28th APRIL 1995

ABONNEMENT GME

REF. 2 No XM 146-00/9

AIR AND FUEL SUPPLY

- **BOSCH VP36 MSA11 (DK5) FUEL INJECTION**

  Operating principle
  Diagnosis

MAN 158931

GB

1

AUTOMOBILES CITROËN
DIRECTION COMMERCE EUROPE
DOCUMENTATION APRÈS VENTE

AIR AND FUEL SUPPLY – SUPERCHARGING

PRESENTATION : BOSCH VP36 MSA11 FUEL INJECTION

1 – PREAMBLE

Engine DK5 ATE incorporates an electronic management of the injection.

Advantages of the electronic management :
- to comply with the emission standards
- to improve the driveability
- to reduce consumption
- and optimise engine performance

2 – PRESENTATION

Main parts constituting the system :
- the injection pump
- the injection E.C.U.

2.1 – Injection pump

The BOSCH injection pump of the VP36 type is derived from the VE type BOSCH pump.

The pump mainly contains :
- the diesel fuel flow electrical actuator (it replaces: load lever, rods, springs)
- an electrovalve for the control of injection advance

2.2 – Injection electronic control unit

The BOSCH MSA11 type E.C.U. checks electrically the following components :
- injection pump
- electrovalve for the control of the exhaust gas recycling valve
- pre and post–heating control unit

The ECU sends the signal :
- engine speed ==> instrument cluster
- instantaneous consumption ==> trip computer
- air con. switch–off

The ECU software integrates :
- the parameters necessary to check injection and emission controls
- the driveability strategies
- the functions of the cruise control
- the coded antitheft function
- the emergency strategies
- the diagnostic with memorisation of fault codes ; the reading is carried out by means of ELIT test unit or SOURIAU station

3 – SYNOPTIC VIEW OF INJECTION

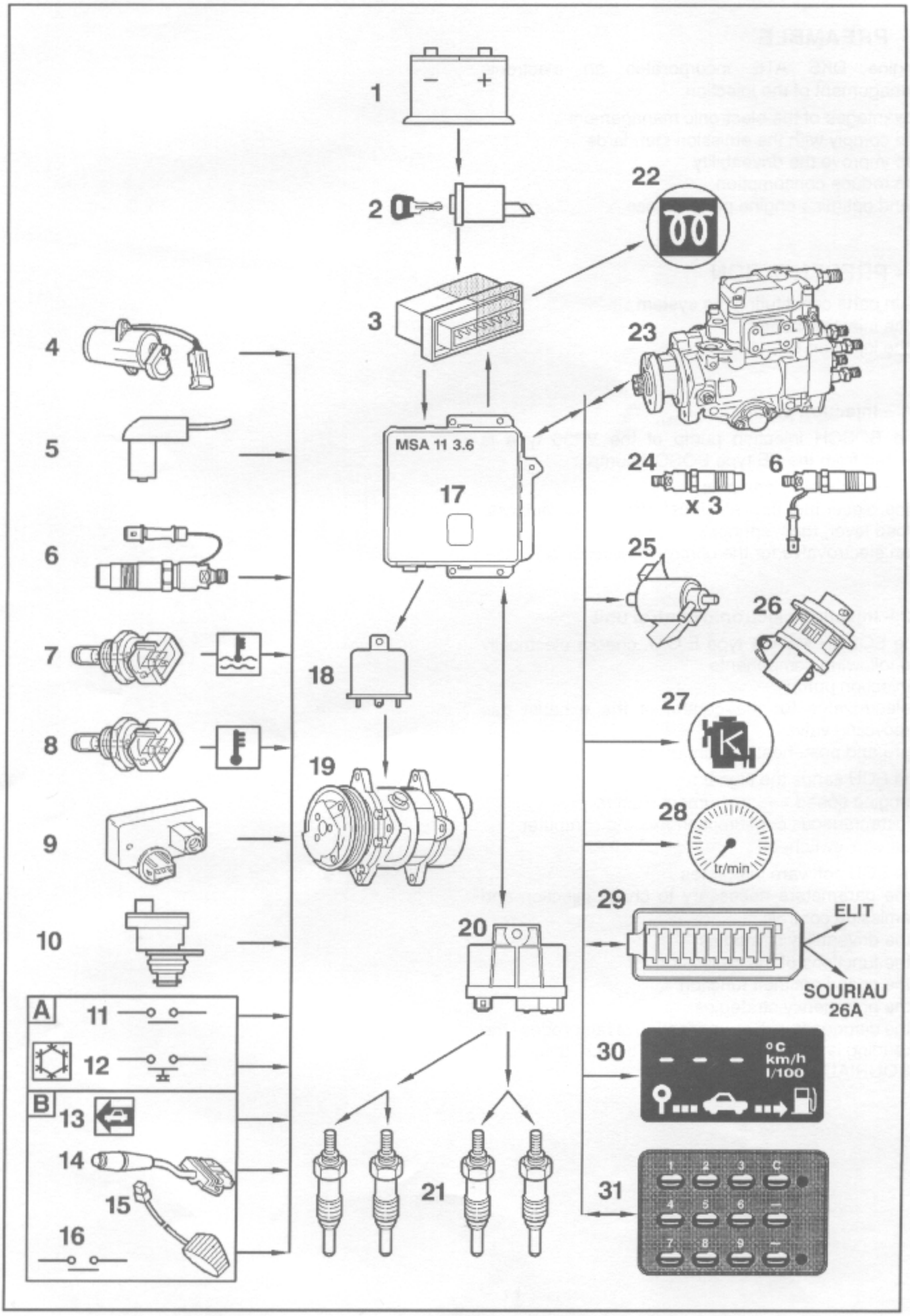


Fig : B1HP0ACP

Parts list :

Code	Component	Code	Component
1	Battery	16	Clutch contact switch
2	Ignition switch	17	Injection electronic control unit + atmospheric pressure sensor
3	Double injection relay	18	Refrigeration compressor cut–off relay
4	Accelerator pedal sensor	19	Refrigeration compressor clutch
5	TDC sensor	20	Pre and post–heating control unit
6	Injector carrier number3 (injector with needle lift sensor)	21	Pre–heater plugs
7	Water temperature sensor	22	Preheating warning lamp
8	Air temperature sensor	23	Injection pump
9	Pressure sensor	24	Injectors
10	Distance sensor	25	Recycling electrovalve
A	Air conditioning function	26	Exhaust gas recycling valve
11	Airconditioning switch (AC ON)	27	Diagnostic warning lamp
12	Pressostat (AC TH)	28	Tachometer
B	Cruise control function	29	Diagnostic socket
13	Cruise control switch	30	Trip computer
14	Cruise control selector switch	31	Coded anti–theft keyboard
15	Stop lamp switch		

FUNCTION – LOCATION : COMPONENTS OF THE SYSTEM

1 – DOUBLE RELAY

1.1 – Location

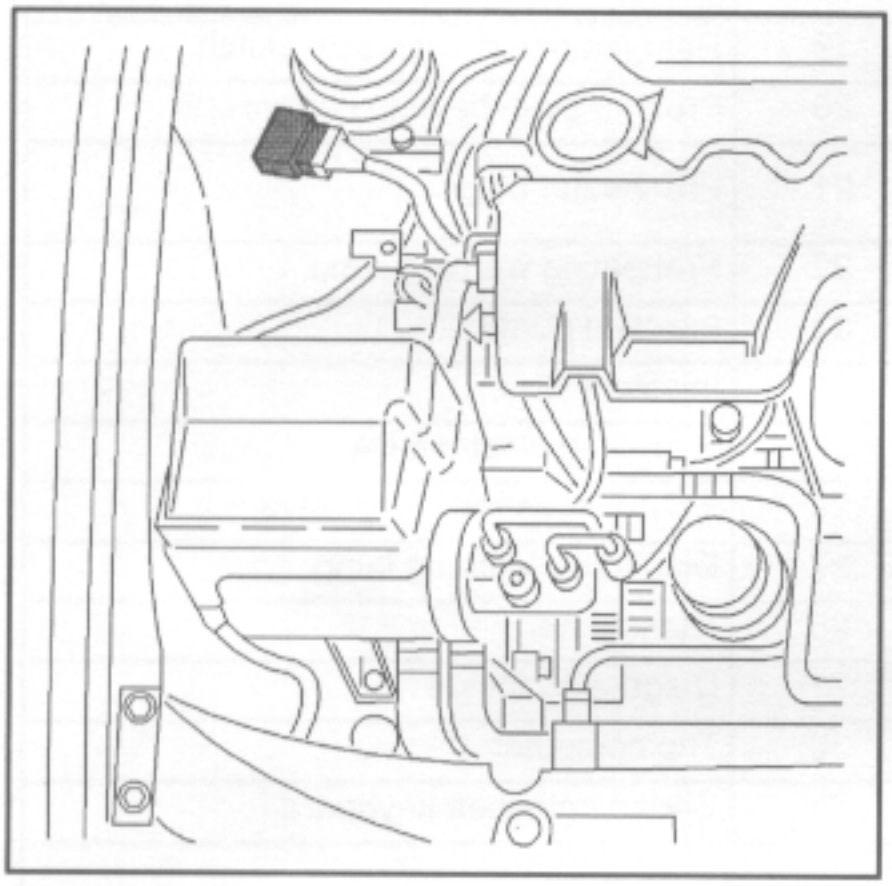


Fig : B1HP09XC

Located : on the R.H. front wheel arch.

1.2 – Function

The double relay enables :

- the supply of the injection ECU
- the illumination of the pre–heating warning lamp, controlled by the injection E.C.U.

2 – ACCELERATOR PEDAL SENSOR

2.1 – Location

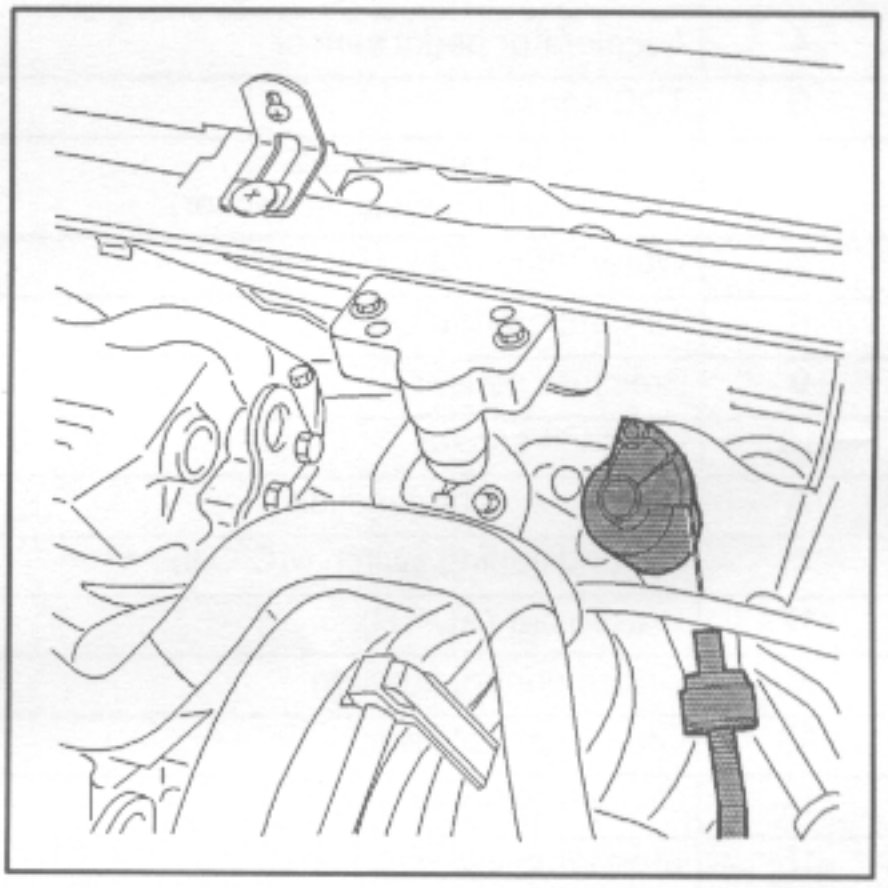


Fig : B1HP09YC

Located : on the scuttle panel aperture, next to the LHM reservoir.

