harmful to its operation; in addition the special design of the hydraulic circuits prevent the accumulation of air.
To facilitate both starting and the supply of full power, irrespective of the climate conditions, the pump is equipped with an automatic flow rate supplement system which increases the amount of fuel injected.
The pump comprises a single pumping element, made up of two opposing pistons, which is an integral part of the distribution rotor. The rotor, in turn, rotates inside a unit known as the hydraulic head.
Each piston comes into contact with the internal lobes of a cam seal by means of an assembly made up of a roller and a roller carrier plate.
The adoption of a single pumping element ensures a uniform supply of fuel for each cylinder and dispenses with balancing the supplies, an operation which is otherwise strictly necessary in all pumps fitted with separate pumping elements.
The fuel, carefully metered during the intake stage into the pumping element, is distributed to each injector at the exact moment thanks to a system of ports in the hydraulic head and the rotor.
When it receives the command from the electronic control unit, the pump can alter the injection advance and is therefore capable of adjusting the start of the injection in the engine cycle so that it takes place at the optimum time in all operating conditions.




P4A05EJ01

The pump is also equipped with a mechanical centrifugal regulator to accurately check the engine speed.

1. Idle speed adjustment screw
2. Connector for diesel return pipe to the tank
3. Accelerator control lever position sensor
4. Accelerator control lever
5. Electro-stop valve anti--tamper cover
6. Fast idle device
7. Connector for diesel supply pipe from the filter
8. Connector for diesel supply pipe to the injectors
9. Advance actuator
10. Fast idle control cable

**Operating principle**

The fuel, taken from the tank (11) and filtered by the filter (12), reaches the transfer pump (7) which has the task of further increasing the pressure of the fuel.

Through the effect of the transfer pump pressure regulator valve (2), this pressure increases in a fairly linear manner as the engine speed increases.

The valve (2) also has the task of shortcircuiting the transfer pump (7) during priming.

From the transfer pump the fuel reaches the meter (6) which determines the quantity of fuel to be sent to the pumping element (4) and consequently the capacity for the injectors.

The position of the meter (6) is controlled by the speed regulator (13) and depends on the position of the accelerator pedal.

The pumping element comprises two small opposing pistons which slide radially in the rotor and are operated, by means of rollers and sliding plates, by the profile of a cam seal.

The pistons do not have return springs because they are thrust outwards by centrifugal force and the pressure of the fuel entering the supply stage.

The rollers which operate the pistons come into contact with the cam profile at different points according to the greater or lesser stroke during the supply stage.

This stroke depends on the quantity of fuel entering the pumping chamber, regulated by the meter and the expansion time of the pumping pistons dictated by the rotation speed of the pump.

During the injection stage the piston control rollers come into contact with the cam seal cams; the pistons themselves are thrust inwards causing an increase in pressure and consequently injection.

At the end of the injection stage, the pistons are thrust outwards creating a decrease in pressure, the fuel is no longer supplied and the valve (5) closes the supply pipe.

In addition to closing the supply pipe, the valve (5) has the function of instantly lowering the pressure in the pipe which is in contact with the injector (10) and therefore cuts off the injection promptly to prevent the injector from dripping.

The maximum quantity of fuel which can be introduced into the pumping element (4) each cycle is determined by a maximum flow rate regulator.

The pressure inside the pumping element (4) is kept at a constant value by the pressure valve (9).

The solenoid valve (8), operated by the electronic control unit, makes it possible to alter the advance for the start of the pump delivery increasing it when the engine load exceeds a given level.

The engine cut out solenoid valve (electrostop) (3) is suitably protected by a special anti-tamper cover.

During the operation of the engine, the solenoid valve remains energized allowing the flow of fuel from the transfer pump (7) to the supply duct.

When the key is turned to switch off the engine, the solenoid valve is de-energized cutting off the flow of fuel; the meter supply chamber is no longer supplied and the engine cuts out.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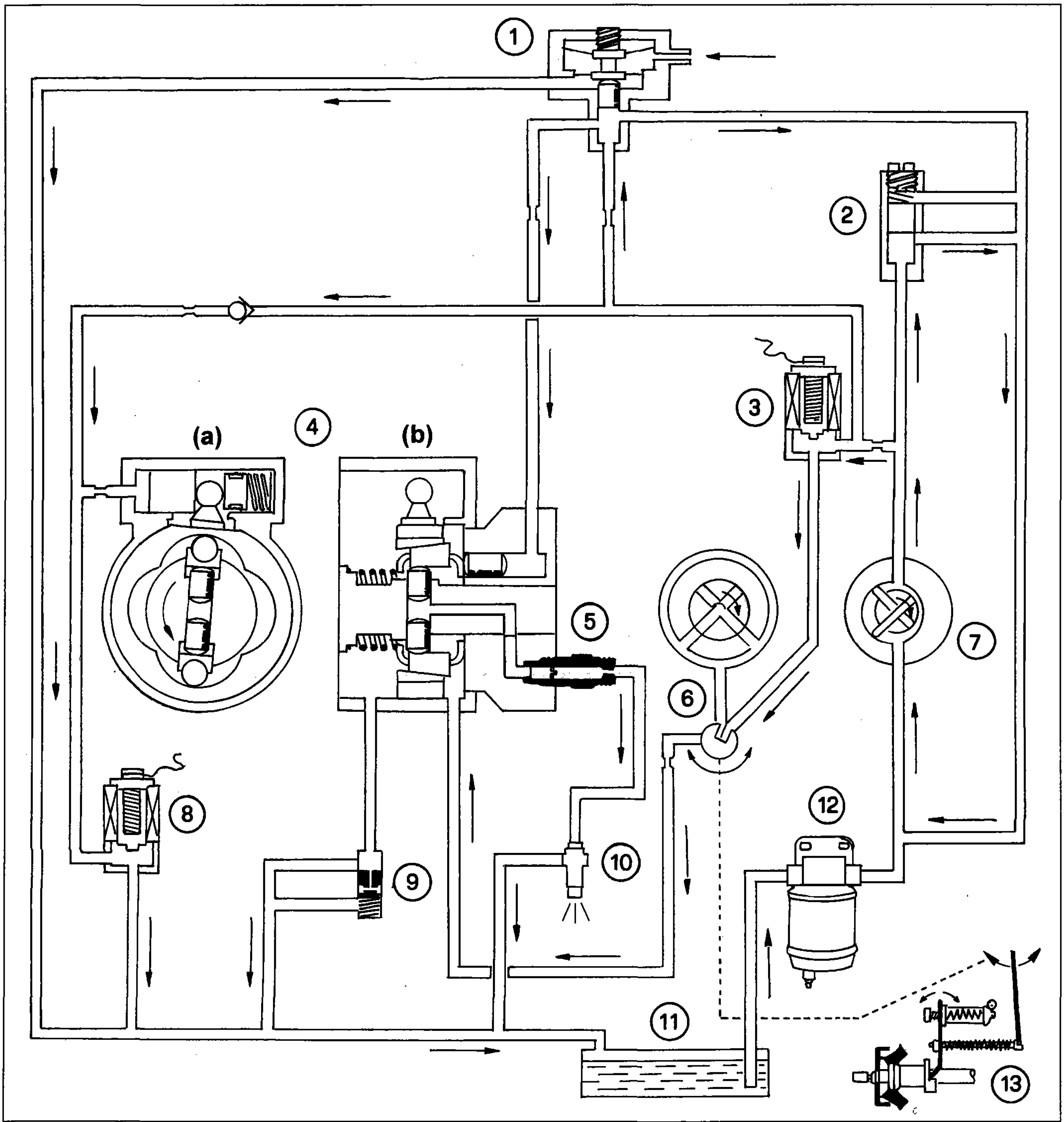
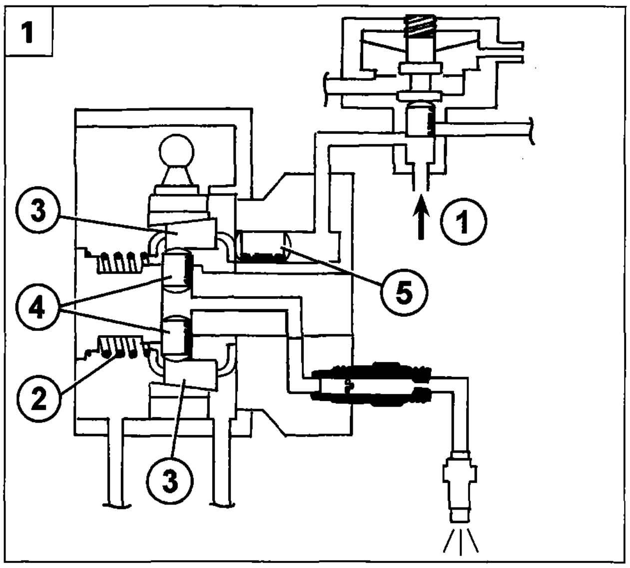
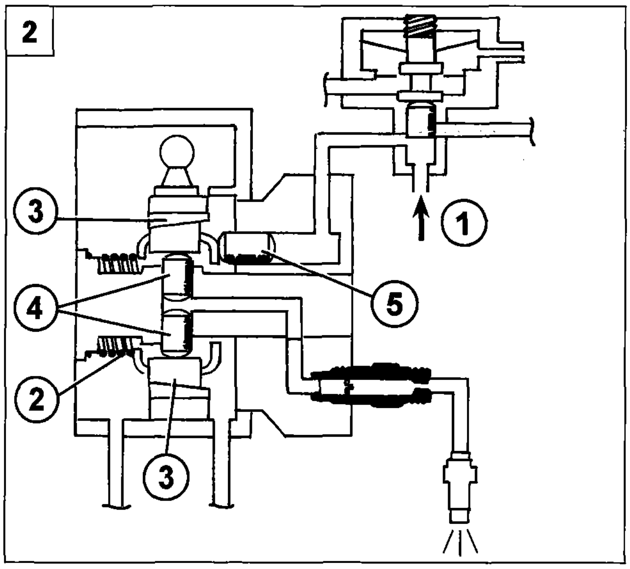
## FUEL CIRCUIT DIAGRAM




1. Supercharing control valve
2. Transfer pressure regulator valve
3. Engine cut out solenoid valve (Electrostop)
4. Pumping element
   (a) front section view
   (b) side section view
5. Supply valve
6. Meter
7. Transfer pump
8. Advance actuator solenoid valve
9. Pressure valve
10. Injectors
11. Tank
12. Filter
13. Speed regulator



P4A08EJ01



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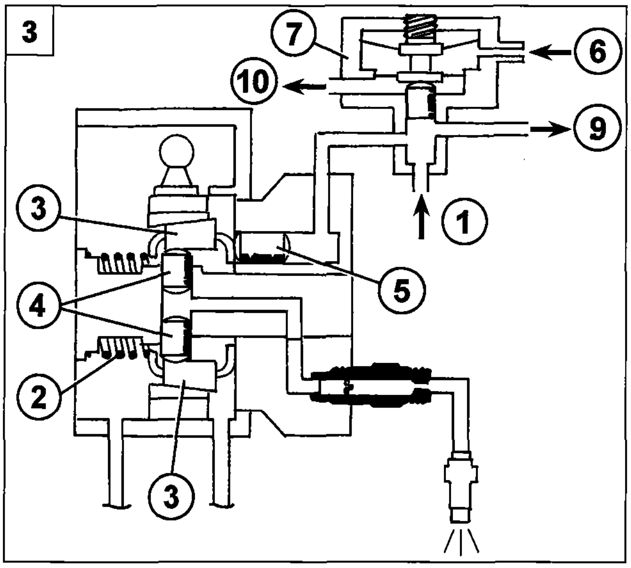

P4A08EJ03

**Flow rate supplement**

In order to facilitate both starting up the engine and the supply of full power, a system is fitted which, by altering the stroke of the pumping element pistons, allows an increase in the maximum fuel flow rate.
The three following operating modes are of special interest:

1) Operation during starting

Whilst the engine is being started up, the intake transfer pressure (1) is relatively low which allows the spring (2) to overcome the force exerted by the pistons (5) and extend in such a way as to move the sliding plates (3) outwards.

Under these circumstances the pistons (4) are in contact with the shorter side of the plates (3) with a consequent increase of the stroke and therefore also the value of the maximum flow rate.

2) Operation with turbocharger not operating

During normal operation, the intake transfer pressure (1) is greater than the opposing force exerted by the spring (2) and this allows the pistons (5) to move the sliding plates (3) inwards.

In this way the pistons (4) are in contact with the longer side of the plates (3) with a consequent decrease in the stroke and consequently the value of the maximum flow rate.

3) Operation with turbocharger working

The operation of the turbocharger causes an intake pressure (6) at the control valve (7) which causes the movement of an internal piston which places the transfer pressure inlet duct (8) in contact with the return ducts (9 and 10).

The decrease in pressure at the piston (5), allows the spring (2) to overcome the pressure of the inlet fuel (1).

The extending of the spring (2) causes the movement of the plates (3) with a consequent increase of the piston (4) stroke and the value of the fuel flow rate..


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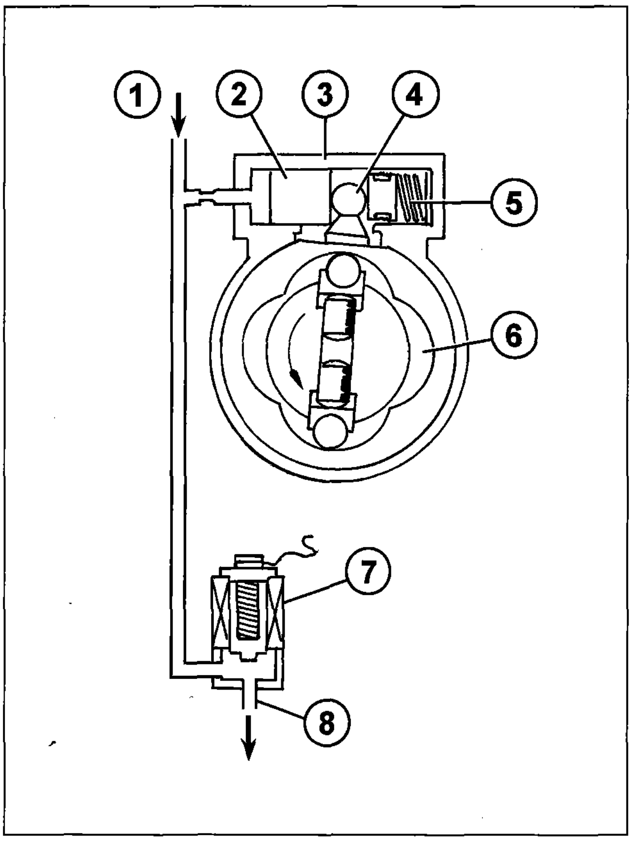
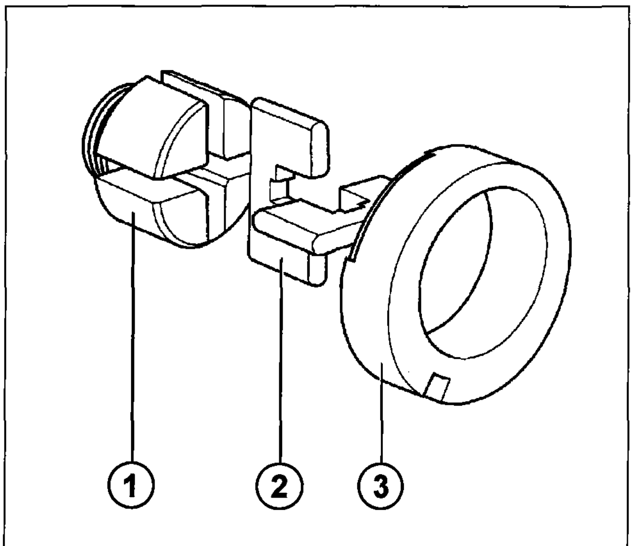



P4A09EJ01

1. Fuel inlet
2. Small piston
3. Cylinder
4. Pin
5. Spring
6. Cam seal
7. Solenoid valve
8. Fuel outlet




P4A09EJ02

1. Transfer pump rotor
2. Brushes
3. Eliptical seal

**Adjusting injection advance**

The injection advance adjustment system makes it possile to vary the start of the injection so that it takes place at the optimum time in all engine operating conditions.
The system comprises a small piston (2) which slides in the cylinder (3) and is opposed by the spring (5).

This piston is connected to the cam seal (6) by means of a threaded pin with a spherical head (4).

If the solenoid valve (7) is not activated, the transfer pressure (1), acting on the piston (2), moves the actual piston overcoming the resistance of the spring (5) and causes the rotation of the cam seal (6), through the pin (4), in relation to the pump control shaft, towards the maximum advance position.

The activation of the solenoid valve (7) allows the fuel to flow towards the vehicle tank via the return pipe (8). This causes a decrease in the pressure acting on the piston (2) allowing the spring (5) to extend fully and, rotate the cam seal towards the miminimum advance position by means of the pin (4).
In this way by varying the solenoid valve (7) opening/closing frequency, the electronic control unit modulates the value of the pressure acting on the piston (2) thereby continuously regulating the start of the injection.

**Transfer pump**

The transfer pump, which is the volumetric type (inlet and pressure), consists of a rotor (1), an eliptical seal (3) and two rigid brushes (2).

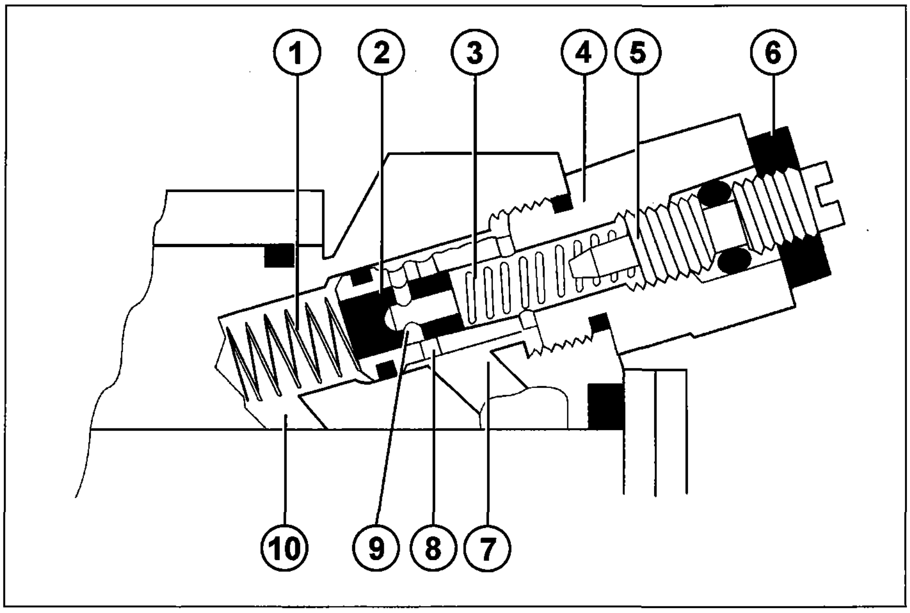
During rotation, the brushes (2) slide in the rotor (1) following the profile of the eliptical seal (3) which is offset in relation to the rotor. As the volume in the chamber increases, a vacuum is created upstream of the blade with the consequent intake of fuel from the tank; the volume decreases downstream of the vane and consequently the fuel in the circuit is supplied under pressure.

# 10.

**Transfer pump regulating valve**

The transfer pump regulating valve is housed in the hydraulic head and carries out three distinct functions:
- creating the transfer pressure;
- controlling this pressure by maintaining a precise relationship between the transfer pressure and the rotation speed;
- pressurizing the fuel metering circuit each time it proves necessary.

The regulating valve consists of a valve casing (4) which contains a piston (2) and a spring (3).
The force applied by the spring (3) can be adjusted by means of an external screw (5) and is opposed by another spring (1) which keeps the piston (2) in its original position.
Increasing the rotation speed of the transfer pump, increases the flow rate and consequently also increases the pressure acting on the piston (2).
When the piston (2) moves it compresses the regulating spring (3) and gradually places the ports (8) and (9) in contact allowing the fuel to return to the transfer pump inlet via the passage (7).
By increasing and decreasing the opening for the ports (8) and (9), the valve makes it possible to regulate the transfer pressure value.
The valve also has the function of filling the transfer pump to ensure priming during the starting stage.
During this stage the lack of inlet pressure allows the spring (3) to extend and move the piston (2) which compresses the spring (1); the fuel in the connector (7) enters through the port (8) and, passing through the piston (2), comes out of the duct (10) reaching the transfer pump.




P4A10EJ01

1. Opposing spring
2. Transfer pump regulating piston
3. Regulating spring
4. Regulating valve body
5. Transfer pump adjustment screw
6. Lock nut
7. Regulated fuel return passage to the transfer pump
8. Adjustment port
9. Filling port
10. Fuel inlet from the transfer pump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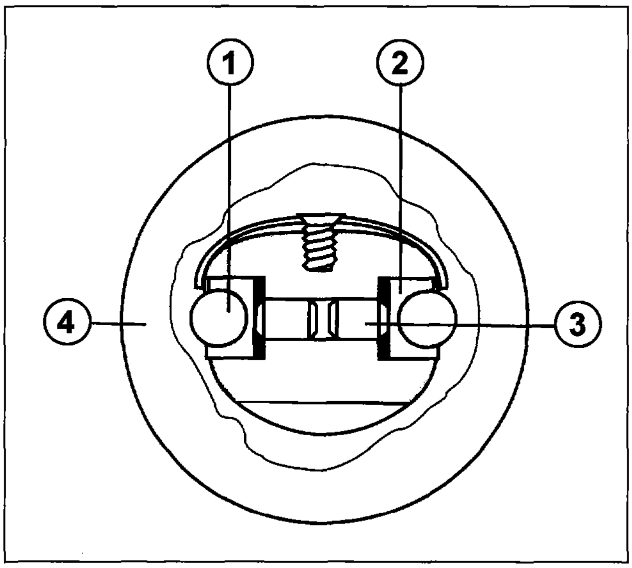
### Hydraulic head

The functions of metering, pumping and distributing take place in the main section of the injection pump, known as the hydraulic head.

The hydraulic head is composed of two groups:

- the hydraulic head stator;
- the distributor rotor, made up of a single element and two pumping pistons.

The distributor rotor is coupled with the housing in the hydraulic head, whilst the pumping pistons are coupled with the housings in the rotor. This means that these parts are not interchangeable with others but constitute a single assembly.



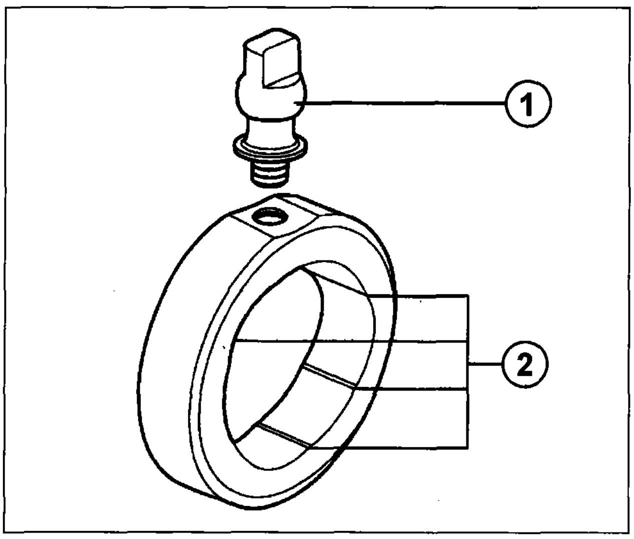

1. Roller
2. Roller carrier
3. Small piston
4. Cam seal

The fuel subject to the transfer pressure enters one of the ports in the hydraulic headl; the opening of this port is controlled by the movement of the metering valve connected to the mechanical regulator.

During the charging cycle, two ports in the rotor are aligned with two filling ports for the head stator. A metered quantity of fuel, regulated by the metering valve, enters the pumping element and moves the pumping pistons (3) away, pushing the group formed by the roller (1) and the roller carrier (2) outwards.

By rotating the rotor interrupts the alignment between the charging and filling ports (end of charging cycle).

By continuing the rotation, one of the fuel supply ports coincides with one of the high pressure outlets.




1. Cam seal
2. Cam seal bolt

### Cam seal

The internal surface of the cam seal has lobes (1) which are diametrically opposite and is machined with precision.

The shape of the lobes causes the pressure movement in the pump, determines the duration of the injection stage and standardizes the supply cycles.

The cam seal bolt (2) connects the latter to the injection advance adjustment system.

When the pump starts the injection cycle, the two roller and roller carrier units which are in contact with the pistons, start to move inwards under the force of the two opposing lobes.

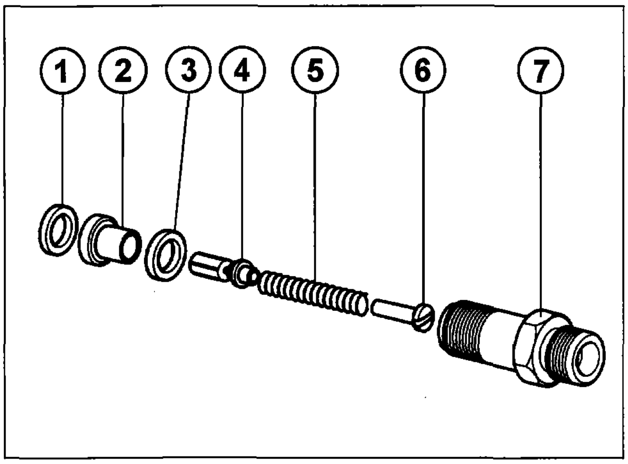
This is the start of the injection.

Whilst the rotor continues to rotate, the rollers move upwards, until they reach the top of the lobes.

This marks the end of the injection.

Continuing the injeciton cycle, the rollers lose contact with the cam seal and the hydraulic head rotor returns to the low pressure condition ready for a new pressurizing cycle.

# 10.




P4A12EJ01

1. Washer
2. Valve body
3. Washer
4. Supply valve
5. Spring
6. Spring guide
7. High pressure outlet connector

**High pressure supply valves**

The supply valves are enclosed between the high pressure outlet connectors (7) and the head stator.

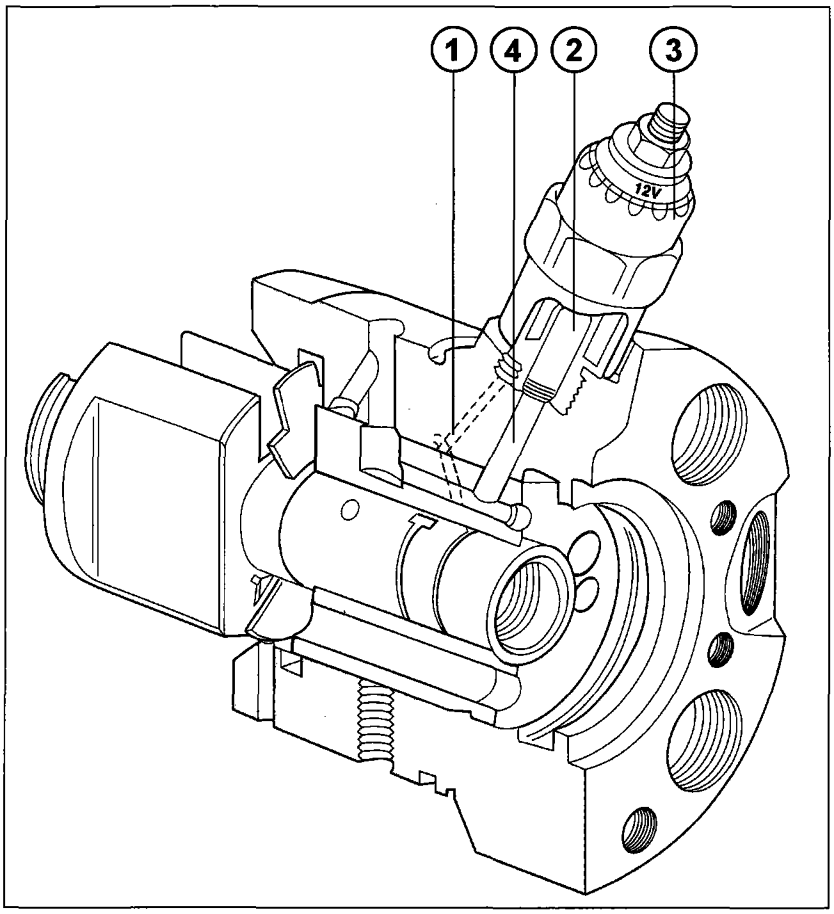
The seal between the valve casing, the head and the connector is achieved by means of two steel washers (1 and 3).

The assembly consists of a valve body (2) and a valve (4) matched together.

The maximum movement of the supply valve is restricted by the spring guide (6).

The spring (5) thrusts the valve (4) against the valve body (2), keeping it in its seat.

At the end of the injection cycle, the supply valves "recall" a certain amount of fuel from the high pressure pipes to ensure the rapid closing of the nozzles and, combined with the cam seal profile, the maintenance of the residual pressure in these high pressure pipes.




P4A12EJ02

**Cut out solenoid**

The engine can be made to cut out by completely removing the supply.

This is achieved by means of a solenoid valve (3) bolted onto the hydraulic head which operates between the flow of transfer pressure (1) and the flow of the metering valve (4).

The cut out solenoid, also known as the Electrostop, is directly connected to the Fiat CODE system and for this reason it is suitably protected by an anti-tamper cover.

1. Passage for transfer pressure
2. Piston
3. Solenoid assembly
4. Passage of fuel towards the metering valve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**Supercharging control valve**

The function of the supercharging control valve is to adjust the value of the maximum fuel flow rate according to the variations in the pressure of the intake air created by the turbocharger.

The supercharging control valve is composed of a valve body (1) which contains a piston (2) which rests on a spacer (3).

There are two different size diaphragms (4) at each side of the spacer (3).

The supercharging pressure, produced by the turbocharger, enters between the two diaphragms via the connector (7).

The supercharging valve is fitted in the transfer pressure circuit somewhere between the transfer pump and the supplementary flow rate device.

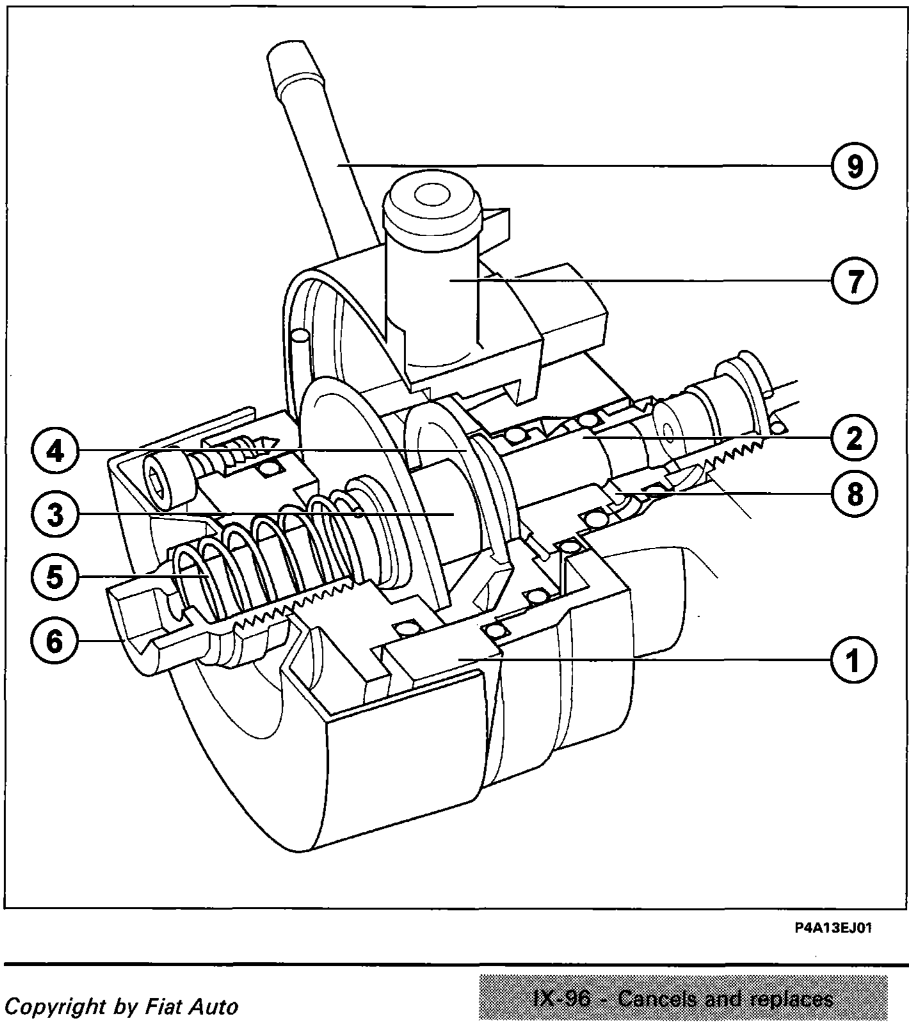
It varies the pressure acting on the supplementary device pistons according to the pressure of the air supplied by the turbocharger.

On accelerating the engine speed increases and consequently so too does the pressure produced by the turbocharger which reaches the supercharing control valve gradually moving the diaphragms (4) which compress the spring (5).

The valve piston (2) moves opening the discharge port (8) producing a drop in pressure behind the supplementary flow rate device pistons.

Under these circumstances the supplementary device spring can gradually thrust the system towards the "supplement engaged" position.

This movement allows the control valve piston (2) to gradually open a port (8) which allows the fuel to be discharged via the diesel return pipes to the vehicle tank and makes it possible to reduce the pressure which builds up upstream of the supplementary device pistons.




P4A13EJ01

1. Valve body
2. Piston
3. Spacer
4. Diaphragms
5. Spring
6. Adjustment screw
7. Connector for the supercharging pressure
8. Discharge of the transfer pressure
9. Recovery connector

# 10.

### Speed regulator

The speed regulator connects the accelerator lever (1) to the metering valve (7). Its function is to control the idle speed (and the fast idle) and the maximum engine speed.

The minimum/maximum regulator unit (mini/maxi device) (2) consists of a pre-loaded spring housed in a steel tube which connects the accelerator lever (1) to the upper part of the regulator plate (3). The regulator plate, in turn, causes the metering valve (7) to rotate by means of a connecting rod (5).

A spring (14), fixed to the front section of the regulator plate, controls the idle speed.

The mass carrier (10), which is fixed to the control shaft (11), contains a certain number of masses (9) subject to a centrifugal force which varies according to the engine rotation speed.

In idling conditions the centrifugal force acting on the masses is weak and the regulator plate is balanced between the force exerted by the masses (9) and the force of the spring (14) resting on the idle shaft.

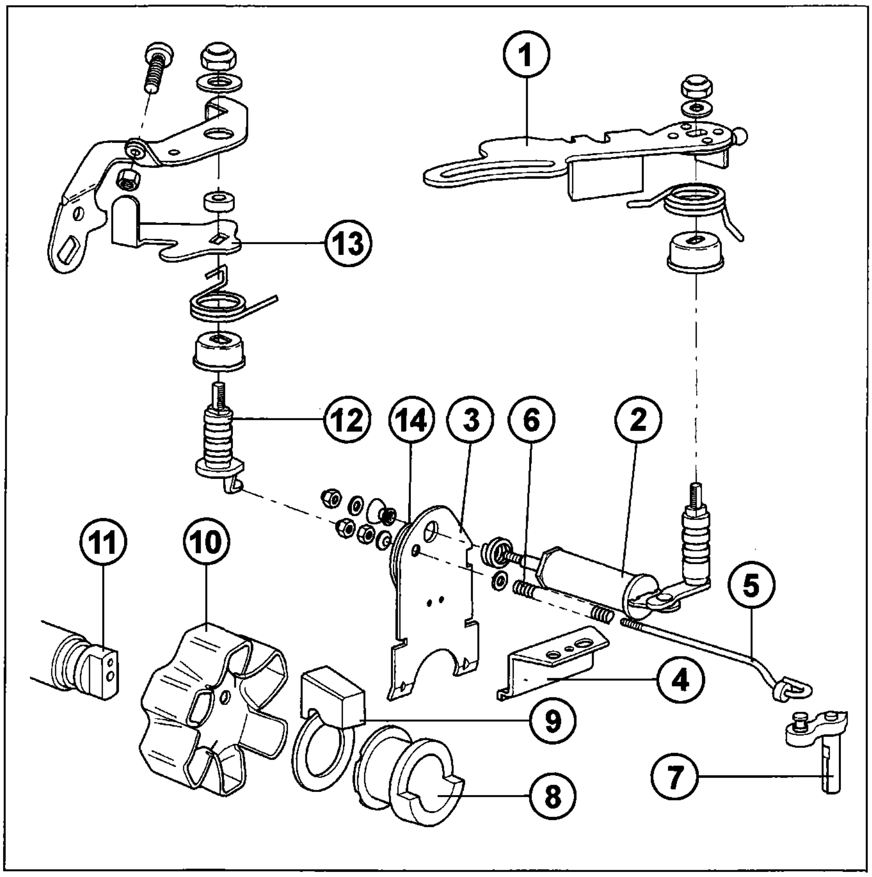
During acceleration, the accelerator lever (1) moves the metering valve (7), via the regulator rod (5), towards the completely open position.

The centrifugal force exerted by the masses increases, but remains lower than the pre-loading of the mini/maxi device (2) spring.

This means that the connection between the metering valve (7) and the accelerator lever (1) is direct.

During the adjustment stage, or when the speed reached increases the centrifugal force of the masses to such an extent as to overcome the mini/maxi device spring pre-loading force, the regulator controls the position of the metering valve (7).

In this case the connection between the metering valve (7) and the accelerator lever (1) is no longer direct.



P4A14EJ01

1. Accelerator lever
2. Mini/maxi device
3. Regulator plate
4. Regulator bracket
5. Regulator rod
6. Regulator rod spring
7. Metering valve
8. Regulator sleeve
9. Regulator masses
10. Mass carrier
11. Drive shaft
12. Idle shaft
13. Idle lever
14. Idle spring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## ELECTRICAL/ELECTRONIC CIRCUIT

The electrical/electronic circuit for the fuel system basically comprises wiring, an electronic control unit and the following sensors and actuators:

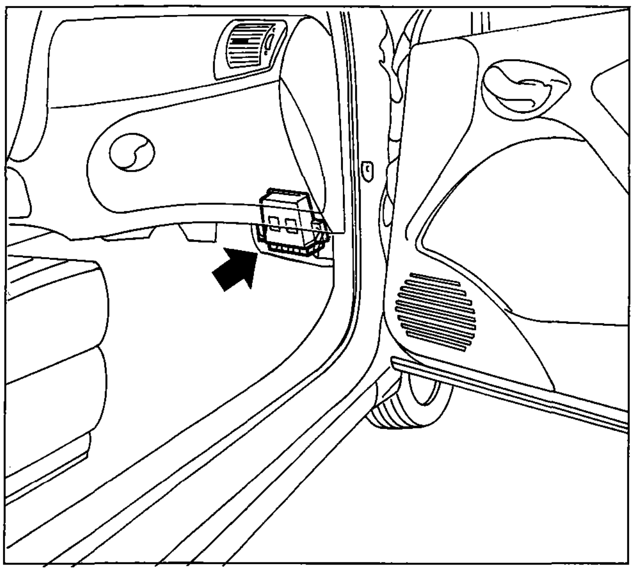
- Rpm sensor
- Coolant temperature sensor
- Air flow meter
- Intake air temperature sensor
- Instrument injector
- Accelerator lever position sensor
- Fast idle solenoid valve
- Pre-heating control unit

### Electronic control unit

The electronic control unit (ECU) is located below the glove compartment (right side) and is connected to the wiring by means of a 25 pin connector.

It receives all the information relating to the engine running conditions transmitted by the various sensors in addition to atmoshperic pressure information obtained by means of a sensor inside the actual control unit.

Through this data and with the aid of special programmes, the control unit is capable of carrying out the following operating strategies:
- injection advance management
- fast idle management
- exhaust gas recirculation management
- air conditioning system management
- heater plugs pre/post heating management



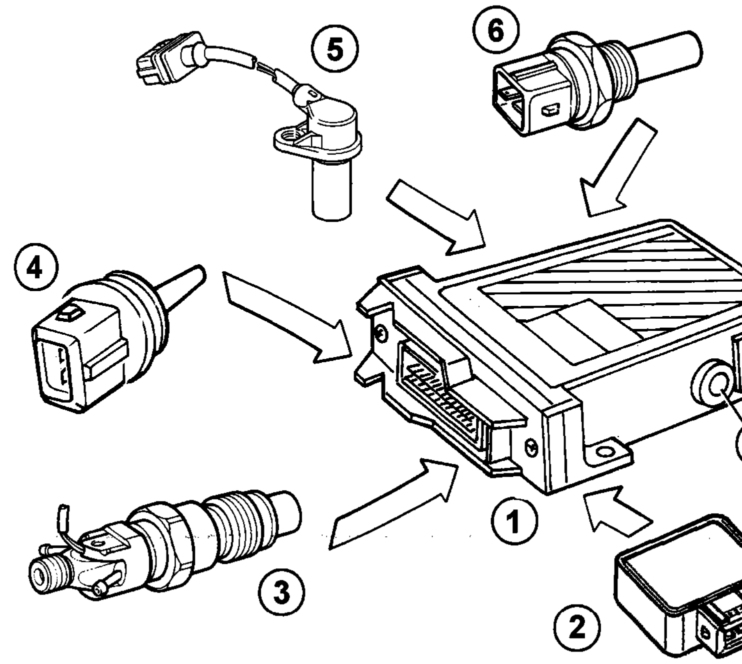
P4A15EJ01

**Location of electronic unit**

## 10.

### INJECTION ADVANCE MANAGEMENT

By means of information relating to the engine speed/TDC, accelerator lever position, atmospheric pressure, temperature of the intake air and temperature of the engine coolant, the electronic control unit calculates the optimum injection advance value and compares it with the actual value transmitted by the instrument injector and, if necessary, it operates the advance actuator solenoid valve so that the start of the injection always takes place at the most appropriate moment for all engine operating conditions.



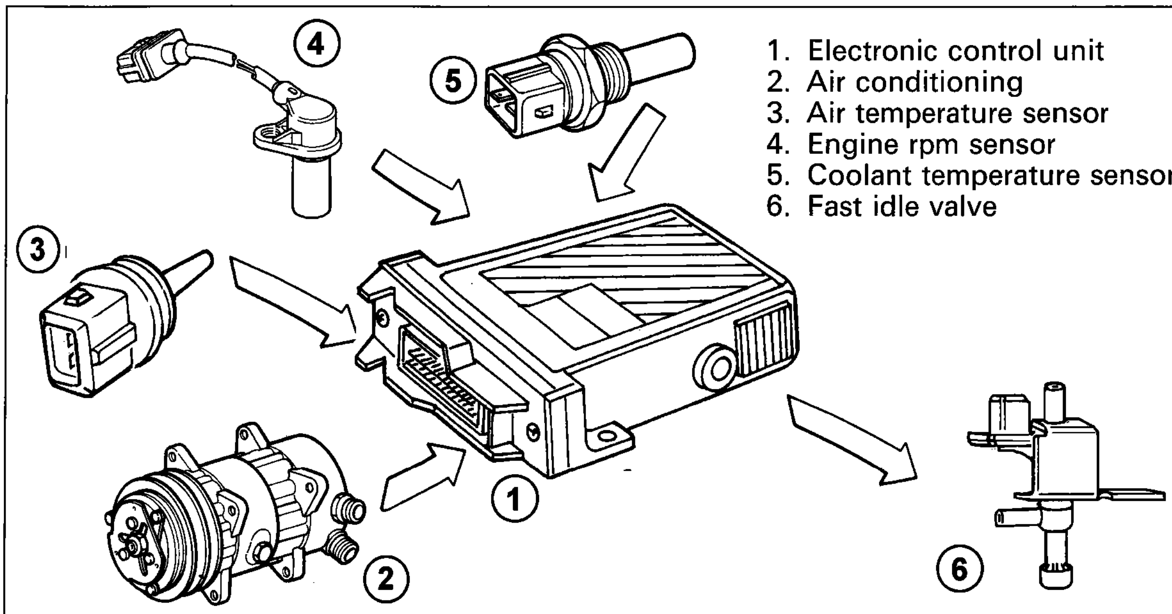

1. Electronic control unit
2. Accelerator lever position sensor
3. Instrument injector
4. Air temperature sensor
5. Engine rpm sensor
6. Coolant temperature sensor
7. Advance actuator solenoid valve
8. Atmospheric pressure sensor

P4A16EJ01

### FAST IDLE MANAGEMENT

The engagement of the fast idle function is implemented by the control unit when at least one of the following conditions prevail:

1. intake air temperature below 25 °C and engine coolant temperature below 55 °C;
2. air conditioning compressor on;
3. engine speed below 750 rpm.




1. Electronic control unit
2. Air conditioning
3. Air temperature sensor
4. Engine rpm sensor
5. Coolant temperature sensor
6. Fast idle valve

P4A16EJ02



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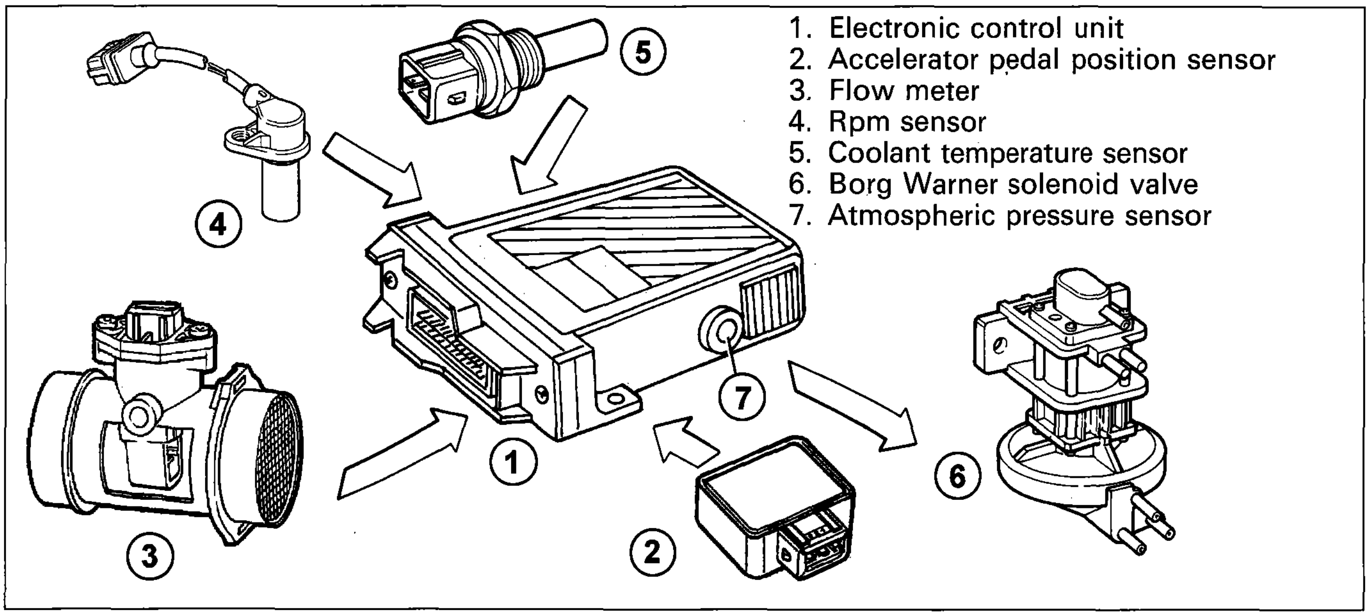
## EXHAUST GAS RECIRCULATION MANAGEMENT

The electronic control unit calculates the weight ratio between the "clean" intake air and the quantity of burnt gases which can be returned to the intake. Depending on the engine load, the temperature of the coolant, the atmospheric pressure and the quantity of intake air, the electronic control unit operates the Borg Warner solenoid valve which, in turn, activates the EGR valve, by means of a vacuum signal, thereby allowing the partial recirculation of the exhaust gases.




1. Electronic control unit
2. Accelerator pedal position sensor
3. Flow meter
4. Rpm sensor
5. Coolant temperature sensor
6. Borg Warner solenoid valve
7. Atmospheric pressure sensor

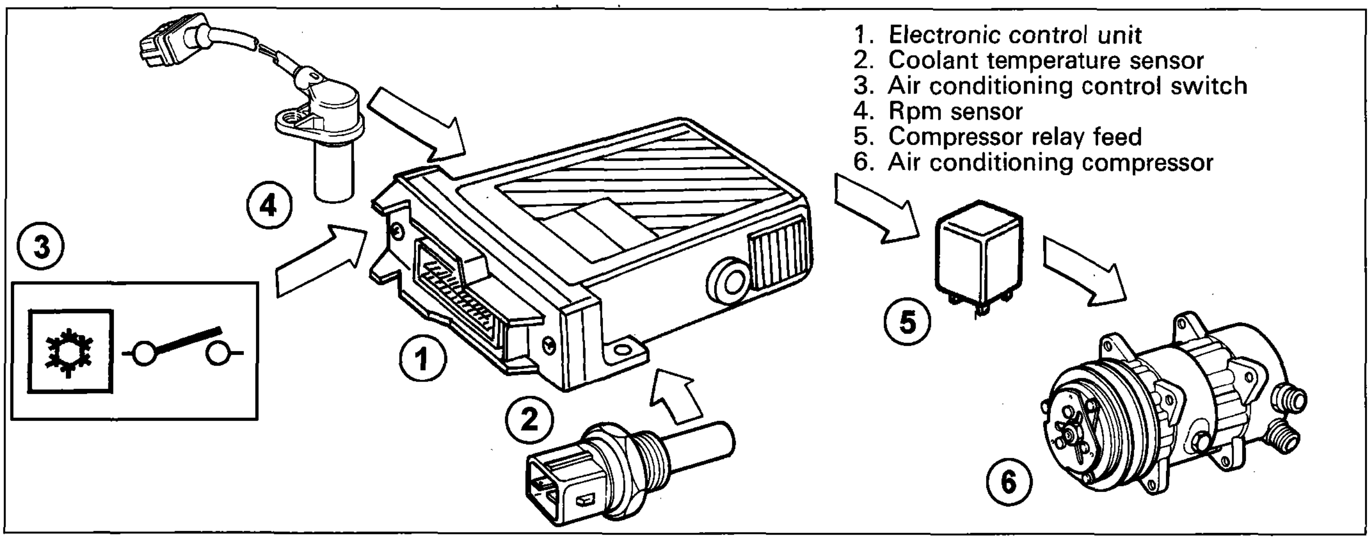
P4A17EJ01

## AIR CONDITIONING SYSTEM MANAGEMENT

When the air conditioning is switched on, the compressor absorbs power from the engine which, when idling, tends to cut out. In order to prevent this problem, the control unit activates the fast idle function described previously.
Another function carried out by the control unit is that of interrupting the compressor supply if one of the following conditions occurs:

1. Coolant temperature more than 110 °C;
2. Exceeding of a certain rpm level (around 4500);
3. High engine power request (strong acceleration).

In conditions 1 and 2 the supply is restored when the coolant temperature or engine rpm values go below the intervention level.
In condition 3 the interruption is only momentary and the supply is automatically restored after several seconds even in the high power request still exists.



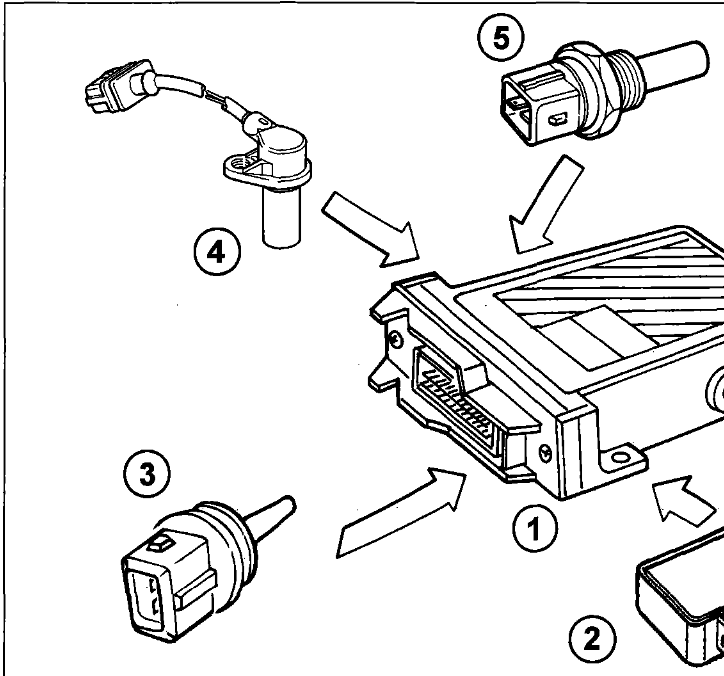

1. Electronic control unit
2. Coolant temperature sensor
3. Air conditioning control switch
4. Rpm sensor
5. Compressor relay feed
6. Air conditioning compressor

P4A17EJ02

## HEATER PLUGS PRE/POST HEATING MANAGEMENT

The electronic control unit directly controls the heater plugs control unit managing the pre and post heating times mainly according to the values for the engine coolant temperature and the intake air temperature.

In order to calculate the post-heating times, the control unit also assesses the accelerator lever position and rpm values, decreasing these times if there is a high engine power request.

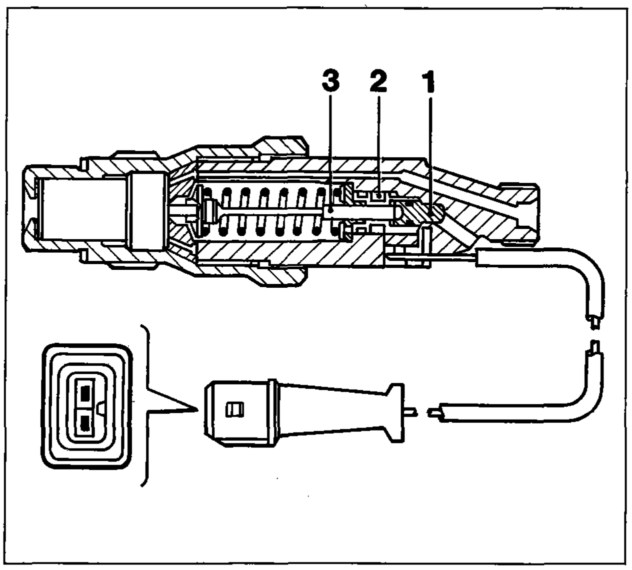



1. Electronic control unit
2. Accelerator lever position sensor
3. Air temperature sensor
4. Rpm sensor
5. Coolant temperature sensor
6. Heater plugs control unit

P4A18EJ01

### Instrument injector

The instrument injector informs the electronic control unit of the actual injection advance (start of the injection stage or of the start of the movement of the needle valve).




P4A18EJ02

According to the signal the control unit corrects the advance set by the injection actuator until the nominal value is reached.

The injector is fitted on the cylinder (1) and is equipped with a device for recognizing the exact moment of the start of the injection stage and with wiring for sending a signal and informing the electronic control unit.

Inside the injector there is a coil (2), a needle valve 93) and an adjustment pin (1). The coil is electrically supplied and produces a magnetic flow which affects the needle valve (3). When the latter initiates the opening of the nozzle for injecting the fuel, this causes a variation in the magentic flow in the coil (2) which the control unit recognizes as the start of the injection and on which the advance adjustment strategy is based.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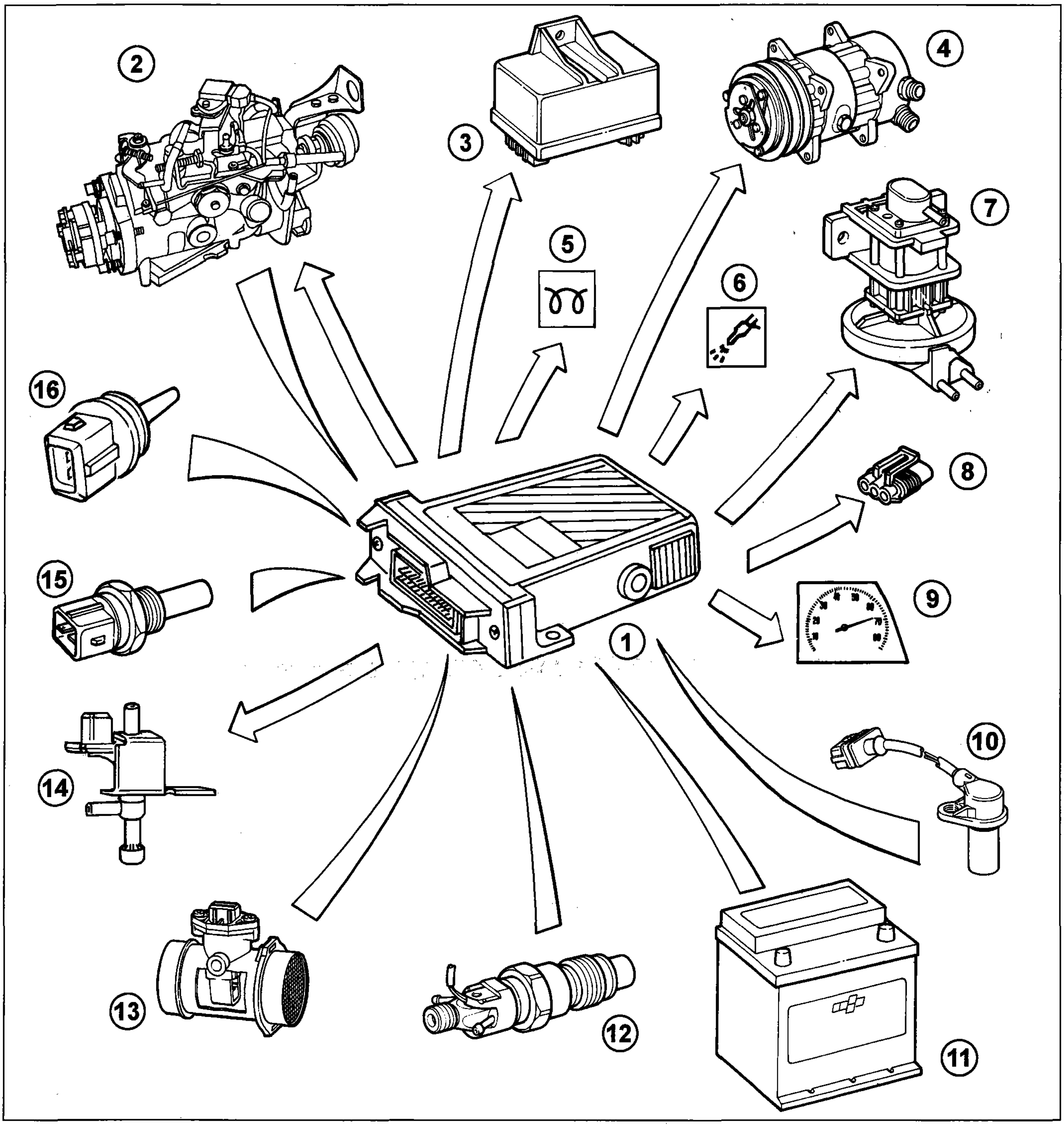
**SIGNALS ARRIVING AT AND LEAVING THE CONTROL UNIT/SENSORS AND ACTUATORS**

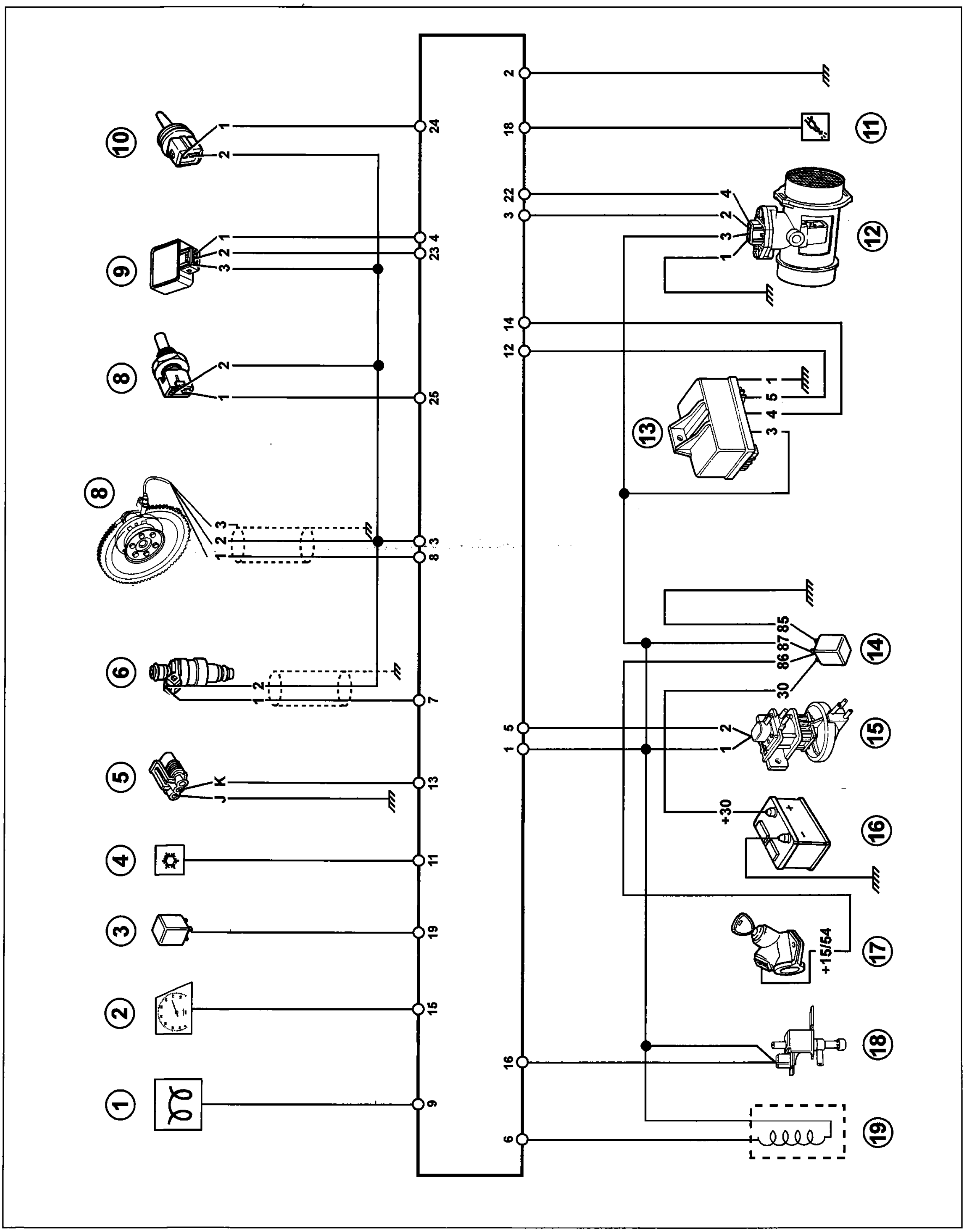



P4A19EJ01

1. Electronic control unit
2. Injection pump
3. Heater plugs control unit
4. Climate control system
5. Heater plugs warning light
6. Injection system failure warning light
7. Borg Warner solenoid valve
8. Diagnostic socket
9. Rev counter
10. Engine rpm sensor
11. Battery
12. Instrument injector
13. Air flow meter
14. Fast idle valve
15. Coolant temperature sensor
16. Air temperature sensor

# 10.

## WIRING DIAGRAM



P4A20EJ01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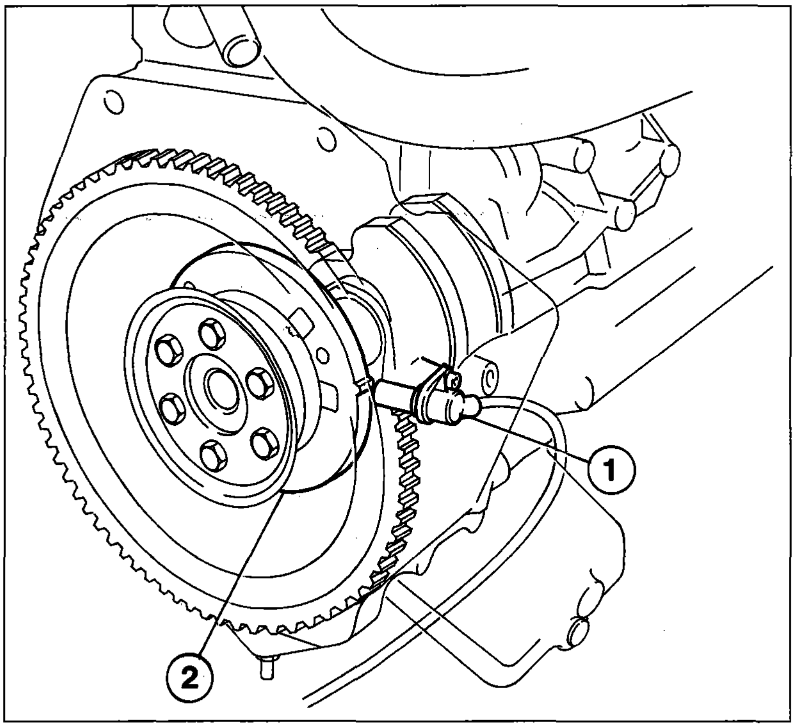
**Wiring diagram key**

1. Heater plugs warning light
2. Rev counter signal
3. Climate control relay
4. Climate control on button
5. Fiat/Lancia Tester diagnostic socket
6. Instrument injector
7. Rpm and TDC sensor
8. Coolant temperature sensor
9. Fuel introduction lever position sensor
10. Intake air temperature sensor
11. Injection system failure warning light
12. Flow meter
13. Pre-heating control unit
14. System relay feed
15. Fuel vapour solenoid valve
16. Battery
17. Ignition switch
18. Fast idle valve
19. Advance adjustment device solenoid

**Engine rpm sensor and flywheel**




P4A13EJ03

**Features:**

Gap
0,8 ÷ 1,5 mm

Winding resistance
860 ohm ± 10% at 20°C

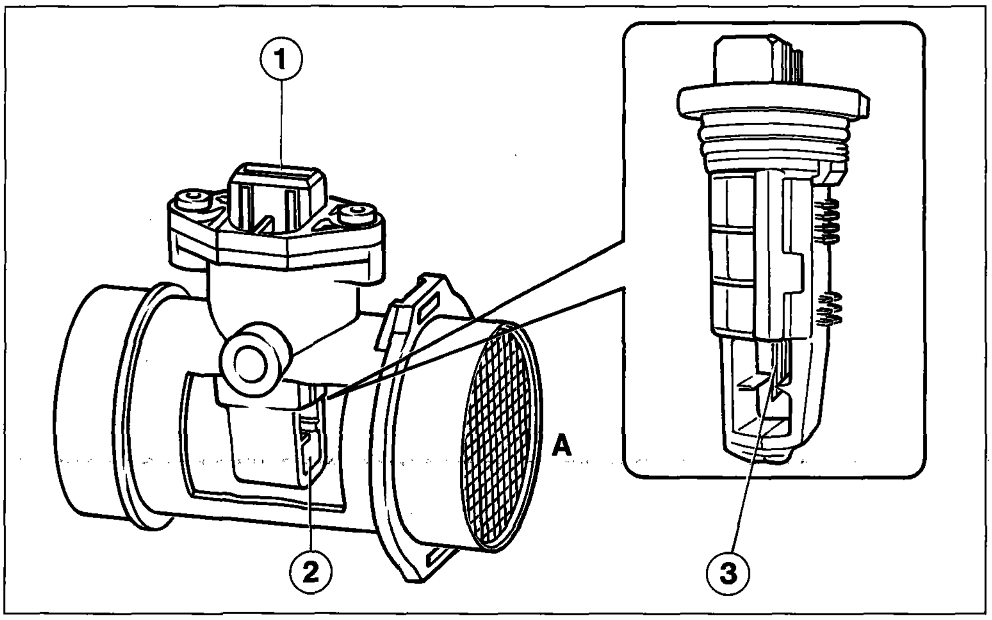
1. Rpm sensor
2. Flywheel

The engine rpm sensor is fitted on the crankcase and is facing a flywheel, located inside the crankcase and fixed to the crankshaft.
The flywheel has 2 reference dowels at 180° from one another, on the outer part of the circumference.

When these dowels or teeth pass under the sensor, as a result of the variation of the gap, this causes a variation in the magnetic flow which produces a current in the coil windings in the sensor.
This signal, sent to the control unit, allows the engine speed to be detected.

**Air flow meter**

The air flow meter is the "heated film" type; the operating principle is based on a heated diaphragm which is placed in a measuring channel through which the intake air which enters the engine flows.
The film diaphragm is kept at a constant temperature ( ~120°C higher than the temperature of the air) by the heating resistance which is in contact with it.
The mass of air which passes through the measuring channel tends to remove heat from the diaphragm therefore, in order to keep it at a constant temperature, a certain current should flow through the heating resistance; this current is measured by a suitable Wheatstone bridge.
The current measured is therefore proporational to the mass of air flowing through.




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

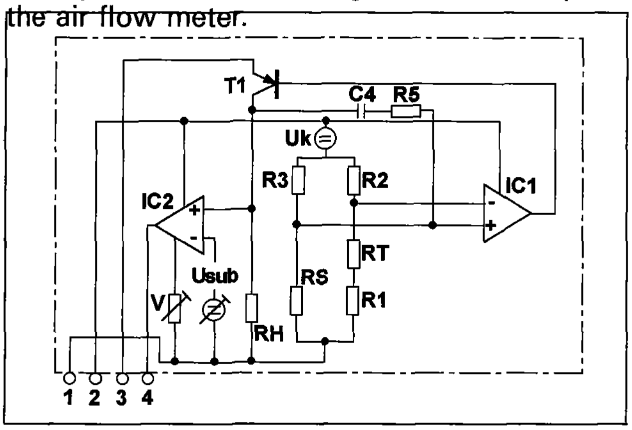
A= Air intake

P4A22EJ01

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

**Description of the operation**

The Wheatstone bridge (made up of R3, R2, Rs, Rt+R1) is in equilibrium when Rs is at around 120°C higher than the temperature of the air.
The air which passes through the diaphragm removes heat from Rs, therefore the bridge is not in equilibrium. This situation is detected by the circuit at IC1, which operates transistor T1 in a manner which is proportional to the imbalance of the bridge with the result that more current passes through Rh to heat up Rs and the equilibrium of the bridge is restored.
Circuit IC2 measures the current which passes through Rh. This current makes it possible to maintain the equilibrium of the bridge and is consequently proportional to the mass of air which passes through the air flow meter.

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**Air flow meter wiring diagram**


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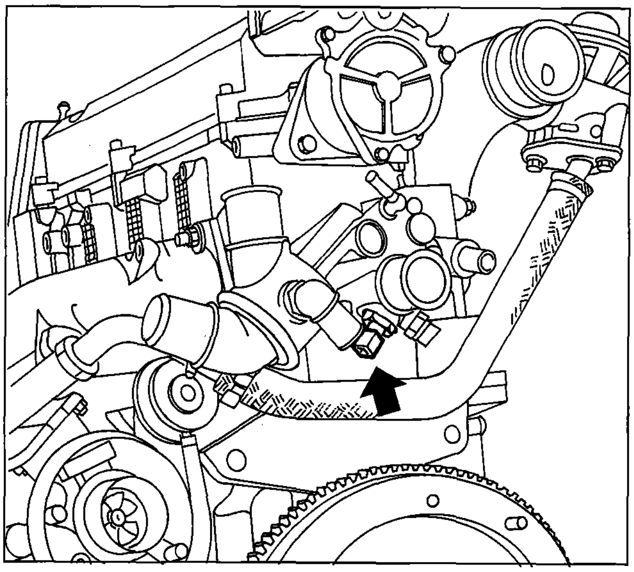
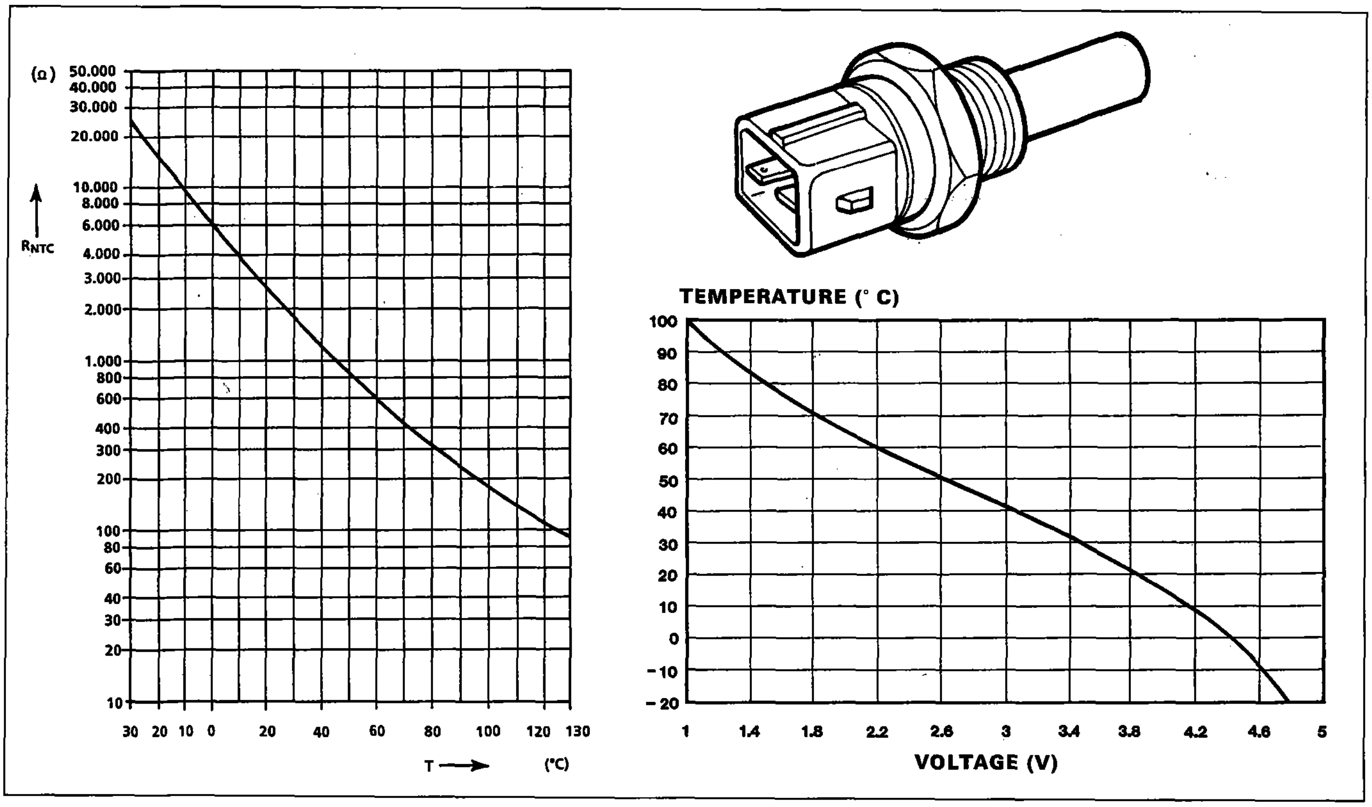


P4A23EJ01

## Coolant temperature sensor

The temperature of the engine coolant is measured by a sensor which comprises an NTC resistor where the resistance varies in a manner which is inversely proportional to the temperature, as illustrated in the diagram.

The control unit detects the variation in voltage proportional to the current intensity circulating in the sensor.
The sensor should be fitted taking care not to exceed the tightening torque of 15 Nm

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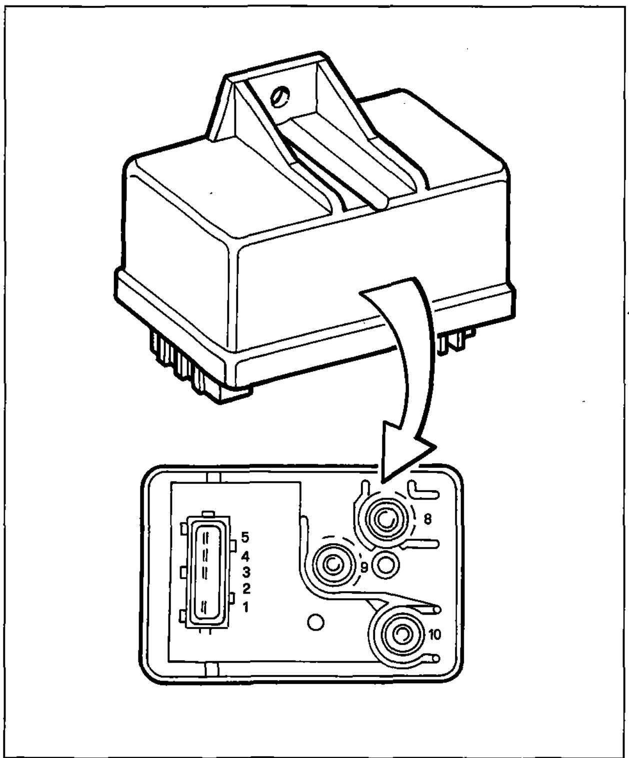


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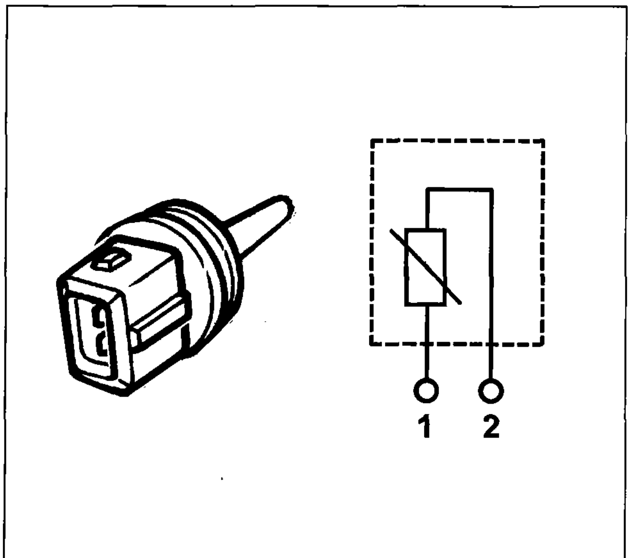
### Pre-heating control unit

The operation of the heater plugs takes place via the pre-heating control unit, under the direct control of the electronic control unit.
There is an "intelligent" relay inside which sends a return response (feed-back) to the injection control unit which is informed in this way of any failures of the pre-heating control unit or short circuit to earth of the heater plugs.
The diagram shows the connectors on the pre-heating control unit base and the relevant pin-out.

*Connections*

1. Vehicle earth
2. Not connected
3. Ignition switch (+15)
4. Electronic control unit (pre-post heating activation)
5. Electronic control unit (fault diagnosis)
8. Battery positive
9. Heater plugs
10. Heater plugs




P4A24EJ02

### Air temperature sensor

The intake air temperature sensor is, on this version, separate from the air flow meter: it comprises a standard NTC (Negative Temperature Coefficient) where the electrical resistance decreases as the temperature increases.

Since the control unit intake circuit is designed as a voltage divider, this voltage is divided between a resistance in the control unit and the sensor NTC resistance.

As a result the control unit is capable of evaluating the variations in the sensor resistance through the changes in voltage and thereby obtain information concerning the temperature.


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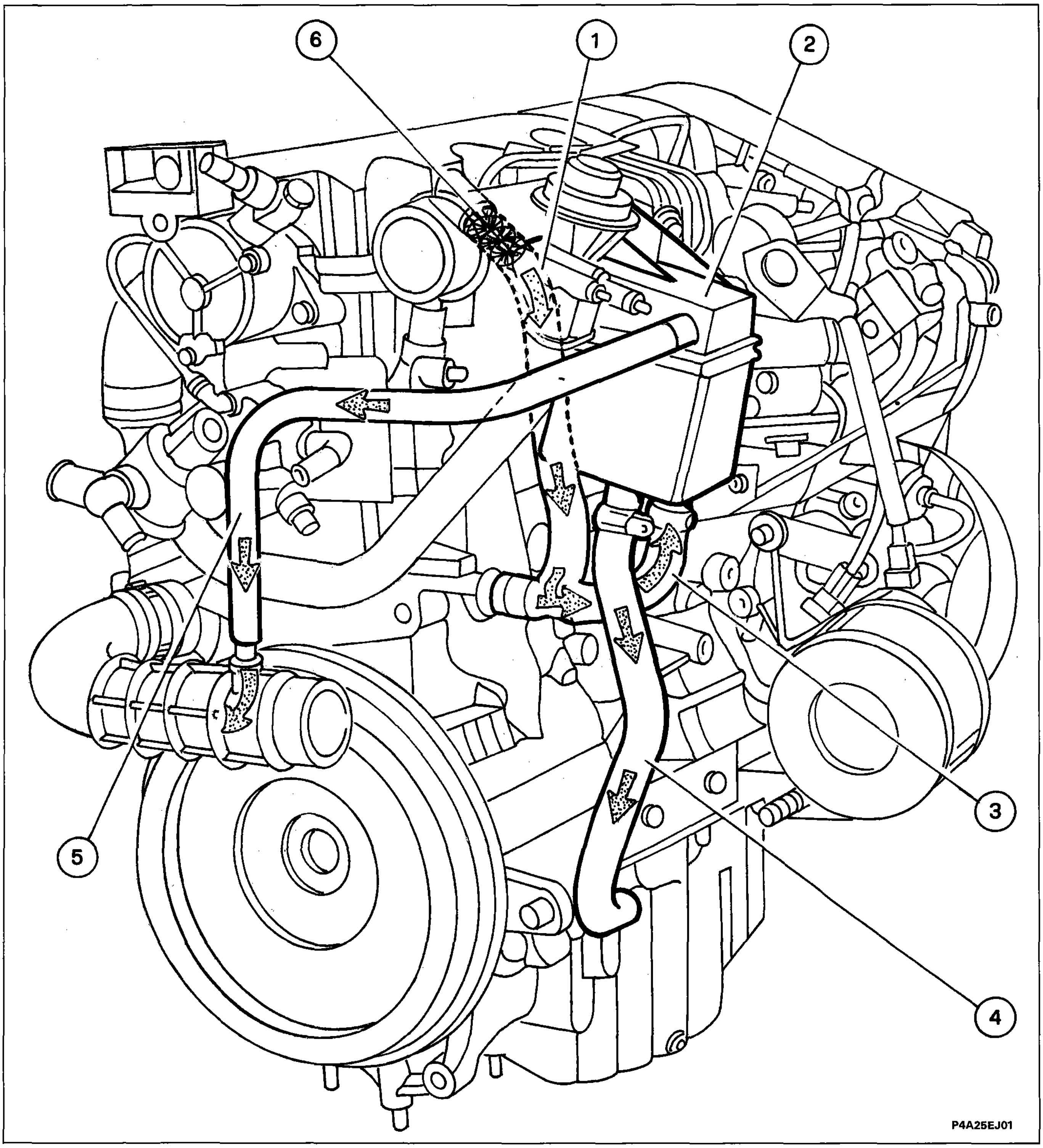
**DIAGRAM SHOWING RECIRCULATION OF GASES COMING FROM THE ENGINE CRANKCASE (BLOW-BY)**




The engine crankcase emissions are composed of a mixture of air, diesel fuel and burnt gases which escape from the piston seals in addition to lubricant oil vapours. They are defined as blow-by or breather gases.
The breather gases coming from both the cylinder block/crankcase and the cylinder head through the pipe (3), reach the separator (2) where, following the vortex action to which they are subjected, they lose part of the oil dissolved in them which returns to the sump through the pipe (4) in the form of droplets.
The remaining gases, on the other hand, are directed, via the pipe (5), to the inlet circuit.
There is a spark-out (6) fitted inside the gas outlet pipe (1) on the cylinder head to prevent combustion due to flame returns.

**EXHAUST GAS RECIRCULATION SYSTEM (E.G.R. - Exhaust Gas Recirculation)**

This system makes it possible to send part of the exhaust gases to the inlet in certain engine operating conditions.

This dilutes the fuel mixture with the inert gases lowering the peak temperature in the combustion chamber: in this way the formation of nitrous oxides (NOx) is contained, with a 30÷50 % at the exhaust.

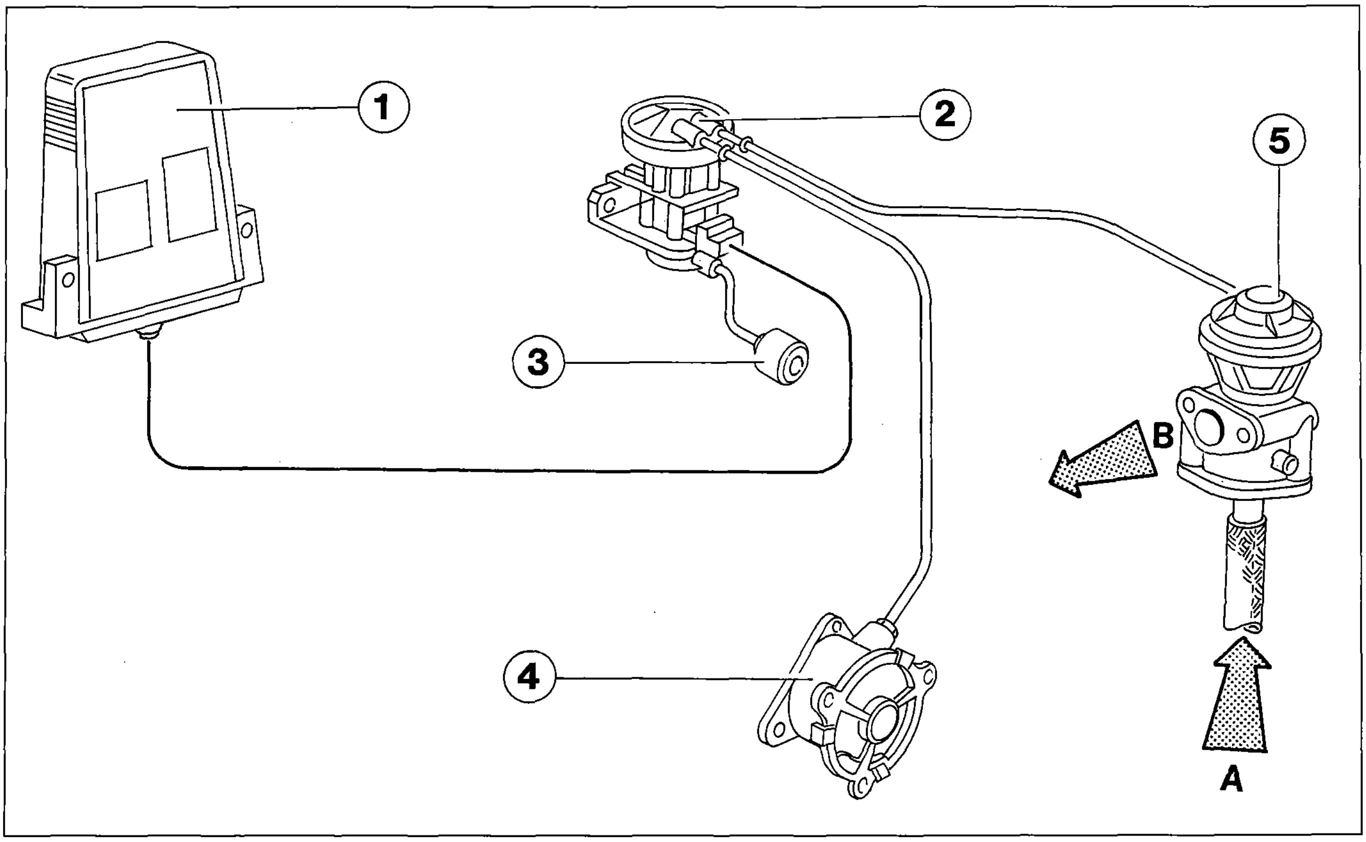
The recirculation of burnt gases is only possible at medium to low loads, when the air/fuel ratio is very high and the operation of the engine is not penalized by the presence of inert gases in place of the air.

The recirculation system is operated by the electronic control unit (1) which receives input signals from the potentiometer at the accelerator control lever (on the injection pump) and from the rpm and engine coolant temperature sensors and provides an output signal to operate the Borg Warner E.G.R. solenoid valve (2).

The latter, connected to the atmosphere via a small filter (3), transmits a lesser or greater vacuum, according to the signal received, coming from the special brake servoc vacuum pump (4) to the Pierburg E.G.R. valve (5).

If the vacuum is sufficient, this valve opens, placing the exhaust manifold in contact with the inlet manifold.

The quantity of gases recirculated can therefore be varied by regulating the opening of the E.G.R. valve continuously, using the maps stored in the control unit memory relating to the degree of opening according to the signals received.



P4A26EJ01

1. Electronic control unit
2. Borg Warner modulating valve
3. Filtrino presa atmosferica
4. Brake servo vacuum pump
5. E.G.R. valve

A. Gases coming from the exhaust manifold
B. Gases sent to the inlet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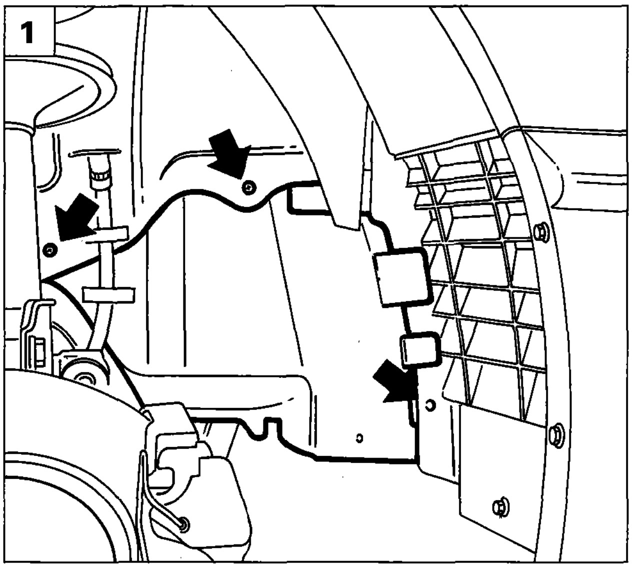

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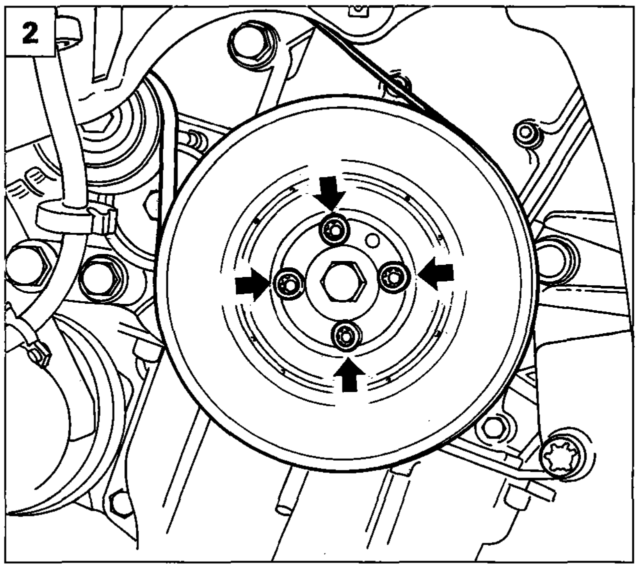

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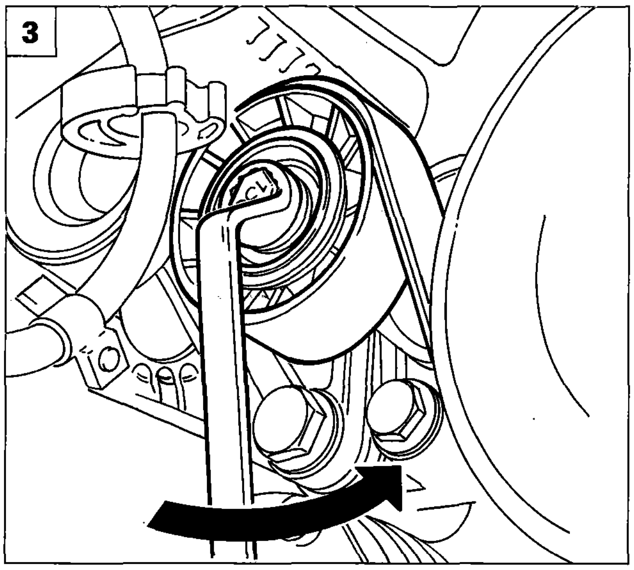

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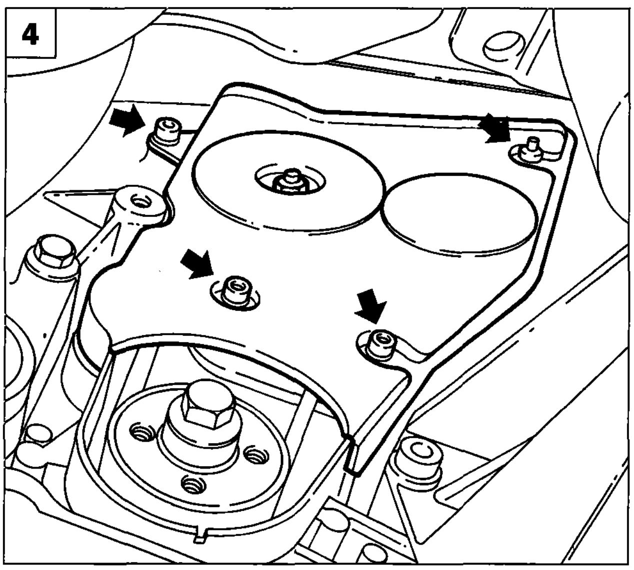


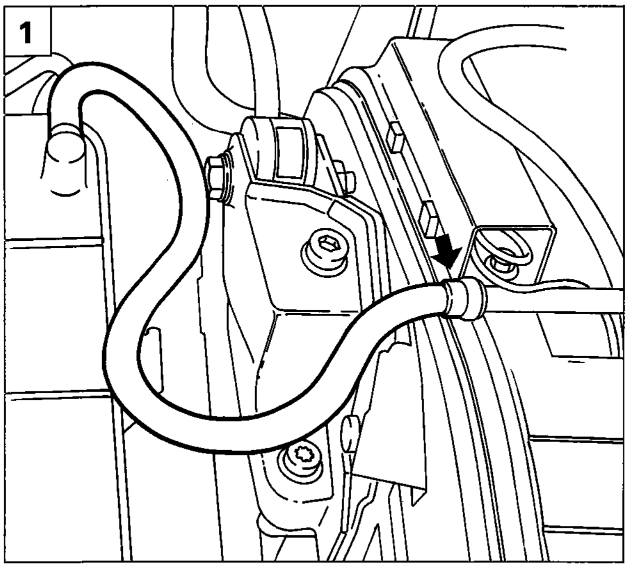
P4A27EJ04

## REMOVING-REFITTING INJECTION PUMP

Position the vehicle on a lift, disconnect the positive battery terminal, remove the right front wheel and proceed as follows:

1. Remove the bolts shown and remove the right front wheel arch liner.
2. Loosen the bolts shown which fix the auxiliary shaft drive pulley.
3. Act on the automatic tensioner to loosen the tension at the auxiliary shaft drive belt, then remove the belt.
4. Remove the lower protection for the timing drive belt.

# 10.

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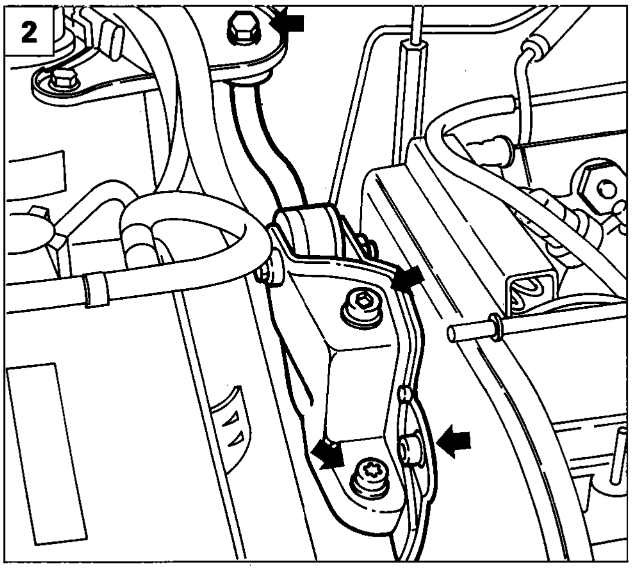


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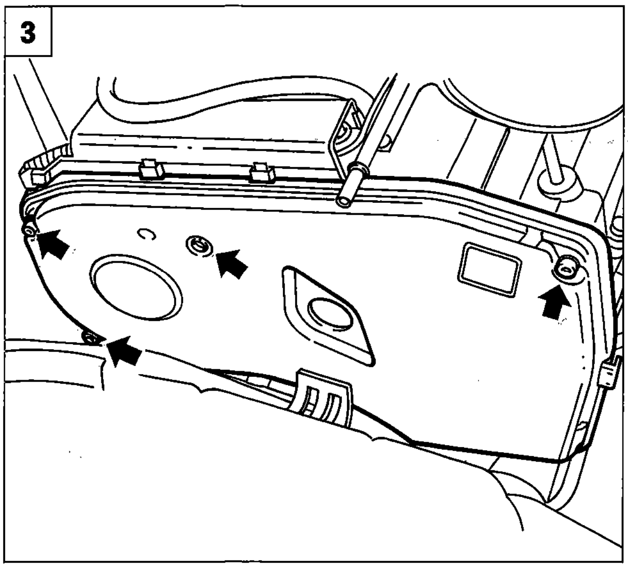


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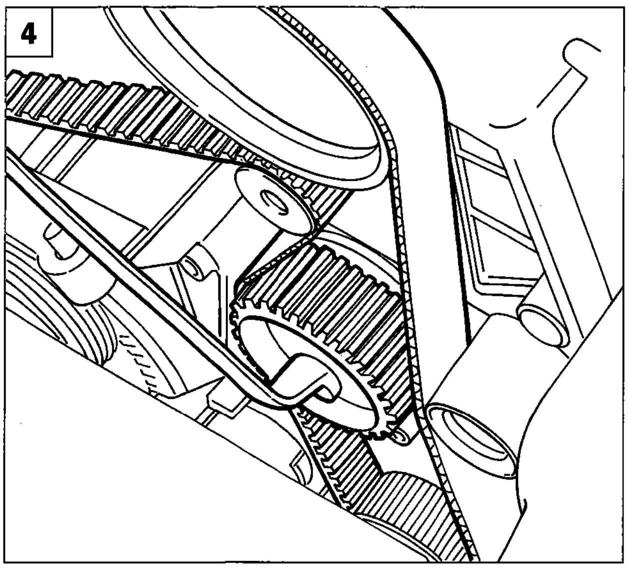


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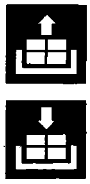

1. Disconnect the engine colant pipe after having loosened the fixing band.
2. Undo the bolts shown, then remove the reaction connecting rod and the mounting bracket (engine side).
3. Undo the fixing bolts and remove the timing belt upper shield.
4. Loosen the nut securing the timing belt tensioning device, then remove the actual belt.



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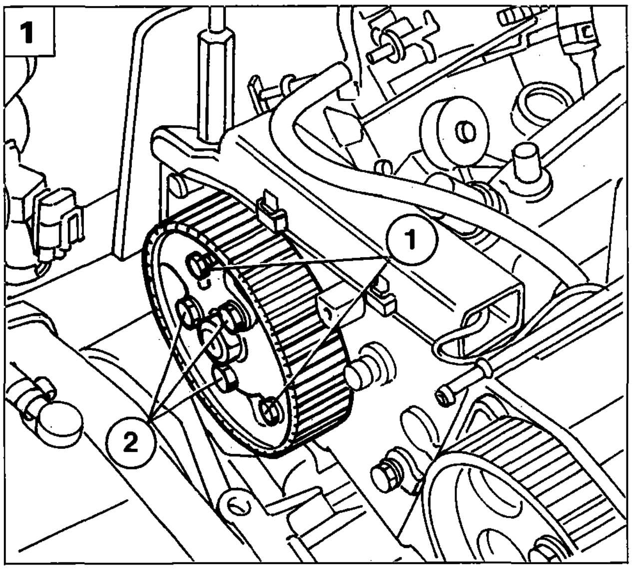


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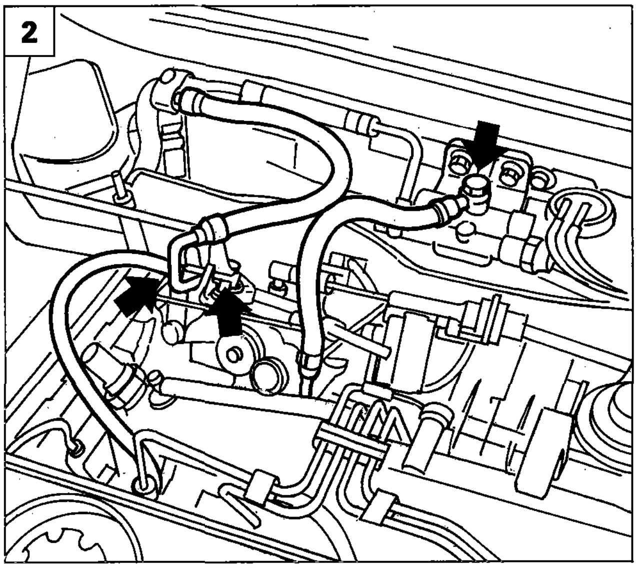


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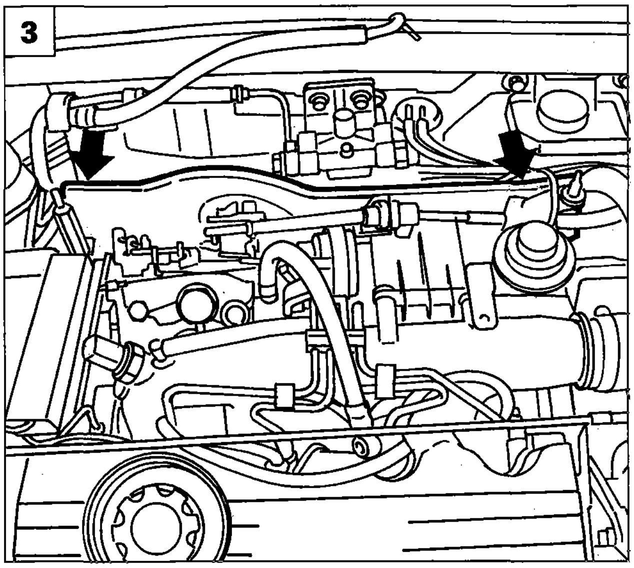


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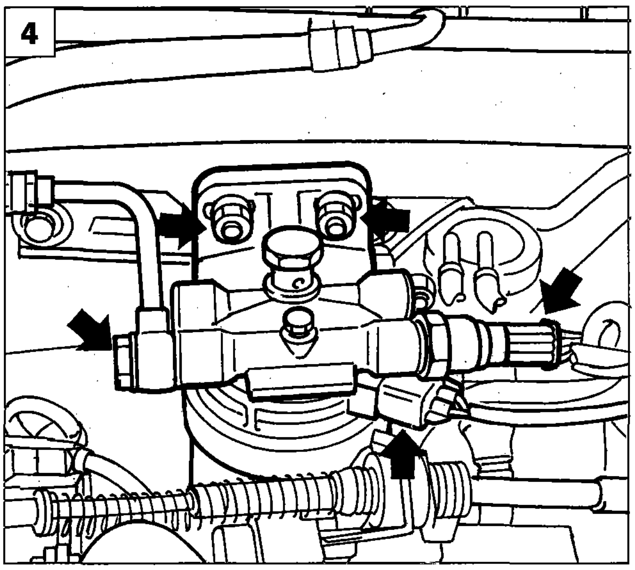
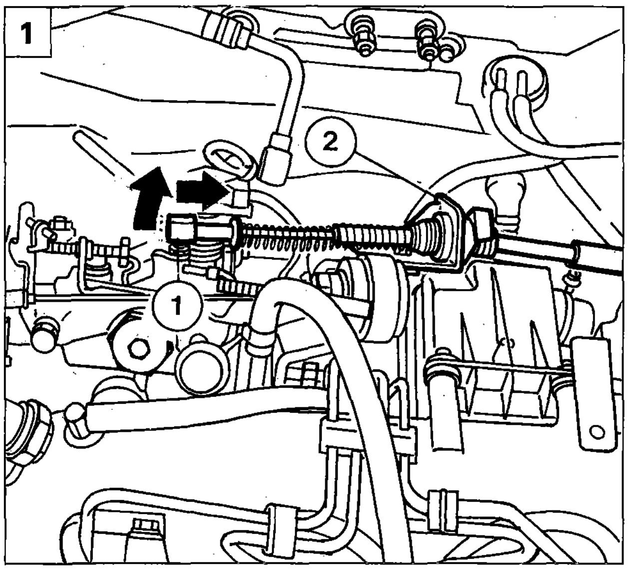



P4A29EJ04

1. Stop the rotation of the injection pump drive pulley by tightening the two service bolts (1) in the special openings in the pump support, then undo the bolts (2) fixing the pulley, undo the bolts (1) and remove the pulley.
2. Acting at the points shown, disconnect the diesel supply pipes from the filter to the pump, the diesel return pipes from the pump to the tank and the diesel return pipes from the injectors to the pump.
3. Undo the fixing bolts and remove the sound insulation shield.
4. Disconnect the electrical connections, disconnect the diesel supply pipe between the tank and the filter, undo the fixing nuts and remove the diesel filter.

## 10.

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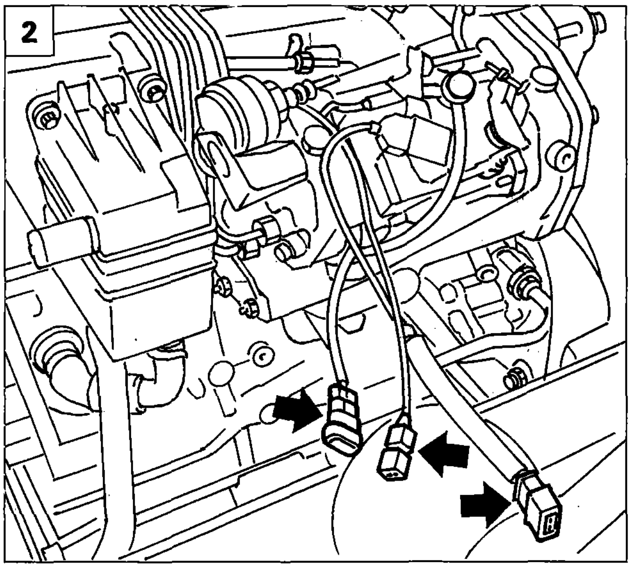


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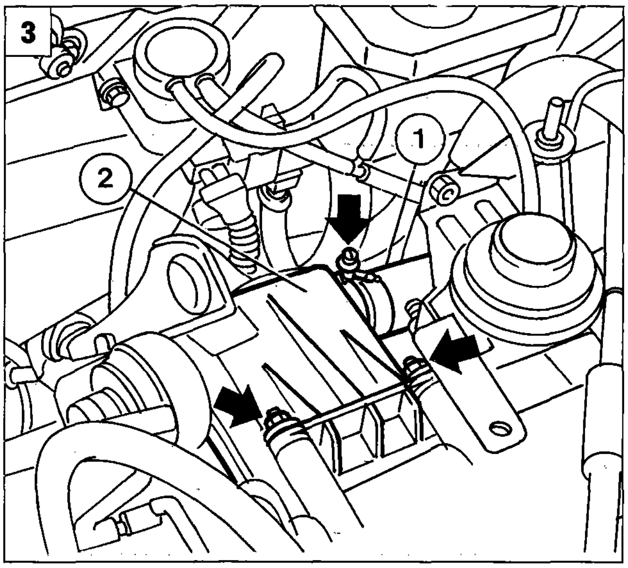


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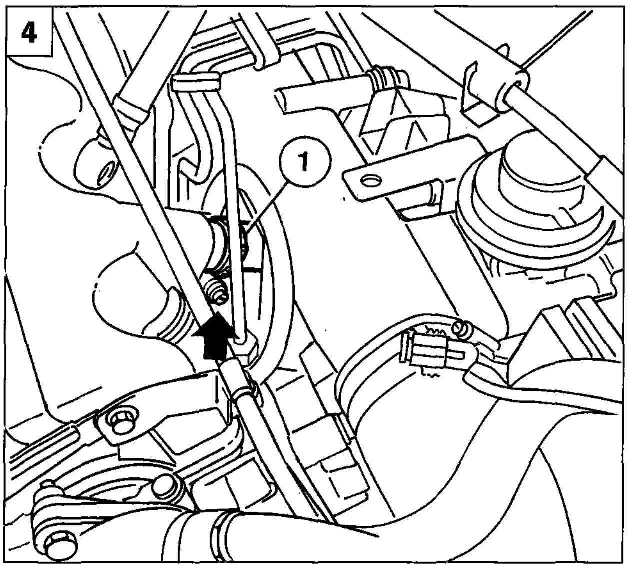


P4A30EJ04

1. Let the band (1) slide in the direction shown by the arrow, then remove the accelerator cable from the injection pump releasing it from the attachment pin and removing it from the mounting and adjustment bracket (2).
2. Disconnect the electrical connections shown
3. Disconnect the pipe (1) from the oil vapour separator (2). Undo the nuts fixing the separator (2); a third nut (not illustrated) is at the lower side of the separator.
4. Disconnect the pipe (1) which connects the oil vapour separator to the tappet cover and move the actual separator towards the engine compartment rear partition.



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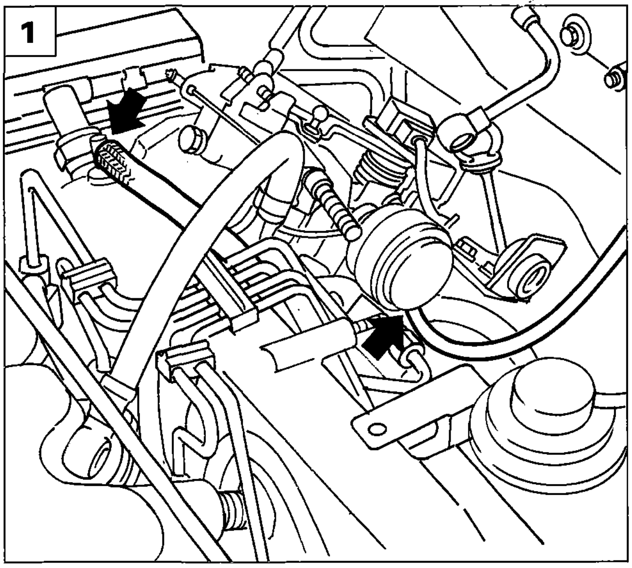


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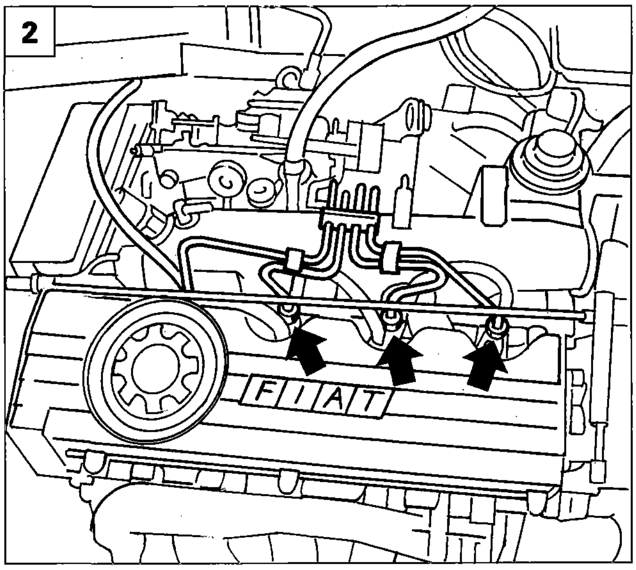


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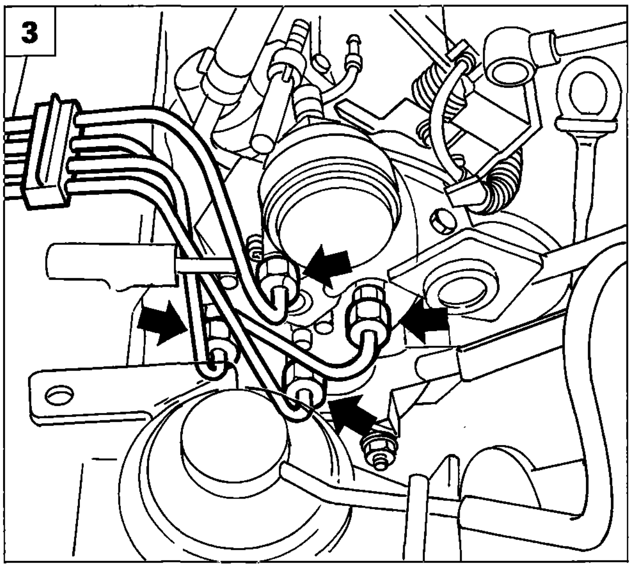


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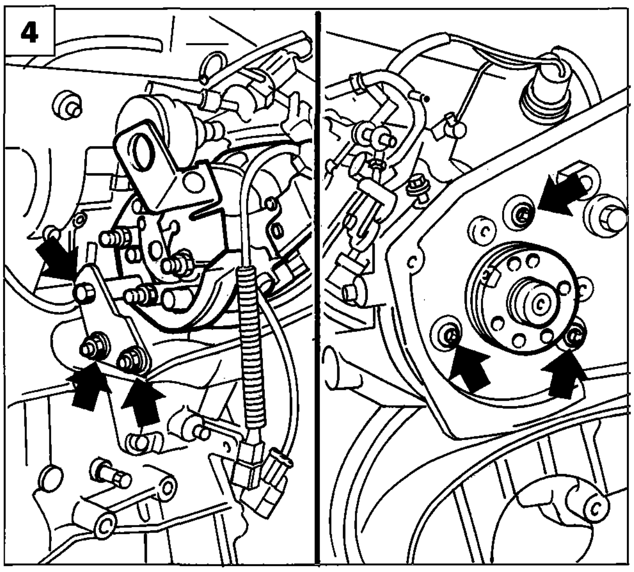


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1. Disconnect the vaccum pipe from the inlet manifold and from the fast idle actuator acting at the points shown.
2. Using spanner 1852138000 undo the connectors for the fuel supply pipes at the injectors.
3. Undo the connectors shown at the pump using a spanner and remove the fuel supply pipes.
4. Remove the injection pump acting on the fixings shown in the diagram;.

*To refit the injection pump reverse the order of the operations carried out for the removal with the exception of the timing belt.*
*Before refitting the timing belt it is necessary to check the timing and then the tension of the belt as specified in the paragraph "Replacing timing belt" in the chapter "Removing-refitting power unit".*

## M.MARELLI-WEBER I.A.W.-49F INTEGRATED FUEL INJECTION-IGNITION

### Introduction

The I.A.W.-49F system fitted to the 1581 i.e. 16v engine belongs to the group of digital electronic ignition systems with static advance and static timing, integrated with an electronic fuel injection system of the intermittent multiple synchronized type.

The identification codes of the system are as follows, depending on the version:
- I.A.W.-49F.B4 for version with manual gearbox
- I.A.W.-49F.L2 for version with automatic transmission.

This system thus has only one control unit, a single set of wiring and a set of sensors common to both systems.

Its function is to inject into the engine's inlet port, upstream of the inlet valves, an exact quantity of petrol to be mixed with the air introduced into the cylinder, so as to obtain a correct mixture strength.

The I.A.W.-49F system ensures efficient operation thus optimizing performance and consumption, and reducing harmful emissions, by providing a response in real time to the engine's different operating conditions.

The system can be divided into the following sub-systems:
- Electrical/electronic system
- Air intake system
- Fuel supply system
- Emission control systems

Via suitable sensors, the system can measure the following parameters:
1. instantaneous engine rpm;
2. the position of each pair of pistons in relation to TDC of cylinder 1;
3. air intake temperature;
4. angular position of the throttle valve;
5. engine coolant temperature;
6. actual mixture strength (via the Lambda probe);
7. pressure in the inlet manifold;
8. vehicle speed;
9. battery voltage;
10. when the air conditioner (if present) is switched on;
11. the presence of any knocking.

This information, generally analogue, is converted into digital signals by the analogue/digital converters (A/D) in order to be used by the control unit.
Finally, it is important to note that the I.A.W.-49F fuel injection-ignition does not require any adjustment as it is self-adjusting and self-adapting.

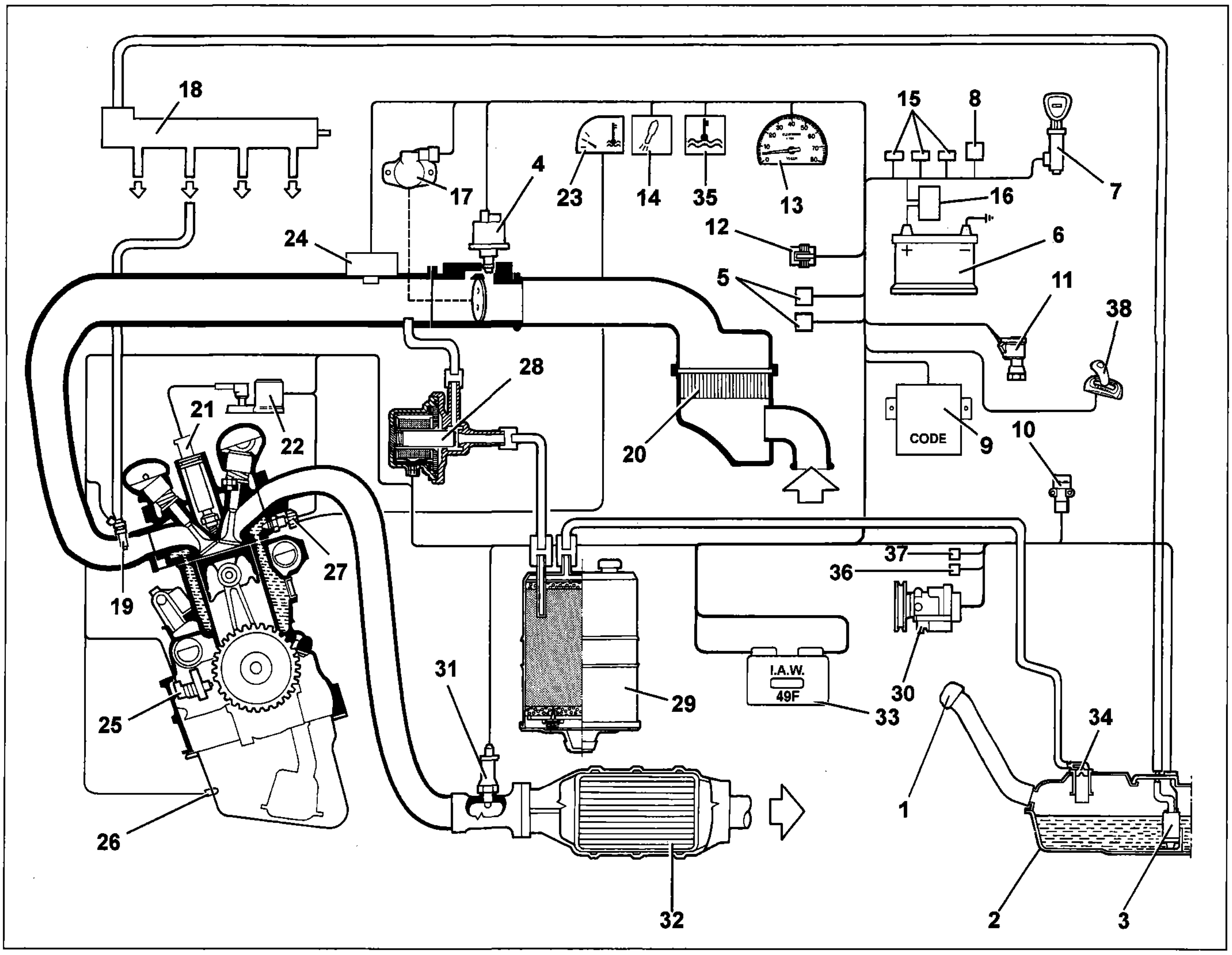
## SYSTEM MANAGEMENT STRATEGIES

The management program (software) resides in the control unit's memory; it consists of a series of strategies, each of which manages a precise control function of the system.
By using the information (inputs) listed above, each strategy works out a series of parameters, based on the data maps stored in appropriate areas of the control unit's memory, and then drives the system's actuators (outputs), the devices which enable the engine to operate, namely:

1. fuel injectors;
2. ignition coils;
3. various types of solenoids;
4. electric fuel pump;
5. engine idle speed actuator;
6. control relays.

# 10.

## FUNCTIONAL DIAGRAM OF FUEL INJECTION-IGNITION




P4A02IJ01

1. Safety and ventilation valve
2. Fuel tank
3. Electric fuel pump
4. Engine idle actuator
5. Relays controlling radiator fan high and low speeds
6. Battery
7. Ignition switch
8. Fuel injection relay
9. Fiat CODE control unit
10. Inertial switch
11. Vehicle speed sensor
12. Diagnostic socket
13. Rev counter
14. Fuel injection fault warning light
15. Fuses protecting fuel injection - ignition system
16. Main fuse box
17. Throttle valve position sensor
18. Fuel supply manifold
19. Fuel injectors
20. Air cleaner
21. Spark plugs
22. Ignition coils
23. Coolant temperature gauge
24. Air temperature and pressure sensor
25. Rpm and T.D.C. sensor
26. Knock sensor
27. Coolant temperature sensor
28. Fuel vapour cut-off solenoid
29. Activated charcoal filter
30. Air conditioner compressor
31. Lambda probe
32. Catalytic converter
33. Fuel injection - ignition control unit
34. Multi-function valve
35. Coolant overheating warning light
36. Air conditioner compressor relay
37. Air conditioner relay
38. Automatic transmission

The management strategies ensure the best ignition advance and fuel delivery, thus providing the correct mixture strength at all times as the engine load and environmental conditions vary.

The system management strategies are basically as follows:

- management of fuel injection;
- management of ignition;
- management of engine starting block function (Fiat CODE);
- management of radiator fan;
- management of engine idle control;
- management of fuel vapour recirculation;
- management of fault diagnosis;
- management of climate control system.

## MANAGEMENT OF FUEL INJECTION

The fuel injection management strategy aims to supply to the engine the correct quantity of fuel at the required instant, in accordance with the engine's operating conditions.

The fuel injection-ignition uses a "SPEED DENSITY-LAMBDA" indirect measuring system, which measures angular speed of rotation, density of intake air and mixture strength control (feedback control).

In practice, the system uses the ENGINE SPEED (rpm) and AIR DENSITY (pressure and temperature) data to measure the quantity of air drawn in by the engine.

The quantity of air drawn in by each cylinder for each engine cycle depends not only on the density of the air drawn in, but also on the unit cylinder capacity and the volumetric efficiency.

Air density is the density of the air drawn in by the engine and calculated in accordance with the absolute pressure and temperature, both measured in the inlet manifold.

Volumetric efficiency is the parameter relating to the cylinder fill coefficient measured in accordance with experimental tests conducted on the engine throughout its operating range, and subsequently stored in the electronic control unit's memory.

After establishing the quantity of air drawn in, the system must provide the quantity of fuel in accordance with the desired mixture strength.

The end-of-injection or delivery timing pulse is contained in a map stored in the control unit's memory, and varies depending on the engine speed and pressure in the inlet manifold. In effect these are processing operations carried out by the control unit to control the sequential opening and timing of the four injectors, one per cylinder, for the length of time strictly necessary for forming an air-petrol mixture as close as possible to the stoichiometric ratio.

The fuel is injected directly in the manifold near the inlet valves at a differential pressure of about 3 bar.

The speed (rpm) and air density (pressure and temperature) are used to measure the quantity of intake air; when this has been determined, the quantity of fuel is metered in accordance with the desired mixture strength. The other sensors present in the system (coolant temperature, throttle valve position, battery voltage, etc.) enable the electronic control unit to correct the basic strategy for all the particular operating conditions of the engine.

Making the air-fuel ratio fluctuate around stoichiometric values is the essential condition for both correct and long-lasting operation of the catalytic converter, and for reducing polluting emissions.

The stoichiometric ratio is obtained using a heated Lambda probe. This probe, by means of constant analysis of oxygen present in the exhaust gases, informs the control unit which, on the basis of data memorized in it, can correct in real time the mixture strength (air-petrol) if it is not stoichiometric.

This system has no method of recording the engine idle speed and CO level in the exhaust gases, or of the throttle valve position.

**Mixture strength control (feedback control)**

**NOTE** *The following ratio is defined as mixture ratio, and it is indicated by the letter α (alpha):*

$$\alpha = \frac{\textbf{quantity of air drawn in by engine}}{\textbf{quantity of injected fuel}}$$

The following ratio is defined as stoichiometric mixture and is indicated by αst:

$$\alpha st = \frac{\textbf{quantity of theoretical air for burning all the injected fuel}}{\textbf{quantity of injected fuel}}$$

*The following ratio is defined as mixture strength and is indicated by the Greek letter λ (lambda):*

$$\lambda = \frac{\textbf{quantity of air drawn in by the engine}}{\textbf{quantity of theoretical air for burning all the injected fuel}}$$

It is easy to observe that $\alpha/\alpha st=\lambda$.

The stoichiometric ratio depends on the type of fuel: for the current non-ethylated (unleaded) petrols, it is about 14.7 - 14.8, which corresponds to a Lambda strength = 1 (ratio 14.8:1 means that 14.8 parts air are required to burn 1 part petrol).

The mixture is rich when the quantity of air is less than the stoichiometric value, and in this case lambda $\leq 1$;

The mixture is weak when the quantity of air is greater than the stoichiometric value, and in this case lambda $\geq 1$;

The strategy has the function of correcting the "basic" fuel injection times so that the mixture strength fluctuates continuously between 0.98 and 1.02.

The oscillation frequency varies depending on the engine load and speed; it is in the region of a few Hertz (about 0.5 - 4 Hertz).

**NOTE**

*1 Hz = 1 oscillation per second*

In the following conditions:

- cut-off,
- throttle 60% open (at low engine speeds this value is lower)
- engine temperature below 25 °C

the strategy is disabled.

### Self-adaptivity

The control unit has a strength self-adaptivity function, which memorizes any deviations between basic mapping and corrections imposed by the Lambda probe which may arise peristently during operation. These deviations (due to ageing of the components of the system and engine) are memorized permanently, allowing the operation of the system to adapt to the gradual alterations of the engine and components in relation to the characteristics when new. To delete the corrections memorized, use the appropriate function on the diagnistic equipment. The corrections are **NOT** lost even if the battery or control unit are disconnected.

The strategy is disabled during the period when the fuel vapour cut-off solenoid is open. If the control unit is replaced, it is advisable to run the engine at idle speed for a few minutes (hot engine) to allow the control unit to re-memorize the corrections. Corrections at speeds higher than idle speed are memorized during normal driving conditions.

The control unit also has a self-adaptivity function which corrects the opening of the idle speed actuator at idle speed on the basis of variations due to leaks from the throttle body or natural ageing of the engine. This specific correction is lost if the battery or control unit are disconnected.

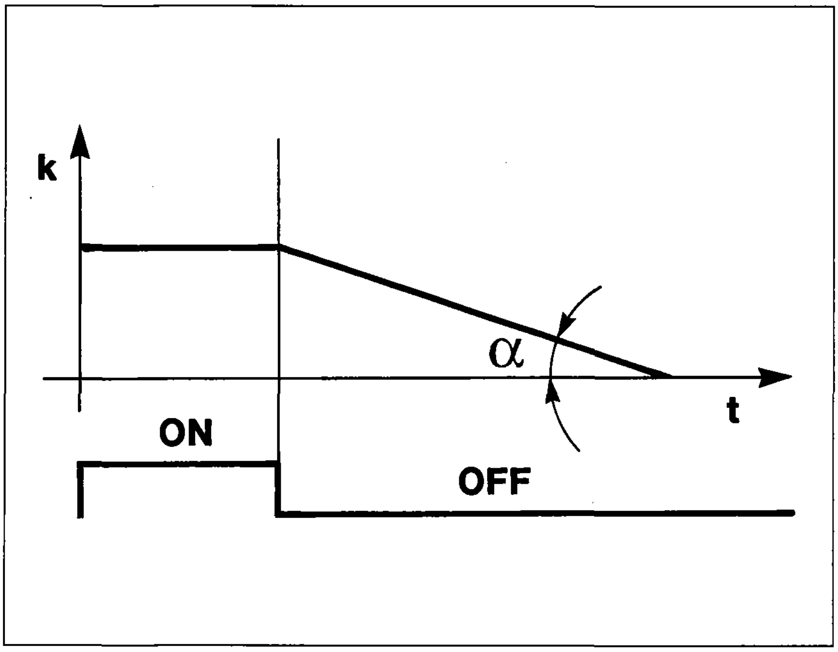
### Starting and post-starting

During starting, it is not possible to recognize instantaneously the engine timing, and so it is not possible to effect phased fuel injection for the first injection of each cylinder.

During the first few engine revolutions, a first simultaneous injection (full group) is effected because significant fluctuations in engine speed do not permit correct calculation of the injection timing; only after does injection become phased.

The "basic" injection time is increased by a multiplicative coefficient for as long as the engine is driven by the starter motor.

After starting, the coefficient is gradually reduced until it disappears within a particular time period which is all the longer the lower the engine temperature.




P4A06IJ01

k : enrichment coefficient

t : time

α : decrease in relation to engine temperature

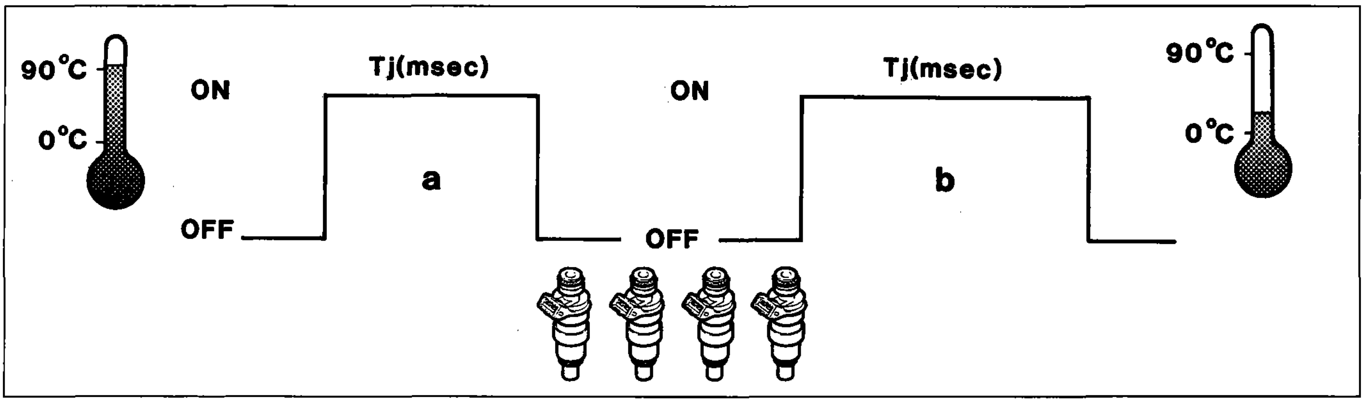
ON: engine driven (crank)

OFF: engine started (run)

### Operation when cold

Under these conditions, the mixture is naturally weakened by poor turbulence of the fuel particles at low temperature, low evaporation and high condensation on the inner walls of the inlet manifold, all heightened by the greater viscosity of the lubricating oil which, as is known, at low temperature increases the resistance to rolling of the engine's mechanical components.

The electronic control unit recognizes this condition and corrects the fuel injection time on the basis of the coolant temperature signal.




P4A06IJ01

Consequently:

- At very low temperatures, the fuel injector remains open for longer (tj) graph (b), with a low air/petrol ratio (rich mixtures).
- The more the engine temperature increases, the shorter the fuel injector's opening time, (tj) graph (a), consequently the higher the air/petrol ratio (poor mixtures).

During the engine warming-up period, the electronic control unit also drives the stepper motor which determines the quantity of air necessary for ensuring the engine's self-sufficient speed.

The idle speed is decreased proportionally as the temperature increases until the nominal value is obtained (850 ± 30 rpm) when the engine is up to temperature. The electronic control unit, by driving the stepper motor, keeps the idle speed constant even when the electrical and mechanical loads vary.

### Connection with the automatic transmission

The control unit adjusts the engine idle speed in accordance with the load which occurs when the selector lever is moved to a gear ratio and transmits to the automatic transmission control unit information relating to the reduction in torque (pin 36), coolant temperature (pin 5) and throttle valve position (pin 16).

The control unit reduces the torque delivered by the engine (mainly by intervening on the ignition advance) during gear changes, when it receives an appropriate signal from the automatic transmission control unit (pin 49).

### Operation at full load

Under full load conditions, the basic injection time must be increased to obtain the maximum power delivered by the engine.

The full load condition is detected by the control unit via values supplied by the throttle position and absolute pressure sensors.

On the basis of this information, the control unit makes the appropriate correction, increasing the basic injection time.

### Operation in deceleration

During this stage of use of the engine, two strategies are superimposed:

1. A negative transient strategy for maintaining a stoichiometric quantity of fuel supplied to the engine (less pollution).

   This stage is recognized by the control unit when the throttle potentiometer signal changes from a high voltage value to a lower value.

2. A strategy for soft accompaniment at low speed (dash-pot) to attenuate the variation of delivered torque (less engine braking).
   When the potentiometer signal indicates closed throttle and the idle speed is high, the control unit, acting on the engine idle speed actuator, gradually decreases the air flow passing through the by--pass.

### Barometric correction

The atmospheric pressure varies in accordance with altitude, causing a variation in the volumetric efficiency such as to require correction of the basic strength (injection time).

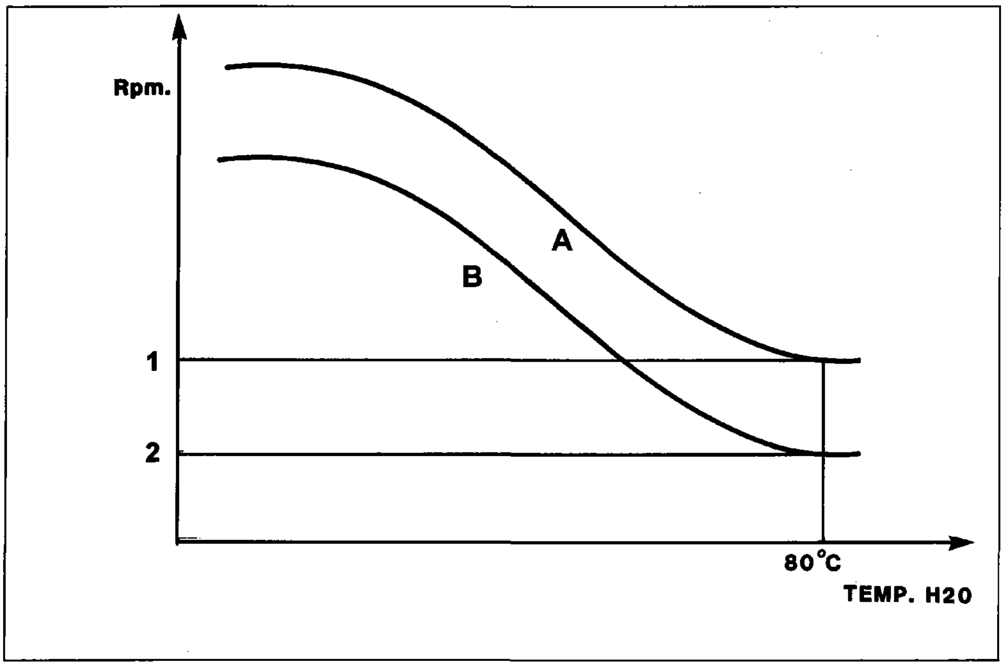
The correction of the injection time will depend on the variation in altitude and will be updated automatically by the electronic control unit whenever the engine is switched off and under particular conditions of throttle valve position and engine speed (typically at low rpm and throttle wide open) (dynamc adjustment of barometric correction).

### Operation in cut-off

The fuel cut-off strategy is effected when the control unit recognizes the throttle valve in idle position (signal from throttle potentiometer) and the engine idle speed exceeds 1350 rpm (1750 rpm for version with automatic transmission). The control unit enables the cut-off only when the engine temperature exceeds 0° C.

The recognition of the throttle valve in a non-closed position of the engine idle speed below 1270 rpm (1650 rpm for version with automatic transmission) re-enables the fuel supply to the engine.

For very high engine speeds, cut-off is also effected when the throttle valve is not fully closed, but with particularly low pressure in the inlet manifold (partial cut-off).




P4A07IJ01

Version with manual gearbox

1. 1350 rpm
2. 1270 rpm

Version with automatic transmission

1. 1750 rpm
2. 1650 rpm

A. entry into cut-off

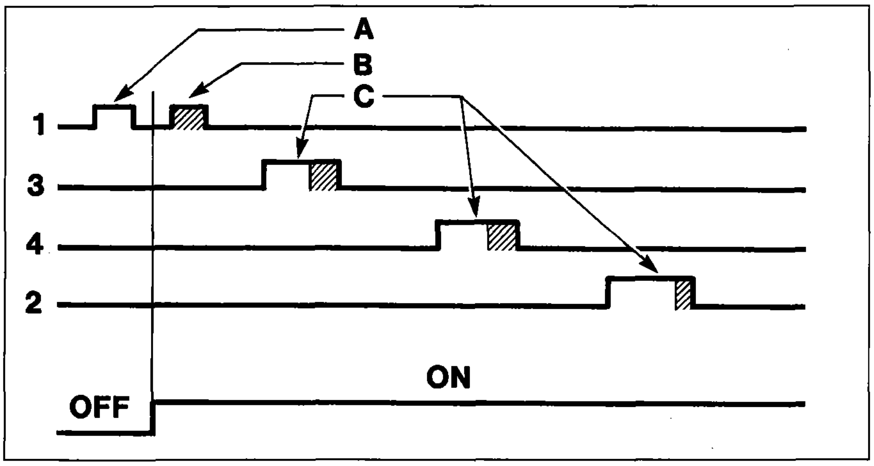
B. exit from cut-off

**Operation in acceleration**

In this stage, the control unit increases as appropriate the quantity of fuel required by the engine (to obtain the maximum torque) in accordance with signals coming from the following components:
- throttle potentiometer;
- absolute pressure sensor;
- rpm and TDC sensor.

The "basic" injection time is multiplied by a coefficient in accordance with the temperature of the engine coolant, how quickly the throttle opens and the pressure increase in the inlet manifold.

If the sudden variation in injection time is calculated when the injector is already closed, the control unit re-opens the injector (extra pulse) to be able to compensate the strength as quickly as possible; subsequent injections are instead increased in accordance with the above-mentioned coefficients.




P4A08IJ01

A. normal injection time

B. re-opening of injector (extra pulse)

C. injection time including enrichment

OFF. engine at stationary speed

ON. engine in transient

**Over-rev protection**

When the engine speed exceeds for over 10 seconds the value of 6700 rpm or instantaneously the "limit" value of 6900 rpm imposed by the manufacturer, the engine is in "critical" operating conditions.

When the electronic control unit recognizes that the above-mentioned speed has been exceeded, it inhibits the driving of the fuel injectors.

When the rpm returns to a non-critical value, driving of the injectors is resumed.

**Electric fuel pump operation**

The electric fuel pump is driven by the engine control unit via a relay.
The pump is stopped:
- if the engine falls below 50 rpm;
- after a certain period (about 5 seconds) with the ignition on without the engine being started (time-lagged enablement);
- if the inertial switch has intervened.

**Fuel injector operation**

The injectors are driven in a phased sequential manner. However, during starting, the injectors are first driven in parallel (full-group).

The injector phasing varies in accordance with the engine speed and intake air pressure in order to improve cylinder filling with advantages in terms of consumption, driveability and pollution.

## MANAGEMENT OF IGNITION

The ignition circuit is of the static type with inductive discharge, i.e. without high tension distributor with power modules located inside the fuel injection-ignition electronic control unit.

The system has two double-output high tension coils combined in a single container and connected directly to the spark plugs.

The primary winding of each coil is connected to the power relay (so is supplied by the battery voltage) and to the pins of the electronic control unit for the earth connection.

After the engine has started, the electronic control unit manages the basic advance obtained from special mapping in accordance with the following input parameters:

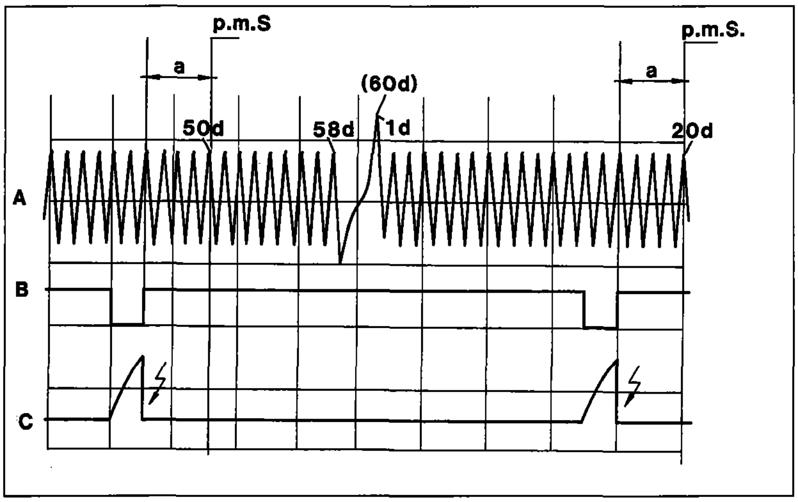
- engine speed (rpm);
- absolute pressure value (mmHg) measured in the inlet manifold.

This advance is corrected in accordance with the temperature of the coolant and intake air.

The value of the advance angle is also corrected under the following conditions:

- during starting;
- in transient acceleration and deceleration periods;
- under cut-off conditions;
- to stabilize the idle speed;
- if there is engine knocking;
- when required by the automatic transmission control unit (gear change).

In order for the ignition system to function correctly, the electronic control unit must recognize the signal picture.




P4A09IJ01

A. Rpm sensor signal

B. Power control

C. Current circulating in the primary winding of a coil

a. Ignition advance relating to the cylinder TDC

The interval or variation of the signal caused by the absence of 2 teeth on the phonic wheel, between the 58th and 1st teeth (also called synchronization tooth) which occurs for every rotation of the crankshaft pulley, is the reference signal which allows the electronic control unit to recognize an advance of 114° in relation to TDC of the pair of pistons 1-4 corresponding to the leading edge of the 20th tooth.

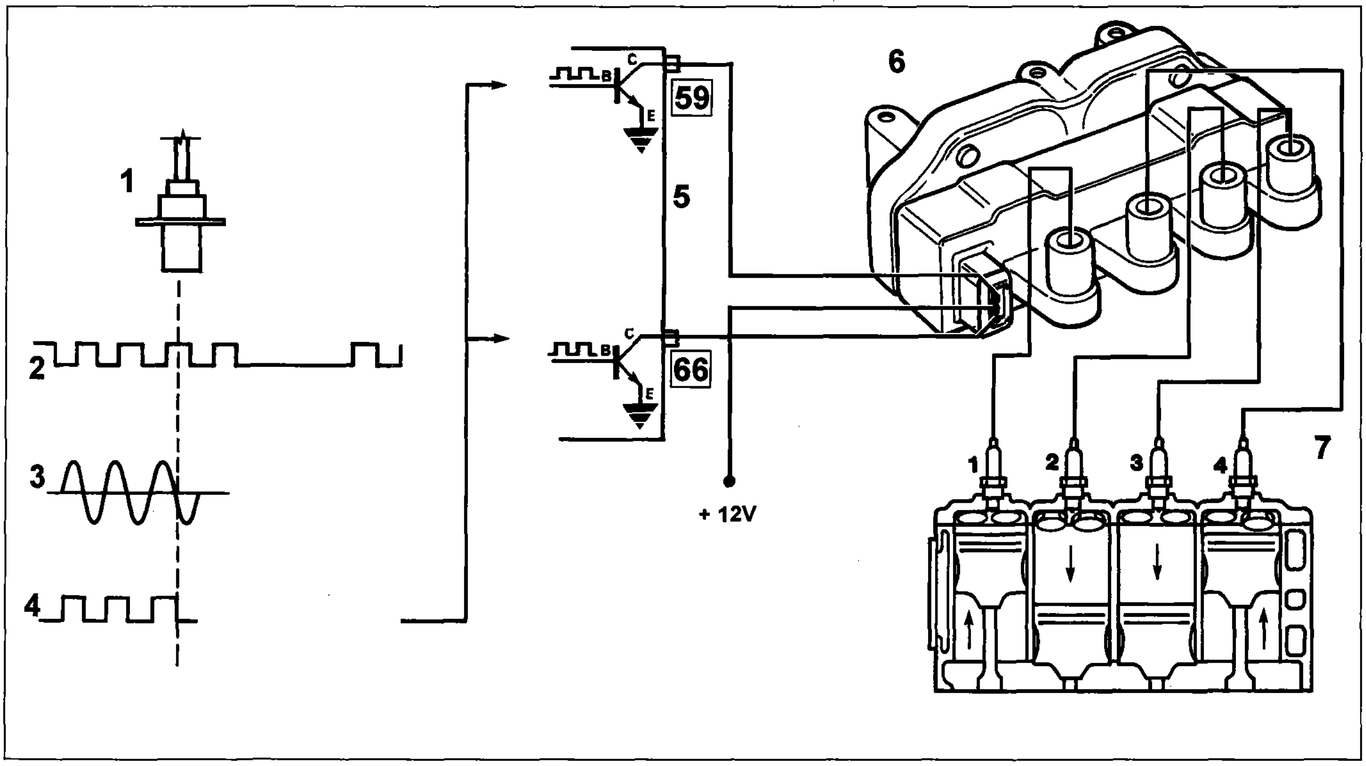
After acquiring the correct signal picture with reference to the TDC signal through the power module (internal) (5), the electronic control unit (see figure on next page) establishes the point of commencement of conduction (supply) of the primary circuits of the coils (6).

# 10.

The leading edge of the signal (graph B-figure on preceding page) thus represents the moment when alternative conduction of the primary windings "could" occur. This point is established solely by the control unit's power module. The conduction time required by the H.T. coils for storing energy is also defined by the DWELL management strategy. It depends on the time taken by the current in the primary circuit of the coil to reach 6A, on the battery voltage and the calculation algorithm carried out by the microprocessor which uses coefficients stored in an appropriate memory; all this naturally depends on the engine rpm.

With reference to the figure on the preceding page, the falling edge of the signal, (B) end-of-conduction point (or fall to zero of the current), is instead a "categoric order" to stop the current circulating in the primary winding, and it represents the point of ignition advance (a) calculated by the computer (the advance - (a) - varies depending on the rpm).

The control unit thus manages both the advance of the spark to the various cylinders in relation to top dead centre, and the conduction time required by the coil for storing energy, alternately controlling the two power stages which permit current to circulate in the primary windings (pins 59 and 66) of the coils (6) for sufficient time to guarantee a nominal 6 A.




P4A10IJ01

**Functional diagram of the ignition**

1. RPM and TDC sensor.
2. Phonic wheel.
3. Signal picture taken from phonic wheel (60-2) teeth.

   The TDCs correspond to teeth 20 and 50.
4. Succession of rectangular wave form signals of constant amplitude.
5. Ignition power module (inside the control unit).
6. Ignition coils.
7. Spark plugs

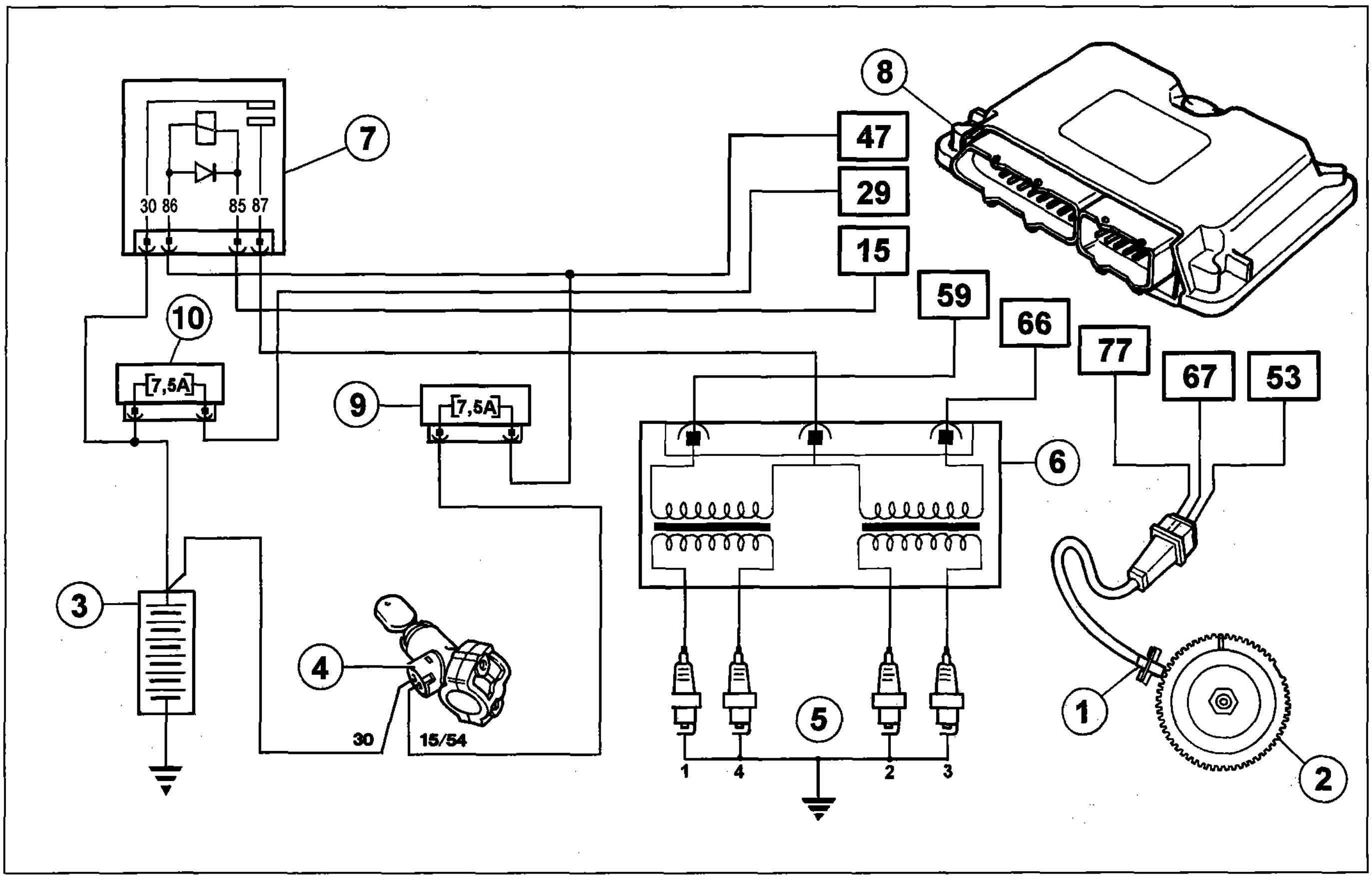
**NOTE** *The numbers in squares indicate the corresponding control unit pins.*

In the instant when the control unit stops driving one of the two power stages, the passage of current is interrupted. This causes, by induction, an increase in voltage (up to 30kV without load) on the secondary winding.

When examining the voltages required for the spark between the plug electrodes, it may be noted that in the cylinder at the compression stroke, this voltage is high (over 10kV) while in the cylinder in the exhaust stroke the voltage is low (about 5kV).

The high voltage distribution is static, i.e. characterized by the absence of a rotor arm and cap, and thus the distributor is in effect eliminated. This offers a considerable advantage to the system as it is known that the insulation characteristics of the rotor arm and cap play a fundamental role; any dispersion of insulation towards earth can be detrimental to ignition, especially during winter or in heavy rain.

The spark plugs of cylinders 1-4 and 2-3 are connected directly (two by two) by high tension cables to the terminals of the coil's secondary winding, and their connection may be considered to be serial as the cylinder head joins them. This solution is also called "lost spark" as the energy accumulated by the coil will be almost exclusively discharged on the electrodes of the spark plug located in the cylinder under compression, allowing the mixture to be ignited. The other spark is naturally not used, as there is no mixture to be ignited in the cylinder, only an environment of used gas at the exhaust stage.




4A11IJ01

1. Rpm and TDC sensor
2. Crankshaft pulley with phonic wheel
3. Battery
4. Ignition switch
5. Spark plugs
6. Ignition coils
7. Fuel injection relay
8. Fuel injection-ignition electronic control unit
9. Fuel injection-ignition system fuse
10. Fuse protecting fuel injection-ignition control unit

### Knock control

The purpose of this strategy is to detect the presence of knocking, by processing the signal coming from the relevant sensor. The strategy continuously compares the signal coming from the sensor with a threshold, which in turn is constantly updated to take account of background noise and ageing of the engine.

If the system recognizes the presence of knocking, the strategy reduces the ignition advance until the phenomenon disappears. The advance is then gradually restored to the basic value or until the phenomenon arises again. In particular, increases in advance are made gradually, while decreases are made immediately.

Under conditions of acceleration, the strategy uses a higher threshold, to take account of the increased noise of the engine in this condition.

The strategy also has a self-adaptive function which memorizes, in a non-permanent manner, decreases in advance that are repeated continuously, so as to adjust the advance to the different conditions of the engine (e.g. use of low octane number fuel). The strategy can restore the advance to the threshold value stored in memory when the conditions that gave rise to the decrease in advance disappear.

## MANAGEMENT OF THE ENGINE STARTING BLOCK FUNCTION (FIAT CODE)

The system has an engine starting block function. This function is carried out by a specific control unit (Fiat CODE), which can dialogue with the fuel injection-ignition control unit, and an electronic key, which has a special transmitter for sending a recognition code.

Whenever the ignition is switched off, the Fiat CODE system completely disables the fuel injection-ignition control unit.

When the ignition is switched on, the following operations take place:

1 - the fuel injection control unit (whose memory contains a secret code) sends a request to the Fiat CODE control unit to send the secret code to disable the function block;

2 - the Fiat CODE control unit responds by sending the secret code only after first receiving the recognition code transmitted by the ignition key;

3 - recognition of the secret code permits the disablement of the block on the fuel injection-ignition electronic control unit and the normal operation of the latter.

**NOTE** *Because of the presence of the Fiat CODE system, during fault diagnosis and/or operating checks,* **DO NOT CARRY OUT** *tests using another fuel injection-ignition control unit. If you do, the Fiat CODE control unit would transfer the (unknown) recognition code to the test control unit, which would then be unusable on other vehicles.*

## MANAGEMENT OF RADIATOR FAN

The control unit checks the operation of the radiator fan directly, in accordance with the engine coolant temperature and whether the climate control system is switched on.

The fan comes on when the temperature exceeds 97 °C (1st speed) and 102 °C (2nd speed). It is switched off with a hysteresis of 3 °C below the threshold for switching on.

The high and low speed functions are managed by the intervention of specific relays located in the control unit of the climate control system, and controlled by the control unit.

## MANAGEMENT OF ENGINE IDLE CONTROL

The general aim of the strategy is to keep the engine idle speed around the value stored in memory (hot engine: 850 rpm): the position assumed by the actuator depends on the engine conditions:

### Starting stage

When the ignition is switched on, the actuator assumes a position in relation to the engine coolant temperature and battery voltage (open loop position).

### Warming-up stage

The rpm is corrected mainly in relation to the coolant temperature.

With the engine up to temperature, depends on the signal coming from the engine rpm sensor; when external loads are switched on, the control unit manages the steady idle.

### Deceleration stage

Under overrun conditions above idle speed, the control unit controls the position of the engine idle actuator by means of a particular flow curve (curva di dash-pot), i.e. it slows down the return of the shutter towards its sealing seat, thus optimizing the engine braking effect.

## MANAGEMENT OF FUEL VAPOUR RECIRCULATION

The strategy controls the position of the cut-off solenoid as follows:

- during starting, the solenoid remains closed, preventing the fuel vapours from making the mixture excessively rich; this condition remains until the coolant reaches a temperature of 65° C;

- when the engine is up to temperature, the electronic control unit sends the solenoid a square-wave signal (duty cycle control) which modulates its opening.

In this way the control unit controls the quantity of fuel vapours sent to the inlet manifold, thus preventing significant changes in mixture strength.

In the operating conditions listed below:

- throttle valve in closed position
- speed below 1500 rpm
- pressure in inlet manifold below a limit value calculated by the control unit in accordance with the rpm

solenoid control is inhibited, and the solenoid is kept in the closed position; this is to improve the engine's operation.

## MANAGEMENT OF FAULT DIAGNOSIS

A complete electronic diagnosis of the fuel injection-ignition is obtained by connecting the appropriate equipment (EXAMINER or SDC station) to the diagnostic socket.

The system also comprises a self-test function which recognizes, stores in memorey and indicates any faults.

If a fault is detected on sensors or actuators, signal reconstruction (recovery) strategies are immediately activated to ensure engine operation at an acceptable level without impairing its functionality. It is thus possible to drive the vehicle to a repair garage for the appropriate operations.

**MANAGEMENT OF CLIMATE CONTROL SYSTEM**

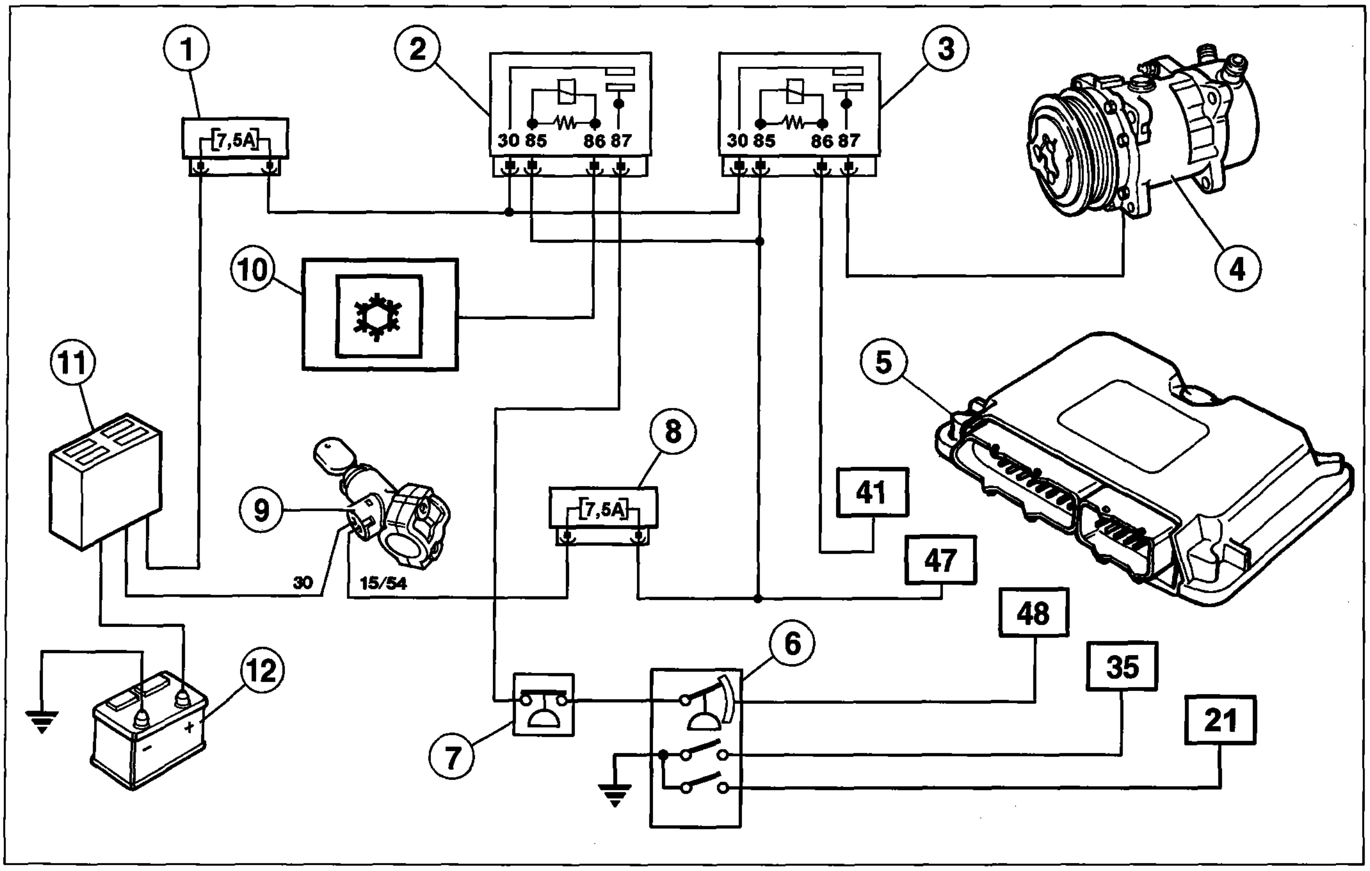
The fuel injection-ignition control unit is connected functionally to the climate control system, as:

1. it receives the request to switch on the compressor and makes the necessary interventions (extra air);
2. it gives enablement to the switching on of the compressor through pin 41, when the conditions envisaged by the strategies arise;
3. it receives information on the status of the four-stage pressure switch from pins 21, 35 and 48 (for cars with three-stage pressure switch, only from pins 35 and 48) and carries out the relevant interventions (controls radiator fan).

As regards point 1, if the engine is idling, the control unit increases the flow rate of the air passing from the idle actuator in advance of the switching on of the compressor, and vice versa it returns the actuator to the normal position retarded in relation to the disconnection of the compressor.

As regards point 2, the control unit automatically controls the disconnection of the compressor:

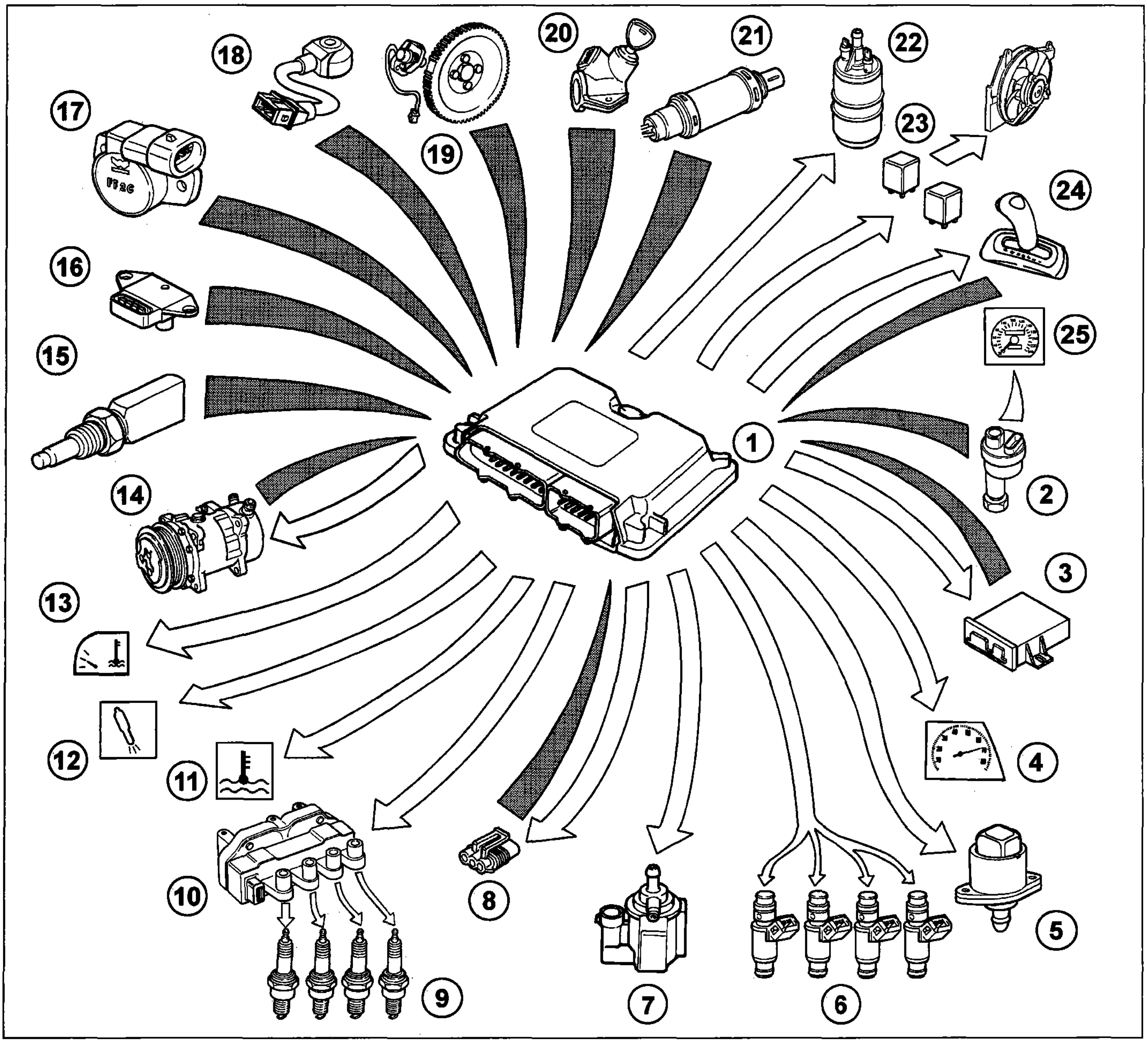
- for a few seconds (time-lagged disconnection):
  - when there is a high requirement for engine power (strong acceleration);
  - on engine pickup;
- for as long as the following critical conditions remain:
  - if the engine coolant temperature exceeds a particular threshold
  - for an engine speed of below 750 rpm.




P4A141J01

1. Air conditioner fuse
2. Air conditioner relay
3. Relay supplying compressor electromagnetic coupling
4. Compressor
5. Fuel injection-ignition control unit
6. Pressure switch
7. Anti-frost sensor
8. Fuel injection-ignition control unit fuse
9. Ignition switch
10. Air conditioner control unit
11. Power fuse box
12. Battery

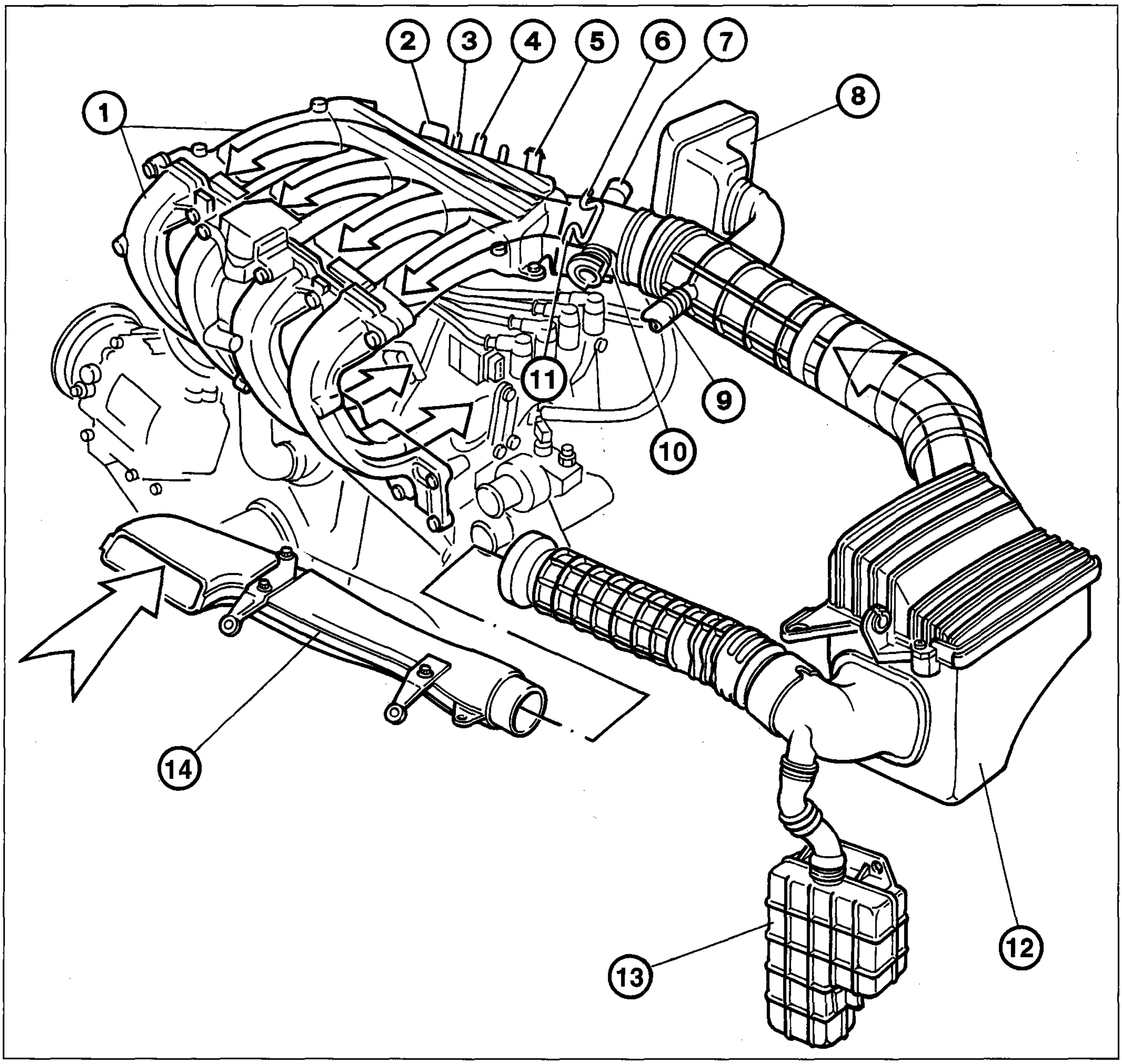
## DIAGRAM OF INPUT/OUTPUT INFORMATION BETWEEN CONTROL UNIT AND SENSORS/ACTUATORS OF THE FUEL INJECTION-IGNITION




1. Electronic control unit
2. Speedometer sensor
3. Fiat CODE control unit
4. Rev counter
5. Engine idle speed actuator
6. Fuel injectors
7. Fuel vapours solenoid
8. Diagnostic socket
9. Spark plugs
10. Ignition coils
11. Engine coolant overheating warning light
12. Fuel injection fault warning light
13. Coolant temperature gauge
14. Air conditioner
15. Engine coolant temperature sensor
16. Intake air temperature and pressure sensor
17. Throttle valve position sensor
18. Knock sensor
19. Rpm and TDC sensor
20. Ignition switch
21. Lambda probe
22. Electric fuel pump
23. Relays controlling radiator fan high and low speeds
24. Automatic transmission
25. Speedometer / mileometer

# 10.

## DIAGRAM OF AIR INTAKE SYSTEM

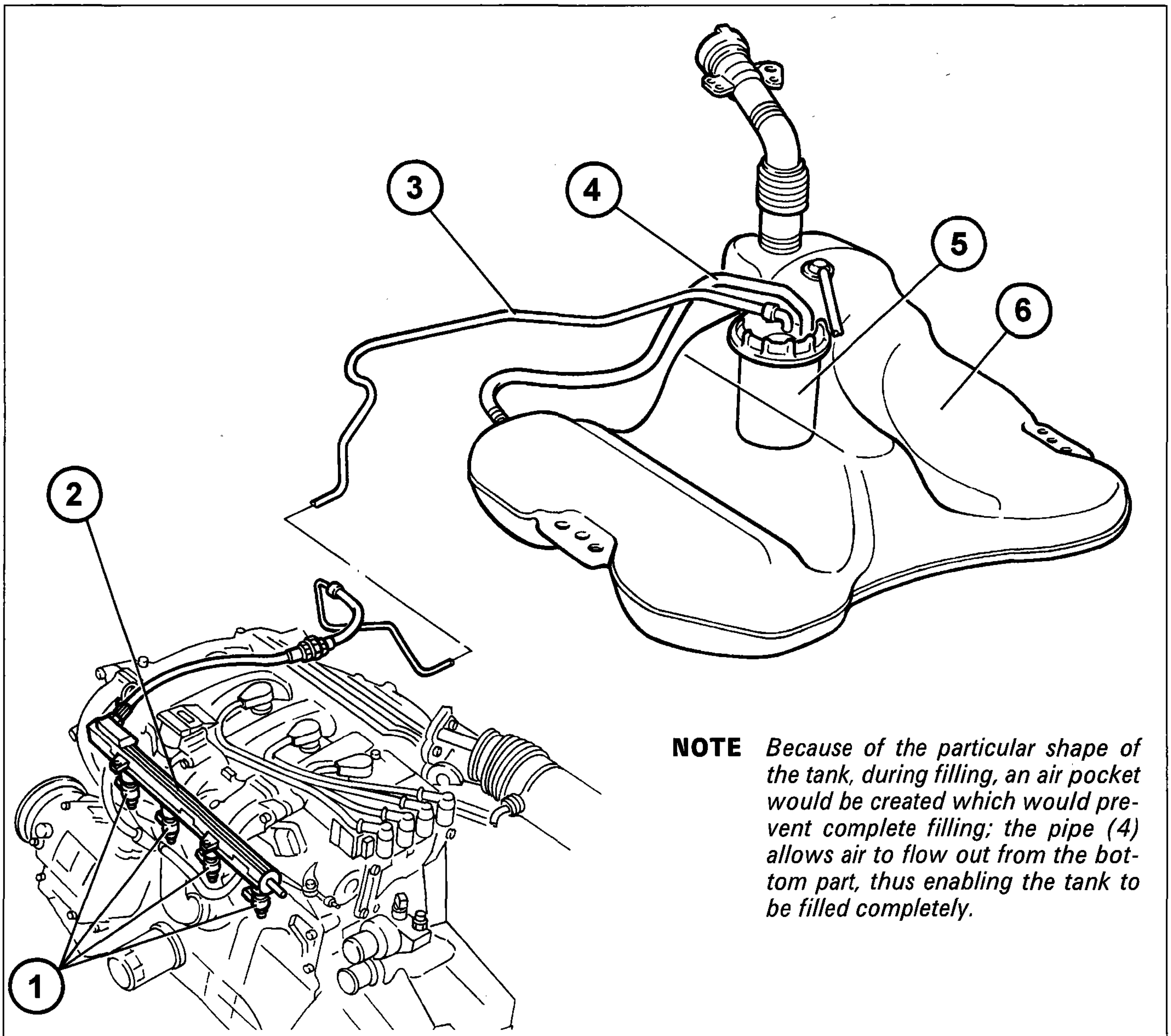



P4A16IJ01

The air intake system comprises various components which convey the necessary air flow to the engine under the various operating conditions.

1. Inlet manifold
2. Intake air pressure and temperature sensor
3. Connection for fuel anti-evaporation system
4. Inlet connection for crankcase gases (blow-by) for recirculation of exhaust gases during idling
5. Brake servo connection
6. Connection for engine coolant outlet pipe
7. Engine idle speed actuator
8. Top resonator
9. Main inlet for crankcase gases
10. Throttle body
11. Connection for engine coolant inlet pipe, for heating throttle body
12. Air cleaner
13. Bottom resonator
14. Inlet vent

**DIAGRAM OF FUEL SUPPLY SYSTEM**




**NOTE** *Because of the particular shape of the tank, during filling, an air pocket would be created which would prevent complete filling; the pipe (4) allows air to flow out from the bottom part, thus enabling the tank to be filled completely.*

P4A17IJ01

1. Fuel injectors
2. Fuel supply manifold
3. Fuel delivery pipe to injectors
4. Vent pipe
5. Electric fuel pump with filter and pressure regulator
6. Tank

The fuel is fed into the system by an electric pump immersed in the tank, which draws in the fuel and sends it to the filter and then to the fuel injectors.

The fuel supply system is of the "returnless" type, i.e. with only one connecting pipe between the fuel tank and engine.

This system makes it possible to:

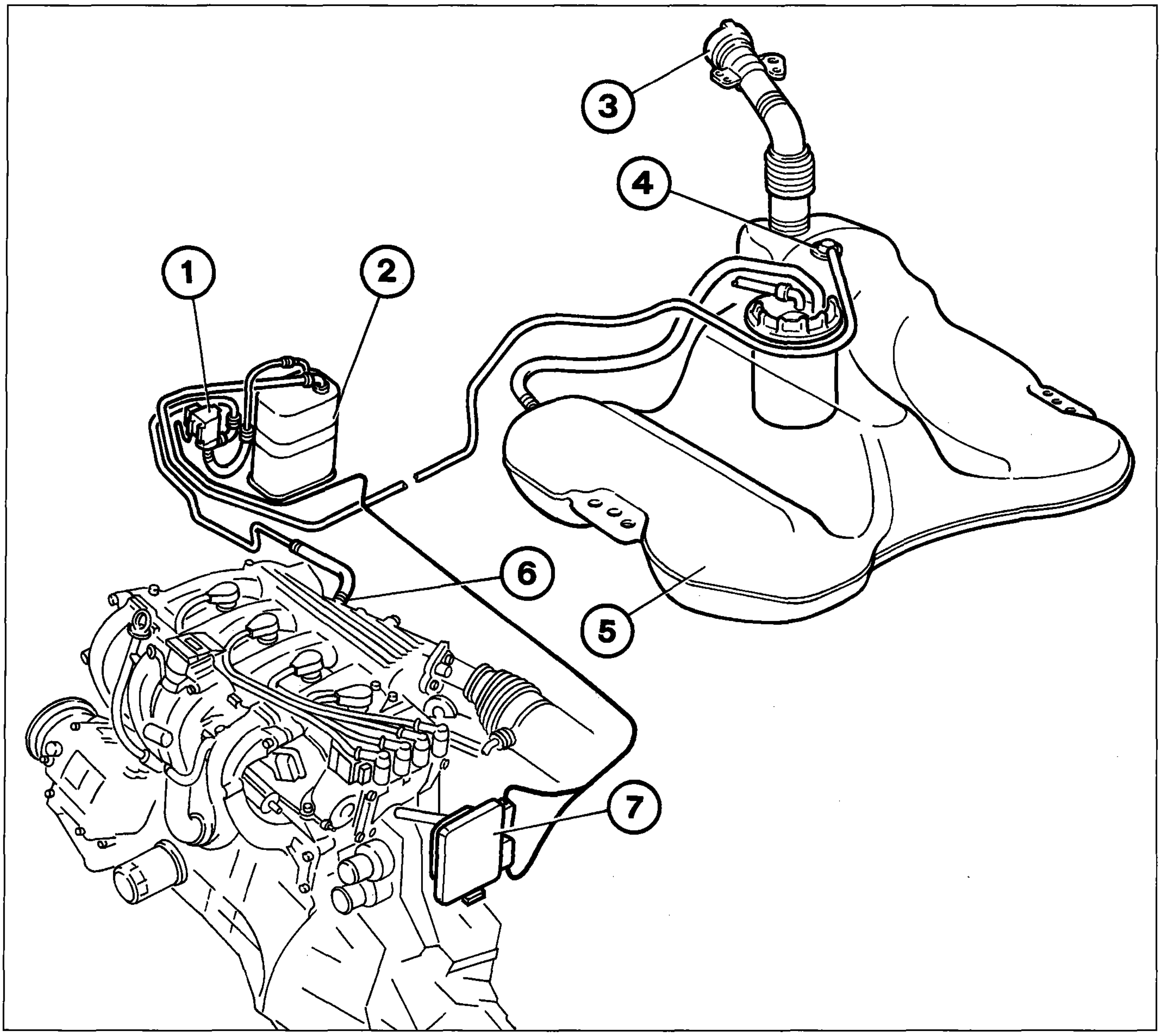
- minimize the possibility of the vehicle catching fire in the event of an accident;
- reduce fuel vapour emissions into the atmosphere.

The fuel pump is enclosed in the cage which also incorporates the fuel pressure regulator, fuel gauge sender and fuel filter.

The system also has an inertial switch which cuts off the supply from the fuel pump in the event of a crash.

# 10.

## DIAGRAM OF FUEL EVAPORATION CONTROL SYSTEM



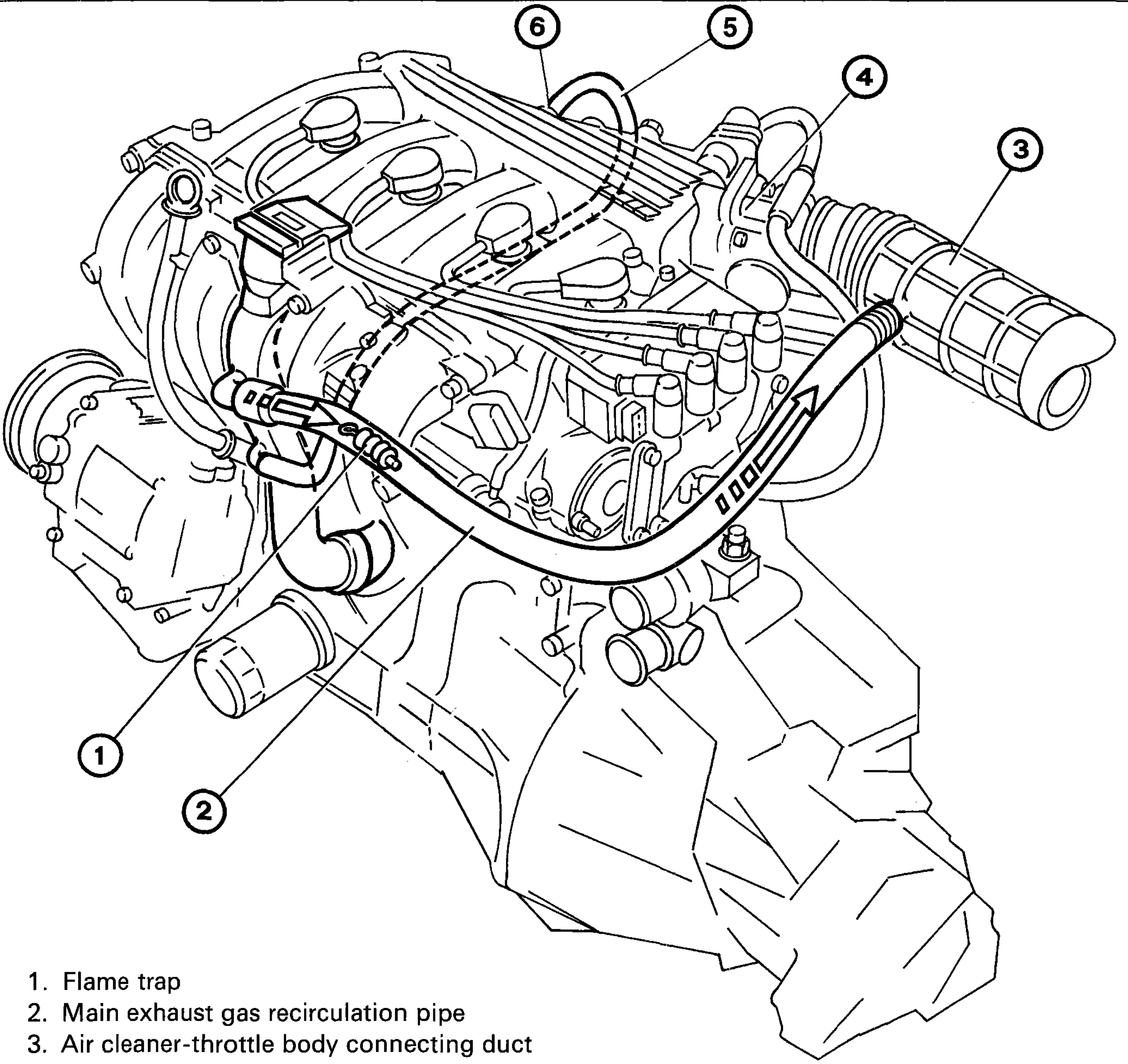

P4A18IJ01

1. Petrol vapour cut-off valve
2. Activated charcoal filter
3. Safety and ventilation valve
4. Multi-function valve
5. Tank
6. Fuel vapour inlet connection in inlet manifold
7. Fuel injection-ignition control unit

The tank ventilation system is of the "closed" type.
This system prevents the petrol vapours which form in the tank or fuel supply system from discharging into the atmosphere and releasing the light hydrocarbons (HC) they contain, thus causing pollution.

The system consists of a tank (5), a multi-function valve (4) for controlling the vapour flow, a two-way safety and ventilation valve (3) located in the fuel filler, an activated charcoal filter (2) and a vapour cut-off valve (1) which is controlled by the control unit (7).

## DIAGRAM OF CRANKCASE GAS RECIRCULATION SYSTEM (BLOW-BY)




1. Flame trap
2. Main exhaust gas recirculation pipe
3. Air cleaner-throttle body connecting duct
4. Throttle body
5. Pipe for exhaust gas recirculation during idling
6. Calibrated hole

P4A19IJ01

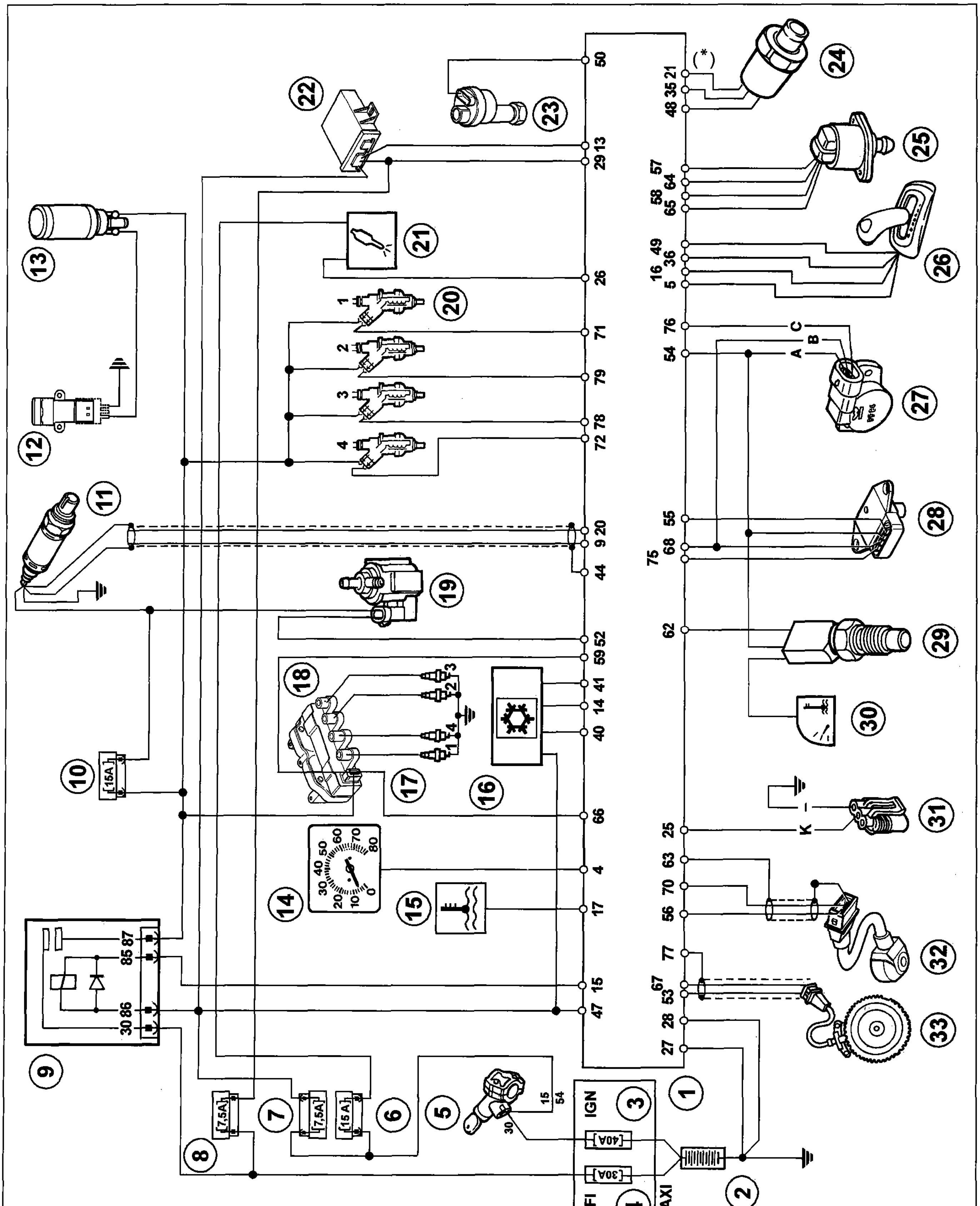
The system controls the emissions, from the crankcase, of the vent gases which consist of air-petrol mixtures and burnt gases leaking through the piston rings, and also lubricating oil vapours, and recirculates them to the inlet.

With the throttle valve open, the vent gases coming from the crankcase reach the connecting duct between the air cleaner-throttle body (3) through the pipe (2), inside which there is a flame trap (1) to prevent combustion phenomena due to flame returns from the throttle body (4).

With the throttle valve closed (engine idling), the vacuum in the inlet manifold draws in the gases (in a small quantity) directly through the pipe (5) and calibrated hole (6).

# 10.

## WIRING DIAGRAM OF FUEL INJECTION-IGNITION




(*) Connection only present on cars fitted with four-stage pressure switch.

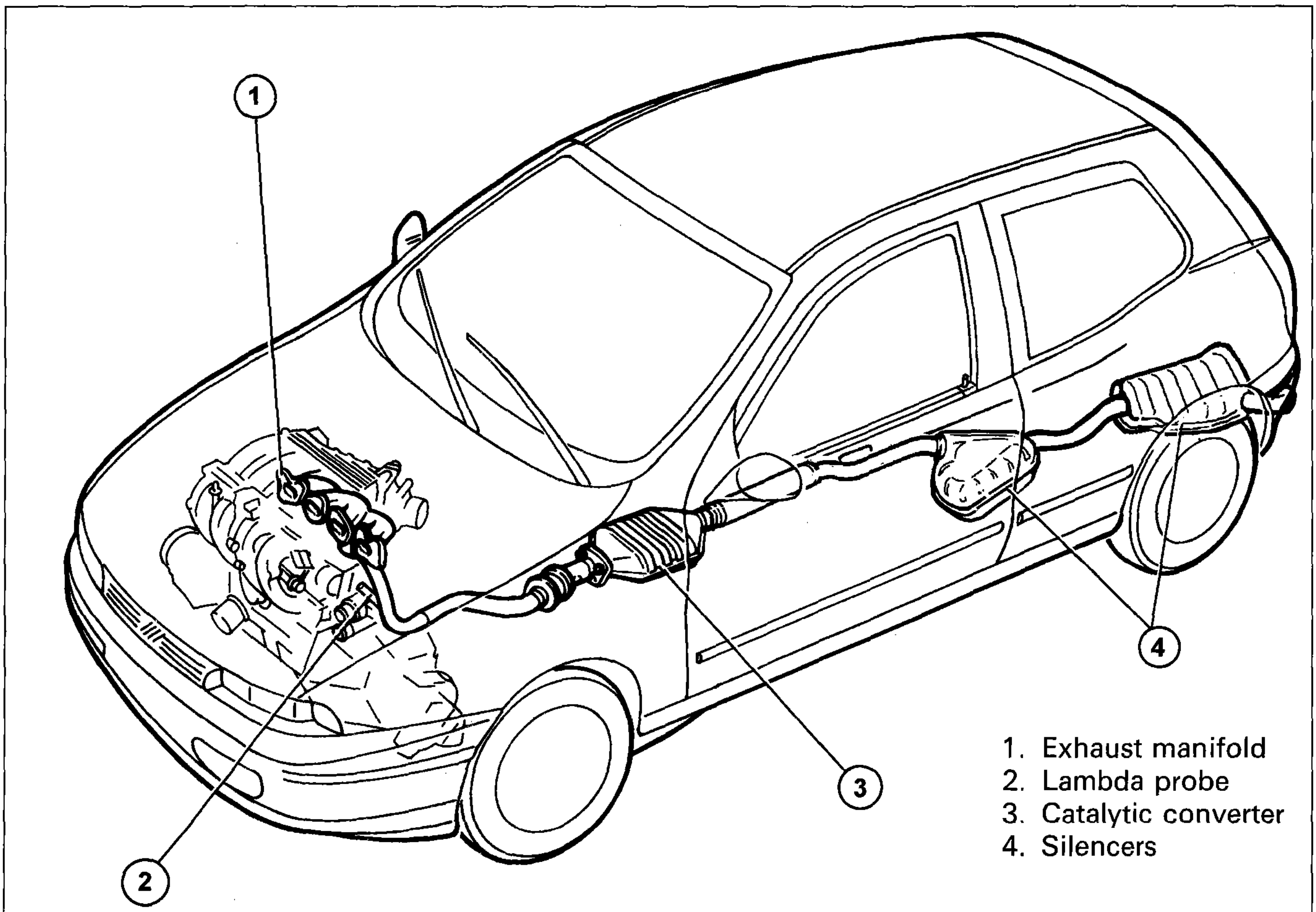
P4A201J01

**Key to components on fuel injection-ignition wiring diagram**

1. Fuel injection-ignition electronic control unit
2. Battery
3. 40A main fuse protecting ignition-dependent devices
4. 30A main fuse protecting fuel injection-ignition
5. Ignition switch
6. 15A fuse protecting fuel injection fault warning light
7. 7.5A fuse protecting various components of fuel injection and supply (+15) to fuel injection control unit
8. 7.5A fuse supplying (+30) fuel injection control unit
9. Relay supplying electric fuel pump, lambda probe, fuel vapour cut-off solenoid, ignition coils and fuel injectors
10. 15A fuse protecting lambda probe and fuel vapour cut-off solenoid
11. Lambda probe
12. Inertial switch
13. Electric fuel pump
14. Rev counter
15. Engine coolant overheating warning light
16. Air conditioner control unit and relays controlling radiator fan high and low speeds
17. Spark plugs
18. Ignition coils
19. Fuel vapour cut-off solenoid
20. Fuel injectors
21. Fuel injection-ignition fault warning light
22. Fiat CODE control unit
23. Vehicle speed sensor
24. Pressure switch (the pressure switch may be three or four stage)
25. Engine idle actuator (stepper motor)
26. Automatic transmission control unit
27. Throttle valve position sensor
28. Intake air temperature and pressure sensor
29. Coolant temperature sensor
30. Coolant temperature gauge
31. Diagnostic socket
32. Knock sensor
33. Rpm and TDC sensor

# 10.

## DIAGRAM OF EXHAUST ASSEMBLY




P4A22IJ01

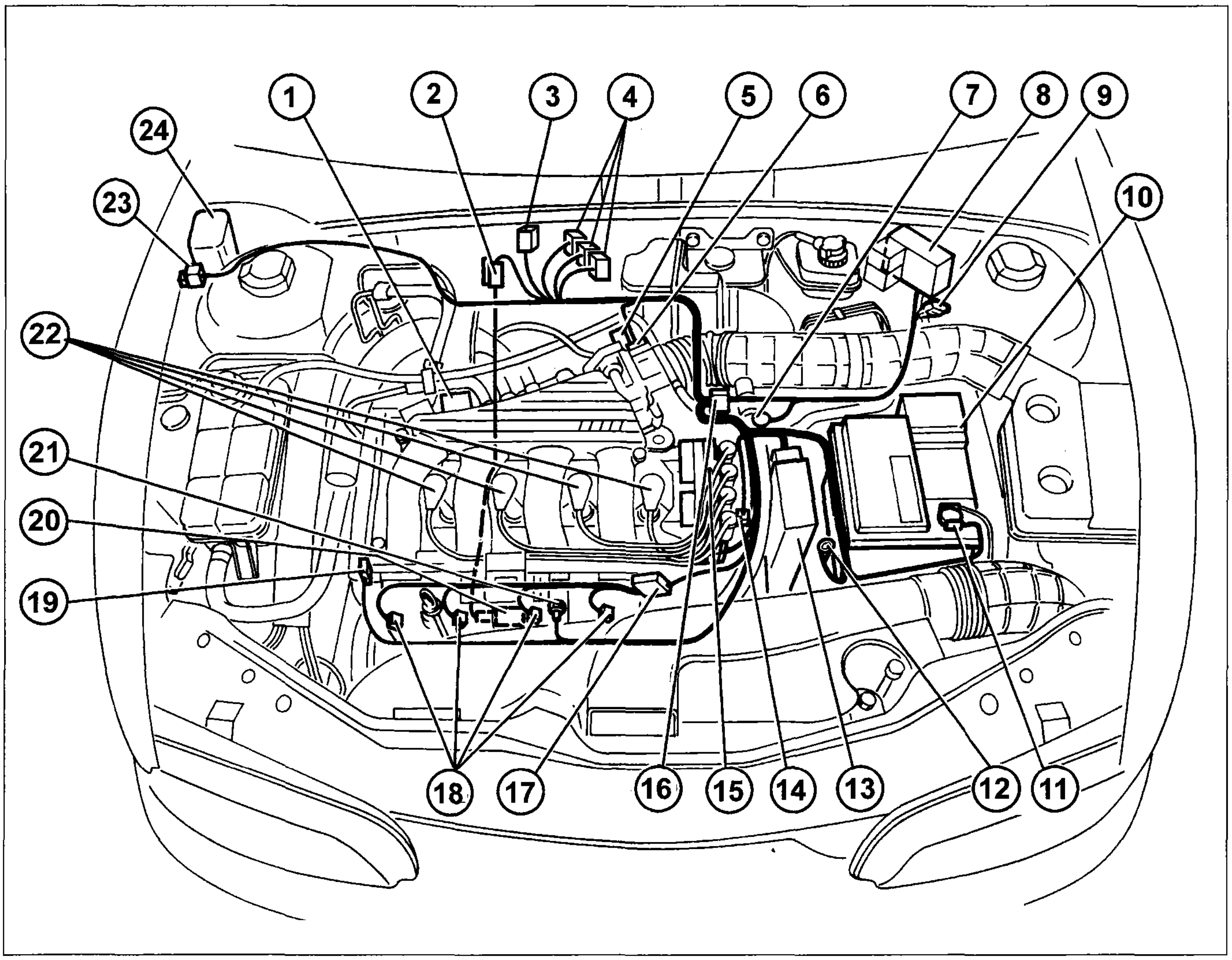
On the I.A.W. system, the closed-loop control of the mixture strength is activated by the Lamba sensor which measures the oxygen content present in the exhaust gases upstream of the catalytic converter.

The Lamba probe's measurements enable the electronic control unit to make continuous corrections of the mixture strength, keeping the air/fuel ratio constant.
In this way, there is control of the harmful emissions in the exhaust, which is completed by the trivalent catalytic converter.
The efficient operation of the catalytic converter and consequently reduction in toxicity of the exhaust gases depends on the air/fuel ratio with which the engine is supplied.
The trivalent catalytic converter simultaneously reduces the three polluting gases present in the exhaust gases: unburnt hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NOx).

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

The causes which quickly and irreparably put the catalytic converter out of use are:
- presence of lead in petrol, which reduces the level of conversion such that its presence in the system is futile;
- presence of unburnt petrol in the converter; a flow of petrol lasting 30 s in an environment of 800°C (silencer's internal temperature) is sufficient to cause the converter to melt and break. It is absolutely necessary for the ignition system to be working perfectly, so **under no circumstances should the spark plugs be removed when the engine is running; during tests, the silencer must be replaced with an equivalent piece of pipe.**

## LOCATION OF INJECTION/IGNITION SYSTEM COMPONENTS

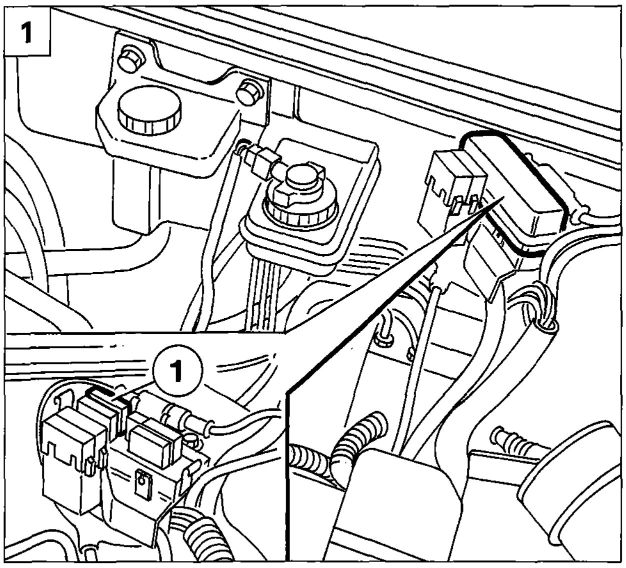



P4A23IJ01

**Components key**

1 Intake air pressure and temperature sensor
2 Lambda sensor coupling
3 Injection system relay
4 Protective fuses
5 Engine idle speed actuator
6 Butterfly valve position sensor
7 Vehicle speed sensor
8 30A general system protective fuse
9 Diagnostic socket
10 Battery
11 Earth at negative battery terminal
12 Connection between injection earth and bodyshell earth
13 Injection/ignition control unit
14 Coolant temperature sensor
15 Ignition coils
16 Join between injection cable and front cable
17 Injectors cable coupling
18 Injectors
19 Rpm and TDC sensor
20 Lambda sensor
21 Detonation sensor
22 Spark plugs
23 Fuel vapour cut out solenoid valve
24 Charcoal filter

# 10.

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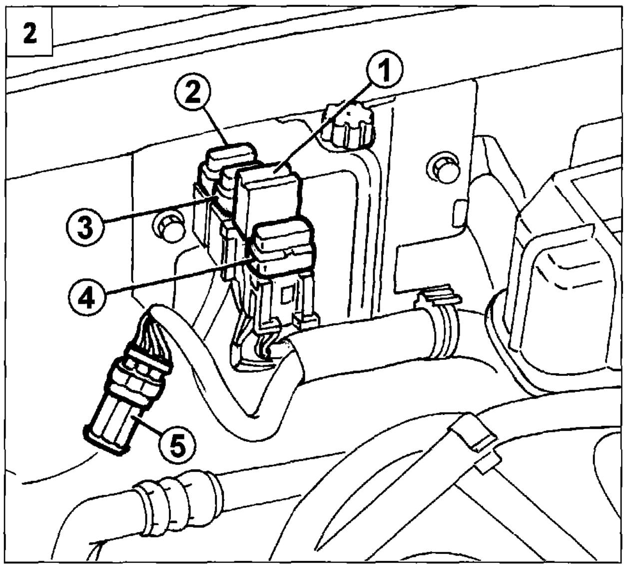


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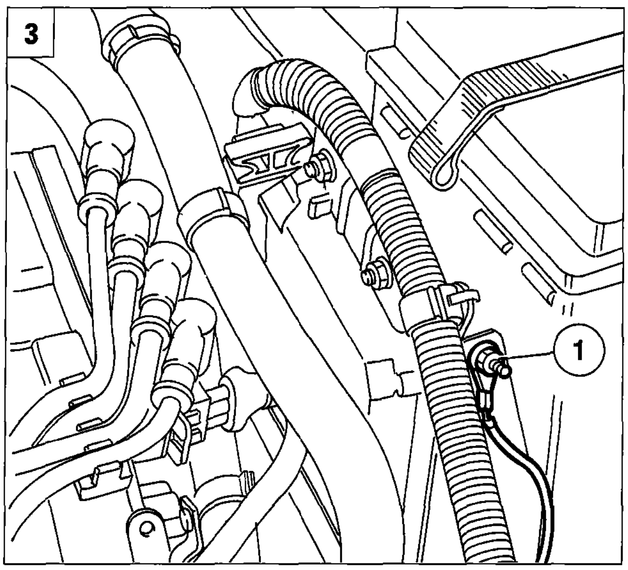



P4A24IJ03

## INJECTION/IGNITION SYSTEM RELAY AND FUSES

### General system protective fuse (fig. 1)

The general fuse (30A) protecting the injection/ignition system (1) is housed inside the power fuse box; to gain access to it, remove the cover releasing it from the side clips.

### Fuses and relay (fig. 2)

The following components are housed on a bracket positioned against the rear wall of the engine compartment:

1. System relay
2. 7.5A fuse protecting +15/54 supply
3. 7.5A fuse protecting +30 supply
4. 15A fuse protecting Lambda sensor and fuel vapour solenoid valve

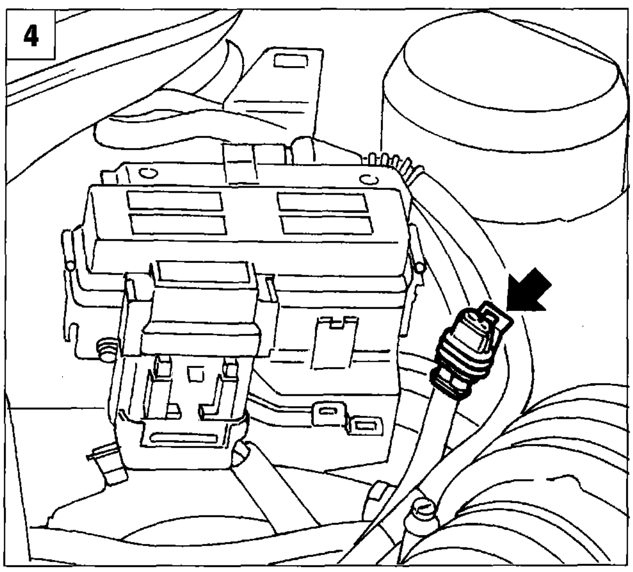
## EARTH POINTS (fig. 3)

In order to improve electro-magnetic compatibility and operational reliability, the earth points have been positioned as follows:

- The main earth for the injection/ignition system is directly connected to the negative battery terminal.
- The earth for the injection/ignition control unit housing (1) is connected to the bodyshell earth on the control unit mounting bracket.

## DIAGNOSTIC SOCKET (fig. 4)

The diagnostic socket for connecting the special equipment (SDC station or EXAMINER) is positioned at the side of the power fuse box.




P4A24IJ04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## COMPONENTS OF THE FUEL INJECTION-IGNITION

The fuel injection-ignition mainly comprises wiring, an electronic control unit and the following sensors and actuators:

**Sensors**

- Rpm and TDC sensor
- Knock sensor
- Throttle position sensor
- Coolant temperature sensor
- Intake air pressure and temperature sensor
- Vehicle speed sensor
- Lambda probe

**Actuators**

- Engine idle speed actuator
- Electric fuel pump
- Fuel vapour cut-off solenoid
- Fuel injectors
- Ignition coils

## FUEL INJECTION-IGNITION WIRING

The various components of the system are connected by a single wiring loom with various types of connectors, laid in special runs mounted on the engine (prewiring).

## FUEL INJECTION-IGNITION ELECTRONIC CONTROL UNIT

The electronic control unit of the fuel injection-ignition used on this version is specific and connected to the electrical wiring by means of two connectors, the top connector with 52 pins and the bottom connector with 28 pins.

It is a digital microprocessor unit characterized by a high calculation capacity, precision, reliability, versatility, low energy consumption and absence of maintenance.

The task of the electronic control unit is to process the signals coming from the various sensors by applying software algorithms, and to control the actuators (in particular the fuel injectors, ignition coils and idle speed actuator) in order to achieve the best possible engine operation.

The structure of the electronic control unit is characterized by the following parts:

- Data acquisition and coding section
- Microprocessor
- ROM memory
- RAM memory
- EEPROM memory
- Drivers

### a. Data acquisition and coding section

It consists of a set of electronic components (A/D converters) assigned to receiving the data in the form of analogue electrical signals. The signals are then converted into digital signals, processed and stored.

**b. Microprocessor**

This electronic component calculates and manages the acquired data; in this respect it should be considered an actual computer mainly responsible for the following: interrogating the memories, comparing the data being processed with the sample data and managing the actuator control circuits.

**c. ROM (Read Only Memory)**

This contains all the programs necessary for the operation of the microprocessor; moreover, as it is permanently programmed before installation in the control unit, its data can be read but not modified.

The ROM is a storage component, so even if the battery terminals are disconnected, the instructions it contains remain stored in memory.

**d. RAM (Random Access Memory)**

The RAM is a transition memory in which the data, in addition to being read, can also be stored in memory.

It is used for both temporary storage of input data in order to render them available for subsequent processing, and also for the storage of signals for coding operating faults, which can arise on the sensors, actuators or certain functions of the control unit.

The RAM is divided into two sections: the first is volatile and is allocated to data storage; it is enabled when the ignition is on and cancelled when the ignition is switched off.

The non-volatile section (RAM STAND-BY) is used to store in memory the self-adapting corrections of the aperture during idling, of the engine idle actuator and the angle position of the fully closed throttle valve. It is also assigned to memorizing the engine parameters and adapting them over time; this means that the control unit, using mainly the Lambda probe's signal, modifies and stores in memory a corrective factor of the injection time which influences the mixture strength.

To be maintained, the self-adapting corrections of the idle speed actuator require the continuous presence of the battery supply (memory in STAND-BY).

If the battery, double relay or control unit connector are disconnected, the parameters are reset. Normal use of the car will restore the adaptation process and the memorization of the new parameters.

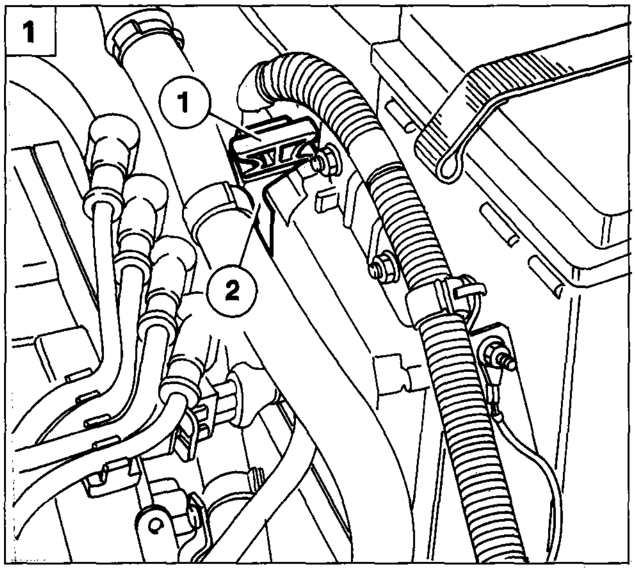
**e. EEPROM (Electrical Erasable Programmable Read Only Memory)**

This is a particular type of memory which can be deleted electrically and reprogrammed several times. Its functions include receiving from the STAND-BY RAM records of faults arising during engine operation, and transmitting this information via the diagnostic socket to the diagnostic equipment (EXAMINER or SDC station). To delete confirmed faults, use the diagnostic equipment in active diagnosis.

The presence of a non-volatile memory also means that data relating to system faults are stored even if the battery is disconnected, and also indications of faults even after the latter disappear.

**f. Drivers (final power stages for driving the actuators)**

These are circuits driven directly by the microprocessor and the specific integrated circuit, and they serve to supply the actuators, namely: fuel injectors, idle control motor, fuel vapour cut-off valve and fuel pump relay.

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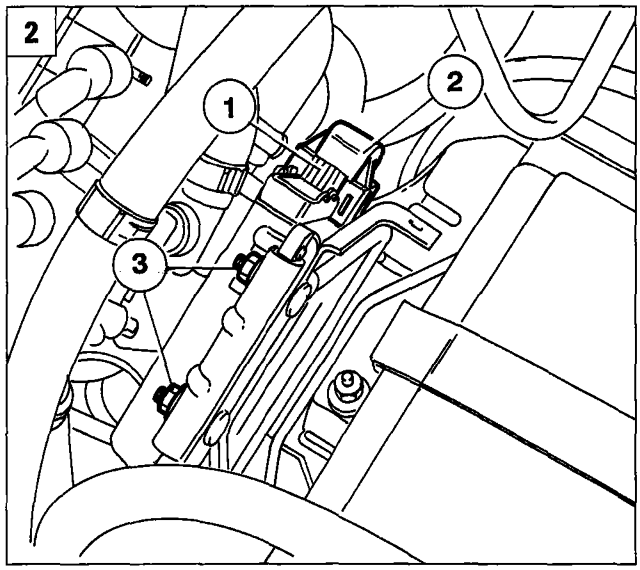
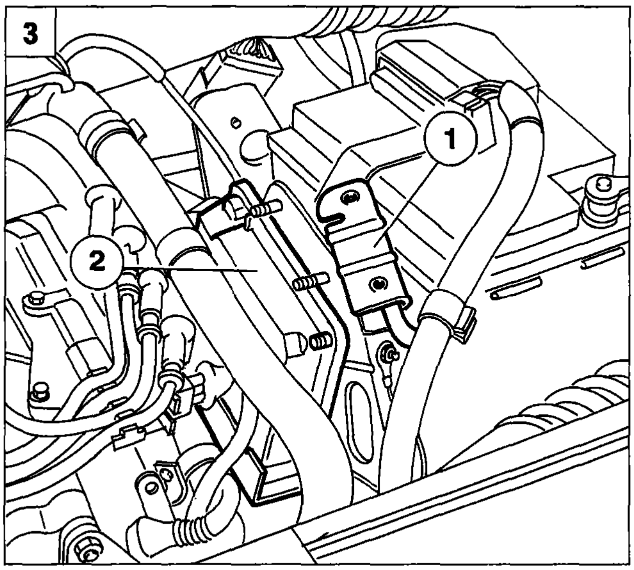



P4A271J02




P4A271J03

**Removing-refitting**

1. Pull the locking device (1) upwards and disconnect the top connector (2).

2. Pull the locking device (1) downwards and disconnect the bottom connector (2) then undo the nuts (3).

3. Remove the bracket (1) and move it aside, then remove the fuel injection-ignition electronic control unit (2).

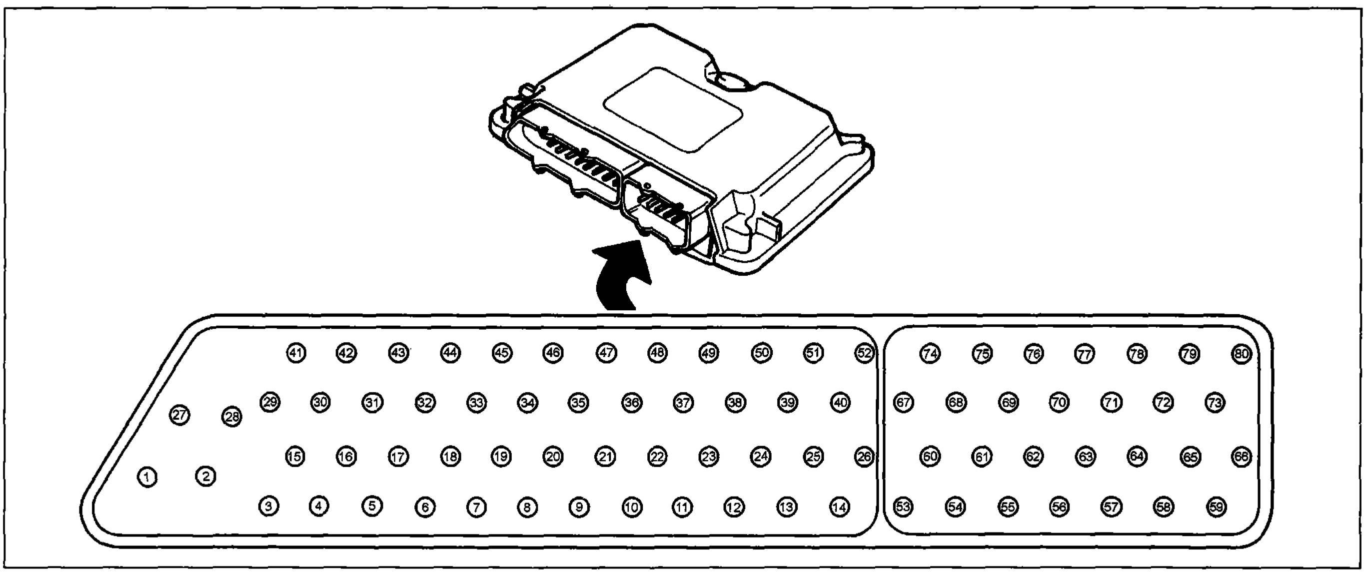
*Under no circumstances may fuel injection control units be exchanged between different vehicles to check whether they are working.*

*During diagnosis, before replacing the control unit, make sure that the component under examination is really not working, as when a new control unit is supplied, the secret code of the Fiat CODE system is memorized, rendering the control unit totally unusable on other cars.*

*Voltage may be present on unconnected pins, so no connection should be made otherwise there will be the risk of short circuit with damage to the control unit.*
*The multi-connector should be inserted and withdrawn with the ignition off (key removed).*

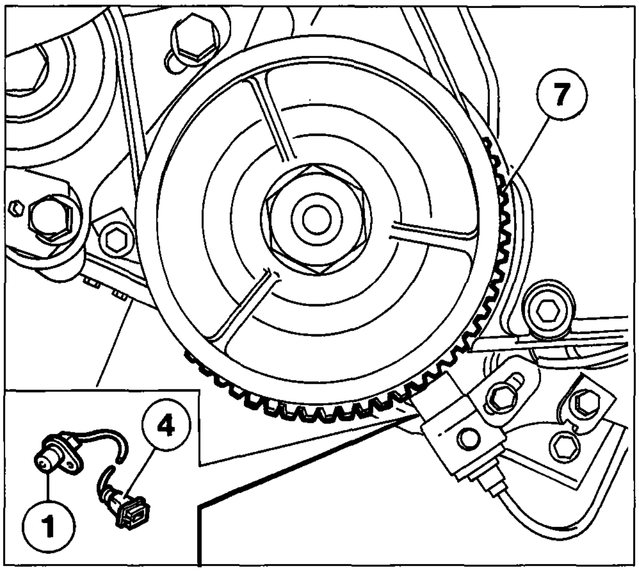
# 10.

**Identification of fuel injection-ignition control unit connections (pin outputs)**



P4A28IJ01

1-3. Not connected
4. Rev counter signal
5. Automatic transmission control unit (coolant temperature signal)
6-8. Not connected
9. Lambda probe (negative)
10-12. Not connected
13. Fiat CODE control unit
14. Radiator fan high speed control (versions with air conditioner)
15. Fuel injection relay enablement
16. Automatic tranmission control unit (throttle valve angle)
17. Engine coolant overheating warning light
18-19. Not connected
20. Lambda probe (positive)
21. 4-stage pressure switch
22-24. Not connected
25. Diagnostic socket (line k)
26. Fuel injection fault warning light
27-28. Earth
29. Fused supply (+30)
30-34. Not connected
35. Signal requesting radiator fan low speed
36. Automatic transmission control unit (torque reduction signal)
37-39. Not connected
40. Radiator fan low speed control (versions with air conditioner)
41. Air conditioner compressor relay
42-43. Not connected
44. Lambda probe cables shielding
45-46. Not connected
47. Supply (+15)
48. Request to switch on air conditioner
49. Automatic transmission control unit (gear change signal)
50. Vehicle speed signal
51. Not connected
52. Fuel vapours solenoid
53. Rpm sensor (positive)
54. Earth of coolant temperature, air pressure/temperature and throttle valve position sensors.
55. Intake air temperature
56. Knock sensor (positive)
57. Engine idle speed actuator
58. Engine idle speed actuator
59. Ignition coils (cylinders 1-4)
60. Supply to throttle valve position sensor
61. Not connected
62. Coolant temperature sensor (positive)
63. Knock sensor cables shielding
64. Engine idle speed actuator
65. Engine idle speed actuator
66. Ignition coils (cylinders 2-3)
67. Rpm sensor (negative)
68. Supply to intake air temperature/pressure sensor
69. Not connected
70. Knock sensor (negative)
71. Cylinder no. 1 fuel injector
72. Cylinder no. 4 fuel injector
73-74. Not connected
75. Intake air pressure signal
76. Throttle valve position signal
77. Rpm sensor cables shielding
78. Cylinder no. 3 fuel injector
79. cylinder no. 2 fuel injector
80. Not connected



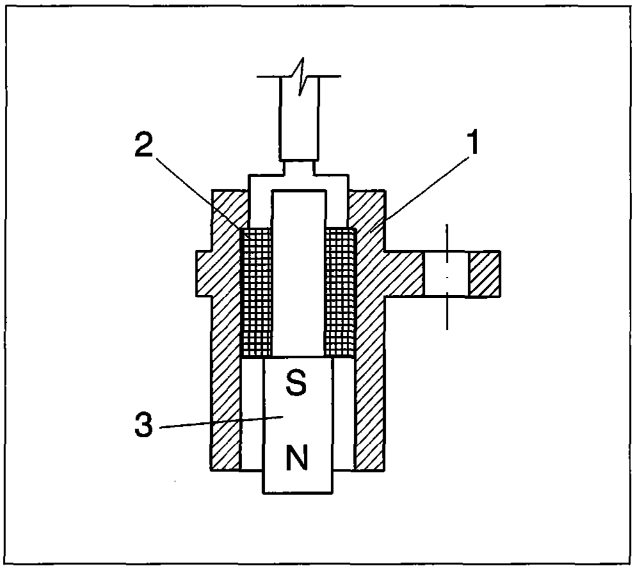

P4A29IJ01

## RPM AND TDC SENSOR (Jaeger CVM02)

The sensor (1) for rpm and reference of the crankshaft angle (identification of TDC) is secured to the engine block and is opposite the phonic wheel (7) located on the crankshaft pulley.

### Principle of operation

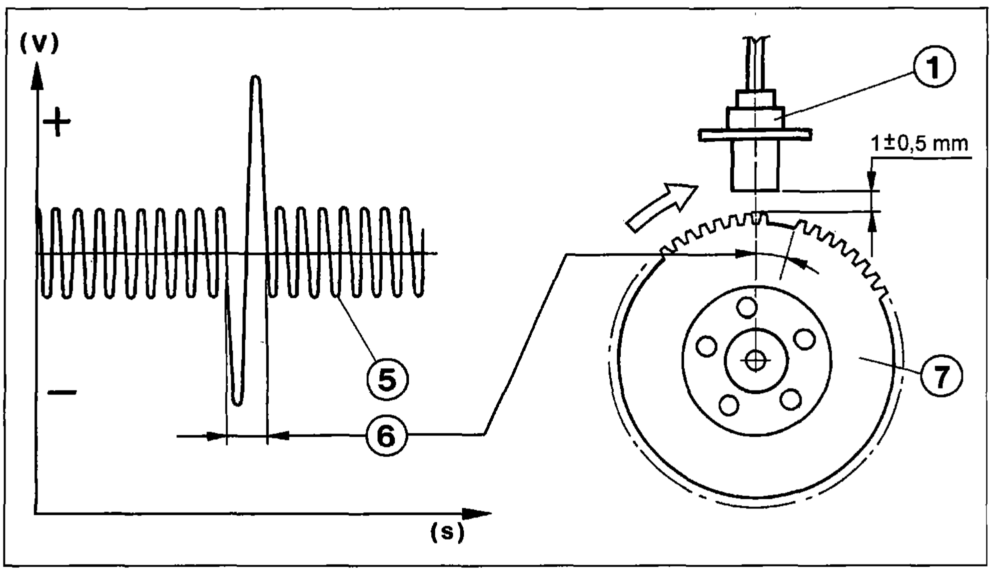
The sensor consists of a tubular case (1) containing a permanent magnet (3) and electrical winding (2). The magnetic flow created by the magnet (3) causes oscillations following the change of gap, because of the passage of the teeth of the phonic wheel.




P4A29IJ02

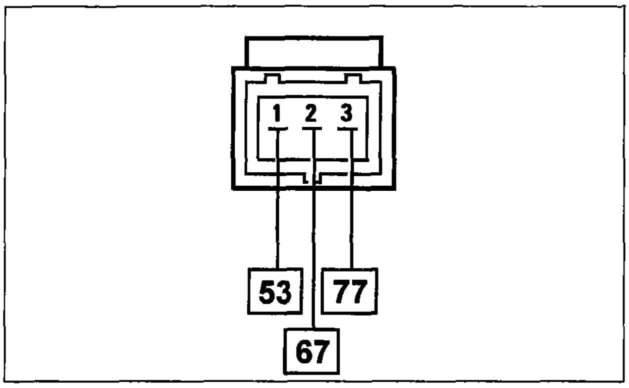
These oscillations induce an electromotive force in the winding (2) at the ends of which there is a voltage which is alternately positive (tooth opposite the sensor) and negative (gap opposite the sensor). Provided all other factors are equal, the peak output voltage from the sensor depends on the distance between sensor and tooth (gap).

The phonic wheel has sixty teeth, two of which are removed to create a reference; the pitch of the wheel thus corresponds to an angle of 6° (360° divided by 60 teeth). The point of synchronization is recognized at the end of the first tooth following the two missing teeth; when this space passes under the sensor, the engine is with the piston pair 1-4 at 114° before TDC.




P4A29IJ03

1. Sensor
2. Winding
3. Permanent magnet
4. Sensor connector
5. Output signal
6. Signal corresponding to the two missing teeth
7. Crankshaft pulley with phonic wheel



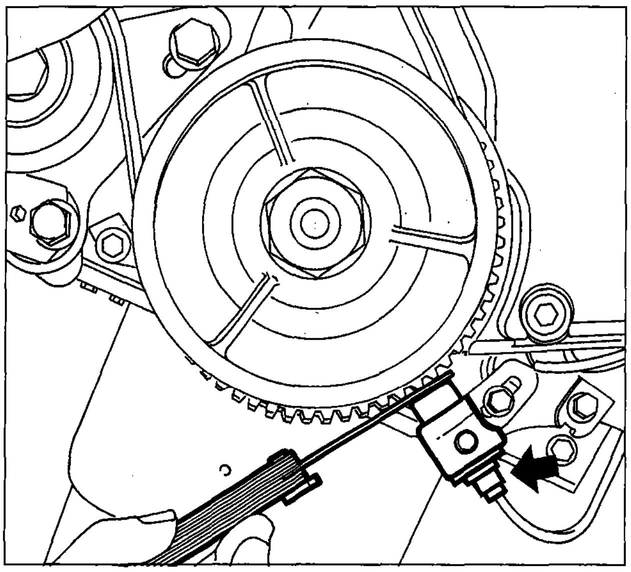

P4A30IJ01

**Wiring connector**

The sensor is connected to the control unit by means of twisted cables covered by a shielded anti-interference sheath.

Pin 1 - Signal
Pin 2 - Earth
Pin 3 - Shielding

**NOTE** *The numbers in boxes indicate the corresponding control unit pins.*



P4A30IJ02

**Removing-refitting**

Disconnect the wiring connector.

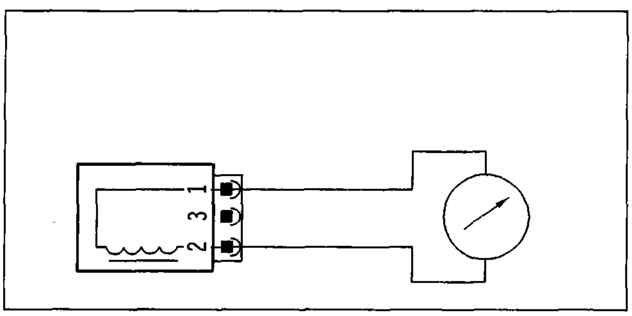
Undo the screw indicated and remove the sensor.

**Checking the gap**

Check the distance between the sensor and phonic wheel teeth (gap).

**Gap: 0.5 - 1.5 mm**

**NOTE** *If work has to be done on the rpm and TDC sensor mounting (e.g. gap outside tolerance limits, sensor misaligned, etc.), the procedure must be carried out for correct positioning of the sensor and its mounting, and setting its timing, as described in the engine overhaul manual (publication no. 504.589/20).*

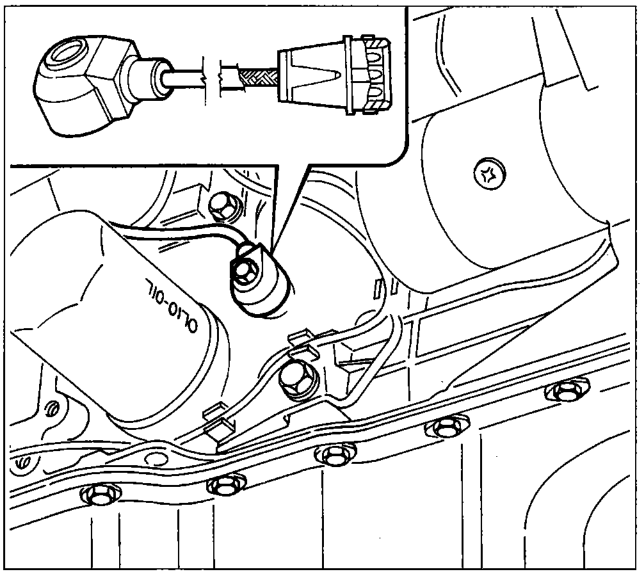



P4A30IJ03

**Checking resistance**

The sensor's resistance can be measured by disconnecting the connector and connecting an ohmmeter to the ends of the sensor.

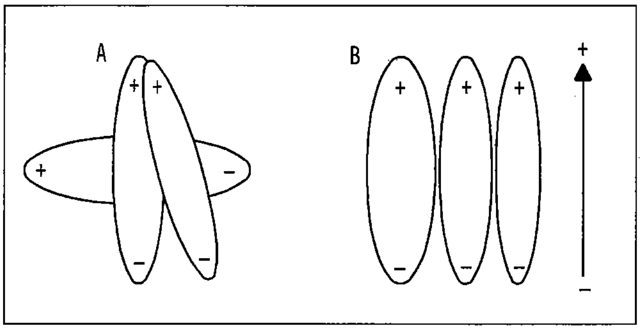
**Resistance 1134 - 1386 ohm at 20 °C**



4A311J01

## KNOCK SENSOR (KNE-03)

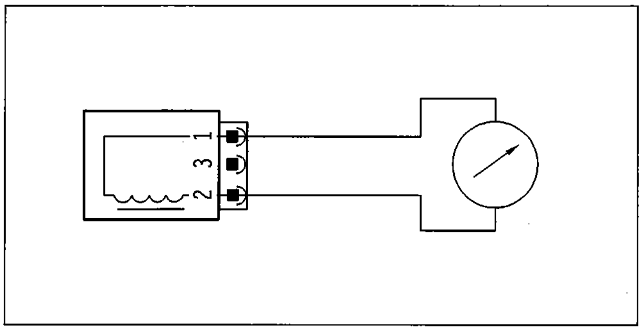
This sensor is the piezoelectric type and is fitted on the cylinder block/crankcase in a position which is symmetrical in relation to the pairs of cylinders 1-2 and 3-4.
This position is determined by the need to detect the onset of knock in the same way for all cylinders.
When there is engine knock, vibrations of a particular frequency are produced .
The effect generates mechanical repercussions on a piezoelectric crystal that sends a signal to a control unit. The control unit then reduces the ignition advance on the basis of this signal until the effect disappears. The advance is then gradually restored to the baseline value.




4A311J02

### Principle of operation

The molecules in a quartz crystal are electrically polarised.
Under rest conditions (A), the molecules are not aligned in any particular direction.
When the crystal is subject to pressure or impact (B), the molecules line up and the degree to which they align is directly proportional to the pressure on the crystal. This alignment creates a voltage at the crystal terminals.
A. Rest position
B. Position under pressure

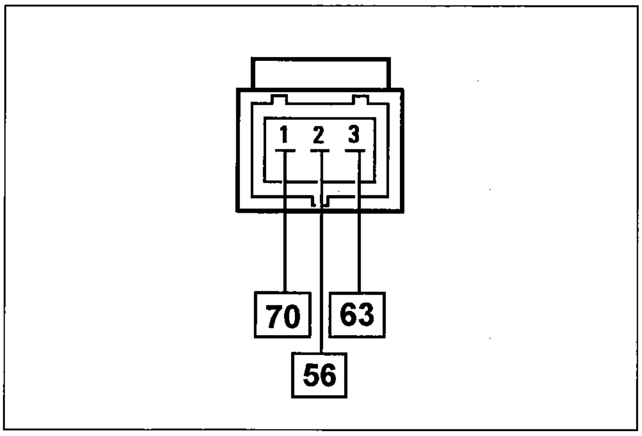



4A30IJ03

### Checking the resistance

The sensor resistance can be measured by disconnecting the connector and connecting an ohmmeter to the sensor terminals

**Resistance 532 - 588 ohm at 20°C**




4A311J03

### Connector wiring

The sensor is connected to the control unit by twisted cables covered in a shielded non-interference sheath.
Pin 1 - Earth
Pin 2 - Signal
Pin 3 - Shielding
The numbers in boxes indicate the corresponding control unit pins.

### Removing-refitting

Disconnect the electrical connection, undo the knock sensor retaining bolt and remove.

# 10.

## THROTTLE BODY

The throttle body meters the quantity of air drawn in by the engine (and consequently the power developed) according to the driver's request via the accelerator.

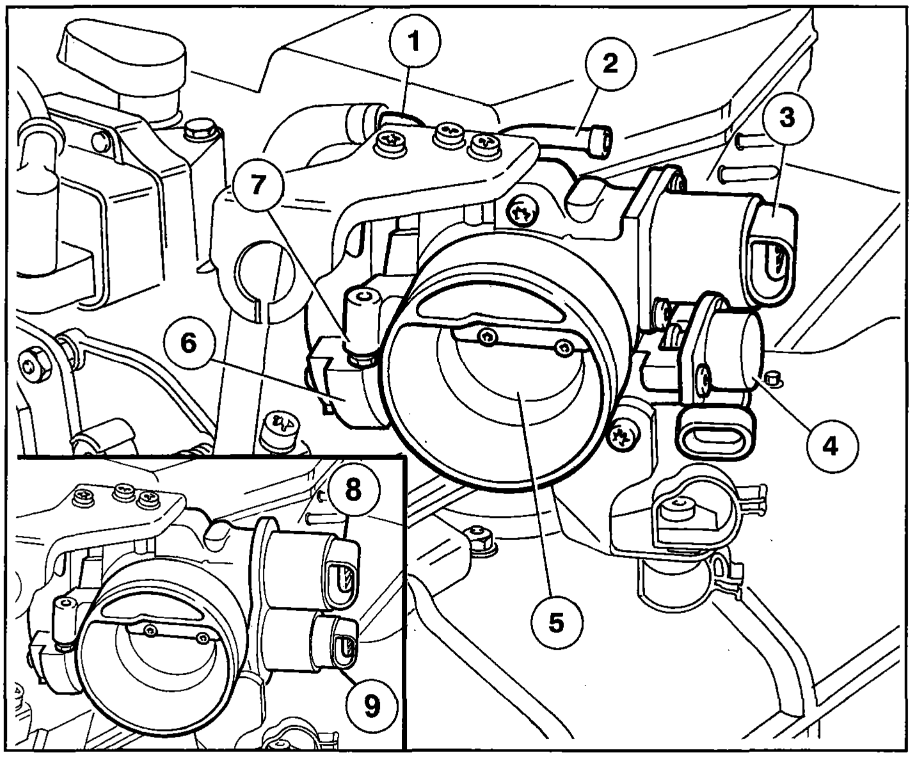
The throttle body is secured to the intake manifold by four bolts: the butterfly is opened by means of linkage where small butterfly opening angles correspond to the pedal being slightly pressed and large angles correspond to it being greatly depressed.

With the pedal completely released (engine decelerating or idling) the necessary additional air is supplied by the engine idle adjustment actuator: under these circumstances, the throttle opening lever is in the end of travel position against an anti-tamper screw which prevents the throttle from getting stuck in a closed position.

To prevent condensation and ice formation that could arise during certain exterior conditions, i.e. low temperature and/or high humidity, the throttle body is heated by recycling a small amount of coolant from the engine thermostat through a chamber inside the body.

The throttle valve position sensor and engine idle speed actuator are fitted to the throttle body.

In the pre-modification version, the engine idle actuator and throttle valve position sensor are bolted to the throttle body. In the post-modification version, they are built into the throttle body.




4A32IJ01

*The anti-tamper screw is adjusted by flushing in the factor and should never be tampered with.*

1. Engine coolant delivery pipe attachment
2. Engine coolant return pipe attachment
3. Engine idle speed actuator bolted to the throttle body (pre-modification solution)
4. Throttle valve position sensor bolted to the throttle body (pre-modification solution)
5. Throttle valve
6. Throttle opening linkage
7. Throttle valve adjustment and antitamper screw (do not tamper with)
8. Engine idle speed actuator built into the throttle body (post-modification solution)
9. Throttle valve position sensor built into the throttle body (post-modification sensor)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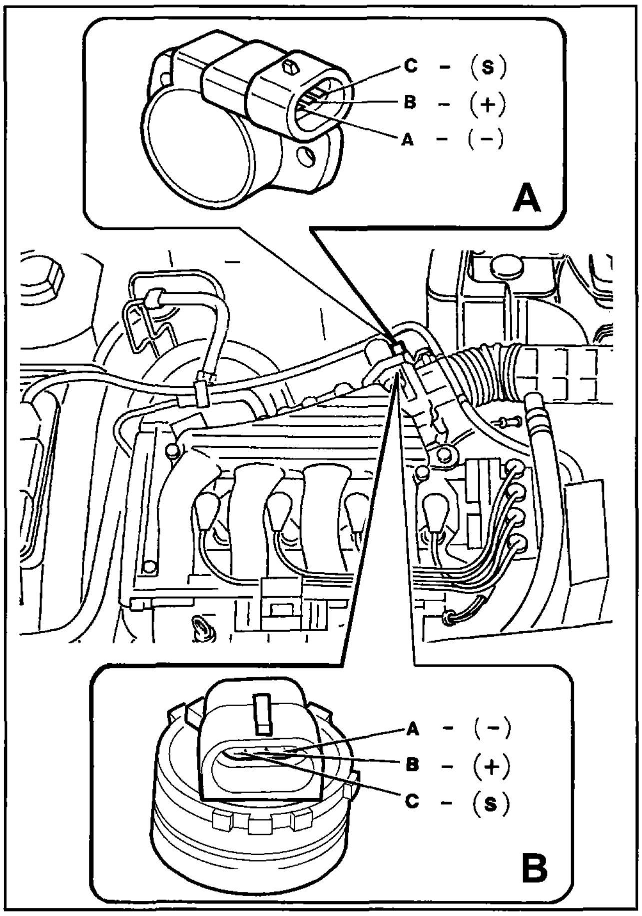
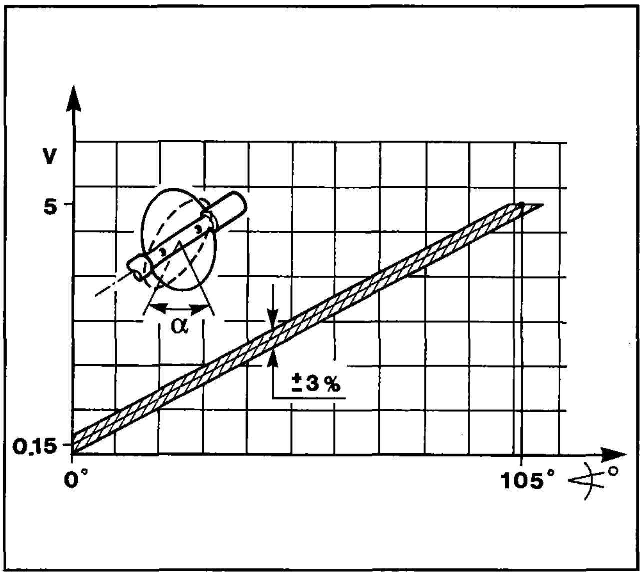



4A33IJ01

The following graph shows sensor voltage output for different throttle opening angles.




4A33JJ02

## THROTTLE VALVE POSITION SENSOR

**A.** Sensor used on premodification cars
**B.** Sensor used on postmodification cars

The sensor consists of a potentiometer with its mobile part controlled by the throttle valve spindle.

The potentiometer is enclosed in a plastic container. In solution **A** adopted on premodification models, the potentiometer case is fitted with two tabs. These have two UNSLOTTED holes to anchor and position the sensor in relation to the throttle valve. In solution **B** adopted on post-modification cars, the sensor is integral with the throttle body.
A three-pin socket (ABC) on the container ensures an electrical connection to the electronic injection-ignition control unit

During operation, the electronic control unit supplies the potentiometer with a voltage of 5 Volts. The parameter measured for injection management is throttle position from idle to full opening.

The output voltage tells the control unit how far the throttle valve is opened and it corrects mixture concentration accordingly.
When the throttle is closed, a voltage signal is sent to the control unit,which recognises idle and cut-off (discerning between them on the basis of engine rpm).

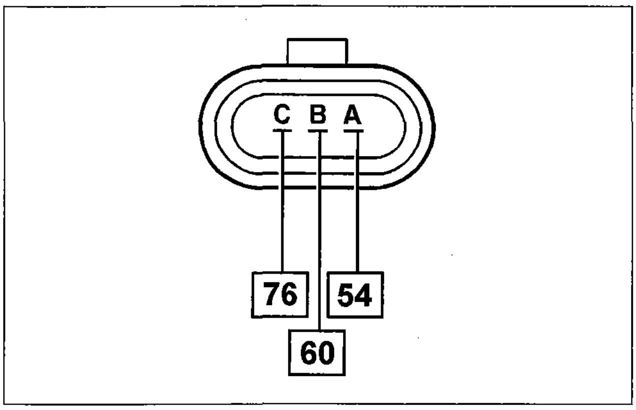
The potentiometer is linear (single ramp type). Its main features are as follows:

Effective electrical angle: 90° ± 2°

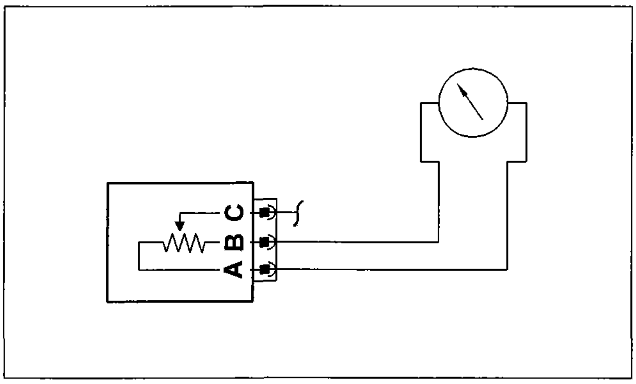
Total mechanical travel: 110° ± 8°

Service temperature range: -30°C - +125°C

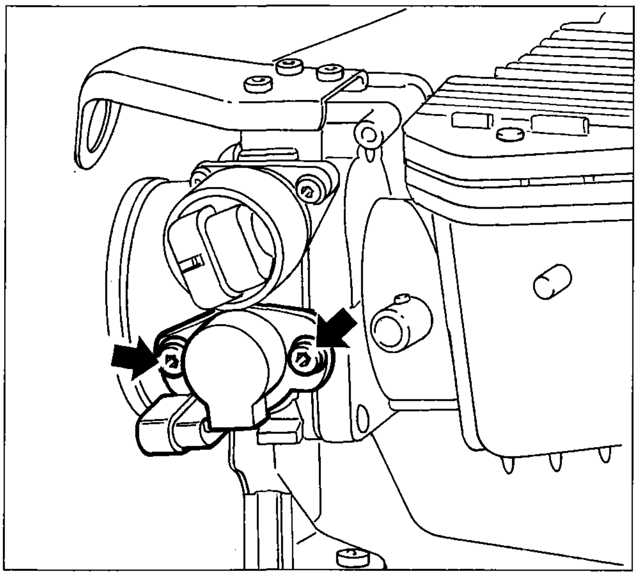
# 10.




4A341J01




4A341J02



4A341J03

**Wiring connectors**

The numbers in squares indicate the corresponding control unit pins.
Pin A - Earth
Pin B – Positive
Pin C – Signal

**Checking the resistance**

Sensor resistance may be measured as follows:
- connect an ohmmeter across sensor pins A and B and check a fixed resistance of 1200 ohms;
- check an ohmmeter between sensor pins A and C and check that resistance varies from 0 to 1200 ohm ± 20% when the throttle is moved.

**Recovery**

The system assumes a value calculated on the basis of rpm and pressure in the inlet manifold. If the pressure sensor fails at the same time, a throttle opening of about 50° is assumed as a fixed value.

Strategies to gradually decrease rpm at idle speed (dashpot) are blocked.

Idle speedself-adaption is blocked.

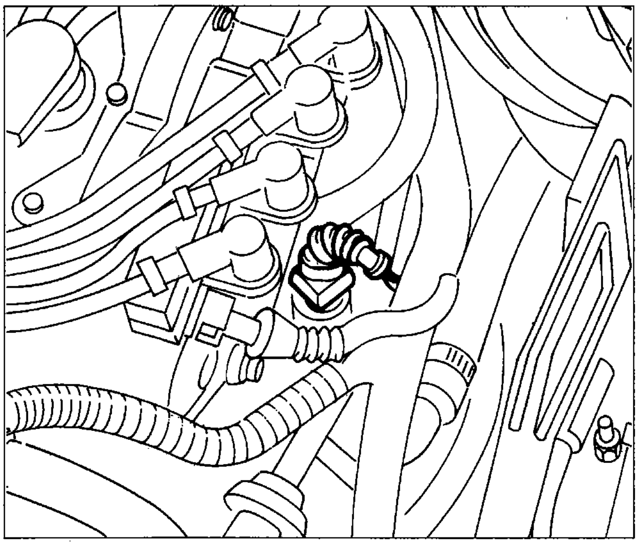
Mixture concentration self-adaption is blocked.

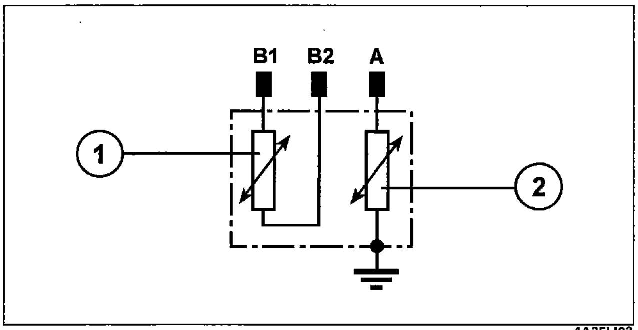
**Removing-refitting**
**Procedure for premodification cars**

Disconnect the electrical connection, undo the two fixing bolts and remove the sensor.

**NOTE** *The sensor is secured to the throttle body by two tabs with two non-slotted holes. Sensor angular position does not require adjustment because the control unit recognises throttle closed or fully open positions by means of special self-adaptive algorithms.*

**NOTE** *Whenever the potentiometer bolts are loosened or removed, they must be replaced because the threads are covered by a light layer of loctite. This secures the bolt once only.*
**NOTE** *On post-modification cars, the throttle valve position sensor is built into the throttle body.*


4A351J01



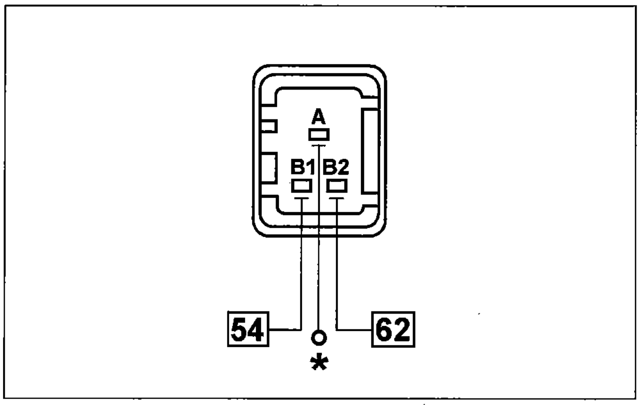
4A351J02

**INJECTION NTC**

| °C | Ω | °C | Ω |
|---|---|---|---|
| -20 | 15970 | 40 | 1150 |
| -10 | 9620 | 50 | 807 |
| 0 | 5975 | 60 | 576 |
| 10 | 3816 | 70 | 418 |
| 20 | 2500 | 80 | 309 |
| 25 | 2044 | 90 | 231 |
| 30 | 1679 | 100 | 176 |

**NTC INSTRUMENT**

| °C | Ω |
|---|---|
| 60 | 512-602 |
| 90 | 184-208 |
| 120 | 76-88 |



4A351J03

* Connection to coolant temperature gauge on instrument panel

## ENGINE COOLANT TEMPERATURE SENSOR

The sensor is fitted on the thermostat case;It is made up of brass casing which affords protection for the actual resistive elements consisting of two NTC (Negative Temperature Coefficient) type thermistors whose electrical resistance decreases as the temperature increases).
The two NTC thermistors are separate and supply temperature inforfmation to a specific indicator on the instrument panel and the injection-ignition control unit
The reference voltage for the injection system NTC element is 5 Volt: since the control unit intake circuit is designed as a voltage divider, the reference voltage is shared between a resistance in the control unit and the actual sensor. As a result, the control unit is capable of evaluating the variations in the sensor resistance through the changes in voltage, thereby obtaining information concerning the temperature.
1. NTC for injection system
2. NTC for indicator on instrument panel

### Recovery

Assumes last temperature reading or a fixed value of 80°C if intake air temperature exceeds a certain value.
Mixture concentration self-adaption is inhibited.
The radiator fan is activated
Idle self-adapation is inhibited

### Checking the resistance

The table alongside shows resistance values that the NTC elements may assume as temperature changes. These values can be measured by disconnecting the connector and connecting an ohmmeter across the sensor pins.

### Removing-refitting

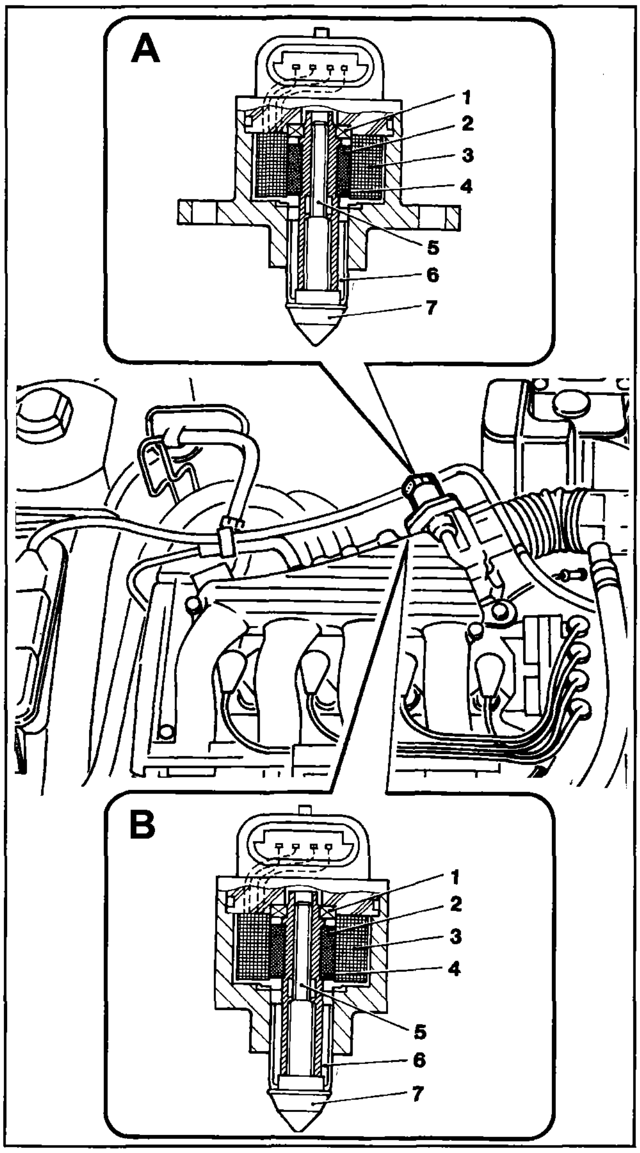
Disconnect the electrical connection and remove the sensor.

**Tightening torque 2.2 daNm**

### Connector wiring

The numbers in boxes indicate the respective control unit pins.

# 10.




4A36IJ01

## ENGINE IDLE SPEED ACTUATOR (step motor)

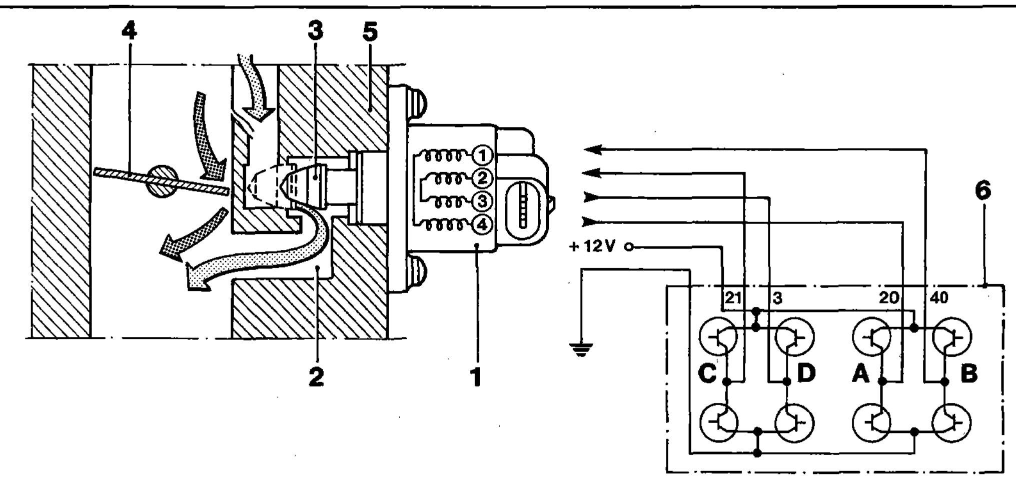
1. Bearing
2. Worm screw
3. Coils
4. Magnet
5. Screw
6. Anti-turn grooves
7. Plunger

**A.** Actuator used on premodification cars
**B.** Actuator used on postmodification cars

The actuator is secured to the throttle body and consists of:

- an electric stepp motor with two windings in the stator and a rotor which includes a certain number of pairs of permanent magnetic poles;
- a worm screw type reduction gear which converts rotary motion into rectilinear motion.

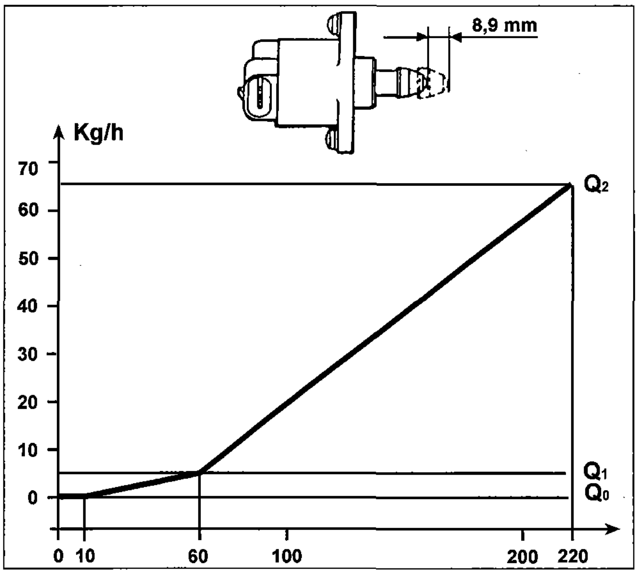
To run at idle speed, i.e with throttle (4) fully closed, the engine needs a certain amount of air (Qo) and fuel to overcome internal frictionand maintain its speed of rotation. The amount of air (Qo) that leaks thorugh closed throttle (4) with the engine idling must be increased while the engine is warming up or when external services or loads are activated (e.g. automatic air conditioner etc.) by an additional quantity of air (Q) to allow the engine to maintain a constant rpm. To achieve this result, the system uses a step motor (1) secured to throttle body (5) and controlled by a drive circuit (6) located inside the injection-ignition control unit. The motor drives a push-rod equipped with a plunger (3), which alters the cross section of by pass duct (2) and thus the amount of air (Qo + Q) taken up by the engine. To control this type of action, the control unit uses angular engine speed and coolant temperature signals from the relevant sensors.




Q. Air flow regulated by actuator (variable)

Qo. Air flow leaking through throttle (constant)

4A36IJ02



4A37IJ01

The step motor is very precise and offers high resolution (about 220 steps per second). Pulses sent by the electronic control unit to the engine are converted from rotary motion into linear movement (about 0.04 mm/step) via a worm screw mechanism. The plunger then works to alter the cross section of the by pass port.
The constant minimum air flow (Qo) due to air leaking beneath the throttle valve is adjusted during production and ensured by a tamperproof cap. Maximum air flow (Q2) occurs when the plunger is fully retracted (about 220 steps corresponding to 8.9 mm).
Air flow follows the law shown in the graph alongside for intermediate values.

