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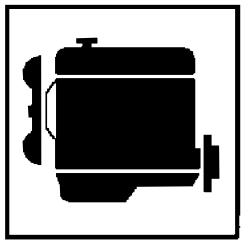

Engine unit

1242 8v

1910 D

Group index

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- GLOSSARY
- SPECIFICATIONS:
- COMPOSITION

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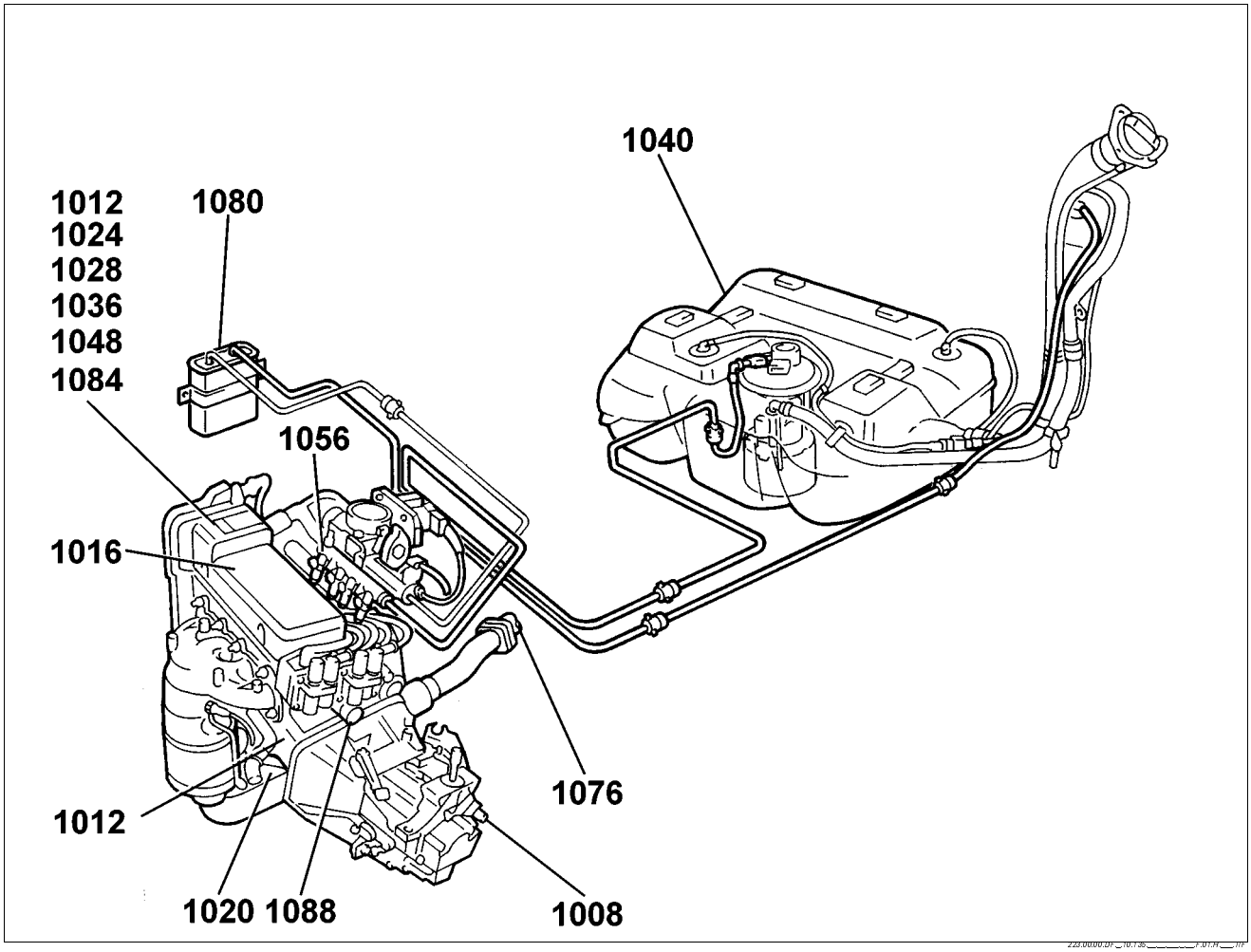


1242 8v

GLOSSARY

Hardened and tempered steel

1242 8v

Heat treatment applied to special steels to improve their mechanical characteristics: it consists of hardening, followed by tempering to induce a significant increase in toughness of the material.
Tempering: consists of heating to a temperature of < 720°C followed by slow cooling, in order to attenuate the effects of the hardening without eliminating its effects.
The material thus returns to a condition as close as possible to a stable chemical-physical balance.
Hardening: this is obtained when the structure of the metal at high temperature is harder and stronger than when cold.

CONTROL AREA NETWORK (CAN)

1242 8v

The CAN communication network allows data transmission between the ECU and other car computers.
The advantages of this system are that it does not require a lot of wiring and the number of sensors is reduced (because the computers are interconnected by the data transmission system, data supplied by one sensor may be used by several devices simultaneously).
The CAN also makes the fault diagnosis system more effective, speeds up signal transmission and improves component electric/magnetic compatibility (relationship between the various electric and electronic circuits on the car and interaction between the car and its surroundings).

The circuit that connects the ECU to the other terminals is an integrated circuit referred to as a CAN interface. Its function is to convert messages received by via the data transmission system into appropriate form.

Condensation

1242 8v

This the reverse of evaporation, i.e. when a substance passes from the vapour state to the liquid state; it takes place by compression or cooling.

TIMING

1242 8v

Numerous components (ignition - timing - injection) work in synchrony with the piston movements. They must therefore be perfectly in time with the crankshaft, to which they are connected by toothed chains or belts. The ignition timing is the angular link between piston position and the moment at which the spark is struck (ignition advance).
Ignition timing is used to determine the moment of valve opening or closure in relation to piston position.
Injection timing is used to determine the injector or electric injector opening position in relation to piston postion.

DUCTILE OR SPHEROIDAL CAST IRON

1242 8v

Cast iron is referred to as ductile or spheroidal when, due to the addition of cerium and magnesium, globules or spheres of carbon at the graphite stage are contained in a mainly ferrite matrix. All the mechanical and technological properties of the metal are improved so it can be forged, welded and machined.
Its applications are very wide, because - unlike normal cast iron - it offers appreciable strength and percentage lengthening values.

Evaporation

1242 8v

Also called vaporization, this is the passage of a body from the liquid state to the gaseous state.
It occurs at any temperature, but all the more slowly the lower the temperature.

MISFIRE

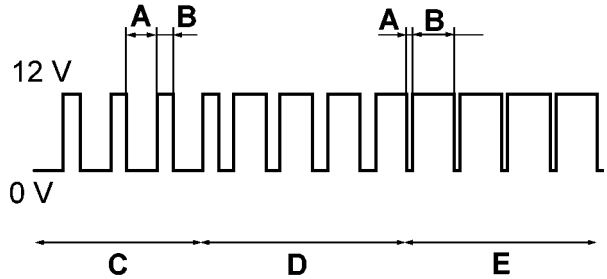
1242 8v

This occurs when the mixture (air/fuel) inside the combustion chamber fails to spark.
The effect gives rise to unneven running, which is particularly discernible when idling or at low speed.
Unburnt fuel emerges from the exhaust as a result and this impairs catalytic converter duration.

PWM PULSE WIDTH MODULATION

1242 8v

This is a fixed voltage with pulses of moduled amplitude and frequency generated by the ECU for the operation of the actuators. A supply with P.W.M. (Pulse Width Modulation) voltage consists of a series of square waves with single polarity, whose duration is varied by the ECU in response to demand.



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A, Off
B, On
C, Low resulting current
D, Medium resulting current
E, Maximum resulting current

1242 8v

A pulse width modulated current varies in proportion to the ratio between Wave and Space. The Wave-Space ratio is the relationship between periods when the power supply is on and periods when it is off.
This ratio may be considered as a percentage, and this is the way the Duty Cycle is measured.

Wheel

1242 8v

This is a system which, stimulated by any form of energy, reacts by changing its state, hence one or more of its characteristics (resistivity, volume, temperature, etc.).
For example, a material which, immersed in a magnetic field, undergoes a change in its conductivity, is a sensor.
New-generation sensors are solid-state devices of microelectronic technology, which can read the environment and provide responses in the form of electrical signals for subsequent processing for final control actions. They can measure forces, acceleration, pressures and temperatures of gases, liquids and solids, concentrations of gases such as nitric oxides, oxygen, etc.

Viscosity

1242 8v

Property of matter whereby the particles of a body meet 'resistance' in sliding in relation to each other.
The value of the resistance or internal friction depends on the nature of the body, i.e. large in solids, very small in viscous liquids and non-existent in gases.
In liquids, viscosity decreases rapidly as temperature increases.

1242 8v

SPECIFICATIONS:

1242 8v

Engine with 4 cylinders in line, 8 valves, 1242 cc., twin overhead camshaft with IAW 5EF electronic injection-ignition.
POWER - 65BHP EC (47.7 Kw) at 5500 rpm
TORQUE - 10.4 kgm EC at 3250 rpm
CYLINDER ARRANGEMENT - 4 in line
BORE - 70.8 mm
STROKE - 78.86 mm
CAPACITY - 1242 cc
CYLINDER HEAD - aluminium
CRANKCASE - cast iron
CRANKSHAFT - in ductile cast iron with 8 counterweights and 5 main bearings with torsional damper
TIMING SYSTEM - two overhead camshafts, mechanical tappets, 2 valves per cylinder
FUEL SYSTEM - returnless system with Marelli 5E F phased sequential injection, pintless Pico inejctors
IGNITION - fully electronic, inductive discharge with lost spark
EMISSION CONTROL DEVICES - trivalent catalytic converter with two lambda probes (EOBD)
LUBRICATION - forced via in-line trochoidal gear pump.
COOLING: liquid with forced circulation via a centrifugal pump and sealed circuit; Radiator and additional expansion tank.

1242 8v

COMPOSITION

1242 8v

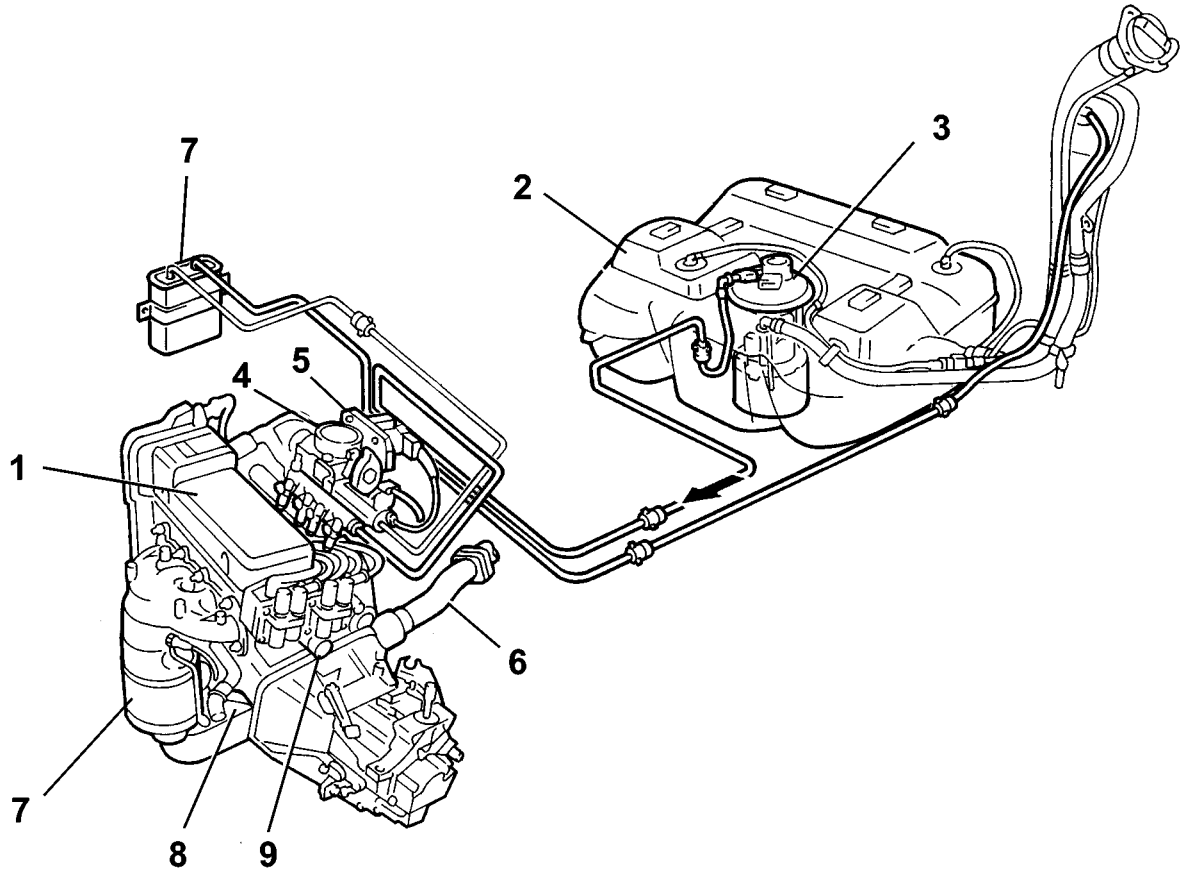
The following systems are involved in engine operation:
- fuel supply system
- air supply system;

- exhaust system with catalytic converter.
- fuel vapour recirculation system.
- lubrication system;
- engine cooling system
- The operation of these systems is optimized by an electronic control system governed by a control unit (see subunit 1056).

View of assembly

1242 8v

Vehicle system diagram



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1, Engine and power unit
2, Fuel tank and pipes
3, Pump(s) and fuel circuit devices
4, Engine air supply circuit
5, Petrol injection system
6, Exhaust pipes and silencers
7, Emission control system (fuel vapours)
8, Engine lubrication system
9, Engine cooling system

fuel supply system

1242 8v

It is the returnless type with an electric fuel pump immersed in the tank and a casing which incorporates the voltage regulator, the fuel gauge and the filter (for further details see 1040).

Air supply system

1242 8v

Air supply system with plastic inlet manifold and large air filter casing to limit inlet noise (for further details see 1048 and 1072).

Exhaust system

1242 8v

The exhaust system is equipped with a system for post-treating exhaust gases with twin lambda probes, one upstream and one downstream of the catalytic converter fitted in the engine bay (for further details see 1076).

Emission control system;

1242 8v

The following emission control systems are fitted on this model:
- Exhaust emission control system with a three-way catalytic converter and twin Lambda probes;
- crankcase vapour/gas recirculation system;
- fuel evaporation control system;

(for further details see 1080).

Cooling system.

1242 8v

Forced circulation with a centrifugal vane pump (for further details see 1088).

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- SUB-GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

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Cmp	Description	Validity

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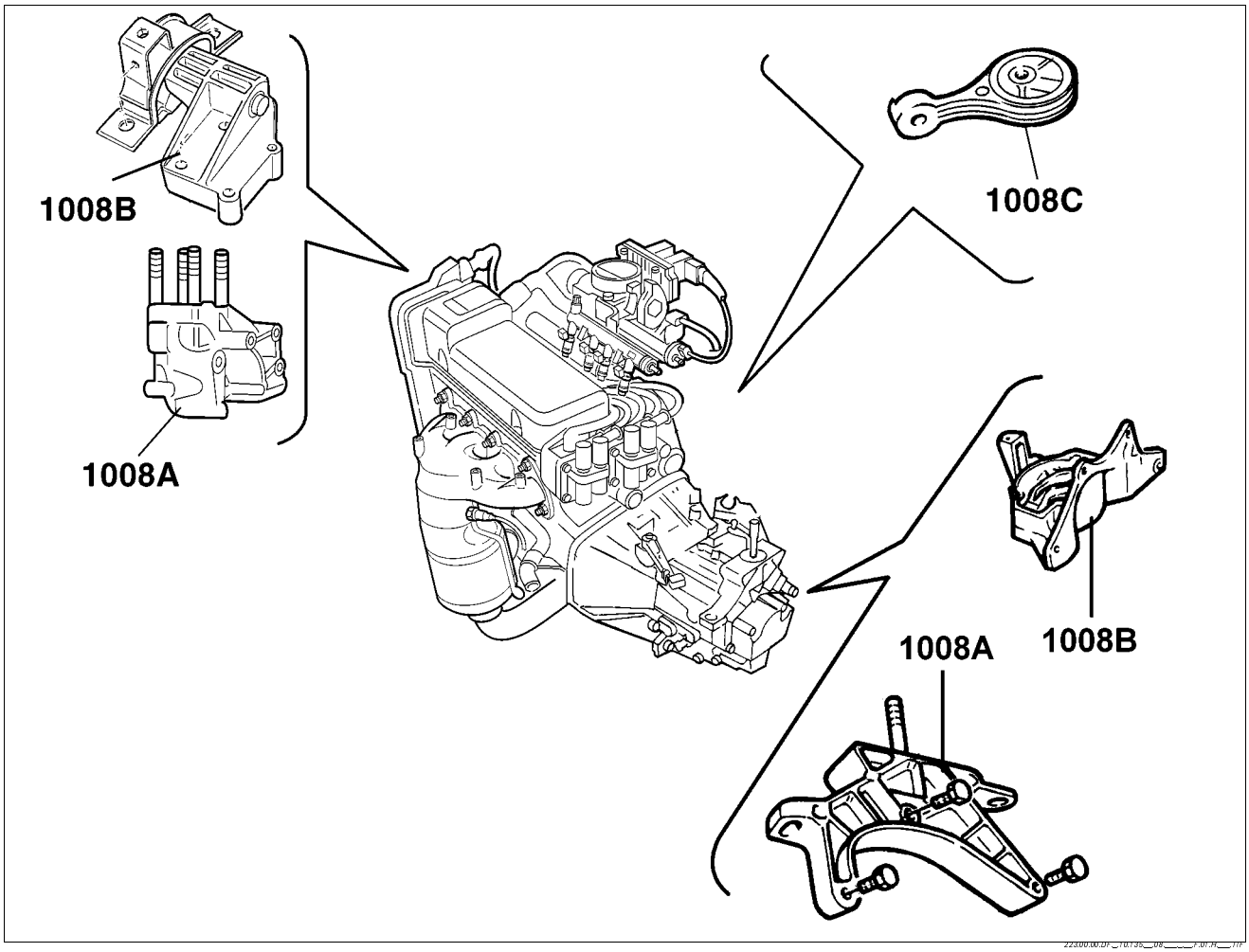


1242 8v

CONSTRUCTION features

1242 8v

The power unit mountings provide the structural connection between the power unit and the bodyshell.
They are rated to support the weight of the power unit and withstand the loads resulting from the torque transmitted by the engine.
Each mounting comprises a rubber-metal block which dampens the vibrations generated by the engine, largely reducing those transmitted to the bodyshell.

Type

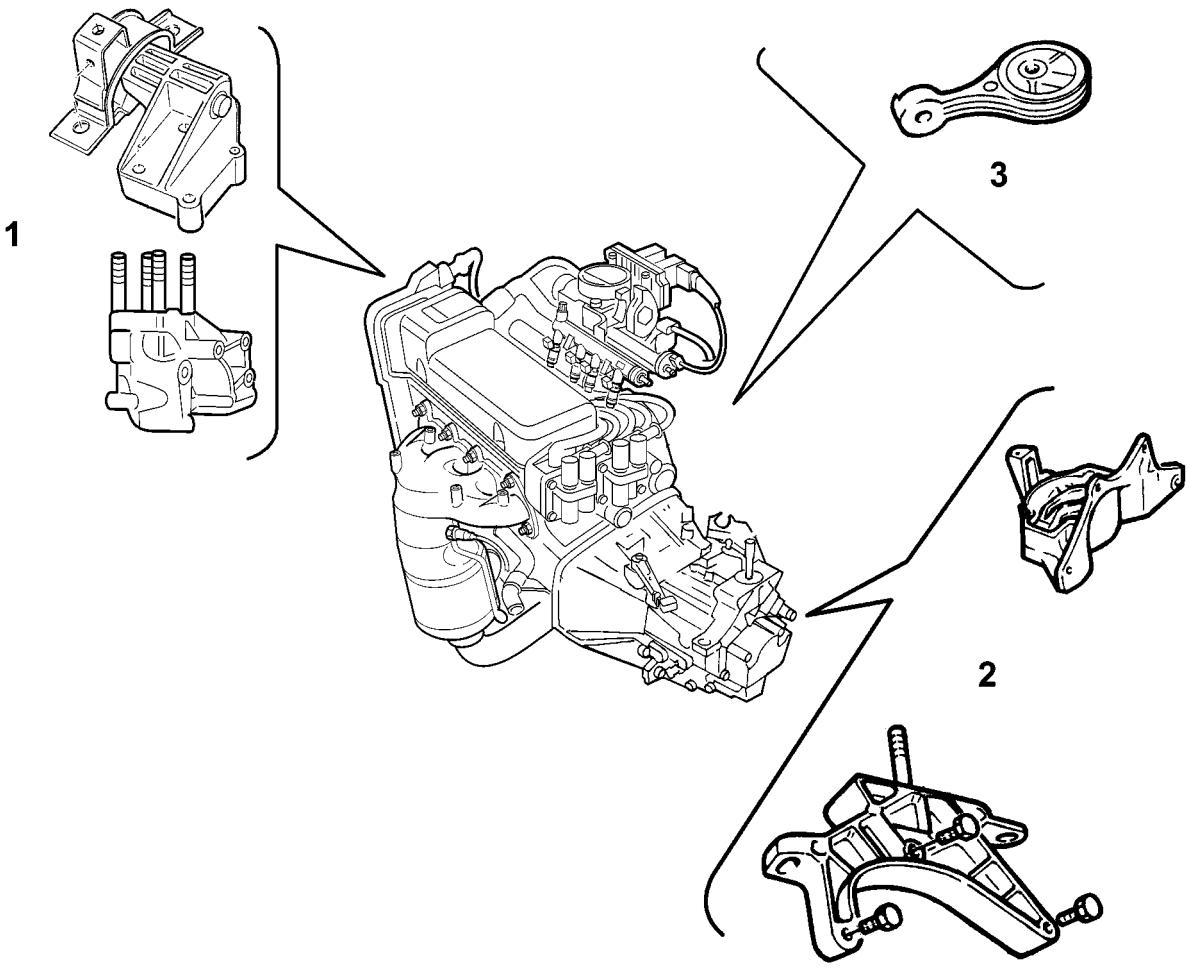
1242 8v

The power unit mounting system is barycentric. It consists of two blocks plus a reaction rod that acts as a link. New mounts are aligned along a centre line passing through the engine centre of gravity in order to achieve reaction forces with zero offset.

System features

1242 8v

This new system has brought about a reduction in noise.
This has brought particular benefits in terms of handlng and interior comfort.



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1, Timing end mount
2, Gearbox side mounting
3, Reaction link

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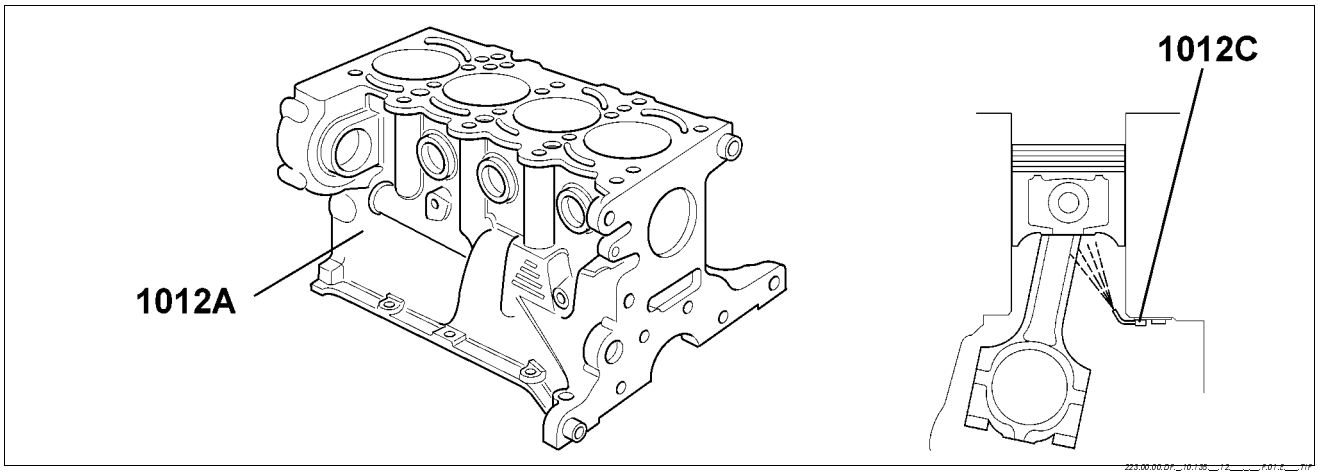
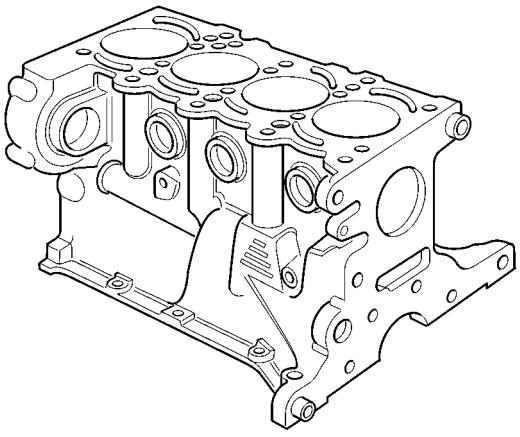


1242 8v

CONSTRUCTION FEATURES

1242 8v

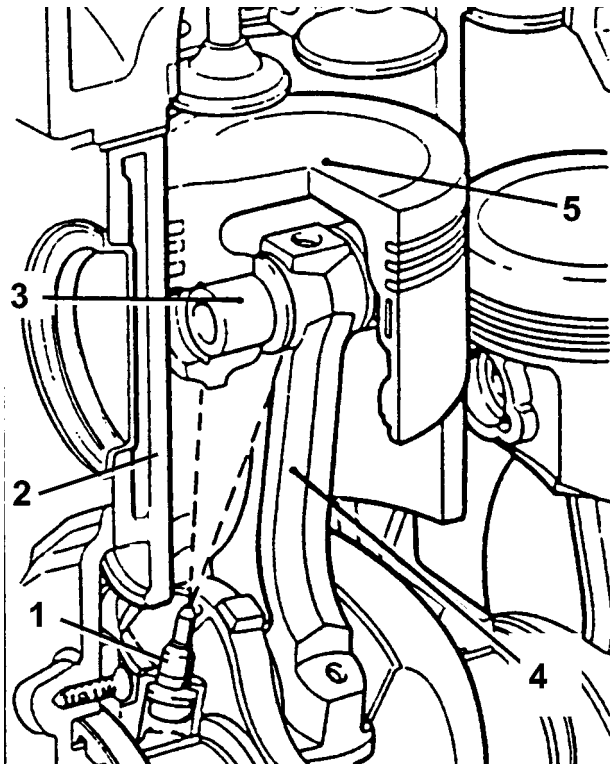
The engine block is spheroidal graphite cast iron, with high mechanical strength.
The crankshaft is supported by means of five main bearings.
The cylinders are formed directly in the engine block, and are graded into three sizes plus one oversize.
There are special channels in the engine block walls which allow the flow of coolant and lubricating oil.



Oil jets cool the pistons.

1242 8v

The diagram below illustrates the oil jets for cooling the pistons.



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1, Oil jet
2, Piston bore/liner
3, Connecting rod-piston gudgeon pin
4, Connecting rod
5, Piston

Operation

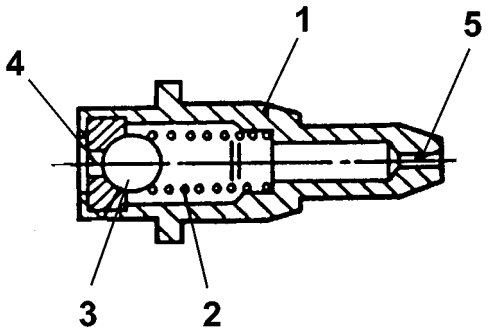
1242 8v

There are four oil jets (1) for cooling the piston crown located in the lower part of the cylinder liner/bore (2). The oil jet is directed so that it partly lubricates the machined housing of the connecting rod and piston gudgeon pin.
The jets incorporate a ball valve which opens at a pressure of about 1.1 bar.

Components

1242 8v

Oil jets for cooling the pistons.



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1, Jet body
2, Spring
3, Valve
4, Oil inlet duct
5, Oil outlet duct

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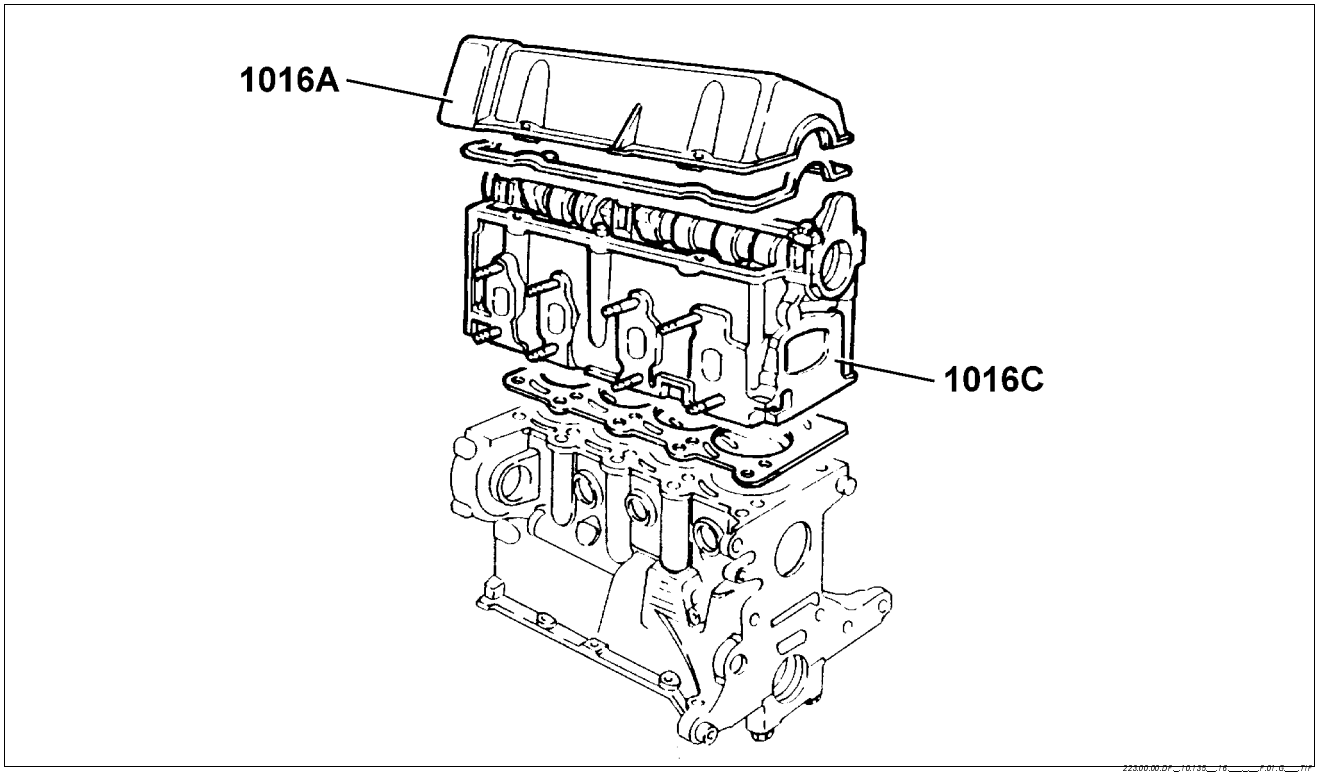
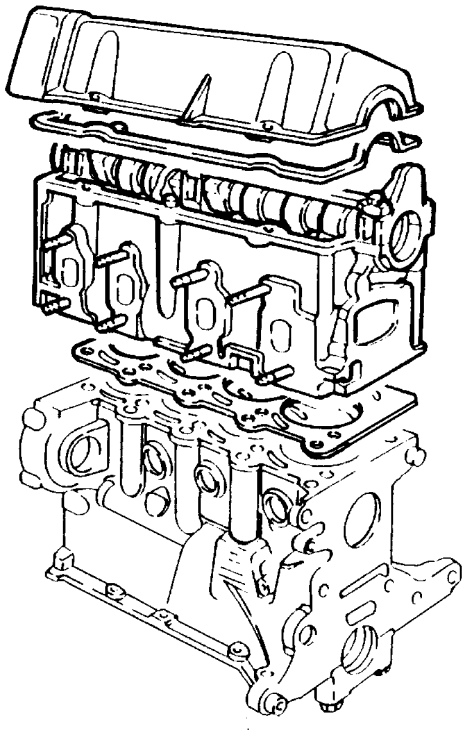


1242 8v

CONSTRUCTION FEATURES

1242 8v

The cylinder head is the monolithic type made from aluminium alloy. The two valves per cylinder are mounted in their respective guides, operated by a camshaft via mechanical tappets and adjustment shims.
The valve guides are installed by interference fit in their seats in the cylinder head.
The inner diameter is finished off after assembly, using a specific reamer.
The cylinder head gasket is of the Aramide fibre type, and there is no need to retighten the cylinder head at all during the life of the engine.



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DESCRIPTION

1242 8v

The cylinder head is the top part of the engine, secured by bolts (or studs) to the engine block.
It is of determining importance for the characteristics of a propulsion unit, on which performance, consumption and polluting emissions depend.
Together with the piston crown, it determines the shape of the combustion chambers.
It houses the valves, in nearly all engines, and the entire timing gear.

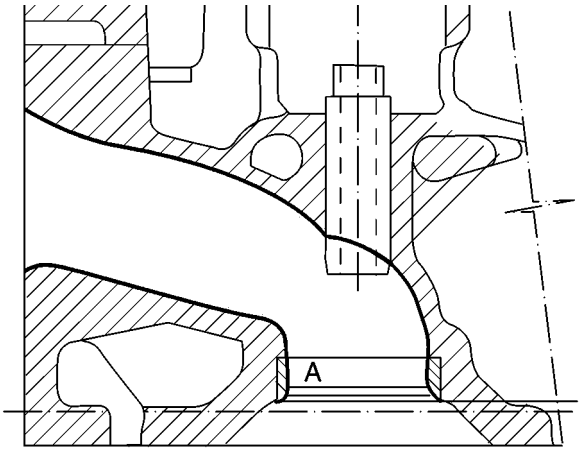
1242 8v

COMPOSITION

1242 8v

The following elements make up the cylinder head:
- camshaft
- camshaft bearings
- tappets
- lubrication pipe
- inlet and exhaust valves
- valve guides
- valve seats
- tappet cover
- studs for fixing exhaust and inlet manifolds

The head contains:
- inlet ducts (with Venturi pipe shaped profile) (1)
- exhaust ducts; valve seats
- coolant ducts
- lubricant ducts; threaded spark plug seats
- the holes for attachment to the engine block, and the combustion chambers.



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1242 8v

OPERATION

1242 8v

The head is the component which closes the cylinder; it contains the combustion chambers, where the air-fuel mixture is compressed and ignited; very high temperatures are reached here. For this reason aluminium alloys are used in the construction of cylinder heads as they are light, resistant to compression and have high termal conductivity properties.
The use of this material makes it possible to increase the compression ratio, moving away from the detonation point, because the heat is dissipated more rapidly away from the hot spots.

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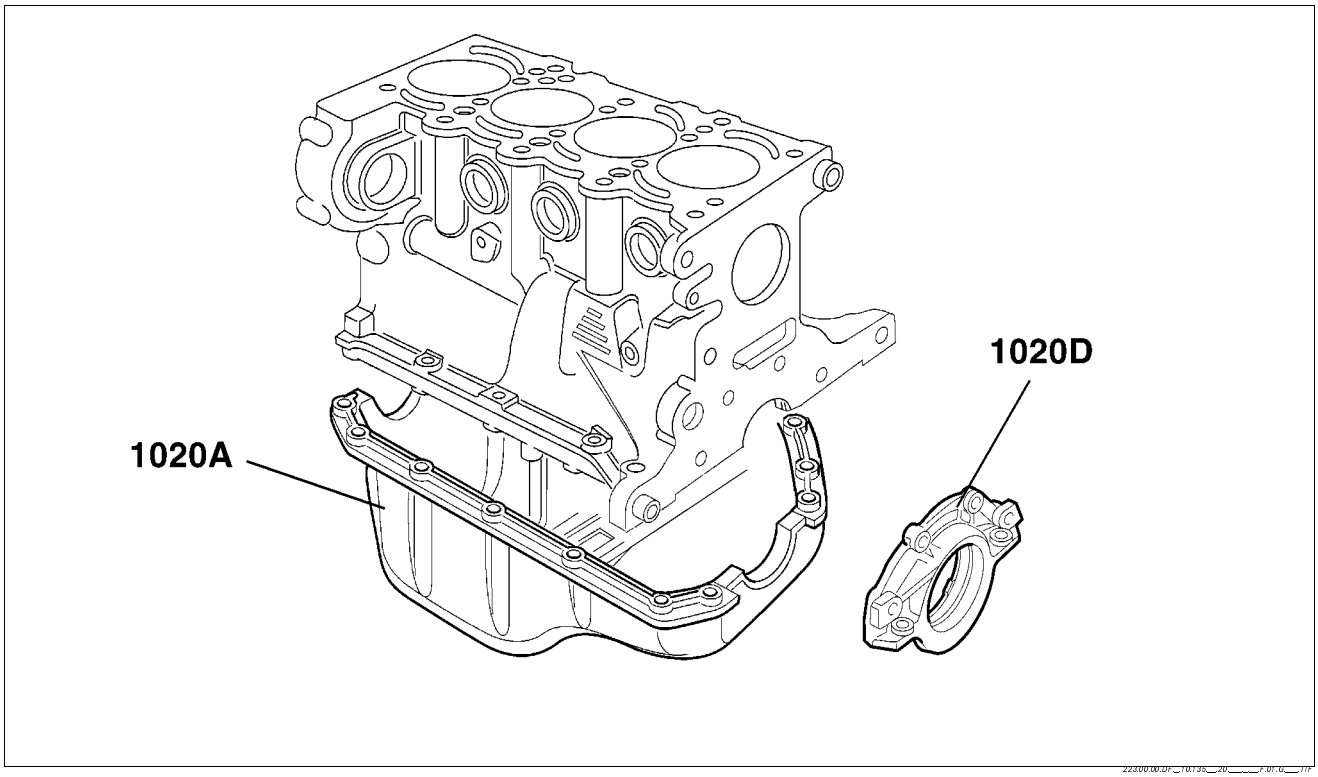
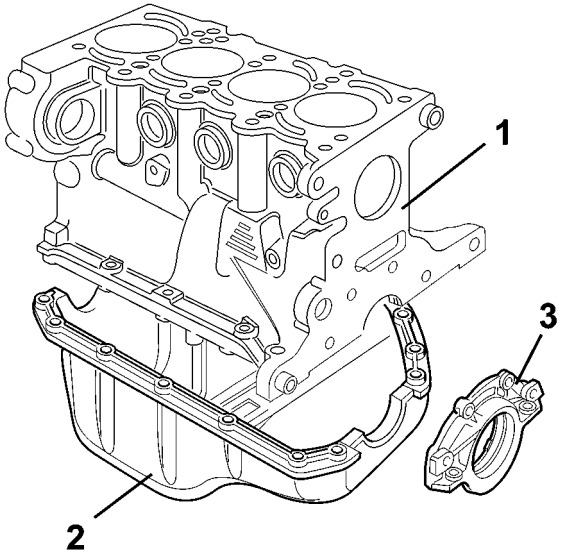


1242 8v

CONSTRUCTION features

1242 8v

The sump has the task of housing the engine lubrication oil; it is made from pressed steel and includes the port and plug for draining the oil and the anti-splash barrier.
The seal with the crankcase is ensured by a bead of silicone sealant. The timing side and flywheel side covers guarantee the crankshaft seal and are fixed to the crankcase by bolts.



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1, Engine block
2, Oil sump
3, Cover, flywheel side

1242 8v

OPERATION

1242 8v

The oil sump or engine lubricant reservoir is responsible for collecting the lubricant to convey it to the point where the oil pump draws the lubricant, sending it under pressure to the lubrication ducts.

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- SUB-GROUP GRAPHIC INDEX

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1024A	Crank shaft	1242 8v
1024B	Engine flywheel	1242 8v

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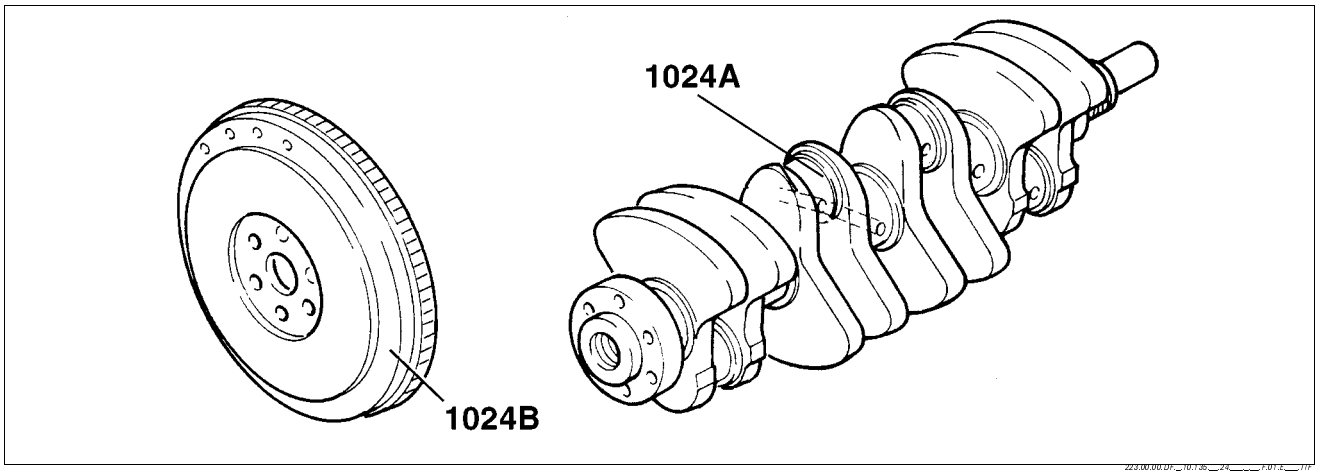


1242 8v

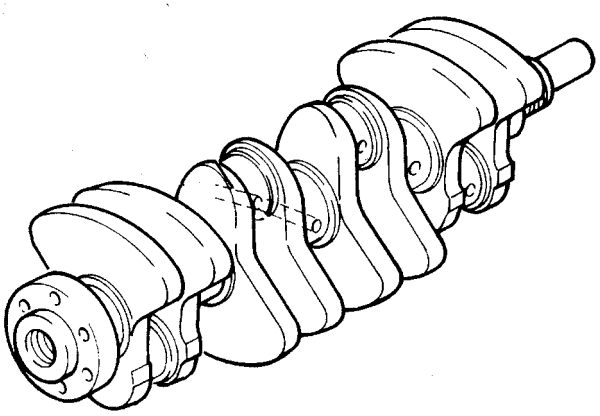
1024A - Crank shaft

1242 8v

CONSTRUCTION FEATURES

1242 8v

Made from spheroidal graphite cast iron, induction hardened. It rests on five main bearings with bearing shells graded into different sizes.
The crankshaft endfloat is optimized by two thrust washers located in relation to the centre main bearing.
Eight counterweights arranged at 180° ensure that the crankshaft rotating masses are perfectly balanced. A channel runs along the inside of the shaft to lubricate the main bearings and big end bearings.



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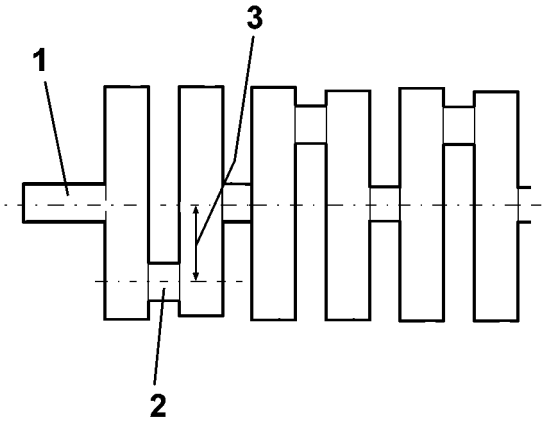
1242 8v

COMPOSITION

1242 8v

The crankshaft consists of:
- main journals (1), which rotated in the main bearings with bearing shells interposed;
- crank pins (2), over which the connecting rod big ends fit;
- crank arms (3), the same height as half the travel, which connect the main journals to the crank pins.



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1242 8v

The shaft is also prepared for:
- the fitting of the flywheel; - the fitting of the sprocket which, via a toothed belt, transmits motion to the timing system components.

1242 8v

OPERATION

1242 8v

The crankshaft is the component which, via the connecting rod, transforms the reciprocating rectilinear motion of the piston into a rotary motion.
It is subjected to forces which vary dramatically in terms of intensity and direction, and must therefore be sufficiently strong.

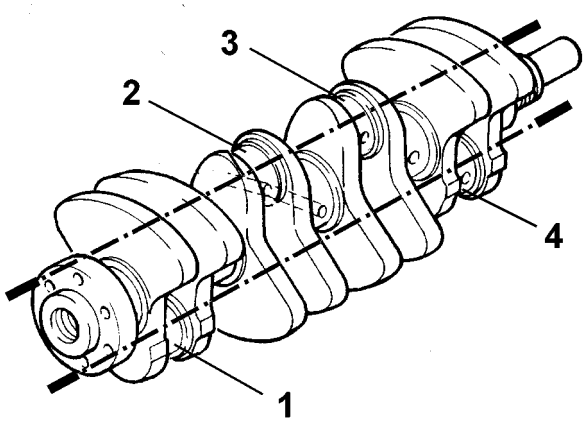
Its shape is designed according to the:
- number of cylinders
- type of engine (in line, a v, a w, etc.)
- number of main bearings
- number of strokes (2 stroke or 4 stroke)

In order to prevent damaging engine vibrations, the crankshaft should be both statically and dynamically balanced. These vibrations are due to:
- centrifugal forces, generated by the masses with rotary motion (crank pins, big ends, 1/3 of the weight of the connecting rod, crank arms);
- inertia forces, generated by the masses with reciprocating rectilinear motion (piston, gudgeon pin, 2/3 of the weight of the connecting rod).

A shaft is said to be statically balanced when, resting on two supports, it remains balanced irrespective of the rotation position.
A shaft is said to be dynamically balanced when, supported between two points corresponding to the rotation axis and made to rotate, it transmits a reaction equal to half of its own weight to each support.
The addition of counter-weights in suitable positions balances the shaft either statically or dynamically.
However, to lessen the engine vibrations, it is not sufficient to balance the crankshaft, but it is necessary also to ensure that its motion is uniform, by both offsetting the working cycles (following a given firing order) and by fitting the shaft with a suitable flywheel.
The firing order is obtained by offsetting the cranks, in engines with several cylinders, at an angle equal to:
$7a = 180° \times t/i$

where:
- t = engine strokes
- i = number of cylinders

In our case (4 stroke engine with 4 cylinders)
The crank offset angle is:
$a = 180° \times 4/4 = 180°$
The cranks are arranged on the same plane and in parallel in twos.



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1242 8v

There may be two firing orders: 1, 2, 4, 3 or 1, 3, 4, 2; the most common firing order is 1, 3, 4, 1 as the centrifugal forces and inertia forces are more balanced.

1242 8v

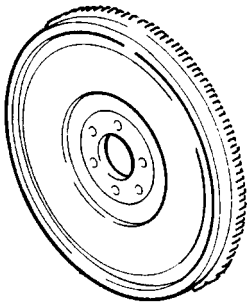
1024B - Engine flywheel

1242 8v

CONSTRUCTION FEATURES

1242 8v

In cast iron, with a press-fitted steel ring gear.
The flywheel is bolted via a flange to the crankshaft.



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1242 8v

OPERATION

1242 8v

This makes the engine turn smoothly. It accumulates energy during active stages (expansion) and returns it during passive stages.
The flywheel is designed to allow the engine to idle without stalling and to overcome the friction developed by the engine during no-load operation.

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Cmp	*Description*	*Validity*
1028H	Pistons and connecting rods	1242 8v

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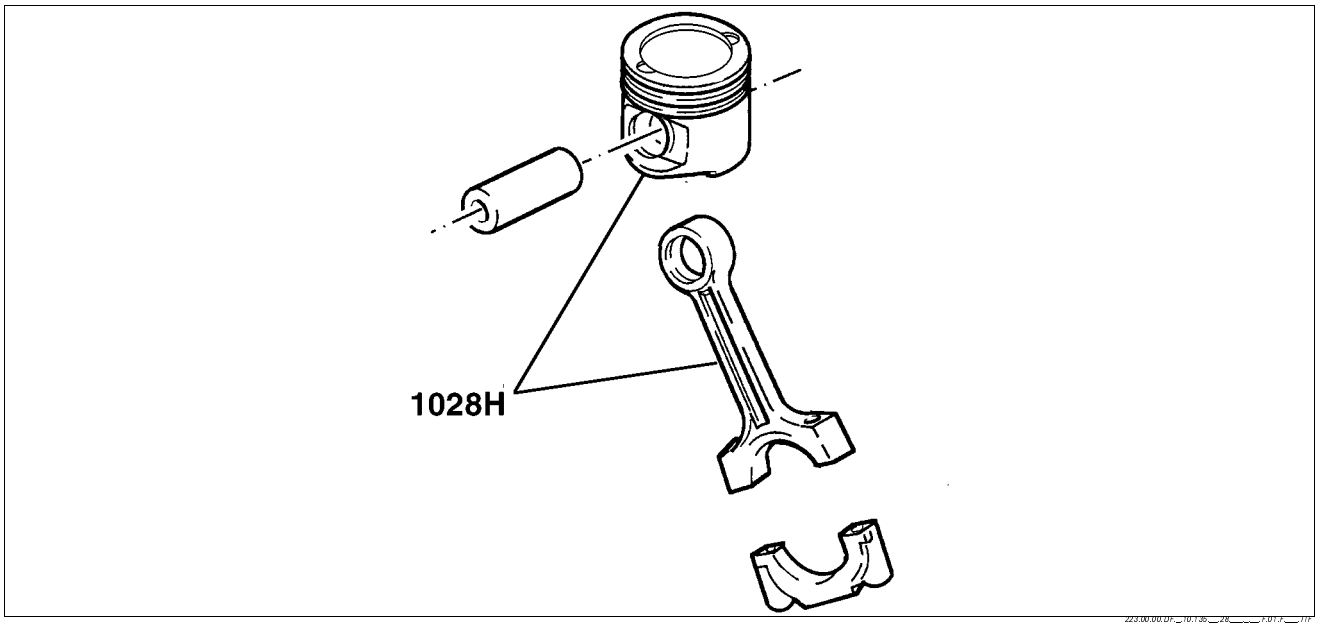


1242 8v

1028H - Pistons and connecting rods

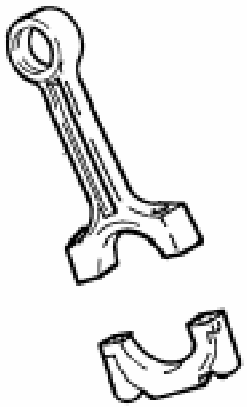
1242 8v

CONSTRUCTION features

description of connecting rods

1242 8v

Any rod with joints at the two ends is thus defined.
In the engine, the connecting rods connect the crankshaft and pistons. The part connected to the crankshaft, called the big end, has a rotary movement, while the upper end (small end) has a reciprocating rectilinear movement and is joined to the piston via the gudgeon pin.



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COMPOSITION OF CONNECTING RODS

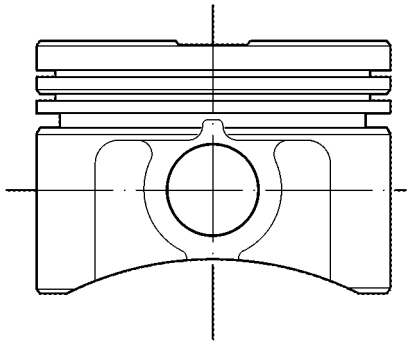
1242 8v

The connecting rods are made from spheroidal graphite cast iron. The gudgeon pins are the fixed type and are an interference fit in the connecting rod.
The connecting rod consists of a body or shank, with a rectilinear axis, which rigidly connects the small end, fixed on the gudgeon pin; and the big end, fixed on the crankpin with bearings interposed.
The big end is divided into two parts for fitting reasons: the fixed part is in one piece with the body and the moving part, called cap, is connected to the former by studs.
As the connecting rod is subjected to compression and combined compressive and bending stresses, it tends to become deformed; consequently the connecting rod body must be made so as to combine light weight with maximum strength, and so it is constructed as a double T section.
The connecting rod is the main connecting element between the piston and the crankshaft.

DESCRIPTION OF PISTON

1242 8v

In the mechanism, called crank gear, which converts the rectilinear motion into rotary motion of the crankshaft, the piston slides reciprocally in the guide, called bore or cylinder.
The top of the piston, or crown, contributes to determining the shape of the combustion chambers. - The part in contact with the cylinder is called skirt, and at the top, it has the grooves for housing the piston rings.
As materials and production technologies are improving, the piston and oil scraper rings have now decreased, and it is likely that in the future they will decrease further.
'Moreover, in racing engines they are already down to two'.



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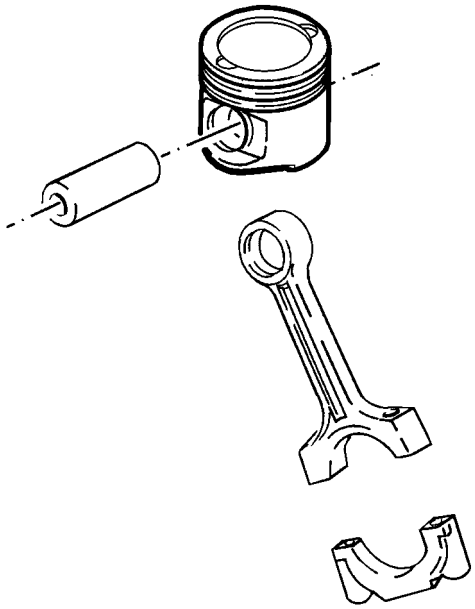
1242 8v

The aluminium-silicon alloy pistons are graded into three sizes; to ensure correct assembly, an arrow is stamped on the crown to show the direction of rotation of the engine.



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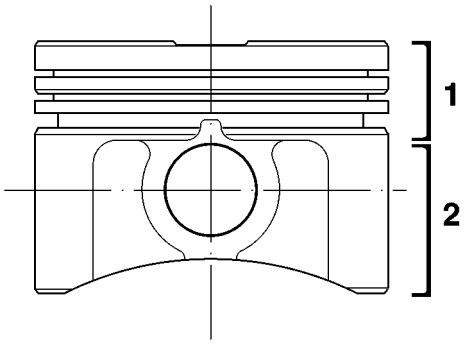
COMPOSITION OF PISTON

1242 8v

The piston consists of two parts:
- The head (1) or the area containing the piston rings, slightly smaller in diameter than the cylinder to allow for the thermal expansion of the metal.
- The skirt (2) or guide for the small end which supports the side thrust. The skirt contains two bosses for housing the gudgeon pin.



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1242 8v

These pistons have a steel ring incorporated between the skirt and the head which has the task of preventing the expansion of the skirt in a transverse direction in relation to the gudgeon pin axis.

PISTON OPERATION

1242 8v

This is the component which directly receives the engine impulse from the pressure of the combustion gas, via the connecting rod, and transmits the drive force to the crankshaft.

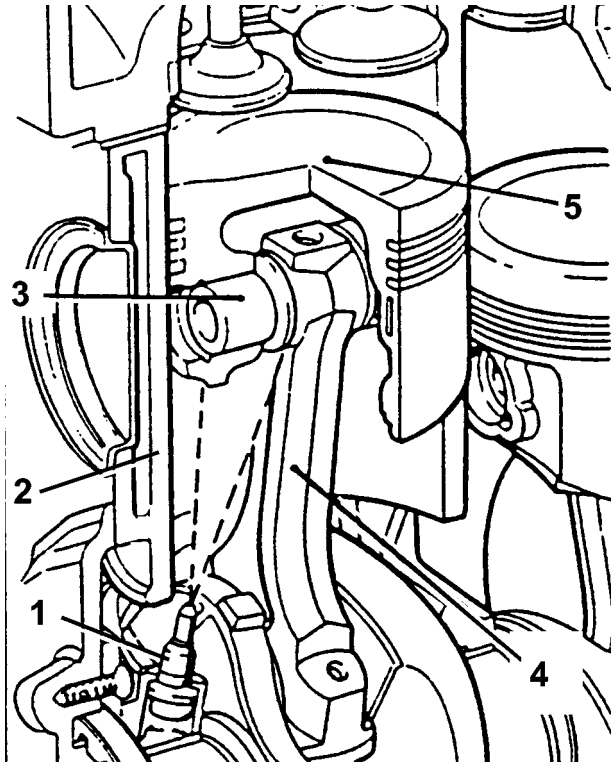
It should meet to the following requirements:
- high mechanical resistance, which makes it possible to withstand the explosion pressures (~35 kg/cm2) and the dynamic stresses;
- high resistance to heat and wear;
- good thermal conductivity, to transmit heat from the hot area to the cold area underneath;
- light weight and extremely quiet operation, both when cold and when hot.

In order to have low specific pressure at the skirt in the working direction and therefore low consumption, both for the skirt and the cylinder liners, the gudgeon pin should be offset (by about 3% of the bore) in relation to the piston axis, on the opposite side to the direction of rotation.

OIL JETS FOR COOLING THE PISTONS

1242 8v

The diagram below illustrates the position and operation of the oil jets for cooling the pistons.



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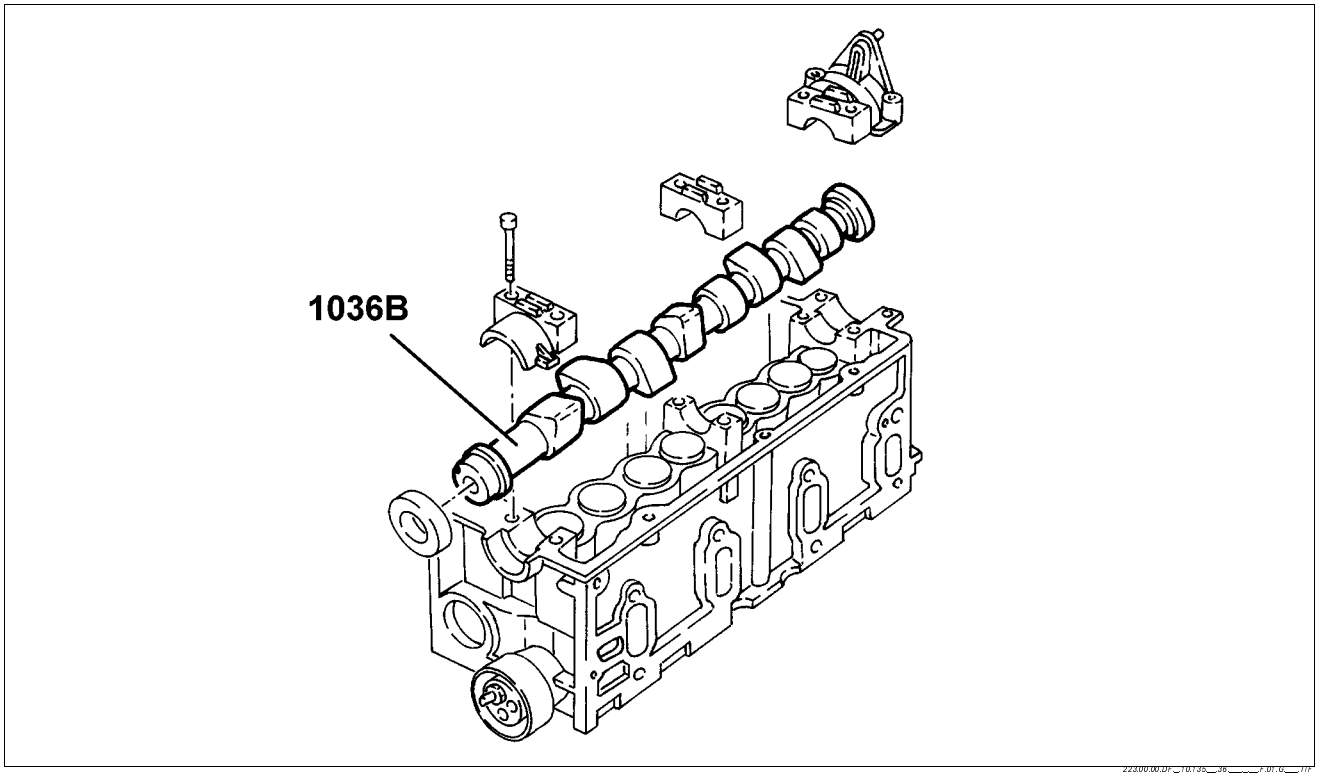
1, Oil jet
2, Piston bore/liner
3, Connecting rod-piston gudgeon pin
4, Connecting rod
5, Piston

Sub-group index

Assembly drawings index

Cmp	Description	Validity

SUB-GROUP GRAPHIC INDEX



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1242 8v

Specifications

1242 8v

The timing system is the collection of components which control the opening and the closing of the inlet and exhaust valves allowing the flow of the air/fuel mixture and burnt gases.
These components are operated by the crankshaft and the movement is transmitted via a toothed belt to the camshafts which, in turn, act on the valves. The various components should be perfectly synchronized (TIMED), if this is not the case, the valves could foul against the upper part of the pistons.

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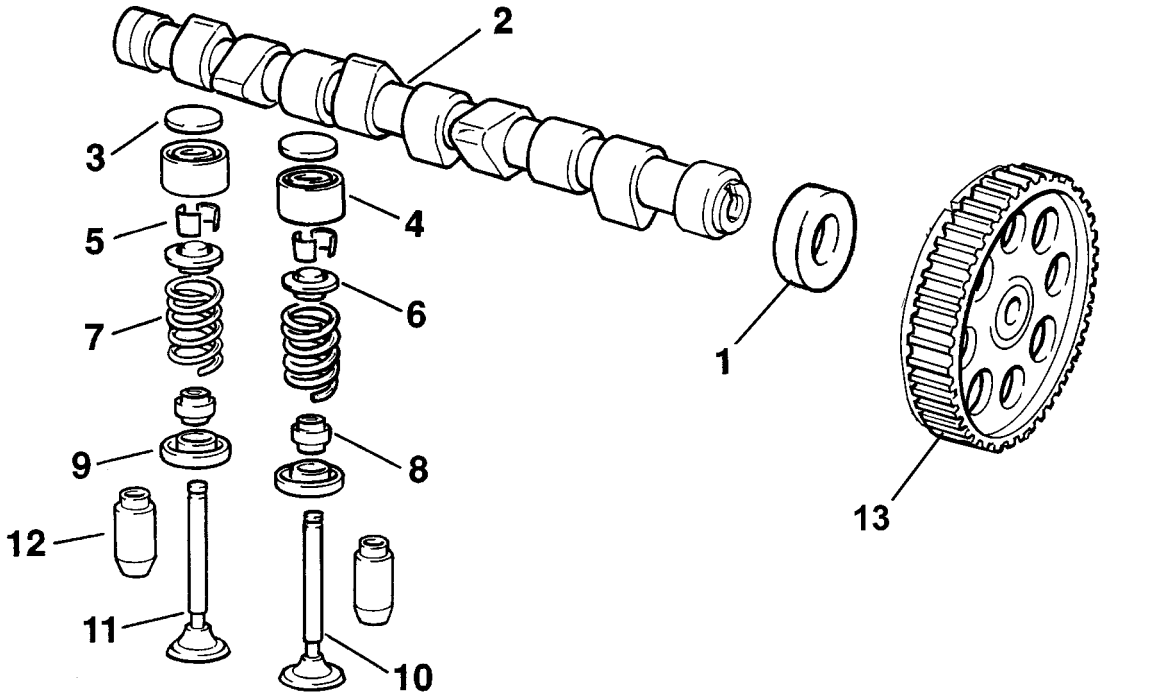
1242 8v

COMPOSITION

1242 8v

There are the same number of suitably positioned cams as there are valves to operate; at the front, it is prepared for the fitting of the toothed pulley, through which the motion of the crankshaft is received, by means of a suitably tensioned belt (see 'repair procedures' section).



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1, Camshaft oil seal
2, Camshaft
3, Tappet adjustment shim
4, Tapppet
5, Cotters
6, Upper shim
7, Spring
8, Oil seal
9, Lower shim
10, Inlet valve
11, Exhaust valve
12, Valve guide
13, Camshaft pulley

1242 8v

OPERATION

1242 8v

The camshaft is the component which, through the cams, opens the valves for the required time.
Since in 4 stroke engines the working cycle takes place during two revolutions of the crankshaft, whilst the valves have to open only once during the cycle, the camshaft only has to rotate once; therefore, the toothed pulley fitted on the camshaft will have twice the number of teeth as the pulley fitted on the crankshaft.

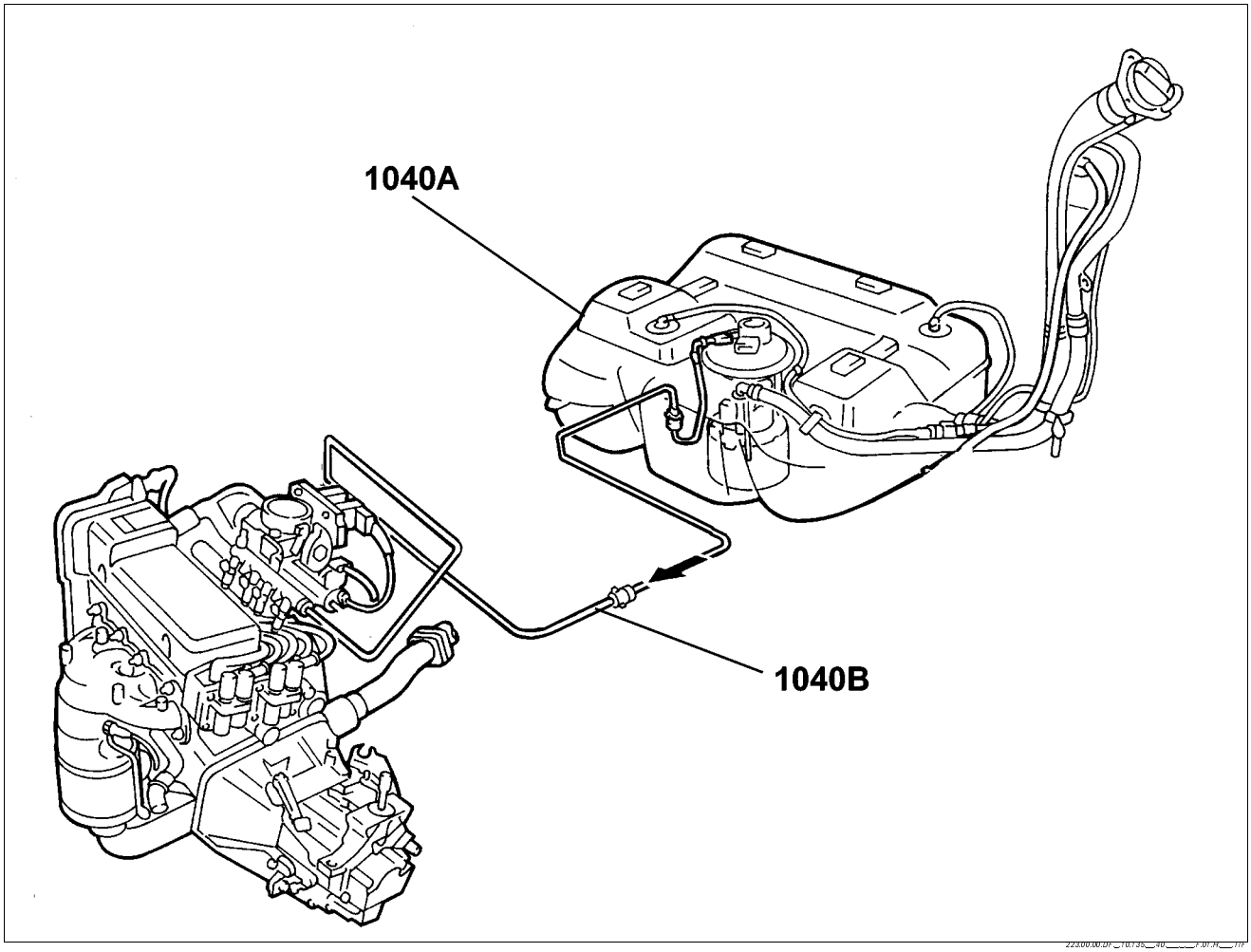
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES
- COMPOSITION

Assembly drawings index

Cmp	Description	Validity
1040A	Fuel tank and components	1242 8v

SUB-GROUP GRAPHIC INDEX



1242 8v

CONSTRUCTION features

1242 8v

The fuel system is the 'returnless' type, i.e. with only one connecting pipe between the fuel tank and engine, on account of which the return pipe, the filter and the pressure regulator have been dispensed with; the latter two components are incorporated in the pump assembly.

This makes it posible:
- to minimize the possibility of the vehicle catching fire in the event of an accident
- to reduce fuel vapour emissions into the atmosphere.

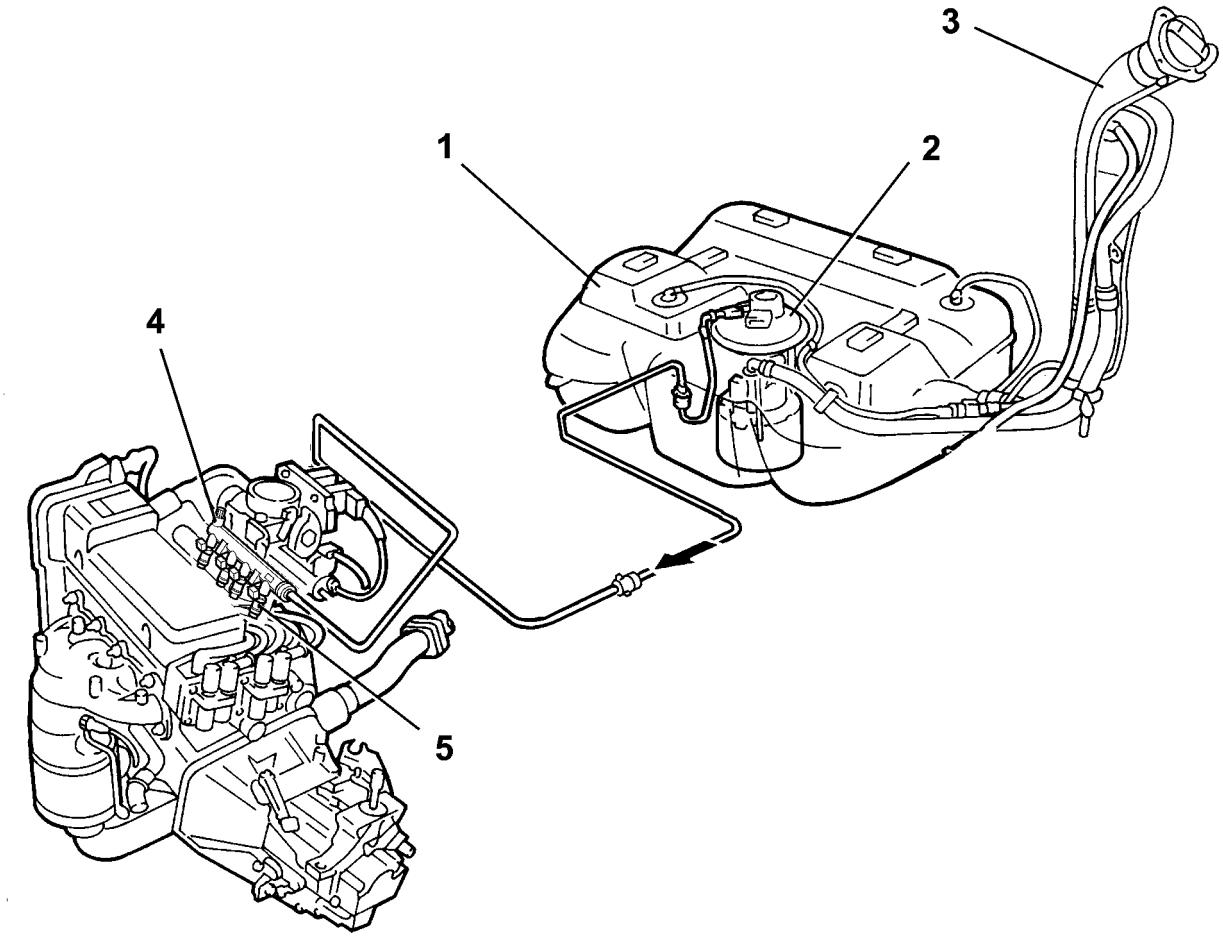
The fuel tank, located in front of the rear axle, is made from a plastic material with high mechanical strength, and has a capacity of 60 litres.

1242 8v

COMPOSITION

1242 8v

The fuel system consists of the components illustrated in the figure below.



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1, Fuel tank
2, Complete immersed pump assembly
3, Fuel filler pipe
4, Fuel manifold
5, Injectors (see 1056)

1242 8v

1040A - Fuel tank and components

1242 8v

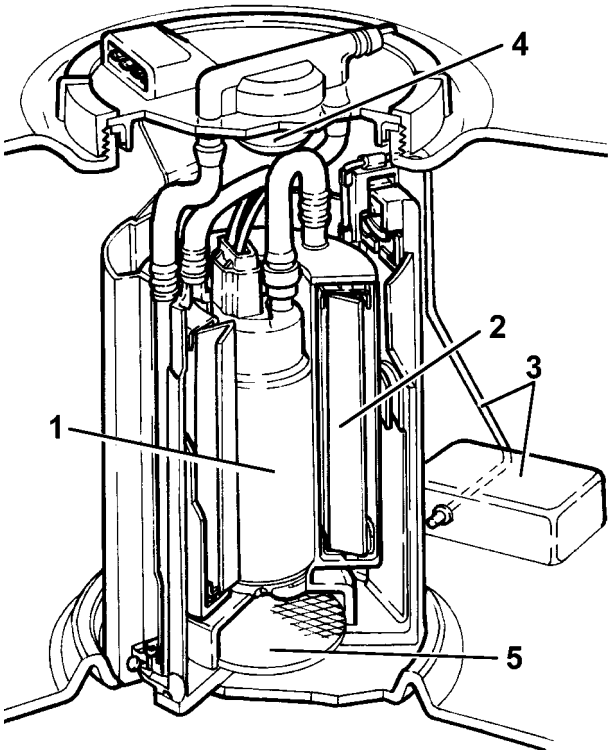
COMPOSITION

Immersed pump unit complete with fuel gauge sender unit

COMPOSITION

1242 8v

It is mainly composed of:
- an electric fuel pump (1)
- a fuel filter (2)
- a float type fuel gauge (3)
- a diaphragm pressure regulator (4)
- a mesh pre-filter (5).



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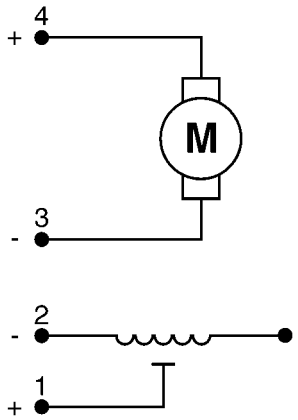
GAUGE ELECTRICAL VALUES

1242 8v

The figure below illustrates the electrical connections of the pump assembly, while the table indicates the sensor's resistance values in relation to the fuel level.



	Ω
4/4	6 ± 3
3/4	64 ± 5
1/2	121 ± 5
1/4	193.5 ± 7.5
R	245 ± 6
0	310 ± 10

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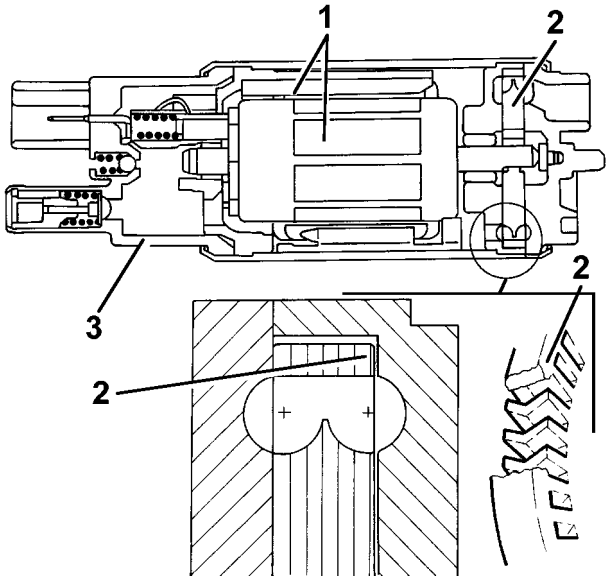
Electric fuel pump

1242 8v

The fuel pump comprises a permanent-magnet electric motor (1) which controls the pump impeller (2), and a terminal-carrier cover (3), which contains the electrical and hydraulic connections.
The pump stage is the single type with peripheral flow, with high performance in low voltage and temperature conditions.

Its advantages compared with pumps operating in accordance with the positive-displacement principle are:
- light weight
- small in size.



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1242 8v

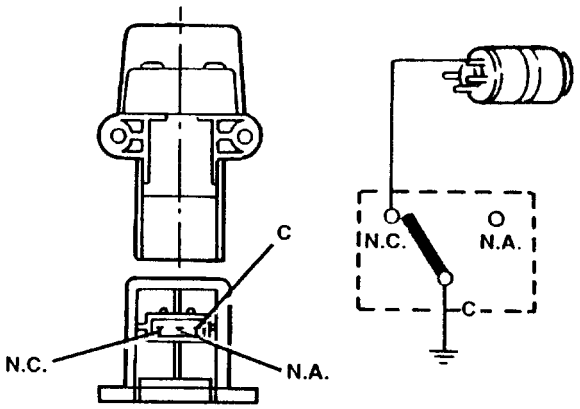
SPECIFICATIONS
- Capacity 110 l/h
- Pressure 3.5 bar
- Voltage 12 V
- Current = 7.5 A

1242 8v

Inertial switch

1242 8v

The inertia switch, fitted on the right under the dashboard on the passenger side, interrupts the connection to earth for the fuel pump and consequently the supply to the injection system, in the case of an impact to the vehicle.



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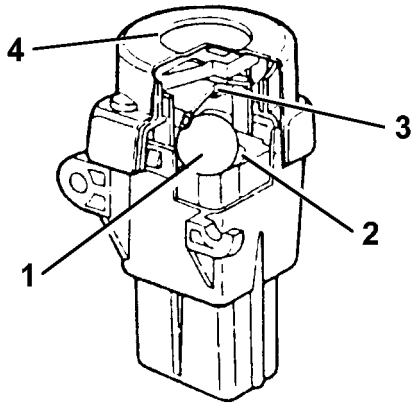
1242 8v

A steel ball (1) mounted in a conical housing (2) is normally locked by the attraction force of an adjacent magnet.
Under specific acceleration loads, the ball is released from the magnetic lock and gradually emerges from the conical housing in an upward movement, following the angle of the cone.
Above the ball, there is a quick-trip mechanism (3) which forms the normally closed (N.C.) electric circuit.
When the mechanism is struck by the ball, it changes position from an N.C. circuit to a normally open (N.A.) circuit, breaking the fuel pump's earth circuit.
The switch can be reset by pressing a button protected by a soft cover (4).

Note: *Even after an apparently minor impact, if there is a smell of fuel or leaks are noticed from the fuel system, do not turn the switch back on, but search for the cause of the problem and remedy it to prevent the risk of fire.*
Otherwise, if there are no leaks and the vehicle can be restarted, press the button to reactivate the pump.



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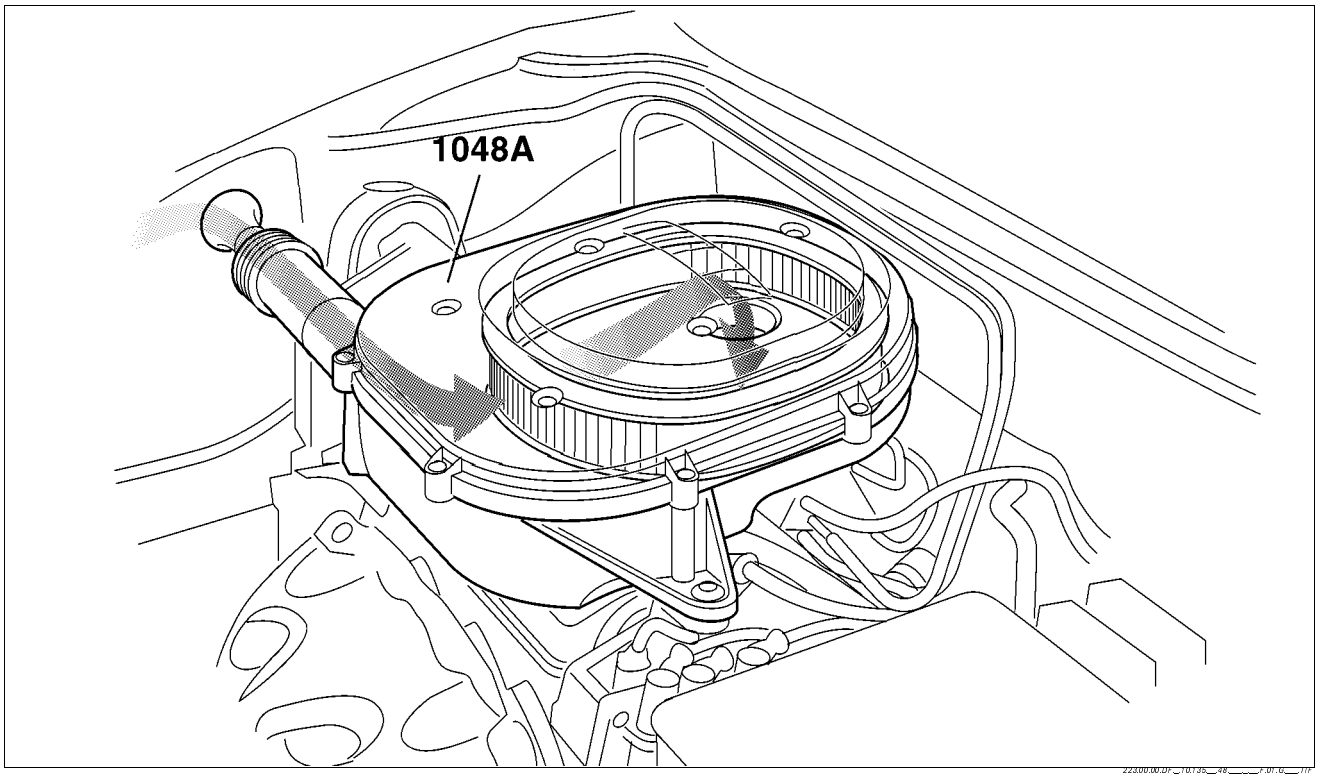
Sub-group index

- SUB-GROUP GRAPHIC INDEX

Assembly drawings index

Cmp	Description	Validity
1048A	Vacuum air circuit	1242 8v

SUB-GROUP GRAPHIC INDEX



1242 8v

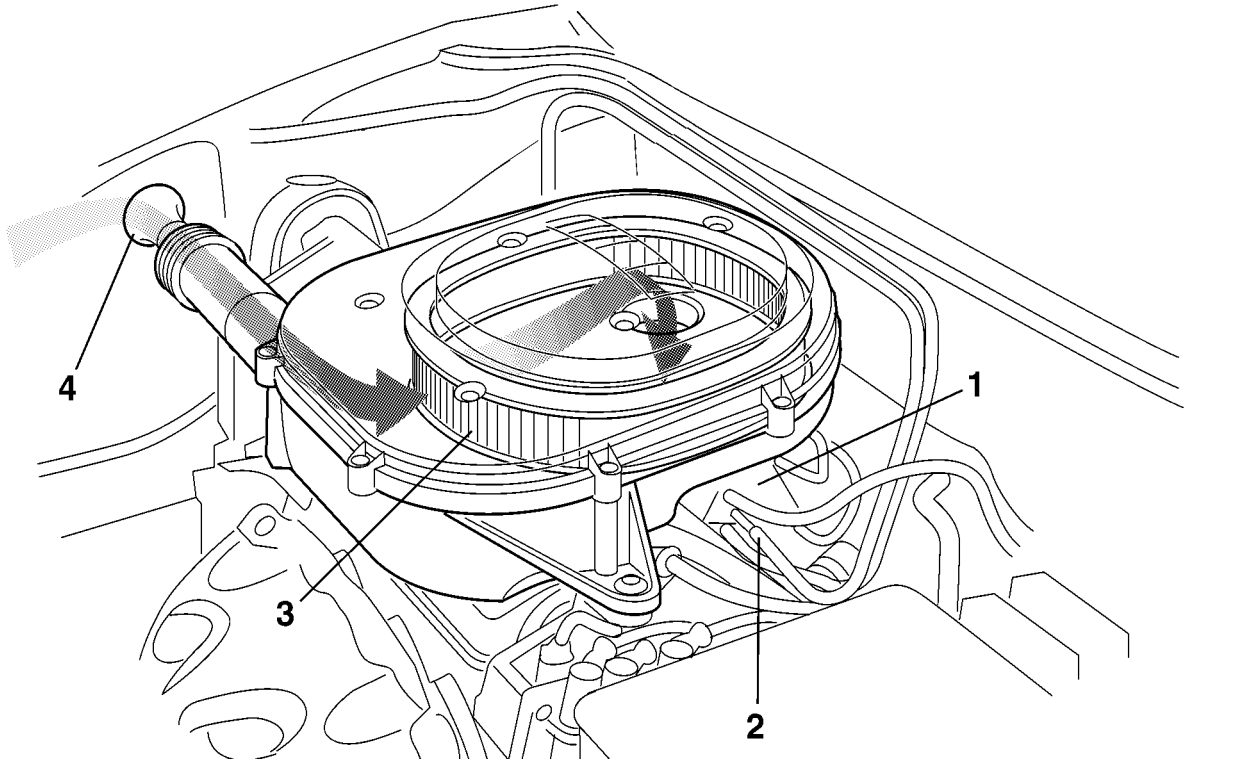
1048A - Vacuum air circuit

1242 8v

SPECIFICATIONS:

1242 8v

The air intake circuit consists of various components which ensure that the air flow required by the engine in the various operating conditions is correctly directed.



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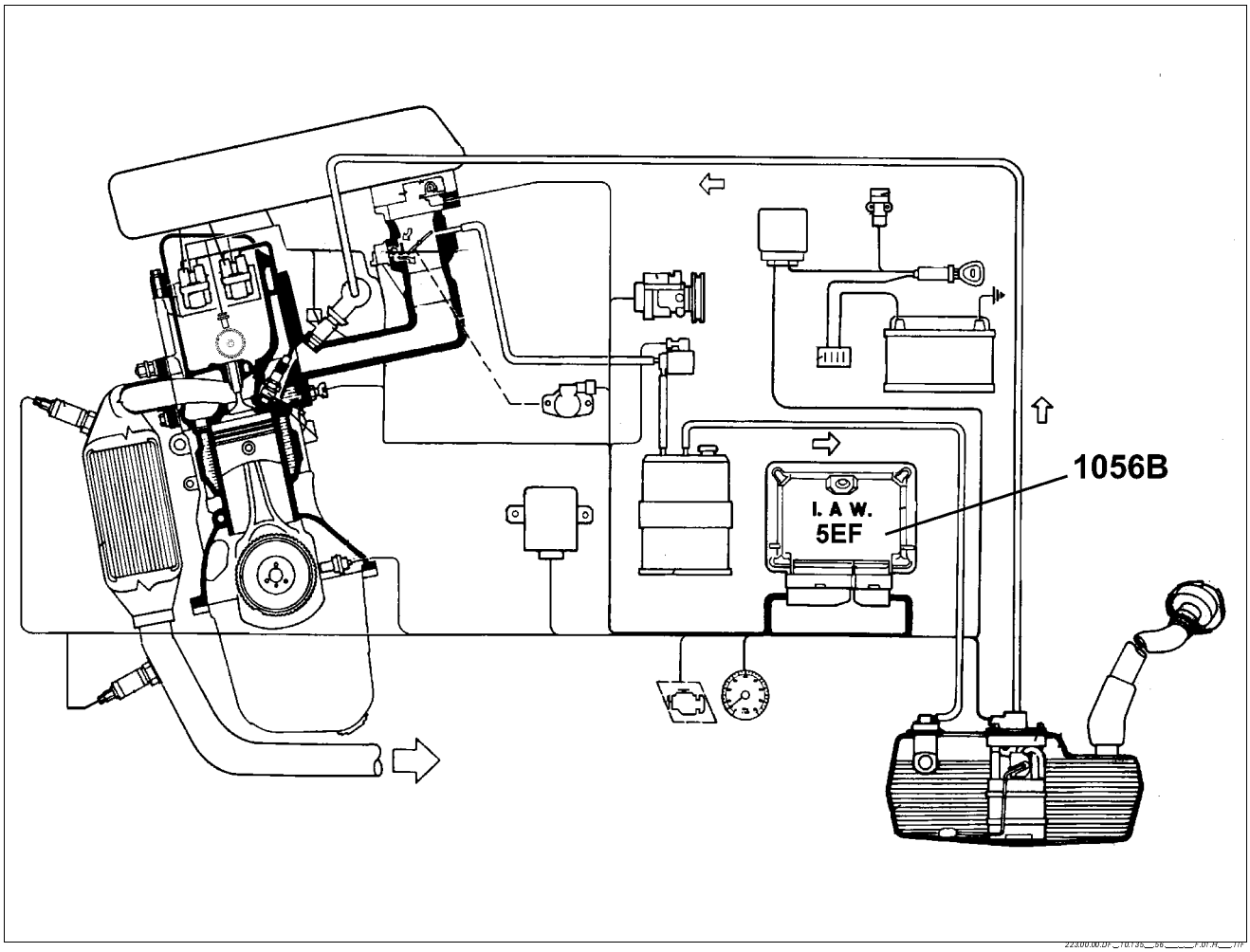
1, Inlet manifold
2, Engine crankcase gas intake (see 1080)
3, Air filter
4, Intake vent

Sub-group index

Assembly drawings index

Cmp	Description	Validity

SUB-GROUP GRAPHIC INDEX



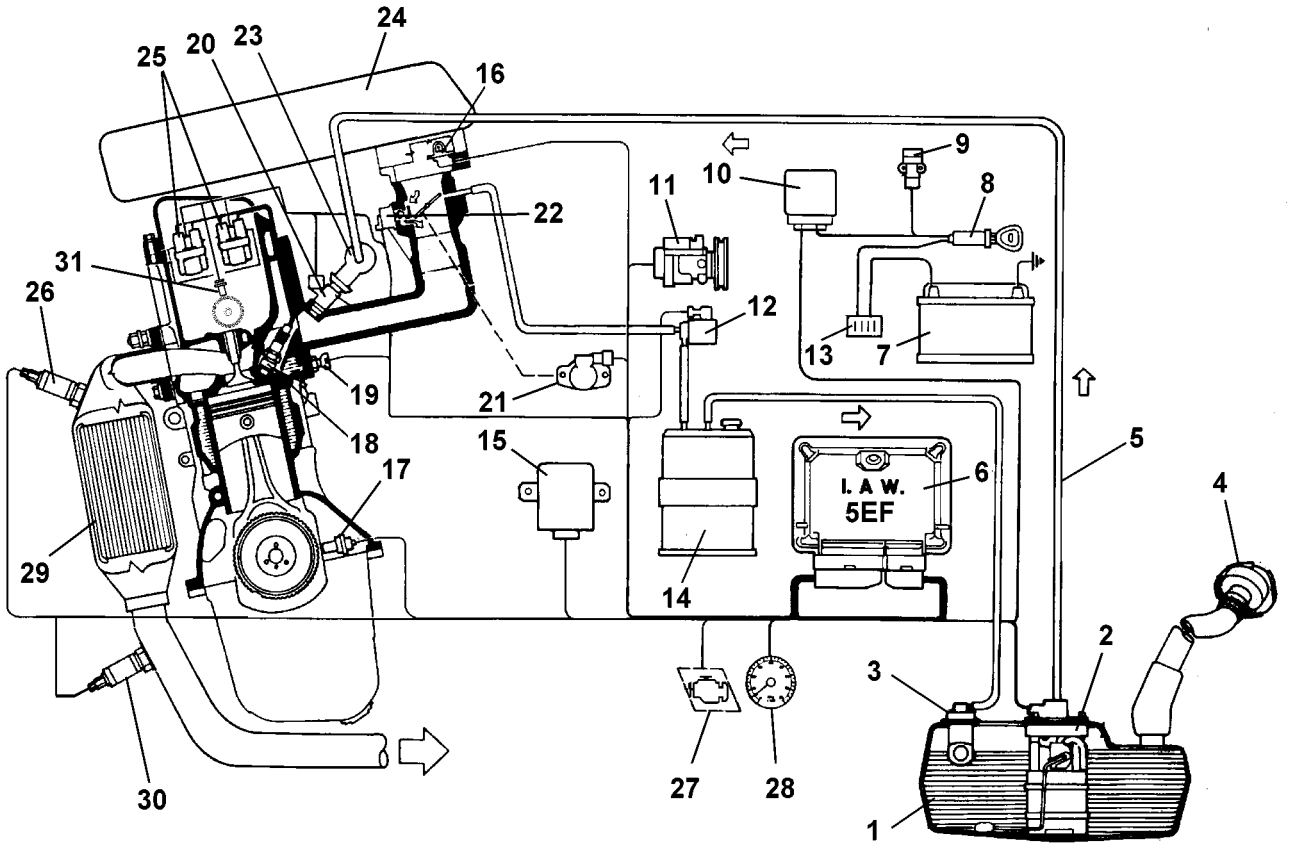
1242 8v

CONSTRUCTION FEATURES

1242 8v

The Marelli IAW 59F system belongs to the category of systems integrated with:
- inductive discharge digital electronic ignition

- distributorless
- sequential, phased electronic injection (1-3-4-2).



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1, Fuel tank
2, Electric fuel pump
3, Multi-purpose valve
4, Safety valve
5, Fuel delivery pipe
6, Injection-ignition ECU
7, Battery
8, Ignition switch
9, Inertia switch
10, System relay
11, Climate control system
12, Fuel vapour cut-off valve
13, Ingition-injection system fuse
14, Activated carbon filter
15, Body Computer (tester connection and Fiat CODE signal)
16, Absolute pressure and temperature sensor
17, Rpm and TDC sensor
18, Spark plugs
19, Coolant temperature sensor
20, Injectors
21, Throttle valve position sensor
22, Idle speed actuator
23, Fuel supply manifold
24, Air cleaner
25, Ignition coils
26, Lambda probe
27, System failure warning light
28, Rev counter
29, Catalytic converter
30, Lambda probe (post catalyzer)
31, Injection timing sensor

1242 8v

Operation of the injection/ignition system

1242 8v

During idling, the control unit checks:

- the ignition instant
- the air flow with the benefit of maintaining correct operation of the engine when the environmental parameters and applied loads vary.

The control unit controls and manages fuel injection so that the stoichiometric ratio (air/fuel) is always at the optimum value.

The system's functions are basically as follows:
- system self-adaptation;
- self test
- recognition of FIAT CODE
- control of cold starting
- control of combustion - Lambda sensors
- control of detonation
- control of mixture enrichment during acceleration
- fuel cut-off during overrunning
- - fuel vapour recovery
- limitation of the maximum rpm
- fuel pump control
- connection to the climate control system
- recognition of cylinder position
- adjustment of injection times
- adjustment of ignition advance values
- control and management of the idle speed
- control of electric cooling fan.

Fuel injection system

1242 8v

The essential conditions that must always be met in the preparation of the air-fuel mixture for the correct operation of controlled-ignition engines are mainly:
- the 'metering' (air/fuel ratio) must constantly be kept as close as possible to the stoichiometric ratio, so as to ensure the necessary rapidity of combustion, avoiding unnecessary fuel consumption
- the 'homogeneity' of the mixture, consisting of petrol vapours, diffused as finely and evenly as possible in the air.

The injection/ignition system uses an indirect measuring system known as the 'SPEED DENSITY LAMBDA' type. in other words the angular rotation speed, density of the intake air and control of the mixture strength. In practice the system uses data on the ENGINE SPEED (rpm) and AIR DENSITY (pressure and temperature) 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 intake air, but also on the unit displacement and the volumetric efficiency.
The density of the air refers to that of the air drawn in by the engine and calculated according to the absolute pressure and the temperature, both detected in the inlet manifold.
Volumetric efficiency refers to the parameter relating to the coefficient for filling the cylinders measured on the basis of experimental tests carried out on the engine throughout the entire operating range and then stored in the electronic control unit memory.
Having established the quantity of intake air, the system has to provide the quantity of fuel according to the desired mixture strength.
The end of injection impulse or supply timing is contained in a map stored in the control unit memory and varies according to the engine speed and the pressure in the inlet manifold. In practice, it involves processing which the electronic control unit carries out to command the sequential, phased opening of the four injectors, one per cylinder, for the length of time strictly necessary to form the air/petrol mixture which is closest to the stoichiometric ratio.
The fuel is injected directly into the manifold near the inlet valve at a pressure of around 3.5 bar.
Whilst the speed (rpm) and the density of the air (pressure and temperature) are used to measure the quantity of intake air, which when established allows the quantity of fuel to be metered according to the desired mixture strength, the other sensors in the system (coolant temperature, butterfly valve position, battery voltage, etc.) allow the electronic control unit to correct the basic strategy for all engine operating conditions. It is vital for the air/fuel ratio to be around the stoichiometric value for the correct and prolonged operation of the catalytic silencer and for the reduction of pollutant emissions.

Ignition system

1242 8v

The ignition is the inductive discharge type, i.e. without a high tension distributor, with power modules located in the electronic injection/ignition control unit.
The system has two high tension twin outlet coils joined in a single container and connected directly to the spark plugs.

The primary winding for each coil is connected to the power relay (thereby receiving the battery voltage) and to the pins for the electronic control unit for connection to earth.

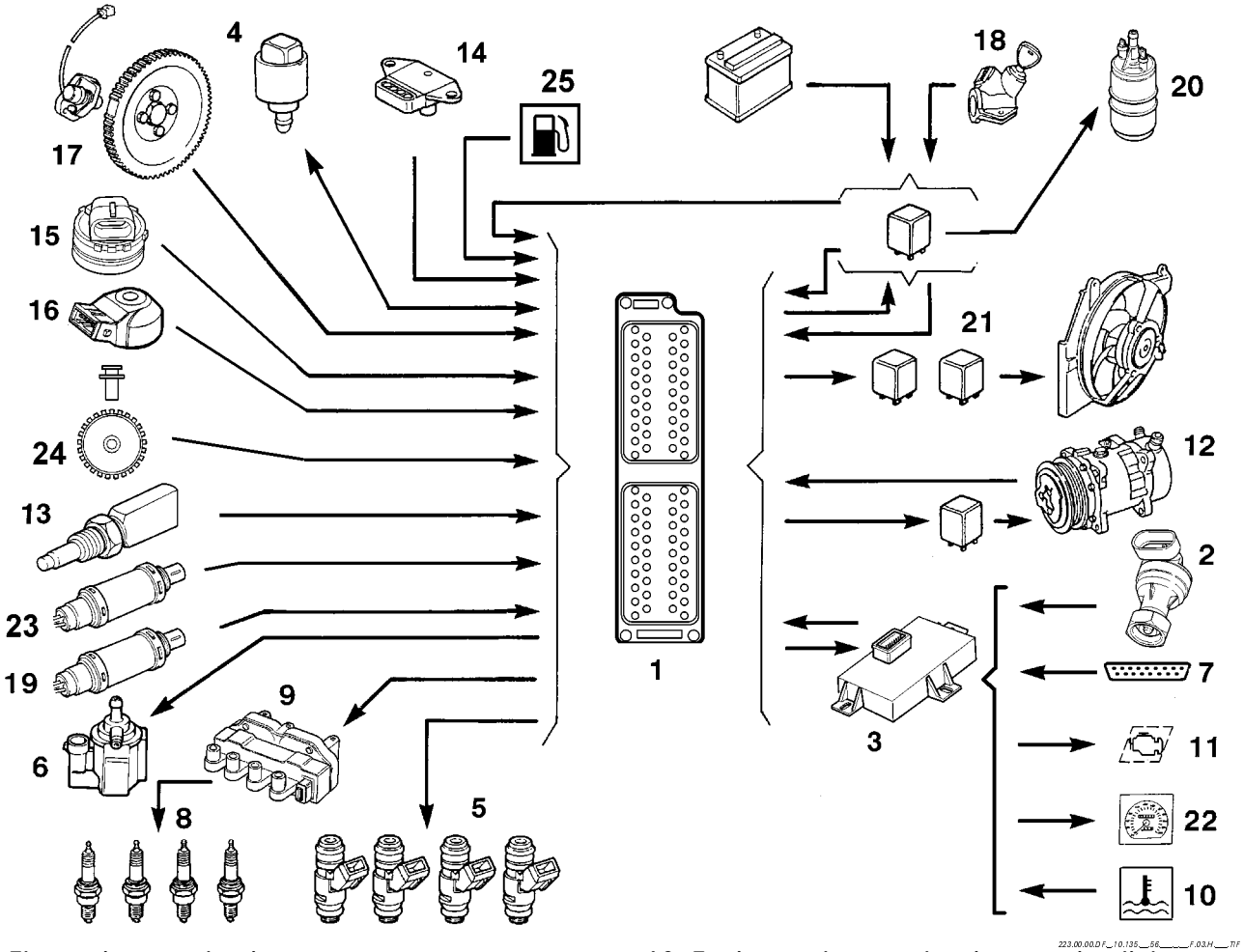
After the starting stage, the electronic unit manages the basic advance taken from a special map according to the:
- engine rpm
- absolute pressure value (mmhg) measured in the inlet manifold.

This advance value is corrected according to the temperature of the engine coolant and the intake air.
The spark plugs for cylinder 1-4 and 2-3 are connected directly (two at a time) by means of high tension leads to the terminals of the coil secondary winding and their connection is in series because the cylinder head joins them.
This solution is also known as the 'lost spark' becuse the energy accumulated by the coil is almost exclusively discharged at the electrodes for the spark plug of the cylinder under compression allowing the ignition of the mixture. The other spark is obviously not used, as no mixture is found in the cylinder to ignite, only exhaust gas.

Diagram of input/output info to/from control unit

1242 8v

The fuel level and engine oil presssure data reach the control unit via the CAN line.



1, Electronic control unit
2, Speedometer sensor (or ABS where present)
3, Body Computer (with built-in Fiat CODE control unit)
4, Engine idle speed actuator
5, Fuel injectors
6, Fuel vapour solenoid valve
7, Diagnostic socket
8, Spark plugs
9, Ignition coils
10, Engine coolant overheating warning light
11, Injection failure warning light
12, Climate control system
13, Engine coolant temperature sensor
14, Intke air temperature and pressure sensor
15, Butterfly valve position sensor
16, Detonation sensor
17, Rpm and TDC sensor
18, Ignition switch
19, Lambda sensor (pre catalyzer)

20, Electric fuel pump
21, Radiator fan high and low speed relay feeds
22, Speedometer / milometer
23, Lambda sensor (post catalyzer)
24, Injection phase sensor
25, Fuel level sensor

Operating strategy

System self-adaption

1242 8v

The control unit has a self-adaption function which recognizes changes in the engine which occur as a result of bedding-in and ageing processes of both components and the engine itself.
These changes are stored in the form of modifications to the basic mapping, and their purpose is to adapt the operation of the system to the gradual alterations in the engine and components compared with their characteristics when new.
This self-adaptation function also makes it possible to even out inevitable differences (due to production tolerances) in any replaced components.
From the exhaust gas analysis, the control unit changes the basic mapping in relation to the original characteristics of the new engine
The self-adaptation parameters are not cancelled if the battery is disconnected.

Self-testing

1242 8v

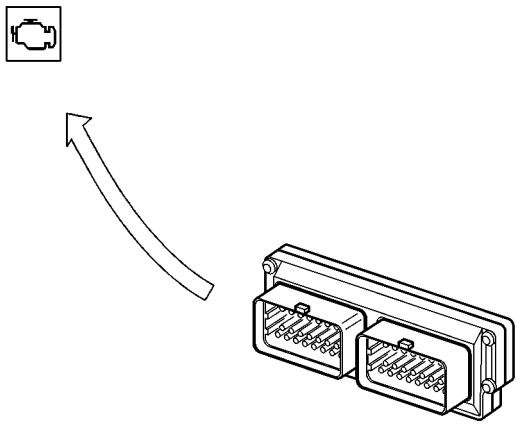
The control unit autodiagnostic system controls the correct operation of the system and signals any faults by means of an (MIL) warning light in the instrument panel which has a standardized European colour and ideogram.
This warning light signals both engine management faults and problems detected by the EOBD strategies.

The (MIL) warning light operating logic is as follows:
- with the ignition key in the ON position, the warning light comes on and remains on until the engine has been started up.
- The control unit's self-test system checks the signals coming from the sensors, comparing them with the permitted limits.

Signalling of faults during engine starting:
- the failure of the warning light to go out once the engine has been started up means that there is an error memorized in the control unit.

Fault indication during operation
- the warning light flashing indicates possible damage to the catalyzer due to misfire.
- if the warning light comes on fixed, it indicates the presence of engine management errors or EOBD RECOVERY diagnosis errors

From time to time, the control unit defines the type of recovery according to the components which are faulty.
The recovery parameters are managed by those components which are not faulty.



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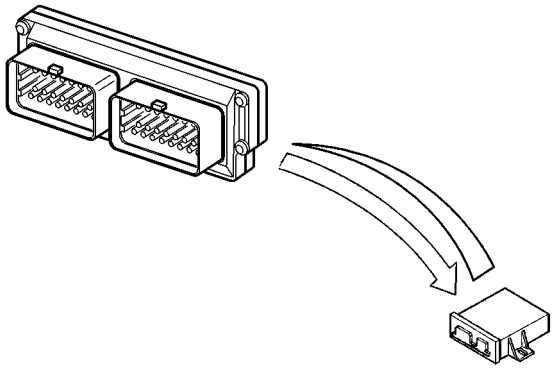
Recognition of FIAT CODE

1242 8v

When the control unit receives the ignition 'ON' signal, it dialogues with the Body Computer (Fiat CODE function) to obtain starting enablement.
Communication takes place via the CAN line which connects the two control units.



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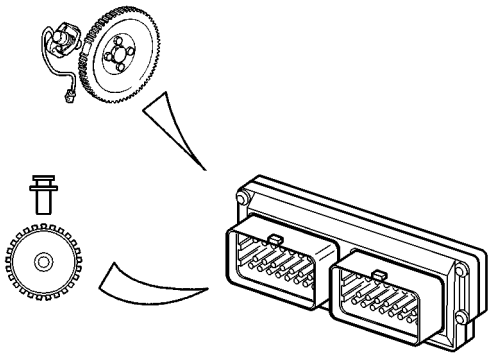
RECOGNITION OF CYLINDER POSITION

1242 8v

The engine timing signal, together with the engine rpm and top dead centre (TDC) signal, allows the control unit to recognize the succession of cylinders to implement phased injection.
This signal is generated by a Hall-effect sensor, positioned on the rocker cover near the phonic wheel formed on the camshaft pulley.



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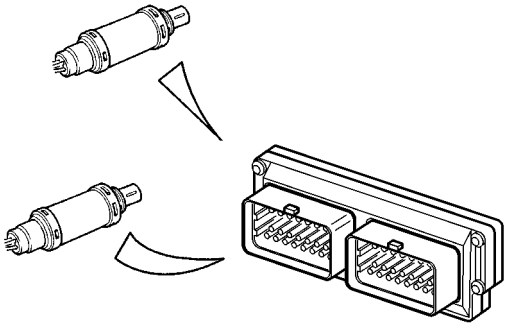
CONTROL OF COMBUSTION - LAMBDA PROBES

1242 8v

In EOBD systems the Lambda sensors, which are all the same type but not interchangeable, are located one before (pre-) the catalyzer and one after (post-) the catalyzer.
The pre-catalyzer sensor carries out the check on the mixture strength called 1st loop (closed loop of the pre-catalyzer sensor).
The post catalyzer sensor is used for the catalyzer diagnosis and for finely modulating the 1st loop control parameters.

With this in mind, the adjustment of the second loop is designed to recover both production differences and the slight deviations which the response from the pre-catalyzer sensor may show as a result of ageing and pollution.
This check is called 2nd loop control (closed loop of post-catalyzer sensor).



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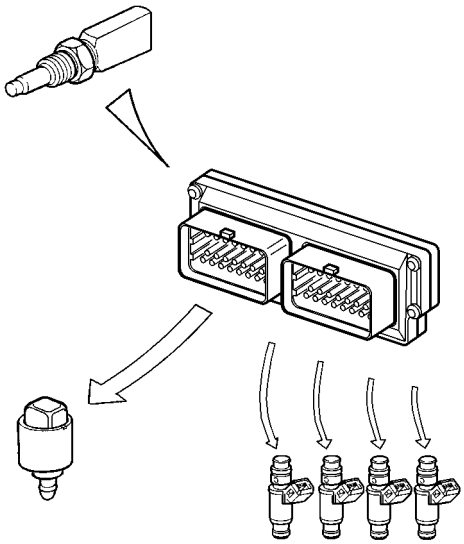
Operation when cold

1242 8v

Under these circumstances there is a natural weakening of the mixture because of the poor turbulence of the fuel particles at low temperatures, reduced evaporation and condensation on the inner walls of the inlet manifold, all of which is exacerbated by the increased viscosity of the lubricant oil which, as is well known, increases the rolling torque of the engine mechanical components at low temperatures.
The electronic control unit recognizes this condition on the basis of the coolant temperature signal, increasing the basic injection time.
Whilst the engine is warming up, the electronic control unit also operates the stepping motor which determines the quantity of air needed to ensure that the engine does not cut out.



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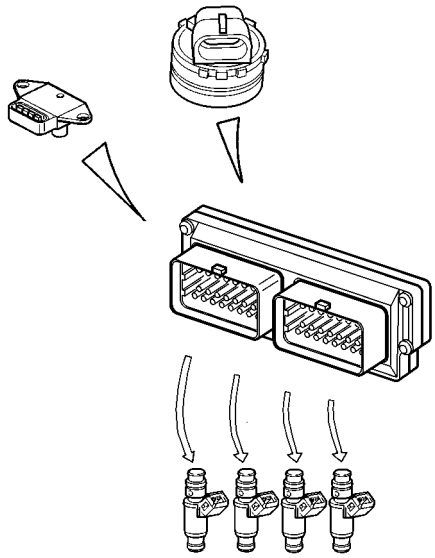
Operation in full load conditions

1242 8v

Operation in full load conditions is detected, by the control unit, through the values supplied by the butterfly position and absolute pressure sensors.
In full load conditions, the basic injection time must be increased to obtain the maximum power supplied by the engine.



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Operation in deceleration conditions

1242 8v

During this stage the engine has two strategies:
- A negative, transitory strategy to keep the quantity of fuel supplied to the engine at the stoichiometric value (less pollution). This stage is recognized by the control unit when the butterfly potentiometer signal goes from a high voltage reading to a lower one.
- A soft accompaniment strategy at the lower speed (dash-pot) to lessen the variation in the torque supplied (reduced engine braking).

Barometric correction

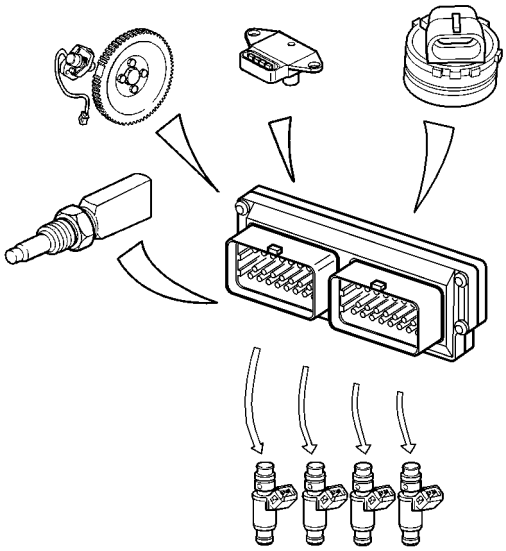
1242 8v

The atmospheric pressure varies according to the altitude creating a variation in the volumetric efficiency which requires the correction of the basic mixture strength (injection time).
The correction of the injection time depends on the variation in altitude and is automatically updated by the electronic control unit each time the engine is switched off and in certain butterfly position and rpm conditions. (for example at low speeds and with the butterfly wide open)

Operation during cut-off

1242 8v

The fuel cut-off strategy is implemented when the control unit recognizes the butterfly valve in the idle position and the engine speed is 1350 rpm (variable indicative value).
The control unit only enables the cut-off when the engine temperature exceeds 0° C.
The control unit with engine speed of 1270 rpm (variable indicative value) and butterfly valve in open position, re-enables the fuel supply to the engine.
For very high speeds the cut-off is implemented even when the butterfly is not completely closed, but when the pressure in the inlet manifold is particularly low (partial cut-off).



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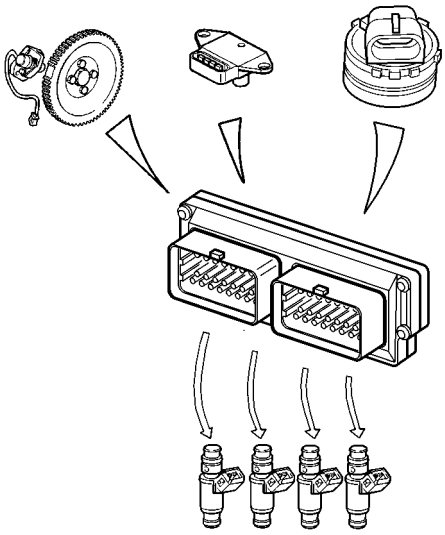
Operation in acceleration conditions

1242 8v

During this stage, the control unit increases the quantity of fuel requested by the engine as appropriate (to achieve maximum torque) according to the signals coming from the following components:
- butterfly potentiometer;
- rpm and P.M.S. sensor.

The 'basic' injection time is multiplied by a coefficient which depends on the temperature of the engine coolant, the opening speed of the accelerator butterfly and the increase in pressure in the inlet manifold.
If the sharp variation in the injection time is calculated when the injector is already closed, the control unit reopens the injector (extra pulse) in order to compensate the mixture strength extremely quickly; the subsequent injections are already increased on the basis of the coefficients mentioned previously.



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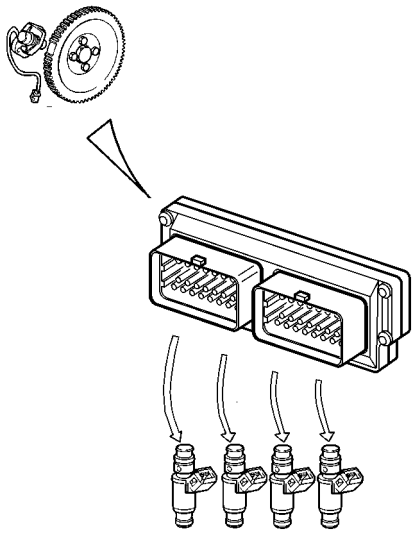
Protection against excess rpm

1242 8v

When the engine rotation speed exceeds 6500 rpm for more than 10 seconds or reaches the 'limit' of 6700 rpm set by the manufacturer for a moment, the engine is operating under 'critcal' conditions.

When the electronic control unit recognizes that the above speed has been exceeded, it prevents the operation of the injectors.
When the rotation speed returns to a non critical value, the operation is resumed.



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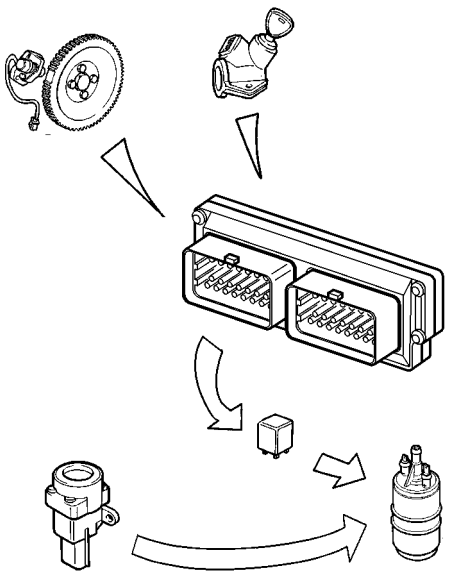
Fuel pump control

1242 8v

The electric fuel pump is controlled by the engine control unit by means of a relay.

The pump cuts out:
- if the engine speed goes below about 50 rpm
- after a certain period (about 5 seconds) with the ignition switch in the ON position without the engine being started up (timed go ahead)
- if the inertia switch has operated.



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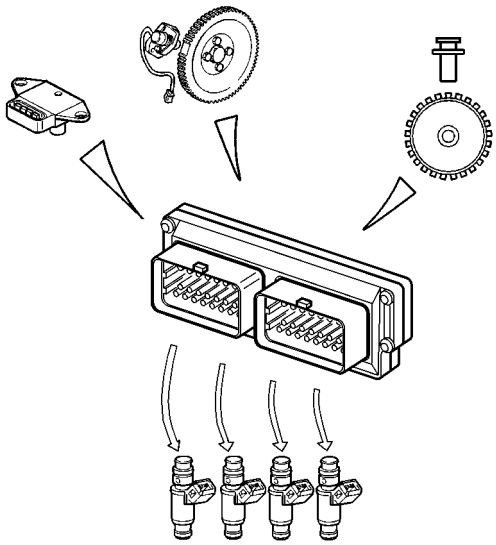
Injector operation

1242 8v

The operation of the injectors is the sequential, phased type. However, during starting the injectors are operated once in parallel (full-group).

The timing of the injector operation varies according to the engine speed and pressure of the inlet air in order to improve the filling of the cylinders with advantages in terms of consumption, driveability and pollution.



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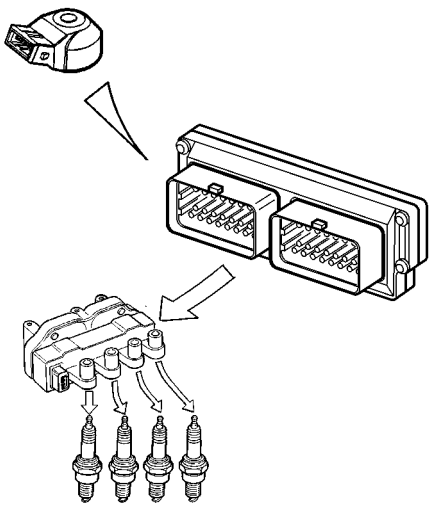
Knock control

1242 8v

The control unit detects 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 value, which, in turn, is continuously updated to take account of background noise and ageing of the engine.
If the system recognizes the presence of detonation, the strategy reduces the ignition advance until the detonation disappears; the advance ia then gradually reset to the basic value, or until detonation arises again. In particular, advance increases are implemented gradually, whilst reductions are implemented immediately.
Under acceleration conditions, a higher threshold is used to take account of the increased engine noise under such conditions.
The strategy also features a self-adaptation function which temporarily memorizes the reductions in the advance that may be continuously repeated, in order to adjust the advance to the different engine operating conditions (for example, the use of a low octane rating fuel). The strategy is capable of restoring the advance to the threshold value memorized when the conditions which have caused the reduction no longer exist.



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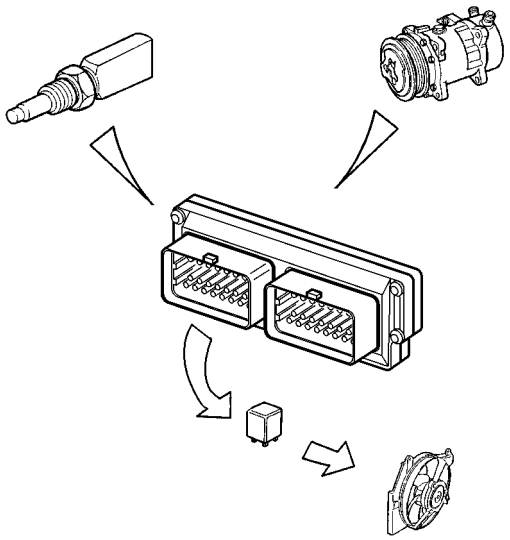
Management of radiator fan

1242 8v

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 switched on when the temperature exceeds 97°C (1st speed) and 101°C (2nd speed). The switching off takes place with a hysteresis of 3°C below the engagement threshold.



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Management of the engine idle

1242 8v

The general aim of this strategy is to keep the engine idling at around the value memorized (engine warm: 750 rpm); the position of the actuator depends on the following engine conditions:

Starting stage

1242 8v

When the key is inserted, the position of the actuator depends on the temperature of the engine coolant and the voltage of the battery (open-loop position).

Warming up stage

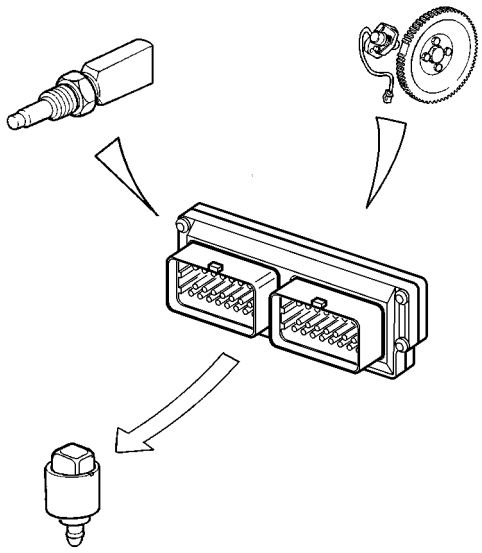
1242 8v

The engine speed is corrected, particularly on the basis of the engine coolant temperature.
When the optimum temperature is reached, the idle management depends only on the signal coming from the rpm sensor; when external loads are switched on, the control unit controls the actuator to adjust the rpm to the new conditions and to manage the engine load while maintaining the idle speed.

Over-run

1242 8v

In deceleration conditions outside of idling, the control unit controls the position of the engine idle speed actuator by means of a special flow rate curve (dash-pot curve), in other words it slows down the return of the shutter towards its seating, improving the engine braking effect (fast idle).



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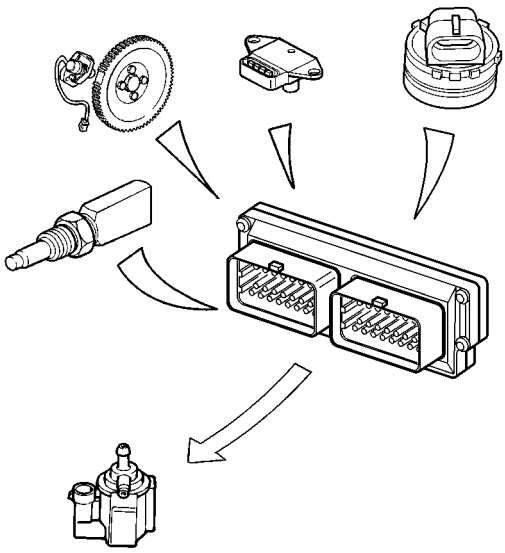
Management of fuel vapour recirculation

1242 8v

This strategy controls the position of the vapour cut out solenoid valve in the following way:
- during starting the solenoid remains closed, preventing the fuel vapours from enriching the mixture; this condition persists until the temperature of the coolant reaches 65° C;
- with the engine up to to temperature, the electronic control unit sends the solenoid a square-wave signal (duty cycle) which modules its opening.

In this way the control unit controls the quantity of fuel vapours sent to the inlet, preventing considerable variations in the mixture strength.

In the condition listed below, the operation of the solenoid valve is inhibitied, maintaining the same in the closed position; this improves engine operation:
- butterfly valve in closed position
- engine speed below 1500 rpm
- inlet manifold pressure below the limit calculated by the control unit depending on the number of revs,



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Management of the climate control system

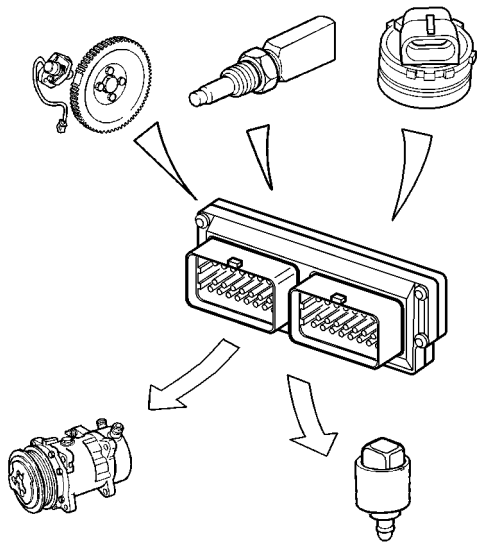
1242 8v

The injection/ignition control unit is connected to the climate control system in that:
- receives the request to switch on the compressor and operate the related interventions (additional air);
- it gives the go ahead to switch on the compressor, when the conditions covered by the stragegies have arisen;
- it receives information on the state of the four stage pressure switch and makes the appropriate interventions (radiator fan operation).

If the engine is idling, the control unit increases the flow rate of the air passing from the idle actuator before the compressor is switched on and, viceversa, it returns the actuator to the normal position after the compressor is switched off.

The control unit disengages the compressor:
- if the coolant temperature exceeds a certain threshold
- if the engine rpm is below 700 rpm.

The control unit temporarily controls the disengagement of the compressor (for a few seconds):
- during high power requests from the engine (strong acceleration)
- during engine pickup:



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recovery

Air temperature sensor

1242 8v

If the error is present during starting:
- it assumes a value of 50 °C
- self-adjustment of the mixture strength is inhibited.

If the error is present in other conditions:
- the last valid value is memorized and updated according to the engine temperature.

Knock sensor

1242 8v

If the sensor is faulty, the engine control unit implements more conservative ignition advance 'maps' to safeguard the engine.

Pressure sensor

1242 8v

If the failure is present during starting, it uses a value of 1024 mbar.
During operation the value used is calculated on the basis of parameters supplied by the butterfly valve position sensor and the rpm sensor.
Self-adjustment of the mixture strength is inhibited.

Butterfly valve position sensor

1242 8v

In the case of a fault, a value calculated from the absolute pressure sensor readings is set, and if this sensor is broken, a fixed value equal to a butterfly opening of 50 degrees is set.
The mixture strength and idle self-adjustment dash-pot strategies are suspended.

Vehicle speed sensor

1242 8v

The last vehicle speed value memorized is assumed.

Coolant temperature sensor

1242 8v

In the case of a fault, the control unit inhibits self-adjustment of the mixture strength and idle.
It sets the last temperature value measured; if this does not correspond to the working temperature, the control unit increases it gradually in accordance to the time since the engine was started until the theoretical 80°C is reached.
In addition when the ignition is switched on, the radiator cooling fan is switched on permanently at the second speed.

Engine idle speed actuator

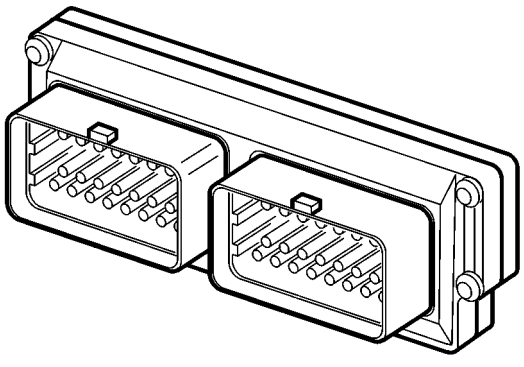
1242 8v

In the event of a fault, the operation of the actuator is disabled and self-adjustment of the idle mixture strength is stopped.

IAW 59F injection/ignition control unit

1242 8v

The control unit is fitted in the engine compatment on the inlet manifold air chamber, and can withstand high temperatures.
It is a digital type with a microprocessor, featuring a high calculation capacity, precision, reliability, versatility and low energy consumption and is maintenance-free.
The task of the electronic control unit is to process the signals coming from the various sensors through the application of software algorithms and control the operation of the actuators (in particular the injectors, ignition coils and idle actuator) in order to ensure optimum engine operation.
The adoption of the Fiat CODE does not allow control units to be exchanged between cars.



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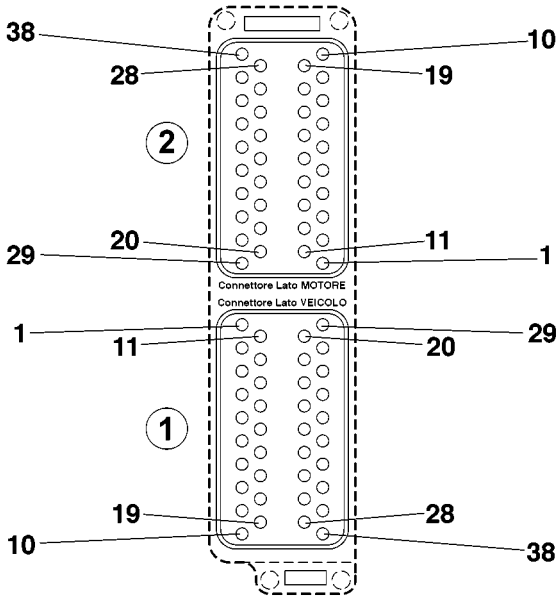
Pins

1242 8v

The diagram below shows the control unit pins



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(1) CONNECTOR FOR VEHICLE SIDE WIRING
1 Post-catalyzer Lambda sensor heater (-)
2 Not connected
3 Engine overheating warning light
4 Control unit supply (+30)
5 Not connected
6 Fuel injection main relay control
7 Code control unit connection
8 Radiator fan 1st speed relay control
9 Rev counter signal
10 Not connected
11 Pre-catalyzer Lambda sensor heater (-)
12 Air conditioner compressor relay control
13 EOBD warning light
14 Not connected
15 Not connected
16 Serial line K
17 Ignition-controlled supply (+15)
18 Radiator fan 2nd speed relay control
19 Not connected
20 Bidirection C.A.N. (HIGH) line
21 Post-catalyzer Lambda sensor signal (-)
22 Pre-catalyzer Lambda sensor signal (+)
23 Not connected
24 Speedometer signal
25 Not connected
26 Not connected
27 Air conditioner activation signal
28 Request from quadrinary for radiator fan 1st speed
29 Bidirectional C.A.N. (LOW) line
20 Not connected
31 Post-catalyzer Lambda sensor signal (+)
32 Pre-catalyzer Lambda sensor signal (-)
33 Fuel reserve signal
34 Lambda sensor shielding
35 Not connected
36 Not connected
37 Not connected
38 Request from quadrinary for radiator fan 2nd speed

(2) CONNECTOR FOR ENGINE SIDE WIRING (2)
1 Not connected
2 Not connected
3 Throttle valve position sensor
4 Not connected
5 Water temperature sensor
6 Knock sensor (+)
7 Not connected
8 Knock sensor shielding
9 Idle actuator control
10 Ignition coil control (cylinders 2-3)
11 Not connected
12 Not connected
13 Absolute pressure sensor
14 Air temperature sensor
15 Knock sensor (-)
16 Not connected
17 Idle actuator control
18 Idle actuator control
19 Idle actuator control
20 Earth for butterfly valve potentiometer and timing sensor
21 Not connected
22 +5V supply for absolute pressure and air temperature sensors
23 Minimum oil pressure switch
24 Timing sensor signal
25 Rpm and TDC sensor (+)
26 Canister solenoid control
27 Cylinder 4 injector control
28 Cylinder 2 injector control
29 Earth for water, absolute pressure and air temperature sensors
30 Not connected
31 Not connected
32 +5V supply for timing and butterfly position sensors
33 Not connected

34 Rpm and timing sensor shielding
35 Rpm and TDC sensor (-)
36 Cylinder 2 injector control
37 Cylinder 3 injector control
38 Ignition coil control (cylinders 1 - 4)

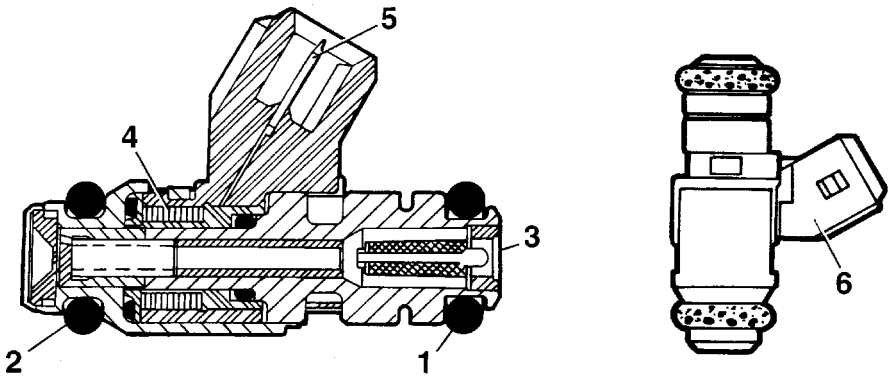
Fuel injectors

Specifications

1242 8v

The injectors are the (peak) miniature type with a supply of 12 V and an internal resistance of 13.8 - 15.2 ohm at 20°C.
The injectors are fixed by the manifold which presses them into their housings in the inlet manifold ducts, whilst two rubber seals (1) and (2) seal the inlet manifold and the fuel manifold.
The fuel is supplied from above (3) the injector, which contains the winding (4) connected to the terminals (5) of the electrical connector (6).

Note: *During removal-refitting, do not exert force on the fuel injector manifold as this could adversely affect its operation.*



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Operation

1242 8v

The fuel jet at the absolute pressure of 3.5 bar, by means of the returnless system, emerges from the injector and is instantly atomized.
The control logic for the injectors is the sequential, phased type, in other words the four injectors are operated according to the inlet sequences.

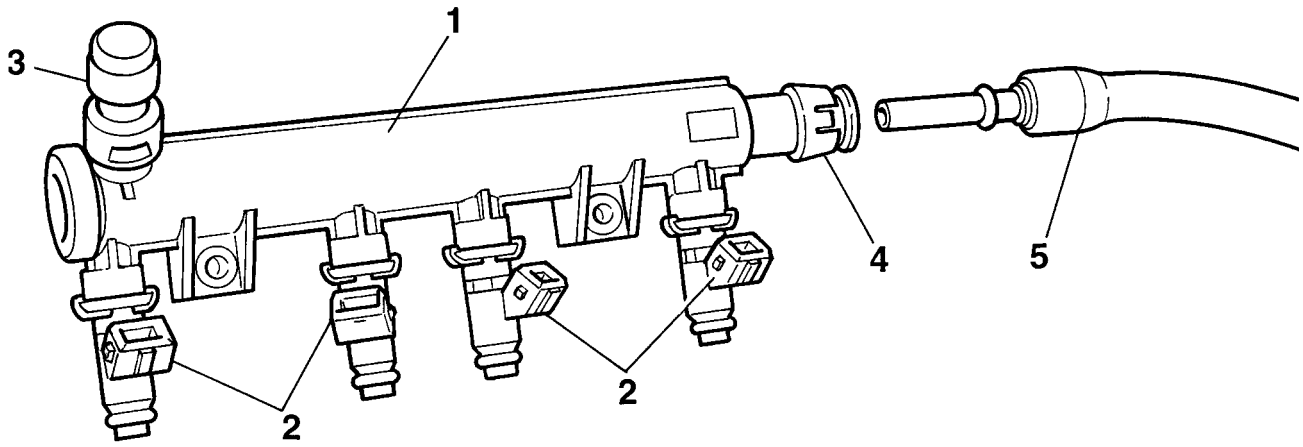
FUEL MANIFOLD

SPECIFICATIONS:

1242 8v

The fuel manifold is fixed to the inner part of the inlet manifold and its function is to send the fuel to the injectors.

On the fuel manifold, in addition to the fuel injector seats, there is a rapid attachment for connection with the fuel supply pipe and an attachment for checking the fuel supply pressure.



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1, Fuel manifold
2, Injector
3, Attachment for fuel drainage pressure
4, Rapid attachment
5, Fuel delivery pipe

ENGINE COOLANT temperature sensor

Specifications

1242 8v

This is mounted on the thermostatic cup, and it measures the coolant temperature by means of an NTC thermistor with a negative resistance coefficient.

Electrical characteristics

1242 8v

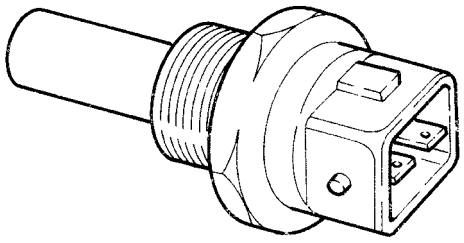
°C	Ω
-20	15971
-10	9620
0	5975
10	3816
20	2502
25	2044
30	1679
40	1152
50	807
60	576
70	418
80	309
90	231

°C	Ω
100	176

Operation

1242 8v

The reference voltage for the NTC element for the injection system is 5 Volt; as the input circuit into the control unit is designed as a voltage divider, this voltage is divided between a resistor located in the control unit and the sensor's NTC resistor.
The control unit is thus able to assess the changes in the sensor's resistance via the changes in voltage, and thus obtain the temperature information.



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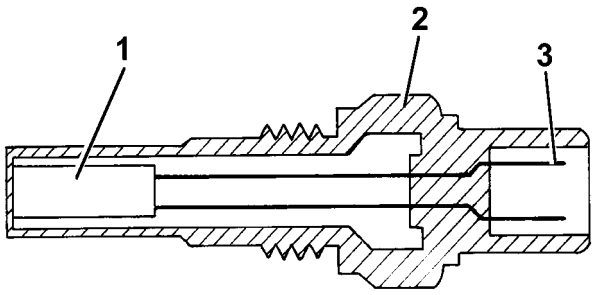
Components

1242 8v

The components which make up the sensor are:



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1, N.T.C. resistor
2, Sensor body
3, Electrical connector

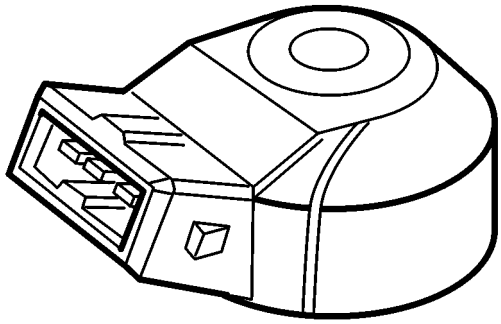
Knock sensor

Specifications

1242 8v

The piezoelectric type detonation sensor is fitted on the cylinder block/crankcase and detects the intensity of the vibrations caused by the detonation in the combustion chambers.
This phenomenon produces a mechanical repercussion on a piezoelectric crystal which sends a signal to the control unit; on the basis of this signal, the control unit reduces the ignition advance until the phenomenon (detonation) has disappeared.

The advance is then gradually restored to the optimum basic operating value.



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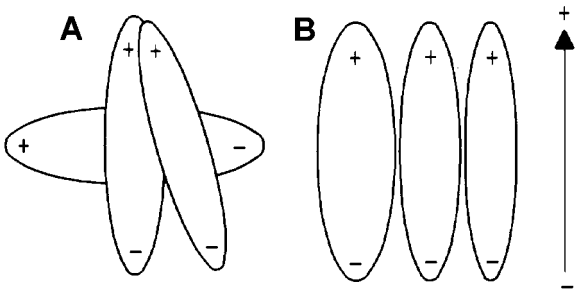
Operation

1242 8v

The molecules of a quartz crystal are electrically polarised.
In rest conditions (A) the molecules do not have a particular direction.
When the quartz crystal is subjected to pressure or an impact (B), they are directed - the higher the pressure to which the crystal is subjected, the more marked their direction.
This direction produces a voltage at the ends of the crystal.



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A, Rest position
B, Position under pressure

Electrical characteristics

1242 8v

resistance: 532-588 ohm at 20°C.

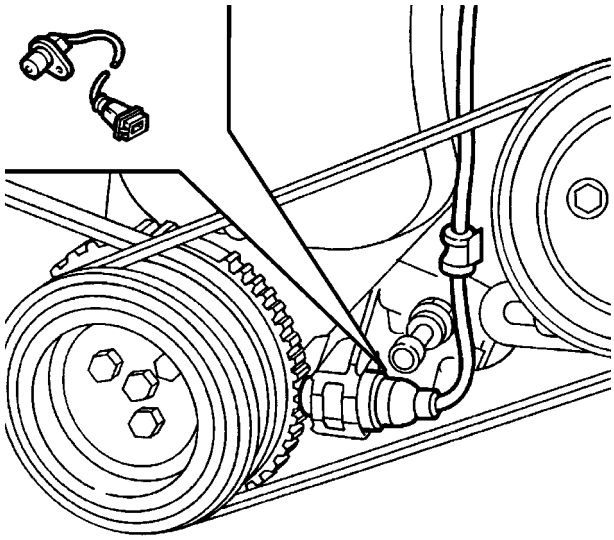
RPM sensor

Specifications

1242 8v

It is fitted on the cylinder block/crankcase and 'faces' the phonic wheel on the crankshaft pulley.
It is of the inductive type, i.e. it functions by means of the variation in the magnetic field generated by the passage of the flywheel teeth (60 - 2 teeth).

The fuel injection control unit uses the rpm sensor to:
- determine the crankshaft rotation speed
- determine the angle of the crankshaft.



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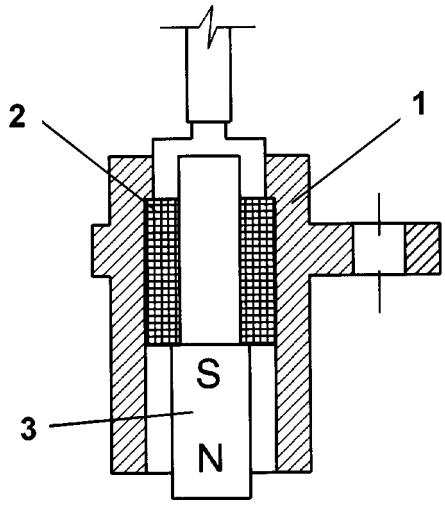
Components

1242 8v

The sensor consists of a tubular casing (1) which contains a permanent magnet (3) and an electrical winding (2).



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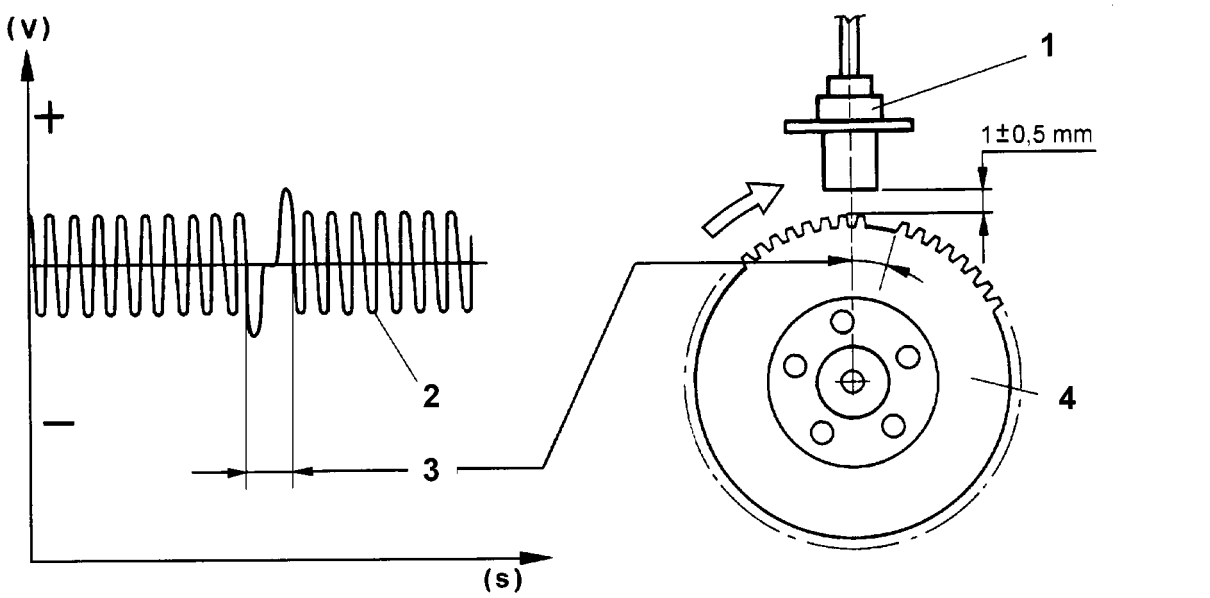
Operation

1242 8v

As the flywheel teeth go past, the magnetic flow produced by the magnet (3) undergoes fluctuations due to the change in the gap.
These fluctuations induce an electromotive force in the winding (2), at the ends of which there is a voltage which alternates between positive (tooth opposite sensor) and negative (gap opposite sensor).
The peak value of the output voltage from the sensor, provided other factors remain the same, depends on the distance between the sensor and tooth (gap).
The phonic wheel comprises sixty teeth, two of which have been removed to create a reference: the pitch of the wheel thus corresonds to an angle of 6° (360° divided by 60 teeth).

The synchronization point is recognized at the end of the first tooth after the space created by the two missing teeth: when this passes under the sensor, the pair of pistons 1-4 of the engine are at 114 degrees before TDC.



1, Sensor
2, Output signal
3, Signal corresponding to the two missing teeth
4, Crankshaft pulley with flywheel

Electrical specifications:

1242 8v

resistance: 1134-1386 ohm at 20°C.
The distance (gap) for obtaining correct signals, between the end of the sensor and the flywheel, should be between 0.5 and 1.5 mm.

Throttle body

Specifications

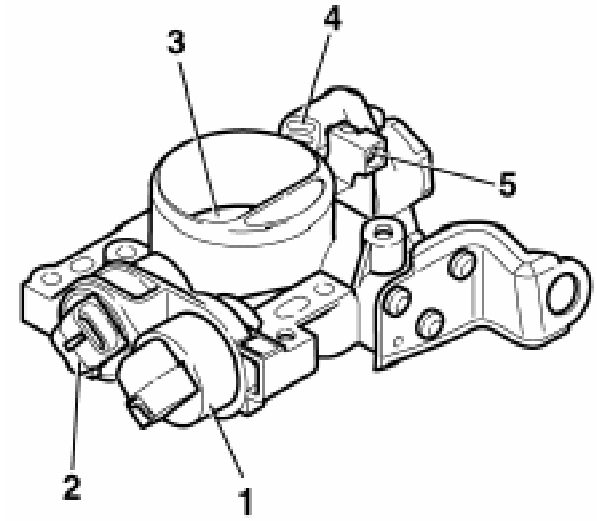
1242 8v

This has the task of metering the amount of air supplied to the engine (and consequently the power developed) according to the request from the driver via the accelerator.
The butterfly casing is fixed to the intake manifold; the butterfly is opened by means of a non linear linkage which, depending on the pedal travel, produces small butterfly opening angles in the first section of the accelerator pedal travel and, conversely, greater angles with the pedal very depressed.
With the pedal completely released (engine decelerating or idling) the additional air required is supplied by the engine idle speed actuator; under these circumstances, the throttle opening lever comes up against an anti-tamper screw which prevents the throttle from getting stuck in the closed position.
The butterfly valve position sensor and the engine idle speed actuator are also fitted on the butterfly casing.

COMPOSITION

1242 8v

The diagram below shows the main components of the throttle body.



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1, Engine idle speed actuator
2, Butterfly valve position sensor (cannot be separated)
3, Butterfly valve
4, Butterfly opening linkage
5, Butterfly valve end-of-travel or anti-tamper screw (not to be tampered with)

1242 8v

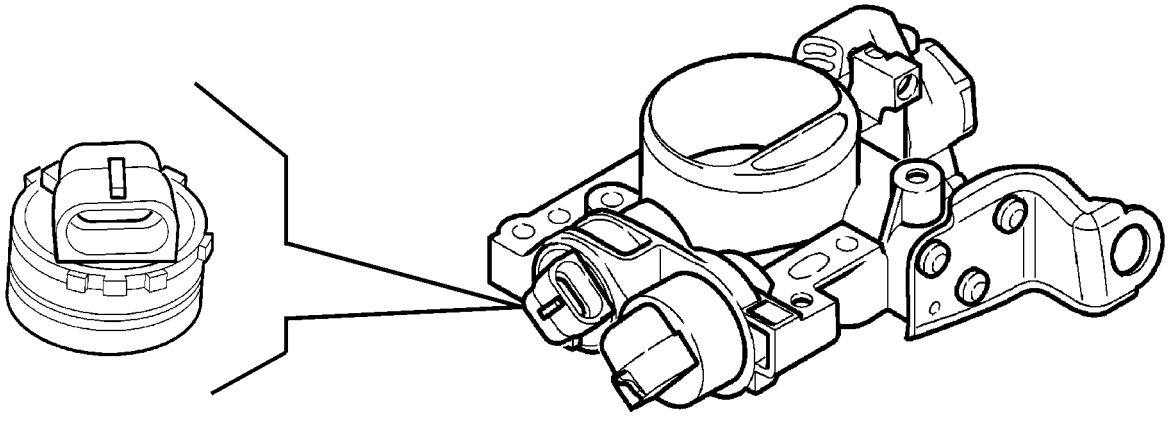
The end-of-travel stop (5) is set during through-flow at the factory and should never be tampered with.

butterfly valve position sensor

Specifications

1242 8v

This sensor consists of a potentiometer where the moving part is controlled by the butterfly valve shaft. The potentiometer is in a plastic container which is designed to guarantee the mounting and the correct positioning of the sensor in relation to the butterfly valve.



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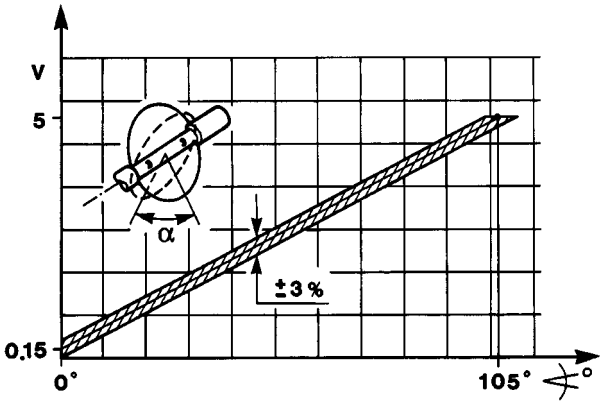
Components

1242 8v

Composition of the linear type potentiometer (single ramp):
- Total mechanical travel of the potentiometer: 110° ± 8°
- Operating range: 90° ± 2°
- Temperature operating range: -30°C - +125°C



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Operation

1242 8v

During operation, the control unit provides the potentiometer with a 5 Volt supply.
The parameter measured is the butterfly position from minimum to full opening for the management of the injection.
On the basis of the output voltage, the control unit recognizes the butterfly valve opening condition and suitably corrects the mixture strength.
With the butterfly closed, an electrical voltage signal is sent to the control unit which recognizes the idle and cut-off conditions (distinguishing between them on the basis of the engine speed).

Electrical specifications:

1242 8v

Fixed resistance (between pins A and B) = 1200 ohm
Variable resistance (between pins A and C) = 0 - 1200 ohm ± 20%.

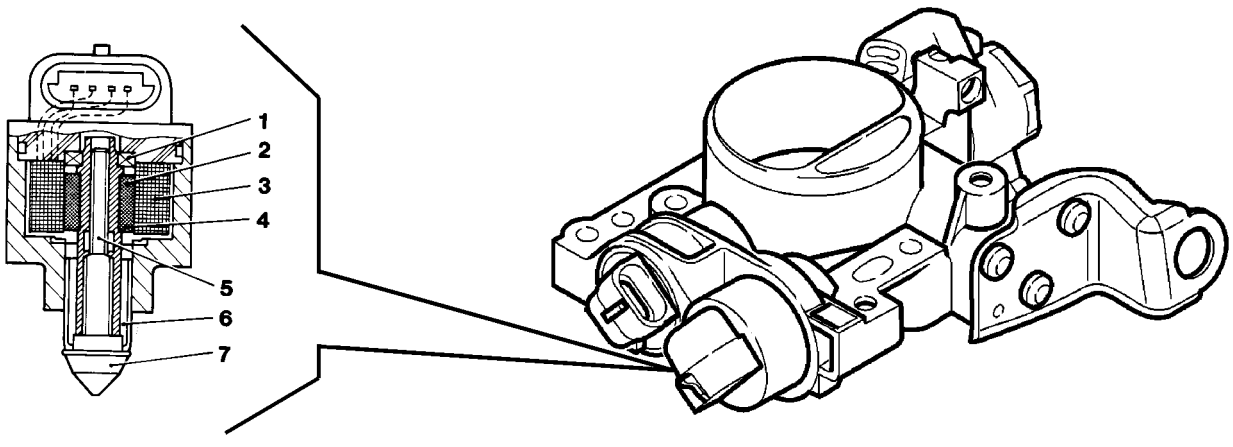
Note: *Note: The sensor cannot be replaced by itself; it forms a single unit with the butterfly casing.*

ENGINE IDLE SPEED ACTUATOR (STEPPING MOTOR)

composition

1242 8v

The actuator, fixed to the butterfly casing, consists of:
- An electrical stepper motor with two windings in the stator and a rotor composed of pairs of permanent magnet poles.
- A worm and nutscrew type reduction gear which converts rotary motion into rectilinear motion.



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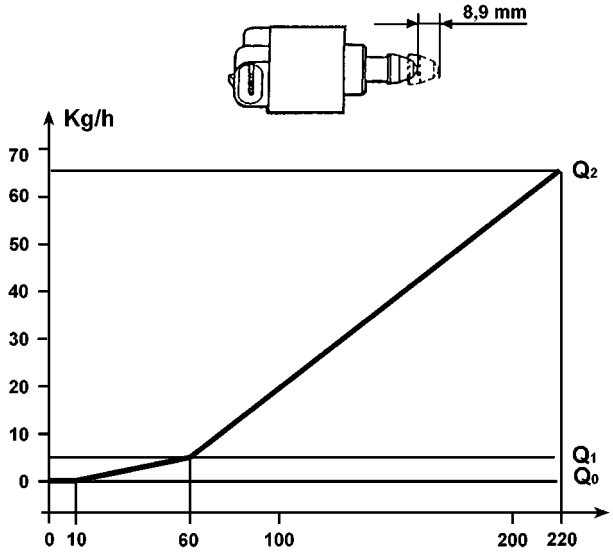
1, Bearing
2, Nutscrew
3, Coils
4, Magnet
5, Screw
6, Anti-rotation splining
7, Shutter

Specifications

1242 8v

The electrical stepper motor features a high degree of precision and rapid resolution (about 220 steps per second). The impulses sent by the electronic control unit to the engine are transformed from a rotary motion into a linear motion (about 0.04 mm/step) by means of a screw-nutscrew type mechanism; when the shutter is operated, the section of the bypass duct is varied (+ or -).
The constant value of the minimum air flow rate (Qo) is due to the leakage (fixed flow) fromr the butterfly valve which is regulated (end of travel) in production and guaranteed by an anti-tamper plug. The maximum flow rate (Q2) is guaranteed by the shutter in the fully retracted position (about 220 steps corresponding to 8.8 mm). The law shown in the graph below applies between these two air flow rate values:



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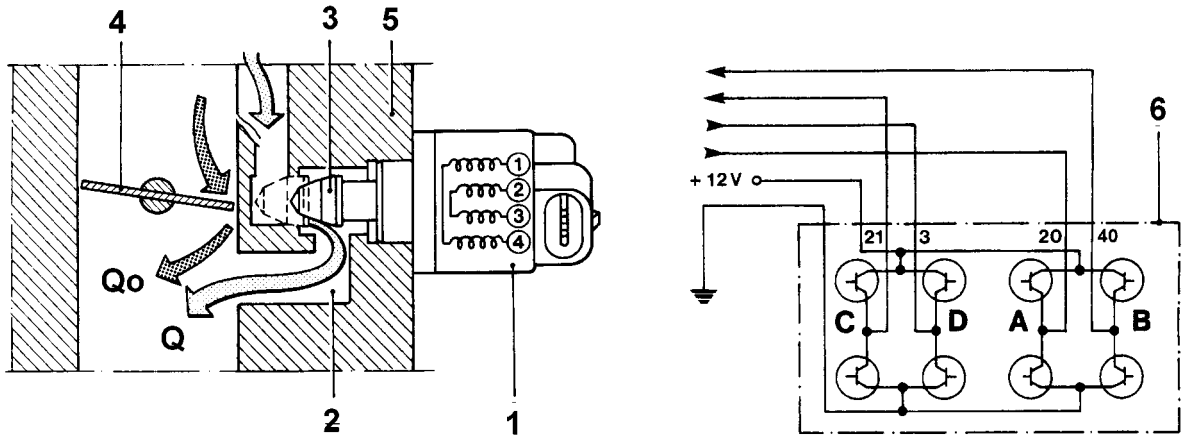
Operation

1242 8v

In order to idle, i.e. with the butterfly (4) completely closed, the engine requires a certain amount of air (Qo fixed flow) and fuel to overcome the internal friction and sustain its rotation speed.
To the amount of air (Qo) arriving from the filter, which during idling leaks through the butterfly valve (4) in the closed position,
should be added, during the engine warm-up stage or the switching on of electrical devices or external loads (air conditioner, etc.), a further quantity of air (Q) to allow the engine to maintain a constant rpm.
To achieve this result the system uses a stepping motor (1) operated by a circuit (6) inside the injection/ ignition electronic control unit which, when operating, moves a stem with a shutter (3) which alters the section of the by-pass duct (2) and, consequently, the quantity of air (Qo + Q) drawn in by the engine.

To adjust this type of action, the electronic unit uses the engine angular speed and coolant temperature parameters, coming from the respective sensors.



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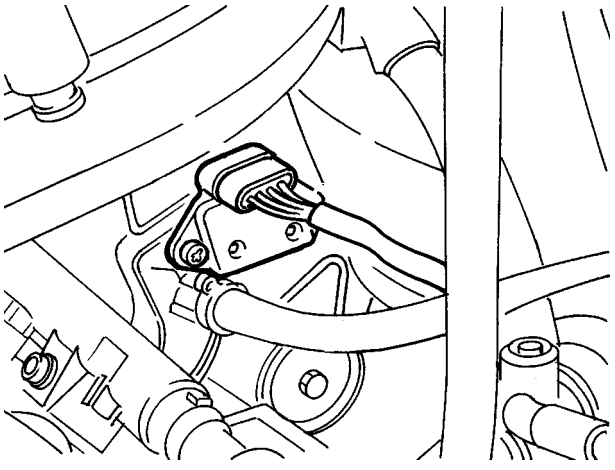
Q, quantity of air regulated by the actuator (variable flow)
Qo, quantity of air leaking through the butterfly (constant flow)

INTAKE AIR TEMPERATURE AND PRESSURE SENSOR

Specifications

1242 8v

The intake air temperature and pressure sensor is a component which is designed to measure the pressure and the temperature of the air inside the inlet manifold. Both pieces of information are used by the injection control unit to define the quantity of air drawn in by the engine; this information is then used to calculate the injection time and the point of ignition. The sensor is fitted on the inlet manifold.



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1242 8v

The air temperature sensor consists of an NTC thermistor (Negative Temperature Coefficient). - The resistance of the sensor decreases as the temperature increases. The control unit input circuit divides the 5 Volt reference voltage between the sensor resistance and a fixed reference value, obtaining a voltage which is proportional to the resistance and therefore to the temperature.
The sensitive element of the pressure sensor consists of a Wheatstone bridge on a cermamic diaphragm.

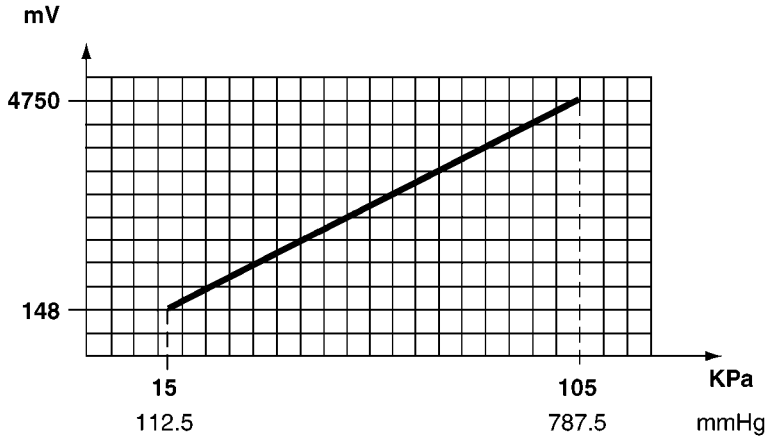
On one side of the diaphgram is the absolute reference vacuum, whilst the vacuum from the inlet manifold acts on the other side. The (piezoresistive) signal from the distortion suffered by the diaphgram, before being sent to the engine control unit, is amplified by an electronic circuit in the support which also houses the ceramic diaphragm. When the engine is off, the diaphragm bends in accordance with the atmospheric pressure; the altitude information is thus obtained.
When the engine is running, the effect of the intake pressure produces a mechanical action on the sensor diaphgram, which bends, altering the resistance value. Since the supply is kept rigorously constant (5V) by the control unit, altering the resistance alters the voltage output value.

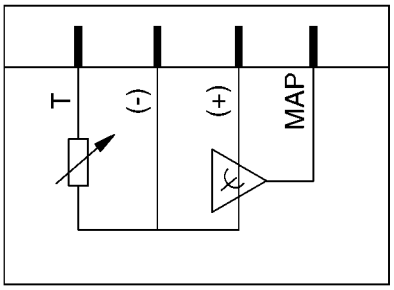
Electrical characteristics

1242 8v

The diagram below shows the electrical characteristics of the pressure and intake air temperature sensor.

T °C	Ω	± Ω %
-40*	49.933	13.6
-30	26.628	12.1
-20	15.701	10.8
-10	9.539	9.6
0	5.959	8.5
+10*	3.820	7.4
+20	2.509	6.5
+25	2.051	6.0
+30	1.686	6.0
+40	1.157	5.9
+50	0.810	5.8
+60	0.578	5.7
+70	0.419	5.6
+80	0.309	5.5
+85	0.263	5.5
+90	0.231	5.5
+100	0.176	5.4
+110	0.135	6.0
+120	0.105	6.5
+125	0.092	6.7
+130	0.083	7.0





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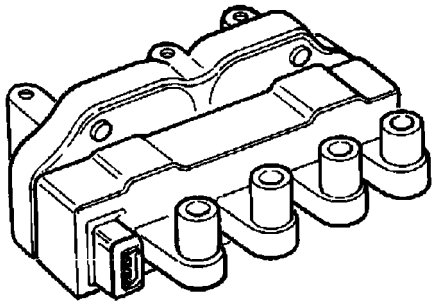
IGNITION COILS

COMPOSITION

1242 8v

The coils are fixed, by a bracket, to the camshaft covers and are the closed magnetic circuit type formed by a lamellar pack whose central core, made from silicon steel with a thin gap, contains both windings.



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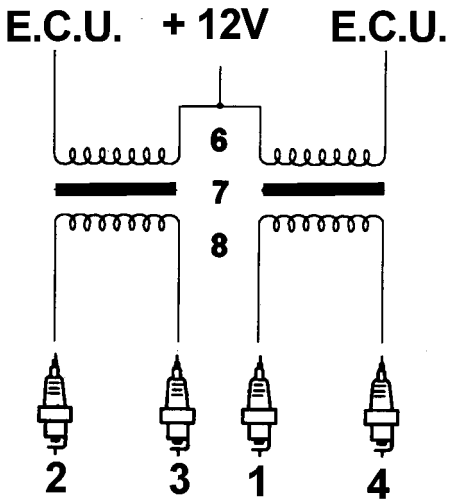
1242 8v

The windings are covered by a pressed plastic container and are insulated through immersion in an epoxy resin and quartz compound which gives them exceptional dielectric, mechanical and thermal properties enabling them to withstand high temperatures. The proximity of the primary winding to the magnetic core reduces the magnetic flow losses optimizing the coupling with the secondary winding.



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1, H.T. socket for spark plug for cylinder 1
2, H.T. socket for spark plug for cylinder 2
3, H.T. socket for spark plug for cylinder 3
4, H.T. socket for spark plug for cylinder 4
5, L.T. socket for control unit connection
6, Primary circuit
7, Gap
8, Secondary circuit

Electrical specifications:

1242 8v

Primary circuit resistance: 0.52-0.62 ohm at 23°C
Secondary circuit resistance: 0.52-0.62 ohm at 23°C

Vehicle speed sensor (SOGECO)

SPECIFICATIONS:

1242 8v

The sensor is located at the differential output, near the left drive shaft joint, and transmits the vehicle speed signal to the body computer; the body computer then makes this signal available on the CAN network.
The control unit obtains the vehicle speed information: the signal is also used for the operation of the speedometer.