2.2 – Function

The sensor :

- records the driver's request (acceleration, deceleration)
- sends information to injection ECU

The injection ECU activates the injection pump, following the driver's request.

2.3 – Constitution

The sensor is linked to the foot throttle pedal by means of a cable, it comprises the following components :

- a potentiometer of which the resistance varies proportionnaly with the position of the foot throttle pedal
- a contact with 2 positions (foot off/foot on)

The contact enables the ECU to check the validity of the information supplied by the potentiometer (the contact is open when the pedal is released).

3 – TDC SENSOR

3.1 – Location

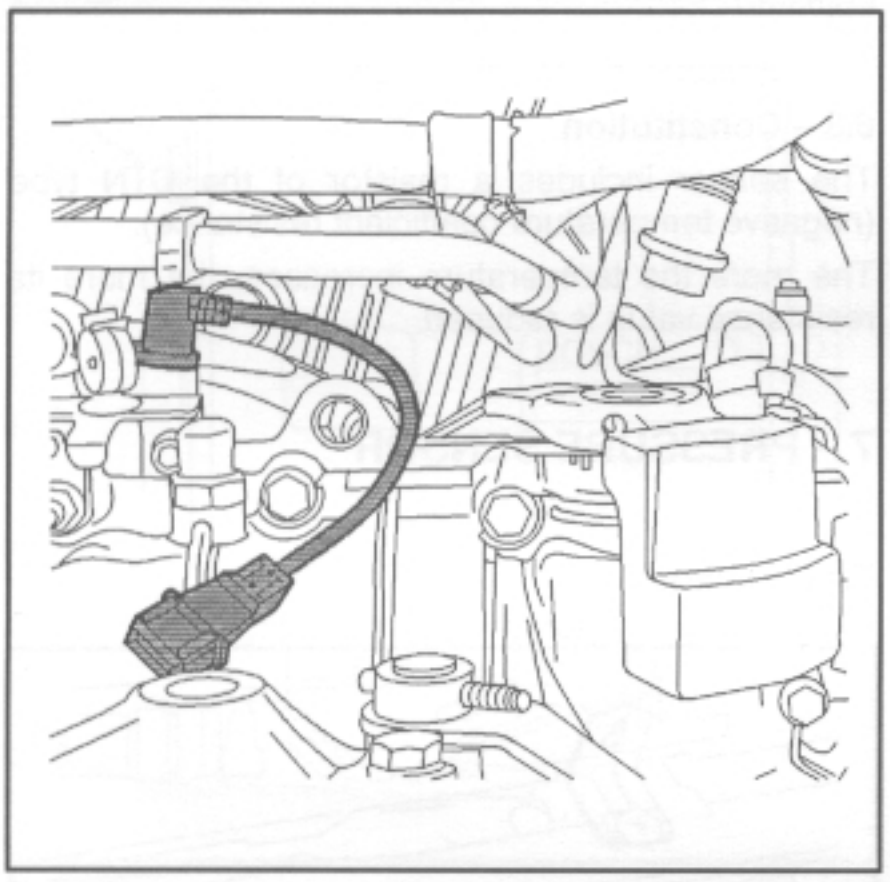


Fig : B1HP09ZC

Located : on the clutch housing.

3.2 – Function

The sensor is of the inductive type.

The sensor supplies the ECU with a signal each time each of the 4 pegs, which are disposed at 90° on the flywheel, pass.

Each impulse is produced 5° after the top dead center (TDC).

The signal enables to determine :
- engine rpm
- position of the reciprocating gear

NOTE : The airgap between the sensor and the flywheel's pegs can't be adjusted.

4 – NEEDLE LIFT SENSOR

4.1 – Location

The sensor is integrated into injector carrier number 3.

4.2 – Function

From the sensor's action, the E.C.U. :
- determines precisely the beginning of the injection
- carries out a dynamical correction of the injection advance

4.3 – Constitution

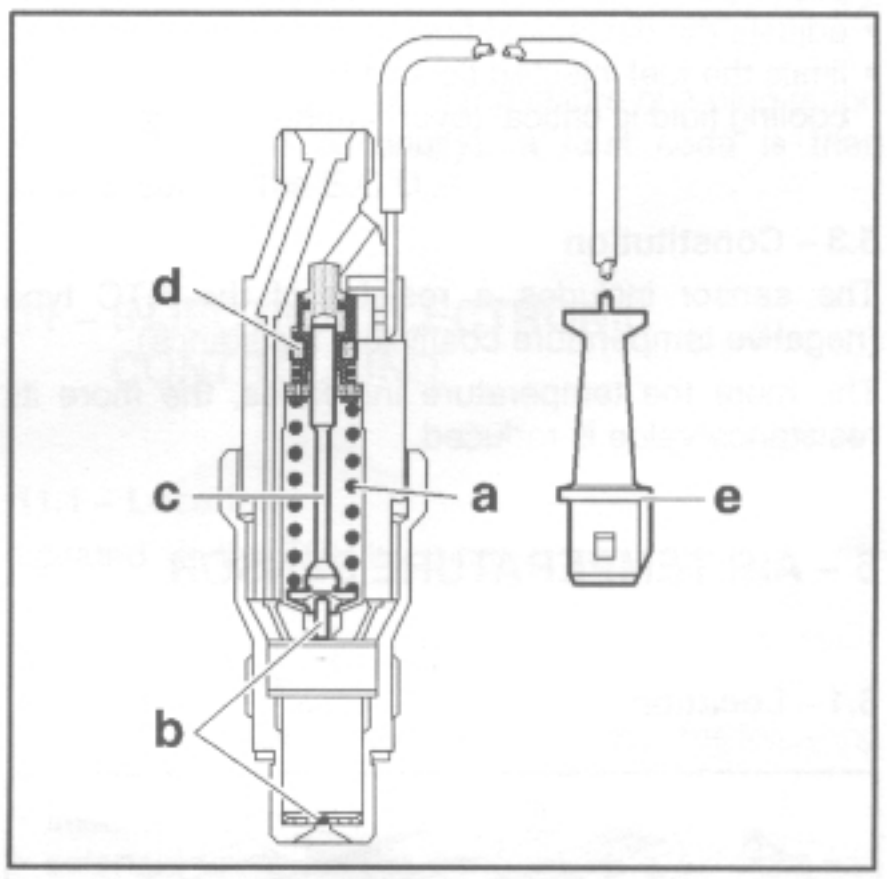


Fig : B1HP0A0C

Injector carrier number3 :
- a : spring
- b : injector needle
- c : magnetic core
- d : ignition coil
- e : 2–way connector

The sensor is of the inductive type.

The injector's needle is extended by a core.

When the injector opens : the core changes its position in the coil ; it creates a modification of the magnetic field.

The variation of the magnetic field generates a current detected by the ECU.

5 – WATER TEMPERATURE SENSOR

5.1 – Location

Located : on the water outlet housing.

5.2 – Function

The water temperature sensor informs the E.C.U. about the engine coolant temperature.

Following the temperature, the E.C.U. :

- adjusts the pre–heating time
- adjusts the post–heating time
- adjusts the starting flow
- adjusts the idling speed
- permits the recycling of exhaust gases
- adjusts the diesel fuel flow
- limits the fuel injected flow if the temperature of the cooling fluid is critical (overheating function)

5.3 – Constitution

The sensor includes a resistor of the NTC type (negative temperature coefficient resistance).

The more the temperature increases, the more its resistance value is reduced.

6 – AIR TEMPERATURE SENSOR

6.1 – Location

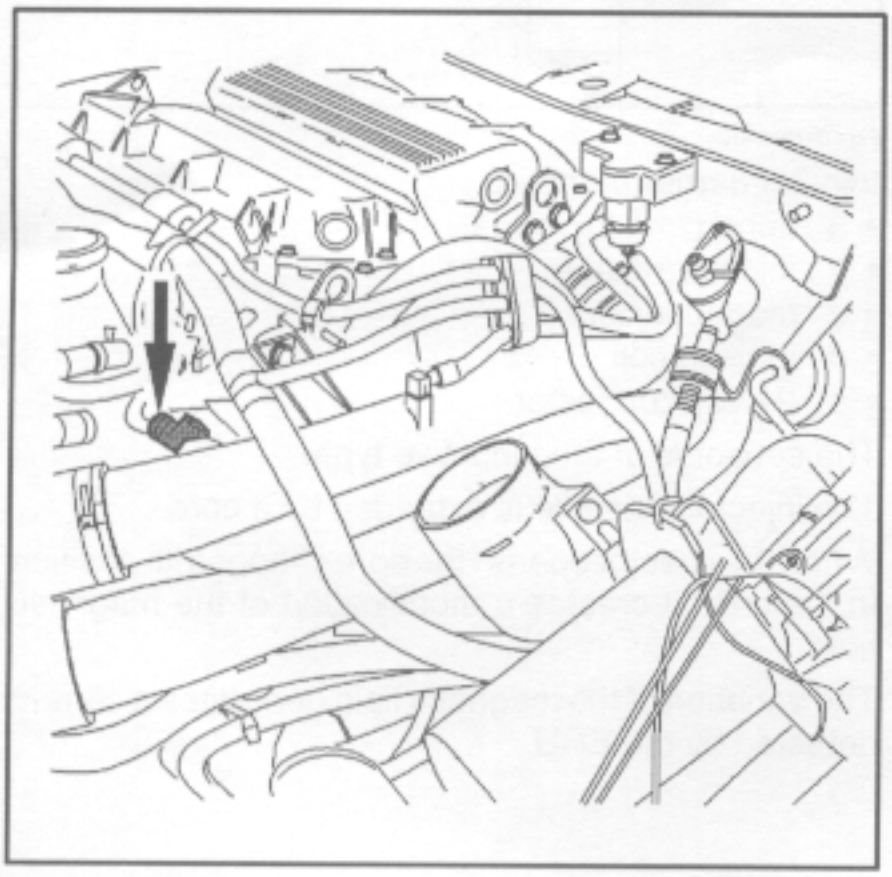


Fig : B1HP0A1C

Located : on the air inlet duct.

6.2 – Function

The air temperature sensor informs the ECU about the temperature of the air taken in.

This information enables the diesel fuel flow to be adjusted.

6.3 – Constitution

The sensor includes a resistor of the CTN type (negative temperature coefficient resistance).