### Motor strategy

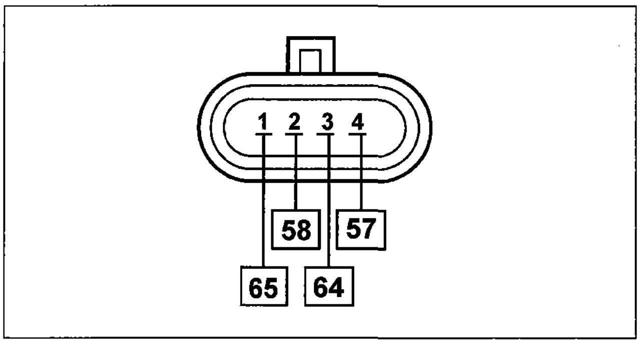
The number of working steps depends on engine condition:
- Ignition stage
  When the ignition key is inserted, the control unit makes the step motor take up a position dependent upon coolant temperature and battery voltage.
- Warm-up stage
  RPM is adjusted according to coolant temperature
- With engine warm:
  Idle management depends on a signal from the engine rpm sensor. The control unit manages sustained idle mode when external loads are activated.
- During deceleration
  The electronic control unit identifies deceleration stage from throttle potentiometer position.
  It controls step motor position via the idle flow law (dashpot law), i.e. it slows the return of plunger (3) to its seat so that a quantity of air bypassed from hole (2) reaches the motor and reduces levels of pollutants in exhaust gases.

### Recovery

Actuator operation disabled, fuel vapour recirculation self-adaptation inhibited and speed limited to 1200 rpm.

### Removing-refitting engine idle speed actuator (step motor)

Procedure for premodification cars
- disconnect the battery negative terminal.
- unscrew both retaining bolts and withdraw the actuator;
- check the condition of the o-ring and remove any impurities from the seat in the case;
- refit the actuator and check that the plunger fits properly into its seat without forrcing.



4A37IJ02

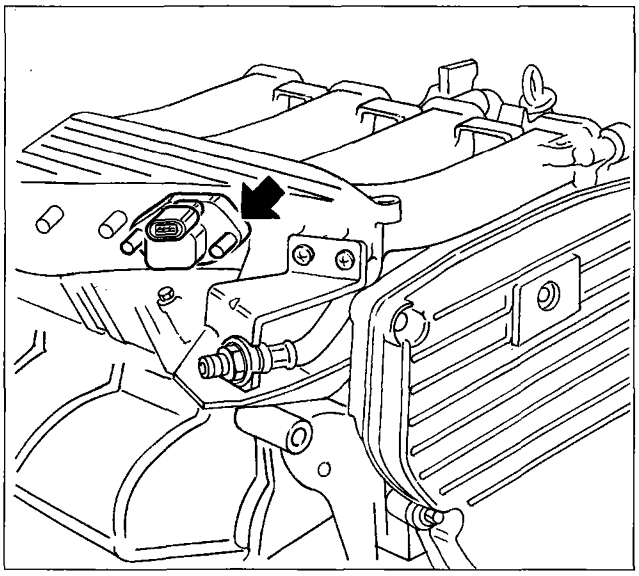
**Step motor bolt tightening torque 0.35 - 0.45da Nm**

**NOTE** *The engine idle speed actuator is built into the throttle body in postmodification cars.*

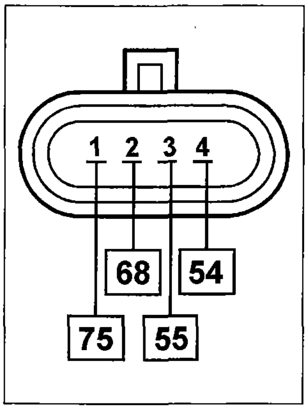
### Connector wiring

The numbers in squares indicate the control unit pins.

# 10.



4A38IJ01




4A38IJ02

Pin 1 - Air pressure signal

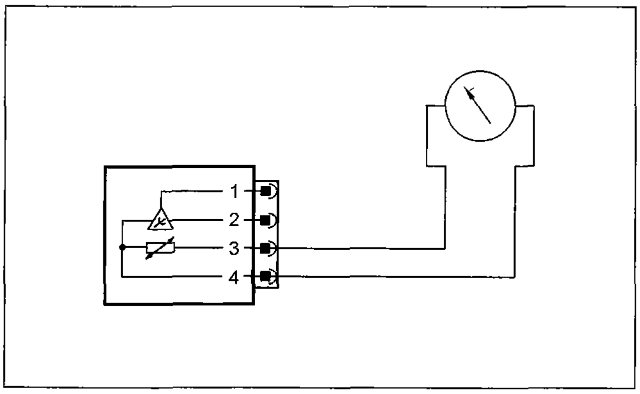
Pin 2 - Positive

Pin 3 - Air temperature signal

Pin 4 - Negative

### Connector wiring

The numbers indicate the corresponding control unit pins




4A38IJ03

### Checking the resistance

The table alongside shows resistance values that the temperature sensor (NTC thermistor) may assume with changing temperature. These values may be measured by connecting an ohmmeter across sensor pins 3 and 4.

## INTAKE AIR PRESSURE AND TEMPERATURE SENSOR (T-PRT 03)

The intake air pressure and temperature sensor is a built-in component that measures the temperature and pressure of air inside the intake manifold.. The injection control unit uses both items of information to define the amount of air taken in by the engine. This information is then used to compute injection time and ignition point. The sensor is fitted to the inlet manifold.

### Self-diagnosis and recovery

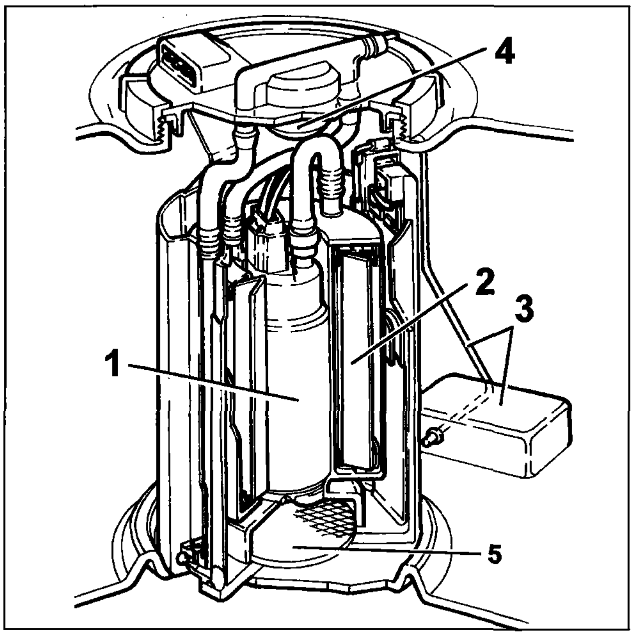
The self-diagnostic system monitors both sensor output signals.

It identifies the following for both signals:

- Short circuit to earth.
- Short circuit to positive and reference voltage.
- Circuit open/broken.

When the sensor pressure signal is cut off, the throttle potentiometer signal and engine rpm signals are used to computer injection time and ignition point. The injection control unit processes these signals to reconstruct the missing signal. If the air temperature sensor fails, the injection control unit uses the last reading as a recovery value or, if the fault is present when the engine is started, it uses a fixed value of 45°C and mixture self-adaptation is disabled.
If the pressure sensor faults, a fixed value of 1024 mBars is used.

| Temperature (°C) | Resistance (Ω) |
|---|---|
| -40 | 49933 ± 13.6% |
| -20 | 15701 ± 10.8% |
| 0 | 5959 ± 8.5% |
| 10 | 3820 ± 7.4% |
| 20 | 2509 ± 6.5% |
| 25 | 2051 ±6.0% |
| 30 | 1686 ± 6.0 |
| 40 | 1157 ± 5.9% |
| 50 | 810 ± 5.8% |
| 60 | 578 ± 5.7% |
| 80 | 309 ± 5.5% |
| 100 | 176 ± 5.4% |

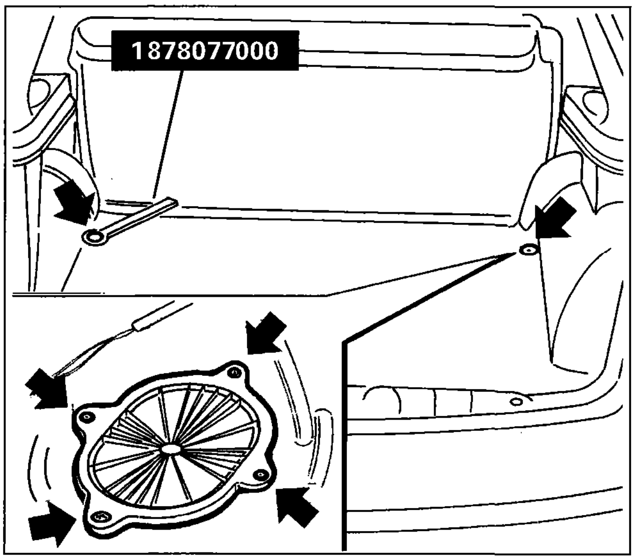



P4A391J01

## ELECTRIC FUEL PUMP (ESS 291)

The electric pump assembly basically comprises:
- an electric fuel pump (1);
- a fuel filter (2);
- a float type level indicator (3);
- a diaphgragm pressure regulator (4);
- a mesh prefilter (5).

The fuel pump is of the single-stage type with peripheral flow, with high performance under low voltage and temperature conditions. The advantages compared with pumps which operate on the positive-displacement principle are its lighter weight and small dimensions.




P4A391J02

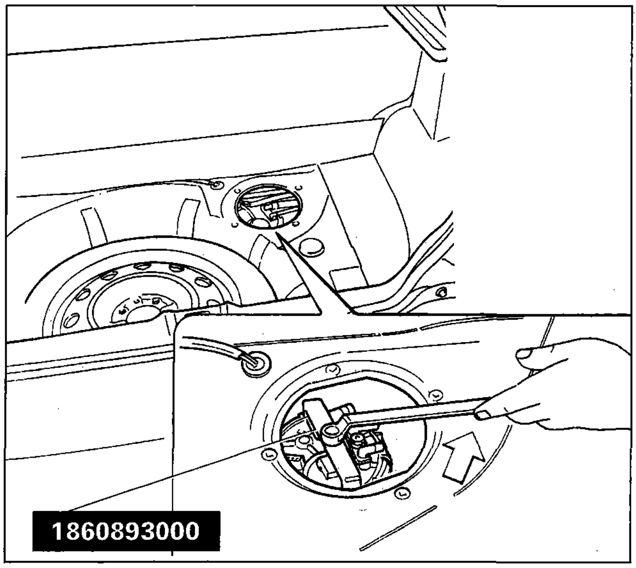
### Removing-refitting electric fuel pump

The electric pump is located in the tank; to remove it:

Remove the attachment buttons (arrowed) using tool 1878077000.

Lift the boot carpet.

Undo the screws (arrowed) and remove the dust cover.



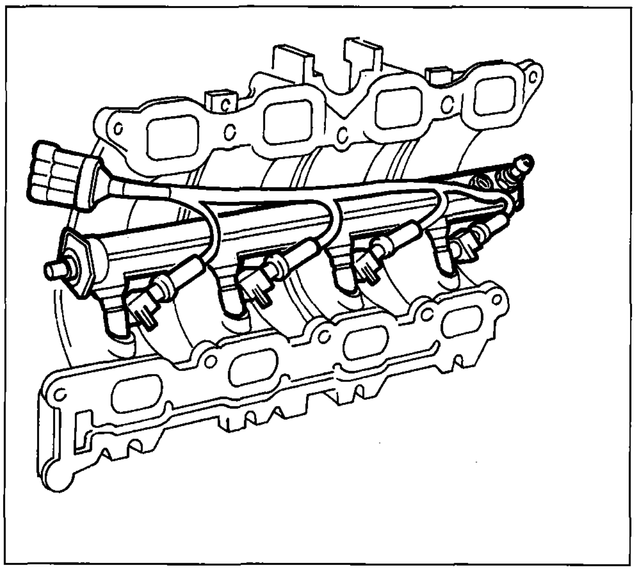

P4A391J03

Disconnect the wiring connection for the pump and fuel gauge sender unit.

Disconnect the fuel delivery pipe.

Undo the ring nut securing the fuel pump to the tank using tool 1860893000 and a ring spanner.

Remove the electric fuel pump assembly.



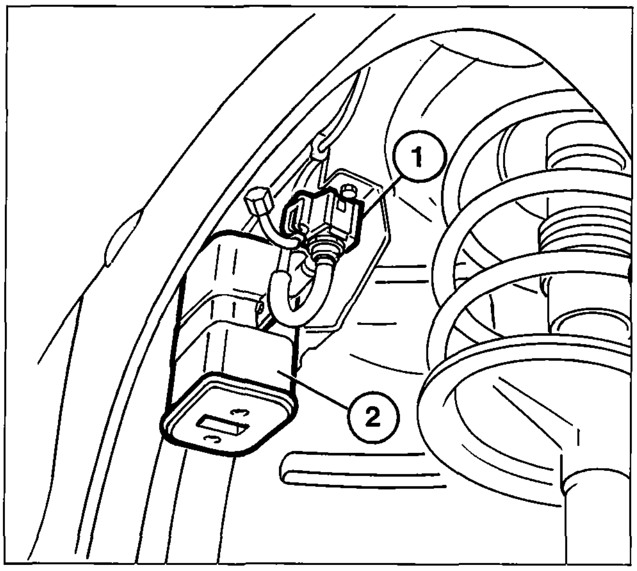
P4A40IJ01

## FUEL MANIFOLD (CB 168)

The fuel manifold is secured to the inside of the inlet manifold, and its function is to send fuel to the fuel injectors.

The fuel manifold is die-cast aluminium and it comprises the seats for the fuel injectors.

The fuel inlet comprises a tapered sealing screw.

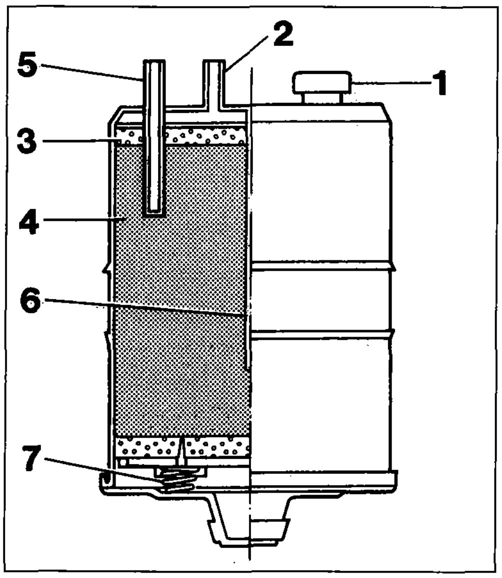



## CHARCOAL FILTER AND FUEL VAPOUR CUT-OFF VALVE

These components form part of the fuel vapour anti-evaporation and recycling system. They are located in the right wheelarch, and to access them the rear section of the trim in the front right wheelarch should be removed.

1. Fuel vapour cut-off solenoid

2. Charcoal filter




P4A40IJ02

### Charcoal filter

This consists of charcoal granules (4) which retain the fuel vapours entering through the connection (5).

The scrubbing air which enters through the connection (1), passing through the paper filter (3), envelops the charcoal granules, removing the petrol vapours and conveying them towards the outlet (2) and then to the cut-off valve.

The air, which comes in through the connection (5), can also be recalled by the vacuum in the tank, so ventilating it. The partition (6) ensures that the scrubbing air drawn in envelops all the charcoal granules, encouraging the release of petrol vapours to the inlet manifold.

There are also two springs (7) which allow expansion of the mass of granules when the pressure increases.

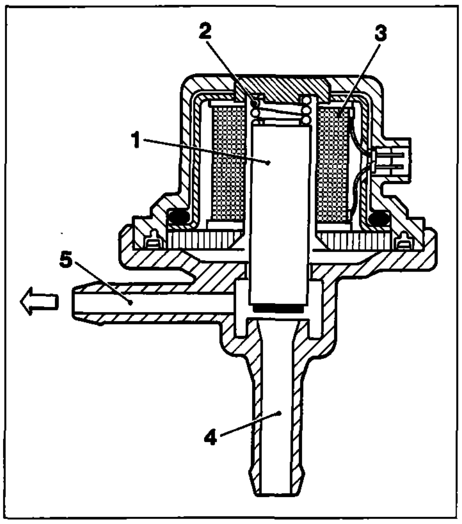
### Fuel vapour cut-off solenoid (EC1)

The function of this valve is to control, via the fuel injection-ignition electronic control unit, the quantity of fuel vapours drawn in by the activated charcoal filter and directed to the inlet manifold.

If there is no supply, this valve is in the closed position, preventing the fuel vapours from making the mixture excessively rich.
Its operation is controlled by the electronic fuel injection-ignition as follows:

- during starting, the solenoid remains closed, preventing the fuel vapours from making the mixture too rich; this condition remains until the coolant reaches a pre-established temperature (about 65 °C)

- with the engine up to temperature, the electronic control unit sends a square-wave signal to the solenoid, which modulates aperture depending on the full/empty ratio of the signal.
  In this way the control unit controls the quantity of fuel vapours sent to the inlet manifold, thus avoiding significant changes in mixture strength.



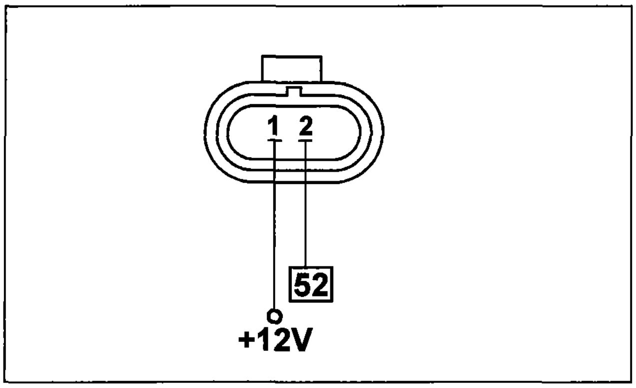
P4A411J01

In the operating conditions listed below:
- throttle in idle position
- engine speed below 1500 rpm
- bottom inlet manifold pressure at a limit value calculated by the control unit in accordance with the rpm

the solenoid control is inhibited, and the solenoid is kept in the closed position, to improve engine operation.

**Longitudinal section of fuel vapour cut-off valve**

1. Valve core.
2. Counter spring.
3. Magnetic winding.
4. Pipe connected to inlet manifold.
5. Pipe connected to activated charcoal filter.



P4A411J02

**Wiring connector**

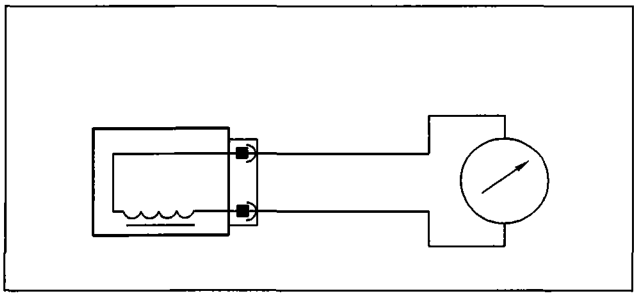
The numbers in boxes indicate the corresponding control unit pins.

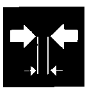
**Recovery**

Solenoid control is inhibited.

Self-adaptivity of fuel vapour recirculation is inhibited.

Self-adaptivity of mixture strength is inhibited.


P4A411J03



**Checking the resistance**

The solenoid's resistance can be measured by disconnecting the connector and connecting an ohmmeter as shown in the figure.

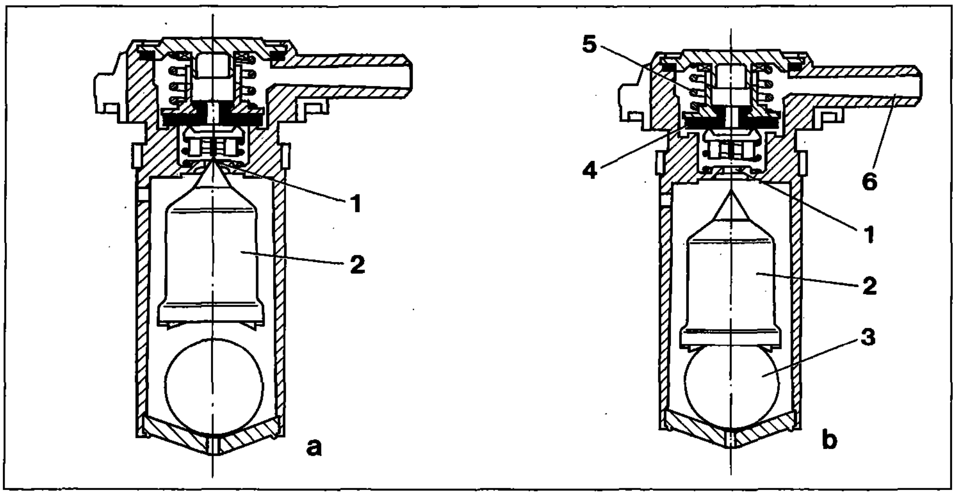
**Resistance: 17.5 - 23.5 ohm to 20 °C**

**MULTI-FUNCTION VALVE (SIRIO 0175.00)**

This valve is used for carrying out various functions, such as:
- prevent the passage of liquid fuel, when the tank is too full or if the vehicle overturns in an accident;
- permit the venting of fuel vapours towards the activated charcoal filter;
- permit ventilation of the tank if it contains a vacuum.

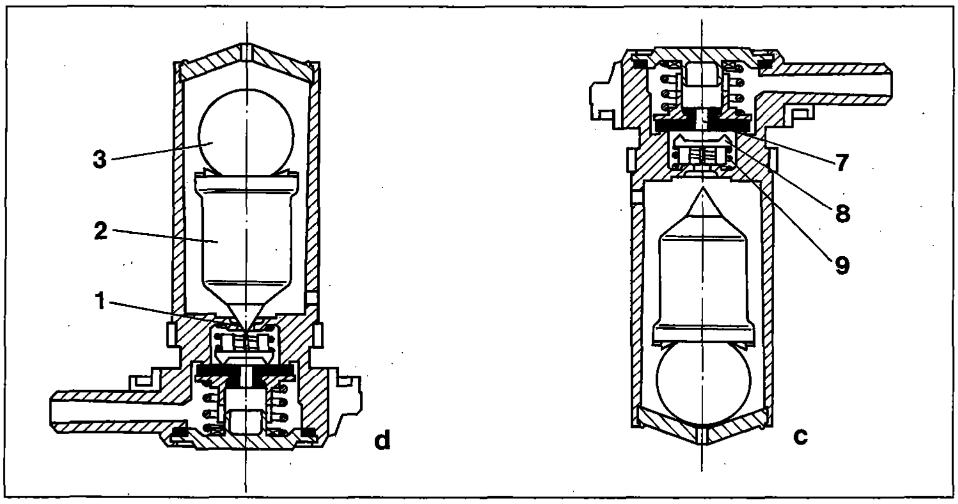
The valve consists of a float (2), a heavy ball (3), a plate (4) pushed home against the valve body by the spring (5), a shim (8) pushed home against the plate (4) by the spring (9). The operation of the multi-function valve may be summarized in the following cases, depending on how full the fuel tank is:

a. if the tank is full, the float (2) blocks the hole (1), preventing the liquid fuel from reaching the activated charcoal filter, thus preventing damage to the latter;
b. if the fuel level falls, the float (2) descends and rests on the ball (3), opening the hole (1); when the pressure exerted by the fuel vapours on the plate (4) exceeds the load of the spring (5), a ring-shaped gap opens between the plate and the valve casing, which allows the fuel vapours to emerge from the pipe (6) and reach the activated charcoal filter;

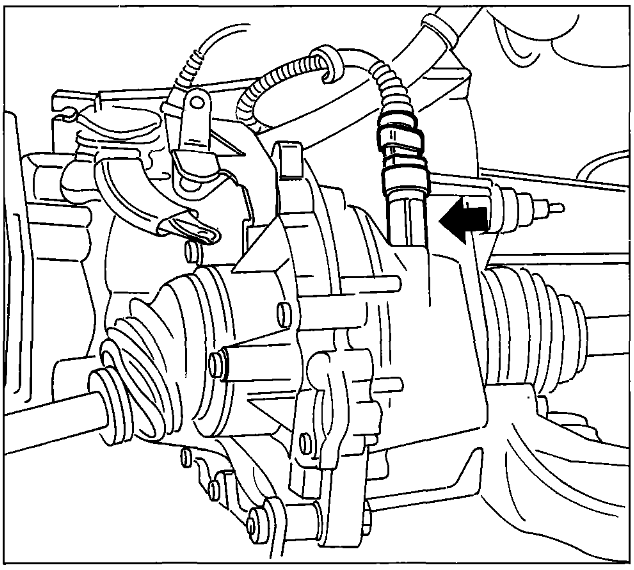



P4A42IJ01 P4A42IJ02

c. if the reduction in fuel level in the tank is such that it creates a vacuum in the tank, this vacuum acts on the plate (8) and, overcoming the load on the spring (9), recalls it downwards, allowing the tank to ventilate through the hole (7);
d. if the vehicle overturns, however full the tank is, the ball (3), weighing down on the float (2), pushes the latter against the hole (1), preventing dangerous leakage of fuel and resulting risk of fire.




P4A42IJ03 P4A42IJ04

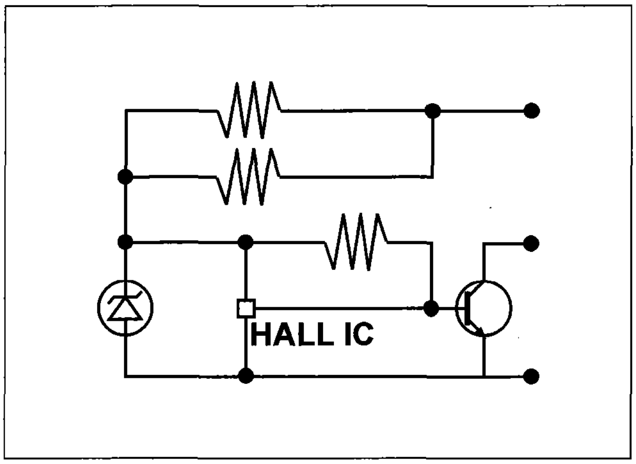


P4A431J01

## VEHICLE SPEED SENSOR (SOGECO)

The sensor is positioned at the differential output, near the left drive shaft coupling, and it transmits to the control unit the vehicle speed information: the signal is also used for the operation of the speedometer.

The sensor is of the Hall-effect type (see "timing sensor" sub-section), and transmits 16 pulses/revolution; thus the vehicle speed can be obtained on the basis of the pulse frequency.




P4A431J02

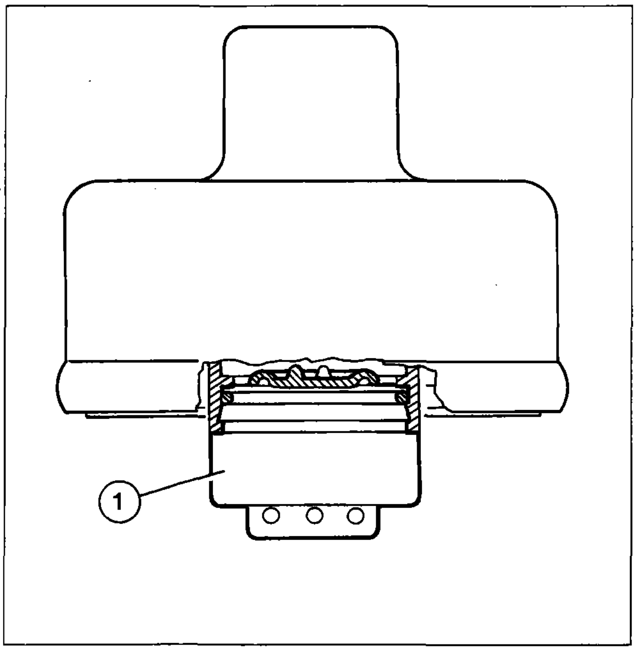
### Removing - refitting

Disconnect the wiring connection and remove the sensor.

**Tightening torque 0.8 daNm**

### Wiring diagram

## SAFETY AND VENTILATION VALVE




P4A431J03

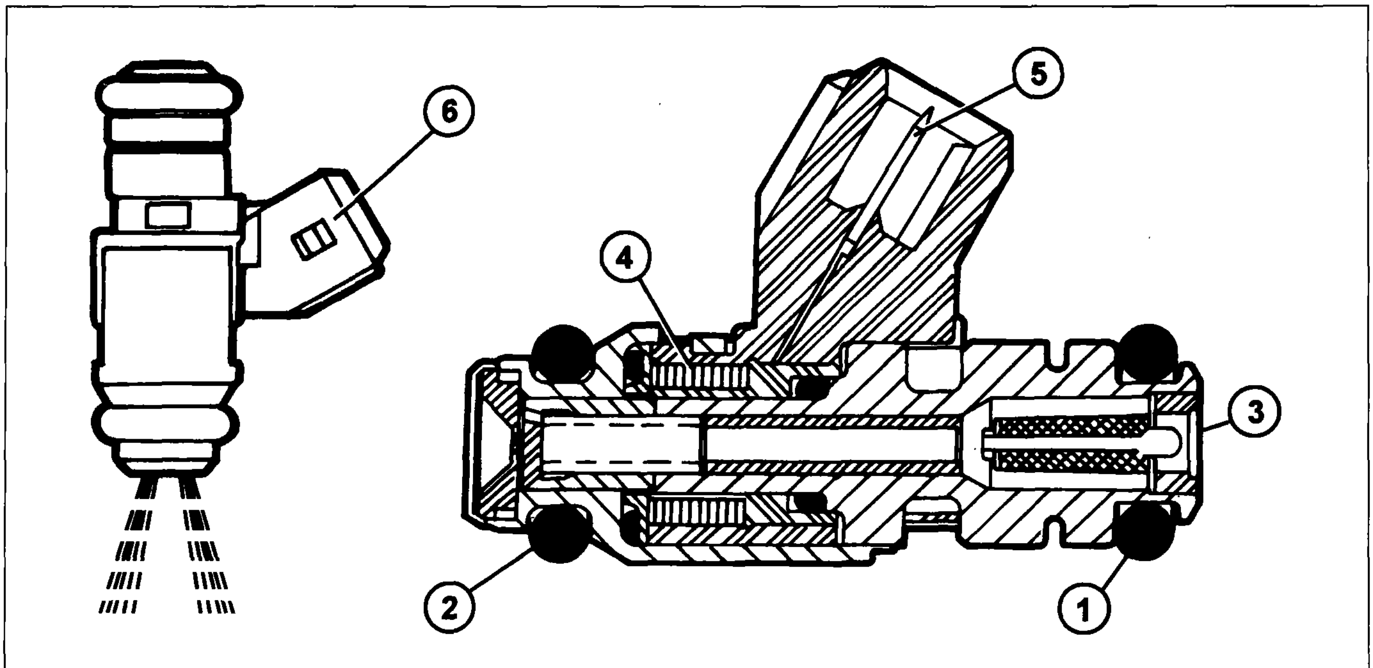
This valve is located in the fuel filler and it performs the following functions depending on the pressure in the tank:

- When the pressure inside the fuel tank exceeds 0.13 - 0.18 bar, it discharges the surplus vapours to the outside (safety function).
- If instead there is a vacuum in the tank of 0.020 - 0.030 bar, it allows air to enter (ventilation function).

## FUEL INJECTORS (IWP 064)

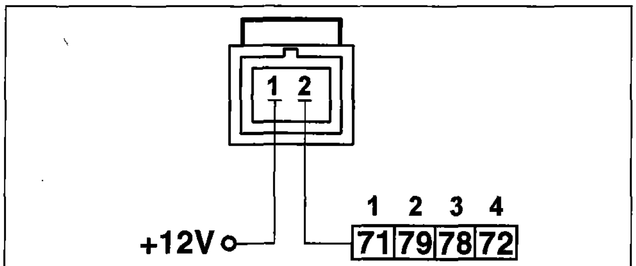
The fuel injectors are of the double jet "top-feed" type (with spray angled in relation to the injector axis). They are specific to engines with 4 valves per cylinder, and enable the jets to be directed towards the two inlet valves.
The jets of fuel at a differential pressure of 3 bar emerge from the injector, are instantly atomized and form two propagation cones.
The control logic of the injectors is of the "phased sequential type"; in other words the four injectors are driven in accordance with the intake sequence of the engine's cylinders, while delivery may start for each cylinder at the expansion stage up until the intake stage already started.
The injectors are fixed by the fuel manifold, which presses them into their seatings in the inlet pipes. They are also anchored to the fuel manifold by means of "safety stops". Two Viton rubber rings (1) and (2) ensure the seal on the inlet pipe and fuel pipe.
The fuel is supplied from the top (3) of the injector, whose body contains the winding (4) connected to the terminals (5) of the wiring connector (6).

**NOTE** *During removal and refitting, do not apply stresses exceeding 120 N on the connector (6) of the injector in order not to impair its operation.*




P4A44IJ01

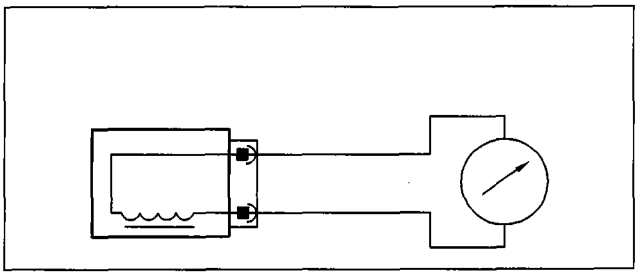
**Wiring connector**




P4A44IJ02

**NOTE** *The numbers in boxes indicate the corresponding control unit pins positioned in the order of cylinder numbers.*

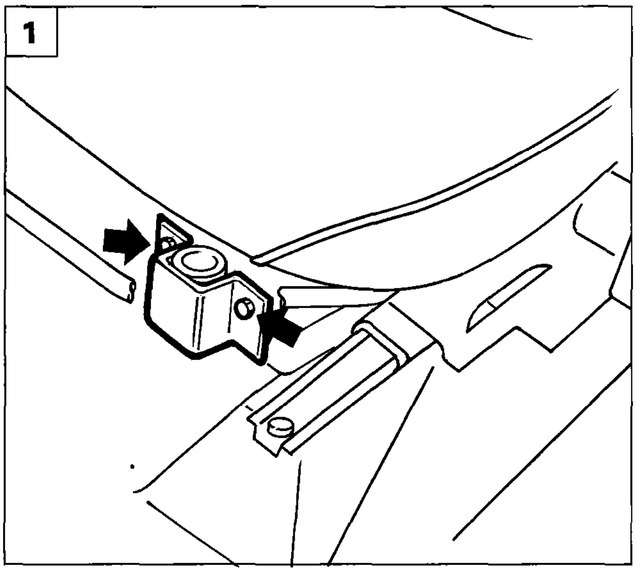
**Check the resistance**



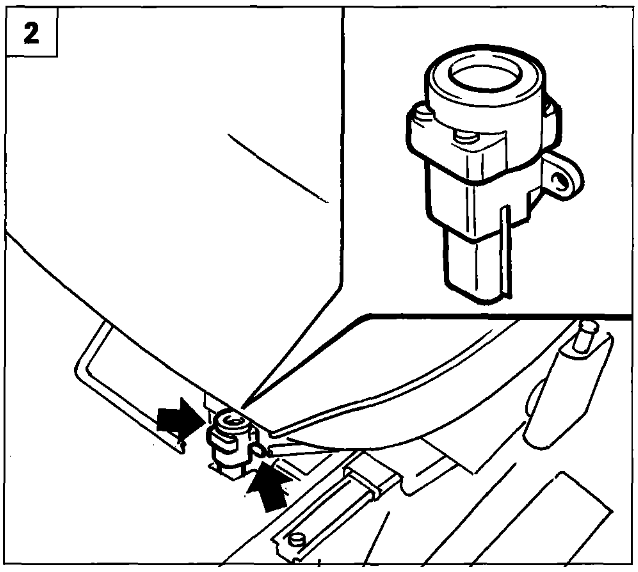
P4A41IJ03

The injector's resistance can be measured by disconnecting the connector and connecting an ohmmeter as shown in the figure.

**Resistance: 13.7 - 15.2 ohm at 20 °C**



P4A451J01



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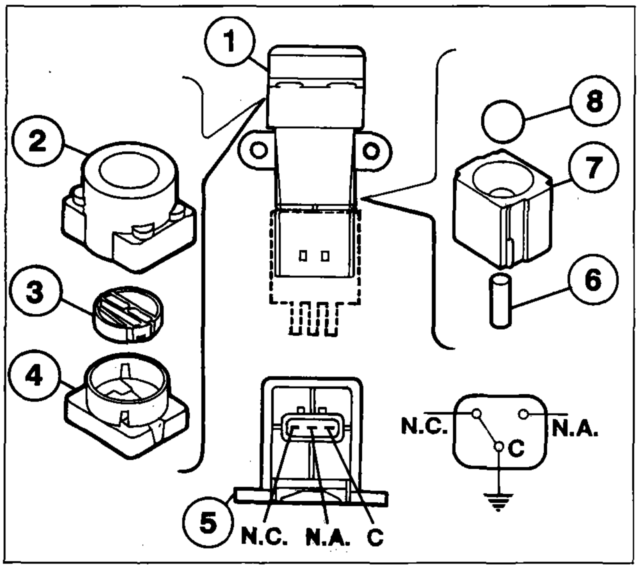


P4A451J03

## INERTIAL SAFETY SWITCH

In order to increase the safety for the vehicle's occupants in a crash, the car has an inertial switch located in the interior compartment under the driver's seat.

This sensor reduces the possibility of fire (caused by fuel leaking from the fuel injection system) by disabling the fuel pump which feeds the injection circuit.
The switch consists of a steel ball mounted in a housing (conical seating) and held in position by the force of attaction of a permanent magnet.
In the event of a violent crash of the vehicle, the ball is released from the magnetic stop and it opens the normally closed (N.C.) electrical circuit, interrupting the earth connection of the fuel pump and consequently the feed to the fuel injection system.

To restore the fuel pump's earth connection, push back the seat and press on the switch until you hear it engage.

### Removing-refitting

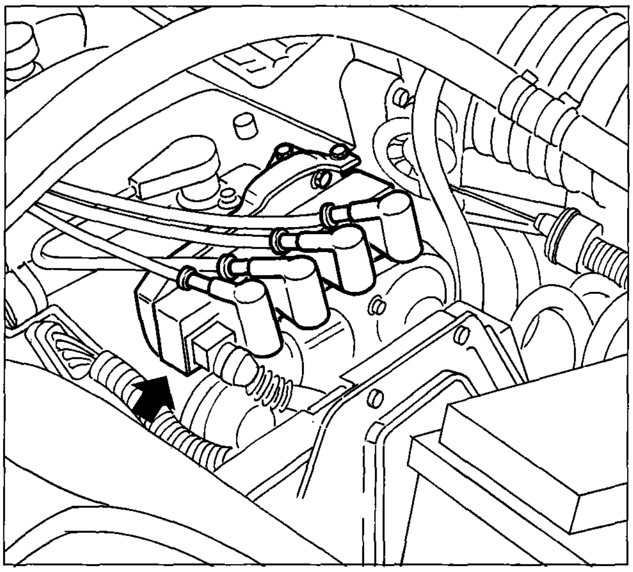
1. Push the driver's seat back fully, undo the bolts indicated and remove the plastic cover.
2. Undo the bolts indicated, disconnect the wiring connection and remove the switch.

*After a crash, even if apparently minor, if the smell of fuel is perceived or there are leaks from the fuel system, do not reset the switch until you have found and eliminated the fault, in order to avoid the risk of fire.*

### Components constituting the inertial switch

1. Complete inertial switch
2. Sheath
3. Button
4. Top
5. Engagement side.
6. Permanent magnet
7. Permanent magnet seating
8. Steel ball

C= Shared terminal
N.C. Normally closed
N.A. Normally open



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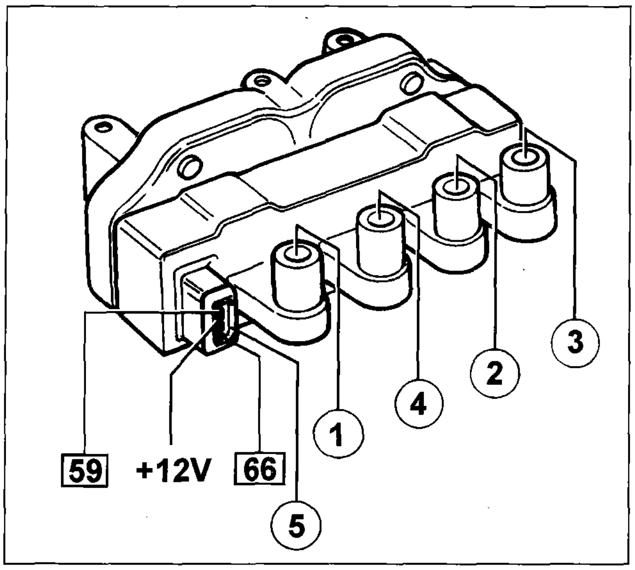
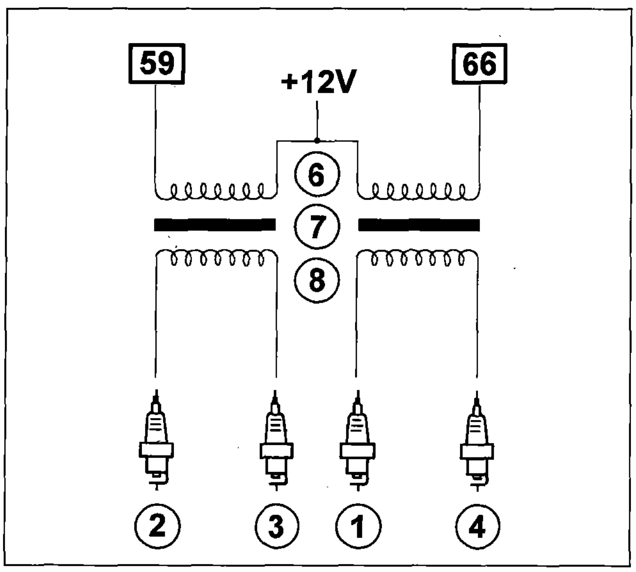



P4A46IJ02




P4A46IJ03

## IGNITION COILS
**(Bae 920A)**
**(Beru 0.040.100.029)**

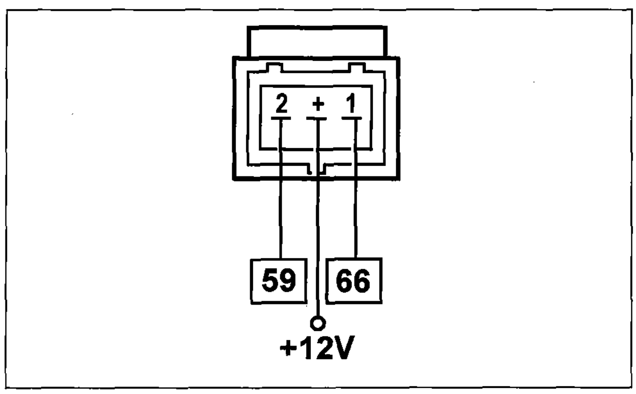
The coils are bracketed onto the camshaft covers; they are of the closed magnetic circuit type, formed by a segment pack whose central core, broken by a thin gap, carries both windings.

The windings are located in a moulded plastic container and encapsulated in an epoxy resin and quartz compound which gives them exceptional dielectric, mechanical and thermal properties, as they can withstand high temperatures. The vicinity of the primary to the magnetic core reduces magnetic flow losses, ensuring maximum connection to the secondary.

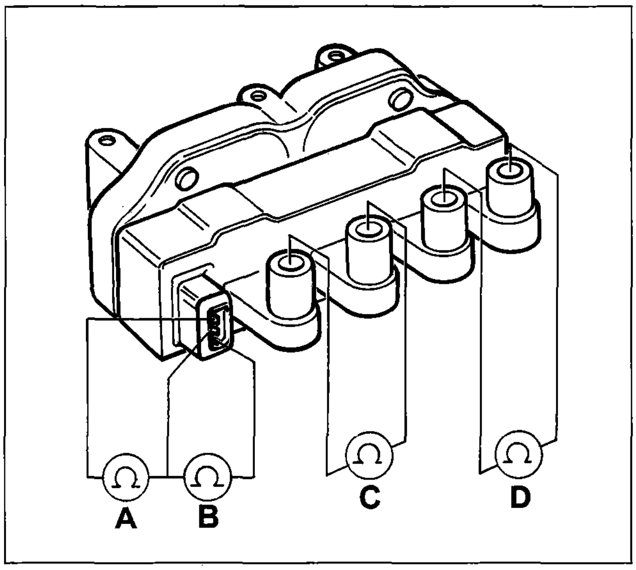
1. H.T. connector for cylinder 1 plug
2. H.T. connector for cylinder 2 plug
3. H.T. connector for cylinder 3 plug
4. H.T. connector for cylinder 4 plug
5. L.T. connector for control unit connection
6. Primary circuit
7. Gap
8. Secondary circuit

### Wiring connector

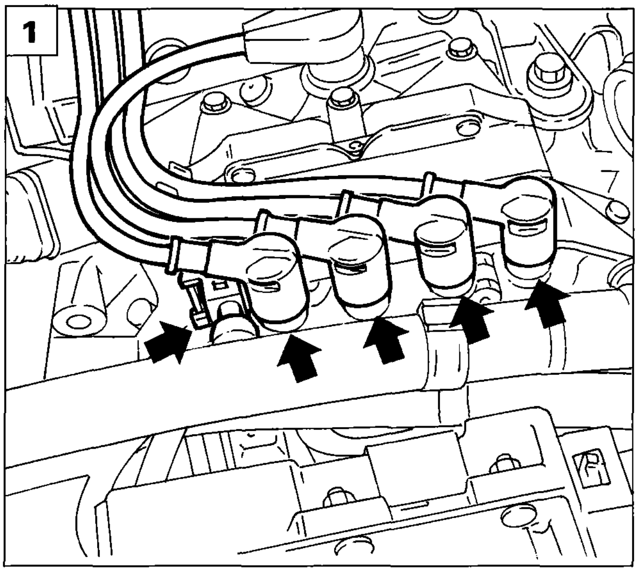
**NOTE** *The numbers in boxes indicate the corresponding control unit pins.*




P4A46IJ04




P4A471J01

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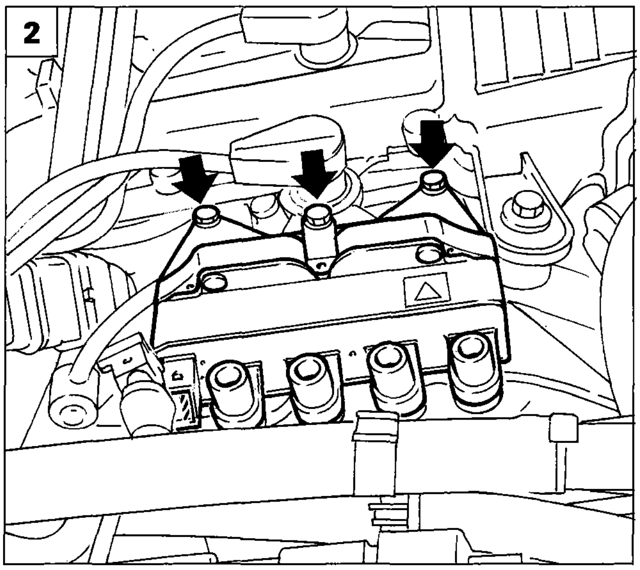



P4A471J03

**Checking winding resistance**

**Primary circuit (A cylinders 1-4, B cylinders 2-3)**

Place the leads of an ohmmeter in contact with the positive terminal (central pin) and negative terminal (pin 1 for circuit A and pin 2 for circuit B).

The resistance of the primary circuit read on the instrument must be between 0.44 and 0.53 ohm at 23°C.

**Secondary circuit (C cylinders 1-4, D cylinders 2-3)**

Connect the leads of an ohmmeter between the two high-tension output terminals.

The resistance of the secondary circuit read on the instrument must be between 4500 and 5500 ohm at 23 °C.

**Recovery**

*Inhibition of the injectors corresponding to the cylinders where there is no ignition.*

Open-loop check of mixture strength.

If there is a short circuit to positive, the command in progress is disabled and there is a retry.

In the case of open circuit or short circuit to earth, a fixed charge time is assumed.

**Removing refitting**

1. Disconnect the high-tension cables and wiring connector from the ignition coils assembly.
2. Undo the bolts (arrowed) and remove the ignition coils.

**LAMBDA PROBE (NTK 0ZA334-A1)**

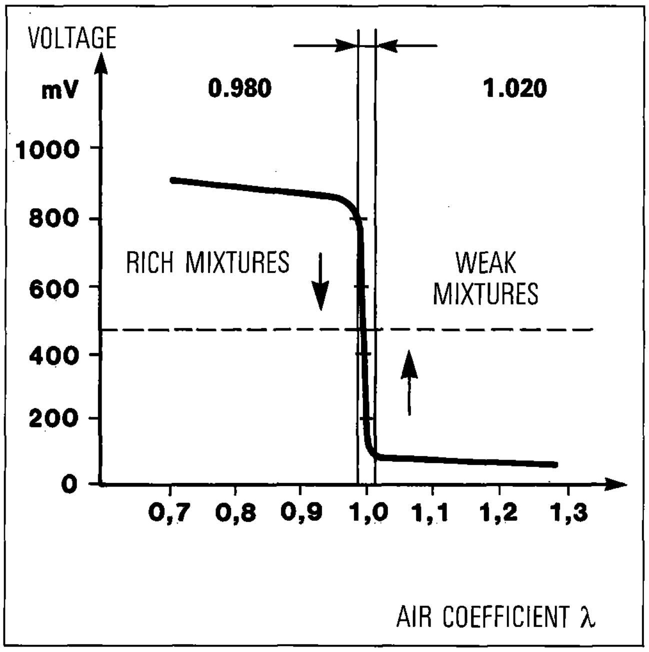
This is the sensor which measures the oxygen content in the exhaust gases.

The sensor's output signal is sent to the electronic control unit to adjust the air-petrol mixture, in order to maintain the mixture's stoichiometric ratio as close as possible to the theoretical value.

To obtain an optimum mixture, the quantity of fuel injected must be as close as possible to the theoretical quantity which would be required to be fully burnt in relation to the quantity of air drawn in by the engine.

In this case the Lambda ($\lambda$) factor is 1; in fact:

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




P4A48IJ01

$\lambda$= 1 Ideal mixture
The CO is within legal limits

$\lambda \geqslant$ 1 Weak mixture
Excess air; the CO tends to be low

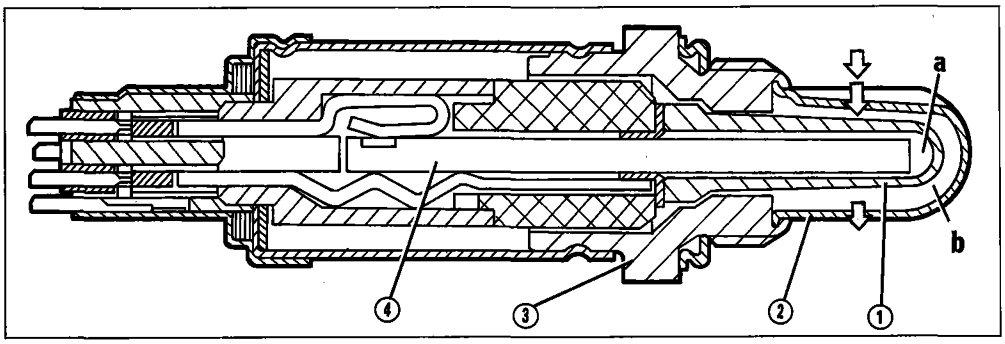
$\lambda \leqslant$ 1 Rich mixture
Lack of air; the CO tends to be high

**NOTE** *While the coefficient $\lambda$ expresses the excess or shortfall of air supplied to the engine in relation to the value theoretically required, the air-petrol mixture is a ratio between these two substances which, combined together, react chemically. For today's engines, this means that they require 14.7-14.8 parts of air to burn 1 part petrol.*

The probe is mounted upstream of the catalytic converter.

This consists of a ceramic casing (1) based on zirconium dioxide, covered with a thin layer of platinum closed at one end, inserted in a protective pipe (2) and housed in a metal casing (3), which provides further protection and permits assembly onto the exhaust manifold. The outer part (B) of the ceramic is exposed to the exhaust gas current, while the inner part (A) communicates with the ambient air.

The operation of the probe is based on the fact that at temperatures exceeding 300°C, the ceramic material becomes a conductor of oxygen ions. Under these conditions, if the quantitiy of oxygen on the two sides (A and B) of the probe is in different percentages, a voltage variation between the two ends is generated, which is an indicator of the difference in quantity of oxygen in the two environments (air side and exhaust gas side).




P4A491J01

a. Electrode (+) in contact with the external air
b. Electrode (-) in contact with the exhaust gases
1. Ceramic casing
2. Protective pipe
3. Metal casing
4. Heating element

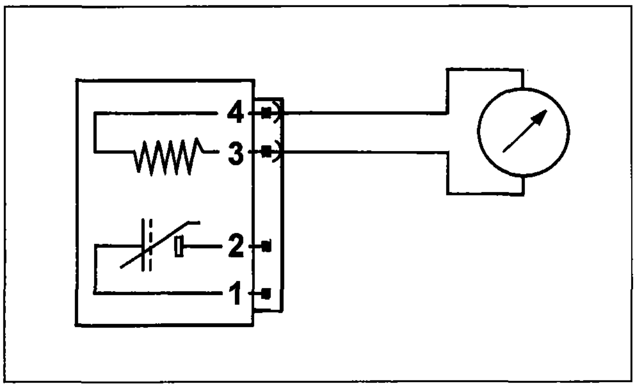
When the probe provides a low voltage level (below 200 mV), the control unit recognizes that the mixture strength is weak (lambda » 1) and increases the quantity of fuel injected. When the probe provides a high voltage level (over 800 mV), the control unit recognizes that the mixture strength is rich (lambda « 1) and reduces the quantity of fuel injected.

The Lambda probe thus varies the injection times so that the engine operates with a Lambda coefficient constantly fluctuating between about 0.980 and 1.020.

For temperatures below 300°C the ceramic material is not active, so the probe does not send usable signals and a particular circuit present in the control unit blocks the closed loop adjustment of the mixture strength during the warming up of the probe.

To ensure that operating temperature is quickly reached, the probe has a heating element (4) supplied by the battery.

*The probe can be quickly put out of service by even small quantities of lead in the fuel.*

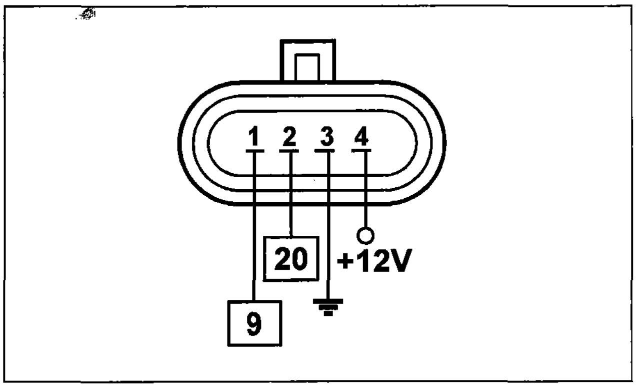



P4A491J02

**Checking the resistance**

The resistance of the heater and probe can be measured by disconnecting the connector and connecting an ohmmeter as shown in the figure.

**Heater resistance = 4.3 - 4.7 ohm**




P4A491J03

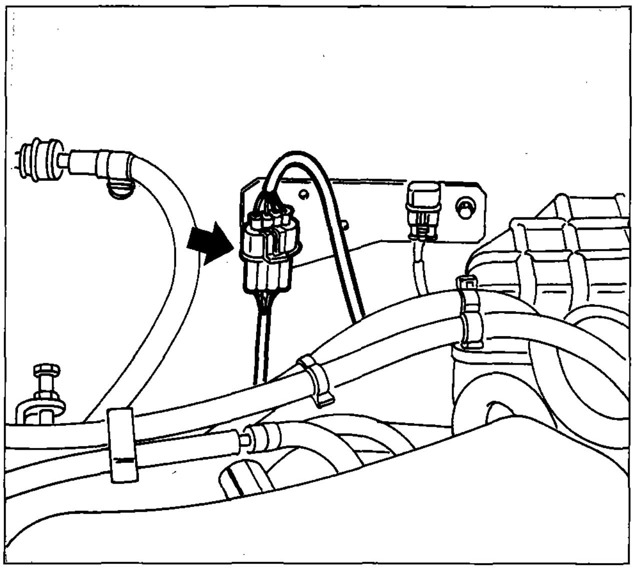
**Recovery**

The Lambda data are ignored (open loop).

**Wiring connector**

The numbers in boxes indicate the corresponding control unit pins.

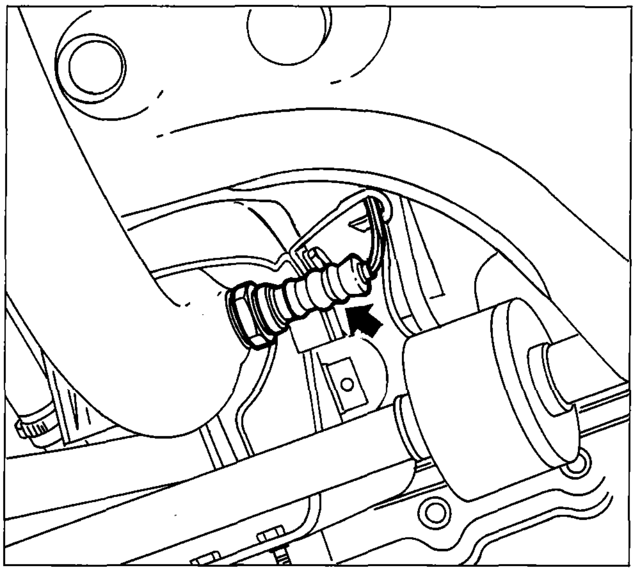
# 10.



P4A50IJ01

**Removing - refitting lambda probe**

- Place the car on ramps.
- Disconnect the battery's negative cable.
- Disconnect the wiring connector installed against the rear wall of the engine compartment.



P4A50IJ02

Remove the Lambda probe from its seating on the exhaust pipe.

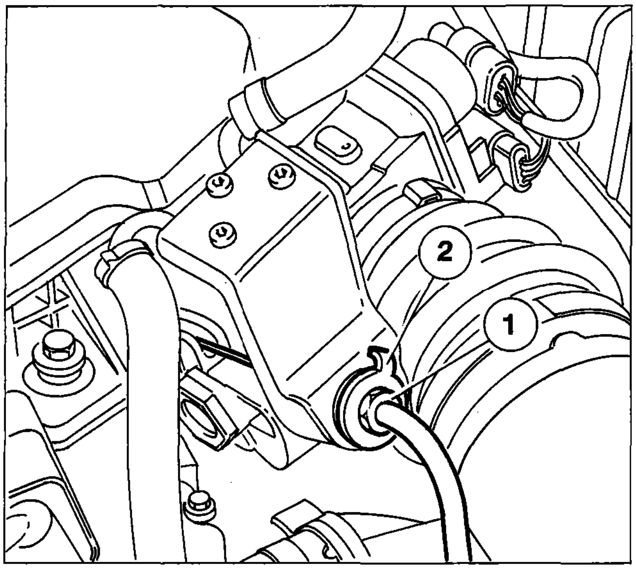
*When refitting, smear ANTISEIZE MATERIA-BORON NITRIDE N.G.K. SPARK PLUG CO-LTD. grease on the threaded part.*

**Tightening torque 3.5 - 4.5 daNm**

## CHECKS - ADJUSTMENTS AND REPAIRS ON THE FUEL INJECTION/IGNITION

*THE FOLLOWING INSTRUCTIONS SHOULD BE FOLLOWED WHEN WORKING ON A CAR FITTED WITH I.A.W. FUEL INJECTION-IGNITION:*
- *do not start the engine when the electrical connectors are connected incorrectly or are loose on the battery terminals;*
- *do not use a fast battery charger to start the engine;*
- *never disconnect the battery from the on-board network with the engine running;*
- *to fast charge the battery, first disconnect the latter from the on-board network;*
- *if the car is placed in a drying oven after painting at temperatures exceeding 80°C, remove the fuel injection-ignition electronic control unit;*
- *do not connect or disconnect the control unit's multi-connector with the ignition on;*
- *always disconnect the battery negative before carrying out electric arc welding on the car.*

*Remember that this system has a permanently supplied memory which stores the learnt self-adaptivity values of the engine idle speed actuator. Disconnecting the battery will lead to the loss of this information, so should be done as little as possible.*

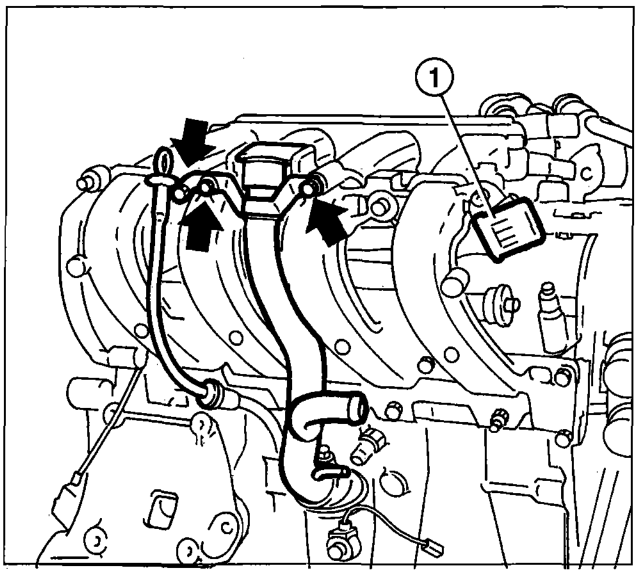



P4A51IJ01

### ADJUSTING THROTTLE CABLE

The throttle cable is adjusted by undoing the nut (1) and moving the clip (2).

Position the clip (2) so that the head of the throttle cable enters freely in the slot without changing the idle speed, then lock the nut (1).

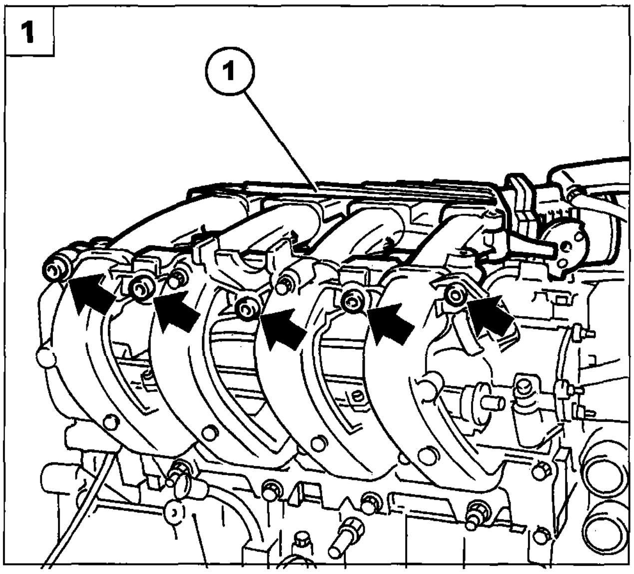



P4A51IJ02

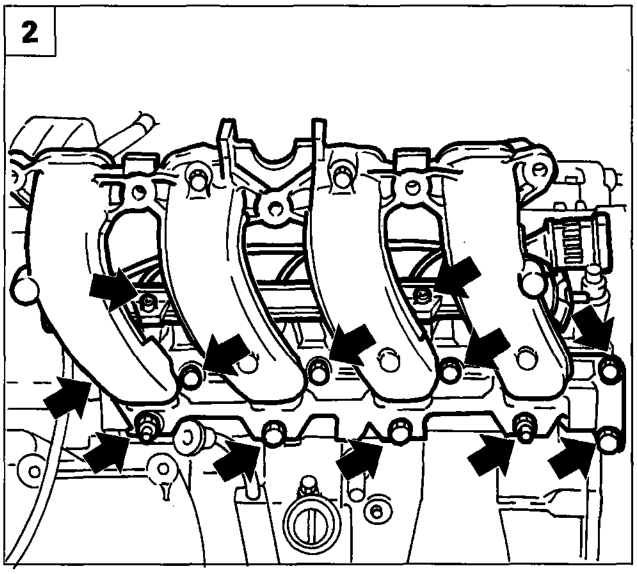
### REMOVING-REFITTING FUEL MANIFOLD AND FUEL INJECTORS

Remove the first section of the oil dipstick and oil filler pipe, then disconnect the injector cable connector (1).

# 10.




P4A521J01



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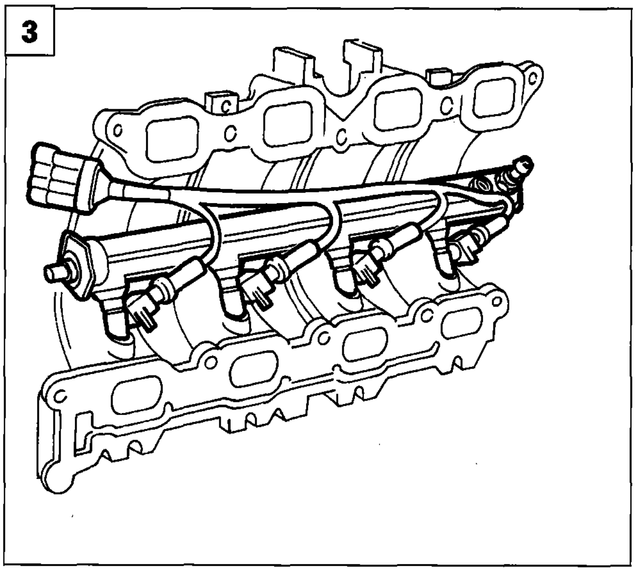

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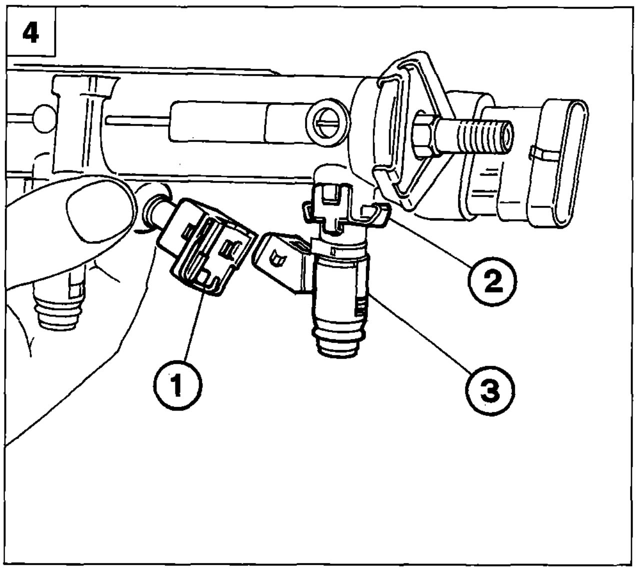


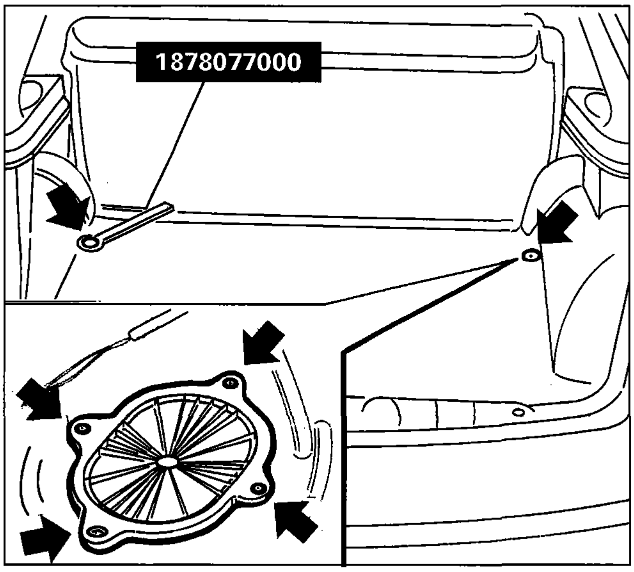

P4A521J03

1. Undo the bolts jointing the two sections of the inlet manifold and remove the first section (1).
2. Undo the bolts securing the fuel supply manifold and the bolts securing the second section of the inlet manifold to the engine block, and remove it.
3. Remove the fuel pipe and remove the manifold complete with fuel injectors.
4. Then remove the fuel injectors as follows:
   - Disconnect the electrical connector (1).
   - Remove the safety clip (2).
   - Remove the fuel injector (3), which is a press fit.

Never pull the electrical connector to remove the injector.

Before refitting, check the condition of the seals.

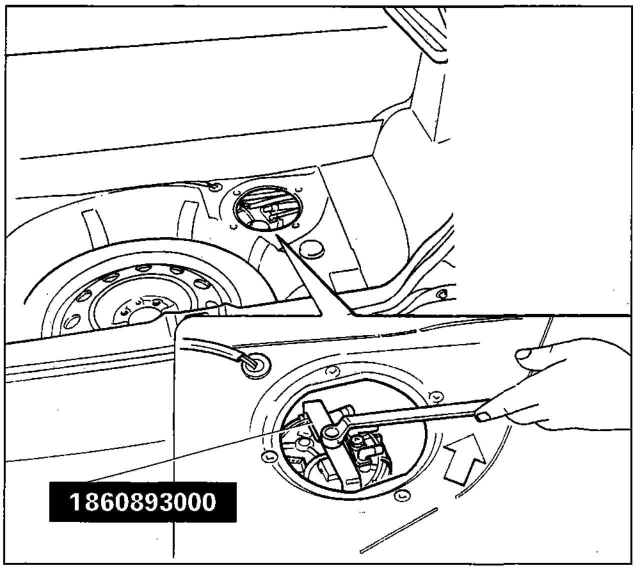
## REMOVING-REFITTING FUEL TANK




P4A39IJ02

Before removing-refitting the tank, drain the fuel, place the car on ramps and disconnect the battery's negative pole. Then proceed as follows:

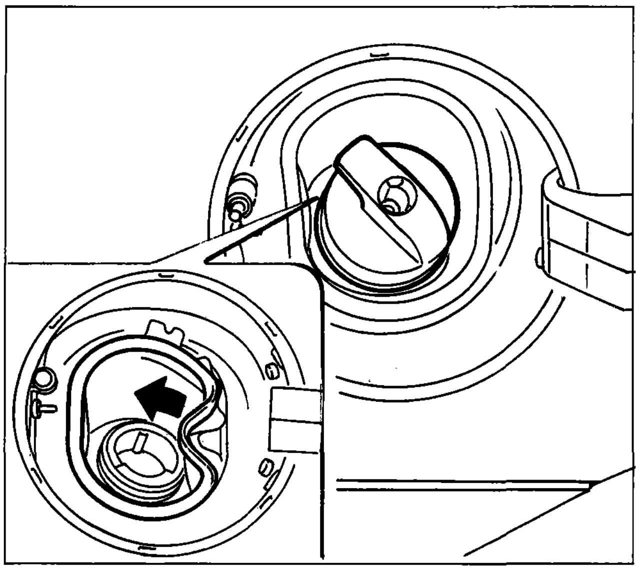
- Lift the boot trim after removing the retaining buttons using the wrench 1878077000. Remove the protective cover shown in the insert by undoing the attachment screws.




P4A39IJ03

- Disconnect the wiring connections from the pump and fuel gauge sender unit. Disconnect the vent pipe (1) by undoing the retaining nut, and the fuel return pipe (2) and delivery pipe (3) by undoing the retaining clips.

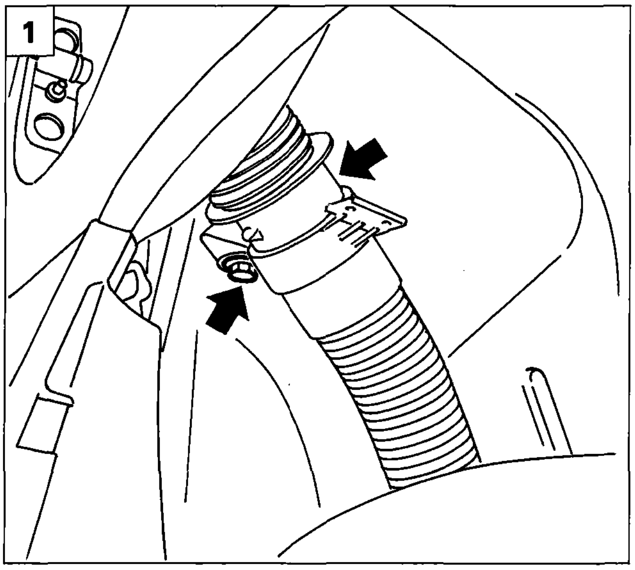
- Undo the ring nut securing the electric pump to the tank using tool 1860893000 together with a ring spanner.



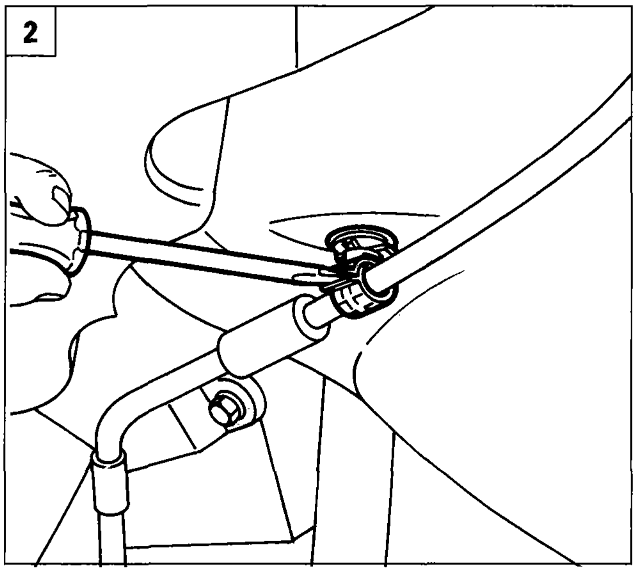
P4A53IJ01

- Undo the cap and remove the fuel filler gaiter from its seating.

# 10.



P4A541J01



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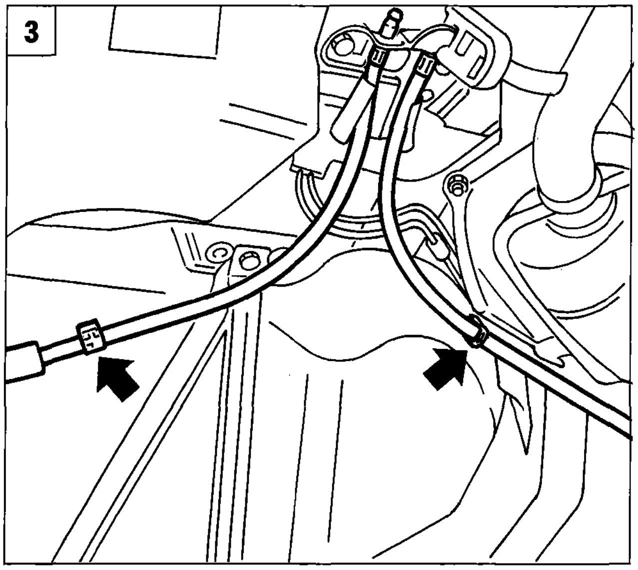

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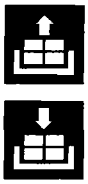
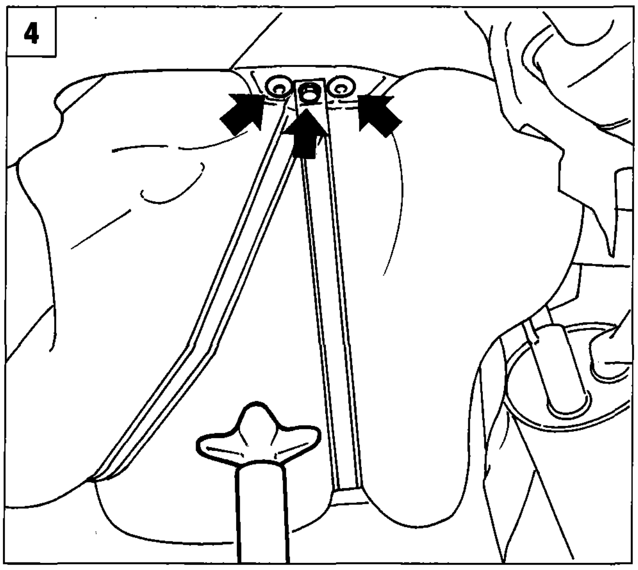


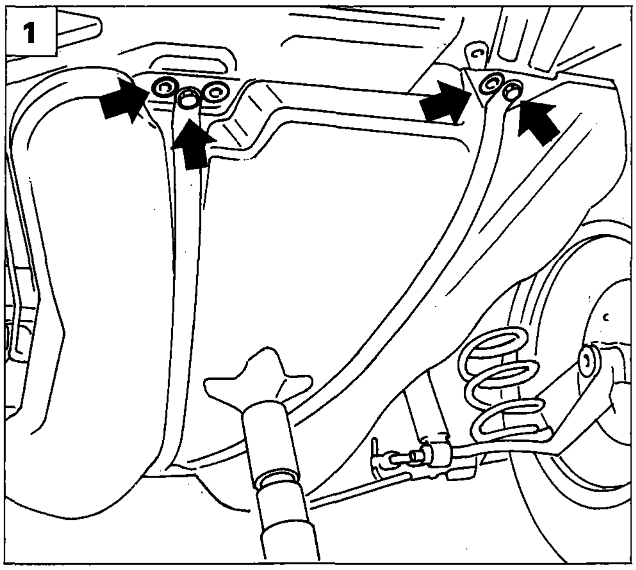
1. Remove the bolt (arrowed) and plug securing the fuel filler to the bodywork.

2-3. Open the clips shown by the arrows and release the handbrake cables from the attachments on the fuel tank.

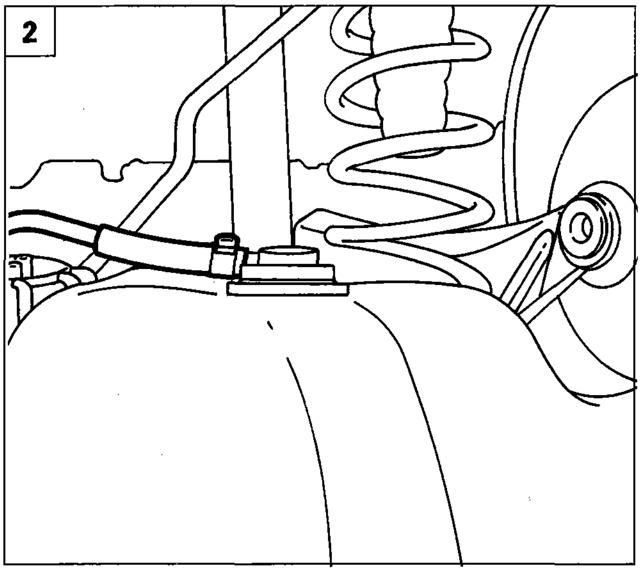
4. Place a suitable hydraulic jack under the tank, to support it during removal-refitting. Then remove the bolt and front plugs securing the tank to the bodywork.



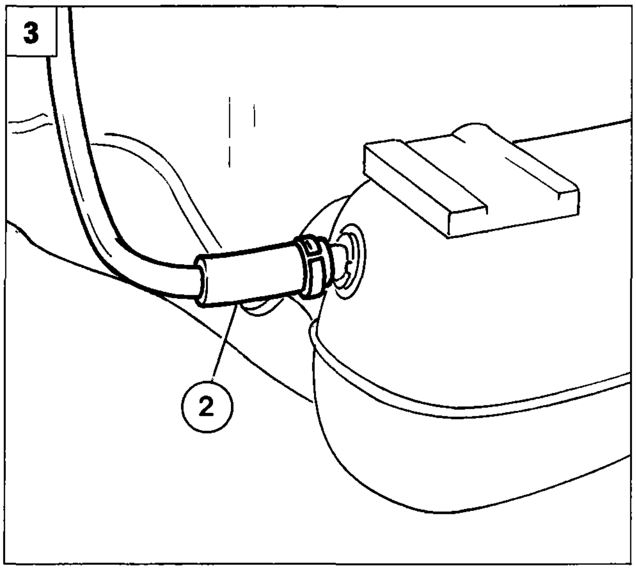
P4A541J04




P4A551J01




P4A551J02

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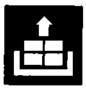
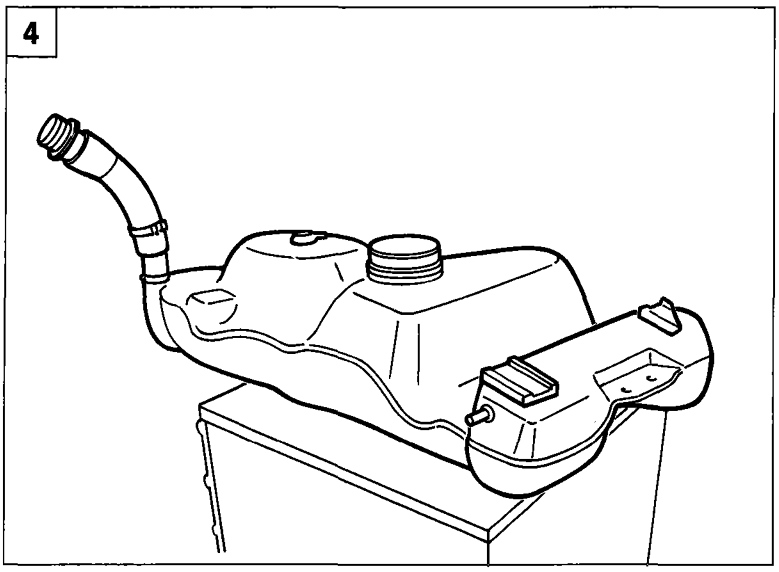


1. Remove the bolts and rear plugs securing the tank to the bodywork.

2. Gradually lower the hydraulic jack, checking that the tank is correctly balanced, then disconnect the fuel vapour recovery pipe.

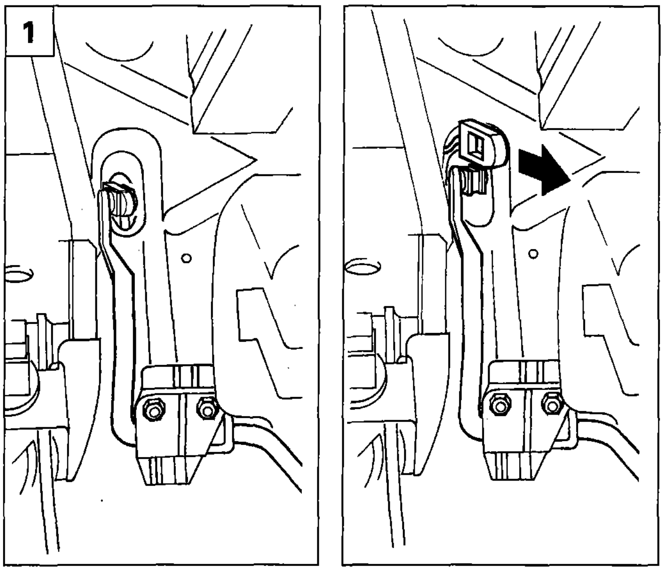
3. If necessary, also disconnect the vent pipe (2) on the tank.



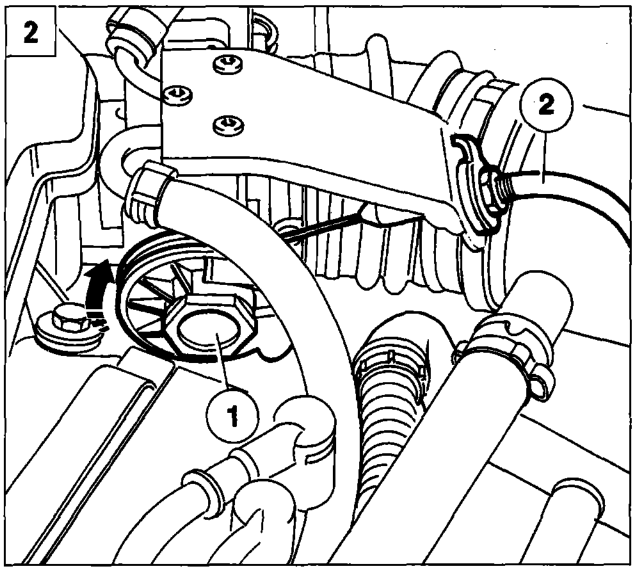

P4A551J04

4. Fuel tank.

# 10.




P4A56IJ01 P4A56IJ02

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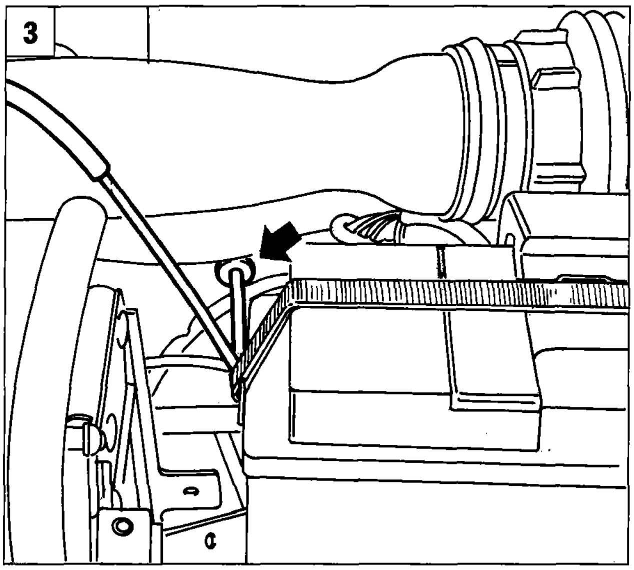


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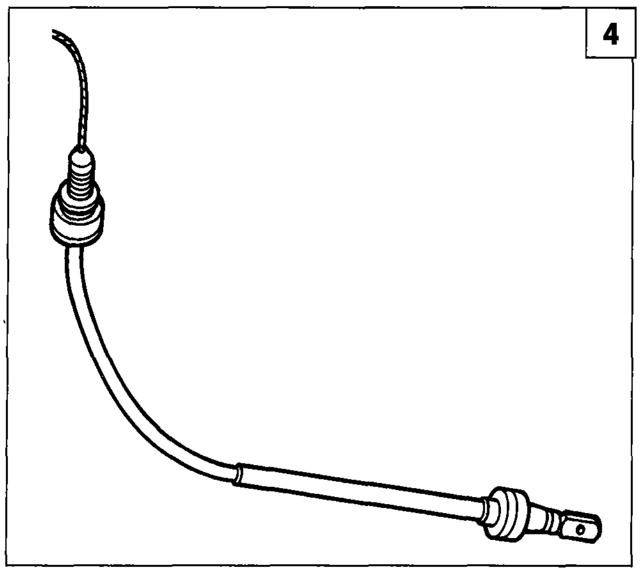



P4A56IJ05

## REMOVING-REFITTING THROTTLE CABLE

Disconnect the battery lead then proceed as described below:

1. Working from inside the car, disconnect the throttle cable from its attachment on the accelerator pedal.
2. In the engine compartment, rotate the throttle valve lever (1) and disconnect the throttle cable. Then withdraw the cable (2) from the mounting bracket.
3. Withdraw the rubber buffer from the anchorage hole on the bulkhead wall, and withdraw the complete throttle cable.

4. Complete throttle cable.

*When fitting, adjust the throttle cable as described in the "Adjusting throttle cable" section.*

## CHECKING ENGINE IDLE SPEED

If the engine idle speed is not 850 ± 50 rpm, and as the fuel injection-ignition is self adjusting, no adjustments can be made, so it is not necessary to check the correct adjustment of the throttle linkage. Faults should therefore be sought by means of full diagnosis using the Fiat/Lancia Tester.

## CHECKING CONCENTRATION OF POLLUTING EMISSIONS

Via the self-adaptivity of the system, the fuel injection-ignition ensures continuous control of the idle speed and CO level, thus rendering any external adjustment unnecessary (there are no adjustment screws). However, a relative check on the contents of the exhaust gases upstream and downstream of the catalytic converter can give useful information on the operating conditions of the fuel injection-ignition, the engine parameters or the catalytic converter.

### Checking CO and HC concentration during idling upstream of the catalytic converter

To check the concentrations of carbon monoxide (CO) and unburnt hydrocarbons (HC) upstream of the catalytic converter, proceed as follows:

1. Undo the plug or nut located on the exhaust pipe, upstream of the catalytic converter, and screw in the tool.
2. Connect the probe of a suitably calibrated CO tester to the tool.
3. Start the engine and bring it up to temperature.
4. Check that the rpm is correct.
5. Check that the CO concentration during idling is as specified in the table below; if not, check:
   - the correct operation of the Lambda probe using the Fiat/Lancia Tester;
   - the presence of air leaks in the area surrounding the Lambda probe seating;
   - the fuel injection and ignition system (**especially the state of wear of the spark plugs**).
6. Check under the same conditions that the HC concentration is below 600 p.p.m.
7. If these values are not found, tune the engine, checking the following in particular:
   - ignition advance;
   - valve clearances;
   - timing;
   - engine compression.

### Table of tolerances for polluting emissions

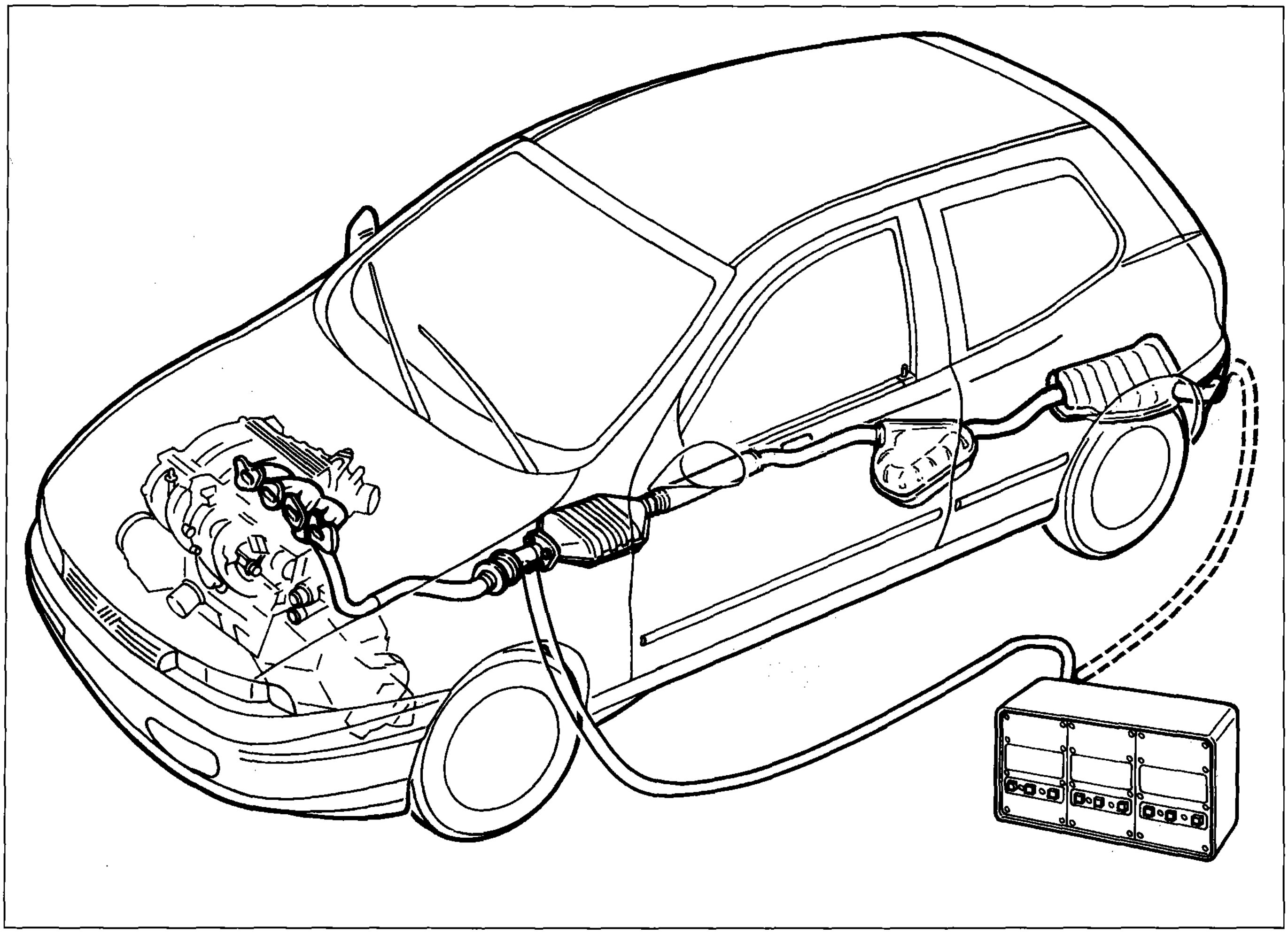
| | CO (%) | HC (p.p.m.) | $CO_2$ (%) |
|---|---|---|---|
| Upstream of catalyzer | 0.4 - 1 | 600 | $\geqslant$ 12 |
| Downstream of catalyzer | $\leqslant$0.35 | $\leqslant$90 | $\geqslant$ 13 |

**Checking CO and HC concentration in the exhaust**

The concentration of carbon monoxide (CO) and unburnt hydrocarbons (HC) in the exhaust is measured by inserting the probe of a suitably calibrated CO tester in the end of the exhaust pipe for at least 30 cm, as shown in the figure.

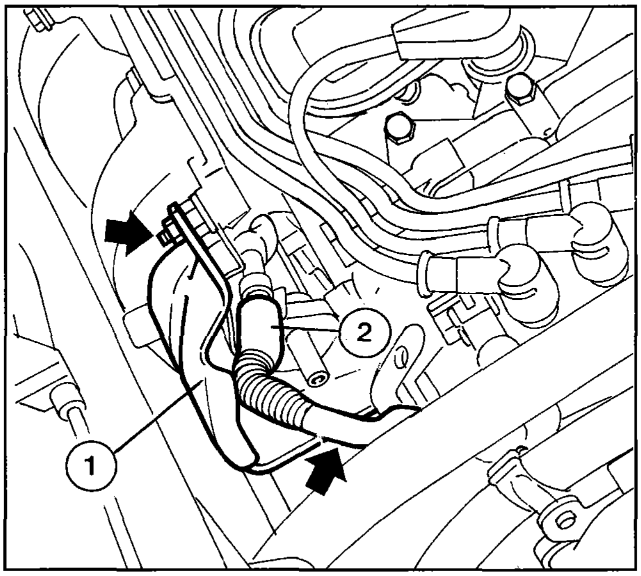
If the shape of the end of the exhaust pipe will not allow the probe to be inserted fully, add an appropriate extension tube which seals properly at the join.

1. Check that the CO and HC concentrations during idling are as specified in the table.
2. If the HC value is outside the specified limit, while the measurement upstream of the catalytic converter was correct, the engine parameters should be considered to be correct, and so the cause of the fault should be sought in reduced efficiency of the catalytic converter.



P4A58IJ01

## CHECKS TO FUEL SUPPLY CIRCUIT




4A59IJ01

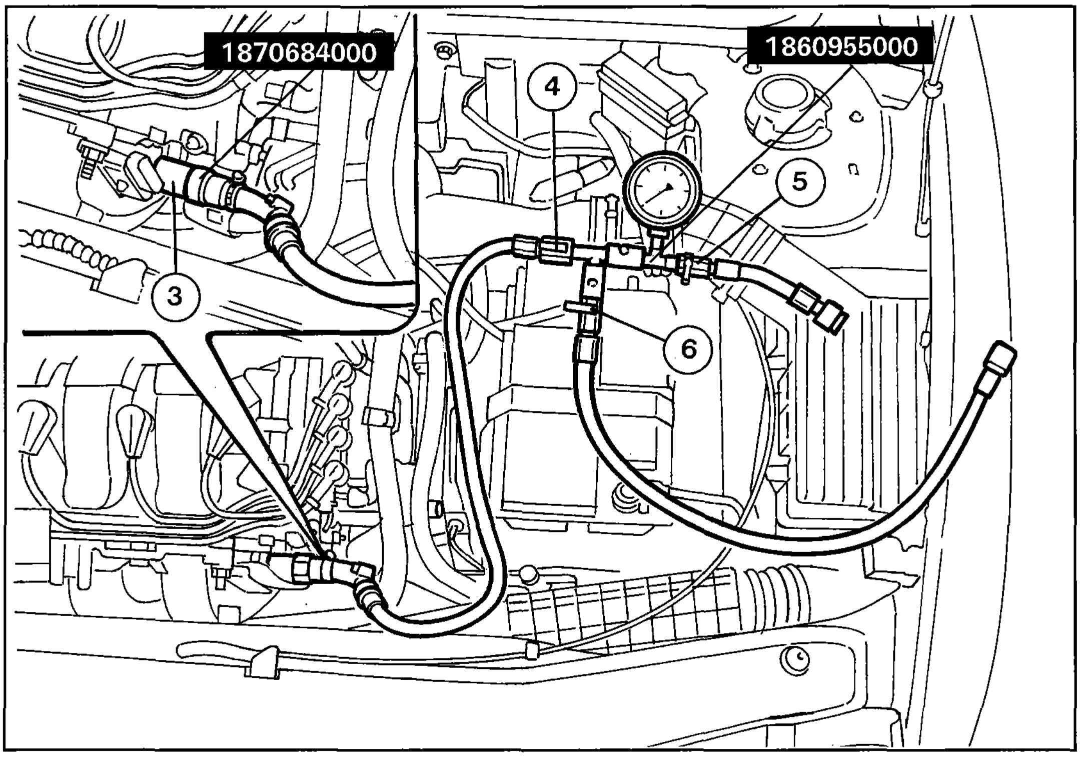
### Checking fuel supply pressure

Check fuel supply pressure as follows:

- unscrew the nuts indicated by the arrows and remove bracket (1);
- disconnect the injector supply connector (2);
- set cock (4) of tool 1860955000 to open position and cocks (5) and (6) to closed position;
- position tool 1860955000and connect to the fuel manfold using adaptor 1870684000 (3). Then reconnect injectorsupply connector (2);

**NOTE** *Tool 1860955000 comes with adaptors for connection to various types of injection system. Before connecting the system, set up the equipment using the appropriate adaptors.*

- start the engine and check that the reading on the pressure gauge remains stable at 3.5 bar ± 0.2 bar, then turn off the engine.
- operate the fuel pump with the engine off using a tester and running the fuel pump test while in active diagnosis mode.
- check the pressure is stable at 3.5 ± 0.2 bar;
- disconnect device 1860955000 from the fuel manifold and refit bracket (1).




4A59IJ02

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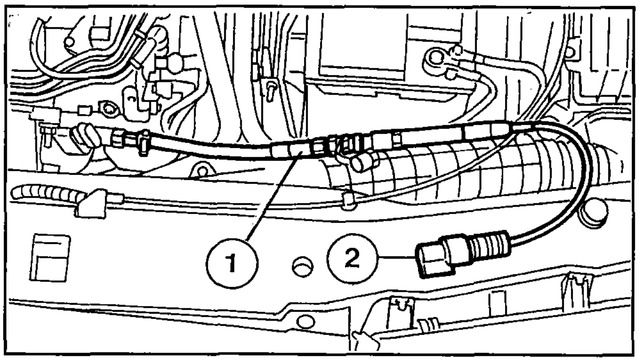



4A60IJ01

**Checking fuel supply pressure using a tester.**

Fuel supply pressure can also be checked using an EXAMINER or SDC. In this case, remove the protective bracket as described in the previous paragraph, connect the tester to transducer (2), which must be connected to the fuel manifold by means of fitting (1).

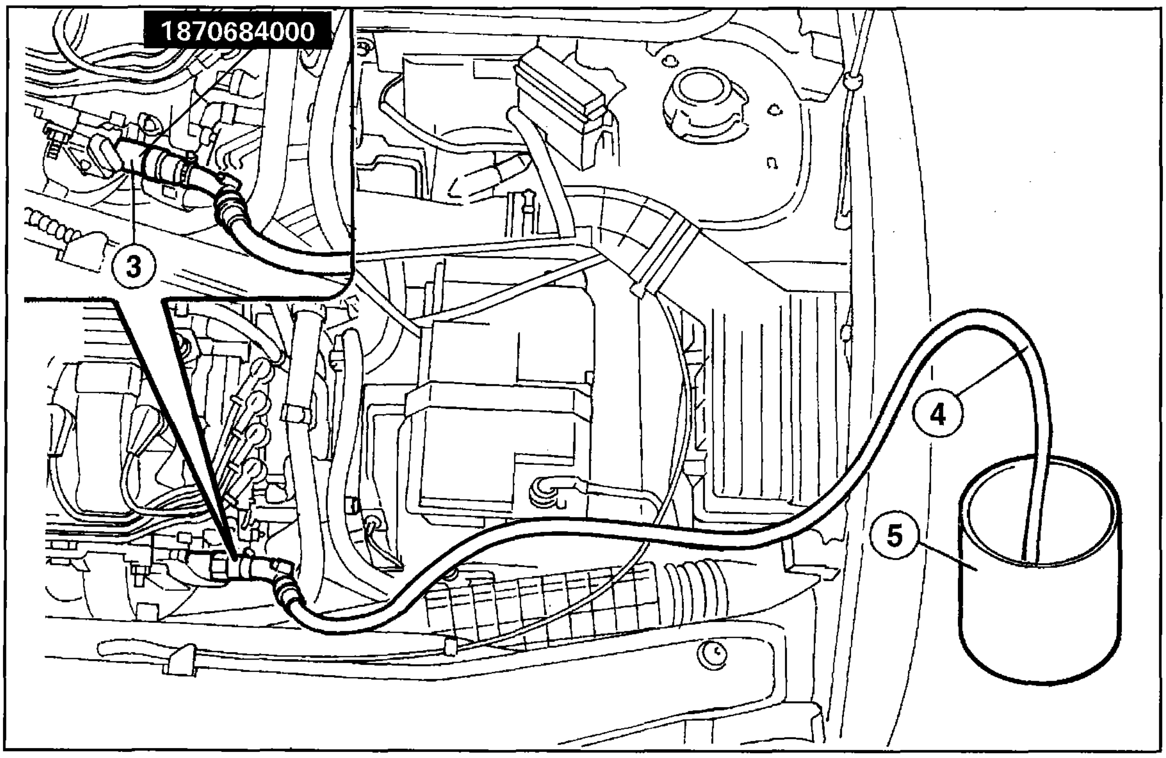
**Testing fuel consumption**

Test fuel consumption as follows:

- remove the protective bracket and disconnect the injector supply connector as described in the previous paragraph on fuel supply pressure testing;

⚠ the fuel supply circuit is maintained at a constant pressure of 3.5 bars even with the engine off. Before disconnecting the delivery pipe, it is therefore necessary to drain pressurised fuel as described below

- obtain a suitable container(5) and insert pipe (4) into it;
- connect the other end of pipe (4) to the fuel manifold using special adaptor 1870684000 (3);
- drain off fuel under pressure into container (5);
- disconnect fuel manifold adaptor (3) and pipe (4), then reconnect the injector supply connector;




4A591J02

- disconnect the fuel delivery pipe from the quick-fit connector located against the rear wall of the engine compartment and, using the connectors of the test equipment 1860955000, make the connections to the Flowtronic device (1806149001) as follows:

  1. Cut and withdraw the end (A) of the connector (2), then connect the end (B) to the connector of the rigid pipe (3) and the end (A) to the inlet pipe into the Flowtronic (4).
  2. Insert the connector (5) into a piece of pipe (6) and lock it with a metal clip, then connect the end (A) to the pipe (1) previously disconnected and the end (B) to the outlet pipe from the Flowtronic device (4).

- carry out a fuel consumption road test in accordance with the Directive 93/116/CE (litres x 100 km):

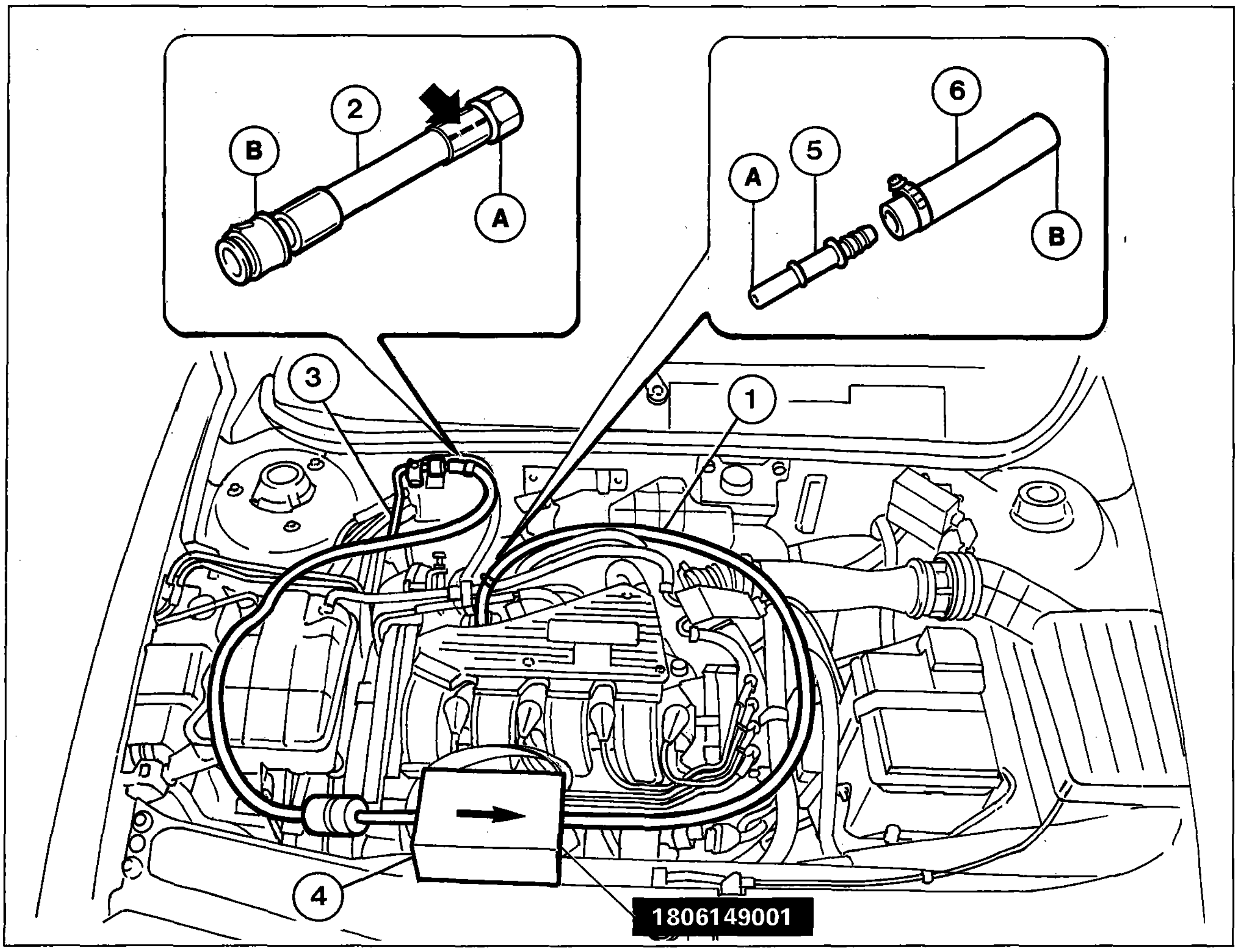
  URBAN CYCLE - includes one cold start, followed by a simulated varied urban journey.

  OUT-OF-TOWN CYCLE - includes frequent accelerations, in all gears, simulating normal out-of-town use of the vehicle; the speed varies between 0 and 120 km/h.

  AVERAGE COMBINED CONSUMPTION - includes 37% urban cycle and 63% out-of-town cycle.

**NOTE** *The type of journey, traffic situations, style of driving, weather conditions, level of fittings/extras/accessories, presence of roof rack, presence of special equipment and the general condition of the vehicle can lead to different fuel consumption values from those measured by the above-mentioned procedures.*

- check that the values measured correspond to those given in the "Introduction and technical data" section.




P4A611J01

### FAULT DIAGNOSIS

Full diagnosis of the fuel injection-ignition is possible by active dialogue with the Examiner or SDC station.
If faults in the sensors are detected, the electronic control unit replaces the data coming from the faulty sensor with pre-memorized data **(recovery)** to allow the engine to continue operating.

Detection of the fault leads to its permanent storage in memory and the exclusion of the sensor from the system until the signal becomes compatible again.
The same procedure is applied if the fault affects an actuator or its control port. The detection of the fault and the replacement with recovery data leads to indication of a fault by the warning light on the instrument panel coming on.
The devices which, in the event of a fault, can be managed by recovery from the control unit are:

- Idle speed actuator
- Ignition coils
- Fuel vapour recirculation solenoid
- Air temperature and pressure sensor
- Coolant temperature sensor
- Knock sensor
- Throttle position sensor
- Lambda probe

In the event of faults in the control unit or rpm sensor, the system, even though it detects the fault, cannot replace it with recovery data and the car stops. The faults can be detected in the memory of the control unit using the Examiner or SDC station.

#### Error recognition and memorization

The error is detected via a system of validations which operates as follows.

When an error is detected, this is checked for a certain period of time to avoid possible interference on the diagnostic line. If the fault passes this stage, it is considered to be present and is stored in RAM (filtered error). It is then checked that the error remains present for a further period of time (called validation time); if this stage is also passed, the error is finally memorized (validated error) and the fault warning light comes on. The stage of writing the error in EEPROM takes place after the ignition is switched off.

#### Error frequency counter

A frequency counter is assigned to each error in order to determine the moment when a fault which is no longer present was memorized. On first detection of a validated error, the counter is set to a fixed set value.

The counter is decremented whenever the car is started without the fault reappearing. If the counter reaches zero, the fault is automatically deleted from EEPROM.

#### Error deletion

Errors can be deleted from EEPROM in two ways:

- by means of the diagnostic equipment (Examiner or SDC station), in active diagnosis
- by resetting the error frequency counter.

**NOTE** *Disconnecting the control unit from the system, even for long periods, does not delete data recorded in the EEPROM.*

#### Management of the system fault warning light

To check its operation, the control unit lights up the warning light and leaves it on for about 4 seconds whenever the ignition is switched on. The warning light then comes on whenever there is a validated error, i.e. for as long as the fault situation remains, and it goes out when the fault disappears.

### Communications between control unit and diagnostic equipment

In the engine compartment, there is a socket for connecting the diagnostic equipment.
The data exchange between control unit and diagnostic equipment takes place by means of a bidirectional diagnostic line (line K) and the communication protocol follows the Key Word 2000 standard. Data transmission takes place in NRZ positive logic at a baud rate of 10400 Baud.
The diagnostic equipment can provide the following information:

- Display of engine parameters;
- Display of errors;
- Active diagnosis.

### Parameters displayed

Engine rpm
Fuel injection time
Absolute pressure in the inlet manifold
Intake air temperature
Engine coolant temperature
Throttle valve aperture angle
Battery voltage
Number of open/close steps of the engine idle speed actuator
Advance
Mixture strength correction (Lambda probe)
Vehicle speed
Self-adaptivity
Error counter
Ignition coil charging time (Dwell)
Petrol vapours solenoid
Start counter
Engine load
Fiat CODE

### List of errors

| | |
|---|---|
| Rpm sensor | Absence of signal |
| Throttle potentiometer | A.C.-D.C. |
| Absolute pressure sensor | A.C.-D.C. |
| Air temperature sensor | A.C.-D.C. |
| Coolant temperature sensor | A.C.-D.C. |
| Battery | Supply> 16.2V<br>Supply< 6V |
| Lambda probe | Implausible signal<br>D.C. |
| Fuel injectors | A.C.-D.C. |
| Ignition coils | A.C.-D.C. |
| Idle speed actuator | A.C.-D.C. |
| Fuel vapours solenoid | A.C.-D.C. |
| Actuators relays | A.C.-D.C. |
| Control unit | Operating faults in the microprocessor or control unit memories are indicated. |
| Self-adaptive parameters | It is indicated whether the limits of self-adaptivity of the control unit have been reached. This indicates that the engine conditions are too far beyond the standards, so the causes should be sought in mechanical faults. |
| Speed sensor | Implausible signal<br>Speed exceeds maximum speed |
| Knock sensor | A.C.-D.C. |
| Fiat CODE | Code not recognized or not received |

# 10.

### Active diagnosis

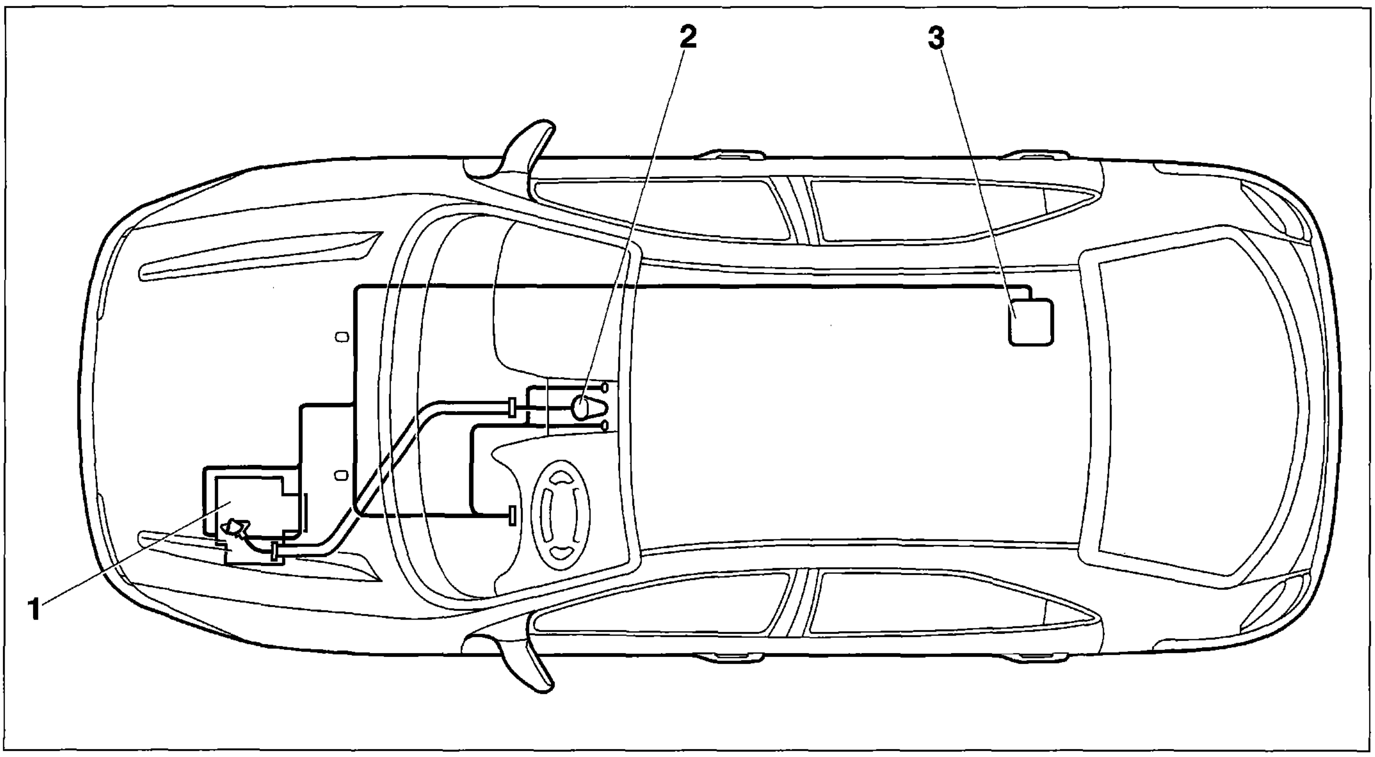
During active diagnosis, some components can be activated and some particular functions can be carried out, for example the error deletion command, as shown in the table below.
In active diagnosis, the ignition must be on and, only for some functions, the engine must be running.

| Function/Actuator | Method of activation |
|---|---|
| Electric fuel pump | Activation of the relay for 30 s |
| Fuel injectors | Activation for 4 ms per s 5 times |
| Ignition coils | Activation for 2 ms per s 5 times |
| Error deletion command | Deletion of validated errors |
| Fuel vapours solenoid | Activation for 20 ms per s 7 times |
| Rev counter | Activation at 125 Hz for 2 s |
| Air conditioner relay | Activation of the relay for 30 s |
| Fuel injection fault warning light | Activation of the warning light for 30 s |
| Coolant overheating warning light | Activation of the warning light for 10 s |
| Engine idle speed actuator | Activation for 32 steps forwards/backwards |
| Fiat CODE | Recovery procedure to permit engine starting |
| Radiator fan | Activation for 10 s at both high and low speeds |

## DESCRIPTION

### Introduction

The Fiat Brava 1581 16v Torque uses an AISIN 60-40 LE automatic gearbox and differenetial unit, 4-speed version AW 596/Y024, specially designed for front-wheel drive vehicles with transverse-mounted engine, fitted with an electronic control system connected to the engine management control unit.




P4A01AB01

1. Gearbox-differential unit
2. Selector lever
3. Control module

The automatic transmission electronic control logic resides in an "intelligent" control unit (or control module), located under the cushion of the rear seat on the right.
The control module is connected to the various sensors/actuators located on the gearbox, engine and dashboard, the control unit of the fuel injection/ignition for exchanging information relating to the engine and the instrument panel for displaying the operating conditions.

The mechanical unit of the automatic transmission comprises:
- an oleodynamic torque converter, with a lock-up clutch which locks the converter in the higher ratios;
- two epicyclic gears, located on the main shaft;
- a band brake B1, a multiple disc brake B2 and four multiple disc clutches, operated hydraulically; there are also two free wheels, which lock the various gearing components to obtain the four forward gears and reverse gear;
- a parking lock, consisting of a gear with ratchet gear which locks the gearbox when the gear lever is in the P (Park) position.

The control module interacts in the hydraulic operation of the gearbox, issuing the appropriate operating commands to the clutches and brakes via four solenoids, contained in a valve unit located at the front of the automatic transmission.

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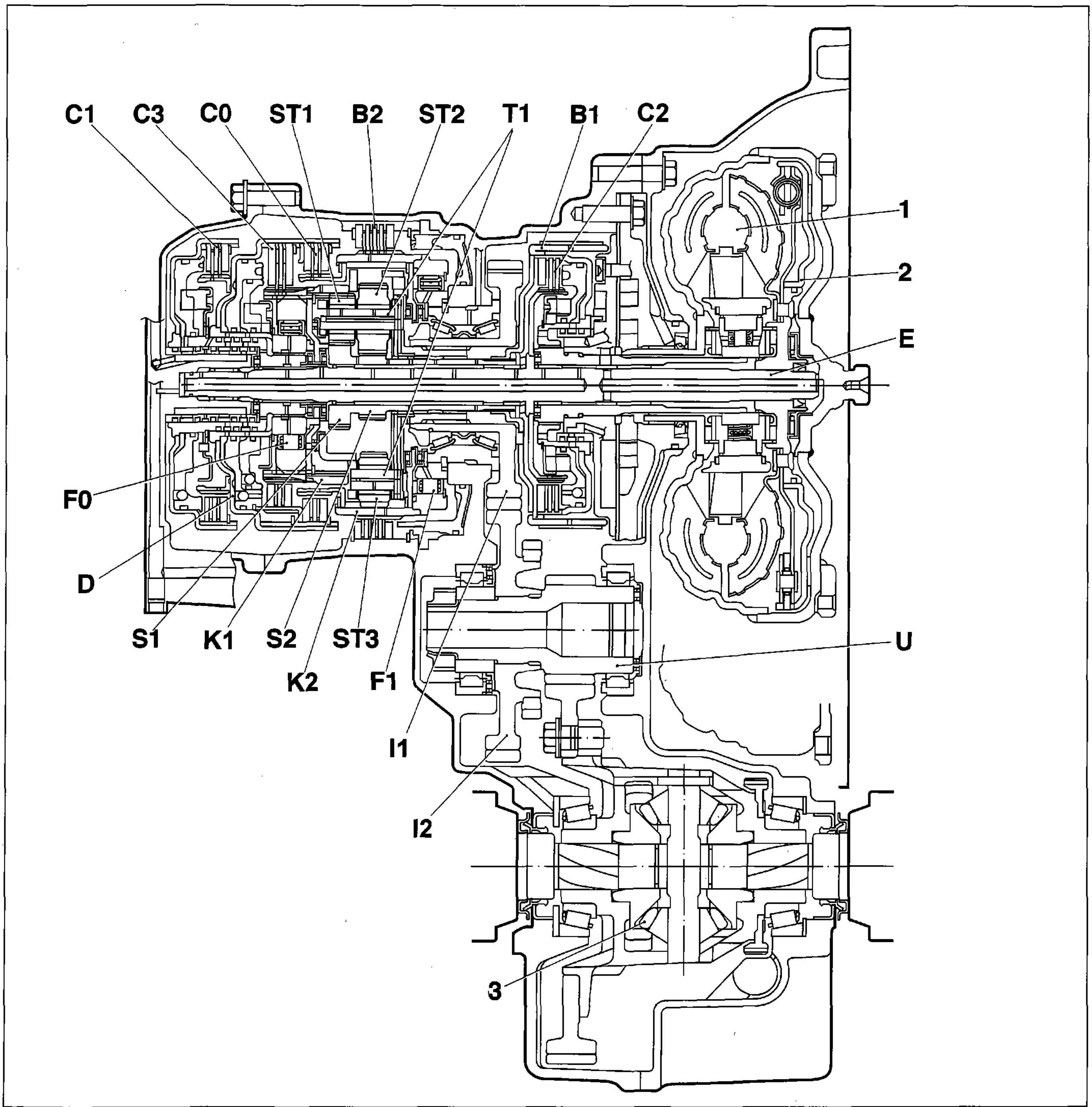
**Cross section of automatic transmission and differential**

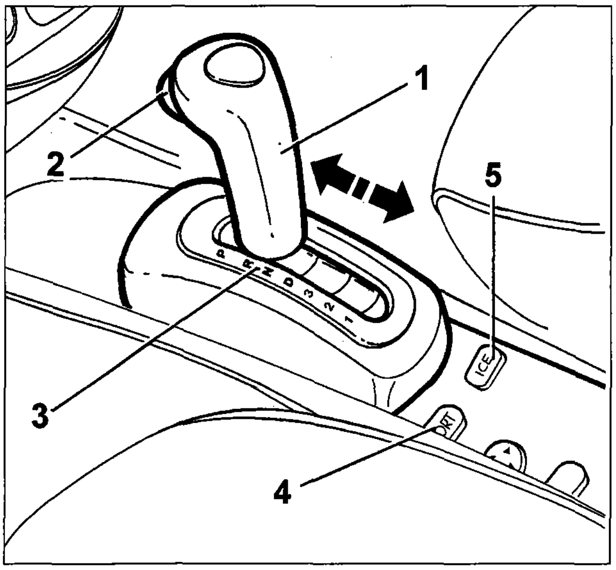



1. Torque converter
2. Lock-up clutch
3. Differential

B1. Band brake
B2. Multiple disc brake
C0. Multiple disc clutch
C1. Multiple disc clutch
C2. Multiple disc clutch
C3. Multiple disc clutch
D. Clutch carrier drum
E. Motion input shaft
F0. Free wheel
F1. Free wheel
I1. Main shaft motion output gear
I2. Layshaft gear
K1. Epicyclic gear set P1 crown wheel
K2. Epicyclic gear set P2 crown wheel
S1. Epicyclic gear set P1 sun gear
S2. Epicyclic gear set P2 sun gear
ST1. Epicyclic gear set P1 planet gear
ST2. Epicyclic gear set P2 planet gear
ST3. Epicyclic gear set P2 outer planet gear
T1. P1 and P2 epicyclic gear train carrier
U. Relay shaft

## SELECTOR LEVER

*To select a gear, use the selector lever located on the central console, which comprises a safety button* (2) to protect against accidental gear engagements. It is connected to the automatic transmission via a flexible cable, and it acts on the valve unit and on an electrical device through which a coded electrical signal indicating the lever's position (P, R, N, D, 3, 2, 1) is transmitted to the control module.



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1. *Selector lever*
2. Safety button (to prevent accidental gear engagement)
3. Lever position display
4. NORMAL/SPORT button (this is for switching over from NORMAL mode to SPORT mode and vice versa)
5. ICE button (for driving on slippery roads)

The following positions may be set using the selector lever:

| | |
|---|---|
| **P** *Park* | The drive wheels are locked (the engine can be started) |
| **R** *Reverse* | Reverse ratio (the reversing lights come on) |
| **N** *Neutral* | Neutral position (the engine can be started) |
| **D** *Drive* | Automatic operation of the gearbox on all four ratios |
| **3** *3rd gear* | Automatic operation of the gearbox on the first 3 gears (the change to 4th gear is inhibited) |
| **2** *2nd gear* | Automatic operation of the gearbox on the first 2 ratios (the change to 3rd and 4th gears is inhibited) |
| **1** *1st gear* | Operation only in 1st gear (with engine braking effect) |

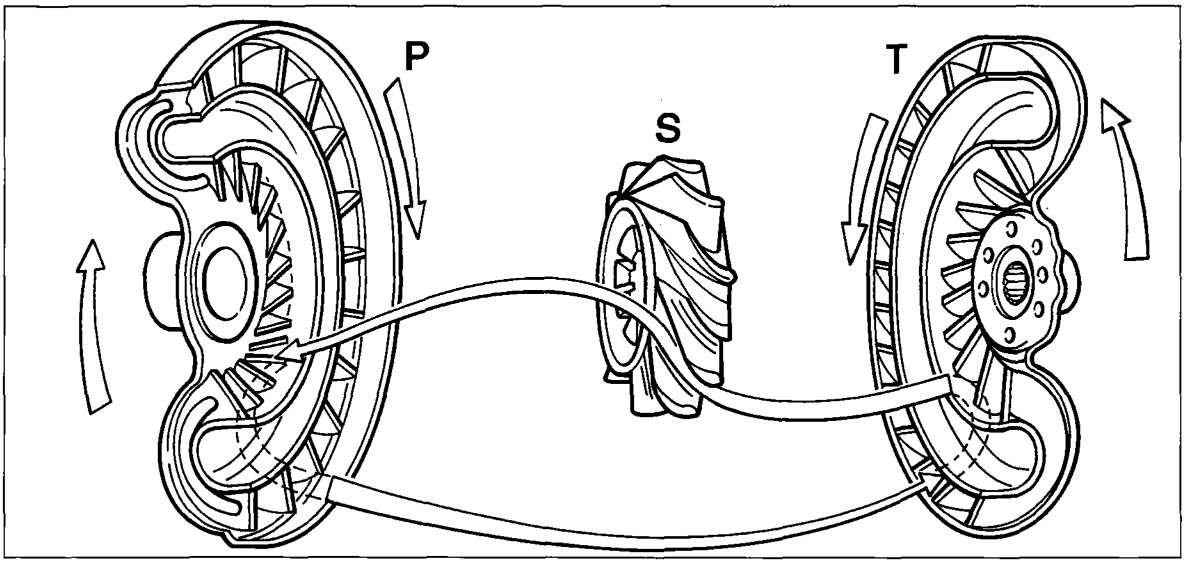
## TORQUE CONVERTER

The purpose of the torque converter is to hydraulically transmit power from the engine to the gearbox, and to increase the torque when the vehicle is accelerating. The rotary motion is transmitted to the epicyclic gearing through two shafts:

- the gearbox main shaft which engages in the hub of the converter turbine.
- the layshaft which engages on the lock-up clutch;

The converter comprises (see figure on next page) a pump P connected to the crankshaft, a turbine T connected to the gearbox main shaft, and a stator S connected to the gearbox outer casing. The converter is filled completely with oil which, because of the kinetic energy impressed upon it by the pump, permits the transmission of the driving torque.

# 21-27.




P. Pump

S. Stator

T. Turbine

**NOTE** *The torque converter does not sustain any kind of wear as there is no mechanical connection between the driven part and the driving part.*

The impeller P is connected to the crankshaft and, rotating in a clockwise direction, acts as a pump, transmitting its energy to the oil.
The centrifugal force pushes the oil towards the periphery of the impeller, where it flows at high speed towards the turbine T. Here the oil's kinetic energy impresses a clockwise rotary movement to the turbine. The oil then passes through the stator S, where it is diverted in accordance with an angle which permits it return to the pump with high efficiency. The stator is connected to the gearbox casing by means of a free wheel engagement system, which prevents its rotation in an anti-clockwise direction and provides a reaction torque, proportional to the oil flow diversion, which is added to that of the turbine.

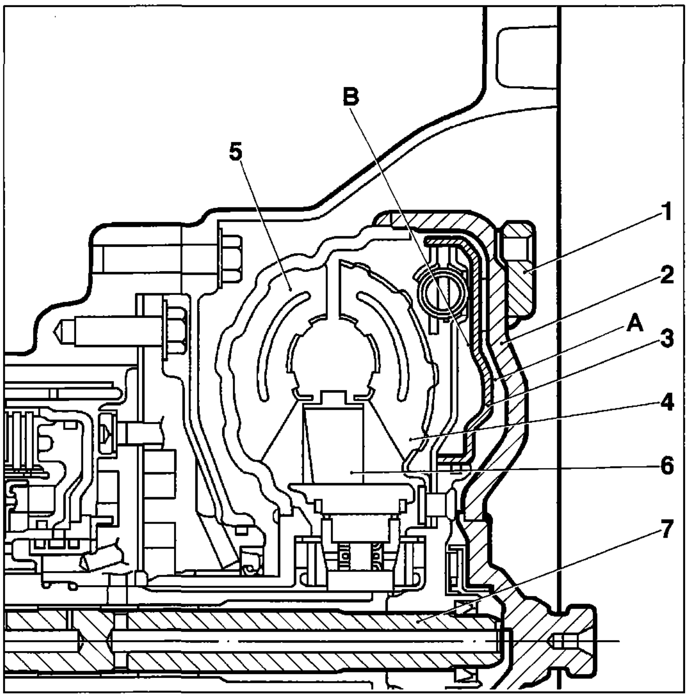
The ratio between the torque acting on the turbine and that provided by the pump is known as the torque multiplication ratio and is proportional to the difference in speed of rotation between the pump and turbine.

With the wheels stopped, the torque is around double that delivered by the engine.
As the turbine speed increases, the torque multiplication decreases continuously and tends to reach the ratio of 1:1, corresponding to a turbine speed of 85-90% of the pump speed. When the turbine and pump speeds are almost the same, the stator is enveloped by an oil flow directed at an angle which makes it change its direction of rotation and, as it is not blocked by the free wheel, it rotates in a clockwise direction without impediment and the torque converter behaves like a simple hydraulic joint.

## LOCK-UP CLUTCH

In first, second and reverse gears, the driving torque is transmitted by the torque converter.
In third and fourth gears, the torque is transmitted first hydraulically by the converter, and secondly mechanically via the lock-up clutch. The lock-up clutch, by connecting the pump to the converter's turbine when the speed increases, eliminates the internal slipping of the converter and provides a mechanical coupling between the engine and the gearbox main shaft.
The locking of the torque converter allows the performance of the transmission to be improved at high speeds, leading to a reduction in fuel consumption on long motorway journeys.

The lock-up clutch is switched on by the control module via the lock-up solenoid SL, at the higher gears (3rd and 4th gears), when it is no longer necessary to multiply the driving torque supplied by the torque converter.
The solenoid SL opens, discharging the oil pressure from the chamber A, while the pressure in the converter continues to act on the face B: the clutch, fitted on the turbine hub, is then pushed against the casing connected to the converter's pump, thus locking the converter.




P4A05AB01

1. Flywheel attachments
2. Casing connected to pump
3. Lock-up clutch
4. Turbine
5. Pump
6. Stator
7. Motion input shaft

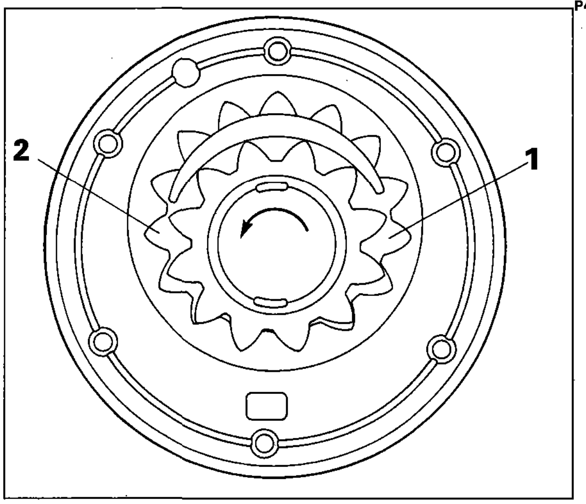
## OIL PUMP

The oil pump used for the AISIN automatic transmission is of the inner gear type.
It is located between the torque converter and gearbox casing, and is driven directly by the converter pump impeller.
The functions of the oil pump are as follows:

- to provide the necessary pressure to the hydraulic control system and the gearbox control components (clutches and brakes);
- to send an oil flow into the torque converter case in order to cool it and to be able to operate the lock-up clutch;
- to lubricate the moving components of the gearbox;
- to circulate oil in the cooling system.

**Structure of the oil pump**

1. Inlet side
2. Delivery side

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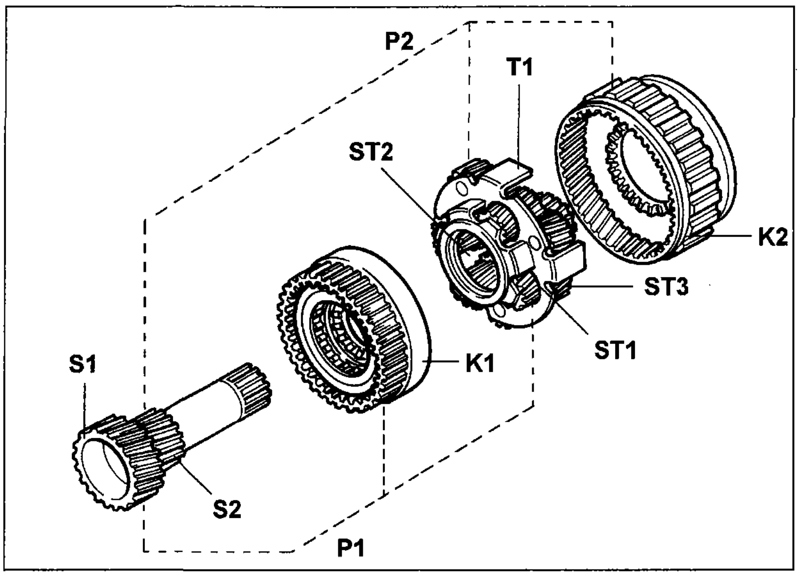
## EPICYCLIC GEARS

The AISIN automatic transmission uses two epicyclic gear sets for obtaining the five transmission ratios (4 forward gears + reverse gear).
The rear gear set P1 is a simple epicyclic gear set comprising a sun gear S1, four planet gears ST1 and a crownwheel K1.
The front gear set P2 consists of an epicyclic gear set comprising a sun gear S2, four inner planet gears ST2, four outer planet gears ST3 and a crownwheel K2.
The shafts of the planet gears ST1, ST2 and ST3 are attached to the gear train carrier T1.

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**Epicyclic gear sets P1 and P2**

K1. Crownwheel of P1
K2. Crownwheel of P2
S1. Sun gear of P1
S2. Sun gear of P2
ST1. Planet gears of P1
ST2. Inner planet gears of P2
ST3. Outer planet gears of P2
T1. Gear train carrier

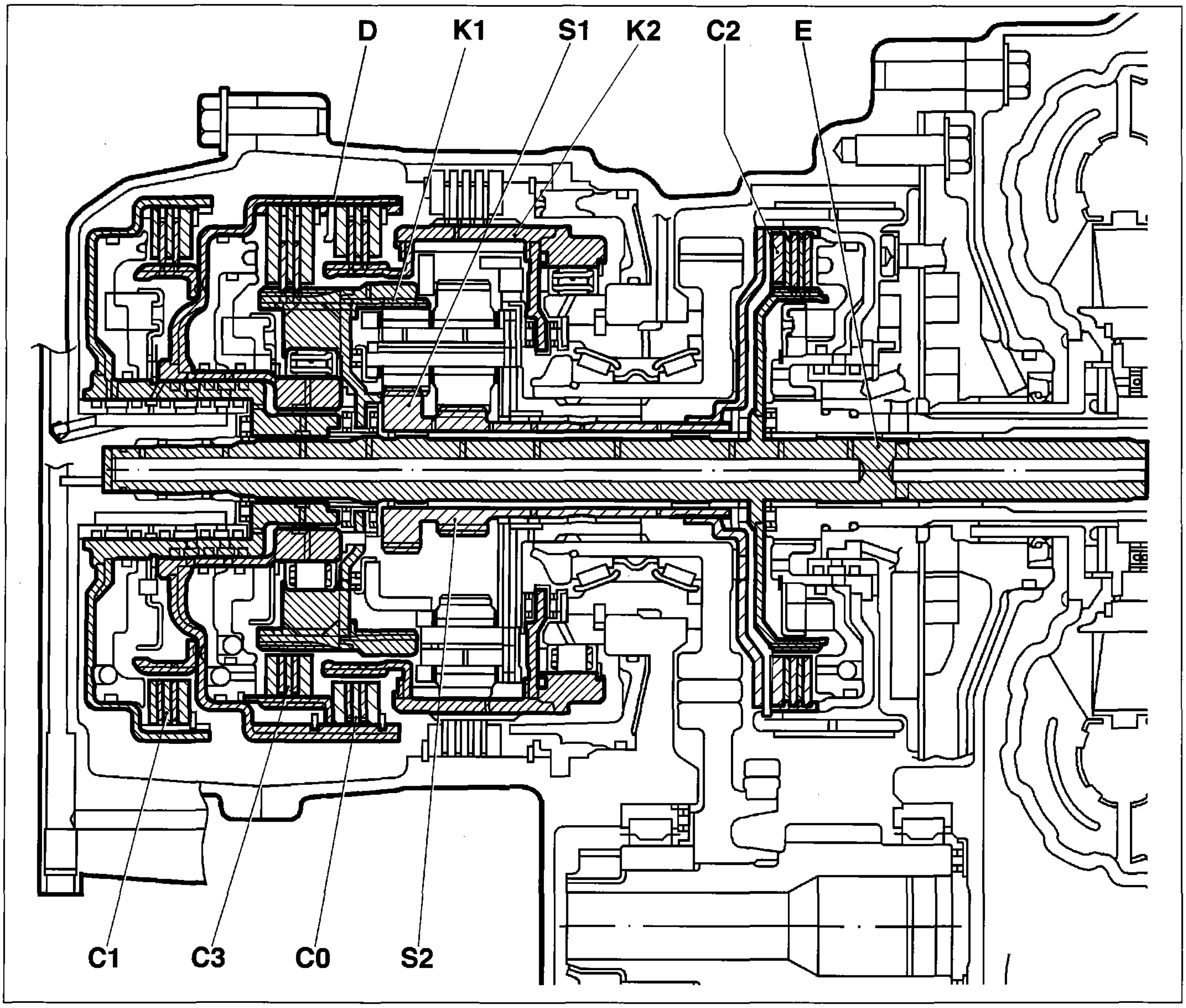
# 21-27.

## CONTROL COMPONENTS

The control components of the automatic transmission consist of clutches, multiple disc brakes, band brakes and free wheels, which prevent the relative rotation between two components of the epicyclic gear sets, or between one of them and the outer casing, to achieve the four forward gears and reverse gear.

### Clutches

Four clutches are used in the AISIN automatic transmission, and they are all of the multiple disc type. They are activated by the valve assembly located in the gearbox hydraulic control system.

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When engaged, the clutch C1 couples the gearbox input shaft E to the clutch carrier drum D.

When engaged, the clutch C2 couples the gearbox input shaft E with the shaft E on which there are the two sun gears S1 and S2 of the gear sets P1 and P2.

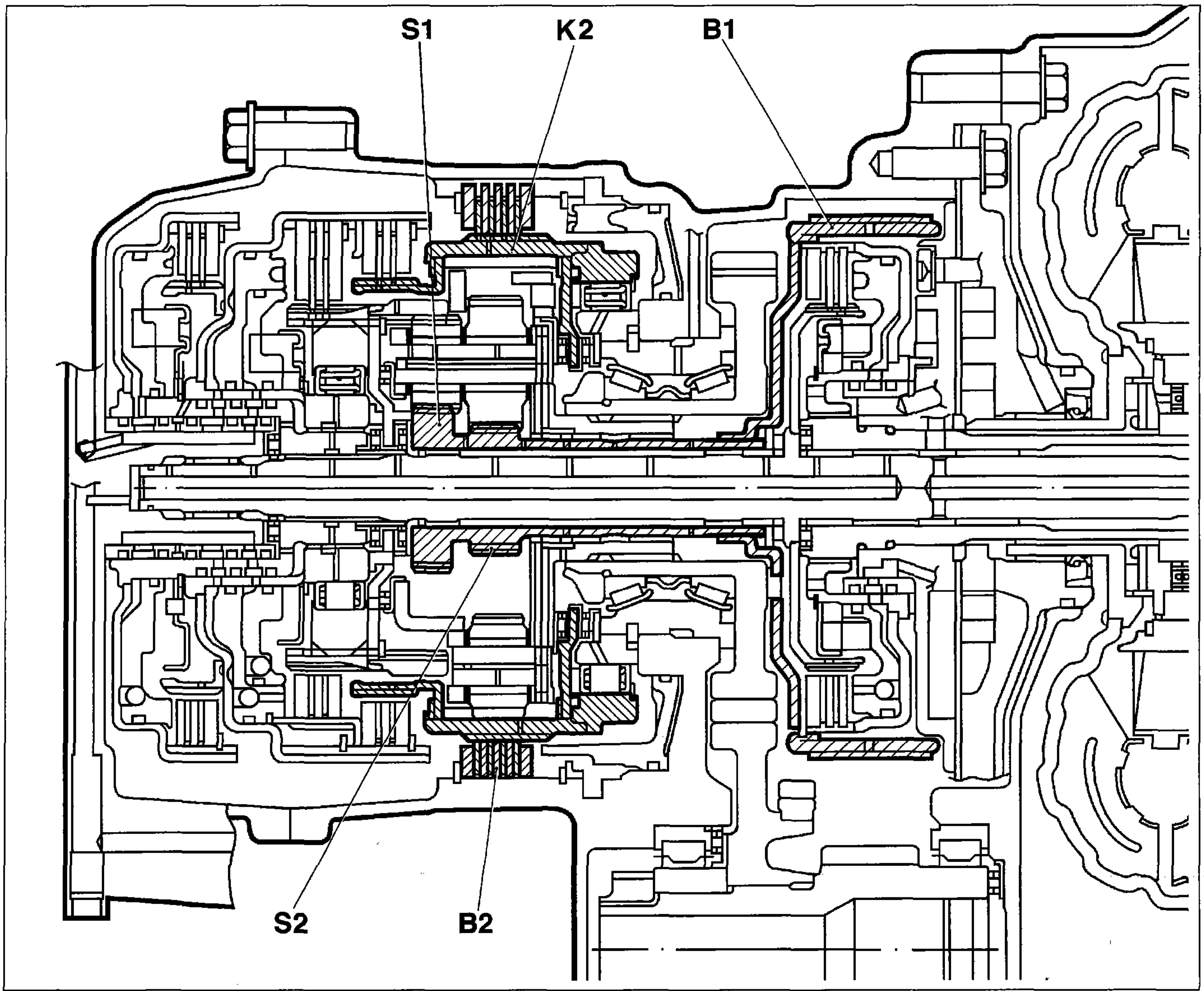
When engaged, the clutch C3 couples the clutch carrier drum D with the crownwheel K1 of the epicyclic gear set P1; in this way the crownwheel K1 receives motion from the gearbox input shaft E through C1-C3.

When engaged, the clutch C0 couples the clutch carrier drum D with the crownwheel K2 of the epicyclic gear set P2; in this way the crownwheel K2 receives the motion from the gearbox input shaft E through C1-C0.

**Brakes**

There are two brakes in the AISIN automatic transmission, one of the multiple disc type (B2), and one band brake (B1).

They are activated by the valve assembly located in the gearbox hydraulic control unit.

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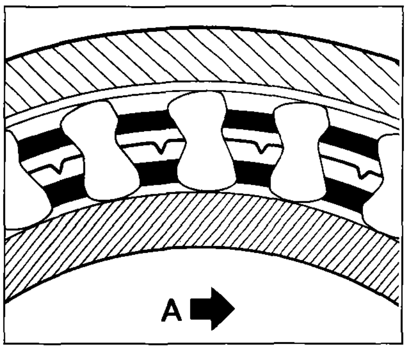
The band brake B1 blocks the rotation of the sun gears S1 and S2 (connected to each other), which form part of the gear sets P1 and P2.

The multiple disc brake B2 blocks the rotation of the crownwheel K2 of the gear set P2.

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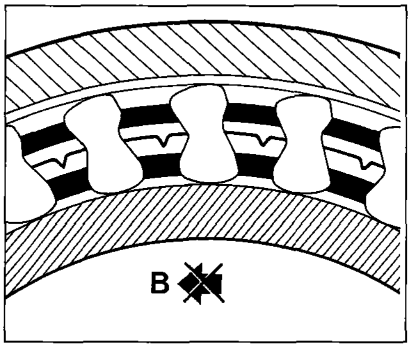


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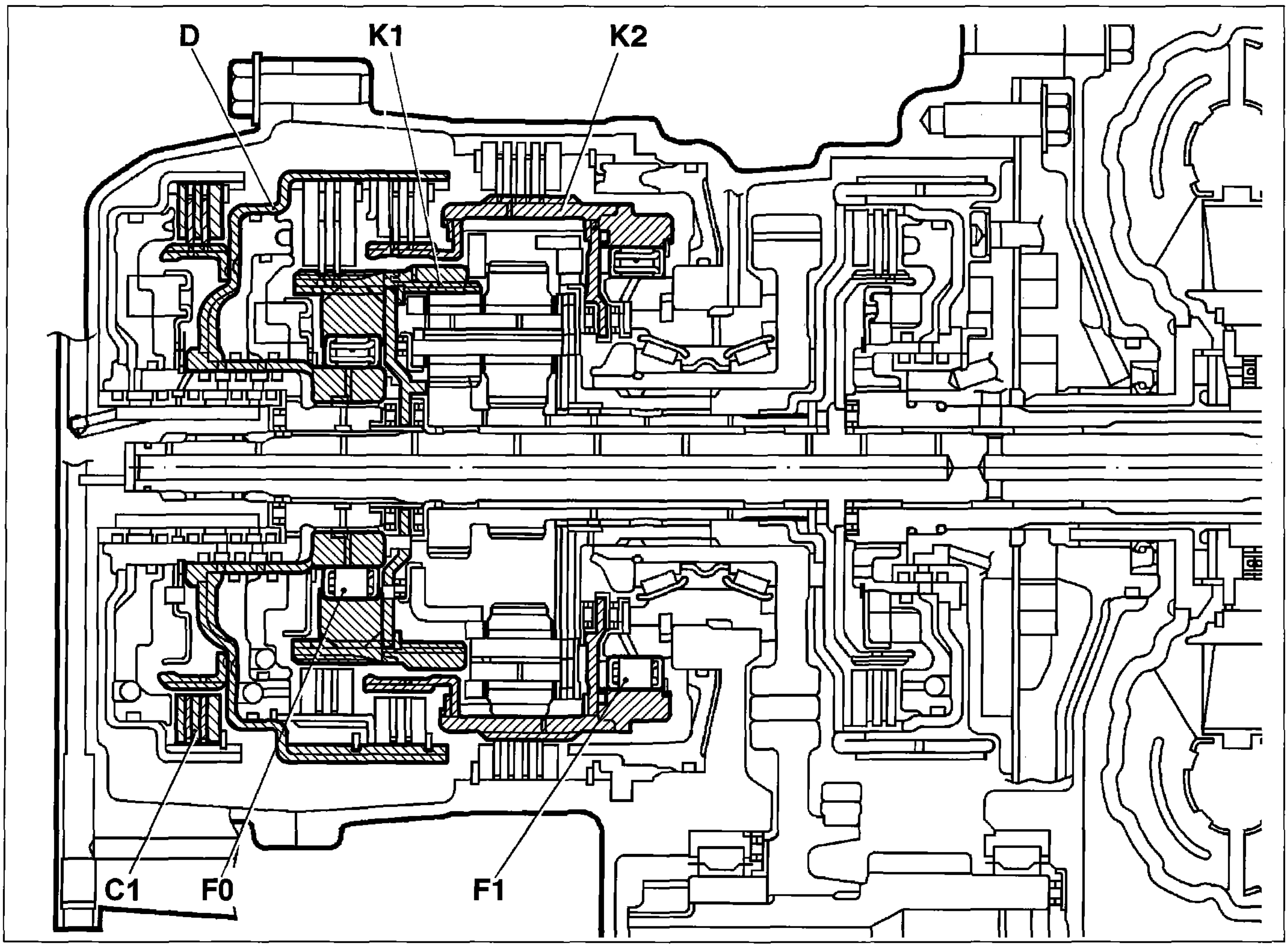
**Free wheels**
The free wheels consist of two concentric races and a cage enclosing a set of asymmetrical pawls, which permit the relative rotation of the two races in a particular direction (A), while in the opposite direction the pawls jam, preventing relative rotation and providing a reaction torque.

The roller clutch F0 connects the clutch carrier drum D and crownwheel K1 of the gear set P1 when the clutch C1 is active, and the motion comes from the gearbox input shaft.
The roller clutch F1 prevents the anti-clockwise rotation of the crownwheel K2 of the gear set P2.




P4A08AB03

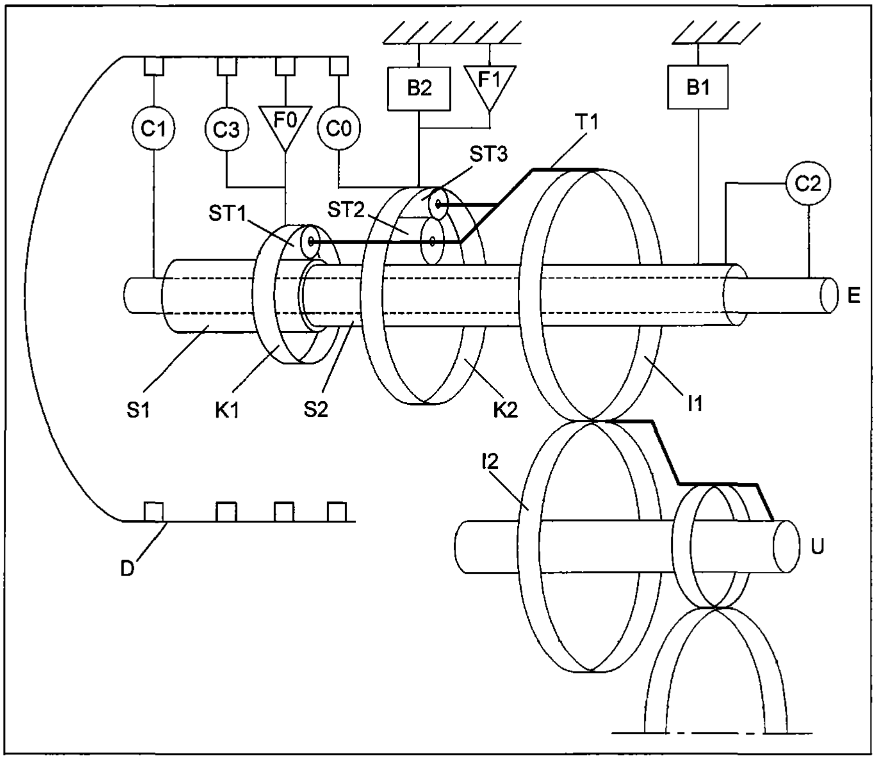
## HYDRAULIC CONTROL SYSTEM

The operation of the automatic transmission is made possible by the operation of the clutches and brakes, via hydraulic actuators driven by valves which move in accordance with the commands issued by the control module. The feed is provided by a gear pump, driven directly by the engine through the torque converter.

A cooling radiator and fan controlled by a thermal switch keeps the oil temperature within pre-established limits.

## TRANSMISSION OF MOTION

The diagram below illustrates in a simplified manner the composition of the gear sets and control components (clutches, brakes and free wheels) of the gearbox.
The same wiring diagram will be used on the following pages to illustrate the intervention of the various control components during the different stages of operation.




P4A09AB01

B1. Band brake
B2. Multiple disc brake
C0. Multiple disc clutch
C1. Multiple disc clutch
C2. Multiple disc clutch
C3. Multiple disc clutch
D. Clutch carrier drum
E. Motion input shaft
F0. Free wheel
F1. Free wheel
I1. Main shaft motion output gear
I2. Layshaft gear
K1. Crownwheel - epicyclic gear set P1
K2. Crownwheel - epicyclic gear set P2
S1. Sun gear - epicyclic gear set P1
S2. Sun gear - epicyclic gear set P2
ST1. Planet gear for epicyclic gear set P1
ST2. Inner planet gear for epicyclic gear set P2
ST3. Outer planet gear for epicyclic gear set P2
T1. P1 and P2 epicyclic gear train carrier
U. Relay shaft

The table below gives the conditions of activation of the components depending on the gear engaged and the position of the selector lever.

| Selector lever position | Gear engaged | Control solenoids | | | Clutches | | | | Brakes | | Free wheels | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S1 | S2 | SL | C1 | C2 | C3 | C0 | B1 | B2 | F1 | F0 |
| P | Park | ○ | | | | | ○ | | | | | |
| R | Reverse (*) | ○ | | | | ○ | ○ | | | ○ | | |
| | Neutral (**) | | ○ | | | ○ | ○ | | | | | |
| N | Neutral | ○ | | | | | ○ | | | | | |
| D | 1st | ○ | | | ○ | | ○ | | | | ○ | ○ |
| | 2nd | ○ | ○ | | ○ | | ○ | | ○ | | | ○ |
| | 3rd | | ○ | ○ | ○ | | ○ | ○ | | | | ○ |
| | 4th | | | ○ | ○ | | | ○ | ○ | | | |
| 3 | 1st | ○ | | | ○ | | ○ | | | | ○ | ○ |
| | 2nd | ○ | ○ | | ○ | | ○ | | ○ | | | ○ |
| | 3rd | | ○ | ○ | ○ | | ○ | ○ | | | | ○ |
| 2 | 1st | ○ | | | ○ | | ○ | | | | ○ | ○ |
| | 2nd | ○ | ○ | | ○ | | ○ | | ○ | | | ○ |
| | 3rd | | ○ | ○ | ○ | | ○ | ○ | | | | ○ |
| 1 | (1st)● | ○ | | | ○ | | ○ | | | ○ | ○ | ○ |
| | (2nd)● | ○ | ○ | | ○ | | ○ | | ○ | | | ○ |

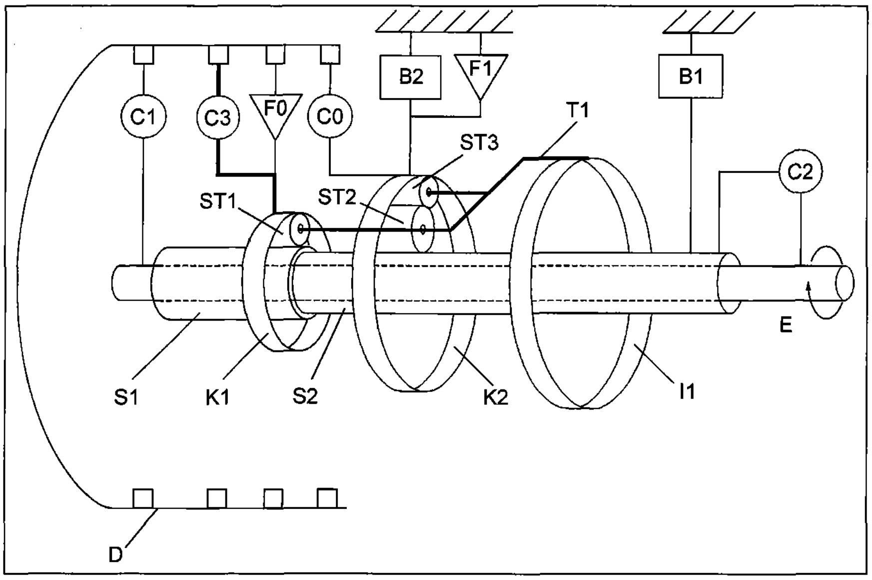
**NOTE** ○=*Solenoid activated (*) Speed* ⩽7km/h (**) Speed > 7km/h (●) Intermediate selection in manual scale.

# 21-27.

**Neutral** (selector lever on position **N**)

The gearbox input shaft **E** rotates in a clockwise direction.
The clutch **C3** couples the crownwheel **K1** to the clutch carrier drum **D**, to permit the transmission of motion without delays or stresses, caused by the simultaneous engagement of several clutches and brakes, when the selector lever is positioned on **R** or **D** (1st gear).
The multiple disc clutches **C1 - C0 - C2** and brakes **B2 - B1** are disengaged, so the epicyclic gear sets **P1** and **P2** do not receive motion, thus isolating the differential relay shaft **U** from the gearbox input shaft **E**.

**NOTE** *The parking lock is off, so the planet gears* **ST1 - ST2 - ST3** *are free to rotate around the sun gears* **S1** *and* **S2***, allowing the vehicle to move if it is on a slope.*

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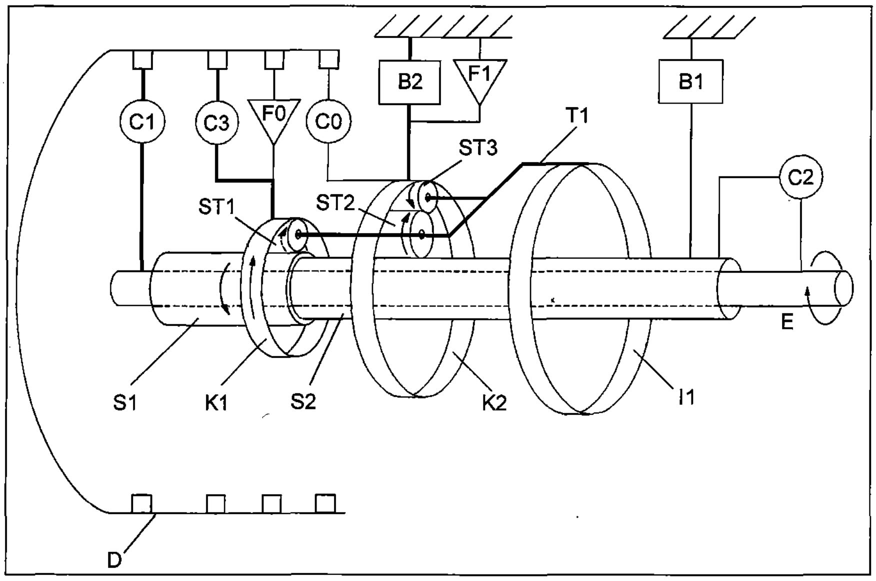
**Park** (selector lever on position **P**)

The control components are as described for position **N**, with the sole difference that the parking lock (ratchet P) is engaged, preventing the vehicle from moving.

**First gear** (selector lever on position **1**)

The gearbox input shaft **E** rotates in a clockwise direction.
The crownwheel **K1** is coupled to the input shaft **E** by the engagement of the multiple disc clutch **C1**, the clutch carrier drum **D** and the clutch **C3** (already engaged with **N** or **P** selected).

The clutch **C3** locks the free wheel **F0**. The crownwheel **K2** is locked to the gearbox casing by the engagement of the multiple disc brake **B2.** The brake **B2** locks the free wheel **F1.** The planet gears **ST1**, driven by the crownwheel **K1** of the epicyclic gear set **P1**, rotate in a clockwise direction and via the sun gears **S1** and **S2** transmit motion, reduced and in a clockwise direction, to the planet gears **ST2** of the epicyclical gear set **P2**.
The planet gears **ST3**, driven by the planet gears **ST2**, rotate in an anti-clockwise direction and, by the reaction on the locked crownwheel **K2**, shift and rotate in clockwise direction the gear train carrier **T1** and gear **I1**.
The gear **I1** transmits motion to the wheels via the gear **I2** and the differential relay shaft **U**.



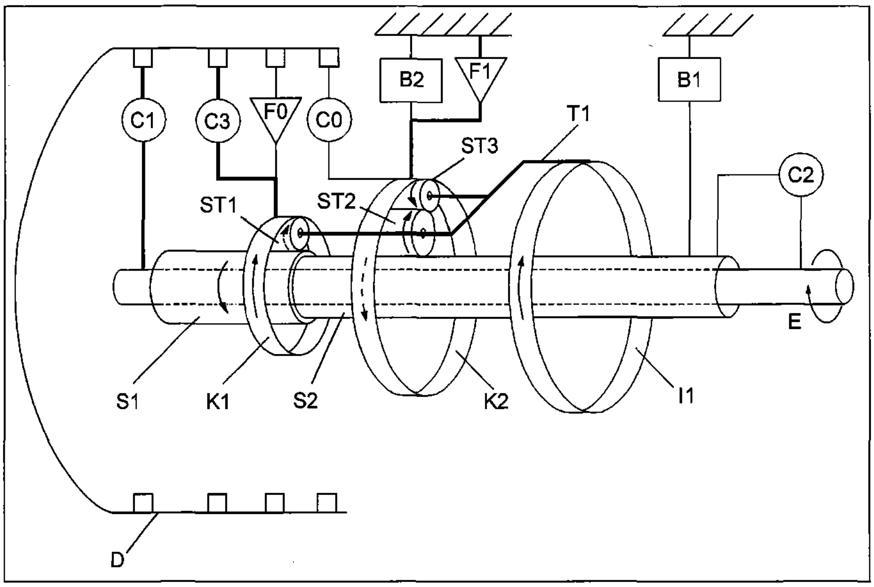

P4A10AB02

**NOTE** *Engaging the brake* **B1** *in 1st and reverse allows the engine to brake the vehicle in deceleration.*

**First gear** (selector lever on position **D-3-2**)

With the selector lever on one of the three positions, the gearbox functions in the same way and with the same transmission ratio as with the selector lever at position **1**, with the only difference that the crown-wheel **K2** of the front gear set **P2** is not locked by the brake **B2**.

As the torque which acts on the crownwheel **K2** is much higher than that acting on the gear train carrier **T1**, the crownwheel would rotate in an anti-clockwise direction, but the free wheel **F1** prevents this rotation, permitting transmission of motion to the gear train carrier and so to the differential relay shaft **U**, as in the previous case.

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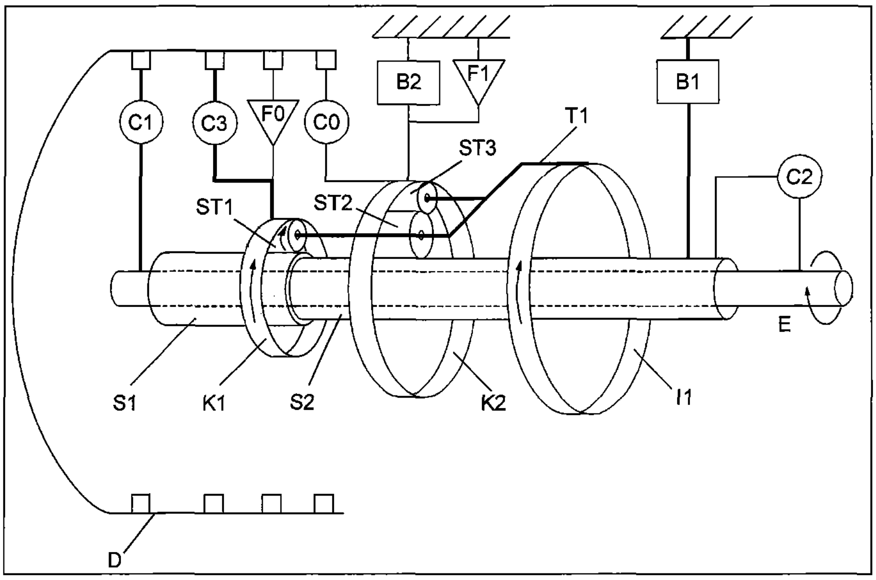
However, in this case there is no engine braking effect, as the crownwheel **K2** can rotate freely in a clockwise direction, allowing the gear train carrier **T1** to rotate at a higher speed than that imposed by the transmission ratio.

**Second gear** (selector lever on position **D-3-2-1***)

*** selected manually (recovery)**

The gearbox input shaft **E** rotates in a clockwise direction.

The crownwheel **K1** is coupled to the input shaft **E** by the engagement of the multiple disc clutch **C1**, clutch carrier drum **D** and clutch **C3** (already engaged with **N** or **P** selected).
The clutch **C3** locks the free wheel **F0**.




P4A11AB02

The sun gear **S1** is locked to the gearbox casing by the engagement of the band brake **B1**.

The planet gears **ST1**, driven by the crownwheel **K1** of the epicyclic gear set **P1**, rotate in a clockwise direction, shifting onto the locked sun gear **S1;** they then transmit motion in a clockwise direction to the gear train carrier **T1** and the gear **I1** coupled to it.

The gear **I1** transmits motion to the wheels via the gear **I2** and the differential relay shaft.

# 21-27.

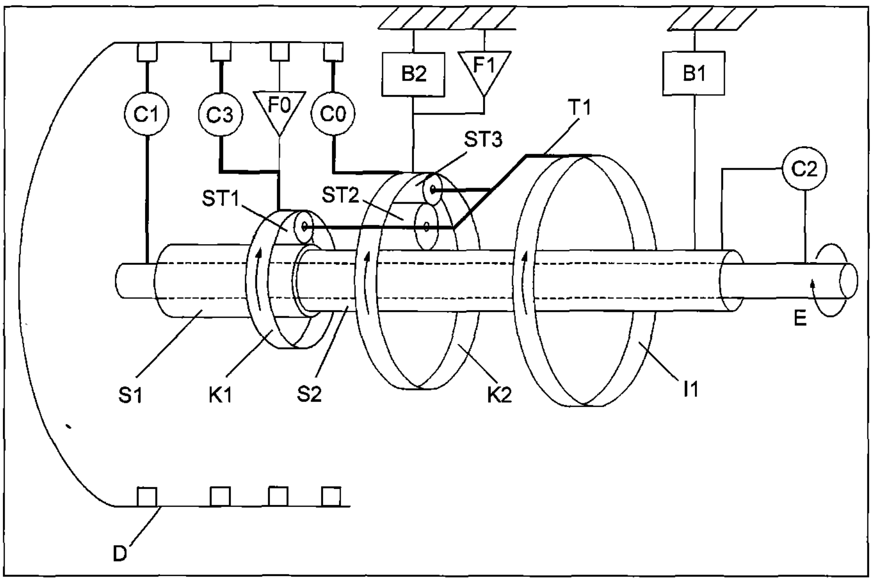
**Third gear** (selector lever on position **D-3**)

The gearbox input shaft **E** rotates in a clockwise direction.

The crownwheels **K1** and **K2** are coupled to the input shaft **E** by the engagement of the clutch **C1**, clutch carrier drum **D** and the clutches **C3** and **C0**.

The clutch **C3** locks the free wheel **F0**.

The epicyclic gear sets **P1** (**S1 - ST1 - K1**) and **P2** (**S2 - ST2 - ST3 - K2**) lock onto each other when their transmission ratios are different.




P4A12AB01

The planet gears **ST1, ST2** and **ST3**, locked, drive the gear train carrier **T1** in a clockwise direction at the same speed as the input shaft **E** (ratio 1:1).

The gear **I1** transmits motion to the wheels via the gear **I2** and the differential relay shaft **U**.

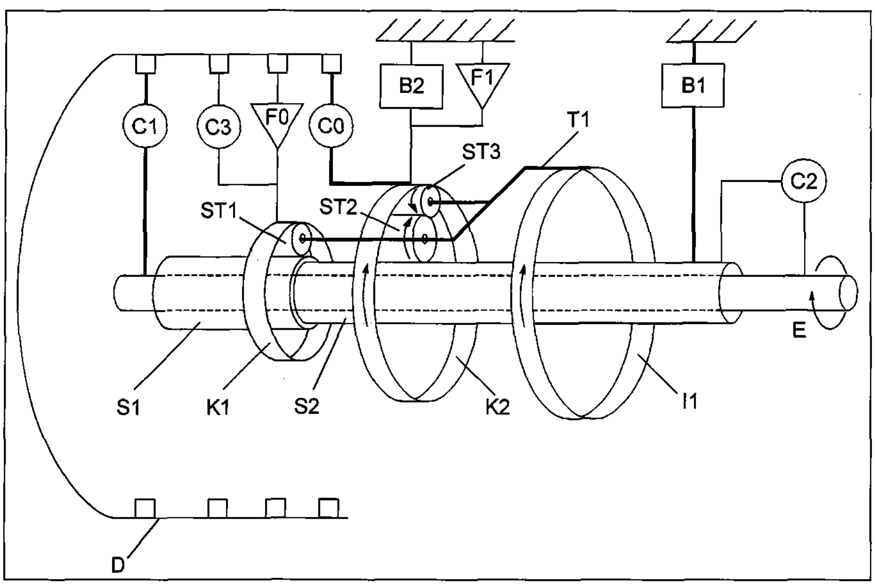
**Fourth gear** (selector lever on position **D**)

The gearbox input shaft **E** rotates in a clockwise direction.

The crownwheel **K2** is coupled to the input shaft **E** by the engagement of the multiple disc clutch **C1**, the clutch carrier drum **D** and the clutch **C0**.

The free wheel **F0** allows the crownwheel **K1** to rotate in a clockwise direction.

The sun gear **S2** is locked on the gearbox casing by the engagement of the band brake **B1**.

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The planet gears **ST2,** driven by the crownwheel **K2** via the planet gears **ST3,** shift onto the locked sun gear **S2,** rotating the gear train carrier **T1** in a clockwise direction.

The clockwise shift of the gear train carrier **T1** makes the planet gears **ST2** rotate in a clockwise direction on the locked sun gear **S2** and the planet gears **ST3** in an anti-clockwise direction.

The anti-clockwise rotation of the planet gears **ST3** on the crownwheel **K2** achieves a further increase in clockwise rotation of the gear train carrier **T1**.

The result is that the speed of the gear train carrier **T1** and the gear **I1** is higher than that of the driving crownwheel **K2**, obtaining 4th gear.

**Reverse** (selector lever on position **R**)

The gearbox input shaft **E** rotates in a clockwise direction.

The sun gears **S1** and **S2** are coupled by the input shaft **E**, by the engagement of the multiple disc clutch **C2**.

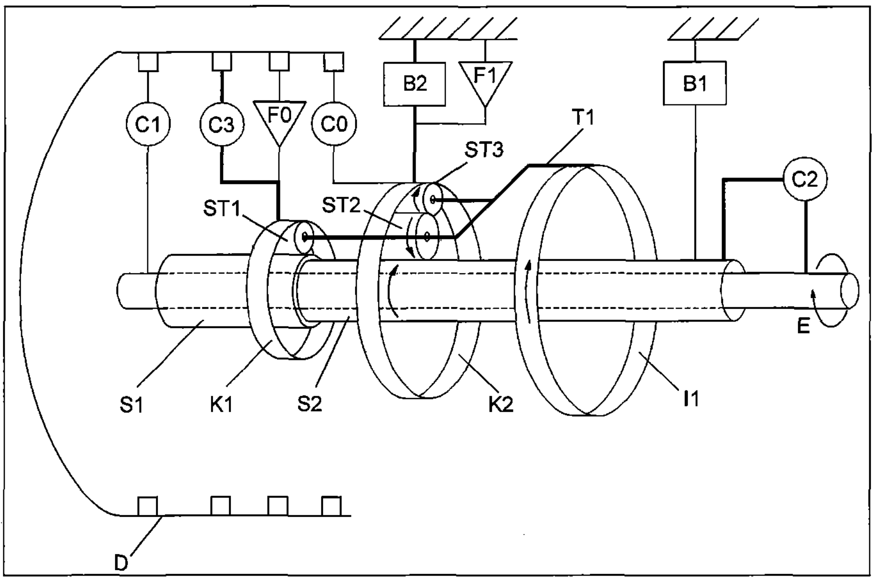
The clutch **C3** locks the free wheel **F0** and couples the crownwheel **K1** to the clutch carrier drum **D**.

The crownwheel **K2** is locked to the gearbox casing via the multiple disc brake **B2**.

The brake **B2** locks the free wheel **F1**.

The sun gear **S2**, coupled to the input shaft **E**, transmits motion anti-clockwise to the planet gears **ST2** and clockwise to the planet gears **ST3**.

The planet gears **ST3**, rotating clockwise, shift onto the locked crownwheel **K2**, thus making the gear train carrier **T1** and gear **I1** rotate anti-clockwise, obtaining reverse gear.

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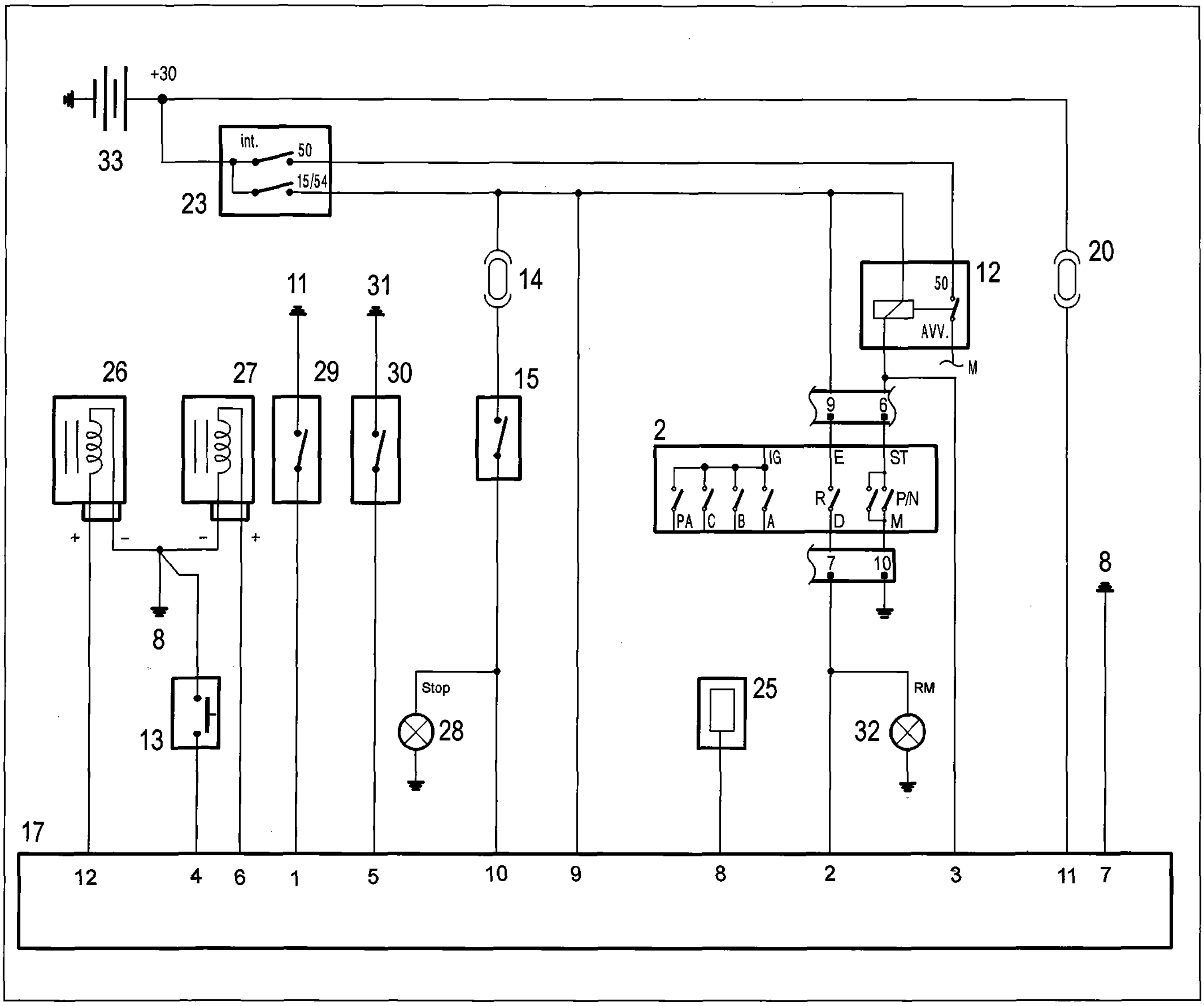
## SAFETY CONTROL UNIT

The safety functions of the AISIN automatic transmission are managed by a special electronic control unit and may be divided into two categories:

1. warning functions, which cause a buzzer to sound when:
   - the selector lever is shifted to position R;
   - a front door is opened when the selector lever is at a position other than P;
   - the engine is switched off with the selector lever in a position other than P;

2. functions which oblige the driver to carry out particular actions to allow:
   - the selector lever to be moved from position P with the engine running only with the brake pedal pressed;
   - the ignition key to be withdrawn only with the selector lever in position P.

# 21-27.




P4A14AB01

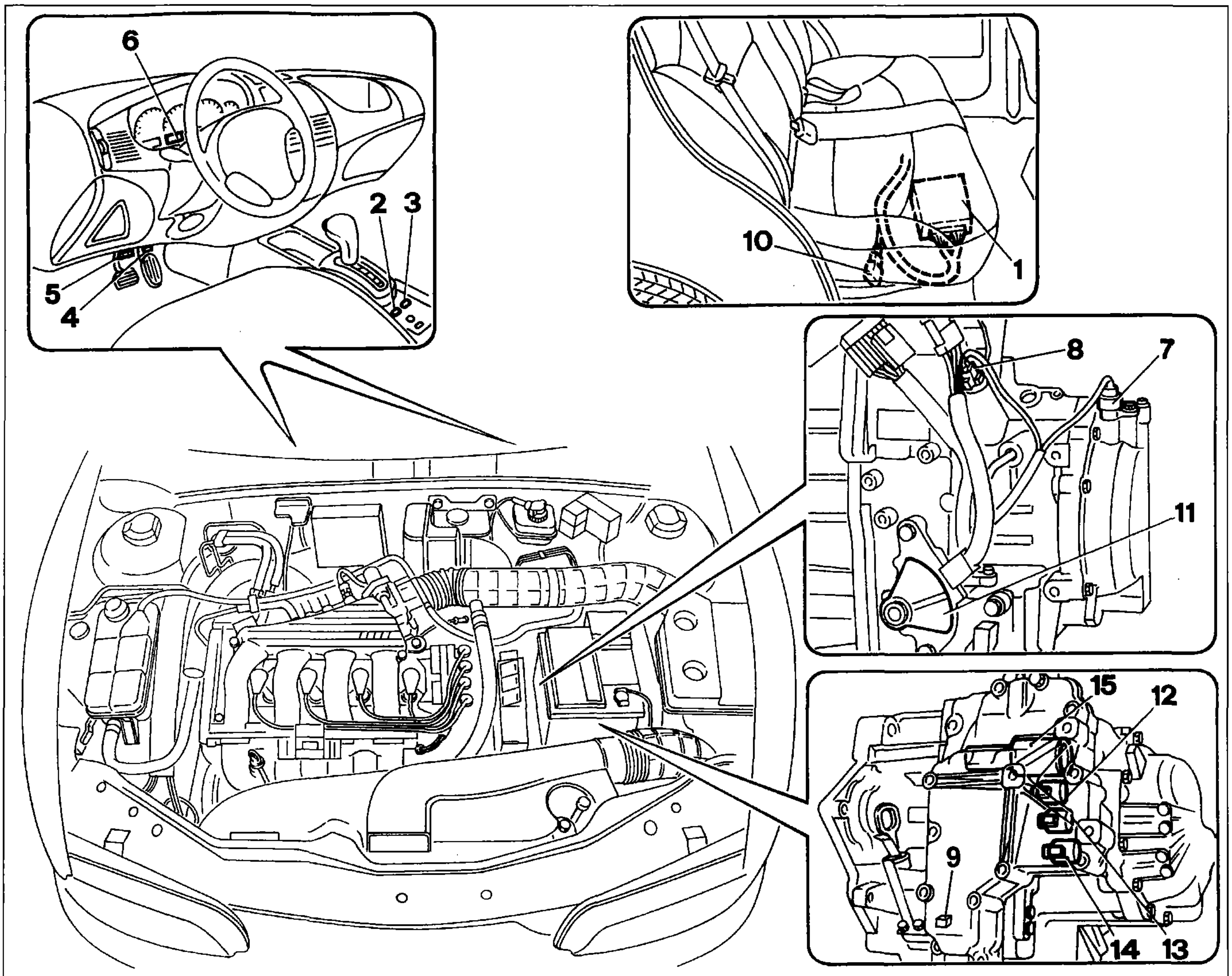
**Wiring diagram of safety control unit connections**

2. Selector lever position sensor
8. Rear earth
11. Left dashboard earth
12. Starter motor relay
13. PARK position additional switch
14. 15A fuse protecting STOP lights
15. STOP lights switch
17. Automatic transmission safety electronic control unit
20. 5A fuse protecting control module
23. Ignition switch
25. Speedometer signal generator
26. Ignition switch solenoid
27. Shift-lock solenoid
28. STOP lights
29. Front left button controlling courtesy light and door open indicator
30. Front right button controlling courtesy light and door open indicator
31. Right dashboard earth
32. Reversing lights
33. Battery

## ELECTRONIC CONTROL SYSTEM

The electronic control system of the AISIN automatic transmission comprises a control module, some switches and sensors which inform the control module of the different operating conditions and four actuators which receive commands from the control module and interact with the hydraulic control system to obtain the engagement of the different gears.
The control module also sends signals to the instrument panel and exchanges information with the fuel injection/ignition control unit and diagnostic socket.

**Location on the car of the control system components of the AISIN AW 596/Y024 automatic transmission**




1. Transmission control module
2. NORMAL/SPORT mode switch
3. ICE mode switch
4. Kick-down switch
5. Stop lights switch
6. Instrument panel
7. Main shaft rpm sensor (black)
8. Vehicle speed sensor (grey)
9. Gearbox oil temperature sensor
10. Diagnostic socket
11. Selector lever position sensor
12. Gear engagement solenoid S1
13. Gear engagement solenoide S2
14. Lock-up clutch solenoid SL
15. Pressure control solenoid STH

## CONTROL MODULE

The control module contains the electronic control logic of the automatic transmission, where the various functions are memorized, and is located under the rear seat.

The control module receives information concerning the operation of the automatic transmission from the various switches and sensors located on the gearbox, engine and dashboard, and issues the appropriate commands to four solenoids contained in a valve assembly located at the front of the automatic transmission, and to the fuel injection/ignition electronic control unit for reducing the driving torque under particular operating conditions.

### Control module functions

In accordance with the commands received from the driver via the various switches and also the signals coming from the sensors concerning the operating conditions, the control module ensures the correct operation of the gearbox by means of the following functions:
- actuation of gear changes,
- locking of torque converter (lock-up function),
- execution of driving mode,
- hydraulic pressure varations,
- check on gear change times,
- check on gear changes,
- safety function,
- self-test function.

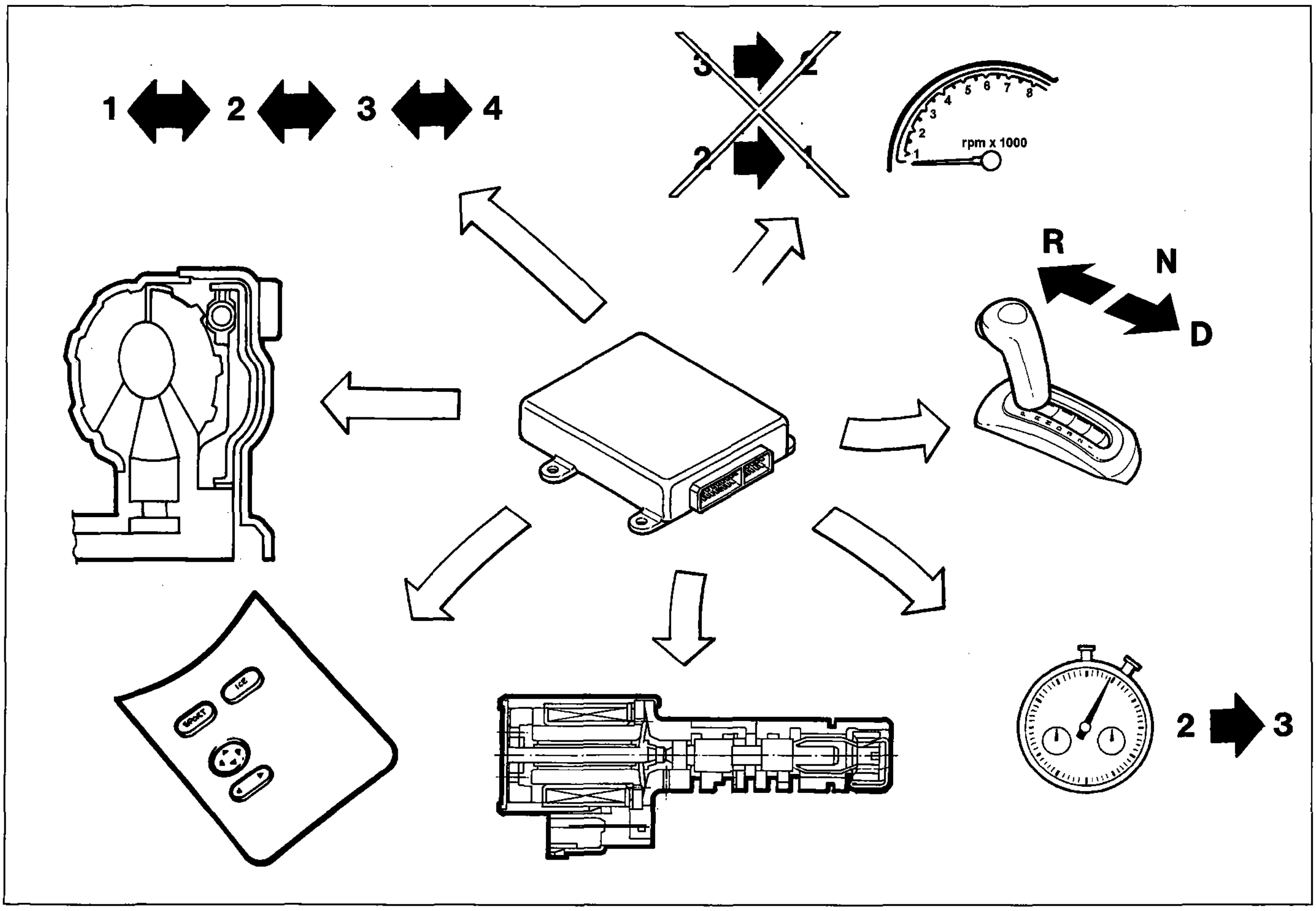



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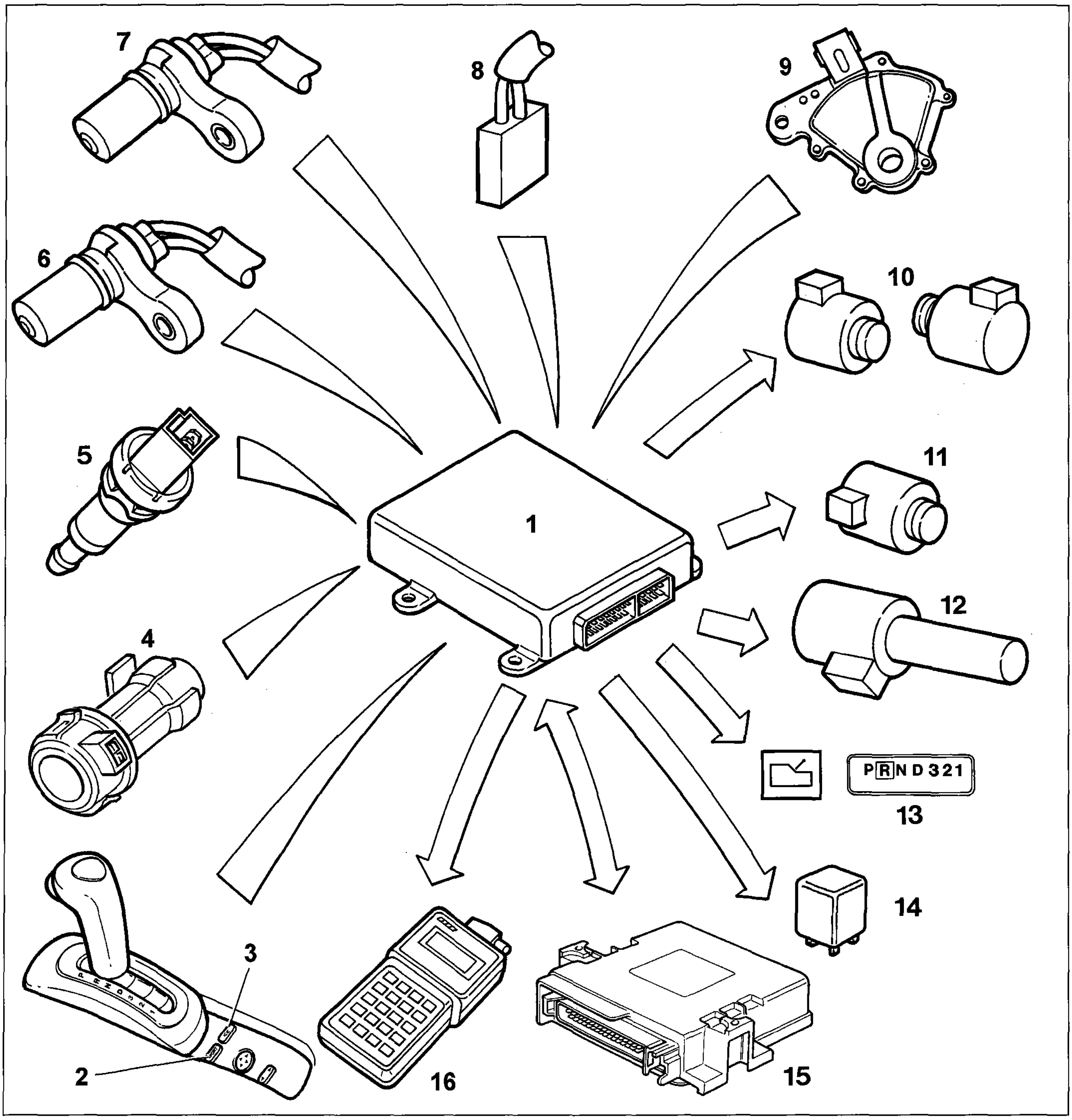
**Diagram of input and output information to/from control module**

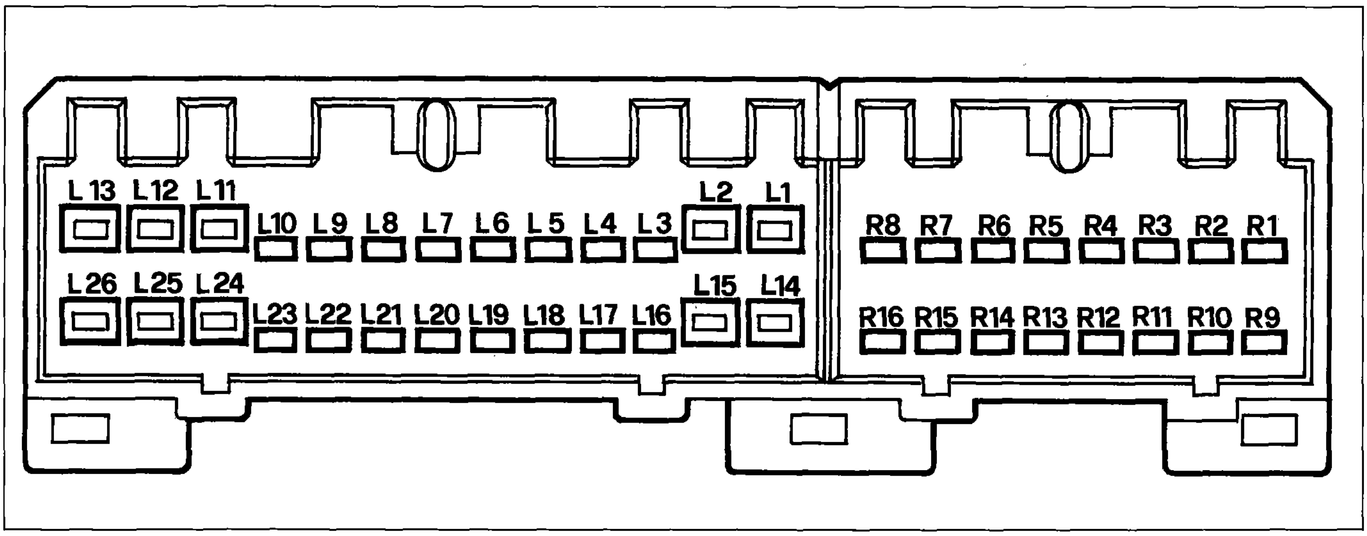



P4A17AB01

1. Control module
2. NORMAL/SPORT mode switch
3. ICE mode switch
4. Kick-down switch
5. Stop lights switch
6. Main shaft rpm sensor
7. Vehicle speed sensor
8. Gearbox oil temperature sensor
9. Selector lever position sensor
10. Gear engagement solenoids S1 and S2
11. Lock-up clutch solenoid SL
12. Pressure control solenoid STH
13. Instrument panel
14. Gearbox oil cooling fan relay
15. Fuel injection-ignition control unit
16. Diagnostic socket

# 21-27.

### Identification of control module connections

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**View of connector side of control module**

| Pin | Connection | Pin | Connection |
|---|---|---|---|
| R1 | Input for throttle aperture signal (fuel injection/ignition control unit pin 44) | L1 | Pressure control STH solenoid (-) |
| R2 | Earth for speed sensor cables | L2 | Earth on car |
| R3 | Main shaft rpm sensor (-) | L3 | Selector lever position sensor (A) |
| R4 | Vehicle speed sensor (-) | L4 | NC |
| R5 | NORMAL/SPORT mode switch | L5 | Gearbox oil temperature sensor (-) |
| R6 | Kick-down switch | L6 | NC |
| R7 | Selector lever position switch (C) | L7 | NC |
| R8 | NC | L8 | Earth on vehicle |
| R9 | Output for torque reduction signal (fuel injection/ignition control unit pin 32) | L9 | STOP lights switch |
| R10 | Input for engine coolant temperature signal (fuel injection/ignition control unit pin 5) | L10 | Display on instrument panel<br>- Selector lever position<br>- Driving mode<br>- Fault/high gearbox oil temperature sensor |
| R11 | Main shaft rpm sensor (+) | L11 | Pressure control solenoid STH (+) |
| R12 | Vehicle speed sensor (+) | L12 | Battery positive |
| R13 | NC | L13 | Solenoid S1 |
| R14 | ICE mode switch | L14 | NC |
| R15 | NC | L15 | NC |
| R16 | Selector lever position sensor (PA) | L16 | Selector lever position sensor (B) |
| | | L17 | NC |
| | | L18 | Gearbox oil temperature sensor (+) |
| | | L19 | Gearbox oil cooling fan relay |
| | | L20 | NC |
| | | L21 | Diagnostic socket earth (line G) |
| | | L22 | Diagnostic socket (line L) |
| | | L23 | Diagnostic socket (line K) |
| | | L24 | Lock-up clutch solenoid SL |
| | | L25 | Key-dependent positive (MAR) |
| | | L26 | Solenoid S2 |

## OPERATING STRATEGIES

### Actuation of gear changes

The change from one gear to the higher or lower gear depends on the accelerator pedal position, the vehicle speed, the engine's characteristic parameters and the driving mode selected by the driver.
The control module sends an ON/OFF signal to the solenoids S1 and S2.
They consent or prevent the oil from reaching the brakes and clutches necessary for obtaining the different transmission ratios, changing their condition from ON to OFF and vice versa as shown in the table below.

| Gear | Solenoid S1 | Solenoid S2 |
|---|---|---|
| 1st | ON | OFF |
| 2nd | ON | ON |
| 3rd | OFF | ON |
| 4th | OFF | OFF |

The 3rd-4th gear change is prevented when the engine coolant temperature is below 75°C.

The control module has specific gear change programs memorized for each driving mode (NORMAL, SPORT, ICE), which will be described on the following pages in the section relating to the driving modes.

### Locking of torque converter (lock-up function)

The engagement of the lock-up clutch for locking the torque converter depends on the gear engaged, the accelerator pedal position, the vehicle speed and the selected driving mode.
The control module sends a duty-cycle signal to the lock-up control solenoid SL, which discharges the oil pressure in the chamber on the flywheel side, causing the clutch to be engaged and the converter to be locked.

The control module has two specific programs for locking the torque converter memorized for the NORMAL and SPORT driving strategies, while for the ICE strategy the torque converter is not locked. These programs are described on the following pages in the section concerning the driving modes.

The converter is not locked under the following conditions:

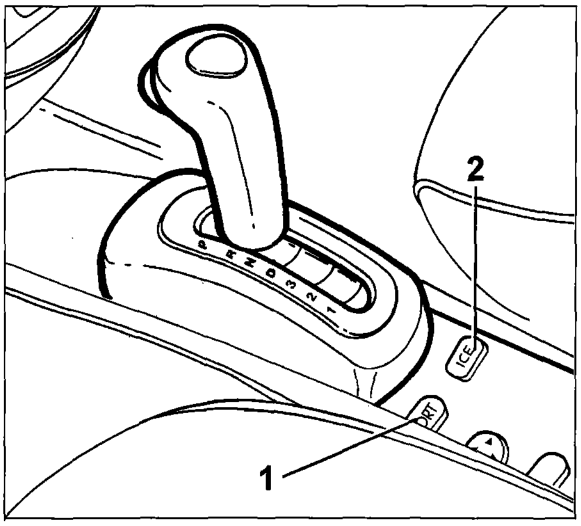
1. when the control system receives a fault signal from one of the components and executes the recovery strategy;
2. when the brake pedal is pressed and the gearbox input speed is below a certain value;
3. when the throttle valve is closed (accelerator pedal not pressed) and the vehicle speed is below 125 km/h with the selector lever on position D;
4. when the engine coolant temperature is below 75°C.

During the 3rd-4th gear change, with lock-up clutch engaged, the control module sends to the solenoid SL a signal with variable duty cycle, so as to temporarily disengage the lock-up clutch, to improve the quality of the gear change.

### Execution of driving mode

The control module is designed to control the operation of the automatic transmission in accordance with three different driving modes.
The three driving modes allow the driver to select the different capabilities of the automatic transmission in accordance with the momentary requirements of use:
- NORMAL to obtain the maximum driving comfort, while minimizing fuel consumption;
- SPORT to obtain the maximum performance of the vehicle;
- ICE to increase driving safety under slippery conditions.

# 21-27.

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At every start-up, the system is set to the NORMAL mode.
When the NORMAL/SPORT pushbutton (1) is pressed, the NORMAL mode is changed to SPORT mode and vice versa.
When the ICE pushbutton (2) is pressed (with the lever in position D), the system uses the ICE mode and excludes the other two modes. When the NORMAL/SPORT button is pressed, the NORMAL strategy is resumed.

1. NORMAL/SPORT pushbutton switch
2. ICE pushbutton

The change from one strategy to the other may be done at any time during driving.
The selected strategy is displayed beside the indication of the selector lever position on the instrument panel.

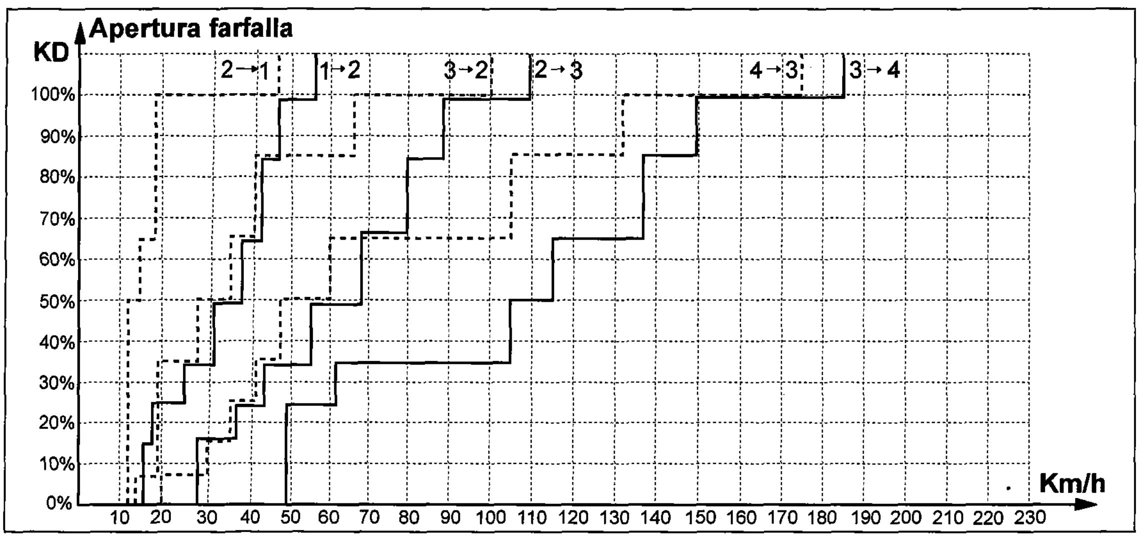

P4A20AB02

**Display of the operating strategy used and the selector lever position**

The behaviour of the AISIN automatic transmission, in accordance with the driving mode (NORMAL, SPORT or ICE) used, is described below.
The characteristic curves of change between the four ratios and the locking of the lock-up clutch are shown, both during progression and during reduction of the ratio (scaling), expressed as a function of the percentage of aperture of the throttle valve and the vehicle speed.

### Operation with NORMAL stategy

The NORMAL strategy is selected by the control module whenever the engine is started up.
With this operating stragegy, very gentle operation is ensured, aimed at optimizing driving comfort and economy of operation.

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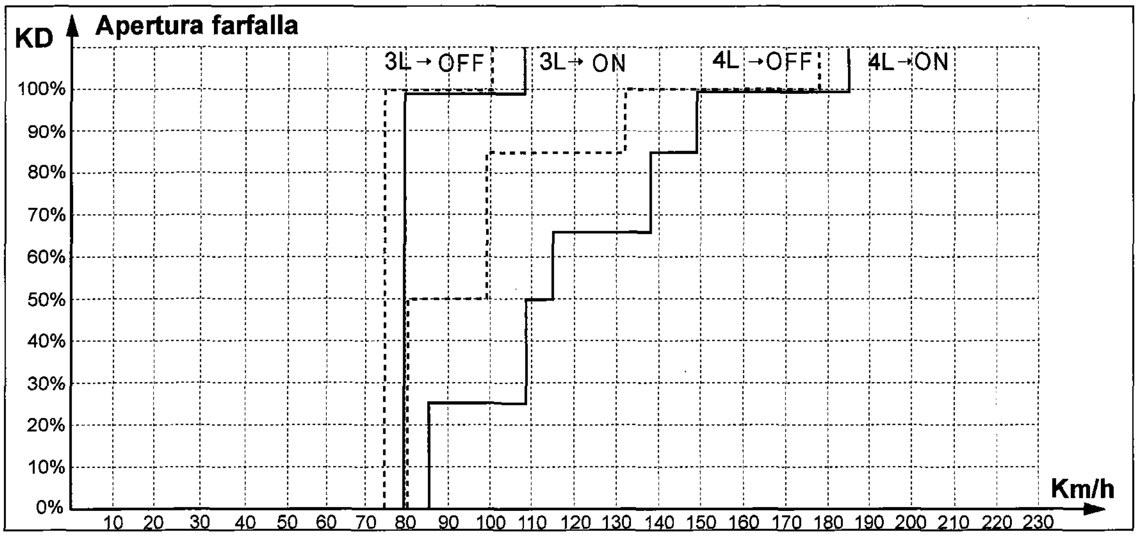
**Gear change program**

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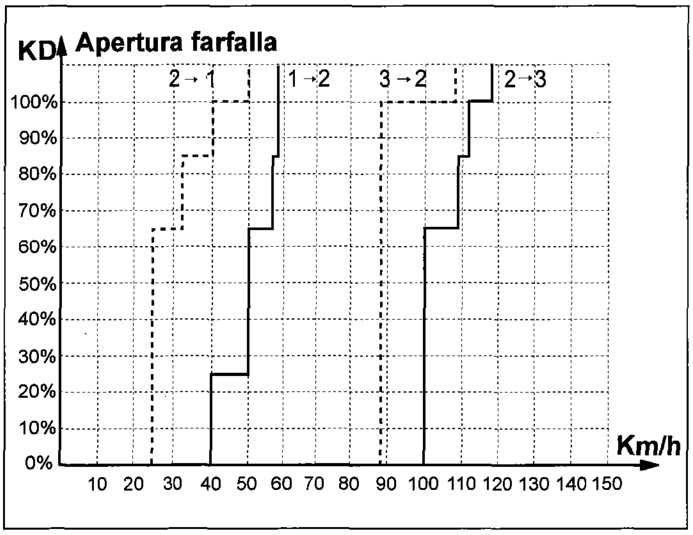
**Loci-up program**

## Operation in SPORT mode

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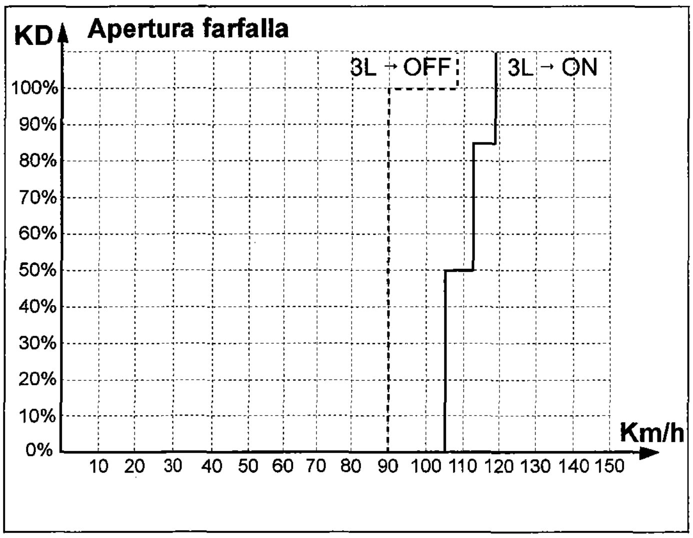
The control module switches to SPORT mode when the NORMAL/SPORT pushbutton located on the left of the selector lever is pressed.
This mode of use of the gearbox is designed to make full use of the power so as to obtain maximum performance from the vehicle; for the same aperture of the throttle valve, the changes to the higher ratios are automatically shifted to a higher engine speed.

The SPORT mode does not use 4th gear (cruising gear).

**Gear change program**




P4A21AB03

The SPORT mode is excluded in the following cases:

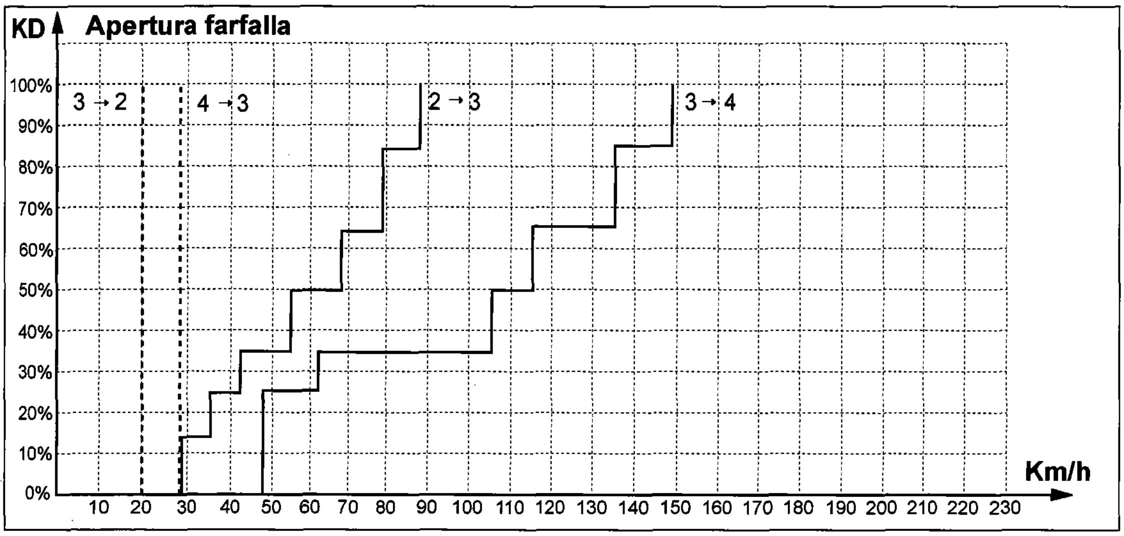
1. if the NORMAL/SPORT pushbutton is pressed again;
2. if the ICE pushbutton switch is pressed;
3. operation under recovery conditions.

**Lock-up program**

# 21-27.

### Operation in ICE mode

The ICE mode can be selected by pressing the ICE pushbutton located on the right of the selector lever, when the latter is at position D. This strategy improves driving safety on slippery roads by ensuring that the vehicle sets off gently by selecting 2nd gear on departure.
When the ICE mode is selected, the lock-up clutch is not locked.




**Gear change program**

P4A22AB01

The ICE mode is excluded in the following cases:
1. if the NORMAL/SPORT button is pressed;
2. if the selector lever is at a position other than D;
3. if the engine is switched off;
4. if the transmission fluid temperature is over 150°C;
5. operation under recovery conditions.

The table below illustrates the ratios which the gearbox uses automatically while the vehicle is driving, in relation to the driving mode used and the selector lever position, and shows the transmission ratio used on departure.

| Selected driving mode | Selector lever position | Ratio selected on departure | Automatic management | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| NORMAL | D | 1st | ← | — | — | → |
| | 3 | 1st | ← | — | → | |
| | 2 | 1st | ← | → | | |
| | 1 | 1st | — | | | |
| SPORT | 3 | 1st | ← | — | → | |
| | 2 | 1st | ← | → | | |
| | 1 | 1st | — | | | |
| ICE | D | 2nd | | ← | — | → |

**Hydraulic pressure variations**

The pressures in the hydraulic system are regulated by the control module, in order to achieve the following functions:
- increase in line pressure when cold;
- reduction in line pressure in the N-R change;
- modulation of driving pressure.

**Increase in line pressure when cold**

With the selector lever at position N, when the transmission oil temperature is below 10°C and the vehicle speed is below 7 km/h, the control module sends a signal for a period of 5 seconds to the solenoid STH, to increase the line pressure, so enabling the N-D and N-R engagement time to be reduced.

This function is excluded in the following cases:
- transmission oil temperature over 20°C;
- vehicle speed over 7 km/h;
- selector lever position other than N.

**Reduction of line pressure in N-R change**

When the selector lever is moved from position N to position R, the control module sends a signal to the solenoide STH to control the line pressure.
This makes the line pressure fall, so as to reduce the jolt caused by the engagement of reverse gear.

**Modulation of driving pressure**

The driving pressure of the hydraulic valves (throttle pressure) is increased by the control module, depending on the aperture of the throttle valve and the vehicle speed.

**Control of gear change times**

Comparing the ratios between the input and output speeds, provided by the main shaft rpm sensor and vehicle speed sensor respectively, with the memorized values of the transmission ratios of the different gears, the control module assesses the time used for the gear changes.

**Controlling gear changes**

In an automatic transmission, the engagement of gears causes jolts resulting from the sudden variation in transmission ratios; these are more pronounced when engaging 1st gear and reverse gear, which permit higher transmission ratios.

These jolts caused by the engagement of 1st gear and reverse gear are inconveniently perceptible for the occupants and also cause stresses on the gearbox gears.

To reduce these stresses and improve driving comfort, the AISIN automatic transmission uses the following features:
- engagement of 1st gear or reverse gear with a reduction in driving torque (garage function);
- N-D change with pitch control (squat);
- N-R change with reduction in line pressure.

**Engagement of 1st gear or reverse gear (garage function)**

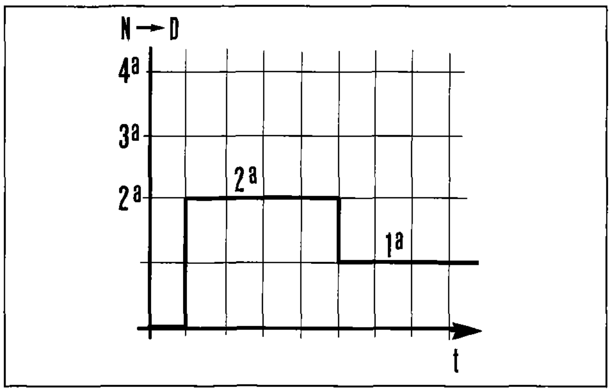
When the selector lever is moved as follows:
- from P or N to R;
- from N to D (3-2-1);

with this function the control module sends a signal to the fuel injection-ignition control unit so as to reduce the driving torque, reducing the jolt caused by the engagement of 1st gear or reverse gear.

# 21-27.

### N-D change with pitch control (squat)

When the selector lever is moved from position N to position D, the control module temporarily engages 2nd gear, and thenn changes to 1st gear. In this way the jolt caused by the engagement of 1st gear and the resulting pitching movement of the vehicle are reduced.

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This function only intervenes if the following conditions arise simultaneously:

- brake pedal pressed (stop lights on);
- throttle valve closed (throttle aperture 0%);
- vehicle speed below 7 km/h;
- driving mode is NORMAL or SPORT;
- when the selector lever is moved from position N to position D.

### Inhibition of reverse gear

With the selector lever at position R, with a vehicle speed of over 7 km/h, the control module sends a signal to the gear change solenoids (solenoid 1 not activated -OFF- and solenoid 2 activated -ON-) inhibiting reverse gear.
The inhibition of reverse is deactivated in the following cases:

- vehicle speed below 5 km/h;
- selector lever position other than R.

### Self-test

The electronic control system constantly monitors the sensors, control solenoids and all the other electronic components, in order to detect faults and malfunctions immediately; these errors are memorized in the control module and can be read using the FIAT/LANCIA Tester.

### Error detection conditions

The control module can detect errors in the various components only under particular conditions. With the ignition set to ON or START, and in all other conditions, the following errors can be detected:

- error in gear change solenoid S1;
- error in gear change solenoid S2;
- error in lock-up clutch control solenoid SL;
- error in pressure control solenoid STH;
- error in selector lever position sensor;
- error in throttle position sensor;
- error in kick-down switch;
- error checking transmission of driving torque reduction signal;
- error in gearbox oil temperature sensor when it still indicates an oil temperature of below 10°C after the engine coolant has reached 75°C.

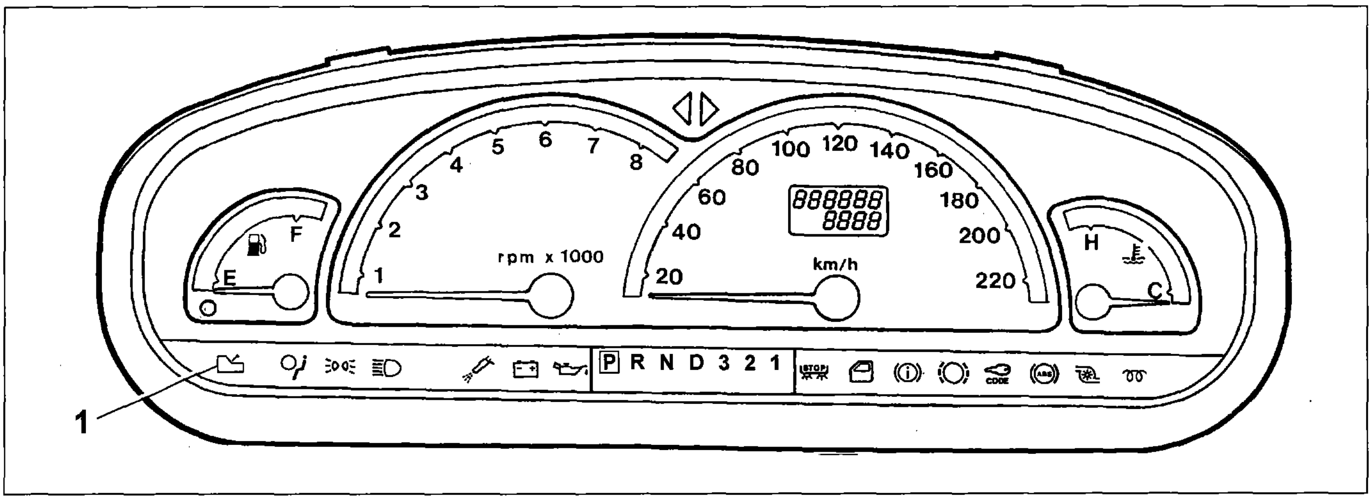
With the engine running, the following are detected:

- error in battery voltage;
- error in coolant temperature sensor after a period of 10 minutes.

With the vehicle moving, the following are detected:
- error in main shaft rpm sensor;
- error in vehicle speed sensor;
- error in transmission ratio, when the ratio between the main shaft rpm and vehicle speed differs for more than one second from the memorized transmission ratios;
- error in gearbox mechanism, when the gear change time exceeds 1.3 seconds or when the change down to a lower ratio is effected at a higher speed than the maximum permitted speed.

**Memorization of errors**

In the case of significant faults, the red warning light (1) on the instrument panel comes on.
If the gearbox oil temperature is over 150°C, the red warning light (1) remains permanently on.

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For each error, the control module memorizes:
- the component which caused the error (e.g. pressure control solenoid);
- the classification of the error (Present or Intermittent);
- the type of error (A.C./D.C. GND/D.C. Vbatt/etc.).

**Error deletion**

The errors memorized by the control module can be deleted by active diagnosis with the FIAT/LANCIA Tester or by disconnecting the battery for over 10 seconds.

**Recovery strategies**

If the control module detects a fault, the red warning light on the instrument panel flashes to warn the driver and, at the same time, the appropriate recovery strategy is activated to allow the car to reach the nearest Authorized Garage.

**Main components**

If the control module has memorized one of the following errors:

- errors in gear change solenoids S1 or S2;
- error in pressure control solenoid STH;
- error in selector lever position sensor;
- error in throttle position sensor;
- error in main shaft rpm sensor;
- error in vehicle speed sensor;
- error in transmission ratio;
- error in checking transmission of driving torque reduction signal;
- error in battery voltage;
- error in gearbox mechanism;

# 21-27.

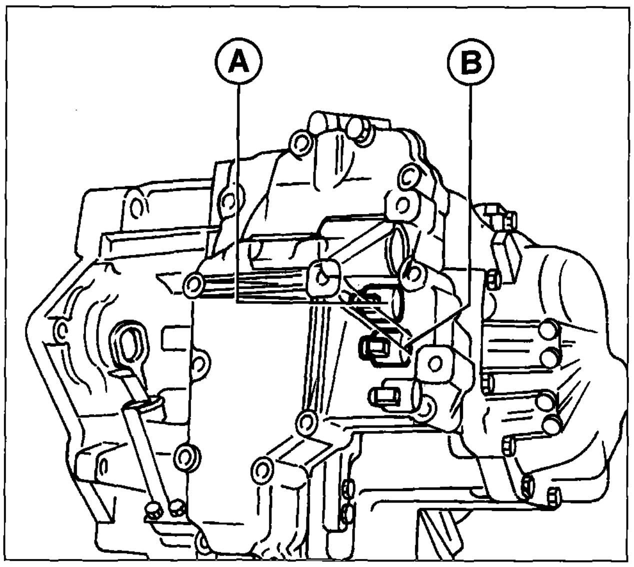
The recovery stragegy involves the deactivation of all the solenoids, so no automatic gear changes are effected, the torque converter is not locked and the hydraulic pressure is not varied.
The vehicle can travel because each position of the selector lever corresponds to the engagement of a particular transmission ratio, by the movement of the hydraulic distributor.

| **Selector lever position** | R | D | 3 | 2 | 1 |
|---|---|---|---|---|---|
| **Gear engaged** | Reverse | 4th | 4th | 3rd | 1st |

**Lock-up control solenoid**
In the case of error, the torque converter locking function is disabled.

**Coolant temperature sensor**
In the case of error, a substitutive value of 75°C is assigned.

**Kick-down switch**
In the case of error, it is considered ON if the throttle valve aperture is greater than 73.5%, OFF if it less than 70%.

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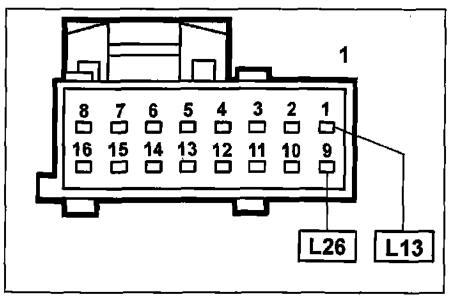


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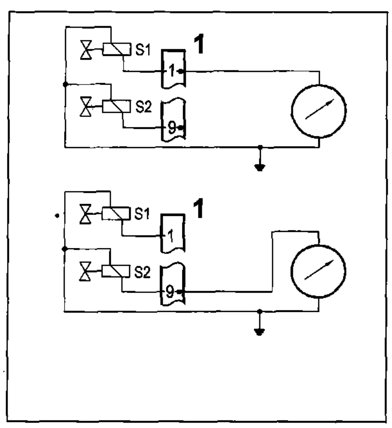
**Gearbox sensors/actuators connector (view of contact side)**

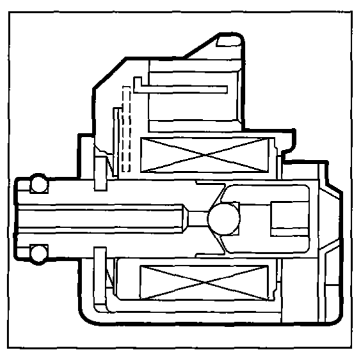
The resistance of the gear change solenoids S1 and S2 can be measured by disconnecting the connector and connecting an ohmmeter as shown in the figure.
**Resistence: 13 ± 2 ohm at 20°C**

**GEAR CHANGE SOLENOIDS**
The gear change solenoids S1 (A) and S2 (B) are located at the front of the gearbox and they manage the gear changes. The solenoids are actually normally closed (N.C.) electrovalves which, receiving a signal from the control module, change their position to allow the engagement of the different transmission ratios, in accordance with the following table.

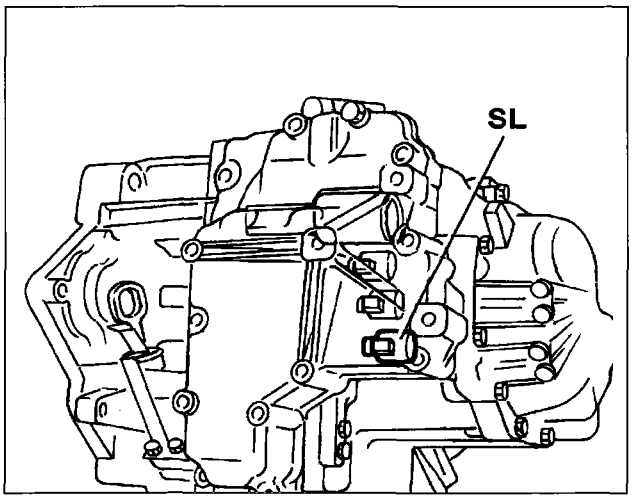
| Gear | Solenoid S1 | Solenoid S2 |
|---|---|---|
| 1st | ON | OFF |
| 2nd | ON | ON |
| 3rd | OFF | ON |
| 4th | OFF | OFF |




P4A26AB03



P4A26AB02

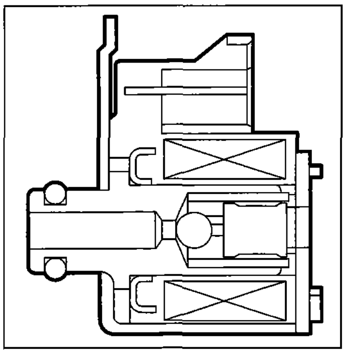



P4A27AB01

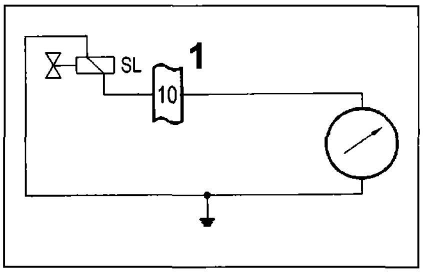
## LOCK-UP CLUTCH CONTROL SOLENOID

The lock-up clutch control solenoid SL is located at the front of the gearbox and manages the locking of the torque converter.

The solenoid, controlled by a duty cycle signal sent by the control module, intercepts the passage of oil, discharging the pressure which acts on the rear face of the clutch.
The clutch, fitted on the turbine hub, is pushed by the pressure in the converter acting on its front face, against the casing joined to the converter pump, so locking it.

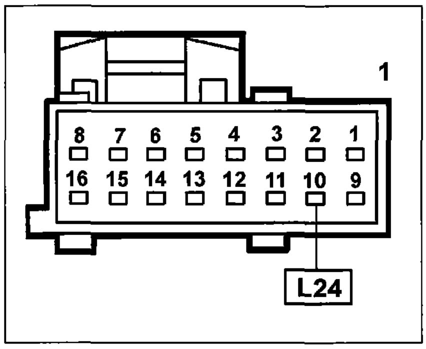


P4A27AB02




P4A27AB03

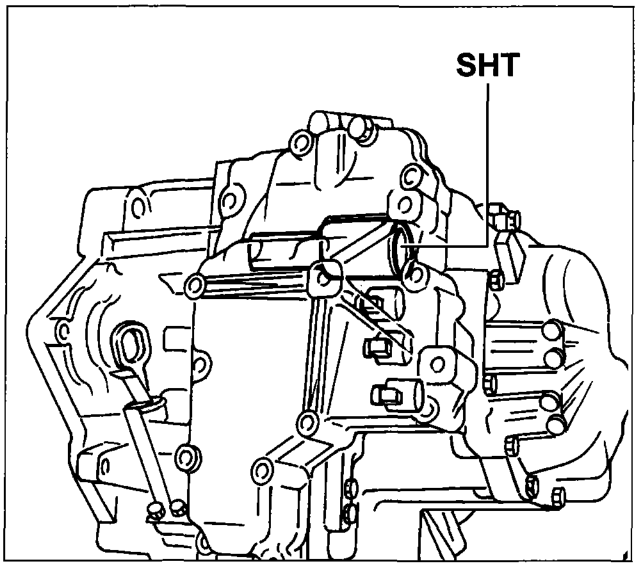
**Resistance: 13 ± 2 ohm at 20°C**




P4A27AB04

**Gearbox sensors/actuator connector (view of contact side)**

The resistance of the lock-up clutch control solenoid SL can be measured by disconnecting the connector and connecting an ohmmeter as shown in the figure.




P4A27AB05

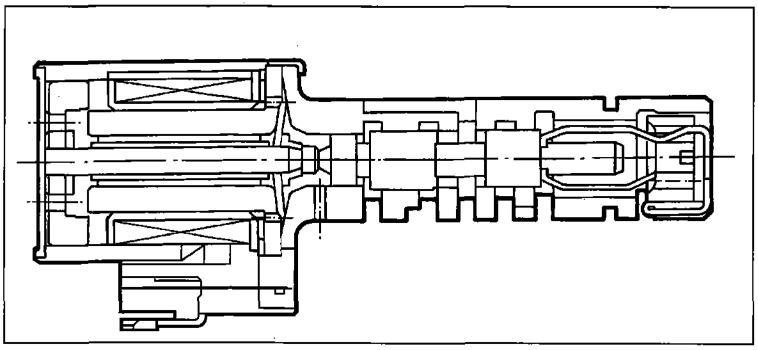
## PRESSURE CONTROL SOLENOID

The line pressure control solenoid STH is located at the front of the gearbox and it manages the changes in hydraulic pressures.

The solenoid, also controlled by a duty cycle signal sent by the control module, regulates the hydraulic pressure acting on the brakes and clutches in order to reduce the gear engagement times when cold and the jolting on engagement of reverse.

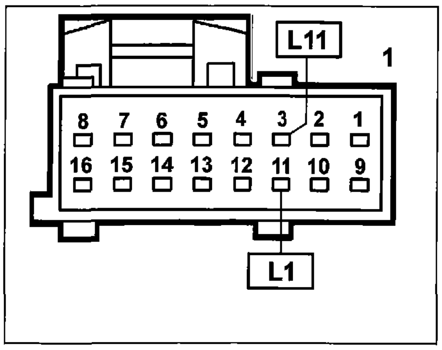
The solenoid also regulates the pressure driving the hydraulic valves in accordance with the throttle valve aperture and the vehicle speed.

## 21-27.



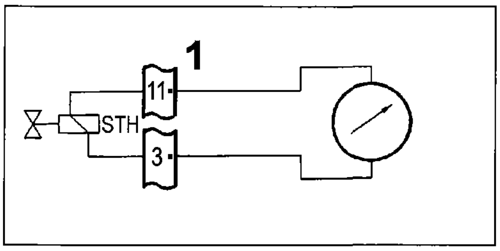
P4A28AB01

The resistance of the line pressure control solenoid STH can be measured by disconnecting the connector and connecting an ohmmeter as shown in the figure.




P4A28AB02

**Gearbox sensors/actuators connector (view of contact side)**

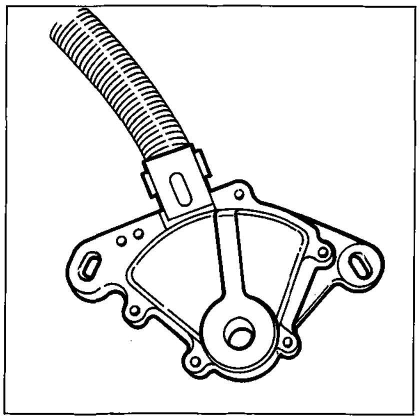



P4A28AB03

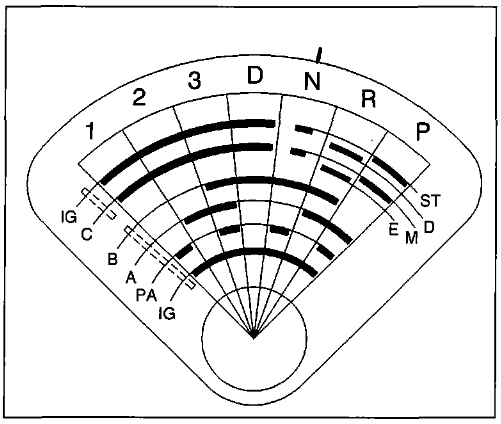
**Resistance: 3.5 ± 0.2 ohm at 25°C**

### SELECTOR LEVER POSITION SENSOR

The sensor, located at the top of the gearbox casing, detects the position of the selector lever (to which it is connected mechanically) and informs the control module via an appropriate electrical signal. The module lights up the warning light on the instrument panel.



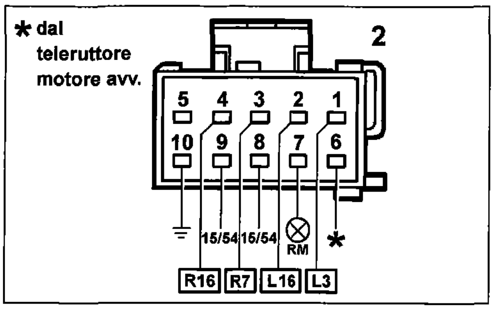
P4A28AB04




P4A28AB05

The sensor also switches on the reversing lights when reverse is engaged, and enables the starter motor only when the selector lever is at position N or P.

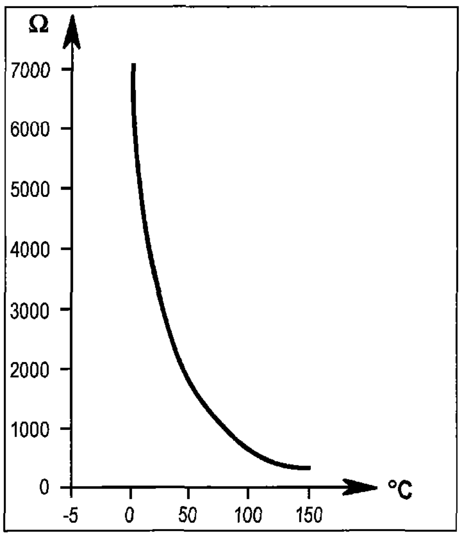
The combination output signals present on the various terminals of the sensor is shown in the following table.




P4A28AB06

**Lever position sensor connector (view of contact side)**

| Connectors | Start. | | REVERSE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Terminals | 6 | 10 | 7 | 9 | 8 | 1 | 2 | 3 | 4 |
| Signals | ST | M | D | E | IG | A | B | C | PA |
| P | • | • | | | • | • | | | • |
| R | | | • | • | • | • | • | | |
| N | • | • | | | • | | • | | • |
| D | | | | | • | | • | • | |
| 3 | | | | | • | • | • | • | • |
| 2 | | | | | • | • | | • | |
| 1 | | | | | • | | | • | • |

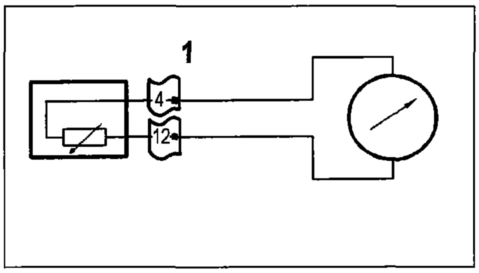



P4A29AB01

## GEARBOX OIL TEMPERATURE SENSOR

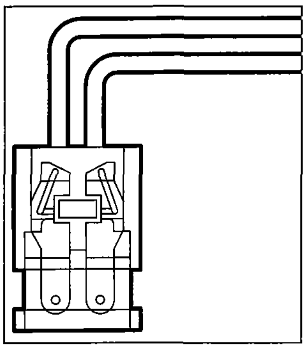
The sensor is located in the gearbox casing and detects the transmission oil temperature through the variation in NTC resistance on the sensitive part of the sensor.
The information provided by the control module is used to increase the line pressure when cold in order to reduce the gear change times.
The resistance of the gearbox oil temperature sensor can be measured by disconnecting the connector and connecting an ohmmeter as shown in the figure.

**Wiring diagram**

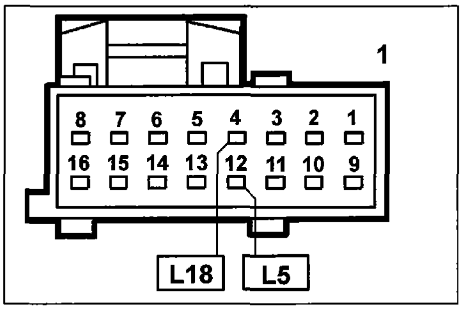



P4A29AB04

**Resistance: 6445 ± 645 ohm at 10°C**
**247 ± 16 ohm at 110°C**
**111 ± 6 ohm at 145°C**

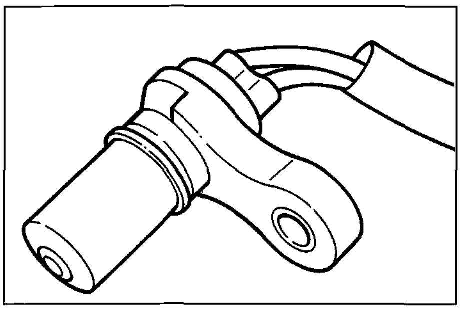


P4A29AB02




P4A29AB03

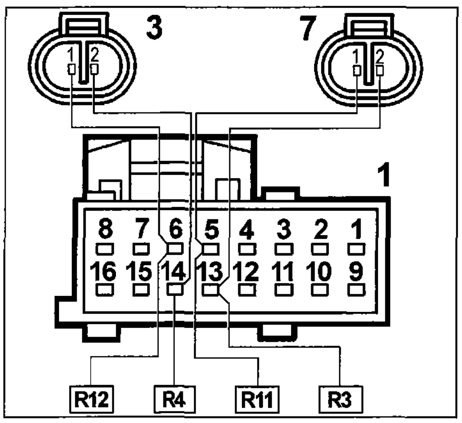
**Gearbox sensors/actuators connector (view of contact side)**



P4A29AB05

## MAIN SHAFT RPM AND VEHICLE SPEED SENSOR

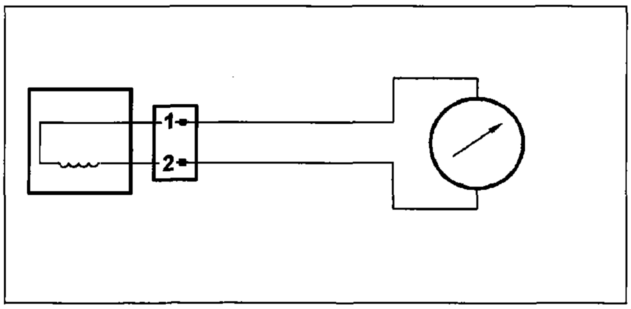
The two magnetic induction sensors located on the gearbox casing allow the control module to check the correct operation of the gearbox with regard to transmission ratios and gear change times, and to conduct diagnoses on the operation of the sensors.
The main shaft rpm sensor detects the speed of rotation of the gearbox main shaft, conneted to the torque converter turbine, via a 20-tooth phonic wheel on the outer surface of the clutch C1.
The sensor sends to the control module a pulse signal (20 pulses per shaft revolution) proportional to the input speed of rotation of the gearbox.
The vehicle speed sensor detects the speed of rotation of the gearbox layshaft, connected to the differential pinion, by means of a 12-tooth phonic wheel constituted by the parking lock gear.
The sensor sends the control modue a pulse signal (12 pulses per shaft revolution) proportional to the output speed of rotation of the gearbox, i.e. to the vehicle speed. This signal is used to effect the gear changes.




P4A29AB06

**Gearbox sensors/actuators connector (view of contact side)**

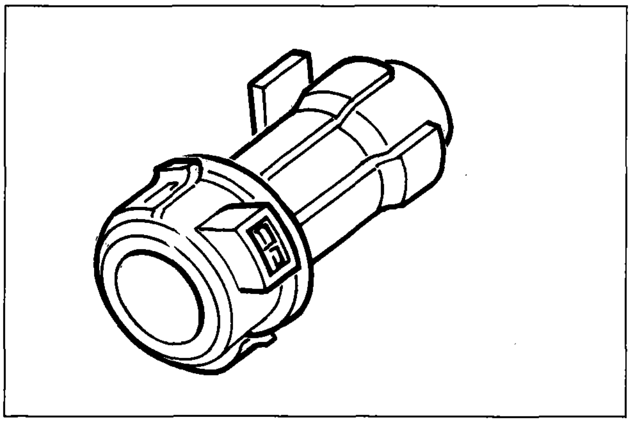
## 21-27.




P4A30AB01

The resistance of the main shaft rpm and vehicle speed sensors can be measured by disconnecting the connectors and connecting an ohmmeter as shown in the figure.

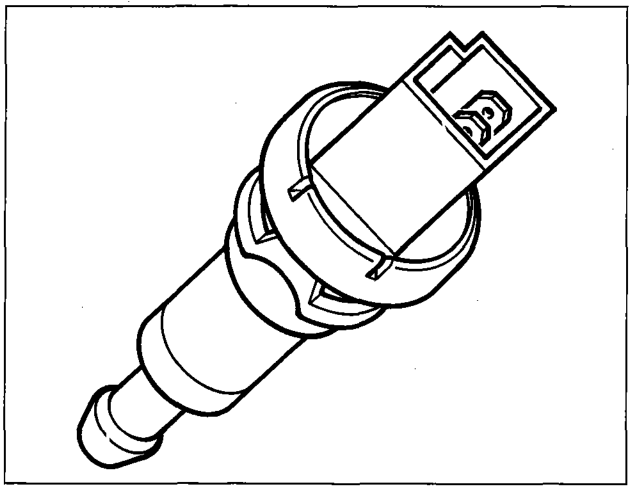
**Resistance of main shaft rpm sensor: 430 ± 43 ohm at 20°C**
**Resistance of vehicle speed sensor: 720 ± 72 ohm at 20°C.**



P4A30AB02

### KICK-DOWN SWITCH

The kick-down switch is installed on the accelerator pedal and is operated when the accelerator pedal is pressed beyond a certain travel.
When the switch is operated, the control module (terminal R6) scales the transmission ratio in accordance with the vehicle speed, adhering to the selected gear change program.
With the switch at the ON position, the control unit effects the gear changes at higher engine speeds.



P4A30AB03

### STOP LIGHTS SWITCH

The switch, mounted on the pedal assembly, is closed when the brake pedal is pressed, causing the STOP lights to come on and supplying the L9 terminal of the control module to exclude the torque converter lock-up function when the brake pedal is pressed.

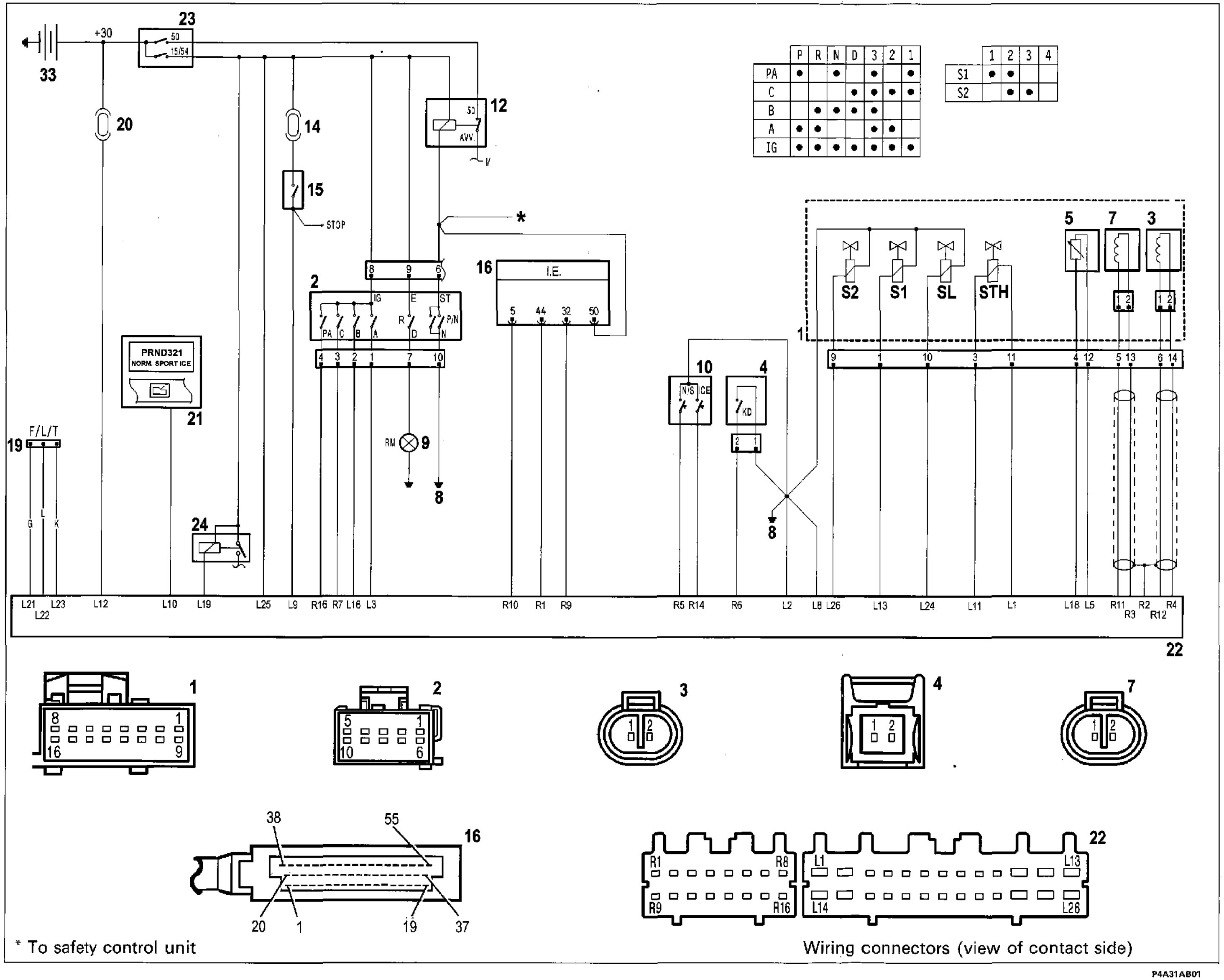
### THROTTLE VALVE POSITION SIGNAL

The throttle valve position signal is acquired by the fuel injection/ignition control unit, which detects it via the potentiometer installed on the throttle body.
The automatic transmission control unit uses this signal (PWM type with variable duty cycle), receiving it directly from the fuel injection/ignition control unit.

### ENGINE COOLANT TEMPERATURE SIGNAL

The engine coolant temperature signal is received by the fuel injection-ignition control unit, which detects it via an NTC sensor located on the thermostat body.
The automatic transmission control unit uses an ON/OFF type signal generated by the fuel injection/ignition control unit; the signal is changed over at a coolant temperature of 75°C.

## WIRING DIAGRAM




| | P | R | N | D | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|
| PA | • | | • | | • | | • |
| C | | | | • | • | • | • |
| B | | • | • | • | • | | |
| A | • | • | | | • | • | |
| IG | • | • | • | • | • | • | • |

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| S1 | • | • | | |
| S2 | | • | • | |

**Key**

1. Solenoid assembly on automatic transmission
2. Selector lever position sensor
3. Vehicle speed sensor
4. Kick-down switch
5. Gearbox oil temperature sensor
7. Main shaft rpm sensor
8. Rear earth
9. Reversing lights
10. NORMAL/SPORT and ICE mode switches
12. Starter motor relay
14. 15A fuse protecting STOP lights
15. STOP lights switch
16. Fuel injection/ignition electronic contdrol unit (P/N position signal)
17. Automatic transmission safety electronic control unit
19. Diagnostic socket for Fiat/Lancia tester
20. 5A fuse 5A protecting control module
21. Warning lights on instrument panel (for displaying selector lever position, selected driving mode and fault indication)
22. Control module
23. Ignition switch
24. Gearbox oil cooling fan relay
33. Battery

## DIAGNOSIS

Operating problems in the AISIN electronic automatic transmission may be caused by the engine, control system or automatic transmission itself.

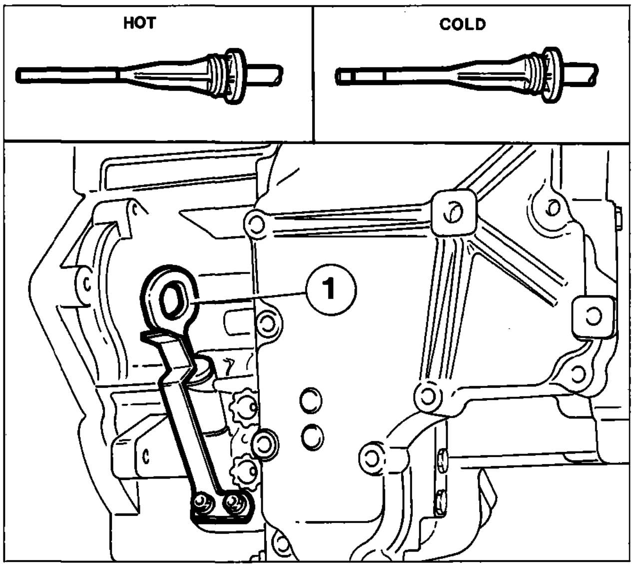
The fault-finding procedure begins with very simple operations, carried out in order of difficulty, initially aimed at establishing whether the fault depends on the engine, control system or gearbox.

Electrical faults are revealed by the self-test funcction of the control module, by the flashing of the red light on the instrument panel.

### Preliminary tests

### Checking oil level

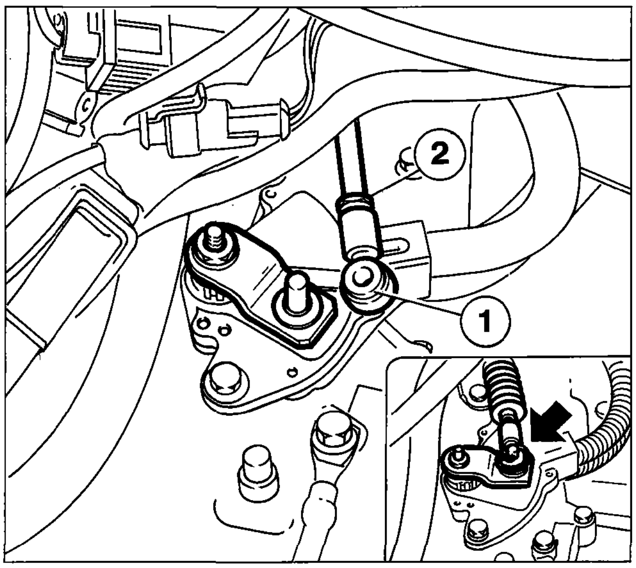
**NOTE** *The gearbox oil level must be checked with the engine and gearbox at normal operating temperatures (gearbox oil: 70 - 80°C), so the vehicle must be driven for a suitable period of time before the check.*



P4A32AB01

To check the level of the gearbox oil, proceed as follows:
- park the vehicle on flat ground and apply the handbrake;
- with the engine idling, gently move the selector lever from position P to position 1, then return it to P;
- withdraw the dipstick (1) and clean it;
- insert the dipstick fully into its seating;
- withdraw the dipstick again and check that the oil level lines up with the notch on the side of the stick marked HOT.

If the oil level is low, identify and eliminate the leaks, then top up the level.
Also check the condition of the oil; if is black or smells burnt, it should be changed.



P4A32AB02

### Checking selector lever position

When the selector lever is moved from position N to the other positions, check that it moves freely without stiffness into any position, and that the position indicator on the instrument panel indicates the correct position.

### Checking starter switch

If the engine does not start when the selector lever is at position N or P, or vice versa it starts when the lever is in a position other than N or P, the selector lever control cable must be adjusted as described on page 45, by adjusting the head (1) and locking it with the locknut (2). Finally check the correct position of the selector lever position sensor as described on page 47.

**Checking idle speed**

Check that the idle speed is correct.

**Tests with FIAT/LANCIA Tester**

Guided fault finding on the electrical part can be conducted by connecting the FIAT/LANCIA Tester with M39-A memory to the control module's diagnostic socket.
Full diagnosis of the system consists of three stages:
1. display of a set of operating parameters (with the engine running);
2. display of errors and elimination of the causes (guided diagnosis);
3. activation of the actuators (active diagnosis).

**1. Display of operating parameters**

The following operating parameters are displayed:
- selector lever position;
- gear engaged;
- vehicle speed;
- throttle valve angle of aperture;
- STH pressure control solenoid;
- kick-down switch,
- brake pedal contact;
- engine coolant temperature;
- gearbox oil temperature;
- gearbox main shaft rpm;
- driving torque reduction function;
- battery voltage.

**2. Display of errors and elimination of causes (guided diagnosis)**

At the beginning of diagnosis, the F/L Tester reads the errors memorized by the control module.
When an error is detected, the F/L Tester emits an acoustic signal and displays a message relating to the error.
A list of the possible causes of the error is then displayed.

After all the necessary repairs or replacements have been carried out and all the faults eliminated, the errors will be automatically deleted by the F/L Tester.

Guided diagnosis can also be carried out by checking step by step the efficiency of the circuits and operation of the various sensors/switches.

Once the faults have been eliminated, a road test should be carried out with the engine and gearbox up to temperature for at least 10 minutes, and then the F/L Tester should be used to check that there are no faults in the system.

**3. Activation of actuators (active diagnosis)**

The following actuators can be activated by a command sent from the F/L Tester, with the engine off and the selector lever at position N:
- gear change solenoids S1 and S2;
- lock-up clutch control solenoid SL;
- line pressure control solenoid STH.

This test is useful for checking the operation of the actuators, as the ticking caused by the internal movement of the solenoids can be heard.

Errors memorized by the control module can also be deleted under active diagnosis (provided they are no longer present or the conditions are not recreated).

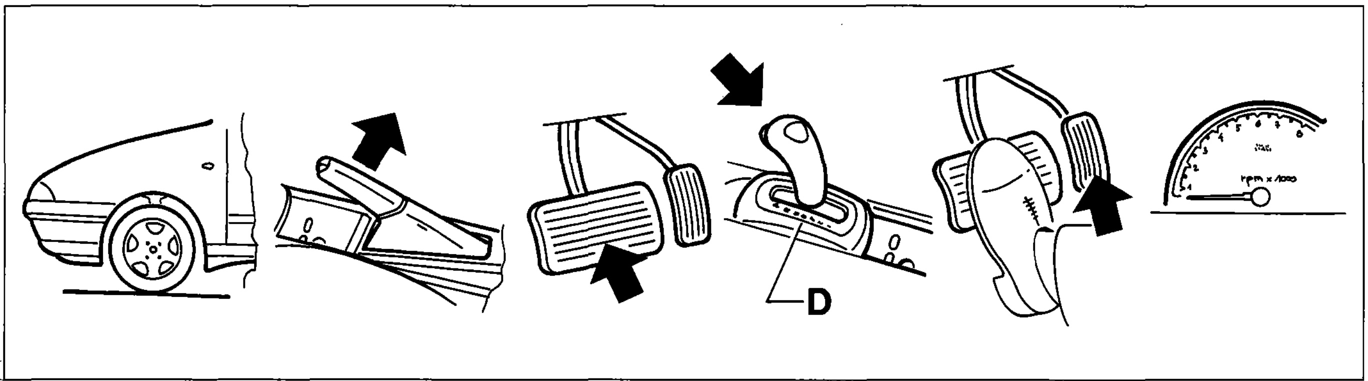
**NOTE** *Errors can also be deleted by disconnecting the battery for over 10 seconds.*

# 21-27.

**Stall speed test**

This test serves to check the performance of the transmission and engine, and is conducted by measuring the maximum rpm that can be reached by the engine with the selector lever at position D and R.

*The duration of the stall speed test must not exceed 5 seconds.*




P4A34AB01

To conduct the stall speed test, proceed as follows:
- chock the vehicle by placing wedges under the wheels;
- apply the handbrake fully;
- start the engine and bring it up to temperature;
- press the brake pedal down hard with the left foot;
- move the selector lever to position D;
- press the accelerator pedal down fully with the right foot and quickly read the maximum speed reached by the engine.

**Stall speed: 2300 ± 150 rpm**

Repeat the sequence of operations, but moving the selector lever to position R.