The Hall effect sensor transmits 16 impulses/rev; according to the frequency of the impulses it is possible to ascertain the speed of the vehicle.

Note: *on versions with ABS, the vehicle speed signal is generated by the ABS control unit, and it transmits the information to the body computer which makes it available to the fuel injection control unit via the CAN network.*

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TIMING SENSOR

COMPOSITION

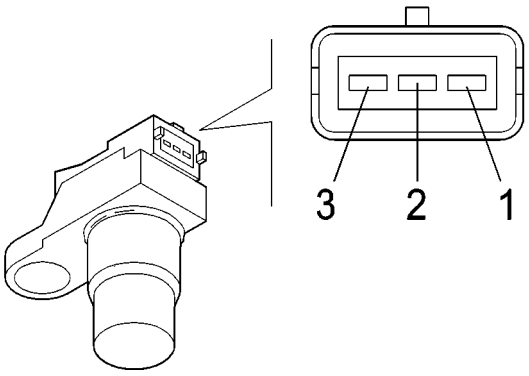
1242 8v

The sensor is of the Hall-effect type. A semiconducting layer, through which current passes, immersed in a perpendicular magnetic field, generates at its ends a difference in potential known as Hall voltage.

OPERATION

1242 8v

The force lines perpendicular to the current direction generate at the ends a different in potential (called Hall voltage).
If the integrity of the current remains constant, the voltage generated depends only on the intensity of the magnetic field; the intensity of the field simply has to vary perpendicularly to produce a modulated electrical signal, whose frequency is proportional to the speed with which it changes magnetic field.
To obtain this change, the distance between the sensor and the pulley on the camshaft varies, as it has three marks, one at 90° and two at 45°. In the rotation of the pulley, the distance varies and a low voltage signal is generated, corresponding to each mark.
Vice versa, where these three marks are not present, the sensor generates a higher voltage signal.
Consequently the high signal alternates with the low signal, six times for each engine cycle.
This signal, together with the rpm and TDC signal (on the crankshaft), allows the control unit to recognize the cylinders and determine the exact point of injection and ignition.



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1, Earth

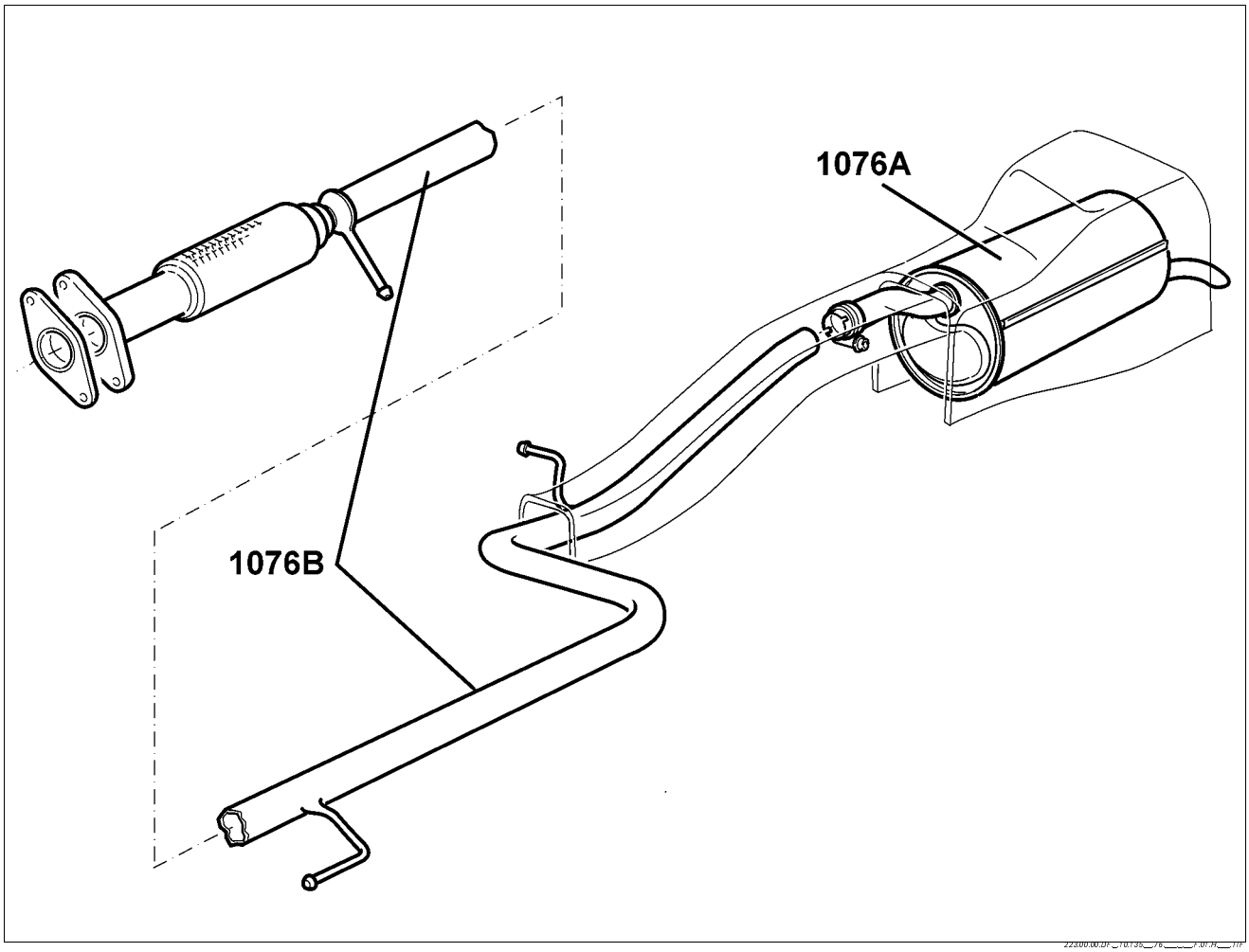
2, Output or signal
3, Supply voltage

Sub-group index

Assembly drawings index

Cmp	Description	Validity

SUB-GROUP GRAPHIC INDEX



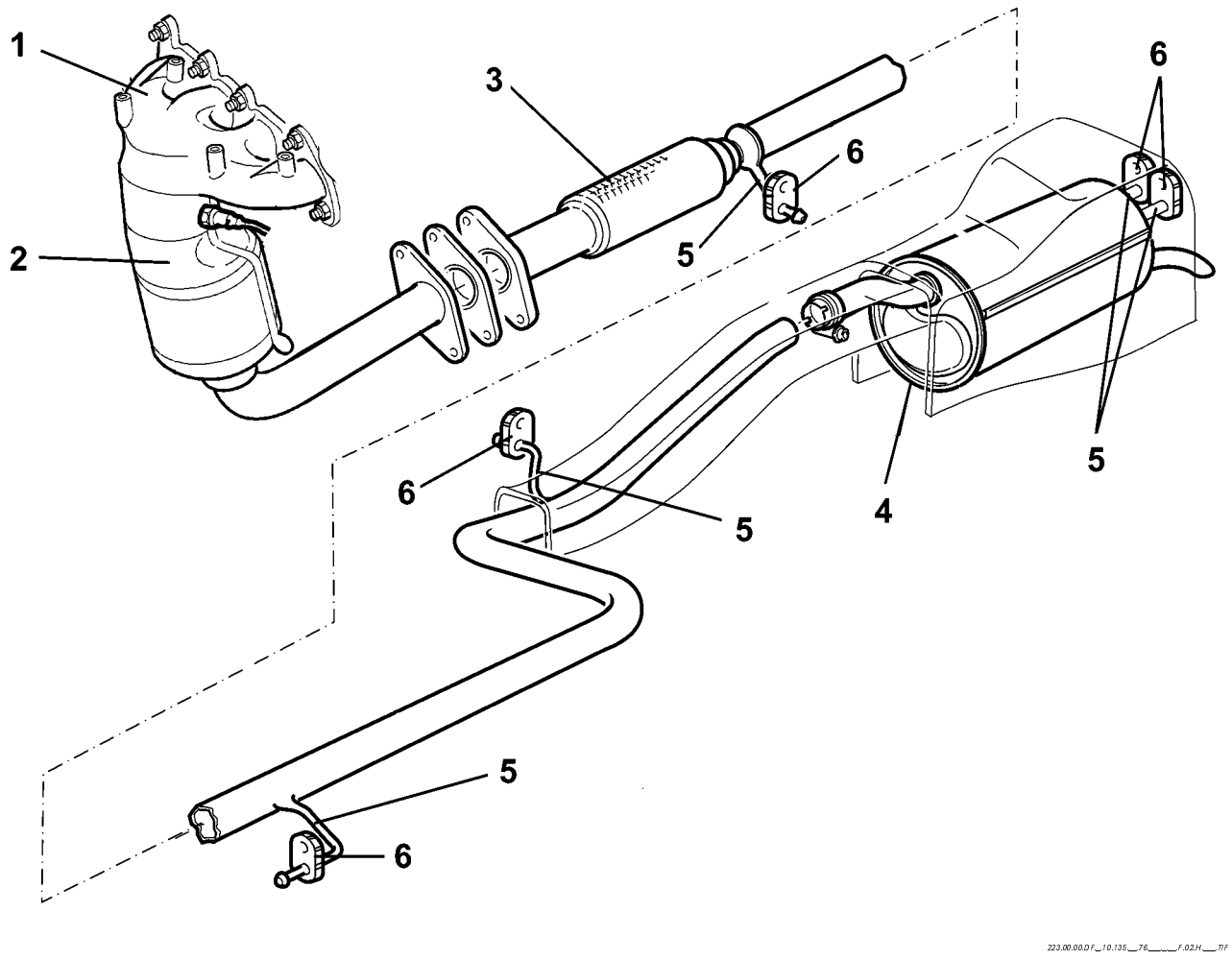
1242 8v

CONSTRUCTION FEATURES

1242 8v

The engine exhaust gases flow through manifold (1) to the three-way catalytic converter (2) (see 1080).
At the front of the exhaust pipe, there is a flexible component (3) for limiting the transmission of vibrations.
The rear exhaust section comprises a single silencer (4).
Special guards limit the radiation of heat towards the bodyshell.

The various components are supported by mountings (5) and rubber rings (6) secured to the underbody.



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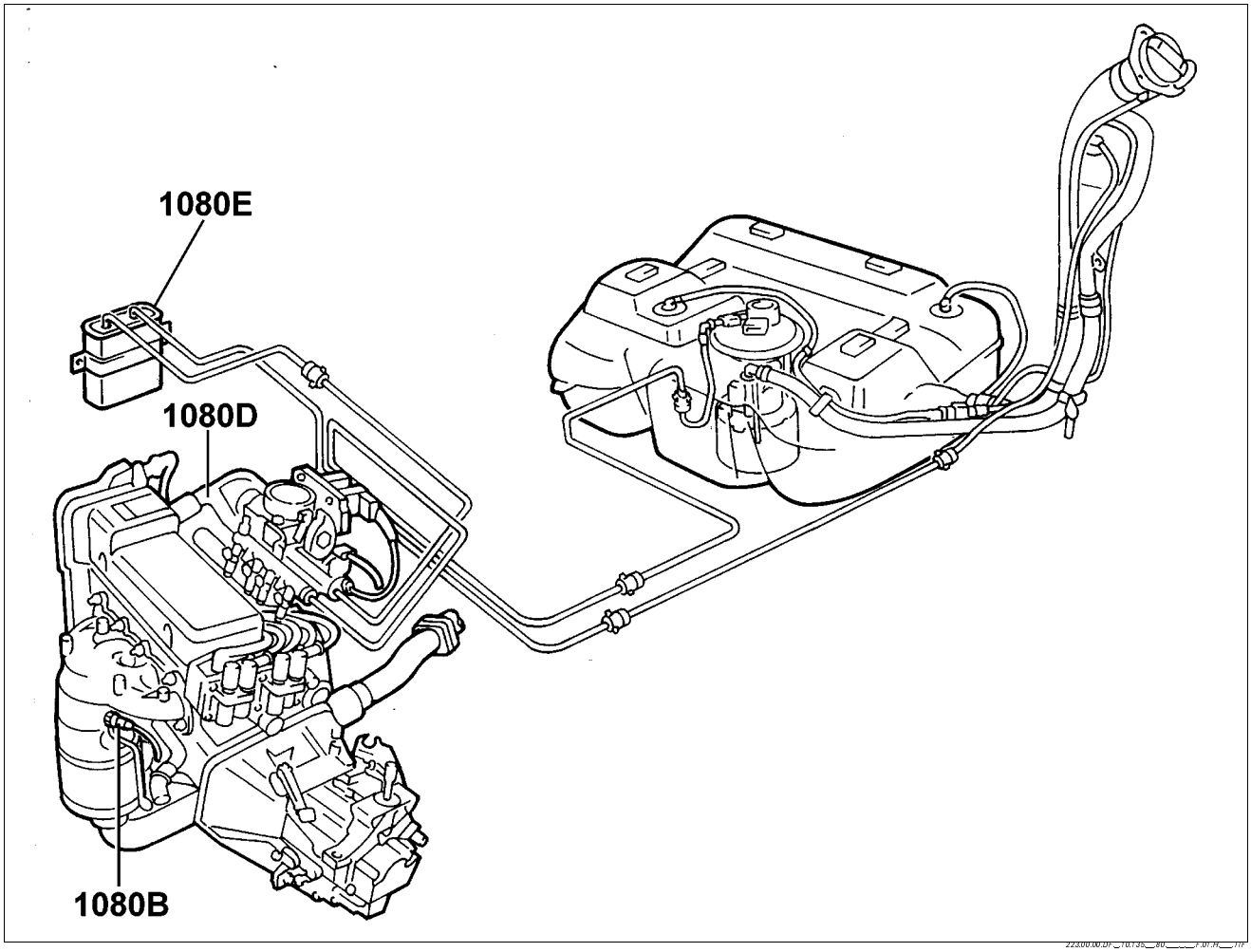
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Assembly drawings index

SUB-GROUP GRAPHIC INDEX



1242 8v

CONSTRUCTION FEATURES

1242 8v

The emission control system includes devices designed to keep down the level of harmful emissions in the atmosphere.

The main vehicle emissions are:
- exhaust emissions
- vapour/gas emission from the crankcase
- fuel vapour emissions from the fuel circuit

1242 8v

1080B - Exhaust emission control system

1242 8v

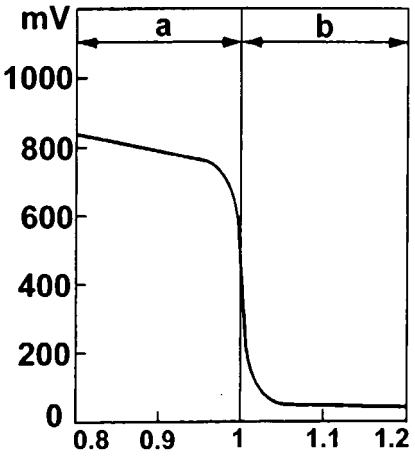
CONSTRUCTION FEATURES

LAMBDA PROBES

1242 8v

The lambda probes are planar type. One is fitted immediately after the exhaust manifold but before the catalytic converter ('PRE'), while the second is fitted immediately after the catalytic converter ('POST').
Both lambda probes supply the engine control unit with information on combustion progress; the pre catalytic converter probe analyses the stochiometric ratio while the post catalytic converter probe monitors catalytic converter operation and reports back to the engine control unit, which fine-tunes the stoichiometric ratio.
To obtain an optimum mixture, the quantity of air drawn in by the engine is the same as the theoretical quantity that would be needed to burn all the injected fuel.
Lambda factor (λ) is therefore the ratio between the amount of air taken in and the theoretical amount of air and the ideal value is 1.

Thus:
- λ = 1 ideal mixture
- λ <1 lean mixture
- λ >1 rich mixture



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A, Rich mixture (lack of air)
B, Lean mixture (too much air)

CATAYTLIC CONVERTER

1242 8v

The catalytic converter is used to reduce emissions of the three main pollutants:
- HYDROCARBONS = HC
- NITROGEN OXIDES = NoX
- CARBON MONOXIDE = CO

Briefly, the catalytic converter consists of a metal mount coated in a substrate. This in turn contains chemically active material that triggers and facilitates two chemical reactions , i.e. oxidation to reduce CO and HC and reduction to reduce NoX.
The active elements are generally made out of noble materials. RHODIUM and PALLADIUM are used for the reduction reactions, while PLATINUM is used for oxidation.
The substrate also contains other chemical compounts that serve the fundamental purpose of storing and releasing oxygen required to carry out chemical reactions.
This feature of catalytic converters is known as OXYGEN STORAGE.

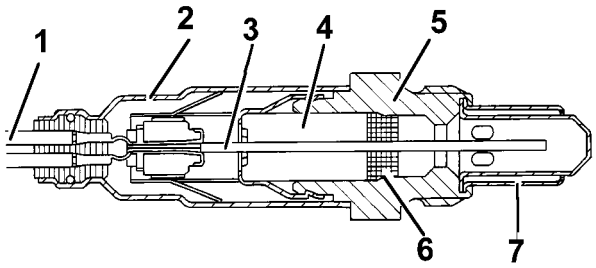
1242 8v

OPERATION

LAMBDA PROBES

1242 8v

When brought into contact with exhaust gases, the Lambda probe generates an electrical signal whose voltage depends on the concentration of oxygen present in the gases.
Even though the lambda probes are the same, they work under different gas conditions and send the engine control unit a different signal; the signal from the pre catalytic converter probe is computed to correct the mixture concentration by the amount by which it deviates from λ.
Simultaneously, the post catalytic converter probe assesses the amount by which the catalytic converter reduces exhaust gas levels and lets the control unit know whether these gases are + or - polluting. The control unit uses this parameter to optimise the lambda value = 1.
To prevent the ceramic case experiencing thermal shock due to condensation formation when the engine is cold, the engine control unit heats the pre and post catalytic converter lambda probes to bring their temperature λ to that of the exhaust gases.
The heater and measuring chamber are built into the 'planar' (laminated) ceramic element to promote fast chamber heating and thus allow a closed loop check within a short time of engine start-up.



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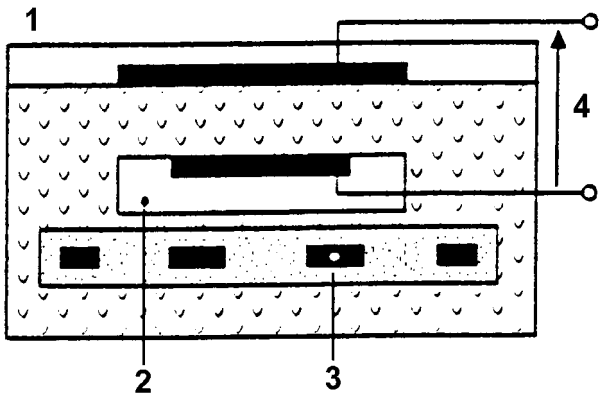
1, Connecting element
2, Protective sleeve
3, Planar sensor element
4, Ceramic tube casing
5, Probe seating
6, Ceramic seal
7, Protective tube

1242 8v

Lambda sensor operation is based on the principle of an oxygen concentration chamber with solid electrolyte. The surfaces of the measuring chamber are coated with microporous layers of noble material.



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1, Exhaust gases
2, Passage of reference air
3, Heater
4, Reference voltage

1242 8v

Electical properties
- Heater power supply. 12V
- Heater coil 0.5 - 1 kΩ

CATALYTIC CONVERTER

1242 8v

The substrate of the new oxygen store catalytic converter contains chemical compounds that store and release the oxygen required for chemical reactions.
Oxygen storage takes place when the mixture is lean. The oxygen required for oxidation is released when the mixture is rich.
This function is typical of oxygen store catalytic converters.
An old or deteriorated catalytic converter carries out chemical reactions less efficiently and the polluting emissins rise accordingly. With a new catalytic converter, the OXYGEN STORE is reduced as appropriate and the post catalytic converter probe supplies a virtually constant output voltage to ensure the catalytic converter uses all the oxygen for its chemical reactions.
As the catalytic converter ages, the OXYGEN STORAGE effect drops gradually and the post catalytic converter probe uses less and less oxygen. Output voltage continues to increase but the frequency is the same as that of the post catalytic converter probe.

1242 8v

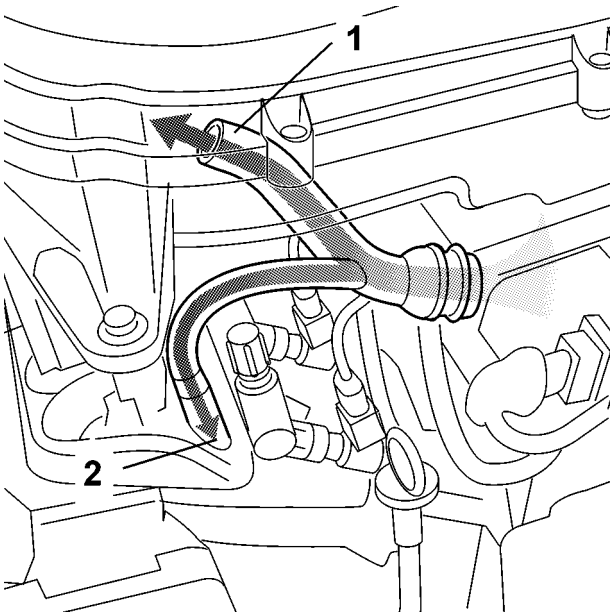
1080D - Crankcase vapour/gas recirculation system

1242 8v

CONSTRUCTION FEATURES

1242 8v

The evaporation emission control system prevents fuel vapours emerging into the atmosphere from the tank. Fuel vapours from the tank are conveyed through this system into an active carbon container, where they are absorbed.
When the engine is running, a controlled intake of environmental air regenerates the active carbon. Fuel vapours are thus extracted and directed to the engine as a result of a command from the engine control unit. The system controls crankcase emissions of vent gases consisting of mixtures of air, fuel vapours and burnt gases that leak through the piston rings and also lubricant oil vapours by redirecting them back to the engine so they can be burnt.



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1242 8v

OPERATTION

1242 8v

Blowby gases from the crankcase rise to the cylinder head and are conveyed to two different intakes:
- with medium-high accelerator throttle openings, the gases are taken in through the port immediately downstream from the air cleaner (1).
- with small throttle openings (particularly when the engine is idling or in over-run), gases are taken in downstream of the throttle (2).

1242 8v

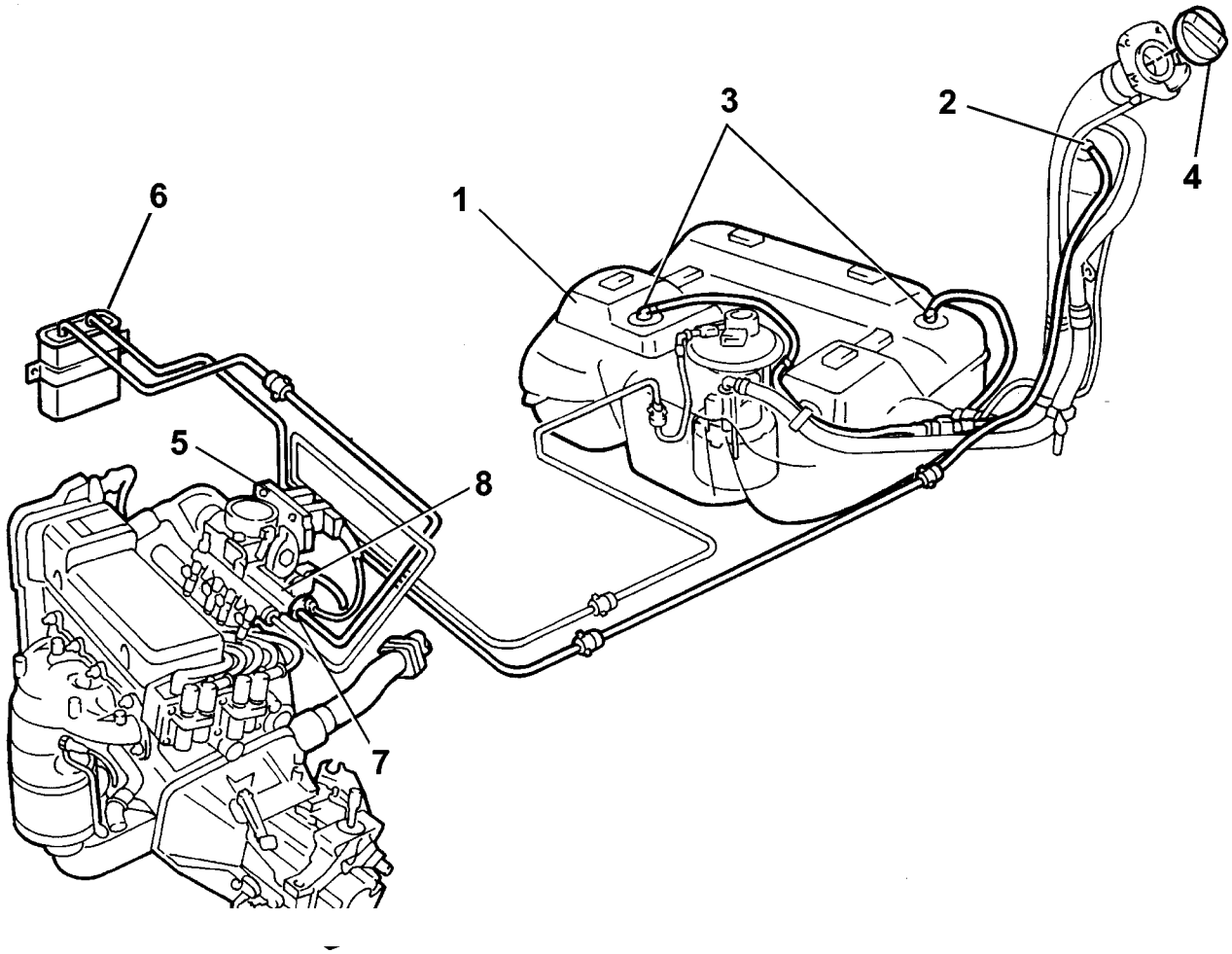
1080E - Evaporation control system

1242 8v

COMPOSITION

1242 8v

The evaporation control system consists of:
- fuel tank
- vapour separators,
- two float valves,
- a two-way ventilation valve inside the fuel tank filler cap,
- an active carbon filter with a filter flushing solenoid controlled by the IAW 59F engine control unit



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1, Fuel tank
2, Vapour separator with multifunction valve
3, Float valve
4, Plug with pressure relief valve
5, Engine control unit
6, Active carbon filter
7, Carbon filter flushing solenoid
8, Intake manifold

1242 8v

OPERATTION

1242 8v

The vapours coming from the tank through the two float valves (3) are sent to the separator (2).
The vapours condensed in the separator (2) fall back into the fuel tank.
Uncondensed vapours are sent through a multi-purpose valve in the separator (2) and the pipe to the canister (6), where they are absorbed and stored by the activated charcoal in the filter.
Vapours are conveyed to the engine intake duct through solenoid (7) controlled by the engine control unit.

FLOAT VALVE

1242 8v

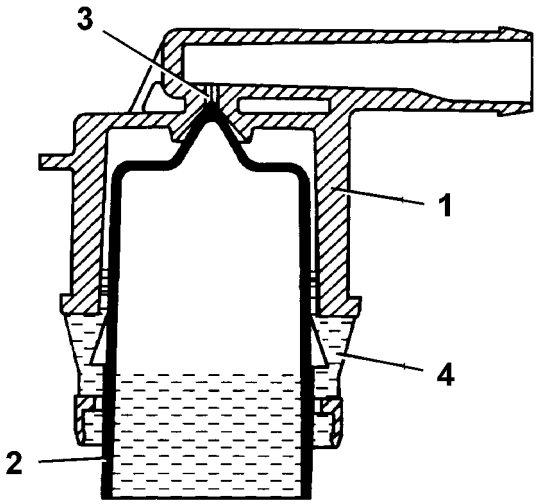
This type of valve is used for carrying out the following functions:
- prevent liquid fuel emerging from the tank in the case of roll-over,
- allow fuel vapours from the tank to be vented to the separator and activated charcoal filter;
- allow tank ventilation if there is a vacuum inside.

The float valve consists of a body (1) and a float/needle valve (2).
Valve operation may be summarised as follows; depending on the level to which the fuel tank is filled.

MAXIMUM TANK LEVEL

1242 8v

If the tank is full, float (2) blocks port (3) preventing the liquid fuel from reaching the separator.



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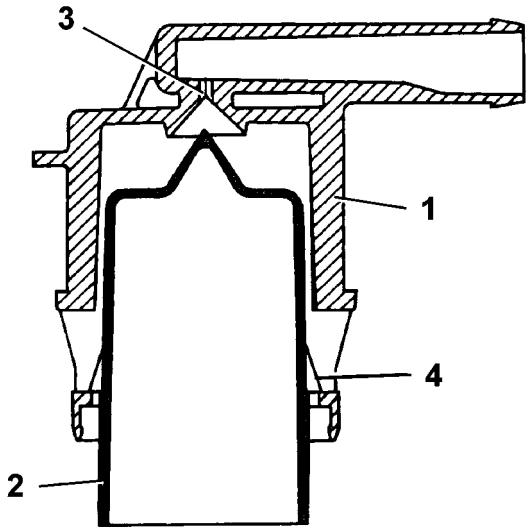
INTERMEDIATE TANK LEVEL

1242 8v

If the level of the fuel in the tank decreases, the float (2) descends and rests via its side tabs (4) on the slits in the valve body (1) to open the port (3). The gas reaches the port through the ring section between the float (2) and the inner seat of valve body (1).
This allows the fuel vapours to escape from the tank and reach the separator.
The tank can be ventilated through the same circuit when the pressure inside is less than the pressure outside.



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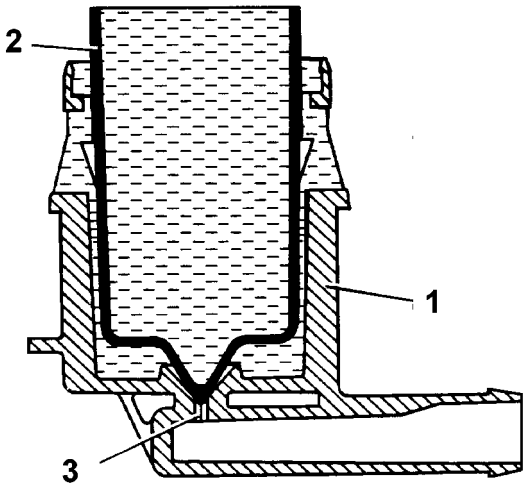
SEAL IN THE EVENT OF ROLL-OVER

1242 8v

if the vehicle rolls over, however full the tank is, float (2) presses down on hole (3) under its own weight and that of the fuel to prevent a dangerous outflow of fuel to the active carbon filter and the consequent risk of the vehicle catching fire.



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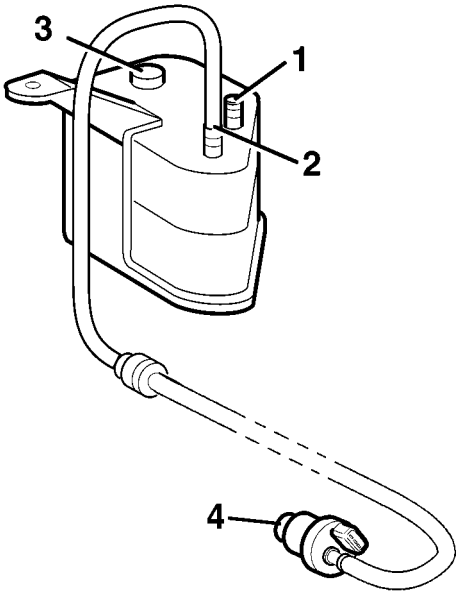
FUEL VAPOUR FILTER (CANISTER)

1242 8v

Fitted in the front right wheelarch, this consists of an activated-charcoal filter element which absorbs the fuel vapours coming from the separator.
A one-way valve (3) allows the entry of external (scavenging) air which comes into contact with the carbon granules, removing the petrol vapours and directing them through the outlet (1) to the inlet manifold when the fuel vapour solenoid valve is opened by the engine control unit.



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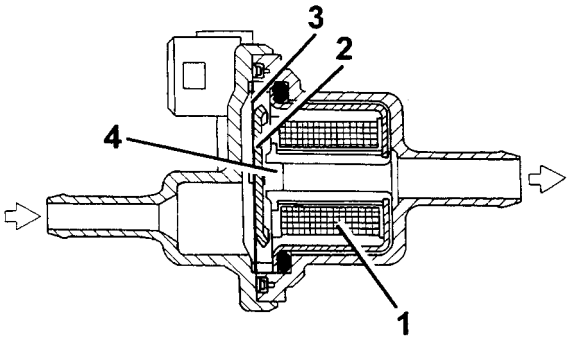
1, From the multifunction valve
2, To the inlet manifold
3, One-way scrubbing valve
4, Fuel vapour solenoid valve

ACTIVE CARBON FILTER SCAVENGING SOLENOID

1242 8v

This is fitted directly to the inlet manifold, and is controlled by the fuel engine control unit.
The function of the solenoid is to allow fuel vapours stored in the engine intake canister through to the engine intake.
If there is no supply the solenoid valve is closed to prevent the fuel vapours from reaching the intake manifold.



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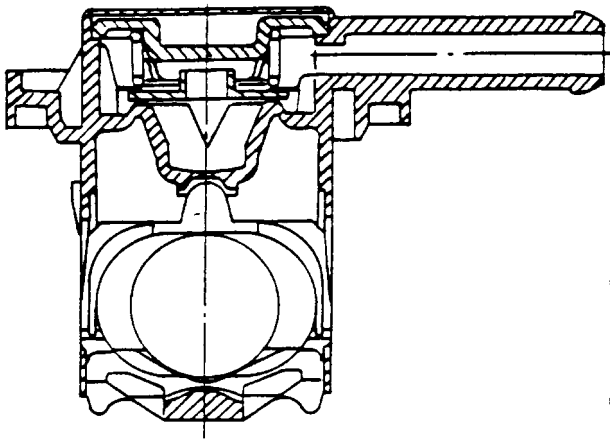
1242 8v

When the engine control unit controls the fuel vapour solenoid, solenoid (1) is excited and attracts plunger (2), which overcomes the load of laminar spring (2) to bring the canister into communication with the engine intake manifold.

MULTI-PURPOSE VALVE

1242 8v

The multi-purpose valve has the following functions:
- to prevent excess pressure in the tank
- to prevent a vacuum in the tank
- to prevent fuel emerging in the case of roll-over



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TANK OVER-PRESSURE

1242 8v

The tank is maintained at a pressure of 30-45 mbar by means of a fluorosilicone rubber valve, which rests on a sealing edge.
The valve is supported by a stainless steel plate and counteracted by a spring.
When the pressure in the tank exceeds the specified value, it overcomes the resistance of the spring and the valve is able to rise, allowing vapours to flow out to the canister. The valve closes again when the pressure falls back to within tank pressurisation limits.

TANK VACUUM

1242 8v

Under particular driving conditions, a vacuum could be created in the tank because of:
- temperature changes
- fuel consumption.

Under the above conditions, the valve makes up pressure in the fuel tank by adding extra air.
A fault in this function could cause the engine to miss or stall, because of difficulties in supplying the fuel pump.
This function is carried out by the 'goose beak' valve formed directly out of the fluorosilicone rubber.

SEAL IN THE EVENT OF ROLL-OVER

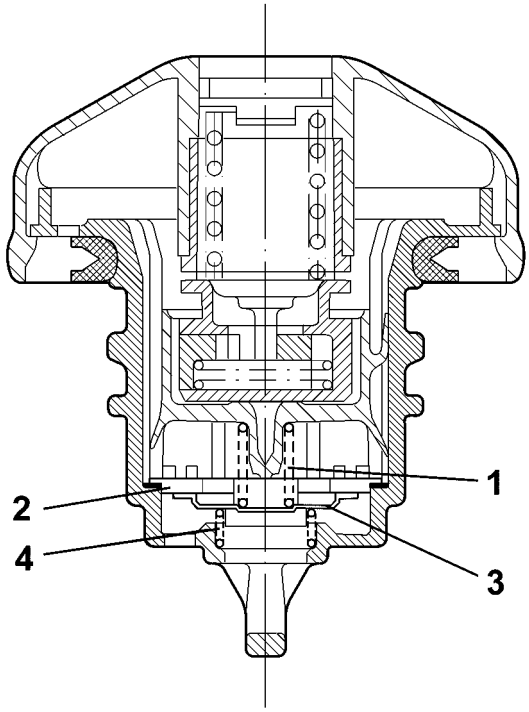
1242 8v

If the vehicle should roll over or tilt to a great extent, the multifunction valve acts to contain the emergence of fuel from the tank.
During normal driving of the vehicle (bends, acceleration, braking, etc.), the fuel slops around and may spill into the canister. The high sensitivity of the multifunction valve prevents such spillages.
Valve closure angle is about 33°.

SAFETY AND VENTILATION VALVE

1242 8v

This valve is built into the fuel filler cap. Its operation is dependent upon pressure in the fuel tank and is as follows:
- (safety function) discharges excessive pressure which forms inside the tank; the pressure acts on the plate (2) and, overcoming the load of the spring (1), allows excess vapours to be discharged outside (ventilation function).
- It allows external air to flow into the tank when an excessive vacuum is created in the tank, following the consumption of fuel. In this case the vacuum overcomes the load of spring (4) to move valve (3) and allow air to be taken into the fuel tank.



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Cmp	Description	Validity

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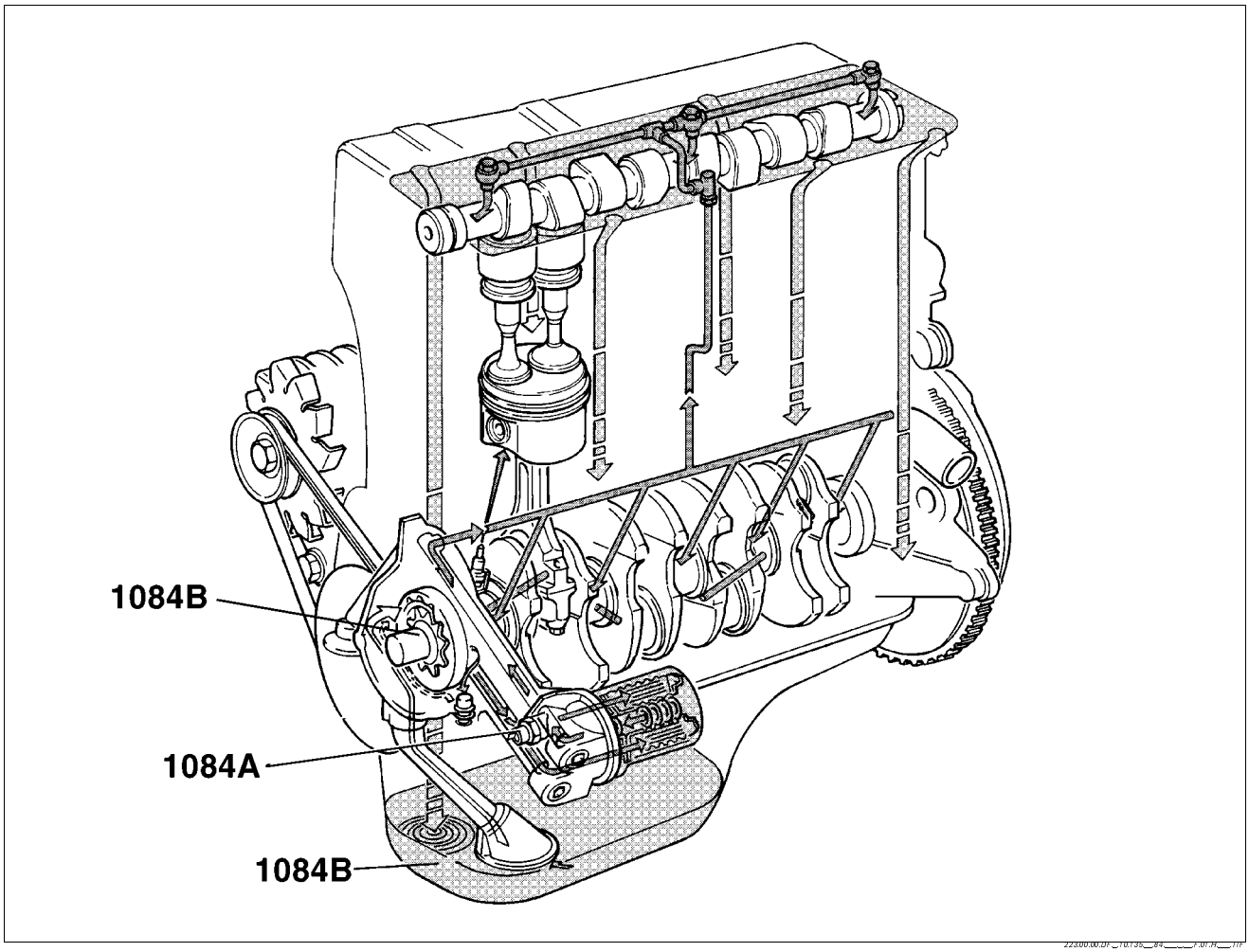


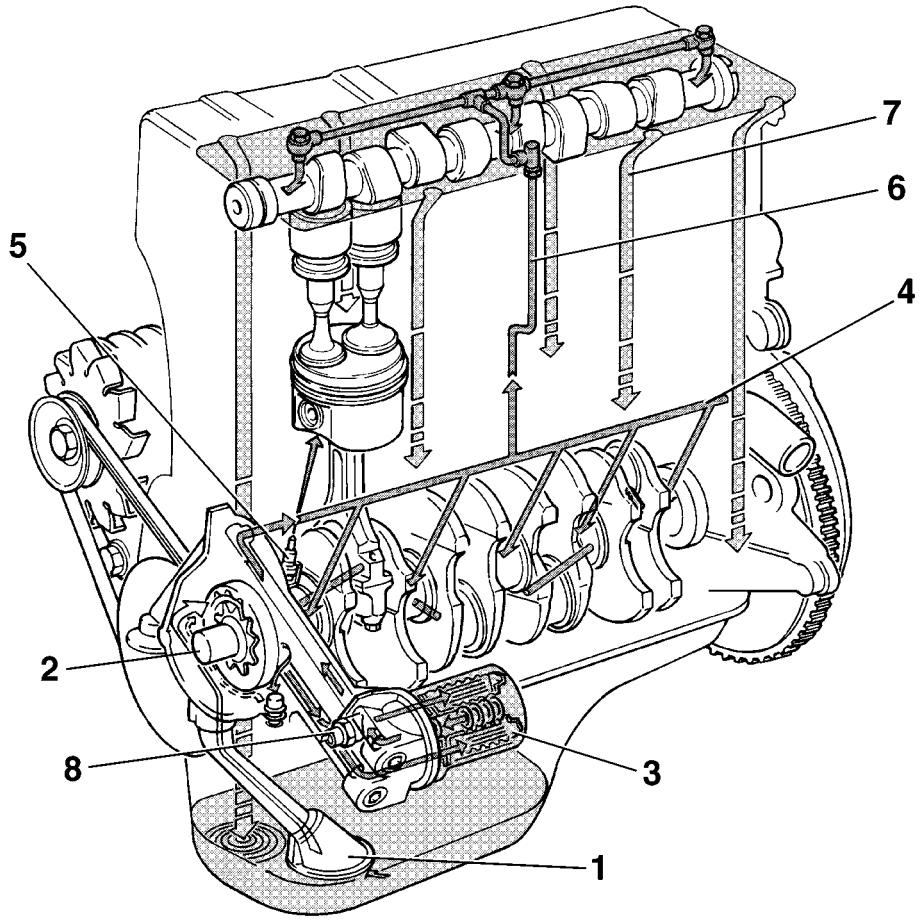
1242 8v

CONSTRUCTION FEATURES

Engine oil supply circuit

1242 8v

The engine oil supply circuit is shown in the following figure.



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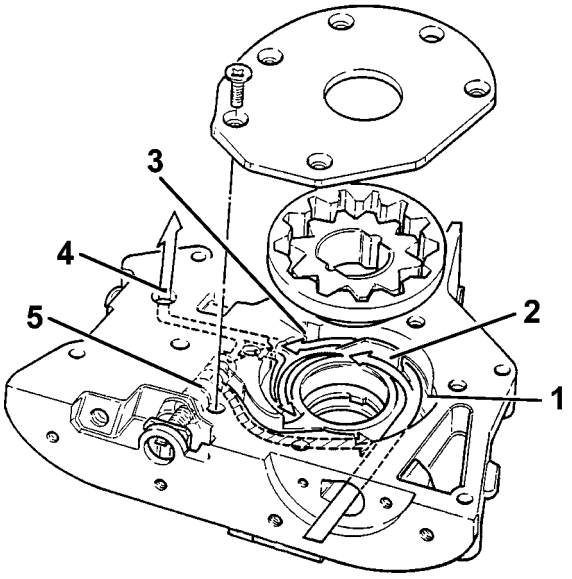
1, Suction pipe with filter mesh
2, Oil pump
3, Oil filter cartridge
4, Main longitudinal duct
5, Jets (piston skirt cooling)
6, Vertical duct (camshaft support lubrication)
7, Oil return to the sump
8, Switch for engine oil pressure warning light

Engine oil pump

1242 8v

The engine oil is drawn in from the sump by means of the vacuum built up by the rotation of the gears fitted on the crankshaft.
Vacuum is present between the gear partition (2) and the oil sump suction pipe.
Pressure instead develops after the separating wall (2) in all the oil delivery pipes (4).
When the pressure exceeds 5 bar, the force exerted on the limiting valve (5) overcomes the reaction of the spring below and moves the valve to open the connecting pipe between the pressure chamber (3) and the low pressure chamber (1).



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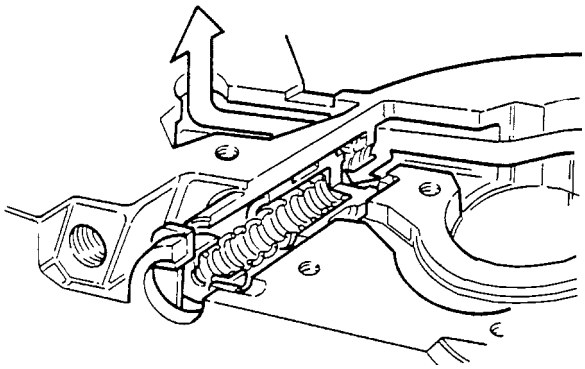
1, Low pressure chamber
2, Separating wall
3, Pressure chamber
4, Oil delivery pipe
5, Pressure limiting valve

Closed operating position of oil pressure limiting valve.

1242 8v

The figure shows the valve in closed position.



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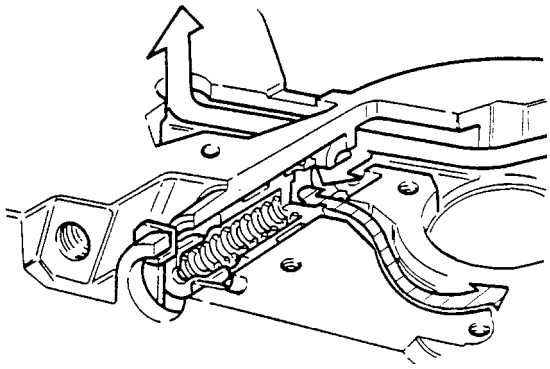
Bypass operating position of limiting valve.

1242 8v

The figure shows the valve in open position.



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- COMPOSITION
- OPERATION

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1088C	Water pump and thermostat	1242 8v
1088E	Coolant temperature control devices	1242 8v

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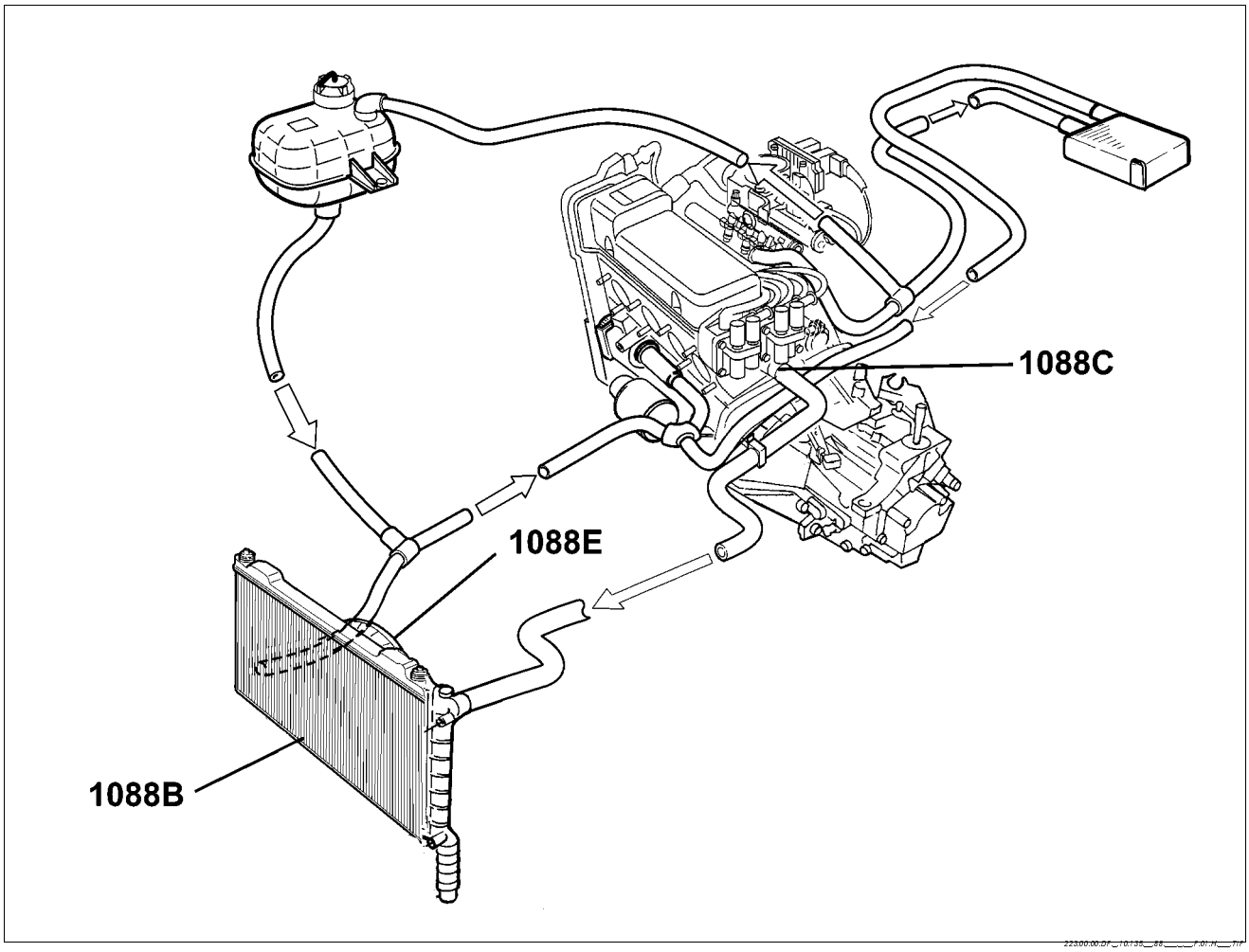
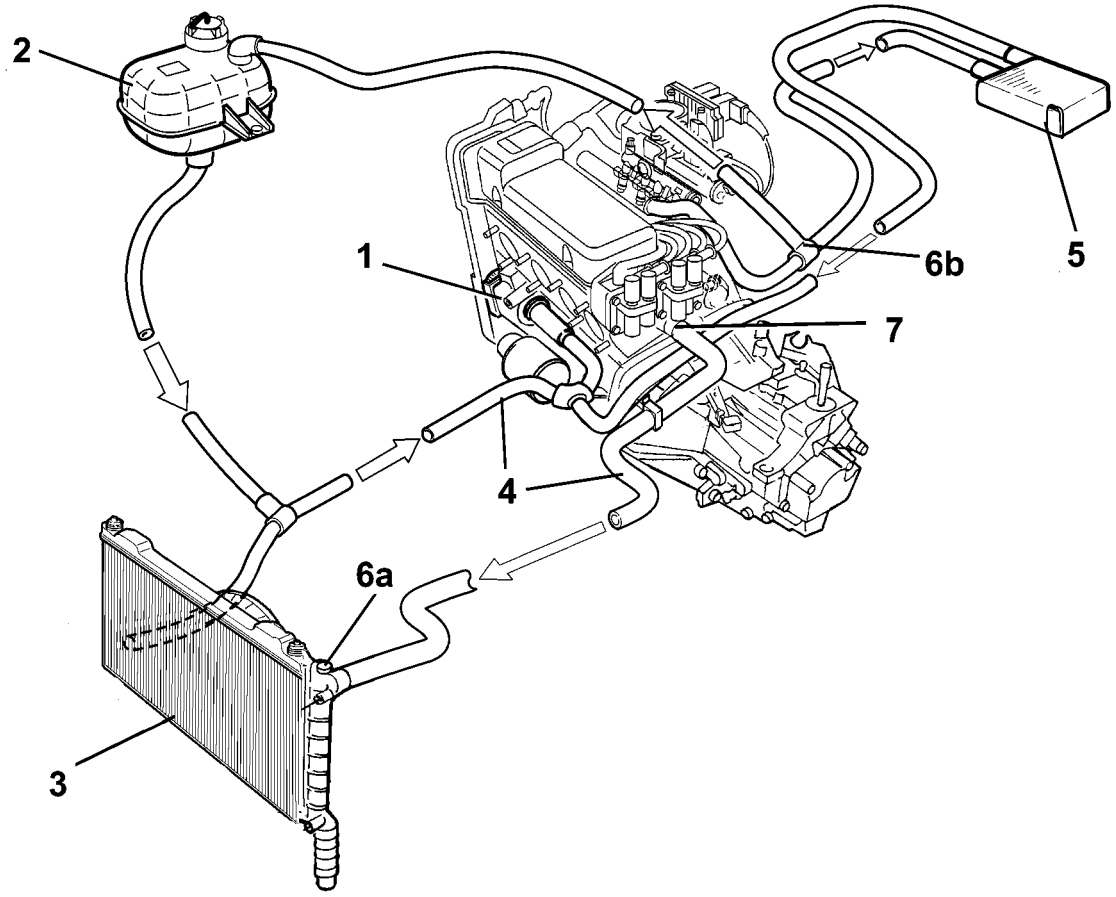


1242 8v

COMPOSITION

1242 8v

The engine cooling circuit consists of:
- pump (1)
- expansion tank with cap incorporating 1.4 bar vent valve (2)
- cooling radiator (3)
- hoses (4)
- car interior heating radiator (5)
- vent plugs (6a)-(6b)-(6c)
- thermostat (7)



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DESCRIPTION

1242 8v

The engine cooling circuit maintains the temperatures at constant working temperature ≅ (90° ÷ 100° C), also supported by engine fan inserts.

1242 8v

OPERATION

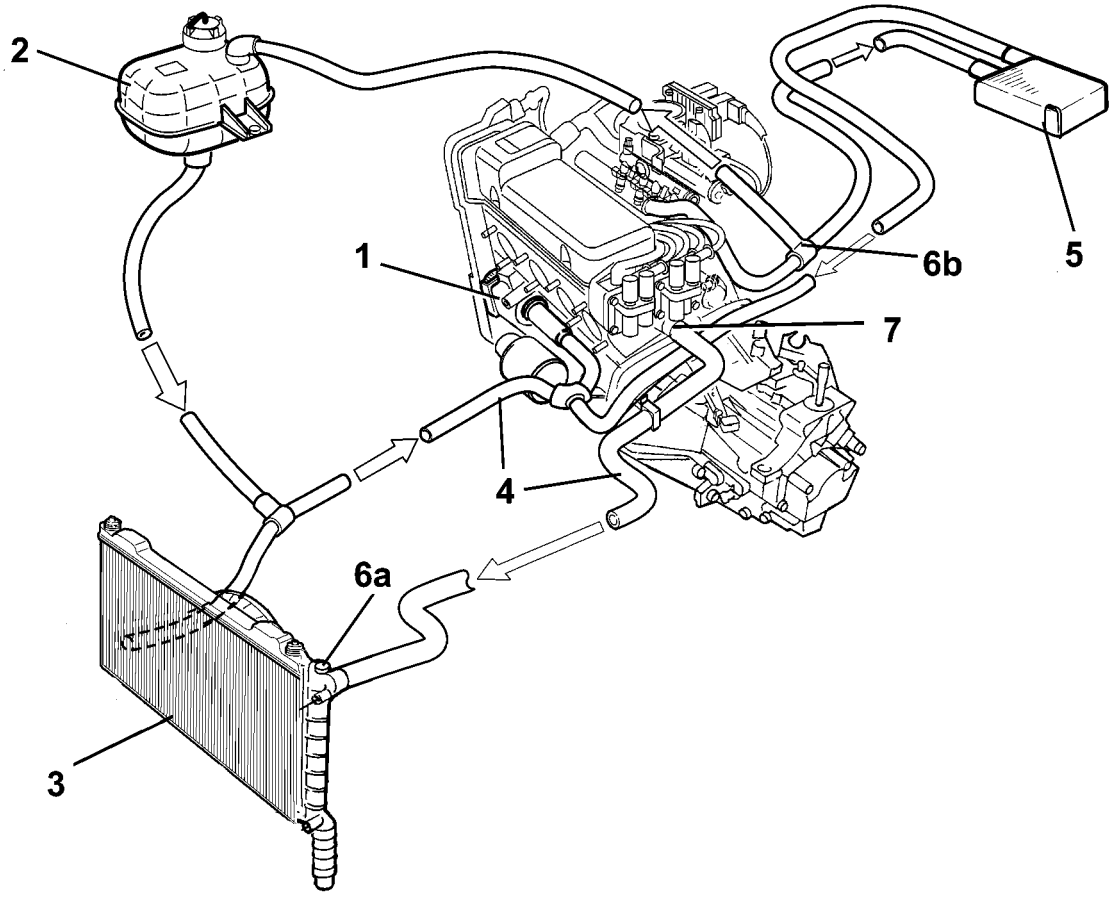
1242 8v

The main function of the engine cooling circuit is to draw fluid from the radiator (3) and send it to the pump (1), which collects the fluid and circulates it into the engine. After absorbing heat from the engine, the fluid emerges and goes to both the radiator (3) and the heater (5), and also the expansion tank (2) to top up the level. Over this route, the fluid dissipates heat taken from the engine and is ready for another engine cooling cycle.
A ≅ 88° C thermostat (8) begins to open until it has opened through its full travel to ≅ 100° C. Under these conditions, the coolant flows through the entire radiator (3) to dissipate heat taken up from the engine.

DESCRIPTION OF FILLING OF COOLING SYSTEM

1242 8v

The enging cooling system should only be filled or topped up with the engine cold.
Open bleed cap (6a) on radiator (3), fill with coolant through the expansion tank cap (2) until fluid emerges through cap (6a), tighten cap (6a) and finish filling to the MAX level on the expansion tank.
Continual bleeding (6b) during the filling stage ensures air is removed from the circuit.
Warm up the engine until the radiator fan has come on twice; allow the engine to cool down to ambient temperature, then check and if necessary top up the level in the expansion tank.



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1242 8v

1088B - Engine cooling tank - r + r

1242 8v

CONSTRUCTION FEATURES

EXPANSION TANK

1242 8v

In addition to supplying the cooling system, the expansion tank also absorbs changes in volume of coolant as the engine temperature varies.
A valve set to 1.4 bar in the coolant tank cap allows air in and out as the engine temperature increases or decreases.

RADIATOR

1242 8v

This consists of a radiating mass and two side tanks that allow coolant in and out.

1242 8v

1088C - Water pump and thermostat

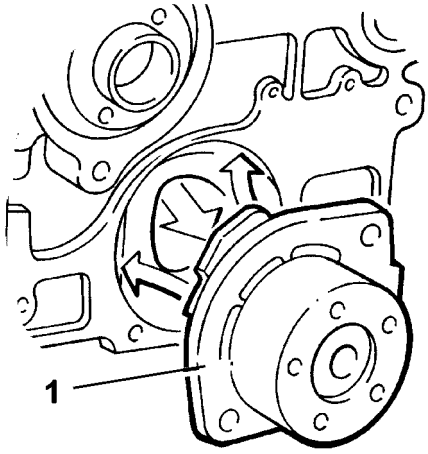
1242 8v

CONSTRUCTION FEATURES

COOLANT PUMP

1242 8v

It is the centrifugal type with vanes, fixed to the crankcase and directly directly by the timing belt.



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THERMOSTAT

1242 8v

Mounted on the rear of the cylinder head, its function is to keep the engine at the optimum temperature:
- with temperature lower than 88° C (thermostat closed), the coolant flow is diverted directly upstream of the pump.
- with temperature higher than 88°C, the thermostat begins to open until the temperature is about 100°C (thermostat fully open).

1242 8v

1088E - Coolant temperature control devices

1242 8v

CONSTRUCTION FEATURES

FAN

1242 8v

The two-speed cooling fan makes it possible to increase heat dissipation by the engine and/or the air conditioning system.
The fan is controlled by the fuel injection E.C.U. in accordance with a strategy for heat dissipation and maintenance of working temperature (for operating logic, see 1056)

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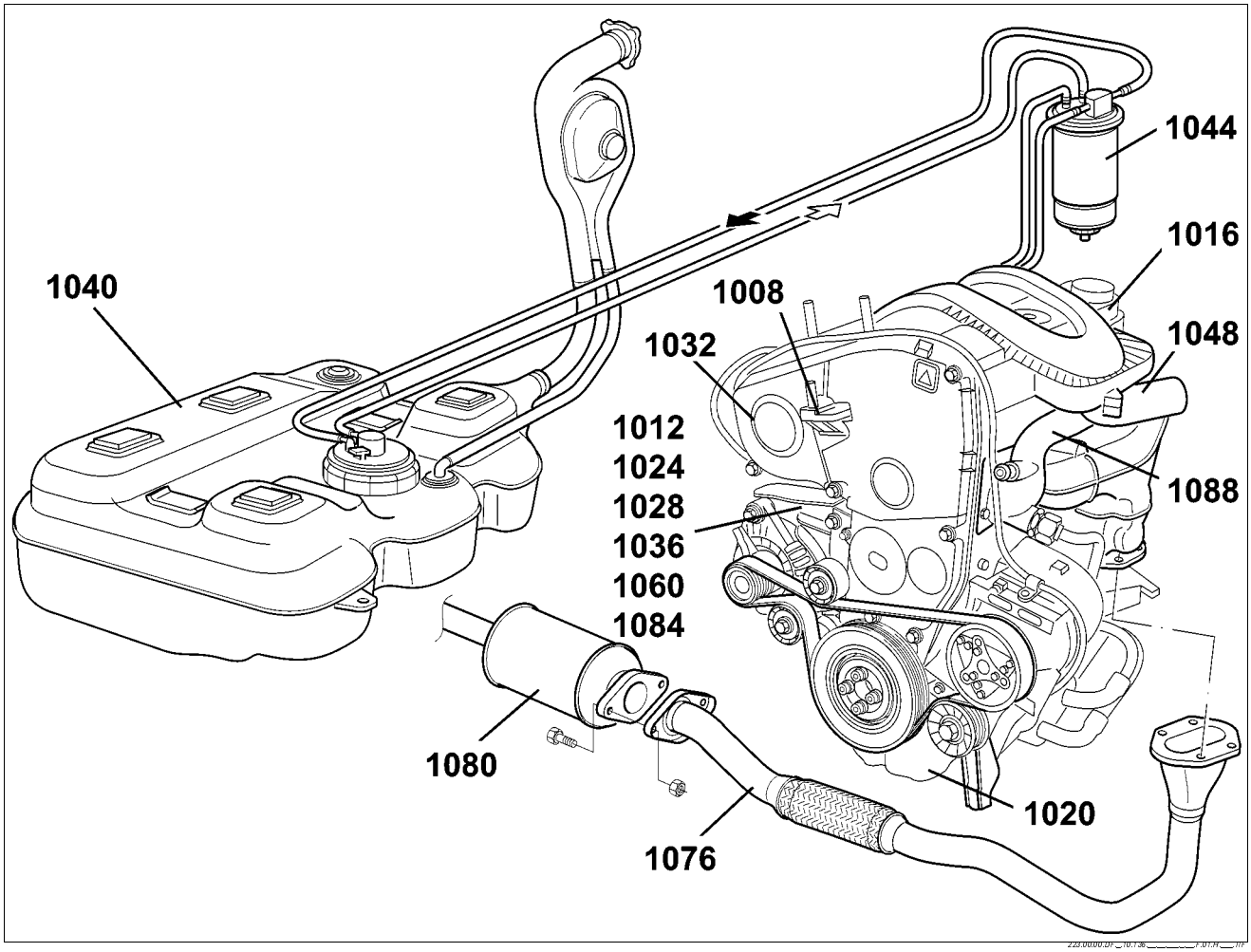


1910 D

GLOSSARY

Hardened and tempered steel

1910 D

Heat treatment applied to special steels to improve their mechanical characteristics: it consists of hardening, followed by tempering to induce a significant increase in toughness of the material.
Tempering: consists of heating to a temperature of < 720°C followed by slow cooling, in order to attenuate the effects of the hardening without eliminating its effects.
The material thus returns to a condition as close as possible to a stable chemical-physical balance.
Hardening: this is obtained when the structure of the metal at high temperature is harder and stronger than when cold.

CONTROL AREA NETWORK (CAN)

1910 D

The CAN communication network allows data transmission between the ECU and other car computers.
The advantages of this system are that it does not require a lot of wiring and the number of sensors is reduced (because the computers are interconnected by the data transmission system, data supplied by one sensor may be used by several devices simultaneously).
The CAN also makes the fault diagnosis system more effective, speeds up signal transmission and improves component electric/magnetic compatibility (relationship between the various electric and electronic circuits on the car and interaction between the car and its surroundings).

The circuit that connects the ECU to the other terminals is an integrated circuit referred to as a CAN interface. Its function is to convert messages received by via the data transmission system into appropriate form.

Closed deck

1910 D

This indicates the type of assembly of the cylinder liners in the cylinder block, closed deck. In this case the two components are integral only at the top.

Condensation

1910 D

This the reverse of evaporation, i.e. when a substance passes from the vapour state to the liquid state; it takes place by compression or cooling.

DUCTILE OR SPHEROIDAL CAST IRON

1910 D

Cast iron is referred to as ductile or spheroidal when, due to the addition of cerium and magnesium, globules or spheres of carbon at the graphite stage are contained in a mainly ferrite matrix. All the mechanical and technological properties of the metal are improved so it can be forged, welded and machined.
Its applications are very wide, because - unlike normal cast iron - it offers appreciable strength and percentage lengthening values.

Evaporation

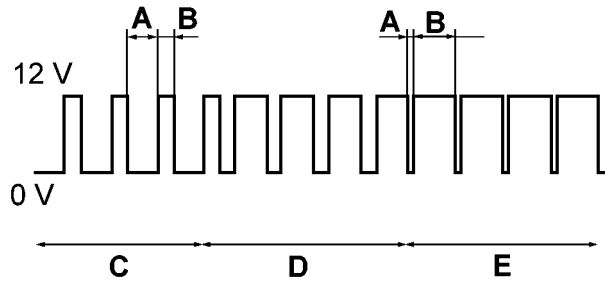
1910 D

Also called vaporization, this is the passage of a body from the liquid state to the gaseous state.
It occurs at any temperature, but, when all other conditions are the same, all the more slowly the lower the temperature.

PWM PULSE WIDTH MODULATION

1910 D

This is a fixed voltage with pulses of moduled amplitude and frequency generated by the ECU for the operation of the actuators. A supply with P.W.M. (Pulse Width Modulation) voltage consists of a series of square waves with single polarity, whose duration is varied by the ECU in response to demand.



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A, Off
B, On
C, Low resulting current
D, Medium resulting current
E, Maximum resulting current

1910 D

A pulse width modulated current varies in proportion to the ratio between Wave and Space. The Wave-Space ratio is the relationship between periods when the power supply is on and periods when it is off. This ratio may be considered as a percentage, and this is the way the Duty Cycle is measured.

Resonance

1910 D

Phenomenon in which the amplitude of oscillations induced in a vibrating system tends, under particular conditions, to become intensified (amplified) beyond all limits.

Sensor

1910 D

This is a system which, stimulated by any form of energy, reacts by changing its state, hence one or more of its characteristics (resistivity, volume, temperature, etc.).
For example, a material which, immersed in a magnetic field, undergoes a change in its conductivity, is a sensor.
New-generation sensors are solid-state devices of microelectronic technology, which can read the environment and provide responses in the form of electrical signals for subsequent processing for final control actions. They can measure forces, acceleration, pressures and temperatures of gases, liquids and solids, concentrations of gases such as nitric oxides, oxygen, etc.

Viscosity

1910 D

Property of matter whereby the particles of a body meet 'resistance' in sliding in relation to each other.
The value of the resistance or internal friction depends on the nature of the body, large in solids, very small in viscous liquids and non-existent in gases.
In liquids, viscosity decreases rapidly as temperature increases.

1910 D

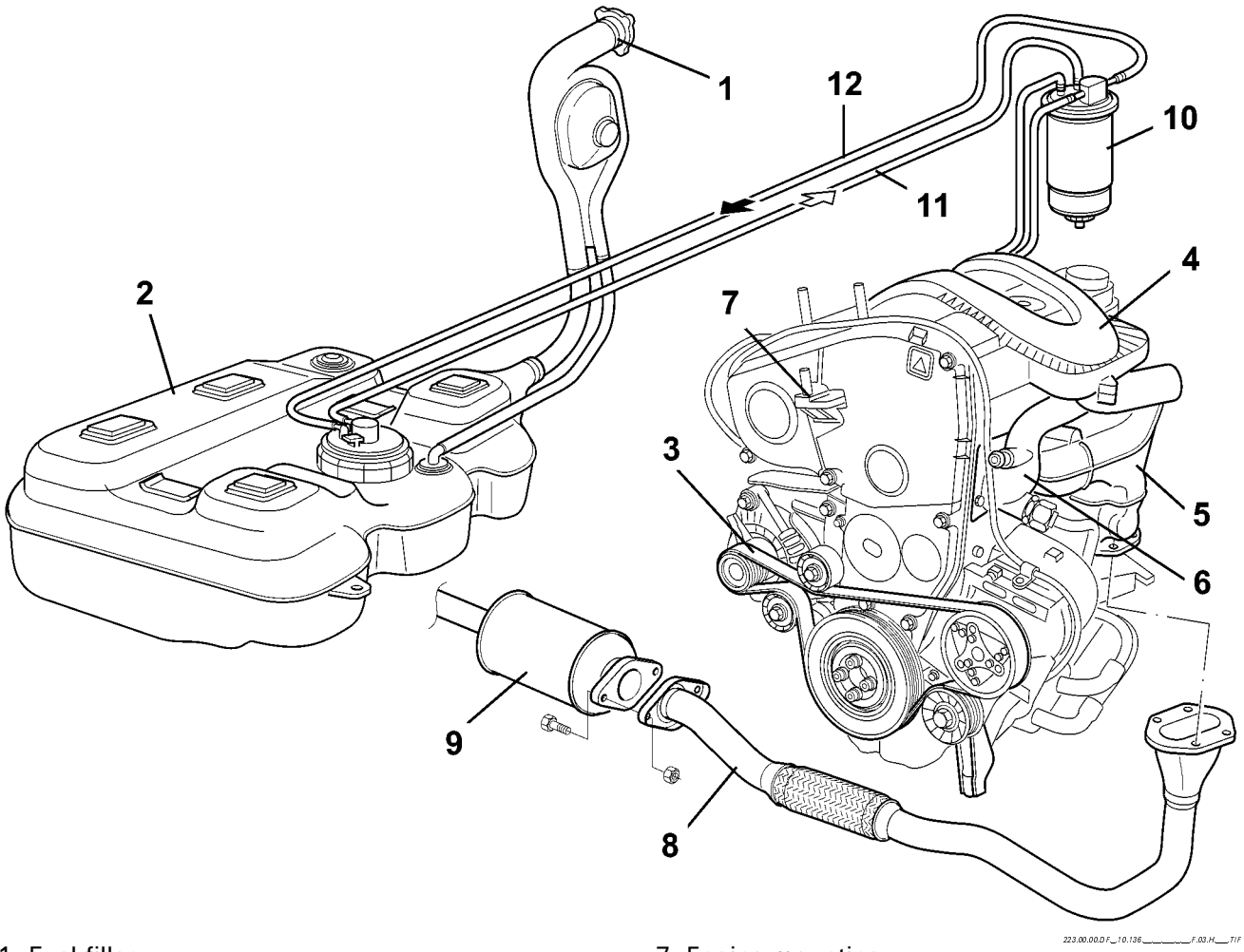
CONSTRUCTION FEATURES

1910 D

It is a new I.D.I. (indirect diesel injection) naturally-aspirated engine which, for the 2230, is the confirmed version in the range of diesel engines.
A naturally-aspirated engine has been chosen in order to minimize fuel consumption (<> -0.7 l per 100 km on a mixed route); a larger cylinder capacity has been used to ensure one of the best performances in the category and excellent handling.
The main changes carried out on this engine amount to a new combustion system.
This high swirl combustion system uses a new combustion chamber to optimise fuel mixing with air and ensure more favourable operating conditions for reduced emissions and noise levels.
POWER: 63 BHP/46 kW 4500 rpm
TORQUE: 12 kgm/103 Nm 2250 rpm
CYLINDER ARRANGEMENT: 4 in line
BORE: 82 mm
STROKE: 90.4 mm
CAPACITY: 1910 cc
CYLINDER HEAD: in aluminium
CRANKCASE: cast iron
CRANKSHAFT: in ductile cast iron with 8 counterweights and 5 main bearings with torsional damper
TIMING GEAR: one overhead camshaft, 2 valves per cylinder
INJECTION SYSTEM: LUCAS EPIC, full electronic control
EMISSION CONTROL DEVICE: oxidising catalytic converter, EGR solenoid
LUBRICATION: forced with in-line gear pump
COOLING: liquid with forced circulation via a centrifugal pump and sealed circuit; - Radiator and additional expansion tank.

The following systems are involved in engine operation:
- fuel system;
- air supply system;
- cooling system;
- exhaust system with catalytic converter;
- oil vapour recirculation system;
- engine lubrication system;

- E.G.R. exhaust gas recirculation system;
- Electrical/Electronic system.



1, Fuel filler
2, Fuel tank
3, Auxiliary drive belt
4, Inlet manifold
5, Exhaust manifold
6, Cooling system pipes
7, Engine mounting
8, Exhaust pipe
9, Oxidising catalytic converter
10, Fuel filter
11, Fuel delivery line
12, Fuel return line

Technical advantages

1910 D

The main technical advantages may be summarized as follows:
- reduced fuel consumption;
- significant reduction of noise level;
- improvements in air-fuel mixing with advantages in terms of emissions and consumption;
- improved idling;
- improved driveability;
- lower polluting emissions;
- high reliability thanks to the adoption of a 'MULTILAYER' metal cylinder head gasket.

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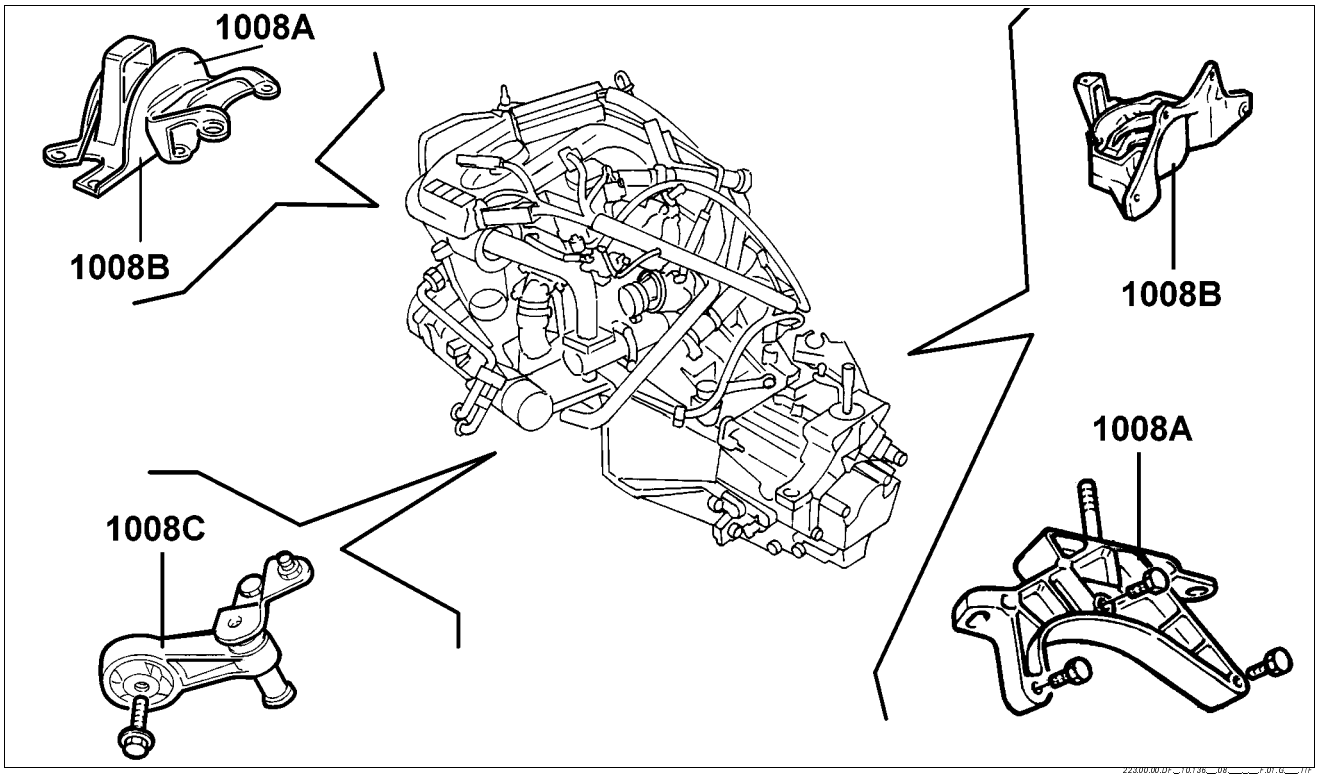


1910 D

CONSTRUCTION FEATURES

1910 D

The power unit mountings provide the structural connection between the power unit and the bodyshell.
They are rated to support the weight of the power unit and withstand the loads resulting from the torque transmitted by the engine.
Each mounting comprises a rubber-metal block which dampens the vibrations generated by the engine, largely reducing those transmitted to the bodyshell.

Type

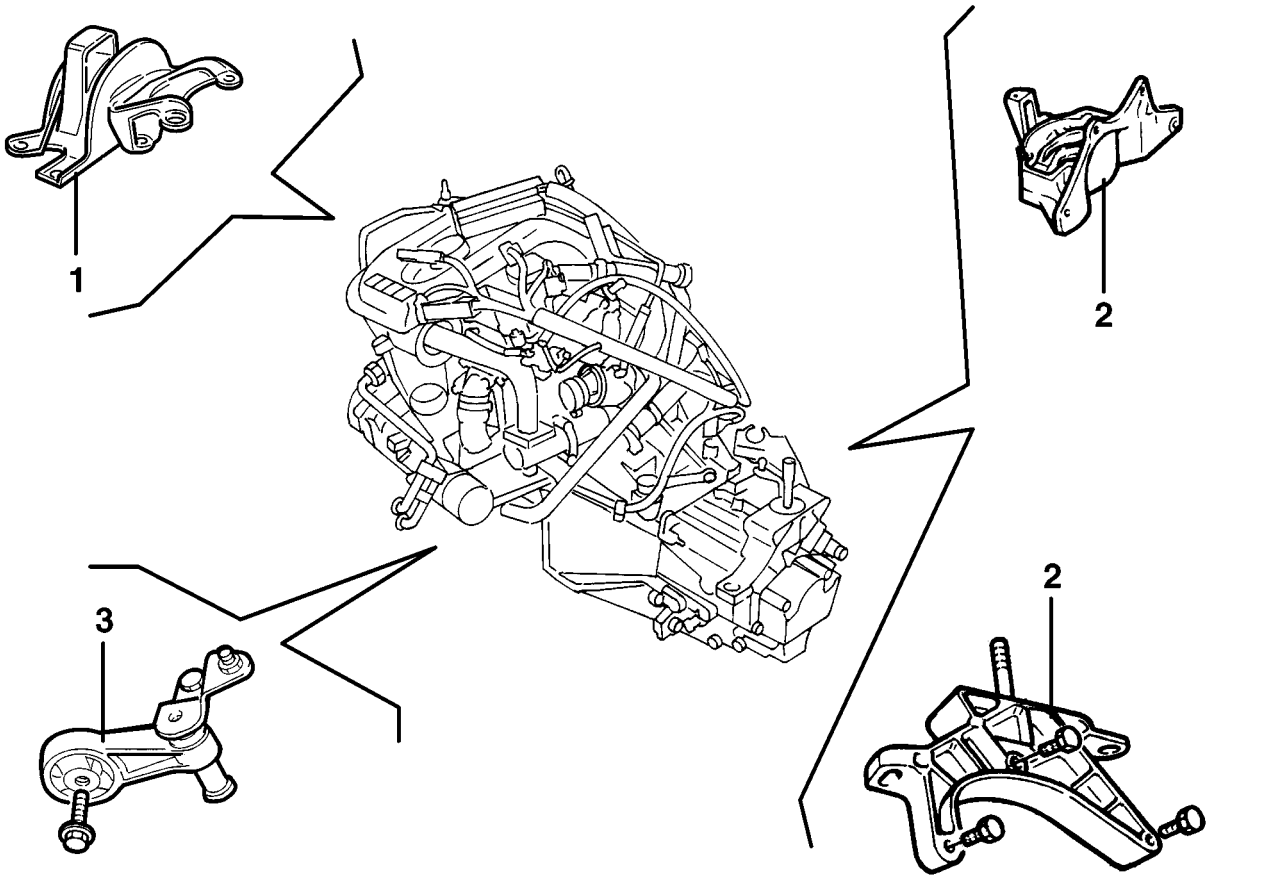
1910 D

The power unit mounting system is baricentric. It consists of two blocks plus a reaction rod that acts as a link. New mounts are aligned along a centre line passing through the engine centre of gravity in order to achieve reaction forces with zero offset.

System features

1910 D

This new system has brought about a reduction of about 2 Db. in the noise.
This has brought particular benefits in terms of handlng and interior comfort.



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1, Timing end mount

2, Gearbox side mounting
3, Reaction link

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Assembly drawings index

Cmp	*Description*	*Validity*

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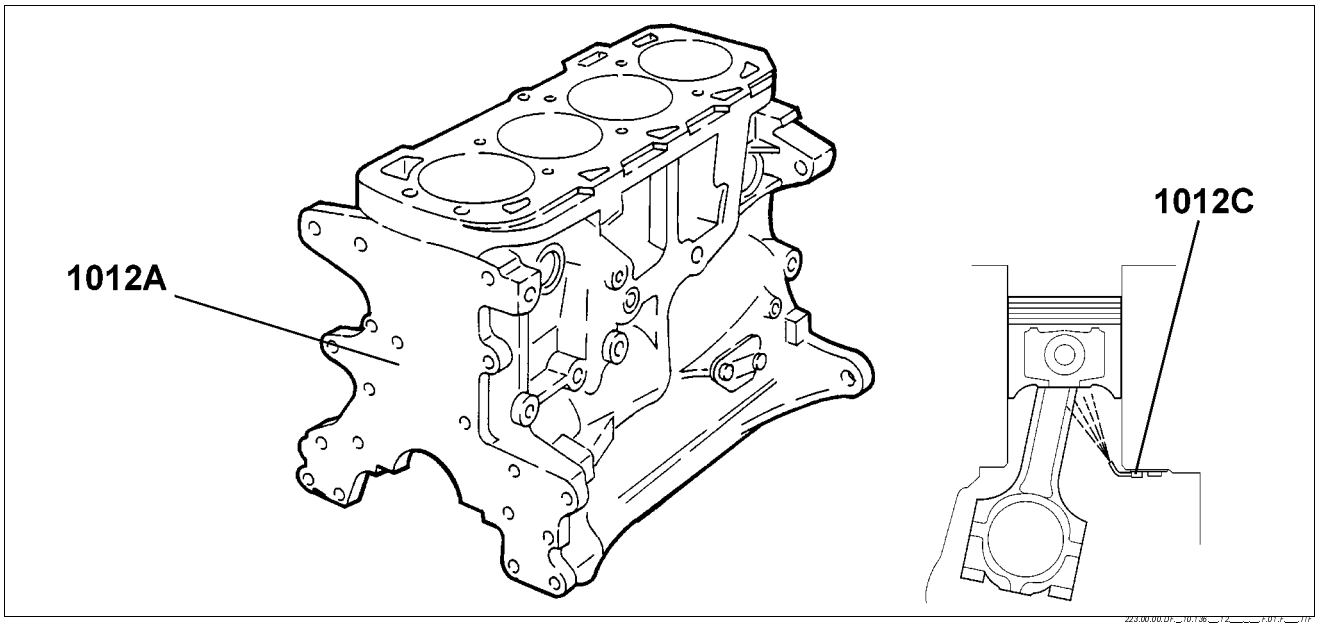


1910 D

CONSTRUCTION FEATURES

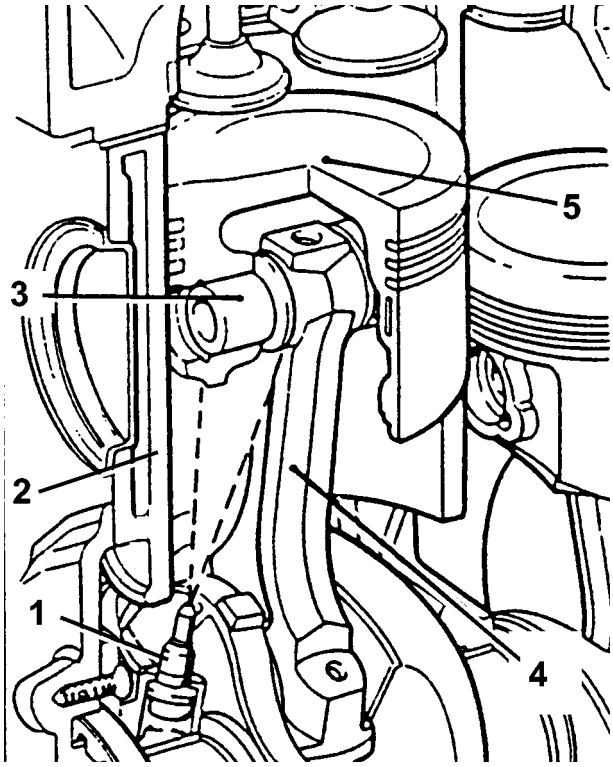
1910 D

The cylinder block/crankcase is made from cast iron with closed-deck type cylinder liners/bores.
The crankshaft is supported by five main bearings.
There are special channels in the engine block walls which allow the flow of coolant and lubricating oil.

Oil jets cool the pistons.

1910 D

The diagram below illustrates the oil jets for cooling the pistons.



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1, Oil jet
2, Piston bore/liner
3, Connecting rod-piston gudgeon pin
4, Connecting rod
5, Piston

Operation

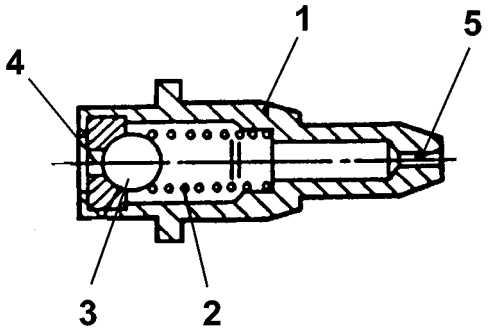
1910 D

There are four oil jets (1) for cooling the piston crown located in the lower part of the cylinder liner/bore (2). The oil jet is directed so that it partly lubricates the machined housing of the connecting rod and piston gudgeon pin.
The jets incorporate a ball valve which opens at a pressure of about 1.1 bar.

Components

1910 D

Oil jets for cooling the pistons.



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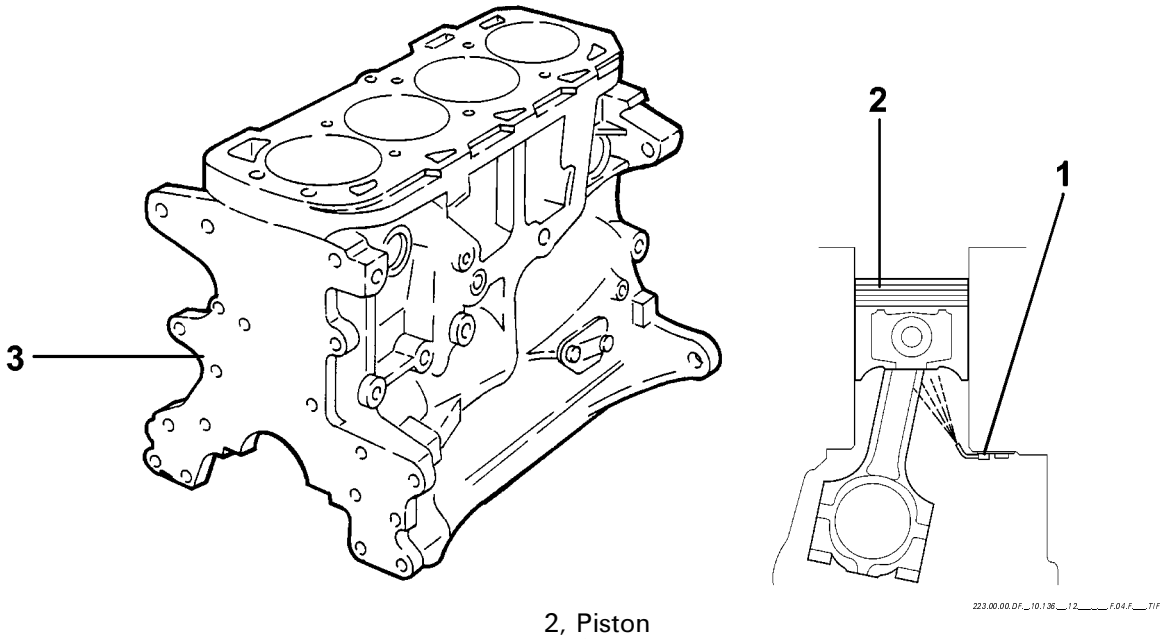
1, Jet body
2, Spring
3, Valve
4, Oil inlet duct
5, Oil outlet duct

1910 D

There are four jets (1) in the lower part of the cylinder liners/bores from which oil is sprayed; the jet is directed in such a way that it cools the piston crown and lubricates the gudgeon pin machined housing.



1, Jet
2, Piston
3, Cylinder block/crankcase

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Cmp	Description	Validity

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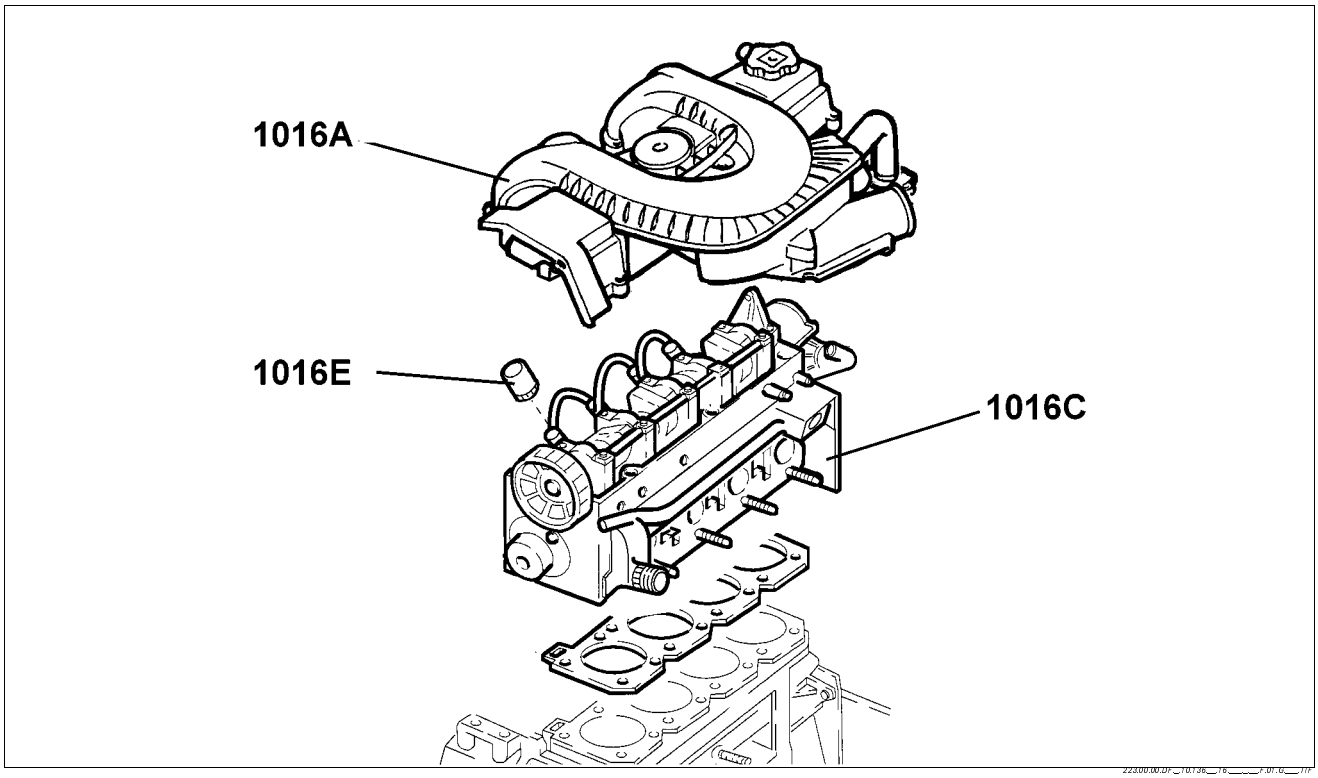


1910 D

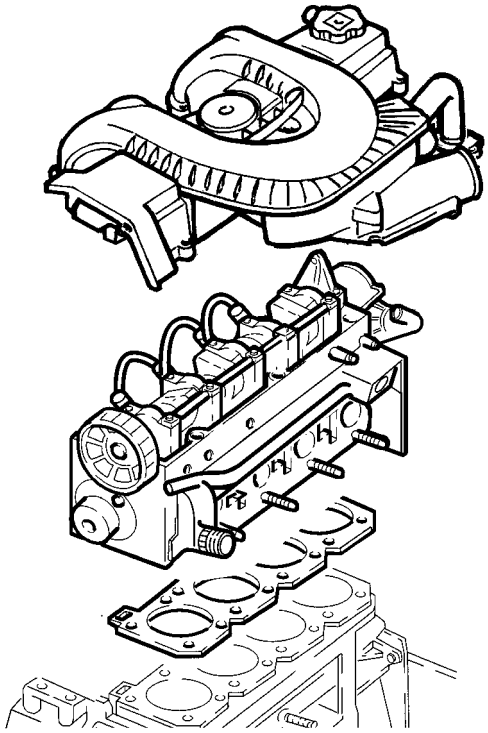
CONSTRUCTION FEATURES

1910 D

The cylinder head is of aluminium and silicon alloy.
The two valves per cylinder, parallel and vertical, are fitted in the valve guides and are operated by a single overhead camshaft with cams acting on mechanical type tappets.
The valve guides are an interference fit in the cylinder head seats and the internal diameter is corrected, after fitting, using a special reamer.

The high swirl combustion prechambers (RICARDO) have been designed:
- To reduce rough operation typical of diesel engines
- To optimise fuel mixture with air.
- To guarantee reduced emissions.

The gasket between the cylinder head and the cylinder block/crankcase is the multilayer metal type and there is no need to retighten the cylinder head for the entire life of the engine.
The tappet cover, made from a damping material, is designed to carry out the function of an engine oil vapour separator.



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RICARDO PRECHAMBER

Specifications

1910 D

This type of spherical prechamber, known also as a high turbulence prechamber, allows the air mass to swirl and pull through diesel sprayed by an injector on the prechamber to make the mixture more even and aid combustion.

Current developments

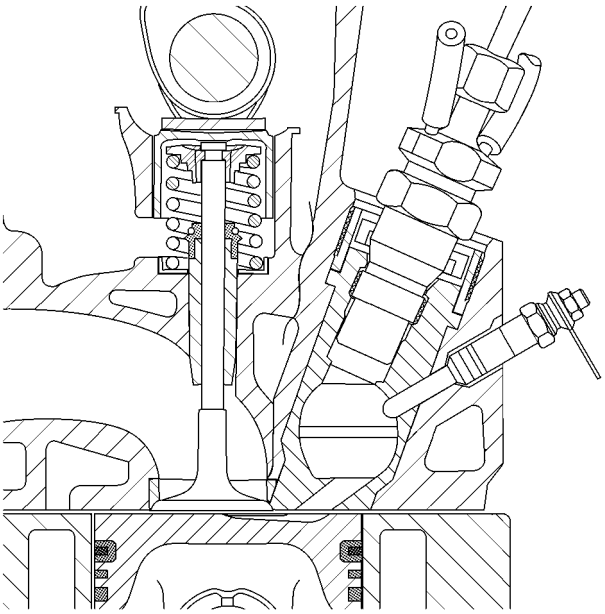
1910 D

Unlike conventional bottom inserted prechambers, the RICARDO prechamber is designed specifically for the FMA engine line (engines built at Pratola Serra). Although the prechamber is TOP INSERTED (inserted from the top of the cylinder head), the machining centre lines on the cylinder head remain unchanged as on current engines.

System features

1910 D

Adoption of this type of RICARDO prechamber allows this engine to meet emission limits imposed by EC STAGE 3 regulations:
- reduce fuel consumption compared with current prechamber engines;
- develop considerable torque at low speeds because combustion is more efficient due to the higher swirl generated by the prechamber;
- increase acoustic comfort due to the special type of smooth combustion offered by the RICARDO prechamber.



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- CONSTRUCTION FEATURES

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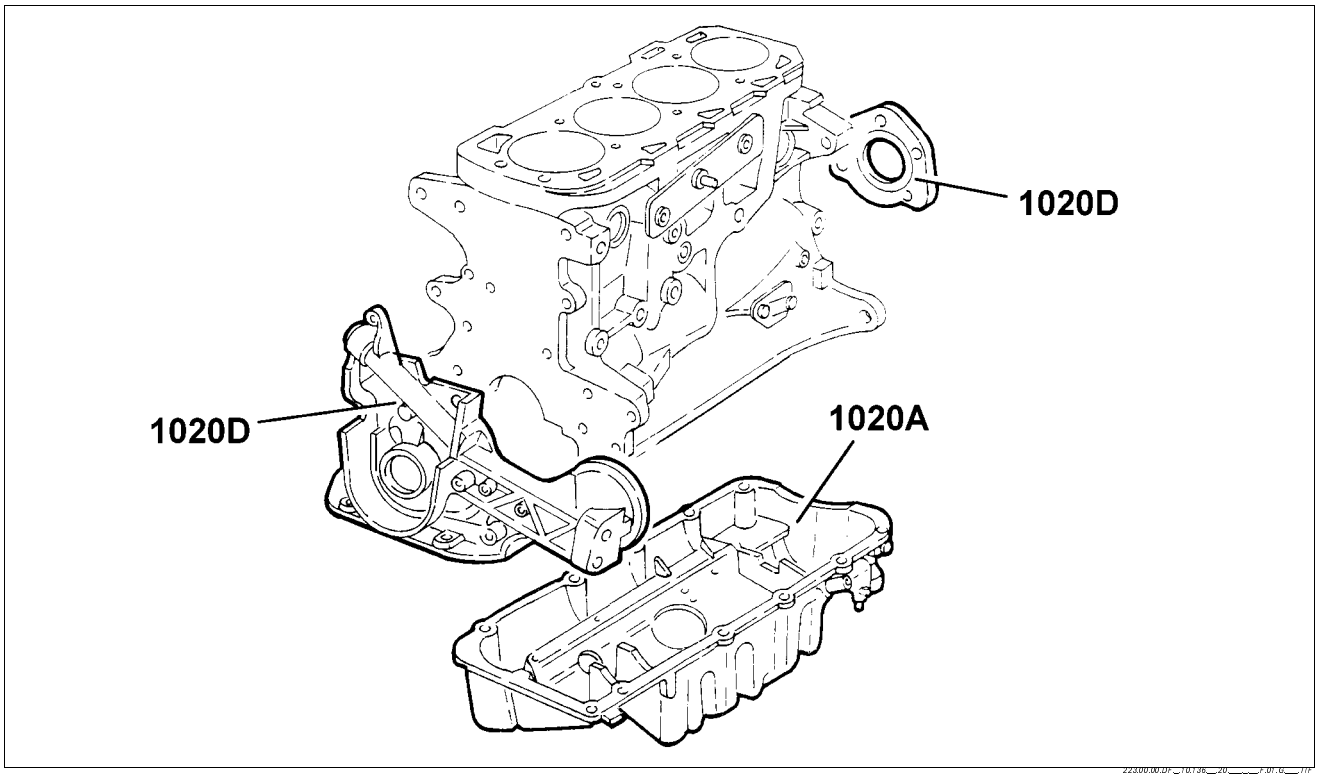
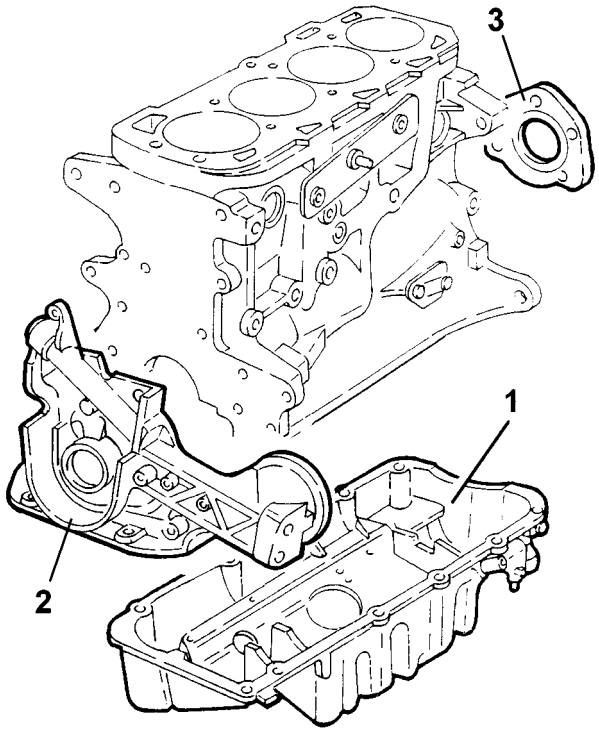


1910 D

CONSTRUCTION FEATURES

1910 D

The oil sump is made of aluminium alloy. Its function is to collect oil for lubricating the engine; it is bolted to the cylinder block. The seal on the join is ensured by a bead of silicone sealant.
The covers on the timing gear and flywheel sides comprise oil seals to seal the crankshaft.
The cover on the timing gear side constitutes the mounting for the oil filter, and incorporates the oil pump (see subgroup 1084).



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1, Oil sump
2, Crankshaft front cover
3, Crankshaft rear cover

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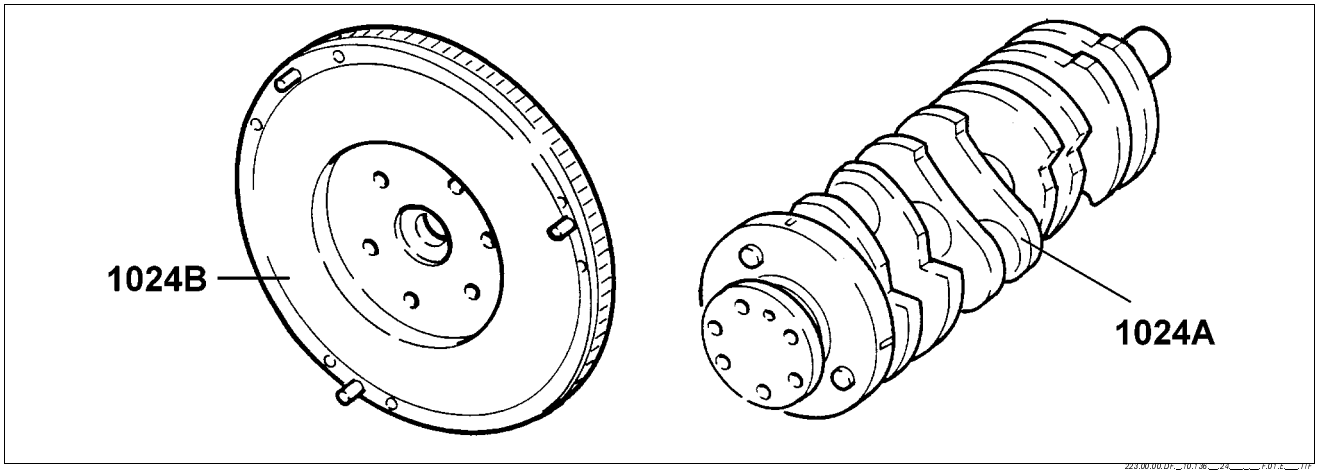
Cmp	*Description*	*Validity*
1024A	Crank shaft	1910 D
1024B	Engine flywheel	1910 D

SUB-GROUP GRAPHIC INDEX



1910 D

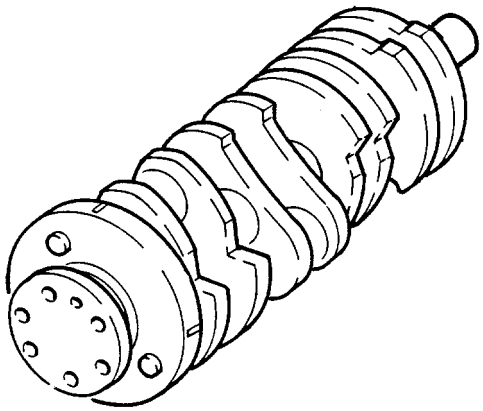
1024A - Crank shaft

1910 D

CONSTRUCTION FEATURES

1910 D

This is of cast iron, it is supported by five main bearings and its endfloat is adjusted by two thrust washers housed in the rear main bearing.
Eight counterweights ensure that the rotating masses of the crankshaft are precisely balanced.
A channel runs along the inside of the shaft to lubricate the main bearings and big end bearings.
At the rear there is a flywheel which contains 4 openings, 90 apart, for the rpm sensor.



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1910 D

1024B - Engine flywheel

1910 D

SPECIFICATIONS:

1910 D

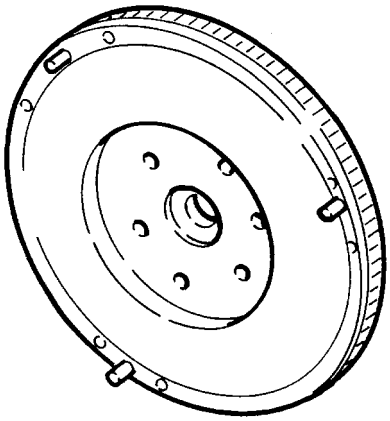
In cast iron, with a press-fitted steel ring gear.
The flywheel is bolted by a flange to the crankshaft. The flywheel is designed to allow the spanner for removing the oil sump bolts to pass through.

1910 D

OPERATION

1910 D

This makes the engine turn smoothly. It accumulates energy during active stages (expansions) and returns it during passive stages.
The flywheel is designed to allow the engine to idle without stalling and overcome the friction developed by the engine during no-load operation.



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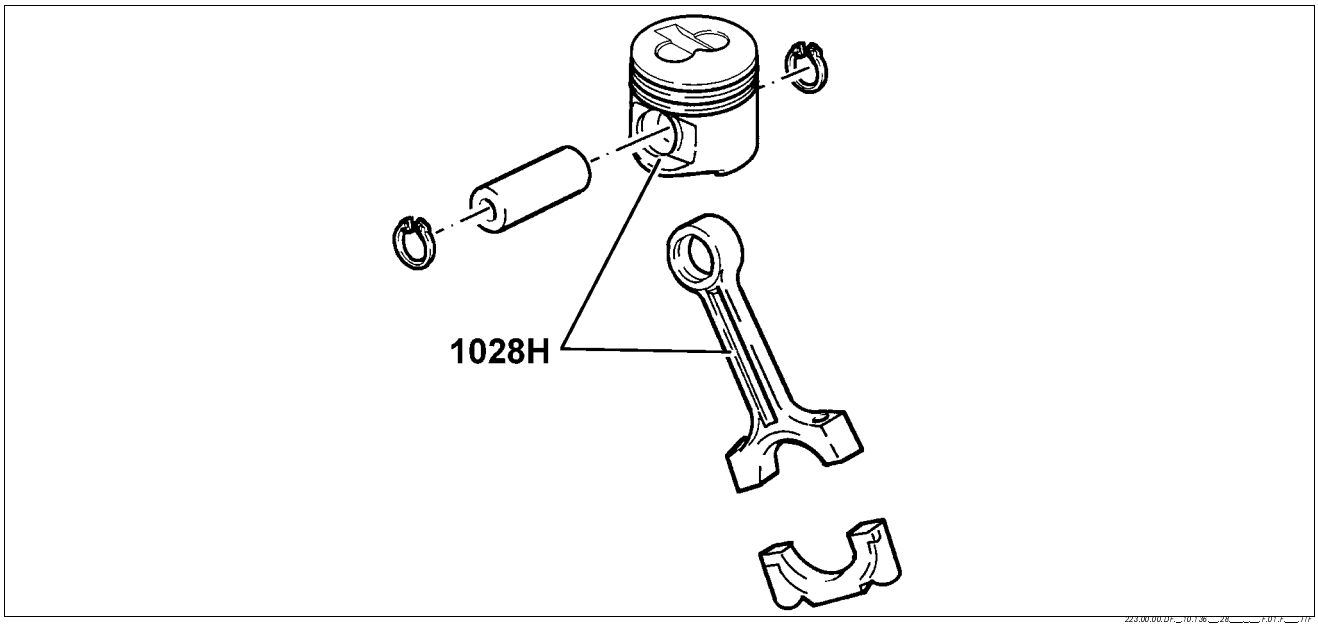


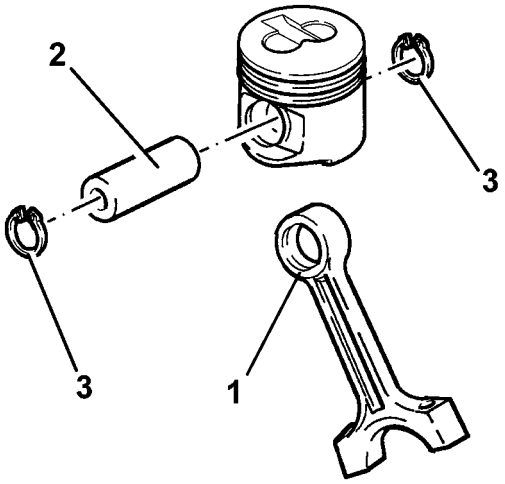
1910 D

CONSTRUCTION FEATURES

Connecting rods

1910 D

The connecting rods are made from hardended and tempered steel, with a copper bush (1) fitted for matching with the gudgeon pin (2).
The floating gudgeon pins are secured by two circlips (3) seated in specific grooves in the piston skirts.



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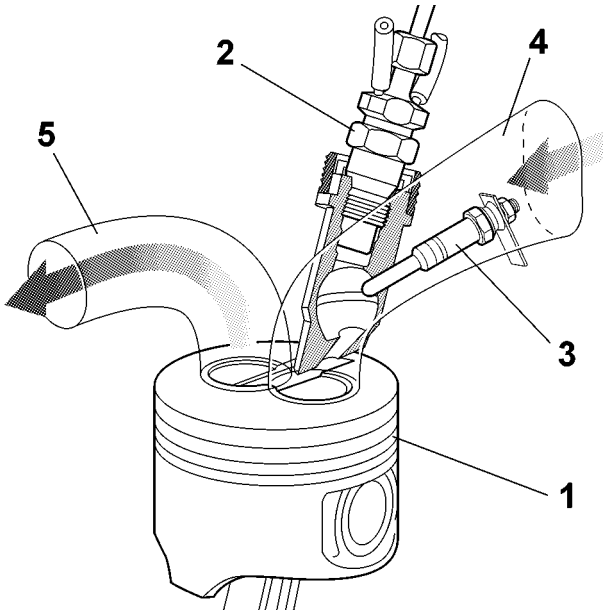
Pistons

1910 D

The light aluminium-silicon alloy pistons with autothermic inserts are graded in three sizes.



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1, Piston
2, Injector
3, Heater plug
4, Air inlet
5, Exhaust gas outlet

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Cmp	Description	Validity

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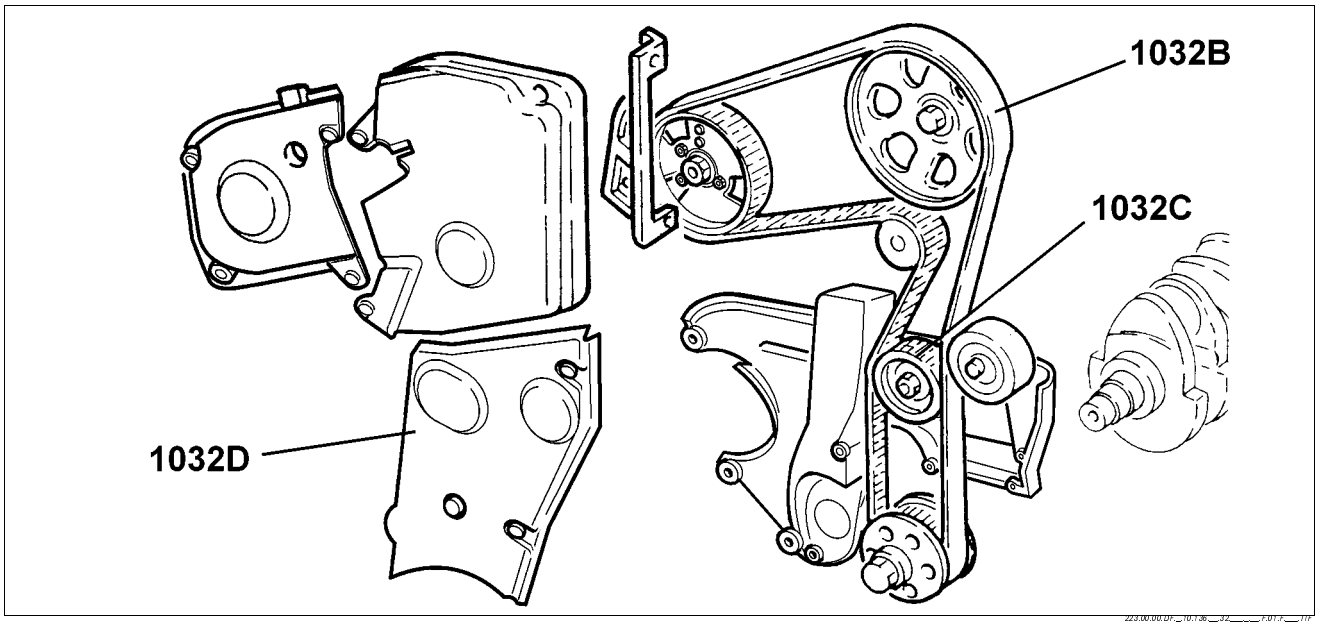
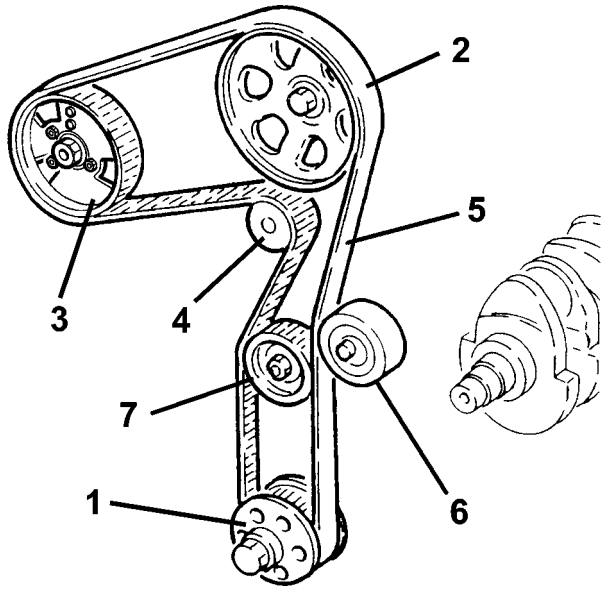


1910 D

SPECIFICATIONS:

1910 D

The timing system is the collection of components which control the opening and the closing of the inlet and exhaust valves allowing the flow of air and burnt gases.
These components are operated by the crankshaft and the movement is transmitted via a toothed belt to the camshafts which, in turn, act on the valves.
The various components should be perfectly synchronized (TIMED), if this is not the case, the upper part of the piston will interfere with the valves.



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1, Engine pulley
2, Camshaft pulley
3, Injection pump pulley
4, Water pump pulley
5, Power drive toothed belt
6, Banging prevention bearing
7, Pulley tensioner

1910 D

OPERATION

1910 D

Since in four stroke engines the working cycle takes place during two revolutions of the crankshaft, whilst the valves have to open only once during the cycle, the camshaft only has to rotate once; therefore the toothed pulley fitted on the camshaft has twice the number of teeth compared with the pulley fitted on the crankshaft.

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- OPERATION

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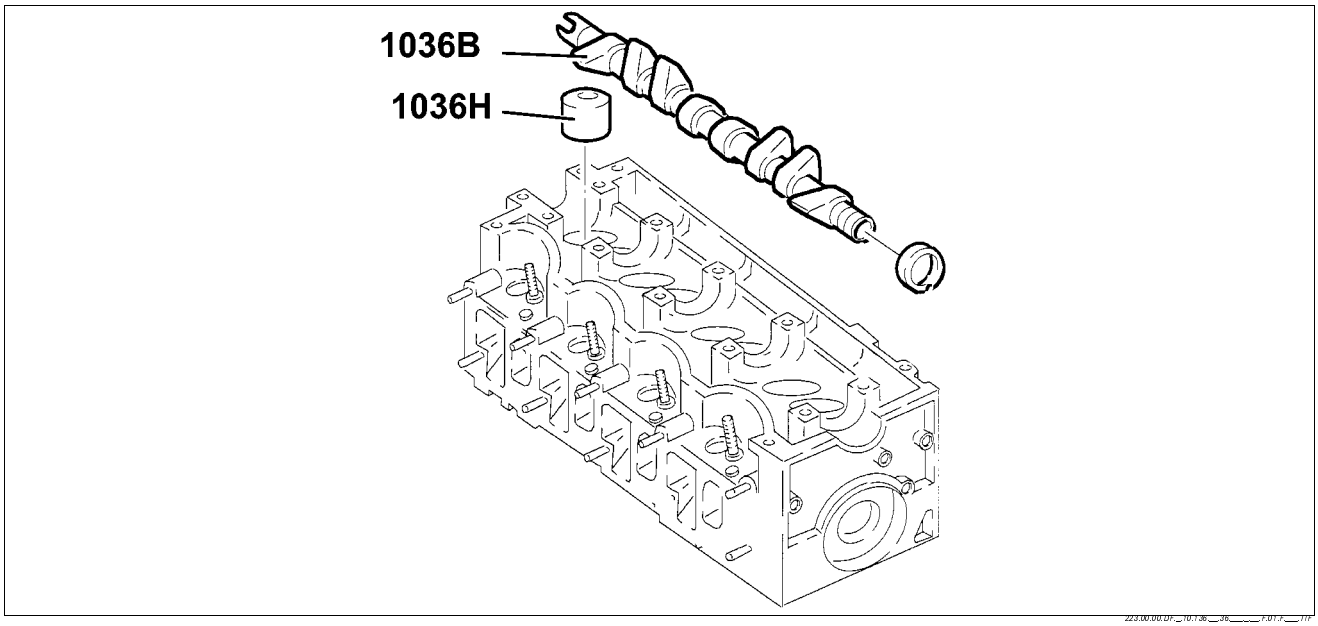
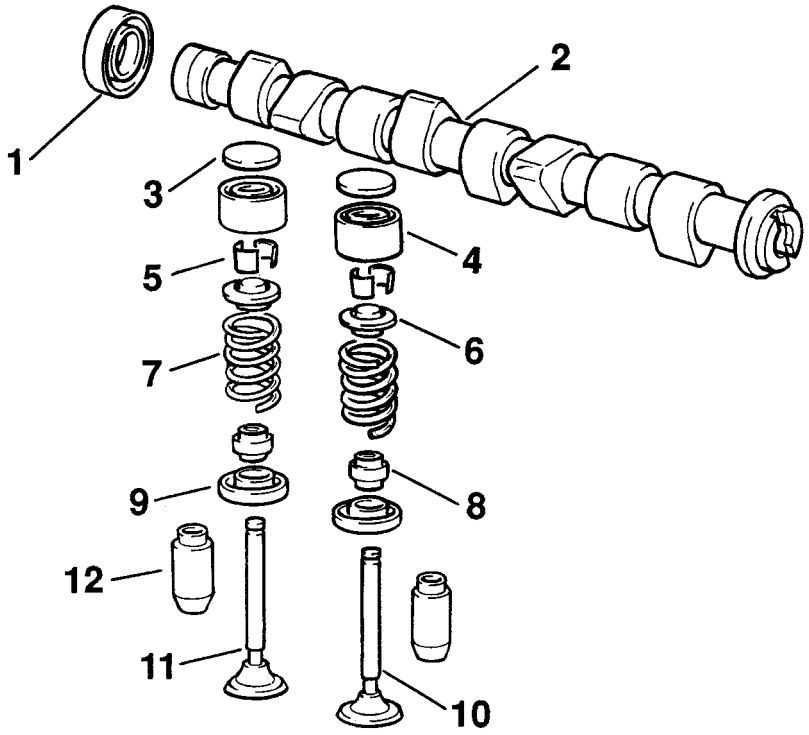


1910 D

COMPOSITION

1910 D

There are the same number of suitably positioned cams as there are valves to operate. At the front, it is prepared for the fitting of the toothed pulley, through which the movement of the crankshaft is received, by means of a suitably tensioned belt.



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1, Oil seal
2, Camshaft
3, Adjustment shim
4, Tapppet
5, Cotters
6, Upper shim spring
7, Spring
8, Oil seal
9, Lower shim
10, Inlet valve
11, Exhaust valve
12, Valve guide

1910 D

OPERATION

1910 D

The camshaft is the component which, through the cams, opens the valves for the required time. Since in 4 stroke engines the working cycle takes place during two revolutions of the crankshaft, whilst the valves have to open only once during the cycle, the camshaft only has to rotate once; therefore, the toothed pulley fitted on the camshaft will have twice the number of teeth as the pulley fitted on the crankshaft. therefore, the toothed pulley fitted on the camshaft will have twice the number of teeth as the pulley fitted on the crankshaft.

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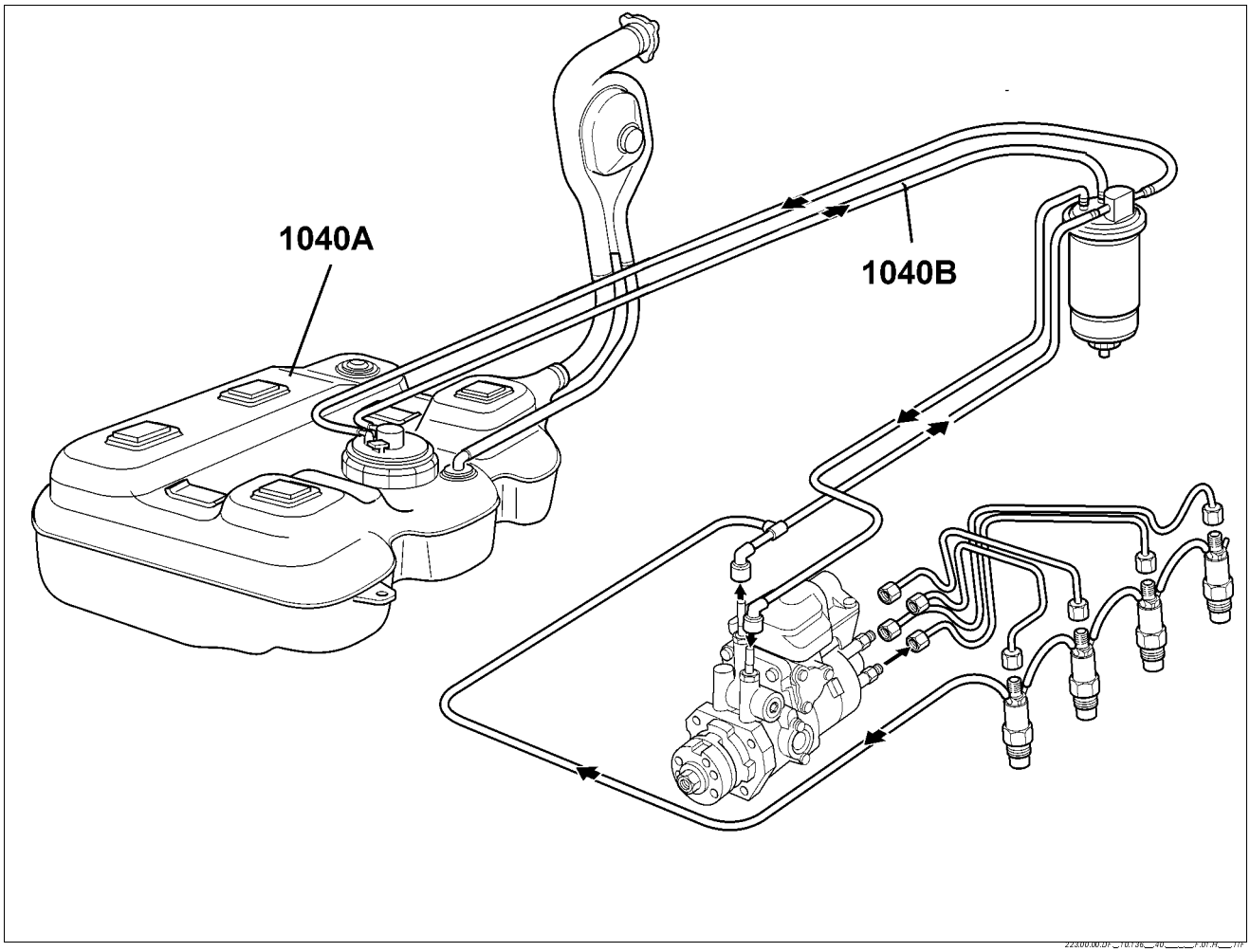


1910 D

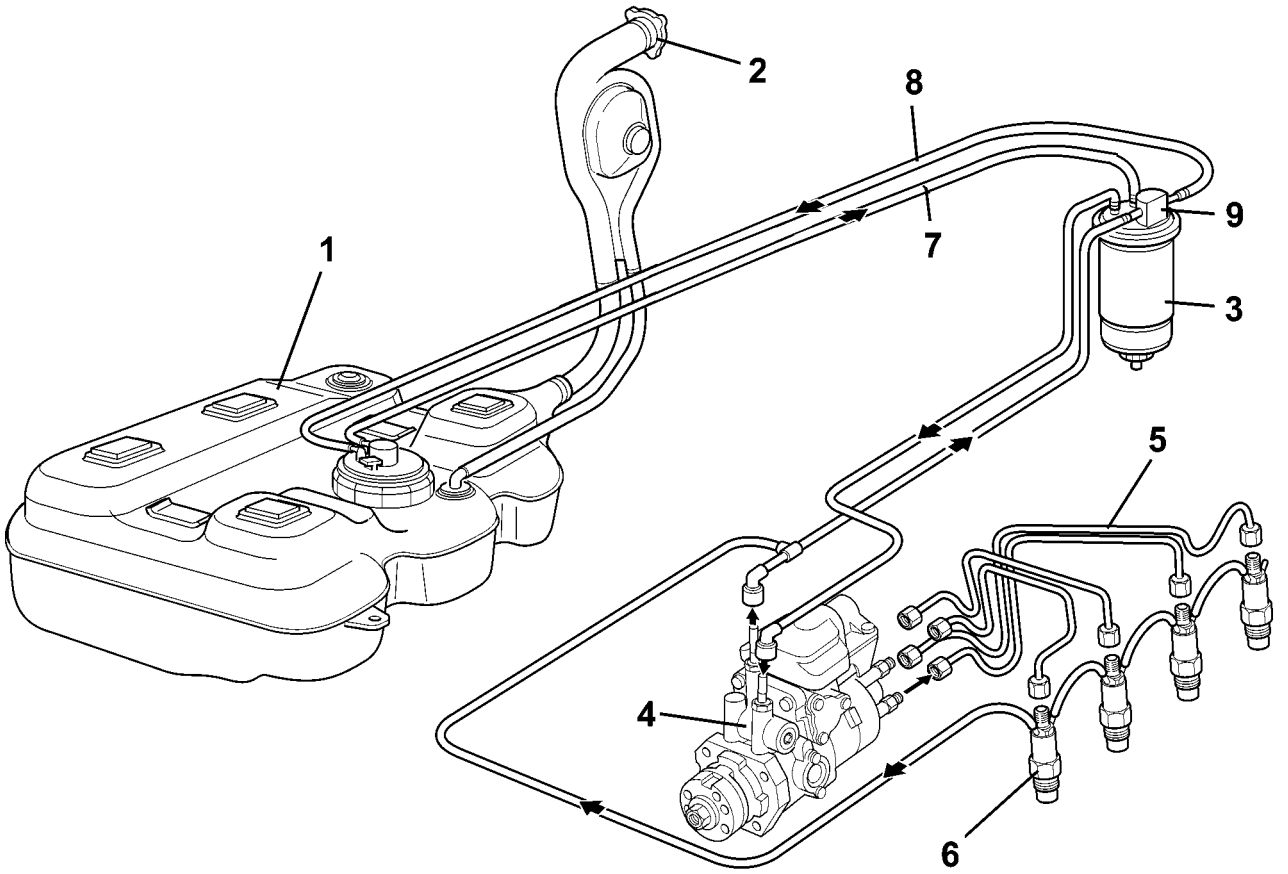
CONSTRUCTION FEATURES

1910 D

The fuel supply system is divided into a low pressure circuit and a high pressure circuit.

The low pressure circuit consists of:
- diesel intake pipe
- accelerator pump built into the injection pump;
- return pipe;

The high pressure circuit consists of:
- Diesel injection pump (see subgroup 1060 DIESEL INJECTION SYSTEM);
- pipes and injectors.



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1, Fuel tank 60 l capacity
2, Fuel filler pipe
3, Diesel filter cartridge
4, Injection pump
5, High pressure pipes
5, Injectors
7, Fuel delivery hose
8, Fuel return hose
9, Fuel recirculation valve

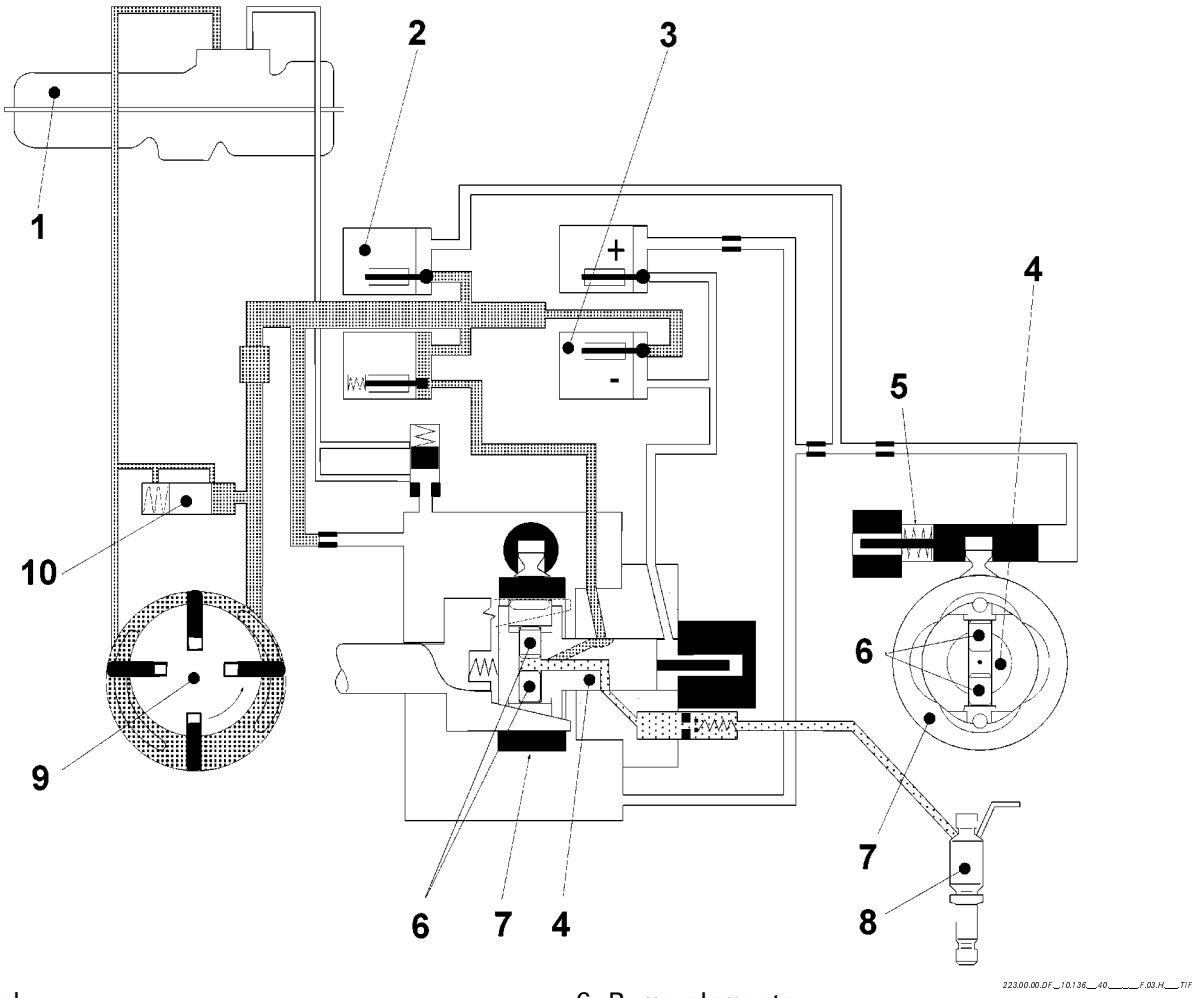
1910 D

OPERATION

1910 D

Fuel is supplied in two stages.
Stage one: fuel is taken up from tank (1) by transfer pump (9). This directs the fuel through the various ducts and chambers inside the pump at a certain pressure (transfer pressure), which is maintained constant by the pressure regulator (10). Fuel flows from the transfer pump to the solenoids, advance (2) and flow - (3). It is then directed to the regulation devices.
Stage two: fuel reaches the intake chamber of distributor rotor (4). Following the pressing action of pump element (6) subject to the action of cam ring (7), high pressure (injection pressure) is generated and fuel is therefore directed to the relevant injector (8).

The first stage is controlled by the transfer pump, the second is achieved as a result of a volumetric change in the compression chamber brought about by a cam ring.



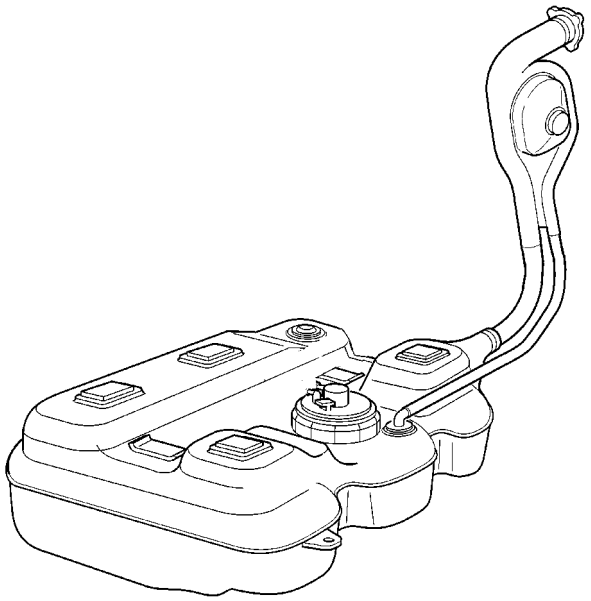
1, Fuel tank
2, Advance solenoid
3, Flow solenoid
4, Distributor rotor
5, Advance piston reaction spring
6, Pump elements
7, Cam ring
8, Injector
9, Transfer pump
10, Pressure regulator

FUEL TANK

CONSTRUCTION features

1910 D

The fuel tank, with a capacity of about 60 litres, is made of a plastic material.
It is fitted with a flexible filler and includes the seating for fitting the fuel gauge.



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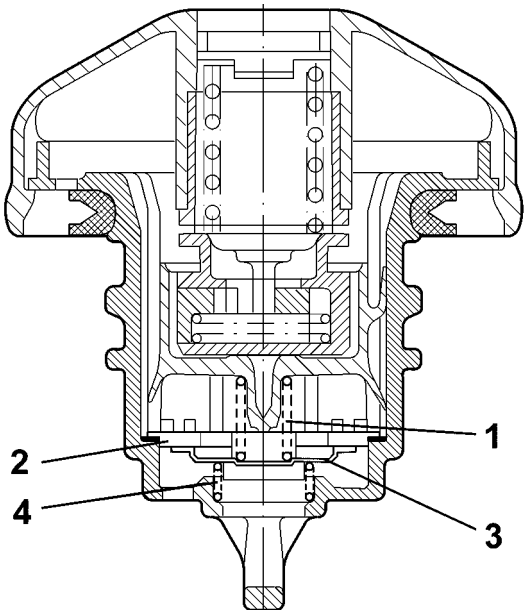
SAFETY AND VENTILATION VALVE

Operation

1910 D

This valve is built into the fuel filler cap, and it carries out the following functions, depending on the pressure present in the tank:
- it discharges to the outside any surplus pressure which is created inside the tank (safety function); the pressure acts on the plate (2) and, overcoming the load of the spring (1), allows the surplus vapours to be discharged to the outside.
- it allows external air to flow into the tank when an excessive vacuum is created in the tank, following the consumption of fuel (ventilation function). In this case, when the vacuum exceeds the load of the spring (4), it moves the valve (3), allowing air to enter.



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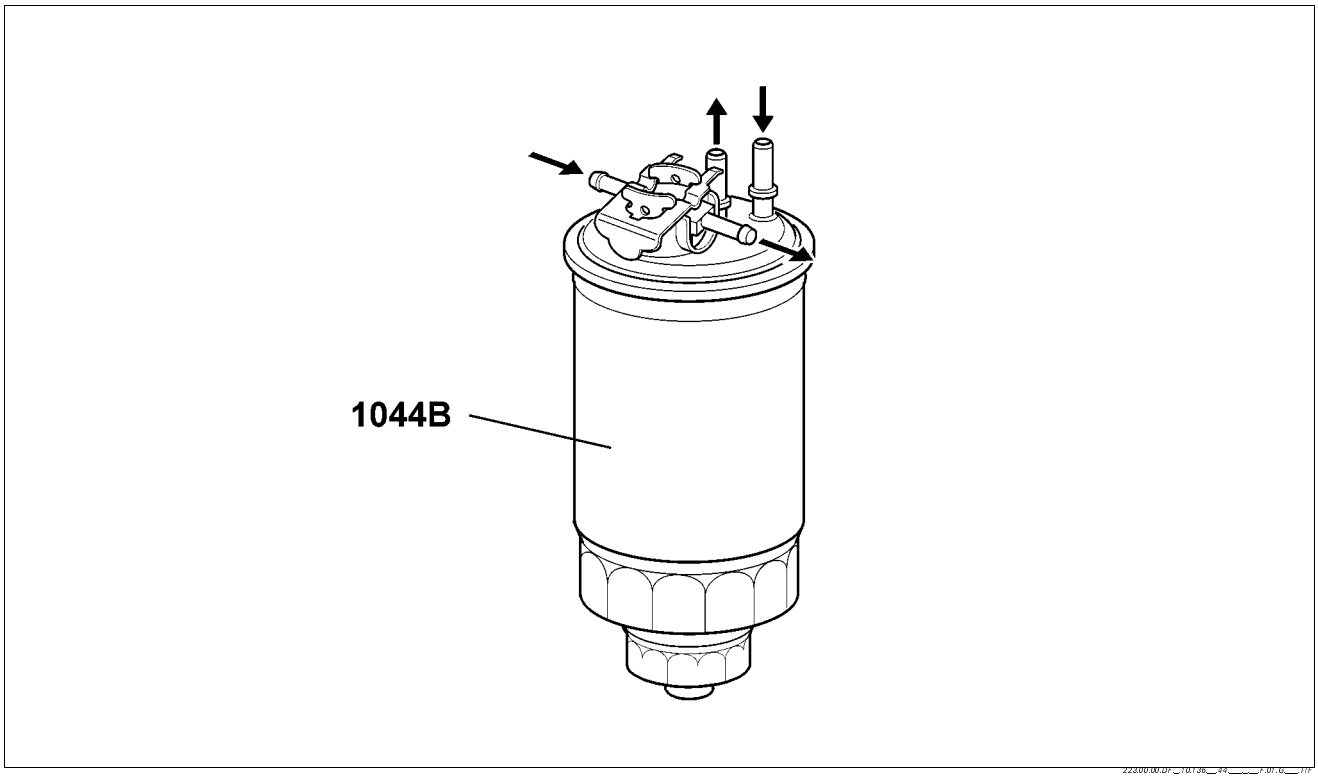
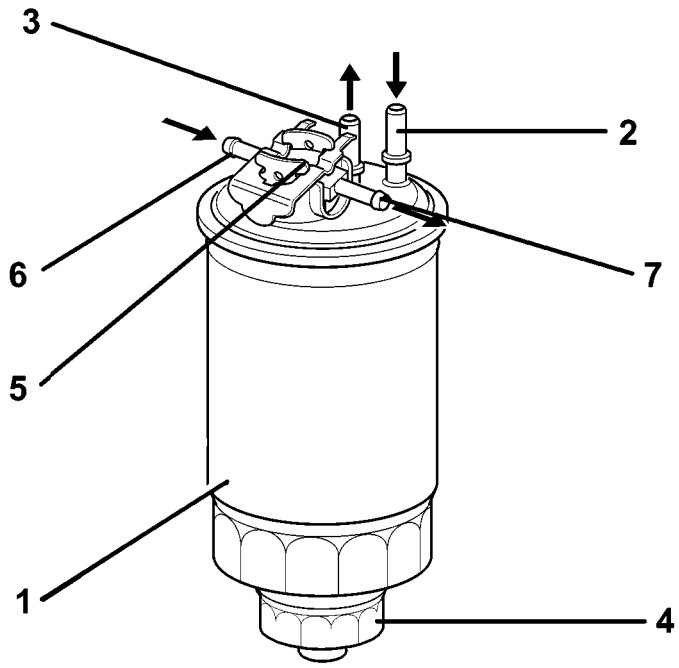


1910 D

CONSTRUCTION FEATURES

1910 D

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 5300 cm and a filtration degree of 4/5 mm. At the bottom there is a plug (4) for draining water. At the top there are two quick-fit connections, (2) inlet from tank, (3) outlet for injection pump. At the top there is a thermal valve (5), to which are connected the return inlet pipe (6) and return outlet to the tank (7).



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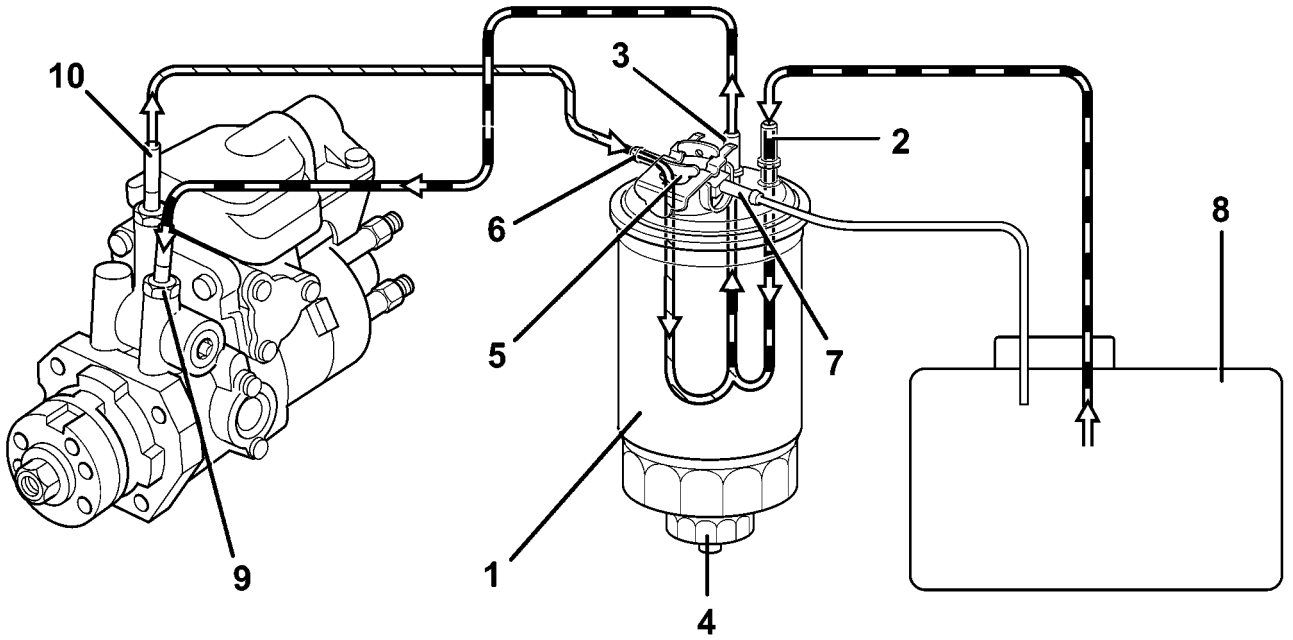
1, Filter element
2, Inlet (diesel delivery)
3, Outlet (diesel delivery)
4, H2O discharge plug (from filter)
5, Return thermal valve
6, Return inlet
7, Return outlet (to tank with diesel > temp°)

OPERATION WHEN COLD (thermal valve)

1910 D

If at the diesel filter the temperature is <15±2 C°, the thermal valve (5) shuts off the return flow to the pipe (7), making the return within the filter (1), and not to the tank (8), thus helping keep the temperature above the diesel solidification threshold.



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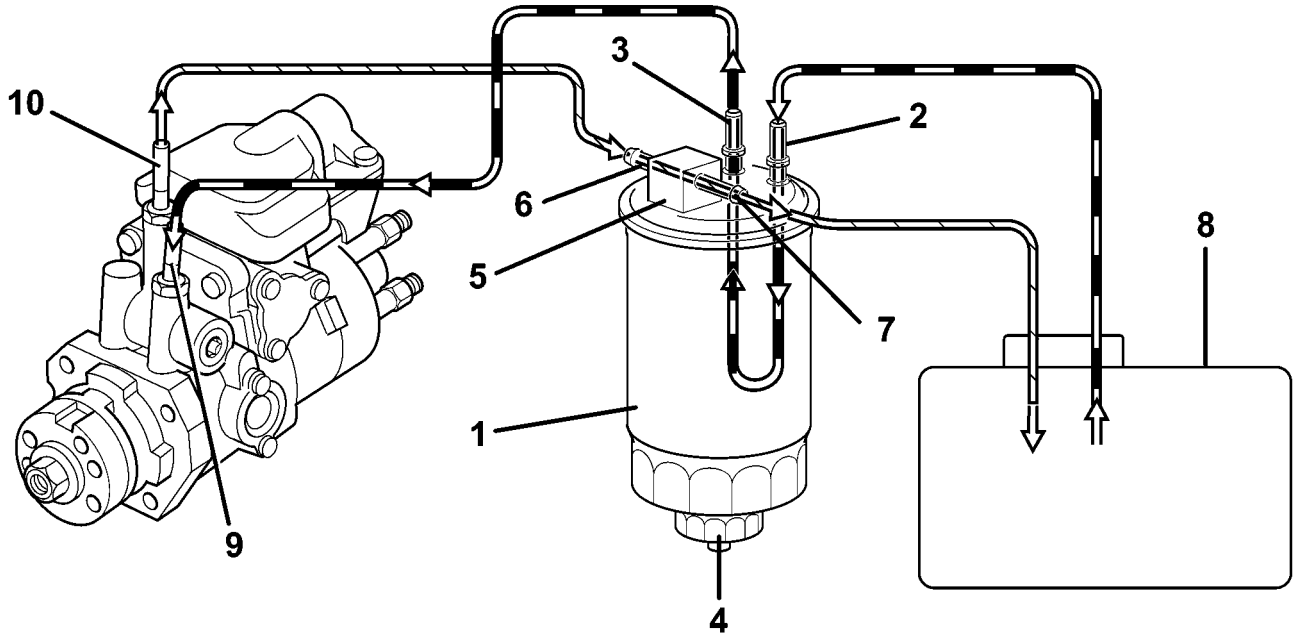
1, Filter element
2, Inlet (diesel delivery)
3, Outlet (diesel delivery)
4, H_2O discharge plug (from filter)
5, Return thermal valve
6, Return inlet
7, Return outlet (to tank with diesel > temp°)
8, Fuel tank
9, Pump inlet (injection)
10. Pump return outlet (injection)

OPERATION WHEN HOT (thermal valve)

1910 D

If at the diesel filter the temperature is > 15±2 C° the thermal valve (5) keeps the pipe (7) open, thus allowing the diesel to flow back to the tank (8).



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1, Filter element
2, Inlet (diesel delivery)
3, Outlet (diesel delivery)
4, H_2O discharge plug (from filter)
5, Return thermal valve
6, Return inlet
7, Return outlet (to tank with diesel > temp°)
8, Fuel tank
9, Pump inlet (injection)
10, Pump return outlet (injection)

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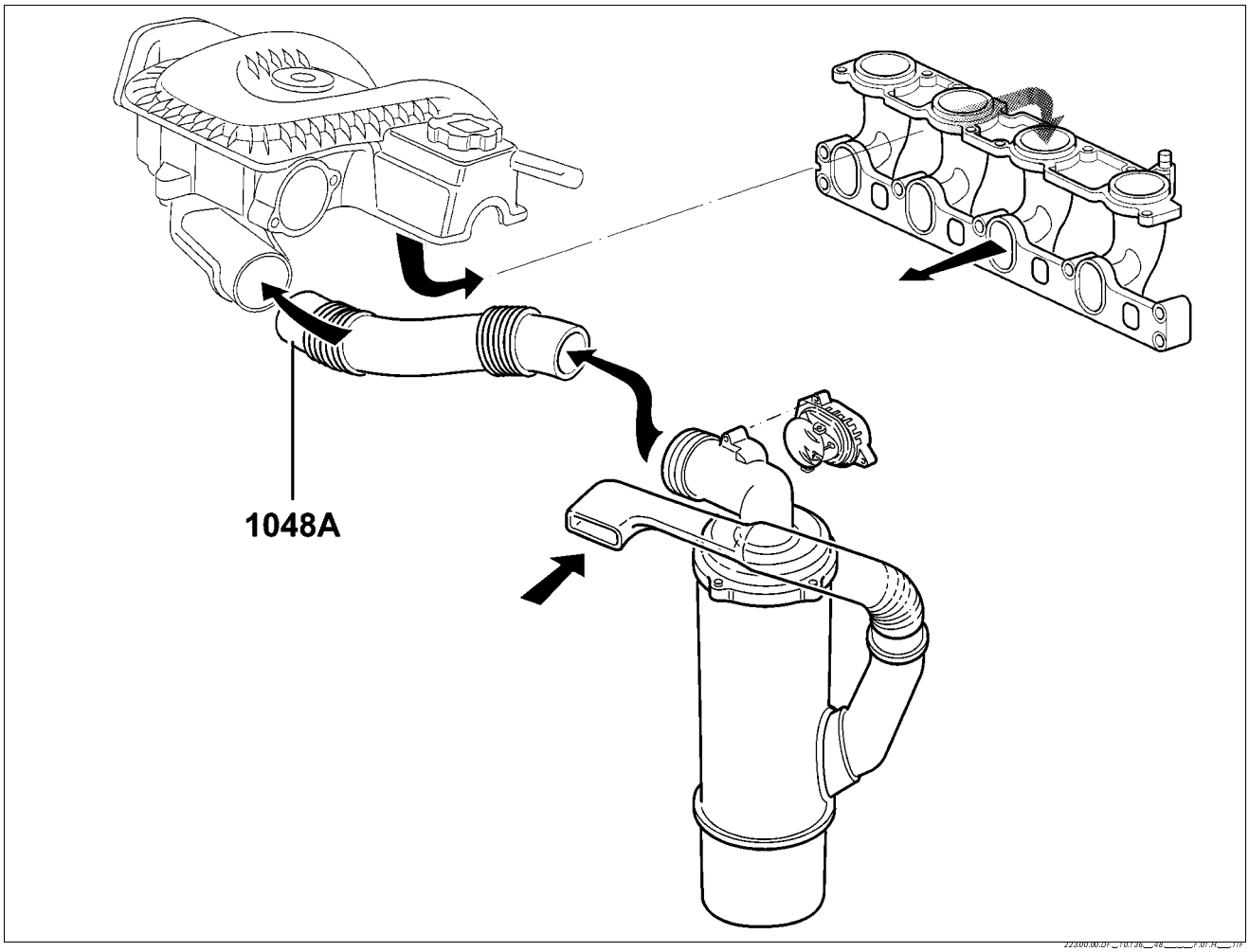
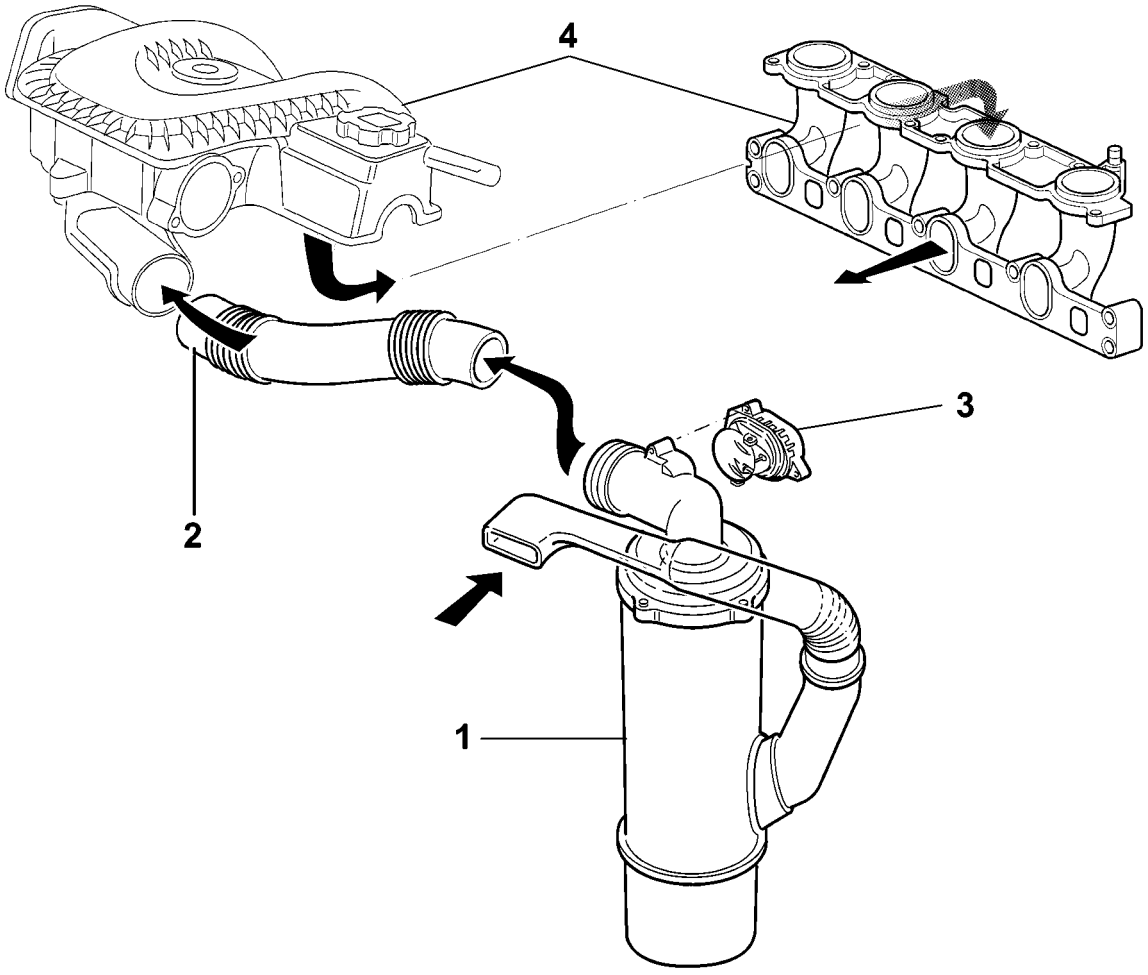


1910 D

CONSTRUCTION FEATURES

1910 D

Intake air is filtered and conveyed to the intake manifold.



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1, Complete filter
2, Sleeve
3, Throttle E.V. body
4, Intake chamber

THROTTLE BODY

Specifications

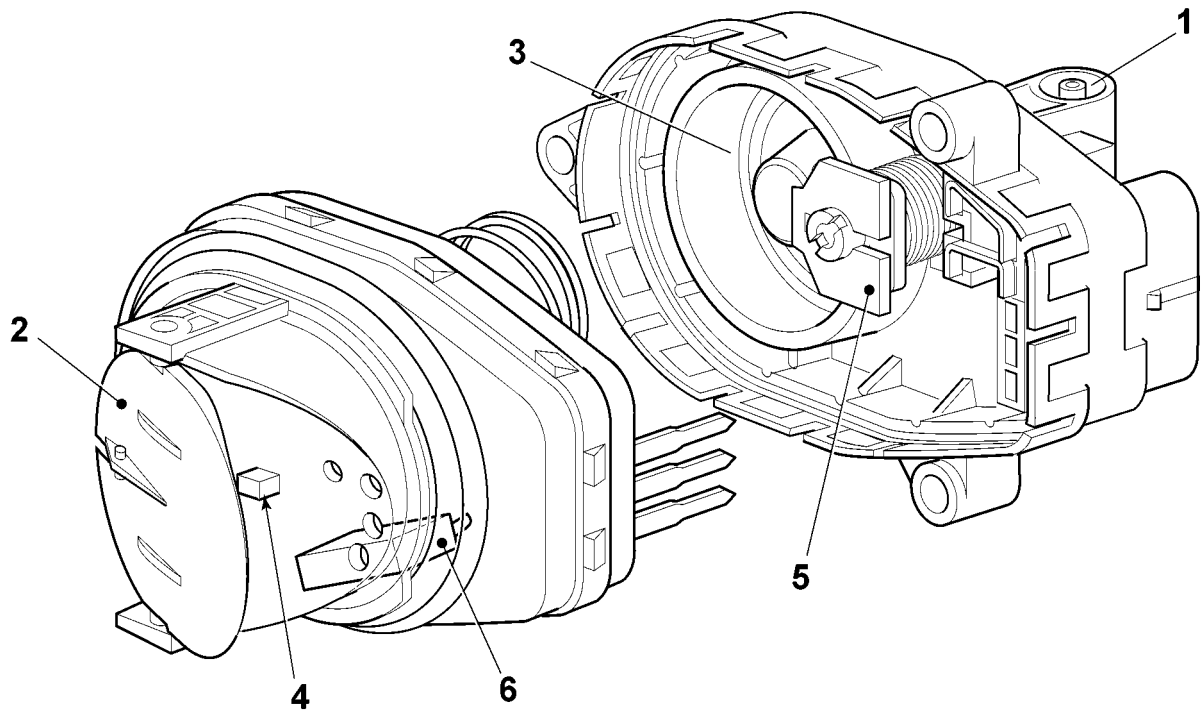
1910 D

A throttlle body is fitted on the clean air intake line. This by-passes the air flow (in accordance with a map established experimentally) to increase the percentage of exhaust gas recirculated to the intake so that the exhaust nitrogen oxide (NOx) emissions are further reduced.

Components

1910 D

The diagram below illustrates the composition of the throttle body.



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1, Vacuum pipe attachment (brake servo)
2, Throttle
3, Pneumatic actuator
4, Air temperature sensor
5, Coil for opening/closing ducts (between intake pressure and vacuum pump pressure)
6, Micro switch (throttle position signal)

Operation

1910 D

The throttle opening and closing function is subordinate to the E.G.R.

With air temperature >20°C and the engine under low or medium load, the E.C.U. positions the throttle in two ways:
- Fully open
- Partially open

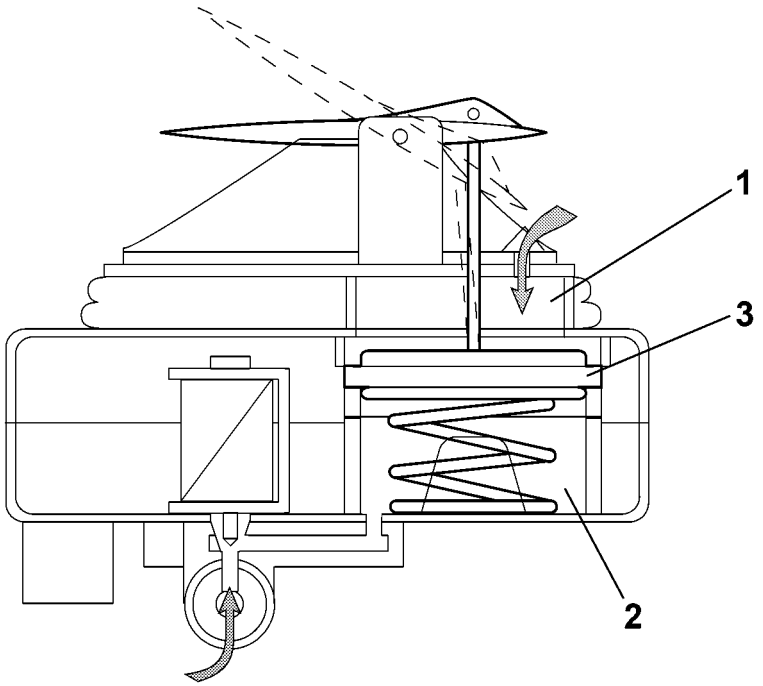
The positions assumed on the basis of the parameters read by the E.C.U. have been designed by experimentation in order to fall within the strictest pollution control regulations.
When the engine is under full load, or if there is a sudden power demand, the throttle will be open.
At the same time, the microswitch informs the E.C.U. of the throttle position.
The microswitch is constantly monitored by the E.C.U. If the throttle status is not as specified by the E.C.U., the latter sets a recovery (called aid map) which limits the engine's performance.

Pressure operation

1910 D

Within the throttle body there are two chambers, separated by a diaphragm (3) with different pressures.

The intake pressure circulates in the chamber (1). On a command from the E.C.U., the chamber (2) communicates with the brake servo pressure circuit; the difference in pressure between the two chambers moves a diaphragm which, by means of a link rod, moves the throttle.



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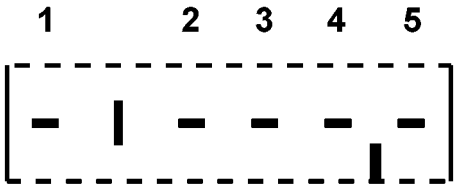
1, Intake pressure chamber
2, Pressure chamber (brake servo)
3, Diaphragm

THROTTLE E.V. PIN-OUT WITH WIRING DISCONNECTED

1910 D

The diagram below shows the throttle body connector.