The more the temperature increases, the more its resistance value is reduced.

7 – PRESSURE SENSOR

7.1 – Location

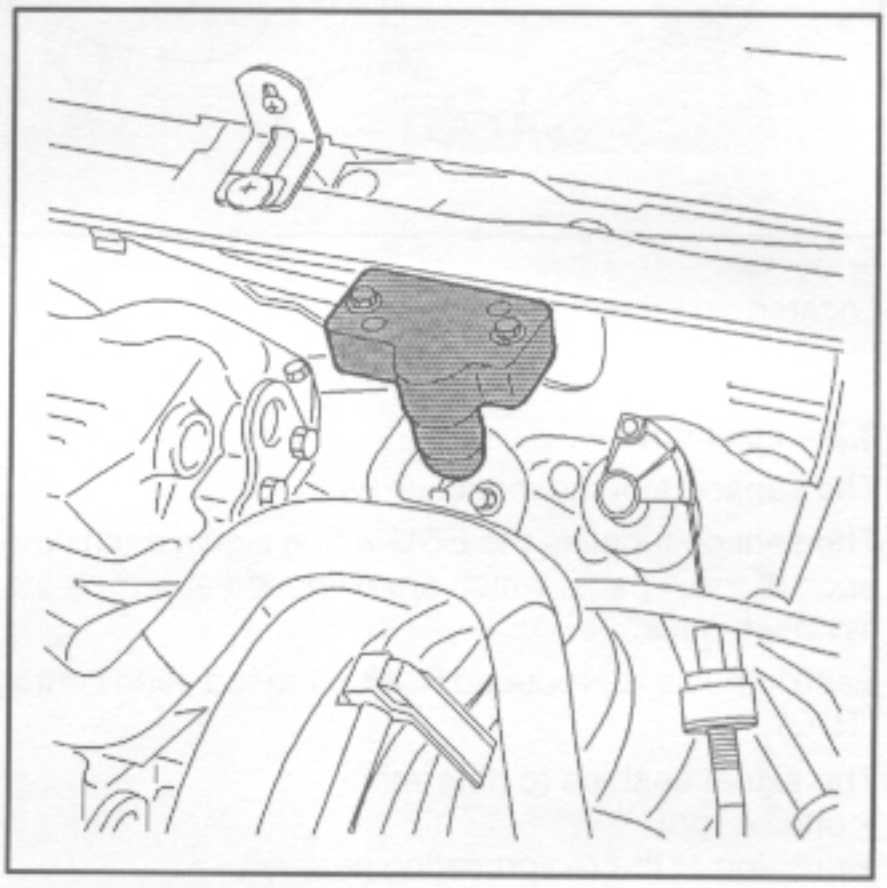


Fig : B1HP0A2C

Located : on the scuttle panel aperture, next to the LHM reservoir.

7.2 – Function

The sensor enables the air pressure in the inlet manifold to be determined.

This information enables the adjustment of the diesel fuel flow.

7.3 – Constitution

The sensor is of the piezoelectrical type. It is composed of stress gauges.

It supplies a voltage proportional to the air pressure in the inlet manifold.

8 – ATMOSPHERIC PRESSURE SENSOR

8.1 – Location

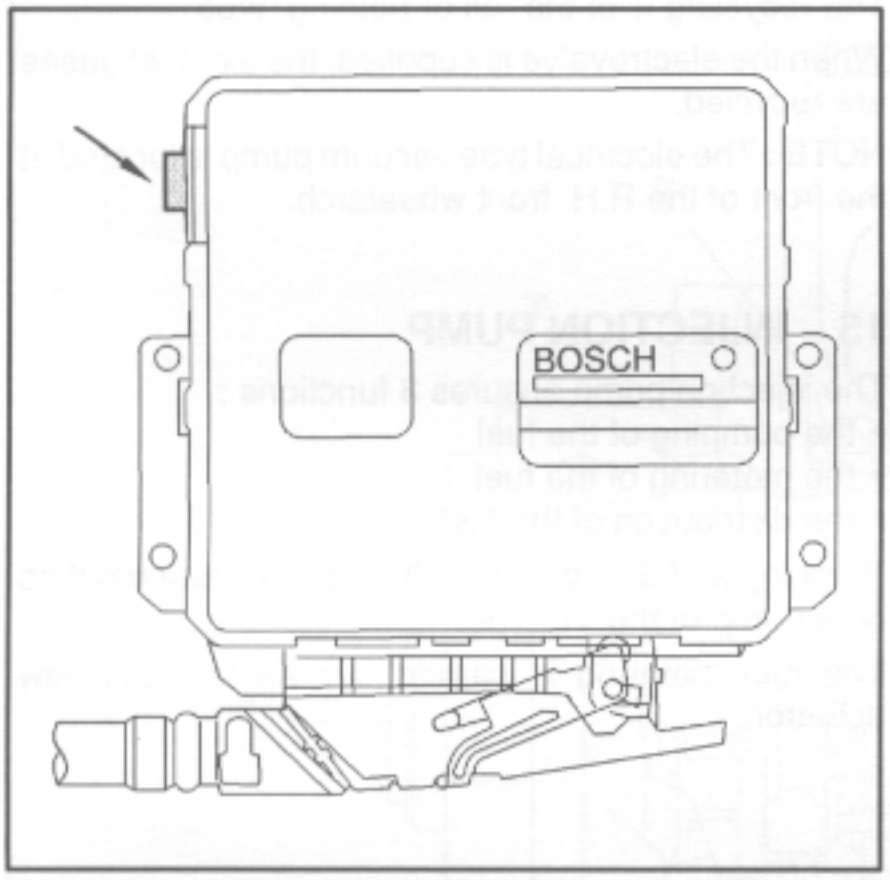


Fig : B1HP0A3C

The sensor is coupled to the injection E.C.U..

8.2 – Function

The sensor informs the ECU about the atmospheric pressure ; this parameter is used to determine injection advance.

9 – VEHICLE SPEED SENSOR

9.1 – Location

The sensor in located on the gearbox.

9.2 – Function

The sensor informs the E.C.U. of the speed of the vehicle, this component is a "Hall effect" type sensor, 5 impulses per meter, 8 impulses per revolution.

With the information from the sensor, the ECU :

- improves the idle speed of the vehicle in motion
- optimises the accelerations
- reduces jerks
- ensures the vehicle cruise control

10 – PRE AND POST–HEATING CONTROL UNIT

10.1 – Location

Located : at the front of the battery tray.

10.2 – Function

The control unit electrically supplies the pre–heater plugs in pairs according to the orders from the injection E.C.U.

The pre–heating and post–heating times are determined by the ECU in accordance with the engine coolant temperature.

The preheating warning lamp is controlled by the injection ECU via the double relay.

The control unit can detect the failure of a plug (short circuit, break in continuity), a fault code is then memorised by the E.C.U..

11 – INJECTION ELECTRONIC CONTROL UNIT

11.1 – Location

Located : in the ECU housing.

11.2 – Function

The ECU ensures the electrical checks of the following elements :

- injection pump
- solenoid valve for the control of the exhaust gas recycling valve
- pre and post–heating control unit

The ECU sends the signal :

- engine speed ==> instrument cluster
- instantaneous consumption ==> trip computer
- air con. switch–off

The ECU software integrates :

- the parameters necessary to check injection and emission controls
- the driveability strategies
- the functions of the cruise control
- the coded antitheft function
- the emergency strategies
- the diagnostic with memorisation of fault codes ; the reading is carried out by means of ELIT test unit or SOURIAU 26 A station

11.3 – Description

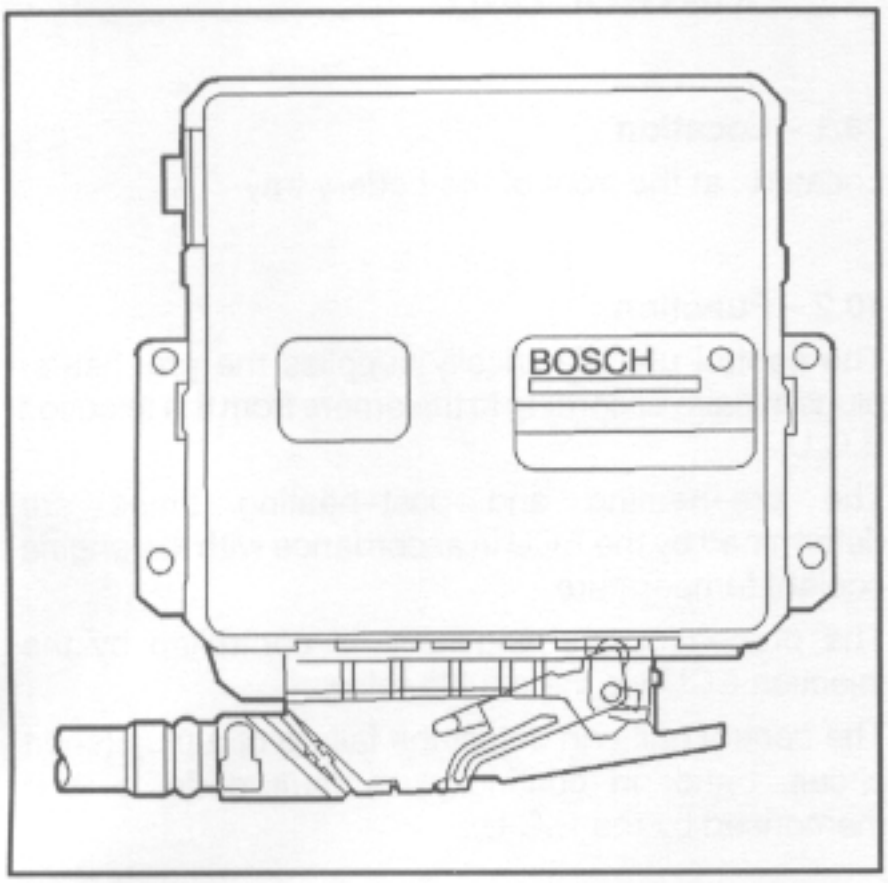


Fig : B1HP0A4C

The ECU includes :
- 1 55–way connector
- 1 atmospheric pressure sensor
- 3 microprocessors

12 – RECYCLING ELECTROVALVE

12.1 – Location

Fig : B1HP0A5C

Located : on the engine (near the engine oil filler neck).

12.2 – Function

The E.C.U. controls the operation of the electrovalve.

The electrovalve links the vacuum pump and the exhaust gas recycling valve capsule (EGR valve).

The recycling is of the "all or nothing" type.

When the electrovalve is supplied, the exhaust gases are recycled.

NOTE : The electrical type vacuum pump is located at the front of the R.H. front wheelarch.

13 – INJECTION PUMP

The injection pump ensures 3 functions :
- the pumping of the fuel
- the metering of the fuel
- the distribution of the fuel

Pumping and distribution of the fuel are carried out as on a pump of the VE type.

The fuel metering is carried out via the fuel flow actuator.