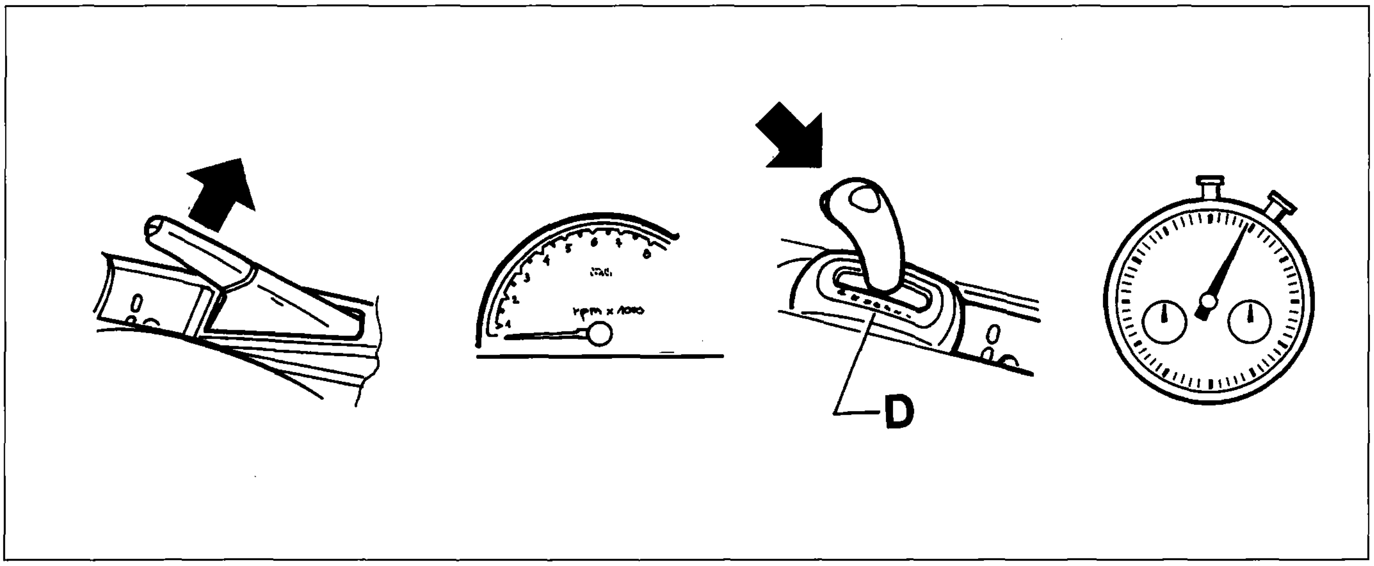
**Stall speed: 2300 ± 150 rpm**

| Stall speed | Possible causes |
|---|---|
| Lower than specified value in both D and R | * Insufficient engine power<br>* Incorrect operation of free wheel on stator of torque converter |
| Higher than specified value in D | * Insufficient line pressure<br>* Clutch C1 and C3 slipping<br>* Incorrect operation of free wheel F1 |
| Higher than specified value in R | * Insufficient line pressure<br>* Clutch C2 slipping<br>* Clutch C3 slipping<br>* Brake B2 slipping |
| Higher than specified value in both D and R | * Insufficient line pressure<br>* Clutch C3 slipping |

**Gear engagement time test**

This test is for checking the condition of clutches C2 and C3 and the brake B2, and is conducted by measuring the time taken to engage first gear or reverse gear.

*To obtain a reliable result, carry out several measurements and take the average value. Allow one minute to pass between two consecutive measurements.*




P4A35AB01

To measure the gear engagement time, proceed as follows:
- apply the handbrake fully;
- start the engine, warm it up to temperature and check that the idle speed is correct;
- move the selector lever from position N to D;
- using a chronometer, measure the time elapsing between the movement of the selector lever and perception of engagement of 1st gear.

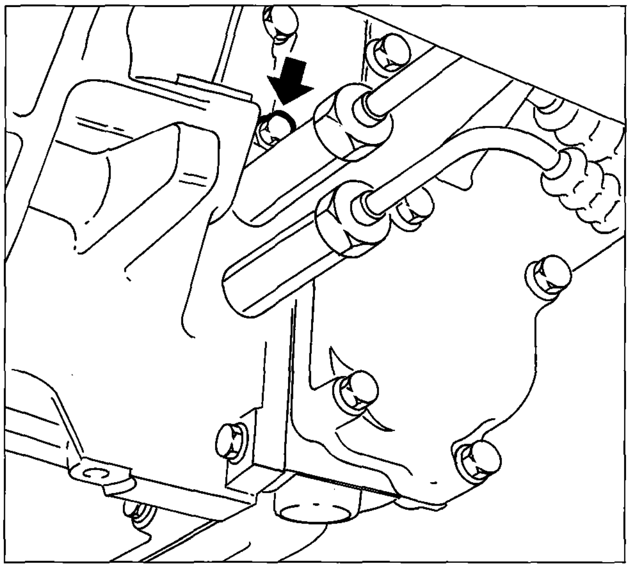
**N-D engagement time: less than 0.7 s**

Repeat the sequence of operations, except moving the selector lever from position N to R.

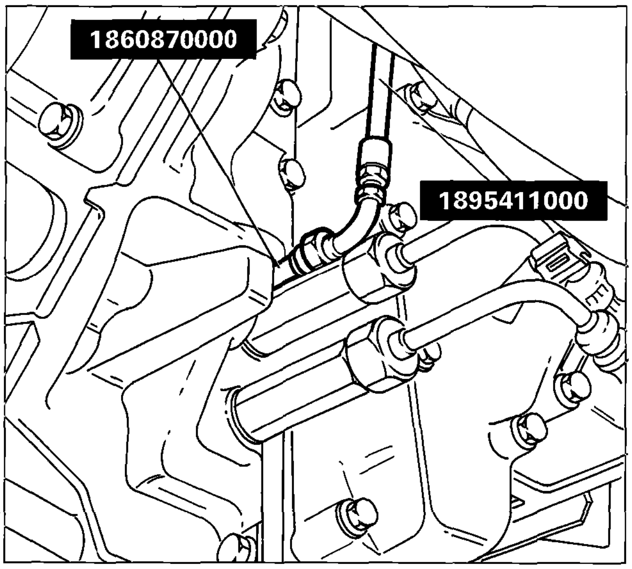
**N-R engagement time: less than 1.2 s**

| Engagement time | Possible causes |
|---|---|
| Higher than specified value from N to D | * Insufficient line pressure<br>* Clutches C1 and C3 slipping<br>* Incorrect operation of free wheel F1 |
| Higher than specified value from N to R | * Insufficientn line pressure<br>* Clutch C2 slipping<br>* Clutch C3 slipping<br>* Brake B2 slipping |

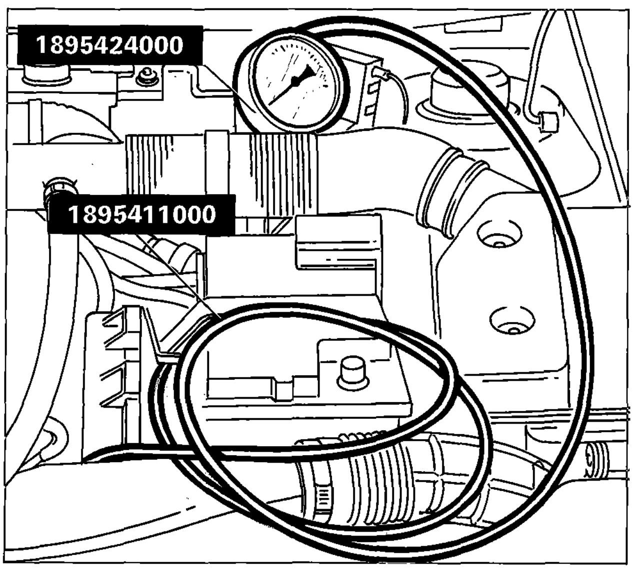
# 21-27.



P4A36AB01

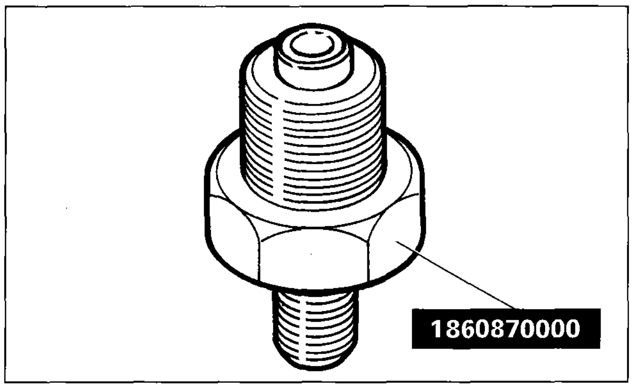



P4A36AB03




P4A36AB04

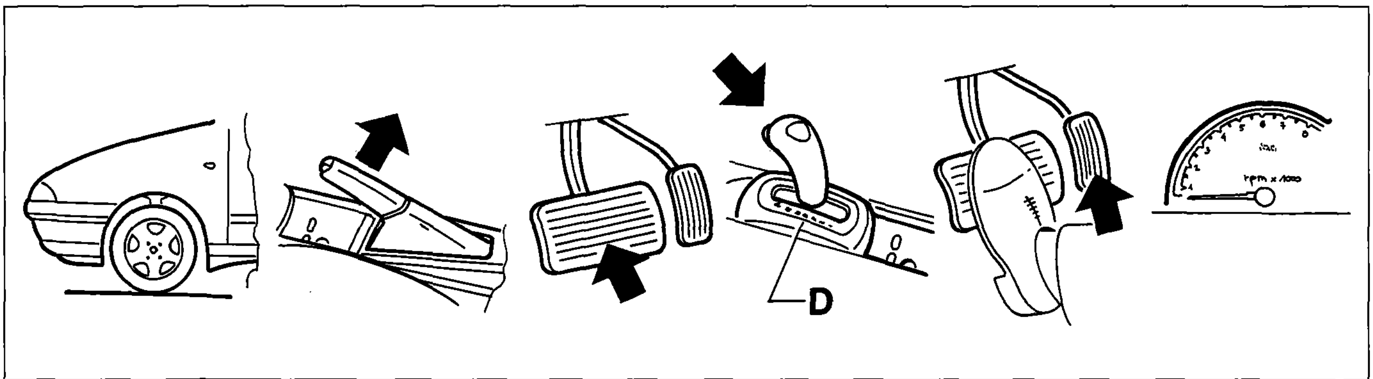
**Hydraulic test**




P4A36AB02

To measure the line pressure, proceed as follows:

- place the car on ramps, then working from under the vehicle remove the gearbox oil screw plug and screw in its place the connector 1860870000;
- pass the pipe 1895411000 from the top of the engine compartment so as to connect one end of the pipe to the connector 1860870000, and connect the other end to the pressure gauge 1895424000. Position it so that it is visible from the driver's seat;



P4A34AB01

- chock the vehicle by placing wedges under the wheels;
- apply the handbrake fully;
- press the brake pedal down hard with the left foot;
- start the engine, warm it up to temperature and check that the idle speed is correct;
- move the selector lever to position D;
- read the measurement of the line pressure during idling;
- fully press the accelerator pedal with the right foot and quickly read the line pressure at the engine's stall speed.

*The stall speed test must not exceed 5 seconds in duration.*

Repeat the last two operations with the selector lever on position R.

| Speed | Position D (and 1-2-3) | Position R (and N-P) |
|---|---|---|
| Idling | 3.7 - 4.3 bar<br>3.8 - 4.4 kg/cm$^2$ | 5.4 - 6.3 bar<br>5.5 - 6.4 kg/cm$^2$ |
| Stall | 10.8 - 12.5 bar<br>11.0 - 12.8 kg/cm$^2$ | 14.1 - 16.9 bar<br>14.4 - 17.2 kg/cm$^2$ |

| Line pressure | Possible causes |
|---|---|
| Higher than specified value in both D and R | Fault in pressure control solenoid<br>Regulating valves faulty |
| Less than specified value in both D and R | Fault in pressure control solenoid<br>Regulating valves faulty<br>Oil pump faulty |
| Less than specified value only in D | Leaks in hydraulic circuit in forward gears |
| Less than specified value only in R | Leaks in hydraulic circuit in reverse and neutral |

### Road tests

These tests are for checking that the automatic transmission is working correctly under actual conditions of use.

*Carry out the following tests with the gearbox oil at normal operating temperature.*

**Test in position D with NORMAL or SPORT driving mode**
Move the selector lever to position D and carry out the following tests with the accelerator pedal in two fixed positions, corresponding to 50% and 100% of the throttle valve aperture.

*A) Changes to higher gears*
Make sure that the gear changes 1-2, 2-3 and 3-4 occur at the correct points of the gear change program (see diagrams on pages 20, 21 and 22).

*B) Jolts and slipping*
In the same way, check that the jolts and slipping caused by the gear changes 1-2, 2-3 and 3-4 are normal.

*C) Locking lock-up clutch*
At a speed of about 85 km/h, gently press the accelerator pedal and check that the engine rpm does not change suddenly.

*D) Vibrations and noises*
Check under normal driving conditions that there are no vibrations or unusual noises.

*E) Kick-down operation*
Proceeding in second, third and fourth gears, with the selector lever on position D, fully press the accelerator pedal to close the kick-down switch and check that the limit speeds for the changes 2-1, 3-2 and 4-3 conform to the gear change program.

*F) Engine brake*
Driving in fourth gear, move the selector lever sequentially from position D to positions 3, 2 and 1 and perceive the engine braking effect at each of these gear changes.

**Tests in position 3, 2 and 1 with NORMAL or SPORT driving mode**
The above tests are repeated for each selector lever position.

**Test in position R**
Move the lever to position R, fully press the accelerator pedal to start the vehicle, checking that the slipping is normal.

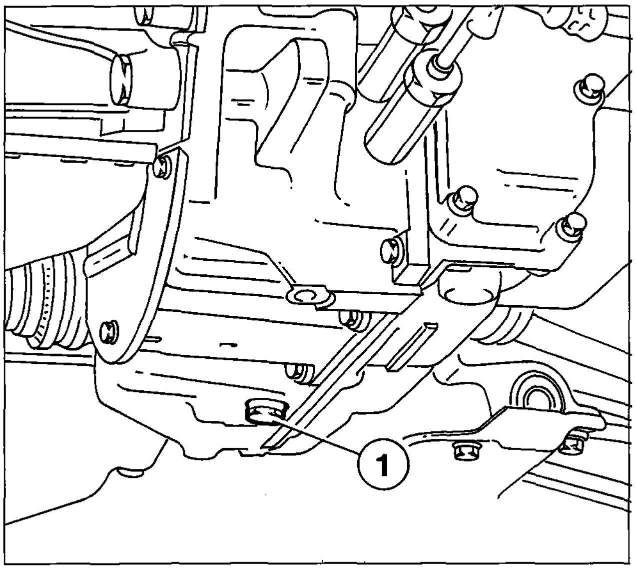
**Test in position P**
Stop the vehicle on a downhill slope, and after moving the lever to position P, release the brake pedal. Check that the locking pawl prevents the vehicle from moving.

### Test with manual operation of the gearbox

Disconnect the control module connectors. Test the vehicle on the road, making sure that whenever the selector lever is moved, the gear changes take place in accordance wiht the table below.

| Selector lever position | P | R | N | D | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|
| Gear engaged | Park | Reverse | Neutral | 4th | 4th | 3rd | 1st |

**NOTE** *With the selector lever at position N, the vehicle must not move spontaneously on a flat road. With the selector lever at position P, the locking pawl must stop the vehicle moving even on a downhill road.*



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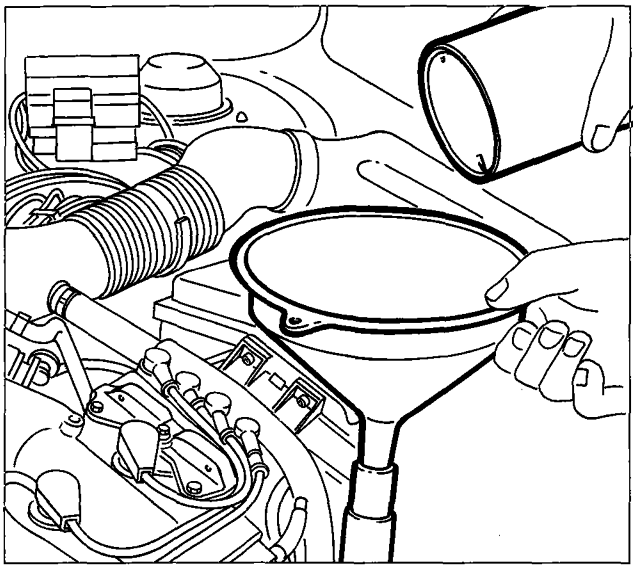
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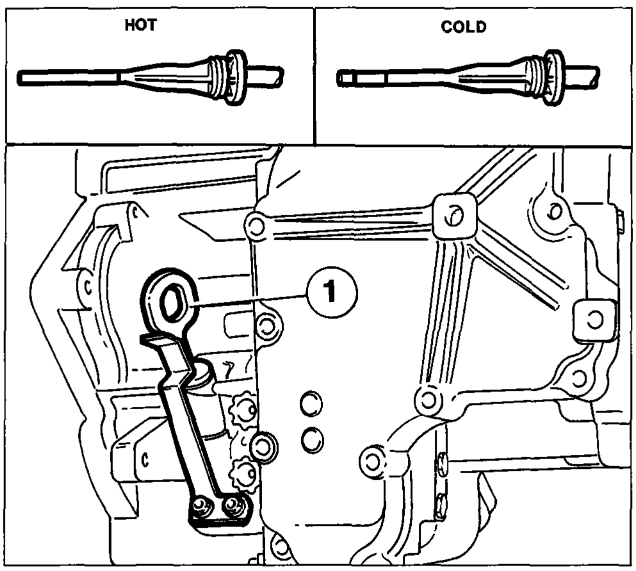

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## CHANGING GEARBOX OIL

### Draining

Drain the gearbox oil after a road journey so that the oil reaches operating temperature. Then carry out the following operations:

- undo the plug (1) and allow the oil to drain;
- retighten the plug (1) after replacing the seal, and tighten it to a torque of between 2.35-5.49 daNm.

### Filling

Withdraw the dipstick and, using a clean funnel so as not to contaminate the oil, pour in the required quantity of gearbox oil. To facilitate the operation, remove the air cleaner. After filling, check that there are no leaks from the drain plug.

**Periodical oil change: 3 litres- 2.7 kg**
**Recommended gearbox oil: TUTELA GI/2**

## CHECKING OIL LEVEL

**NOTE** *The gearbox oil level must be checked with the engine and gearbox at normal operating temperature (gearbox oil temperature: 70 - 80°C), so the vehicle must be driven for an appropriate period of time before the check.*

To check the gearbox oil level, proceed as follows:

- park the vehicle on flat ground and apply the handbrake;
- with the engine idling, gently move the selector lever from position P to position 1, then return it to P;
- withdraw the dipstick (1) and clean it;
- insert the stick fully into its seating;
- again withdraw the dipstick and check that the oil level lines up with the notch on the side of the stick marked HOT.

If the oil level is low, identify and eliminate any leaks, then add oil to top up the level.

*If the check has to be conducted at a low oil temperature, check that the oil level is within the notch on the side of the dipstick marked COLD. If possible, recheck the oil level at the correct temperature (70 - 80 °C).*

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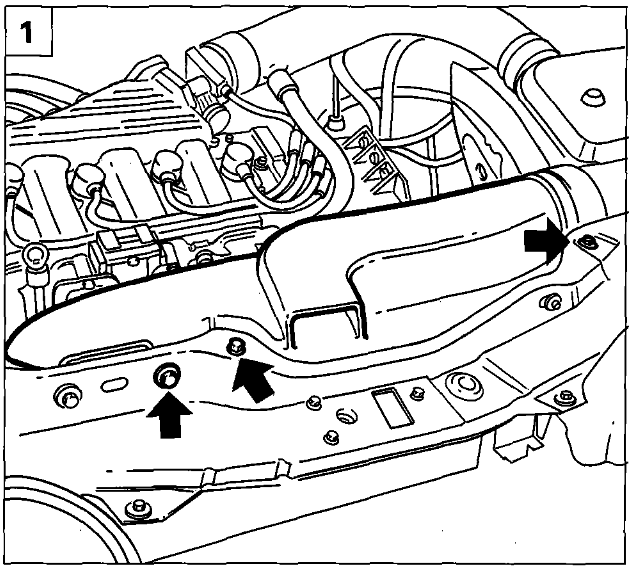
*Also check the condition of the oil, and in particular that there is no white contamination caused by contact with the coolant from the oil cooling circuit, and that there are no metal particles due to wear of internal components or a burnt smell.*

**WARNINGS**

- If the oil level is low, there may be a reduction in the line pressure owing to the fact that the oil pump draws in air, resulting in malfunctioning of the transmission.
- If the oil level is higher than normal, there may be oil leaks from the vent pipe.
- Contamination of the oil with water or the use of an oil with different characteristics from the recommended oil causes higher consumption and malfunction of the transmission.



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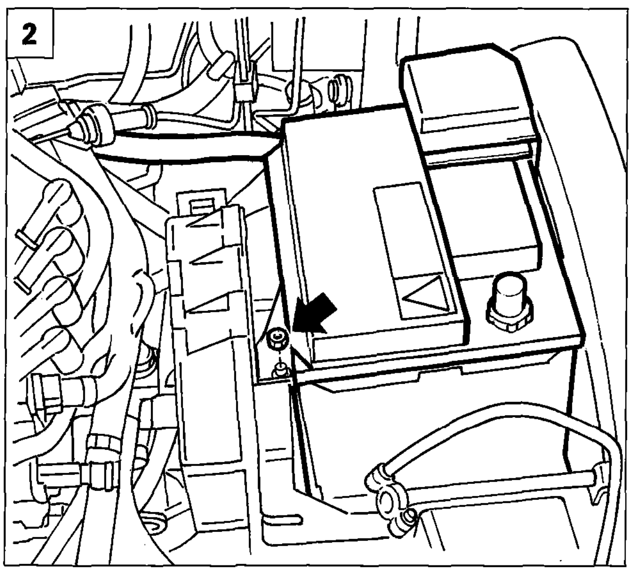
## GEAR CHANGE CABLE

### Removing

Disconnect the battery's negative cable, then proceed as described below:

1. Remove the air intake duct by undoing the bolts shown in the figure, which secure it to the front cross panel.
2. Lift the cover protecting the battery positive pole and disconnect the cable; undo the nut securing the battery to the cage, then remove the battery from the engine compartment.
3. Remove the cover from the relay and fuse box by undoing the screw indicated.



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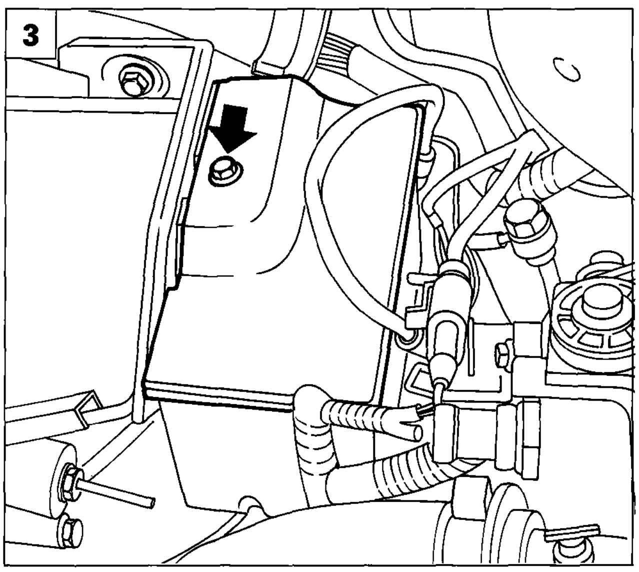

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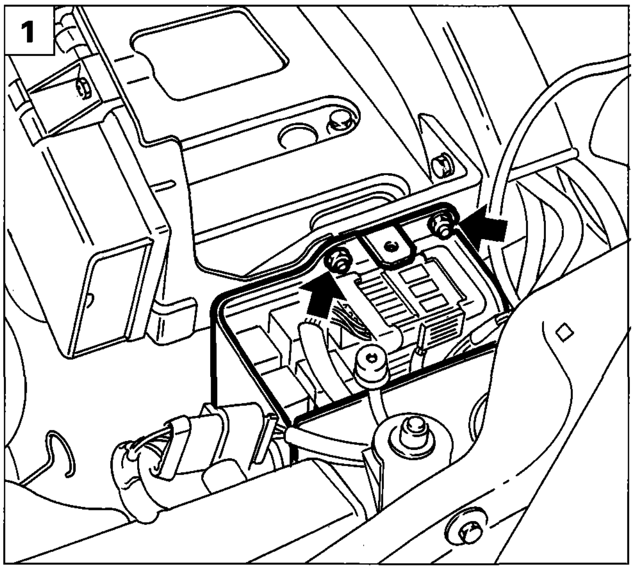

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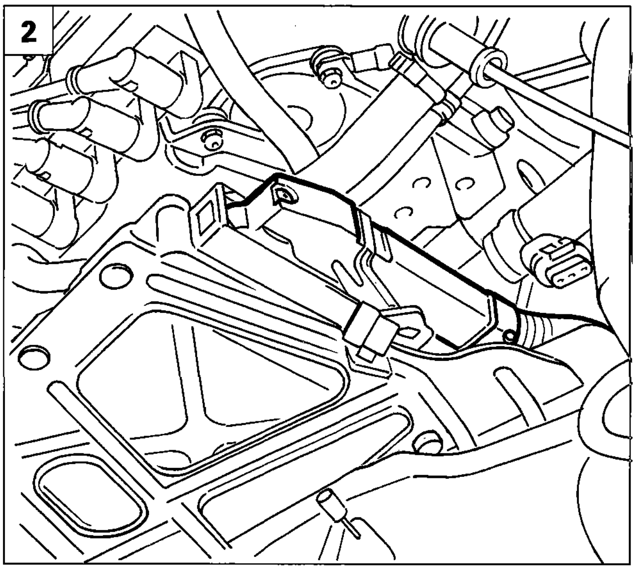

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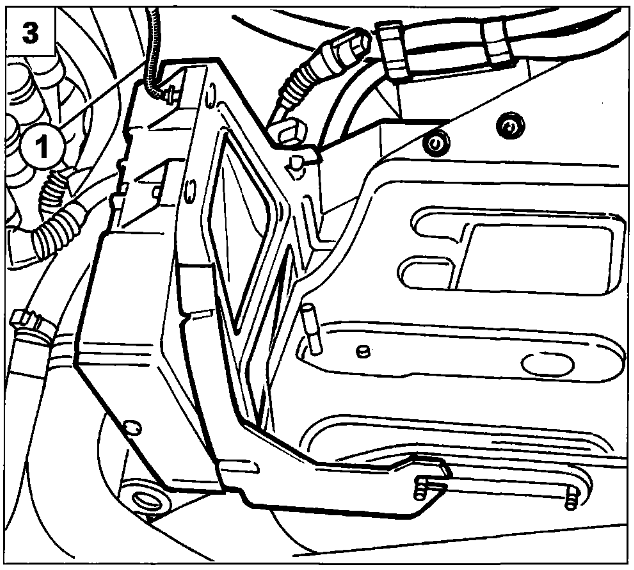

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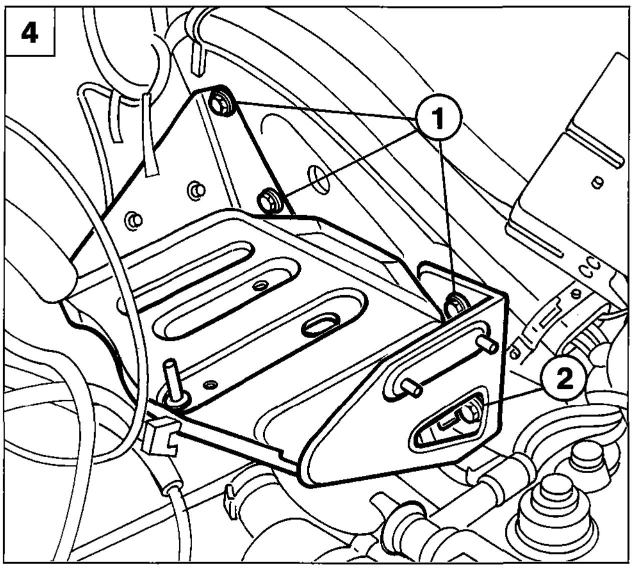
1. Remove the nuts securing the relay and fuse box to the battery cage, then move the box over to one side.
2. Disconnect the i.e. control unit supply connector.
3. Disconnect the earth cable (1), remove the nuts securing the i.e. control unit mounting bracket, then remove the control unit from the engine compartment. The nuts indicated also secure the starter motor supply wiring and the front cable/fuel injection cable connection.
4. Remove the bolts (1) and slacken the bolt (2) securing the battery cage to the body shell. Before removing the cage, disconnect the cable clip underneath.
5. Remove the split pin and washer shown in the figure; lift the gear change cable head so as to disconnect it from the gear change lever position sensor.



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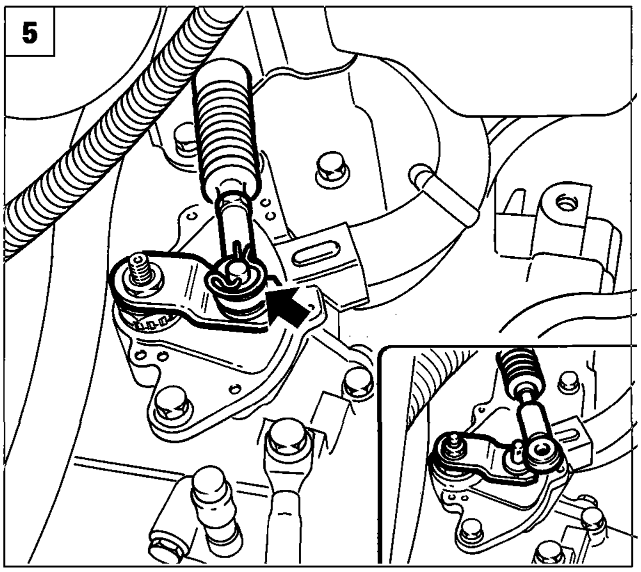

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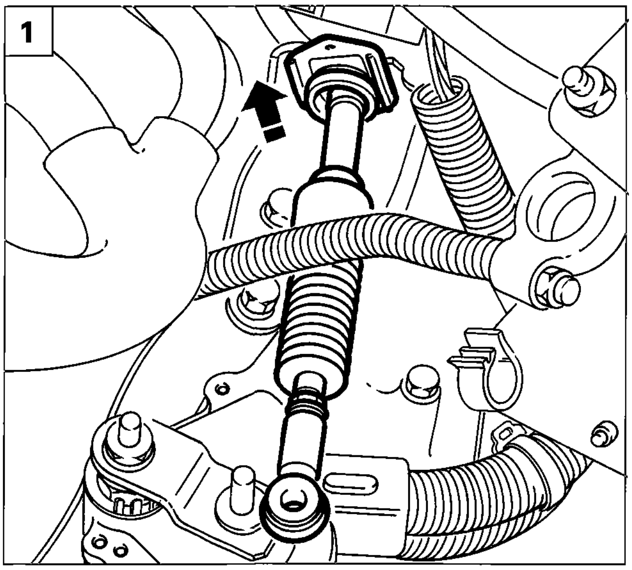


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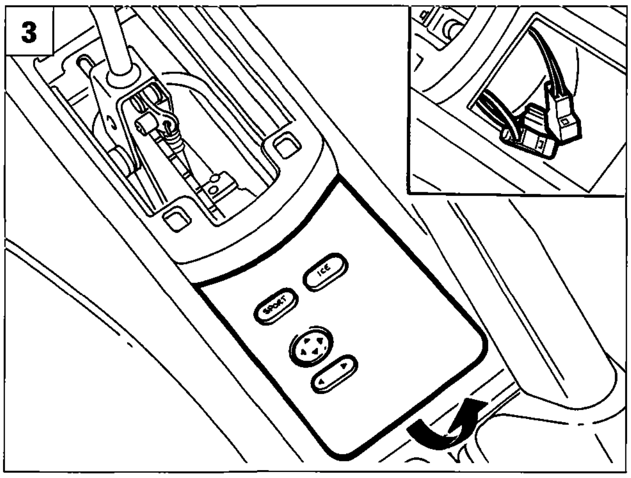


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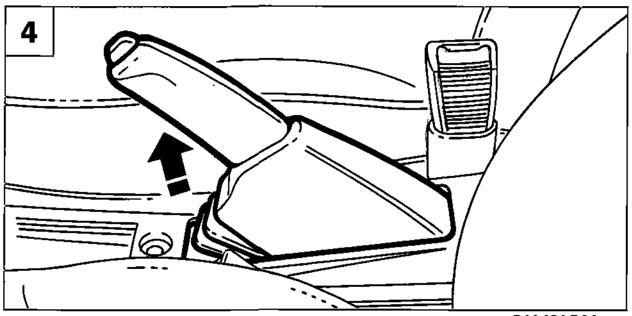


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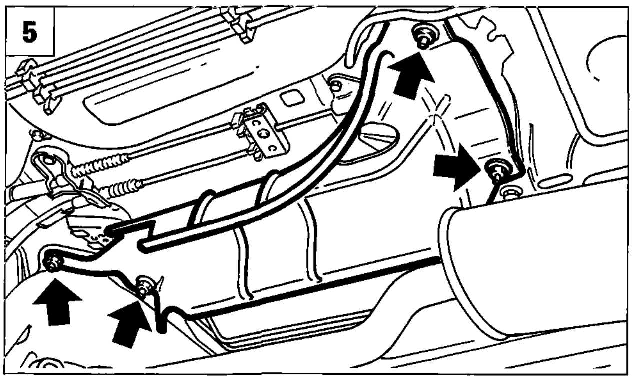


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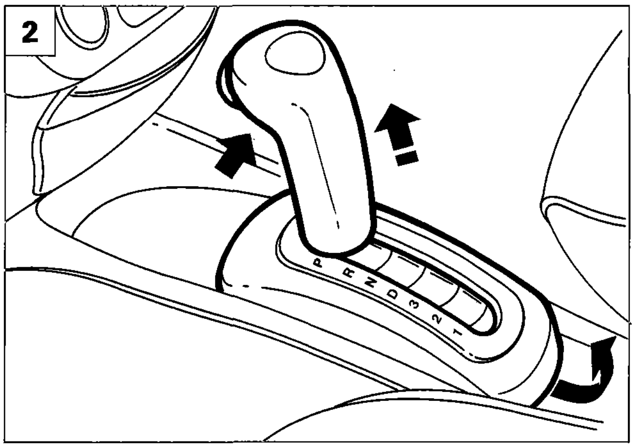
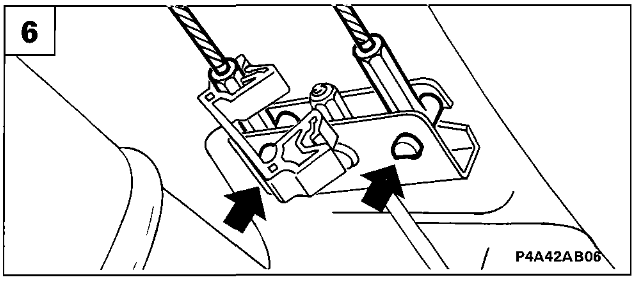


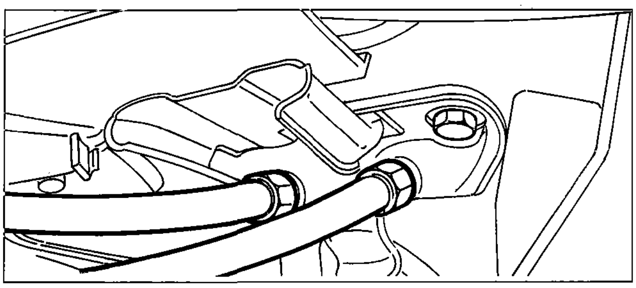

P4A42AB02

1. Lift the gearbox control cable retaining bracket to release it from the mounting bracket.
2. Working from inside the car, position the selector lever on P, remove the retaining bolt on the front of the selector lever handle and then withdraw the handle upwards, then remove the selector lever position indicator panel.
3. Release the driving mode switch panel, disconnect the electrical connectors and withdraw the panel.
4. Remove the plastic trim from the handbrake lever; slacken the tension from the relevant cable and disconnect the wiring connector for the handbrake on indicator.

Place the car on ramps and carry out the following operations from under the car:

5. Remove the heat shield indicated.
6. Disconnect the cables operating the handbrake from the mounting and release them from the bracket.



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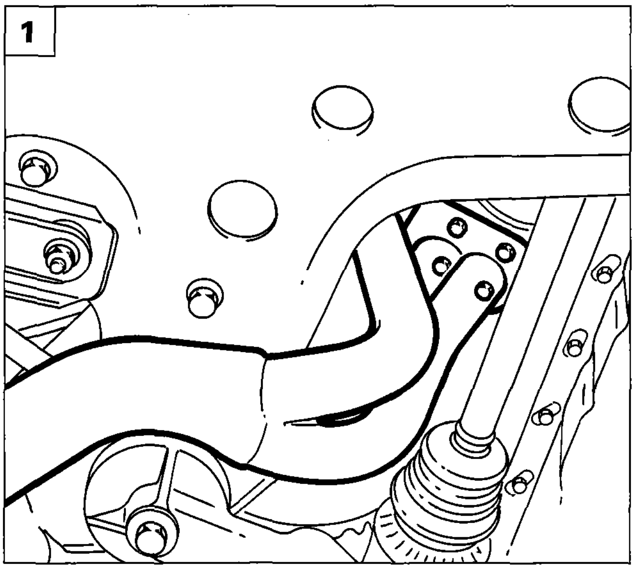


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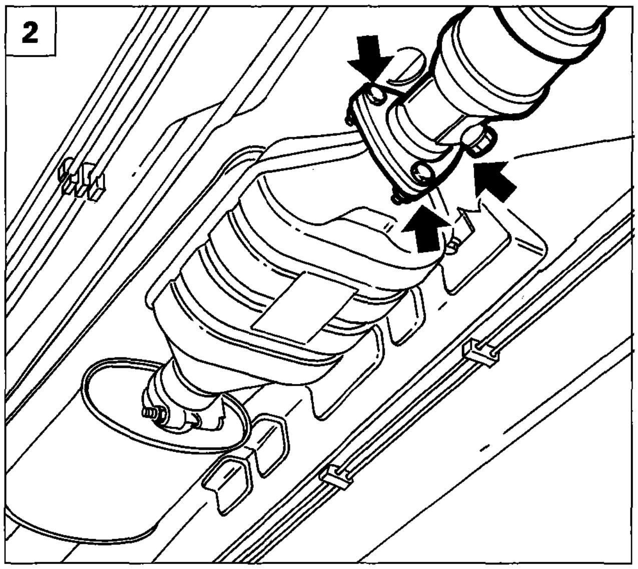


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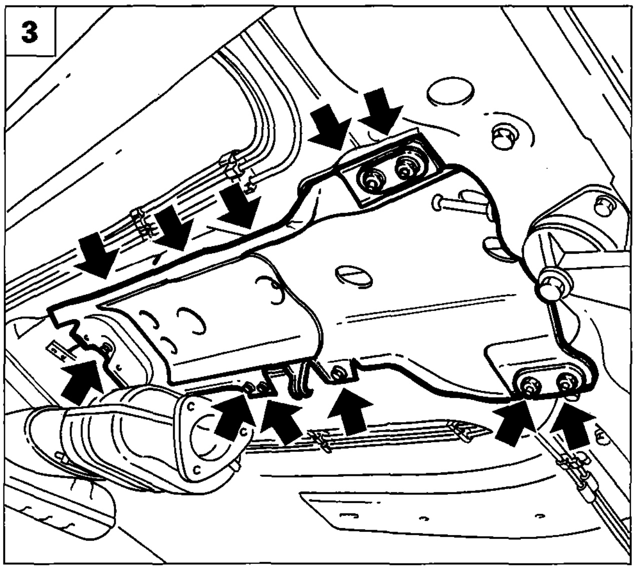


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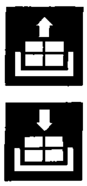
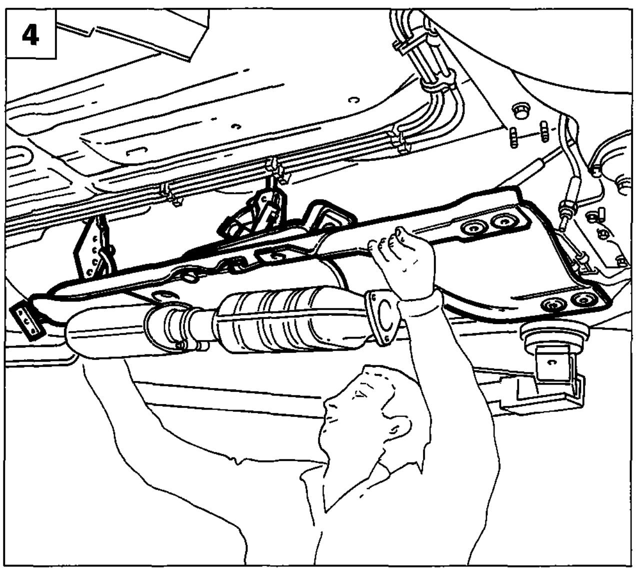


1. Disconnect the Lambda probe wiring connector, then disconnect the first section of the exhaust pipe from the exhaust manifold.
2. Remove the first section of the exhaust pipe by undoing the attachments to the catalytic converter.
3. Undo the bolts securing the gear change internal linkage mounting and handbrake to the body shell.
4. Withdraw the internal gear change linkage mounting downwards.
5. Internal linkage assembly.

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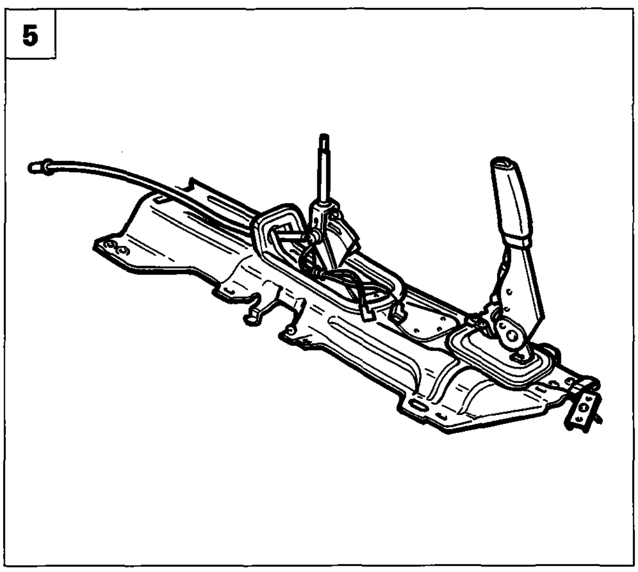


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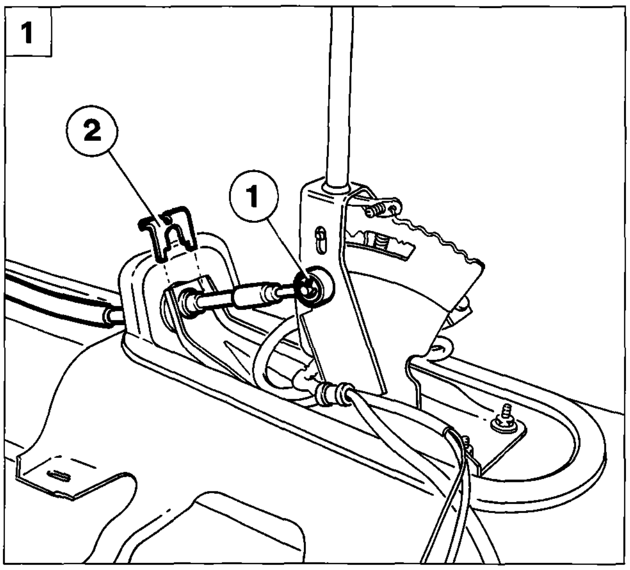


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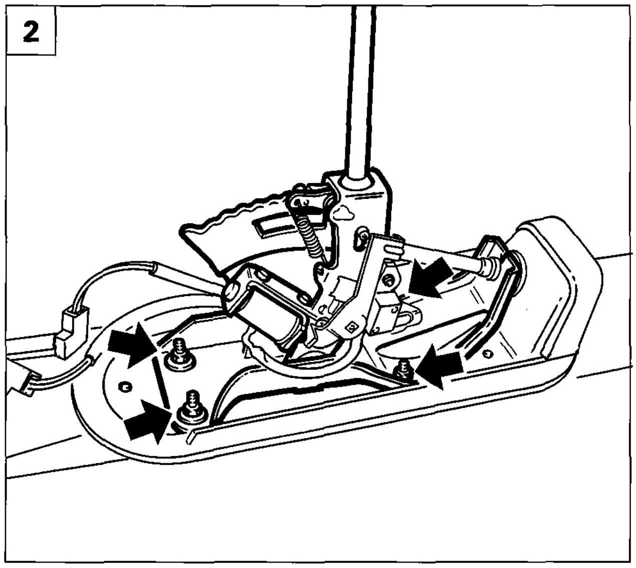


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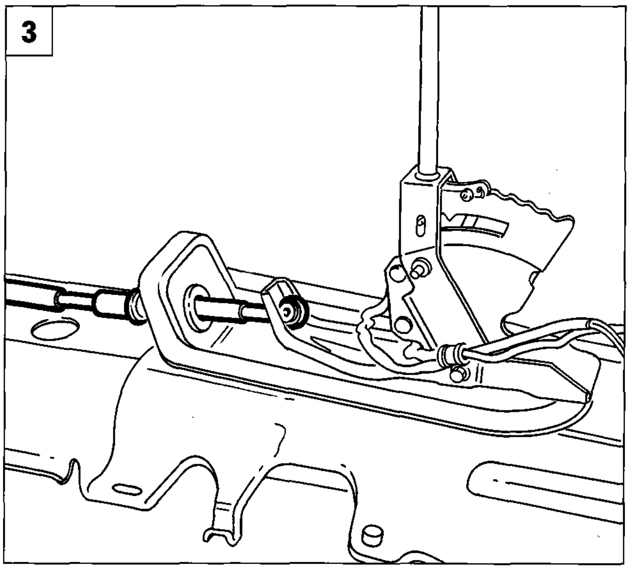


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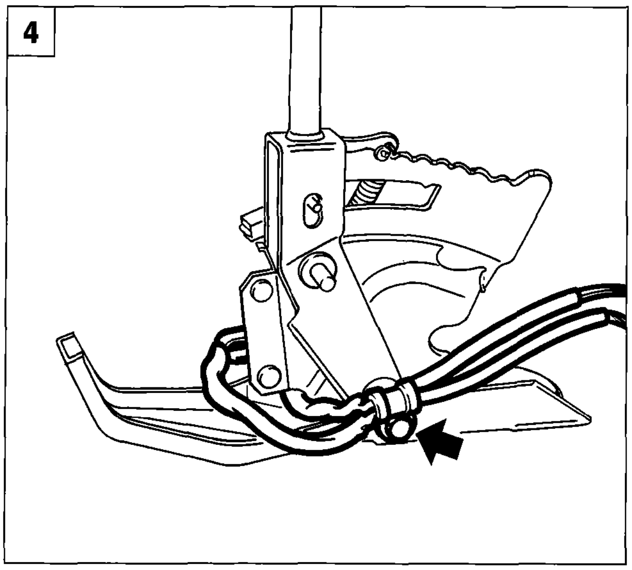
1. Remove the split pin (1) and bracket (2) securing the gear change cable to the selector lever.
2. Undo the nuts securing the selector lever mounting and remove the mounting.
3. Disconnect the gear change cable from the selector lever mounting; then replace the cable.

**Dismantling selector lever**

4. Undo the bolt securing the clip retaining the supply cables to the shift-lock device and additional PARK position switch.

5. Undo the nuts securing the additional PARK position switch (1); if the shift-lock device (2) has to be worked on, undo the bolts shown in the figure.

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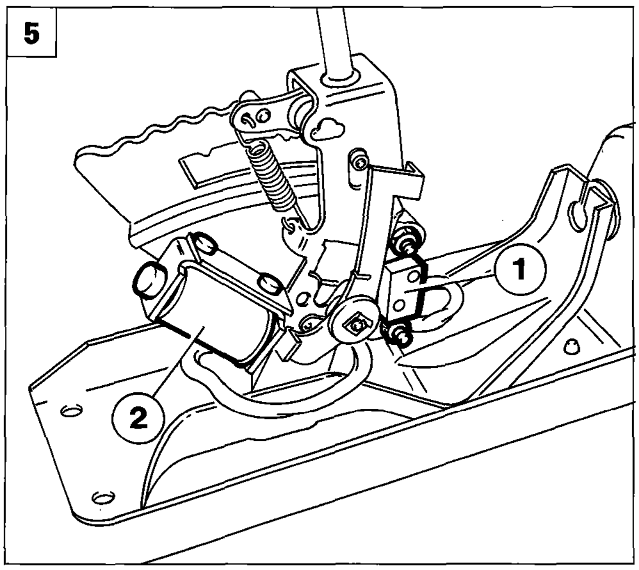


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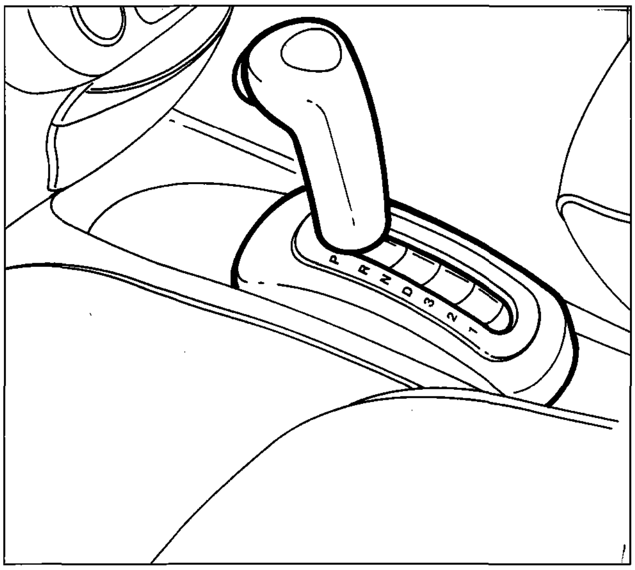
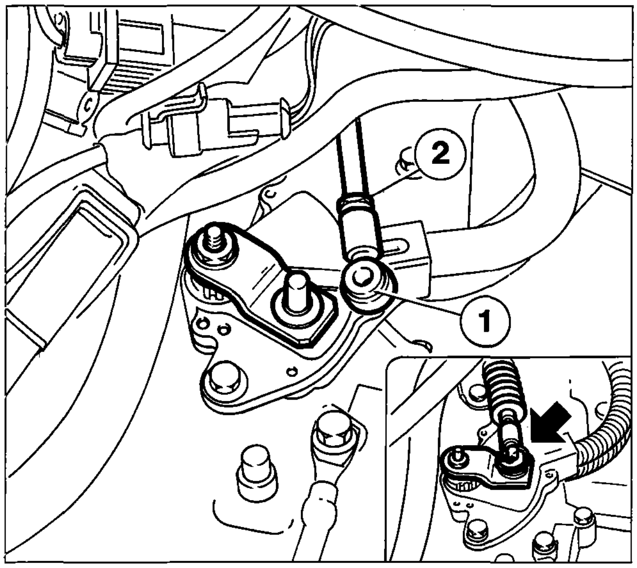


P4A45AB01

### Refitting

Refit the gear change cable and selector lever by reversing the procedure for removal, bearing in mind the following:

- check that the gear change lever is positioned at P (lever fully forward);
- check that the selector lever is also set to position P;

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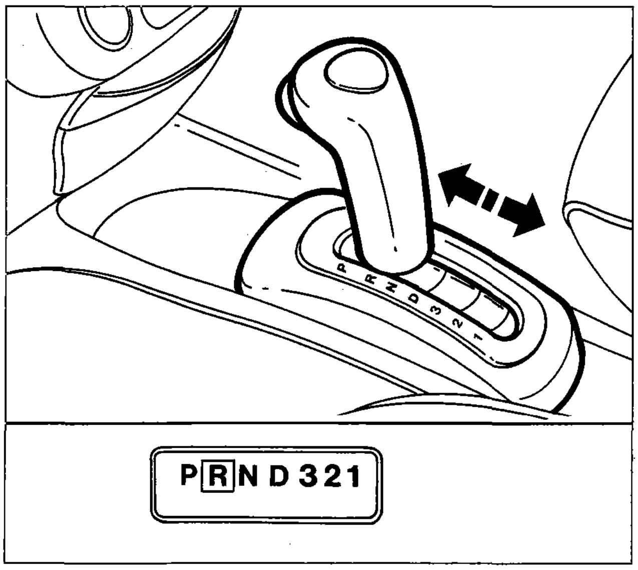
- fit the gear change cable head (1) to the lever located on the gearbox. If the cable length needs to be adjusted, adjust the head (1) by screwing it or unscrewing it on the threaded part of the cable, then lock it with the nut (2). Finally fit the washer and split pin;
- operate the selector lever and check that, at each position, you can hear the gear change lever clicking into position.

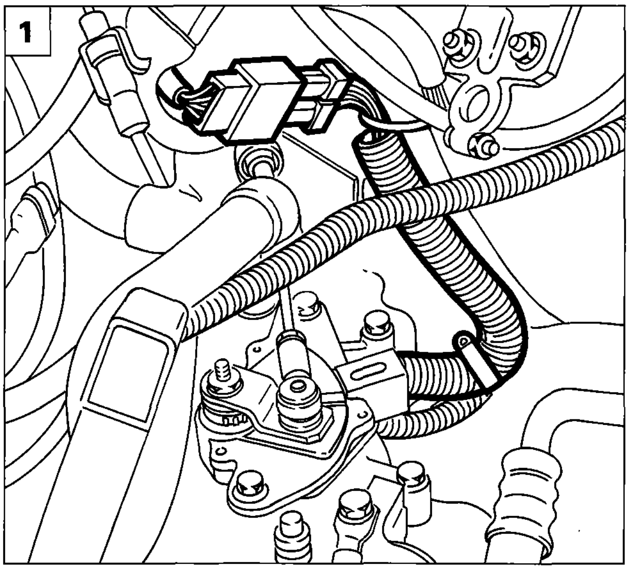



P4A45AB02

Complete the assembly by securing the battery cage, i.e. control unit, battery and air intake duct.

Finally carry out the following checks:

- the engine must only start with the selector lever in position P or N;
- each position of the selector lever must be accompanied by the relevant indications on the indicator panel and instrument panel display.



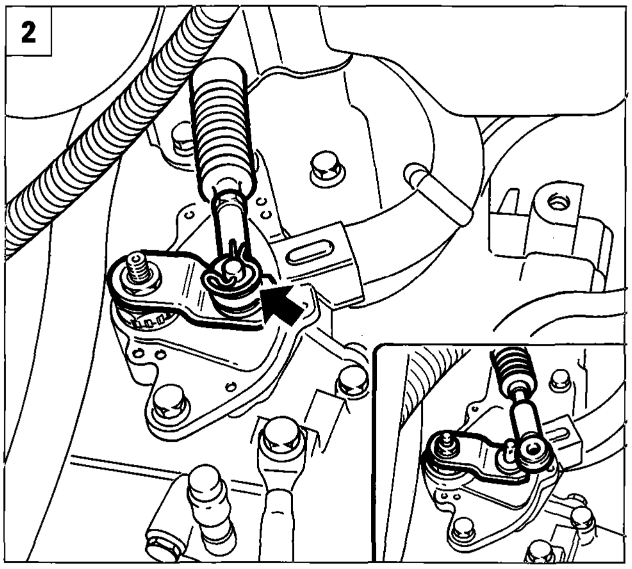

P4A46AB01

## GEAR CHANGE LEVER POSITION SENSOR

### Removing

Remove the air intake duct, battery, relay and fuse box (move it to one side) the i.e. control unit and battery cage, as described for the removal of the gear change cable, position the selector lever at P, then carry out the following operations:

1. Disconnect the wiring connector from the gear change lever position sensor.

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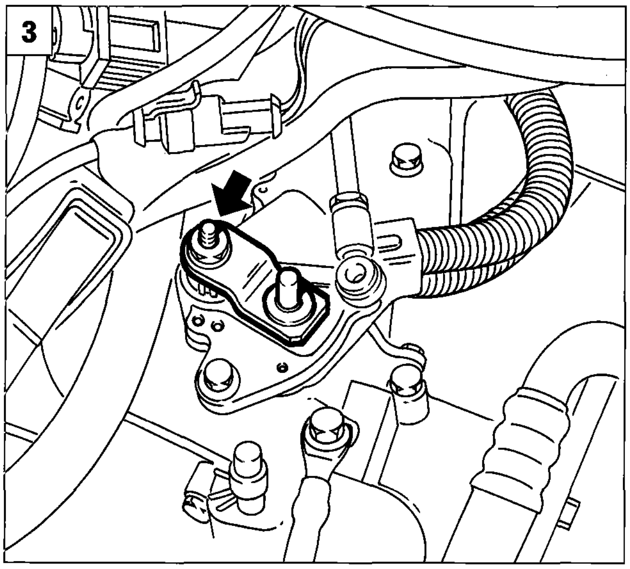
2. Remove the split pin and washer so as to disconnect the gear change cable from the lever on the sensor.
3. Undo the nut securing the lever to the sensor, then remove the lever.
4. Release the central nut from the washer and remove the nut, then undo the two side bolts securing the sensor and remove the sensor.

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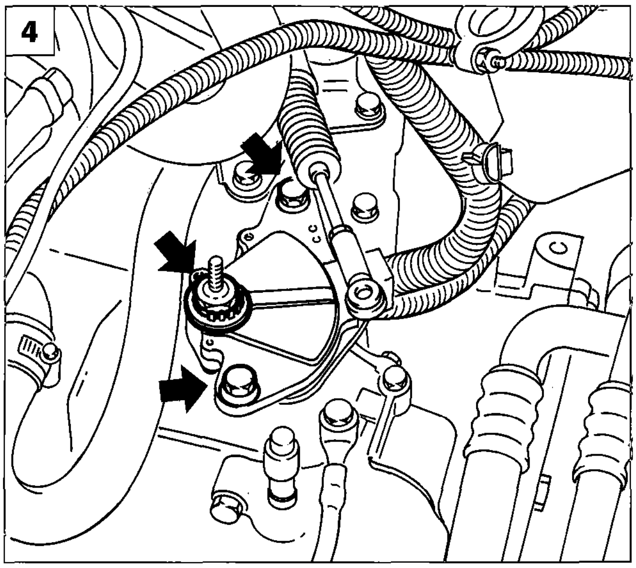


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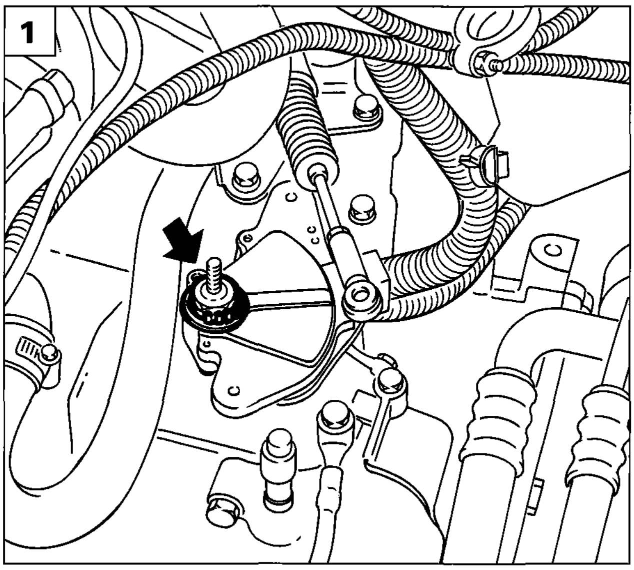

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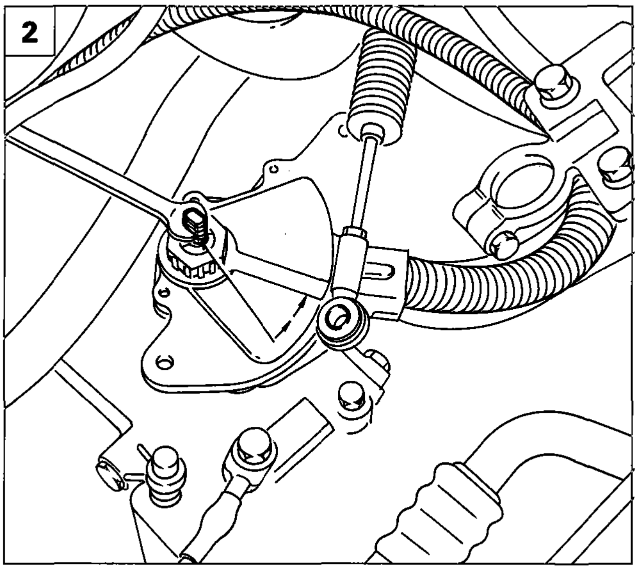

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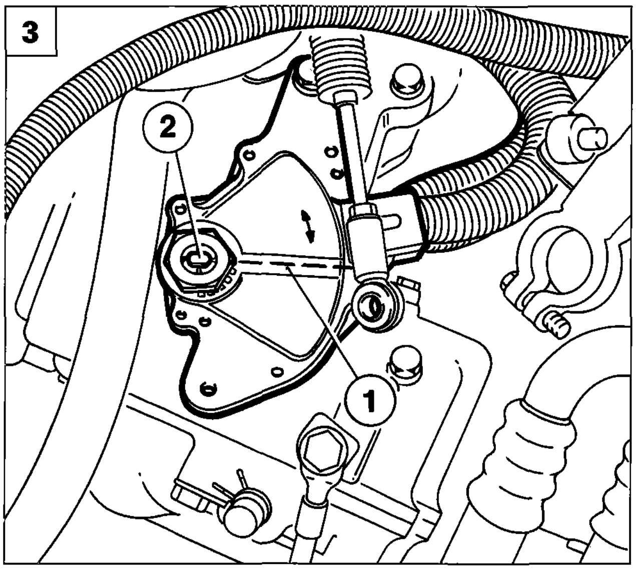

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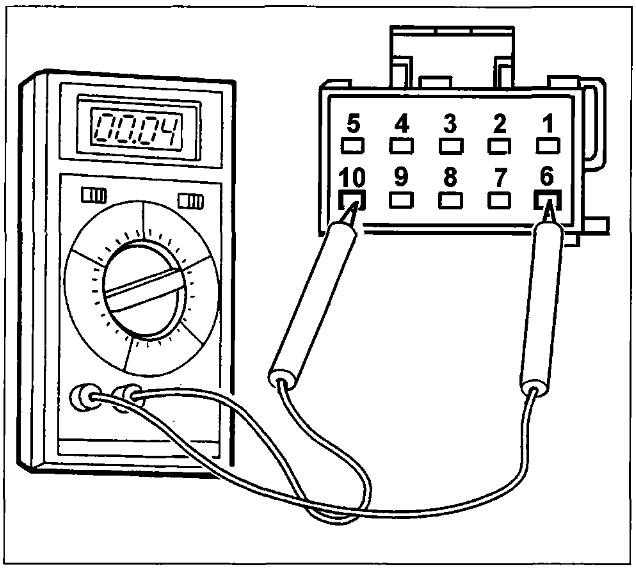
**Refitting**

Refit the selector lever position sensor as follows:

1. position the sensor, tighten the central nut and lock it with the washer;
2. from position P (fully rotated in a clockwise direction) move the pin of the lever to position N (rotating the pin two notches in an anti-clockwise direction);
3. rotate the sensor so that the projection on the top surface (1) lines up with the side machining on the pin (2), then lock the sensor in this position by tightening the two side screws.



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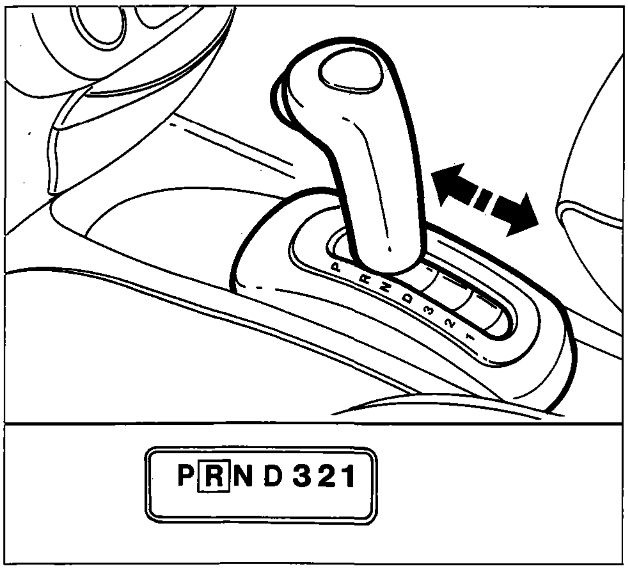
*It is advisable to position the sensor using an ohmmeter connected between terminals 6 and 10 of the supply connector. Rotate the sensor to the centre of the area in which the ohmmeter detects continuity (contacts N and P closed), then tighten the sensor screws.*

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Finish refitting the selector lever position sensor by reversing the procedure for removal. Finally carry out the following checks:

- the engine must only start with the selector lever in position P or N;
- each position of the selector lever must be accompanied by the relevant indications on the indicator panel and instrument panel display.

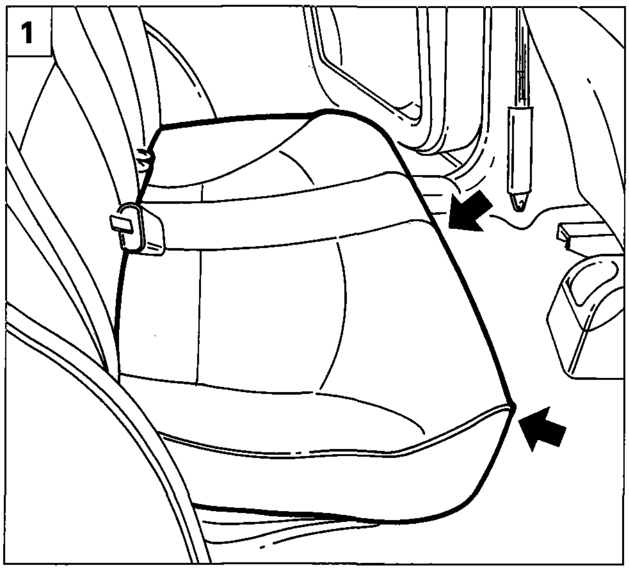
**REMOVING-REFITTING GEAR CHANGE CONTROL UNIT (CONTROL MODULE)**

The gear change control unit is located under the rear seat cushion, on the right. Before proceeding with removal, disconnect the battery's negative pole, then:

1. Remove the rear seat cushion by undoing the bolts securing the retaining brackets to the body shell.
2. Lift the trim under the rear seat cushion, then remove the bolts and nut securing the control unit mounting bracket to the body shell.
3. Rotate the control unit mounting bracket, disconnect the supply wiring, then undo the nuts securing the control unit to the bracket.

**WARNINGS**

- *Handle the control unit carefully to avoid any impact.*
- *Do not remove the control unit cover or try to dismantle it.*
- *Do not touch the connector pins directly.*
- *Insert the connector fully into the control unit until it clicks.*

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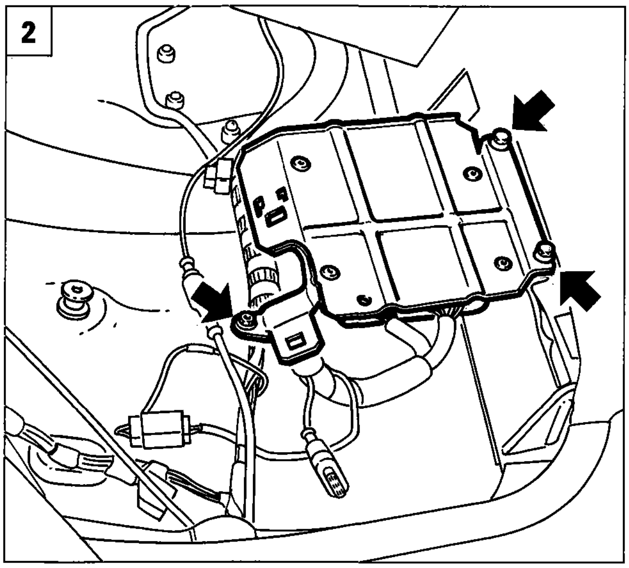


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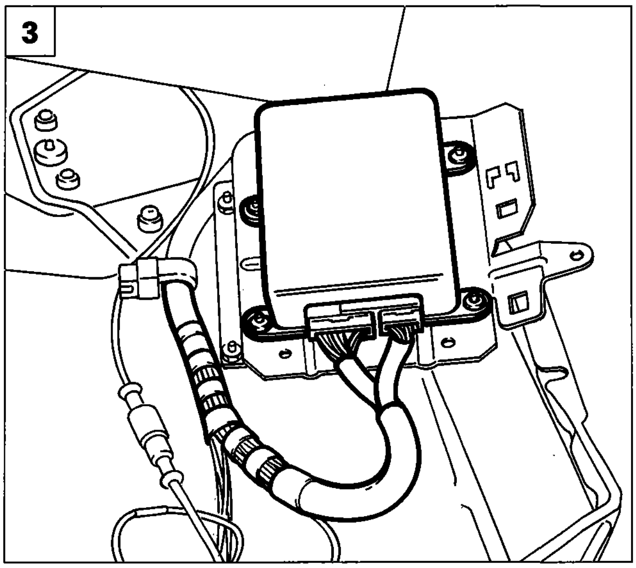


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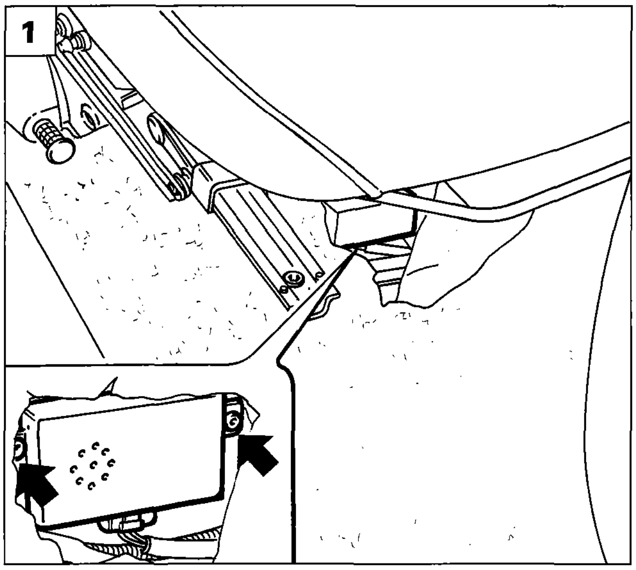


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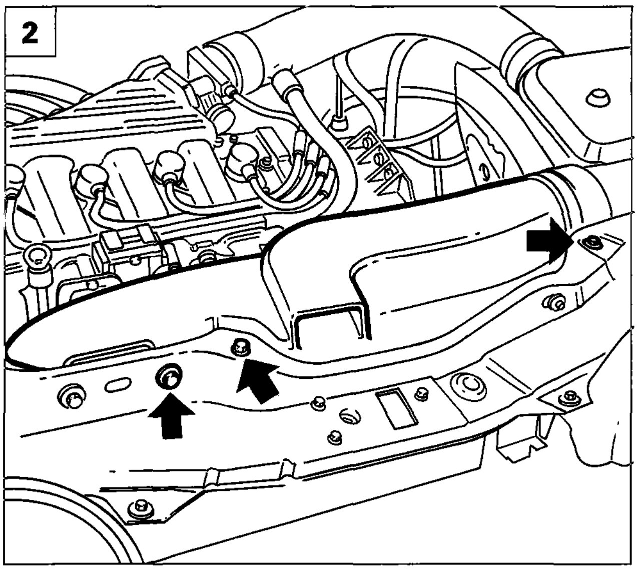
### REMOVING-REFITTING SAFETY CONTROL UNIT

The safety control unit is located under the front passenger's seat. To remove it, first disconnect the battery's negative pole, then proceed as described below:

1. Push the front passenger's seat fully back so as to gain access to the safety control unit. Undo the bolts securing the control unit to the body shell, disconnect the supply wiring connector, then remove the control unit.

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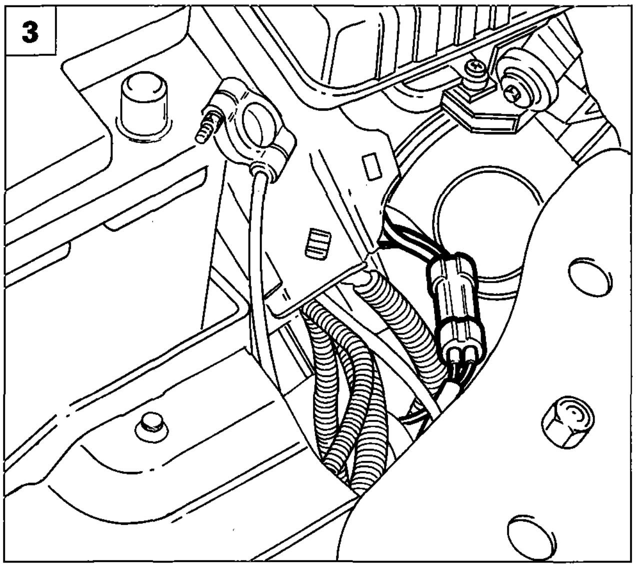
### REMOVING-REFITTING GEARBOX OIL COOLING RADIATOR AND FAN

Place the car on ramps, disconnect the battery's negative pole, remove the front left wheel, drain the gearbox oil and then proceed as described below:

2. Remove the air intake duct by undoing the bolts shown in the figure, securing it to the front cross panel.
3. Disconnect the cooling fan supply wiring connector.
4. Raise the car and, working from the left wheelarch, undo the bolts securing the cooling fan, then remove the fan.

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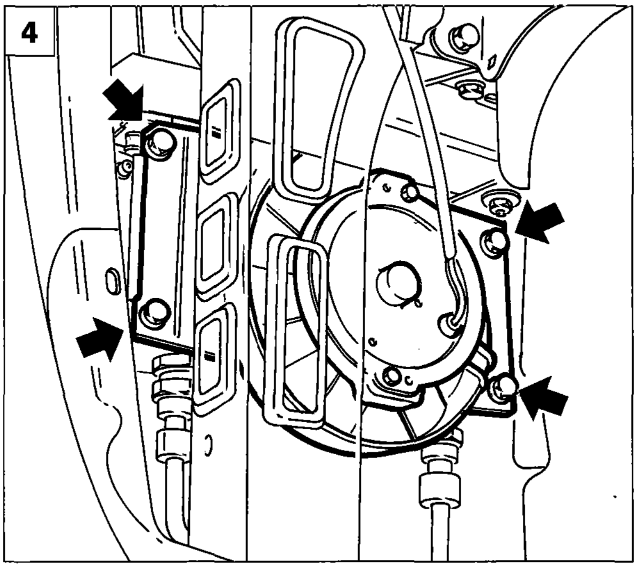


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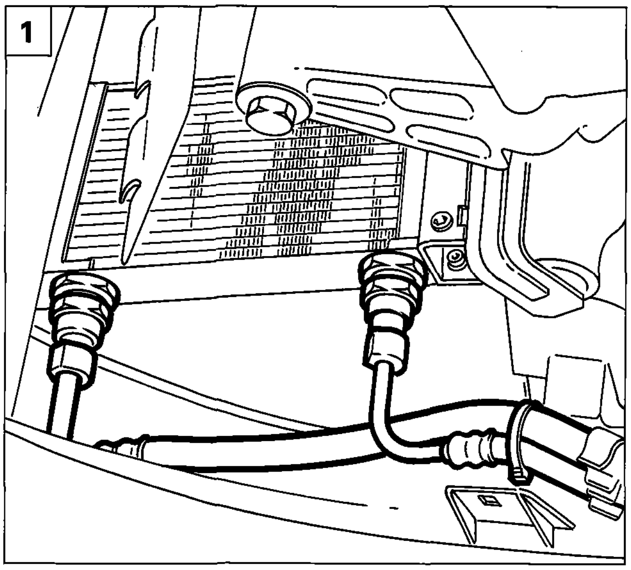
# 21-27.

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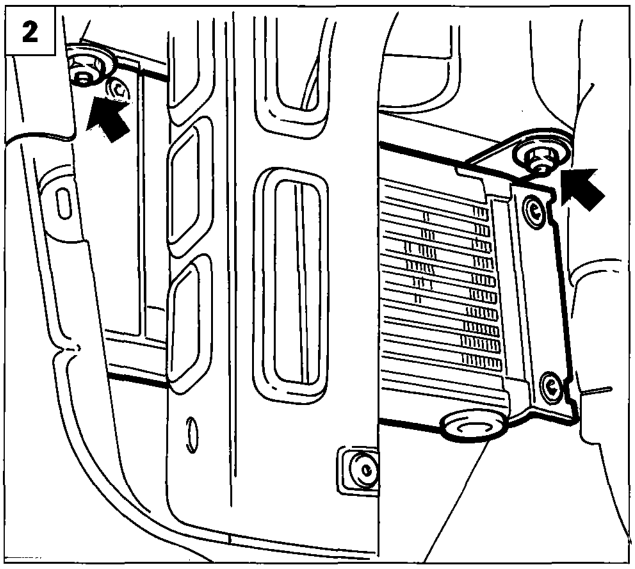


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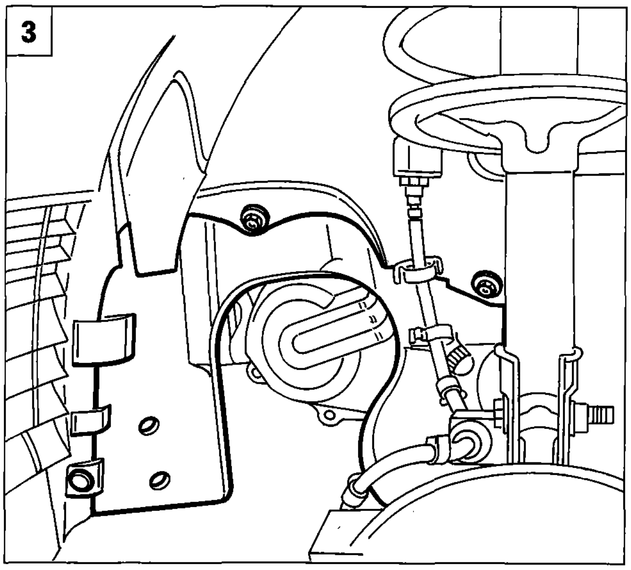


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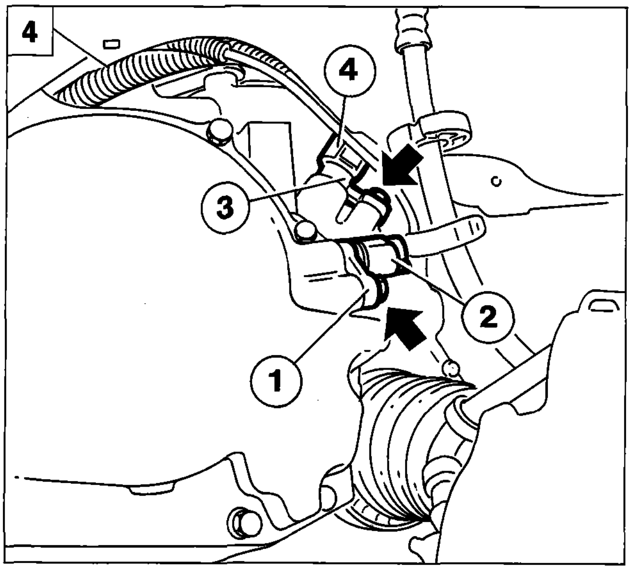



P4A50AB04

1. To remove the gearbox oil cooling radiator, first remove the fan, then disconnect the coolant inlet and outlet pipes from the radiator.
2. Undo the nuts shown in the figure, securing the radiator.
   To refit, reverse the procedure for removal, topping up the gearbox oil to the correct level.

**MAIN SHAFT RPM SENSOR - VEHICLE SPEED SENSOR**

**Removing-refitting**

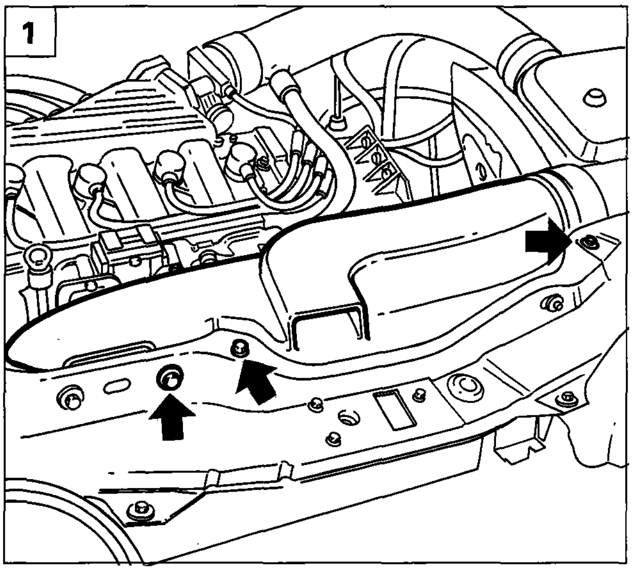
Place the car on ramps, disconnect the battery's negative pole, remove the front left wheel, then:

3. Remove the left wheelarch trim in order to gain access to the sensors.
4. To remove the main shaft rpm sensor (1) (black), disconnect the relevant supply connector (2), then undo the bolt securing the sensor to the gearbox casing and remove the sensor by pulling it upwards.
   To remove the vehicle speed sensor (3) (grey), disconnect the supply connector (4), then undo the bolt securing the sensor to the gearbox casing and remove the sensor.

Check the resistance between the terminals:
- Main shaft rpm sensor: 387 - 473 Ω
- Vehicle speed sensor: 648 - 792 Ω

If the resistance is not within these values, replace the sensor concerned.

*Always replace the seal; smear it with grease to avoid damage during fitting.*



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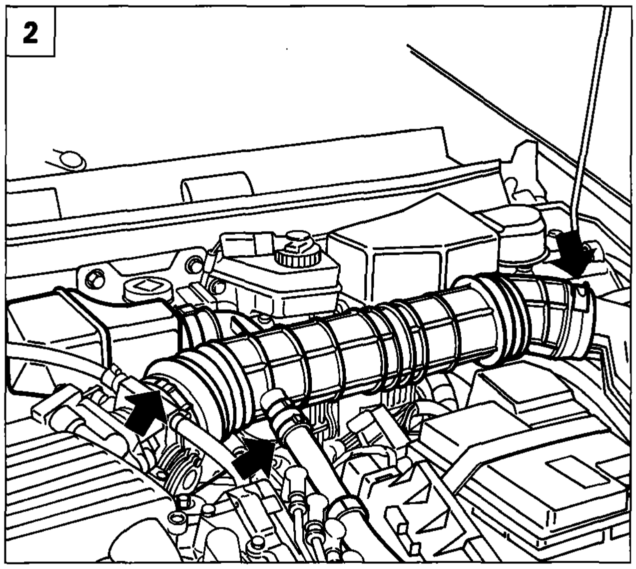

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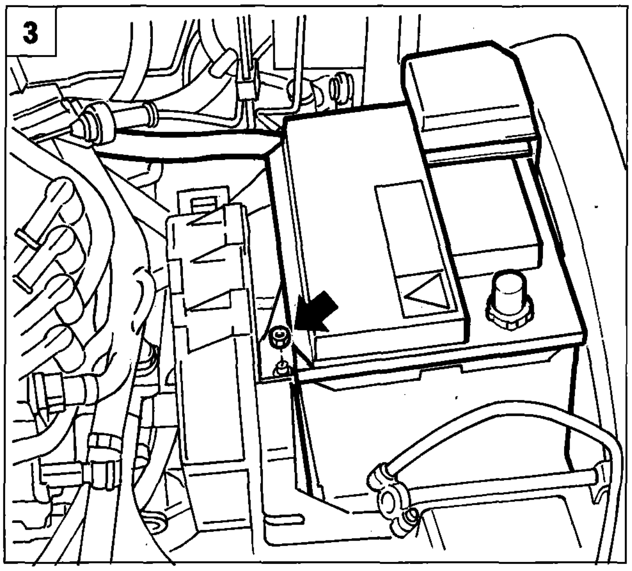

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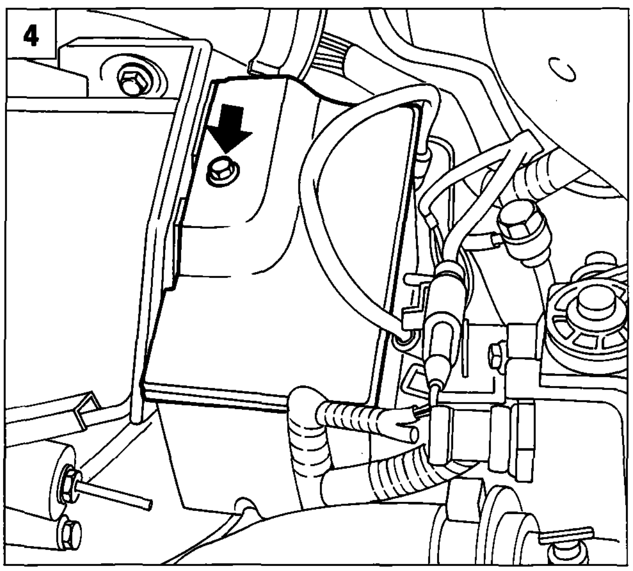


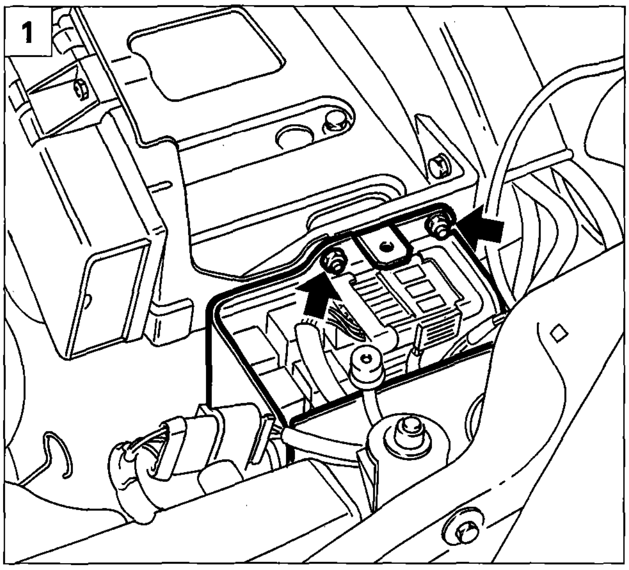
P4A40AB03

## REMOVING-REFITTING GEARBOX

Place the car on ramps, disconnect the battery's negative pole, remove the front wheels and drain the gearbox oil, then proceed as described below:

1. Remove the air intake duct by undoing the bolts shown in the figure, securing it to the front cross panel.
2. Remove the air inlet pipe by undoing the clips shown in the figure, then remove it from the engine compartment complete with resonator.
3. Left the cover protecting the battery's positive pole and disconnect the cable; undo the nut securing the battery to the cage, then remove the battery from the engine compartment.
4. Remove the relay and fuse box cover by undoing the bolt indicated.

## 21-27.

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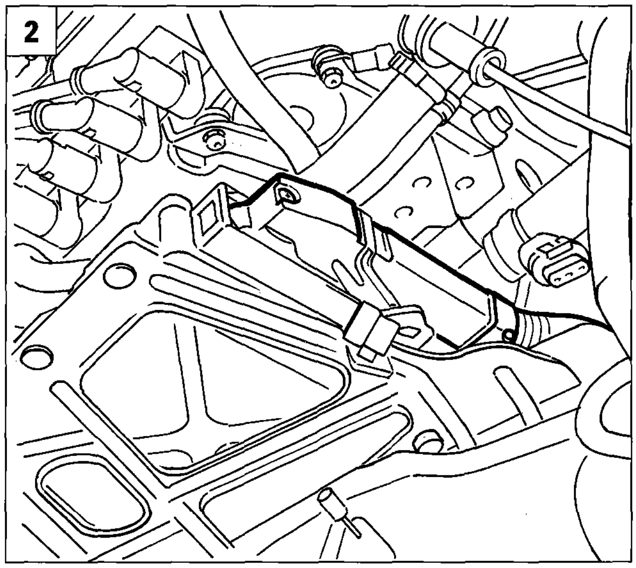


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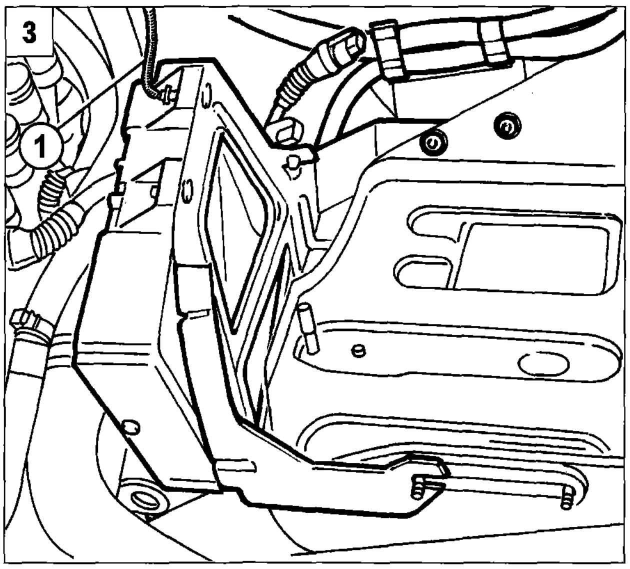
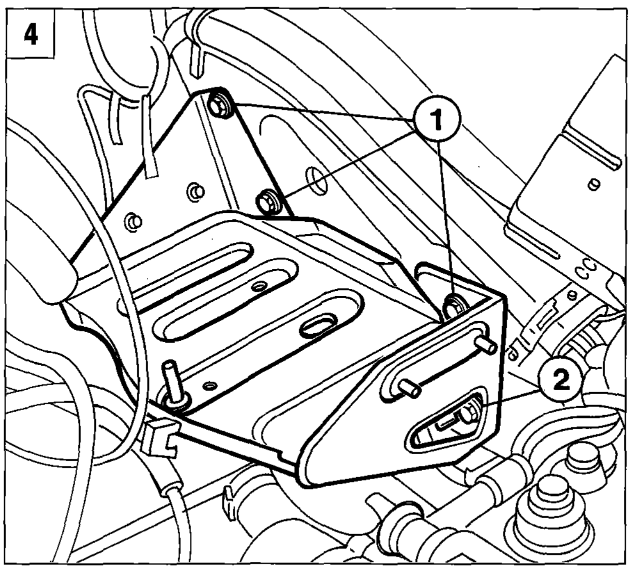



P4A41AB03

1. Remove the nuts securing the fuse and relay box to the battery cage, then move the box over to one side.
2. Disconnect the i.e. control unit supply connector.
3. Disconnect the earth cable (1), remove the nuts securing the i.e. control unit mounting bracket, then remove the control unit from the engine compartment. The nuts indicated also secure the starter motor supply cables and the front cable/fuel injection cable connection.
4. Remove the bolts (1) and slacken the bolt (2) securing the battery cage to the body shell. Before removing the cage, disconnect the cable retaining clip underneath.
5. Remove the split pin and washer shown in the figure; lift the gear change control cable head so as to disconnect it from the gear change lever position sensor.

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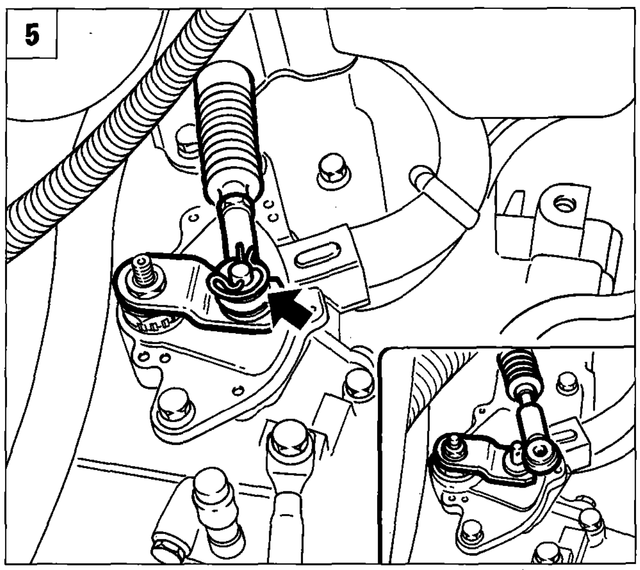


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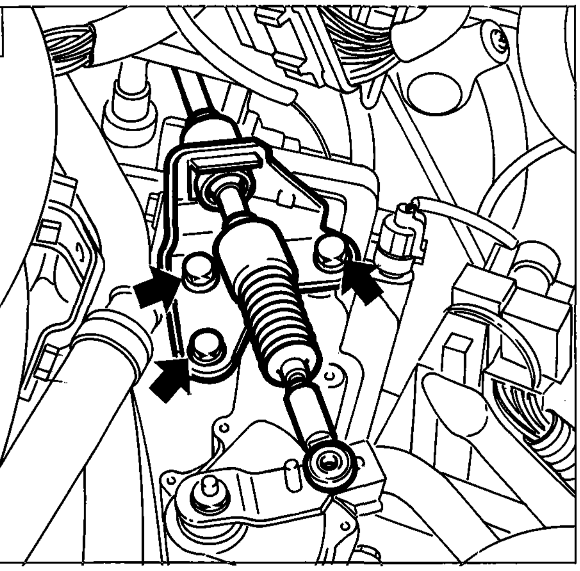
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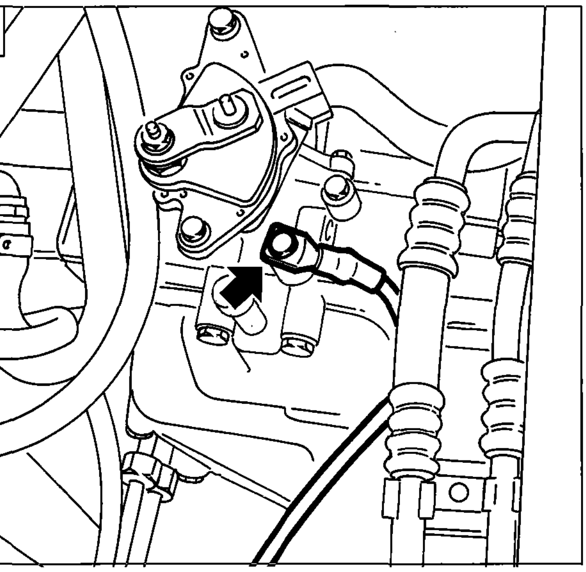
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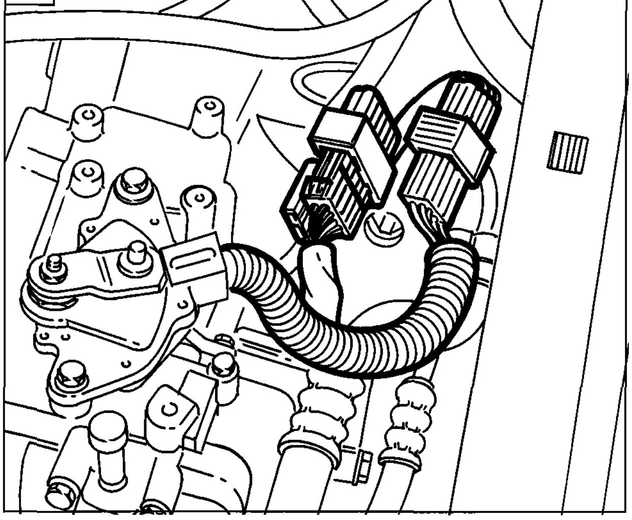
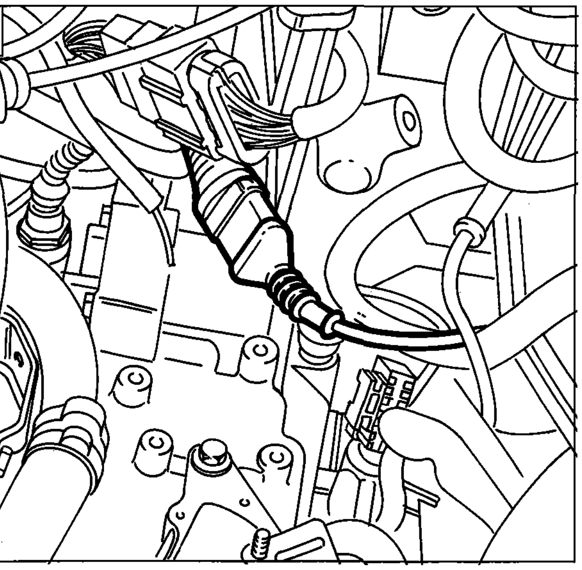

P4A53AB03

1. Remove the nuts securing the gear change control cable mounting bracket, and move it over to one side.
2. Disconnect the earth cable shown in the figure, from the gearbox.
3. Disconnect the connectors shown in the figure of the selector lever position sensor and solenoids (gear change, lock-up clutch control and pressure control) after releasing them from the retaining clips.
4. Disconnect the connector shown in the figure.
5. Disconnect the speedometer drive cable.

4

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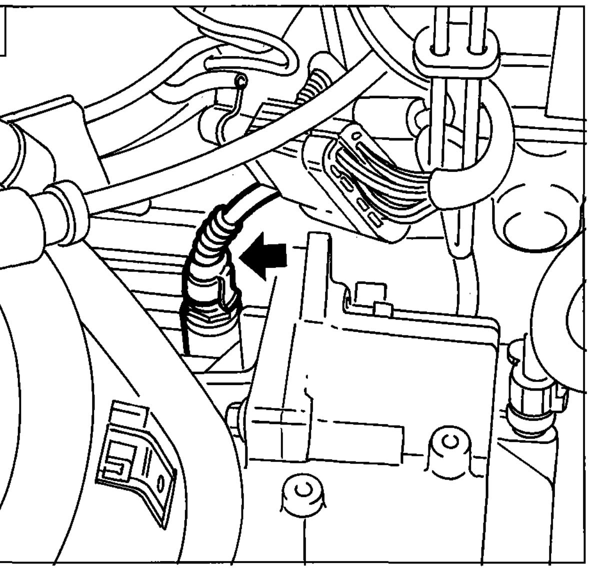
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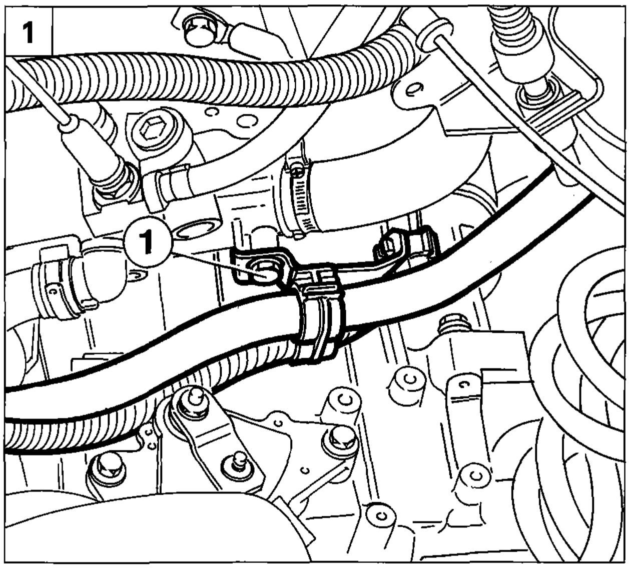
## 21-27.

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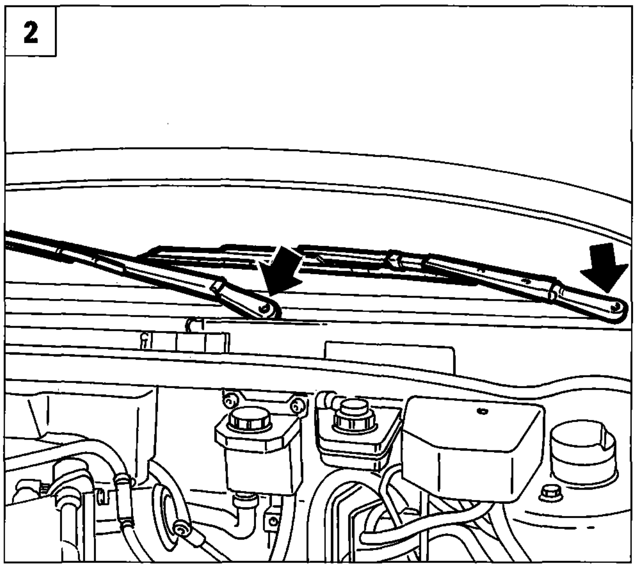


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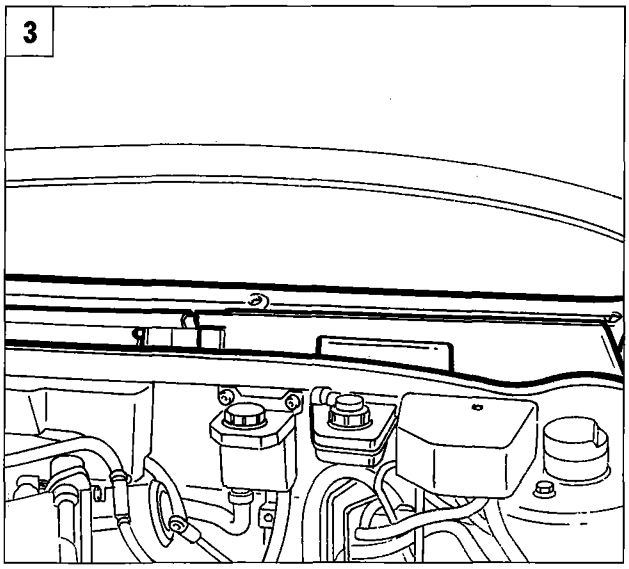
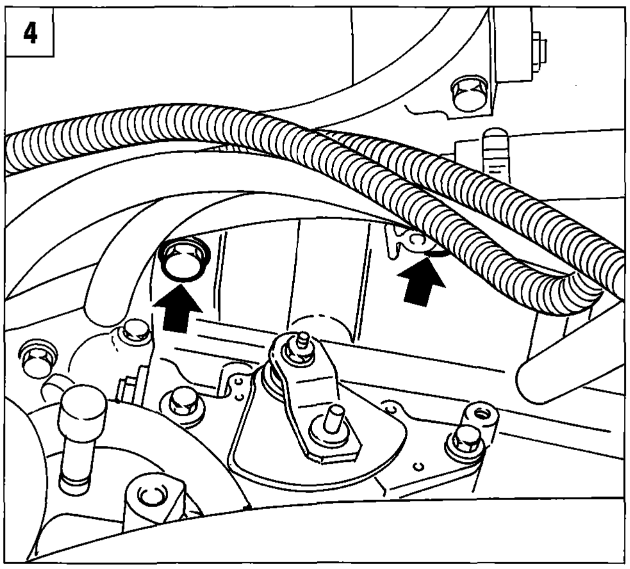



P4A54AB03

1. Remove the bolt (1) securing the retaining bracket for the pipes shown in the figure.
2. Remove the windscreen wiper arms (right and left) by undoing the central fixing nut, after removing the protective cap.

3. Remove the plastic covers from the space under the windscreen, to allow the engine support tool to be installed during removal and refitting of the gearbox.

4. Remove the gearbox top mountings.
5. Fit a suitable supporting eye at the point shown in the figure, to hook up the power unit during removal of the gearbox.

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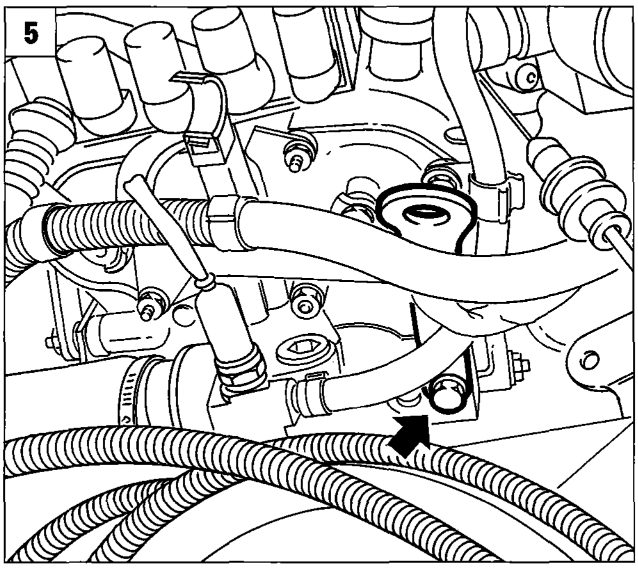


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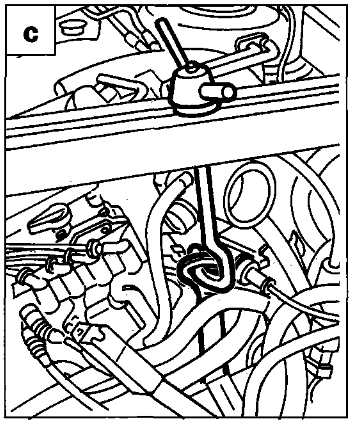
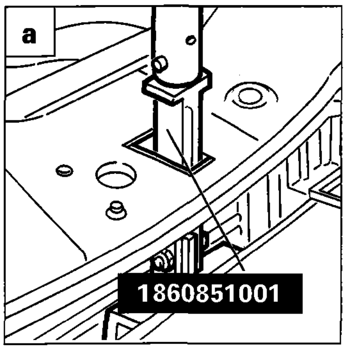


P4A55AB02

1. Fit the engine support crossbeam 1860851000 and the special adaptor 1860851001 at the appropriate mounting points.

   a. Front mounting: fit the tool in the bonnet catch seating, so that it rests on the front cross member.
   b. Rear mounting: fit the tool level with the central reinforcement of the fire-proof bulkhead.
   c. Secure the cross member hook to the eye positioned previously, near the thermostat.

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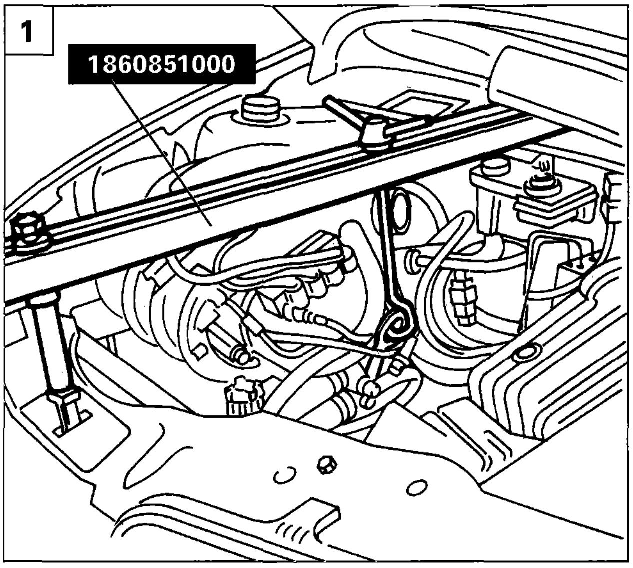


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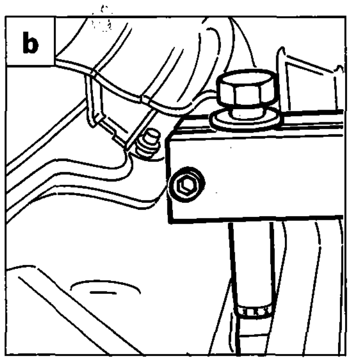

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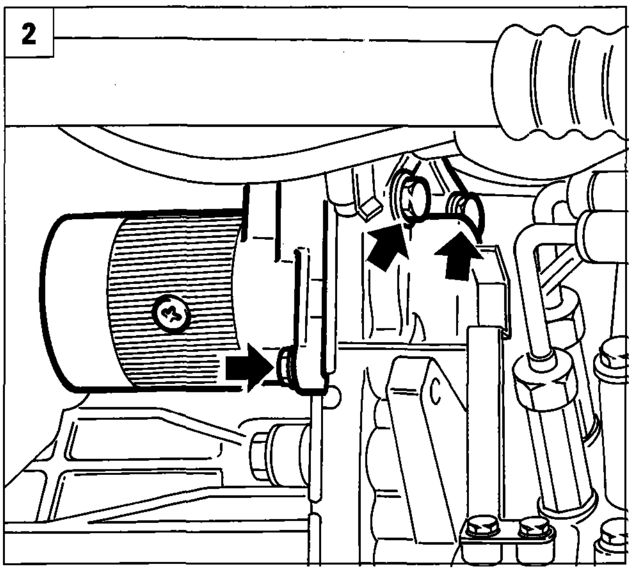
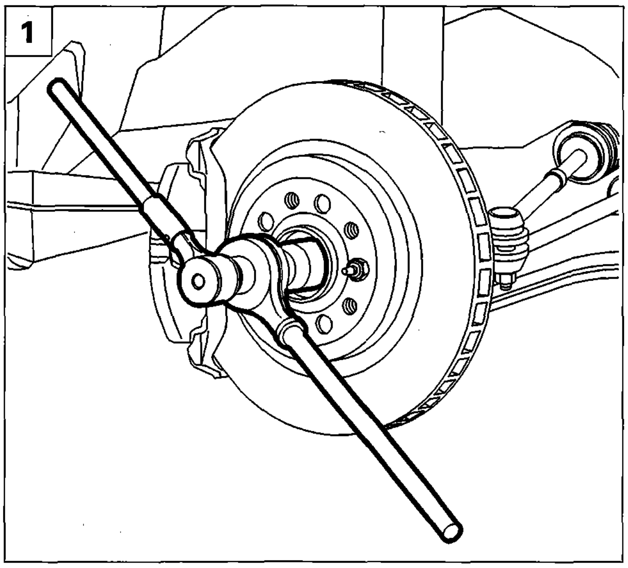


P4A55AB05

2. Remove the starter motor by undoing its bolts; then move the starter motor to one side, securing it, taking care not to damage the supply cables.

# 21-27.

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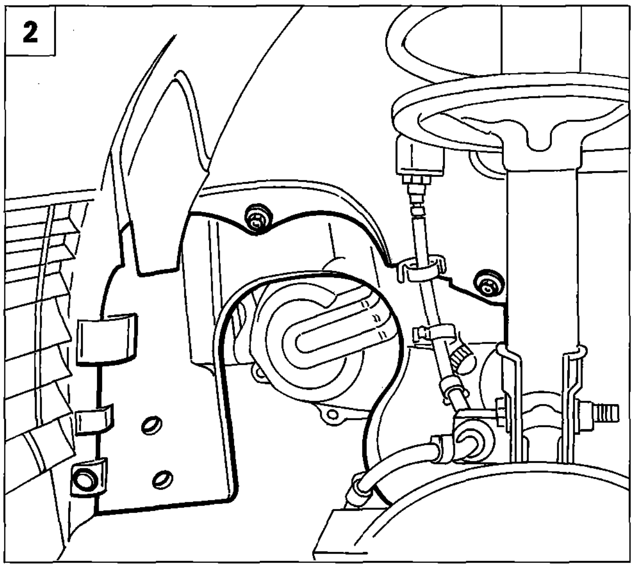


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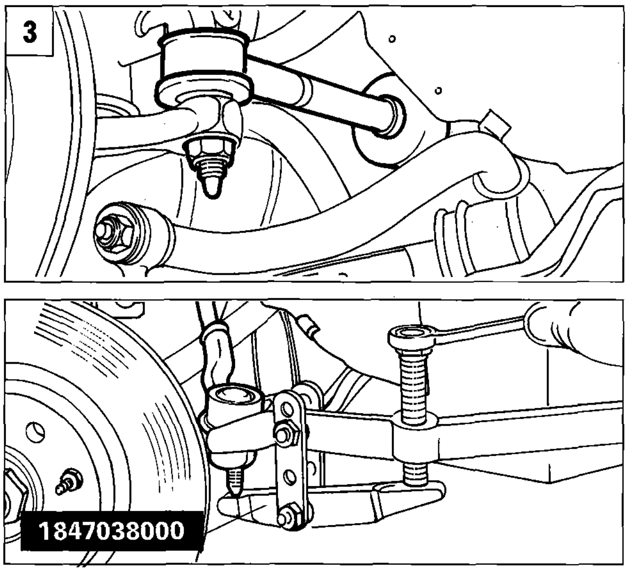


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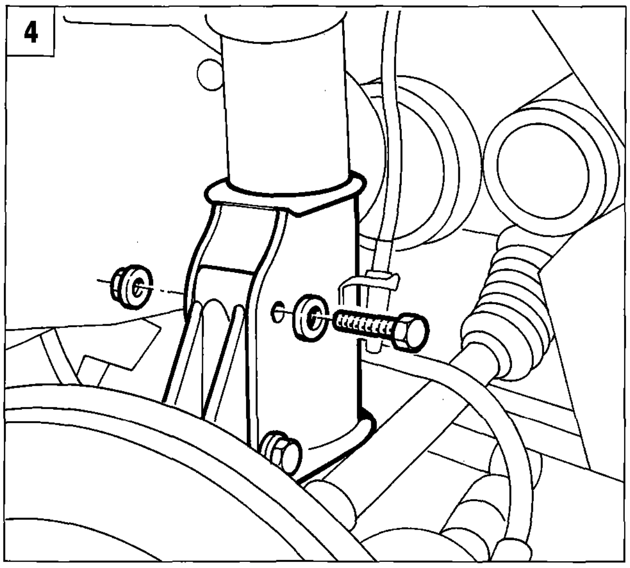
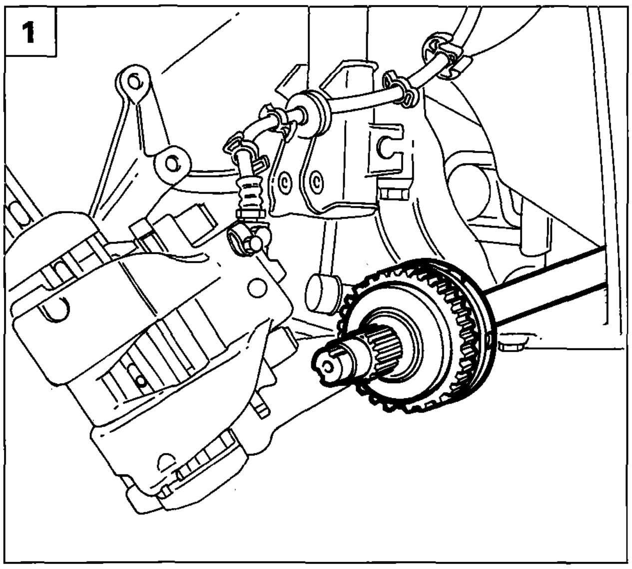



P4A56AB04

1. Relieve the staking then remove the wheel hub nut (gearbox side and timing gear side).
2. Remove the plastic wheelarch trim on the gearbox side by undoing the screws and retaining button shown in the figure. To remove the trim, also disconnect the brake pad wear sensor connector (repeat the operation on the other side).
3. Remove the nut securing the track rod end to the vertical link, then remove the latter from the vertical link arm using the puller 1847038000 (repeat the procedure on the other track rod end).
4. Remove the bolts securing the vertical link (gearbox side and timing gear side) to the shock absorber.



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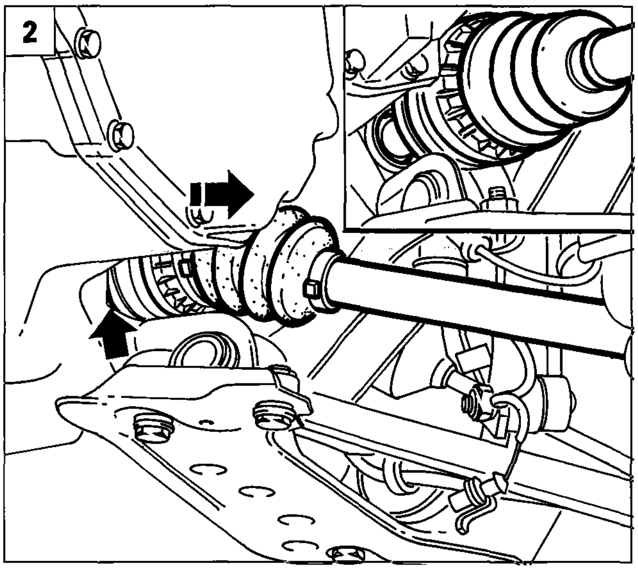

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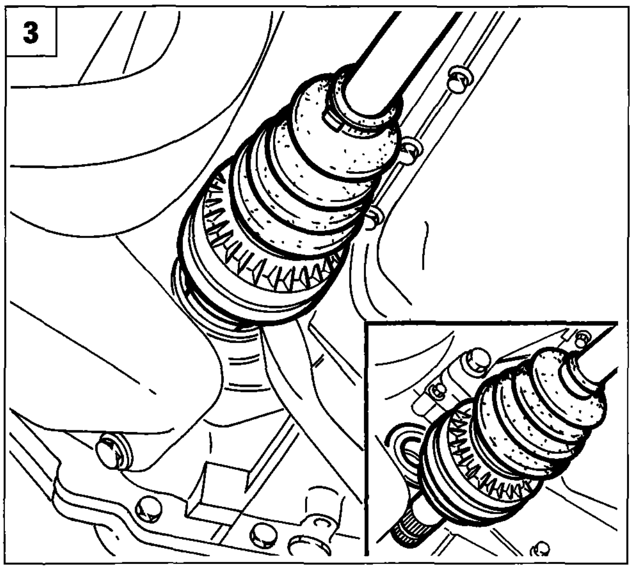

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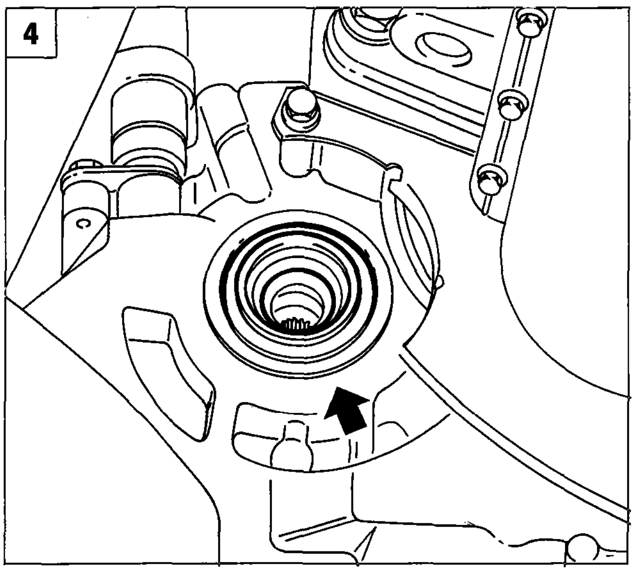
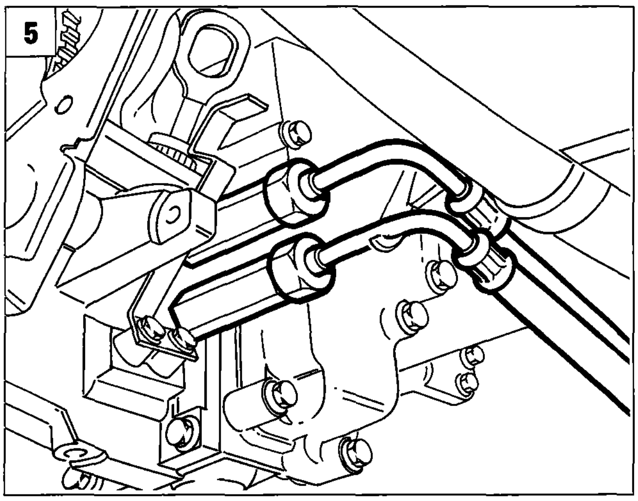


P4A57AB04

1. Rotate the vertical link so as to withdraw the drive shaft from the wheel hub (repeat the procedure for the other drive shaft).
2. Disconnect the drive shaft on the gearbox side from the differential, levering on the anchorage point, and move it away from the working area.
3. Disconnect the drive shaft on the timing gear side from the differential, levering on the anchorage point.
4. Differential oil seals.

*When withdrawing the drive shafts, take care not to damage the differential seals. Withdraw them perfectly horizontally.*

5. Remove the connectors shown in the figure in order to disconnect the oil pipes from the gearbox. Then place the pipes over to one side.



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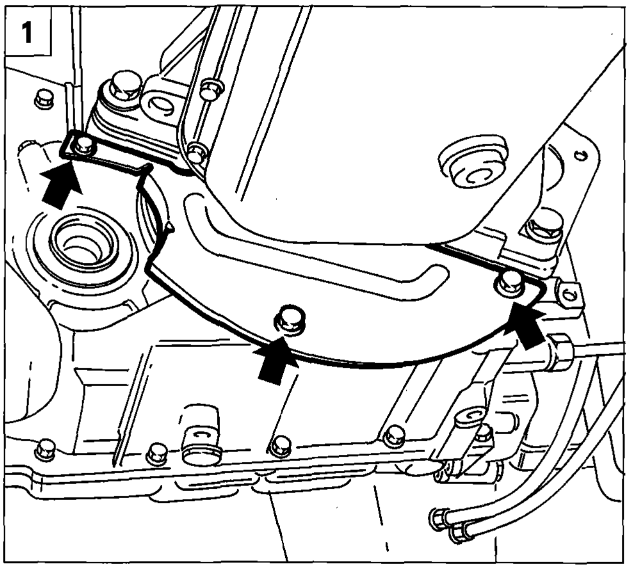
# 21-27.

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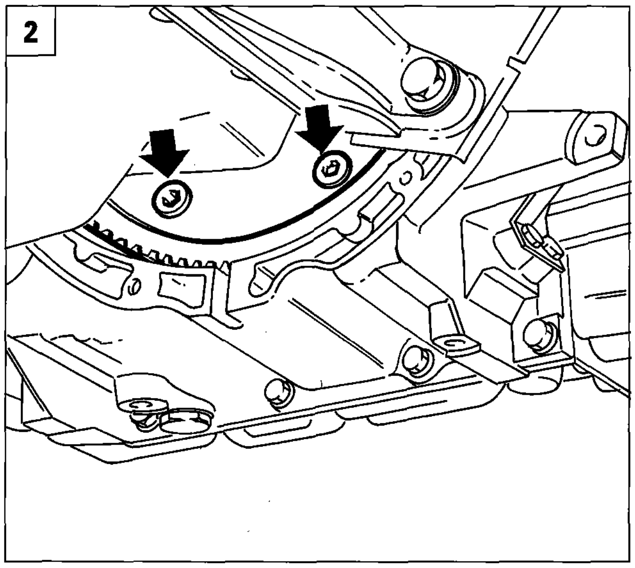


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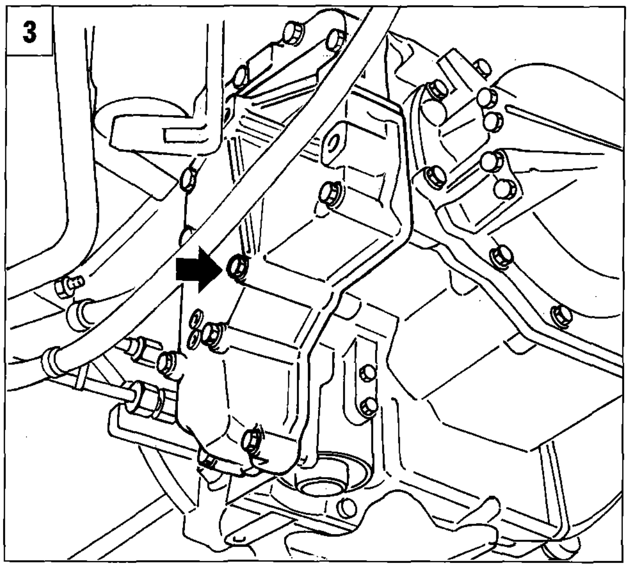
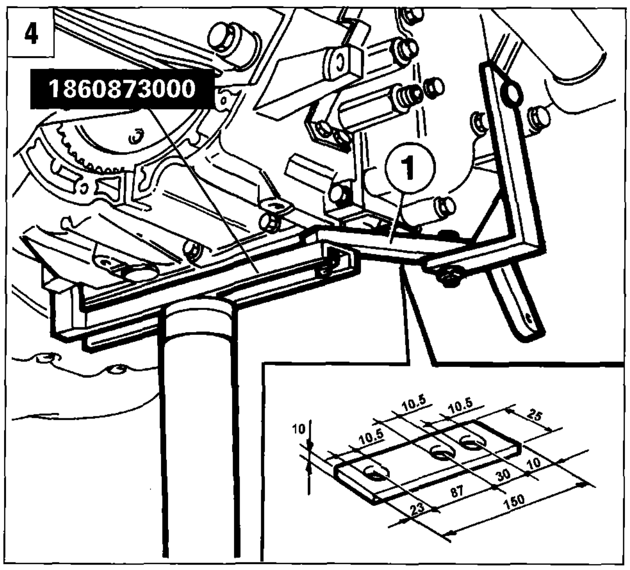



P4A58AB03

1. Remove the guard shown in the figure from the bottom of the gearbox.
2. Remove the bolts securing the converter to the flywheel. First undo the two visible bolts, then turn the crankshaft to gain access to the remaining bolts (total of 6).

3. Undo the bolt shown in the fibure from the valve assembly cover to allow the gearbox support tool to be installed.

4-5. Place the gearbox support tool 1860873000 on a hydraulic jack, then secure it to the gearbox at the points shown in the figure. To fit the tool correctly, also fit a bracket (1), to be manufactured on site, of the dimensions shown in the insert (dimensions in mm).

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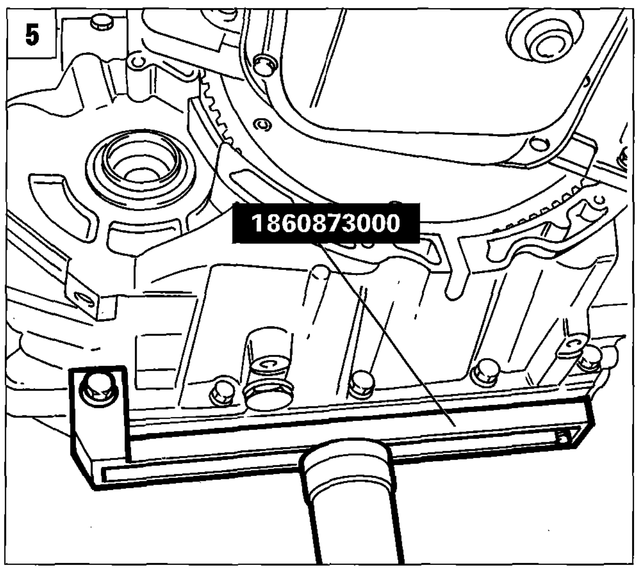


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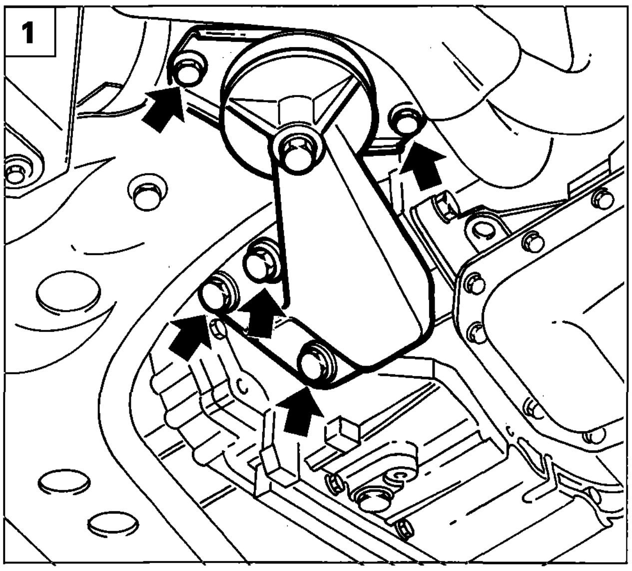


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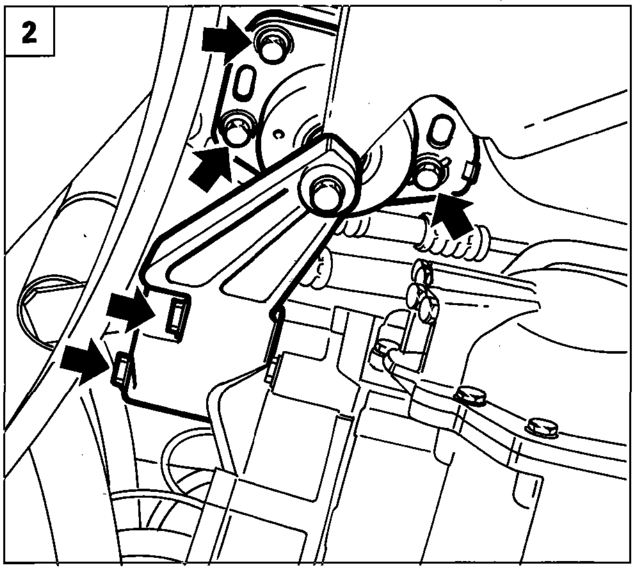


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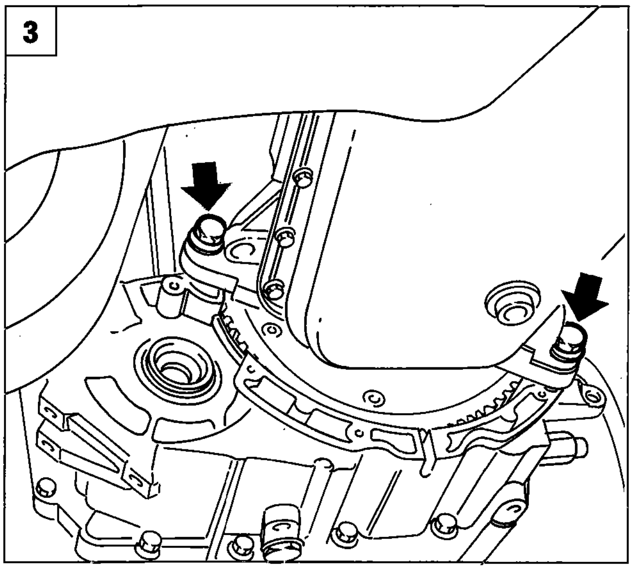


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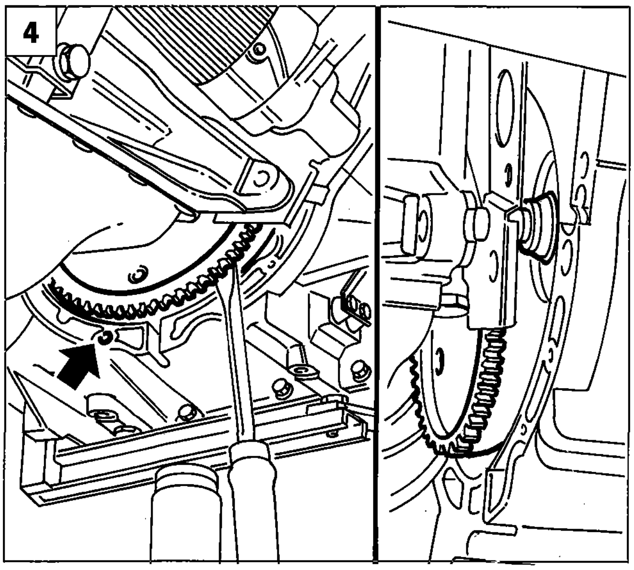
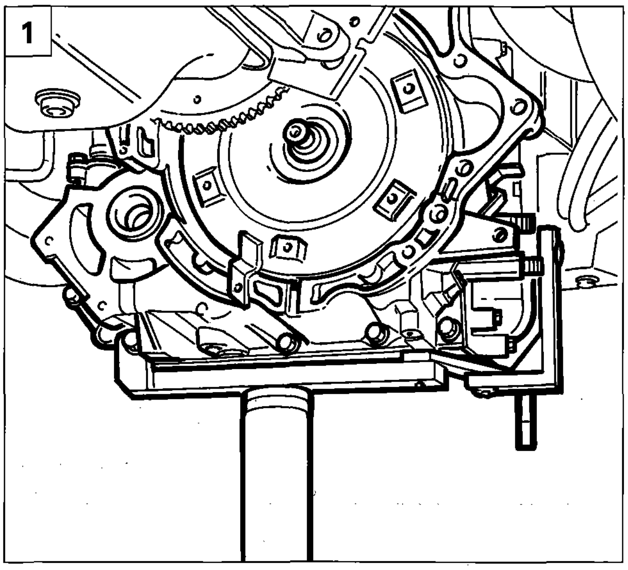



P4A59AB04

1. Remove the power unit central mounting by undoing the bolts shown in the figure.

2. Remove the power unit mounting on the gearbox side by undoing the bolts shown in the figure.
3. Remove the bottom bolts securing the gearbox to the engine.
4. Gently separate the bellhousing from the engine, then manoeuvre the converter back into its seating. For greater safety, fit a bracket, to be manufactured on site, screwing it into the seat of the bolt securing the gearbox bottom guard, to prevent the converter falling out of its seating.

## 21-27.



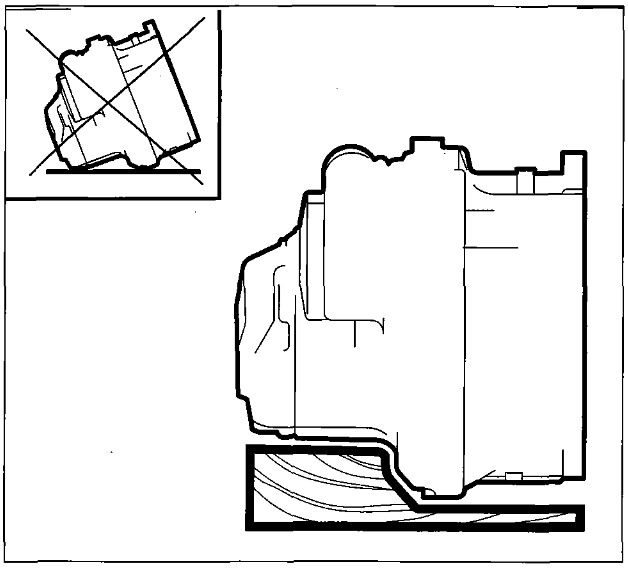

P4A60AB01

1. Manoeuvre the hydraulic jack as appropriate to release the gearbox from the surrounding parts. Gradually lower the jack and withdraw the gearbox.

*Take particular care to prevent the converter falling out of its seating.*

*When refitting, fit the gear change control cable, then carry out the checks described for removal of the cable.*

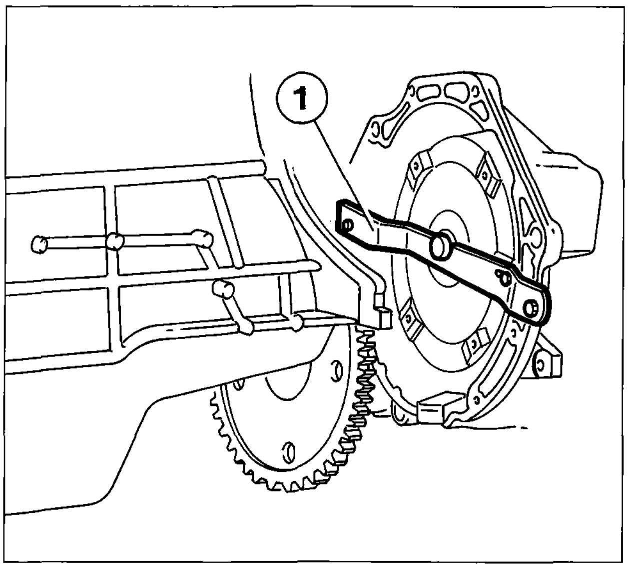
**NOTE** *Top up the gearbox oil level and check that there are no leaks from the drain plug (tighten to 2.35 - 5.49 daNm).*



P4A60AB02

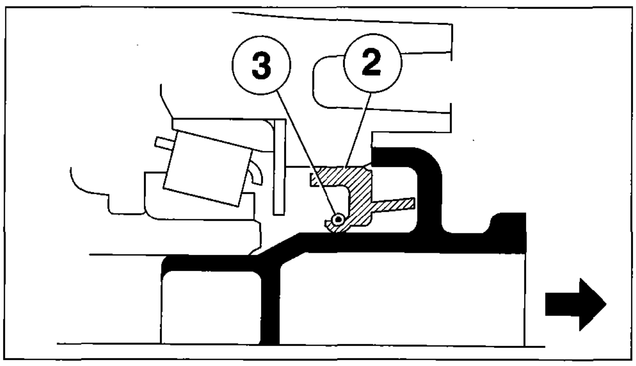
**PRECAUTIONS**

After releasing the cable from the support tool, do not place it directly on the floor, to avoid damaging its structure and the external components. Interpose a suitably shaped wooden wedge.




P4A60AB03

If the gearbox is replaced, before fitting the new transmission, remove the bracket (1) in the converter seating and the plugs on the differential outlet, fitted to stop foreign bodies entering the gearbox. Remove the above-mentioned plugs perfectly horizontally, to avoid damaging the oil seals (2) on the differential and to prevent the spring (3) inside the seals from falling out.

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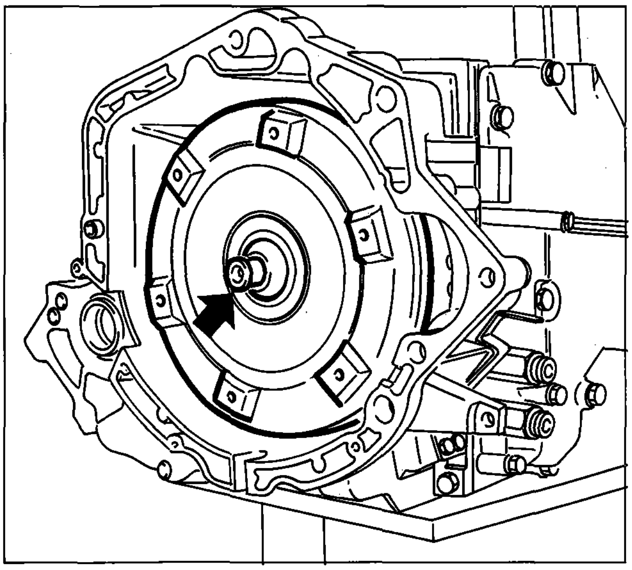
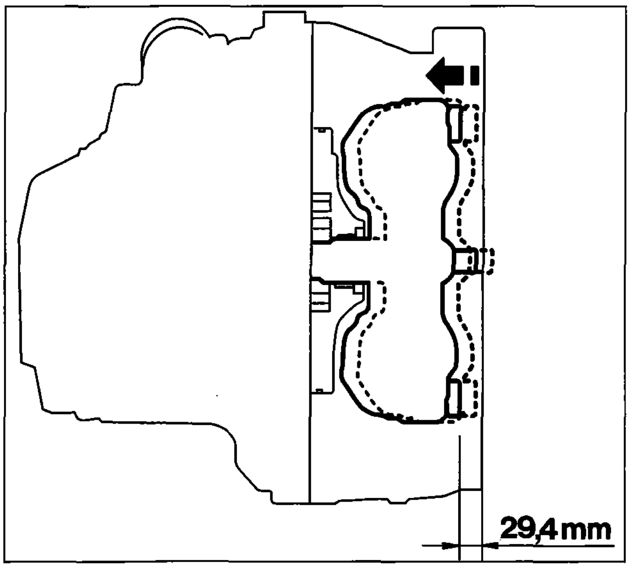


P4A61AB01

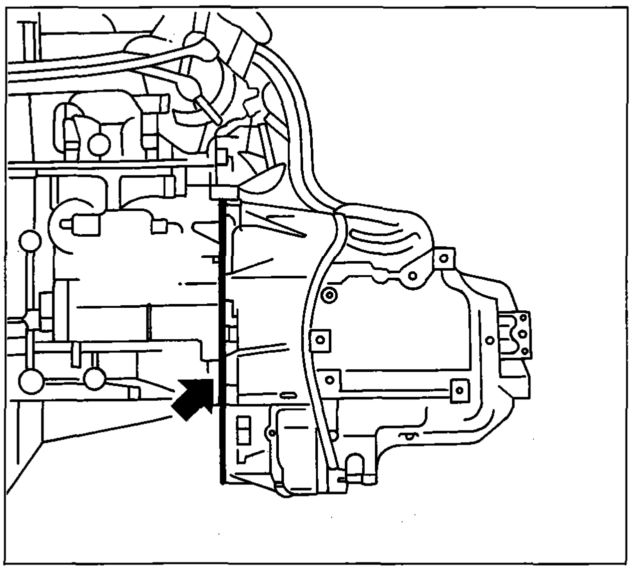
Do not damage the converter centring nose while fitting the gearbox. If the point is damaged, it could fail to fit onto the cranskshaft correctly, and consequently damage the converter and oil pump.




P4A61AB02

Before fitting the transmission, make sure that the converter is fitted properly on the oil pump. If it is not fitted properly, the bush and oil pump gearing could be damaged.

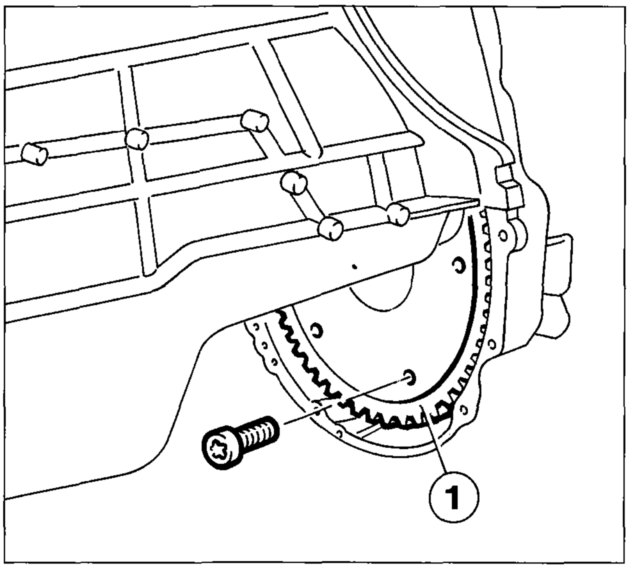
Make sure that the distance between the holes of the bolts securing the converter to the flywheel and the gearbox front surface is 29.4 mm.



P4A61AB03

When fitting the gearbox, check that the centring pins are positioned correctly, and also check that there is no gap between the contact line between the engine and gearbox casing.

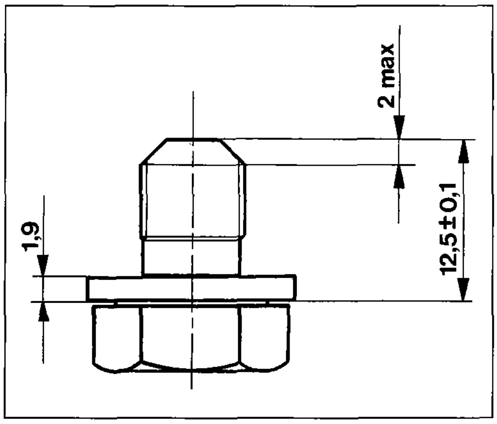
## 21-27.




P4A62AB01

When coupling the converter to the flywheel, use bolts of the correct length (M8x1.25 bolts with tapered shakeproof washer drawing 46450230, of the dimensions indicated in the figure) and make sure that they are not mixed up with other bolts.

1. Bolts which are too long could damage the other end of the converter and deform the clutch seal.
2. Bolts which are too short may not withstand the input torque and could break.

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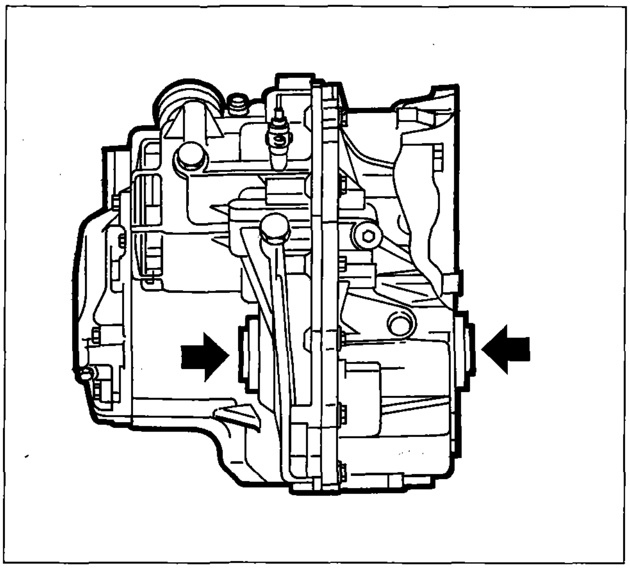

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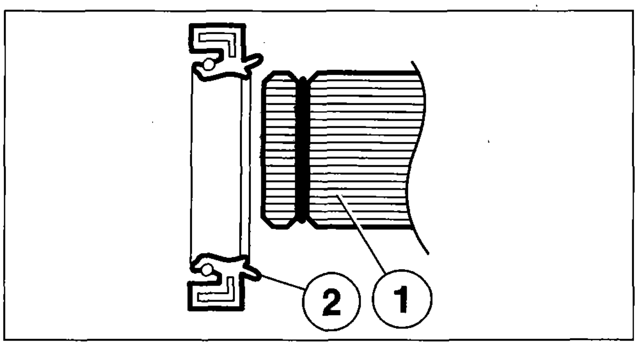
When fitting the drive shafts, take particular care not to damage the differential oil seal (2) on the splined part (1) of the drive shaft. Insert the drive shaft perfectly horizontally. If the seal is damaged, it could cause oil leaks.

*Make sure that the drive shaft is clean before assembly to avoid foreign bodies entering into the differential.*

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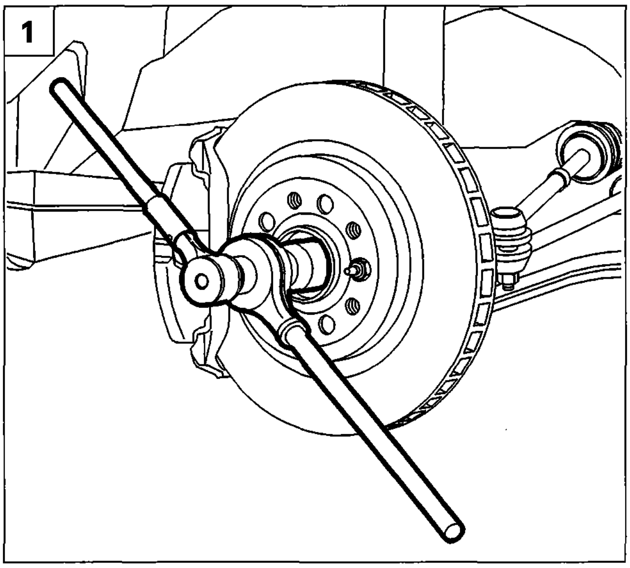

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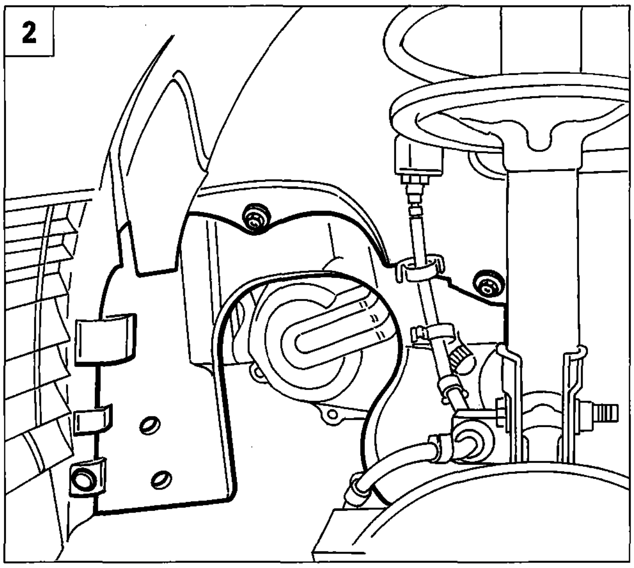

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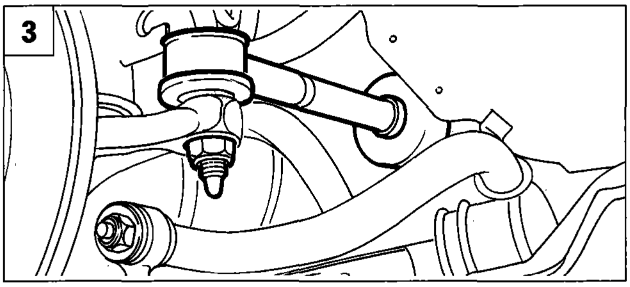

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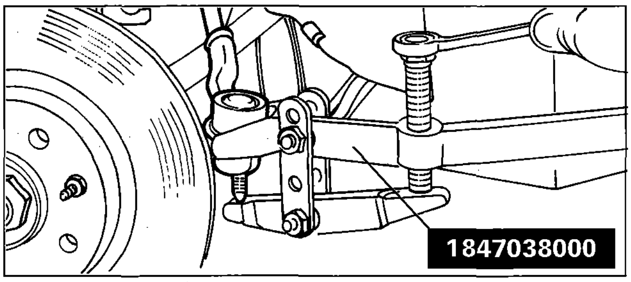


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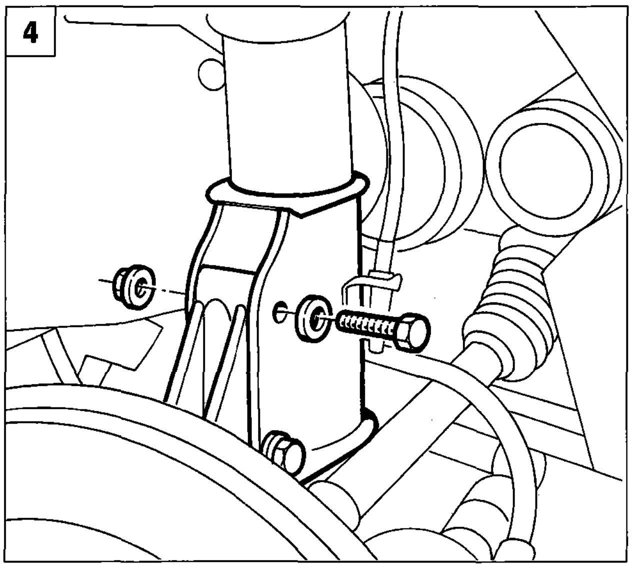

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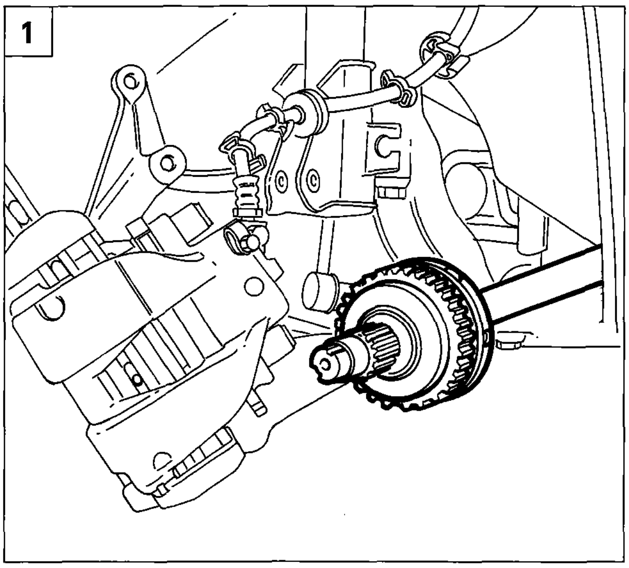
### REMOVING-REFITTING

Place the vehicle on ramps, remove the front wheels, drain the gearbox oil and then proceed as described below:

1. Relieve the staking then remove the wheel hub nut (gearbox side and timing gear side).
2. Remove the wheelarch plastic trim on the gearbox side by undoing the bolts and retaining button shown in the figure. To remove the trim, also disconnect the brake pad wear sensor (repeat the procedure for the other side).
3. Remove the nut securing the track rod end to the vertical link, the remove the latter from the vertical link arm using the puller 1847038000 (repeat the procedure on the other track rod end).
4. Remove the bolts securing the vertical link (gearbox side and timing gear side) to the shock absorber.

## 21-27.

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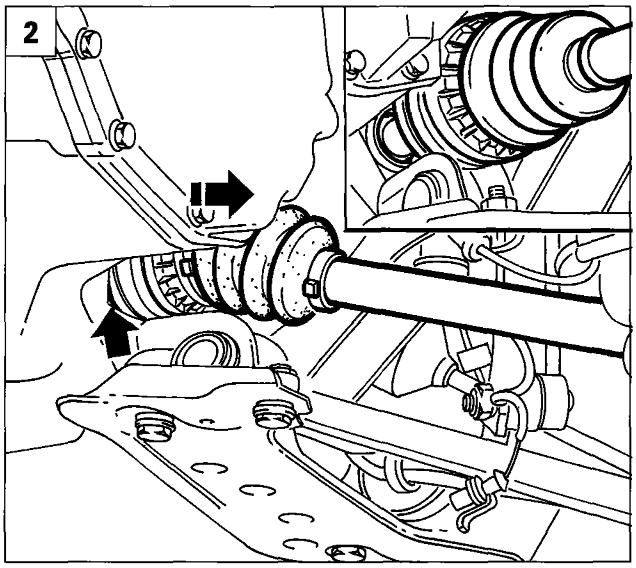


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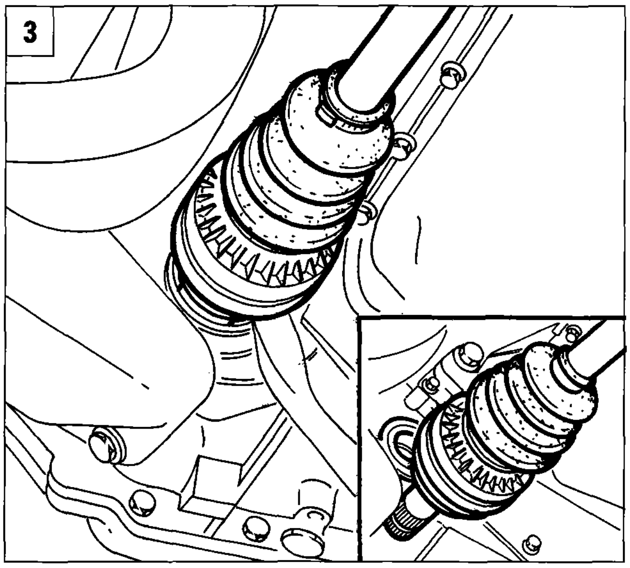


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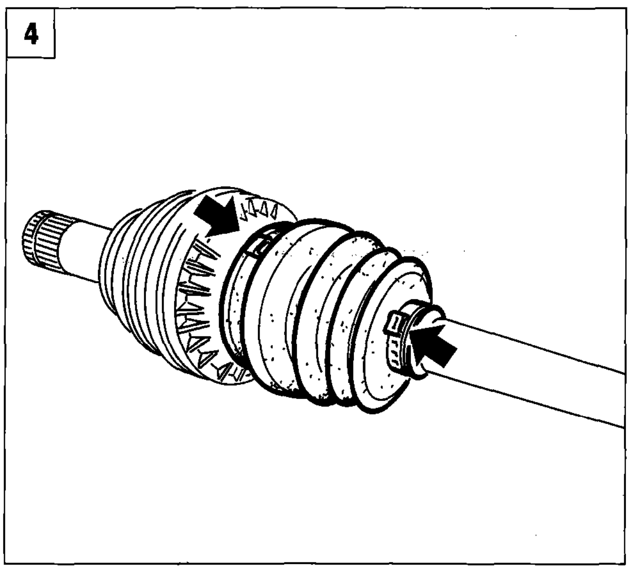



P4A64AB01

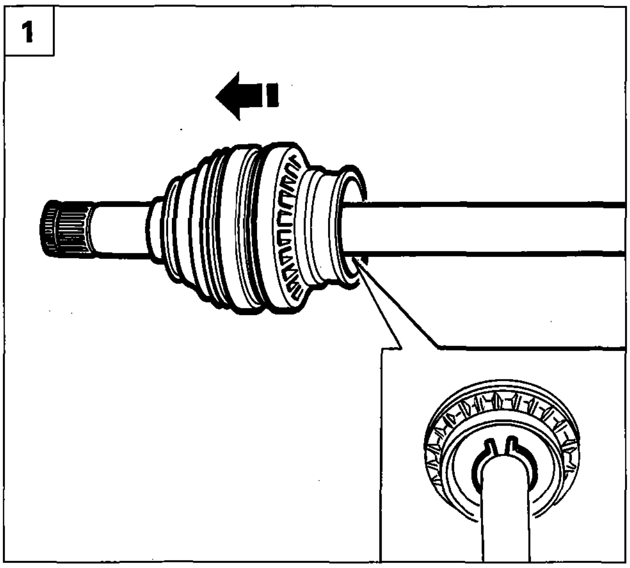
1. Rotate the vertical link in order to withdraw the drive shaft from the wheel hub (repeate the procedure for the other side).
2. Disconnect the drive shaft on the gearbox side from the differential, levering on the anchorage point.
3. Disconnect the drive shaft on the timing gear side from the differential, levering on the anchorage point.

**NOTE** *When refitting, reverse the procedure for removal, tightening the wheel hub nut to the specified torque.*

*To remove and refit the drive shafts, bear in mind the warnings mentioned under removing-refitting the gearbox.*

### DISMANTLING-REASSEMBLY

4. Place the drive shaft in a vice, then remove the clips retaining the protective gaiter on the sliding joint on the gearbox side.

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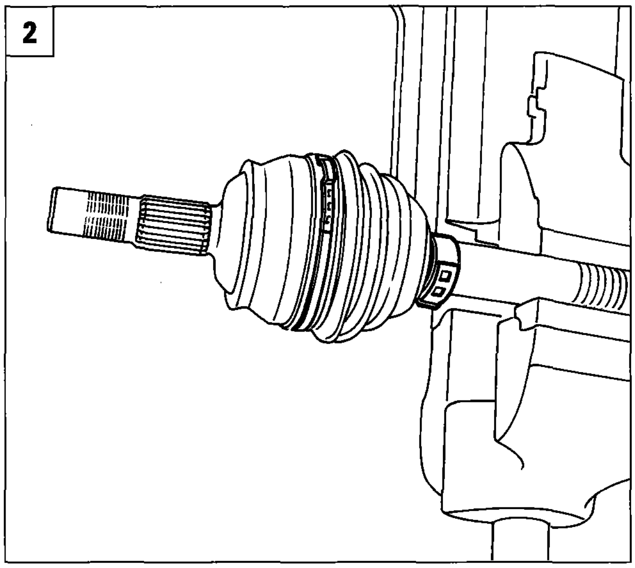


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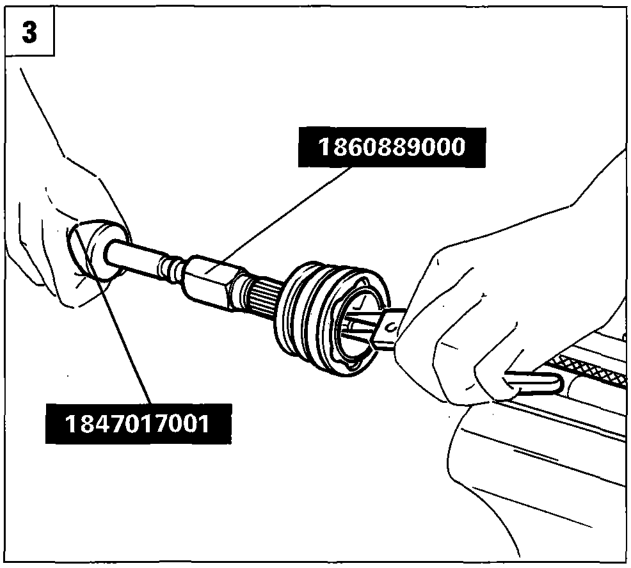


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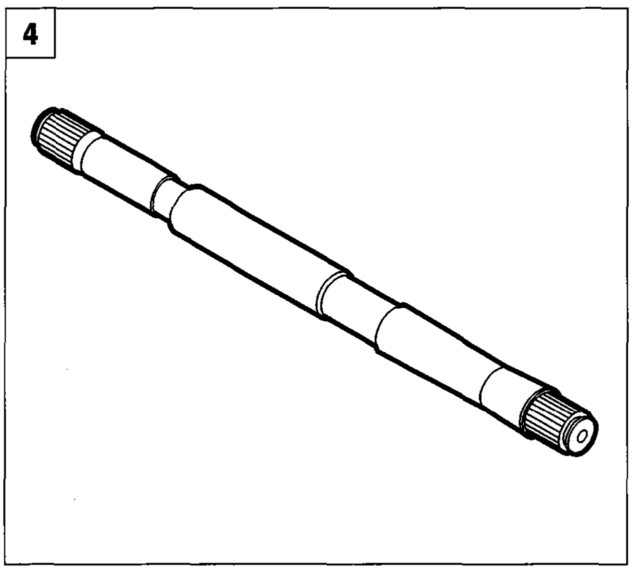


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1. Remove the circlip retaining the sliding joint (gearbox side), then remove the joint by withdrawing it from the drive shaft.
2. Undo the clips retaining the protective gaiter on the constant velocity joint on the wheel side, then remove the gaiter from the side opposite the drive shaft.
3. Degrease the inside of the constant velocity joint. Using tools 1847017001 and 1860889000, and holding the circlip inside the joint at the same time, remove the joint from the drive shaft.
4. Check that the drive shaft is not deformed or out of true, and that the surface in contact with the seal is not worn.

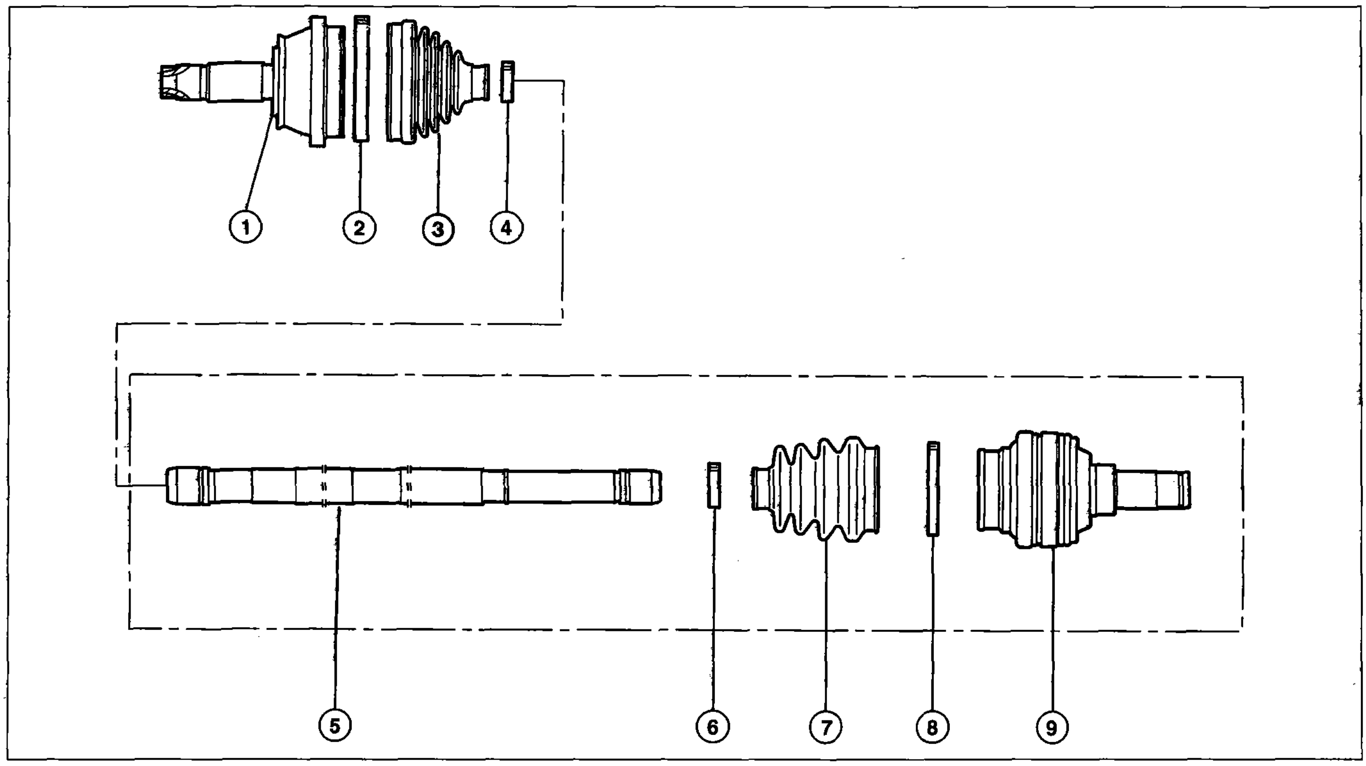
**REFITTING**

*When refitting, reverse the procedure described for removal.*
*Whenever a gaiter is removed, it is advisable to replace it, and it is important to fill both the constant velocity joint or sliding joint and the gaiter with TUTELA MRM2 grease.*

| Drive shaft-joint coupling, wheel side | | | |
|---|---|---|---|
| **Shaft classification** | | **Joint classification** | |
| **Category** | **Colour** | **Category** | **Colour** |
| **2** | **Green** | **2** | **Green** |
| **3** | **White** | **3** | **White** |

When refitting, the constant velocity joints must be coupled to the shaft as indicated in the table. Conduct a final check on the joint, to make sure that there are no signs of seizure or scoring.

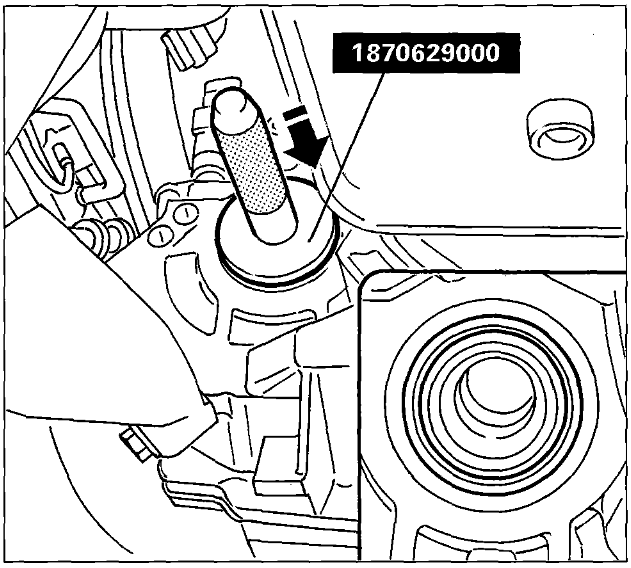
**TRANSMISSION COMPONENTS**




P4A66AB01

1. Constant velocity joint
2-4. Clips retaining constant velocity joint protective gaiter
3. Constant velocity joint protective gaiter
5. Drive shaft

6-8. Clips retaining sliding joint protective gaiter (gearbox side)
7. Sliding joint protective gaiter (gearbox side)
9. Sliding joint

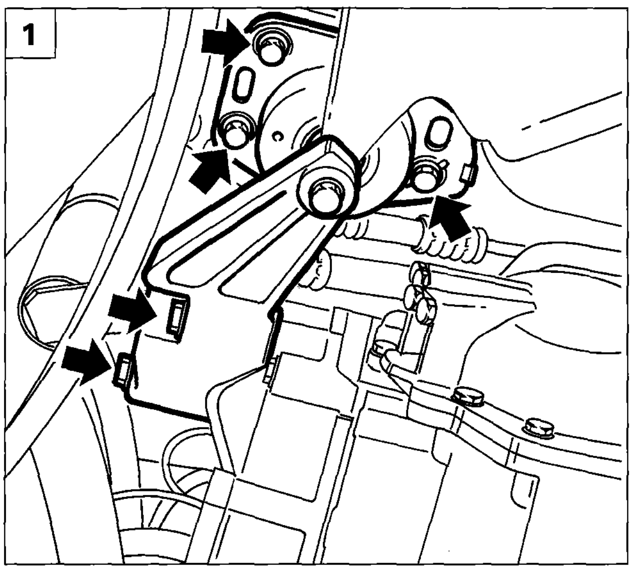



P4A67AB01

### Replacing differential oil seal

Disconnect the drive shaft from the differential as described above, then remove the oil seal from the differential, using a screwdriver as a lever.
When refitting, use the drift 1870629000 with an appropriate handle.

*Operate with care to avoid damaging the oil seal and causing leaks.*

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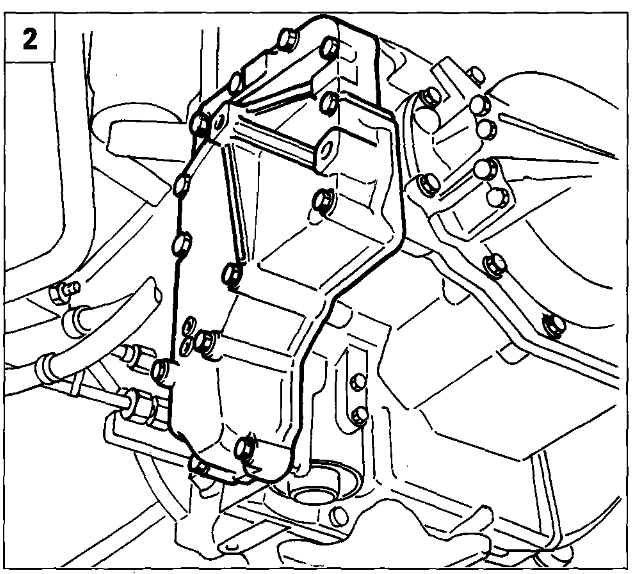
### REMOVING-REFITTING VALVE ASSEMBLY

Place the car on ramps, disconnect the battery's negative pole, drain the gearbox oil, then proceed as described below, working from under the vehicle:

1. Place a hydraulic jack under the bellhousing, then remove the power unit mounting on the gearbox side to allow the valve assembly cover to be removed.

2. Undo the bolts securing the valve assembly cover and remove the cover.
3. Disconnect the valve assembly solenoid supply connectors, disengage the gearbox oil temperature sensor (1) from its mounting bracket and move the wiring aside.

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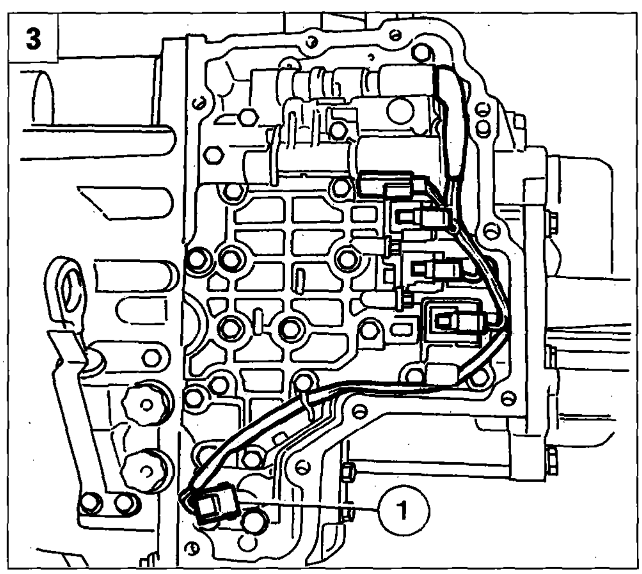


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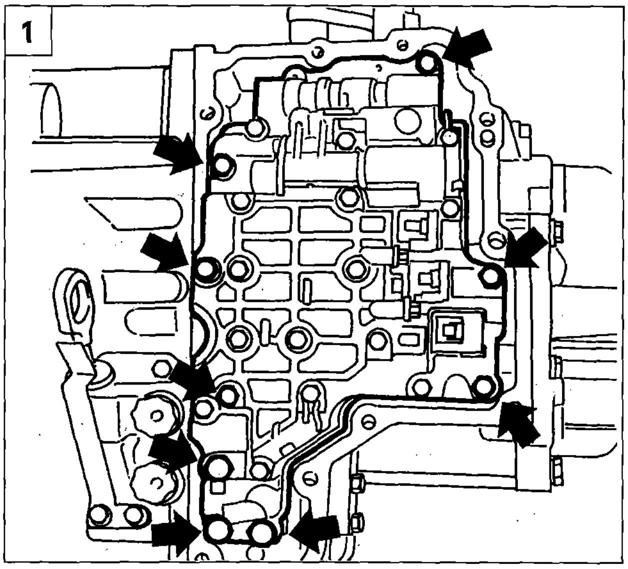
# 21-27.

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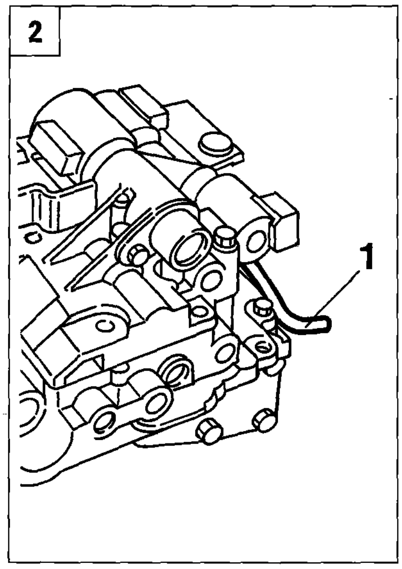


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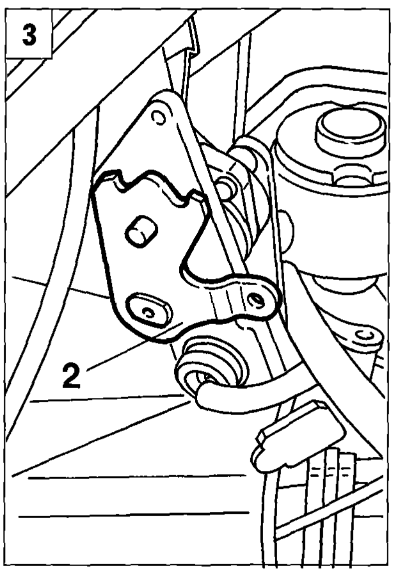


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1. Undo the bolts shown in the figure securing the valve assembly, then remove the complete assembly.

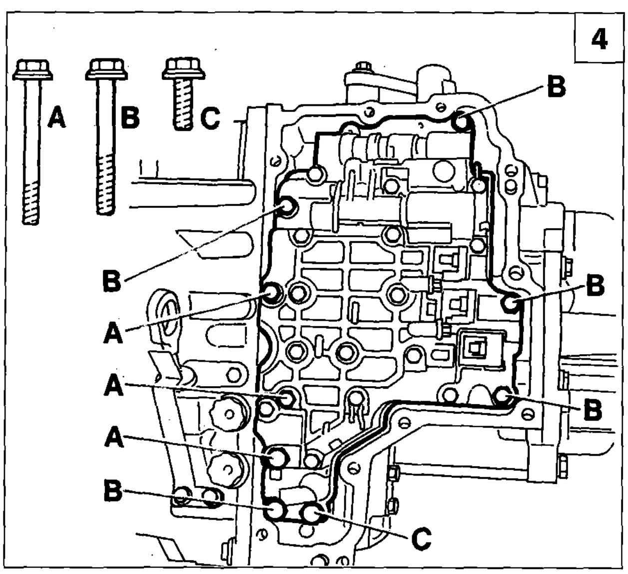
**Refitting**

2-3. Insert the lever (1) of the selector valve in the hole of the lever (2).

4. Position the valve assembly and tighten the fixing bolts. Connect the solenoid supply connectors and fit the gearbox oil temperature sensor on the mounting bracket.

*The valve assembly bolts are of different lengths. Arrange the bolts as shown in the figure.*

5. Using solvent, clean off any sealant residues from the valve assembly cover. Apply a bead of silicone sealant 1-1.5 mm thick along the edge of the cover, cleaning off any surplus inside the cover.

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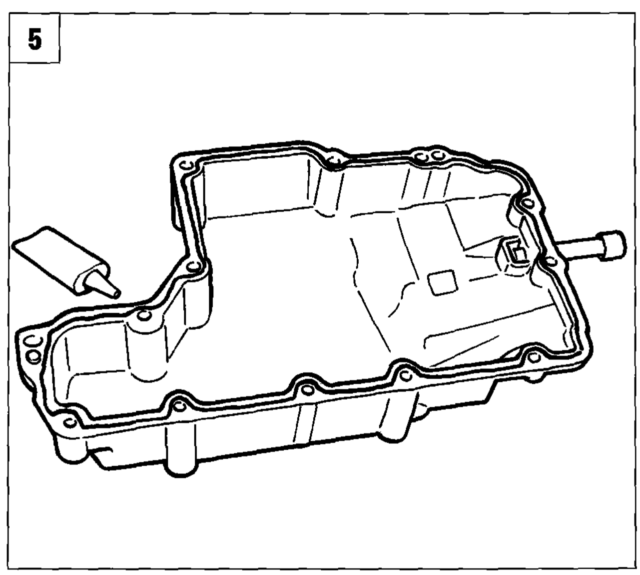


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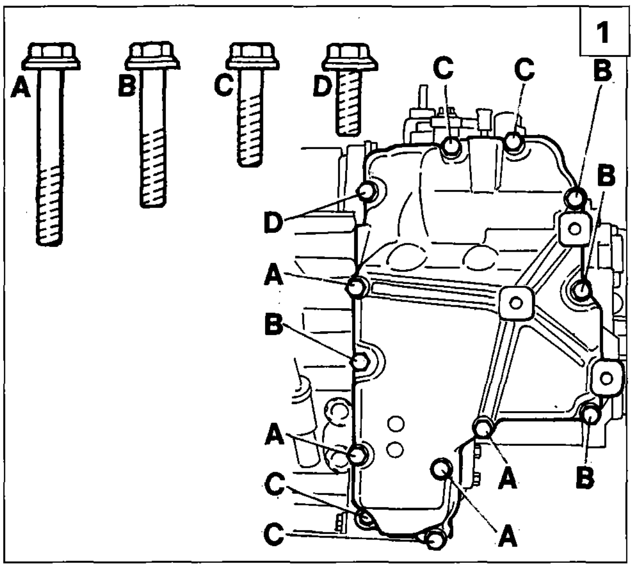


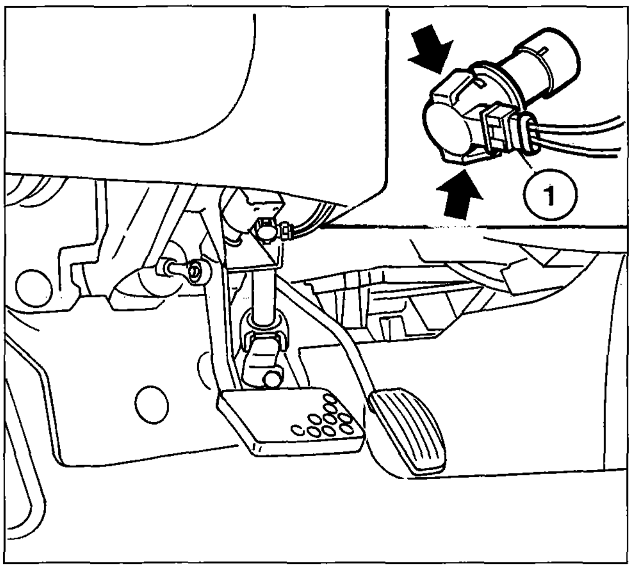

P4A69AB01

1. Fit the valve assembly cover and tighten the bolts.

*The bolts securing the valve assembly cover are of different lengths. Arrange the bolts as shown in the figure and tighten them to a torque of 1.96 - 2.74 daNm.*

**NOTE** *Fit the gearbox oil drain plug and tighten to a torque of 2.35-5.49 daNm. Top up the oil level, then check that there are no oil leaks from the valve assembly cover or drain plug.*

Finish refitting the valve assembly by reversing the procedure for removal.

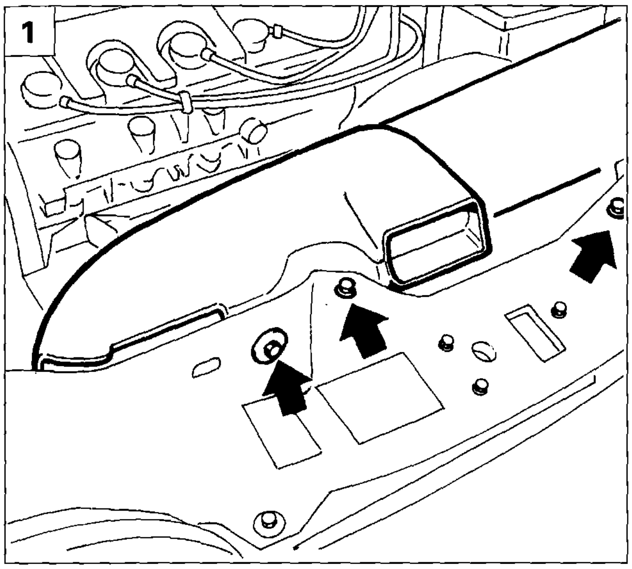



P4A69AB02

## KICK-DOWN SWITCH

The kick-down switch is located on the accelerator pedal. To remove this switch, release the lugs which secure the switch to the mounting bracket. Disconnect the supply connector (1), then replace the switch.

*It is virtually essential to replace the kick-down switch if it is removed, as the retaining lugs could break during removal.*



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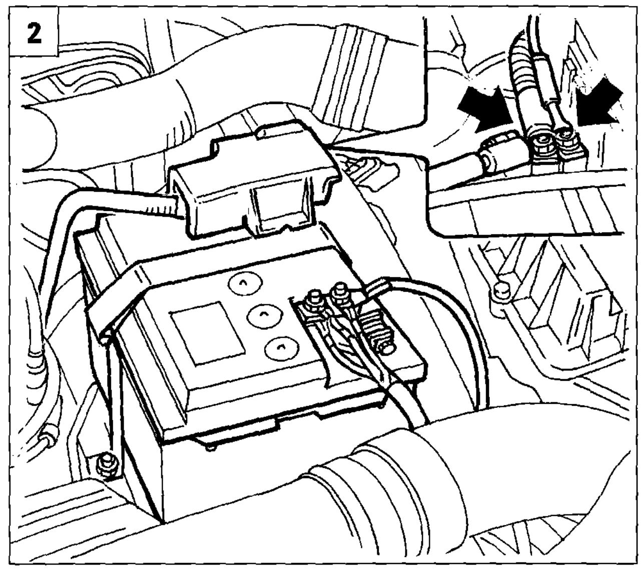

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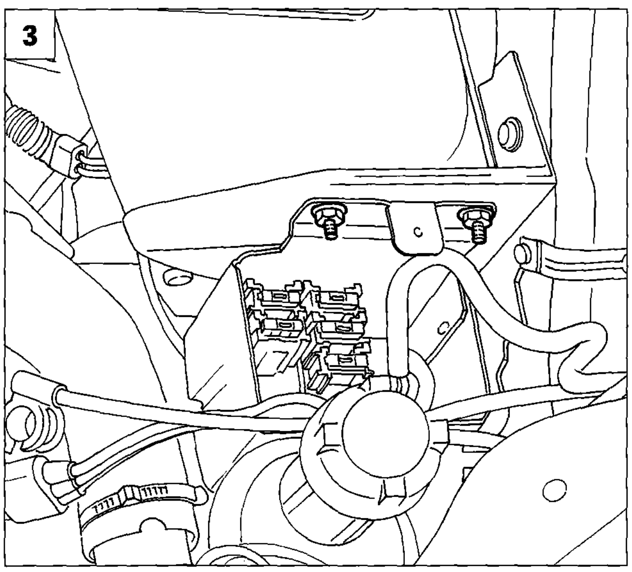

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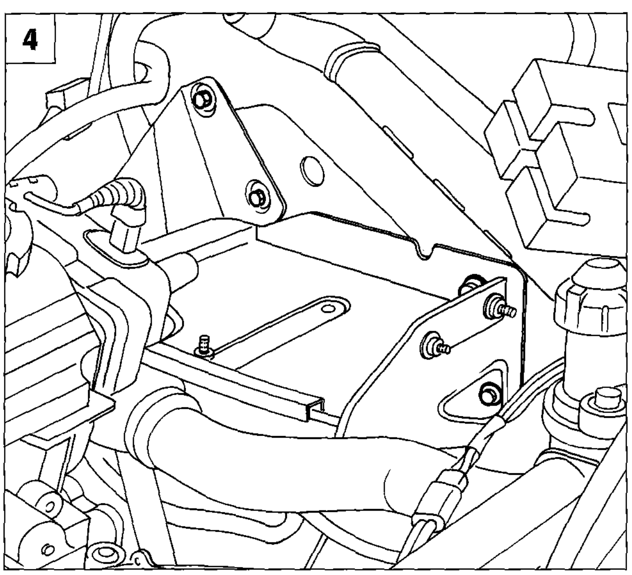


P4A01BB04

## REMOVING-REFITTING

### Removing

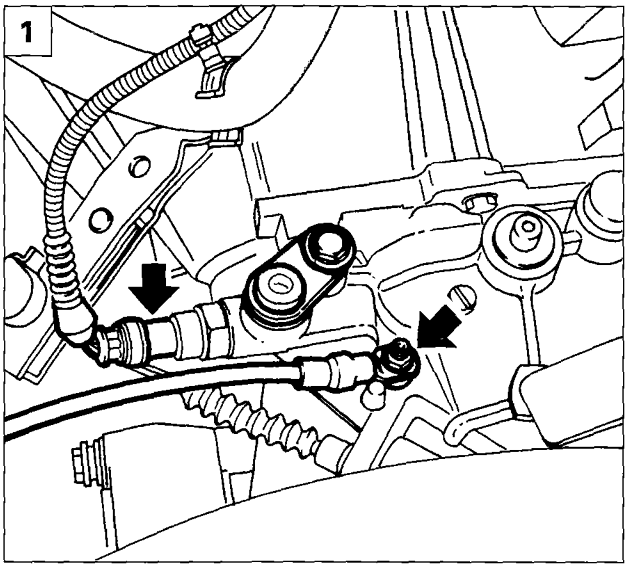
Position the vehicle on a lift, remove the front wheels then proceed as described below:

1. Undo the three fixing bolts and remove the air intake disconnecting it firstly from the air filter.

2. Disconnect the negative battery lead, remove the protective cover for the positive pole, disconnect the terminal and separate the latter from the starter motor supply leads; undo the nut securing the battery to the drip tray, then remove the latter from the engine compartment.

3. Undo the bolt securing the relay casing cover and remove it, then undo the nuts fixing the casing to the battery drip tray and place the casing at the side.

4. Remove the battery drip tray undo the bolts fixing it to the bodyshell.



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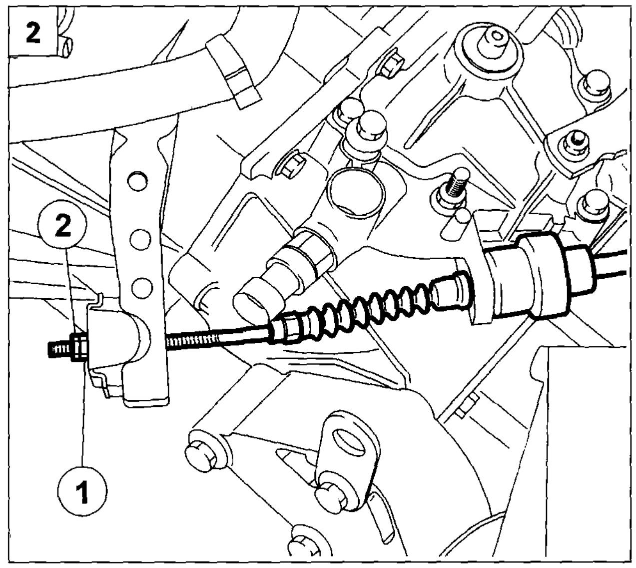

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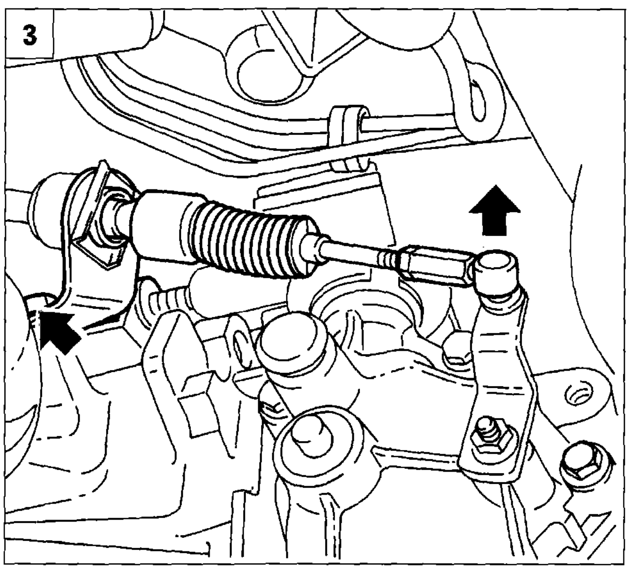
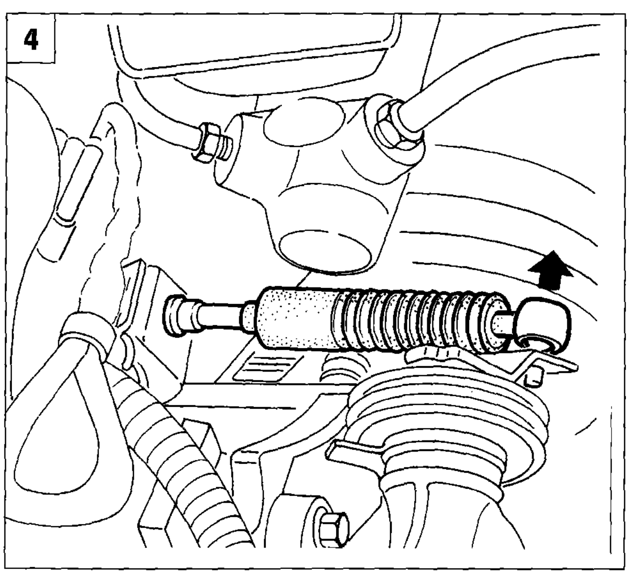


P4A02BB03

1. Disconnect the connector for the reversing lights switch and the earth cable.
2. Acting on the nut (1) and the lock nut (2), disconnect the clutch cable from the control lever.
3. Disconnect the end of the gear engagement cable and undo the bolts fixing the mounting bracket.
4. Disconnect the end of the gear selection cable, then move the selection and engagement cables to the side of the engine compartment.
5. Undo the upper bolts (1) fixing the gearbox to the engine and the bolt (2) fixing the starter motor to the gearbox.



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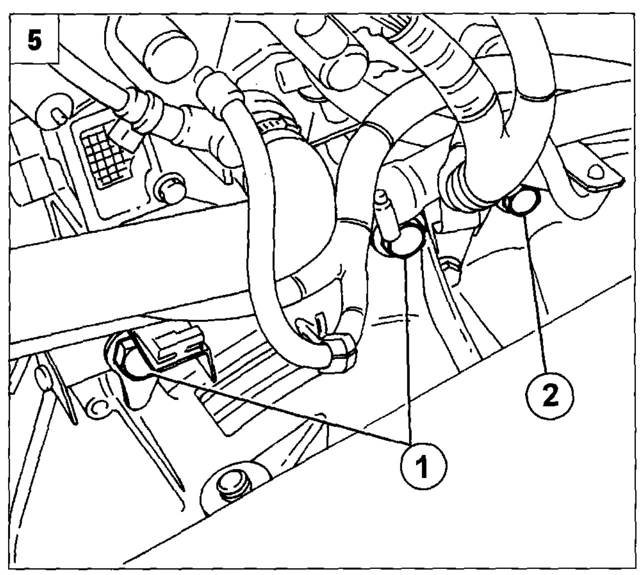

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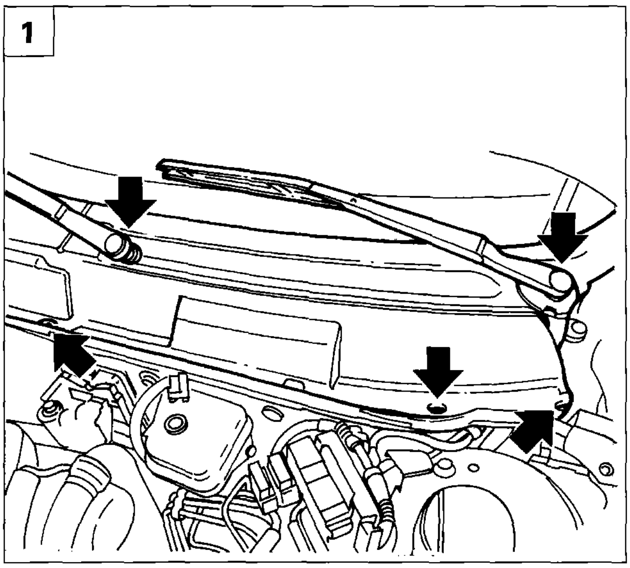
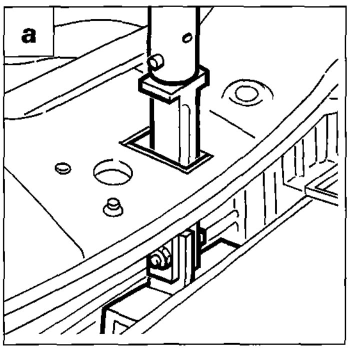


P4A03BB01

1. Remove the wiper arms, then remove the plastic shield for the pollen filter acting on the special bolts illustrated in the diagram.



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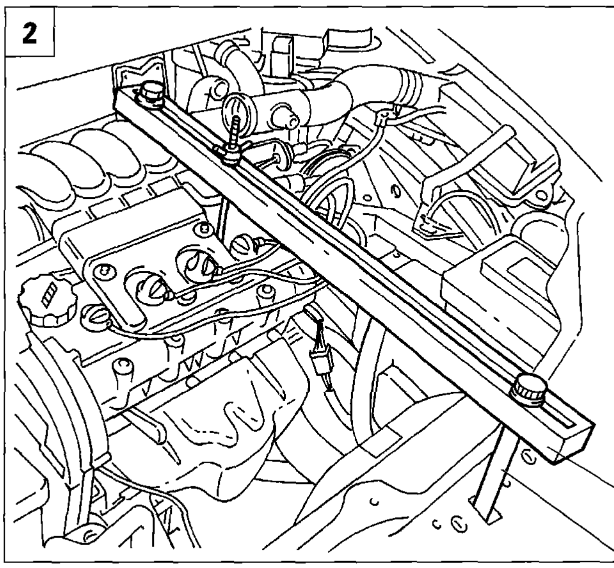

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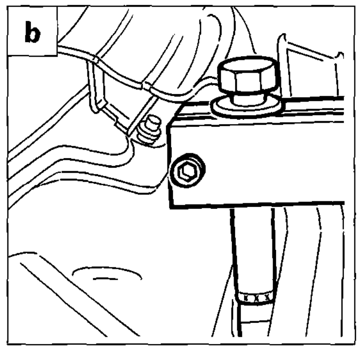


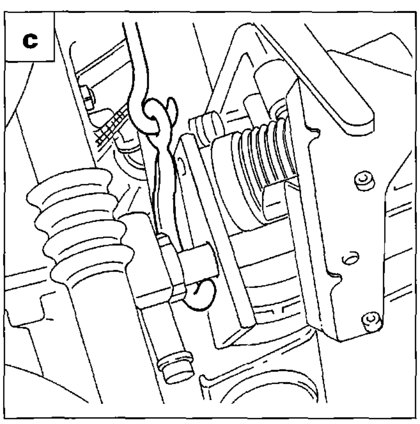
P4A03BB04

2. Position the cross member 1860851000 for supporting the engine at the points illustrated.

a. Front support: fit the tool in the housing in the bonnet lid lock so that it rests on the front cross member.

b. Rear support: position the tool by the centre reinforcement for the flame partition.

c. Fix the hook for the cross member to the heater water supply pipe so that the engine is resting in the centre.



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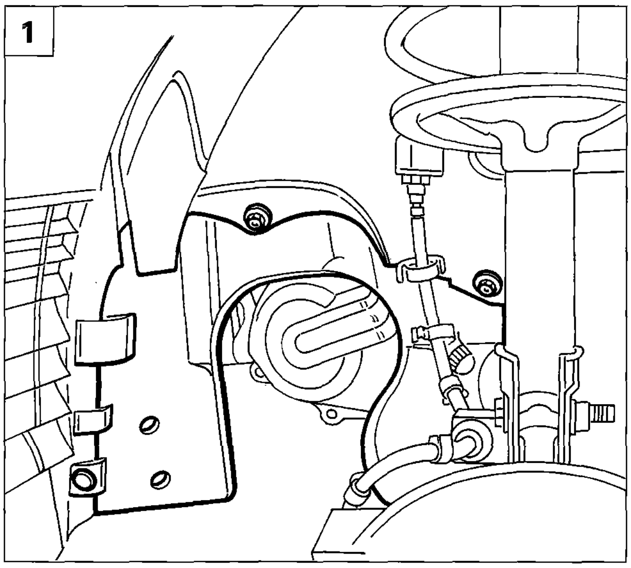


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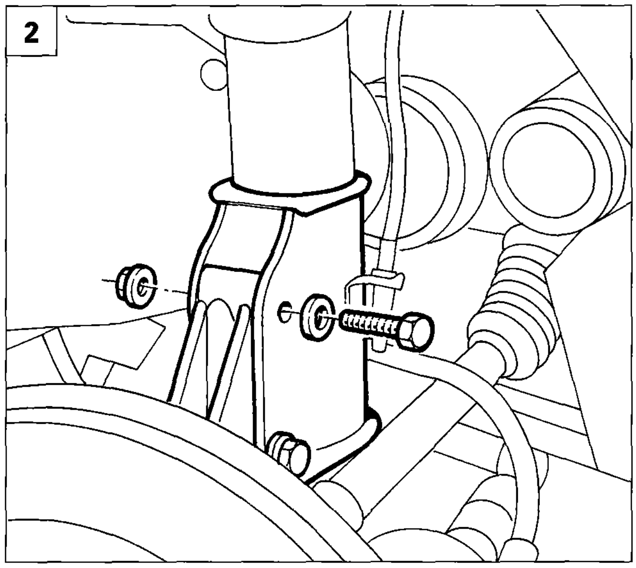


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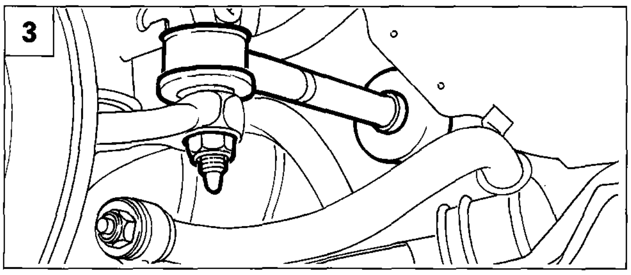


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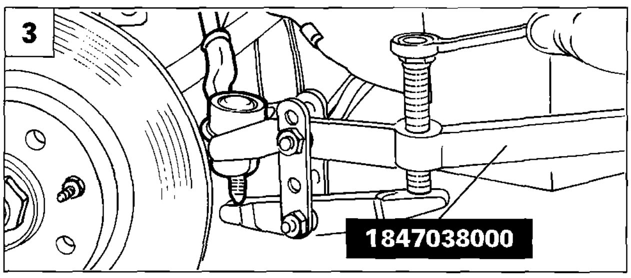


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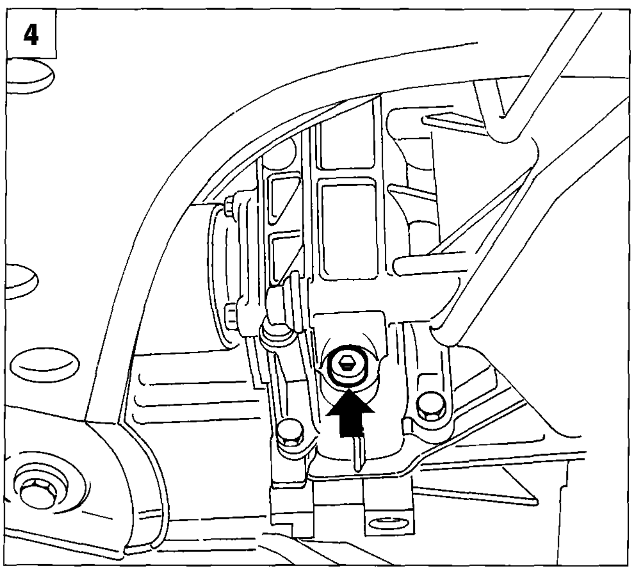


P4A04BB05

1. Remove the button fixing the dust shield to the bodyshell, then undo the bolts and release the shield from the housing. Repeat the operation for the dust shield on the other side.

2. Remove the bolts fixing the shock absorber to the steering knuckle and rotate the steering knuckle towards the inside, releasing the brake pipe from the shock absorber. Repeat the operation on the other side.

3. Undo the fixing nut the steering track rod end to the steering knuckle, then, using tool 1847038000, disconnect it from the steering knuckle. Repeat the operation for the steering track rod end on the other side.

4. Position a container for recovering the transmission fluid, then undo the plug shown and drain the oil from the gearbox.


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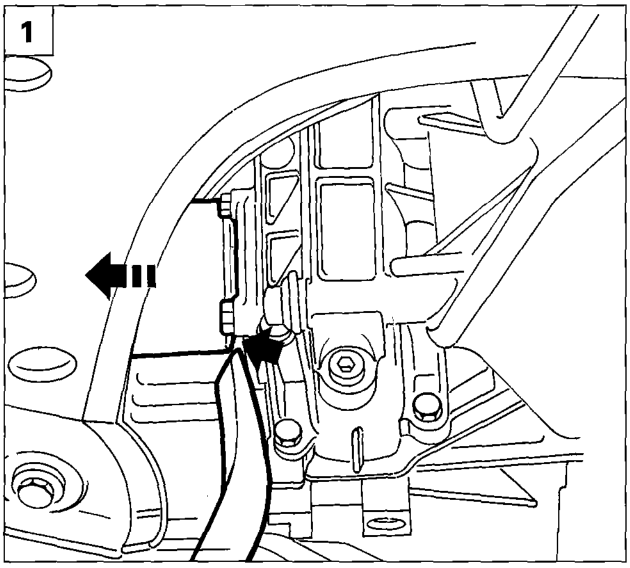


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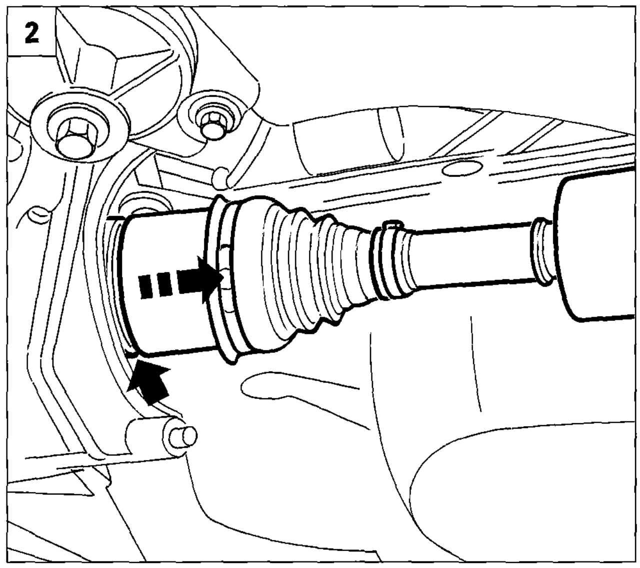


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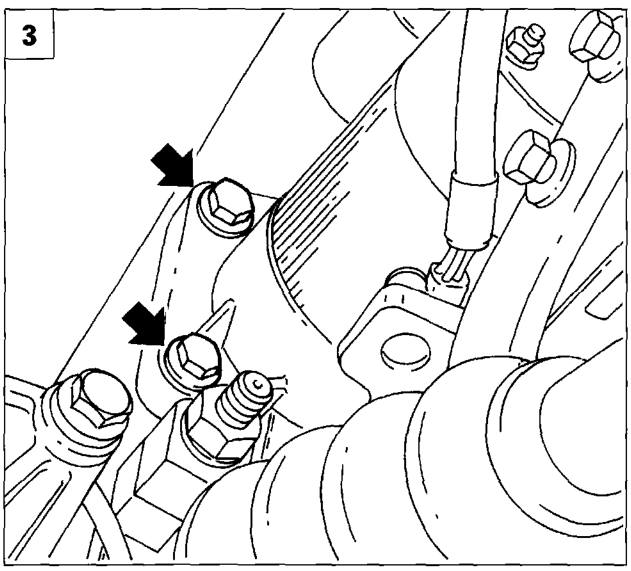
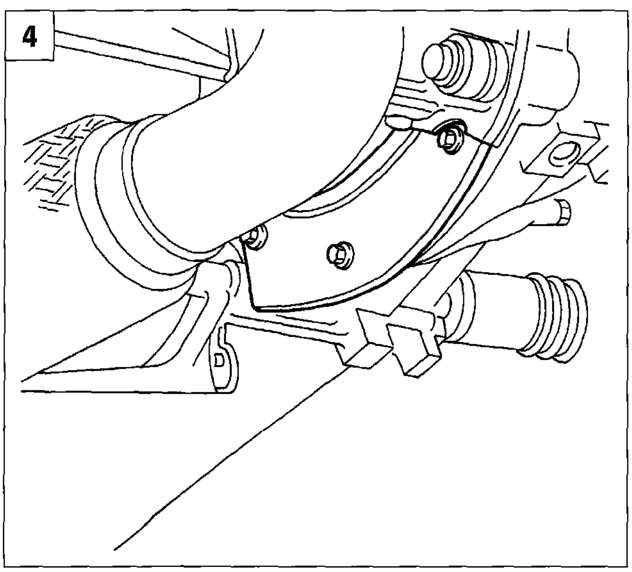



P4A05BB03

1. Disconnect the gearbox side drive shaft from the differential using leverage at the engagement point and move it away from the work area.
2. Disconnect the timing side drive shaft using leverage at the engagement point; then move the driveshaft away from the work area.
3. Undo the lower bolts fixing the starter motor to the gearbox, disconnect the electrical connections then remove the actual starter motor.
4. Remove the engine flywheel shield acting on the fixing bolts.
5. Undo the bolt fixing the gearbox to the engine.

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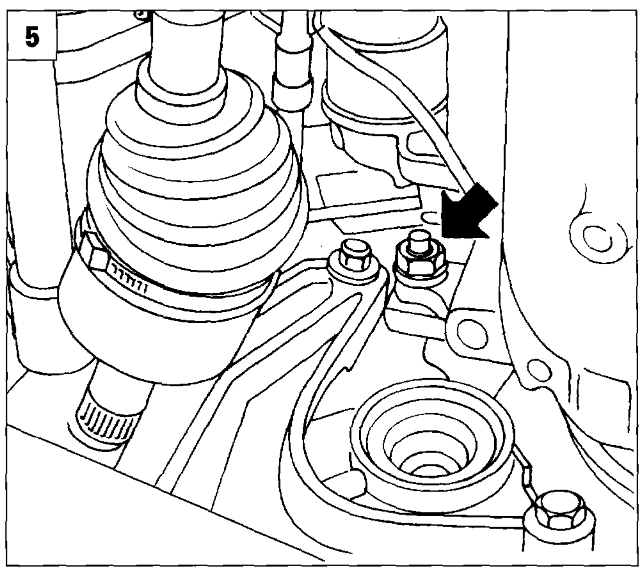


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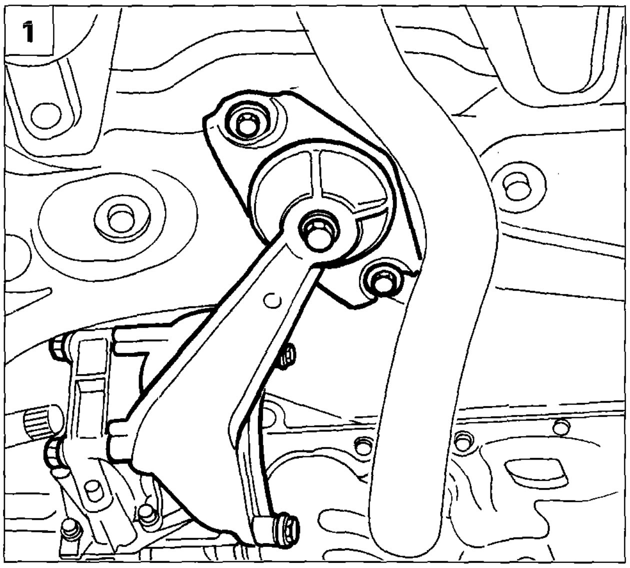


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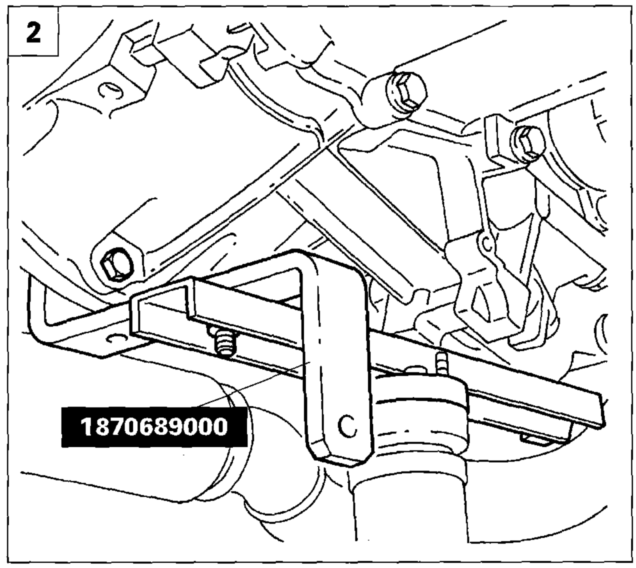


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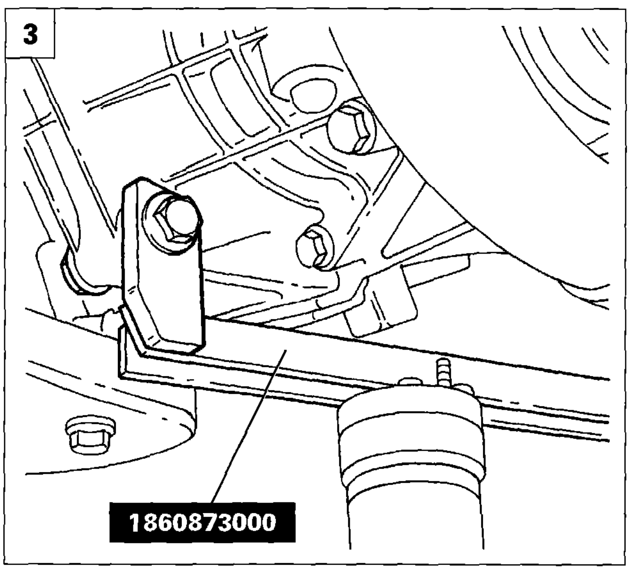


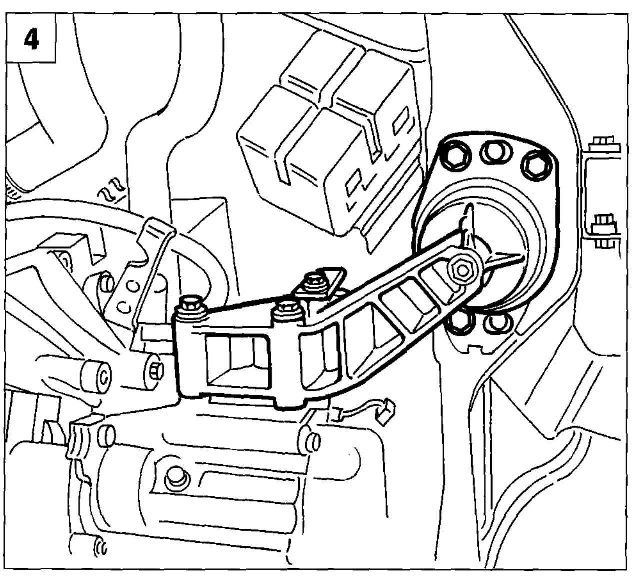

P4A06BB03

1. Remove the centre power unit support from the bodyshell and the gearbox.

2.3 Position the tool illustrated for supporting the gearbox during the removal operation.

4. Remove the power unit mounting, gearbox side from the bodyshell and the gearbox.

5. Undo the remaining bolt fixing the gearbox to the engine.

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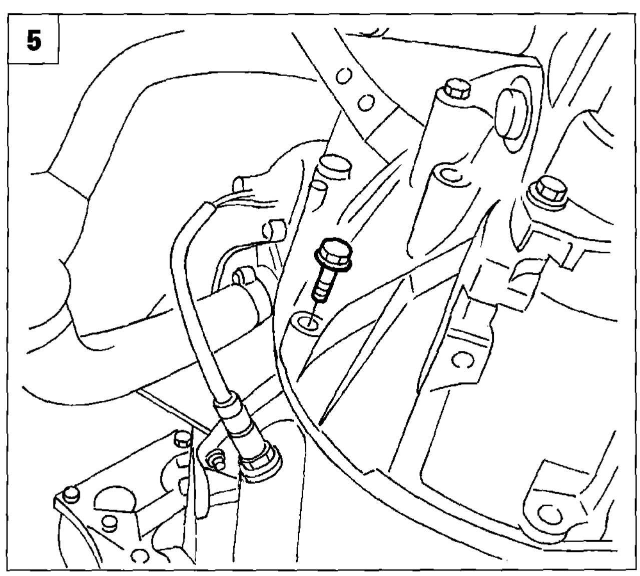


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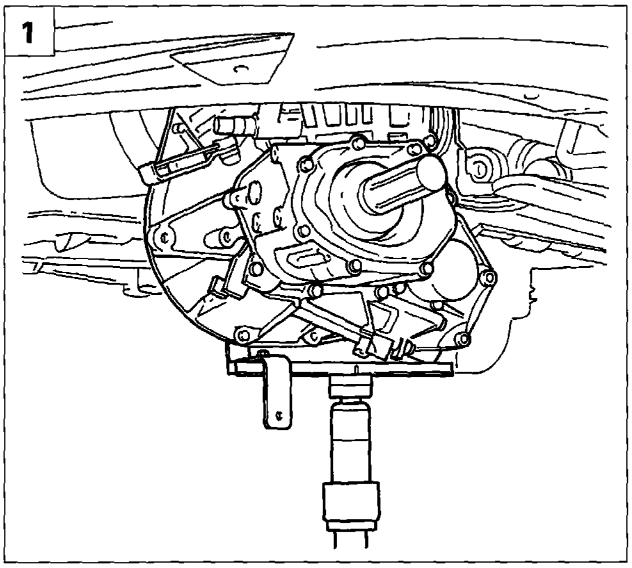
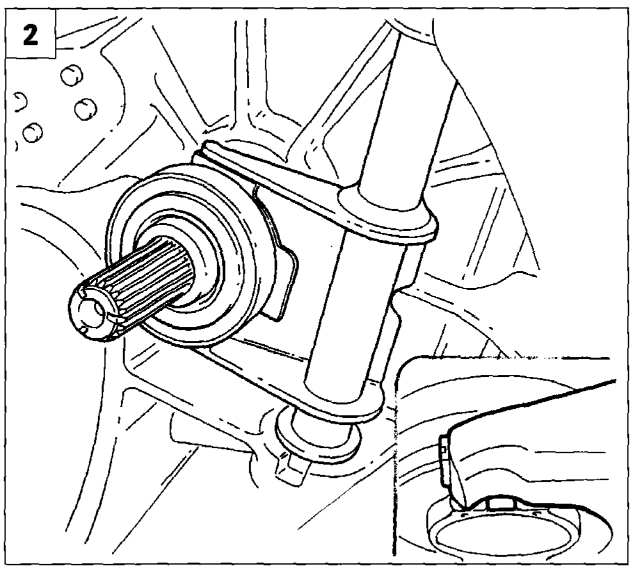


P4A07BB01

1. Using the hydraulic jack, suitably maneouvre the gearbox so that it is released from the centering pins, then remove it from the engine compartment slowly lowering the hydraulic jack.

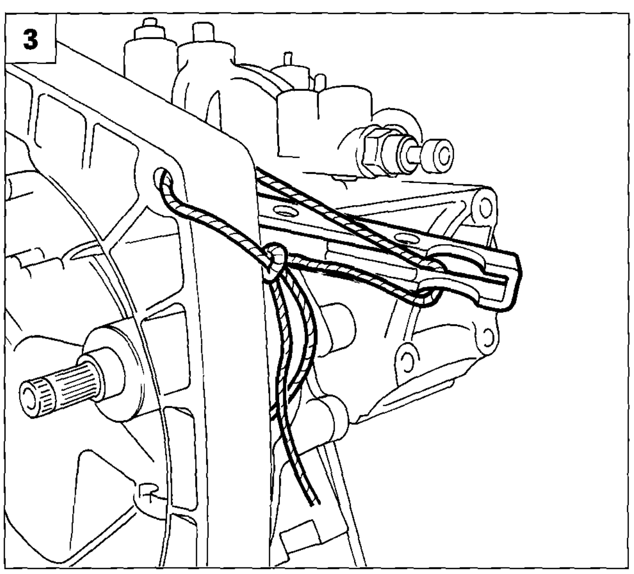


P4A07BB02

**Refitting**

*Before refitting the gearbox - differential unit, it is necessary to check that the thrust bearing has remained in the bell housing and is not interfering with the clutch. Carry out the operations described below:*

2. Check that the thrust bearing is correctly matched with the gearbox main shaft control lever, checking that the teeth on the thrust bearing mesh with the control lever as shown in the diagram.



P4A07BB03

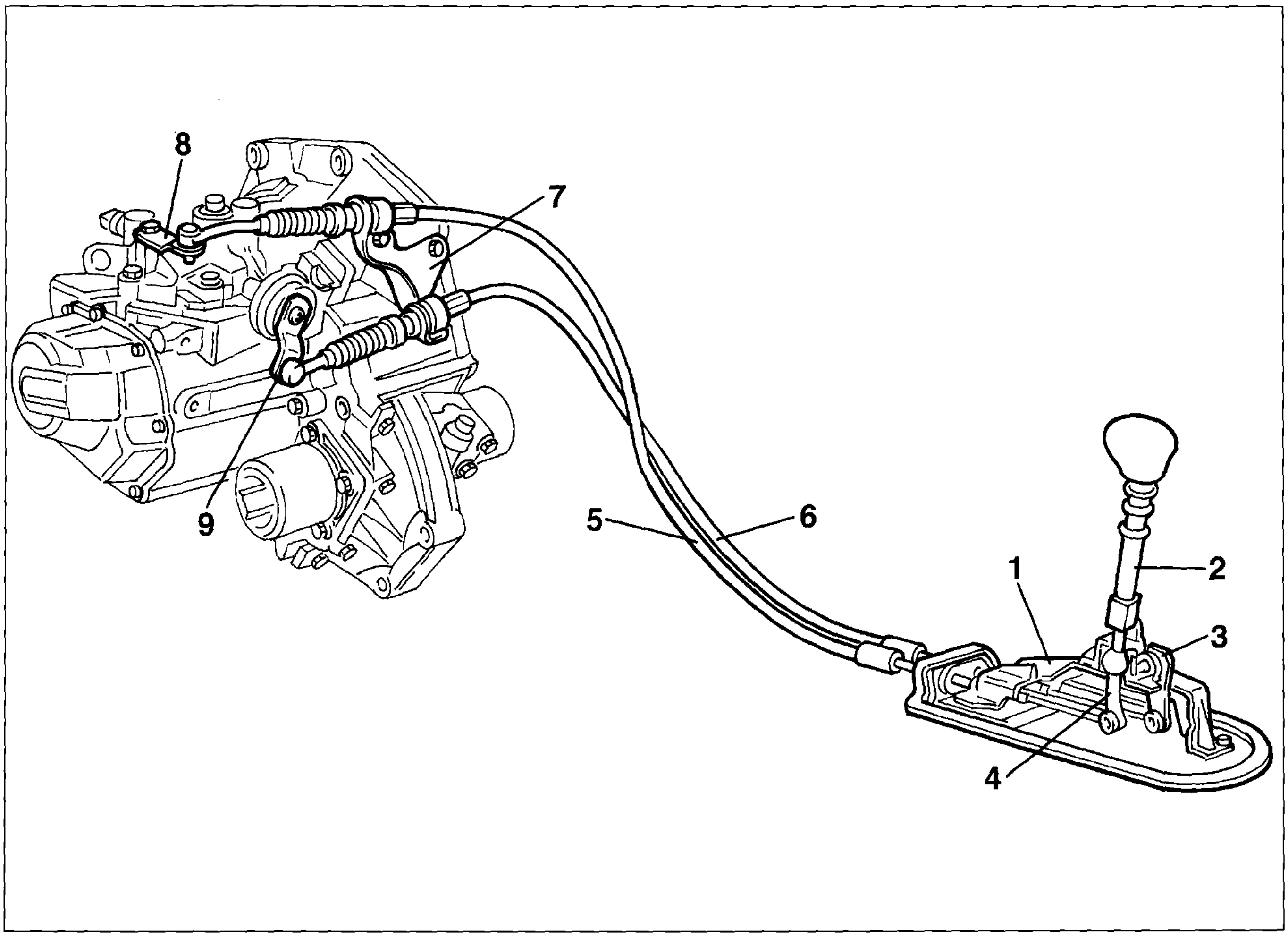
3. Fix the clutch release lever, in a fully retracted position, on the bell housing, then, using the hydraulic jack move the gearbox - differntial unit near the clutch, centre it on the special references and fix it to the engine. For future operations, reverse the order of the operations carried out for the removal.

**DRIVE SHAFTS**

For the removing-refitting and the dismantling of the drive shafts, refer to the "Drive shafts" paragraph for the 1370 12v version.

# 21.27

## DIAGRAM SHOWING EXTERNAL GEARBOX CONTROLS




1. External controls support
2. Gear lever
3. Selector linkage on lever
4. Engagement linkeage on lever
5. Gear engagement cable
6. Gear selector cable
7. Cable mounting bracket
8. Selector linkage on gearbox
9. Engagement linkage on gearbox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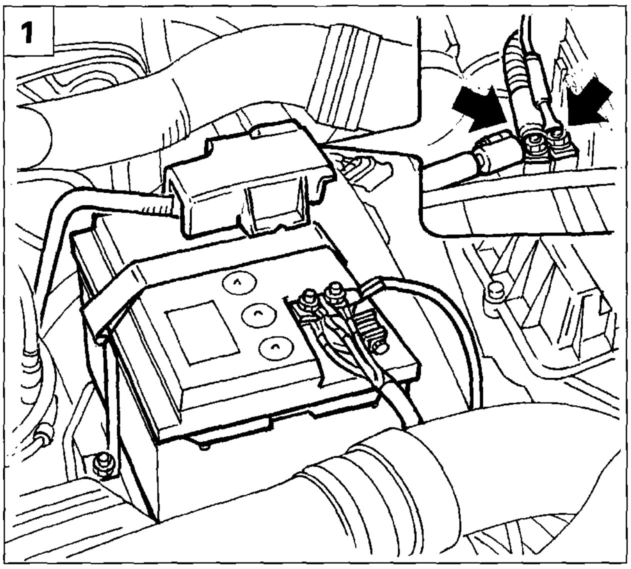
1

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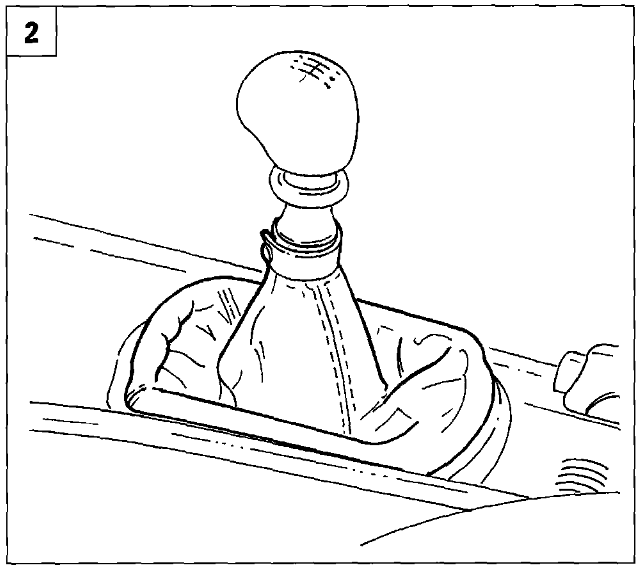
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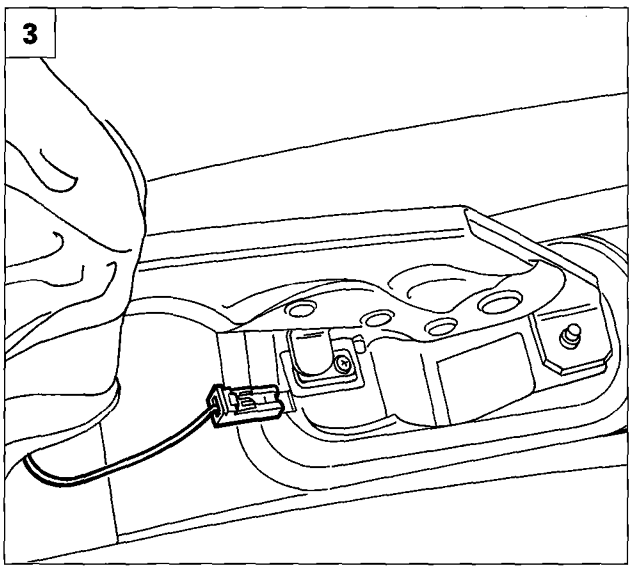
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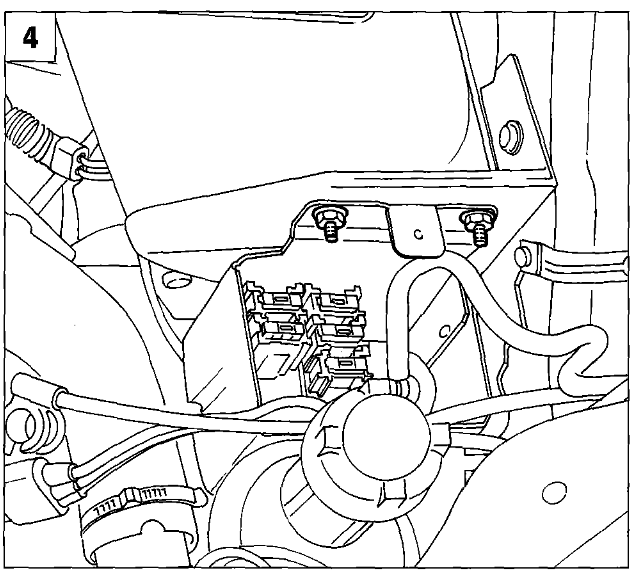

P4A01BB03

**REMOVING-REFITTING**

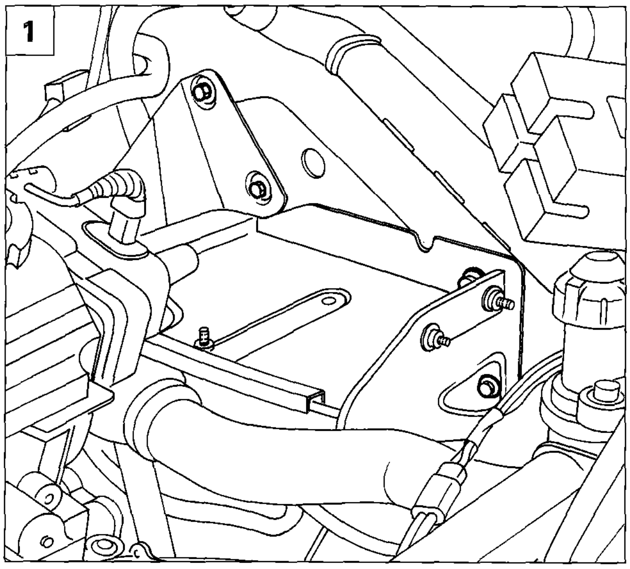
Position the vehicle on a lift, and proceed with the removal of the external controls as described below.

1. Disconnect the negative battery lead, remove the protective cover for the positive pole, disconnect the terminal and separate the latter from the starter motor supply leads; undo the nut securing the battery to the drip tray, then remove the latter from the engine compartment.

2. Remove the gear lever cover from the vehicle interior.

3. Remove the handbrake protective boot, then disconnect the electrical connection underneath.

4. Undo the bolt securing the relay casing cover and remove it, then undo the nuts fixing the casing to the battery drip tray and place the casing at the side.

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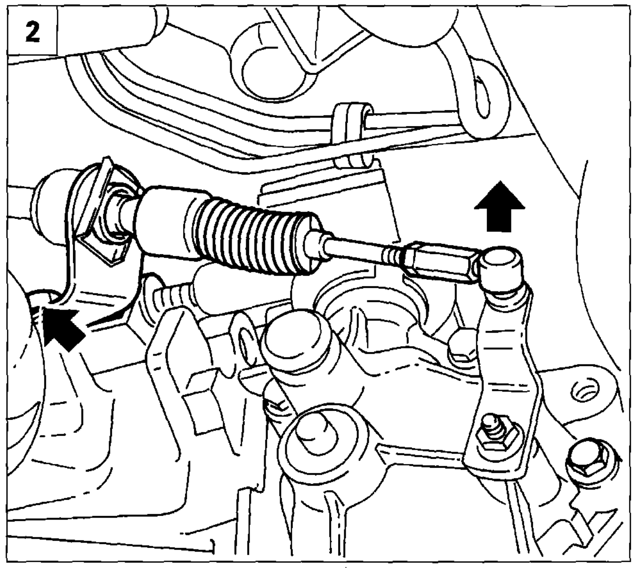


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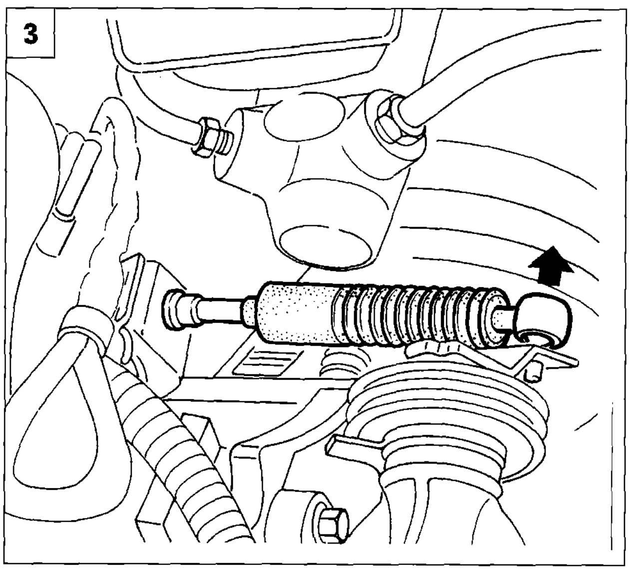
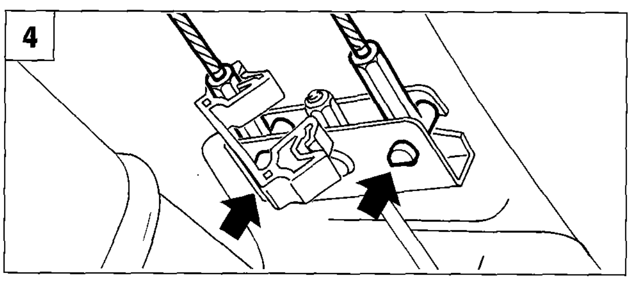



P4A02BB04

1. Remove the battery drip tray undo the bolts fixing it to the bodyshell.
2. Disconnect the end of the gear engagement cable and undo the bolts fixing it to the mounting bracket.
3. Disconnect the end of the gear selector cable, then move the gear selector and engagement cable assembly to the side of the engine compartment.
4. Raise the vehicle and disconnect the handbrake cables from the support and release them from the bracket.
5. After having disconnected the electrical connection for the Lambda sensor, undo the bolts fixing the exhaust pipe to the manifold.

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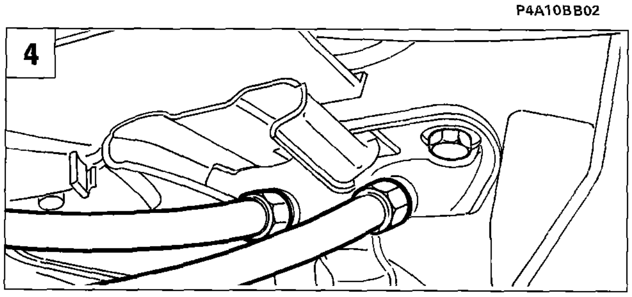


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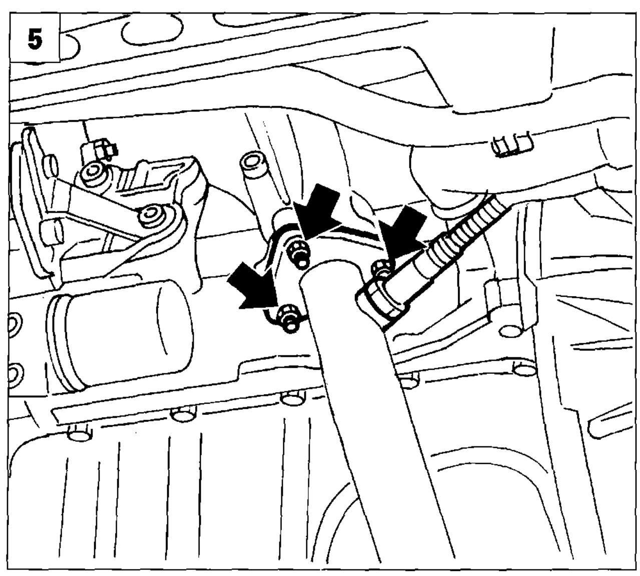


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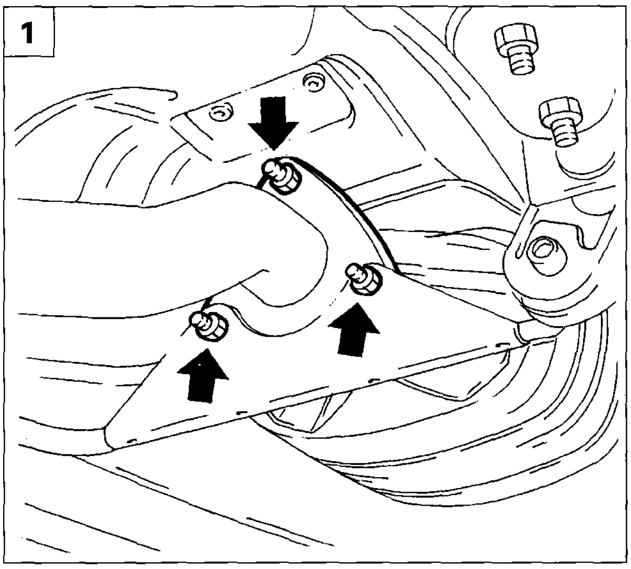


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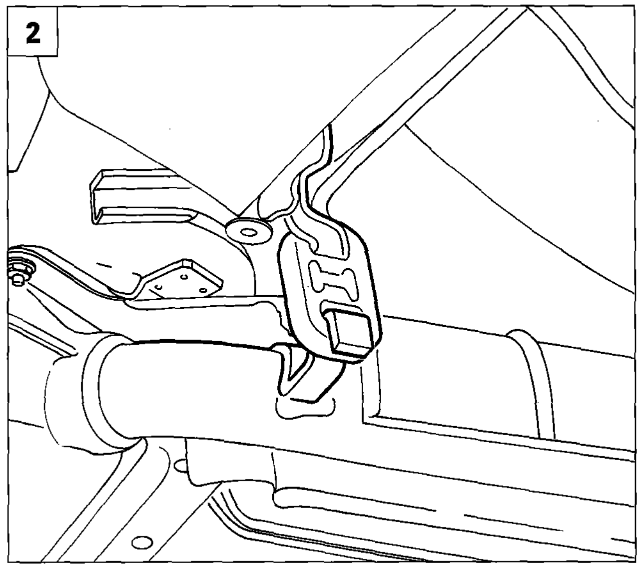


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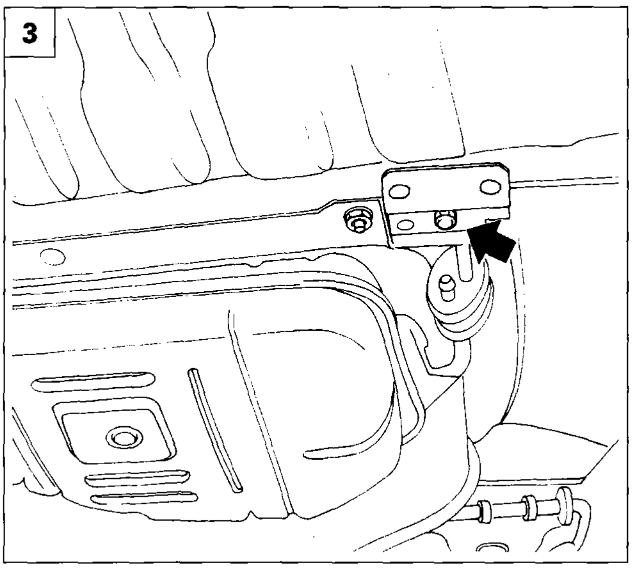



P4A11BB03

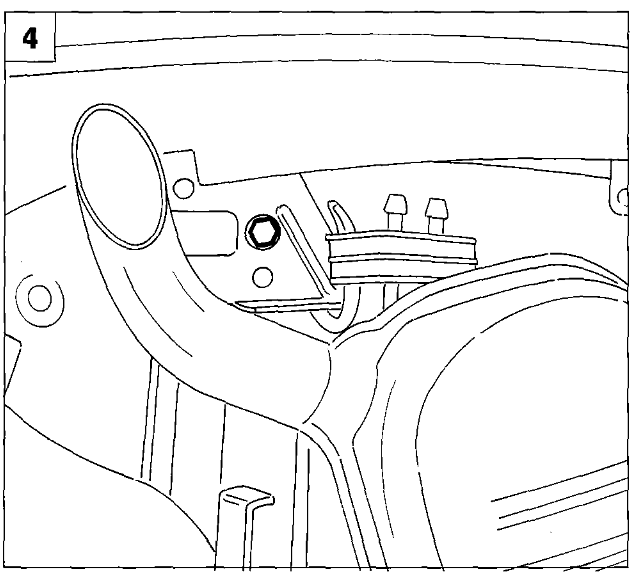
1. Undo the nuts fixing the first section of the exhaust pipe to the catalytic converter, then remove the pipe.

2. Release the exhaust pipe from the rubber mounting shown in the diagram.

3. Undo the bolt fixing the exhaust pipe front mounting bracket.

4. Undo the bolt fixing the exhaust pipe rear mounting bracket, then extract it from the vehicle.

5. Remove the heat shield acting on the fixings illustrated.

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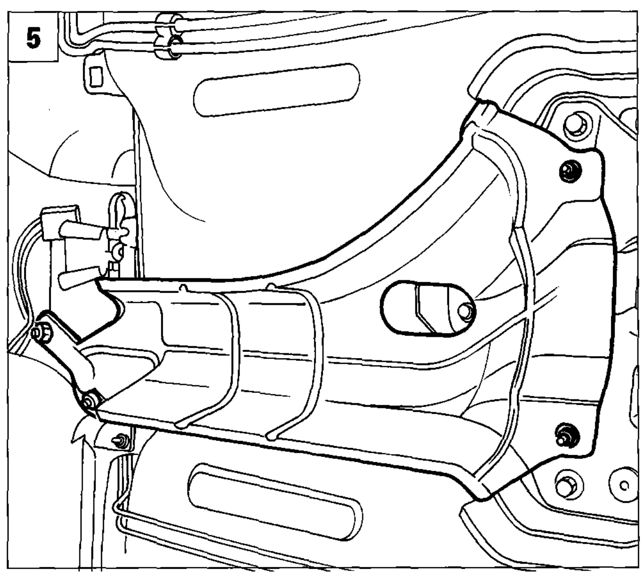


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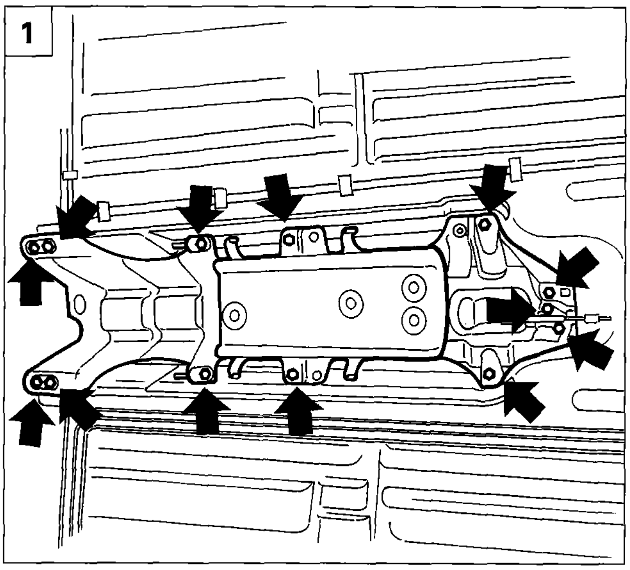


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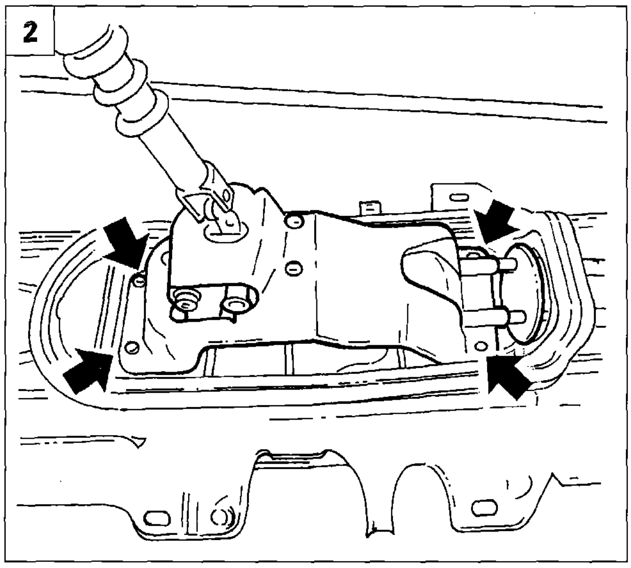


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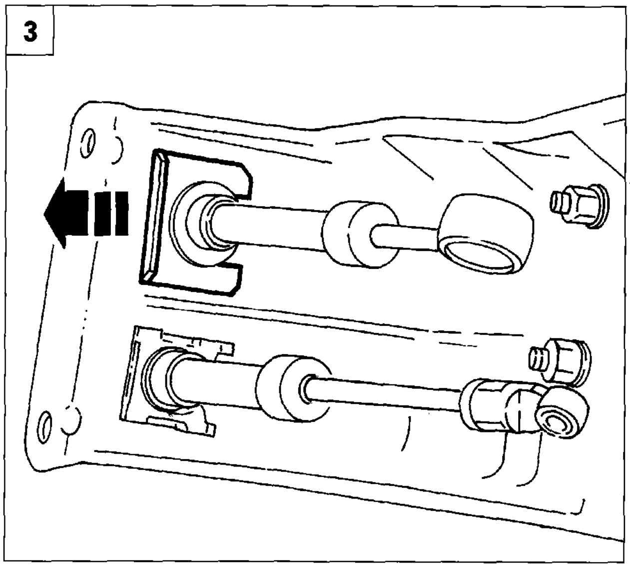


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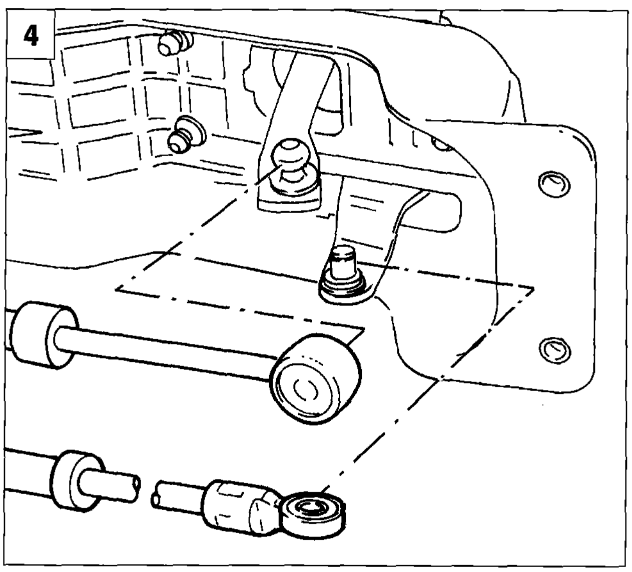


P4A12BB04

1. Undo the front and rear bolts fixing the support for the external gearbox controls and handbrake.

- Carefully lower the external controls support assembly from its housing, then remove the cables from the engine compartment and extract the assembly from the vehicle.

**DISMANTLING AT THE BENCH**

2. Remove the gear lever assembly, undoing the bolts, then remove the rubber cable cover.

3. Remove the two clips securing the cables to the lever support.

4. Disconnect the cables from the lever support: the engagement one is a press fit and the selector one is fixed by a circlip.



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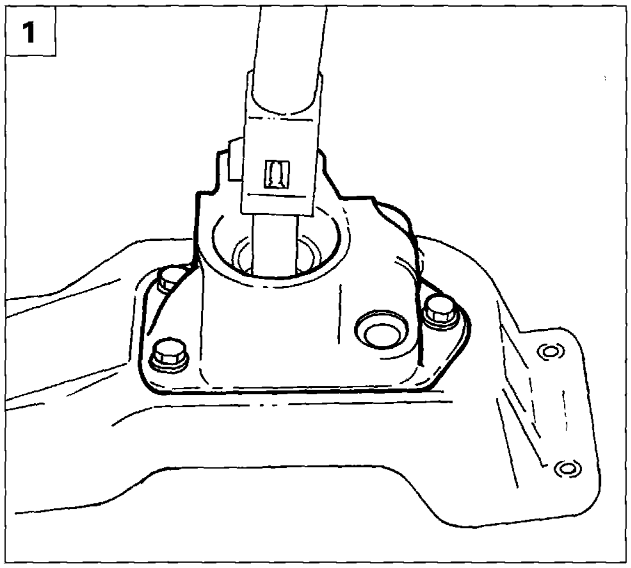
1

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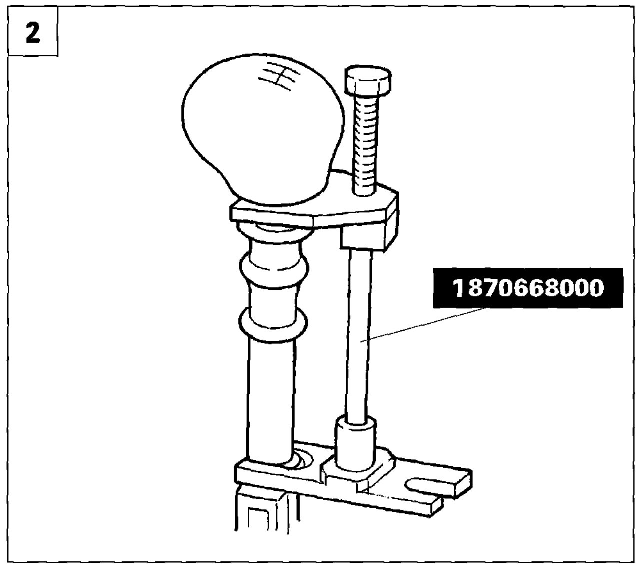
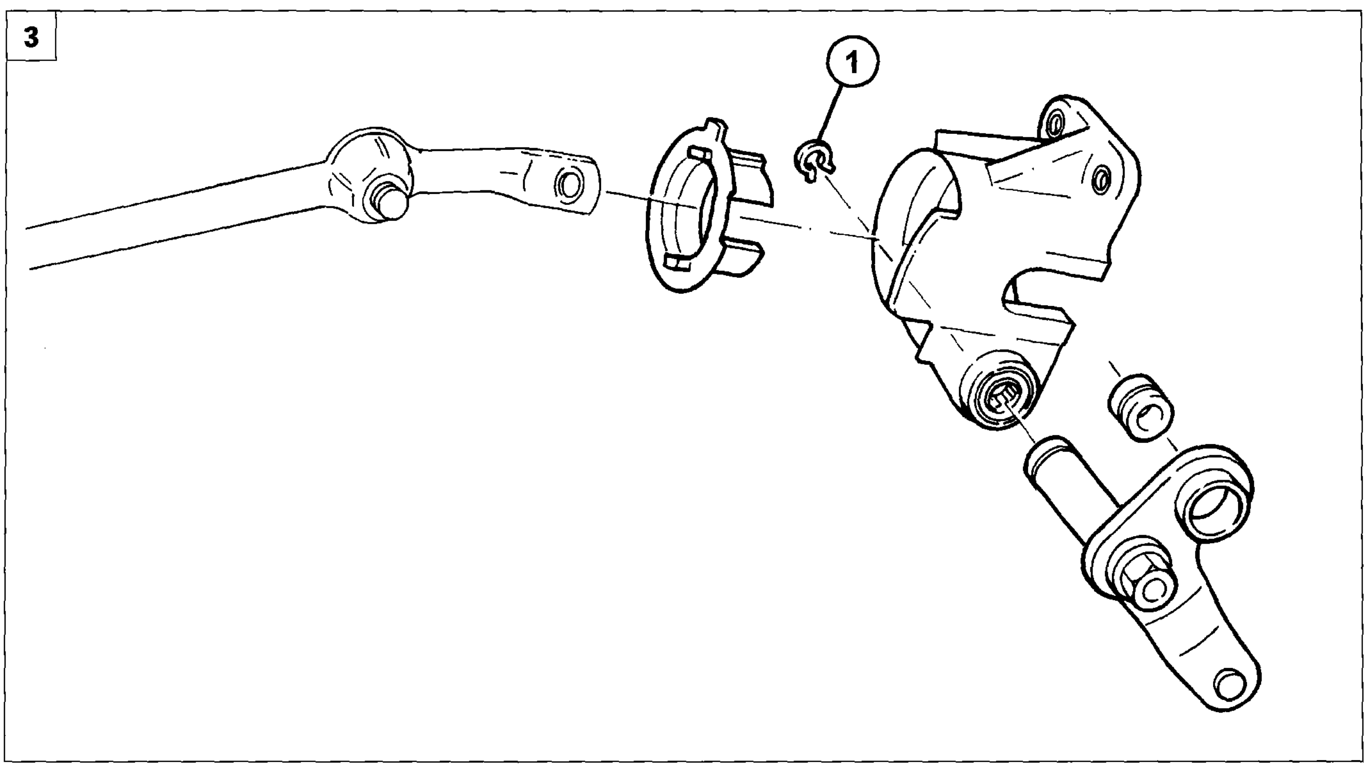


P4A13BB02


1. Remove the gear lever mechanism, undoing the bolts fixing it to the support.
2. Using tool 1870668000, remove the knob from the gear lever, the internal spring and the reverse gear inhibitor outer sleeve.
3. Remove the circlip (1) and dismantle the gear lever mechanism.

3


P4A13BB03

## ELECTRONICALLY OPERATED BRAKE FORCE DISTRIBUTION DEVICE (EBD)

The Teves MK20 ABS system, described in the relevant chapter of this manual, is coupled with the EBD function (Electronic Brake-force Distribution), which electro-hydraulically controls the distribution of the pressure sent to the brakes between the front and rear axles.

This function is controlled by the ABS electronic control unit which uses the same sensors and actuators as the ABS circuit to calculate and implement the distribution of the braking pressure.

The introduction of this function makes the use of the conventional mechanical load proportioning valve superfluous and it is removed from the rear brake hydraulic circuit.

In addition, the optimum exploitation of the rear brakes is ensured as the device is capable of constantly sending the ideal braking pressure to prevent the rear wheels from locking.

The diagrams overleaf illustrate the location of the device components, the majority of which are the same as on the ABS system.