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1, Earth
2, Solenoid control (ECU pin 29)
3, Air temperature (ECU pin 4)
4, Earth (ECU pin 65)
5, Throttle position (ECU pin 48)

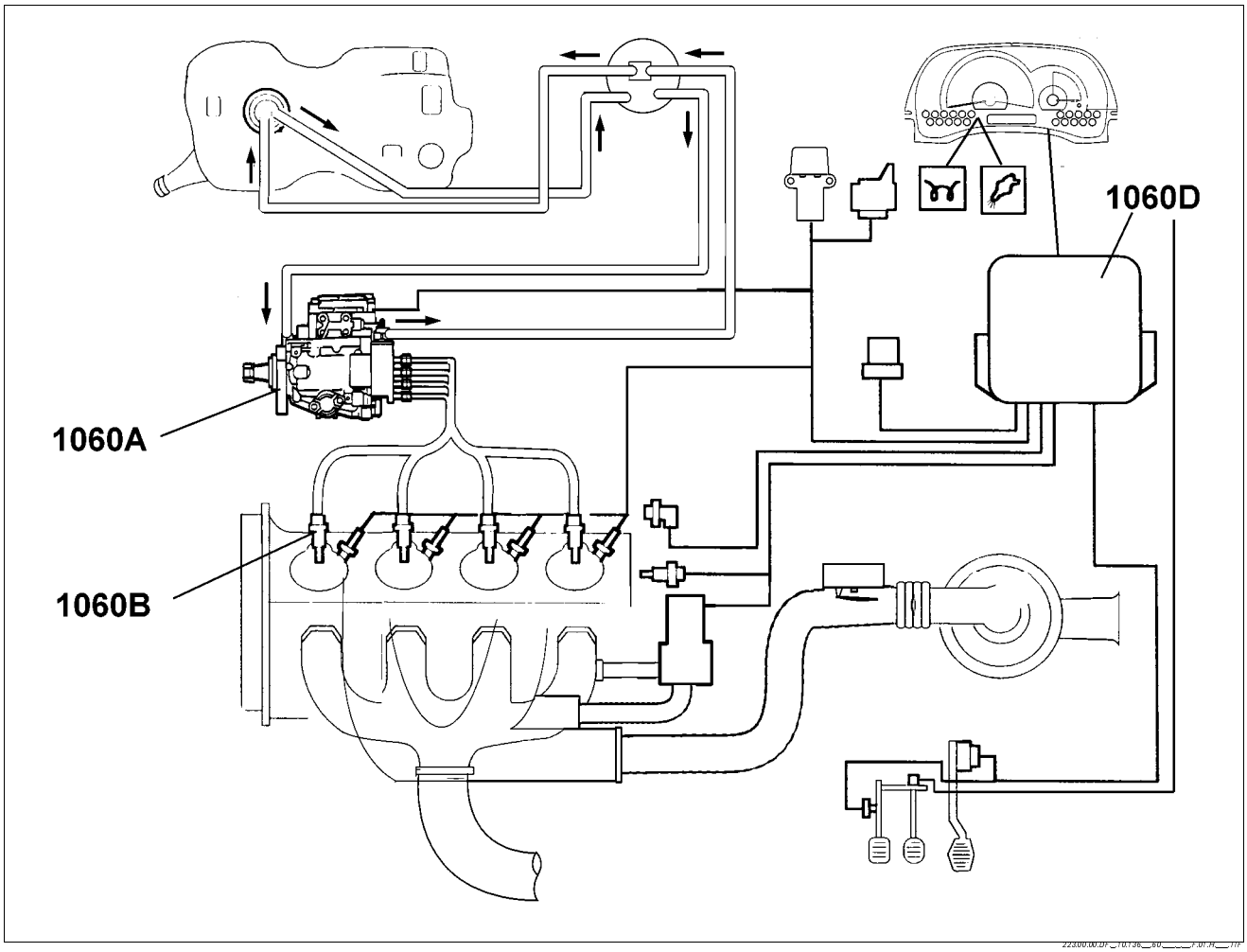
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- SPECIFICATIONS:

Assembly drawings index

Cmp	Description	Validity
1060A	Diesel injection pump and control	1910 D
1060G	Pressure pump electric control	1910 D

SUB-GROUP GRAPHIC INDEX



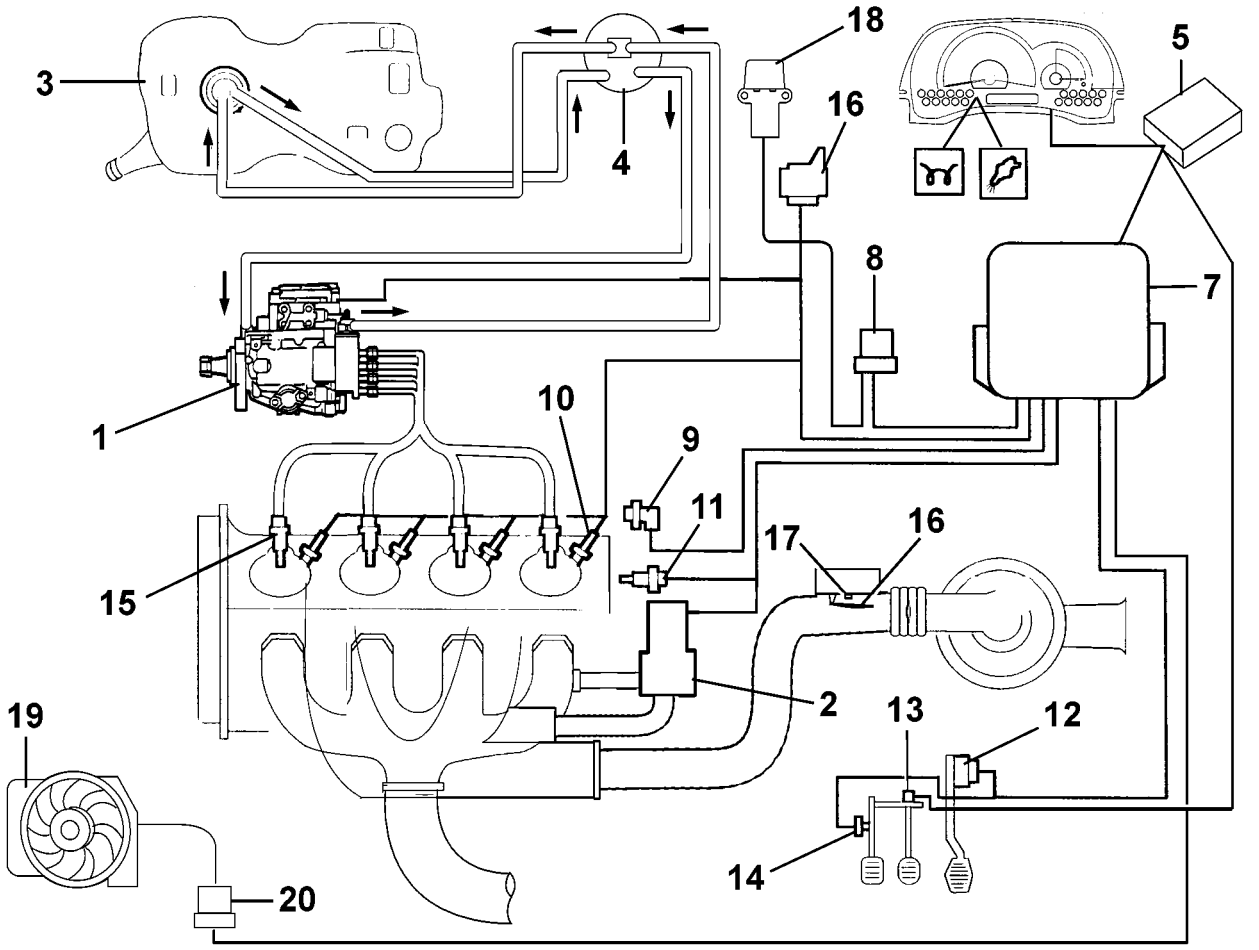
1910 D

SPECIFICATIONS:

VIEW OF ASSEMBLY

1910 D

The figure below shows a view of assembly.



1, Injection pump
2, EGR modulating solenoid valve
3, Fuel tank
4, Fuel filter
5, Body computer
6, Glow plug preheating electronic control unit
7, Electronic control unit
8, System supply relay
9, RPM and TDC sensor
10, Glow plug
11, Coolant temperature sensor
12, Accelerator pedal potentiometer
13, Brake pedal switch (CAN)
14, Switch on clutch pedal
15, Injectors
16, Throttle valve
17, Air temperature sensor
18, Inertia switch
19, Engine fan
20, Engine fan relay

1910 D

1060A - Diesel injection pump and control

1910 D

1910 D

Construction features

LUCAS e.p.i.c. DIESEL INJECTION (stage 3)

1910 D

The EPIC pump is of the 'rotary distributor' type, based on the pumping/distribution principle, and it ensures the following functions:
- supply of fuel to the injectors;
- metering of the fuel;
- injection advance.

1910 D

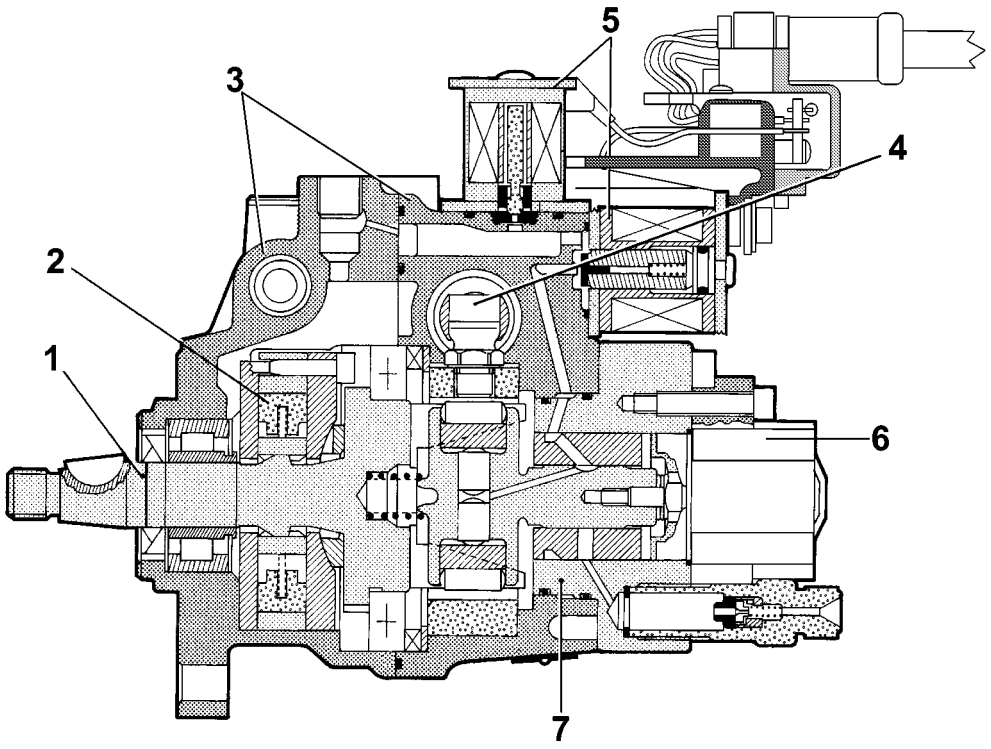
COMPOSITION

1910 D

The E.P.I.C. (Electronically Programmed Injection Control) system consists of:
- A fuel injection pump complete with controls and solenoids.
- A D.C.U. control unit (Diesel Control Unit).
- Sensors.

The EPIC pump is of the 'rotary distributor' type based on the principle of pumping/distribution. A pump consisting of a body (3) divided into two parts, which encloses the drive shaft (1), transfer pump (2) with the regulation device, hydraulic head unit (7) and advance device (4).
Some sensors (6) and solenoids (5) are applied to the pump.
The quality of injected fuel and the start of injection are controlled by the D.C.U. Two sensors outside the pump collect information on the parameters to be sent to the D.C.U.

The D.C.U. analyses the various information using a special application software. It then starts with the commands to the solenoids present on the pump to determine the corrections.



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1910 D

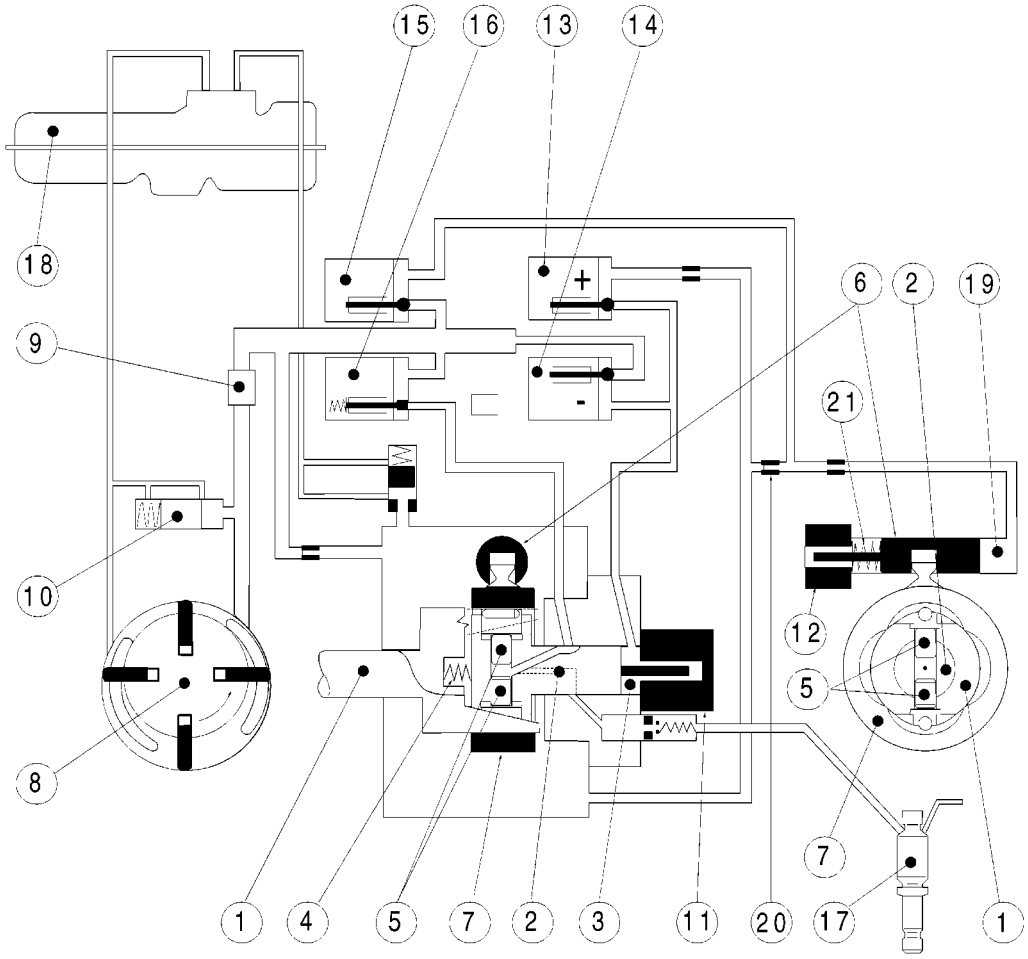
OPERATION

1910 D

Amount of fuel injected and injection start point are controlled by an electronic control unit.
The electronic control unit analyses the data using special application software. It then communicates with the controls and solenoids in the pump to control pump actions.

The EPIC system:
- meets current and future emission control regulations;
- reduces fuel consumption;
- increases efficiency;
- improves driving conditions;
- adapts its specifications easily to different applications.

DIAGRAM SHOWING INTERNAL SUPPLY PUMP CIRCUIT COMPONENTS



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1, Drive shaft
2, Distributor rotor
3, Rotor cavity
4, Counterspring
5,Pump elements
6,Advance piston
7,Cam ring
8,Transfer pump
9,Fuel filter
10,Transfer pressure regulator
11,Rotor position sensor
12,Cam position sensor
13,Flow + solenoid
14,Flow - solenoid
15,Advance solenoid
16,Stop solenoid
17,Injector
18,Fuel tank
19,Control chamber
20,Calibrated hole
21,Reaction spring

TRANSFER PUMP

Specifications

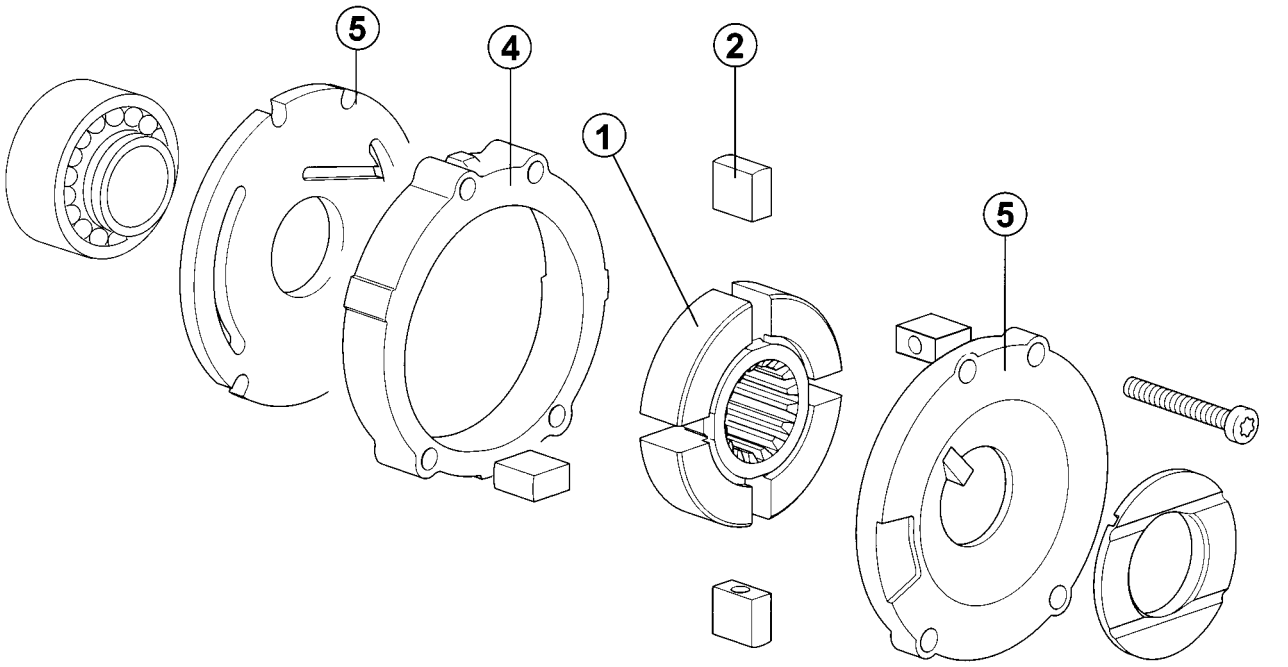
1910 D

The transfer pump located inside the injection pump is volumetric vane-type.
It takes up fuel from the tank and sends it under pressure (transfer pressure) to the actuators and compression chamber to make an injection.

Components

1910 D

The transfer pump is fitted on the drive side of the pump. It is volumetric, intake-compression type. It consists of a rotor (1), stator (4), four steel brushes (2) and a sealing plate (5).



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Operation

1910 D

The rotor is integral with the drive shaft and turns the four brushes (2) on the stator (4), which is secured to the pump case. Contact between the brushes and stator cam profile gives rise to volume changes that generate pressure changes.

DRIVE

Specifications

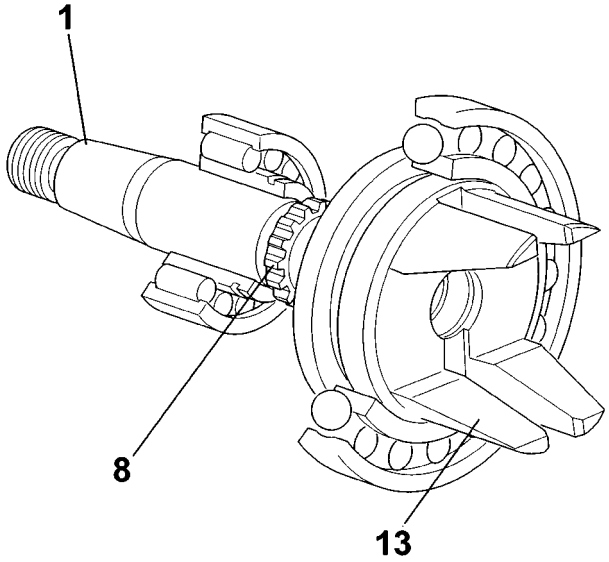
1910 D

Drive shaft (1) ensures a connection between motor distribution and pump hydraulic head.

Components / operation

1910 D

The shaft drives transfer pump (8) and roller carrier ramp (13).



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TRANSFER PRESSURE REGULATION VALVE

Specifications

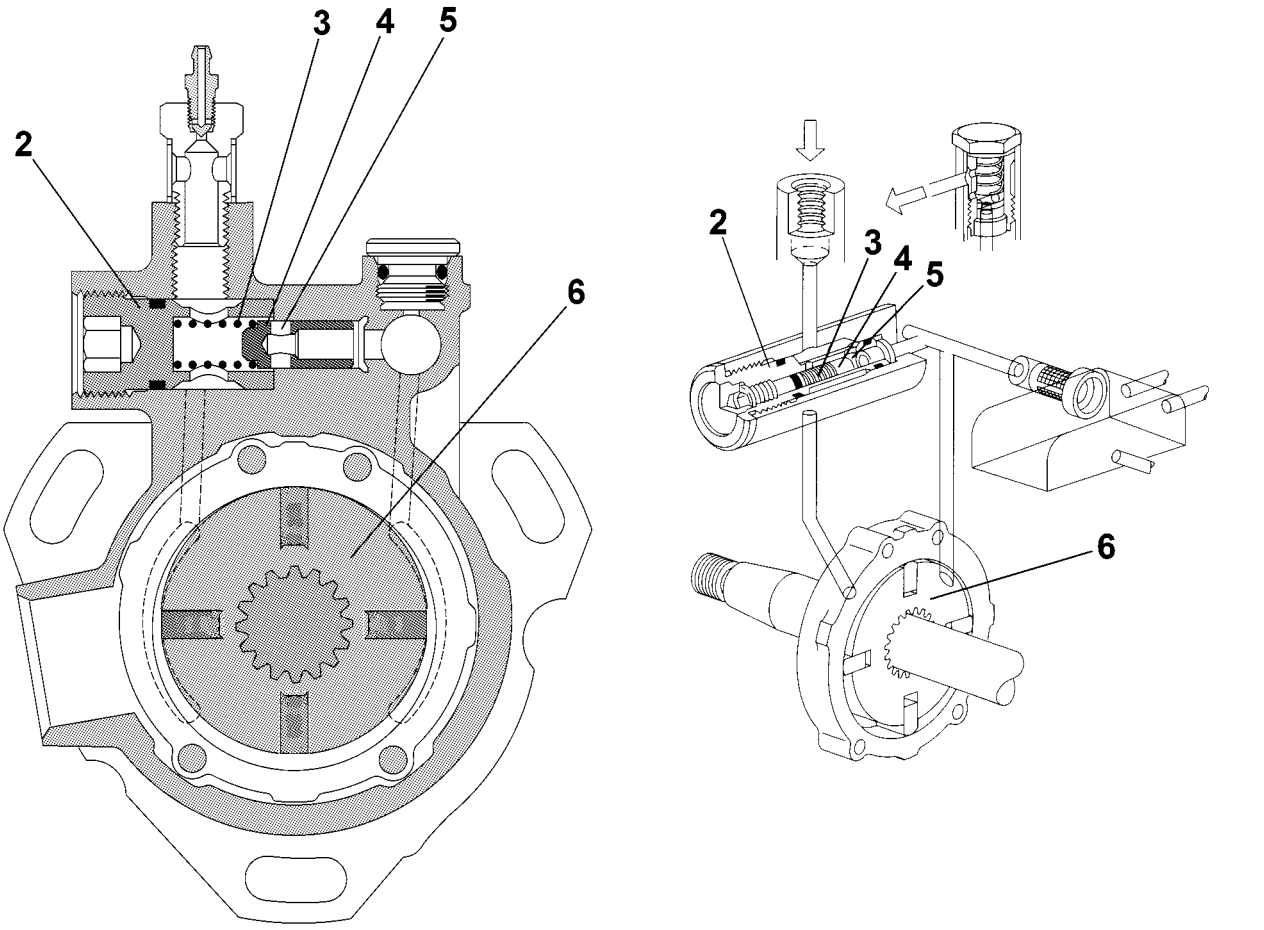
1910 D

The transfer pressure regulation valve screwed into the pump case controls transfer pressure in relation to rotation speed.

Components

1910 D

It consists of a screw (2) that contains piston (4) and spring (3).



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Operation

1910 D

Pressure generated by transfer pump (6) exercises a thrust on the base of piston (4).
When this force exceeds the preload of spring (3), the piston moves and uncovers drain hole (5), thus limiting pressure to the required level.
Maximum transfer pressure is achieved at low speeds.

HYDRAULIC HEAD

Specifications

1910 D

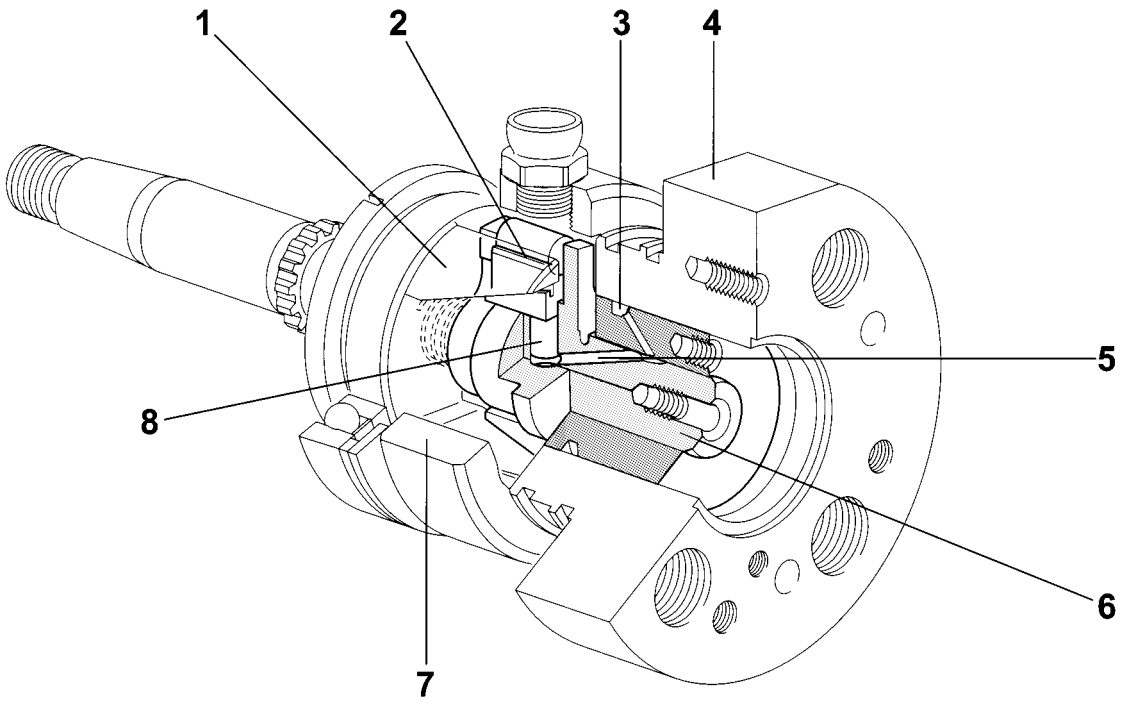
The hydraulic head assembly performs metering-pumping and distribution functions.

Components

1910 D

This assembly consists of:
- a stator (4) or single hydraulic head;
- rotary distributor (6), which includes a pumping element made up of two counter-acting pistons (8).

The rotor is coupled to the hydraulic head and the pumping pistons are coupled to the rotor.



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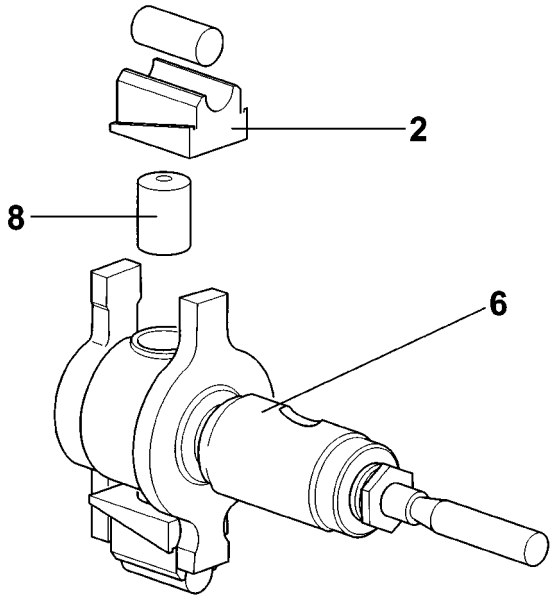
1910 D

Distributor rotor



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Operation

1910 D

Diesel is driven by the transfer pressure to rotor channel (5) via supply channel (3) during the filling stage.
The pump pistons open to push roller carrier pads (2) into contact with drive shaft ramps (1).
When the rotor turns, channel (5) communicates with one of the drainage holes on the hydraulic head. At the same time, the rollers come into contact with the two opposing protrusions on cam ring (7). This presses the two pistons against one another and pressurises the pumping element.
The cycle is repeated for each exit corresponding to each engine cylinder.

CAM RING

Specifications

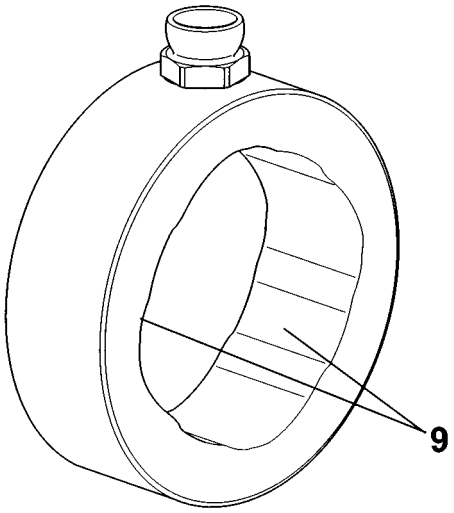
1910 D

The cam ring allows the pump element to create a high pressure.

Components

1910 D

The cam ring takes the form of a ring. Diametrically opposed protrusions (9) are precision-machined inside the ring.
The shape of these protrusions determines pump injection duration and controls the properties of each injection stage.



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Operation

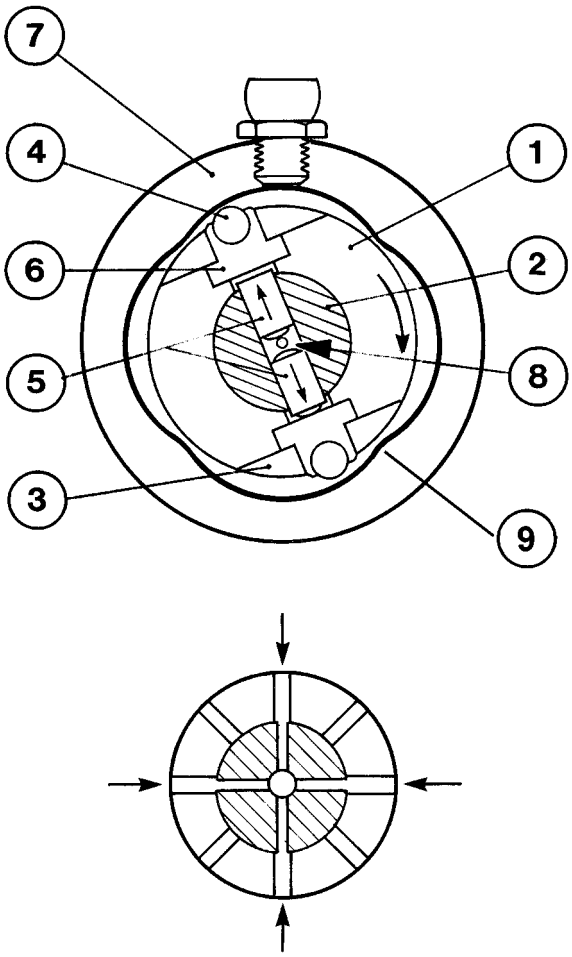
1910 D

Injection begins at the moment the rollers come into contact with the cam protrusions and continues until they reach the end of the cam (9).
When the rotor turns, the rollers are no longer in contact with the cam ring. Low pressure is restored inside the rotor and it refills.

Fuel intake

1910 D

The figure below shows:
- STAGE A: fuel intake into compression chamber



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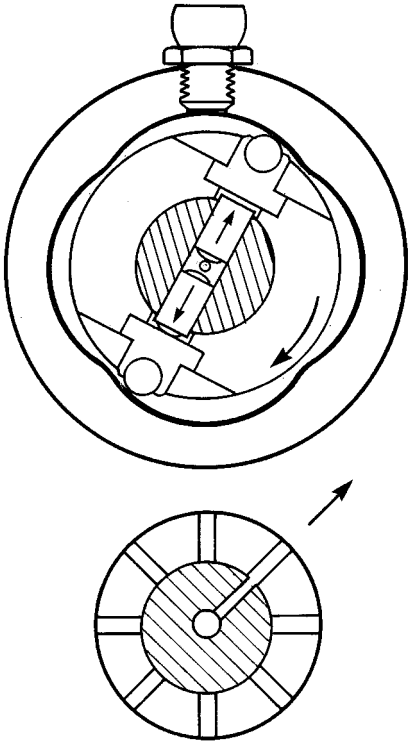
1, Drive shaft
2, Rotary distributor
3, Ramps
4, Rollers
5, Pump elements
6, Pad
7, Cam ring
8, Compression chamber
9, Cams

Fuel intake

1910 D

The figure below shows:
- Stage B: fuel delivery to injector



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HIGH PRESSURE OUTLETS

Specifications

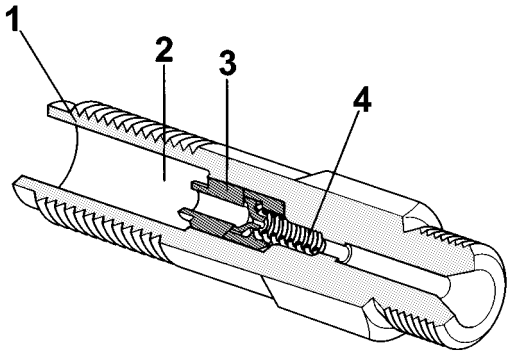
1910 D

Valves in the high pressure outlets prevent the injector pintle rising a second time.

Components

1910 D

Each high pressure outlet connection (1) encloses a valve (3) and a spring (4) and a dead volume chamber (2).



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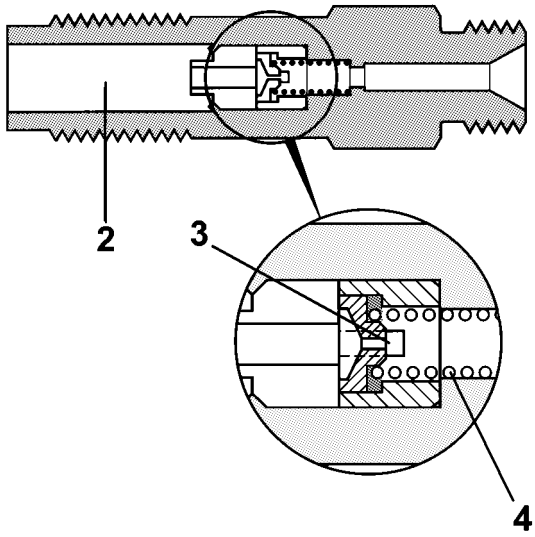
Operation

1910 D

During the 'injection' stage, the valve (3) rises, compressing the spring (4). The pressure waves generated at the end of injection could cause the injector pintle to rise again and secondary injections to take place. The valve therefore acts as a pressure wave damper, i.e. it encloses pressure waves inside the dead volume (2) of the high pressure outlet fitting.



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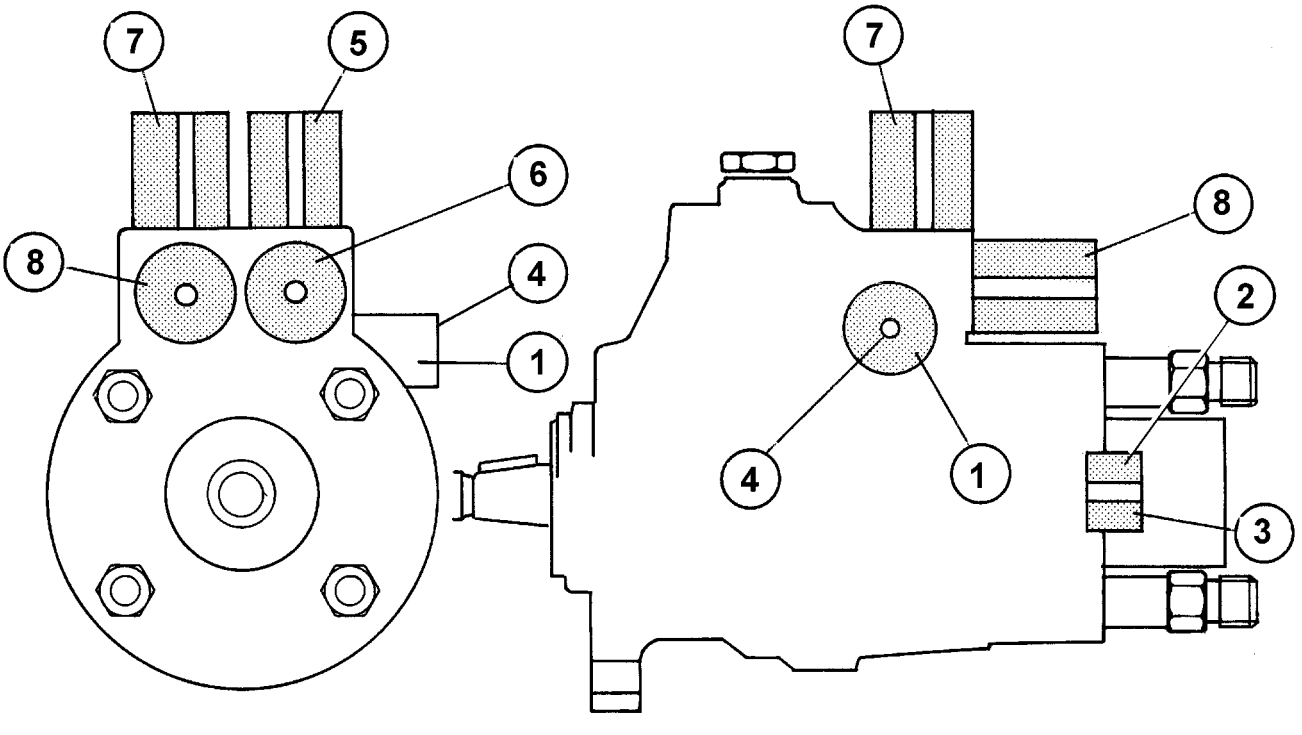
LOCATION OF COMPONENTS ON THE PUMP

1910 D

The figure below shows the location of the pump components.
The pump is equipped with the following devices:



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1, Fuel temperature sensor

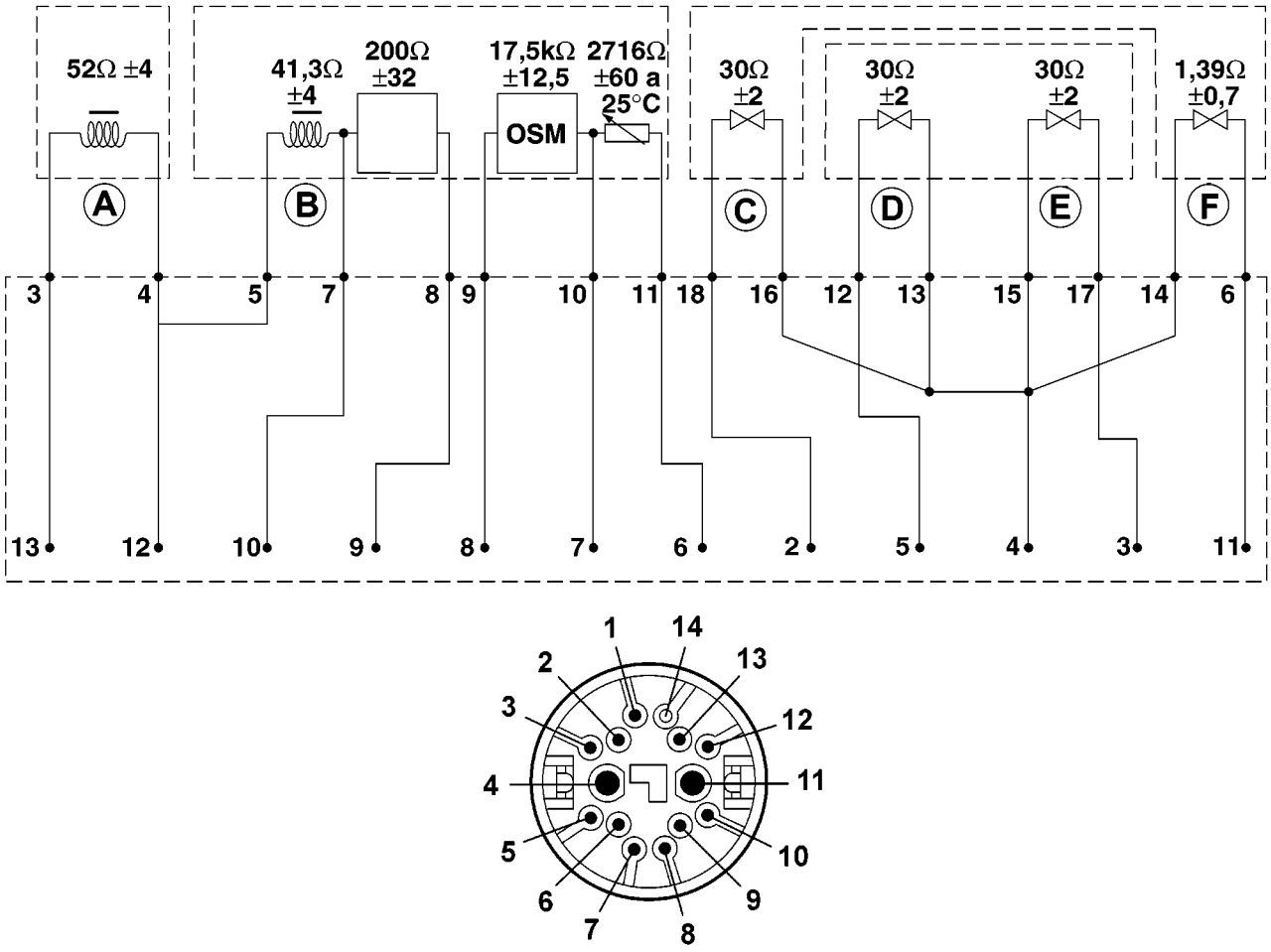
2, Sensor memory (OSM)

3, Rotor position sensor
4, Cam position sensor
5, Flow solenoid +
6, Flow solenoid -
7, Advance solenoid
8, Stop solenoid

INJECTION PUMP PIN-OUT WITH CONNECTOR DISCONNECTED

1910 D

The figure shows an internal diagram of the injection pump and the control unit pin out.



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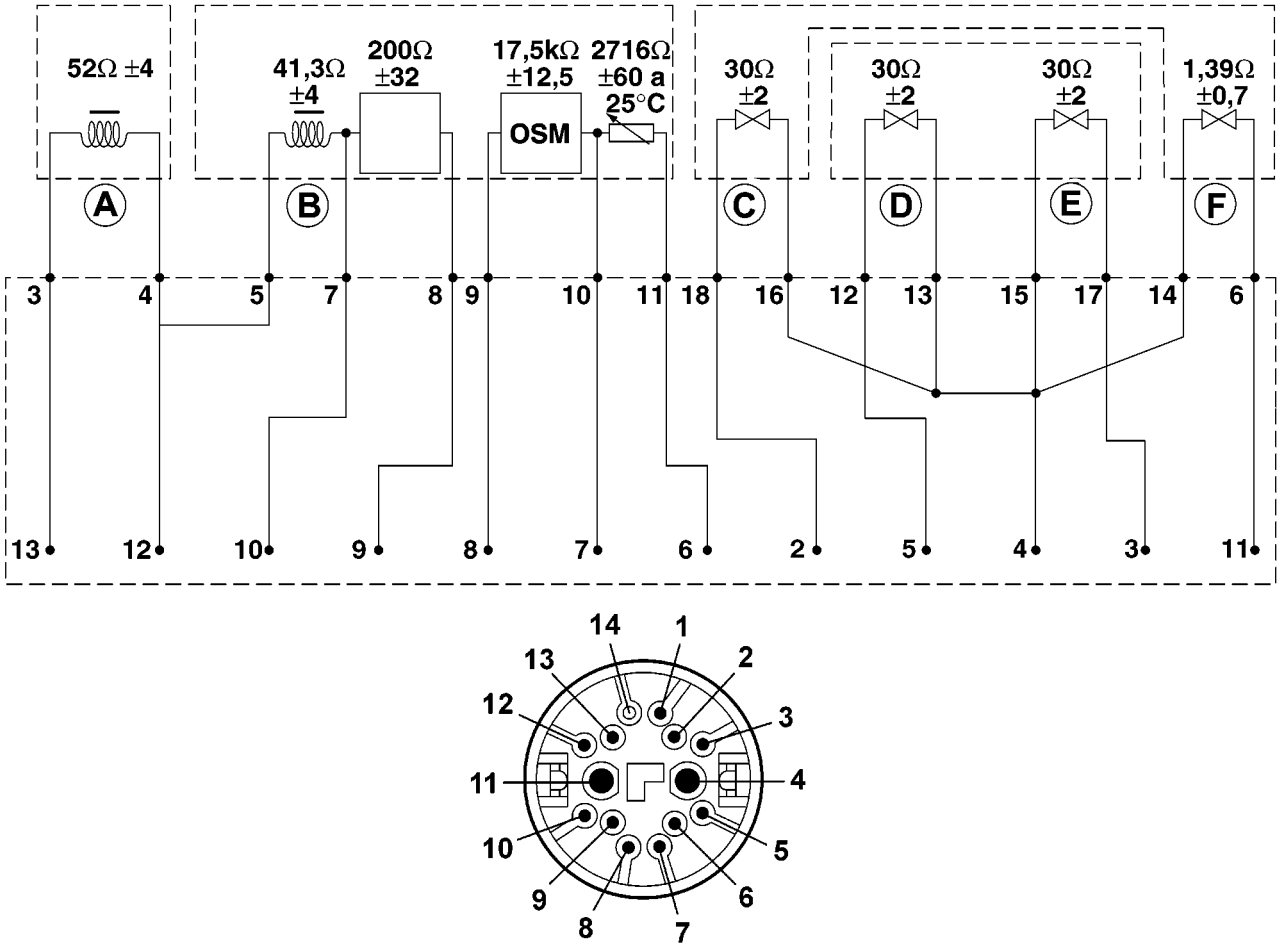
A. Advance sensor
B. Rotor position sensor
C. Rotor filling actuator (-)
D. Rotor emptying actuator (+)
E. Advance actuator
F. ESOS actuator
1, Screen earth (to ECU pin 9)
2, Solenoid control - (to ECU pin 90)
3, Cam solenoid control (to ECU pin 89)
4, Ignition-operated power supply (+15)
5, Solenoid control + (to ECU pin 60).
6,Temp. intake diesel (to ECU pin 36)
7, Diesel and OSM temp. sensor earth (to ECU pin 67)
8, Input to OSM sensor memory (to ECU pin 51)
9, Rotor compensation resistor (to ECU pin 12)
10, Rotor sensor input (to ECU pin 14)
11, Electrostop control (to ECU pin 30)
12, Rotor and cam position sensor power supply (to ECU pin 15)
13, Cam sensor input (to ECU pin 13)
14, N.C.

WIRING PIN-OUT WITH CONNECTOR DISCONNECTED

1910 D

The figure shows an internal diagram of the control unit and pin out of the connector, wiring side.



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A. Advance sensor
B. Rotor position sensor
C. Rotor filling actuator (-)
D. Rotor emptying actuator (+)
E. Advance actuator
F. ESOS actuator
1, Screen earth (to ECU pin 9)
2, Solenoid control - (to ECU pin 90)
3, Cam solenoid control (to ECU pin 89)
4, Ignition-operated power supply (+15)
5, Solenoid control + (to ECU pin 60).
6,Temp. intake diesel (to ECU pin 36)
7, Diesel and OSM temp. sensor earth (to ECU pin 67)
8, OSM sensor memory input (to ECU pin 51)
9, Rotor compensation resistance (to ECU pin 12)
10, Rotor sensor input (to ECU pin 14)
11, Electrostop control (to ECU pin 30)
12, Rotor and cam position sensor power supply (to ECU pin 15)
13, Cam sensor input (to ECU pin 13)
14, N.C.

DELIVERY + AND DELIVERY - SOLENOIDS

Specifications

1910 D

The delivery + and delivery - solenoids regulate delivery.

Components

1910 D

Output is metered by the axial position of rotor (4). This alters the position of roller carrier (5) in relation to drive shaft ramps (6) to adjust maximum pump piston opening and thus the metered diesel quantity.

Output + solenoid (1) and output - solenoid (2) are fastened to the pump case above the hydraulic head and connected electrically to the control unit. They are governed by an ON-OFF control.
These control volume (3) of diesel in the rear part of the rotor and are closed when supplied with electricity.

Operation

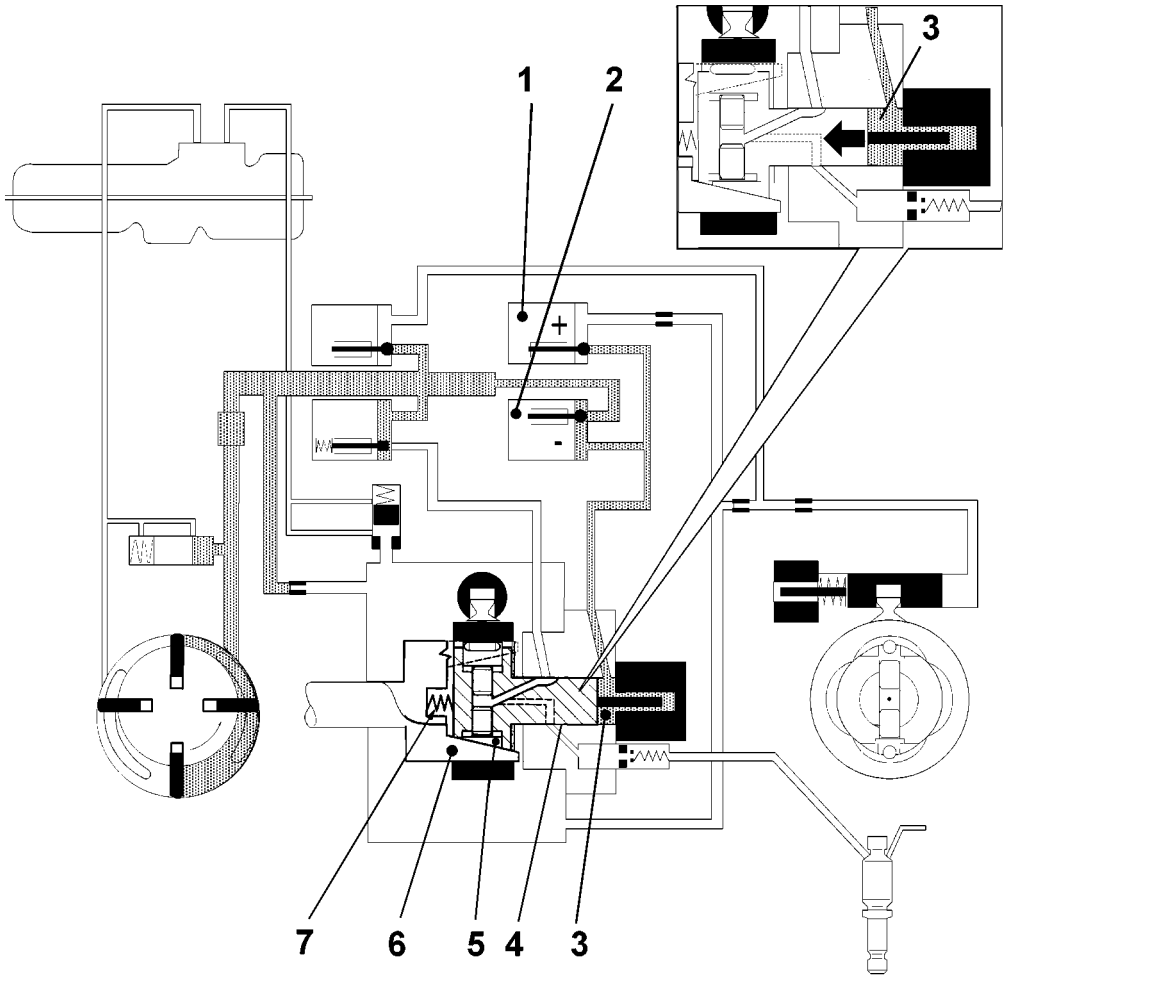
1910 D

When output - valve is open, volume is increased via the transfer pressure. The rotor moves, compressing the spring (7); it thus also limits the maximum opening of the pump pistons and so the amount injected.
Opening of the + solenoid causes a leak from rotor compartment (3) towards the internal pressure, thus reducing the volume and allowing the rotor to move under the action of spring (7) towards the maximum output position.

Reduced Output

1910 D

The figure below shows the circuit in the reduced output stage.



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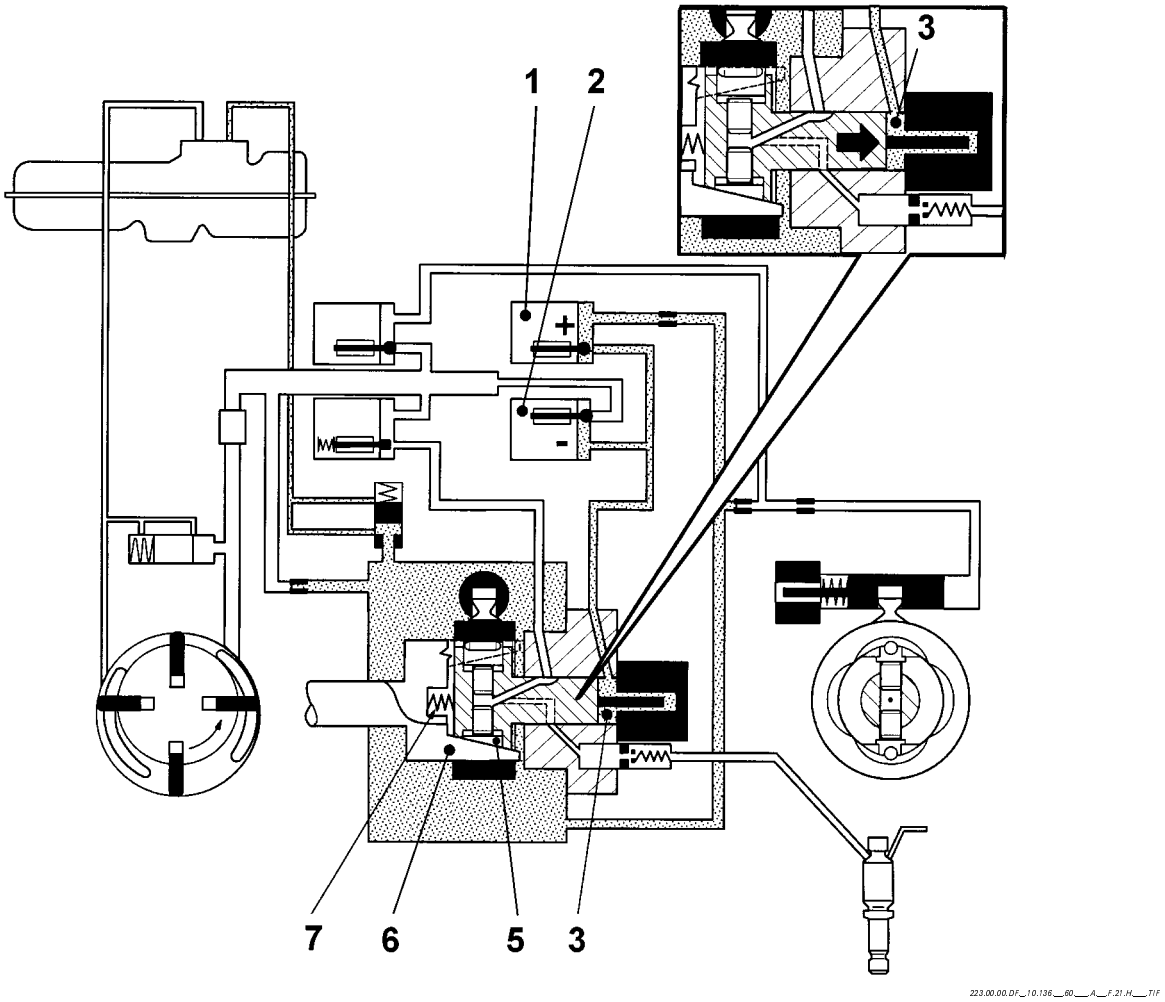
INCREASED OUTPUT

1910 D

The figure below shows the circuit in the reduced output stage.



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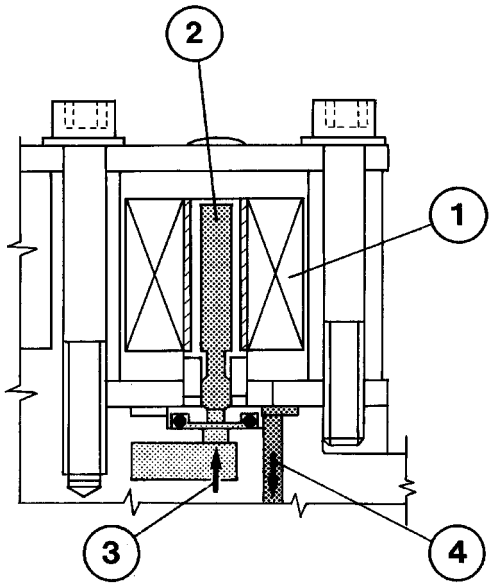
1910 D

Cross section of delivery + and delivery - solenoids.



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1, Winding
2, Core
3, Fuel input
4, Fuel output

ROTOR POSITION SENSOR

Specifications

1910 D

The rotor position sensor records the axial position of the hydraulic head rotor and sends the information to the control unit.

Components

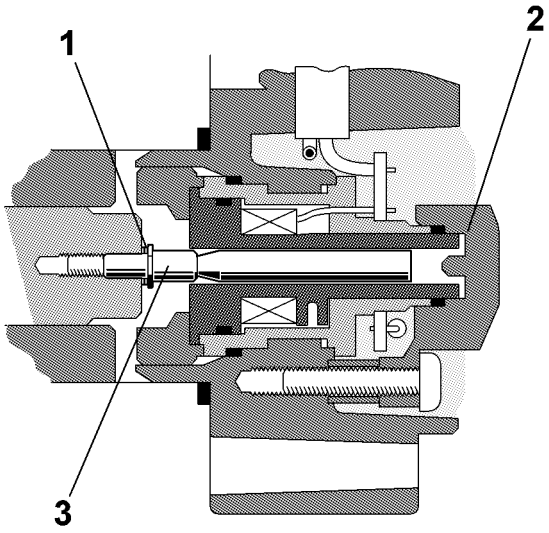
1910 D

Rotor position sensor (2) is fastened to the hydraulic head between the high pressure outputs. Core (3) of this inductive sensor is integral with the hydraulic head rotor and moves inside a coil to alter its inductance.

Operation

1910 D

One injected output value must correspond to each value measured by the computer. For this reason, core position in relation to the rotor is adjusted by shim (1) to allow pre-adjustment of the pump output.



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Memory in the sensor (OSM)

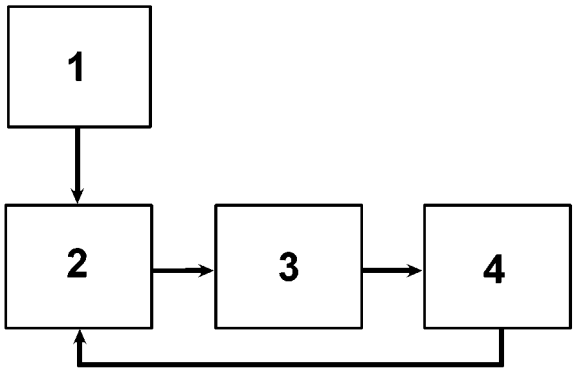
1910 D

The sensor memory forms an integral part of the pum rotor sensor. This memory contains the pump serial number, an advance setting map, an output setting map, delivery required for start-up and rotor sensor decoding values (in minimum and maximum positions).

Principle of closed-loop output control

1910 D

According to engine operating conditions, the control unit determines the output to be injected via the various sensors. The output corresponds to a set rotor position.
The control unit compares this position with the required position and, if necessary, corrects the setting by opening one of the two output + or output - solenoids for a calculated time period (a few milliseconds) to achieve the required displacement.



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1, Output required from pump
2, Required rotor position (rotor demand)
3, Action on + or - solenoid
4, Measured rotor position

STOP SOLENOID (ESOS)

Specifications

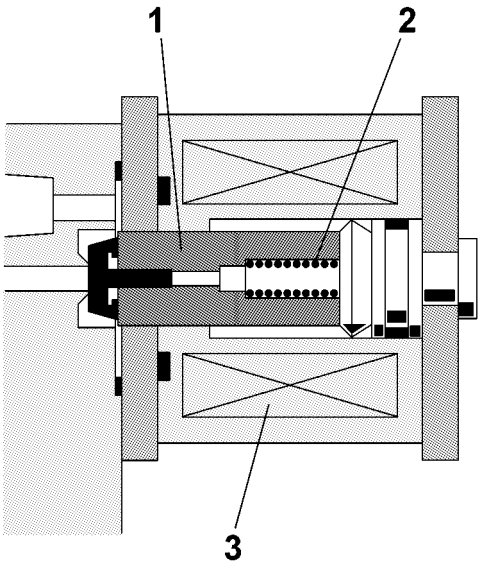
1910 D

The stop solenoid cuts off fuel supply to the hydraulic head rotor and thus stops the engine.

Components

1910 D

The stop solenoid (3) is secured to the pump case. It is reactivatable and thus may be closed and reopened with the engine running.



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running

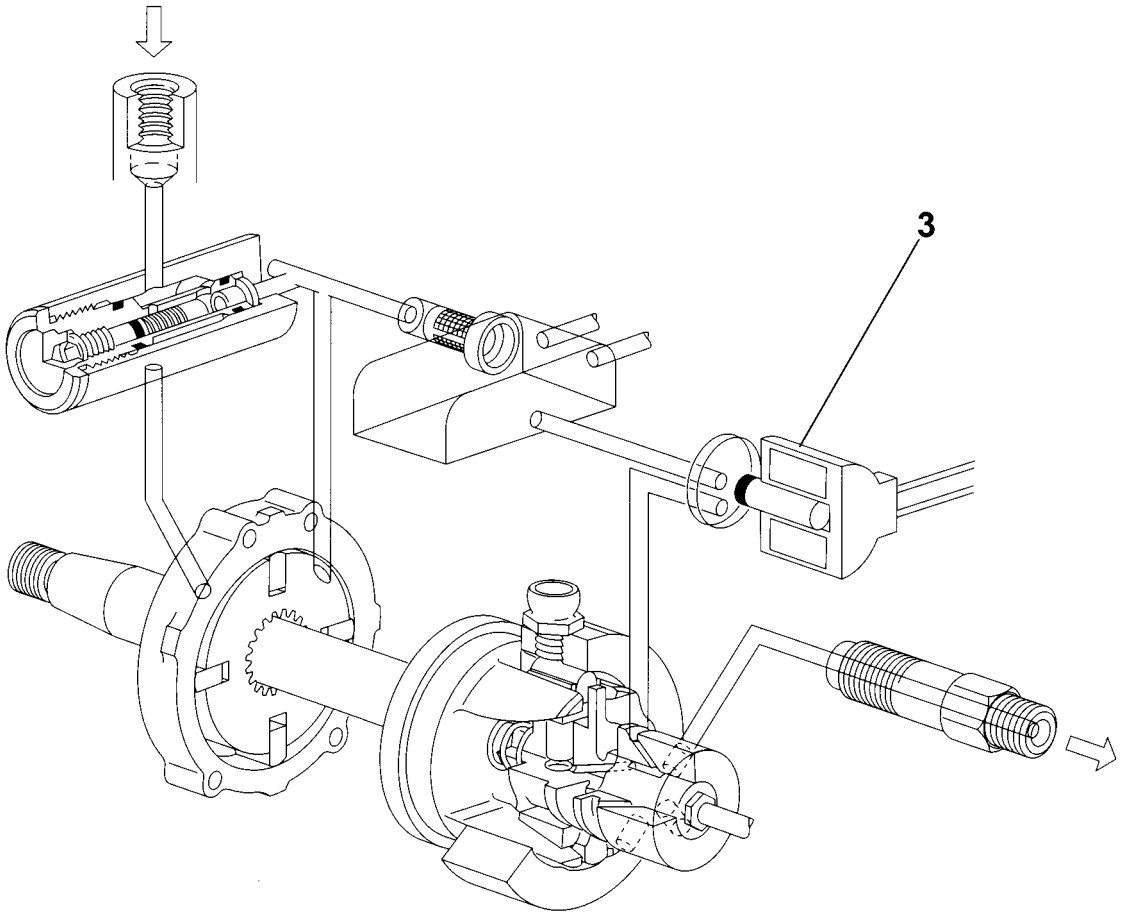
1910 D

ESO piston (1) is held in closed position by a spring (2). ESO coil (3) must be excited to lift the piston.

The ESO power supply is Pulse Width Modulated (PWM). - Refer to the Glossary for an explanation of PWM. The ECU modifies the ratio between on and off periods to provide the required current level during the 3 ESO operating stages; these stages are as follows:
- Engine off, panel on; the ECU sends a slight current to check the condition of the ESO circuit.
- While the engine is starting up, the ECU checks that the rotor is set to the required start-up position and transmits the maximum current for rapid ESO opening.
- When the ESO is completely open less current is required for keeping it in this position; the ECU therefore reduces the current as required.

To minimize black fumes during starting at temperatures above 0°C, the ESO is not operated until the pump rotor is in the correct position for starting. With T° = 18 °C the ESO is instantaneously operated during starting.

Do not supply the solenoid with continuous 12 V, as the winding could suffer damage.



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ADVANCE DEVICE

Specifications

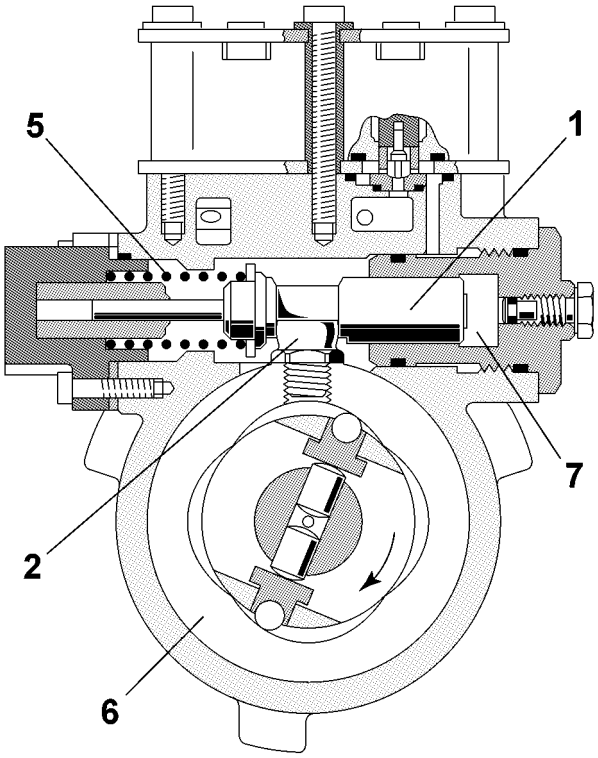
1910 D

The advance device adjusts the start of injection according to information gathered from the various sensors.

Components

1910 D

The advance device is built into the upper part of the case.
It consists essentially of an advance unit and a solenoid.
The advance unit consists of piston (1) connected to cam ring (6) via a ball-headed screw (2). The piston is subject to transfer pressure from side (7) and to the force of spring (5) from the other side.
Advance solenoid (3) is secured to the case.



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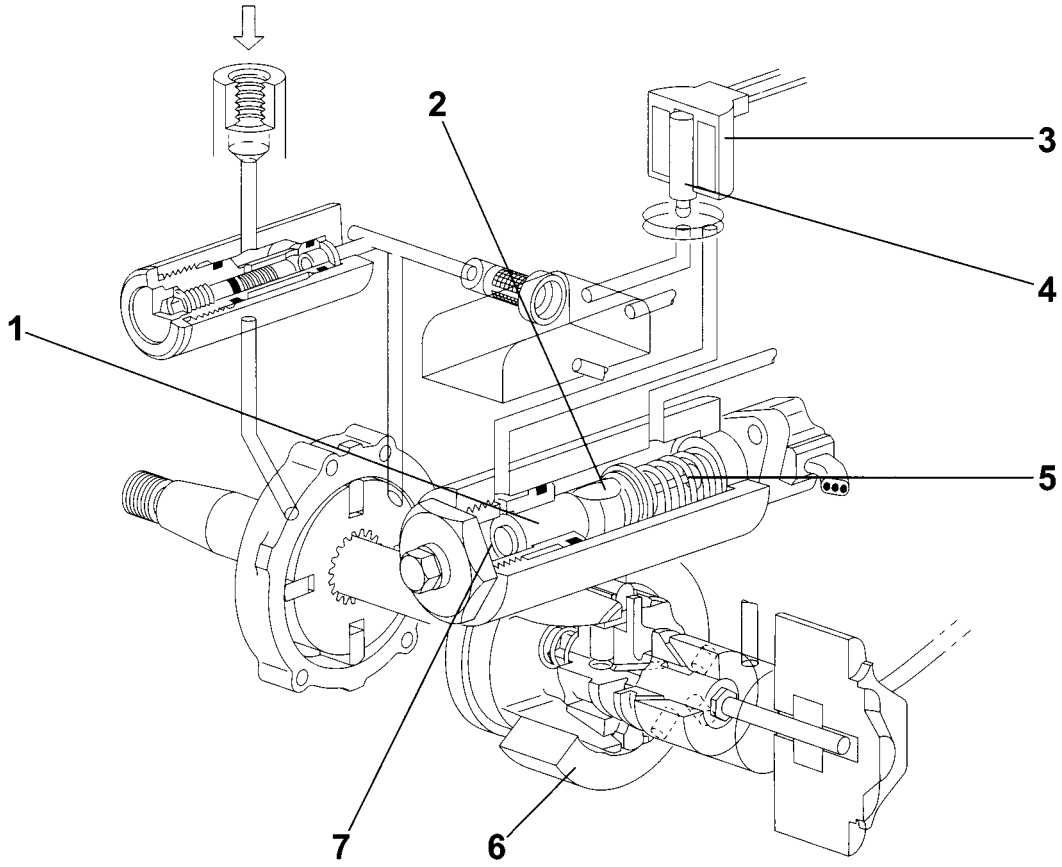
1910 D

Perspective view of the advance device



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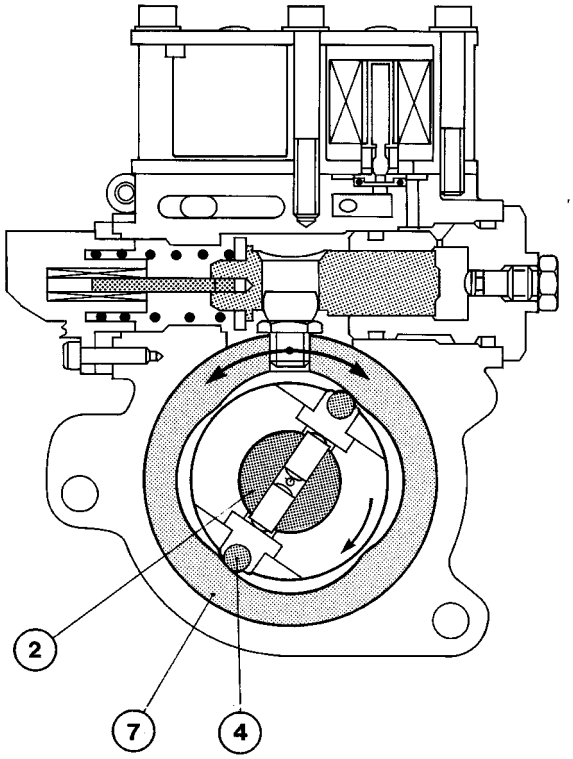
OPERATION

1910 D

Injection advance is determined by the offset between the start of injection and engine TDC.
The electronic control unit computes the injection advance according to rpm signals, atmospheric pressure and output. It makes corrections based on air tempererature and engine temperature.
Injection begins at the moment when rollers (4) of distributor rotor (2) come into contact with cam ring (7). This moment depends on the position of the cam ring and the position of the roller/pad/pump element assembly, which varies according to flow.
Injection advance changes are determined by the cam ring moving in relation to the distributor rotor drive shaft.



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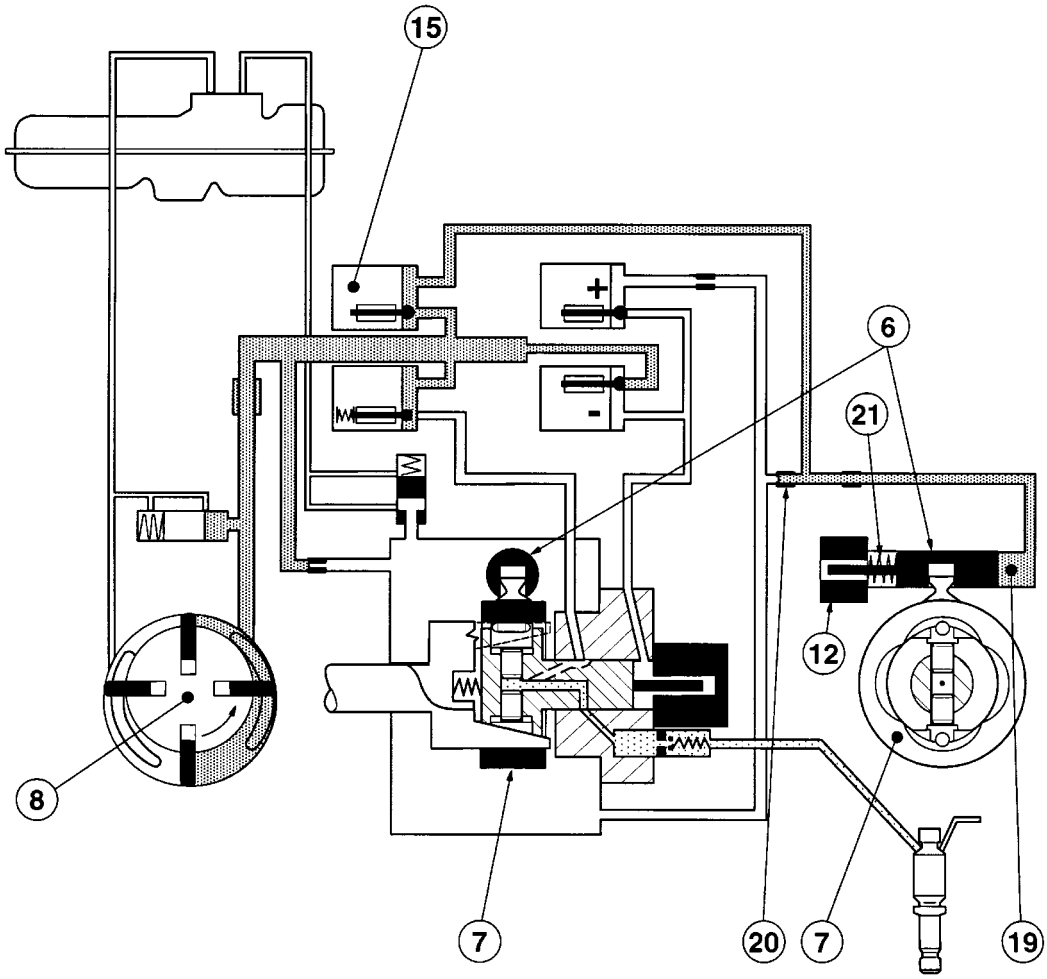
ADJUSTING INJECTION ADVANCE

1910 D

The angular position of cam ring (7) determines injection advance and is controlled by solenoid (15) controlled via PWM by engine control unit.
Ring angular displacement is brought about by the flow of fuel from transfer pump (8), which is directed under pressure into control chamber (19) and acts on piston (6), countered by reaction spring (21).
The fuel flow permitted by the solenoid increaes the injection advance,while calibrated hole (20) allows fuel to flow from the control chamber to reduce the advance.
Cam ring position is recorded by the control unit via a variable reluctance sensor (12) integral with the hydraulic control piston.

The engine management control unit compares actual injection advance with computed advance and, if necessary, the ECU then implements cam ring position corrections to ensure actual values coincide with calculated values.



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CAM POSITION SENSOR

Specifications

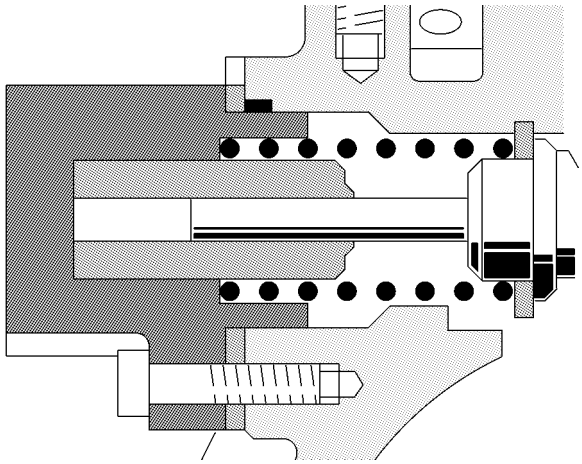
1910 D

The cam position sensor detects advance piston position and cam ring position, then sends this data to the control unit.

Components

1910 D

Cam position sensor (1) is fitted in line with the advance device. It consists of core (3) secured to piston (4), which moves to alter the inductance of coil (5).



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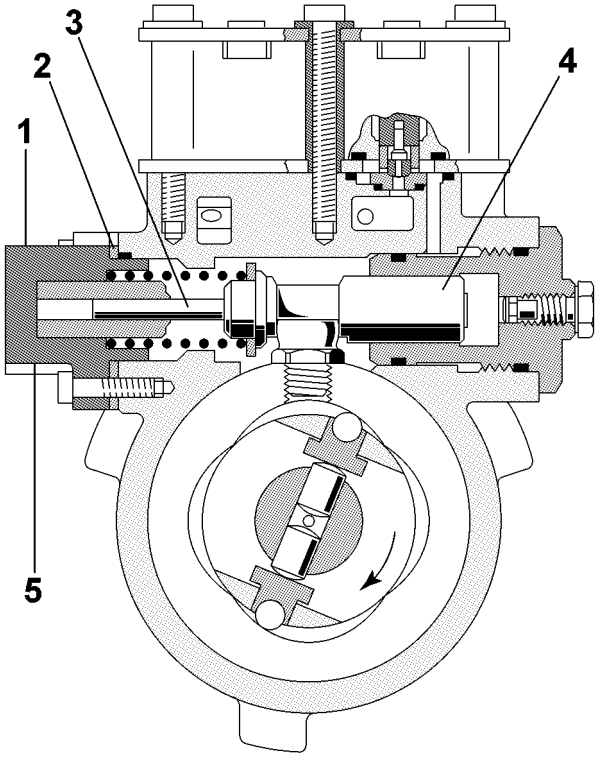
Operation

1910 D

The sensor is connected to a control unit that measures current formation times in the coil that vary according to piston position.
The position indicated by the advance sensor is correlated with piston position via a shim (2) fitted between sensor and pump case.
A pump temperature sensor is built into the cam position sensor. It is an NTC type thermistor (the resistance increases as the temp. decreases) which compensates for the effect of temperature on the sensor while also sending pump temperature data to the control unit.



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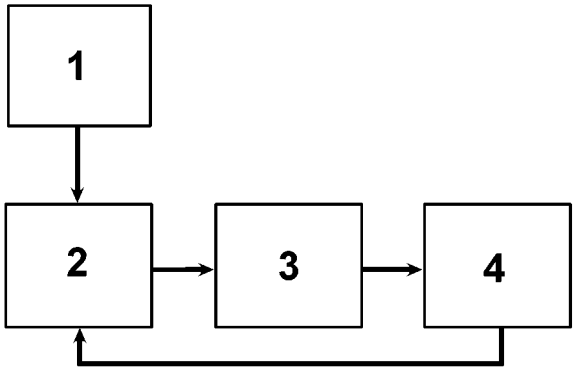
PRINCPLE OF CLOSED-LOOP ADVANCE CONTROL

1910 D

According to engine service conditions as detected by the various sensors, the control unit determines the advance to be achieved at a particular piston position.
The control unit compares this position with the required position and, if necessary, applies a correction by altering the current (PWM). This modifies advance solenoid opening to achieve the required movement.



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1, Required advance
2, Required cam position
3, Action on advance solenoid
4, Measured cam position

1910 D

1060G - Pressure pump electric control

1910 D

Construction features

1910 D

The LUCAS EPIC injection system (ELECTRONICALLY-PROGRAMMED INJECTION CONTROL) fitted to the 223 car with indirect injection 1910 diesel engine features electronic control of the injection pump and other engine management devices via an electronic control unit (ECU).

Technical advantages

1910 D

The system:
- meets current and future emission control regulations;
- reduced fuel consumption;
- improves handling.

1910 D

Operation

1910 D

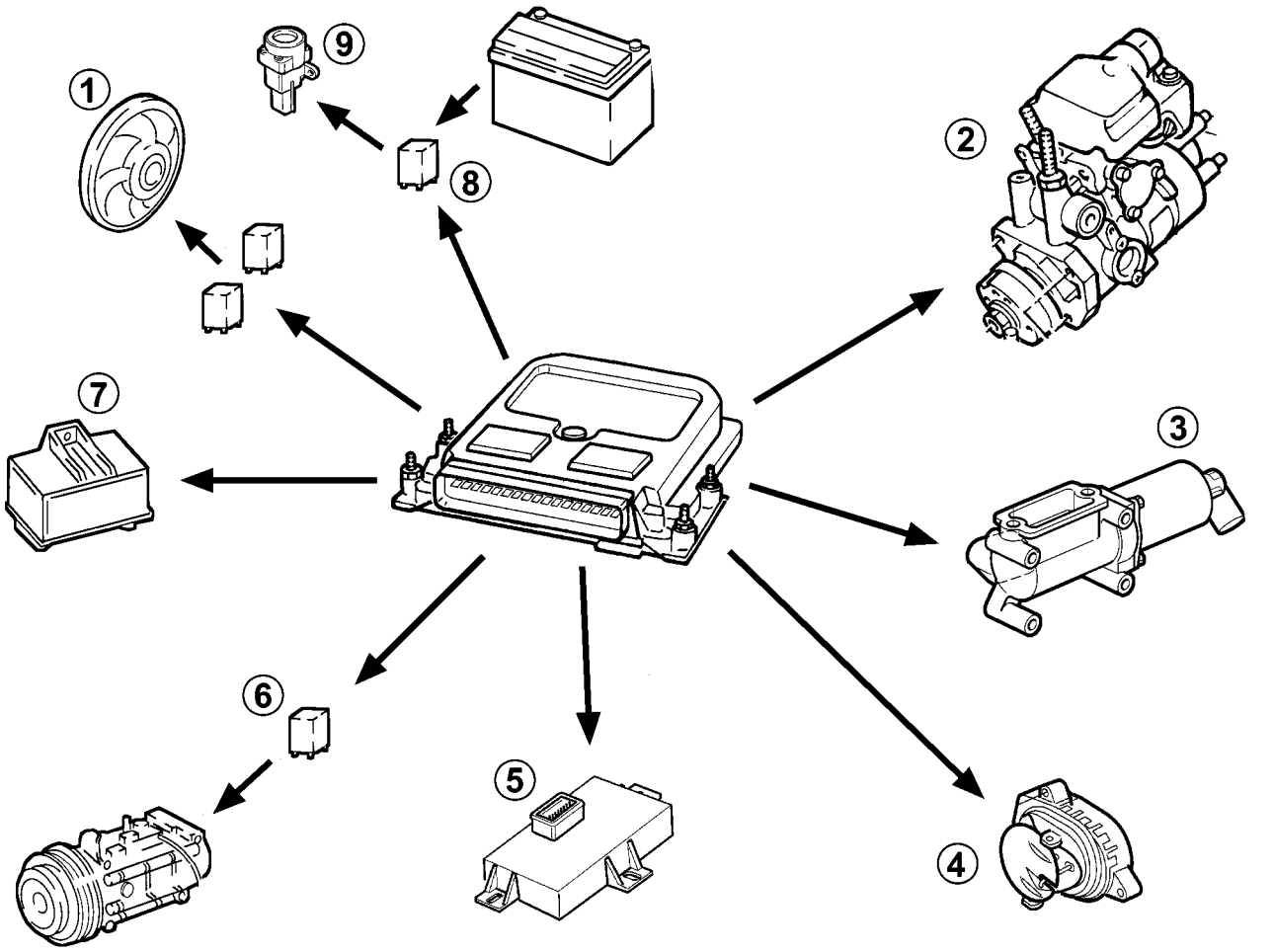
The control unit monitors the following parameters via specific sensors:
- engine rotation speed;
- atmospheric pressure;
- accelerator pedal position and manoeuvre speed;
- engine coolant temperature;
- intake air temperature;
- injection pump distributor rotor position;
- injection pump cam ring position;
- fuel temperature inside pump;
- vehicle speed;
- battery voltage;
- switching on of air conditioning compressor.

This information, generally analogue, is converted into digital signals by analogue/digital (A/D) converters inside the control unit.
There is a management programme (software) inside the control unit memory which consists of a series of strategies which manage specific system control functions.

OUTPUT COMMANDS

1910 D

The figure below represents the control unit's output signals.



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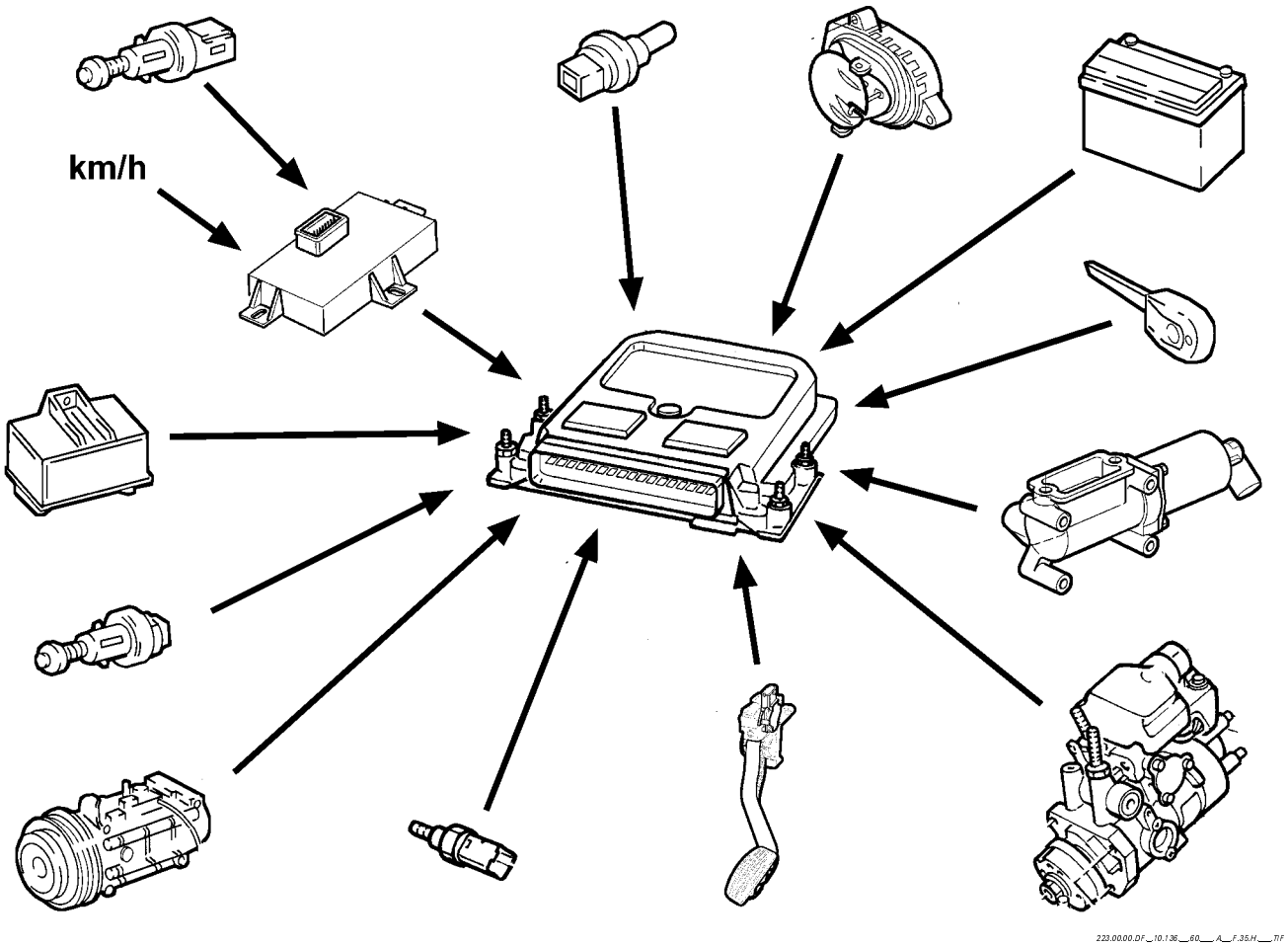
1, Engine cooling fan
2, Fuel injection pump
3, E.G.R. valve
4, Butterfly solenoid
5, Body computer
6, Air conditioning compressor relay
7, Heater plugs ECU
8, Main relay
9, Inertia switch

INPUT SIGNALS

1910 D

The figure below represents the input signals to the control unit.



1910 D

The system can:
- monitor and regulate injection pump output
- monitor and regulate injection advance
- monitor and regulate recirculated exhaust gas quantity via the EGR
- control butterfly solenoid
- monitor and regulate glow plug pre and postheating
- control climate control system compressor activation/deactivation
- control engine cooling fan activation/deactivation
- send and receive a set of information via the CAN network
- test the system and set recovery parameters if faults are present

The ECU may be called upon to manage the following conditions:
- prestarting
- starting
- operation
- idling
- acceleration and deceleration (transition states)
- vehicle stopping

MONITORING AND ADJUSTING INJECTION PUMP OUTPUT

1910 D

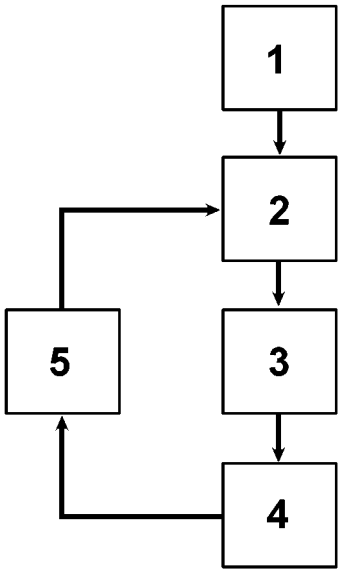
Monitoring injection output
Output is controlled by a closed-loop system (feedback control)

Note: *Because the system is fitted with a flow control device, the accelerator pedal is no longer connected directly to the pump but acts on a sensor that sends the pedal position signal to the control unit.*
The control unit computes the required flow and defines rotor position on the basis of input from the sensors and its own resident software strategies. The control unit therefore downloads actual rotor position and compares it with the required position. If there is a difference between the two positions, the control unit drives the relevant flow solenoid to shift the rotor in the required direction. The new position is read and compared with the required position. A new command is issued if the position is wrong - and so on.

Injection output control flow diagram

1910 D

The diagram below illustrates the principle of injection flow control.



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1, Required flow
2, Calculated rotor position
3, Flow solenoid operation
4, Measured rotor position
5, Feedback

1910 D

The output solenoid control is ON-OFF, 12V type.
The strategy controls engine speed by altering output to avoid speed fluctuations.

Do not supply the solenoid with continuous 12 V; the winding could be damaged.

MONITORING AND ADJUSTING INJECTION ADVANCE

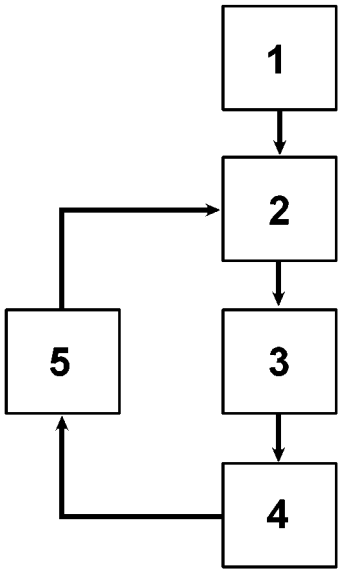
1910 D

Injection advance is controlled in the same way as described for injection output control.
The control unit computes the advance required for the various service parameters and thus determines the corresponding cam position.
By measuring actual cam position, the control unit is able to determine the error between both positions (computed error and real error) and to control the solenoid in order to obtain the computed position.
The solenoid is operated in PWM.

Injection advance control flow diagram

1910 D

Control of injection advance.



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1, Required advance
2, Cam position
3, Solenoid operation
4, Measured cam position
5, Cam position feedback

ELECTRIC STOP CONTROL

1910 D

When the ignition switch is turned ON, the control unit earths the electric stop circuit (which re-opens) to allow diesel to supply the pump internal circuits.
When the ignition switch is turned to STOP, the control unit opens the circuit by removing the earth connection to the electric stop (which closes), zeros engine speed and then cuts off the fuel supply.
If the engine does not stop (e.g. due to a fault in the electric stop device), the control unit controls the flow solenoid until the rotor is in zero output position in order to turn off the engine.

MONITORING AND ADJUSTING THE EGR

1910 D

The control unit regulates the flow of exhaust gases entering the intake port via a Pierburg EGR solenoid on the basis of engine parameters (rpm, load, temperature, atmospheric pressure, air temperature).
It communicates the position of a potentiometer built into the EGR solenoid to the control unit, it provides the control unit with a return signal on the position assumed by the internal plunger so that the control unit can determine the error between calculated position and real position and thus make the necessary corrections.

Checking and adjusting intake air

1910 D

Con temperature > 20 °C. In parallel with the E.G.R. valve and in accordance with the same engine parameters, a butterfly solenoid is driven with an ON-OFF signal to partially close the intake duct, thus increasing the quantity of exhaust gas recirculating in the intake ducts.

HEATER PLUGS CHECK

1910 D

The control unit, during the following stages:
- starting
- post start-up

times the operation of the heater plugs control unit according to the engine temperature and tests the glow plugs.

CONTROLLING CLIMATE CONTROL SYSTEM COMPRESSOR ACTIVATION

1910 D

The control unit operates the air conditioning compressor:
- switching it on/off when the relevant switch is pressed
- switching it off in the case of:
- 1, strong acceleration (0 - 30 s) or request for maximum power
- 2, excessive engine temperature
- 3, engine rpm too low or too high

CONTROLLING ENGINE COOLING FAN ACTIVATION/DEACTIVATION

1910 D

The control unit controls the relays that activate 1st and 2nd fan speeds on the basis of engine temperature.
- 1st speed activation: 95 +- 2 °C
- 1st speed deactivation: 93 +- 2 °C
- 2nd speed activation: 100 +- 2 °C
- 2nd speed deactivation: 97 +- 2 °C
- The fans may be activated (if the car is fitted with a climate control system) also in accordance with the pressure of the R 134A gas of the air conditioner circuit.

In this case, the control unit receives activation signals from the 4-stage (quadrinary) pressure switch, which earths pin 16 of the control unit to activate the first fan speed and earths pin 19 to activate the second speed when the following values are achieved:
- 1st speed activation: 15 ± 1 bar
- 1st speed deactivation: 11 ± 2 bar
- 2nd speed activation: 20 ± 1.2 bar
- 2nd speed deactivation: 16 ± 2.2 bar

COMMUNICATION VIA THE CAN NETWORK

1910 D

The engine control unit receives and sends signals via the CAN network

The signals received are as follows:
- stop switch signal
- Fiat CODE
- vehicle speed
- mileometer
- key status (start 50 on int. off)
- heated rear window activation
- handbrake control (if cruise control is fitted)
- fuel level

The following signals are transmitted:
- Fiat CODE (code request)
- oil pressure
- °C acqua motore
- engine overheating
- rpm
- fuel consumption - instantaneous consumption
- battery voltage
- heater plug warning light
- fault warning light

PRESTARTING

1910 D

The control unit performs a series of checks from the time the contact is activated and before the engine starts up. These are as follows:
- rotor maximum home position
- advance minimum home position

Then it communicates with the following devices:
- stop solenoid
- delivery + and delivery - solenoids
- advance solenoids

Starting

1910 D

During start-up, the rotor moves to the required start-up position. The control unit then opens the stop solenoid and the rotor changes to closed-loop control position.
At the same time, the advance device also transfers to closed-loop operation.

1910 D

Operation

1910 D

During operation, several strategies are used to ensure good driving quality, efficiency and reduced emissions.

Idling

1910 D

The control unit guarantees the very small fuel injection required to maintain idling on the basis of information supplied by the sensors.
The control unit also corrects output to each engine cylinder by measuring instantaneous speed changes to maintain a balance.

Acceleration and deceleration.

1910 D

During acceleration and deceleration, the system modulates the delivery and so optimizes it, to avoid surging, thus improving driveability under conditions of sudden throttle pedal release and subsequen reacceleration.

Stopping the engine

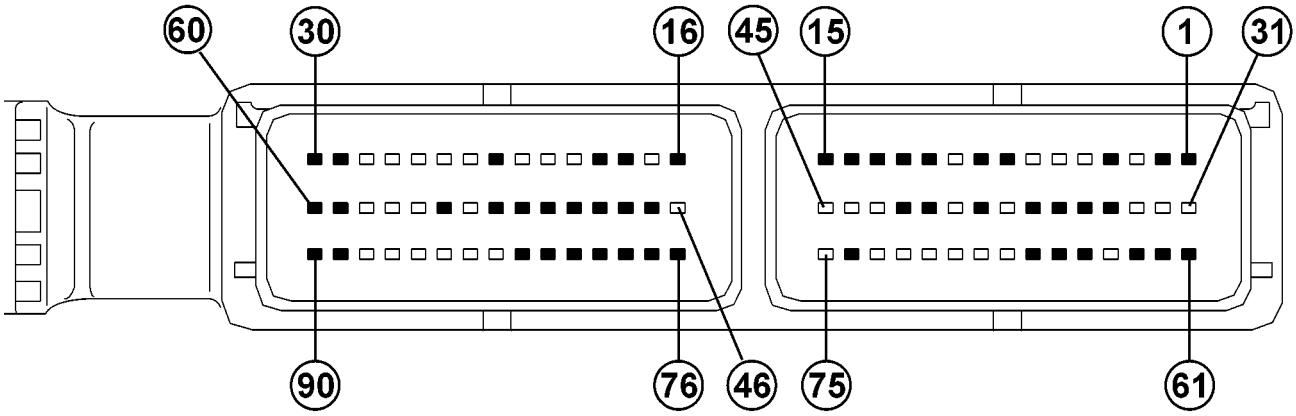
1910 D

When the driver turns off the ignition, the control unit closes the stop solenoid and then controls rpm level. If rpm does not fall after a short instant, the control unit keeps the delivery solenoid open to set the rotor to zero output position.
When the engine stops, the fault history in the non-erasable memory is updated and the control unit shuts itself down.

WIRING PIN-OUT WITH CONNECTOR DISCONNECTED

1910 D

The figure below represents the wiring PIN-OUT with connector disconnected.



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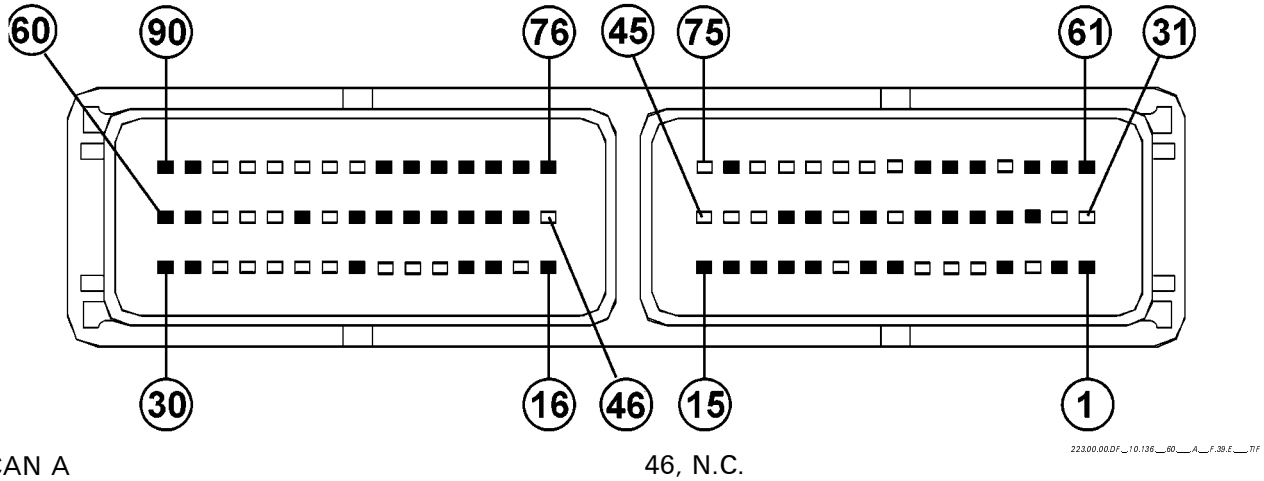
1, CAN A
2, CAN B
3, N.C.
4, Air temp. input
5, N.C.
6, N.C.
7, N.C.
8, Accelerator pedal 1 (pin 4)
9, Pump sensor shield earth
10, N.C.
11, Engine rpm sensor input
12, Rotor compensation resistor
13, Cam sensor
14, Rotor sensor
15, Cam/rotor sensor supply
16, Fan low speed request
17, N.C.
18, Oil pressure sensor input
19, Fan high speed activation request
20, N.C.
21, N.C.
22, N.C.
23, Fan speed control
24, N.C.
25, N.C.
26, N.C.
27, N.C.
28, N.C.
29, Butterfly solenoid control
30, Engine stop control
31, N.C.
32, N.C.
33, Line K
34, Coolant temp. input
35, EGR feed back
36, Diesel temp. input
37, Accelerator pedal 2 (pin 6)
38, N.C.
39, EGR sensor supply
40, N.C.
41, Accelerator sensor supply 1 (pin 2)
42, Acc. sensor supply 2 (pin 1)
43, N.C.
44, N.C.
45, N.C.
46, N.C.
47, Air conditioner activation request
48, Butterfly posit. sensor
49, Spark plug control unit diagnosis
50, Clutch button signal
51, ON SENSOR MEMORY (EPIC pump)
52, Spark plug control unit control
53, Fan low speed control
54, N.C.
55, Air conditioner relay control
56, N.C.
57, N.C.
58, N.C.
59, EGR control
60, Delivery + butterfly control
61, Accelerator pedal earth (1) (PIN 3)
62, Accelerator pedal earth (2) (PIN 5)
63, EGR solenoid earth
64, N.C.
65, Engine temp. sensor earth
66, Air temp. sensor + butterfly sensor earth
67, Diesel temperature sensor earth
68, N.C.
69, N.C.
70, N.C.
71, N.C.
72, N.C.
73, N.C.
74, Engine rpm sensor earth
75, N.C.
76, + 15 ECU
77, + 15 ECU
78, ECU earth
79, ECU earth
80, ECU earth
81, + 15 ECU
82, IE relay control
83, N.C.
84, N.C.
85, N.C.
86, N.C.
87, N.C.
88, N.C.
89, Cam control
90, Delivery - solenoid control

ENGINE CONTROL UNIT PIN-OUT WITH WIRING DISCONNECTED

1910 D

The diagram below shows the control unit PIN-OUT with wiring disconnected.



1, CAN A
2, CAN B
3, N.C.
4, Air temp. input
5, N.C.
6, N.C.
7, N.C.
8, Accelerator pedal 1 (pin 4)
9, Pump sensor shield earth
10, N.C.
11, Engine rpm sensor input
12, Rotor compensation resistor
13, Cam sensor
14, Rotor sensor
15, Cam/rotor sensor supply
16, Fan low speed request
17, N.C.
18, Oil pressure sensor input
19, Fan high speed activation request
20, N.C.
21, N.C.
22, N.C.
23, Fan speed control
24, N.C.
25, N.C.
26, N.C.
27, N.C.
28, N.C.
29, Butterfly solenoid control
30, Engine stop command
31, N.C.
32, N.C.
33, Line K
34, Coolant temp. earth
35, EGR feed back
36, Diesel temp. earth
37, Accelerator pedal 2 (pin 6)
38, N.C.
39, EGR sensor supply
40, N.C.
41, Accelerator sensor supply 1 (pin 2)
42, Acc. sensor supply 2 (pin 1)
43, N.C.
44, N.C.
45, N.C.
46, N.C.
47, Air conditioner activation request
48, Butterfly posit. sensor
49, Spark plug control unit diagnosis
50, Clutch button signal
51, ON SENSOR MEMORY (EPIC pump)
52, Spark plug control unit control
53, Fan low speed control
54, N.C.
55, Air conditioner relay control
56, N.C.
57, N.C.
58, N.C.
59, EGR control
60, Delivery + solenoid control
61, Accelerator pedal earth (1) (PIN 3)
62, Accelerator pedal earth (2) (PIN 5)
63, EGR solenoid earth
64, N.C.
65, Engine temp. sensor earth
66, Air temp. sensor + butterfly sensor earth
67, Diesel temperature sensor earth
68, N.C.
69, N.C.
70, N.C.
71, N.C.
72, N.C.
73, N.C.
74, Engine rpm sensor earth
75, N.C.
76, + 15 ECU
77, + 15 ECU
78, ECU earth
79, ECU earth
80, ECU earth
81, + 15 ECU
82, IE relay control
83, N.C.
84, N.C.
85, N.C.
86, N.C.
87, N.C.
88, N.C.
89, Cam control
90, Delivery - solenoid control

1910 D

Engine rpm sensor

CONSTRUCTION features

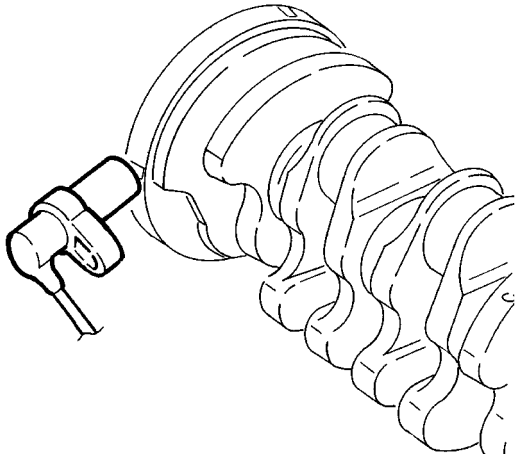
1910 D

The function of this sensor is to detect the engine's speed of rotation and angular position.
It is a transducer with variable magnetic reluctance (pick-up) mounted on the cylinder block, and it faces the phonic wheel with 4 holes at 90° secured to the crankshaft.
Electrical characteristics
Winding resistance R = 860 Ω ± 10% a 20 °C.

composition

1910 D

The figure below identifies the location of the engine rpm sensor.



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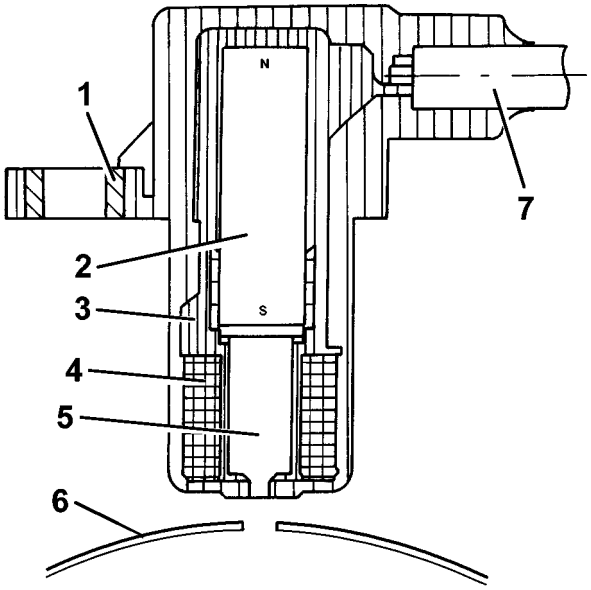
1910 D

The figure below identifies the composition of the engine rpm sensor.



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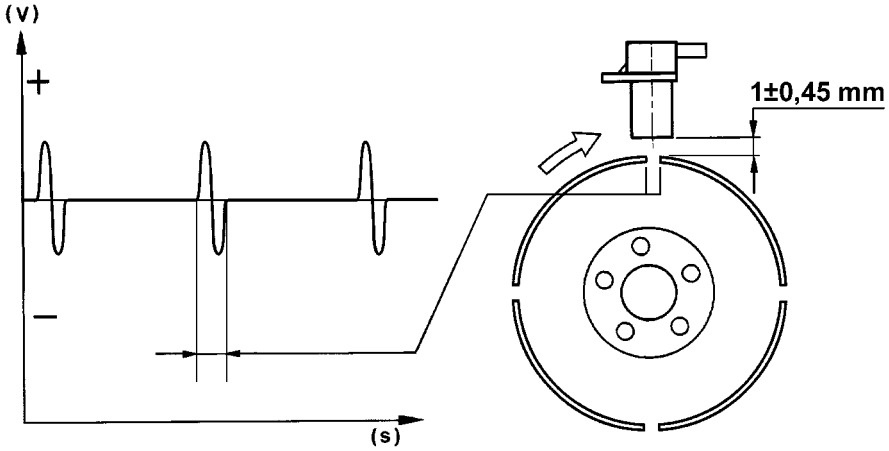
1, Brass bush
2, Permanent magnet
3, Plastic sensor casing
4, Coil winding
5, Polar core
6, Phonic wheel
7, Coaxial two-wire cable or electrical connection

OPERATION

1910 D

As the teeth of the phonic wheel (6) go past, the magnetic flow created by the magnet (2) undergoes fluctuations due to the change in gap. These fluctuations induce an electromotive force in the winding (4), at the ends of which there is a voltage which alternates between positive and negative (pulses). The peak value of the output voltage from the sensor, provided other factors remain the same, depends on the gap.
There are four openings in the flywheel spaced 90 ° apart.
The distance (gap), for obtaining the correct signals, between the end of the sensor and the phonic wheel should be 1 mm +- 0.45.
This gap is not adjustable, so if a value outside the tolerance range is measured, check the condition of the sensor and the phonic wheel.



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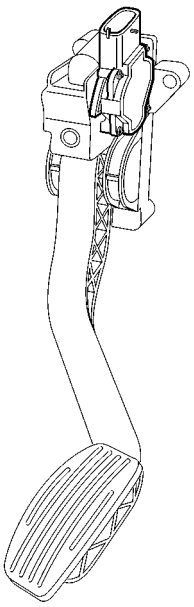
Accelerator pedal potentiometer

CONSTRUCTION features

1910 D

The sensor consists 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 and one safety.
There is a coil spring on the shaft which guarantees the correct resistance to the pressure whilst a second spring ensures the return on release.



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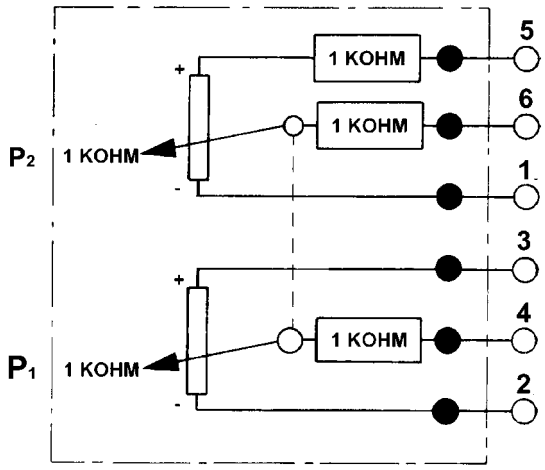
1910 D

Internal diagram of potentiometer



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Operation

1910 D

The position of the accelerator pedal is transformed into an electrical voltage signal and is sent to the fuel injection control unit by the potentiometer connected to the accelerator pedal.
The accelerator pedal position signal is processed together with the information relating to the rpm, to obtain the fuel injection times and relevant pressure.

Atmospheric pressure sensor

CONSTRUCTION features

1910 D

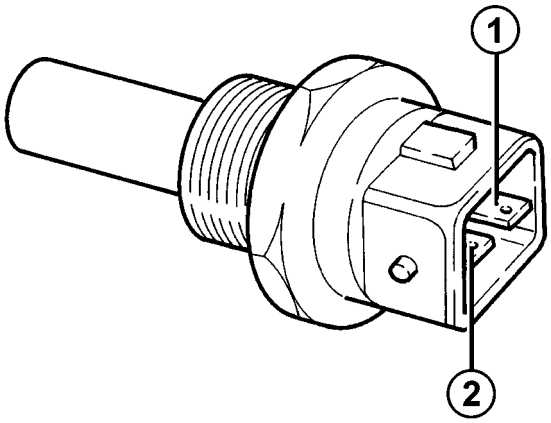
It measures the atmospheric pressure in order to correct the measured air flow rate and the reference air flow rate for control of the EGR.
Integrated in the fuel injection control unit (ECU).

Engine coolant temperature sensor

CONSTRUCTION features

1910 D

This measures the coolant temperature in order to give the control unit an indication of the engine's temperature status.
It is an NTC sensor, whose active part is a resistor with negative coefficient, produced through sintering; the nominal resistance is 1.9 - 2.2 kΩ at 25 °C.
It is mounted on the thermostat.
Electrical characteristics: +5V ± 0.15 V supply
Range: -40° - 120 °C
Although the sensor specifications are not linear, they are considered as such; the temperature read by the control unit differs in relation to the actual figure.



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1910 D

The table below gives the values of the sensor's resistance in accordance with the temperature measured.

ENGINE TEMPERATURE SENSOR	
Temperature (°C)	R = Ω between PINS 1 and 2 of the sensor
-40	From 45,286 to 52,234
-10	From 9,096 to 10,145
25	From 1,965 to 2,122
50	From 783.5 to 830.3
80	From 302.6 to 314.6
110	From 133.6 to 136.8
120	From 103.9 to 106.9

composition

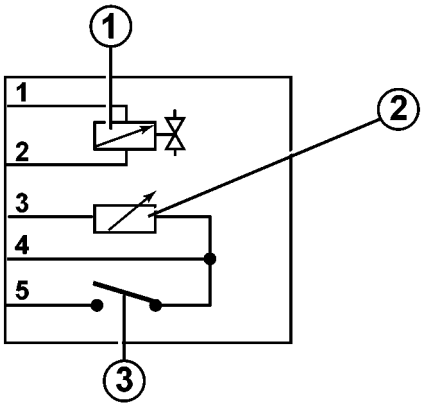
1910 D

The sensor consists of a brass casing which protects the actual resistive element, which consists of an NTC thermistor (Negative Temperature Coefficient, whose electrical resistance decreases as the temperature increases).

BUTTERFLY CASING

1910 D

Interior diagram of butterfly casing



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1, Air butterfly control solenoid
2, Intake air temperature thermistor
3, Air butterfly switch

Operation

1910 D

The reference voltage is 5 Volt. as the input circuit into the control unit is designed as a voltage divider, this voltage is divided between a resistor located in the control unit and the sensor's NTC resistor. The control unit is thus able to assess the changes in the sensor's resistance via the changes in voltage, and thus obtain the temperature information in the range -40 - 120 °C.

Intake air temperature sensor

CONSTRUCTION features

1910 D

This measures the temperature of the intake air, to define its density and reference air flow rate for controlling the EGR.
It is an NTC sensor, whose active part is a resistor with negative coefficient.
The sensor is located in the throttle body.
Nominal resistance at 25 °C = 2.3 - 2.6 kΩ
The table below gives the values of the sensor's resistance in accordance with the temperature measured.

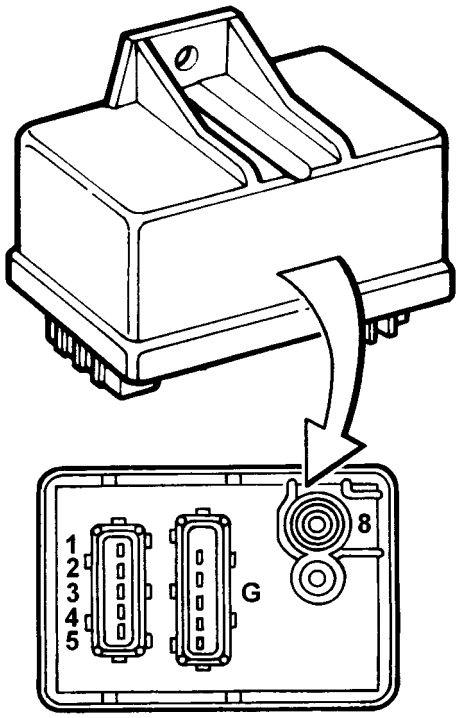
ENGINE TEMPERATURE SENSOR	
Temperature (°C)	R=Ω between PINS 3 and 4 of the throttle casing
-40	From 35,140 to 43,760
-10	From 7,943 to 9,307
25	From 2,290 to 2,551
50	From 1,096 to 1,238
80	From 312 to 370
110	From 144 to 176
120	From 114 to 141

HEATER PLUGS ELECTRONIC CONTROL UNIT

Components

1910 D

The heater plugs are controlled by the heater plug control unit, under the direct control of the fuel injection control unit.
Inside the heater plug control unit, there is an 'intelligent' relay which sends a feedback response to the fuel injection control unit, which is thus informed of a possible fault in the heater plug control unit or short circuit to earth of the heater plugs.
The figure shows the connectors at the base of the heater plug control unit and the pin connections.



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1, Earth
2, Earth
3, Ignition-operated positive (+15)
4, Activation
5, Testing
8, Battery positive (+30)
G, Heater plugs

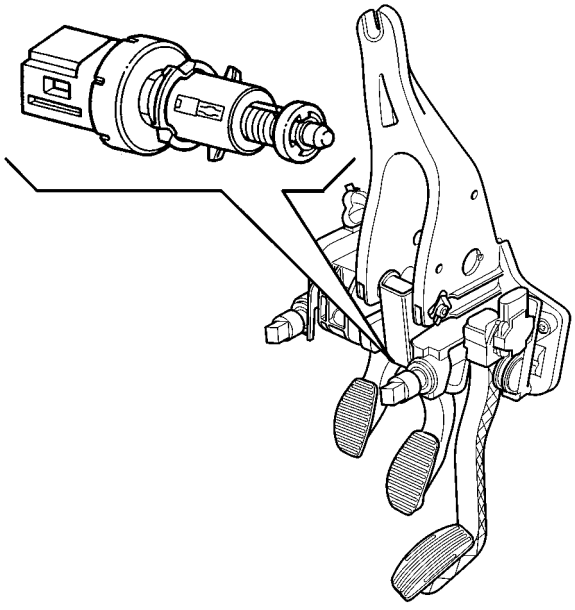
Brake pedal switch

1910 D

There is a switch on the brake pedal which operates the vehicle brake lights; this switch sends a signal to the body computer which makes it available to the CAN network.

The 'brake pedal pressed' signal is used by the control unit to:
- perceive that there is a deceleration situation;
- check the plausibility of the signal coming from the accelerator potentiometer (released accelerator).

If there is a discrepancy between the brake sensor and accelerator sensor, the brake pedal sensor prevails in the ECU.



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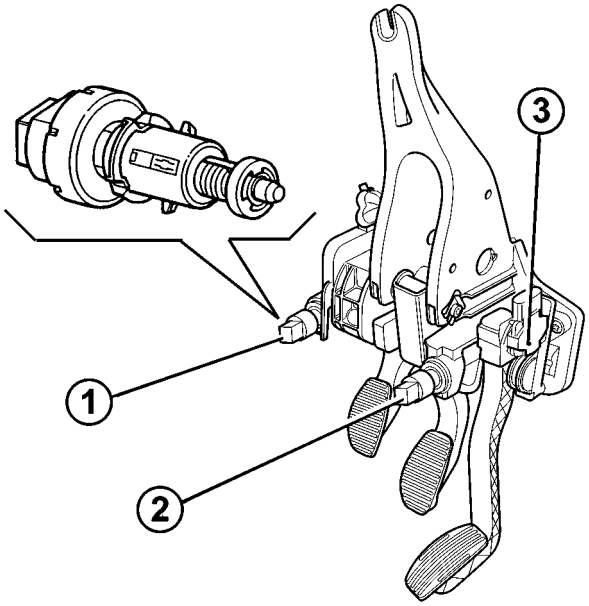
Clutch pedal switch

1910 D

On the clutch pedal, there is a switch (1) connected to pin 50 of the fuel injection control unit. The 'clutch pedal operated' signal is used by the fuel injection control unit to distinguish the gear engaged and gear change conditions.



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1, Clutch sensor
2, Brake sensor
3, Accelerator sensor

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Assembly drawings index

Cmp	Description	Validity

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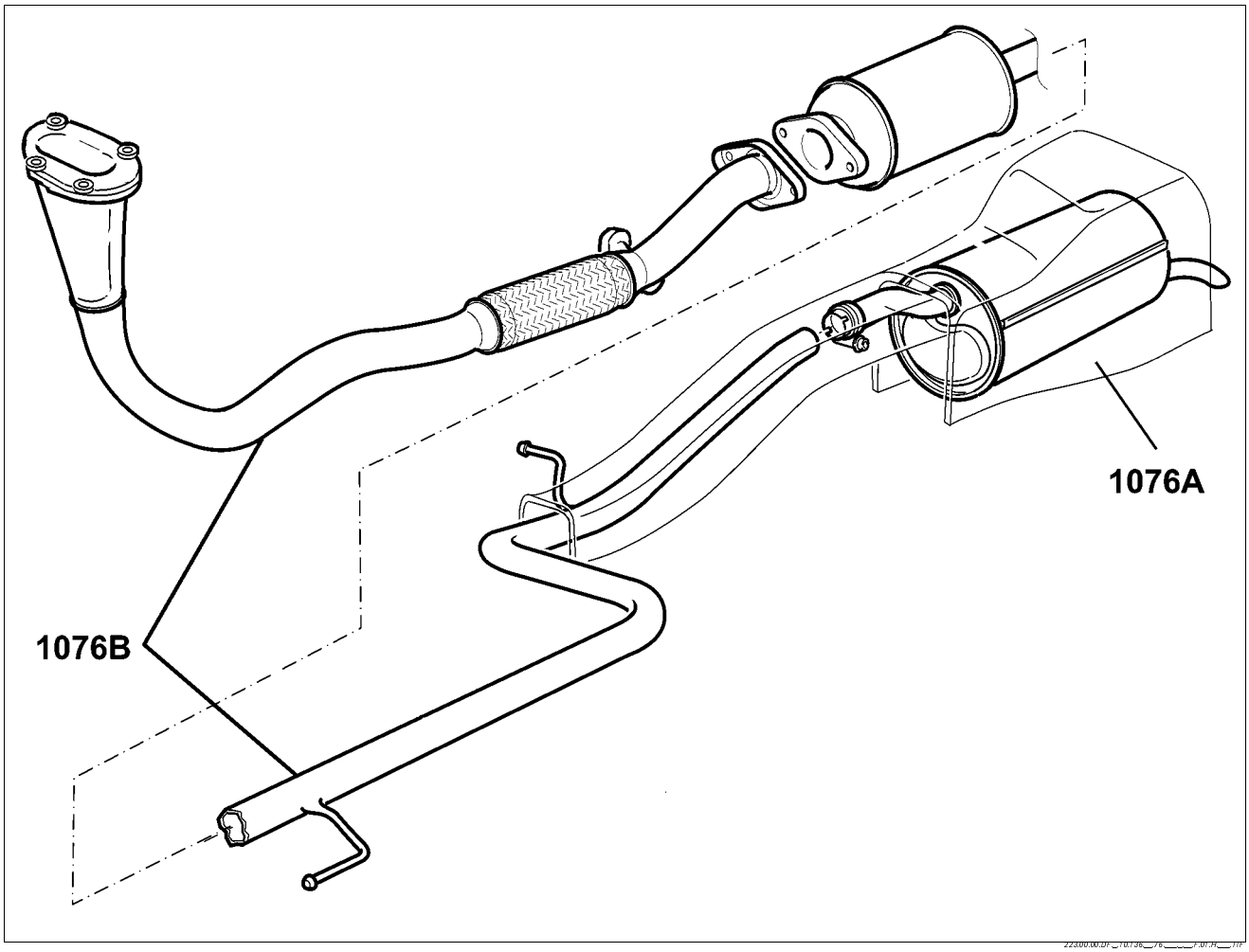


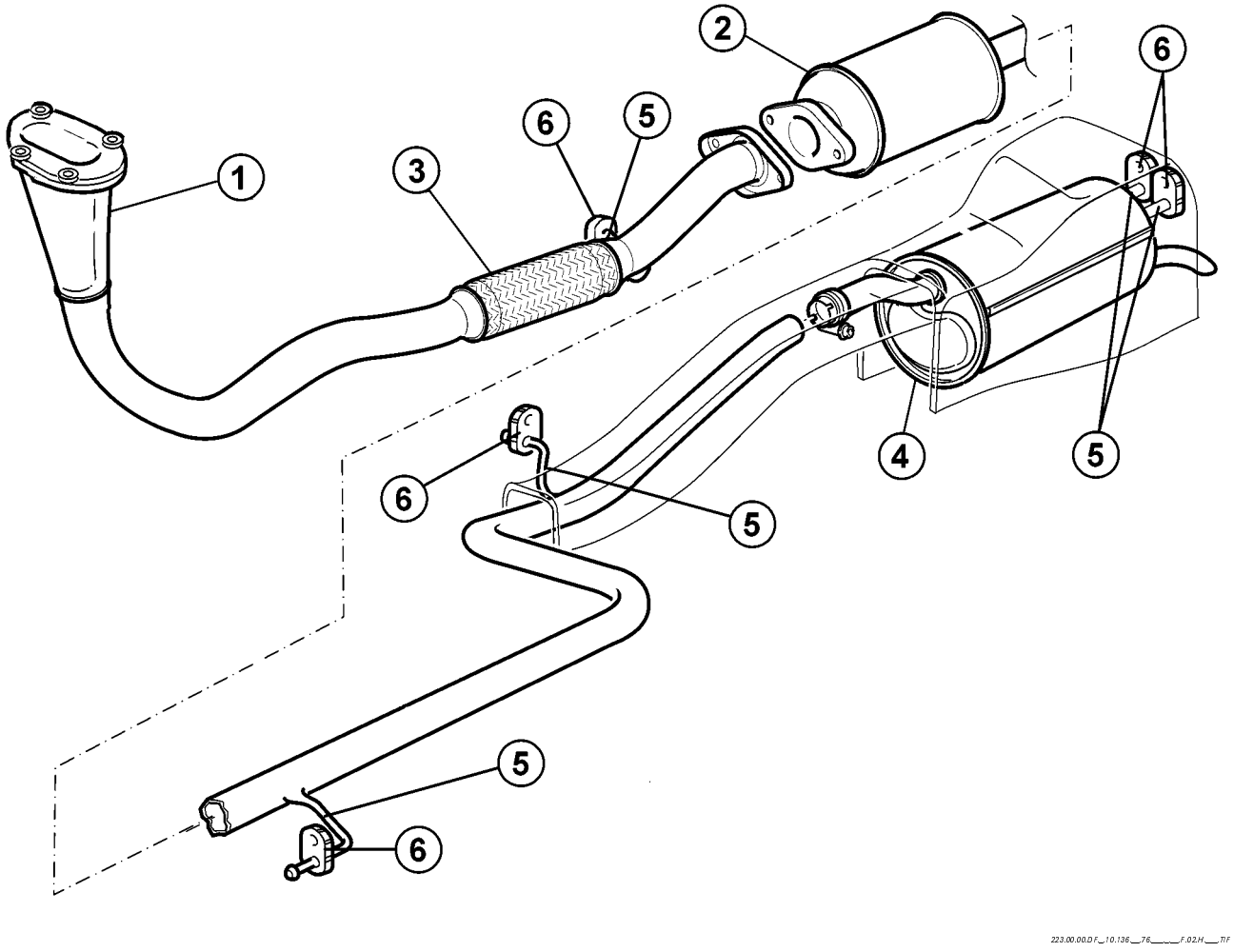
1910 D

CONSTRUCTION FEATURES

1910 D

The engine exhaust gases flow through the manifold (1) to the catalytic converter (2) (see 1080).
At the front of the exhaust pipe, there is a flexible component (3) for limiting the transmission of vibrations.
The rear exhaust section comprises a single silencer (4).
Special guards limit the radiation of heat towards the bodyshell.

The various components are supported by mountings (5) and rubber rings (6) secured to the underbody.



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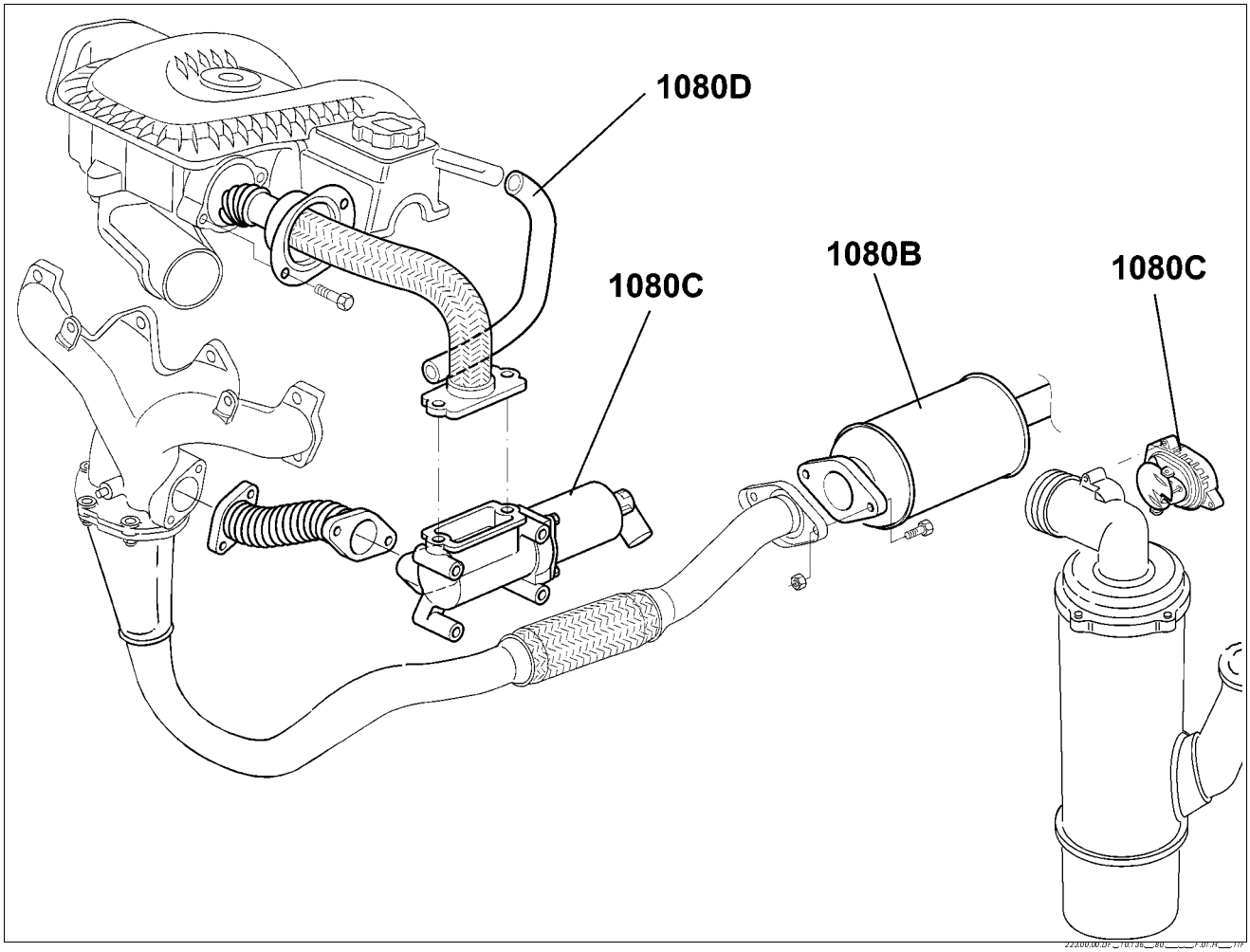
Sub-group index

- SUB-GROUP GRAPHIC INDEX

Assembly drawings index

Cmp	Description	Validity
1080B	Exhaust emission control system	1910 D
1080C	Exhaust gas recirculation system (e.g.r.)	1910 D
1080D	Crankcase vapour/gas recirculation system	1910 D

SUB-GROUP GRAPHIC INDEX



1910 D

1080B - Exhaust emission control system

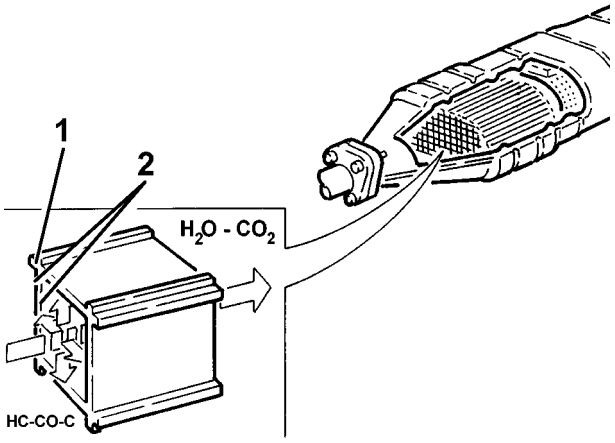
1910 D

CONSTRUCTION FEATURES

Catalytic converter

1910 D

The oxidising catalytic converter is a post-treatment device for oxidising the CO, HC and particles, transforming them into carbon dioxide (CO_2) and water vapour (H_2O).
The catalytic converter consists of a ceramic, honeycomb structure monolith (1) with cells impregnated with platinum (2), which acts as a catalyst for the oxidation process.
The exhaust gases which pass through the cells heat the catalyzer, triggering the conversion of the pollutants into inert compounds.
The chemical reaction which causes the oxidation of the CO, HC, and particle matter takes place at temperatures of between 200 and 350°C.
In effect, at temperatures above 350°C the sulphur, contained in the diesel fuel, starts to oxidize, producing sulphur dioxide and sulphur trioxide.



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1910 D

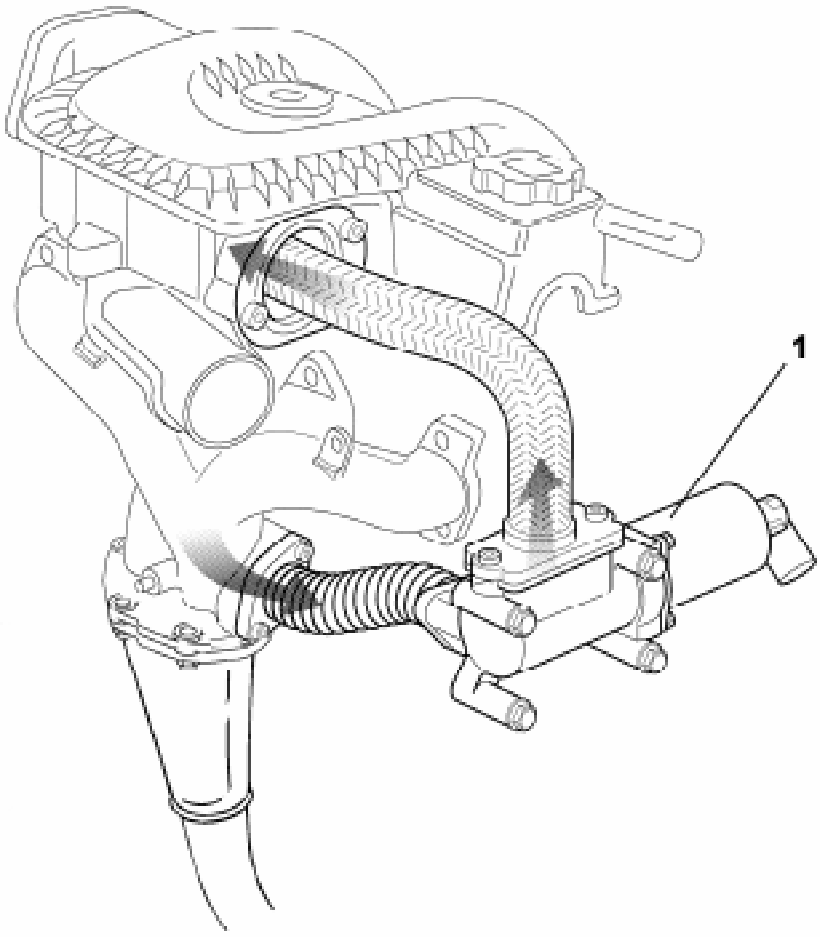
1080C - Exhaust gas recirculation system (e.g.r.)

1910 D

CONSTRUCTION FEATURES

1910 D

This system directs a proportion of exhaust gases to the intake under certain service conditions.
This lowers the temperature peak in the combustion chamber to reduce the formation of nitrogen oxides (NOx).



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1910 D

COMPOSITION

1910 D

The system consists of:
- a Pierburg EGR solenoid (1)
- the pipe coming from the exhaust manifold (from which the exhaust gases come)
- the pipe connected to the intake (the exhaust gases are introduced here).

1910 D

OPERATION

1910 D

When coolant temperature is > 20 °C and engine speed is between 800 and 3500 rpm, the engine control unit governs the EGR solenoid by means of a PWM signal.

The change in this signal allows the EGR coil to move a plunger and thus adjust the flow of burnt gases from the exhaust manifold to the intake manifold; two results are thus obtained:
- less air is introduced
- combustion temperature is reduced (due to the presence of inert gases) to reduce NOx (nitrogen oxide) production.

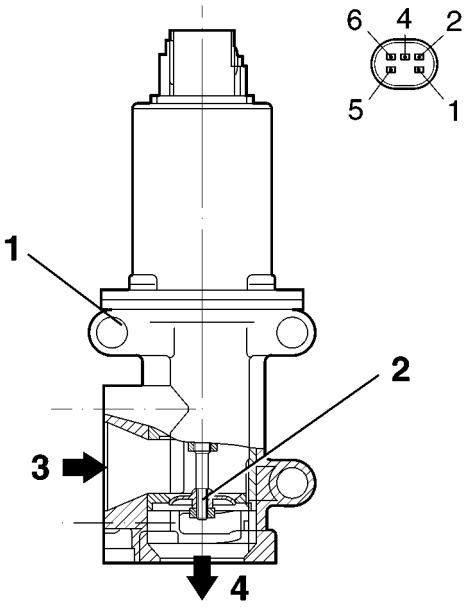
The engine control unit is constantly informed on the butterfly position, interpreting the signals coming from the potentiometer in the EGR.
The atmospheric pressure signal is used when controllling the EGR valve to recognize when the car is driving at altitude and so reduce the quantity of recirculated gas and prevent the engine from producing fumes.

EGR solenoid

SPECIFICATIONS:

1910 D

The Pierburg EGR valve fitted to the intake manifold modulates the flow of exhaust gas to the intake according to a command received from the injection control unit.
Modulation takes place via an internal solenoid controlled in PWM by the control unit, which operates the control rod from the internal valve.
For greater precision, a control rod position sensor included in the valve sends the control unit a feedback signal. The control unit continually compares this signal with the signal relating to required pin position and makes automatic adjustments when necessary to correct the air flow.



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1, EGR valve body
2, Internal valve
3, Gas intake from exhaust manifold
4, Gas outlet to inlet manifold

1910 D

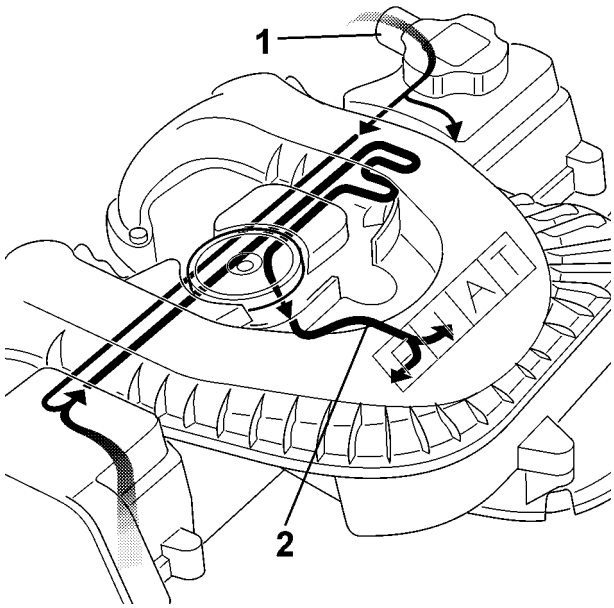
1080D - Crankcase vapour/gas recirculation system

1910 D

CONSTRUCTION FEATURES

1910 D

The oil vapour emissions are controlled by a separator built into the cam cover which collects the vapours released from the crankcase using the pipe (1).
The difference in temperature between the separator and the oil vapours causes partial condensation.
Condensed vapours are sent to the crankcase through vertical ducts.
Uncondensed vapours are sent to the air intake ducts through passage (2).



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Assembly drawings index

Cmp	Description	Validity

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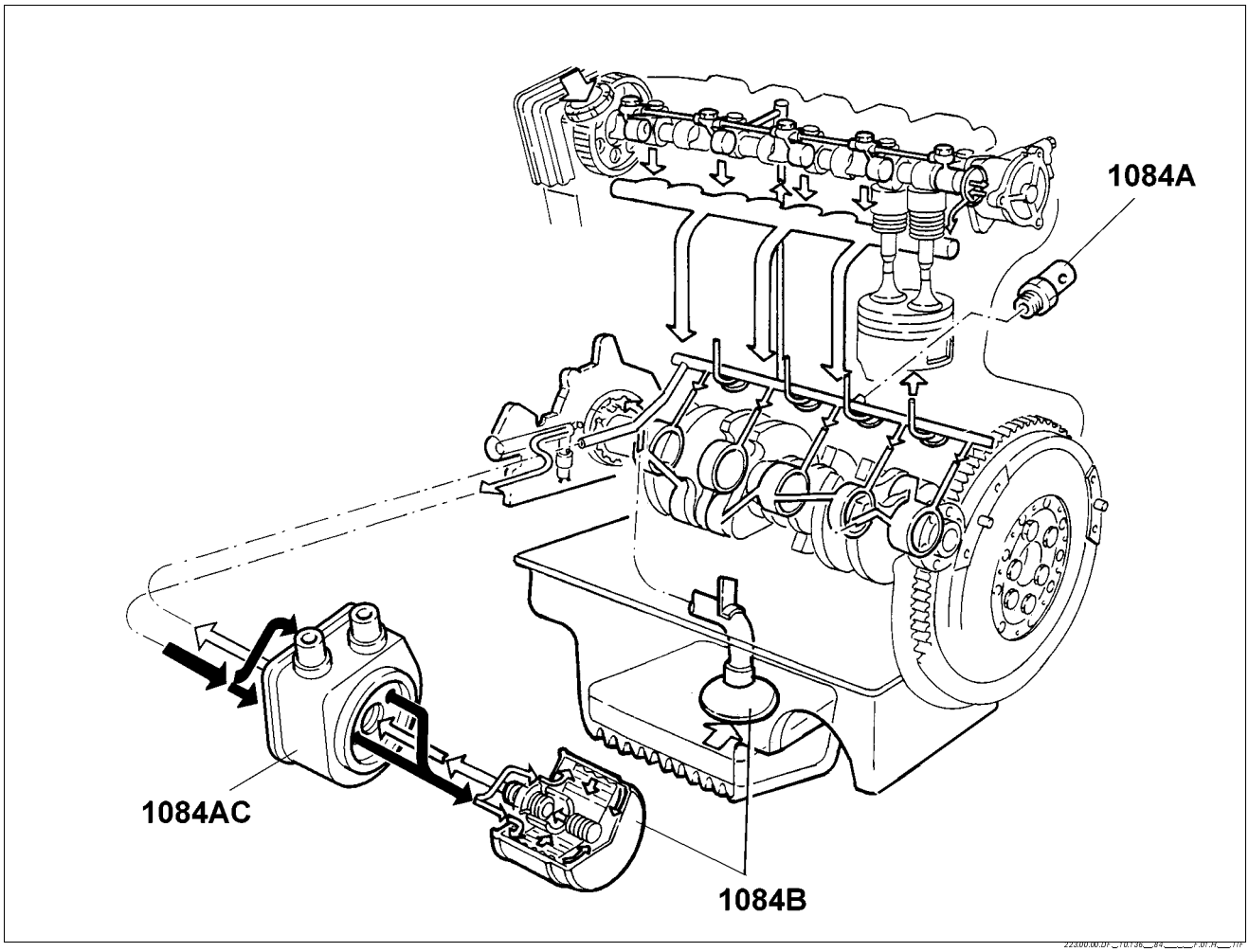


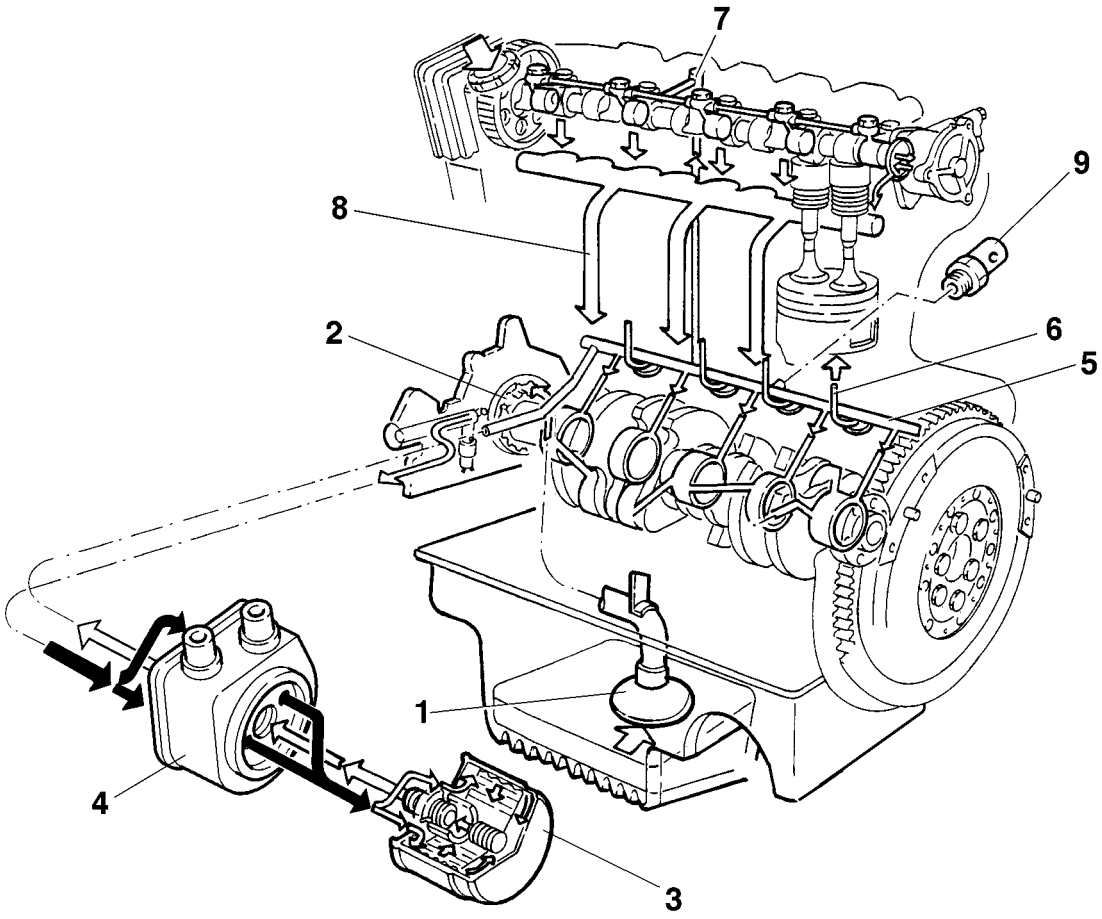
1910 D

ENGINE OIL SUPPLY CIRCUIT

CONSTRUCTION FEATURES

1910 D

The diagram below represents the engine oil supply circuit.



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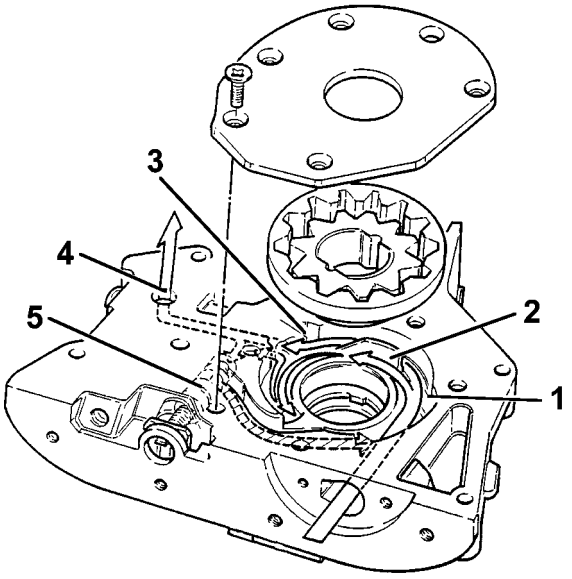
1, Suction pipe with filter mesh
2, Oil pump
3, Oil filter cartridge
4, Water/oil heat exchanger
5, Main longitudinal duct
6, Jets (piston skirt cooling)
7, Vertical duct (camshaft support lubrication)
8, Oil return to sump
9, Engine oil pressure warning light switch

Engine oil pump

1910 D

The engine oil is drawn in from the sump by means of the vacuum created by the rotation of the sprockets fitted on the crankshaft.
Vacuum is present between the sprocket separating wall (2) and the oil sump suction pipe.
Pressure instead develops after the separating wall (2) in all the oil delivery pipes (4).
When the pressure exceeds 5 bar, the force exerted on the limiting valve (5) overcomes the reaction of the spring below and moves the valve to open the connecting pipe between the pressure chamber (3) and the low pressure chamber (1).



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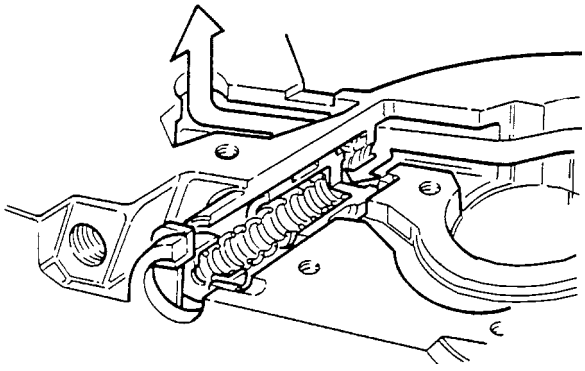
1, Low pressure chamber
2, Separating wall
3, Pressure chamber
4, Oil delivery pipe
5, Pressure limiting valve

1910 D

Closed operating position of oil pressure limiting valve.



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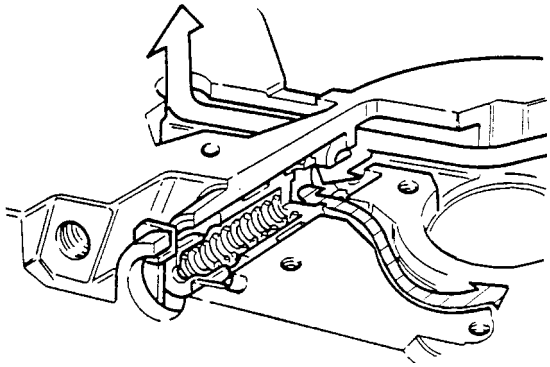
1910 D

Bypass operating position of limiting valve.



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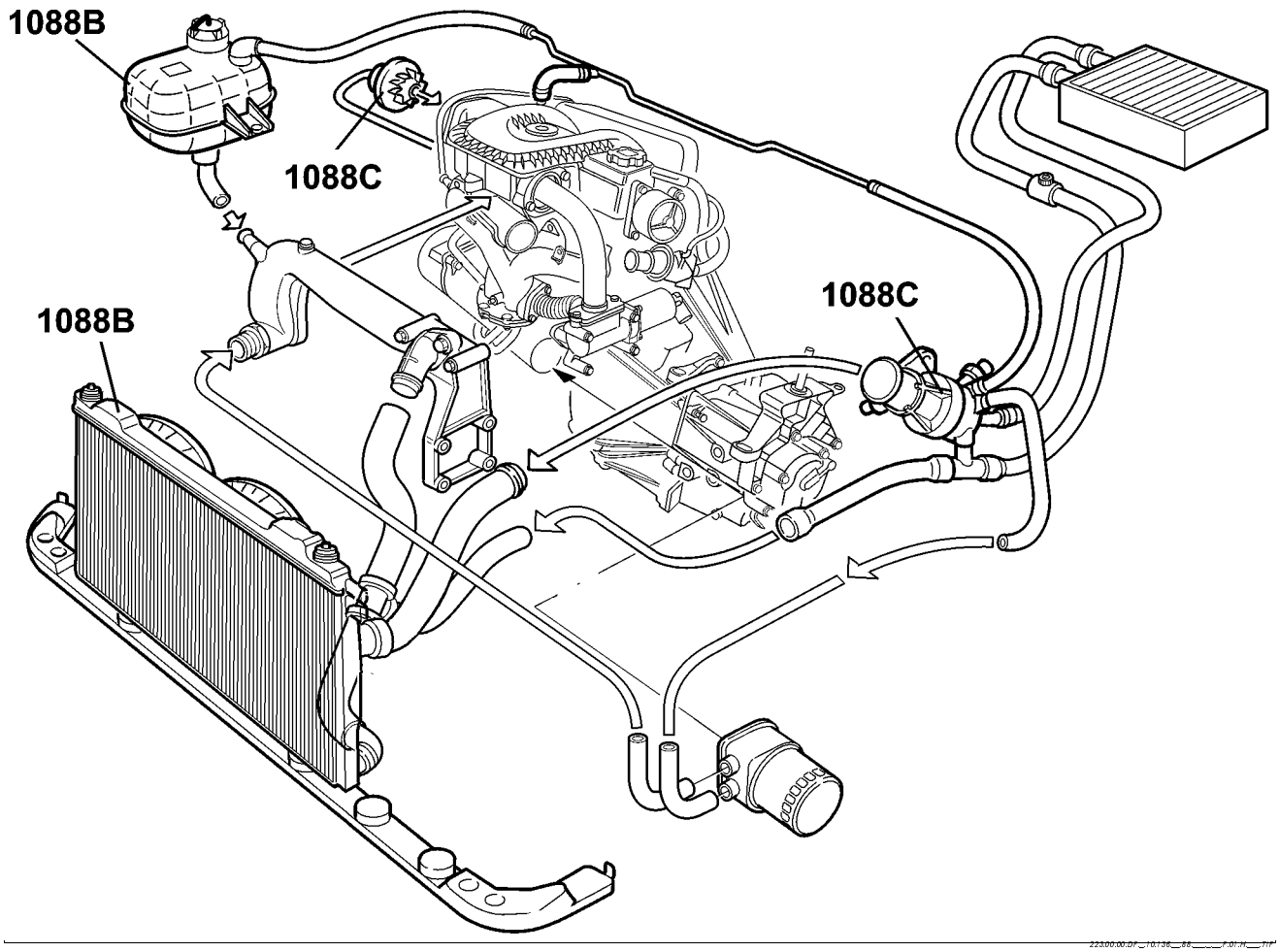
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- COMPOSITION
- OPERATION

Assembly drawings index

Cmp	*Description*	*Validity*
1088B	Engine cooling tank - r + r	1910 D
1088C	Water pump and thermostat	1910 D

SUB-GROUP GRAPHIC INDEX



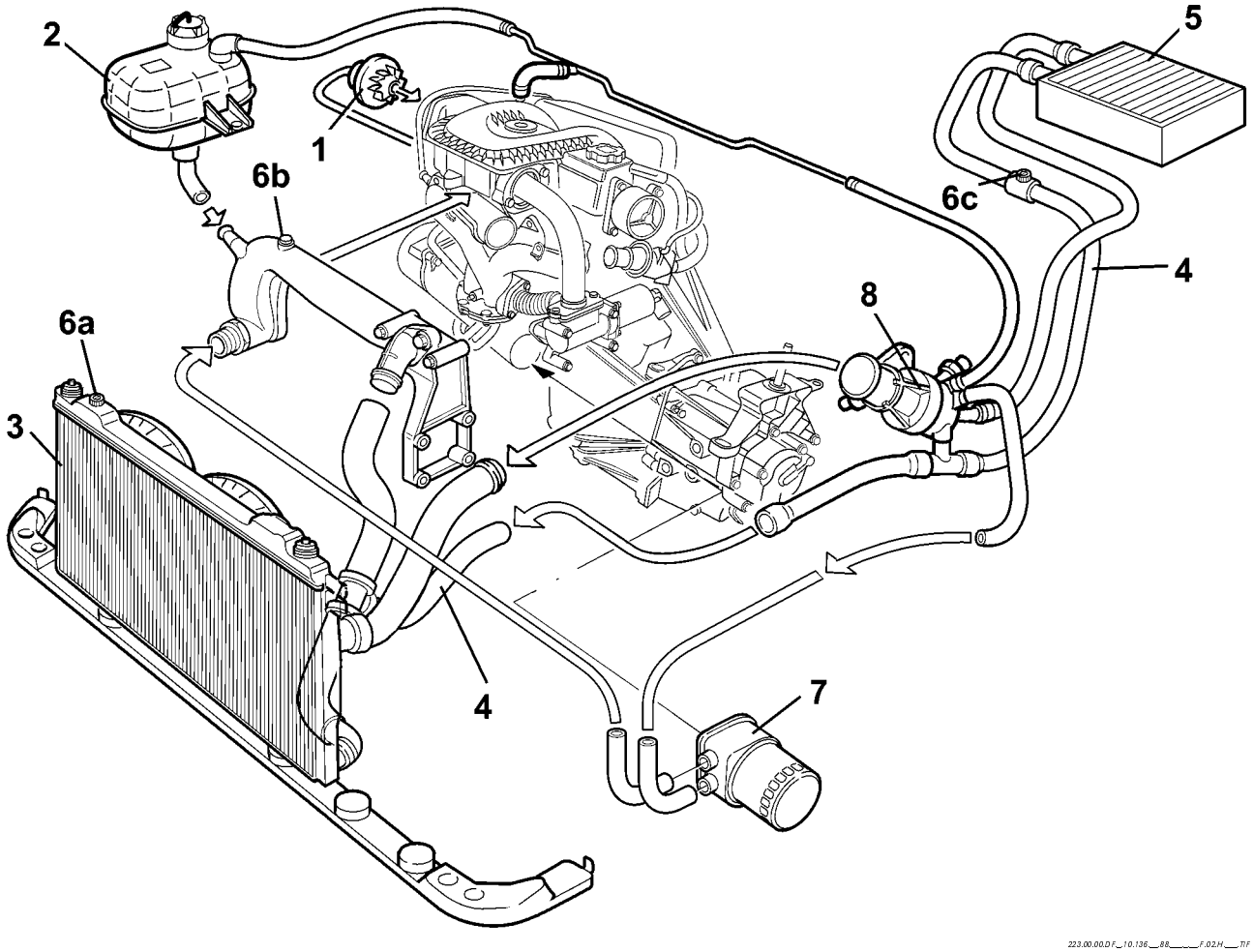
1910 D

COMPOSITION

1910 D

The cooling circuit on the 1910 D NATURALLY-ASPIRATED engine comprises:
- pump (1)

- expansion tank (2)
- cooling radiator (3)
- hoses (4)
- car interior heating radiator (5)
- vent plugs (6a)-(6b)-(6c)
- heat exchanger (7)
- thermostat (8)



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DESCRIPTION

1910 D

The engine cooling circuit maintains the temperatures at constant working temperature (90° - 100° C); for heat dissipation, it is supported by the engine ratiator fans (3).

1910 D

OPERATION

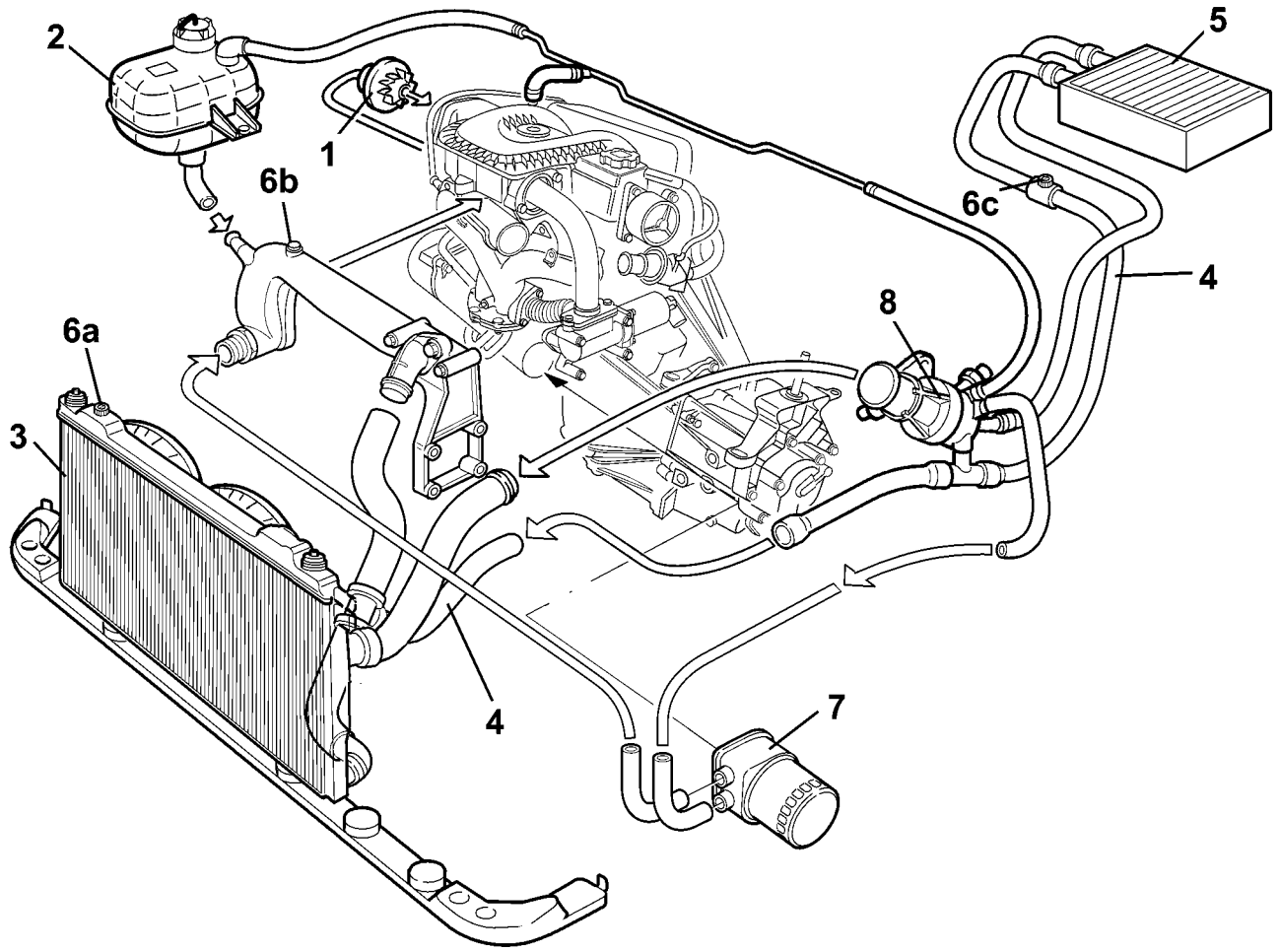
1910 D

The main function of the engine cooling circuit is to draw fluid from the radiator (3) and send it to the pump (1), which collects the fluid and circulates it into the engine. After absorbing heat from the engine, the fluid emerges and goes to both the radiator (3) and the heater (5), and also the expansion tank to top up the level. At about 88° C, the thermostat (8) begins to open, reaching its full travel at about 100° C; under these conditions the coolant circulates fully from the radiator (3), dissipating the heat absorbed from the engine. The heat exchanger (7) serves to keep the two fluids (oil and coolant) at equal temperatures.

DESCRIPTION OF FILLING OF COOLING SYSTEM

1910 D

The enging cooling system should only be filled or topped up with the engine cold.
Before filling, open the plugs (6a, 6b, 6c).
Topping up is done through the expansion tank filler (2) until the fluid emerges from the plug (6c); close (6c). Continue topping up until fluid emerges from (6b); close 6b). Again continue topping up until fluid emerges from (6a); close (6a). During this stage the air in the cooling system is bled. Top up the expansion tank to the MAX level.
Warm up the engine until the radiator fan has come on twice; allow the engine to cool down to ambient temperature, then check and if necessary top up the level in the expansion tank.