13.1 – Description

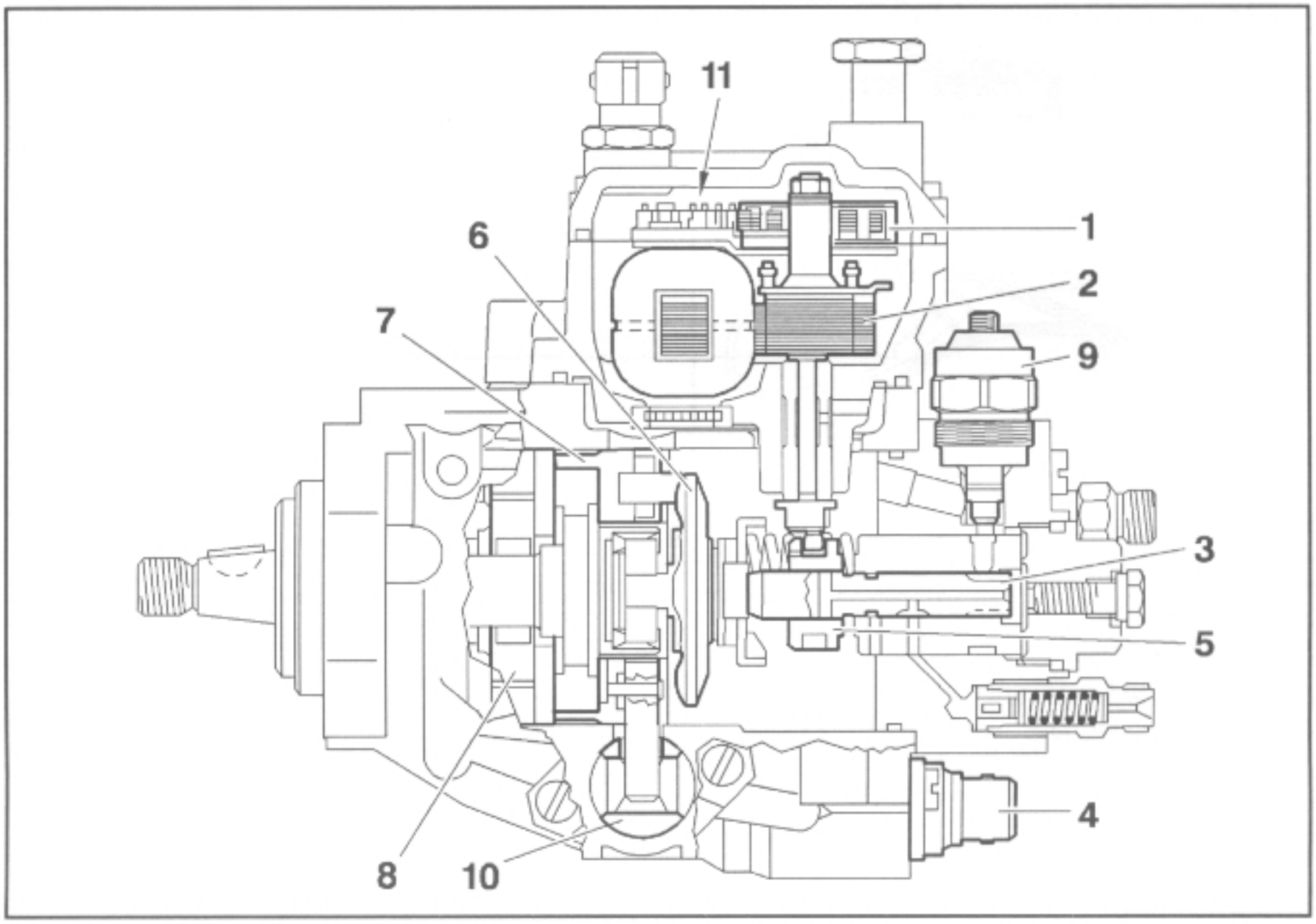


Fig : B1HP0A6D

1 : regulating slide valve position sensing sensor.
2 : fuel flow actuator.
3 : high pressure piston.
4 : advance electrovalve.
5 : regulating slide valve (sliding block).
6 : cam plate.
7 : roller bearing ring.
8 : transfer pump.
9 : electric fuel cut–off solenoid.
10 : advance piston.
11 : diesel fuel temperature sensor.

The electrical information of the injection pump go through a 7–way black KOSTAL type round connector.
The connector is attached to the wiring harness of the injection pump ; location : next to the E.C.U. housing.

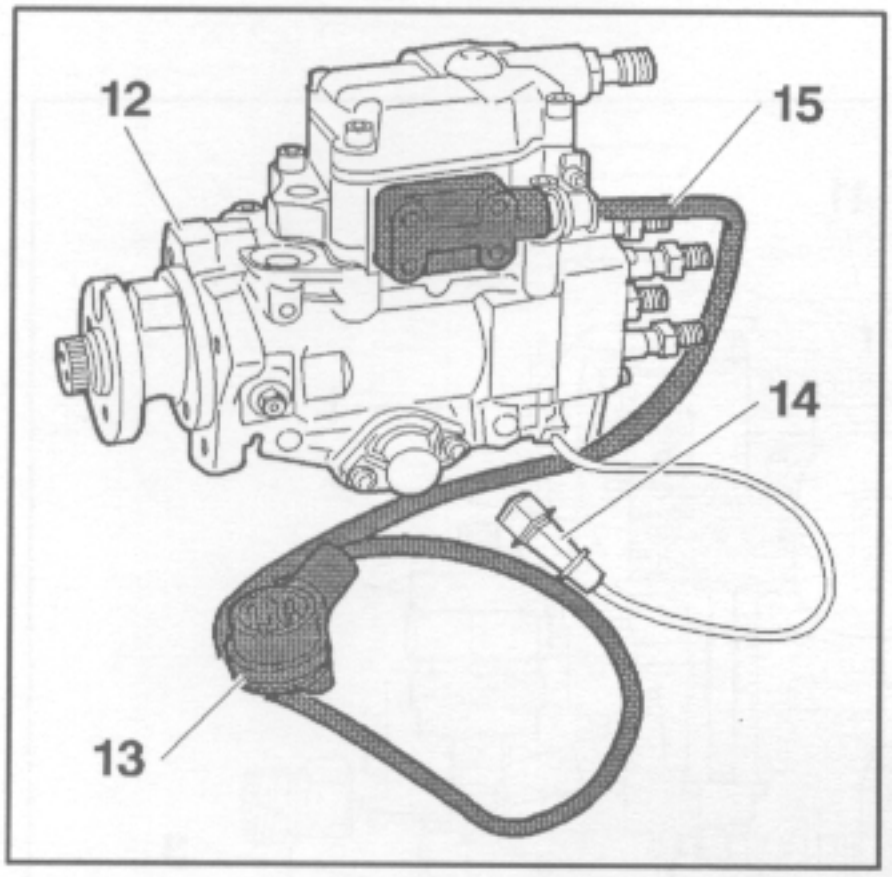


Fig : B1HP0A7C

12 : injection pump.
13 : pump connector.
14 : connector of the advance electrovalve.
15 : pump wiring harness.

13.2 – Fuel flow actuator

13.2.1 – Function

The flow actuator replaces the regulator unit for mechanical injection pumps, it regulates the fuel flow injected.

It is controlled by the injection E.C.U. (variable cyclic ratio current).

13.2.2 – Description

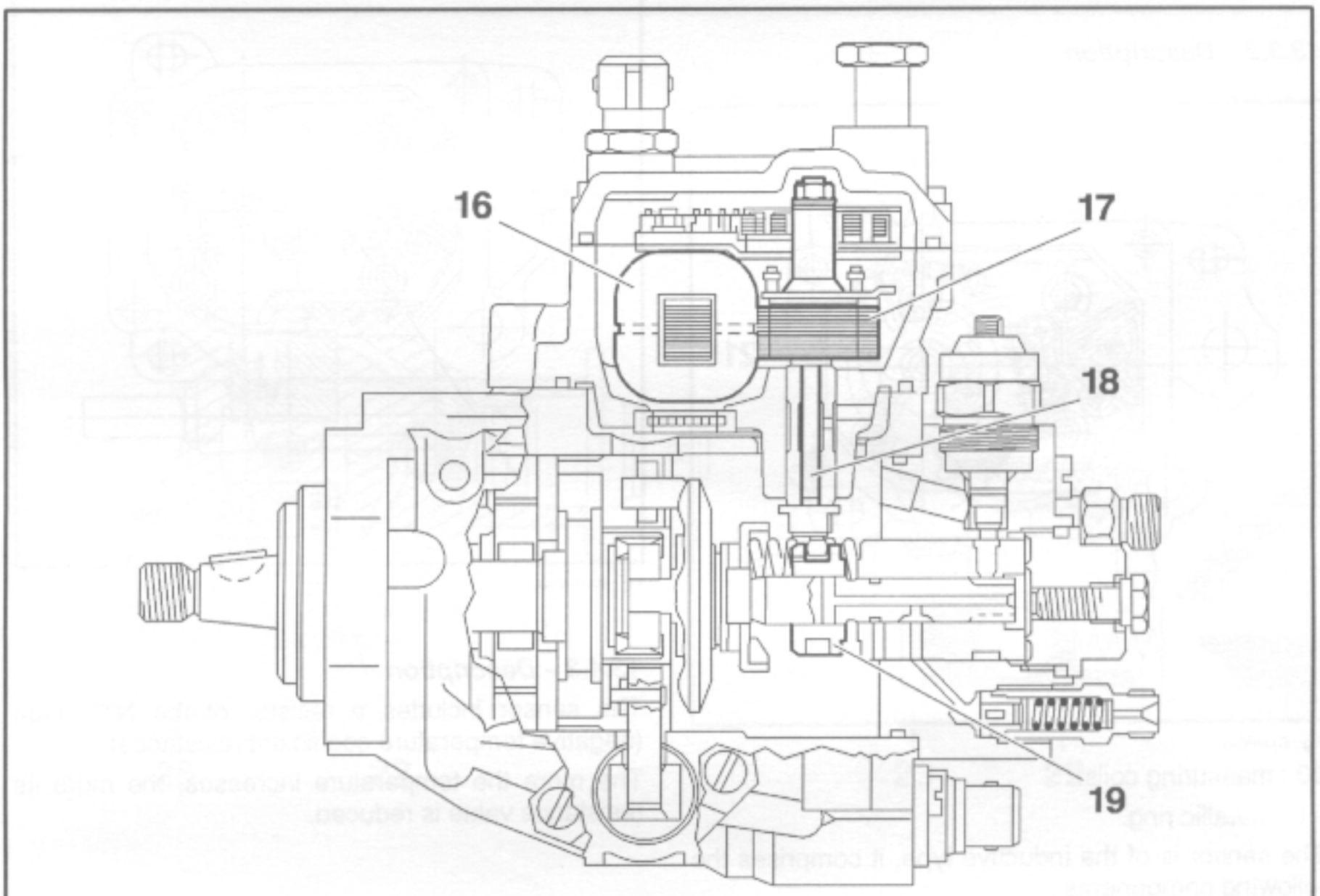


Fig : B1HP0A8D

16 : solenoid.

17 : permanent rotary magnet (on the axle).

18 : connection axle.

19 : regulation slide valve.

The flow actuator is composed of the following components :
- a rotary magnet attached to the regulation slide valve
- a fixed solenoid supplied by a variable cyclic ratio current

When the flow actuator is not supplied the diesel fuel flow is nil (the regulation slide valve is positioned to zero delivery by return springs).