**Key for diagrams showing braking system with ABS integrated with EBD function**

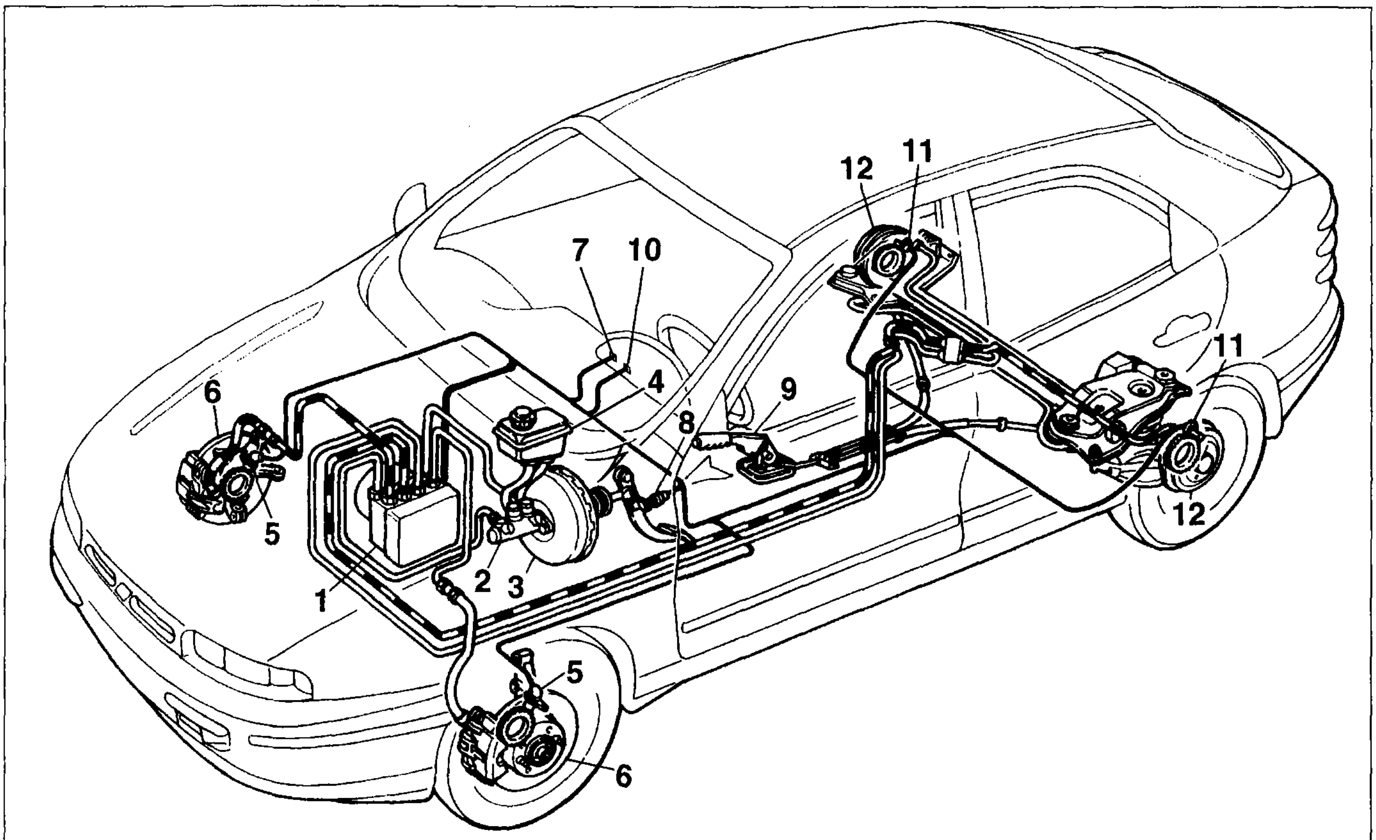
Hydraulic circuit for right front and left rear brake

Hydraulic circuit for left front and right rear brake

1. Hydraulic control unit with electronic control unit incorporated
2. Brake pump
3. Brake servo
4. Brake fluid reservoir
5. Rpm sensors for front wheels
6. Front disc brakes
7. Warning light signalling ABS system failure
8. Brake lights switch
9. Handbrake lever
10. Handbrake warning light or low brake fluid level
11. Rpm sensors for rear wheels
12. Rear drum brakes (excluding 1998 20v)
13. Rear disc brakes (only for 1998 20v)

# 33.

**Diagrams showing braking system with ABS system integrated with EBD function**

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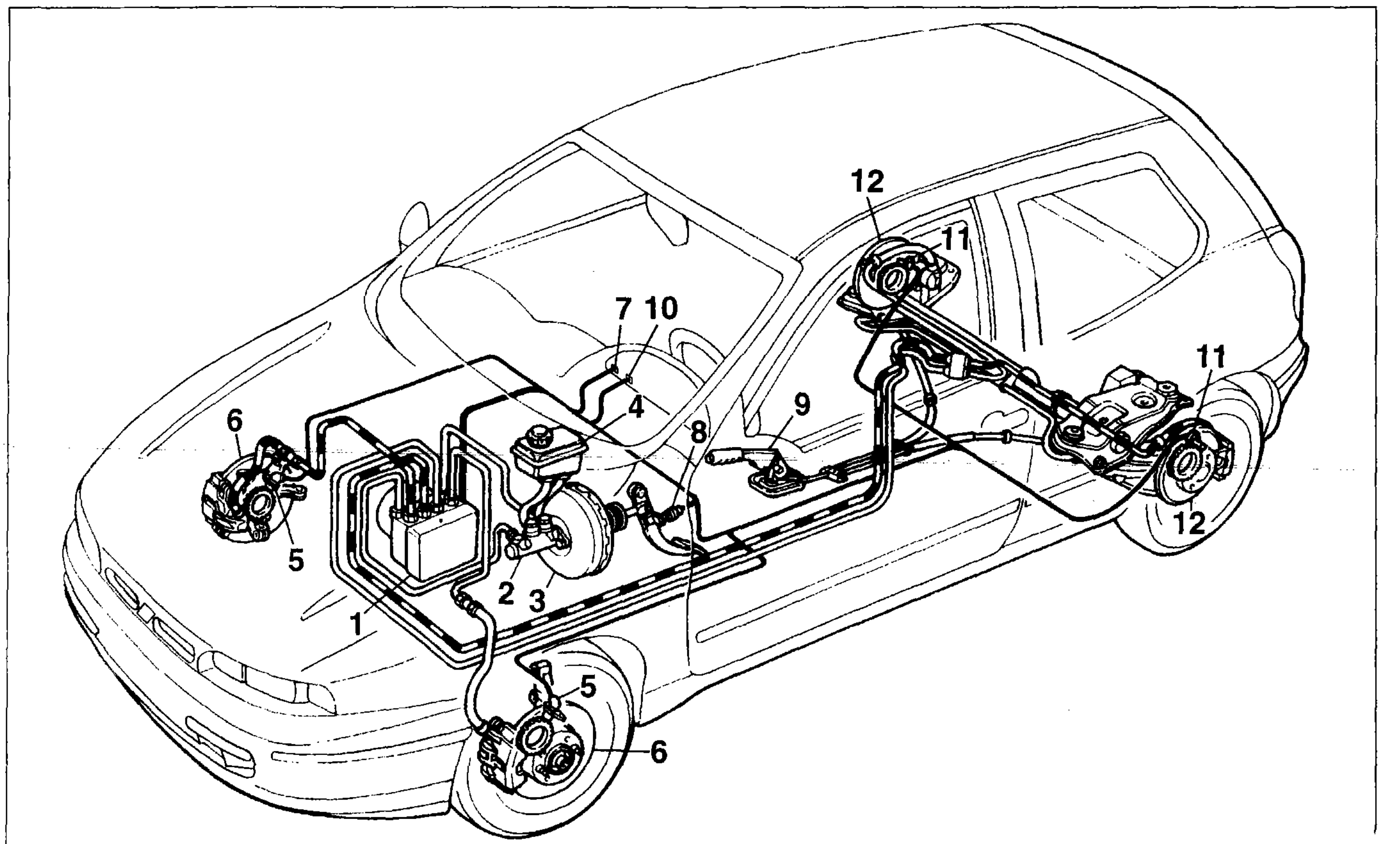


P4A02BD02



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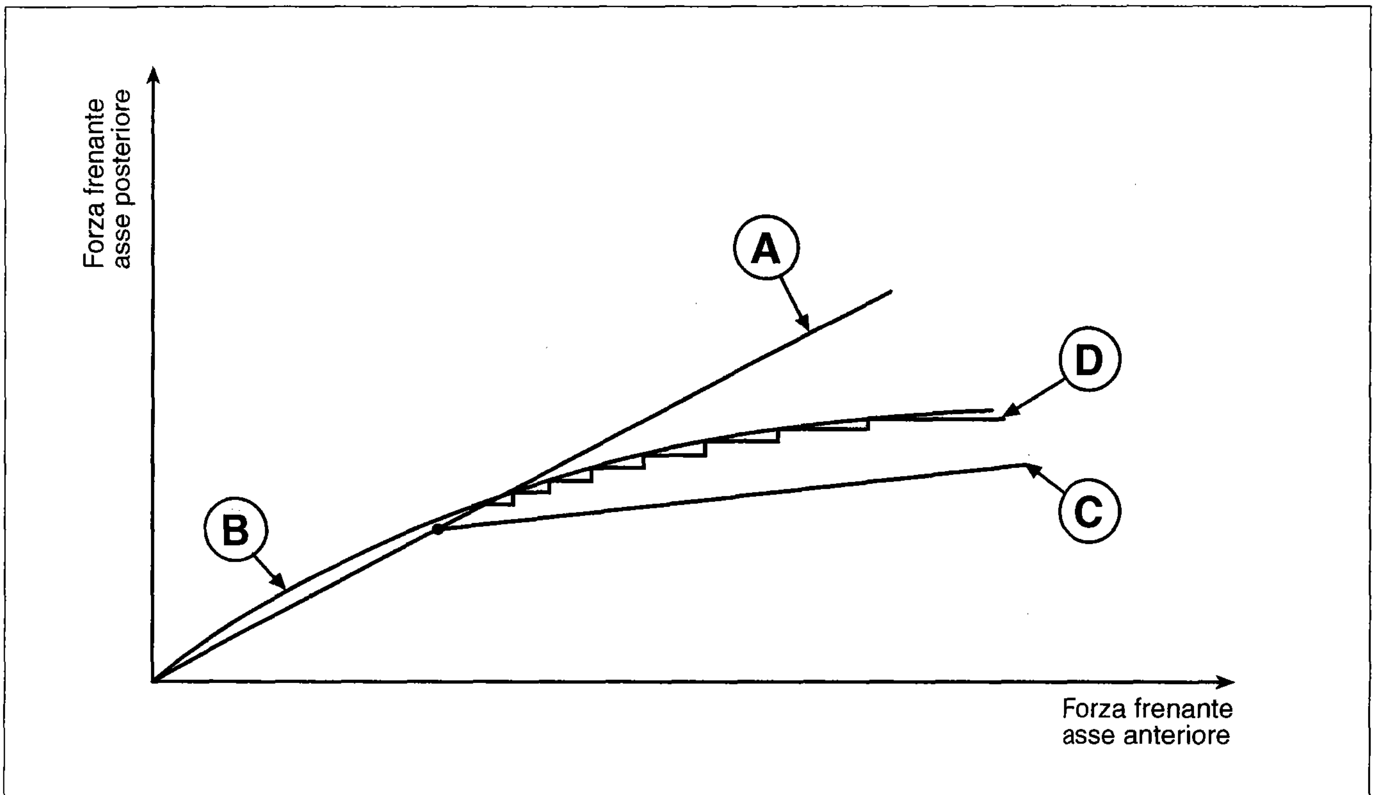
### Description of the EBD function (Electronic Brake-force Distribution)

The introduction of the EBD function to the ABS system allows the distribution of the brake force between the front and rear axles using a specific electronic control unit function.

With this in mind, the electronic control unit constantly compares the speed of the front and rear wheels by means of speed sensors and controls the hydraulic unit in order to prevent the rear wheels from locking, always ensuring maximum adhesion to the ground in all load conditions.

The EBD function makes the use of the hydraulic load proportioning valve acting on the rear axle load superfluous so it has therefore been removged from the braking circuit.

The graph below illustrates the operation of the EBD device (curve D) in relation to the pressure in the braking system (curve A), the ideal braking pressure for the rear axle (curve B) and the reduction in the braking pressure for the rear axle normally implemented by the conventional load proportioning valve (curve C).




P4A03BD01

A. Distribution implemented by the braking system

B. Ideal distribution

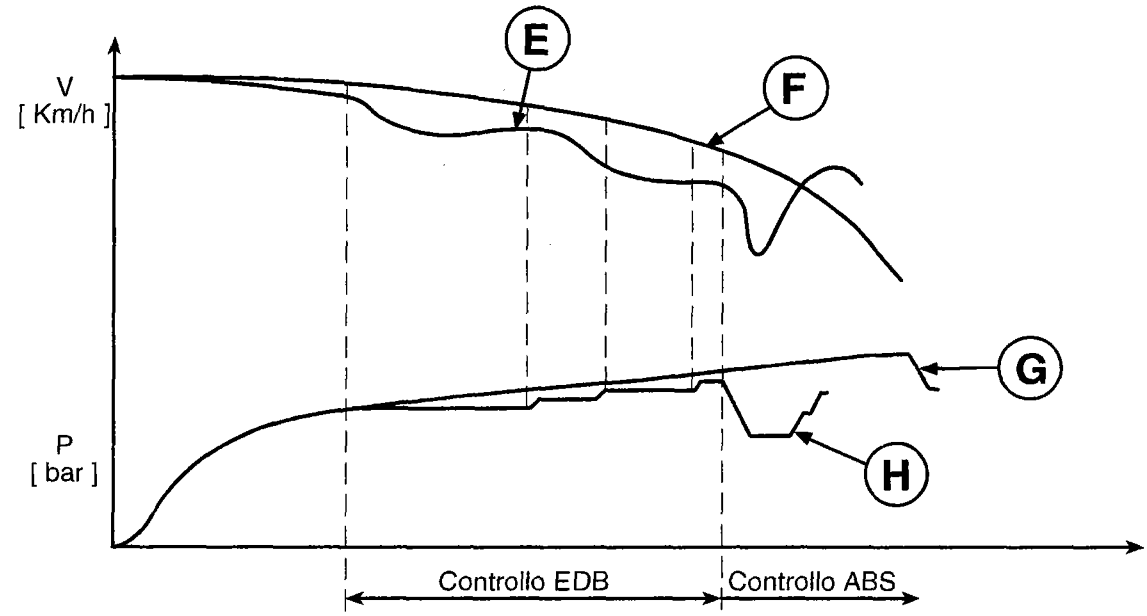
C. Distribution implemented by the mechanical load proportioning valve

D. EBD control

As it can be noted, the EBD function for the ABS system is capaable of adapting to the ideal pressure curve, always taking advantage of the adhesion available in all braking conditions.

The integration of the EBD function into the normal implementation logic of the ABS system allows the simultaneous operation of the two strategies; as a result, the system normally intervenes to keep the "creeping" of the rear wheels within values very close to the ideal ones with the possibility, however, of intervening with the ABS strategy when one rear wheel tends to lock (for example on a surface with poor adhesion).

The graph below illlustrates the braking pressure implementation strategy, operated by the electronic control unit, according to the input data, represented by the signal for the rotation speed of the wheels of the two axles.




P4A04BD01

E. Rear wheel speed

F. Front wheel speed

G. Front wheel pressure

H. Rear wheel pressure

**Operation of the EBD device**

The braking pressure for the rear axle is implemented by the control unit in a similar way to the description of the operation of the ABS system during the pressure increase, maintenance and reduction stages.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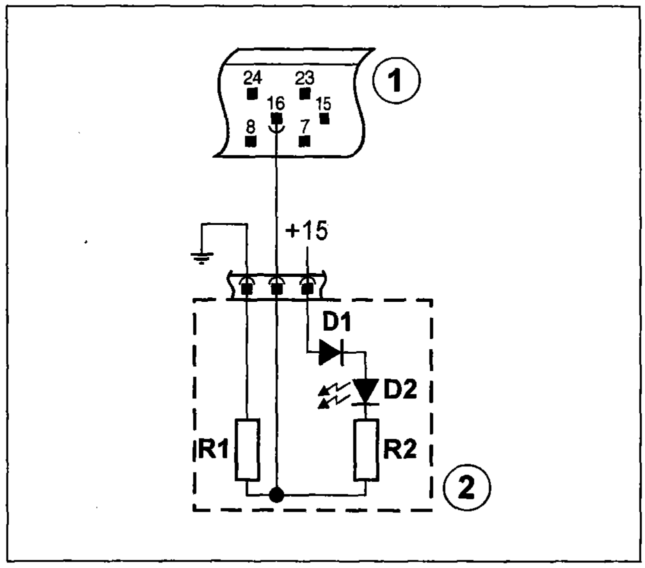
### ABS failure warning light

On vehicles equipped with ABS and an EBD device, there is a special ABS failure warning light.

The new type of warning light, known as "INTELLIGENT", comprises an LED (D2) controlled by an electronic circuit which, as illustrated in the diagram at the side, allows the warning light to come on both if there is an actual failure in the ABS system and if the connection between pin 16 of the control unit (1) and the instrument panel (2) is interrupted or short circuited to earth.

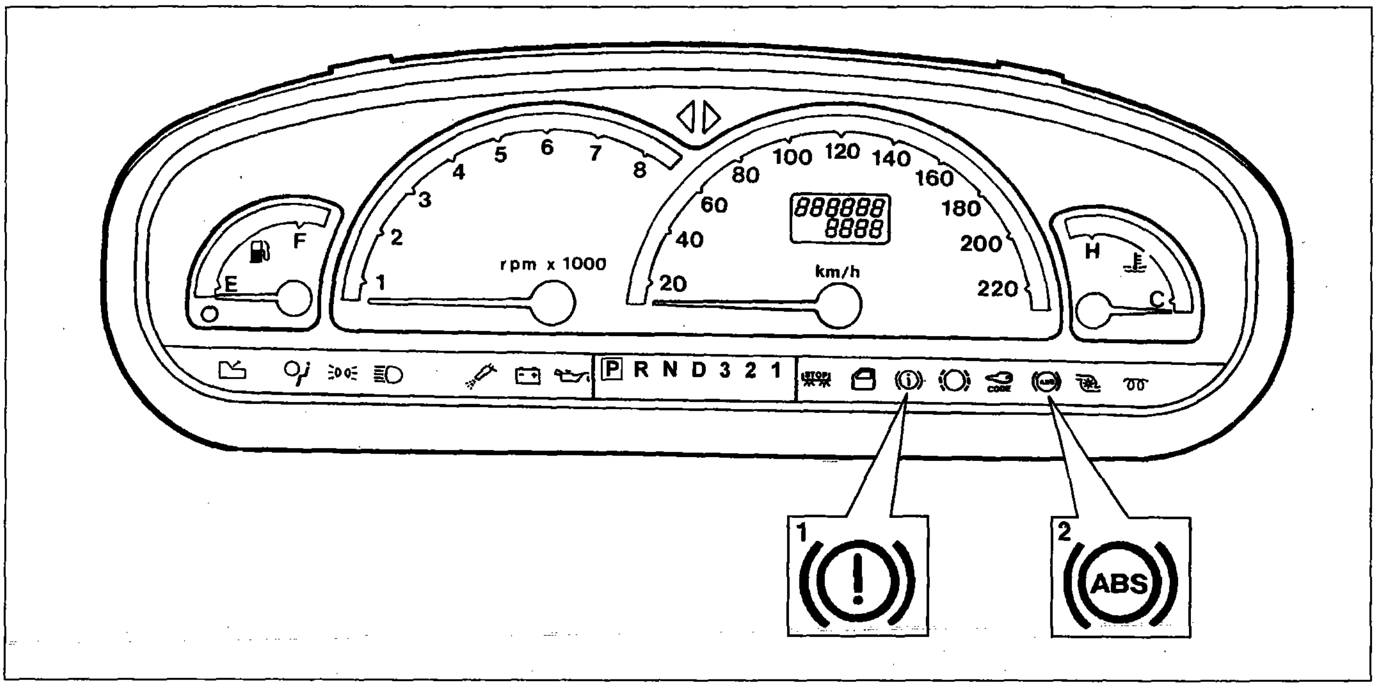
D1: Protective diode
D2: LED
R1 and R2: Load resistances




P4A05BD01

### EBD function failure signal

A failure in the EBD function is signalled simultaneously by the braking system failure warning light (1) in the dashboard and the ABS system failure warning light (2) both coming on.




P4A05BD02

The warning light (1) in the dashboard coming on without the ABS warning light (2) coming on means that there is not an EBD malfunction, but that there is a different fault (low brake fluid level, handbrake applied).

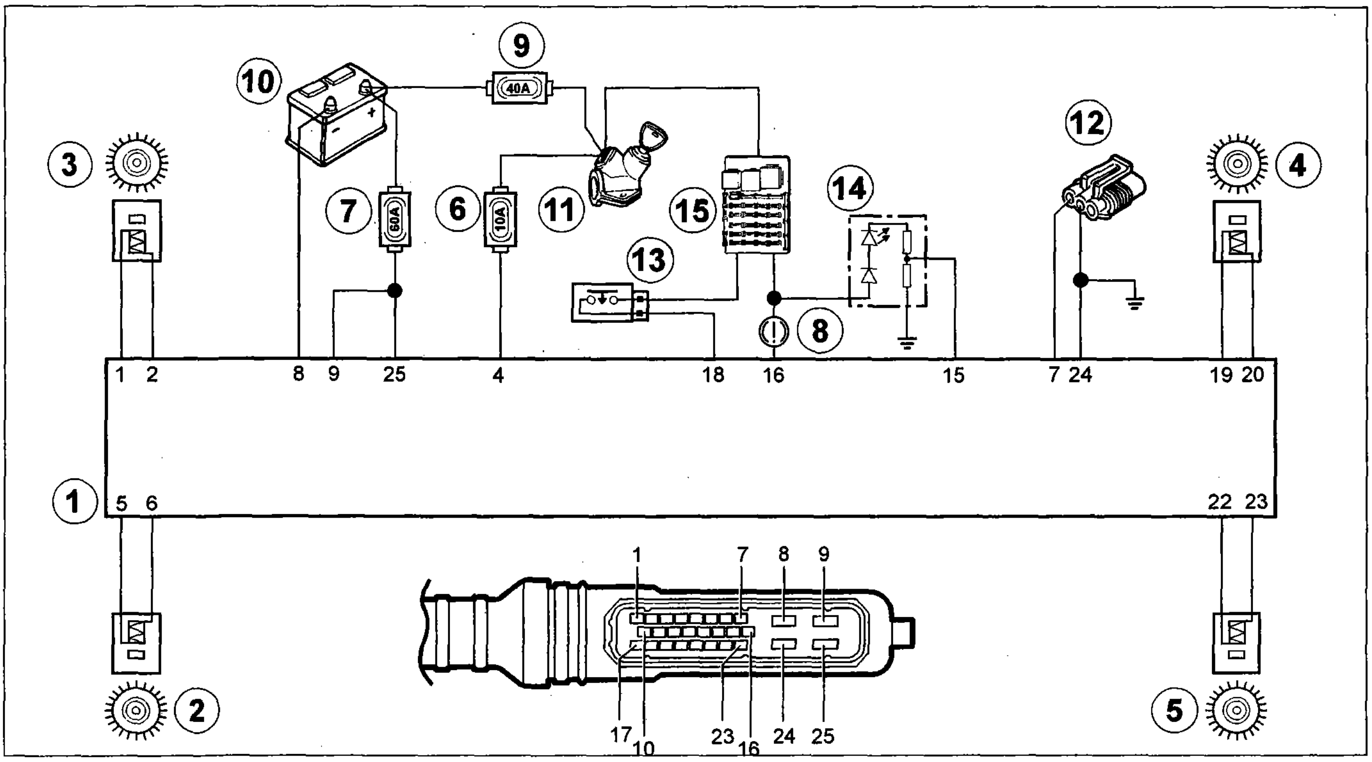
Conversely, the ABS warning light only coming on without the warning light (1) coming on, indicates a failure in the ABS system as described in the relevant chapter of this manual without the operation of the EBD device being adversely affected.

If there is a failure in the EBD function, the distribution of the brake force between the front and rear axles starts to fail with the consequent risk of the rear wheels locking during braking.

## 33.

### Wiring diagram for ABS system integrated with EBD function

The wiring diagram for the ABS system with EBD only varies from the wiring diagram for the ABS system on its own through the addition of the connection of the ABS control unit with the braking system warning light (low brake fluid level/handbrake applied).




P4A06BD01

1. Electronic control unit
2. Left rear rpm sensor (RL)
3. Left front rpm sensor (FL)
4. Right front rpm sensor (FR)
5. Right rear rpm sensor (RR)
6. 10A protective fuse
7. 60A protective fuse
8. Braking system failure warning light
9. Protective fuse (40A) for consumers controlled by ignition
10. Battery
11. Ignition switch
12. Diagnostic socket
13. Brake lights switch
14. ABS warning light
15. Junction unit

### Fault diagnosis

It is possible to search for and identify any faults in the ABS system components by connecing one of the following instruments to the diagnostic socket:

- Fiat-Lancia Tester
- S.D.C.-Computerized Diagnostic Station
- Examiner

The ABS system with EBD does not have a blink-code function, as a result of which the fault diagnosis can only be carried out using one of the instruments mentioned above.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## WHEEL RPM (ACTIVE) SENSORS

The ABS Bosch 5.3 system adopted on the 98 range, uses new design sensors known as "active" for detecting the speed of the wheels.
The operation of "active sensors" is based on the variation of the internal electrical resistance according to the intensity and the direction of the lines of force of an external magnetic field, producing a square wave signal whose frequency varies according to the rotation speed of the wheel, but whose range is constant.

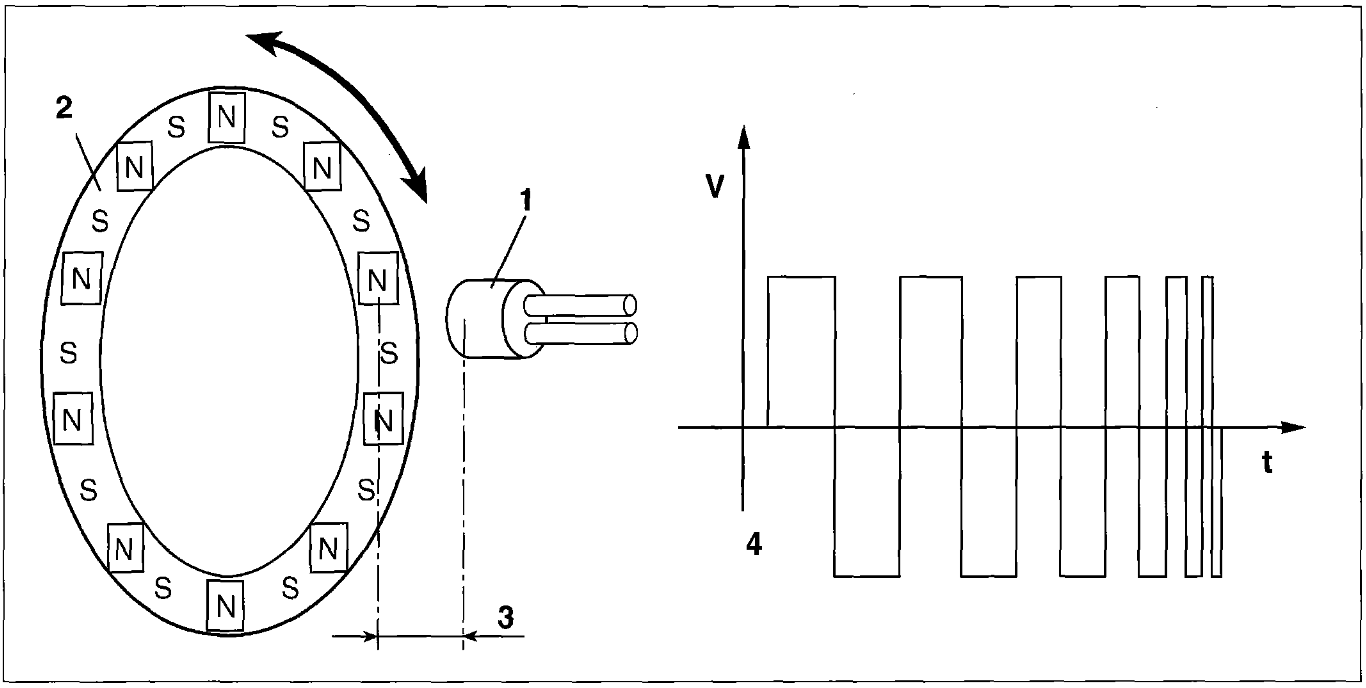
The external magnetic field is produced by a so-called "multi-polar ring", consisting of an elastomer equipped with a certain quantity of magnetic particles which, by means of a special magnetization technique, are positioned in such a way as to form different magnets with alternating North - South polarities around the circumference.

The multi-polar ring can be fitted on the wheel bearing seal or on the (rear wheel) hub.

The sensor is supplied by the ABS electronic control unit and produces a square wave signal whose range is almost constant and whose frequency is proportional to the rotation speed of the wheel.

The use of this new type of sensor offers the following advantages compared with traditional magnetic induction type sensors:

- less sensitivity to the distance between the sensor and the magnetic ring;
- improved immunity to electro-magnetic fields;
- the capacity of the sensor to measure the speed of the wheel down to zero (rather than 2.5 kph for passive sensors);
- a reduction in the weight and size on the vehicle.




P4A07BD01

1. Active sensor body
2. Multi-polar ring
3. Gap
4. Example of an output signal from the wheel rpm sensor

# 33.

The recommended distance (gap), to obtain the correct signals, between the end of the sensor and the multi-polar ring should be between:

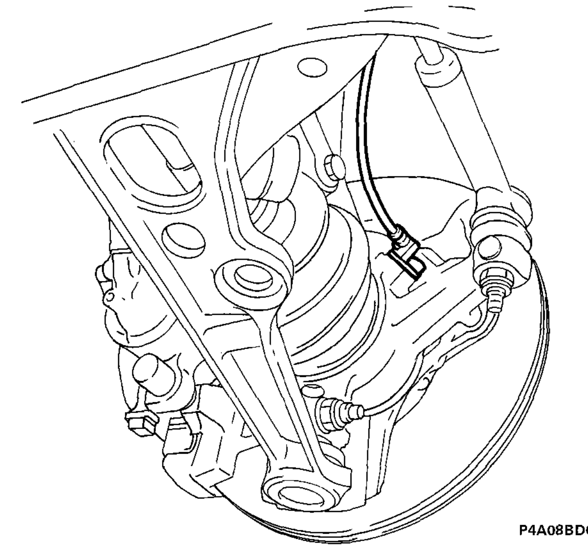
**0.16 - 1.71 mm for the front wheels**

**0.37 - 1.13 mm for the rear wheels**

This distance cannot be adjusted therefore if the gap measured is outside of the tolerance, check the condition of the sensor and the multi-polar ring.

**NOTE** *Each time an rpm sensor is fitted, it should be lubricated with water-repellant grease, to avoid the effects of heat variations, over a period of time, causing deterioration and making it difficult to extract.*

### Positioning of front wheel sensor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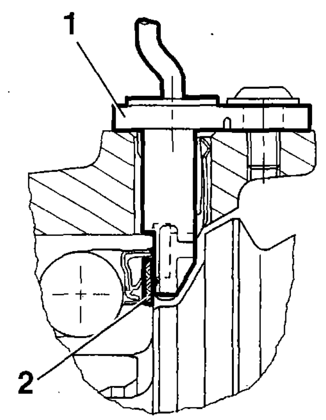

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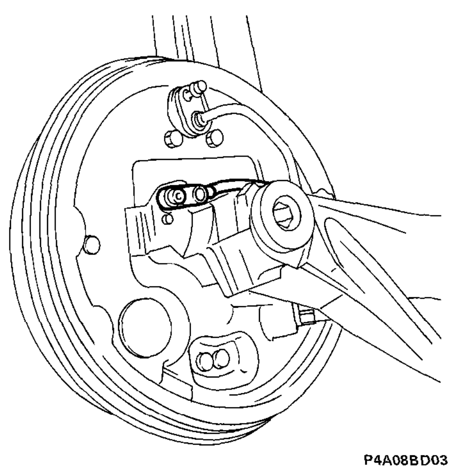
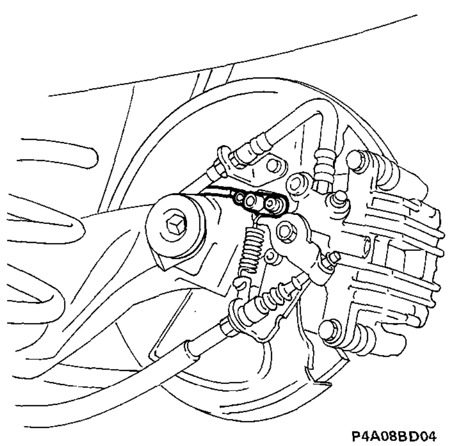
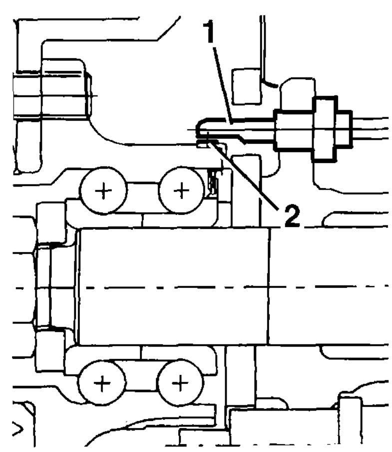
### Positioning of rear wheel sensor

Version with drum brakes


P4A08BD03

Version with disc brakes


P4A08BD04



P4A08BD05

1. Active sensor
2. Multi-polar ring


Print no. 506.670/17

page

**CLIMATE CONTROL**



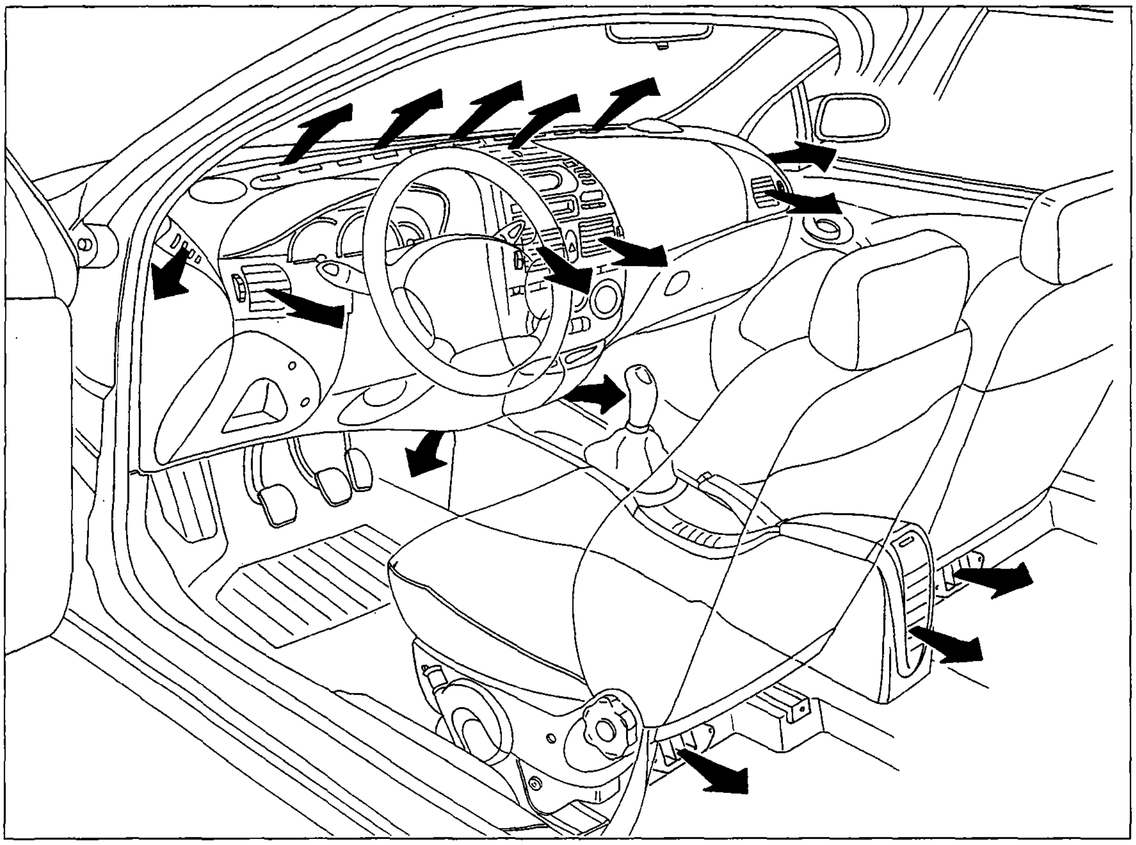
**ADDITIONAL HEATER**



*For anything not dealt with, refer to the previous edition (print no. 506.670/01)*

**INTRODUCTION**

The climate control system in the vehicle passenger compartment may consist of one of the following systems:
- THERMOSTATICALLY ADJUSTED CLIMATE CONTROL
- MANUALLY OPERATED HEATER



P4A01CH01

**THERMOSTATICALLY ADJUSTED CLIMATE CONTROL**

The system with thermostatic adjustment has SEMI-AUTOMATIC CONTROL of the vehicle climate control system;

In effect, it automatically manages the following, according to the desired temperature requested for the passenger compartment:

- air temperature at the vents
- fan speed (continuous variation)

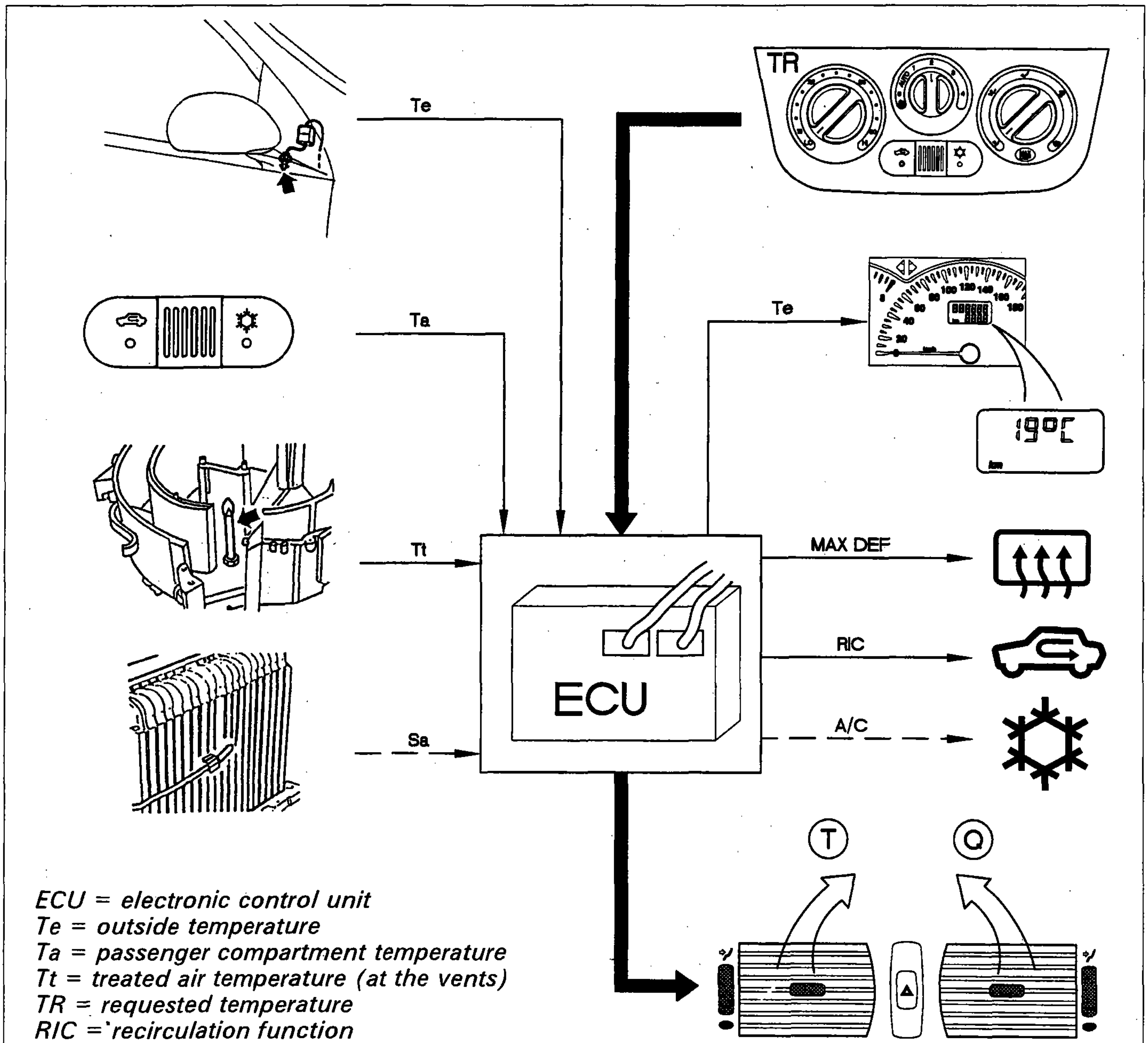
Manual operation, on the other hand, is required for:

- fixed fan speed (4 speeds)
- engaging the compressor (air refrigeration circuit)
- engaging the air recirculation
- "MAX DEF" function

Lastly, the adjustment of the distribution of the air flows to the various air vents is totally manual (by means of bowden cables).

### OPERATING LOGIC

A special electronic control unit manages the automatic operation of the system controlling the thermodynamic parameters to ensure a comfortable climate (temperature and humidity) for the vehicle occupants.




*ECU = electronic control unit*
*Te = outside temperature*
*Ta = passenger compartment temperature*
*Tt = treated air temperature (at the vents)*
*TR = requested temperature*
*RIC = recirculation function*
*T = air temperature sent to the passenger compartment*
*Q = air flow rate sent to the passenger compartment*

*- - - - - "climate control" version only*
*Sa = frost sensor*
*A/C = compressor engagement (air refrigeration circuit)*

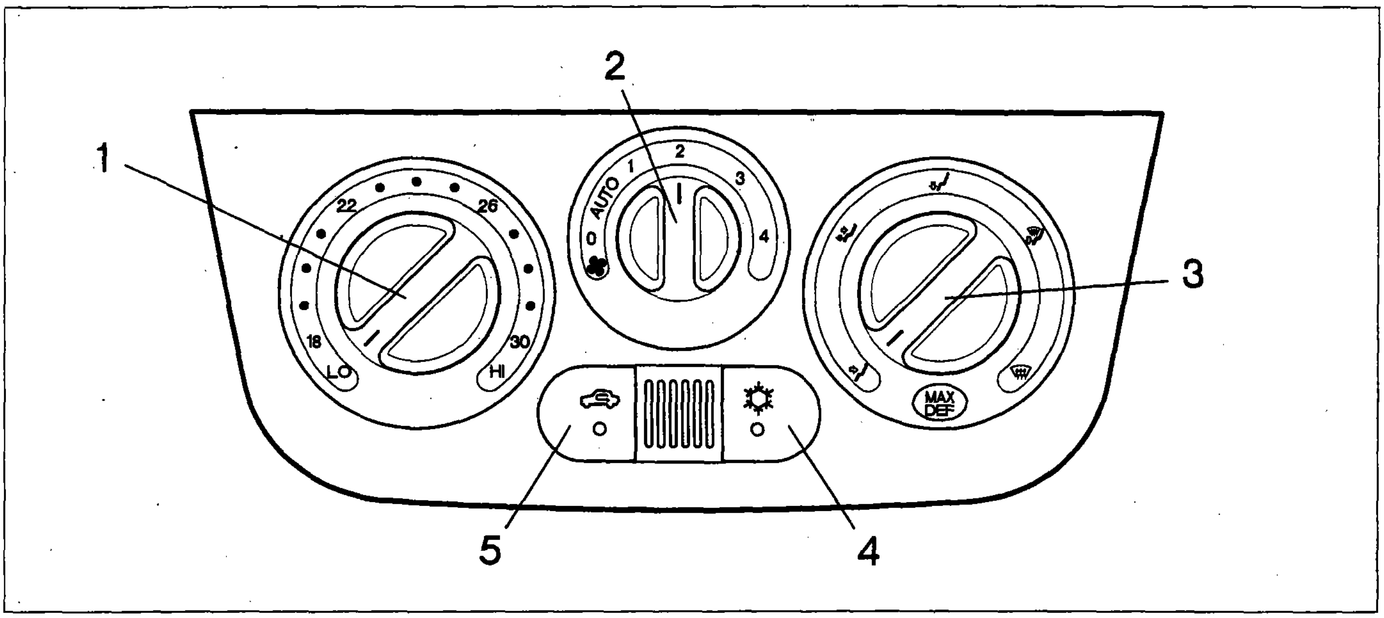
P4A02CH01

According to the requests received and the temperature conditions detected, the control unit carries out/sets certain functions aimed at adjusting the temperature of the passenger compartment to meet the requirements.



*Print no. 506.670/16*

## CONTROLS




P4A03CH01

The left knob (1) is for selecting the REQUESTED TEMPERATURE (between 18 and 30 °C): it is connected to a potentiometer which detects the various angular positions and transmits a signal to the electronic control unit for a total of 15 different positions (one per degree centigrade) with two extreme positions "LO" and "HI" corresponding to the maximum cold and maximum hot settings, respectively.

The centre knob (2) is for adjusting the AIR VENTILATION: it is also connected to a potentiometer which detects the various angular positions and sends a signal to the electronic control unit. There are four possible air flow rates which can be set manually (1, 2, 3 and 4), whilst in the "AUTO" position the system itself automatically selects the most suitable flow rate for reaching or maintaining the desired temperature.

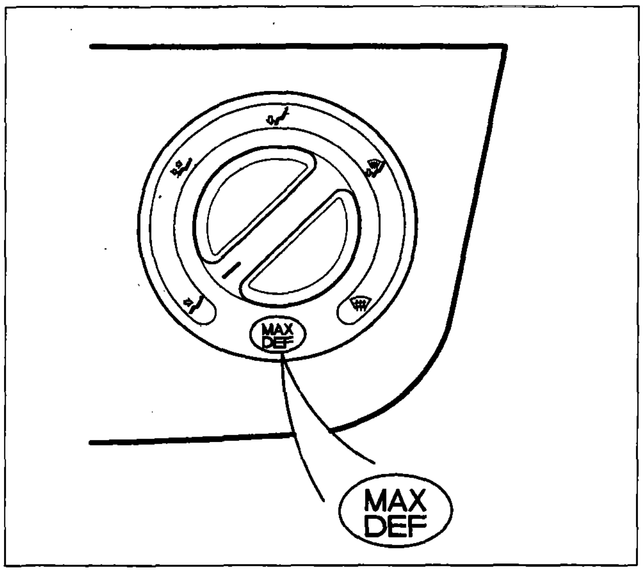
**NOTE** *Position "0" indicates minimal ventilation: the fan is off and there is only a slight flow of air at the vents.*
*With the compressor on, the fanis always "forced" at the first speed, even with the knob at "0".*

**NOTE** *There are two different maps inside the control unit which correlate the air flow rate and the speed of the fan: the pollen filter on the outside air inlet ensures that the flow rate is lower - in relation to the fan speed - in the "dynamic air" condition compared with the "recirculation" condition.*

The right knob (3) is for selecting the FLOW DISTRIBUTION for the air towards the passenger compartment and is achieved in five different ways: the selection is made manually via a cable which controls the movement of the distribution flaps.

Pressing button (4) enables the operation of the COMPRESSOR (air refrigeration circuit); if the button is released, the operation ceases. Engagement is entirely manual: the compressor is only always enabled in the "MAX DEF" setting even with the button released.

Pressing button (5) engages the AIR RECIRCULATION function inside the passenger compartment; releasing the button produces a "dynamic"air flow from the outside.
Engagement is entirely manual: the recirculation function is only excluded in the "MAX DEF" setting even if the button is pressed.

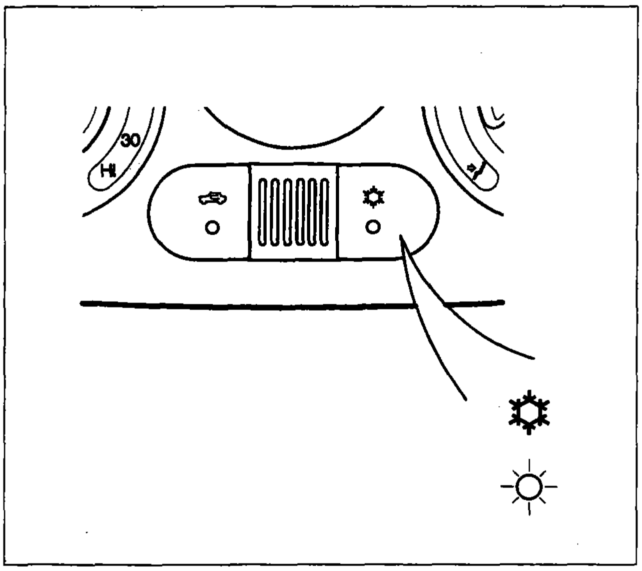



P4A04CH01

### "MAX-DEF" Function

With the distribution knob turned completely in a clockwise direction the "MAX DEF" rapid demisting function is activated by a special microswitch. This function involves:

- maximum air flow rate
- mixture with maximum heat available
- recirculation switched off, whatever position the button (5) is in
- compressor enabled, whatever position the button (4) is in
- signal requesting engagement of heated rear windscreen : this engagement is managed by the integrated services control unit (see Group 55)




P4A04CH02

### Compressor engagement

When the button shown in the diagram is pressed this enables the OPERATION OF THE COMPRESSOR (air refrigeration circuit); if the button is released, the operation ceases.

The effective engagement of the compressor, however, depends on the following conditions:

- outside temperature below 5°C: (switches off below 4°C and switches on again above 6°C)
- temperature detected by the frost sensor: (switches off below 3.5°C and switches on again above 5°C)

It should be rememebered that the compressor can also be switched off through the intervention of the four stage pressure switch or the engine control unit. This logic dependson the different engine management control units, as detailed below:

### CONNECTION WITH THE ENGINE CONTROL UNIT

The electronic control unit for the climate control system sends a command signal to the engine control unit giving the go ahead required for engaging the compressor.

There are two different types of connection according tothe type of engine control unit

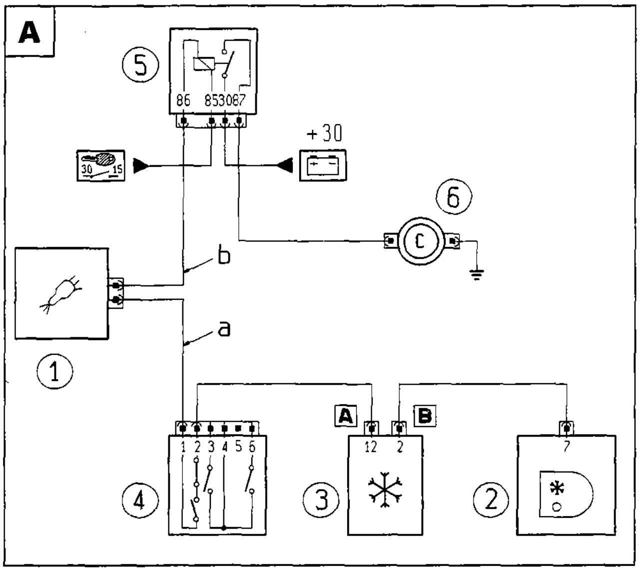
**A**: 1242 - 1581 - 1998 - 1910 JTD engines

**B**: 1910 TD 75 engine (Soft)

**NOTE** *For the 1747 version, refer to the details in the previous edition (print no.506.670/01).*

**NOTE** *For the 1910 TD 75 version, which does not have an engine control unit, the go ahead for operating the compressor is given by a special thermal switch and by the EGR control unit, as well as the four stage pressure switch.*

**Case A:** the engine management control unit (1) receives the signal to engage the compressor (a) directly from the control switch (2): the same signal also arrives as a go ahead (b) after having passed through the climate control control unit (3) and the four stage pressure switch (4): if the pressure is in the refrigeration circuit is not correct, this signal is, in effect, interrupted. Lastly, if other particular exclusion conditions exist (e.g. maximum power request, idling, etc.), then the control unit (1) sends the command (c) to engage the compressor (6) via the relay (5).

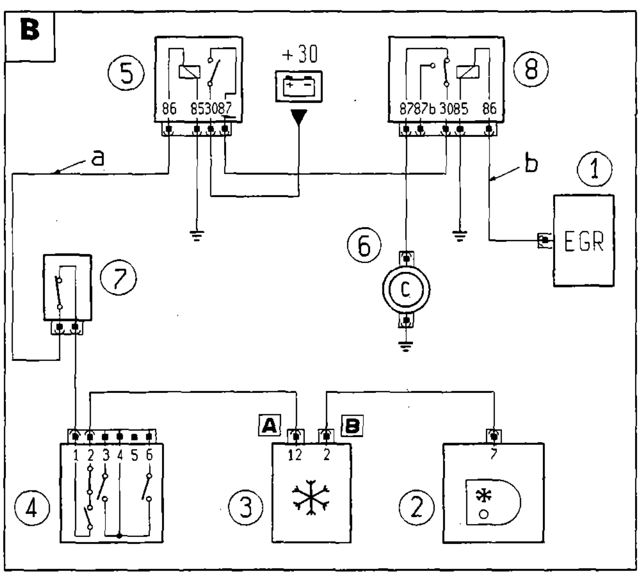



P4A05CH01

**1242 - 1581 - 1998 - 1910 JTD Engines**

1. Injection control unit
2. Climate control controls
3. Climate control control unit
4. Four stage pressure switch
5. Compressor relay
6. Compressor

**Case B:** the signal (a) to engage the compressor is sent, from the control switch (2), via the climate control control unit (3), the four stage pressure switch (4) and the thermal switch (7), to the compressor engagement relay (5). If the conditions for disengaging the compressor (6) exist, (for example maximum power request, idle speed, etc.), then a signal (b) is sent by the EGR control unit (1) to a remote control switch (8) and the compressor is switched off.




P4A05CH02

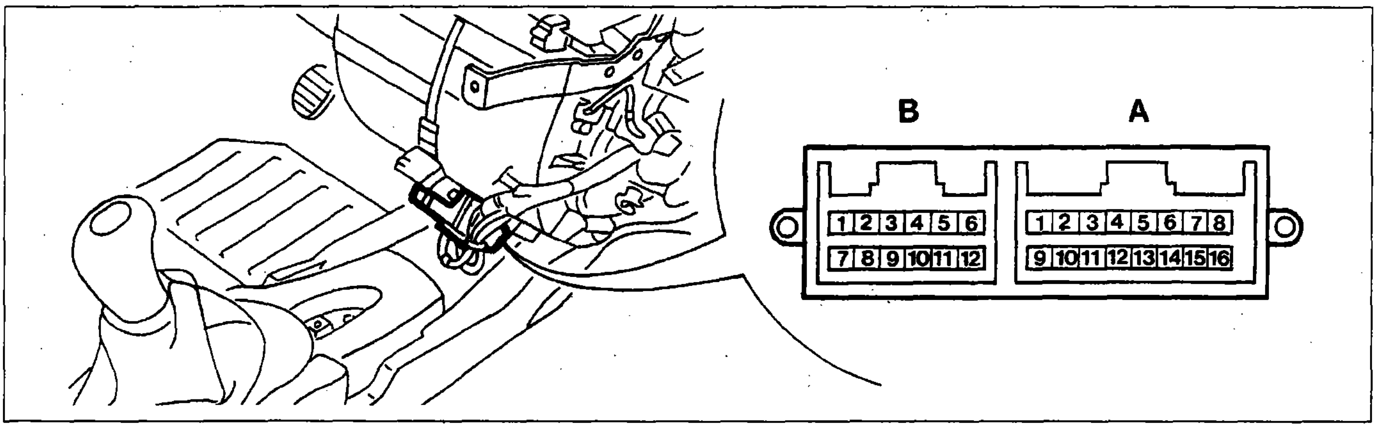
**1910 TD 75 engine (Soft)**

1. EGR control unit
2. Climate control controls
3. Climate control control unit
4. Four stage pressure switch
5. Compressor relay
6. Compressor
7. Thermostatic switch on water pump
8. Remote control switch for disengaging compressor

## SYSTEM COMPONENTS

### Electronic control unit

The electronic control unit manages the automatic operation of the system controlling the thermodynamic parameters to produce a comfortable climate (temperature and humidity) for the occupants of the vehicle.
At is located in the lower part of the duct-distributor assembly, fixed to it by two bolts and is easily accessible from the passenger compartment. The connector for the diagnostic equipment is found next to it.




P4A06CH01

**Connector B**

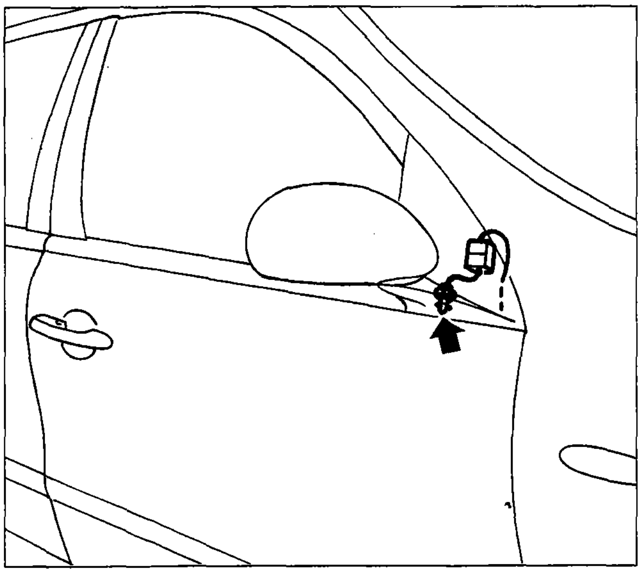
| TERMINAL | FUNCTION |
|---|---|
| 1 | "MAX DEF" |
| 2 | Compressor engagement |
| 3 | Earth (NOT USED) |
| 4 | Ventilation potentiometer |
| 5 | Requested temperature potentiometer |
| 6 | Treated temperature sensor |
| 7 | Engagement of recirculation |
| 8 | Diagnostic line K |
| 9 | Diagnostic line L |
| 10 | Potentiometer supply - 5V - |
| 11 | +30 from battery |
| 12 | Earth for sensors |

**Connector A**

| TERMINAL | FUNCTION |
|---|---|
| 1 | Earth (NOT USED) |
| 2 | Passenger compartment temperature sensor |
| 3 | Outside temperature sensor |
| 4 | N.C. |
| 5 | Mixture actuator feed-back |
| 6 | Frost sensor |
| 7 | Instrument panel display |
| 8 | Fan operation |
| 9 | Earth for electric fan |
| 10 | Mixture control (LO) - 5V - |
| 11 | Mixture control (MI) - 5V - |
| 12 | Compressor operation |
| 13 | +15 from key |
| 14 | Recirculation engagement control - 5V - |
| 15 | Recirculation exclusion control - 5V - |
| 16 | Rearscreen |



*Print no. 506.670/16*

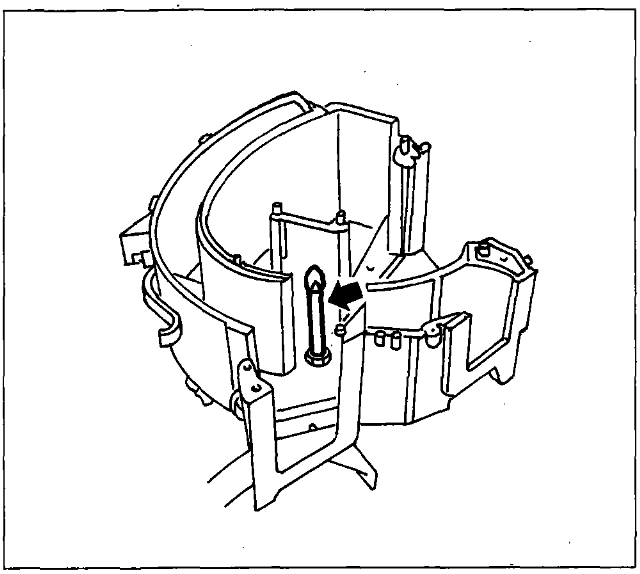


P4A07CH01

### Outside air temperature sensor

It is on the right external rear view mirror.

It consists of an NTC sensor where the resistance decreases with the temperature - (R at 25°C = 10 kOhm), with an operating range of between -30°C and +50°C

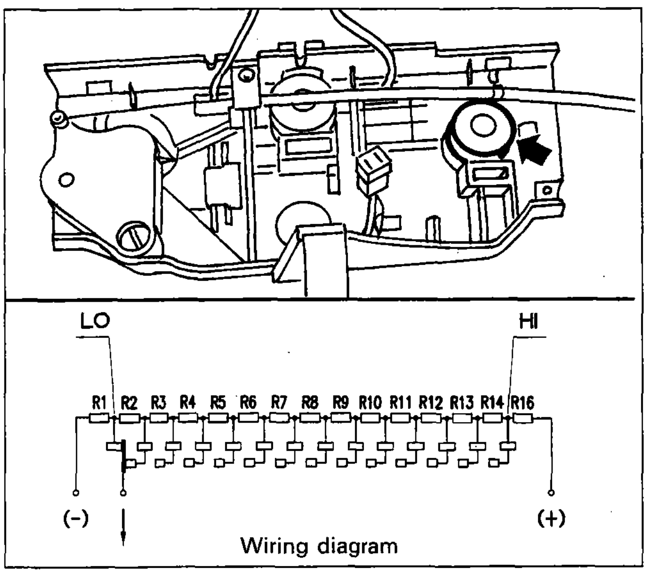


P4A07CH02

### Treated air temperature sensor

*It is inside the distributor assembly immediately upstream of the distribution flaps for the air flows to the various vents.*

It consists of an NTC sensor (R at 25°C = 10 kOhm), with an operating range of between 0°C and +80°C




P4A07CH03

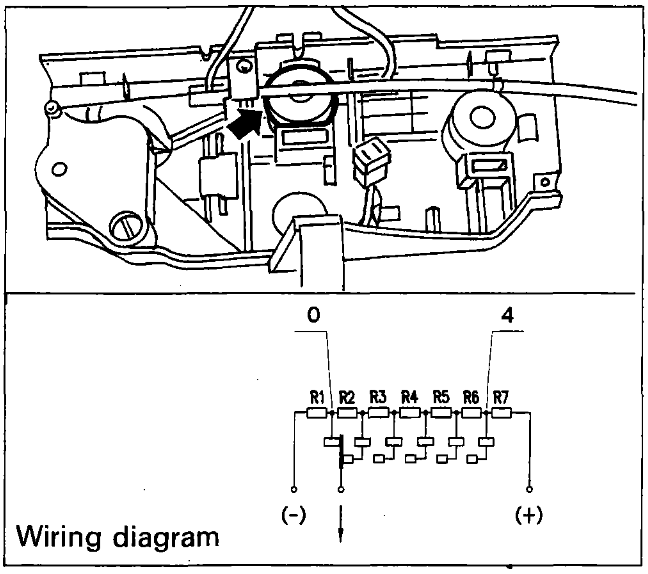
### Requested temperature potentiometer

This potentiometer is connected to the temperature knob and detects the various angular positions, sending a signal to the electronic control unit for a total of 15 different positions (one for each degree centigrade) with two extreme positions "LO" and "HI".

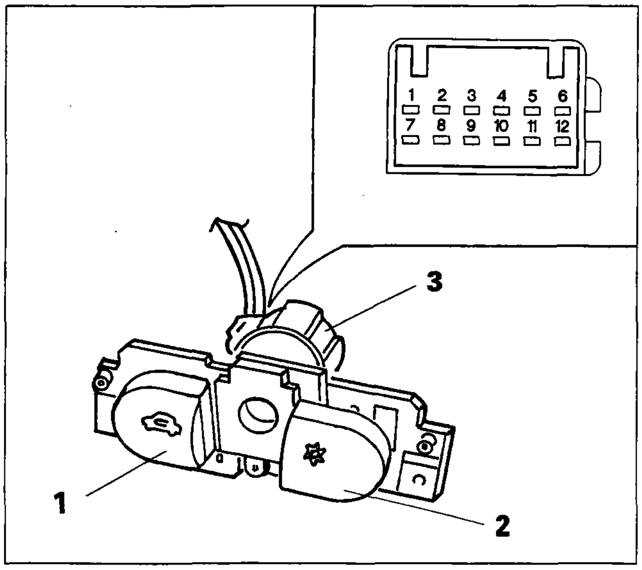
It receives a 5V supply from the control unit and has a controlled earth and gives a signal which corresponds to the position of the knob:

*R1 - R16= 681 Ohm ± 1%*

# 50.




P4A08CH01




P4A08CH02

1. *Recirculation function switch*
2. *Compressor enablement switch*
3. *Passenger compartment temperature sensor*

**Requested air flow rate potentiometer**

This potentiometer is connected to the air ventilation knob and detects the various angular positions, sending a signal to the electronic control unit: there are four possible air flow rates which are set manually (1, 2, 3 e 4), plus an "AUTO" position and "0".

It receives a 5V supply from the control unit and has a controlled earth and gives off a signal corresponding to the position of the knob:

*R1-R7=1500 Ohm±1%*

**Recirculation function switch**

Pressing this switch engages the recirculation function which is managed completely manually:

**Compressor enablement switch (air refrigeration circuit)**

Pressing this switch enables the operation of the compressor (air refrigeration circuit).

**Passenger compartment temperature sensor**

This is located in the climate control control panel between the recirculation and compressor switches.
It consists of an NTC sensor (R at 25°C = 2.2 kOhm), with an operating range of between +5°C and +45°C. The sensor is "ventilatated", in other words it incorporates a small fan which is always supplied so that the temperature reading is not affected by stagnant air inside the dashboard giving a misleading picture.

These last three components make up a single element which is connected by a single connector.

| Terminal | FUNCTION |
|---|---|
| 1 | Motor for ventilated sensor (+) |
| 2 | Motor for ventilated sensor (-) |
| 3 | Earth for passenger compartment temperature sensor |
| 4 | Signal for passenger compartment temperature sensor |
| 5 | MAX-DEF |
| 6 | N.C. |

| Terminal | FUNCTION |
|---|---|
| 7 | Compressor operation |
| 8 | Warning lights operation (NC) |
| 9 | +15 |
| 10 | Ideogram lights (+) |
| 11 | Ideogram lights (-) |
| 12 | Recirculation control |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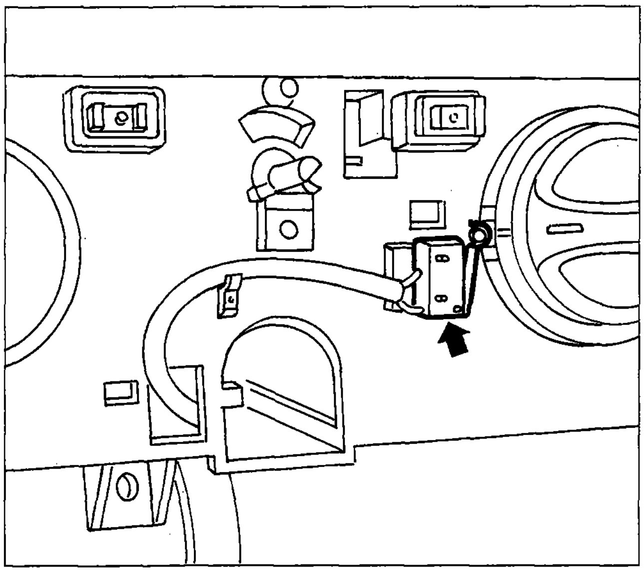
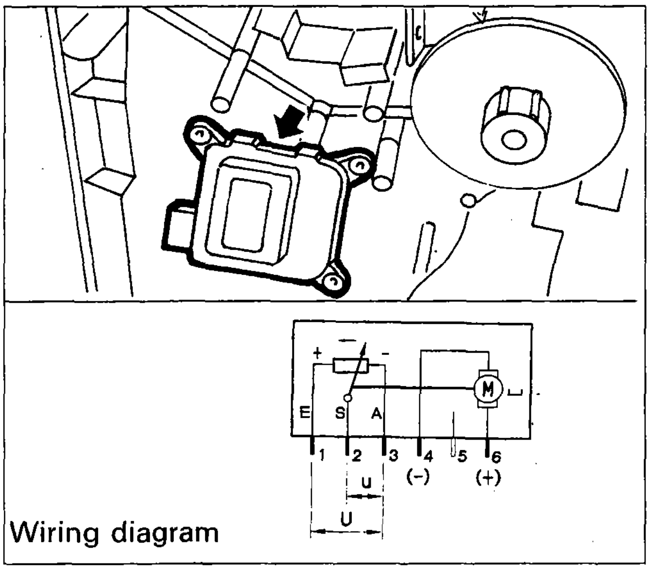


P4A09CH01

## MAX DEF function switch

A special switch activates the MAX DEF function: it is located on the distribution knob: it is an N.A. contact which is closed with the knob completely turned in a clockwise direction.



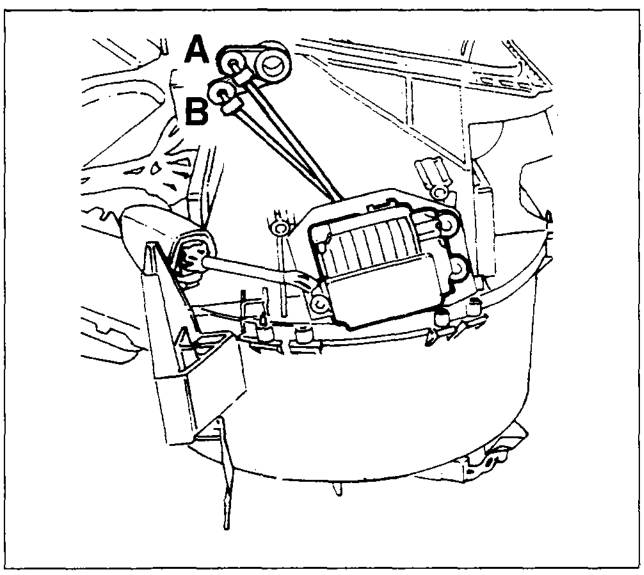

P4A09CH02

## Mixture electrical actuator

The adjustment of the temperature of the treated air is carried out through the actuator which mixes the hot air and the cold air acting on the flap which either does or does not send the flow of air entering the heater radiator, through which the hot water coming from the engine passes through.

A motor with a 12 V supply controls the rotary movement of a drive pin which acts directly on the mixture flap. A potentiometer detects the actual positionand acts as "feedback" to the control unit.

*Total rotation angle between max. hot and max. cold = 62°*
*Ratio u/U for max. hot = 0.707*
*Ratio u/U for max. cold = 0,26*



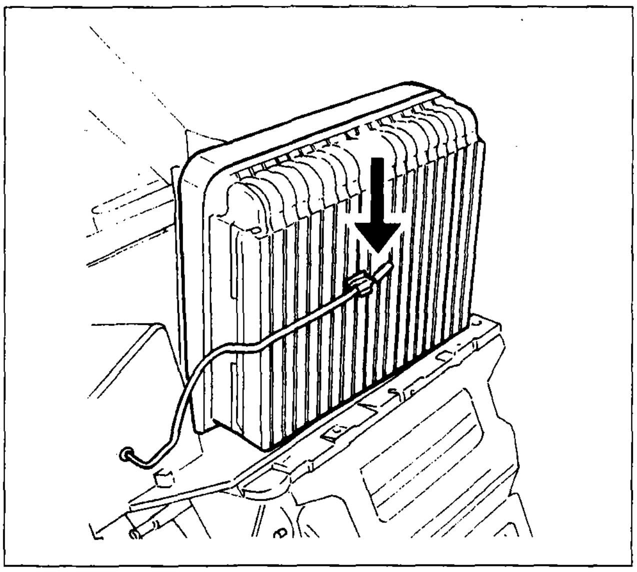

P4A09CH03

## Electrical recirculation actuator

The outside air intake flap is rotated by means of the recirculation actuator which acts on the flap itself moving from position (A) "dynamic air" to position (B) "recirculation".
There are NO intermediate positions.

A motor with a 12 V supply controls the rotary movement of a drive pin which acts directly on the flap. Reversing the polarity results in a movement in the opposite direction.

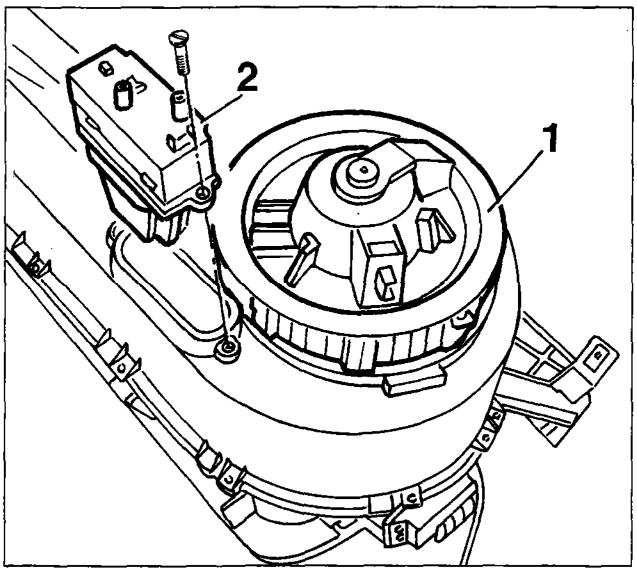
# 50.



P4A10CH01

### Frost sensor

The frost sensor is located inside the duct-distributor assembly, fitted directly on the evaporator and detects the temperature warning the control unit, if necessary, to switch off the compressor to avoid freezing. It consists of NTC sensor (R at 25°C = 10 kOhm), with an operating range of between -5°C and +25°C.

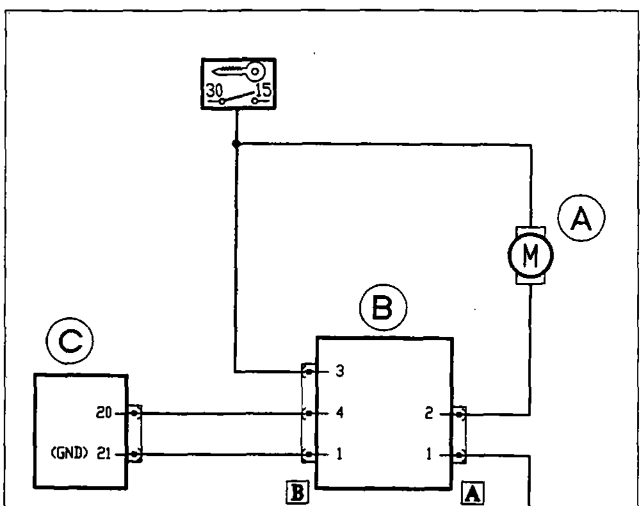



P4A10CH02

### Electric fan with electronic speed regulator

This fan which sends the outside or recirculation air towards the duct-distributor receives a 12 V supply and is operated at different speeds continuously by an electronic regulator positioned nearby.

1. *Electric fan*
2. *Electronic regulator*




Wiring diagram

P4A10CH03

The electronic regulator receives an input signal from the control unit and transforms it into a continuously variable power earth signal to operate the fan.

A. *Electric fan*
B. *Electronic regulator*
C. *Electronic control unit*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## AUTODIAGNOSIS

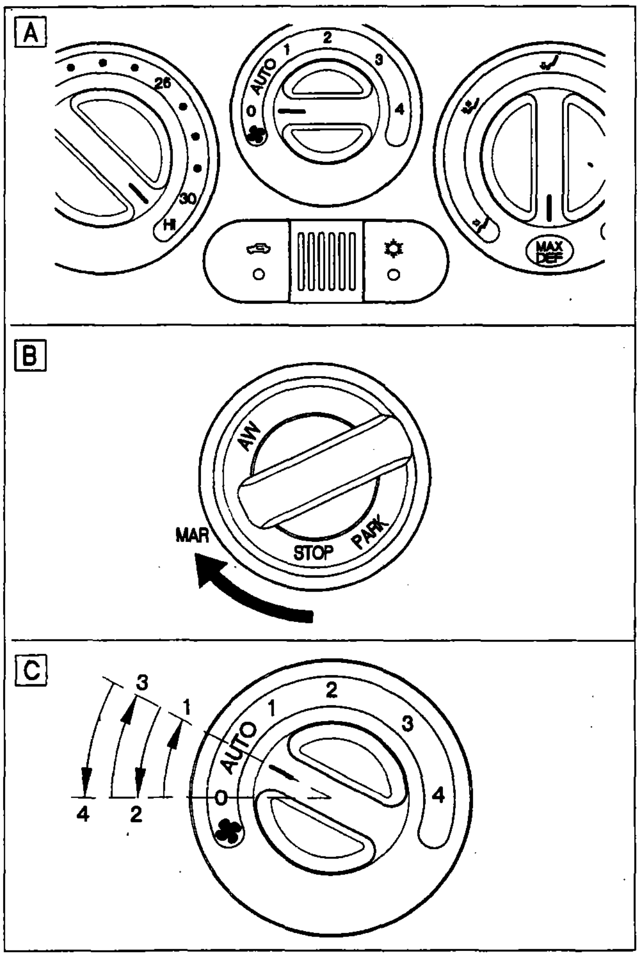
Using suitable control logics for the sensors and adjustment with "self-learning" for the actuators, the electronic control unit is capable of recording and storing and series of problems and faults which can occur in the system.

When confronted with these problems, the control unit continues to manage the operation of the system replacing any incorrect values detected with appropriate recovery values which ensure a minimum level of operation for the system even if it is not ideal.

Two types of errors are memorized:
- occasional errors, which are zeroed when the key is turned OFF
- permanent errors: if an error occurs more than 5 times in a certain period it is considered permanent and is stored in the control unit memory; these errors are NOT zeroed when the key is turned OFF, but only after a specific external command (diagnostic equipment).

The control unit has two methods for reading errors it is storing:
- by means of the diagnostic equipment
- through the display in the on board panel enabled by reading the outside temperature.

As an error detected by the control unit occurs (even an occasional type error), the words "Error Cli" appear on the on board panel display to indicate that the system has memorized a fault.
By pressing the "outside temperature" button in the centre of the dashboard if these words remain, this means that the error involves the outside temperature sensor, if, on the other hand the correct temperature value appears, this means that the error relates to other system components and it is then possible to identify the fault memorized through the following procedure;




P4A11CH01

- Turn the left knob completely in a clockwise direction (HI position)
- Turn the right knob completely in a clockwise direction (MAX DEF position)
- Turn the centre knob (to position 0)

- Turn the ignition key from the OFF position to the ON position

- Within 10 seconds, turn the centre knob, placing it in the following positions: "0" - "AUTO" - "0" - "AUTO" - "0"

# 50.

At this point the control unit will send a series of messages to the on board panel display: an error code, in accordance with the table below, will be displayed in place of "Cli".

| MALFUNCTIONS WHICH CAN BE DETECTED | DISPLAY CODE |
|---|---|
| C.C. to treated temperature sensor earth | 12 |
| C.A. or C.C. indistinguishable treated temperature sensor | 14 |
| C.C. to outside temperature sensor earth | 32 |
| C.A. or C.C. indistinguishable outside temperature sensor | 34 |
| C.C. to passengger compartment temperature sensor earth | 42 |
| C.A. or C.C. indistinguishable passenger compartment temperature sensor | 44 |
| C.C. to frost sensor earth | 52 |
| C.A. or C.C. indistinguishable frost sensor | 54 |
| Mixture actuator malfunction | 65 |
| C.C. to requested temperature potentiometer earth | 82 |
| C.A. or C.C. indistinguishable requested temperature potentiometer | 84 |
| C.C. to ventilation potentiometer earth | 92 |
| C.A. or C.C. indistinguishable ventilation potentiometer | 94 |
| C.C. to mixture earth feedback | B2 |
| C.A. or C.C. indistinguishable mixture feedback | B4 |
| Fan operation malfunction | D5 |
| C.C. to 5 V supply earth | E2 |
| C.C. to + battery supply 5V | E3 |

If several errors are present, they are displayed every 3 seconds.
Having concluded all the rrors, the milometer is displayed once again.

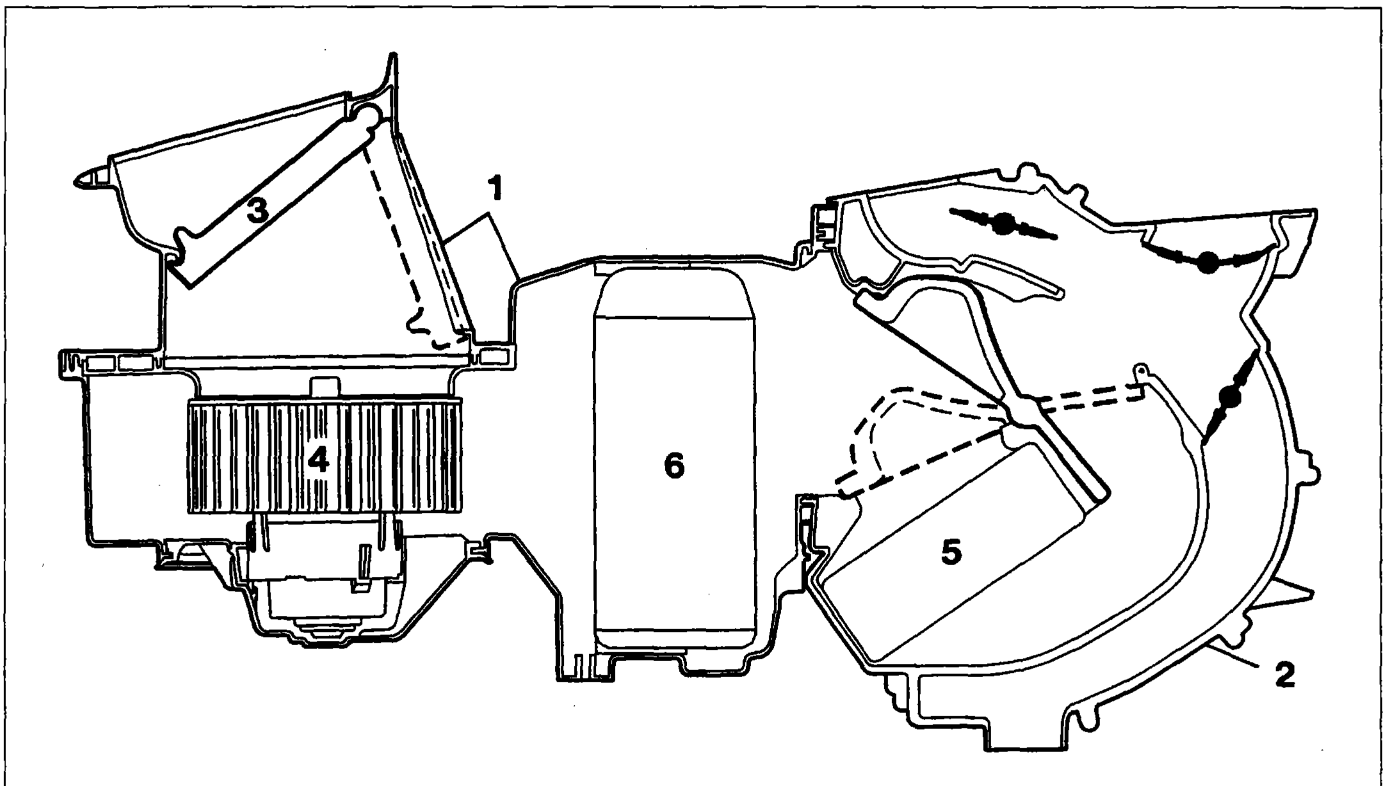
If the codes differ from those mentioned above, bear in mind that the first figure or letter identifies the component, whilst the second figure identifies the type of fault, namely:
1. Open circuit - 2. Short circuit to earth - 3. Short circuit to + battery - 4. Short circuit and open circuit indistinguishable - 5. General actuator malfunction.

*If a system fault diagnosis is carried out* **AFTER A REPAIR OPERATION** *which have involved disconnecting the battery and/or control unit, it is necessary to:*
- *turn the ignition switch to the ON position,*
- *wait for around* **30 seconds:** *the control unit will carry out a "self-learning" cycle,*
- *return the ignition key to the OFF position,*
- *carry out fault diagnosis as illustrated and described previously.*


Print no. 506.670/16

**DUCT / DISTRIBUTOR ASSEMBLY**

The assembly illustrated in cross section in the diagram below is the main component of the system and consists of a duct (1) and a heater-distributor assembly (2).
The duct (1) consists of two parts, a lower one and an upper one; the right part of the latter is shaped in such a way that it matches perfectly with the right upper surface of the dashboard (area below the windscreen by the bulkhead between the engine compartment and the passenger compartment) which it is in contact with.
There are two rectangular shaped openings in the upper part of the duct at the top on the right side; the first is in an almost horizontal position matching with the one in the dashboard and therefore in contact with the outside ambient, whilst the other one is facing the passenger in an almost vertical position, allowing the intake of air in the passenger compartment.
There is a flap (3) fitted on the inside of the duct, at the top, which is directed by a special actuator which can take up a position between closed and one of the above mentioned two openings.
There is an electric fan (4) fitted inside the duct in the lower part by the above mentioned openings which, when supplied at different voltages, can rotate at different speeds.
The heater-distributor assembly basically consists of a casing which houses the following, in order:
- a mixture flap in the centre which, directed by a knob via a cable either does or does not allow the entire air flow introduced by the fan (4) or part of it to come into contact with the finned surface of the heater radiator (5);
- the heater radiator (5) in the centre at the bottom, with inlet and outlet connectors projecting beyond the right side surface of the above mentioned assembly;
- four flaps, at the top and the front, which, directed by a knob via a special actuator, a toothed sector and a splined disc with a distribution function, either shutter or completely close the section of the internal ducts which direct the air to the footwell vents, the front vents and the vents for demisting the windscreen.

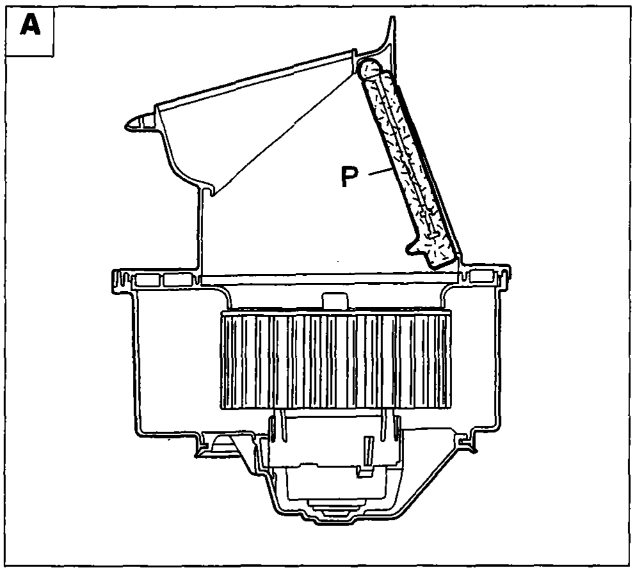



P4A13CH01

The evaporator (6) is located between the duct (1) and the distributor (2).

### Dynamic / recirculation air

The special actuator rotates the air intake flap (P) between the two extreme positions: the one if figure A closes the internal air intake and consequently the electric fan only draws in outside air; the latter is inhibited and recirculation air is drawn in if the flap is positioned as illustrated in figure B.

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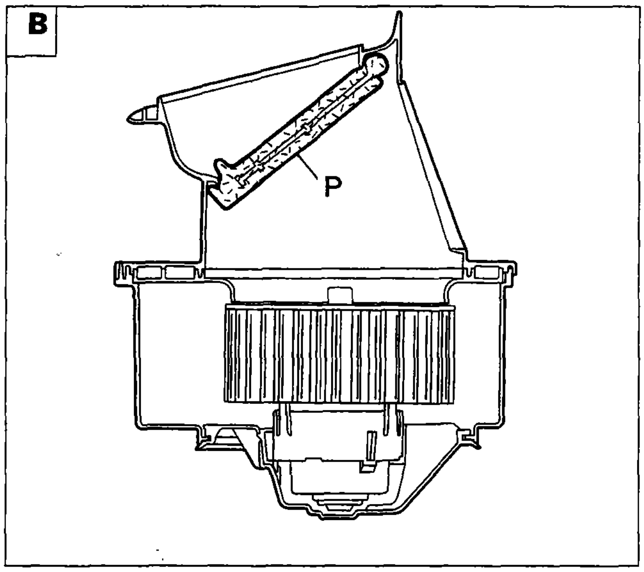
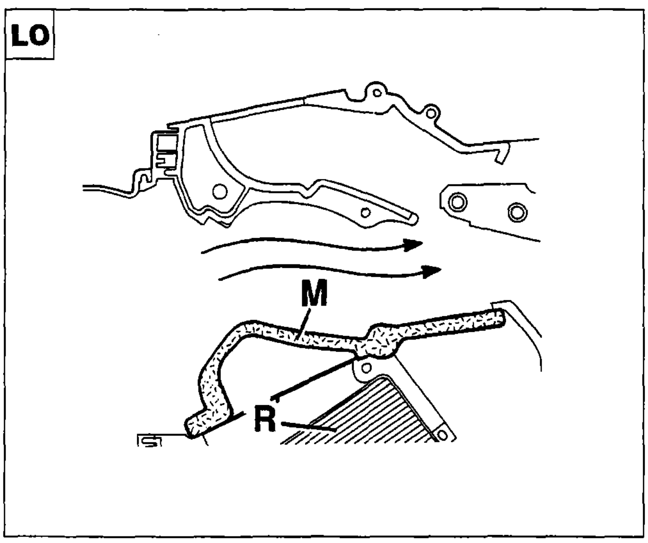


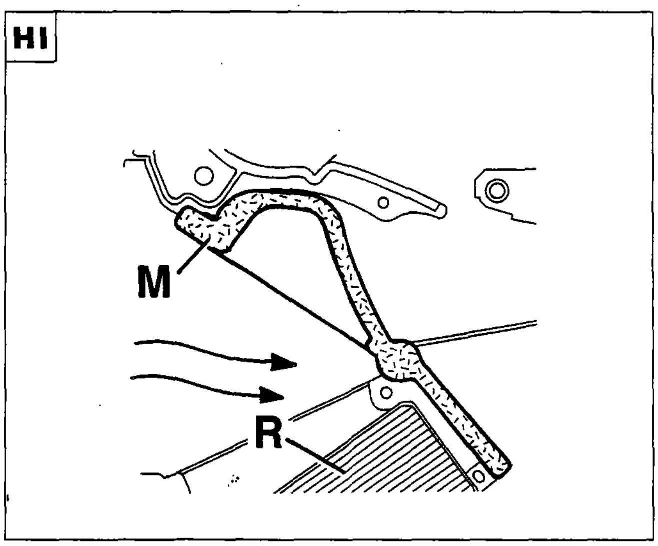

P4A14CH02

### Hot/cold air mixing

The special actuator rotates the flap (M) between the extreme positions (LO) and (HI).
In the (LO) position, the flow of air drawn in by the fan is distributed to the various vents without undergoing any variation in temperature because it is impossible to come into contact with the heater radiator (R) finned surface.
When the mixture flap is in the limit position (HI) the entire flow of air introduced by the electric fan has to come into contact with the heater radiator fins with hot air at the maximum possible temperature being distributed to the various vents.
When the mixture flap is in an intermediate position between the two positions mentioned above, only part of the air flow introduced by the electric fan comes into contact with the heater fins.




P4A14CH03




P4A14CH04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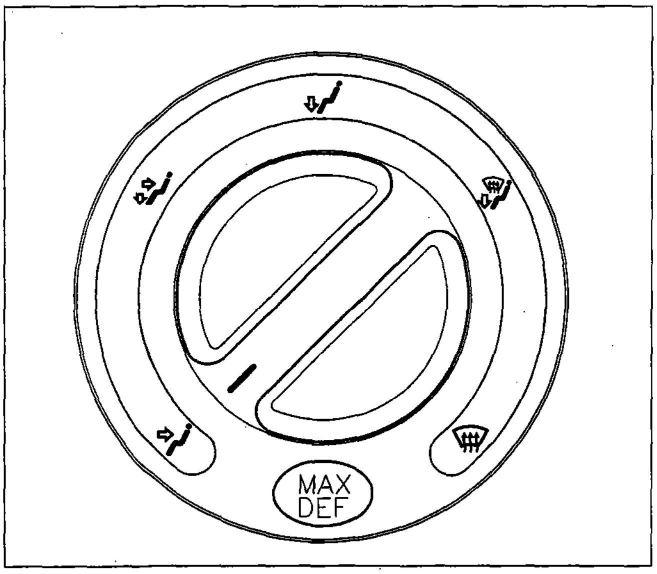
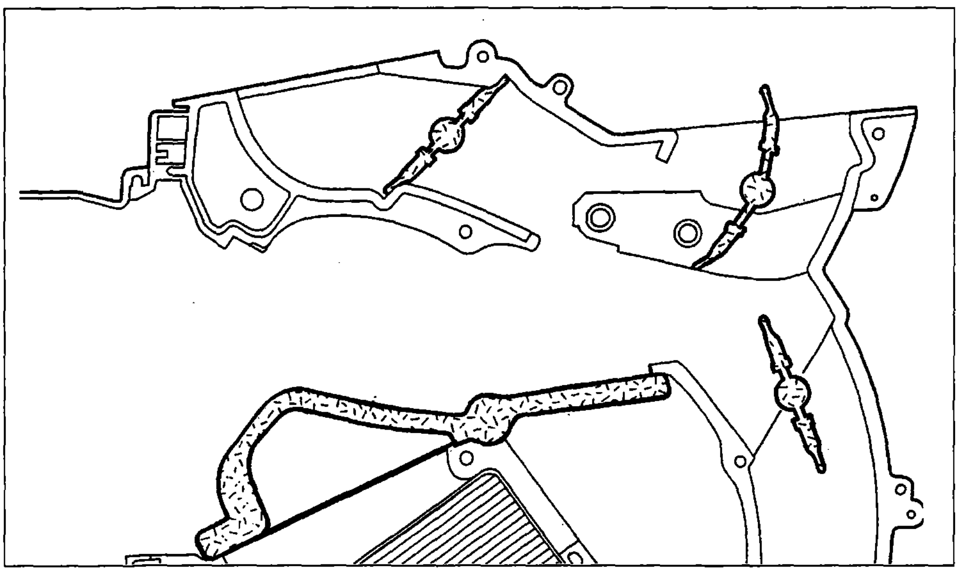


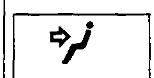

P4A15CH01

### Air distribution

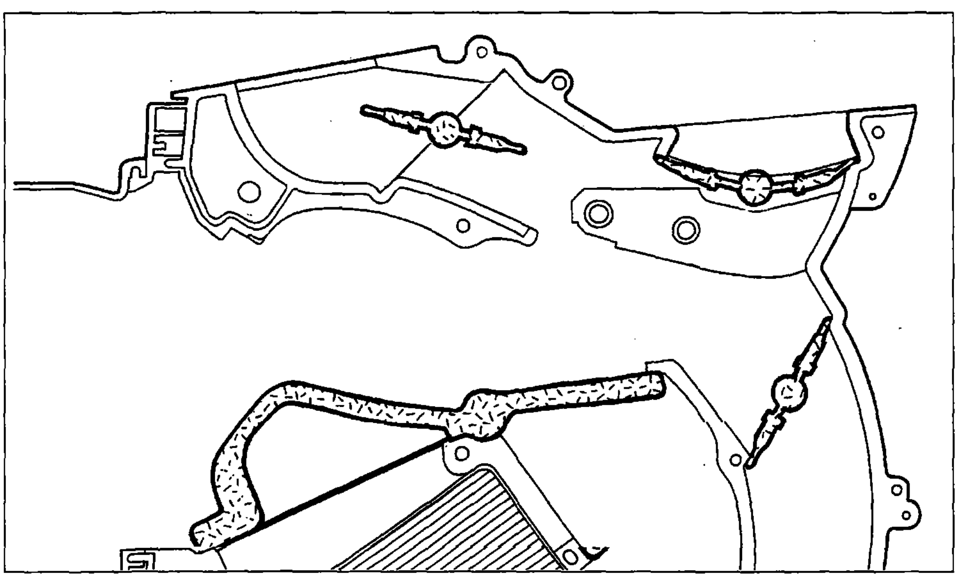
By turning the right knob in a clockwise direction the four flaps are rotated so that the air is distributed as illustrated on the various ideograms, i.e. starting from to the front vents only, ending with the windscreen vents, as illustrated in the diagrams below.



P4A15CH02



**View of positioning of the various distribution flaps when the knob is rotated completely in an anti-clockwise direction**



P4A15CH03

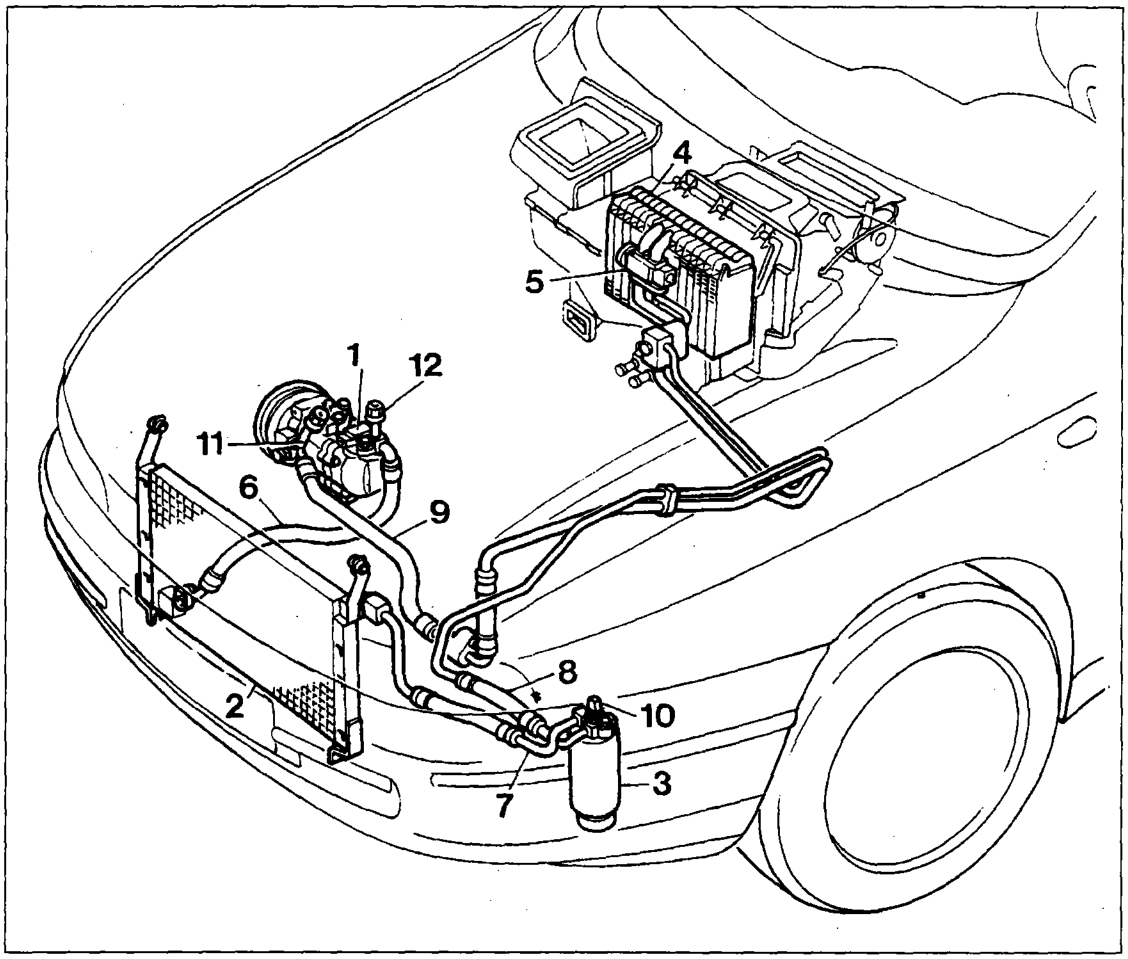
**View of positioning of the various distribution flaps when the knob is rotated completely in a clockwise direction**

## LOCATION OF CLIMATE CONTROL SYSTEM COMPONENTS

The climate control system consists of the following components:

- a variable flow rate compressor (SKROLL for 1242 16v and 1910 JTD versions - NIPPONDENSO TV 12SC for other versions) which is fixed to the engine by brackets;
- a condenser which is a heat exchanger fitted in front of the engine coolant radiator;
- a drier filter which is located near the left side of the condenser;
- an evaporator which is the second heat exchanger for the system and is located in the above mentioned assembly;
- an expansion valve which is fitted on the evaporator inlet duct;
- various rigid and flexible pipes which connect the various system components;
- a threee stage pressure switch which is fitted on the drier filter.

There are two small pipes, fitted to the high and low pressure pipes, with a needle valve which is designed to drain and repressurize the system.




P4A16CH01

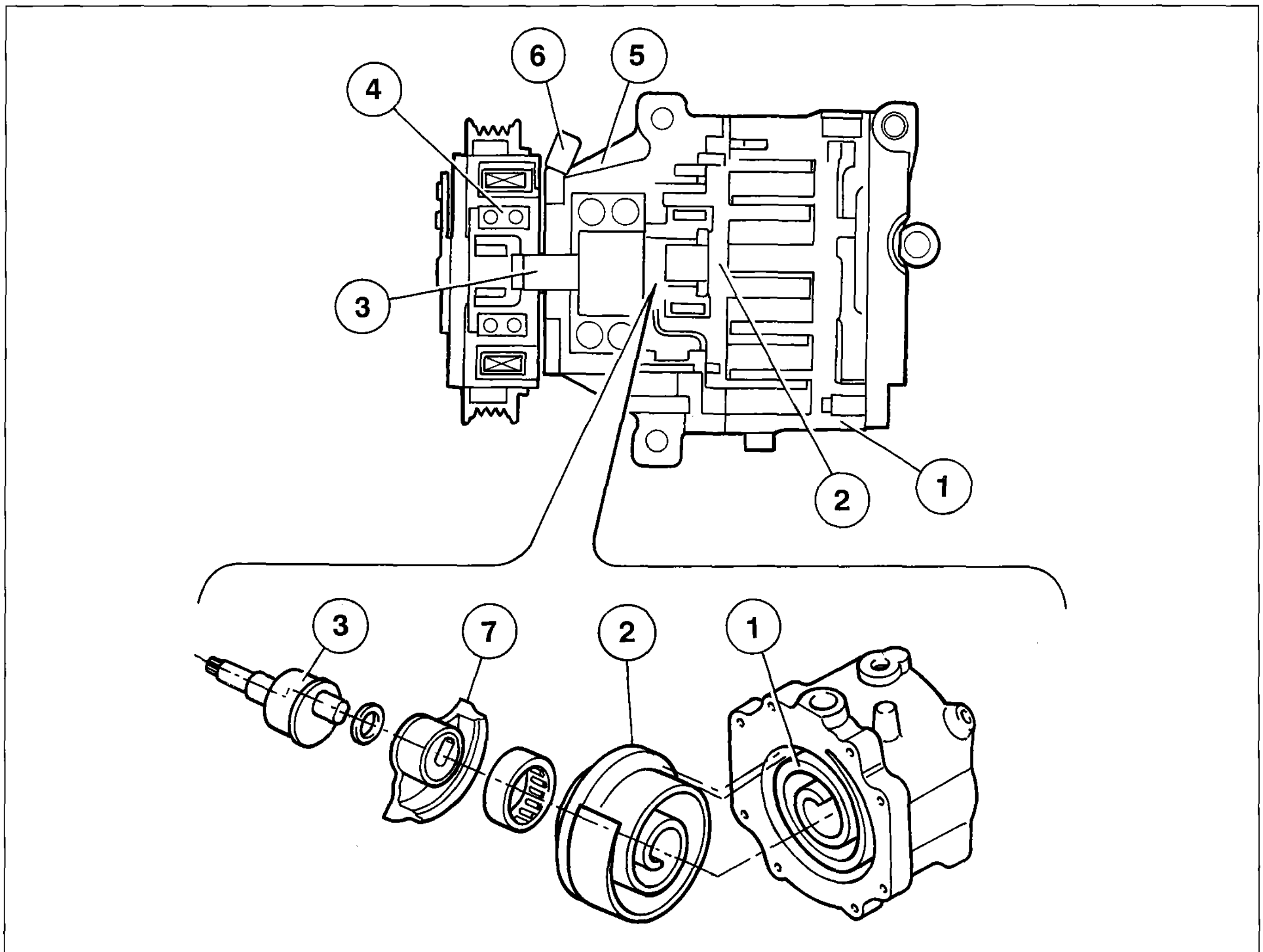
1. Compressor
2. Condenser
3. Drier filter
4. Evaporator
5. Expansion valve
6. Pipe between compressor and condenser
7. Pipe between condenser and drier filter
8. Pipe between filter and evaporator
9. Pipe between evaporator and compressor
10. Three stage pressure switch
11. Needle valve for draining the system (low pressure side)
12. Needle valve for draining and repressurizing the system (high pressure side)


*Print no. 506.670/16*

## SCROLL SCS08 COMPRESSOR

The compressor used on this vehicle is the scroll type and is equipped with a system which deactivates it when the evaporator reaches temperatures where freezing may take place.
The compressor consists of a fixed scroll (1) which has a casing and an orbital scroll (2); the movement of the two scrolls, which takes place through the camshaft (3) connected to the pulley, produces a chamber in which the volume decreases during rotation allowing compression.

The adoption of this compressor, consisting of only two moving parts, has resulted in the following advantages:
- no seals are required;
- there are no leaks, either radial or axial;
- low load losses through the absence of internal valves and pipes;
- the wear of the spirals produces an improved seal of the side panels of the actual spirals;
- the absence of valves, knocking and impulses reduces noise levels.



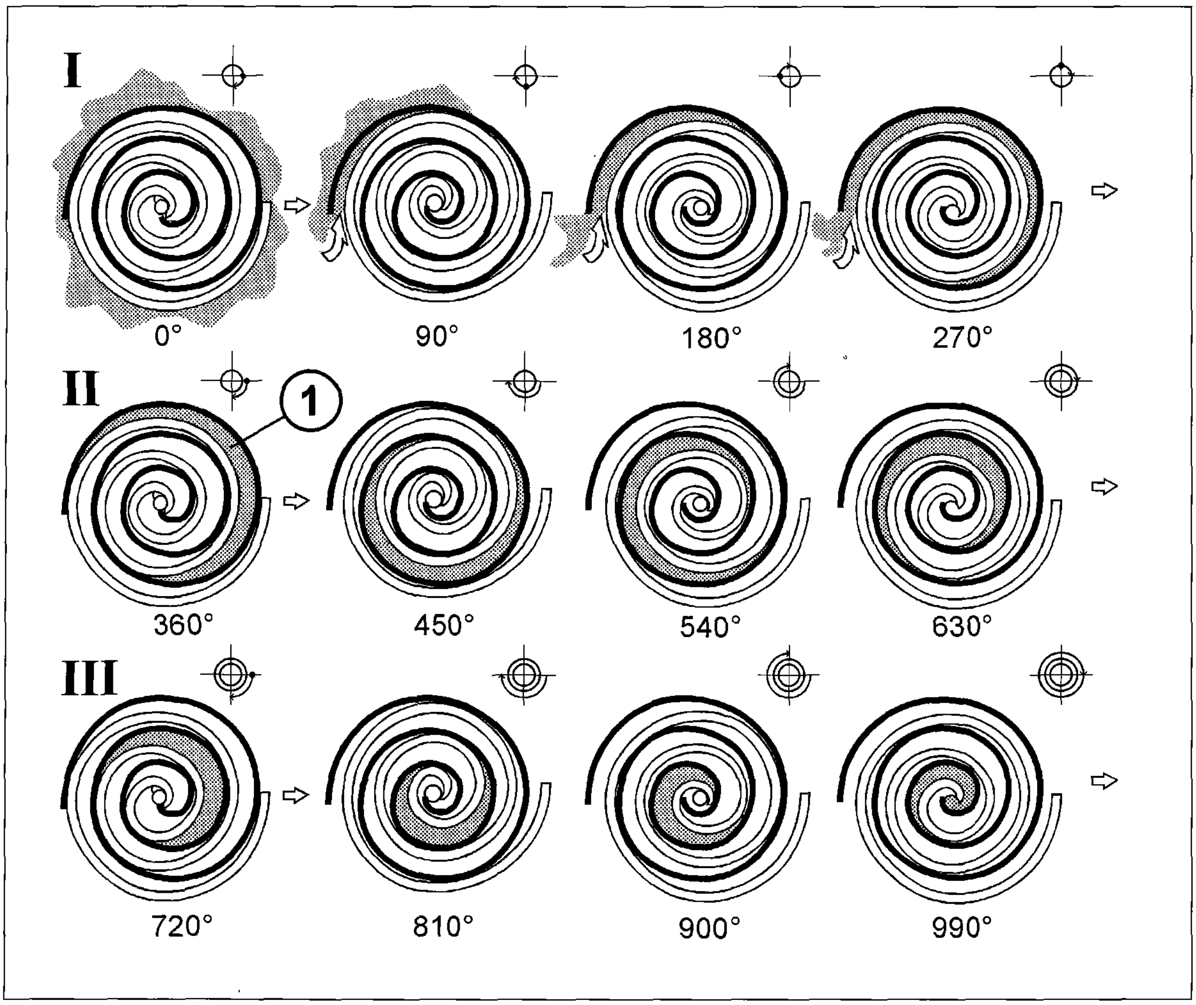

P4A17CH01

1. Fixed scroll (casing)
2. Orbital scroll
3. Camshaft
4. Camshaft seal
5. Shield
6. Compressor supply electrical connection
7. Balancing mass

### Compression mechanism

The contact between the compressor fixed scroll and the orbital scroll produces a chamber (1) in which the gas is imprisoned with the volume tending to gradually decrease as the orbital scroll rotates. As shown in the sequence illustrated, the compression chamber is alternately open for the supply of gas, closed for transportation and open once again (at the outlet connector) for the discharge of the gas under pressure.

The volume defined by the two scrolls decreases determining the compression mechanism for the gas stored. The pressure gradually increases until the gas arrives at the centre zone where operating pressure is reached; at this point thegas is released through the outlet connector to the condenser.



P4A18CH01

The sequence illustrates the different gas compression stages; the compression takes place after three complete revolutions of the orbital scroll. Naturally, the cycle is continuous therefore the moment a compression stroke takes place, a gas inlet stroke occurs simultaneously and the previous phase ends with the escape of the gas under pressure.

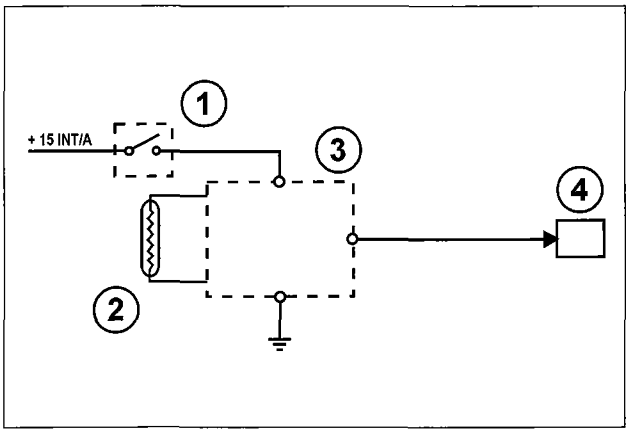

Print no. 506.670/17

## OPERATION OF THE COMPRESSOR ELECTRONIC CONTROL UNIT

The system for activating/deactivating the compressor is operated by an electronic control unit (electronic thermostat) (3), which acts on the compressor clutch according to the temperature of the evaporator, measured by an N.T.C. type sensor (2).

If the temperature of the evaporator reaches values below 3.5 °C, the electronic unit releases the compressor coupling relay and consequently the compressor coupling.

The compressor coupling is disengaged if the driver accelerates fully and when the engine temperature reaches 107 °C, to prevent overheating. These control operations are carried out by the fuel injection control unit.



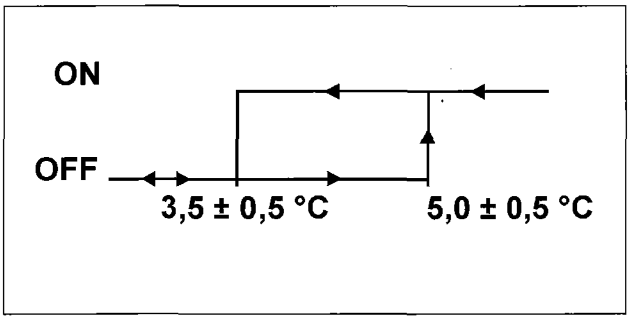

P4A19CH01

1. Air conditioning on switch
2. Air temperature sensor on the evaporator
3. Compressor electronic control unit (electronic thermostat)
4. Four stage pressure switch

### Air temperature sensor on the evaporator

The temperature sensor is an N.T.C. resistance and is kept in place, by means of a retaining spring, on the evaporator fins, on the downstream side of the air flow and is not accessible from the outside.

The control unit which deactivates the compressor according to the temperature of the air measured at the evaporator outlet is calibrated as follows:




P4A19CH02

In particular, the control unit activates the coupling when the temperature of the air exceeds 5.0 ±0.5 °C and deactivates it when the temperature goes below 3.5 ±0.5 °C.

## MAINTENANCE AND SERVICE OPERATIONS

### Lubricant oil

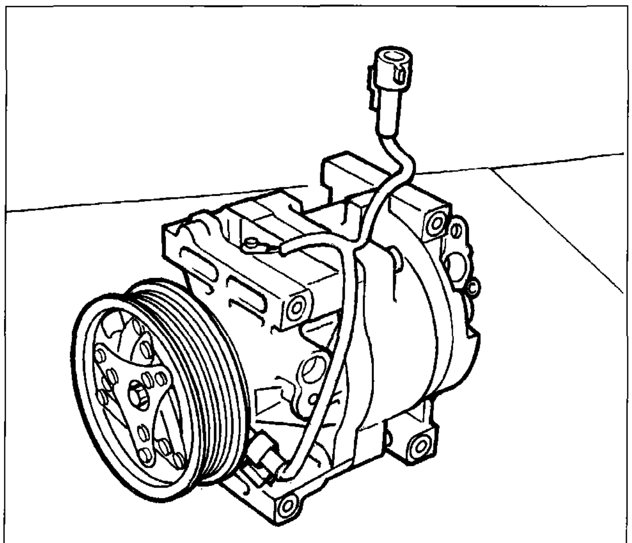
*The compressor is lubricated by about 80±20 cc of ND8 oil. Only this type of oil (ND8) should be used for topping up or oil changes.*

In case of service operations which involve replacing some of the system components such as the condenser or the evaporator, 40 cc of oil must be added for each of the parts replaced. If the compressor is being replaced, it is available as spares with the recommended quantity of oil. For this reason, before fitting it on the vehicle the amount of oil corresponding to that remaining in the system must be removed first. In order to do this it is necessary to:

*The compressor is available as spares pressurized with nitrogen to prevent dampness and impurities from entering; therefore when refitting, remove the inlet and outlet connector plugs slowly with the compressor positioned exactly as illustrated in the diagram below (with the cover facing upwards).*

1. Pour the quantity of oil in the compressor which is being replaced into a graduated test tube (C) taking care to let it drain well.
2. Pour the quantity of oil in the new compressor into a graduated test tube (D) taking care to let it drain well.
3. Remove the excess quantity of oil(E) corresponding to the difference between the quantity of oil in test tube (C) and test tube (D) (E = D - C).

*The oil is extremely hygroscopic: avoid leaving the containers open.*
*Avoid leaving the compressor or any other component disconnected from the system for longer than is necessary.*
*Do not tilt the compressor or turn it upsidedown.*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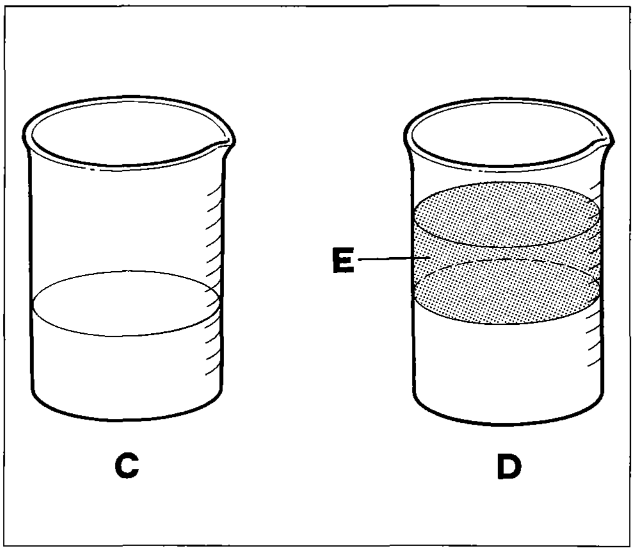

P4A20CH02

**Determining the quantity of lubricant oil to be introduced into the compressor**



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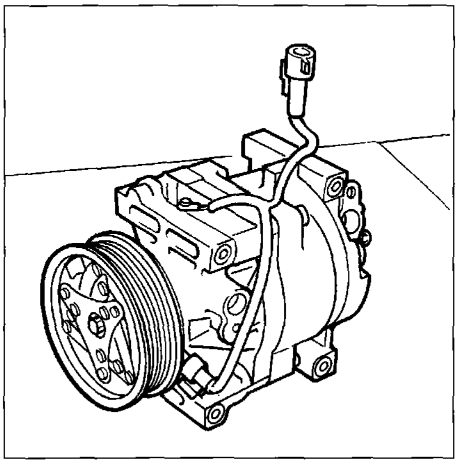
*Any time the compressor is removed or moved, it should be positioned with the cover facing upwards as illustrated in fig. 1 to prevent oil leaks and the fouling of the compressor.*



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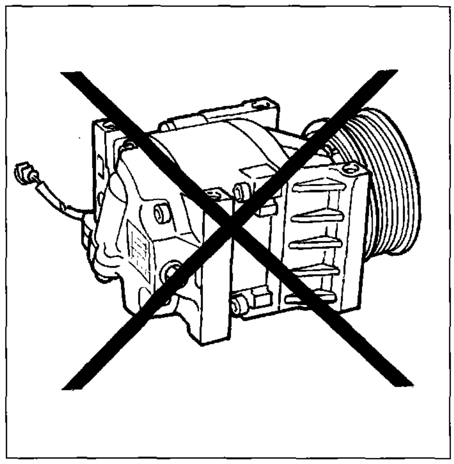
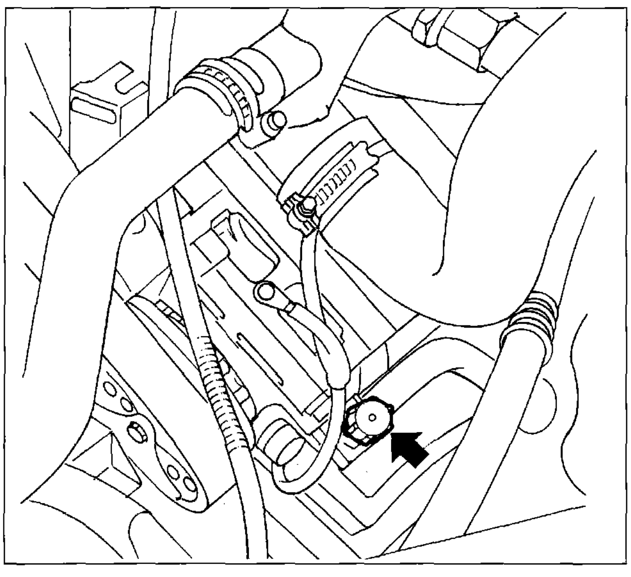


P4A21CH03

*Before carrying out operations which could cause the escape of refrigerant fluid, the air conditioning system must be drained. Protective gloves and goggles should be worn during this operation.*
*In order to facilitate the draining operation, the engine and the system should be left to run for at least 10 - 15 minutes.*

**NOTE** *If the O-ring seals are being replaced, use green or black coloured seals, making sure that they are current production ones which are resistant to R134A fluid. Do not, under any circumstances, use old production black seals because they are permeable.*

**NOTE** *If the system pipes are dismantled, it is advisable to seal the disconnected ends of the pipes with suitable plugs if they are not going to be refited immeidately to prevent dampness or foreign bodies from entering.*



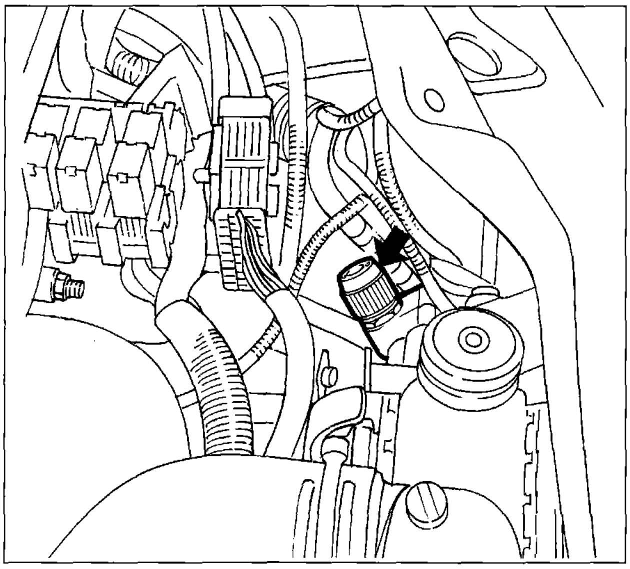
P4A21CH04

**Connecting the equipment to the vehicle air conditioning system**

Carry out the following operations in order:

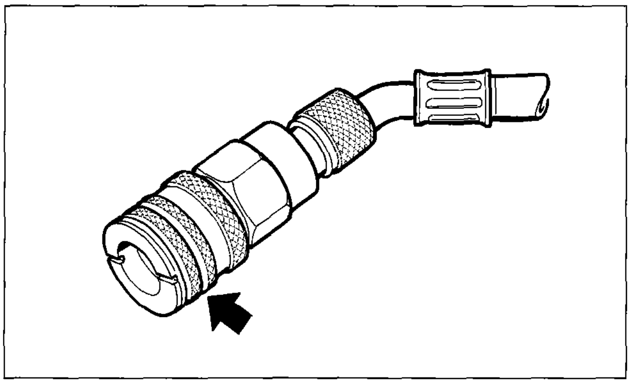
- Check that the equipment taps are closed and that the electrical control knobs are in position 0 (off), then engage the connector for the light blue flexible pipe with the needle valve on the section of pipe which connects the evaporator to the compressor.

# 50.



P4A22CH01

- Attach the connector for the red flexible pipe to the needle valve on the four stage pressure switch connector.



P4A22CH02

**NOTE** *Move the ring nut shown by the arrow completely upwards before fitting the connector on the needle valve.*



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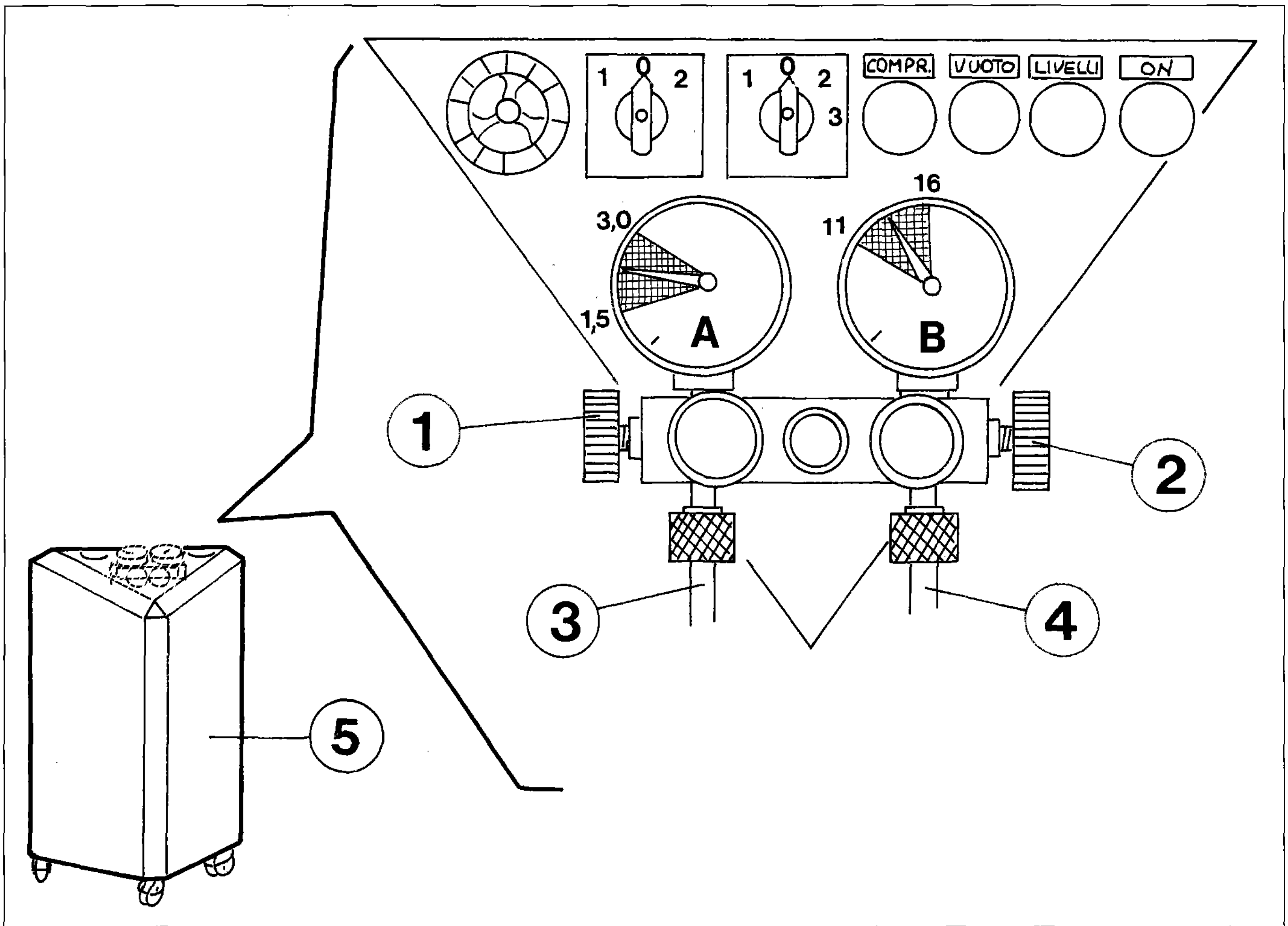
**Checking air conditioning system pressure**




P4A23CH01

(A) low pressure circuit gauge
(B) high pressure circuit gauge

1. Low pressure tap (LOW)
2. High pressure tap (HIGH)
3. Light blue low pressure pipe
4. Red high pressure pipe
5. Cleaner 134 equipment

The pressure is checked using the Cleaner 134 equipment with the engine running (rotation speed of around 1500 rpm) and the outside temperature 20 - 28 °C, after having connected the pipes as illustrated on the previous page; under these circumstances the pressure gauge readings should be:

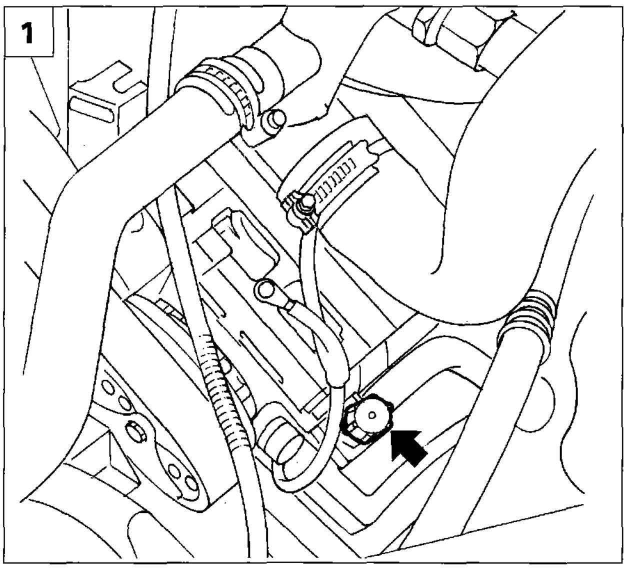
**low pressure circuit (pressure gauge A): 1.5 - 3.0 bar**

**high pressure circuit (pressure gauge B): 11 - 16 bar**

**NOTE** *The radiator/condenser cooling fan is switched on at a high pressure circuit pressure of 15 - 16 bar.*

**Quantity of R 134 A refrigerant fluid contained in the system: 650 ± 25 cc.**

# 50.

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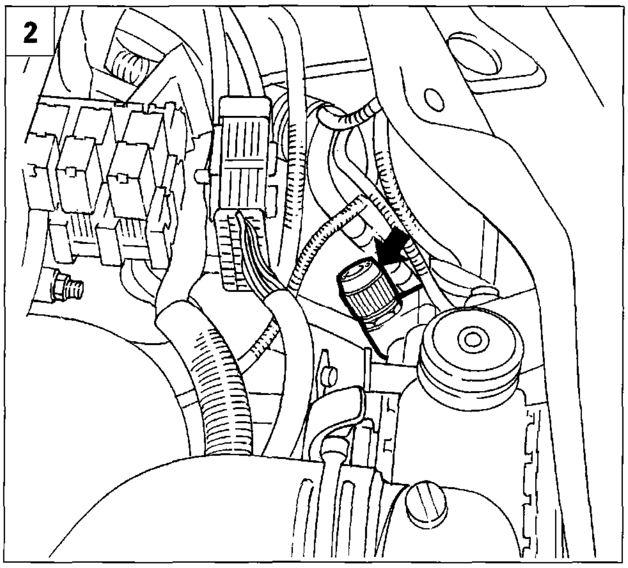


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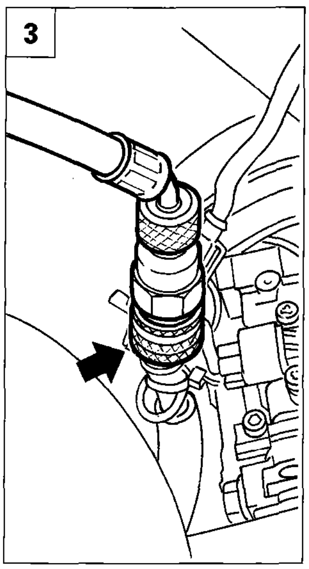


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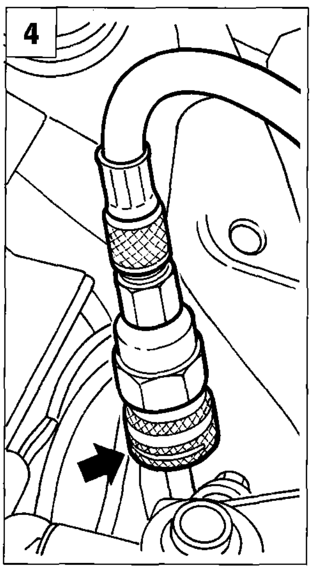



P4A24CH02

## DRAINING THE SYSTEM

*Before carrying out any operation which could result in R 134 A fluid escaping, the climate control system must be drained.*
*During the operation of draining the system, wear protective gloves and goggles for protection against contact with any jets of R 134 A fluid.*

In order to faciliate the draining of the fluid from the vehicle air conditioning system, the engine should be started up and the system left to run for 10-15 minutes before commencing the draining operations.

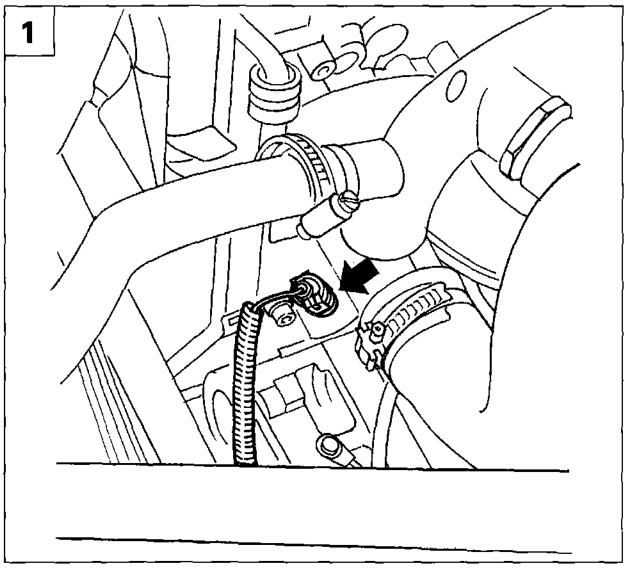
To drain the vehicle climate control system, use the Cleaner 134 equipment manufactured by ICF and carry out the following operations:

1. Undo the plug for the needle valve (low pressure side) which is at the end of a pipe on the pipe which connectors the evaporator to the compressor.
2. Undo the plug for the needle valve (high pressure side) which is at the end of a pipe which is an integral part of the connector, at the end of the pipe which connects the condenser to the drier filter.

3.4. Fit the rapid attachment connector for the ends of the blue (low pressure side) and red (high pressure side) flexible connecting pipes for the Cleaner R134 equipment on the above mentioned needle valves; then carry out the operations for recovering and recycling the refrigerant fluid descried and illustrated in the Bravo-Brava 2nd volume Manual (print no. 506.670/01).

**NOTE** *To improve safety, the rapid attachment connectors for the pipes connected to the equipment and the needle valves have different diameters: the low pressure side ones are larger and the high pressure side ones are smaller. Before attaching the rapid attachment connectors to the needle valves, the knurled ring nut shown by the arrow must be moved upwards.*


*Print no. 506.670/17*

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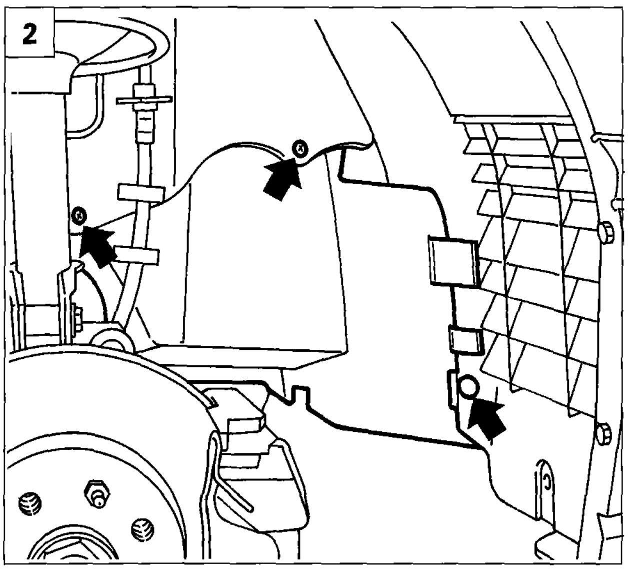


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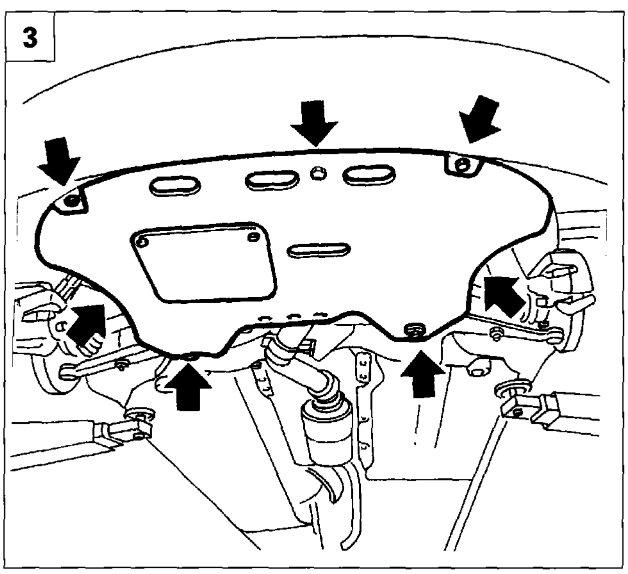



P4A25CH03

## COMPRESSOR

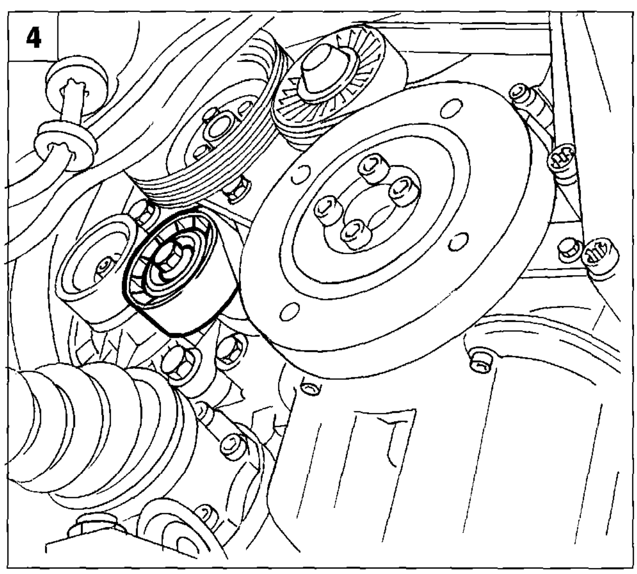
### Removing

1. Position the vehicle on a lift, disconnect the negative battery lead and drain the climate control system, carry out the following operations in order:

- disconnect the connector and release it from the retaining band;

2. raise the vehicle and remove the right front wheel, remove the clip and undo the bolts shown in the diagram, fixing the wheel arch liner to the bodyshell.
3. Undo the bolts shown in the diagram and remove the lower shield from the engine compartment.
4. Acting on the belt tensioning device, loosen the tension of the single engine components drive belt; release the belt from the pullies and remove it.

**NOTE** *Avoid the belt coming into contact with oil or solvents which could affect the elasticity of the rubber with a consequent loss of grip. Also check that there are no cracks or cuts on the belt or else it will have to be replaced.*




P4A25CH04

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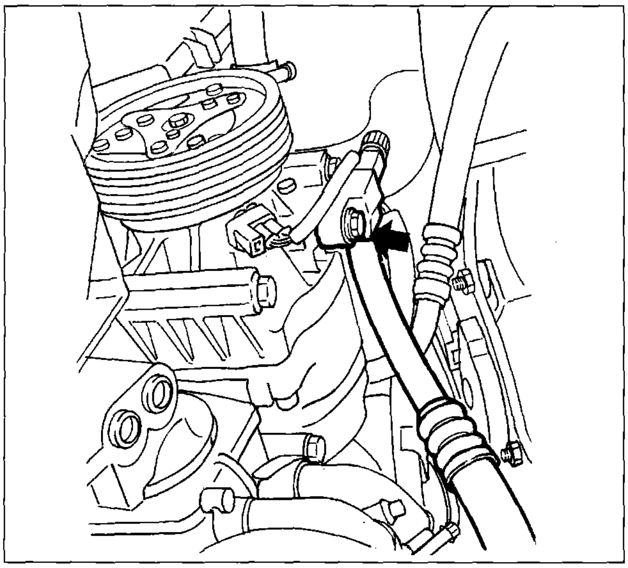
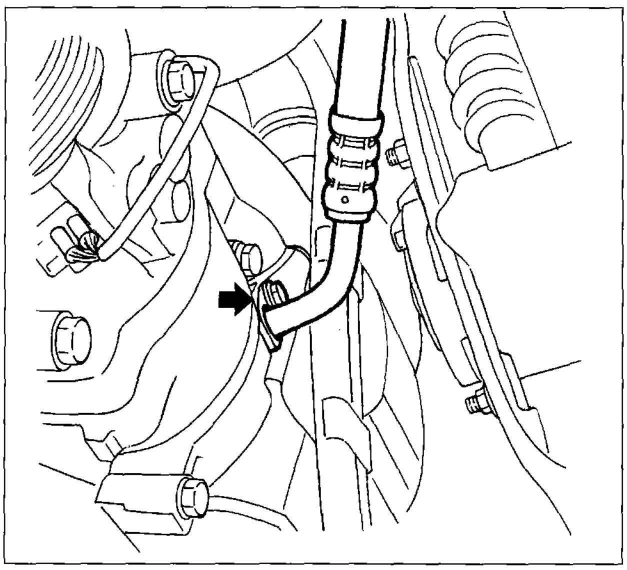


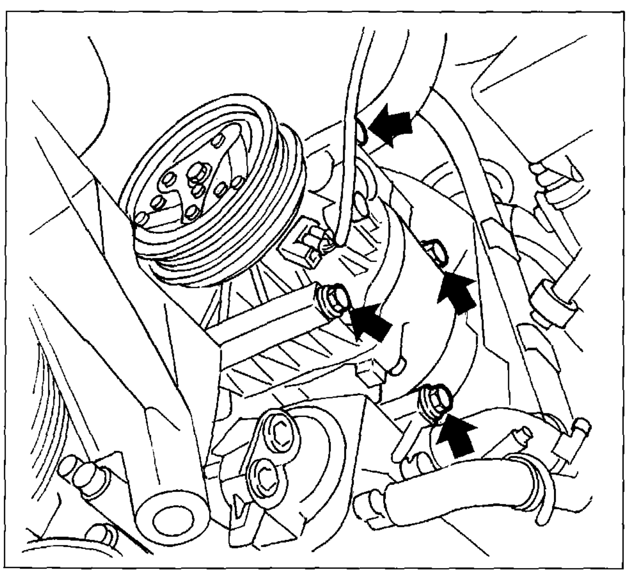
P4A26CH01

- Undo the bolt shown in the diagram and release the pipe from the compressor inlet duct;
- seal both the end of the pipe and the compressor duct using suitable plugs;



P4A26CH02

- undo the bolt shown and release the pipe from the compressor supply duct;
- seal both the end of the pipe and the compressor duct using suitable plugs;



P4A26CH03

- undo the bolts shown in the diagram and remove the compressor;

### Refitting

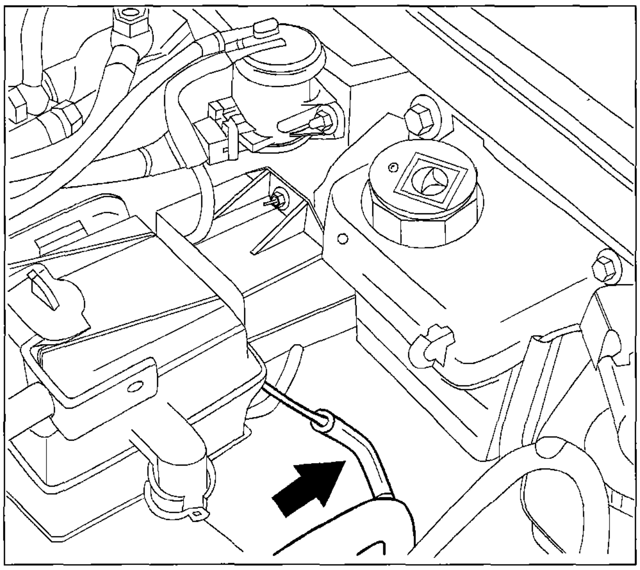
To refit, simply reverse the order of the operations carried out for the removal.



Print no. 506.670/17

## INTRODUCTION'

The heating inside the vehicle via the heater unit is insufficient, with the engine cold, especially in the case of diesel engines which reach operating temperature more slowly.
An additional heating system is offered for these engines which is activated when the engine is first running until a certain temperature is reached.
The system consists of an additional heating device, located on the engine coolant supply pipe to the heater unit.
This device contains three spark plugs which are very similar to those used for pre-heating the combustion chamber.


P4A27CH01

**Location of car interior coolant heater plugs**

The additional heater containing the three heater plugs is located on the coolant supply pipe to the heater unit.
The coolant temperature sensor is located on the same pipe, immediately upstream towards the engine thermostat.
The three relays are connected by the diesel filter, on a special bracket fixed to the engine compartment bulkhead.
The system control unit is located under the dashboard, behind the glove compartment.

### Operating logic

The operation of the heater plugs is controlled by an electronic control unit which operates one, two or three heater plugs thereby giving a supply 200W, 400W or 600W

This control logic depends on:
- the temperature of the coolant leaving the engine;
- the power level available;
- the engine speed.

The first information is supplied by a special temperature sensor located on the supply pipe towards the heater; the control logic deactivates the heater plugs when the temperature of the coolant coming from the engine exceeds 70 °C.
The control unit also takes into account the parameter of the temperature of the air in the engine compartment; it is not measured by a special sensor, but is assumed to be the same as the temperature of the coolant during starting; the switching off figure decreases from 70 °C to 65 °C if the temperature of the air is assumed to be greater.

# 50.

The second piece of information is the electrical power available and is obtained from the battery voltage value; of the voltage is above 12.8 V, the operation of the heater plugs is enabled, below this figure one, two or all three heater plugs are gradually deactivated.

This parameter is checked every 10 seconds in order to keep the power absorbed constantly under control so that the battery is not run down.

The information concerning the engine speed is used to prevent the operation of the heater plugs with the engine switched off, the enabling takes place at around 660 rpm.

The supply of one, two or three heater plugs is operated by two relays:

1st level is activated by the first relay.
2nd level is activated by the second relay.
3rd level is activated by both relays.

There is a third relay/remote control safety switch which interrupts the supply for the heater plugs if the earth contact is not correct; the metal device containing the heater plugs is, in effect, connected to the engine earth by means of a special cable loom; if this connection is interrupted, the relay stops the current supply to the heater plugs.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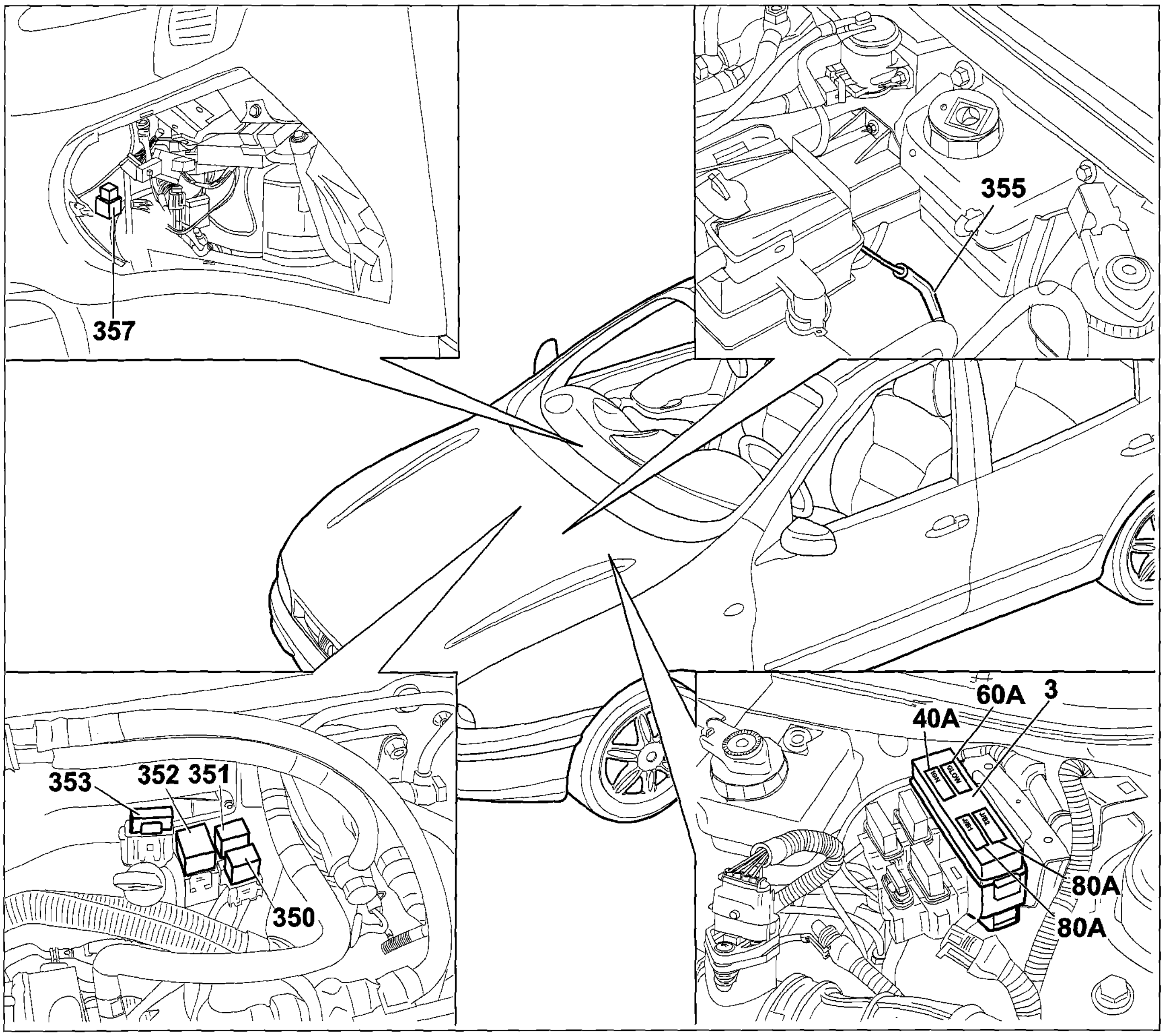
## LOCATION OF COMPONENTS ON VEHICLE




P4A29CH01

**Components key**

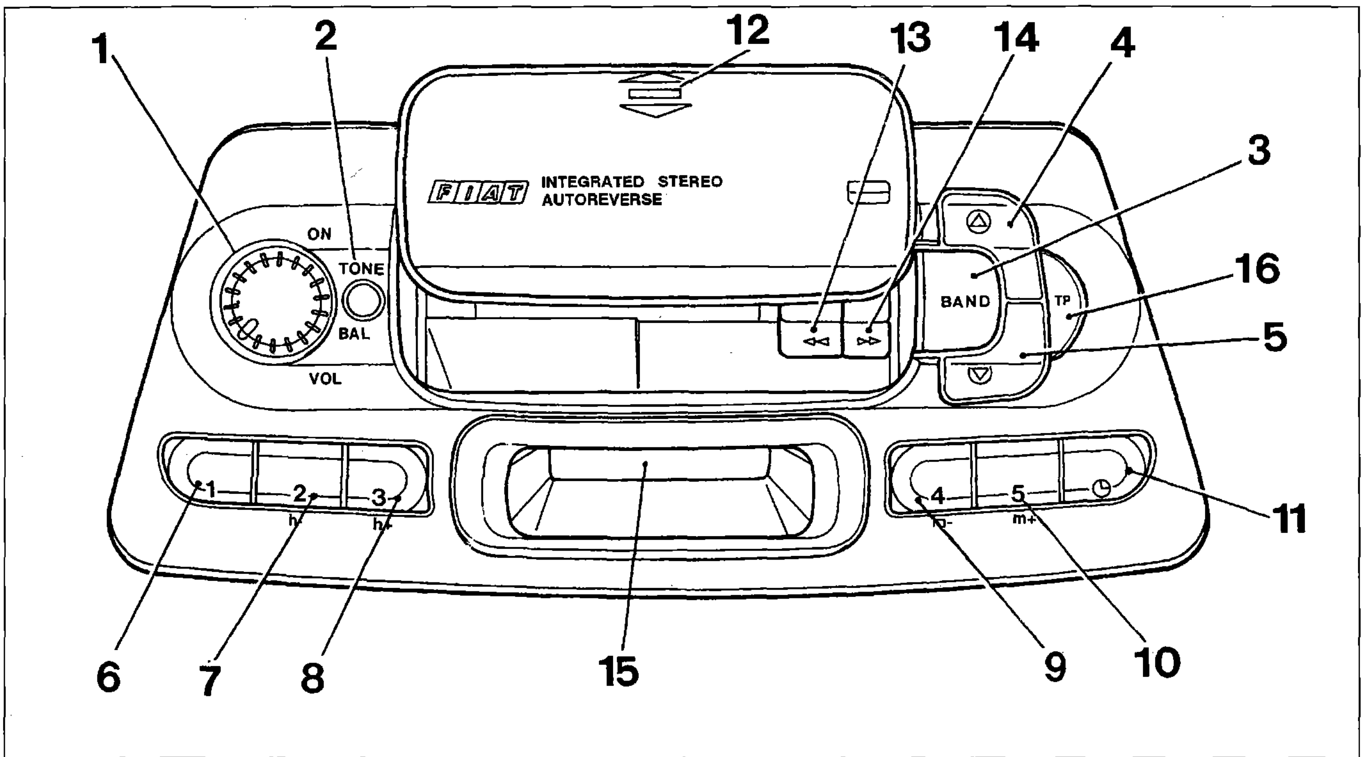
3. Power fuse box
350. Relay for heating passenger compartment coolant
351. Safety relay for heating passenger compartment coolant
352. Relay for heating passenger compartment coolant
353. 70A protective fuse for passenger compartment coolant heater plugs
355. Passenger compartment coolant heater plugs
357. Passenger compartment coolant heater plugs control unit

page

**RADIO**

**AD 185 M RADIO AND CASSETTE PLAYER**

Some versions of the cars are fitted as standard with a radio which comprises the following main components:
- non-removable AD 185 M radio and cassette player which is located at the centre of the instrument panel; its front, customized for FIAT, is fully integrated in the line of the dashboard;
- two loudspeakers located on the inside panels of the front doors;
- fishpole aerial located at the front centre of the car roof.

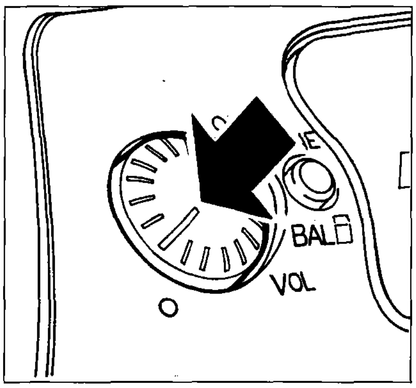



P4A01CL01

1. Knob for switching on the radio and adjusting the volume;
2. Cylindrical knob for adjusting the tone and and adjusting the sound balance between the two loudspeakers;
3. Wave band selection button (FM1 - FM2 - MW - LW);
4. Button for automatic or manual search in order of increasing frequency of transmitting stations.
5. Button for automatic or manual search in order of decreasing of transmitting stations.
6. Button for preselecting transmitter no. 1 - selection of priority of indication of time / radio frequency on display.
7. Button for preselecting transmitter no. 2 - adjustment of hours in decreasing order.
8. Button for preselecting transmitter no. 3 - adjustment of hours in increasing order.
9. Button for preselecting transmitter no. 4 - adjustment in increasing order of minutes.
10. Button for preselecting transmitter no. 5 - adjustment in decreasing order of minutes.
11. Button for switching between displaying radio frequency / time and for selecting time adjustment.
12. Spot on which to press the door covering the cassette insertion slot, in order to lift the door.
13. Button for fast rewind of the cassette tape and for ejecting the tape from its seating (press together with button 14).
14. Button for fast forward winding of the cassette tape and for ejecting the tape from its seating (press together with button 13).
15. Display of wave band / frequency of station being listened to / stereo transmission / search sensitivity / time.
16. Button for selecting Traffic Program mode.

### DESCRIPTION OF OPERATION OF MODEL AD 185 M RADIO

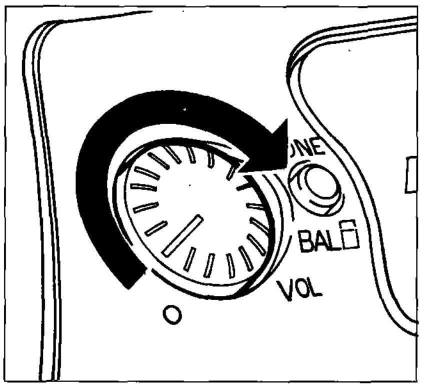
**SWITCHING RADIO ON**




P4A048L02

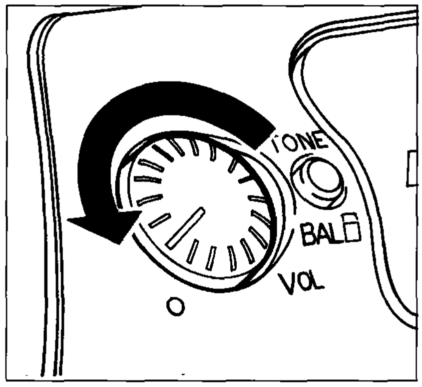
Press the button

**ADJUSTING VOLUME**




P4A048L03

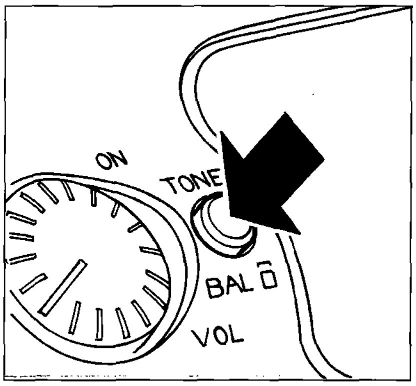
Increase volume




P4A048L04

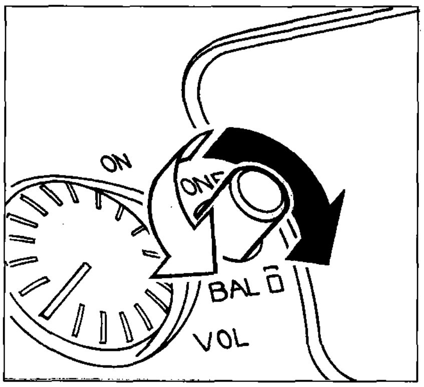
Decrease volume

**ADJUSTING TONE**




P4A048L05

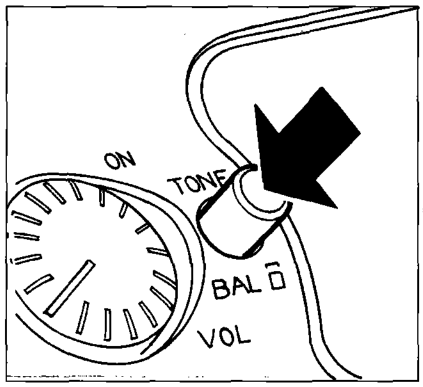
Press the button




P4A048L06

(●) Emphasize high tones

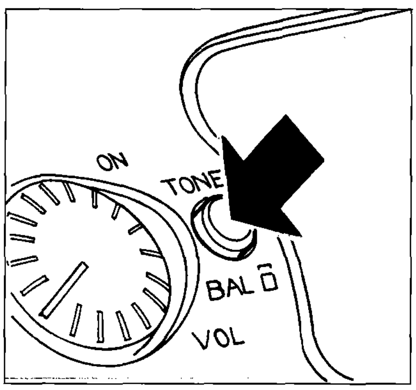
(○) Emphasize low tones




P4A048L07

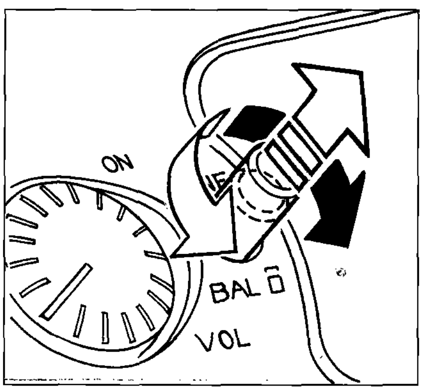
Press the button again after completing the adjustment

**ADJUSTING BALANCE**




P4A048L08

Press the button

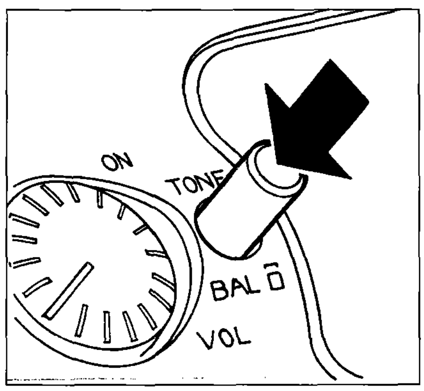



P4A048L09

Withdraw the button until it clicks

(●) Emphasize sound from right loudspeaker

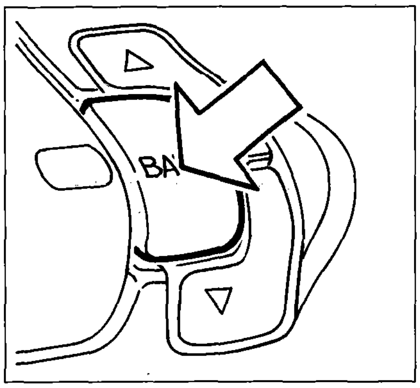
(○) Emphasize sound from left loudspeaker



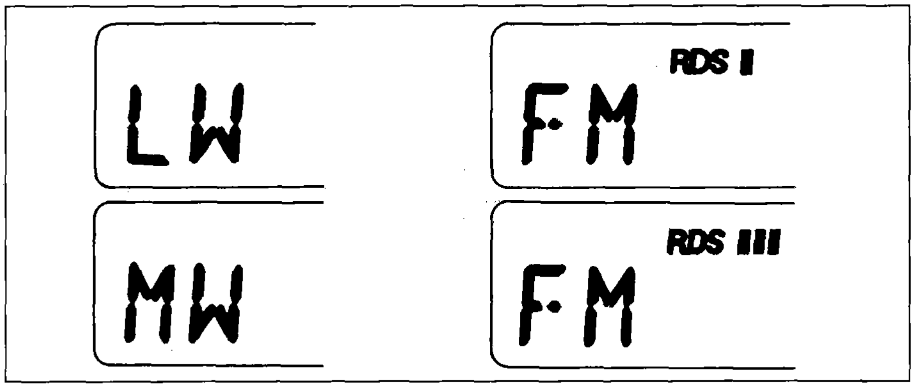

P4A048L10

Press the button again after completing the adjustment

## SELECTING FREQUENCY RANGE




P4A048L11




P4A03CL01

Briefly press the button several times until the display shows the abbreviation of the desired frequency band.

**LW**=Long wave
**MW**=Medium wave

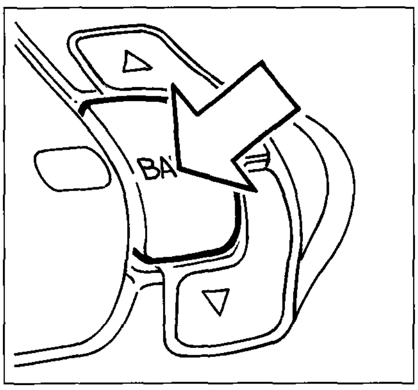
**FM** = frequency modulation
**FM-RDS** = Divided into three sub-bands with the indications RDS I, RDS II, RDS III for stations which transmit in RDS.

**NOTE** **RDS FUNCTION (Radio Data System)**
*The RDS system permits, with the enabled transmitters, automatic tuning of the optimum frequency of the selected station; you can therefore continue listening to the station without having to change frequency when you change zone. Naturally it must be possible to receive the station in question in the area you are passing through.*
*The name of the station transmitting in RDS appears on the display.*

## MEMORIZATION OF LAST STATION LISTENED TO

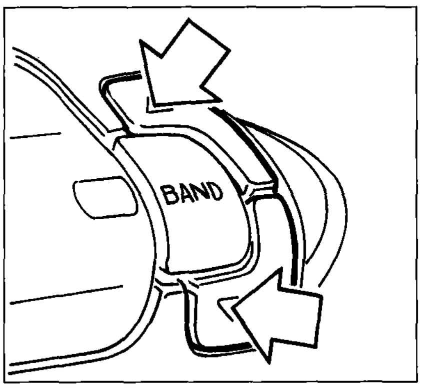
This takes place automatically for each frequency band which is tuned when you switch on the radio or change frequency band.

## TUNING AUTOMATIC SEARCH



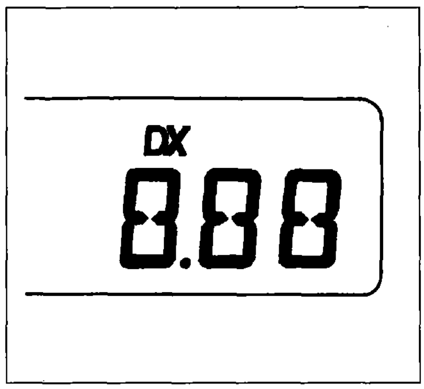

P4A03CL02

Briefly press the button several times until you select the desired frequency band.




P4A03CL03

Briefly press one of the two tuning buttons.

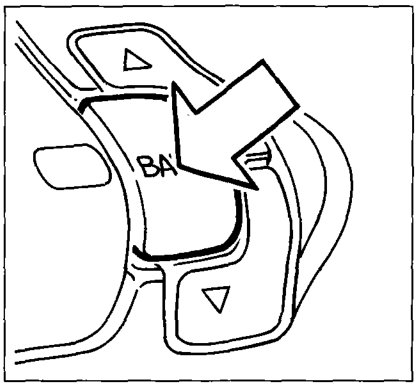



P4A03CL04

The sensitivity of the search increases in the 2nd and 3rd re-scan of the entire range of frequencies: from the 3rd pass, the letters DX appear on the display.
To immediately select the maximum search sensitivity, keep one of the two above-mentioned buttons pressed until the letters DX are displayed.

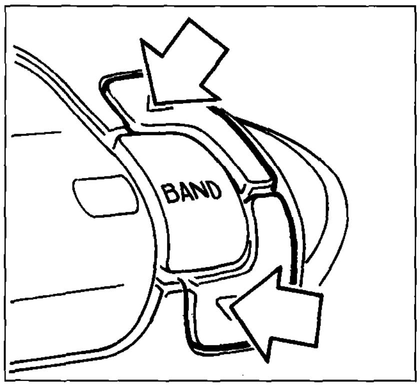
⚠ *Do not keep the button pressed for long, otherwise manual tuning search would be selected in the LW, MW or FM bands.*

### TUNING - MANUAL SEARCH



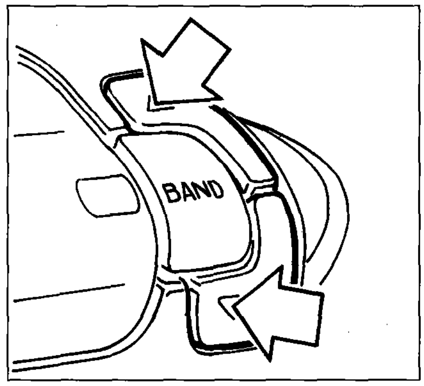

P4A03CL02

Briefly press the button several times until the desired frequency band is selected.




P4A03CL03

Keep one of the buttons pressed until the letters "MAN" appear flashing on the display.




Press (**) one of the two buttons again to select the desired station.

(**) Press the button briefly to change frequency gradually and in stages, and press the button for longer for a fast frequency change.

**NOTE** *The manual search function is NOT active for the FM-RDS bands.*

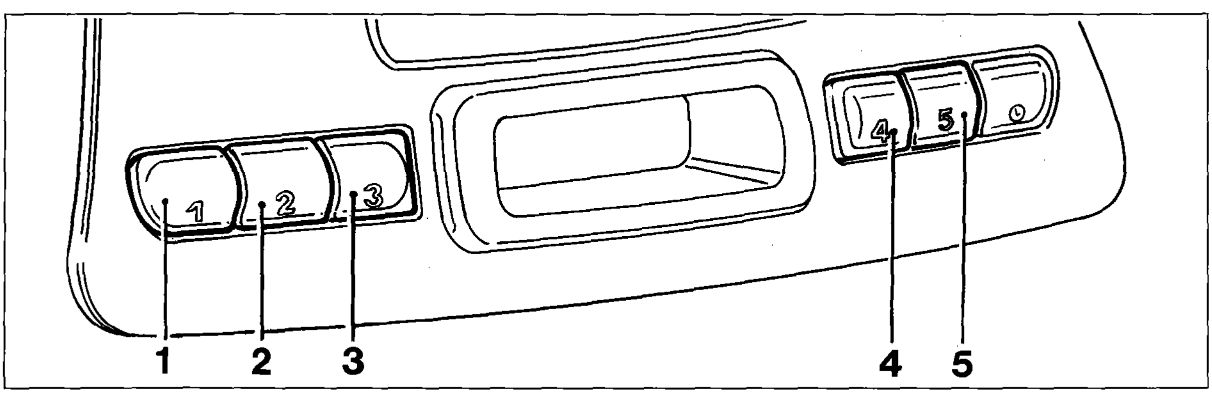
After 60 seconds, or after pressing one of the buttons illustrated below and identified by the numbers 1 to 5, you pass from automatic tuning mode and the letters "MAN" flashing on the display disappear.

If one of the five buttons is pressed, the radio is tuned to the station previously memorized with that button.

**NOTE** *When the frequency band is selected, you change from manual to automatic search.*

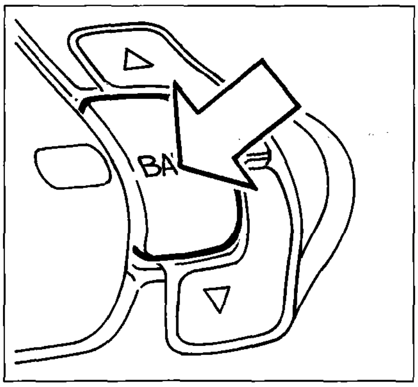
### MANUAL MEMORIZATION OF A STATION

You can memorize the station you are listening to within the selected frequency band by using of the 5 numbered buttons (figure below), which must be pressed until the station is again heard and the number of the button pressed appears on the display.
The settings remain memorized even if there is a cut in the supply to the radio.

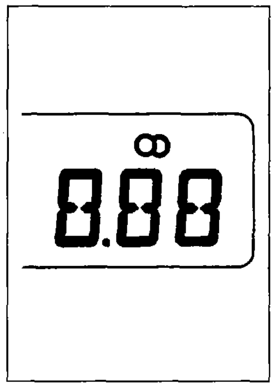



P4A048L16

## LISTENING TO A MEMORIZED STATION



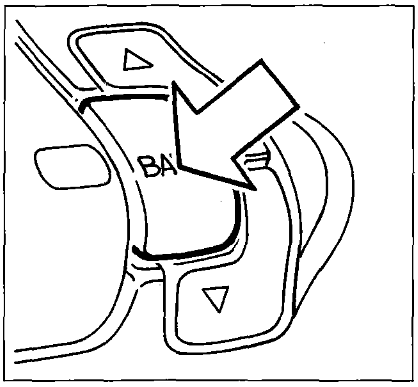
P4A03CL02



P4A05CL01

After selecting the desired frequency range by means of quick presses on the BAND button, briefly press one of the five buttons (see figure at bottom of previous page) for memorizing the stations, and the number of the latter appears on the display.
When the tuned station transmits programmes in stereo, the symbol 00 appears on the display (see figure), but if the incoming signal is weak, the reproduction is automatically changed from stereo a mono.

## AUTOMATIC MEMORIZATION OF 5 STATIONS IN THE FM-RDS BAND (AUTOSTORE)



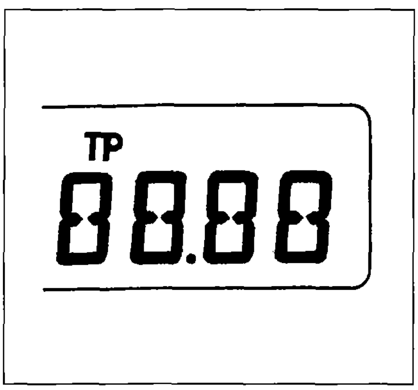
In this mode you can memorize up to five stations for each of the three bands FMRDS I, FMRDS II and FMRDS III.
Proceed as follows:

- Press the BAND button until the desired band is selected.
- Keep the BAND button pressed until the tape is switched off and the letters "AST" are displayed.

The buttons numbered 1 to 5 (see figure at bottom of preceding page) automatically memorize the stations which have a strong signal at that moment in the selected band.

A maximum of two re-scans of the entire range of frequencies are executed, with increasing search sensitivity, and this operation is concluded when tape is switched on again and the letters AST disappear. The radio is tuned to the station memorized on button 1.

### TP function (Traffic Program)



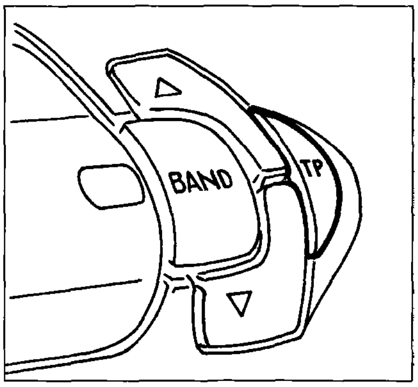

P4A05CL02

Some stations belonging to the RDS I, RDS II and RDS III bands also transmit information on the traffic conditions.
With the TP (Traffic Program) function you can:

a) search only the RDS stations which transmit traffic information;
b) receive traffic information even if the cassette player is in operation;
c) receive traffic information at a pre-set minimum volume even with the radio volume set to zero.

**NOTE** *Instructions are given below for carrying out each of the operations described in points a), b) and c) above.*

# 55.




P4F06CL01

**Point a)**

- Select an RDS I, RDS II or RDS III band as described above;
- briefly press the "TP" button so that the letters "TP" are displayed.

If the outgoing transmitter is not enabled to supply traffic information, the radio will automatically tune to the nearest transmitter enabled to do so.
If you wish to search other stations enabled for the service, press the tuning buttons (A).
To memorize the transmitters with the "TP" function activated, carry out the memorization operations (see "Memorization of a station" sub-section).

As an alternative to manual memorization, keep the "BAND" button pressed until the cassette is switched off, to effect automatic memorization (see "Automatic memorization in the FM-RDS band - Autostore")

**Point b)**

If you wish to receive traffic information, before inserting the cassette tape, tune to an RDS TP transmitter. If traffic information is transmitted from the latter during listening of the tape, the tape will automatically stop temporarily and will resume automatically when the message has finished.

**Point c)**

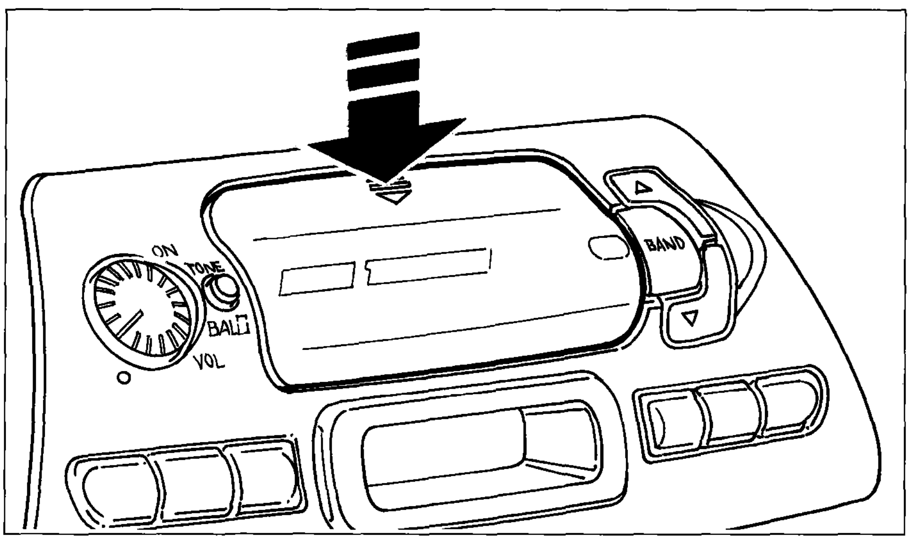
You can receive traffic information even if you are not listening to the radio. After tuning to an RDS TP transmitter and setting the volume to zero, if that transmitter transmits traffic information, it will be heard at a pre-set minimum volume.

*In some countries there are stations which do not transmit traffic information, even with the TP function activated.*

**EON (Enhanced Other Network) function**

In some countries there are circuits which group together several transmitters enabled to transmitt traffic information.
In these cases, listening to the programme of the RDS TP will be temporarily interrupted to receive traffic information, whenever this information is transmitted by one of the transmitters on the same circuit.

To exclude the EON function, press the "TP" button briefly.

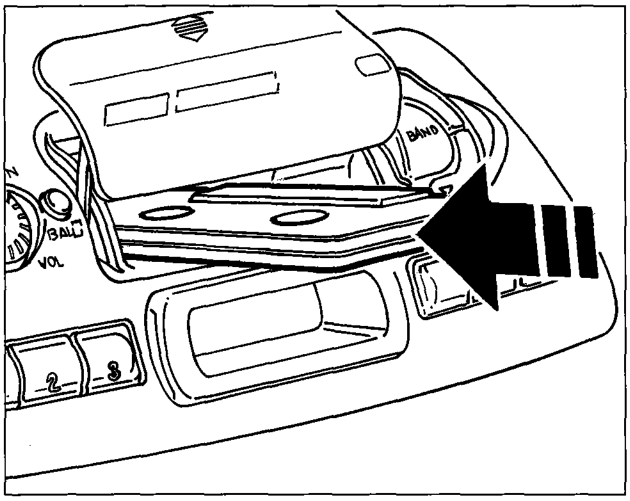



P4F048L19

**CASSETTE PLAYER**

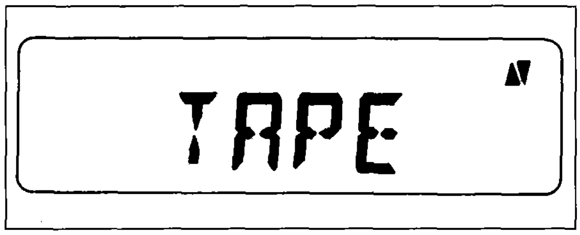
**Cassette tape reproduction**

Press vertically on the two arrows at the top of the door on the tape insertion slot, until you hear the click of the clip disengaging.



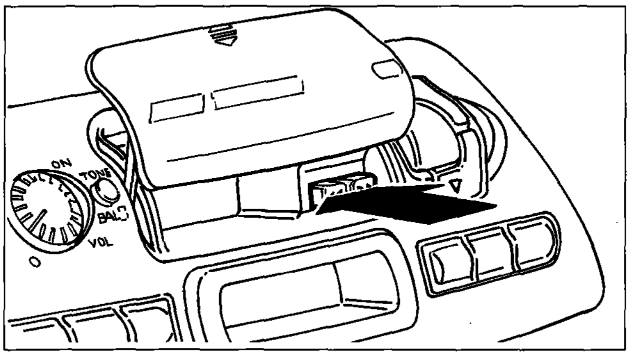
P4A048L20

Insert the cassette tape fully into its slot until it clicks into position; if the radio is on, it automatically starts playing the tape and the word "TAPE" appears on the display.




P4A07CL01

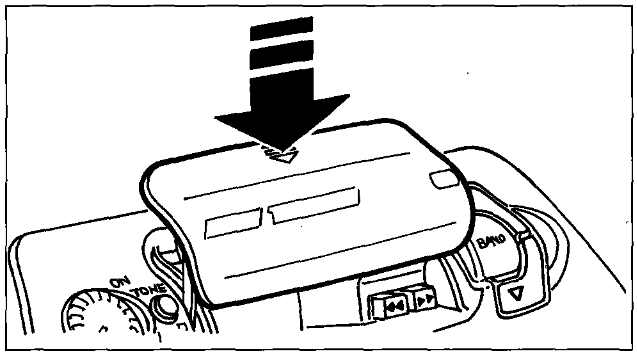
If the radio is switched off during listening of the tape and is then switched on again, the tape automatically starts at the point where it was interrupted.



P4A048L22

To change to radio, press simultaneously the buttons shown in the figure, which cause the cassette tape to be ejected from its compartment. The word "TAPE" disappears from the display and the radio is switched on.

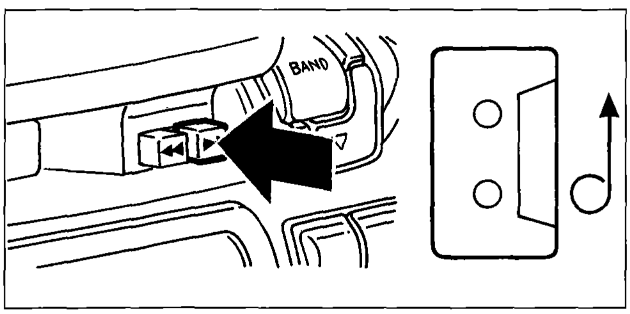
The cassette tape can be ejected even if the radio is off.



P4A048L23

To close the cassette compartment, press vertically on the arrows at the top of the door, until the lock clicks.

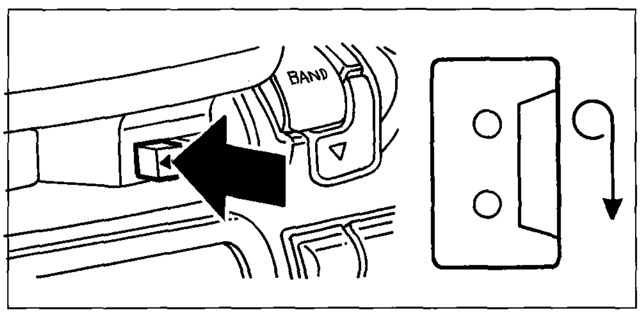
**FAST FORWARD WINDING OF THE CASSETTE TAPE**



P4A048L24

Fully press the button indicated

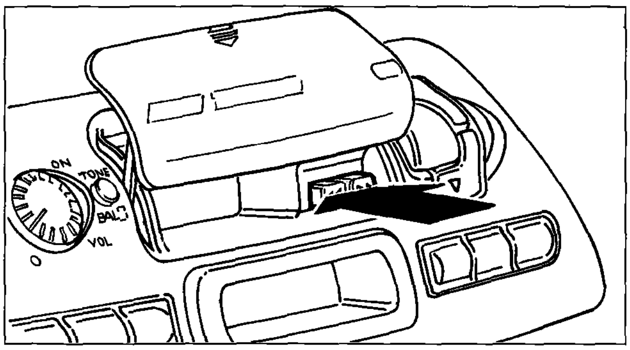
**FAST REWIND OF THE CASSETTE TAPE**



P4A048L25

Fully press the button indicated

To stop the forward winding or rewinding of the cassette tape, gently press the button next to the one previously pressed.




P4A048L22

#### AUTOREVERSE FUNCTION

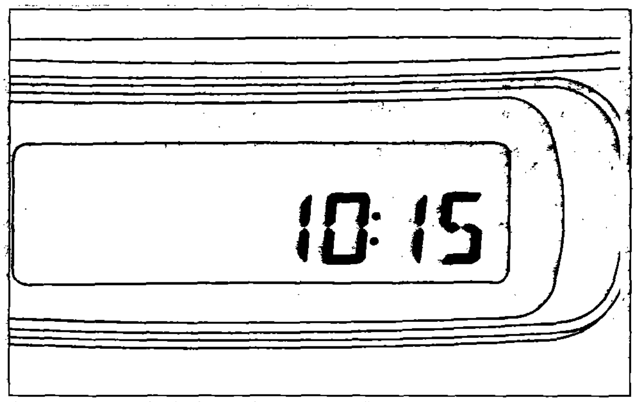
At the end of the tape, the side of the tape is changed automatically (Autoreverse).

The side of the tape being listened to is shown on the display.
To change the side of the tape, gently press the buttons shown in the figure until you hear a click.

#### EQUALIZATION

The equalization of the cassette reader is automatically selected to read chromium tapes (CrO2).

#### CLOCK FUNCTION




P4A08CL01

The clock function displays hours and minutes. A colon, between the hours and minutes, flashes at a frequency of once a second. The clock is still displayed when the radio is off.

**Display modes**

When the radio is on, two display modes are possible, with these characteristics:

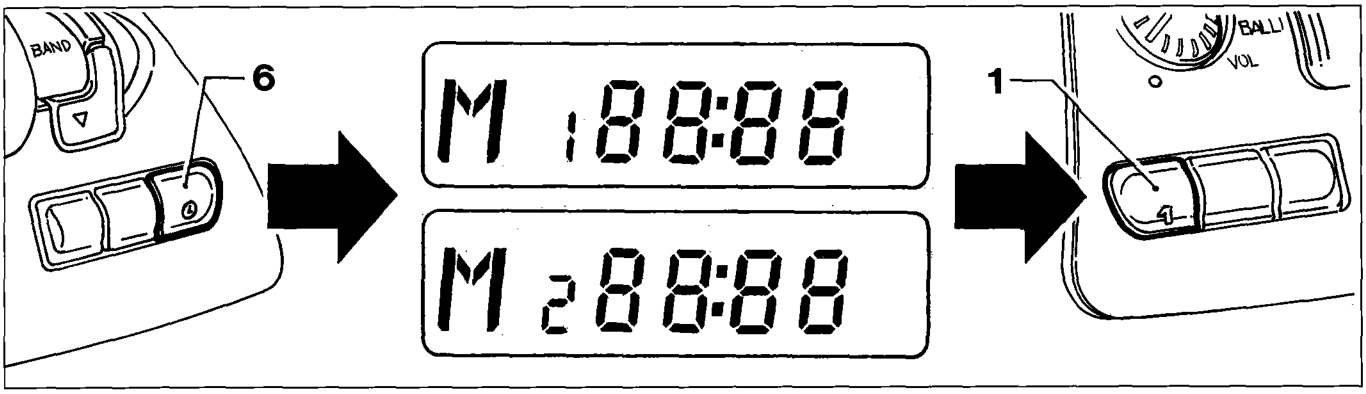
**Mode 1 (M1)**

The clock is displayed instead of the radio meassages (priority to clock function). When the radio is switched on without a cassette being inserted, or when a radio station is selected or a cassette is inserted with the radio on, the relevant message is displayed for about 10 seconds, after which the clock is again displayed.

**Mode 2 (M2)**

The messages relating to the radio function are displayed instead of the clock (priority to radio function).
When the radio is switched on, it automatically selects the mode present just before switching off.

### Selecting display modes

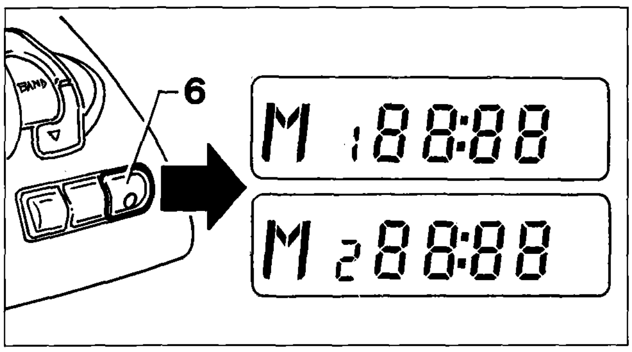



P4A048L29

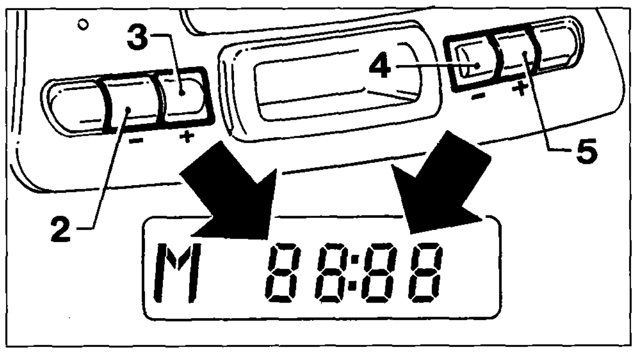
Proceed as follows:

- keep the button (6) pressed until the colon between the hours and minutes stops flashing, and the letters "M1" or "M2" appear depending on the selected display mode;
- press the (1) button to select the other display mode;
- briefly press the button (6) again to confirm the selection; the colon between the hours and minutes starts flashing again and the letters "M1" or "M2" disappear.

### Setting correct time




P4A048L30




P4A048L31

Keep the button (6) pressed until the colon between the hours and minutes stops flashing and the letters "M1" or "M2" appear depending on the selected display mode;

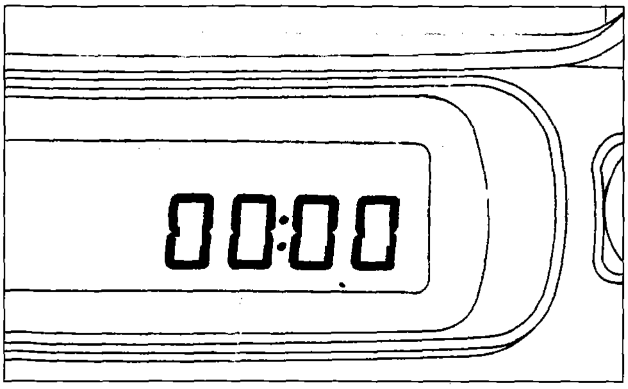
Adjust the hours and minutes on the display as follows:
- to decrease the hours press button (2);
- to increase the hours press button (3);
- to decrease the minutes press button (4);
- to increase the minutes press button (5).

If the buttons (2-3-4-5) are pressed briefly, the hours and minutes are increased/decreased by one unit. Press the buttons for longer to change the hours/minutes display quickly.
Once the correct time has been set, press the button (6) briefly again; this starts from 0 seconds so the clock can be set accurately. The colon between the hours and minutes starts flashing again and the letters "M1" or "M2" disappear.

### Changing priority between display of time/frequency

Briefly press the button (6) to switch between the display of the clock and the messages relating to the radio function, for a duration of 10 seconds; after which the indication which has priority depending on the selected display mode with reappear automatically.

55.

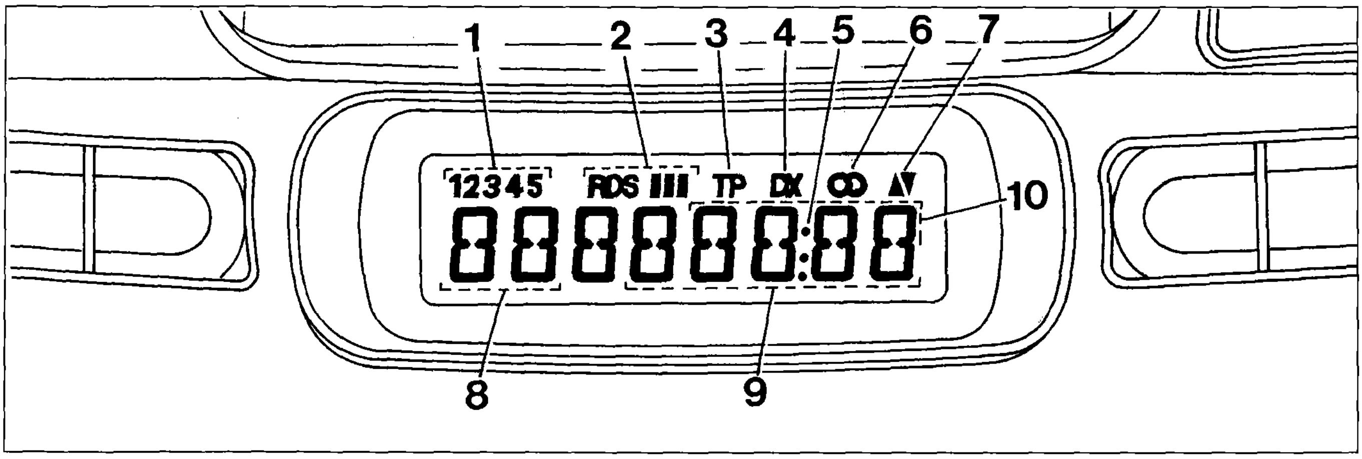


P4A10CL01

**Power cut**

If the power supply to the radio is cut off (even for a few minutes), when it is reconnected, the display shows "00 : 00" with the digits flashing and the colon fixed, indicating that the clock has to be reset.

**DISPLAY INFORMATION**



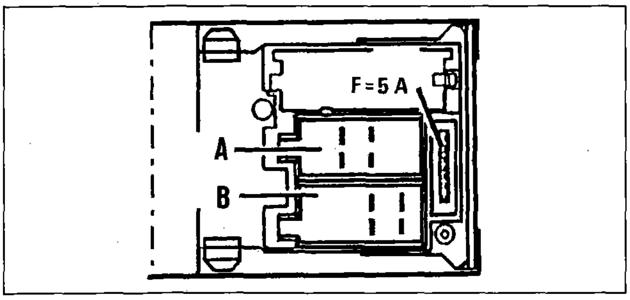
P4A10CL02

1. Number of preselected transmitting station.
2. Indication of RDS sub-bands.
3. Selection of Traffic Program mode.
4. Symbol of sensitivity of search of transmittint stations.
5. Colon between hours and minutes (in clock function).
6. Symbol indicating listening to transmission in stereo.
7. Direction of feed of cassette (in cassette playing function).
8. Distinctive letters of wave band.
9. Numbers indicating tuning frequency with decimal point of frequency.
10. Hours and minutes (in clock function).

**CARE AND MAINTENANCE**

Never expose the cassettes to heat or to direct sunlight, and always put them back in their boxes after use. It is recommended that you use high-quality tapes, and not longer than C-90 in order to ensure excellent reproduction at all times.
Clean the trim cover only with a soft anti-static cloth. Detergents and polishes could damage the surface.
Impurities on the reading head coming from the tapes could, over a period of time, cause a reduction in the high tones during reproduction. It is therefore advisable to clean the reproduction head periodically with a special non-abrasive head-cleaning cassette.

**Rear view of radio**




P4A11CL01

| TECHNICAL CHARACTERISTICS | |
|---|---|
| No. of output channels | 2 |
| Musical output power | About 8W peak (per channel) |
| Nominal output power | About 4W RMS |
| Load impedance | 4 Ohm |

**CONNECTOR A SEATING**

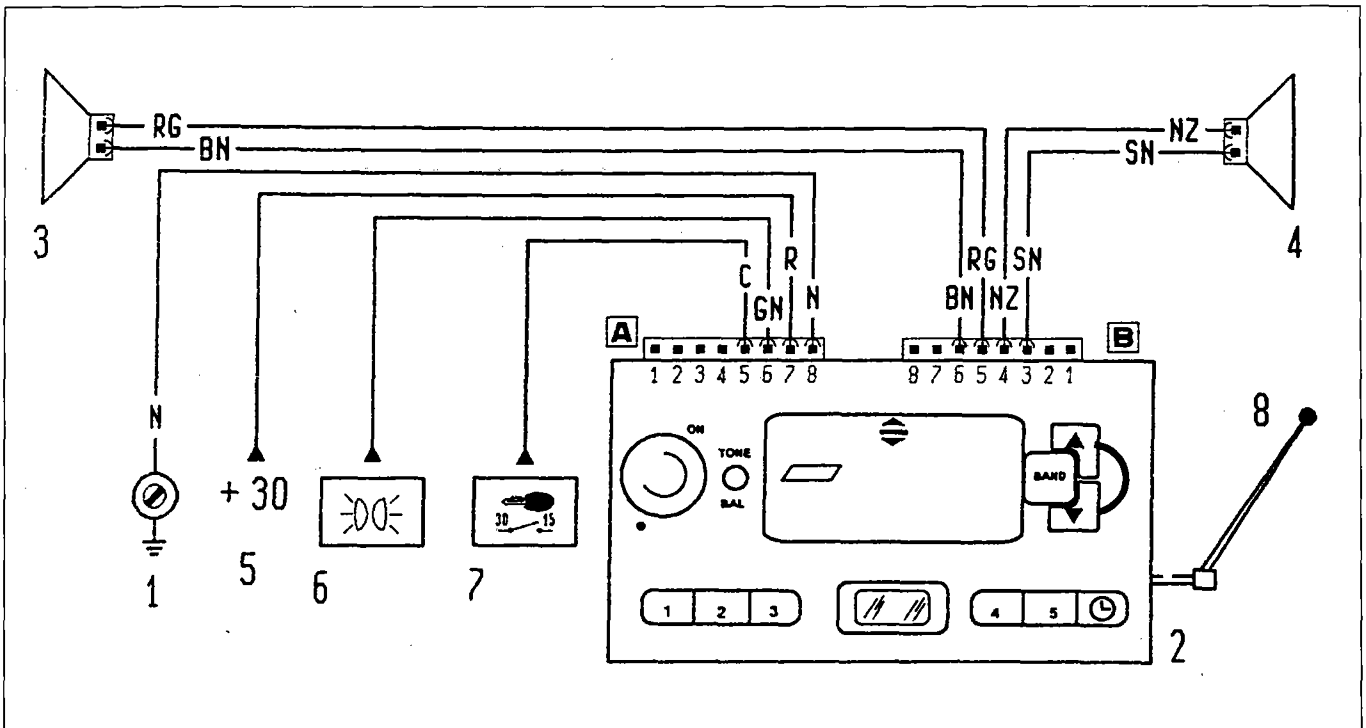
| N° | Connection |
|---|---|
| 5 | Key dependent (+15) |
| 6 | Lighting |
| 7 | Supply (+30) |
| 8 | Earth |

**CONNECTOR B SEATING**

| N° | Connection |
|---|---|
| 3 | Right loudspeaker |
| 4 | Right loudspeaker |
| 5 | Left loudspeaker |
| 6 | Left loudspeaker |

**NOTE** *The terminals not mentioned in the tables are not connected.*

**Wiring diagram**




P4A11CL02

1. Earth on right dashboard
2. Radio
3. Loudspeaker on left door
4. Loudspeaker on right door
5. Battery supply (+ 30)
6. Lighting supply
7. Key supply (+ 15)
8. Fishpole aerial

page

## 55.

| NAME | Bravo | | | | | Brava | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | | SX | | GT | S | | SX | | EL | ELX |
| | 1910 (75 bhp) | 1910 (100 bhp) | 1910 (75 bhp) | 1910 (100 bhp) | 1910 (100 bhp) | 1910 (75 bhp) | 1910 (100 bhp) | 1910 (75 bhp) | 1910 (100 bhp) | 1910 (100 bhp) | 1910 (100 bhp) |
| Version with air conditioner<br>Engine cooling system - Water temperature gauge | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Starting system - Recharging system and warning light - Low engine oil pressure warning light - Heater plugs warning light - Fuel injection fault warning light - Fiat CODE system fault warning light - Rev counter | | 9 | | 9 | 9 | | 9 | | 9 | 9 | 9 |
| Starting system - Recharging system and warning light - Low engine oil pressure warning light - Heater plugs warning light - Fuel injection fault warning light - Fiat CODE system fault warning light - Rev counter | 13 | | 13 | | | 13 | | 13 | | | |
| *Version without air conditioner*<br>Engine cooling system - Water temperature gauge - Car interior ventilation | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| Windscreen wash/wipe - Rear window wash/wipe - Electric horns - Heated rear window and warning light - Headlamp washer | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
| Air conditioner | 29 | 25 | 29 | 25 | 25 | 29 | 25 | 29 | 25 | 25 | 25 |
| Fuel level gauge and reserve warning light - Handbrake on/low brake fluid level warning light - Speedometer - Trip recorder/mileage counter and relevant reset button - Water temperature gauge - Low engine oil pressure warning light - Front brake pade wear warning light - Heater plugs warning light - Rev counter | 33 | 33 | 33 | 37 | 37 | 33 | 33 | 33 | 33 | 41 | 41 |
| Instrument panel connections | 45 | 45 | 45 | 49 | 49 | 45 | 45 | 45 | 45 | 53 | 53 |

4A66ZL 4A67ZL

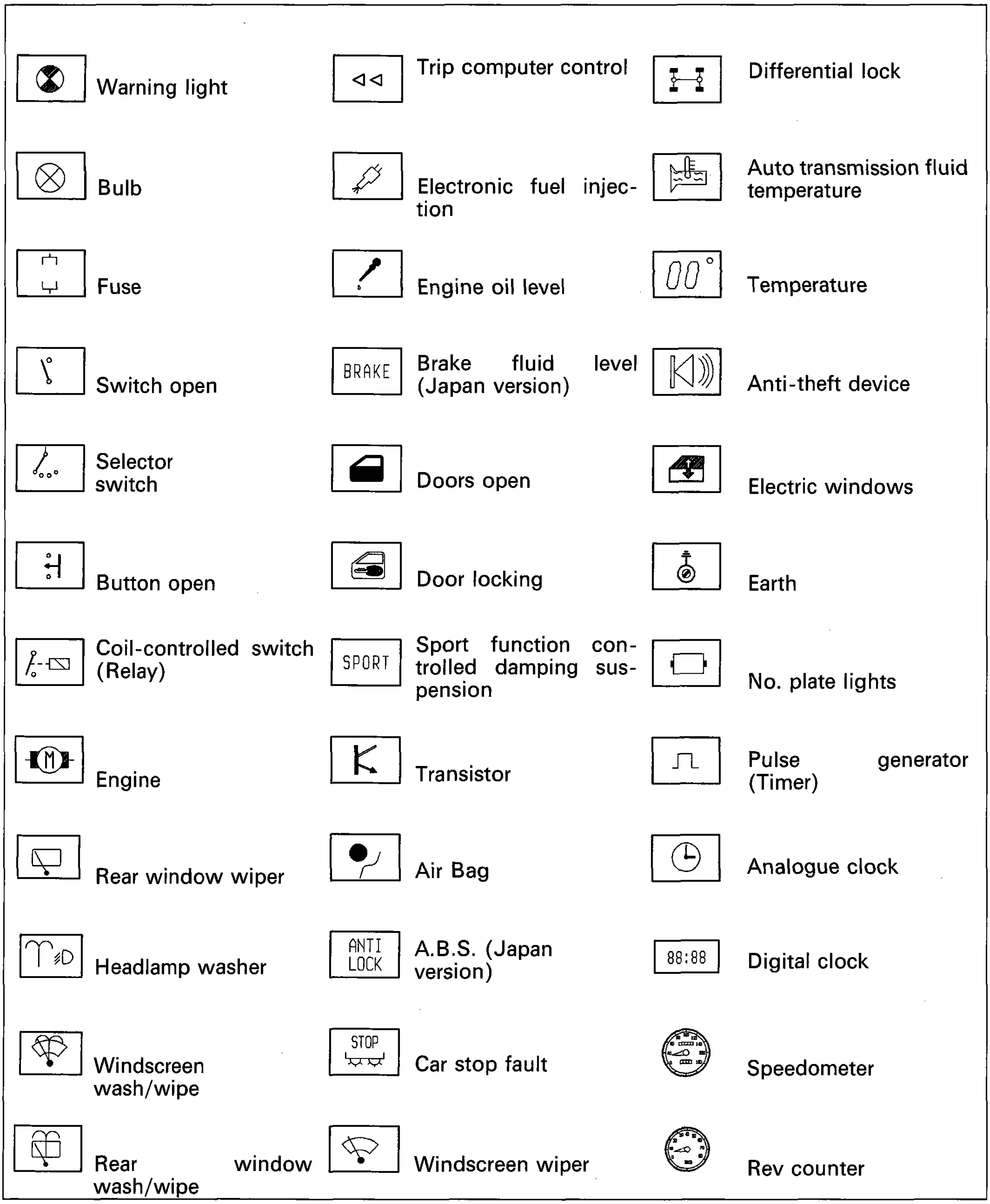
### Electrical symbols

| | | |
|---|---|---|
| Side lights | Choke (starter) | Ign.switch discharge |
| Main beam headlamps | Water in fuel filter | Dipped headlamps |
| Heated seat | Plug preheating | Indicators with central door locking |
| Seat belts | Turbo compressor pressure | Electric horns |
| Heated rear window | Rear fog lamps | Left indicator |
| Handbrake on and low brake fluid level | Front fog lamps | Right indicator |
| A.B.S. | Brake pad wear | Engine cooling system |
| Hazard | Turbo compressor pressure | Windscreen wiper |
| Indicators | Auto transmission fluid temperature | Electric sunroof |
| Handbrake on and low brake fluid | Speed limits | Catalytic converter temperature |
| Recharging | Fuel gauge | Resistor |
| Engine oil pressure | Coolant temperature | Diode |

P4A001N01

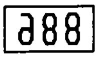
# 55.

**Electrical symbols**




P4A002N01

## Electrical symbols

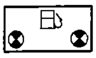

Digital speedometer

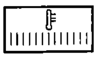

Digital rev counter


Digital fuel gauge


Analogue fuel gauge


Analogue coolant temperature gauge


Econometer


Digital coolant temperature gauge


Engine oil temperature

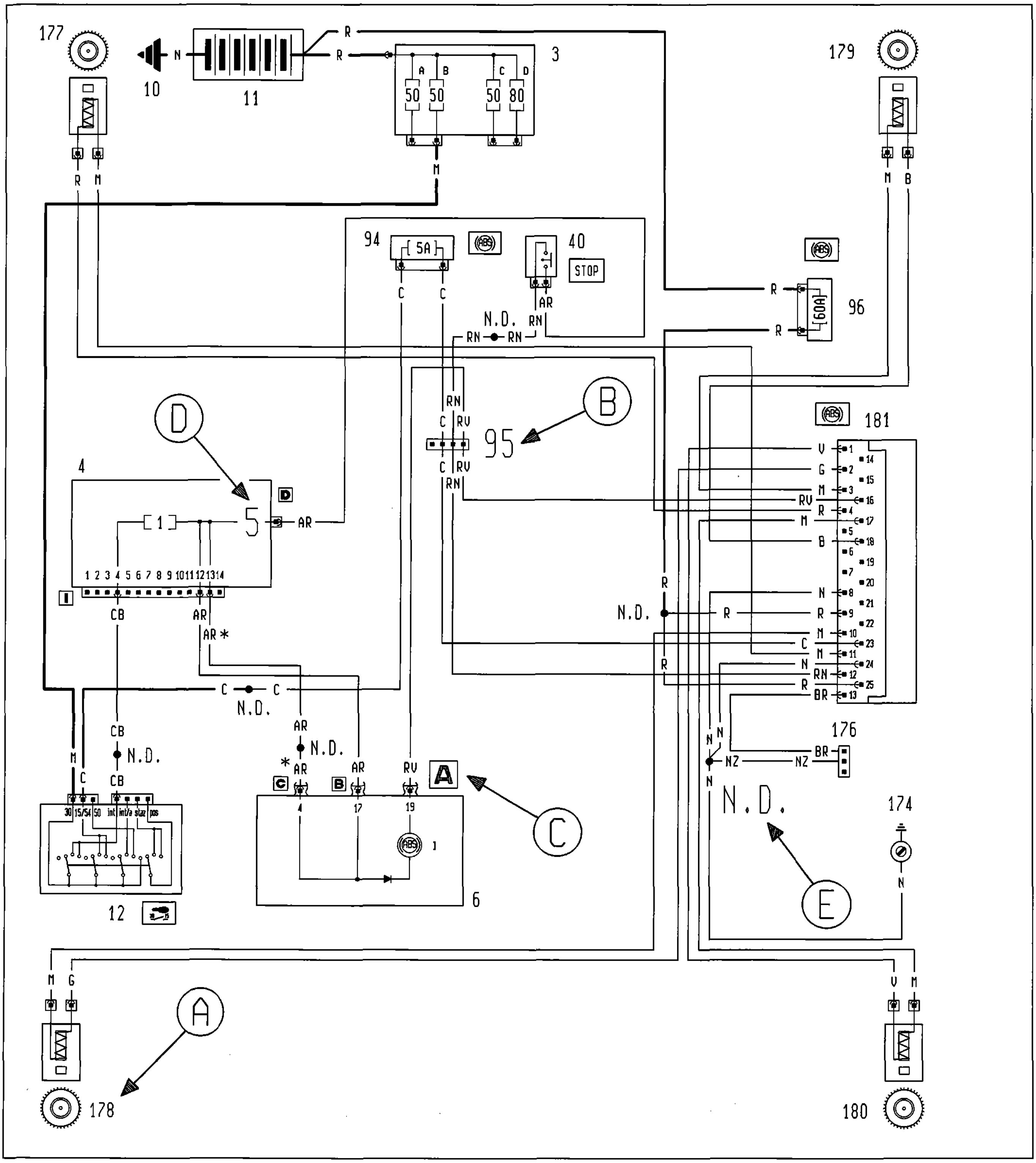

Engine oil pressure gauge


Voltmeter

P4A003N01

## 55.

**Explanation to reading wiring diagram**



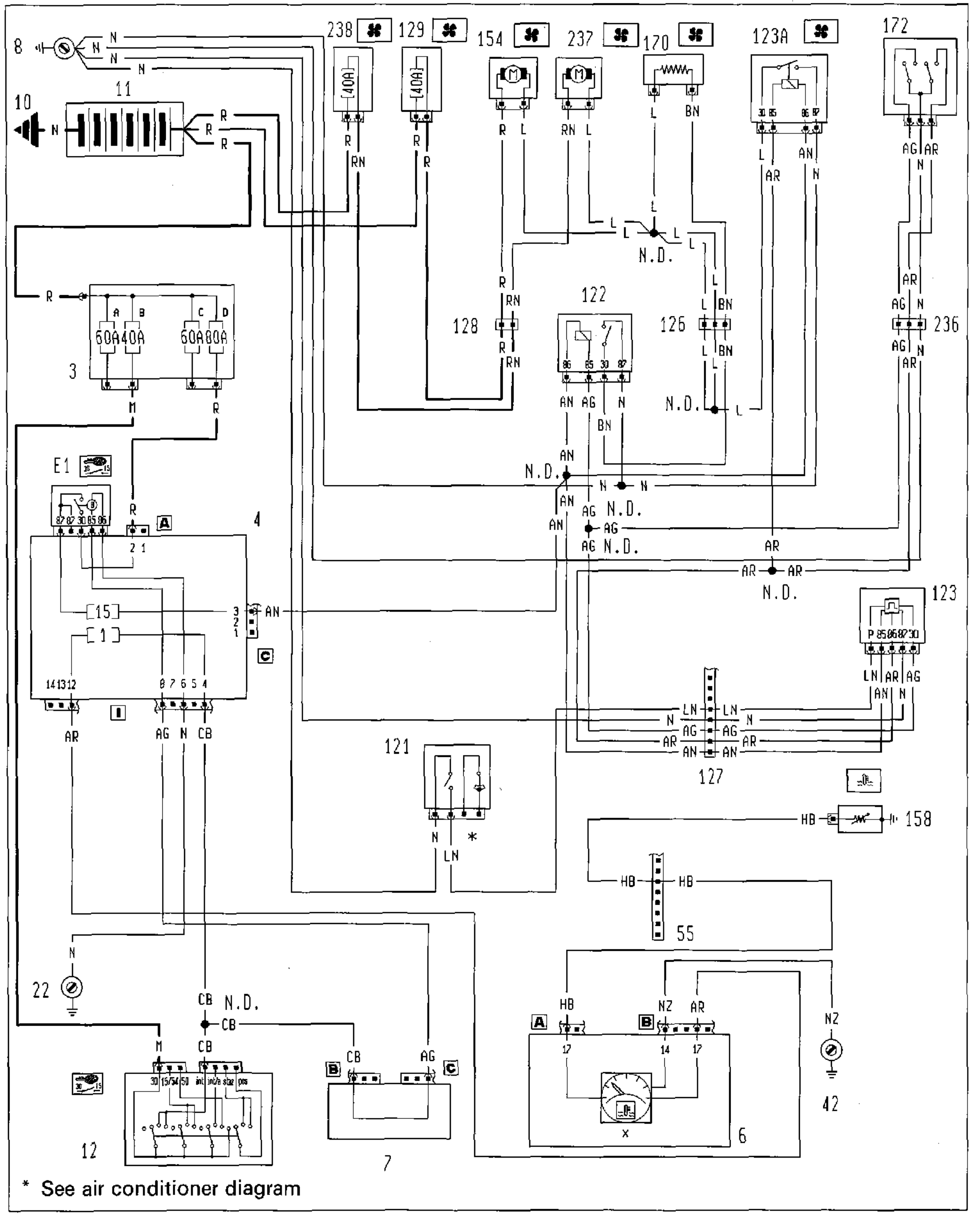

P4A004N01

**Key to references**

A Component number
B Connection number
C Connector identification on component
D Connecting pin number
E Ultrasound-soldered joint taped into wiring loom

**Version with air conditioner**

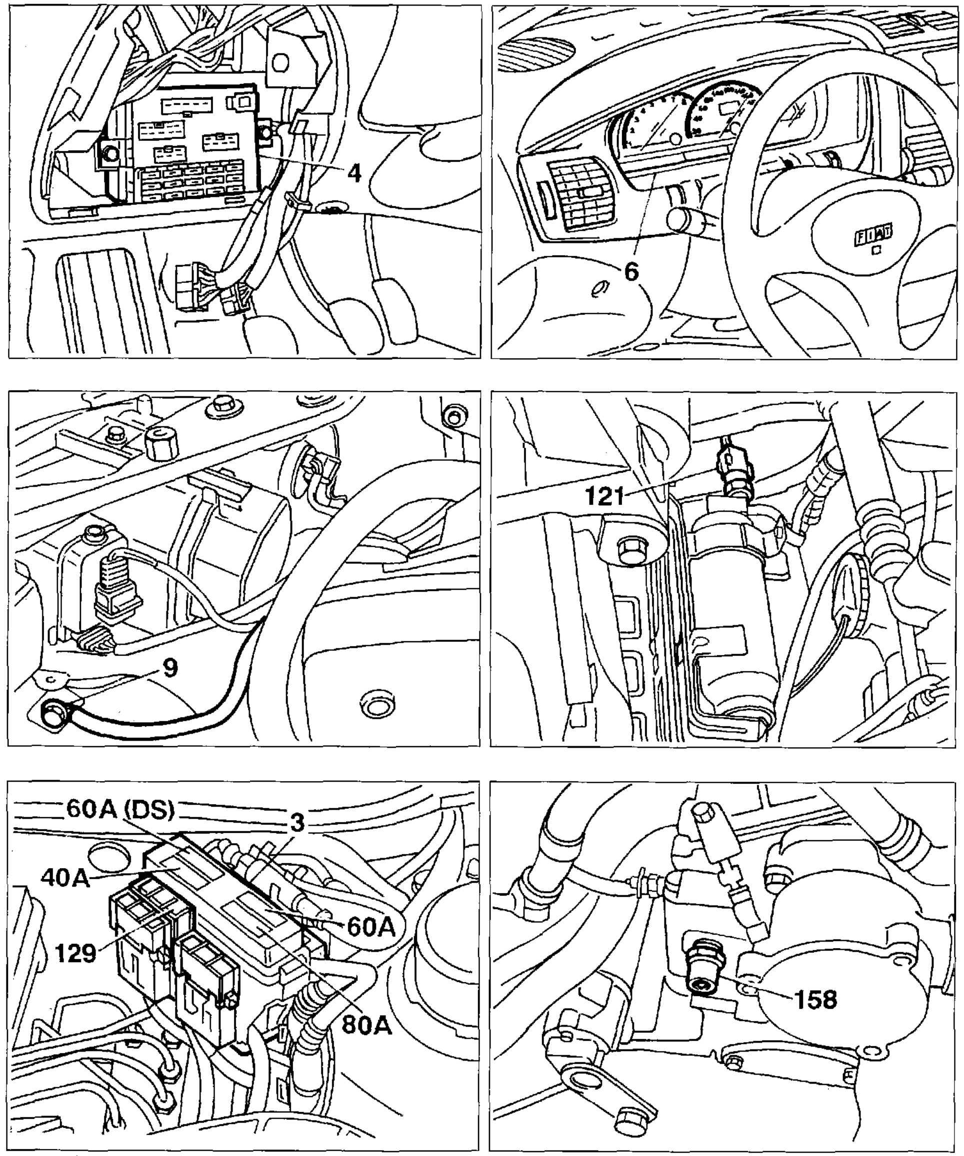
**Engine cooling system - Water temperature gauge - (See key following diagrams)**




* See air conditioner diagram

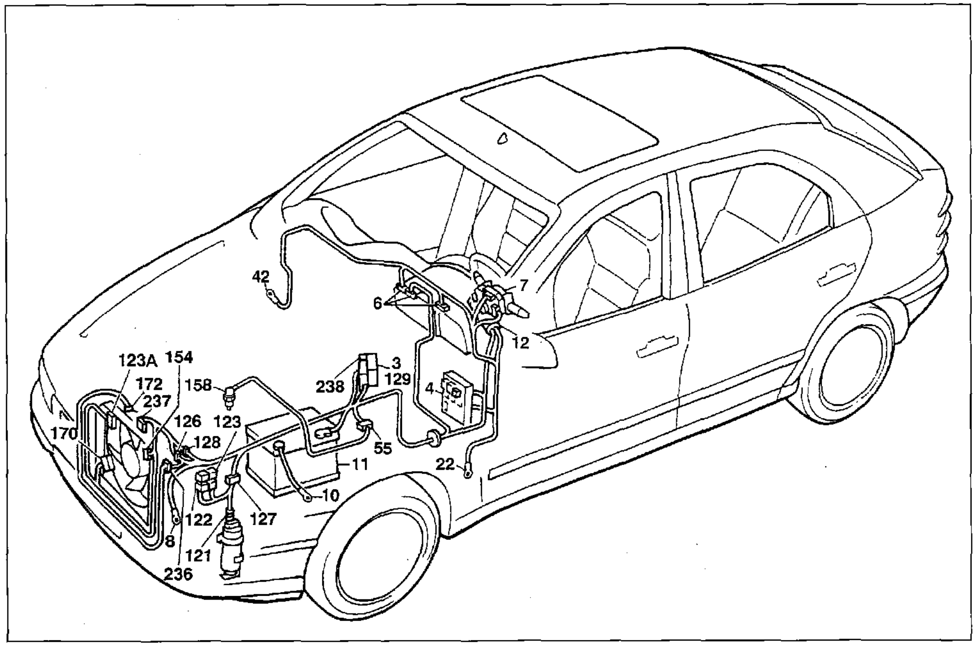
P4A05ZL01

**Location of components**




4A06ZL

P4A026N02




P4A07ZL01

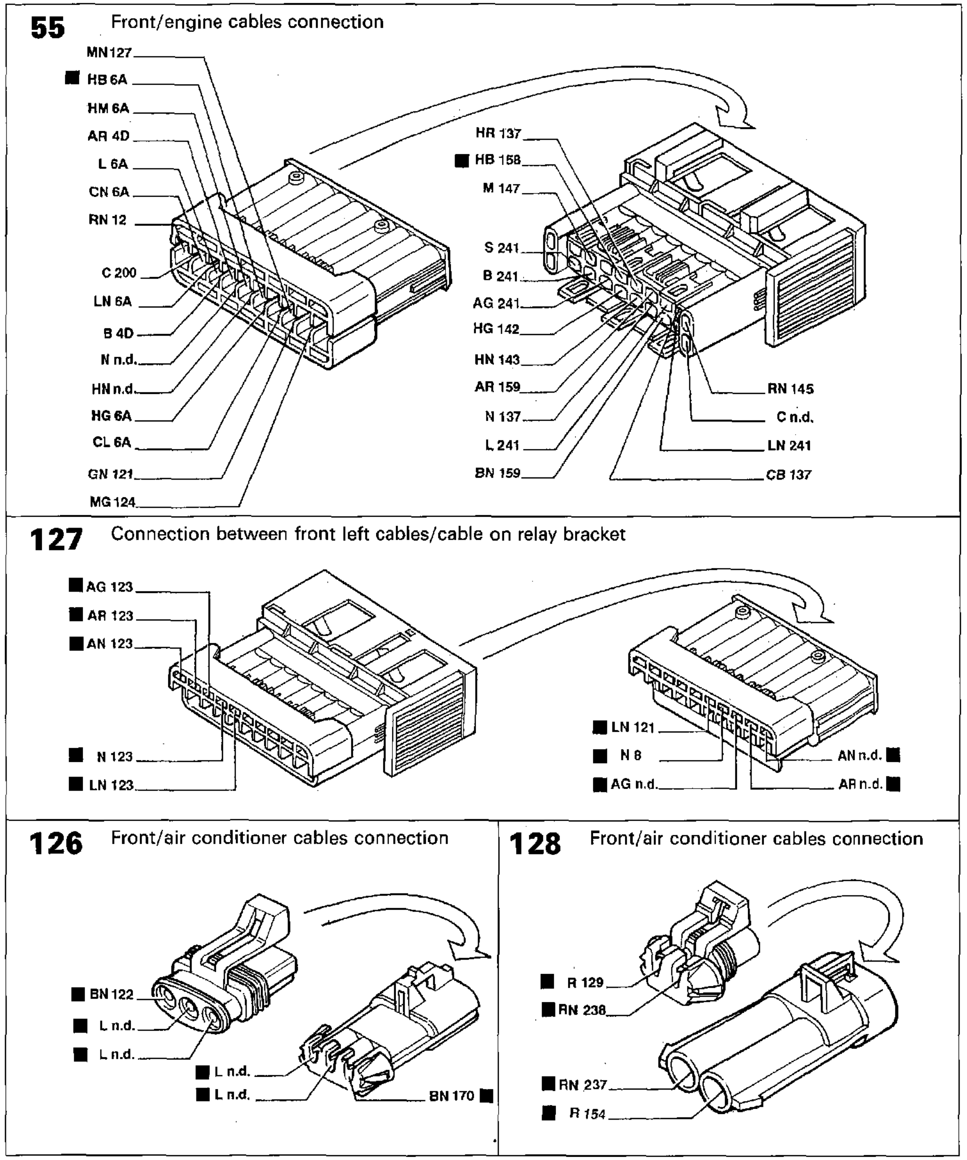
**Version with air conditioner**

**Engine cooling system - Water temperature gauge**

**Key to components**

3 Power fuse box:
A 60A fuse protecting fuel injection system
B 40A fuse protecting ignition system
C 60A fuse protecting additional optional extras
D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit:
E1 Ignition switch discharge relay
6 Instrument panel:
X Water temperature gauge
7 Stalk unit
8 Front left earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
22 Left dashboard earth
42 Right dashboard earth
55 Front/engine cables connection
121 Three-stage pressure switch
122 Engine cooling fan low speed control relay
123 Engine cooling fan high speed timer
123A Engine cooling fan high speed control relay
126 Front/air conditioner cables connection
127 Connection between front left cables/cable on relay bracket
128 Front/air conditioner cables connection
129 40A power fuse protecting engine cooling fan
154 Engine cooling fan
158 Coolant temperature sensor for instrument
170 Engine cooling fan limiting resistor
172 Two-stage thermostat
236 Front/air conditioner cables connection
237 Additional engine cooling fan
238 40A power fuse protecting engine cooling fan

N.D. Ultrasound-soldered joint taped in wiring loom

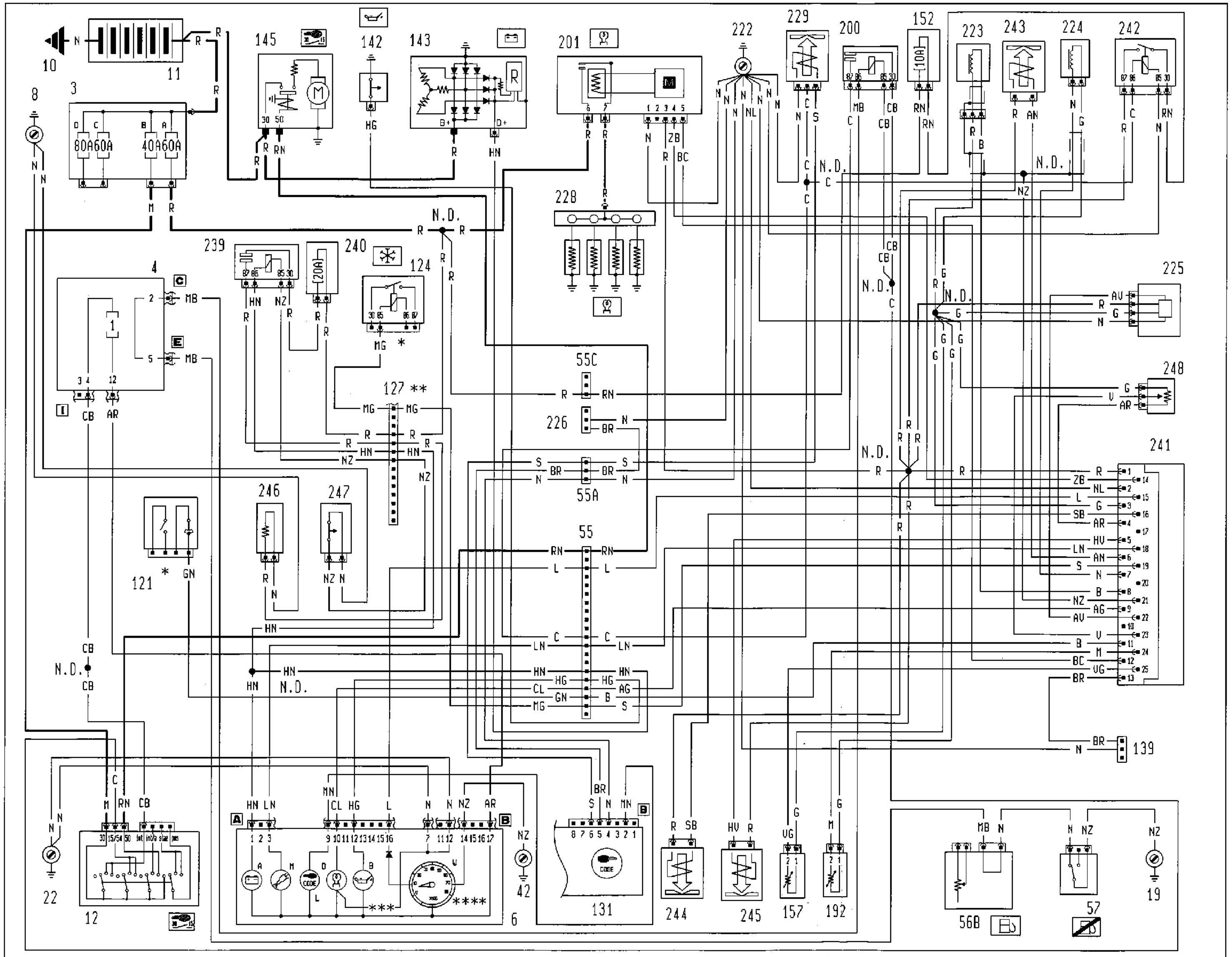



P4A08ZL01

The cables involved in the wiring diagram are marked with a solid square

**Model: 1910 100 BHP**

**Starting system - Recharging system and warning light - Low engine oil pressure warning light - Heater plugs warning light - Fuel injection fault warning light - Fiat CODE system fault warning light - Rev counter - (See key following diagrams)**




* See air conditioner wiring diagram

** Not present on versions with heater

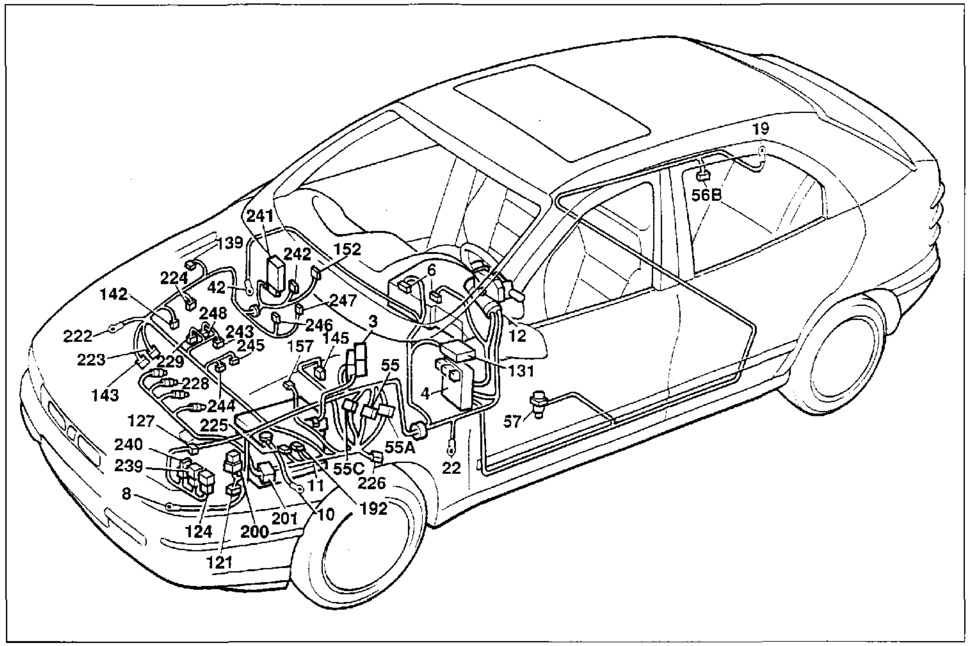
*** Variant connection for S version

**** Not present on S version

P4A09ZL01

4A09ZL

## 55.




P4A11ZL01

**Model: 1910 100 BHP**
**Starting system - Recharging system and warning light - Low engine oil pressure warning light - Heater plugs warning light - Fuel injection fault warning light - Fiat CODE system warning light - Rev counter**

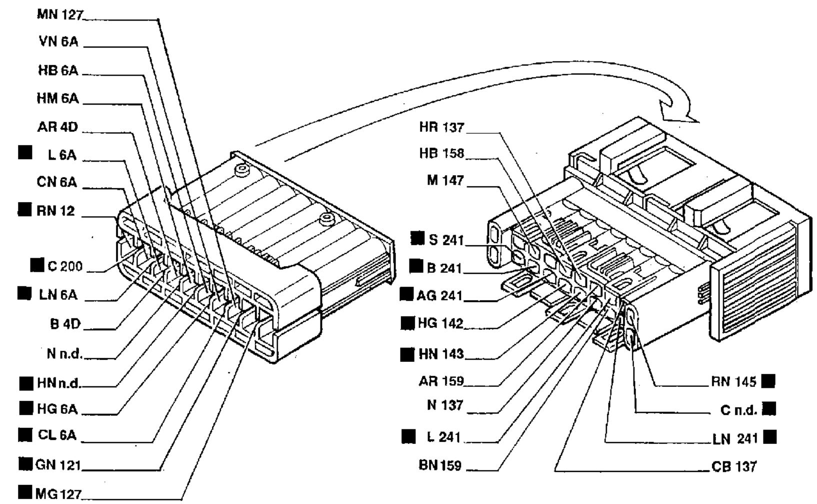
### Key to components

3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting fuel injection system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

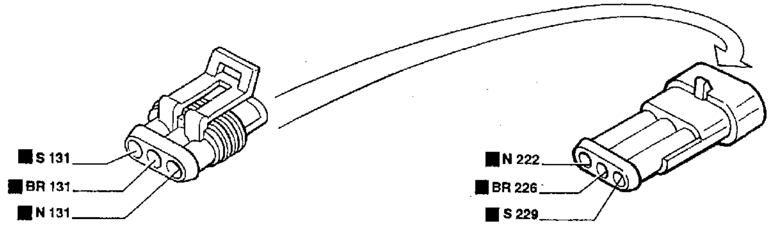
4 Fuse and relay unit
6 Instrument panel:
- A Low generator charge warning light
- B Low engine oil pressure warning light
- L Fiat CODE system fault warning light
- M Fuel injection fault warning light
- O Plug preheating warning light
- W Rev counter

8 Front left earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
19 Rear right earth
22 Left dashboard earth
42 Right dashboard earth
55 Front/engine cables connection
55A Front left/engine cables connection
55C Front left/engine cables connection
56B Fuel gauge sender unit
57 Inertial switch
121 Three-stage pressure switch
124 Air conditioner compressor control relay
127 Connection between front left cables/cable on relay bracket
131 Fiat CODE electronic control unit
139 Diagnostic socket for fuel injection
142 Low oil pressure warning light switch
143 Alternator
145 Starter motor
152 10A fuse protecting fuel injection
157 Water temperature sensor for fuel injection
192 Air temperature sensor
200 Inertial switch relay
201 Plug preheating control unit
222 Earth for fuel system
223 Wheel speed sensor
224 Instrumented fuel injector
225 Flowmeter
226 Diagnostic socket for Fiat CODE system
228 Heater plugs
229 Engine cut-off electrostop
239 Heated diesel filter relay
240 20A fuse protecting heating diesel filter relay
241 Fuel pump electronic control unit
242 Fuel injection relay
243 Engine advance adjustment solenoid
244 Fast idle solenoid
245 E.G.R. solenoid
246 Heated fuel filter
247 Heated fuel filter thermal contact
248 Potentiometer on fuel pump
N.D. Ultrasound-soldered joint taped in wiring loom

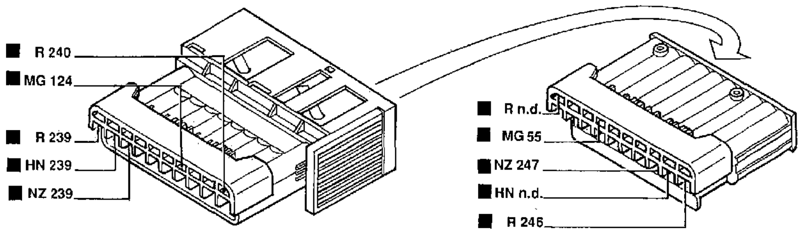
**55** Front/engine cables connection




**55A** Front left/engine cables connection



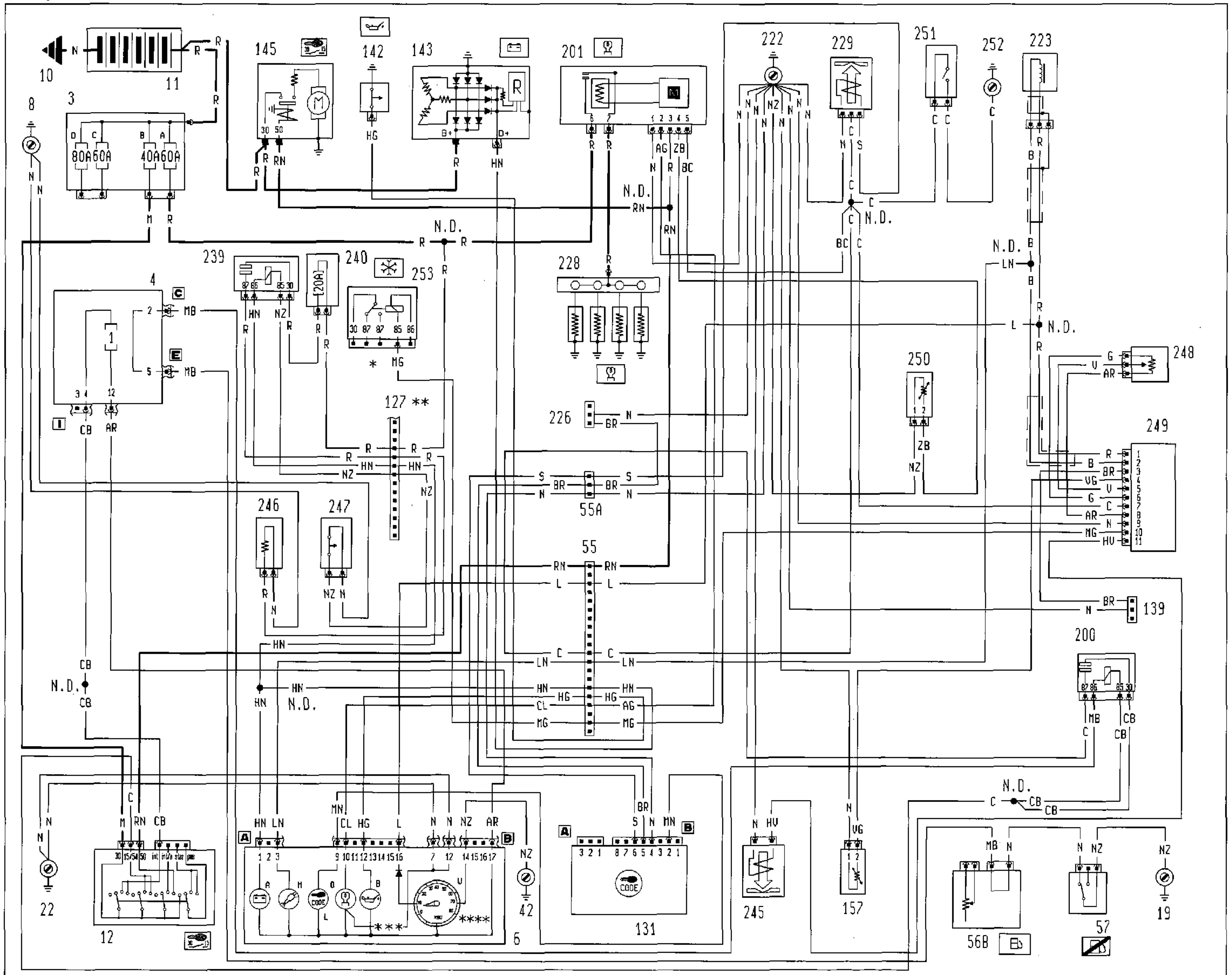

**127** Connection between front left cables/cable on relay bracket




P4A12ZL01

**Version: 1910 75 BHP**

**Starting system - Recharging system and warning light - Low engine oil pressure warning light - Heater plugs warning light - Fuel injection fault warning light - Fiat CODE fault system warning light - Rev counter (See key following diagrams)**

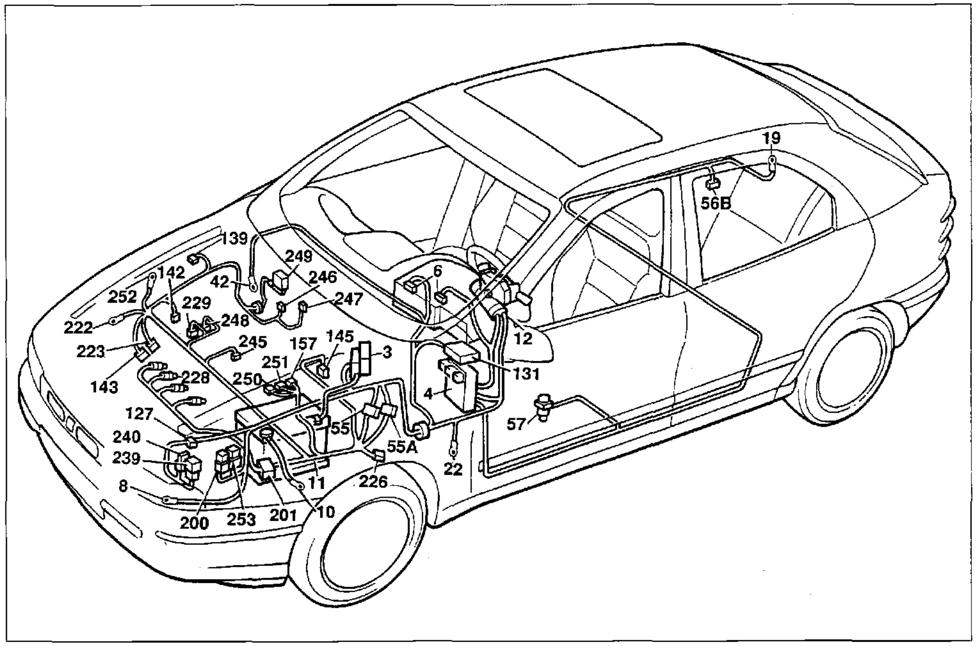


* See air conditioner diagram  ** Not present on versions with heater  *** Variant connection for S version  **** Not present on S version

P4A13ZL01

4A13ZL

# 55.




P4A15ZL01

**Model: 1910 75 BHP**
**Starting system - Recharging system and warning light - Low engine oil pressure warning light - Heater plugs warning light - Fuel injection fault warning light - Fiat CODE system fault warning light - Rev counter**

## Key to components

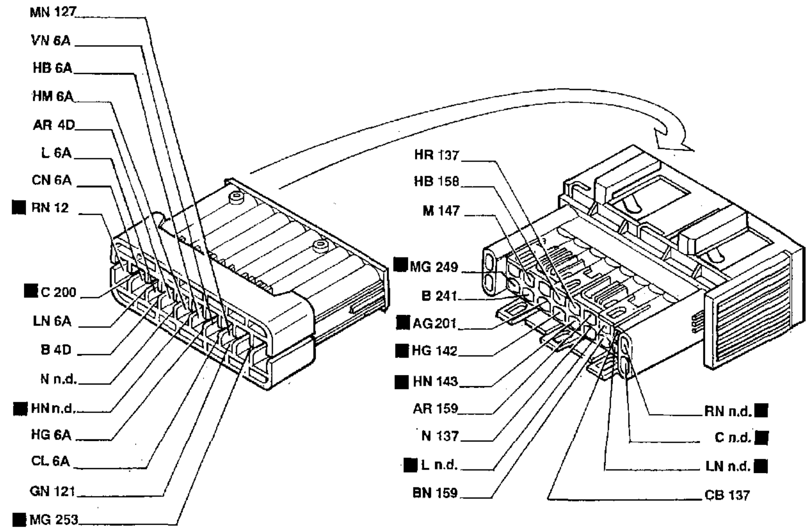
3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting ignition system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit
6 Instrument panel:
- A Low generator charge warning light
- B Low engine oil pressure warning light
- L Fiat CODE system fault warning light
- M Fuel injection fault warning light
- O Heater plug warning light
- W Rev counter

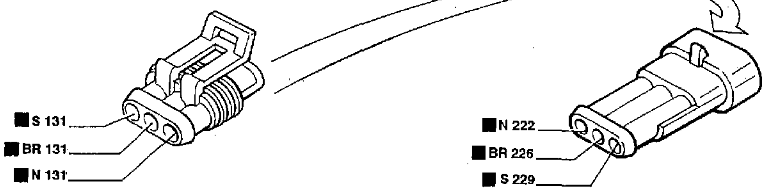
8 Front left earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
19 Rear right earth
22 Left dashboard earth
42 Right dashboard earth
55 Front/engine cables connection
55A Front left/engine cables connection
56B Fuel gauge sender
57 Inertial switch
127 Connection between front left cables/cable on relay bracket
131 Fiat CODE electronic control unit
139 Diagnostic socket for fuel injection
142 Low oil pressure warning light switch
143 Alternator
145 Starter motor
157 Water temperature sensor for fuel injection
200 Inertial switch control relay
201 Plug preheating control unit
222 Earth for fuel system
223 Wheel speed sensor
226 Diagnostic socket for Fiat CODE system
228 Heater plugs
229 Engine cut-off electrostop
239 Heated diesel filter relay
240 20A fuse protecting heated diesel filter relay
245 E.G.R. solenoid
246 Heated fuel filter
247 Heated fuel filter thermal contact
248 Potentiometer on fuel pump
249 E.G.R. electronic control unit
250 Water temperature sensor for preheating control unit
251 K.S.B. thermal switch
252 K.S.B. earth
253 Relay for switching off compressor
N.D. Ultrasound-soldered joint taped in wiring loom

4A15ZL

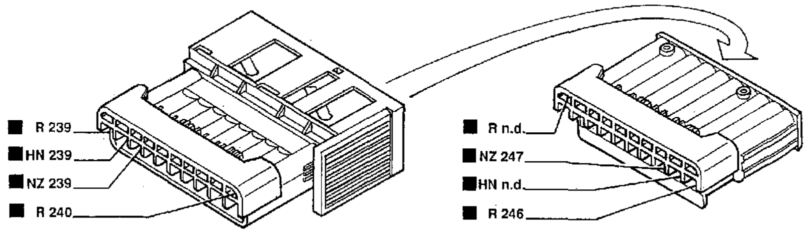
## 55 Front/engine cables connection




## 55A Front left/engine cables connection




## 127 Connection between front left cables/cable on relay bracket

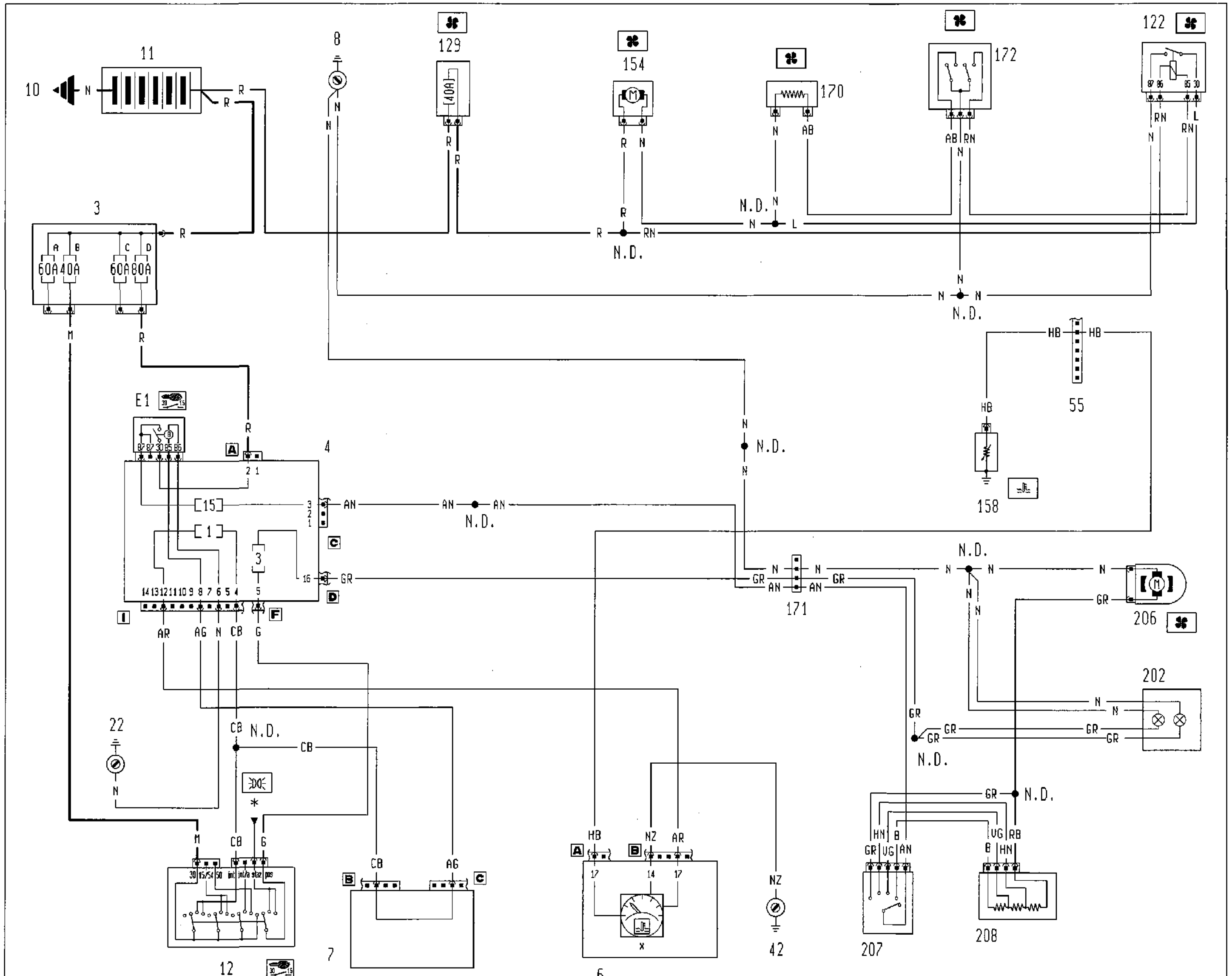



P4A16ZL01

4A16ZL

**Version without air conditioner**

**Engine cooling system - Water temperature gauge - Car interior ventilation - (See key following diagrams)**

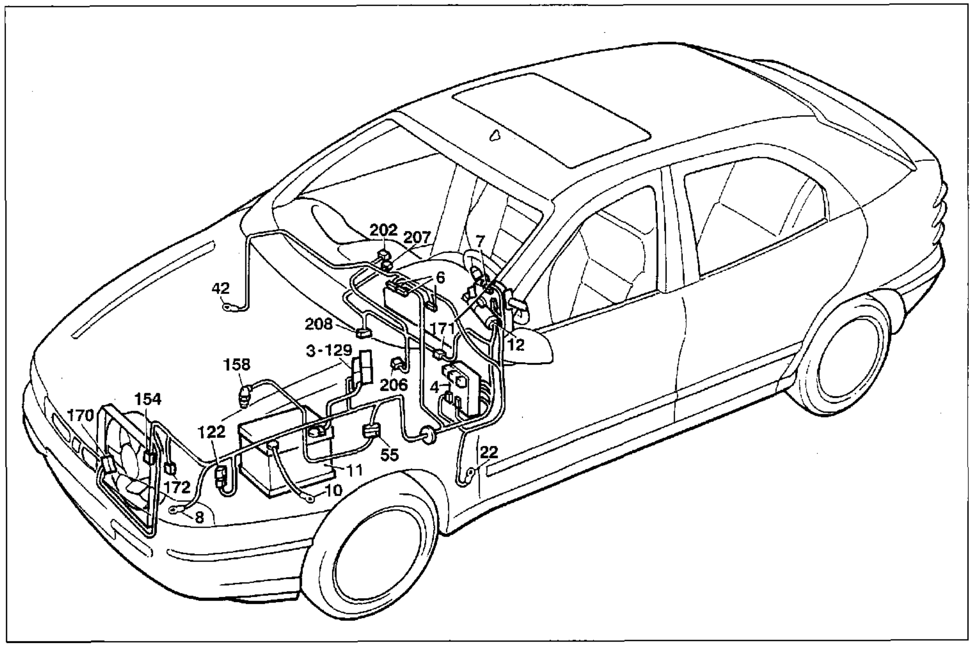


* See side lights diagram

P4A17ZL01

4A17ZL

## 55.




P4A19ZL01

**Version without air conditioner**

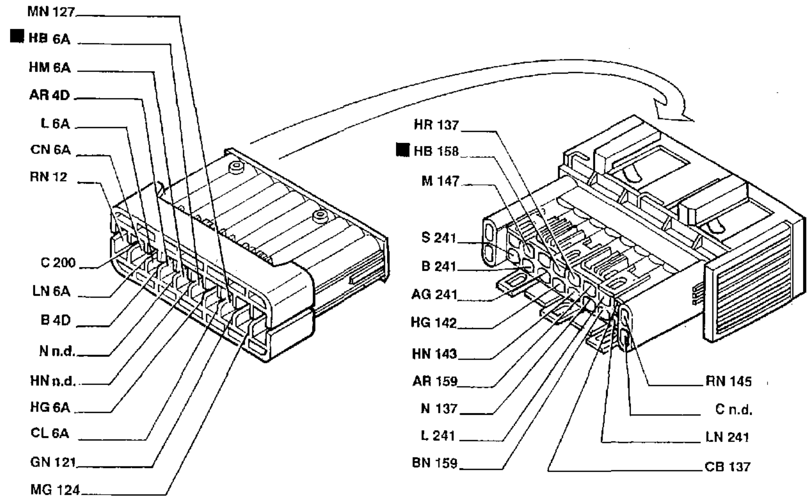
**Engine cooling system - Water temperature gauge - Car interior ventilation**

**Key to components**

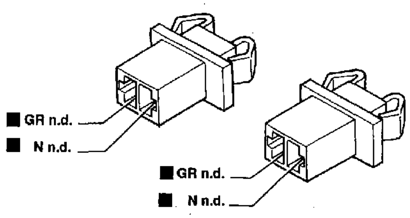
3 Power fuse box:
  A 60A fuse protecting fuel injection system
  B 40A fuse protecting ignition system
  C 60A fuse protecting additional optional extras
  D 80A protecting fuse and relay unit
4 Fuse and relay unit
  E1 Ignition switch discharge relay
6 Instrument panel:
  X Coolant temperature gauge
7 Stalk unit
8 Front left earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
22 Left dashboard earth
42 Right dashboard earth
55 Front/engine cables connection
122 Engine cooling fan low speed relay
129 40A power fuse protecting engine cooling fan
154 Engine cooling fan
158 Coolant temperature sensor for gauge
170 Engine cooling fan limiting resistor
171 Heater unit
172 Two-stage thermostat
202 Bulbs for heater/air conditioner unit
206 Heater/air conditioner electric fan
207 Speed control switch for heater/air conditioner unit
208 Limiting resistor for heater/air conditioner unit

N.D. Ultrasound-soldered joint taped in wiring loom

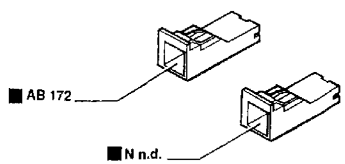
**55** Front/engine cables connection



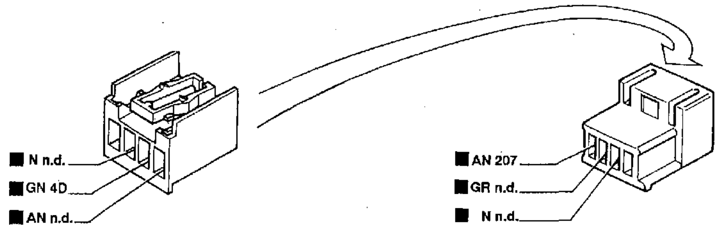

**202** Bulbs for illuminating symbols on heater/air conditioner controls




**170** Resistor for engine cooling fan




**171** Heater cables connection

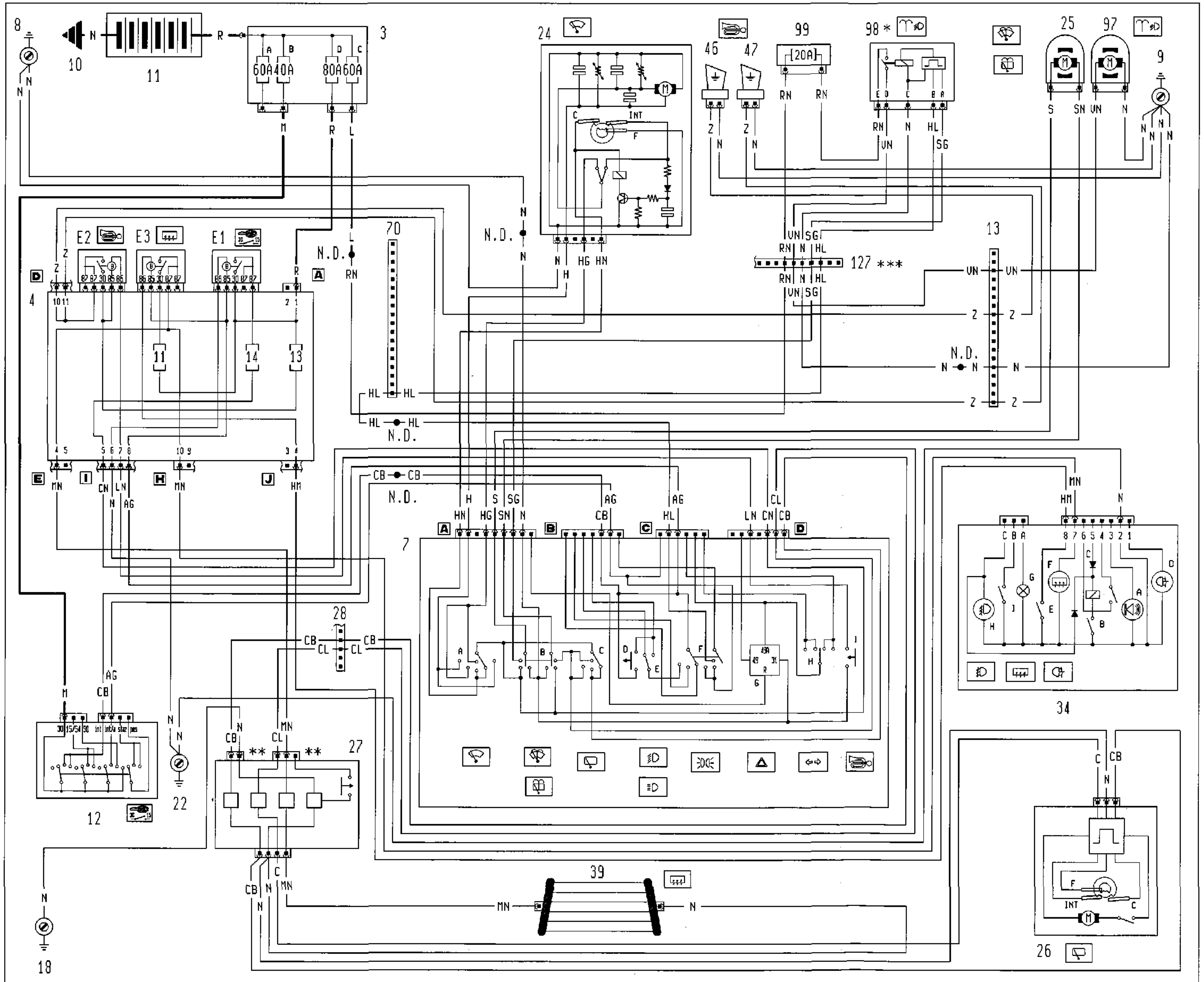



P4A20ZL01

4A19ZL

4A20ZL

**Windscreen wash/wipe - Rear window wash/wipe - Electric horns - Heated rear window and warning light - Headlamp washer - (See key following diagrams)**

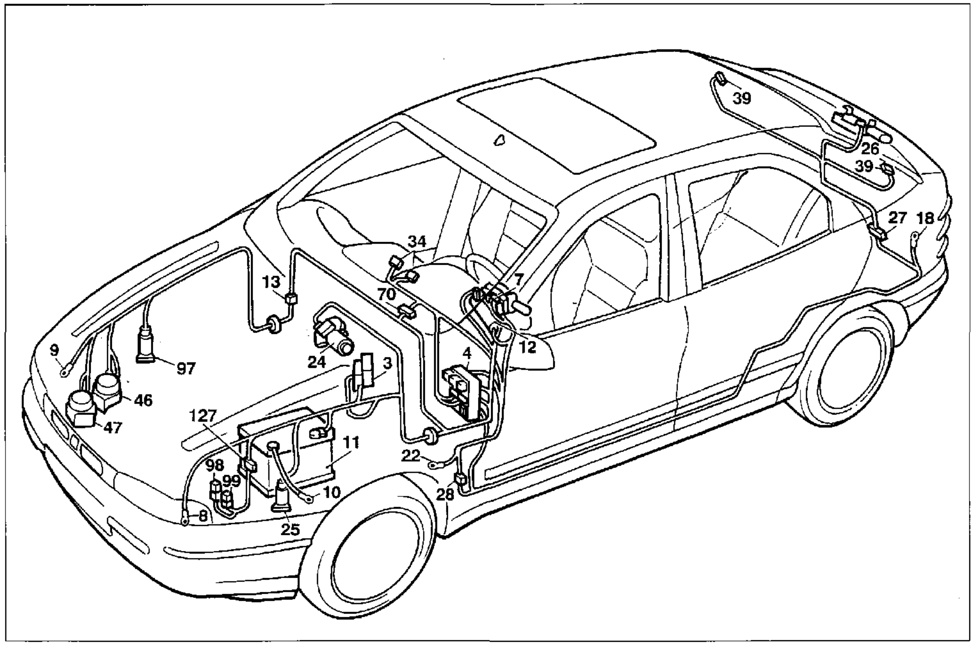


* Not present on S version
** Single connector for Bravo version
*** Not present on versions with heater

P4A21ZL01

4A21ZL

# 55.




P4A23ZL01

**Windscreen wash/wipe - Rear window wash/wipe - Electric horns - Heated rear window and warning light - Headlamp washer**

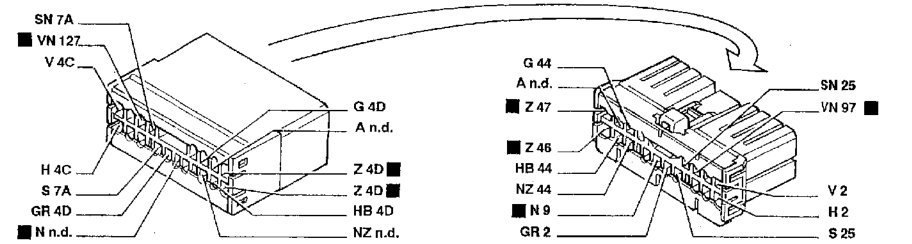
**Key to components**

3 Power fuse box:
  A 60A fuse protecting fuel injection system
  B 40A fuse protecting fuel injection
  C 60A fuse protecting additional optional extras
  D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit:
  E1 Ignition switch discharge relay
  E2 Horn relay
  E3 Heated rear window relay
7 Stalk unit:
  A Windscreen wiper speed control switch
  B Windscreen wash/headlamp wash/rear window wash controlswitch
  C Rear window wiper switch
  D Flasher button
  E Dipped beam/main beam switch
  F Side lights switch
  G Indicators/hazard lights intermittent switch
  H Direction indicators switch
  I Horn button
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
18 Rear left earth
22 Left dashboard earth
24 Windscreen wiper motor
25 Windscreen/rear window wash pump
26 Rear window wiper motor
27 Rear connections contact assembly with built-in boot light switch
28 Dashboard/longitudinal cables connection
34 Switches control unit:
  A Alarm on warning light
  B Rear fog lamps switch
  C Rear fog lamps relay
  D Rear fog lamps warning light
  E Heated rear window switch
  F Heated rear window warning light
  G Symbol light on switch assembly
  H Front fog lamps warning light
  I Front fog lamps switch
39 Heated rear window
46 Left horn
47 Right horn
70 Dashboard/front cables connection
97 Headlamp washer pump
98 Headlamp washer intermittent switch
99 20A fuse protecting headlamp washer
127 Front left cables/cable on relay bracket

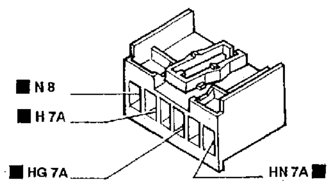
N.D. Ultrasound-soldered joint taped in wiring loom

4A23ZL

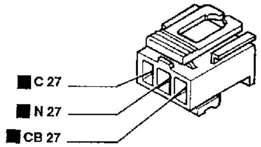
**13** Front right/left cables connection