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1910 D

1088B - Engine cooling tank - r + r

1910 D

CONSTRUCTION FEATURES

Expansion tank

1910 D

In addition to supplying the cooling system, the expansion tank also absorbs the variations in volume of coolant as the engine temperature varies.
In the expansion tank cap, there is a specific valve calibrated at 1.4 bar, which allows air to both get out and come in, as the engine temperature increases or decreases.

RADIATOR

1910 D

This consists of a radiating mass and two side chambers acting as cooling inlet and outlet.

1910 D

1088C - Water pump and thermostat

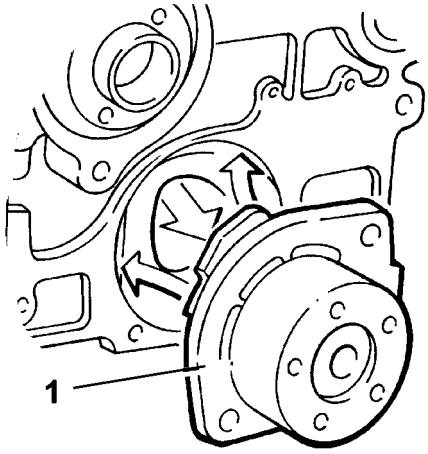
1910 D

CONSTRUCTION FEATURES

Pump

1910 D

It is the centrifugal type with vanes, fixed to the crankcase and operated directly by the timing belt.



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Thermostat

1910 D

Fitted on the gearbox side of the cylinder head, its function is to keep the engine at optimum working temperature.
At temperatures < 88° C (thermostat closed), the coolant flow is diverted directly upstream of the pump.
At temperatures of > 88° C the thermostat begins to open, up to a temperature of 100° C (the thermostat is fully open).

FAN

1910 D

The two-speed cooling fan makes it possible to increase the dissipation of the heat produced by the engine and/or the air conditioning system.
The fan is controlled by the fuel injection E.C.U. in accordance with a strategy for heat dissipation and maintenance of working temperature (operating logic: SEE SUBGROUP 1056 FUEL INJECTION SYSTEM).

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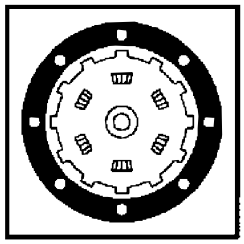

Clutch unit

1242 8v

1910 D

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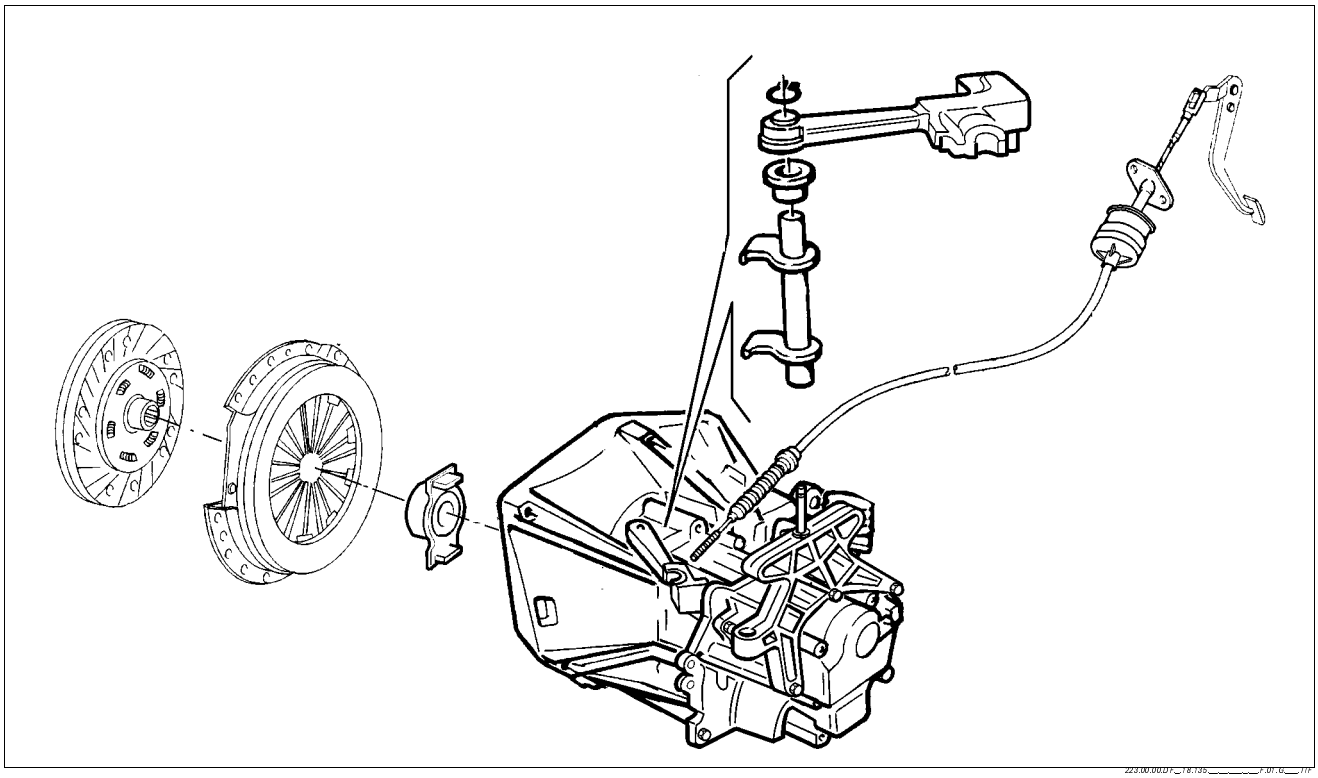
- GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Sub-groups index

Sbgrp.	Description	Validity

GROUP GRAPHIC INDEX



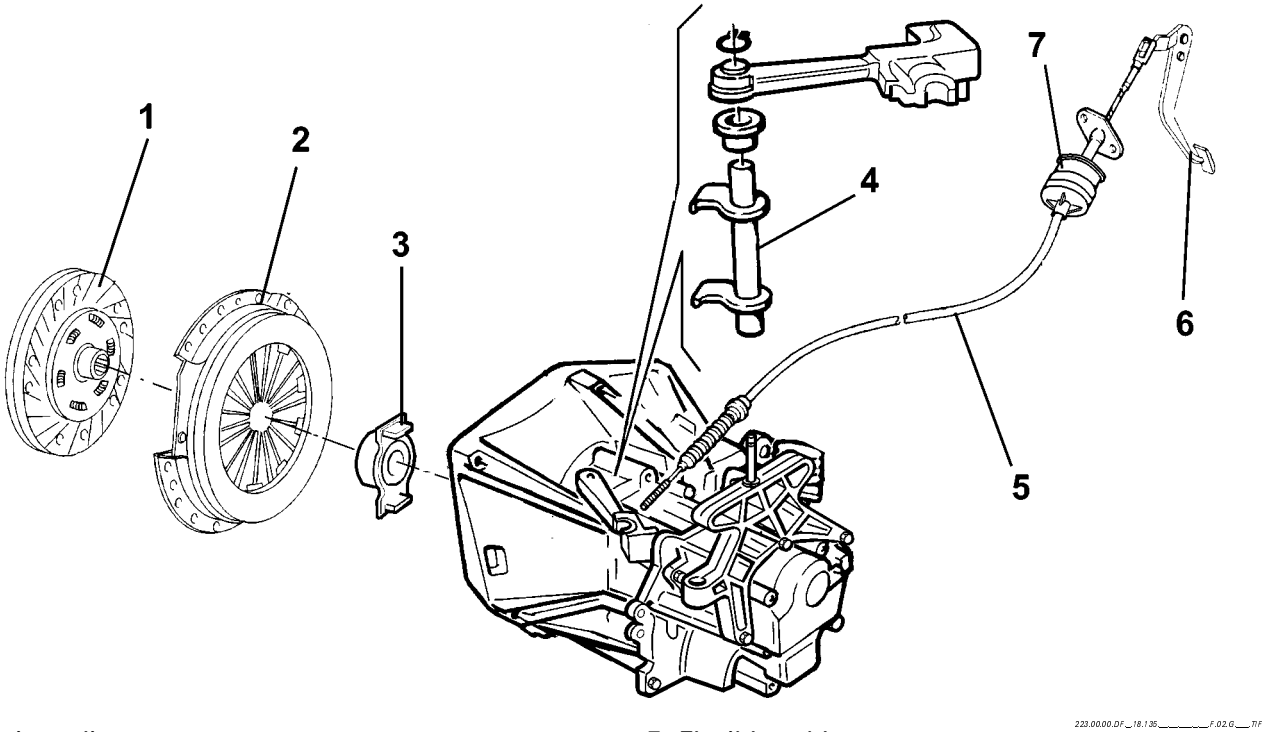
1242 8v

CONSTRUCTION FEATURES

1242 8v

The clutch is the dry, single plate type with a thrust bearing always in contact with the flexible coupling spring.

The driven disc is driven by the pressure exerted by a diaphram spring. Clutch release is achieved through a flexible cable operated mechanically by the pedal via a damper.



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1, Driven disc
2, Flexible coupling
3, Thrust bearing
4, Release mechanism
5, Flexible cable
6, Control pedal
7, Damper

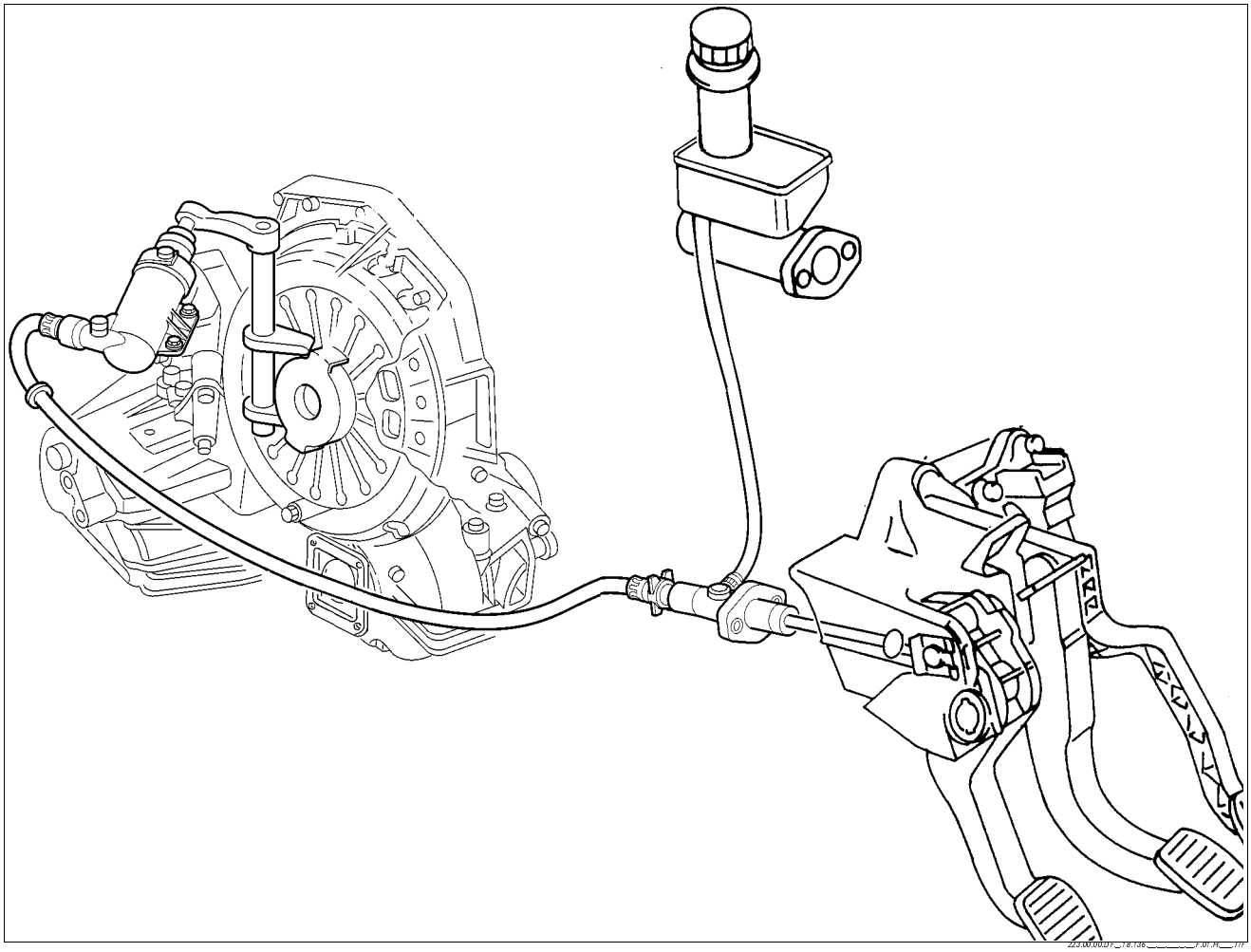
Group index

- GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES
- COMPOSITION
- OPERATTION

Sub-groups index

Sbgrp.	Description	Validity

GROUP GRAPHIC INDEX



1910 D

CONSTRUCTION FEATURES

1910 D

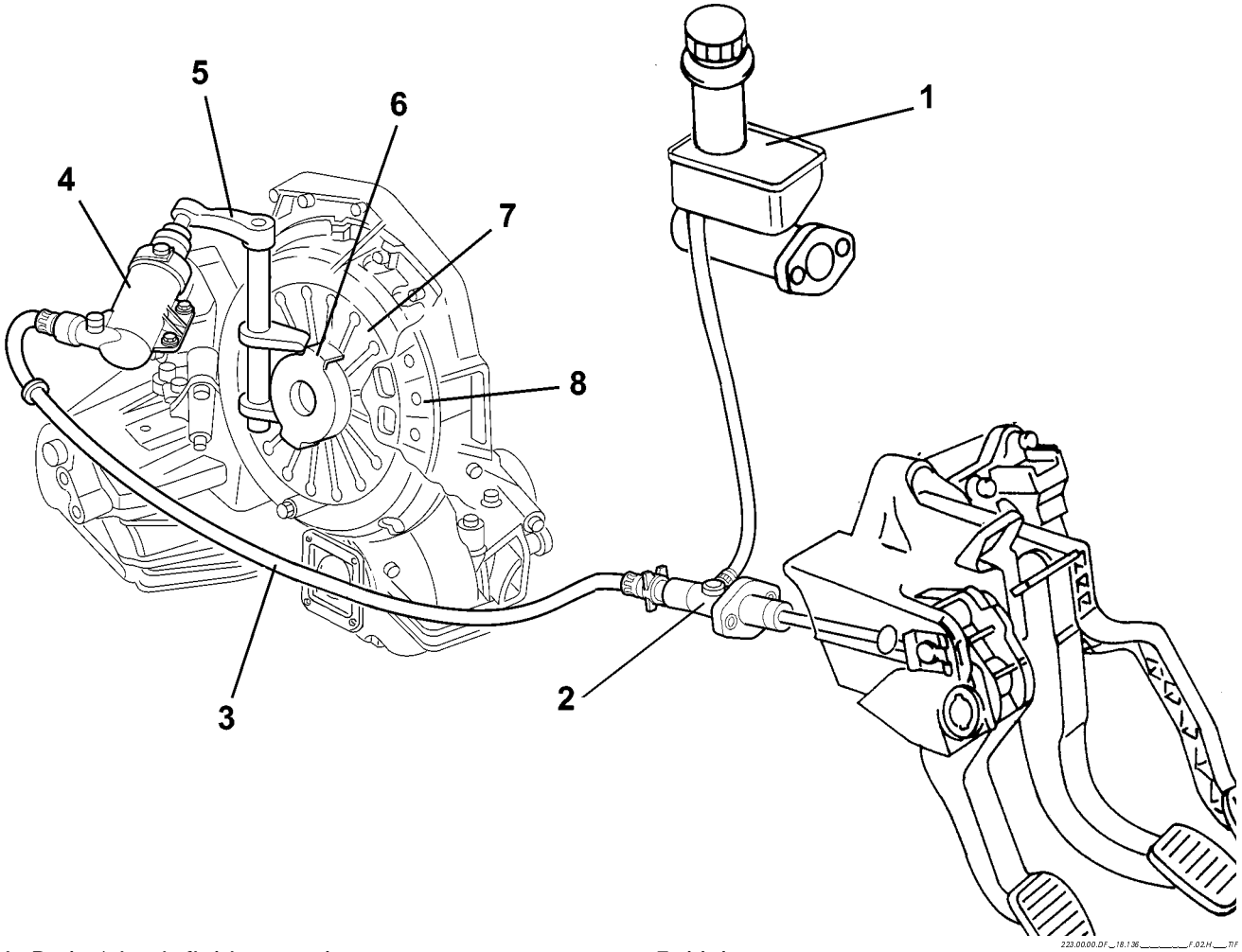
The clutch is the dry, single plate type with a thrust bearing always in contact with the flexible coupling spring. The driven disc is driven by the pressure exerted by a diaphram spring. The clutch is released by a pedal-operated hydraulic system.

1910 D

COMPOSITION

1910 D

The system consists of:
- a reservoir (1) common to the brake and clutch systems,
- a clutch pump (master cylinder) (2), which has the task of compressing the fluid and is fixed to the pedals;
- a connecting pipe (3) between the pump and the clutch operating cylinder;
- a clutch operating cylinder (4) fixed to the gearbox;
- linkage (5) operating the thrust bearing;
- a thrust bearing (6);
- a clutch drip tray with diaphragm springs (7);
- a clutch plate (8);



1, Brake/clutch fluid reservoir
2, Clutch pump
3, Connecting pipe between pump and cylinder
4, Clutch operating cylinder
5, Linkage
6, Thrust bearing
7, Diaphragm spring
8, Clutch plate

1910 D

OPERATTION

1910 D

The pump (2), operated by the clutch pedal, pressurizes the hydraulic circuit and activates the clutch operating cylinder (4).
The latter acts on the operaating linkage (5), which 'pulls' the thrust bearing (3), overcoming the action of the pressure plate springs (7).
This action uncouples the clutch plate (8) from the flywheel.
When the pedal is released, the action of the diaphragm springs (7) returns the mechanism to the original position.

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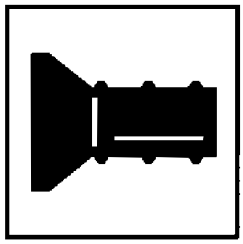


Gearbox unit

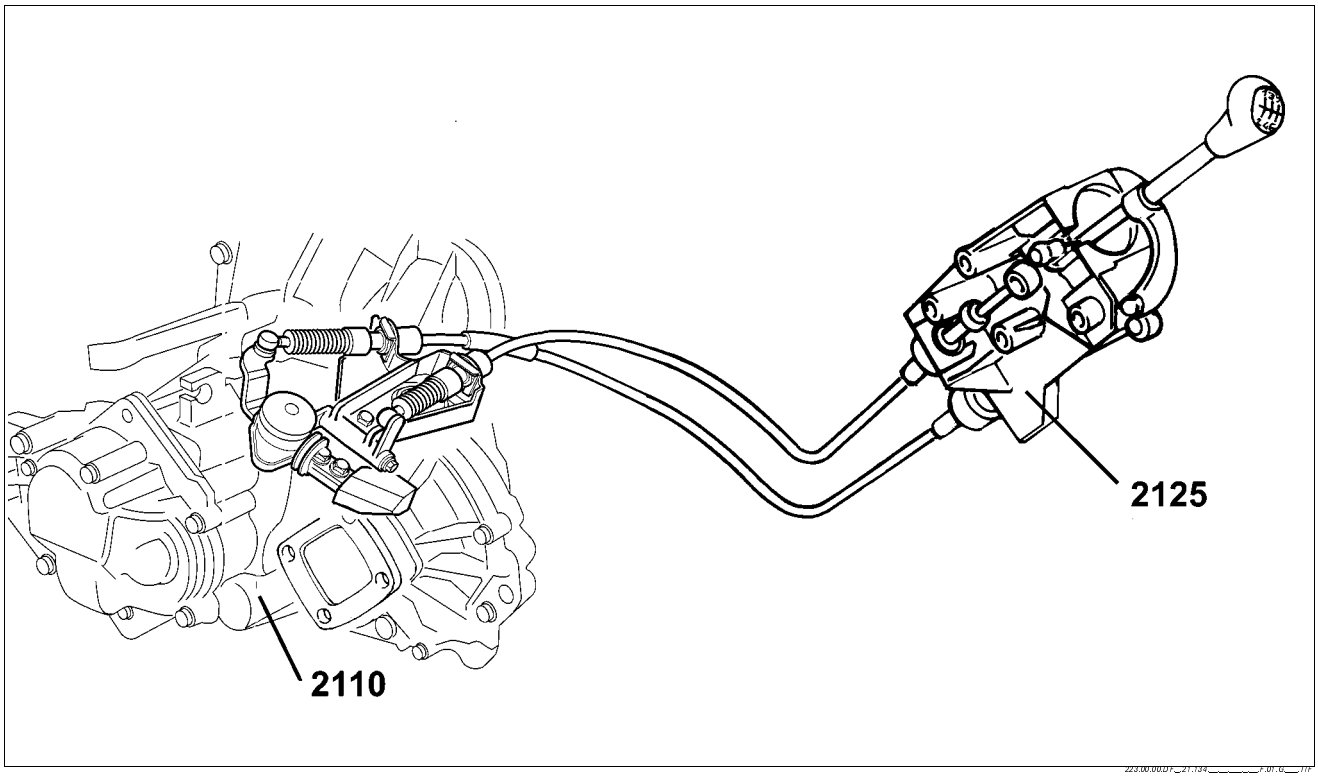
Group index

- GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Sub-groups index

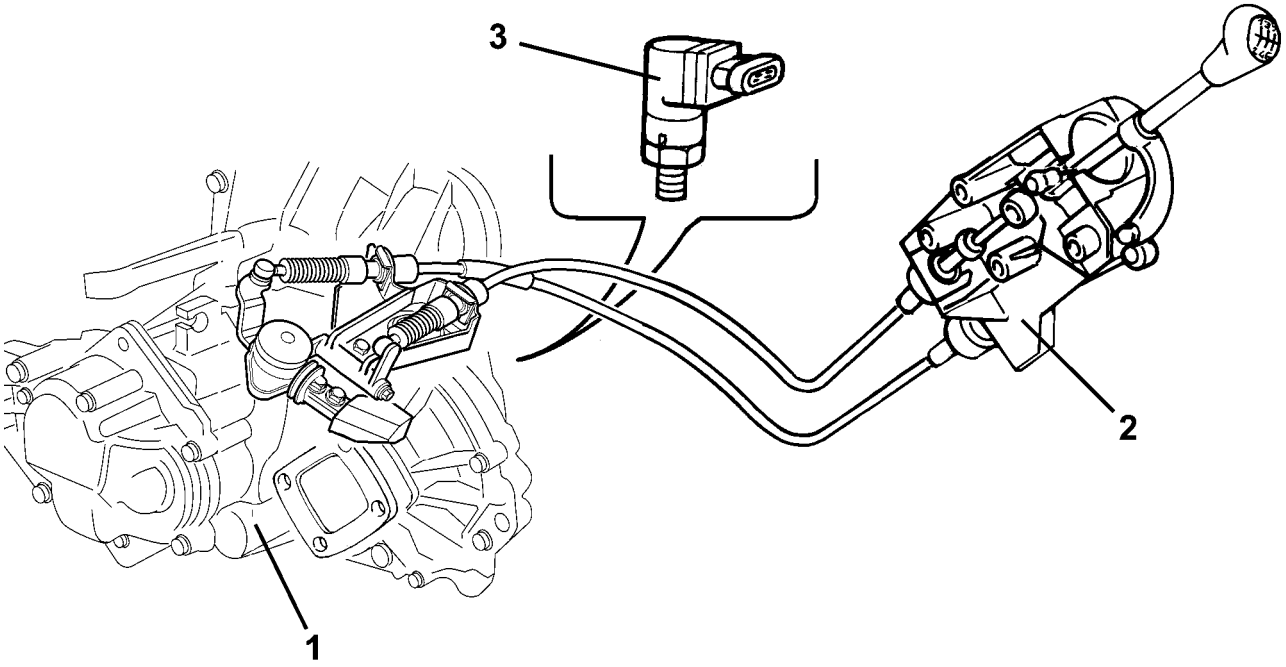
Sbgrp.	Description	Validity
2110	Manual gearbox with differential	
2125	Manual gearbox external controls	

GROUP GRAPHIC INDEX



CONSTRUCTION FEATURES

5 speed gearbox positioned transversely in the engine compartment, including 3 shafts supported by bearings with the gears always meshed and a final drive reduction. The twin cable external control is made from plastic materials with excellent properties (resistance to fatigue, self-lubrication capacity, reduced weight)



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1, Manual gearbox with differential

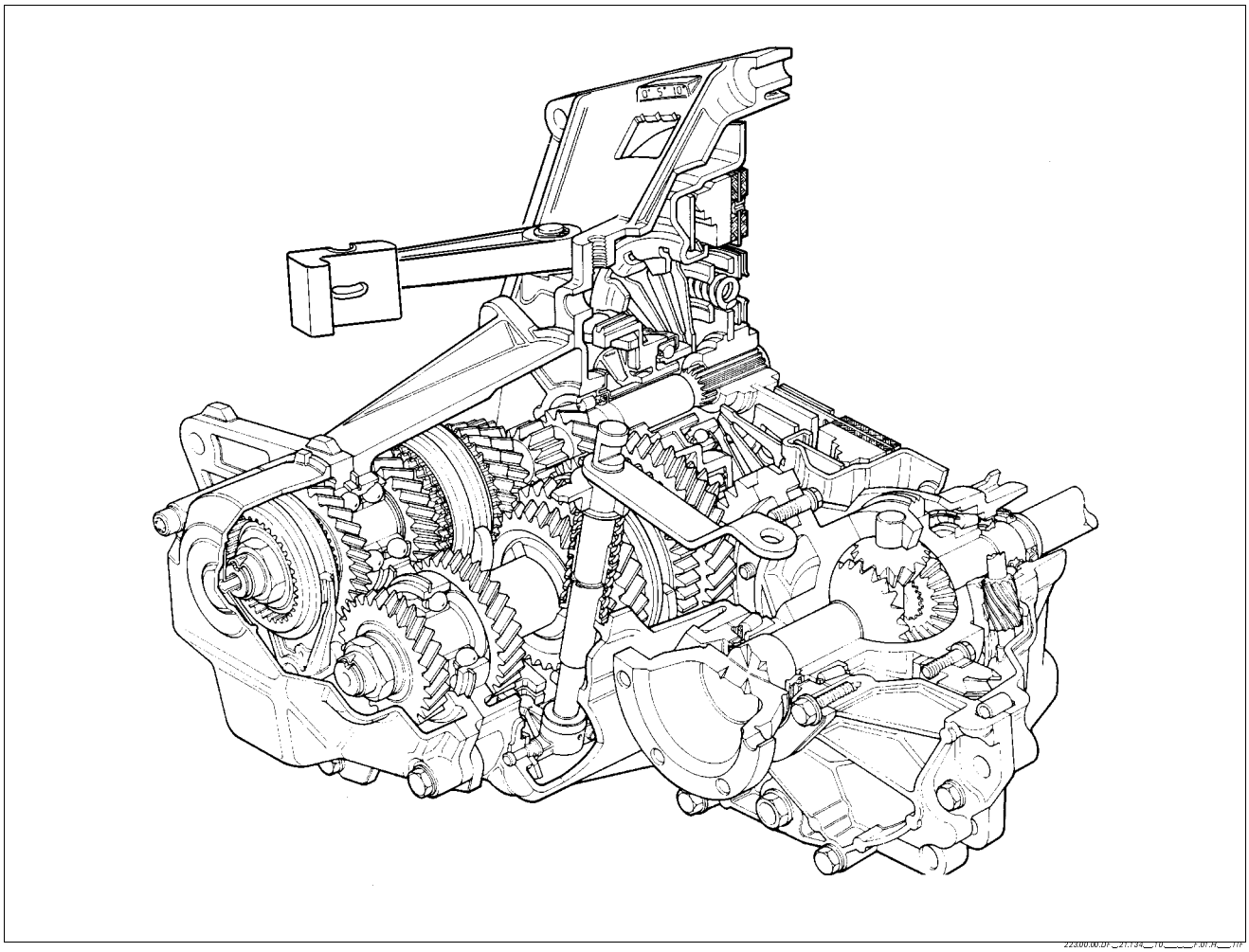
2, Manual gearbox external controls
2, Speedometer sensor

Sub-group index

Assembly drawings index

Cmp	*Description*	*Validity*

SUB-GROUP GRAPHIC INDEX

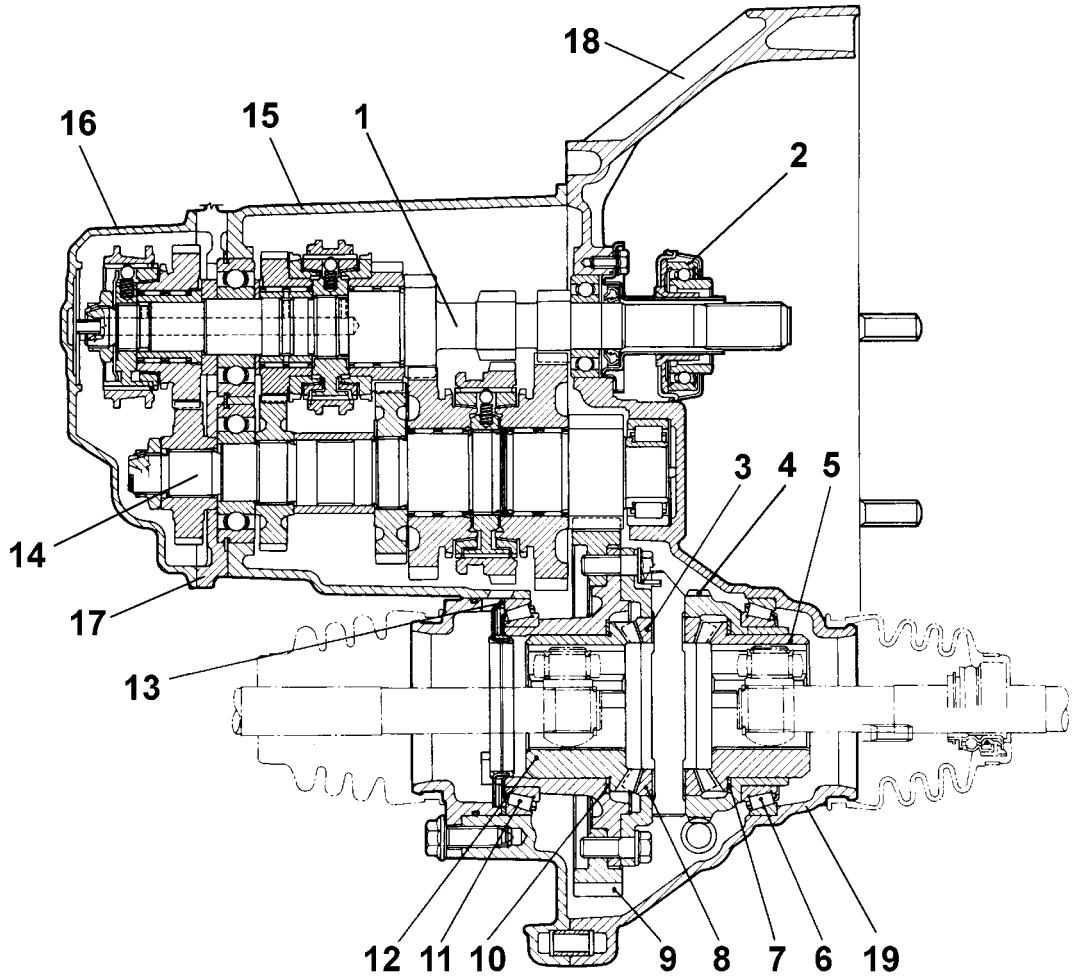


CONSTRUCTION FEATURES

The structure of the gearbox consists of:
- a gear casing (15), which contains and supports mainshaft (1) and llayshaft (14), rods, forks and the gear selection and engagement device;
- a rear cover (16) that contains the 5th speed gears
- plate (17) retaining the mainshaft and layshaft rear bearings;
- casing (18) joining the gearbox to the engine, which contains the clutch thrust bearing (2) and control linkage.

Because the vehicle is front wheel drive, the rear part of the gearbox (considering the vehicle's direction of motion) also houses a differential case (19), which contains:
- crownwheel (9) connecting the differential to the layshaft,

- differential wheels (5) and (12) with taper roller bearings (6) and (11) and shims (7) and (10),
- planet wheels (3) and (8)
- mileometer gear mechanism (4)



1, Main shaft
2, Thrust bearing
3, Planet gear
4, Speedometer gear
5, Differentialgear
6, Taper roller bearing
7, Differential gear adjustment shim
8, Planet gear
9, Ring gear
10, Differential gear adjustment shim
11, Taper roller bearing
12, Differential gear
13, Differential housing bearing adjustment shim
14, Layshaft
15, Gear casing
16, Rear cover
17, Rear bearing retaining plate
18, Gearbox bell housing
19, Differential case

Main shaft

The main shaft consists of:
- 1st, 2nd speed and Reverse gears fitted directly on the shaft
- 3rd, 4th and 5th speed gears fitted on the shaft

The mainshaft is supported by two press-fitted ball bearings. The rear bearing is on a special support plate secured to the gear casing and the front bearing is on the gearbox bell housing.

Layshaft

The layshaft supports the 1st and 2nd speed gears on roller bearings, while the 3rd, 4th and 5th speed gears are fitted to the shaft by means of grooved spur-toothed couplings.

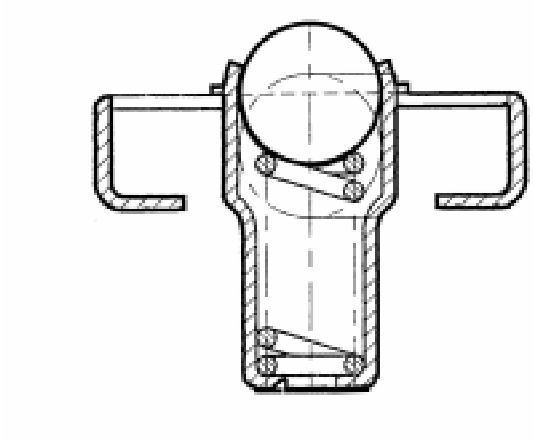
The layshaft is supported by:
- a front roller bearing fitted to the gearbox bell housing
- a rear ball bearing fitted to a special support plate secured to the gear casing

Gears

The gears are the following type:
- helical toothed for the forward speeds
- straight toothed for reverse.

synchronisers

The synchronizers for the forward speeds are the Borg-Warner type.
The arrangement for the synchronizers is the split type because the synchronizers for the 1st and 2nd speeds are fitted on the layshaft, whilst those for the 3rd, 4th and 5th speeds are on the main shaft.
This solution reduces gearbox noise in neutral from the moment 3 of the 5 pairs of gears are not driven.
In addition, the engagement and synchronization loads are reduced as a result of the corresponding reduction in the inert masses rotating downstream of the crankshaft.
The synchronisers used for all speeds adopt a new type of presynchronisation block to replace the conventional rollers and springs. This consists of a spring and ball within single unit that cannot be dismantled.
This solution facilitates dismantling during service.



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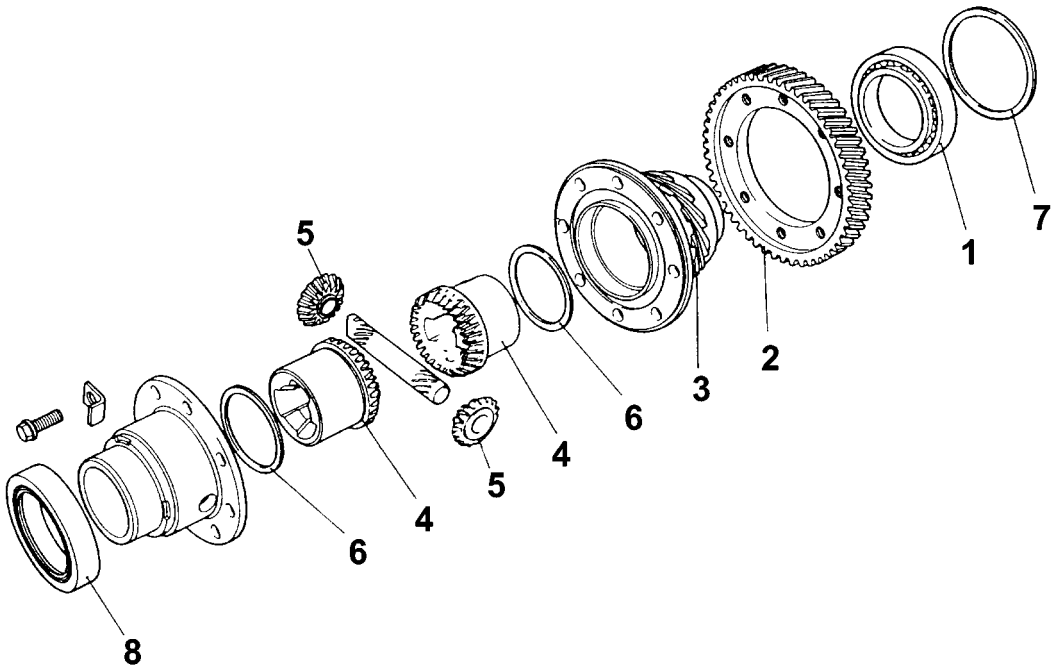
Differential

The differential unit is located behind the gear casing in relation to the vehicle's direction of motion.

This consists of:
- a crown wheel and pinion reduction
- two half casings which include the differential and planet gears.

The differential is supported by two taper roller bearings which should be preloaded before fitting.
The two drive shafts that transmit drive to the wheels slide on three splines inside the differential gears by means of a tripod joint.

The gear that transmits motion to the mileometer electronic sensor is fitted on the outside of the differential housing.



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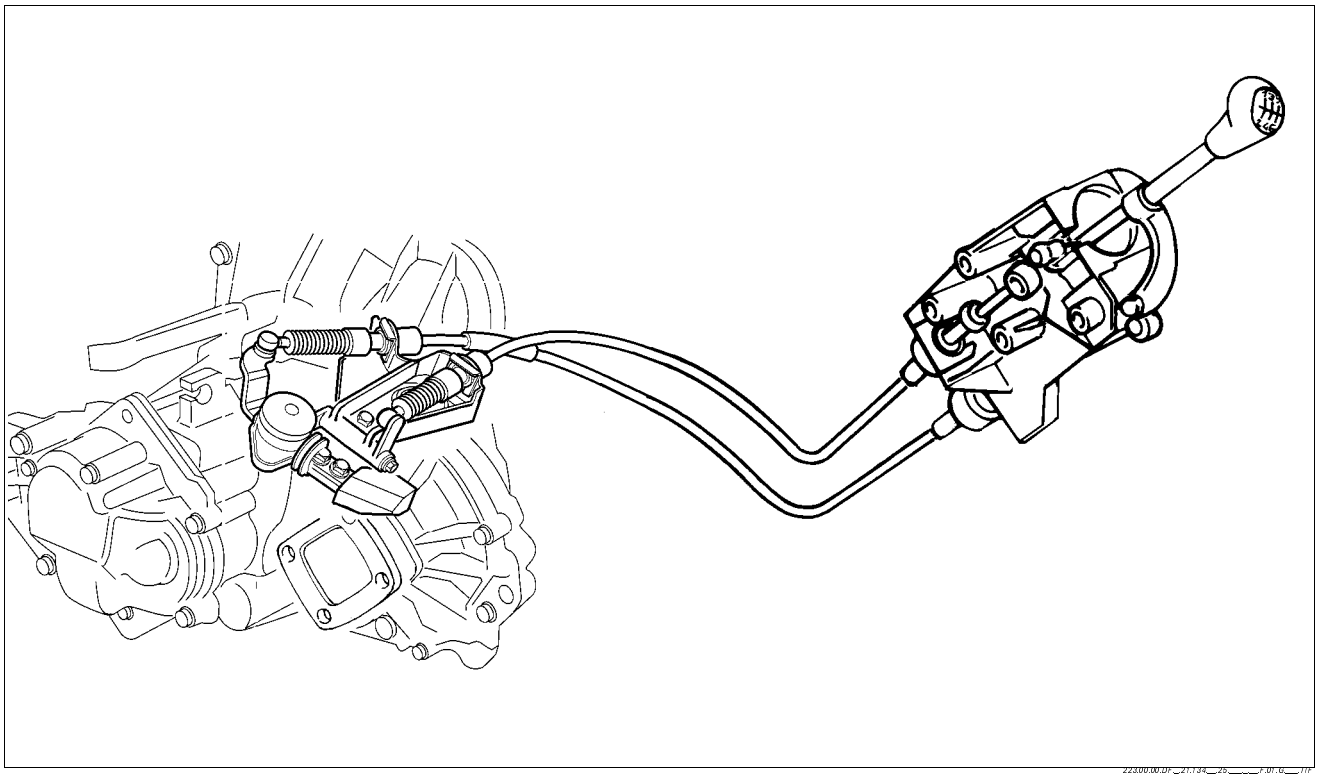
1, Bearing for differential housing
2, Ring gear
3, Speedometer gear
4, Differential gears
5, Planet gears
6, Differential gear adjustment shims
7, Differential housing bearing adjustment shim
8, Bearing for differential housing

Sub-group index

Assembly drawings index

Cmp	*Description*	*Validity*

SUB-GROUP GRAPHIC INDEX

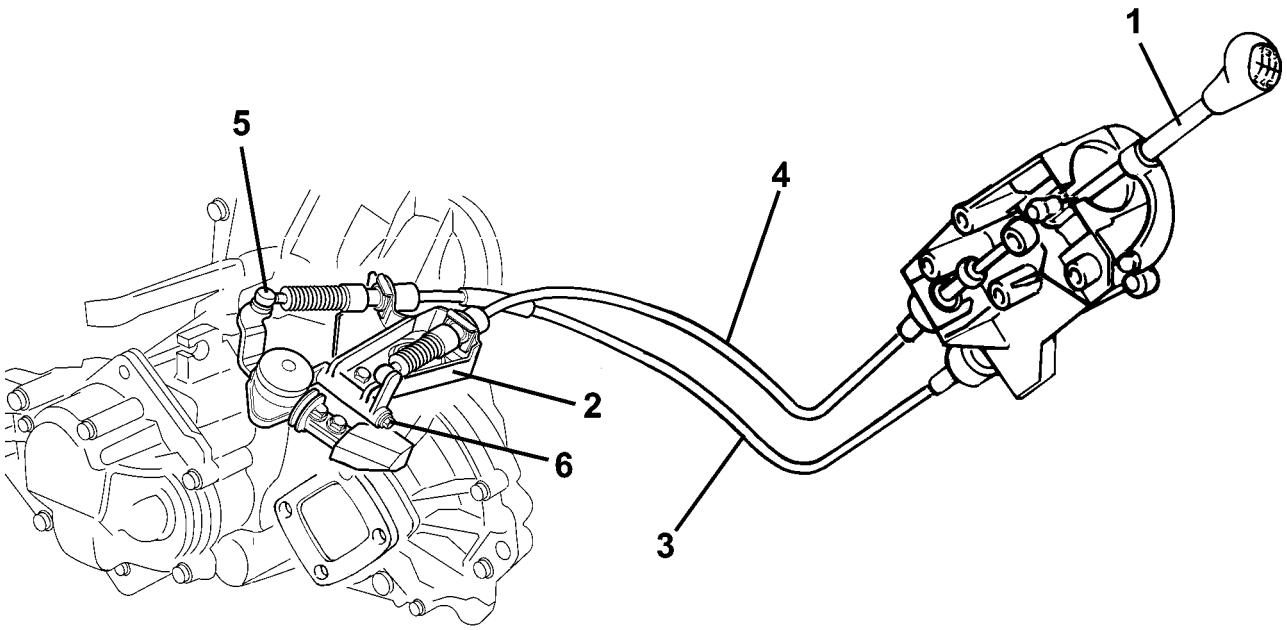


CONSTRUCTION FEATURES

The solution adopted with bowden cables makes it possible to:
- eliminate the vibrations transmitted by the engine to the gear lever
- improve the layout of the components and accessories in the engine compartment for the best possible positioning of the cables in relation to the rods.

One of the flexible cables is used for gear selection and the other for gear engagement.

The flexible engagement cable comes with an adjustable gearbox end head; this cannot be adjusted, however, for service reasons.



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1, Gearbox control lever
2, Support for gear selector and engagement cables
3, Gear engagement cable
4, Gear selector cable
5, Gear engagement lever
6, Selection lever

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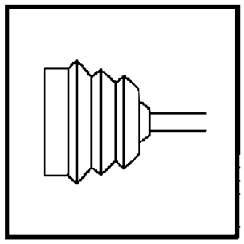


Axle

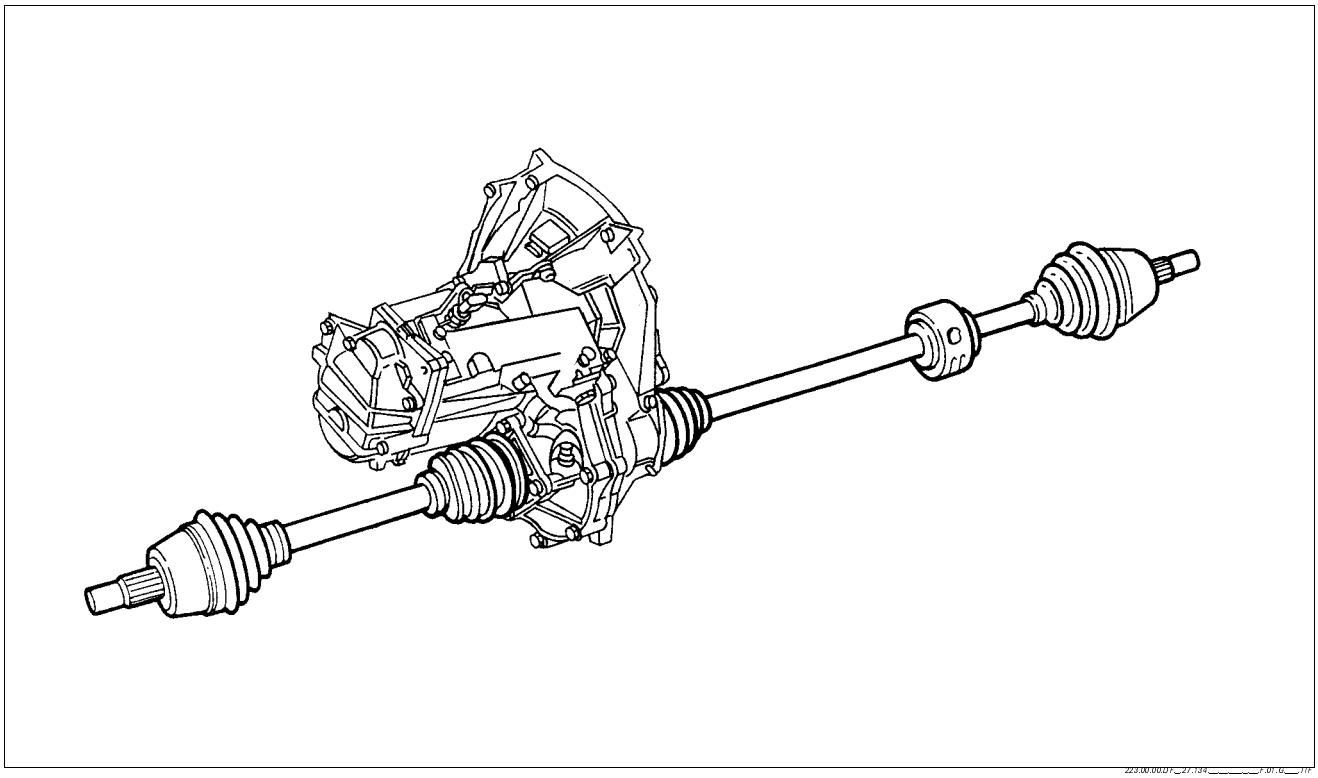
Group index

- GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Sub-groups index

Sbgrp.	Description	Validity

GROUP GRAPHIC INDEX



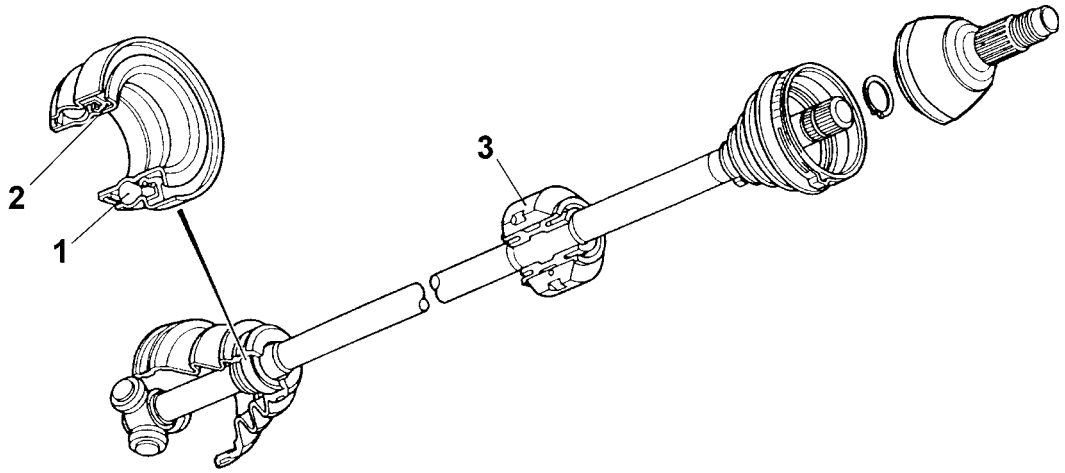
CONSTRUCTION FEATURES

Drive shafts with constant velocity joints at the wheel end and tripod joints at the differential end make up a transmission assembly that transmits motion from the gearbox to the drive wheels.

DRIVESHAFTS

The power is transmitted through driveshafts with wheel side constant velocity joints and gearbox side three-lobe joints.
In order to keep oil leaks to a minimum, there are sealed ball bearings (2) on the gearbox side boots, fitted on the actual driveshafts.
There is a seal (2) which is an integral part of the bearing (1).
The bearing and gaiter are replaced as one unit during service.

The right drive shaft comes with a hot press-fitted vibration damping mass that must never be removed. It is advisable to check that the position is correct at intervals and replace the whole drive shaft if necessary.



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1, Sealed bearing
2, Gasket
3, Damper mass

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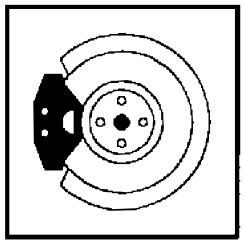


Brake unit

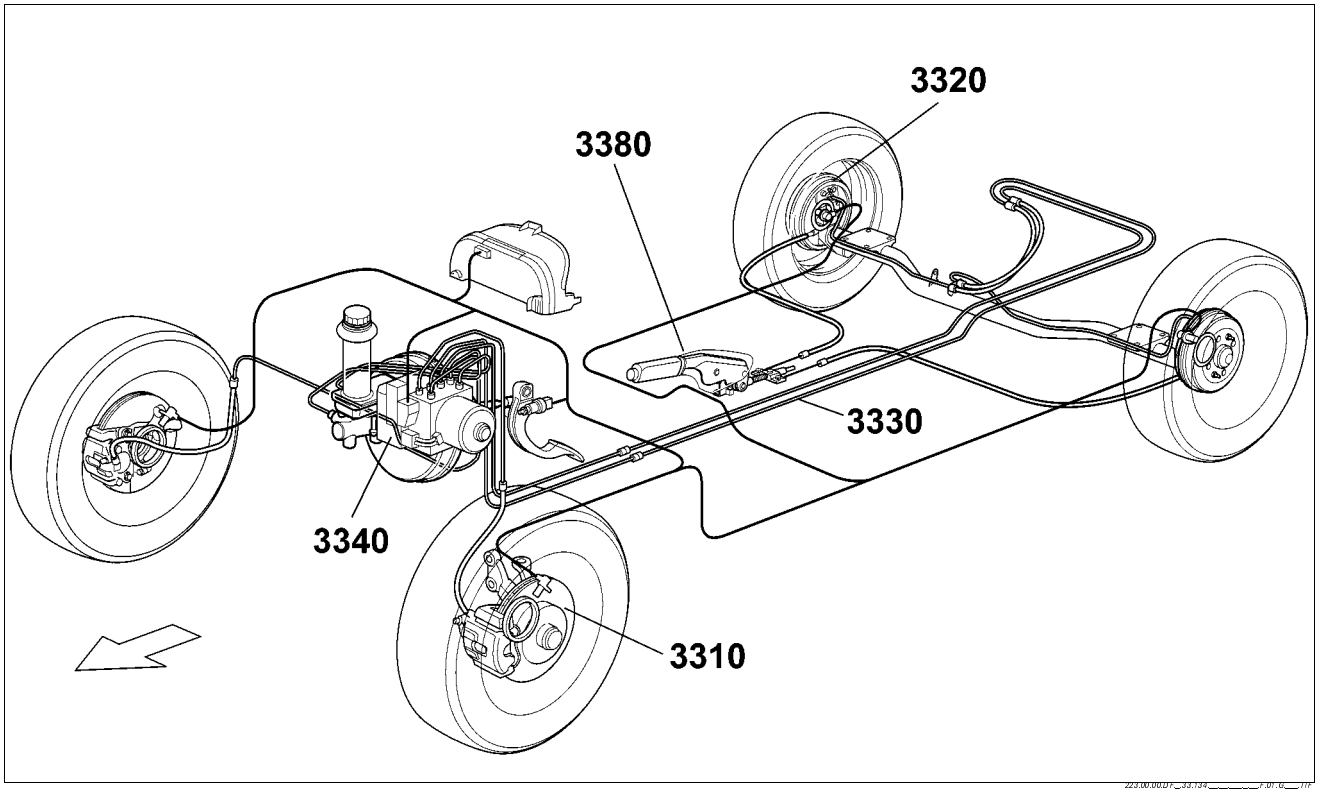
Group index

- GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Sub-groups index

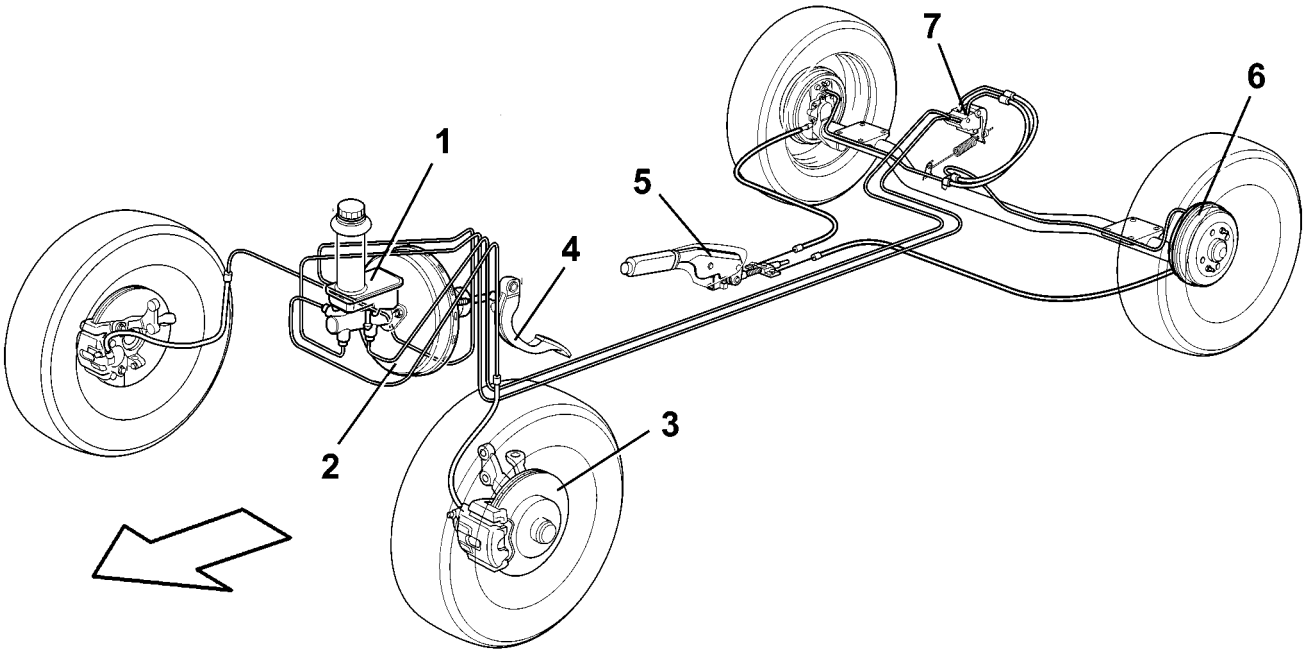
Sbgrp.	Description	Validity
3340	Anti-lock brake system (abs)	

GROUP GRAPHIC INDEX



CONSTRUCTION FEATURES

The vehicle is fitted with self-ventilated front disc brakes with floating calipers and rear drum brakes with self-centring shoes and automatic recovery of the clearance. The braking system is operated by a pedal with a 10' vacuum brake servo for the 1242 engine and a 9' vacuum servo for the 1910D version, both combined with a 7/8' master cylinder. The hydraulic system is the split type with two independent crossover circuits with a load proportioning valve on the rear brake circuit (versions without ABS).



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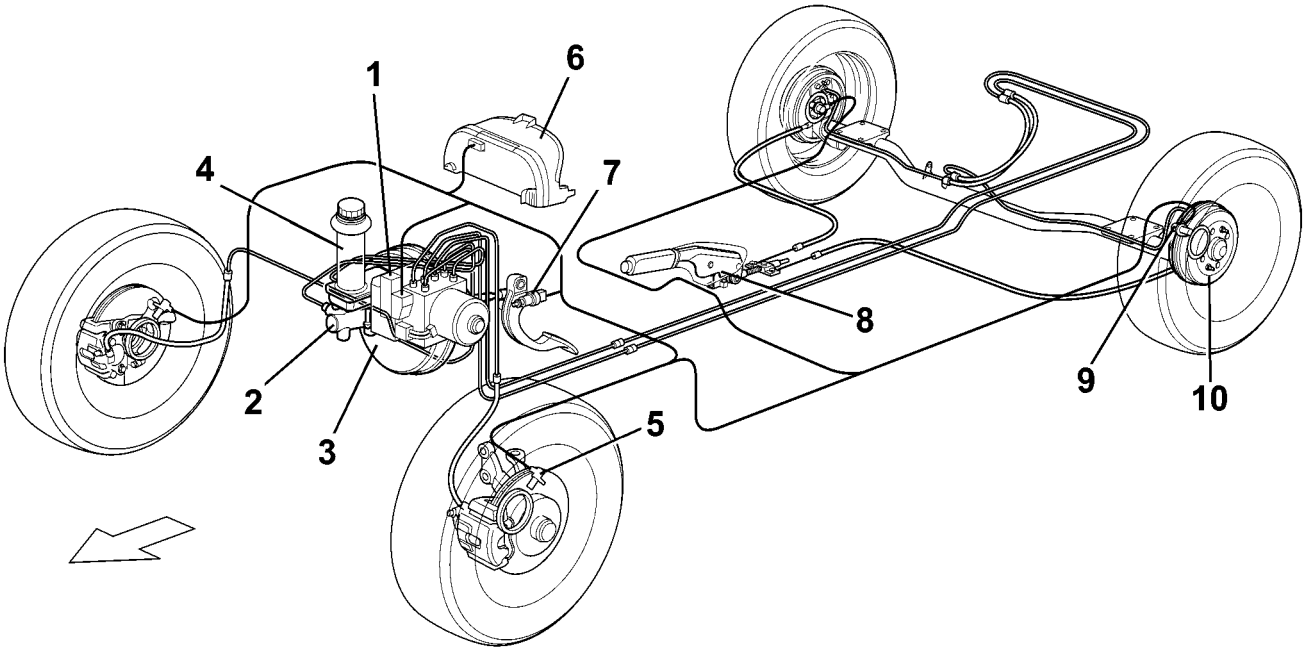
1, Brake fluid reservor and pump for independent brake circuits
2, Vacuum brake servo
3, Front disc brakes
4, Brake pedal
5, Parking brake control lever
6, Rear drum brakes
7, Load proportioning valve

TEVES MK20 anti-lock brakes with four active sensors and four channels are available as an option.
The system control unit controls the EBD (Electronic Brake force Distribution) function for distributing the braking between the front and rear axles (in this case a conventional load proportioning valve is not fitted).

Mechanical type handbrake with twin cable.



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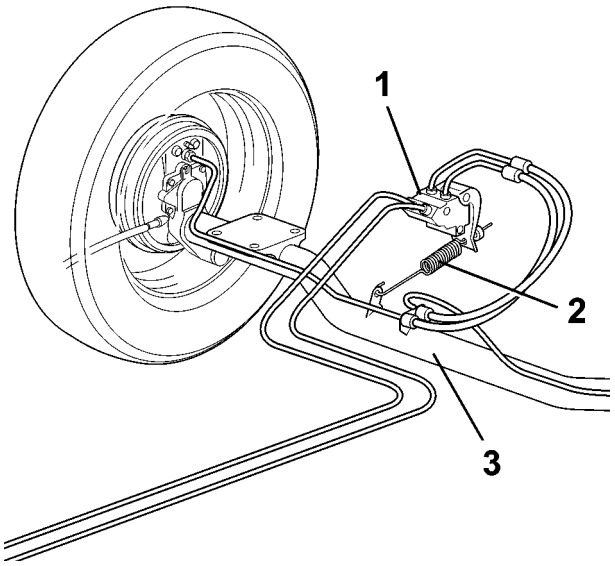
1, Hydraulic control unit
2, Master cylinder
3, Brake servo
4, Brake fluid reservoir
5, Front rpm sensor
6, System fault indicator (on instrument panel)
7, Brake light switch
8, Parking brake lever
9, Rear rpm sensor
10, Rear drums

LOAD PROPORTIONING VALVE

On versions without ABS, a load proportioning valve is fitted to distribute braking action over the front and rear wheels as effectively as possible.
The device reduces pressure in the rear drum brake control cylinders by an amount proportional to the static load acting on the rear axle and according to the dynamic load acting on the wheels of the axle.
Device (1) secured to the vehicle floor pan is connected via a spring (2) to the rear axle (3).
The aim of the device is to prevent the rear wheels locking (due to excessive braking action) when the vehicle is low and also to ensure that the braking action increases to allow the vehicle to brake under higher load conditions.
Under conditions of high static load (laden car), the load proportioning valve acts to maximum effect, i.e. the device allows more fluid to pass through it and thus an increased braking action. With a low static load, on the other hand, axle movement during car motion triggers release of the return link and thus reduces braking action.

Note: *If replaced, the part should be installed in accordance with installation procedures shown in the removal and refitting procedure.*

Note: *If the spring becomes separated from the load proportioning valve as a result of maintenance operations on the rear axle, it should be refitted as described in the removal/refitting procedure.*



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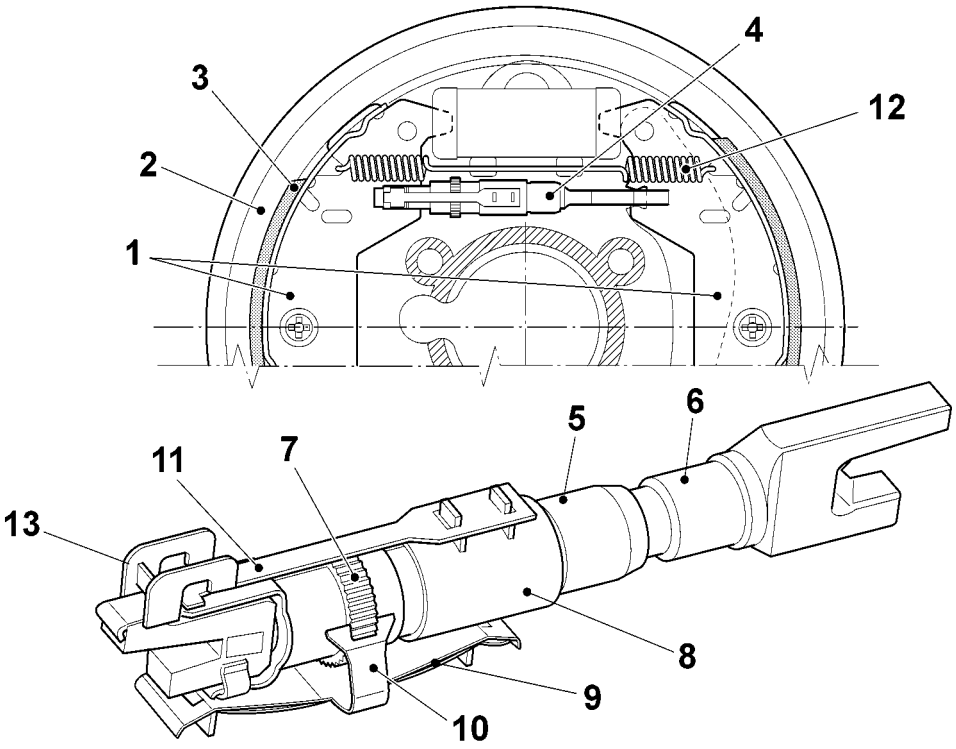
REAR SHOE-DRUM AUTOMATIC PLAY TAKE-UP DEVICE

Play between shoes (1) and rear drum (2) due to wear on lining (3) is taken up automatically by a mechanical device (4).
The device consists of a link in two parts. The forked ends of the parts are held in contact with the brake shoes by a spring inside the device.
The automatic adjustment system is operational during service brake operation and also during parking brake operation because the parking brake mechanism is also in contact with the rear adjustment device fork.
Both parts of the device are joined together by an interior worm screw system. An external toothed lock-ring (6) is in contact with a ratchet integral with the spring.
The device works on the principle that it extends during braking and then stays long enough to take up the clearance due to wear on the friction material.
When the brake shoes widen during braking, spring action allows the link to extend by unscrewing the worm screw system.
If the extending link causes the outer lock-ring to turn so much that it causes the ratchet to click, it is impossible for both parts of the device to come together again during the successive brake release stage.
A thermal clip (6) is also present to allow the device to operate properly if the rear brakes overheat. The heat-sensitive clilp blocks the operation of the autoamtic play take-up device if the brake shoes expand because otherwise the brakes would lock when the shoes cooled down.

If the brake shoes are replaced, the device is adjusted by means of lock-ring (5) until it fits the new shoes.



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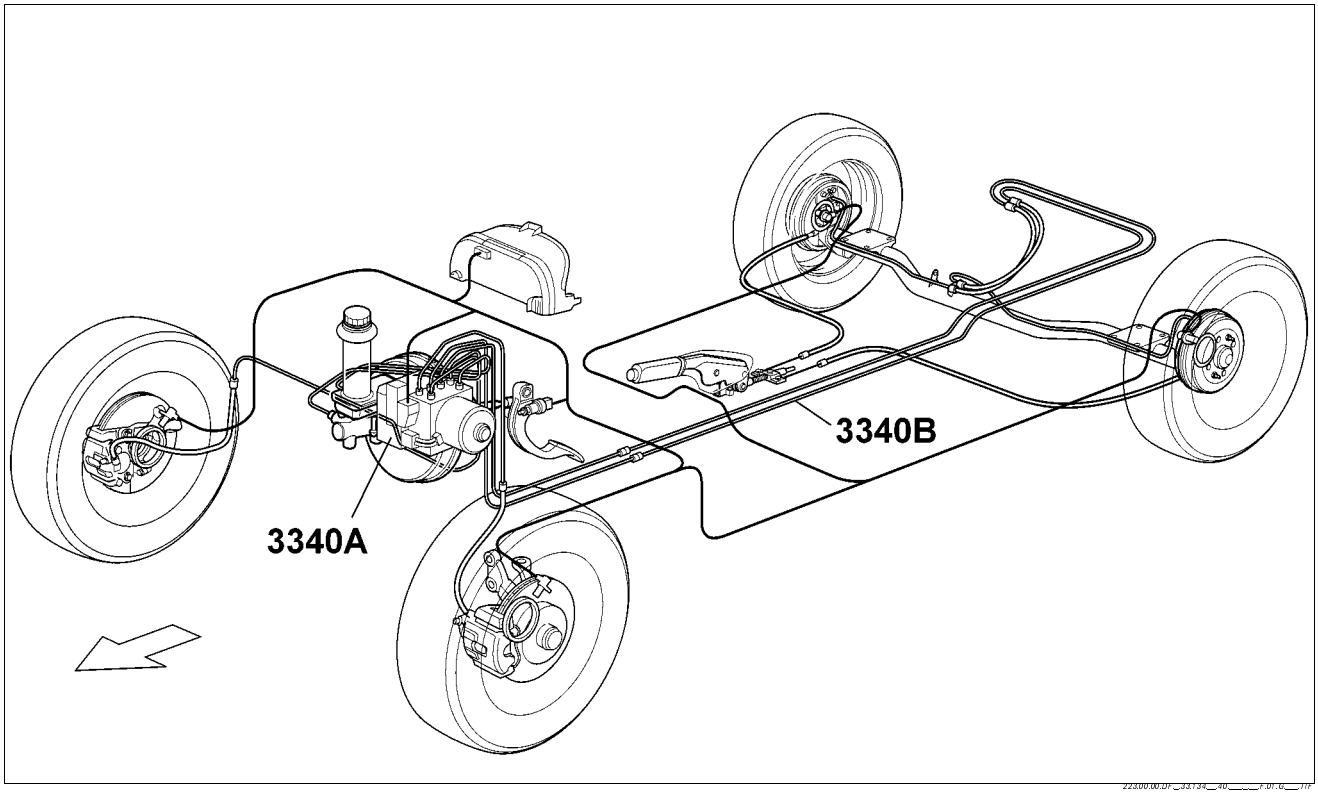
Sub-group index

Assembly drawings index

Cmp	*Description*	*Validity*

SUB-GROUP GRAPHIC INDEX



CONSTRUCTION FEATURES

INTRODUCTION

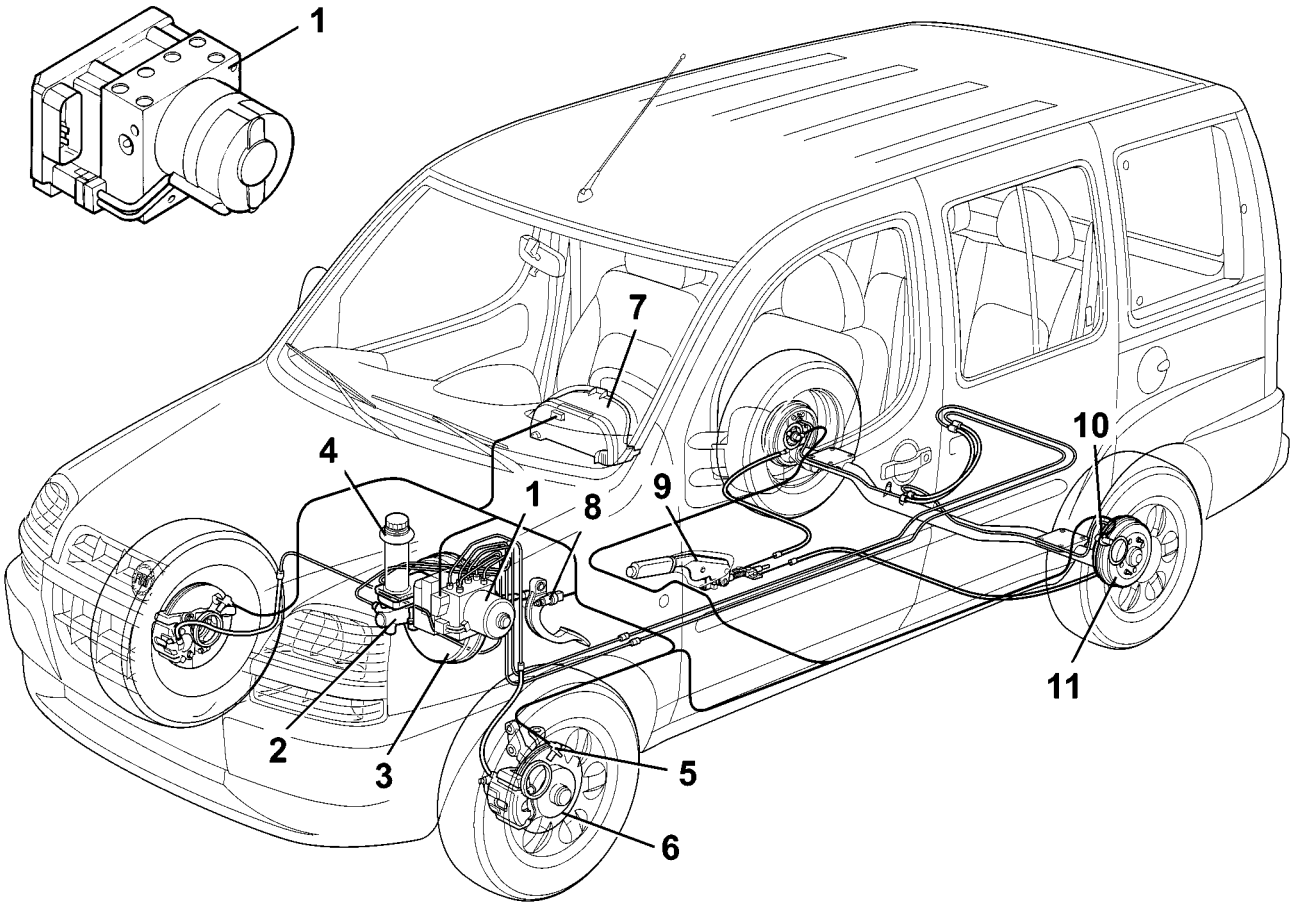
The brake system must be big enough to deal with the weight of the car when fully laden and the maximum possible ground/tyre grip coefficient. The aim is to ensure effective slowing or halting in the shortest possible time under all driving conditions.
Brake system size may be increased to deal with the most common conditions of partial load and reduced grip. Under these circumstances, application of maximum braking force leads to the brakes locking immediately. The grip-friction coefficent is therefore reduced and braking efficiency decreases.
If car motion is to be halted quickly and effectively in all situations, the wheels must be kept rolling. Depite this, for design reasons, the braking force applied to the linings is often too much for the car's normal kerb weight and normal grip coefficients.
The wheels must therefore be prevented from locking by means of an electronic anti-lock braking device that is built into the car's braking system.
Becuase it is not possible to assess grip conditions beforehand, braking efficiency can be checked only after recording the effects of intial tyre slip brought about by a braking force that is excessive for the existing grip coefficient.

Once this effect has been recorded by special sensors, braking force can be modulated by the action of a series of solenoids and scavenging pumps that act on the braking circuit and are governed by an electronic control unit.

COMPOSITION

The TEVES MK20 ABS with EBD is integral with: the brake cylinder (2), brake servo (3), front brake calipers (6), rear drums (12) of the conventional braking system and consists of:
- a control unit (1) that contains an electronic control unit (A), a hydraulic section (B) that modulates braking pressure via eight solenoids, two per wheel, and a scavenging pump (C);
- a warning light (7) on the control panel that indicates whether the system is working efficiently;
- four 'active' type sensors, two at the front (5) and two at the rear (11) which detect the angular rotation speed of the wheels.
- a switch on brake pedal (8) that records braking condition.

The system is completed by hydraulic system lines, special wiring and a tester connection point.
If a fault is present, the ABS is immediately deactivated
Information on faults present may be read by connecting a computerised tester station to the tester connection point.



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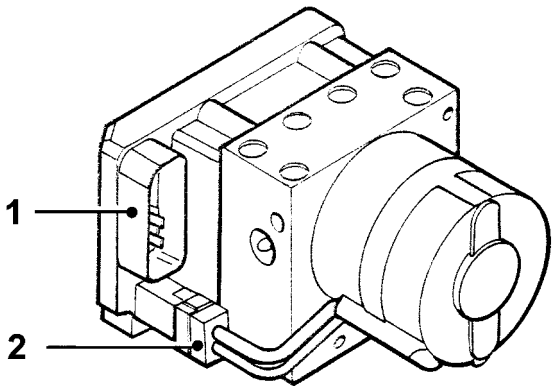
1 Hydraulic control unit
2 Brake pump
3 Brake servo
4 Brake fluid reservoir
5. Front active sensors
6. Front disc brakes
7. Fault warning light
8 Brake light switch
9 Parking brake control lever
10 Rear active sensors
11. Rear drum brakes

Control unit

The electronic control unit (ECU) consists of:
- an input circuit with a 25-pin connector for downloading of digital signals from the active sensors.
- integrated circuits for processing of input signals and memory management
- a data memory
- a power stage designed to control modulation solenoids and scavenging pump motor via connector (2) and the fault warning light.



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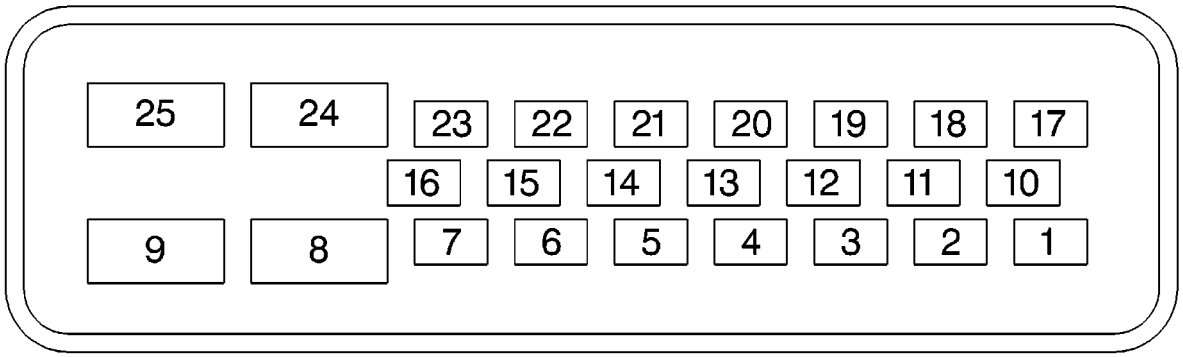
Teves MK20 control unit pin-out

Control unit side connector



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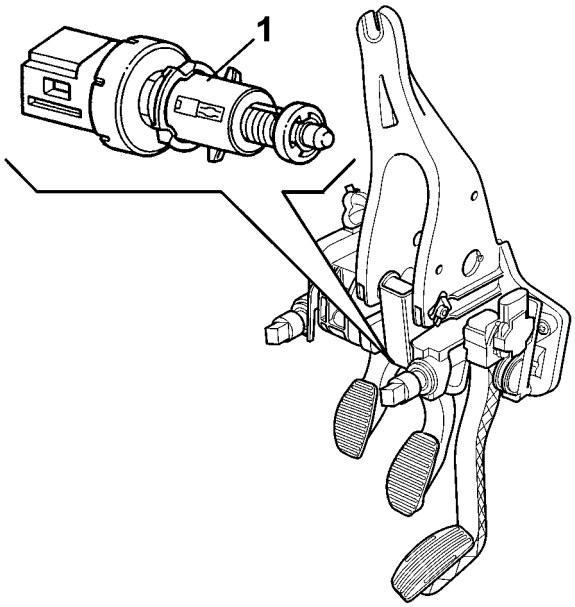
1 Left front sensor signal
2 Left front sensor power supply
3 N.C.
4 N.C.
5. Left rear sensor signal
6. Left rear sensor power supply
7. Tester connection
8 Signal earth
9 Power supply from battery
10 N.C.
11. N.C.
12. N.C.
13. Ignition-operated power supply (+15)
14. N.C.
15. System failure warning lights (ABS - EBD)
16. N.C.
17. N.C.
18. Brake pedal switch
19. Right front sensor signal
20. Right front sensor power supply
21. N.C.
22. Right rear sensor power supply
23. Left rear sensor signal
24. Power earth
25. Power supply from battery (+30)

BRAKE light switch

The brake pedal operating signal reaches the control unit via the connection of switch/selector (1), wihch controls the car brake lights.
This information is useful for controlling braking under certain conditions, e.g. when the car is strongly braked after an abrupt acceleration that makes the wheels skid - or in the case of irregular road surfaces (corrugations, steps) that can cause wheel speed to change for reasons unconnected to the braking manoevre.

Under these conditions, the microprocessors implement a strategy dependent upon changes in wheel speeds at these given moments in order to restore the braking manoeuvre to within correct parameters.
System efficiency is not affected if the brake pedal switch is not connected to the control unit under these specific brake control conditions.
For this reason, the warning light does not come on and the ABS is disabled.



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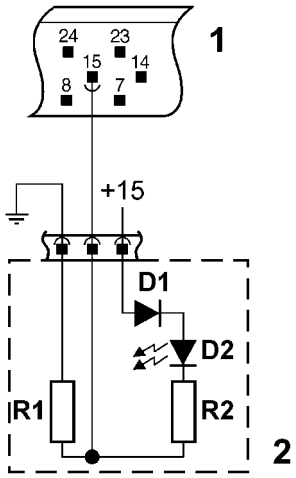
ABS failure warning light

Under conditions of inefficient operation, the red warning light (shown in the figure) goes off
When the ignition key is turned to MAR to start the car, the control unit runs a static self-check for about 4 seconds during which the warning light remains on.
The indicator goes off if no anomalies are detected after this time.
The control unit runs continuous self-checking cycles while the car is in motion. If an error is detected, the warning light comes on and the ABS is disabled. The conventional braking system works as normal.



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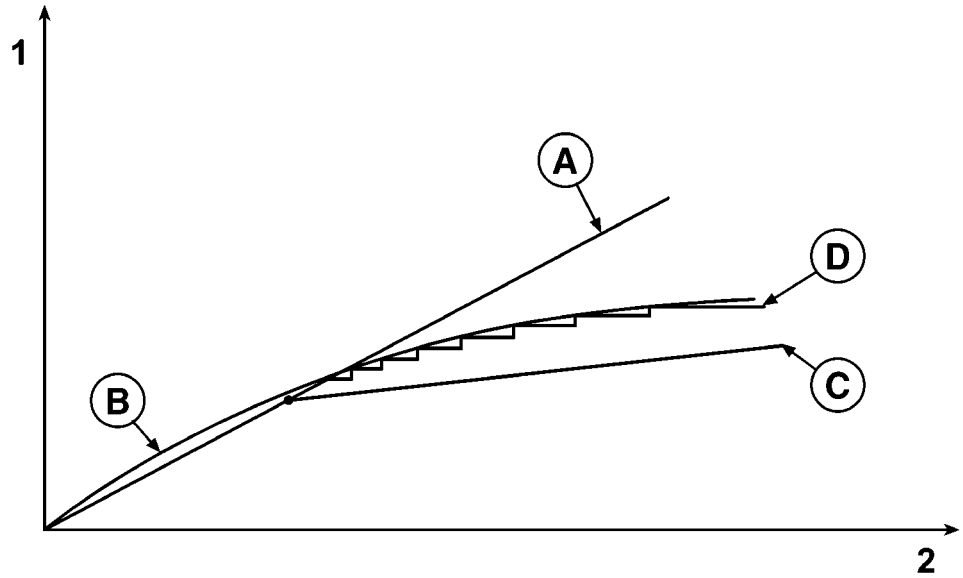
The fault indication warning light is a SMART type.
The warning light takes the form of a led (D2) controlled by an electronic circuit, which consists of two resistances R1 and R2 protected by a diode (D1). The diode is made as shown in the diagram alongside and allows the warning light to come on if the ABS is faulty or if the connection between pin 15 of control unit (1) and instrument panel (2) is broken or short-circuited to earth.

EBD function

The Teves MK20 ABS used on this car incorporates an EBD function (Electronic Brakeforce Distribution) that distributes pressure acting on the brakes over the front and rear axes hydraulically.

This function is controlled by the ABS electronic control unit, which uses the ABS sensors and actuators to calculate and implement brake pressure distribution.
The introduction of this function makes the conventional mechanical load proportiioning valve superfluous and this has been removed from the rear brake hydraulic circuit.
The EBD function also allows optimal use of the rear brakes because the device is able to send the ideal brake pressure at all times to prevent the rear wheels locking if grip is insufficient.
The electronic control unit continually compares front and rear wheel speed by means of the speed sensors and controls the hydraulic unit to prevent the rear wheels locking.
The graph below shows how the EBD function (curve D) works in relation to pressure in the braking system (curve D), ideal pressure to the rear axle brakes (curve B) and pressure reduction to the rear axle brakes normally implemented by the conventional load proportioning valve (curve C).



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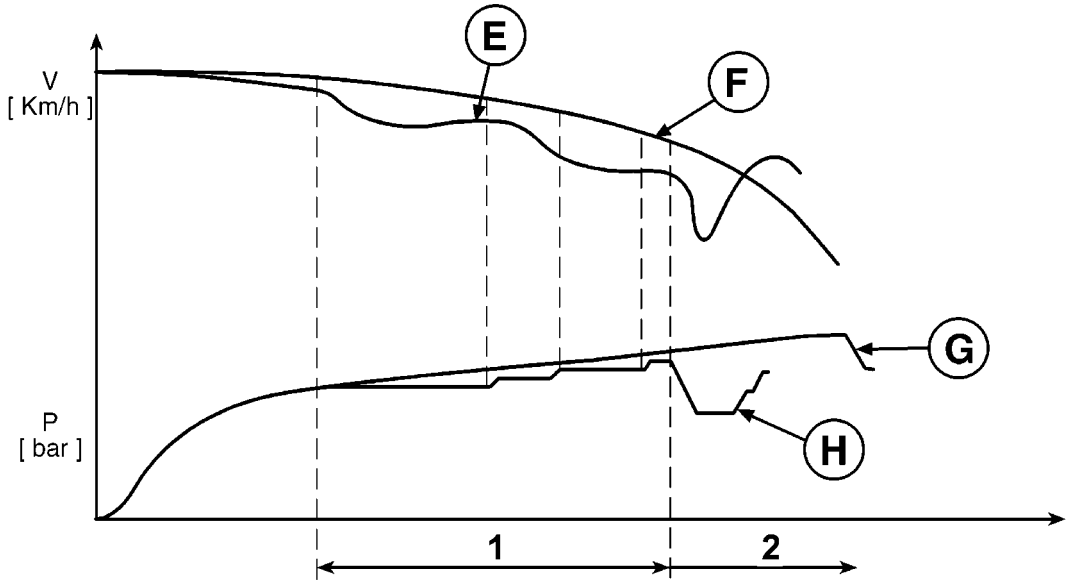
1 Rear axle brake force
2 Front axle brake force
A. Distribution implemented by the braking system
B. Ideal distribution
C. Distribution implemented by the mechanical load proportioning valve
D. EBD control

As you can see, the EBD function of the ABS is able to adjust to an ideal pressure cuve and make the most of available grip under all braking conditions.
By making the EBD function part of the normal ABS operating system, both strategies are able to work in tandem; the system therefore works normally to keep the rear wheels rolling within limits very close to ideal values. The ABS strategy can cut in when a rear wheel tends to lock (e.g. changeover to a surface with lower grip).

The following graph shows the brake pressure implementation strategy controlled by the electronic control unit on the basis of input data. This is represented by a signal indicating wheel rotation speed on both axes.



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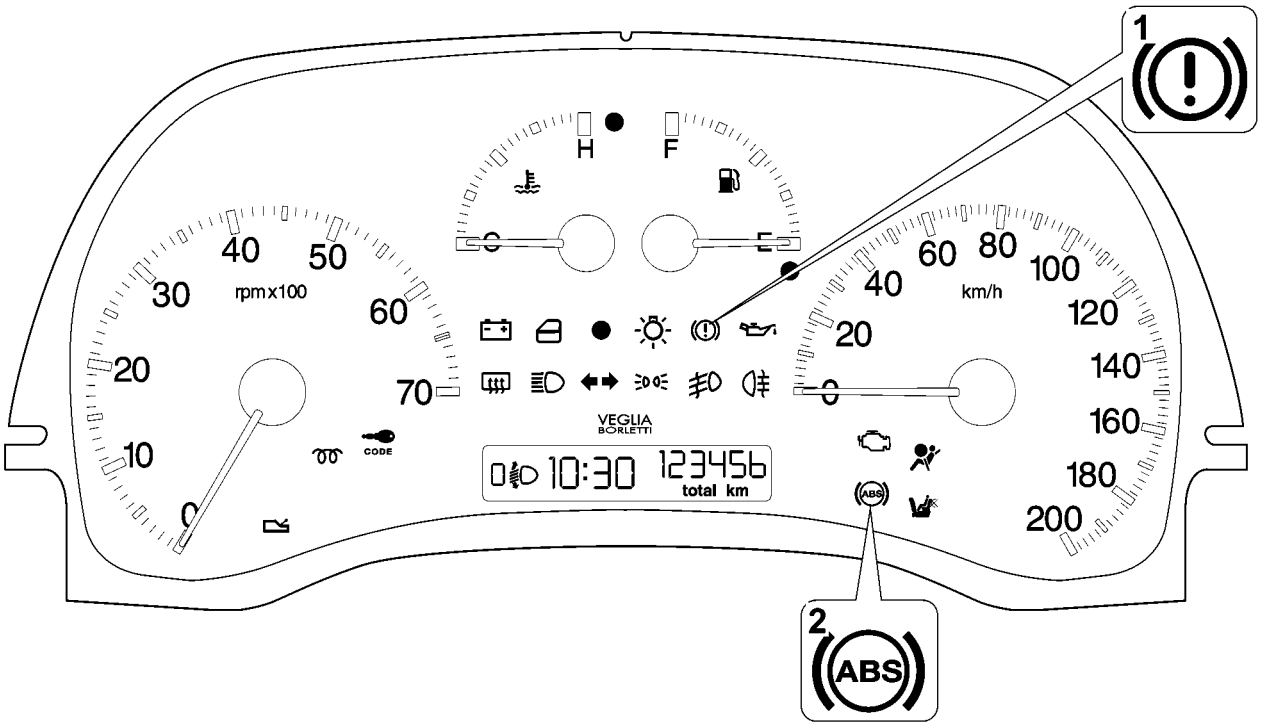
1 EBD control
2 ABS control
E. Rear wheel speed
F. Front wheel speed
G. Front wheel pressure
H. Rear wheel pressure

EBD system failure warning light

A fault in the EBD system is indicated by the brake system warning light (1) and ABS fault indiator (2) lighting up on the instrument panel.
If warning light (1) lights up on the instrument panel but ABS warning light (2) does not come on too, this does not indicate a fault in the EBD fuction but one of the other faults the warning light is designed to indicate (low brake fluid level, handbrake on).
If ABS warning light (2) comes on alone without warning light (1) coming on, this indicates a fault in the ABS as described i the specific chapter, but the EBD function is not affected.

If the EBD function is faulty, brakeforce is no longer distributed over the front and rear axles. This means that the rear wheels are at risk of locking under certain braking conditions.



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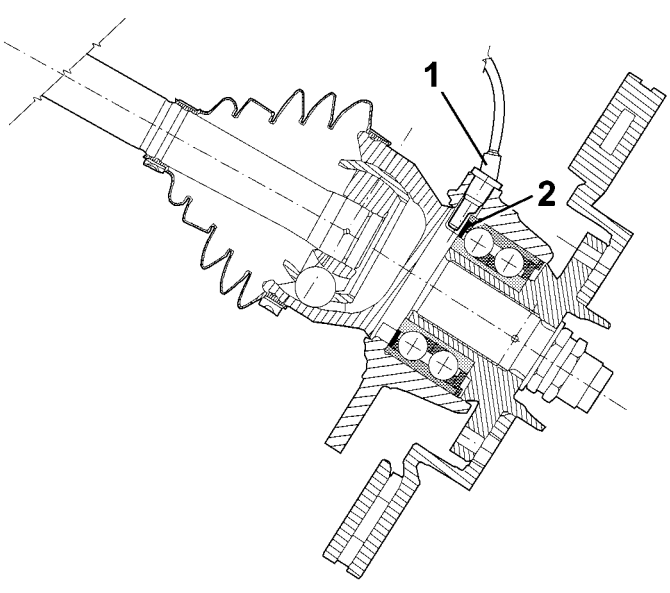
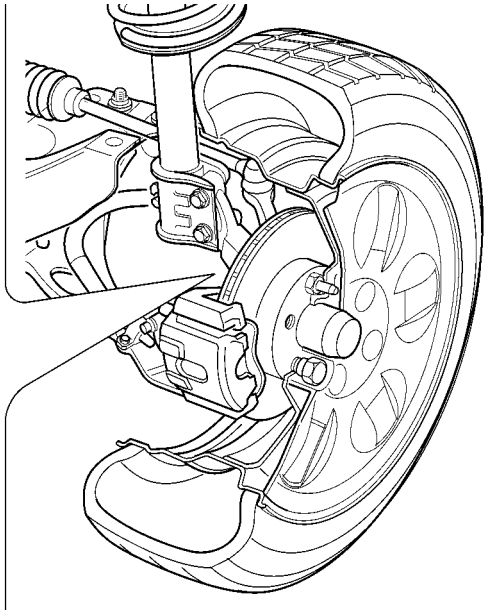
Active sensors

The Teves MK20 ABS uses active sensors (1) to detect wheel speed.
These sensors are fitted in front of the wheel hub and to the rear of the drum casing. They are supplied electrically by the ABS.





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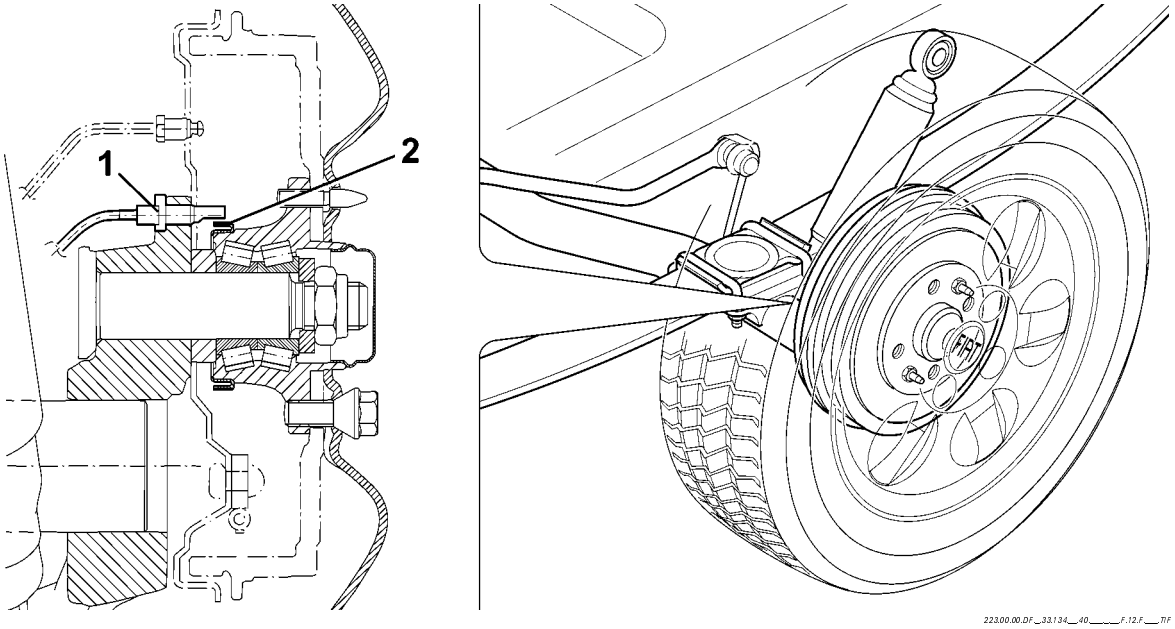
The sensors face a multipolar ring (2), which is fitted to the wheel bearing seal at the front and press-fitted to the hub at the rear.



The use of active sensors offers the following advantages compared with conventional magnetic induction sensors:
- improves the negative effects of the gap between the sensor and the magnetic ring
- improves immunity to electromagnetic fields
- improves sensor detection ability at low speeds (down to zero km/h)
- reduces car weight and bulk

In order to ensure correct signals, the specified gap between the end of the sensor and the multipolar ring must be between:
0.4 and 1.5 mm for the front wheels
0.4 and 1.2 mm for the rear wheels

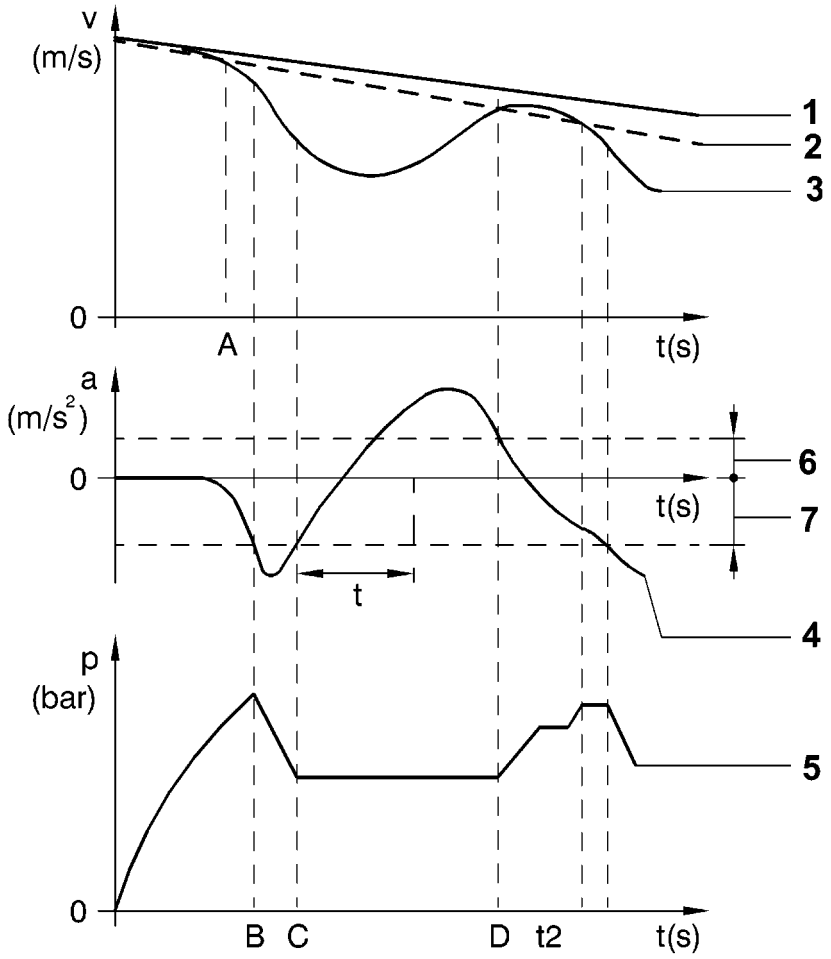
Note: *Because this gap cannot be adjusted or measured if malfunction is suspected, check sensor condition visually to ensure they do not show signs of wear or damage. In this case, they must be replaced.*

Note: *Whenever an rpm sensor is fitted, spread with water-repellent grease so that it is not destroyed by removal due to the effect of thermal changes.*

OPERATION

Introduction to the system

The signals sent by the rpm sensors on the wheels are square wave signals



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1 Effective car speed
2 Reference car speed
3 Peripheral wheel speed
4 Wheel acceleration/deceleration
5. Brake circuit pressure
6. Permissible acceleration band
7. Permissible deceleration band

Frequency is directly proportional to wheel rotation speed and interpreted by the control unit to determine individual wheel speed values (3) and acceleration and deceleration values (4).
Reference speed (2) is processed from a combination of individual peripheral wheel speeds. This is continuously updated to provide an indication of effective vehicle speed (1).
The control unit memory contains two threshold acceleration/deceleration values (6) and (7) that should never be exceeded by each individual wheel. Effective wheel roll during braking is kept under control by continual monitoring of wheel deceleration/acceleration values.
The wheels can decelerate to different extents when the driver presses the brake pedal.
The system does not cut in to control the system if the car slows down or halts with deceleration within the permissible stored band.
If excessive braking force makes the wheel speed drop faster than the car reference speed, the system begins to compute rate of deceleration (point A).
When the programmed deceleration threshold (7) is exceeded, the system cuts in to control the solenoids and reduce pressure (point B).
Once pressure has been reduced, the now-unbraked wheel reverses its tendency to lock and picks up speed again after an initial few moments when deceleration continues to increase due to system inertia.
When deceleration is restored to a level within the permissible range (7), the control system adopts a different strategy and instigates the pressure maintenance stage (point C).
If wheel has not been restored within a preset time (t), a new pressure preduce stage is instigated.
The wheel normally picks up speed until it exceeds the reference speed. A new braking cycle now begins (point D). This features three modulation stages to reduce, maintain or restore the pressure exerted by the driver on the brake pedal to the brake calipers.

The strategy described is naturally linked to tyre dynamic behaviour on the basis of different grip coefficients and the respective deceleration/acceleration thresholds at different speeds.
The number and frequency of corrective interventions is determined by the dynamic behaviour of a chain made up of the braking circuit and ABS, and to an even greater extent by the tyre/road surface grip coefficient.
The system may cut in as many as six-eight times per second when braking on dry asphalt. This frequency drops considerably when the car is driven on ice or a wet surface.
The electronic control unit controls the various stages to supply the solenoids with pulses of different current intensities.

Note: *During the intervention cycle, the brake pedal moves slightly according to the increase or decrease in controlled pressure.*

If one of the tyres is deflated, the ABS cuts in to control braking conditions if necessary.
The ABS is also active when the car brakes while reversing.
The device normally ceases to intervene at speeds below 0.6 km/h to allow the wheels to lock completely when the car is at a standstill.

Note: *Because the parameters controlled by the control unit (wheel speed and acceleration) are influenced by wheel/tyre inertia, cars with an ABS should be fitted only with rims, tyres and brake linings recommended and approved by the Manufacturer.*

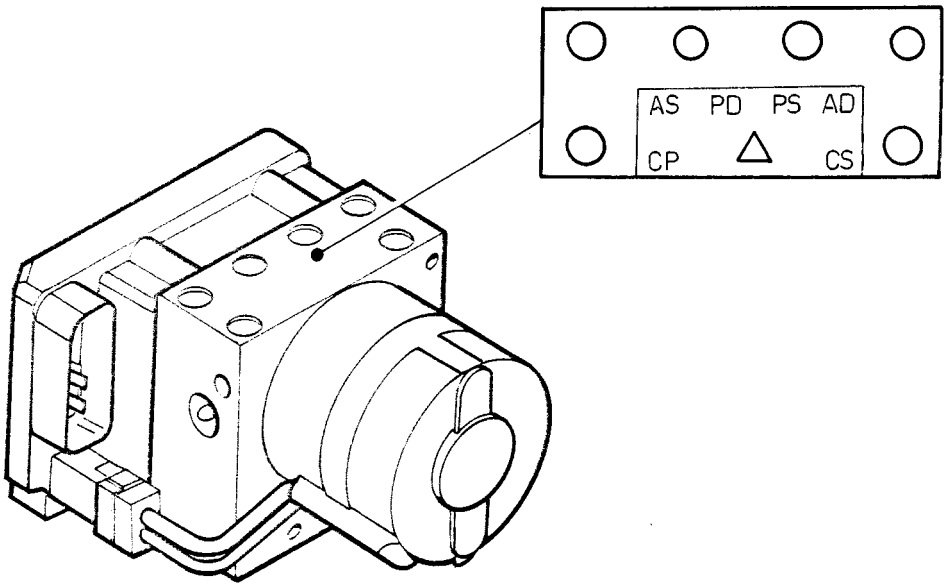
If snow chains are fitted, the new rolling conditions give rise to signals that are filtered by the control unit to ensure the ABS does not cut out when the car is driven over hard, compact snow.
Under conditions of aquaplaning, the electronic control unit detects an anomalous condition during normal, unbraked motion via the wheel rpm sensors because the drive wheels tend to spin faster than the driven wheels.
Under these conditions, the ECU would normally implement a modulation cycle that would not be what was required; for this reason, the ABS cuts itself out temporarily (the effect is so short-lived that the warning light does not come on) and comes back on as soon as the aquaplaning effect has ceased.

Electro-hydraulic control unit

The electronic control unit is connected to the brake pump and brake caliper cylinder by brake pipes and is integral with the electronic control unit.
Its task is to alter brake fluid pressure in the brake calipers in response to control signals from the electronic control unit.
ABS control unit connections

	Description	Colour	Connection
CP	Pump primary winding	-	M12 x 1
AS	Left front	Yellow	M12 x 1
PD	Right rear	Red	M10 x 1
PS	Left rear	Blue	M12 x 1
AD	Right front	Green	M10 x 1
CS	Pump secondary winding	-	M12 x 1

Note: *The colour is also shown on the pipe*



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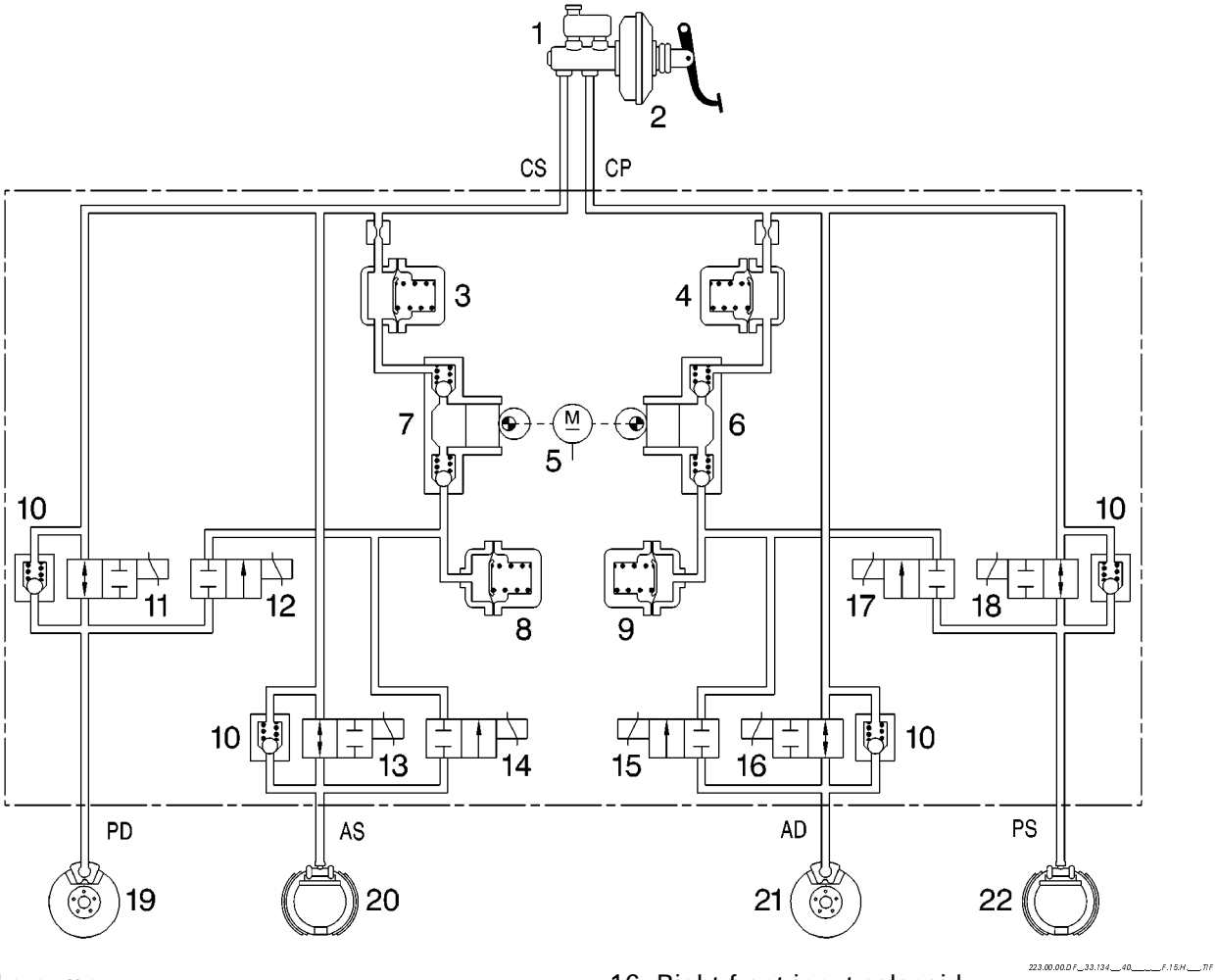
This consists of eight two-way solenoids (two per hydraulic circuit) and a dual-circuit scavenging pump that are governed by the electronic control unit.
In particular, the pump allows brake fluid to be recovered during the pressure reduction stage so that it can be made available again upstream of the solenoids for the subsequent pressure increase stage.
Accumulators allow brake fluid to be absorbed during the pressure reduction stage.

Note: *The hydraulic control unit cannot be serviced. The whole unit must be replaced if a fault is detected. New control units are supplied already full of brake fluid. The brake system is bled in the same way as a conventional system.*

Operation of A.B.S. TEVES MK20 hydraulic system

The car's hydraulic circuit is illustrated in the following operating diagram. The various stages of system operation are then described.



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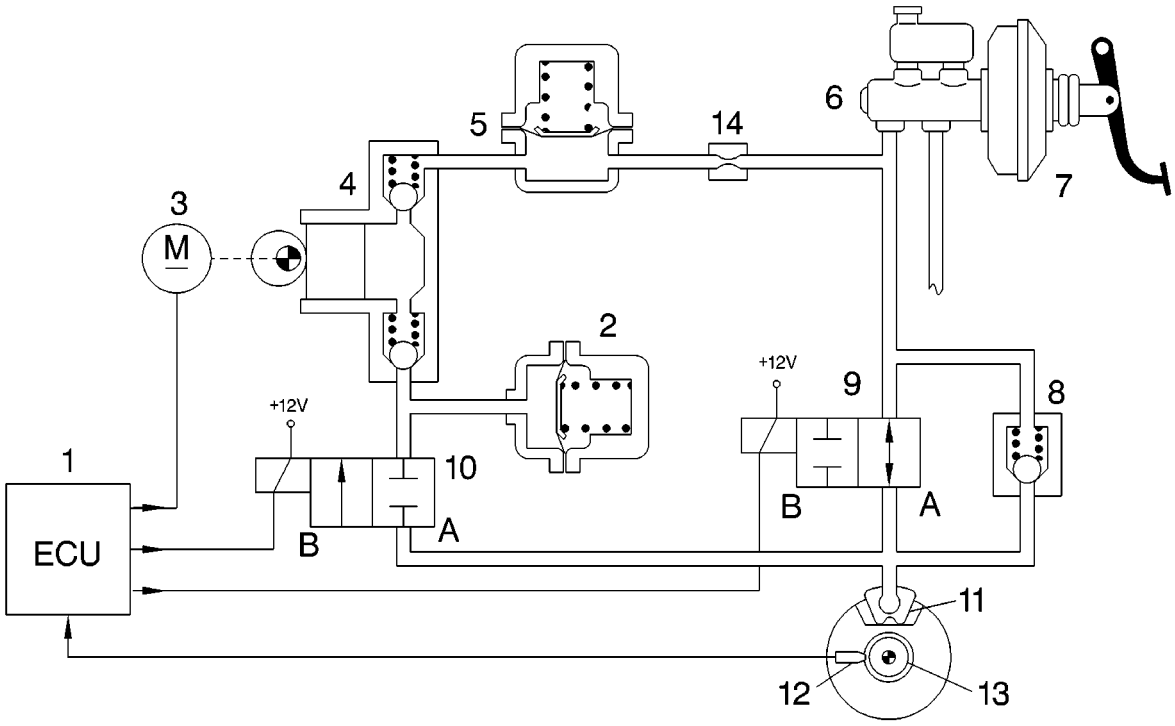
1 Brake pump
2 Brake servo
3 High pressure accumulator (damping chamber)
4 High pressure accumulator (damping chamber)
5. Scavenging pump motor
6. Scavenging pump
7. Scavenging pump
8 Low pressure accumulator (reservoir)
9 High pressure accumulator (reservoir)
10 Rapid pressure reduction valve
11. Right rear input solenoid
12. Right rear output solenoid
13. Left front input solenoid
14. Left front output solenoid
15. Right front output solenoid
16. Right front input solenoid
17. Left rear input solenoid
18. Left rear output solenoid
19. Right rear brake drum
20. Left front brake caliper
21. Right front brake caliper
22. Left rear brake drum
C.P. Control unit primary winding branch supply connection
C.S. Control unit secondary winding branch supply connection
P.D. Connection for input to right rear caliper
A.S. Connection for input to left front caliper
A.D. Connection for input to right front caliper
P.S. Connection for input to left rear caliper

Operating conditions

The 'resting stage' is described below



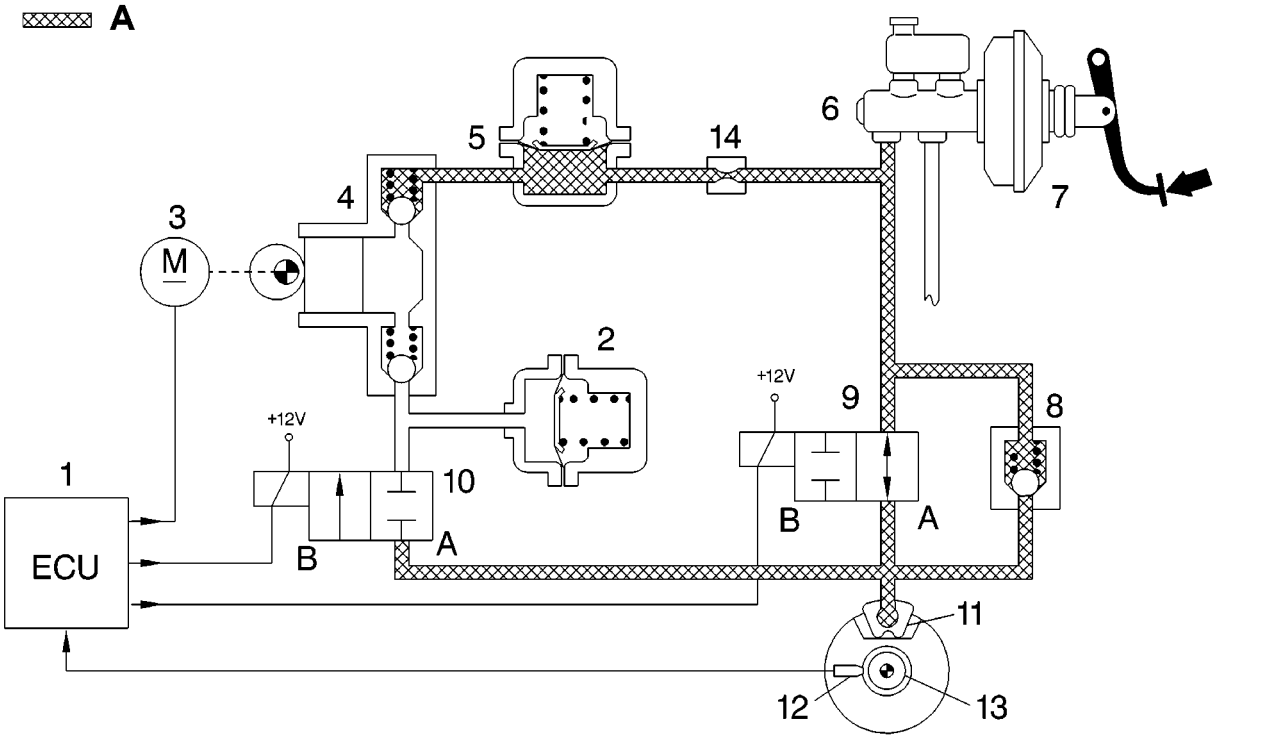
1 Electronic control
2 Low pressure accumulator (reservoir)
3 Scavenging pump control motor
4 Scavenging pump
5. High pressure accumulator (damping chamber)
6. Brake pump
7. Brake servo
8 Rapid pressure reduction valve
9 Imput solenoid (A) open (B) closed
10 Output valve (A) closed (B) open
11. Brake calipers
12. Active wheel rpm detection sensor
13. Multipolar ring
14. Restriction

The Teves MK20 ABS uses two, 2-way solenoids for each branch (primary and secondary).
The input solenoid (9) is normally open type, i.e. it allows fluid to pass through to the brake calipers when not earthed by the control unit (deactivated).
When the valve is supplied electrically, the solenoid casing changes from open to closed position. Conversely, output solenoid (10) is normally closed type, i.e. it does not allow fluid to drain toward the low pressure accumulator (2) when not earthed by the control unit.
Accumulators (2) and (5) are responsible for storing brake fluid temporarily during the pressure reduction stage.
Scavening pump (4) recovers brake fluid leaving the caliper during the pressure reduction stage and sends it via accumulator (5) to brake pump (6).
On the basis of signals received from the rpm sensors on the wheels, the electronic control unit controls the hydraulic section to adjust the pressure of brake fluid sent to the calipers in three stages: pressure increase, maintenance or decrease.

Pressure increase stage

When the driver presses the brake pedal, pressure generated by brake pump (6) reaches the brake calipers without undergoing any changes because solenoids (9) and (10) are not supplied with electricity by the control unit. They operate as normal, as shown in the figure.
As braking force increases, wheel deceleration increases so that the car decelerates faster and wheel slip increases.
Wheel slip should not exceed a given threshold. Beyond this threshold, the wheel loses its grip on the ground and begins to slip. Directionality is thus lost and the stopping distance is increased.

Active sensor (12) indicates that the new deceleration values are hgh enough to affect wheel grip on the ground. At this point, control unit (1) controls the hydraulic unt solenoid to reduce braking force. This manoeuvre increases speed and thus allows grip to be recovered.



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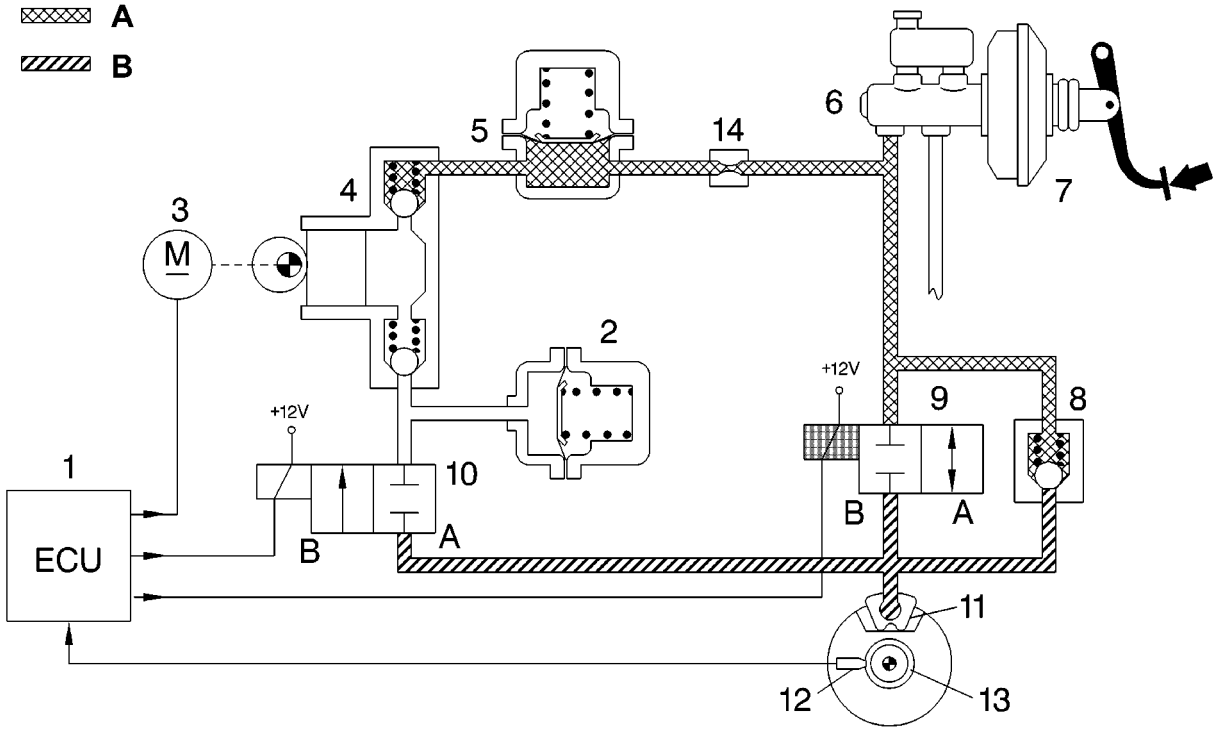
A. System branch with increasing pressure
1 Electronic control
2 Low pressure accumulator (reservoir)
3 Scavenging pump control motor
4 Scavenging pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Brake servo
8 Rapid pressure reduction valve
9 Input solenoid (A) open (B) closed
10 Output solenoid (A) closed (B) open
11. Brake calipers
12. Active wheel rpm detection sensor
13. Multipolar ring
14. Restriction

Pressure maintenance stage

During this stage, control unit (1) earths input solenoid (9), which closes, while output solenoid (10) is normally closed because it is not earthed.
The hydraulic connection between brake pump (6) and brake caliper (11) is broken and caliper pressure value remains as before regardless of brake pedal action.
Even though braking force continues to exert a slowing action, wheel speed can vary depending on wheel grip on the ground. This continues until the active wheel rpm detection sensor (12) detects a value comparable to the reference speed calculated by electronic control unit (1).

At this point, the control unit changes from the maintenance stage to the pressure increase stage (if the wheel accelerations) or reduction stage (if the wheel tends to lock).



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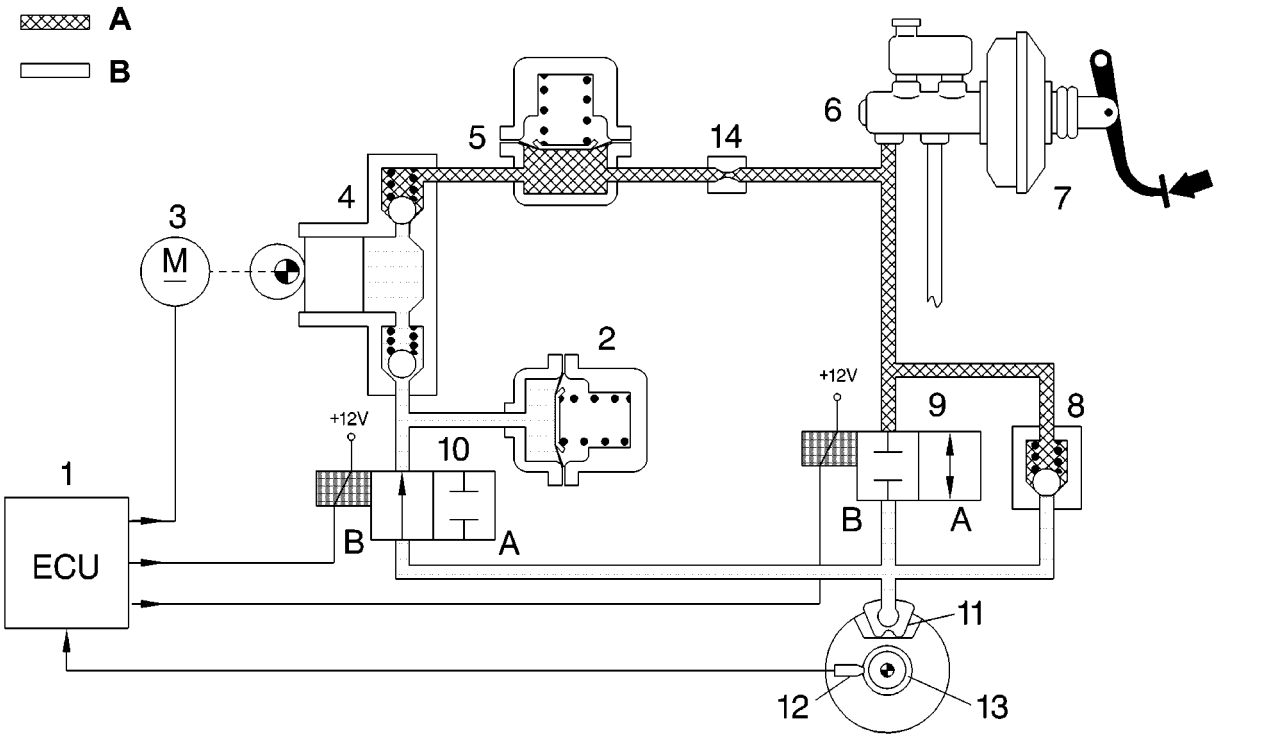
A. Branch of system with increasing pressure
B. Branch of system with constant pressure
1 Electronic control
2 Low pressure accumulator (reservoir)
3 Scavenging pump control motor
4 Scavenging pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Brake servo
8 Rapid pressure reduction valve
9 Input solenoid (A) open (B) closed
10 Output solenoid (A) closed (B) open
11. Brake caliper
12. Active wheel rpm detection sensor
13. Multipolar ring
14. Restriction

Pressure reduction stage

Electronic control unit (1) detects the wheel's tendency to lock and activates the hydraulic unit to contain wheel deceleration within permitted threshold limits.
Electronic control unit (1) is connected to earth and maintains the connection between brake pump (6) and brake calipers (11) uninterrupted; output solenoid (10) opens to establish a hydraulic connection between brake calipers (11), low pressure accumulator (2) and scavenging pump (4) in order to remove part of the fluid from brake caliper (11) and reduce pressure in the calliper.
At the same time, control unit (1) supplies motor (3) of scavenging pump (4), which allows fluid taken from the caliper to be returned to the main circuit.
Circuit accumulator (2) (low pressure tank) stores part of the brake fluid removed from the calipers.
Under the action of scavenging pump (4), fluid is taken up and sent to the main brake pump circuit (6) via damping chambers (5) and restriction (14).
A series of pressure waves (or hydraulic thrusts) generated at this stage are damped by the damping chamber (5) and restriction (14).
Druing this stage, the wheel tends to return to the reference speed calculated by the electronic control unit under the effect of a reduction in the braking force.
The braking action occurs intermittently or in steps via a succession of stages determined by the rolling conditions of the braked wheel and in a repeated cycle. The driver does not perceive the cycles as judders because they occur so quickly at such high frequency and because they are countered by wheel inertia: the wheel is prevented by reaching extreme slip coefficients because the device cuts in so quickly.
On cars without an ABS, the driver can operate the brake pedal intermittently at a rate of 1 cycles at most (2 depresssions and 2 releases).
With an ABS, the number of cycles can vary from 4 to 10 depending on the grip.
Normally the ABS ceases to cut in at speeds lower than 0.6 km/h to allow the wheels to lock completely when the car is at a standstill.

Note: *The scavenging pump is dual-circuit free piston type and controlled by an electric motor that rotates permanently during recovery stages. The pistons are not coupled to the electric motor but are moved through their travel by a cam only when brake fluid arrives. The pump is thus able to achieve only one pressure stroke: the aspiration stroke is prevented by the lack of a mechanical connection between motor and pump.*

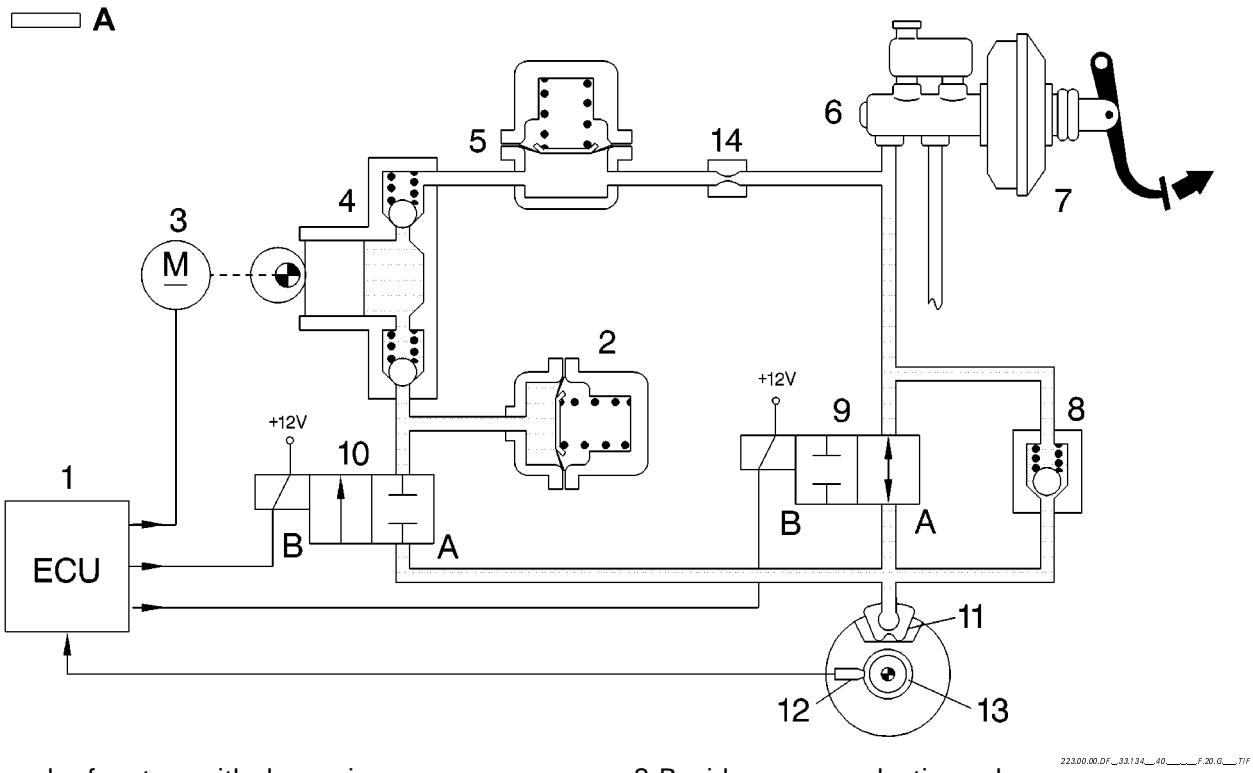


A. Branch of system with decreasing pressure
1 Electronic control
2 Low pressure accumulator (reservoir)
3 Scavenging pump control motor
4 Scavenging pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Brake servo
8 Rapid pressure reduction valve
9 Input valve (A) open (B) closed
10 Output valve (A) closed (B) open
11. Brake caliper
12. Active wheel rpm detection sensor
13. Multipolar ring
14. Restriction

Brake pedal release

The system is fitted with a check valve (8) connected in parallel with input solenoid (9) to allow pressure to be rapidly reduced in brake caliper (11) when the pedal is released.

When the pedal is released, the pressure in the branch upstream of the solenoid drops and the downstream branch is under higher pressure. Under these conditions, the check valve opens and fluid pressure in the brake caliper drops.



A. Branch of system with decreasing pressure
1 Electronic control
2 Low pressure accumulator (reservoir)
3 Scavenging pump control motor
4 Scavenging pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Brake servo
8 Rapid pressure reduction valve
9 Input valve (A) open (B) closed
10 Output valve (A) closed (B) open
11. Brake caliper
12. Active wheel rpm detection sensor
13. Multipolar ring
14. Restriction

Rules to be observed on cars equipped with an ABS

Before carrying out welding work using an electrical welding machine, disconnect the control unit connector.
If the battery is removed, tighten its terminals properly before refitting.
Disconnect the battery negative lead before removing from the hydraulic control unit.
Check the entire system using a Tester before replacing any component.
After any repair to the ABS hydraulic circuit or brake system, fill and/or top up with recommended fuel and bleed the system. Then check the seal of all connections.
New hydraulic control units are supplied full of brake fluid with solenoids not supplied.
Brake system bleeding and refilling operations are described in the repair procedure. The procedure does not differ essentially from the procedure carried out on a system without an ABS but it takes longer.
Check that the pipes do not come into contact with the body at any point. This prevents the risk of damage to the pipe sheaths and also prevents noise transmission during ABS operation.

Do not add mineral oil to the brake circuit because the gaskets will be damaged. The hydraulic unit, brake pump and calipers will have to be replaced if oil is added accidentally.

Diagnostics

The system comes with a self-diagnostic function which checks for any irregularities in the components listed below.
- wheel rpm sensor
- input solenoid
- output solenoid

If a circuit malfunction is detected, the control unit safety circuit cuts out the ABS but the conventional system continues to work as normal.
Deactivation of the ABS is indicated by a warning light coming on on the control panel.
For safety reasons, the electronic control unit's two microprocessors are able to monitor all ABS strategies, system software and also all input signals.
If the microprocessors receive identical input signals, they must produce identical output signals during normal operation.
If a discrepancy is noted between input signals and output signals that lasts longer than a preset threshold, the system detects a fault and turns itself off.
The electronic control unit is equipped with a safety circuit which has the task of safeguarding the efficiency of the A.B.S. system before each start-up and while the car is in motion.

The safety circuit carries out the following automatic checks:
- 1. after the ignition key has been inserted and for about 2 seconds, it checks the operation of the control unit, solenoid operating relays and sensor connection;
- 2. after engine start-up, as soon as the car is travelling faster than 5 km/h, it operates the solenoids and scavenging pump to check operation; it also checks that all four speed signals are present;
- 3. it also checks that all four speed signals are present whenever the car exceeds 20 km/h, beginning with the car at a standstill;
- 4. during motion, it continuously monitors wheel peripheral speed and compares it wth a calculated reference speed. It checks memory status and supervises solenoid control relay operation
- 5. it constantly checks the battery voltage while the car is in motion

The system can be monitored using a Tester only with wheel speed lower than 4 km/h, battery voltage higher than 7 volts and the ABS not operational.
Full system diagnosis involves the following three stages:

a) display of the following operational parameters:
- individual wheel speed
- scavenging pump motor status
- brake pedal switch status
- fault indication warning light status

b) The following diagnostic procedures:
- fault detection
- error storage
- error deletion

c) Active diagnosis of the following parts:
- input solenoids
- output solenoids
- fault warning light
- scavenging pump motor

Fault detection
This is carried out during the execution of basic functions and diagnostic tests on sensors/actuators.

Error storage and error memory structure
The error type code and error counter are stored for each error in the order in which they occur.
This parameter consists of the code of the last fault detected and the relevant counter.
This is set to 31 if a fault occurs and then decreased by 1 each time the car is started up and driven at more than 20 km/h without the fault occurring.

Error deletion

Errors are deleted:
- by a manual command from a Tester
- automatically when the error counter reaches zero.

Note: *The failure warning light stays on during the entire procedure because the system is disabled by starting the procedure.*
The procedure is suspended if car speed exceeds 10 km/h.

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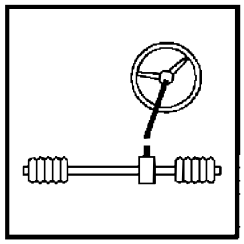


Steering unit

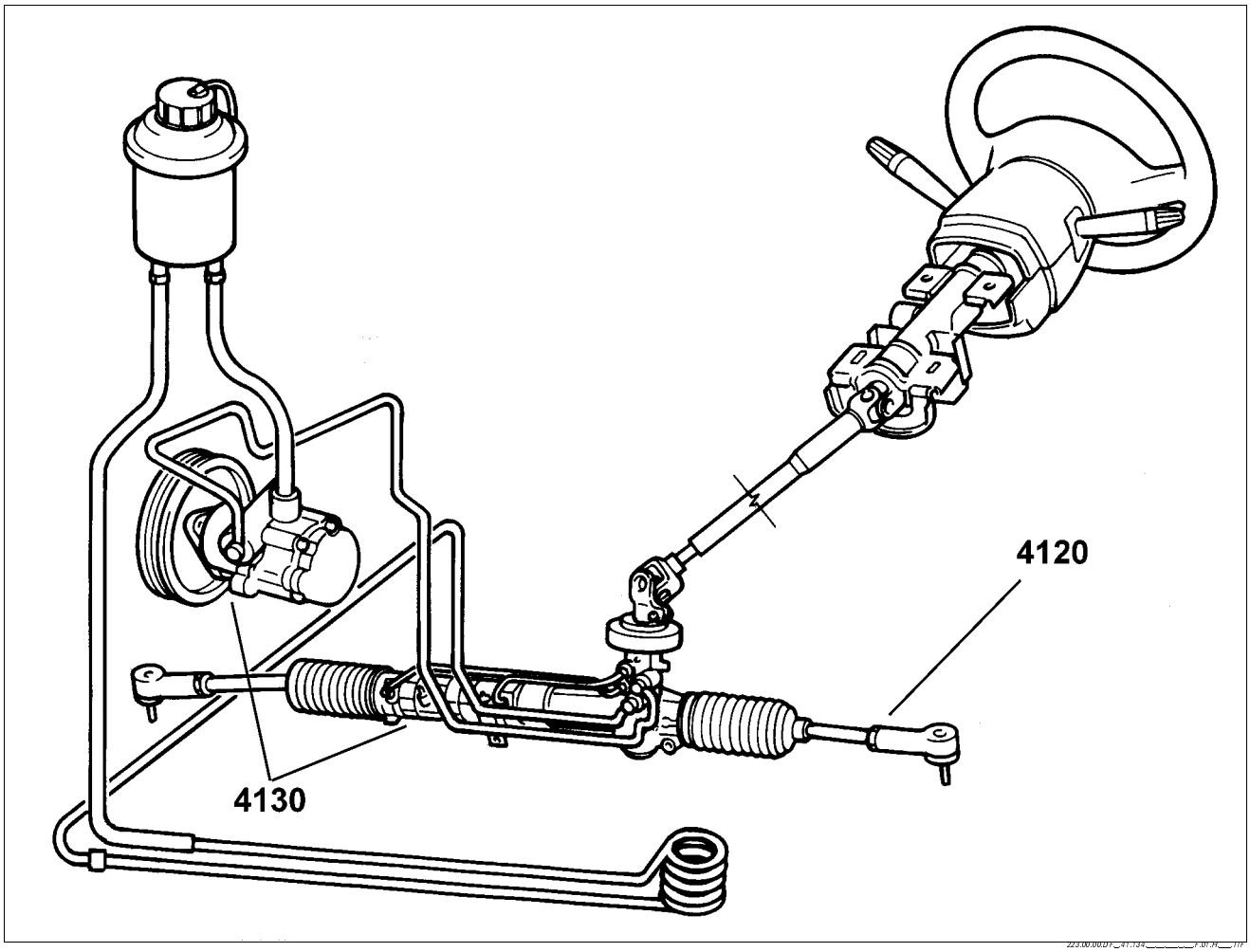
Group index

- GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Sub-groups index

Sbgrp.	Description	Validity
4120	Steering box	
4130	Power steering	

GROUP GRAPHIC INDEX



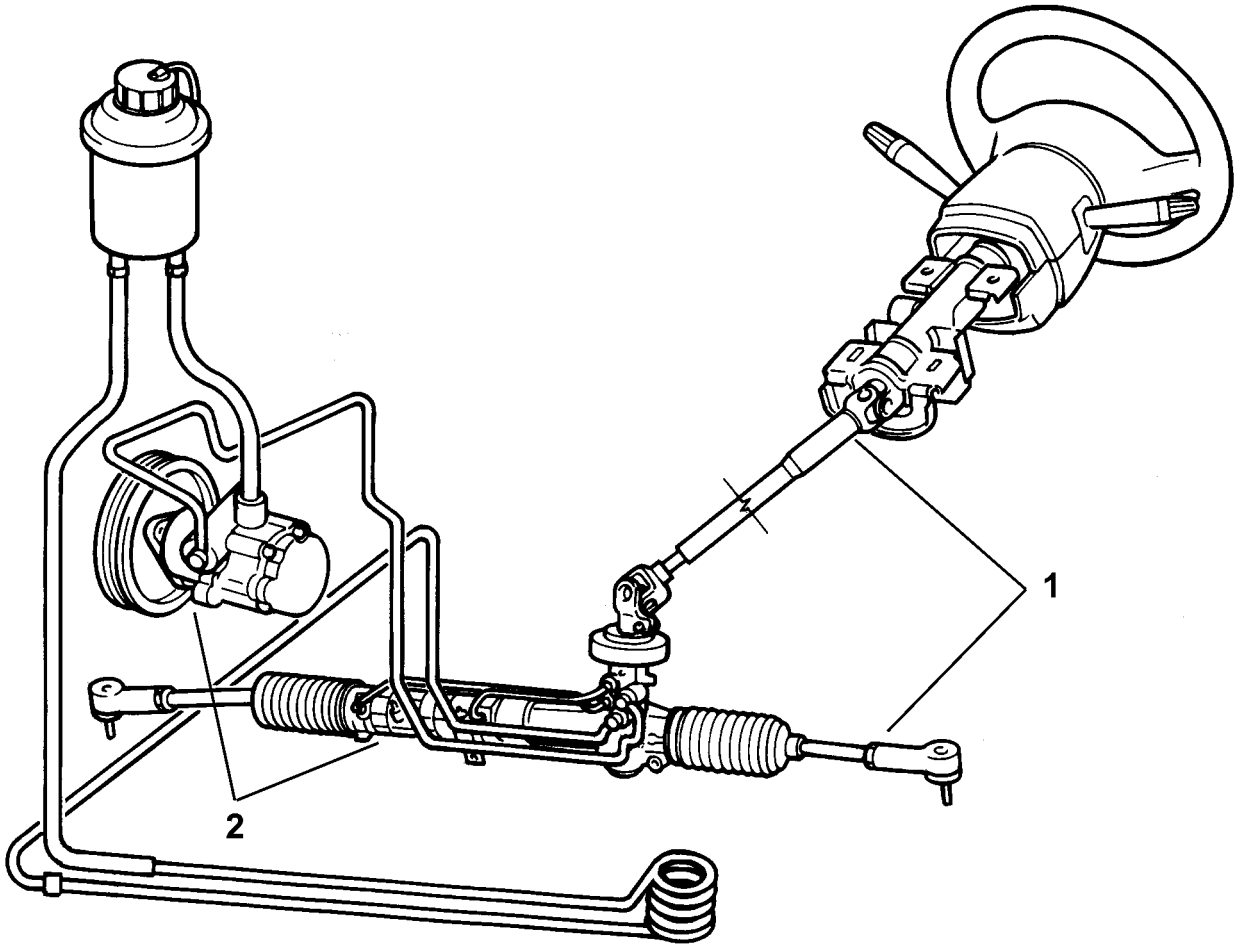
CONSTRUCTION FEATURES

The steering system for the standard versions is the mechanically operated rack and pinion type.
There are also plans, to fit as standard on the 1910 D version and have as an available option on the 1242 8v version a hydraulic type power assisted steering unit with an operating ration of 60 mm/rev.

It guarantees:
- lightness and easy handling of the steering in all operating conditions
- precision and safety at high speeds.

The steering column is collapsable and makes it possible to improve safety for the driver in the case of a frontal impact.

A height adjustable type steering wheel, made from mangnesium to reduce its weight and increase its strength is also available as an option.
On versions fitted with power assisted steering, in order to minimize the hydraulic impulses which could create noise, high pressure oil pipes have been fitted whose length and shape are optimum with internal resonators and a cooling coil for the power assisted steering fluid to prevent cavitation.



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1, Steering control and linkage
2, Power assisted steering

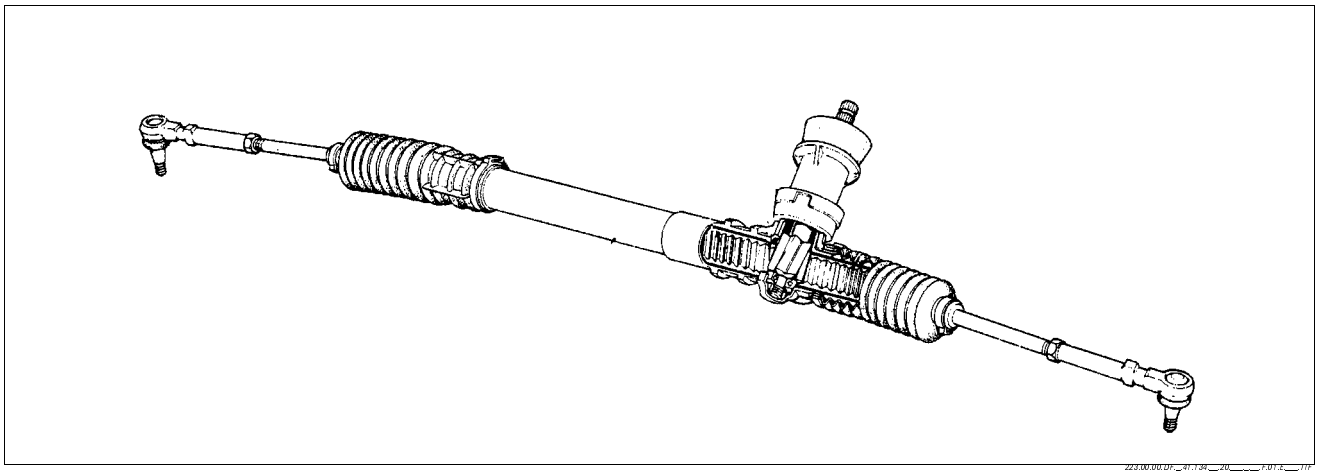
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Assembly drawings index

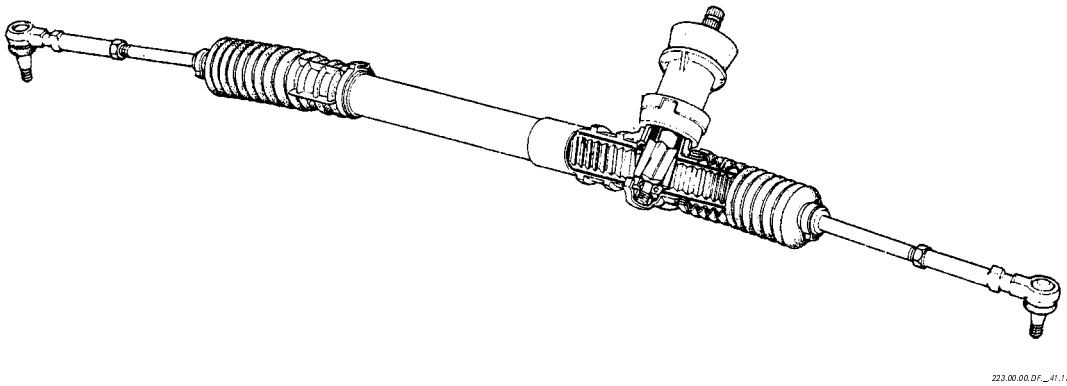
Cmp	Description	Validity

SUB-GROUP GRAPHIC INDEX



CONSTRUCTION FEATURES

The mechanical rack and pinion steering box is the traditional type and features a fixed ration of 32 mm/rev.

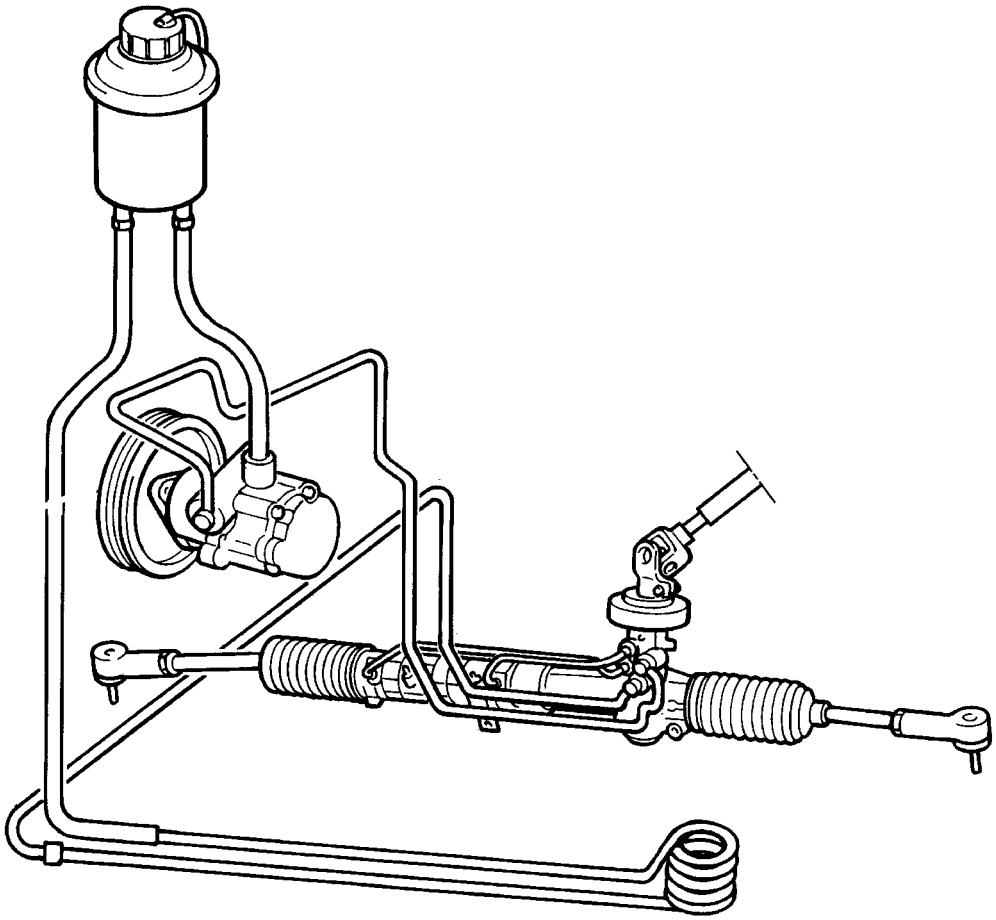


Sub-group index

Assembly drawings index

Cmp	Description	Validity

SUB-GROUP GRAPHIC INDEX



CONSTRUCTION FEATURES

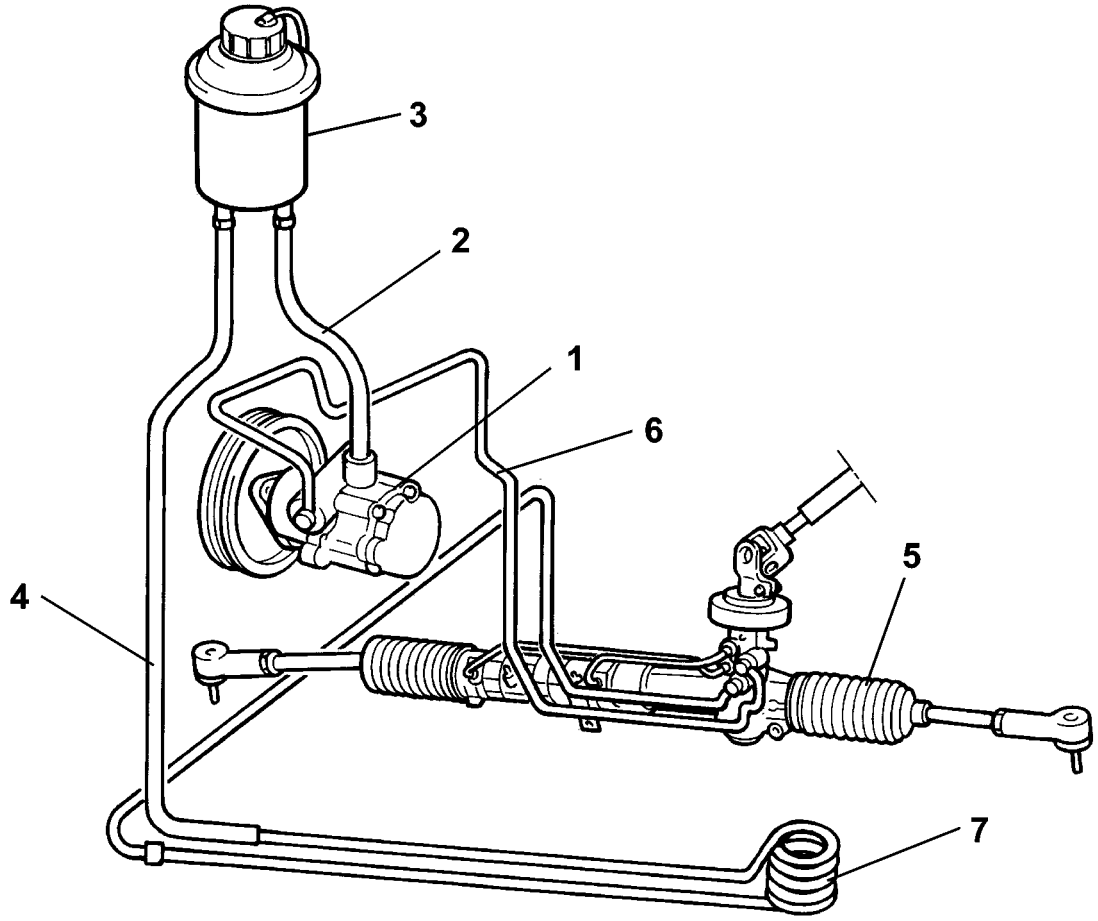
INTRODUCTION

The hydraulic type power assisted steering system adopted on the vehicle is fitted as standard on the 1910 D version and is available as an option on the 1242 8v version.
The improvement of the rack and pinion coupling has made it possible to achieve a transmission ratio of 60 mm/rev; a figure which corresponds to excellent manoeuvrability for vehicles in this category.

STEERING CONTROL AND LINKAGE

The power assisted steering system consists of:
- the fluid reservoir in the engine compartment

- the vane pump, driven by the engine, including the maximum pressure and flow rate valve
- a series of pump-distributor valve-operating cylinder-reservoir connecting pipes
- a rack and pinion steering box with hydraulic power assistance.



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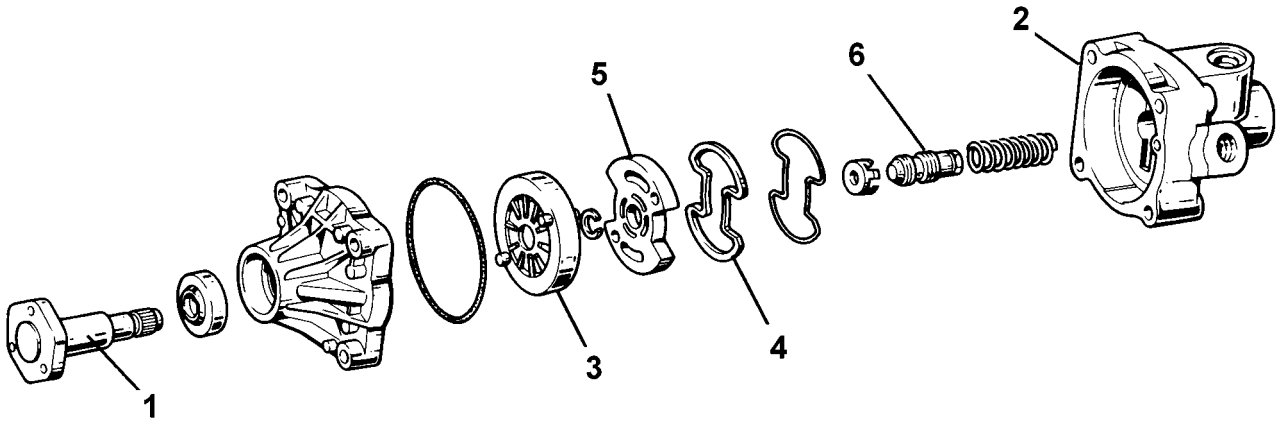
1, Power assisted steering pump
2, Oil supply pipe to the pump
3, Fluid reservoir
4, Oil return pipe to the reservoir
5, Power assisted steering box
6, Oil supply pipe under pressure
7, Heat exchanger

VANE PUMP

The vane pump is driven directly by the engine through a belt and is capable of providing the system with a supply pressure which varies from 3.5 bar to 85 bar.



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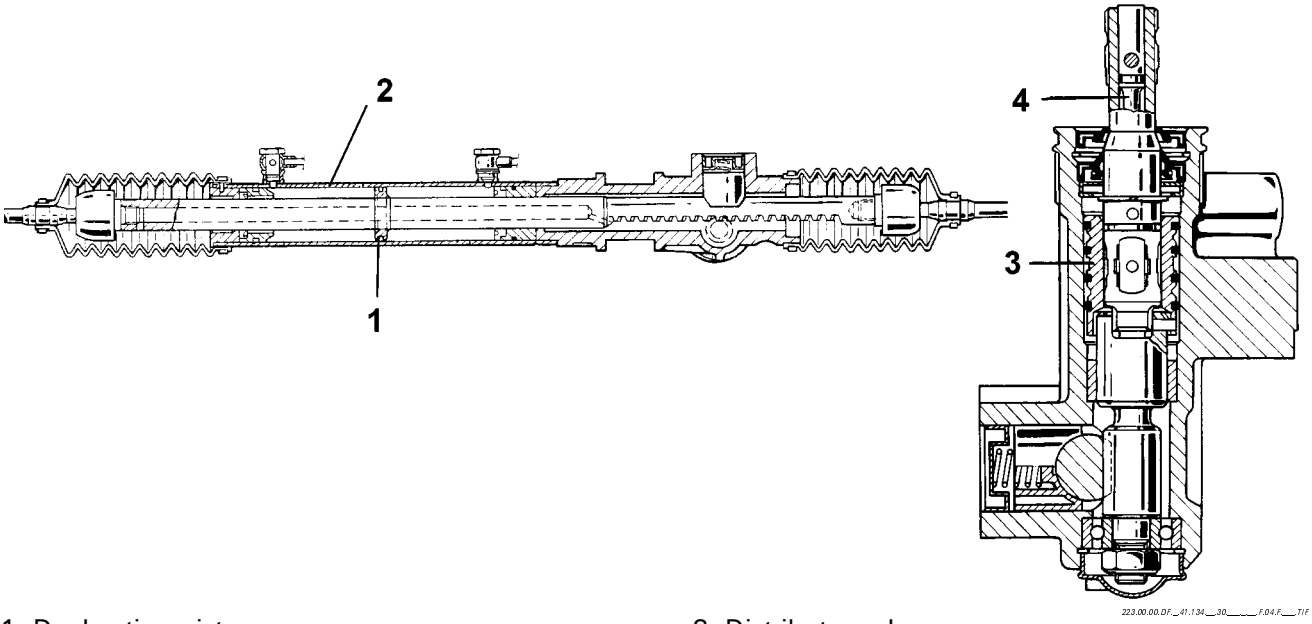
1, Control shaft
2, Pump casing

3, Impeller with vanes
4, Gasket
5, Impeller side plate
6, Regulating valve

Power assisted steering box

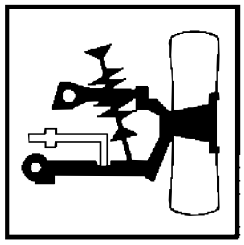
The power assisted steering box is the rack and pinion type; it contains an operating cylinder (2) in which a dual acting piston (1), fixed to the rack rod, slides.
The worm screw housing contains a distributor valve (3). The latter is controlled according to the effort detected by a torsion device (4) located at the end of the worm screw, steering column side.



1, Dual action piston
2, Operating cylinder
3, Distributor valve
4, Torsion device

According to the torsion force transmitted by the steering wheel to the torsion device, the oil under pressure is sent to the reservoir (recirculated), or to one of the two chambers in the operating cylinder.
The force produced by the pressure of the oil on the surface of the piston determines the power assisted effect provided by the device, in particular for the vehicle in question.

44



Suspension and wheels

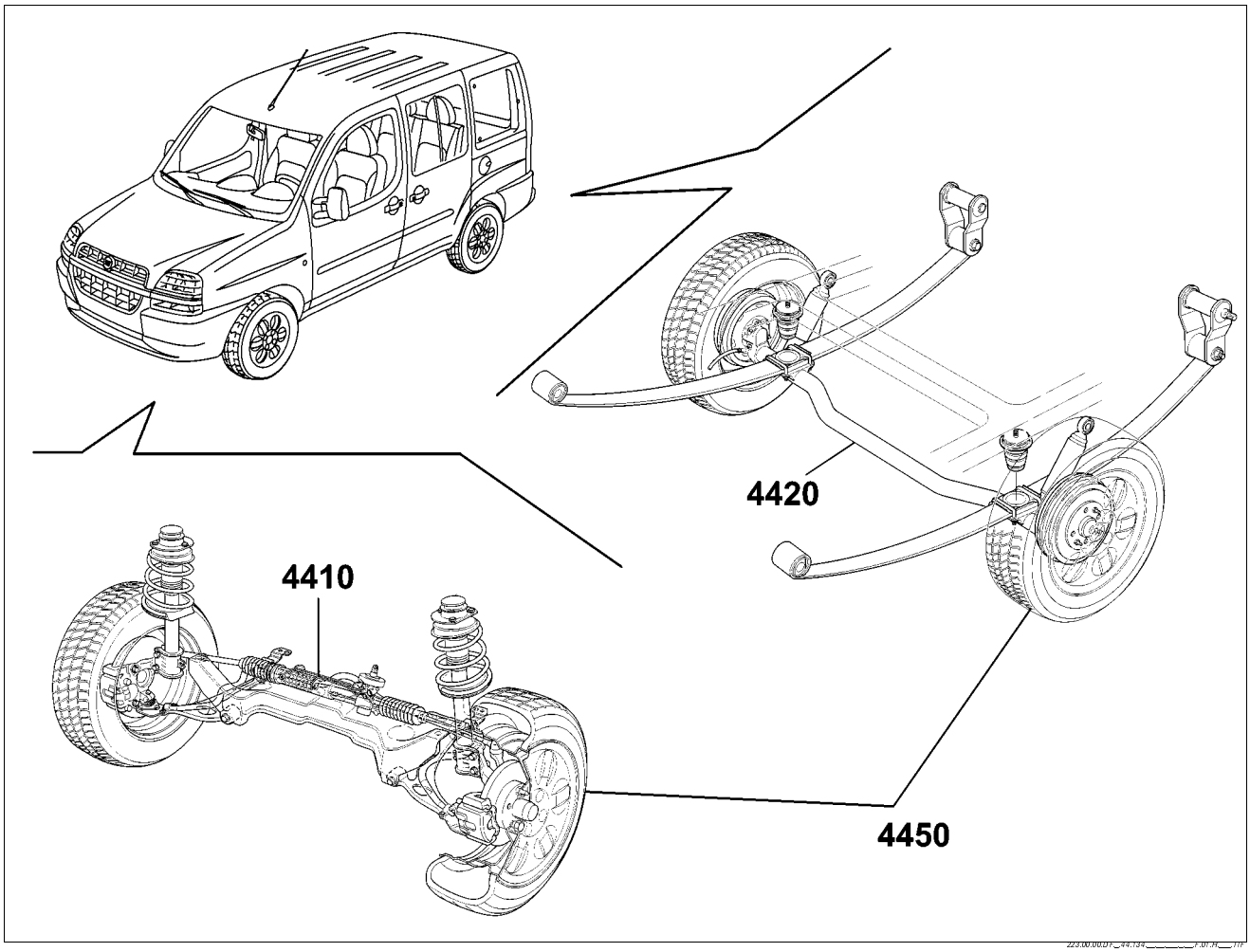
Group index

- GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Sub-groups index

Sbgrp.	Description	Validity
4410	Front suspension	
4420	Rear suspension	

GROUP GRAPHIC INDEX

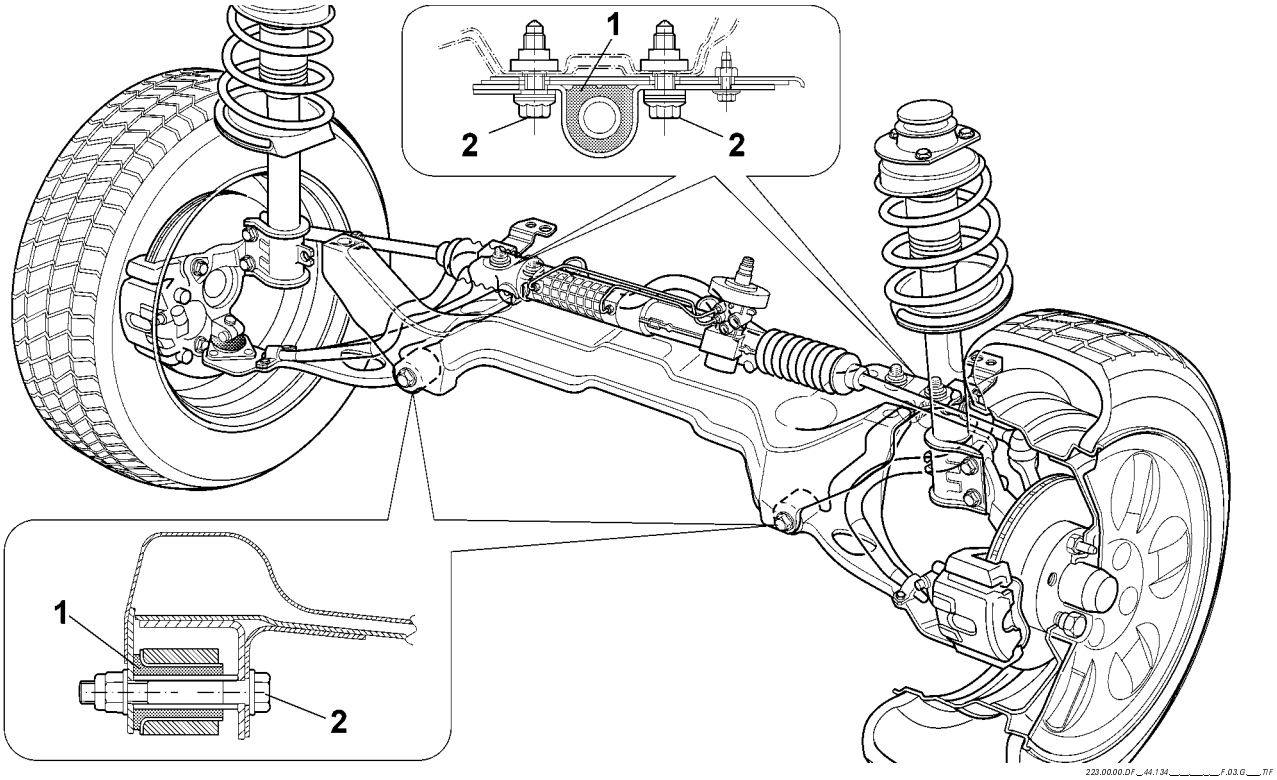


CONSTRUCTION FEATURES

Front suspension, independent, McPherson type with forged steel track control arms anchored to an auxiliary crossmember.
Offset coil springs and double acting, telescopic, hydraulic shock absorbers. Anti-roll torsion bar.
The rear suspension is the 'rigid axle' type with single leaf springs and double acting, telescopic hydraulic shock absorbers.
For the Panorama versions there are also plans for a rear torsion beam which, secured to the chassis and connected to the ends of the wheel hubs, makes it possible during the compression of the leaf spring, to reduce the roll effect improving driving comfort.
The front and rear wheel hubs on versions equipped with A.B.S. have an instrument bearing for the active sensors (see group 33) which replaces the flywheel on previous systems.