13.3 – Regulating slide valve position sensing sensor

13.3.1 – Function

The sensor supplies the ECU with the information : position of the regulating slide valve = amount of diesel fuel injected.

If the position of the regulating slide valve differs from the pre–determined position : the fuel flow actuator is activated to move it back to the pre–determined position.

13.3.2 – Description

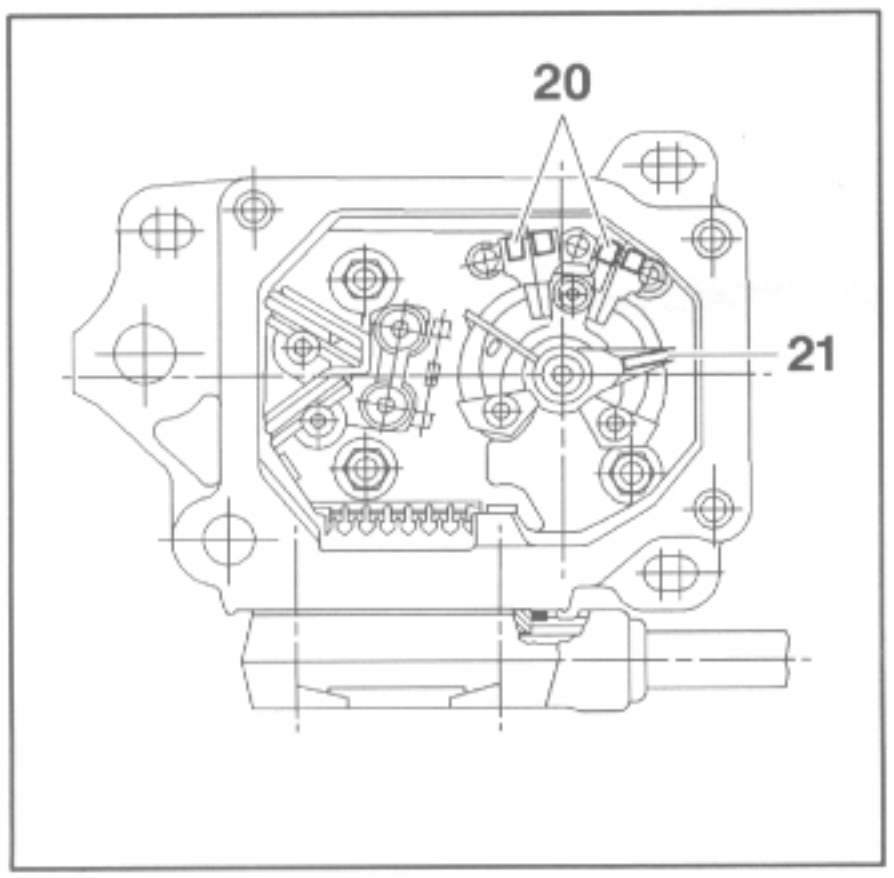


Fig : B1HP0A9C

20 : measuring coils.

21 : metallic ring.

The sensor is of the inductive type, it comprises the following components :

- 2 measuring coils
- a metallic ring moving before the measuring coils

The metallic ring is attached to the axle of the fuel flow actuator ; it causes the inductance of the measuring coils to vary.

13.4 – Diesel fuel temperature sensor

13.4.1 – Function

The sensor informs the ECU about the temperature of the diesel fuel ; this information enables the diesel fuel flow to be adjusted according to the fluidity of the fuel.

13.4.2 – Location

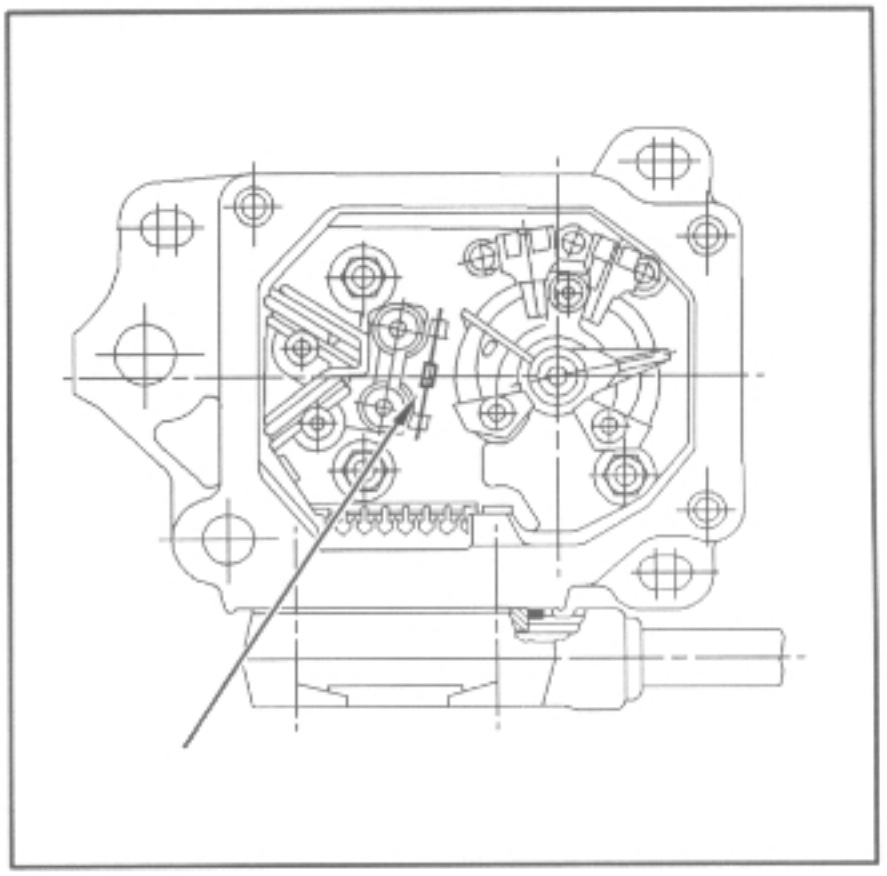


Fig : B1HP0AAC

13.4.3 – Description

The sensor includes a resistor of the NTC type (negative temperature coefficient resistance).

The more the temperature increases, the more its resistance value is reduced.

13.5 – Solenoid valve of motion

13.5.1 – Function

The solenoid valve makes it possible to modulate the pressure applied onto the advance piston (connected to the cam plate), which enables the injection advance to vary.

It is supplied by a varying cyclic ratio current.

13.5.2 – Presentation of the system

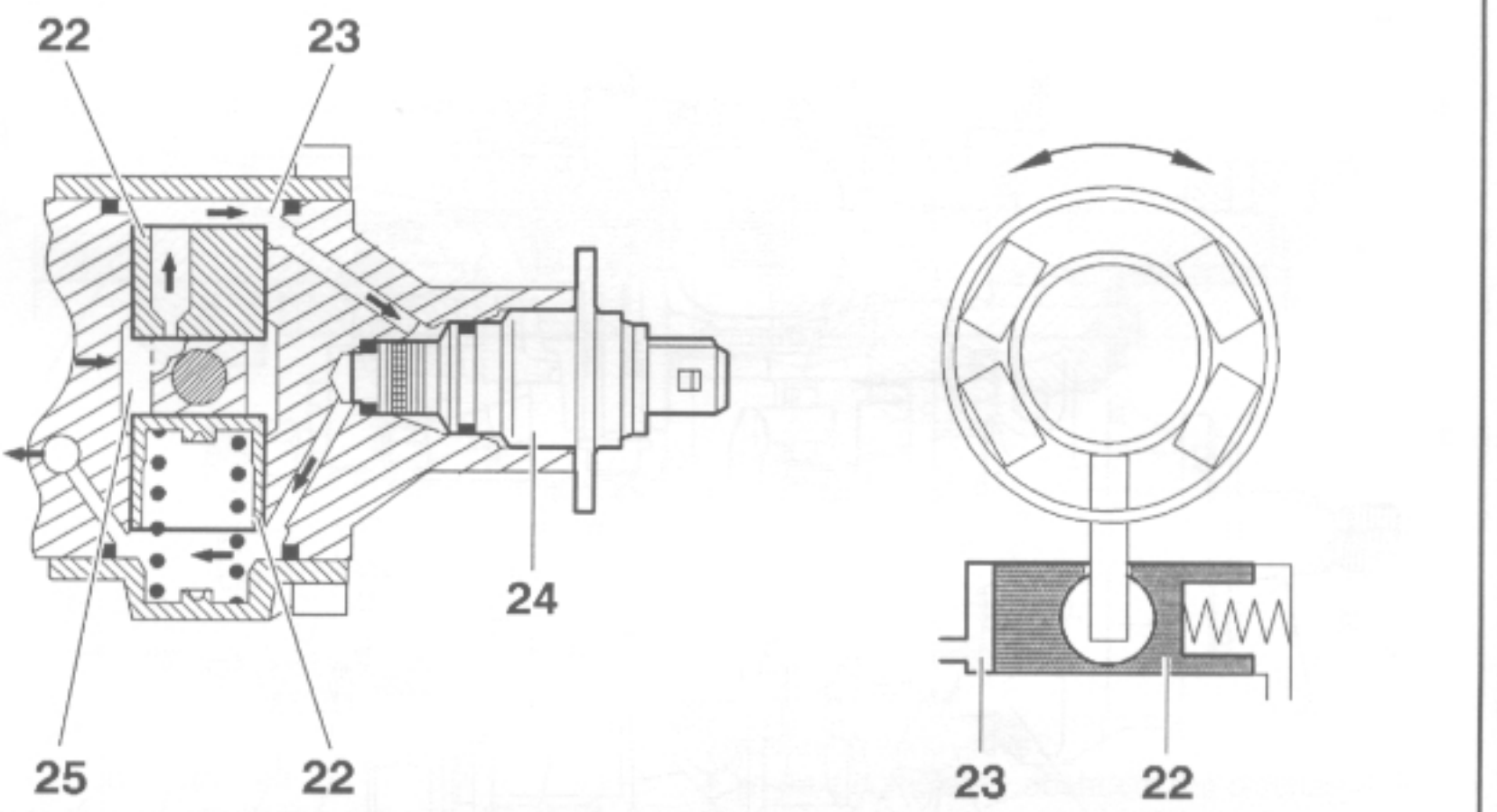


Fig : B1HP0ABD

22 : advance piston.

23 : modulated pressure.

24 : electrovalve.

25 : internal pressure of the pump.