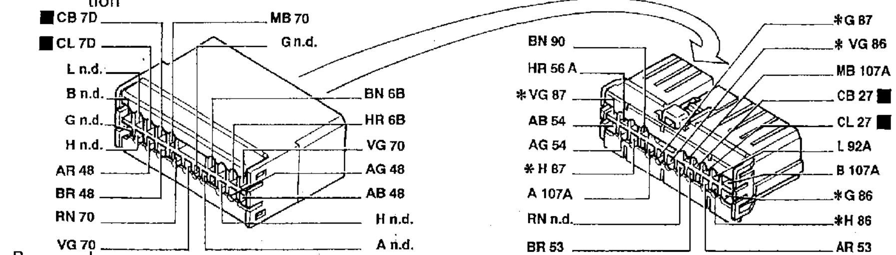

**24** Windscreen wiper motor




**26** Rear window wiper motor

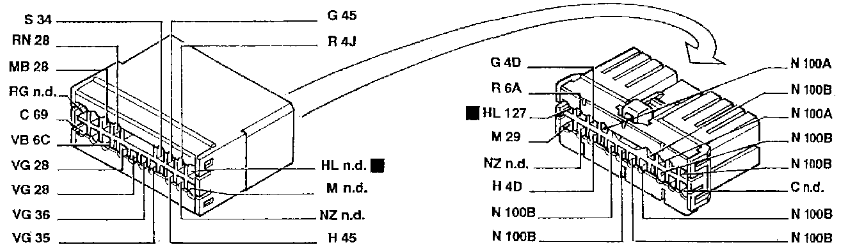



**28** Dashboard/longitudinal cables connection




* Brava only

**70** Dashboard/front cables connection



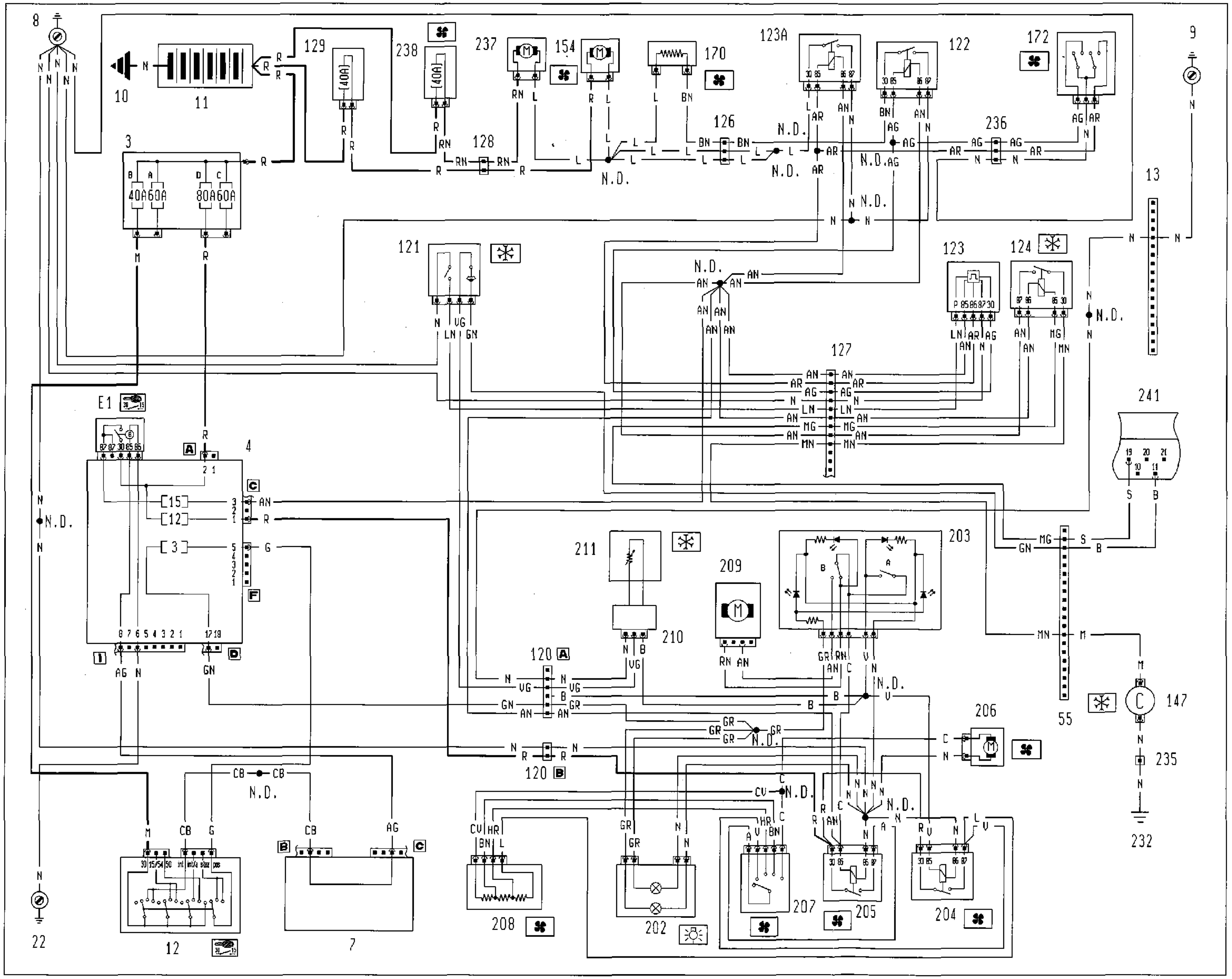

The cables involved in the wiring diagram are marked with a solid square

P4A24ZL01

4A24ZL

**Model: 1910 100 BHP**

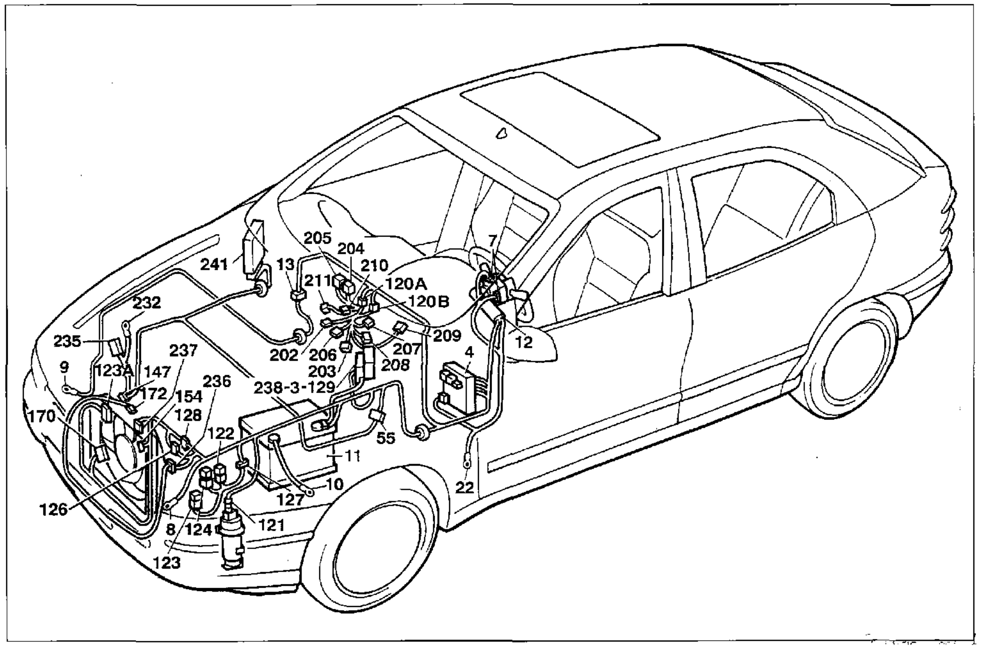
**Air conditioner - (See key following diagrams)**




P4A25ZL01

4A25ZL

# 55.




P4A27ZL01

**Version: 1910 100 BHP**
**Air conditioner**

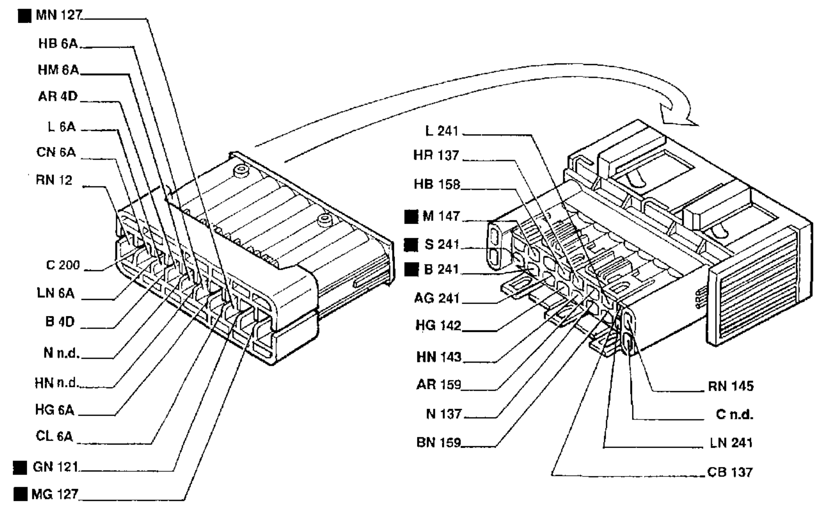
### Key to components

3 Power fuse box:
A 60A fuse protecting fuel injection system
B 40A fuse protecting ignition system
C 60A fuse protecting additional optional extras
D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit:
E1 Ignition switch discharge relay
7 Stalk unit
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
22 Left dashboard earth
55 Front/engine cables connection
120 Air conditioner cables connection
121 Three-stage pressure switch
122 Engine cooling fan low speed control relay
123 Engine cooling fan high speed timer
123A Engine cooling fan high speed relay
124 Air conditioner compressor relay
126 Front/air conditioner cables connection
127 Connection between front left cables/cable on relay bracket
128 Front/air conditioner cables connection
129 40A power fuse protecting engine cooling fan
147 Compressor for air conditioner
154 Engine cooling fan
170 Cooling fan limiting resistor
172 Two-stage thermostat
202 Bulbs for lighting heater/air conditioner unit
203 Air conditioner controls:
A Switch for switching on air conditioner
B Switch controlling air conditioner recirculation
204 Relay controlling air conditioner electric fan 1st speed
205 Air conditioner fan relay
206 Heater/air conditioner electric fan
207 Switch controlling speed of heater/air conditioner
208 Limiting resistor for heater/air conditioner
209 Actuator controlling external air/recirculation flap
210 Electronic thermostat cables connection
211 Electronic thermostat (N.T.C.)
232 Compressor earth
235 Air conditioner compressor cables connection
236 Front/air conditioner cables connection
237 Additional engine cooling fan
238 40A fuse protecting engine cooling fan
241 Fuel pump electronic control unit

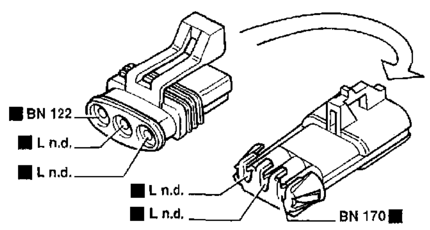
N.D. Ultrasound-soldered joint taped in wiring loom

4A27ZL

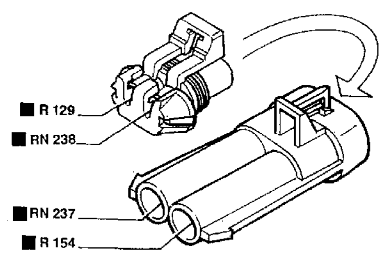
**55** Front/engine cables connection



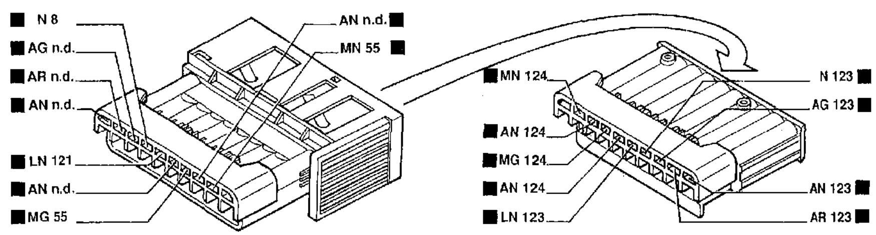

**126** Front/air conditioner cables connection




**128** Front/air conditioner cables connection




**127** Connection between front left cables/cable on relay bracket



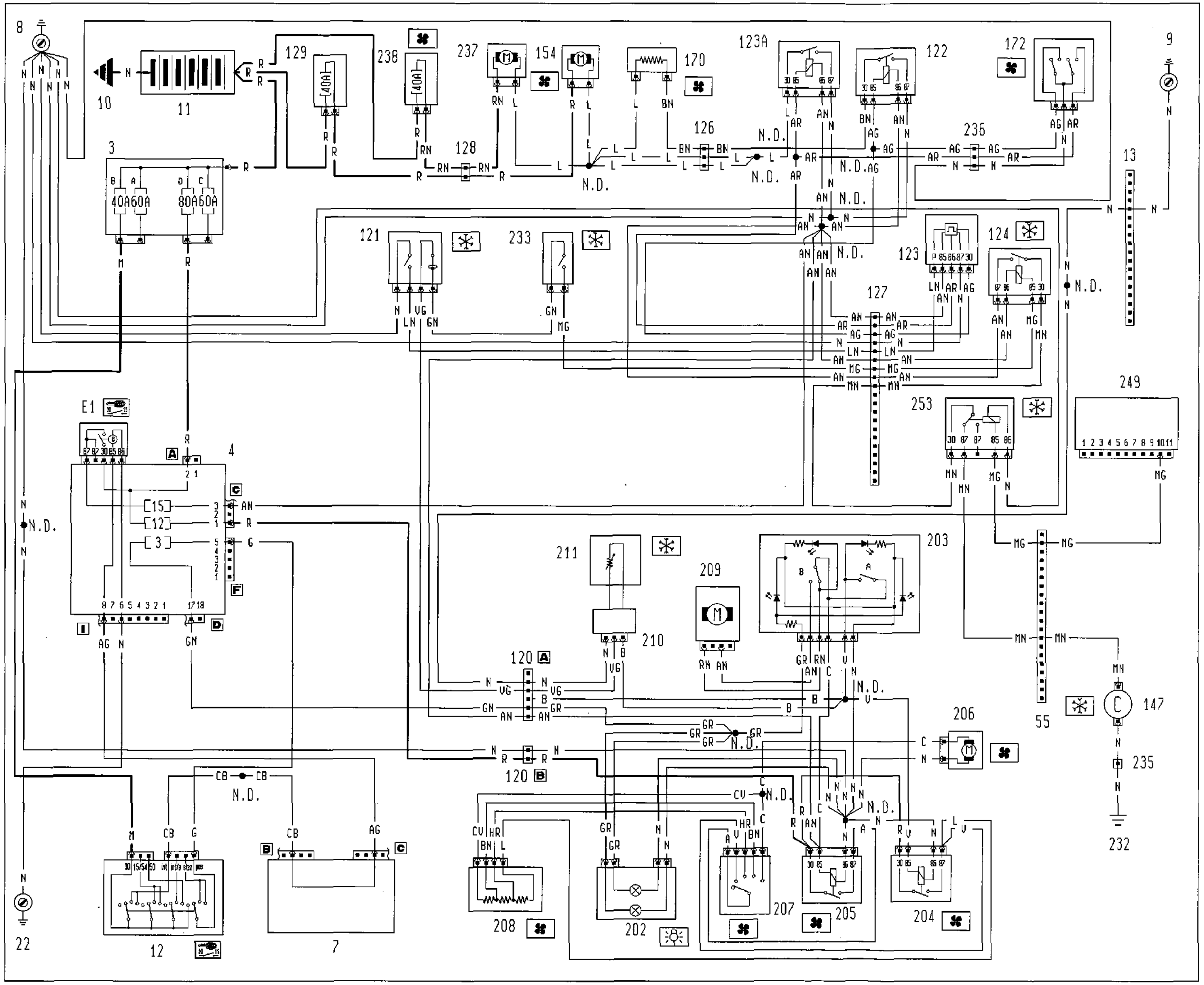

P4A28ZL01

The cables involved in the wiring diagram are marked with a solid square

4A09ZL

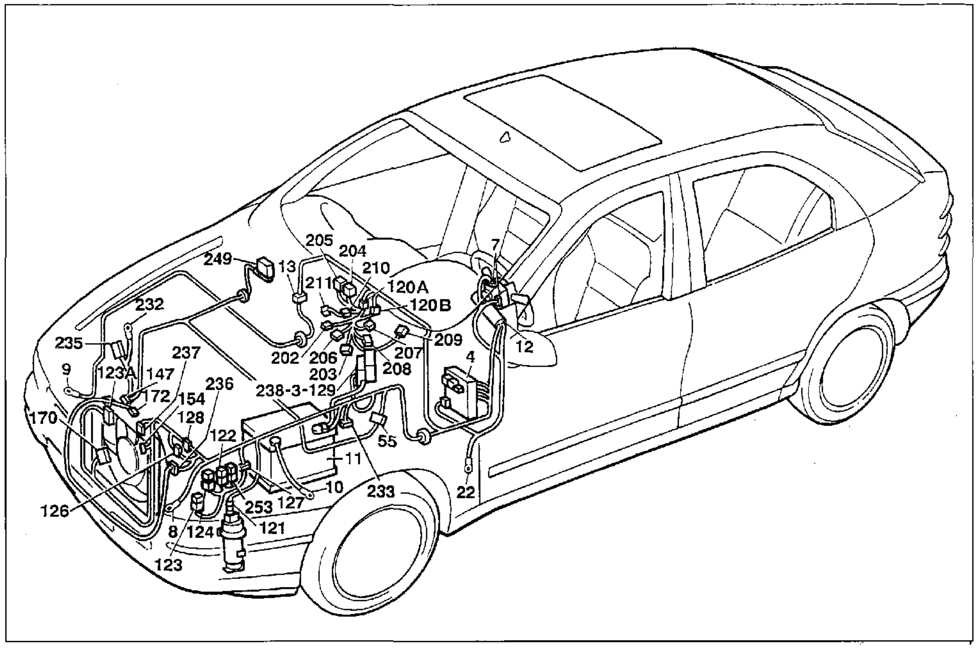
**Model: 1910 75 BHP**

**Air conditioner - (See key following diagrams)**




4A29ZL

## 55.




P4A31ZL01

**Model: 1910 75 BHP**

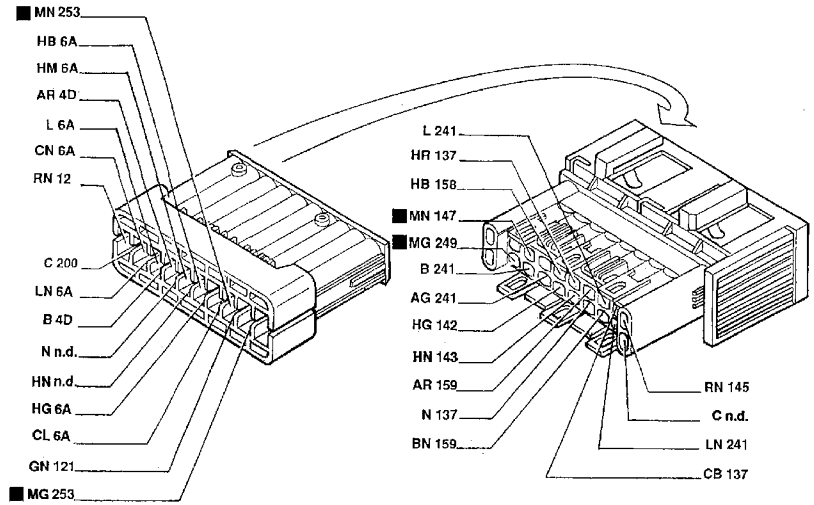
**Air conditioner**

**Key to components**

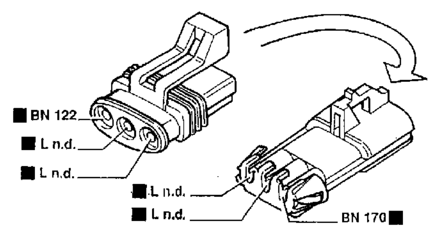
3 Power fuse box:
A 60A fuse protecting fuel injection system
B 40A fuse protecting ignition system
C 60A fuse protecting additional optional extras
D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit:
E1 Ignition switch discharge relay
7 Stalk unit
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
22 Left dashboard earth
55 Front/engine cables connection
120 Air conditioner cables connection
121 Three-stage pressure switch
122 Engine cooling fan low speed relay
123 Engine cooling fan high speed timer
123A Engine cooling fan high speed relay
124 Air conditioner compressor relay
126 Front/air conditioner cables connection
127 connection between front left cables/cable on relay bracket
128 Front/air conditioner cables connection
129 40A power fuse protecting engine cooling fan
147 Compressor for air conditioner
154 Engine cooling fan
170 Engine cooling fan limiting resistor
172 Two-stage thermostat
202 Bulbs lighting heater/air conditioner unit
203 Air conditioner controls:
A Switch for switching on air conditioner
B Air conditioner recirculation switch
204 Air conditioner fan 1st speed relay
205 Air conditioner fan relay
206 Heater/air conditioner electric fan
207 Heater/air conditioner speed control switch
208 Limiting resistor for heater/air conditioner
209 Actuator controlling exterior air/recirculation flap
210 Electronic thermostat cables connection
211 Electronic thermostat (N.T.C.)
232 Compressor earth
233 Thermostat on coolant pump
235 Air conditioner compressor cables connection
236 Front/air conditioner cables connection
237 Additional engine cooling fan
238 40A fuse protecting engine cooling fan
249 E.G.R. electronic control unit
253 Relay switching off compressor

N.D. Ultrasound-soldered joint taped in wiring loom

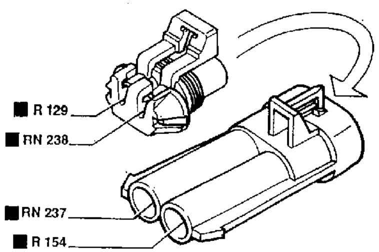
**55** Front/engine cables connection



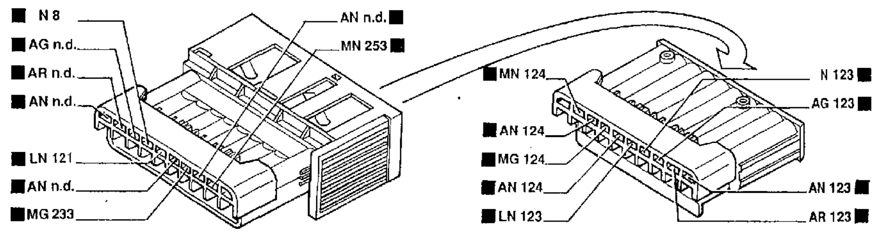

**126** Front/air conditioner cables connection




**128** Front/air conditioner cables connection



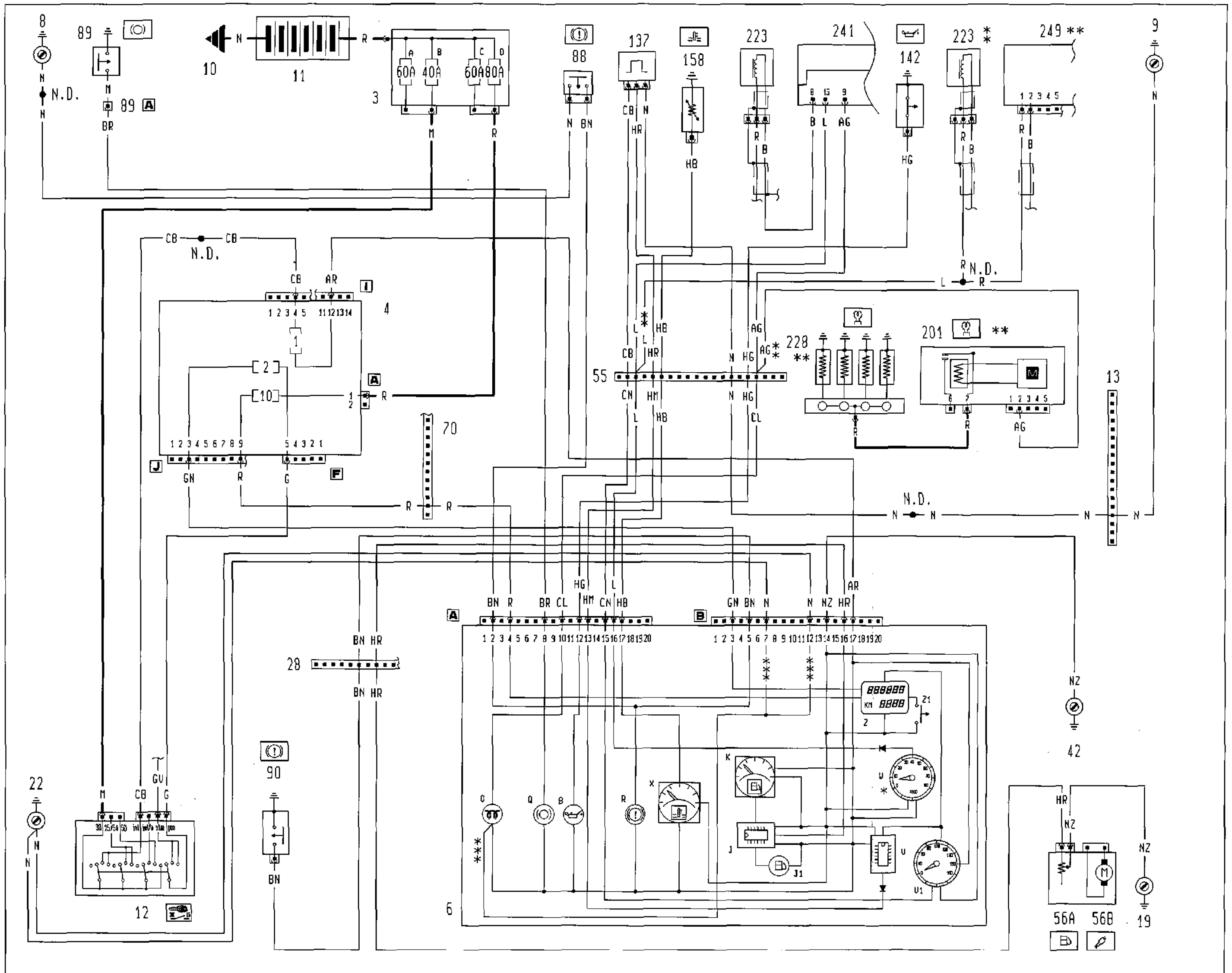

**127** Connection between front left cables/cable on relay bracket




P4A32ZL01

The cables involved in the wiring diagram are marked with a solid square

**Version: S -SX**
**Fuel level gauge and reserve warning light - Handbrake on/low brake fluid level warning light - Speedometer - Trip recorder/mileage counter and relevant reset button - Water temperature gauge - Low engine oil pressure warning light - Front brake pad wear warning light - Heater plugs warning light - Rev counter - (See key following diagrams)**



* Not present on S version

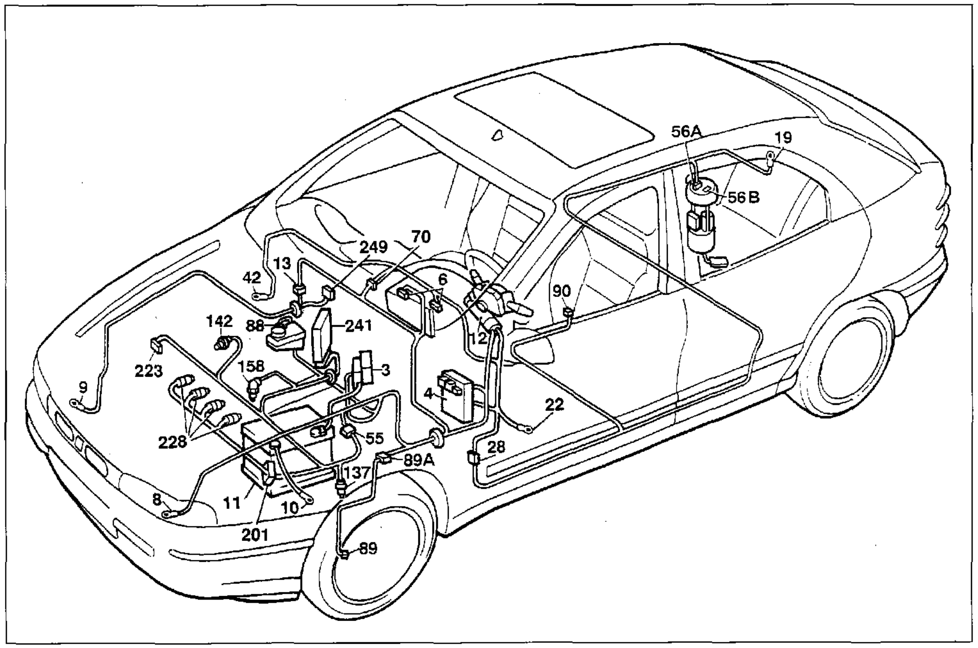
** Variant connection for soft versions (75cv)

*** Variant connection for S version

P4A33ZL01

4A33ZL

# 55.




P4A35ZL01

**Version: S - SX**

**Fuel level gauge and reserve warning light - Handbrake on/low brake fluid level warning light - Speedometer - Trip recorder/mileage counter and relevant reset button - Water temperature gauge- Low engine oil pressure warning light - Front brake pad wear warning light - Heater plugs warning light - Rev counter**

**Key to components**

3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting ignition system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit
6 Instrument panel:
- B Low engine oil pressure warning light
- J *Fuel reserve circuit control module*
- J1 Low fuel level warning light
- K Fuel gauge
- O Heater plugs warning light
- Q Front brake pad wear warning light
- R Handbrake on / low brake fluid level warning light
- V Speedometer control module
- V1 Speedometer
- W Rev counter
- X Coolant temperature gauge
- Z Trip recorder / mileage counter
- Z1 Trip recorder reset button

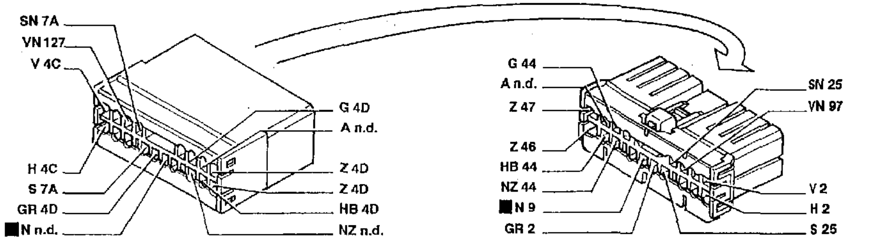
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front/left cables connection
19 Rear right earth
22 Left dashboard earth
28 Dashboard/longitudional cables connection
42 Right dashboard earth
55 Front/engine cables connection
56 Fuel gauge sender assembly
- A Fuel level sensor
- B *Electric fuel pump*

70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
137 Vehicle speed sensor
142 Low oil pressure warning light switch
158 Coolant temperature sensor for gauge
201 Plug preheating control unit
223 Wheel speed sensor
228 Heater plugs
241 Fuel pump electronic control unit
249 E.G.R. electronic control unit

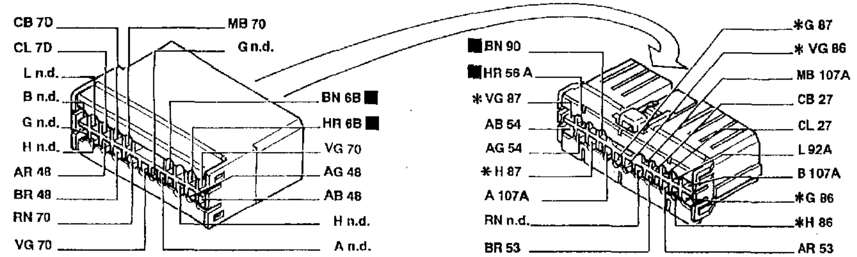
N.D. Ultrasound-soldered joint taped in wiring loom

4A35ZL

**13** Front right/left cables connection

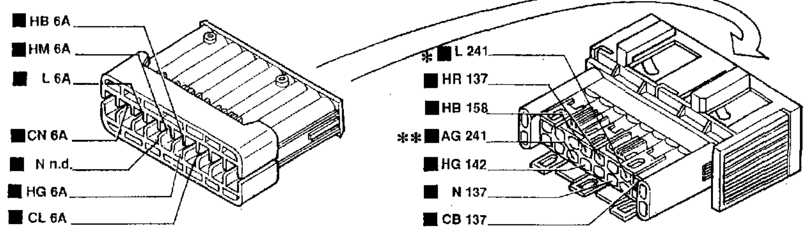



**28** Dash./longitudinal cables connection



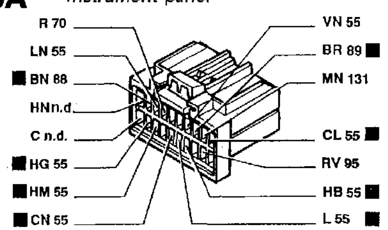

* Brava only

**55** Front/engine cables connection

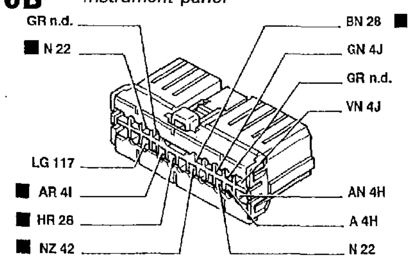



* N.D. for soft version (75cv) ** 201 for soft version (75cv)

**6A** Instrument panel




**6B** Instrument panel




The cables involved in the wiring diagram are marked with a solid square

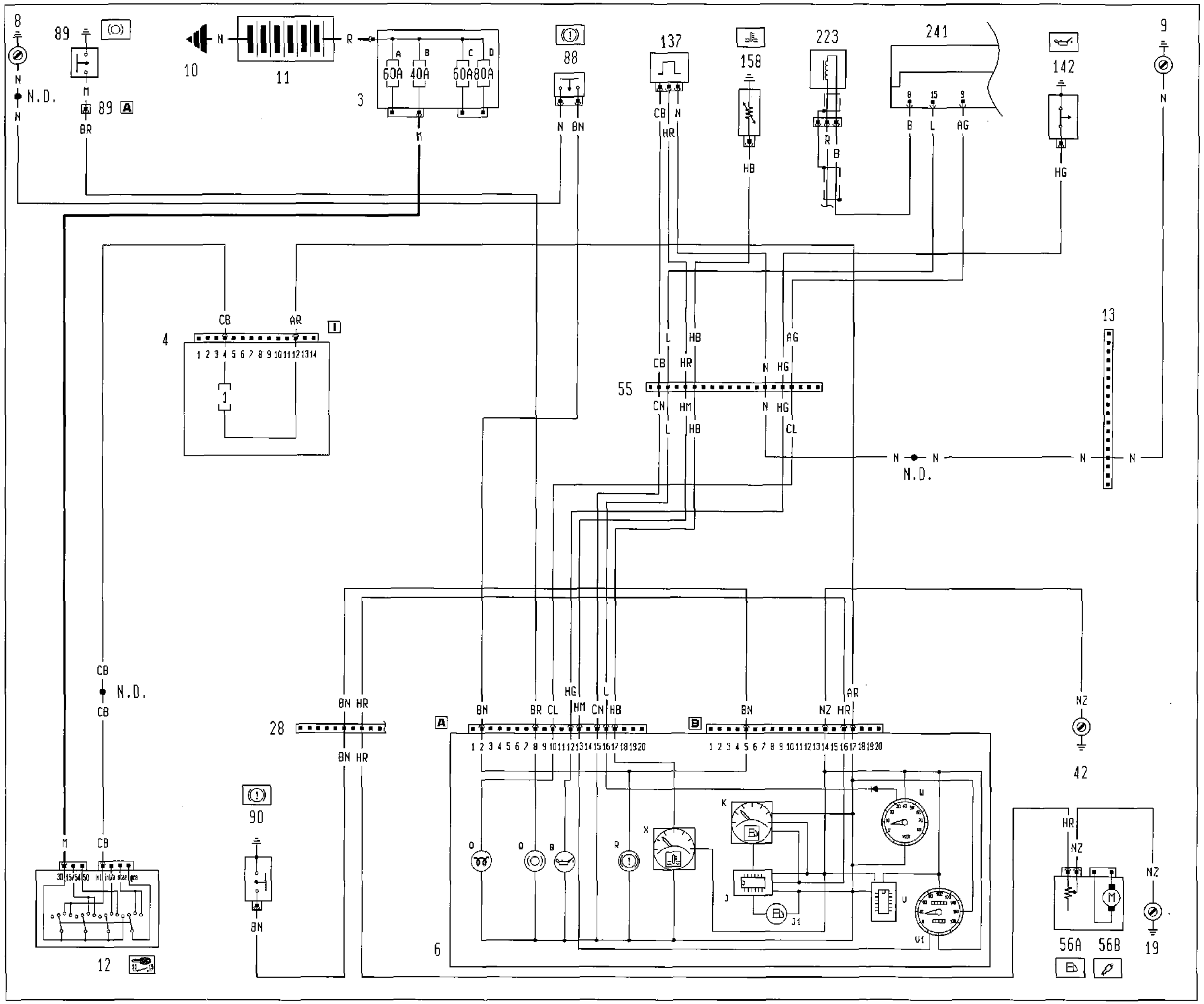
P4A36ZL01

4A36ZL

# 55.

**Version: SX - GT**

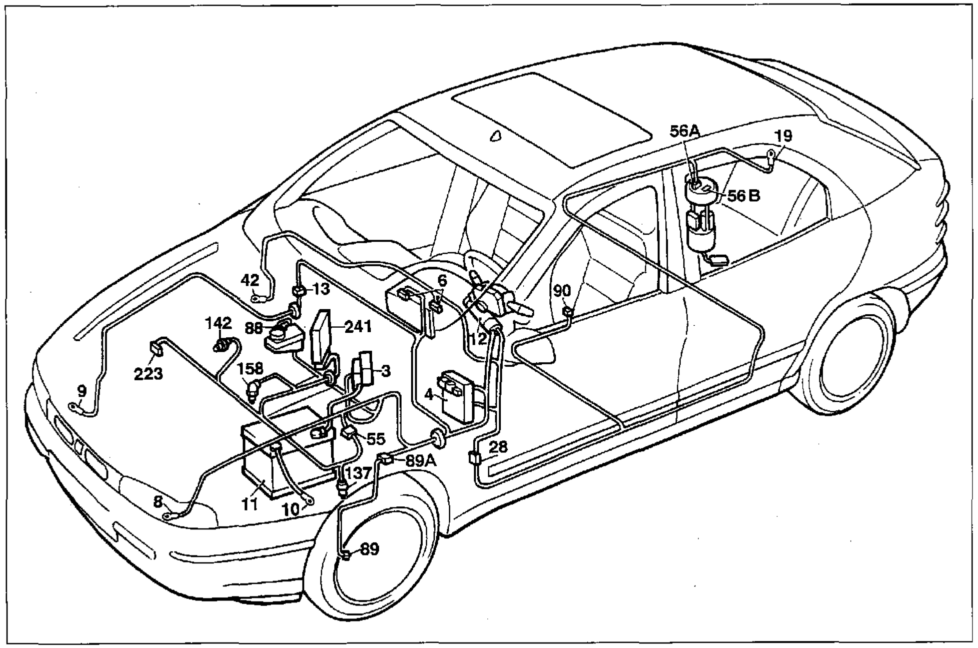
**Fuel level gauge and reserve warning light - Handbrake on/low brake fluid level warning light - Speedometer - Water temperature gauge- Low engine oil pressure warning light - Front brake pad wear warning light - Heater plugs warning light - Rev counter - (See key following diagrams)**




4A37ZL

P4A37ZL01

# 55.




P4A39ZL01

**Version: SX - GT**

**Fuel level gauge and reserve warning light - Handbrake on/low brake fluid level warning light - Speedometer - Water temperature gauge- Low engine oil pressure warning light - Front brake pad wear warning light - Heater plugs warning light - Rev counter**

## Key to components

3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting ignition system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

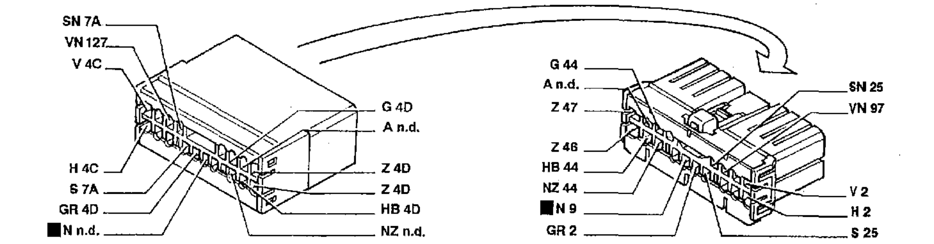
4 Fuse and relay unit
6 Instrument panel:
- B Low engine oil pressure warning light
- J Fuel reserve circuit control module
- J1 Low fuel level warning light
- K Fuel gauge
- O Heater plugs warning light
- Q Front brake pad wear warning light
- R Handbrake on / low brake fluid level warning light
- V Speedometer control module
- V1 Speedometer
- W Rev counter
- X Coolant temperature gauge

8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
19 Rear right earth
28 *Dashboard/longitudinal cables connection*
42 Right dashboard earth
55 Front/engine cables connection
56 Fuel gauge sender assembly
- A Fuel level sensor
- B Electric fuel pump

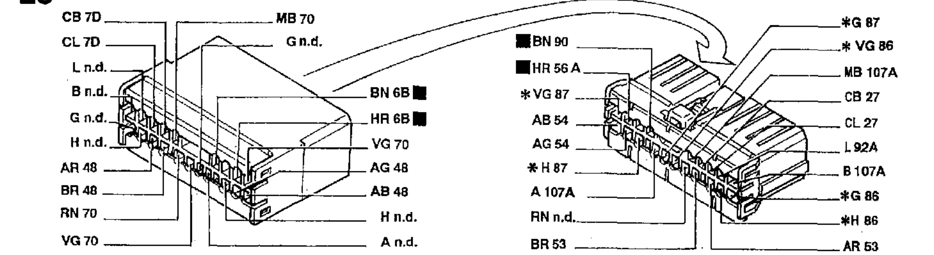
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
137 Vehicle speed sensor
142 Low oil pressure warning light switch
158 Coolant temperature sensor for gauge
223 Wheel speed sensor
241 Fuel pump electronic control unit

N.D. Ultrasound-soldered joint taped in wiring loom

**13** Front right/left cables connection

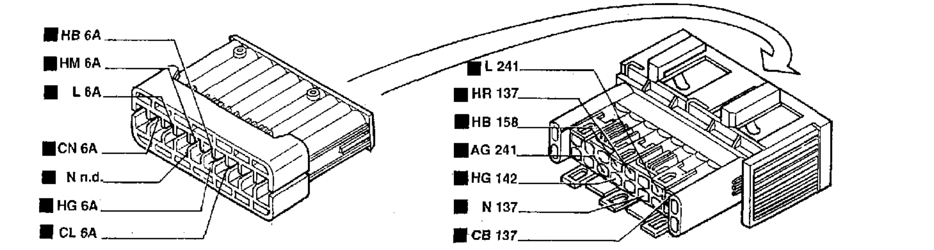



**28** Dash./longitudinal cables connection

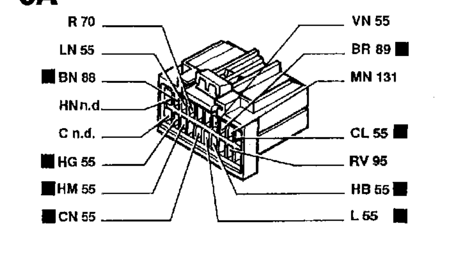



* Brava only

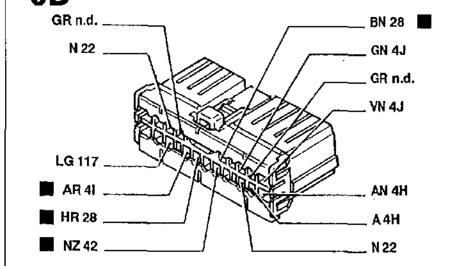
**55** Front/engine cables connection




**6A** Instrument panel




**6B** Instrument panel




The cables involved in the wiring diagram are marked with a solid square

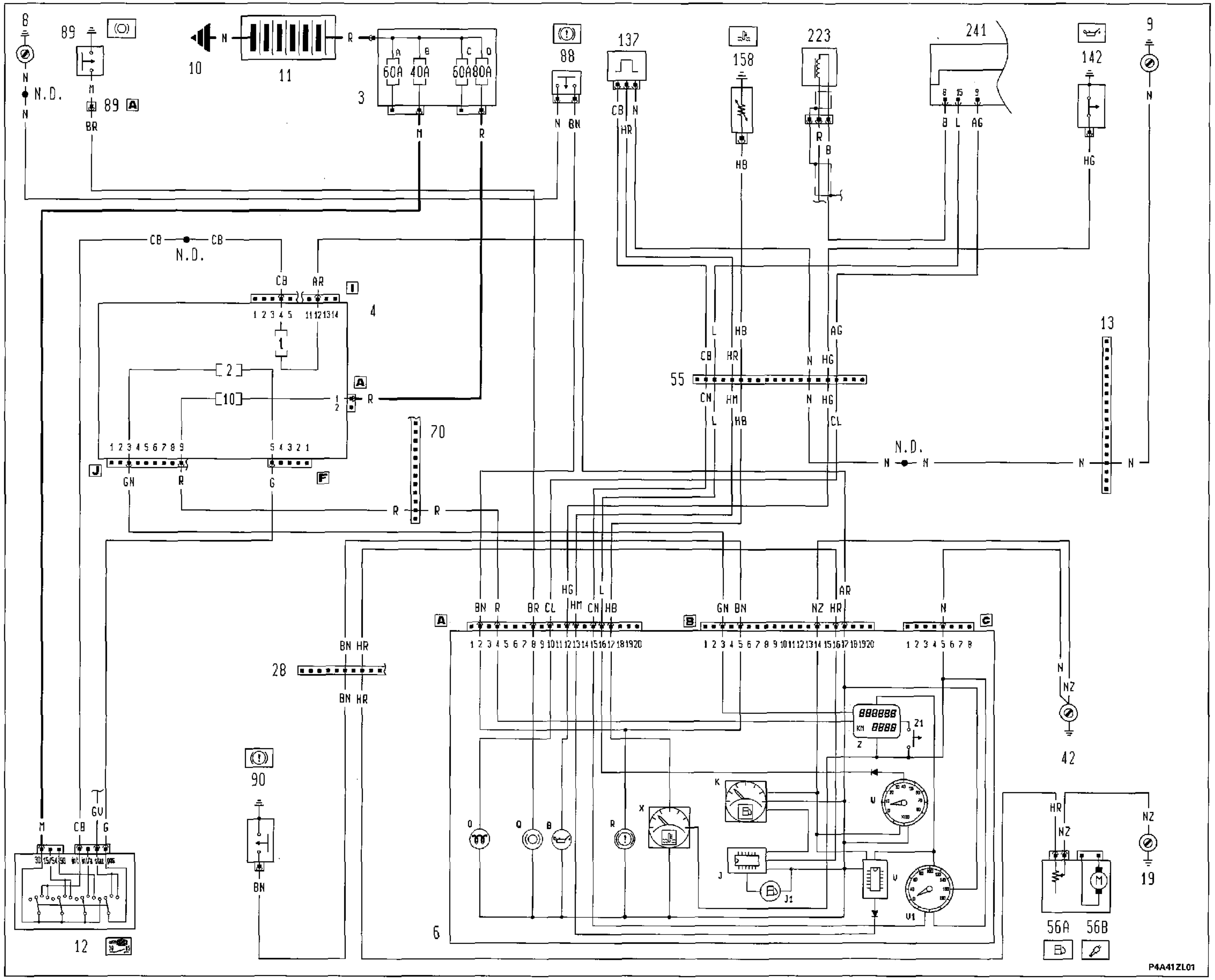
P4A40ZL01

4A39ZL

4A40ZL

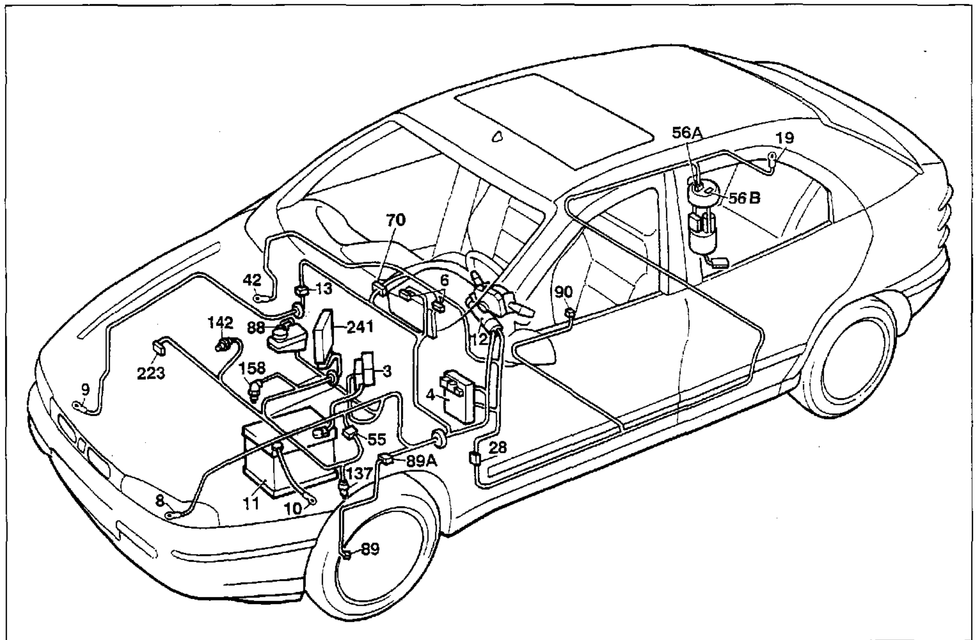
**Version: EL - ELX**

**Fuel level gauge and reserve warning light - Handbrake on / low brake fluid level warning light - Speedometer - Trip recorder/mileage counter and relevant reset button - Water temperature gauge - Low engine oil pressure warning light - Front brake pad wear warning light - Heater plugs warning light - Rev counter - (See key following diagrams)**



4A41ZL

# 55.




**Version: EL - ELX**

**Fuel level gauge and reserve warning light - Handbrake on/low brake fluid level warning light - Speedometer - Trip recorder/mileage counter and relevant reset button - Water temperature gauge - Low engine oil pressure warning light - Front brake pad wear warning light - Heater plugs warning light - Rev counter**

**Key to components**

3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting ignition system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit
6 Instrument panel:
- B Low engine oil pressure warning light
- J *Fuel reserve circuit control module*
- J1 Low fuel level warning light
- K Fuel gauge
- O Heater plugs warning light
- Q Front brake pad wear warning light
- R Handbrake on / low brake fluid level warning light
- V Speedometer control module
- V1 *Speedometer*
- W Rev counter
- X Coolant temperature gauge
- Z Trip recorder/mileage counter
- Z1 Trip recorder reset button

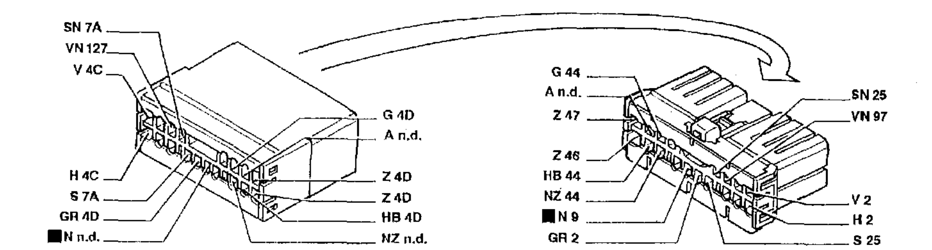
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
19 *Rear right earth*
28 Dashboard/longitudinal cables connection
42 Right dashboard earth
55 Front/engine cables connection
56 Fuel gauge controller
- A Fuel level sensor
- B Electric fuel pump

70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
137 Vehicle speed sensor
142 Low oil pressure warning light switch
158 Coolant temperature sensor for gauge
223 Wheel speed sensor
241 Fuel pump electronic control unit

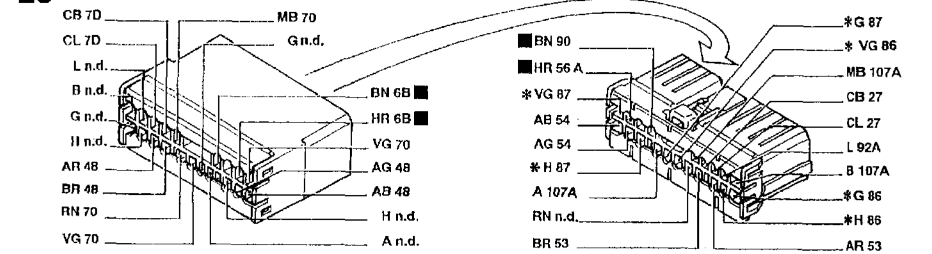
N.D. Ultrasound-soldered joint taped in wiring loom

4A43ZL

## 13 Front right/left cables connection

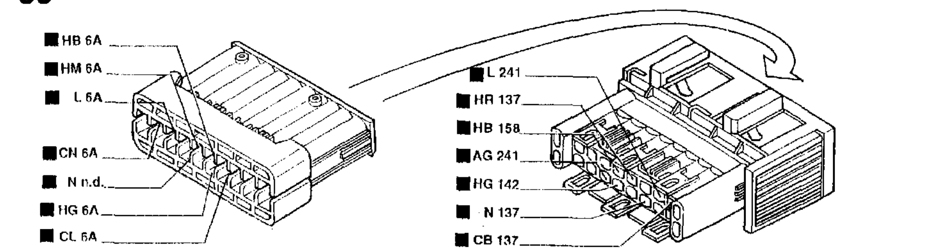



## 28 Dash./longitudinal cables connection

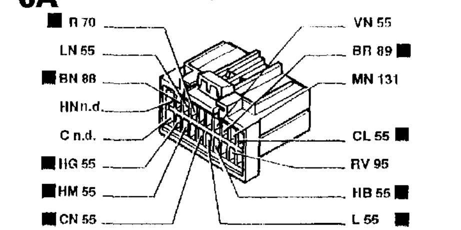



* Brava only

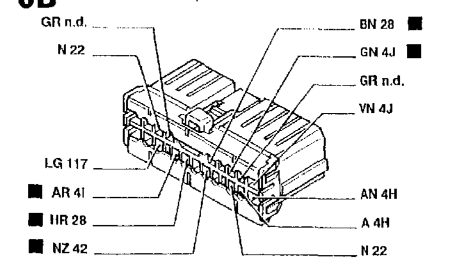
## 55 Front/engine cables connection




## 6A Instrument panel




## 6B Instrument panel



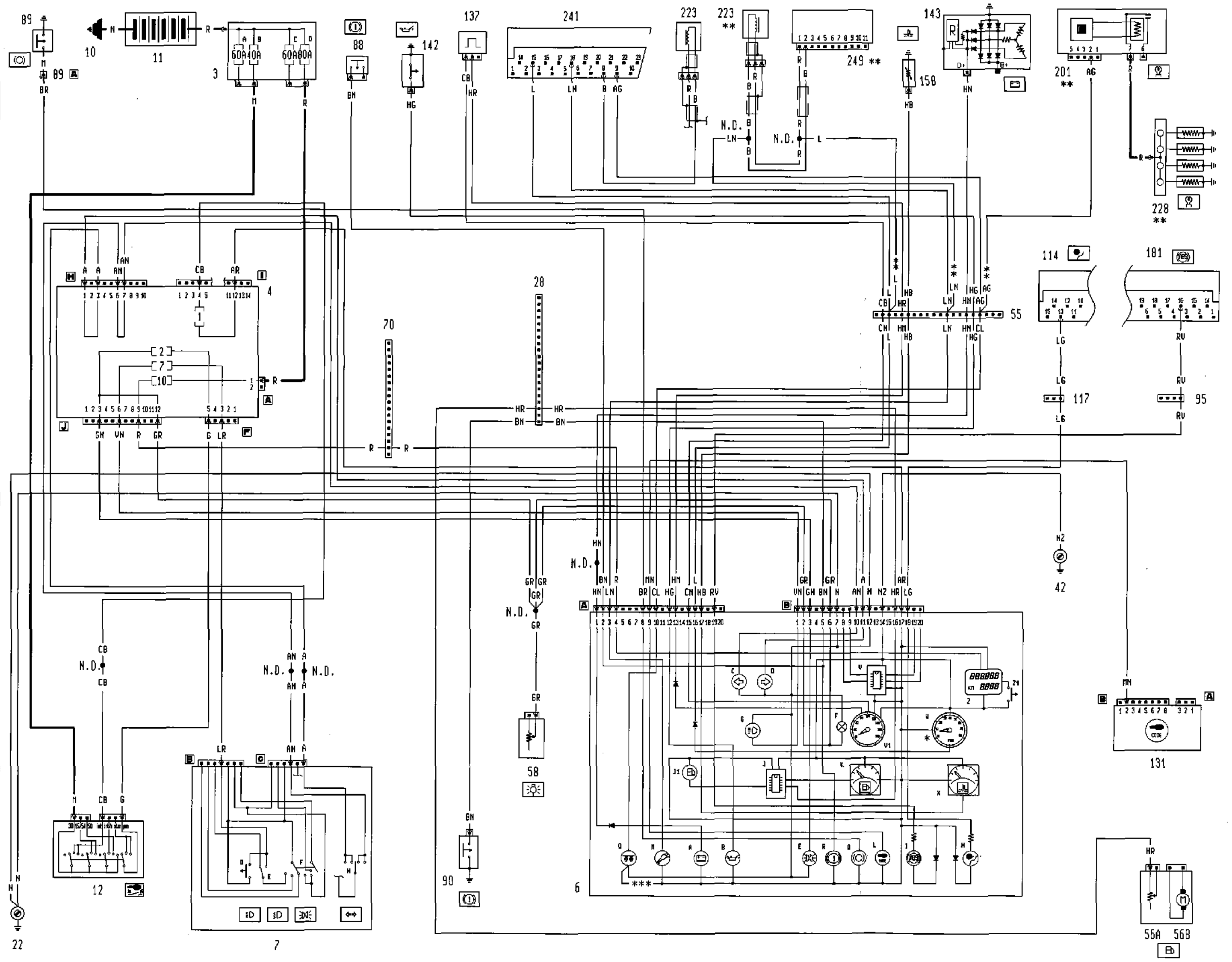

The cables involved in the wiring diagram are marked with a solid square

P4A44ZL01

4A44ZL

**Version: S - SX**

**Instrument panel connections - (See key following diagrams)**

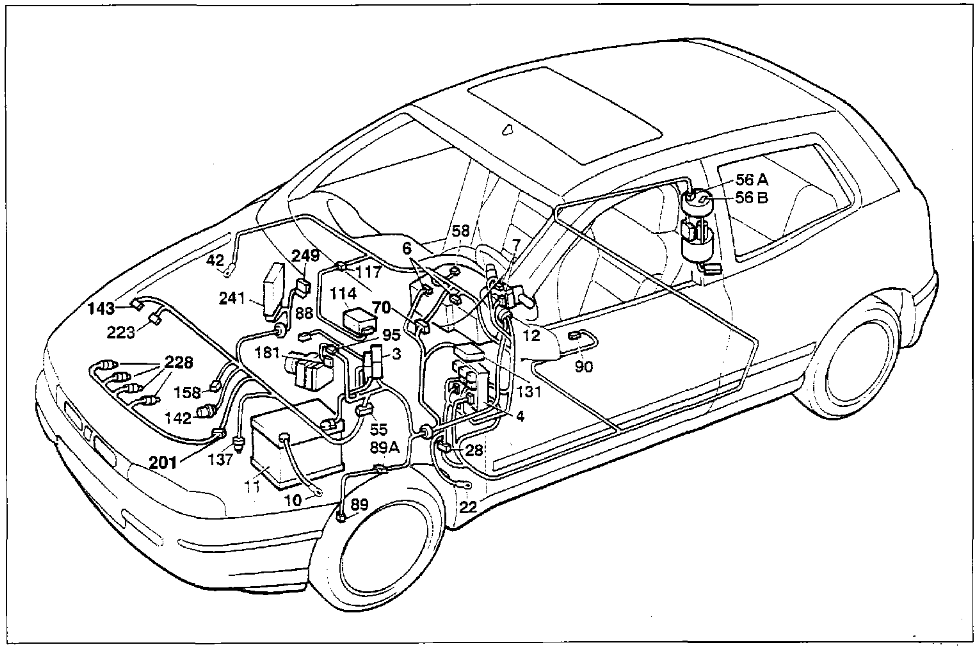



* Not present on S version
** Variant connection for soft versions (75cv) *** Variant connection for SX version

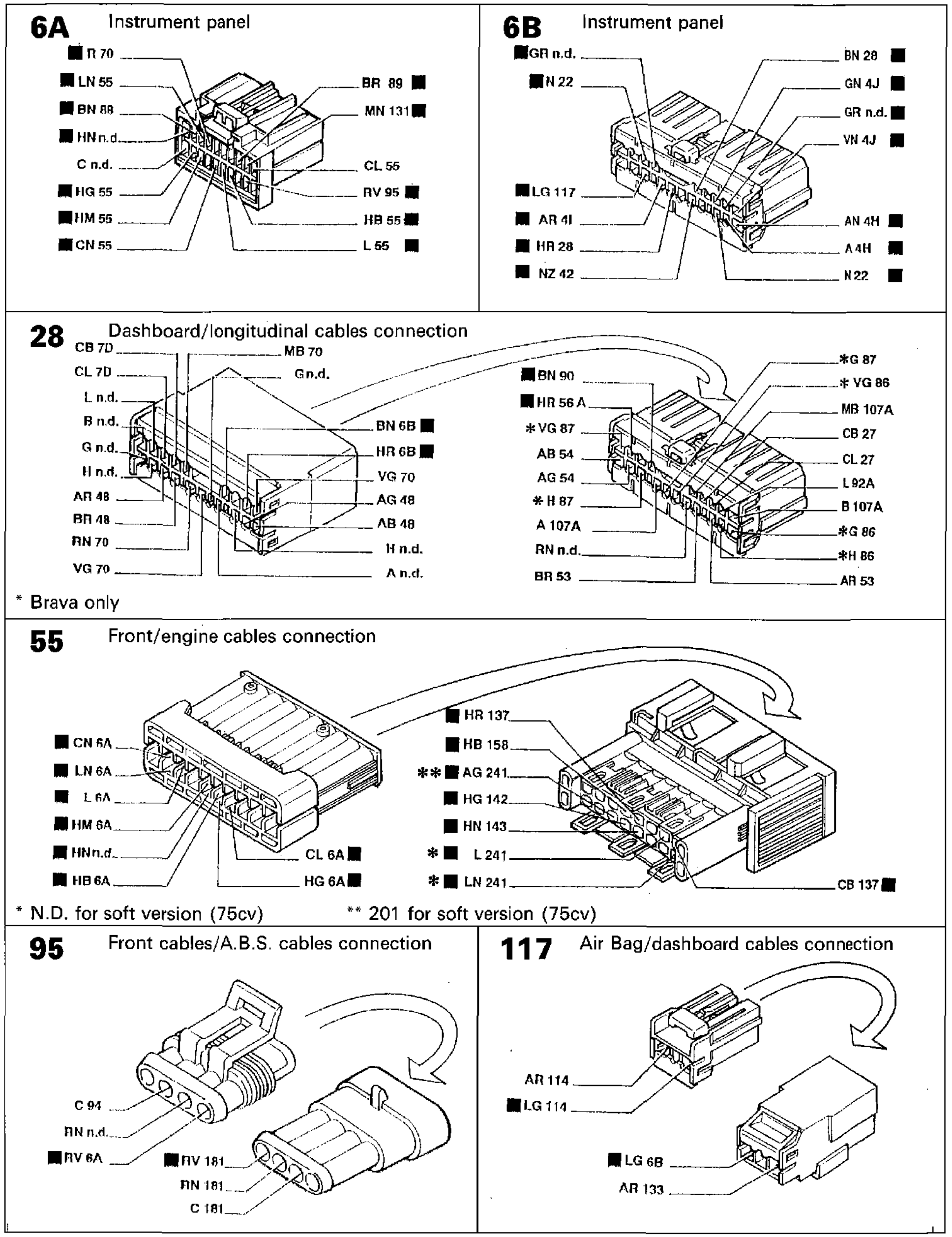
P4A45ZL01

4A46ZL

# 55.




P4A47ZL01




P4A48ZL01

**Version: S - SX**

**Instrument panel connections**

**Key to components**

3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting ignition system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit

6 Instrument panel:
- A Low generator charge warning light
- B Low engine oil pressure warning light
- C Left direction indicator warning light
- D Right direction indicator warning light
- E Side lights warning light
- F Instrument panel symbol lights
- G Main beam headlamps warning light
- H Air Bag fault warning light
- I ABS fault warning light
- J Fuel reserve circuit control module
- J1 Low fuel level warning light
- K Fuel gauge
- L Fiat *CODE* system fault warning light
- M Fuel injection fault warning light
- O Heater plugs warning light
- Q Front brake pad wear warning light
- R Handbrake on / low brake fluid level warning light
- V Speedometer control module
- V1 Speedometer
- W Rev counter
- X Coolant temperature gauge
- Z Trip recorder / mileage counter
- Z1 Trip recorder reset button

7 Stalk unit:
- D Headlamp flasher button
- E Dipped beam/main beam headlamps switch
- F Side lights switch
- H Direction indicators switch

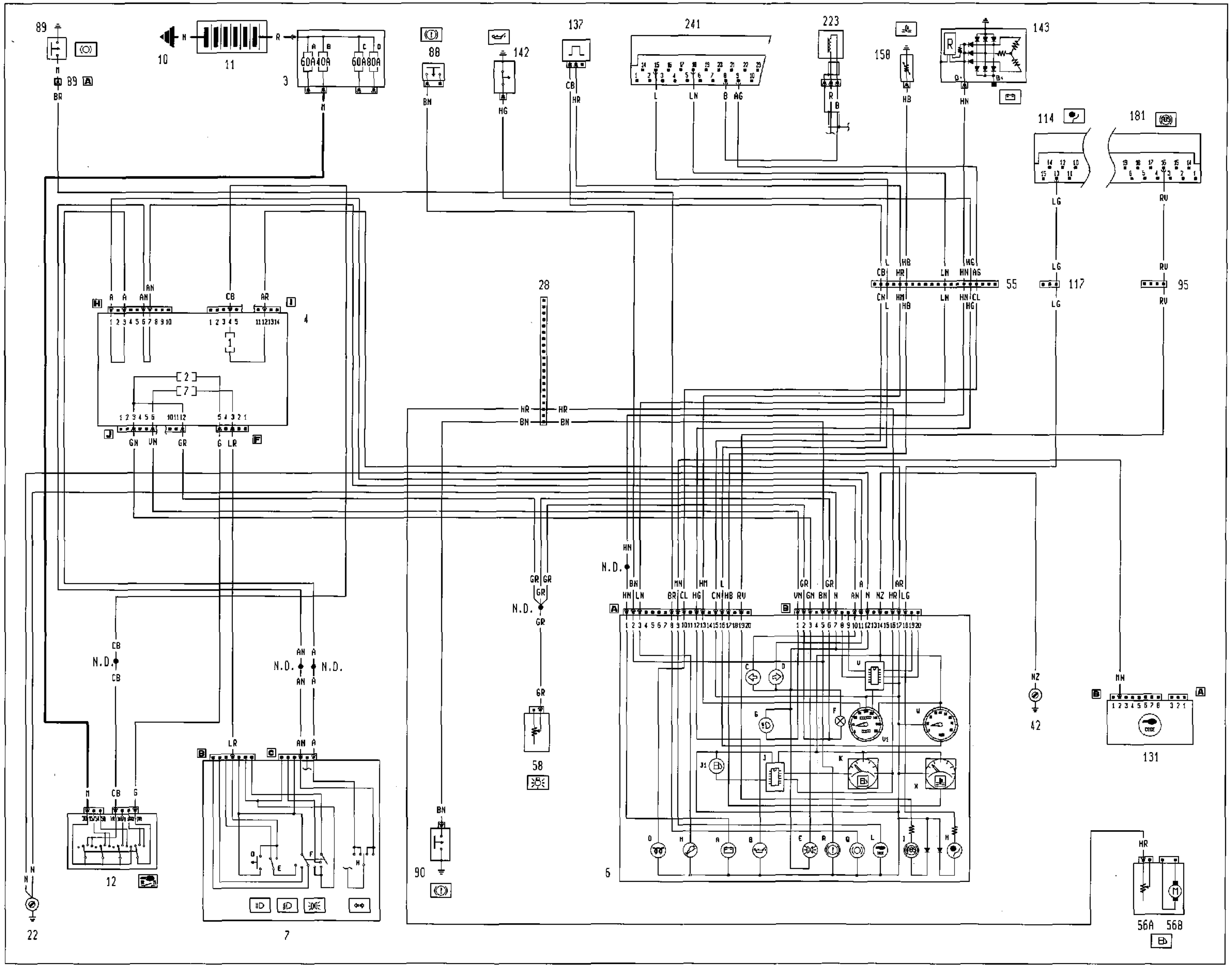
10 Battery earth on body shell
11 Battery
12 Ignition switch
22 Left dashboard earth
28 Dashboard/longitudinal cables connection
42 Right dashboard earth
55 Front/engine cables connection
56 Fuel gauge controller
- A Fuel level sensor
- B Electric fuel pump

58 Lighting brightness adjustment rheostat
70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
95 Front cables/A.B.S. cables connection
114 Air Bag electronic control unit
117 Air Bag/dashboard cables connection
131 *Fiat CODE electronic control unit*
137 Vehicle speed sensor
142 Low oil pressure warning light switch
143 Alternator
158 Coolant temperature sensor for gauge
181 Electrohydraulic control unit for anti-lock braking system (A.B.S.)
201 Plug preheating control unit
223 Wheel speed sensor
228 Heater plugs
241 Fuel pump control unit
249 E.G.R. electronic control unit

N.D. Ultrasound-soldered joint taped in wiring loom

**Version: SX - GT**

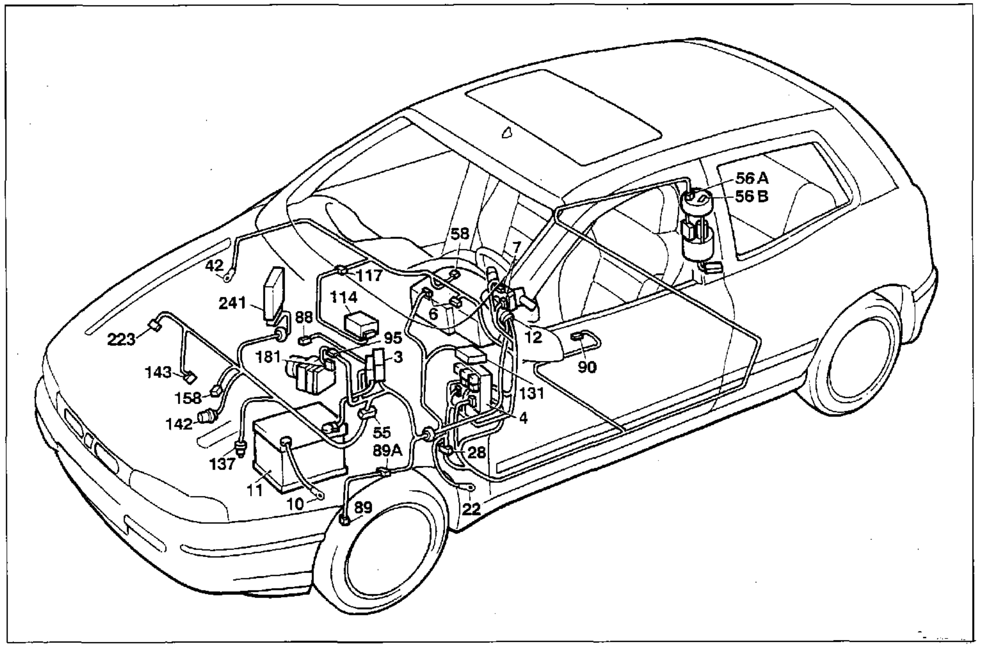
**Instrument panel connections - (See key following diagrams)**




4A49ZL

P4A49ZL01

# 55.




P4A51ZL01

**Version: SX - GT**

### Instrument panel connections

### Key to components

3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting ignition system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit

6 Instrument panel:
- A Low generator charge warning light
- B Low engine oil pressure warning light
- C Left direction indicator warning light
- D Right direction indicator warning light
- E Side lights warning light
- F Instrument panel symbol lights
- G Main beam headlamps warning light
- H Air Bag fault warning light
- I Anti-lock braking system fault warning light
- J Fuel reserve circuit control module
- J1 Low fuel level warning light
- K Fuel gauge
- L Fiat CODE fault warning light
- M Fuel injection fault warning light
- O Heater plugs warning light
- Q Front brake pad wear warning light
- R Handbrake on / low brake fluid warning light
- V Speedometer control module
- V1 Speedometer
- W Rev counter
- X Coolant temperature gauge

7 Stalk unit:
- D Headlamp flasher button
- E Dipped beam/main beam headlamps switch
- F Side lights switch
- H Direction indicators switch

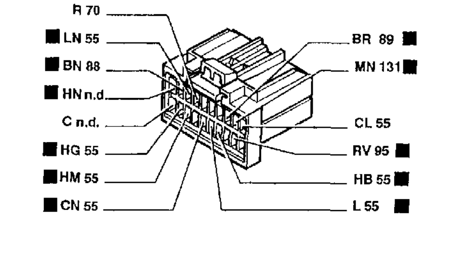
10 Battery earth on body shell
11 Battery
12 Ignition switch
22 Left dashboard earth
28 Dashboard/longitudinal cables connection
42 Right dashboard earth
55 Front/engine cables connection
56 Fuel gauge controller
- A Fuel level sensor
- B Electric fuel pump

58 Lighting brightness adjustment rheostat
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
95 Front cables/anti-lock braking system (A.B.S.) connection
114 Air Bag electronic control unit
117 Air Bag/dashboard cables connection
131 Fiat CODE electronic control unit
137 Vehicle speed sensor
142 Low oil pressure warning light switch
143 Alternator
158 Coolant temperature sensor for gauge
181 Electrohydraulic control unit for anti-lock braking system (A.B.S.)
223 Wheel speed sensor
241 Fuel pump electronic control unit

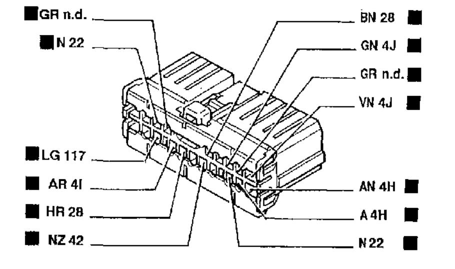
N.D. Ultrasound-soldered joint taped in wiring loom

4A51ZL

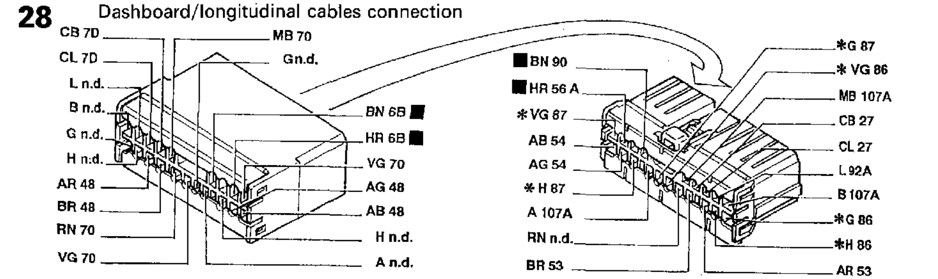
**6A** Instrument panel




**6B** Instrument panel

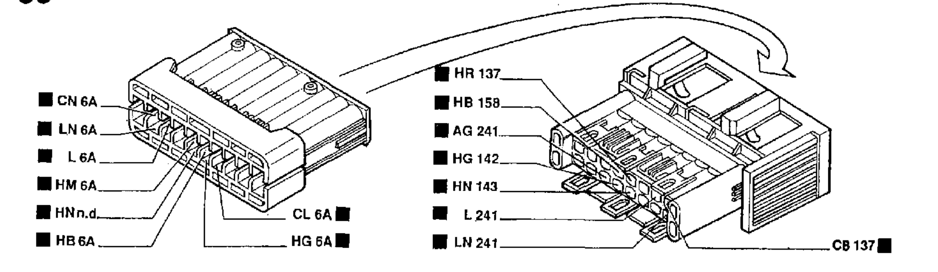



**28** Dashboard/longitudinal cables connection

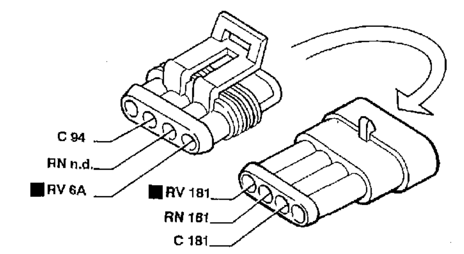



* Brava only

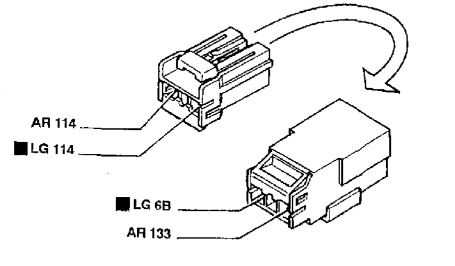
**55** Front/engine cables connection




**95** Front cables/anti-lock braking system (A.B.S.) cables connection




**117** Air Bag/dashboard cables connection

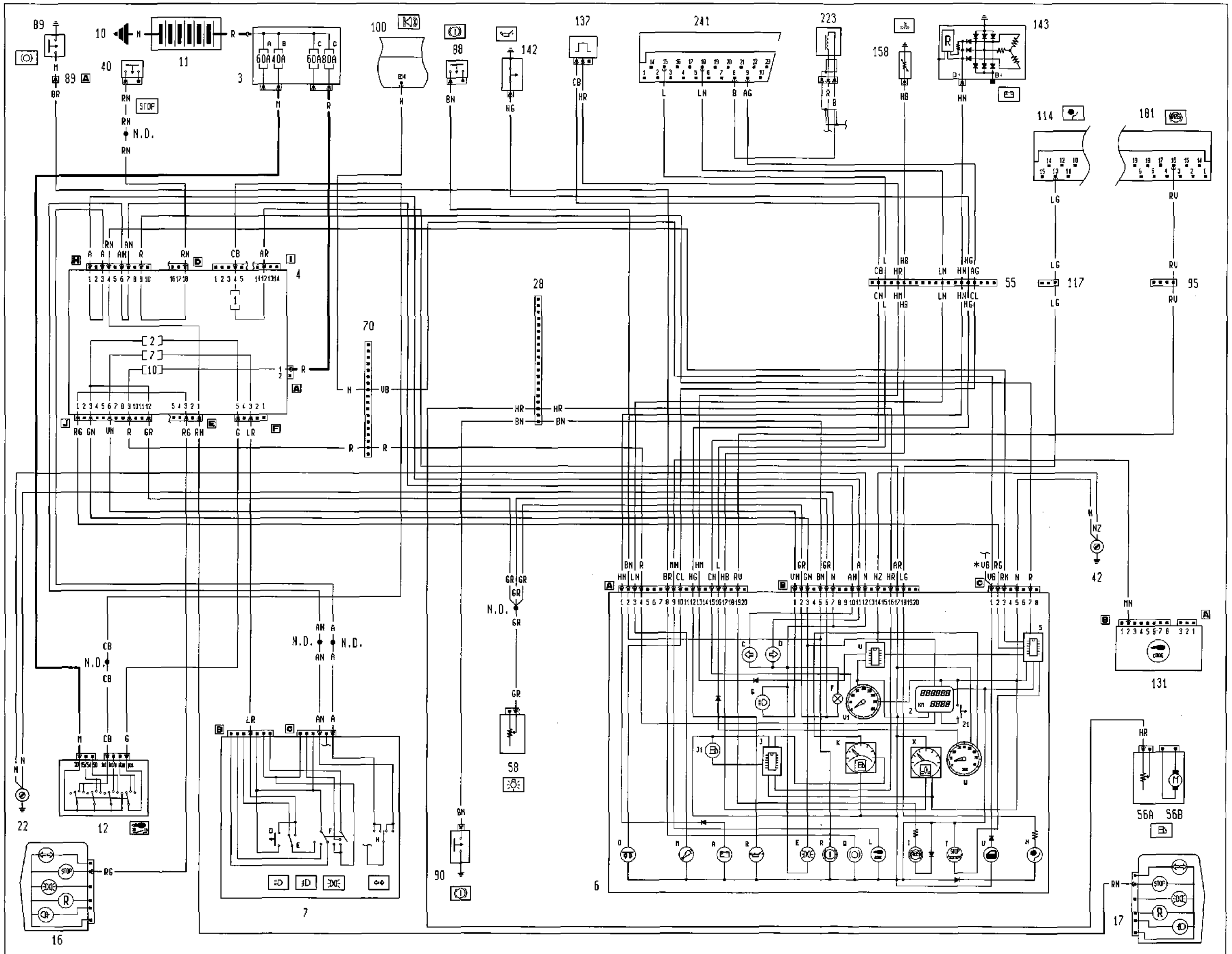



P4A52ZL01

4A52ZL

**Version: EL - ELX**

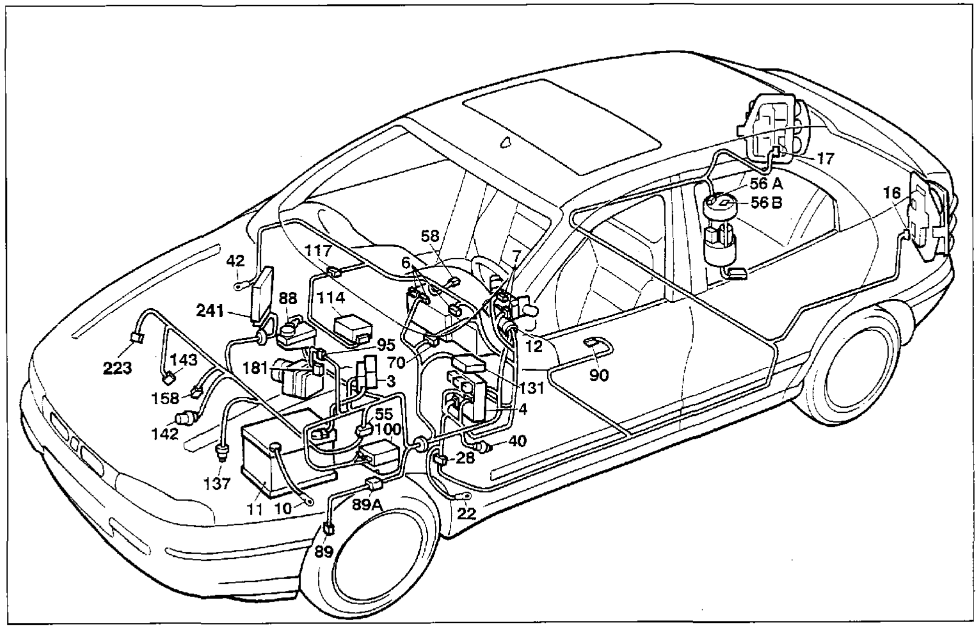
**Instrument panel connections - (See key following diagrams)**



* Variant connection for versions without alarm (see door locking)

4A53ZL P4A53ZL01

# 55.




P4A55ZL01

**Version: EL - ELX**

**Instrument panel connections**

**Key to components**

3 Power fuse box:
- A 60A fuse protecting fuel injection system
- B 40A fuse protecting ignition system
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit

6 Instrument panel:
- A Low generator charge warning light
- B Low engine oil pressure warning light
- C Left direction indicator warning light
- D Right direction indicator warning light
- E Side lights warning light
- F Instrument panel symbol lights
- G Main beam headlamps warning light
- H Air Bag fault warning light
- I Anti-lock braking system fault warning light
- J Fuel reserve circuit control module
- J1 Low fuel level warning light
- K Fuel gauge
- L Fiat CODE system fault warning light
- M Fuel injection fault warning light
- O Heater plugs warning light
- Q Front brake pad wear warning light
- R Handbrake on/low brake fluid level warning light
- S Stop lights fault indicator electronic control module
- T Stop lights fault warning light
- U Doors open warning light
- V Speedometer control module
- V1 Speedometer
- W Rev counter
- X Coolant temperature gauge
- Z Trip recorder/mileage counter
- Z1 Trip recorder reset button

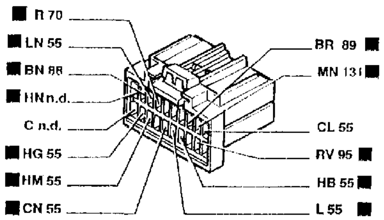
7 Stalk unit:
- D Flasher button
- E Dipped beam/main beam headlamps switch
- F Side lights switch
- H Direction indicators switch

10 Battery earth on body shell
11 Battery
12 Ignition switch
16 Rear left lights cluster
17 Rear right lights cluster
22 Left dashboard earth
28 Dashboard/longitudinal cables connection
40 Stop lights switch
42 Right dashboard earth
55 Front/engine cables connection
56 Fuel gauge controller
- A Fuel level sensor
- B Electric fuel pump

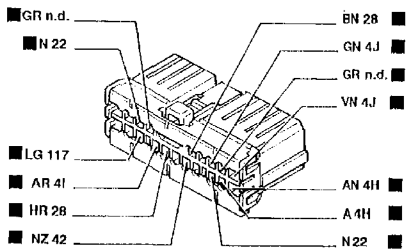
58 Lighting brightness adjustment rheostat
70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
95 Front cables/anti-lock braking system (A.B.S.) cables connection
100 Alarm electronic control unit
114 Air Bag electronic control unit
117 Air Bag/dashboard cables connection
131 Fiat CODE electronic control unit
137 Vehicle speed sensor
142 Low oil pressure warning light switch
143 Alternator
158 Coolant temperature sensor for gauge
181 Electrohydraulic control unit for anti-lock braking system (A.B.S.)
223 Wheel speed sensor
241 Fuel pump electronic control unit

N.D. Ultrasound-soldered joint taped in wiring loom

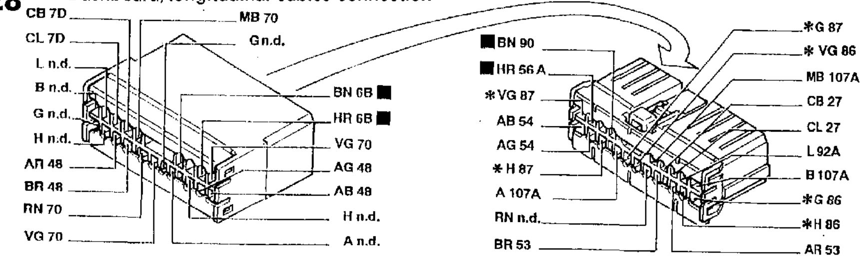
**6A** Instrument panel




**6B** Instrument panel

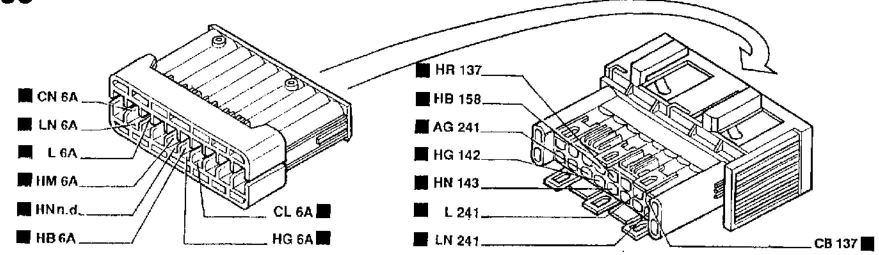



**28** Dashboard/longitudinal cables connection

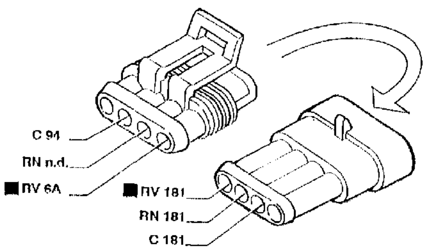



* Brava only

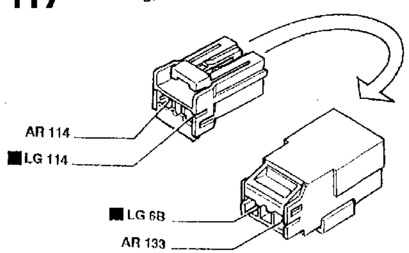
**55** Front/engine cables connection




**95** Front/anti-lock braking system (A.B.S.) cables connection




**117** Air Bag/dashboard cables connection




P4A56ZL01

## CONNECTOR BLOCKS *

INTRODUCTION page



* With regard to the 1910 Turbo D engine, the connector blocks have been added from the previous publication; for aspects not covered, refer to the Bravo-Brava publication no. 506.670/02.

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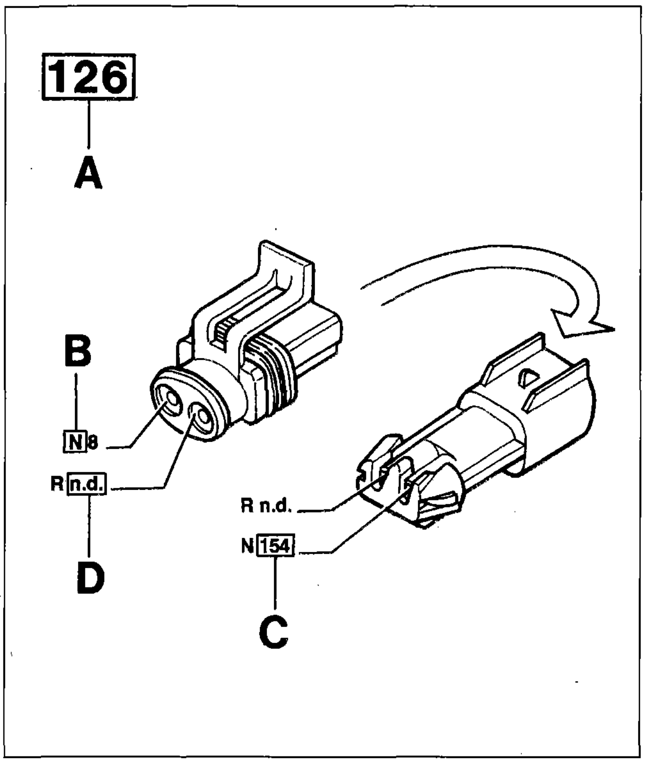
## INTRODUCTION

**Interpretation of the codes on the connector blocks**




P4A58ZL01

**A** Connector block identification number referring to the wiring diagrams

**B** Cable colour identification code

**C** Identification number of the cable's destination block

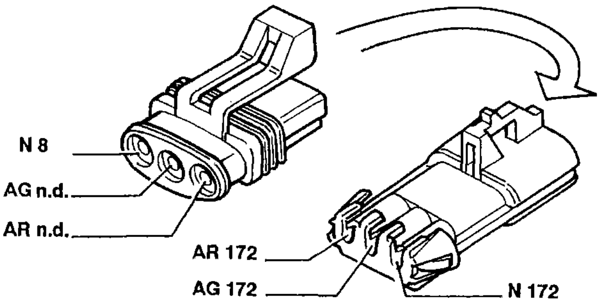
**D** The abbreviation n.d. identifies an ultrasound-soldered joint taped into the wiring loom

**Cable colour codes**

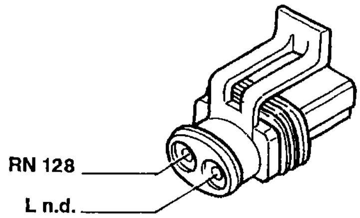
| | | | | | |
|---|---|---|---|---|---|
| **A** | Light blue | **BG** | White-Yellow | **LB** | Blue-White |
| **B** | White | **BL** | White-Blue | **LG** | Blue-Yellow |
| **C** | Orange | **BN** | White-Black | **LN** | Blue-Black |
| **G** | Yellow | **BR** | White-Red | **LR** | Blue-Red |
| **H** | Grey | **BV** | White-Green | **LV** | Blue-Green |
| **L** | Blue | **BZ** | White-Purple | **MB** | Brown-White |
| **M** | Brown | **CA** | Orange-Light blue | **MN** | Brown-Black |
| **N** | Black | **CB** | Orange-White | **NZ** | Black-Purple |
| **R** | Red | **CN** | Orange-Black | **RB** | Red-White |
| **S** | Pink | **GN** | Yellow-Black | **RG** | Red-Yellow |
| **V** | Green | **GL** | Yellow-Blue | **RN** | Red-Black |
| **Z** | Purple | **GR** | Yellow-Red | **RV** | Red-Green |
| **AB** | Light blue-White | **GV** | Yellow-Green | **SN** | Pink-Black |
| **AG** | Light blue-Yellow | **HG** | Grey-Yellow | **VB** | Green-White |
| **AN** | Light blue-Black | **HN** | Grey-Black | **VN** | Green-Black |
| **AR** | Light blue-Red | **HR** | Grey-Red | **VR** | Green-Red |
| **AV** | Light blue-Green | **HV** | Grey-Green | **ZB** | Purple-White |

4A58ZL

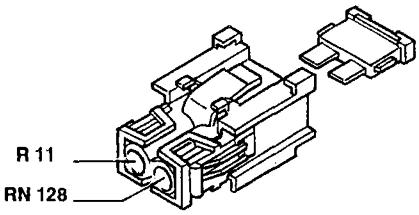
### 236 Front/air conditioner cables connection



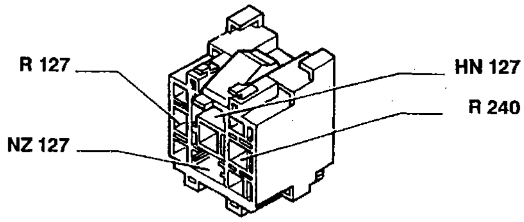

### 237 Additional engine cooling fan



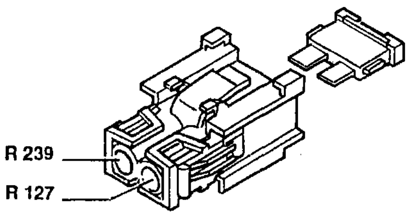

### 238 40A fuse protecting engine cooling fan



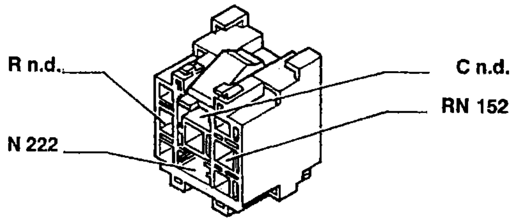

### 239 Heated diesel filter control relay



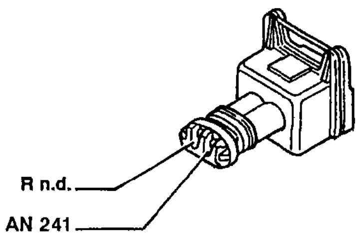

### 240 20A fuse protecting heated diesel filter control relay



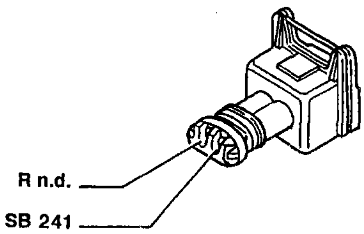

### 242 Fuel injection control relay




### 243 Engine advance adjustment solenoid




### 244 Fast idle adjustment solenoid

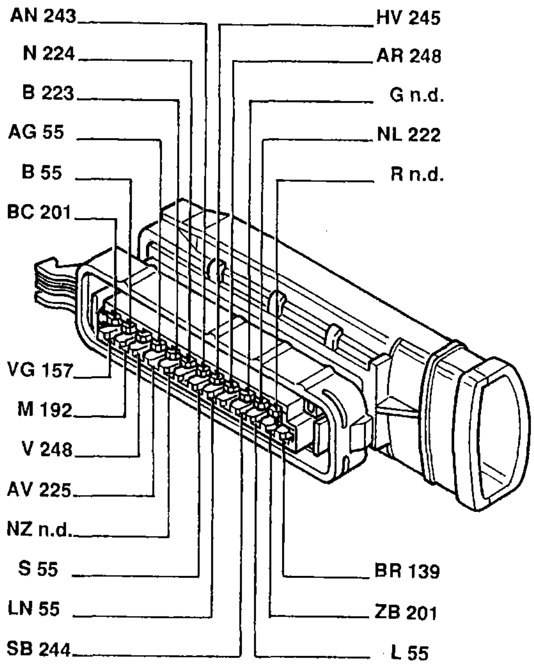



P4A59ZL01

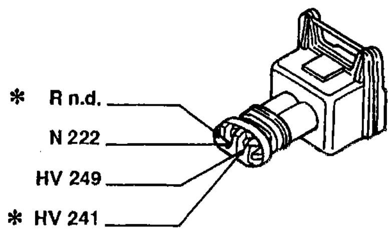
4A09ZL

# 55.

## 241 Fuel pump electronic control unit

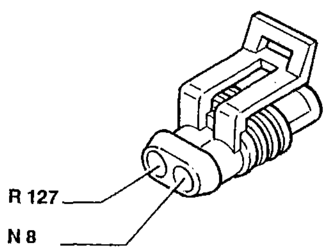



## 245 E.G.R. solenoid

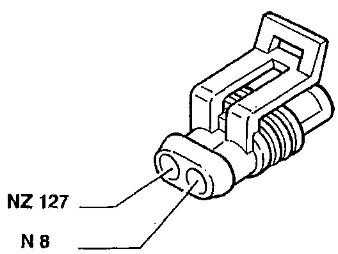



* Variant connections for 100 BHP version

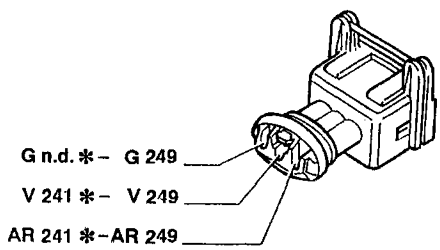
## 246 Heated fuel filter




## 247 Heated fuel filter thermal contact




## 248 Potentiometer on fuel pump

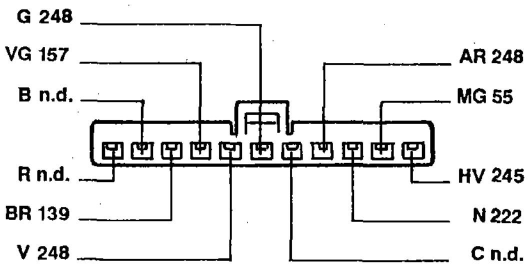



* Variant connections for 100 BHP version

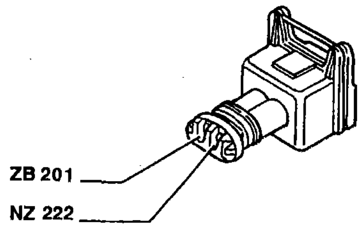
P4A60ZL01

4A60ZL

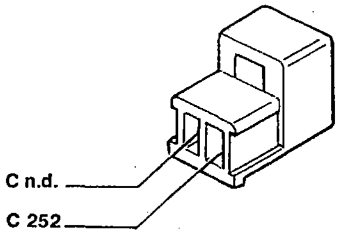
## 249 E.G.R. electronic control unit



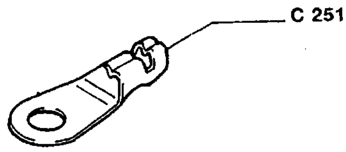

## 250 Water temperature sensor for preheating control unit



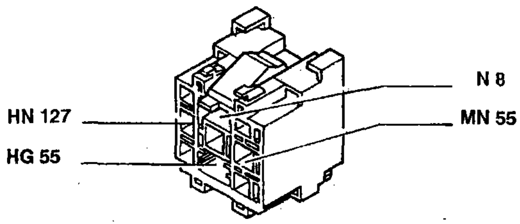

## 251 Thermal switch for K.S.B.




## 252 Earth for K.S.B. device




## 253 Relay for switching off compressor




P4A61ZL01

# 55.

**Key to compnents:**

3 Power fuse box:
  A 60A fuse protecting fuel injection system
  B 40A fuse protecting ignition system
  C 60A fuse protecting additional optional extras
  D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit:
  E1 Ignition switch discharge relay
  E2 Horn relay
  E3 Heated rear window relay
6 Instrument panel:
  A Low generator charge warning light
  B Low engine oil pressure warning light
  C Left direction indicator warning light
  D Right direction indicator warning light
  E Side lights warning light
  F Instrument panel symbol lights
  G Main beam headlamps warning light
  H Air Bag fault warning light
  I Anti-lock braking system fault warning light
  J Fuel reserve circuit control module
  J1 Low fuel level warning light
  K Fuel gauge
  L Fiat CODE fault warning light
  M Fuel injection fault warning light
  O Heater plugs warning light
  Q Front brake pad wear warning light
  R Handbrake on / low brake fluid level warning light
  S Stop lights fault indicator electronic control module
  T Stop lights fault warning light
  U Door open warning light
  V Speedometer control module
  V1 Speedometer
  W Rev counter
  X Water temperature gauge
  Z Trip recorder/mileage counter
  Z1 Trip recorder reset button
7 Stalk unit:
  A Windscreen wiper speed switch
  B Windscreen wash/headlamp wash/rear window wash switch
  C Rear window wiper switch
  D Headlamp flasher button
  E Dipped beam/main beam headlamps
  F Side lights switch
  G Indicators/hazard lights intermittent switch
  H Direction indicators switch
  I Horn button
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
18 Rear left earth
19 Rear right earth
22 Left dashboard earth
24 Windscreen wiper motor
25 Windscreen/rear window washer pump
26 Rear window wiper motor
27 Rear connections contact assembly with built-in boot light switch
28 Dash./longitudinal cables connection
34 Switch controls unit:
  A Alarm on warning light
  B Rear fog lamps switch
  C Rear fog lamps relay
  D Rear fog lamps warning light
  E Heated rear window switch
  F Heated rear window warning light
  G Switch controls unit symbol light
  H Front fog lamps warning light
  I Front fog lamps switch
39 Heated rear window
42 Right dashboard earth
46 Left horn
47 Right horn
55 Front/engine cables connection
55A Front left/engine cables connection
55C Front left/engine cables connection

56 Fuel gauge controller
A Fuel level sensor
B Electric fuel pump
57 Inertial switch
58 Lighting brightness adjustment rheostat
70 Dash./front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
95 Front/anti-lock braking system (A.B.S.) cables connection
97 Headlamp washer pump
98 Headlamp washer intermittent switch
99 20A fuse protecting headlamp washer
114 Air Bag electronic control unit
117 Air Bag/dashboard cables connection
120 Air conditioner cables connection
121 Three-stage pressure switch
122 Engine cooling fan low speed relay
123 Engine cooling fan high speed timer
123A Engine cooling fan high speed relay
124 Air conditioner compressor relay
126 Front/air conditioner cables connection
127 Connection between front left cables/cable on relay bracket
128 Front/air conditioner cables connection
129 40A power fuse protecting engine cooling fan
131 Fiat CODE electronic control unit
137 Car speed sensor
139 Diagnostic socket for fuel injection
142 Low oil pressure warning light switch
143 Alternator
145 Starter motor
147 Compressor for air conditioner
152 10A fuse protecting fuel injection
154 Engine cooling fan
157 Water temperature sensor for fuel injection
158 Water temperature sensor for gauge
170 Engine cooling fan limiting resistor
171 Heater unit
172 Two-stage thermostat
181 Electrohydraulic control unit for anti-lock braking system (A.B.S.)
192 Air temperature sensor
200 Inertial switch relay
201 Plug preheating control unit
202 Heater/air conditioner light bulbs
203 Air conditioner controls:
A Switch for switching on air conditioner
B Air conditioner recirculation control switch
204 Engine cooling fan 1st speed control relay
205 Air conditioner fan control relay
206 Heater/air conditioner fan
207 Heater/air conditioner speed control switch
208 Heater/air conditioner limiting resistor
209 Actuator controlling exterior air/recirculation
210 Electronic thermostat cables connection
211 Electronic thermostat (N.T.C.)
222 Earth for fuel system
223 Wheel speed sensor
224 Instrumented fuel injector
225 Flowmeter
226 Diagnostic socket for Fiat CODE system
228 Heater plugs
229 Engine cut-out electrostop
232 Compressor earth
233 Thermostat on coolant pump
235 Air conditioner compressor cables connection
236 Front/air conditioner cables connection
237 Additional engine cooling fan
238 40A fuse protecting engine cooling fan
239 Heated diesel filter relay
240 20A fuse protecting heated diesel filter relay
241 Fuel pump electronic control unit
242 Fuel injection control relay
243 Engine advance adjustment solenoid
244 Fast idle solenoid
245 E.G.R. solenoid
246 Heated fuel filter
247 Heated fuel filter thermal contact
248 Potentiometer on fuel pump
249 E.G.R. electronic control unit
250 Water temperature sensor for preheating control unit
251 K.S.B. thermal switch
252 K.S.B. earth.
253 Relay for switching off compressor

N.D. Ultrasound-soldered joint taped into wiring loom

**Cable colour code:**

| | |
|---|---|
| **A** | Light blue |
| **B** | White |
| **C** | Orange |
| **G** | Yellow |
| **H** | Grey |
| **L** | Blue |
| **M** | Brown |
| **N** | Black |
| **R** | Red |
| **S** | Pink |
| **V** | Green |
| **Z** | Purple |
| **AB** | Light blue-White |
| **AG** | Light blue-Yellow |
| **AN** | Light blue-Black |
| **AR** | Light blue-Red |
| **AV** | Light blue-Green |
| **BG** | White-Yellow |
| **BL** | White-Blue |
| **BN** | White-Black |
| **BR** | White-Red |
| **BV** | White-Green |
| **BZ** | White-Purple |
| **CA** | Orange-Light blue |
| **CB** | Orange-White |
| **CN** | Orange-Black |
| **GN** | Yellow-Black |
| **GL** | Yellow-Blue |
| **GR** | Yellow-Red |
| **GV** | Yellow-Green |
| **HG** | Grey-Yellow |
| **HN** | Grey-Black |
| **HR** | Grey-Red |
| **HV** | Grey-Green |
| **LB** | Blue-White |
| **LG** | Blue-Yellow |
| **LN** | Blue-Black |
| **LR** | Blue-Red |
| **LV** | Blue-Green |
| **MB** | Brown-White |
| **MN** | Brown-Black |
| **NZ** | Black-Purple |
| **RB** | Red-White |
| **RG** | Red-Yellow |
| **RN** | Red-Black |
| **RV** | Red-Green |
| **SN** | Pink-Black |
| **VB** | Green-White |
| **VN** | Green-Black |
| **VR** | Green-Red |
| **ZB** | Purple-White |

page

# 55.

| NAME | Bravo | | Brava | | | |
|---|---|---|---|---|---|---|
| | S | SX | S | SX | EL | ELX |
| | 1581 16v | 1581 16v | 1581 16v | 1581 16v | 1581 16v | 1581 16v |
| Side lights and warning lamp - Dipped beam headlamps - Main beam headlamps and warning light - Parking lights - Number plate lights - | 5 | 5 | 5 | 5 | 5 | 5 |
| Front fog lamps and warning light - Rear fog lamps and warning light | 7 | 7 | 7 | 7 | 7 | 7 |
| Version with air conditioner<br>Engine cooling system - Water temperature gauge | 9 | 9 | 9 | 9 | 9 | 9 |
| Anti-lock braking system (A.B.S.) and fault warning light - Hand brake on/low brake fluid level warning light | 11 | 11 | 11 | 11 | 11 | 11 |
| Fiat-CODE system and fault warning light | 13 | 13 | 13 | 13 | 13 | 13 |
| Starting - Electronic ignition and fuel injection - Recharging and warning light - Low engine oil pressure warning light - Fuel injection fault warning light - Rev counter | 15 | 15 | 15 | 15 | 15 | 15 |
| Model without air conditioner<br>Engine cooling system - Water temperature gauge - Car interior ventilation | 17 | 17 | 17 | 17 | 17 | 17 |
| Direction indicators and warning lamp - Hazard warning lights and warning lamp - Stop lights - Reversing lights | 19 | 19 | 19 | 19 | 21 | 21 |
| Fuel level gauge and reserve warning light - Hand brake on/low brake fluid level warning light - Speedometer - Trip recorder/total mileage counter and trip recorder reset button - Water temperature gauge - Low engine oil pressure warning light - Rev counter - Front brake pad wear warning light | 23 | 23 | 23 | 23 | 25 | 25 |
| Air conditioner | 27 | 27 | 27 | 27 | 27 | 27 |
| Courtesy light - Symbol illumination | 29 | 29 | 29 | 29 | 29 | 29 |
| Instrument panel connections | 31 | 31 | 31 | 31 | 33 | 33 |
| Diagnostic socket connections | 35 | 35 | 35 | 35 | 35 | 35 |

### Electrical symbols

| | | |
|---|---|---|
| Side lights | Choke (starter) | Switch discharge |
| Main beam | Water in fuel filter | Dipped headlamps |
| Heated seat | Heater plug | Indicators flashing with central door locking |
| Seat belts | Compressor turbo pressure | Electric horns |
| Heated rear window | Rear fog lamps | Left indicator |
| Hand brake on and low brake fluid level | Front fog lamps | Right indicator |
| A.B.S. | Brake pad wear | Engine cooling |
| Hazard warning | Compressor turbo pressure | Windscreen wiper |
| Indicators | Auto transmission fluid temperature | Electric sunroof |
| Handbrake on and low brake fluid level | Speed limits | Catalytic converter temperature |
| Recharging | Fuel gauge | Heating element |
| Engine oil pressure | Engine coolant temperature gauge | Diode |

P4A01EL01

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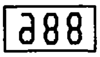
## Electrical symbols

| | | | | | |
|---|---|---|---|---|---|
| | Warning light | | Trip computer control | | Differential lock |
| | Bulb | | Electronic injection | | Auto transmission fluid temperature |
| | Fuse | | Engine oil level | 00° | Temperature |
| | Switch open | BRAKE | Brake fluid level (Japan version) | | Anti-theft device |
| | Selector switch | | Doors open | | Electric windows |
| | Button open | | Central locking | | Earth |
| | Coil-controlled switch (Relay) | SPORT | Sport function on electronic suspension system | | No. plate lights |
| M | Motor | | Transistor | | Pulse generator (Timer) |
| | Rear window wiper | | Air Bag | | Analogue clock |
| | Headlamp washer | ANTI LOCK | A.B.S. (Japan version) | 88:88 | Digital clock |
| | Screen wash/wipe | STOP | Car stop fault | | Speedometer |
| | Rear win. wash/wipe | | Windscreen wiper | | Rev counter |

P4A02EL01

**Electrical symbols**

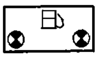
 Digital speedometer

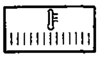
 Digital rev counter

 Digital fuel gauge

 Analogue fuel gauge

 Analogue coolant temperature gauge

 Econometer

 Digital coolant temperature gauge

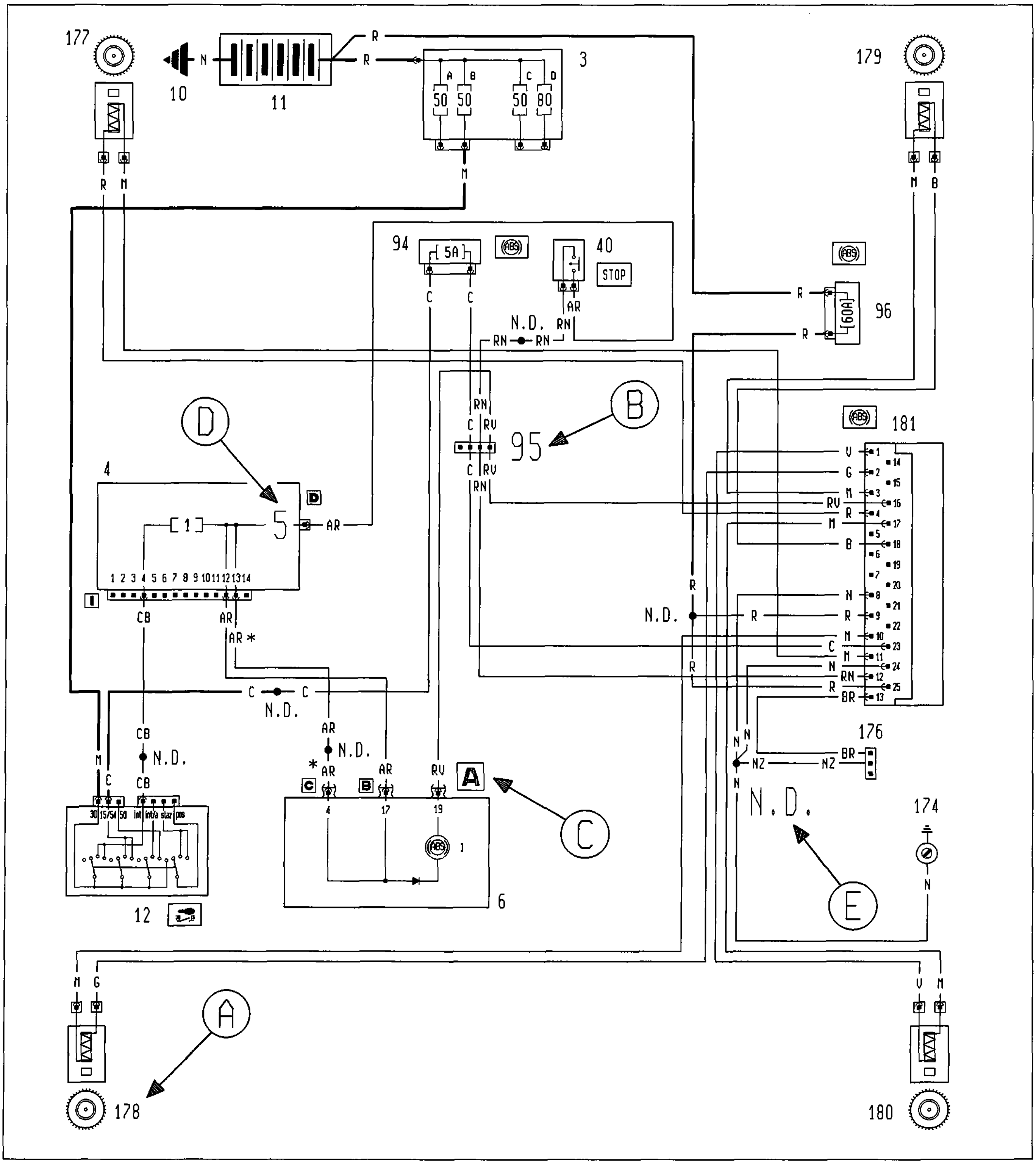
 Engine oil temperature

 Engine oil pressure gauge

 Voltmeter

P4A03EL01

**How to read the wiring diagrams**

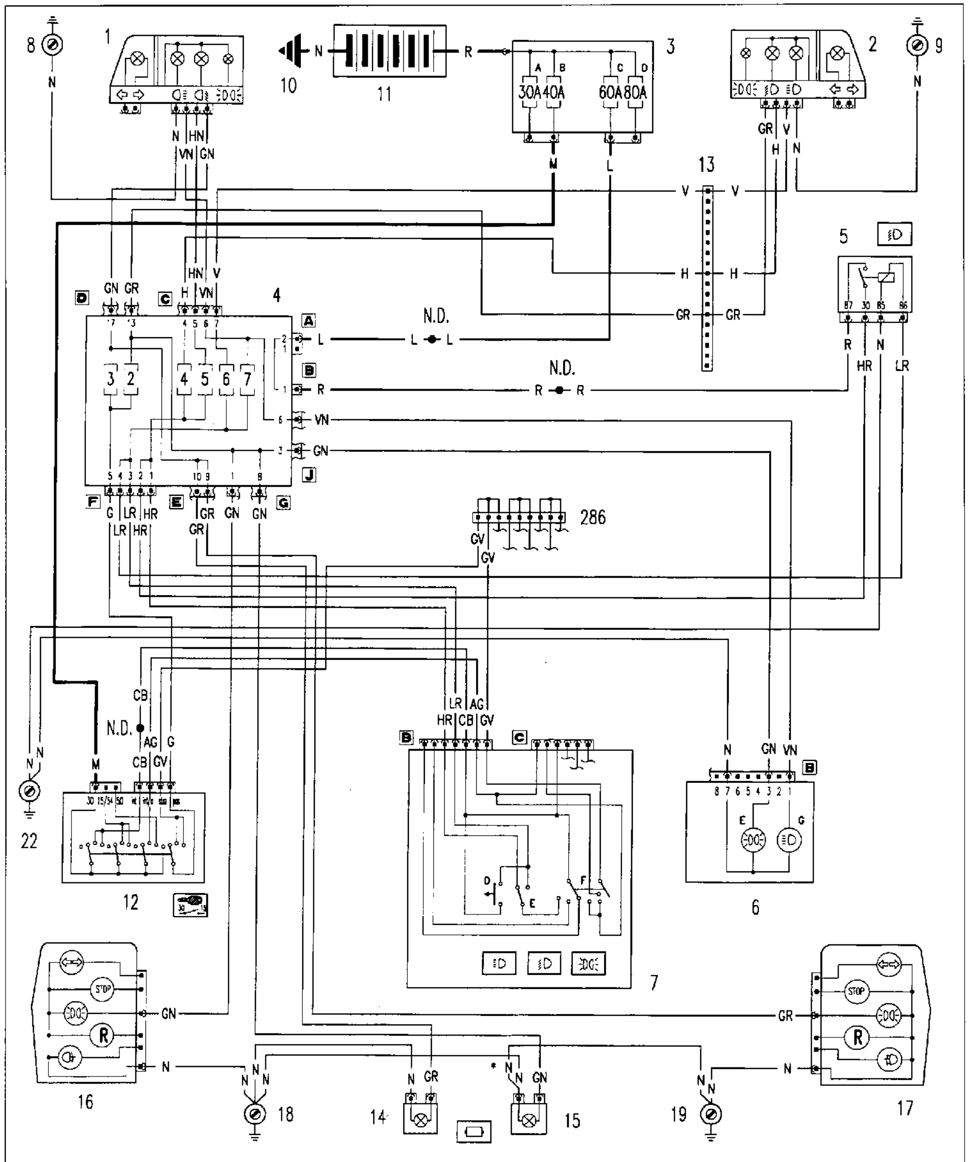



P4A04EL01

**Key to references**

- A Component number
- B Connection number
- C Identification of connector on component
- D Connecting pin number
- E Ultrasound-soldered joint taped in wiring loom

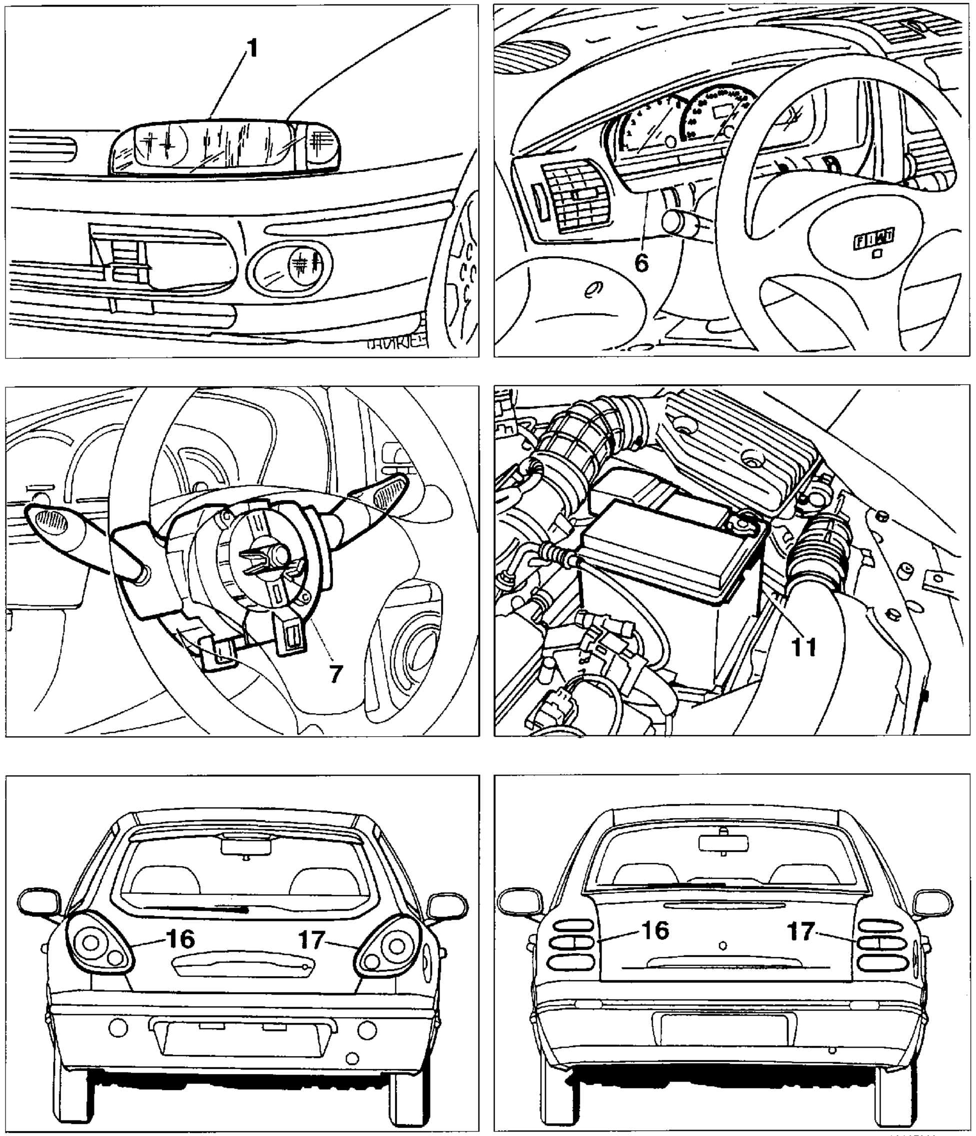
**Side lights and warning lamp - Dipped beam headlamps - Main beam headlamps and warning light - Parking lights - Number plate lights -**




* Variant connections for Bravo versions

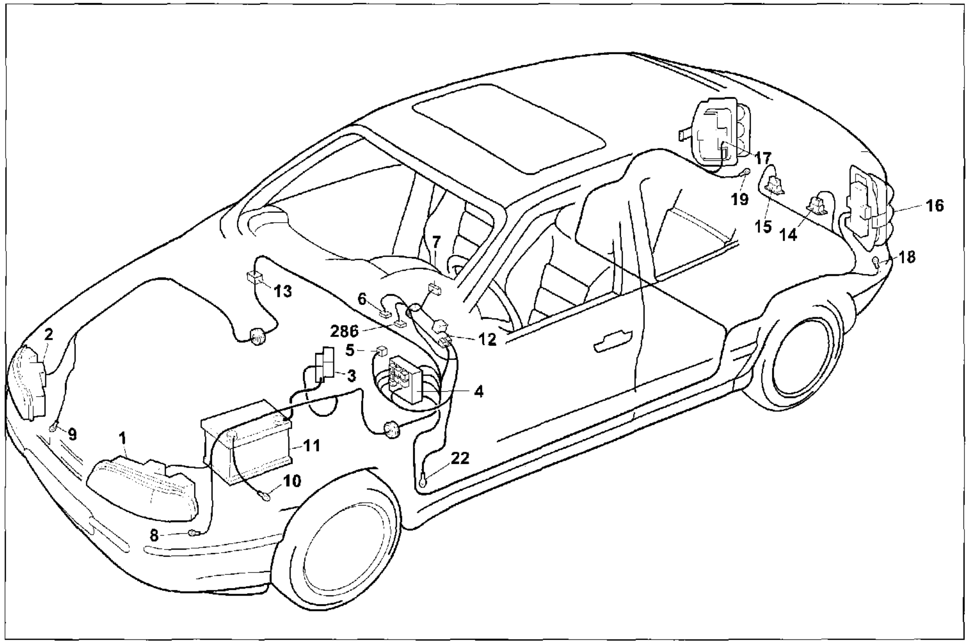
P4A05EL01

**Location of components**




P4A06EL01

# 55.



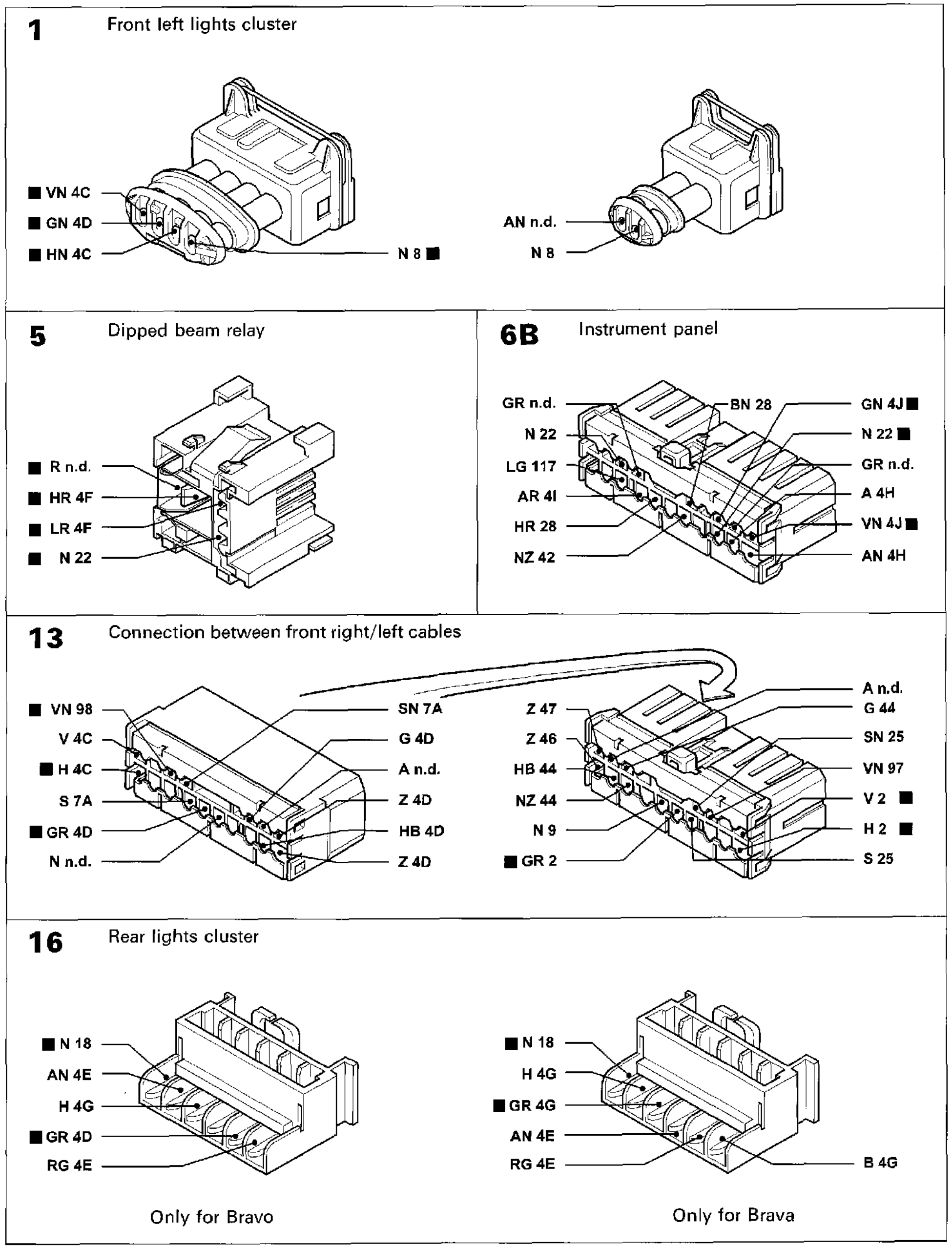

P4A07EL01

**Side lights and warning lamp - Dipped beam headlamps - Main beam headlamps and warning light - Parking lights - Number plate lights**

**Key to components**

1 Front left lights cluster
2 Front right lights cluster
3 Power fuse box:
  A 30A fuse protecting fuel injection
  B 40A fuse protecting ignition
  C 60A fuse protecting additional optional extras
  D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
5 Dipped beam relay
6 Instrument panel:
  E Side lights warning light
  G Main beam headlamps warning light
7 Stalk unit:
  D Flasher button
  E Main beam/dipped beam headlamps stalk
  F Side lights stalk
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Connection between front right/left cables
14 Left number plate light
15 Right number plate light
16 Rear left lights cluster
17 Rear right lights cluster
18 Rear left earth
19 Rear right earth
22 Left dashboard earth
286 Short-circuiting connection

N.D. Ultrasound-soldered joint taped in wiring loom

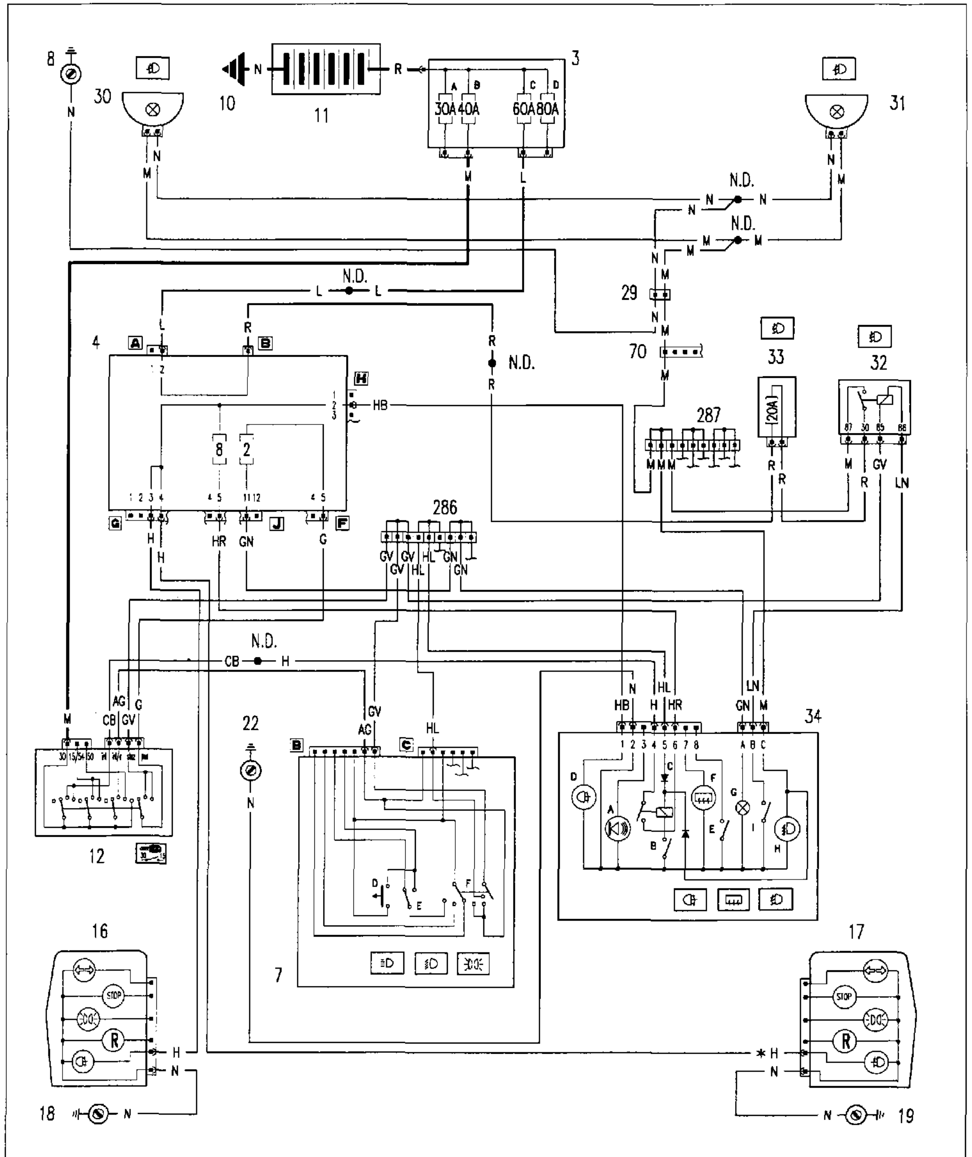



P4A08EL01

■ The cables involved in the wiring diagram are marked by a solid square

# 55.

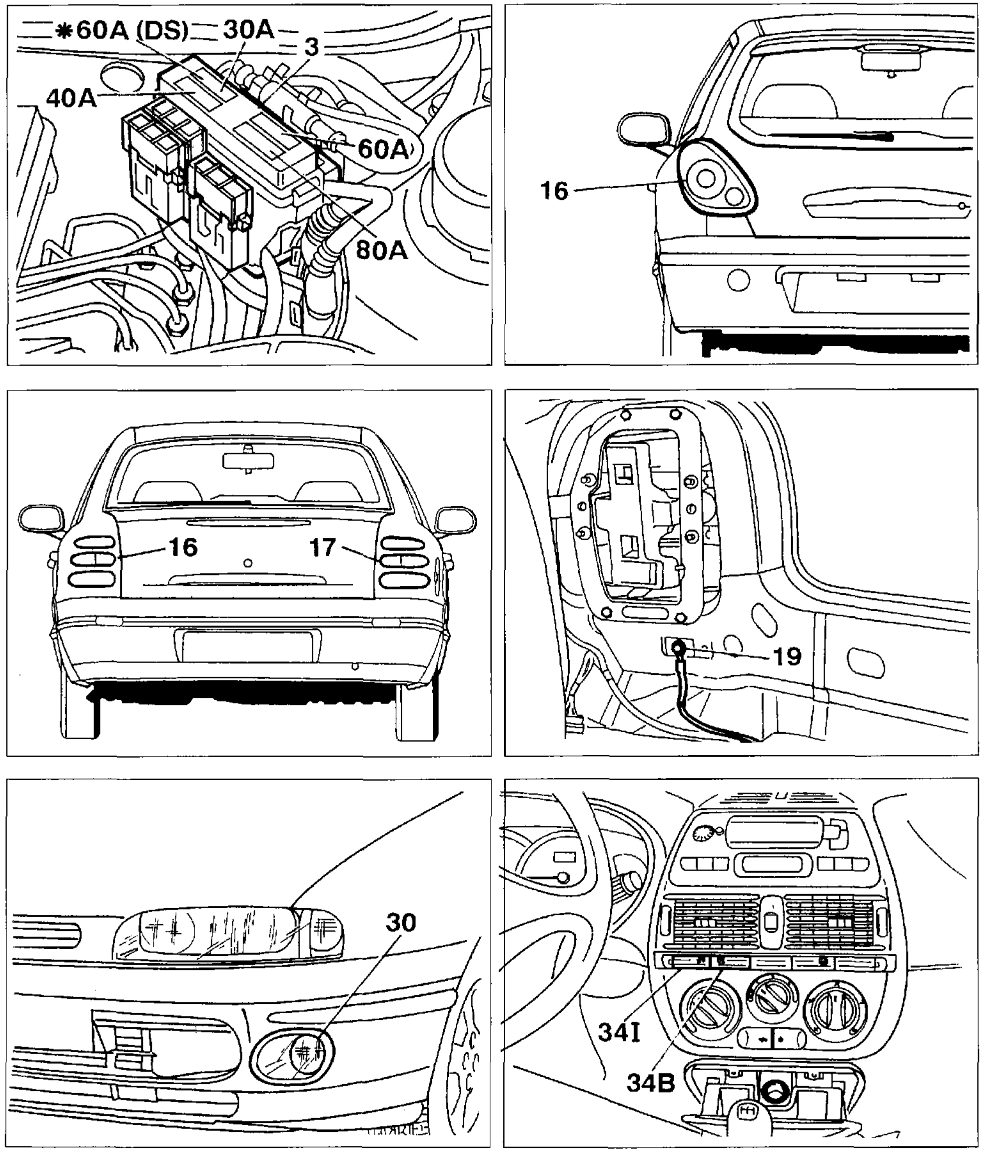
**Front fog lamps and warning light - Rear fog lamps and warning light**




* Not present on Bravo

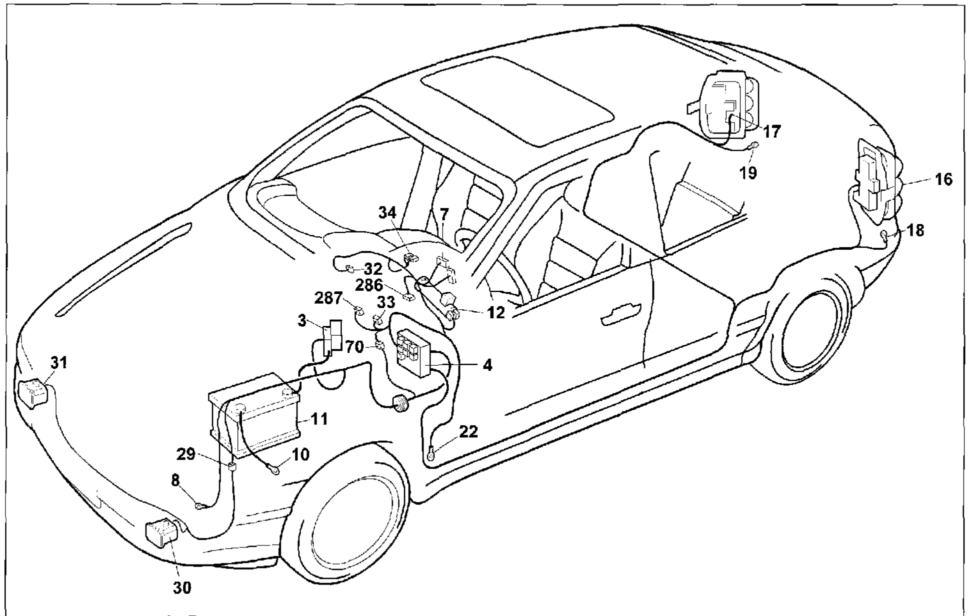
P4A09EL01

**Location of components**




P4A10EL01

# 55.




**Front fog lamps and warning light - Rear fog lamps and warning light**

**Key to components**

3 Power fuse box:
- A 30A fuse protecting fuel injection
- B 40A fuse protecting ignition
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

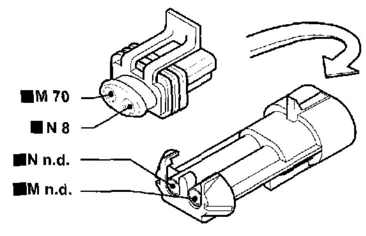
4 Fuse and relay unit
7 Stalk unit:
- D Flasher button
- E Dipped beam/main beam headlamps stalk
- F Side lights stalk

8 Front left earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
16 Rear left lights cluster
17 Rear right lights cluster
18 Rear left earth
19 Rear right earth
22 Left dashboard earth
29 Front/front fog lamps cables connection
30 Front left fog lamp
31 Front right fog lamp
32 Front fog lamp relay
33 20A fuse protecting front fog lamps
34 Switch controls unit:
- A Alarm on warning light
- B Rear fog lamps switch
- C Rear fog lamps relay
- D Rear fog lamps warning light
- E Heated rear window switch
- F Heated rear window warning light
- G Switch controls unit symbol light
- H Front fog lamps warning light
- I Front fog lights switch

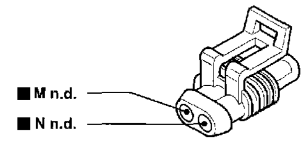
70 Dashboard/front cables connection
286 Short-circuiting connection
287 Short-circuiting connection

N.D. Ultrasound-soldered joint taped in wiring loom

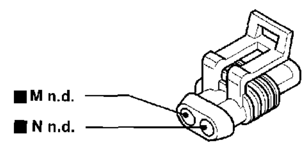
**29** Front/front fog lamps cables connection



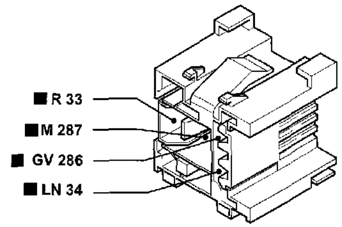

**30** Front left fog lamp



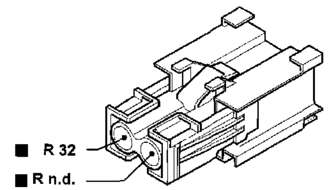

**31** Front right fog lamp



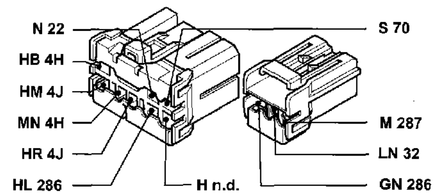

**32** Front fog lamp relay



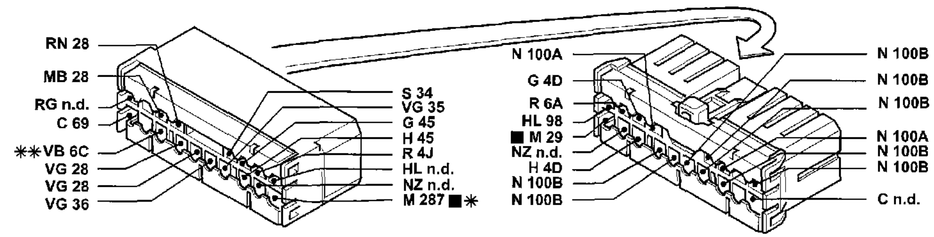

**33** 20A fuse protecting front fog lamps




**34** Switches controls unit




**70** Dashboard/front cables connection



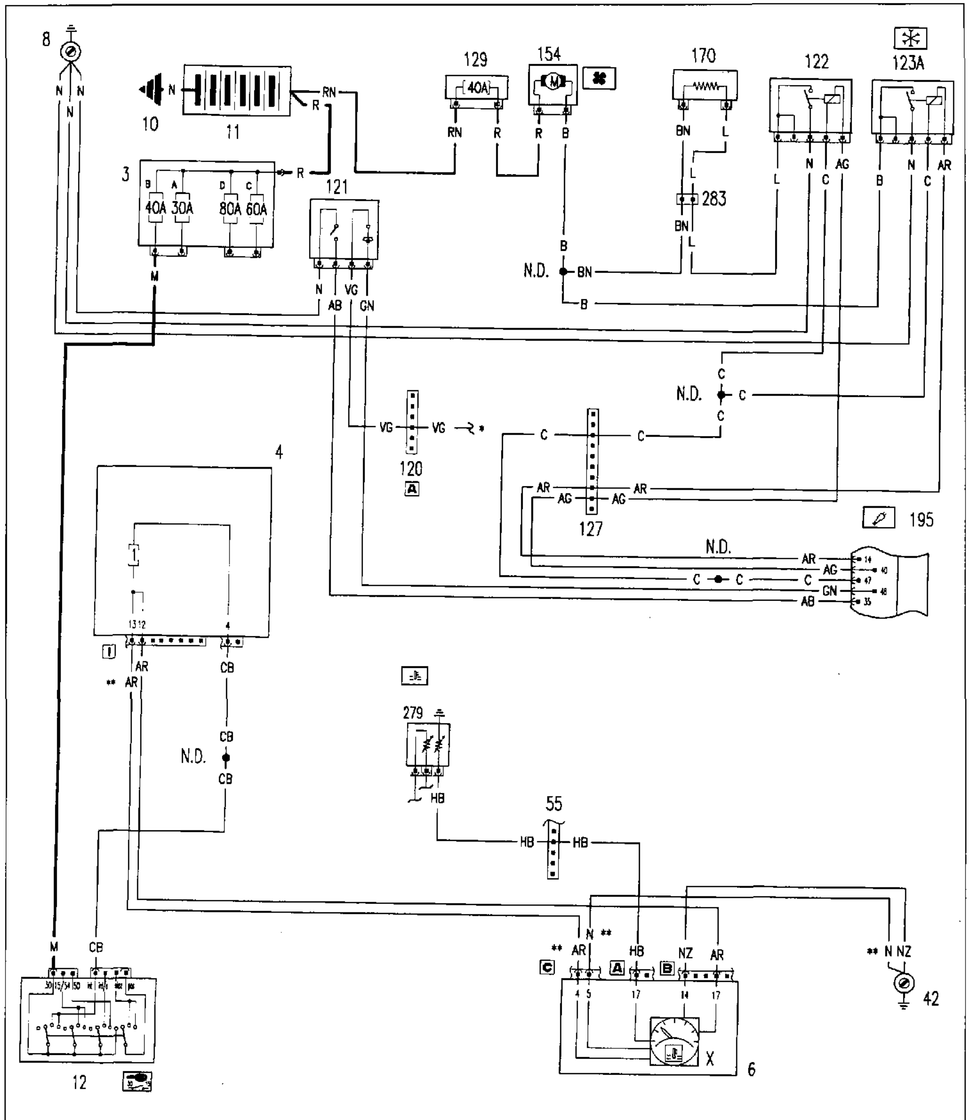

* Not present on S version   ** Applies only to EL/ELX version

P4A12EL01

■ The cables involved in the wiring diagram are marked with a solid square

**Version with air conditioner**

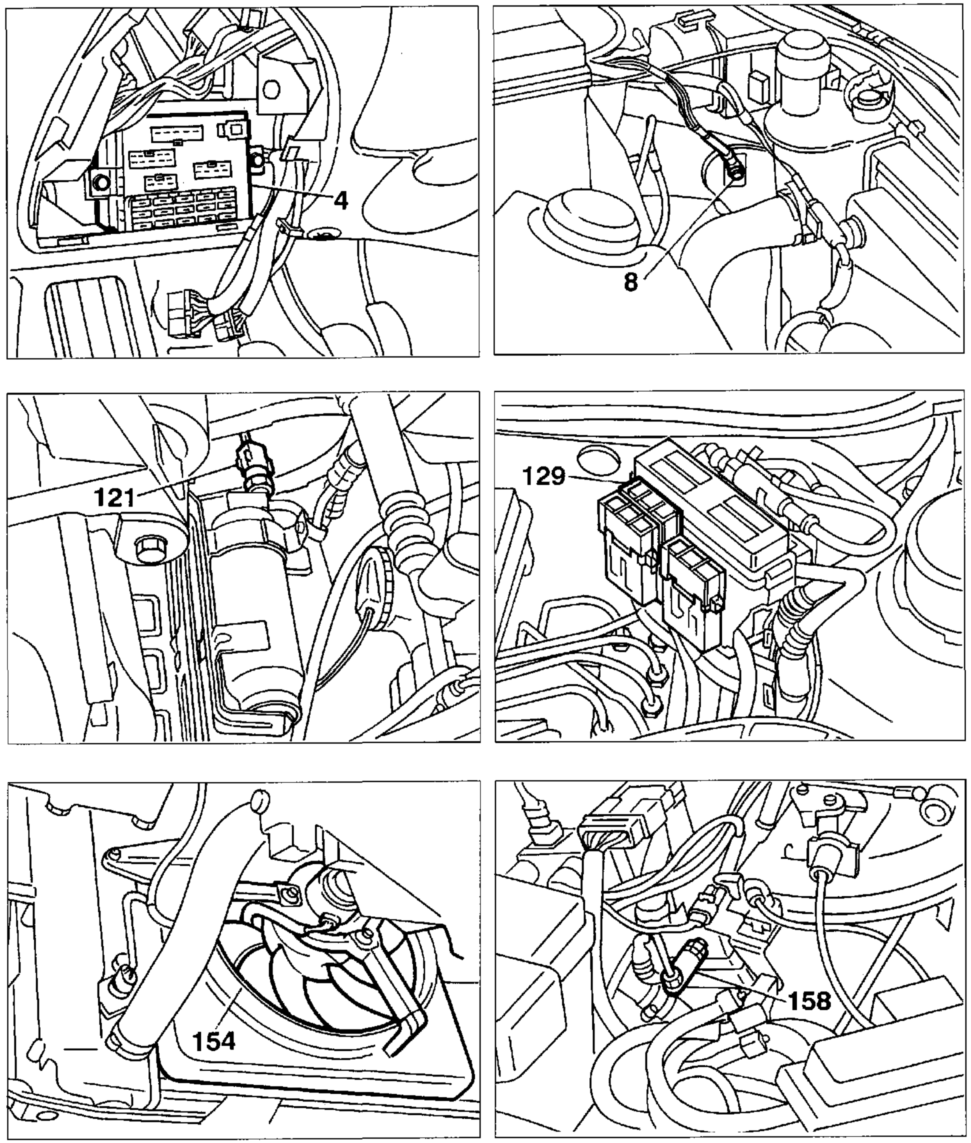
**Engine cooling system - Water temperature gauge**




* See air conditioner wiring diagram
** Variant connections for EL/ELX versions

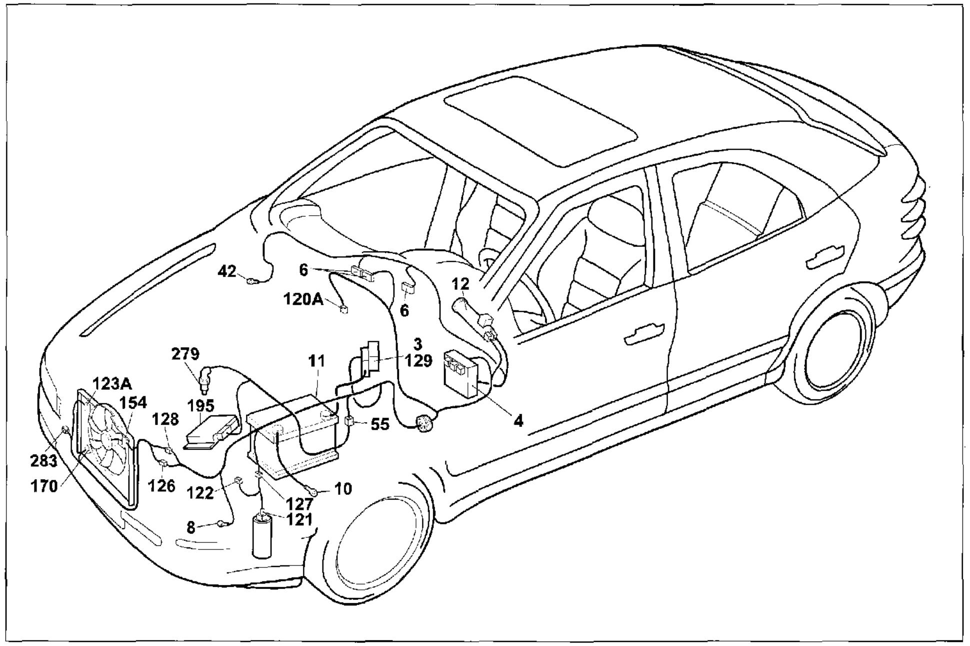
P4A13EL01

**Location of components**




P4A14EL01

# 55.




P4A15EL01

**Version with air conditioner**

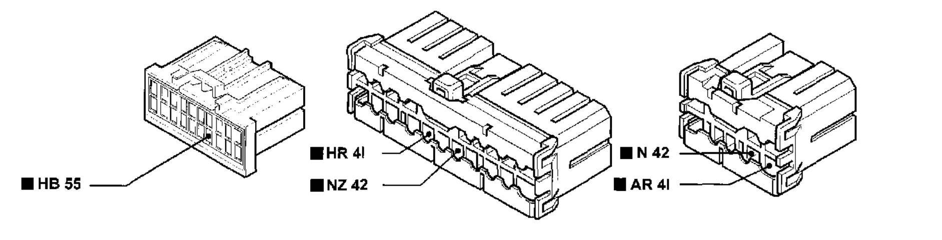
**Engine cooling system - Water temperature gauge**

**Key to components**

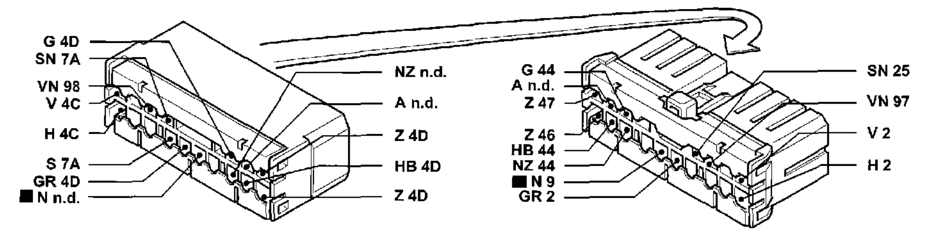
3 Power fuse box:
30A fuse protecting fuel injection
B 40A fuse protecting ignition
C 60A fuse protecting additional optional extras
D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit:
E1 Ignition switch discharge relay
6 Instrument panel:
X Water temperature gauge
8 Front left earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
42 Right dashboard earth
55 Connection between front cables/fuel gauge control
120 Air conditioner
121 Three-stage pressure switch
122 Engine cooling fan low speed control relay
123A Engine cooling fan high speed control relay
127 Connection between front left cables/cable on relay carrier bracket
128 Front/air conditioner cables connection
129 50A power fuse protecting engine cooling fan
154 Engine cooling fan
170 Engine cooling fan limiting resistor
195 Ignition/fuel injection electronic control unit (1581)
279 Engine coolant temperature double sender unit
283 Front cable/resistor connection

N.D. Ultrasound-soldered joint taped in wiring loom

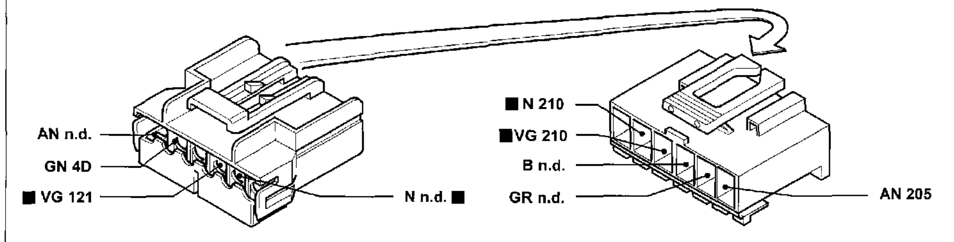
## 6 A - B - C Instrument panel



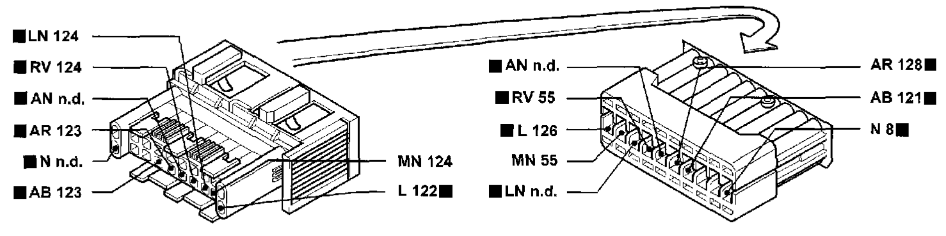

## 13 Front right/left cables connection




## 120 Air conditioner cables connection



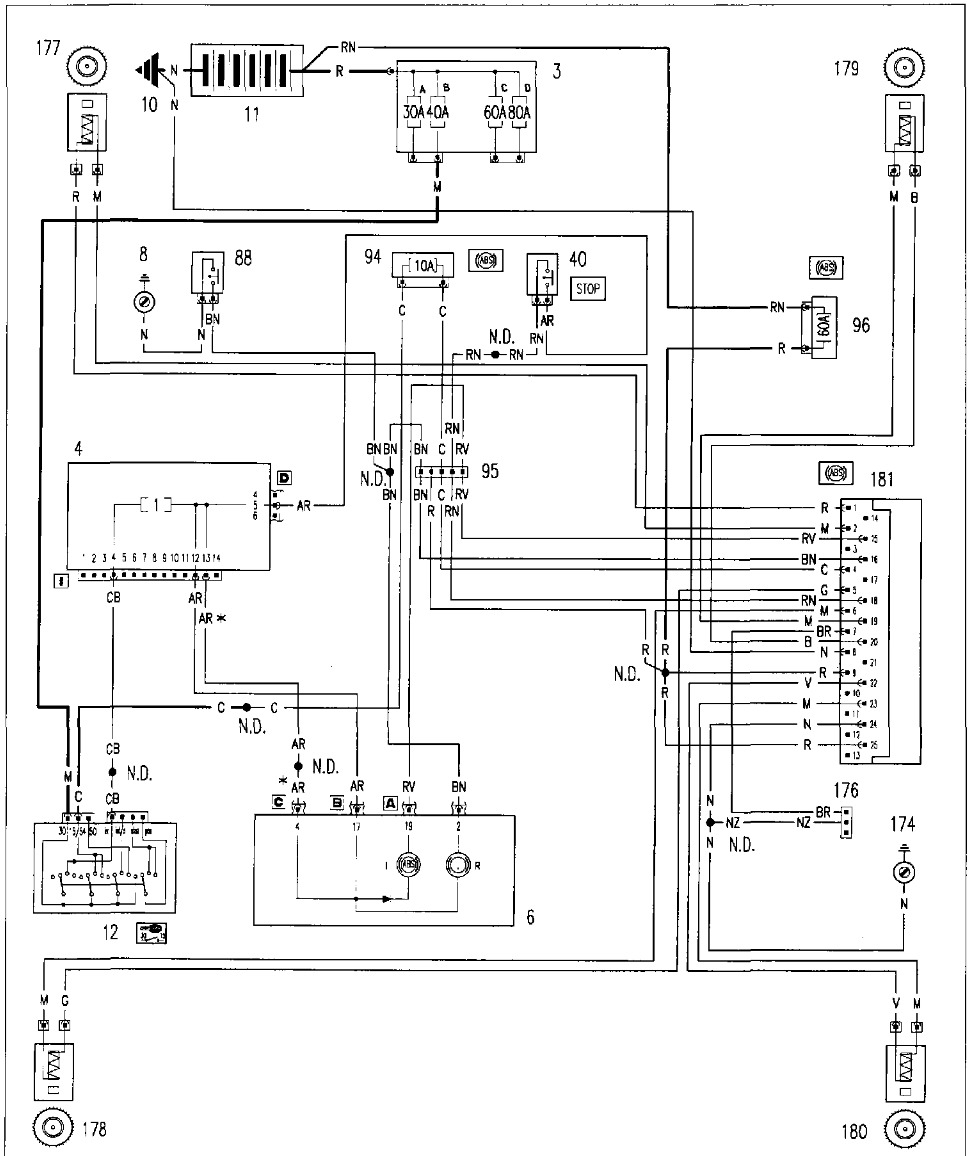

## 127 Connection between front left cables/cable on relay carrier bracket




P4A16EL01

## 55.

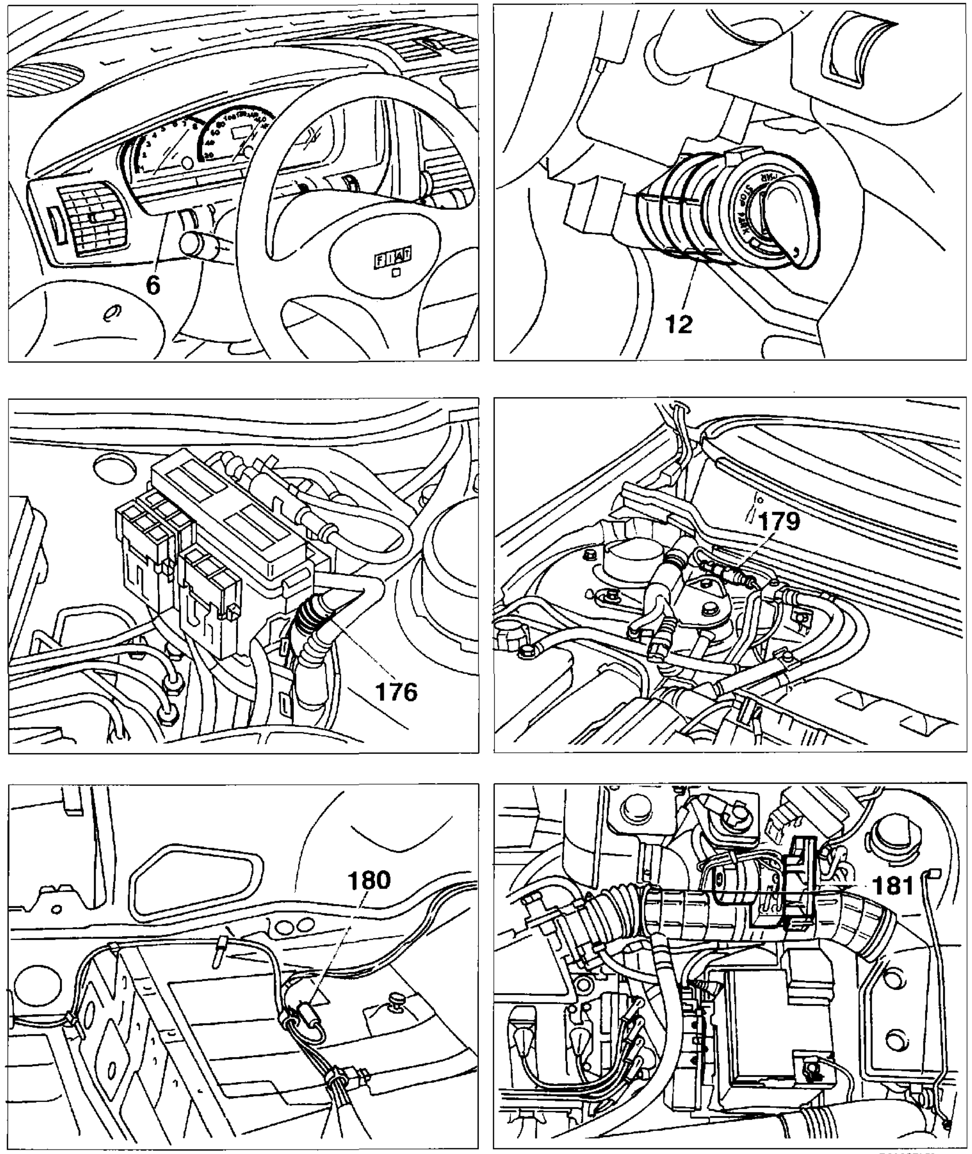
**Anti-lock braking system (A.B.S.) and fault warning light - Hand brake on/low brake fluid level warning light**




* Variant connections for EL - ELX versions

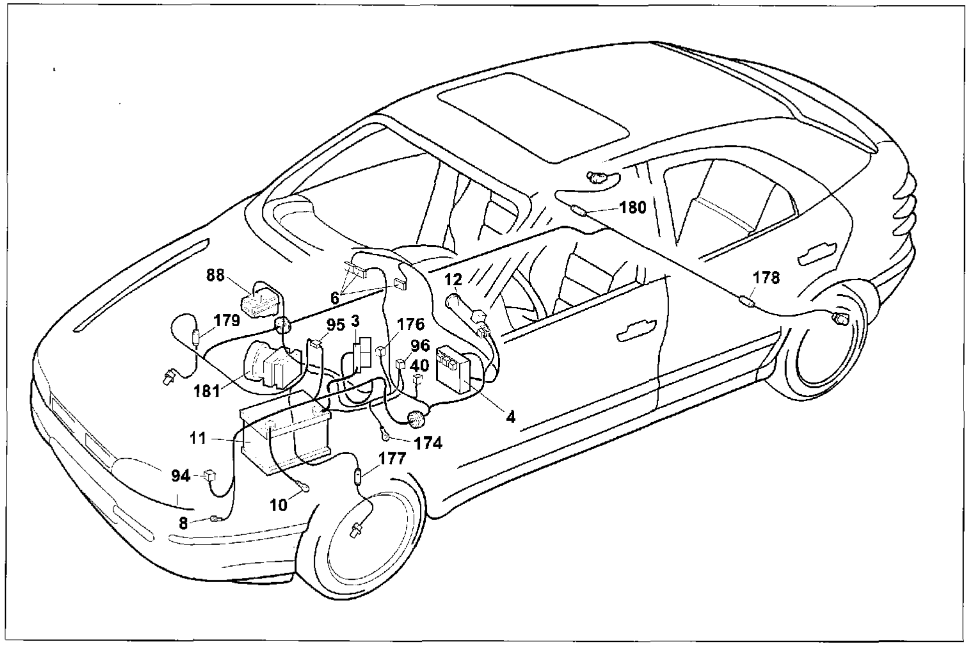
P4A17EL01

**Location of components**




P4A18EL01

# 55.




P4A19EL01

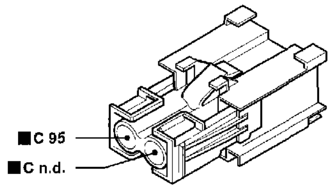
**Anti-lock braking system (A.B.S.) and fault warning light - Hand brake on/low brake fluid level warning light**

**Key to components**

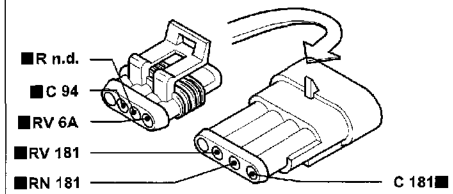
3 Power fuse box:
A 50A fuse protecting fuel injection
B 50A fuse protecting ignition
C 50A fuse protecting additional optional extras
D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
6 Instrument panel:
I Hand brake on/low brake fluid warning light
8 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
40 Stop lights switch
88 Low brake fluid level sensor
94 5A fuse protecting anti-lock braking system (A.B.S.)
95 Front cables/anti-lock braking system (A.B.S.) connection
96 60A fuse protecting electrical system
174 Power earth for anti-lock braking system (A.B.S.)
176 Diagnostic socket for anti-lock braking system (A.B.S.)
177 Sensor on front left wheel for anti-lock braking system (A.B.S.)
178 Sensor on rear left wheel for anti-lock braking system (A.B.S.)
179 Sensor on front right wheel for anti-lock braking system (A.B.S.)
180 Sensor on rear right wheel for anti-lock braking system (A.B.S.)
181 Anti-lock braking system (ABS) electronic control unit.)

N.D. Ultrasound-soldered joint taped in wiring loom

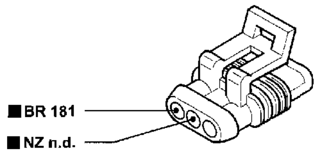
**94** 5A fuse protecting anti-lock braking system (A.B.S.)



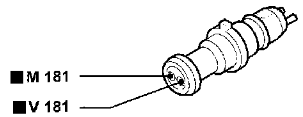

**95** Front cables/anti-lock braking system (A.B.S.) connection



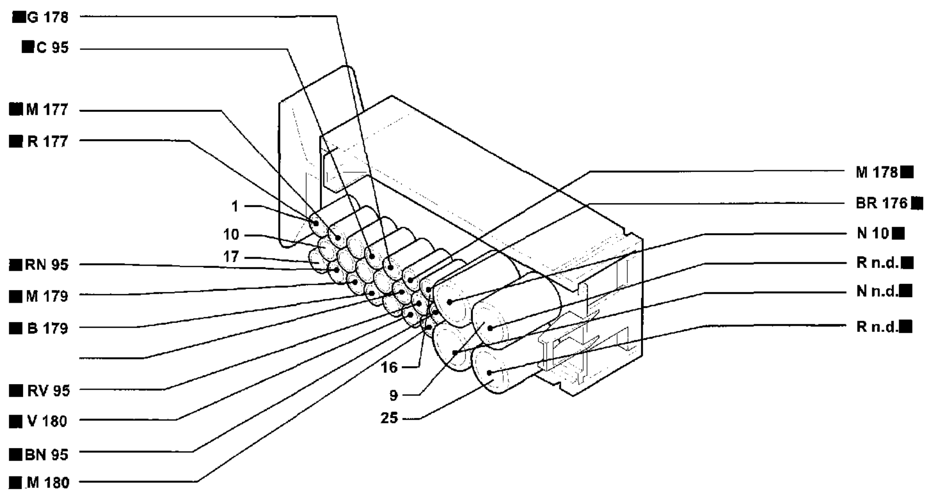

**176** Diagnostic socket for anti-lock braking system (A.B.S.)




**180** Sensor on rear right wheel for anti-lock braking system (A.B.S.)



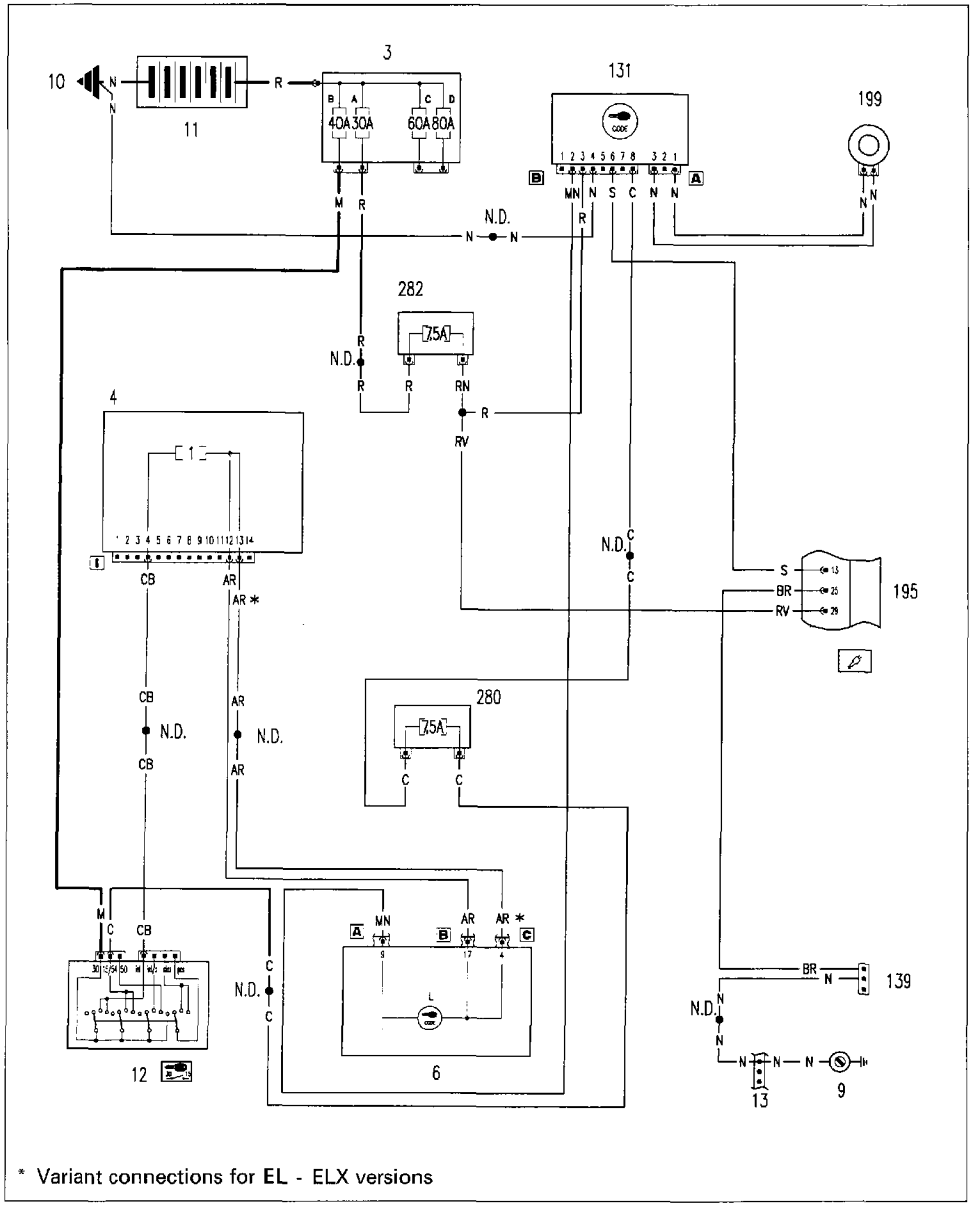

**181** Anti-lock braking system (ABS) electronic control unit




P4A20EL01

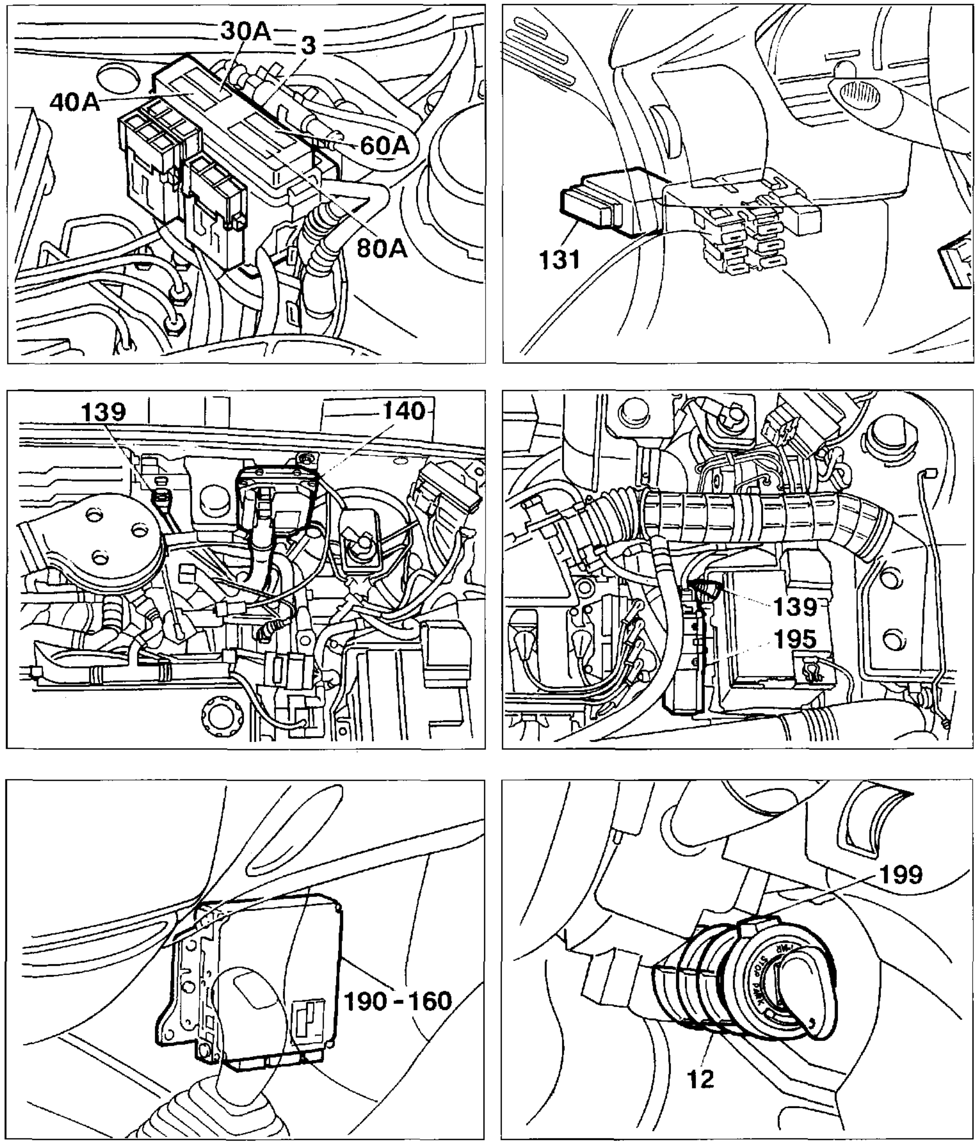
■ The cables involved in the wiring diagram are marked with a solid square

**Fiat-CODE system and fault warning light**



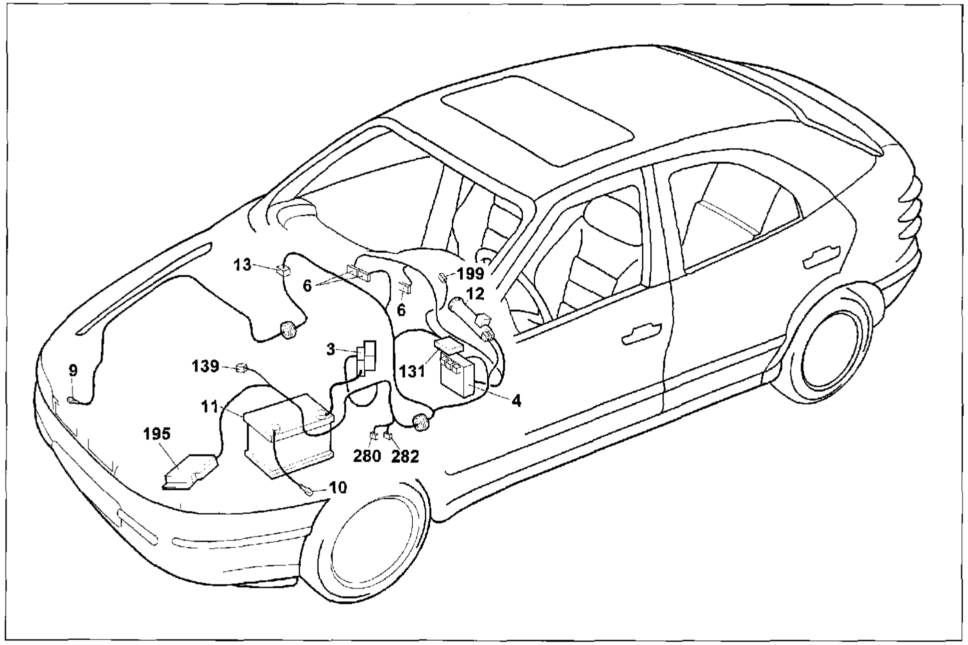

P4A21EL01

**Location of components**




P4A22EL01

# 55.




P4A23EL01

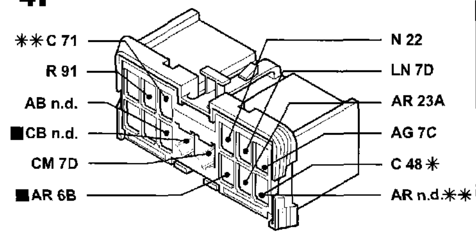
**Fiat-CODE system and fault warning light**

**Key to components**

3 Power fuse box:
 A 30A fuse protecting fuel injection
 B 40A fuse protecting ignition
 C 60A fuse protecting additional optional extras
 D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
6 Instrument panel:
 L Fiat-CODE fault warning light
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Right/left cable connection
131 Fiat-CODE electronic control unit
139 Diagnostic socket for fuel injection
195 Ignition/fuel injection electronic control unit (1581)
199 Aerial for Fiat-CODE system
280 7.5 A fuse protecting ignition switch
282 7.5 A fuse protecting Fiat-CODE/electronic fuel injection

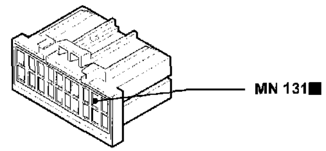
N.D. Ultrasound-soldered joint taped in wiring loom

**4I** Fuse and relay unit

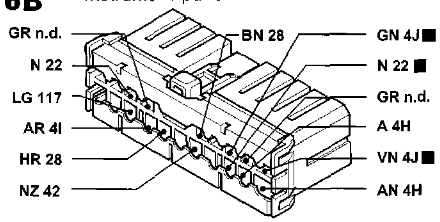



* Applies only to S/SX version
** Applies only to EL/ELX version

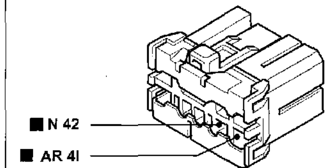
**6A** Instrument panel



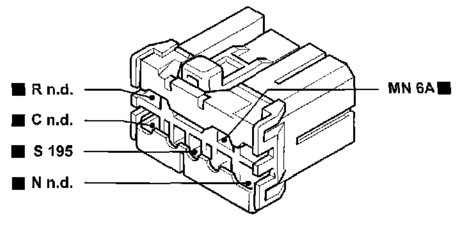

**6B** Instrument panel



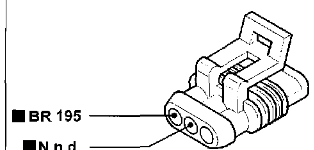

**6C** Instrument panel



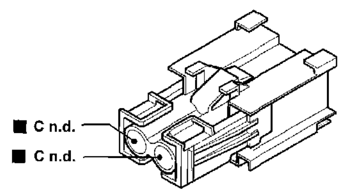

**131** Fiat-CODE electronic control unit



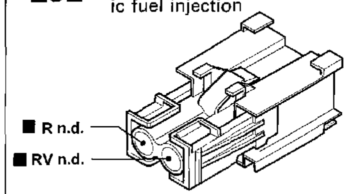

**139** Diagnostic socket for fuel injection




**280** 7.5A fuse protecting ignition switch




**282** 7.5A fuse protecting Fiat-CODE/electronic fuel injection

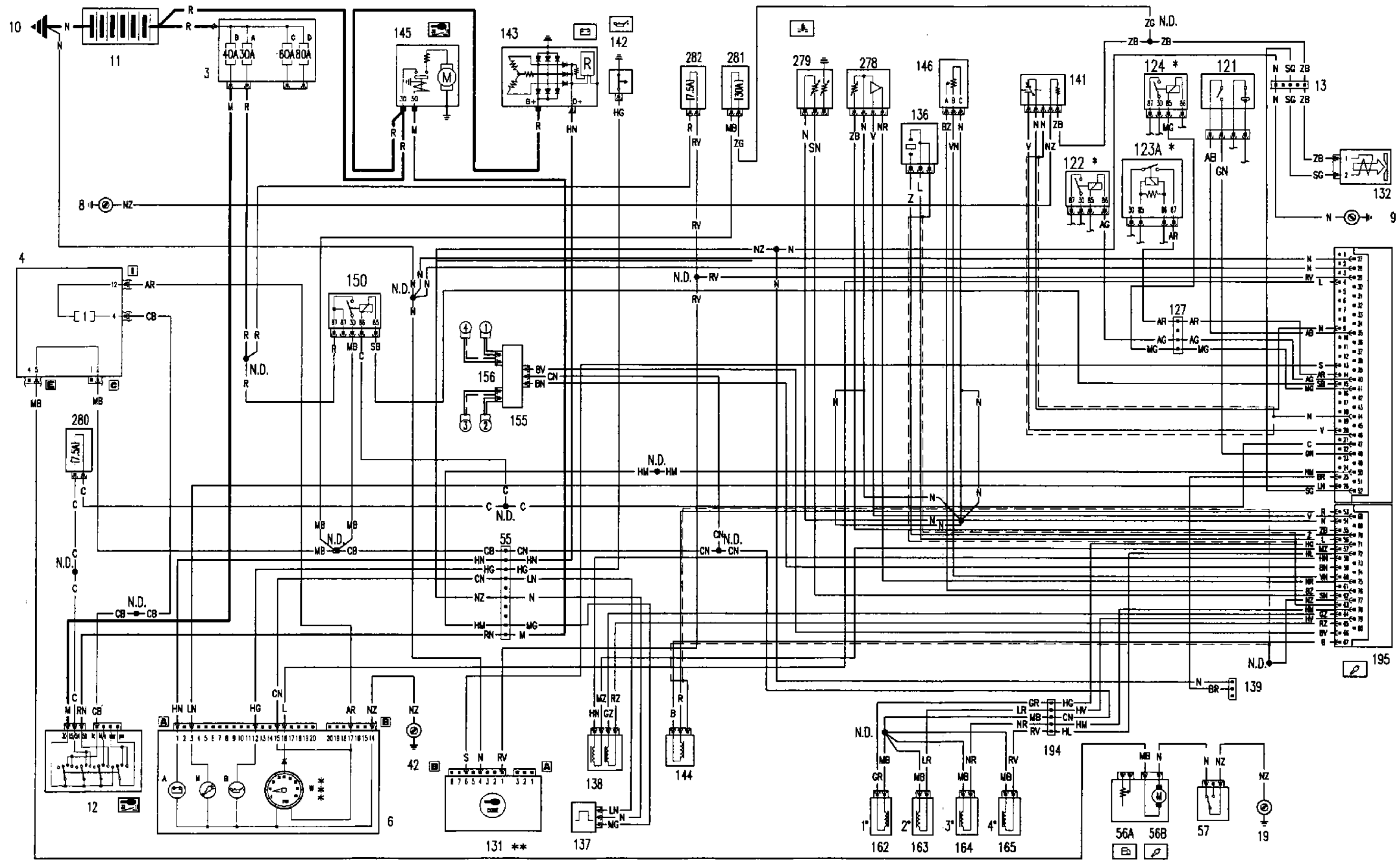



P4A24EL01

■ The cables involved in the wiring diagram are marked with a solid square

# 55.

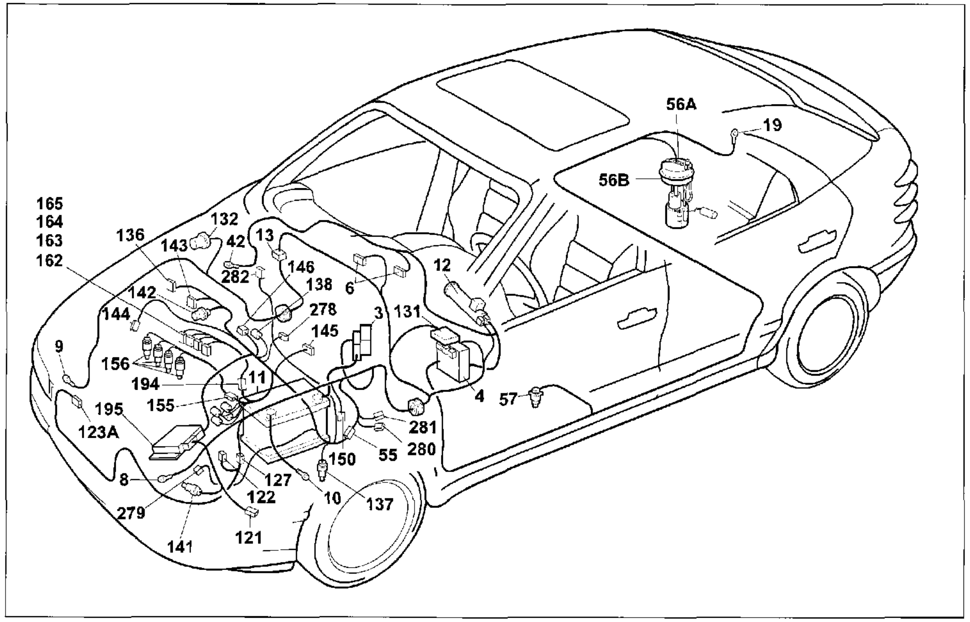
**Starting - Electronic ignition and fuel injection - Recharging and warning light - Low engine oil pressure warning light - Fuel injection fault warning light - Rev counter**




* See air conditioner diagram
** See Fiat-CODE diagram
*** Not present on S versions

P4A26EL01

# 55.




P4A27EL01

**Starting - Electronic ignition and fuel injection - Recharging and warning light - Low engine oil pressure warning light - Fuel injection fault warning light - Rev counter**

**Key to components**

3 Power fuse box:
A 30A fuse protecting fuel injection
B 40A fuse protecting ignition
C 60A fuse protecting additional optional extras
D 80A fuse protectiing fuse and relay unit
4 Fuse and relay unit
6 Instrument panel:
A Low generator recharging warning light
B Low engine oil pressure warning light
M Fuel injection fault warning light
W Rev counter
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
19 Rear right earth
42 Right dashboard earth
55 Front cables/fuel gauge control connection
56 Fuel gauge control unit
A Fuel gauge sensor
B Electric fuel pump
57 Inertial switch
121 Three-stage pressure switch
131 Fiat-CODE electronic control unit
132 Petrol vapours cut-off solenoid (canister)
136 Knock sensor
137 Car speed sensor
138 Idle adjustment actuator
139 Diagnostic socket for fuel injection
141 Heated Lambda probe
142 Low oil pressure warning light switch

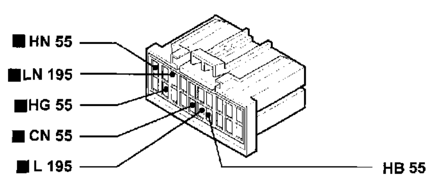
143 Alternator
144 Rpm and T.D.C. sensor
145 Starter motor
146 Potentiometer on throttle valve
150 Fuel injection control relay
155 Ignition coils assembly
156 Spark plugs
162 Fuel injector (1st)
163 Fuel injector (2nd)
164 Fuel injector (3rd)
165 Fuel injector (4th)
194 Fuel injection cables/fuel injector flange connection
195 Ignition/fuel injection electronic control unit (1581)

278 Integrated air temperature/pressure sender unit
279 Engine coolant temperature double sender unit

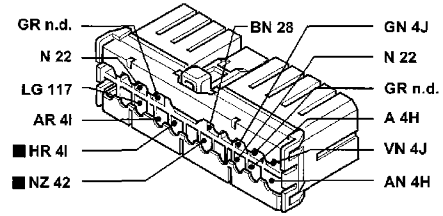
280 7.5A fuse protecting ignition switch
281 30A fuse protecting Lambda probe/canister solenoid

282 7.5 A fuse protecting Fiat-CODE/electronic injection

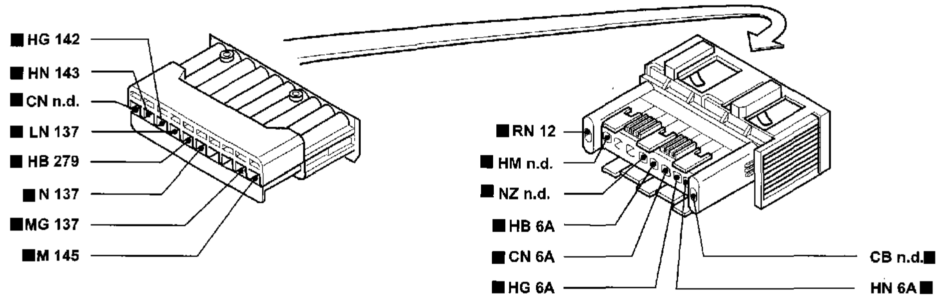
**6A** Instrument panel



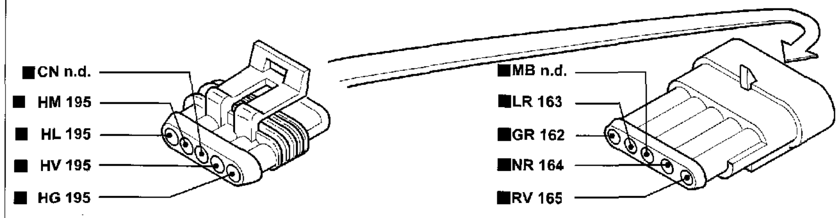

**6B** Instrument panel




**55A** Front left/engine cables connection




**194** Fuel injection cables/injector flange connection

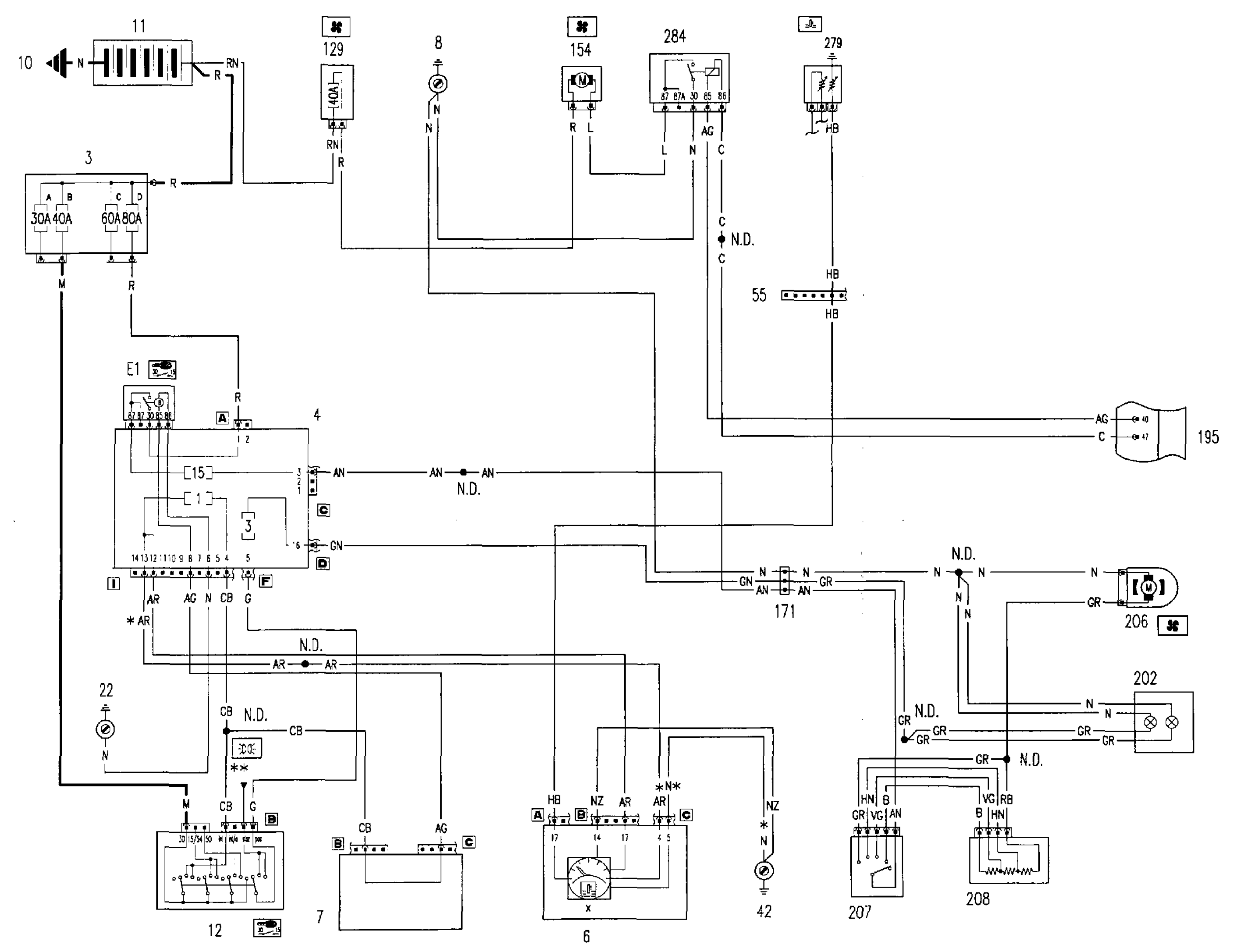



P4A28EL01

■ The cables involved in the wiring diagram are marked with a solid square

**Model without air conditioner**

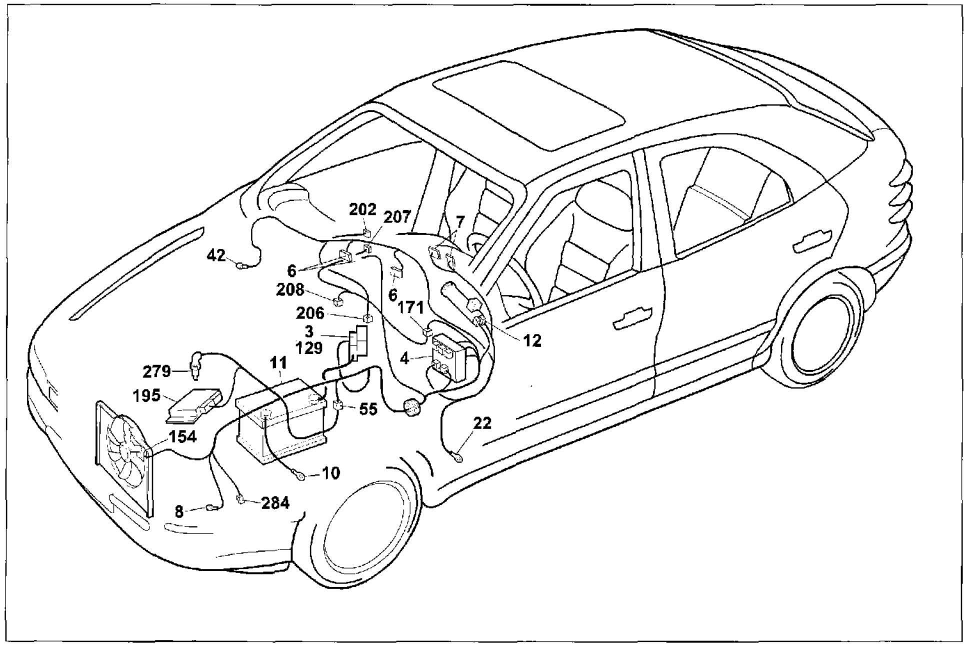
**Engine cooling system - Water temperature gauge - Car interior ventilation**




* Variant connections for EL - ELX versions
** See side lights diagram

P4A29EL01

# 55.



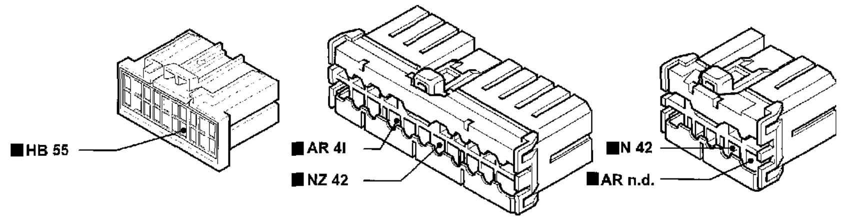

**Engine cooling system - Water temperature gauge - Car interior ventilation**

**Key to components**

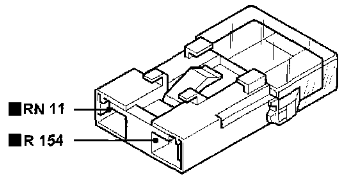
3 Power fuse box:
A 30A fuse protecting fuel injection
B 40A fuse protecting ignition
C 60A fuse protecting additional optional extras
D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
E1 Ignition switch discharge relay
6 Instrument panel:
X Coolant temperature gauge
7 Stalk unit
8 Front left earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
22 Left dashboard earth
42 Right dashboard earth
55 Front cables/fuel gauge control connection
129 50A power fuse protecting engine cooling fan
154 Engine cooling fan
171 Heater unit
195 Ignition/fuel injection electronic control unit (1581)
202 Heater/air conditioner light bulbs
206 Heater/air conditioner electric fan
207 Heater/air conditioner speed control switch
208 Limiting resistor for heater/air conditioner
279 Engine coolant temperature double sender unit
284 Engine cooling fan relay

N.D. Ultrasound-soldered joint taped in wiring loom

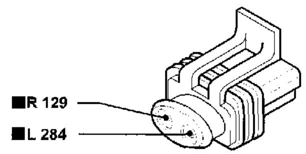
**6A - 6B - 6C** Instrument panel



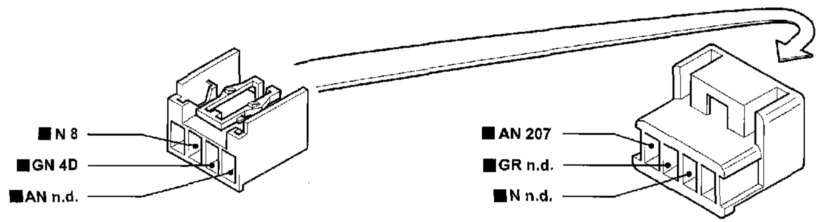

**129** 50A power fuse protecting engine cooling fan



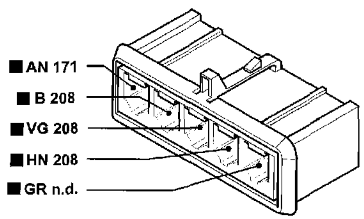

**154** Engine cooling fan



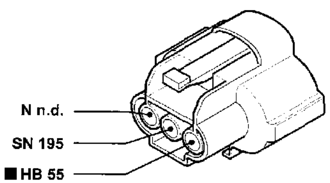

**171** Heater unit cables connection




**207** Electric fan speed control switch




**279** Engine coolant temperature double sender unit

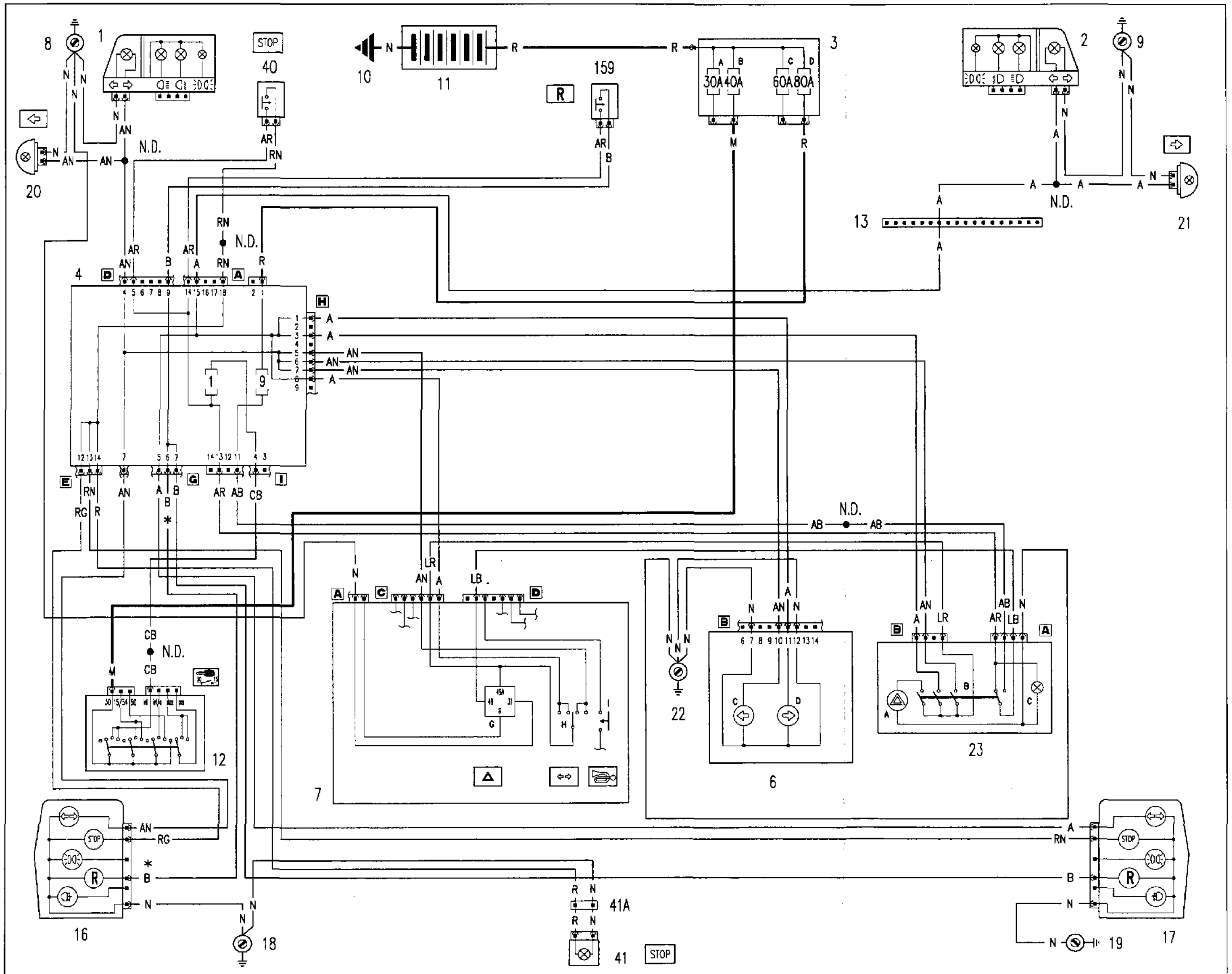



P4A32EL01

■ The cables involved in the wiring diagram are marked with a solid square

**Version: S - SX**

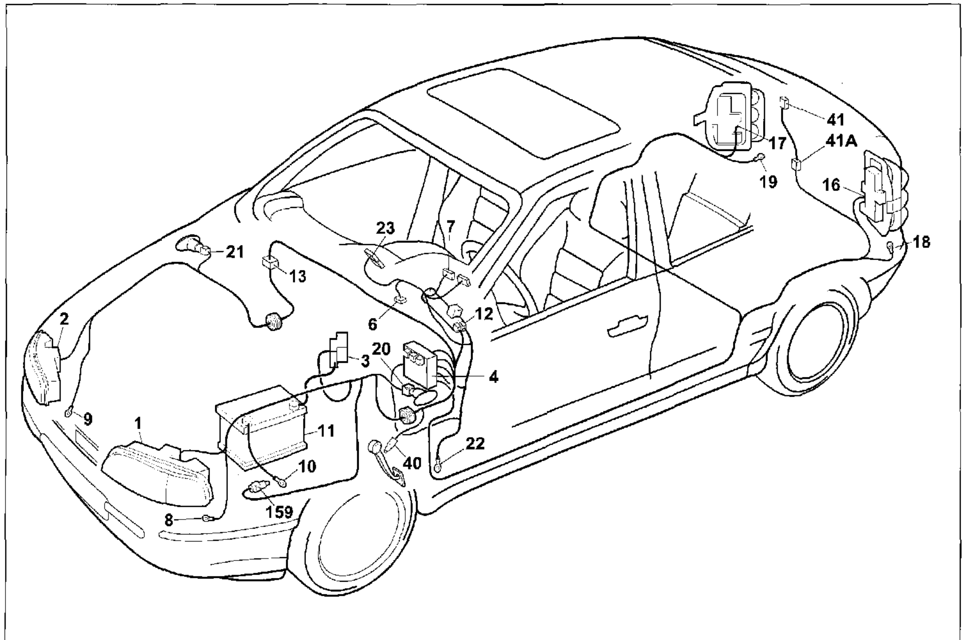
**Direction indicators and warning lamp - Hazard warning lights and warning lamp - Stop lights - Reversing lights**



* Not present on Bravo

P4A33EL01

# 55.




P4A35EL01

**Version: S - SX**

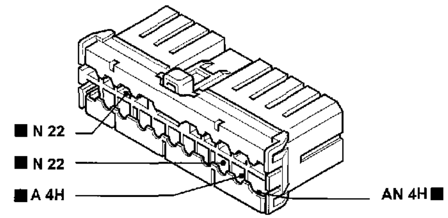
**Direction indicators and warning lamp - Hazard warning lights and warning lamp - Stop lights - Reversing lights**

**Key to components**

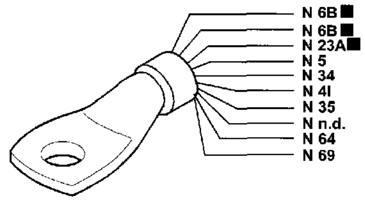
1 Front left lights cluster
2 Front right lights cluster
3 Power fuse box:
  A 30A fuse protecting fuel injection
  B 40A fuse protecting ignition
  C 60A fuse protecting additional optional extras
  D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
6 Instrument panel:
  C Left direction indicator warning light
  D Right direction indicator warning light
7 Stalk unit:
  H Direction indicators stalk
  I Horn button
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
16 Rear left lights cluster
17 Rear right lights cluster
18 Rear left earth
19 Rear right earth
20 Front left side repeater
21 Front right side repeater
22 Left dashboard earth
23 Hazard lights switch unit
  A Hazard warning lights warning lamp
  B Hazard lights control switch
  C Hazard lights unit symbol light
40 Stop lights switch
41 Additional stop light
41A Additional stop light rear cables connection
159 Reversing lights switch

N.D. Ultrasound-soldered joint taped in wiring loom

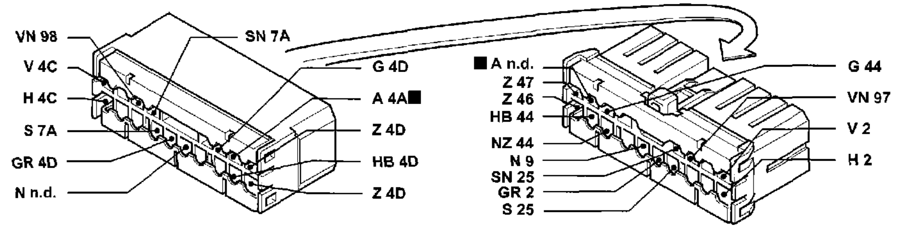
**6A** Instrument panel



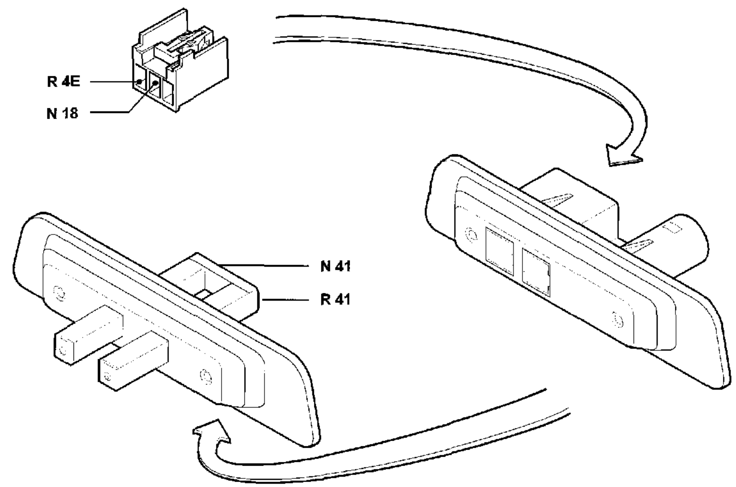

**22** Left dashboard earth




**13** Front right/left cables connection



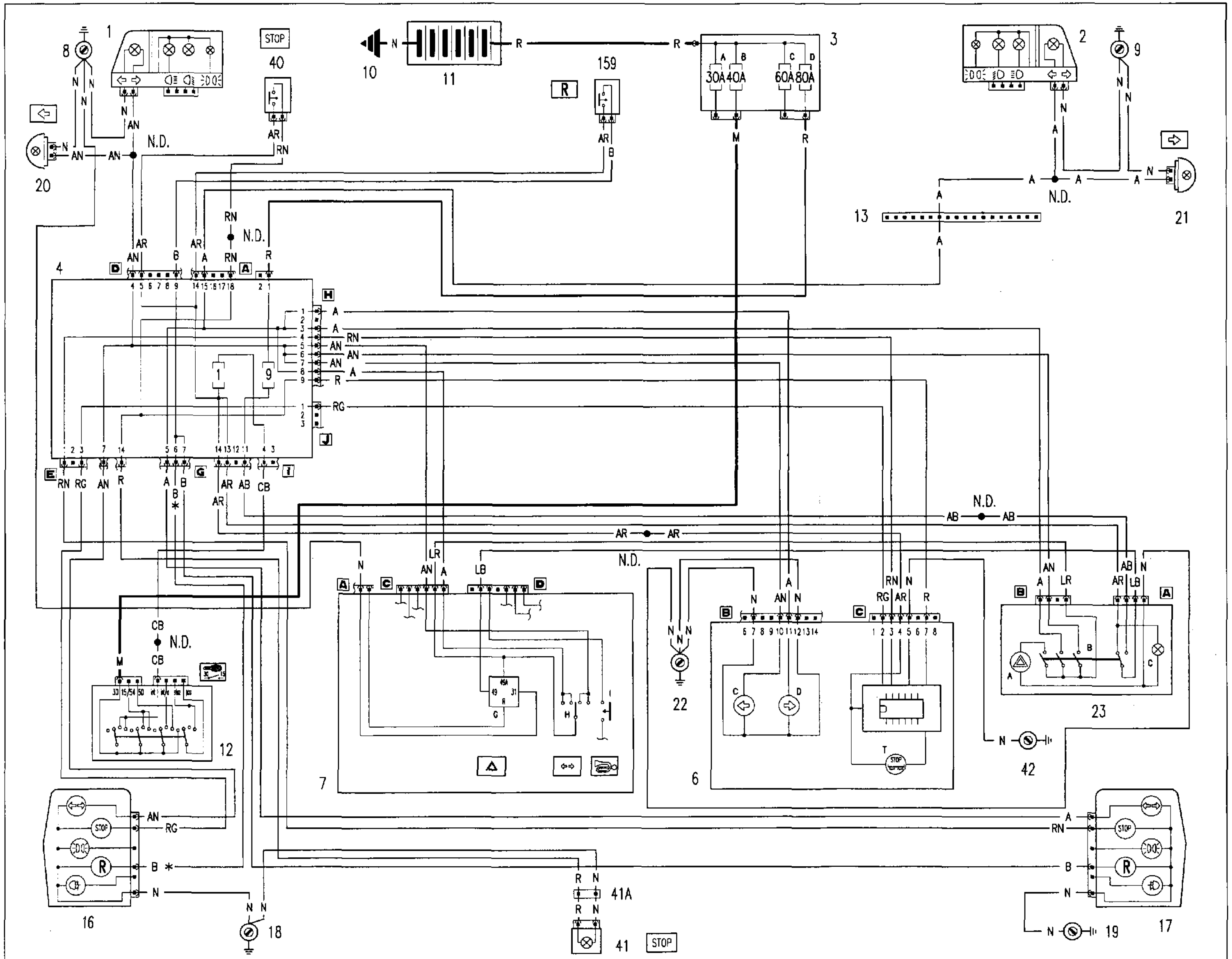

**41A** Additional stop light rear cables connection




P4A36EL01

■ The cables involved in the wiring diagram are marked with a solid square

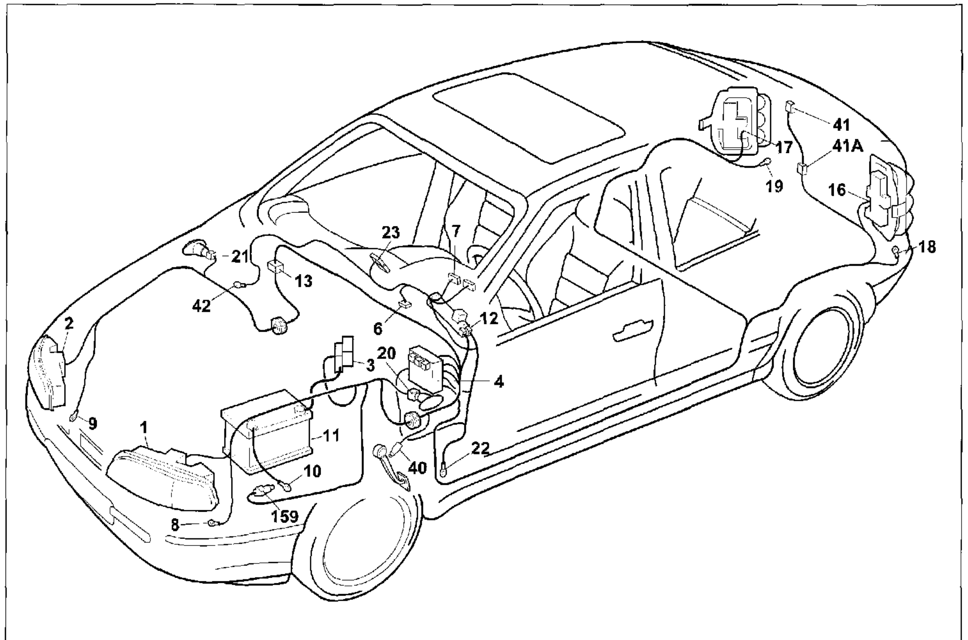
**Version: EL - ELX**
**Direction indicators and warning lamp - Hazard warning lights and warning lamp - Stop lights - Reversing lights**



* Not present on Bravo

P4A37EL01

# 55.




P4A39EL01

**Version: EL - ELX**

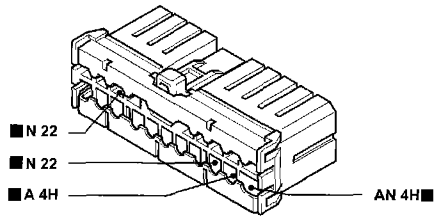
**Direction indicators and warning lamp - Hazard warning lights and warning lamp - Stop lights - Reversing lights**

**Key to components**

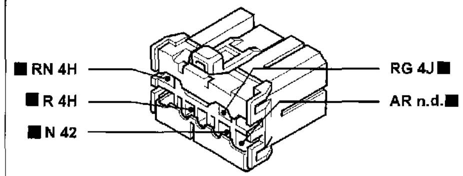
1 Front left lights cluster
2 Front right lights cluster
3 Power fuse box:
 A 30A fuse protecting fuel injection
 B 40A fuse protecting ignition
 C 60A fuse protecting additional optional extras
 D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
6 Instrument panel:
 C Left direction indicator warning light
 D Right direction indicator warning light
 T Stop lights fault warning light
7 Stalk unit:
 H Direction indicators stalk
 I Horn button
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
16 Rear left lights cluster
17 Rear right lights cluster
18 Rear left earth
19 Rear right earth
20 Front left side repeater
21 Front right side repeater
22 Left dashboard earth
23 Hazard warning lights switch unit
 A Hazard warning lights warning lamp
 B Hazard warning lights switch
 C Hazard warning lights unit symbol light
40 Stop lights switch
41 Additional stop light
41A Additional stop light rear cables connection
42 Right dashboard earth
159 Reversing lights switch

N.D. Ultrasound-soldered joint taped in wiring loom

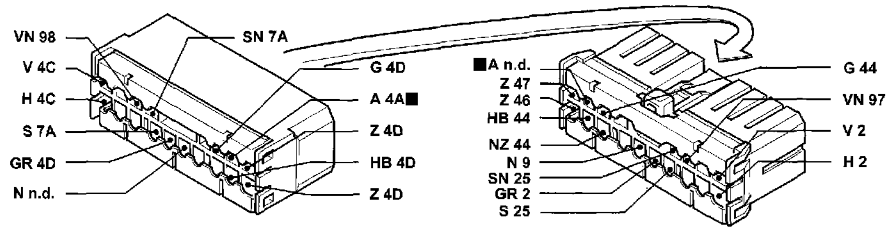
**6B** Instrument panel



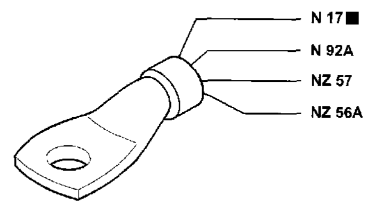

**6C** Instrument panel



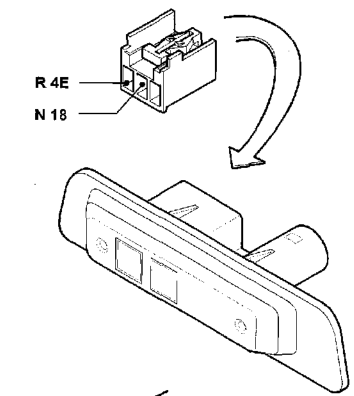

**13** Front right/left cables connection




**19** Rear right earth




**41A** Additional stop light rear cables connection



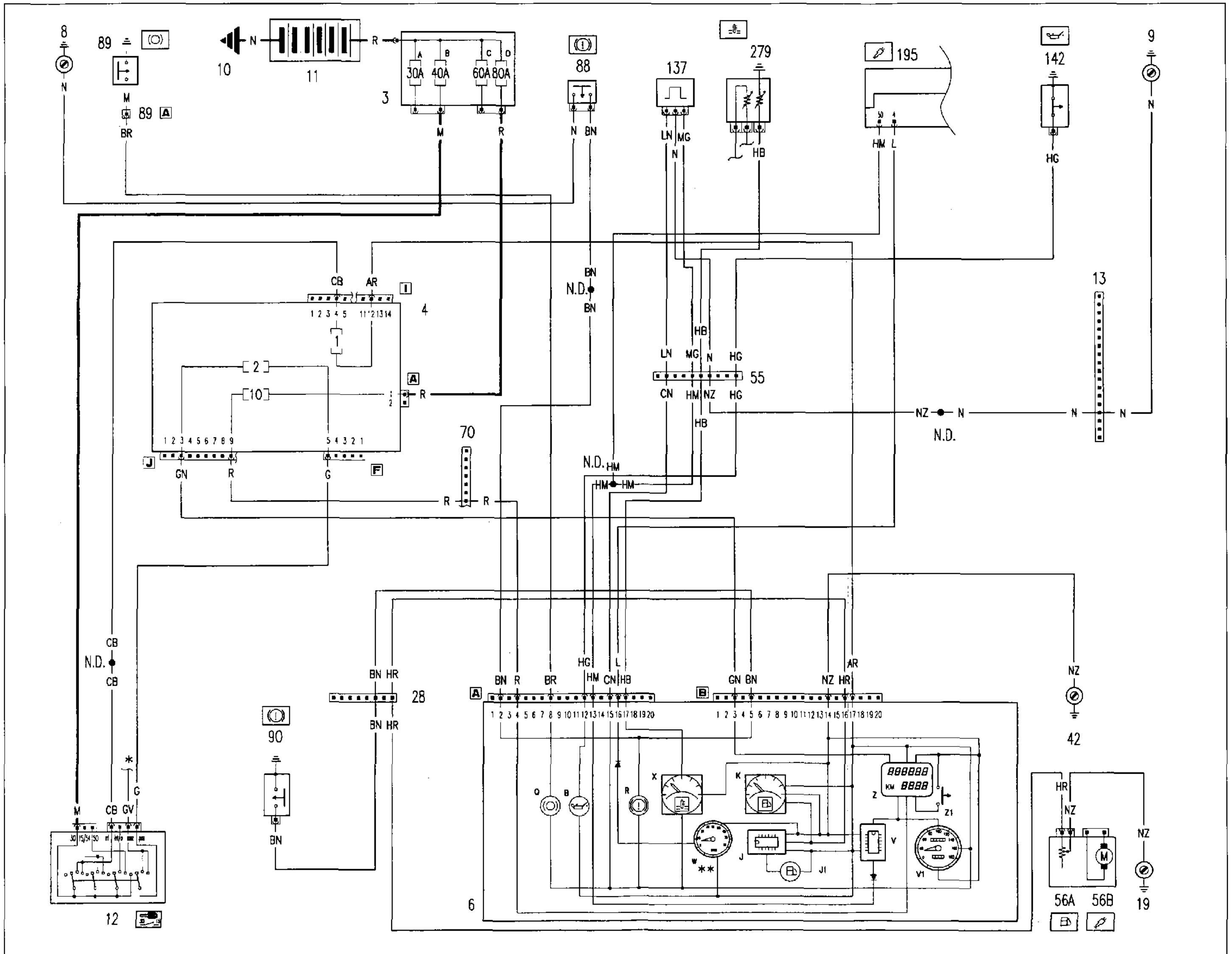

P4A40EL01

■ The cables involved in the wiring diagram are marked with a solid square

# 55.

**Version: S - SX**

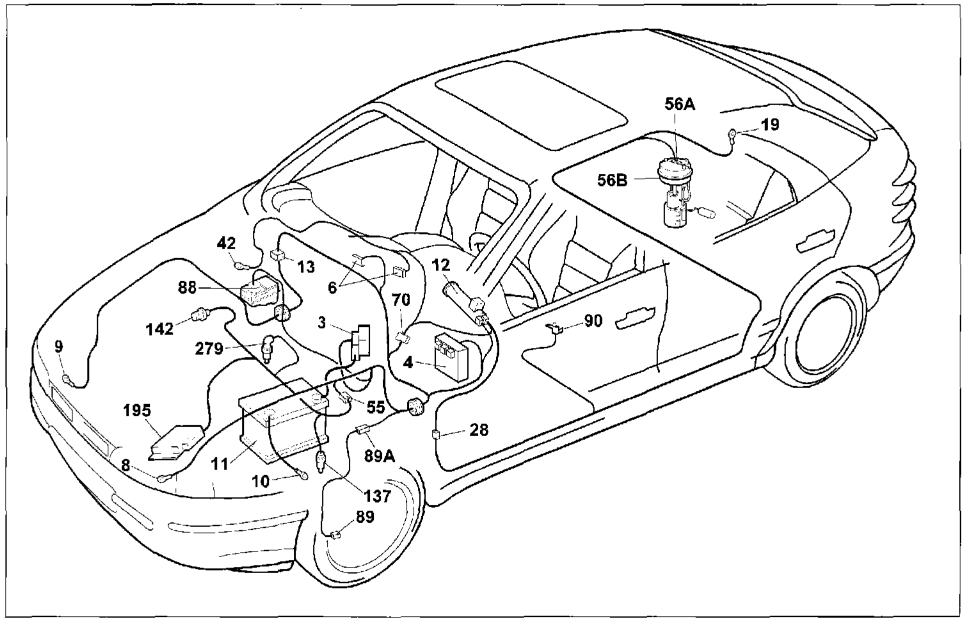
**Fuel level gauge and reserve warning light - Handbrake on/low brake fluid level warning light - Speedometer - Trip recorder/total mileage counter and reset button - Water temperature gauge - Low engine oil pressure warning light - Rev counter - Front brake pad wear warning light**



* See side lights diagram    ** Not present on S versions

P4A41EL01

## 55.




P4A43EL01

**Version: S - SX**

**Fuel level gauge and reserve warning light - Hand brake on/low brake fluid warning light - Speedometer - Trip recorder/- total mileage counter and reset button - Water temperature gauge - Low engine oil pressure warning light - Rev counter - Front brake pad wear warning light**

**Key to components**

3 Power fuse box:
  A 30A fuse protecting fuel injection
  B 40A fuse protecting ignition
  C 60A fuse protecting additional optional extras
  D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
6 Instrument panel:
  B Low engine oil pressure warning light
  J Fuel reserve circuit control module
  J1 Low fuel level warning light
  K Fuel gauge
  Q Front brake pad wear warning light
  R Hand brake on/low brake fluid level warning light

  V Speedometer control module
  V1 Speedometer
  W Rev counter
  X Coolant temperature gauge
  Z Trip recorder/total mileage counter
  Z1 Trip recorder reset button
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch

13 Front right/left cables connection
19 Rear right earth
28 Dashboard/longitudinal cables connection
42 Right dashboard earth
55 Front cables/fuel gauge control connection

56 Fuel gauge control unit
  A Fuel gauge sensor
  B Electric fuel pump
70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection

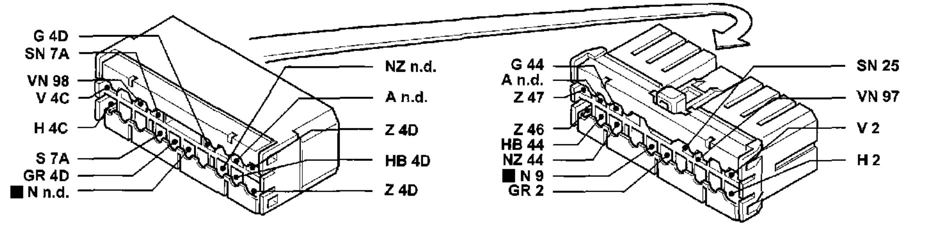
90 Handbrake on warning light switch
137 Vehicle speed sensor
142 Low oil pressure warning light switch

195 Ignition/fuel injection electronic control unit (1581)

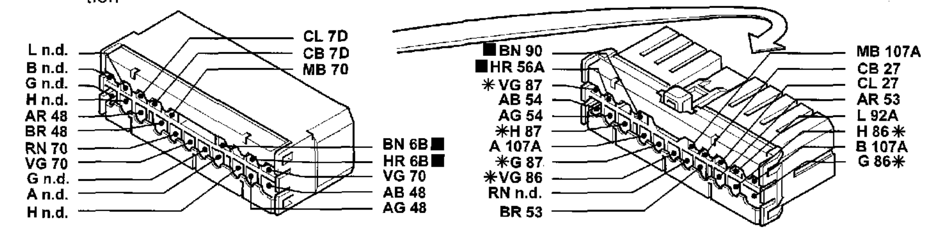
279 Engine coolant temperature double sender unit

N.D. Ultrasound-soldered joint taped in wiring loom

**13** Front right/left cables connection

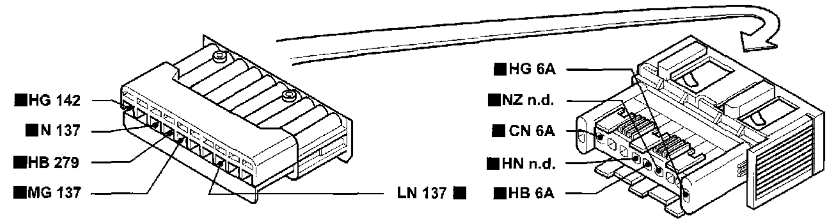



**28** Dashboard/longitudinal cables connection

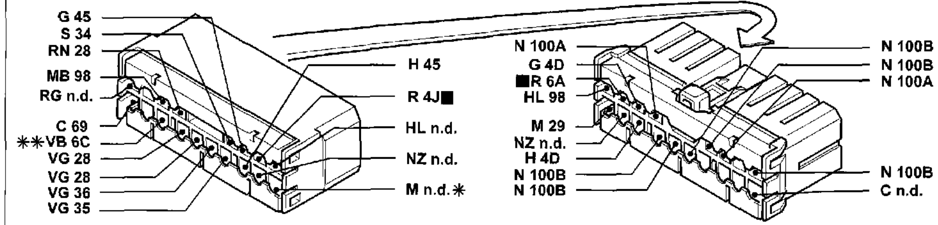



* Only for Brava

**55** Front/engine cables connection




**70** Dashboard/front cables connection



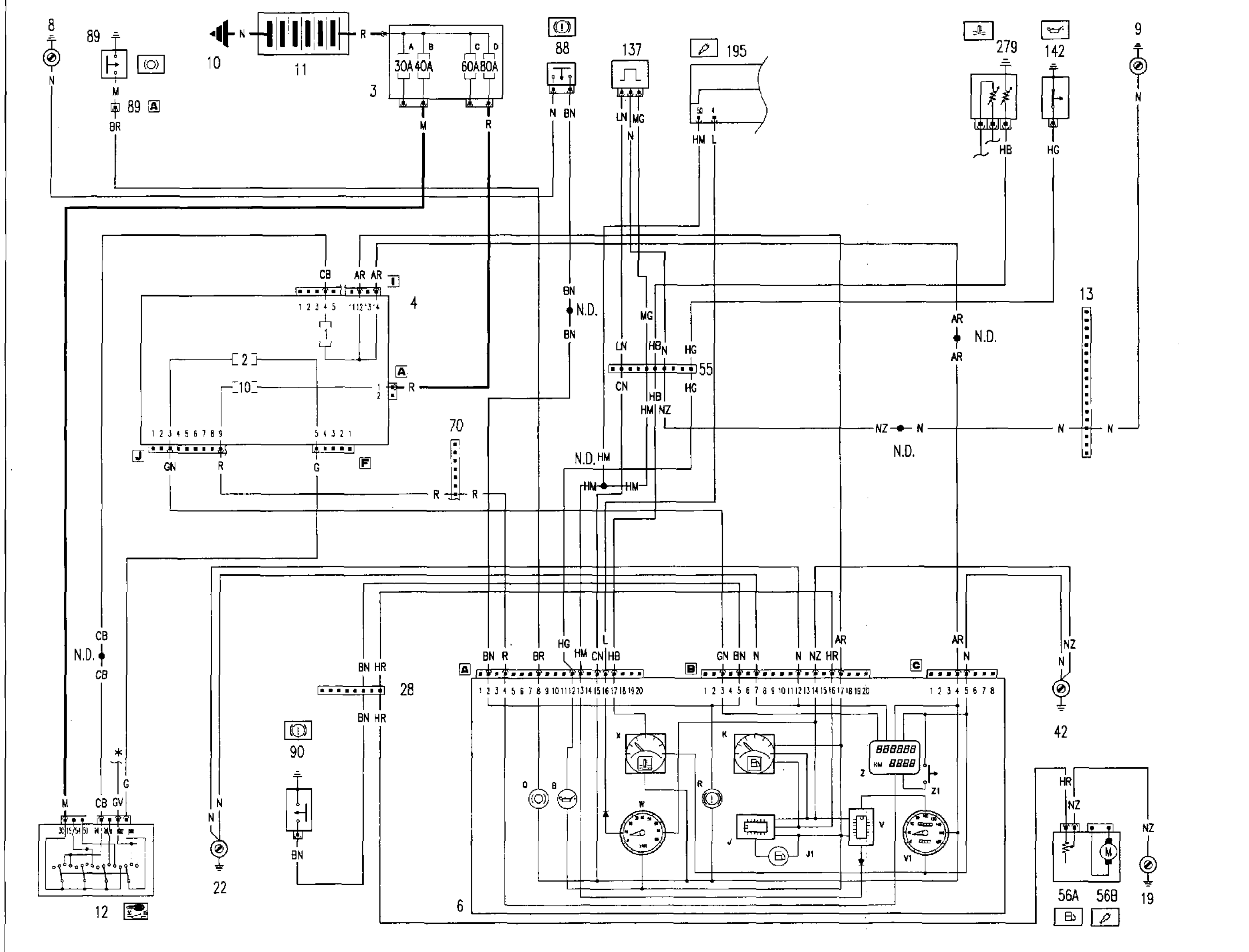

* Not present on S version    ** Applies to EL/ELX version

P4A44EL01

■ The cables involved in the wiring diagram are marked with a solid square

**Version: EL - ELX**

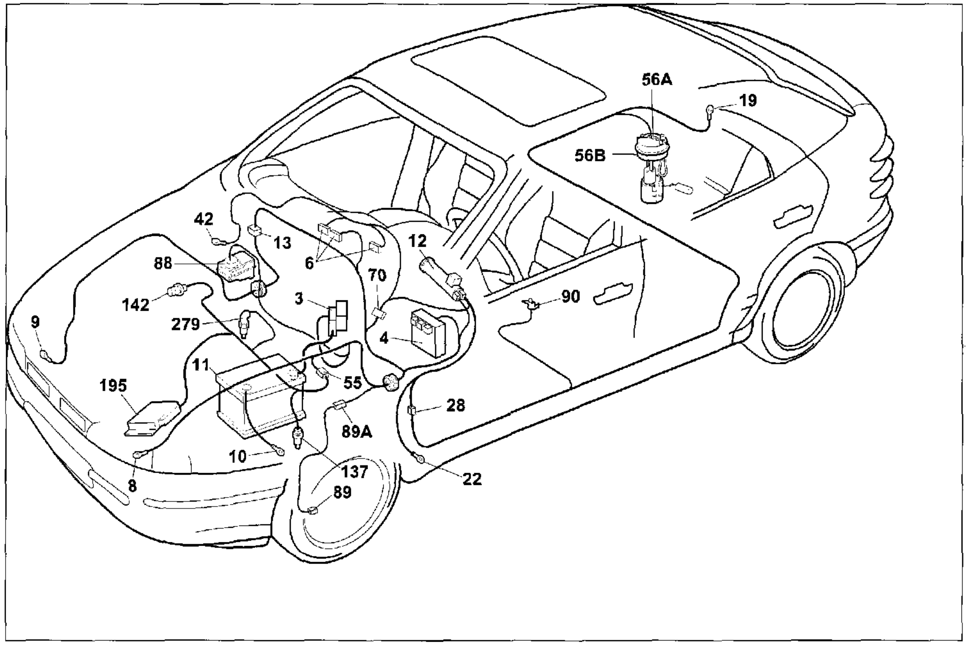
**Fuel level gauge and reserve warning light - Hand brake on/low brake fluid warning light - Speedometer - Trip recorder/ total mileage counter and reset button - Water temperature gauge - Low engine oil pressure warning light - Front brake pad wear warning light - Rev counter -**



* See side lights diagram

P4A45EL01

# 55.




**Version: EL - ELX**

P4A47EL01

**Fuel level gauge and reserve warning light - Hand brake on/low brake fluid level warning light - Speedometer - Trip recorder/total mileage counter and reset button - Water temperature gauge - Low engine oil pressure warning light - Front brake pad wear warning light - Rev counter**

**Key to components**

3 Power fuse box:
- A 30A fuse protecting fuel injection
- B 40A fuse protecting ignition
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit

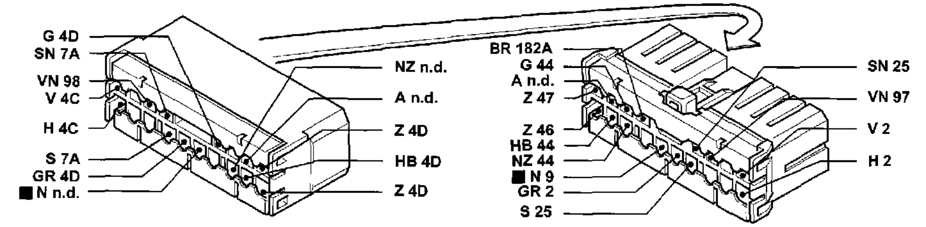
6 Instrument panel:
- B Low engine oil pressure warning light
- J Fuel reserve circuit control module
- J1 Low fuel level warning light
- K Fuel gauge
- Q Front brake pad wear warning light
- R Hand brake on/low brake fluid warning light
- V Speedometer control module
- V1 Speedometer
- W Rev counter
- X Coolant temperature gauge
- Z Trip recorder/total mileage counter
- Z1 Trip recorder reset button

8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
19 Rear right earth
22 Left dashboard earth
28 Dashboard/longitudinal cables connection
42 Right dashboard earth
55 Front cables/fuel gauge control connection
56 Fuel gauge control unit
- A Fuel gauge sensor
- B Electric fuel pump

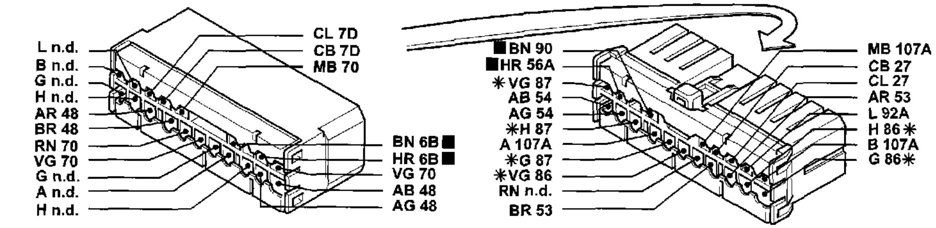
70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
137 Car speed sensor
142 Low oil pressure warning light switch
195 Ignition/fuel injection electronic control unit (1581)
279 Engine coolant temperature double sender unit

N.D. Ultrasound-soldered joint taped in wiring loom

**13** Front right/left cables connection

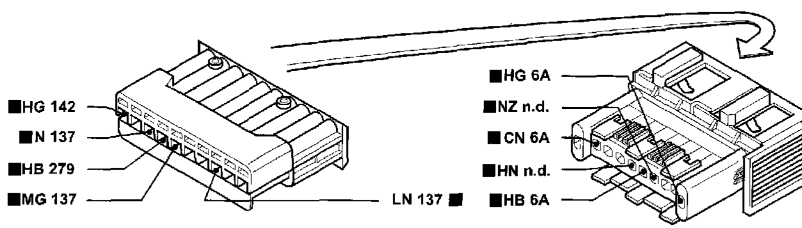



**28** Dashboard/longitudinal cables connection

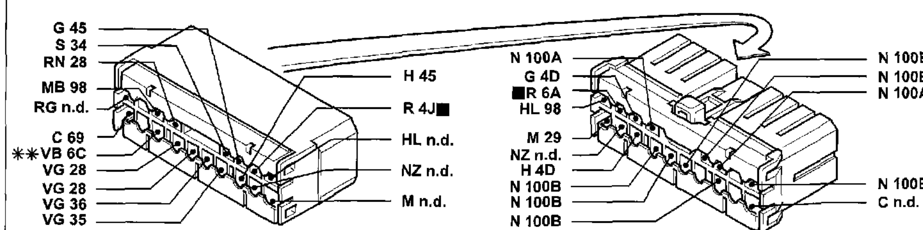



* Only for Brava

**55** Front/engine cables connection




**70** Dashboard/front cables connection



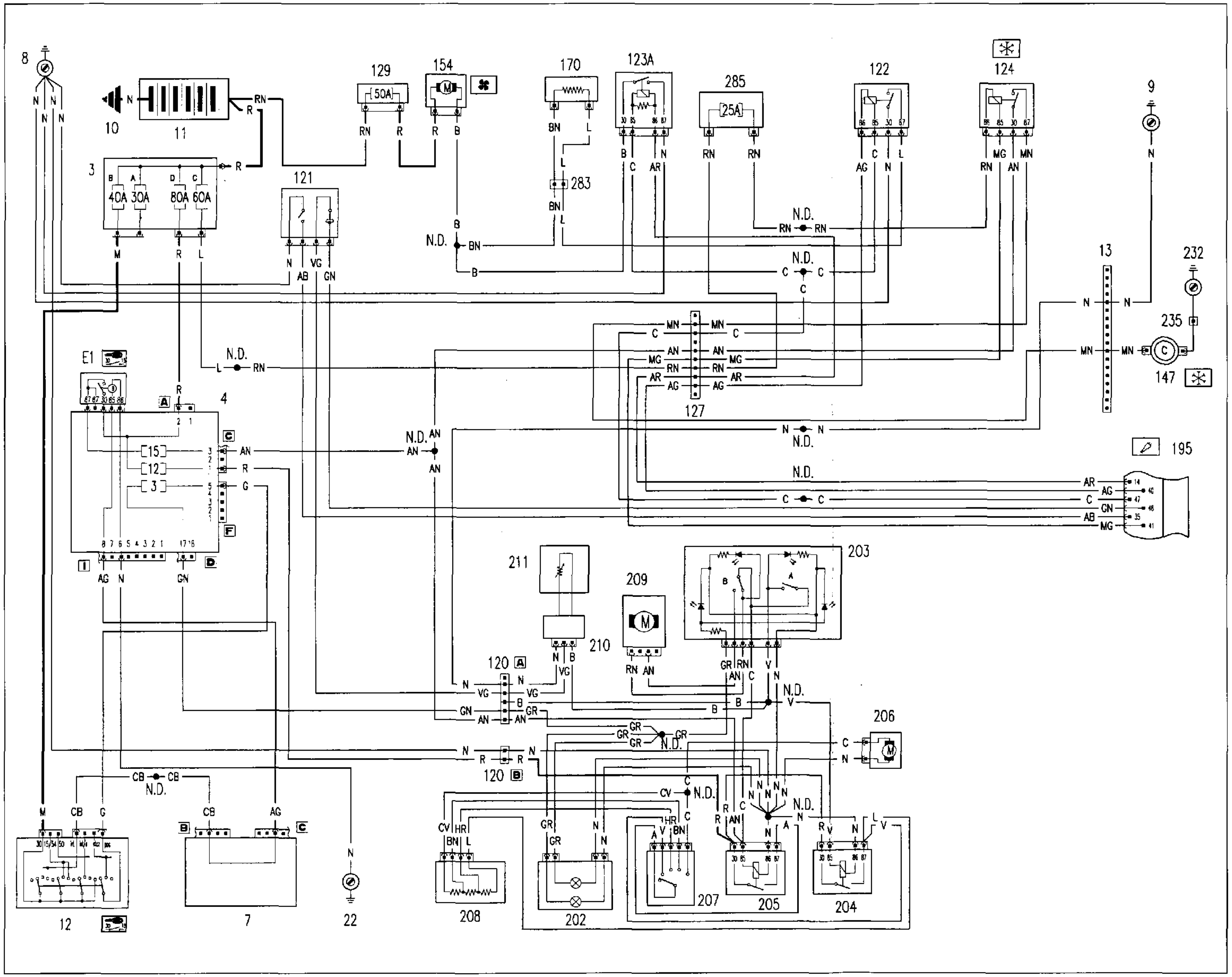

* Not present on S version

** Applies to EL/ELX version

■ The cables involved in the wiring diagram are marked with a solid square

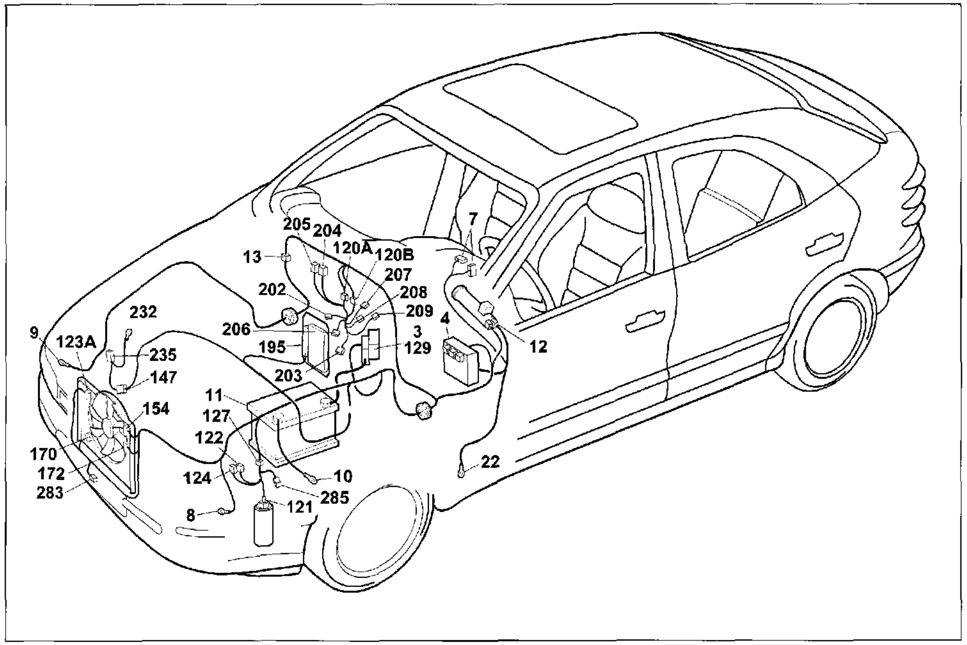
P4A48EL01

**Air conditioner**

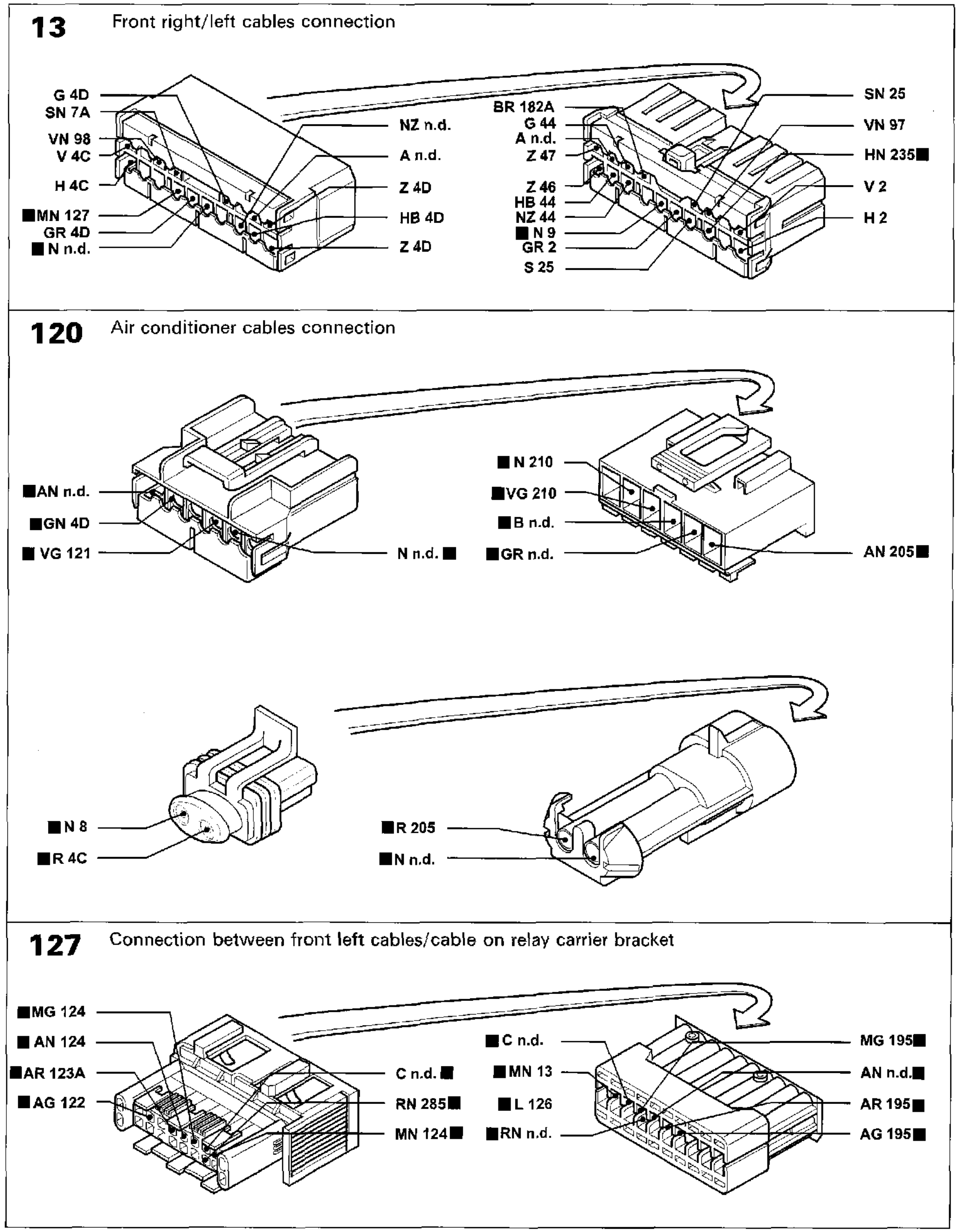


P4A49EL01

## 55.




P4A51EL01




P4A52EL01

■ The cables involved in the wiring diagram are marked with a solid square

### Air conditioner

### Key to components

3 Power fuse box:
- A 30A fuse protecting fuel injection
- B 40A fuse protecting ignition
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

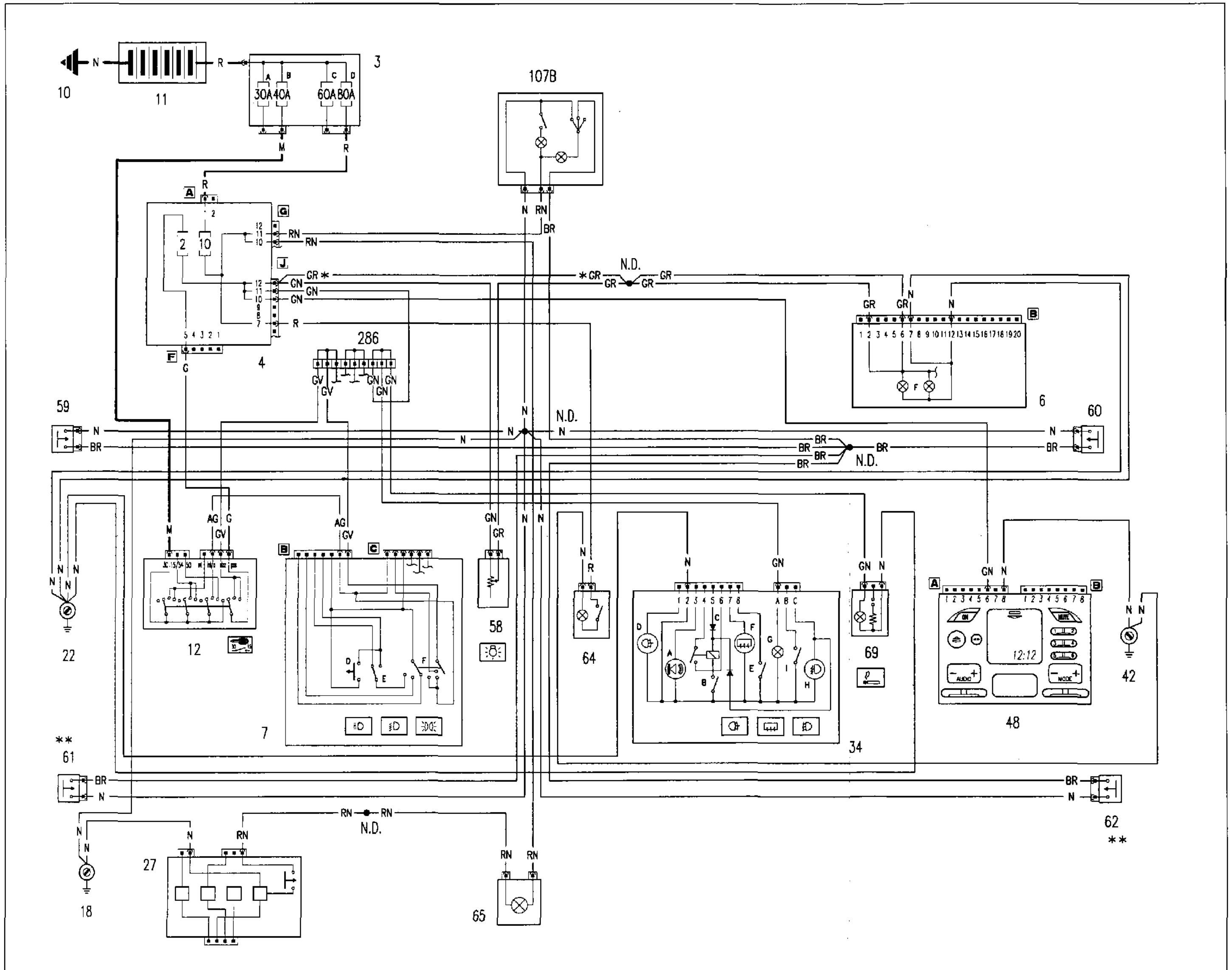
4 Fuse and relay unit:
- E1 Ignition switch discharge relay

7 Stalk unit
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
22 Left dashboard earth
120 Air conditioner cables connection
121 Three-stage pressure switch
122 Engine cooling fan low speed relay
123A Engine cooling fan high speed relay
124 Air conditioner compressor control relay
127 Connection between front left cables/cable on relay carrier bracket
129 50A power fuse protecting engine cooling fan
147 Compressor for air conditioner
154 Engine cooling fan
170 Engine cooling fan limiting resistor
195 Ignition/fuel injection electronic control unit (1581)
02 Heater/air conditioner light bulbs
203 Air conditioner controls unit:
- A Switch for switching on air conditioner
- B Switch for air conditioner recirculation

204 Air conditioner fan 1st speed control relay
205 Air conditioner fan relay
206 Heater/air conditioner electric fan
207 Heater/air conditioner speed control switch
208 Limiting resistor for heater/air conditioner
209 External/recirculation air flap actuator
210 Electronic thermostat cables connection
211 Electronic thermostat (N.T.C.)
232 Earth for compressor
235 Air conditioner compressor cables connection
283 Front cable/resistor cable connection
285 25A fuse protecting headlamp washer/compressor relay

N.D. Ultrasound-soldered joint taped in wiring loom

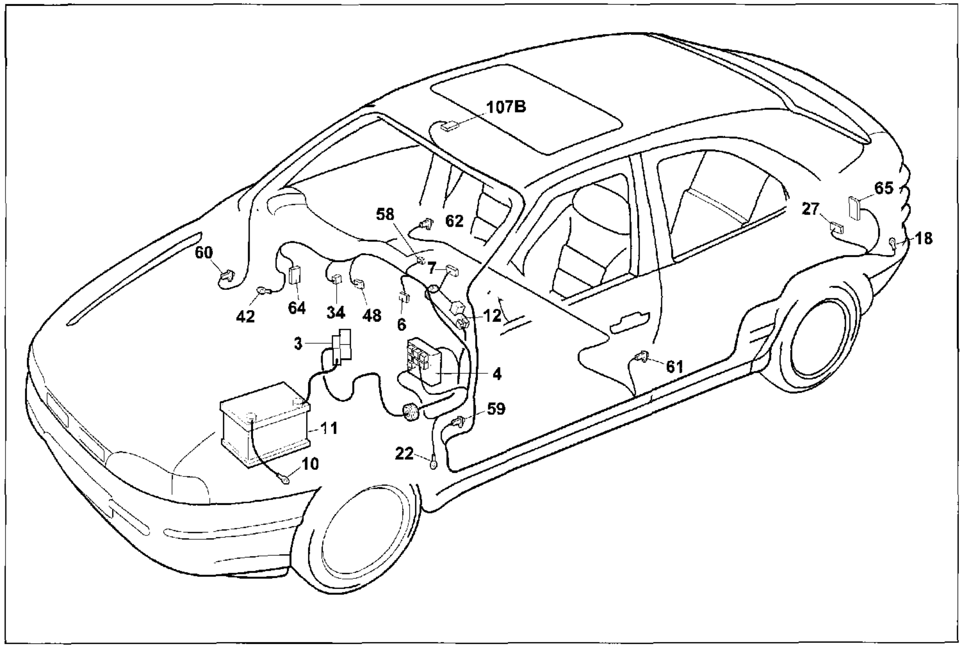
**Courtesy light - Symbol illumination**



* Variant connections for S - SX versions
** Not present on Bravo

P4A53EL01

## 55.




P4A56EL01

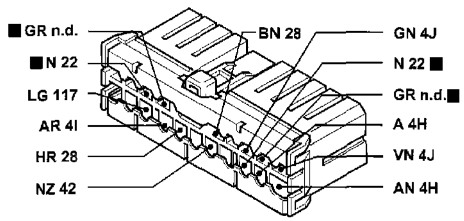
**Courtesy light - Symbol illumination**