Maintenance instructions

The presence of flexible bushes on the suspension components means that, in the case of maintenance operations, the specific fitting instructions must be carried out to ensure the correct operating conditions for these bushes.
The incorrect pre-loading of the flexible elements (1) can, in effect, lead to them reaching breaking point during operation.
It is therefore necessary to tighten the fixing elements (2) after having made sure that the load conditions acting on the flexible components do not exceed those in the 'Theoretical design load' for the operation of the vehicle.



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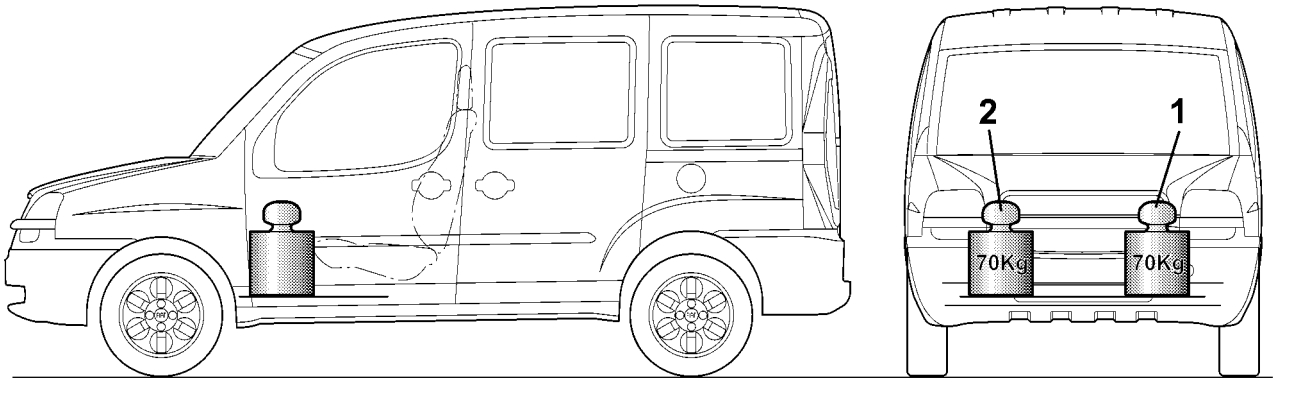
The 'Theoretical Design Load' is obtained with the wheels fitted and the vehicle on the ground ballasting the front footwell area with a load of about 70 kg on both the right side (1) and the left side (2) for the front suspension.

Note: *The load should be placed on the floor and not on the seat because if not the distribution of the load between the front axle and the rear axle would not correspond to the Design conditions.*



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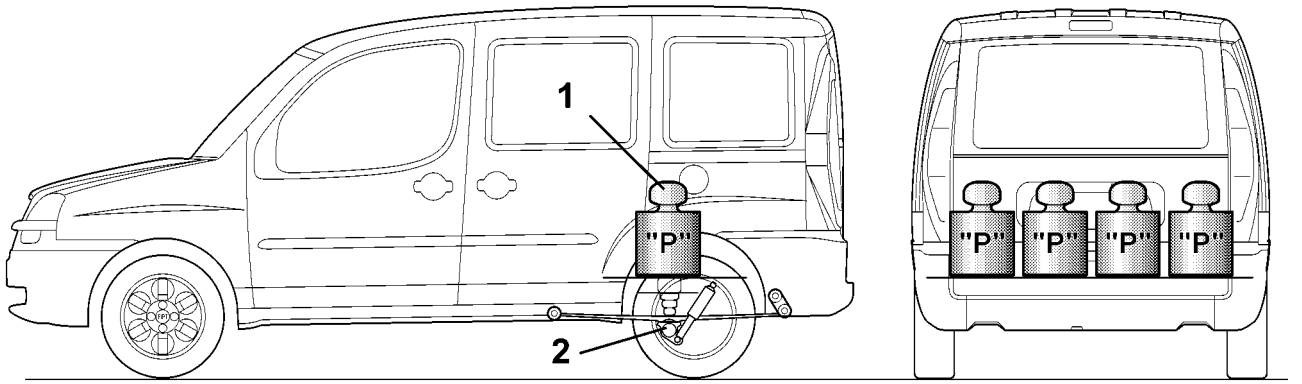
For the rear suspension, the load (1) should be arranged evenly near the rear axle (2) according to the version with instructions given in the table below.



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VERSION	LOAD
Panorama	kg. 350
Van	kg. 510
Extra-load van	kg. 660

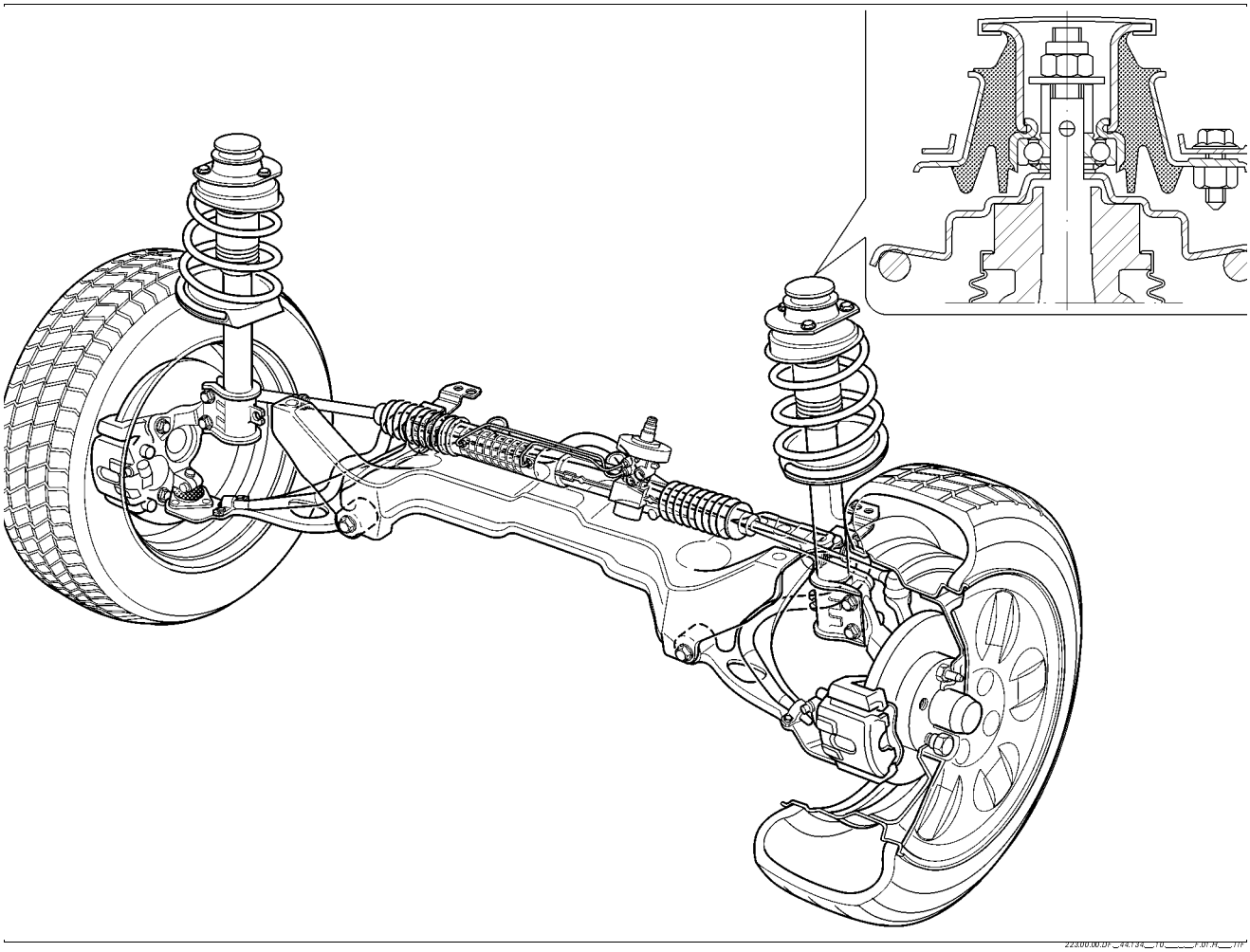
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Assembly drawings index

Cmp	Description	Validity

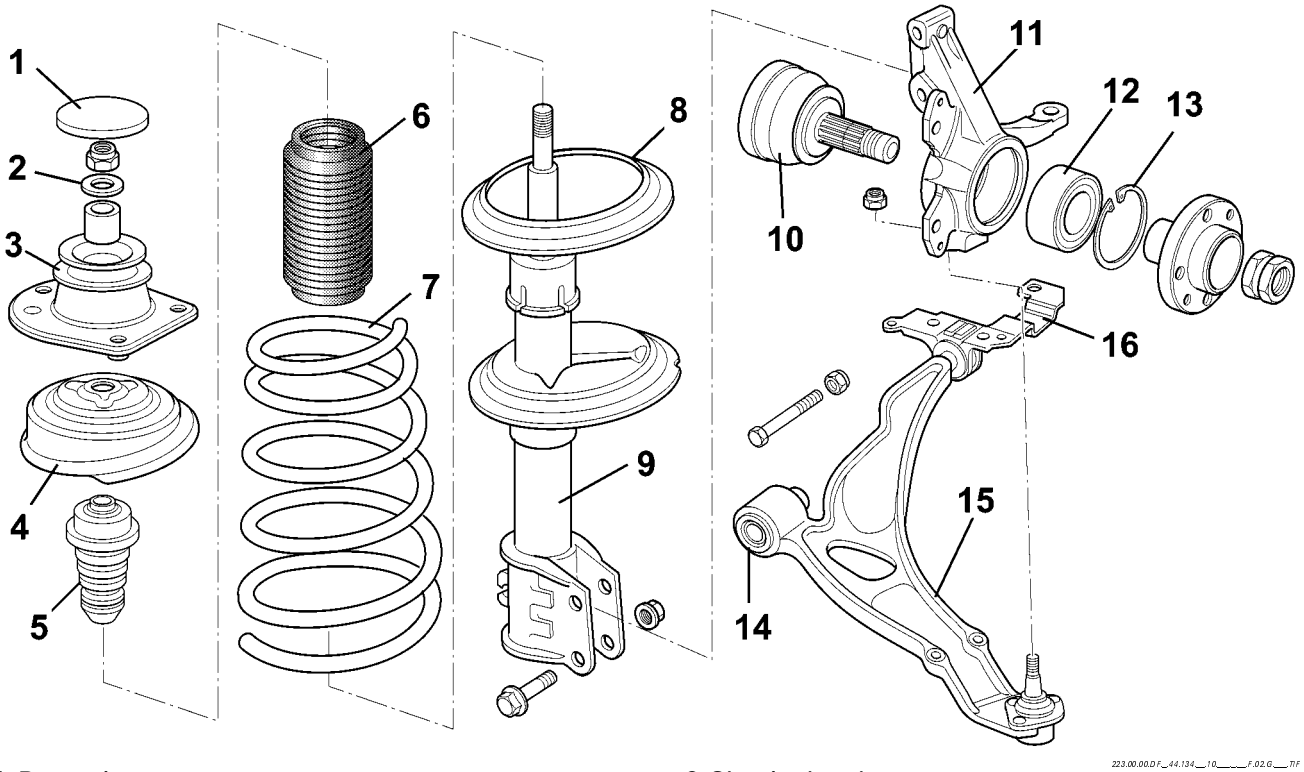
SUB-GROUP GRAPHIC INDEX



CONSTRUCTION FEATURES

The vehicle is equipped at the front with independent, McPherson type suspension with an anti-roll bar.
The front suspension crossmember is the type with box sections at the bodyshell attachments in order to strengthen the structure and improve the passenger compartment noise filtration.
The track control arms, made from forged steel, have horizontal axle bushes.
The ball joints at the end of the track control arms are rivetted and, if necessary, can be replaced by replacing the rivets with suitable fastening systems (Bolt-Nut-Washer) supplied together with the replacement part.
Side load type coil spring to reduce tangential forces on the shock absorber stem with a consequent improvement in the absorption of small irregularities in the road surface.
The shock absorbers are the double acting, telescopic hydraulic type with an axial bearing incorporated in the flexible mounting.

The front steering knuckle is made from steel and the wheel hub contains an oblique ball bearing.



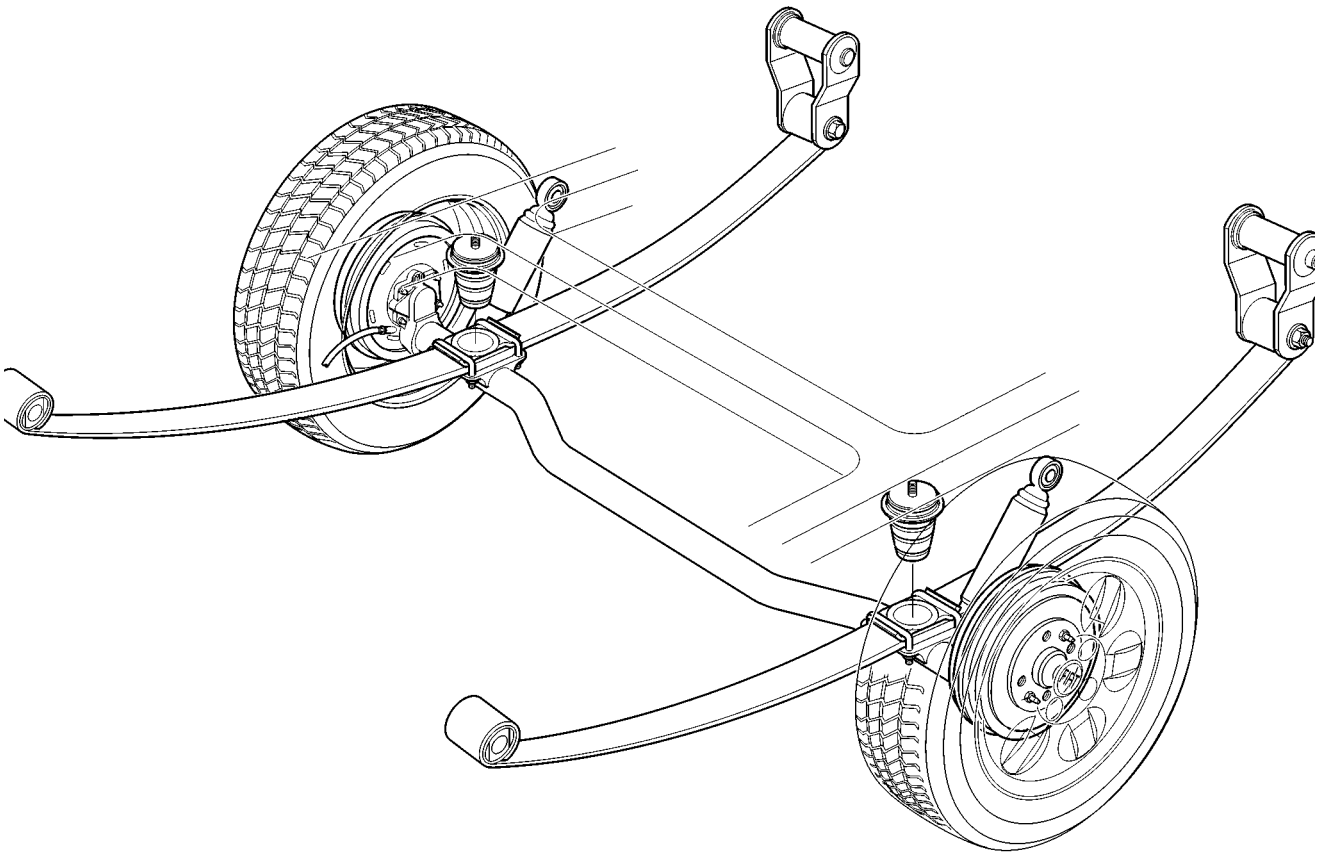
1 Protective cover
2 Washer
3 Pad
4 Shock absorber mounting
5. Buffer
6. Bellows
7. Coil spring
8 Coil spring support plate
9 Shock absorber
10 Hub
11. Steering knuckle
12. Bearing
13. Circlip
14. Arm support
15. Track control arm
16. Bar/arm support

Sub-group index

Assembly drawings index

Cmp	*Description*	*Validity*

SUB-GROUP GRAPHIC INDEX



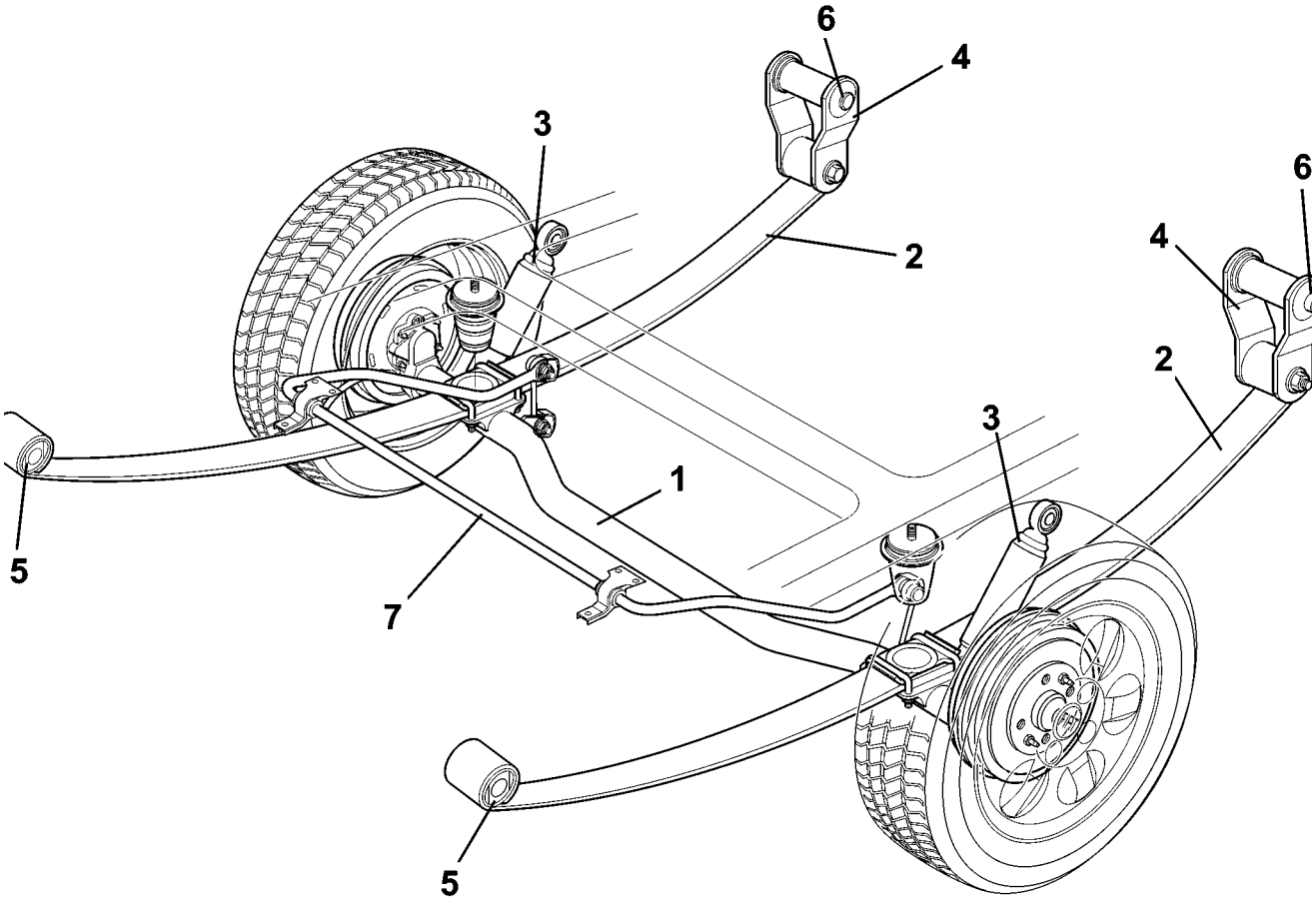
CONSTRUCTION FEATURES

The rear suspension is the rigid axle type connected to the bodyshell by means of longitudinal leaf springs fitted with Cellast end of travel buffers.

The advantages of this solution are:
- simple structure and therefore easy to maintain
- economical construction
- constant wheel camber irrespective of the acting load.

On the Panorama version there are also some solutions aimed to improving driving comfort:
- the adoption of an anti-roll bar connected to the bodyshell by means of flexible mountings and secured to the rigid axle by two levers at the end. This solution makes it possible to reduce the roll effect of the body-shell at the same time guaranteeing improved road holding.

- the use of leaves with specific tapering makes it possible to reach higher flexibility values for the leaves (0.55 m/kg) compared with those for the van version (0.42 m/kg).
- the use of a sliding type front bush instead of the traditional type making it possible to reduce the effects of rebound and bumping.



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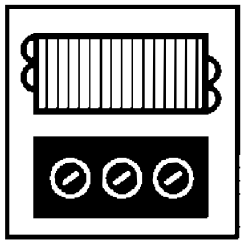
1, Rear axle
2, Leaf
3, Shock absorber
4, Shackle
5, Front support (fixed to bodyshell)
6, Rear support (fixed to bodyshell)
7, Anti-roll bar (Panorama versions only)

The rigid axle solution does not allow for adjustments of the wheel geometry (camber, caster, toe in); if, whilst checking, the recommended figures and those given below do not correspond, check the bodyshell and the axle and, if necessary, replace it.

Rear axle geometry	Value (degrees)
Rear wheel toe in	0 ± 1°
Rear wheel camber	0 ± 1°

50



Auxiliary units

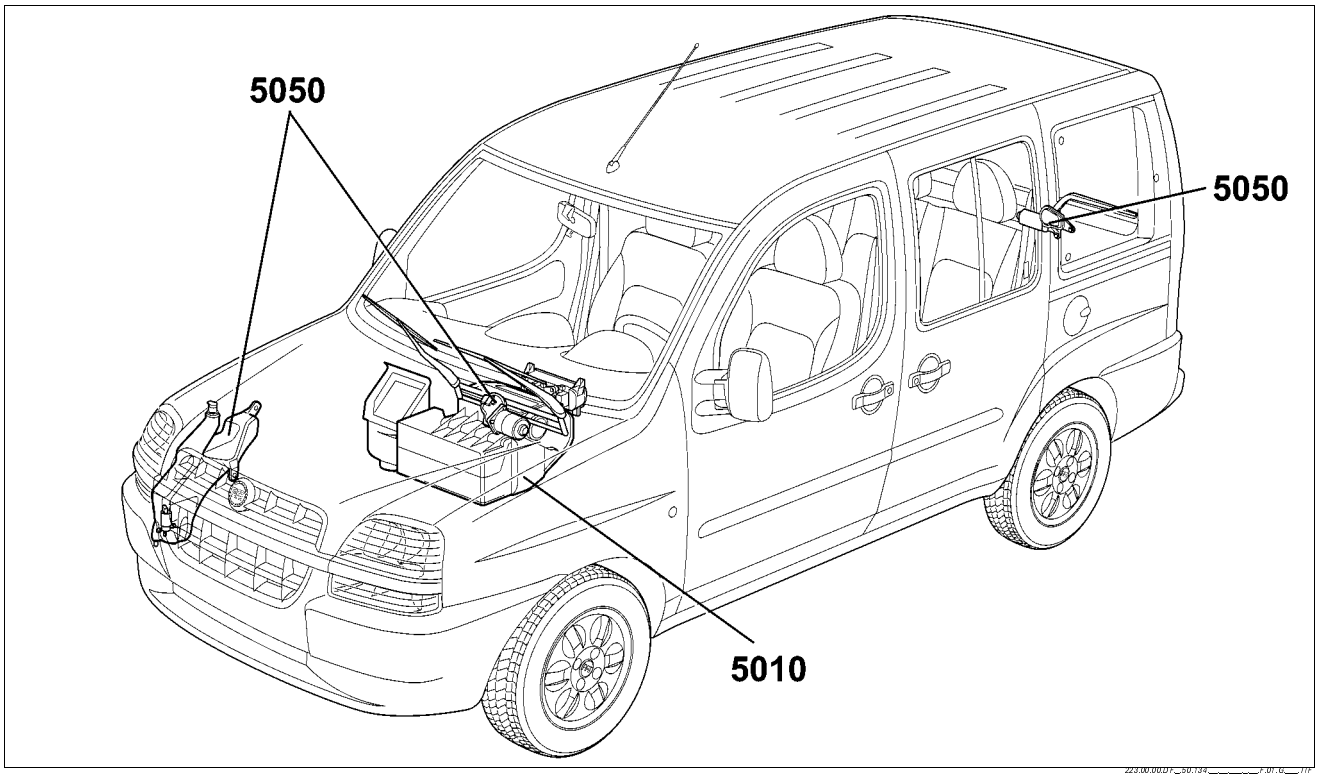
Group index

- GROUP GRAPHIC INDEX

Sub-groups index

Sbgrp.	Description	Validity
5010	Heating/ventilation - miscellaneous	
5050	Screen washers and headlamp wash/wipe	

GROUP GRAPHIC INDEX



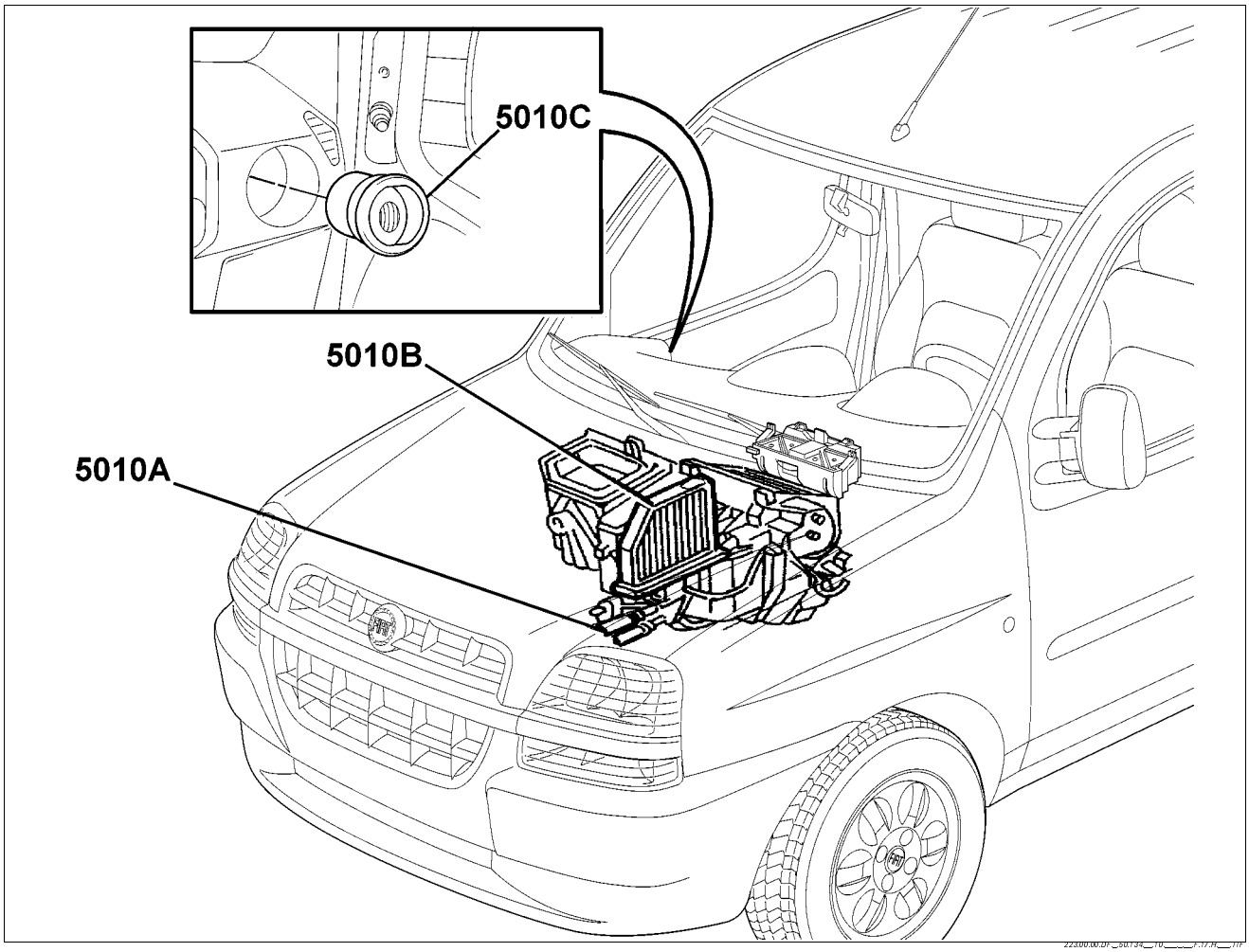
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES

Assembly drawings index

Cmp	Description	Validity

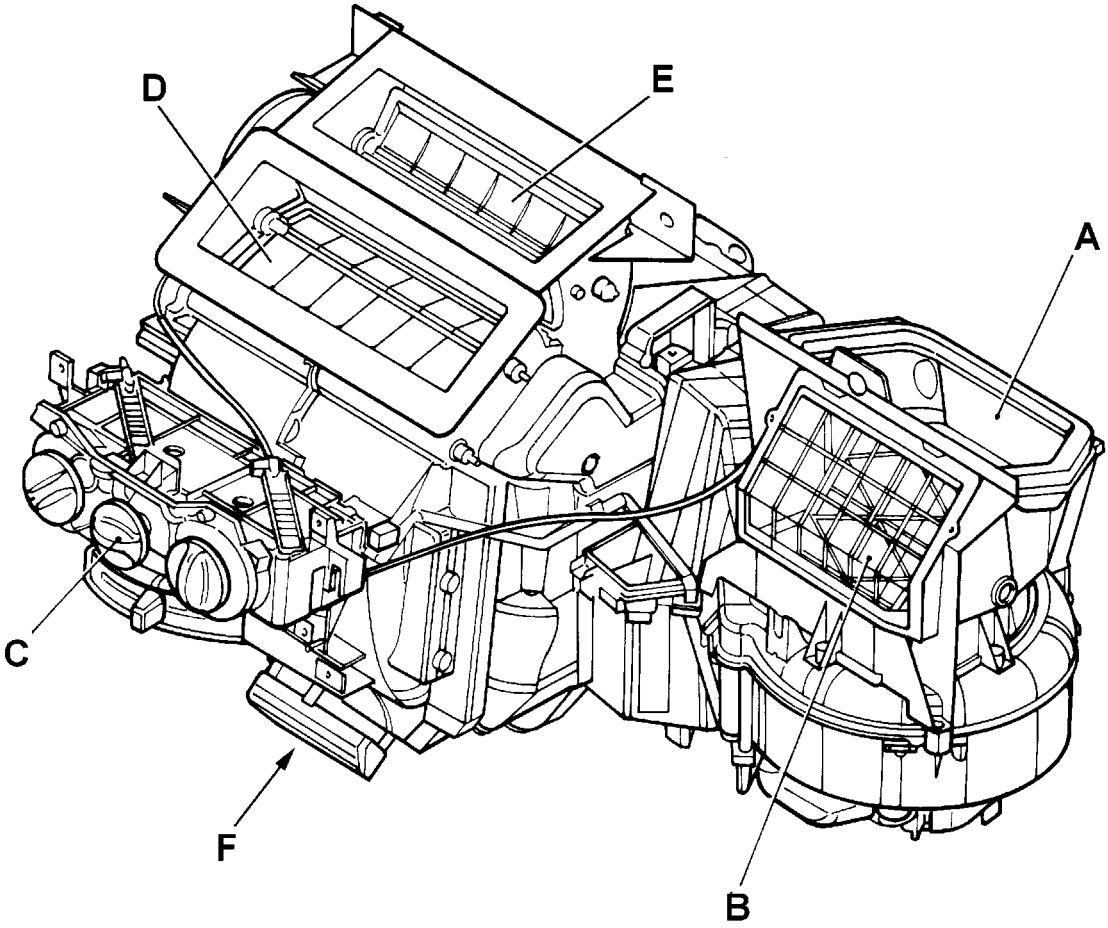
SUB-GROUP GRAPHIC INDEX



CONSTRUCTION FEATURES

MANUALLY OPERATED AIR CONDITIONING - HEATER ASSEMBLY

The evaporator - heater - distributor assembly represents the main component in the manually operated climate control and heating system.



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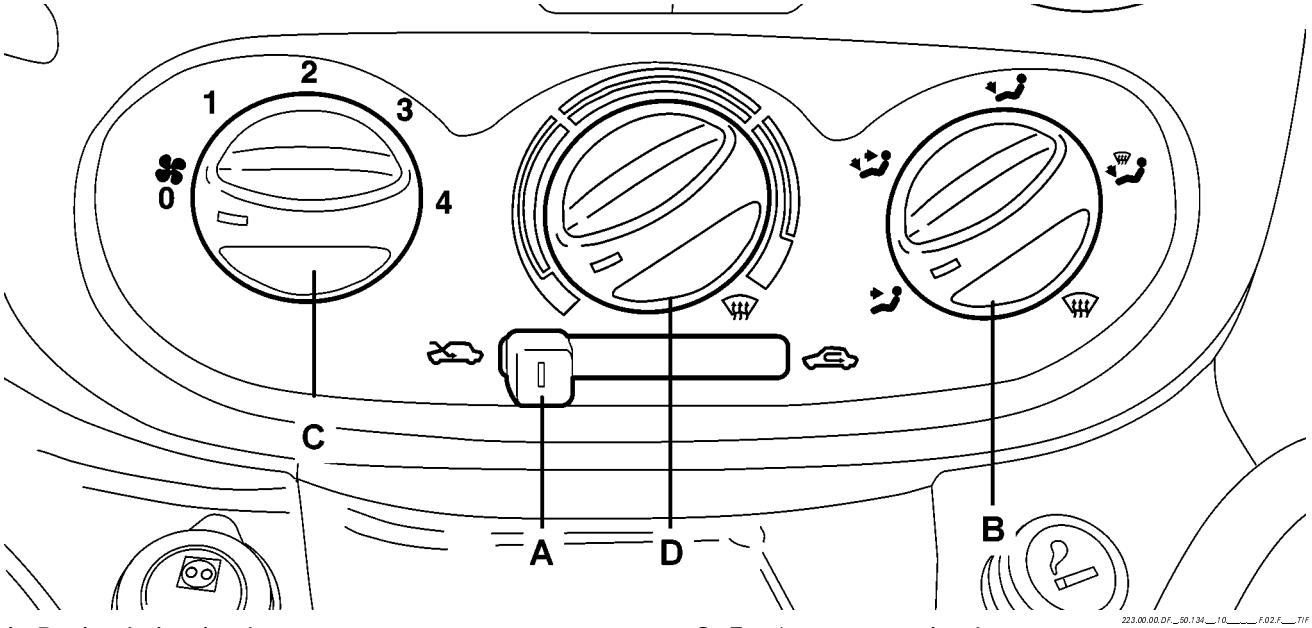
A. Outside air intake
B. Inside air intake (recirculation)
C. Control unit
D. Defroster air vent flap
E. Front air vent flap
F. Footwell air vent flap

The following components distinguish the climate control from the heater:
- An evaporator (not present on the heater)
- Electronic thermostat (not present on the heater)
- Central compressor activation LED (amber) on the fan speed control (not present on the heater)
- Compressor activation control on the fan speed control (not present on the heater).

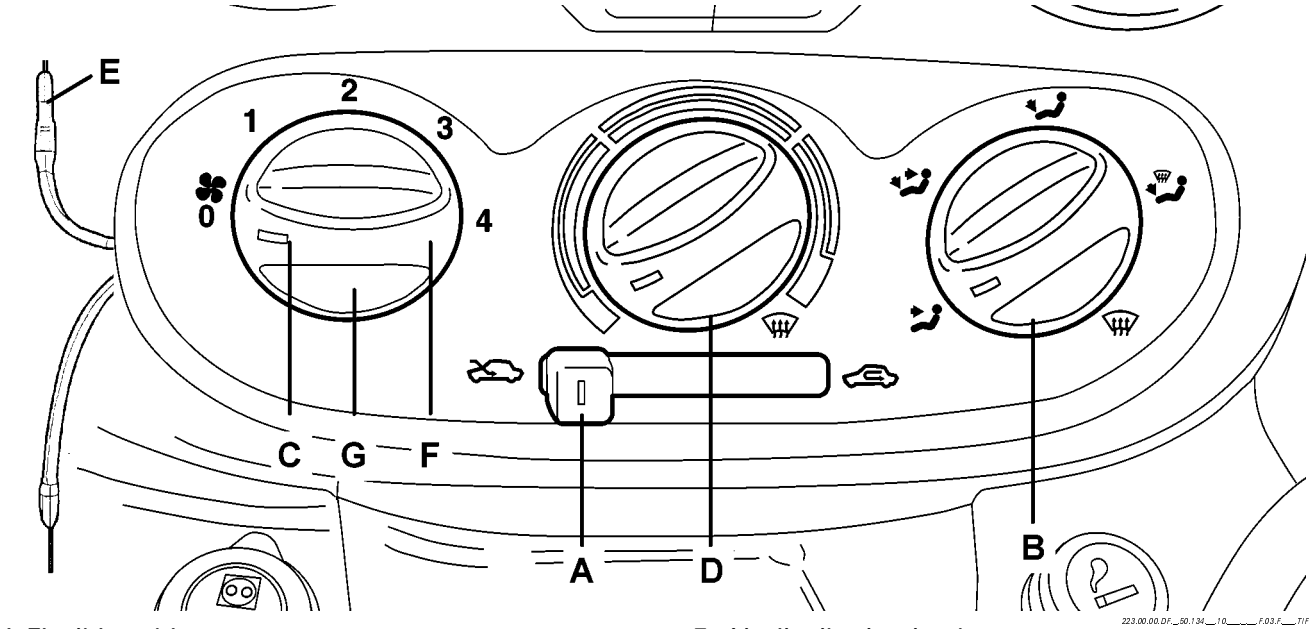
HEATER CONTROLS



A. Recirculation knob
B. Air distribution knob
C. Fan/compressor knob
D. Warm/cold air mixer knob

System functions are controlled by three rotary controls and one lower centre sliding control, as illustrated in the figure.

AIR CONDITIONER CONTROLS



1 Flexible cable
2 Warm/cold air mixer knob
3 Fan/compressor knob
4 Recirculation knob
5. Air distribution knob
6. Air conditioner symbol
7. Air conditioner activation LED

The controls for the air temperature (2), air distribution (5) and air recirculation (4) are connected to the flaps via flexible cables. The central fan speed control (5) is an electrical device with a sliding contact.

On the air conditioned version alone, the air speed control (3) incorporates a compressor control and a central amber compressor activation LED

Pressure must be exerted on the air speed control (3) to switch the compressor on and off.

All the controls are located in the ergonomically designed centre console incorporated in the dashboard and they are used, respectively, to adjust the:
- Air temperature (2), by blending warm and cold air
- Fan speed (3), via the four speed fan
- Air distribution (5), this control is designed to allow the air introduced into the vehicle to reach all areas of the passenger compartment via special vents that are present in some outfits and absent in others.

R 134A AIR CONDITIONING SYSTEM COOLANT

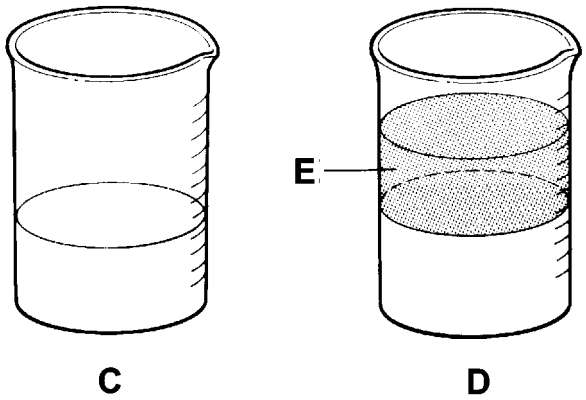
The gas used in this system is a TETRAFLUOROETHANE type which is considered environmentally friendly under EC law.
R134a gas cannot be used in systems which run on Freon because its different molecular composition can permeate some components (e.g. seals, pipes, etc.). For this reason parts of systems in which environmentally friendly gases are used ARE NOT INTERCHANGEABLE UNDER ANY CIRCUMSTANCES with those designed to run on Freon.
For this reason the operation of pressurizing/draining the system must only be carried out using the recommended equipment.

The quantity of R134a gas required for this system is: 650 +/- 25 grams.

If operations are carried out which involve replacing the system components, check the lspecific fluid (D - Oil for SCO8 and SCS08 compressors) is present in the quantities indicated below and top up if necessary.
- Drier filter: 15cc of oil;
- Pipes: 5cc of oil per metre
- Evaporator 40 cc of oil
- Condenser: 40cc of oil;
- Compressor: 80cc +/- 20 cc of oil (quantity for the entire air conditioning system);

If only the compressor is being replaced, carry out the procedure described below.

Pour the compressor fluid which should be changed into test tube A. Repeat the same operation for the new compressor, pouring the fluid into test tube B. Introduce the same quantity of fluid into the new compressor as was removed from the old one (test tube A), taking it from test tube B.



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A. Quantity of oil in the old compressor

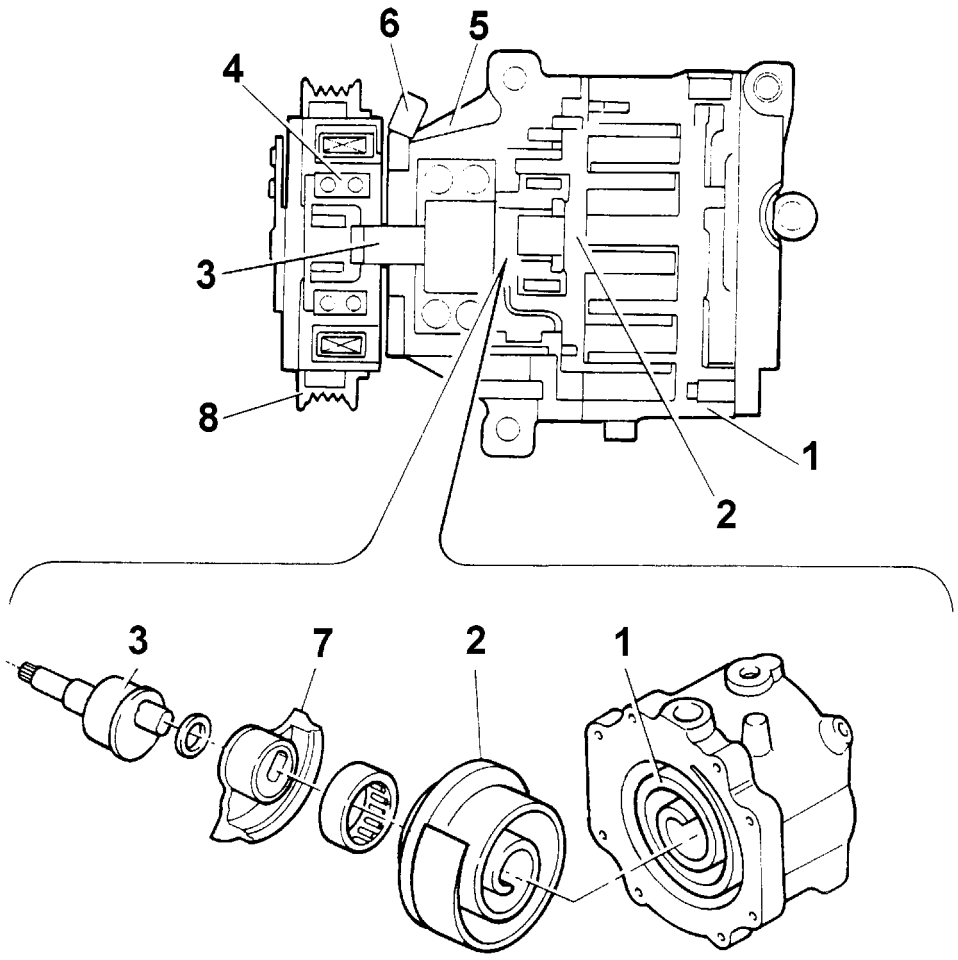
B. Quantity of new compressor fluid
E. Excess quantity of oil (already contained in the system)

COMPRESSOR

The compressor performs the following functions:
- Allows coolant to circulate through the climate control system
- Increases coolant pressure
- Increases coolant temperature

The climate control system may be fitted with the following compressors:
- SCROLL SC08 with orbital coil (1.2 8V FIRE)
- SCROLL SCS08 with orbital coil (1.9 Diesel)

These compressors consist of a fixed scroll (1) which is an integral part of the compressor casing and a moving scroll (2).
The moving scroll is made to revolve by a camshaft (3) connected to the pulley (8), which creates a chamber whose volume is reduced during the orbiting motion.



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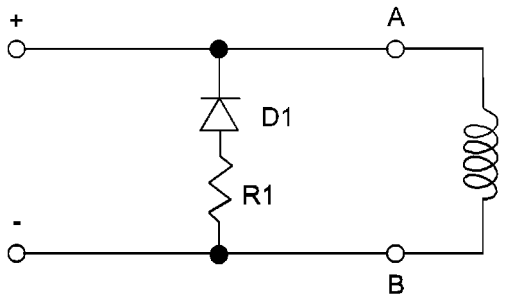
1 Fixed scroll (casing)
2 Orbiting scroll
3 Camshaft
4 Camshaft seal
5. Guard
6. Compressor electrical supply connection
7. Balancing mass
8 Pulley

The adoption of these compressor, consisting of only two parts, has led to the following advantages:
- No gaskets are required.
- There are no radial or axial leaks.
- Low charge loss due to the absence of internal pipes and valves.
- As the scrolls wear down, the side seal is improved.
- The absence of valves, knocking and pulsing reduces noise.

COMPRESSOR ELECTROMAGNETS

The compressor electro-magnet coupling supply wiring now includes an electromagetic diode D1 and a resistance R1 (in series to one another and in parallel to the electro-magnet) in order to eliminate generated electromagnetic interference.



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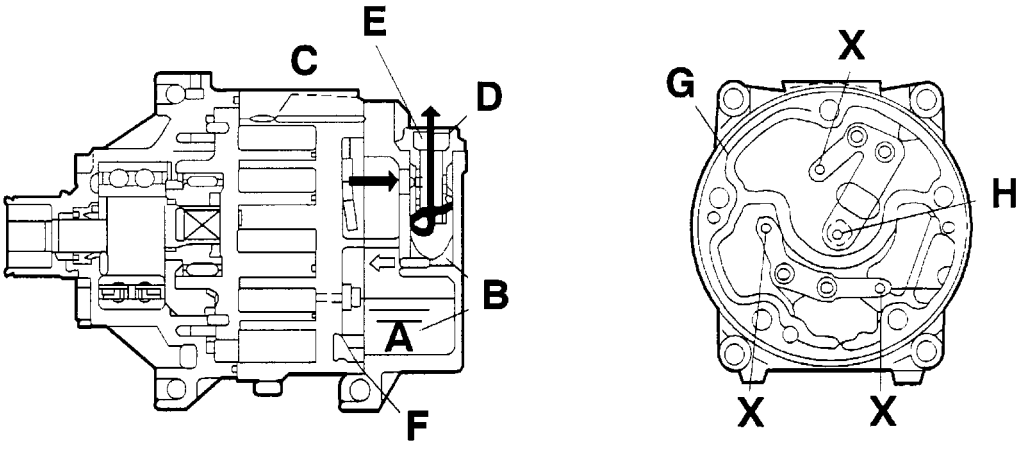
Difference between SC08 and SCS08 compressors

From a compression mechanism point of view, compressors SCS08 and SC08 are identical, the only difference being that compressor SC08 has an oil separator device (E), fitted in the gas outlet connector, which separates the gas from the oil which falls to the bottom of chamber (A) through the effect of gravity, whilst the gas escapes through the connector (D).
This device makes it possible to keep the quantity of oil introduced into the air conditioning system to a minimum.
In effect, by reducing the quantity of oil in the air conditioning system, the film of oil which is deposited on the walls of the heat exchangers (evaporator and condenser) is also reduced with a consequent improvement in thermal efficiency (it is possible to achieve improvements in the cooling of the air at the vent outlets of around 12 degrees Celsius).
If a quantity of oil is introduced into the air conditioning system and ends up in the gas compression chamber, it could damage the compressor because the oil is incompressible. To prevent this happening, three strip valves (x) are distributed along the gas compression route. If pressure in the oulet chamber increases excessively, these valves open to recycle the oil to the intake circuit through return port (C).



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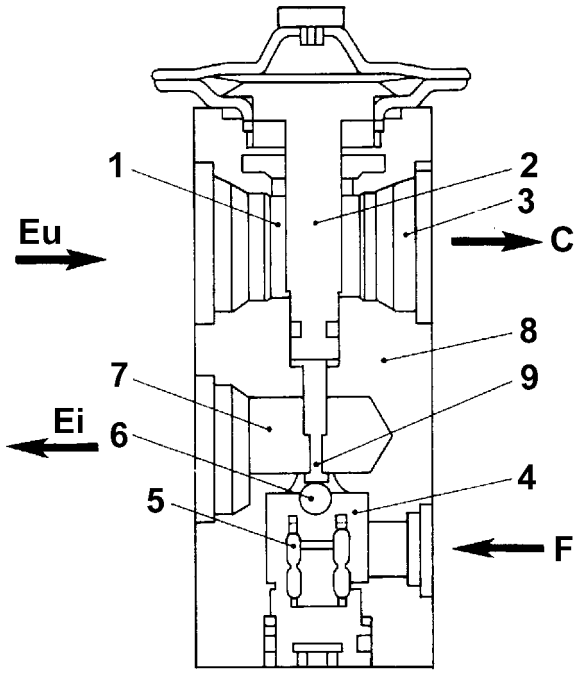
A. Oil
B. Oil
C. Oil return port
D. Connector
X. Safety valve

EXPANSION VALVE

The diagram below shows a section of the expansion valve and identifies the main components.



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1 Evaporator fluid outlet port
2 Heat-sensitive element
3 To the compressor inlet connector
4 Pressurised fluid
5. Counter-spring
6. Ball and calibrated port
7. Expanded fluid (at evaporator intake connector)
8 Valve casing
9 Rod
C. To compressor
Ei. Evaporator input
Eu. Evaporator outlet
F. To drier filter

This valve performs the following functions::
- Separates the high pressure circuit from the low pressure circuit;
- Expands the coolant (change from liquid state to gaseous state);
- Regulates the evaporation process (flow rate);
- Regulates evaporation temperature
- Protects the compressor from the coolant

The expansion valve controls the flow of fluid to the evaporator to achieve maximum system cooling power. Fluid flow and pressure are modulated as compressor rotating speed are altered.

This type of valve has two different routes for the coolant:
- A lower route allows the entry of fluid under high pressure in the liquid state from filter (F). It contains rod (9) driven by heat-sensitive element (2), counter-spring (5) and a ball valve housed in the calibrated port;
- An upper route allows fuel to return from the evaporator, where it reaches compressor (C) in the gaseous state under low pressure. It contains heat-sensitive sensor (2), which is connected at one side to the upper part of the diaphragm in the capsule and to the housing of ball (6) on the other intake side.

This valve performs three different functions in the system:
- Controls coolant flow
- Stabilises evaporation temperature
- Controls overheating

Control of coolant flow

The flow rate control function is exerted through the movement of the ball (6), connected via the rod (9), to the thermostatic sensor (2). Ball action is countered by spring (5). The position of ball (6) depends on pressure differences acting on a diaphragm located inside sensor (2); This in turn depends on evaporator fluid outlet temperature.
High outlet temperatures from evaporator (1) (corresponding to high heat dissipation levels) increase pressure inside thermostatic sensor (2); this brings about movement in rod (9) and connected ball (6) to increase passage cross-section and thus increase system flow.

The opposite takes place when the outlet temperature at evaporator (1) is low.

Stabilisation of evaporation temperature

Evaporation pressure is stabilised according to the temperature difference between evaporator inlet and outlet as follows: the lower part of the diaphragm is sensitive to the temperature of coolant at the evaporator inlet due to a port that links the inlet to the valve outlet downstream of the calibrated port, while the upper part is sensitive to the evaporator outlet temperature. Pressure changes between evaporator inlet and outlet impose temperature changes that act against the direction of rod (9) and connected ball (6) (thus helping to damp fluctuations).

Control of overheating

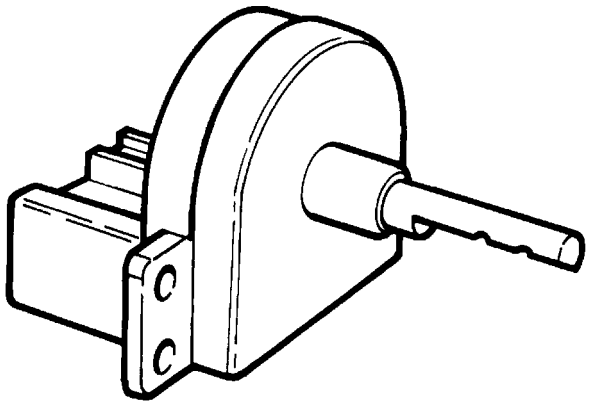
Overheating is controlledby spring (5), which is calibrated to allow effective operation with a preset temperature rise. This temperature rise (overheating) means the fluid in the evaporator is in a vapour state, i.e. contains no fluid that could be taken in by the compressor and damage the valves.

ELECTRICAL CIRCUIT COMPONENTS

The main components of the electrical circuit are:
- 4 speed rotary switch with A/C control;
- 4 speed additional resistance;
- Interior air fan motor;
- Electronic thermostat with external NTC (frost) sensor;
- 4 stage pressure switch
- Coolant compressor.

4 SPEED ROTARY SWITCH WITH A/C CONTROL

The A/C control is only present on versions with air conditioning. The diagram shows a view of the switch.



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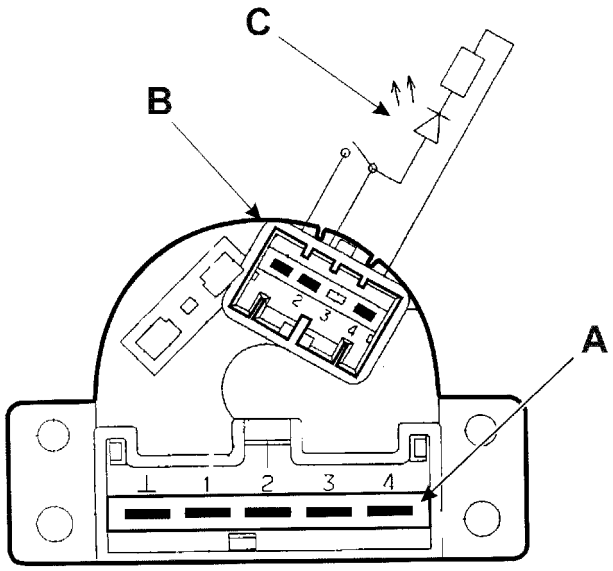
The main tasks of this module are to:
- Allow fan speed to be altered;
- Activate the compressor (only for the air conditioning system).

The switch control shaft can only be pressed to engage the A/C function in positions 1 - 2- 3 - 4, whilst in position '0' this function is not permitted, either mechanically or electrically.
When the A/C function is activated an amber LED (C) in the switch is lit up.
The diagram below identifies the position of the switch connectors.



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The pin out for connector A is shown in the following diagram.
Wiring diagram

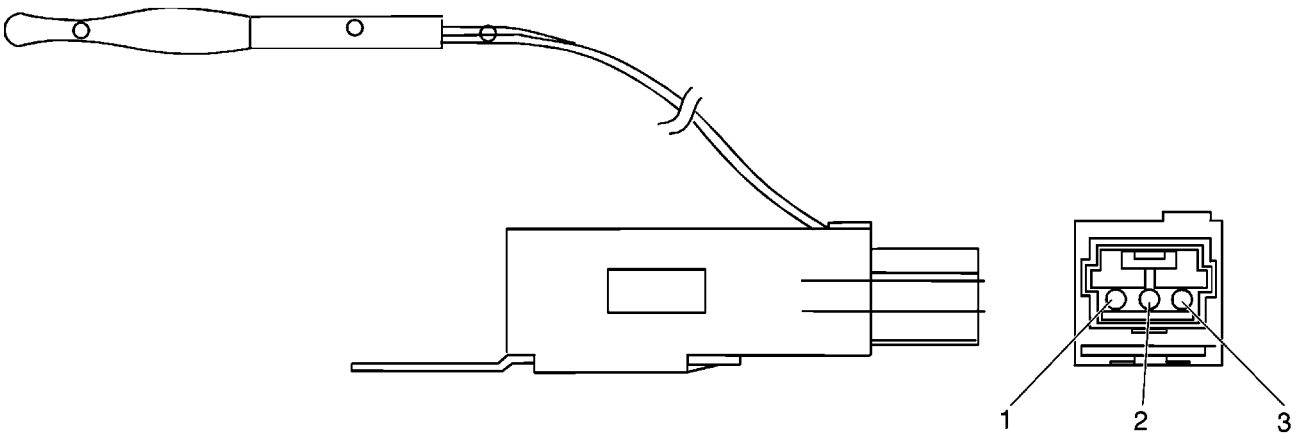
Position	0	relay	relay	3	4	A/C FUNCTION
0	X					Open
relay	X	X				Closed/Open
relay	X		X			Closed/Open
3	X			X		Closed/Open
4	X				X	Closed/Open

The pin out for connector B is shown in the following diagram.

relay	+ 15 INT/A
relay	A/C signal output
3	Free (not connected)
4	LED earth

ELECTRONIC THERMOSTAT

The diagram below shows a view of the thermostat and connector:



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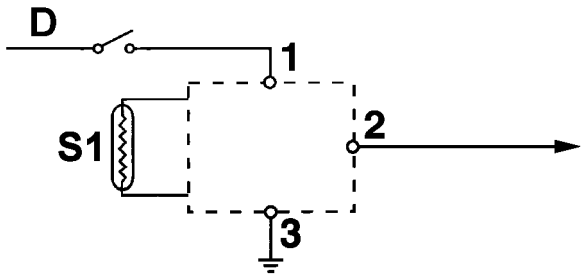
1 Aux power supply
2 Signal to 4-stage pressure switch
3 Earth

This performs the following functions:
- Controls evaporator temperture
- Prevents too much ice forming on the evaporator
- Activates and deactivates the compressor

Electrical characteristics

Rated voltage	13.5 Volt
Operating voltge	10 Volt - 16 Volt
Insulation resistance	A 500 Volt A 10 MW
Destructive discharge voltage	1000 Volt for 1 minute
Operating temperature	-40 °C; +85 °C
Response time	4 ± 1 σ
Wheel	NTC with dual component epoxide resin impermeable coating or similar

Electronic thermostat operation:



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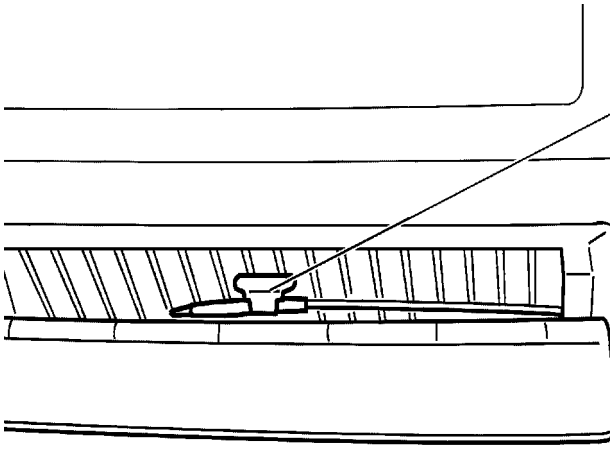
1 Aux supply
2 Signal to 4 stage pressure switch
3 Earth
D. +15 INT/A
S1. NTC sensor

The system controlling the activation/deactivation of the compressor is operated by an electronic thermostat which acts on the compressor clutch relay according to the temperature of the evaporator, measured by an NTC sensor located on the evaporator fins on the side downstream of the air flow and it is not accessible from the outside (see digram below).



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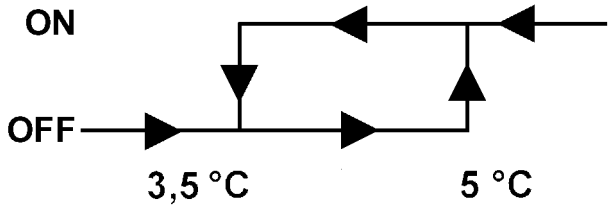
NTC sensor

The electronic thermostat activates and deactivtes the compressor as outlined in the table below:



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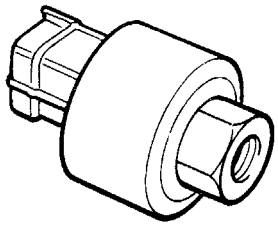
From the table it can be deduced that at temperatures above 5 Celsius the compressor is activated, whilst at temperatures below 3.5 Celsius the compressor is deactivated.

4 STAGE PRESSURE SWITCH

This performs the following functions:
- Deactivates the compressor if coolant pressure is lower than 2.45 bars (level I) or higher than 28 bars (level IV)
- Activates engine cooling fan speed I if coolant pressure is higher than 15 bar (level II).
- Activate engine cooling fan speed II if coolant pressure is higher than 20 bar (level II).



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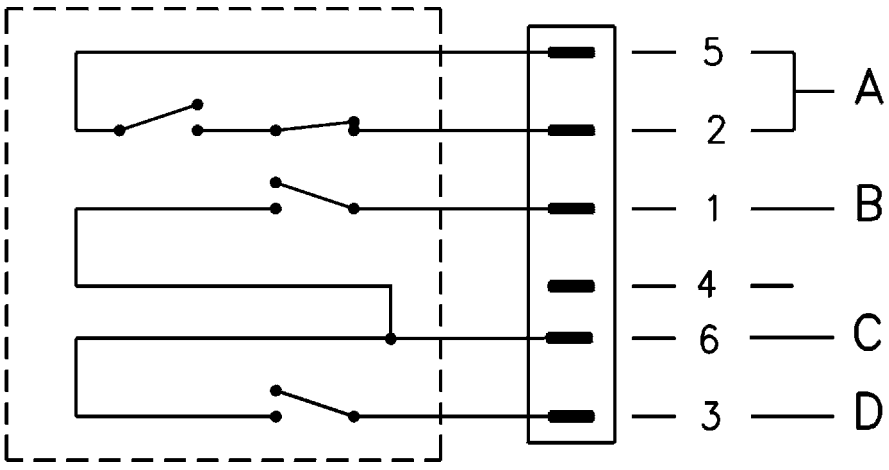
The 4 stage (frost) pressure switch is fitted on the coolant filter (right hand side, near the lamp).



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A. First and fourth stages (2 - 5)

B. Second stage (6 - 1)

C. Shared
D. Third stage (6 - 3)
The pressure setting figures for the intervention of the various levels are summarized in the table below:
4 stage pressure switch setting figures (bar)

4 STAGE PRESSURE SWITCH SETTING FIGURES			
STAGE	OPEN	CLOSE	DIFFERENTIAL
I°	2.45 ± 0.35	3.5	---
II°	---	15 ± 1	4 ± 1
III°	---	20 ± 1.2	4 ± 1
IV°	28 ± 2	---	6 ± 2

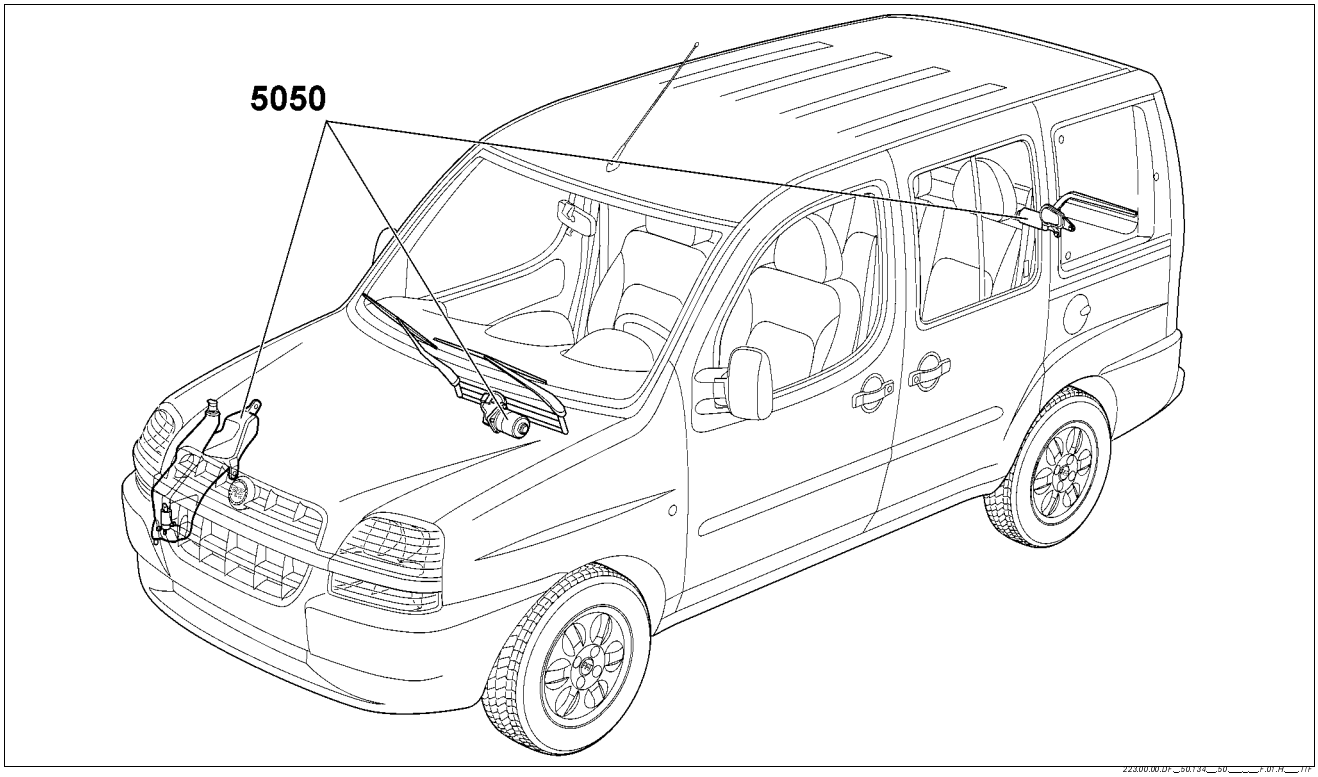
The 4 stage pressure switch has an interface with the injection wiring via an intermediate coupling D04.

Sub-group index

Assembly drawings index

Cmp	Description	Validity

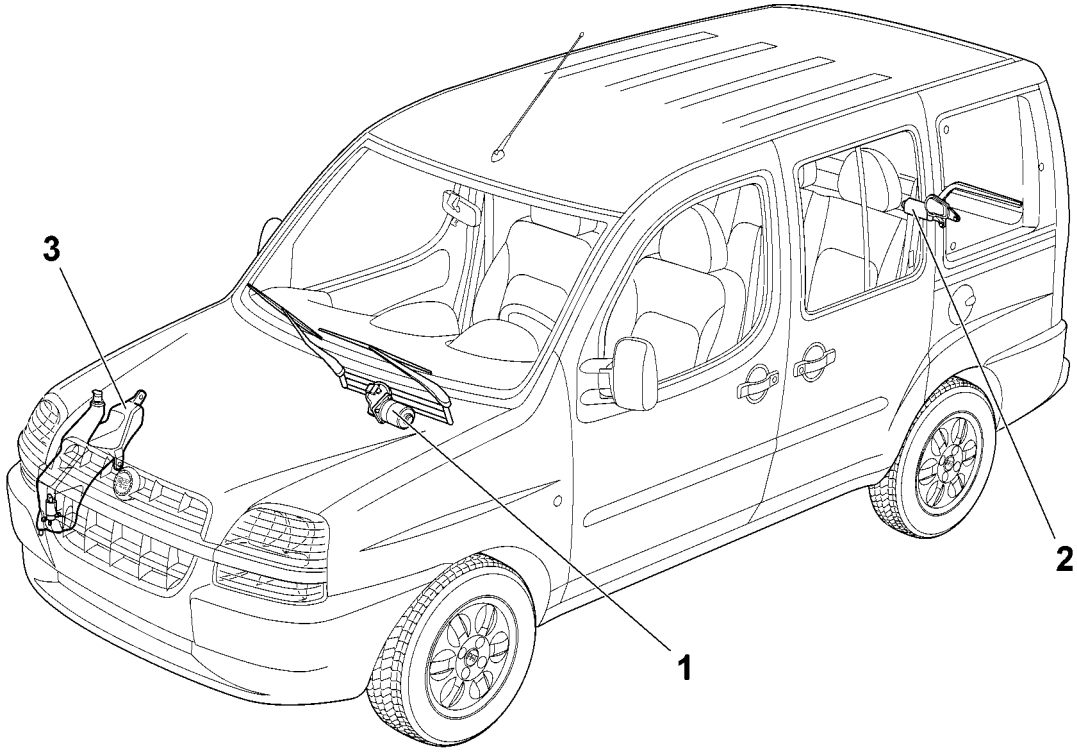
SUB-GROUP GRAPHIC INDEX



SPECIFICATIONS:

LOCATION OF COMPONENTS ON VEHICLE

The following diagram shows the components of the windscreen/rear window wash/wipe system



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1 Windscreen wiper
2 Rearscreen wiper
3 Reservoir

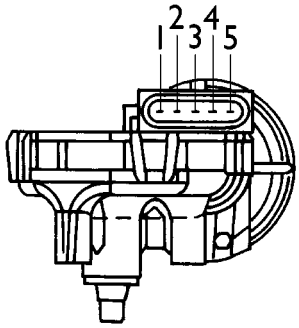
RESERVOIR

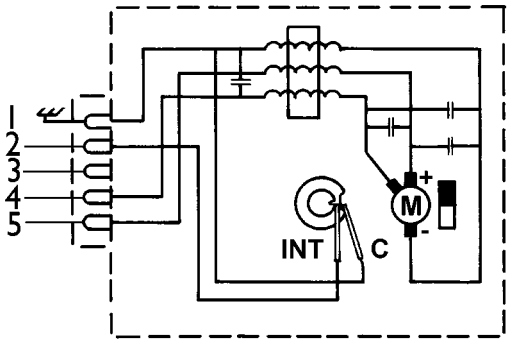
The reservoir, located on the left side panel under the wing, supplies the windscreen/rearscreen washer system pump with the necessary water/anti-freeze mixture for cleaning the front and rear windscreens.
The reservoir is the same on all versions. The only difference is that a different pump is fitted if a rear wiper is present.
The pump is either one-way (for outfits without a rear wiper) or two-way (for outfit with a rear wiper)
Reservoir capacity is 7 litres. The two-way pump supplies both spray units for the front windscreen and the rearscreen through two connected pipes.

WINDSCREEN WIPER/REAR WIPER

The windscreen wiper assembly is traditionally located in the service tank. In addition to the arm mechanisms, it includes an electric motor whose operation is controlled by the body computer.

The motor offers two operating speeds and comes with an electrical connection. Its layout is as shown below





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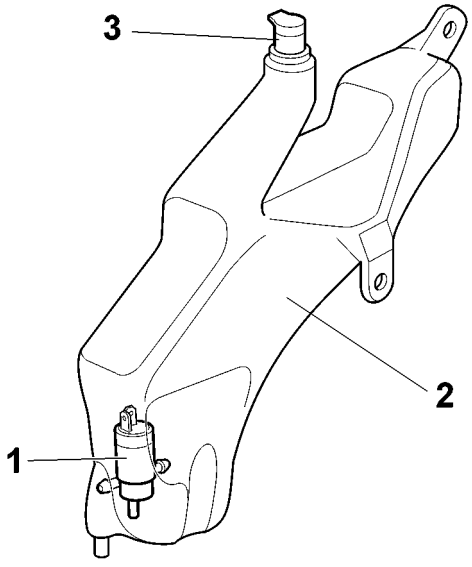
1 Power supply earth
2 Zero control
3 N.C.
4 Second windscreen wiper speed control
5. First windscreen wiper speed control

The rear wiper comes with only one speed setting and consists essentially of a motor secured to the rear door. Its threaded end is used to fit the wiper arm.

COMPOSITION

The reservoir, made from polythene plastic, is designed to be housed on the inside of the right front wheel arch. It comes with retaining tabs that allow effective, secure anchorage to the body.
The filler fitting is located on the upper part of the reservoir. This is easily accessible to facilitate filling and topping-up operations.
The polypropylene cap contains a filter element that prevents the introduction of impurities into the reservoir and a breather opening which does not allow fluid to escape.
The lower part of the reservoir contains a special housing for the electric pump and a rubber seal guarantees the perfect seal between the reservoir/electric pump.



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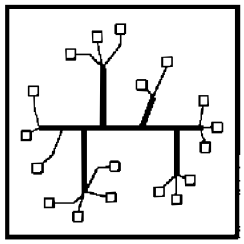
1 Electric pump
2 Reservoir
3 Filler fitting

OPERATION

The window cleaning system is controlled by stalks on the steering wheel stalk unit.
The windscreen wiper d.c. motors are fitted with a cam secured to the actual motor which operates as an active earthed switch. At each rotation, this sends an earth signal to the control unit which thereby recognizes the end of travel position.
This same signal is used as a control parameter to protect the motors from overloading.

The body computer cuts off the electrical supply to the motor under the following circumstances:
- the control unit does not receive a cam switching signal within three seconds of motor activation (the motor cannot start);
- more than twenty seconds elapse after a switching command without a further switching command being received (the motor is locked by a sudden event).

55



Electrical equip-ment

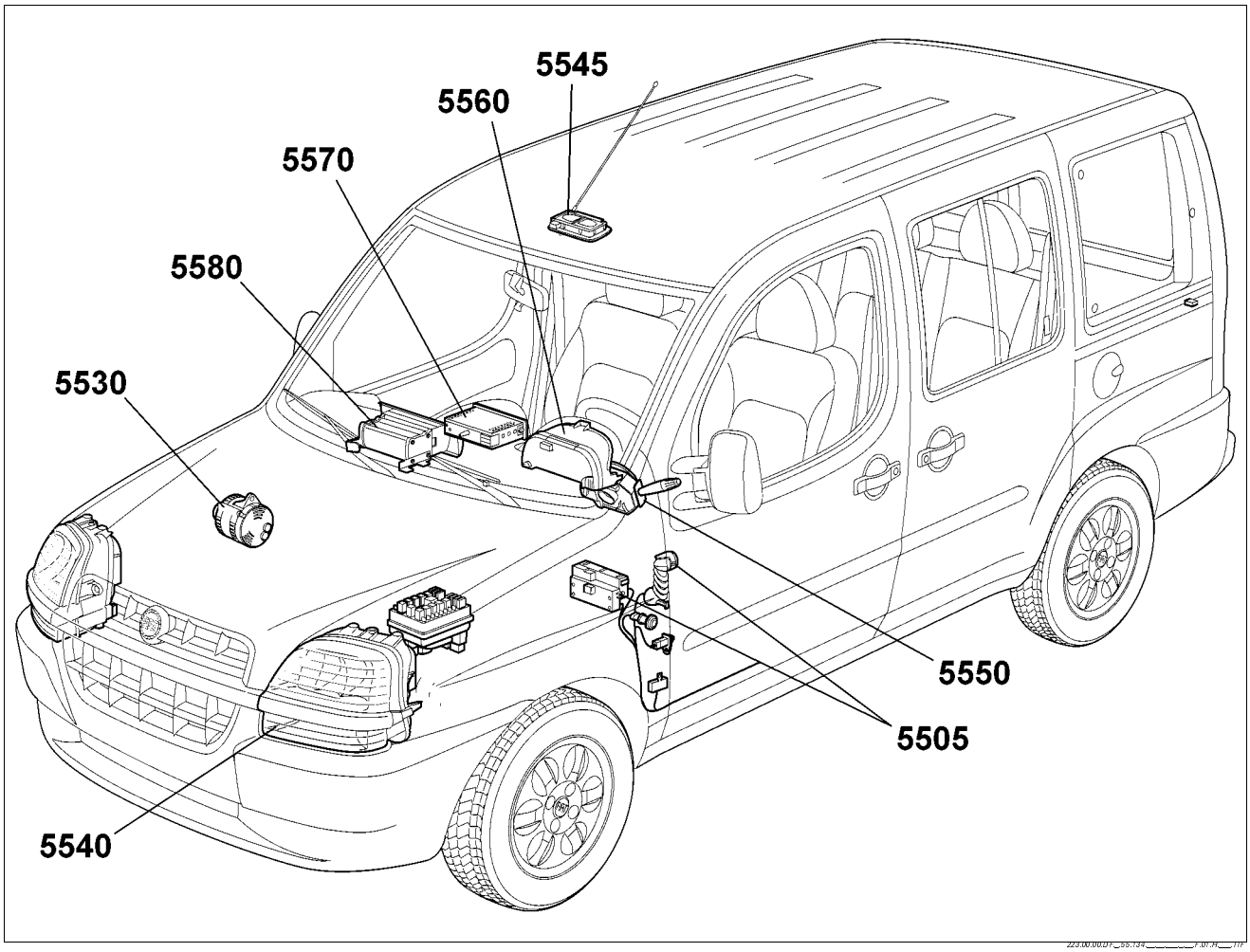
Group index

- GROUP GRAPHIC INDEX
- GLOSSARY

Sub-groups index

Sbgrp.	Description	Validity
5505	Instrument/guage electrical wiring	
5530	Current generation lighting	
5540	Exterior lighting	
5550	Warning and manoeuvring indicators	
5560	Instruments	
5570	Accessories	
5580	Special accessories	

GROUP GRAPHIC INDEX



GLOSSARY

VENICE
Complex system management for the simultaneous control of several smart systems (Vehicle Network Integration Component Electronics).

CAN
Controller Area Network

NETWORK
Electrical line formed by two shielded electrical wires.

NQS
Instrument Panel Connector

NBC
Body Computer Connector

TIM2
Triggering and Ignition Module (for 2 pretensioners)

ACU3
Third generation Air Bag Central Unit

RSU
Remote Side Sensing Unit (side impact sensor)

CCM
Engine Management Control Unit

NRR
De-Luxe Radio Connector

BIT
Elementary unit of a digital message

MULTIPLEX
Static switchover device

PROTOCOL
A set of rules defining the construction of a message in a certain system

BAUDRATE
Number of bits sent on a line in a second

HDR
Makes it possible to identify and synchronize the start of transmission

IND
Makes it possible to identify the destination address

CMD
Data to be transmitted

NBD
Number of command data bytes

B1...BN
Data bytes

CKS CHECKSUM
This is the check on the correct receipt of the data package

ACK
Command acknowledged and done

NACK
Command not acknowledged

NAP
Command not applicable

SELF-DIAGNOSIS
Test automatically carried out by the device

RECOVERY
A strategy used to replace a missing signal with a standard signal

ISO
International Organisation for Standardisation

MASTER
Main, primary, etc.

ID
Identification code

NODE
ECU internal interface

SAE
Society of Automotive Engineers

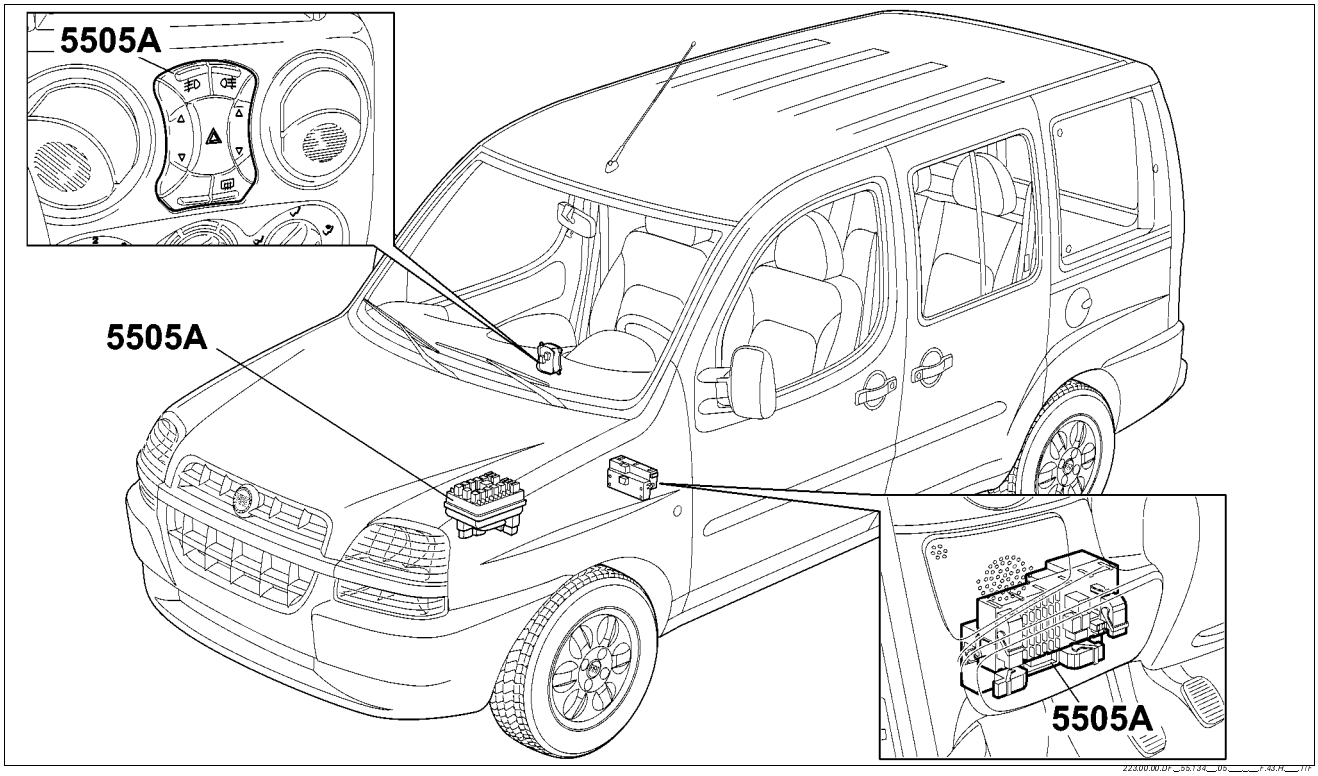
Sub-group index

- **SUB-GROUP GRAPHIC INDEX**
- **SPECIFICATIONS:**

Assembly drawings index

Cmp	*Description*	*Validity*
5505A	**Multi-function components**	

SUB-GROUP GRAPHIC INDEX



SPECIFICATIONS:

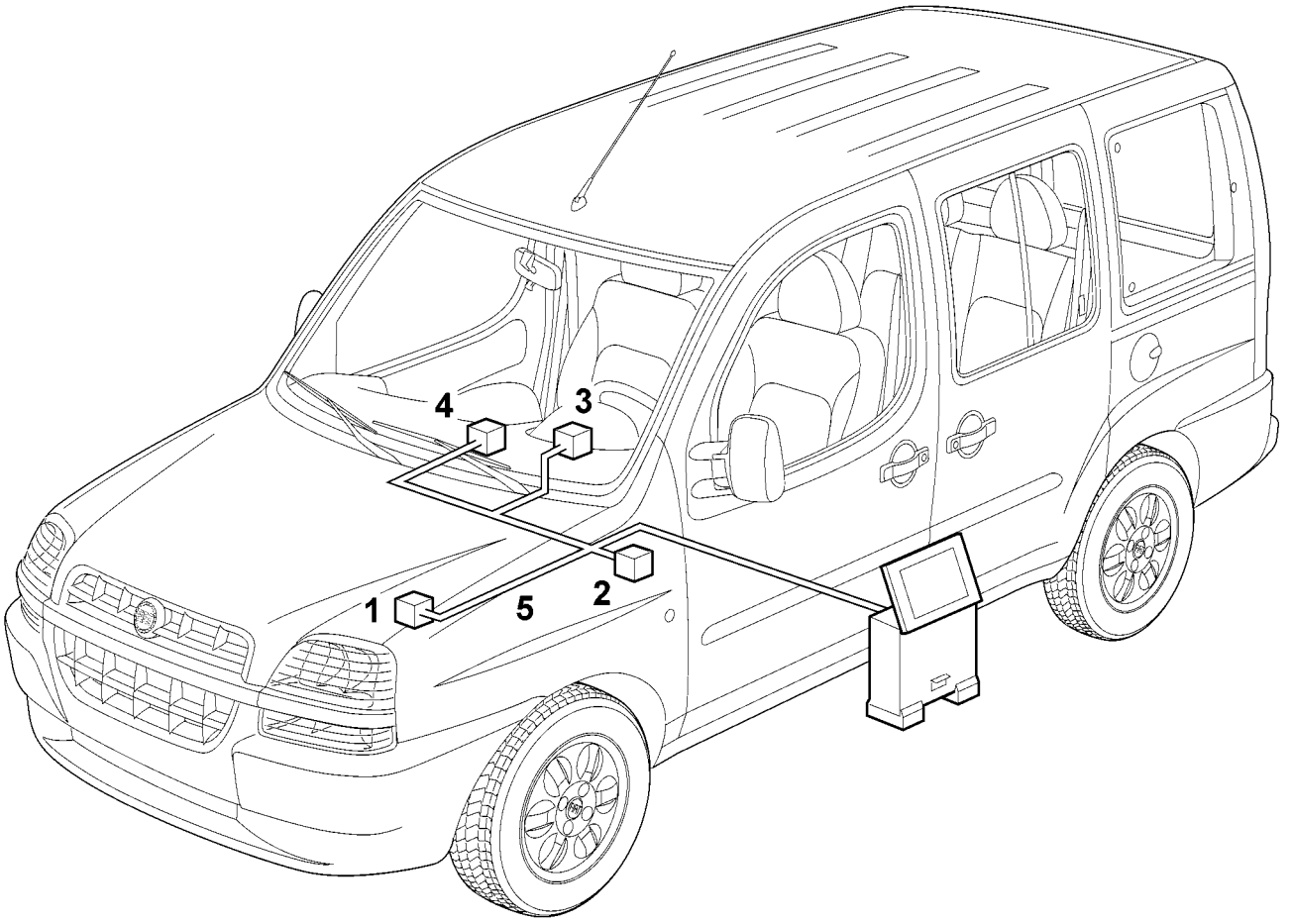
THE VENICE SYSTEM

FUNCTIONS

'VeNICE' stands for Vehicle Network Integration Component Electronics.

For this reason, 'VeNICE' is a powerful software and hardware solution which efficiently manages the resources in the vehicle allowing:
- data to be shared between the various ECUs;
- several ECUs to be integrated in a network;
- high data exchange speed in the network;
- cost-effective solutions, since the number of wiring harnesses and connectors are considerably reduced in the vehicle;
- a higher standard in terms of quality and reliability.

The conventional 'VeNICE' architecture is shown in the following figure.



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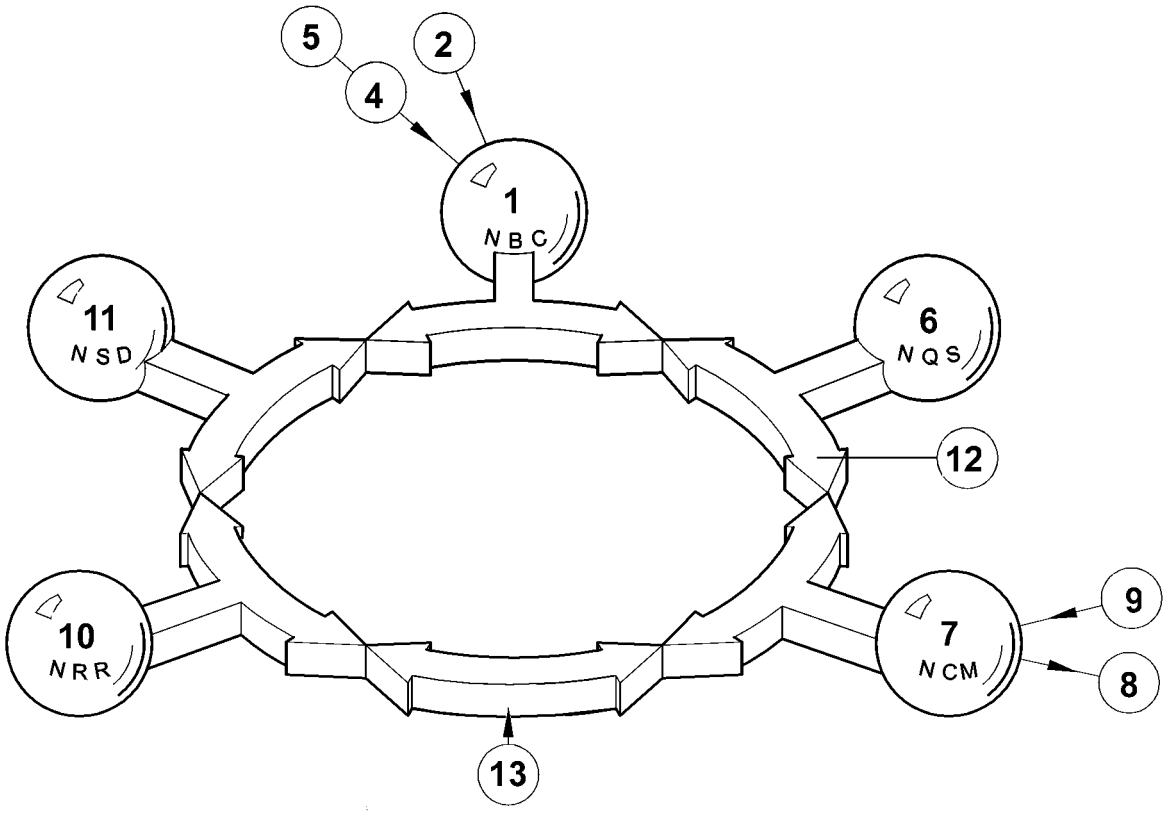
In its most comprehensive configuration, the VeNICE system consists of the following parts:
- engine bay control unit (1) (electromechanical)
- facia node (2) (electromechanical/electronic)
- instrument panel node (3) (electronic)
- control panel node (4) (electromechanical and electronic)
- wiring (5)

SYSTEM ARCHITECTURE IN GENERAL

The various 'Node' ECUs in the system are connected to the CAN (17) via communication interfaces called 'Transceivers'.

The interfaces are built into the ECUs and form gates for sending/reading data on the CAN (12) or on the serial lines.



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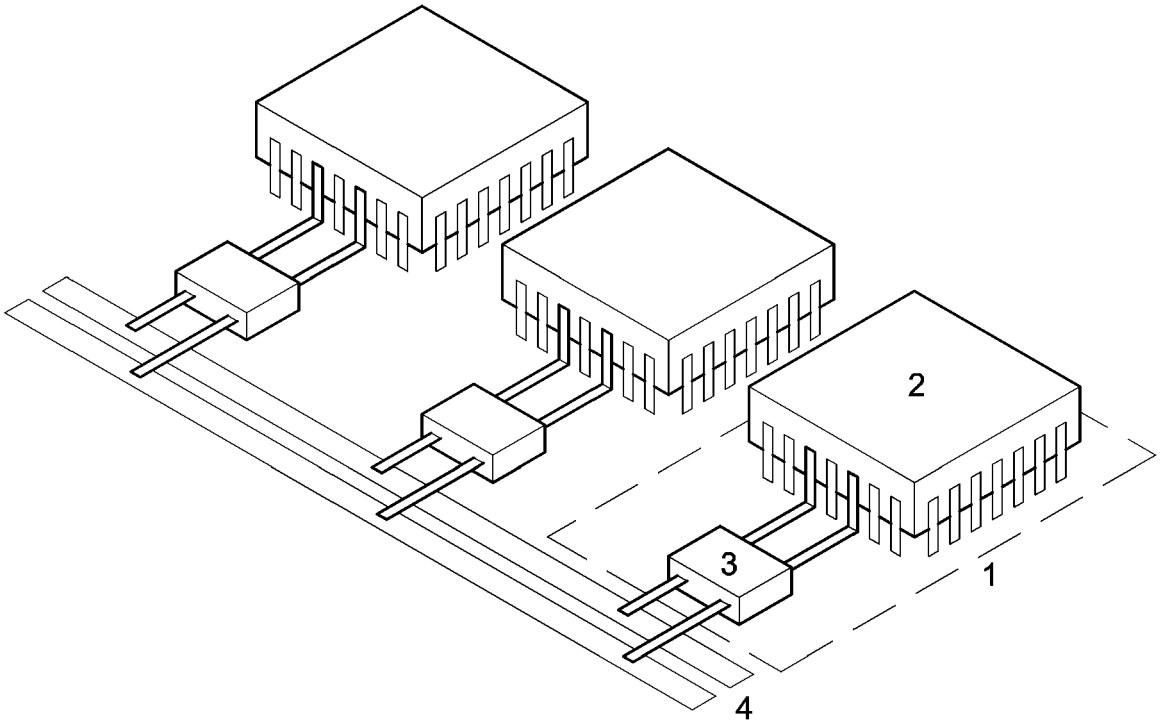
1 (NBC) Body Computer Node
2 Control panel
3 Steering wheel stalk unit
4 Brake control unit (ABS)
5. ABS sensors
6. Instrument Panel Node (NQS)
7. Engine Control Node (NCM)
8 NCM actuators
9 NCM sensors
10 Radio Node (NRR)
11. Examiner Tester Node (NSD)
12. Controller Area Network (CAN)
13. Serial line

The following figure illustrates the communication interface:



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1 NODE electronic unit
2 Microprocessor
3 Communication interface
4 CAN network (double)

System designers assign control functions to the Body Computer in the VeNICE architecture (see relevant assembly for details on the NBC functions).

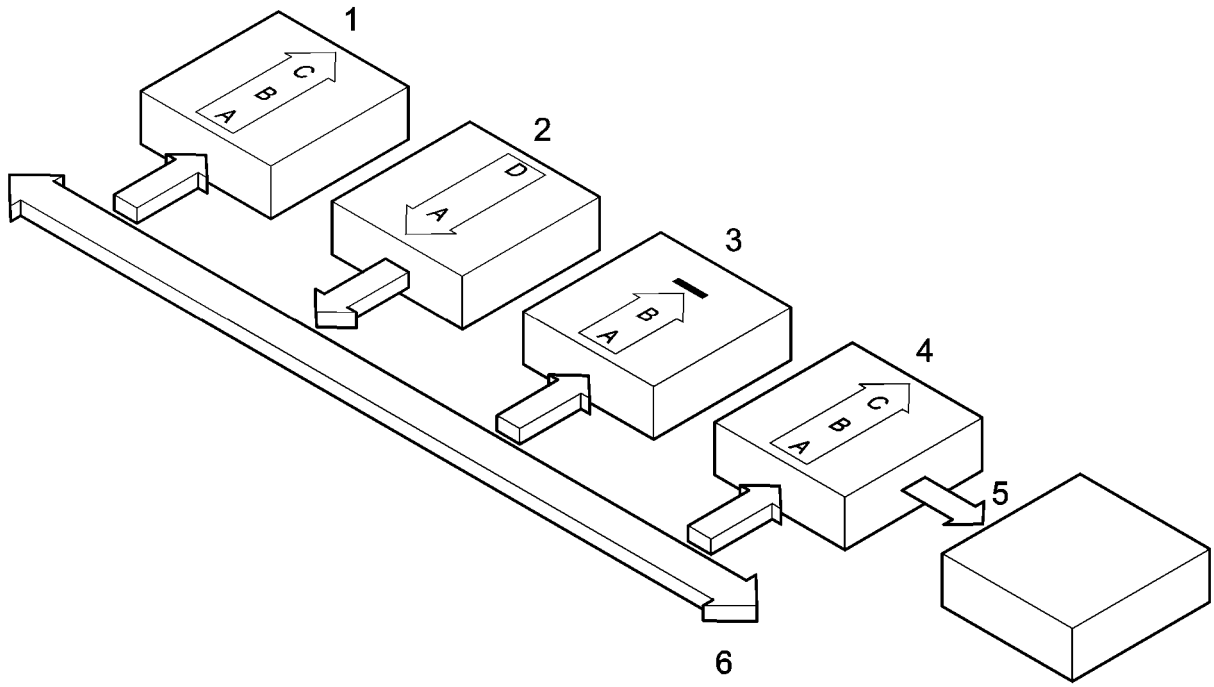
The additional Body Computer functions provide information on:
- network activity status;
- the functional failure status of individual node ECUs;
- CAN failure.

The Body Computer node 'wakes the system up' when the ignition key is turned to MAR.
In the event of an NBC failure, the network is woken up by the Instrument panel node (NQS) which intervenes only if the system is not woken up by the Body Computer for a certain time after the key is turned to MAR to prevent network conflicts.

OPERATING PRINCIPLES

Each 'Node' ECU processes the various signals from the respective sensors in order to manage themselves and the other ECUs.

For greater clarity, the following drawings illustrates a possible data sharing procedure between units connected in a network.



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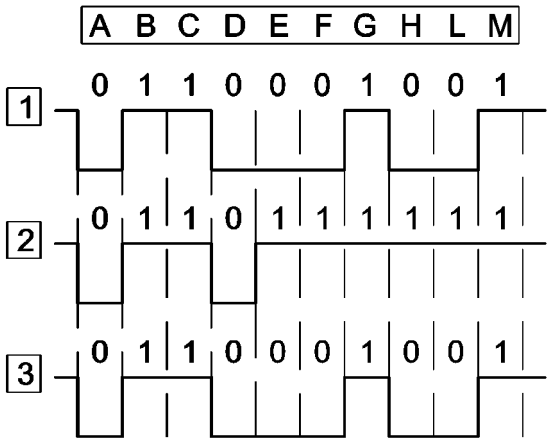
1 Body Computer node
2 Engine Control Node
3 Radio Receiver Node
4 Instrument Panel Node
5. Serial Line
6. CAN (double)
A. Send/Read message
B. Check message
C. Accept message
D. Create message

Example:
- The Engine control node (2) sends an rpm signal to the network (6).
- The Instrument panel node (4) reads the data and uses it to control the rev gauge to inform the driver of the engine rpm.

DATA TRANSMISSION PRIORITY

The VeNICE system employs a 'CSMA/CD' - Carrier Sense Multiple Access / Collision Avoiding - mechanism to allow several 'Node' ECUs simultaneous access to the network (double wire).
The CAN system is used because various ECUs interface and consequently a high number of signals is managed. A double copper wire CAN is therefore used. One wire is associated to the high level (H) and the other to the low level (L). The combined use of two wires and differential signals offers very strong signal communication even in environments with high electromagnetic interference.
The maximum number of distinct IDs for the CAN standard is 2032.
The following diagram shows simultaneous data transmission in the network to illustrate the transmission priority mechanism between nodes.



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1 Electronic unit 'A'
2 Electronic unit 'B'
3 Information on network

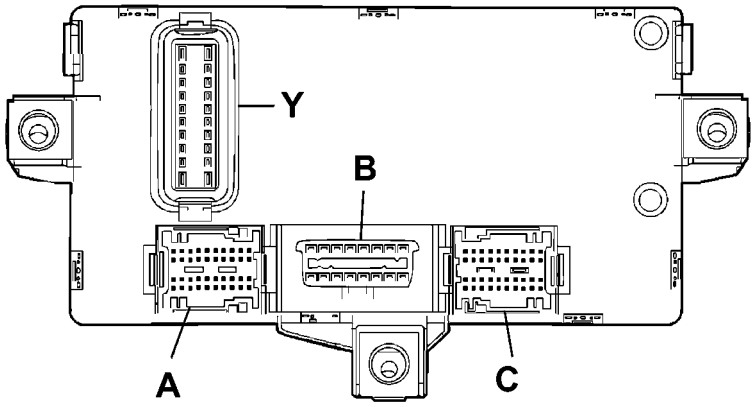
As shown in the diagram, nodes (1) and (2) simultaneously send the same message to point (D).
Nodes (1) and (2) present a mismatching byte in point (E). In this condition, node (1) modifies the value of the node (2) byte taking it to a lower level.
Node (2) acknowledges that its byte has been changed and that another node with higher priority is transmitting. It immediately stops sending and stands by until node (1) frees the line.
It is important to note that while acknowledging transmitting priority, node (1) sends its message without interruption.

5505A - Multi-function components

SPECIFICATIONS:

FUNCTIONS

The Body Computer Noder (NBC) is mechanically fastened to the second electro-mechanical junction unit and both are located under the dashboard cover, on the driver's side. The NBC manages a series of functions and controls relating to several devices:
- Rear side lights
- Parking lights
- Vehicle brake lights (except the third brake light)
- Rear fog lamps
- Fog lights (relay only)
- Dim dip light relay
- Heated rear windscreen timer (and fault diagnosis).
- Turn signal control and warning lights on the instrument panel
- Door lock/release control



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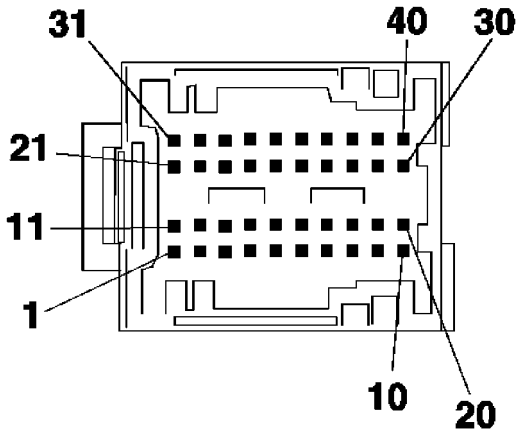
Control unit pin out

Connector A:



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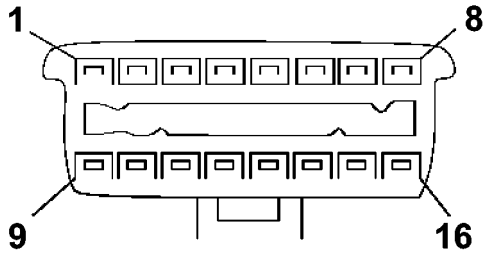
1 Driver's door open signal (on door pillar)
2 Left side direction indicator control
3 Right rear direction indicator control
4 Fuel gauge sensor signal (positive)
5. Left rear side light control
6. Right rear side lights control
7. Anti-theft volumetric sensor serial line (function not implemented on this car)
8 Driver's door open signal
9 Not connected.
10 Serial line for AUTOCLOSE
11. Passenger door open signal (on door pillar)
12. Left rear direction indicator control
13. Right side direction indicator control
14. Handbrake applied signal
15. Fuel gauge sensor signal (negative)

16. Left rear door open signal
17. Right front door release signal (NA)
18. K line aggregate 3
19. Not connected.
20. Not connected.
21. Courtesy light timer control
22. Right brake light control
23. Courtesy light power supply
24. Left front door release control signal (NA)
25. Passenger side door open signal
26. Right rear door open signal
27. Volumetric sensor power supply (function not implemented on this car)
28. Not connected.
29. Not connected.
30. Not connected.
31. Rear fog lamp control
32. Left brake light control
33. Boot light power supply
34. Door lock control signal - left front door (NC)
35. Door lock control signal - right front door (NC)
36. Boot open signal
37. Not connected.
38. Not connected.
39. Not connected.
40. Not connected.

Connector B:



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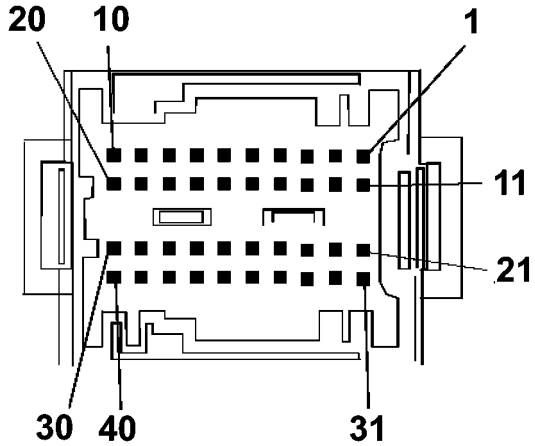
1 K line for ABS
2 Not connected.
3 K line for Airbag
4 Power earth
5. Signal earth
6. Can B
7. K line for Engine Management Control Unit
8 K line for immobiliser
9 Predisposition for aggregates 1 (facia)
10 Not connected.
11. Antitheft device (function not implemented on this car)
12. Predisposition for aggregates 2 (front)
13. Predisposition for aggregates 3 (rear)
14. Can A
15. Not connected.
16. Fuel system

Connector C



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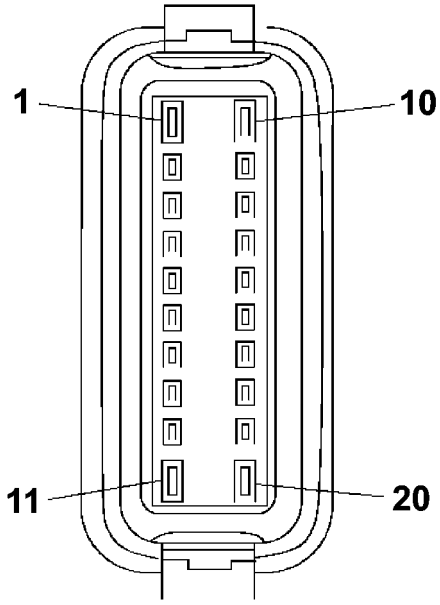
1 Reversing signal for stalk unit
2 Not connected.
3 Screen fitting
4 Immobilizer aerial
5. Immobilizer aerial
6. ABS serial line
7. ABS speedometer signal
8 Fog lamp relay coil control
9 Main beam relay coil control
10 INT power supply for speedometer generator
11. Not connected.
12. Not connected.
13. Headlamp washer signal (Function not implemented on this car)
14. Headlamp relay coil control (Function not implemented on this car)
15. Earth for speedometer generator
16. K line for ABS
17. Speedometer signal from pulse generator
18. Brake fluid level signal

19. Alternator D+ signal
20. Engine Control Unit diagnostics K line
21. Radio frequency aerial earth
22. Not connected.
23. Not connected.
24. Boot open signal
25. Serial line for car alarm siren (Function not implemented on this car)
26. Can A for electric drive node (Function not implemented on this car)
27. Can B for electric drive node (Function not implemented on this car)
28. Repeater for speedometer signal
29. IS05 interface for dialogue between immobilizer and Engine Management Control Unit
30. Right front side light control
31. Radio frequency aerial
32. Not connected.
33. Not connected.
34. Car alarm siren power supply (Function not implemented on this car)
35. Predisposition for aggregates 2 (K line for diagnostics)
36. CAN A from Engine Control Unit
37. CAN from Engine Control Unit
38. Left front turn signal control
39. Right front turn signal control
40. Left front side light control

Connector Y



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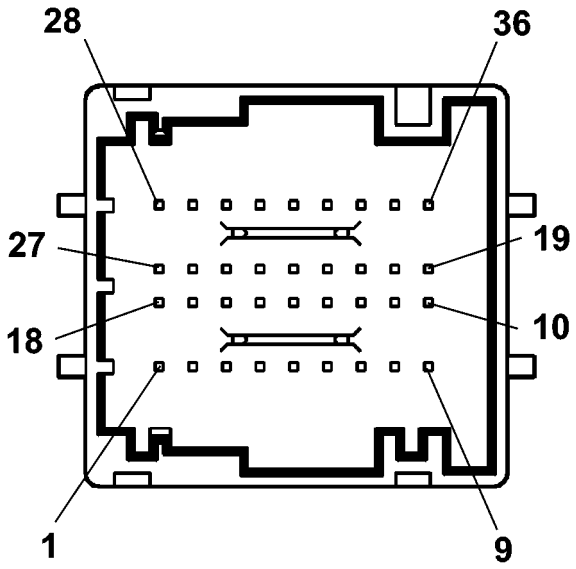
1 Door release motor control
2 Light system power supply from ignition switch
3 INT power supply for Instrument Panel Node
4 Relay coil control
5. Interior lighting and number plate light power supply
6. Not connected.
7. Service/SBMT service power supply
8 Body Computer, immobiliser, CAN, side light, rear fog lamp power supply
9 Turn signal, hazard warning light, Instrument Panel Node power supply
10 Door lock earth
11. Door lock motor control
12. INT power suppy for Body Computer
13. Main beam relay coil control
14. CAN A for facia control unit
15. Heated rear window relay coil control
16. CAN B for Facia Control Unit
17. Not connected.
18. Reverse control signal
19. Brake light control signal
20. Door lock system power supply

Rear connector



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1 Not connected.
2 Not connected.
3 Power supply for Instrument Panel Node
4 Dipped beam control signal
5. CAN A for instrument panel node
6. CAN B for instrument panel node
7. Right turn signal control signal
8 Body Computer signal earth
9 Body Computer power earth
10 Body Computer power earth
11. Predisposition for K line aggregates 2
12. K line for airbag
13. Rear fog lamp warning light control
14. Predisposition for car alarm led power supply (Function not implemented on this car)
15. Predispositio for power supplies
16. Predisposition for light power supply
17. Not connected.
18. Not connected.
19. Body Computer signal earth
20. Fog light control signal
21. Predisposition for heated rear window warning light control
22. Predisposition for rear fog lamp warning light control
23. Speedometer signal repeater
24. Not connected.
25. Not connected.
26. Not connected.
27. Not connected.
28. Not connected.
29. Hazard warning light warning light control
30. Left turn signal control signal
31. INT power supply for Instrument Panel Node
32. Heated rear window control signal
33. Main beam control signal
34. Hazard warning light control signal
35. Rear fog lamp control signal
36. Instrument panel node earth

COMPOSITION

STRUCTURE

The NBC is equipped with a microprocessor and static electronic components which are responsible for:
- receiving the control signal for the switches / remote control switches (panel, steering column switch unit, etc.)
- activating the consumers (direction indicators, courtesy light, etc.)
- downloading, converting and transmitting figures to the CAN network (ABS, fuel level, etc.)
- carrying out and managing fault diagnosis (of the connectors involved) and transmitting on the CAN network.

Each input is protected by filters against electrostatic discharge or radiofrequency signals which could adversely affect the smooth operation of the device. The exterior lights are activated by semiconductor switches or relays which simultaneously check and control the function. Faults in the above mentioned bulbs or side lights are signalled to the control panel at the CAN network.

The NBC comes on when the following conditions exist:
- door opening or transmitter key command received
- ignition key in ON position

The control unit remains on stand-by (in other words the energy required by the vehicle from the battery whilst the vehicle is NOT being used decreases), it 'wakes up' when one of the above mentioned functions is activated

OPERATION

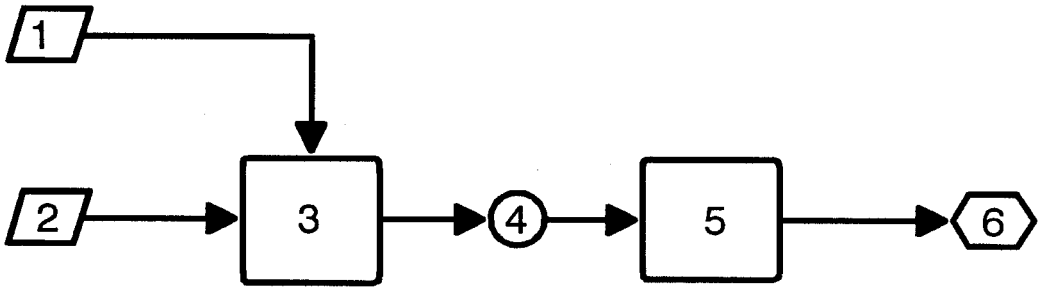
OPERATING PRINCIPLES

Each Body Computer is 'programmed' by the production plant using an electronic code system. All the codes are then stored in a DATA BASE managed by the PARTS DIVISION.
Therefore, when a new vehicle is handed over to a customer, the Service Network should not carry out any programming procedures. If a Body Computer is being replaced, a request should be put in to the Parts Dept. following the procedures described in the 'REPAIR PROCEDURES' section.

MAIN FUNCTIONS

Downloading signal D+

The NBC control unit receives a voltage reading via a dedicated input from the alternator. The Node is thus able to manage information effectively as it changes. The body computer converts data to be sent via the CAN network for use by the relevant Nodes.



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1 Battery voltage value
2 Ignition key state check
3 Body Computer node
4 Sending recharging state at CAN line
5. Instrument panel connector
6. Alternator warning light signal

Parking lights

The parking lights are enabled if the following conditions exist: ignition key turned to PARKING
The rear side lights, the warning light on the instrument panel and the number plate light are used as parking lights when the parking light switch (in the ignition lock barrel) is on.

Vehicle brake lights

The brake lights are enabled if the following conditions exist:
- Ignition key in ON position
- Switch on brake pedal activated.

The car brake lights are controlled when current from the NBC is sent to the two bulbs (not the third brake light). Fault signals are sent to the instrument panel Node (NQS).

Rear fog lamps

The rear fog lamps are enabled if the following conditions exist:
- Ignition key in ON position
- Rear fog lamp button activated.
- Dipped beams activated or only side lights plus fog lamp (where fitted)

The control unit sends a signal to turn on the rear fog lamp warning light located in the NQS.

Fog lamps

The fog lights relay feed is activated if the following conditions exist:
- ignition key in ON position
- side light switch activated
- Fog lamp button activated

If a fault occurs, the NBC does not send signals to the NQS but makes them available to the CAN.

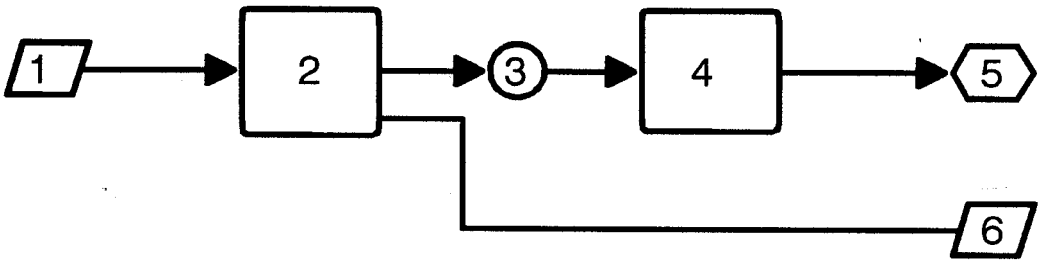
Main beam headlamps

The main beam headlamps relay feed is activated if the following conditions exist:
- ignition key in ON position
- side light switch activated
- dipped/main beam switch activated

The main beam flasher switch may be activated for an unlimited time. The warning light on the main beam control panel is controlled via the CAN. Fault diagnosis can only be carried out on the dipped headlamps relay and made available on the CAN network

Dipped headlamps 'following' function

This function allows the dipped beams to be kept on after the key has been turned off for 30 seconds or multiiples thereof.
When the main beam headlamp flasher lever is operated, the dipped headlamps can be switched on within two minutes of the ignition being switched off. Each time the lever is operated, the time the lights remain on increases by 30 seconds up to a maximum of 5 minutes. The deterrent LED also comes on to indicate the dipped headlamps follow-me-home function. If the bulbs come on, the deterrent LED comes on constantly for the duration of the function.



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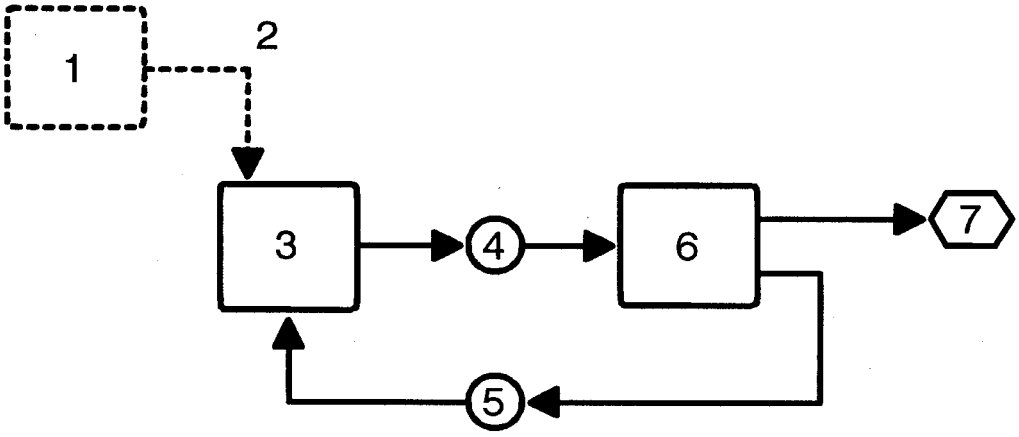
1 Ignition key control, light control
2 Body Computer node
3 Main beam / dipped headlamps status
4 Instrument panel connector
5. Headlamp warning light signal
6. Main/dipped headlamp lighting

ABS EBD signal download

The NBC is equipped with an input from the ABS control unit, which allows the microprocessor to process the data, supplied via the dedicated serial line, decode it and convert it so that it can be sent to the CAN network and used by the Nodes involved.

The signals are:
- ABS EBD system anomaly
- Car speed



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1 ABS EBD control unit
2 ABS EBD TC control unit connection via dedicated serial line
3 Body Computer node
4 Transmission to CAN network of ABS EBD control unit fault status
5. ABS EBD TC failure warning light status, warning light failure
6. Instrument panel connector
7. ABS EBD TC failure warning light on

Heated rear windscreen timer

The heated rear windscreen timer relay is activated when the following conditions exist:
- Ignition key in the ON position;
- Heated rear windscreen button (active type return) with timer activated.

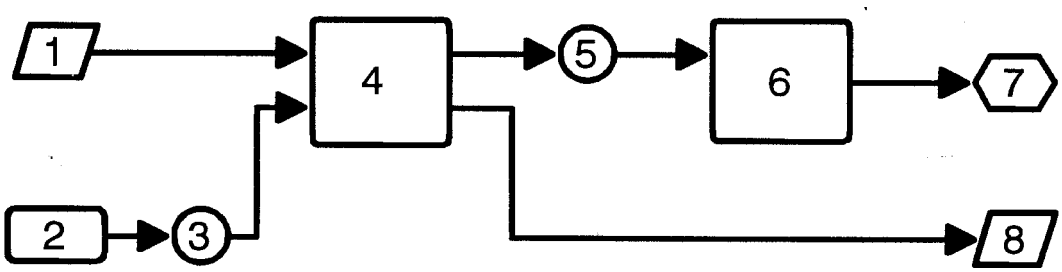
Activation only occurs when the switch is released to prevent the heated rear windscreen being on constantly if there is a short circuit in the NBC intake circuit.

The NBC output which operates the heated rear windscreen can be deactivated:
- Manually, by pressing the control switch or if there is no ignition ON signal
- Automatically, after 30 minutes of actual heated rear windscreen operation.

The automatic operation of the heated rear windscreen is basically connected to the:
- Engine rpm signal (around 1000 rpm)
- Battery voltage
- Heated rear windscreen button on/off strategy

The strategy for switching the heated rear windscreen on/off is as follows:
- For the first 10 minutes, operation does not depend on the engine speed
- Once this time is exceeded, if the rpm level is lower than 1000 rpm, then the heated rear windscreen must be disconnected after an interval of 10 seconds, if the rpm exceeds 1000 rpm for at least 10 seconds, then the heated rear windscreen remains on until it has been effectively operating for 30 minutes.

- During the entire automatic operating range, the heated rear windscreen relay should be switched off when the battery voltage decreases too quickly. - Engagement of the heated rear windscreen turns on the warning light in the control panel which remains on constantly for a maximum of 30 minutes i.e. throughout operation. The warning light goes off only if the heated rear window is disconnected manually.



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1 Ignition key control, Battery voltage control, Activation of heated rear windscreen
2 Engine Management Control Unit
3 Sending idle speed to CAN network
4 Body Computer node
5. Heated rear windscreen status
6. Instrument panel connector
7. Heated rear windscreen status signal
8 Heated rear window activation

Timed passenger compartment courtesy light

When one of the side doors is opened, the courtesy light is turned on for a period of 3 minutes
If whilst opening one door, another is opened, the counting starts again from zero.
If a door remains open for more than three minutes, the courtesy light goes out and remains off until one of the other doors is next opened.
If, during this period of 3 minutes, all the doors are closed again, a second period of 7 seconds is activated and is interrupted if the ignition key is turned on.
The courtesy light is on for 15 seconds if activated by the remote control, the light also goes out on the ignition key on signal. Conversely, when locking the doors with the remote control, the courtesy light goes out after the check to see that the doors are correctly shut.
The courtesy light is also operated, always for 3 minutes, by removing the key from the ignition lock barrel. This operation is enabled for a period of 2 minutes from when the ignition is switched off.
With the ignition switched on, the courtesy light is set to operate when the doors are opened/closed without timed delays (when the door is open, the light is on, when the last door is closed, the light goes out).

Fuel level signal download

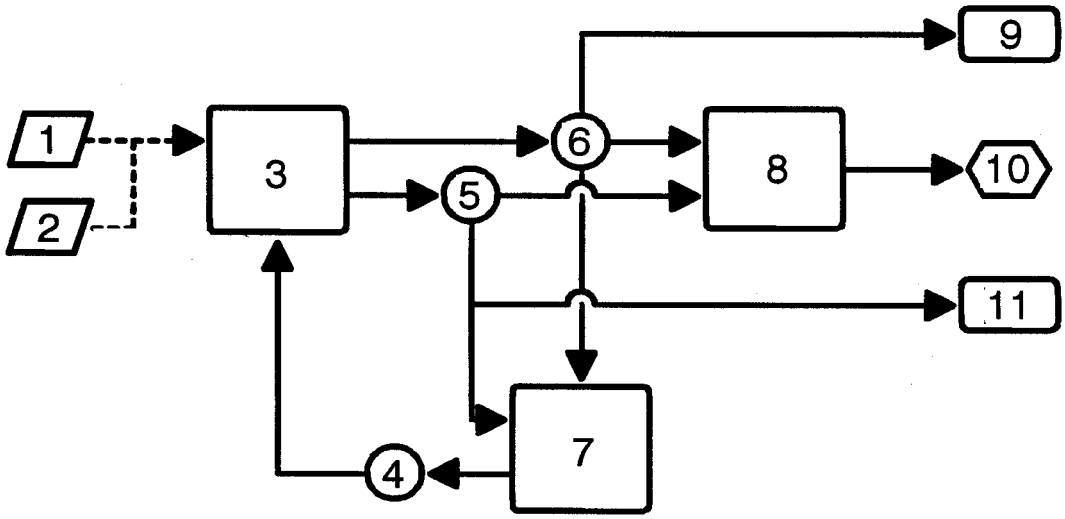
The NBC downloads a reading from the fuel level gauge (CILC) via a dedicated input. The microprocessor allows the data to be processed and converts it so that it can be sent to the CAN network for the use by the NQS and Engine Management Control Unit (CCM) Nodes. Two reference values can be set in the programme:
- Curve A = 60 litres
- Curve B = error

Vehicle speed signal download

The vehicle speed signal is acquired by converting the signals coming from the:
- speedometer impulse generator on the differential
- Signal obtained by averaging signals from ABS sensors

The microprocessor, together with a programme inside the NBC device, makes it possible to convert the wheel impulses into a journey reading expressed as Km / hour. This data is memorized and sent to the CAN network for use by the NQS and Engine Management Control Unit (CCM) Nodes.

It should be remembered that if the instrument panel is being replaced, the NQS 'total kilometres / miles' should NOT be updated if the NQS 'Total Km / mile' value is higher than the 'Total km / mile' value memorized in the NBC and/or CCM. The 'Total Km / mile' memory is in the body computer and the instrument panel.



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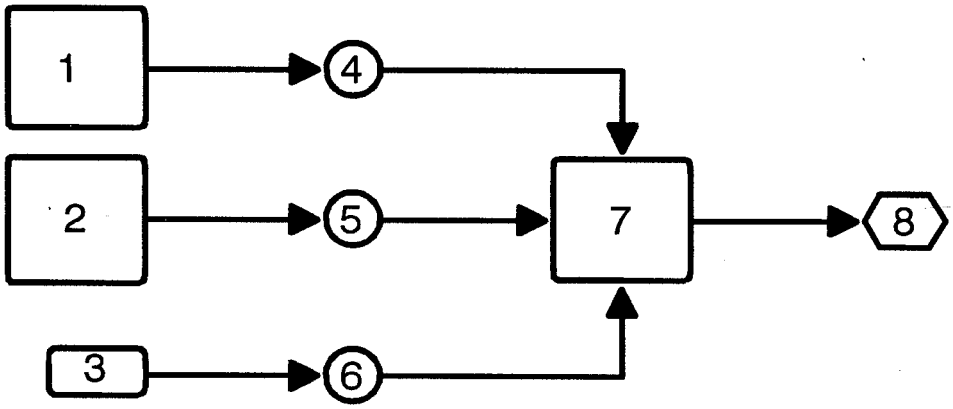
1 Speedometer impulse generator speed signal
2 ABS speed signal
3 Body Computer node
4 Vehicle speed plausibility check
5. 6, Vehicle speed or speed error status
6. Mileometer value, distance travelled
7. Engine Management Control Unit
8 Instrument panel connector
9 Availability of speedometer signal on NQS
10 Mileometer speedometer reading
11. Car speed or error status for NRR

Turn signal check

The NBC control unit activates and checks the power uptake of turn signal bulbs. The check also extends to the relay feed, the control unit is capable of sending the signal for a possible fault via the CAN line to be used by the NQS lights failure reading.

Trip computer

Trip computer data flow



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1 Engine management ECU
2 Body computer connector
3 Distance travelled counted by the NBC
4 Fuel consumption
5. Fuel gauge and sensor fault
6. Distance covered
7. Instrument panel connector
8 Reading display

Operating behaviour

The trip computer is a function of the NQS which makes it possible to display the following information:
- Trip mileage
- Total mileage
- Average speed
- Journey time
- Average fuel consumption

These values are calculated using information received by the NBC (Body Computer) such as, for example:
- Distance covered at the time;
- Fuel level (% of a full tank);
- Tank capacity;

The Engine Management Control Unit computes the following:
- Instantaneous fuel consumption (in litres/hour)
- Journey time counted by an internal clock

Door lock/release - Operating strategies

The control unit controls the simultaneous operation of the lock motors on two or all four doors upon a command:
- From the key;
- From the front door switches (knobs);
- From the remote control

The control unit monitors lock status by means of signals received from switches located on the four locks (these signals are also used to time the lighting).
A lock command is issued only when all doors are properly closed and the front locks are released.
Conversely, a release command is issued only when the front catches are locked.

The control unit also carries out a series of safety checks:
- Switch position is checked at the end of each operation. If this position does not agree with the action carried out (e.g. if a door is open), a repulsion command is issued, i.e. the opposite manoeuvre is carried out to realign all the locks.
- If the control unit detects too many complete, consecutive lock/release manoeuvres - at least 11 within 25 seconds - the system cuts in to limit the manoeuvres: the system is inhibited in release position for 30 seconds.
- If battery voltage drops below 9 V during a lock/release operation, the system suspends the operation. If battery voltage is lower than 9 V at the outset, no command is issued.

Remote control
A radio transmitter is built into the key grip, which is sealed.

DIAGNOSIS

Specifications
The NBC control unit is connected to the CAN, via which it communicates with the Examiner/Examiner Plus. In this way, all readings and faults can be made available to the tester.

The NBC control unit checks:
- Whether the switch circuit is activated or not
- Whether there is a short circuit or open circuit
- Whether incorrect bulbs have been fitted (21W instead of 5W and viceversa).

This last check is carried out for the following functions:
- Rear fog lamps
- Rear side lights
- Direction indicators
- Vehicle brake lights

Fitting incorrect power bulbs is shown by the diagnostic equipment, at the CAN network, in the following way:
- SHORT CIRCUIT, if a 21W bulb is fitted in place of a 5W one
- OPEN CIRCUIT, if a 5W bulb is fitted in place of a 21W one.

Network

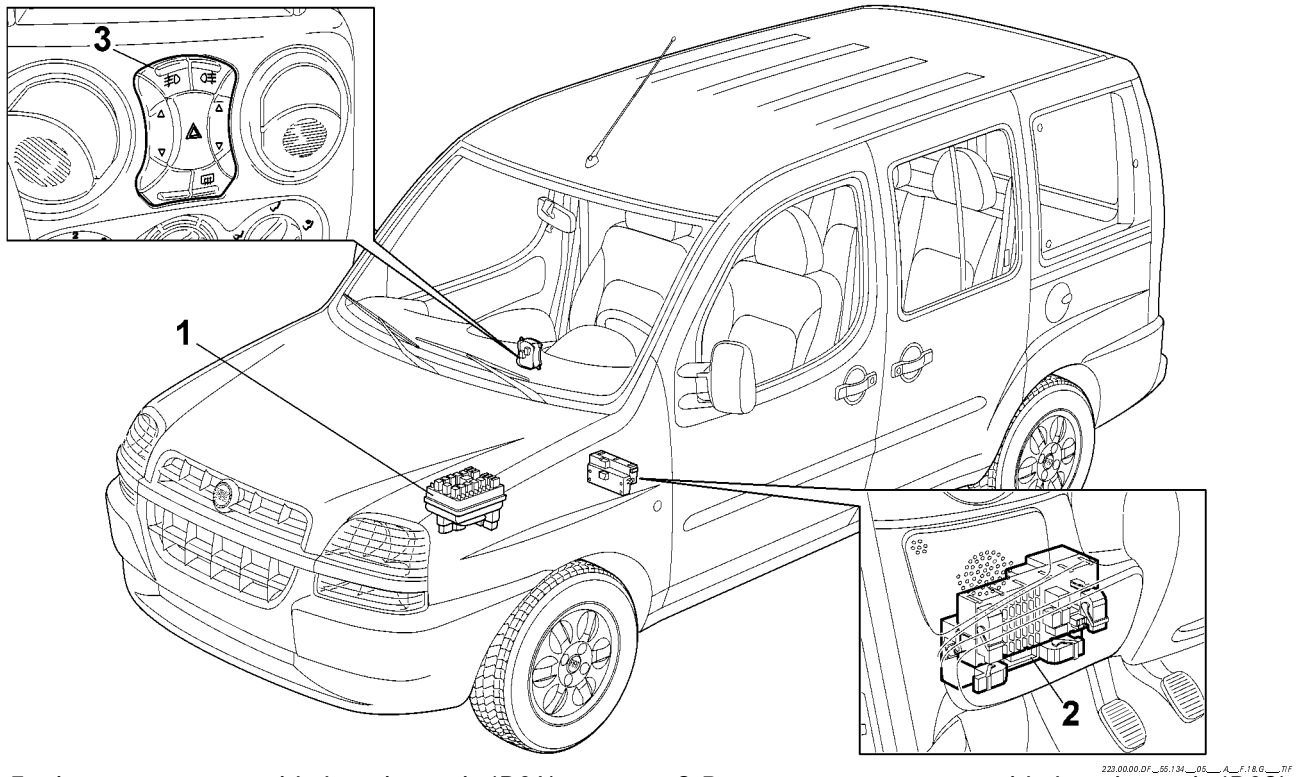
Even if all the Nodes attached to the CAN have the same value, CAN status is basically monitored by the body computer node, which checks the following parameters:
- Configured Node status
- Active Node status
- Status of active Nodes with errors
- Physical errors on the line

The NBC behaves like a MASTER Node within the network and is responsible for initiating communication when the ignition is switched on and then 'waking up' the network.
If the NBC is faulty, another node is able to initialise the CAN, i.e. the instrument panel Node. This is enabled to wake up the network only once the key has been turned on for a certain time without the network being woken by other nodes.

MULTI-PURPOSE COMPONENTS

LOCATION OF COMPONENTS ON VEHICLE

The location of the components is illustrated in the diagram below.

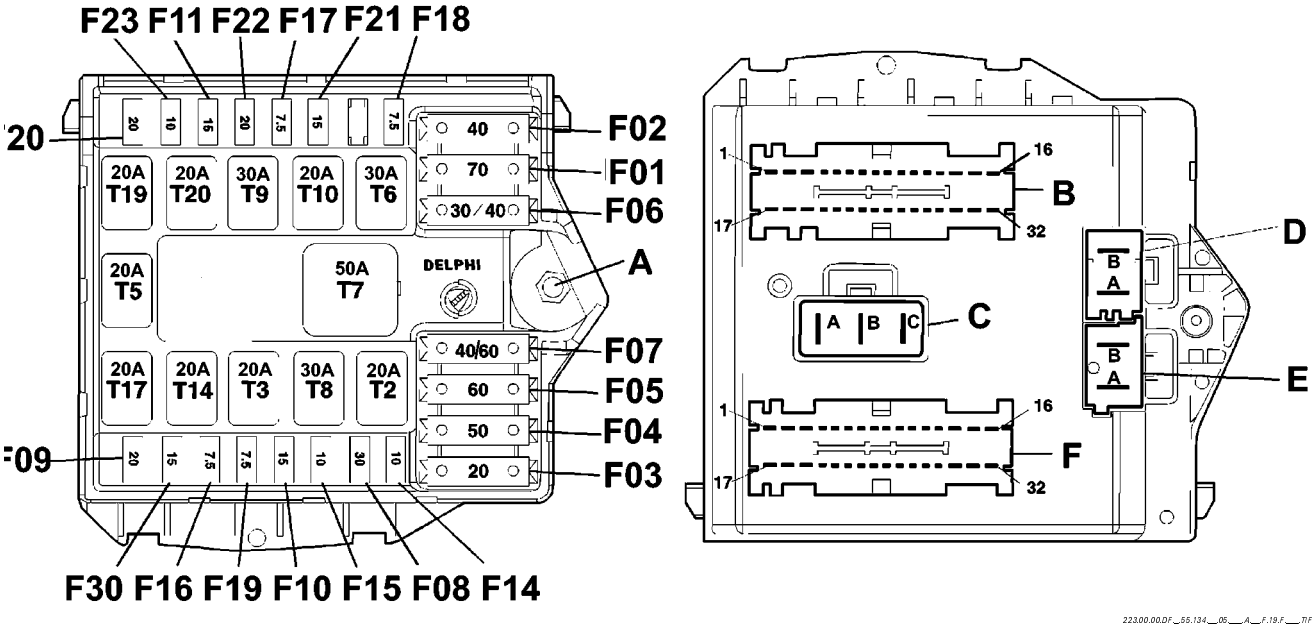


1 Engine compartment side junction unit (B01)
2 Passenger compartment side junction unit (B02)
3 Control panel

ENGINE COMPARTMENT SIDE JUNCTION UNIT (B01)

VIEWS OF JUNCTION UNIT

Front and rear view of engine bay junction unit



PROTECTIVE FUSES KEY

Component	Colour	Capacity (A)	Model	Description
F01	Beige	70	Maxi	Facia control unit power supply: standard functions
F02	Amber	40	Maxi	Facia control unit supply: optional functions
F03	Yellow	20	Maxi	Ignition switch
F04	Red	50	Maxi	ABS power supply
F05	Blue	60	Maxi	Preheating
F06	Green / Amber	30/40	Maxi	Radiator fan single speed (1.28V version with heater) First radiator fan speed (1.28V versions with manual climate control) First radiator fan speed (version 1.9D)
F07	Amber / Blue	40/60	Maxi	Second radiator fan speed (version 1.9D)
F08	Green	30	Mini	Passenger compartment fan
F09	Yellow	20	Mini	Headlamp washer (function not implemented on this car*)
F10	Light Blue	15	Mini	Horn
F11	Light Blue	15	Mini	Fuel vapour recirculation solenoid Speedometer generator Lambda probes (oxygen sensors)
F14	Red	10	Mini	Right main beam
F15	Red	10	Mini	Left main beam
F16	Brown	7.5	Mini	Engine management ECU (ignition-operated) Engine cooling system remote control switch Engine control system relay
F17	Brown	7.5	Mini	Engine control unit (power supply) Diesel pump solenoid unit (1.9D versions)
F18	Brown	7.5	Mini	Engine control unit (+battery)
F19	Brown	7.5	Mini	Manual climate control system compressor
F20	Yellow	20	Mini	Heated diesel filter
F21	Light Blue	15	Mini	Engine stop solenoid (1.9D versions) Fuel pump
F22	Yellow	20	Mini	Ignition coils Injectors Fuel pump (1.28V version)
F23	Red	10	Mini	Automatic transmission (Function not implemented on this car)
F30	Light Blue	15	Mini	Fog lights

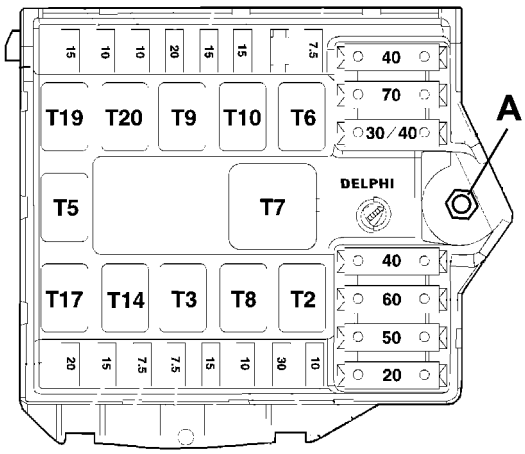
RELAY KEY

Component	Colour	Capacity (A)	Model	Description
T02	Black	20	Micro	High beams
T03	Black	20	Micro	Horns
T02	Black	20	Micro	High beams

Component	Colour	Capacity (A)	Model	Description
T06	Red	20	Micro	First radiator fan speed
T02	Black	20	Micro	High beams
T08	Red	20	Micro	Car interior fan
T02	Black	20	Micro	High beams
T10	Black	20	Micro	Fuel pump/electric arrest
T02	Black	20	Micro	High beams
T17	Black	20	Micro	Headlamp washer (Function not implemented on this car)
T02	Black	20	Micro	High beams
T20	Black	20	Micro	Automatic transmission (Function not implemented on this car)

CONNECTOR PIN OUT KEY

Connector (a) - 1pin



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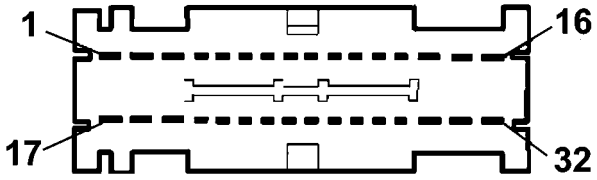
A. Junction unit supply from battery positive (M6 stud)

Connector (f) - 32 pin - colour (black/purple or blue/purple)



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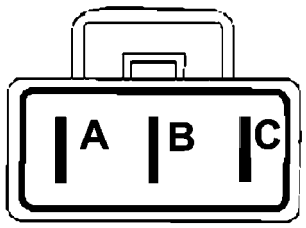
1 Available
2 VVT/fuel filter power supply
3 Predisposition for relay T20 coil power supply
4 Air conditioner compressor power supply
5. Air conditioner compressor relay control
6. VVT/heated filter relay coil power supply
7. Supply for Lambda probe - Canister solenoid valve - Speedometer generator
8 + 15/54 Engine control system relay coil supply
9 + 15 / 54 engine management control unit key sensor
10 Engine control system relay coil power supply
11. Fuel pump/electric arrest relay control
12. Engine control system relay control
13. Available
14. Available
15. Available
16. Available

17. Predisposition for power supply from relay T20
18. Power supply to injectors/coils/fuel pump (1.2 fire 8V)
19. + 50 electro-magnet for starter motor
20. Available
21. Radiator fan second speed relay control
22. VVT/heated filter relay control
23. Engine control unit battery positive power supply
24. Available
25. Available
26. Available
27. Available
28. Radiator fan single/first speed relay control
29. Fuel pump/electric arrest relay coil power supply
30. Fuel pump/electric arrest power supply
31. Engine control system primary winding charge power supply
32. Engine control unit power supply

Connector (c) - 3 pin - colour (black)



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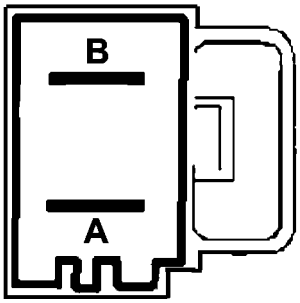
A. Radiator second speed power supply

B. Supply for single stage thermostatic switch for radiator fan
C, Single / 1st speed radiator fan supply

Connector (d) - 2 pin - colour blue



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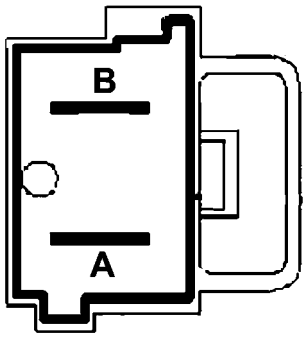
A. Electric steering control unit supply (*)
B. Antiskid (ABS) control unit supply
Connector (e) - 2 pin - colour grey



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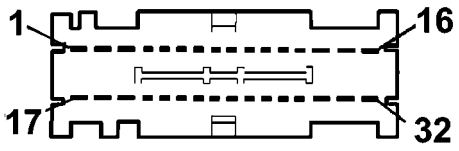
A. Dashboard control unit supply (basic)
B. Dashboard control unit supply (optional)
Connector (b) - 32 pin - colour brown/purple or green/purple



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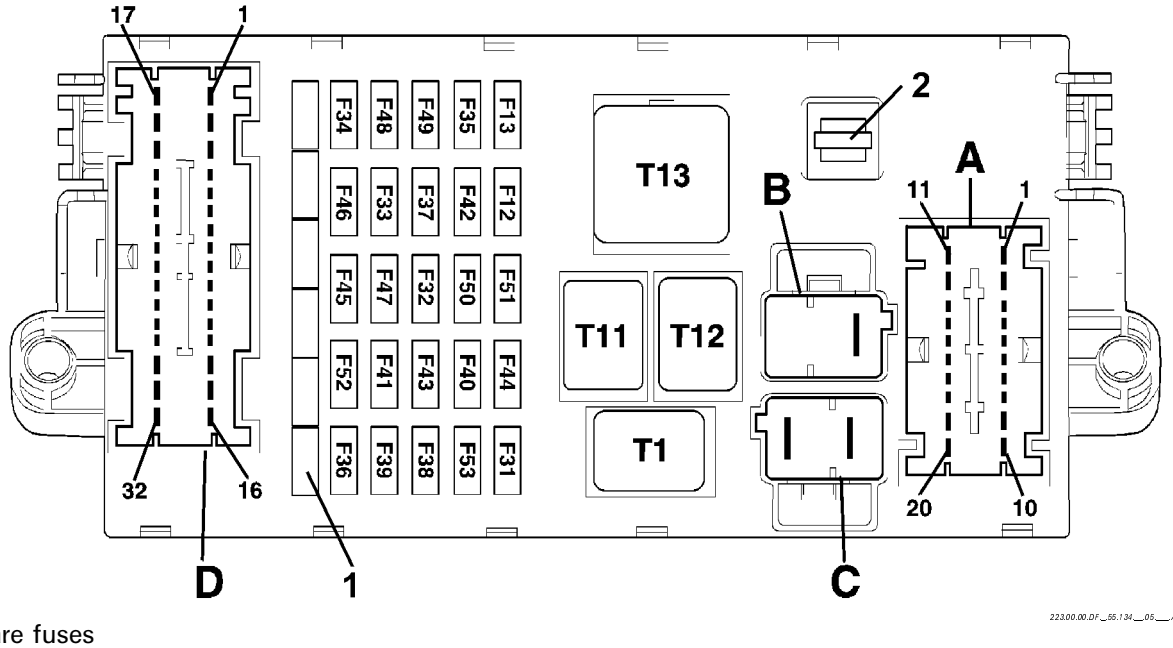
1 Headlamp washer pump motor supply (Function not implemented on this car)
2 Predisposition for primary winding charges
3 Available
4 Left fog light supply
5. Right fog light supply
6. Headlamp washer relay control (*)
7. Available
8 Available
9 Reversing light power supply INT/A
10 INT/A for air conditoner
11. INT/A power supply input
12. Main beam relay control
13. Available
14. Automatic transmission relay coil power supply (Function not implemented on this car)
15. + 50 ignition switch (start-up)
16. fuel pump supply
17. Automatic transmission relay control (Function not implemented on this car)
18. Automatic transmission relay control power supply (Function not implemented on this car)
19. Available
20. Predisposition for primary winding charge INT
21. Horn relay control
22. Right main beam power supply
23. Fog lamp relay control
24. Predisposition for main beam power supply
25. Left main beam headlamp supply
26. Passenger compartment fan relay coil earth
27. High tone two tone horn supply
28. Supply for one tone horn - low tone two tone horn
29. Available
30. + 15 / 54 igntion switch (+ key)
31. Ignition switch supply
32. Vehicle interior fan power supply

PASSENGER COMPARTMENT SIDE JUNCTION UNIT (B02)

VIEWS OF JUNCTION UNIT (B02)

Front view of junction unit



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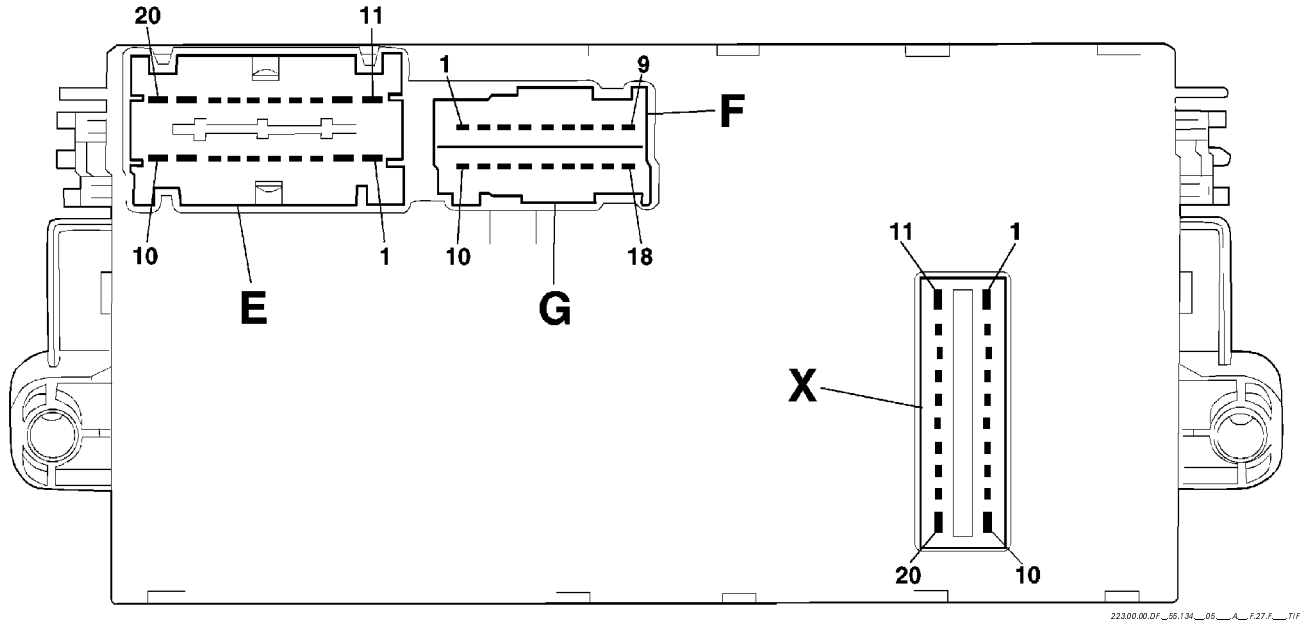
1 Spare fuses
2 Housing for clip

Rear view of junction unit



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PROTECTIVE FUSES KEY

Component	Colour	Capacity (A)	Model	Description
F12	Red	10	Mini	Right main beam
F13	Red	10	Mini	Left dipped beam Headlamp alignment adjustment

Component	Colour	Capacity (A)	Model	Description
F31	Brown	7.5	Mini	Reversing light power supply Air conditioner activation control Passenger compartment heater fan system relay Headlamp washer relay (Function not implemented on this car)
F32	Blue	15	Mini	Lighting system
F33	Green	30	Mini	Left rear electric window (Function not implemented on this car)
F34	Green	30	Mini	Right rear electric window (Function not implemented on this car)
F35	Red	10	Mini	Electric steering (Function not implemented on this car) Automatic transmission system (Function not implemented on this car) Traction control switch (Function not implemented on this car)
F36	Blue	15	Mini	Subwoofer system (Function not implemented on this car)
F37	Red	10	Mini	Instrument panel and warning lights (ignition-operated power supply) Brake lights Third brake light (supplementary)
F38	Yellow	20	Mini	Central locking
F39	Red	10	Mini	Luggage compartment Courtesy light Services + 30 (radio, mobile phone,horn, tester connection)
F40	Green	30	Mini	Heated rear windscreen
F41	Brown	7.5	Mini	Electric, heated door mirrors
F42	Brown	7.5	Mini	ABS control unit (ignition-operated)
F43	Blue	30	Mini	Windscreen - rearwindow washer pump Winscreen wiper
F44	Yellow	20	Mini	Cigar lighter
F45	Blue	15	Mini	Heated seat
F46	Natural	25	Mini	Sun roof (Function not implemented on this car)
F47	Green	30	Mini	Left front electric window
F48	Green	30	Mini	Right front electric window
F49	Brown	7.5	Mini	+ 15 Services (radio, mobile phone, facia control lighting, electric mirrors, trailer, heated seat control lighting)
F50	Brown	7.5	Mini	Air Bag
F51	Brown	7.5	Mini	Number plate light,facia service lighting power supply
F52	Light Blue	15	Mini	Rearscreen wiper
F53	Red	10	Mini	Hazard warning light Turn signals Instrument and warning light panel (battery power supply)

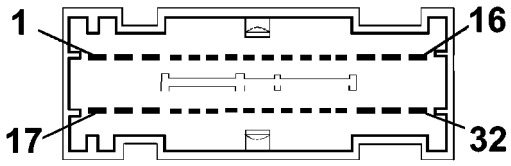
RELAY KEY

Component	Colour	Capacity (A)	Model	Description
T01	Black	20	Micro	High beams
T11	Red	30	Micro	Heated rear windscreen

Component	Colour	Capacity (A)	Model	Description
T12	Black	20	Micro	Basic key discharge
T13	Black	50	Maxi	OPT key discharge

CONNECTOR PIN-OUT KEY

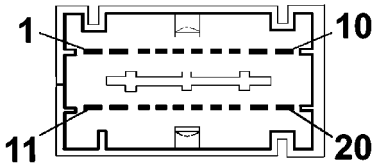
Connector (d) - 32 pin - colour (black/purple or blue/purple)



223.00.00.DF__55.134__05___A__F.28.A___TIF

1 Left rear electric window supply (Function not implemented on this car)
2 Right rear electric window supply (Function not implemented on this car)
3 Sun roof power supply (Function not implemented on this car)
4 Heated seat power supply
5. Third brake light power supply
6. Brake signal for trailer
7. Reversing signal
8 Passenger side reversing light control
9 Rearscreen wiper brake
10 CAN A line (predisposition for rear aggregates)
11. Power supply from fuse F23 (predisposition)
12. Power point
13. Subwoofer power supply (Function not implemented on this car)
14. Power point
15. Heated rear window power supply
16. Door lock control
17. Right front electric window power supply (predisposition)
18. Door release control
19. Electric window control and lighting power supply
20. Rear wiper motor power supply
21. Heated seat control lighting
22. Seat belt warning light control predisposition
23. Predisposition for rain sensor supply from F49 and power point for aftermarket
24. Switch for trailer
25. Number plate light power supply (predisposition)
26. Number plate light power supply
27. Light power supply (predisposition)
28. CAN B line (predisposition for aggregates at rear)
29. Available
30. Left front electric window power supply (predisposition)
31. Left and right heated mirror
32. Fuel pump power supply

Connector (a) - 20 pin - colour (brown/purple or blue/purple)



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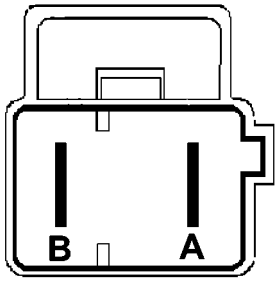
1 Left and right headlamp alignment corrector control signal
2 Left and right headlamp alignment correctors motor power supply

3 Left dipped beam power supply
4 Automatic transmission TDS fluid level (Function not implemented on this car)
5. City/Normal electric steering control (Function not implemented on this car)
6. TDS fluid level (Function not implemented on this car)
7. Int./A for relay coils
8 Reverse control signal
9 Fuel pump supply
10 Windscreen wiper/two-way pump power supply
11. Switch for ABS
12. Right dipped beam power supply
13. +lights for heater/air conditioner system
14. brake light switch power supply
15. brake light control signal
16. brake signal for ABS
17. Switch for For electric steering (Function not implemented on this car)
18. Switch for Traction Control (Function not implemented on this car)
19. Automatic transmission (Function not implemented on this car)
20. Left and right headlamp corrector earth

Connector (b) - 2 pin - colour (blue)



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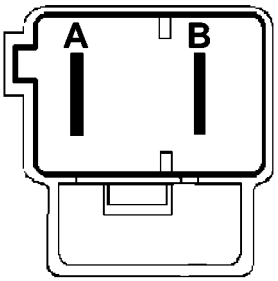
A, Battery positive for services (predisposition)
B. Available

Connector (c) - 2 pin - colour (grey)



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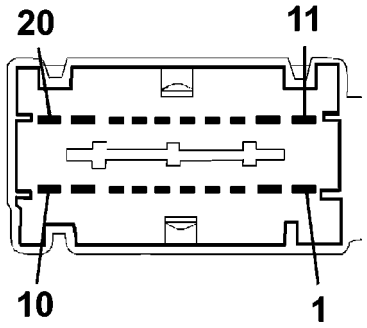
A. Battery positive for basic dashboard control unit
B. Battery positive for optional dashboard control unit

Connector (e) - 20 pin - colour (green/purple or black/purple)



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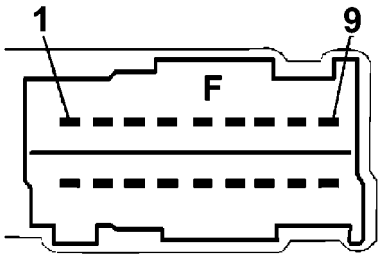
1 Switch for /A from ignition switch
2 Parking lights control signal from ignition switch
3 Switch for for radio
4 Switch for for radio phone (predisposition)
5. CAN B radio
6. Switch for Air Bag
7. Radio and radio memory supply
8 Radio/radio phone power supply
9 Power supply for cigar lighter
10 Facia control unit power earth
11. Switch from ignition switch
12. radio/radio phone lighting
13. Cigar lighter lighting
14. Int./A protected by F31 (predisposition)
15. TDS engine oil level (Function not implemented on this car)
16. City / Normal electric steering control (Function not implemented on this car)
17. Radio Can A
18. Not available
19. Right front electric window power supply
20. Left front electric window power supply

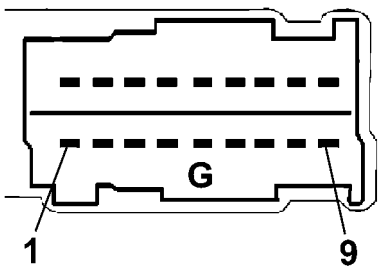
Connector (f) - 9 pin - colour (black)



223.00.00.DF_55.134__05___A__F.33.A___TIF

1 Automatic transmission/fluid level serial line (Function not implemented on this car)
2 Switch from F37 (predisposition)
3 Not available
4 Not available
5. Predisposition for seat belt warning light for instrument panel node
6. Not available
7. Not available
8 Predisposition for headlamp alignment corrector lighting
9 Predisposition for + lighting

Connector (g) - 9 pin - colour (purple)



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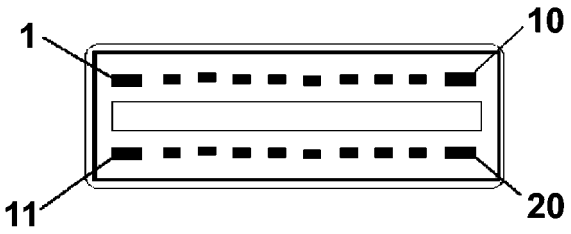
1 Predisposition for headlamp alignment earth
2 Rearscreen wiper control
3 Switch for control panel
4 + lights signal from steering column switch unit
5. Headlamp alignment corrector power supply in instrument panel
6. Rearscreen wiper brake
7. Light system supply
8 Rearscreen wiper supply
9 Headlamp alignment corrector control signal

Connector (x) - 20 pin -



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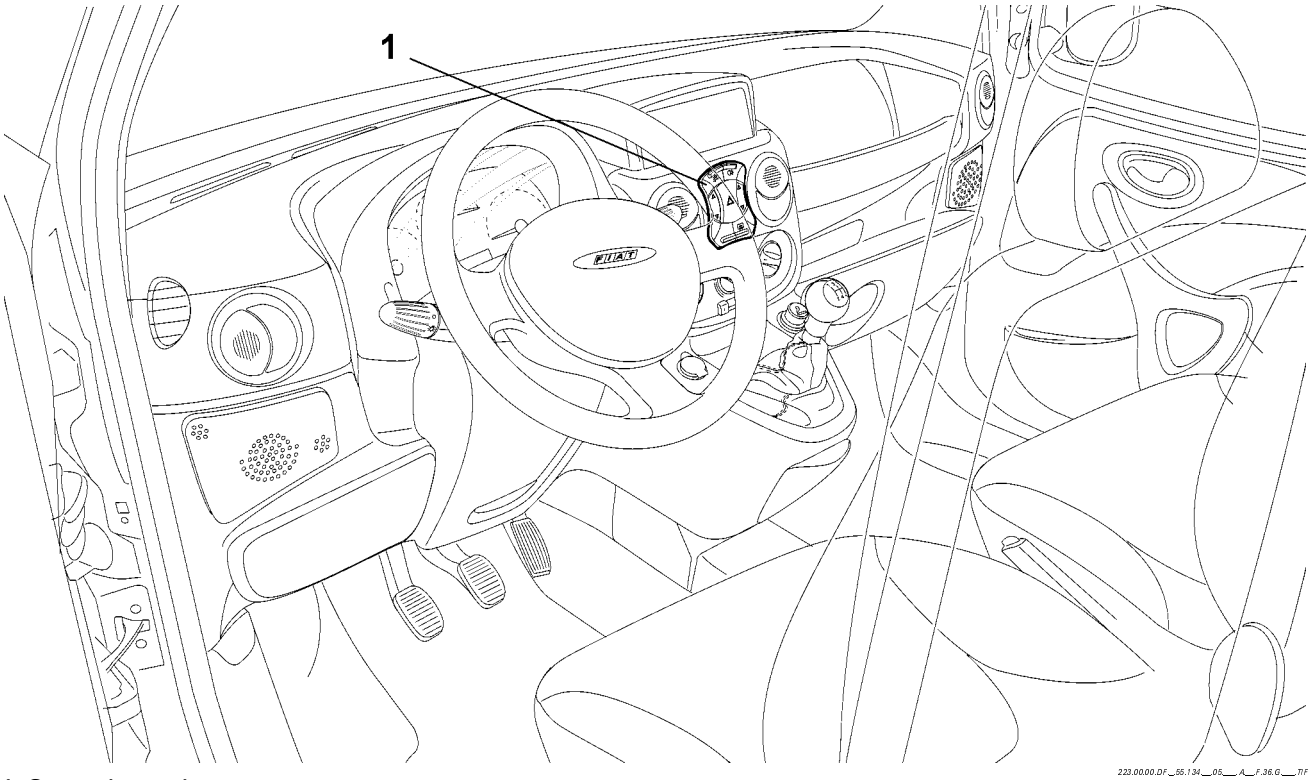
1 Door lock power supply
2 Brake light signal
3 Reversing control signal
4 Not available
5. Can B
6. Heated rear windscreen relay coil control
7. Can A
8 Dipped beam relay coil control
9 Switch for for body computer
10 Door lock control
11. Door release control
12. Lighting system power supply
13. Switch, protected for instrument panel node
14. Optional services relay coil operation
15. Number plate lights and interior lighting power supply
16. Not available
17. Services power supply
18. Body computer power supply (immobilizer, CAN, side lights, rear fog lamp)
19. Protected supply for direction indicators - hazard warning lights / instrument panel node
20. Door lock earth

CONTROL PANEL

LOCATION OF CONTROL PANEL

The following figure shows the location of the control panel



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1 Control panel

SPECIFICATIONS:

FUNCTIONS

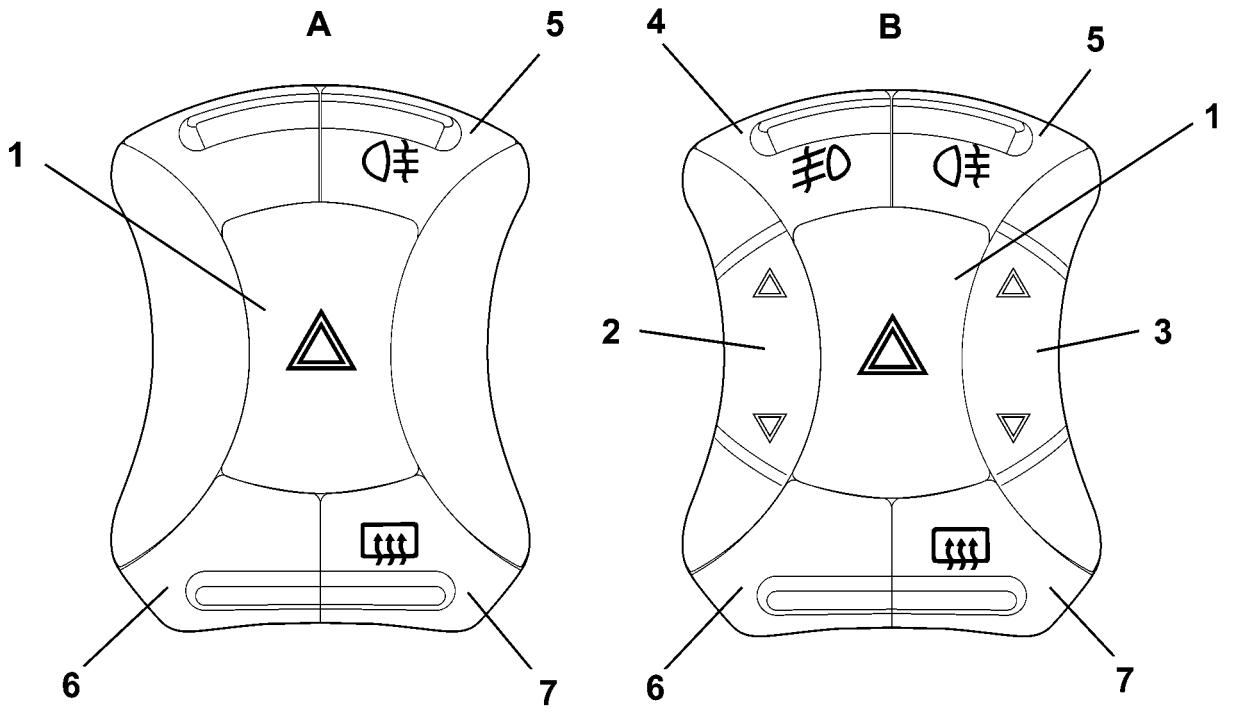
The control panel is an electronic and electro-mechanical unit which involves the use of a series of controls, symbol lighting , interconnection circuits and, only on versions with automatic electric windows, an electronic control unit. There are two variants for the electric windows: the simpler version consists of two rocker switches which operate the front electric window motors directly. The fuller version also has electronic operation with an automatic raising and lowering function for the driver's window. The controls for different versions are indicated in the table below:

FUNCTIONS	BASE	DE-LUXE
Heated rear windscreen operation	X	X
Rear fog lamp control	X	X
Hazard warning lights control	X	X
Driver's electric window remote control switch with ideogram light		X
Passenger electric window remote control switch with ideogram light		X
Hazard warning light warning light	X	X

COMPOSITION

STRUCTURE

The following figure shows control panel configuration for the various outfits and also individual key functions



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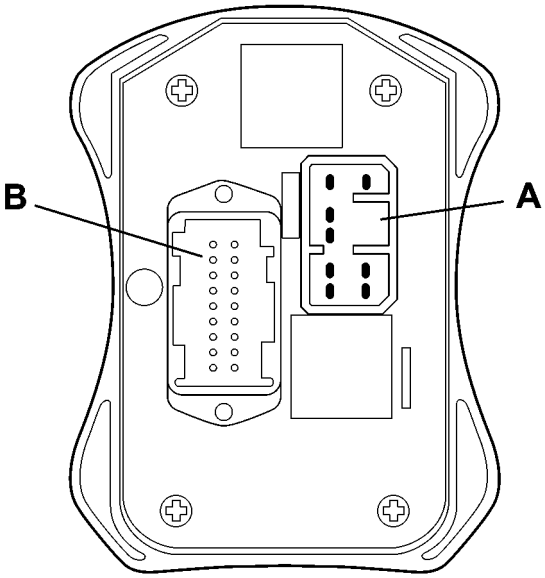
A. Basic version panel
B. Deluxe version panel
1 Hazard warning lights
2 Left front electric window
3 Right front electric window
4 Fog lights
5. Rear fog lamp
6. Plug
7. Heated rear window Where required, this switch operates also or only (e.g. fan) the door mirror demister.