OPERATING PRINCIPLE : BOSCH VP36 MSA11 FUEL INJECTION

1 – FLOW ADJUSTMENT

Parameters which determine the flow of fuel injection controlled by the ECU :
- request of driver
- maximum injection flow taken in
- amount of air entering the engine
- full load output

1.1 – Injection pump

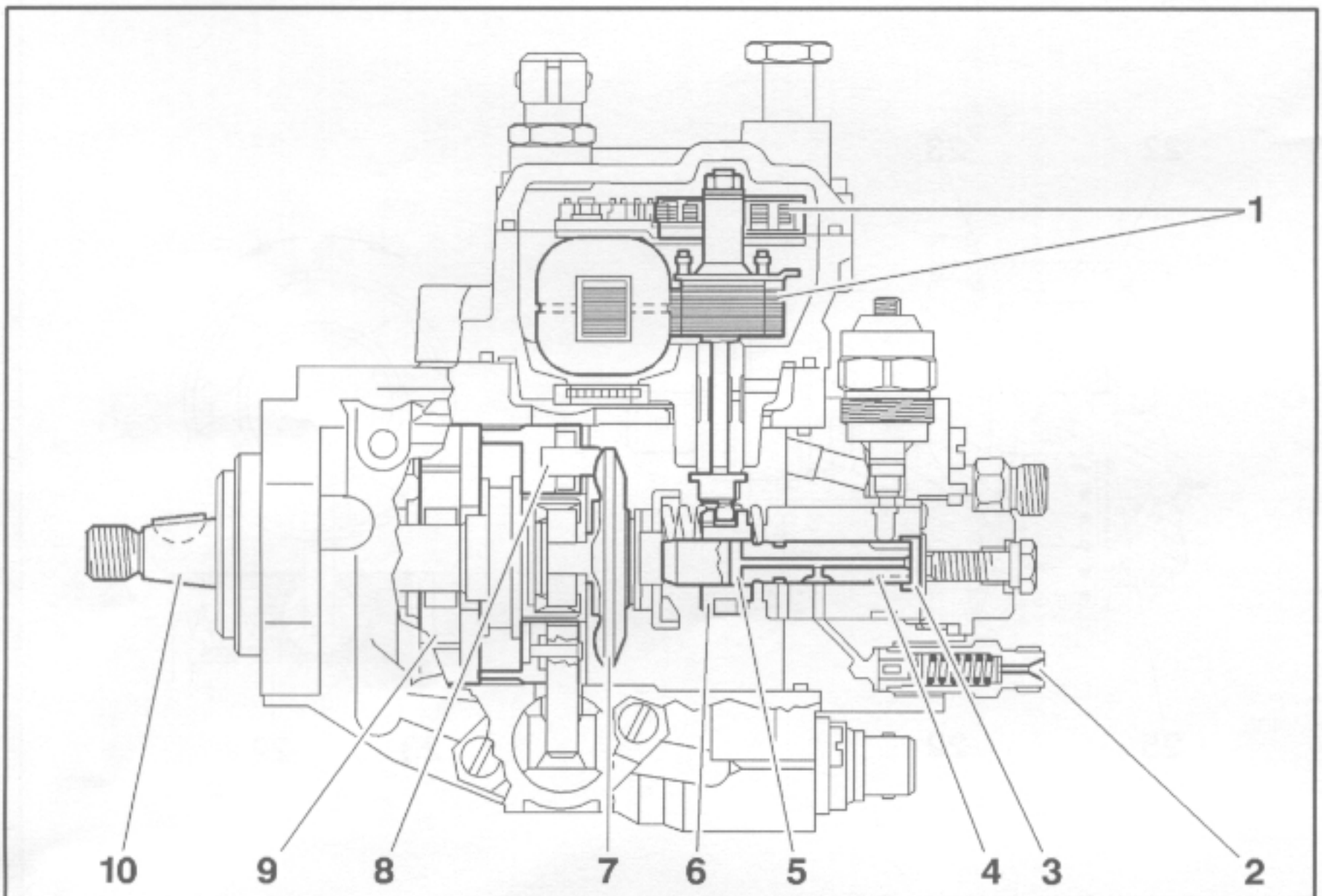


Fig : B1HP0ADD

(1) fuel flow actuator.
(2) outlet towards injector.
(3) delivery chamber.
(4) injection piston.
(5) fuel discharge port.
(6) regulating slide valve.
(7) cam plate.
(8) roller bearing ring.
(9) fuel pump.
(10) drive shaft of injection pump.

The injection pump shaft drives the following components :
- fuel pump
- cam plate

Cam plate :
- it rests on the roller bearing ring
- it transmits a rotating and alternating movement to the piston

1.2 – Phases of operation

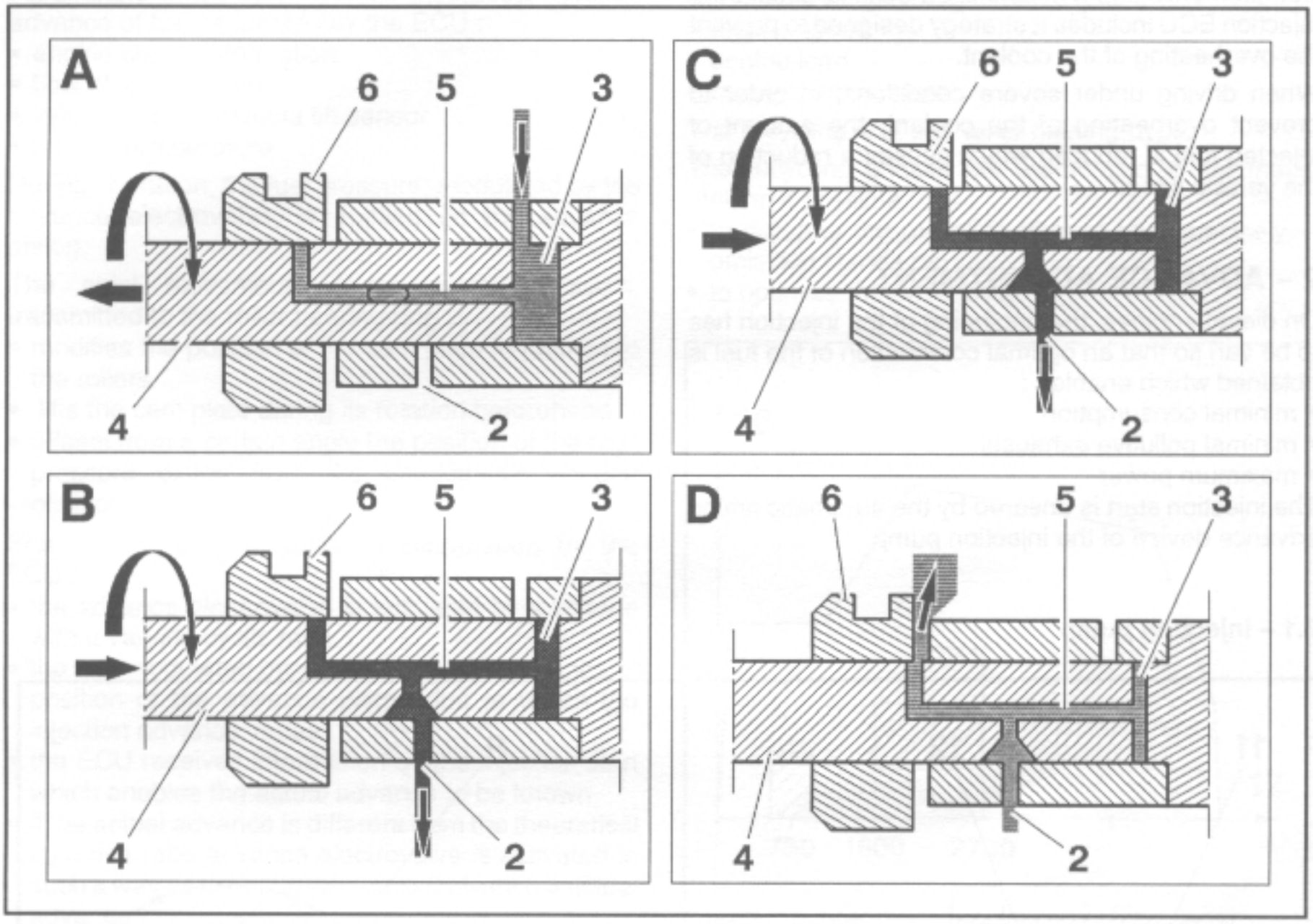


Fig : B1HP0AED

(A) phase 1 : suction.

(B) phase 2 : delivery.

(C) phase 3 : distribution.

(D) phase 4 : metering.

Phase 1 : suction.
- the piston moves to the left
- it increases the volume of the delivery chamber
- it permits the opening of the supply passage and the suction of the fuel

Phase 2 : delivery.
- the piston moves to the right
- it closes the feed gallery
- it enables injection by an increase in pressure

Phase 3 : distribution.
- the piston pivots on its axle
- the piston connects the delivery chamber with an injector outlet

Phase 4 : metering.

The regulating slide valve, positioned by the slide valve actuator, varies the fuel delivery by modifying the end of injection (partial obstruction of the discharge port).

Regulating slide valve :
- when it completely obstructs the discharge port : a maximum quantity of fuel is injected
- when it leaves the discharge channel completely open : no fuel is injected

According to the injection flow determined by the E.C.U. :
- the flow actuator is activated by a voltage (the fuel delivery increases or decreases through the movement of the regulating slide valve)
- the E.C.U. reads the position of the regulating slide valve – position sensor
- if the position of the slide valve is different from the pre–determined one, the E.C.U. makes a correction (if necessary) by a new activation of the actuator

1.3 – Anti–ebullition protection

Complementary to the optimised cooling circuit, the injection ECU includes a strategy designed to prevent the overheating of the coolant.

When driving under severe conditions, in order to prevent overheating of the coolant, the amount of injected fuel is reduced which causes a reduction of the vehicle speed.

2 – ADVANCE ADJUSTMENT

On diesel engines, the beginning of the injection has to be vari so that an optimal combustion of the fuel is obtained which enables :

- minimal consumption
- minimal pollutive exhausts
- maximum power

The injection start is ensured by the automatic timing advance device of the injection pump.