**Key to components**

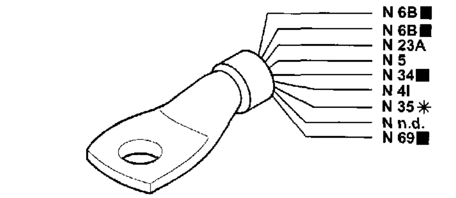
3 Power fuse box:
  A 30A fuse protecting fuel injection
  B 40A fuse protecting ignition
  C 60A fuse protecting additional optional extras
  D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit
6 Instrument panel:
  F Instrument panel symbol lights
7 Stalk unit:
  D Flasher button
  E Main beam/dipped beam headlamps stalk
  F Side lights stalk
10 Battery earth on body shell
11 Battery
12 Ignition switch
18 Rear left earth
22 Left dashboard earth
27 Rear connections contact assembly with built-in boot light
34 Switch controls unit:
  A Anti-theft "on" warning light
  B Rear fog lamps control switch
  C Rear fog lamps relay
  D Rear fog lamps warning light
  E Heated rear window switch
  F Heated rear window warning light
  G Switch controls unit symbol light
  H Front fog lamps warning light
  I Front fog lights switch
42 Right dashboard earth
48 Radio with clock
58 Lighting brightness adjustment rheostat
59 Courtesy light button on front left pillar
60 Courtesy light button on front right pillar
61 Courtesy light button on rear left pillar
62 Courtesy light button on rear right pillar
64 Glove compartment light with built-in switch
65 Boot light / anti-theft device "on"
69 Cigarette lighter
107B Car interior courtesy light
286 Short-circuiting connection

N.D. Ultrasound-soldered joint taped in wiring loom

**6B** Instrument panel

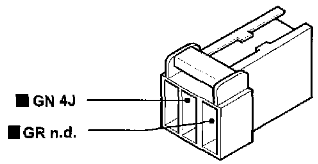



**22** Left dashboard earth

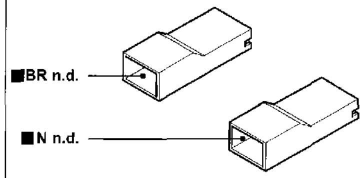



* Only for ELX version

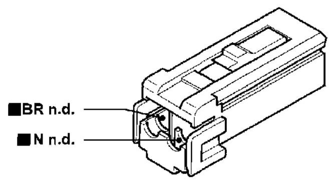
**58** Courtesy light brightness adjustment rheostat



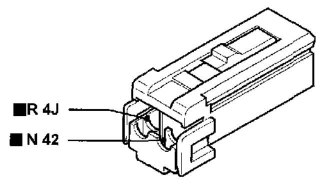

**59** Courtesy light button on front left pillar



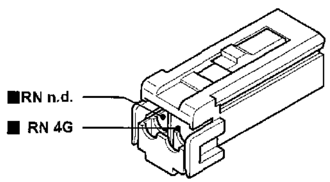

**62** Courtesy light button on front right pillar



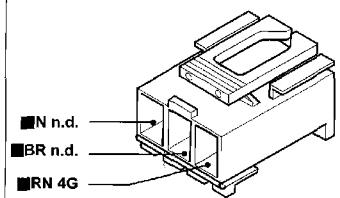

**64** Glove compartment light bulb with integrated switch




**65** Boot light bulb/anti-theft device "on"




**107B** Car interior courtesy light

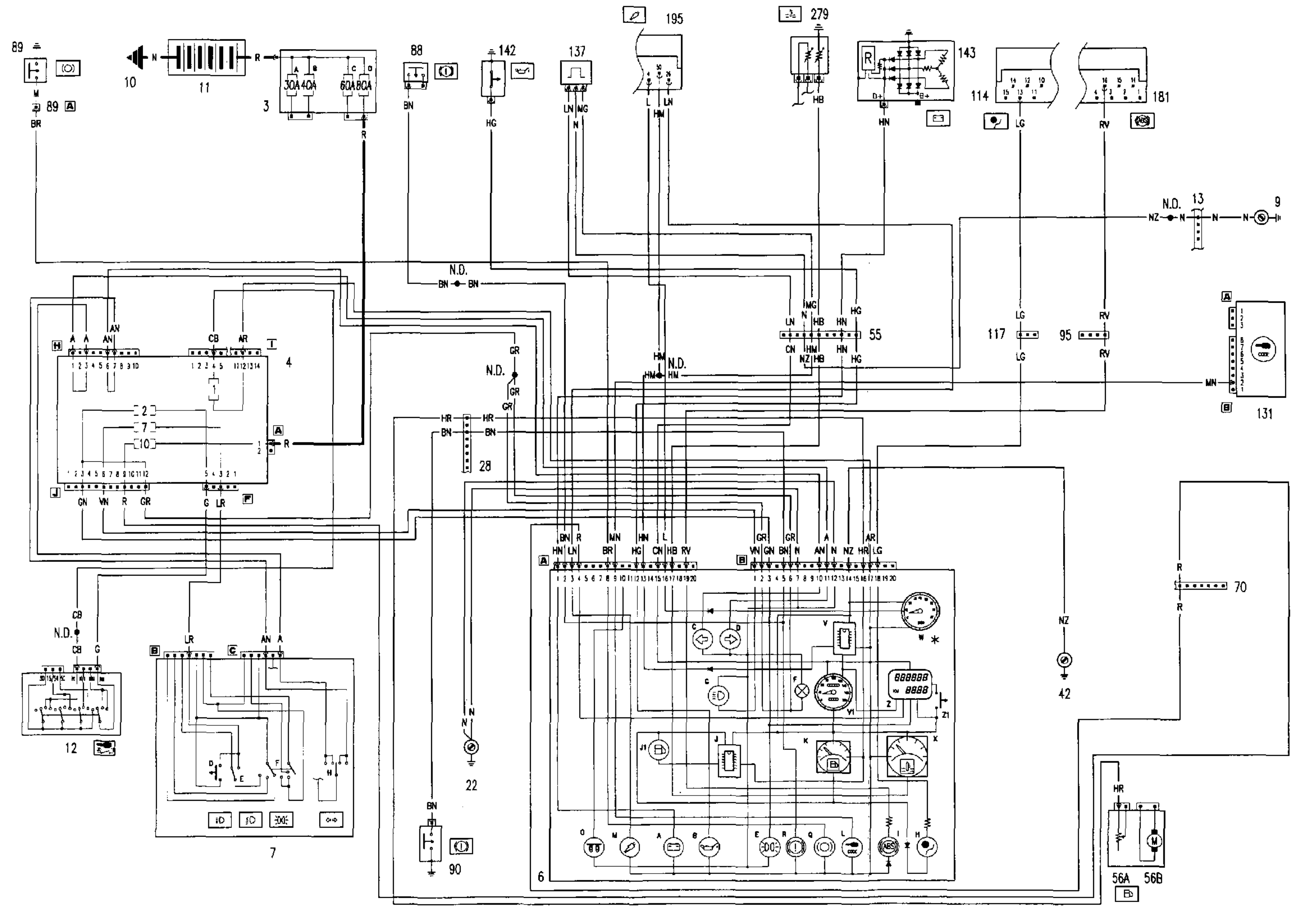



P4A56EL01

■ The cables involved in the wiring diagram are marked with a solid square

**Version: S - SX**

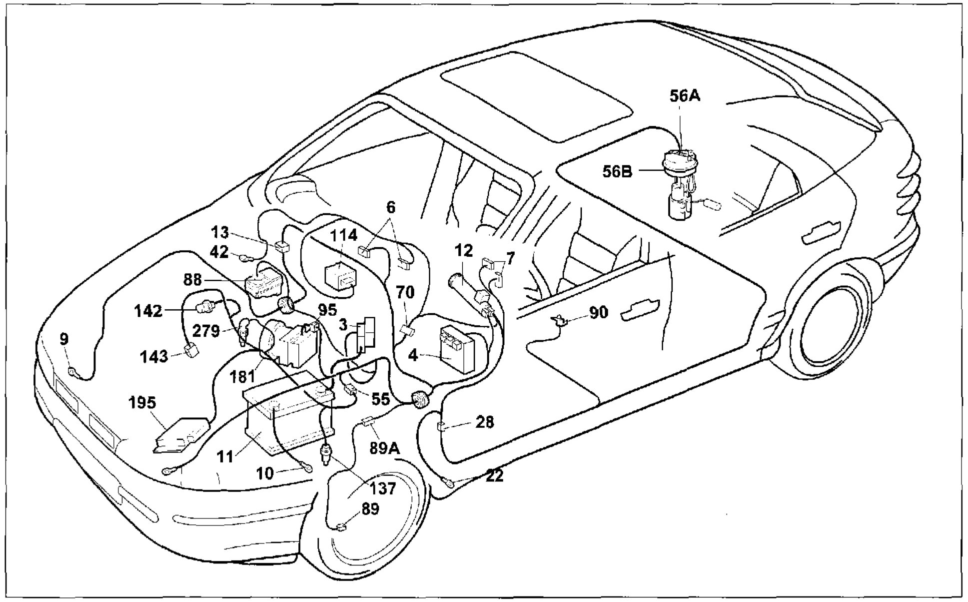
**Instrument panel connections**



* Not present on S versions

P4A57EL01

# 55.




**Version: S - SX**

**Instrument panel connections**

### Key to components

3 Power fuse box:
- A 30A fuse protecting fuel injection
- B 40A fuse protecting ignition
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

4 Fuse and relay unit

6 Instrument panel:
- A Low generator recharging warning light
- B Low engine oil pressure warning light
- C Left direction indicator warning light
- D Right direction indicator warning light
- E Side lights warning light
- F Instrument panel symbol lights
- G Main beam headlamps warning light
- H Air Bag system fault warning light
- I Anti-lock braking system fault warning light
- J Fuel reserve circuit control module
- J1 Low fuel level warning light
- K Fuel gauge
  - L Fiat-CODE system fault warning light
  - M Petrol/diesel fuel injection fault warning light
- Q Front brake pad wear warning light
- R Hand brake on / low brake fluid level warning light
- V Speedometer control unit
  - V1 Speedometer
  - W Rev counter
  - X Coolant temperature gauge
  - Z Trip recorder / total mileage counter
  - Z1 Trip recorder reset button

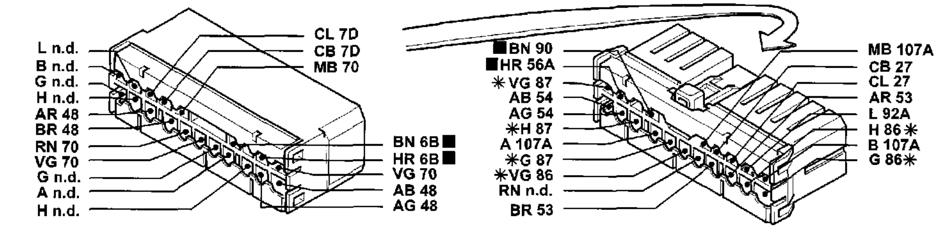
7 Stalk unit:
- D Flasher button
- E Main beam/dipped beam headlamps stalk
- F Side lights stalk
- H Direction indicators stalk

9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front left/right cables connection
22 Left dashboard earth
28 Dashboard/longitudinal cables connection
42 Right dashboard earth
55 Front/fuel gauge control cables connection
56 Fuel gauge control unit
- A Fuel level sensor
- B Electric fuel pump

70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
95 Front cables/anti-lock braking system (A.B.S.) connection
114 Air Bag electronic control unit
117 Air Bag/dashboard cables connection
131 Fiat CODE electronic control unit
137 Car speed sensor
142 Low oil pressure warning light switch
143 Alternator
181 Electrohydraulic control unit for anti-lock braking system (A.B.S.)
195 Ignition/fuel injection electronic control unit (1581)
279 Engine coolant temperature double sender unit

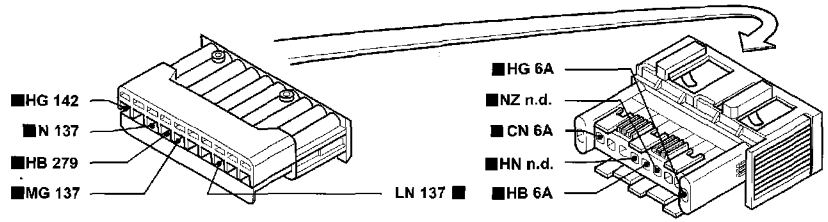
N.D. Ultrasound-soldered joint taped in wiring loom

**28** Dash./longitudinal cables connection

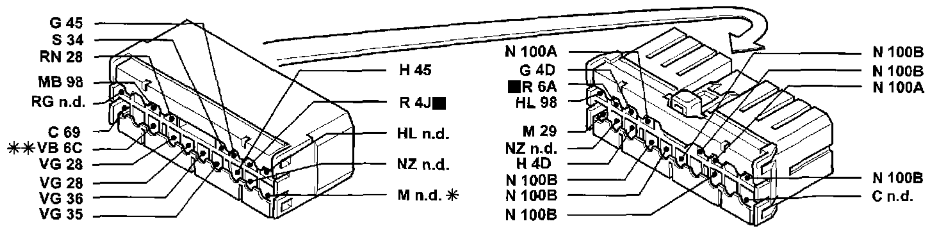



* Only for Brava

**55** Front/engine cables connection

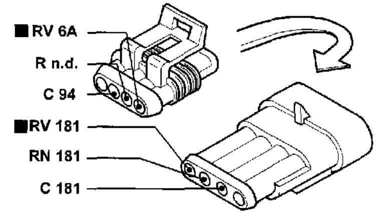



**70** Dashboard/front cables connection

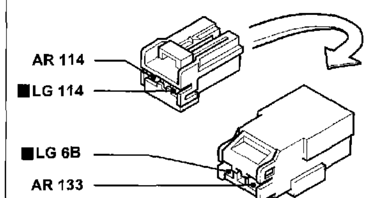



* Not present on S version ** Applies only to EL/ELX version

**95** Front/anti-lock braking system (A.B.S.) cables connection




**117** Air Bag/dashboard cables connection



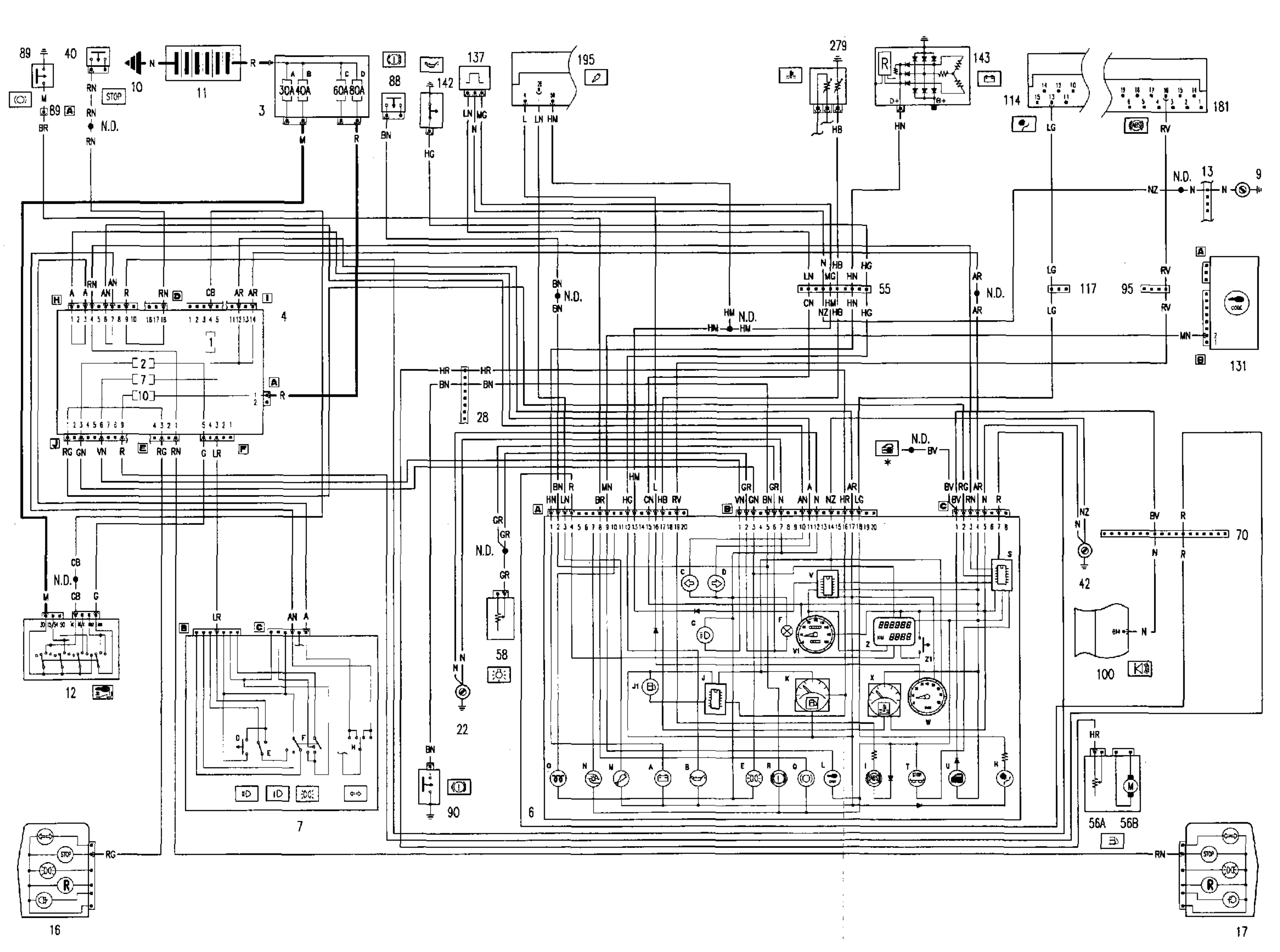

P4A60EL01

■ The cables involved in the wiring diagram are marked with a solid square

# 55.

**Version: EL - ELX**

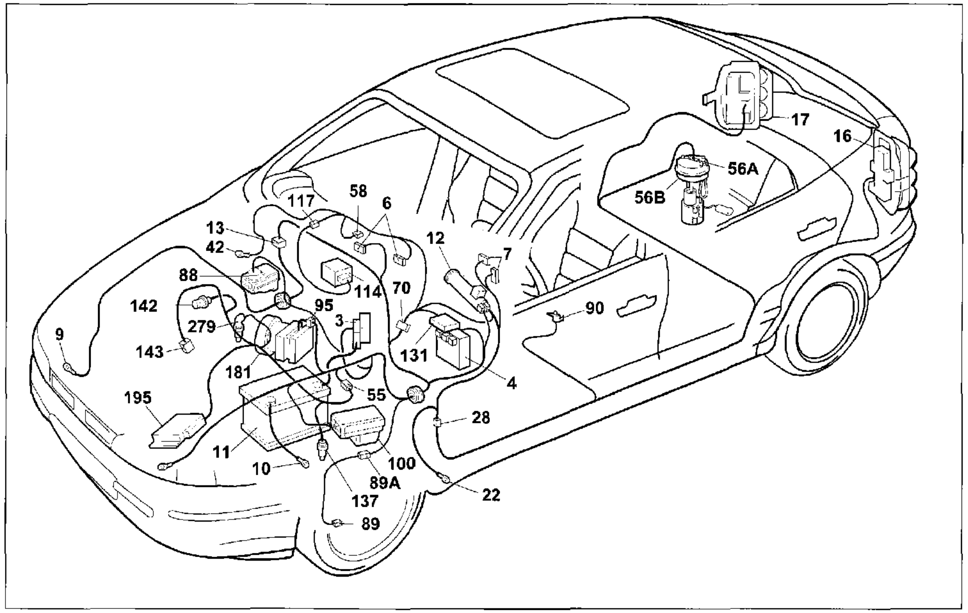
**Instrument panel connections**




* Variant connections for versions without alarm (See central door locking)

P4A61EL01

# 55.




P4A63EL01

**Version: EL - ELX**
**Instrument panel connections**

### Key to components

3 Power fuse box:
- A 30A fuse protecting fuel injection
- B 40A fuse protecting ignition
- C 60A fuse protecting additional optional extras
- D 80A fuse protecting fuse and relay unit

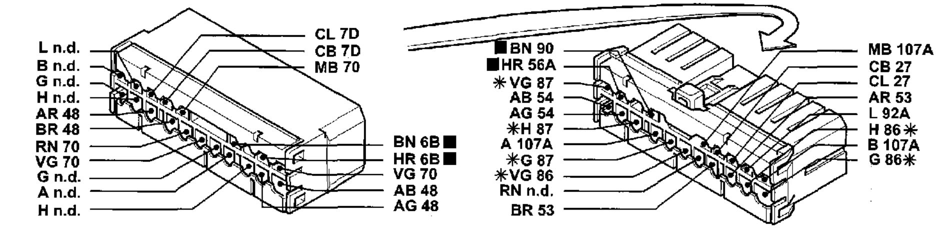
4 Fuse and relay unit
6 Instrument panel:
- A Low generator recharging warning light
- B Low engine oil pressure warning light
- C Left direction indicator warning light
- D Right direction indicator warning light
- E Side lights warning light
- F Instrument panel symbol lights
- G Main beam headlamps warning light
- H Air Bag fault warning light
- I Anti-lock braking system fault warning light
- J Fuel reserve circuit control module
- J1 Low fuel level warning light
- K Fuel gauge
- L Fiat-CODE system fault warning light
- M Fuel injection fault warning light
- N Maximum turbocharging pressure warning light
- O Heater plugs warning light
- Q Front brake pad wear warning light
- R Hand brake on/low brake fluid level warning light
- S Electronic module for car stop lights fault indicator system
- T Stop lights fault warning light
- U Door open warning light
- V Speedometer control module
- V1 Speedometer
- W Rev counter
- X Water temperature gauge
- Z Trip recorder / total mileage counter
- Z1 Trip recorder reset button

7 Stalk unit:
- D Flasher button
- E Main beam/dipped beam headlamps stalk
- F Side lights stalk
- H Direction indicators stalk

9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
16 Rear left lights cluster
17 Rear right lights cluster
22 Left dashboard earth
28 Dashboard/longitudinal cables connection
40 Stop lights switch
42 Right dashboard earth
55 Front/fuel gauge control cables connection
56 Fuel gauge control unit
- A Fuel level sensor
- B Electric fuel pump

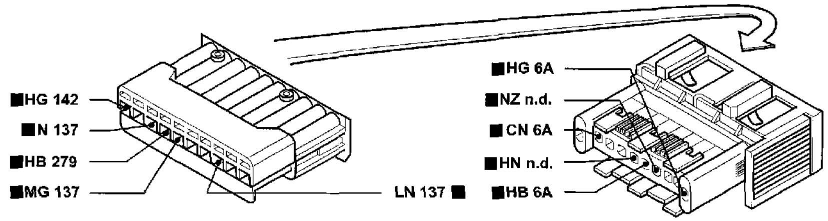
58 Lighting brightness adjustment rheostat
70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 Left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
95 Front/anti-lock braking system (A.B.S.) cables connection
100 Alarm system electronic control unit
114 Air Bag electronic control unit
117 Air Bag/dashboard cables connection
131 Fiat-CODE electronic control unit
137 Car speed sensor
142 Low engine oil pressure indicator switch
143 Alternator
181 Electronic control unit for anti-lock braking system (A.B.S.)
195 Ignition/fuel injection electronic control unit (1581)
279 Engine coolant temperature double sender unit
N.D. Ultrasound-soldered joint taped in wiring loom

**28** Dash./longitudinal cables connection

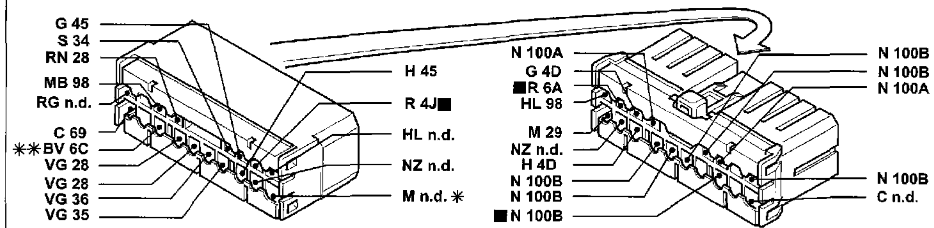



* Only for Brava

**55** Front/engine cables connection

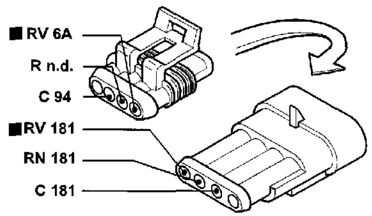



**70** Dashboard/front cables connection

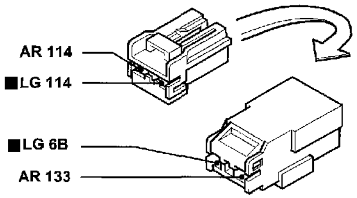



* Not present on S version ** Applies only to EL/ELX version

**95** Front/anti-lock braking system (A.B.S.) cables connection



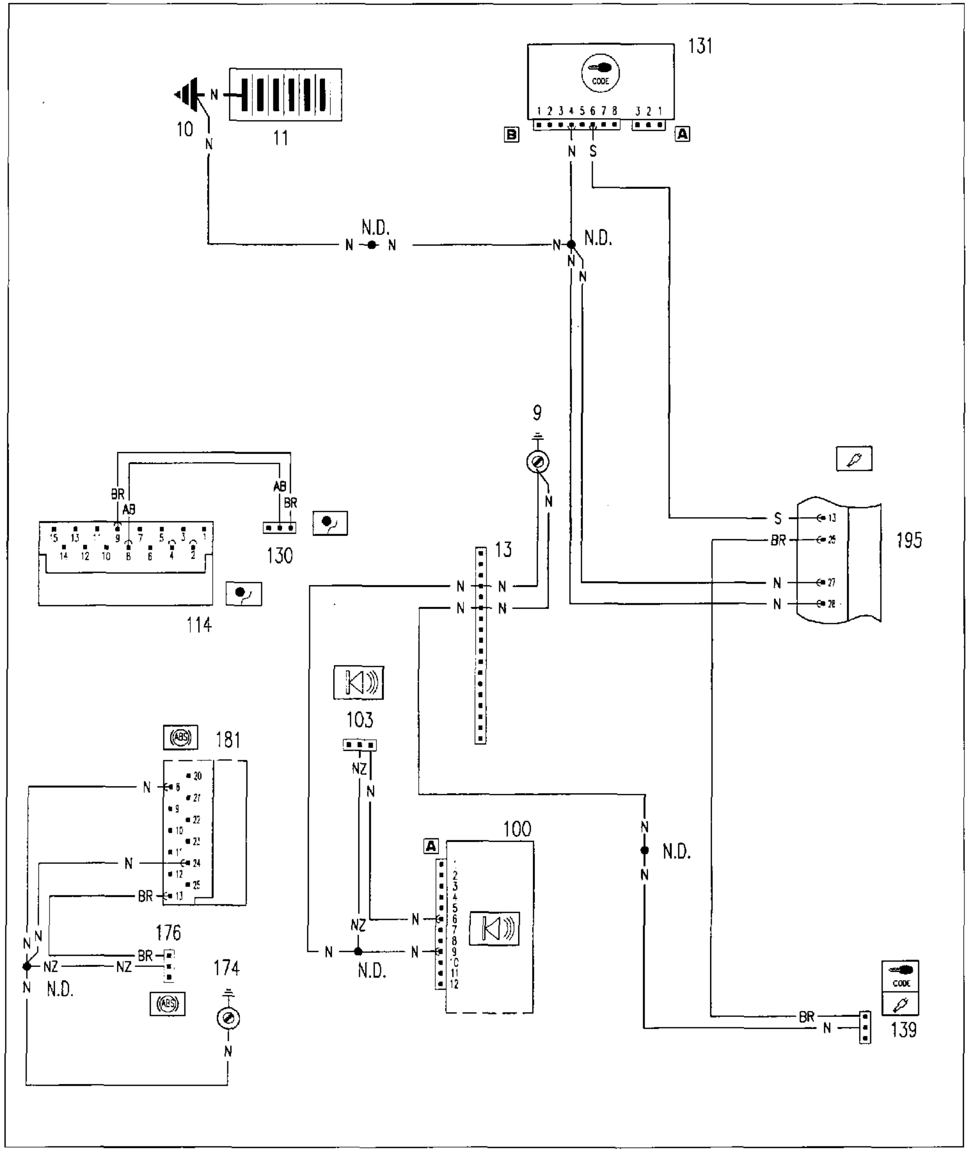

**117** Air Bag/dashboard cables connection



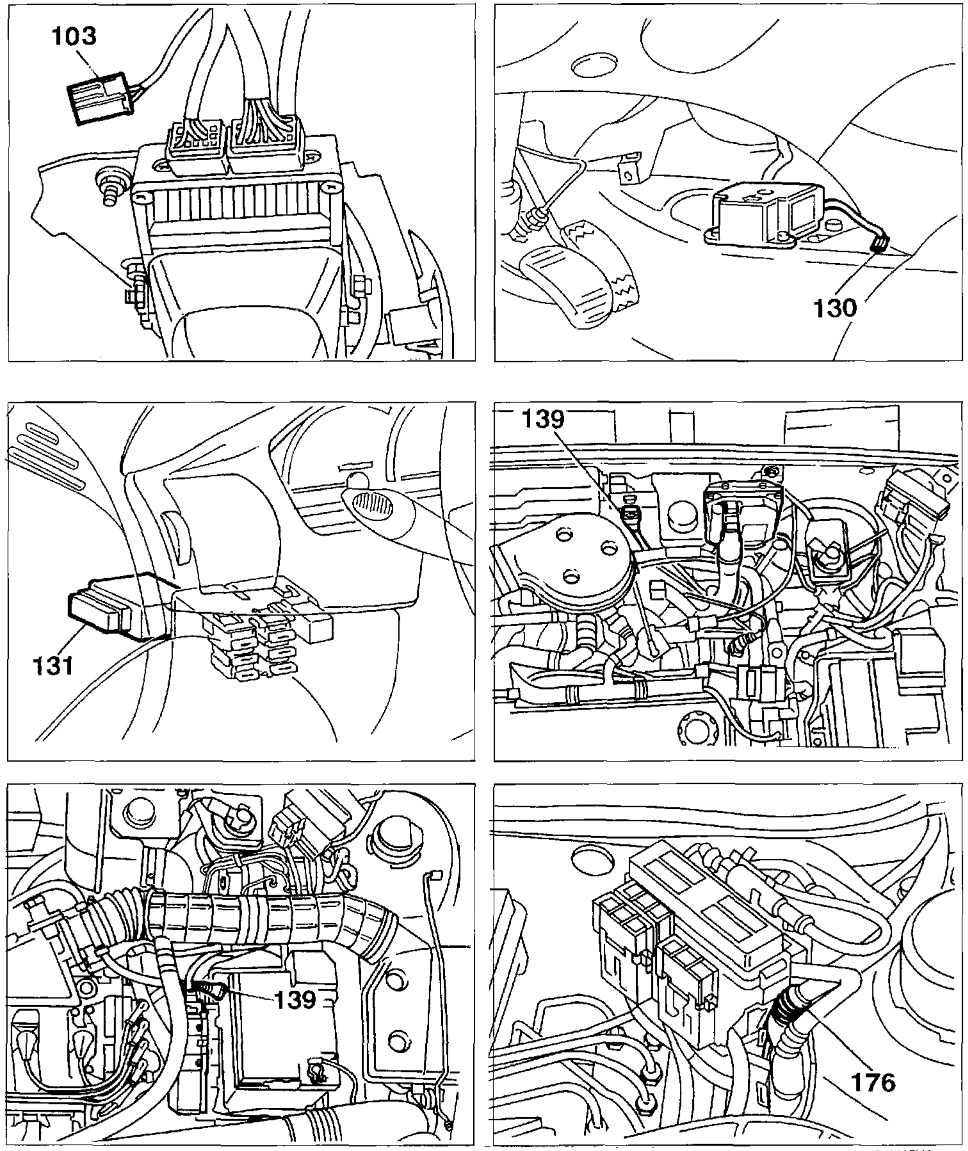

P4A64EL01

■ The cables involved in the wiring diagram are marked with a solid square

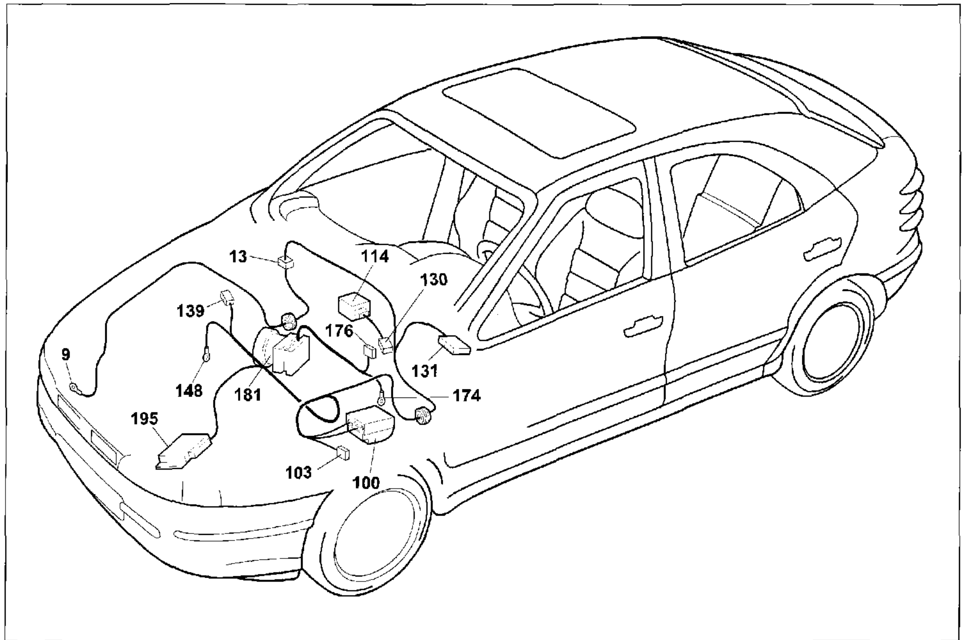
### Diagnostic socket connections




### Location of components



## 55.




P4A67EL01

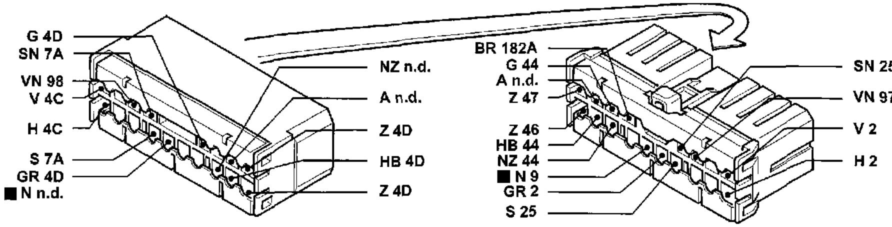
**Diagnostic socket connections**

**Key to components**

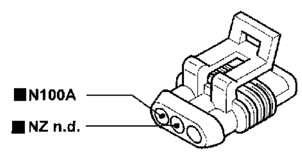
9 Front right earth
10 Battery earth on body shell
13 Front right/left cables connection
100 Alarm electronic control unit
103 Diagnostic socket for alarm
114 Air Bag electronic control unit
130 Diagnostic socket for Air Bag system
131 Fiat-CODE electronic control unit
139 Diagnostic socket for fuel injection
148 Earth for electronic fuel injection
174 Power earth for anti-lock braking system (A.B.S.)
176 Diagnostic socket for anti-lock braking system (A.B.S.)
181 Anti-lock braking system (ABS) electronic control unit.)
195 Ignition/fuel injection electronic control unit (1581)

N.D. Ultrasound-soldered joint taped in wiring loom

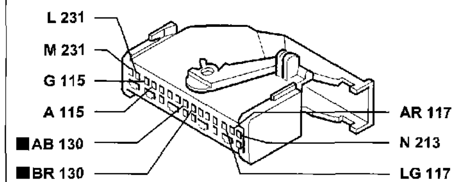
**13** Front right/left cables connection



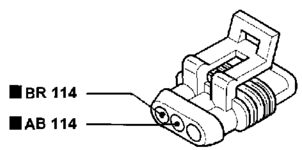

**103** Diagnostic socket for alarm



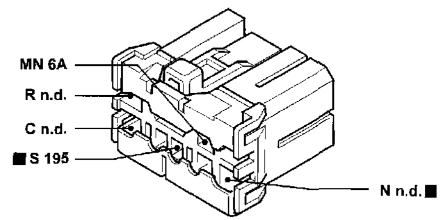

**114** Air Bag electronic control unit



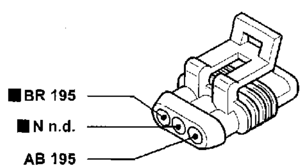

**130** Diagnostic socket for Air-bag system



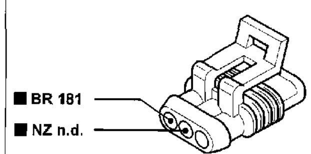

**131** Fiat-CODE electronic control unit




**139** Diagnostic socket for fuel injection




**176** Diagnostic socket for A.B.S




P4A68EL01

■ The cables involved in the wiring diagram are marked with a solid square

**Key to components**

1 Front left lights cluster
2 Front right lights cluster
3 Power fuse box
A 50A fuse protecting fuel injection (60A for D versions)
B 50A fuse protecting ignition
C 50A fuse protecting additional optional extras
D 80A fuse protecting fuse and relay unit
4 Fuse and relay unit:
E1 Ignition switch discharge relay
5 Dipped beam relay
6 Instrument panel:
A Low generator recharging warning light
B Low engine oil pressure warning light
C Left direction indicator warning light
D Right direction indicator warning light
E Side lights warning light
F Instrument panel symbol lights
G Main beam headlamps warning light
H Air Bag system fault warning light
I Anti-lock braking system fault warning light
J Fuel reserve circuit control module
J1 Low fuel level warning light
K Fuel gauge
L Fiat CODE fault warning light
M Petrol fuel injection fault warning light
Q Front brake pad wear warning light
R Hand brake on / low brake fluid warning light Car stop lights fault warning light
V Speedometer control module
V1 Speedometer
W Rev counter
X Water temperature gauge
Z Trip recorder / total mileage counter
Z1 Trip recorder reset button
7 Stalk unit:
A Windscreen wiper speed control stalk
B Windscreen wiper headlamp washer/rear window wiper stalk
C Rear window wiper switch
D Flasher button
E Dipped beam/main beam headlamps stalk
F Side lights stalk
H Direction indicators stalk
I Horn button
8 Front left earth
9 Front right earth
10 Battery earth on body shell
11 Battery
12 Ignition switch
13 Front right/left cables connection
14 Left number plate light
15 Right number plate light
16 Rear left lights cluster
17 Rear right lights cluster
18 Rear left earth
19 Rear right earth
20 Front left side repeater
21 Front right side repeater
22 Left dashboard earth
23 Hazard lights switch unit
A Hazard warning lights warning lamp
B Hazard warning lights switch
C Hazard warning lights symbol light
27 Contact assembly for rear connections with integrated boot light switch
28 Dash./longitudinal cables connection
29 Front/front fog lamps cables connection
30 Front left fog lamp
31 Front right fog lamp
32 Front fog lamp relay
33 20A fuse protecting front fog lamps
34 Switch controls unit:
A Anti-theft device "on" warning light
B Rear fog lights switch
C Rear fog lights relay
D Rear fog lamps warning light
E Heated rear window switch
F Heated rear window warning light
G Switch controls unit symbol light
H *Front fog lamps warning light*
I Front fog lights switch
40 Stop lights switch
41 Additional stop light
41A Additional stop light rear cables connection
42 Right dashboard earth
48 Radio with clock
55 Front/fuel gauge control cables connection
56 Fuel gauge control unit
A Fuel level sensor
B Electric fuel pump

4A89EL

57 Inertial switch
58 Lighting brightness adjustment rheostat
59 Courtesy light button on front left pillar
60 Courtesy light button on front right pillar
61 Courtesy light button on rear left pillar
62 Courtesy light button on rear right pillar
64 Glove compartment light with integrated switch
65 Boot light bulb/anti-theft device "on"
69 Cigarette lighter
70 Dashboard/front cables connection
88 Low brake fluid level sensor
89 left brake pad wear sensor
89A Left brake pad wear sensor cables connection
90 Handbrake on warning light switch
94 5A fuse protecting anti-lock braking system (A.B.S.)
95 Front/anti-lock braking system (A.B.S.) cables connection
96 60A power fuse protecting electrical system
100 Anti-theft electronic control unit
107B Car interior courtesy light
103 Diagnostic socket for anti-theft device
114 Air Bag electronic control unit
117 Air Bag/dashboard cables connection
120 Air conditioner cables connection
121 Three-stage pressure switch
122 Engine cooling fan low speed relay
123A Engine cooling fan high speed relay
124 Air conditioner compressor relay
127 Connection between front left cables/ cable on relay carrier bracket
128 Front/air conditioner cables connection
129 50A power fuse protecting engine cooling fan
130 Diagnostic socket for Air Bag
131 Fiat-CODE electronic control unit
136 Knock sensor
137 Vehicle speed sensor
138 Idle adjustment actuator
139 Diagnostic socket for fuel injection
141 Heated Lambda probe
142 Low oil pressure warning light switch
143 Alternator
144 Rpm and T.D.C. sensor
145 Starter motor
146 Potentiometer on throttle valve
147 Compressor for air conditioner
148 Earth for electronic fuel injection
150 Fuel injection relay
154 Engine cooling fan
155 Ignition coils assembly
156 Spark plugs
159 Reversing lights switch
162 Fuel injector (1st)
163 Fuel injector (2nd)
164 Fuel injector (3rd)
165 Fuel injector (4th)
170 Engine cooling fan limiting resistor
171 Heater
174 Power earth for anti-lock braking system (A.B.S.)
176 Diagnostic socket for anti-lock braking system (A.B.S.)
177 Sensor on front left wheel for anti-lock braking system (A.B.S.)
178 Sensor on rear left wheel for anti-lock braking system (A.B.S.)
179 Sensor on front right wheel for anti-lock braking system (A.B.S.)
180 Sensor on rear right wheel for anti-lock braking system (A.B.S.)
181 Electrohydraulic control unit for anti-lock braking system (A.B.S.)
194 Injection/injector flange cables connection
195 Ignition/fuel injection electronic control unit (1581)
199 Aerial for Fiat CODE system
202 Heater/air conditioner light bulbs
203 Air conditioner controls:
A Air conditioner recirculation switch
B Air conditioner "on" switch
204 Air conditioner fan 1st speed relay
205 Air conditioner fan relay
206 Heater/air conditioner fan
207 Heater/air conditioner speed control switch
208 Limiting resistor for heater/air conditioner
209 External/recirculation air flap actuator
210 Electronic thermostat cables connection
211 Electronic thermostat (N.T.C.)
232 Earth for compressor
235 Air conditioner compressosr cables connection
278 Integrated air temperature/pressure sender unit
279 Engine coolant temperature double sender unit
280 7.5A fuse protecting ignition switch
281 30A fuse protecting Lambda probe/canister solenoid
282 7.5A fuse protecting Fiat-CODE/electronic fuel injection
283 Front cable/resistor connection
284 Engine cooling fan relay
285 25A fuse protecting headlamp washer/ compressor
286 Short-circuiting connection
287 Short-circuiting connection
288 Short-circuiting connection
289 Short-circuiting connection

**Cable colour codes**

| | | | |
|---|---|---|---|
| A | Light blue | GN | Yellow-Black |
| B | White | GL | Yellow-Blue |
| C | Orange | GR | Yellow-Red |
| G | Yellow | GV | Yellow-Green |
| H | Grey | HG | Grey-Yellow |
| L | Blue | HN | Grey-Black |
| M | Brown | HR | Grey-Red |
| N | Black | HV | Grey-Green |
| R | Red | LB | Blue-White |
| S | Pink | LG | Blue-Yellow |
| V | Green | LN | Blue-Black |
| Z | Purple | LR | Blue-Red |
| AB | Light blue-White | LV | Blue-Green |
| AG | Light blue-Yellow | MB | Brown-White |
| AN | Light blue-Black | MN | Brown-Black |
| AR | Light blue-Red | NZ | Black-Purple |
| AV | Light blue-Green | RB | Red-White |
| BG | White-Yellow | RG | Red-Yellow |
| BL | White-Blue | RN | Red-Black |
| BN | White-Black | RV | Red-Green |
| BR | White-Red | SN | Pink-Black |
| BV | White-Green | VB | Green-White |
| BZ | White-Purple | VN | Green-Black |
| CA | Orange-Light blue | VR | Green-Red |
| CB | Orange-White | ZB | Purple-White |
| CN | Orange-Black | | |

# Index

# 55.

## PROTECTION AND SAFETY DEVICES

All the vehicle fuel lines have been designed taking into account the most up to date directives dealing with safety and protection, especially the risk of fire.

There are two main types of protection:
- active protection, aimed at reducing possible causes of problems "at the source";
- passive protection, aimed at keeping the effects of a possible problem to a minimum.

The first category includes care design of the cables, their positioning and securing along appropriately shielded and protected routes.
Suitable modifications have been made to the alternator and starter motor cables, with the adoption of protective covers; a protective outer sheath has also been adopted for some sections of cable which are particularly exposed.
The passive protection includes all operations, which have always been adopted on vehicles, to reduce high currents (overloading or short circuits).
The size of all the system fuses is based on the nominal absorption of the simultaneous loads and is designed to guarantee operation in the case of a short circuit.
Through the adoption of a fuse box containing four maxi fuses, plus other located outside, it is possible to protect all the supplies, with the sole exception of the cable which connectrs the battery to the starter motor and the one which connects the latter to the alternator; these cables are protected by an additional outer casing.

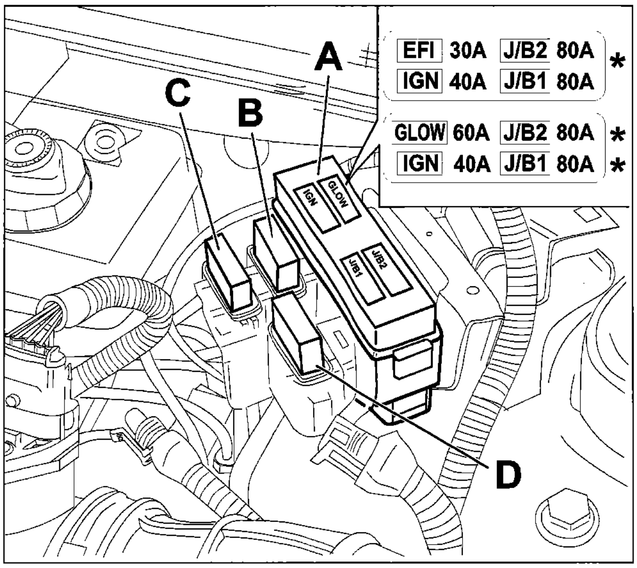
"MAXI" fuse box **A:**

**EFI:** electronic injection fuse (petrol)
**GLOW:** heater plugs fuse (diesel)
**IGN:** ignition switch fuse
**J/B2:** general supply fuse
**J/B1:** general supply fuse

next to the box:

**B:** fan fuse (see table)

| ENGINE | VERSION | AMP |
|---|---|---|
| **242 16v - 1581 16v /C.A.** | Heated<br>Air conditioned | 30<br>40 |
| **1747 - 1998 20v** | Heated<br>Air conditioned | 40<br>50 |
| **1910 TD SOFT** | Heated<br>Air conditioned | 40<br>40 |
| **1910 JTD** | Heated<br>Air conditioned | 50<br>40 |

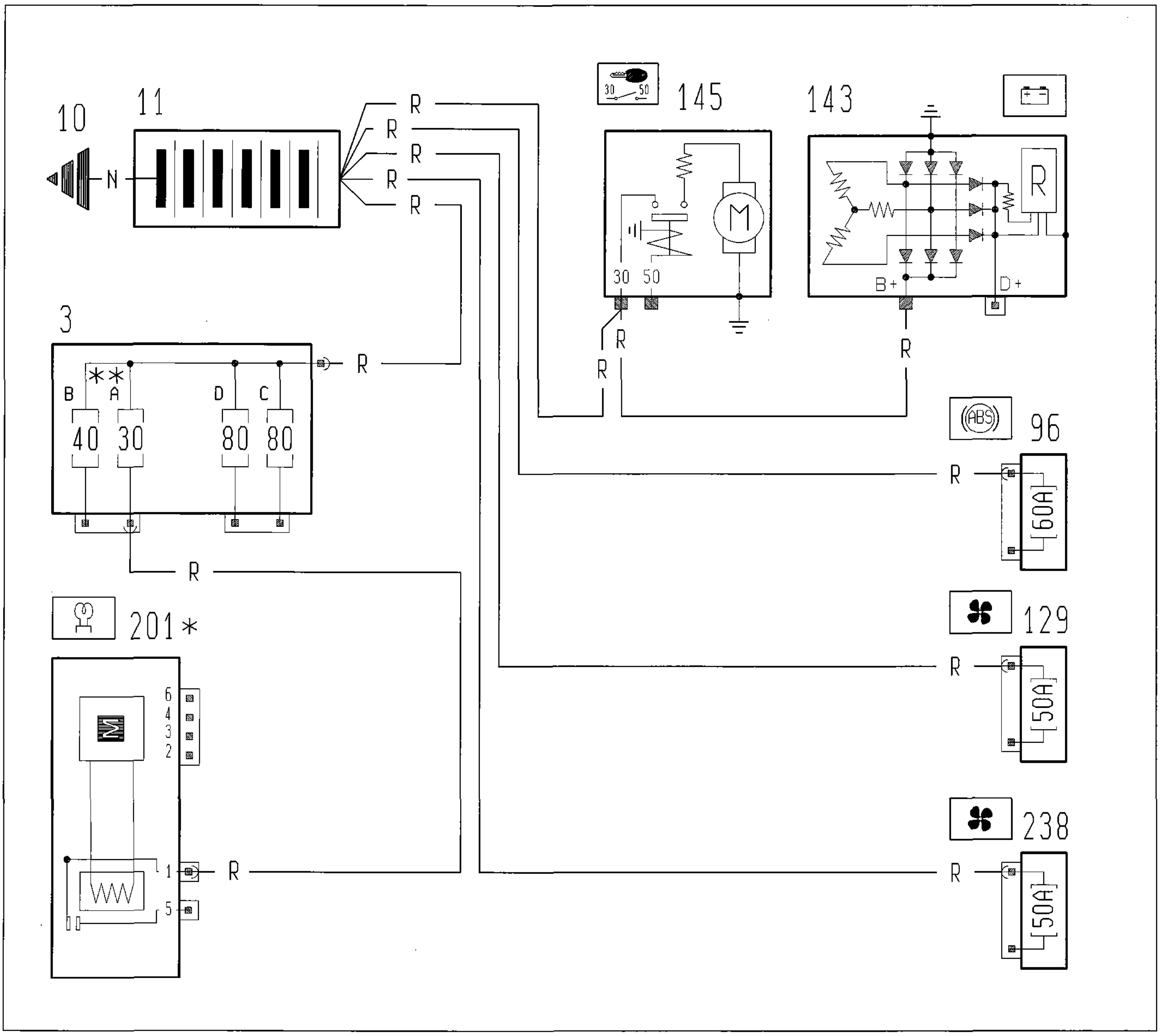



P4A01HL01

**C:** 40A fuse for air conditioning for 1910 JTD only
**D:** 60A fuse for ABS

* petrol versions
** Diesel versions

**Diagram showing device with hot cables**




P4A02HL01

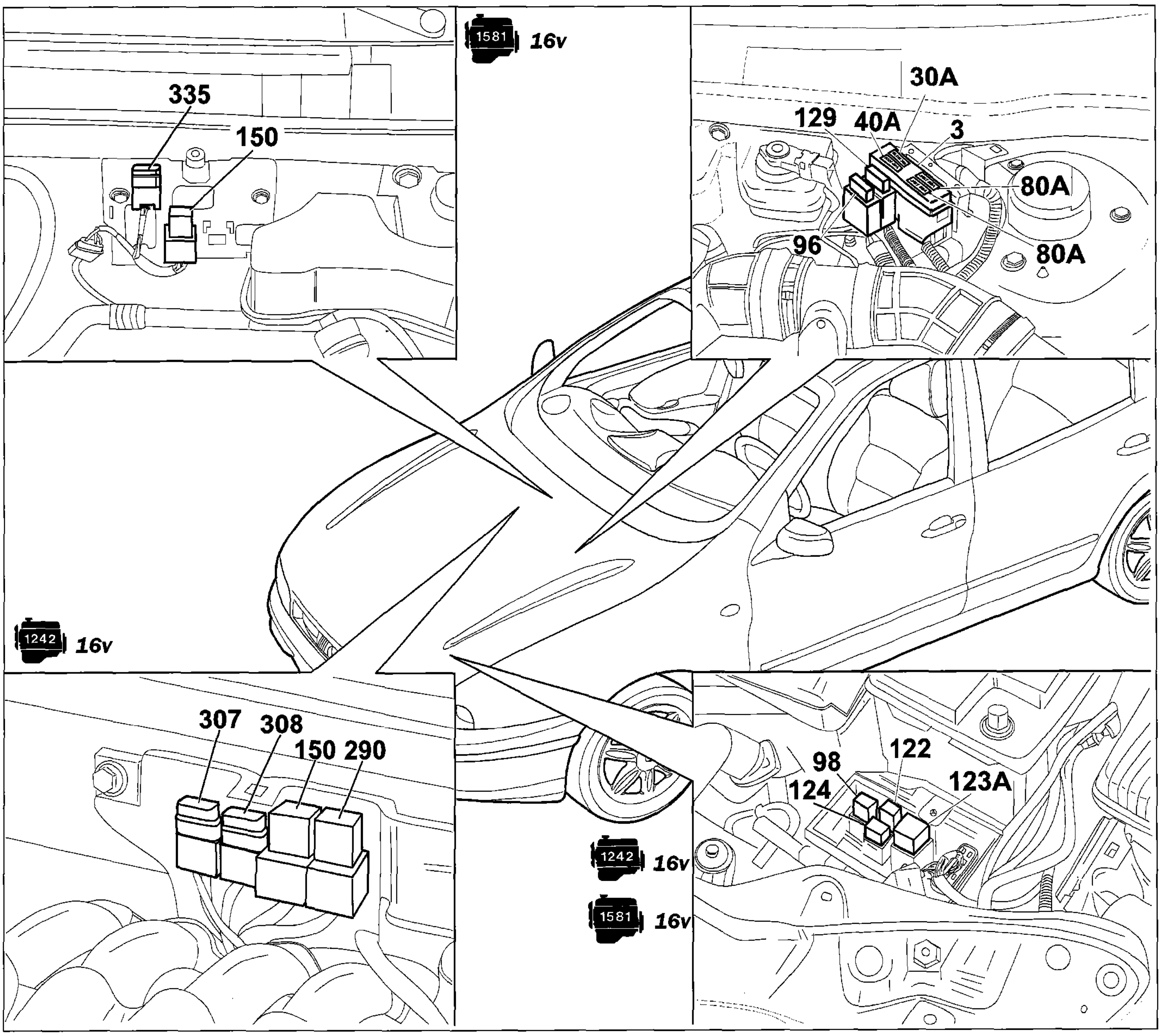
3. Power fuse box
10. Earth for battery on bodyshell
11. Battery
96. 60A power fuse protecting electrical equipment
129. Power fuse protecting engine cooling fan (See air conditioning - engine cooling wiring diagrams for relevant engine types)
143. Alternator
145. Starter motor
201. Heater plugs control unit
238. Power fuse protecting engine cooling fan (See air conditioning - engine cooling wiring diagrams for relevant engine types)

* Exists only for the Turbo Diesel versions
** 60A fuse for Turbo Diesel versions


XI-98 - Cancels and replaces

Print no. 506.670/17

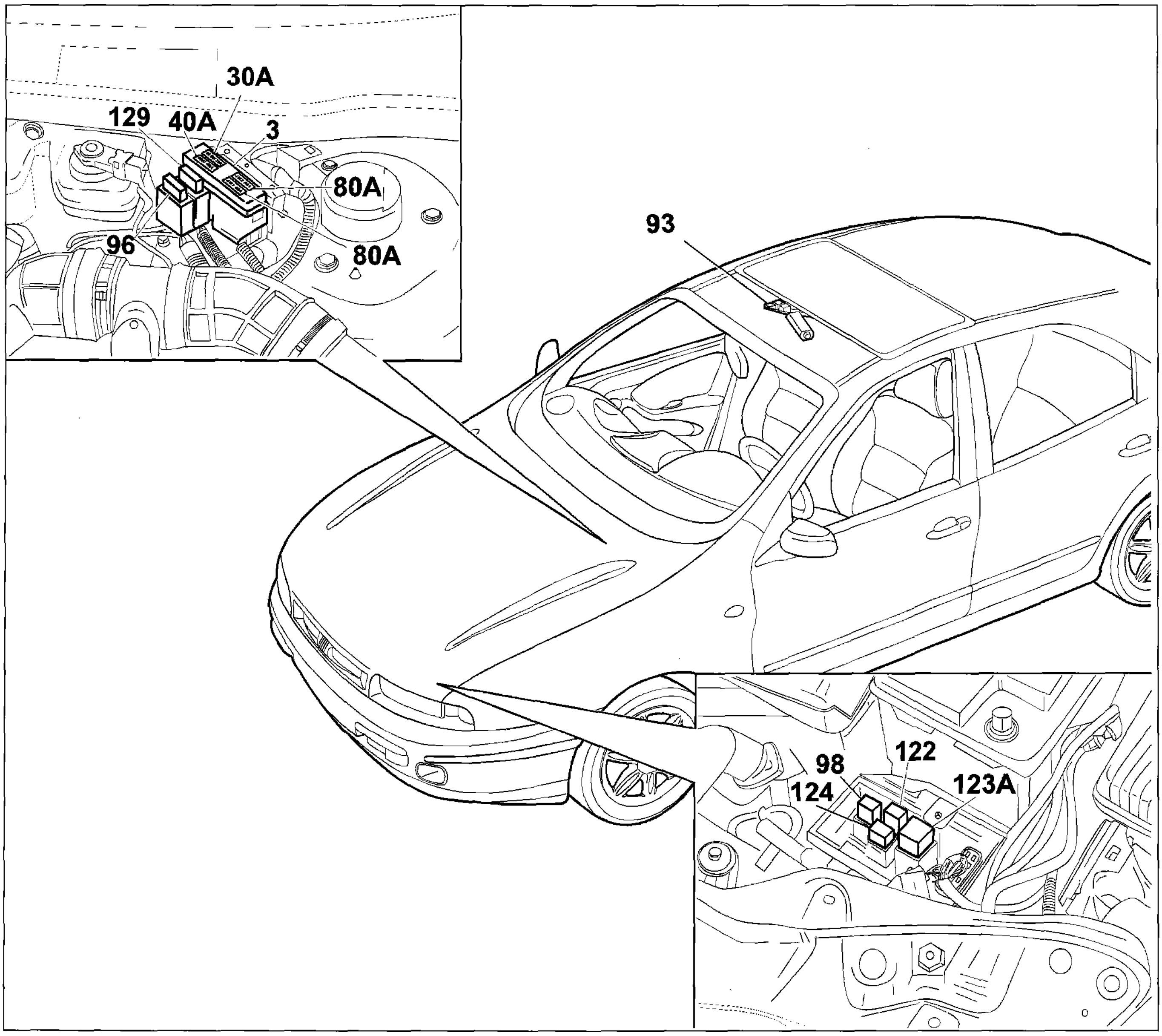
**LOCATION OF RELAYS AND FUSES ON VEHICLE (Engine compartment 1242 16v - 1581 16v)**




3. Power fuse box
96. A.B.S. system protective power fuse
98. Preparation for headlamp washer intermittent device
122. Engine cooling fan low speed relay
123A. Engine cooling fan high speed relay
124. Air conditioning compressor relay
129. Power fuse protecting engine cooling fan
150. Injection system relay feed
290. Electric fuel pump relay feed
307. I.E. system protective fuse (1242 16v)
308. 15A fuse protecting canister solenoid valve
335. 15A fuse protecting Lambda sensor

# 55.

**LOCATION OF RELAYS AND FUSES ON VEHICLE (Engine compartment 1998 20v)**

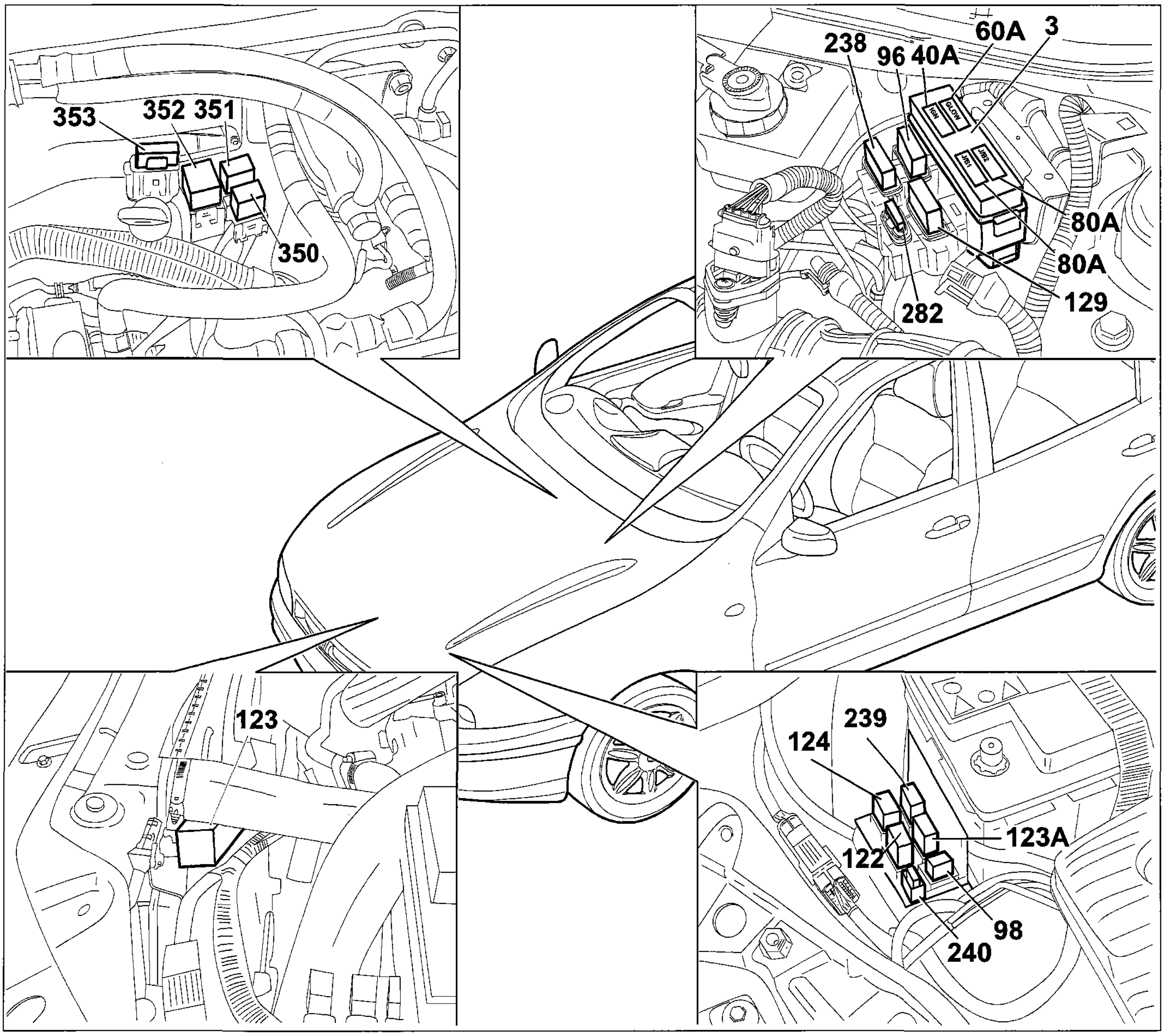



3. Power fuse box
93. Electrically operated sun roof control unit (all versions and engine types)
96. Power fuse protecting A.B.S. system
98. Preparation for headlamp washer intermittent device
122. Engine cooling fan low speed relay
123A. Engine cooling fan high speed relay
124. Air conditioning compressor relay
129. Power fuse protecting engine cooling fan


XI-98 - Cancels and replaces

*Print no. 506.670/17*

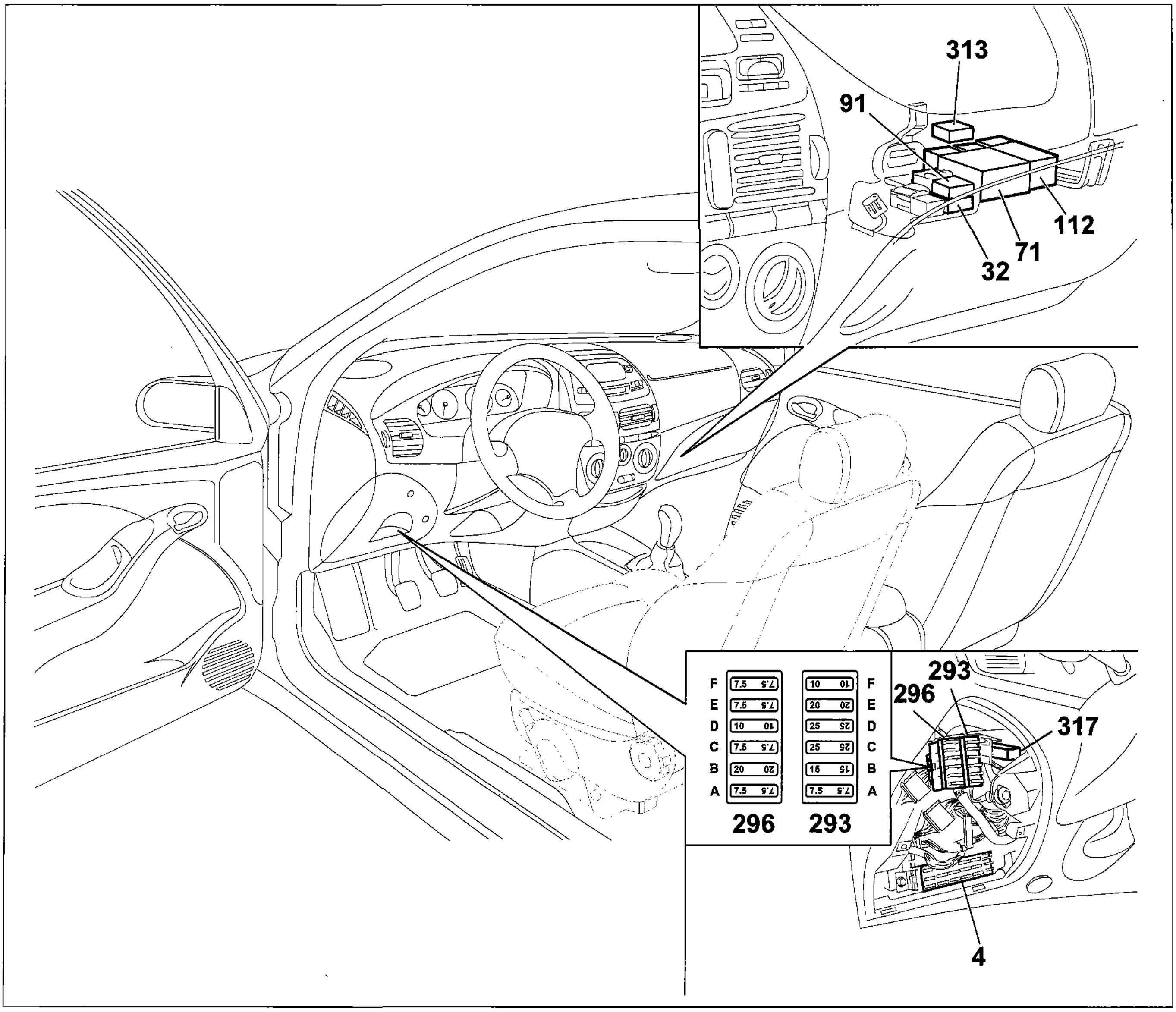
**LOCATION OF RELAYS AND FUSES ON VEHICLE (Engine compartment 1910 JTD)**




3. Power fuse box
96. A.B.S. system protective power fuse
98. Preparation for headlamp washer intermittent device
122. Engine cooling fan low speed relay
123. Engine cooling fan high speed timer
123A. Engine cooling fan high speed relay
124. Air conditioning compressor relay
129. 50A protective power fuse for engine cooling fan
238. Protective power fuse for 2nd engine cooling fan
239. Diesel preheating protective relay (1910 JTD)
240. Diesel pre-heating protective fuse (1910 JTD)
282. Fiat CODE- I.E. control unit 30A protective fuse
350. Passenger compartment coolant heating relay
351. Passenger compartment coolant heating safety relay
352. Passenger compartment coolant heating relay
353. 70A fuse protecting passenger compartment coolant heater plugs

# 55.

**LOCATION OF RELAYS AND FUSES ON VEHICLE (Passenger compartment SX version)**



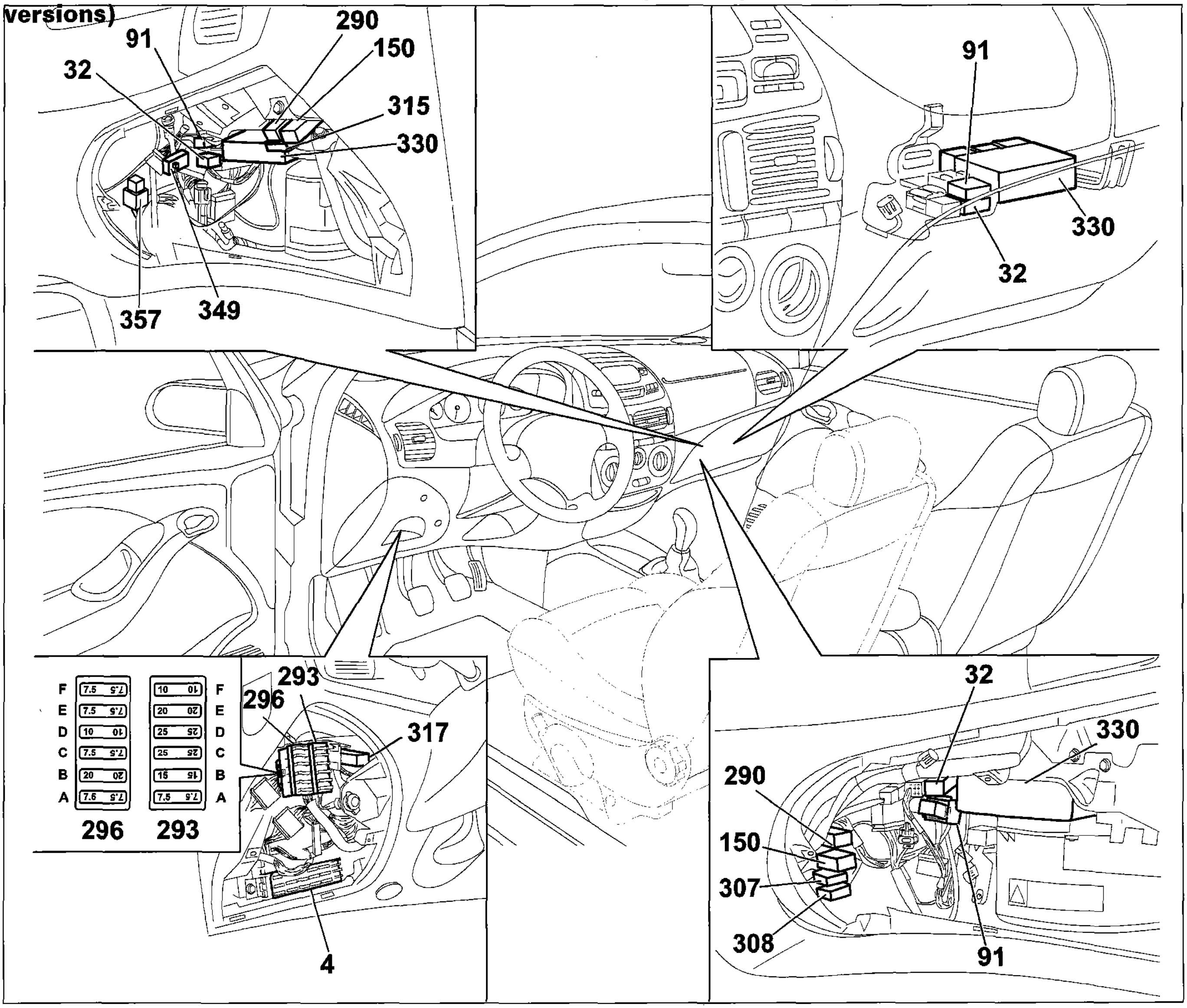

P4A06HL01

4. Junction unit
32. Fog lights relay
71. Electric front windows control unit
91. Power relay controlled by the ignition
112. Central door locking control unit
293. Fuse carrier base on dashboard cable
    - A 7.5A fuse protecting switch panel light, radio phone, radio, electric mirrors
    - B 15A fuse protecting fog lamps maintenance relay
    - C Spare
    - D 25A fuse protecting central locking control unit
    - E 20A protective fuse current socket, cigar lighter, electric seats
    - F 10A fuse protecting EURO-BAG
296. Fuse carrier base on front cable
    - A 7.5A fuse protecting cooling system/I.E., alarm, automatic transmission
    - B 20A fuse protecting windscreen wiper
    - C 7.5A fuse protecting Fiat-CODE, cooling system/I.E.
    - D 10A fuse protecting anti-lock braking system (A.B.S.)
    - E 7.5A fuse protecting climate control system
    - F 7.5A fuse protecting electronic injection
313. Relay for reversing air conditioning signal
317. Main beam headlamps maintenance relay



*Print no. 506.670/17*

**LOCATION OF RELAYS AND FUSES ON VEHICLE (Passenger compartment GT-ELX-HSX-HGT versions)**

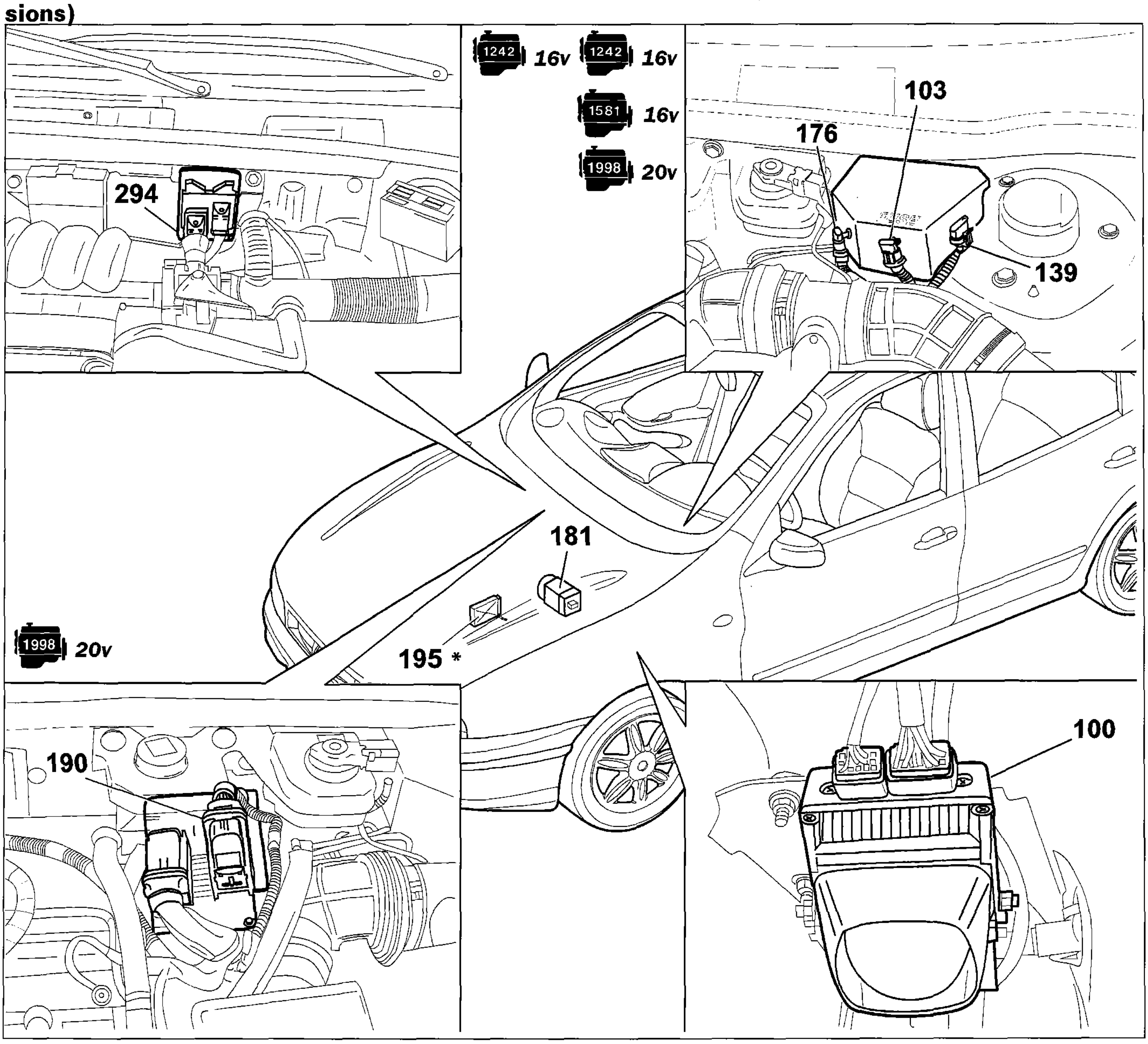



P4A07HL01

4. Junction unit
32. Fog lights relay
91. Power relay controlled by the ignition
150. Injection system relay feed
290. Electric fuel pump relay feed
293. Fuse carrier base on dashboard cable
    - A 7.5A fuse protecting switch panel light, radio phone, radio, electric mirrors
    - B 15A fuse protecting fog lamps maintenance relay
    - C 25A fuse protecting electric windows
    - D 25A fuse protecting A.B.I. control unit
    - E 20A fuse protecting current socket, cigar lighter, electric seats, electrically operated sun roof
    - F 10A fuse protecting EUROBAG
296. Fuse carrier base on front cable
    - A 7.5A fuse protecting cooling system/I.E., alarm, automatic transmission
    - B 20A fuse protecting windscreen wiper
    - C 7.5A fuse protecting Fiat-CODE, cooling system/I.E.
    - D 10A fuse protecting anti-lock braking system (A.B.S.)
    - E 7.5A fuse protecting climate control system
    - F 7.5A fuse protecting electronic injection/Fiat-CODE
307. 15A fuse protecting injection system
308. 15A fuse protecting canister solenoid valve
315. 7.5A fuse protecting electronic injection control unit 1910 TD JTD
317. Main beam headlamps maintenance relay
330. A.B.I. control unit. (Alzacristalli Bloccaporte Integrato - Integrated Central locking electric windows)
349. Engine oil control unit
357. Passenger compartment coolant heater plugs control unit

# 55.

**LOCATION OF CONTROL UNITS AND DIAGNOSTIC SOCKETS (Engine compartment- petrol versions)**

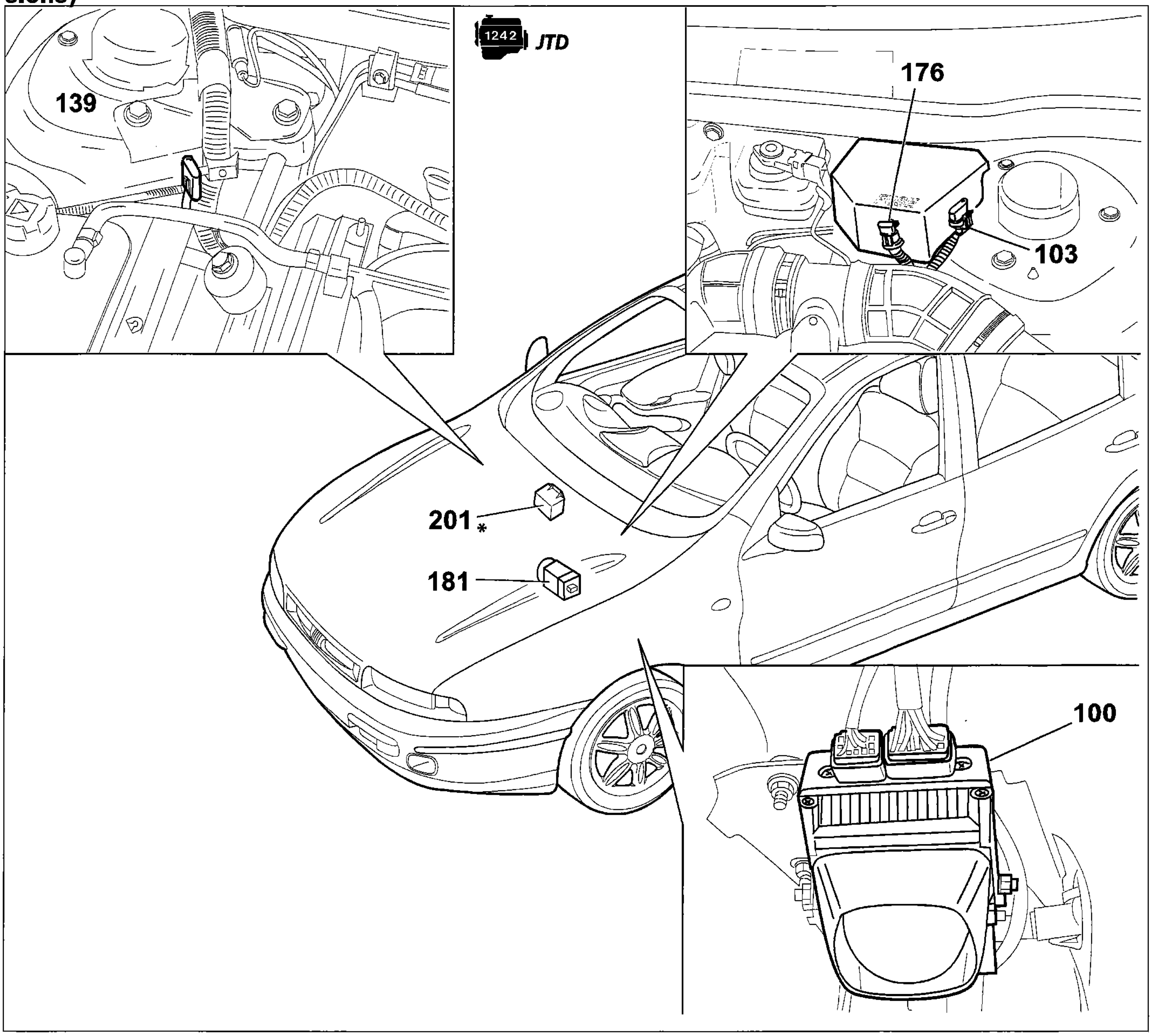



P4A08HL01

* Engine 1910 JTD

100. Alarm device electronic control unit
103. Diagnostic socket for alarm
139. Diagnostic socket for injection system
176. Diagnostic socket for anti-lock braking system (A.B.S.)
181. Electro-hydraulic control unit for anti-lock brakes (A.B.S.)
190. Injection/ignition electronic control unit (1998) 20v
195. Injection/ignition electronic control unit (1581) 16v
294. Injection/ignition electronic control unit (1242) 16v

**LOCATION OF CONTROL UNITS AND DIAGNOSTIC SOCKETS (Engine compartment Diesel versions)**

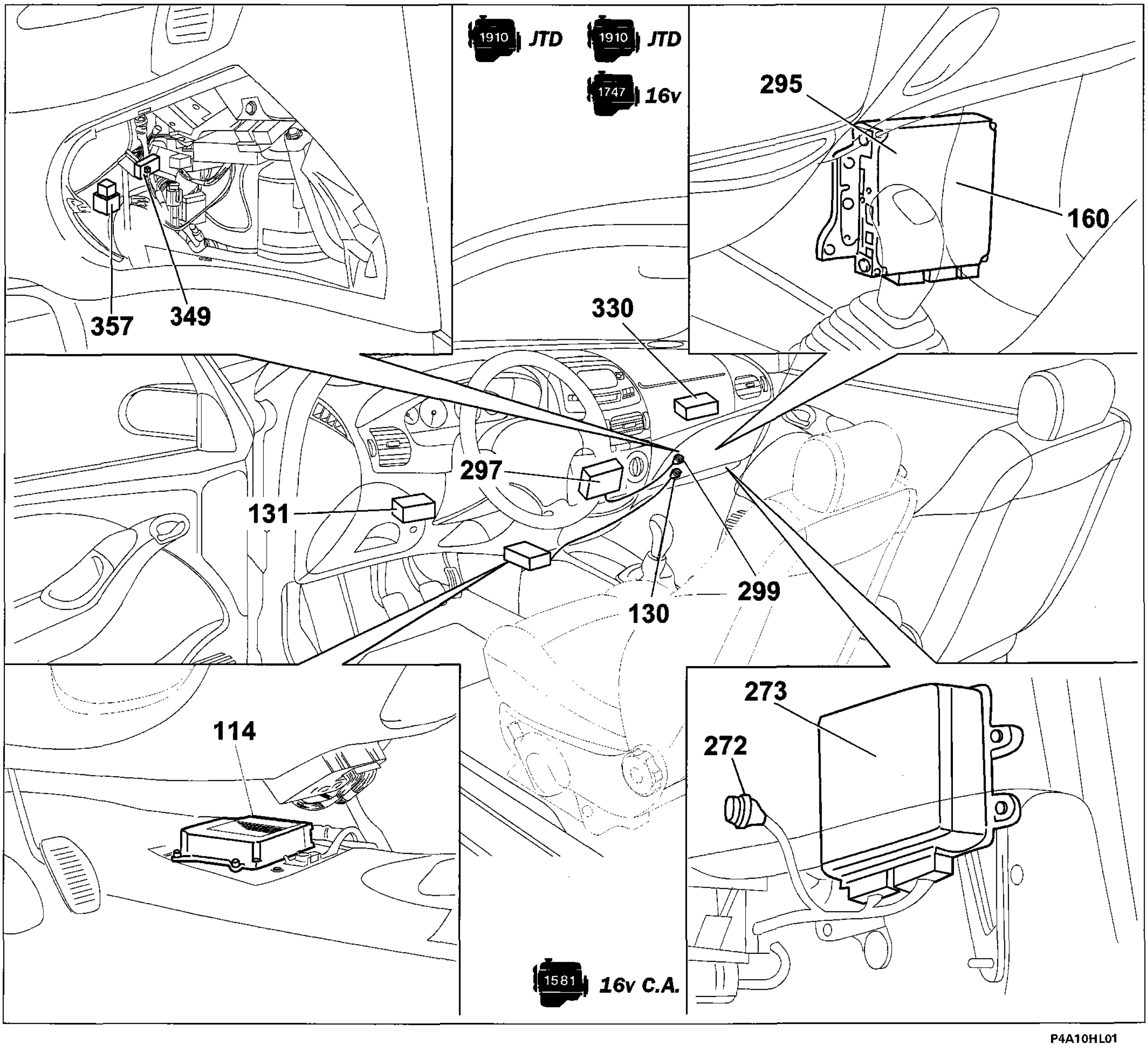



* Engine 1910 JTD

100. Alarm device electronic control unit
103. Diagnostic socket for alarm
139. Diagnostic socket for injection system (1910 JTD)
176. Diagnostic socket for anti-lock braking system (A.B.S.)
181. Electro-hydraulic control unit for anti-lock brakes (A.B.S.)
201. Heater plugs control unit (1910 JTD)

# 55.

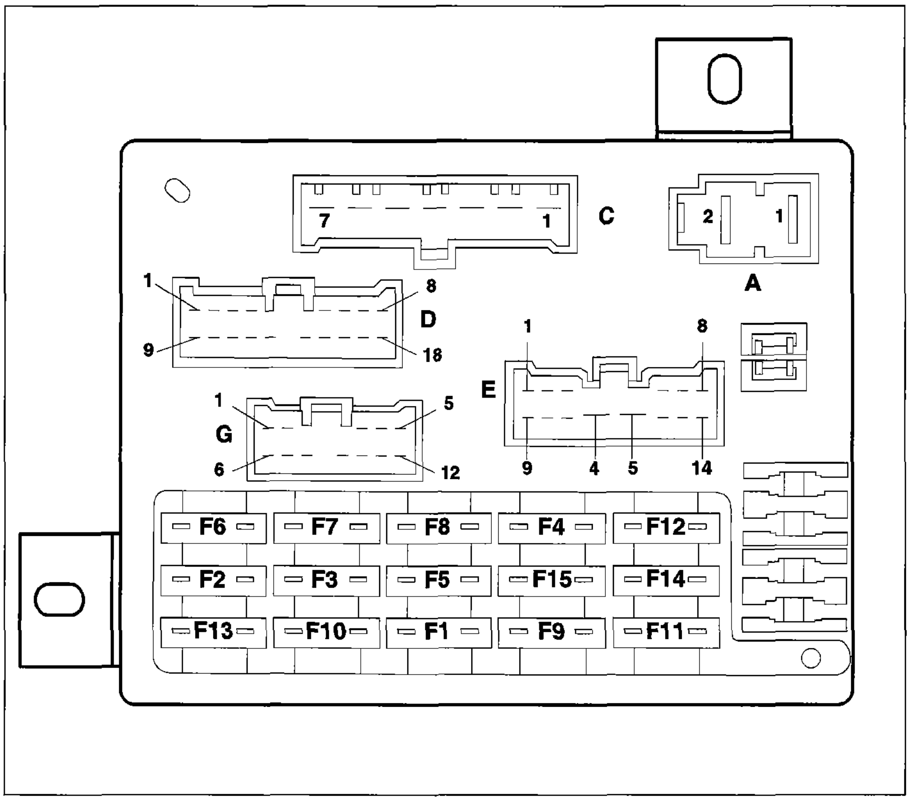
**LOCATION OF CONTROL UNITS AND DIAGNOSTIC SOCKETS (Passenger compartment)**




114. EURO-Bag electronic control unit
130. Diagnostic socket for EURO-Bag
131. Fiat CODE electronic control unit
160. Injection/ignition electronic control unit 1747 16v
272. Automatic transmission diagnostic socket
273. Automatic transmission control unit
295. Injection/ignition electronic control unit 1910 JTD
297. Climate control control unit
299. Diagnostic socket for climate control system
330. A.B.I. control unit (Alzacristalli Bloccaporte Integrato - Inegrated Central locking electric windows)
349. Engine oil control unit
357. Passenger compartment coolant heater plugs control unit


XI-98 - Cancels and replaces
Print no. 506.670/17

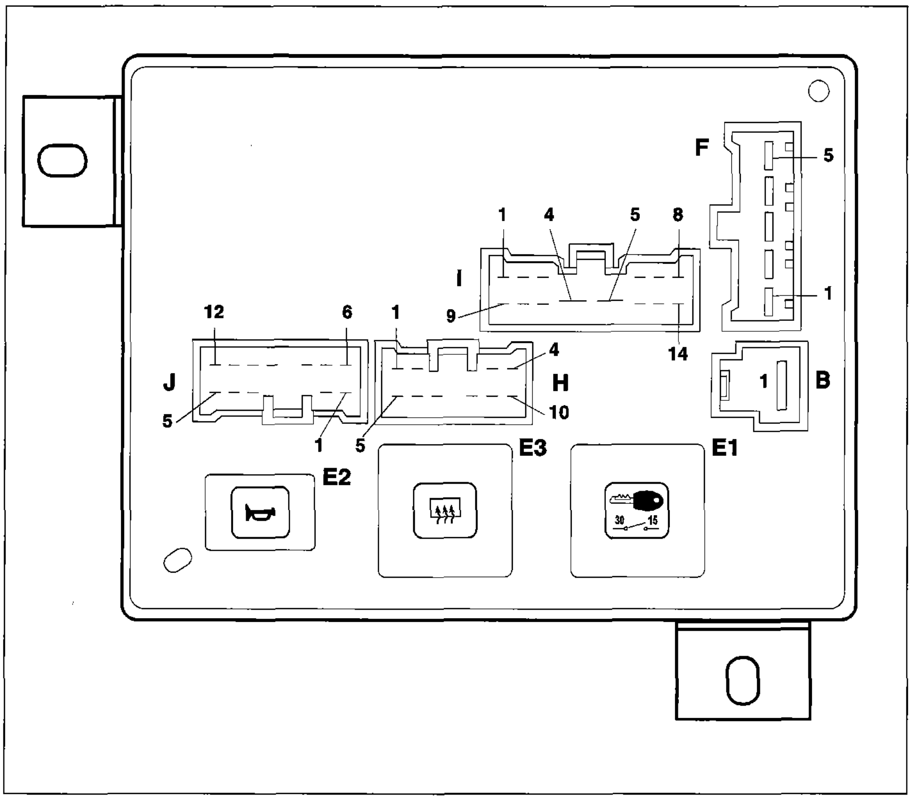
## JUNCTION UNIT




**Front view of the junction unit and identification of fuses**

P4A11HL01

*The connectors cannot be connected incorrectly as they are each a particular shape. The identification letters for the connectors are the same as those used in the wiring diagrams*




**Rear view of the junction unit and Location of relays**

E1. Ignition discharge relay during starting
E2. Heated rear windscreen relay
E3. Horn relay

P4A11HL02

## 55.

**List of fuses and main circuits protected**

| Fuse No. | Amp. | Ideo-gram | Circuit protected |
|---|---|---|---|
| 1 | 10 | SERVIZI SERVICES | Reversing lights -Brake lights - Additional brake light (if fitted) - Direction repeater - Instrument panel supply - Check supply (where fitted) - Control for electric mirrors (where fitted) - Radio supply - Remote control (+ signal controlled by the ignition). |
| 2 | 10 | | Right front side light - Left rear side light - Right no. plate light - Radio lights - Instrument lights and side light warning light - Cigar lighter light - Switch panel light. |
| 3 | 10 | | Left front side light - Heating/air conditioning controls light - Right rear side light - Left no. plate light. |
| 4 | 10 | | Left dipped headlamp. |
| 5 | 10 | | Right dipped headlamp - Headlamp alignment. |
| 6 | 10 | | Right main beam headlamp. |
| 7 | 10 | | Left main beam headlamp - Main beam headlamps warning light. |
| 8 | 20 | | Rear fog lamps. |
| 9 | 10 | | Hazard warning lights flasher. |
| 10 | 10 | SERVIZI SERVICES | Interior light - Luggage compartment light - Clock supply - Remote control receiver supply (where fitted) - Radio supply - Glove compartment light - Anti-theft device (+ signal from battery). |
| 11 | 30 | | Heated rear windscreen - Heated rear windscreen warning light - Mirror defrosting (where fitted). |
| 12 | 30 | | Engine fan (versions with air conditioning). |
| 13 | 20 | | Horns. |
| 14 | 20 | | Windscreen wiper - Rearscreen wiper - Windscreen/rearscreen electric washer pump - Headlamp washer intermittent device. |
| 15 | 20 | | Climate control fan motor and resistance for determining fan speed - Relays for before and second condenser and radiator fan speed and delay for engaging 2nd speed - Air conditioning compressor relay - Cigar lighter. |



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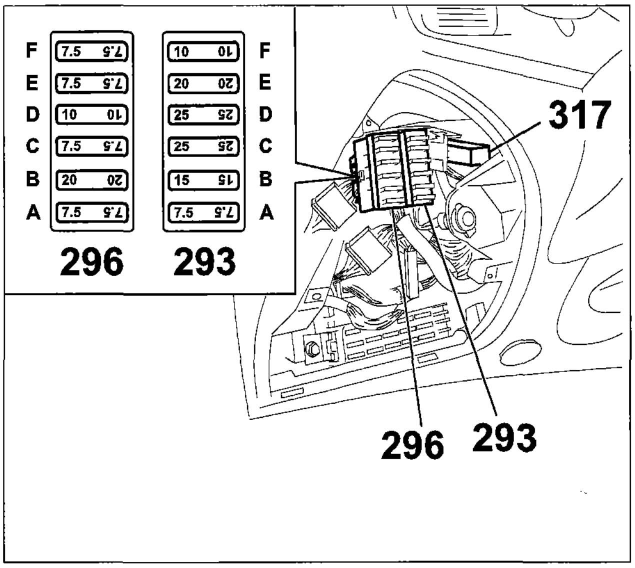
### Additional fuses

To gain access to these fuses, the junction unit shield must be removed, following the instructions given on page 16.
The fuses are:

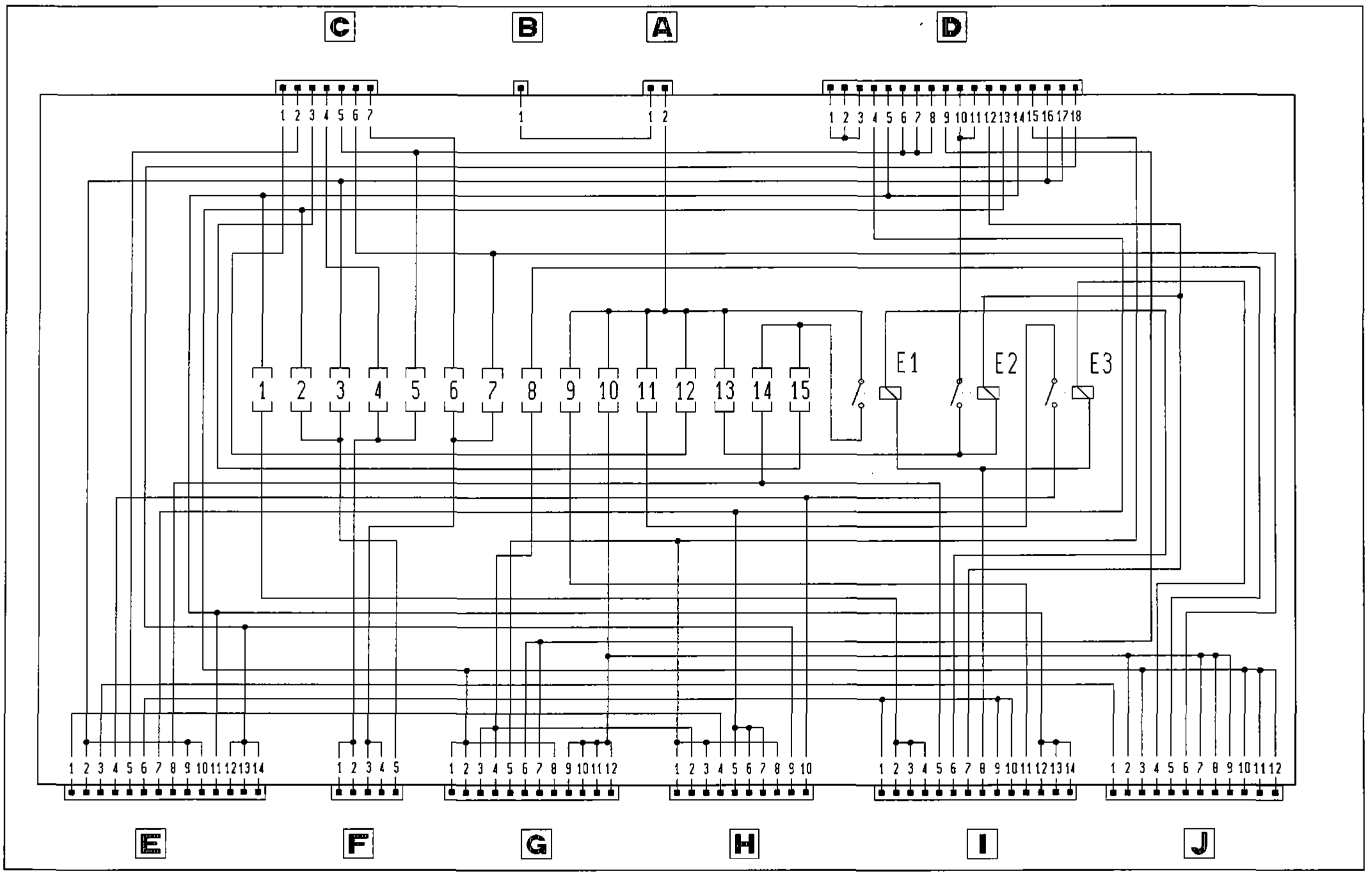
293. Fuse carrier base on dashboard cable
    - A 7.5A fuse protecting switch panel light, radio phone, radio, electric mirrors
    - B 15A fuse protecting fog lamps maintenance relay
    - C Spare
    - D 25A fuse protecting central locking control unit
    - E 20A fuse protecting current socket, cigar lighter, electric seats
    - F 10A fuse protecting EURO-BAG




P4A13HL01

296. Fuse carrier base on front cable
    - A 7.5A fuse protecting cooling system/I.E., alarm, automatic transmission
    - B 20A fuse protecting windscreen wiper
    - C 7.5A fuse protecting Fiat-CODE, cooling system/I.E.
    - D 10A fuse protecting anti-lock braking system (A.B.S.)
    - E 7.5A fuse protecting climate control system
    - F 7.5A fuse protecting electronic injection

### DIAGRAM SHOWING CONNECTIONS INSIDE THE JUNCTION UNIT




E1. Ignition discharge relay during starting
E2. Horn relay
E3. Heated rear windscreen relay

P4A13HL02

**DESCRIPTION OF CABLES AND CONNECTORS**

**CONNECTOR A**

| Term. No. | Cable colour | Circuit concerned |
|---|---|---|
| 1 | R | +30 supply from fuse box |
| 2 | BR | +30 supply from fuse box |

**CONNECTOR C**

| Term. No. | Cable colour | Circuit concerned |
|---|---|---|
| 1 | R | Car interior fan supply (with air conditioning), air conditioning control unit |
| 2 | MB | Electric fuel pump operation, inertia switch |
| 3 | AN | Heating/air conditioning system speed control switch |
| 4 | H | Right dipped headlamp |
| 5 | HN | Left dipped headlamp, headlamp washer go ahead. |
| 6 | VN | Left main beam headlamp |
| 7 | V | Right main beam headlamp |

**CONNECTOR E**

| Term. No. | Cable colour | Circuit concerned |
|---|---|---|
| 1 | RN | Right rear brake light (versions with Check Panel) |
| 2 | - | N.C. |
| 3 | RG | Left rear brake light (versions with Check Panel) |
| 4 | MN | Rearscreen supply |
| 5 | MB | Electric fuel pump, inertia switch |
| 6 | AG | Multi-purpose switch for electric mirrors |
| 7 | AN | Left rear direction indicator |
| 8 | - | N.C. |
| 9 | GR | Right rear side light (without Check Panel) |
| 10 | GR | Left no. plate light (without Check Panel) |
| 11 | - | N.C. |
| 12 | RG | Left brake light (without Check Panel) |
| 13 | RN | Right brake light (without Check Panel) |
| 14 | R | Additional brake light |

**CONNECTOR B**

| Term. No. | Cable colour | Circuit concerned |
|---|---|---|
| 1 | R | Services supply (OPT) |

**CONNECTOR D**

| Term. No. | Cable colour | Circuit concerned |
|---|---|---|
| 1 | G | Left headlamp alignment |
| 2 | G | Right headlamp alignment |
| 3 | G | Headlamp alignment control |
| 4 | AN | Front and left side direction indicator |
| 5 | AR | Brake lights operation |
| 6 | HB | Left headlamp alignement supply |
| 7 | HR | Headlamp alignment supply - Headlamp wash/wipe |
| 8 | HB | Right headlamp alignment supply |
| 9 | B | Reversing lights operation |
| 10 | Z | Horns |
| 11 | Z | Horns |
| 12 | - | N.C. |
| 13 | GR | Right front side light |
| 14 | AR | Engine oil level control unit |
| 15 | A | Front and right side direction indicator |
| 16 | GN | Heater unit/air conditioning lights |
| 17 | GN | Heater unit/air conditioning controls light |
| 18 | RN | Brake lights operation |

**CONNECTOR F**

| Term. No. | Cable colour | Circuit concerned |
|---|---|---|
| 1 | H | Main beam headlamps maintenance relay |
| 2 | - | N.C. |
| 3 | LR | Main beam h/lamps op. (st. col. switch unit) |
| 4 | LR | Headlamp alignment go ahead |
| 5 | G | Ignition switch |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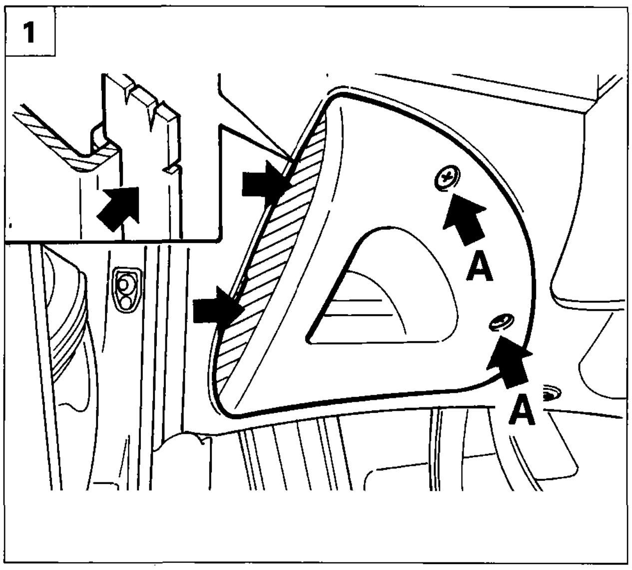
| CONNECTOR G | | |
|---|---|---|
| **Term. No.** | **Cable colour** | **Circuit concerned** |
| 1 | GN | Left rear side light |
| 2 | GV | Multi-purpose switch for electric mirrors |
| 3 | - | N.C. |
| 4 | - | N.C. |
| 5 | A | Right rear direction indicator |
| 6 | B | Left reversing light |
| 7 | B | Right reversing light |
| 8 | GN | Right no. plate light |
| 9 | RN | Supply for rear courtesy light |
| 10 | RN | Supply for lug. comp. courtesy light |
| 11 | RN | Supply for front courtesy light |
| 12 | RN | Supply for rear courtesy light |

| CONNECTOR H | | |
|---|---|---|
| **Term. No.** | **Cable colour** | **Circuit concerned** |
| 1 | A | Right direction indicator warning light |
| 2 | CZ | Central door locking control unit |
| 3 | A | Hazard warning lights operation |
| 4 | RN | Instrument panel (device signalling brake lights failure) |
| 5 | AN | Right direction indicator control |
| 6 | AN | Hazard warning lights control |
| 7 | AN | Left direction indicator warning light |
| 8 | A | Left direction indicator control |
| 9 | BR | Instrument panel (device signalling brake lights failure) |
| 10 | MB | Safety switch for electric mirrors |

| CONNECTOR I | | |
|---|---|---|
| **Term. No.** | **Cable colour** | **Circuit concerned** |
| 1 | - | N.C. |
| 2 | - | N.C. |
| 3 | - | N.C. |
| 4 | CB | Ignition switch |
| 5 | CN | Steering column switch unit |
| 6 | N | Earth |
| 7 | LN/R | Horns signal |
| 8 | AN | +15 supply from key (excluding starting) |
| 9 | AG | Right external rear view mirror |
| 10 | AG | Left external rear view mirror |
| 11 | RG | Hazard warning lights switch unit |
| 12 | AR | Supply for instrument panel |
| 13 | AR | Hazard warning lights switch unit |
| 14 | AR | Supply for instrument panel |

| CONNECTOR J | | |
|---|---|---|
| **Term. No.** | **Cable colour** | **Circuit concerned** |
| 1 | R G/GN | Left brake light (versions with Check Panel) |
| 2 | RV | Alarm supply |
| 3 | GN | Side lights warning light, switch panel light, auto. trans. controls light |
| 4 | HM/HV | Heated rear windscreen control |
| 5 | R/LR | Control for rear fog lamps, electric window supply, rear view mirrors, radio, central locking |
| 6 | VN | Main beam headlamps warning light, main beam headlamps relay |
| 7 | R | Instrument panel |
| 8 | R | Glove compartment light supply |
| 9 | R | Instrument panel supply |
| 10 | GN | Radio with clock |
| 11 | GN | Switch control unit |
| 12 | G R/GN | Cigar lighter light - Instrument panel light dimmer |

# 55.




P4A16HL01

### REMOVING-REFITTING JUNCTION UNIT AND SHIELD

#### Removing control unit shield

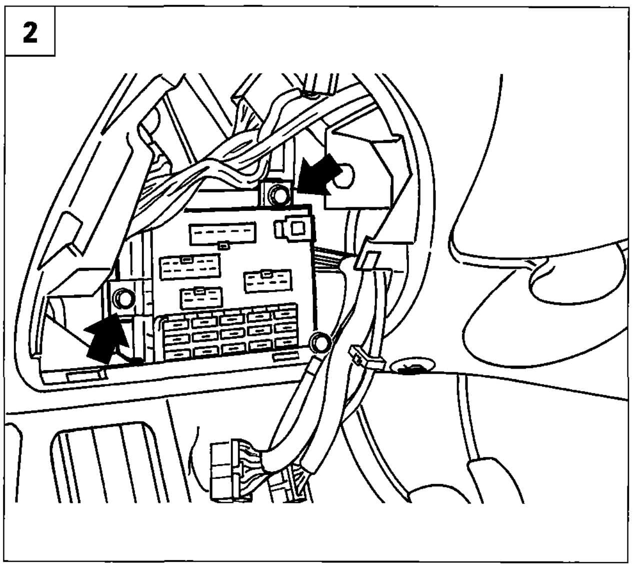
1. Undo the bolts (A) using the ignition key or a suitable screwdriver; exert slight pressure on the left side of the shield in the direction shown by the arrows to facilitate the release of the two side retaining tabs, then remove the shield.
2. After having removed the shield, disconnect the connectors from the front of the control unit and undo the bolts fixing the control unit to the dashboard. Move the control unit aside, disconnect the connectors from the rear and remove the control unit from the dashboard.

*Suitably reverse the operations carried out for the removal*

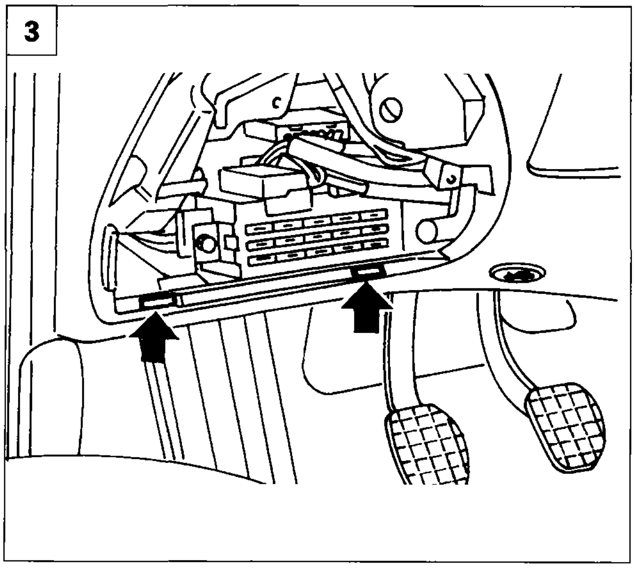
#### Refitting control unit shield

3. Position the shield in the housing in the dashboard, inserting the centering tabs located on the lower part.
4. Turn the shield upwards, until it is contact with the dashboard.

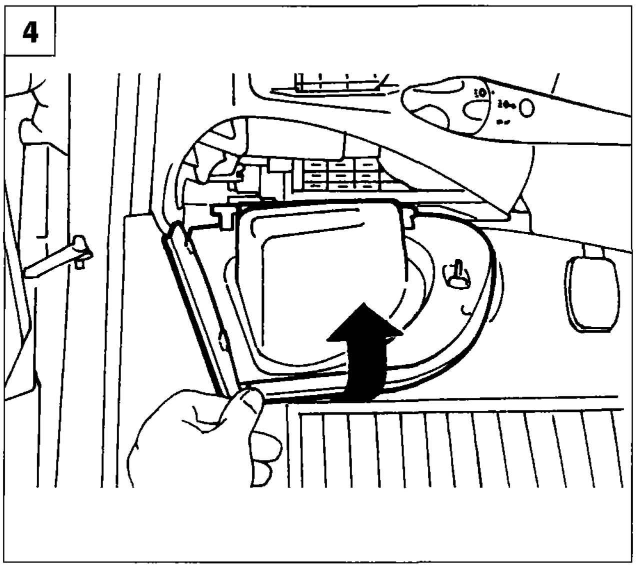
Complete the refitting, proceeding as follows (see figure 1):
- position the two bolts (A) in their housings and tighten them by several turns;
- taking great care, exert slight pressure on the left side of the shield (at both the side and the front) so that the two side retaining tabs are fully inserted in the dashboard;
- tighten the bolts (A).




P4A16HL02




P4A16HL03



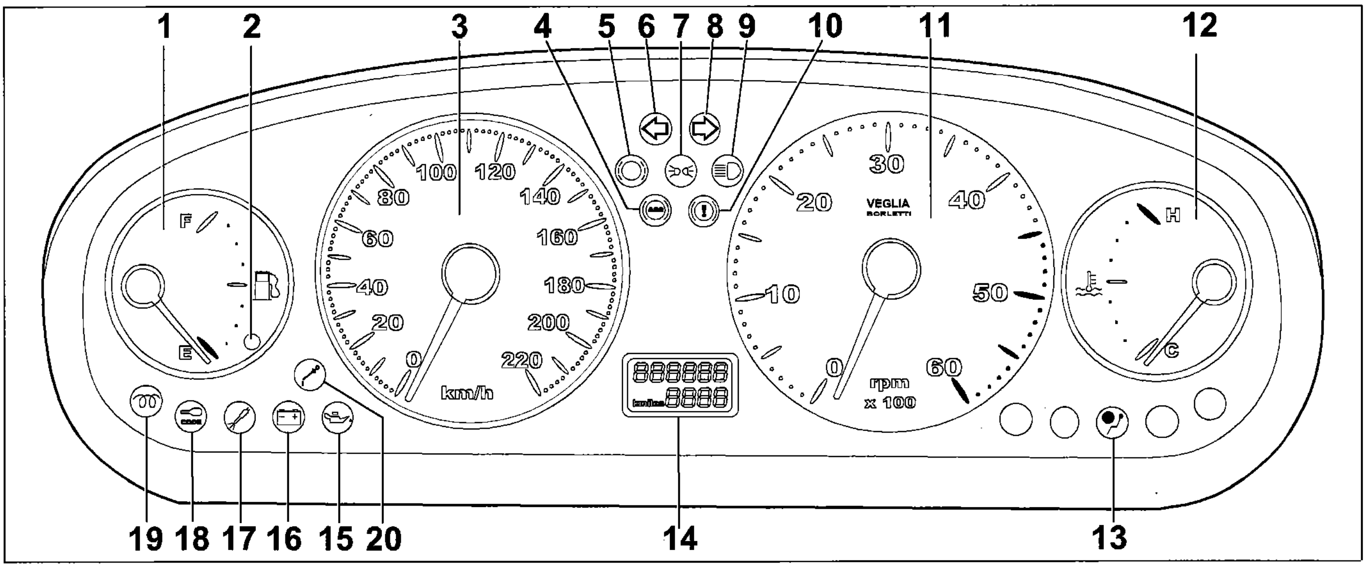

P4A16HL04



*Print no. 506.670/17*

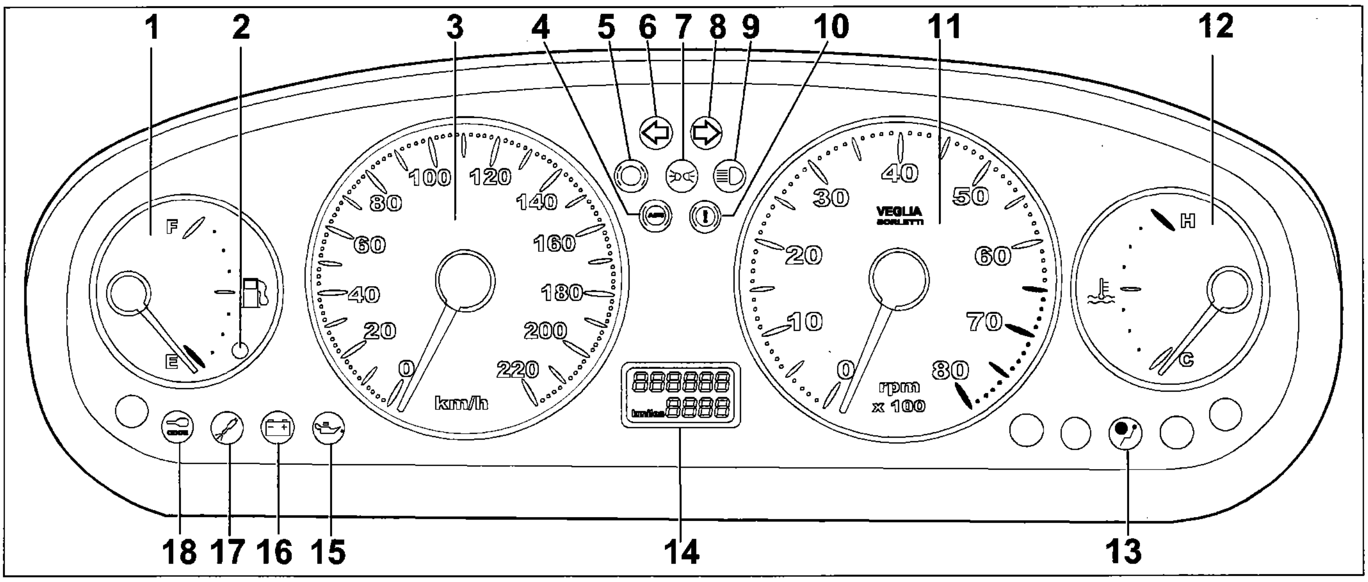
# 55.

**VEGLIA BORLETTI CONTROL PANEL TURBO DIESEL VERSION FOR OUTFITS: SX, (75CV SOFT), SX, GT, HSX (105BHP JTD)**




4A17HL01

**VEGLIA BORLETTI CONTROL PANEL PETROL VERSIONS FOR OUTFITS: SX, GT, HSX**



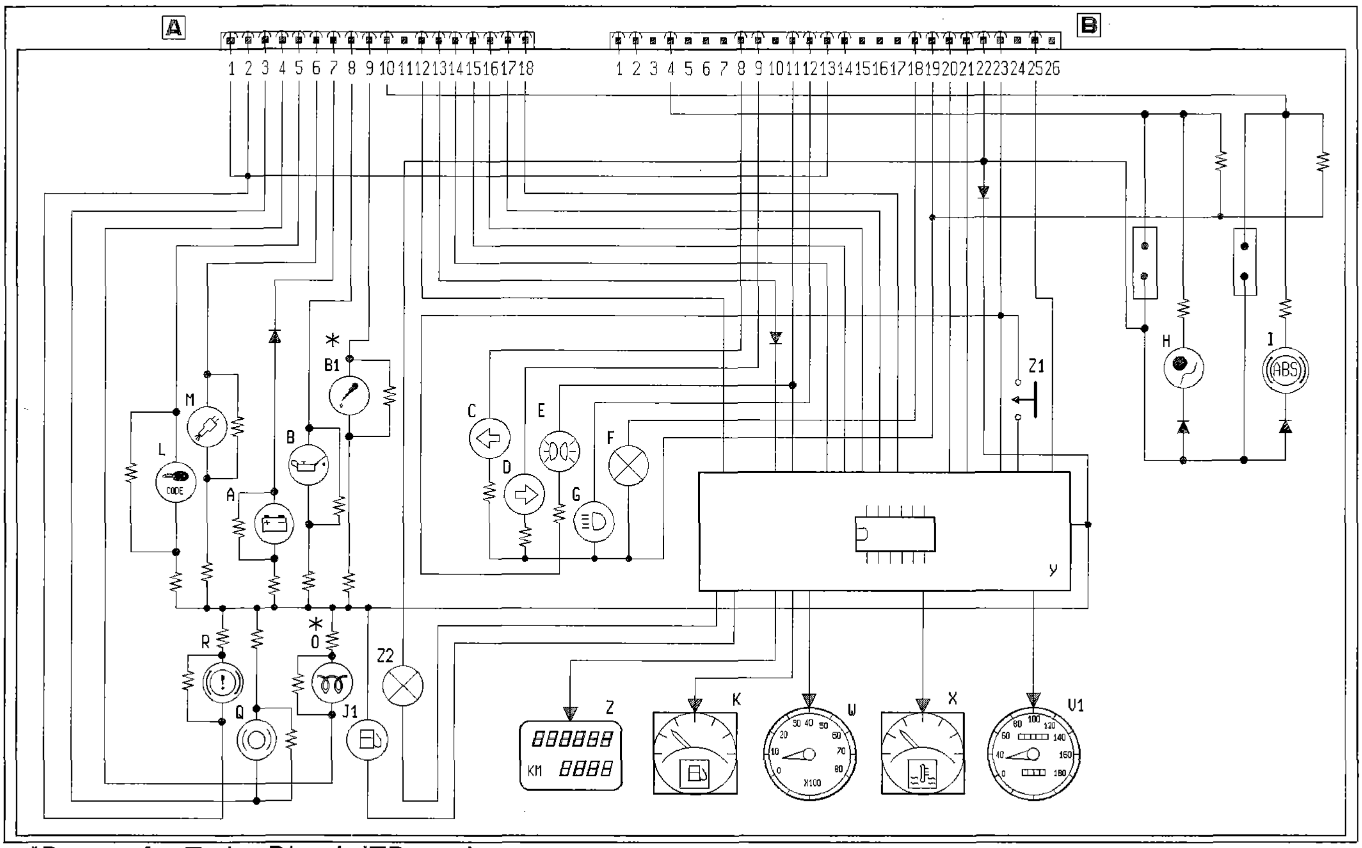

4A17HL02

**Front side of control panel**

1. Fuel gauge
2. Fuel reserve warning light
3. Speedometer
4. A.B.S. failure warning light
5. Brake pad wear warning light
6. Left direction indicator warning light
7. Side lights warning light
8. Right direction indicator warning light
9. Main beam headlamps warning light
10. Handbrake applied/insufficient brake fluid level warning light
11. Rev counter
12. Engine coolant temperature gauge
13. EURO BAG system failure warning light
14. Odometer
15. Low engine oil pressure warning light
16. Battery recharging warning light
17. Injection system failure warning light (not present for 1910 SOFT TD)
18. FIAT CODE system failure warning light
19. Glow plug warning light (only for TD versions)
20. Insufficient engine oil level warning light (only for JTD versions)

# 55.

**Wiring diagram for outfits PETROL SX, GT, HSX and TURBO DIESEL SX, GT, HSX (105BHP JTD)**



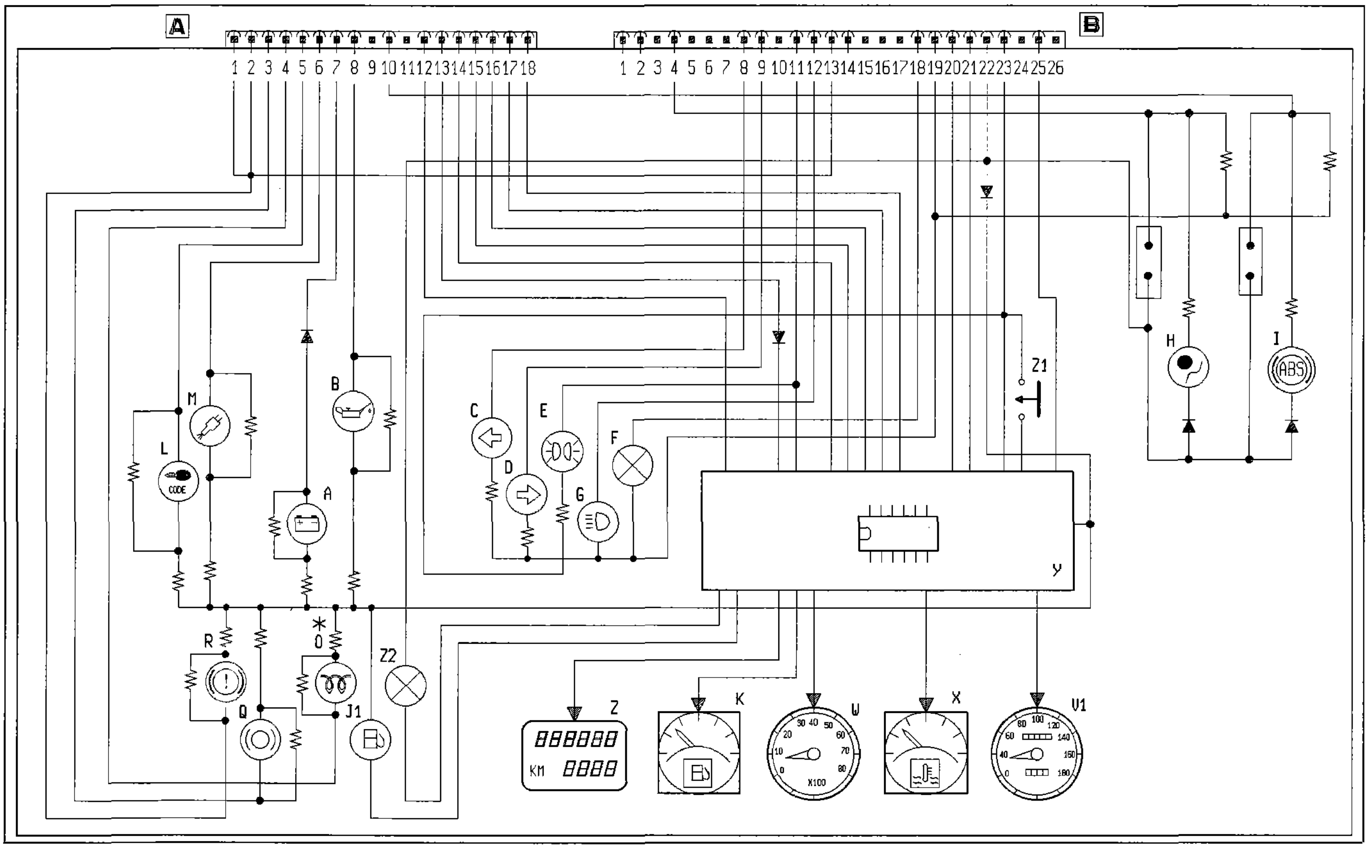

*Present for Turbo Diesel JTD versions

4A18HL01

6. Instrument panel:

A Battery recharging warning light
B Low engine oil pressure warning light
B1 Insufficient engine oil level warning light (only for 1910 JTD)
C Left direction indicator warning light
D Right direction indicator warning light
E Side lights warning light
F Instrument panel ideogram light
G Main beam headlamps warning light
H EURO BAG system failure warning light
I Anti-lock brakes failure warning light
J1 Fuel reserve warning light
K Fuel gauge
L Fiat-CODE failure warning light
M Petrol/Diesel injection system failure warning light
O Glow plug warning light (only for 1910 JTD)
Q Front brake pad wear warning light
R Handbrake applied/insufficient brake fluid level warning light
V1 Speedometer
W Rev counter
X Engine coolant temperature gauge
Y Electronic module
Z Milometer/trip meter display
Z1 Trip meter zeroing button
Z2 Z2 Trip counter display light

## Wiring diagram for TURBO DIESEL SX outfits (75 bhp SOFT)




*Present for Turbo Diesel versions (75 bhp SOFT)

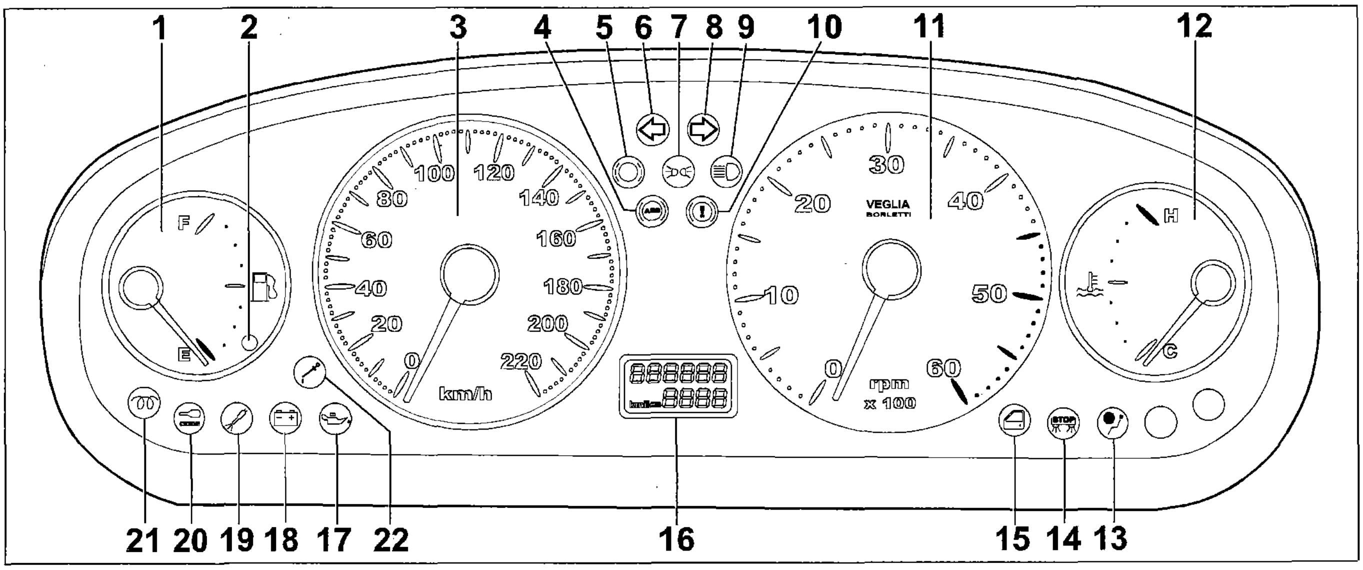
4A18HL02

6. Instrument panel:

A Battery recharging warning light
B Low engine oil pressure warning light
C Left direction indicator warning light
D Right direction indicator warning light
E Side lights warning light
F Instrument panel ideogram light
G Main beam headlamps warning light
H EURO BAG system failure warning light
I Anti-lock brakes failure warning light
J1 Fuel reserve warning light
K Fuel gauge
L Fiat-CODE failure warning light
M Petrol/Diesel injection system failure warning light
O Glow plug warning light
Q Front brake pad wear warning light
R Handbrake applied/insufficient brake fluid level warning light
V1 Speedometer
W Rev counter
X Engine coolant temperature gauge
Y Electronic module
Z Milometer/trip meter display
Z1 Trip meter zeroing button
Z2 Trip counter display light

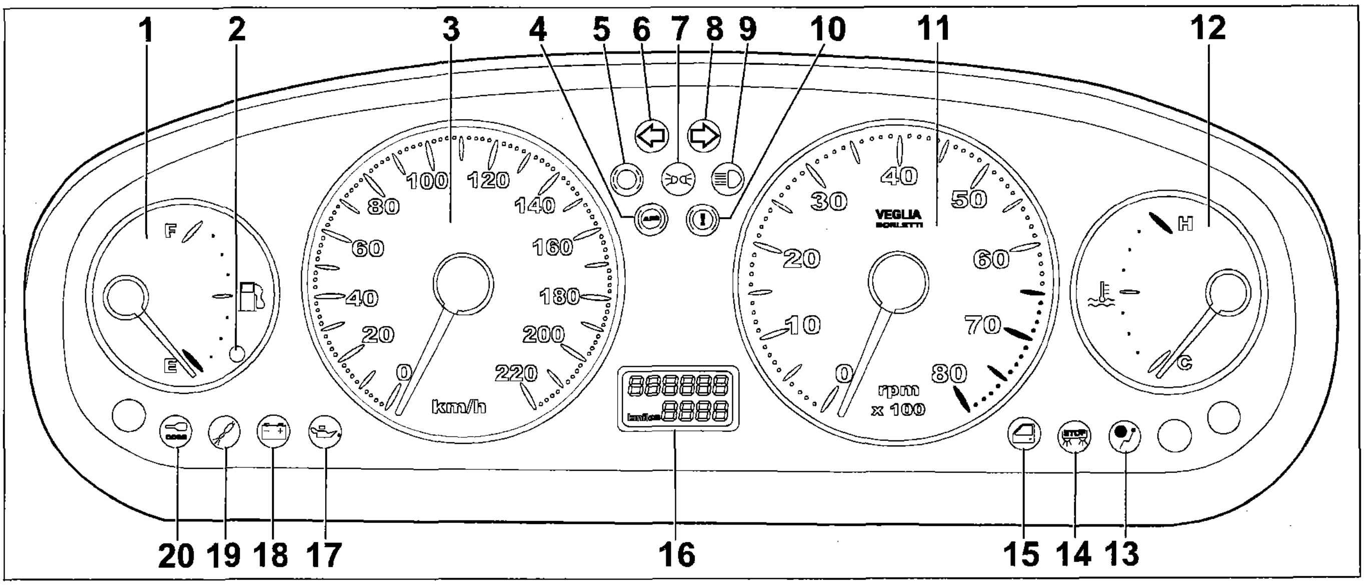
# 55.

**VEGLIA BORLETTI CONTROL PANEL TURBO DIESEL VERSION FOR OUTFITS: ELX (105CV JTD)**




4A18HL03

**VEGLIA BORLETTI CONTROL PANEL PETROL VERSIONS FOR OUTFITS: ELX**

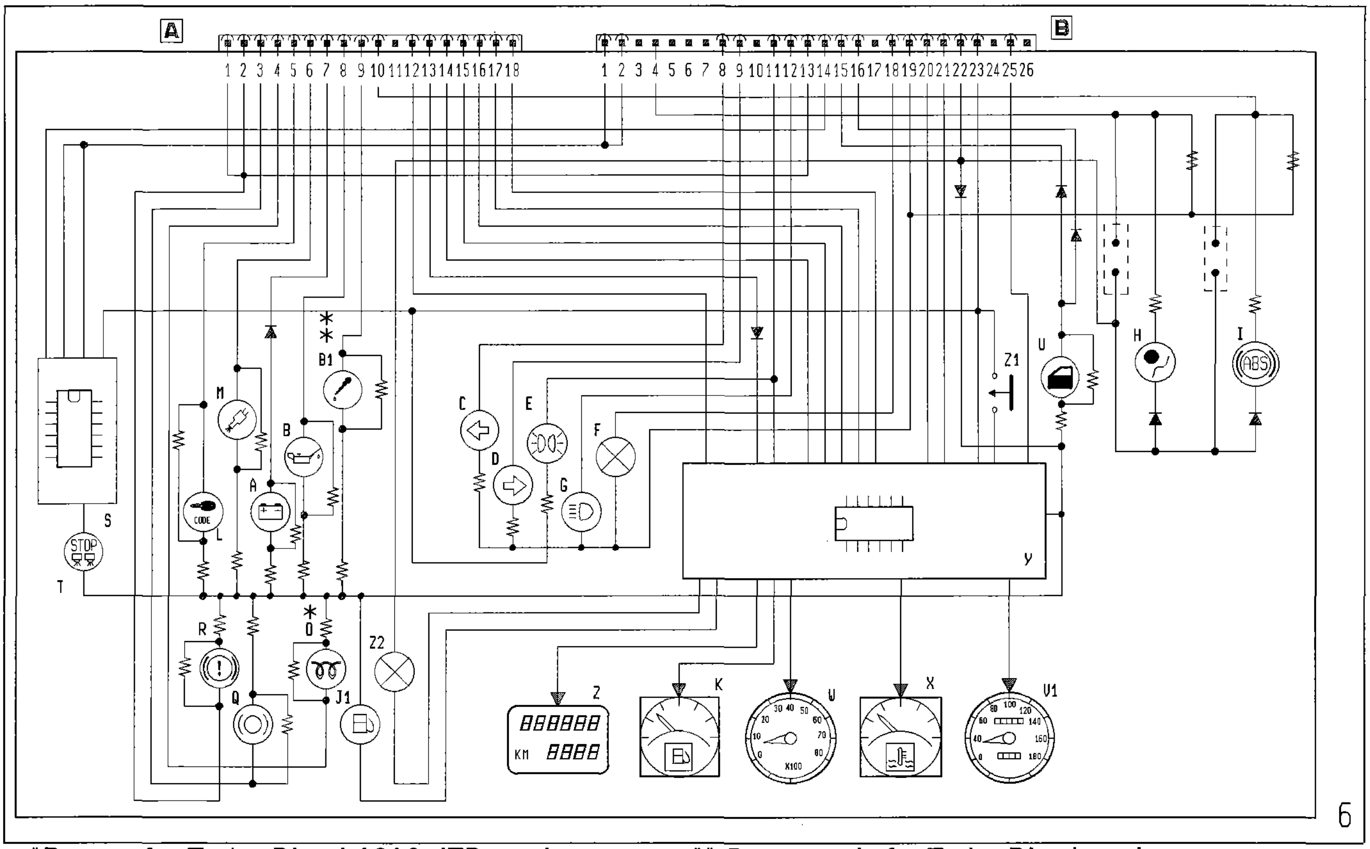



4A18HL04

**Control panel front side**

1. Fuel gauge
2. Fuel reserve warning light
3. Speedometer
4. A.B.S. failure warning light
5. Brake pad wear warning light
6. Left direction indicator warning light
7. Side lights warning light
8. Right direction indicator warning light
9. Main beam headlamps warning light
10. Handbrake applied/insufficient brake fluid level warning light
11. Rev counter
12. Engine coolant temperature gauge
13. EURO BAG system failure warning light
14. Brake lights failure warning light
15. Doors open warning ilght
16. Odometer
17. Low engine oil pressure warning light
18. Battery recharging warning light
19. Injection system failure warning light
20. Fiat CODE system failure warning light
21. Glow plug warning light (only for JTD versions)
22. Insufficient engine oil level warning light (only for JTD versions)

**Wiring diagram for PETROL ELX and TURBO DIESEL (105bhp JTD) ELX outfits**




*Present for Turbo Diesel 1910 JTD versions

** Present only for Turbo Diesel versions (105bhp JTD)

4A18HL05

6. Instrument panel:

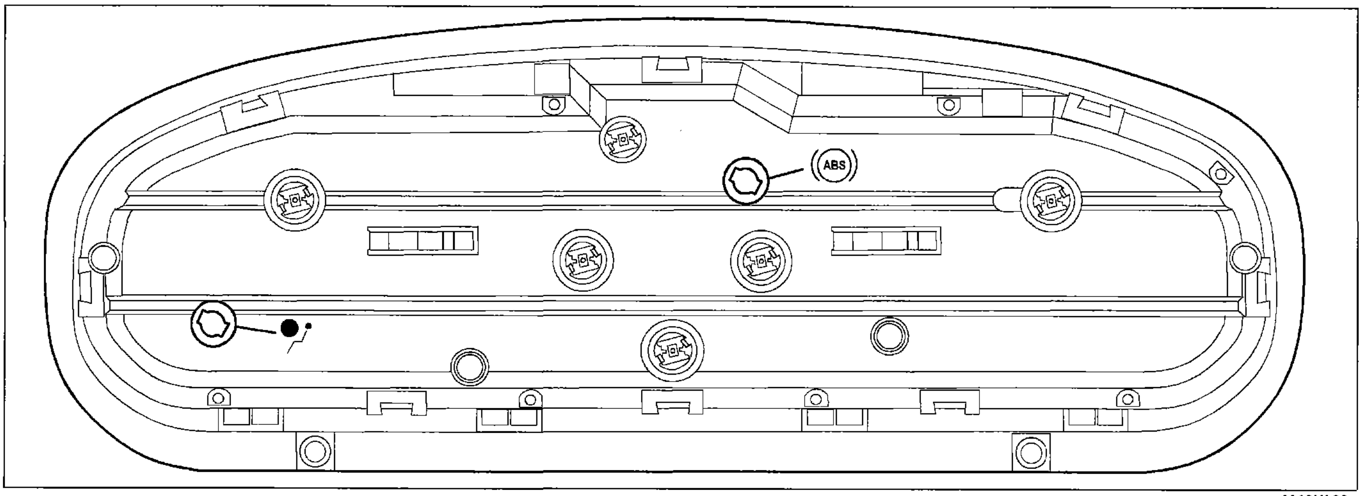
A Battery recharging warning light
B Low engine oil pressure warning light
B1 Insufficient engine oil level warning light (only for JTD)
C Left direction indicator warning light
D Right direction indicator warning light
E Side lights warning light
F Instrument panel symbol light
G Main beam headlamps warning light
H EURO BAG system failure warning light
I Anti-lock brakes failure warning light
J1 Fuel reserve warning light
K Fuel gauge
L Fiat-CODE failure warning light
M Petrol/Diesel injection system failure warning light
O Glow plug warning light (only for JTD)
Q Front brake pad wear warning light
R Handbrake applied/insufficient brake fluid level warning light
S Brake lights failure electronic module
T Brake lights failure warning light
U Doors open warning ilght
V1 Speedometer
W Rev counter
X Engine coolant temperature gauge
Y Electronic module
Z Milometer/trip meter display
Z1 Trip meter zeroing button
Z2 Z2 Trip counter display light

# 55.

### Operations to be carried out when replacing control panel

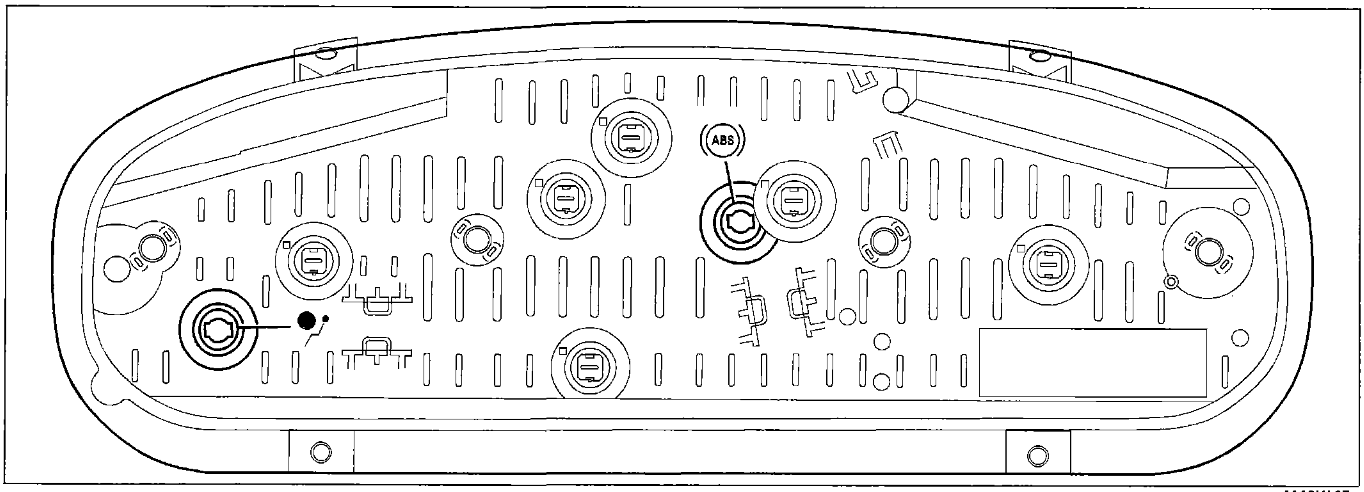
New instrument panels come with caps in place of the ABS and AIR-BAG device warning lights. The caps must therefore be replaced with the releavnt warning lights if one or both devices are present.

### Location of caps on VEGLIA BORLETTI instrument panel



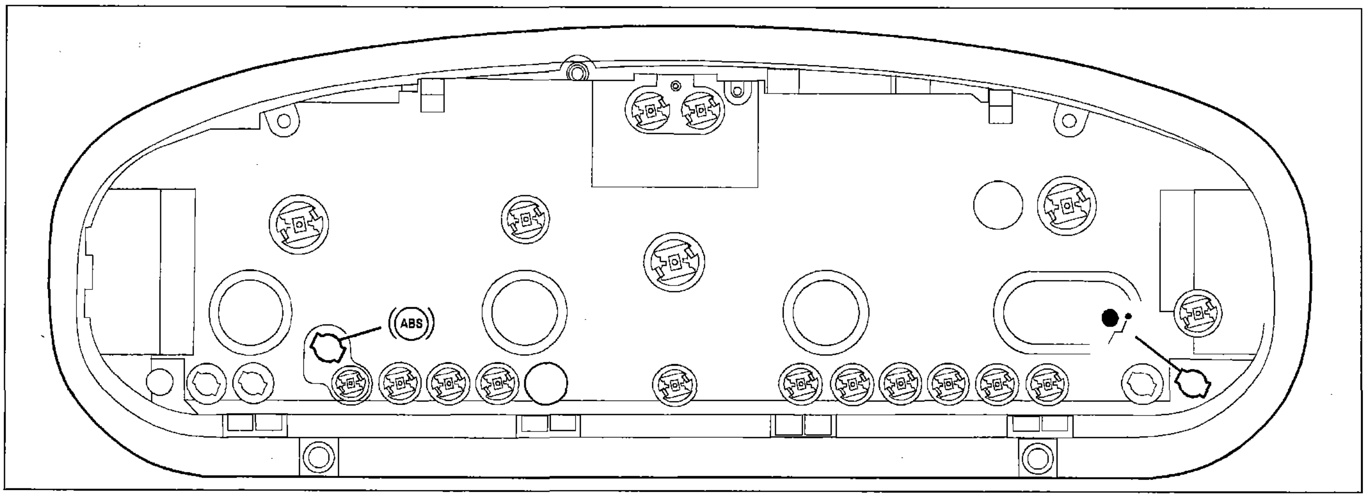

4A18HL06

### Location of caps on NSI instrument panel

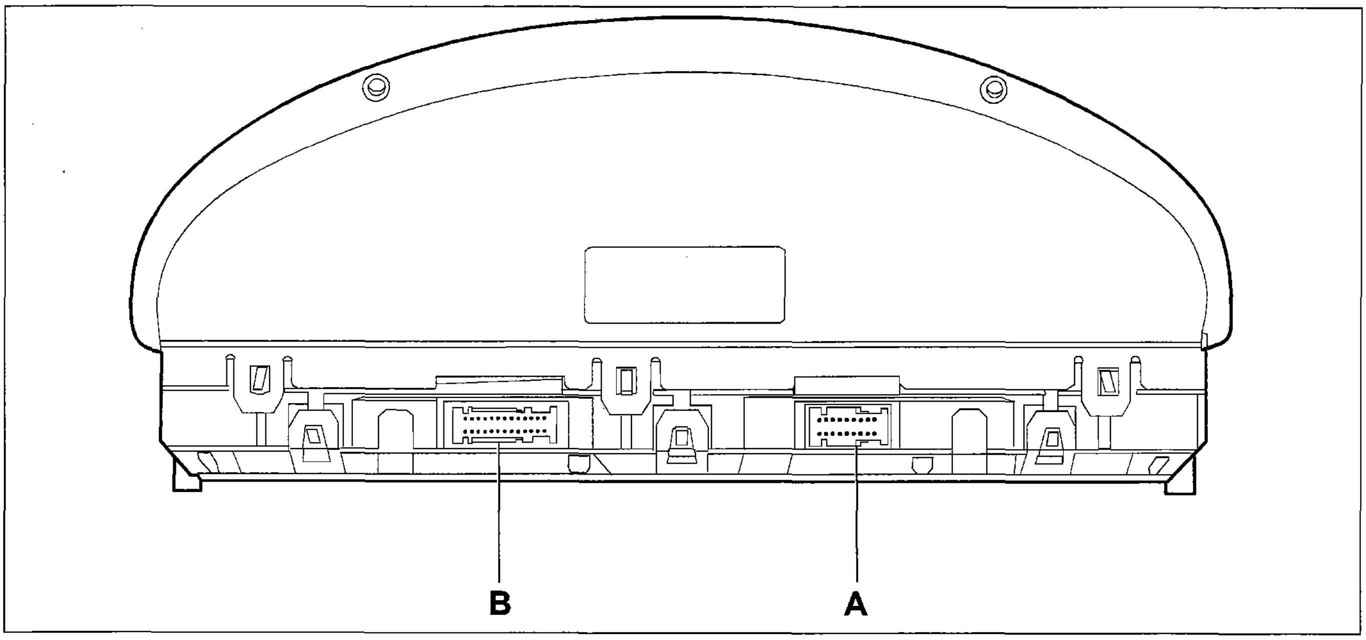



4A18HL07

### Location of caps on VEGLIA BORLETTI instrument panel with automatic transmission

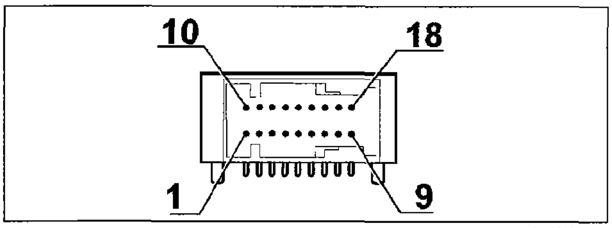



4A18HL08




4A19HL01

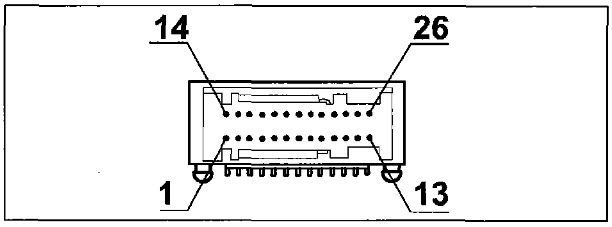
**Rear side (connector seats are shown)**




4A19HL02

**Connector A on left front lead**

| No. pin | Wiring colours | Circuit involved |
|---|---|---|
| 1 | M | Electronic brake disributor failure (EBD) |
| 2 | BN | Brake fluid level |
| 3 | BR | Brake lining wear |
| 4 | CL | Glow plug preheating (Turbo Diesel versions) |
| 5 | MN | Fiat CODE |
| 6 | LN | Injection failure (not present for Turbo Diesel 75 BHP SOFT versions) |
| 7 | HN | Generator |
| 8 | HG | Low engine oil pressure |
| 9 | VG | Low engine oil level (1910 JTD versions) |
| 10 | RV | ABS system failure |
| 11 | - | Not connected |
| 12 | HL | Speedometer signal |
| 13 | R | + 30 battery |
| 14 | CN | Speedometer generator supply |
| 15 | HB | Engine coolant temperature |
| 16 | SB | Outdoor temperature serial signal |
| 17 | HM | Speedometer signal |
| 18 | L | Rev counter signal |



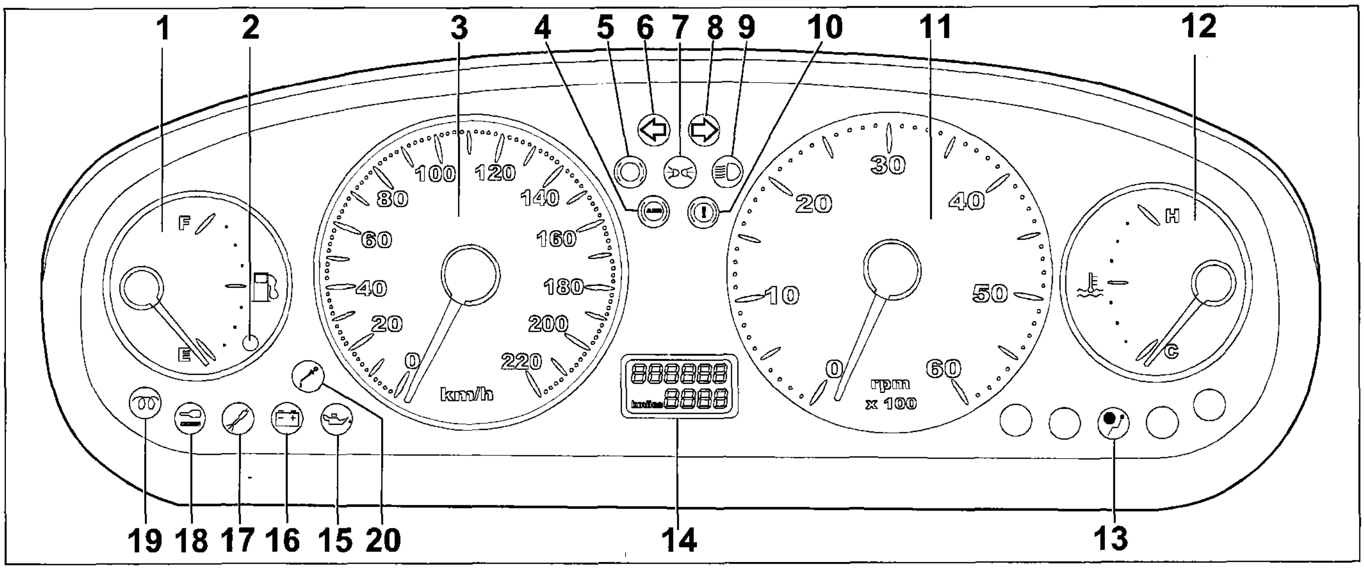

4A19HL03

**Connector B on facia lead**

| No. pin | Wiring colour | Circuit involved |
|---|---|---|
| 1 | RG | Left car brake light failure |
| 2 | BR | Brake light |
| 3 | - | Not connected |
| 4 | LG | Euro-bag device failure |
| 5 | - | Not connected |
| 6 | - | Not connected |
| 7 | - | Not connected |
| 8 | AN | Left turn signal |
| 9 | A | Right turn signal |
| 10 | - | Not connected |
| 11 | GN | Side lights |
| 12 | VN | Main beam headlamps |
| 13 | BN | Handbrake on |
| 14 | RN | Right car brake light failure |
| 15 | - | Not connected |
| 16 | - | Not connected |
| 17 | - | Not connected |
| 18 | GR | Instrument panel light |
| 19 | N | Earth (lighting) |
| 20 | HR | Fuel level |
| 21 | VB | Outdoor temperature display |
| 22 | AR | + 15 |
| 23 | NZ | Electronic earth |
| 24 | - | Not connected |
| 25 | HM | Speedometer signal |
| 26 | - | Not connected |

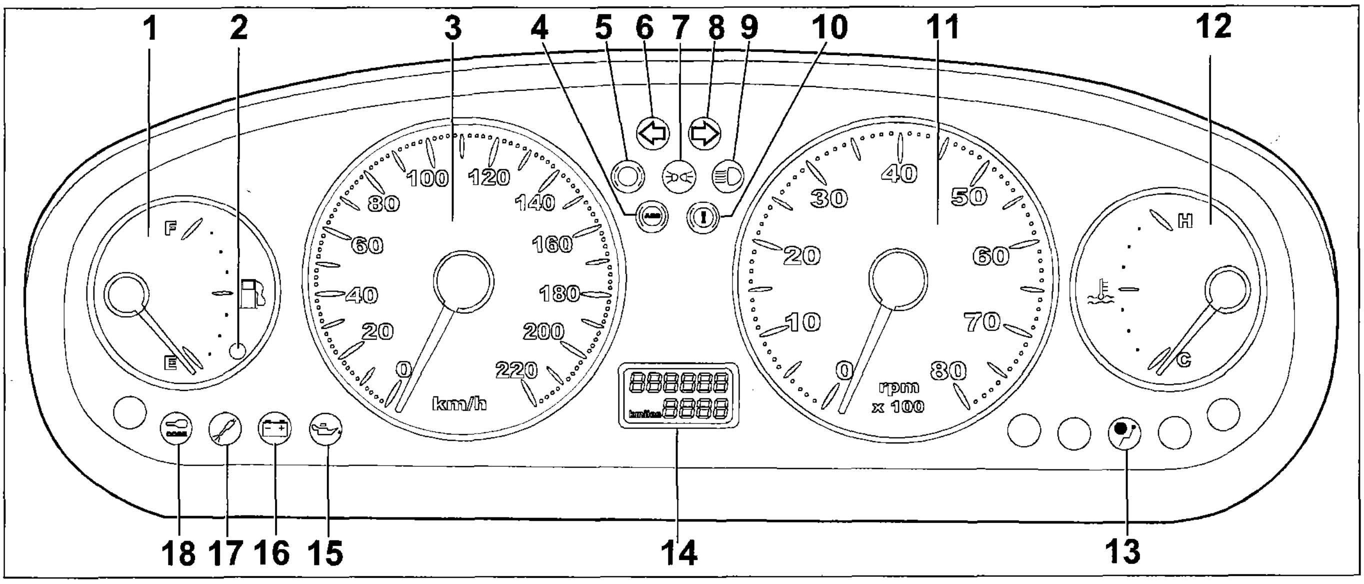
# 55.

**TURBO DIESEL VERSION NSI CONTROL PANEL FOR OUTFITS: SX, (75BHP SOFT), SX, GT, HSX (105C V JTD)**




4A20HL01

**PETROL VERSION NSI CONTROL PANEL FOR OUTFITS: SX, GT, HSX**

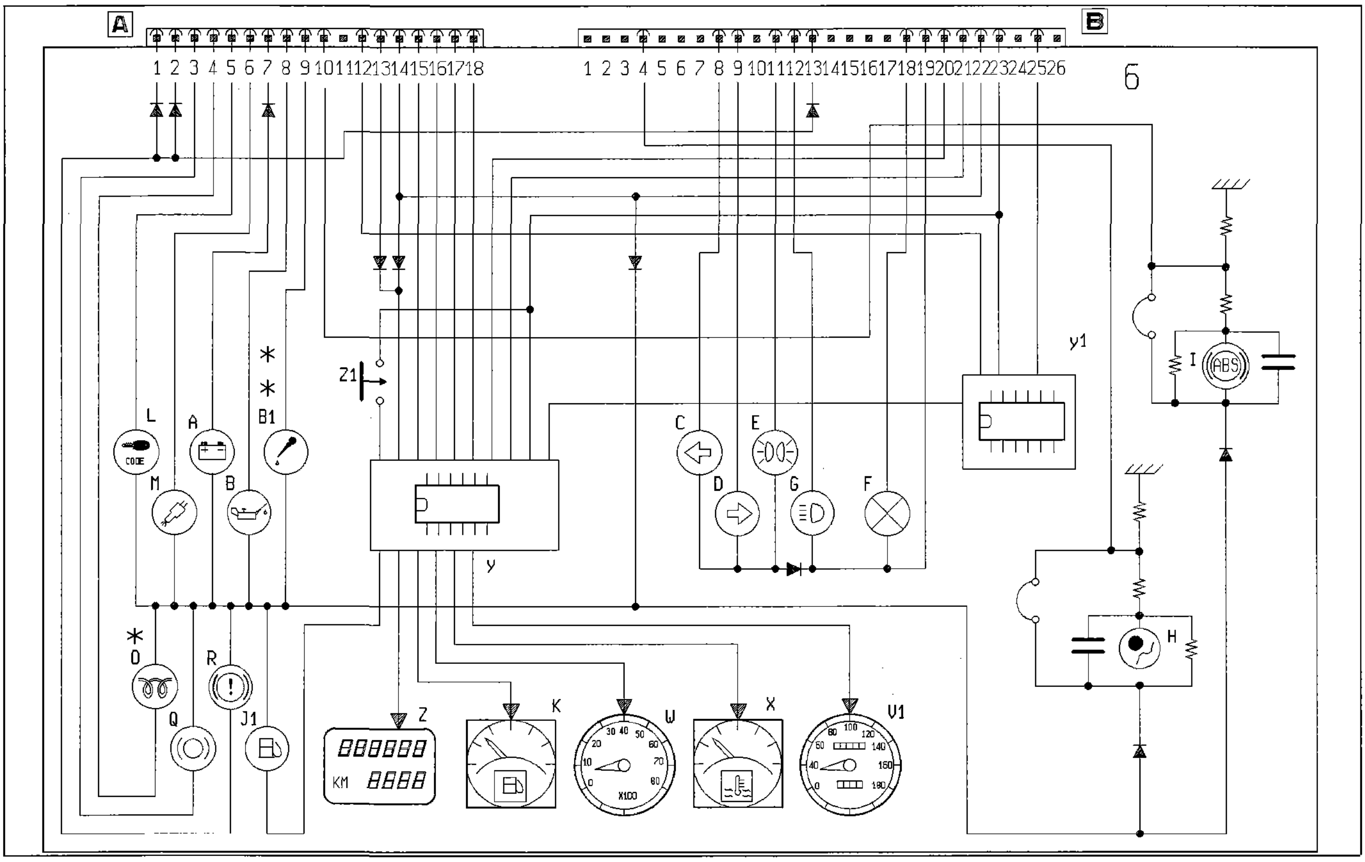



4A20HL02

### Control panel front side

1. Fuel level gauge
2. Fuel reserve warning light
3. Speedometer
4. A.B.S. failure warning light
5. Brake pad wear warning light
6. Left direction indicator warning light
7. Side lights warning light
8. Right direction indicator warning light
9. Main beam headlamps warning light
10. Handbrake applied/insufficient brake fluid level warning light
11. Rev counter
12. Engine coolant temperature gauge
13. EURO BAG system failure warning light
14. Odometer
15. Low engine oil pressure warning light
16. Battery recharging warning light
17. Injection system failure warning light (not present for 1910 SOFT TD)
18. Fiat CODE system failure warning light
19. Glow plug warning light (only for TD versions)
20. Insufficient engine oil level warning light (only for JTD versions)

**Wiring diagram for outfits PETROL SX, GT, HSX and TURBO DIESEL SX (75BHP SOFT), SX, GT, HSX (105BHP JTD)**




* Present for Turbo Diesel versions (75BHP SOFT)

** Present only for Turbo Diesel versions (105BHP JTD)

4A21HL01

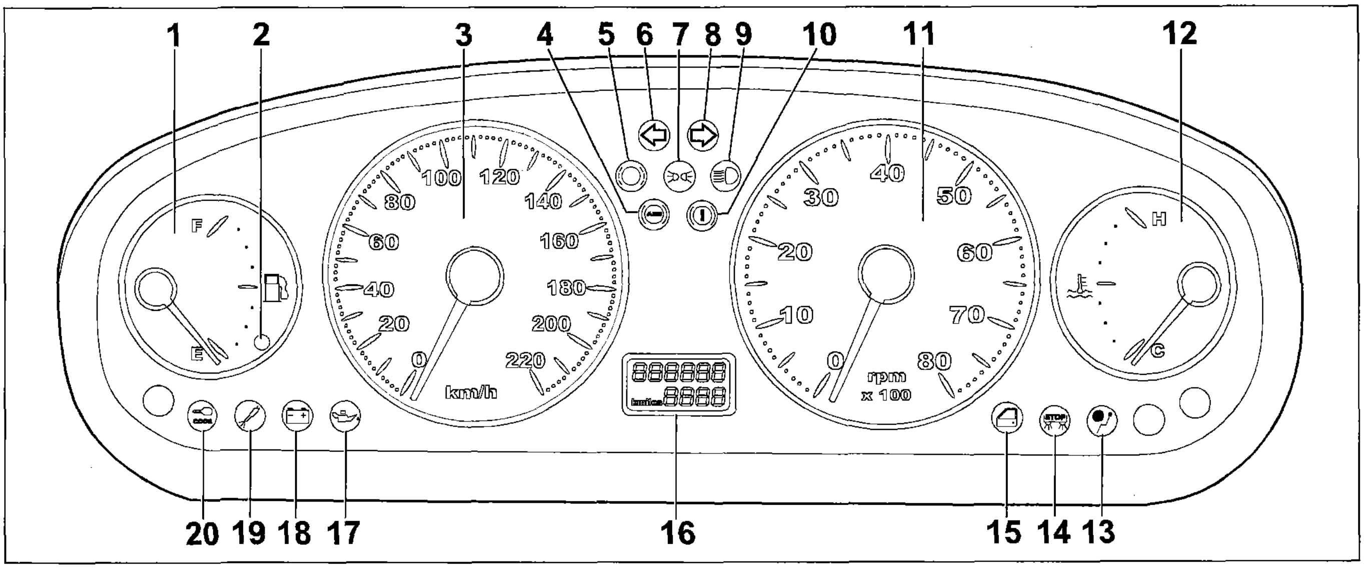
6. Instrument panel:

A Battery recharging warning light
B Low engine oil pressure warning light
B1 Low engine oil pressure warning light
C Left direction indicator warning light
D Right direction indicator warning light
E Side lights warning light
F Instrument panel ideogram light
G Main beam headlamps warning light
H EURO BAG system failure warning light
I Anti-lock brakes failure warning light
J1 Fuel reserve warning light
K Fuel gauge
L Fiat-CODE failure warning light
M Injection system failure warning light
O Glow plug warning light (only for Turbo Diesel)
Q Front brake pad wear warning light
R Handbrake applied/insufficient brake fluid level warning light

V1 Speedometer
W Rev counter
X Engine coolant temperature gauge
Y Electronic module
Y1 Speed control module
Z Milometer/trip meter display
Z1 Trip meter zeroing button
Z2 Trip counter display light

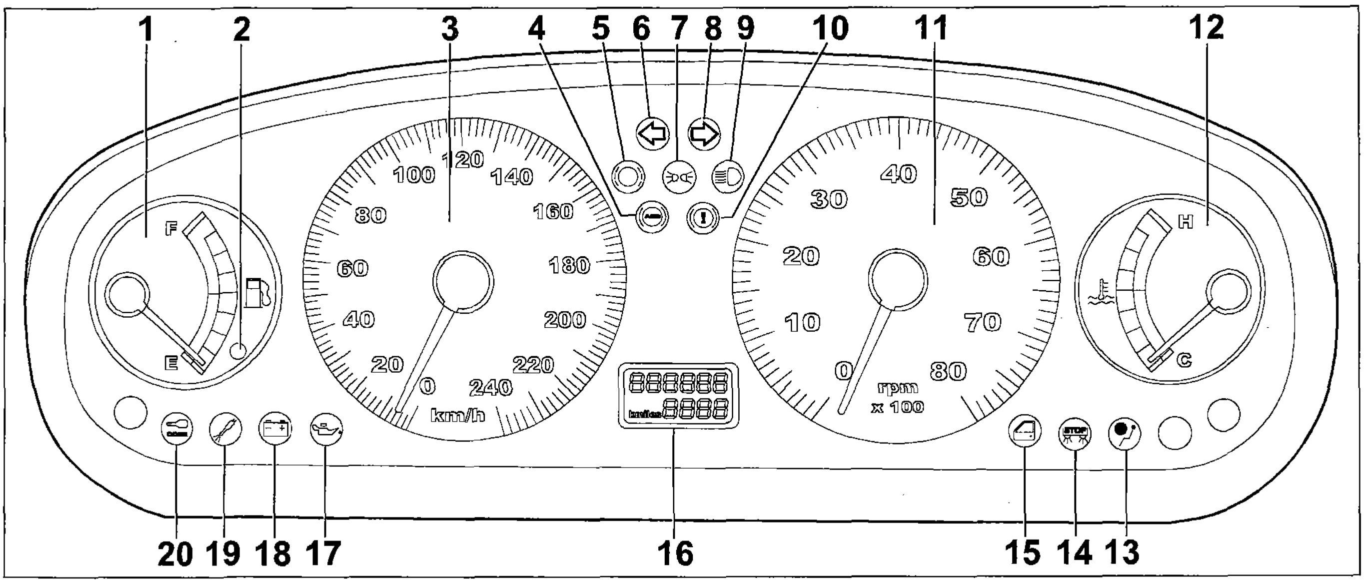
# 55.

PETROL VERSION NSI CONTROL PANEL FOR OUTFITS: ELX




4A22HL01

PETROL VERSION NSI CONTROL PANEL FOR OUTFITS: HGT




4A22HL02

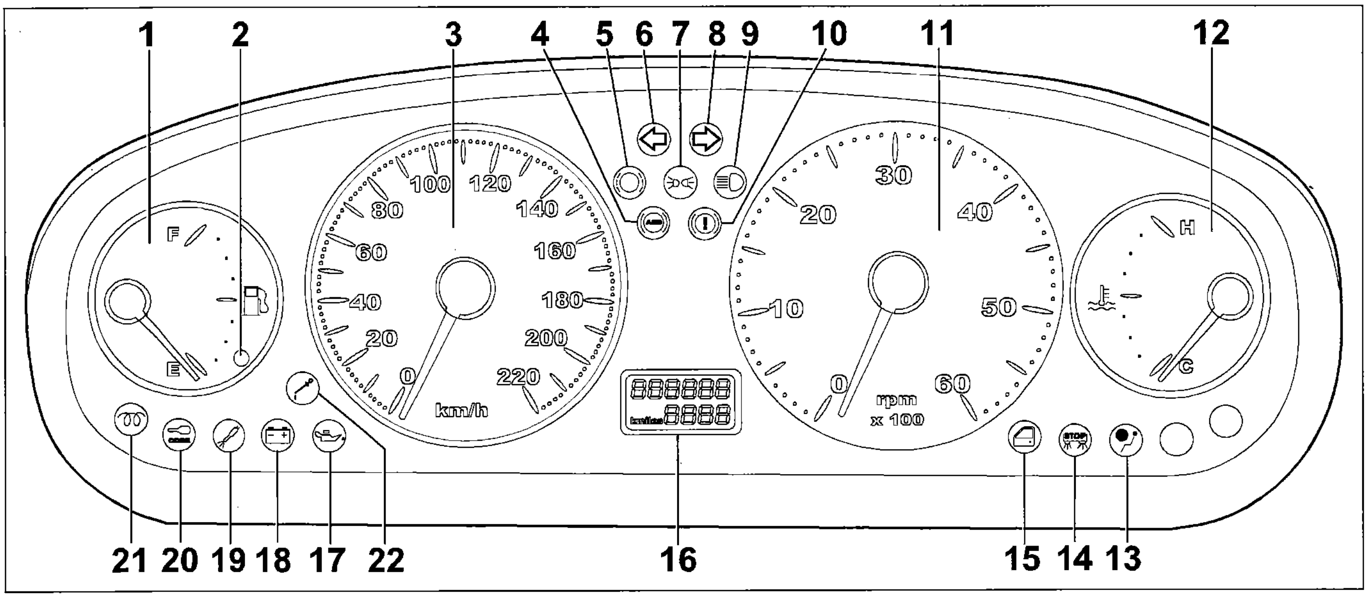
**Control panel front side**

1. Fuel gauge
2. Fuel reserve warning light
3. Speedometer
4. A.B.S. failure warning light
5. Brake pad wear warning light
6. Left direction indicator warning light
7. Side lights warning light
8. Right direction indicator warning light
9. Main beam headlamps warning light
10. Handbrake applied/insufficient brake fluid level warning light
11. Rev counter
12. Engine coolant temperature gauge
13. EURO BAG system failure warning light
14. Brake lights failure warning light
15. Doors open warning ilght
16. Odometer
17. Low engine oil pressure warning light
18. Battery recharging warning light
19. Injection system failure warning light
20. Fiat CODE system failure warning light



*Print n° 506.670/21*

TURBO DIESEL VERSION NSI CONTROL PANEL FOR OUTFIT:
ELX (105BHP JTD)




4A22HL03

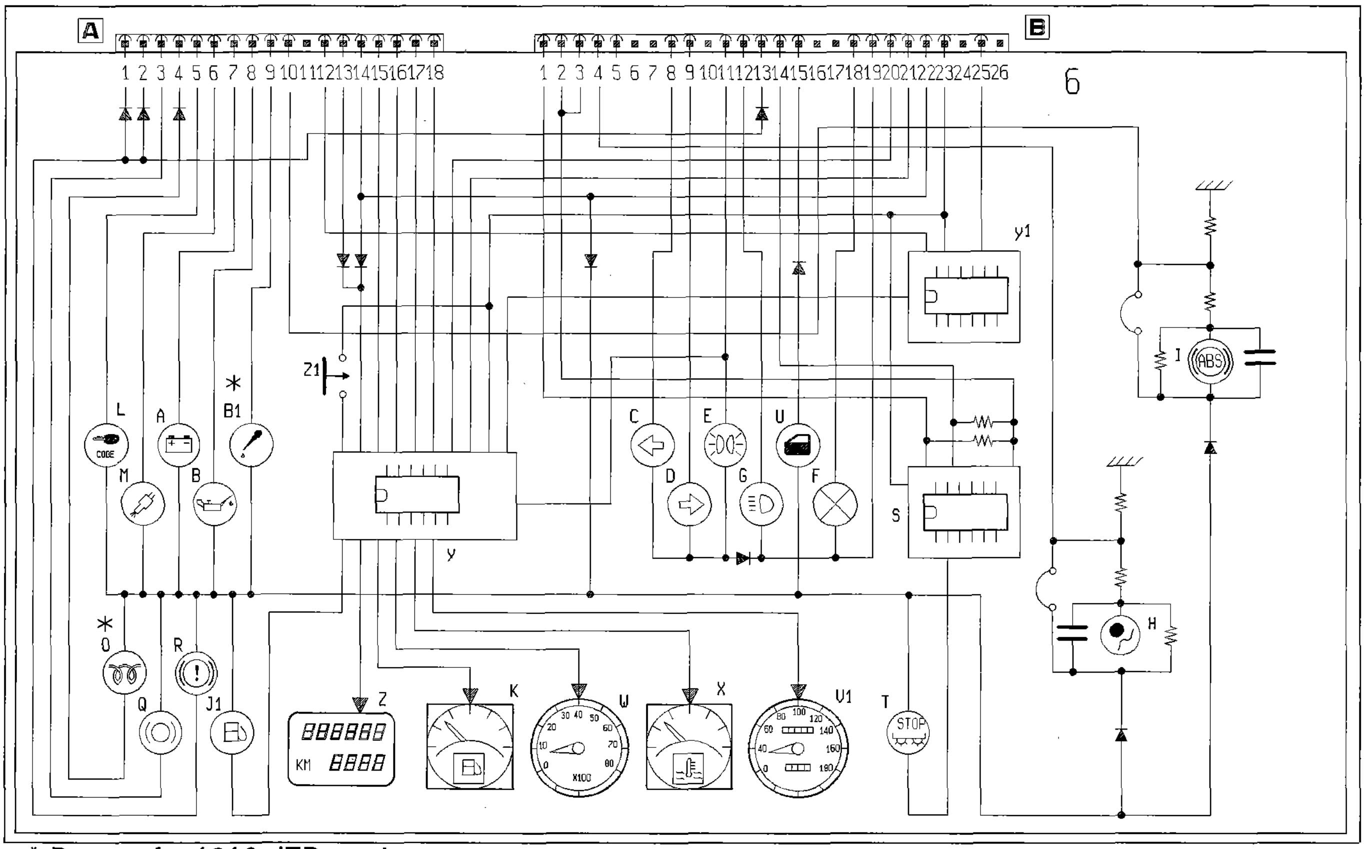
**Control panel front side**

**Key**

1. Fuel gauge
2. Fuel reserve warning light
3. Speedometer
4. A.B.S. failure warning light
5. Brake pad wear warning light
6. Left direction indicator warning light
7. Side lights warning light
8. Right direction indicator warning light
9. Main beam headlamps warning light
10. Handbrake applied/insufficient brake fluid level warning light
11. Rev counter
12. Engine coolant temperature gauge
13. EURO BAG system failure warning light
14. Brake lights failure warning light
15. Doors open warning ilght
16. Odometer
17. Low engine oil pressure warning light
18. Battery recharging warning light
19. Injection system failure warning light
20. Fiat CODE system failure warning light
21. Glow plug warning light
22. Engine oil warning light

# 55.

**Wiring diagram for SX - GT outfits**

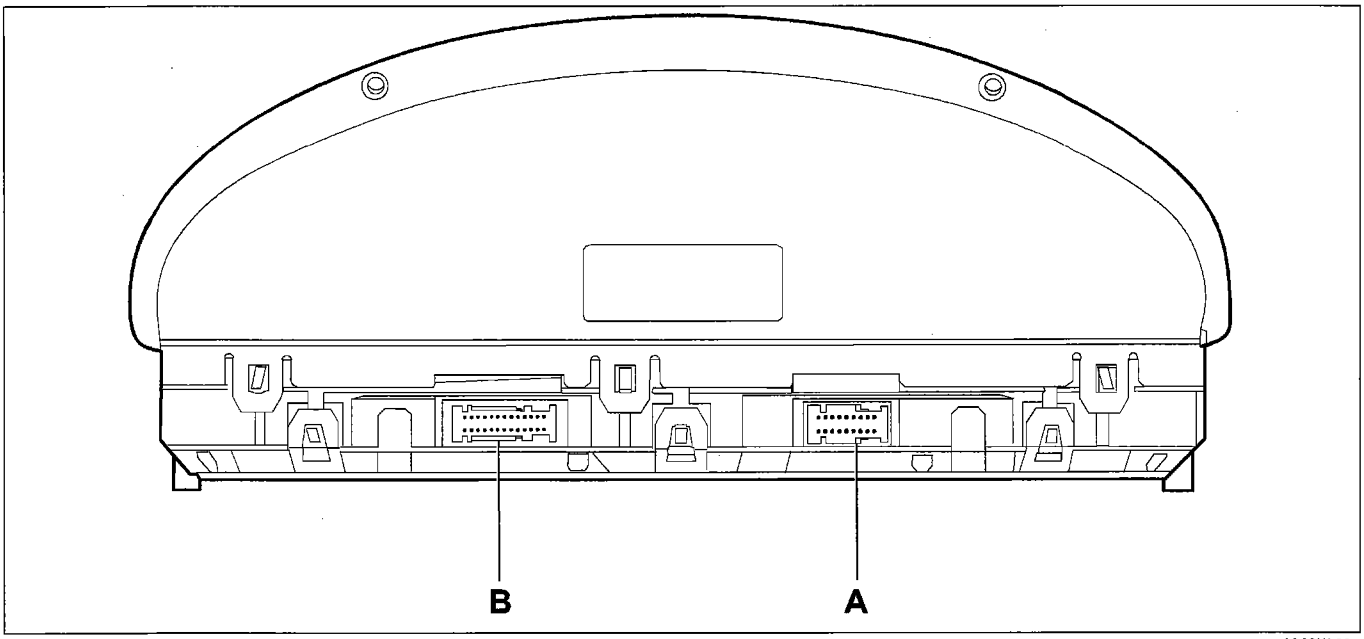



* Present for 1910 JTD versions

4A22HL04

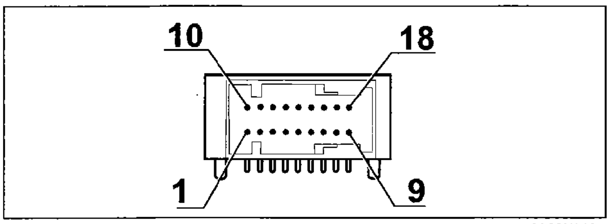
6. Instrument panel:

- A Battery recharging warning light
- B Low engine oil pressure warning light
- B1 Insufficient engine oil level warning light (only forJTD versions)
- C Left direction indicator warning light
- D Right direction indicator warning light
- E Side lights warning light
- F Instrument panel ideogram light
- G Main beam headlamps warning light
- H EURO BAG system failure warning light
- I Anti-lock brakes failure warning light
- J1 Fuel reserve warning light
- K Fuel gauge
- L Fiat-CODE failure warning light
- M Petrol/Diesel injection system failure warning light
- O Glow plug warning light (only for JTD versions)
- Q Front brake pad wear warning light
- R Handbrake applied/insufficient brake fluid level warning light
- S Brake lights failure electronic module
- T Brake lights failure warning light
- U Doors open warning ilght
- V1 Speedometer
- W Rev counter
- X Engine coolant temperature gauge
- Y Electronic module
- Y1 Speed control module
- Z Milometer/trip meter display
- Z1 Trip meter zeroing button
- Z2 Trip counter display light

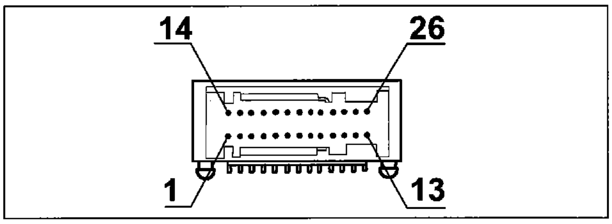



4A23HL01

**Rear side (connector sockets are shown)**




4A23HL02




4A23HL03

**Connector A on left front lead**

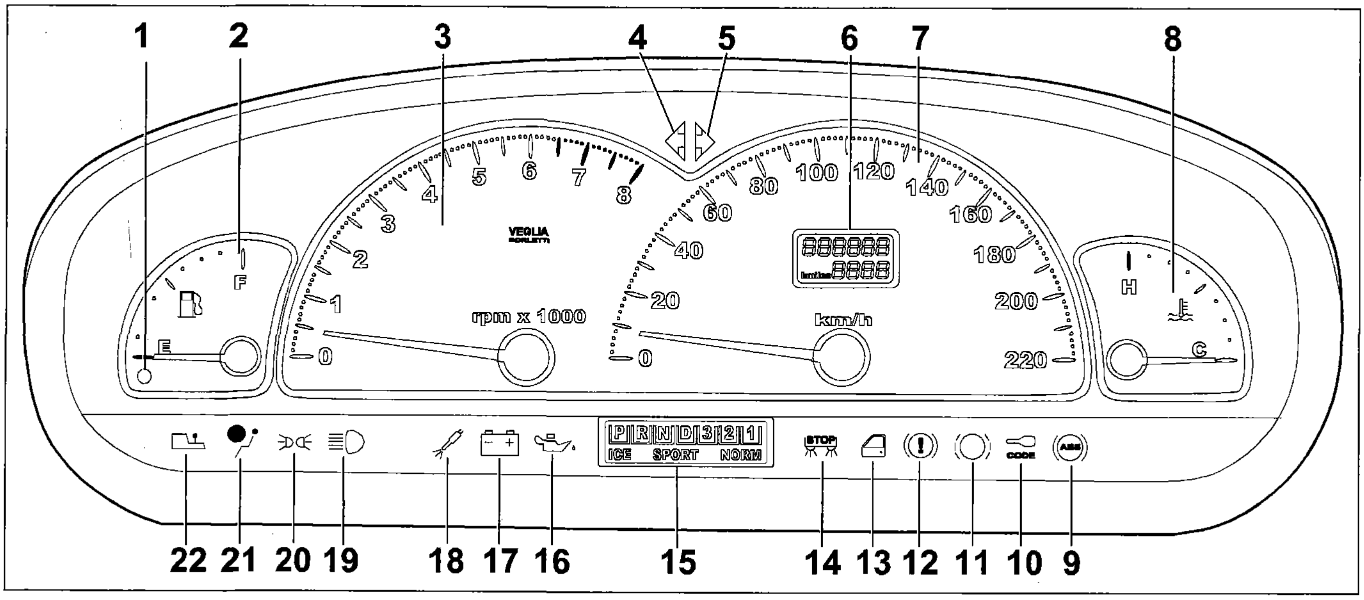
| No. pin | Wiring Colour | Circuit involved |
|---|---|---|
| 1 | M | Electronic brakeforce distributor (EBD) failure |
| 2 | BN | Brake fluid level |
| 3 | BR | Brake lining wear |
| 4 | CL | Glow plug preheating (Turbo Diesel versions) |
| 5 | MN | Fiat CODE |
| 6 | LN | Injection failure (Not present for Turbo Diesel 75 BHP SOFT versions) |
| 7 | HN | Generator |
| 8 | HG | Insufficient engine oil pressure |
| 9 | VG | Insufficient engine oil level (not present for HGT) |
| 10 | RV | ABS failure |
| 11 | - | Not connected |
| 12 | HL | Speedometer signal |
| 13 | R | + 30 battery |
| 14 | CN | Speedometer generator power supply |
| 15 | HB | Engine coolant temperature |
| 16 | SB | Outdoor temperature serial signal |
| 17 | HM | Speedometer signal |
| 18 | L | Rev counter signal |

**Connector B on facia lead**

| No. pin | Wiring Colour | Circuit involved |
|---|---|---|
| 1 | RG | Left car brake light failure |
| 2 | BR | Brake light |
| 3 | - | Not connected |
| 4 | LG | Euro-Bag device failure |
| 5 | BL | Passenger Euro-bag deactivated |
| 6 | - | Not connected |
| 7 | - | Not connected |
| 8 | AN | Left turn signal |
| 9 | A | Right turn signal |
| 10 | - | Not connected |
| 11 | GN | Side lights |
| 12 | VN | Main beam headlamps |
| 13 | BN | Handbrake on |
| 14 | RN | Right car brake light failure |
| 15 | BH | Doors open |
| 16 | NR | Boot open (not present for ELX) |
| 17 | - | Not connected |
| 18 | GR | Instrument panel light |
| 19 | N | Earth (lighting) |
| 20 | HR | Fuel level |
| 21 | VB | Outdoor temperature display |
| 22 | AR | + 15 |
| 23 | NZ | Electronic earth |
| 24 | - | Not connected |
| 25 | HM | Speedometer signal |
| 26 | - | Not connected |

# 55.

**PETROL VERSION VEGLIA BORLETTI CONTROL PANEL FOR OUTFIT: SX, ELX (1581 WITH AUTOMATIC TRANSMISSION)**



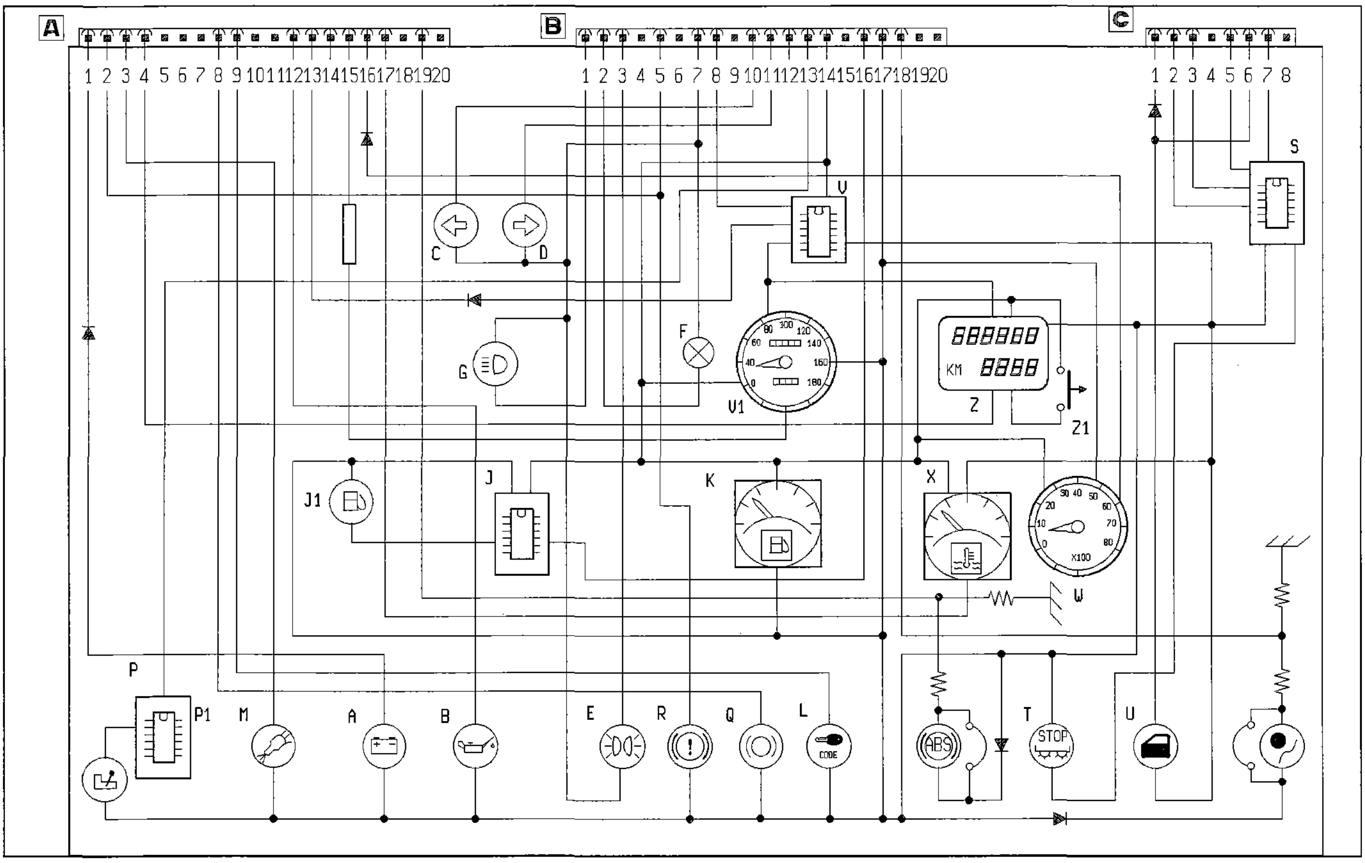

4A24HL01

## Front side of control panels

## Key

1. Fuel reserve warning light
2. Fuel gauge
3. Rev counter
4. Left direction indicator warning light
5. Right direction indicator warning light
6. Odometer
7. Speedometer
8. Engine coolant temperature gauge
9. A.B.S. failure warning light
10. Fiat CODE system failure warning light
11. Brake pad wear warning light
12. Handbrake applied/insufficient brake fluid level warning light
13. Doors open warning ilght
14. Brake lights failure warning light
15. Automatic transmission warning light
16. Low engine oil pressure warning light
17. Battery recharging warning light
18. Injection system failure warning light
19. Main beam headlamps warning light
20. Side light failure warning light
21. EURO BAG system failure warning light
22. Automatic transmission system failure warning light

**Wiring diagram for PETROL version, SX, ELX (1581 with AUTOMATIC TRANSMISSION)**

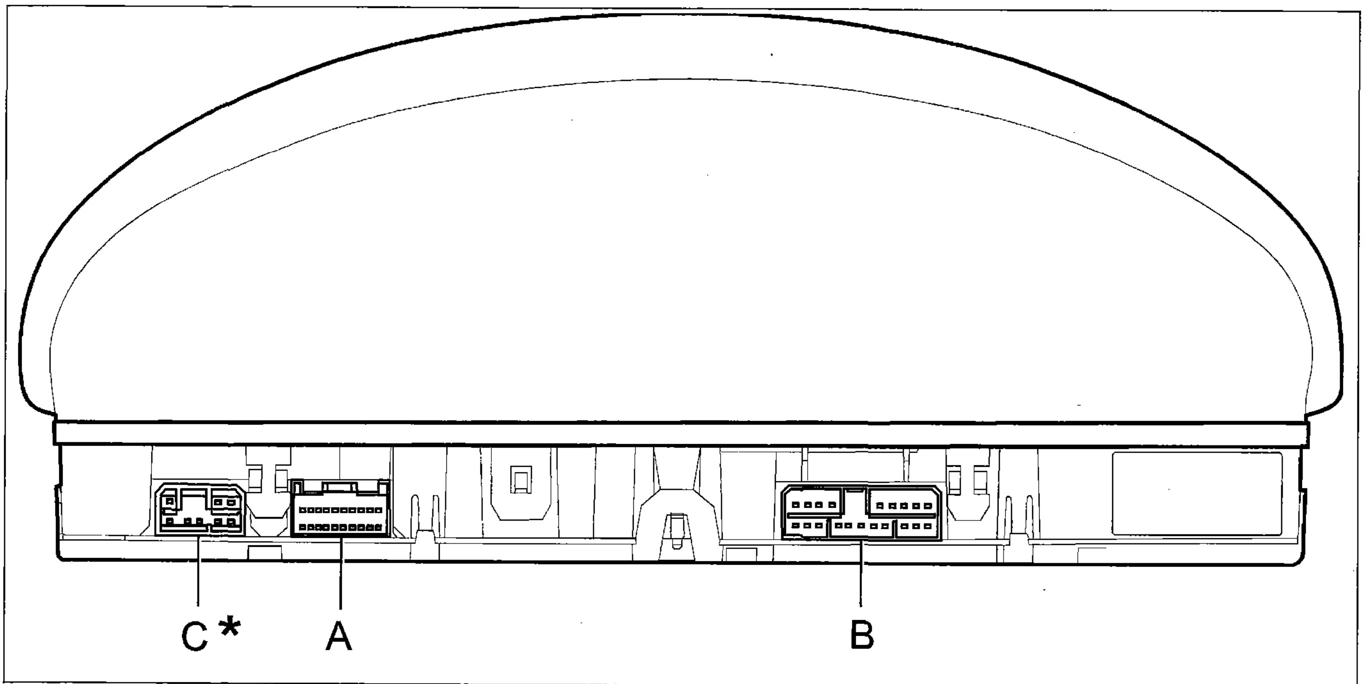



4A25HL01

6. Instrument panel:

A Battery recharging warning light
B Low engine oil pressure warning light
C Left turn signal warning light
D Right turn signal warning light
E Side lights warning light
F Instrument panel ideogram light
G Main beam headlamps warning light
H EURO BAG system failure warning light
I Anti-lock brakes failure warning light
J Fuel reserve circuit control module
J1 Fuel reserve warning light
K Fuel gauge
L Fiat-CODE failure warning light
M Petrol injection system failure warning light
P Automatic transmission failure warning light
P1 Automatic transmission circuit control module
Q Front brake pad wear warning light
R Handbrake applied/insufficient brake fluid level warning light
S Brake lights failure warning device electronic module
T Brake lights failure warning light
U Doors open warning ilght
V Speedometer control module
V1 Speedometer
W Rev counter
X Engine coolant temperature gauge
Z Milometer/trip meter display
Z1 Trip meter zeroing button

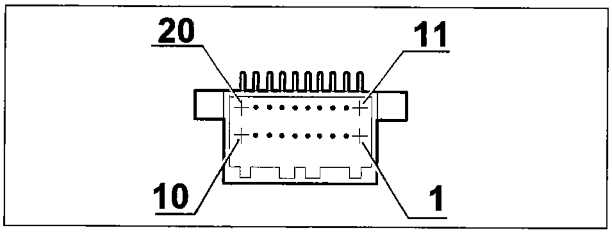
# 55.




* Present only for ELX version

4A26HL01

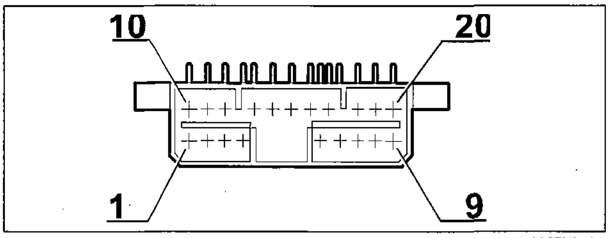
**Rear side (connector sockets are shown)**




4A26HL02

**Connector A on left front lead**

| No. pin | Wiring Colour | Circuit involved |
|---|---|---|
| 1 | HN | Generator |
| 2 | BN | Brake fluid level |
| 3 | LN | Injection failure |
| 4 | R | +30 battery |
| 5 | - | Not connected |
| 6 | - | Not connected |
| 7 | - | Not connected |
| 8 | BR | Brake lining wear |
| 9 | MN | Fiat CODE |
| 10 | - | Not connected |
| 11 | - | Not connected |
| 12 | HG | Insufficient engine oil pressure |
| 13 | HM | Speedometer signal |
| 14 | - | Not connected |
| 15 | CN | Speedometer generator power supply |
| 16 | L | Rev counter signal |
| 17 | HB | Engine coolant temperature |
| 18 | - | Not connected |
| 19 | RV | ABS system failure |
| 20 | - | Not connected |

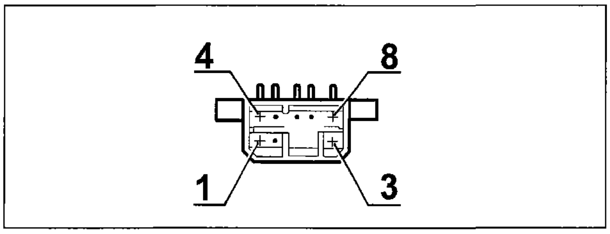



4A27HL01

**Connector B on facia lead**

| No. pin | Wiring Colour | Circuit involved |
|---|---|---|
| 1 | VN | Main beam headlamps |
| 2 | GR | Instrument panel light |
| 3 | GN | Side lights |
| 4 | - | Not connected |
| 5 | BN | Handbrake on |
| 6 | - | Not connected |
| 7 | N | Earth |
| 8 | HG | Speedometer output 1 |
| 9 | - | Not connected |

| No. pin | Wiring Colour | Circuit involved |
|---|---|---|
| 10 | AN | Left turn signal |
| 11 | A | Right turn signal |
| 12 | - | Not connected |
| 13 | ZN | Automatic transmission signal |
| 14 | NZ | Electronic earth |
| 15 | - | Not connected |
| 16 | HR | Fuel level |
| 17 | AR | + 15 |
| 18 | LG | Euro-bag device failure |
| 19 | - | Not connected |
| 20 | - | Not connected |




4A27HL02

**Connector C**

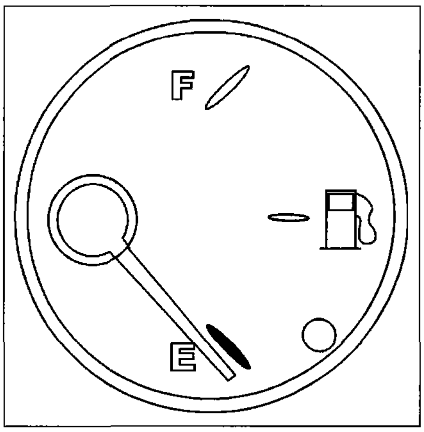
| No. pin | Wiring Colour | Circuit involved |
|---|---|---|
| 1 | BH | Boot open |
| 2 | RG | Left brake light failure |
| 3 | RN | Right brake light failure |
| 4 | AR | + 15 battery |
| 5 | N | Electronic earth |
| 6 | - | Not connected |
| 7 | BR | Brake light |
| 8 | - | Not connected |

# 55.

The following tables contain values for checking the various gauge positions: fuel level and coolant level

## FUEL GAUGE

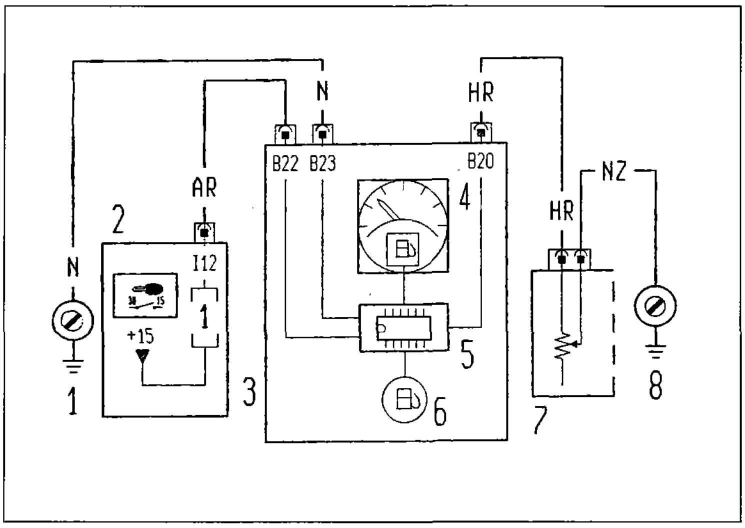
| Values for checking settings | |
|---|---|
| **Pointer position** | **Value in Ohms** |
| 4/4 (F) | 16 ± 6 |
| 1/2 | 140 ± 5 |
| Start of reserve | 240 ± 5 |
| 0 (E) | 292.5 ± 9 |




4A28HL01

**Electrical operating diagram**
**Fuel gauge**

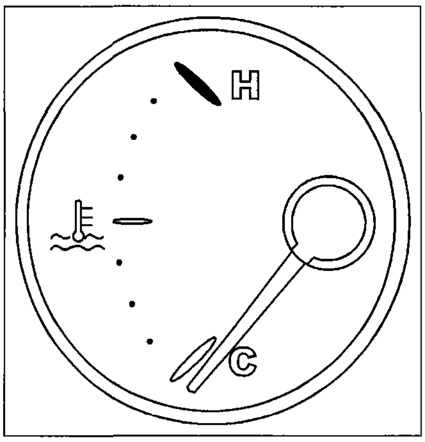
1. Left dashboard earth
2. Junction unit
3. Instrument panel
4. Fuel gauge
5. Fuel gauge control module
6. Fuel reserve warning light
7. Fuel level gauge
8. Right rear earth




4A28HL02

## COOLANT TEMPERATURE GAUGE
## ENGINE COOLANT

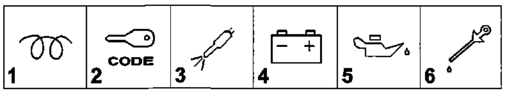
| Temperature of Coolant (°C) | Sensor Value (Ohms) | Pointer position |
|---|---|---|
| 50 | 820 ± 36 | 0° |
| 80 - 100 | $273 - 143\ ^{+11}_{-4}$ | 45° |
| 130 | 62 ± 4 | 90° |



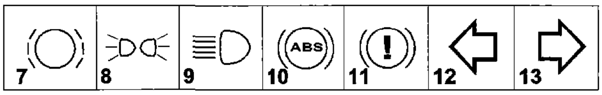

4A28HL03

## WARNING LIGHTS

**Warning lights for Turbo Diesel and petrol versions with outfits: SX; HSX; GT.**

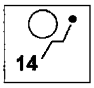



4A29HL01




4A29HL02

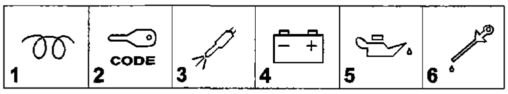
1. Glow plug warning light (only for turbodiesel versions)
2. Fiat-CODE failure warning light
3. Injection system failure warning light
4. Battery recharging warning light
5. Low engine oil pressure warning light
6. Insufficient engine oil level warning light (only for JTD versions)
7. Brake pad wear warning light
8. Side lights warning light
9. Main beam headlamps warning light
10. A.B.S. failure warning light
11. Handbrake applied/insufficient brake fluid level warning light
12. Left direction indicator warning light
13. Right direction indicator warning light



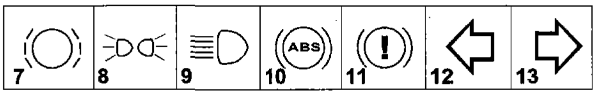

4A29HL03

14. Passenger side EURO BAG system failure warning light

**Warning lights for turbo diesel and petrol versions with outfit: ELX.**

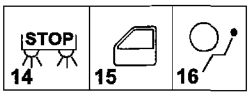



4A29HL04




4A29HL05

1. Glow plug warning light (only for turbodiesel versions)
2. Fiat-CODE failure warning light
3. Injection system failure warning light
4. Battery recharging warning light
5. Low engine oil pressure warning light
6. Insufficient engine oil level warning light (only for JTD versions)
7. Brake pad wear warning light
8. Side lights warning light
9. Main beam headlamps warning light
10. A.B.S. failure warning light
11. Handbrake applied/insufficient brake fluid level warning light
12. Left direction indicator warning light
13. Right direction indicator warning light

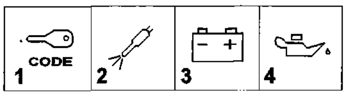



4A29HL06

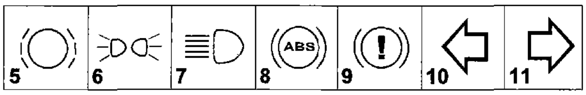
14. Brake lights failure warning light
15. Doors open warning ilght
16. EURO BAG system failure warning light

# 55.

**Warning lights for petrol version with outfit: HGT**

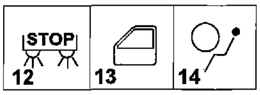



4A30HL01




4A30HL02

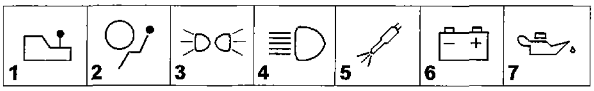
1. Fiat-CODE failure warning light
2. Injection system failure warning light
3. Battery recharging warning light
4. Low engine oil pressure warning light
5. Brake pad wear warning light
6. Side lights warning light
7. Main beam headlamps warning light
8. A.B.S. failure warning light
9. Handbrake applied/insufficient brake fluid level warning light
10. Left direction indicator warning light
11. Right direction indicator warning light



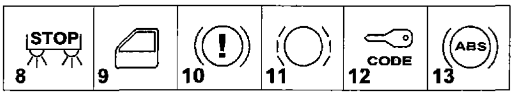

4A30HL03

12. Brake lights failure warning light
13. Doors open warning ilght
14. Passenger side EURO BAG off warning light

**Warning lights for 1581 version with automatic transmission and oufits: SX, ELX.**

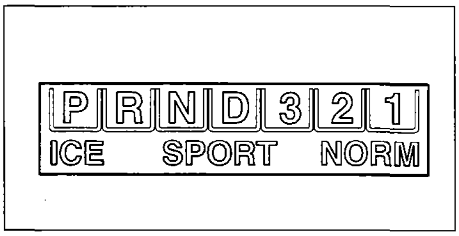



4A30HL04

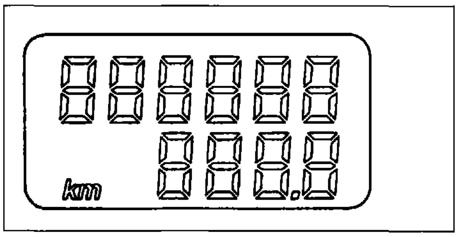



4A30HL05

1. Automatic transmission system failure warning light
2. EURO BAG system failure warning light
3. Side lights warning light
4. Main beam headlamps warning light
5. Injection system failure warning light
6. Battery recharging warning light
7. Low engine oil pressure warning light
8. Brake lights failure warning light (not present for SX versions)
9. Doors open warning ilght (not present for SX versions)
10. Handbrake applied/insufficient brake fluid level warning light
11. Brake pad wear warning light
12. Fiat-CODE failure warning light
13. A.B.S. failure warning light




P4A31HL01

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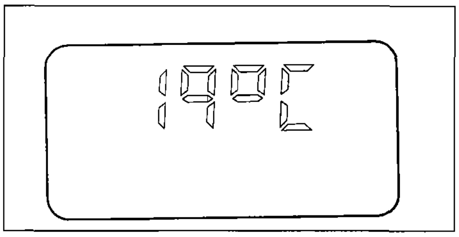


P4A31HL03

## AUTOMATIC TRANSMISSION GEARS INDICATOR

On versions with automatic transmission it indicates the gear engaged and the selction mode

## MILOMETER

With the ignition ON, the milometer displays the total or partial mileage (by pressing the special button).
If the button is pressed for longer than 0.7 seconds, the trip meter is zeroed

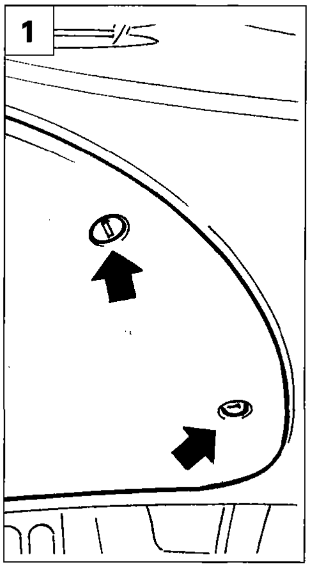
## OUTSIDE TEMPERATURE

On versions fitted with climate control it is possible, by pressing the button in the console for at least 1 second, to display the outside temperature (in °C), which is shown for about 10 seconds; the instrument automatically returns to the milometer function.
If the outside temperature is below +3°C, it is displayed FLASHING for about 10 seconds in order to attract the driver's attention to the possibility of it being icy.

When the 10 seconds have elapsed, the dispay automatically returns to the milometer state for 20 seconds and then the outside temperature is flashed for 10 seconds.
The sequence described above is known as the "warning cycle".
This takes place only once after the detection of an outside temperature below +3 °C and can only be repeated after the outside temperature goes above 6 °C and then below 3 °C.
With the ignition ON and the outside temperature below 3 °C the instrument displays the "warning cycle" for the first 10 seconds.
If, during the first 10 seconds after the ignition is switched on, the outside temperature button is pressed, the "warning cycle" does not take place and the switching tothe outside temperature state is immediate.
Pressing the zeroing button during the warning cycle has the following effect:
Pressing the button for 1 second whilst the temperature is displayed causes the "warning cycle" to stop; pressing it for 1 second during the 20 seconds when the mileage is displayed causes the zeroing of the trip meter, but does not interrupt the "warning cycle".

⚠ *The milometer display is also used to carry out a fault diagnosis of the thermostatically adjusted air conditioning electronic system (see group 50)*

# 55.



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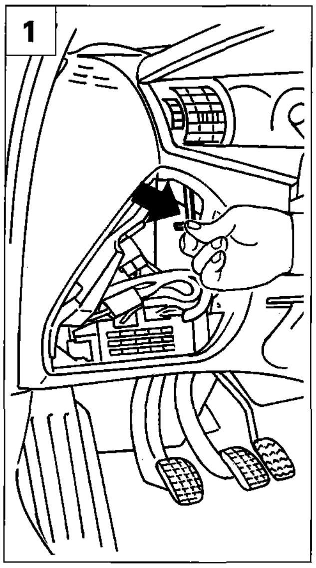

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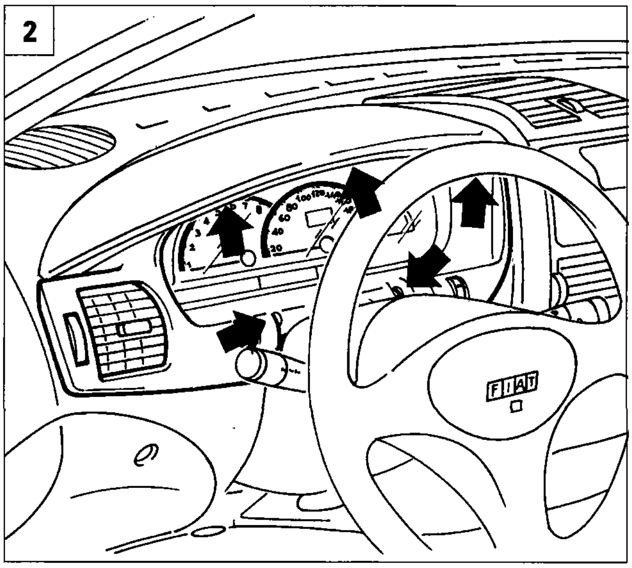

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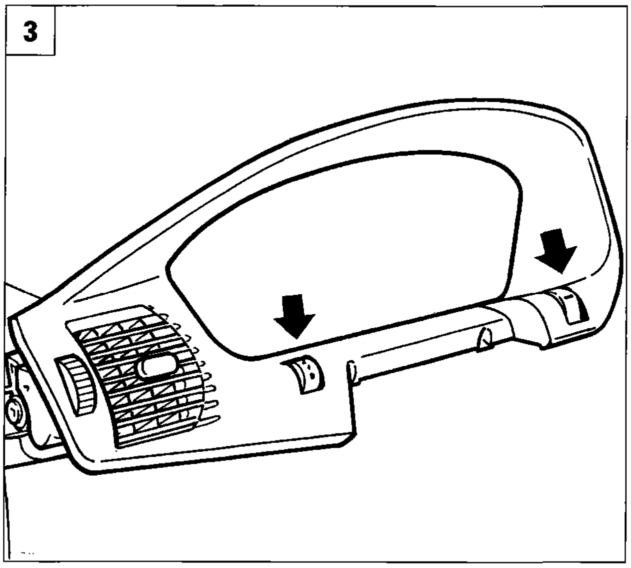
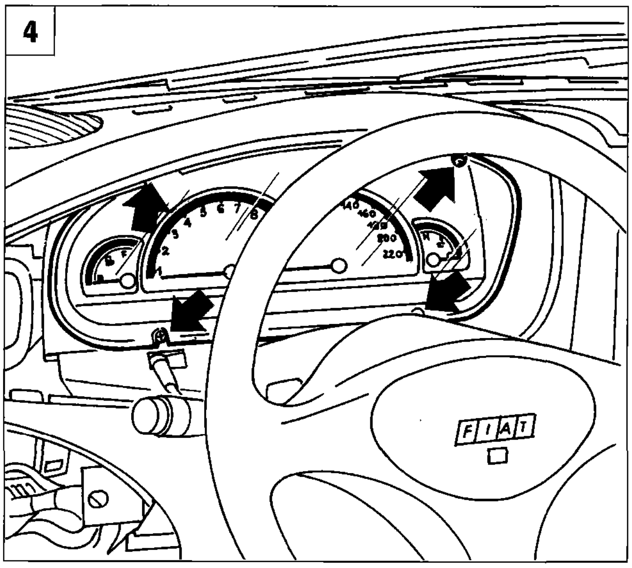


P4A32HL04

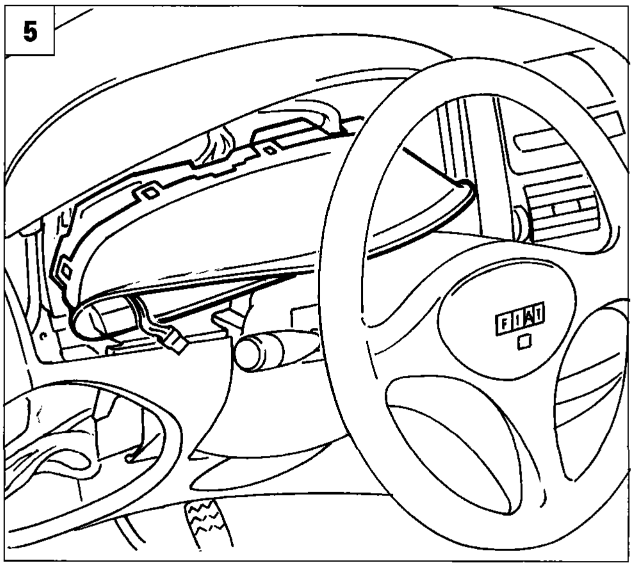
### REMOVING-REFITTING

Remove the steering column upper and lower covers and then proceed as described below:

1. Remove the protective cover for the junction unit. Undo the outer bolt fixing the instrument panel frame.
2. Undo the outer bolts fixing the instrument panel frame.
3. Extract the frame from the dashboard after having disconnected the connector for the headlamp dimmer (shown by the arrow).
4. Undo the bolts fixing the instrument panel to the dashboard.
5. Disconnect the two electrical connections for the instrument panel and remove it from the vehicle.



P4A32HL05



P4A32HL06

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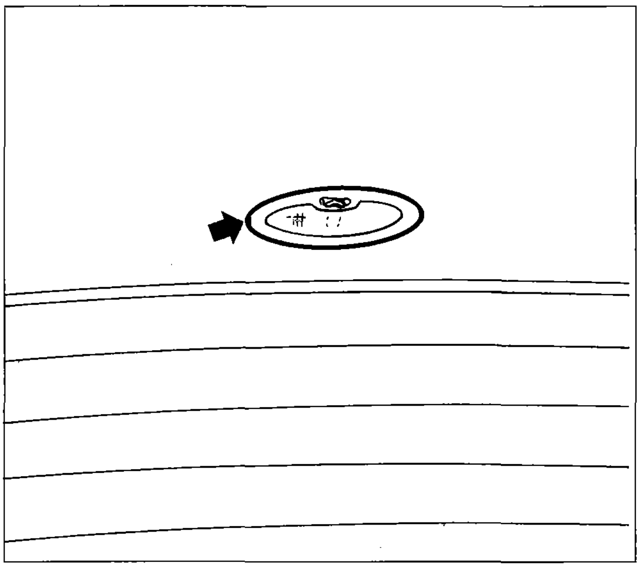
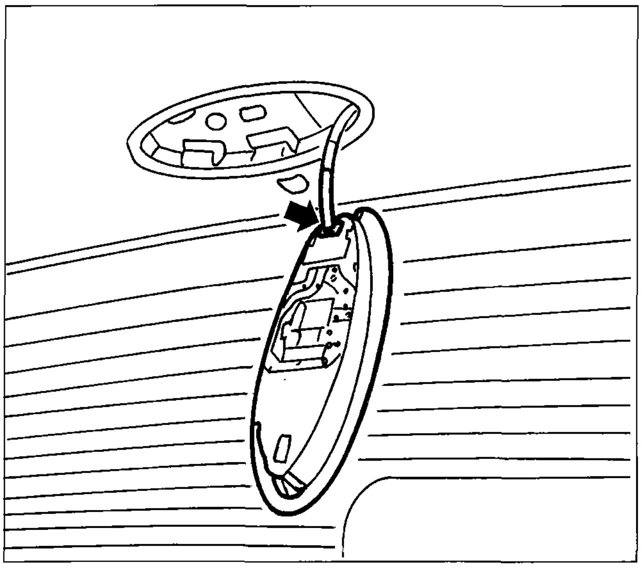


P4A33HL01

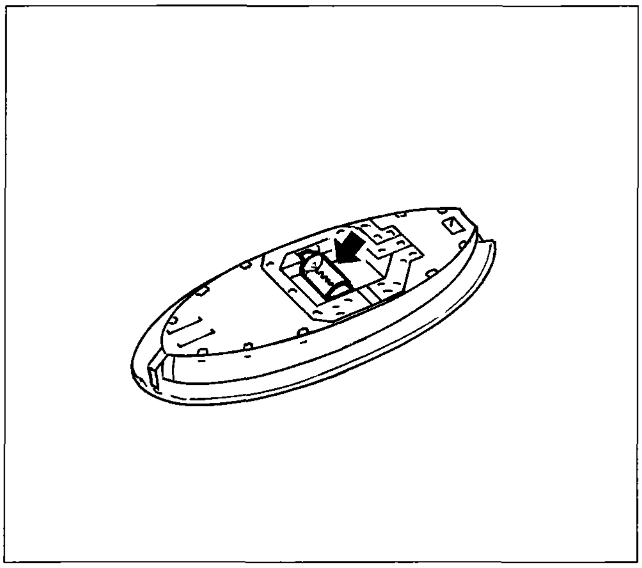
### REMOVING-REFITTING REAR COURTESY LIGHT AND REPLACING BULB

- Using a screwdriver in the side slit, remove the courtesy light from its housing;



P4A33HL02

- disconnect the connector and remove the courtesy light;

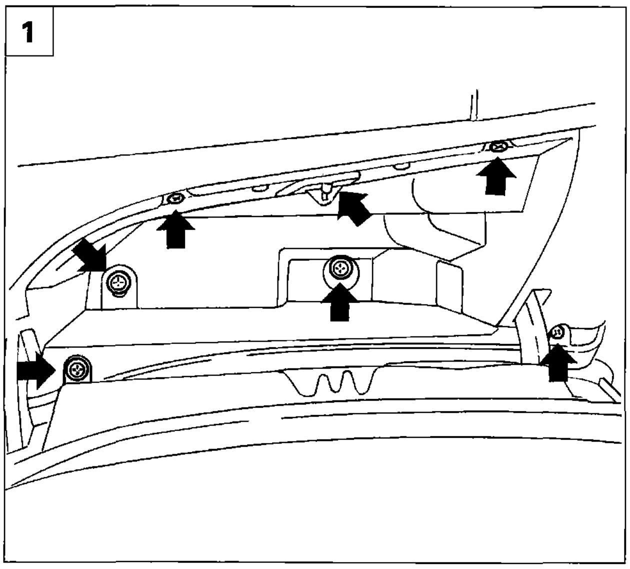


P4A33HL03

- release the bulb from the flexible tabs and remove it.

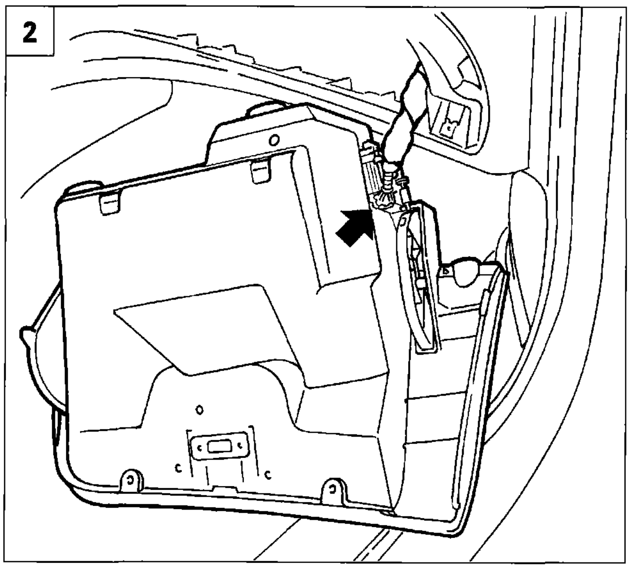
# 55.

**LOCATION OF ADDITIONAL FUSES - RELAYS (dashboard - passenger side)**




P4A34HL01

1. Undo the bolts shown in the diagram and extract the glove compartment from its housing;




P4A34HL02

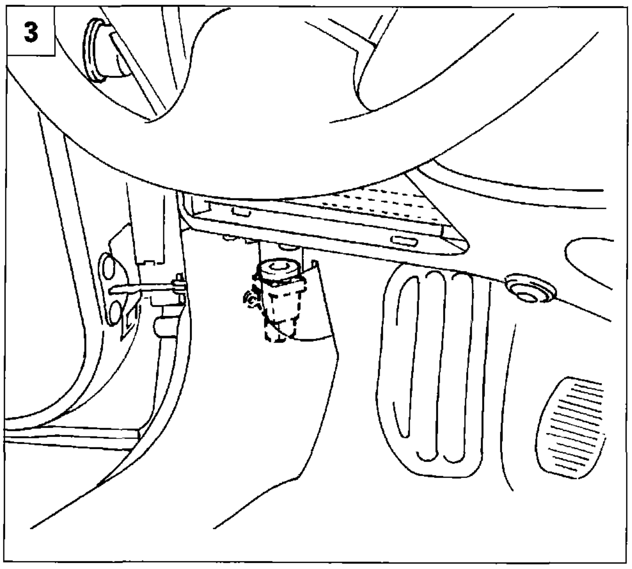
2. disconnect the electrical connector and remove the glove compartment from the vehicle, behind which the additional relays and fuses are located.

**INERTIA SWITCH**

3. The inertia switch is located inside the vehicle under the dashboard on the driver's side

**POWER ASSISTED STEERING PUMP SENSOR**

4. Location of power assisted steering pump sensor (valid for 1242 versions only)

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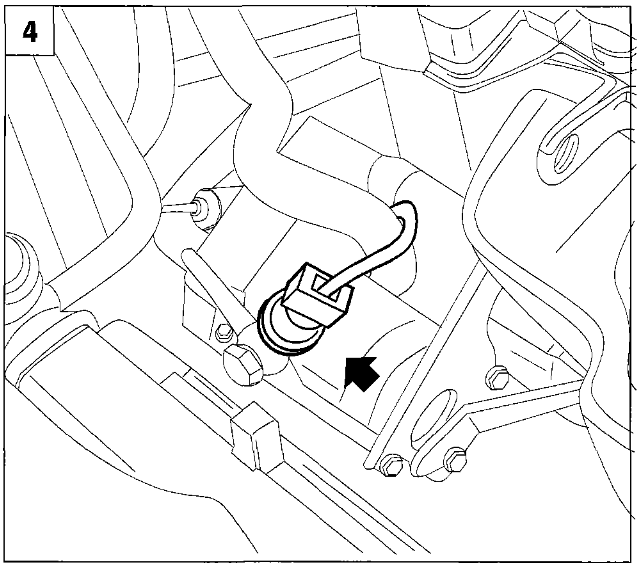


P4A34HL04


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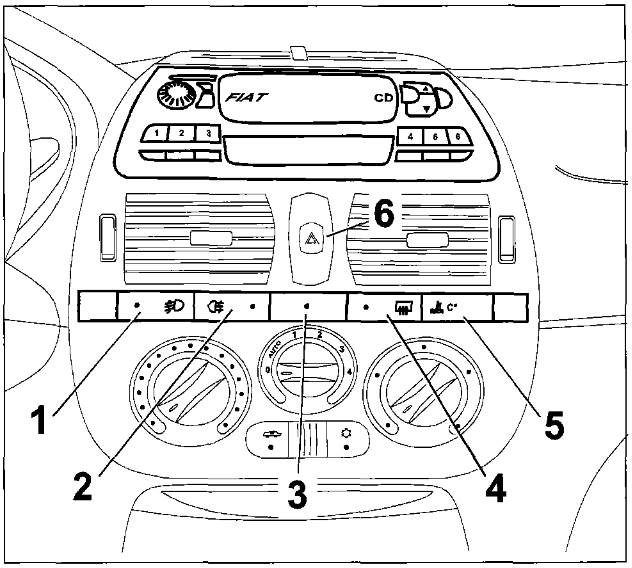
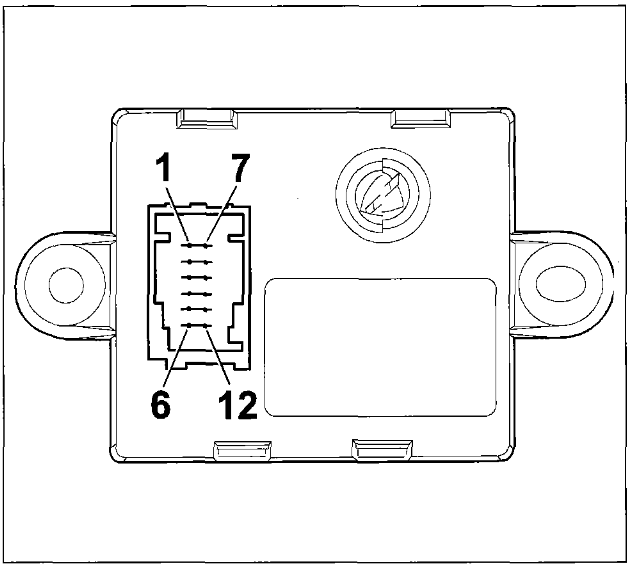



P4A35HL01

## CONTROL BUTTONS IN THE DASHBOARD

1. Front fog lights (where fitted);
2. Rear fog lamps;
3. LED signalling "alarm on" (where fitted);
4. Button for switching heated rear windscreen on/off;
5. Button for outside temperature display
6. Button for switching hazard warning lights on/off




P4A35HL02

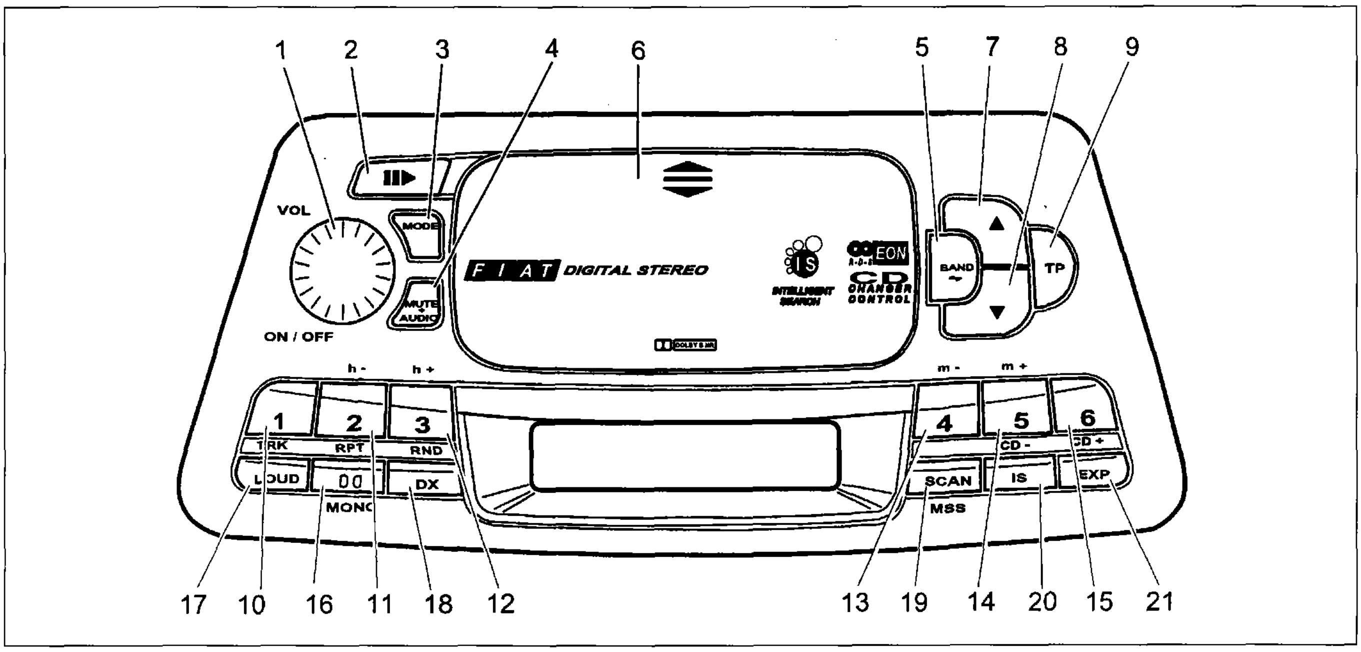
## ENGINE OIL LEVEL CONTROL UNIT

| PIN No. | 12 way connector |
|---|---|
| 1 | Key |
| 2 | + Battery |
| 3 | GND |
| 4 | Sensor earth |
| 5 | Sensor positive |
| 6 | Outlet for warning light |
| 7 | Spare |
| 8 | Test |
| 9 | Magneti Marelli Test |
| 10 | Spare |
| 11 | Spare |
| 12 | Spare |

The 1919 JTD version is fitted with a warning light signalling the engine oil level operated by a control unit located behind the glove compartment.
The warning lights in the instrument panel carry out a self-test lasting about 2 seconds when the ignition is switched on.
If the engine oil level is below the minimum level, the electronic control unit switches on the warning light for 30 seconds at a frequency of 2 Hz.
In the case of a sensor short circuit or open circuit, there will be a signal consisting of 2 flashes at a frequency of 2 Hz, a pause of 2 seconds and 2 flashes at 2 Hz with the cycle repeated 10 times in 30 seconds.
With the voltage below 8.5 V, the control unit displays the engine oil level memorized at the last reading via the warning light.
With the engine oil level below the minimum level, the warning light remains on constantly for 30 seconds.

# 55.

### AD 182 H2 RADIO CASSETTE PLAYER




P4A36HL01

4. VOL control: switching on/off of radio, adjustment of high/low tones and Balance/Fader functions
2. Cassette eject button
3. MODE button: selection of Radio, Audiocassette player and CD player functions; temporary pause in listening to audiocassette
4. AUDIO-MUTE control: selection of Bass, Treble, Balance and Fader functions; MUTE fuction
5. BAND button: selection of FM1, FM2, FM3, MW and LW bands; change side of audiocassette; section of AUTOSTORE function
6. Audiocassette housing

7.8. Buttons for recalling contents of IS memory; RDS transmitter searth; manual transmitter search; TP function volume setting; selection of PTY programmes; changing of audiocassette or CD track; fast forward/rewind of CD or audiocassette; sections of EXPERT control level adjustements

9. TP button: selection of Traffic Program (TP) function and Types of programmes function (PTY); selection of Alternative Frequencies (AF) function
10. Switch for programming station N1: selection of TRACK REPEAT function
11. Switch for programming station N2: CD player TRACK REPEAT function
12. Switch for programming station N3: selecting TRACK RANDOM function; setting time (hour); introducing secret code figures
13. Switch for programming station N4: selecting TP function volume; setting minutes; deactivating clock syncrhonization with RDS TIMER signals; selecting LNR function; setting on volume; selecting radio suppressing function when "HANDS-FREE" phone is fitted; adjusting telephone input sensitivity; keying in secret code figures; switching off BOOSTER delay
14. Switch for programming station N5: selecting TP function volume; selecting previous CD; activating synchronization of clock with RDS TIMER signals; switching off LNR function; setting on volume; switching on BOOSTER delay; deactivating audio suppressing function when HANDS-FREE system is fitted; selecting telephone input sensitivity; keying in secret code
15. Switch for programming station N6: selecting previous CD
16. DOLBY function button
17. LOUDNESS function on/off button
18. Button for setting sensitivity for radiophone station search.
19. SCAN/MSS button: activating/deactivating of audiocassette player MSS function; activating/deactivating of CD player SCAN function
20. IS button: tuning and automatic "intelligent" search
21. EXP button: activating EXPERT control level



XI-98 - Update

*Print no. 506.670/17*

## GENERAL DESCRIPTION

The vehicle is available, on request, with a radio system consisting of the following main components:

- radio cassette player (which cannot be removed) model AD 182 H2 fitted in place of the previous version in the centre of the instrument panel. The personalized front section is fully integrated with the line of the dashboard;
- six speakers, two of which are located at the sides in the upper part of the dashboard, two positioned as in the previous system in the inner panels of the front doors and, lastly, two located at the sides of the rear parcel shelf;
- aerial located in the front centre section of the roof.
- cable for connection with compact disc player (CD), if fitted;

The AD 182 H2 radio cassette player contains the following functions:

**Radio section**

- PLL tuning with FM/MW/LW frequency bands
- RDS (Radio Data System) with TP (Traffic Program) - EON functions
- Automatic / manual station tuning
- Manual programming of 6 stations on FM1, FM2, FM3 bands and MW and LW bands
- Automatic programming of transmitters through Autostore function at buttons 1,2,3,4,5,6 on FM1, FM2, FM3, MW and LW bands
- DX automatic function (Distant: maximum sensitivity in searching for radio stations)
- Automatic programming (Autostore)

**Audiocassette function**

- Autoreverse
- Tape fast forward or rewind
- Music Search System function (automatic search for previous / next track)
- DOLBY B (noise reduction circuit) (*)

**Compact Disc section** (if a CD player is fitted)

- Disc selection (Disc No.)
- Track selection (forwards / backwards)
- Track scanning (SCAN function)
- Fast forward or rewind (TRACK FAST function)
- Track repetition (TRACK REPEAT)
- Track repetition (REPEAT function)
- Track repetition in random order (TRACK RANDOM function)

**Audio section**

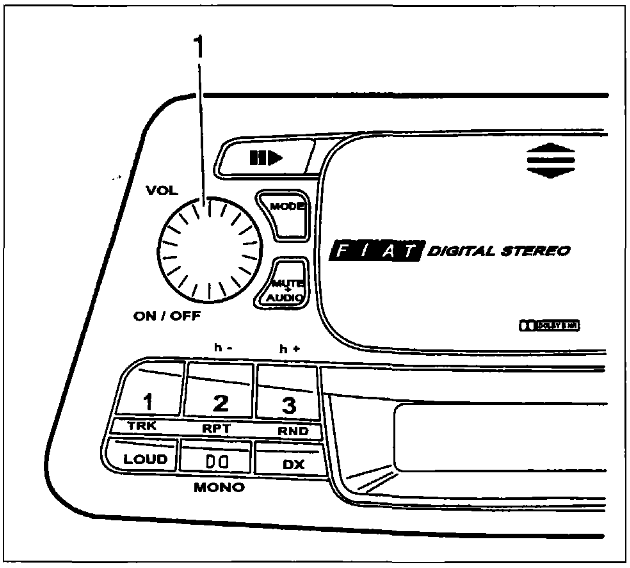
- Loudness Function
- Mute Function
- Pause Function
- Separate adjustment of high / low tones
- Right / left and front / rear channels balance
- Radio on / off logic selection
- TP function volume level pre-setting

**Clock section**

- Adjustment of hours / minutes
- Expert control level section
- Anti-theft protection

*(*) The DOLBY noise reduction circuit is manufacturered, under licence, by Dolby Laboratories Licensing Corporation. DOLBY and the double D symbol are the registered trade marks.*

# 55.

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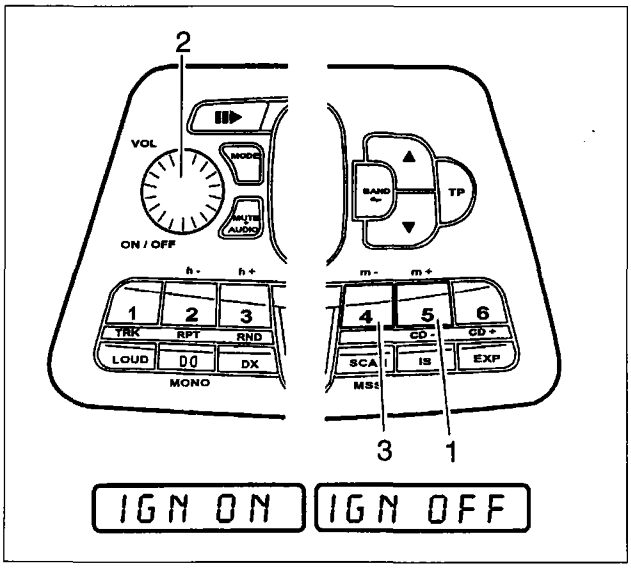


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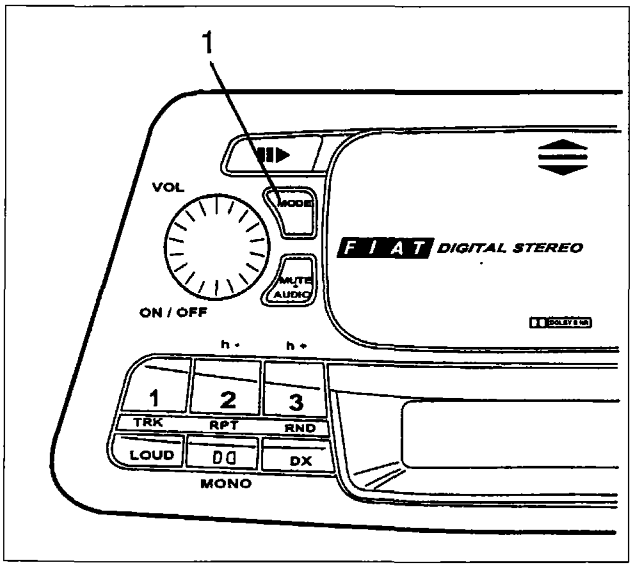



P4A38HL03

**OPERATION**

**Switching on the radio**

Press the VOL control (1) once: the radio should come on. If the radio is on when the engine is switched off, it switches off automatically after about 20 minutes.

**Switching on/off with engine started up-/switched off**

The radio contains a switching on logic which, if activated, allows the radio to be switched on/off at the same time as the engine is started up/switched off.
If the logic is activated: when the engine is started up/switched off, the radio is autoamtically switched on/off;
If the logic is not activated: the switching on/off of the engine takes place independently of the switching on/off of the radio.
To activate this logic, keep the button 5 for selecting stations (1) with the radio switched off pressed until the words "IGN ON" appear on the display, then switch on the radio using the VOL control (2).
**The logic is only activated whenthe radio is switched on via the VOL control.**
To deactivate this logic, keep the button 4 for selecting stations (3) with the radio switched off pressed until the message "IGN OFF" appears on the display.

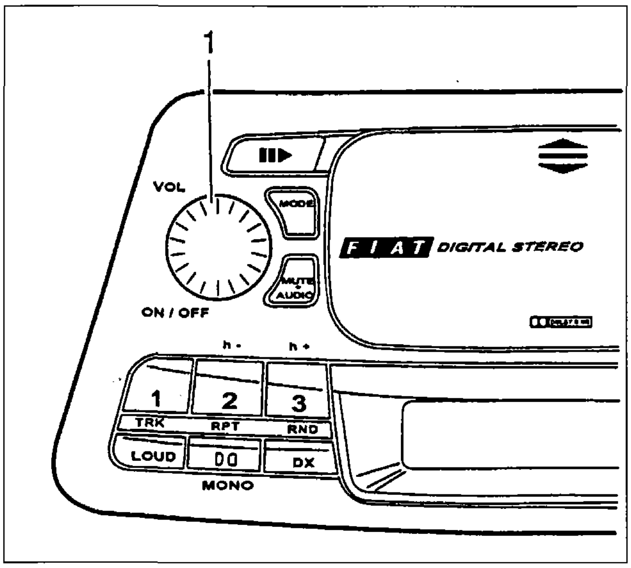
**Selecting radio/audiocassette/Compact Disc functions**

Press the MODE button (1) repeatedly to cyclically select one of the following functions:
- RADIO, the displays will temporarily show the message "RADIO"
- AUDIOCASSETTE (if switched on previously), the display will temporarily show the message "TAPE A" or "TAPE B"
- COMPACT DISC (if a Compact Disc player is fitted), the display will show the message "MCD"

**NOTE** *The functions which cannot be selected are automatically excluded.*



*Print no. 506.670/17*



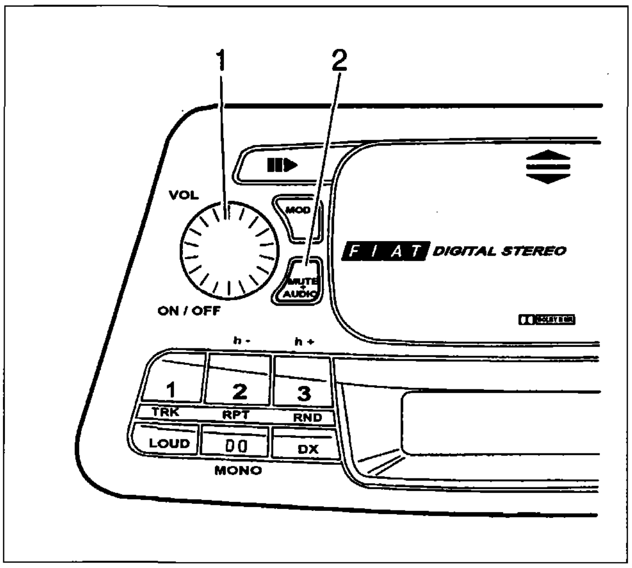

P4A39HL01

### Pause function

If another function (such as for example the radio) is selected whilst listening to an audiocassette or a Compact Disc, the reproduction is halted and on returning to the "Audiocassette" or "Compact Disc" mode it continues from where it left off. If another function is selected whilst listening to the radio, when returning to the "Radio" mode, the last station selected is tuned into.

### Adjusting the VOLUME

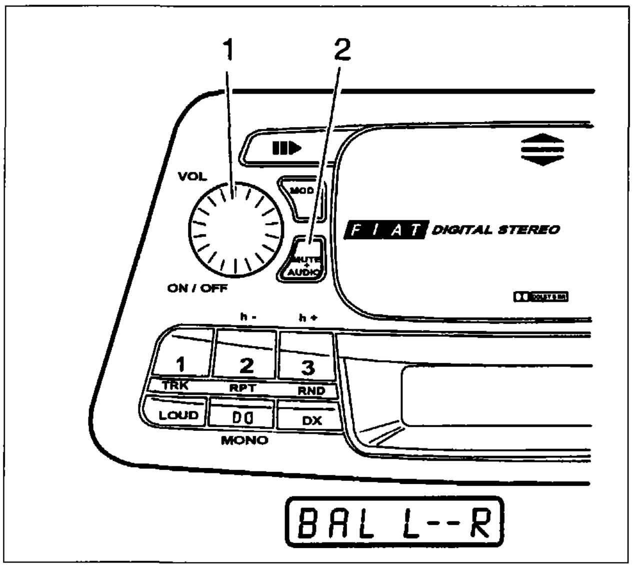
The desired volume is adjusted using the VOL control (1).
The volume level, between "VOL 00" and "VOL 31" is shown on the display during the adjustment.




P4A39HL02

### Adjustment of LOW and HIGH tones (BASS and TREB)

Select the "BASS" or "TREB" function by pressing the AUDIO button (2) briefly once or more.
Having selected the function, adjust the desired sound using the VOL control (1).
To restore the basic adjustment, press the AUDIO button (2) for about 3 seconds until the message "00" or "--" appears on the display.

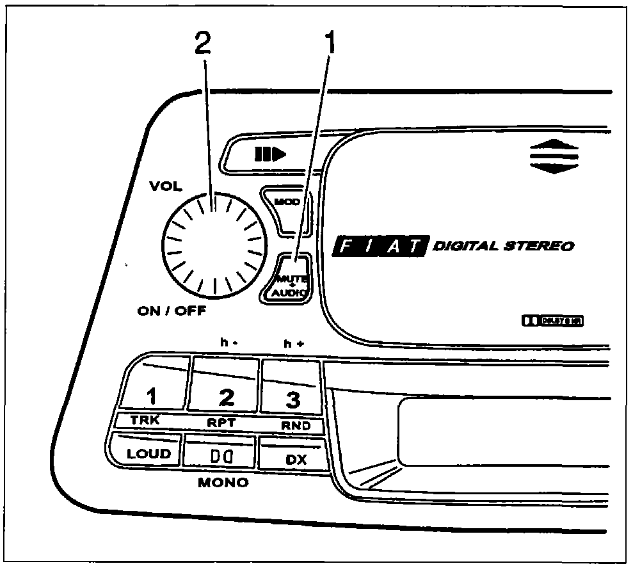



P4A39HL03

### Adjusting the BALANCE between the left and right speakers

The balance is the "volume ratio" between the left and right speakers.
The adjustment is possible by pressing the AUDIO button (2) briefly several times to select the "BALANCE" function. The display will show the message "BAL L- -R". The desired balance can be obtained by regulating the VOL control (1).
The values which can be selected range from 0 to 15.
To restore the basic setting, press the AUDIO button (2) for about 3 seconds until the message "00" or "- -" appears on the display.

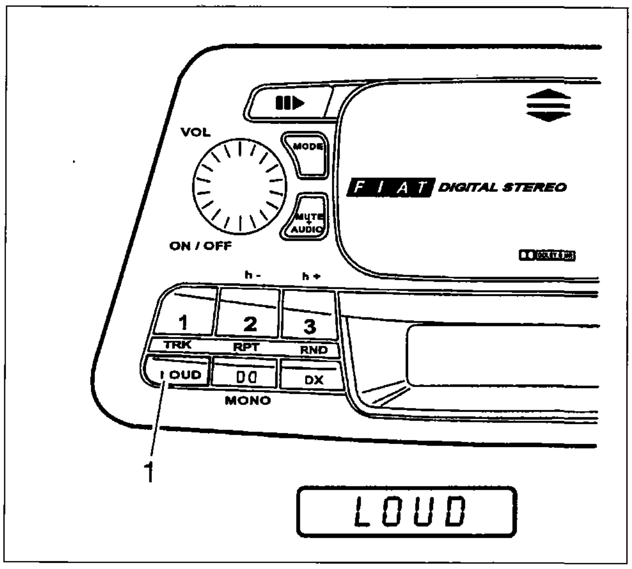
# 55.




P4A40HL01

**Adjustment of balance between front and rear speakers (FADER)**

By selecting the FADER function it is possible to modify the "distribution of the volume" between the front and rear speakers.
The FADER function is selected by pressing the AUDIO button (1) once or more until the message "FAD 0" appears on the display.
The VOL control (2) is used to adjust the intensity of the sound, accentuating the sound coming from the front speakers or from the rear speakers.



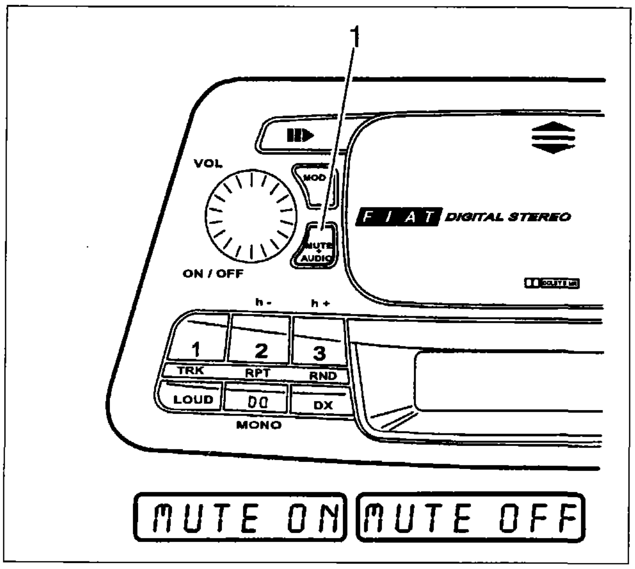

P4A40HL02

**LOUDNESS function**

The LOUDNESS function involves improving the sound with the volume turned down.
By pressing the LOUD button (1) this function is activated and the message "LOUD" appears on the display.
To deactivate the function activated previously, simply press the LOUD button (1) again.

**MUTE function**

By pressing the AUDIO button (1) for about 3 seconds, the MUTE function is selected and the message "MUTE ON" appears on the display (diagram below).
To deactivate this function, the AUDIO button has to be pressed again. The message "MUTE OFF" will appear on the display.
When the Mute function is selected, the radio no longer sends any signals to the speakers.




P4A40HL03

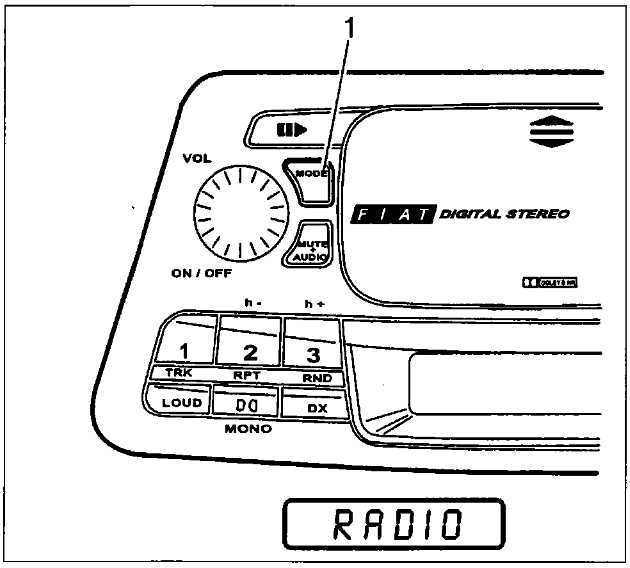
**RADIO function**

*Reception conditions vary constantly whilst driving. Reception can be interefered with by the presence of mountains, buildingsor bridges, especially when the transmitter is far away.*

**NOTE** *When the "RADIO" function is activated, the last station listened to before switching off is received.*



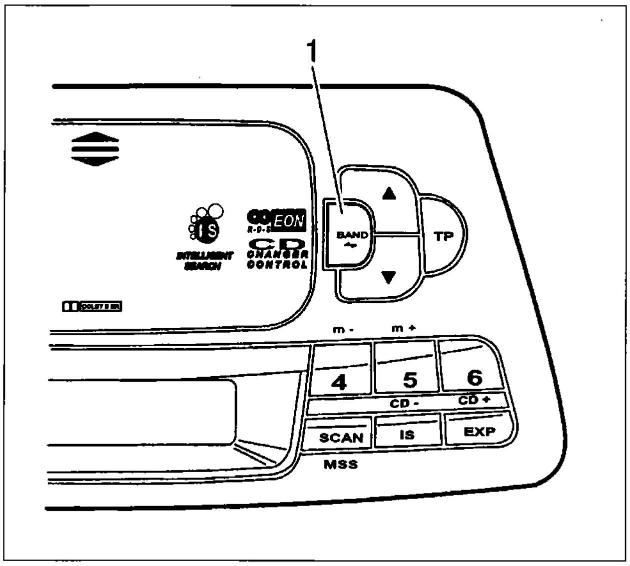
*Print no. 506.670/17*




P4A41HL01

### Selecting a function

As soon as the system is switched on, the radio is played. To select the Radio function whilst listening to a cassette or a Compact Disc, press the MODE button (1) repeatedly until the word "RADIO" appears on the display.




P4A41HL02

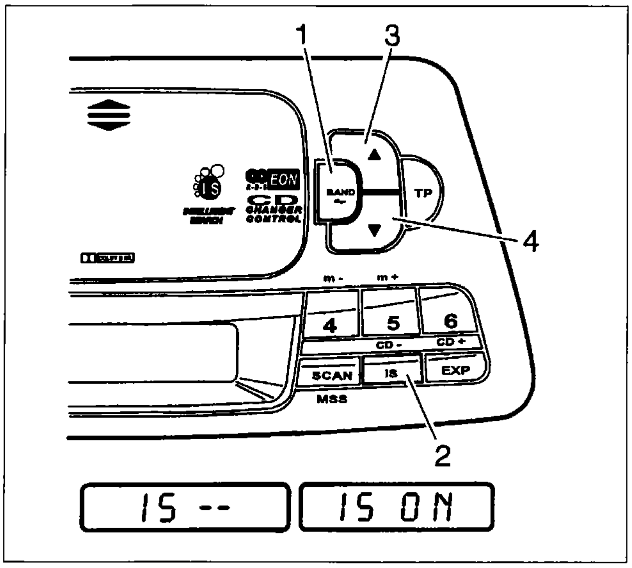
### Selecting a band

By pressing the BAND button (1) briefly several times it is possible to select the available bands. The display shows the message for the band selected. The possible messages are:

- "FM1", "FM2", "FM3" for FM frequency bands
- "MW", medium wave, "LW", long wave, for AM bands.

### Automatic intelligent turning (IS function)

Using the BAND button (1) select the "FM1", "FM2" or "FM3" range.
Press the IS button (2) briefly for the intelligent automatic search.
At the end of the search the RDS programmes are memorized first and then the transmitters according to their transmission power in the radio IS memory. The IS memory is capable of storing up to 30 transmitters. If reception is not possible, it remains constantly activated; to interrupt it, press one of the station selection buttons (1,2,3,4,5,6).
To recall the transmitters stored in the IS memory, select the IS operating mode by pressing one of the buttons "▲" "▼" (3,4) for about 3 seconds until the message "IS - -" is shown on the display and then "IS ON".
By pressing one of the "▲" " ▼" buttons briefly it is possible to gradually recall the transmitters memorized.

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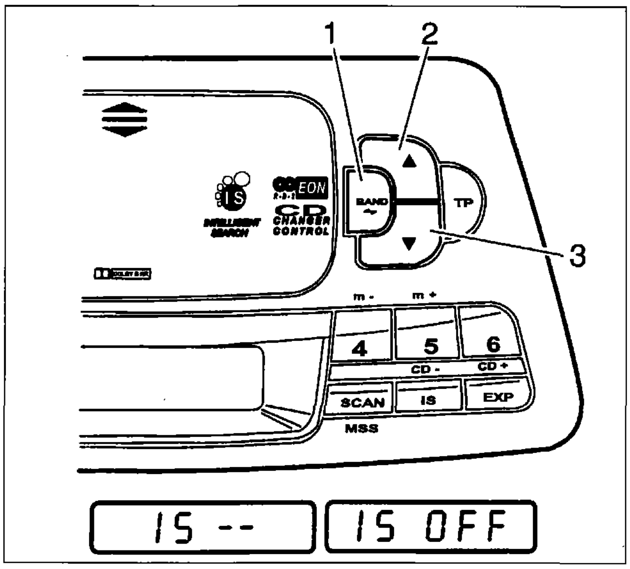
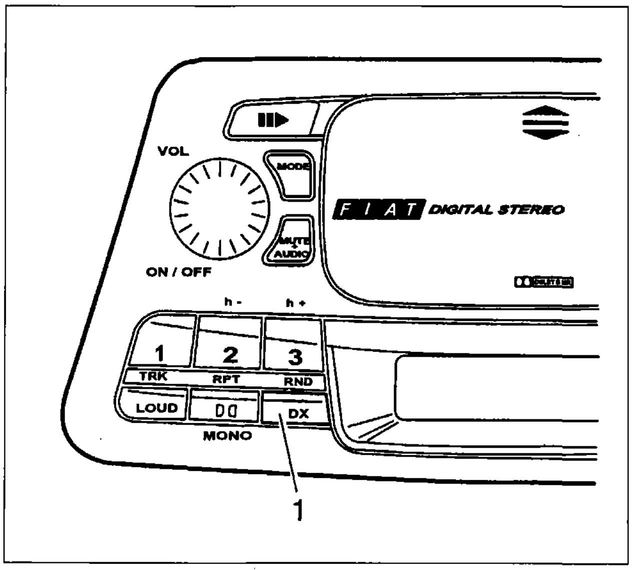



P4A42HL01

### Automatic tuning into RDS transmitters

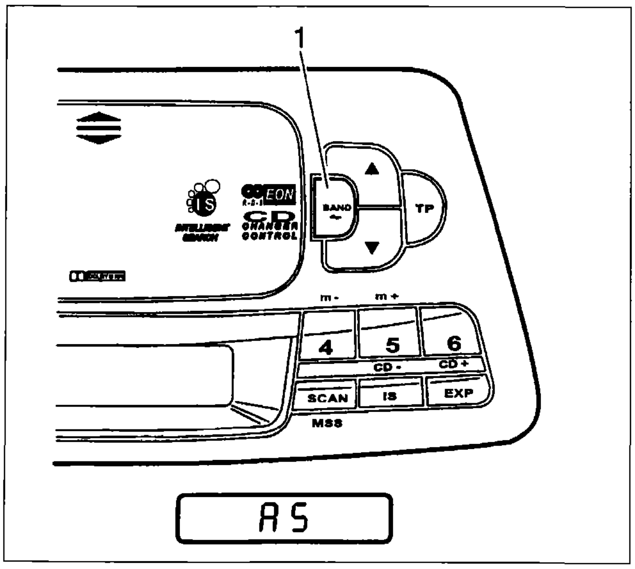
Select the FM or AM frequency desired using the BAND control (1).
The IS function should not be activated for this type of selection. If the IS function is switched on, press one of the "▲" "▼" buttons (2,3) for about 3 seconds until the message "IS - -" and then "IS OFF" appears on the display.
Pressing one of the "▲" "▼" buttons (2,3) briefly starts the automatic search.
When an (RDS) transmitter with an identification code is found, it can be seen on the display.