Basic panel (for versions with mechanically-operated windows)
Rear view of basic panel



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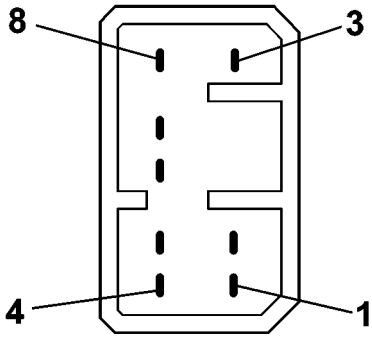
CONNECTOR A PIN OUT



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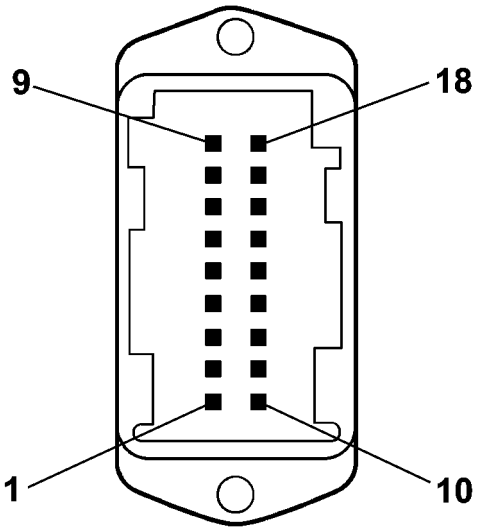
1 Left electric window supply
2 Left electric window control unit earth
3 Left electric window raise command
4 Left electric window lower command
5. Right electric window lower command
6. Right electric window raise command
7. Right window power supply
8 Right electric window earth

CONNECTOR B - PIN OUT



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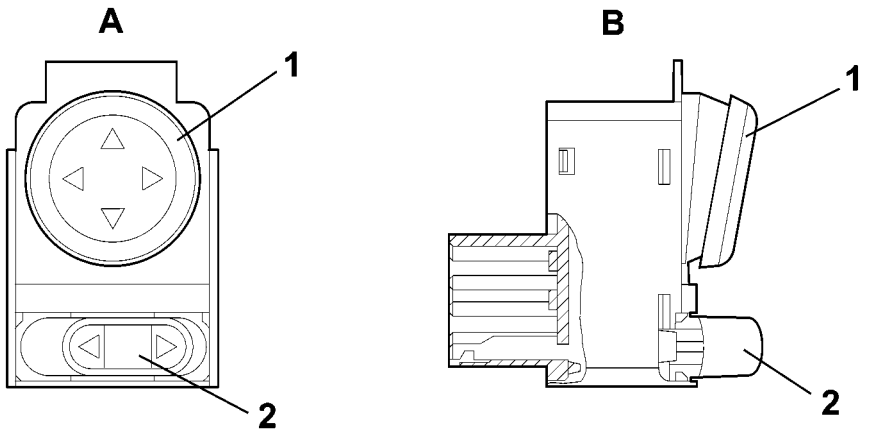
1 Hazard warning light led warning lights
2 Heated rear windscreen operation
3 Not connected.
4 Rear fog lamps control
5. Hazard warning lights control
6. Panel led power supply
7. Control panel earth
8 Not connected.
9 Not connected.
10 Not connected.
11. Not connected.
12. Not connected.
13. Not connected.
14. Not connected.
15. Not connected.
16. Fog lights control
17. Not connected.
18. Not connected.

DOOR MIRROR ADJUSTMENT SWITCH

DESCRIPTION

The switch allows the user to adjust the left and right door mirrors electrically from the driver's seat.

It consists of:
- Selector switch for adjusting mirror in both directions
- Cursor for selecting mirror to be adjusted



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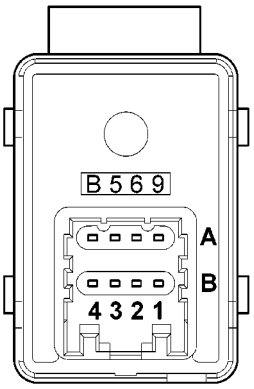
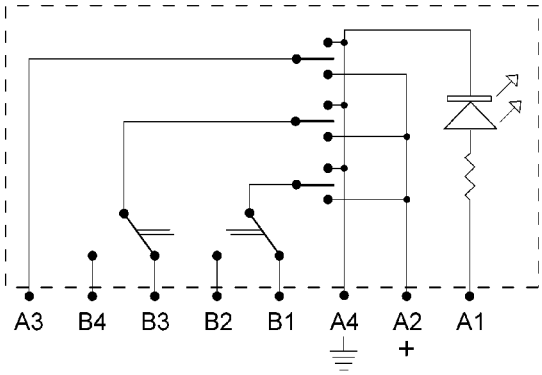
A. Rear view (connector attachment)
B. Side view
1 Mirror adjustment control switch
2 Cursor for selecting mirror to be adjusted

WIRING DIAGRAM AND PIN OUT

The following diagram shows the internal wiring diagram for the interior mirror adjustment switch and the pin-out





	POSIZ. D					POSIZ. G				
	0	H1	H2	V1	V2	0	H1	H2	V1	V2
A1	+	+	+	+	+	+	+	+	+	+
A2	+	+	+	+	+	+	+	+	+	+
A4	-	-	-	-	-	-	-	-	-	-
A3	0	-	+	+	-	0	-	+	+	-
B1	0	0	0	0	0	0	+	-	0	0
B2	0	+	-	0	0	0	0	0	0	0
B3	0	0	0	0	0	0	0	0	-	+
B4	0	0	0	-	+	0	0	0	0	0

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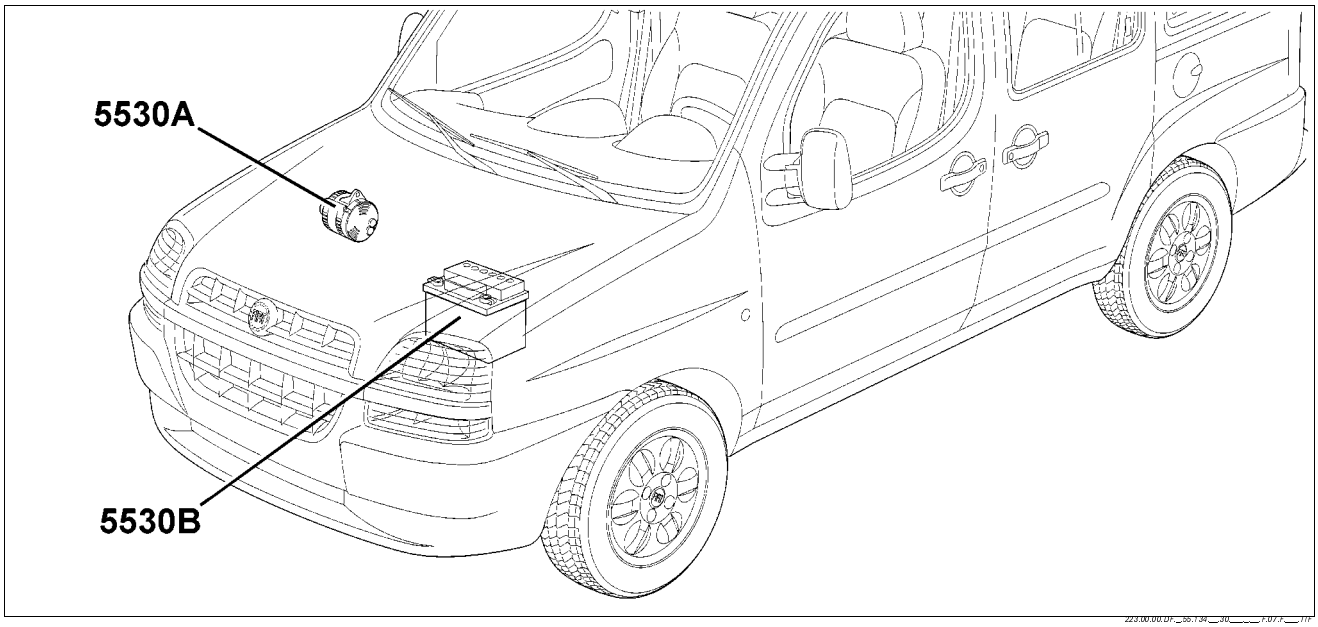
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- SPECIFICATIONS:

Assembly drawings index

Cmp	*Description*	*Validity*

SUB-GROUP GRAPHIC INDEX

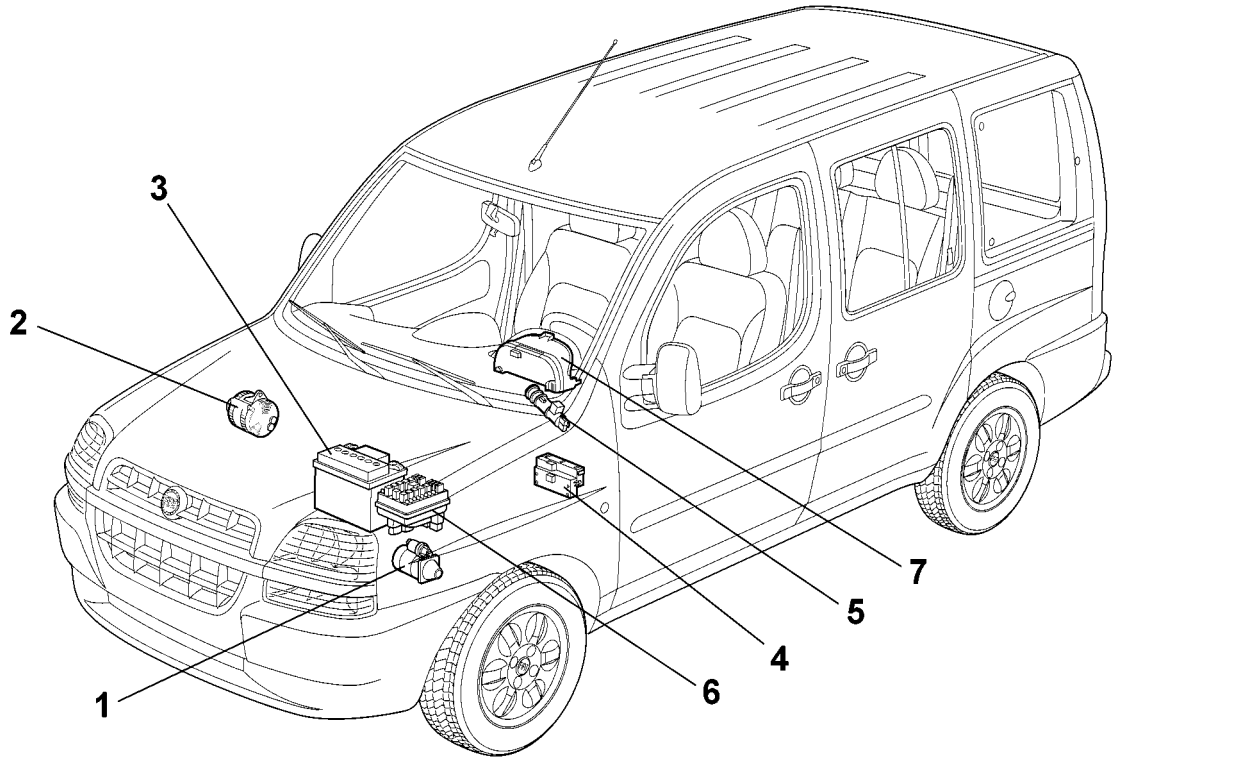


SPECIFICATIONS:

STARTING AND RECHARING

LOCATION OF COMPONENTS ON VEHICLE

The following figure shows component location.



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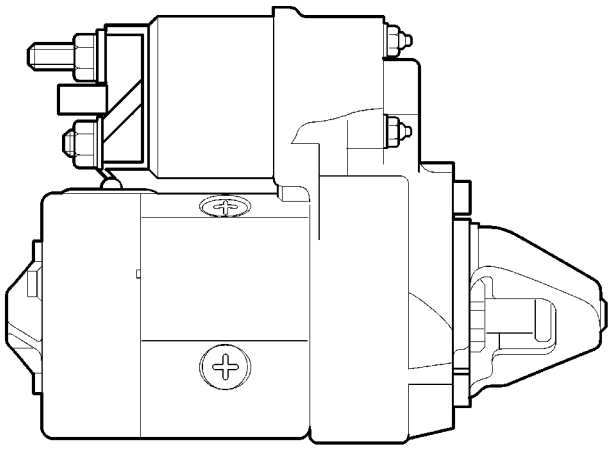
1 Starter motor (A20)
2 Alternator (A10)
3 Battery (A1)
4 Electronic management control unit (M1) (Body Computer)
5. Ignition lock barrel (H1)
6. Junction unit (B 1)
7. Instrument panel (E 50)

STARTER MOTOR

SPECIFICATIONS:

FUNCTIONS

The vehicle is equipped with a starting and recharging system which has the following functions:
- The starting circuit has the function of turning the engine over, at a certain speed, to allow the engine management control unit to trigger the ignition.
- The recharging circuit has the function of guaranteeing all the energy required for correct operation for the system and the individual electrical/electronic on-board devices.



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Types of starter motors fitted on the vehicle according to the version:

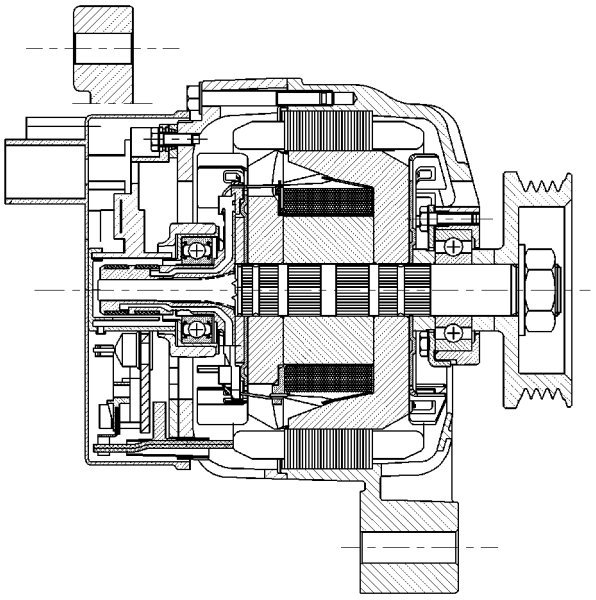
Engine	Supplier	Model	Rated power	Rated voltage
1242 8V	Magneti Marelli	EMM 12.51	0.9 kW	12V
1910 D	Bosch	EMB 38.01	2.0 kW	12V
1910 D	Denso	EMM 36.01	1.8 kW	12V

ALTERNATOR

SPECIFICATIONS:

FUNCTIONS

The alternator is a rotary machine which transforms mechanical energy into electrical energy.



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If recharging signals are not present or irregular, carry out the following checks before dismantling the alternator:
- Check belt tension
- Check the nut on the positive alternator terminal (B+) is tight and ensure the washer is present

- Check the nut on the excitation terminal (D+) is tight and ensure the washer is present
- Check that the nuts on the positive junction unit in the engine bay are tight
- Check the bolts securing the negative terminal to the body are tight
- Check the battery terminals are clean and fully tight

Types of alternators fitted on the vehicle according to the version:

Engine	Description	Supplier
12428V without air conditioner	A 115I - 14V- 33 /60 A	Denso
12428V with air conditioner	A 115I - 14V- 40 /75 A	Magneti Marelli
1910 D	A 115I - 14V- 40 /75 A	Denso
1910 D	A 115I - 14V- 50 /90 A	Denso

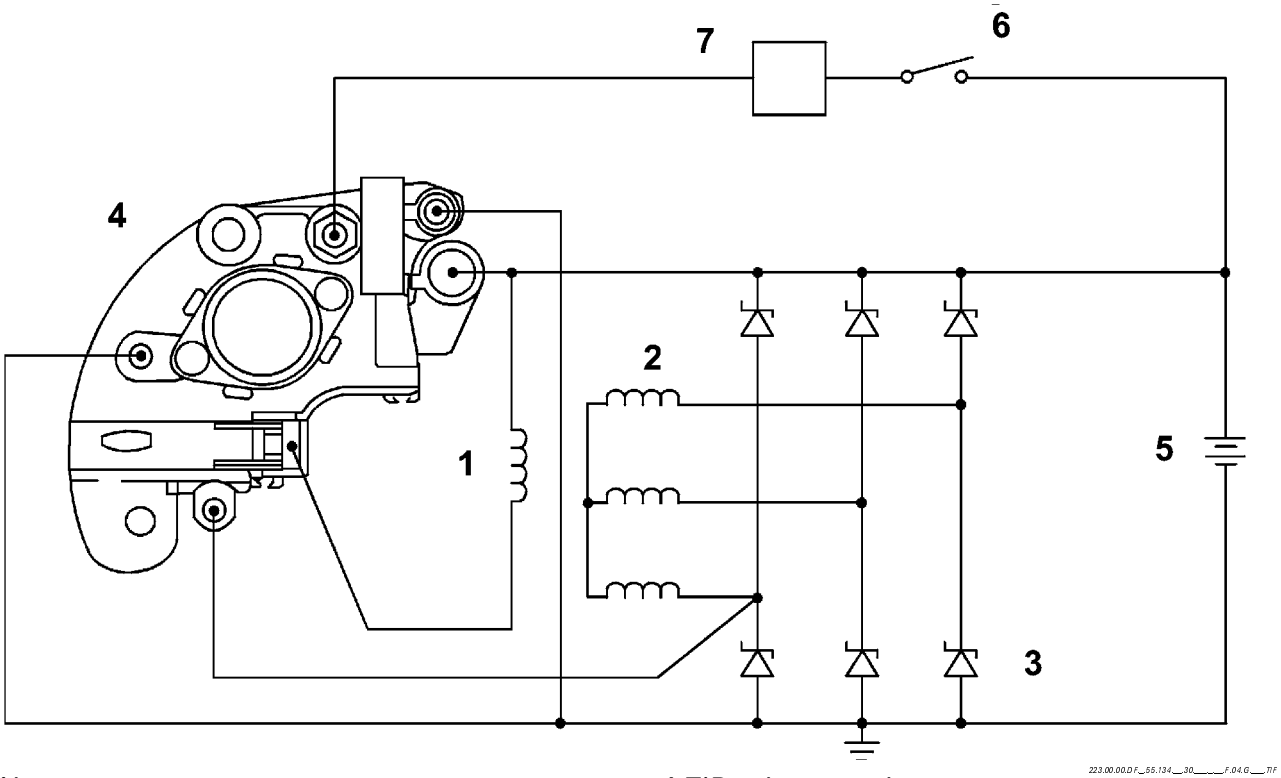
OPERATION

OPERATING PRINCIPLE

The alternator shaft (rotor) is turned by the crankshaft by means of a belt.
The rotor produces a magnetic field that induces an alternating current in the fixed coil (stator).
A diode rectifier bridge, at the back of the alternator, transforms the alternating current into a direct current which is sent to recharge the battery and supply the various devices.
A voltage regulator, also built into the alternator, maintains a constant voltage supply at around 14 Volt for all engine load and speed ranges.
Two small internal radial fans cool the alternator. When the ignition key is turned to the ON position, a supply signal controlled by the ignition reaches alternator terminal D+, via the Body Computer.

Note: *If the Body Computer does not provide the energizing signal, the alternator is energized at 1000 engine rpm (about 2200 alternator rpm) to make use of the residual magnetic field.*

The 'RTM Puls' voltage regulator on receiving this signal, in turn, energizes the rotor coil to create a minimal electro-magnetic field to generate the magnetic poles (alternating north and south). When the engine is started up, a rotary motion is transmitted to the alternator, thereby also causing the rotation of the electro-magnetic field which, cutting the coils of the three stator windings, produces an alternating induced voltage. The resulting voltage cannot be used directly by the vehicle system. Before distribution, it is rectified by means of an electrical circuit with a bridge configuration made up of 6 Zener diodes.

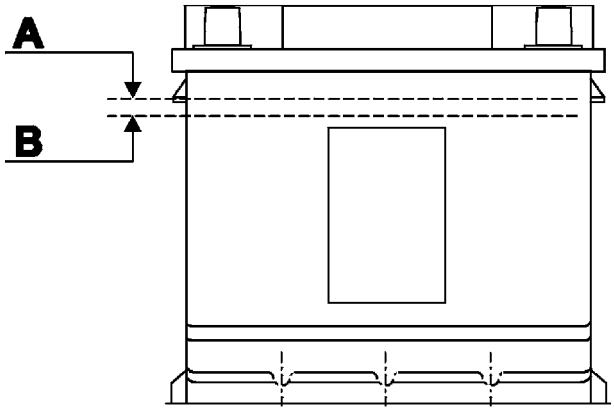


1 Alternator rotor
2 Alternator stator
3 Pressfit Zener diode bridge
4 TIP voltage regulator
5. Battery

6. Ignition key
7. Body computer (M1)

BATTERY

The following diagram shows correct battery electrolyte levels



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A. Maximum electrolyte level
B. Minimum electrolyte level

ELECTRICAL/MECHANICAL SPECIFICATIONS

Three different battery models are fitted to the Doblò

ELECTRICAL SPECIFICATIONS

Battery	Power uptake Max.	Voltage	Internal elements
48 Ah	350A	12V	Number of plates: 6 positive - 6 negative
40 Ah	200A	12V	Number of plates: 4 positive - 3 negative
50 Ah	250A	12V	Number of plates: 5 positive - 4 negative

Note: *If it is discovered that the electrolyte level in one or more of the battery cells is below the minimum level on the plastic container, open the cover and add distilled or deoinized water (the same as for regular batteries).*

Never subject the battery to rapid recharging at voltages above 15.5 Volt or to high recharging amperages.
Correct battery dimensions for model / trim level have been calculated to take into account power uptake when the ignition is switched off.
This absorption should not exceed 0.6 mA for each Ah of battery capacity; This is to ensure that, if the vehicle has been left for one month with all the consumers not controlled by the ignition switched on, residual battery capacity is half of nominal capacity, i.e. enough charge is left to start up the engine under normal environmental temperature conditions.

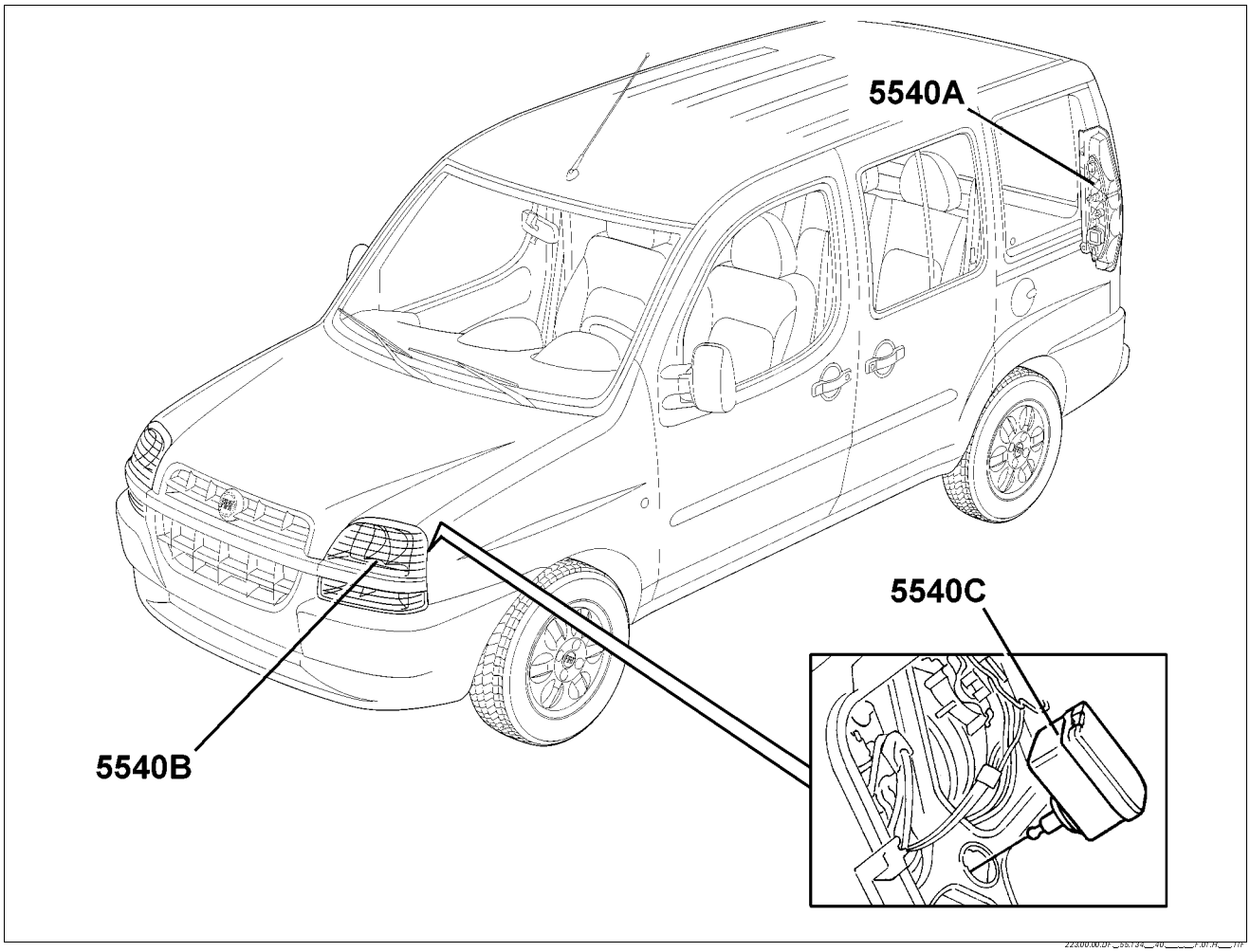
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- SPECIFICATIONS:
- OPERATTION

Assembly drawings index

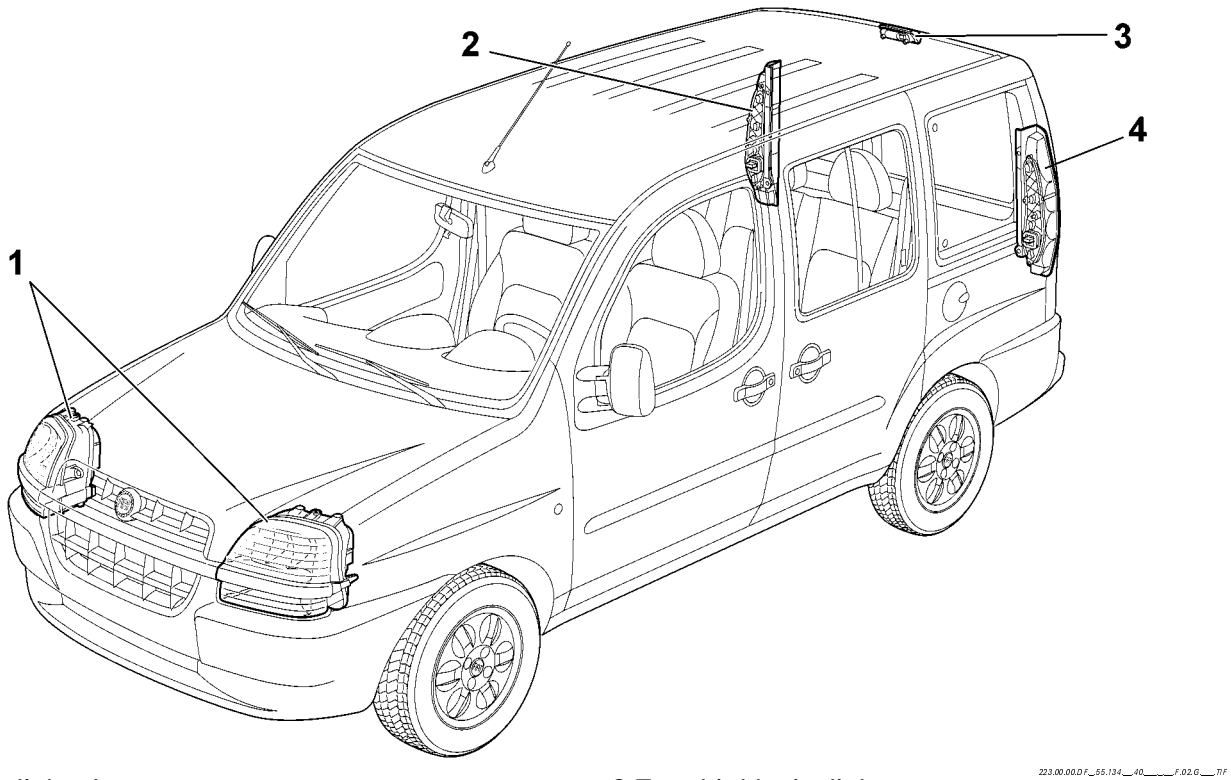
Cmp	*Description*	*Validity*

SUB-GROUP GRAPHIC INDEX



SPECIFICATIONS:

LOCATION OF COMPONENTS ON VEHICLE



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1 Front light cluster
2 Right tail-light cluster
3 Top third brake light
4 Left tail-light cluster

FUNCTIONS

The vehicle's exterior lighting system has been designed with two aims in mind:
- ensuring maximum efficiency in terms of complying with international regulations which define the illumination specifications of the various components
- to blend with the design of the vehicle so that the various components enhance the overall image.

In particular, the front light cluster includes the separate function of the side light, dipped headlamp, main beam headlamp, fog light and direction indicators ina single unit.
The clear element is made out of one piece of plastic.

SYSTEM SPECIFICATION

PERFORMANCE

The nominal operating voltage for the system can vary from 9 to 16 volts.

COMPOSITION

STRUCTURE

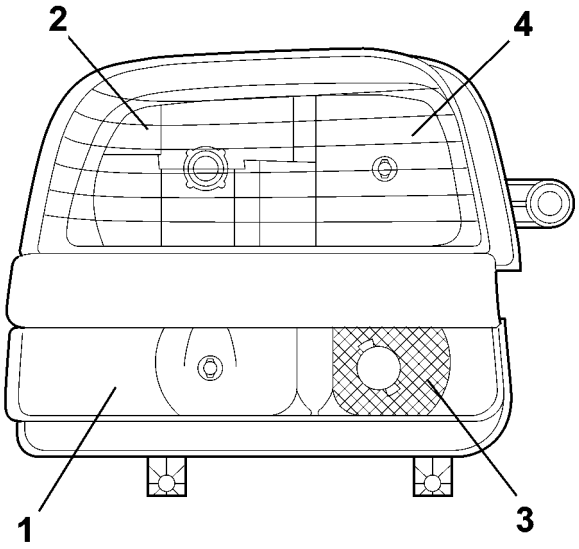
The front light cluster consists of the following components:

A light unit which includes:
- A housing for the fog light and the lens cover which focuses the light beam.
- A housing for the dipped headlamp and the lens cover which focuses the light beam and an internal element for adjusting the light beam geometry to meet standards.
- A housing for the direction indicator with an orange reflector lens cover.
- A housing for the main beam headlamp and parabola with mirrored surface.
- A housing for the side light and the reflector lens cover.

Light beam vertical adjustment device inside the light cluster operated by means of two buttons on the left of the instrument panel.

The following are also present:
- A fog light bulb 12 Volt - 55 Watt (1)

- A dipped headlamp bulb 12 Volt - 55 Watt (2)
- A direction indicator bulb 12 Volt - 5 Watt (3)
- A main beam headlamp bulb 12 Volt - 55 Watt (4)
- A side light bulb 12 Volt - 5 Watt



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1 Fog lamp
2 Dipped headlamps
3 Turn signal
4 Main beam headlamps

OPERATTION

OPERATING PRINCIPLES

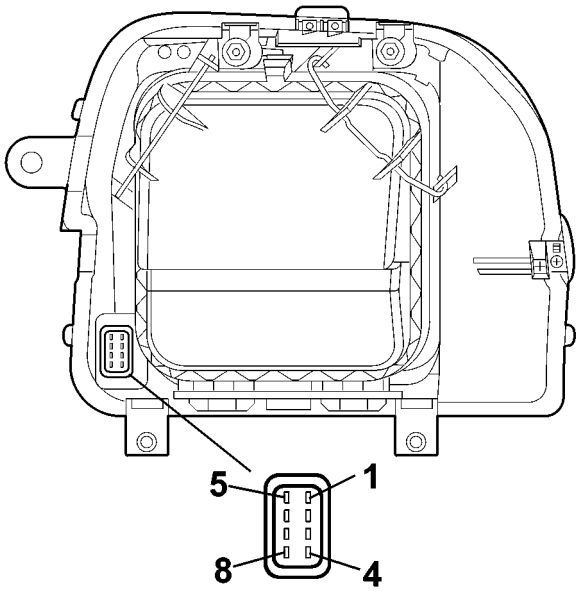
The user can operate a ring at the end of the left steering wheel stalk to turn on the side lights, dipped beams and main beams (fixed or flashing position).
The same stalk also controls turns signals for lane changes and foglamp/rear foglamp enablement (for further details, see stalk unit 5550A and Body Computer description)

FOLLOW ME HOME FUNCTION

This is a strategy available on the SX trim level which allows the dipped headlamps to remain on, even with the ignition switched off, for a pre-set time.
This function is particularly useful, for example, after parking the car in a garage or in poorly lit areas.
The function is activated, after the key off, for a maximum of 2 minutes; within this period, pulling the left steering column switch unit lever in the direction of the steering wheel activates the dipped headlamps for 30 seconds; each time the lever is operated, the time increases by a further 30 seconds, up to a maximum of 5 minutes.

Pins

A connection on the light cluster casing controls the side lights, dipped headlamps, main beam headlamps, direction indicators and light beam vertical adjustment



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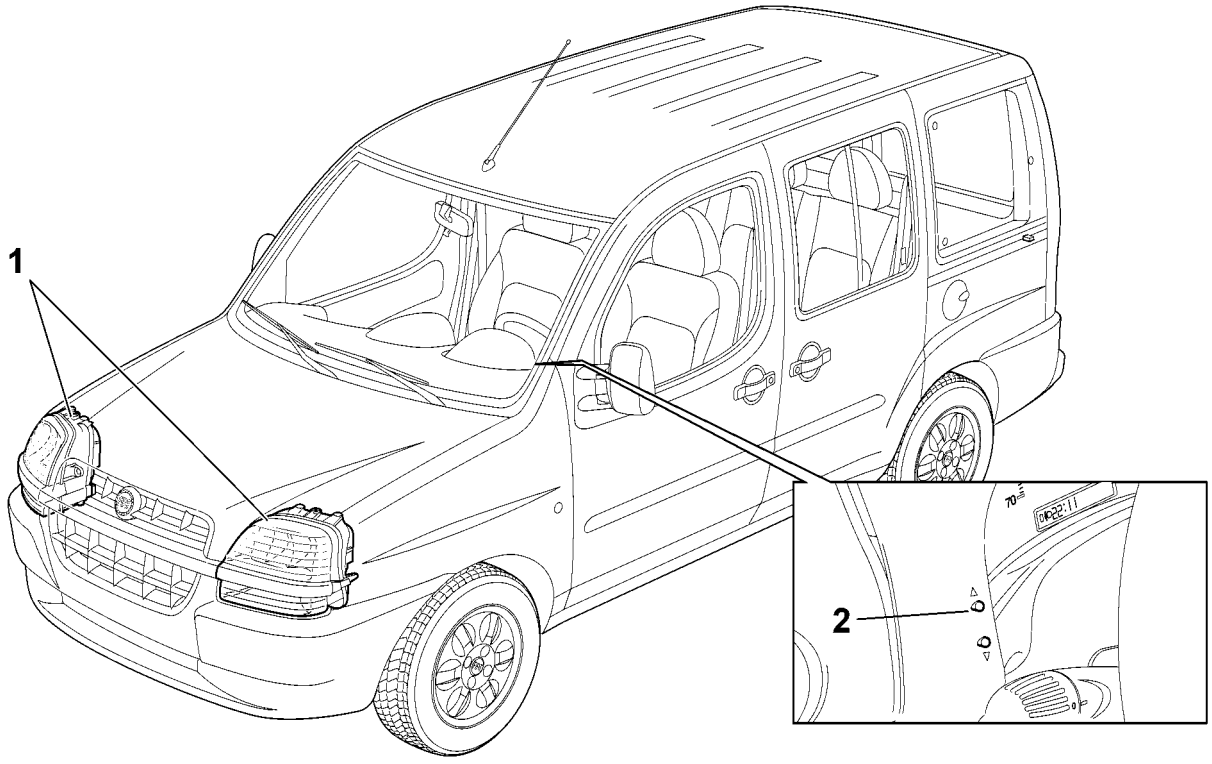
1 cross/corrector (+)
2 Depth (+)
3 Position (+)
4 Direction (+)
5. Fog lamp (+)
6. Corrector control (+)
7. Cross/position/corrector (-)
8 Direction/fog lamp/depth (-)

HEADLAMP ALIGNMENT ADJUSTMENT

LOCATION OF HEADLAMP ALIGNMENT ADJUSTMENT COMPONENTS ON VEHICLE



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1 Front light cluster
2 Light beam adjustment buttons

SPECIFICATIONS:

Operation

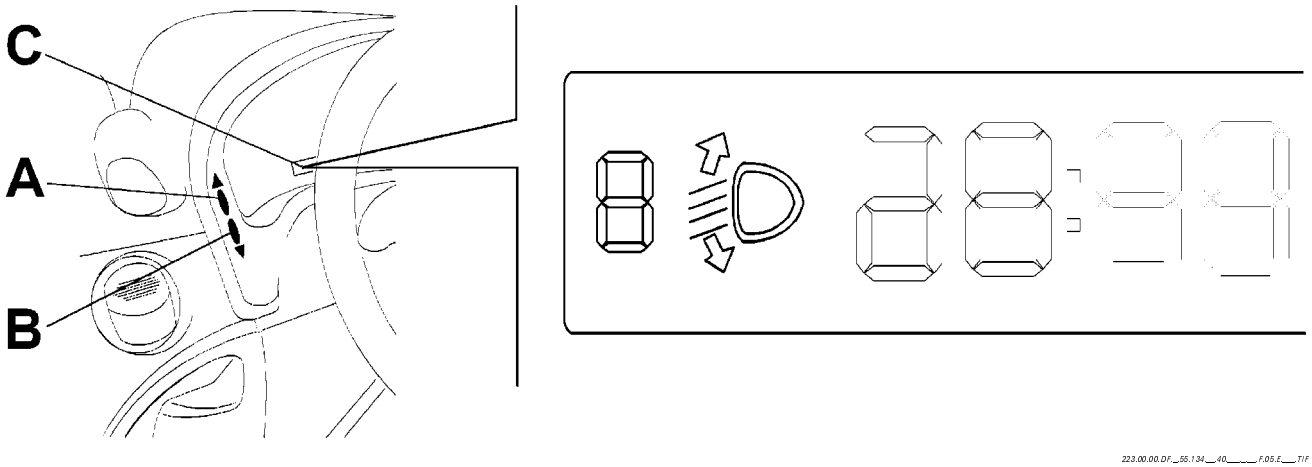
The headlamp alignment adjustment device is designed to correctly position the dipped headlamp light beam, in a vertical direction, irrespective of the load on the axles.

Operating methods

It is possible to vary the angle of the light clusters with 4 standard positions by acting on the two switches on the left hand side of the instrument panel.
The positions are shown in a special display in the instrument panel.
The table below illustrates the three positions which can be selected according to the vehicle load conditions:

Headlamp alignment position	Panorama version	Cargo version
-	Load status	Load status
0	empty, driver, driver + front passenger	empty, driver
relay	all seats occupied	-
relay	all seats occupied + luggage compartment loaded to the maximum technically permissible limit (180 kg)	-
3	driver + luggage compartment loaded to maximum limit on the rear axle (430 kg)	driver + luggage compartment loaded to maximum technically permissible limit and max on the rear axle (550 kg)

The various positions refer to a full fuel tank and an initial vertical adjustment of the light cluster of -1%.



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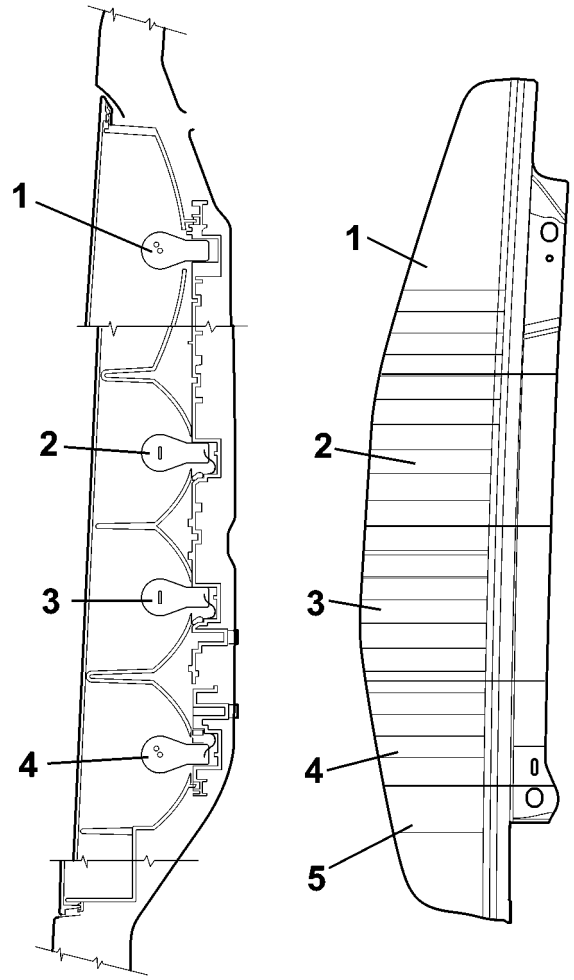
To carry out the headlamp alignment adjustment, proceed as described below:
- Press button A and keep it pressed until there is an increase by one position (e.g. 0>1, 1>2)
- Press button B and keep it pressed until there is an increase by one position (e.g. 2>1, 1>0)

The display C will show the positions whilst the adjustment is being made.

TAIL-LIGHT CLUSTER

View of tail-light cluster



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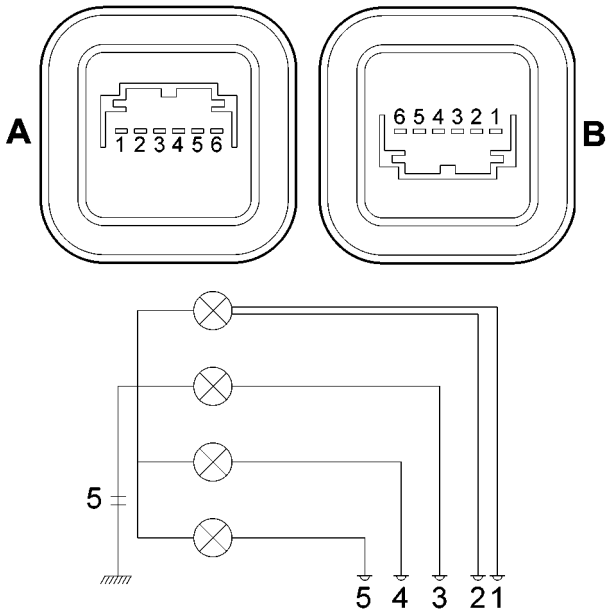
1 Side light + brake light (red lens)
2 Turn signal (colourless lens)
3 Reversing light (colourless lens)
4 Rear fog lamp (left) (red lens)
5. Reflector indicators (red lens)

View of connectors and internal diagram



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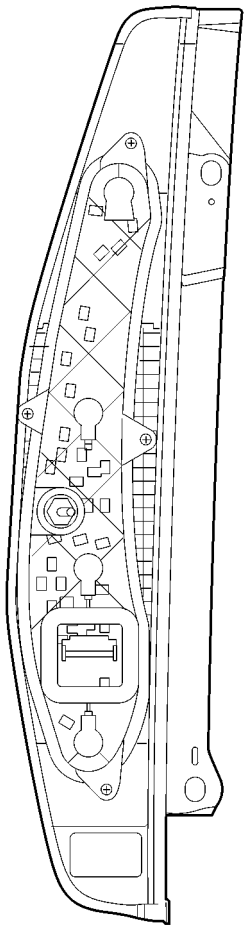
A. Right light
B. Left light

1 Position
2 Brake lights

3 Turn signal
4 Reverse gear
Vehicle side view
5. Rear fog lamp
6. Earth



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The vehicle's exterior lighting system has been designed with two aims in mind:
- Ensuring maximum efficiency in terms of complying with international regulations which define the illumination specifications of the various components
- To blend in with vehicle design so that the various components enhance the image.

The clear element is made out of one piece of plastic.

SYSTEM SPECIFICATION

PERFORMANCE

The nominal operating voltage for the system can vary from 9 to 16 volts.
Power of bulbs for brake light, direction indicator, reversing light, rear fog lamp 21 Watt - 12 Volt.
Power of bulb for side light 10 Watt - 12 Volt

COMPOSITION

STRUCTURE

The right rear light cluster consists of the following components:
- A light unit which includes:
- A housing for the side light (1) with a reflector lens cover and brake light.
- A housing for the direction indicator (3) with a reflector lens cover.
- A housing for the reversing light (4) with a reflector lens cover.

The left rear light cluster consists of the following components:
- A light unit which includes:
- A housing for the side light (1) with a reflector lens cover.
- A housing for the direction indicator (3) with a reflector lens cover.

- A housing for the rear fog lamp (4) with a reflector lens cover.
- A housing for the reversing light

PINS

There is a connection on the rear light cluster casing:
Connection

PIN	Operation
relay	Side light control
relay	Brake light control
3	Turn signal control
4	Reversing light control
5	Rear fog lamp earth (left)
6	Earth

OPERATION

OPERATING PRINCIPLES

See the steering column switch unit for the operation of the direction indicators and the side lights
See the specific assembly for the operation of the brake lights and the reversing light

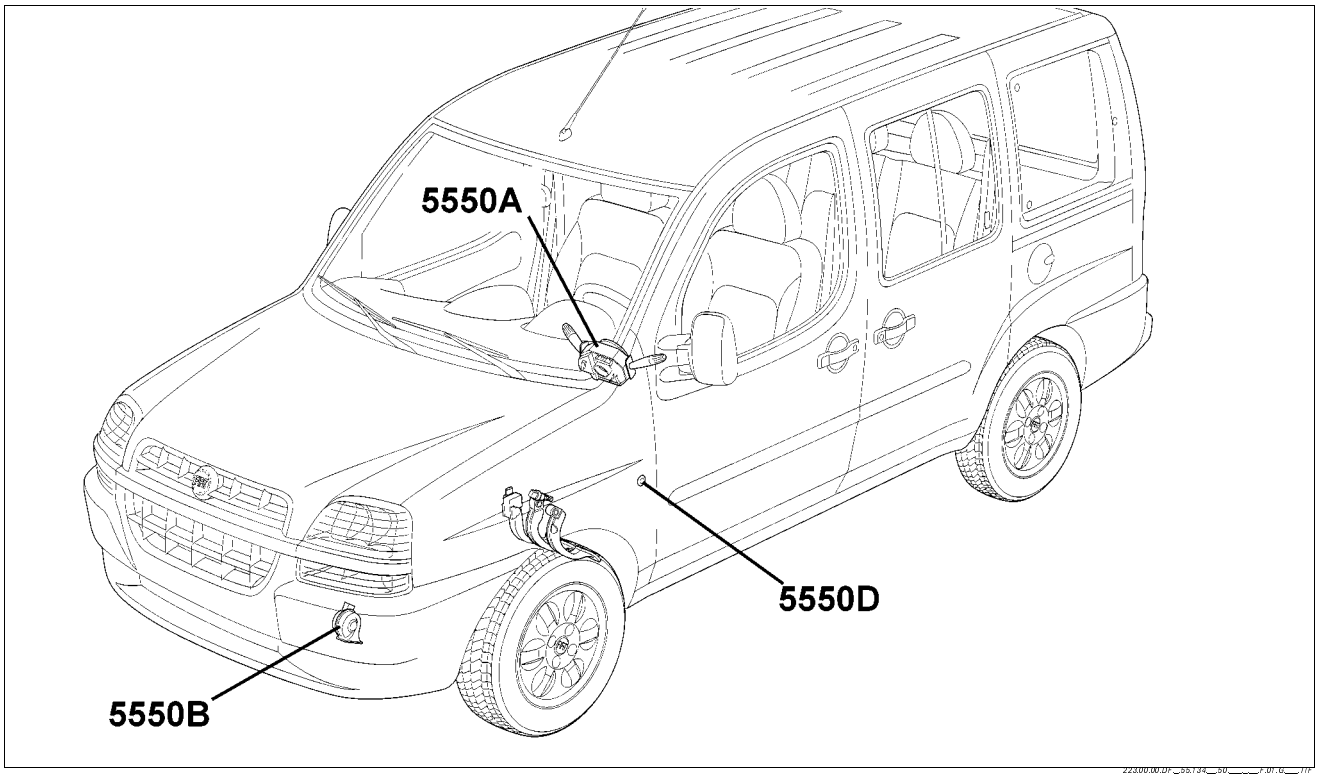
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- SPECIFICATIONS:

Assembly drawings index

Cmp	Description	Validity

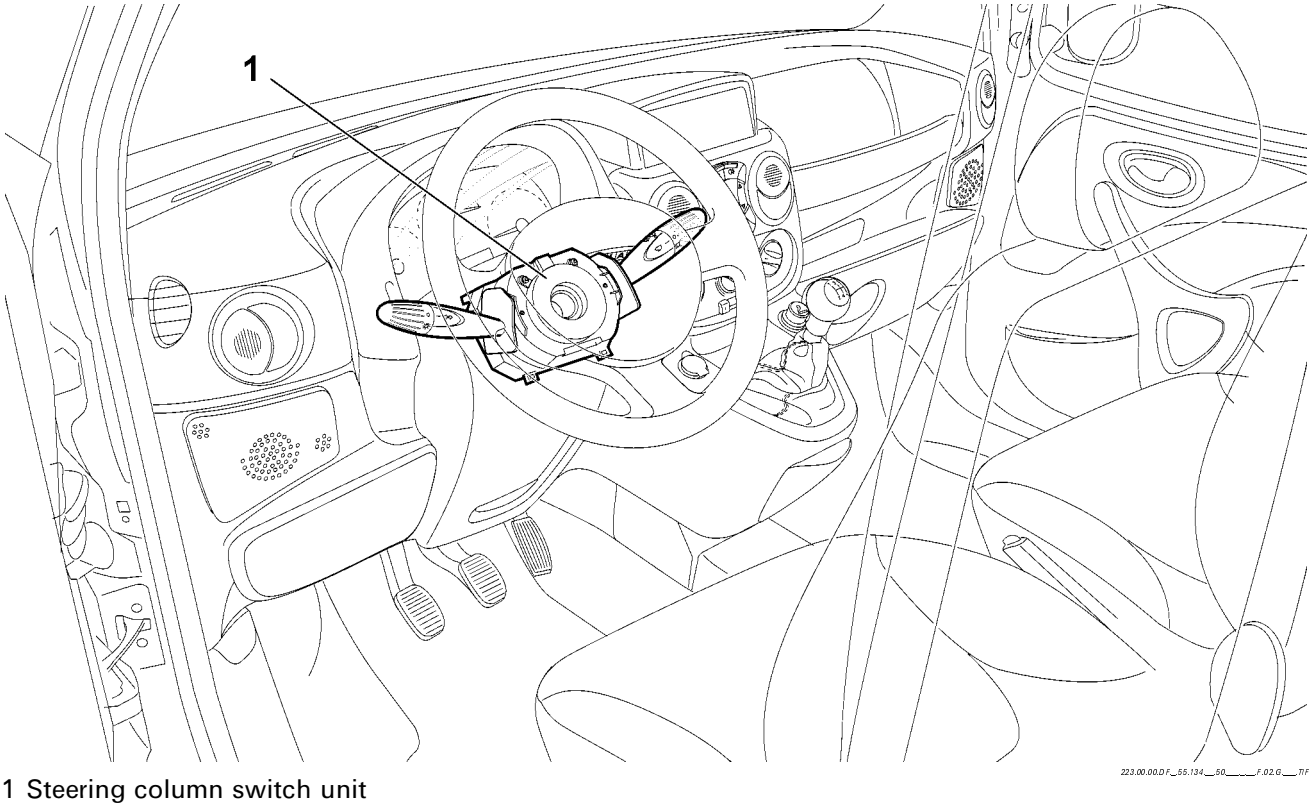
SUB-GROUP GRAPHIC INDEX



SPECIFICATIONS:

STALK UNIT

LOCATION OF COMPONENTS ON VEHICLE



1 Steering column switch unit

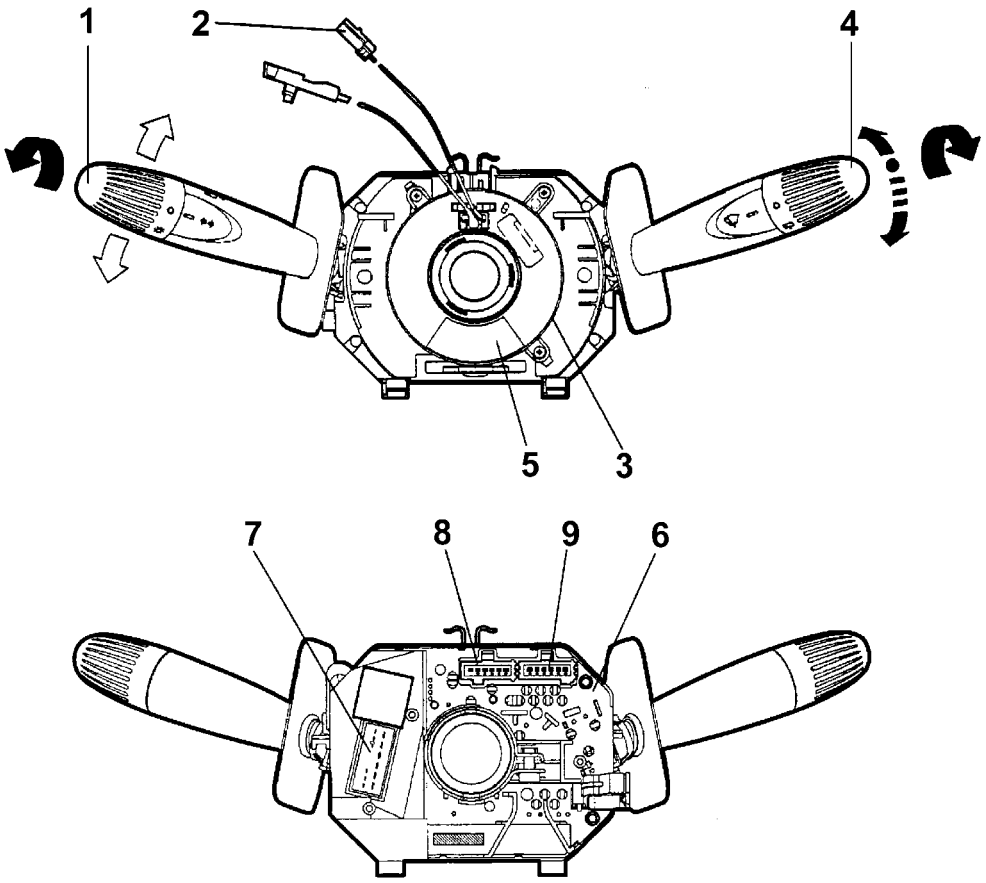
FUNCTIONS

The steering column switch unit is designed to produce the following commands:
- Side lights, dipped headlamps, main beam headlamps;
- Headlamp flasher;
- Direction indicators;
- Windscreen wash/wipe;
- Rearscreen wash/wipe

STRUCTURE

The steering column switch unit, as represented diagrammatically below, consists of the following components:

Front view



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1 Left lever
2 Air Bag and horn connector
3 Release wheel and clock spring
4 Right lever
5. Casing
6. Internal electronic module
7. Connector A
8 Connector B
9 Connector C

BODY

FUNCTIONS

It is a part of the steering column switch unit containing the electrical circuits and the switching and automatic release mechanisms which return the left lever to the rest position once the steering wheel has been realigned.

The typical angles are listed below:
- Engagment angle 80° ± 5°;
- Release angle 60° ± 5°.

COMPOSITION

The front part of the casing houses the release wheel or the air bag clock spring which provides the interface with the steering wheel.
At the rear is the manifold with a retaining band for fastening it to the steering column and additional attachments which guarantee the axial and angular position of the steering column switch unit on the steering column.
The steering column switch unit casing contains the fastenings for the upper/lower half casing trims.
The rear of the casing contains the housigns for the electrical connectors.

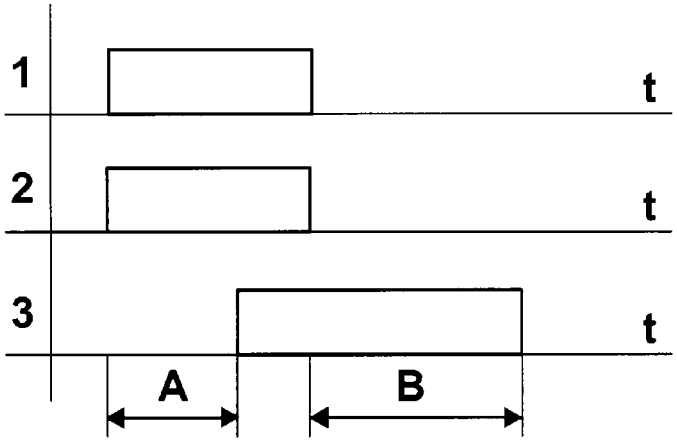
INTERNAL ELECTRONIC MODULE

FUNCTIONS

The electronic module inside the steering column switch unit casing has the task of controlling the following functions:
- Windscreen wiper (frequency for de-luxe version only);
- Rearscreen wiper (frequency for de-luxe version only);
- Windscreen washer function ('smart' washing for all versions);
- Rearscreen washer function ('smart' washing for de-luxe version only)

Smart washing

Smart washing makes it possible to operate the water jet and the wipers in one single movement; the wipers start working 1 second after the lever which controls the jet of water is operated and they stop working 4 strokes after the control has been released.
The smart washing function is valid for both the windscreen washer and the rearscreen washer.
There are two smart washing logics according to the trim level (standard or de-luxe) with the operating modes described in the diagrams:
Basic trim level



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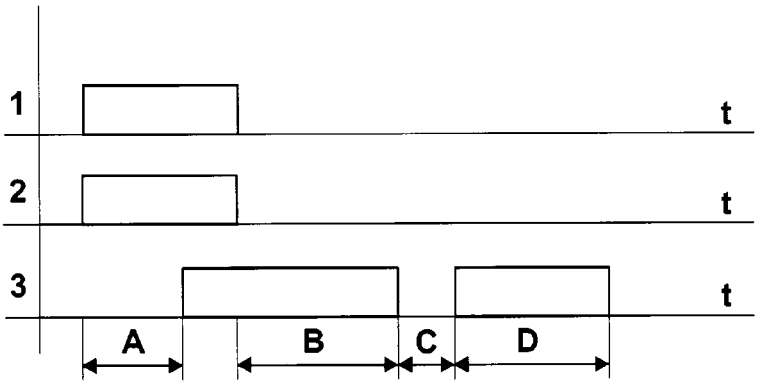
1 Operation
2 Punp
3 Windscreen/rearscreen wiper
A. 1 second
B. 4 windscreen/rearscreen wiper strokes

De-Luxe trim level



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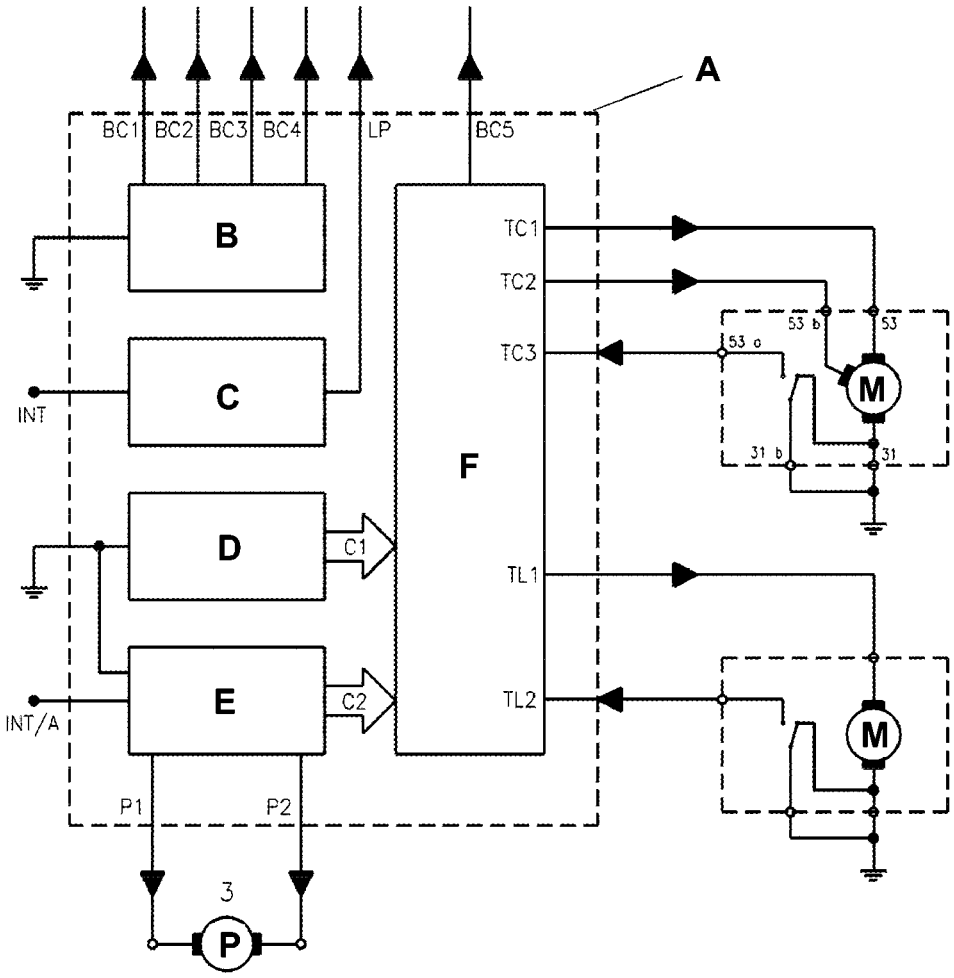
1 Operation
2 Punp
3 Windscreen/rearscreen wiper
A. 1 second
B. 4 windscreen wiper strokes
C. 10 seconds
D. 1 windscreen/rearscreen wiper stroke

COMPOSITION

STRUCTURE

The electronic module consists of an electronic control unit electrically connected to the steering column switch unit casing by means of special terminals and mechanically fastened to it so that it can be replaced if faulty.

WIRING CIRCUIT DIAGRAM



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A. Steering column switch unit
B. Lights/direction indicator controls
C. Side lights control
D. Wiper controls
E. Pump controls
F. Electronic module
1 Winscreen wiper
2 Rearscreen wiper
3 Electric pump

The following interfaces are defined with reference to the wiring diagram illustrated:

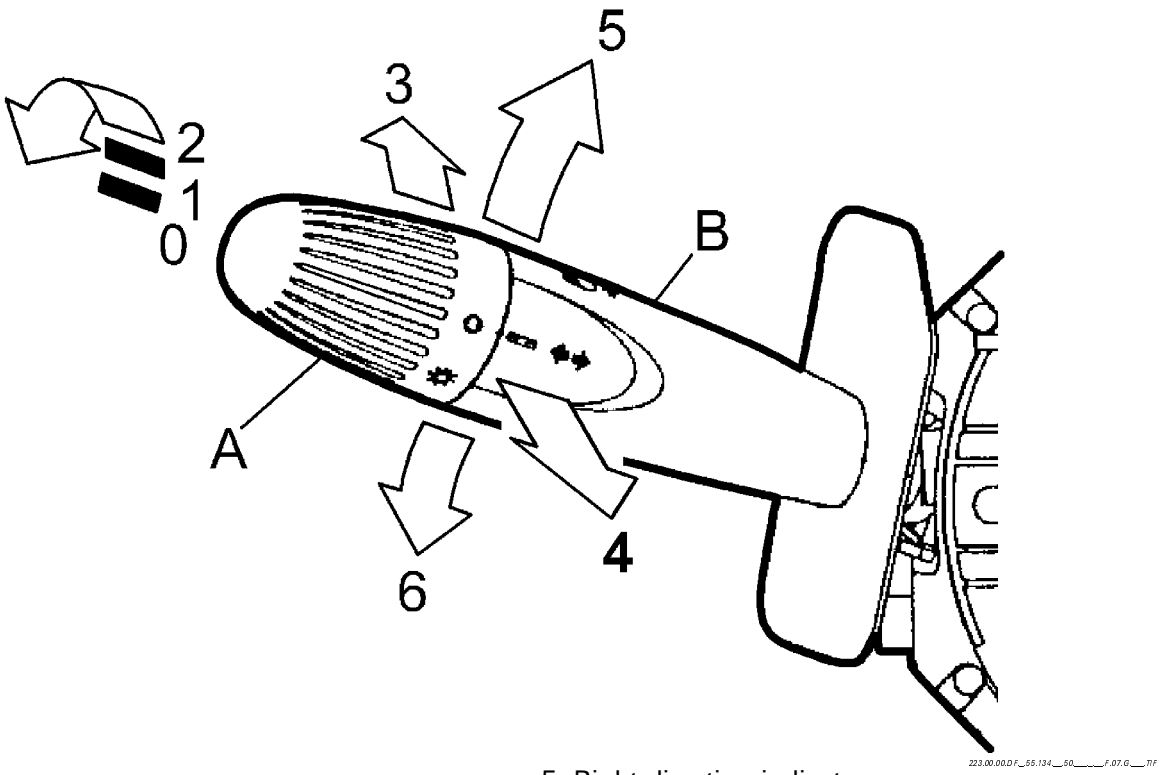
Interface	Signal	Description
BC1	OUT	Left direction indicator operation request to body computer
BC2	OUT	Right direction indicator operation request to body computer
BC3	OUT	Dipped headlamps operation request to body computer
BC4	OUT	Main beam headlamps operation request to body computer
LP	OUT	Direct operation of no. plate light and passenger compartment controls lights, also acquired from body computer for operating the side lights.
TC2	OUT	Windscreen wiper 2nd speed command Nominal absorption from 1.7 to 4 Ampere, with the windscreen wiper motor stopped the absorption increases to 32.4 Ampere with a voltage value of 13.5 Volt.

Interface	Signal	Description
TC3	IN	Windscreen wiper zeroing cam, this consists of a switch fitted on the motor which is normally open when the windscreen wiper is in the rest position (wiper blades parked at bottom) and is active when earthed.
TL1	OUT	Rearscreen wiper operation. Absorption from 1 to 2.5 Ampere, with the windscreen wiper motor stopped the absorption increases to 14 Ampere, with a voltage value of 13.5 Volt.
TL2	IN	Rearscreen wiper zeroing cam, this consists of a switch fitted to the motor which is normally open when the rearscreen wiper is in the rest position (wiper blades parked at bottom) and is active when earthed.
P1	OUT	Windscreen/rearscreen washer pump operation Absorption from 2.5 to 3.5 Ampere, with the windscreen wiper motor stopped the absorption increases to 11.8 Ampere, with a voltage value of 13.5 Volt.
P2	OUT	Windscreen/rearscreen washer pump operation Absorption from 2.5 to 3.5 Ampere, with the windscreen wiper motor stopped the absorption increases to 11.8 Ampere, with a voltage value of 13.5 Volt.
C1	IN	This represents the set of wiping and washing function commands to the electric module.
C2	IN	This represents the set of wiping and washing function commands to the electric module.

LEFT LEVER

SPECIFICATIONS:

FUNCTIONS



0. Lights off
1 Side lights on
2 Dipped headlamps on
3 Main beam headlamps on (stable position)
4 Headlamp flasher (unstable position)
5. Right direction indicators
6. Left direction indicators
A. Ring nut
B. Lever

The left lever has the task of controlling:
- The main lights switch (side lights);
- Dipped/main beam headlamps switch;
- The headlamp flasher on main beam;
- Direction indicators and lane chage.

COMPOSITION

STRUCTURE

The left lever consists of two parts:
- A lever for controlling the main beam headlamps and the direction indicator;
- A ring nut at the end of the actual lever for controlling the side lights and the dipped headlamps.

OPERATION

OPERATING METHODS

The operation of the exterior lights is controlled by the right lever as described below.

Main lights switch

The lights control is at the end of the lever and is activated by rotating a ring nut.

There are 3 stable positions for the ring nut when it is rotated in an anti-clockwise direction:
- Zero position (0), in this rest position, the lights are off;
- Position one (1), side lights on;
- Position two (2), side lights and dipped headlamps on, plus the go ahead to switch on or flash the main beam headlamps and the rear fog lamp/fog light.

All manoeuvres of the ring nut (from 0 to 2 and viceversa) are only possible using the left steering column switch unit lever in the dipped headlamps position; the above movements cannot be made with the lever in the main beam headlamps position.

Dipped/main beam headlamps switch

By moving the lever starting from position (3) in the opposite direction to the steering wheel rim (movement perpendicular to the steering wheel plane) position (4) is created, i.e. the main beam headlamps stable position. During this switching stage from dipped to main beam headlamps and viceversa there is no break in the electrical contact causing the lights to go out (preventative safety).

Control for headlamp flasher

By moving the lever starting from position (2) towards the steering wheel rim (movement perpendicular to the steering wheel plane) position (4) is produced, i.e. the main beam headlamps unstable (flashing) position, when the lever is released, it returns to the rest position.

Control for direction indicators and lane change

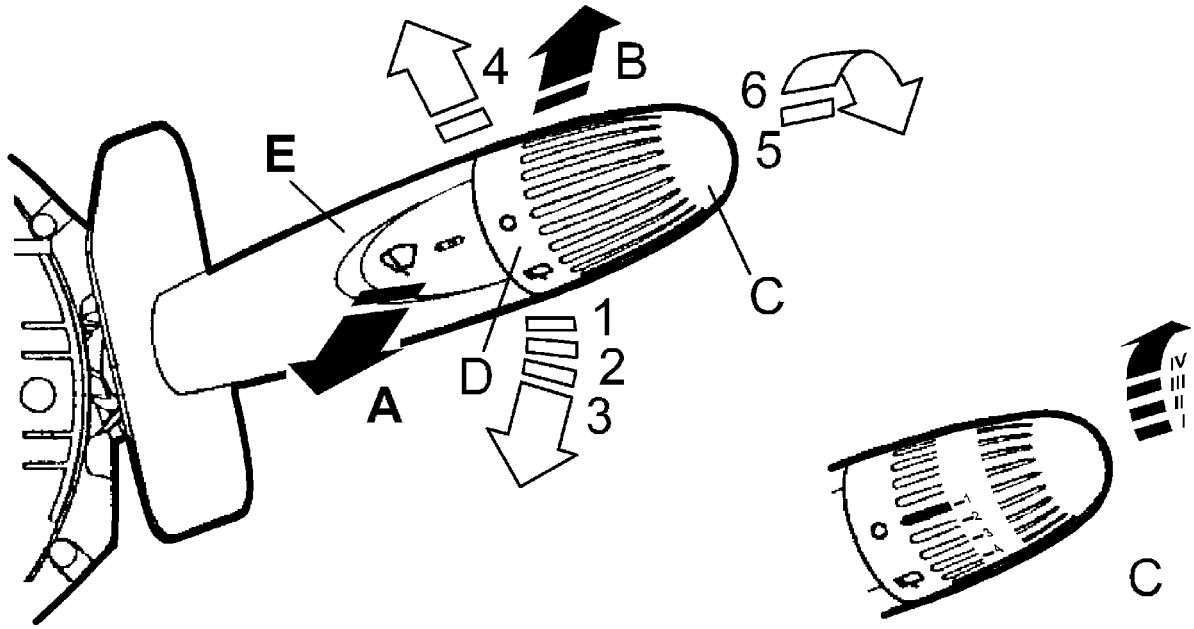
The direction indicators are operated by moving the lever on the steering wheel plane in two directions - clockwise and anti-clockwise (5) and (6).
The movement of the control, in each direction, involves two distinct activating modes for the same electrical contact, one defined as UNSTABLE (lane change) and one defined as STABLE (change of direction).
The lane change function is activated through a lesser angular movement than that required for activating the change in direction.
The automatic release device intervenes for each stable position of the direction indicators and has the function of returning the lever to the rest position (position 2) after the steering wheel has been realigned.

RIGHT LEVER

SPECIFICATIONS:

FUNCTIONS

The diagram below illustrates the functions performed by the right lever.



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0. Windscreen wiper switched off
1 Intermittent operation (stable)
2 Continuous slow operation (stable)
3 Continuous fast operation (stable)
4 Anti-panic function (unstable)
5. Rearscreen wiper off
6. Rearscreen wiper on (stable)

A. Windscreen washing and wiping (unstable)
B. Rearscreen washing and wiping (unstable)
C. Ring nut adjusting frequency of wiping from I to IV (only on de-luxe version)
D. Ring nut
E. Lever

The right lever has the task of controlling:
- The winscreen wiper;
- The windscreen washer;
- The rearscreen wiper;
- The rearscreen washer.
- The adjustment of the frequency of the windscreen/rearscreen stroke (de-luxe version only)

COMPOSITION

STRUCTURE

The left lever consists of two parts:
- A lever for controlling the front and rear wipers;
- A ring nut at the end of the lever for adjusting the frequency of the strokes (de-luxe version only).

OPERATION

WINDSCREEN AND REARSCREEN WIPER OPERATING METHODS

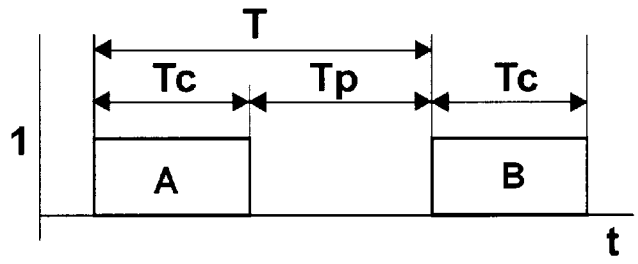
The operation of the windscreen wiper and the rearscreen wiper is controlled by the right lever as described below.

Windscreen wiper operation

The operation is achieved by moving the lever on the steering wheel, there are 5 different positions:

POS 0	No circuit switched on	(stable)	[Rest position]
POS 1	Intermittent	(stable)	[clockwise direction]
POS 2	Continuous 1st speed	(stable)	[clockwise direction]
POS 3	Continuous 2nd speed	(stable)	[clockwise direction]
POS 4	Anti-panic position	(unstable)	[anti-clockwise direction]

Control for adjusting windscreen wiper intermittent function (de-luxe trim level version)
The control is at the end of the right lever and is operated by turning a special ring nut in a clockwise direction in 4 stable positions. The control has two stable positions when moved in a clockwise direction to which 4 intermittent windscreen wiper operating modes correspond, with increasing frequency, see the graph and the table below for better clarity:



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1 Operation
A. First impulse
B. Second impulse
T. is the intervla between two successive wind-screen/rearscreen wiper strokes
Tc. is the time managed by the electronic module
Tp. is the rest time between two control impulses managed by the electronic module

Windscreen washer control
The windscreen washer is operated by pulling the lever towards the steering wheel, the control is UNSTABLE as a result of which when the lever is released it returns to the rest position.
The operation of the control involves activating the windscreen wiper in accordance with the 'smart washing' function described under the ELECTRONIC MODULE.

Rearscreen wiper control
The control for the rearscreen wiper is at the end of the right lever and is operated by turning a special ring nut. The control has two STABLE positions and is turned in a clockwise direction:

Basic trim level:
- Pos. 0 = No circuit switched on;
- Pos. 1 = Rearscreen wiper operating continuously

De-Luxe trim level:
- Pos. 0 = No circuit switched on;
- Pos. 1 = Rearscreen wiper operating intermittently

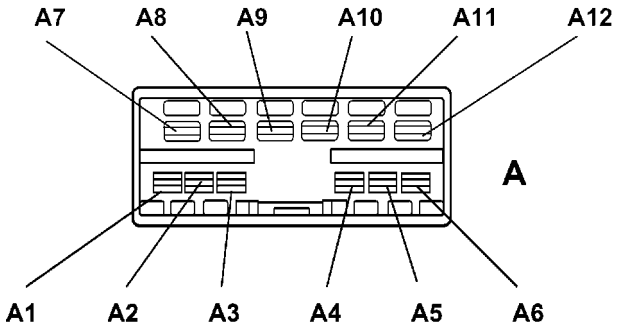
All the instructions given for the operation of the windscreen wiper are valid.

Rearscreen washer control
It is operated by pushing the right lever towards the dashboard, the position is UNSTABLE as a result of which when the lever is released it returns to the rest position.
The operation of the control involves the activation of the rearscreen wiper in continuous mode on the basic trim level and with the 'smart washing' function described under the ELECTRONIC MODULE.

RELEASE WHEEL

PINS

The pin-outs for the connectors on the steering column switch unit are illustrated below.



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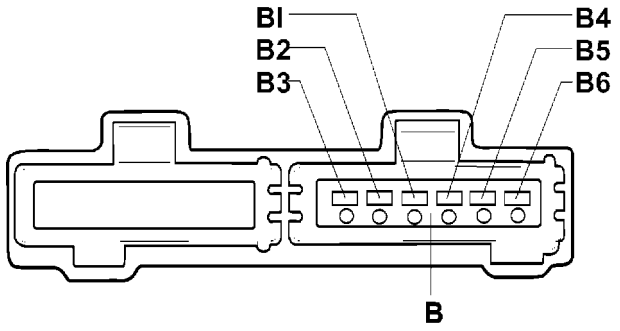
Connector A

Pin	Operation	Rated current (A)
A1	Horn output	0.2
A2	Standard anti-theft device preparation output	0.2
A3	Spare N.C	---
A4	Spare N.C	---
A6	Windscreen wiper zeroing input	0.07
A7	Power earth input	2.5 - 3.5
A8	2nd windscreen wiper speed output	1.7 - 4.0
A9	1st windscreen wiper speed output	1.1 - 2.9
A10	Rearscreen washer two-way pump control output (positive)	2.5 - 3.5
A11	Windscreen wiper/pump INT/A input	6.5
A12	Rearscreen washer two-way pump control output (positive)	2.5 - 3.5



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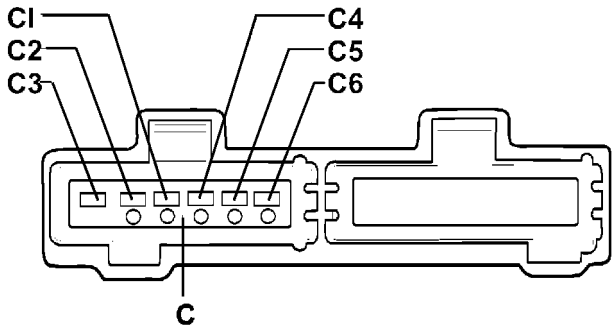
Connector B

Pin	Operation	Rated current (A)
B1	Right turn signal control	0.05
B2	Main beam headlamp/flasher control	0.05
B3	Dipped headlamps control	0.05
B4	Rear fog lamp go ahead	0.2
B5	INT for side lights operation	2.0
B6	Side lights control to Body C.	0.05



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Connector C

Pin	Operation	Rated current (A)
C1	Available	---
C2	Rearscreen wiper supply	3.5
C3	Rearscreen wiper motor supply	3.5
C4	Rearscreen zeroing input	3.5
C5	Signal earth	0.5
C6	Left hand turn signal control	0.05

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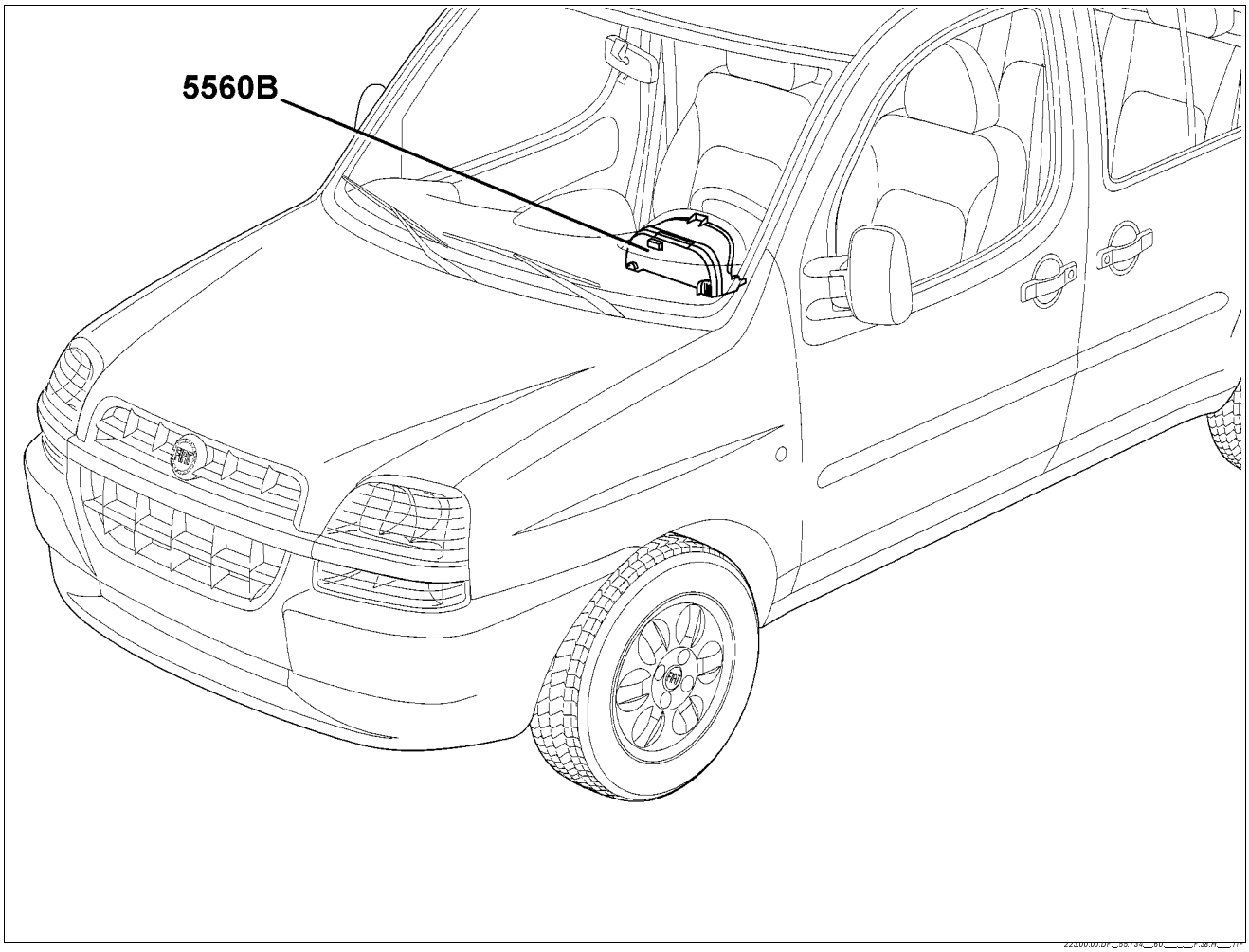
- SUB-GROUP GRAPHIC INDEX
- SPECIFICATIONS:

Assembly drawings index

Cmp	*Description*	*Validity*

SUB-GROUP GRAPHIC INDEX



SPECIFICATIONS:

GENERAL DESCRIPTION OF THE SYSTEM

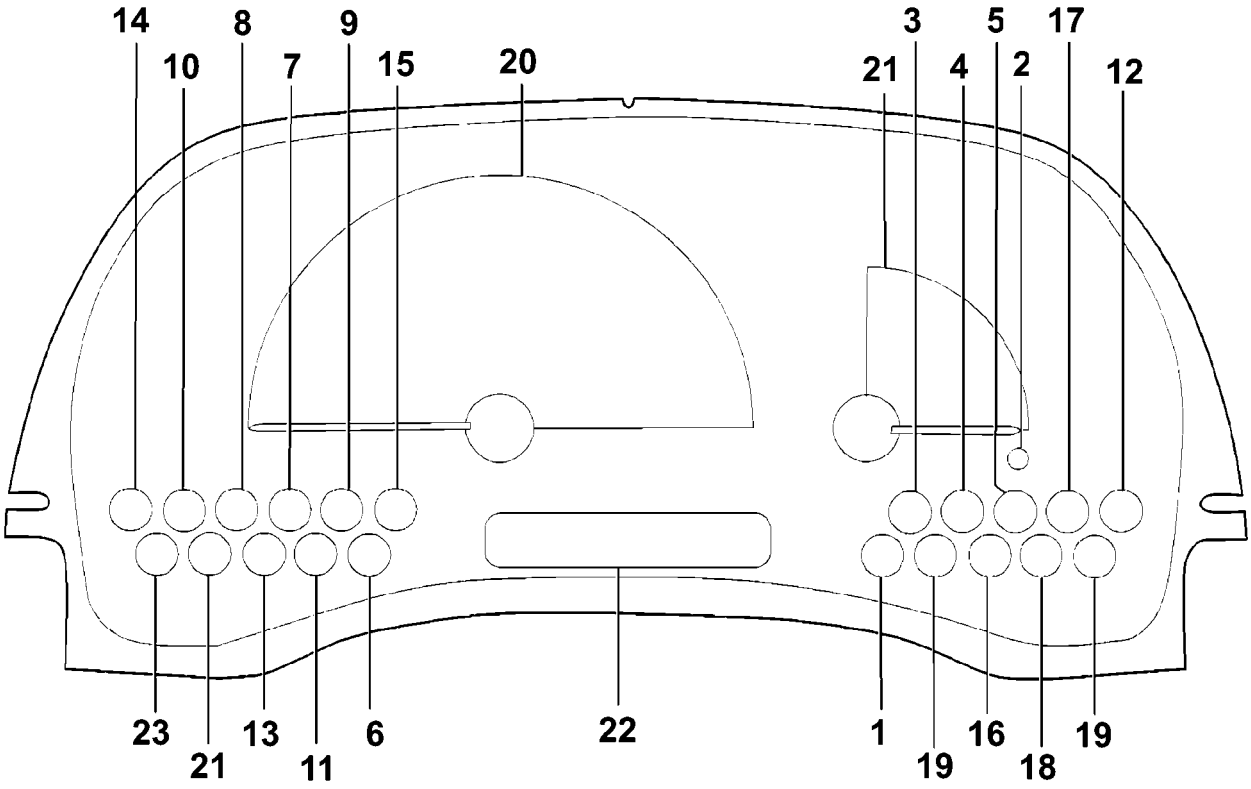
NQS OPERATION

The instrument panel is the component which makes it possible to display the main functional parameters of the vehicle for the driver. This instrument panel includes a CAN interface at low speeds to allow dialogue with other system connectors (e.g. engine management control unit, dashboard connector, ...).
The instrument panel is available in four versions and these panels have a printed circuit.
The instrument panels SHOULD NOT be dismantled in the service network because their assembly requires precision instruments; otherwise serious, irreparable damage can be caused.

The panel has several functions with the ignition switched off, such as the adjustment and display of the clock, the switching on of the alarm warning light abd the switching on of the arrow warning lights etc.

BASIC VERSION (STANDARD CARGO, STANDARD PANORAMA)

The instrument usage functions for the basic models (standard cargo, standard panorama) are:
- vehicle speed (speedometer);
- mileage (milometer display with total and trip mileage);
- fuel level (gauge and reserve warning light);
- clock (hours and minutes) (integrated in the milometer display);
- warning lights
- headlamp alignment corrector with two buttons (display of control position).



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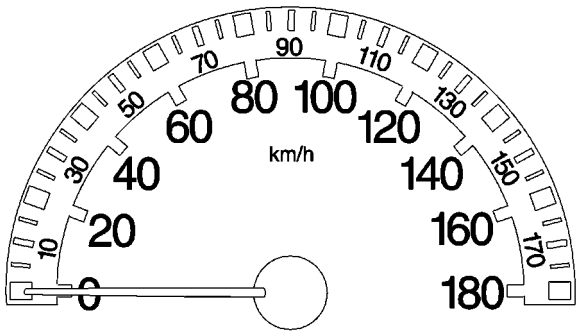
1 Coolant temperature overheating
2 Fuel reserve
3 Recharging
4 Engine oil pressure
5. OBD failure
6. Handbrake - insufficient brake fluid EBD
7. Side lights
8 Main beam headlamps
9 Direction indicators
10 Rear fog lamp
11. Heated rear windscreen
12. Immobilizer
13. Heater plugs
14. Fog lights
15. Alarm LED
16. ABS failure
17. (Air Bag failure) if available
18. (Passenger Air Bag failure) if available
19. Seat belt (preparation)
20. Electronic speedometer
21. Fuel level gauge (E1)
22. LCD with display of: headlamp position, clock, six figures with 7 segments for milometer; tot. 6 figures partial 4
23. Available

SPEEDOMETER (C1)



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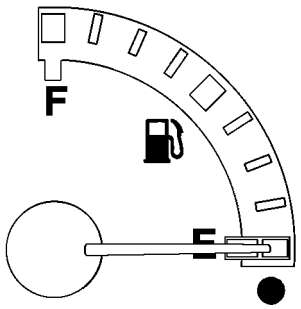
I.L.B. INDICATOR (E1)



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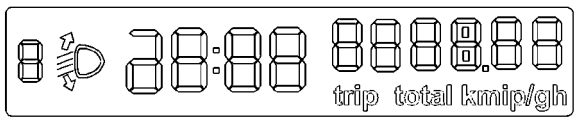
LCD (G1)



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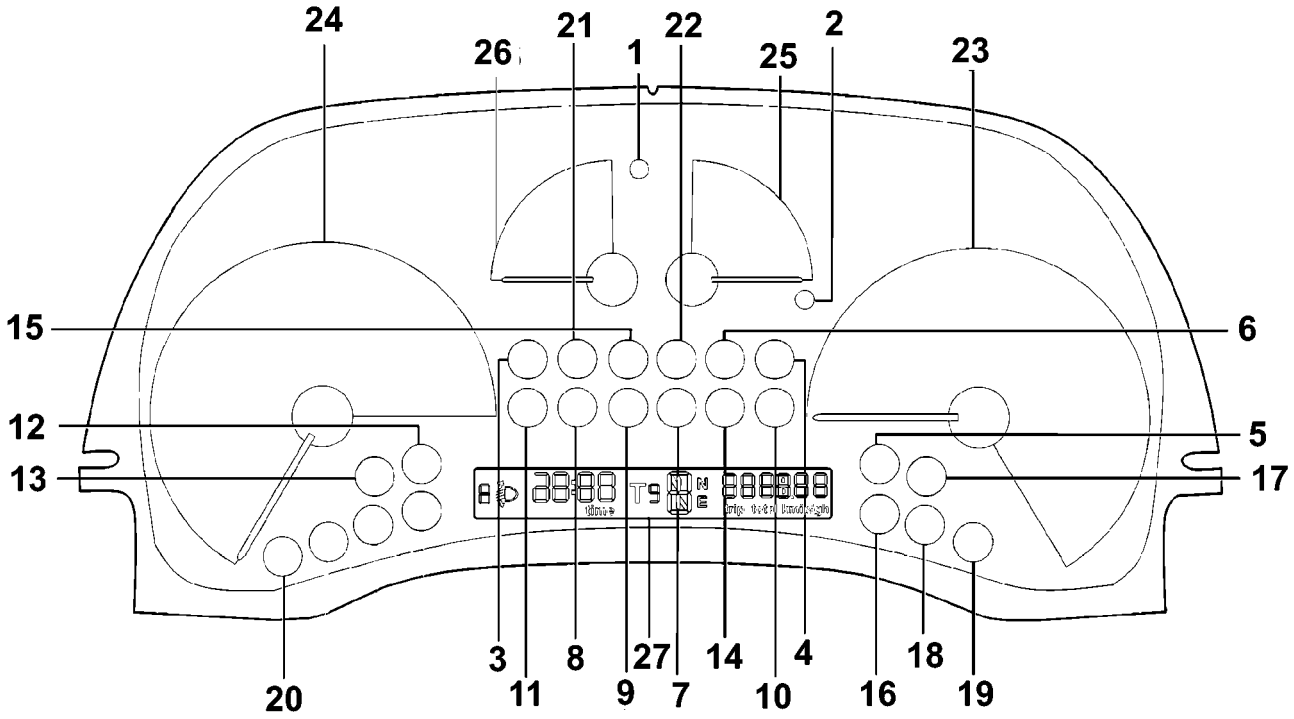
SUPER VERSION (ELEGANT VAN, ELEGANT PANORAMA)

like the basic version with the addition of:
- engine rpm (rev counter);
- coolant temperature (gauge and overheating warning light);

- warning lights
- trip computer with LCD display of trip mileage, range, average speed, journey time and average consumption.



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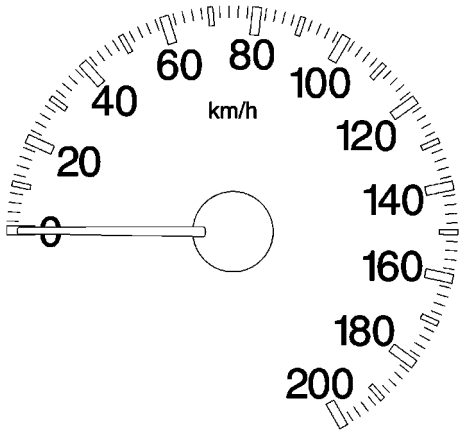
1 Coolant temperature overheating
2 Fuel reserve
3 Recharging
4 Engine oil pressure
5. OBD failure
6. Handbrake - insufficient brake fluid EBD
7. Side lights
8 Main beam headlamps
9 Direction indicator
10 Rear fog lamp
11. Heated rear windscreen
12. Immobilizer
13. Heater plugs
14. Fog lights
15. Alarm LED
16. ABS failure
17. Air Bag failure (if fitted)
18. Passenger Air Bag deactivted (if fitted)
19. Seat belt (preparation)
20. Available
21. Doors open
22. Available
23. Electronic speedometer
24. Rev counter
25. Fuel level gauge (E1)
26. Coolant temperature gauge
27. LCD with display of headlamp position, clock

SPEEDOMETER (C3)



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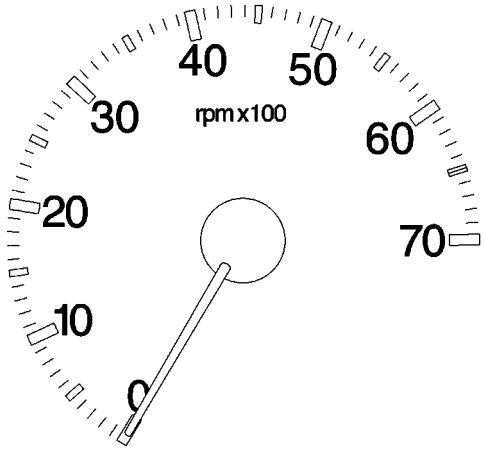
REV COUNTER (D1)



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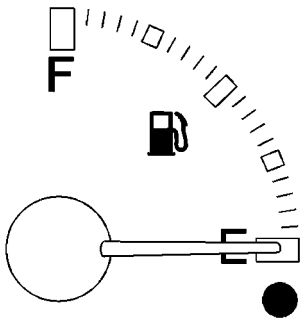
I.L.B. INDICATOR (E2)



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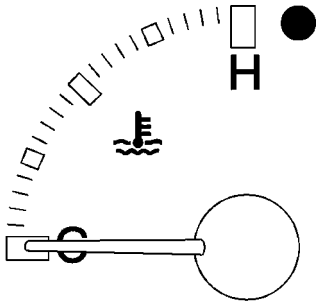
COOLANT TEMPERATURE GAUGE (F1)



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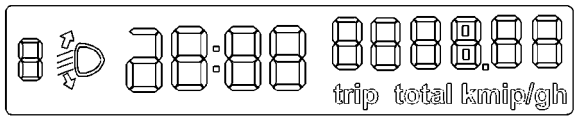
LCD (G1)



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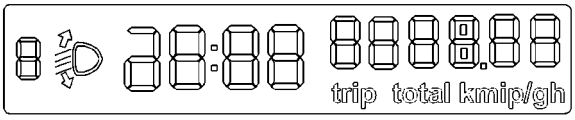
COMPONENTS AND OPERATION

The main components of the instrument panel feature:
- External scale in white and internal scale in red and sector in grey (excluding de-luxe versions);
- Serigraphy lighting and indexes in orange.
- Rev counter (petrol and diesel) without danger zone.
- Coolant temperature gauge with danger area in red.
- LCD always lit up in orange.
- Warning lights.

LCD:

The following are displayed on the LCD DISPLAY:
- clock
- headlamp position
- six figures with seven segments for the milometer
- four figures for the trip meter.



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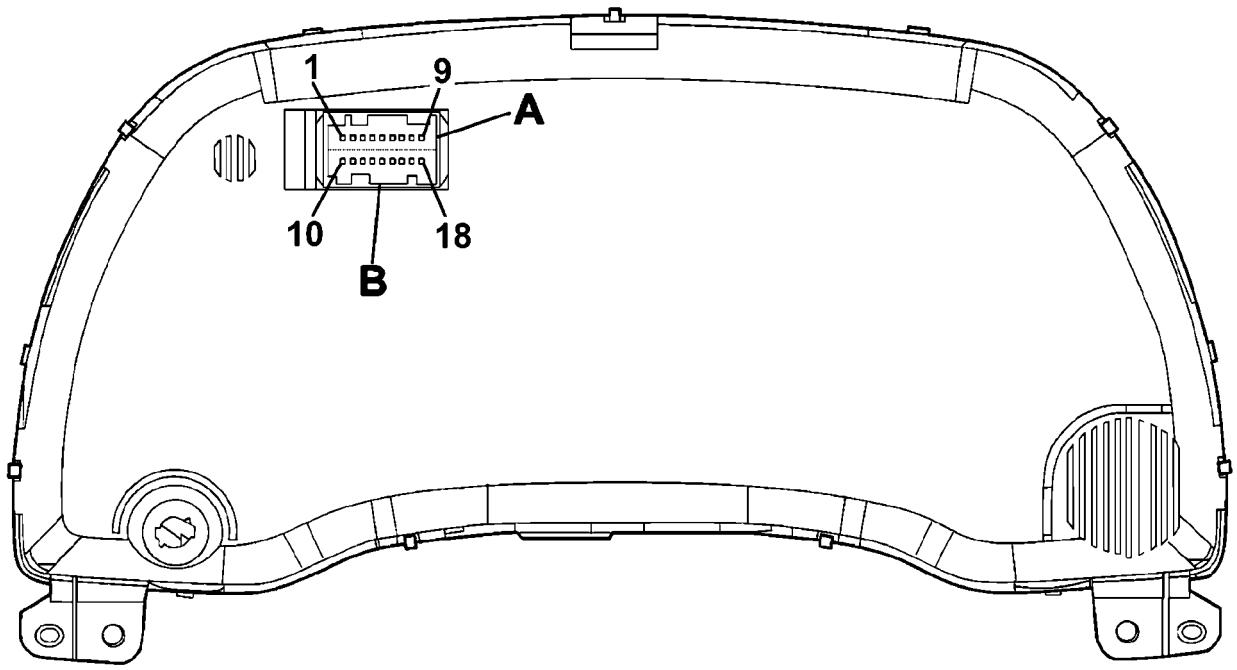
All the information from and for the instrument panel is transferred, through the CAN interface at low speed, with the exception of data expressly indicated in the pin out. The fault diagnosis is also carried out through the CAN line.



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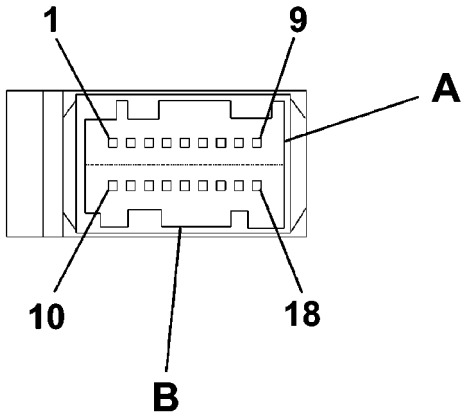
A = Connector E03PA (pins 1 to 9)
B = Connector E03PB (pins 10 to 18)
A single AMO MQS 18-way vertical connector is used.

PIN OUT



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1 +15 panel supply
2 + battery instrument panel and clock
3 CAN A
4 CAN B
5. Headlamp aglinment signal
6. + Dipped headlamps
7. Instrument panel earth
8 Oil pressure (preparation)
9 Coolant temperature (preparation)
10 + Dimmer lights input (preparation)
11. Engine rpm signal (preparation)
12. Input for available warning light
13. Air Bag fialure warning light
14. Passenger Air Bag disabled warning light
15. Preparation for seat belts not fastened warning light
16. Free
17. Free
18. Engine oil level earth

Direct inputs

List of direct input signals:
- + 15 key;
- + battery;
- + lights from dimmer;
- Air Bag failure warning light (only for versions with Air Bag);
- Passenger Air Bag disabled warning light (only for versions with Air Bag);
- Seat belt warning light for Japanese version only;
- CAN line;
- Dipped headlamps signal for headlamp alignment;

Network direct inputs

List of direct input signals:
- Vehicle speed;
- RPM
- Fuel level;
- Fuel consumption
- Coolant temperature
- Mileometer;
- Warning lights
- Network management messages.

Direct outputs

List of direct output signals:
- Headlamp alignment signal;
- Oil level sensor operation;

Network output

Network management messages and NQS operaton.

GENERAL DESCRIPTION

The programming (in the production plant) is carried out with a special instrument, on the vehicle assembly line, using the CAN serial line.
The Instrument Panel Connector (NQS) receives all the configuration parameters with a single Fiat EOL (end of line) command. The Instrument Panel therefore memorizes the data.

EOL PROGRAMMING

The Instrument Panel Connector (NQS) described so far uses four basic electronic fittings common to all versions, the difference being in the reception of the configuration parameters. If the NQS is replaced in the service network it is configured using the diagnostic equipment (SDC Examiner).
If any one of the connectors is not correctly configured or if the various connectors have been configured using incompatible data, then the Instrument Panel display segments used will flash at a frequency of 1 Hz, duty cycle 50%.
This procedure is necessary to signal the failed or incomplete personalization of one of more connectors for the CAN network on the vehicle following replacement operations in the service network.

NQS PROGRAMMING

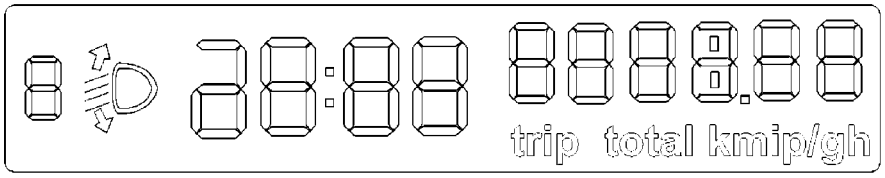
The following Instrument Panel Connector (NQS) parameters are personalized, according to the version:
- Tank capacity according to the version (Diesel / Petrol);
- Tank percentage which activates the reserve warning light;
- Oversize percentage in the vehicle speed reading;
- ABS;
- Diesel/Petrol version;
- Right/left hand drive.

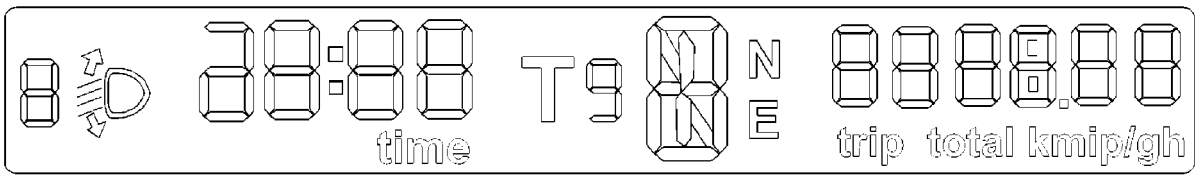
The information necessary for identifying the product, such as the Fiat design code, the HW code, the SW code, the production date, etc., should be added to these parameters.
Only once the EOL (end of line) programming has taken place in the plant or in the service network should the panel move over from the default parameters (which should remain intact until that moment) to the new parameters.

If the instrument panel does not accept the configuration in the service network, it is necessary to make sure that the product code is correct.

MILOMETER

View of milometer





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The NQS receives information on the journey distance, via the CAN line, from the Body Computer. This information corresponds to a counter value which is increased by one unit each time 10m is travelled.
For every 10 counter values the trip meter is increased and therefore every 1000 metres, the total mileage is increased by 1 km.
The internal microprocessor converts the value received at the CAN network from km to miles using a suitable algorhythm.
The NQS memorizes the journey data in kilometres and only converts them into miles during the display. The limit for the trip meter remains 999.9 for both the km and miles, whilst the total limit is in kilometres only (399999) equal to around 248,547 miles.

When the limit (399999 km) is exceeded, the display shows 5 dashes at the centre and in place of the figures.

There is no planned synchronization between the NQS and the NBC when the trip meter figure is zeroed in the instrument panel, the maximum possible error is (10 m).
When the trip meter reaches 999.9 km or miles, it returns to 0.0.
The switching between the total and trip mileage is carried out using a special button (top right) which, if pressed for more than 3 seconds, zeros the trip value.
If the battery is disconnected, the instrument panel memorizes the total mileage so that not more than 1 km is lost. In this case the trip mileage is lost from the memory.
The instrument is supplied by the factory, with the possibility of resetting the total mileage counter only once during the first 200 km. It is possible if the display shows the letter H as the second digit on the left (7 segements).
The operation is carried out by keeping the zeroing button / trip selector (top right) pressed for at least four seconds.
The zeroing should be carried out before 200 km are reached, the total mileage counter is zerored and the letter H disappears. This operation cannot be carried out once 200 km are exceeded because the letter H disappears and the mileage reading displayed is maintained.
The NQS accepts the programming of the total number of Km (if it is replaced in the service network). This programming is NOT, however, possible if a certain mileage, greater than the value to be entered has already been memorized (e.g. taking the instrument panel from another vehicle to reduce the mileage).

CLOCK

The clock is shown in the same display as the milometer and is located between the headlamp alignment reading and the milometer figures; the reading is in hours and minutes and goes from 00.00 to 23.59. Each time the battery is connected the clock shows 00:00.
The two dots between the hours and the minutes flash every second.

The clock adjustment button is in the instrument panel. When it is pressed, the clock adjustment takes place as follows:
- Pressing the button for 0.1 seconds produces an increase of one minute;
- Pressing the button for between 1 and 3 seconds increases the minutes at an increasing speed which varies in a linear manner starting from an increase of 1 minute every 0.5 seconds, up to an increase of 1 minute every 0.2 seconds.
- Continuing to keep the button pressed for longer than 3 seconds causes an increase in 10 minute steps (rounded off to the next ten);

The second counter starts again after the minutes have been set.
The display shows the hours / minutes and the adjustment button also works with the ignition switched off.

SPEEDOMETER

The instrument panel receives speed information via the CAN line. The value received in this way is increased for the EOF value programmed and is then displayed on the graduated scale
The calculation error for values expressed in miles (milometer and speedometer) is less than 0.1 %. The panel configuration is for operation in miles. This parameter is only modified at the Magneti Marelli EOL (end of line).
The Instrument Panel Connector receives the engine rpm informtion, directly from the engine management control unit and without corrections the panel processes the engine rpm data with a constant time so that the response at zero RPM - end of scale RPM is less than 2 seconds.

INDICATOR RECOVERY LOGICS (STEPPING MOTOR)

The recovery of any steps which may be lost by the instrument is guaranteed for each individual indicator. The 'return to zero' logic for the indicators occurs for every battery disconnecting / reconnecting operation. An (automatic) 'return to zero' logic is used for the indicators each time the ignition is switched on and off.

SPEEDOMETER AND REV COUNTER PRECISION

The indicator precision is around 1 km for the tachograph and 50 rpm for the rev counter.

ENGINE COOLANT TEMPERATURE GAUGE

Every 200 ms the panel receives information concerning the engine coolant temperature, via the AN line, correspondding to a scale of - 40 to + 215 degrees C.

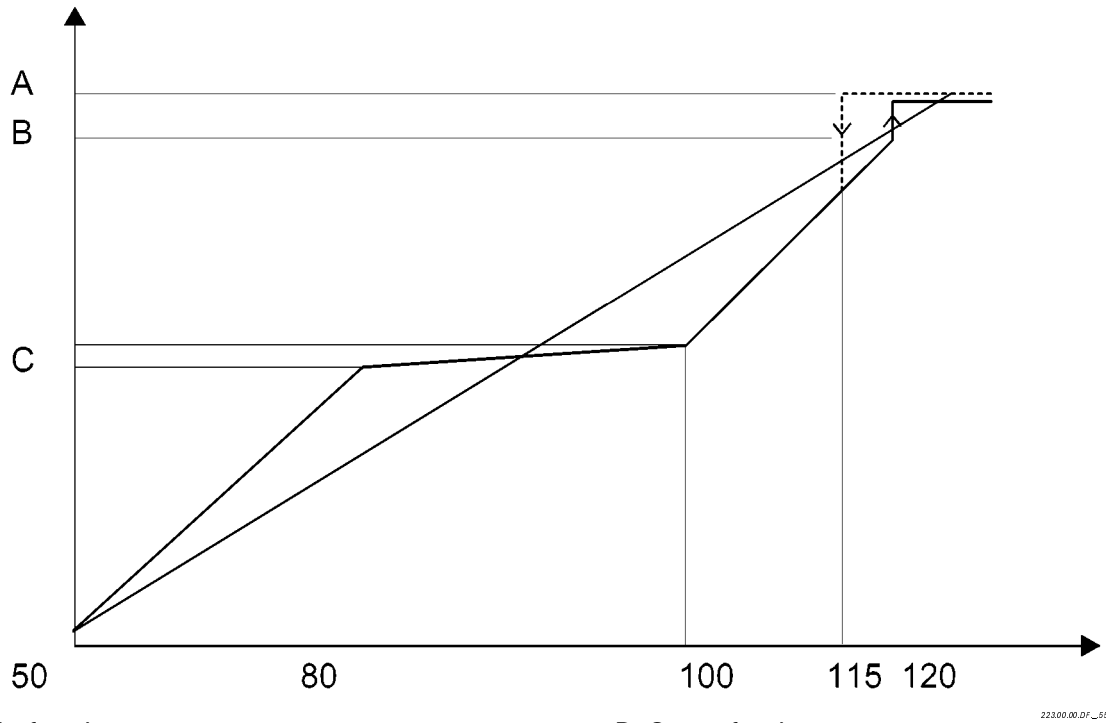
The movement of the pointer in the red sector corresponds to a dangerous temperature equal to 120 degrees C. With the ignition switched on, the pointer should reach the temperature value according to the following logic:

- if T < 50 °C the pointer should be in line with the first reference/graduation on the scale
- if T > 50 °C the pointer should be positioned on the reference corresponding to the temperature value measured.

If, with the ignition switched on, there is a burst of heat, then the temperature reading corresponds to the position of the pointer when the ignition was switched off, then the pointer should reach the position corresponding to the actual temperature in a time of 2 mins.

ENGINE COOLANT TEMPERATURE GAUGE OPERATING LOGIC

For temperatures equal to T = 50 °C, the pointer is positioned on the first reference on the scale (start of the scale).
For temperatures between 50 and 80 °C the pointer should move in a linear manner (between the zero and the centre of the scale).
For temperatures between 80 and 100 °C (normal operation), the pointer should remain stable in the centre of the scale.
For temperatures between 100 and 120 °C (uphill) and between 115 and 100 °C (downhill) the pointer should move in a linear manner (betwen the centre of the scale and the start of the red sector).
For temperatures equal to T = 120 °C, the pointer should be positioned at the start of the red sector of the scale.
For temperatures equal to T = 122 degrees C, the pointer should reach the position corresponding to the start of the red sector and as soon as the Engine Mangement Control Unit sends the warning light on signal, it should be positioned at the end of the scale and the coolant overheating warning light should come on with a delay of 5 seconds after receiving the information at the CAN network.
If the Engine Management Control Unit sends the signal to switch off the warning light (when the temperature goes below the level T = 115 degrees C), the instrument panel immediately switches off the engine coolant overheating warning light and the pointer returns to the position corresponding to the (actual) temperature value measured.



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A. End of scale
B. Start of red sector
C. Centre of temperature scale between 80 °C and 100 °C

ENGINE COOLANT TEMPERATURE OVERHEATING WARNING LIGHT

The panel receives information concerning the switching on / off of the warning light via the CAN line.
Each time the ignition is turned on the engine management control unit sends the instrument panel the command to switch on the warning light in order to check the communication line or the warning light signal.

If the ignition is switched on and the conditions for switching on the warning light exist (engine coolant overheating and warning light already on when the ignition was switched off previously), then the CCM keeps the command to switch on the warning light activated and the instrument panel continues to keep the warning light on and position the pointer at the end of the scale.

FUEL GAUGE

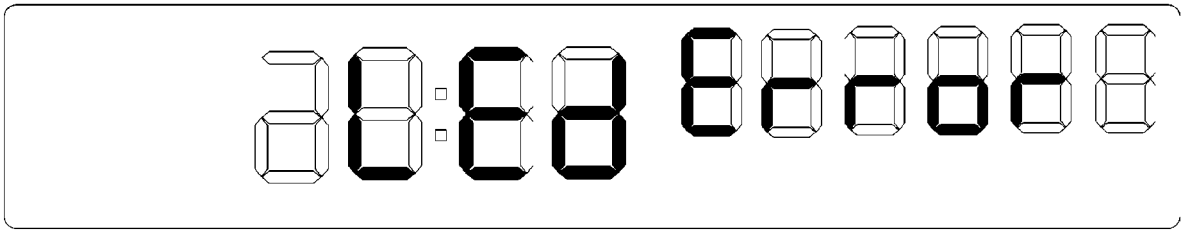
The gauge signals the fuel level. The NBC contains damping software to prevent incorrect readings due to the fuel splashing around in the tank. The instrument panel is restricted to displaying the data received at the CAN line.
The precision / calibration guaranteed is 2 angular degrees throughout the scale.

Reserve warning light

The NQS lights up the reserve warning light when the NBC signals a fuel level equal to the value programmed at the EOL for the tank capacity. In order to prevent the reserve warning light from flashing, it comes on with a delay (timed hysteresis) of 50 seconds after the reserve condition occurs; the warning light goes out with a delay of 30 seconds from the moment this condition no longer exists.

WARNING LIGHTS FAILURE SIGNAL

The NQS checks the operation of the following warning light signals: ABS, EBD. When the warning light is on to signal a fault. At the end of the initial check on the warning lights, the panel signals any failure for one or more of the warning lights displaying the words 'LED Error' flashing for 10 secs at 1 Hz, duty cycle 50%.



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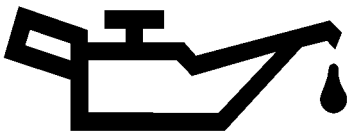
INSTRUMENT PANEL WARNING LIGHTS ON/OFF LOGIC

The behaviour of the warning lights in the NQS instrument panel can be simplified as follows:

Engine oil pressure warning light

The ENGINE OIL PRESSURE warning light comes on for four seconds when the ignition is switched on and its operation is determined the receipt of a message from the CCM.
The warning light remains off if the NQS is disconnected from the CAN line or if there is no message from the CCM.



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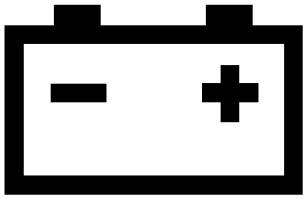
Recharging warning light

The RECHARING warning light comes on for four seconds when the ignition is switched on and its operation is determined by the receipt of the message from the NBC. The warning light remains off if the NQS is disconnected from the CAN line or if the message from the NBC is missing.



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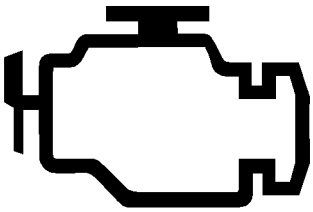
Engine control failure warning light

The ENGNIE CONTROL FAILURE warning light comes on for four seconds when the ignition is switched on and its operation is determined by the receipt of the message from the CCM. The warning light goes out if the NQS is disconnected from the CAN line, if there is a break in communication at the CAN after four seconds the check maintains the state of the warning light



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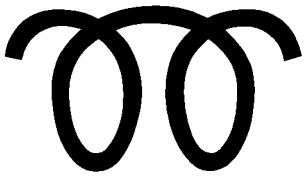
Heater plugs warning light

The HEATER PLUGS warning light (diesel versions only) comes on for four seconds when the ignition is switched on and its operation is determined by the receipt of the message from the CCM with the light on constantly with the ignition switched on and flashing (1 Hz d.c. 50%) when the heater plugs failure signal is received.
The warning light remains on when the message from the CCM is received even during the CHECK stage and even if the NQS is disconnected from the CAN line after the four seconds following the switching on of the ignition.



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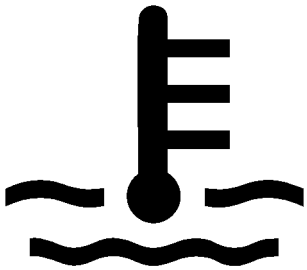
Engine coolant overheating warning light

The ENGINE COOLANT OVERHEATING warning light comes on for four seconds when the ignition is switched on and its operation is determined by the receipt of the message from the CCM.
If the NQS is disconnected from the CAN line, if there is no messager from the CCM or if the message from the CCM is a sensor/wiring failure, then the previous state of the warning light is maintained.



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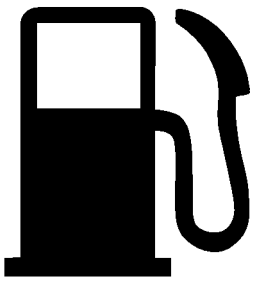
Fuel reserve warning light

The FUEL RESERVE warning light comes on for four seconds when the ignition is switched on and its operation is determined by the receipt of the message from the NBC corresponding to the reserve value (on CONSTANTLY)
The warning light goes out when the message received from the NBC corresponds to a suitable fuel level. If either the NQS or the NBC is disconnected from the CAN line or the message received from the NBC indicates a sensor / wiring failure, then the warning light starts flashing



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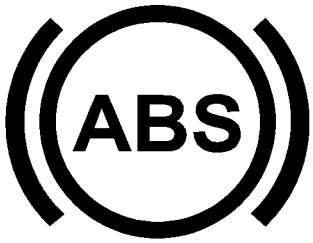
ABS failure warning light

The ABS FAILURE warning light comes on when the message from the NBC is received and the fault diagnosis is carried out when the warning light is on to signal a failure
The warning light comes on if the NQS and the NBC are disconnected from the CAN line (the operation is controlled by the NQS electronics)



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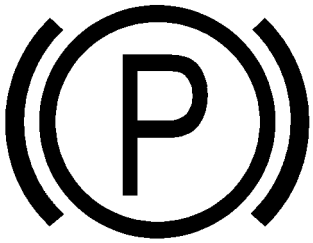
Handbrake warning light

The HANDBRAKE warning light comes on CONSTANTLY when the message is received from the NBC that the handbrake is applied.
The BRAKE FLUID LEVEL warning light comes on CONSTANTLY (handbrake released) when the message received from the NBC indicates that the fluid level is too low
The EBD FAILURE warning light comes on CONSTANTLY when the EBD failure message is received from the NBC or if the NQS and the NBC are disconnected from the CAN line.



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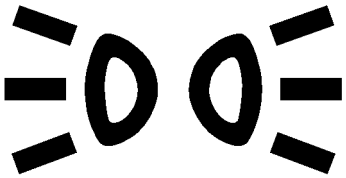
Side lights warning light

The operation of the SIDE LIGHTS warning light is determined by the receipt of the message from the NBC that the side lights are on / off
It comes on with the key in the parking position.
The warning light goes out if the NQS and the NBC are disconnected from the CAN line.



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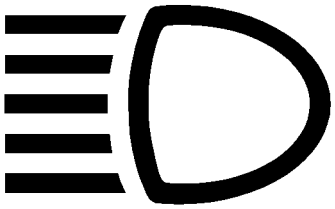
Main beam headlamps warning light

The operation of the MAIN BEAM HEADLAMPS warning light is determined by the receipt of the message from the NBC that the main beam headlamps are on / off.
The warning light goes out if the NQS and the NBC are disconnected from the CAN line.



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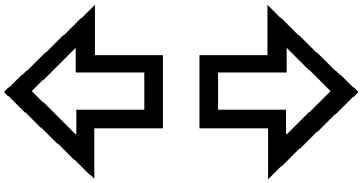
Direction indicators warning light

The operation of the DIRECTION INDICATORS warning light is determined by the receipt of the message from the NBC that the direction indicators are on or that the hazard warning light are on (the warning light for the latter can also come on with the ignition switched off) where the flashing frequency is given by the NBC
The warning light goes out if the NQS and the NBC are disconnected from the CAN line.
The warning light signals that the function has taken place by switching on the warning lights for the same family in a synchronous manner



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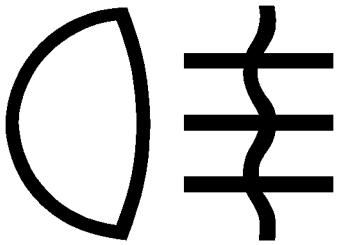
Rear fog lamps warning light

The operation of the REAR FOG LAMPS warning light is determined by the receipt of the message from the NBC that the rear fog lamps are on / off
The warning light goes out if the NQS and the NBC are disconnected from the CAN line.



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Fog light warning light

The operation of the FOG LIGHTS warning light is determined by the receipt of the message from the NBC that the fog lights are on / off
The warning light goes out if the NQS and the NBC are disconnected from the CAN line.

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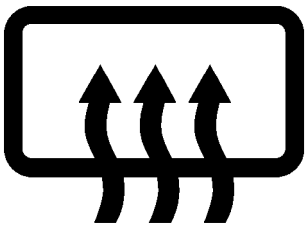
Heated rear windscreen warning light

The operation of the HEATED REAR WINDSCREEN warning light is determined by the receipt of the message from the NBC that the heated rear windscreen is on / off
The warning light goes out if the NQS and the NBC are disconnected from the CAN line.



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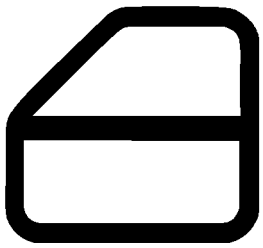
Door open warning light

The operation of the DOOR OPEN warning light is determined by the receipt of the message from the NBC that one or more of the doors or the boot is open or that al the doors are closed
The warning light goes out if the NQS and the NBC are disconnected from the CAN line.



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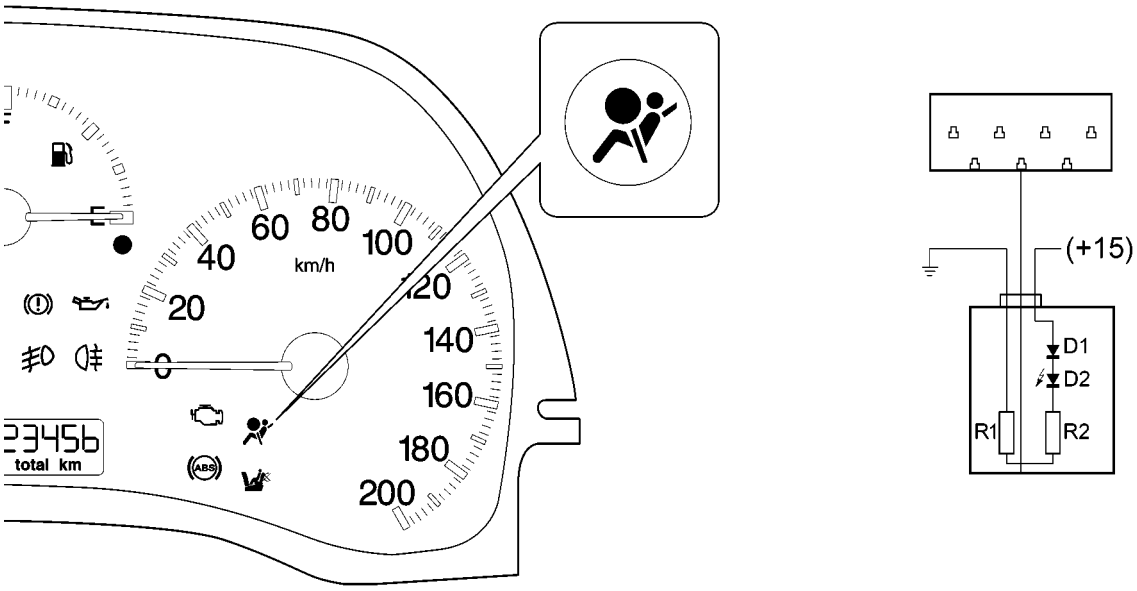
Air Bag system failure warning light (interface circuit shown in the diagram)

The AIR BAG SYSTEM FAILURE warning light (only for versions with AIR BAG) is operated directly by the AIR BAG control unit. The warning light is not connected to the CAN line, if the cable is disconnected then it comes on



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The Air Bag warning light is an intelligent warning light because it is capable of signalling a failed connection with the actual control unit. The diagram shows the Air Bag warning light in the instrument panel. It consits of an LED (D2) connected to earth by two resistances in series (R1-R2). The LED anode is supplied through a diode (D1) by +15 controlled by the ignition, whilst the the Air Bag control unit warning light pin is connected between the two resistances (R1-R2). When the key is turned, the Air Bag control unit earths pin 13 and checks the warning light. The same happens if the system is faulty. If the Air Bag control unit is not connected to the system or there is a break in the warning light control line, when the key is turned to the ON position, the warning light comes on through the connection to earth and the resistances (R1-R2).

Passenger air bag deactivated warning light (interface circuit shown in the diagram)
The PASSENGER AIR BAG DEACTIVATED warning light (only on versions with AIR BAG) is operated directly by the AIR BAG control unit. The warning light is not connected to the CAN line

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Seat belt warning light n.b. versions for Japan, Cyprus and Malta only (interface circuit shown in the diagram)
The SEAT BELT warning light is operated directly by the system, the warning light is available. The warning light is not connected to the CAN line

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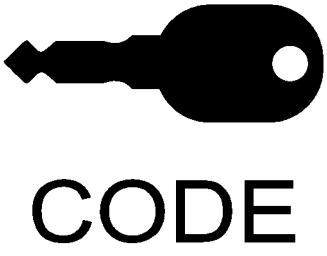
Code warning light
The CODE immobilizer warning light comes on for four seconds when the ignition is switched on and its operation is determined by the receipt of the message from the NBC in accordance with the code described in the table
The warning light remains off if the NQS is disconnected from the CAN line.



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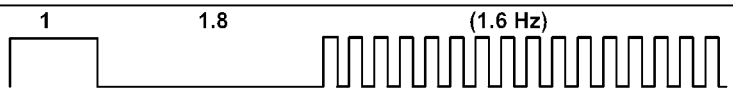
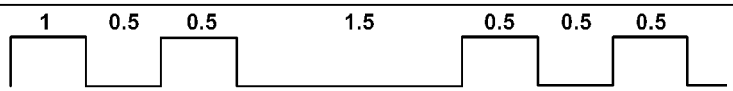
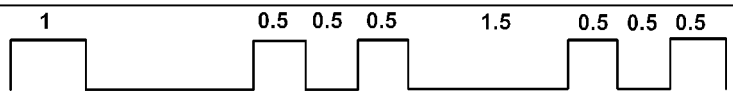
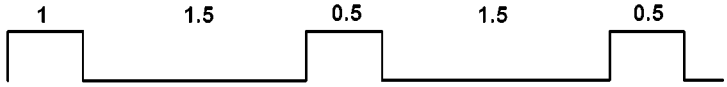
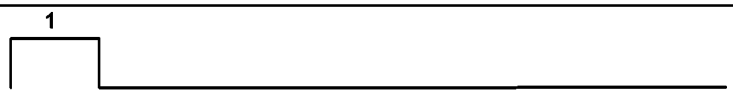
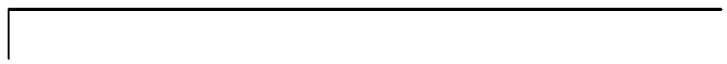
CODE WARNING LIGHT BLINK CODE TABLE

The NBC column indicates whether the Body Computer needs to be initialized (virgin V) or whether it is already programmed (M).
The CCM column indicates whether the Body Computer needs to be initialized (virgin V) or whether it is already programmed (M).
The column TRAS indicates the state of the transponder with OK - everything alright and KO not working
The LINK column indicates the state of the dialogue between the NBC and the CCM with OK standing for everything alright and KO meaning not working

NBC	CCM	TRAS	LINK	
V	V	OK	OK	
V V	V M	KO KO	OK OK	
V	M	OK	OK	
V V V V	M M V V	OK KO OK KO	KO KO KO KO	
M M	V M	OK OK	OK OK	
M M M M M M	V V V M M M	KO OK KO KO OK KO	OK KO KO OK KO KO	

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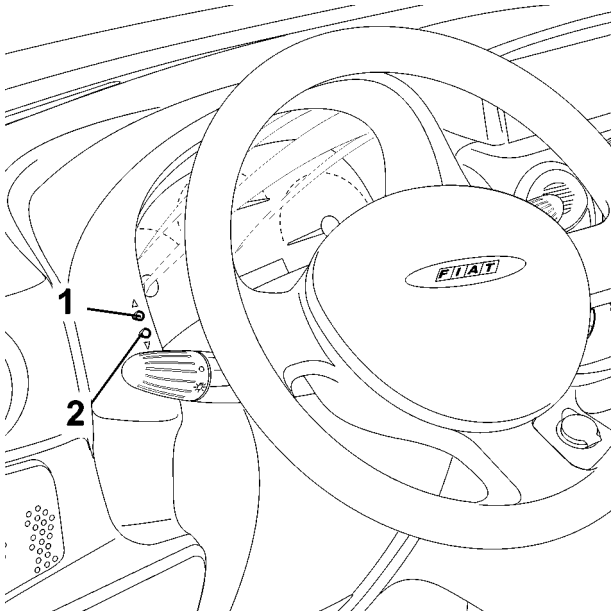
PANEL LIGHT

The orange coloured 'backlight' LEDs for the LCD (Liquid Crystal Display) are always on (even when the side lights are switched off, but the ignition is on)
The backlight LEDs for the scales and gauges are activated when the side lights on message is received by the The actual panel activates the backlight LEDs if the NQS is disconnected from the CAN line.

HEADLAMP ALIGNMENT ADJUSTMENT

The panel has two dedicated inputs for the Headlamp Alignment Adjustment (CAF); one carries the dipped headlamps on signal, which is used to supply the operating circuit, the second is the signal which goes to the adjustment device on the headlamps.



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The headlamp alignment can be adjusted using two switches which can assume four positions:
- the upper switch (1) (increases the voltage) decreases the value of the position (the light beam is raised),
- the lower switch (2) (decreases the voltage) increases the value of the position (the light beam is lowered).

The switch should be pressed for about 200 ms (to receive the signal); the switches should be released and pressed again to change position.
With a nominal supply of 13.5 Volt from the battery, the operating circuit, inside the panel, provides the following voltages:

POSITION 0	11.42 Volt
POSITION 1	8.89 Volt
POSITION 2	7.59 Volt
POSITION 3	6.25 Volt

With a tolerance of one Volt
The instrument panel display shows the reading for the adjustment device position with an ideogram of the number corresponding to the position selected.

Note: *The switches are only activted if the dipped headlamps are on and the ignition is switched on.*

TRIP COMPUTER

The TRIP COMPUTER is a function of the instrument panel (NQS) which makes it possible to display the following:
- TOTAL MILOMETER;
- TRIP METER;
- VEHICLE RANGE;
- AVERAGE SPEED;
- JOURNEY TIME;
- AVERAGE CONSUMPTION.

All these readings, connected to the trip, are shown by the milometer display, using the most suitable figures and letters in the display. The TRIP function is only available on versions with a rev counter and coolant temperature gauge.
The following information is sent to the Body Computer Connector (NBC): mileage; fuel level in the tank (as a percentage of a full tank) and speed.
The information sent by the Engine Management Control Unit (CCM) includes the 'instant consumption' (in litres/hour) and the journey time counted by a clock inside the Instrument Panel Connector (NQS) making it possible to calculate the values displayed
When the vehicle is stopped with the engine switched off, the counting of the various values stored in the memory (average speed, journey time...) are halted but not reset and resume as soon as the vehicle sets off again.
Therefore the countign only takes place when the ignition is switched on and the consumption signal is received from the CCM.

The figures stored in the memory can be zeroed through a manual reset (using the top right button) or when the maximum value which the milometer can display is reached. Therefore when the user resets the value, a new calculation is started, referring to the interval between one reset and the next.

AVERAGE SPEED

The 'average speed' is calculated using the instant speed starting from when the driver reset the function.
Every second the instant speed value is added in an accumulator and is then divided by the number of seconds which have elapsed since the start of the calculation, the value obtained in this way is updated on the display.
The value calculated is in tens of km/h or tens of mph.

RANGE

The range of the vehicle is the estimated distance in km or miles, assuming that the journey will continue in the same consumption conditions, which the vehicle can travel with the fuel in the tank. The value is calculated using the information received via the CAN (mileage; tank capacity and level; instant consumption; journey time).
If the fuel reserve warning light is on, the vehicle range is calculated and dashes appear on the display.
The range is calculated by multiplying the average consumption by the number of litres of fuel in the tank from when the battery was disconnected / connected or, better, from when the function was reset.
When the battery is connected, an average consumption of 15 km/litre is used for the calculation. To prevent the range from varying in an uncontrolled fashion, the average consumption settles down with the use of the vehicle.
When a new calculation is begun, the average consumption figure for the values measured previously when the function was reset is used as an initial value for counting the range for the new measurement and calculating the figures.
Whilst proceeding with detecting the information, the weight of the initial value loses importance and the average consumption data for the new measurement prevail. The average consumption depends a great deal on the driving style. In the moments following the start of a new measurement. The panel assumes that the tank has been refilled if there is an increase in the fuel level equal to at least 7% of the tank capacity.
If the tank is refilled, the panel displays a new range figure straight away, whilst during the use of the vehicle, the variation in the range data displayed takes place with increases proportional to the difference between the value displayed and the value calculated. In any case, the data is updated once every 30 seconds.

AVERAGE CONSUMPTION

Average consumption refers to the ratio between the distance travelled since the reset and the number of litres consumed since the figures have started to be measured.
The constant 1 gallon = 4.546 litres is used for the conversion from litres to gallons
The average consumption figure is updated every 10 seconds.
The average consumption figure tends to be 0 if the vehicle is stopped for a long period with the engine switched off.

DISPLAY MODES

All the information linked to the trip (trip mileage, range, average speed, journey time, average consumption) are displayed by the milometer, from time to time using the most suitable figures and letters from the display.
After the battery has been connected the TOTAL MILEAGE is diplayed

Repeatedly pressing the TRIP button (if it is for less than 3 seconds) makes it possible to move cyclically, in the display, from one set of information to another, in the following order:
- total mileage;
- trip mileage;
- average consumption;
- range;
- average speed;
- journey time;
- total mileage;
- etc.

The various pieces of information remain on the display until the Trip button is pressed
If the vehicle speed sensor is faulty, all the trip information display shows 5 dashes together with the description of the function (A and km for the range, km/h foar the average speed, etc.). If the fuel sensor is faulty, then dashes are displayed for the range and the average consumption.
If the sensor situation returns to normal, the counting continues according to the appropriate modes for each piece of information and none of the figures are reset and no new calculation is begun.

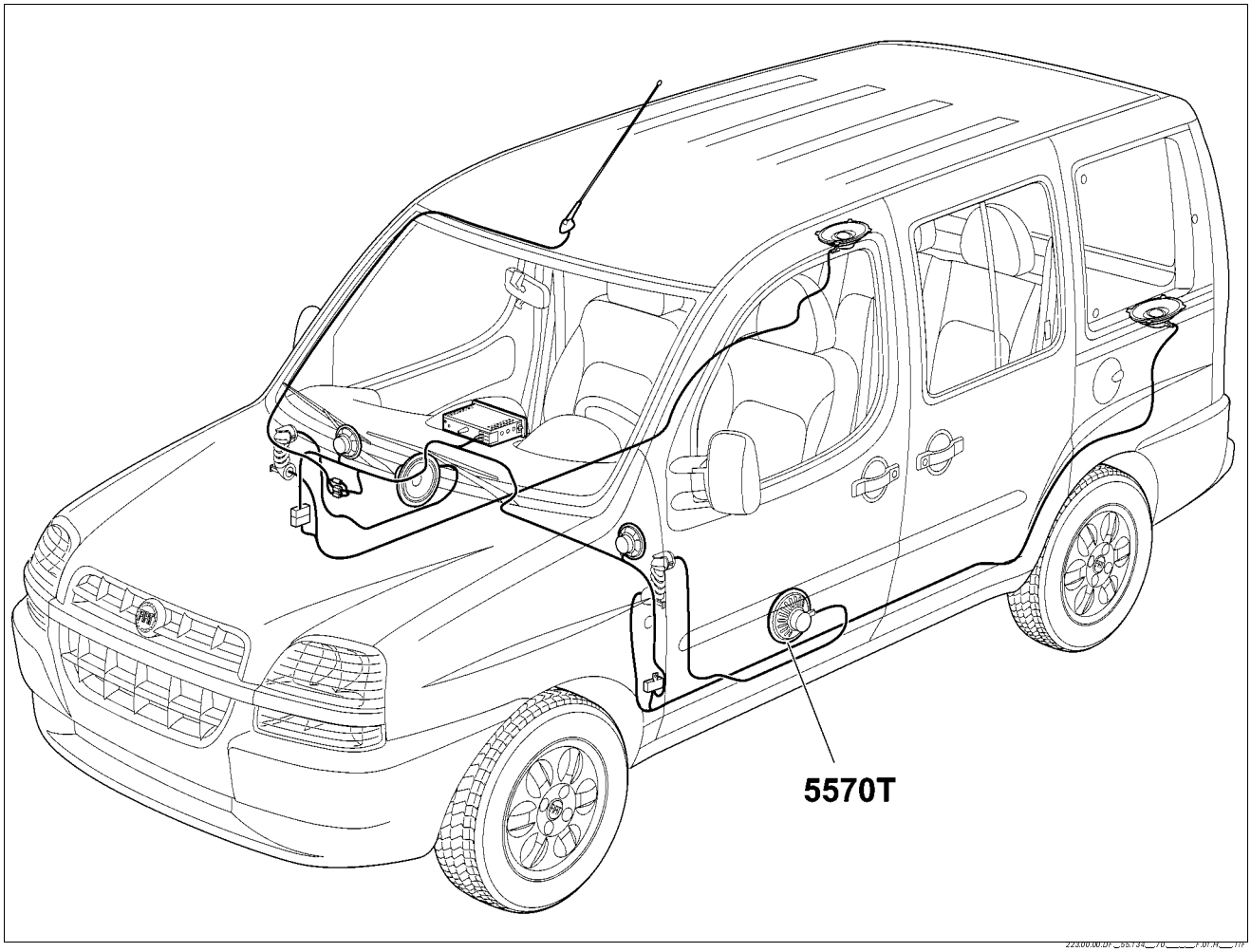
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- GLOSSARY

Assembly drawings index

Cmp	Description	Validity
5570T	Car radio and car telephone	

SUB-GROUP GRAPHIC INDEX



GLOSSARY

TWEETER

Speaker for the reproduction of high frequency sounds

WOOFER

Speaker for the reproduction of low frequency sounds

RDS (RADIO DATA SYSTEM)

Radio data system combined with FM broadcasting station radio signals

AF (ALTERNATIVE FREQUENCY):

Function for RDS transmitters: automatic switching from one frequency to another with better reception

TP (TRAFFIC PROGRAM)

Special signal from RDS transmitter broadcasting traffic new flashes

5570T - Car radio and car telephone

SPECIFICATIONS

Two models of radio are available as an option: one with a CASSETTE and one with a CD.

Both models have been developed in conjunction with BLAUKPUNT (BOSCH) based on the following criteria:
- The radio has been designed in accordance with the specific acoustic conditions of the passenger compartment and fits perfectly with the design of the dashboard.
- The radio is placed in a user-friendly position for the driver and passengers.
- It is easy to use thanks to the small number of controls which can be easily identified.
- It includes a theft protection system that ensures the radio can only be used on the vehicle to which it has been factory-fitted.

Anti-theft protection is ensured by two different systems:
- the radio with cassette comes with a four-figure code that is requested whenever the radio is turned on after the battery has been disconnected;
- the radio with CD, on the other hand, communicates with the electronic unit that manages the electrical equipment (body computer). When the radio is activated, the body computer reads the radio code and determines whethe to turn it on or not. When the radio is connected to another car without a body computer, the set cannot be used because the radio does not recognise the electronic unit it is designed to communicate with and the radio is blocked. If the radio is used on another vehicle with a body computer, it can be used only if the four figure security code is known.

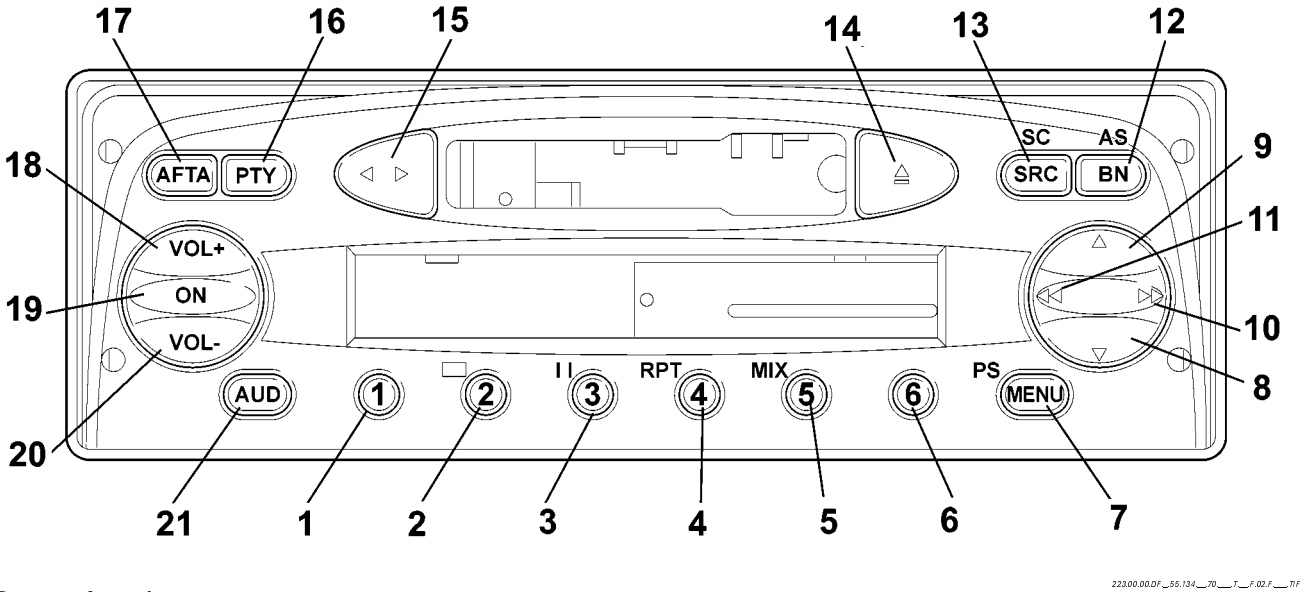
The radio also features a logic which automatically switches the radio on and off: if the radio has been accidentally left on (with the engine switched off), it will switch off automatically after 20 minutes to prevent the battery from being run down.

To summarize, the radio specifications are:
- 5 frequency bands FM I, FM II, FMS, MW and LW
- Automatic and manual station search
- 30 programmable stations, 18 on FM, 6 on MW and 6 on LW
- RDS/EON receiver
- TA traffic news function
- Autostore for FMS, MW and LW
- Automatic mono/stereo selector
- Volume adjustment according to speed (Speed volume control) - (CD version only)
- CD player and programming with functions that can be set: selection/search, random selection, scan - (CD version only)
- Dolby B noise reduction - (CD version only)
- Radio reception when setting CD - (CD version only)
- Cassette player with mechanical autoreverse
- 4 channels with 20W peak power each
- Aerial
- 2 speakers (Van version) 6 speakers (Panorama version)
- 2 tweeters in dashboard
- 2 Ø 165 in front door panel
- 2 Ø eliptical in rear parcel shelf mounting
- Separate treble - bass controls
- Balance control
- Last status: each time the radio is turned on, the settings prior to deactivation are restored.
- Telephone mute: when a phone is connected (only for Motorola or Motorola-compatible mobiles) to the car, every other radio function can be deactivated when there is an incoming call.
- Telephone in: radio speakers can be used to listen to the phone in handsfree mode.

COMPOSITION

Front view (version with cassette)

The diagram below shows the front view of the radio with cassette.



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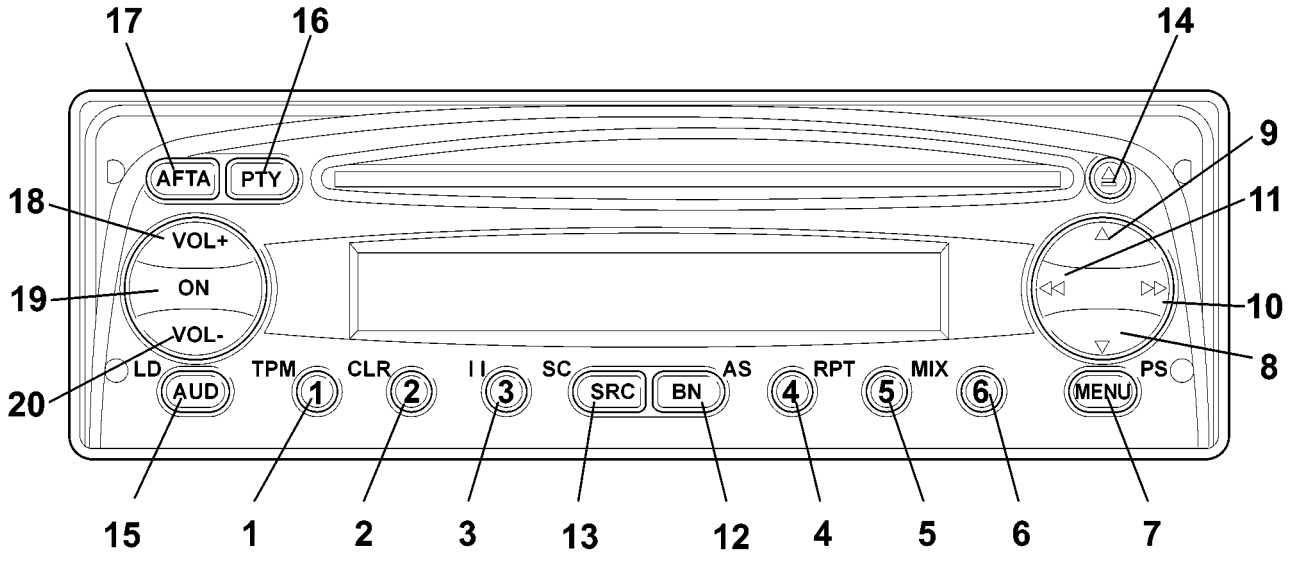
Button functions

Button N°	Description of functions		Tuner	Cassette
	Short button press	Long button press		
1	Recall preset	Programme preset	1. Recall preset 2. Programme preset	Button 2: Dolby B ON/ OFF
2				
3				
4				
5				
6				
7	Access menu	Scan preselection	1 Access menu 2 Scan preselection	Access menu
8	Automatic backwards search	Automatic continuous backwards search	Automatic search	MSS backwards
9	Automatic forwards search	Automatic continuous forwards search	Automatic search	MSS forwards
10	1. Manual forwards search 2.Next PTY programme 2. Fast forward	1.Manual forwards search 2.Next PTY programme 3.Fast forward 4.Next track selection	1.Manual forwards search 2.Next PTY programme	Fast forward
11.	1.Manual backwards search 2.Previous PTY programme 3.Fast rewind	1.Manual backwards search 2.Previous PTY programme 3.Fast rewind 4.Start of track	1.Manual backwards search 2.Previous PTY programme	Fast rewind

Button N°	Description of functions		Tuner	Cassette
12.	Radio band selection	Travelstore (FMT)	1.Band selection FM1, FM2, FMT, MW, LW 2.Travelstore (FMT)	Travelstore (FMT)
13	In order: Tuner, CC	Source scan	1.In order: Synthesizer, CC 2.FM/AM scanning	1.In order: Synthesizer, CC 2.Cassette scanning
14	Cassette eject	-	Cassette eject	Cassette eject
15	Autoreverse	-	Autoreverse	-
16	PTY ON/OFF	Displays the type of programme	1.PTY ON/OFF 2.Displays the type of programme	-
17	TA ON/OFF	AF ON/OFF	1.TA ON/OFF 2.AF ON/OFF	1.TA ON/OFF2.AF ON/OFF
18	Increases the volume by one step	Increases the volume rapidly	1.Increases the volume by one step 2.Increases the volume rapidly	1.Increases the volume by one step 2.Increases the volume rapidly
19	Mute ON/OFF	1.Radio on 2.Radio off	-	-
20	Decreases the volume by one step	Decreases the volume rapidly	1.Decreases the volume by one step 2.Decreases the volume rapidly	1.Decreases the volume by one step 2.Decreases the volume rapidly
21	Bass, treble, balance, fader selection	Loudness ON/OFF	1.Bass, treble, balance, fader selection 2.Loudness ON/OFF	1.Bass, treble, balance, fader selection 2.Loudness ON/OFF

Front view (version with CD)

The diagram shows the front view of the radio with CD



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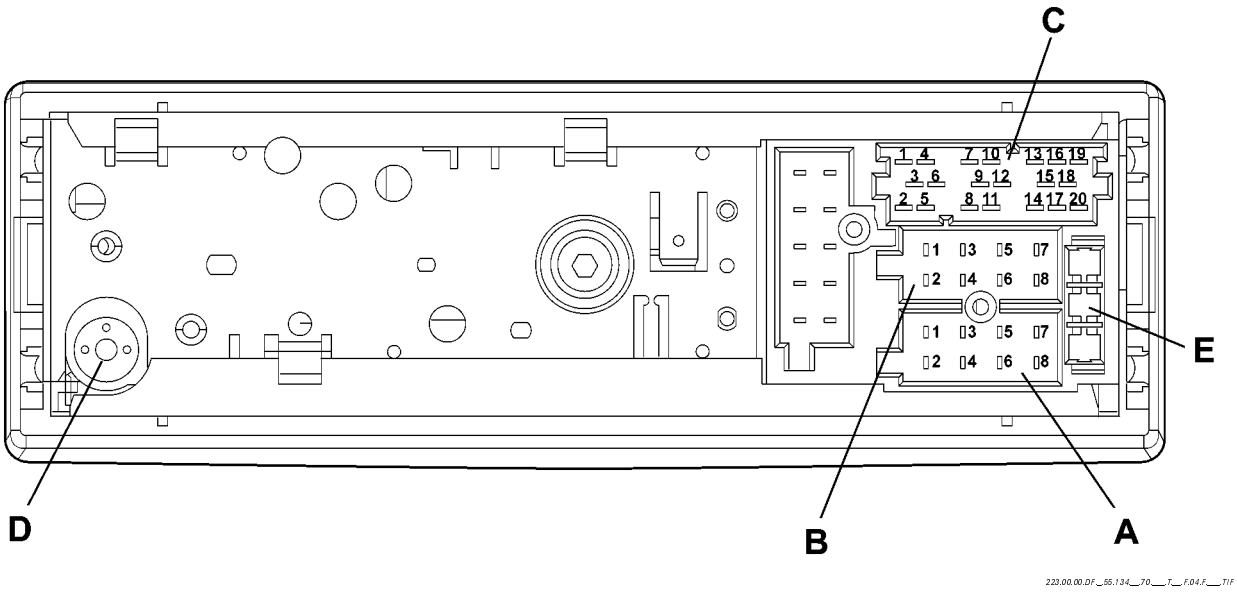
Button function

Button N°	Description of functions		Tuner	Cassette
	Short button press	Long button press		

Button N°	Description of functions		Tuner	Cassette
1 2 3 4 5 6	1.Recall preset 2.TPM ON/OFF 3.Pause ON/OFF 4.Repeat ON/OFF 5.Mix ON/OFF	1.Programme preset 2.Programme/rest TPM	1.Recall preset 2.Programme preset	button 1:- 1.TPM ON/OFF - 2. Programme TPM button2: Rest TPM button 3: Pause ON/OFF button 4: Repeat ON/OFF button 5: Mix ON/OFF
7	Access menu	Scan preselection	1 Access menu 2 Scan preselection	Access menu
8	Automatic backwards search	Automatic continuous backwards search	Automatic search	Previous track selection
9	Automatic forwards search	Automatic continuous forwards search	Automatic search	Next track selection
10	1.Manual forwards search 2.Next PTY programme 3.Next track selection	1.Manual forwards search 2.Next PTY programme 3.Fast forward 4.Next track selection	1.Manual forwards search 2.Next PTY programme	Next track selection
11.	1.Manual backwards search 2.Previous PTY programme 3.Fast rewind	1.Manual backwards search 2.Previous PTY programme 4.Start of track	1.Manual backwards search 2.Previous PTY programme	Start of track
12.	Radio band selection	Travelstore (FMT)	1.Band selection FM1, FM2, FMT, MW, LW 2.Travelstore (FMT)	Travelstore (FMT)
13	In order: Tuner, CC	Source scan	1.In order: Synthesizer, CD 2.FM/AM scan	1.In order: tuner, CD
14	Cassette eject	-	CD eject	CD eject
15	Bass, treble, balance, fader selection	Loudness ON/OFF	1.Bass, treble, balance, fader selection 2.Loudness ON/OFF	1.Bass, treble, balance, fader selection 2.Loudness ON/OFF
16	PTY ON/OFF	Type of programme displayed	1.PTY ON/OFF 2.Type of programme displayed	-
17	TA ON/OFF	AF ON/OFF	1.TA ON/OFF 2.AF ON/OFF	1.TA ON/OFF 2.AF ON/OFF
18	Increases the volume by one step	Increases the volume rapidly	1.Increases the volume by one step 2.Increases the volume rapidly	1.Increases the volume by one step 2.Increases the volume rapidly
19	Mute ON/OFF	1.Radio on 2.Radio off	-	-
20	Decreases the volume by one step	Decreases the volume rapidly	1.Decreases the volume by one step 2.Decreases the volume rapidly	1.Decreases the volume by one step 2.Decreases the volume rapidly

Rear view (version with cassette / CD)

The diagram below shows the rear view of the radio.



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RADIO INTERCONNECTIONS

Connector A

N°	Connection functions	Input / Output	Voltage/max current	Type of protection
1	CAN - BUS B	I/U	13.5V / 10mA	-
2	-	-	-	-
3	CAN - BUS A	I/U	13.5V / 10mA	-
4	-	-	-	-
5	12V switchable for aut. Aerial	U	13V / 400mA	-
6	-	-	-	-
7	Ignition (+30)	I	13.5V / 10A	Polarity reversal
8	Earth (+31)	I	0V / 10A	Polarity reversal

Connector B

N°	Connection functions	Input / Output	Voltage/max current	Type of protection
1	RR+ (right rear speaker +)	U	11V / 4.5A	Short circuit Temperature
2	RR- (right rear speaker -)	U	11V / 4.5A	Short circuit Temperature
3	RF+ (right rear speaker +)	U	11V / 4.5A	Short circuit. Temperature
4	RF - (right rear speaker -)	U	11V / 4.5A	Short circuit. Temperature
5	LF + (right rear speaker +)	U	11V / 4.5A	Short circuit. Temperature

N°	Connection functions	Input / Output	Voltage/max current	Type of protection
6	LF- (right rear speaker -)	U	11V / 4.5A	Short circuit. Temperature
7	LR+ (right rear speaker +)	U	11V / 4.5A	Short circuit. Temperature
8	LR- (right rear speaker -)	U	11V / 4.5A	Short circuit. Temperature

Connector C

N°	Connection functions	Input / Output	Voltage/max current	Type of protection
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	Telephone NF in +	I	11V / 2mA	-
8	Telephone NF in -	I	11V / 2mA	-
9	Telephone mute	I	13.5V / 2mA	-
10	-	-	-	-
11.	-	-	-	-
12.	Signal earth	I/U	0V / 40mA	-
13	ASCI-BUS in	U	5V / 11mA	-
14	ASCI-BUS out	I	5V / 11mA	-
15	-	-	-	-
16	-	-	-	-
17	ASCI-BUS Earth	I/U	0V / 10A	-
18	-	-	-	-
19	-	-	-	-
20	-	-	-	-

Connector D: Aerial
E: 10A fuse

FRONT SPEAKERS

SPECIFICATIONS:

100mm diameter speakers located in the dashboard:
- Rated impedance: 6 Ohm
- RMS power: 15 Watt
- MAX power: 30 Watt

165mm diameter speakers, located in the front door panel:
- Rated impedance: 6 Ohm
- RMS power: 20 Watt
- MAX power: 40 Watt

REAR SPEAKERS

SPECIFICATIONS:

9x15 eliptical speakers located in the rear parcel shelf mounting:
- Rated impedance: 4 Ohm
- RMS power: 20 Watt
- MAX power: 40 Watt

AERIAL

Two types of aerial can be fitted on vehicles which have a radio depending on the accessories:
- one model known as the style aerial is fitted on vehicles which can accommodate preparation for mobile phones.
- one model, known as the dual function aerial is fitted on vehicles which do not have preparation for mobile phones.

Front section

Lighting

The lighting consists of an LED.
Only the display lighting can be adjusted.
The lighting signal is connected through pin A6.

If the signal is:
- <3.3V±5%, the day light is activated (maximum light intensity).
- >3.3V±5%, the night light is activated (the lighting depends on the signal).

Example of Tuner screen:

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Operation

general functions

Switching the equipment on using the ON button

The equipment is switched on by pressing the ON button for more than 20 msecs. The display should respond immediately (within 1 sec., last source indication), the audio function should usually be heard within 2.5 secs. To switch the equipment off, press the ON button for moore than 1 sec.

On/off logic, time mode

It switches off automatically 20 minutes after the ignition has been switched off. The radio can be switched on, for a futher 20 minutes, after it has been switched off automatically, by pressing the On button.

Last status

After the radio has been switched on/off, the same settings persist, if the volume level is above 30 then the equipment will resume at 30.

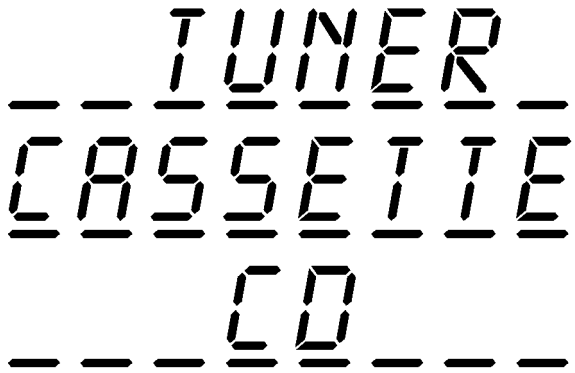
The values can be modified.

CC/CD ejection

To eject the cassette/CD, press the eject button Δ (only if the radio is on). The cassette/CD will be ejected and the source listened to before the cassette/CD was played will be heard.

Switching source

To access and change the available sources, press the SRC button briefly.
After each change of source, the new source is displayed for 2.5 secs:



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Whilst the message is displayed, the last source is played.

Alternative frequency search

To activate / deactivate the search for alternative frequencies for the station selection,press the AF/TA button for a while (1 sec., an auditory signal will follow). The letters RDS will still be shown on the display (if available) and the 'AF' symbol will be displayed if the AF function has been activated.
If the radio is in AM mode, when the AF/TA button is pressed the Tuner will move to the FM band for the last station selected.
Manufacturer's pre-defined setting: AF on

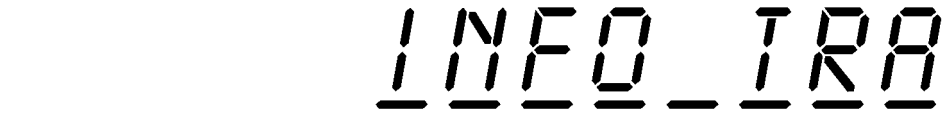
Traffic information

To activate / deactivate the traffic news function, press the AF/TA button briefly (<1 sec.).
If the traffic news function is activated, but the radio station selected does not broadcast traffic information, an auditory message (beep) will be sounded every 30 secs.
If the broadcaster is on the AM band and the AF/TA button is pressed briefly (<1 sec.), the tuner will tune into the last FM1 station listened to. If the station selected does not broadcast traffic news, the search will start and an auditory signal will be produced.
If the source activated is CC or CD or telephone or mute and the AF/TA button is pressed briefly (<1 sec.), then the traffic news function is activated and traffic information will be broadcast. If the last source was the AM radio, then the tuner will switch to FM1 for the last broadcaster selected (background).
If the station selected does not broadcast traffic information, the search will start (it should be noted that this takes place in the background, without acoustic or visual feedback).

Traffic news volume:
- Listening volume < 30: Traffic news voume = 30 (fixed volume)
- Listening volume = 30: Traffic news volume equal to listening volume + 1

If the vehicle leaves the area covered by the radio station tuned into, this is what happens:
- Tuner mode: a warning signal will be activated every 30 seconds
- CC or CD mode or telephone activated or mute function activated: a tuning search will be launched (it should be pointed out that there will be no visual or acoustic information)

If the AF/TA button is pressed briefly (<1 sec.) during the transmission of a traffic bulletin, the news will no longer be transmitted even if the traffic news function (TA) continues to be activated.
If a traffic news flash is being transmitted, the following will be shown on the display:



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By pressing the AF/TA button briefly (< 1sec.) whilst a traffic news flash is being transmitted, it will be interrupted and the traffic news function will continue to be activated.

General information on traffic news:
- During a traffic bulletin the audio function can be activated using the 'AUD' button.
- There are no separate audio values, in other words the audio will be adoped even after the traffic message.
- The alteration of the volume during a traffic bulletin will not be confirmed on the display. The value regulated is only valid for the individual bulletin.
- During a traffic bulletin it is possible to recall a programm using the preselection buttons and the traffic bulletin will be deactivated.(only in radio mode)
- During a traffic bulletin, the source can be changed using the predefined SRC button (the traffic bulletin will be deactivated).

PTY31

The PTY31 process is similar to the traffic news function, but without the possibility of deactivating it or changing a preselected station.

Autostore (automatic programming)

Press the BN button for a while (=1 sec., auditory signal follows) to activate the Autostore function. The radio uses this function to programme the six stations with the strongest signal in decreasing order of intensity for the signal on the FMT frequency band. If the traffic news function is activated, only stations broadcasting traffic information are programmed.
The following information is shown on the display during the automatic programming process:

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If the autostore process is activated in CC or CD mode or the source is changed, this process takes place in the background.
Each station is only programmed once.
Exception: For regional programmes the second figure of the PI cannot be taken into consideration during the autostore process with the result that a broadcaster could be programmed with 2 different PI codes.
To interrupt the automatic programming process, press the BN button again (the last station selected before the programming process was started will be selected).
At the end of the autostore function, the system will automatically activate the 1st station preselected on the FMT level.