2.1 – Injection pump

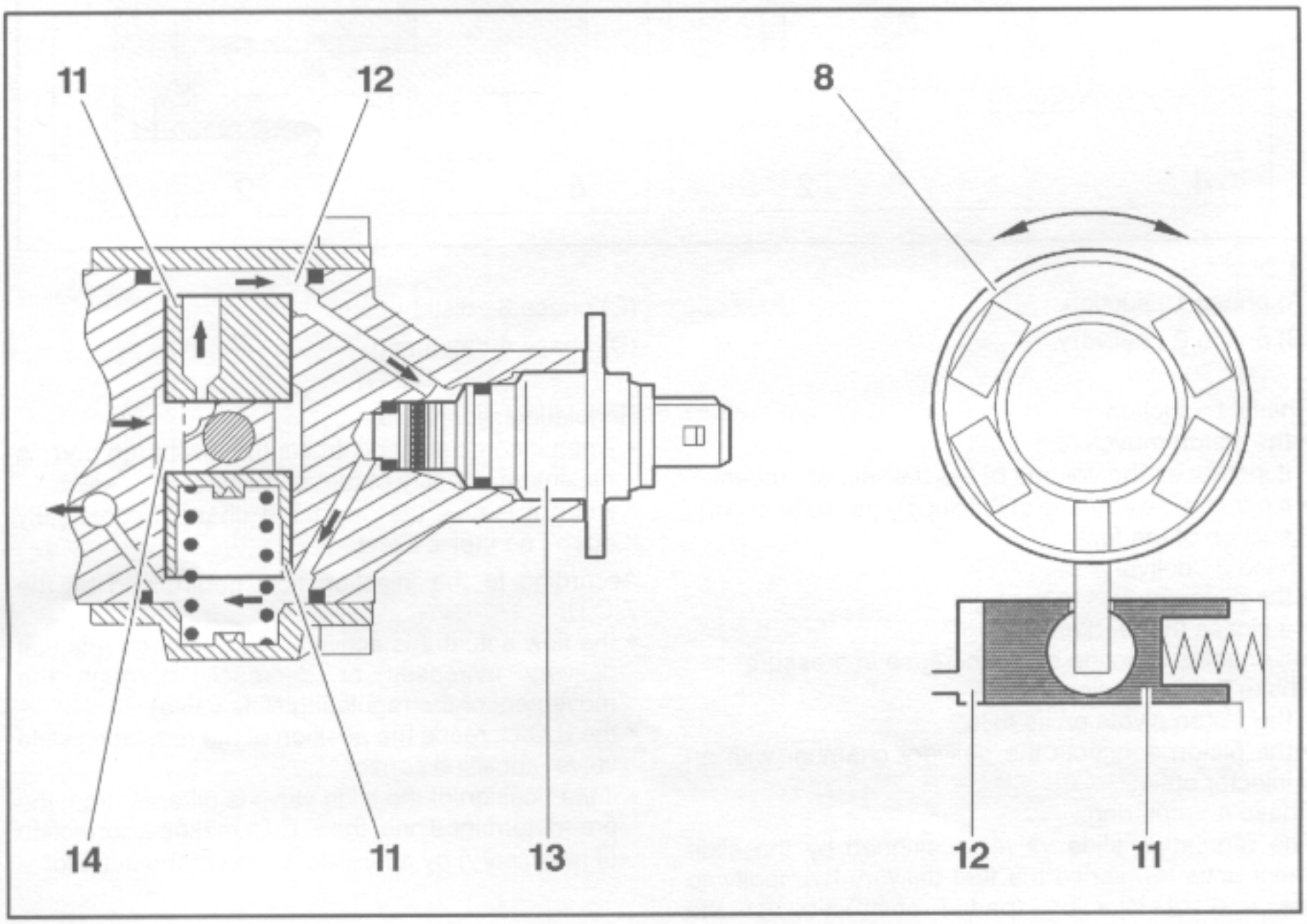


Fig : B1HP0AFD

(8) roller bearing ring.
(11) advance piston.
(12) modulated pressure.
(13) advance electrovalve.
(14) internal pressure of the pump.

2.2 – Operation

Parameters which determine the theoretical injection advance of fuel requested by the ECU :
- engine speed information
- flow of injected fuel
- injection start – needle lift sensor
- coolant temperature

During operation, the fuel pressure, modulated by the advance electrovalve, is applied on the advance piston.

The axial movement of the advance piston, transmitted to the roller bearing ring :
- modifies the position of the cam plate in relation to the rollers
- lifts the cam plate during its rotation beforehand
- offsets from a certain angle the position of the high pressure piston from the crankshaft's angular position

From the theoretical advance determined by the ECU :
- the advance electrovalve is activated by a voltage with a varying cyclic ratio
- the fuel modulated pressure enables the change of position of the advance piston due to which the injection advance varies
- the ECU receives information on the injection start which enables the actual advance to be known
- if the actual advance is different from the theoretical advance : the advance electrovalve is activated in such a way as to obtain theoretical advance = actual advance

During the deceleration phase, there can be an injection cut off :
- the injection start information no longer exists
- the ECU then manages the injection advance in an open loop

3 – RECYCLING OF EXHAUST GASES

Conditions for recycling exhaust gases :
- engine speed
- engine load
- coolant temperature

The recycling is of the "all or nothing" type.

The recycling phases are memorised in the maps making it possible :
- to determe the recycling phases very precisely – emission standards
- to optimise the driveability

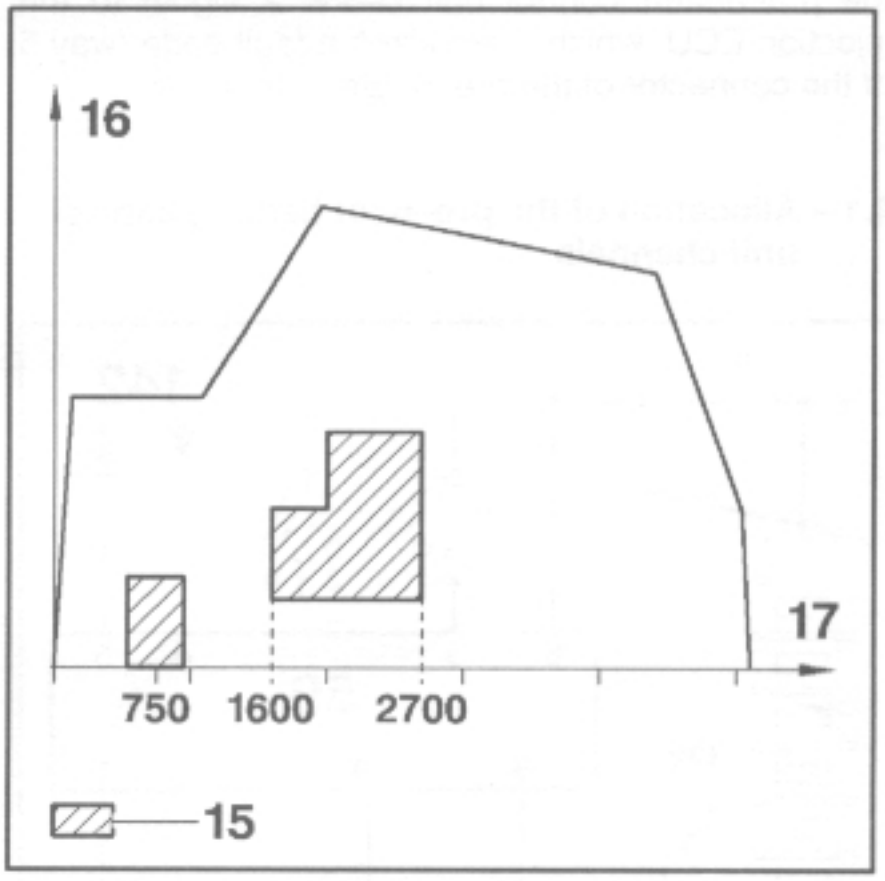


Fig : B1HP0AGC

(15) phases of exhaust emission EEC 93 recycling.

(16) fuel delivery.

(17) speed (rpm).

NOTE : There's no more recycling at altitudes above 1700 meters.

4 – PRE–POST HEATING

The control unit electrically supplies the pre–heater plugs in pairs according to the orders from the injection E.C.U..

The pre and post–heating times are determined by the injection E.C.U..

The pre–heating warning lamp is controlled by the injection ECU via the double relay.

The diagnosis of the pre–heater plugs is managed by the injection ECU.

In the case of a failure of one of the pre–heater plugs, the pre–heater control unit sends a signal to the injection ECU, which memorizes a fault code (way 5 of the connector of the pre–heater control unit).

4.1 – Allocation of the pre–post heating control unit channels

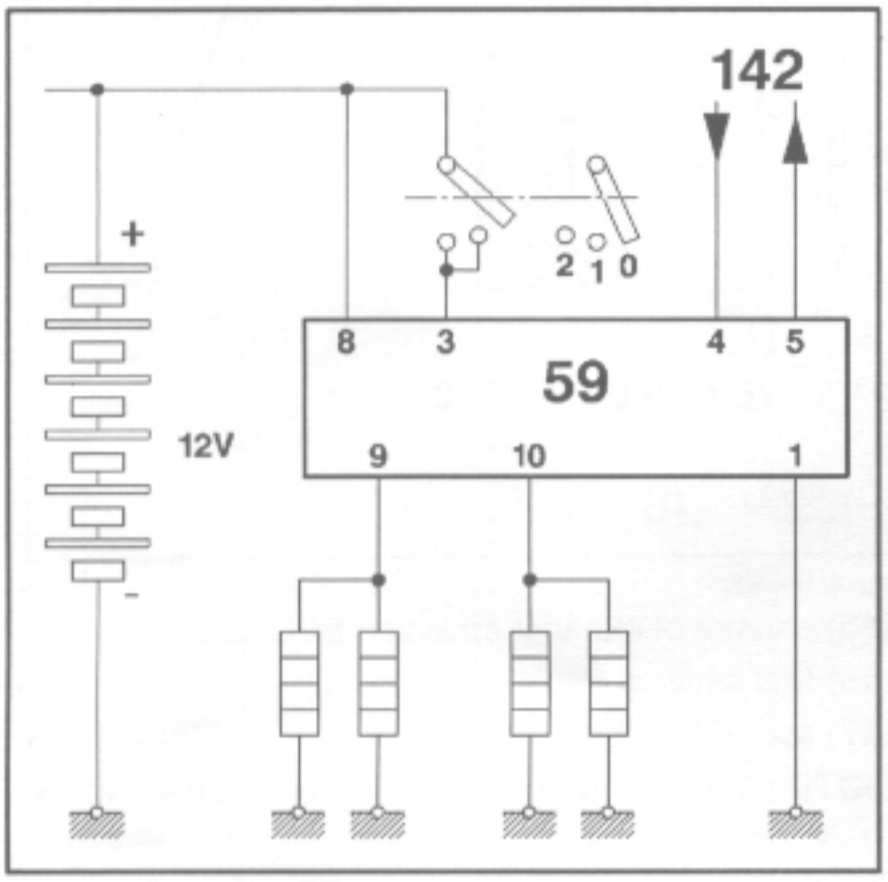


Fig : B1HP0AHC

59 : pre and post–heater control unit.

142 : injection E.C.U.s.

Ways 9/10 : pre and post–heater plugs.

4.2 – Pre–heating and post–heating

The pre–heating and post–heating times are determined by the ECU in accordance with the engine coolant temperature.

Pre–heating duration : 16 seconds (max.).

Post–heating duration : 3 minutes (max.).

Parameters which can interrupt the post–heating :
- engine load
- coolant temperature > 70 °C

5 – IMPROVEMENT OF DRIVING

5.1 – Adjustment of idling speed

The idling speed is regulated from the following information :
- engine speed
- coolant temperature
- engagement of the air conditioning compressor
- vehicle speed (vehicle driven at idling speed)

The following are possible through a modulation of the injection flow :
- to adjust the idling speed
- to obtain a degressive fast idle speed following the heating of the engine
- to inject a personal amount of fuel for each cylinder in order to correct possible failures of acyclisme
- to correct the engine speed during engagement of the air conditioning compressor
- to improve the idling speed of the vehicle in motion

5.2 – Reduction of jerks

The driver's request is filtered by the injection ECU in order to avoid jerkiness.

During acceleration :
- the injection flow is increased by a small value
- the power unit swings on its blocks
- the ECU detects a slight variation of the engine rpm (engine speed sensor)
- the power unit rests on its blocks
- the injection flow is applied without risking jerks

NOTE : During deceleration the injection flow is reduced gradually to avoid jerkiness.

5.3 – Over–speed regulation

When the engine exceeds the maximum speed value, the injection system reduces the injection flow gradually in order to reduce the "wall" effect.

5.4 – Temporary overflow

Under some conditions, an "increased" temporary flow is supplied to improve accelerations.

6 – OTHER FUNCTIONS

6.1 – Refrigeration

The ECU can cut off the supply to the electromagnetic clutch of the air conditioning compressor in the following cases :

- starting the vehicle
- acceleration
- coolant temperature > 119 °C

When the air conditioning compressor is released, it can be engaged only after a time delay of 4 seconds.