P4A42HL02

### DX Function

The DX function makes it possible to choose the sensitivity with which to search for radio transmitters. With the DX function activated, the radio only selects stations above a certain power level. With the DX function deactivated, radio stations with lower power levels are also selected. To activate the DX function, press the button (1); the function is then deactivated if the same button is pressed again.




P4A42HL03

### Automatic memorizing of transmitters (AUTOSTORE Function)

Select the frequency desired using the BAND control (1). The message on the display will show the frequency range selected.
Press the BAND control for about 6 seconds. The display will show firstly the message "AS" and then the scanning of the frequencies.
When the scanning of the frequency range is over, the six most powerful transmitters are available with the buttons (1,2,3,4,5,6).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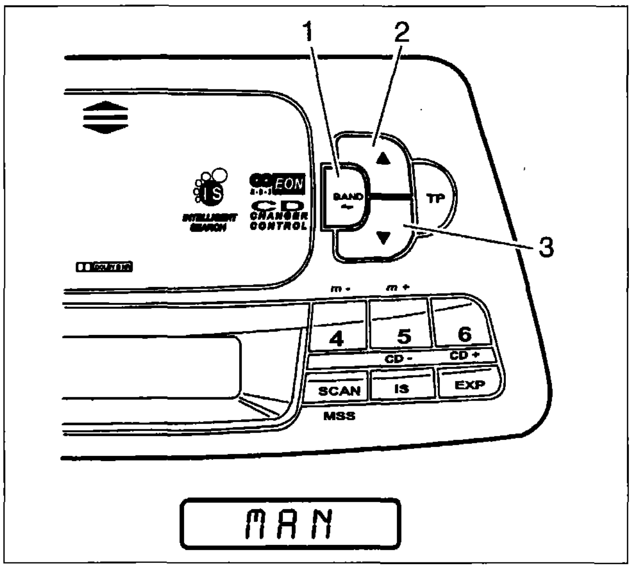
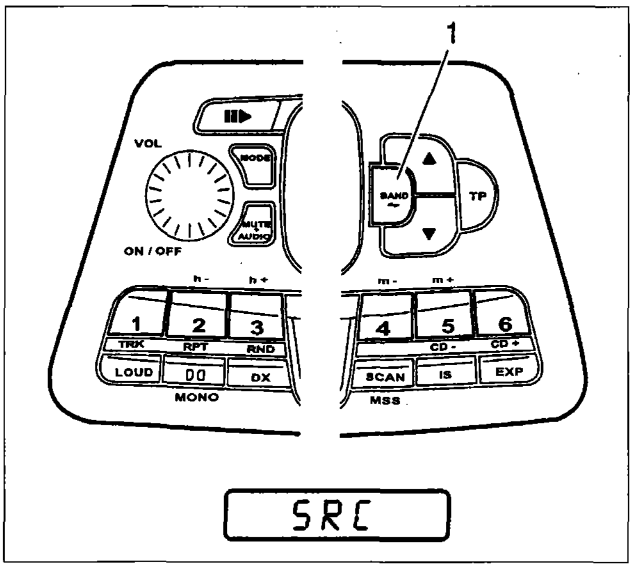



P4A43HL01




P4A43HL02

**Manual programming of a transmitter**

Select the frequency by repeatedly pressing the BAND control (1). The display will show the band selected: "FM1", "FM2", "FM3", "MW" or "LW".
Press one of the buttons "▲" "▼" (2,3) for about 6 seconds until the message "MAN" appears on the display and the radio frequency is tuned in. It is possible to alter the tuning frequency using the "▲" "▼" buttons.
The station being listened to can be memorized in the frequency range selected using the frequency selection buttons (1,2,3,4,5,6). To programme it press the pre-selected frequency selection button until the radio can be heard once again.
The manual tuning can be concluded at any time by pressing one of the frequency selection buttons or if no buttons are pressed for sixty seconds.

**Listening to programmed stations**

Proceed as follows:
1. Select the desired band using the BAND control (1).
2. Briefly press one of the frequency selection buttons (1,2,3,4,5,6).

The display will show the button pressed and the transmitter code if it is an RDS transmitter.
If the transmitter selected offers an RDS service and the reception is not good, the radio will search for an alternative frequency. The display will show "SRC" during the search.

**TP Function (TRAFFIC PROGRAM)**

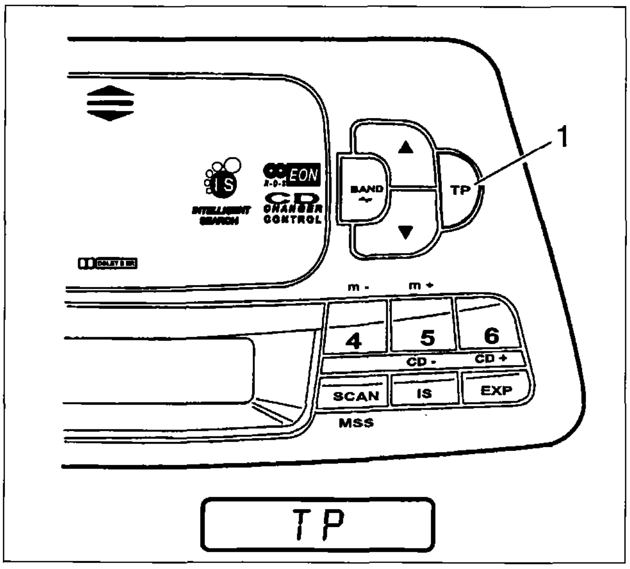
Several stations beloning to RDS1, RDS2 bands also broadcast traffic news. With the TP (Traffic Program) function it is possible to:

a) search for RDS stations only broadcasting traffic news;

b) receive traffic news even if the cassette player or Compact Disc player are working;

c) receive traffic news at a pre-set quiet volume even with radio volume at zero.

# 55.




P4A44HL01

**NOTE** *Below are the instructions for carrying out each of the operations illustrated in points a), b) and c) mentioned previously.*

**Point a)**

To select a transmitter with a traffic news service, press the TP button (1) briefly. The message "TP" will appear on the display.
If the transmitter is not enabled to provide traffic news, the radio will automatically tune into the nearest enabled transmitter and broadcast it.

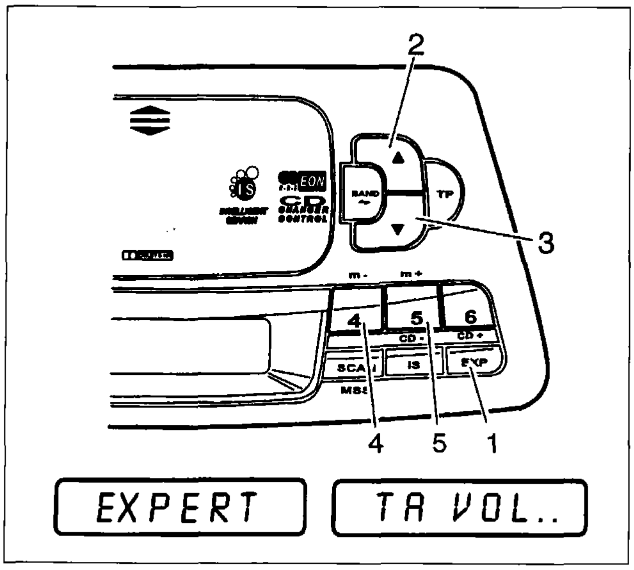
Several transmitters, providing a traffic news service, can be programmed using the station selection buttons. Follow the instructions in the "Tuning into and programming a transmitter" paragraph, pressing the TP button at the beginning to activate the TP function.
As an alternative to the manual programming, it is possible to follow the instructions in the "Automatic transmitter programming (AUTOSTORE)" paragraph, pressing the TP button at the beginning to activate the TP function.

**Point b)**

If you wish to receive traffic news, before inserting the audio cassette or Compact Disc, tune into an RDS TP transmitter. If, whilst listening to a cassette or a Compact Disc, there is a traffic news flash, the reproduction of the tape or the Compact Disc will be temporarily halted and then resumed automatically afterwards.

**Point c)**

It is possible to receive traffic news even when not listening to the radio. After having tuned into an RDS TP transmitter and set the volume level at zero, if this transmitter broadcasts traffic news, it can be heard at a pre-set low volume.




P4A44HL02

*In some countries there are radio stations which, even though the TP function is activated, do not transmit traffic news.*

**Setting TP function volume level (Traffic Program)**

To select the volume for the traffic news, press the EXP button (1) until the message "EXPERT" appears on the display. Then press the "▲" (2), "▼" (3) buttons until the display shows the message "TA VOL..". Using buttons 4 (4) and 5 (5) it is possible to select the desired volume. The volume can vary from 5 to 31.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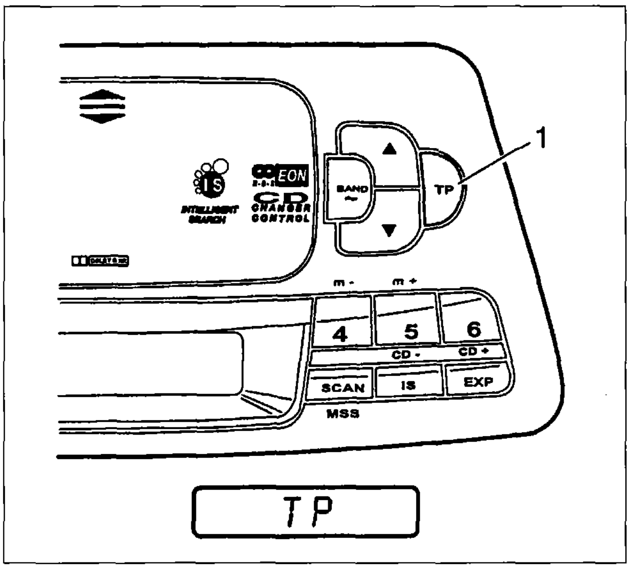
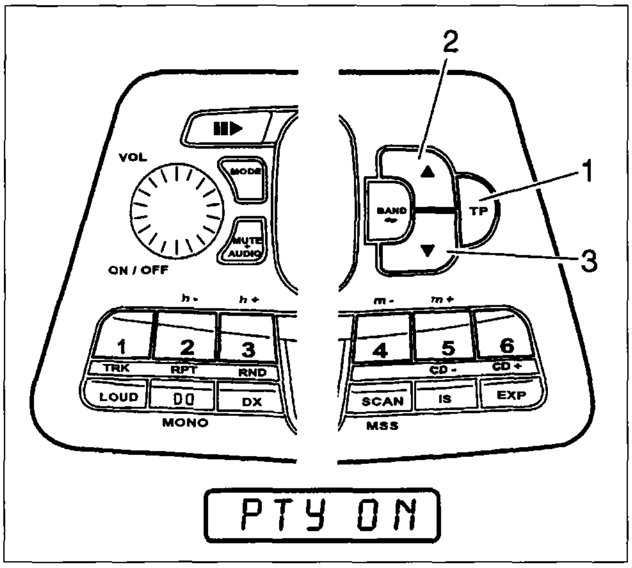



P4A45HL01

### EON Function (ENHANCED OTHER NETWORK)

In some countries there are networks which group together several transmitters enabled to broadcast traffic news.
In these cases listening to an RDS TP station programme will be temporarily interrupted to receive traffic news each time it is transmitted by one of the broadcasters on the same network.
To exclude this function (EON), press the "TP" button (1) briefly; the LED under the button will go out.




P4A45HL02

### PTY Function

Several transmitters offer the "Types of programme" (PTY) service in the FM range. The PTY function can be used to automatically select a transmitter offering a certain type of programme, for example, classical music.

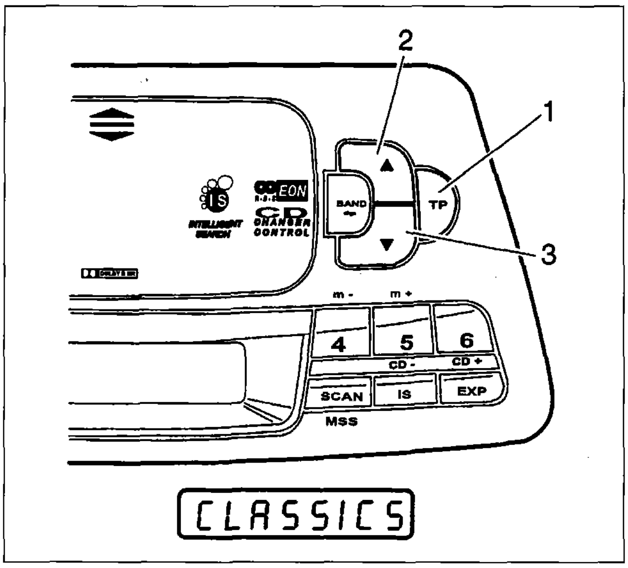
### PTY automatic search

The search can be carried out by allocating 6 types of programmes, selected at will, to the station selection buttons (1,2,3,4,5,6) or by selecting the type of programme from the list memorized and then starting the search.
For further details, refer to the paragraphs below.

### Programming desired types of programmes using the station selection buttons

Press the TP button (1, in the diagram above) for about 6 seconds until the display shows the message "PTY ON". Select the type of programme desired using the "▲" (2), "▼" (3) buttons.
Having identified the type of programme desired, for example, classical music "CLASSICS", press the station selection button (1,2,3,4,5,6) desidered for more than 2 seconds. The type of programme selected will be associated with the button pressed.
Each station selection button makes it possible to listen to a particular type of programme by repeating the procedure described above.
To start the automatic search for a transmitter broadcasing a certain type of programme, press the TP button (1) again for about 6 seconds.
The display will show the message "PTY ON". The press the station selection button for the type of programme desired. The display will show the type of programme selected. The automatic search can be initiated by pressing one of the "▲" (2), "▼"(3) buttons for about 2 seconds. The search is interrupted when a transmitter broadcasting the type of programme desired is found.

# 55.

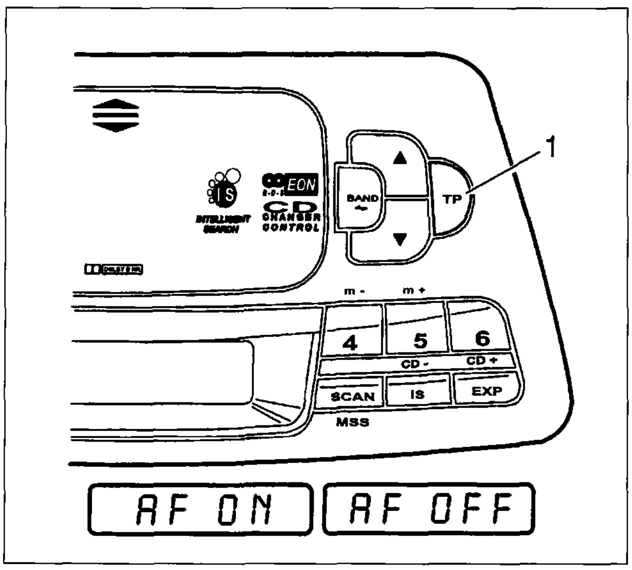



P4A46HL01

### List of types of programme available

The types of programme offered by a radio station can change according to the programme broadcast.

NEWS News and current events
AFFAIRS Politics and current affairs
INFO Special information programmes
SPORT Sport
EDUCATE Education
DRAMA Drama and literature
CULTURE Culture, church and religion
SCIENCE Science
VARIED Variety
POP Pop music (hits)
ROCK M Rock music
EASY M Light music
LIGHT M Light classical music
CLASSICS Classical music
OTHER M Music programmes which cannot be classified (e.g. folk)




P4A46HL02

### Tuning into the type of programme using the list

Activate the PTY function by pressing the TP (1) button for about 6 seconds until the display shows the message "PTY ON".
By repeatedly pressing one of the "▲" "▼" (2,3) buttons, the display will gradually show the types of programme available from the list. Having identified the type of programme desired, press one of the " " " " buttons for about 2 seconds to start the automatic search. The search stops when the radio tunes into a transmitter broadcasting the type of programme selected. The display will show the type of programme, for example "CLASSICS".

WEATHER Weather forecasts
FINANCE Financial news
CHILDREN Childrens broadcasts
SOCIAL A Social information
RELIGION Religion/philosophy broadcasts
PHONE IN Phone ins
TRAVEL Travel information
LEISURE Leisure, hobby and pastimes
JAZZ Jazz music
COUNTRY Country music
NATIONAL National broadcasts
OLDIES Golden Oldies
FOLK M Folk music
DOCU Special services
NO PTY No identification code for the type of programme

### Alternative frequencies (AF)

If an RDS programme is being received, which is broadcast by several transmitters at different frequencies, the radio will automatically switch to the frequency with the best reception.
To activate the AF function, press the TP button (1) until the display shows the message "AF ON".
To deactivate the AF function, press the TP button (1) until the display shows the message "AF OFF".



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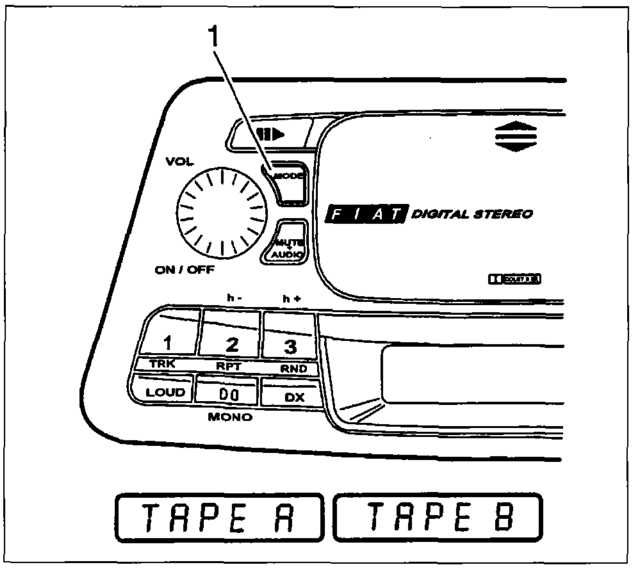
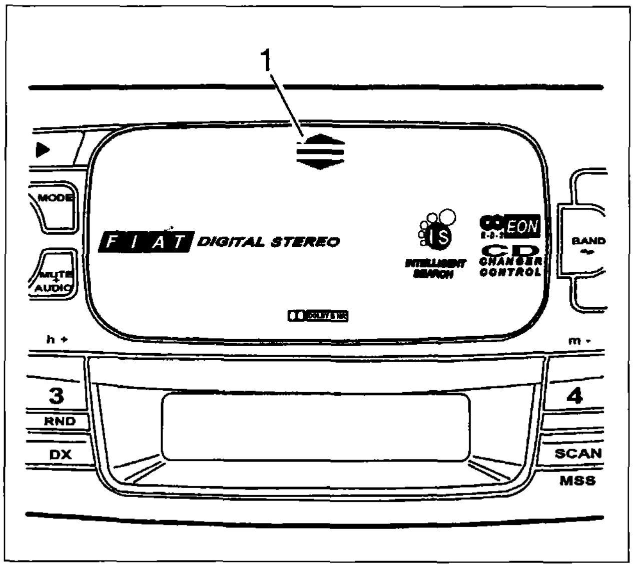



P4A47HL01

## AUDIO CASSETTE PLAYER

### Activating the audio cassette player

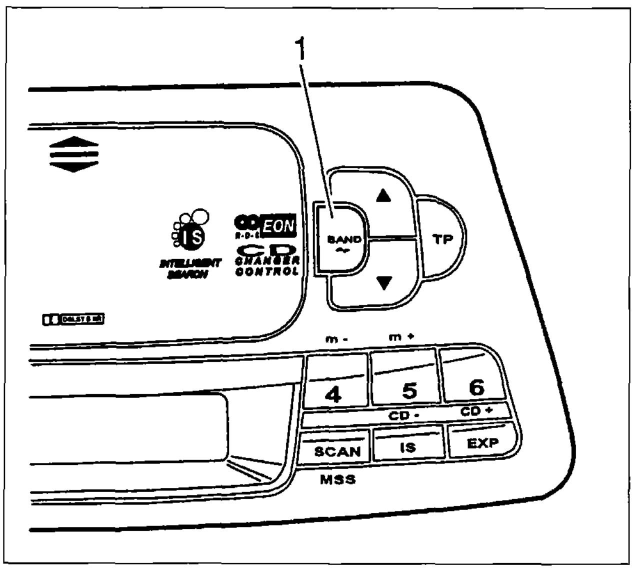
The radio is fitted with an audio cassette player which can be activated by introducing a cassette directly or, when a cassette is already inserted, by repeatedly pressing the MODE button (1) until the display shows the message "TAPE A" or "TAPE B".
Both sides of the tape can be listened to without having to extract it (AUTOREVERSE function).




P4A47HL02

### Inserting an audio cassette

Open the protective flap for the cassette player by pressing the button (1).
Fully insert the audio cassette, by hand, until the radio automatically switches to playing it.
To close the audio cassette housing, press the button (1) vertically, closing the flap until the retaining spring can be heard clicking.

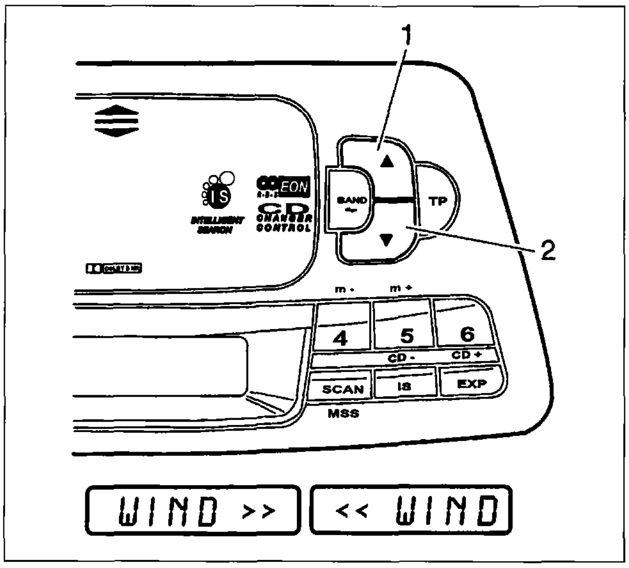



P4A47HL03

### Changing the side of the tape listened to

When the audio cassette housing contains a cassette and message "TAPE A" or "TAPE B" appears on the display, press the BAND (1) control briefly. When the end of the tape is reached the side is automatically switched.
The messages "TAPE A" and "TAPE B" refer to the upper and lower sides of the cassette, respectively.

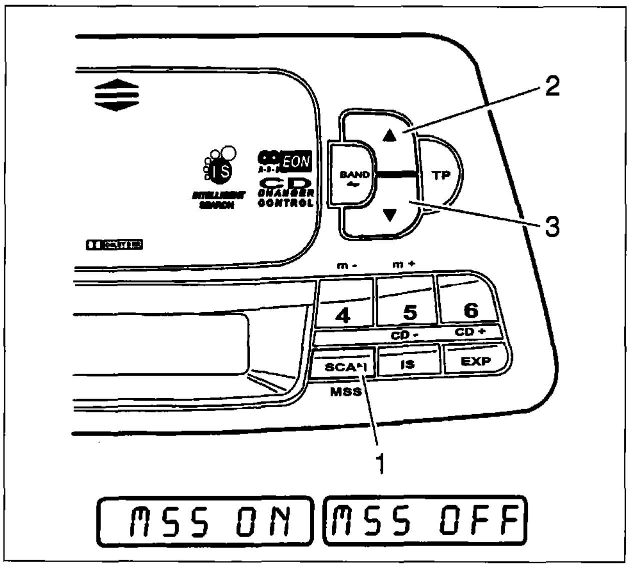
# 55.




P4A48HL01

### Fast forward/rewind

Whilst listening, briefly press the "▲" (1) or "▼" (2) button to fast forward or rewind the tape. During this operation the display will show the message "WIND»" or "«WIND".
To interrupt this function, briefly press the "▲" (1) or "▼" (2) button. Having interrupted the function, the cassette player will automtaically start the reproduction of the cassette.
When the rewinding or forwarding of the tape is complete, the player will be ready for the automatic reproduction of the same side or the other side of the cassette.




P4A48HL02

### Search for previous/next tract (MUSIC SEARCH SYSTEM function)

This makes it possible to skip or repeat one or more music tracks when there are pauses of at least three seconds between them.
To activate this function, press the MSS button (1) during operation of the cassette. The message "MSS ON" will appear on the display.
To move onto the next track, press the "▲" (2) button, whilst to move to the previous track, press the "▼" (3) button.
By pressing the "▲" button or the "▼" button repeatedly, the same number of tracks as the number of times the buttons has been pressed are skipped.
To deactivate the MSS function, press the "MSS" button (1) whilst listening to the cassette. The message "MSS OFF" will appear on the display.

⚠ *The search for previous/next track function may not be correctly activated with the following types of tape:*
- tapes recorded at low levels (for example, weak sound and imperfect recording);
- tapes with conversations;
- tapes with blank sections of tape lasting less than 3 seconds;
- tapes with long periods of silence in the recording;
- tapes which do not have blank sections of tape (for example, live recordings);
- tapes with a lot of background noise in the blank sections.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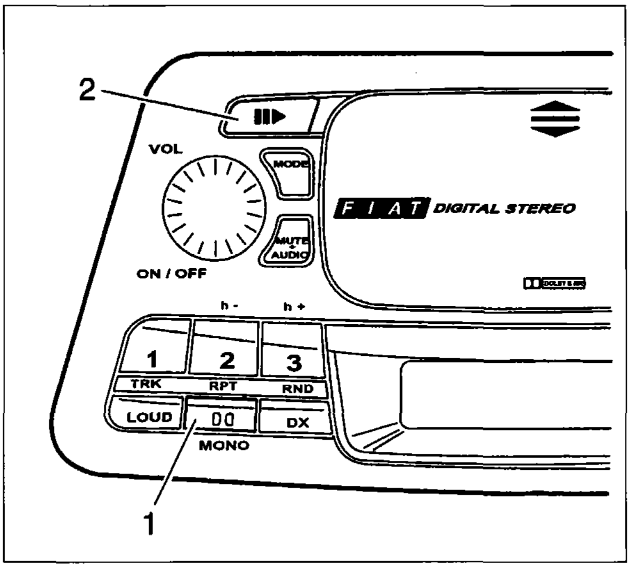


P4A49HL01

### DOLBY B Function

Press the button (1) to activate / deactivate the Dolby B function (noise limited device produced under licence by the "Dolby Laboratories Licensing Corporation") (*).

When the Dolby function is activated the symbol appears on the display.

*(*) Dolby and the (double D symbol) are the registered trade marks of the above company.*

### Audio cassette ejection

To eject the cassette from the housing, slide the control (2) to the right until the exit.

- After ejection, the word "TAPE" appears on the display and the radio operates, tuned into the last station listened to.

*The audio cassette cannot be ejected with the radio switched off.*

### Temporary halt whilst listening to a cassette

It is possible to temporarily stop listening to a cassette by pressing the MODE button; listening to a cassette can be resumed by pressing it again.

*Never expose audio cassettes to heat or direct sunlight, always store them in their container after use.*
*It is advisable to use good quality tapes not longer than C-90 in order to ensure optimum reproduction.*
*Impurities on the head caused by tapes can, in time, cause a deterioration in the high tones during reproduction, therefore it is advisable to clean the head periodically using a special, non abrasive, cleaner.*

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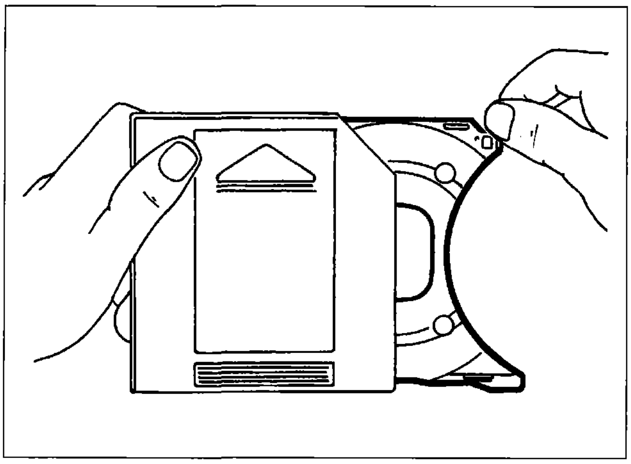
## COMPACT DISC PLAYER FUNCTION

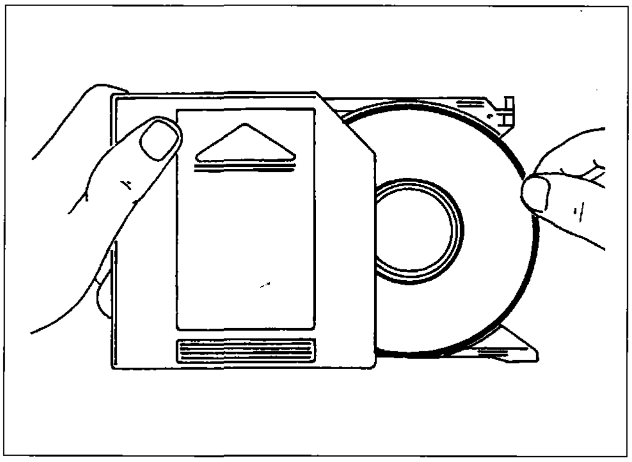
Vehicles equipped with AD 182 H2 radios, have the preparation for the installation of a Compact Disc (CD) player, which consists of a multi-polar cable ending in the luggage compartment on the left side.
A kit is available from Linea Accessori FIAT which includes a Compact Disc player, an additional multi--polar connecting cable and a mounting bracket.
The player is supplied with a special loader which can hold up to 6 Compact Discs.



P4A50HL01

### Filling the Compact Disc loader

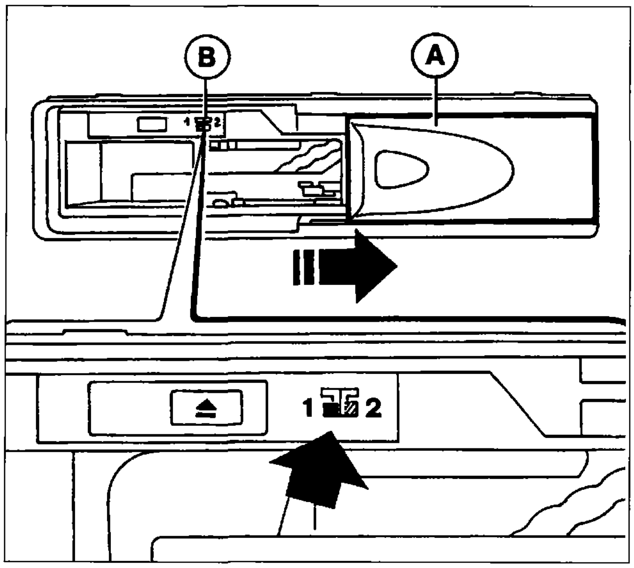
- Extract a support for each Compact Disc that you wish to play;



P4A50HL02

- insert the Compact Disc with the label or the printed section facing the support.

*If the Compact Disc has been positioned incorrectly, it cannot be played.*




P4A50HL03

### Inserting the loader in the Compact Disc player

**NOTE** *The player cannot play 8 cm Compact Discs (unless a special adaptor, available from HI-FI shops, is fitted).*

To insert the loader in the Compact Disc player, proceed as described below:

- slide the flap A towards the right, as illustrated in the diagram, until it is not locked;
- check that the switch B is in position "1";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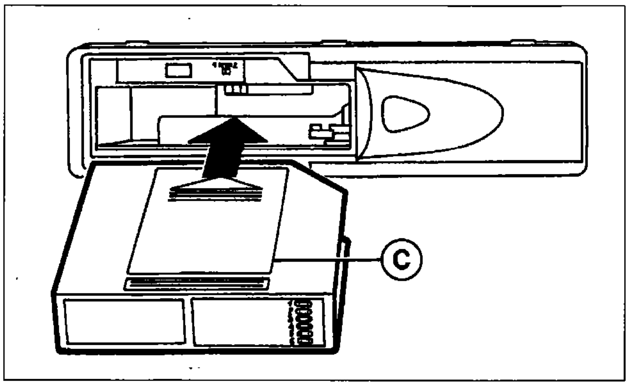
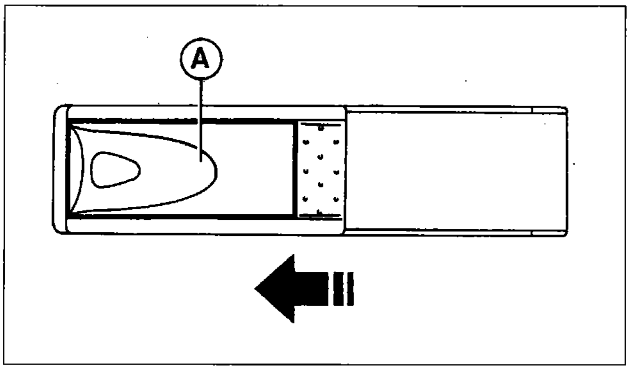


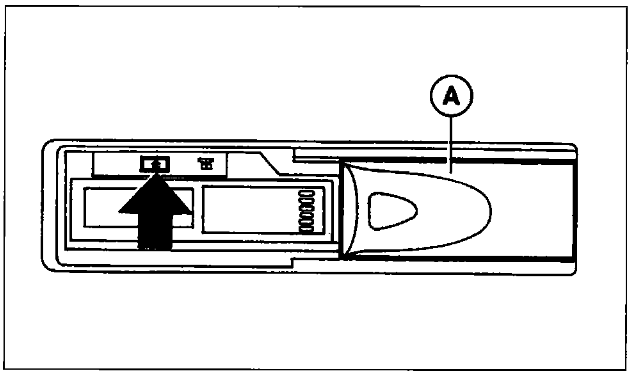

P4A51HL01

- insert the loader C in the Compact Disc player with the side with the label (see arrow) facing upwards;




P4A51HL02

- close the sliding flap A after having inserted the loader to prevent the entry of foreign bodies or dust into the player.



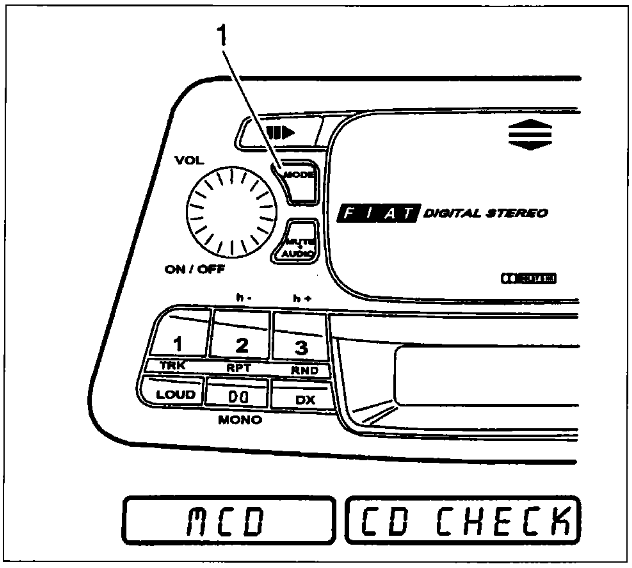

P4A51HL03

### Extracting the loader from the Compact Disc player

Proceed as described below:
- slide the flap A to the right, as illustrated in the diagram, until it is not locked;
- press the eject button, shown by the arrow, on the Compact Disc player.

### Removing Compact Discs from the loader

Remove the discs and supports from the loader, in order.




P4A51HL04

### Compact Disc reproduction

To play Compact Discs (CD) already inserted previously in the player, press the "MODE" button (1) repeatedly until "MCD" appears on the display.
If this function is selected, after each insertion in the loader, the words "CD CHECK" appear on the display, whilst the connections and the contents of the loader are examined.
Whilst listening the following appear on the display: "CD", the number of the track (for example "T03" = third track), the time of reproduction (e.g. "03:14" = 3 minutes and 14 seconds) and the number of the CD (for example "4").

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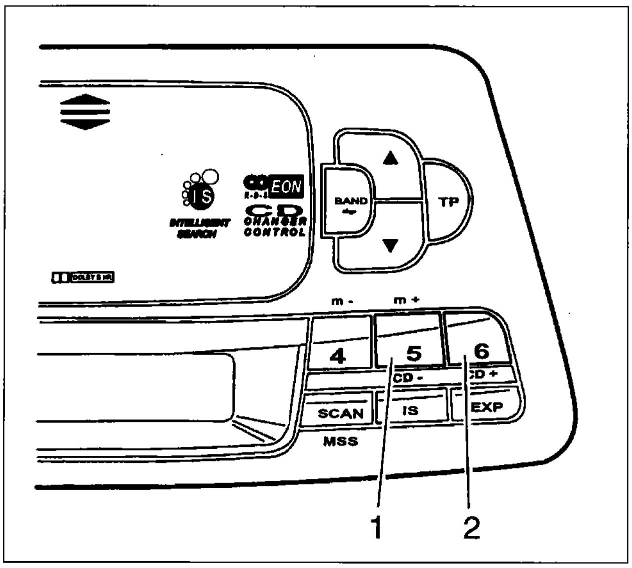
**Possible error messages**

If the loader has not been introduced or has not been inserted correctly in the Compact Disc player, the word "MAGAZINE" will appear on the display.
If the loader does not contain any Compact Discs, the words "NO CD" will appear on the display.
If a Compact Disc is damaged or has been introduced incorrectly into the loader, the word "SURFACE" will appear on the display.
If there is a break in the connection with the Compact Disc player, the words "NO COMMU" will appear on the display.
In the case of a mechanical fault with the CD player, the word "MECHANIC" will appear on the display.
If the Compact Disc player has overheated, the words "TOO HOT" will appear on the display

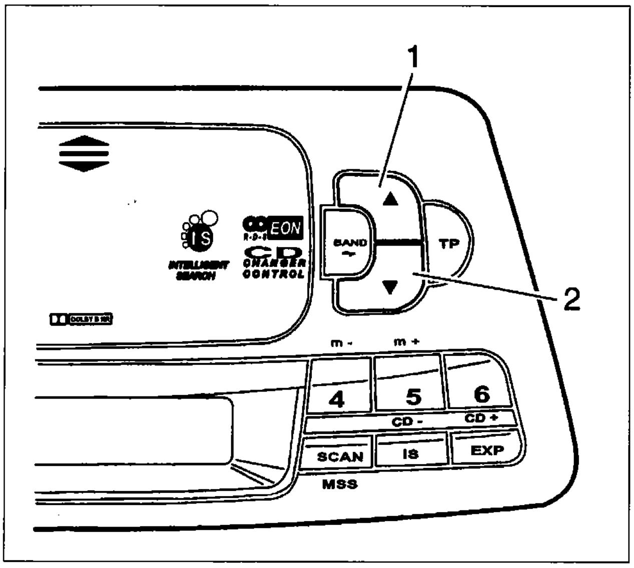
*If the last condition mentioned above occurs, it is advisable to switch off the CD player for a while.*



P4A52HL01

**Disc selection**

Press the station selection button 5 (1) or 6 (2) briefly and repeatedly until the number of the desired CD appears on the display.
Using station selection button 6 it is possible to move on to the next CD, whilst button 5 locates the previous one.



P4A52HL02

**Track search (forwards/backwards)**

Press button "▲" (1) or "▼" (2) repeatedly until the number of the desired track appears on the display.
Button "▲" is used for selecting the next track, whilst button "▼" is used for listening to the same track again or, if pressed repeatedly, for selecting previous tracks.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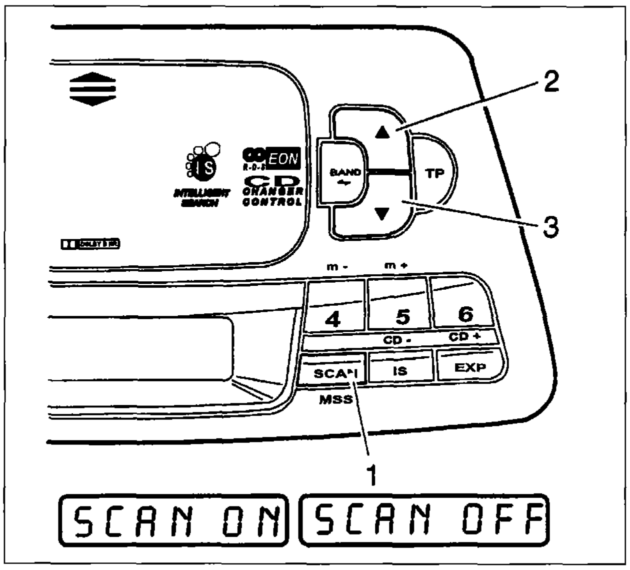


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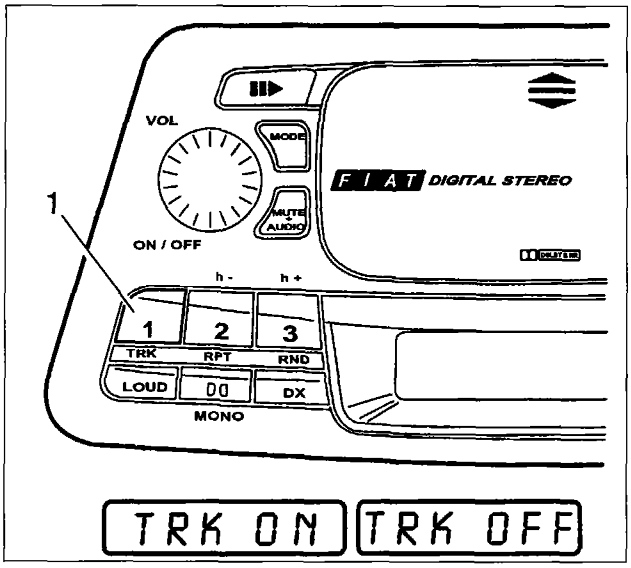


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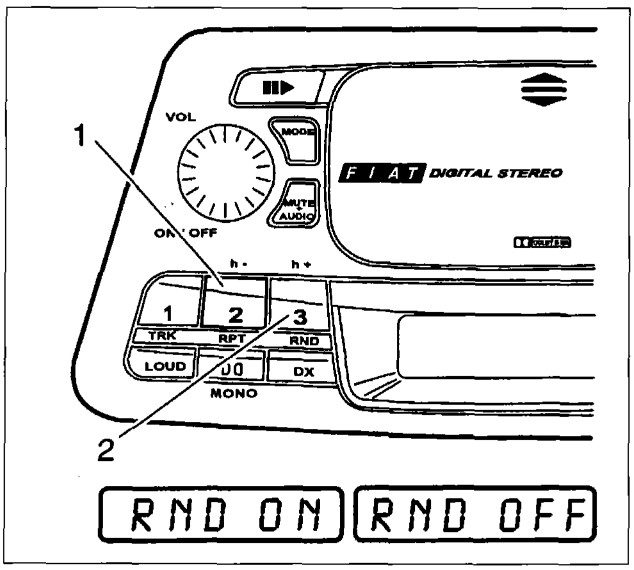



P4A53HL03

**Scanning tracks on CD selected (SCAN function)**

By pressing the SCAN button (1) briefly, the display shows the "SCAN ON" message and the player plays all the tracks on the CD selected for 10 seconds each.
To disable the SCAN function, switched on previously, press the SCAN button (1) briefly. The display shows the message "SCAN OFF".

**Fast forward and rewind (TRACK FAST function)**

To listen during the track fast function at a lower volume, press button "▲" (2) for winding forward or button "▼" (3) for rewinding, and keep it pressed.

**Track repeat (TRACK REPEAT function).**

To repeat the track being listened to, press the station selection button (1). The message "TRK ON" will appear on the display.
By pressing the station selection button 1 (1) again, the TRACK REPEAT function selected previously will be disabled.
The message "TRK OFF" will appear on the display.

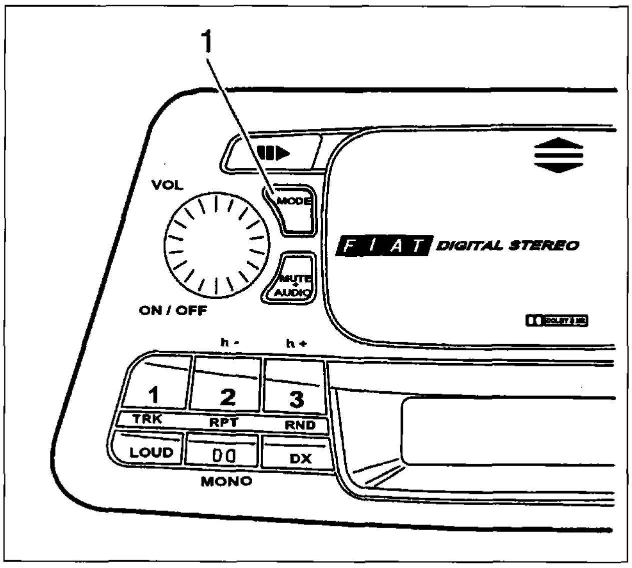
**Repeating tracks from the CD selected (REPEAT function)**

To repeat the CD being listened to, press the station selection button 2 (1). The message "RPT CD" will appear on the display.
To end the repetition of the CD, press the station selection button 2 (1) again. The message "RPT MAG" will appear on the display.
The reproduction of the CD ends when the player plays the last track of the CD.

**Repetition of tracks in a random sequence (TRACK RANDOM function)**

To start the search for the random sequence of tracks, press station selection button 3 (2) briefly. The message "RND ON" will appear on the display.
To end the serach for the random track sequence, press the station selection button 3 (2). The message "RND OFF" will appear on the display.

# 55.

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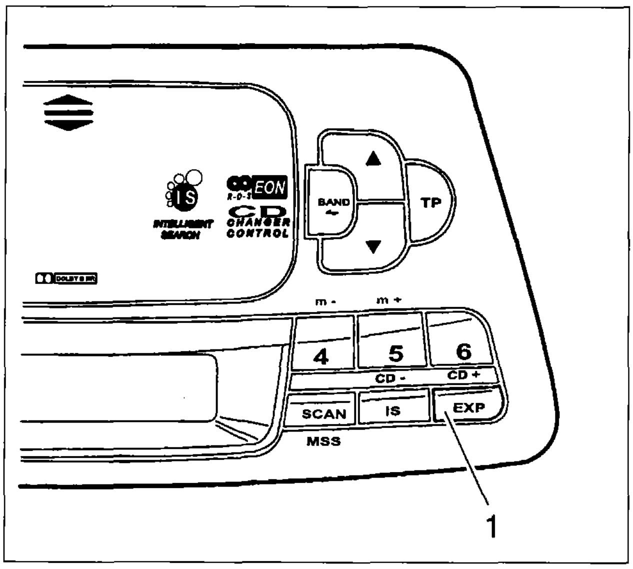


P4A54HL02

Once all the tracks have been played, another Compact Disc is selected and so on. Once all the discs have been played, the random reproduction starts again in the same way.

**NOTE** *If the "CD Repeat" mode has been selected previously, only the random reproduction of all the tracks on the disc selected will take place.*

### End of CD player operation

By pressing the MODE button (1) listening to the CD player and the radio is ended and the RADIO configuration is restored.

### Display of the CD player state

By pressing the EXP button (1) briefly, any special function activated, for example "TRK ON", is displayed.

*Never expose discs to sources of heat or direct sunlight, always place them back in their container after use.*
*Compact Discs should be protected from dust and the surface of the discs should never be fingered or the sound will be adversely affected.*
*If the surface of a disc is dirty, it should be cleaned using a dry cloth, working from the centre outwards. Do not insert damaged or distorted discs in the magazine.*


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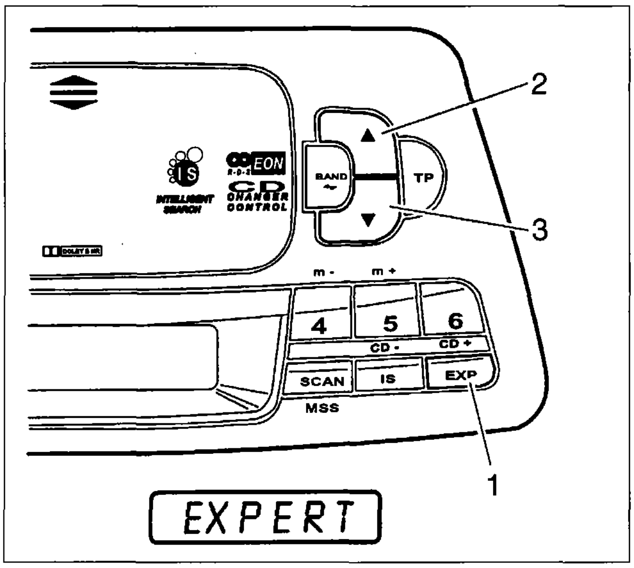
### EXPERT control level

It is possible, using the EXPERT additional level, to carry out various adjustments which may be required only once (for example setting the exact time) or occasional adjustments (for example the minimum volume adjustment for listening to the traffic news).

### List of possible EXPERT adjustments

The following adjustments can be carried out through the EXPERT control level:
1. Setting the time
2. Switching the clock RDS synchronization on/off
3. Minimum volume for traffic news
4. LRN on/off
5. Switching automatic change of regional programme on/off
6. Limiting on volume
7. BDLY delay for switching Booster connected on/off
8. Switching on/off via the vehicle ignition switch
9. Suppressing the audio function during car phone operation
10. Telephone input sensitivity
11. SCV
12. Code adjustment



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### Selecting and modifying adjustments via the EXPERT control level

Premere il tasto EXP (1) fino a quando il display visualizza il messaggio "EXPERT".
Selezionare mediante i tasti "▲" "▼" (2,3) la regolazione che si desidera effettuare.
Premendo i tasti opportuni di selezione delle frequenze, è possibile impostare il livello desiderato.
I tasti di selezione delle frequenze interessati dipendono dalla regolazione che si desidera effettuare.
Per la loro identificazione si rimanda ai paragrafi successivi relativi alle singole regolazioni possibili.
Per concludere la regolazione premere nuovamente il tasto "▲" (2) o "▼" (3) oppure il tasto EXP (1), per circa 3 secondi.

### Setting the TIME

The frequency selection buttons needed for adjusting the time are:
Buttons 2 and 3 for setting the hour
Buttons 4 and 5 for setting the minutes
To start the clock precisely, press the EXP button briefly.

### Synchronizing the clock

The clock can be synchronized with the RDS TIMER signals emmited by the transmitters.
The necessary frequency selection buttons are;
button 5 for activating the synchronization
button 4 for deactivating the synchronization
By pressing frequency selection button 5 the display will show the message "SYNC ON", whilst pressing frequency selection button 4 afterwards, will produce the message "SYNC OFF" on the display.

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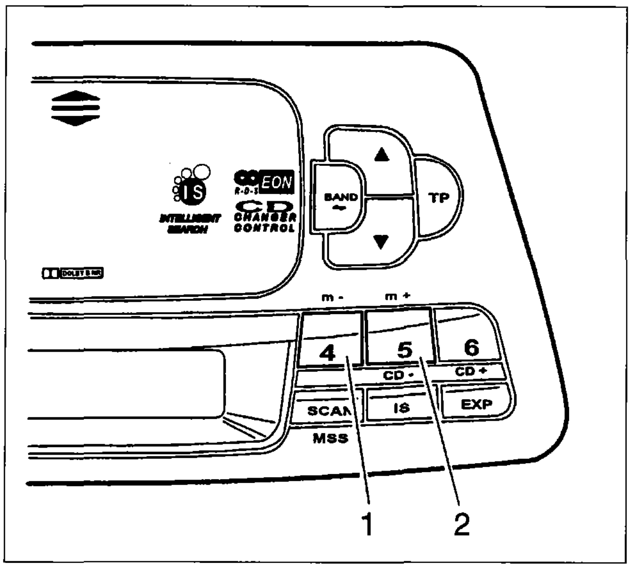


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### Minimum listening volume for traffic news

The desired level can be set using the frequency selection buttons 4 (1) and 5 (2) to increase or decrease the volume, respectively. During the adjustment, the message "TAVOL YY" will appear on the display where YY refers to the level of the volume set.

### Switching LNR function on/off (RADIO function)

This allows the search for RDS transmitters broadcasting traffic news to be switched on or off.
The frequency selection buttons for the switching on and off are buttons 4 (1) and 5 (2), respectively.
The messages "LRN ON" and "LRN OFF", respectively appear on the display when the function is switched on or off (see diagram).

### Automatic programme change (REGIONAL)

When the RDS programme consists of different regional transmissions, the radio may switch between these transmissions, selecting the one with the strongest signal.
The frequency selection buttons needed are button 5 (1) for switching the function on and button 4 (2) for switching it off.
The messages displayed are "RES ON" when the function is switched on and "RES OFF" when the function is switched on (see diagram).

### Limiting the switching on volume

It is possible to select the level of the volume when the radio is switched on using frequency selection buttons 4 (1) and 5 (2), respectively, for increasing or decreasing the volume.
When buttons 4 or 5 are pressed the message "ONVOL xx" appears on the display where the level of the volume set appears in place of xx (see diagram).

### Delay in switching on/off for BOOSTER (BDLY)

To switch the Booster delay on or off, press frequency selection buttons 4 (1) and 5 (2), respectively.
The message on the display will be "BDLY ON" or "BDLY OFF" (see diagram).

### Switching on/off using the vehicle ignition switch

See "Switching on radio" paragraph.


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#### Suppression of audio function during car phone operation

To switch the radio function on or off, when a radio phone system is fitted in the vehicle, press frequency selection buttons 4 and 5, respectively.
The messages "PHONE OFF" and "PHONE ON", respectively, will appear on the display when the function is on or off.
When the function is on and a phonecall is received, the radio will automatically be deactivated and the dialogue will be reproduced via the speakers.

#### Telephone input sensitivity

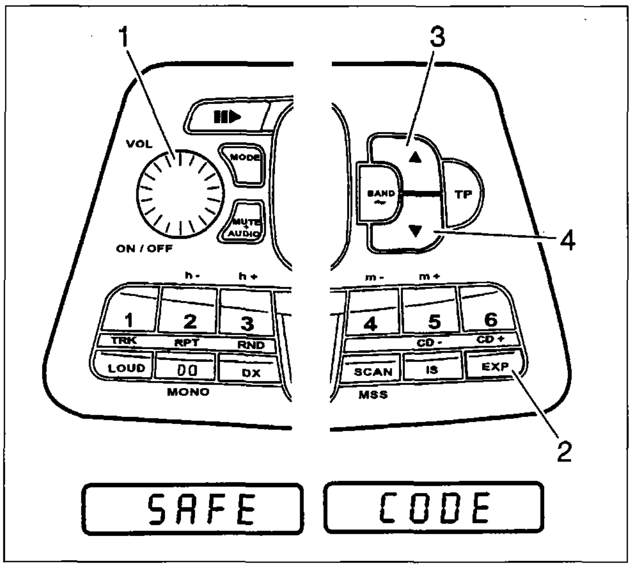
The telephone input sensitivity can be regulated using frequency selection button 4 or 5.
The messages "PHONE 00" or "PHONE 03", respectively will appear on the display for low or high sensitivity.

#### Adjusting the volume according to the speed

For safety reasons, this adjustment should be carried out by suitably trained personnel.

#### Activating the code

See paragraphs dealing with anti-theft protection

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## ANTI-THEFT PROTECTION

The radio is equipped with an anti-theft protection system consisting of a 4 digit secret code.
The protection system makes it impossible to use the radio after it has been extracted from the dashboard if it is stolen.

#### Secret code

The 4 digit secret code is on the "Security Code Card" which is given at the same time as the "Fiat Code Card". The secret code should be kept in a safe place (for example, together with the vehicle documents), **but not in the vehicle.**

#### *Entering the secret code for the first time*

Switch on the radio by pressing the VOL control (1).
Press the EXP button (2) and press the "▲" "▼" (3,4) buttons until the message "SAFE" or "CODE" appears on the display (SAFE if the code is activated, CODE if it is deactivated).
Introduce the code using the frequency selection buttons 2,3,4,5.
If, for example, the code is 1703, press the frequency selection buttons as follows:
- press button 2 once for digit 1, the display will show "1 - - - "
- press button 3 seven times for digit 7, the display will show "17 - - "
- press button 4 once for digit zero, the display will show "170 - "
- press button 5 three times for digit 3, the display will show the entire code.

Having set the code in the display, confirm it by pressing the EXP button (2) until the message "SAFE" appears on the display. The code should be activated.
To switch off the EXPERT function, press the EXP button (2) for about 3 seconds until the message "EXIT" appears on the display.

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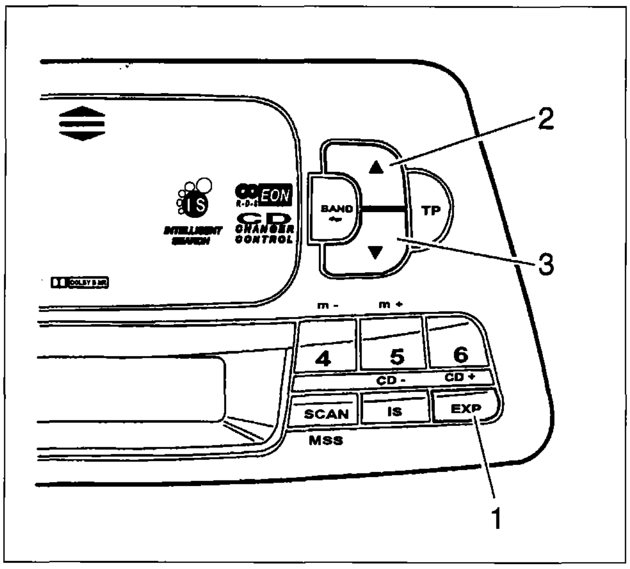


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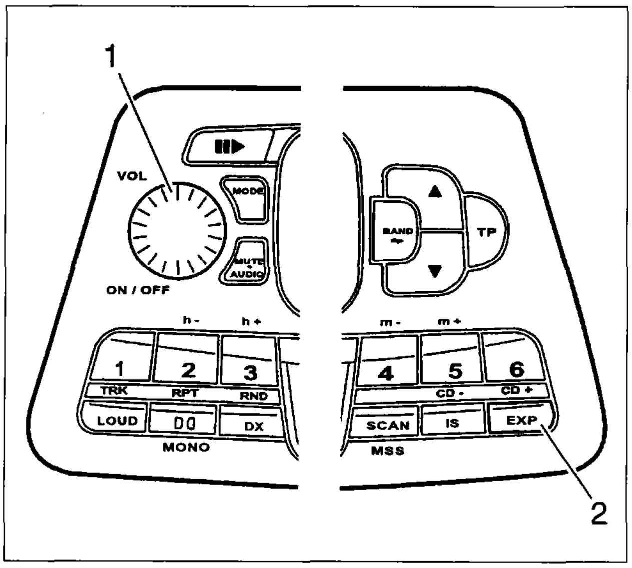


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### Deactivating the code

The code has to be deactivated before removing the radio.
To deactivate the code, proceed as described below:
Press the EXP button (1) and press the "▲" "▼" buttons (2,3) until the message "SAFE" appears on the display.
Briefly press the frequency selection button 2 (4); the message "I - - - -" will appear on the display.
Key in the code following the instructions in the earlier example.
Confirm the code by pressing the EXP button briefly until the message "CODE" appears on the display.
The code is no longer activated.
If an incorrect code has been entered, the message "SAFE" will appear on the display; the entire procedure should be repeated to deactivate the code.

### Restoring the operation of the radio by entering the code

When the radio is disconnected from the positive supply, with the safety code activated, it is electronically protected. In order to be used again, the code must be introduced following the procedure described below:
Switch on the radio using the VOL control (1); the message "SAFE" will appear on the display followed by "I - - - -".
Key in the code following the previous example.
Confirm the code by briefly pressing the EXP button (2).
After around 3 seconds the radio will start to work.

If an incorrect code is introduced, the message"SAFE" will appear on the display again. To enter the correct code, repeat the procedure from the beginning, following the waiting periods.
After each failed attempt the radio logic introduces a waiting period during which the radio does not respond to the commands. These waiting periods are:
1st attempt waiting period 21 seconds
2nd attempt waiting period 1.5 minutes
3rd attempt waiting period 5.5 minutes
4th attempt waiting period 22 minutes
5th attempt waiting period 1.5 hours
6th attempt waiting period 6.0 hours
7th attempt waiting period 24 hours
8th attempt waiting period 24 hours
The radio should not be switched on during the waiting period.



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## TECHNICAL INFORMATION

### Aerial

The vehicle is fitted with an aerial located in the roof.

**Electrically operated aerial and external amplifier (available on request)**

The radio is prepared for an automatic electric aerial (which comes out the moment the radio is switched on and goes back in when it is switched off) and an external amplifier.
The switching voltage for the aerial is at contact 5 (connector "A") of the radio and the switching voltage for the amplifier is at contact 3 (connector "A").
The switching voltage for both outputs is + 12 V with a maximum current of 0.5 A.

### Speakers for radio equipment

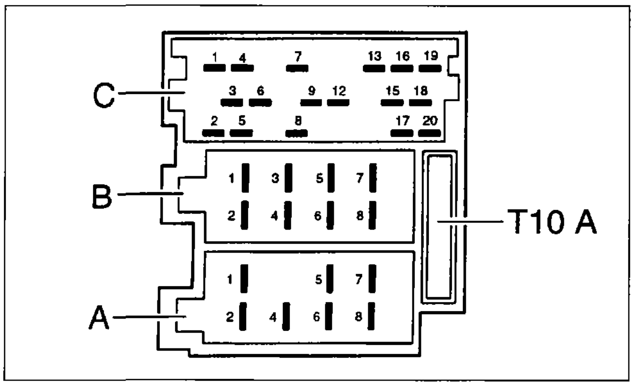
The acoustic equipment consists of:
- 2 elliptical diffusers 130 x 180 mm with a power of 30 W max. each;
- 2 tweeter-dome fluid-iron diffusers with a power of 40 W max. each;
- 2 130 mm diffusers with a power of 30 W max. each.

### Fuses

The radio has a 10 A protective fuse.

### Connections

This paragraph describes the connector at the rear of the radio.



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### Supply voltages

**Contacts at blade A:**
**A8 Connection for earth**
Connect to terminal 31 (earth) of the vehicle.

**A7 Connection for 12 V supply voltage**
Connect to terminal 30 (continuous positive) of the vehicle.

**A6 Connection for instrument lights**
Contact not connected: no lights with radio switched off if the instrument lights are switched on.

**A5 12 V switching voltage output (max 0.5 A)**
Present at the contact at blades A5 when the radio is on.
For automatic aerial (extension/retraction), aerial amplifier (supply voltage) etc.

**A4 Connection for ignition voltage of +12 V**
Connect to terminal 15 of the vehicle, if the radio is going to be switched on and off by the ignition.
Connection A4 may also not be wired. In this case, the radio should come on and off via the **VOL control.**
With the engine switched off the equipment switches off after about 20 minutes

**A2 Phone-Mute connection for car phone or receiver/transmitter**
The radio audio function is deactivated during the operation of the car phone or receiver/transmitter.
The message "PHONE" appears on the display.
Contact A2 should be earthed from the telephone/receiver-transmitter mute outlet

**A1 SCV (+) connection "for adjusting volume according to the speed.**

**Speakers**

**Blade contacts B**
Maximum power at speakers 4 : 4 x 20 W.

Front speaker:
B3 right +
B4 right -
B5 left +
B6 left -

Rear speaker:
B1 right +
B2 right -
B7 left +
B8 left -

⚠ *The connections for the speakers should not be electrically connected to each other and should not be earthed!*

**Additional connections**

**Blade contacts C**

Line output
Possibility of connection for power amplifier (Booster) or activated speaker.
C1 Left rear speaker +
C2 Right rear speaker +
C3 Earth -
C4 Left front speaker -
C5 Right front speaker -
C6 Switching voltage for power amplifier: on/off (max 0.3 A)

Steering remote control:
C8 Earth
C9 Remote control

Telephone input:
Possibility of connection for car phone or receiver-transmitter (listening through radio).
C7 Telephone NF
C12 Telephone earth NF

Disc change connections:+
C13 CD bus control line
C15 CD bus earth
C16 Supply voltage of +12 V for disc changer
C17 Switching voltage for disc changer
C18 CD earth NF
C19 CD NF on the left
C20 CD NF on the right


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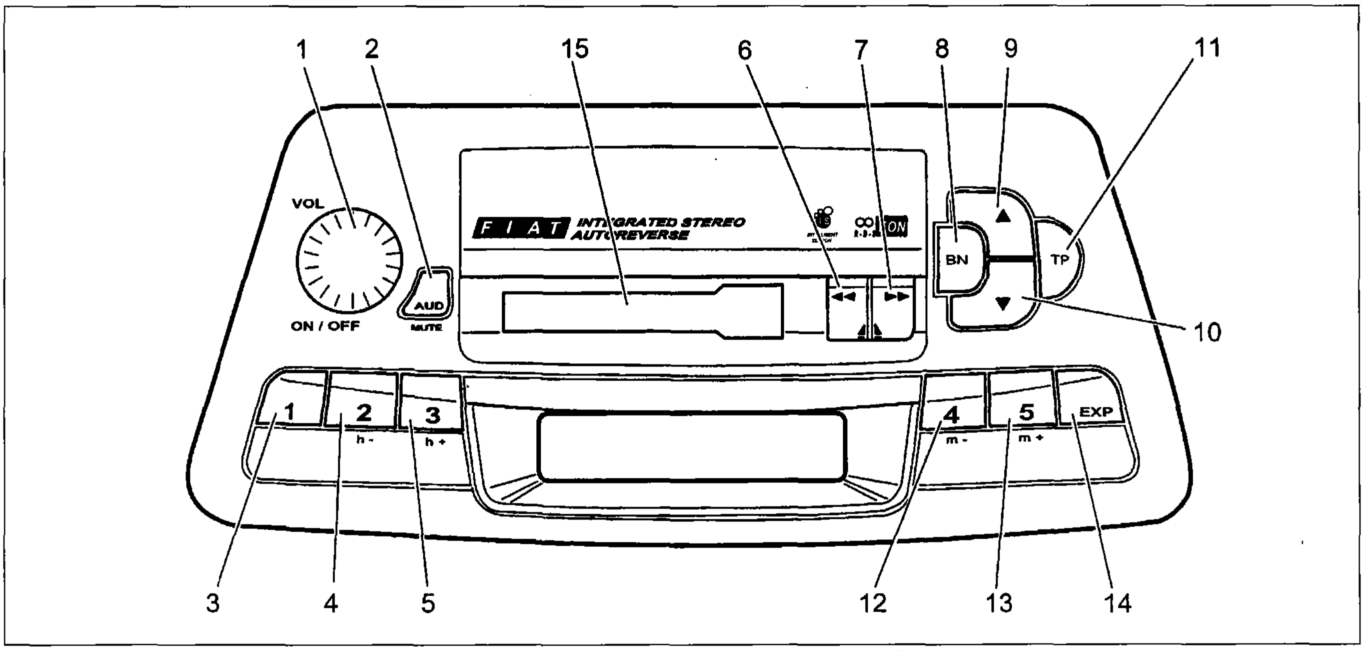
## RADIO CASSETTE PLAYER AD 182 M

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1. VOL control: radio on/off, level adjustment Bass, Treble, Balance, Fader.
2. AUD-MUTE button: function selection Bass, Treble, Balance, Fader, MUTE activation.
3. N1 station programming button.
4. N2 station programming button, for setting the time.
5. N3 station programming button, for setting the hour.
6. Audio cassette fast rewind button.
7. Audio cassettet fast forward button.
8. BN button: for selecting FM1, FM2, FM3, MW, LW frequencies; for starting IS automatic search, for selecting AUTOSTORE function.

9-10. For recalling IS memory, for RDS transmitters automatic search, for manual tuning into transmitters, for setting the type of programme, for selecting the type of adjustment from the EXPERT menu.

11. TP button: for selecting the TP function, for selecting AF alternative frequencies, for acting the PTY function.
12. N4 station programming button, for altering EXPERT adjustments.
13. N5 station programming button, for altering EXPERT adjustments.
14. EXP button: for activating EXPERT control level.
15. Audio cassette housing.

## GENERAL DESCRIPTION

The vehicle is available, on request, with a radio system, consisting of the following main components:

- radio cassette player (which cannot be removed) model AD 182 M which is fitted in place of the previous version in the centre of the instrument panel with the personalized front section completely integrated with the line of the dashboard.
- four speakers, two of which are located at the sides in the top part of the instrument panel, with the other two in the same position as on the previous system, in the front doors;
- aerial in the centre front section of the roof.

The AD 182 M radio cassette player features the following functions:

### Radio section

- PLL turning with FM/MW/LW bands
- RDS (Radio Data System) with TP (Traffic Program) - EON functions
- Automatic/manual station tuning
- Manual programming of 5 stations on FM1, FM2, FM3 bands and MW and LW band
- Automatic programming of transmitters via the AUTOSTORE function with buttons 1,2,3,4,5 on the FM1, FM2, FM3, MW and LW bands
- Automatic IS search tuning

### Audio cassettte section

- Autoreverse
- Tape fast forward and rewind

### Audio section

- Loudness function
- Mute function
- Pause function
- Separate low/high tone adjustment
- Right/left and front/rear channel balancing
- Radio on/off logic selection
- Pre-setting of TP function volume level.

### Clock section

- Adjustment of hours/minutes

### EXPERT control level section

- Setting of time
- RDS synchronization of the time
- Traffic news minimum volume
- LRN
- Regional programme automatic change
- LOC function
- MONO function
- LOUDNESS function
- FADER function
- Volume limitation
- BDLY function
- On/off through ignition
- Audio mute during operation of car phone
- Telephone input sensitivity


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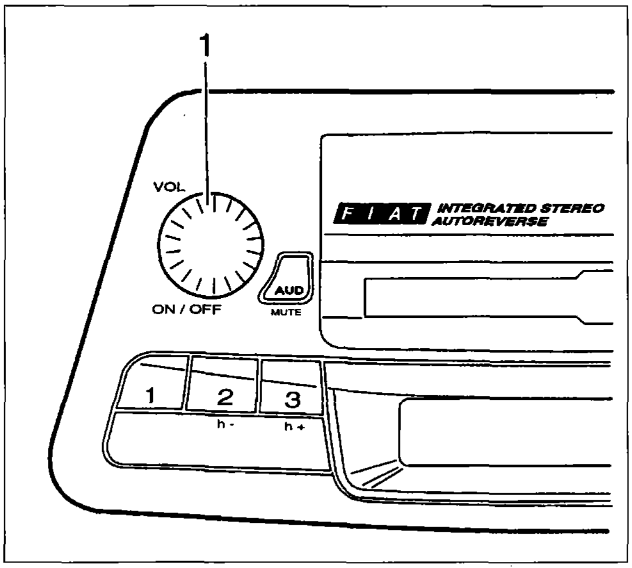


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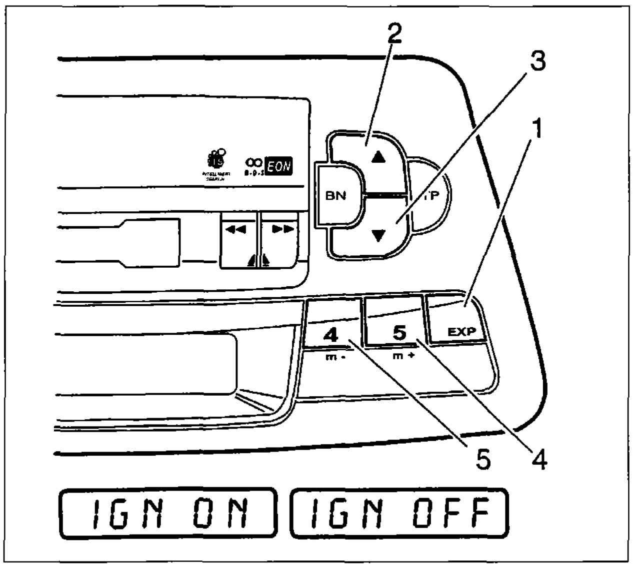
## OPERATION

### Switching on the radio

Press the VOL control (1) once: the radio should come on. If the radio is on when the engine is switched off, it will switch off automatically about 20 minutes later.

### Switching on/off when the engine is switched on/off

The radio possesses a switching on logic which, if activated, allows the radio to be turned on/off at the same time as the engine is started up/switched off.
If the logic is activated: when the engine is started up/switched off, the radio is automatically turned on/off;
If the logic is not activated: the radio will switch on/off irrespective of whether the engine is switched on/off.

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Press the EXP button (1) for about 3 seconds until the message "EXPERT" appears on the display.
Select the on/off adjustment via the ignition switch using the "▲" (2) and "▼" (3) buttons.
Press frequency selection button 5 (4) to activate the function or, if activated previously, press frequency selection button 4 (5) to deactivate it.
The messages "IGN ON" and "IGN OFF", respectively will appear on the display when the function is activated or deactivated.

**NOTE** The procedure described above should be carried out with the ignition switched on.

*If you wish to turn on the radio after it has been switched off using the ignition switch, press the VOL control.*

### Pause function

If the "Radio" function is selected whilst listening to a cassette, the reproduction is interrupted and on returning to the "Audio cassette" mode it is resumed from where it left off. If the "Audio cassette" function is selected whilst listening to the radio, on returning to the "Radio" mode, the last station selected is tuned into.

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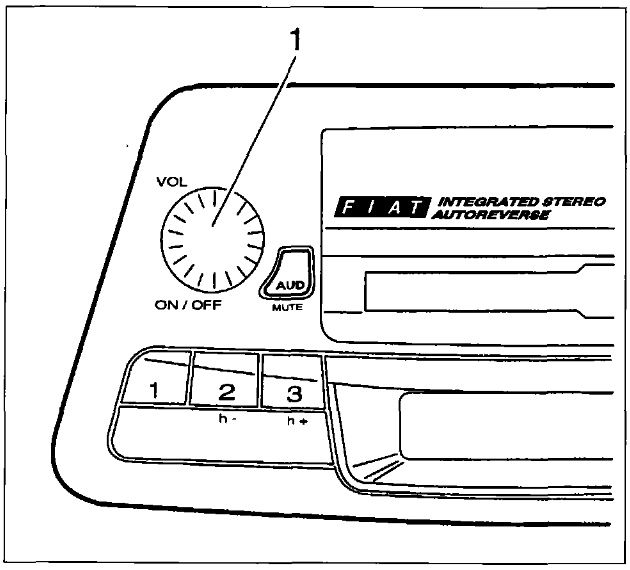


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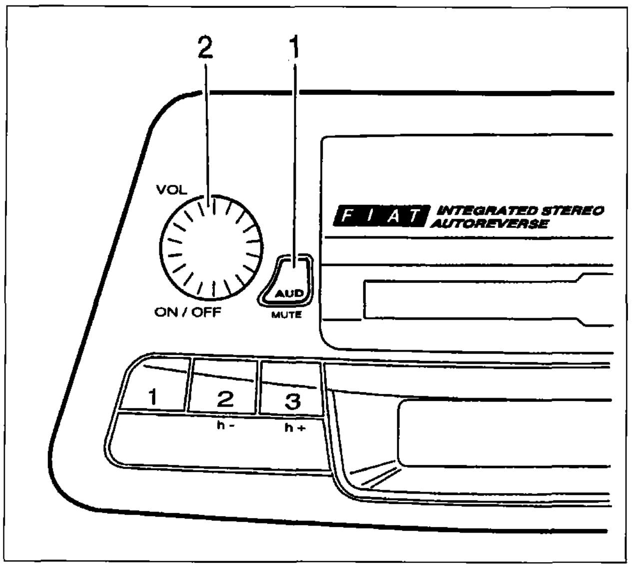
**VOLUME adjustment**

The volume can be adjusted via the VOL control (1).
The volume level, between "VOL 00" and "VOL 31" is displayed during the adjustment.

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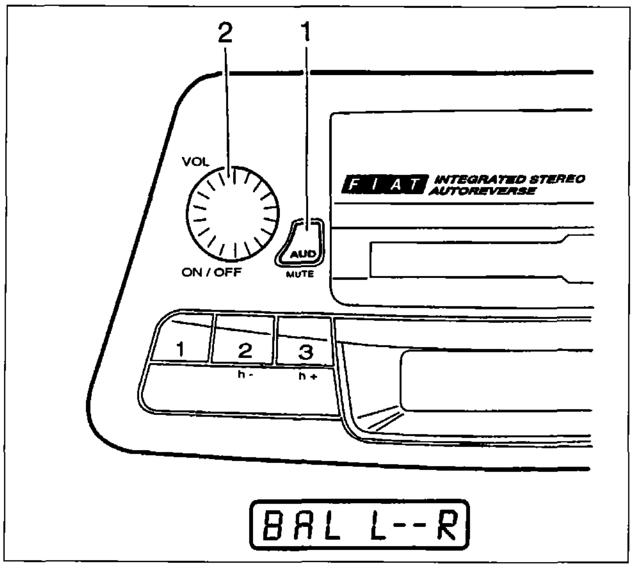
**Adjustment of LOW and HIGH tones (BASS and TREBLE)**

Select the "Bass" or "Treb" function by pressing the AUD button (1) briefly.
Having selected the function, adjust the sound via the VOL control (2).
To restore the basic adjustment, press the AUD button for about 3 seconds until the message "00" or "--" appears on the display.




P4A64HL03

**Adjustment of balance between left and right speakers (BALANCE)**

The balance is the "volume ratio" between the left and right speakers. The adjustment can be made by pressing the AUD button (1) several times briefly to select the "BALANCE" function. The message "BAL L- -R" will appear on the display. The VOL control (2) can be used to adjust the balance levels.
The values which can be selected range from 0 to 15.
To restore the basic adjustment, press the AUDIO button for about 3 seconds until the message "00" or "- -" appears on the display.



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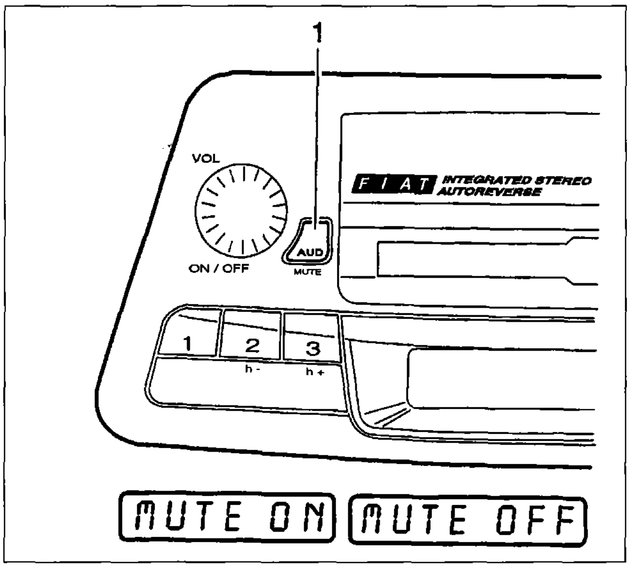
### Adjusting the balance between the front and rear speakers (FADER)

Consult the "EXPERT control level" section and the point dealing with the "FADER function" for the adjustment.

### Loudness function

Consult the "EXPERT control level" section and the point dealing with the"LOUDNESS function" for the adjustment.

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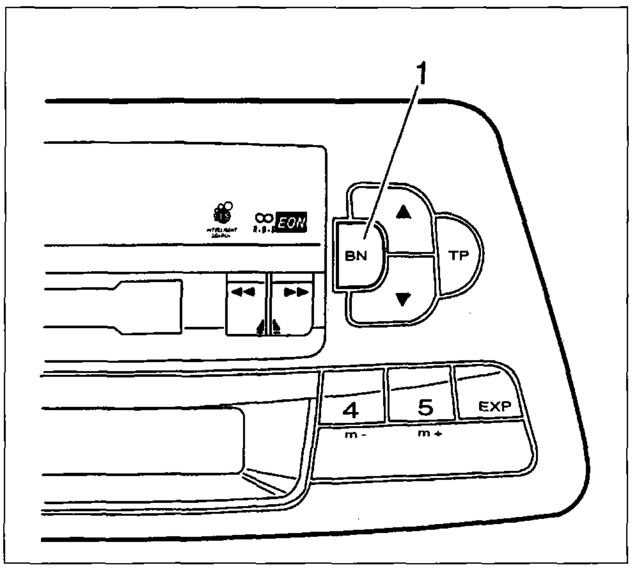
### MUTE function

By pressing the AUD button (1) for about 3 seconds the MUTE function is selected and the message "MUTE ON" appears on the display.
To deactivate this function the AUD button must be pressed again. The message "MUTE OFF" will appear on the display.
When the Mute function is selected, the radio no longer sends any signals to the speakers.

## RADIO FUNCTION

*Reception conditions vary constantly whilst driving. Reception can be interfered with by the presence of mountains, buildings or bridges, especially when the broadcasing transmitter is far away.*

**NOTE** *When the "RADIO" function is activated, the last station listened to before switching off is received.*

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### Function selection

As soon as the radio is switched on, the radio is heard.

### Selecting the band

By pressing the BN button (1) briefly several times it is possible to select the frequency bands available. The message for the range selected will appear on the display. The possible messages are:
"FM1", "FM2", "FM3" for FM frequency ranges
"MW", medium wave, "LW", long wave, for AM ranges

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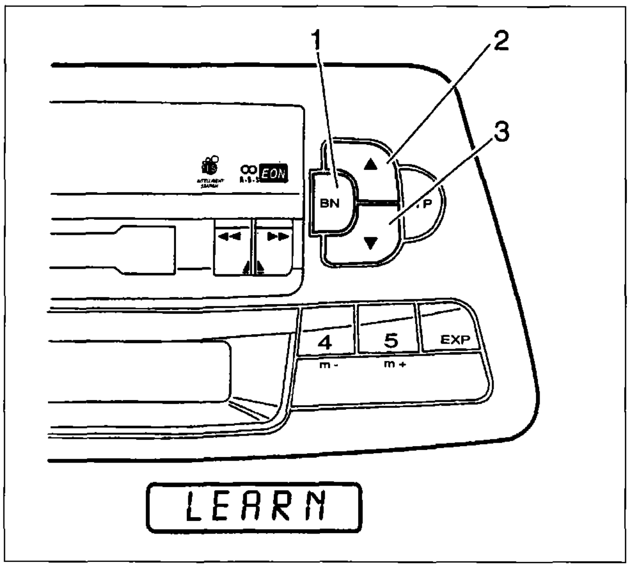


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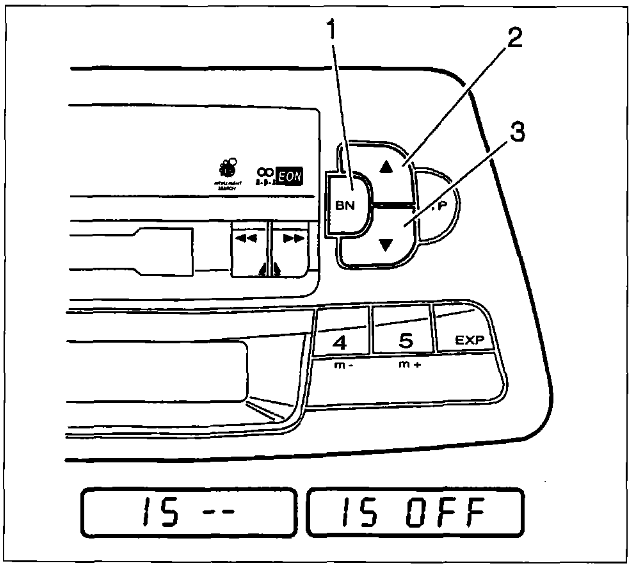
**Automatic intelligent search tuning (IS function)**

Using the BN button (1), select the "FM1", "FM2" or "FM3" band.
Press the BN button (1) for about 3 seconds to activate the saerch; the message "LEARN" will appear on the display.
At the end of the search first the RDS programmes and then the transmitters according to their transmission power in the radio IS memory are programmed. The IS memory can store up to 30 transmitters.
If no reception is possible, the reception does remain continuously activated; to interrupt it, press one of the station selection buttons (1,2,3,4,5,).

To recall transmitters programmed in the IS memory, select the IS operating mode by pressing one of the "▲" "▼" buttons (2,3) for about 3 seconds until the message "IS - -" appears on the display, followed by "IS ON". By pressing one of the "▲" "▼" buttons briefly it is possible to recall the transmitters programmed.
To deactivate the IS function, press one of the "▲" "▼" buttons briefly until the message "IS OFF" appears on the display.

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**RDS transmitters automatic search tuning**

Select the FM or AM frequency desired using the BN button (1).
The IS function should not be activated for this type of selection.
If the IS function is switched on, press either button "▲" (2) or "▼" (3) for about 3 seconds until the message "IS - -" appears on the display followed by "IS OFF".
Pressing one of the buttons "▲" (2) or "▼" (3) briefly starts the automatic search. When a transmitter with an identification code is found (RDS transmitter) it is shown on the display. If the transmitter is going to be programmed in a selector button (1,2,3,4,5), press the pre-selected button for about 2 seconds. The radio audio function will be interrupted until the programming has been completed.


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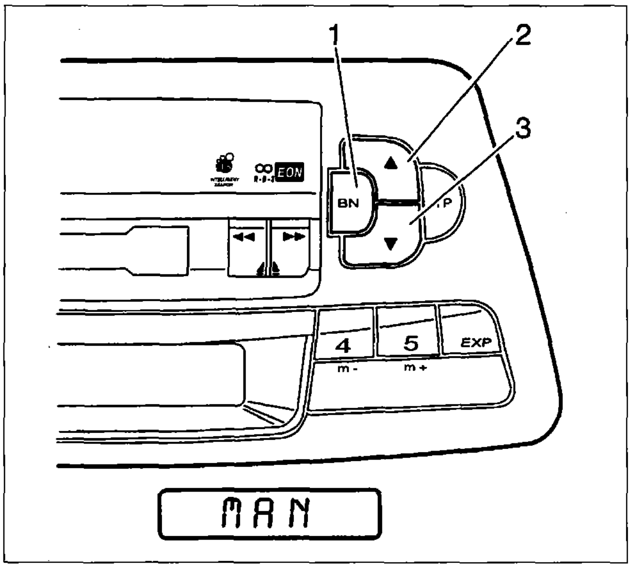
### Manual transmitter tuning and programming

Select the frequency range by pressing the BAND (1) button repeatedly. The message on the display will depend on the band selected "FM1", "FM2", "FM3", "MW" or "LW".

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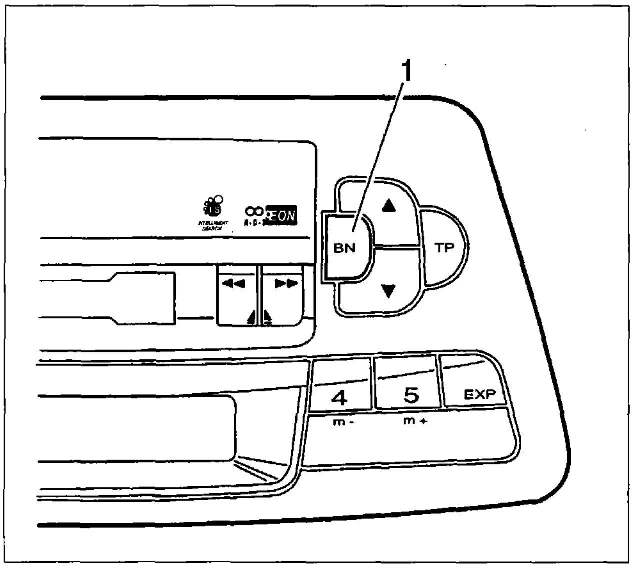
Having selected the band, press one of the "▲" "▼" buttons (2,3) for about 6 seconds until the message "MAN" and the frequency tuned into appears on the display. Using the "▲" "▼" buttons it is now possible to alter the tuning frequency in 50 Hz steps for FM ranges and 1khz for AM frequencies.
The station being listened to can be programmed in the frequency range selected using the frequency selection buttons. At the end of the programming, press the selection button for the frequency until the sound can be heard once again.
The manual tuning can be ended at any time by pressing one of the frequency selection buttons or if none of the buttons has been pressed for 60 seconds.

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### Listening to programmed stations

Select the desired band using the BN button (1). Press one of the frequency selection buttons briefly.
The display will show the button pressed and the transmitter code if it is an RDS transmitter.
If the transmitter selected offers an RDS service and the reception is not good, the radio will search for an alternative frequency. During the search for the alternative frequency the display will show "SRC".

### TP function (Traffic Program)

Several stations on RDS1, RDS2 bands also broadcast traffic news.
With the TP function (Traffic Program) it is possible to:
a) carry out the search for RDS stations only transmitting traffic news;
b) receive traffic news even if the cassette player is working;
c) receive traffic news at a pre-set minimum volume even with the radio volume control at zero.

**NOTE** *Below are the instructions for carrying out each of the operations illustrated in points a), b) and c) previously.*

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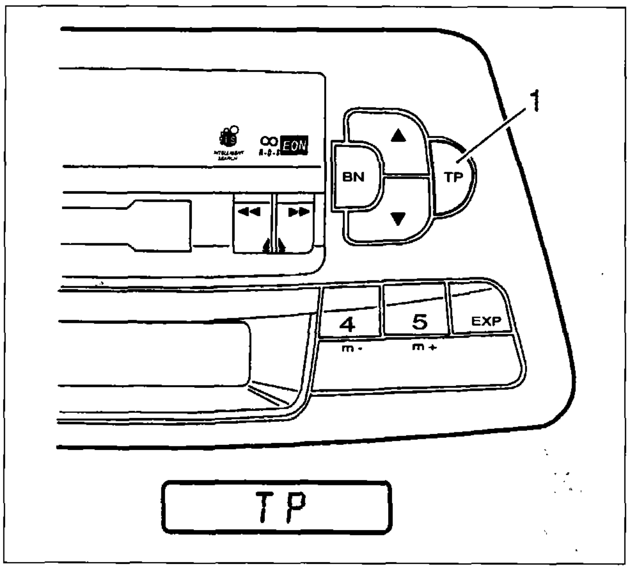


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**Point a)**
To select a transmitter with a traffic news service, press the TP (1) button briefly. The message "TP" will appear on the display.
If the transmitter is not enabled to provide traffic news, the radio will automatically tune into the closed enabled broadcaster and transmit it.
Several transmitters, providing a traffic news service, can be programmed using the station selection buttons. Follow the instructions in the "Transmitter manual tuning and programming" paragraph, initially pressing the TP button to activate the TP function.
As an alternative to the manual programming, it is possible to follow the instructions in the "Transmitter automatic programmein (AUTOSTORE)" paragraph.

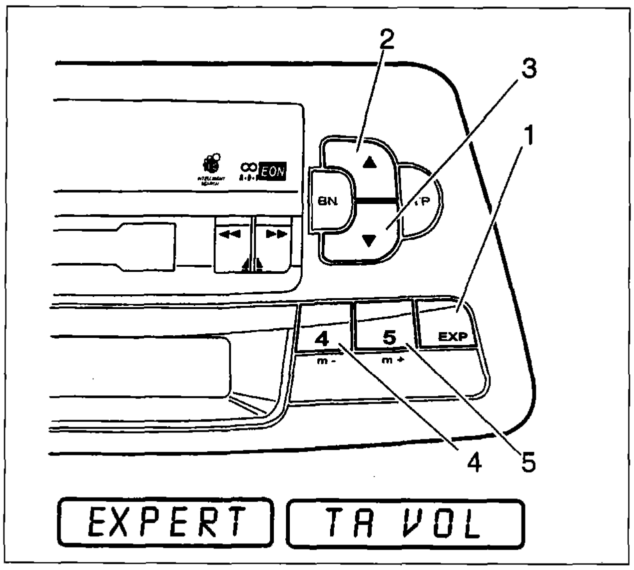
**Point b)**

If you wish to receive traffic news, before inserting the audio cassette, tune into an RDS TP transmitter. If traffic news is broadcast whilst listening to a cassette, the reproduction of the tape will be temporarily halted and resumed automatically when the news flash is over.

**Point c)**

Even when not listening to the radio it is possible to receive traffic news. After having tuned into an RDS TP transmitter and set the volume at zero, if this transmitter broadcasts traffic news it can be heard at a pre-set minimum volume.

⚠ *In some countries there are radio stations which, even if the TP function is activated, do not transmit traffic news.*

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**Pre-setting volume level for TP function (Traffic Program)**

To select the volume for listening to traffic news, press the EXP button (1) until the message "EXPERT" appears on the display. Then press the "▲" "▼" buttons (2,3) until the message "TA VOL" appears on the display. Using buttons 4 (4) and 5 (5) it is possible to select the desired volume. The volume ranges between 5 and 31.


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### EON function (Enhanced Other Network)

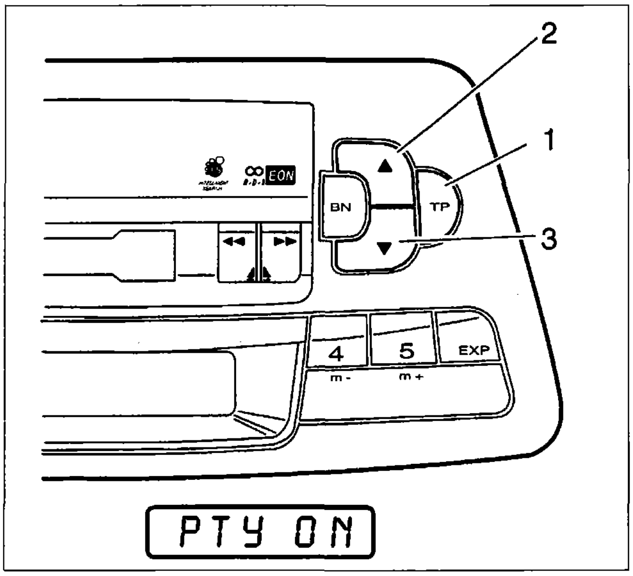
In some countries there are networks which group together several transmitters able to broadcast traffic news.
In these cases, when listening to a programme on an RDS TP station, it will be temporarily interrupted to receive traffic news flashes each time one of the broadcasters on the same network transmit them.
To exclude this function (EON), press the "TP" button briefly (the LED under the button will go out).

### PTY function

Several transmitters in the FM range offer a "Type of Programme" service (PTY). The PTY function can be used to automatically select a transmitter offering a certain type of programme, for example classical music.

### PTY autoamtic search

The search can be carried out by allocating 5 types of programme, selected at will, to the station selection buttons 1,2,3,4,5 or by selecting the type of programme from the list memorized and then starting the search.
For more details, see the paragraphs below.

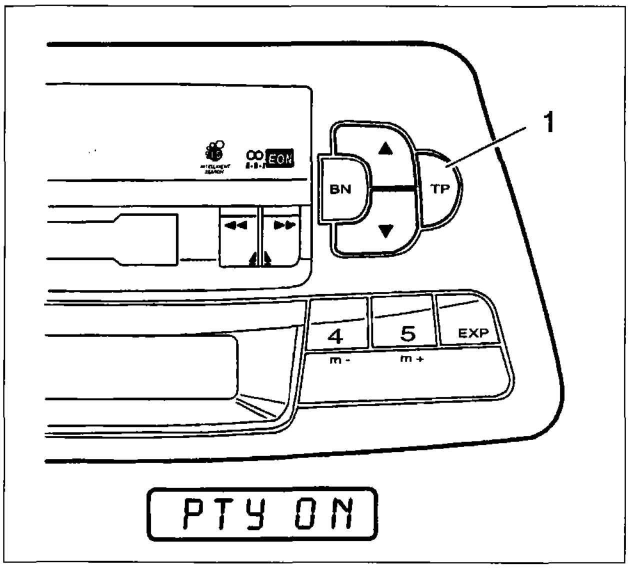



P4A69HL01

**Programming the types of programme desired in the station selection buttons**

Press the TP button (1) for about 6 seconds until the message "PTY ON" appears on the display. Select the type of programme desired using buttons "▲" "▼" (2,3).
Having identified the type of programme desired, for example classical music "CLASSIC", press the station selection button (1,2,3,4,5) desidered for more than 2 seconds. The type of programmed selected is associated with the button.

Each selection button can be associated with a particular type of programme by repeating the procedure described above.
To start the automatic search for a transmitter broadcasting a certain type of programme, press the TP button again for about 6 seconds. The message "PTY ON" will appear on thedisplay. Then press the station selection button for the type of programme desired. The display will show the type of programme selected. The automatic search can be started by pressing one of the buttons "▲" "▼" again for about 2 seconds. The search is interrupted when the first transmitter broadcasting the type of programme desired is found.



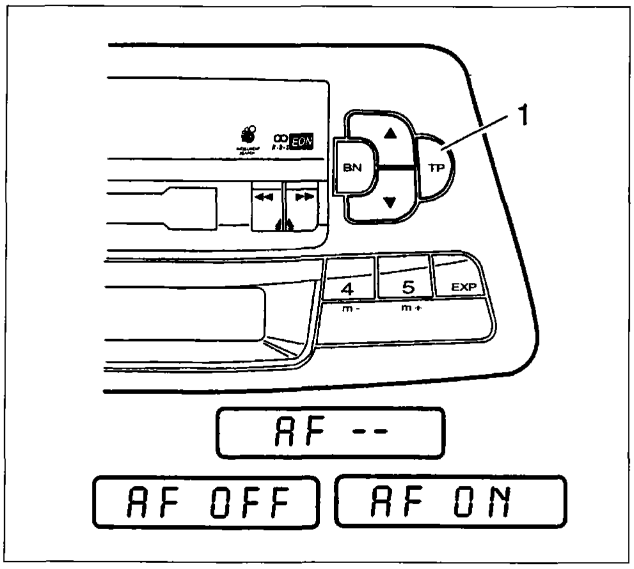

P4A70HL01

### Tuning into the type of programme using the list

Activate the PTY function by pressing the TP button (1) for about 6 seconds until the message "PTY ON" appears on the display.
By repeatedly pressing one of the "▲" "▼" buttons (2,3) the display will show the types of programme contained in the list. Having identified the type of programme desired, press one ofthe "▲" "▼" buttons for about 2 seconds to start the automatic search. The search is halted whtn the radio tunes into a transmitter broadcasting the type of programme selected.

### List of types of programme available

NEWS News and current events
AFFAIRS Politics and current affairs
INFO Special information programmes
SPORT Sport
EDUCATE Education
DRAMA Drama and literature
CULTURE Culture, the church and religion
SCIENCE Science
VARIED Variety
POP Pop music (hits)
ROCK M Rock music
EASY M Light music
LIGHT M Light classical music
CLASSICS Classical music
OTHER M Music programmes which cannot be classified (e.g. folk)
WEATHER Weather forecasts
FINANCE Financial news
CHILDREN Childrens programmes
SOCIAL A Social information
RELIGION Religion and philosophy programmes
PHONE IN Phone ins
TRAVEL Travel news
LEISURE Leisure, hobbies and pastimes
JAZZ Jazz music
COUNTRY Country music
NATIONAL National broadcasts
OLDIES Golden Oldies
FOLK M Folk music
DOCU Special services
NO PTY No identification code for the type of programme




P4A70HL02

### Alternative frequencies (AF function)

If an RDS programme is received, which is broadcast by several transmitters on different frequencies, the radio will automatically switch to the frequency with the best reception.
The function is activated at the time of supply. To deactivate the AF function, press the TP button (1) for about 3 seconds until the message "AF - - " followed by "AF OFF" appears on the display. To activate the AF function again, press the TP button until the message "AF OFF" followed by "AFF ON" appears on the display.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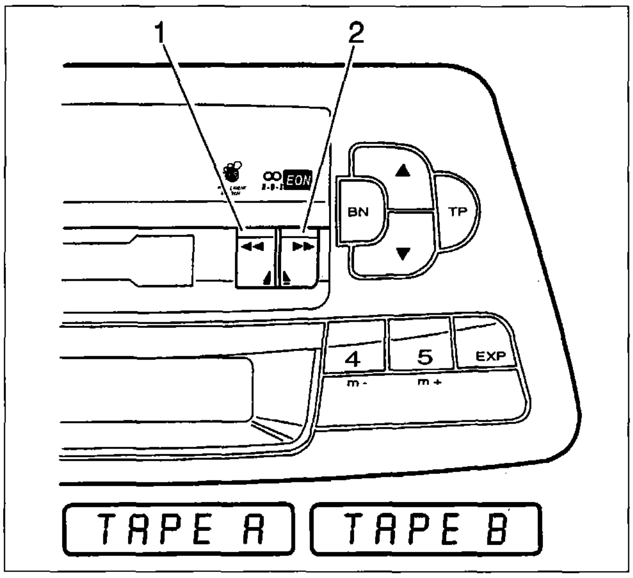
## AUDIO CASSETTE PLAYER

### Activating the audio cassette player.

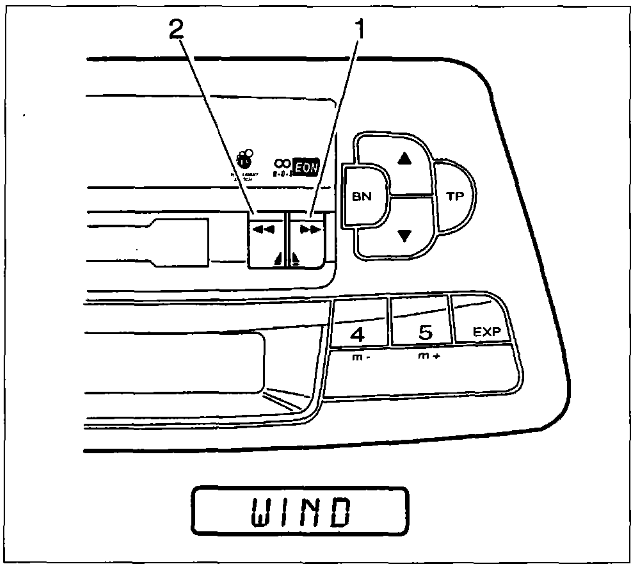
The radio system is fitted with an audio cassette player which can be activated by introducing an audio cassette directly into the special housing.
Both sides of the tape can be listened to without extracting the cassette and turning it over.
To start playing an audio cassette, insert it in the special housing, pushing it by hand until it goes in autoamtically and starts playing.



P4A71HL01

### Changing the side of the cassette being listened to.

When there is a cassette in the housing and the message "TAPE A" or "TAPE B" appears on the display, briefly press buttons (1) and (2) simultaneously.
The player will play the other side of the tape.
The messages "TAPE A" and "TAPE B" mean the upper side and the lower side of the audio cassette, respectively.

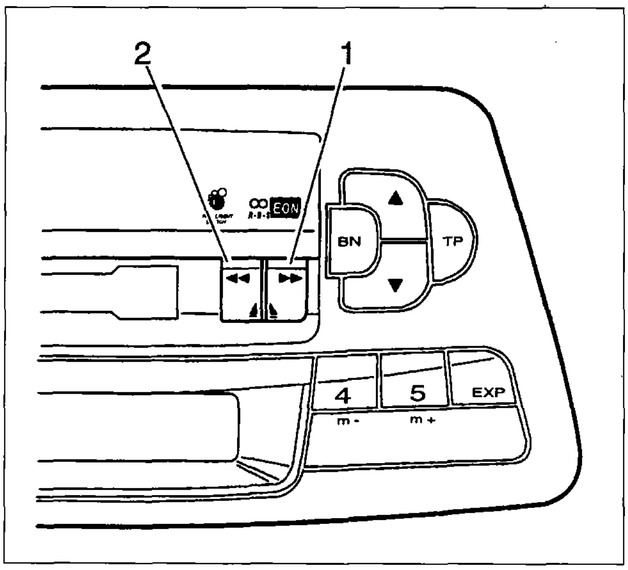


P4A71HL02

### Fast forward and rewinding

Whilst listening, briefly press button (1) or (2) to fast forward or rewind the audio cassette, respectiv ely. The message on the display during this operation will be "WIND". To interrupt this function, briefly press button (1) or (2). Having interrupted the function, the audiocassette player will automatic resume the reproduction of the cassettte.
When the tape has been fast forwarded or rewound, the player will resume the automatic reproduction of the same side or the other side.

# 55.



P4A72HL01

**Ejecting the cassette.**

To eject the cassette from the audiocassette housing, briefly press buttons 1 and 2 simultaneously.
After the audio cassette has been ejected, the message "TAPE" will appear on the display and the radio will operated, tuned into the last transmitter listened to.

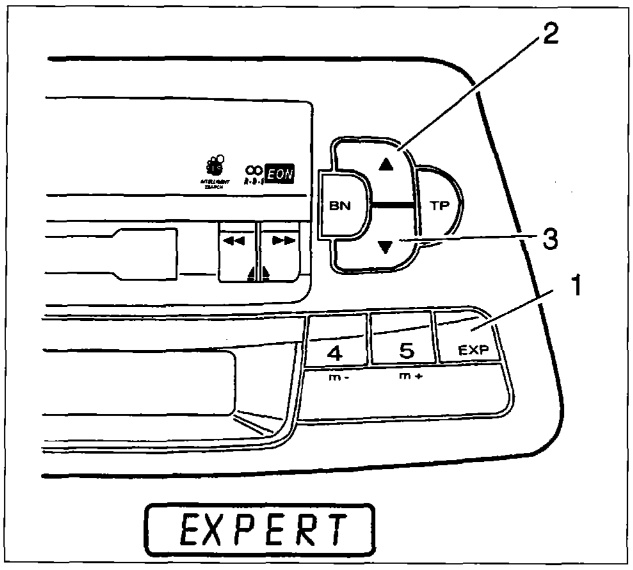
### EXPERT control level

Using the EXPERT additional level it is possible to carry out different adjustments which may only be necessary once, for example, setting the exact time, or occasional adjustments such as, for example, the adjustment of the minimum volume for traffic news.

### List of possible EXPERT adjustments

The following adjustments can be carried out using the EXPERT control level:

1. Setting the time
2. Switching the clock RDS tuning on/off
3. Traffic news minimum volume
4. LRN on/off
5. Regional programme automatic change on/off
6. LOC on/off
7. MONO on/off
8. LOUDNESS on/off
9. FADER on/off
10. Limiting volume when switching on
11. BDLY delay in switching BOOSTER connected on/off
12. Switching on/off via ignition
13. Audio mute during operation of car phone
14. Telephone input sensitivity



P4A72HL02

**Selecting and modifying the adjustments using the EXPERT control level.**

Press the EXP button (1) until the message "EXPERT" appears on the display.
Using buttons "▲" (2) and "▼" (3) select the desired adjustment.
By pressing the frequency selection buttons it is possible to set the desired level.
The frequency selection buttons involved depend on the desired adjustment.
For their identification, refer to the paragraphs which follow dealing with the individual possible adjustments.

To end the adjustment, press the EXP button for about 3 seconds.



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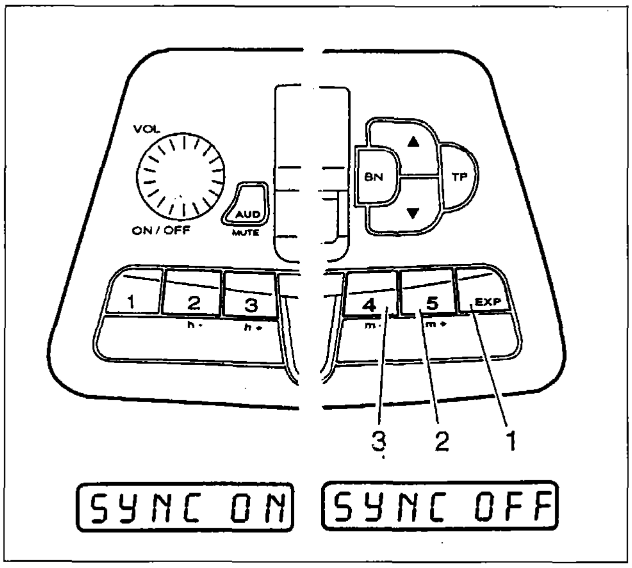


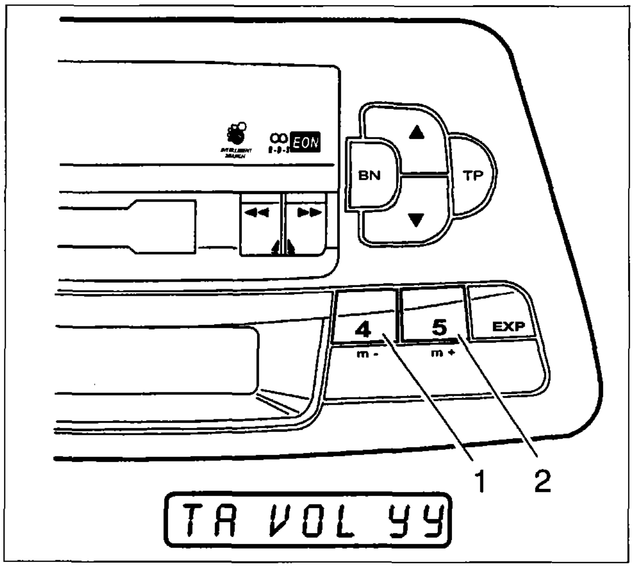

P4A73HL01

### Setting the TIME

The frequency selection buttons required for the adjustment of the hour are:
Buttons 2 and 3 for setting the hour
Buttons 4 and 5 for setting the minutes
To start the clock with precision, press the EXP button (1) briefly.

### Synchronizing the clock

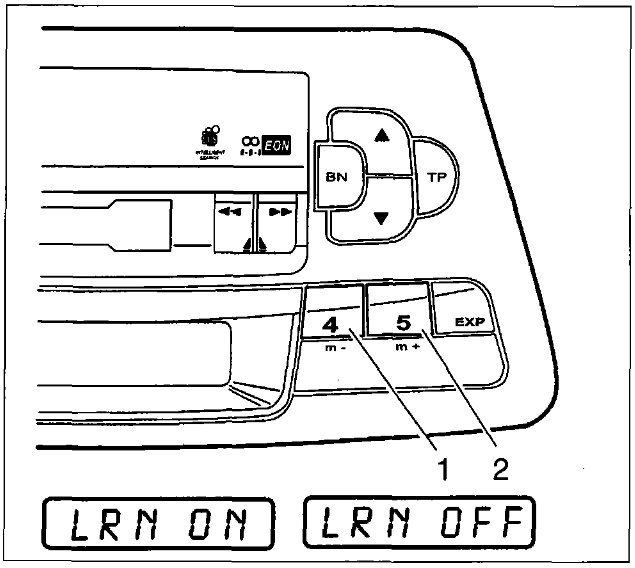
This allows the clock to be synchronized with the RDS TIMER signals transmitted by the broadcaster.
By pressing frequency selection button 5 (2) the message on the display will be "SYNC ON", whilst if frequency selection button 4 (3) is pressed the message "SYNCH OFF" will appear on the display.




P4A73HL02

### Minimum volume for listening to traffic news

The desired level can be set using frequency selection buttons 4 (1) and 5 (2) to increase or decrease the volume, respectively.
During the adjustment, the message "TAVOL YY" will appear on the display where YY refers to the volume level set.

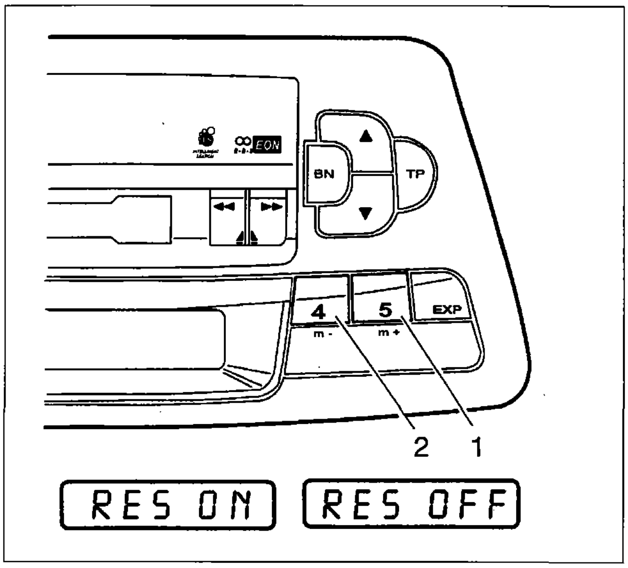



P4A73HL03

### Switching LNR on/off (radio function)

This makes it possible to switch the search for RDS traffic new broadcasters on or off.
*The frequency selection buttons for switching it on and off are buttons 4 (1) and 5 (2), respectively.*
The messages "LRN ON" and "LRN OFF" respectively, will appear on the display when the function is switched on or off.

# 55.

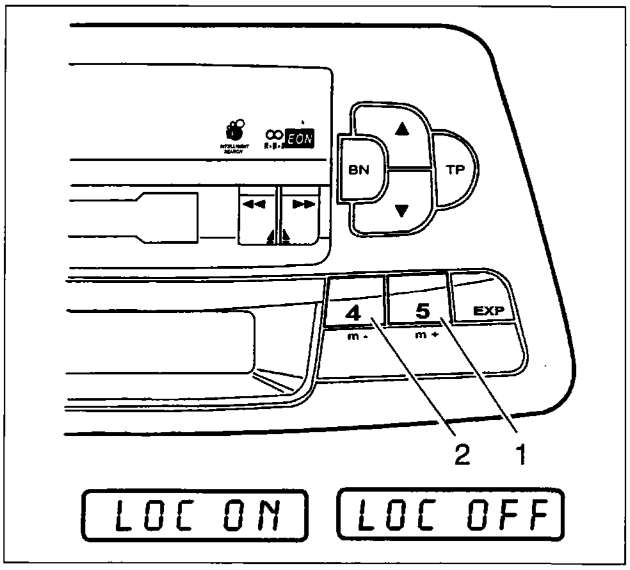



P4A74HL01

### Automatic programme change (REGIONAL)

When the RDS programme consists of various regional broadcasts, the radio may switch between transmitters, selecting the one with the most powerful signal.
The frequency selection buttons required are button 5 (1) for switching the function on and button 4 (2) for switching it off.

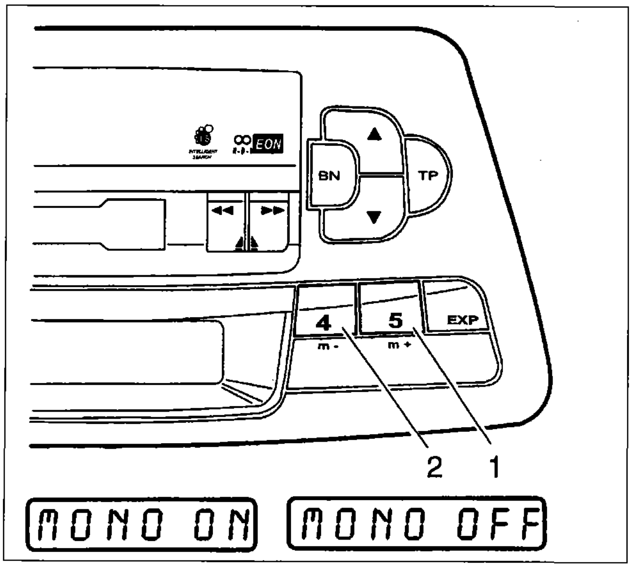
The messages displayed will be "RES ON" when the function is switched on and "RES OFF" when the function is switched off.




P4A74HL02

### LOC function

This makes it possible to search for FM frequencies according to their transmission power.
With the LOC function selected, the radio system searches for the most power broadcasting stations whilst if the function is not selected the search is also extended to less powerful transmissions.
To activate the LOC function, press the frequency selection button 5 (1) until the message "LOC ON" appears on the display. To deactivate the function selected previously, press frequency selection button 4 (2) until the message "LOC OFF" appears on the display.




P4A74HL03

### MONO function

The MONO function makes it possible to set the radio equipment to stereo or mono reproduction. In the case of a stereo broadcast, there are two different channels, whilst in the case of a MONO broadcast there is one channel only. For good quality sound, the setting should correspond to the type of transmission (Stereo or MONO).

To select the MONO function, press frequency selection button 5 (1) until the message "MONO ON" appears on the display. To deactivate the MONO function, press the frequency selection button (2) until the message "MONO OFF" appears on the display.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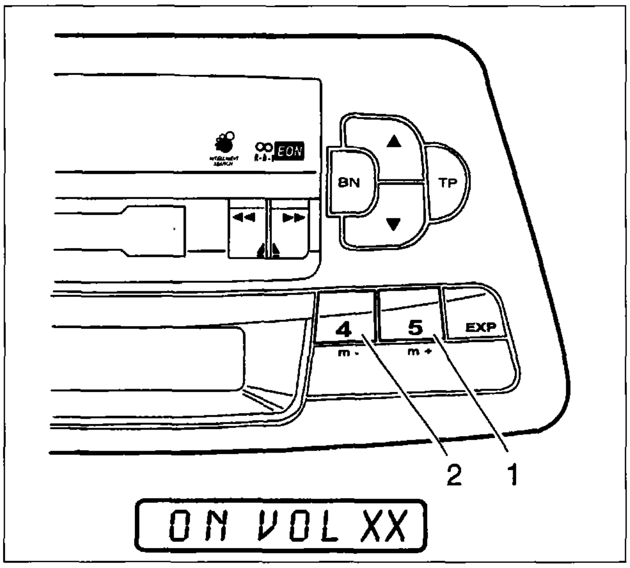
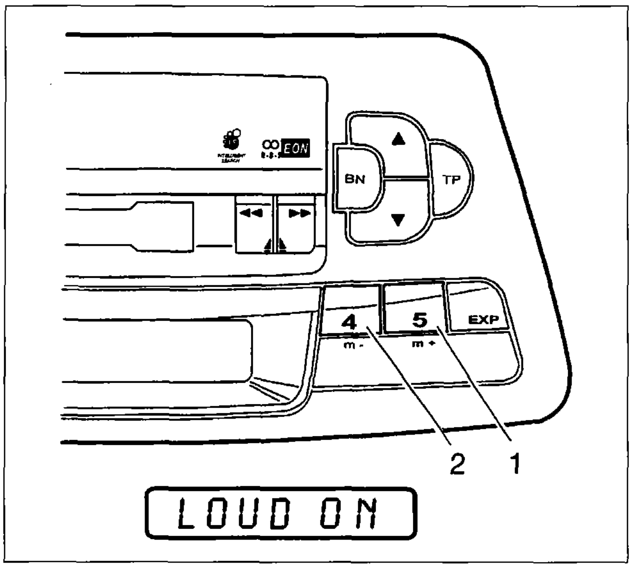



P4A75HL01

### Limiting the volume on switching on

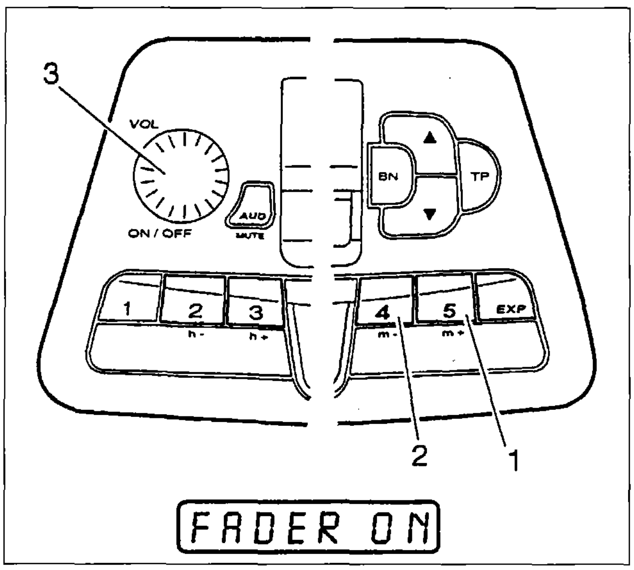
It is possible to select the volume at which the radio is switched on using frequency selection buttons 5 (1) and 4 (2), respectively to increase or reduce the volume.
By pressing buttons 4 or 5 the message "ON VOL xx" will appear on the display where the level of the volume set will appear in place of xx.




P4A75HL02

### LOUDNESS function

The LOUDNESS function makes it possible to improve the quaility of the sound at a reduced volume.
To activate the LOUDNESS function, press frequency selection button tasto 5 (1) until the message "LOUD ON" appears on the display. To deactivate the LOUDNESS function, activated previously, press frequency selection button 4 (2).

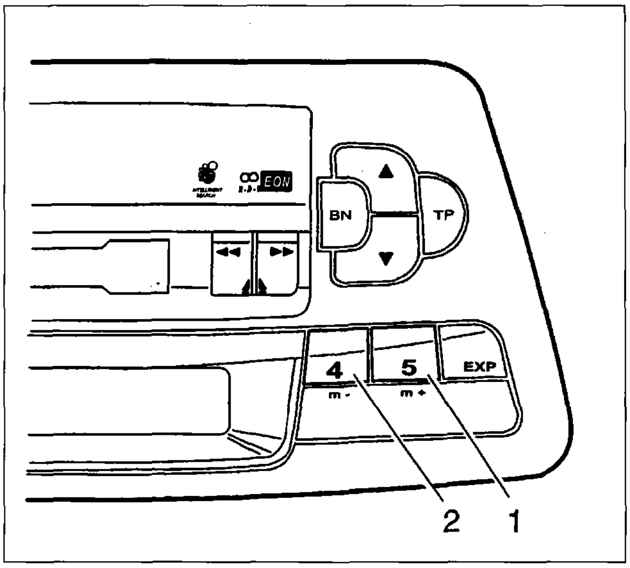



P4A75HL03

### FADER function

By selecting the "FADER" function it is possible to alter the distribution of the volume between the front and rear speakers.
To select the FADER function, press frequency selection button 5 (1) until the message "FADER ON" appears on the display. To deactivate the function, press frequency selection button 4 (2). The VOL control (3) is used to regulate the intensity of the sound, emphasizing the sound coming from the front speakers or from the rear speakers.

# 55.




P4A76HL01

**Delay in switching BOOSTER on/off (BD-LY)**

To switch the Booster delay on or off, press frequency selection buttons 5 (1) and 4 (2), respectively.
The message "BOLY ON" or "BOLY OFF" will appear on the display.

**Switching on and off via the ignition**

See paragraph on "Switching on radio".

**Audio mute function during the operation of the car phone**

To switch the radio on or off, when the vehicle is equipped with a car phone system, press frequency selection buttons 4 and 5, respectively.
The messages "PHONE OFF" and "PHONE ON", respectively will appear on the display when the function is off or on.
When the function is switched on and a telephone call is received, the radio is automatically deactivated and the conversation is relayed through the speakers.

**Telephone input sensitivity**

The telephone input sensitivity can be adjusted using frequency selection button 4 or 5.
The messages "PHONE 00" or "PHONE 03", respectively are displayed for lesser or greater sensitivity.

## TECHNICAL INFORMATION

**Aerial**

The vehicle has an aerial located on the roof.

**Electrically operated aerial and external amplifier (available on request)**

The radio is prepared for an automatic electrically operated aerial (it is raised the moment the radio is switched on and is lowered when it is switched off) and an external amplifier.

The switching voltage for the aerial is at contact 5 of connector "A" for the radio and the switching voltage for the amplifier is at contact 3 of connector "A".

The switching voltage for both outlets is + 12 V with a maximum current of 0.5 A.

**Speakers for AD182H radio equipment**

The acoustic system consists of:
- 2 ferro-fluid tweeter-dome diffusers with a power of 40 W max. each;
- 2 130 mm diffusers with a power of 30 W max. each.

**Fuses**

The radio has a 10 A protective fuse.



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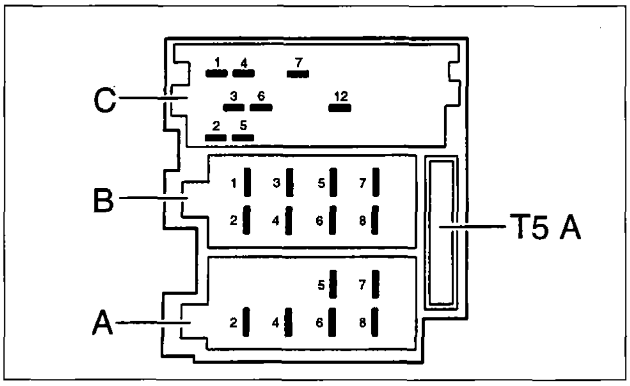
### Connections

This paragraph contains the connect at the rear of the radio equipment.




P4A77HL01

### Supply voltages

**Blade contacts A:**

**A8 Connection for earth**
Connect to terminal 31 (earth) of the vehicle.

**A7 Connection for 12 V supply voltage**

Connect to terminal 30 (continuous positive) of the vehicle.

**A6 Connection for instrument light**

Contact not connected: no light with the radio switched off if the instrument light is on.

**A5 Output switching voltage of +12 V (max 0.5 A)**
Present at A5 blade contact when the radio is on.
For automatic aerial (extended/retracted), aerial amplifier (supply voltage).

**A4 Connection for voltage of +12 V**

Connect to terminal 15 of the vehicle if the radio is going to be switched on and off via the ignition.
Connection A4 may also be not wired. In this case, the radio should come on and off via the **VOL control.**
With the engine switched off, the equipment is switched off about 20 minutes later

**A2 Phone-Mute connection for car phone or receiver-transmitter**
The radio audio function is deactivated during the operation of the car phone or the receiver-transmitter.
The message "PHONE" appears on the display.
Contact A2 should be earthed from the mute outlet of the telephone/receiver-transmitter!

### Speakers

**Blade contacts B**

Maximum power at speakers 4 : 4 x 20 W or 2 x 15 W

Connection for 4 x 20 W

Front speaker:
B3 right +
B4 right -
B5 left +
B6 left -

Rear speaker:
B1 right +
B2 right -
B7 left +
B8 left -

Connection for 2 x 15 W
B3 right +
B2 right -
B5 left +
B8 left -
When operating with 2 x 15 W the FADER should be switched off in the EXPERT Menu

The connections for the speakers should not be electrically connected to each other or earthed!

**Additional connections**

**Blade contacts C**

Line output
Possibility of connection for power amplifier (Booster) or speaker activated.
C1 Left rear speaker +
C2 Right rear speaker +
C3 Earth -
C4 Left front speaker -
C5 Right front speaker -
C6 Switching voltage for power amplifier:
on/off (max 0.3 A)

Steering remote control:
C8 Earth
C9 Remote control

Telephone input:
Possibility of connection for car phone or receiver-transmitter (listening through the radio).
C7 Telephone NF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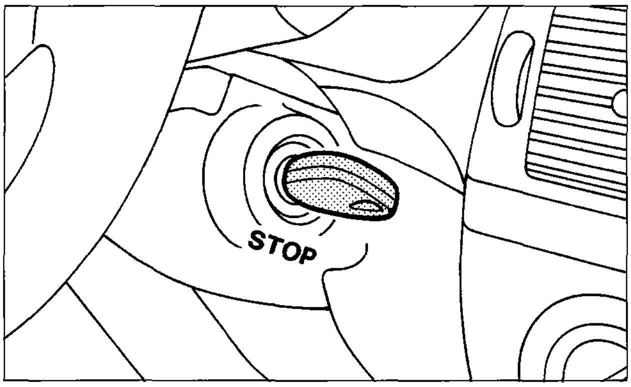
**PROGRAMMING IGNITION KEYS (only on 1910 JTD version)**

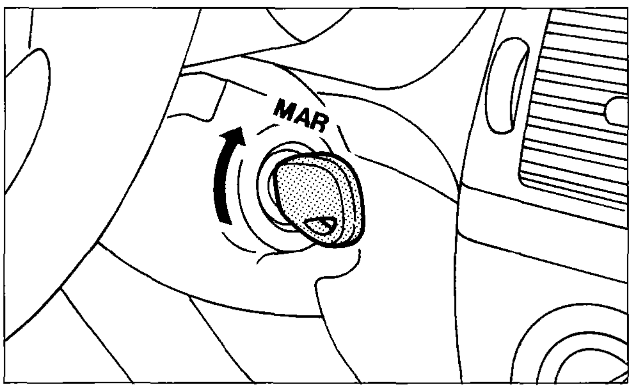
**For anything not dealt with in the pages which follow, refer to the Fiat CODE system described in the Fiat Bravo-Brava Service Manual II° volume (print no. 506.670/01)**

*On the version in question, as a result of a differenti CODE system software configuration, the specific procedure described below must be followed.*
*At least two main keys are required in addition to the MASTER key.*




P4A79HL01

Insert the (wine) MASTER key in the ignition switch in the OFF position.




P4A79HL02

Turn the MASTER key to the ON position (+15), the CODE warning light should come on for 0.7 secs.

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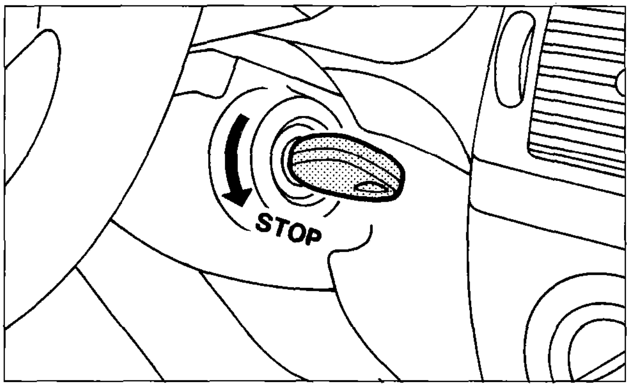
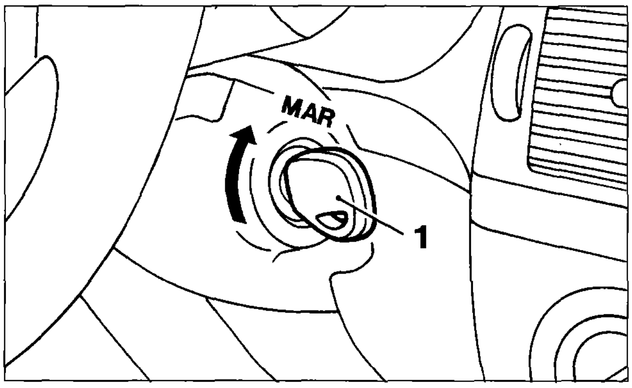



P4A80HL01

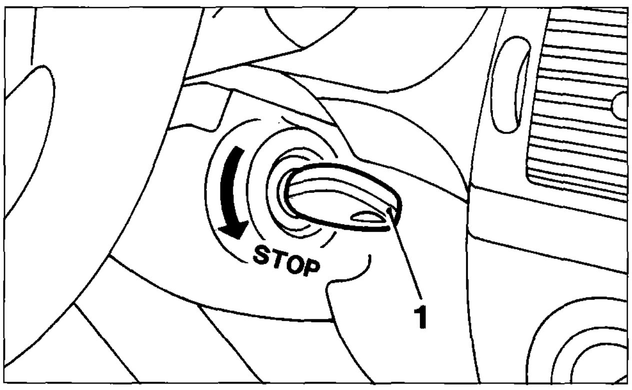
When the CODE warning light goes out, turn the MASTER key to the OFF position and extract it.




P4A80HL02

Within 10 seconds:

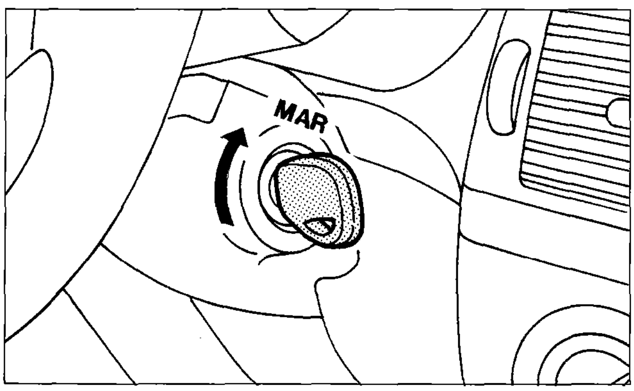
- insert a new key (1) in the ignition and turn it to the ON position (+15), the CODE warning light should come on for 0.7 secs.




P4A80HL03

- When the CODE warning light goes out, turn the key (1) to the OFF position and extract it.

Repeat the operations, as for the key (1), for the second key and for all the keys to be programmed.




P4A79HL02

Within 10 seconds:

- insert the MASTER key once again in the ignition and turn it to the ON position (+15), the CODE warning light should come on for 0.7 secs.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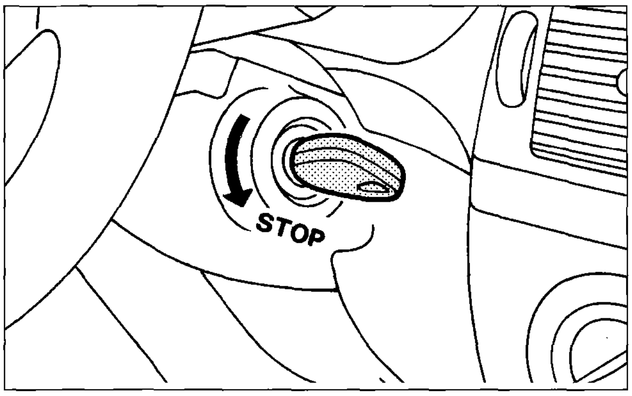
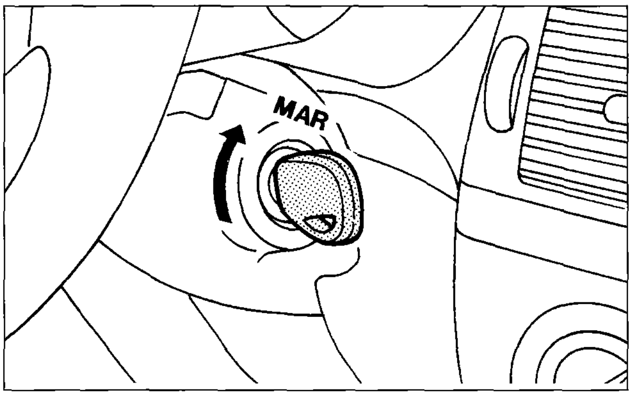


P4A80HL01

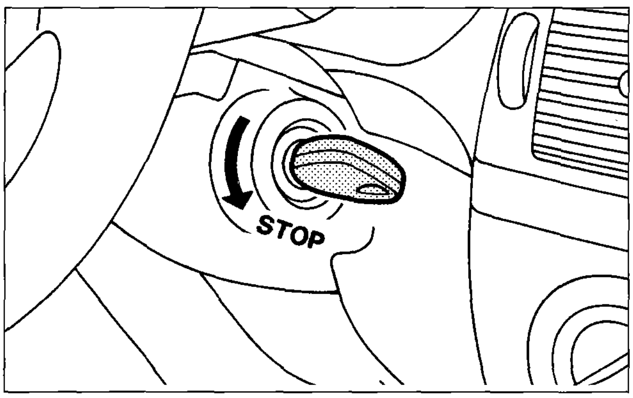
When the CODE warning light goes out, turn the MASTER key to the OFF position, leaving it in this position for between 4 to 9 secs.

*Do not leave the MASTER key in the OFF position for longer than 10 secs because all the codes programmed will be cancelled.*

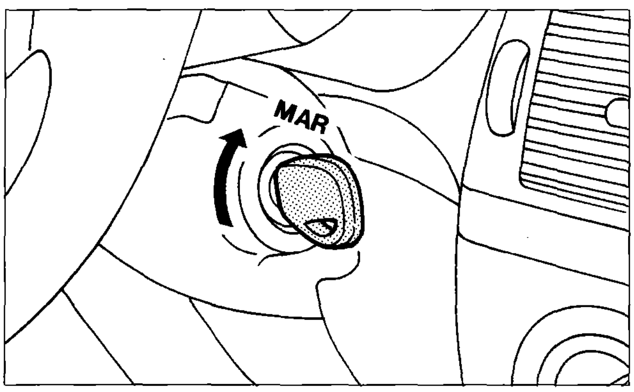


P4A79HL02

Turn the MASTER key to the ON position (+15), the CODE warning light should come on for 0.7 secs.

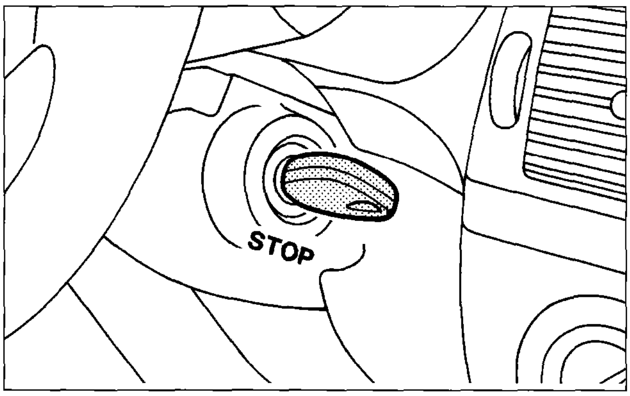



When the CODE warning light goes out, turn the MASTER key to the OFF position.




Repeat the two previous operations until, when the MASTER key is turned to the ON position, the CODE warning light rather than coming on for 0.7 seconds remains on constantly.

**55.**




P4A79HL01

Place the MASTER key in the OFF position, extract it and return it, the key programming procedure is over.

If the procedure has been carried out correctly, i.e. as far as the timing and operations are concerned, if the ignition key is placed in the ON position, the CODE warning light will go out after coming on initically for 0.7 seconds, otherwise it will start to flash in rapidly (1.6 Hz); if this is the case, the programming procedure must be repeated.

*If a mistake is made (at any time) during the programming procedure, place the ignition key in the ON position for longer than 2 seconds or in the OFF position for longer than 10 seconds, then start the key programming procedure again.*

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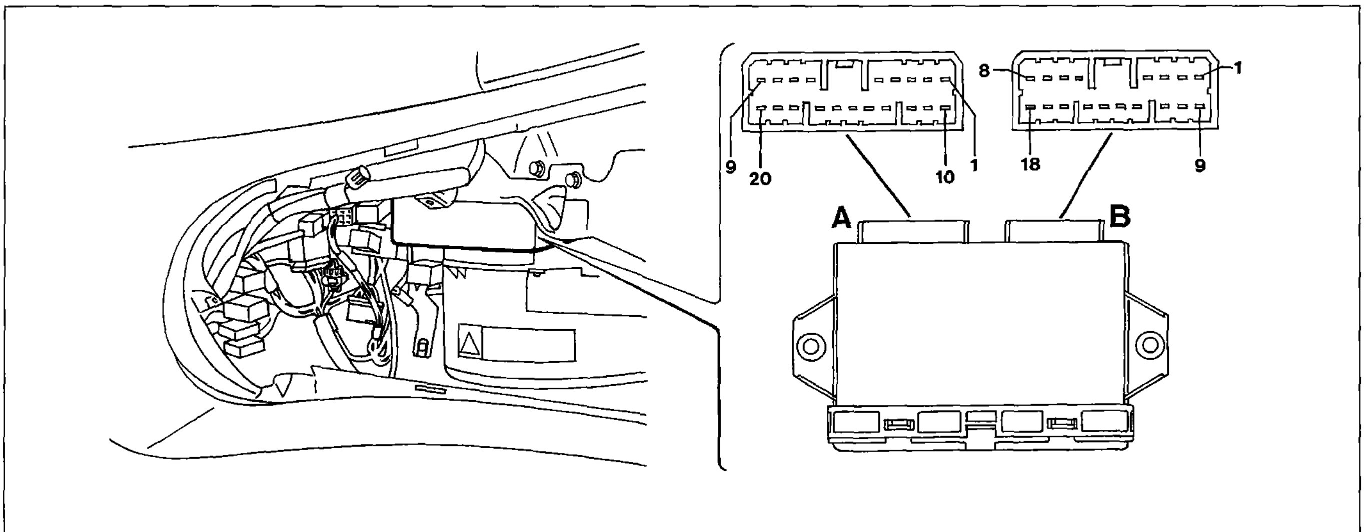
### INTEGRATED SERVICES ELECTRONIC CONTROL UNIT

A single electronic control unit known as the ABI (Alzacristalli Bloccaporte Integrati - Integrated electric window and door lock) located beneath the right facia trim controls a set of functions and controls that are normally controlled by several different components.
The various functions are as follows:
- **Front electric window operation;**
- **Door lock/release;**
- **Timed passenger compartment lighting;**
- **Timed activation of heated rear window and door mirror demisters.**

**Location of ABI control unit**

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**Control unit signals**

Connector A:

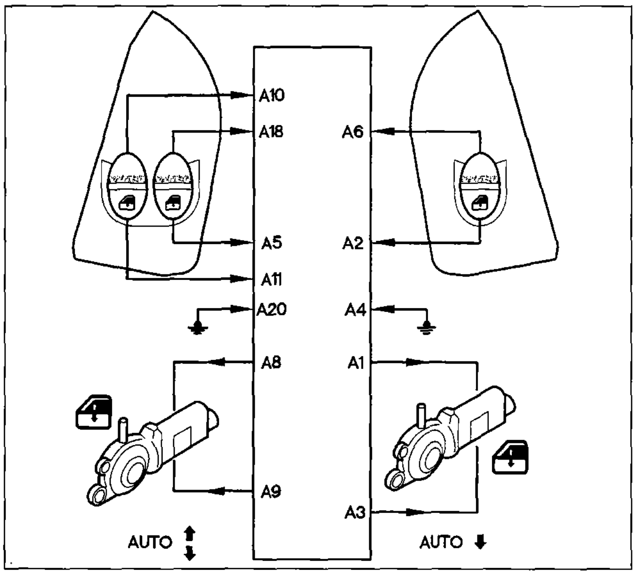
1 Supply to passenger side window motor - raise
2 Passenger side window motor control - lower
3 Supply to passenger side window motor - lower
4 Passenger side window earth
5 Passenger side window control from driver's side - lower
6 Passenger side window motor control - raise
7 N.C.
8 Supply to driver side window motor - raise
9 Supply to driver side window motor - lower
10 Driver side window motor control - raise
11 Driver side window motor control - lower
12 Lock control from remote control unit
13 Release control from remote control unit
14 N.C.
15 Power supply (+30)
16 Power supply (+30)
17 N.C.
18 Passenger side window control from driver's side - raise
19 N.C.
20 Driver's side window earth

Connector B:

1 Timed ear courtesy light power supply
2 Driver side front door switch for interior lights
3 Passenger side front door switch for interior lights
4 Door lock motor power supply (release)
5 Door lock motor power supply (lock)
6 N.C.
7 Power supply (+15)
8 Power supply (+30)
9 Heated rear window relay power supply
10 Timed front courtesy light power supply
11 Outlet for heated rear window warning light
12 Driver side rear door switch for interior lights
13 Electronic earth and door lock
14 Heated rear window control
15 Lock command from front locks (from key or switches)
16 Release command from front locks (from key or switches)
17 Heated rear window control from climate control system (MAX DEF)

Passenger side rear door switch for interior lights

# 55.

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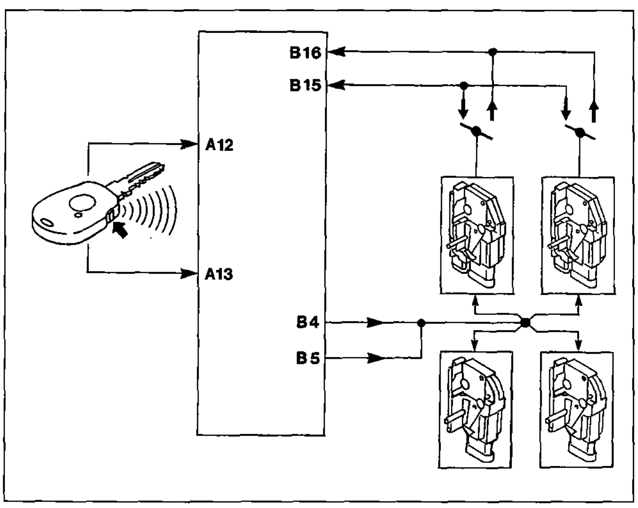
### FRONT ELECTRIC WINDOW OPERATION

Operation is automatic for window raise and lower on the driver side, but only for lowering on the passenger side.
Operation is manual when key operating time is from 60 to 300 milliseconds.
Operation is automatic when key operating time exceeds 300 milliseconds.
The window stops when the key is operated in the opposite direction.

### Safety systems

The window stops (i.e. motor electrical supply is cut off) when the glass reaches the upper or lower end stop or if an obstacle gets in the way and blocks the glass. This is regulated by controlling the self-adaptive motor direct current.
The electronic control unit behaves as follows:
- If the motor control signal cuts out during operation, the control unit deactivates the system within a maximum time of 500 milliseconds. This interruption occurs when the controlled current taken up by the electric window motor drops to less than 0.8 A.
- If the control buttons are faulty (short-circuit or keys stuck down), control operation is inhibited at the time of control unit activation until the defect disappears (or the key is released) for longer than 60 milliseconds;
- if the buttons are pressed for longer than 12 seconds, motor operation is inhibited; if the descending key is short-circuited or pressed for longer than 30 seconds, the control is inhibited so that the glass can be closed.

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### DOOR LOCK/RELEASE

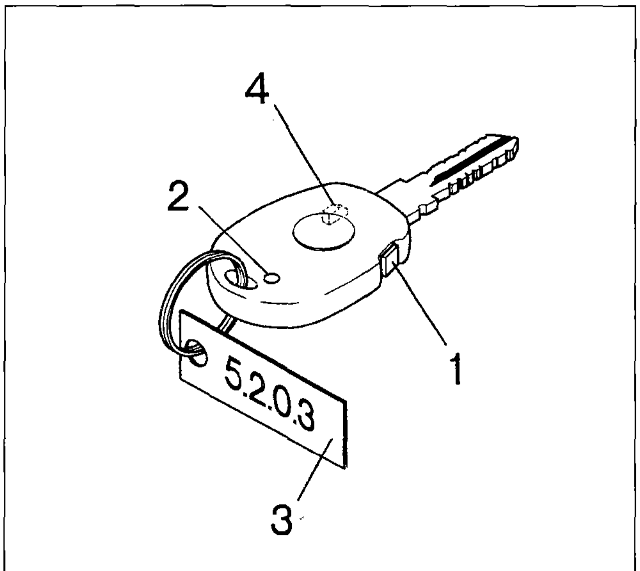
The locks are operated simultaneously upon a control from the key, the front door switches (knobs) or via the remote control (see next page).

**NOTE** *Locking takes place only with the doors properly closed and the locks locked. Conversely, release takes place with the doors properly closed and the doors locked.*

## CENTRAL DOOR LOCKING/OPENING

Software in the electronic control unit runs a series of safety checks:

- It reads switch position at the end of each operation. If this position does not agree with the action carried out, a repulsion takes place. Everything is as normal if it agrees with the action carried out. Repulsion takes place after a locking manoeuvre and after a release manoeuvre.
- If the motors are commanded to lock and the operation is not carried out together, i.e. the commands do not agree or a door is open (in the case of the lock manoeuvre alone, the circuit carries out an opposite manoevre to attempt to realign the lock;
- if the control unit records several consecutive, complete lock/unlock manoeuvres, the system cuts in to operate the manoeuvre limiter. The system therefore remains inhibited in released position for 30 seconds.
- the system cuts off operation if battery voltage drops below 9 V.

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## DOOR OPENING/CLOSURE REMOTE CONTROL

**NOTE** *The remote control, not available as standard, is built into the ignition key.*

Whenever the control button (1) is pressed, the sender unit sends a radio code with action radius of about 10 metres to the receiver in the courtesy light.

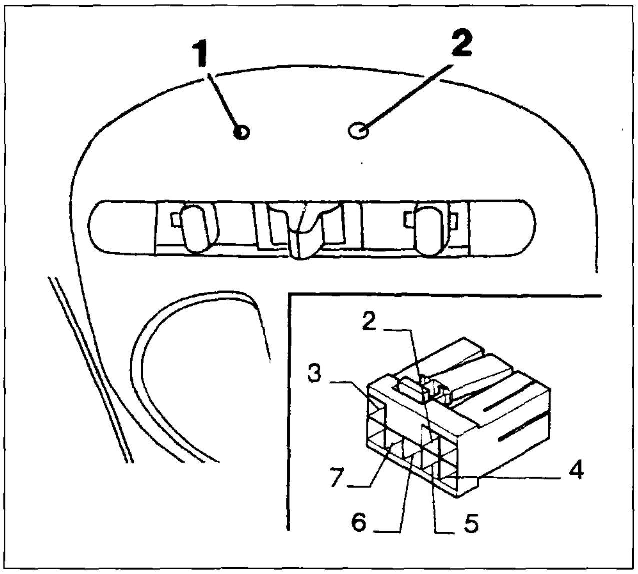
1. Control button
2. Repeater led
3. Password code card
4. Transponder (used by invisible Fiat CODE)

**NOTE** *Each key with remote control unit has a plate (3) with a 4-figure password to protect against unauthorised programming (protected programming). The Dealer must remove the plate at the time of sale and place it on the back of the Code Card (refer to the Fiat CODE chapter). If the plates are lost, the remote control can still be used but NEW REMOTE CONTROL UNITS cannot be stored (see next page). if this is necessary, replace the receiver on the courtesy light and the keys (to obtain the plates).*

## RECEIVER

The receiver, built into the courtesy light, is an electronic device that receives a signal from the remote control. This performs door opening/closure functions. Each receiver may be programmed with one or more remote controls (up to eight) and store the relevant codes. A green led (1) on the receiver lights up when the signal is received, while a button (2) is used to store the code. When fitted in the cars, receivers contain a UNIVERSAL code that is used to carry out end of production line tests using a remote control unit with a universal code. When the car is delivered to the customer, the receiver must be personalised by replacing the UNIVERSAL code with codes for remote control units provided with the car (see PROGRAMMING on the next page).

# 55.

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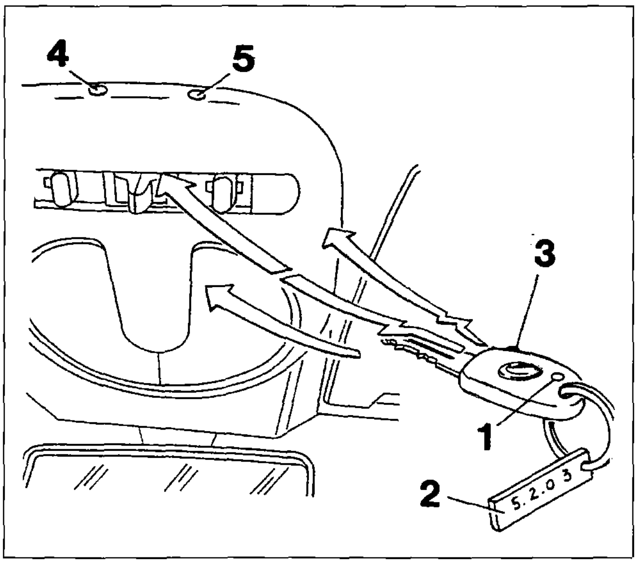


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1. Red LED on remote control unit
2. Password code, 4-figure
3. Control button on sender unit
4. Green LED on courtesy light
5. Programming button

1. Green led
2. Store button

**Receiver connector**
1. Not connected
2. Provision for alarm system
3. Positive from battery (+30)
4. Earth
5. Door release
6. Door lock
7. Ingition-operated positive (+15)
8. Not connected

### SIMPLIFIED PROGRAMMING

A remote control unit must always be stored with the ignition key remove or in STOP or PARK position
With this programming system, any number of remote control codes are recognised but only the last 8 remain stored by the alarm system as follows:

1. press and hold down button (5) on the receiver built into the courtesy lightl. The adjacent LED (4) should flash.
2. Hold button (5) down and press remote control unit key (3).
3. Then release key (3) when the light of led (4) on the receiver should become fixed.
4. Then release button (5) on the courtesy light at the end of the cycle.
5. The remote conrol unit is now programmed.

**NOTE** *Repeat the operations below to store the next remote control units.*

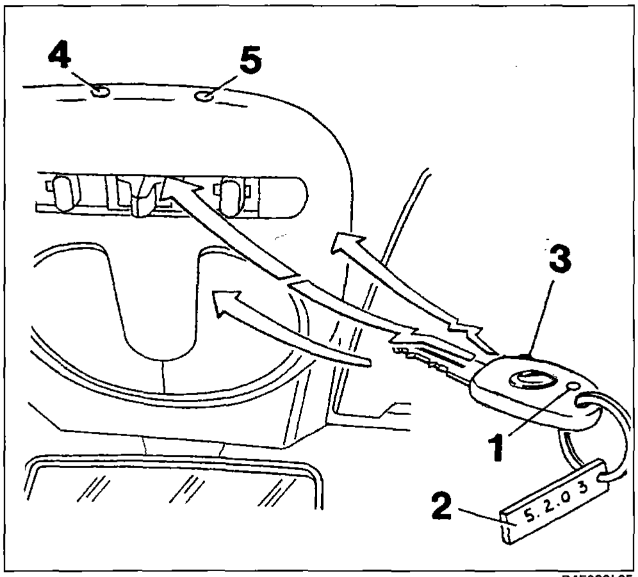
6. If the receiver led stops flashing and goes off (when the remote control ke is pressed), the receiver memory is closed. Use PROTECTED PROGRAMMING to store the remote control unit code.

### PROTECTED PROGRAMMING

If the memory is closed, further remote control codes can be entered onlly after opening the memory.

### OPENING MEMORY AND STORING A NEW REMOTE CONTROL UNIT

**Opening the memory**
To open the memory, carry out the following operations in rapid succession:
1. Press button (5) on the receiver for about 1 second. LED (4) flashes as long as the button is pressed.
2. Release the button; after about 3 seconds, the LED emits a short flash to indicate that the first figure of the password can be entered.



P4F039L05

Press button (5) as many times as is indicated by the first figure of the Password (e.g, if the Password is 5.2.0.3, press 5 times). Whenever the button is operated, LED (4) lights up briefly to give visual confirmation.

1. Red LED on remote control unit
2. Password code (4-figure)
3. Control button on remote control unit
4. Green LED on courtesy light
5. Programming button

4. About 3 seconds after the last press on the button (the fifth in this case), the LED emits another flash to ask for the next figure to be entered.
5. Repeat the process from poen 3 to enter all four figures (do not press if the figure is "0" but wait for the next request).
6. If the Password has been correctly entered (memory open) the LED begins to flash (for about 10 seconds). If it comes on with a fixed light (for about 10 seconds), repeat the cycle from point 1.

**Storing a new remote control unit.**

7. While LED (4) is flashing, press and hold down button (5). Led (40 continues to flash.
8. Press key (3) of the new remote control unit until the light on the green LED (4) on the courtesy light becomes fixed.
9. Then release key (3) of the remote control unit when the light on LED (4) on the courtesy light becomes fixed;
10. then release button (5) on the courtesy light when the programming cycle is concluded.
11. The remote control unit is then programmed.

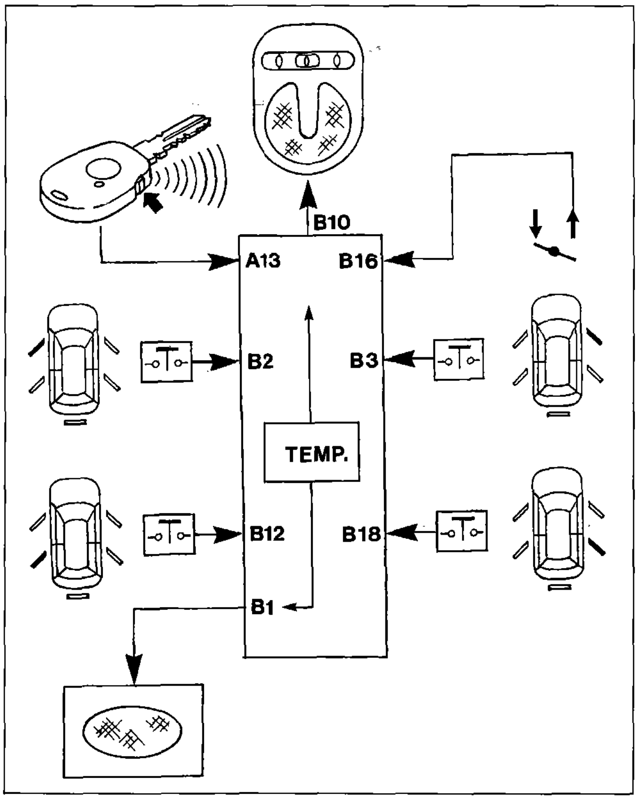
*The memory closes again after storing the new remote control unit.*

**TIMED PASSENGER COMPARTMENT LIGHTING**

When the door is released by key or remote control unit, both front and rear passenger compartment lights are operated on a timer as follows:
- after any of the doors is opened (i.e. door open switches operated), a door release command is given or the ignition key is removed, timers are enabled that come on that gradually turn on all car courtesy lights from zero to maximum intensity within 3 seconds. At the end of the timed period, all car courtesy lights are turned off gradually from maximum intensity to zero within 3 seconds. Whenever a door is open, the current timer is re-initialised.

Timers are as follows:
- 6 seconds from door release by means of a key from outside the car, by remote control unit or via safety button inside the passenger compartment. This timer does not work with the ignition key on.

**55.**

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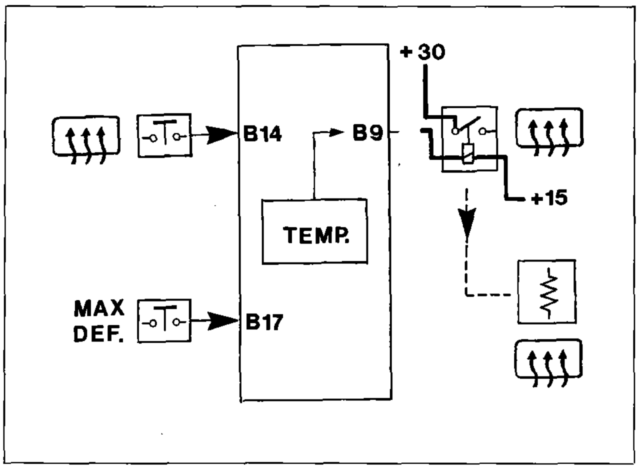



P4A88HL02

- 6 second when the door is reclosed to allow the driver to enter the car and turn the ignition key on;
- 6 seconds when the door is reclosed to allow the driver to enter the car and insert the ignition key. The timer locks when the ignition is turned on;
- 6 seconds when the ignition key is taken out;
- 3 minutes to prevent the battery charging if the door is accidentally left open.

**NOTE** *When any of the doors is opened, the timer begins again from zero.*

### TIMED OPERATION OF THE HEATED REAR WINDOW (and door mirrors)

The control unit operates the heated rear window (and the door mirrors demister coils) on a timer as follows:
- key turned ON;
- an activation signal is received from the switch on the facia;
- an activation signal is received from the air conditioner (MAX DEF)

The power supply ceases if:
- the key is turned to STOP or taken out
- a deactivation signal is received from the switch on the facia;
- a MAX DEF function deactivation signal is received.

If one of these two signals is not received, the timer keeps the coils activated for 20 MINUTES, but a specific system is applied:
- the power supply stays on AT ALL TIMES for the first 10 MINUTES;
- During the SUBSEQUENT TEN MINUTES, the power is cut off if battery voltage drops below 11.6 V (and is restored if voltage rises to more than 13V).

Once the first 20 minutes of operation have elapsed, the heated rear window relay control working cycle is 2 minutes active and 2 minutes deactive until the heated rear window control switch is turned off. During the active stage, battery voltage affects operation as described previously. When the rear window remains active, the warning light is turned on.

**NOTE** *A command from the facia switch always takes priority over the MAX DEF function, i.e. if the rear window is turned on using the MAX DEF command and the facia switch is pressed, the heated rear window will go off.*

Bravo/Brava

## Click here to choose chapter



Back

This supplement contains the main rules to be followed for the repair and maintenance of the right hand drive version of **Fiat Bravo and Fiat Brava cars.**

For further information, consult the left hand drive version of the Fiat Bravo and Fiat Brava manual.

**COMPOSITION OF RIGHT HAND DRIVE VERSION**

| Publication no. | Sections | Number of pages | Notes |
|---|---|---|---|
| 508.876 | 10 | 1 - 4 | 1370 12v engine fuel system |
| | | 5 - 7 | 1910 TD 75 engine fuel system |
| | 18 | 1 - 8 | Components and operation<br>1370 12 clutch operation |
| | | 9 - 11 | 1910 TD 75 clutch operation |
| | 33 | 1 - 12 | 1370 12v clutch operation |
| | | 13 - 17 | 1910 TD 75 clutch operation |
| | 41 | 1 - 7 | Operation |
| | 50 | 1 - 4 | Heater with manual controls |
| | 55 | 1 - 7 | Removal and refitting |
| | 70 | 1 - 15 | Removal and refitting |

# Graphic representations and symbols

| | |
|---|---|
| Remove<br>Disconnect | Intake |
| Refit<br>Connect | Exhaust |
| Disassemble<br>Dismantle | Operation |
| Refit<br>Compose | Tolerance<br>Weight difference |
| Tighten to torque | Preload |
| Tighten to torque<br>plus angle | Rotate |
| Fully tighten | Compression<br>ratio |
| Stake nut | Select<br>categories |
| Adjust<br>Regulate | Oversized<br>Oversized to ....<br>Maximum — Undersized<br>Undersized to ....<br>Minimum |
| Visual check<br>Check | Rpm |
| Attention | Ratio |
| Lubricate<br>Damp | Pressure |
| Change<br>Original parts | Temperature |
| Bleed braking<br>system air | Temperature <0°C<br>Cold<br>Winter |
| Surfaces to be machined<br>After machining | Temperature >0°C<br>Warm<br>Summer |
| Interference<br>Press-fit | Windscreen wiper<br>with pump<br>washer fluid |
| Dimension to measure<br>Measurement – Check<br>Thickness - Clearance | Rearscreen wash/wipe<br>with pump<br>rear washer fluid |
| Rolling torque | Engine |

# 10.

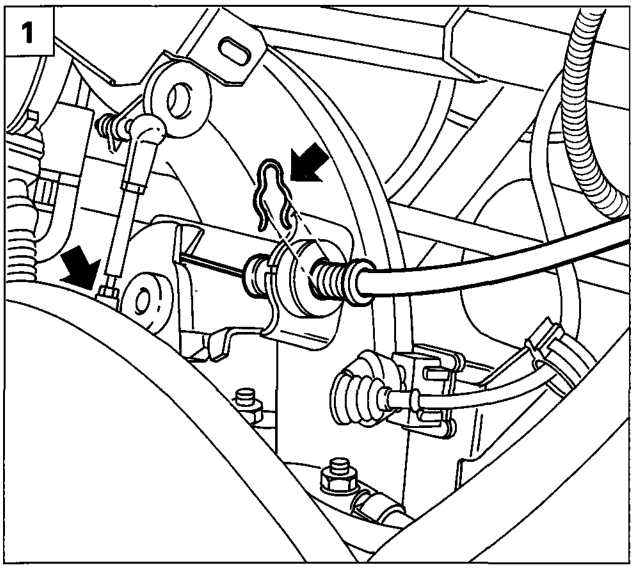
page

## FUEL SYSTEM

**1370** ***12v***



**1910** ***TD 75***



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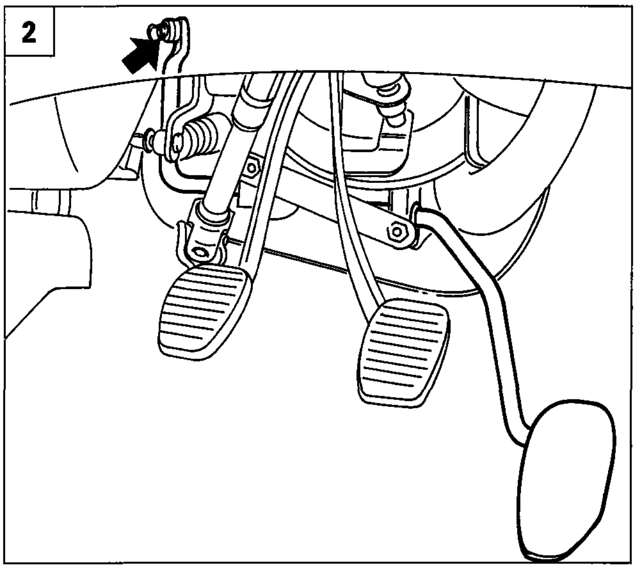

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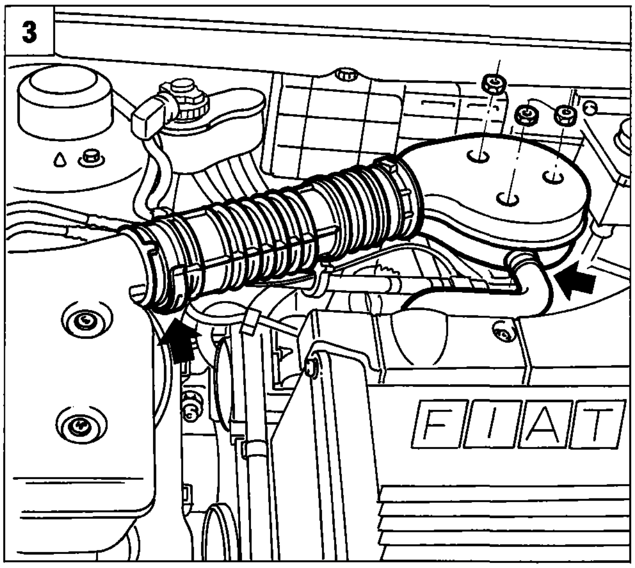
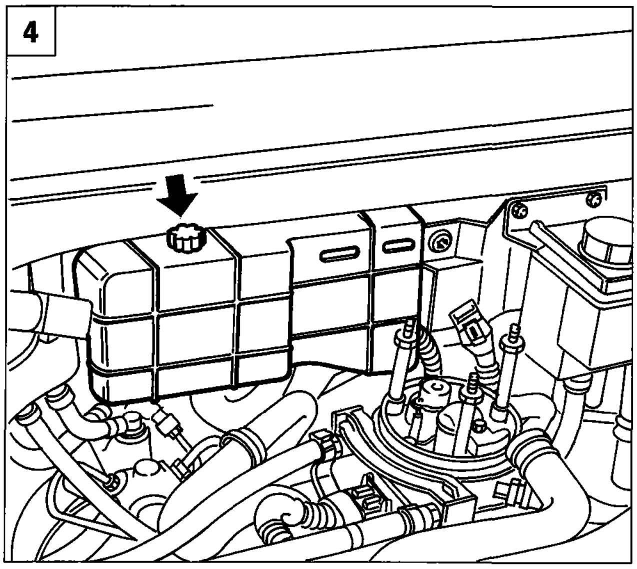


P4A01DA03

## REMOVING-REFITTING ACCELERATOR CABLE

Disconnect the battery negative terminal, then proceed as follows:

1. In the engine bay, turn the throttle valve control lever and release the accelerator cable. Remove the clip, then withdraw the cable from the bracket.
2. Working from inside the car, remove the left foot rest, then disconnect the control cable from the anchorage on the accelerator pedal.
3. Remove the pipe connecting the air cleaner to the butterfly valve case.
4. Remove the relay unit protective cover.
5. Unscrew the relay bracket retaining bolts and position unit to one side.



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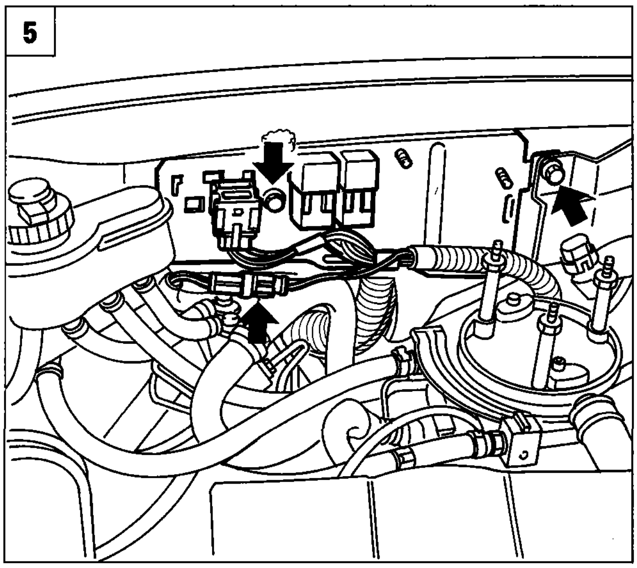

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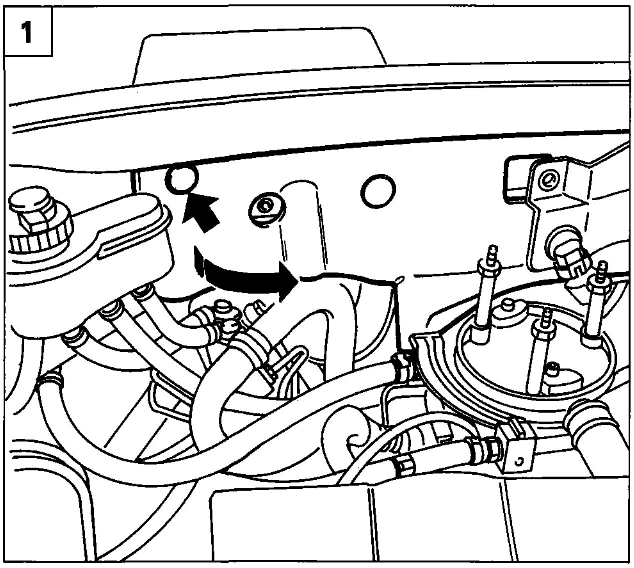

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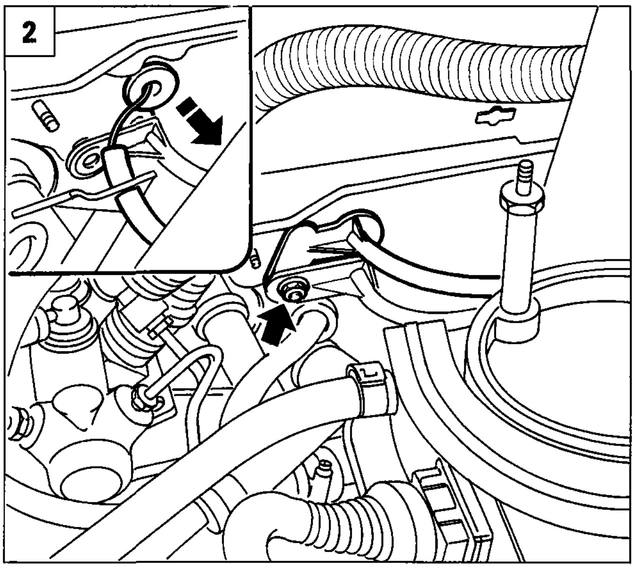

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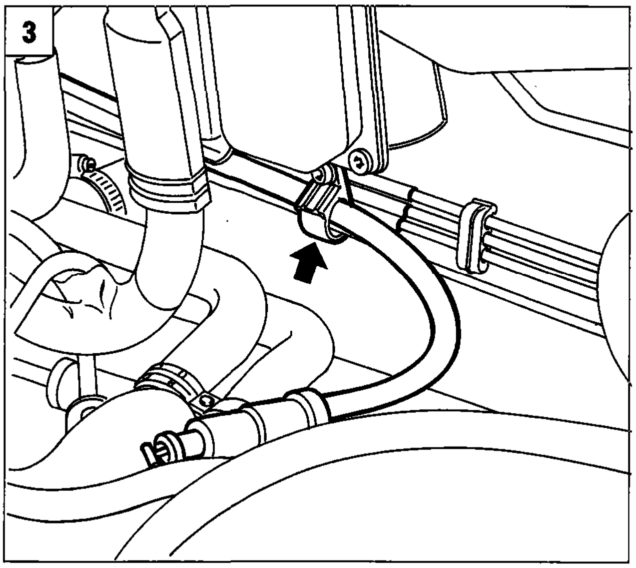

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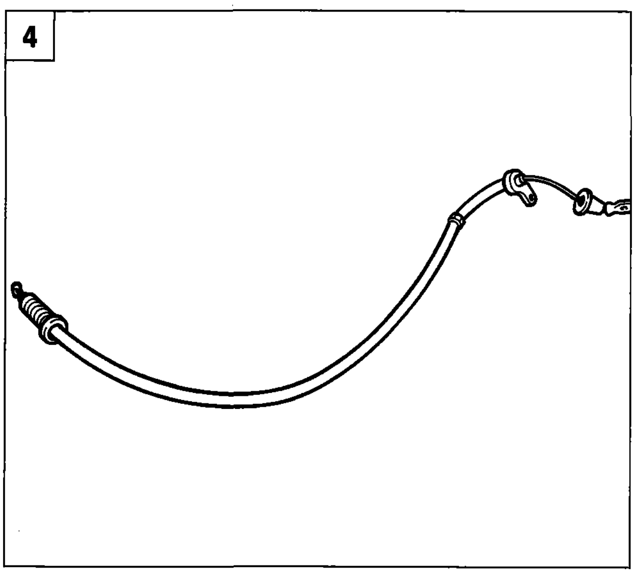
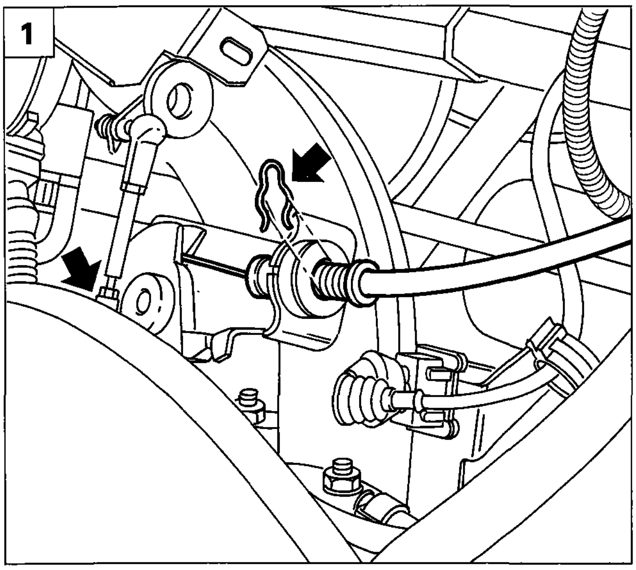


P4A02DA04

1. Remove the stud shown in the figure and move the lining of the bulkhead between engine bay and passenger compartment to one side.
2. Unscrew the bolt retaining the accelerator cable ducting device, on the bulkhead between engine bay and passenger compartment. Also remove the underlying rubber block in order to free the hole and allow removal of the cable.
3. Release the accelerator cable from the retaining clip located beneath the injection control unit.
4. Withdraw the cable through the hole in the bulkhead between engine bay and passenger compartment and remove from the engine bay.

*When refitting, adjust the cable as described in the paragraph "Adjusting throttle cable" in Section 10 "Fuel system" for the left hand drive version.*



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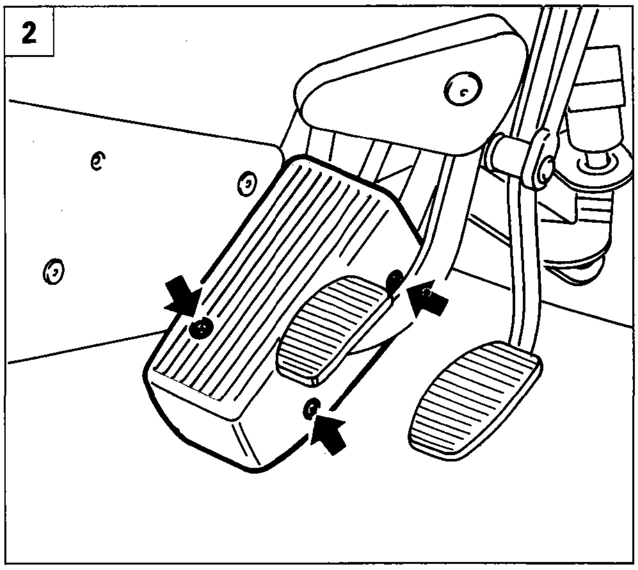

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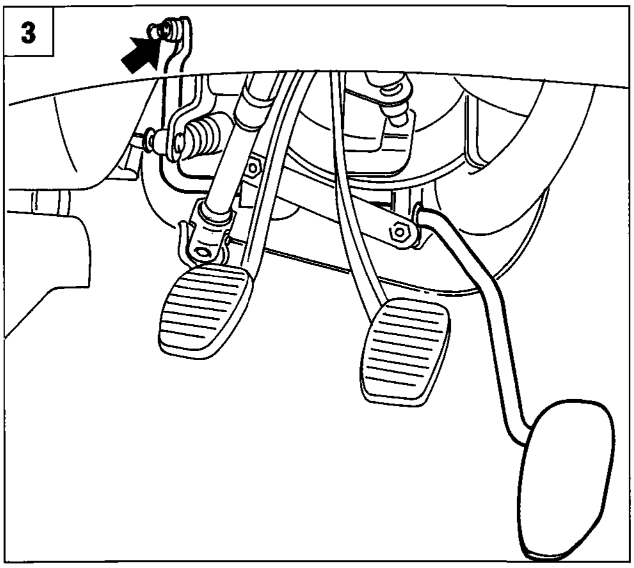

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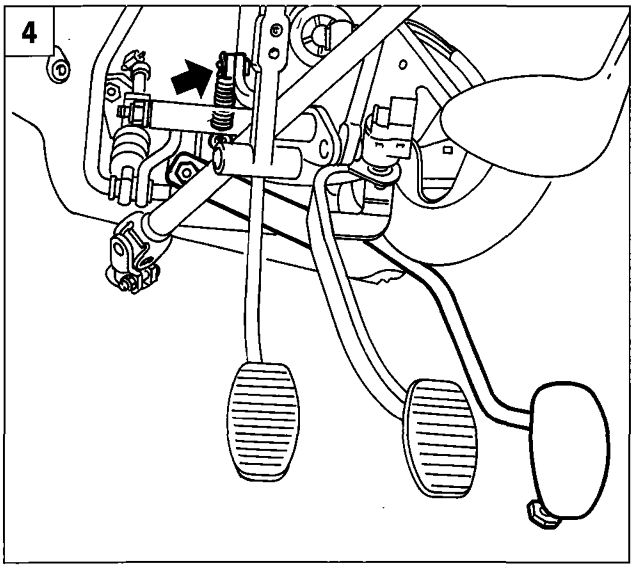

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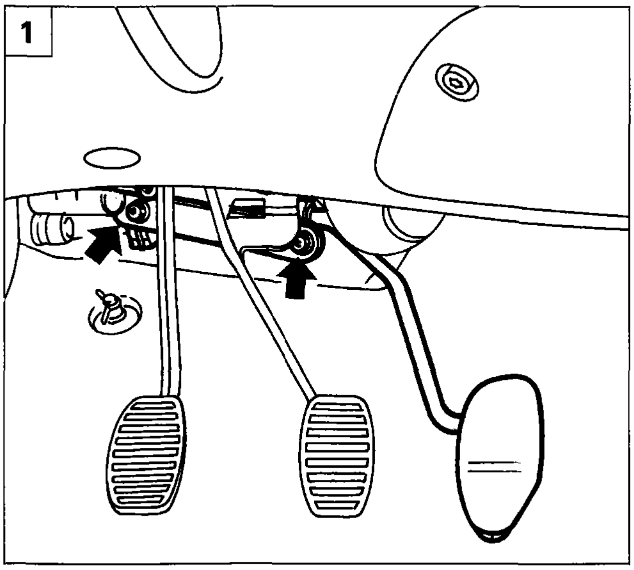
## REMOVING-REFITTING ACCELERATOR PEDAL

Disconnect the battery negative terminal, then proceed as follows:

1. In the engine bay, turn the throttle valve lever and release the accelerator cable. Remove the clip and withdraw the cable from the bracket. This operation is necessary to facilitate removal of the accelator cable from the control pedal.
2. Working from inside the car, remove the left foot rest by undoing the retaining bolts shown in the figure.
3. Disconnect the control cable from the anchorage on the accelerator pedal.
4. Disconnect the clutch pedal reaction spring (attached to the accelerator pedal bracket) by removing the roll pin indicated.

# 10.

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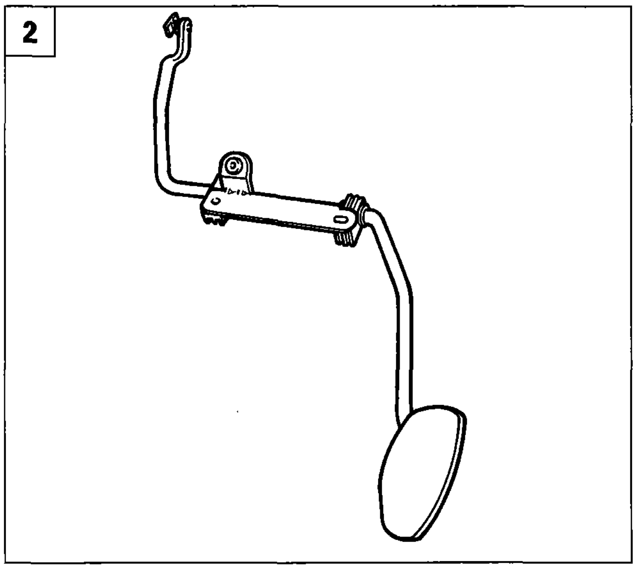


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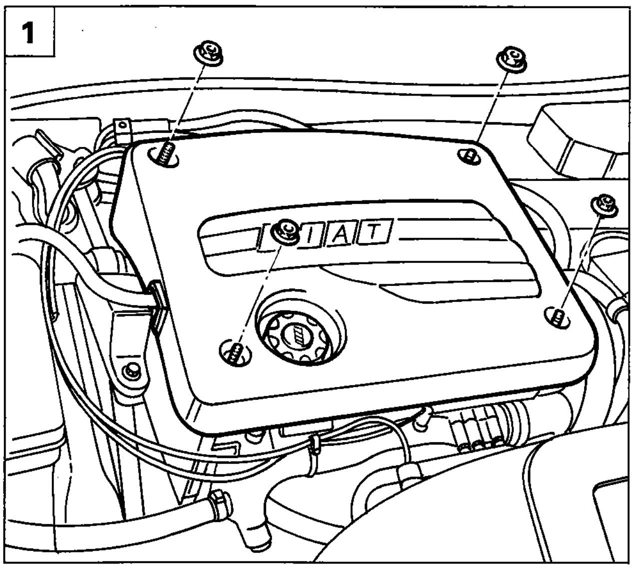
1-2. Unscrew both nuts retaining the accelerator pedal bracket, then remove from the car.



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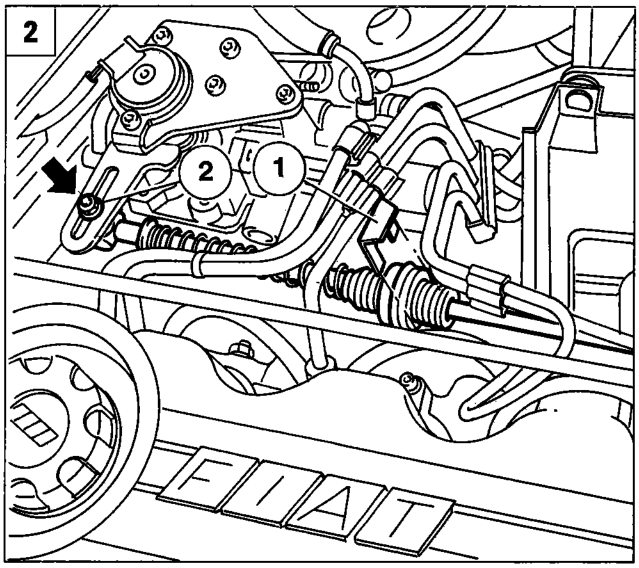

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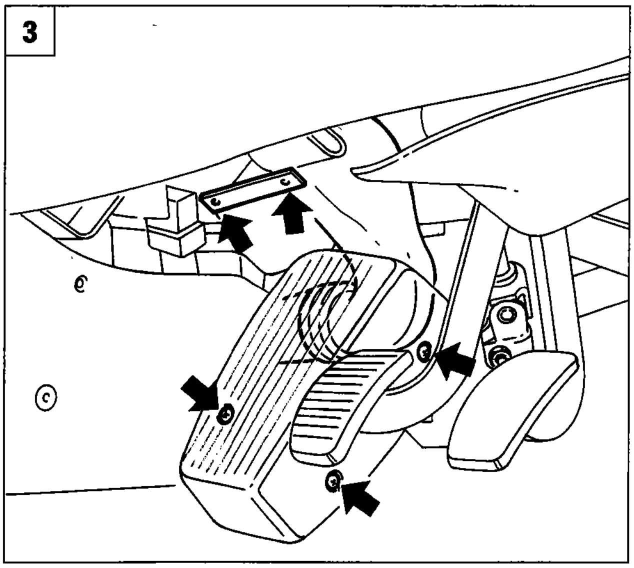

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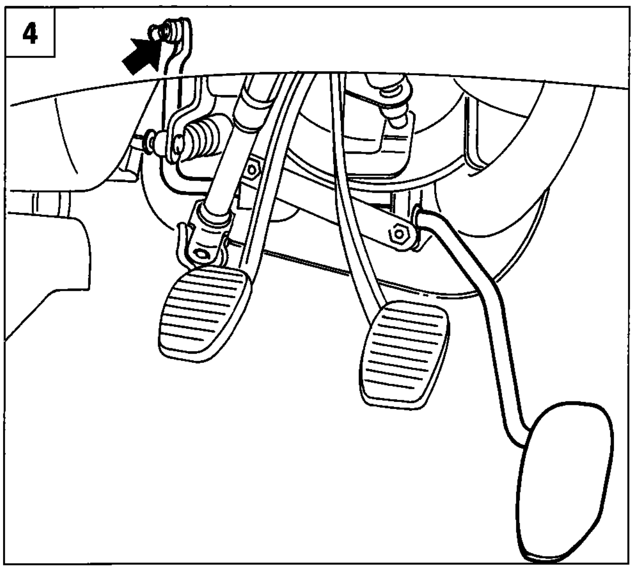


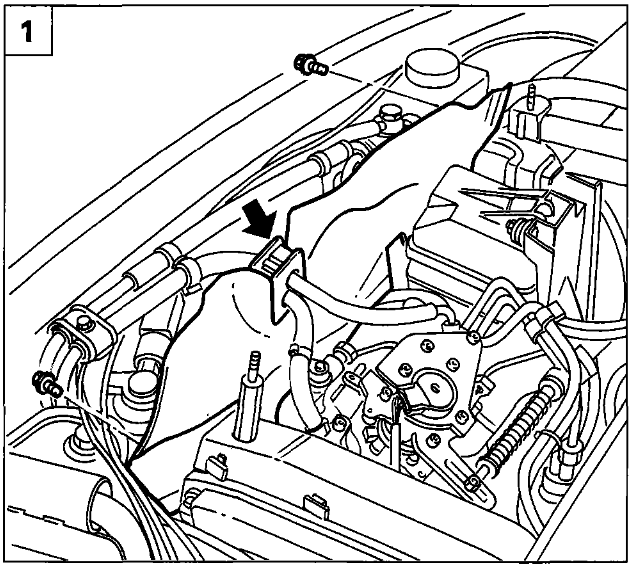
P4A01DA02

## REMOVING-REFITTING ACCELERATOR CABLE

Disconnect the battery negative terminal, then proceed as follows:

1. Remove the upper cam cover protection.
2. In the engine bay, release the accelerator cable by taking out retaining clip (1) and unscrewing nut (2).
3. Working from inside the car, remove the left foot rest and unscrew the bracket retaining the air hose shown. Disconnect the pipe from below to allow access to the cable anchorage on the accelerator pedal.
4. Disconnect the control cable from its anchorage on the accelerator pedal.

# 10.



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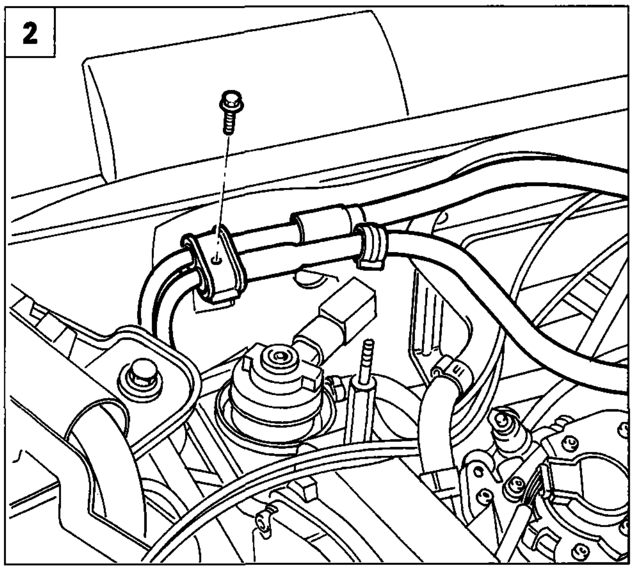

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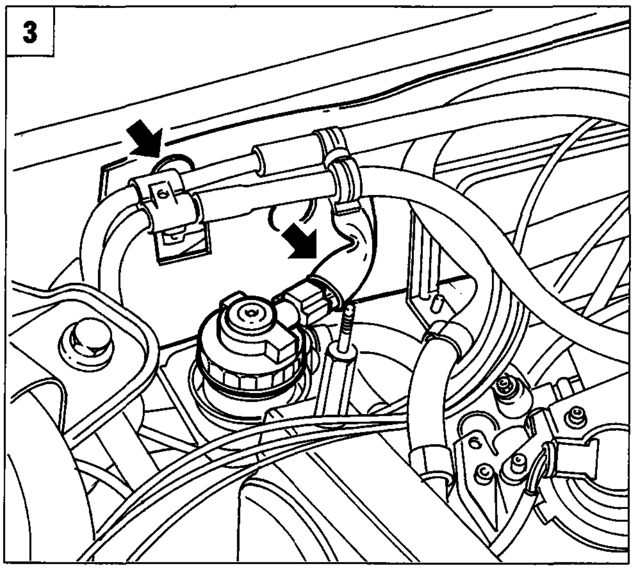

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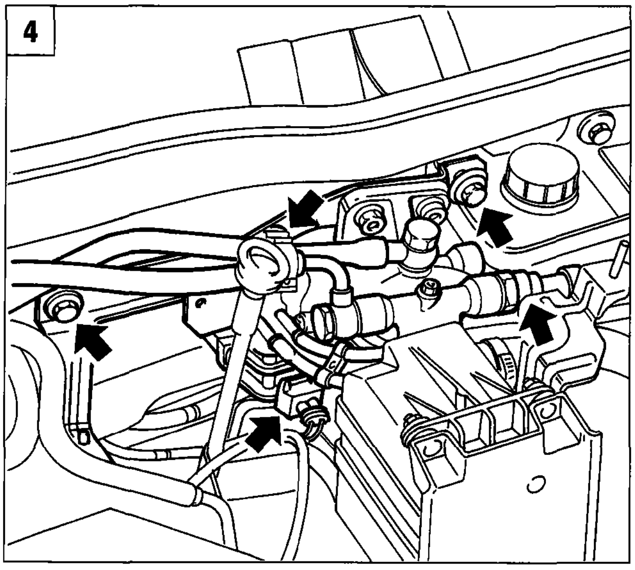
1. Remove the trim shown in the figure by undoing the retaining bolts and releasing the diesel lines from the retaining clip.
2. Remove the bolt retaining the bracket joining the fuel lines.
3. Disconnect the connector of the brake and clutch fluid level sensor, then remove the stud retaining the lining of the bulkhead between engine bay and cabin, and move the lining to one side.
4. Unscrew the bolts retaining the diesel filter bracket, disconnect the connections shown and position the bracket to one side.
5. Move the lining of the bulkhead between engine bay and cabin further to one side, then unscrew the nut retaining the accelerator cable to the bulkhead, remove the underlying rubber guide and withdraw the accelerator cable.



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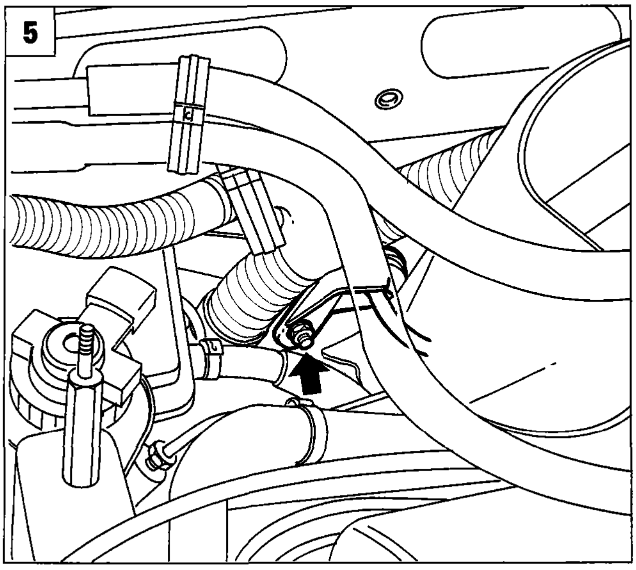

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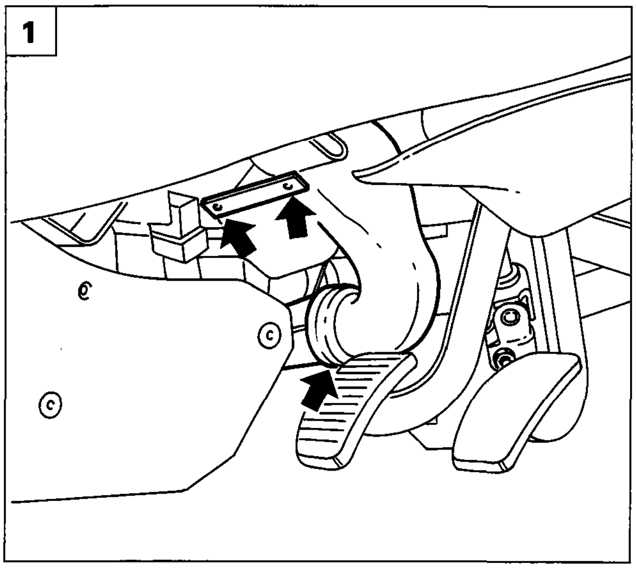


P4A07DA01

**REMOVING-REFITTING ACCELERATOR CONTROL PEDAL**

1. Proceed as described for the 1370 12v engine, *but remove the air pipe bracket* shown in the figure in order to release the pipe and gain access to the accelerator cable anchorage on the pedal.

page

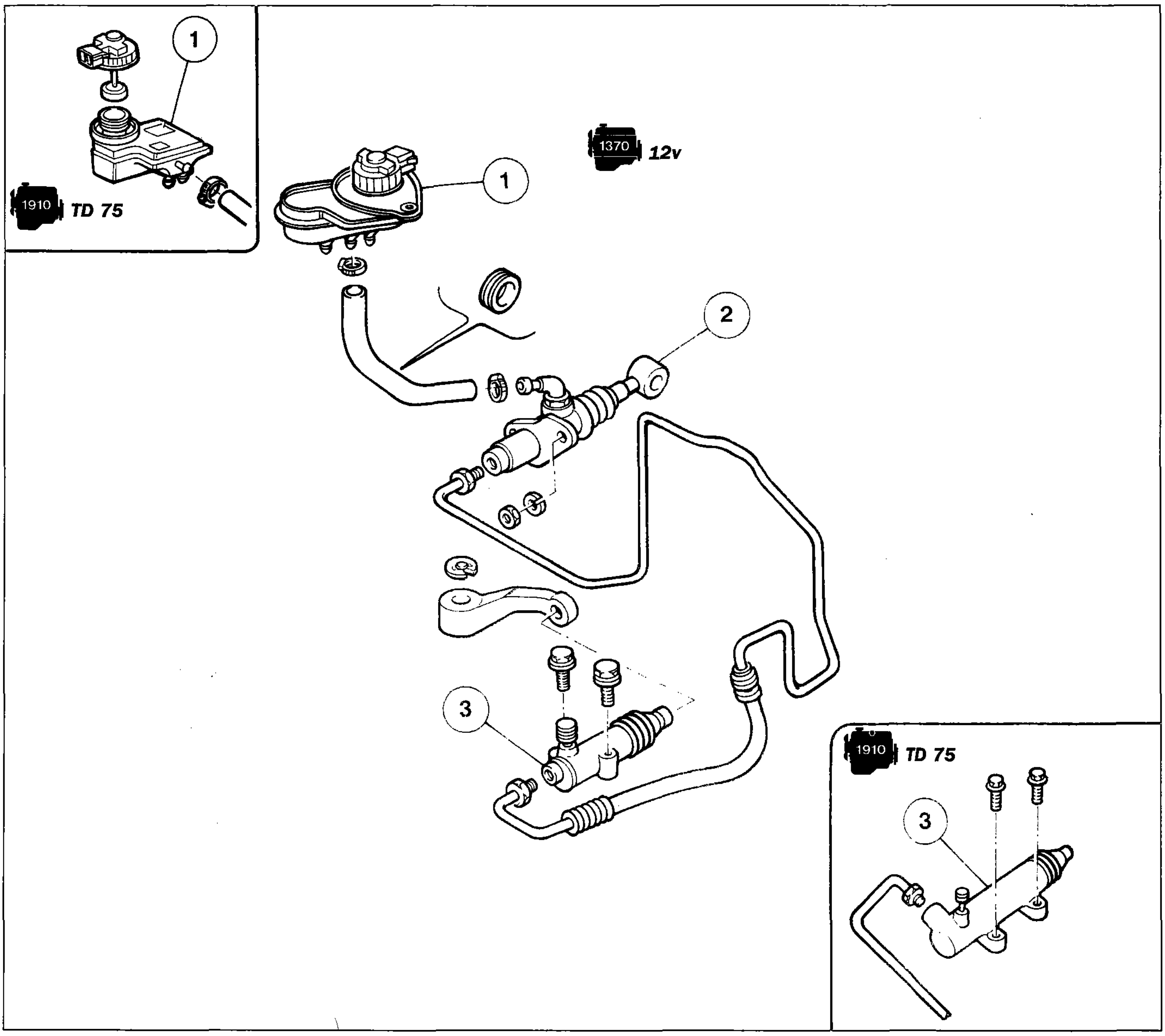
**CLUTCH WITH HYDRAULIC RELEASE MECHANISM**

Right hand drive versions are fitted with a hydraulic clutch release device. This device consists of a reservoir shared with the braking system (1), a pump (2) fastened to the pedal assembly and a slave cylinder (3) fastened to the clutch bell housing.

This hydraulic device is more efficient and reliable than the mechanical device. Clutch operation is also smoother and less jerky, particularly when high torques are transmitted.

The car is more comfortable to drive, because fewer vibrations are transmitted to the power unit due to the damping effect of the fluid.

The adoption of this device eliminates the need for periodic adjustment because play is eliminated and wear on the driven plate is taken up automatically.

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**Operation**

The clutch is single, dry plate type, with a hydraulic release device and thrust bearing constantly in touch with the thrust spring. The driven plate is controlled by pressure exercised by a diaphragm spring.

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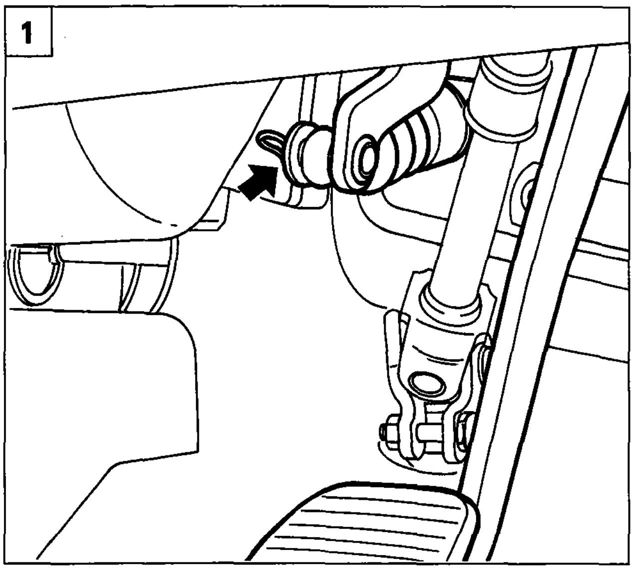


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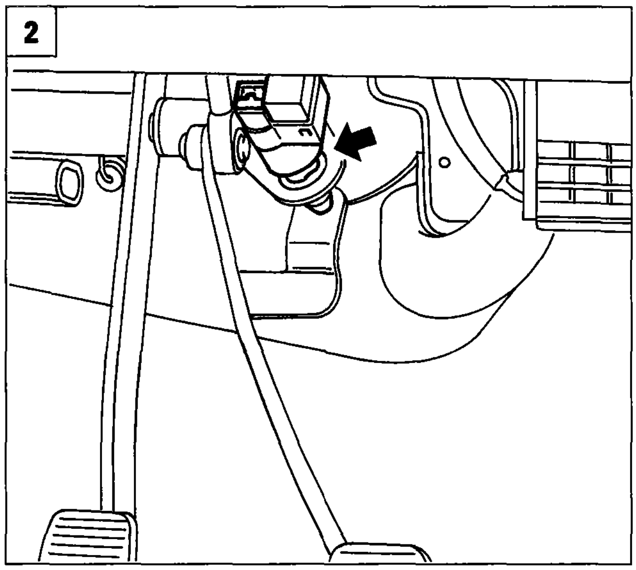


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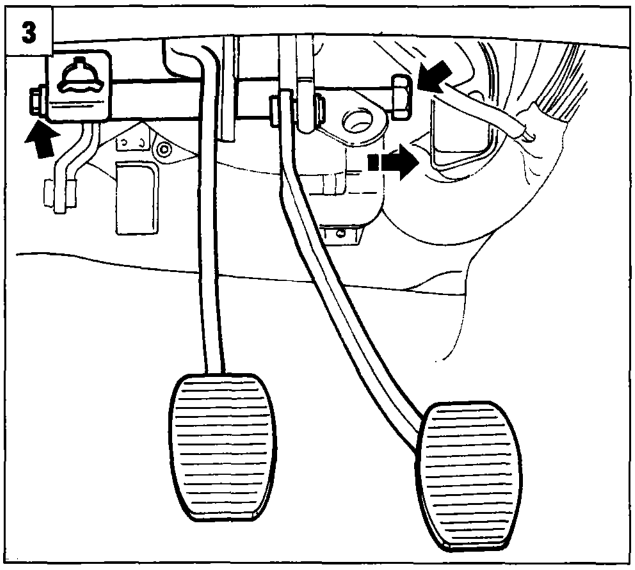


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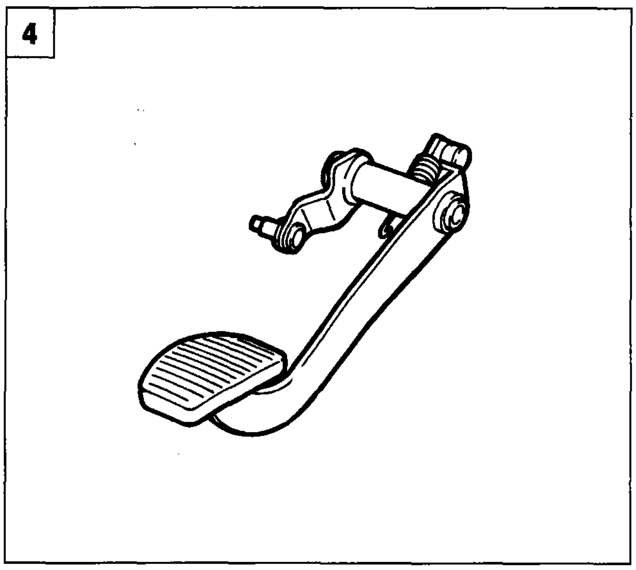


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### REMOVING-REFITTING CLUTCH PEDAL

*Before removing the clutch pedal, remove the accelerator pedal as described in "Section 10 - Fuel system".*

1. Remove the roll pin retaining the clutch pump rod to the pedal.

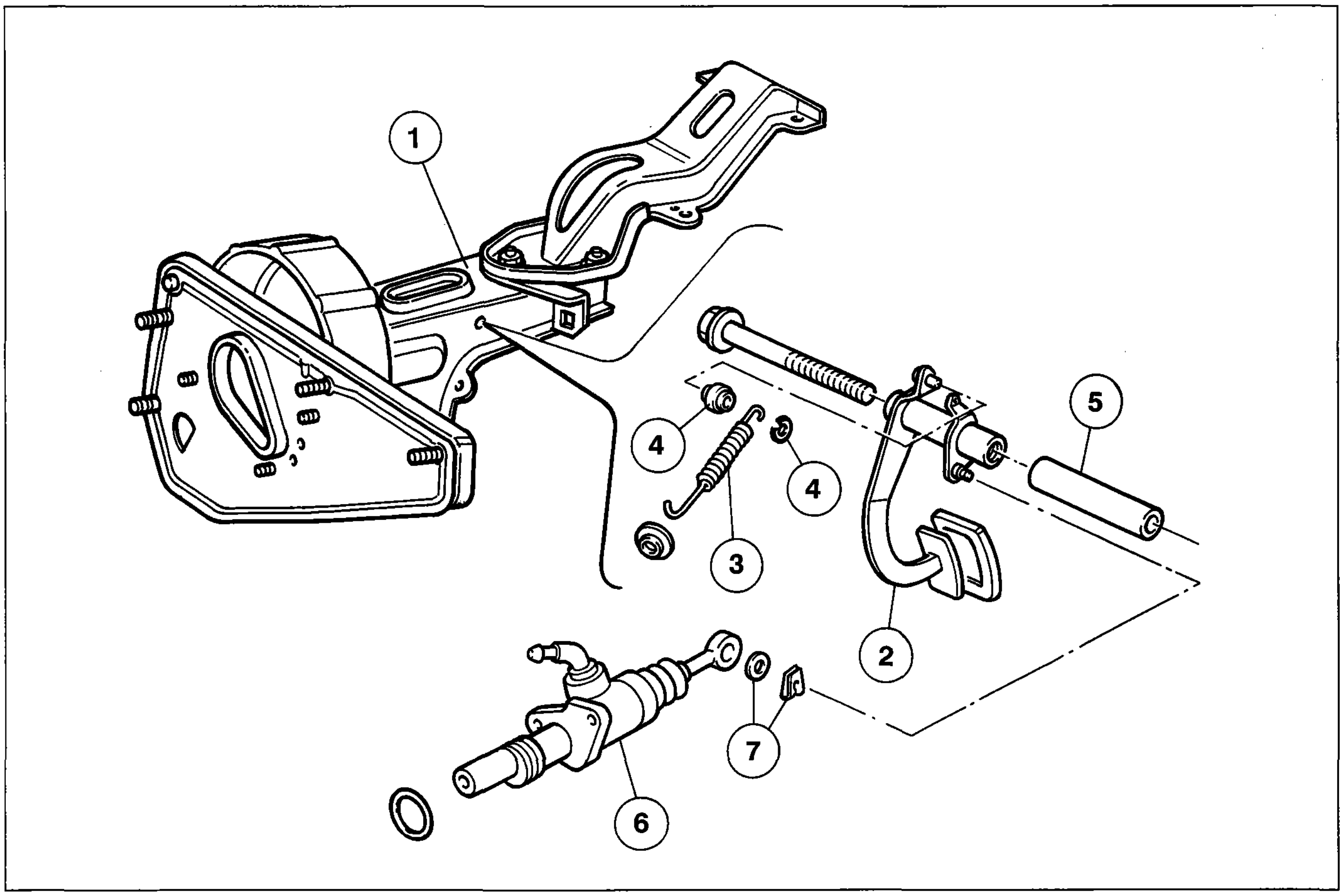
2. Remove the car brake light switch to facilitate access to the clutch and brake pedal retaining bolt.

3. Unscrew the bolt retaining the clutch and brake pedal, withdraw in the arrowed direction until the clutch pedal is released.

*If brake pedal removal is not required, do not take the bolt retaining the clutch and brake pedal any further out.*

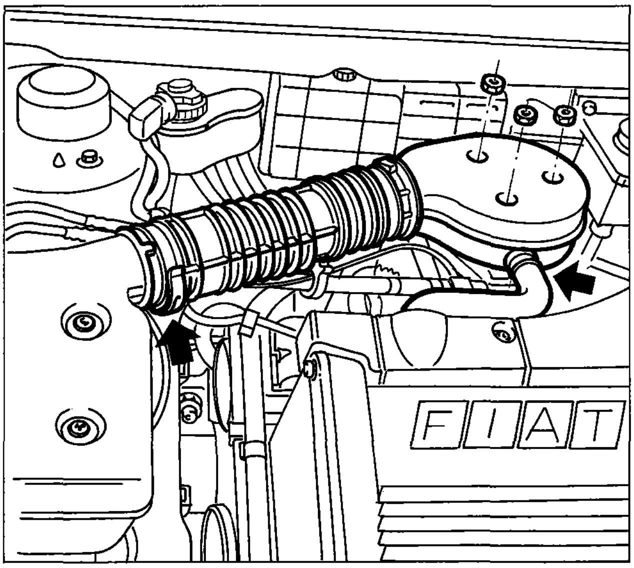
4. Release the clutch pedal from the clutch pump rod and remove from the pedal unit.

**Components of clutch pedal**




P4A11DA01

1. Pedal unit
2. Clutch pedal
3. Clutch pedal return spring
4. Roll pin and bush retaining spring to clutch pedal
5. Bush
6. Clutch pump
7. Roll pin and washer retaining clutch pump rod to pedal



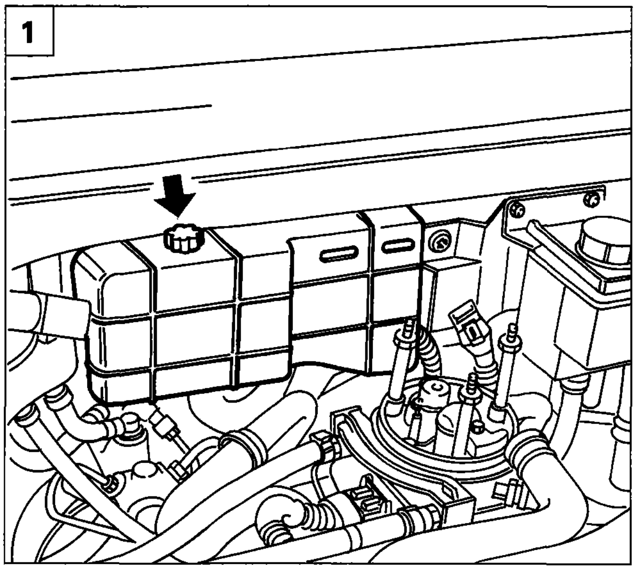

P4A01DA03

## REMOVING-REFITTING CLUTCH PUMP

1. Remove pipe connecting air cleaner to butterfly valve case by undoing the fastenings shown in the figure.

# 18.

1



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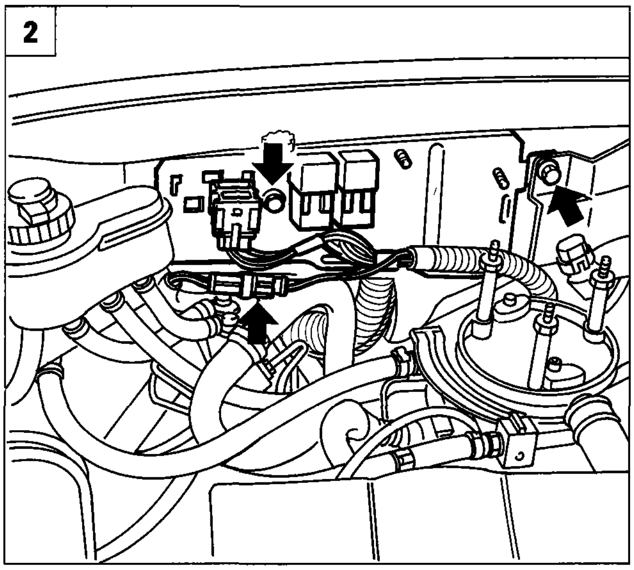

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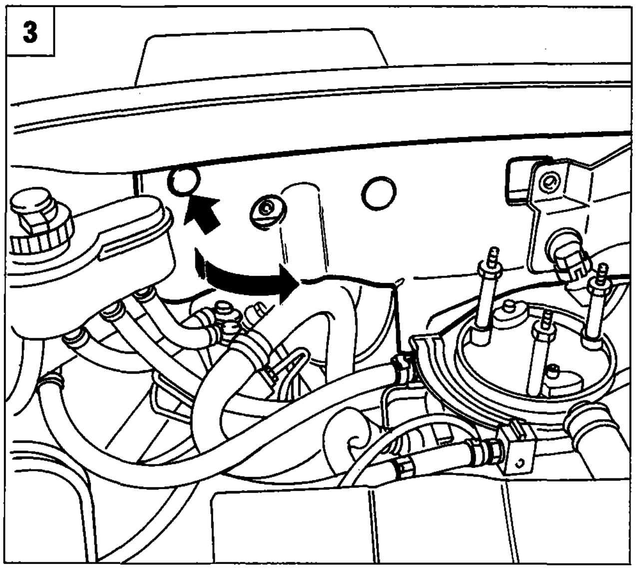
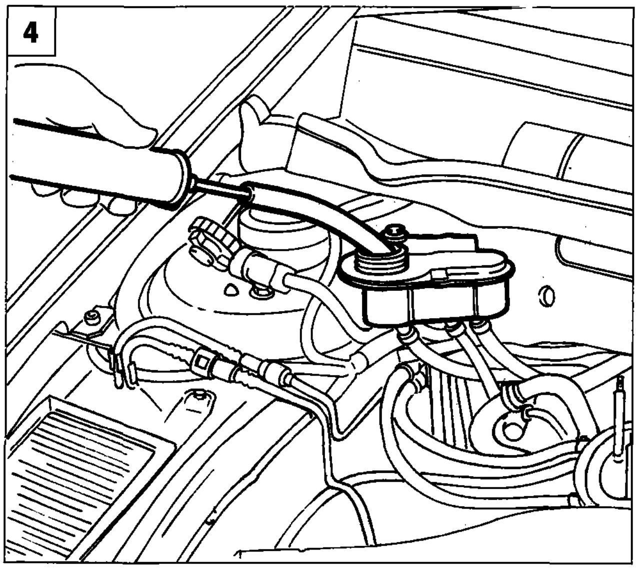


P4A02DA01

1. Remove the relay protective cover.
2. Unscrew both nuts retaining the relay bracket, disconnect the connection indicated and position the bracket to one side.
3. Remove the stud retaining the lining of the bulkhead between lining to one side.
4. Drain the brake and clutch fluid from the reservoir after disconnecting the level gauge connector and removing the reservoir cap.
5. Disconnect the central line connected to the clutch pump, marked "FRIZ", from the reservoir.

4



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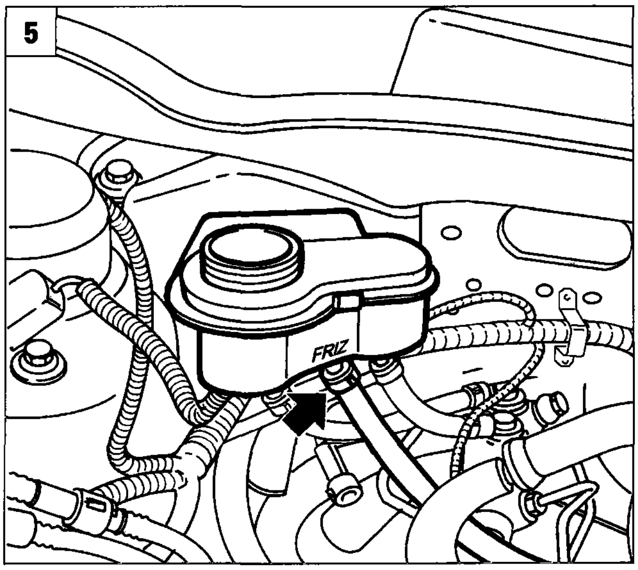


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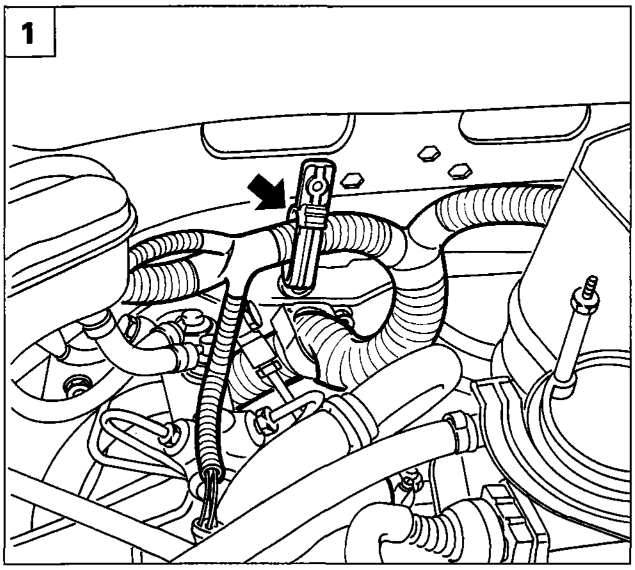


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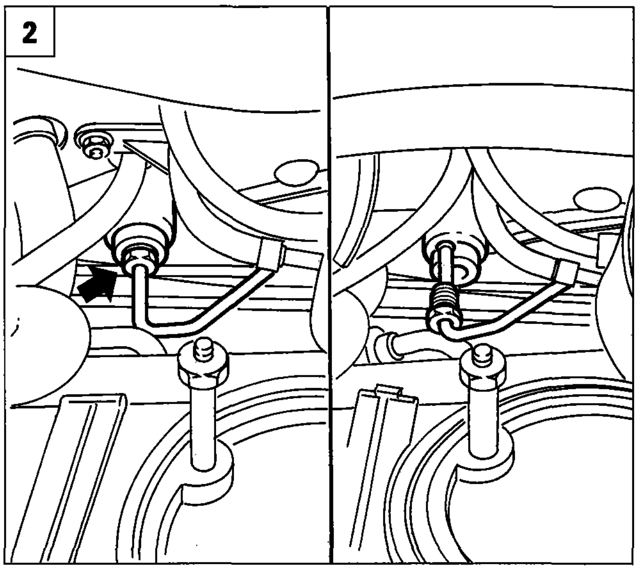


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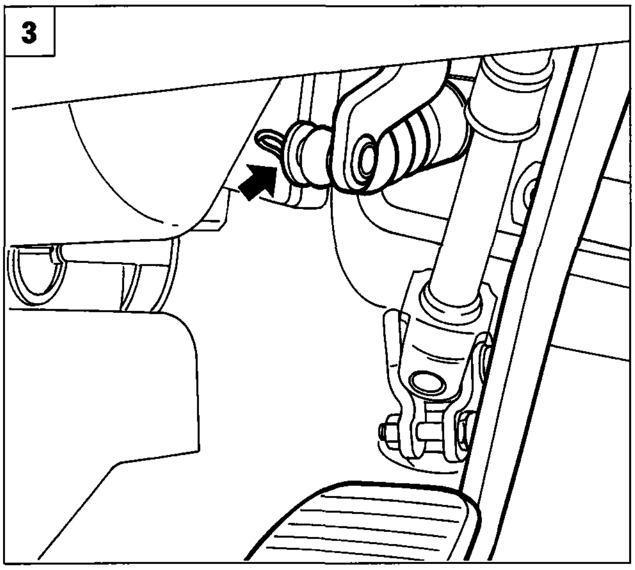


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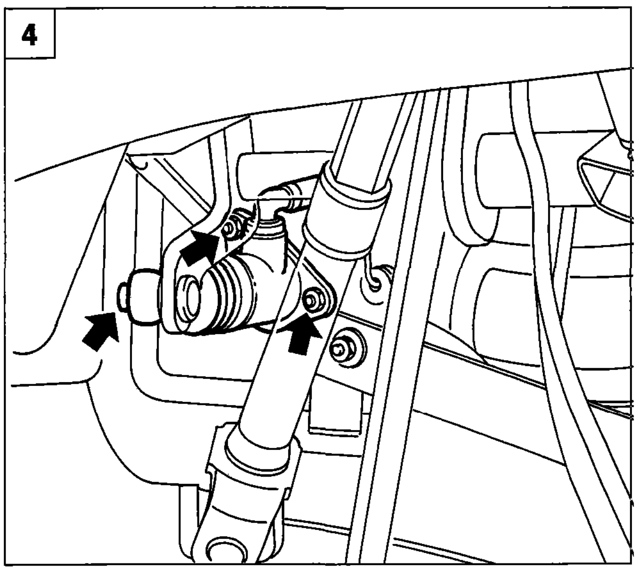
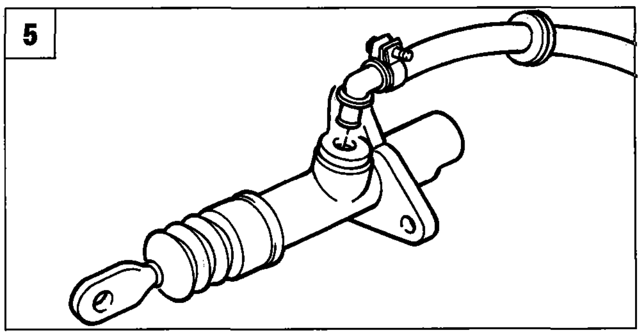



P4A13DA03

1. Release the injection wiring bundle from the retaining clip to allow access to the fitting of the pipe connected to the slave cylinder on the clutch pump.
2. Disconnect the fitting of the pipe connecting clutch pump - slave cylinder.
3. Working from inside the car, remove the roll pin retaining the clutch pump rod to the pedal.
4. Unscrew the nuts retaining the clutch pump to the body take out slightly in order to release the rod from the clutch pedal, then remove complete with connection pipe leading to the reservoir.
5. Working on the bench, separate the clutch pump from the pipe connected to the reservoir.

*Reverse disassembly instrutions to assemble. To refit the pump connection line to the reservoir, first position the rubber fitting over the hole in the body, and then thread the pipe from inside the car into the engine bay.*

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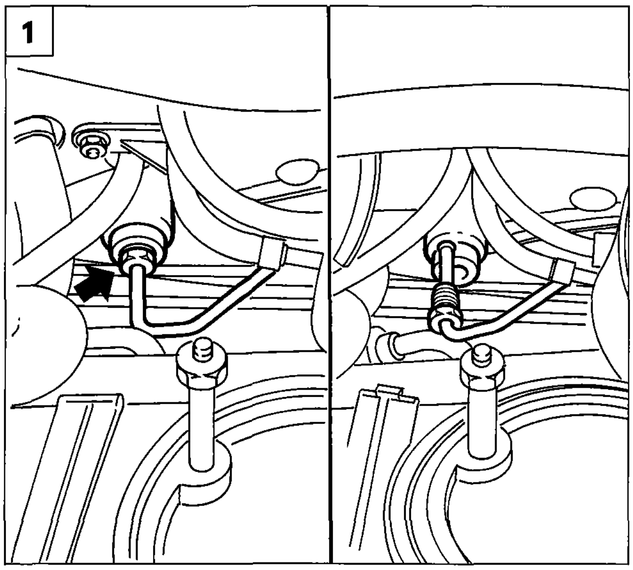


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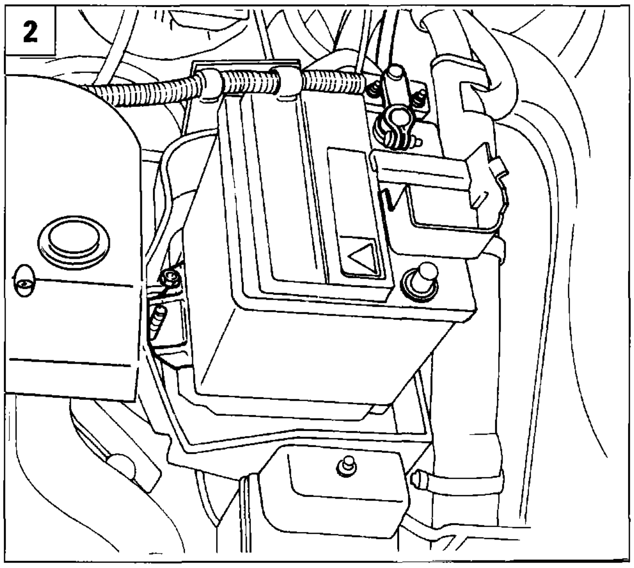


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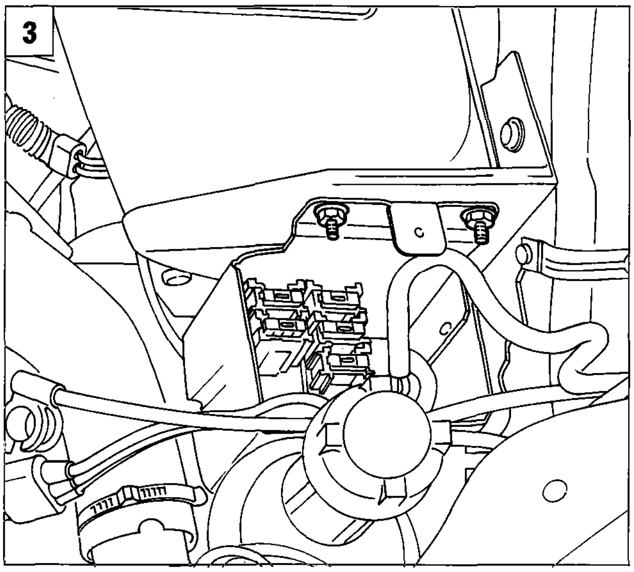


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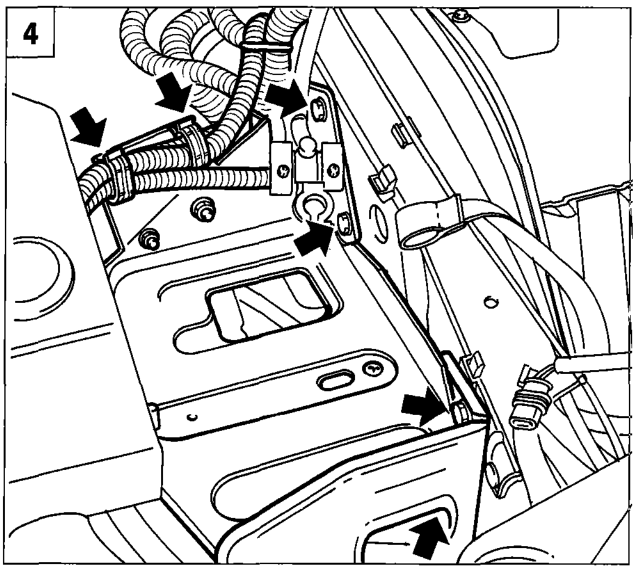


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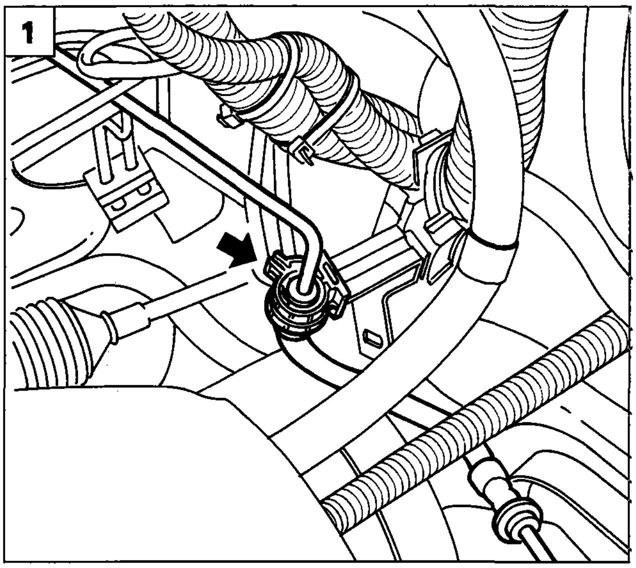
4A14DA

## REMOVING-REFITTING PIPE CONNECTING CLUTCH PUMP - SLAVE CYLINDER

*Working inside the engine bay, remove the same parts as removed to disconnect the clutch pump to gain access to the fitting of the line connected to the slave cylinder on the pump.*

1. Unscrew the fitting of the line connecting the pump to the slave cylinder on the clutch pump.
2. Disconnect the leads from the battery negative terminals, then remove by unscrewing the nut securing the retaining bracket.
3. Remove the relay box cover, then unscrew the nut retaining the box to the battery cradle and position to one side.
4. Release the electrical leads shown in the figure from their retaining clips, then remove the battery cradle by undoing the retaining bolts indicated.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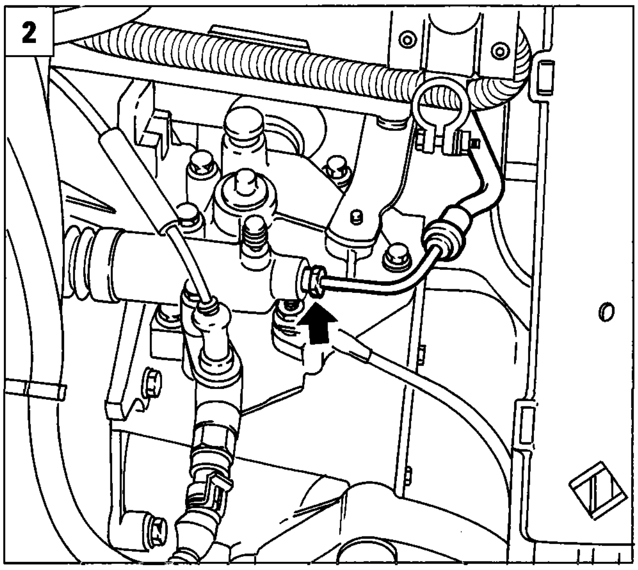
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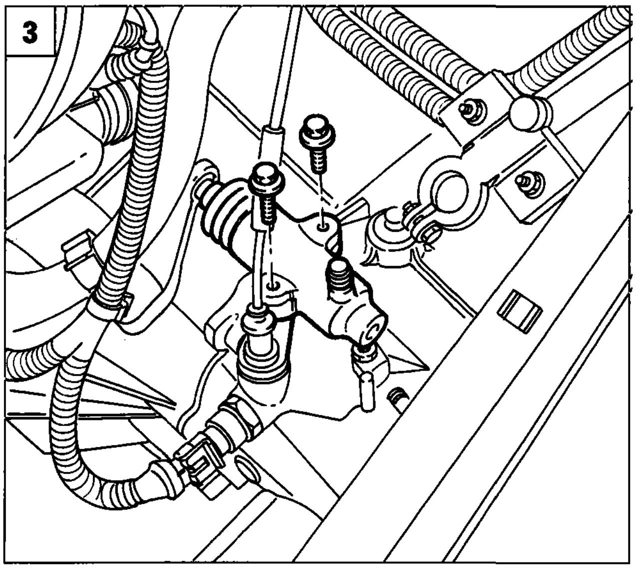
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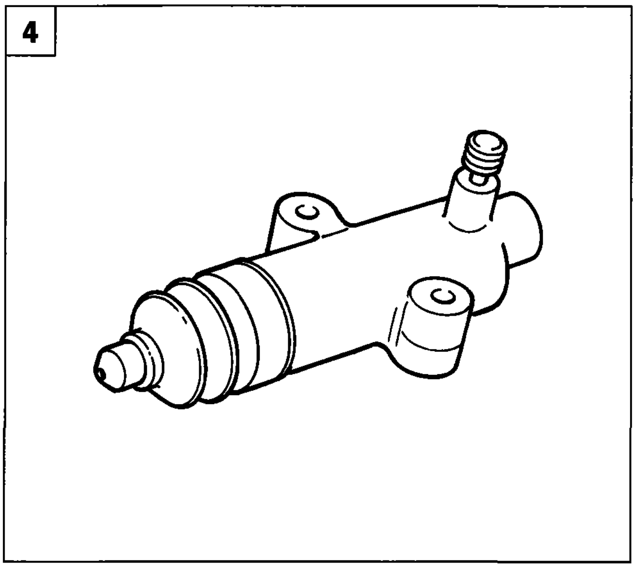
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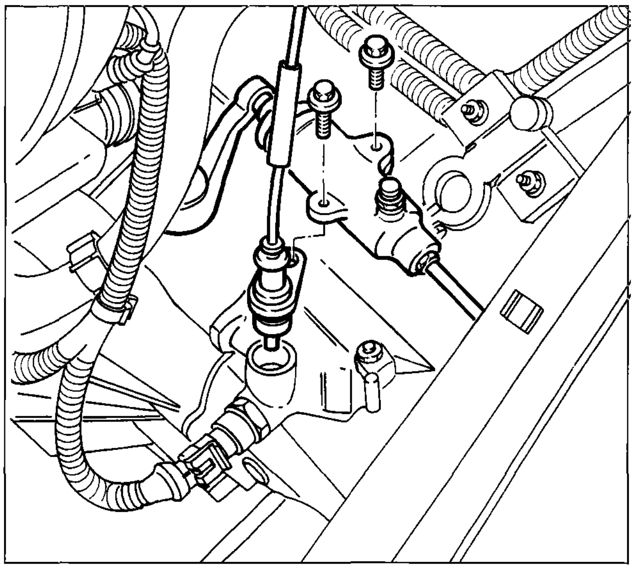
1. Release the pipe connecting clutch pump - slave cylinder from the retaining clip shown in the figure.
2. Disconnect the pipe fitting on the slave cylinder and then remove the pipe.

## REMOVING-REFITTING SLAVE CYLINDER

Remove: battery, relay box, battery cradle as described for removal of the clutch pump connection pipe - slave cylinder. Also disconnect the pipe connecting clutch pump - slave cylinder on the slave cylinder.

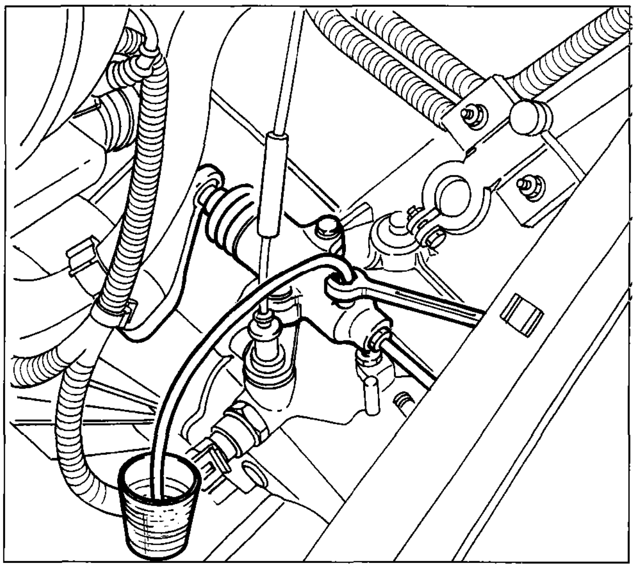
3-4. Unscrew the bolts retaining the slave cylinder and remove from the engine bay.

# 18.



P4A16DA01

**NOTE** *Proceed as described for the left hand drive version to remove the reverse inhibitor, Note, however, that the bolt retaining the inhibitor also secures the clutch slave cylinder; remove the latter without disconnecting the fittings. It will now be possible to disconnect the reverse inhibitor as shown in the figure.*



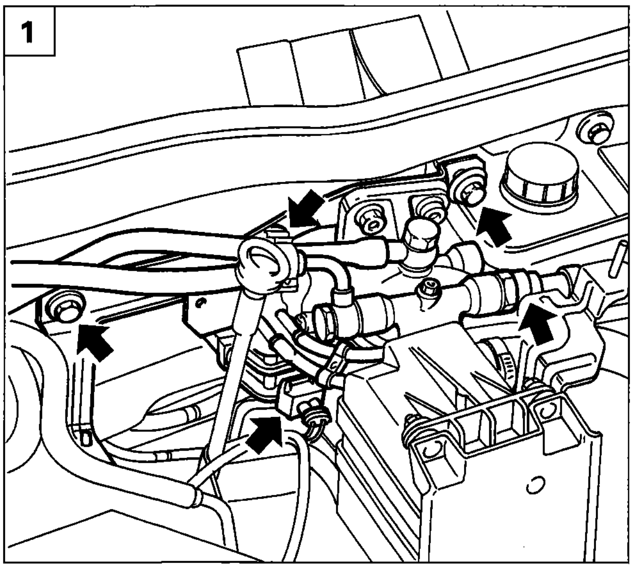
P4A16DA02

**BLEEDING**

Connect the end of a hose to the clutch slave cylinder bleed screw and insert the opposite end in a suitable container. Fill the brake and clutch fluid reservoir, then bleed the clutch system by loosening the bleed screw on the slave cylinder. Simultaneously press down the clutch pedal and allow it to return slowly. Repeat the operation until all air bubbles have been removed. With the clutch pedal pressed to the floor, tighten the bleed screw and remove the pipe.

*During the bleeding operation, keep the fluid level in the tank above the MIN mark. Do not reuse fluid drained during the disassembly and bleed stages.*

Top up the fluid level in the reservoir and refit the cap. Lastly, check the efficiency of the hydraulic clutch system.

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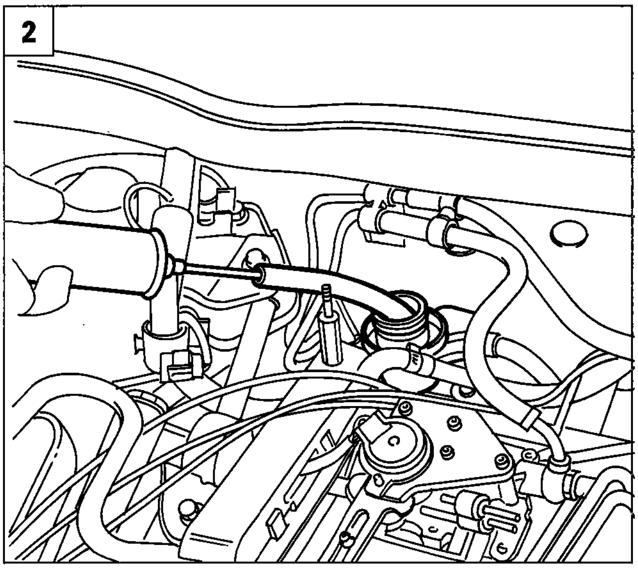


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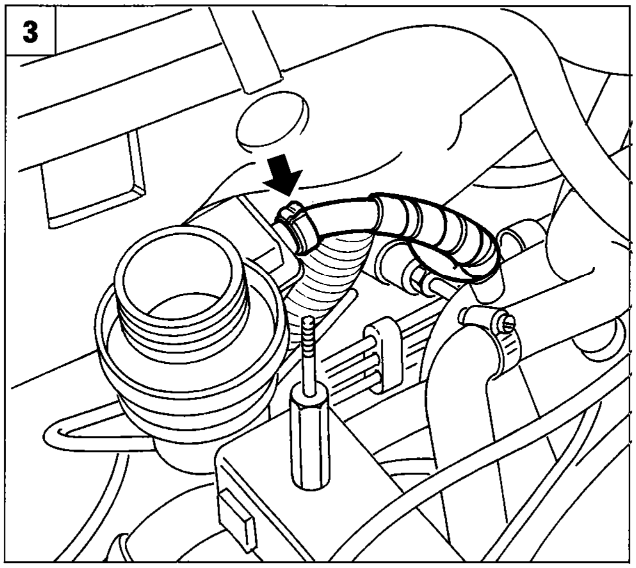
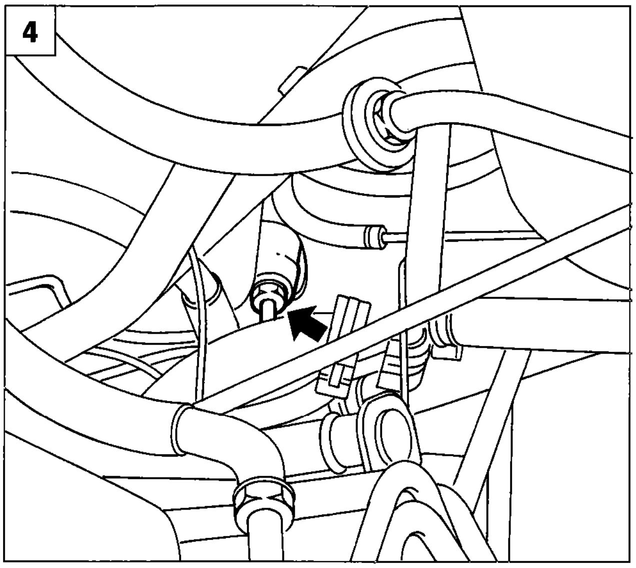



P4A17DA02

### REMOVING-REFITTING CLUTCH PUMP

1. After removing the upper cam cover protection and the guard in front of the brake and clutch fluid reservoir, unscrew the bolts retaining the diesel filter bracket, disconnect the connectors indicated and position the bracket to one side without disconnecting the diesel lines.
2. Drain the brake and clutch fluid from the reservoir.
3. Disconnect the pipe connected to the clutch pump from the brake and clutch fluid reservoir.
4. Disconnect the fitting of the line connected to the slave cylinder from the clutch pump.
5. From inside the car, remove the left foot rest and disconnect the air pipe from the points indicated, then position to one side.

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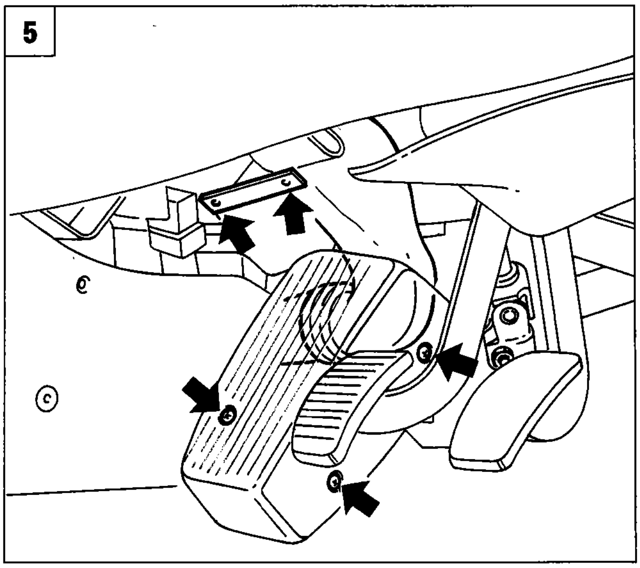


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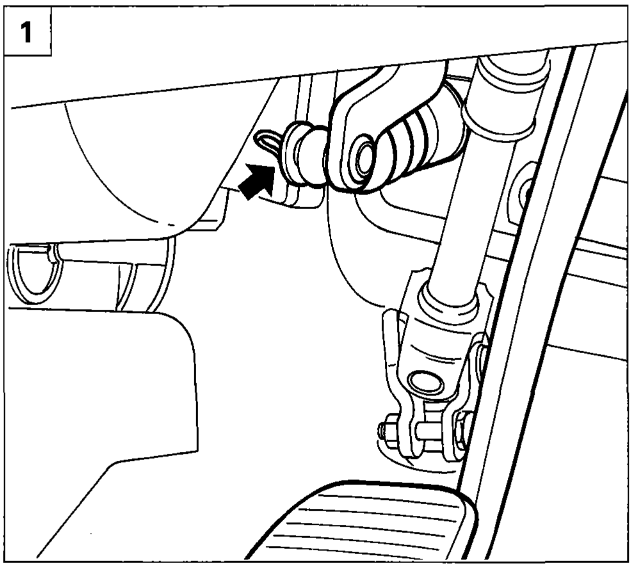
## 18.



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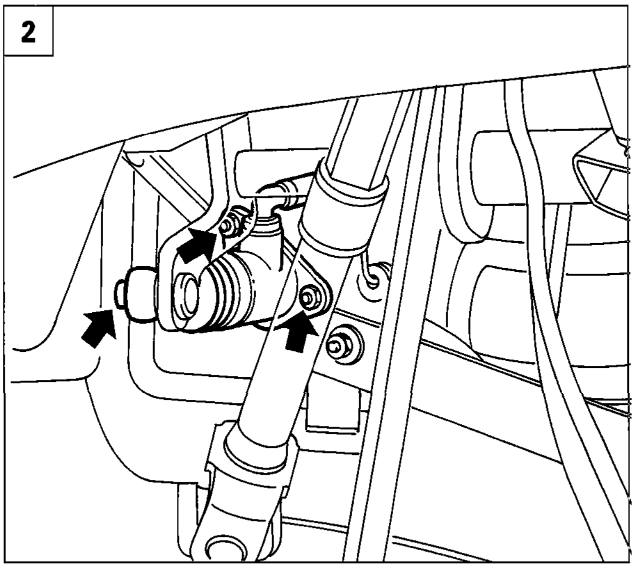

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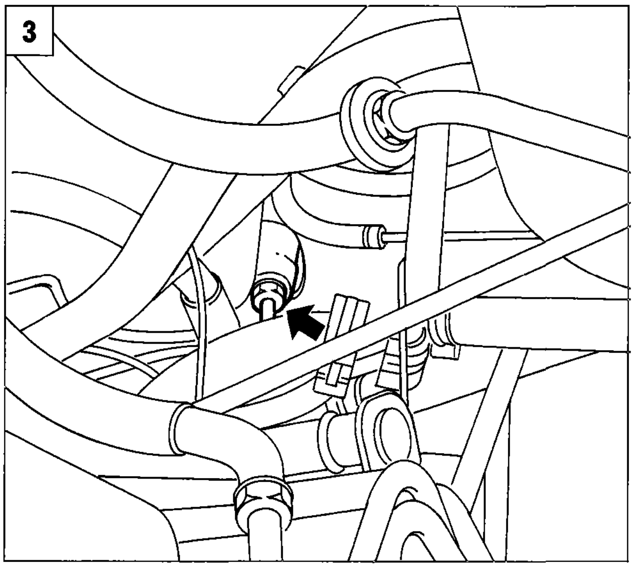

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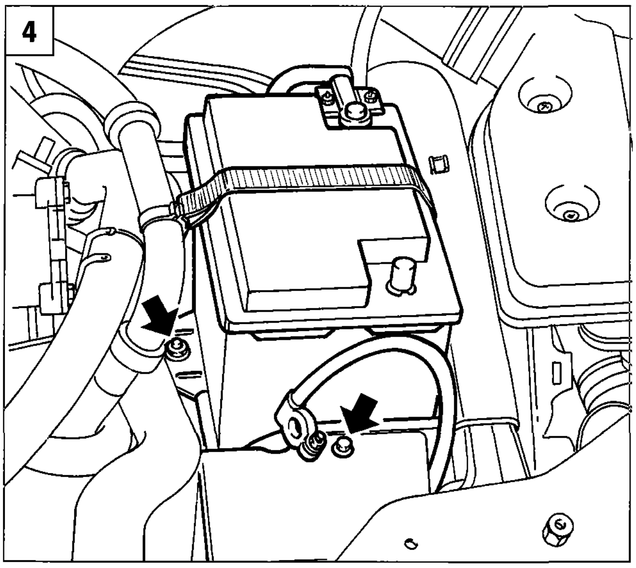


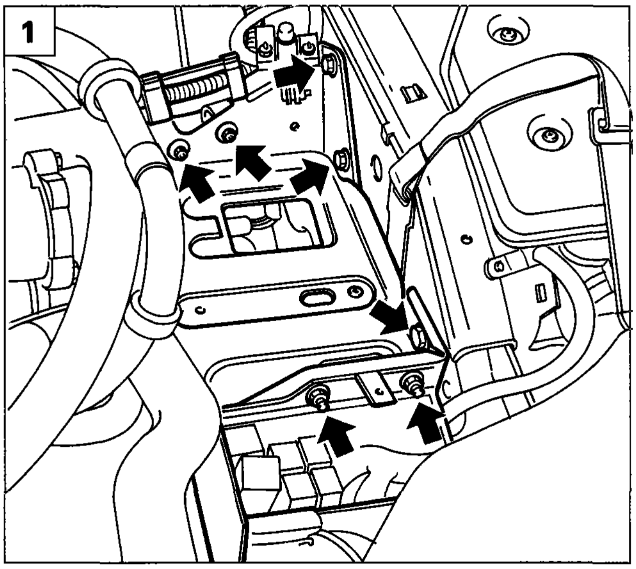
P4A18DA01

1. Working from inside the car, remove the roll pin retaining the clutch pump rod to the pedal.
2. Unscrew the bolts retaining the clutch pump to the body, remove slightly to release the rod from the clutch pedal, then remove complete with pipe connected to the reservoir. At the bench, separate the clutch pump from the pipe connected to the reservoir.

### REMOVING-REFITTING PIPE CONNECTING CLUTCH PUMP TO SLAVE CYLINDER

*Remove the upper cam cover protection and the guard in front of the brake and clutch fluid reservoir, then unscrew the bolts retaining the diesel filter bracket and drain the brake and clutch fluid from the reservoir, as described in the previous paragraph.*

3. Unscrew the fitting of the pipe connecting the pump to the slave cylinder on the clutch pump.
4. Disconnect the battery terminal leads and remove the battery from the engine bay after detaching from the bracket. Also remove the relay box cover.

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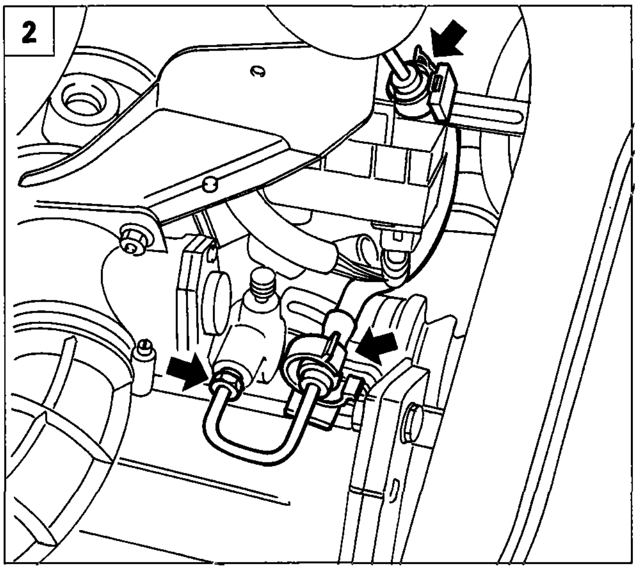


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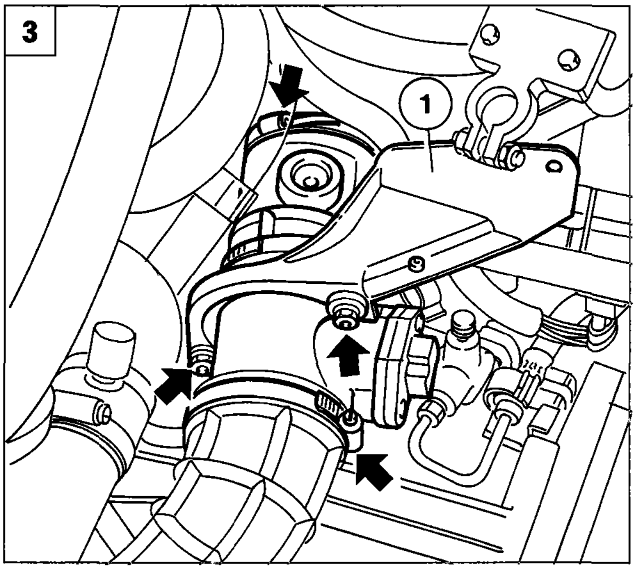


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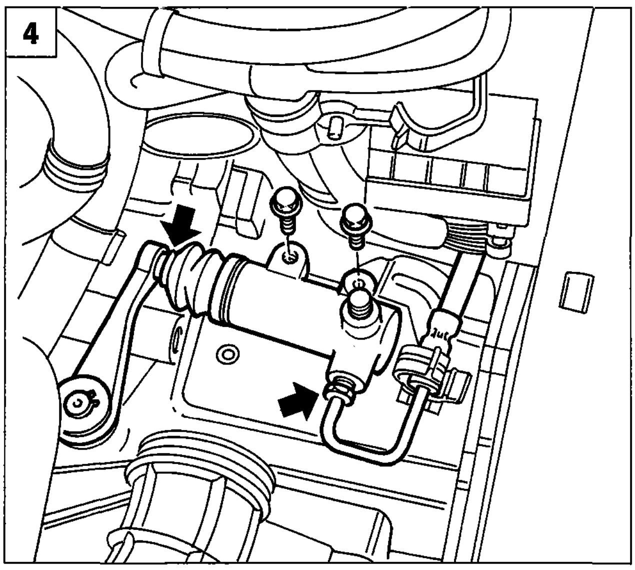



P4A19DA04

4A19DA

1. Release the relay box from the battery cradle by undoing the retaining bolts. Then remove the cradle by undoing the bolts indicated and disconnecting the wiring bundle.

2. Unscrew the fitting of the pipe connected to the clutch pump on the slave cylinder, detach the pipe from the retaining clips and remove from the car.

## REMOVING-REFITTING SLAVE CYLINDER

*Drain the brake and clutch fluid, remove the battery, the cradle and the relay box as described in the previous paragraph.*

3. Undo nuts retaining bracket (1) and remove; disconnect the clips indicated and remove the flow meter in order to gain access to the underlying slave cylinder.

4. Disconnect the fitting of the pipe connected to the clutch pump, then unscrew the slave cylinder retaining bolts and remove from the car.