If less than six stations can be received, the preselection buttons remaining free will be represented by four horizontal lines for 2 secs. and the last broadcaster listened to will be reproduced:

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General information when the autostore function is activated:
- At the start of the autostore function, all the other functions and menus are disabled;
- Pressing a button with a function for the radio (e.g. PTY, >>, <<, preselection buttons) will interrupt the autostore function, the last station listened to before the start of the process will be tuned into and the function associated with the button selected will be carried out;
- Pressing the TA button during the autostore process will interrupt the process, the TA function will be activated / deactivated and a new autostore process will be initiated.
- Changing source will not interrupt the autostore process, but it will continue in the background.

Mute function

Press the ON button briefly (< 1 sec.) to activate/deactivate the Mute function. If the Mute function is activated, the volume will decrease in 800 msecs. from the current volume to the value 0e the display will show:

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If the Mute function is deactivated, the volume will increase by 0 to the value previously listened to in 800 msecs. and the display will show whatever was displayed before the activation of the Mute function.

General information when the Mute function is activated:
- Pressing the volume button deactivates the Mute function and alters the listening volume
- All the functions and the menu can be used
- If a traffic bulletin is received (with the TA function activated) or a PTY31 message is received, the activated Mute function will be be ignored

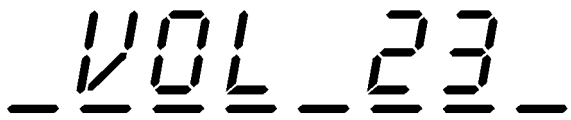
Soft Mute function

The Soft Mute function is activated if one of the 6 preselection buttons or the BN button or the ON/OFF button is used
If one of these buttons is pressed, the volume decreases with a soft mute effect. The ramp is set to reach volume 0 from the current volume in one sec.

If the button is pressed for:
- < 1 sec.: the moment it is released the volume increases with a soft demute. This ramp is set to reach the current volume from volume 0 in 500 msecs.
- =1 sec.: if the button is pressed for 1 sec., an acoustic signal is sounded (station programming). At the end of the acoustic signal, the volume is the current volume (no soft demute).

Volume

The volume can be adjusted in 67 steps from VOL 0 to VOL 66 using the 2 volumes buttons VOL + and VOL -.
The volume level will appear on the display for 4 seconds.
Example:



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The volume display disappears as soon as another function is selected.
If the volume level is changed during the transmission of a traffic bulletin or when the telephone is activated, this setting only remains valid for the current traffic bulletin. Later on, the equipment will adjust to the original level. If the traffic bulletin or the telephone function ends whilst the volume is being changed, the level will continue to change starting from the setting activated before the transmission of the traffic bulletin or the telephone function (including the display).
Volume function:

Speed volume control

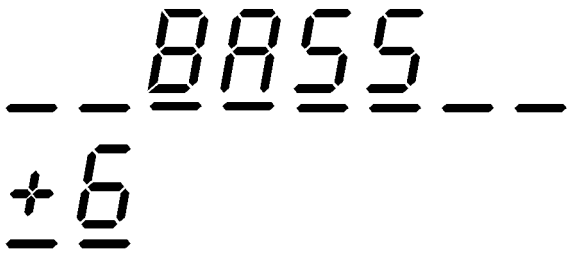
This control is used to automatically increase the volume proportionally according to the speed of the vehicle. This information is received from the CAN bus.
Speed control in 10 steps memorized in the EEPROM (can be changed during development).

In dB	Switching level during acceleration [Km/h]	Switching level during vehicle braking [Km/h]
0	-	25
1.2	30	45
2.4	50	65
3.6	70	85
4.8	90	105
6	110	125
7.2	130	145
8.4	150	165
9.6	170	185
10.8	190	200
12.	210	-

The speed volume control can be activated / deactivated in all modes (Tuner, CC, CD) using the menu.

Bass, Treble, Balance and Fader

After the first brief press (< 1 sec.) of the 'AUD' button, the current bass setting is displayed.
Example:



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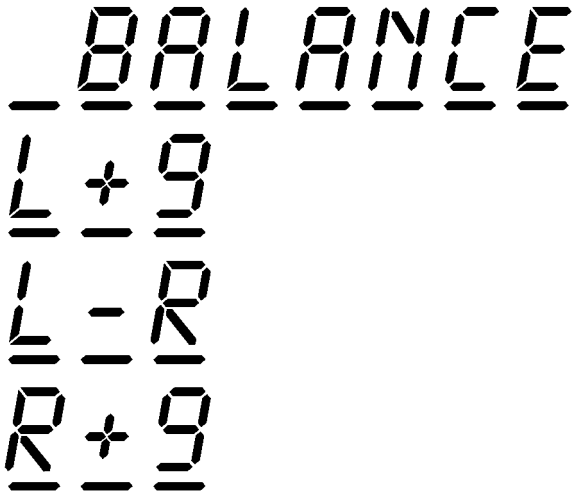
The setting is changed using the VOL + and VOL - buttons.
Control range: ± 12 dB in steps of 2 dB
Display: -6...0...+6
No stop at '0'.
If the 'AUD' button is pressed a second time, the current treble level setting is displayed.
Example:

223.00.DF-55.134-70-T-F.13.A-TIF

The setting is changed using the volume disc encoder.
Control range: ± 12 dB in steps of 2 dB
Display: -6...0...+6
No stop at '0'.
By pressing the 'AUD' button for a third time, the current balance setting level is displayed.

Examples:



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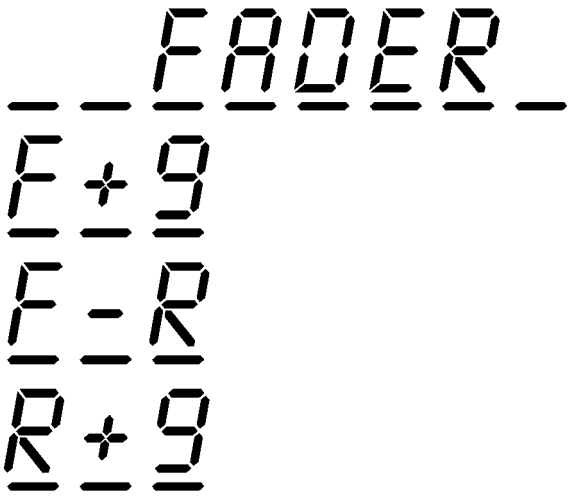
The setting can be changed using button (and (.
If the 'AUD' button is pressed for a fourth time, the current fader level is displayed.
Examples:



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The setting can be changed using the volume disc encoder.

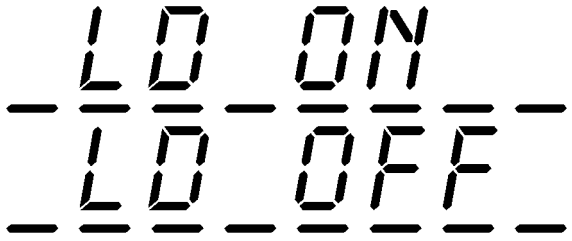
If the 'AUD' function is deactivated, the value adjusted is memorized and the equipment activates the last mode used:
- Automatically, 8 secs. after the last audio adjustment.
- By initiating an action or (de-)activating a function which requires the display of new information.
- When a new function or mode is launched (for example a T.A. broadcast, a telephone deactivation or the insertion of a cassette or CD).

Manufacturer's pre-defined setting: Bass, Treble, Balance, Fader = 0

Loudness

To activate / deactivate the Loudness function, press the AUD button for more than 1 sec (an acoustic signal is produced). The loudness mode is displayed for 4 secs.

Examples:



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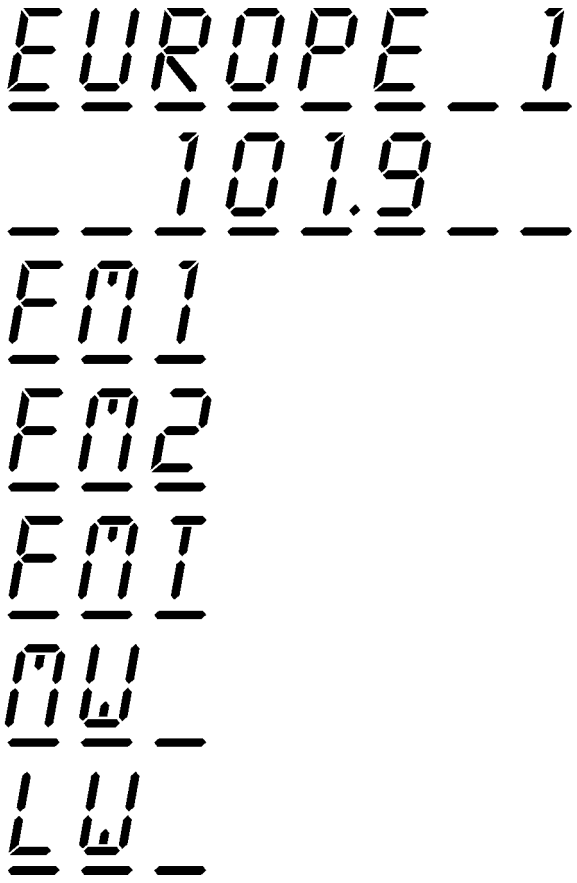
The writing on the display disappears as soon as another function is selected.

Radio Receiver Mode

The name (RDS station) or the frequency (non RDS station) of the station selected appears on the display and the frequency level is shown.
Examples:



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Frequency band switching

By pressing the BN button briefly (< 1 sec.), it is possible to activate the following frequency bands in order FM 1, FM 2, FM T, MW, LW, FM 1,.... The last station selected on the respective ban will be tuned into.
The 'Info' section of the display will show the new band

If the station selected is programed, 2 seconds later the pre-selection number will be displayed on the 'Info' side for 5 secs.
Example of pre-selection number:

223.00.00.DF..55.134...70...T...F.18.A...TIF

Pre-selection buttons (from 1 to 6)

Pre-selections:
- 18 x FM (6 x FM 1, 6 x FM 2, 6 x FMT (STORE)
- 6 x MW
- 6 x LW
- 6 x type of programme (PTY, in FM mode only, see point 5.7)

To recall the desired pre-selected station, select the frequency band desired and then press the relevant pre-selection button briefly (< 1 sec.).
The pre-selection number (rather than the band) will appear on the display (for example FM1) on the information side (see pint 5.1) and the frequency will be displayed on the RDS side for 2 secs. before the frequency band and the name of the RDS (if available) appear.
If the PI code cannot be received on the frequency pre-set for a button, the radio will start to search for this PI on another frequency as soon as the vehicle leaves the area covered by the first frequency.
The following will appear on the display:

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If the PI memorized cannot be received on any frequency, after having searched the entire, the radio will tune into the programmed frequency.
By pressing the pre-selection button for longer (+1 sec.), the station tuned into will be programmed. The system always programmes the frequency and the PI code.
The programming process is confirmed by an acoustic signal.

Automatic tuning

Press the up / down button (/v) briefly (<1 sec.) to start the automatic tuning of the next station that can be received in the direction selected. If the button is pressed for longer (= 1 sec.) the rapid search is launched. Once the tuner has tuned into the first station with a strong signal, it will stop for 1 sec. (in mute) before the rapid search continues. When the button is released, the tuner stops at the next station which can be received.
If the traffic news function is activated, the system only searches for stations which broadcast traffic news.
If the PTY function is activated, the system only searches for PTY stations. During the search the display shows the type of programme and the word SEARCH, alternately (every 2 secs.).

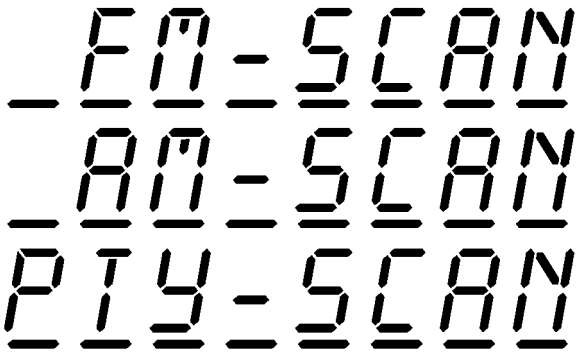
If the frequency is the same as the frequency programmed in the pre-selection on the same band (FM1, FM2, FMT, MW, LW), then the pre-selectino number will appear on the display for 5 secs.

Manual tuning

To start the gradual tuning in the direction selected, press the left / right button (<</>>) briefly (< 1 sec.). If the button is pressed for longer (= 1 sec.) the rapid function is carried out as long as the button remains pressed.
If the PTY function is activated, then it must be deactivated in order to use this function.
If the AF function is activated, then it must be deactivated in order to use this function.
If the frequency is identical to the frequency programmed for the pre-selection on the same band (FM1, FM2, FMT, MW, LW) then the pre-selection number will appear on the display for 5 secs.

FM / AM - scan

If the SRC button is pressed for longer (= 1 sec., followed by an acoustic signal), the scan of stations on the current frequency band (FM, MW, LW) will be launched. Each station found will be played for 10 secs. and its name or frequency will flash on the display. During the search (min. 2 secs.) the following will appear on the display:



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If the traffic news function is activated, the system will only search for stations broadcasting traffic news.
If the PTY function is activated, the system will only search for PTY stations.
At the start of the SCAN, all the other functions and the Menu are cancelled.

De-activating FM/AM search:
- To continue the reproduction of the station currently sought, prss the SRC button again. This operation is also valid even if the equipment is switched off whilst the FM / AM search function is in progress.
- By pressing the up or down button.
- By pressing a pre-selectino button the station programmed is tuned into
- By activating the automatic memory
- By activating / deactivating the PTY
- By changing the FM or band level
- By activating the AUD or MENU the reproduction of the current station is continued
- If the FM / AM scan finds a station transmitting traffic news and the traffic news function is activated, the search will be cancelled.
- By inserting a cassette

If no station is selected, the search function will be deactivated after the frequency band scan. The reproduction of the station selected previously will be resumed.

Pre-selection scan

Press the button for longer (MENU = 1 sec.) to start the pre-selection scan on the current frequency band: FM, MW, LW
Each pre-selection will be reproduced for 10 secs, with their name or frequency flashing on the display. During the time when changing from one pre-selection to another, the following will appear on the display (RDS side) (for 2 secs.):

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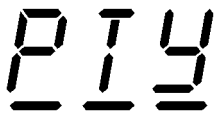
During the first 2 secs. in which the new pre-selection station is listened to, the current frequency band will be shown on the Info side and during the remaining scan time the pre-selection button number will be displayed, also on the Info side.
If the traffic news function is activated, the system will only search for stations which broadcast traffic news.
At the start of the SCAN all the other functions and the menu will be cancelled.

Deactivating pre-selected stations scanning
- By pressing the SRC button the current radio station can be listened to. This operation is also valid if the equipment is switched off whilst the scanning is activated.
- By pressing the up or down button.
- By pressing a pre-selection button
- By activating the automatic memory
- By activating the PTY
- By changing the source
- By changing the FM level or the band
- By activating the AUD or MENU the current station will continue to be reproduced
- If the preselected scanning tunes into a station which is broadcasting a TA message whilst the TA function is activated, then the scanning is aborted.
- By inserting a cassette/CD

If no pre-selection is made, the reproduction of the station selected will be resumed.

Programme type selection PTY

To activate the PTY function, press the PTY button briefly (< 1 sec.). If the PTY function is activated, the 'PTY' symbol appears on the display



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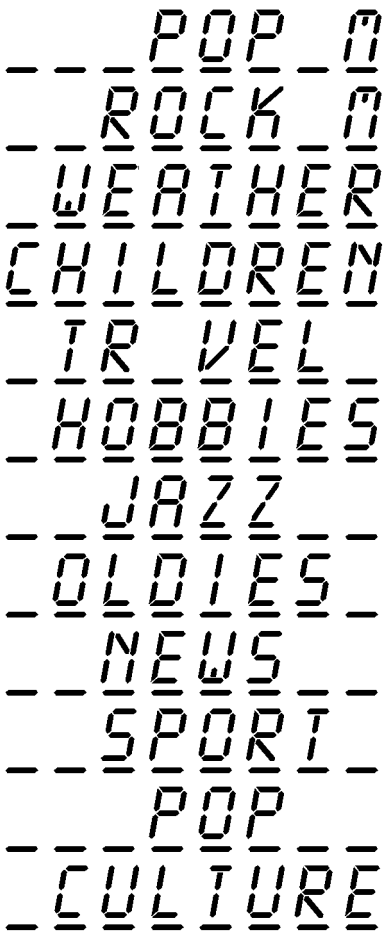
Examples of types of programmes:



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The name of the station or the frequency is displayed after 2 secs.
To change the type of PTY programme, press the << / >> buttons or one of the 6 pre-selection buttons. If the display shows the frequency or the name of the broadcaster, pressing the << / >> button will display the type of current programme.
To programme the current type of programme on one of the 6 pre-selection buttons, press the pre-selection button for longer (= 1 sec.). The programming is confirmed by an acoustic signal.
To deactivate the PTY function, press the PTY button again (< 1 sec.).
Manufacturer's pre-defined setting: PTY off.

Station PTY type of programme check

Press the PTY button for longer (= 1 sec., followed by an acoustic signal) to activate the type of programme check. After the acoustic signal, the type of programe offered by the station currently reproduced will appear on the display. If the current station has no PTY code, then the following will appear on the display:

223.00.00.DF_55.134__70___T__F.24.A___TIF

Scrolling tranmissions

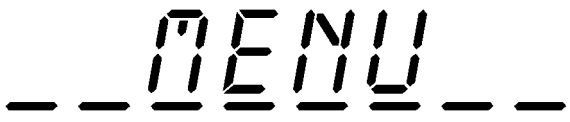
It is possible to receive different programmes on the same network and scroll them (only on FM) -
To activate this function, press AF for longer (= 1 sec.) to activate the AF function. The user can then start the scrolling by pressing the >> / << buttons.

Note: *The broadcaster should have been received previously at least once.*

MENU

MENU button

To activate the menu function, press the MENU button briefly ((1 sec.). The following will appear on the display:



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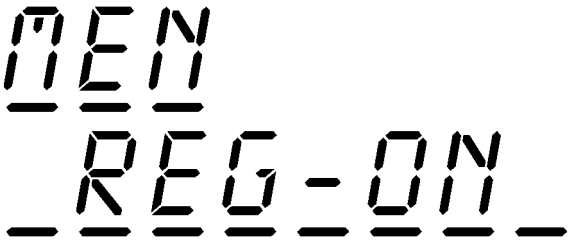
After 2 secs., the following will appear on the display:



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To exit the Menu function, press the MENU button again.

Function selection

Press the up / down button (^/v) to change the menu function to be altered. The following functions can be used:
- Balancer activation / deactivation (version with CD)
- Balancer settings (only if the balancer is activated) - (version with CD)
- Activation/deactivation of alternative frequency function (Regional)
- Adjustment of radio receiver sensitivity
- Activation / deactivation of volume control according to the speed
- Allocation of names to the CDs (only if CD mode is activated)
- Activation / deactivation of radio control function
- Telephone volume
- Hicut on/off

Activation (on) / deactivation (off) of balancer

The user can use this function to activate or deactivate the integrated balancer. If this function is not activated, the user can only alter the audio settings by changing the bass and treble. If one balancer is activated, it can make use of several settings to modify the acoustic curves:
- Preset: specific sound for the vehicle
- User: specific sound for the vehicle plus 7 band setting balancer
- Classic: fixed Rock audio curve
- Jazz: fixed Jazz audio curve

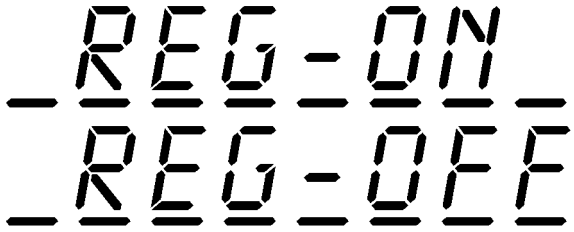
If this function is selected, one of the last three possibilities is shown on the display (last setting):

223.00.DF_55.134_70_T_F.60.C_TIF

To change this function, use the (((((buttons. If one of the balancers is activated, the 'EQ' symbol will appear on the display.

Regional function

If this function is selected, the current setting, out of 2 possibilities, will appear on the display:



223.00.DF_55.134_70_T_F.27.A_TIF

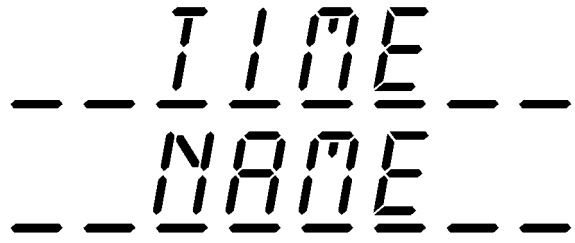
Use the << / >> buttons to change the function.
Manufacturer's pre-defined setting: REG-off.

CD display function

If this function is selected, the following will appear on the display:

223.00.00.DF_55.134__70___T__F.49.A___TIF

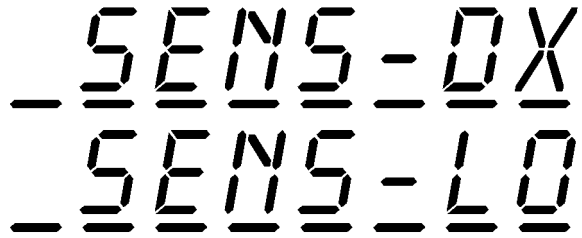
Use the << / >> buttons to change this function. The current setting, which is one of the following two possibilities, will appear on the display:



223.00.00.DF_55.134__70___T__F.50.A___TIF

Adjustment of radio receiver sensitivity

If this function is selected, the current setting, from the following 2 possibilities, will appear on the display:

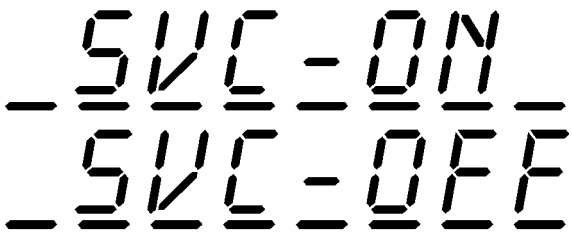


223.00.00.DF_55.134__70___T__F.28.A___TIF

Use the << / >> buttons to change the function.

Speed volume control function

If this function is selected, the display will show the current setting from the following 2 possibilities:

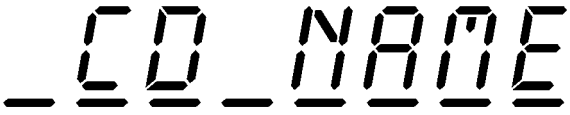


223.00.00.DF__55.134.__70.___T.__F.29.A.___TIF

Use the << / >> buttons to change the function.

CD naming function

This function can only be selected if a CD is inserted. The following appears on the display:



223.00.00.DF__55.134.__70.___T.__F.51.A.___TIF

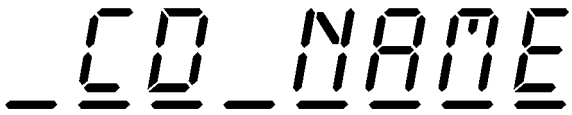
Use the << / >> buttons to activate this function. If the CD already has a name, this will appear on the display.
Example:

223.00.00.DF__55.134.__70.___T.__F.52.A.___TIF

If the CD does not have a name, then eight small lines will appear on the display:

223.00.00.DF_55.134__70___T__F.30.A___TIF

If no memory is available for a new name, then the first name in the memory will be displayed.
To change the name or to allocate a name to the new CD, press the << / >> buttons. Press the << / >> buttons again to select the position of the character to change. Use the (/(buttons to select / alter the character. To memorize the name, press the MENU button again. The following will appear on the display:

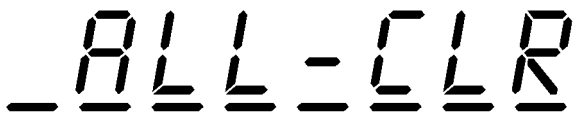


223.00.00.DF_55.134__70___T__F.53.A___TIF

To cancel the name of a CD inserted, press the pre-selection 2 button (CLR) for two seconds after having activated the CD name function:

223.00.00.DF_55.134__70___T__F.54.A___TIF

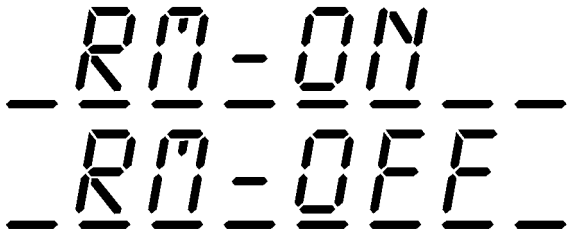
To cancel all the names, press the pre-selection 2 button (CLR) for eight seconds after having activated the CD name function. An acoustic signal is produced between the 2 and 8 seconds and the following appears on the display for 2 seconds:



223.00.DF_55.134__70___T__F.55.A___TIF

Radio monitor function

Using this function the customer can activate or deactivate the radio monitor function. If the function is not activated, the customer does not hear the cassette being wound forward/rewound. If the function is activated, the customer will hear the last station selected in the radio mode.
If this function is selected, the current setting, from the following 2 possibilities, will appear on the display:

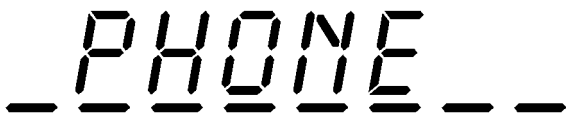


223.00.DF_55.134__70___T__F.31.A___TIF

Use the << / >> buttons to alter the function.

Telephone adjustment

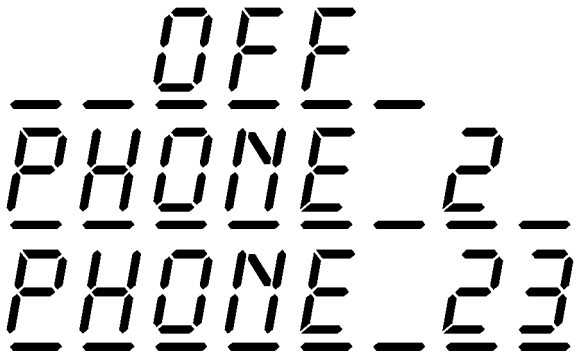
The customer can use this function to activate (setting 1 - 66) or deactivate (off setting) the audio exclusion function for the telephone.
If the telephone audio deactivation function is activated, the customer can select an initial AF telephone volume. The volume can be adjusted in 66 steps from VOL 1 ot VOL 66 using the VOL + and VOL - buttons.
If this function is selected, the following will appear on the display:



223.00.DF_55.134__70___T__F.32.A___TIF

To activate this function, press the << / >> buttons. The display will show the last setting.

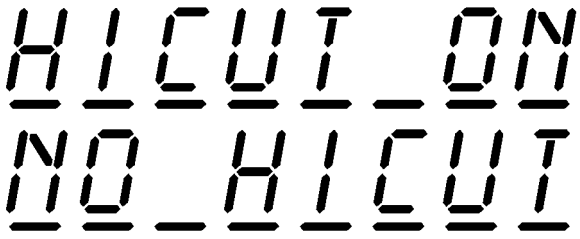
Examples:



223.00.00.DF.55.134.70.T.F.33.A.TIF

Hicut adjustment (selection which allows interference to be cut out)

The customer can use this function to activate or deactivate the Hicut function (dynamic reduction in high sounds for RF signal).
If this function is activated, the display will show one of the 2 possibilities for the current status:



223.00.00.DF.55.134.70.T.F.34.A.TIF

To change the status, use the << / >> buttons.

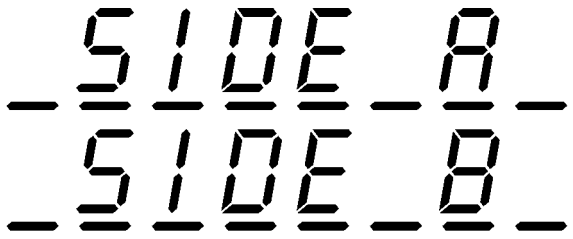
CC Mode

Activation of CC mode

Activation of CC mode:
- Insert a cassette (if the radio is off, the radio will come on in cassette mode)
- Press the SRC button until the CC mode is activated (only if there is already a cassette in the player)

If there is a casssette inserted, the 'CC-IN' symbol will appear on the display and the system will change the source and activate the reproduction of the cassette on side 1 (the side of the cassette with the label legible when the cassette is inserted).

If the CC reproduction mode is activated, one of the following two possibilities will appear on the display:



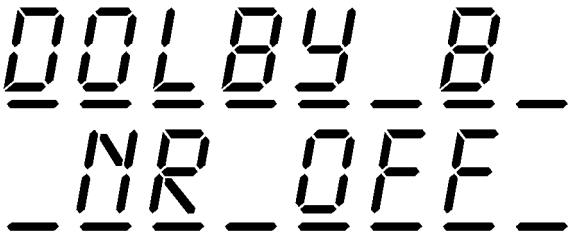
223.00.DF-55.134-70-T-F.35.A-TIF

Changin tape direction

The tape direction can be changed automatically once the end of the tape is reached or manually by pressing the reverse button (().
The reading on the display will change as a result.

DOLBY B noise reduction

To activate / deactivate the DOLBY B noise reduction, press button 2 and the following will appear on the display for 2 secs.:



223.00.DF-55.134-70-T-F.36.A-TIF

If the Dolby function is activated, the Dolby symbol will appear on the display.

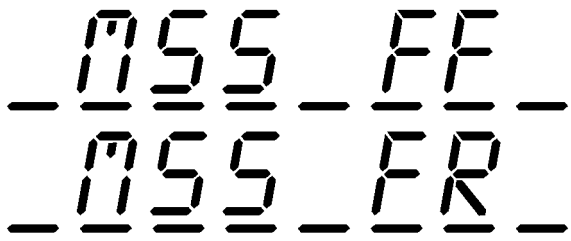
MSS (allows 'send forwards' or rewinding to find the previous or next track)

Press the button to check the MSS selection in the forwards direction (maximum of 9 titles) and the v button to check the MSS selection in the reverse direction (maximum of 9 titles). Keep the button pressed to continue the MSS selection. When the MSS modes are activated, the following appears on the display:

- Number of titles to omit:

223.00.00.DF._55.134.__70.___T.__F.37.A.___TIF

MSS direction:



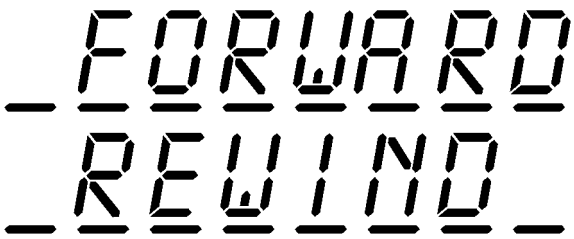
223.00.00.DF._55.134.__70.___T.__F.38.A.___TIF

If the MSS is activated, the fast forward or rewind will stop as soon as the system detects the position of the tape not recorded or at the end of the tape.

The MSS search is interrupted in the following cases:
- When the source is changed
- When the cassette is ejected
- In case of reversal
- By initiating an action or by (de-)activating a function which requires the display of new information
- When the radio is switched off
- The TA, Tel-mute and PTY31 functions cancel the MSS function. After the message, the equipment returns to reproduction mode
- When the << / >> button is pressed, the reproduction mode starts

Fast forward and fast rewind

To start the tape fast forward function, press the << and the >> buttons. The direction selected will appear on the display:



223.00.DF-55.134-70-T-F.39.A-TIF

The fast forward/rewind function is interrupted in the following cases:
- When the source is changed
- When the cassette is ejected.
- In the case of reversal
- By initiating an action or by (de-)activating a function which requires the display of new information
- When the radio is switched off
- The TA, Tel-mute and PTY31 functions cancel the fast foward/rewind function. After the message the equipment moves to reproduction mode.
- Pressing the / v button starts the reproduction mode

Pause function (for both models)

Press preselection button 3 to pause the cassette. The display shows:

223.00.DF-55.134-70-T-F.40.A-TIF

To remove the pause function, press button 3 again.
The pause function will be cancelled by changing the source.

Scan function (for both models)

The SCAN function is only available in play mode.
Whilst moving from one track to another, the display will show (for a minimum of 2 secs.):

223.00.00.DF_55.134___70___T___F.41.A___TIF

Each title of the cassette is reproduced for 10 secs. Whilst the track is played the display will show 'SCAN'.

The scan order is:
- From the track played to the end of the side
- Change of side and scan of side
- Changing side again and scan of side. The function will be deactivated at the end of the side.

Deactivating the scan:
- Press the SRC button again to continue listening to the track currently being played. This is also the same if a cassette is being played.
- Activate the Pause button
- Press a button for a search in 4 directions
- Press the reverse button
- Activate the AUD button
- If the TA function is activated and the station selected is being transmitted, the scan will be interrupted
- Activate the Menu

CD MODE

Activating the CD mode

Activating the CD mode:
- Insert a CD (if the radio is switched off, the CD mode comes on)
- Press the SRC button until the CD mode is activated

Track selection (forward/back);

In the CD mode, press the ((button to rewind and the ((button to forward the track selected. For the rapid function, keep the button pressed for 5 seconds.

Repeat function

Press preselection button 4 to keep repeating the track currently selected. The following will appear on the display for 2 seconds:

223.00.00.DF_55.134___70___T___F.56.A___TIF

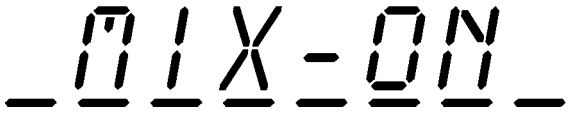
To deactivate the repeat function, press preselection button 4 again. The following will appear on the display for 2 seconds:

223.00.DF__55.134__70___T__F.57.A___TIF

If the repeat function is activated, the Scan and Mix functions will be deactivated.
After the reproduction of the track selected, the display will show 'REPEAT' again for 2 seconds.
After changing source, the repeat function is deactivated.

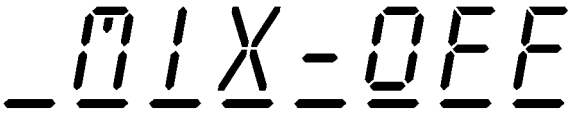
Mix function

Press preselection button 5 to activate the CD mix function. A new track will be played and the following will appear on the display for 2 seconds:



223.00.DF__55.134__70___T__F.58.A___TIF

To deactivate the mix function, press preselection button 5 again. The following will appear on the display for 2 seconds.



223.00.DF__55.134__70___T__F.59.A___TIF

If the mix function is activated, all the tracks on the current disc will be played in random order and the REPEAT and SCAN functions will be deactivated. After playing the track, the word MIX ON will appear again on the display for 2 seconds.

Telephone

General Information

To prevent an earth current, the negative telephone terminal (-) (or the telephone ground) should be connected to the special intake for the connector template.

Telephone audio input

As soon as the telephone audio deactivation function is activated, the radio audio is connected to the telephone input.
The telephone sound always arrives at a fixed volume, which is adjusted in the Menu function (point 6.8), however, it can be altered during a telephone conversation. With the exception of the volume, ON and TA buttons, all the other buttons do nto work whilst the telephone audio deactivation function is activated.
Whilst the telephone audio deactivation function is activated, the following appears on the display (nothing appears on the information side and the readings side)

223.00.00.DF._55.134.__70.___T.__F.42.A.___TIF

If the telephone audio deactivation function is activated, all the functions, with the exception of the autostore and search are cancelled.
A traffic bulletin or PTY31 announcement interrupts the telephone audio, however the traffic news can be deactivated by pressing the TA button. The equipment remains on even if the logic has been switched off, at the end of a conversation the equipment switches off automatically.

CAN FUNCTIONS

CAN bus functions:
- Speed volume control
- Code

Code: when fitting the radio in another vehicle equipped with a CAN network, the code entered using the radio keys should be transmitted to the vehicle microprocessor via the CAN

Code exchange via CAN

When reconnecting the radio to a Scudino CAN network at a later stage, the radio and the audio will compare both the codes and the following will appear on the display:

223.00.00.DF._55.134.__70.___T.__F.43.A.___TIF

If the codes are the same, then the equipment will work.
If the codes are not the same or the radio has been connected for the first time, then the equipment will notify the driver to enter the code following the procedure described in paragraph 12.3.
Until the code is correct, the external display will not be supported.
When the radio is connected to a vehicle without a Scudino CAN network, the equipment will not work and the radio will not work.

Procedure for entering code

When the radio is connected to the power supply, the following will appear on the display:

223.00.00.DF__55.134__70___T__F.44.A___TIF

For 2 secs. and then

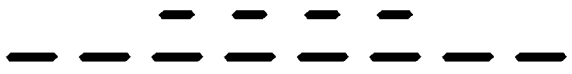
223.00.00.DF__55.134__70___T__F.45.A___TIF

The first digit is selected by selecting the corresponding station (1-6). After this the digits from 2 to 4 are selected in the same way.
If the four digits are not completed within 20 seconds, the word 'CODE' will appear again on the display for 2 seconds and then '----'. This type of time out is not considered as having entered the incorrect code.
After entering the fourth digit, the radio will start to play.

If an incorrect code is entered, the radio will produce an acoustic signal; the following information will appear on the display:

223.00.00.DF_55.134__70___T__F.46.A___TIF

For 2 secs. and then:



223.00.00.DF_55.134__70___T__F.47.A___TIF

Advising the user to enter another code.
Each time the user enters an invalid code, the waiting time increases (1 min, 2 min, 4 min, 8 min, 16 min, 30 min, 1h, 2h, 4h, 8h, 16h, 24h) until a maximum time of 24h
The waiting time is displayed as follows:

223.00.00.DF_55.134__70___T__F.48.A___TIF

After this it is possible to start the procedure for entering the code again.

Connector template

36 pin connector template See appendix C.
With automatic aerial, max. 150 mA.

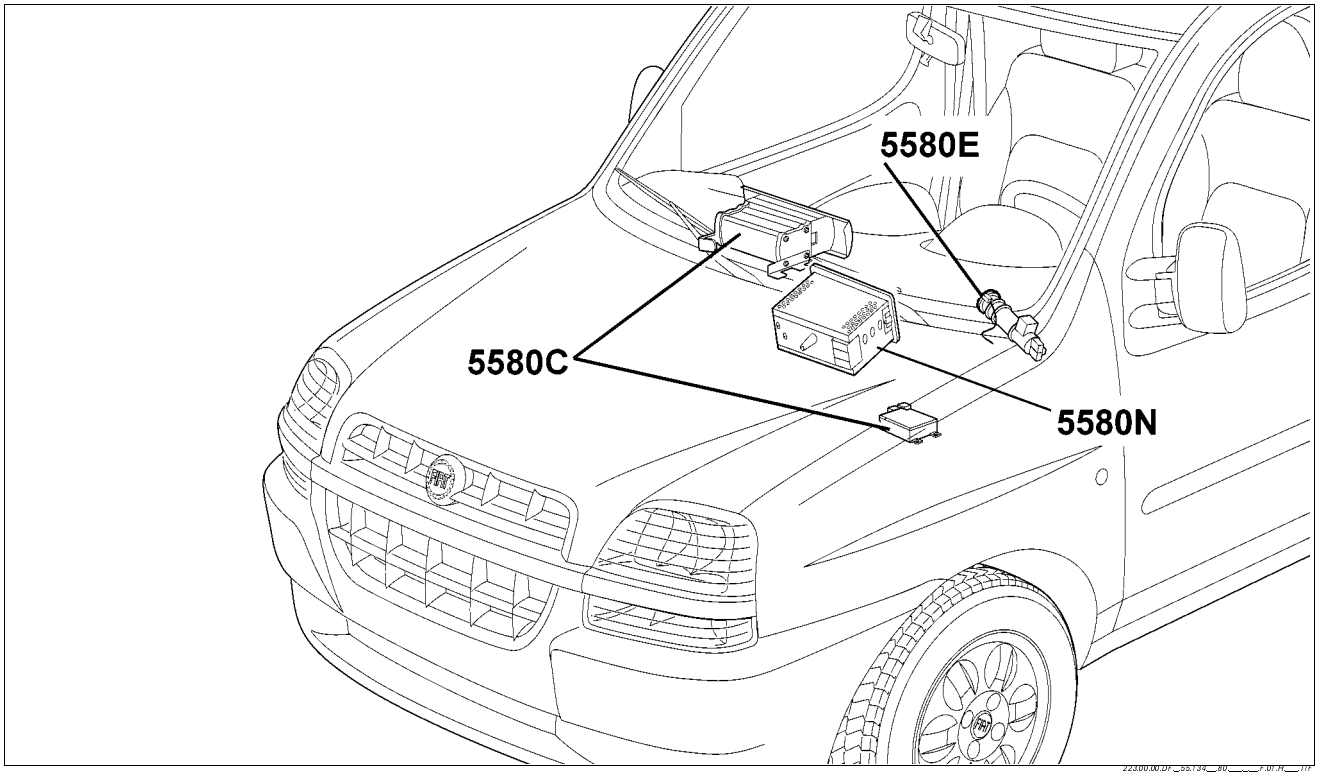
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- GLOSSARY

Assembly drawings index

Cmp	Description	Validity
5580C	Air bag system	
5580E	Anti-theft device	
5580N	Intergrated control system (ics) panel	

SUB-GROUP GRAPHIC INDEX



GLOSSARY

AF (ALTERNATIVE FREQUENCY):

Radio device function which makes it possible, whilst receiving an RDS programme broadcast by several transmitters on different frequencies, to automatically switch to the frequency with the best reception.

BALANCE

Radio device function which makes it possible to adjust the sound distribution between the left and right side speakers

BASS

Radio device function which makes it possible to adjust the acoustics (LOW TONES)

EON

Radio device function which makes it possible to receive information on traffic conditions from radio channels not currently tuned into, temporarily interrupting the station being listened to.

FADER

Radio device function which makes it possible to adjust the distribution of the sound between the speakers.

FM

Long wave radio transmission frequency between 87.5 and 108 MHz.

GPS (GLOBAL POSITIONING SYSTEM)

Satellite positioning system which is designed to provide any user with the possibility of determining their position on the earth's surface.

GSM

Communication standard for mobile equipment (GSM = Global System for Mobile Communication) currently used in about 90 counties enjoying optimum coverage.

LOUDNESS

Radio device function which makes it possible to improve the sound by increasing the low tones.

LW

Long wave radio transmission frequency between 153 and 279 KHz.

MW

Long wave radio transmission frequency between 531 and 1602 KHz.

NIT

Telematic Info Connector

POI (Point of interest)

This consists of keying in an information sequence in order to select a particular POI (in relation to which other information can be obtained)

PTY

Radio device function which makes it possible, with the RADIO mode activated, to select the type of programme, e.g.: NEWS (news and current affairs), AFFAIRS (politics and events) etc. for the radio stations which provide this type of information.

RDS (RADIO DATA SYSTEM)

Radio data system designed for radio transmission in the range 87.5 to 108.0 MHz

RG (Route Guidance)

Route guidance

TA

Radio device function which makes it possible, if set, to receive traffic news broadcasts irrespective of the current radio operating mode.
The reproduction of a CD is interrupted and the volume is automatically increased.

TFT (THIN FILM TRANSISTOR)

Technology used for the construction of liquid crystal screens.

TP (TRAFFIC PROGRAMME)

RDS transmitter with traffic news.

TREBLE

Radio device function which makes it possible to adjust the acoustics (HIGH TONES)

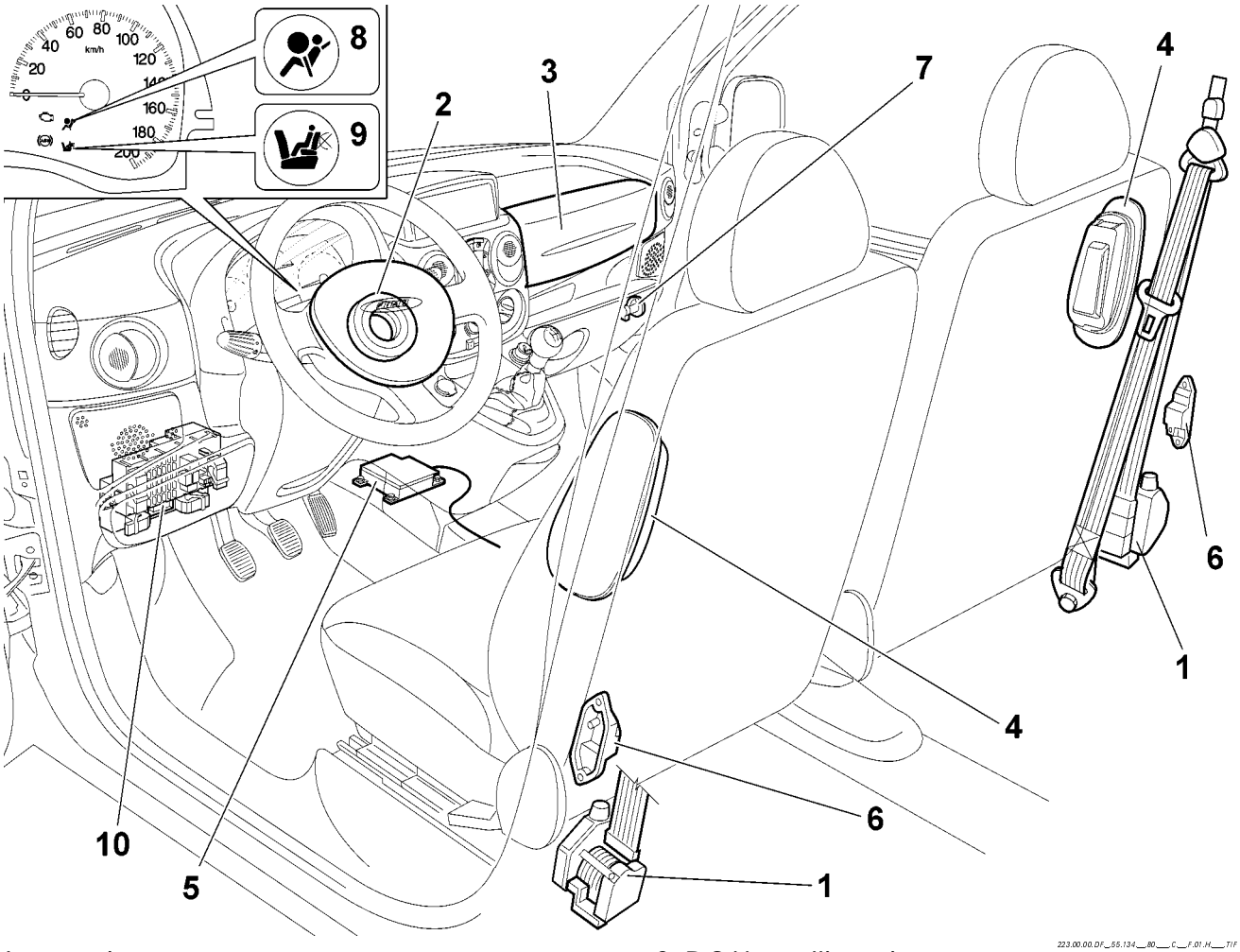
5580C - Air bag system

CONSTRUCTION FEATURES

The diagram below illustrates the Air Bag system components

The Safety Retention Systems are specially designed to work in a particular make and model of vehicle. They should therefore not be tampered with, adapted or installed on other types of vehicle, but only on the one for which they have been designed and manufactured. Any attempt to reuse, adapt or install them on a different type of vehicle could cause serious or fatal injury to the occupants of the vehicle either during normal usage or the vehicle or in the event of a crash.

Note: *in order for the safety retention system to work as efficiently as possible, the occupants must wear the seat belts, with pretensioners, correctly.*



223.00.00.DF__55.134__80__C__F.01.H__TIF

1 pretensioners
2 driver's Air Bag
3 passenger Air Bag
4 side bag
5. control unit
6. R.S.U. satellite units
7. passenger Air Bag disabling switch
8 failure warning light
9 passenger Air Bag inhibitor warning light
10 line K connector

COMPOSITION

One single control unit manages all these systems:
- SEAT BELT PRETENSIONER SYSTEM
- SIDE BAG SYSTEM
- DRIVER'S AIR BAG SYSTEM
- PASSENGER AIR BAG SYSTEM (single or dual)

Control units for TRIM LEVEL VERSIONS

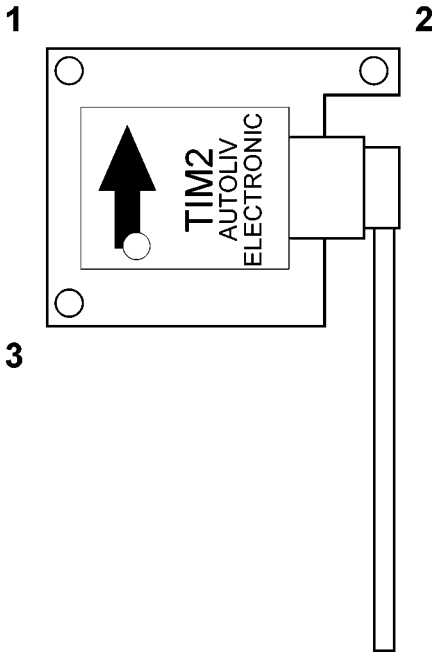
Each control unit has an idenfication label. The following control units are available:
- T.I.M2 control unit which manages the front pretensioners only.
- A.C.U.3-C03 control unit which manages the front pretensioners / driver's Air Bag.
- A.C.U.3-C05 control unit which manages the front pretensioners / driver's Air Bag / passenger Air Bag.
- A.C.U.3-R07 control unit which manages the front pretensioners / Driver's Air Bag / passenger Air Bag.

The operation of the system for the vehicle in question depends solely on the type of electronic control unit used.
The A.C.U3-R07 control unit is assisted by two satellite units or negative transverse acceleration (or deceleration) sensors. The positive and negative acceleration sensors send a signal to the control unit. The control unit records deceleration and commands the priming of the pyrotechnic charges.
All the A.C.U3 control untis manage the accumulation of energy and memorize both fault codes and crash codes. The operation of the red warning light in the instrument panel is intelligent.
The control unit only has to be replaced after the pretensioners or the Side Bags have been activated three times.
The control unit must always be replaced if the front Air Bags are activated.

DESCRIPTION OF CONTROL UNIT FASTENING

The position the AIR BAG control units should be fitted in is shown by an arrow and MUST be observed.

Note: *The arrow should be pointing towards the front of the vehicle.*
Before replacing the control unit, make sure that the new one is compatible by checking the design number on the label.
Fit the bolts and tighten them in order the illustrated in the diagram. All the bolts should be tightened, in order, to a torque of 6.4 - 9.6 Nm to ensure that the control unit is correctly secured to the bodyshell.



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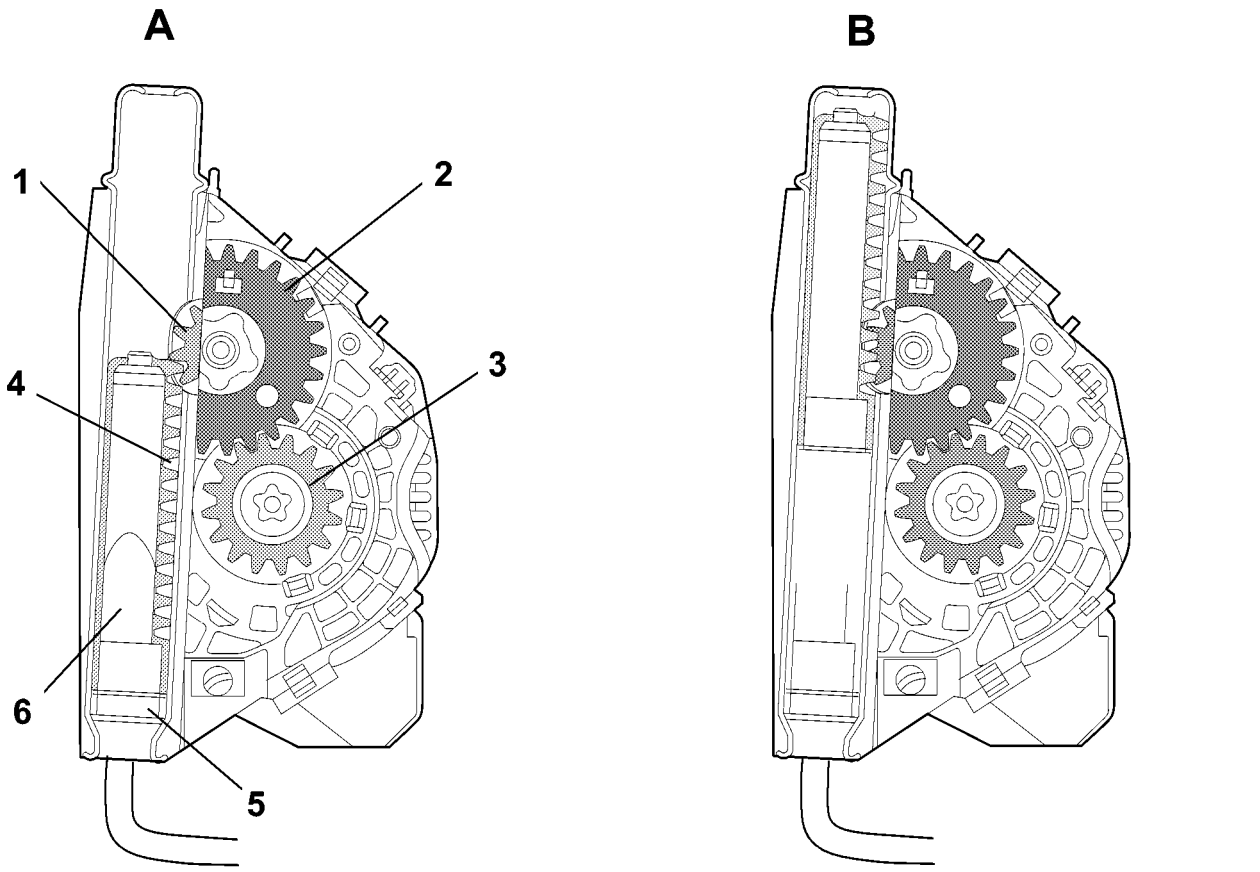
AIR BAG CONTROL UNIT CONNECTORS

The control unit connectors are the twin wire 2 x 24 pin AMP type with 12 short circuit bars. There are 3 types of connector, one for each version of control unit, with different colours and different mechanical fool-proof polarity:
- CONTROL UNIT ACU3-C03 = BLACK CONNECTOR
- CONTROL UNIT ACU3-C05 = BROWN CONNECTOR
- CONTROL UNIT ACU3-R07 = ORANGE CONNECTOR

SEAT BELT PRETENSIONER SYSTEM

Cross section of pretensioners before and after activation



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1. Ring gear
2. Ring gear
3. Toothed bush
4. Rack piston
5. Pyrotechnic charge
6. Propellant

A. Before activation
B. After activation

COMPOSITION

This system consists of inertia reel front seat belts with electrically controlled, pyrotechnically activated pretensioners. The negative acceleration (or deceleration) electronic sensor is located inside the control unit which manages the intelligent warning light.
The pyrotechnic activation system is an integral part of the reel and thereby creates a single component which is fitted to the vehicle pillar.

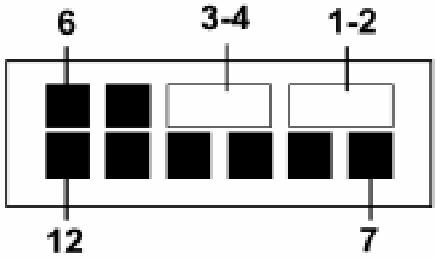
Note: *The position of the centering pin must be correct when fitting the pretensioner and the tightening torque should be betweenm 36 and 44 Nm.*
The position of the fastening on the centre tunnel in the passenger compartment must be correct when fitting the control unit and the tightening torque should be between 6.4 and 9.6 Nm.

OPERATION

The moment a longitudinal negative acceleration (or deceleration) of sufficient magnitude takes place, an electro-mechanical sensor in the control unit records this condition and sends a command from pins 7-8, via the power circuit, to the driver's pretensioner and from pins 9-10 to the passenger pretensioner.
The electrical control primes the gas generator pyrotechnic charges (5).
The burning of the propellant (6) produces a chemical reaction creating (inert) gas whose pressure creates a force which thrusts the rack pinion (4) upwards.
The upwards movement of the rack pinion (4) rotates the ring gear (1) which is connected to the ring gear (2). The ring gear (2) meshes with the toothed bush (3) changing the rotary movement of the spindle to the opposite direction to the unwinding of the seat belt, rewinding it by several centimetres.

Note: *After ach impact which sets off the pretensioner, the control unit and the belts can no longer be used and must be replaced.*

Front view of control unit T.I.M2 connector PIN-OUT



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1. N.C.
2. N.C.
3. N.C.
4. N.C.
5. Dedicated earth fixed to bodyshell stud
6. + 12 VBat (controlled by ignition)
7. Driver's pretensioner control -
8. Driver's pretensioner control +
9. Passenger pretensioner control -
10. Passenger pretensioner control +
11. Failure warning light (at Key on 4.6 secs. max)
12. N.C.

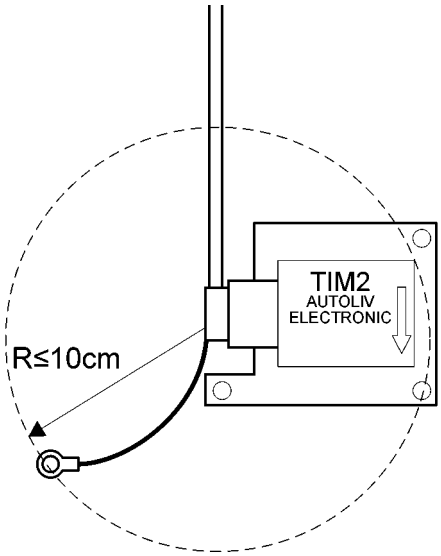
T.I.M2 CONTROL UNIT AUTO-TEST

The warning light in the instrument panel comes on at the Key on for about 4 secs. to indicate the control unit and warning light autotest.
After 4 seconds the control unit carries out the continuous diagnosis of the system.

The AIR BAG failure warning light remains on after the 4 seconds of the check stage when:
- the control unit is not connected
- one of the two pretensioners is not connected,
- the supply voltage is interrupted,
- a fault is detected in the two seconds after the check stage.

Note: *The vehicle should never be handed over to a customer with the warning light on.*
the earth lead is a dedicated cable and should not have couplings and/or shunts of any type between pin 5 of the control unit and the bodyshell stud and should not be (200 mm long.

The resistance between the vehicle electrical earth and pin 11 of the control unit should be R = 100 mO



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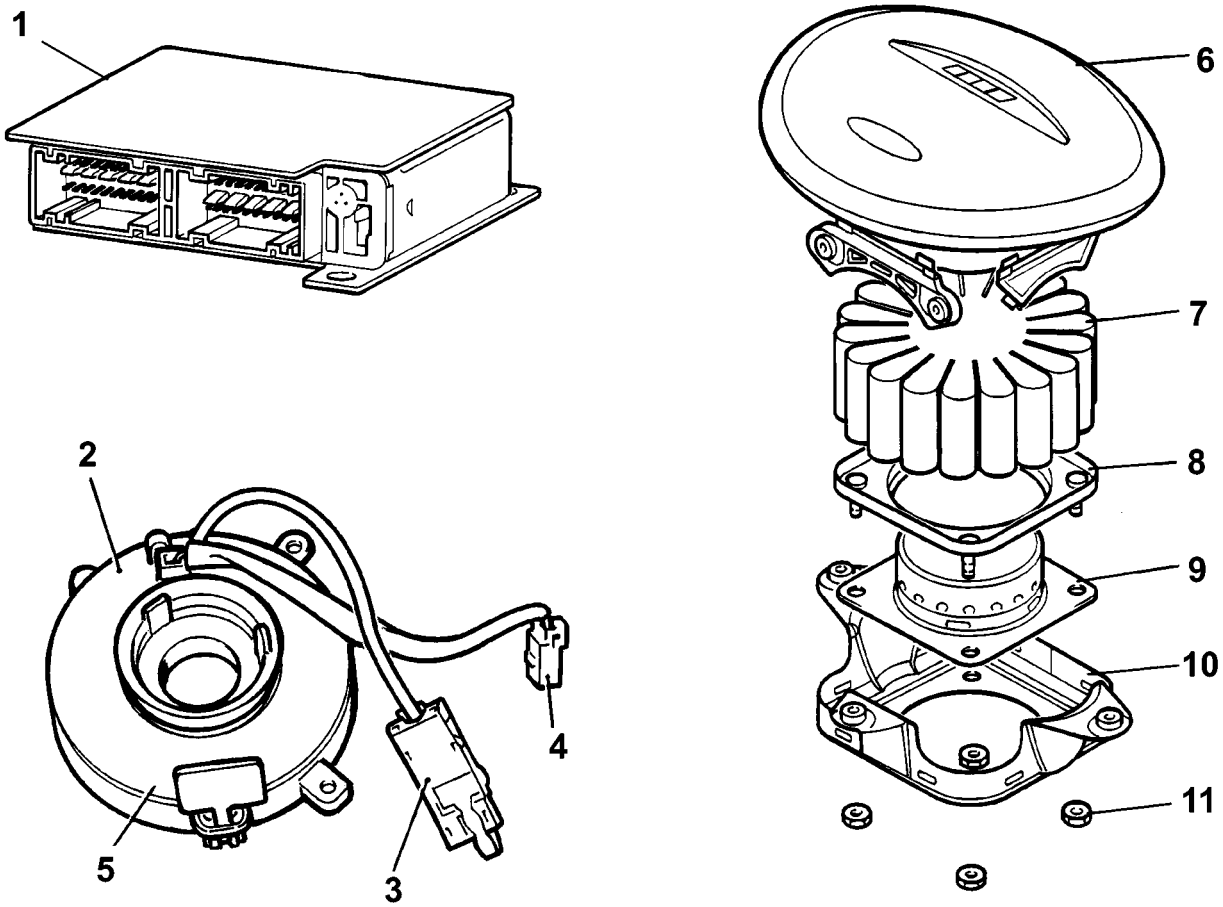
DRIVER'S AIR BAG SYSTEM

The diagram below illustrates the driver's Air Bag system components.



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1. Electronic control unit
2. Clock spring
3. Air Bag electrical connection
4. Horn electrical connection
5. Safety device
6. Cover
7. Bag
8 Bag retaining ring

9. Gas generator
10. Housing
11. Nuts

COMPOSITION

The driver's Air Bag system consists of:
- Cover
- Bag
- Gas generator
- Clock spring
- A.C.U3 control unit

A housing containing the following is fastened to the steering wheel: the pyrotechnic device with gas generator and folded bag, a cover with a pre-breakage area to facilitate the escape of the bag. In the lower part, between the steering whel and the lights switch unit, there is a clock spring which guarantees the electrical connection between the steering wheel and the A.C.U3.

OPERATION

All the components inside the control unit are subject to autodiagnosis.

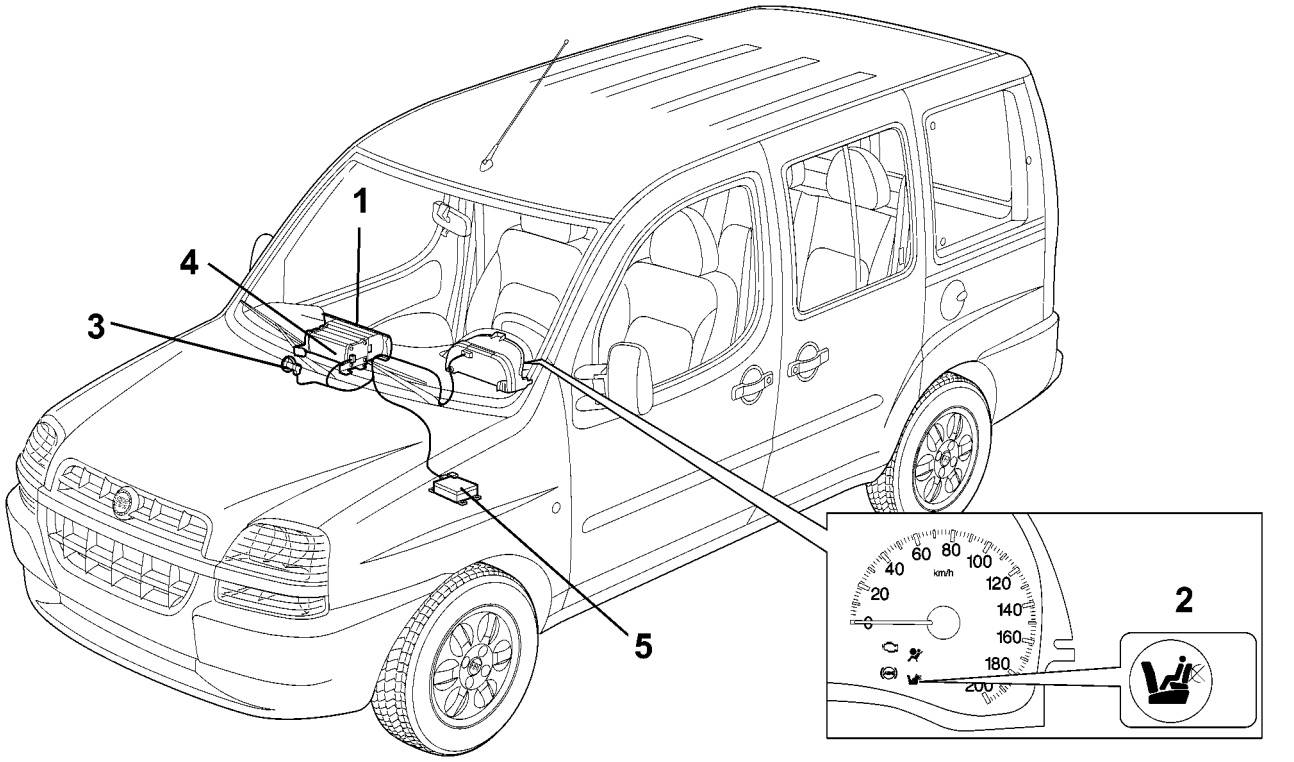
The control unit also diagnoses the functions and parameters listed below:
- BATTERY voltage,
- satellite sensors (where fitted),
- the electrical part of the pyrotechnic charges depending on the configuration of the system.

Incorrect configurations are detected as an open circuit, if the number of components is below the number planned. If the number is higher, this is not possible because the components which make it possible to diagnose the additional lines are missing.
The control unit is equipped with a special condenser, capable of storing an energy reserve to be used for operating the front Air Bag pyrotechnic charges.
This reserve energy is available for around 200 ms. from the possible electrical supply failure due to a collision and the consequent disconnection of the battery or short circuit.
The pretensioners and the Side Bags (protecting the head and chest) are supplied directly and there is no reserve energy in the control unit for these devices.
The auto diagnosis is activated at each Key on for a time of ≅ 4 secs.
At the same time the control unit lights up the warning light and if, after having carried out the check, no faults are detected, the warning light goes out.
At the time of a collision of a sufficient magnitude, the control unit can record both longitudinal or transverse acceleration or deceleration by means of the accelerometers.
When figures are recorded above the pre-set level in the control unit map, the pretensioners and later the driver's and passenger front Air Bags are activated.

PASSENGER AIR BAG SYSTEM

COMPOSITION

The passenger Air Bag system consists of:



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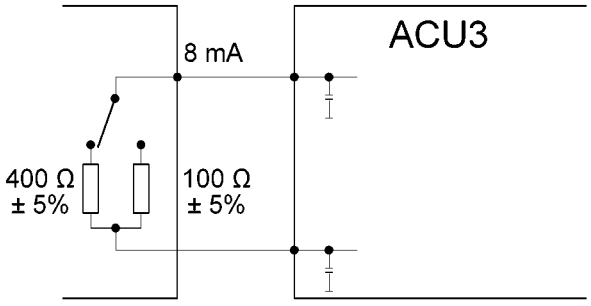
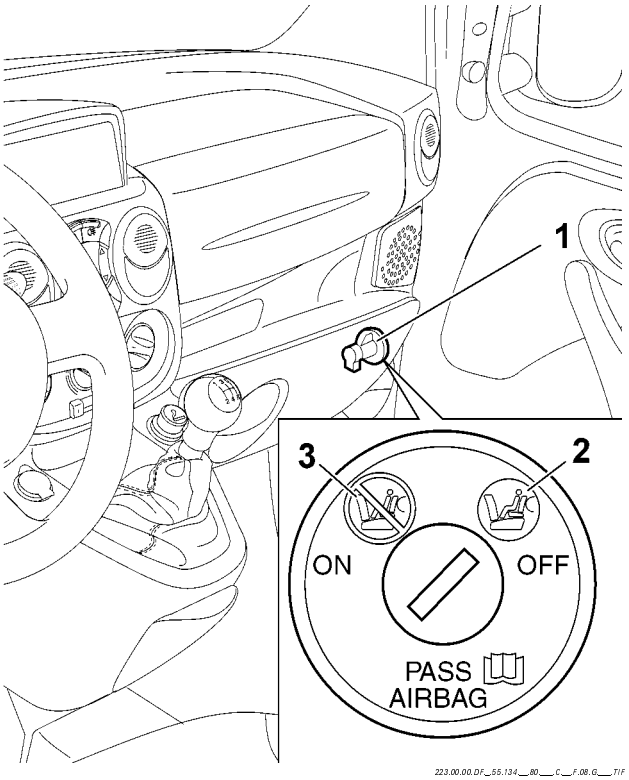
1. Dual bag
2. On warning light
3. On switch
4. Pyrotecnic charges (2)
5. A.C.U3 control unit

-





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The enabling / disabling of the passenger Air Bag is determined by the switch on the right hand side of the dashboard.
The switch is activated with the key in the ignition.
The passenger Air Bag control unit (A.C.U3-C05 or A.C.U3-R07 depending on the version) should record a resistance value of 95 - 105 O for the enablement.
For the disablement, the resistance value should be 380 - 420 Ω.

OPERATION

At the key on and during the first 4 - 6 seconds, the A.C.U3 control unit tests the inhibitor switch.
If the resistance value is ≅ 100 Ω (Bag ON) the control unit prepares for the operation of the passenger Air Bag.
If the resistance value is ≅ 400 Ω (Bag OFF) the control unit prepares for the non-operation of the passenger Air Bag.
The passenger Air Bag ON/OFF condition can be easily recognized by the operation of the special warning light in the instrument panel.
With the switch ON, the warning light flashes for 4 seconds after the 4 seconds of the test at Key on (all O.K. warning light off).
With the switch OFF, the warning light remains on after the test at Key on.
If the inhibitor system is broken, the error and the inhibition state are recorded, the failure and inhibitor warning lights are on constantly and only the passenger Air Bag will not be activated in the case of a crash because the driver's Air Bag and pretensioners will be.
If, after a key on with the ignition switched on, the user changes the status of the switch, the control unit records this as a plausibility error causing the failure and inhibitor warning lights to come on.
The passenger Air Bag will not be activated when required.
If the inhibitor warning light is broken or the enabling/disabling signal is outside of the operating range, the passenger Air Bag will automatically be disabled by the control unit.

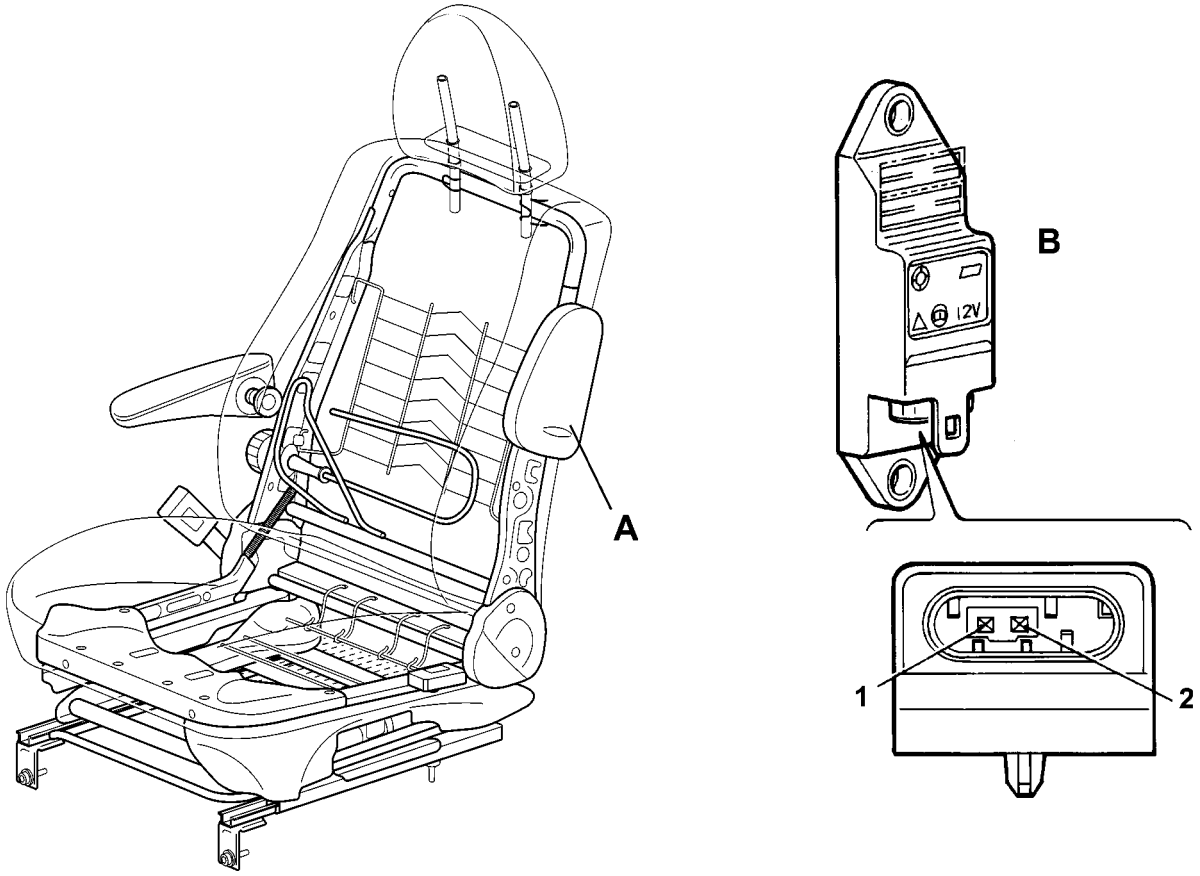
Transferring failure warning light operation to disabling warning light

If the Air Bag system failure warning light is broken, the control unit will inhibite the operation of the passenger Air Bag and, at the same time, will switch on the disabling warning light at a frequency of 4Hz to signal the failure warning light fault.

Note: *The vehicle should never be handed over to the customer with the failure warning light on.*
the earth lead is a dedicated cable and should never have couplings and/or shunts of any type between pin 5 of the control unit and the bodyshell stud and should never be (200 mm long.
The resistance between the vehicle's electrical earth and pin 11 of the control unit should be R = 100 mΩ

SIDE BAG SYSTEM R.S.U. SATELLITE SENSORS (Remote Side Sensing Unit)

The diagram below illustrates the SIDE BAGS.



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A. Side Bag
B. Side impact satellite sensor
1. Sensor signal
2. Sensor earth

COMPOSITION

The SIDE BAG modules are fitted on the door side of the front seat backrest with the module cover in view.

The module consists of the following components:
- a bag.
- a gas generator which incorporates the studs for fixing the module.
- a pin for connecting the earth.
- a casing for housing the parts mentioned above together with the cover.
- a cover.

The satellite sensor container is made from an insulating material with the connector incorporated.
The satellites have a centering pin to ensure that they are correctly positioned; this pin is fixed in the threaded opening in the bodyshell centre pillar.
The A.C.U3-R07 manages the entire system.
The control unit and the satellite sensors MUST be fixed in the correct position. The sensor centering pin should be correctly inserted in the opening in the pillar.
The satellites should be installed with the connector facing the floor of the vehicle.
The satellites are fastened to the base of each centre pillar, one on the right side and one on the left side and tightened to a torque of 6.4 - 9.6 Nm.

Note: *The position of the sensors is defined during the design stage to ensure the optimum detection of a side impact so their position should not be altered.*

OPERATION

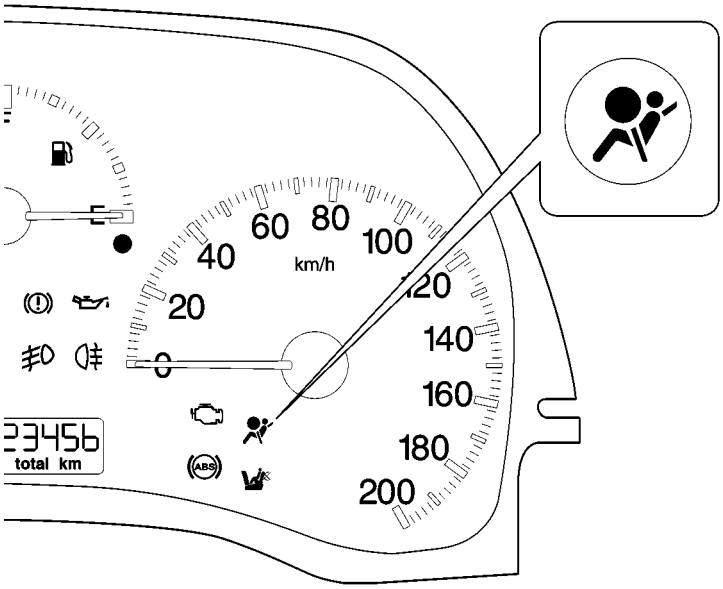
At the KEY ON, the control unit supplies pin 2 of the side sensors and they initiate the auto-test operation.
The sensors conclude the auto-test within a maximum period of 1 second. The result of the test is transmitted to the control unit. In case of an error, the control unit lights up the failure warning light. The sensors send repeated messages to the control unit until the next KEY ON.
If the sensors do not detect errors within 1 second they do not send a serial code to the control unit.
If the sensors detect an error during the starting stage, in order to transmit it to the control unit in the form of a serial code it takes ≅ 740 ms.

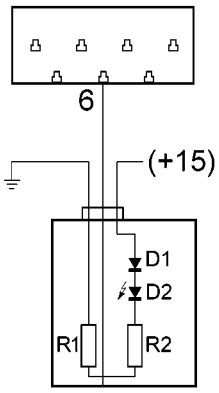
Note: *The side impact sensor function is not available during the auto-test.*
At the time of a side impact of a certain severity, the control unit receives the transverse negative acceleration (or deceleration) serial line signal from pin 2 of the satellite sensor concerned. If the control unit detects the same condition through its internal sensor, it gives a power command to activate the gas generator whose chemical reaction creates a pressure sufficient to inflate the bag on the side where the negative acceleration (or deceleration) signal is coming from.

FAILURE WARNING LIGHT

COMPOSITION

The diagram below illustrates the components connected to the failure warning light.





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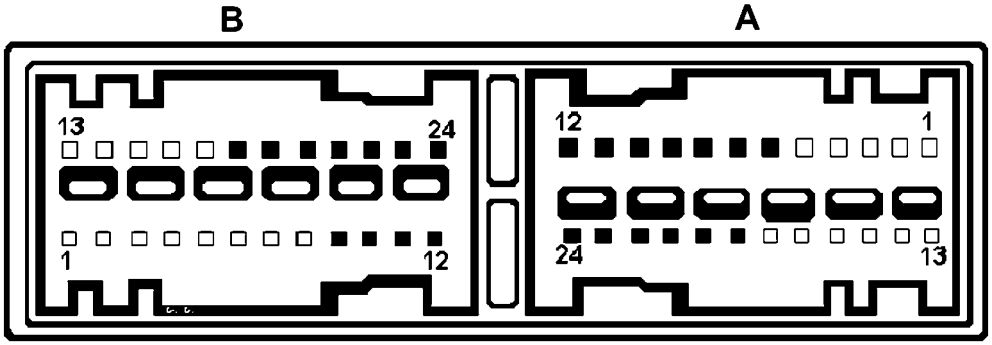
1. Warning light in instrument panel
2. Integrated circuit in instrument panel
3. Signal transmitted by the A.C.U3

OPERATION

The operation of the AIR BAG systems failure warning light is known as intelligent because it is also capable of signalling a failed connection with the actual control unit.
The diagram shows the AIR BAG warning light in the instrument panel. The LED (D2) is earthed by two resistances in series (R1-R2). The LED anode is supplied by a diode (D1) controlled by the ignition +15, whilst the the control unit control pin is connected between the two resistances (R1-R2)
At the Key On, the control unit earths pin 6 for 4 seconds and checks the system components and the actual warning light.
If the control unit is not connected to the system or there is a break in the warning light control line, the warning light comes on at the Key On through the connection to earth and the resistances (R1-R2).
Depending on the trim level of the vehicle, if there is also a passenger Air Bag disabled warning light, the failed operation of the failure warning light is signalled by the flashing at a frequency of 4 Hz. of the disabling warning light.

A.C.U3-R07 CONTROL UNIT CONNECTOR SIDE PIN OUT

Control unit side view



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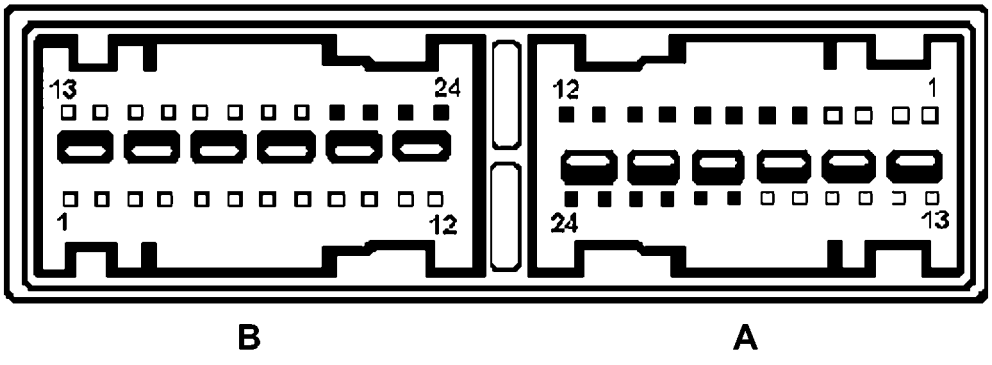
A. Connector A (Orange)
1. N.C.
2. N.C.
3. N.C.
4 N.C.
5. PASSENGER AIR BAG DISABLED WARNING LIGHT
6. FAILURE WARNING LIGHT
7. PASSENGER MANUAL DEACTIVATION +
8. PASSENGER MANUAL DEACTIVATION -
9. N.C.
10. LINE K
11. EARTH
12. + 12 CONTROLLED BY IGNITION
13. N.C.
14. N.C.
15. N.C.
16. N.C.
17. N.C.
18. N.C.
19. PASSENGER BAG + (2
20. PASSGNER BAG - (2
21. PASSENGER BAG - (1
22. PASSENGER BAG + (1
23. DRIVER'S BAG -
24. DRIVER'S BAG +

B. Connector B (Orange)
1. N.C.
2. N.C.
3. N.C.
4. N.C.
5. N.C.
6. N.C.
7. N.C.
8 N.C.
9 + R.S.U. RIGHT
10 - R.S.U. RIGHT
11. + R.S.U. LEFT
12. - R.S.U. LEFT
13. N.C.
14. N.C.
15. N.C.
16. N.C.
17. + LEFT SIDE BAG
18. - LEFT SIDE BAG
19. + RIGHT SIDE BAG
20. - RIGHT SIDE BAG
21. + DRIVER'S PRETENSIONER
22. - DRIVER'S PRETENSIONER
23. + PASSENGER PRETENSIONER
24. - PASSENGER PRETENSIONER

A.C.U30C05 CONTROL UNIT CONNECTOR SIDE PIN OUT

Control unit side view



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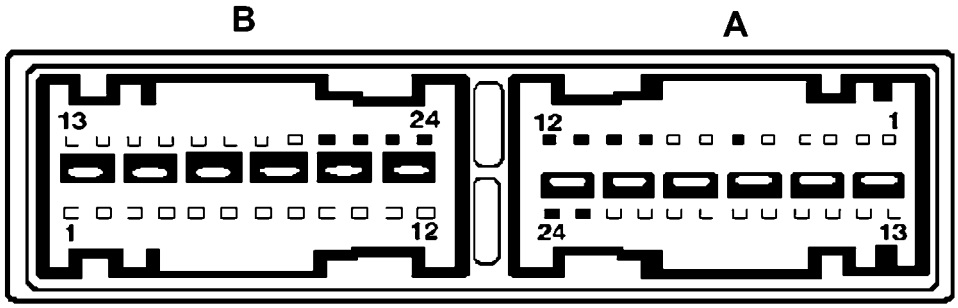
A. Connector A (Brown)
1. N.C.
2. N.C.
3. N.C.
4. N.C.
5. PASSENGER AIR BAG DISABLED WARNING LIGHT
6. FAILURE WARNING LIGHT
7. + PASSENGER MANUAL DEACTIVATION
8. - PASSENGER MANUAL DEACTIVATION
9. N.C.
10. LINE K
11. EARTH
12. + 12 V CONTROLLED BY IGNITION
13. N.C.
14. N.C.
15. N.C.
16. N.C.
17. N.C.
18. N.C.
19. + PASSENGER BAG (2
20. - PASSENGER BAG (2
21. - PASSENGER BAG (1
22. + PASSENGER BAG (1
23. - DRIVER'S BAG
24. + DRIVER'S BAG

B. Connector B (Brown)
1. N.C.
2. N.C.
3. N.C.
4. N.C.
5. N.C.
6. N.C.
7. N.C.
8. N.C.
9. N.C.
10. N.C.
11. N.C.
12. N.C.
13. N.C.
14. N.C.
15. N.C.
16. N.C.
17. N.C.
18. N.C.
19. N.C.
20. N.C.
21. + DRIVER'S PRETENSIONER
22. - DRIVER'S PRETENSIONER
23. + PASSENGER PRETENSIONER
24. - PASSENGER PRETENSIONER

A.C.U3-CO3 CONTROL UNIT CONNECTOR PIN OUT

Control unit side view



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A. Connector A (Black)
1 N.C.
2 N.C.
3 N.C.
4 N.C.
5 N.C.
6 FAILURE WARNING LIGHT
7 N.C.
8 N.C.
9 N.C.
10 LINE K
11 - EARTH
12 + 12 V CONTROLLED BY IGNITION
13 N.C.
14 N.C.
15 N.C.
16 N.C.
17 N.C.
18 N.C.
19 N.C.
20 N.C.
21 N.C.
22 N.C.
23 - DRIVER'S BAG (1
24 + DRIVER'S BAG (1

B. Connector B (Black)
1 N.C.
2 N.C.
3 N.C.
4 N.C.
5 N.C.
6 N.C.
7 N.C.
8 N.C.
9 N.C.
10 N.C.
11 N.C.
12 N.C.
13 N.C.
14 N.C.
15 N.C.
16 N.C.
17 N.C.
18 N.C.

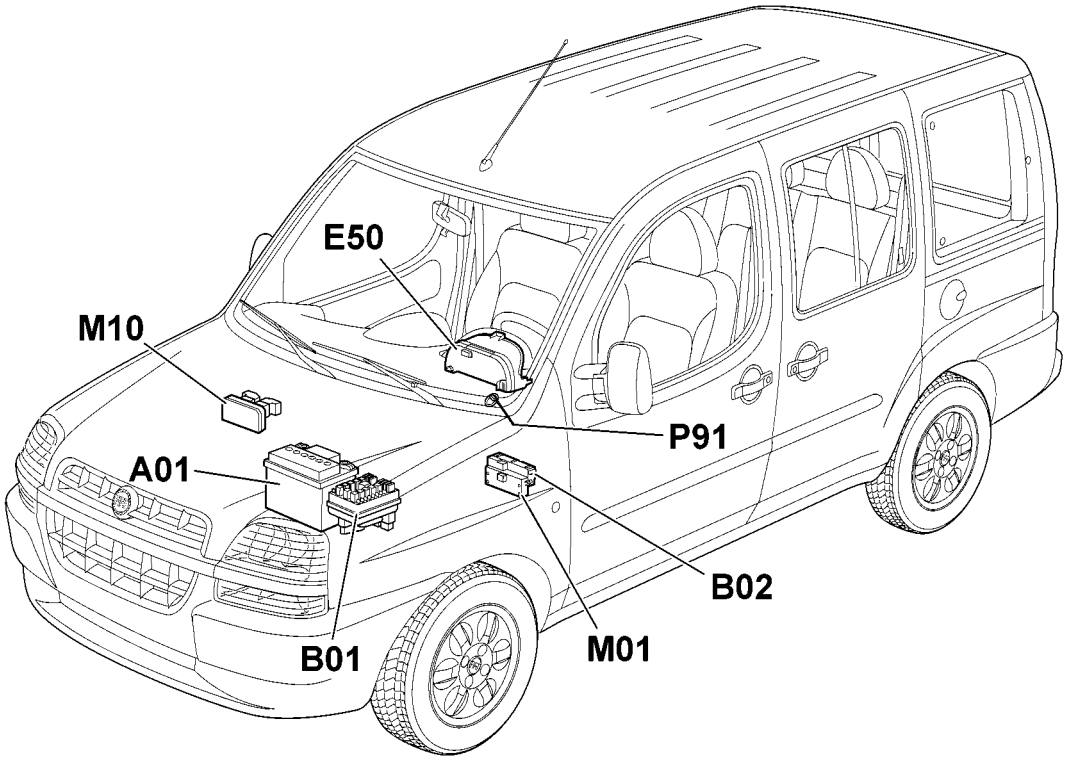
19 N.C.
20 N.C.
21 + DRIVER'S PRETENSIONER
22 - DRIVER'S PRETENSIONER
23 + PASSENGER PRETENSIONER
24 - PASSENGER PRETENSIONER

5580E - Anti-theft device

SPECIFICATIONS:

LIST OF COMPONENTS

The location of the components is illustrated in the diagram below.



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A1. Battery
B1. Junction unit
B2. General supply MAXI FUSE
E50. Instrument panel
M1. Body Computer
M10. Engine management control unit
P91. Aerial for FIAT-CODE

OPERATTION

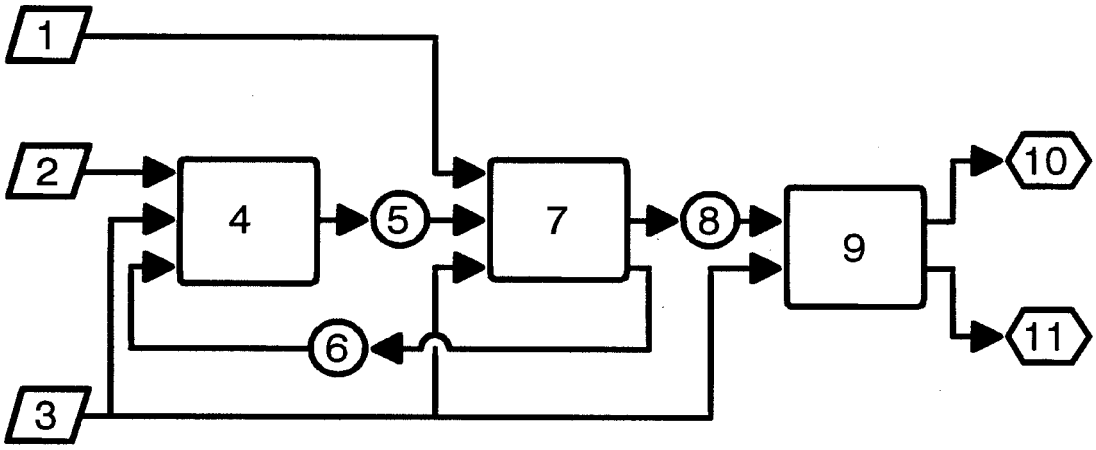
OPERATION OF THE ASSEMBLY

Dialogue between NBC CODE section, key and engine managment control unit.

The dialogue takes place as follows:
- With the ignition key in the ON position, the engine management control unit asks the CODE section of the NBC for the MINIKRYPT code.
- The Code section asks the transponder in the key for the ID code.
- The transponder transmits its ID to the CODE section of the NBC which compares it with the enabled ones in its memory.
- If the ID received is amongst the enabled ones, the secret code is checked through a coded dialogue between the CODE section and the transponder
- If this recognition takes place, the CODE control unit sends the MINIKRYPT code via the CAN network to the CCM which checks that it conforms and enables the starting of the engine. The Code warning light goes also goes out at that moment.
- If the recognition does not, on the other hand, take place, the CODE section does not allow the engine to be started up. The Code warning light also remains on.

FIAT CODE FUNCTION (MINIKRYPT)

Diagram showing Fiat Code system information.



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1 Serial connection from code aerial
2 Accelerator pedal control
3 Ignition key control
4 Engine management control unit
5. Code request at CAN network
6. Code response at CAN network
7. Body computer connector
8 Code warning light status
9 Instrument panel connector
10 Code light at NQS
11. CCM fault diagnosis warning light

The Code and engine management control units 'converse' by means of the CAN network.

ACCESSORIES FUNCTION

SYSTEM SELF-TESTING

The CODE section of the NBC has a direct diagnostic CAN line, dependent on the engine management control unit line.

The control unit carries out a continuous autodiagnosis of the system operation. In particular:
- it detects and memorizes any faults
- it recognizes the various components and the type of fault;
- it signals the onset of these faults via the special warning light in the instrument panel:

The control unit then recognizes faults in all the system components:
- NBC;
- aerial;
- key transponder;
- CAN network

Once the faults have been repaired, it is then possible to cancel the faults memorized by the control unit.

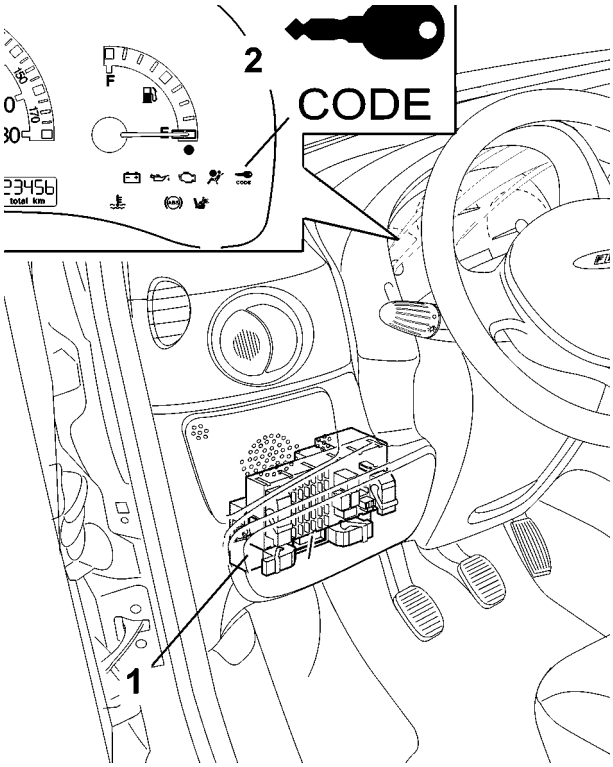
DATA BASE

There is a centralized DATA BASE (for all markets) managed by the PARTS DEPT. for ordering all system components.
The production plant transfers all the details needed into this DATA BASE together with the chassis number of the new vehicle.
This PARTS DATA BASE should be used by the Service Network for ordering replacement components.

The DATA BASE contains various information, including:
- vehicle chassis number;
- key ID codes (for a maximum of 8 keys)
- secret key codes (for a maximum of 8 keys)
- mechanical key code;

COMPONENT DESCRIPTIONS

The diagram below illustrates the position of the components described below:



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1 Body computer connector
2 CODE system warning light

CODE SECTION BODY COMPUTER CONNECTOR

SPECIFICATIONS:

Operation

The main function of the CODE section of the NBC is to recognize the key inserted in the ignition switch.
The CODE section is also responsible for programming the keys and for the Code warning light.

COMPOSITION

Location

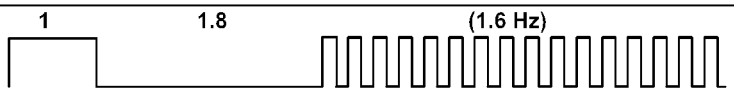
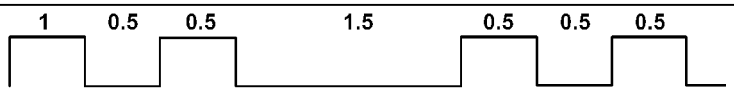
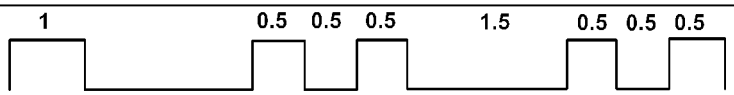
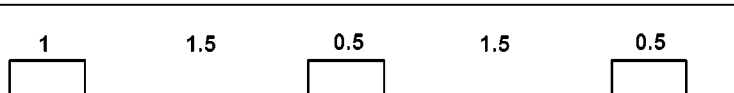
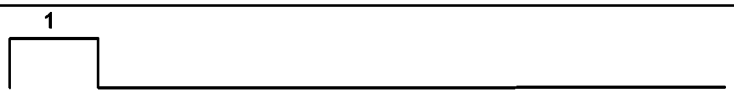
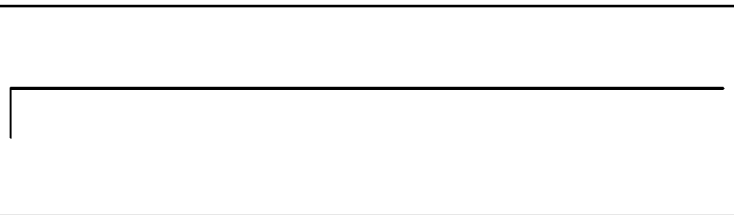
The electronic section of the FIAT CODE is incorporated in the body computer control unit located at the front, uner the dashboard cover, driver's side.

CODE SYSTEM WARNING LIGHT

OPERATION

The FIAT CODE immobilizer warning light comes on for four seconds when the ignition is switched on and its operation is determined by the receipat of the message from the NBC in accordance with the code described in the table.
On briefly (1 second) and then off; key recognized, correct system operation. The warning light remains off if the NQS is disconnected from the CAN line.
The operation of the warning light is summarized in the following diagram.
The NBC column indicates whether the Body Computer needs to be initialized (virgin V) or whether it is already programmed (M).
The column CCM indicates whether the Body Computer has to be initialized (virgin V) or whether it is already programmed (M)
The column TRAS indicates the state of the transponder with OK - everything alright and KO not working
The LINK column indicates the state of the dialogue between the NBC and the CCM with OK standing for everything alright and KO meaning not working

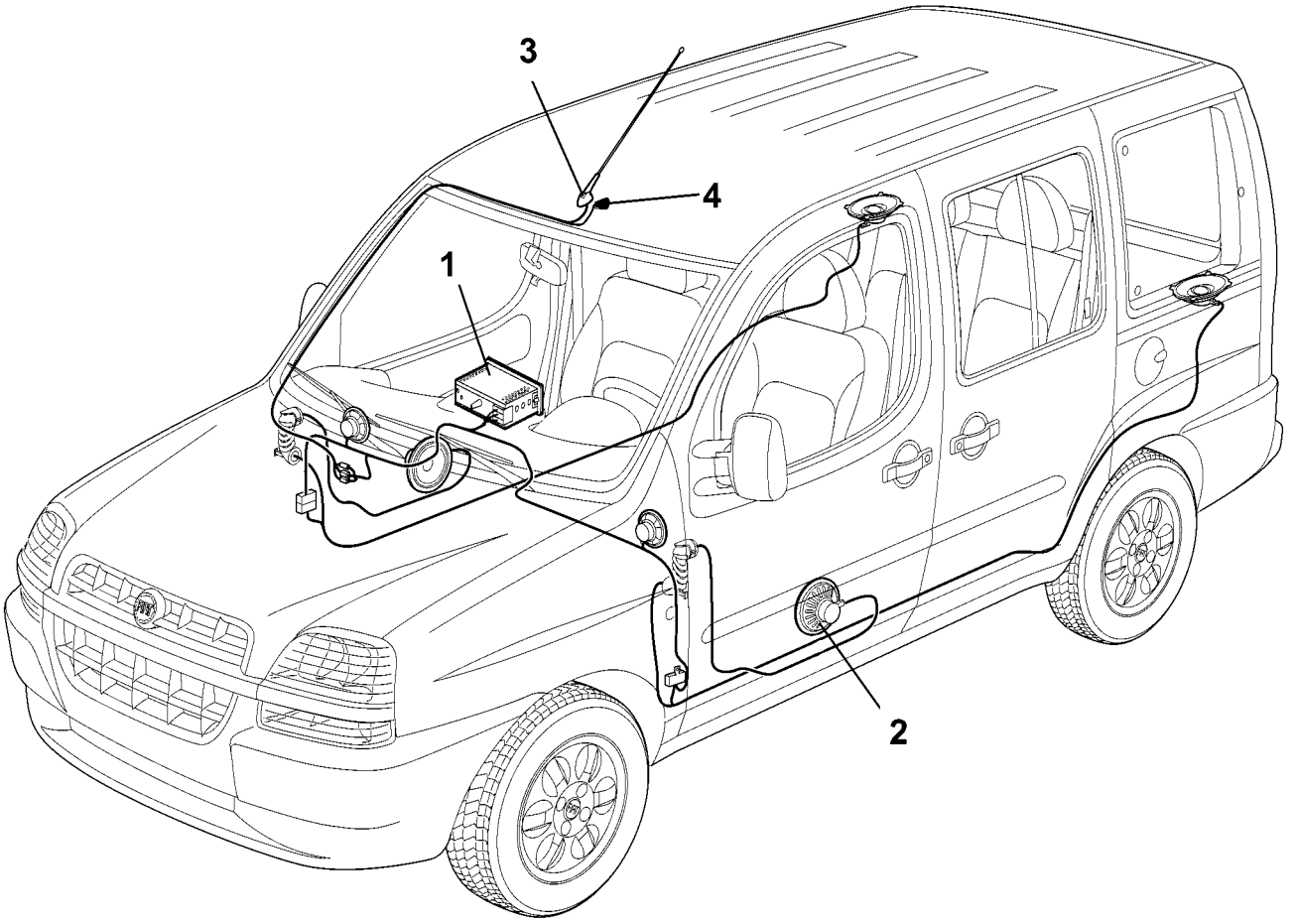
Warning light blink code table

NBC	CCM	TRAS	LINK	
V	V	OK	OK	
V V	V M	KO KO	OK OK	
V	M	OK	OK	
V V V V	M M V V	OK KO OK KO	KO KO KO KO	
M M	V M	OK OK	OK OK	
M M M M M M	V V V M M M	KO OK KO KO OK KO	OK KO KO OK KO KO	

5580N - Intergrated control system (ics) panel

SPECIFICATIONS:

The diagram below illustrates the configuration of the components for the N.I.T. (Telematic Info Connector)



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1 NIT module
2 Speakers
3 Radio/GPS/GSM aerial
4 Hands free microphone

System configuration levels

An integrated information and control system for several of the systems and devices fitted on the vehicle is available as an option on the entire vehicle range. This system, located in the centre of the dashboard and known as the N.I.T. (Telematic Info Connector) is available in two configuration levels: one BASIC level and one DE-LUXE level.

The BASIC version features the following modules and functions:
- Front control panel
- Radio
- CD player - Audio
- GSM module
- GPS module
- Assistance services
- LCD 128x64 pixel graphic display

The DE-LUXE version features the following modules and functions:
- Front control panel
- Radio
- CD-ROM player + CD - Audio
- GPS module

- GSM module + SIM Card reader
- Gyroscope
- Autonomous navigation with maps
- Assistance services
- 5' TFT display

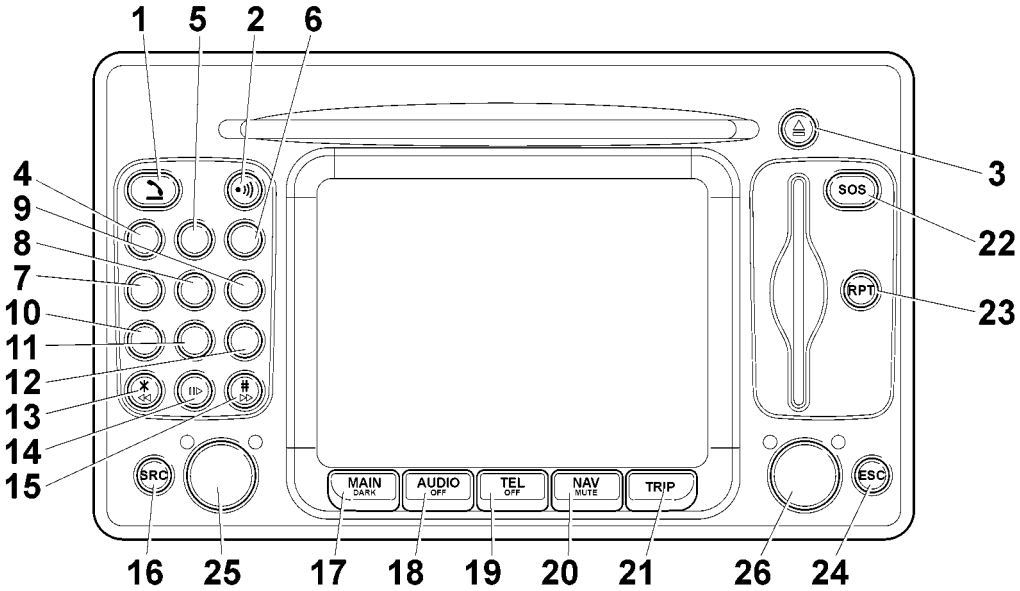
composition

DESCRIPTION OF MODULES

The system, as described previously, can consist of various modules depending on the level chosen. The individual modules carry out the functions described below.

FRONT CONTROL PANEL

The front control panel groups together: the control buttons, the CD/CD ROM and SIM CARD reader modules and the display; the display differs for the BASIC and DE-LUXE versions through the graphics and the road maps.



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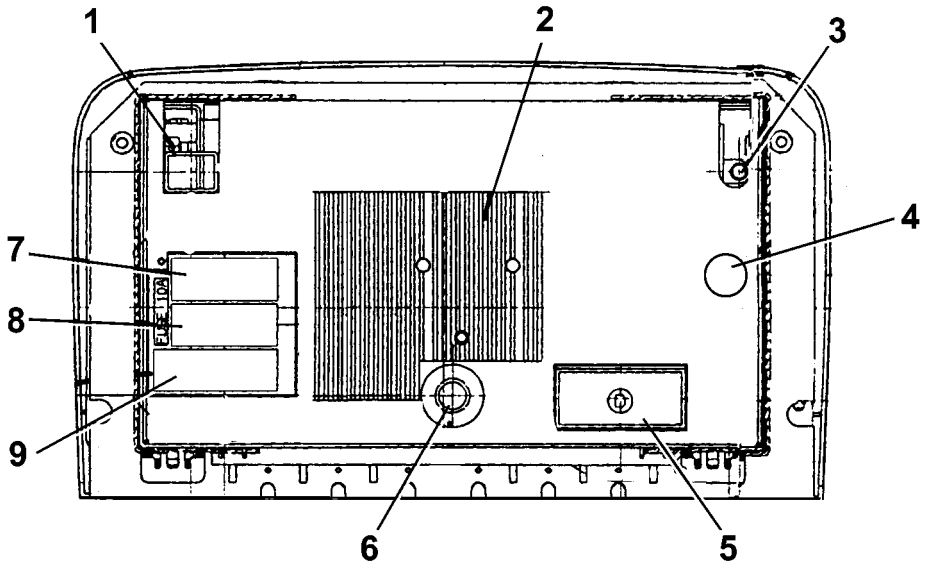
1. Telephone on/off button
2. Not used
3. CD eject button
4. Radio and telephone systems multi-purpose button
5. Radio and telephone systems multi-purpose button
6. Radio and telephone systems multi-purpose button
7. Radio and telephone systems multi-purpose button
8. Radio and telephone systems multi-purpose button
9. Radio and telephone systems multi-purpose button
10. Telephone system button
11. Telephone system button
12. Telephone system button
13. Radio, telephone and CD systems multi-purpose button
14. Telephone and CD systems multi-purpose button
15. Radio, telephone and CD systems multi-purpose button
16. Audio source selector button (radio/CD frequencies)
17. Main menu display button
18. Audio menu display button
19. Telephone menu display button
20. Navigation system display button
21. Trip menu display button
22. Emergency call button
23. Last navigation system sound instruction repeat button
24. Return to previous display button
25. ON/OFF knob and volume control
26. Selection and confirmation knob

ELECTRICAL CONNECTIONS

The NIT module is secured to the dashboard and connected to the vehicle's electrical system through the connections illustrated in the diagram below:



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1. GSM aerial connector
2. Heat exchanger
3. GPS aerial connector
4. Radio aerial connector
5. Telephone/navigation system modules connector
6. Centering pin
7. Radio A connector
8. Radio B connector
9. Connector C not used

AUDIO CD PLAYER (BASIC version only)

The module consists of an Audio CD player capable of reading and managing audio type compact discs and playing the musical tracks recorded on them.

CD ROM PLAYER (DE-LUXE version only)

The module consists of a CD ROM player capable of reading and managing both CD ROMS (containing street maps) and audio CDs.
The CD ROMs are accepted by the NIT containing information files for the voice messages in the various languages and the map database needed for navigation.
The audio CDs, on the other hand are normally CDs available on the market.

GSM MODULE (both versions)

The Dual Band GSM module, structurally connected by a direct connection to the Sim Card reader (which allows recognition of the user SIM phone card) is, basically, an integrated cell phone.
There is also preparation for an external microphone (for hands free operation) and an additional telephone handset.
Audio operation:
There are 2 different inputs for the microphone and 2 different outputs for the speaker

SIM CARD READER (both versions)

The Sim Card reader is desiged for 'large' type cards.
'Small' Sim Cards can only be used with a special adapator.
This adaptor, available directly from the Provider (Omnitel, TIM, Wind, ecc.) together with the Sim or available commercially, is not supplied together with the NIT.

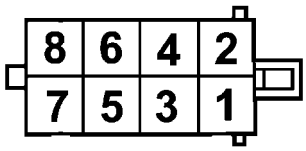
RADIO MODULE (both versions)

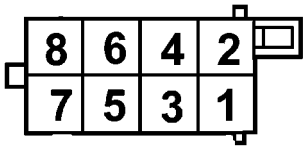
Composition of the module

The module consists of the following sections:
- Receiver
- Power audio amplifier
- Control logic

- CD interface
- Outside audio input interface

Interface connectors
The diagram below shows the radio connector pin outs at the rear of the device





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ISO connectors
This type of ISO connector is used for both the radio signals and the signals used by the NIT main electronic card.
8-way connector p/n 1/24502/90-91350-40 (A)

Pin	Function
1	n.c.
2	n.c.
3	n.c.
4	Key on input (+Key)
5	12 V for automatic aerial
6	n.c.
7	12 V permanent
8	GND supply

8-way connector p/n 1/24503/97-91350-40 (B)

Pin	Function
1	Right rear speaker positive
2	Right rear speaker earth
3	Right front speaker positive
4	Right front speaker earth
5	Left front speaker positive
6	Left front speaker earth
7	Left rear speaker positive
8	Left rear speaker earth

Connector for aerial
ISO NEW type coaxial connector
This connector also provides the supply for the amplified aerial.

Audio inputs
Telephone audio (analogue - mono)
Navigation audio (analogue - mono)
CD-DA audio player inside the NIT (digital - I2S format)

Audio outputs
4 channel amplified analogue audio output

Audio source management
Any one of the audio sources (see audio inputs) including the radio receiver can be selected.
It is also possible to mix the navigation system at the source selected.
The audio sources can be listened to through all the speakers.

Receiver specifications
RDS EON (including PTY Search, REG on/of, TA on/off)

Tuning into the following bands:
- USW (87.5-108 MHz) (FM)
- MW (153-279 KHz) (AM)
- LW (531-1602 KHZ) (AM)
- FM South America (as and alternative to FM)

Manual and automatic tuning into 5 Bands (FM1, FM2, FM3, MW, LW)
Max programming of 6 stations per band (30 stations in total)
LOC/DX sensitivity
RDS-TMC

Audio parameters:

The following parameters are managed:
- Fader
- Balance
- Bass
- Treble
- Loudness
- Digital volume control
- Soft Mute
- Equalizer with 5 frequency bands (adjustment +/- 6dB on each band)

GYROSCOPE
Angular speed sensor based on a piezoelectric ceramic element.

Technical specifications
The gyroscope features a maximum angular speed of +/- 80 degrees/second

GPS MODULE
The GPS module allows the NIT to interface with the GPS to determine the position of the vehicle on the earth's surface.
There must be at least three satellite signals for the module to work properly.

OPERATION

SYSTEM SUPPLY

The events or components which directly or indirectly allow the user to interact the general operating state of the system are:
- the electrical signal linked to the position (ON or OFF) of the ignition key (+key)
- the On/Off button in the front panel.
- the SOS button in the front panel.

System operating states

The operating states of the NIT from the point of view of the supply and general operation are:
- Off State (off),
- On State (on),
- Stand By state (stand by).

Off State
All the Telematic Info Node functions are disabled and the various hardware modules are not supplied.

ON State
In the ON state, the NIT is completely activated, i.e. all the system functions are managed in accordance with the system configuration and the internal modules are operational, as are the internal communication lines.

Stand By State
In this state, the NIT is partially activated, but appears to the user exactly the same as in the OFF state.
In this case, the network management and (internal) location modules only remain activated, whilst the following modules are deactivated: Telephone, Radio, Audio, CD and CDC Audio, Voice Recognition, Voice Synthesis and Navigation System.

SWITCHING THE SYSTEM ON AND OFF

Switching on

The telematic info node can be activated in two ways:
- by turning the ignition key to the ON position
- by using the on/off button in the control panel (even with th ignition switched OFF0

In the first case, if the NIT was switched off, it comes on and finds itself in the ON or STAND BY condition (depending on what the system status was before it was switched off last time).
If the system was in the STAND BY condition before it was switched off last time, the user can move to the ON condition after having tuned the ignition key by using the On/Off button.
In the second case, the user can switch the system on (or change it from OFF to ON) by pressing the On/Off button or the 'Service Call' button in this case, however, the PIN no. must be entered in order to be able to use the telephone.

Switching off
The user can switch the system off (either in the ON state or in the STAND BY state) by turning the ignition key OFF.
In this case, both the back up data and the system configuration are saved.
The switching off is, however, delayed if a phone call or a 'Service Call' is in progress.
In this case, the NIT will switch off automatically when the call is ended by the user (if the call is longer than 20 minutes) or 20 minutes after the key has been removed (if the call is shorter than 20 minutes).
If the NIT, on the other hand, was on, with the ignition key switched OFF, using the ON/OFF button or after a 'Service Call', the system will automatically switch off after the above mentioned time out has elapsed (20 minutes operating without the key) or when the On/Off button is pressed.

Stand By movement (false switching off)
From the ON state it is possible to move the Stand By state (an operation which appears to the user like switching off but in which, in reality, as described previously, the NIT is activated and prevents usage) when the user presses the On/Off button whilst the ignition key is in the ON position.
It is possible to exit the Stand By state and return to the ON condition using the On/Off button or by activating the 'Service Call' button and entering the PIN no. to use the telephone.

SIGNALS AND CAN NETWORK
Since the NIT on the vehicle is not connected to this network, the main information has to be supplied via direct electrical signals.

These signals are:
- +key signal (ignition key signal - used to switch on the NIT the moment the key is turned ON)
- reverse gear engaged signal (to identify the direction of travel of the vehicle)
- milometer signal (to calculate the distance travelled by the vehicle)
- + lights signal (to modify the brightness of the screen)

LANGUAGES AVAILABLE

The languages available for both the instructions displayed and the navigation voice messages are:
- French
- English
- Italian
- Portugese (European)
- Spanish
- German

The language is selected in the NIT using a special configuration menu.

AUDIO

The possible audio sources are the standard sources (Radio Receiver, CD Audio) whose specifications are described in detail later in the chapter, the PTY31 alarms and Traffice Announcements, seen as separate functions and the sources linked to other modules such as the Telephone, the telephone Ringing and the navigation system Voice Synthesis.

General audio functions

The user can adjust the audio parameters using the following controls:
- Balance modification - The ratio between the volume of the left speakers and the right speakers is adjusted.
- Fader modification - The ratio between the volume of the front speakers and the back speakers is adjusted.
- Bass modification - The bass level is adjusted
- Treble modification - The treble level is adjusted
- Balance - The parameters for each of the 5 equalizer bands is adjusted
- Change of audio source - Any one of the audio sources can be selected
- Volume management - The volume of the different standard audio sources can be altered directly by the user. It is also possible to pre-define the volume of the PY31 Alarm/Traffice Announcement, the Telephone, the telephone Rining and the Navigation System separately.
- Loudness - Enabling/disabling of loudness function (amplificatino of bass and treble frequency range).
- Audio OFF - Disabling of audio for standard sources. In other words, these sources are muted.
- Stereo - Change between mono and stereo/
- Auto Volume Control - If enabled, the volume of the general source, whatever it is, is adjusted depending on the speed of the vehicle. In practice, the volume is increased by an offset proportional to the speed.

Interaction between Audio sources

The table below illustrates the possibilities of simultaneous operation of the audio sources available:

Sources activated simultaneously	Standard	Telephone	Ringing	PTY31_A1	Navigation system
Standard	X	-	-	-	X
Telephone	-	X	-	-	X
Ringing	-	-	X	-	-
Voice Recognition	-	-	-	-	-
PTY31_A1	-	-	-	X	X
Navigation System	X	X	-	X	X

System audio states:

Standard Sources:
- With one of the two standard sources activated Radio and/or CD (possibly interrupted by a 'Traffic Bulletin' programme) the navigation imessages and information are available and have priority.

Telephone call in progress:
- With one of the standard sources activated, if a phone call is received, at the end of the conversation the source activated before the phone call will be returned to whilst the navigation messages and information are available at the same time as the phone call.

Ringing:
- The navigation messages are not enabled during the ringing which signals an incoming phone call.

PTY31 Alarm
- Due to the reception of a PTY31 message by the radio receiver. The navigation messages are available.

AUDIO PARAMETER AND VOLUME MANAGEMENT

Standard Source

The typical Audio Set Up parameters (balance/fader ...) are treated as one for all Audio sources.
Only the volume follows a different path, the radio/CD sources have one single volume.

There are several volumes for the:
- Telephone
- Ring
- TA/PTY

- Navigation system
- Voice Recognition

When any source is activated, the user can alter its volume which remains like that until the next modification. Only the Ring volume cannot be altered during the operation of the function, but has to be done using the telephone menu option.
The ring volume is the only one which cannot be modified in this way.
In other cases, the user can alter the volume of the source, at any time, using the volume control.

Traffic Announcement (TA) and PTY 31 Alarm

The TA volume is managed by the Audio module. This defines the TA volume starting from the standard audio source volume at the time the TA is activated. The user can then alter the volume during the TA using the volume control.
At the end of the TA, the volume returns to the value before the TA, whilst the setting made by the user will not be taken into account during the next TA.
The PTY31 source follows the same rules as the TA source as far as the volume management is concerned.

RADIO RECEIVER

FM, MW and LW type radio receiver with RDS, PTY and TP management

User functions available

Skip:
- Station search (forwards / backwards) When the station is found, the NIT tunes in automatically. If the AF mode is activated, only RDS stations are considered. If a particular PTY has been selected, then a PTY type search is conducted.

AutoStore:
- The six stations with the best reception are programmed on the valid band. If the AF mode is activated, only RDS stations are considered.

Manual tuning:
- A station can be tuned into manually by the user in the Step By Step mode in steps of 50KHz in FM or steps of 1KHz in AM

Band:
- One of the bands available is selected (FM1,FM2,FM3,MW,LW). The tuner will tune into the last station tuned into on the band

PTY:
- One of the PTY codes can be selected for searches.

If the stations provide this service, it is possible to define the type of programme one is interested in. In this way, the radio receiver will only suggest stations broadcasting the type of programme selected.

The following PTYs are available:
- News
- Information
- Education
- Culture
- Varied
- Rock Music
- Light Classical
- Other Music
- Finance
- Social Affairs
- Phone In
- Leisure
- Country Music
- Oldies Music
- Documentary
- Alarm
- Affairs
- Sport
- Drama
- Science
- Pop Music
- M.o.R.Music
- Classical
- Weather
- Children's programmes

- Religion
- Travel
- Jazz Music
- National Music
- Folk Music
- Alarm Test

Memory

The user is capable of:
- recalling one of the pre-programmed stations.
- programming a station selected manually.

Configuration functions
Different operating modes can be used by the user. They are listed below.

Alternative Frequency:
- Activating this mode enables the frequency skip linked to the RDS Alternative Frequency function. In addition, any search only takes RDS stations into account.

Traffic Announcement - TA:
- The TA function is activated, in this way the radio receiver passes automatically to a TP (Traffic Programme) station which is broadcasing Traffic Announcements. In addition, any search only takes TP stations into account.(function only available if AF is activated).

Regional:
- If activated in conjunction with the AF, it only makes skips on the AF frequency possible towards stations with the same regional code as the current station.

Local/DX:
- Change between local and DX (distance) search modes

CD Audio

The Audio CD source and therefore the function can be selected at the NIT from the various audio sources. This function is possible on the BASIC version thanks to an Audio CD player whilst on the DE-LUXE version there is a CD-ROM DA player.
The controls available to the user differ both through the direct buttons (front panel) and using the screen menu selection.

CD Audio controls

These controls are:
- Play: starts the listening to the audio track starting from the current position the disc. The tracks are played in the order they appear on the disc (in regular mode) or at random (in RANDOM mode).
- Pause: the listening in progress is halted and the CD laser remains in the current position.
- Stop: the listening in progress is interrupted and the CD laser positions itself at the start of the track sequence.
- Skip: the CD laser moves directly to the start of the previous track or the next one.
- Scan: it is possible to use this control to listen to the beginning of all the tracks on the CD. The actual sequence on the CD is followed.
- Eject: the user can eject the CD.
- Random: the tracks are played in a random order.
- Repeat: this allows the repetitin of a single track or an entire sequence and is repeated until the user stops it.

Lastly, it is possible to set the listening time displayed:
- time elapsed since the start of the current track.
- time remaining until the end of the current track.
- time elapsed since the start of the sequence.
- time remaining until the end of the sequence.

Dead Reckoning (DE-LUXE version only)
The module receives direction progress and variation data from the sensors, accumulates them and integrates them with the current position in order to produce an Estimated Position.

Sensors and Signals

The signals needed for the correct location of the vehicle are:

- Signals from the Milometer: supplied to the NIT via the physical signal (see Pin Out) Useful in determining the movement of the vehicle.
- GPS Signal: detected by a suitable aerial, it is deciphered by the GPS receiver inside the NIT. Useful for the location and for the calibration of certain parameters.
- Gyroscope Signal: provided by the gyroscope module inside the NIT. Useful in determining possible vehicle rotation.
- Reversing signal: supplied to the NIT via a physical signal (see Pin Out). Required for identifying the direction of travel of the vehicle.

External parameters

The external parameters which must be supplied to the NIT for correct operation are those relating to the rolling circumference of the tyre fitted on the vehicle.

Operation (DE-LUXE version only)

The main functions carried out are:
- Calculation of the angular variation in direction from the gyroscope signal
- Treatment of the milometer signal for calculting the movement carried out.
- Management of the communication with the GPR receiver and processing data received.
- Dynamic calibration of the factor transforming milometer impulses into decimetres (milometer scale factor) [The milometer scale factor expresses the ratio between the movement of the vehicle and the milometer impulses produced in the same time span. - The milometer scale factor can be used to convert the milometer impulses to vehicle movement.] .
- Dynamic calibration of the gyroscope signal offset.
- Calculation of the Estimated Position of the Vehicle.
- Validation of the vehicle direction through the GPS (direction reset). The dead reckoning module, constantly estimates the so-called direction of the GPS using the south/north and east/west GPS speed components. The observation of these directions is integrated to allow the correction of the dead reckoning estimated direction. In practice, a number of consecutive directions are observed, the possible direction error variance is estimated and if this goes below certain levels the dead reckoning direction is reset assuming the estimate through the GPS speed components as more valid.
- Possible propagation of GPS position in case of temporary non availability.
- Memory buffer management for memorizing on board and vehicle position sensor calibration parameters. This data is permanent because it is stored in the flash memory.

Navigation System (DE-LUXE version only)

The Navigation module is capable of carrying out the following functions.

Interface functions with other modules

Acquisition of RDS-TMS traffic information from Tuner module

The navigation module receives traffic information, from the radio receiver module, via RDC-TMC messages in the geographical areas where they are available. In any case, the information referred to is only textual (message useful for the driver) or graphic (icons which are positioned on a map).
It should be remembered that the Data Bases containing the associations between the codes received and the relevant info (geographic location which depends on the language set) are contained in the Navigation CD ROMs. The moment the user changes the language, the CD data base will be updated accordingly.

The following functions are managed by the RDS-TMD module:
- definition of a Geographical Area of interest in order to filter messages concerning different countries from the one the user is in.
- The RDS-TMC messages are stored in a volatile memory and are therefore lost when the system is switched off. As they are transmitted cyclically by the control unit, however, when the system is switched on, updated information will be received and made available to the user. If the user, on the other hand, places the NIT on stand by (at the key on), the data will still be available on leaving stand by, unless it is switched off in the meantime.
- the storing of and access to the data received will be managed according to different criteria (proximity to a particular place, priority of the event, class of the event, reception order).
- the entering, updating and cancelling of events from the file will be carried out with regard to the possible expiry time linked to the message, the arrival of new messages which replace the previous ones, the reception of a precise cancellation command.
- each message should be validated by at least a double reception before being made available to the user.
- extremely urgent events will be given special attention (for example with the immediate display of a test message on the screen)

The reception and display of RDS-TMC information is strictly connected to the tuning of the radio receiver into a station capable of transmitting this information. The moment the user changes the tuning, the information will be lost (because it is no longer valid) and will be replaced by any information received through the new channel.

A different audio source other than the radio can be selected by the user (CD, CDC...), but the radio receiver must be tuned into the RDS-TMC station to receive the desired messages.
Lastly, the RDS-TMC information is not available during navigation without a CD.

Internal functions

Location

The task of the location function is to supply all the other current vehicle position, direction and speed modules.
To do this it interfaces with the dead reckoning module from which it obtains data relating to the estimated movement, direction and speed; it also receives the data supplied by the GPS. This estimated position tends to differ from the current position as a result of sensor imprecision. To correct this error, every 30 metres an algorhythm, known as Map Matching, is activated which makes the correlation between the distance travelled by the vehicle and the road network in the map data base. It is possible to identify the correct position of the vehicle in the road network using this correlation.
As a result of the relatively large error range (about 300m), the position data supplied by the GPS is used if the distance from the current location is greater than appropriate levels relating to different navigation systems.

The GPS measurements used inside the NIT nagivation system are:
- Estimated position of the vehicle (Latitude / Longitude in radiants, Height in metres)
- Speed of the vehicle in m/s along the north - south / east - west axes.
- PDOP of the GPS point (in practice an estimate of the GPS position error variance).
- Quality data relating to the signal received: (number of satellites, S/N ratio, 3D point).
- Time-fix relating to the last measurement received (makes it possible to identify the time the measurement refers to).

Some of the sensors inside the NIT Navigation System are subject to possible imprecisions.

These sensors are:
- The milometer sensor
- The timer sensor, according to which the milometer sensor sampling is carried out.
- The gyroscope.
- The GPS system, in addition to measurement imprecisions (estimate of the radio signal flight time) is also affected by a selective availability error.

The probability of finding the vehicle within a 300 m radius around the GPS point is about 0.99 (or 99%). However, the 300 m error estimate should be considered as pessimistic.
The position correction algorhthym based on the GPS data comes into operation each time a new piece of GPS information becomes available (depending on the GPS cover about once a second), the correction algorhthym cannot, however, be recalled more often than 10 times per second.
As far as the type of levels used and their control logic is concerned, the difference between the GPS reading and the navigation estimate is measured continuously.
These differences are then inserted in a filter which estimates the GPS error variance. If the variance goes beow a pre-set level, the location corrects the position, taking the GPS gradually into account.

Route Guidance

Route Guidance involves all those activities designed to provide the navigation module with information to be used in guiding the driver to the desired destination.
The following activities are carried out.

Route calculation:
- Calculation of the route between the current position and the destination.
- Recalculation of the route in the case of deviation from the current route.
- Caculation of an alternative route.

Actual route guidance
- Identification of a point on the route (and calculation of the distance to the destination).
- Identification of junctions on the route.
- Identification of manoeuvres at the junctions on the route (and graphic and voice instructions for the user).
- Calculation of the distance to the next junction at which the user has to make a turn.

Operation

The user entering a destination activates the calculation of the route; the final result of this is to identify a chain of segments (route) which connect the current position of the vehicle to the destination.
It is possible to select several destinations which are managed in order or gradually as they are reached.
When there is a route, the route guidance produces all the information needed for the navigation module to guide the user to the destination. It calculates the actual distance from the destination and keeps it constantly updated; it explores the route ahead of the vehicle to search for the first junction (intersection of at least 3 roads) where the user will have to make a turn (they will have to follow a road which is not in the same direction as they are currently travelling along) and identifies the manoeuvre (e.g. a left turn) that the user will have to make; lastly, it calculates the distance to this junction and keeps it updated.

By checking that the vehicle is located along the route, the route guidance must take into account any deviation in which case the route must be recalculated.
The user can request an alternative route calculation, by selecting the desired distance on the original route, to prevent local viabiilty problems.
If an alternative route is found, the user should accept the alternative proposed.

User interface

Thanks to the route guidance activities, the user is given various assistance near a junction:
- zoom of the junction in other words display of the map on a reduced scale (1:5000) [DE-LUXE version only].
- display of a dynamic bar near the junction; bar which is presented starting from 350m (default) or 2.1 Km (auto location on motorway segment) from the junction [DE-LUXE version only].
- navigation voice messages. These give details of the type of junction and the distance from the junction. - They are given twice: a certain distance from the junction and just near it (e.g. 'turn right in 2 Km', 'turn right'). The distance at which the first of the two instructions is given depends on the type of road and the speed of the vehicle. The possible settings are 2Km, 1Km, 500m, 300m, 200m and 100m.

Back Up management

When the system is switched off, the route calculated, the destination set and the navigation settings are saved as a back up (flash memory).
They are therefore available the next time the system is switched on, irrespective of whether the data base management is complete or reduced.
In the case, however, of a reduced data base, this information will only be available to the user after the navigation CD has been inserted again, because the map data base is not saved.

Complete data base management

The map data base interface supplies all the other map data system functions. This means that access to any map information (segments, areas, services, ...) for the other modules takes place through one of the functions available from this interface; a memory management is also implemented in order to ensure optimum performance of the system: part of the memory available is, in effect, allocated and contains information from the data base regarding an area which is far more extensive than the one displayed in order to have the data available the moment it is required.
If the map CD ROM is present then the navigation function uses the entire data base available.

Reduced data base managment with no CD ROM (listening to music)

It is possible to listen to a music CD during navigation. In this case the navigation function requires the map CD to be inserted during the route calculation and route guidance procedures.
At the end of these procedures, the system loads the map area containing the route calculated into the memory, thereby allowing the user to replace the map CD with a music CD.
This involves a fixed range of about 2 Km, with some limitations as far as the information included is concerned; for example, the availability of town and road names is only relevant for segments of the route.
If the areas driven through along the route feature particularly detailed maps and the route itself is very long, then not all of the route from the departure point to the destination can be memorized, only a part of it. In this case, when the user reaches the limits of the area mapped in the memory, the NIT will ask them to temporarily insert the navigation CD in order to update the necessary data.
The reduced data base in the memory makes it possible to deviate from the route without having to insert the CD ROM again. However, the efficiency of this recalculation depends greatly on the characteristics of the map for the original route.
The destination cannot, however, be altered.
The reduced data base is not saved as a back up; the CD ROM must be inserted again after switching the system off and on again in order to obtain any of the navigation functions.
If the user, on the other hand, places the NIT on stand by (at the Key On), the map allocated in the memory will still be available on exit from stand by unless the system is switched off in the meantime.

Functions seen by the user

Map display (DE-LUXE version only)

If the navigation function is activated, the user can select the representation of the area map on the display with the features listed below:
- Possible scales: From 1:10,000 up to 1:20,000,000 (zoom available with scale from 100m to 200km per cm; the possible steps correspond to 1 cm for the following distances : 100m, 200m, 500m, 1Km, 2Km, 5Km, 10Km, 20Km, 50Km, 100Km, 200Km).
- North up or Heading up available
- Area colouring (parks, expanses of water, etc.)
- Road colouring according to the importance of the road.

- Town names. The names displayed depend on the scale activated (an algorhythm prevents overlap is also displayed). Depending on the scale activated, the following are displayed: 100/200 Km --> capitals and large towns; 50 Km -->medium sized towns as well; 5/10/20 Km --> small towns as well; 2 Km --> any towns as well; 500m/1Km --> even hamlets; 100m/200m --> even districts.
- RDS-TMC icon
- POI icon (only the following categories: Restaurants, Hotels, Service Stations, Car Parks). Only one category at a time is displayed for reasons of screen definition and space.
- Colouring of the route calculated (fuschia) in a completely different colour. This colouring is activated for the entire route.

Entering location

Method for entering address

This consists of providing the system with the following location data:
- District or hamlet.
- Road name. Simply enter any of the words which make up the Place-Name (it is vital to enter a road or at least indicate the centre of the district/hamlet).
- Street number (if the number is not entered, the segment closest to the vehicle, belonging to the road selected, will be used as a reference).

Method for entering junction

This makes it possible to define the point as a junction between two roads. The former is defined as in the previous case (district or hamlet, place-name), the second road is selected from a list of roads which form a junction with the former in the same district or hamlet (in other words, if a district is specified then we have all the roads in the district which form a junction with it, whilst if a hamlet is specified, then we only have the roads in the hamlet which form a junction).

Method for entering Points of Interest (POI)

This consists of entering the following information, in order, to select a particular POI (in relation to which other information can be obtained).

Request for name: the following must be entered:
- District
- Type of POI (Hotel, station, etc.)

Name of POI (Mercure, Novotel, etc.)

Request for nearby services: the following must be entered:
- Type of POI (Hotel, station, etc.)
- Selected from list of those closest to the vehicle location.

Request for services close to destination set previously: the following must be entered:
- Type of POI (Hotel, station, etc.)
- Selected from the list of those closest to the destination selected:

Request for services close to a general address: the following must be entered:
- Type of POI (Hotel, station, etc.)
- Address
- Selection from the list of those closest to the address selected.

Agenda

Selection of locations from those entered previously by the user in the agenda

Previous destination memory

Selection of location from previous destinations.
The list of previous destinations consists of 10 elements corresponding to the last 10 destinations set (in other words entered into the list of active destinations).

Usage

Once a precise geographic location is selected, one of the activities described above can be carried out.

Individual or multiple destinations:
- The system calculats the optimum route for reaching the location(s) set. Up to 10 active destinations can be defined.
- The system calculates the route to the first location on the list. Having reached this, the NIT asks the user whether they wish the next route to be calculated. And so on until the list is exhausted.

Relocation: - This makes it possible to set the location as the vehicle position. This has the sole aim of relocating the vehicle if the following two conditions occur simultaneously:
- The vehicle is transported with the engine switched off (ferry)
- The GPS constellation is not visible (underground car park, tunnel)

Memorizing in agenda. - The location can be memorized in an agenda in order to be recalled easily later on. The system allows a descriptive text to be associated with the location. The maximum number of positions is 200. It is possible to memorize both a point belonging to one of the map segments and an unmapped geographic point (latitude, longitude) in the agenda, selected in 'Atlas' mode (in this case, however, no description will be automatically associated with the point).

Vehicle location information

Name of road driven along and location

The name of the road driven along and the district appear constantly in a special window if the map display is selected.

Arrow on map

An icon in the shape of an arrow represents the location of the vehicle on the map (if the latter is displayed). The vehicle point refers to the barycentre of the symbol (TBD point of the arrow)

Traffic information

Starting with the RDS-TMC information described previously, the user receives the following traffic information.

Icon on map

The system can be configured to display the icon on the map corresponding to any traffic jams. Only certain types of traffic jams are displayed.

Explanatory text

An explanatory text is associated with each event. There are two ways of accessing this text:
- If there is map, select the icon and when confirming the system will display the text corresponding to that case.
- From the menu, access the list of types of event, select the type and access the list of all corresponding events.

Route Guidance

The route guidance or the instructions that the NIT is capable of giving for the user to manage to follow the pre-determined route are based on the following functions.

Voice messages

These are part of the general set of NIT voice messages, pre-recorded with a female voice
Repetition

The user can ask for the message to be repeated; there are the following possibilities according to when the request is made:
- no message has been synthesized for the next junction and the junction is more than 2 Km away: No repetition
- no message has been synthesized for the next junction and the junction is less than 2 Km away: Send message for junction (the distance is rounded off through a defect in one of the levels used.
- the first message (type of junction and distance) has already been synthesized for the next junction: Send second message (type of junction only)
- the second message (type of junction only) has already been synthesized but the junction has not yet been passed: Send second message (type of junction only)
- the junction has been passed: Send or message or not for the next junction according to the distance from it.

Zoom type junction on map (DE-LUXE version only)

The system can be configured to show, as a manoeuvre is approaching, the junction enlarged in great detail with explanations of the route to follow.

Pre-defined pictogram type junction

The navigation screen permanently shows simplified pictograms of the next two manoeuvres to be made beyond the map (DE-LUXE version only).
On the DE-LUXE version the pictogram for the first junction is highlighted by the position and the colour (fuschia).

Name of the road to take
When approaching a junction, the system indicates the name of the road to take at the end of the manoeuvre.

Compass driving
The moment the user defines a destination, an arrow appears indicating the direction to follow to reach the set destination.
When starting from a point which is not on the map or if the vehicle is not located on a segment, this indication is the only one given by the route guidance. The calculation of the route will, in effect, only be carried out when the vehicle is located on a map segment.

Function disabling (RG-off)
The route guidance function can be disabled. In this case, the user will be given no indication of the route (neither voice messages or pictograms of the junction).
The map only (only on the DE-LUXE version) will be displayed with the current poitn of the vehicle and the route still highlighted (fuschia).

Disabling voice messages
There is a mute function for the voice instructions with the navigation pictograms maintained.

Specific configurations for navigation function

Selection of display modes (L4 only)

Map:
- North up
- Heading up
- Automatic (becomes N.U. on less detailed scales)

Junction zoom YES/NO
Characteristic areas design YES/NO (characteristic areas refer to topographical areas with specific identification functions such as parks, stretches of water, industrial areas, urban areas, etc.).

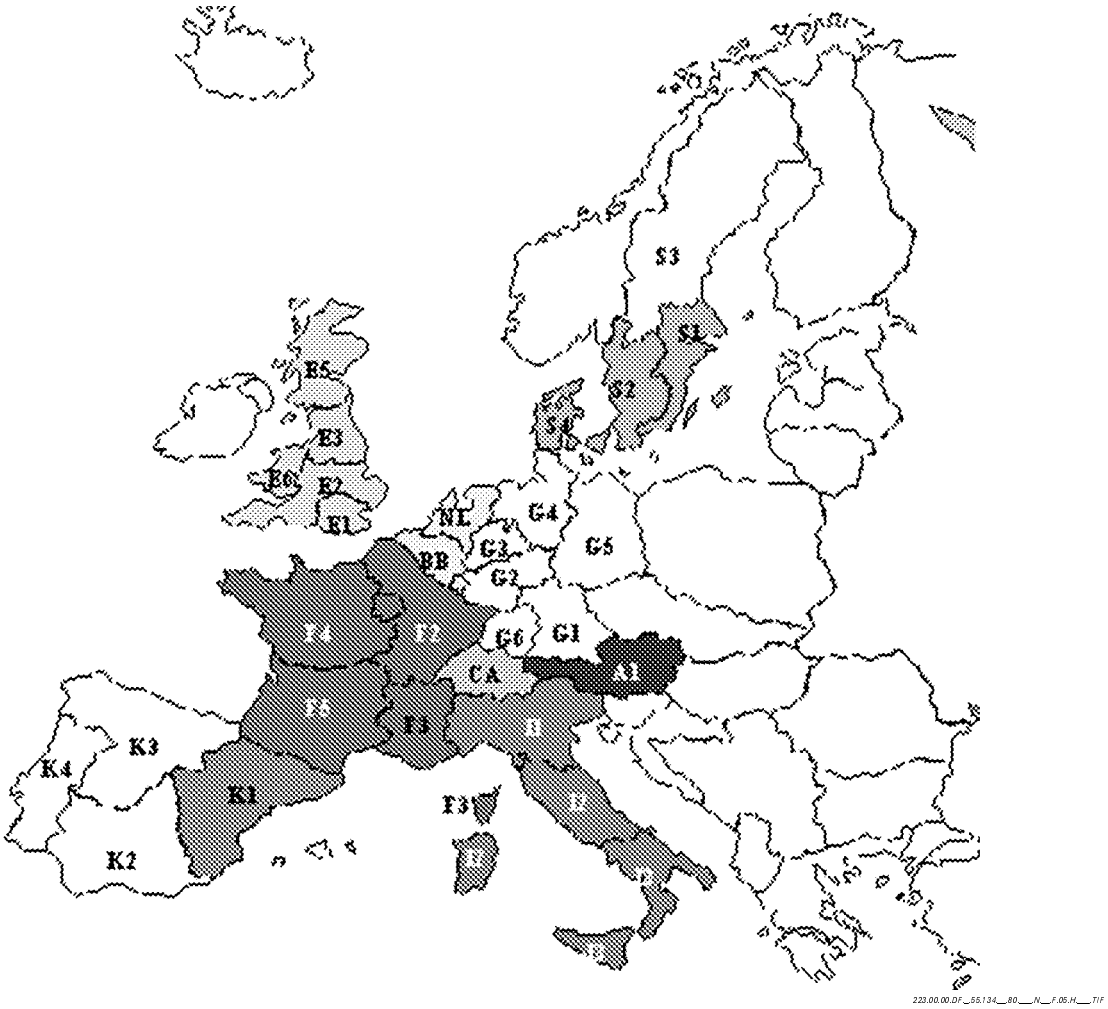
Route calculation configuration
Less time/less distance
Motorway YES/NO
Route Guidance YES/NO
RDS TMC icon YES/NO
POI icon YES/NO

List of maps available
Each navigation CD contains the map of a single country or a given zone, in accordance with the table below and the determination of the areas in the European data base figure.

Navigation CD	Areas included
Germany	from G1 to G7
France	from F1 to F5
Benelux	BB, NL
UK	from E1 to E6
Italy	I1, I2, I3
Central Europe [Austria - Switzerland]	CA, A1, I1, G1, G6
Spain/Portugal	K1, K2, K3, [K4 partial]

Each CD, in addition to one of the areas mentioned above, also contains the complete European motorway network with motorway maps and service areas.

Note: *the motorway maps contain the names of certain towns which can be reached from the various motorway exits (exactly the same as the actual motorway maps).*



Emergency services (NIT)

The following functions can be activated manually via a special button ('Service Call') which makes it possible to send an automatic service call to one or more Service Providers:
- Medical aid
- Mechanical service
- Traffic information
- Point of Interest

It is also possible to activate a call to a 'private number' unconnected to a service provider but defined by the user.

Operating modes

Press 'Emergency Call' button
'Services' screen appears on the NIT display with 'Medical aid' function displayed.
If the user does not change the default selection within 10 secs., using one of the buttons, a call is made to the Service Provider for 'Medical aid'.
Otherwise the user can select 'Mechanical service' (in which case the call will be made to the Service Provider for 'Mechanical service'), 'Private number' or exit from the service screen by cancelling the call.
The automatic activation of the call can be enabled or disabled by the user through the configuration menu.

Telephone module

The telephone module allows normal telephone activities, the management of short messages and the transmission of data.
A secondary activity is support for the Service Call to the Provider described in the appropriate chapter.

Functions available to the user

Telephone functions

Thanks to the telephone module it is possible to:
- accept an incoming phone call.
- refuse an incoming phone call.
- send a telephone call.

SIM data base access functions

The possibilities for the Sim Card data base are:
- reading the list of telephone numbers stored on the SIM;
- entering a telephone number on the SIM.
- cancelling a telephone number from the SIM.
- copying the entire SIM onto another SIM.

Information is also provided on the state of the SIM (SIM Card correctly inserted or not) and on the space available in the SIM memory.

Last numbers function

The module is capable of taking into account the last 10 numbers called to make it easier for the user to call numbers used regularly.

SMS message functions

The module manages SMS messages for both the user and a Service Provider.

It is therefore possible to:
- display messages received but not yet read (complete list or selected message).
- display messages received already read and memorized (complete list or selected message).
- store a message received.
- cancel a message (as soon as it is received or one already stored).
- send a message to a particular number entered by the user.
- define the reference Service Provider number for SMS messages.
- reply to a message.
- call the sender of the message by phone.

GSM state display function

It is possible to obtain information on the:
- aerial signal quality
- name of the network operator
- presence of any SMS messages received and not yet read.
- any credit in the case of a pre-paid SIM Card.

Configuration function

The following are possible:
- 'call divert' : it is possible to divert incoming calls to another telephone number specifying the type (Voice, Data ...)
- network operator management : the module manages both the selection of the network opertor (manual or automatic search) and the use of a list of preferred operators (with display, cancellation, entering and over-writing operations).
- automatic reply : the user can select a number of rings, after which the module automatically accepts the incoming call.
- security : use of PIN code, PUK, display of number of attempts at entering PIN remaining before PUK code request, change of PIN code.

General usage modes

In order to use the telephone module, the PIN security code must be entered by the user each time the telephone is switched on after it has been switched off (the telephone is switched off when the NIT is in the OFF state, the NIT is in the stand by state, the telephone is in the OFF state) (unless the 'PIN request exclusion' has been entered in the configuration parameters).

Without a SIM card or with a SIM card but without the PIN code entered, only emergency calls can be made (112) but not normal calls by the user or Service Calls.

If the incorrect PIN is entered three times, the module requests the PUK code to release the activities.

The options linked to entering the PIN are:
- enabling the NIT to remember the last PIN entered (and to enter it automatically the next time the SIM is inserted).
- disabling the PIN on the SIM.
- changing the PIN.

The modification of these options is protected by an obligatory PIN request in order to be able change the current settings.

DIRECTORY

There are two different directories inside the NIT: one for telephone usage and the other for navigation usage. The aim for both is to facilitate the entering operation (of a telephone number or destination) required from the user not making them have to go through a rather long process every time.
This operation can be carried out once and the result is stored in the NIT under a mnemonic name; later on, it is simply necessary to identify one of the possible choices stored in the memory by selecting it from a list or by entering the mnenomic name.
Both the directories are also stored in a back up memory (flash memory); this implies that the information recorded is kept even after the system is switched on and off repeatedly or the battery is disconnected.

Telephone directory

The fields in this telephone directory are:
- name: mnemonic label for fast access to the directory.
- telephone number: number which is used by the NIT for possible call.
- origin: origin of the item in the directory (NIT memory or SIM CARD).

The name and number can be entered by the user whilst creating a new item in the directory. In this case, the original field will indicate that the item is stored definitively in the directory inside the NIT.
Either the Name or the Number can be on the SIM Card which the user has inserted into the NIT SIM Reader. The system will also display information such as the telephone directory items. With this aim in mind, after inserting the Card, the module which manages the directory will read all the items on this Card and, if the name/number pair is not already in the NIT directory, it will produce a copy, creating new temporary items. In this case, the original field will indicate that the item comes from the SIM CARD.
This type of items are cancelled from the directory the moment it is extracted or the system is switched off.

The following functions relating to the telephone directory are available to the user:
- entering new item
- cancelling existing item
- voice selection for telephone call
- modifying name field or number field for individual item.

There is also the possibility of definitively copying all the items from the SIM Card onto the NIT directory (the original field will therefore be modified).

Navigation directory

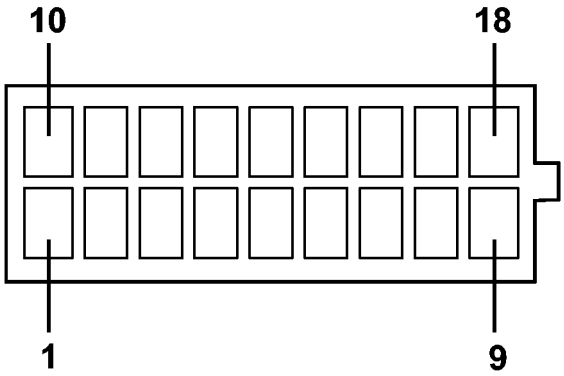
The fields in the navigation directory are:
- name: mnemonic label for fast access to the directory.
- description of the geographical place defined by the user : string consisting of name of town / name of road or name of associated POI ...
- co-ordinates : place co-ordinates (not available to the user and for internal use for possible locations or route calculations).

The name can be entered by the user whilst creating a new item in the directory whilst the description and co-ordinates are selected by accessing the map data base.

The following telephone directory functions are available to the user:
- entering new item
- cancelling existing item
- selecting item (by name) for calculating route/vehicle location
- modifying name field for individual item.

TELEPHONE/NAVIGATION MODULE CONNECTOR AND PIN OUT

View of connector



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18-way MQS connector

Pin	Function
1	Not connected
2	Not connected
3	Reverse Signal Input
4	'Service Call ' Repeat Button (outside E-Call)
5	Microphone output (to outside E-Call)
6	Hook (input from Intimity receiver)
7	Audio signal (output to Intimity receiver)
8	Microphone input (input from Intimity receiver)
9	Microphone input
10	Not connected
11	Milometer signal input
12.	GND RF
13	Microphone supply (from outside E-call)
14	Ref. Microphone (to outside E-call)
15	+ Lights signal input
16	Ref. Audio (input from Intimity receiver)
17	Ref. Microphone (output to Intimity receiver)
18	Ref. Microphone.

NIT information

The information which can be obtained is divided into three categories:
- EEPROM data: This is data relating to the NIT configuration, the number of times overheating is recorded, the number of Key Ons since the last overheating and the details of internal errors.
- RAM data: This data relates to: the insertion or not of a CD and the CD play time, the presence or not of the CD Changer and the play time of the CD in the CD Changer, the presence or not of a SIM
- Identification data: This is the data which identifies the system hardware and software.

EEPROM data

This consists of:

Internal error details or signalling of error in the following functions:
- communication with GSM module
- communication with GPS module
- communication with radio module
- communication with CD module
- Main Board

Configuration or information on the presence of certain modules which are not always provided for in the NIT; these modules are:
- Telephone
- Services
- Voice Recognition
- TFT colour display
- Outside E-CALL module

Number of overheatings; this is a simple counter.
Number of Keys On since the last overheating; this too, involves a counter.

RAM data

This data is the volatile memory is valid when the diagnosis is activated. It includes:
- CD data: The playback time since the start of the track (expressed in seconds) is indicated. There is also a check as to whether the NIT recognizes the presence of a CD or not.
- Presence of SIM Card: There is a check as to whether or not the NIT recognizes the presence of a SIM Card in the SIM Reader.

SELF-DIAGNOSIS

The NIT is capable of self-diagnosing five possible types of error:

These are:
- Fault in the casing connection (each casing is diagnosed separately).
- Fault in the GPS aerial
- Fault in the AM/FM aerial
- Overheating fault
- General internal error

The following information is available for each type of error:
- the error code [DTC - Diagnostic Trouble Code]
- the DTC status (present / memorized but not present / absent).
- the conditions in which the error occurred (overheating)
- an error counter.

Product SW update

Loading a new SW version onto the NIT can be done as follows according to the levels referred to:
- as far as the DE-LUXE version is concerned, an updated Software version can be loaded by CD ROM
- the BASIC model, on the other hand, only has a CD Audio and not ROM player. The downloading therefore requires the intervention of the dealer/service centre which, using special equipment connected to the K line (serial ISO9141) allows the SW to be read and transferred to the NIT.

Electrical Absorption

The L4 level NIT absorption figures are:
Ioff = 2.2 mA
Normal operation (Vbattery 13.5 volt) = 3.8 Amp
Max operation (Vbattery 13.5 volt) = 10.5 Amp
Impulsive (battery attachment) 24 Amp (for a time < 2 ms)

70

Body

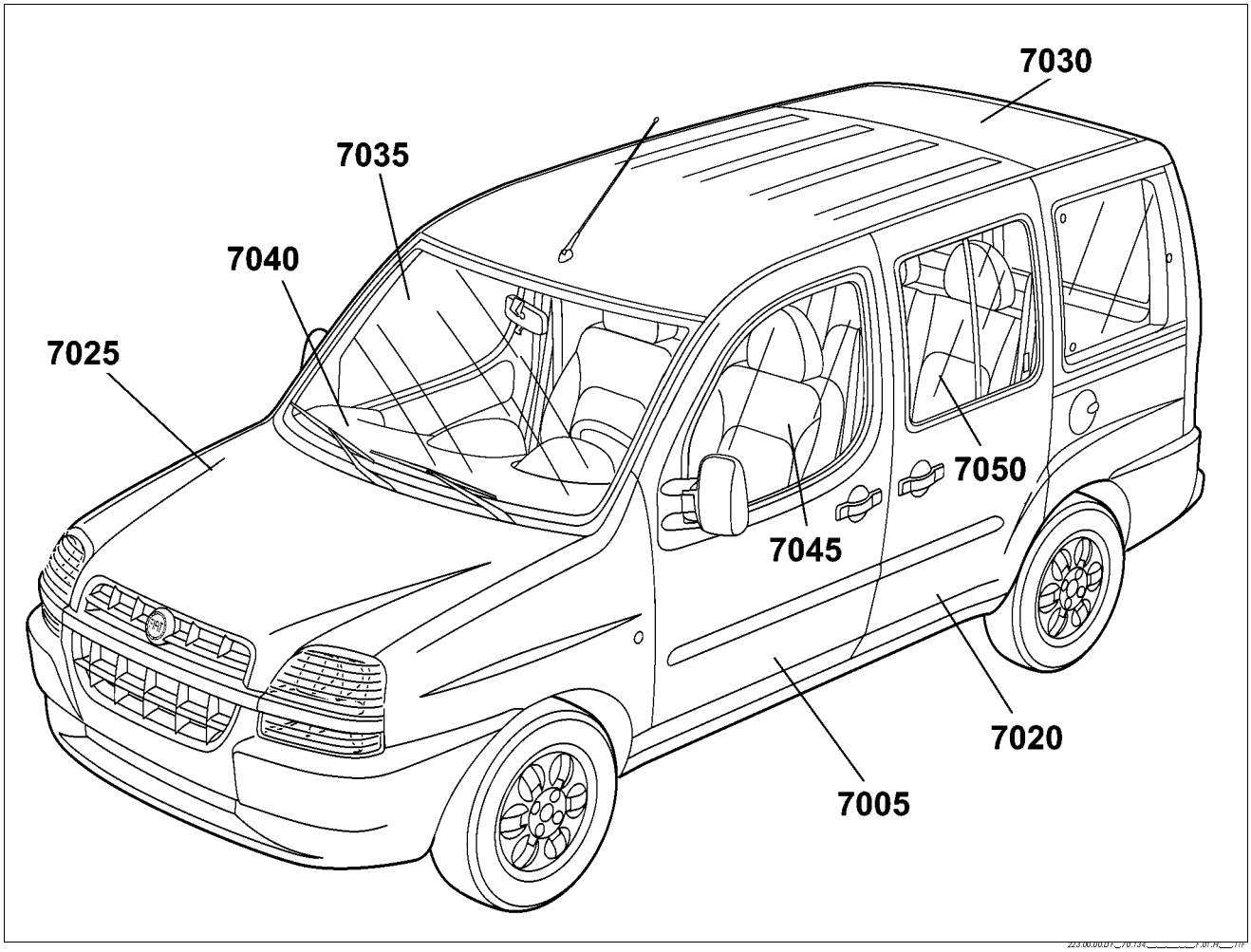
Group index

- GROUP GRAPHIC INDEX

Sub-groups index

Sbgrp.	Description	Validity
7005	Passenger compartment front side door	
7020	Load compartment doors	
7025	Compartment covers lids	
7030	Sun roof and hood	
7035	Body window glasses	
7040	Body interior upholstery and trim	
7045	Front seats	
7050	Rear seats	Doblò

GROUP GRAPHIC INDEX



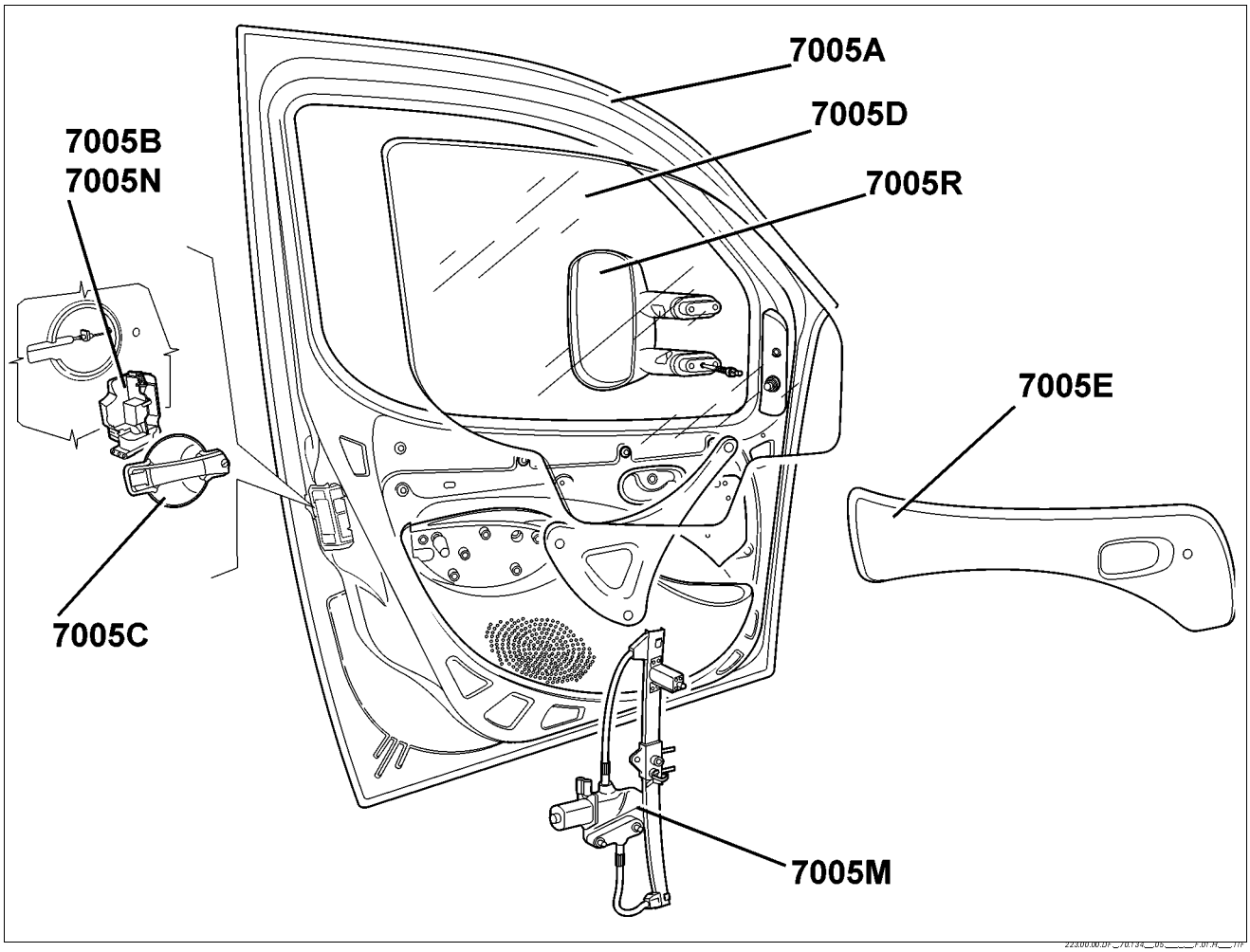
Sub-group index

- SUB-GROUP GRAPHIC INDEX
- CONSTRUCTION FEATURES
- COMPOSITION

Assembly drawings index

Cmp	Description	Validity

SUB-GROUP GRAPHIC INDEX



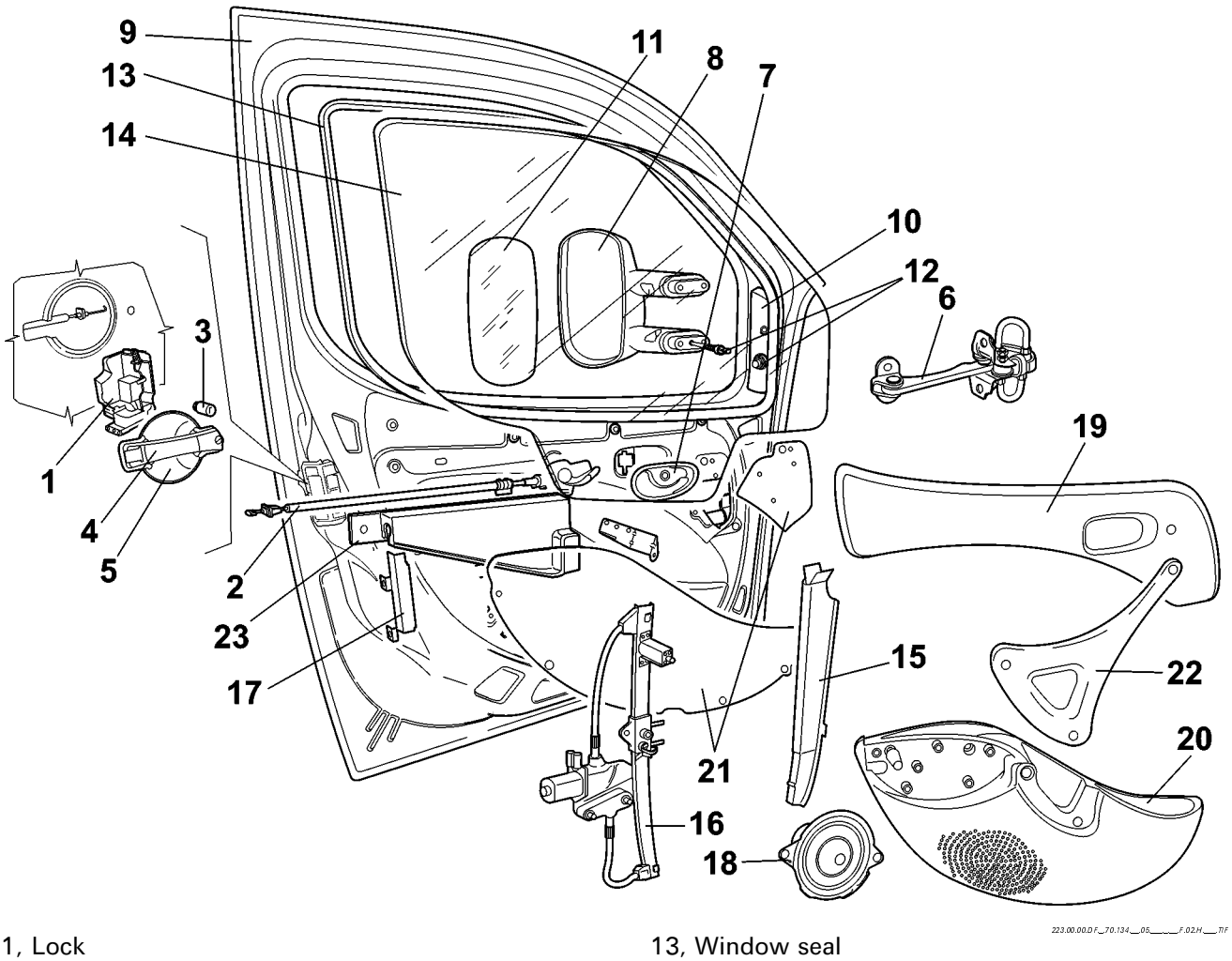
CONSTRUCTION FEATURES

The front doors are manufactured using conventional pressing processes and include features designed to ensure passive safety and protection against theft.
They are fitted with anti-intrusion bars, waist reinforcements to contain side impacts, hinge reinforcements and panels without sharp corners.
The lock includes a new control lever.
The door opening/closure lever mechanism is protected by new-design theft-proof partitions that prevent access to the mechanism and the lock from outside.
The rear view mirrors can be fitted with an electric or manual adjustment device.
The window opening mechanism may be electrically or manually controlled and incorporates a guide cable.
The operating buttons are located in the middle of the facia.

The window seals incorporate a glass scraper to ensure a good seal against wind noise.

COMPOSITION

Exploded view of front door

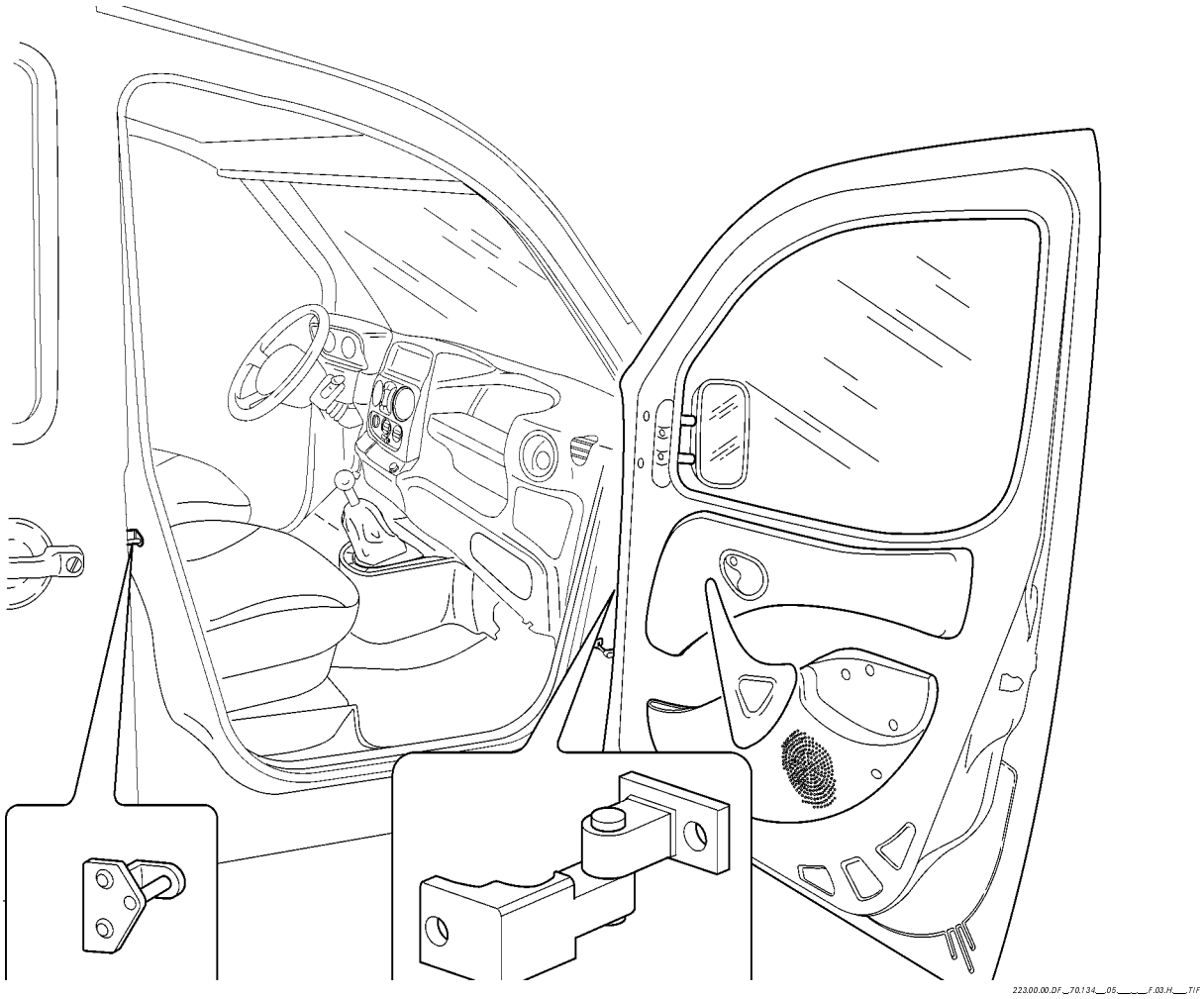


1, Lock
2, Interior door opening link
3, Lock barrel
4, Exterior handle
5, Exterior handle mount
6, Door opening limiter
7, Interior opening and security handle
8, Rear view mirror
9, Door frame
10, Mirror control cover
11, Reflector
12, Mirror adjustment device
13, Window seal
14, Window glass
15, Front guide
16, Window mechanism
17, Rear guide
18, Speaker
19, Upper door panel
20, Front door pouch
21, Water guard protection (opal)
22, Inner g rab handle
23, Theft-proof partition

ADJUSTMENT

The front door is adjusted by means of the hinges, which are bolted to the door and the front pillar. The gap may be aligned and the load on the door seal may be modulated by adjusting one hinge at a time.
Adjust the hinge secured to the door to increase or decrease the load on the seal.
Adjust the hinge secured to the pillar to align the gaps.

Adjustment of the lock striker only allows load on the seal in the rear part of the door to be restored.



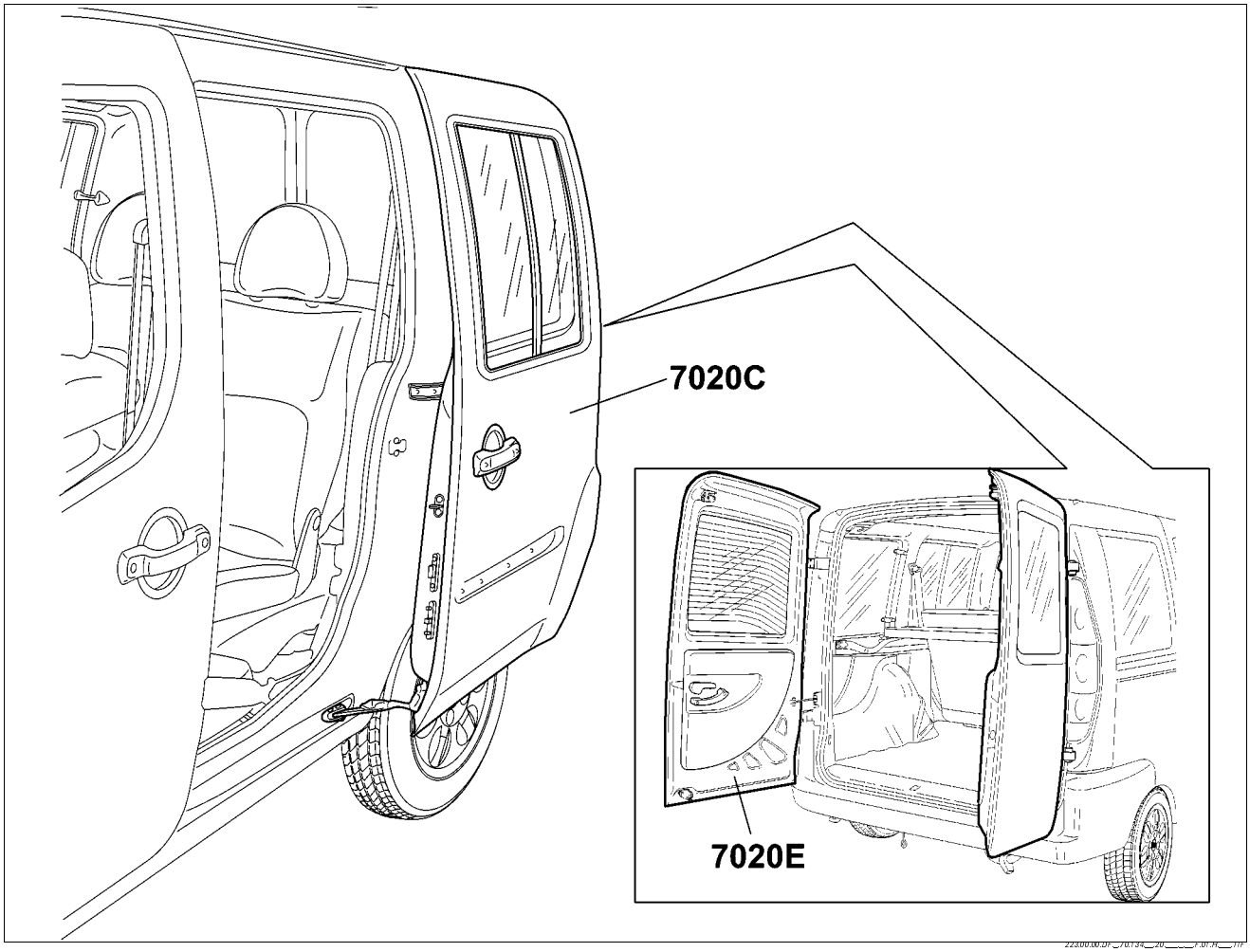
Sub-group index

- SUB-GROUP GRAPHIC INDEX

Assembly drawings index

Cmp	*Description*	*Validity*
7020C	Sliding side door	
7020E	Rear swinging door	

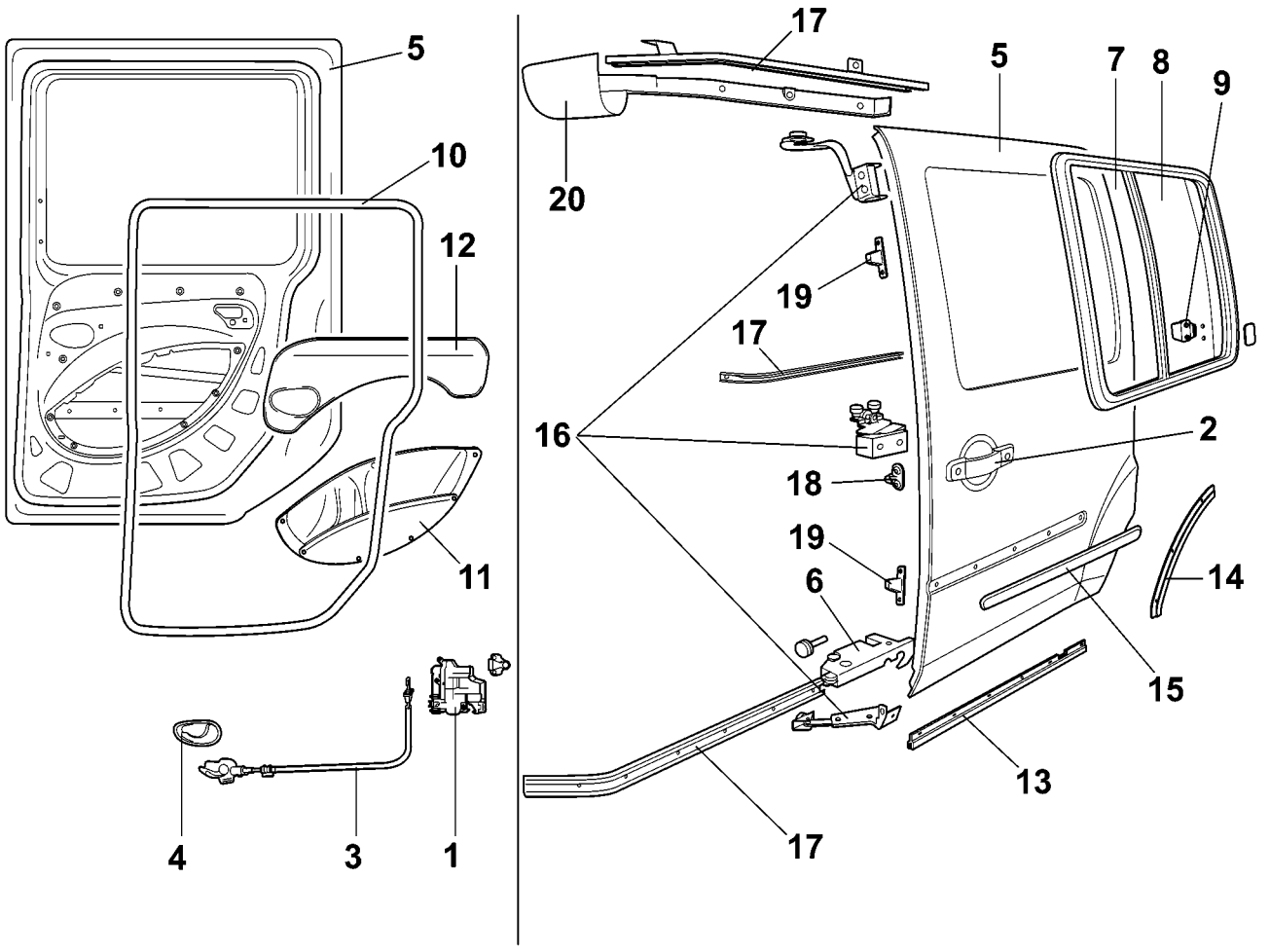
SUB-GROUP GRAPHIC INDEX



7020C - Sliding side door

COMPOSITION

The side door is manufactured using conventional pressing processes and includes a sliding opening and closure system with three anchorage points. Passive safety is assured by side impact bars.
The door is anchored and locked shut at the rear by means of a conventional central lock.
An electrical contact device located at the lower front of the door ensures a contact for the door open indicator and door safety lock when the door is closed.
The glazed door window includes two panes that slide over one another and are anchored in the middle to close.



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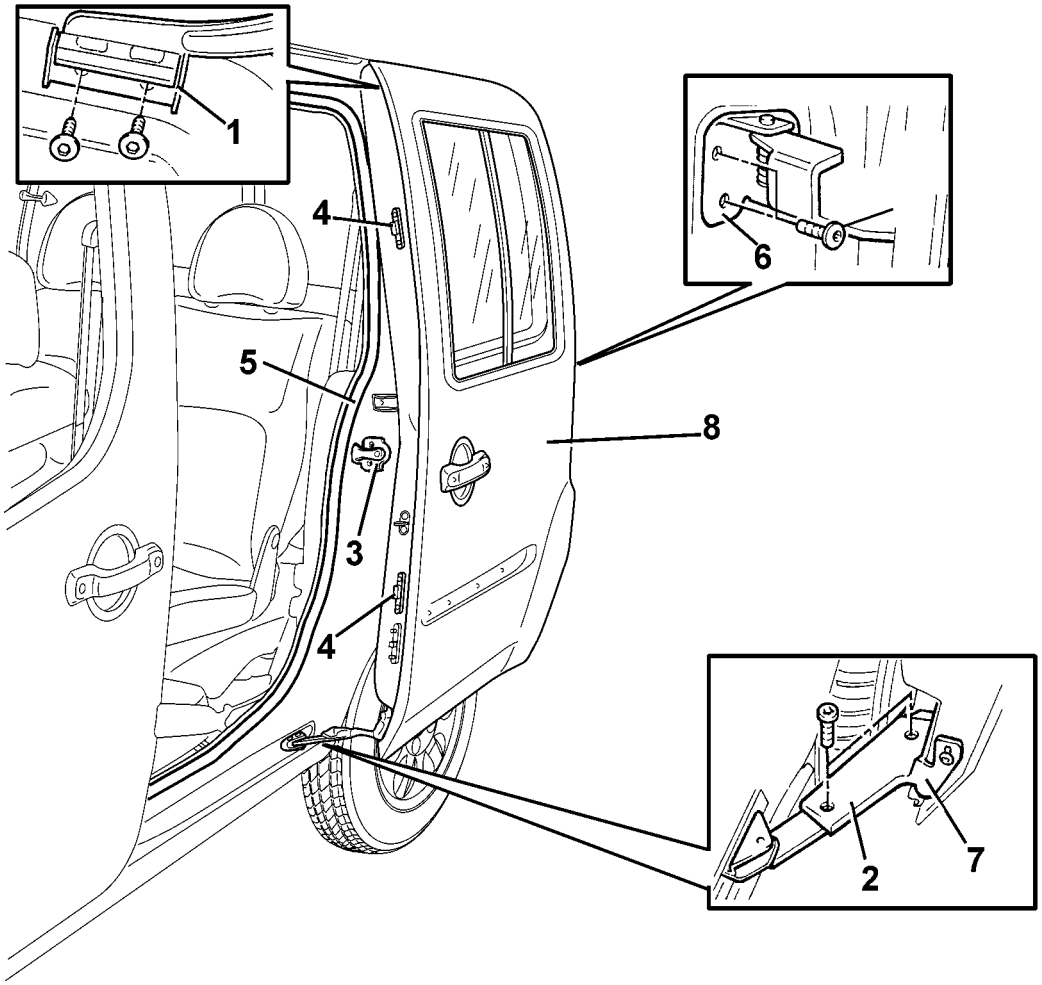
1, Lock
2, Outer handle
3, Interior door opening link
4, Interior handle and safey device
5, Door frame
6, Door open limiter and lock
7, Fixed window glass
8, Sliding window glass
9, Device for locking sliding glass open
10, Door compartment seal
11, Interior door panel
12, Rear door pouch
13, Lower seal
14, Rear seal
15, Exterior sliding door moulding
16, Anchorage devices
17, Sliding mount guides
18, Safety pin
19, Sliding door locating pins
20, Upper guide cover

ADJUSTMENT

The right or left sliding side door (8) incorporates slots in anchorage points (1), (2), (6) and (7) for adjusting gaps and seal loads.
At the top, upper device (1) and lower device (2) allow load on door compartment seal (5) to be increased or decreased. Before adjusting these devices, loosen locating pins (4) at the front.
To increase the load on seal (5) at the rear of the door, adjust lock striker (3) secured to the pillar.

Lower slide (7) allows vertical adjustment of the front part. Central slide (6) allows vertical adjustment of the rear part.

Note: *It is advisable to adjust only one device at a time and also to tighten the fastenings to the recommended torque before going on to the next adjustment.*



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1, Upper anchorage device
2, Lower anchorage device
3, Lock striker
4, Locating pins
5, Seal
6, Rear anchorage device
7, Lower anchorage device on the door
8, Sliding side door

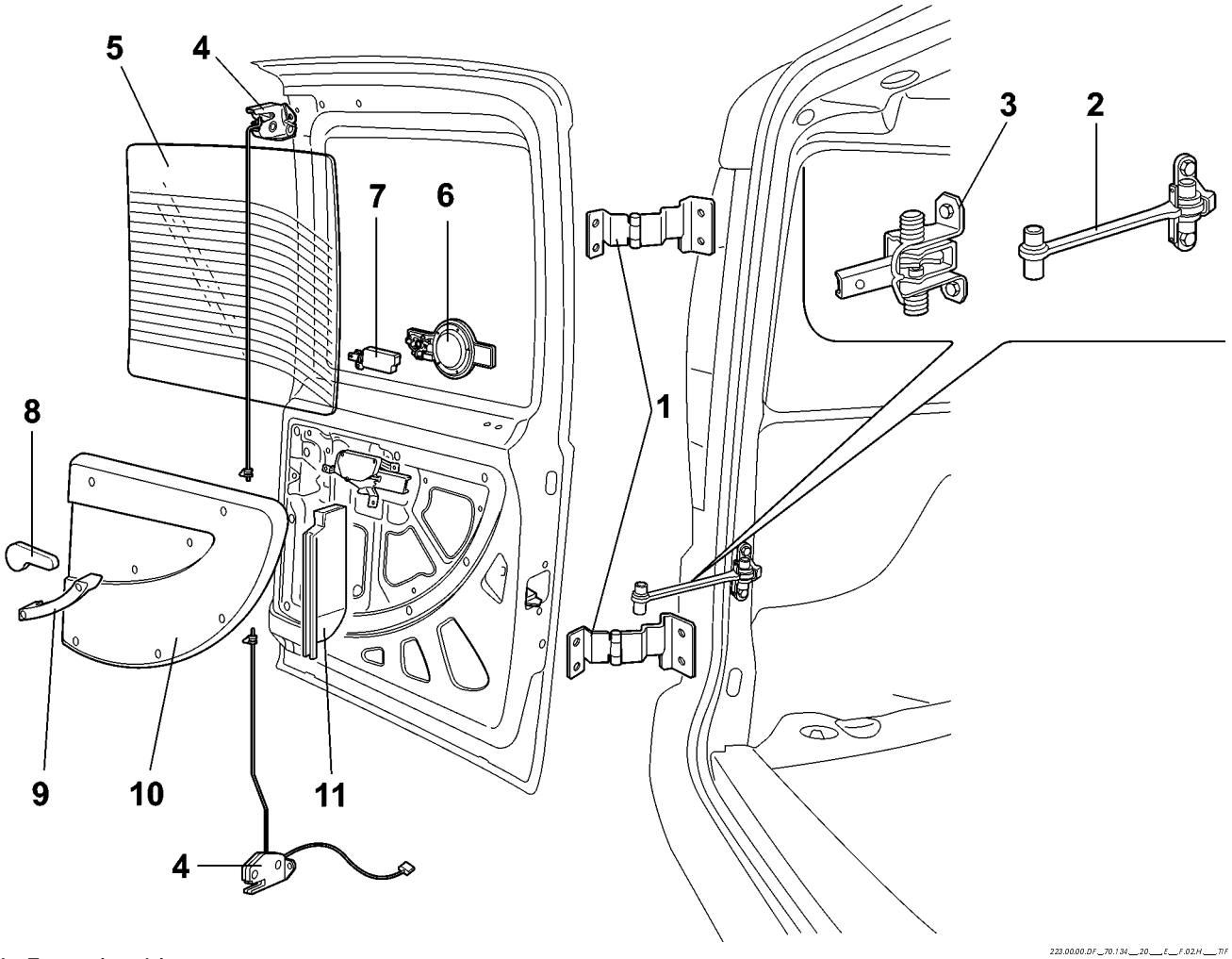
7020E - Rear swinging door

CONSTRUCTION FEATURES

The assymetrical rear doors may be windowless or glazed according to the outfit. The door structures are identical.
Each door is secured to the pillar by two hinges on the outside. Then hinges allow a 90° book-type opening and incorporate a detent that can be automatically released to allow an 180° opening. When the doors are closed, the door detent re-engages automatically.
The central catches engage on the roof at the top and on the floor at the bottom.
The left door incorporates the third brake light, number plate holder and the central opening and closure handle.
An inner handle on the right door is used to open and close the door after opening the left door.
The glazed doors feature two large windows bonded to the structure by means of a polyurethane adhesive. The windows are tinted with solid and stippled black screen printing. A demisting device is built into the area swept by the wiper blade.

COMPOSITION

Exploded view of assymetrical doors



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1, Fastening hinges
2, Door opening limiter
3, Door opening limiter housing
4, Catches
5, Catch control link
6, Exterior door opening handle
7, Door lock device

8, Interior door opening handle
9, Interior grab handle
10, Interior panel rear door
11, Theft-proof guard

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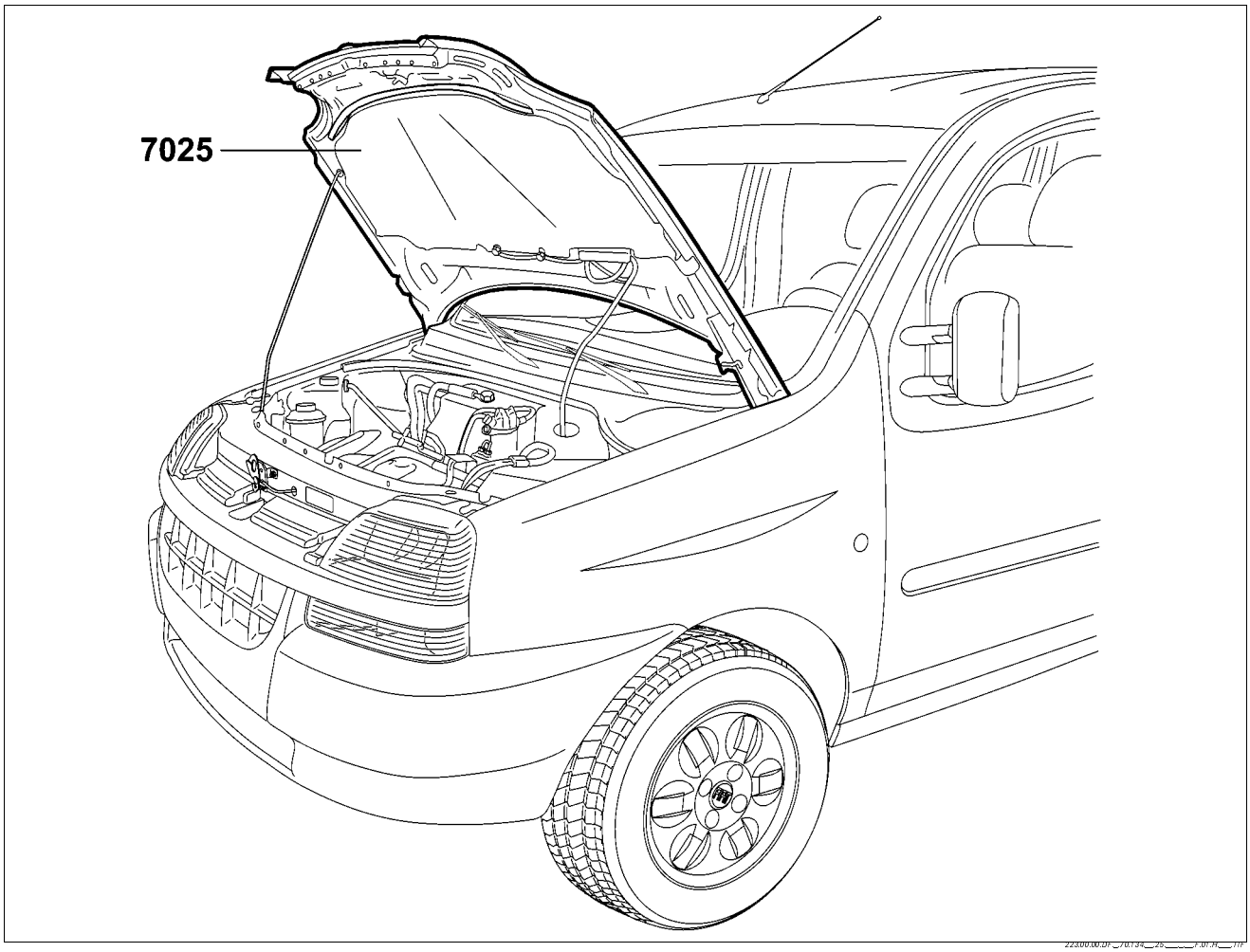
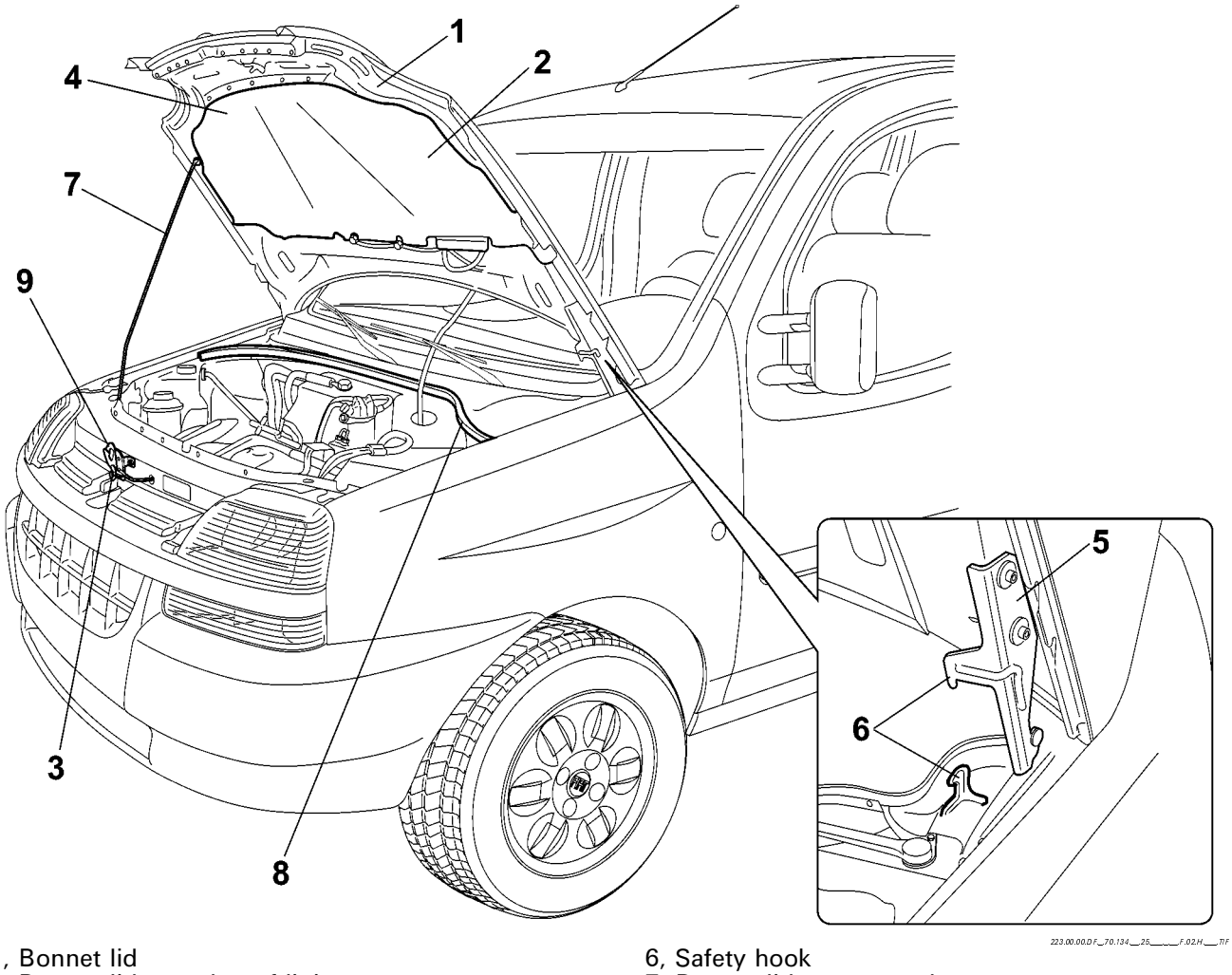


CONSTRUCTION FEATURES

The bonnet lid has been manufactured to include various safety features; These include preset collapse lines that - together with special retaining devices - prevent the bonnet going through the windscreen in the case of impact.
The bonnet is lined throughout with a preformed panel in sound-absorbent material. This reduces noise emissions to the outside of the car and also to the car interior to increase passenger comfort.
The preformed panel is secured by a sufficient number of studs to ensure effective fastening to the bonnet frame.

COMPOSITION

Bonnet lid (1) is supported by two hinges (5) that incorporate a hook (6) to secure the bonnet in case of a collision; this hook is made directly out of the mobile part of the hinge.
The bonnet is closed by means of a single central catch assembly (3) controlled by bowden cable. The catch assembly incorporates a safety hook (9).
The inner part of the lid is fitted with two wind seals, one at the front (4) and one at the rear (8).
The bonnet interior can also be fitted with a sound-proof lining (2) depending on the version.



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1, Bonnet lid
2, Bonnet lid soundproof lining
3, Bonnet lid catch
4, Bonnet lid front wind seal
5, Bonnet lid hinges
6, Safety hook
7, Bonnet lid support rod
8, Bonnet lid rear wind seal
9, Safety hook

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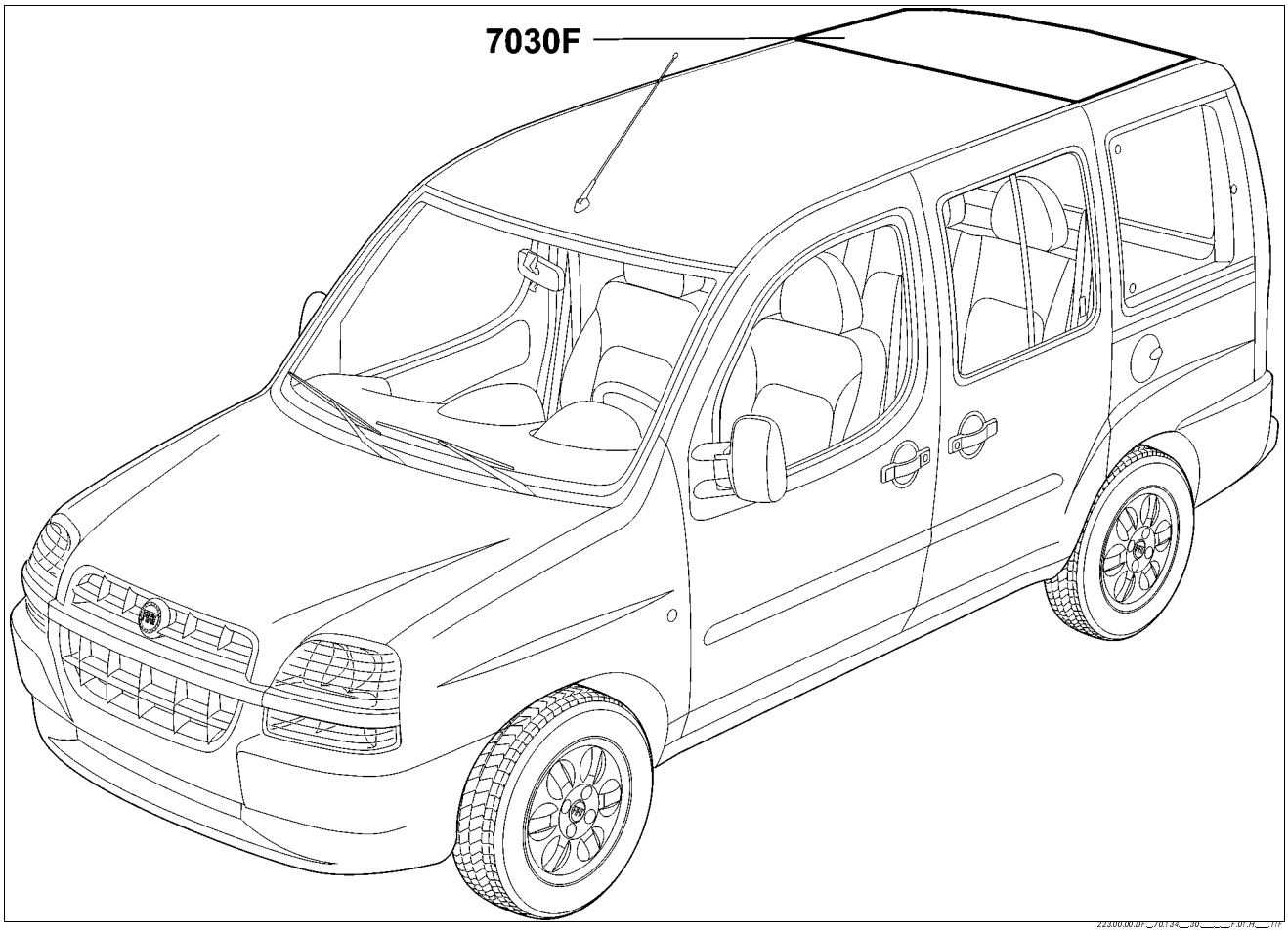


CONSTRUCTION FEATURES

The roof spoiler consists of an aesthetic trim and a frame.
The material used for both is polyester reinforced with fibreglass. This is compression-moulded in the case of the trim and injection moulded in the case of the frame.
The compression-moulded part is made out of pre-impregnated sheets produced by combining a fibreglass reinforcement and a resin that has already been charged, dyed and catalysed. The prepared sheets are cut to the required shapes and placed inside hot moulds where catalysis takes place.
The injection-moulded parts are produced by injecting resin into a closed mould that already contains a dry fibreglass reinforcement; in some cases the resin and reinforcement (ground fibreglass) are mixed before being injected into the mould.
Plastics offer the benefits of improving vehicle aerodynamics, reducing weight (both these attributes help reduce fuel consumption) while also eliminating corrosion and minimising the possibility of impact damage.
Parts with large surface areas are reinforced with fibreglass to give them essential qualities of strength and rigidity.

General repair instructions

Some repairs can be carried out using suitable products because the composition of resins and polyesters reinforced with fibreglass are technically very similar to the composition of the initial part

Working temperature

These resins must not worked at temperatures below 15°X
Acceleration of setting time

Setting time can be accelerated:
- In a drying cabin
- Under a mobile infra-red drying lamp (at a minimum distance of 70cm from the repair area)

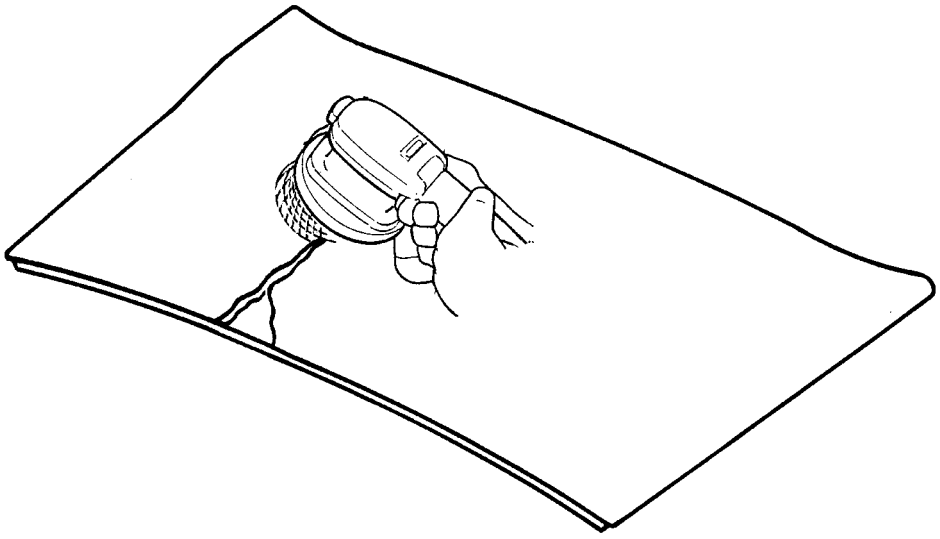
In any case, wait 15 to 20 minutes before subjecting the repair to a maximum temperature of 60°X

Cleanliness and protection

When sanding, use:
- A sander with a vacuum device (due to the dust generated and because of the presence of fibreglass)
- Protective goggles
- Rubber gloves
- Mask (to filter out organic dust)
- Watertight overalls
- Safety footwear (optional)

Rebuilding

When the repair is difficult to build up or places driver safety at risk, the damaged part must be replaced.
To repair a crack or deep scratch (that does not go right through the full thickness of the laminated part), proceed as follows:
1 Remove the roof spoiler, place on a work bench and sand the area to be repaired using a grinding wheel P180



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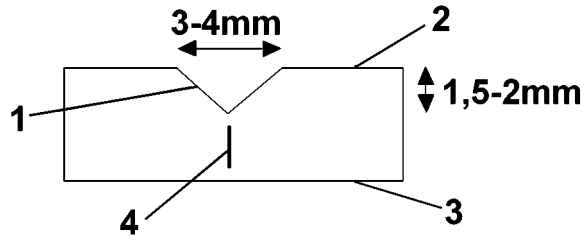
2 Chamfer the damaged part using a grinding wheel (abrasive wheel P40)



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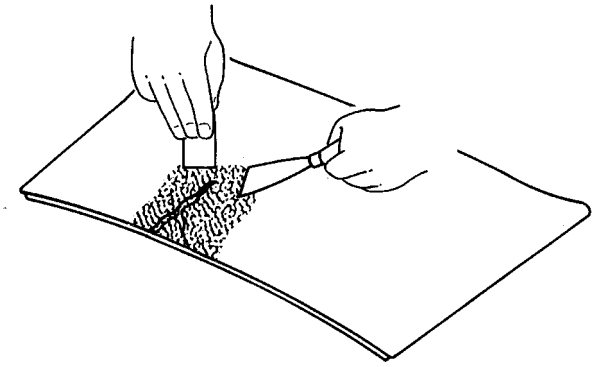
1 Chamfer
2 External part
3 Internal part
4 Crack

3 Use the following material for the repair:
- Polyester resin loaded with fibreglass
- Catalyser

Prepare sufficient resin for the repair and catalyse

Note: *Consult the product technical data sheet to find out the correct amount of catalyser*

4 Carefully mix the product and catalyser and use a spatula to cover the chamfered area entirely



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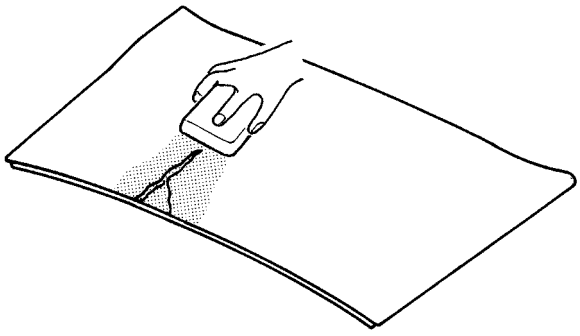
5. Remove any excess material using a grinding wheel (abrasive wheel P80)
6. Apply a layer of finishing filler (metal filler) to make the surface non-porous and uniform
7. Sand using a block and sandpaper. Use 200 grade first and finish with 600 grade.



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Lastly, touch up the paint using primer and enamel.

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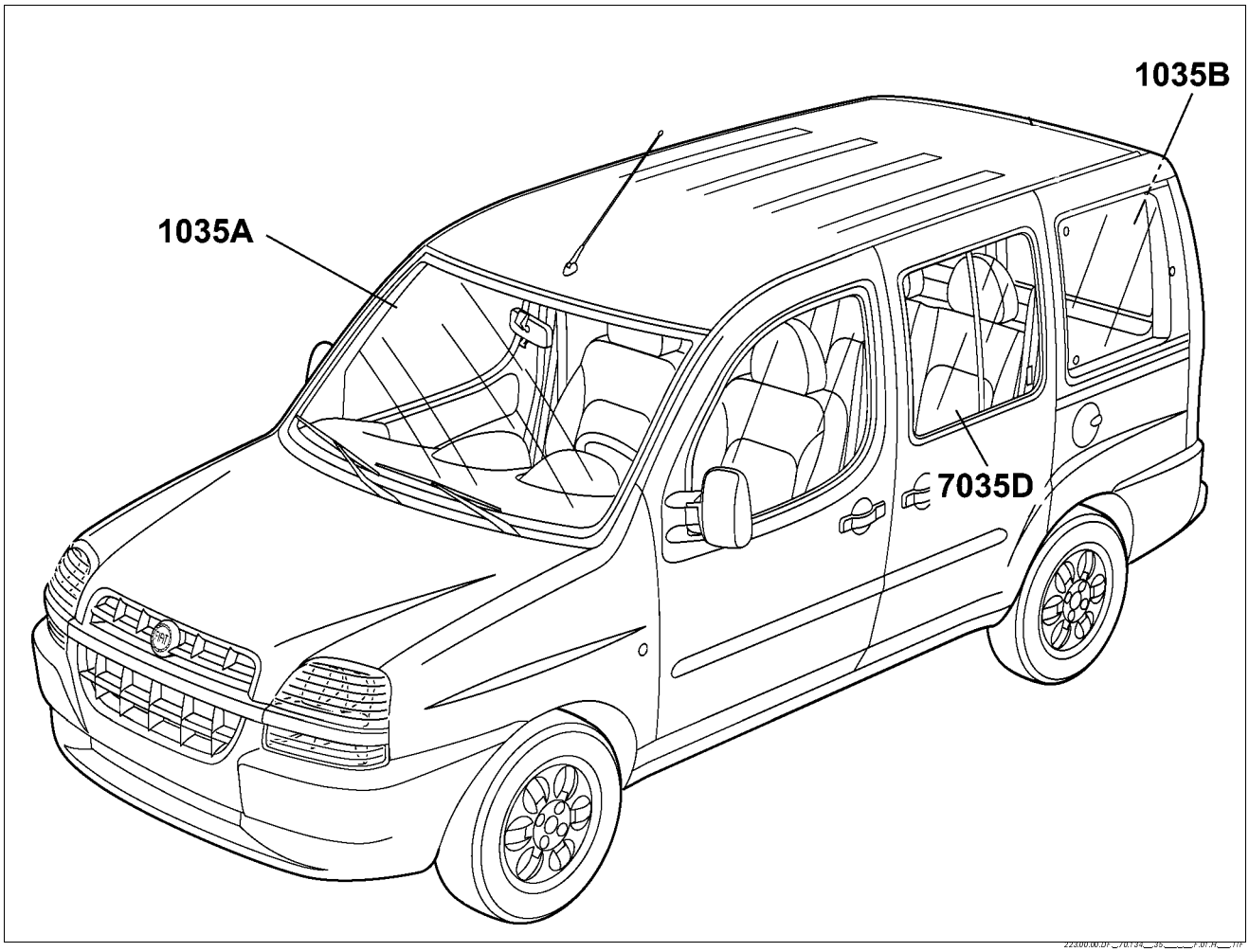
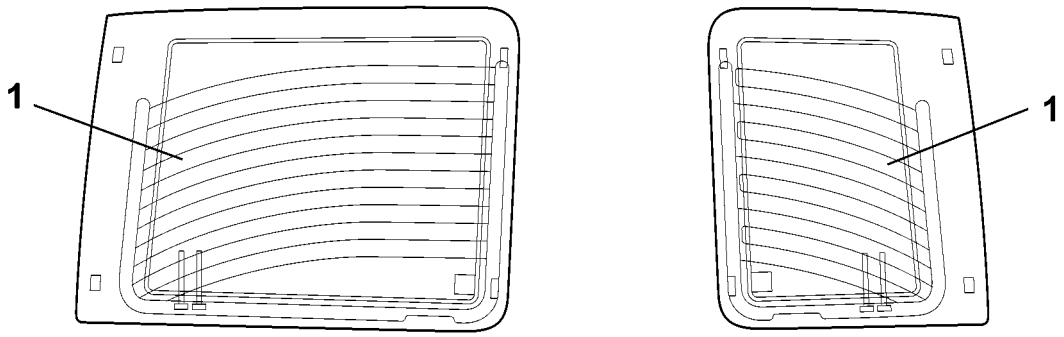


SPECIFICATIONS:

HEATED REAR WINDSCREEN

Two different types of heated rear window may be fitted according to the version.



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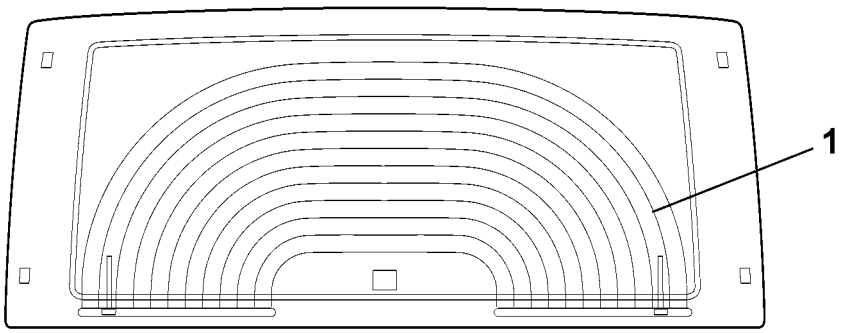
1 Heated rearwindow fitted to versions with a rear door with two asymmetrical flaps
-



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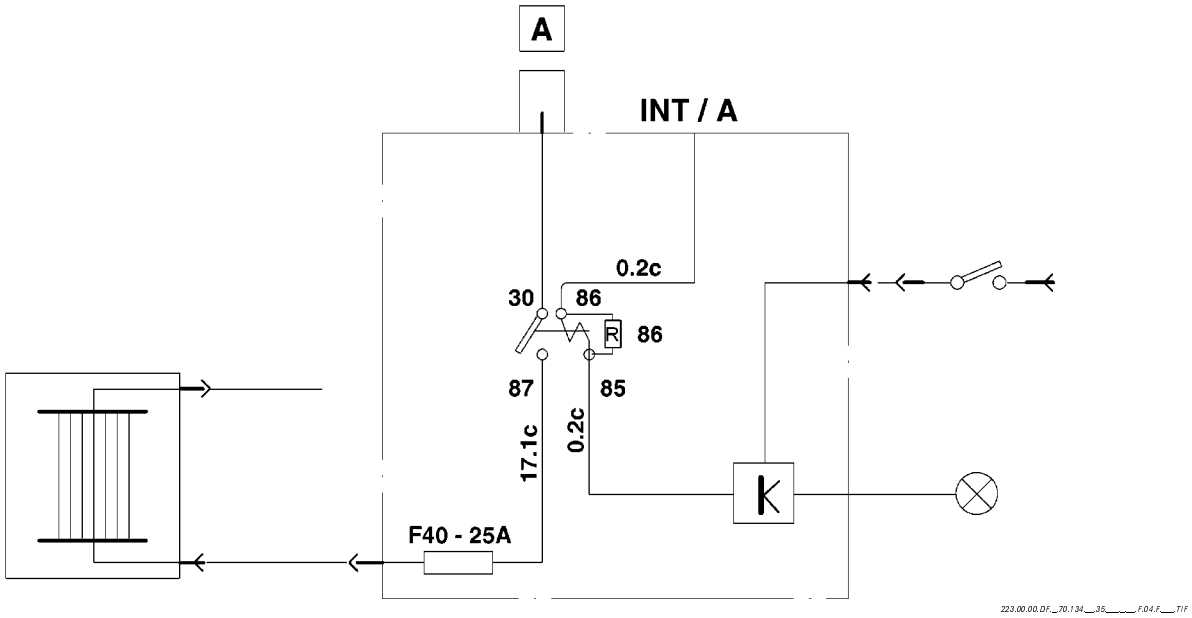
1 Heated rear window fitted to versions with a swinging rear door.

Heated rear window wiring diagram



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7040A	**Passenger compartment trim**	
7040E	**Interior courtesy light system**	

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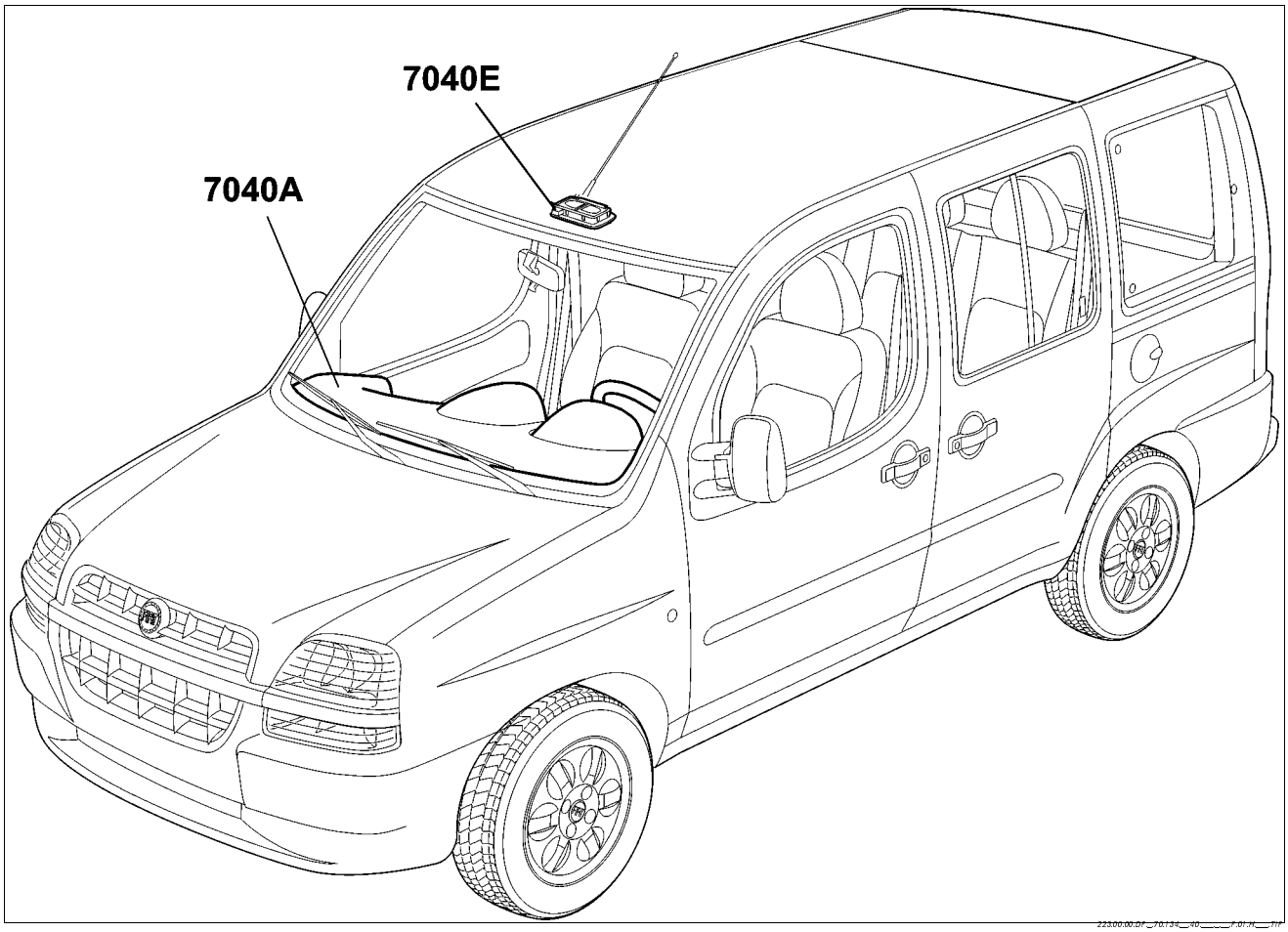


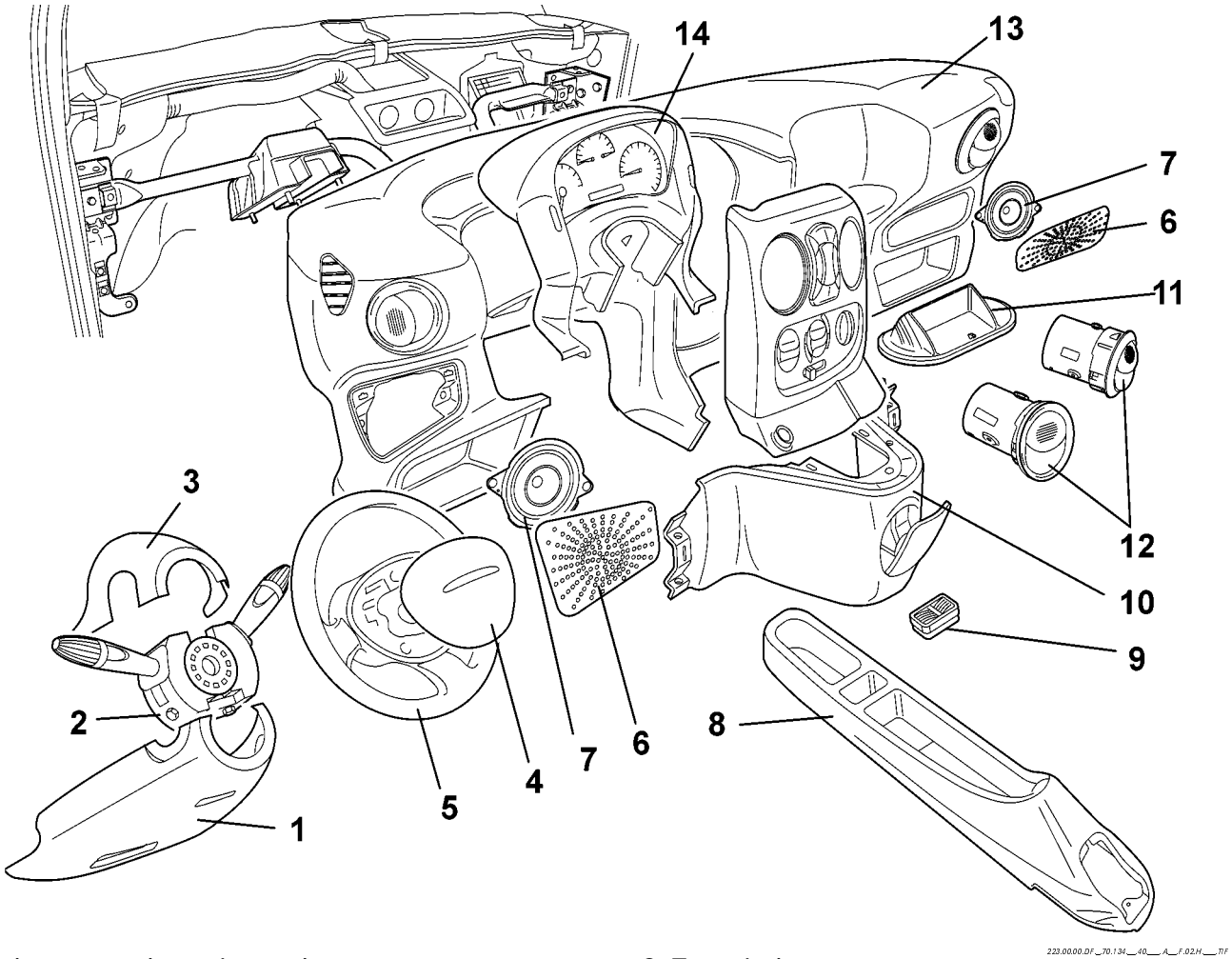
7040A - Passenger compartment trim

CONSTRUCTION FEATURES

All car interior trim meets stringent US flammability standards.
The main components are slow-burning: they do not ignite due to accidental contact (for example, if a cigarette is dropped), flames do not develop and, in the presence of fierce heat they burn to produce strong, dense smoke.
The dashboard is a one-piece, modular, symmetrical structure separated into two areas: driver and passenger; The controls are within easy reach and easily accessible. The gearlever is particularly accessible and located in a raised position.
Like all the other car components, it has been designed and manufactured to reduce the effects of impact against the facia in any type of accident.
Its rounded shape and smooth trim is a safety feature and not simply for the sake of appearance.
To avoid vibration and squeaking, anchorage devices should always be checked before refitting and replaced if necessary.

COMPOSITION

Exploded view of the facia



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1, Lower steering column trim
2, Stalk unit
3, Upper steering column trim
4, Driver's airbag module
5, Steering wheel
6, Speaker grille
7, Speaker
8, Tunnel trim
9, Coin holder
10, Underfacia trim
11, Storage compartment flap
12, Central air outlets
13, Facia trim
14, Instrument panel

7040E - Interior courtesy light system

SPECIFICATIONS:

LOCATION OF COMPONENTS ON VEHICLE

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1 Front courtesy light

Pin - out

Connector A

Pin	Description
relay	Earth
relay	Direct battery supply
3	Timed control

OPERATTION

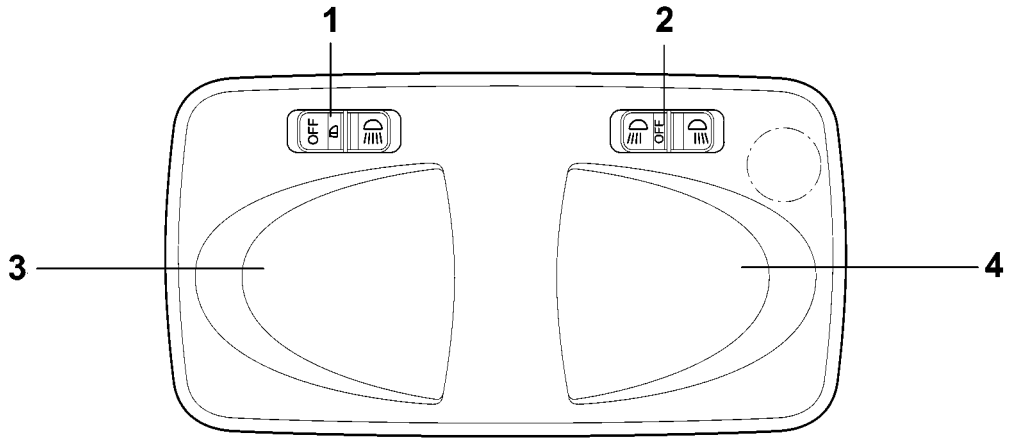
OPERATING PRINCIPLES

The front courtesy light has two timing strategies for the courtesy lights:

1 Vehicle entry stage:
- When the front doors are unlocked, using the key or the RF remote control, an initial courtesy light timer is activated for about 15 seconds.
- When one of the side doors is opened, a second courtesy light timer starts for a period of around 3 minutes, after which the courtesy light goes out and remains off until the next time one of the doors is opened again.
- If the door is closed during these 3 mins., a third timer comes on for 7s. This is interrupted if the panel ignition key is turned ON.

2 Vehicle exit stage:
- After having extracted the ignition key from the ignition switch, an initial period of 7 seconds is activated (if no more than two minutes have elapsed since the vehicle is switched off, after the opening of the one of the side doors, a second period of 3 minutes is activated.
- When the door is closed, as long as it takes place during this time interval, a third period of around 7 seconds is activated.

FRONT COURTESY LIGHT



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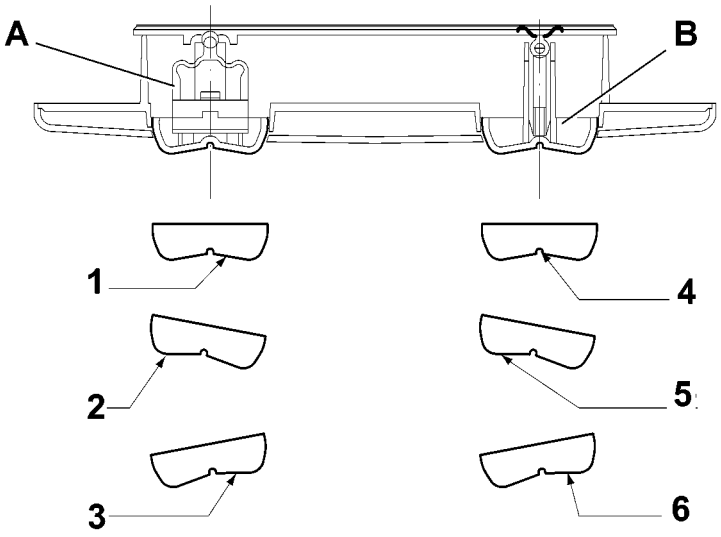
1 Left courtesy light switch.
2 Right courtesy light switch
3 Left courtesy light
4 Right courtesy light

SWITCH POSITION A and B



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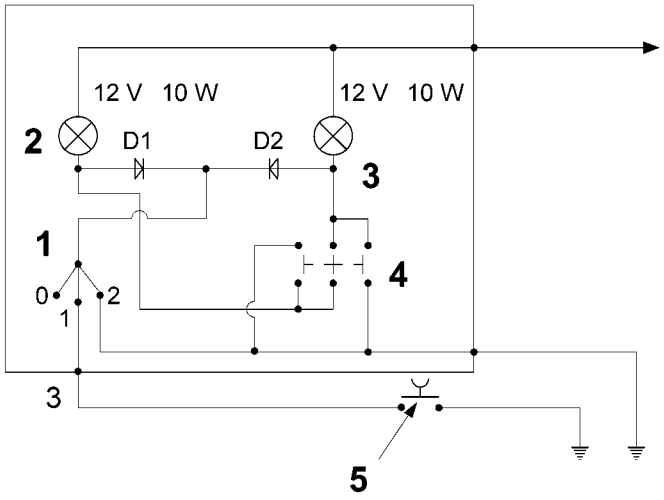
A. Left courtesy light switch
B. Right courtesy light switch
1 Pos. 1 Courtesy light (door light)
2 Pos. 0 Courtesy light (off)
3 Pos. 2 Courtesy light (on)
4 Pos 0 Spot (off)
5. Pos. 1 Left spot (on)
6. Pos. 2 Right spot (on)

WIRING DIAGRAM



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1 Courtesy light switch
2 Left spot
3 Right spot
4 Spot switch
5. Switch on door pillar

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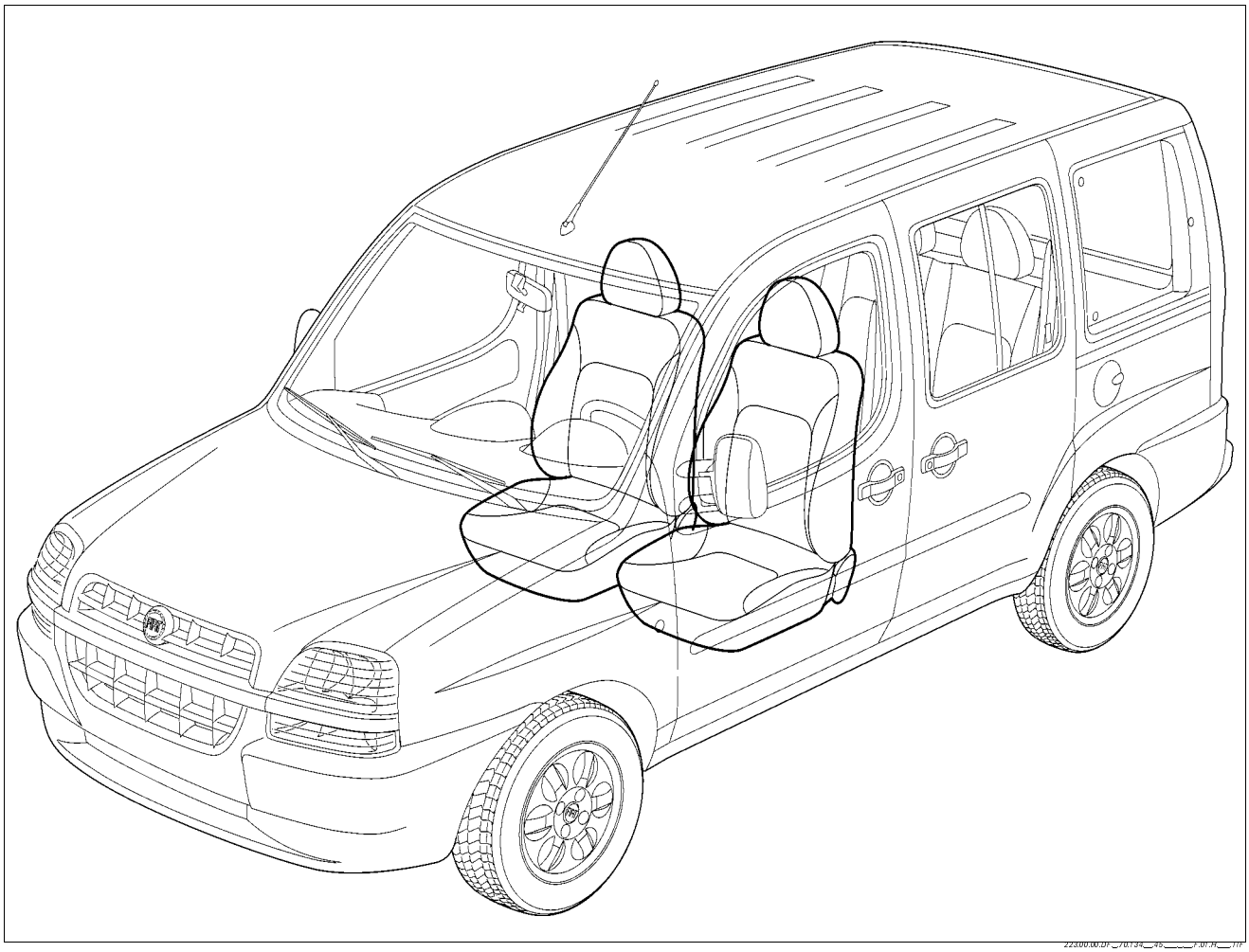
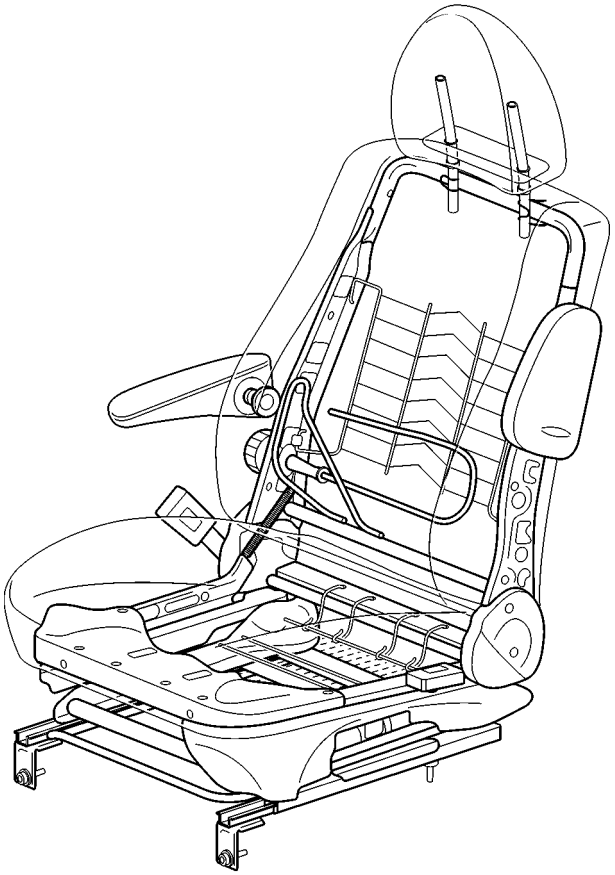


CONSTRUCTION FEATURES

Because the body of this vehicle comes in so many variants, the front seats can be arranged in many different ways.
All seat versions have been designed to ensure comfort and safety while driving. The structure of the seating area has an anti-submarining ridge to prevent the passenger from sliding under the section of the seat belt which goes round their abdomen in the case of strong deceleration (submarining effect). The squab frame consists of a steel structure that is secured by a joint designed to improve strength and energy absorbance in the case of rear impact.

Driver's seat



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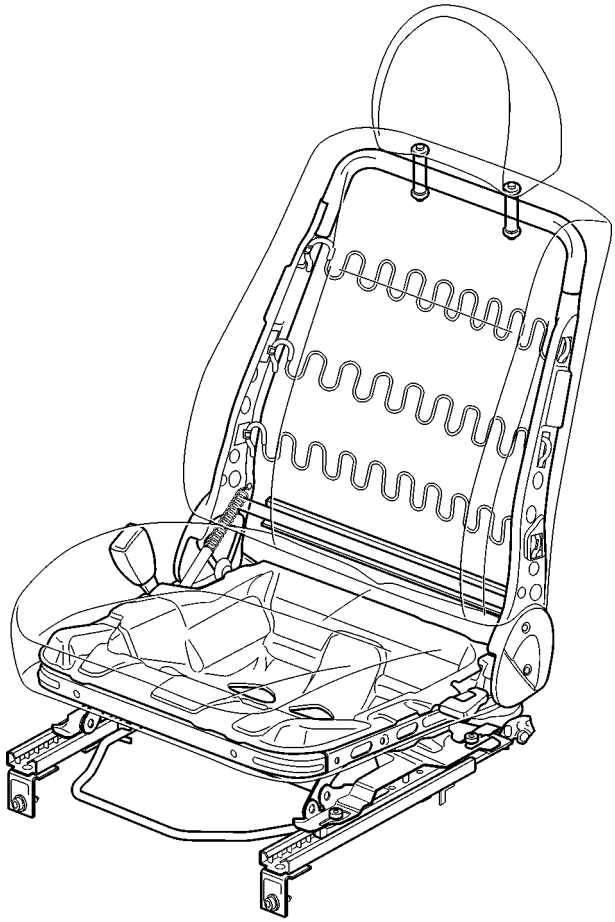
Sliding seat with reclining squab, height adjustment, arm-rest, lumbar adjustment and side bag
Panorama version passenger seat



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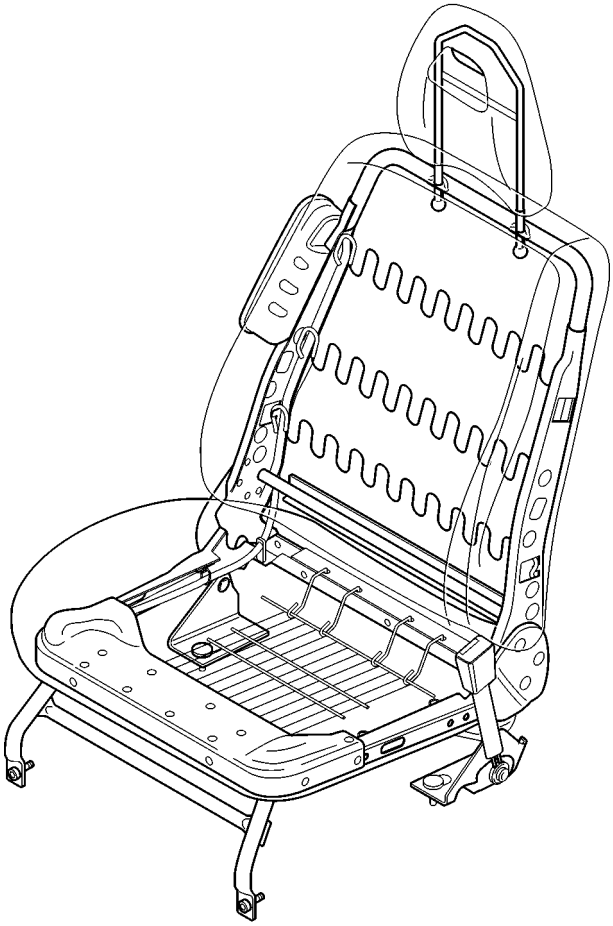
Sliding seat with easy entry function (guides with mechanical memory device)
Cargo version passenger seat



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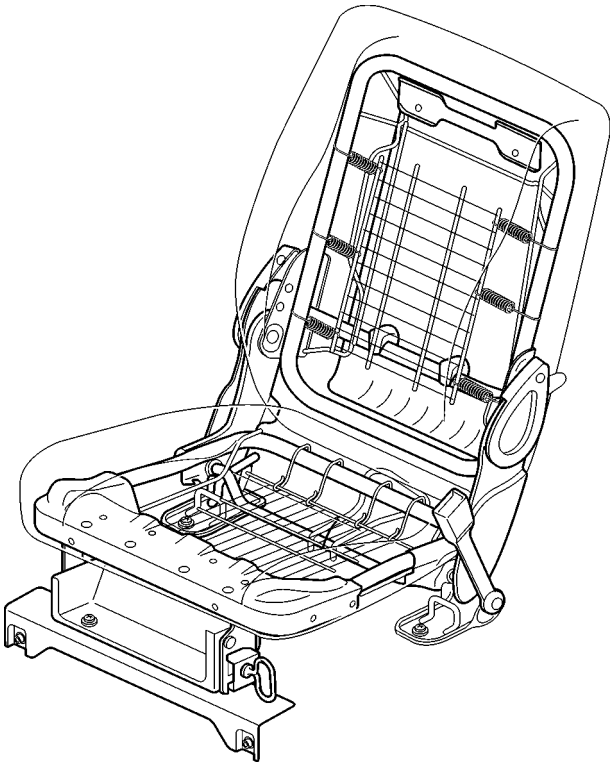
Fixed seat
Cargo version passenger seat



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Folding seat

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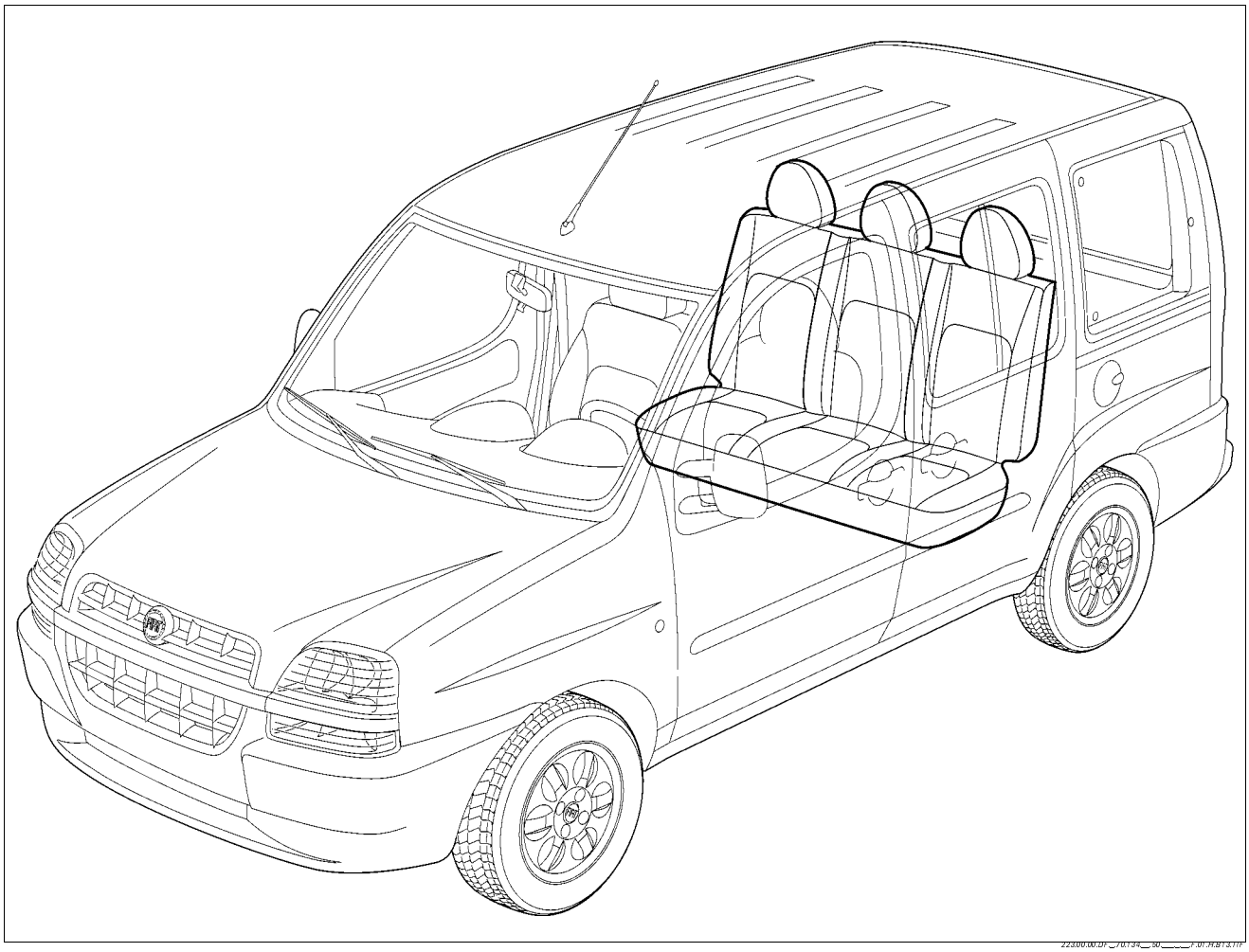
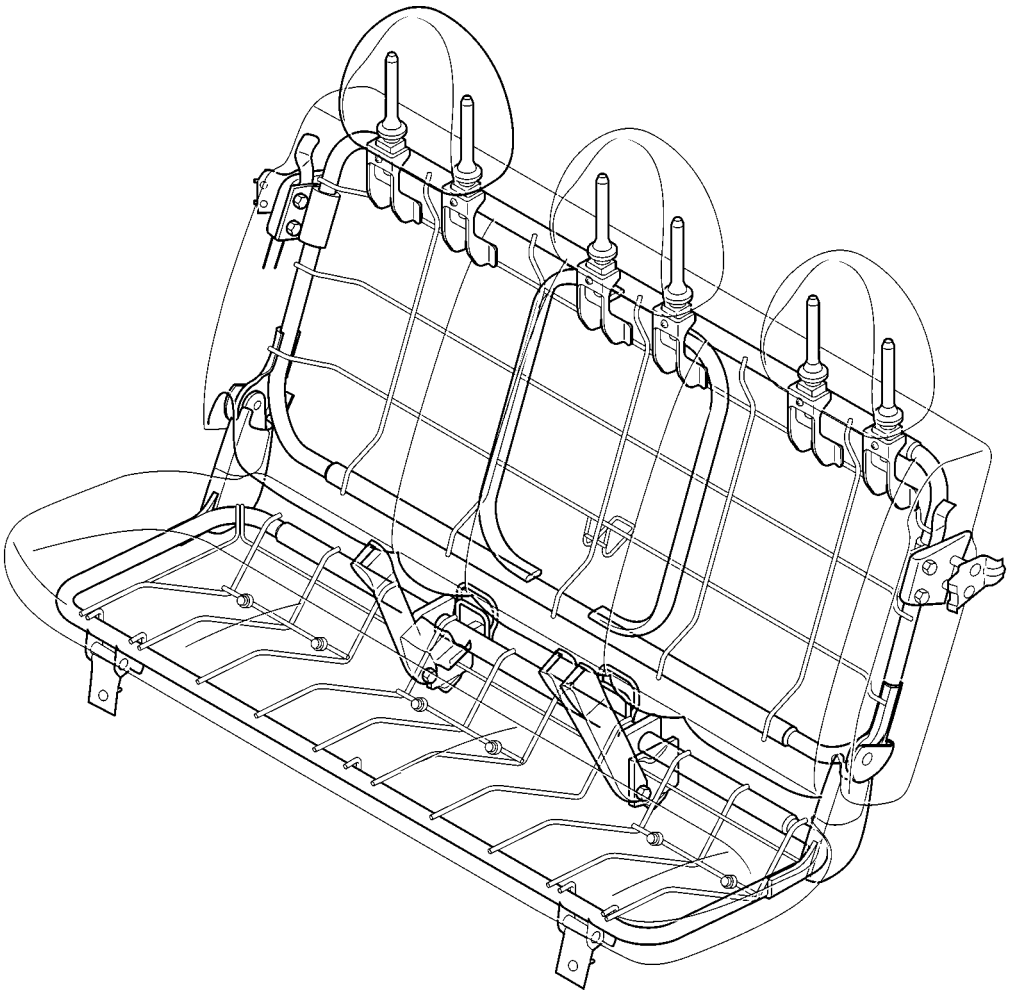


CONSTRUCTION FEATURES

Doblò

In case of rear impact, the tubular seat structure protects passengers from contact with items in the luggage compartment and ensures the body does not submarine underneath the seat belt.
The seat may be one-piece or split

One-piece rear seat



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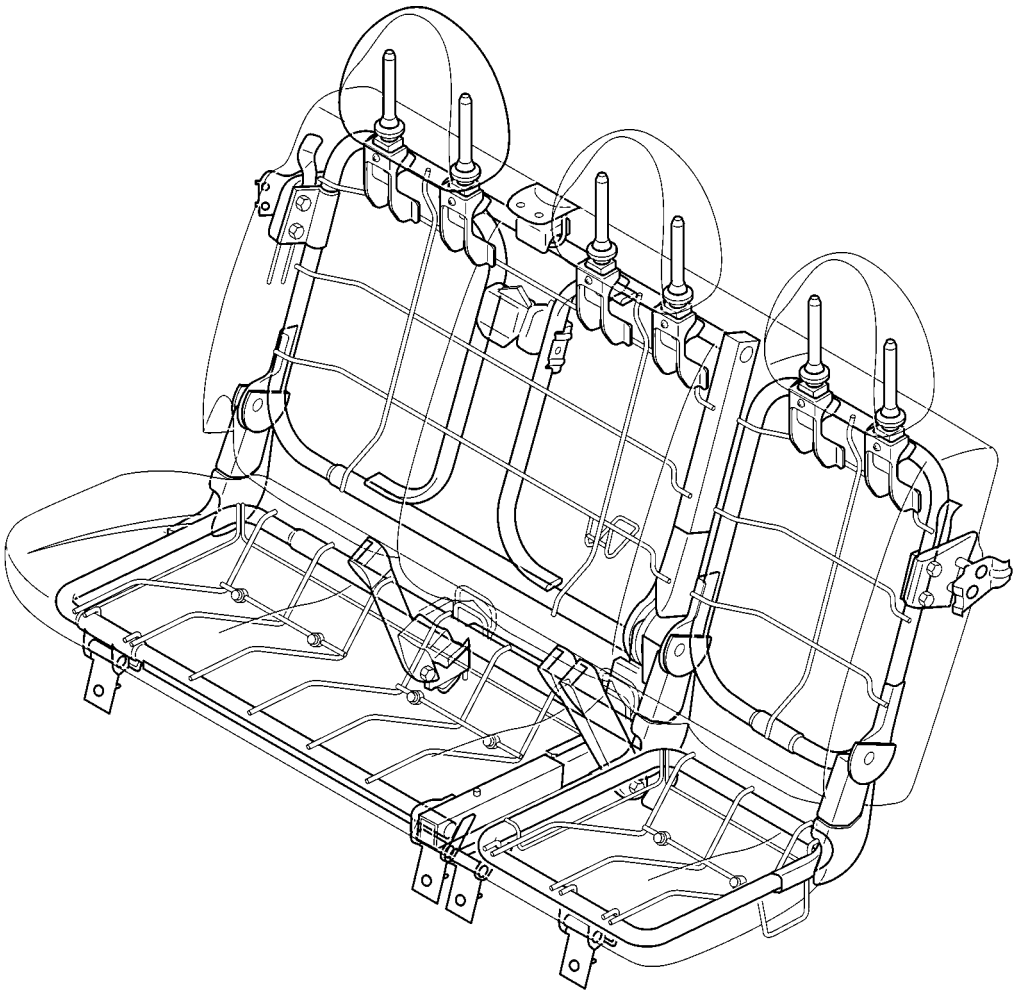
Doblò

Split rear seat



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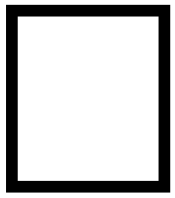

Body panel and reinforcement

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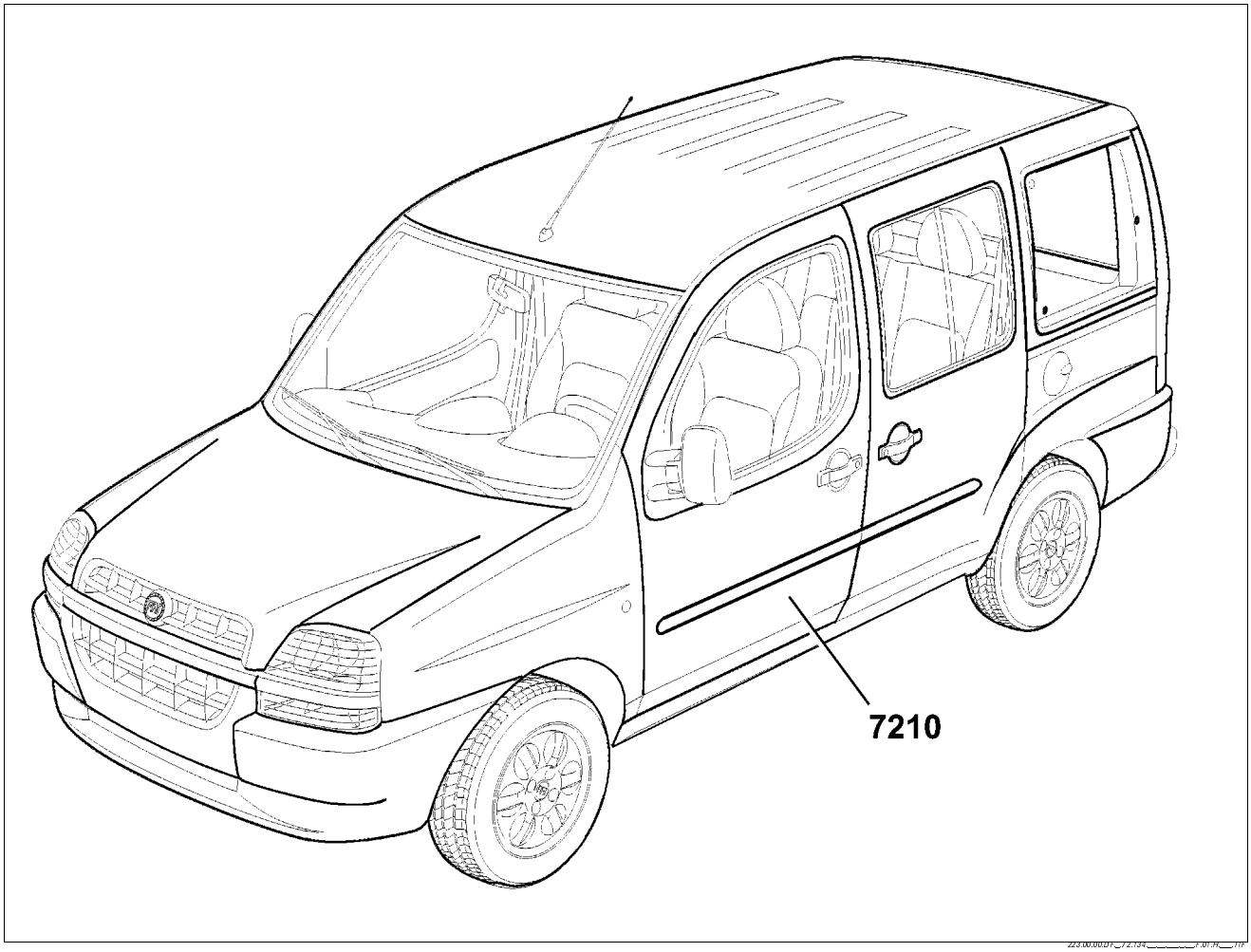
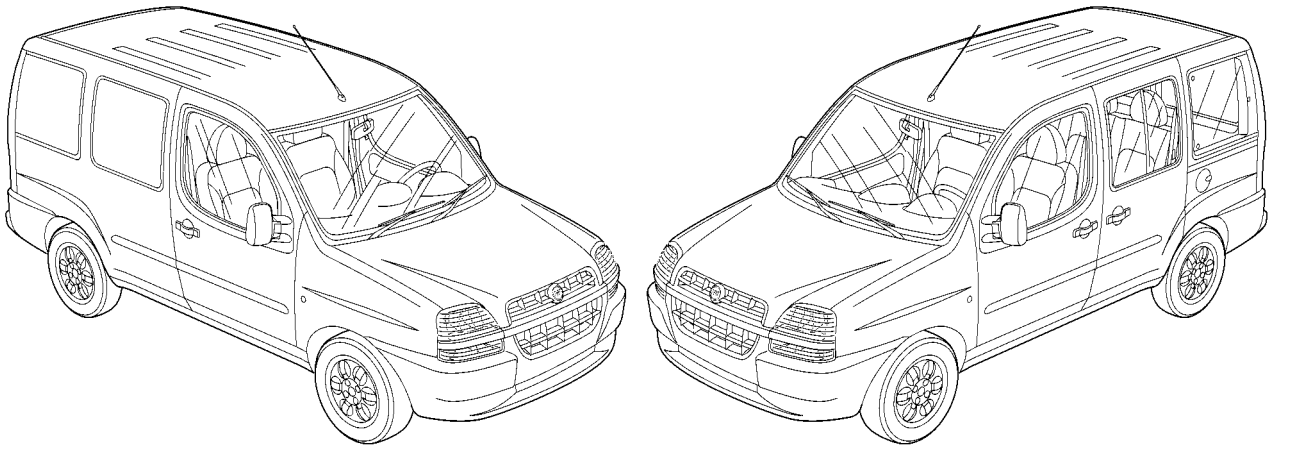


SPECIFICATIONS:

The vehicle's uniquely distinctive design is evident in all the body variants, which are provided to meet innumerable service requirements.
At the front, the grille and headlamps are surrounded by plastic elements that protect against low-speed impact.
The side panels feature rounded front door windows and generous rear windows that create a sense of lightness that adds to travelling comfort.

The presence of sliding side doors, asymmetrical rear swinging doors or a tilting tail-gate do not affect the overall harmony of the model but blend naturally with the vehicle's exterior design.



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Drag coefficient (Cd) 0.32

PASSIVE SAFETY

The main aim of passive safety components is to create a survival chamber that protects passengers effectively in the case of accident.
The car body is designed to crumple in controlled fashion in the case of impact from the front, side or rear and to absorb impact energy without affecting passenger compartment living space.

TORSIONAL AND FLEXURAL RIGIDITY

The body's high torsional and flexural rigidity gives the car good qualities of passive strength to generate a sensation of solidity and comfort while driving.
These positive qualities help maintain the original body features and thus ensure the absence of structural weakening that could affect safety.

Torsional rigidity

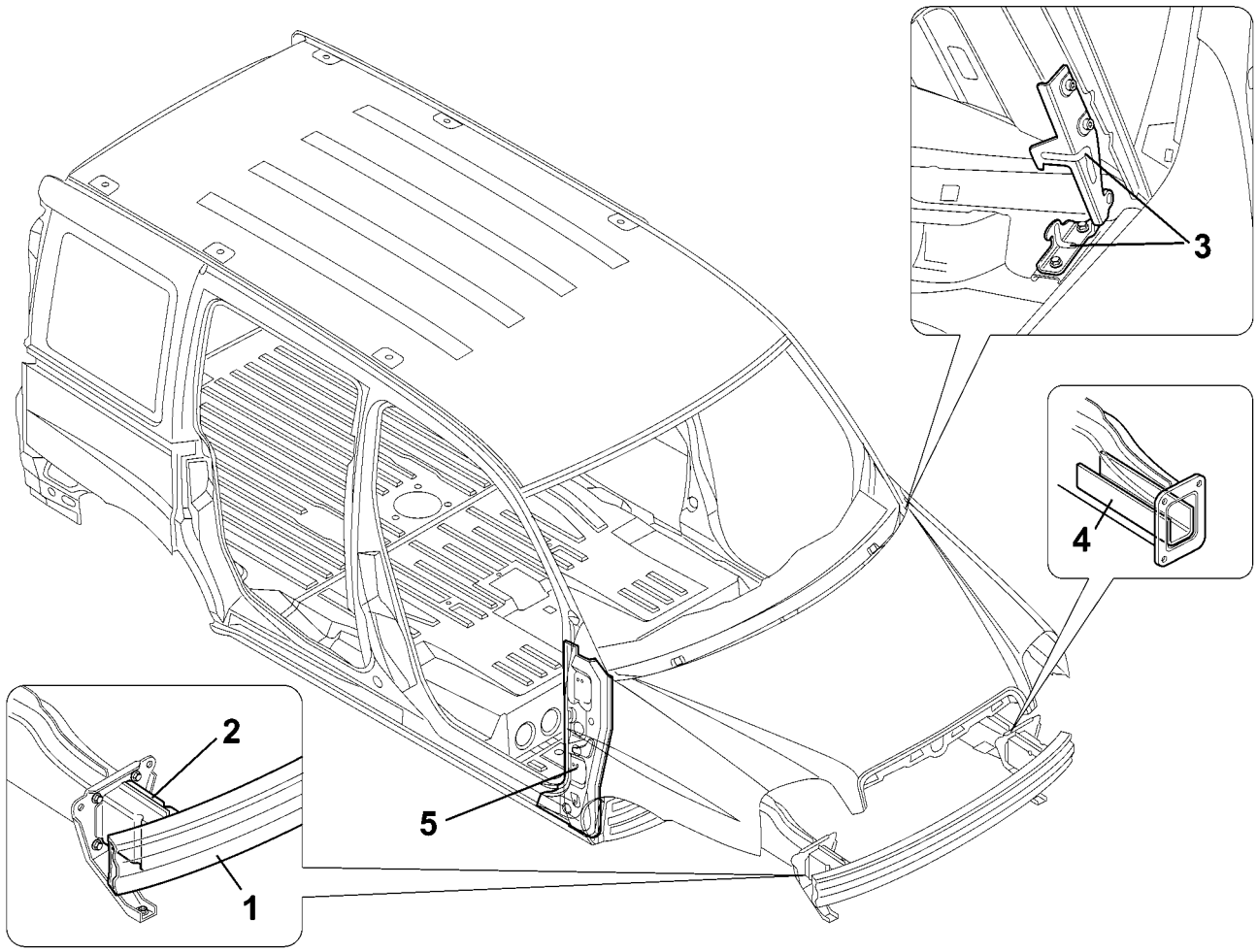
VEHICLE OUTFIT	daNm/rad
1 Unadorned body + windscreen	88700
2. As 1 + rear swinging doors	98400
3 As 2 + front doors	101900
4 As 3 + slidiing side doors	107300

Flexural rigidity

VEHICLE OUTFIT	daN/mm
1 Unadorned body + windscreen	1500
2 As 1 + rear swinging doors	m
3 As 2 + front doors	1620
4 As 3 + sliding side doors	1890

RESISTANCE TO FRONTAL IMPACTS

The main body features designed to ensure resistance to frontal impact are as follows:
- front beam
- crash-box
- bonnet lid retaining hook
- reinforcements in the struts
- reinforcements on the front pillar



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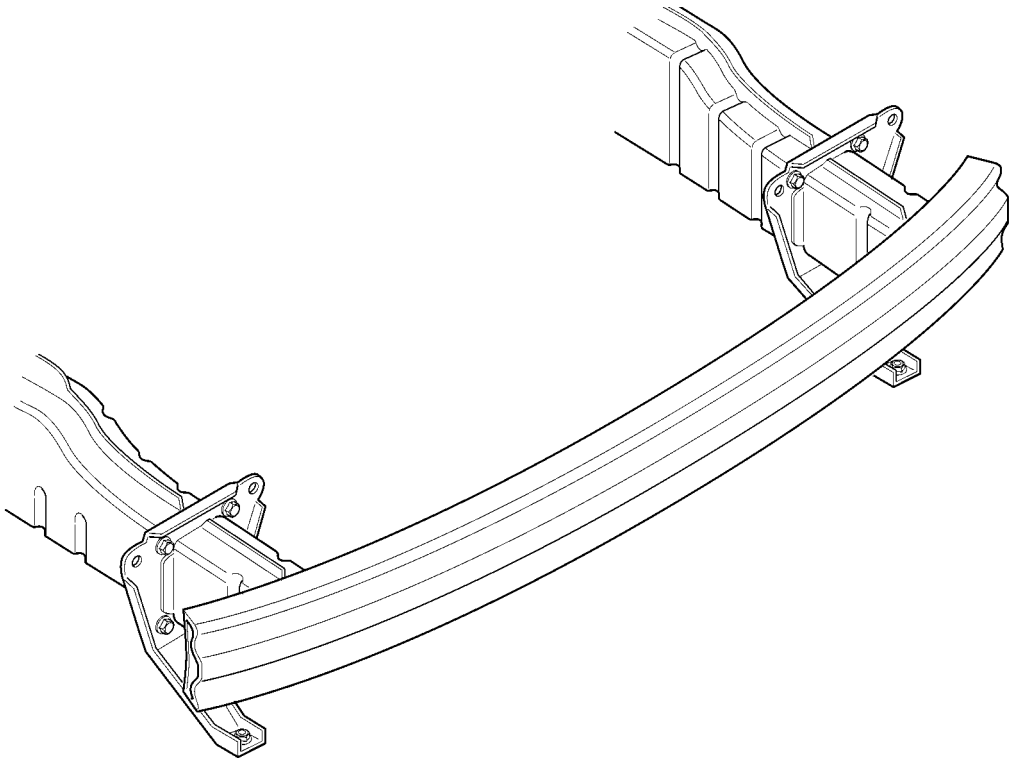
The car meets ECE R94 standards for front impact at 56 km/h against a barrier offset in relation to the car's centre line (involving 40% of the front end).
This test checks structural properties (effects on the vehicle) and biomechanical properties (effect on the occupant) ; effects on the occupant are measured using crash dummies.

Front beam
Transverse view of front with crash box



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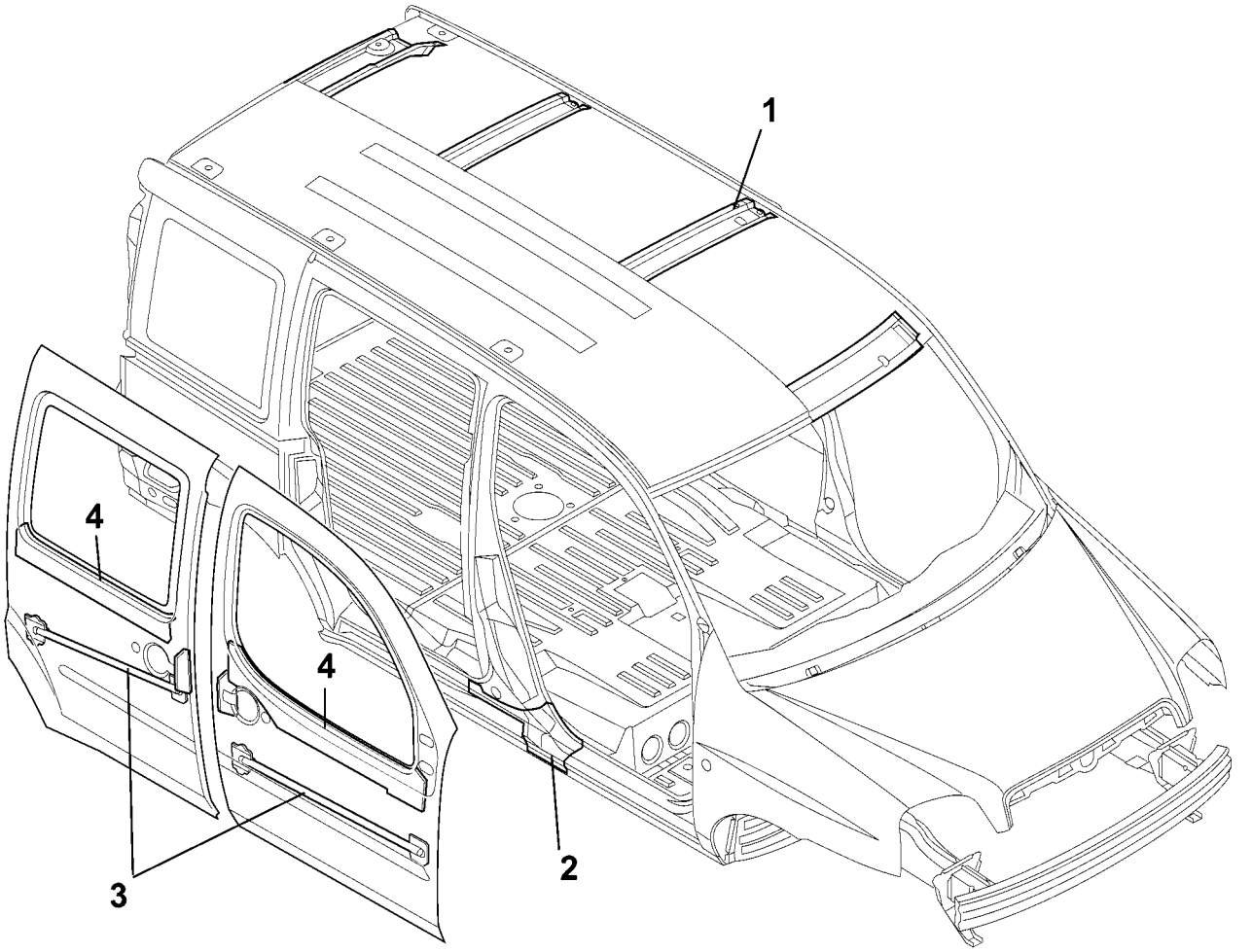
The front beams and crash boxes on this range are a departure from the norm because they are integral structural parts and bolted to the body.
They are designed to reduce repair costs following low speed impact.
These two parts are the only components that crumple in the case of front impact at 16 km/h againt an offset barrier (frontal vehicle involvement equal to 40%).
The specific shape of the beam and the material of which it is made (high-strength steel) ensure minimum intrusion in this type of impact to safeguard mechanical components.

Note: *During body repairs, if the structural reinforcements are distorted they must always be replaced.*

RESISTANCE TO SIDE IMPACTS

As far as resistance to side impacts is concerned, the body guarantees a high safety level. Special crumple zones safeguard the passenger survival cell.

The above has been achieved by:
- reinforcing the central pillar
- fitting connection hoops between the side pillars
- with side impact bars and waist reinforcements in the doors



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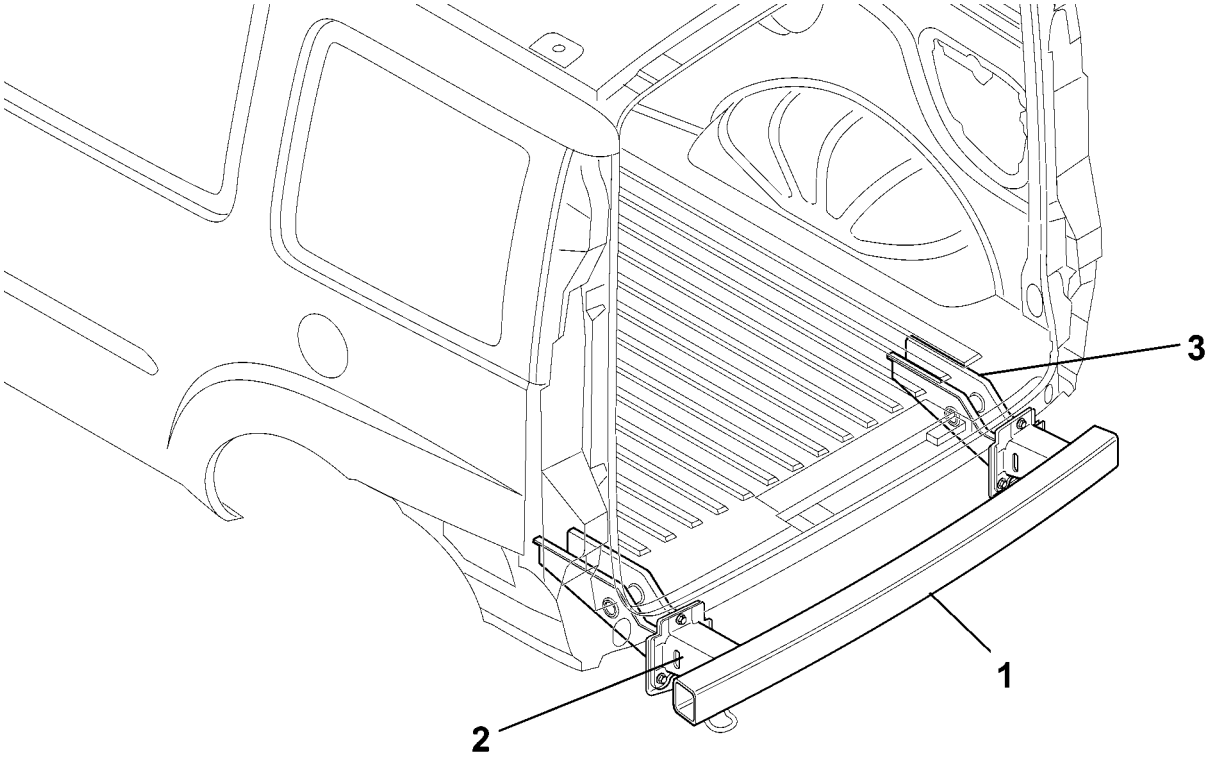
The car conforms to ECE R95 side impact standards against a deformable barrier (located centrally in relation to the front seat when half way along its travel and adjusted fully down) at 50 km/h

Note: *During body repairs, if the structural reinforcements are distorted they must always be replaced.*

RESISTANCE TO REAR IMPACTS

The main body interventions to increase resistance to rear impact are as follows:
- rear crossmember
- crash-box
- floor pan reinforcements



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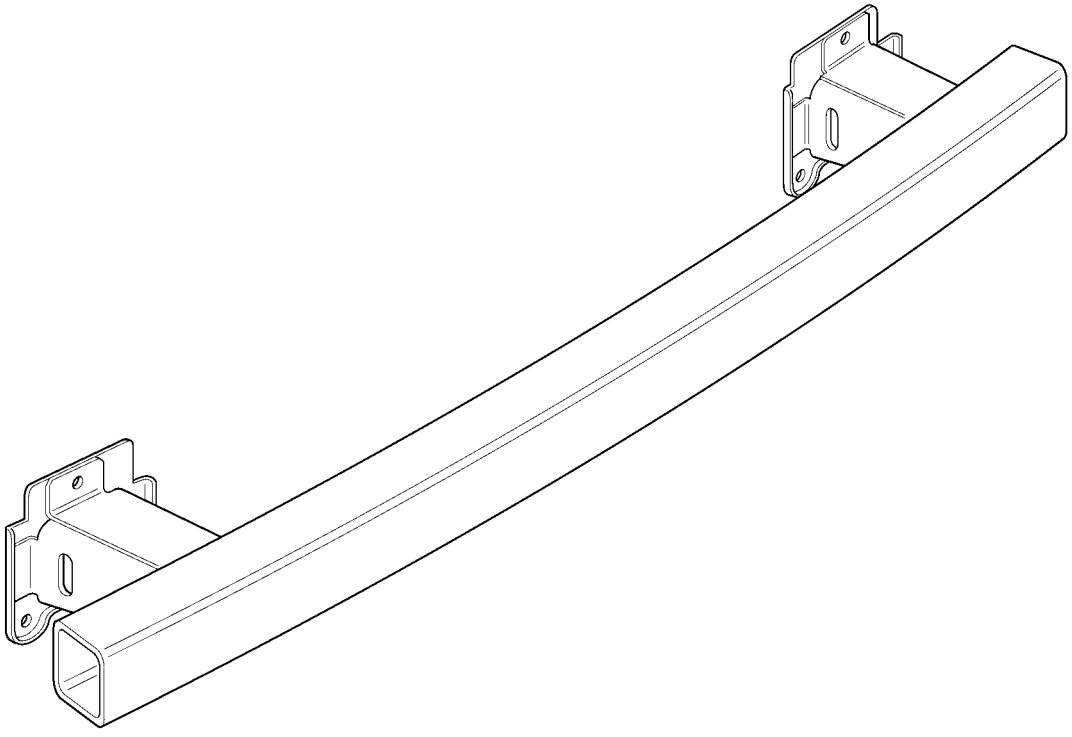
The car meets Japanese rear impact standards tested using a rigid barrier at 50 km/h (involving 100% of the rear end).



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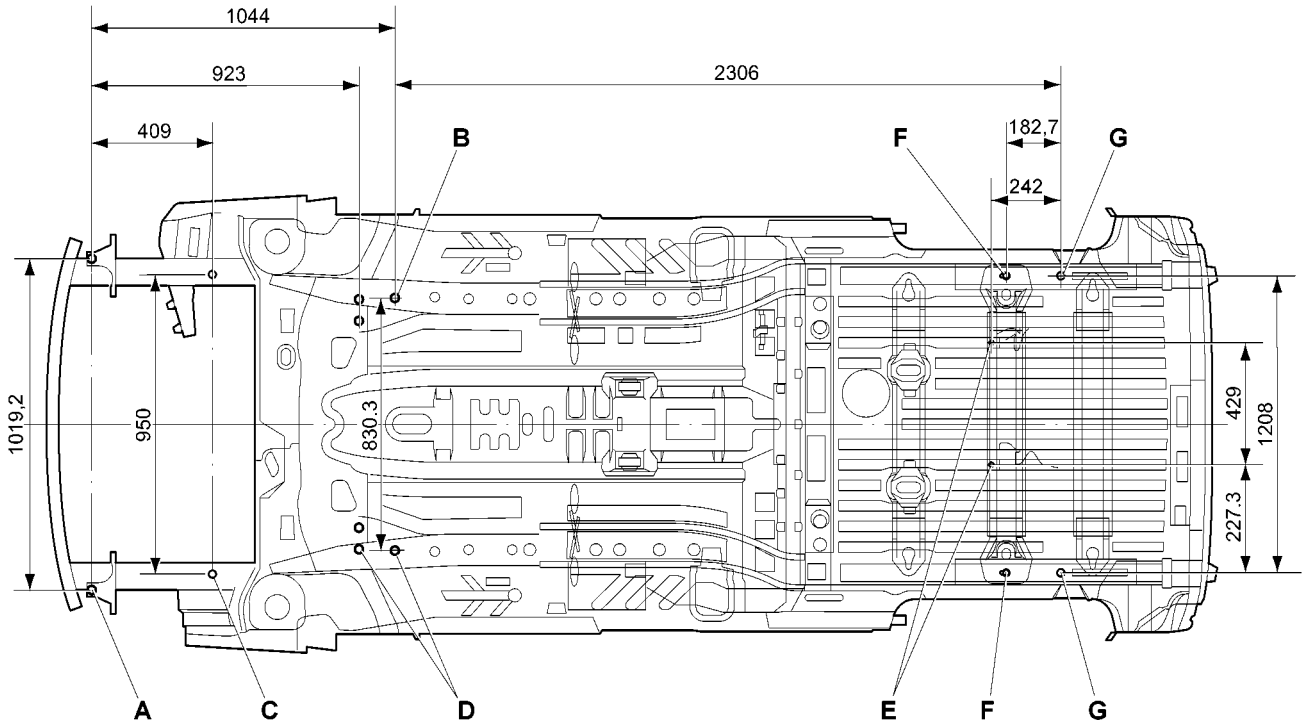
The front beams and crash boxes on this range are a departure from the norm because they are integral structural parts and bolted to the body.
They are designed to reduce repair costs following low speed impact.
These two parts are the only components that crumple in the case of front impact at 16 km/h againt an offset barrier (frontal vehicle involvement equal to 40%).

Note: *In the case of operations to the bodyshell, if the structural reinforcements are distorted they must always be replaced.*

TYPICAL BODYSHELL MEASUREMENTS

DIAGRAM FOR CHECKING UNDERBODY

This chapter contains typical body measurements that may be used by bodyshops to achieve the best results if repairs are necessary.



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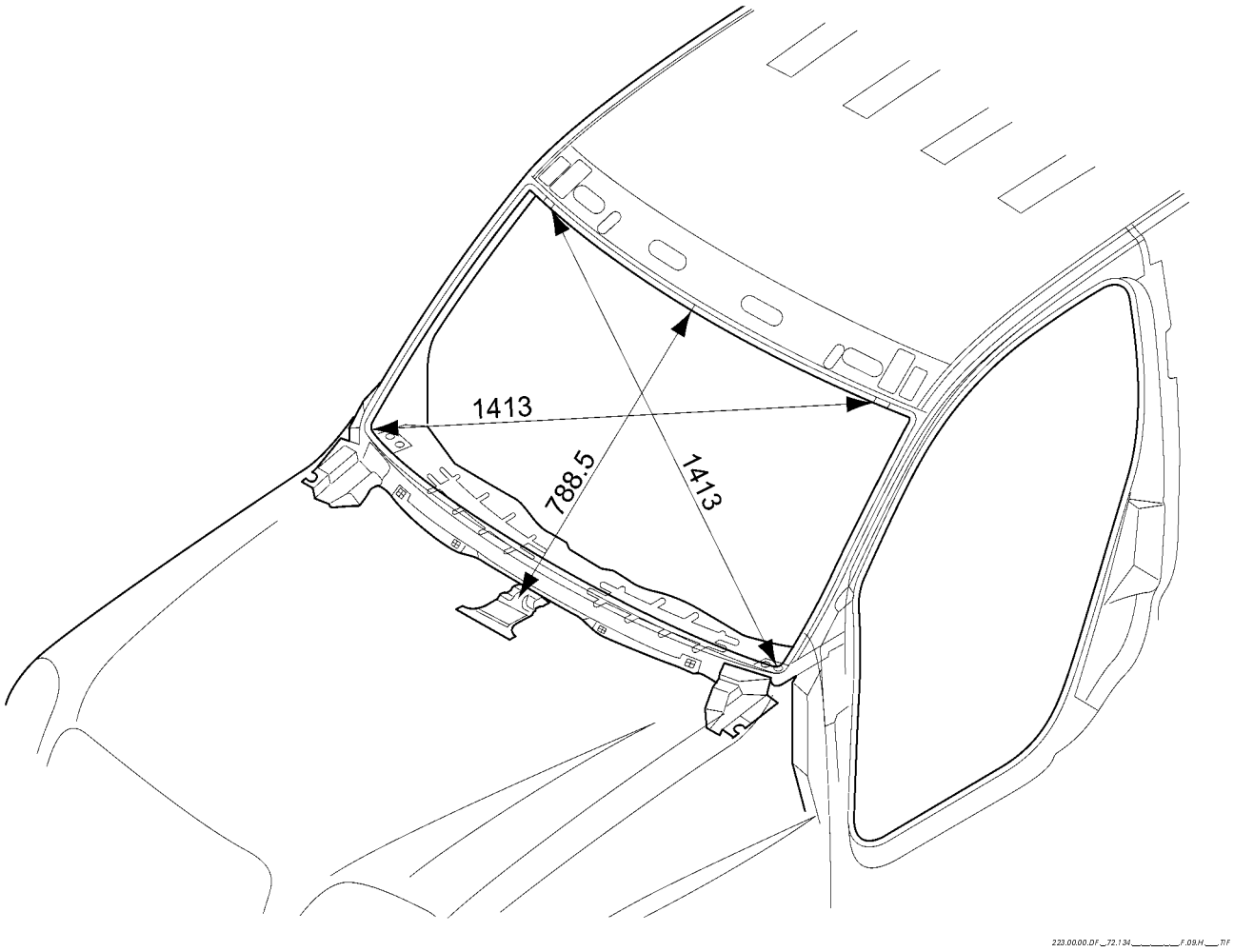
WINDSCREEN COMPARTMENT DIMENSIONS

The dimensions are expressed in millimetres with a tolerance of about ± 2mm



DOOR COMPARTMENT DIMENSIONS

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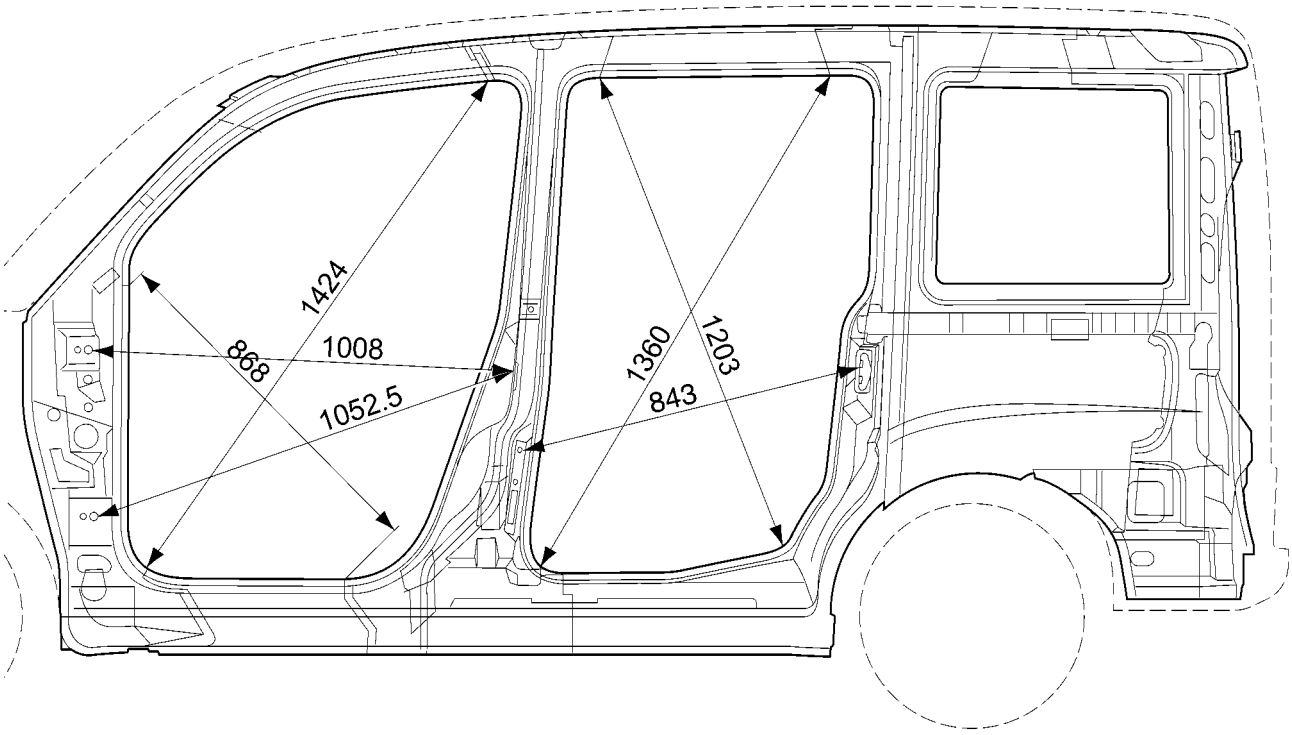

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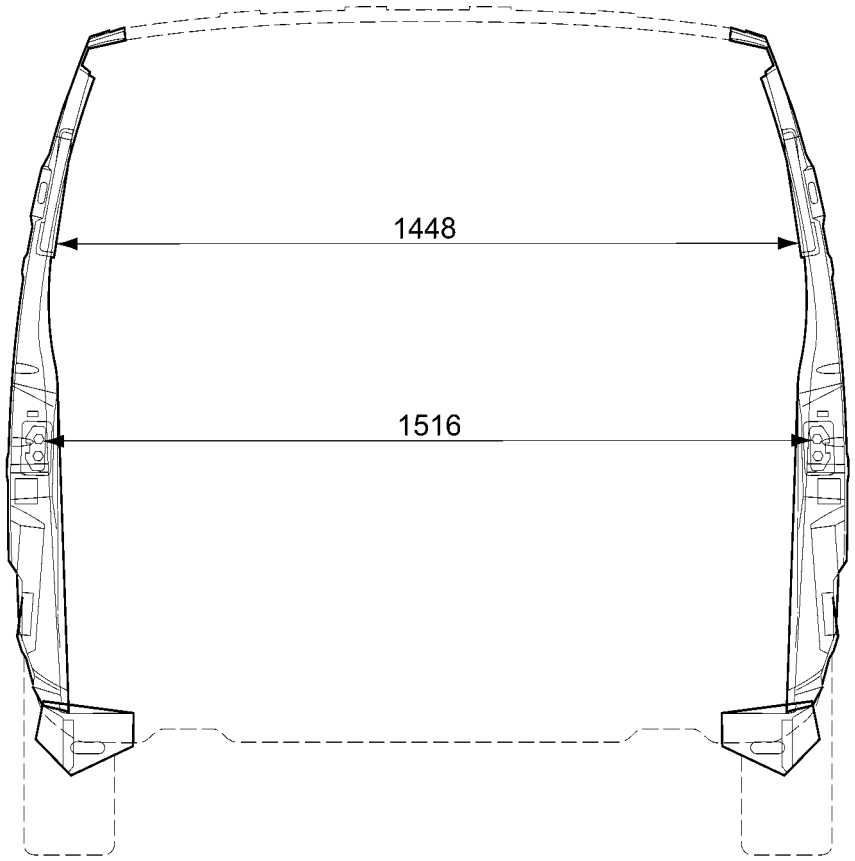
MEASURING DIMENSIONS OF COMPARTMENT BETWEEN CENTRAL PILLARS

The dimensions are expressed in millimetres with a tolerance of about ± 2 mm



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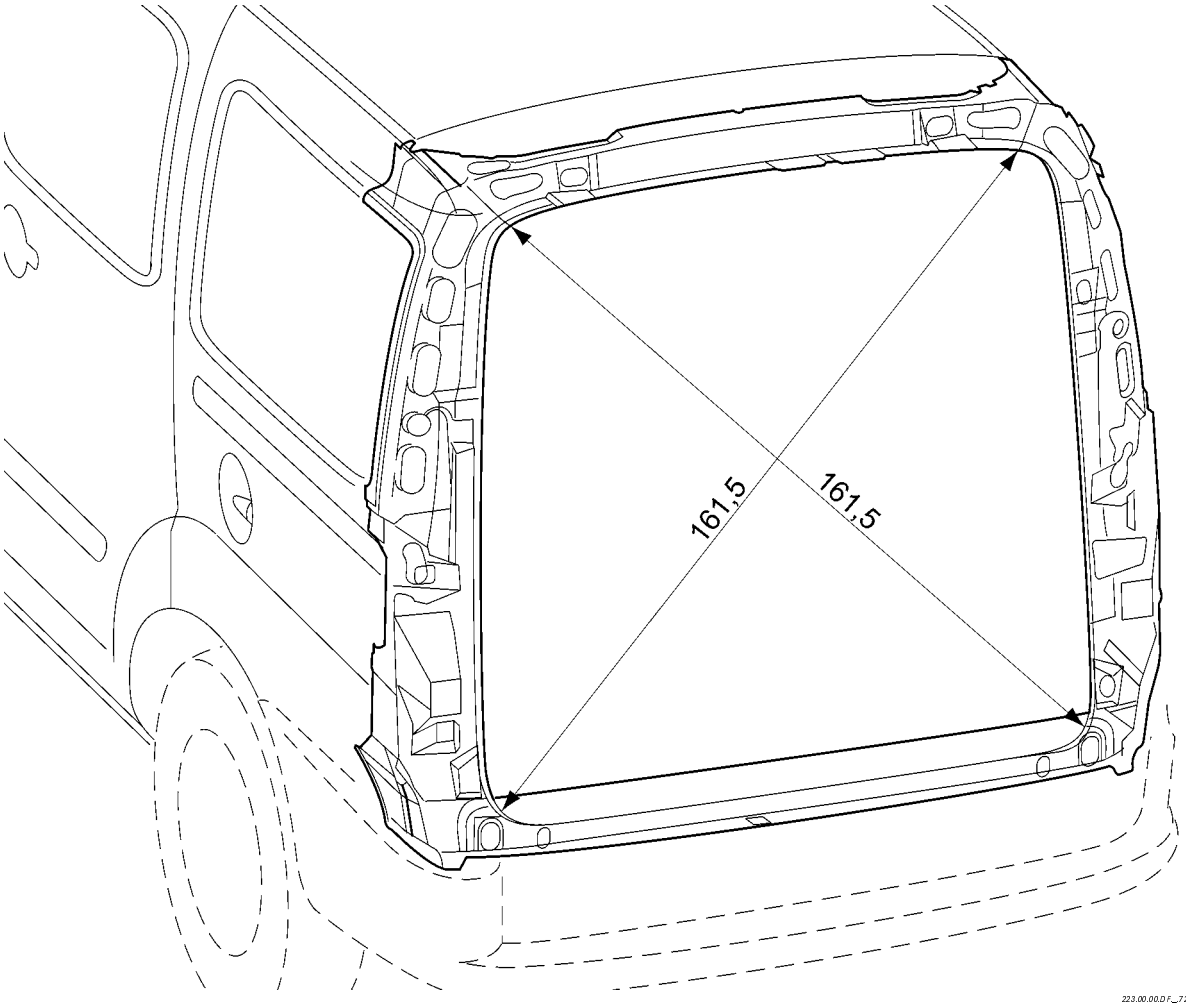
REAR COMPARTMENT DIMENSIONS

The dimensions are expressed in millimetres with a tolerance of about ± 2 mm



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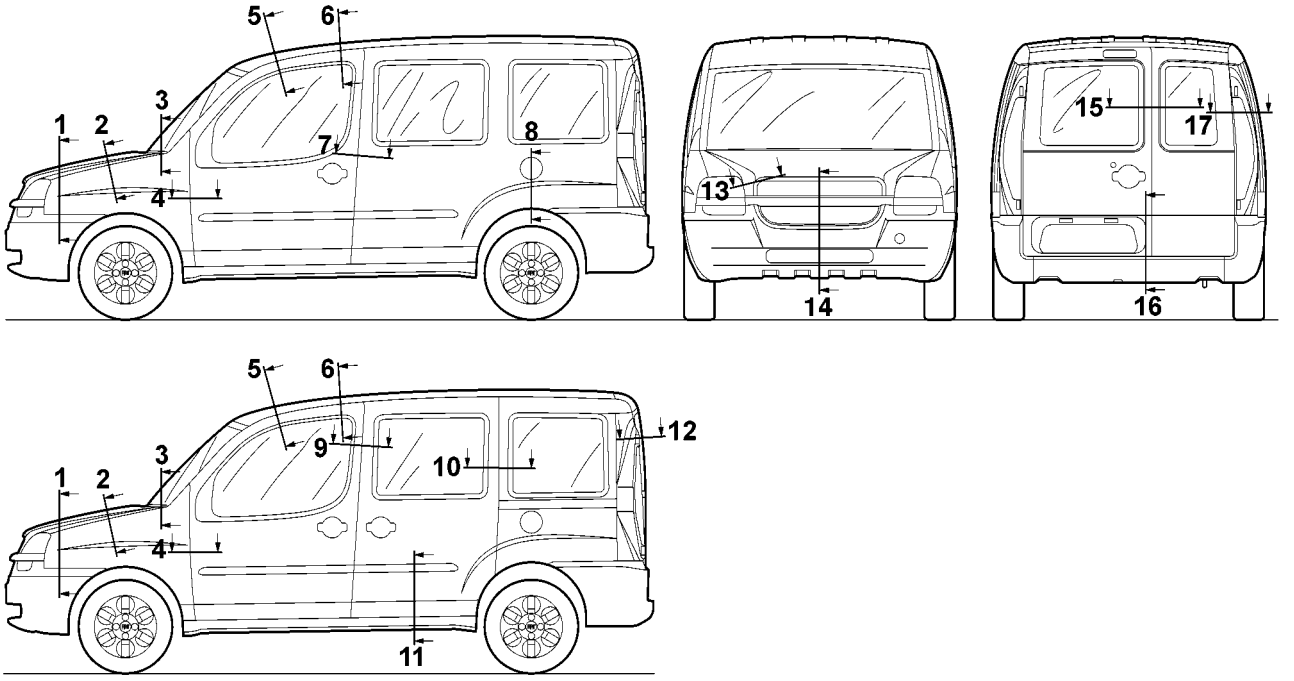
MEASUREMENTS FOR ADJUSTING MOVEABLE PARTS

To facilitate moveable part refitting operations, herewith gap values (expressed in millimetres) to ensure effective adjustment.
Adjustment methods are illustrated in the sections containing the procedures for removing and refitting the moveable parts.



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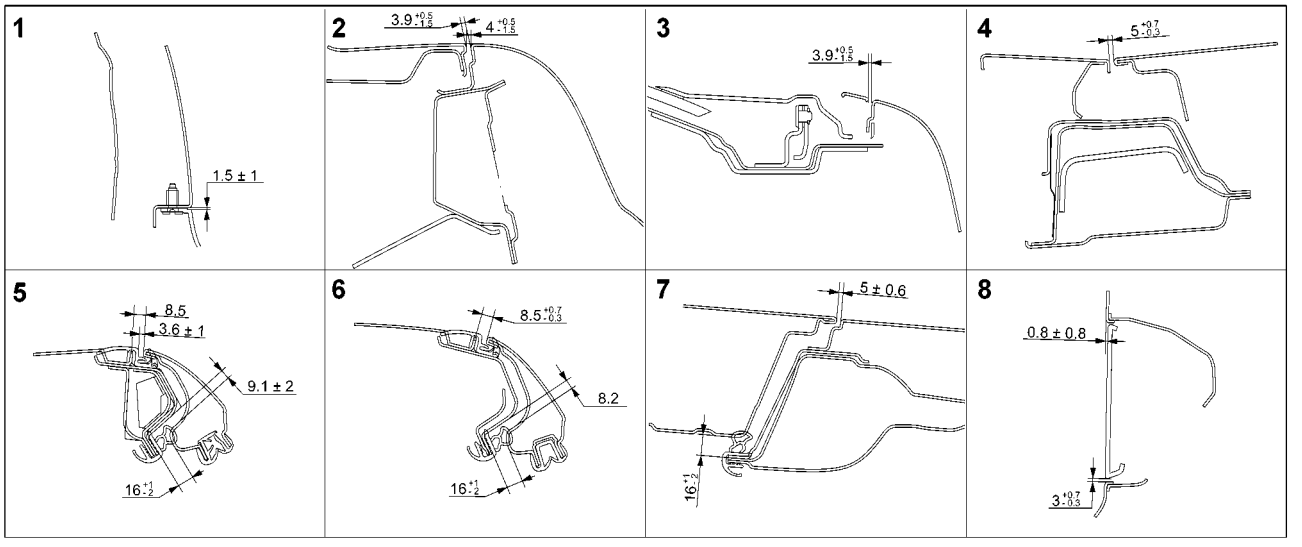
Sections 1 to 8



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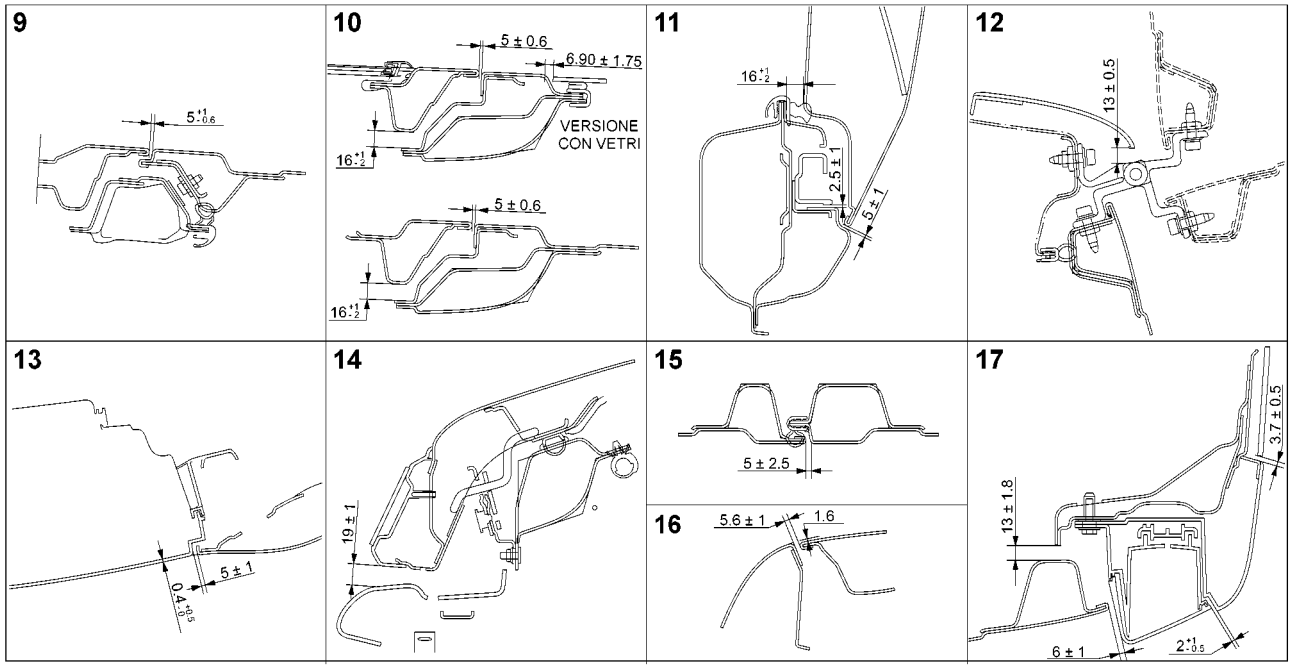
Sections 9 to 17



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PREVENTATIVE SAFETY

SOUND INSULATION

According to EU regulations, exterior noise levels must be lower than 74 decibels. At a speed of 120 km/h when driving in fifth gear, noise level inside the passener compartment is 73 decibels (76 decibels for the CARGO).

Driving comfort (i.e. passenger compartment noise levels and roominess) has been improved by making improvements in the following noise generation areas:
- wheel rolling
- engine
- aerodynamic

All the engines fitted to the car belong to a new generation engineered for improved acoustic/vibrational qualities.
This same principle also applies to the power transmission components, the suspension and the mountings on the bodyshell.

Diagram showing interior sound levels for slow acceleration in 5th gear:

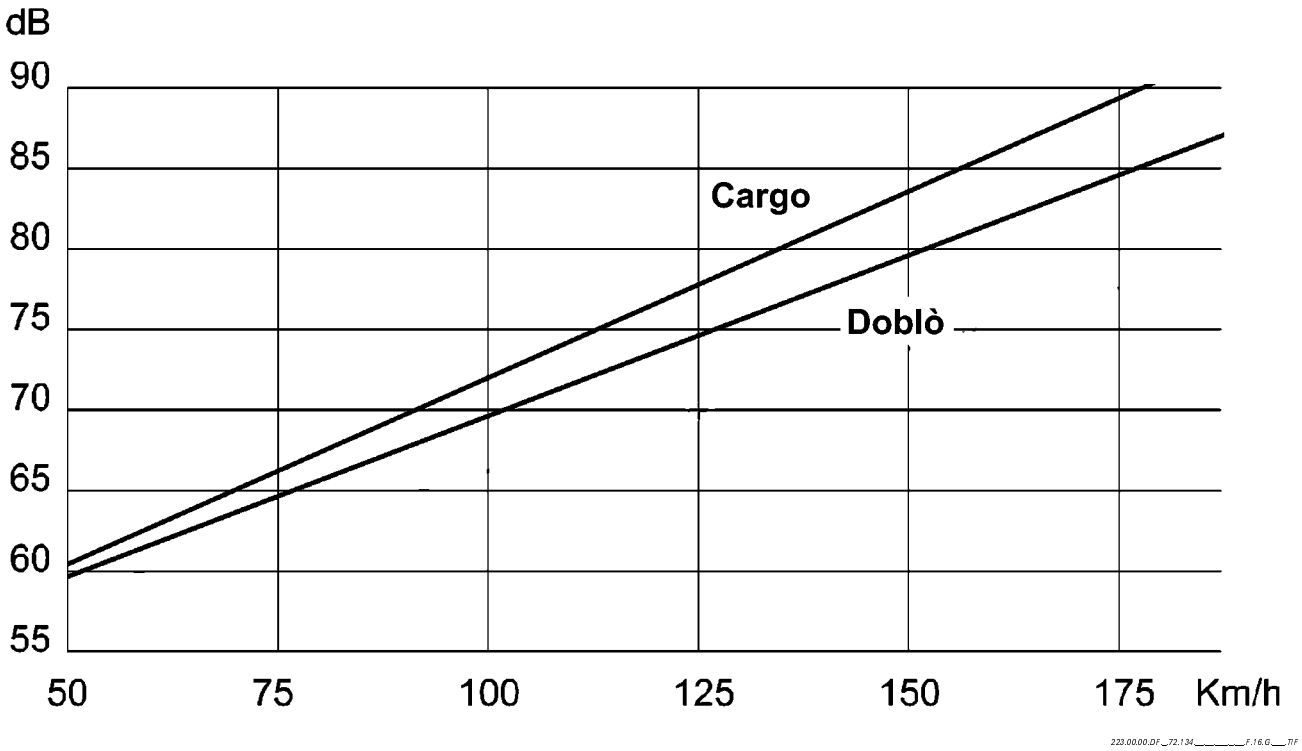
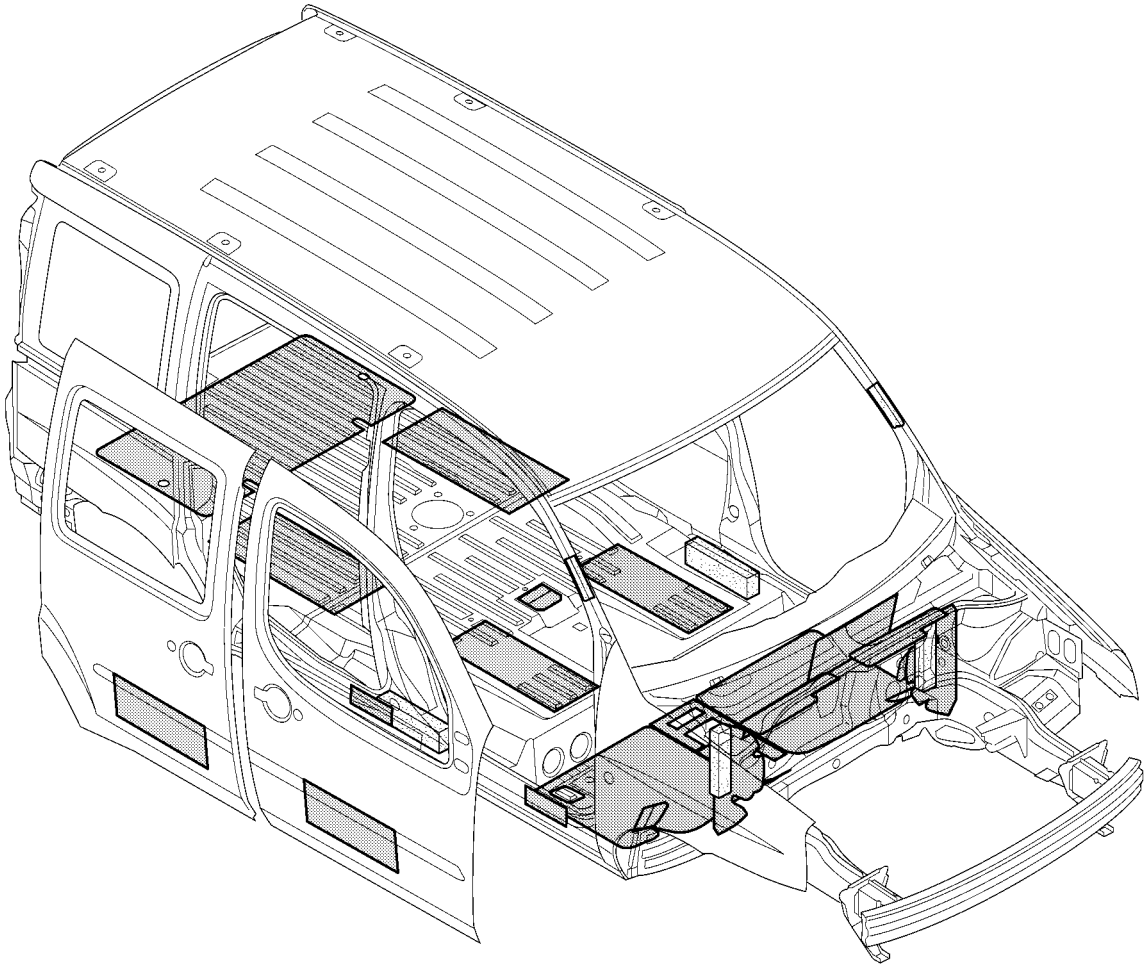


Diagram showing application of soundproofing and thermo-expansive materials



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Soundproofing materials are mainly bitumin-based
Their function is to damp noise generated by mechanical vibrations in areas such as the underbody and inside the doors.
The thermo-expansive materials are synthetic rubbers or resins. Their function is to fill in boxed sections to eliminate sound propogation (noise, wind noise.
When the body is placed inside the paint-stoving ovens, these materials expand and vulcanise so that they bond to the inner surfaces of panels with which they come into contact and fill the box section cavity.

Note: *To maintain the high level of acoustic comfort, the car must be restored to its original manufacturing standards in the case of repairs.*

Diagram 1 Application of sealants

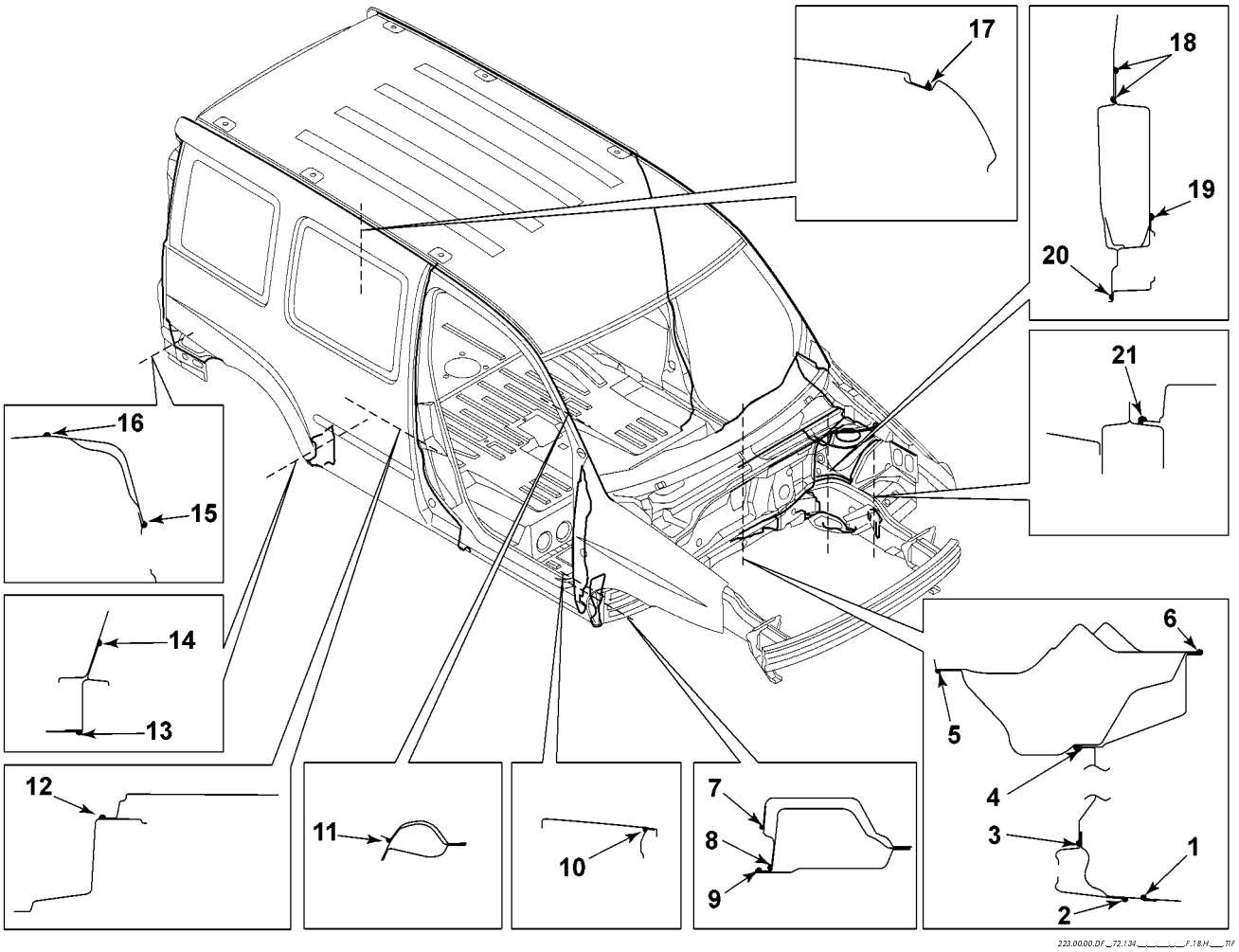


Diagram 2 Application of sealants

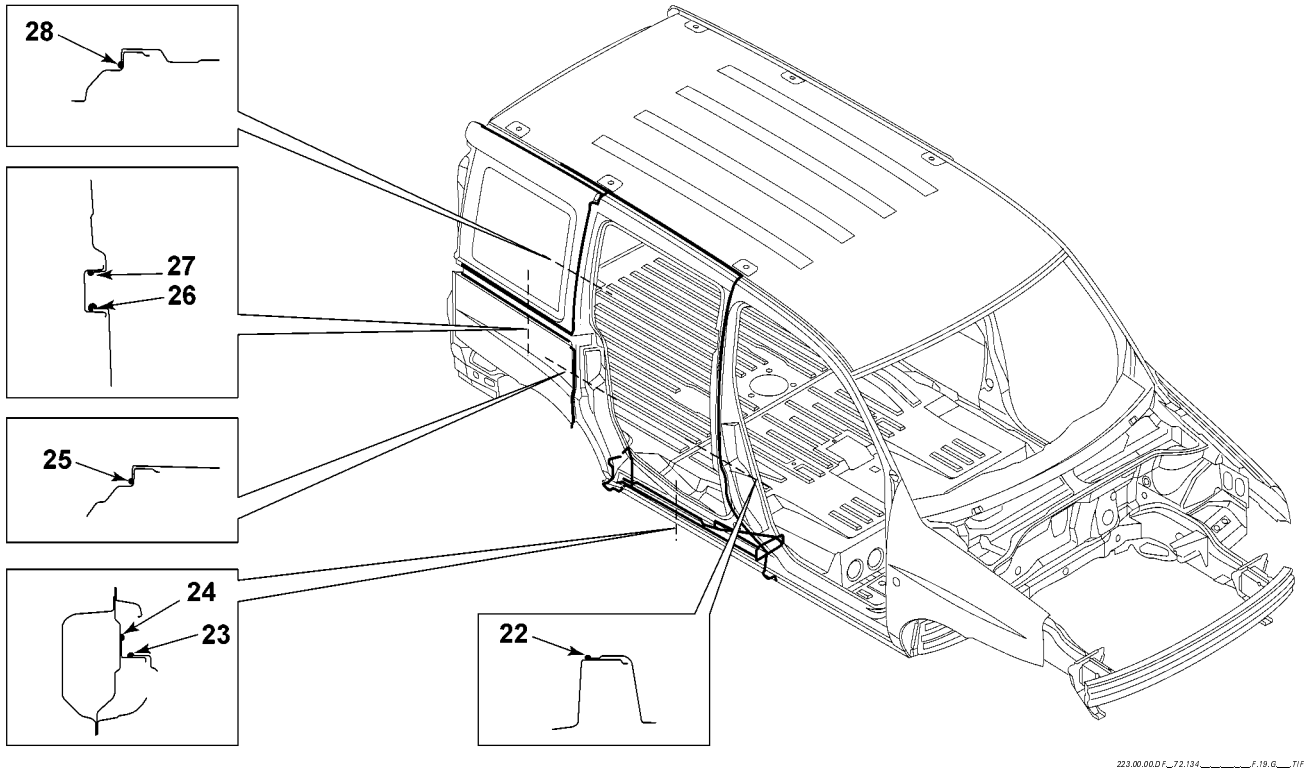


Diagram 3 Application of sealants

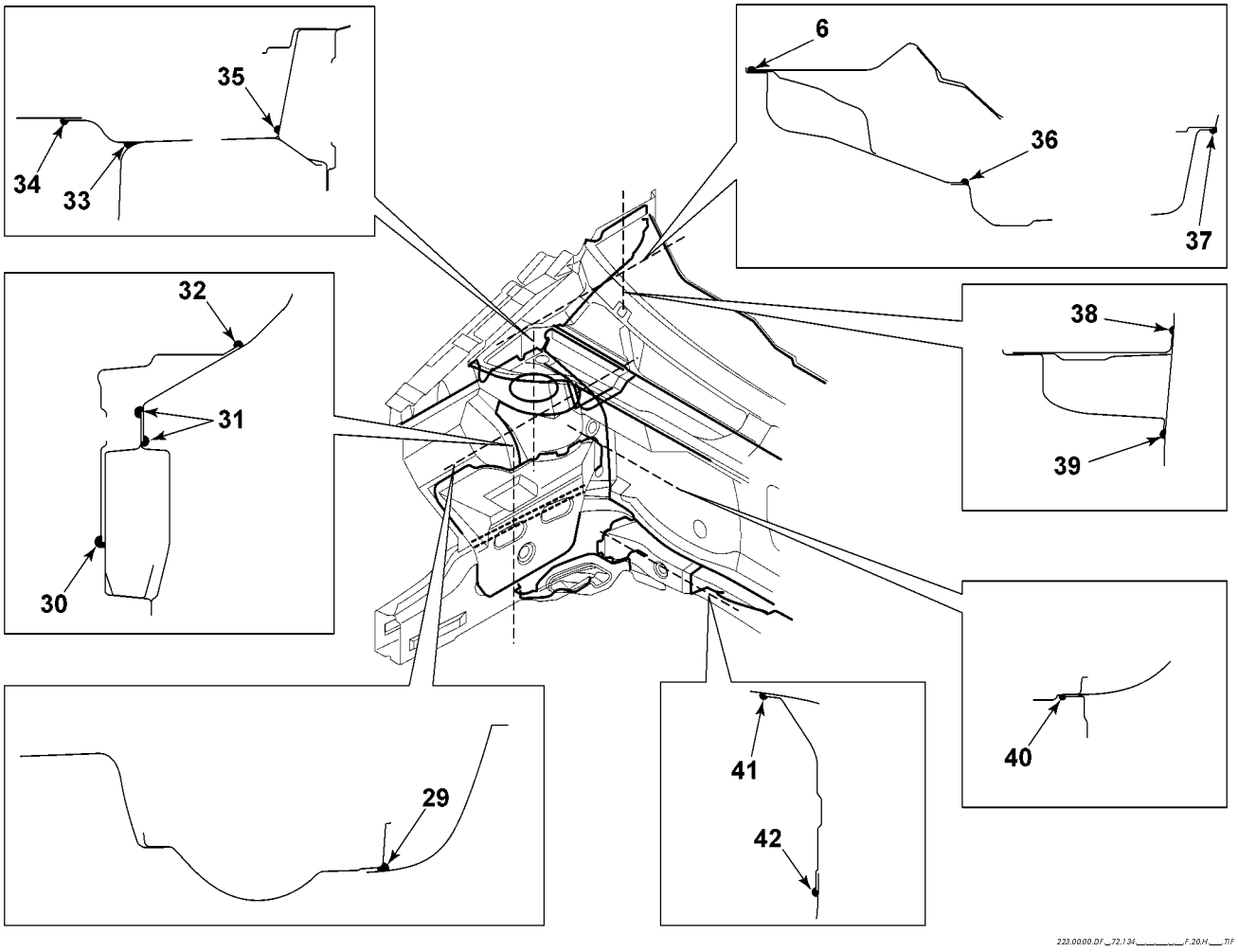
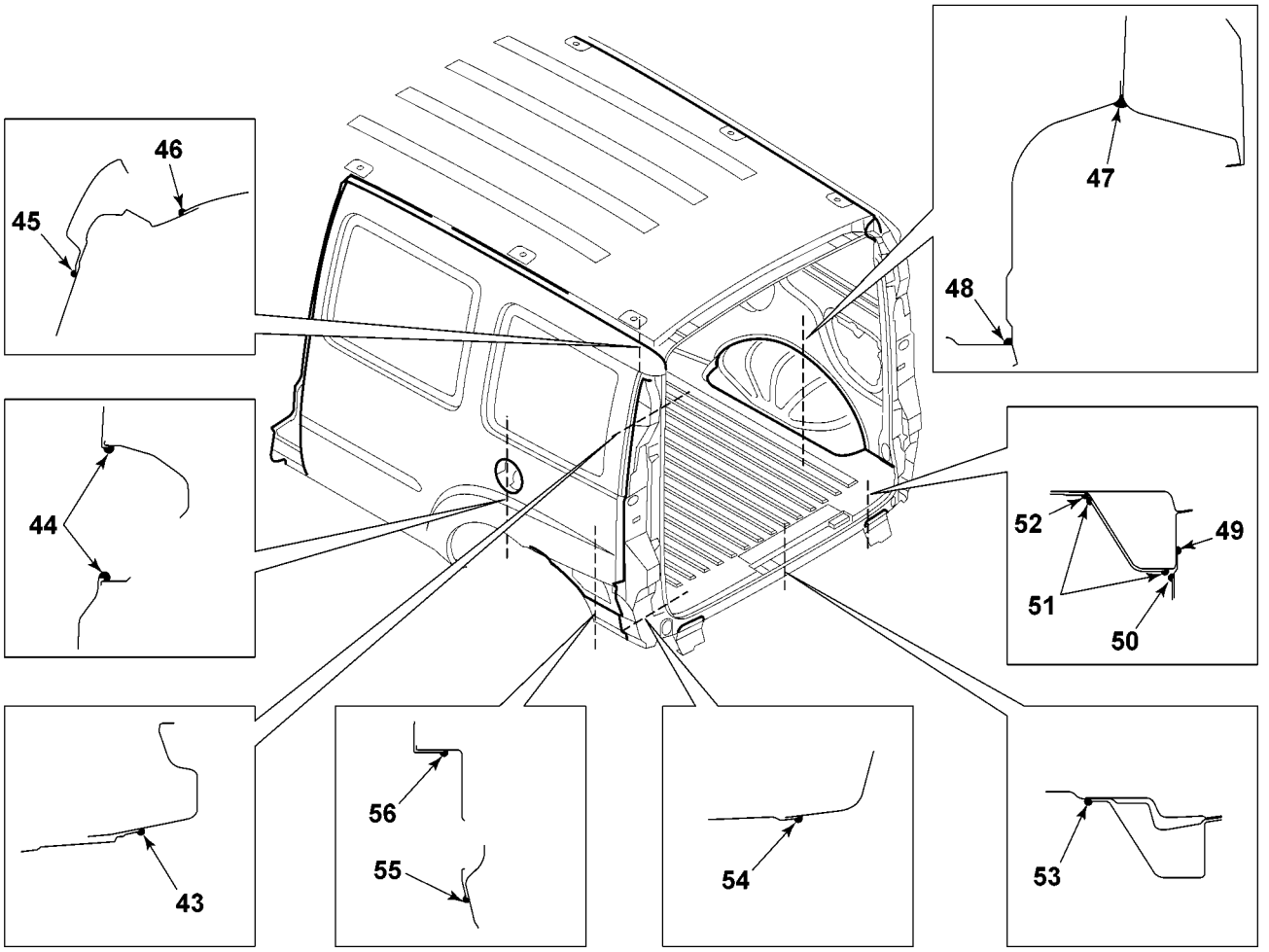


Diagram 4 Application of sealants



1 JOIN BETWEEN DASHBOARD PLATFORM AND LOWER DASHBOARD CONNECTION INSERT
2 JOIN BETWEEN LOWER INSERT CONNECTING DASHBOARD TO LOWER DASHBOARD BEAM
3 JOIN BETWEEN LOWER DASHBOARD AND LOWER DASHBOARD BEAM
4 JOIN BETWEEN LOWER DASHBOARD AND UPPER DASHBOARD
5. JOIN BETWEEN UPPER DASHBOARD AND DASHBOARD BOX SECTION
6. JOIN BETWEEN UPPER DASHBOARD AND UPPER DASHBOARD BOX SECTION
7. JOIN BETWEEEN FRONT DOOR COMPARTMENT AND LOWER INSERT DOOR COMPARTMENT RING
8 FRONT PILLAR REINFORCEMENT JOINT DOOR COMPARTMENT RING WITH LOWER FRONT INSERT DOOR COMPARTMENT RING
9 JOIN BETWEEN DOOR COMPARTMENT LOWER FRONT RING AND INNER FRONT SIDE PANEL
10 JOIN BETWEEN FRONT WING EXTERIOR AND REAR INSERT
11. JOIN BETWEEN FRONT DOOR COMPARTMENT RING AND WINDSCREEN PILLAR REINFORCEMENT
12. JOIN BETWEEN EXTERIOR PANEL AND FRONT DOOR COMPARTMENT RING
13. JOIN BETWEEN SIDE RAIL BASE AND REAR SIDE RAIL
14. JOIN BETWEEN LOWER REAR RIBBING INSERT AND INTERIOR SIDE REINFORCEMENT
15. JOIN BETWEEN HEADLAMP BASE AND LOWER REAR SIDE PANEL INSERT
16. JOIN BETWEEN REAR HEADLAMP BASE AND REAR PILLAR REINFORCEMENT
17. JOIN BETWEEN ROOF PANEL EXTERIOR AND EXTERIOR SIDE PANEL
18. JOIN BETWEEN FRONT SUSPENSION PILLAR AND SIDE STRUT BOX SECTION
19. JOIN BETWEEN FRONT SUSPENSION AND REAR REINFORCEMENT FRONT SUSPENSION CROSS-MEMBER
20. JOIN BETWEEN FRONT STRUT BOX SECTION AND FRONT SUSPENSION REAR BEAM REINFORCEMENT
21. JOIN BETWEEN BATTERY DRIP TRAY MOUNT REINFORCEMENT AND FRONT SIDE STRUT
22. JOIN BETWEEN SLIDING DOOR COMPARTMENT RING AND FRONT DOOR COMPARTMENT RING
23. JOIN BETWEEN SLIDING DOOR COMPARTMENT RING AND LOWER INSERT ON SLIDING GUIDE SIDE PANEL
24. JOIN BETWEEN REAR RAIL REINFORCEMENT AND LOWER INSERT ON SLIDING GUIDE SIDE PANEL

25. JOIN BETWEEN SLIDING DOOR COMPARTMENT RING AND LOWER EXTERIOR SIDE PANEL
26. JOIN BETWEEN UPPER EXTERIOR SIDE PANEL AND CENTRAL UPPER INSERT
27. JOIN BETWEEN LOWER EXTERIOR SIDE PANEL AND CENTRAL SUPPER INSERT
28. JOIN BETWEEN SLIDING DOOR COMPARTMENT AND UPPER EXTERIOR SIDE PANEL
29. JOIN BETWEEN FRONT SUSPENSION PILLAR AND FRONT INTERIOR WHEEL ARCH
30. JOIN BETWEEN ENGINE ATTACHMENT REINFORCEMENT AND FRONT SIDE STRUT
31. JOIN BETWEEN STRUT BOX SECTION AND INTERIORSIDE PANEL INSERT
32. JOIN BETWEEN ENGINE ATTACHMENT REINFORCEMENT AND INTERIOR SIDE PANEL INSERT
33. JOIN BETWEEN SERVICE TANK SIDE INSERT AND FRONT SUSPENSION PILLAR
34. JOIN BETWEEN SERVICE TANK SIDE INSERT AND LOWER DASHBOARD BOX SECTION
35. JOIN BETWEEN SERVICE TANK SIDE INSERT AND UPPER RAIL AND INTERIOR SIDE PANEL
36. JOIN BETWEEN UPPER DASHBOARD AND SERVICE TANK SIDE INSERT
37. JOIN BETWEEN SERVICE TANK SIDE INSERT AND UPPER DASHBOARD BOX SECTION
38. JOIN BETWEEN UPPER DASHBOARD BEAM AND FRONT INNER SIDE PANEL
39. JOIN BETWEEN UPPER DASHBOARD AND FRONT INNER SIDE PANEL
40. JOIN BETWEEN LOWER DASHBOARD AND FRONT SUSPENSION PILLAR
41. JOIN BETWEEN LOWER FRONT BEAM STRUT SIDE CONNECTION AND FRONT SIDE STRUT
42. JOIN BETWEEN FRONT BEAM STRUT SIDE CONNECTION AND LOWER DASHBOARD
43. JOIN BETWEEN HEADLAMP BASE AND EXTERIOR SIDE PANEL
44. JOIN BETWEEN FUEL FILLER BASE AND LEFT EXTERIOR SIDE PANEL
45. JOIN BETWEEN HEADLAMP BASE AND EXTERIOR SIDE PANEL
46. JOIN BETWEEN HEADLAMP BASE AND ROOF EXTERIOR
47. JOIN BETWEEN REAR INNER WHEEL ARCH AND INTERIOR SIDE RIBBING
48. JOIN BETWEEN REAR FLOOR AND INTERIOR REAR WHEEL ARCH
49. JOIN BETWEEN REAR BUMPER ATTACHMENT BRACKET AND REAR RAIL CONNECTION BEAM
50. JOIN BETWEEN REAR BUMPER ATTACHMENT BRACKET AND REAR SUSPENSION ATTACHMENT REINFORCEMENT
51. JOIN BETWEEN REAR SUSPENSION ATTACHMENT REINFORCEMENT AND REAR RAIL CONNECTION BEAM
52. JOIN BETWEEN REAR SUSPENSION ATTACHMENT REINFORCEMENT AND REAR RAIL
53. JOIN BETWEEN REAR RAIL CONNECTION BEAM AND REAR FLOOR PAN
54. JOIN BETWEEN HEADLAMP BASE AND REAR HEADLAMP BASE REINFORCEMENT
55. JOIN BETWEEN REAR LOWER SIDE PANEL INSERT AND REAR HEADLAMP BASE REINFORCEMENT
56. JOIN BETWEEN EXTERIOR SIDE PANEL AND REAR LOWER SIDE PANEL INSERT

Sealants are plastic materials with the consistency of a paste
They are set by heat when the body is placed in ovens to stove-dry the paint.
Sealants are applied using an extrusion gun or spray
Once they are set, they look like a flexible mass adhering to the panel. They act as soundproofing and seal panel joints against water, air and dust.
They undergo a final paint treatment using products used as part of the painting cycle.

BODYSHELL PROTECTION

The car body has been designed to withstand any type of environmental attack for many years. This applies to internal parts, which are not visible but potentially subject to corrosion, and external parts, subject above all to damage which could adversely affect the appearance of the vehicle.
This result has been achieved through widespread use of galvanised and double-galvanised panels and by applying many treatments to all surfaces.

Galvanizing

Galvanized panels can be produced through two different technological processes:
- deposition of zinc by galvanisation
- fire-deposition of zinc

When the zinc is deposited by galvanisation, the panel is washed with (in the case of a single galvanised panel) or submerged in (in the case of a double galvanised panel) a solution of zinc salts; a layer of pure zinc with a high level of surface finish is deposited by electrolysis on the panel.
In the case of fire deposition, molten zinc is deposited on the panel by the effect of heat; This process can produce zinc thicknesses of up to 20 microns compared with the 8 microns achieved using galvanisation.
In the presence of water and the iron in the body panel, the zinc layer generates an electrocouple with an electric potential that prevents the iron from rusting.
On this vehicle, 82% of the bodyshell consists of galvanized panels, subdivided into 55% double galvanized panels and 27% single galvanized.
Following the galvanizing treatment, the bodyshell is subjected to bonderization (a treatment which washes any grease or surface oxidation from the panels) and to painting by cataphoresis, a treatment which is essential for protection, particularly of areas due to undergo welding and painting.
All joints between bodyshell panels are thoroughly sealed to prevent leaks.

Painting

The aim of painting is to protect panels and maintain the car's appearance (gloss and richness of colour)
The car colour range includes 5 pastel shades and 5 metallic shades.
All pastel colours except white are two-layer (opaque base + clear coat)
The following table indicates the vehicle range and relevant colour codes
PASTEL COLOURS

Description	Code
Titian Red	199
White	249
Capri Blue	451
Orange	570
Carioca Yellow	241

METALLIC COLOURS

Description	Code
Baroque Red	124
Midnight Blue	426
Steel Grey	647
Elba Blue	718
Island Green	307