*Bleeding clutch system*

# Braking system

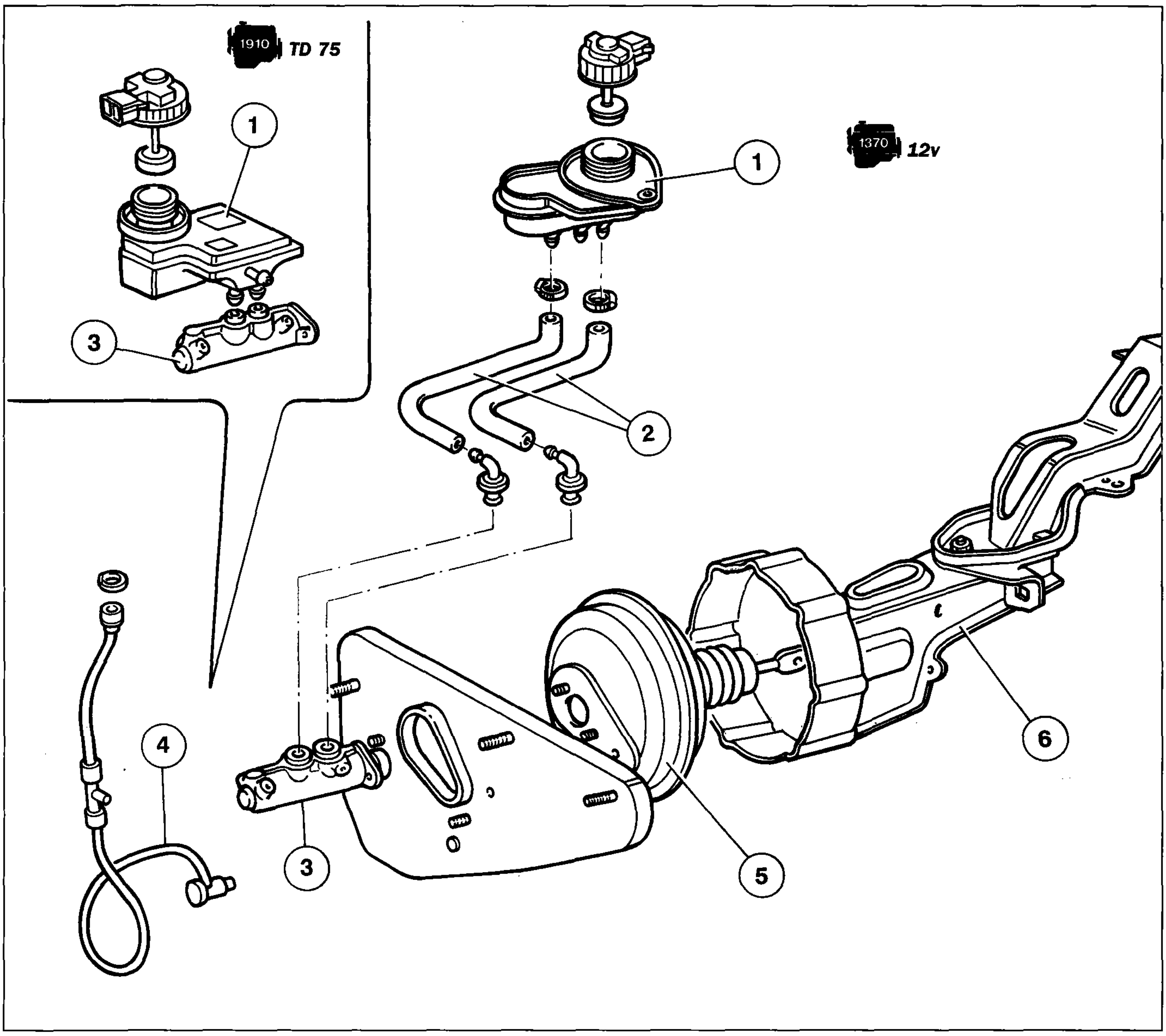

## Contents

# 33.

page

### HYDRAULIC OPERATION

## COMPONENTS OF HYDRAULIC BRAKING SYSTEM

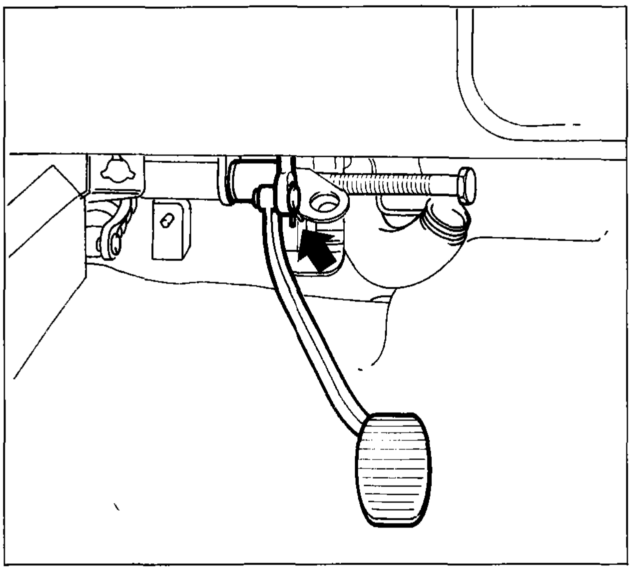



1. Brake fluid reservoir
2. Pipe connecting brake fluid reservoir to pump
3. Brake pump
4. Brake servo vacuum pipe
5. Servo brake
6. Complete pedal mount

According to the version, the brake fluid reservoir may be connected to the pump by pipes or may be fitted directly to the brake pump.

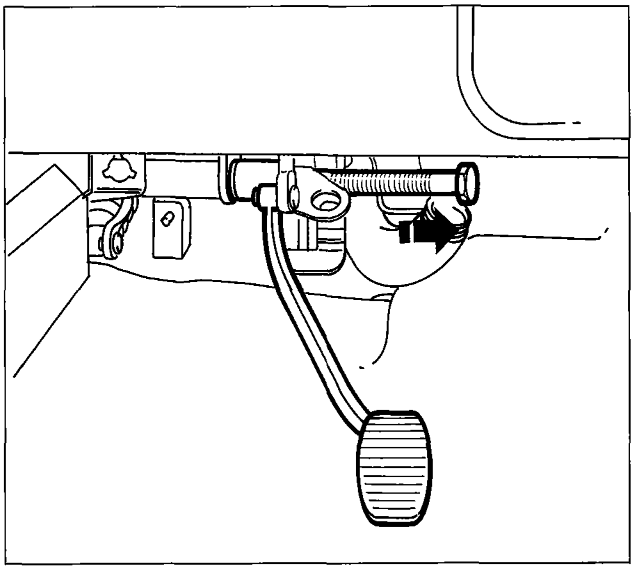
## REMOVING-REFITTING BRAKE PEDAL

*Before removing the brake pedal, remove the clutch pedal as described in "Section 18" of the right hand drive supplement.*



P4A22DA01

1. Remove the roll pin retaining the brake servo rod transmission on the brake pedal.



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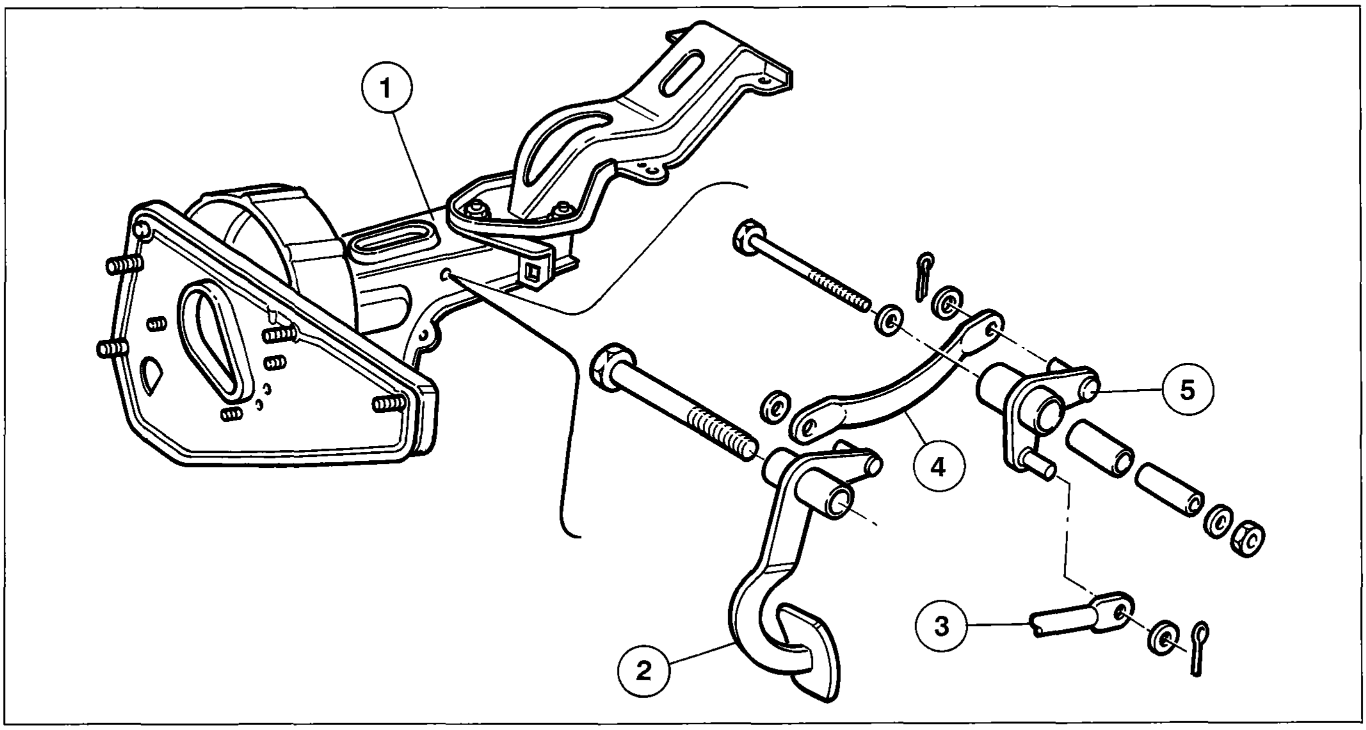
2. Remove clutch and brake pedal retaining bolt completely and then remove the pedal from the car.

**Brake pedal fastening details**

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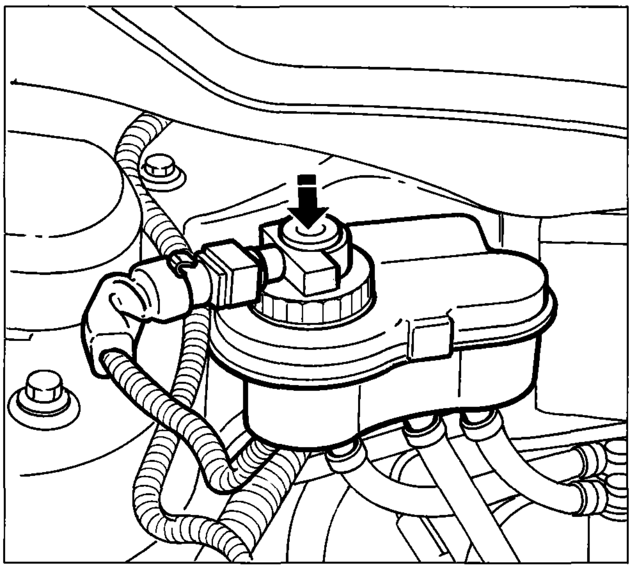
1. Pedal unit
2. Brake pedal
3. Brake servo rod
4. Transmission connecting brake pedal - brake servo rod
5. Device for anchoring brake servo rod and transmission to brake pedal



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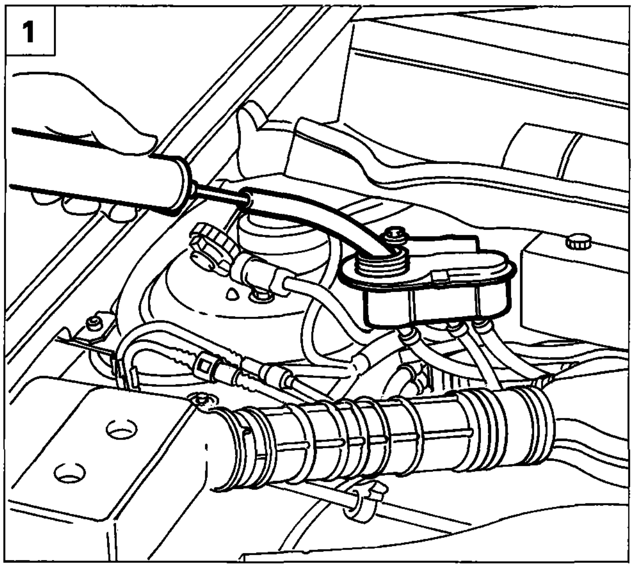
## BRAKE-CLUTCH FLUID RESERVOIR

### Checking low brake fluid warning light

**NOTE** *At intervals, check warning light operation by pressing down on the top edge of the reservoir cover (arrowed). The brake system warning light should come on when the ignition is turned to MAR.*

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### Removing-refitting

Proceed as follows to remove the brake fluid reservoir:

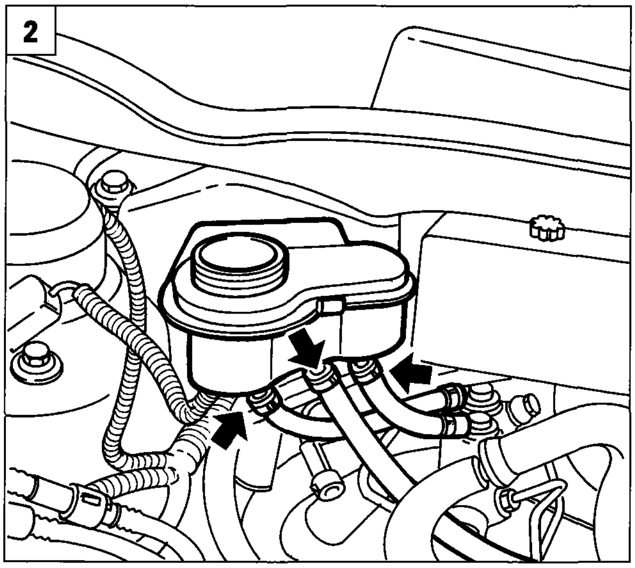
1. Disconnect the connector of the fluid level sensor and remove the reservoir cap, then drain the brake fluid from the reservoir using a syringe.
2. Disconnect both brake pipes and the hydraulic clutch pipe from the reservoir.
3. Unscrew the bolt retaining the reservoir to the body and remove from the vehicle.

*Take care the fluid remaining in the reservoir does not leak out.*

**NOTE** *Carry out removal operations in reverse order to refit the brake and clutch reservoir.*

*Before filling the tank, ensure it is extremely clean.*

*Bleeding hyrdaulic brake and clutch system*

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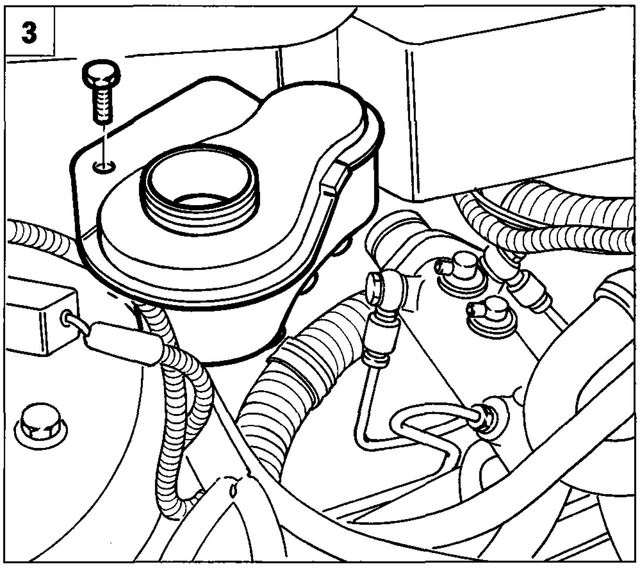


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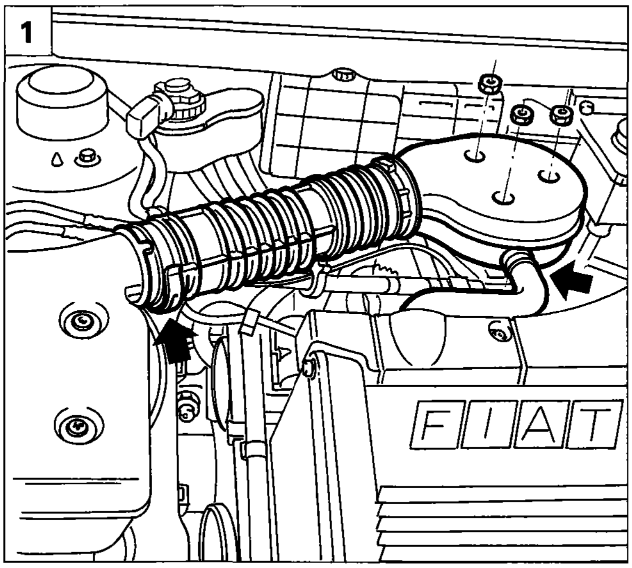


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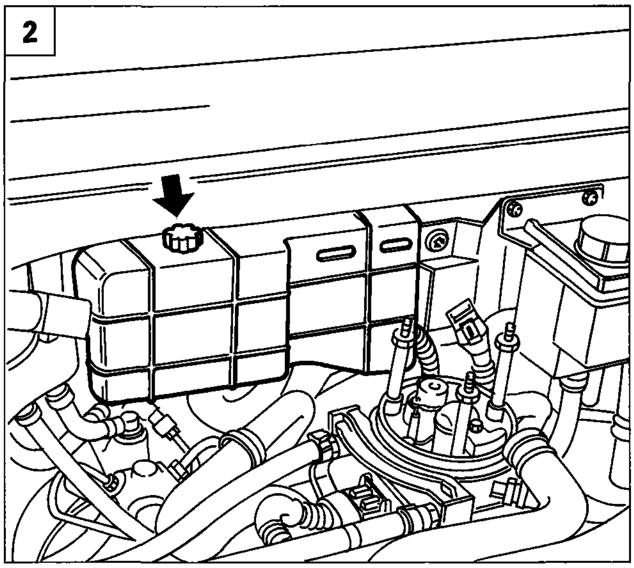


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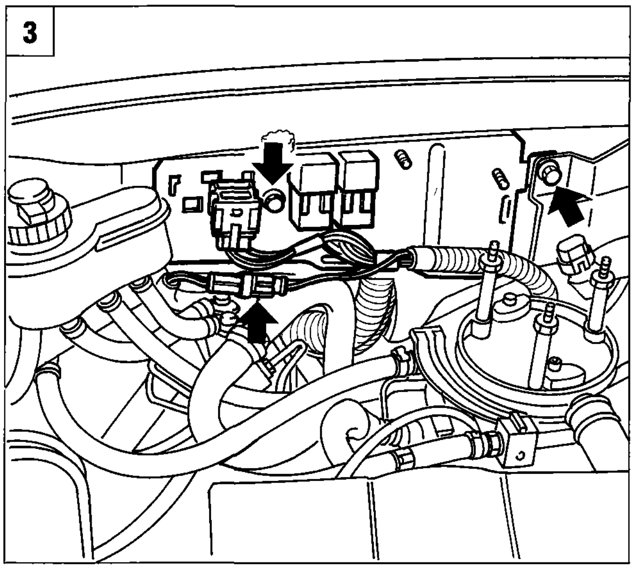


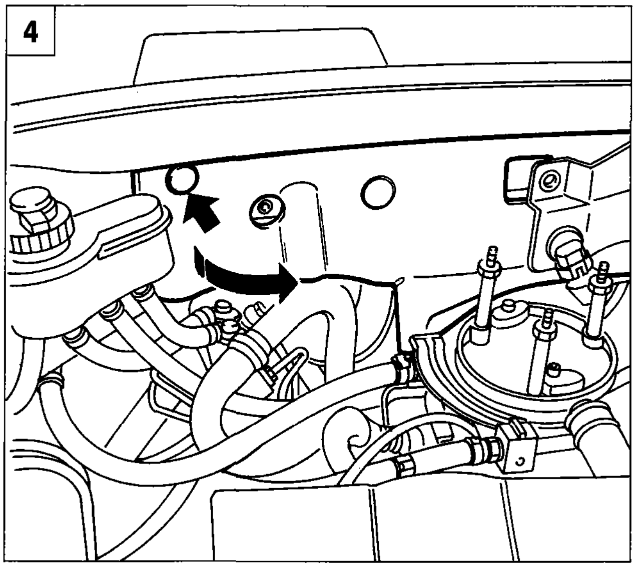

P4A01DA05

## REMOVING-REFITTING BRAKE PUMP

Proceed as follows to remove the brake pump:

1. Disconnect the pipe connecting air cleaner to butterfly valve cause by undoing the fastenings indicated in figure.
2. Remove the relay cover.
3. Remove the relay bracket by undoing the bolts retaining it to the body, disconnect connector indicated and move the bracket to one side.
4. Remove the retaining stud of the lining of the bulkhead between lining to one side.

5. Remove the cap from the brake and clutch fluid reservoir after disconnecting the fluid level sensor connector. Then drain the fluid from the reservoir.

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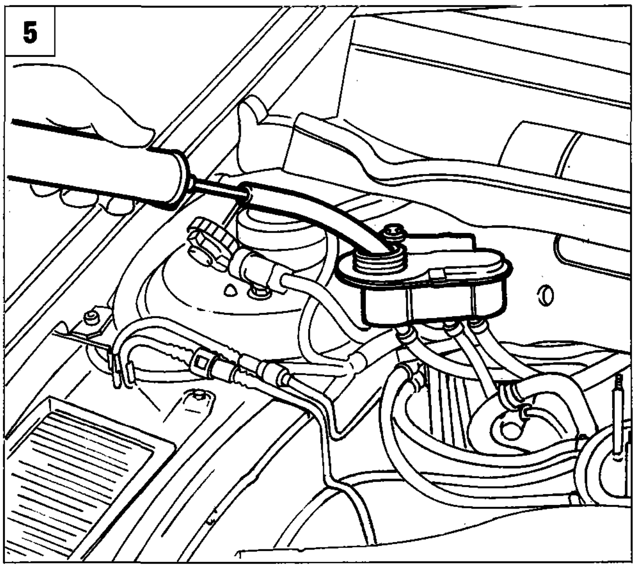


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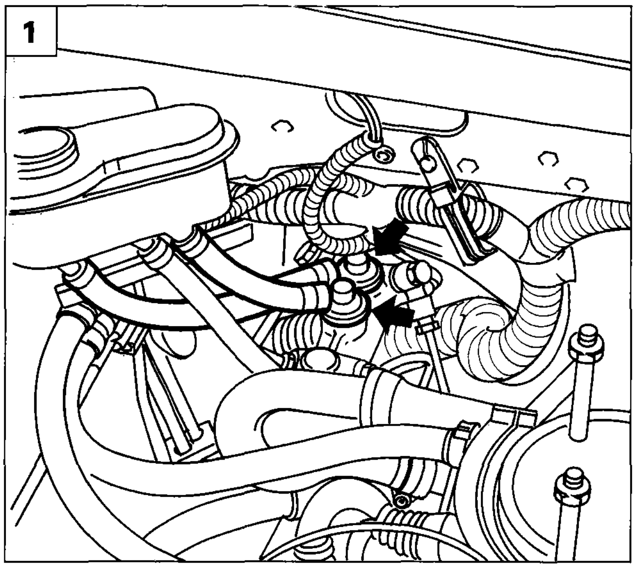
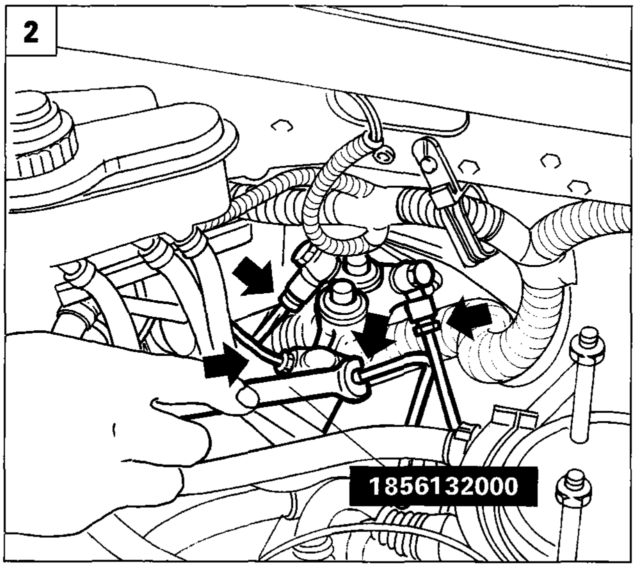



P4A25DA01

1. Disconnect the brake fluid inlet pipes from the reservoir from the brake pump.



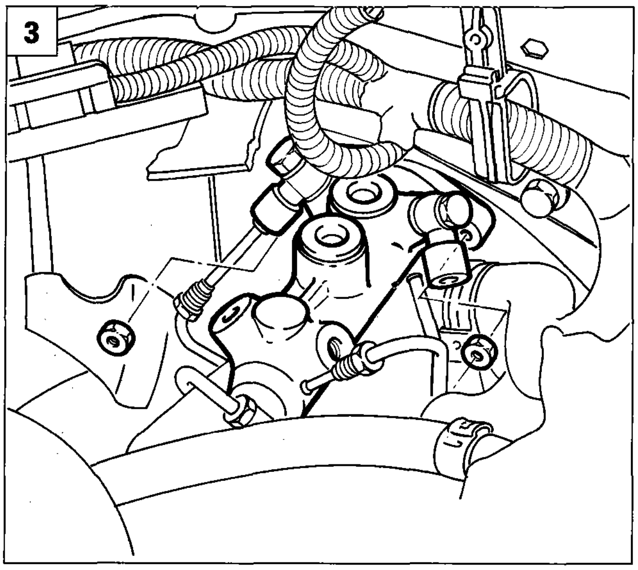

P4A25DA02

2. Use wrench 1856132000 to disconnect the brake pipe fittings from the brake pump.

*Bleeding brake system*

3. Unscrew both nuts retaining the brake pump to the brake servo, then remove the pump from the car.

*Reverse removal instructions to refit, making sure that the brake pump is properly fitted to the brake servo rod and washer.*

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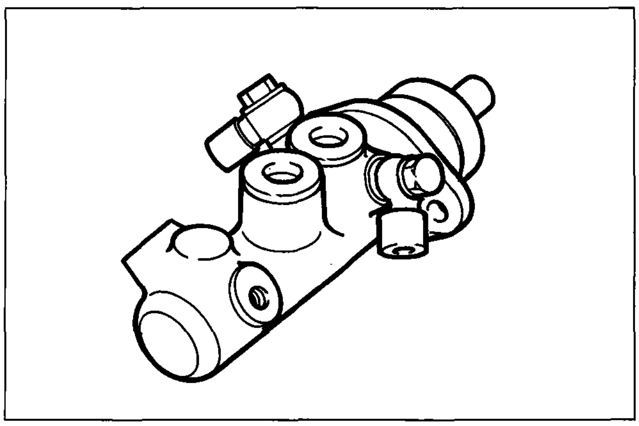

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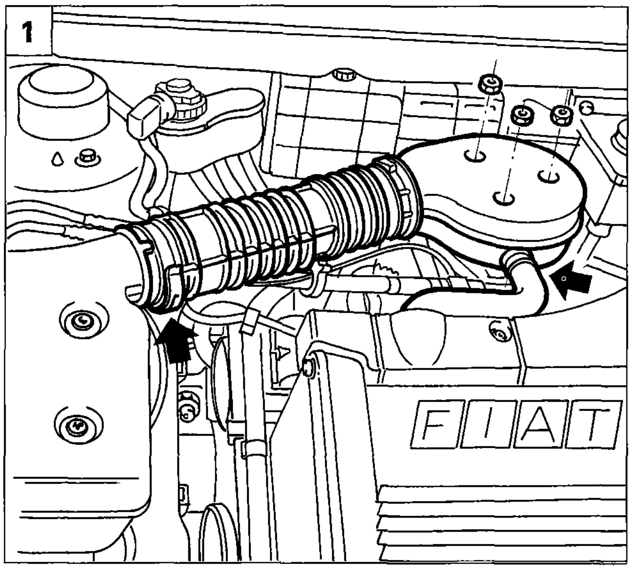

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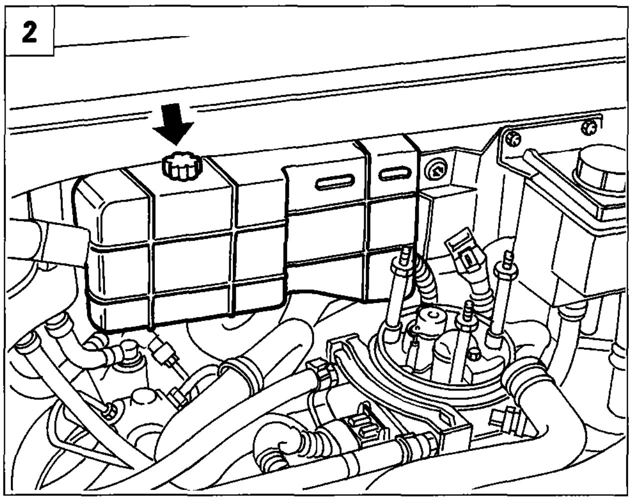

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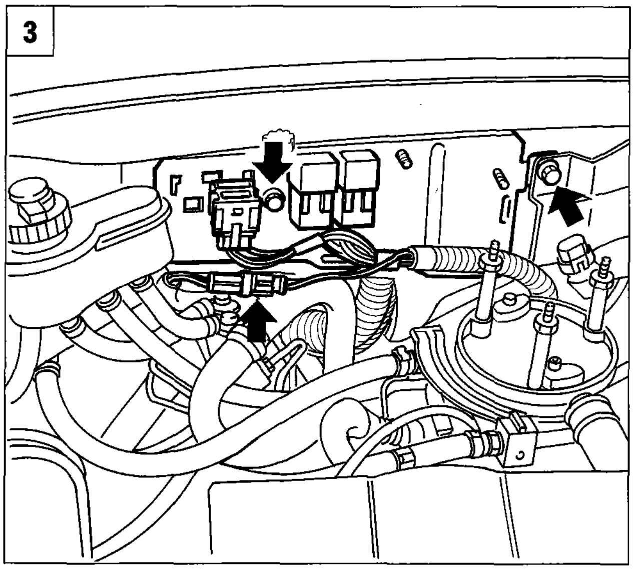

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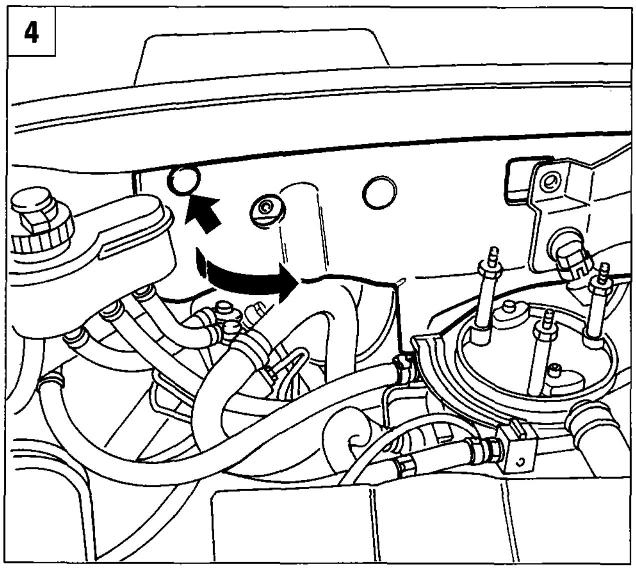
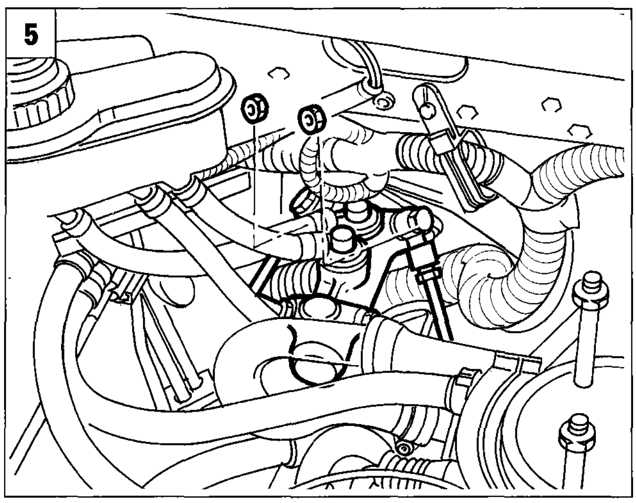


P4A02DA01

## REMOVING-REFITTING SERVO BRAKE

*On right hand drive vehicles, the brake servo is positioned inside the cabin under the pedal unit. To take out, remove the facia trim as described in Section 70, then proceed as follows.*

1. Working from the engine bay, remove the sleeve connecting air cleaner and butterfly valve case.
2. Remove the protective relay cover located on the bulkhead between engine bay and cabin by undoing the bolt indicated.
3. Remove the relay bracket by undoing the bolts retaining it to the body, disconnect connector indicated and move the bracket to one side.
4. Remove the retaining stud and move the lining of the bulkhead between engine bay and cabin to one side.
5. Undo both nuts retaining the brake pump to the brake servo.



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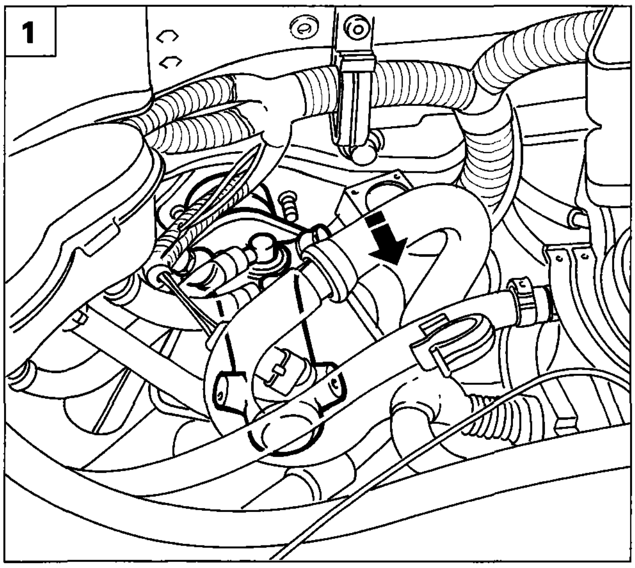

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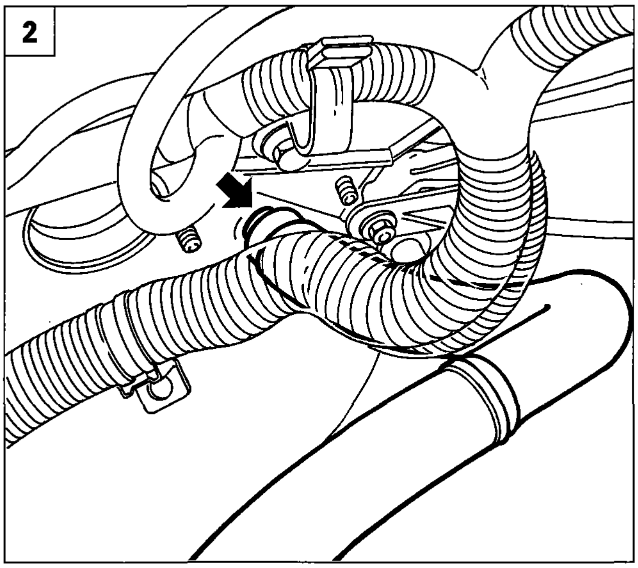

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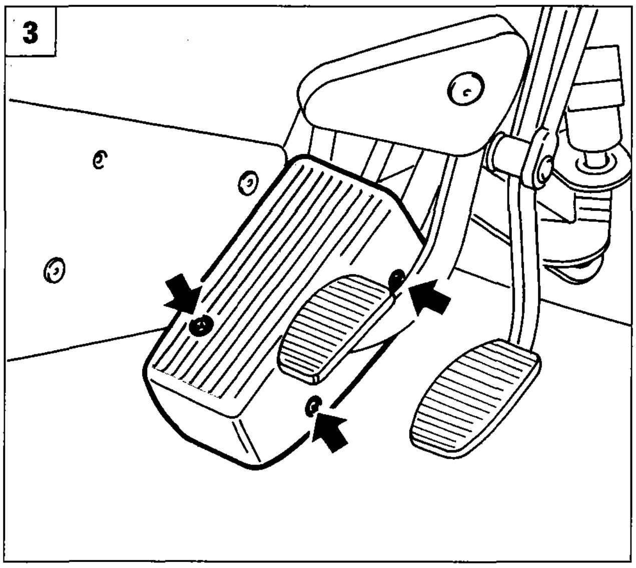
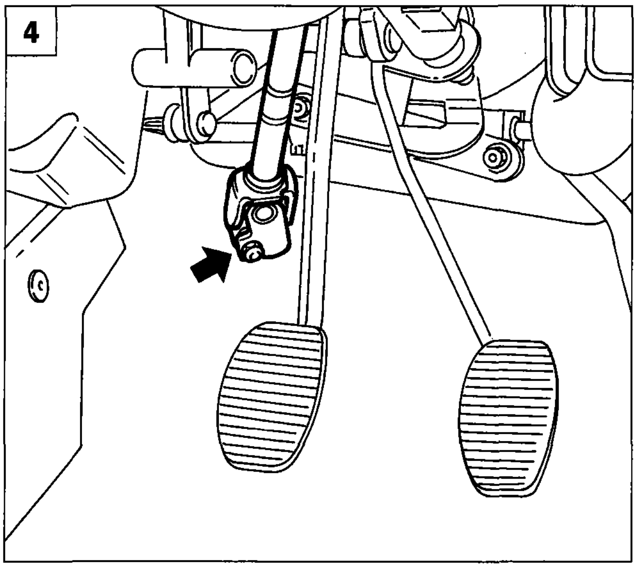


P4A03DA01

1. Remove the brake pump without disconnecting the connected brake lines, in order to release the brake servo rod from the pump.
2. Release the injection wiring bundle from the retaining clip, then disconnect the vacuum intake line from the brake servo.
3. Working from inside the cabin, remove the left foot rest, located beside the clutch pedal.
4. Remove the bolt retaining the lower steering column to the power steering box pinion.
5. Remove the steering column reinforcement bar by unscrewing the retaining bolts indicated in the figure.



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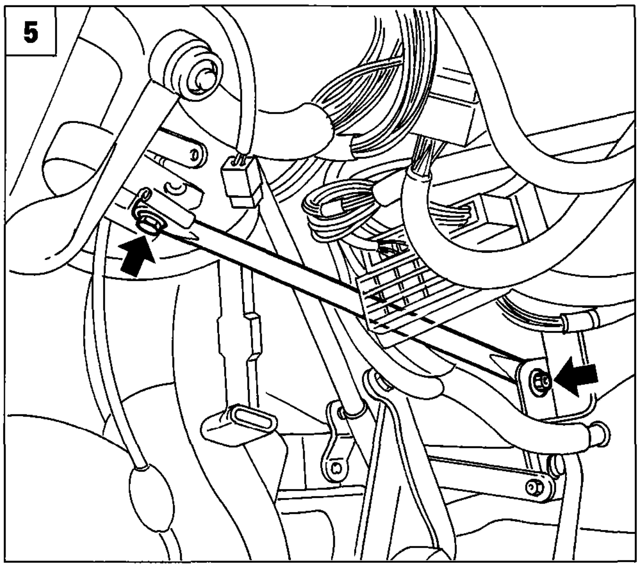

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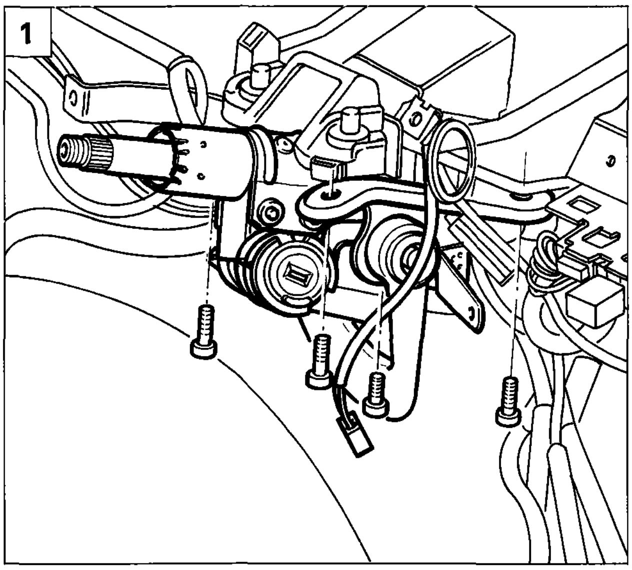


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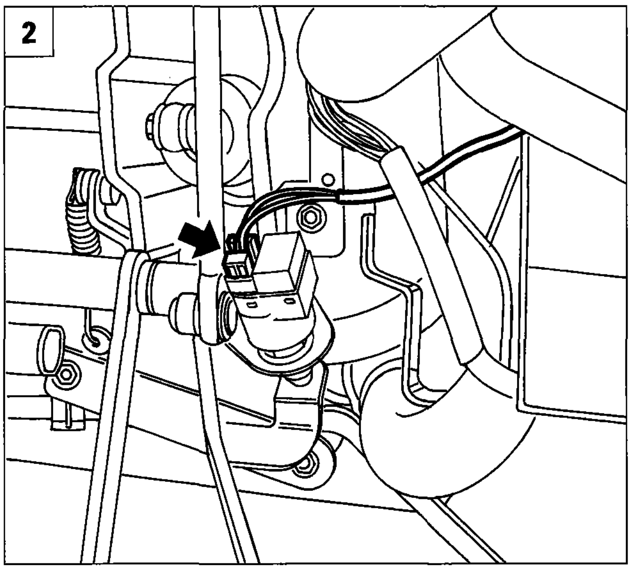


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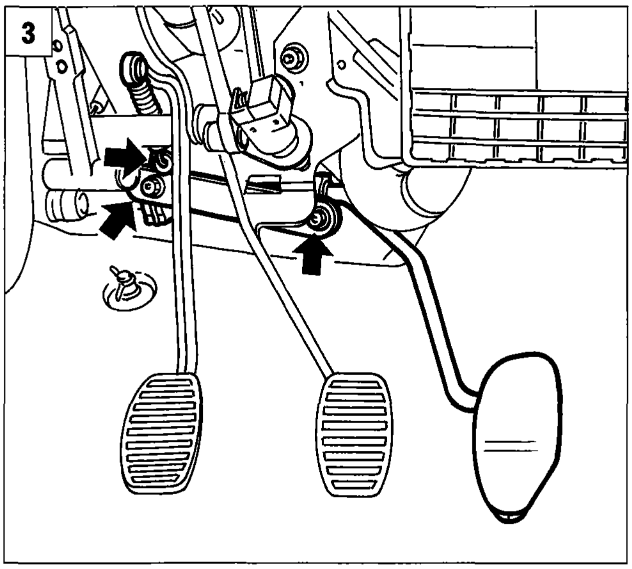
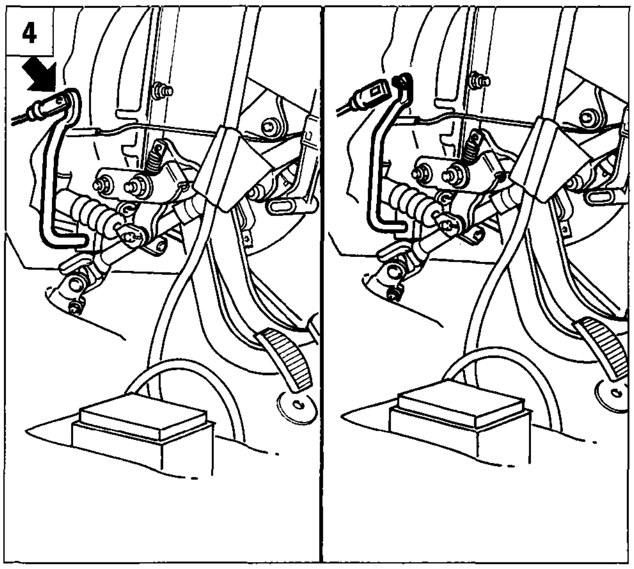



P4A28DA03

1. Disconnect electrical connection from the ignition, then unscrew the bolts fastening the steering column and remove from the car.
2. Disconnect the braking light switch connector.
3. Unscrew both nuts retaining the accelerator pedal retaining bracket and release the clutch pedal return spring from the bracket.
4. Disconnect the control cable from its anchorage on the accelerator pedal, then remove the accelerator pedal from the vehicle.
5. Remove rubber fitting (1) from the bonnet opening lever and then release the end of the opening cable from its seat and take out through the housing hole of rubber fitting (1).

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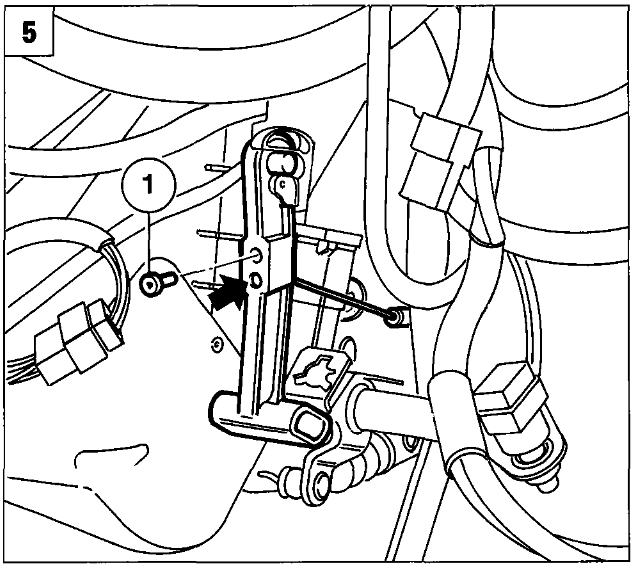


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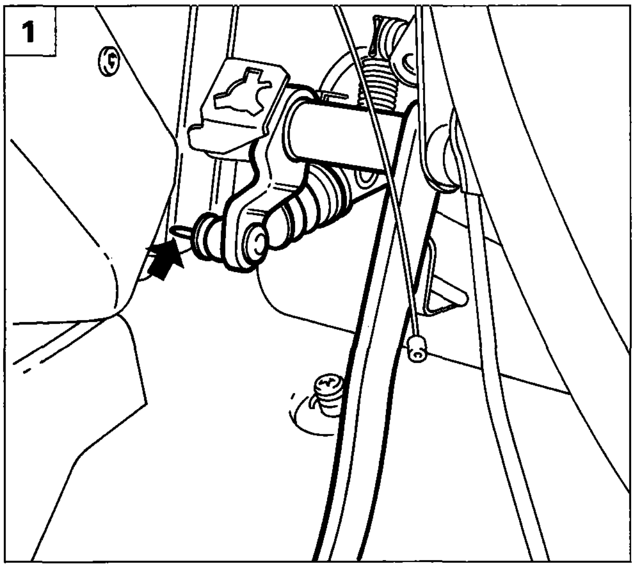


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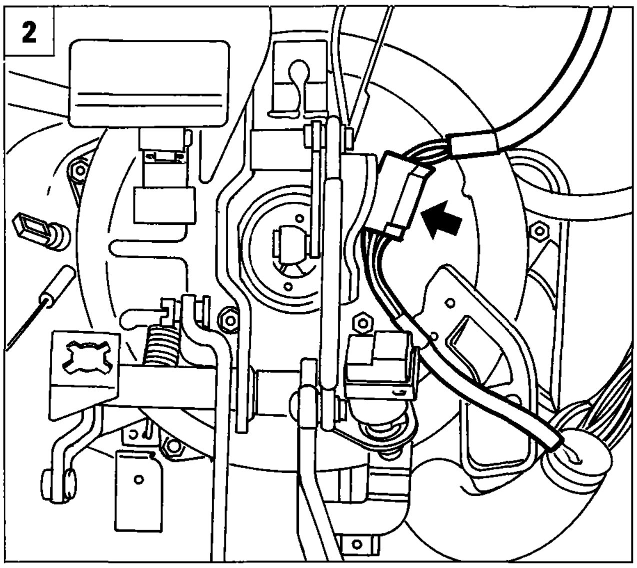


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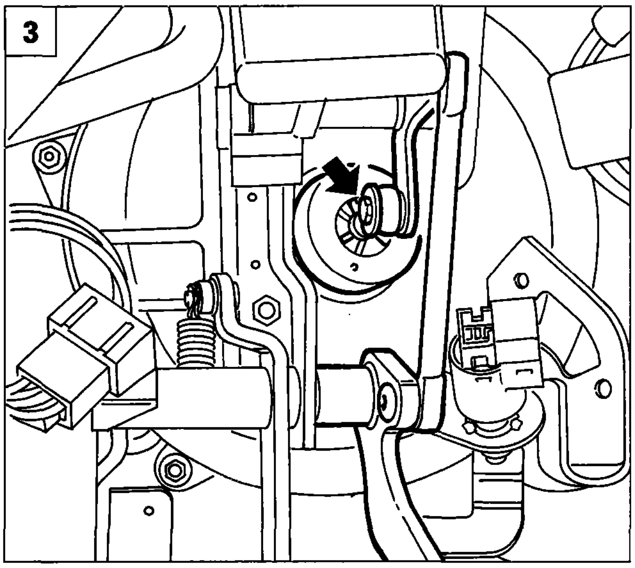
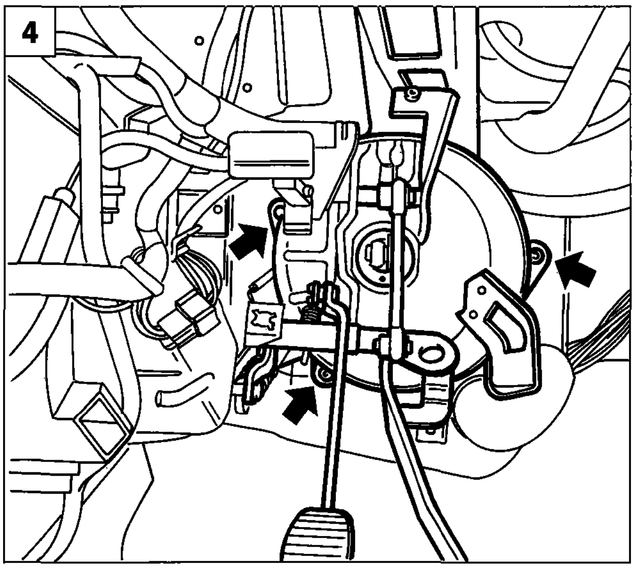



P4A29DA03

1. Remove the roll pin retaining the clutch pump rod on the control pedal.
2. Release the electrical connector shown in the figure from the pedal mount.
3. Remove the roll pin retaining the brake servo rod to the control pedal transmission.
4. Remove nuts retaining the pedal unit to the body, then remove the pedal unit and servo brake from the body by releasing the clutch pedal from the clutch pump rod.
5. At the bench, unscrew the four bolts retaining the brake servo to the pedal unit.

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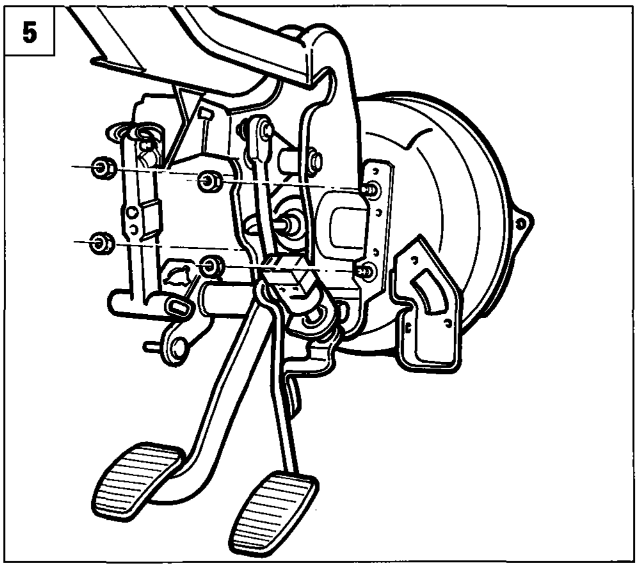


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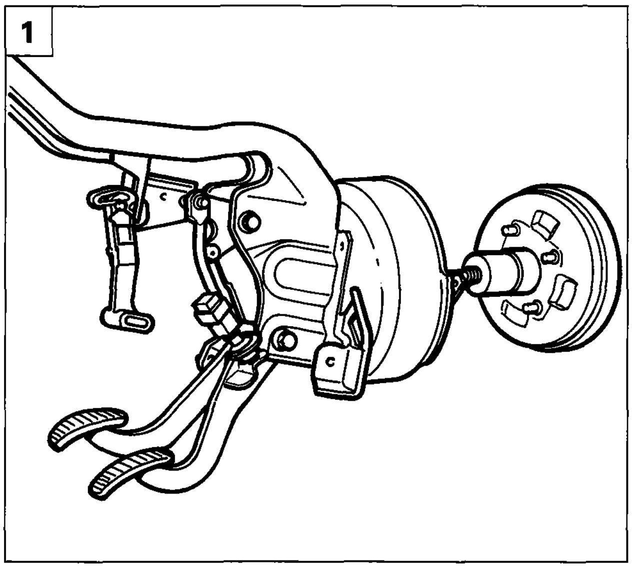


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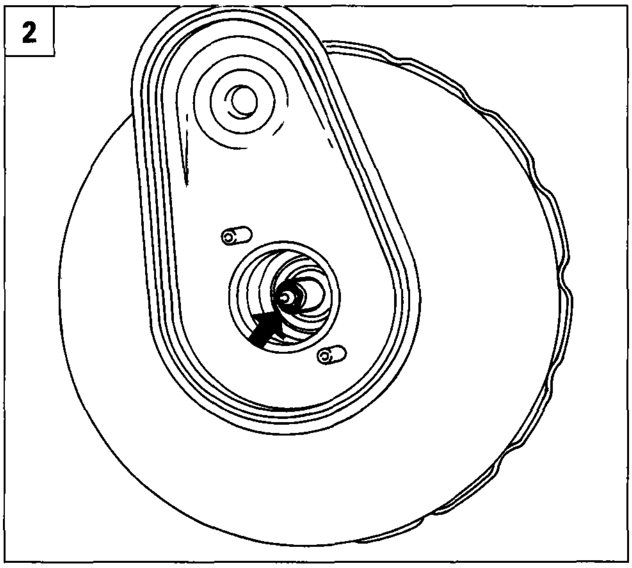


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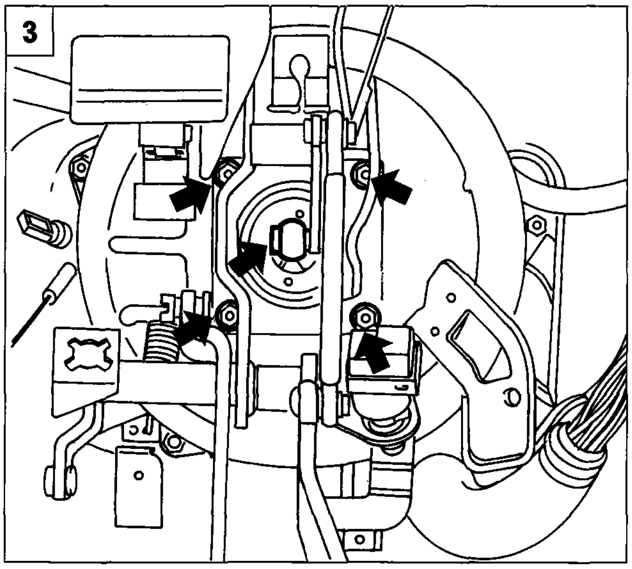


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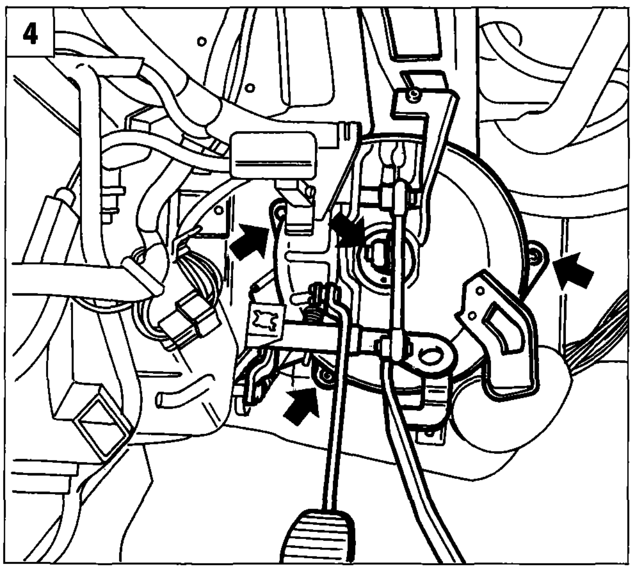



P4A30DA04

1. Separate the brake servo from the pedal unit by releasing the brake servo rod from the transmission on the control pedal.

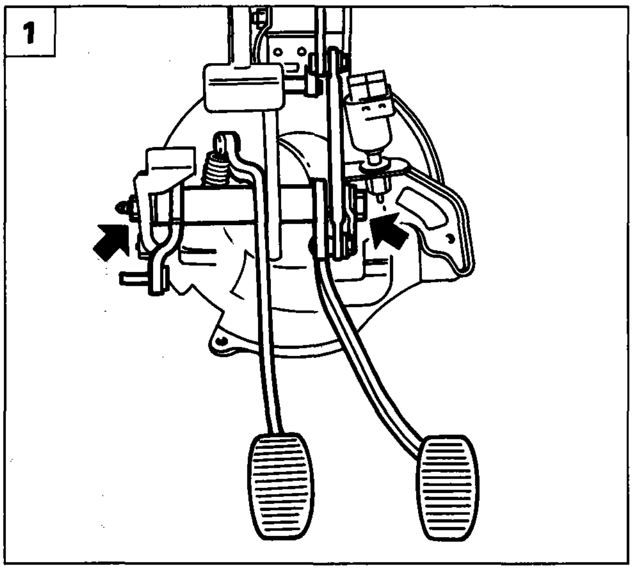
**Refitting**

2. Reverse removal instructions to refit. Take care to position the control rod and washer in their correct place on the brake servo, to ensure that they do not come out of place when fitting the brake pump.

## REMOVING-REFITTING PEDAL UNIT

*Proceed as described for the brake servo removal to remove the pedal unit. Note that the brake pump need not be removed from the brake servo and vacuum intake pipe. Before removing the pedal assembly, unscrew the nuts retaining the brake servo to the pedal mount as shown in the figure.*

3. Unscrew nuts retaining the brake servo to the pedal mount and remove the roll pin securing the brake servo rod to the brake pedal transmission.
4. Undo nuts securing the pedal mount and remove from the car after releasing the brake servo rod from the transmission on the control pedal.

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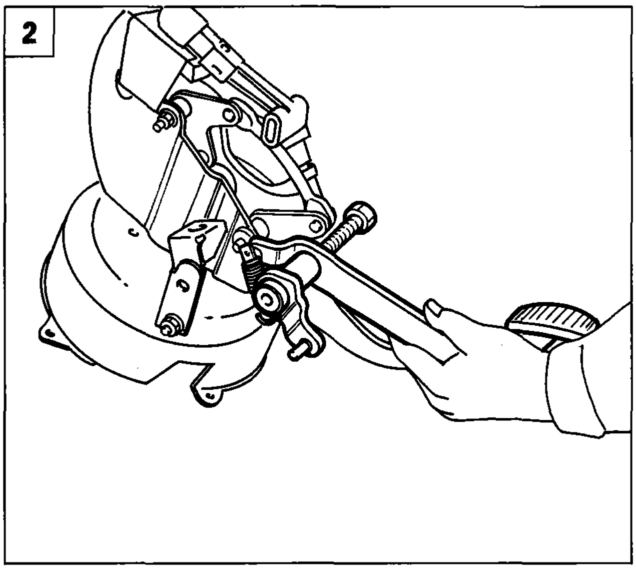


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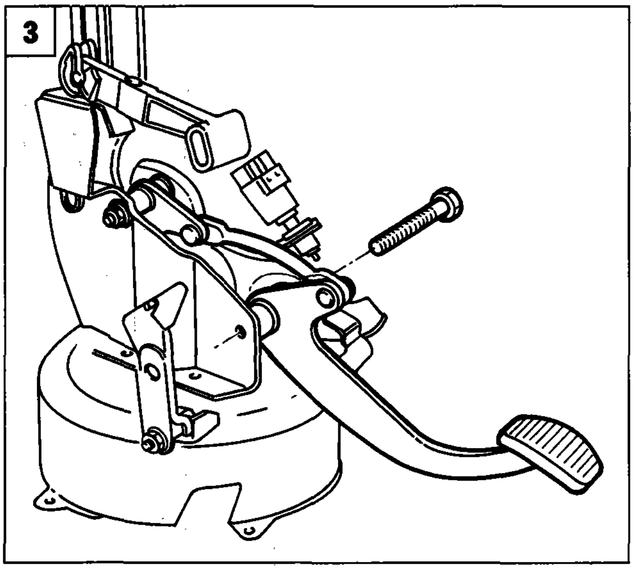
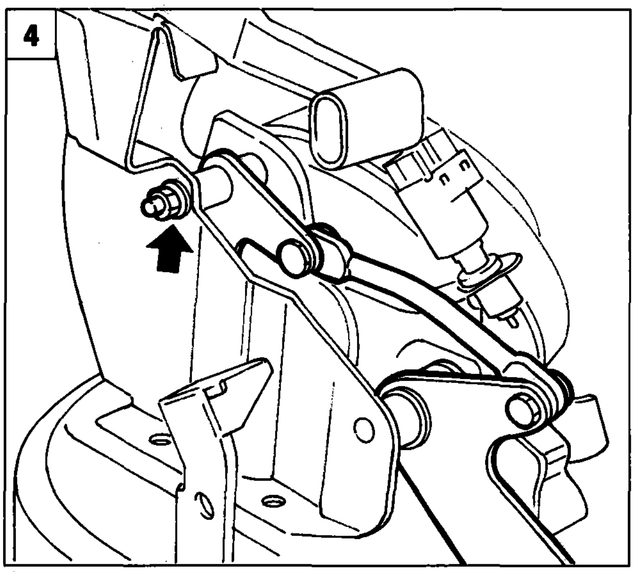



P4A31DA03

**Dismantling pedal assembly at the bench**

1. Unscrew bolt retaining the clutch and brake pedals.
2. Pull out the bolt retaining the clutch and brake pedals until the clutch pedal comes off, then remove.
3. Pull the bolt out further until the brake pedal comes off too.
4. Unscrew bolt retaining the brake pedal transmission anchoring the brake servo rod, then remove the pedal.
5. View of pedals:
   1. Clutch pedal - 2. Brake pedal.

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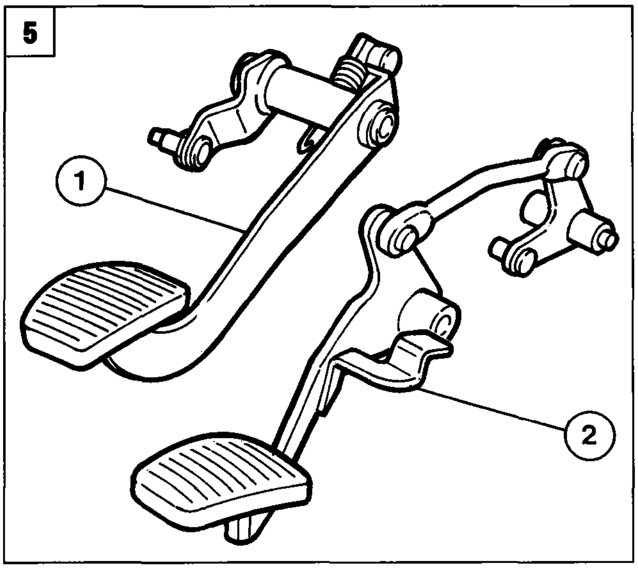


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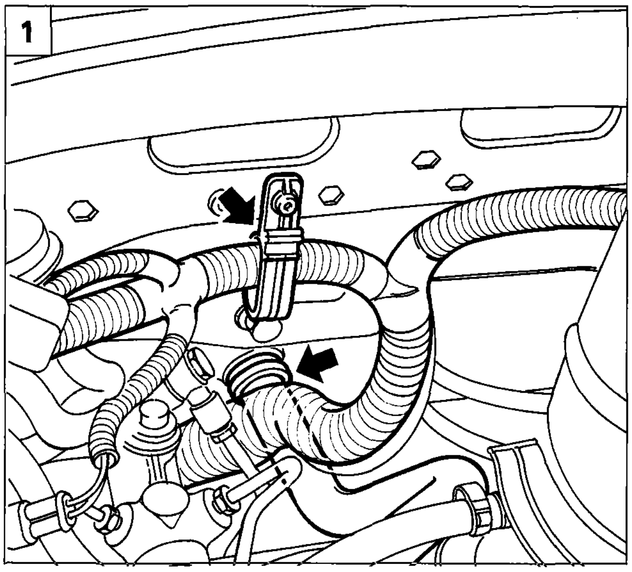

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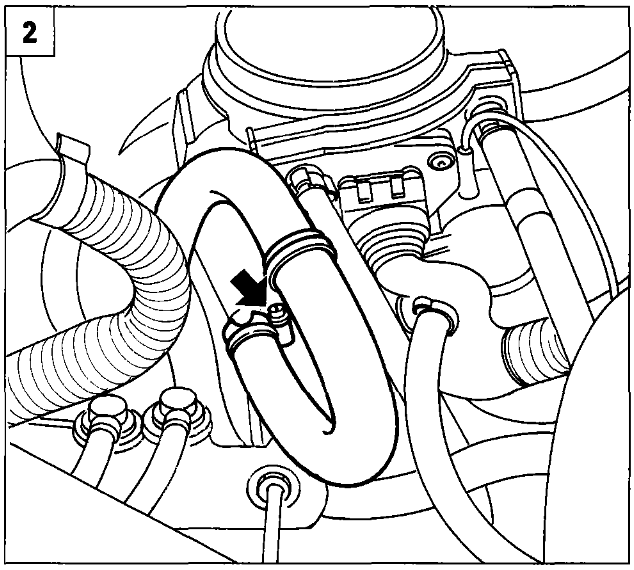

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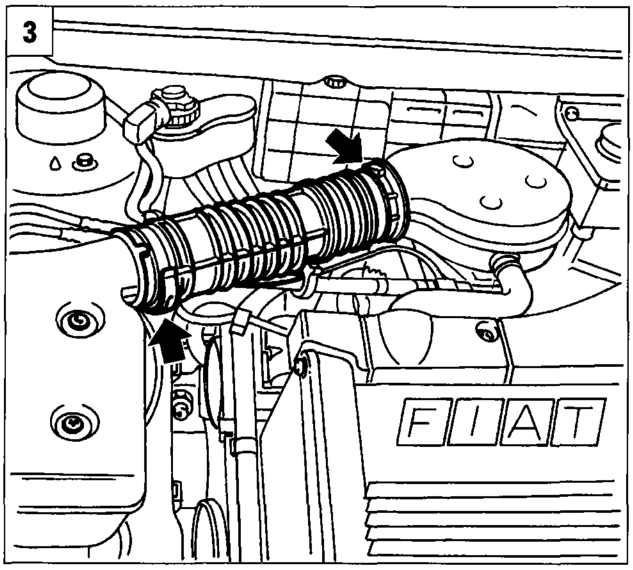
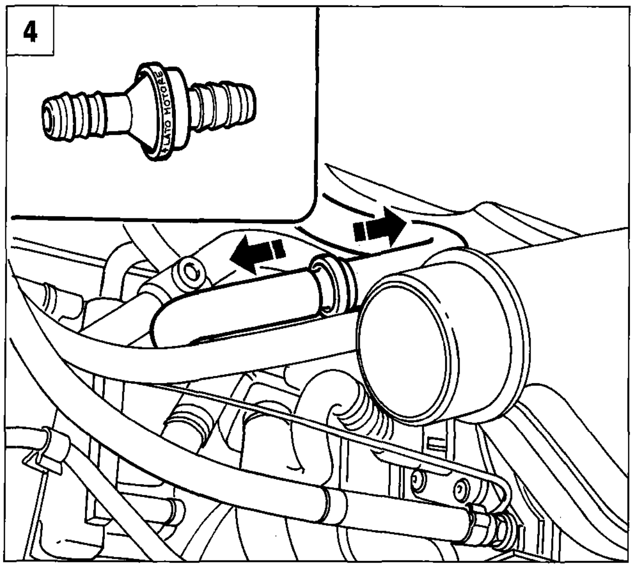


P4A32DA03

## REMOVING-REFITTING BRAKE SERVO VACUUM INPUT PIPE

*Remove the pipe connecting the air cleaner to the butterfly valve case, the relay cover and the relay bracket, move the lining of the bulkhead between engine bay and cabin, as described for removal of the brake servo, then proceed as follows.*

1. Release the injection wiring bundle from the retaining clip, then disconnect the vacuum intake pipe from the brake servo.
2. Unscrew clip retaining the vacuum intake pipe to the engine and remove the pipe.

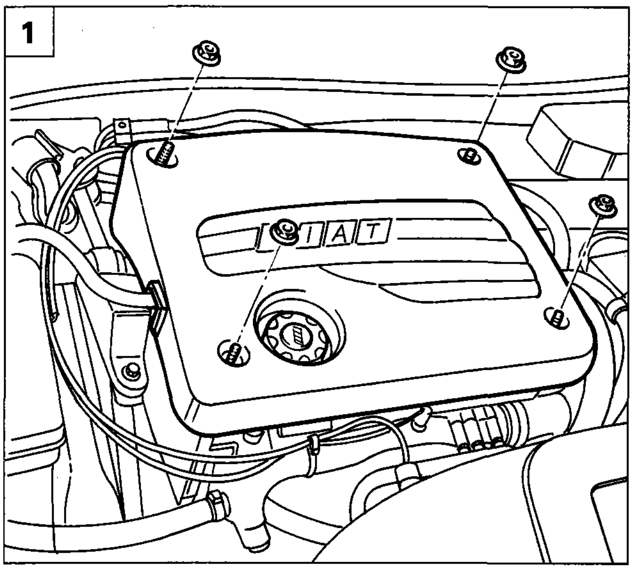


P4A32DA04

## REMOVING-REFITTING ONE-WAY VALVE

3. Remove the pipe connecting air cleaner at butterfly valve case by undoing the clip indicated in figure.
4. Remove the one-way valve from both parts of the brake servo vacuum intake pipe.

*When fitting a new one-way valve, take care to position properly with the engine end arrow turned toward the engine.*



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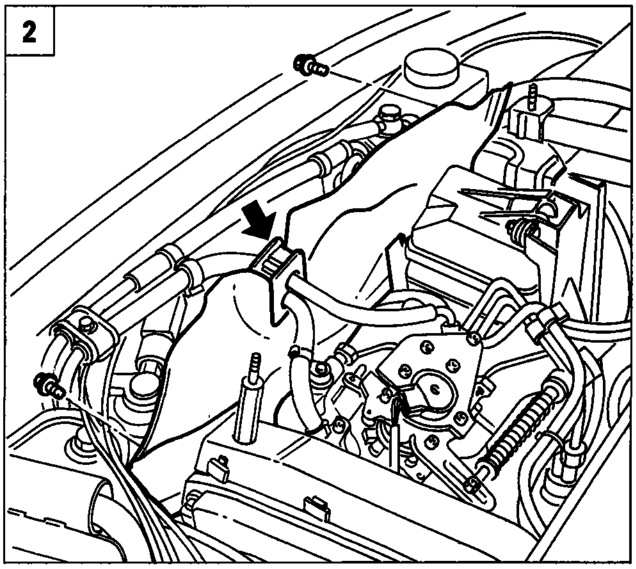

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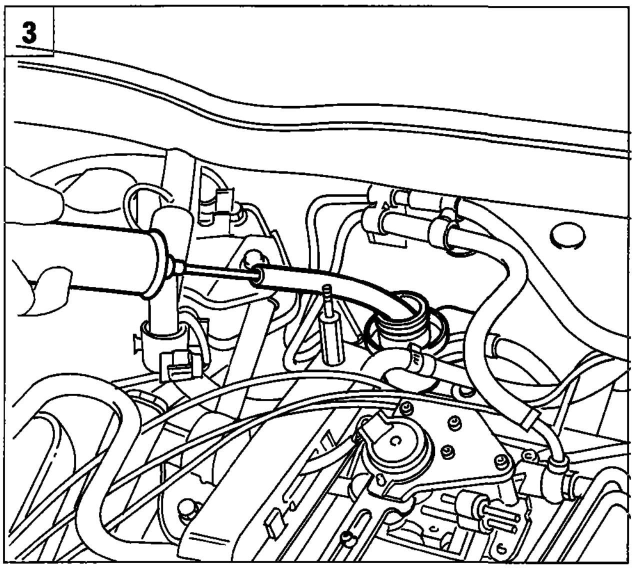

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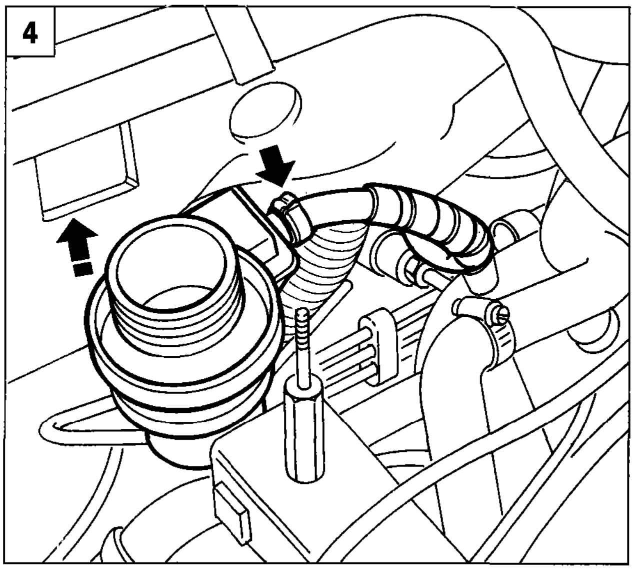

P4A33DA01

## BRAKE-CLUTCH FLUID RESERVOIR

### Removing-refitting

1. Remove the upper cam cover protection.
2. Release the diesel lines from the retaining clip, then remove the trim shown in the figure by undoing the retaining bolts.
3. Disconnect fluid level sensor connector and remove the reservoir cap, then drain the brake fluid from the reservoir using a syringe.
4. Disconnect the hydraulic clutch line from the reservoir, then separate the reservoir from the brake pump and lift out.

*Ensure fluid remaining in the reservoir does not leak out.*

**NOTE** *Carry out brake and clutch fluid reservoir removal operations in reverse order to refit.*

*Ensure the reservoir is extremely clean before filling.*

*Bleeding hydraulic brake and clutch system*

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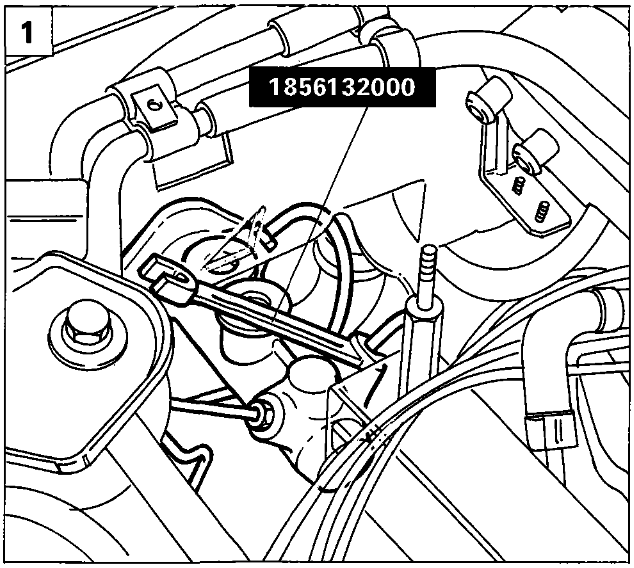


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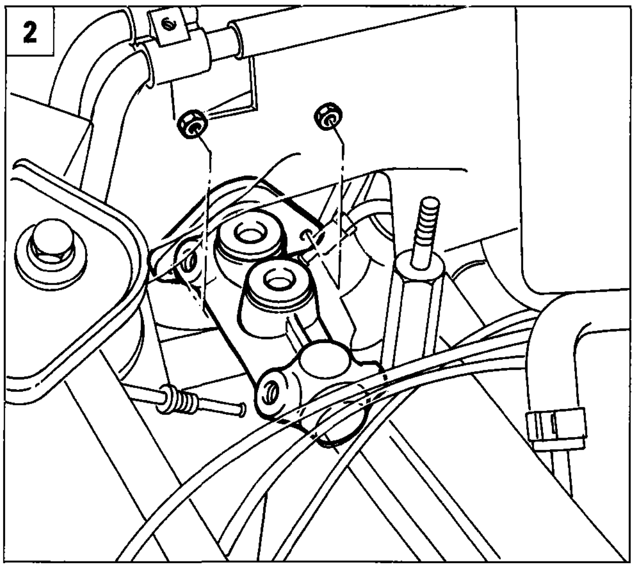


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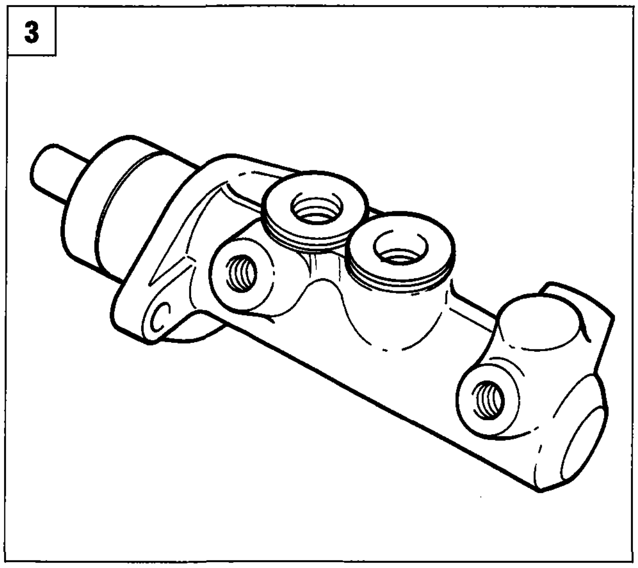



P4A34DA03

## REMOVING-REFITTING BRAKE PUMP

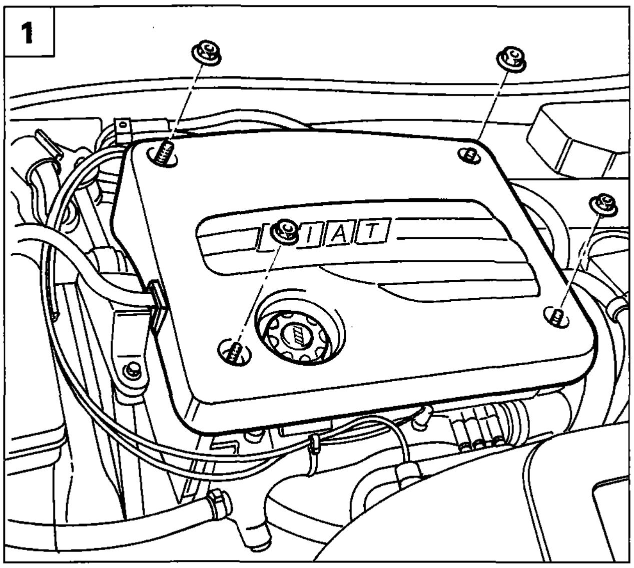
*Carry out operations described for removal of the brake and clutch fluid rervoir (1910 TD), but without disconnecting the hydraulic clutch and placing the reservoir to one side.*

1. Use wrench 1856132000 to disconnect the brake line fittings from the brake pump.

*Bleeding brake system*

2-3. Unscrew both nuts retaining the brake pump to the brake servo, then remove the pump from the car.

*Reverse removal instructions to refit, taking care to fit the brake pump properly to the brake servo rod and washer.*



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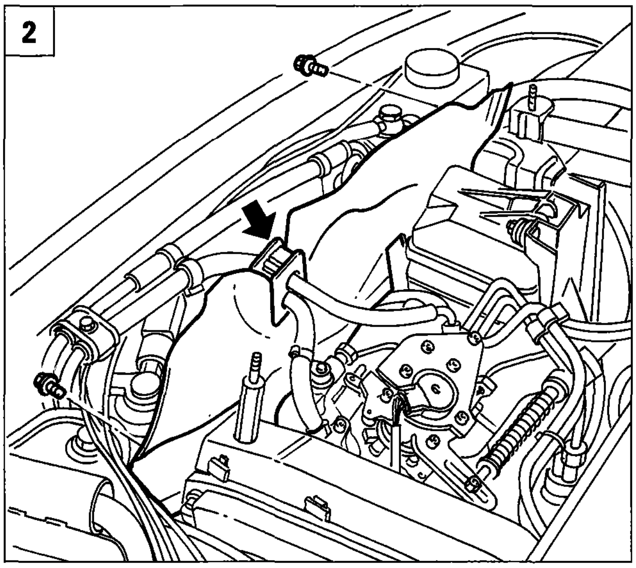

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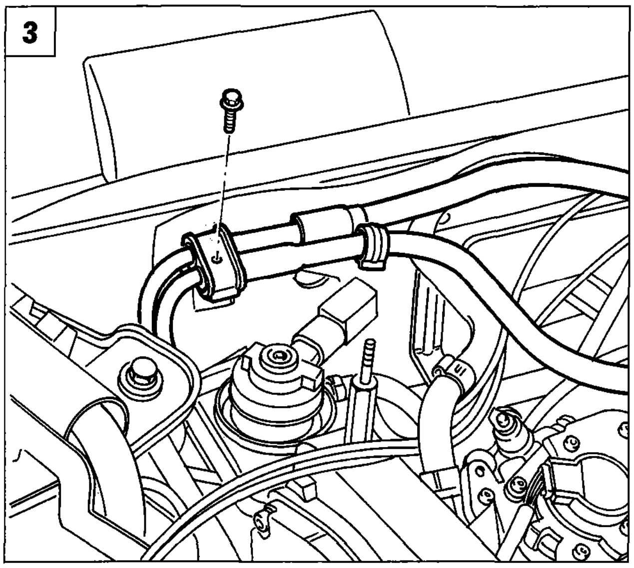

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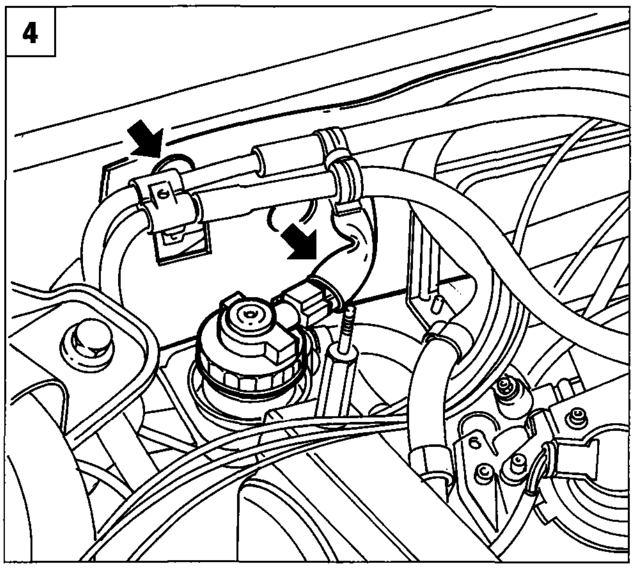
## REMOVING-REFITTING SERVO BRAKE

1. Remove the upper cam cover protection.

2. Release the diesel lines from the retaining clip, then remove the trim shown in the figure by undoing the retaining bolts.
3. Unscrew bolts retaining the diesel line retaining bracket.
4. Disconnect the brake and clutch fluid level sensor, then remove the stud retaining the lining of the bulkhead between engine bay and cabin, then move the lining to one side.
5. Unscrew the bolts fastening the diesel filter bracket, disconnect the connections shown and position the bracket to one side.



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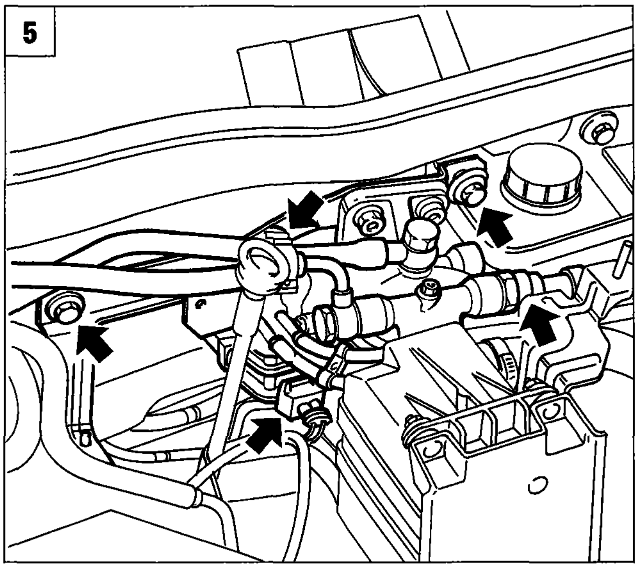

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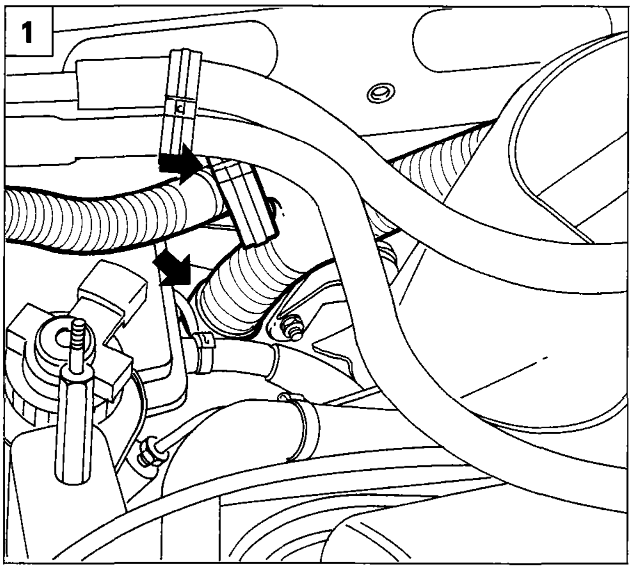


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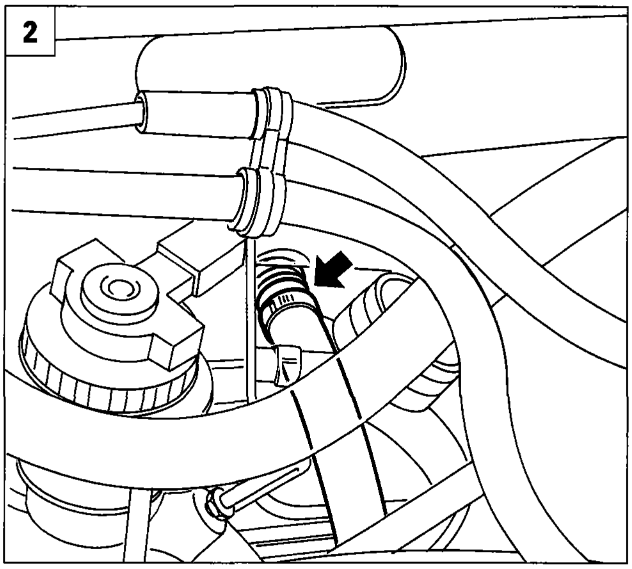


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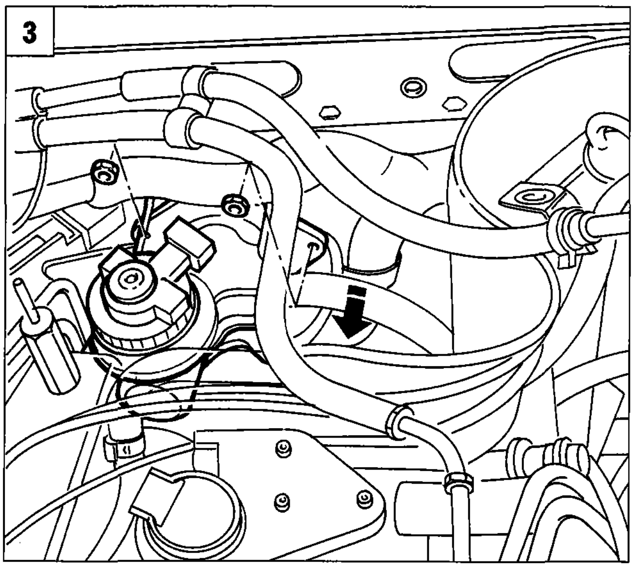


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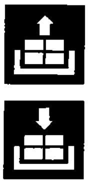
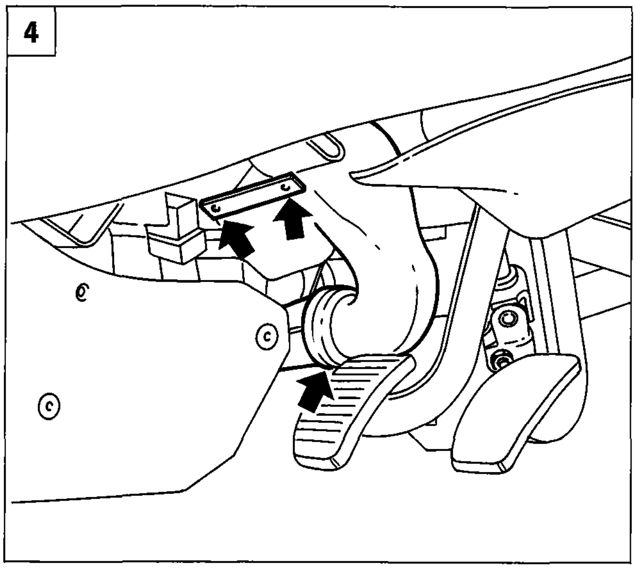


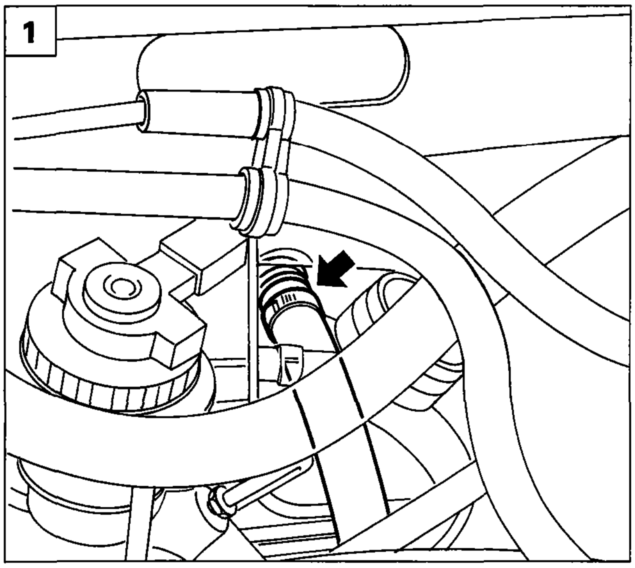
1. Release the EGR control unit wiring bundle from the clips shown.
2. Move the lining of the bulkhead between engine bay and cabin further to one side, then disconnect the vacuum inlet pipe from the brake servo.
3. Undo nuts securing the brake pump to the brake servo, then take the pump out slightly without disconnecting the brake lines.




P4A07DA01

*Continue by removing parts from inside the car and then removing the brake servo as described for the 1370 12v version. Note that the air line shown in the figure alongside must also be disconnected for the 1910 TD version.*

4A36DA

1

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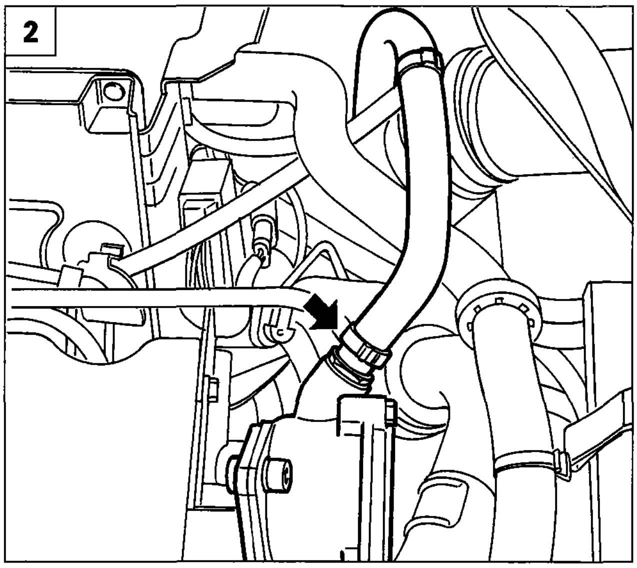
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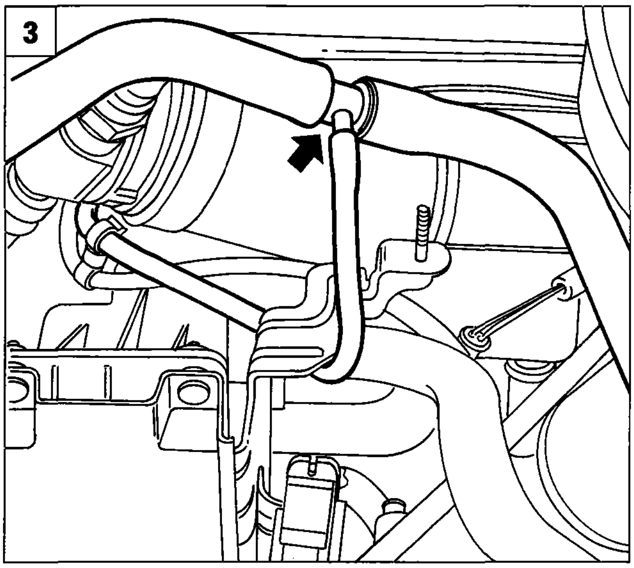
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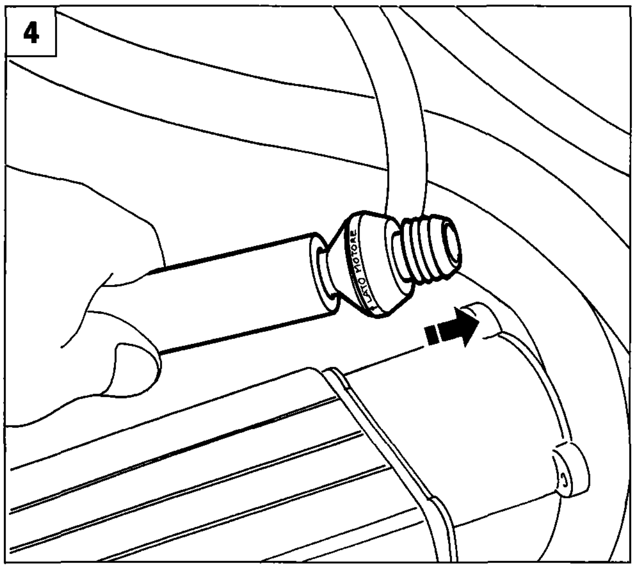
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## REMOVING-REFITTING BRAKE SERVO VACUUM INLET PIPE AND ONE-WAY VALVE

*Proceed as described for the brake servo inside the engine bay, but without disconnecting the brake pump from the brake servo.*

1. Disconnect the vacuum inlet pipe from the brake servo.
2. Disconnect the clip retaining the vacuum inlet pipe from the vane vacuum pump.
3. Disconnect the pipe indicated in the figure from vacuum inlet pipe, then remove the pipe.
4. Separate the one-way valve from the vacuum inlet pipe. When refitting, position the valve with the wording LATO MOTORE turned toward the engine.

4A37DA

page

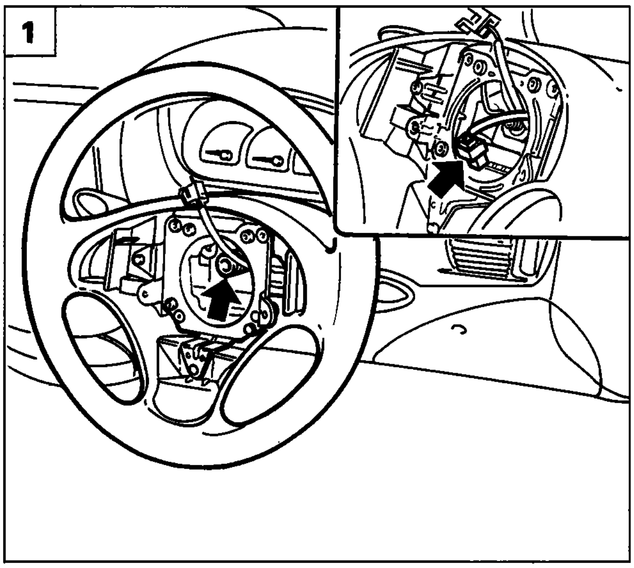
**OPERATION**



1370 ***12v***



1910 ***TD 75***

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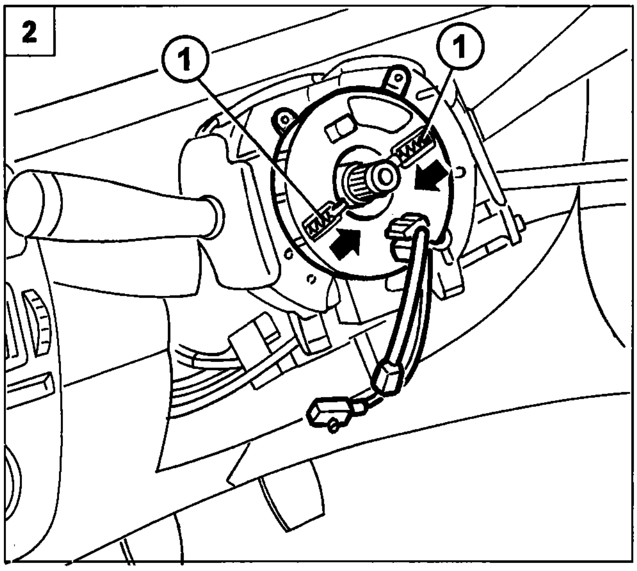


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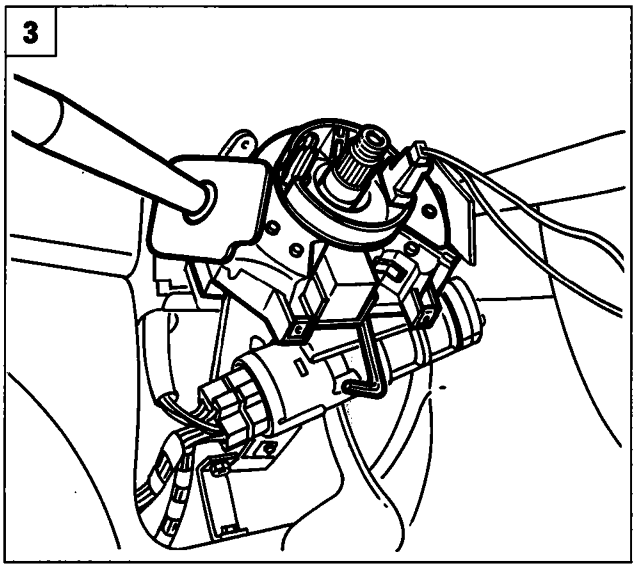


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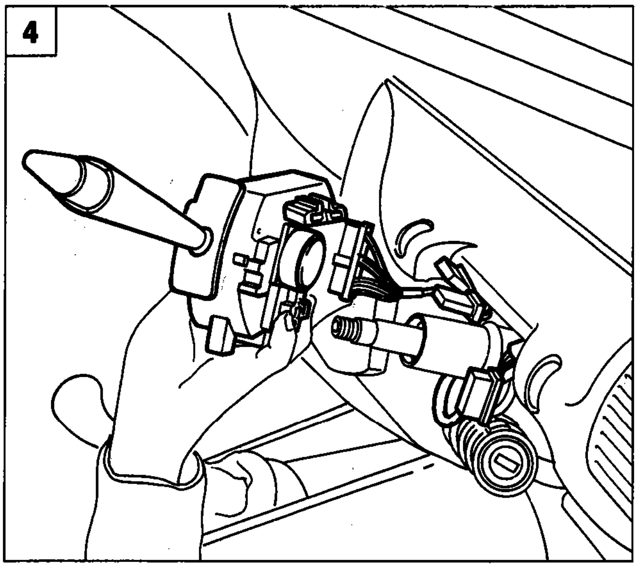



P4A39DA04

**STEERING WHEElRemoving-refitting**

*Remove the air bag module from the steering wheel as described in Section 55.*

1. Unscrew the nut retaining the steering wheel to the steering column, the disconnect the horn electrical connection and remove the steering wheel.
2. Mark the positions of the steering wheel hub and steering columns and remove the steering wheel.

*During the operation, take care NOT TO STRIKE THE STEERING WHEEL.*

*The clock spring is fitted with a safety clip to prevvent the lower and upper plates turning in relation to one another when the steering wheel is not fitted in the car. This is achieved by springs (1), which close as shown in the figure.*

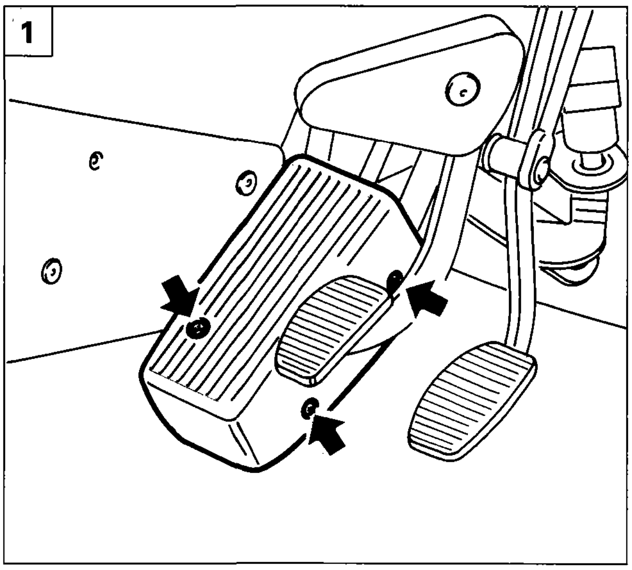
*Remove the clock spring as described in Section 55.*

**STALK UNIT-RELEASE Removing-refitting**

Remove the stalk unit-release as follows:

3. Use a socket wrench to loosen the bolt of the stalk unit-release retaining collar and withdraw.
4. Disconnect electrical connectors from the stalk unit-release and remove.

4A39DA

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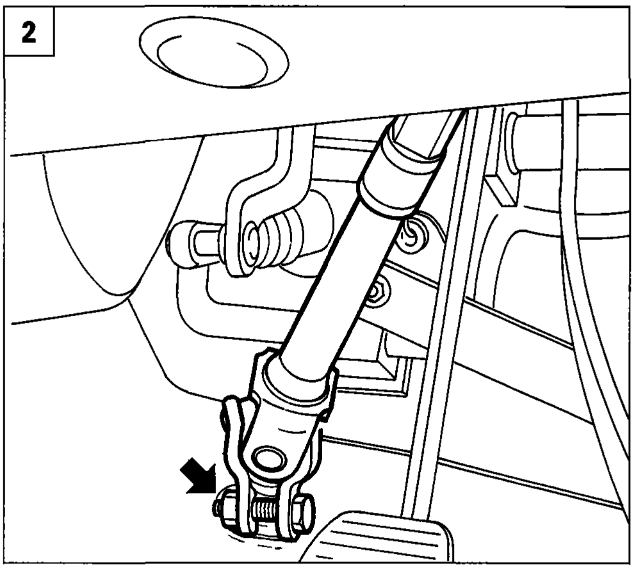


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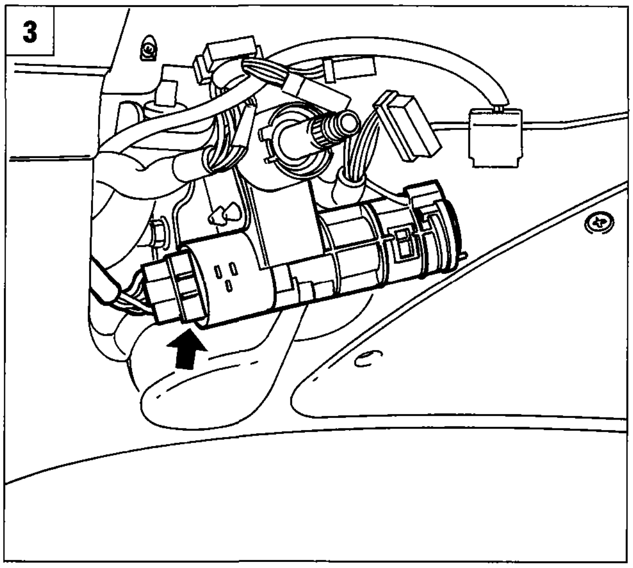
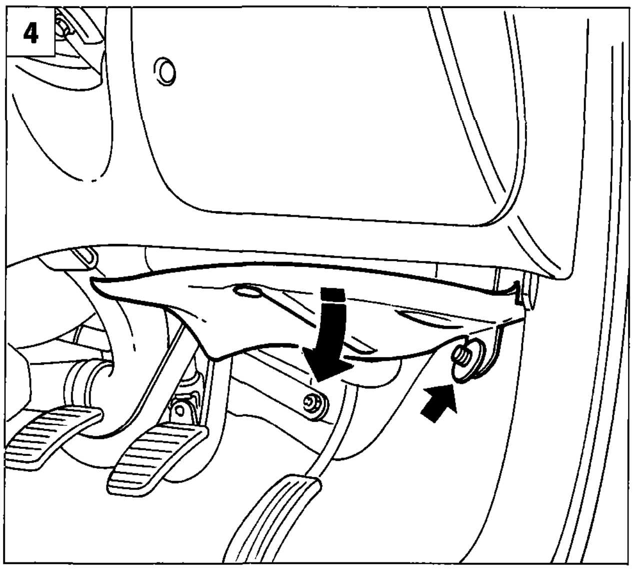



P4A40DA02

### STEERING COLUMNRemoving-refitting

Proceed as follows to remove the steering column:

1. Remove the left foot rest located beside the clutch pedal.
2. Unscrew bolt retaining the lower steering column shaft to the power steering box pinion.
3. Disconnect the ignition connector.
4. Remove the lower junction unit protection.
5. Remove the steering column reinforcement bar by unscrewing the retaining bolts indicated in figure.

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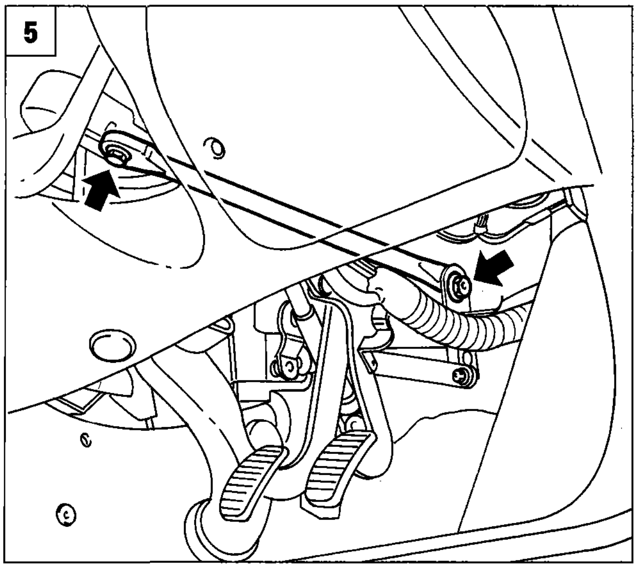


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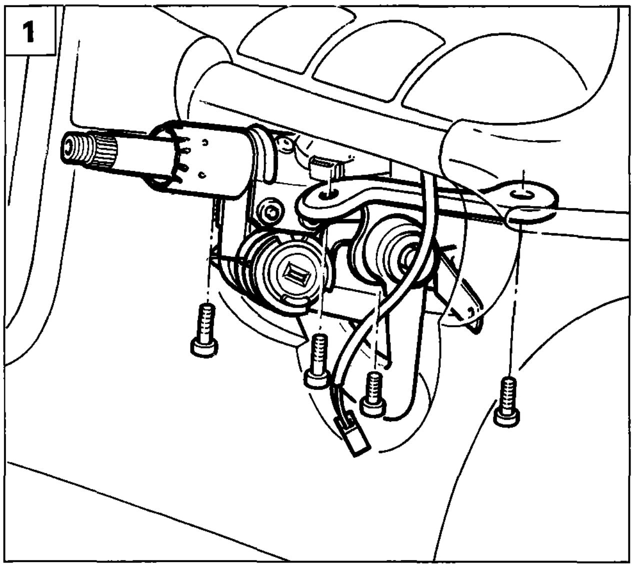

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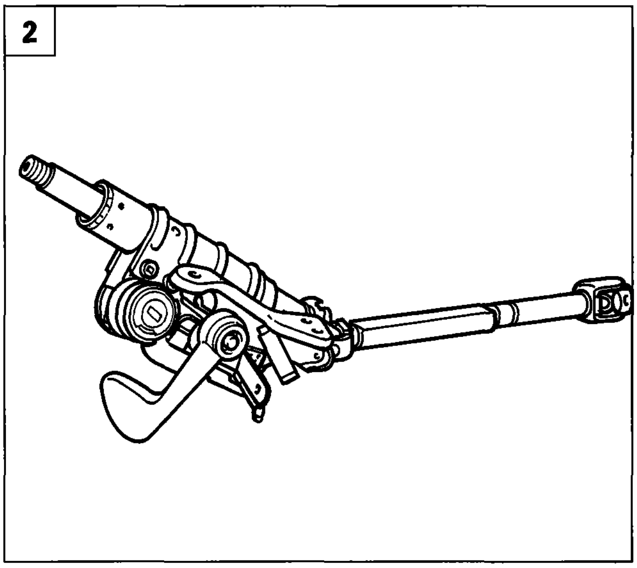

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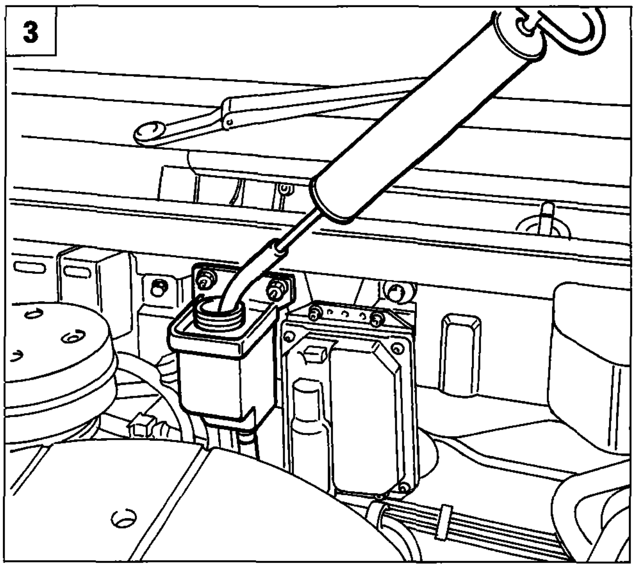


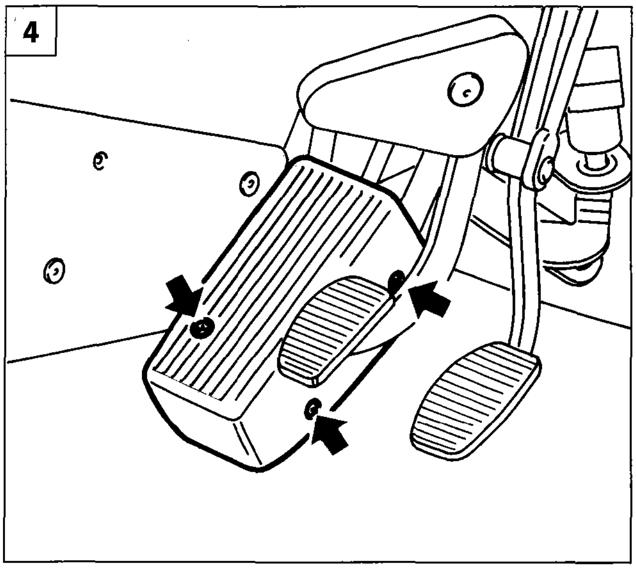
P4A41DA03

1-2. Unscrew the bolts fastening the steering column mount to the body and remove the steering column together with the lower shaft.

**RACK AND PINION POWER STEERING BOX**

**Removing-refitting**

3. Disconnect the negative battery terminal lead, position the car on a lift, then drain the power steering fluid from the reservoir using an appropriate syringe.
4. Remove the left foot rest located alongside the clutch pedal.
5. Unscrew bolt retaining the lower steering shaft to the power steering box pinion.



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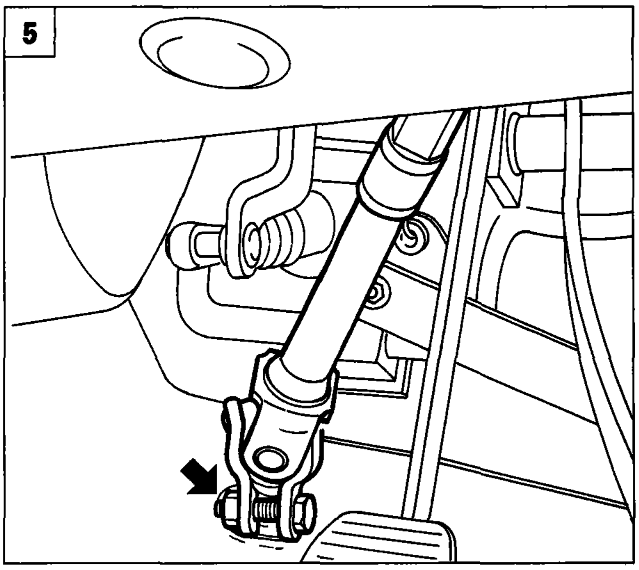

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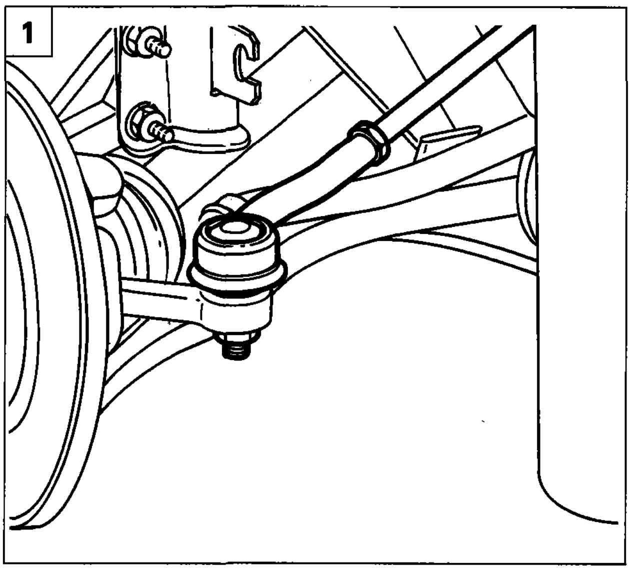
# 41.

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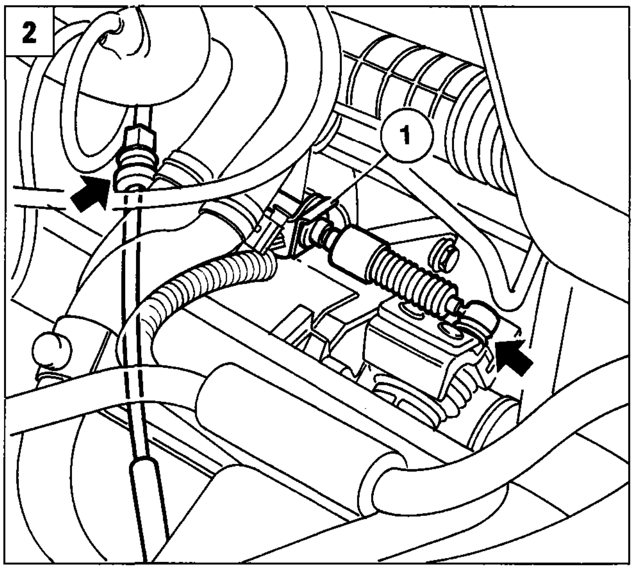


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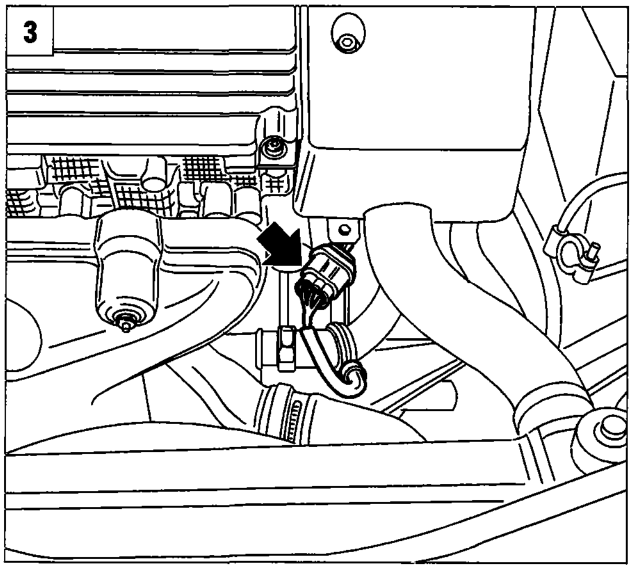
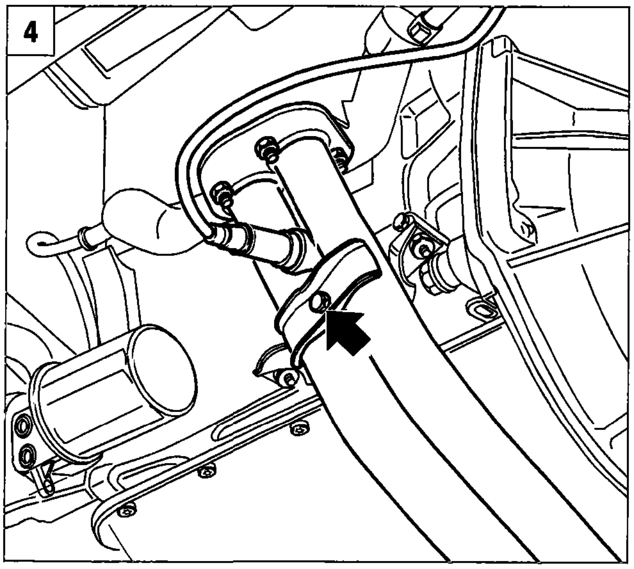



P4A42DA03

1. Remove the front wheels, then unscrew the bolts retaining the steering link heads (right and left) to the pillars and remove from the pilars using extractor 1847038000.
2. Release the reverse inhibition lead from the retaining clip, then lift clip (1) and disconnect the gear selection bowden cable head.
3. Disconnect electrical connection of the lambda probe.
4. Remove the bracket retaining the first exhaust pipe section to the crankcase.
5. Unscrew bolts retaining the first exhaust pipe section to the catalytic converter.

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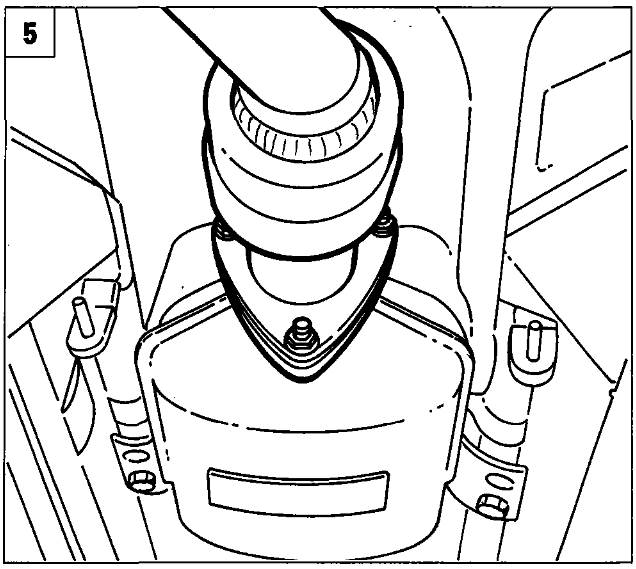


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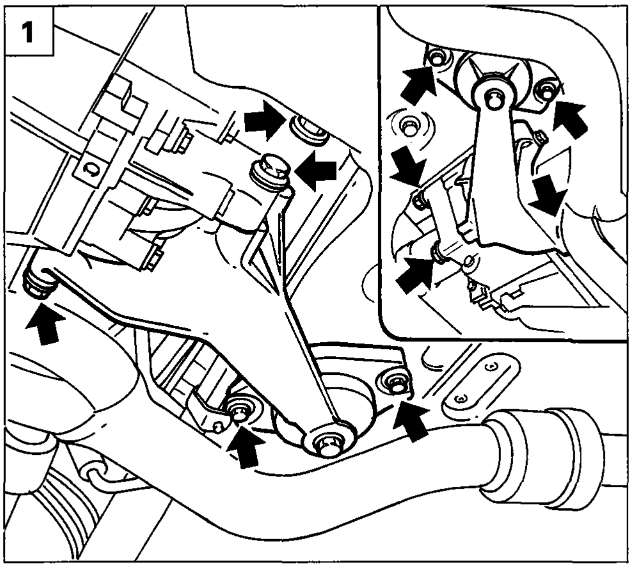

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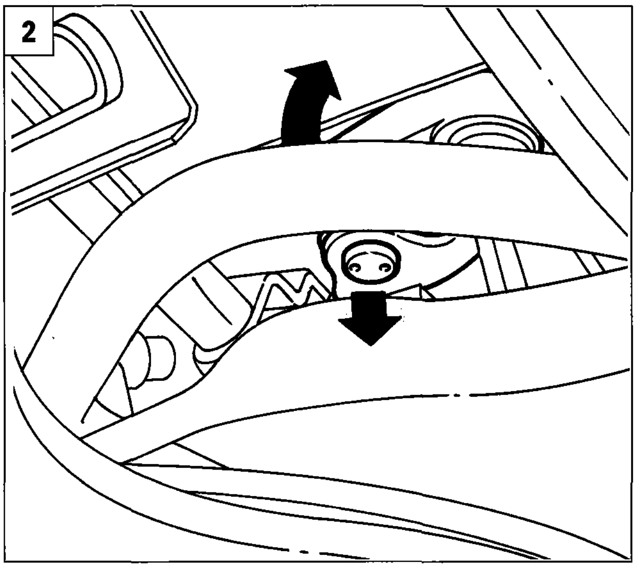

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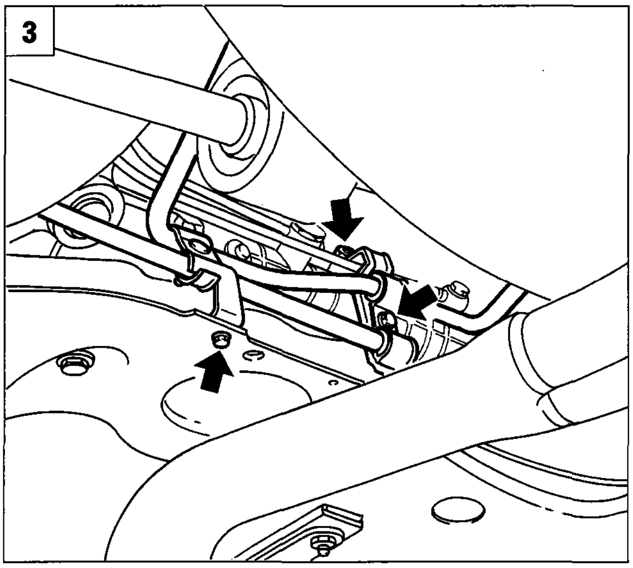
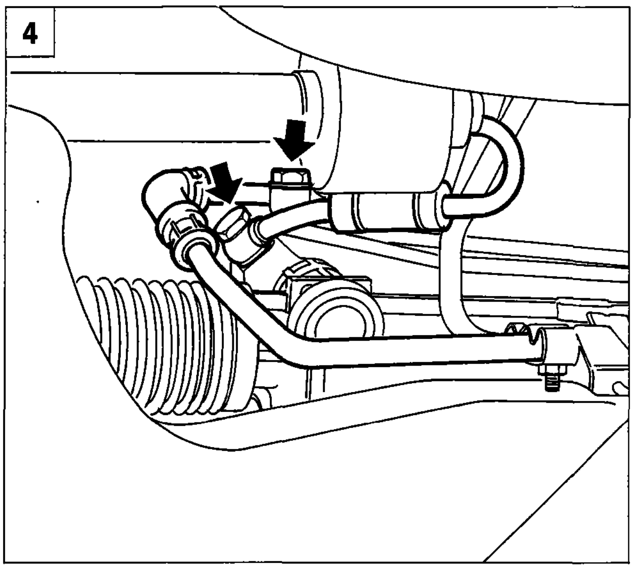


P4A43DA03

1. Position a hydraulic jack beneath the engine and then unscrew the bolts retaining the central engine mount and remove.
2. Prise off the head anchoring the gear lever to the transmission mount, working from the lower rear of the engine bay.
3. Unscrew the nuts and bolt shown in the figure, which retain the power steering fluid return line brackets to the reservoir.
4. Disconnect the fitting for the inlet line for fluid under pressure from the pump and the fitting of the fluid return line to the reservoir.
5. Unscrew the bolts fastening the power steering box to the front beam.



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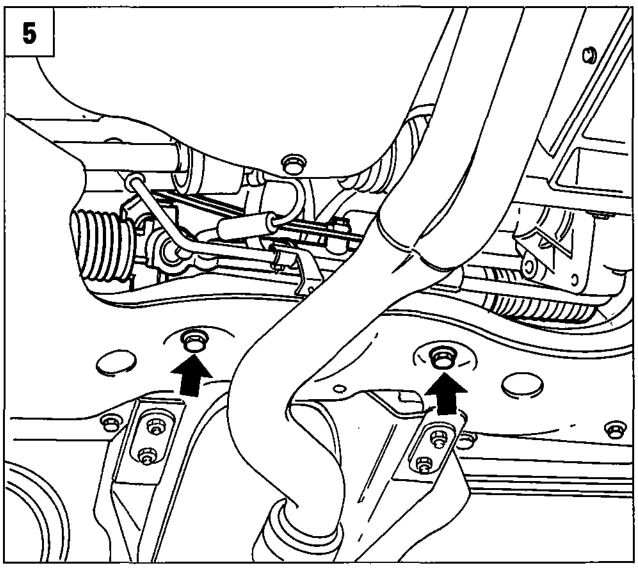

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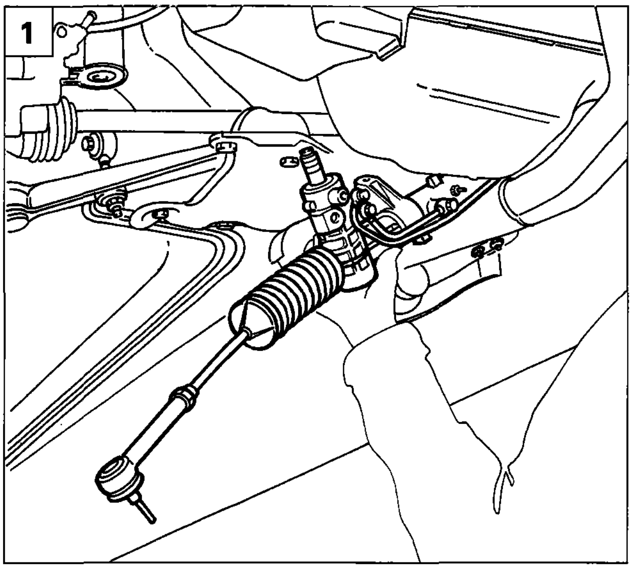


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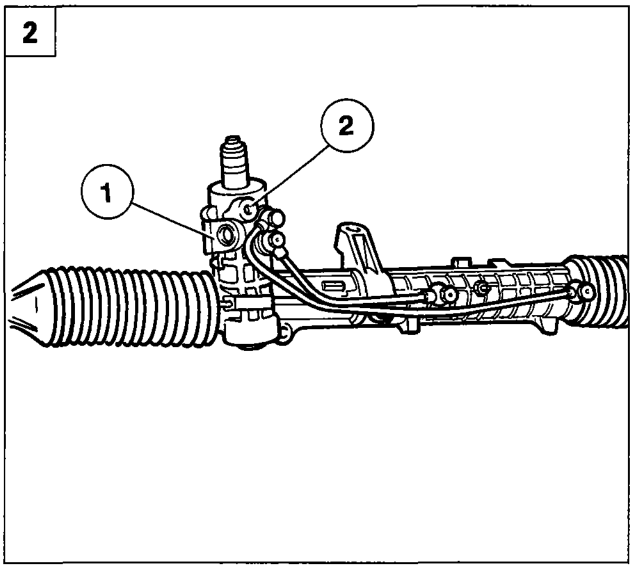
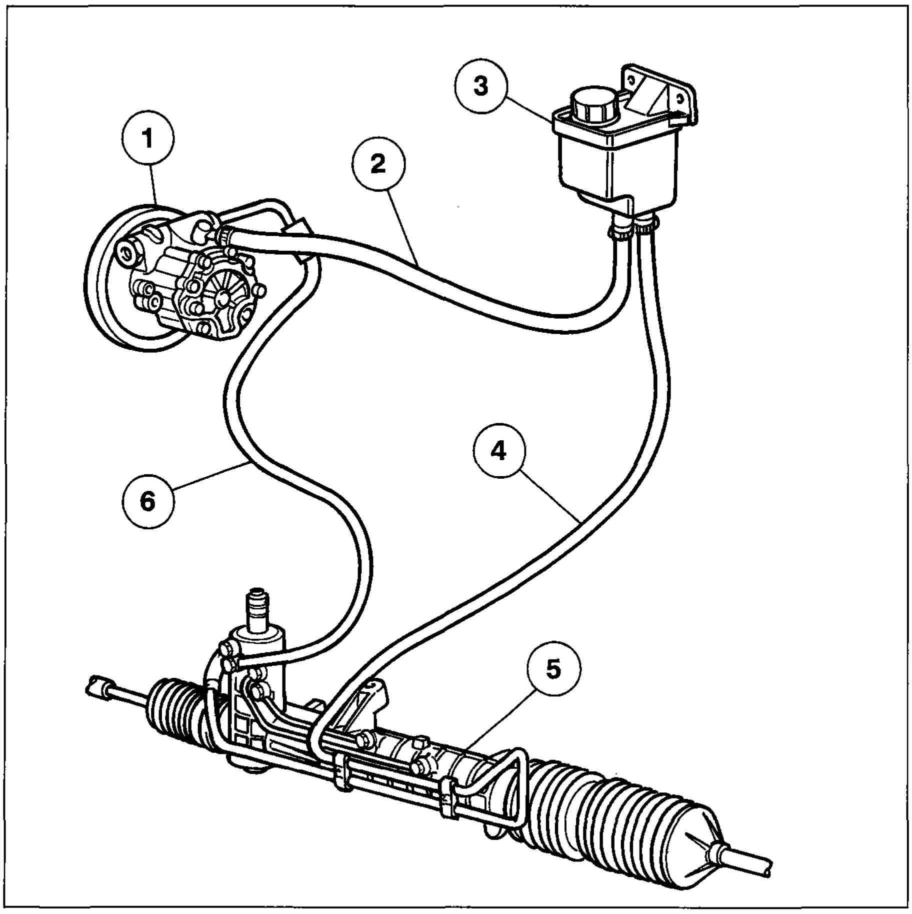



P4A44DA02

1. Remove the power steering box from the vehicle, by moving the entire assembly toward the gearbox end and taking out from the middle as shown in the figure.

2. Power steering box
   1. Fitting for pipe carrying fluid under pressure from the pump
   2. Fitting for fluid return line to reservoir

## COMPONENTS OF POWER STEERING SYSTEM




P4A44DA03

1370 12v

1. Pump
2. Fluid delivery line to pump
3. Power steering fluid reservoir
4. Fluid return line to reservoir
5. Power steering box
6. Pipe carrying fluid under pressure from pump

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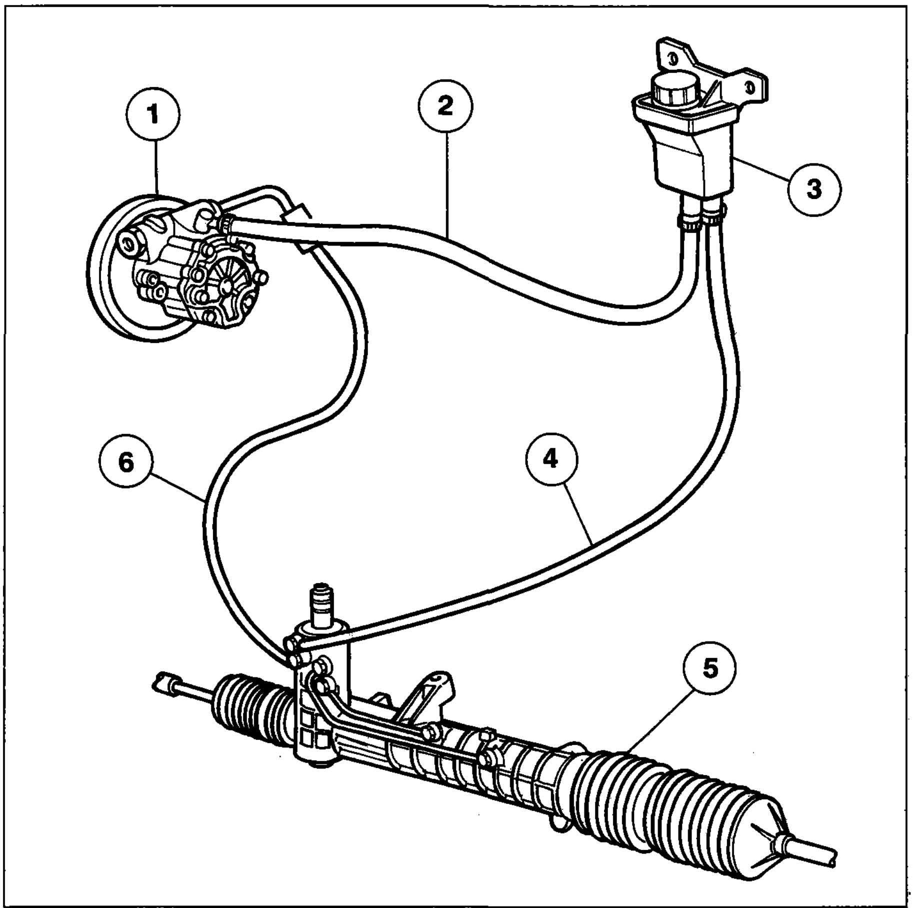
## COMPONENTS OF POWER STEERING SYSTEM



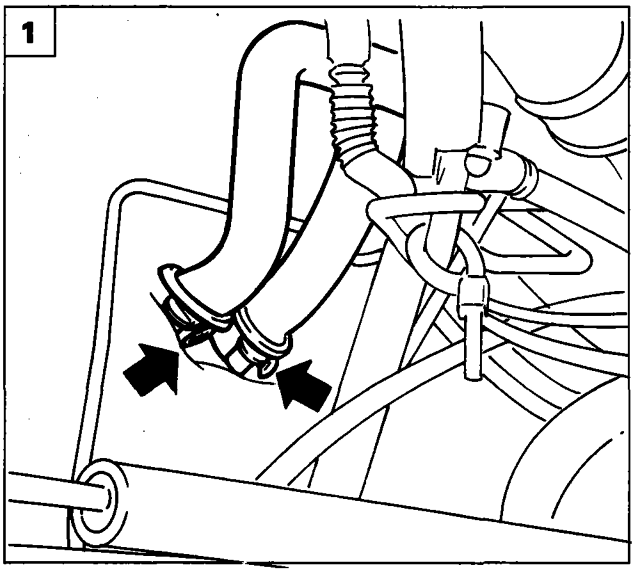

P4A45DA01

1910 TD 75

1. Pump
2. Fluid delivery line to pump
3. Power steering fluid reservoir
4. Fluid return line to reservoir
5. Power steering box
6. Pipe carrying fluid under pressure from pump

page

HEATER WITH MANUAL CONTROLS



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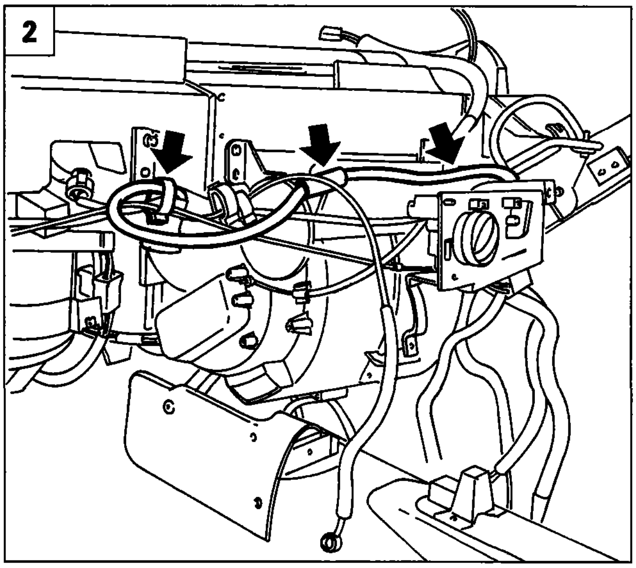

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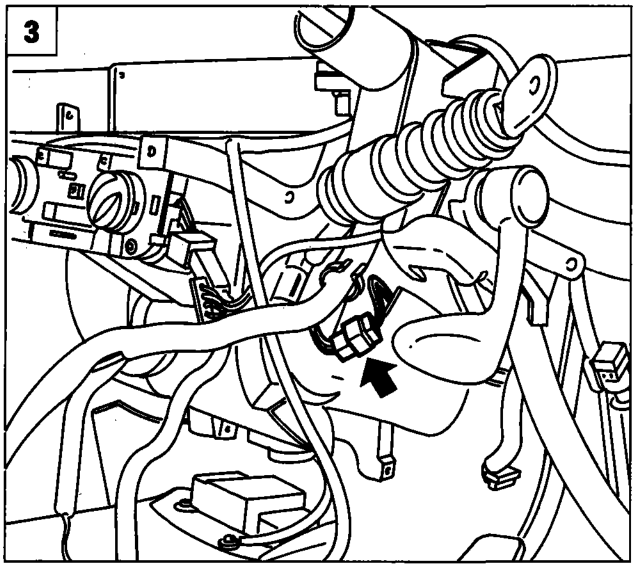

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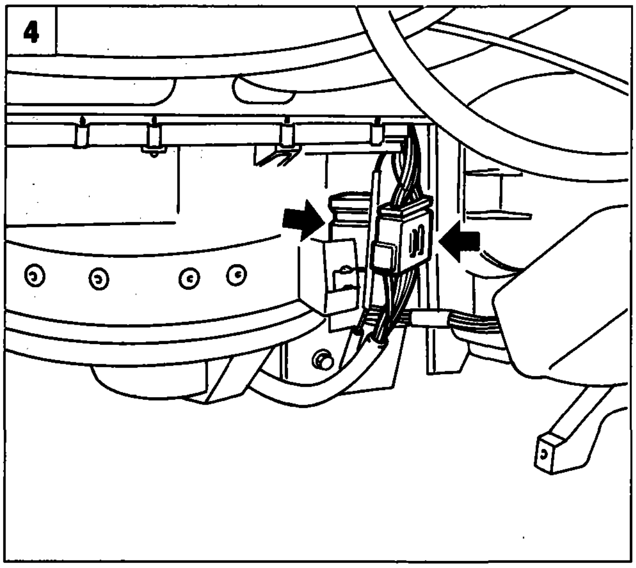


P4A47DA04

## DISTRIBUTOR HEATER ASSEMBLY

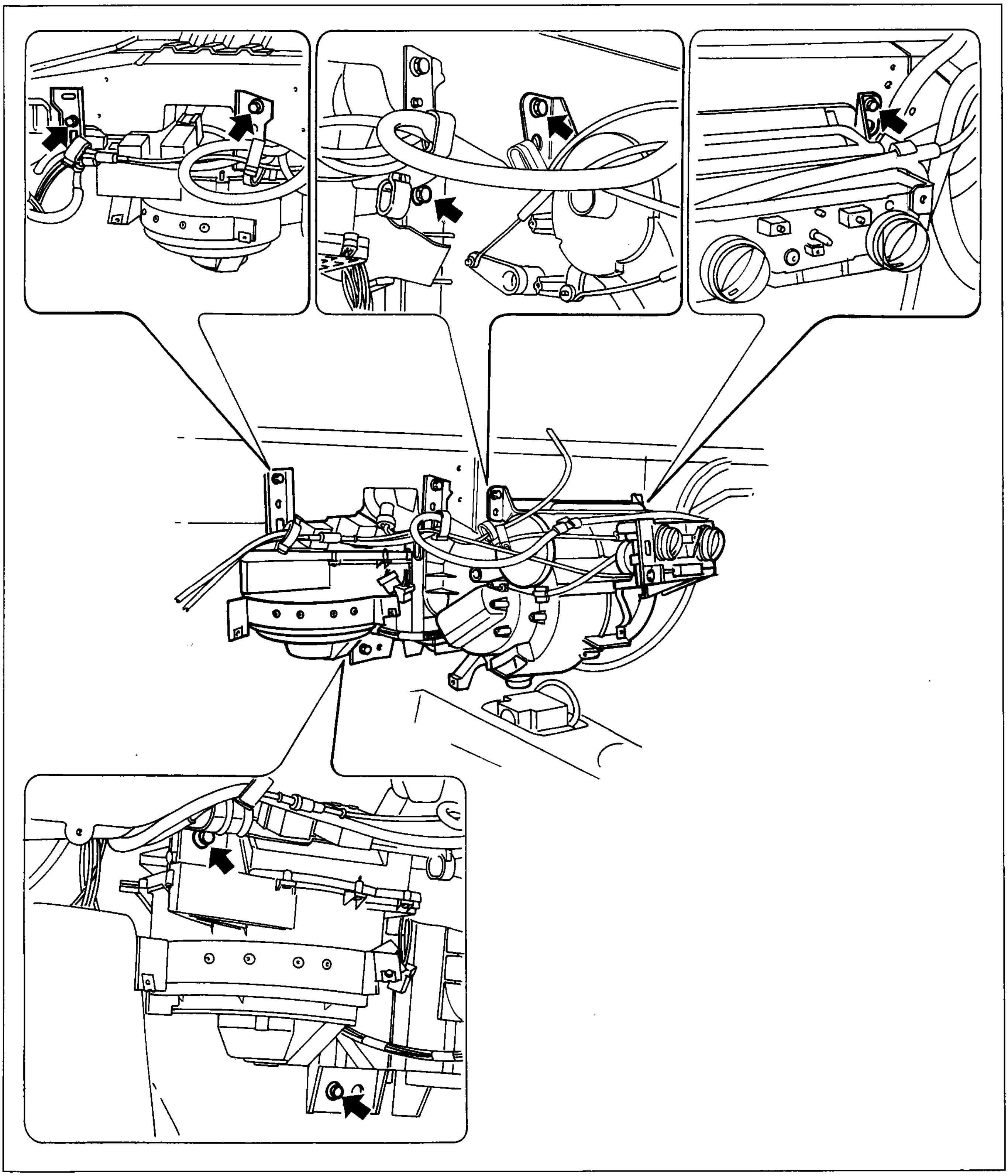
### Removing-refitting

*Drain the cooling system, then remove the facia and central tunnel trim as described in Section 70.*

1. Working from the lower rear of the engine bay, loosen both clips arrowed in the figure and disconnect both rubber pipes from the metal ends of the heater radiator.
2. Release the air bag lead from the retaining brackets.
3. Disconnect electrical connection located alongside the clutch pedal.
4. Disconnect electrical connections located alongside the cabin fan.

# 50.

Unscrew bolts indicated in figure which secure the heater-distributor assembly to the body, then remove the assembly from the car.



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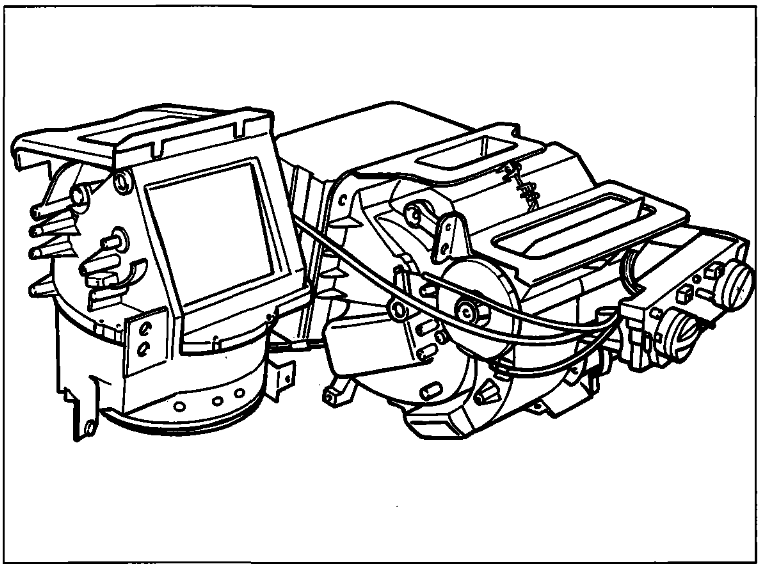
**View of the heater-distributor unit**



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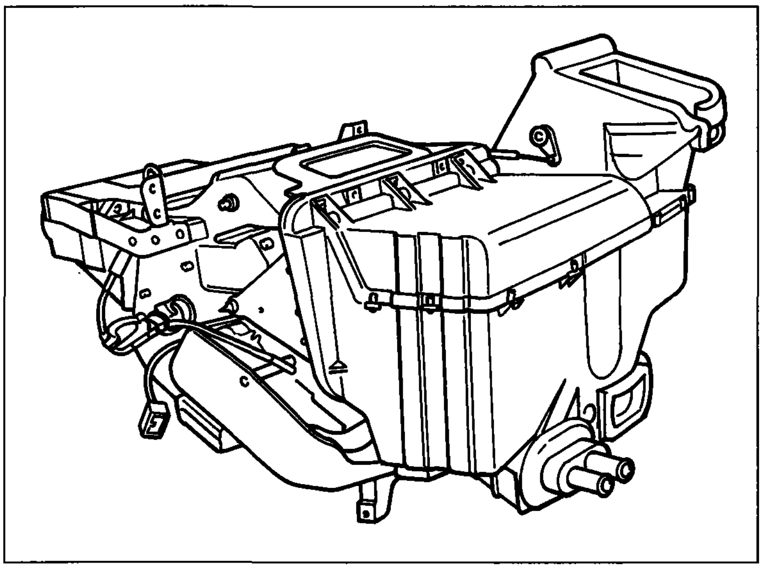

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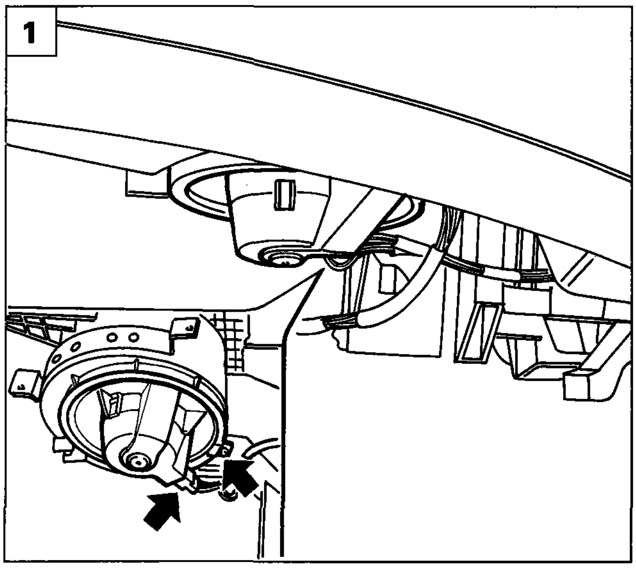


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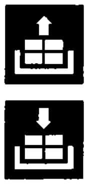
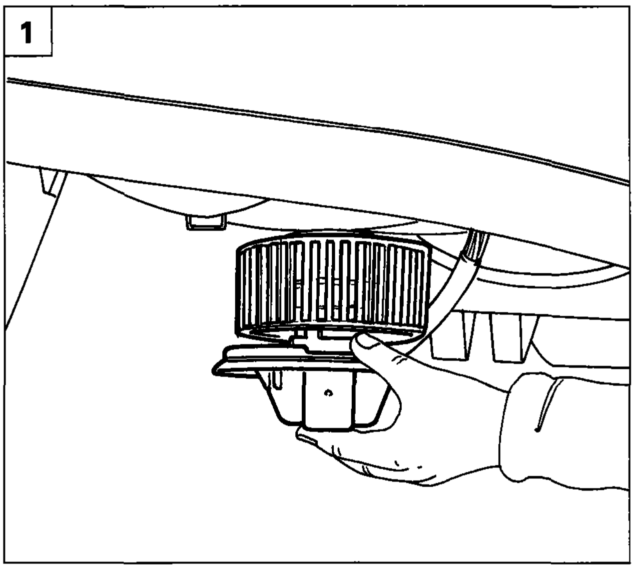


**REMOVING-REFITTING CABIN FAN**

1. Disconnect the battery negative terminal, then work from the lower left part of the facia to disconnect the supply connector and remove the fan cover retaining bolt.

# 50.

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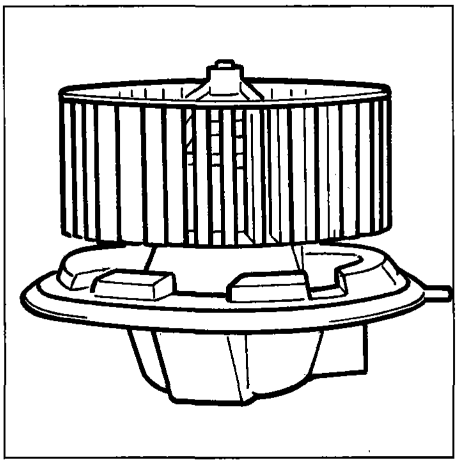


P4A50DA02

1. Remove the cabin fan from the lower left hand side of the facia.

page

## LOCATION OF WIRING

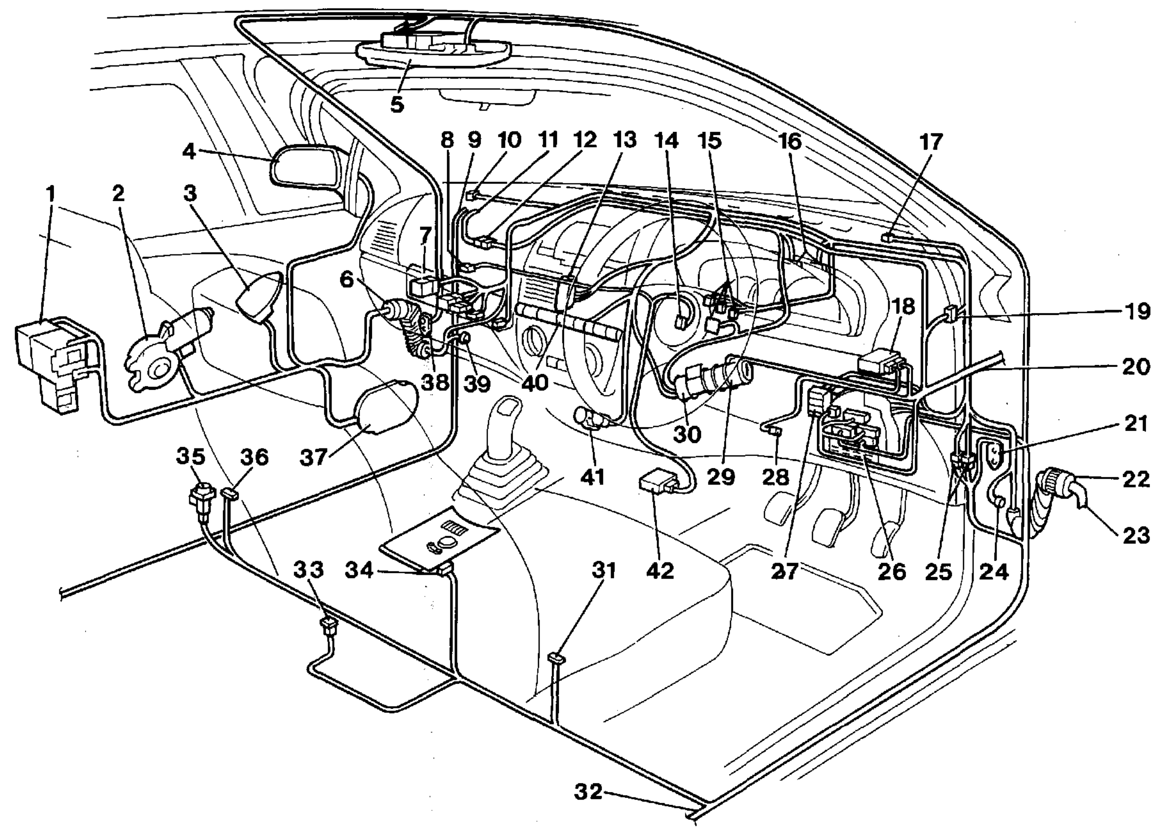


## INSTRUMENT PANEL



## AIR BAG

**PERSPECTIVE VIEW OF FACIA WIRING**




1. Front left door lock
2. Left front window motor
3. Push button for electric front windows on left armrest
4. Left external rear wiew mirror
5. Front courtesy light
6. Dashboard/front left door cables connection
7. Fuses bracket under glove box
8. Passenger's Air Bag
9. A.B.S. cables
10. Front left speaker (Tweeter)
11. Front left cable
12. Front right/left cables connection
13. Hazard warning lights switch unit
14. Driver's Air Bag
15. Stalk unit
16. Instrument panel
17. Front right speaker (tweeter)
18. Fiat CODE electronic control unit
19. Dashboard/front cables connection
20. Front right cable
21. Courtesy lights front right switch
22. Dashboard/front right door cable connection
23. Front right door cable
24. Right dashboard earth
25. Dashboard/rear cables connection
26. Fuse and relay unit
27. Fuses on auxiliary bracket
28. Stop lights switch
29. Fiat CODE antenna
30. Ignition switch
31. Rear cables/driver's heated seat connection
32. Rear cable
33. Hand brake on warning light switch
34. Push button unit for electrically-adjustable external rear view mirrors
35. Inertial switch
36. Rear cables/passenger's heated seat connection
37. Loud speaker on front left door
38. Courtesy lights front left switch
39. Left dashboard earth
40. Switch control assembly
41. Cigarette lighter
42. Air Bag electronic control unit

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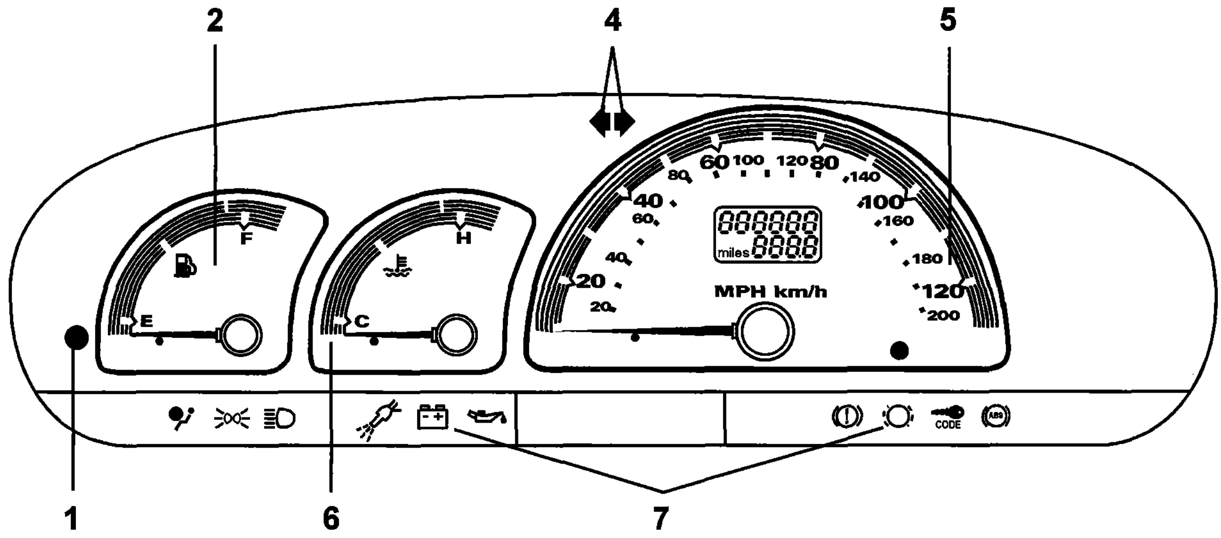
**INSTRUMENT PANEL**




**Bravo-Brava 1370 12v**

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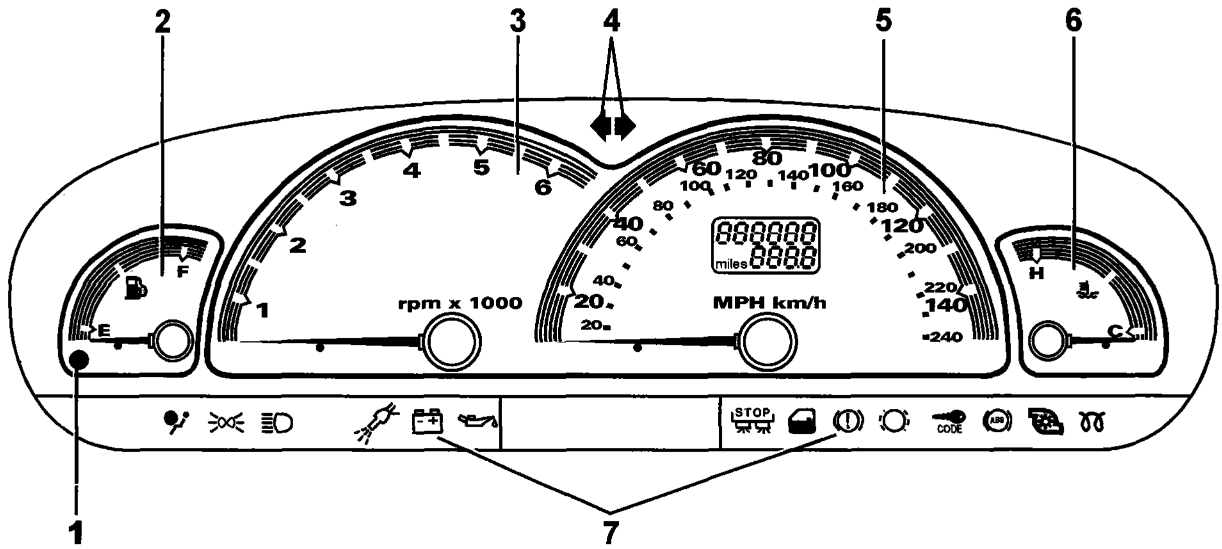


**Bravo-Brava 1910 TD 75**

P4A53DA02

1. Fuel reserve warning light
2. Fuel level gauge
3. Rev counter
4. Turn signal warning lights
5. Speedometer and dual mileometer (total and trip counter)
6. Coolant temperature gauge
7. Warning lights

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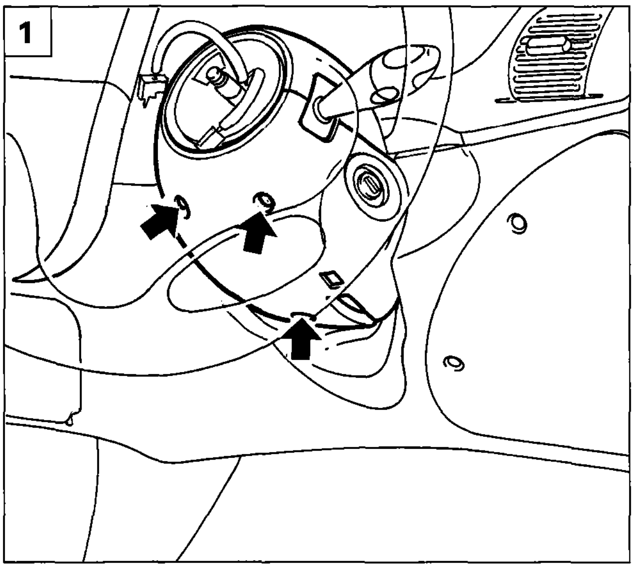
# 55.

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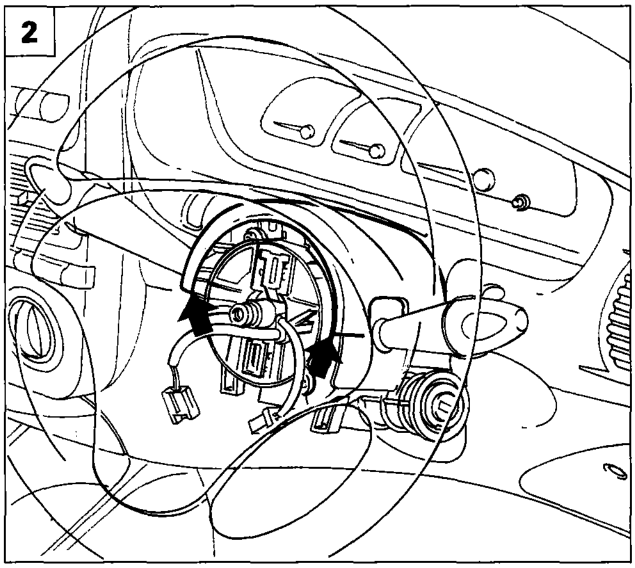


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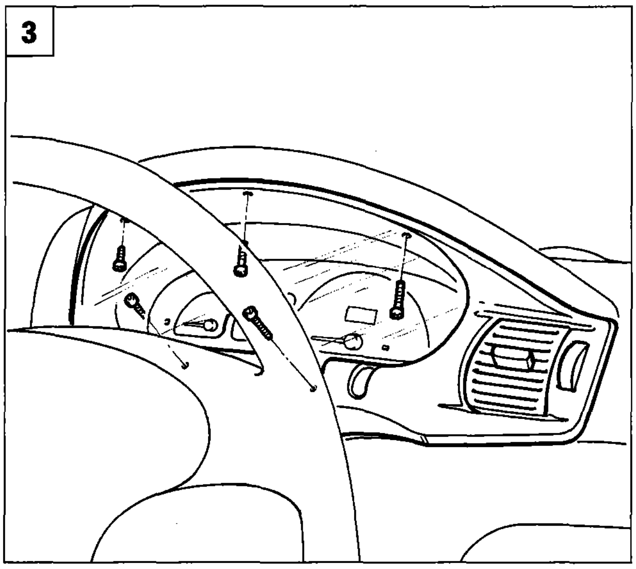
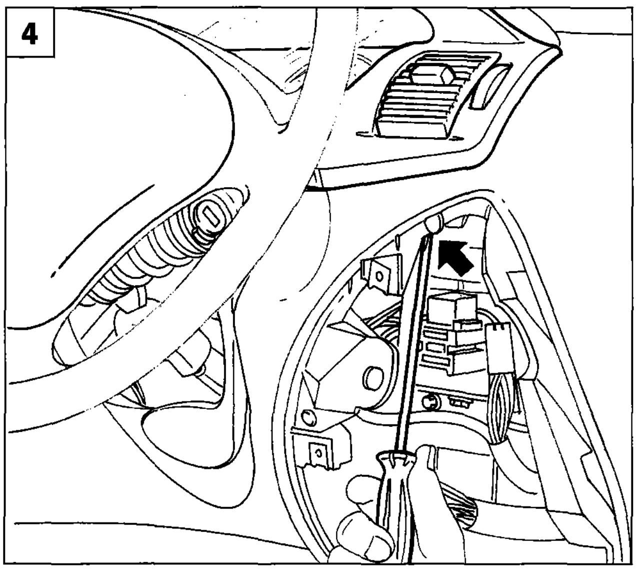


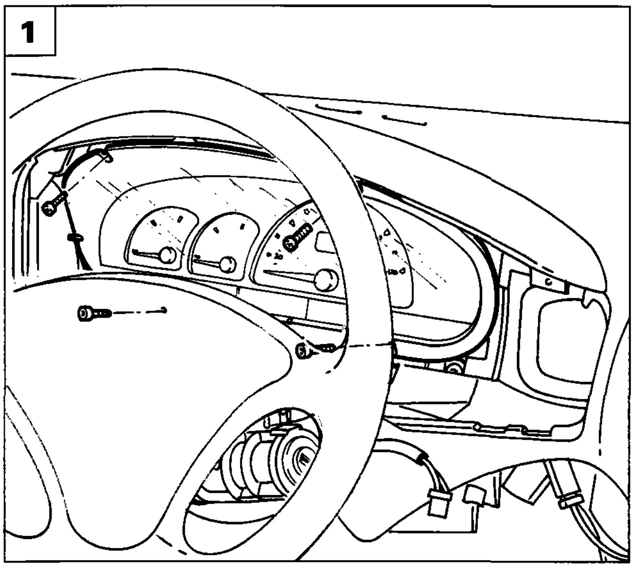

P4A54DA03

### REMOVING-REFITTING

1. Disconnect the battery negative terminal, then remove the lower steering column trim by undoing the bolts indicated in the figure.
2. Remove the upper steering column trim in order to allow removal of the lower control panel frame screws.
3. Unscrew the bolts fastening the outside of the control panel frame.
4. Remove the junction unit protective cover. Unscrew the outer control panel frame retaining screw. Remove the frame from the facia and disconnect the lighting dimmer and headlamp beam alignment connectors.

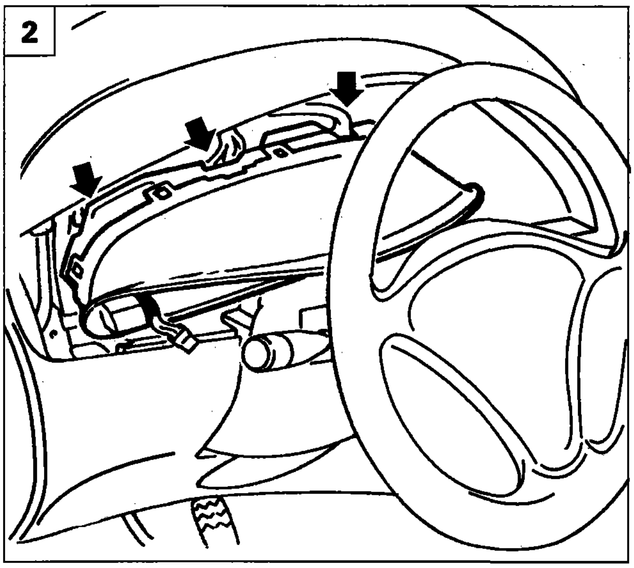



P4A54DA04



P4A55DA01

1. Unscrew screws fastening control panel to facia.



P4A55DA02

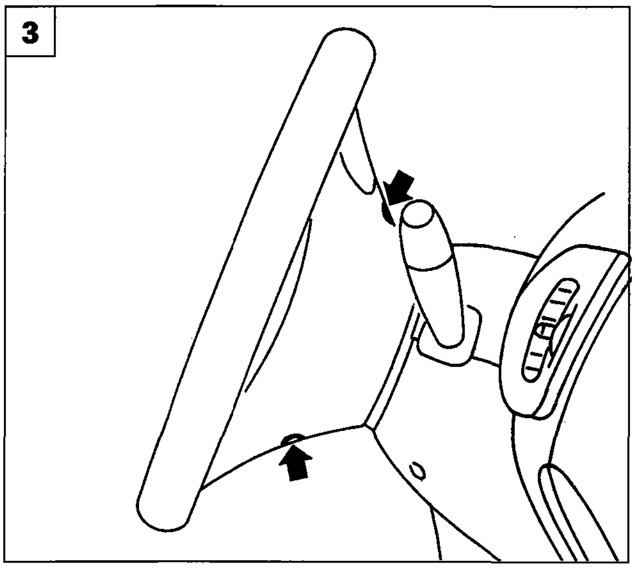
2. Disconnect electrical connections for the instrument panel and remove from the car.

**NOTE** *Reverse order of removal operations to refit.*

## REMOVING-REFITTING DRIVER'S SIDE AIR BAG

*The air bag modules must be removed and refitted with the ignition key turned to "STOP" and removed, and the battery positive and negative terminal and properly insulated. Wait for 10 minutes before continuing.*

**TAKE CARE TO OBSERVE ALL THE SAFETY RULES SET OUT IN THE CHAPTER ON "AIR BAG And PRETENSIONERS" IN THE MANUAL FOR THE LEFT HAND DRIVE VERSION**

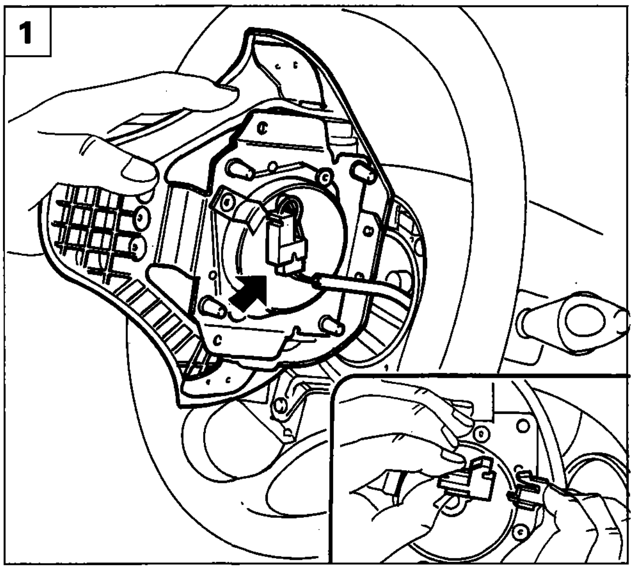


P4A55DA03

3. Unscrew both hexagonal-headed socket screws indicated. Turn the steering wheel to gain access to each screw.

4A55DA

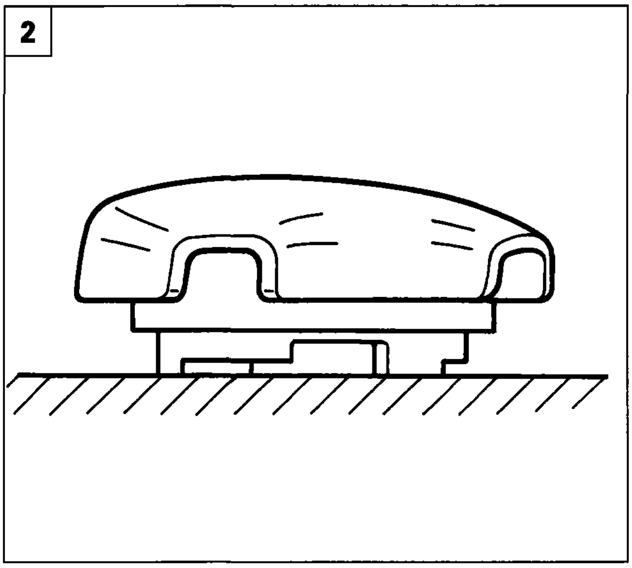
# 55.




P4A56DA01

1. Move the air bag module slightly. Carefully disconnect connector indicated, taking care nto to pull by the wire but by the connector case. Then remove the air bag module and rest on the work bench with the cover uppermost.

**NOTE** *For safety reasons, when the module connecter is disconnected the two terminals automatically short circuit; a special spring-loaded device keeps both terminals connected.*



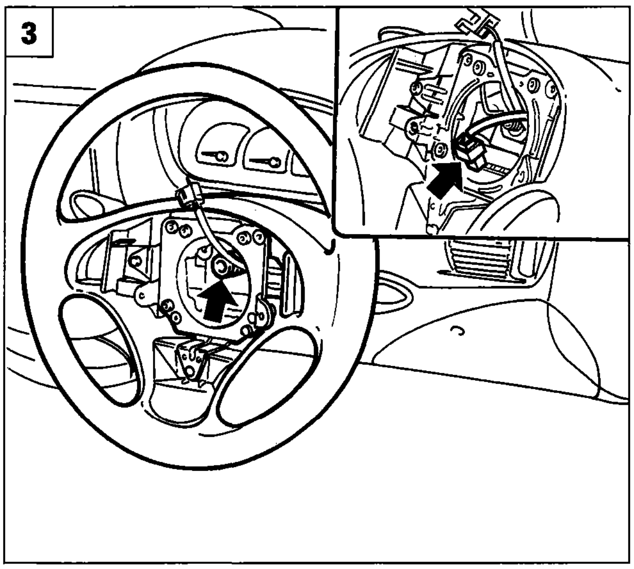

P4A56DA02

2. Replace the module in the appropriate cabinet. The diagram shows how the module should be positioned.

**NOTE** *Carry out removal operations in reverse order to refit.*

*DO NOT CONNECT THE BATTERY UNTIL INSTALLATION IS COMPLETE*

**NOTE** *After the operation, check the system using a Fiat/Lancia Tester.*



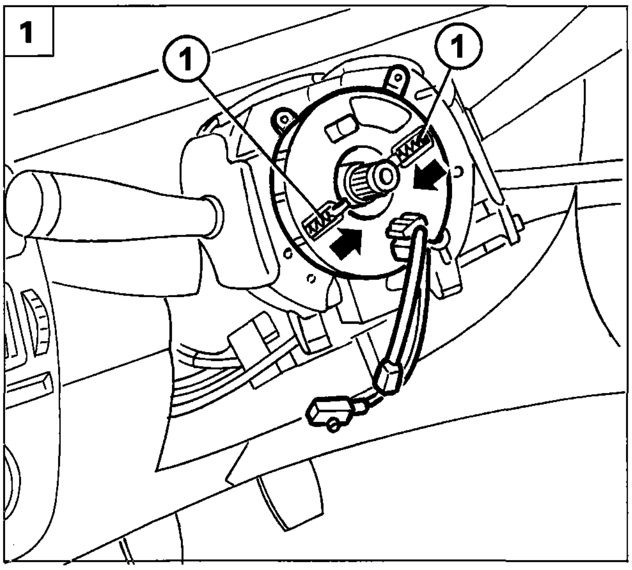

P4A39DA01

## REMOVING-REFITTING CLOCK SPRING

*Remove the driver's air bag as described on the previous page and observing the SAFETY REGULATIONS described.*

*All the following operations must be carried out with the WHEELS ALIGNED WITH THE LONGITUDINAL ACCESS OF THE VEHICLE (wheels straight). Secure the steering wheel if necessary.*

3. Remove the horn connector from its seat and disconnect, then unscrew the bolt retaining the steering wheel to the steering column.

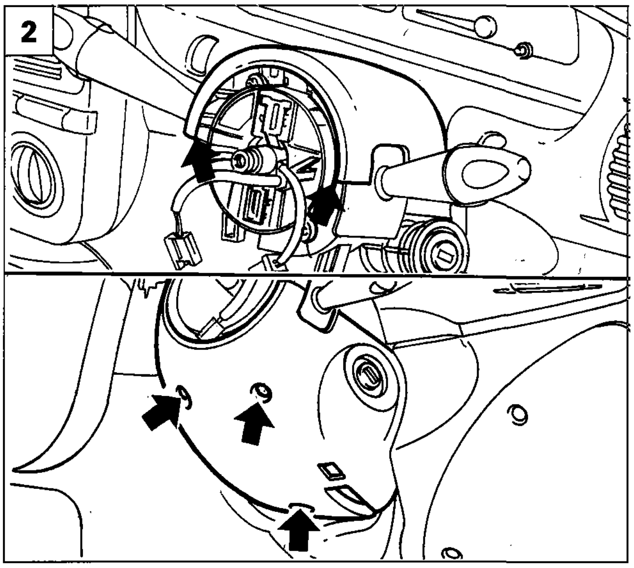



P4A39DA02

1. Mark the respective positions of the steering wheel hub and steering column, and remove the steering wheel.

*During the operation, take care NOT TO STRIKE THE STEERING WHEEL.*

*The device is fitted with a safety catch to prevent the upper and lower plates turning in relation to one anothe rwhen the steering wheel is not fitted in the car. To achieve this, springs (1) close as shown in the figure.*

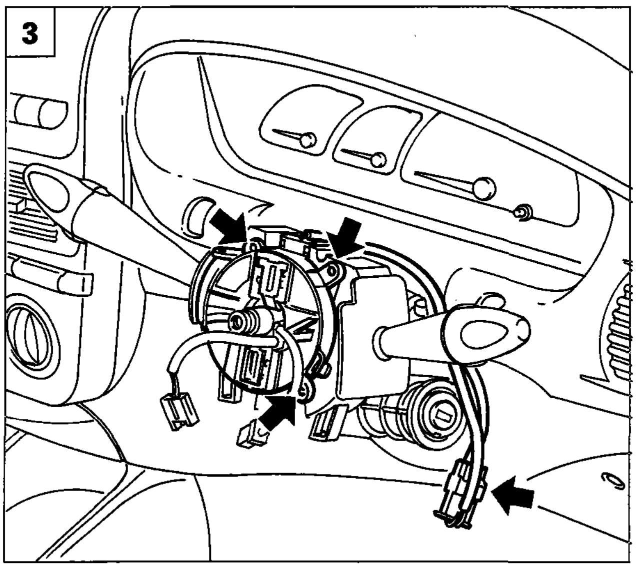



P4A67DA01

2. Unscrew the bolts fastening the upper and lower steering column guards.

3. Disconnect the connection connecting the clock spring to the Air Bag lead (yellow). Undo the three clock spring bolts and then remove.

*Once the steering wheel has been removed, the clock spring is blocked so that the lower and upper plates cannot turn..*
*If the upper plate of the clock spring should turn in relation to the lower for any reason, so that the position upon removal is lost, the CLOCK SPRING MUST BE REPLACED. Once the clock spring has been removed, carefully secure the device to prevent the two plates from turning accidentally.*




4A57DA

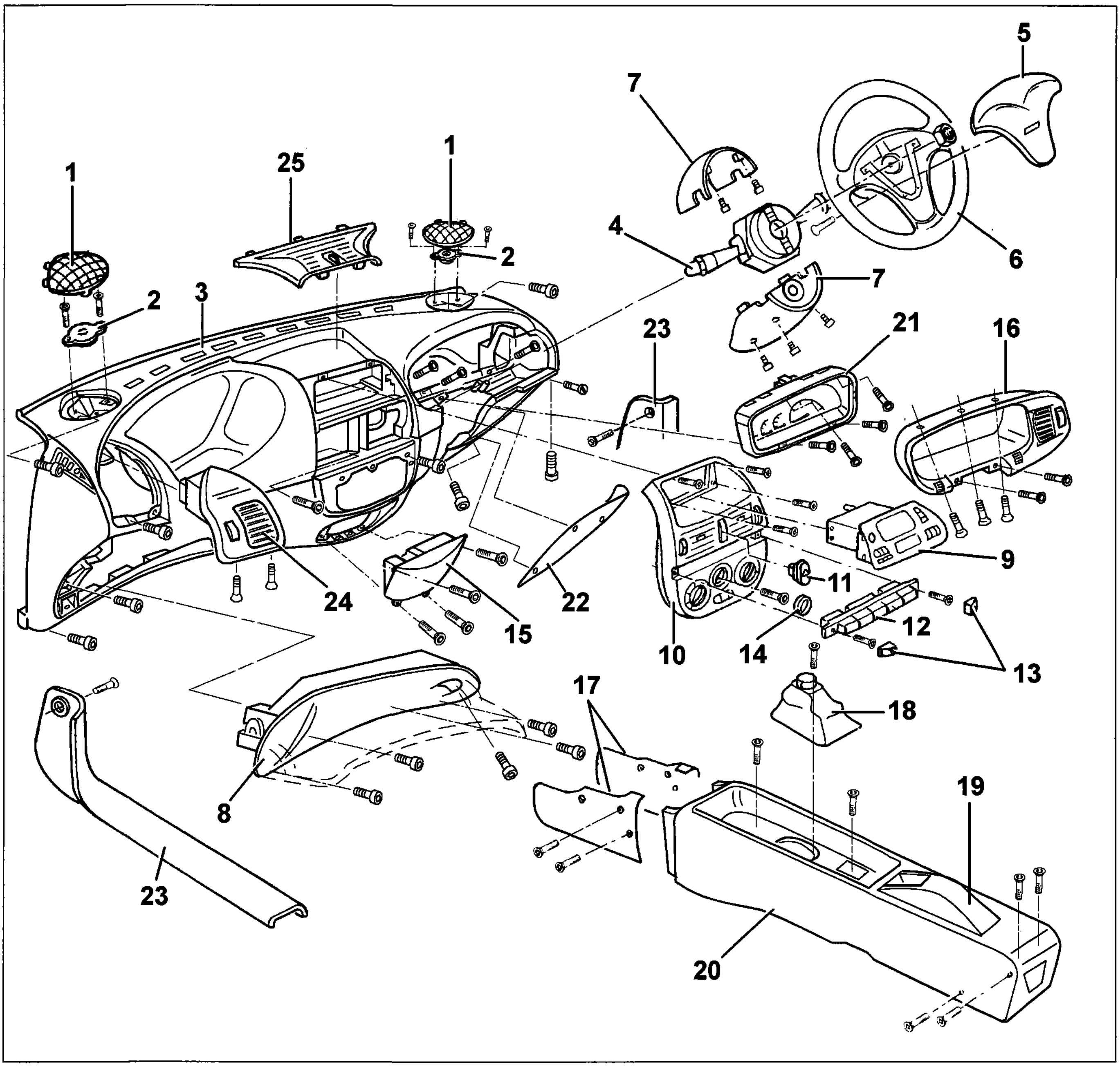
P4A67DA02

*Reverse order of removal operations to refit. When refitting the steering wheel, tighten the nut securing it to the steering column to a torque of 5 daNm.*

page

**INTERIOR TRIM**

## DASHBOARD - GENERAL EXPLODED VIEW

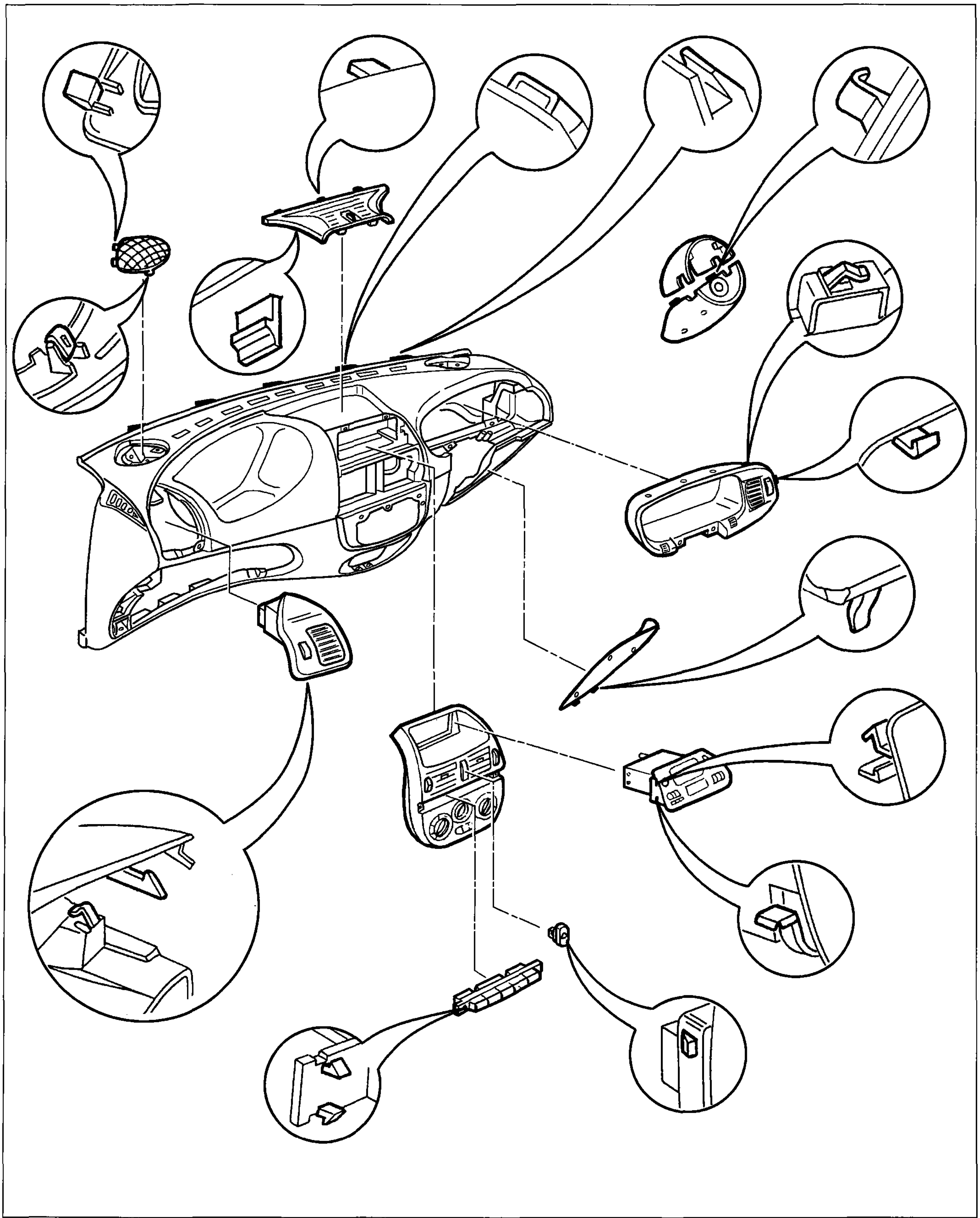



P4A59DA01

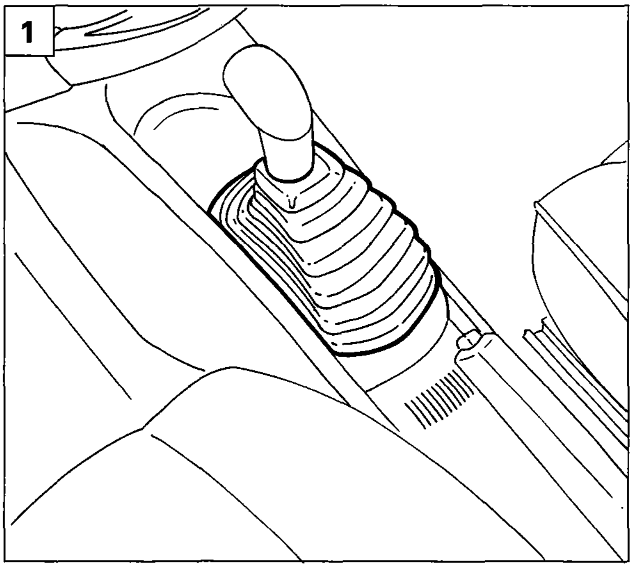
1. Speaker grille
2. Speaker
3. Instrument facia
4. Stalk unit
5. Horn/air bag protection
6. Steering wheel
7. Halves
8. Glove compartment
9. Car radio
10. Central panel
11. Hazard warning switch
12. Switch unit
13. Panels
14. Fan control knob
15. Ashtray/cigar lighter unit
16. Control panel frame
17. Protecting
18. Gear lever boot
19. Handbrake lever boot
20. Tunnel cover console
21. Instrument panel
22. Junction unit protection
23. Door sill trims)
24. Left ventilation outlet
25. Upper grille

4A59DA

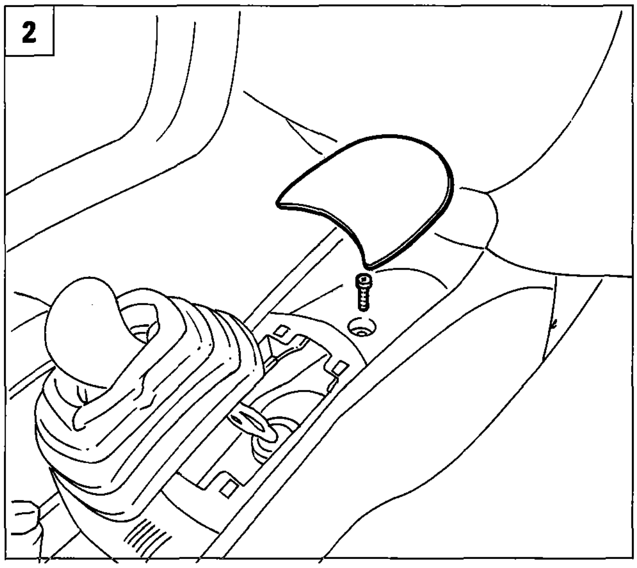
## GENERAL VIEW OF RETAINERS



P4A60DA01



P4A61DA01



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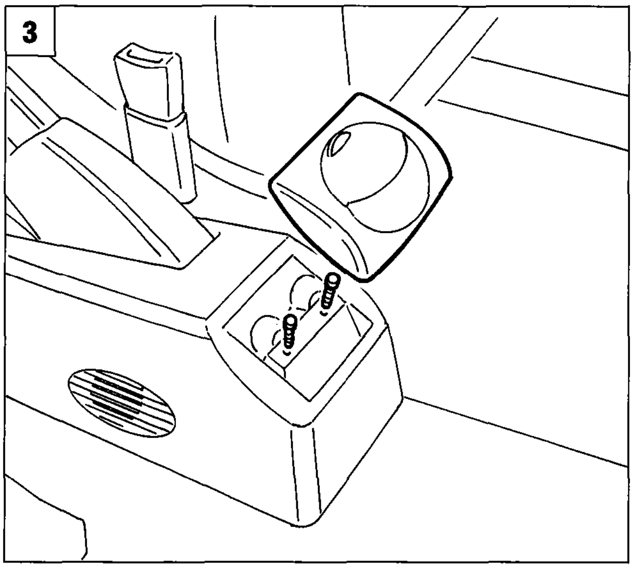
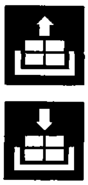


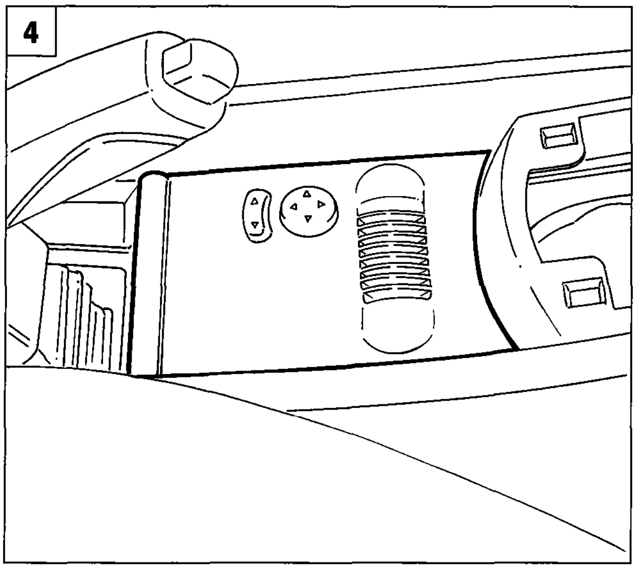
P4A61DA03



## EMOVING-REFITTING DASHBOARD

Disconnect the battery negative terminal, then remove the stalk unit from the car as described in section 41 - Steering.

1. Prise up the protective gear lever boot.
2. Lift the luggage compartment trim shown in the figure and unscrew the bolt underneath.
3. Remove the rear ashtray by lifting out and unscrew the underlying central tunnel retaining bolts.
4. Undo the retaining tabs to lift the door mirror control panel.
5. Disconnect supply connector for the electric door mirrors and remove the panel.



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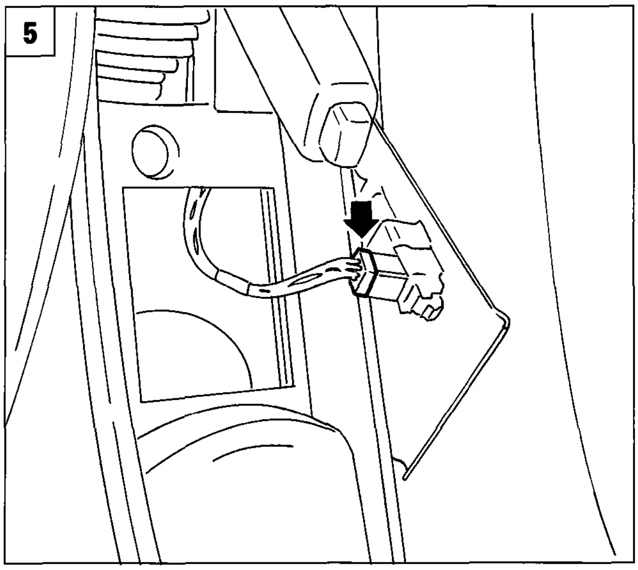

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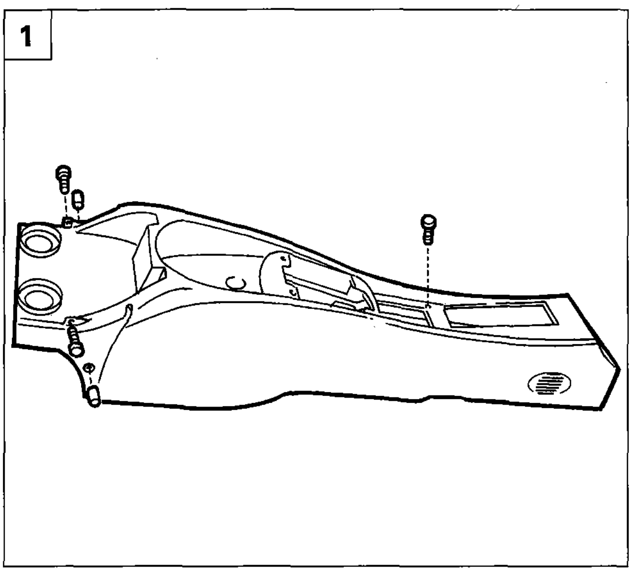


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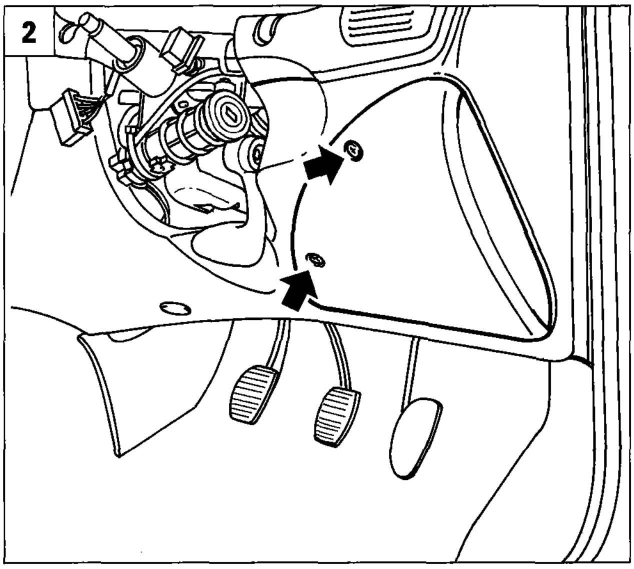


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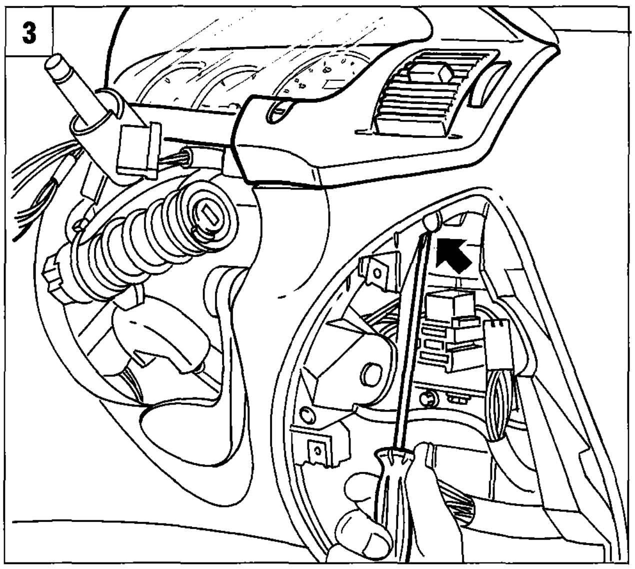


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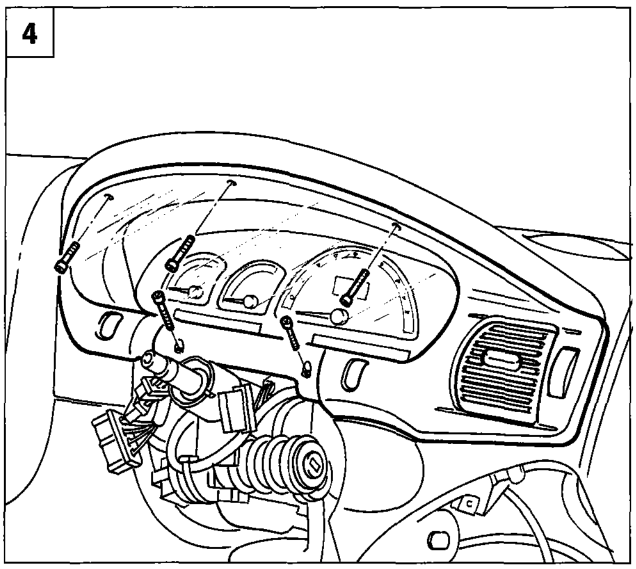
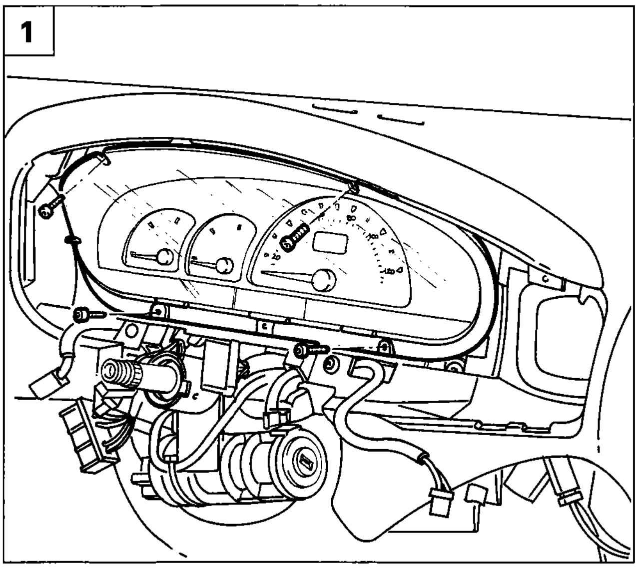



P4A62DA04

1. Remove the clips, unscrew the bolts shown and remove the tunnel trim from the car. Lift the parking brake lever fully to allow removal of the trim.
2. Remove the junction unit protection by undoing the fastenings shown in the figure.
3. Working from inside the junction unit housing compartment, unscrew screw retaining the instrument panel frame.
4. Unscrew the bolts indicated, then move the instrument panel slightly to one side, disconnect the headlamp alignment adjuster and instrument light dimmer connections and then remove the frame.

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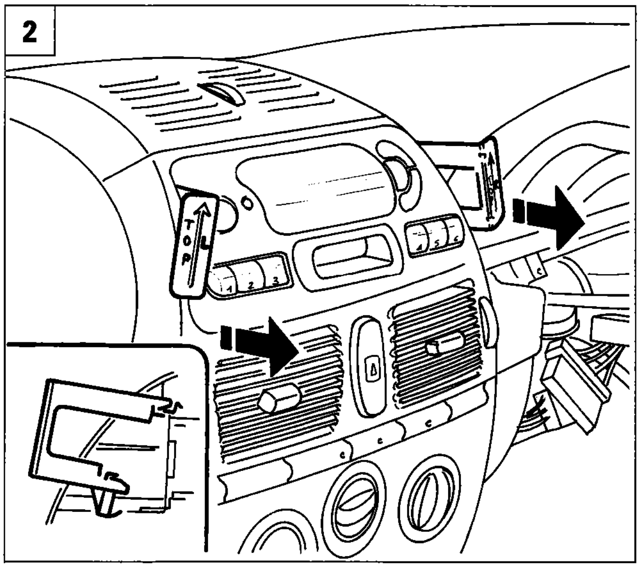


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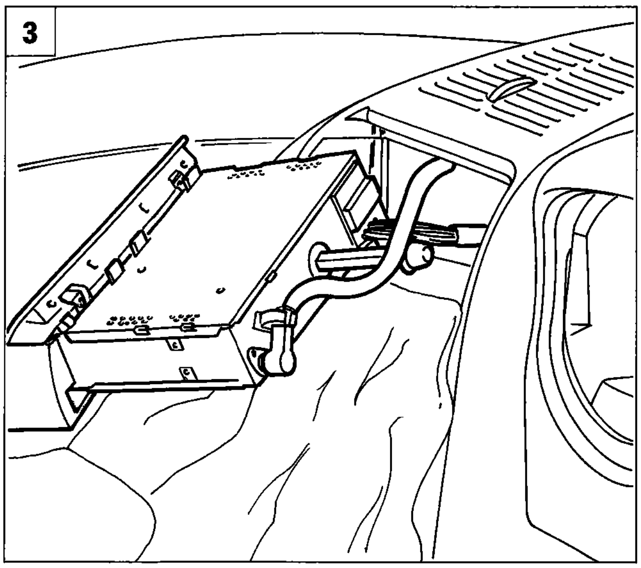



P4A63DA03

1. Unscrew the retaining bolts indicated, disconnect the connectors on the rear of the instrument panel, then remove remove from the instrument facia.
2. Remove the car radio with the aid of tools 1860897000.

*Tool 1860897000 is made up of a left hand part and a right hand part, marked L and R respectively. The correction direction of use of each part is indicated by means of an arrow (TOP).*

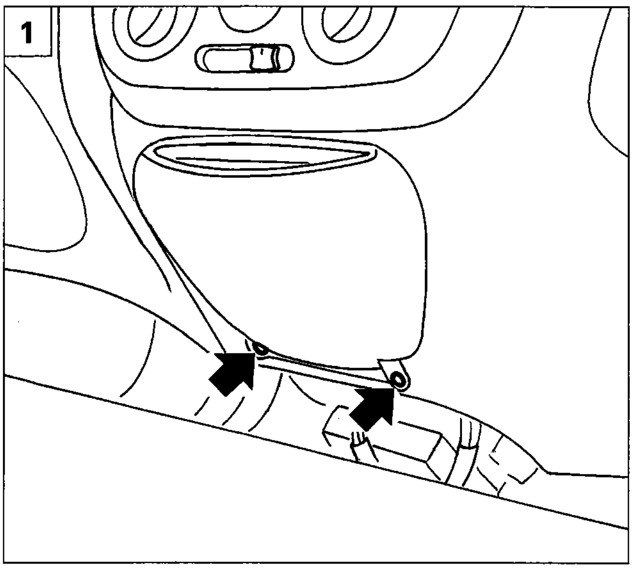
*It is advisable to work from the passenger side to facilitate removal operations.*

Move the car radio slightly to the left and carefully fit right hand part (R) of tool 1860897000 until it clicks into the radio clips. Use right hand part (R) to pull out the right hand side of the radio slightly, move it to the right and carefully fit the left hand part (L) of tool 1860897000 until it clicks into the radio clips. Grasp both sides of the tool and pull the radio out partly, then release both parts of tool 1860897000 from the radio.

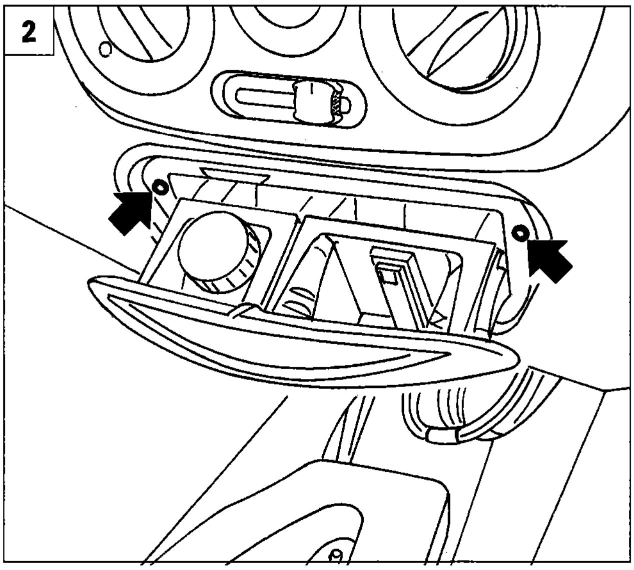
*Do NOT remove the radio by pulling from the glove compartment, but only by using both parts of tool 1860897000 and following the procedure described previously.*

3. Protect the area of the instrument facia below the radio using a cloth, pull out the radio fully and disconnect the supply leads and aerial lead.

# 70.




P4A64DA01

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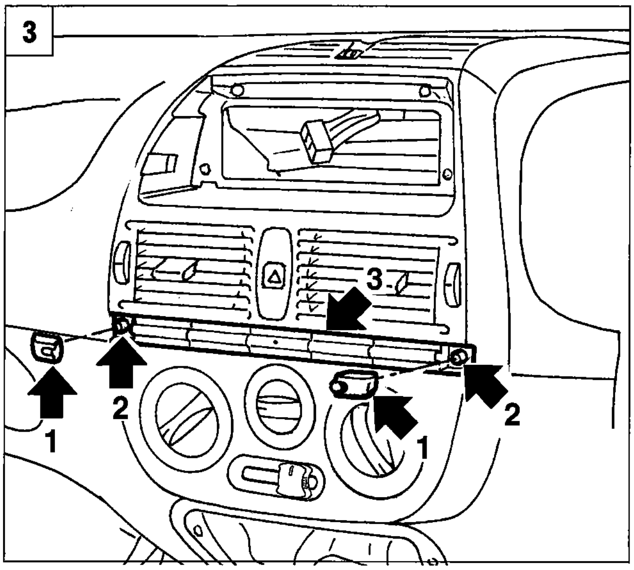


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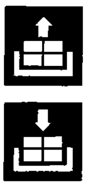
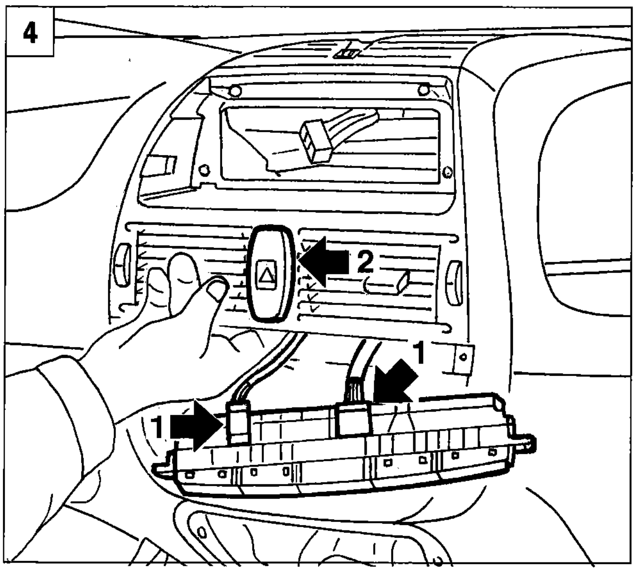
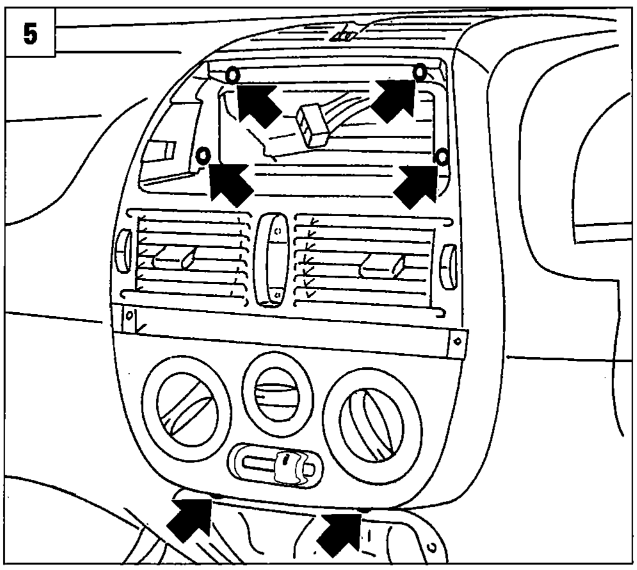


1. Unscrew the lower screws securing the ashtray to the instrument facia.
2. Unscrew bolts indicated in figure, disconnect connector for the cigar lighter/lighting and remove the ashtray.
3. Use a screwdriver to prise up panel (1). Unscrew screws (2) and pull switch unit (3) out slightly.
4. Disconnect connectors (1) and remove the switch unit. Proceed as described in the figure to remove hazard warning light switch (2) and disconnect both connectors.
5. Unscrew the bolts fastening the heater and control panel.




P4A64DA04

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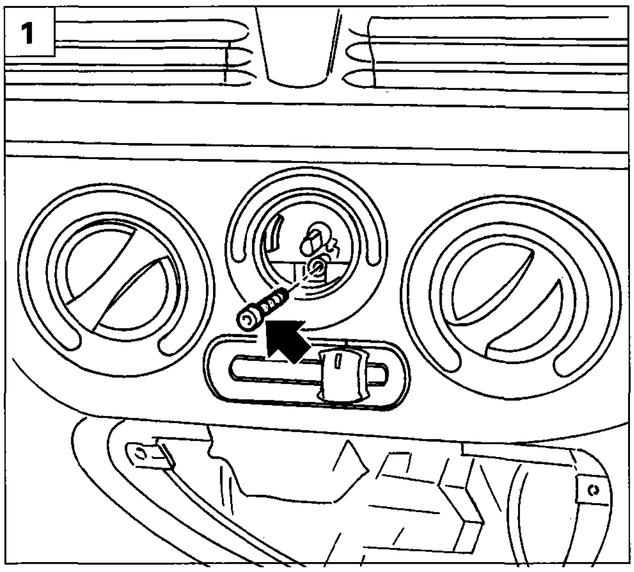
4A64DA

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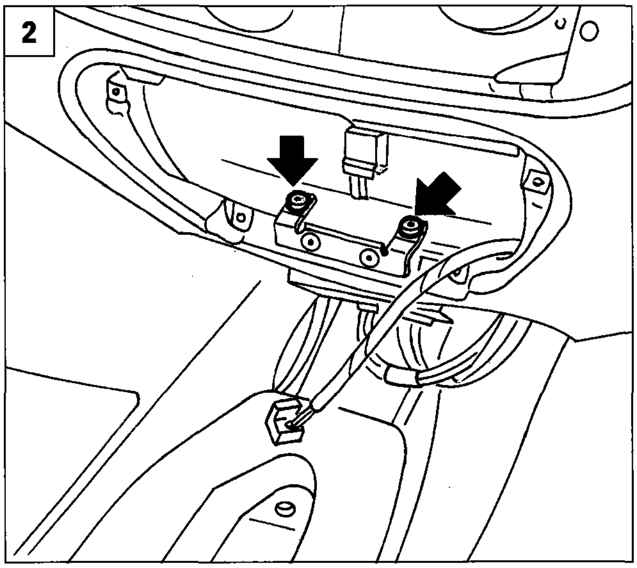


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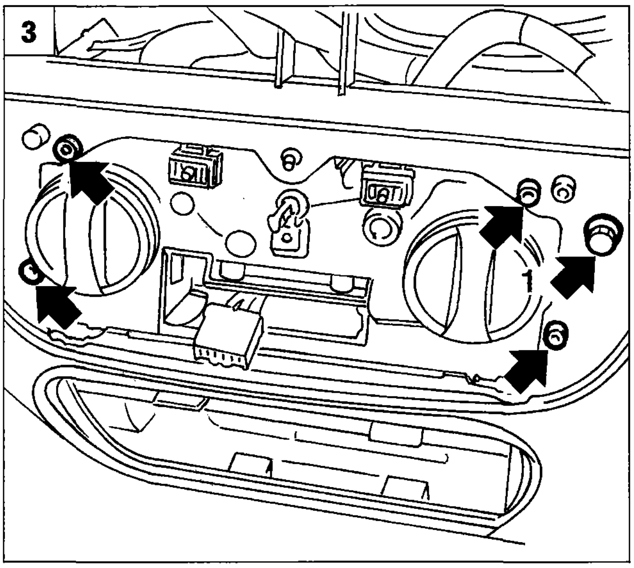
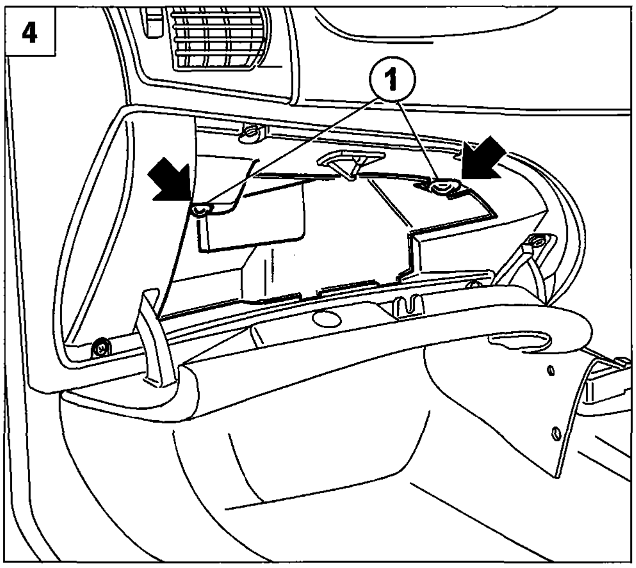



P4A65DA03

1. Remove the central fan control knob, unscrew the underlying screw and disconnect the heater and switch control panel by disconnect the underlying supply connector.
2. Unscrew the bolts fastening the instrument facia, located in the ashtray compartment.
3. Unscrew the bolts fastening the instrument facia to the heater and screw (1).
4. Work from inside the glove compartment to undo clips (1) and remove the compartment lining.
5. Unscrew the bolts indicated, which retain the glove compartment, and pull out slightly.

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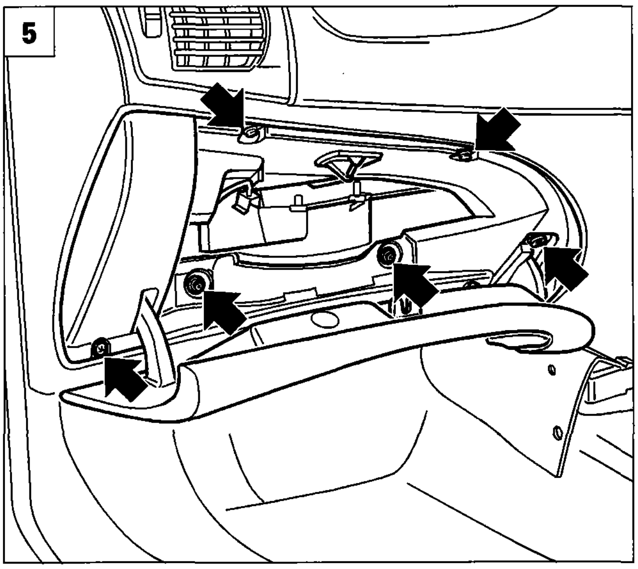


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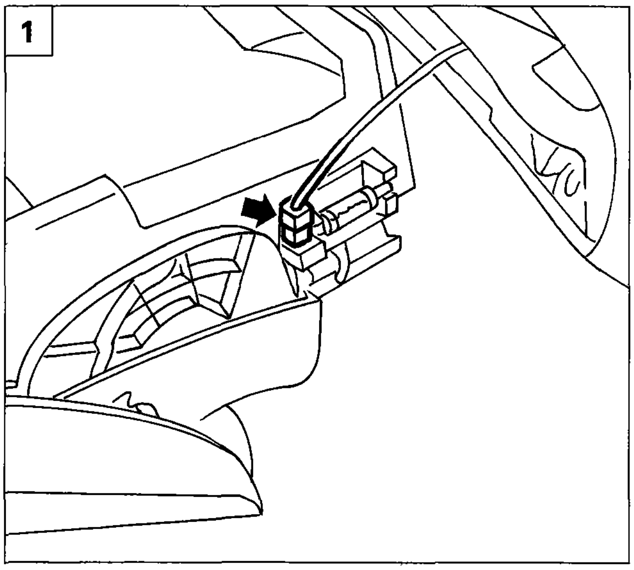
# 70.

1

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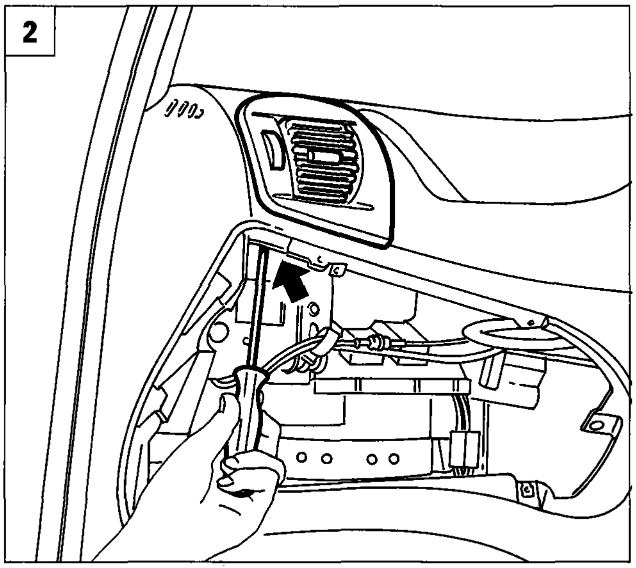
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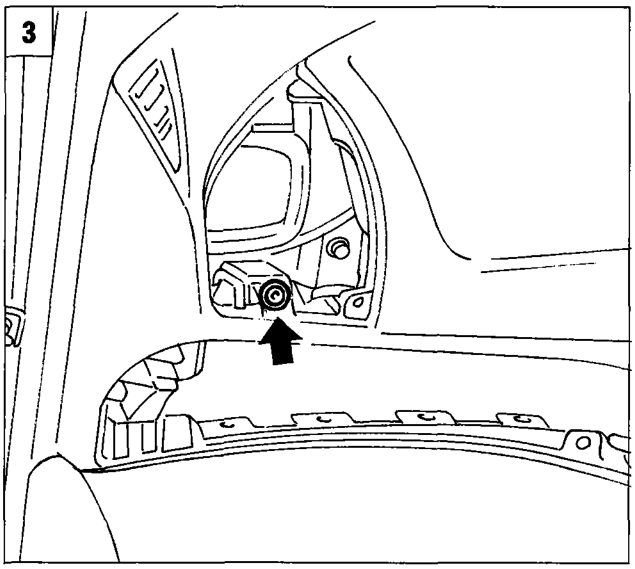
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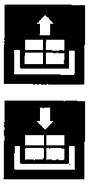
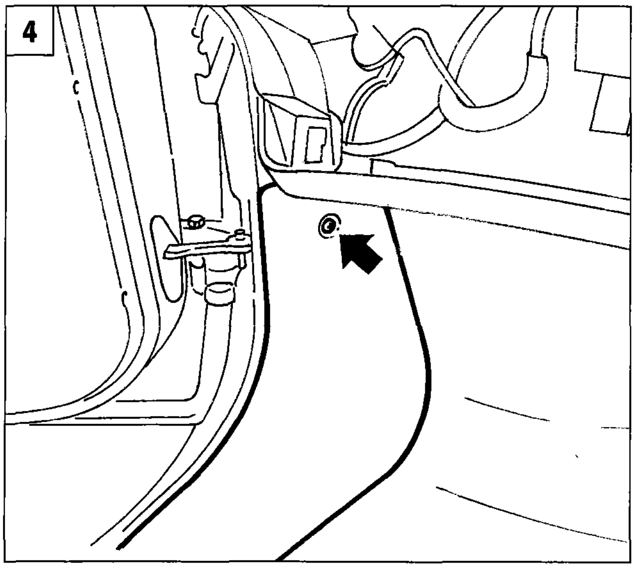


1. Disconnect connector of the glove compartment light, then remove the light from the car.
2. Unscrew the bolts fastening the left ventilation outlet, then remove.
3. Unscrew the screw indicated, which secures the left hand side of the instrument facia.
4. Unscrew the screw indicated and move the door sill trim away on both sides of the car.
5. Unscrew the lower bolt retaining the instrument facia to the body on both sides.

4

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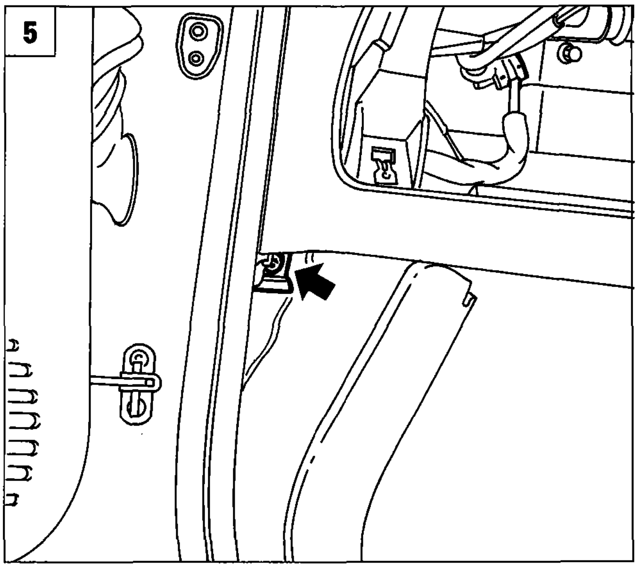
5

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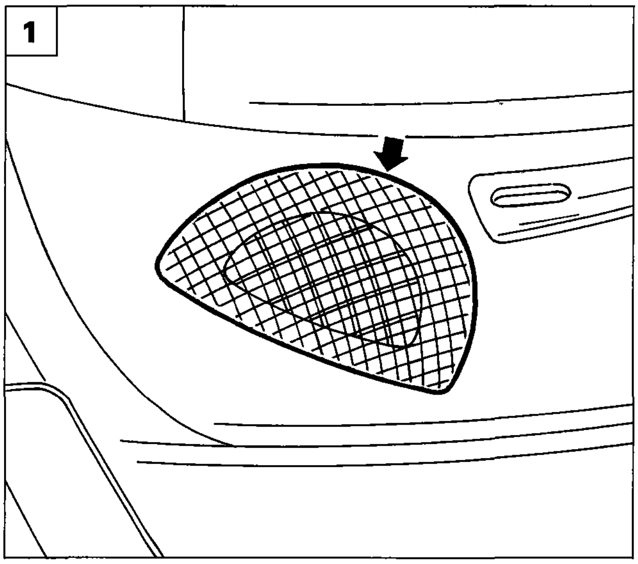


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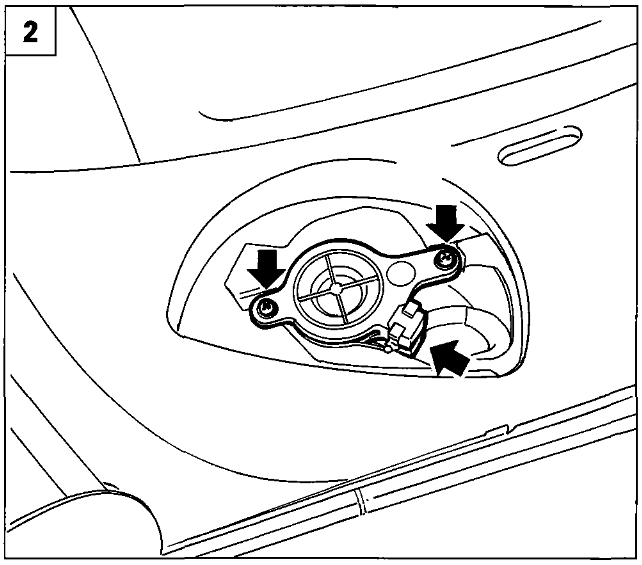


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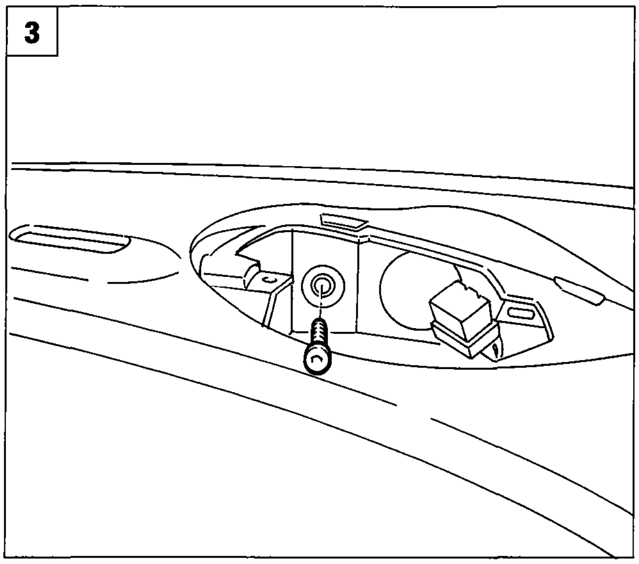
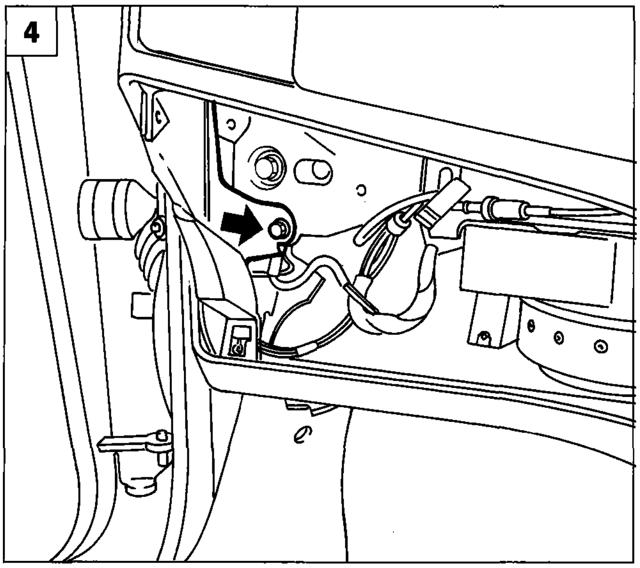



P4A67DA03

1. Undo the retaining tabs and remove the left and right speaker grilles on the facia.
2. Disconnect the right and left speakers by unscrewing the retaining bolts and disconnecting the connectors.
3. Unscrew screw located in the right and left speaker compartment, which secures the instrument facia to the body.
4. Remove the bolt retaining the instrument facia to the body, on the left side.
5. Remove the central bolt securing the instrument facia to the body.

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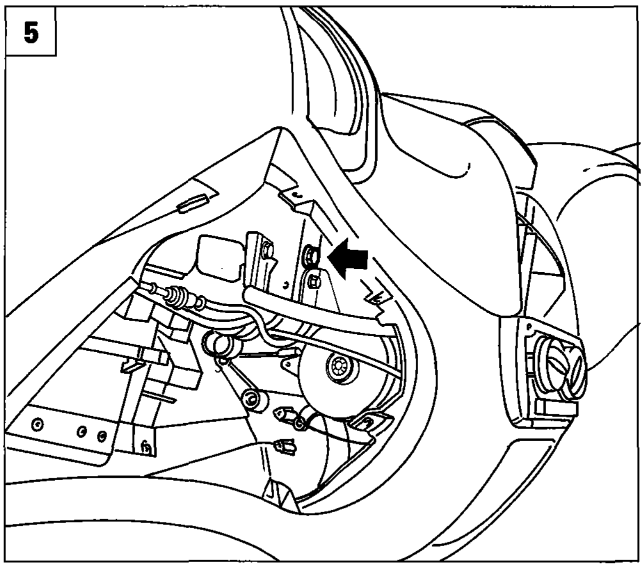


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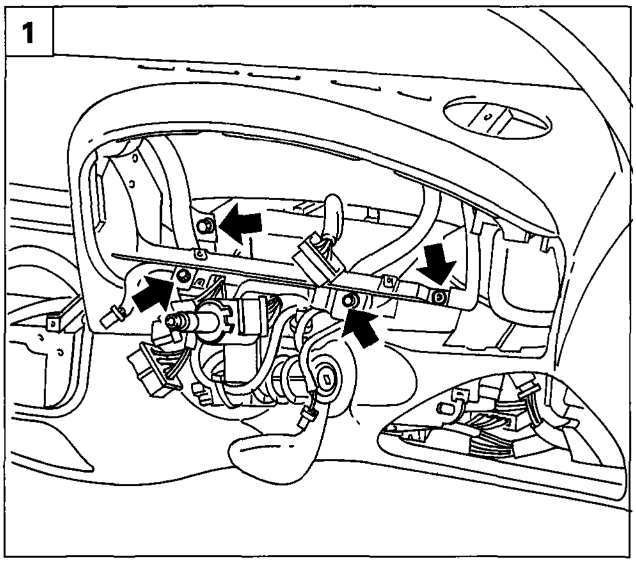

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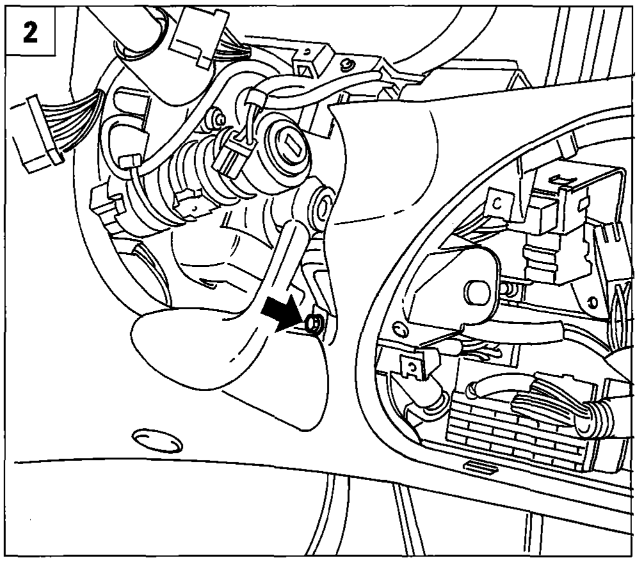

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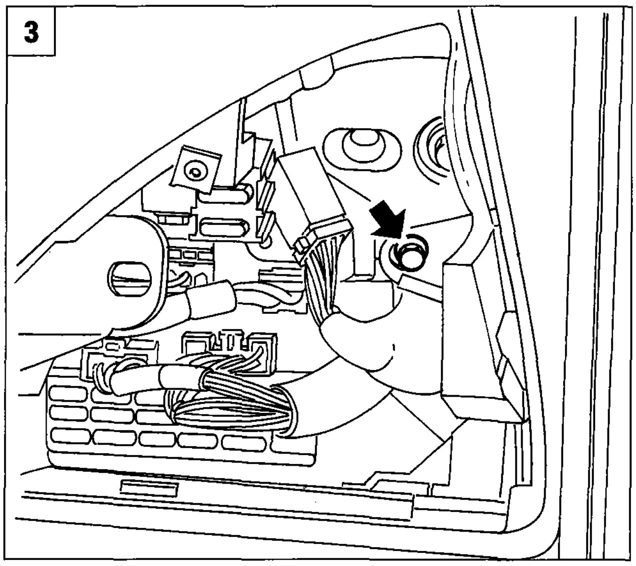
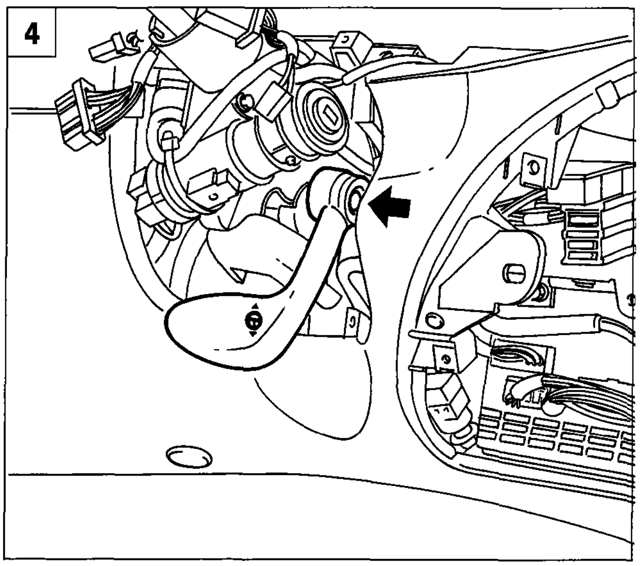


P4A68DA03

1. Unscrew the bolts fastening instrument facia to the front beam.
2. Unscrew screw retaining the facia, located near the steering wheel adjustment lever.
3. Remove the instrument facia retaining screw on the rihgt hand side near the junction unit.
4. Loosen the bolt retaining the steering wheel adjustment lever in order to facilitate removal of the instrument facia.
5. Remove the instrument facia with the aid of a second operator.

*Reverse removal operations to refit.*



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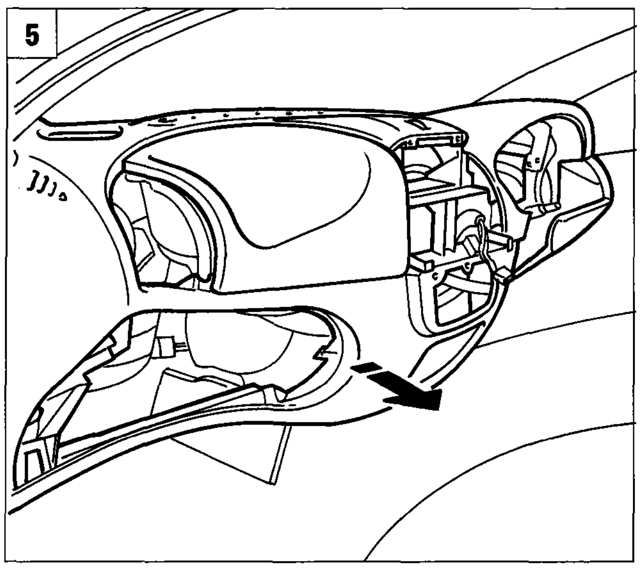

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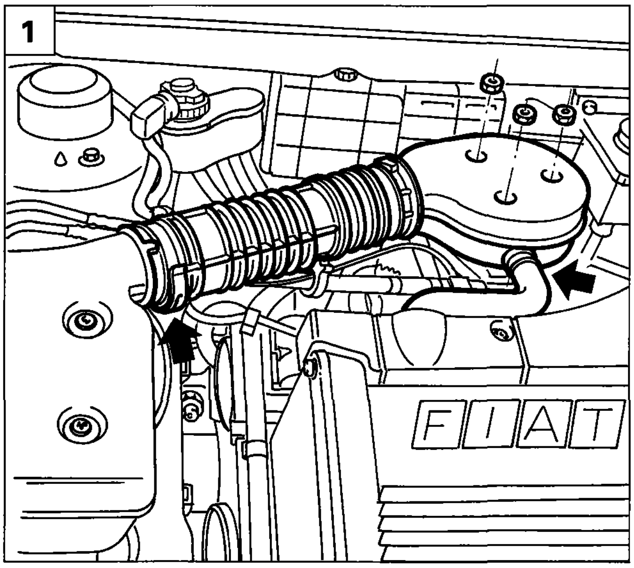

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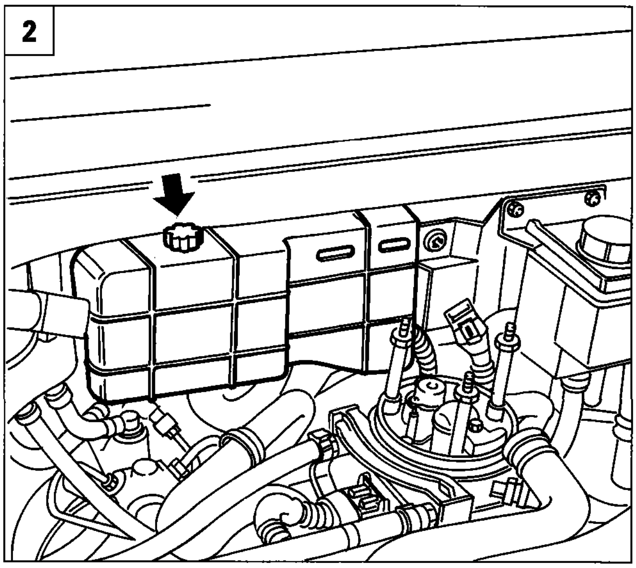

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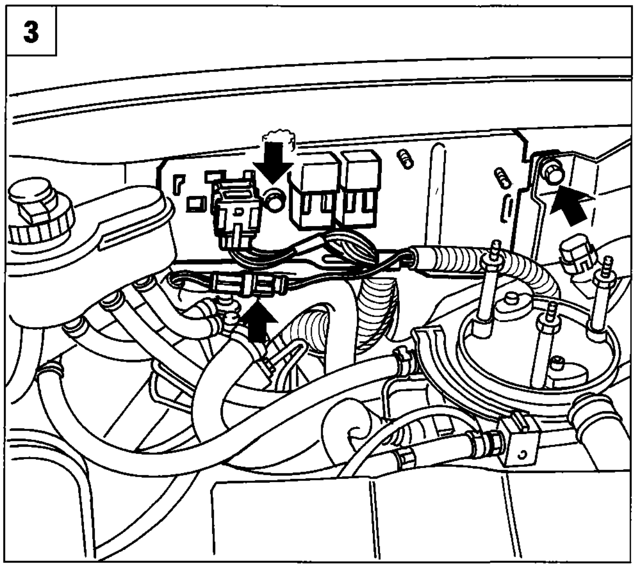
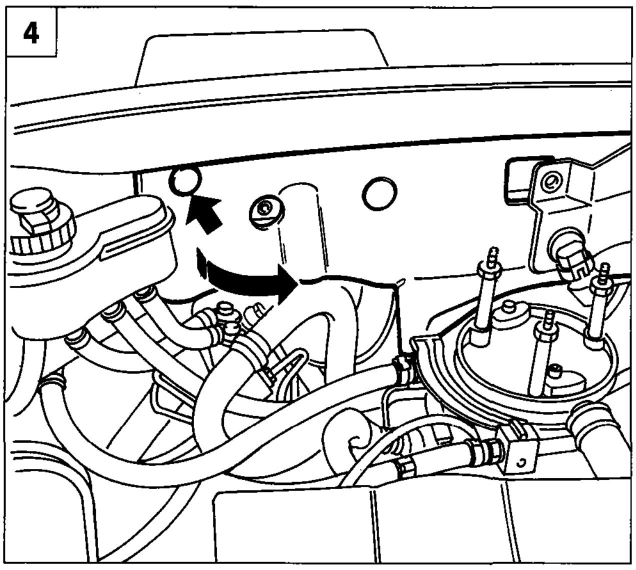


P4A69DA03

## REMOVING-REFITTING BONNET OPENING CABLE

1. Remove the pipe connecting air cleaner to butterfly valve case.
2. Remove the relay unit protective cover.
3. Unscrew the bolts fastening the relay bracket and position to one side.
4. Remove the stud shown in figure and move the lining of the bulkhead between engine bay and cabin to one side.
5. Unscrew nut retaining the bonnet opening cable to the bulkhead between engine bay and passenger compartment. Remove the underlying guide block.



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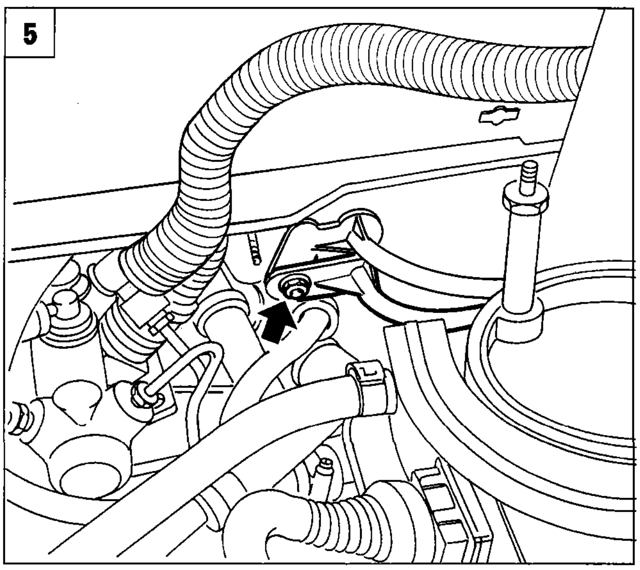

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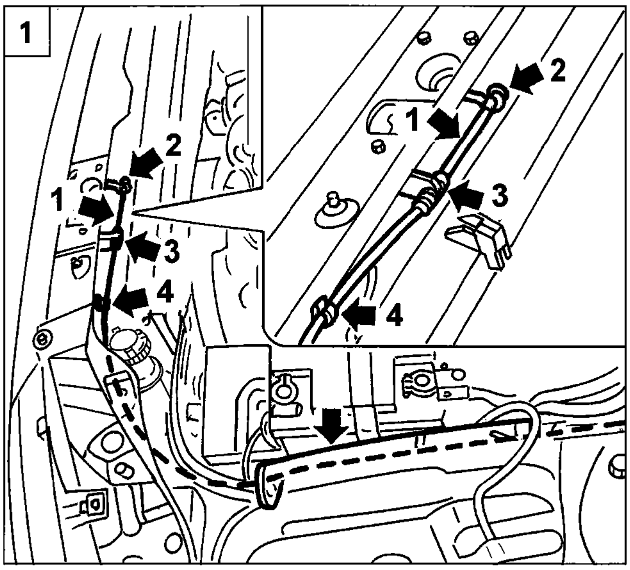
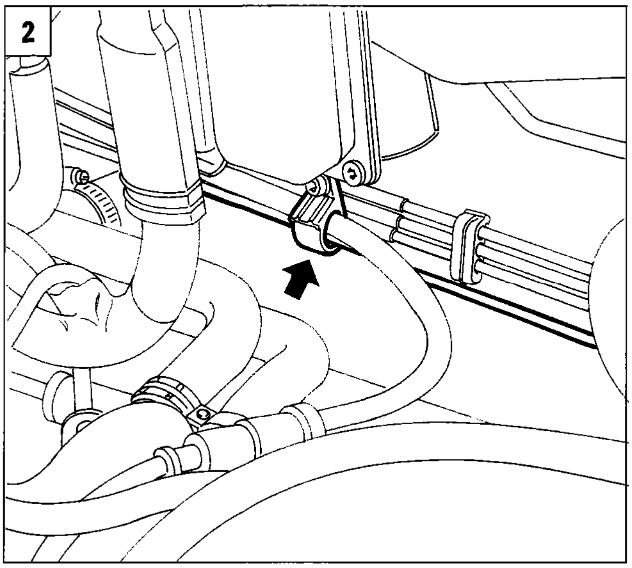
## 70.




P4A70DA01

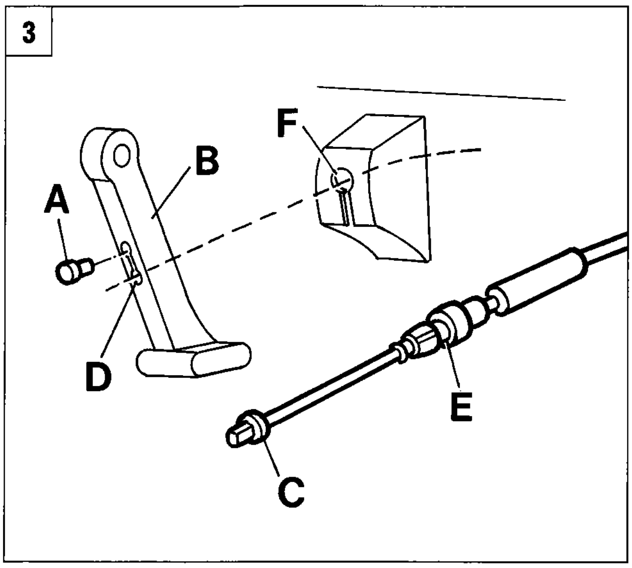
1. Disconnect bonnet opening cable (1) from the seats of fastenings (2) and (3) and from the retaining clip (4).




P4A70DA02

2. Release the bonnet opening cable from the retaining clip located beneath the injection control unit.

3. Working from beneath the steering wheel, remove cap (A) from bonnet opening lever (B), then release the end (C) of the opening cable from seat (D).
   Release opening cable fastener (E) from seat (F) on the body.

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*Fasten the opening cable to a probe in order to facilitate refitting through the bulkhead between engine bay and cabin.*
*Withdraw and disconnect the bonnet opening cable.*

**NOTE** *Reverse order of removal operations to refit.*

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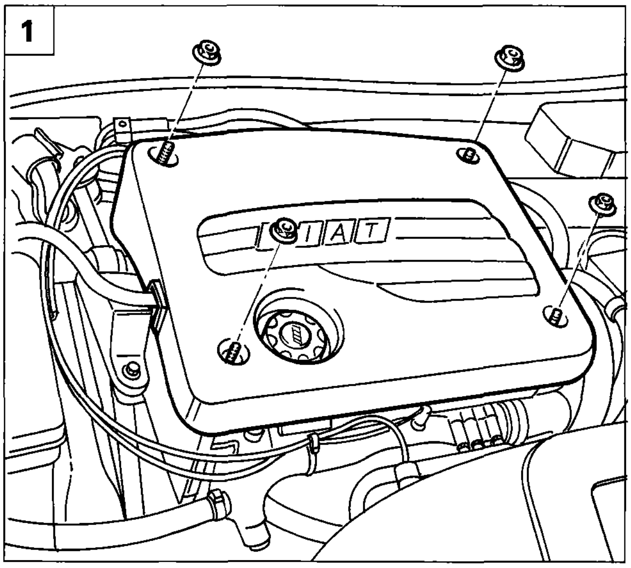

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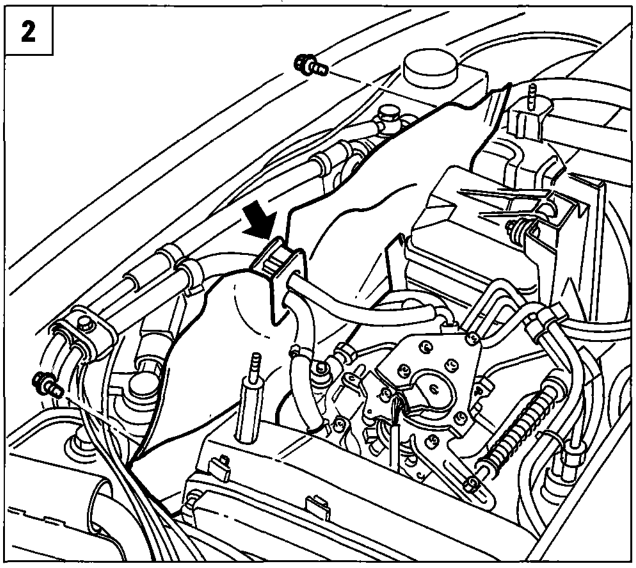

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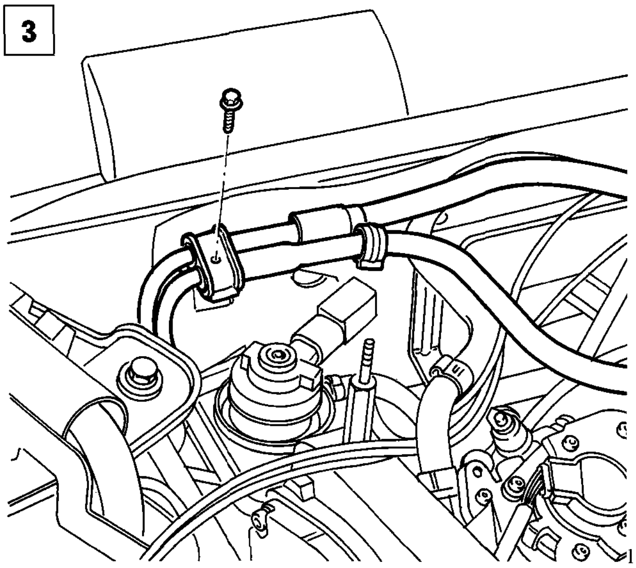
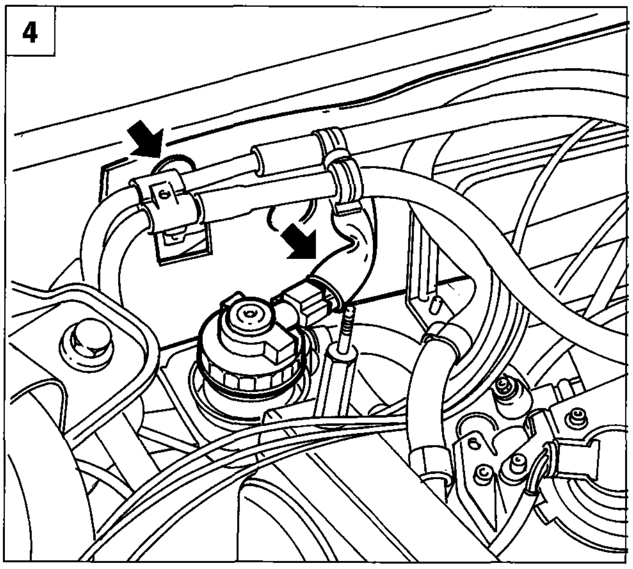


P4A06DA02

## REMOVING-REFITTING BONNET OPENING CABLE

1. Remove the upper cam cover protection.
2. Remove the trim shown in the figure by undoing the retaining bolt and releasing the diesel lines from the retaining clip.
3. Remove the bolt retaining the fuel line connection bracket.
4. Disconnect connector of the brake and clutch fluid level sensor, then remove the stud retaining the lining of the bulkhead between engine bay and cabin, then move the trim to one side.
5. Unscrew the bolts fastening the diesel filter bracket, disconnect connections shown and place the bracket to one side.



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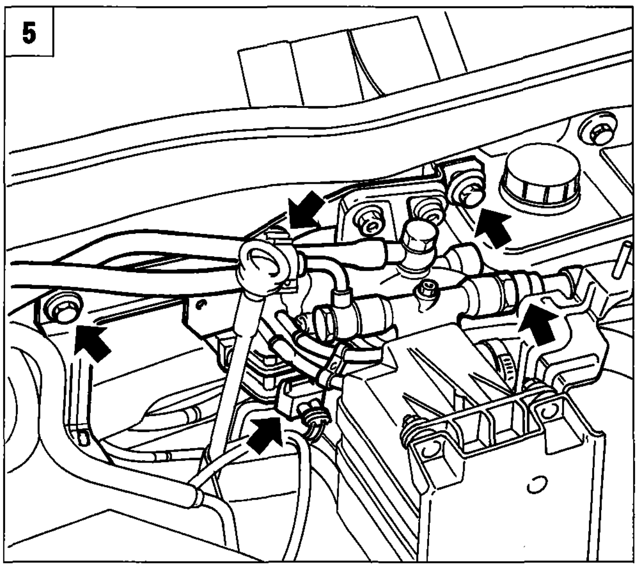

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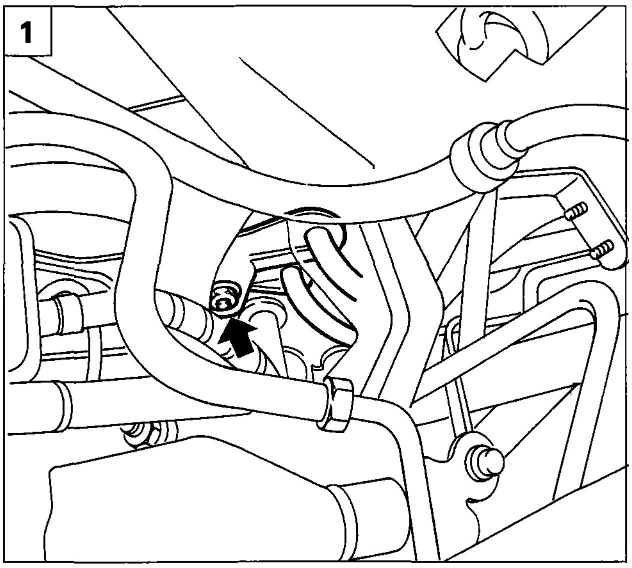
# 70.

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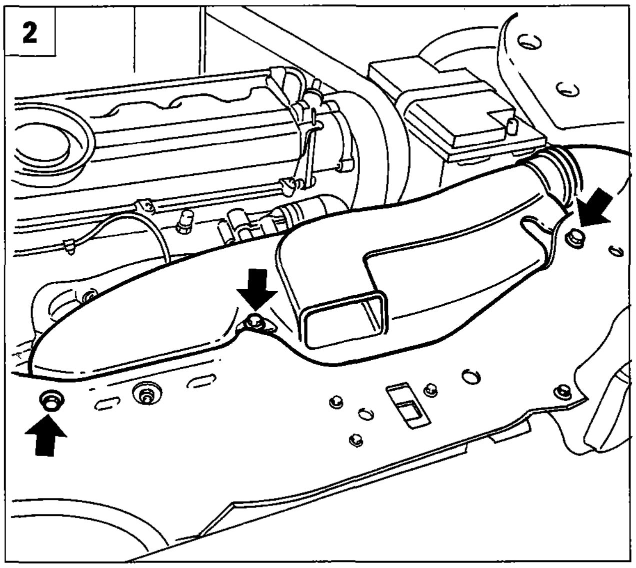


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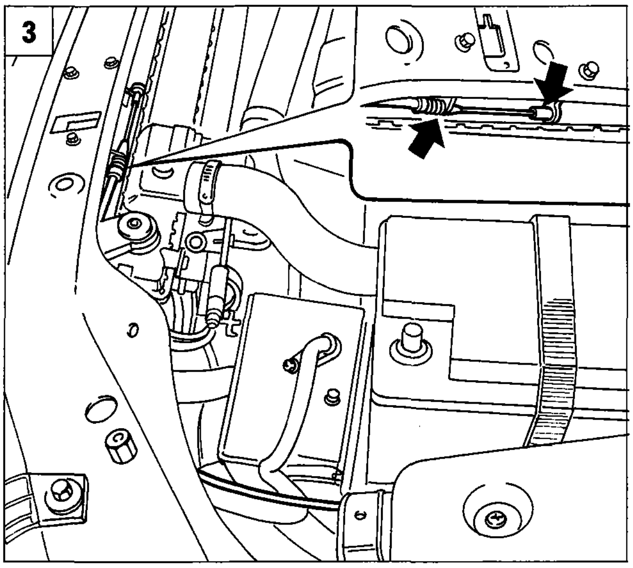


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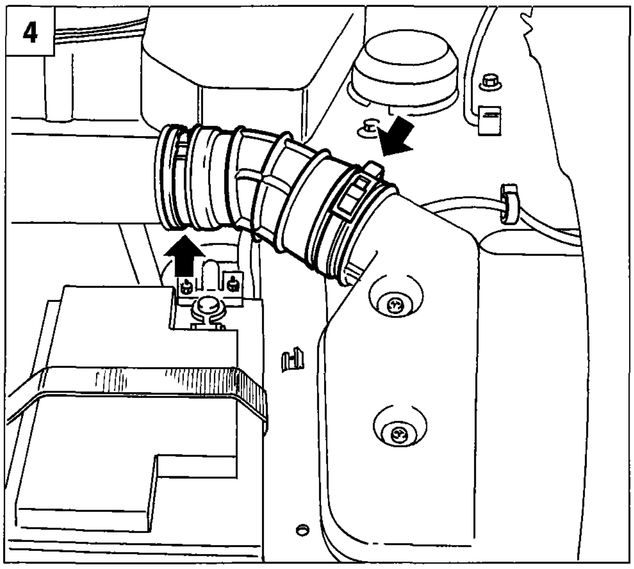
1. Move the lining of the bulkhead between engine bay and cabin further, then remove the nut retaining the bonnect opening cable to the above bulkhead.
2. Remove the air duct by undoing the fasteners indicated in figure.
3. Disconnect the bonnect opening cable from the retainer seats and the retaining clip.
4. Disconnect the air sleeve from the filter.
5. Open the cable duct and remove the bonnet opening cable.

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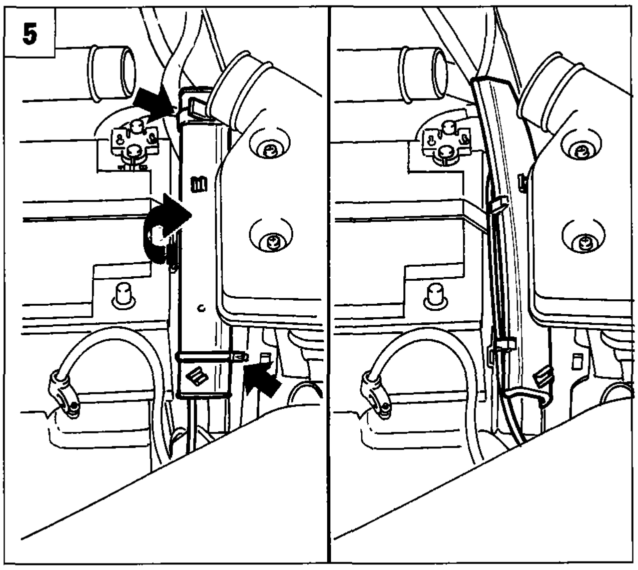


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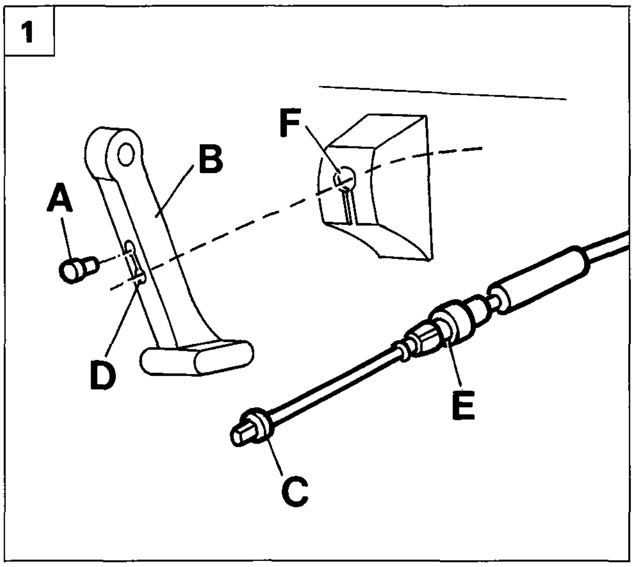


P4A70DA03

1. Working from beneath the steering wheel, remove plug (A) from bonnet opening lever (B) , then disconnect end (C) of the opening cable from seat (D).
   Release opening cable fastener (E) from seat (F) on the body.

*Fasten the opening cable to a probe in order to facilitate refitting through the bulkhead between engine bay and passenger compartment.*
*Withdraw and disconnect the bonnet opening cable by releasing from the retaining clip.*

**NOTE** *Reverse order of removal operations to refit.*