6.2 – Trip computer

The injection ECU sends the instantaneous consumption information in the form of voltage fluctuations to the on–board computer.

6.3 – Coded anti–theft device

ATTENTION : If the code of the coded antitheft device is lost, the injection ECU has to be replaced.

DATA : BOSCH VP36 MSA11 FUEL INJECTION

1 – INJECTION ELECTRONIC CONTROL UNIT

Make : BOSCH.

Type : MSA 11 3.6.

Reference of the Manufacturer :
- engine DK5ATE/L, emission control EEC93 : 0 281 001 212
- engine DK5ATE/Y, emission control US87 : 0 281 001 213

2 – INJECTION PUMP

		Remarks
Make	BOSCH	
Pump type	VP36	
Reference	VE R520 535 0 460 404 993	
Static timing at TDC	Check piston lift only : 0.52 mm	Not adjustable
Idling speed – without air conditioning With engine hot	Pre–determined rated value 750 rpm (+0 / –20 rpm)	 Adjustable (*)
Idling speed – with air conditioning With engine hot	 820 rpm	 Not adjustable
Maximum no load speed (rpm)	5150 rpm	Not adjustable
Max. speed under load (rpm)	4430 rpm	Not adjustable
Dynamic timing, at idle With engine hot	4°	Cartographic advance Not adjustable

(*) : the adjustment requires the use of the SOURIAU 26 A station or the ELIT test unit.

ATTENTION : By its design, the pump only requires timing by means of a checking rod (see the relevant operation).

3 – PRE AND POST HEATING CIRCUITS

3.1 – Pre and post–heating control unit

Make : BOSCH.

Reference of the Manufacturer : 0 281 003 004.

3.2 – Pre–heater plugs

Make	Reference of the Manufacturer	Voltage	Time required to reach 850 °C	Intensity after 20 seconds	Extremity dia.	Tightening torque
BOSCH	0250201033	11V	4 ± 1.5 s	9A	6 mm	2.5 m.daN
BERU	0100226186	11V	4 ± 1.5 s	9A	6 mm	2 m.daN

REPAIRS : BOSCH VP36 MSA11 FUEL INJECTION

1 – INJECTION PUMP

On the following parts, carrying any operation is prohibited :

- diesel fuel temperature sensor
- fuel flow actuator
- regulating slide valve position sensor (sliding block)
- advance electrovalve
- injection pump electrical harness

ATTENTION : By its design, the pump only requires timing by means of a checking rod (see the relevant operation).

2 – CHECKING–ADJUSTING

2.1 – Accelerator pedal sensor

The checks are carried out by means of ELIT test unit or SOURIAU 26 A station.

Check the voltage supplied by the sensor, in the "full throttle" position.

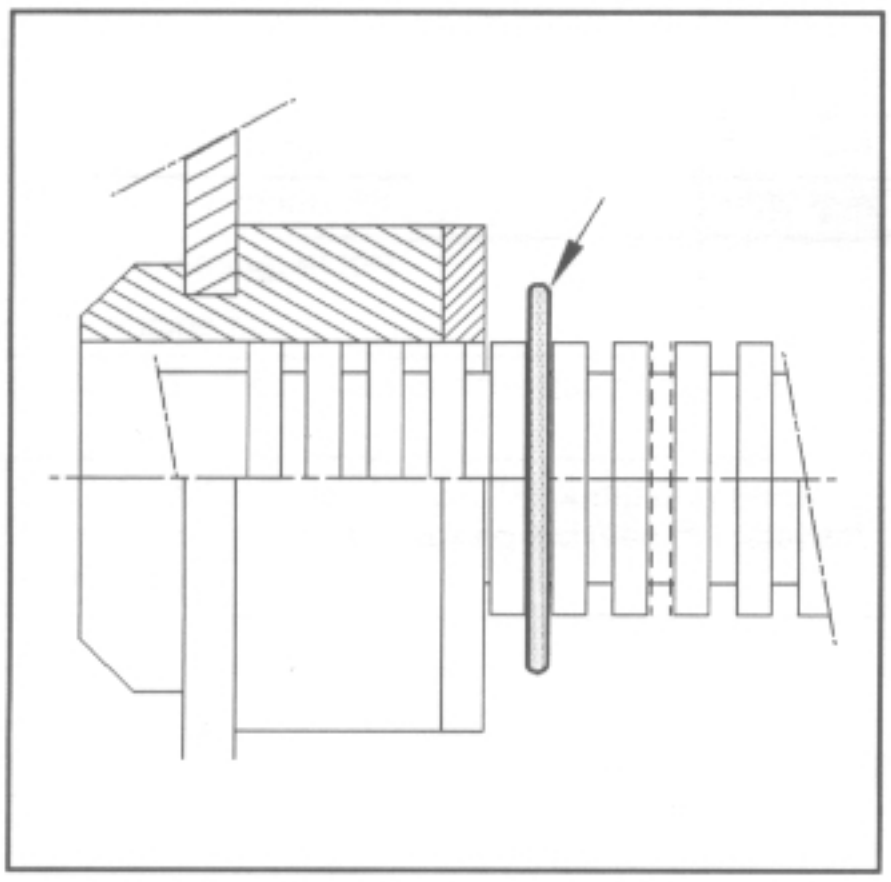


Fig : B1HP09WC

Move the pin in the notches of the accelerator cable to obtain "at full throttle," a voltage between 3.6 and 3.9 volts.

ATTENTION : In the case of an incorrect adjustment, full load would not be obtained.

2.2 – Idling speed

ATTENTION : The checks and adjustments must be carried out with engine hot, no fault memorised by the E.C.U., vehicle at rest, refrigeration de–activated.

2.2.1 – Checks

The idling speed is adjustable. It is determined by the injection E.C.U. according to the maps in memory and the information received.

Idling speed, engine hot : 750 rpm (+0 / –20 rpm).

2.2.2 – Adjustments

ATTENTION : This procedure must be used only upon recommendation of the manufacturer or in the case of serious disturbances in the operation of the engine : the engine stalls, noises and vibrations at idling (engine mounting assembly not responsible).

The adjustment requires the use of the SOURIAU 26 A station or the ELIT test unit.

Possible rotational speed increase by 63 rpm in 3 steps of 21 rpm.

Possible rotational speed decrease by 63 rpm in 3 steps of 21 rpm.

2.3 – Flow injected on starting

ATTENTION : The checks and adjustments must be carried out with engine hot ; if the water temperature is above 70 °C.

2.3.1 – Checks

Flow injected on starting : it is determined by the injection E.C.U. according to the maps in memory and the information received.

Flow injected on starting = 35 mg per stroke.

2.3.2 – Adjustment

ATTENTION : This procedure must be used only upon recommendation of the manufacturer or in the case of serious disturbances in the operation of the engine.

Possible increase of 4.8 mg per stroke in 16 steps of 0.3 mg per stroke.

Possible decrease of 4.8 mg per stroke in 16 steps of 0.3 mg per stroke.

The adjustment requires the use of the SOURIAU 26 A station or the ELIT test unit.

ATTENTION : Untimely corrections will have an effect on the noise and fumes on starting.

2.4 – Full load output

2.4.1 – Checks

Full load output : it is determined by the injection E.C.U. according to the maps in memory and the information received.

Pre–determined nominal value : 100.2 %.

2.4.2 – Adjustment

ATTENTION : This procedure must be used only upon recommendation of the manufacturer or in the case of serious disturbances in the operation of the engine : the engine lacks power, consumption too high, fumes from the exhaust.

Possible increase of 2.3 %, i.e., 3 increments of 0.781 %.

Possible decrease of 4.7 %, i.e., 6 increments of 0.781 %.

The adjustment requires the use of the SOURIAU 26 A station or the ELIT test unit.

The adjustment is for the operating phases :

- full load
- max. speed
- acceleration

ATTENTION : The performance and the maximum output of the engine are obtained with the nominal value ; untimely corrections will have an effect on fuel consumed and fumes emitted.

3 – INJECTOR CARRIER NUMBER3

In the case of a failure of the needle lift sensor, the complete injector carrier has to be changed.

The sensor–injector assembly is adjusted in the factory. Every modification of adjustment (for example pressure setting) will cause engine malfunction (wrong information on the beginning of injection).

ATTENTION : Every pressure setting of injector number 3 is prohibited.

IMPERATIVE : Make sure that injector number 3 is fitted correctly on to cylinder number 3 (injector with needle lift sensor).

FAULT FINDING : BOSCH VP36 MSA 11 FUEL INJECTION

1 – DIAGNOSTIC TOOLS

1.1 – ELIT test unit : 4125–T

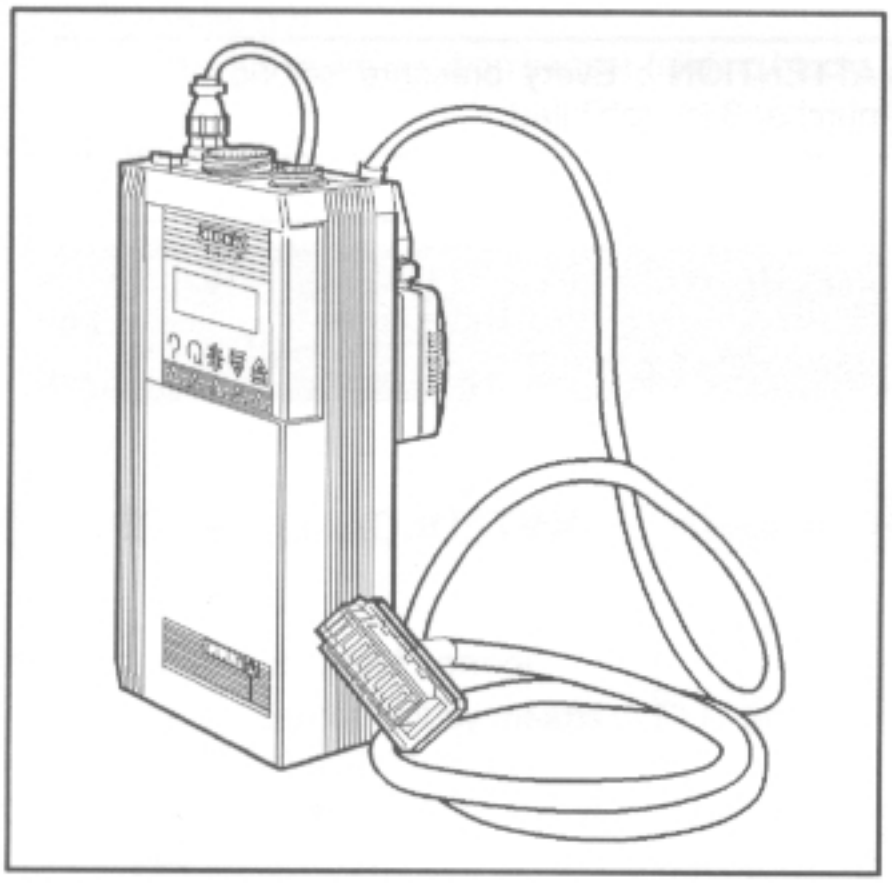


Fig : B3BP039C

The tool can be used for :
- reading the fault codes
- road testing
- operating the actuating components
- measuring the parameters

1.2 – Test connector box : 4109–T

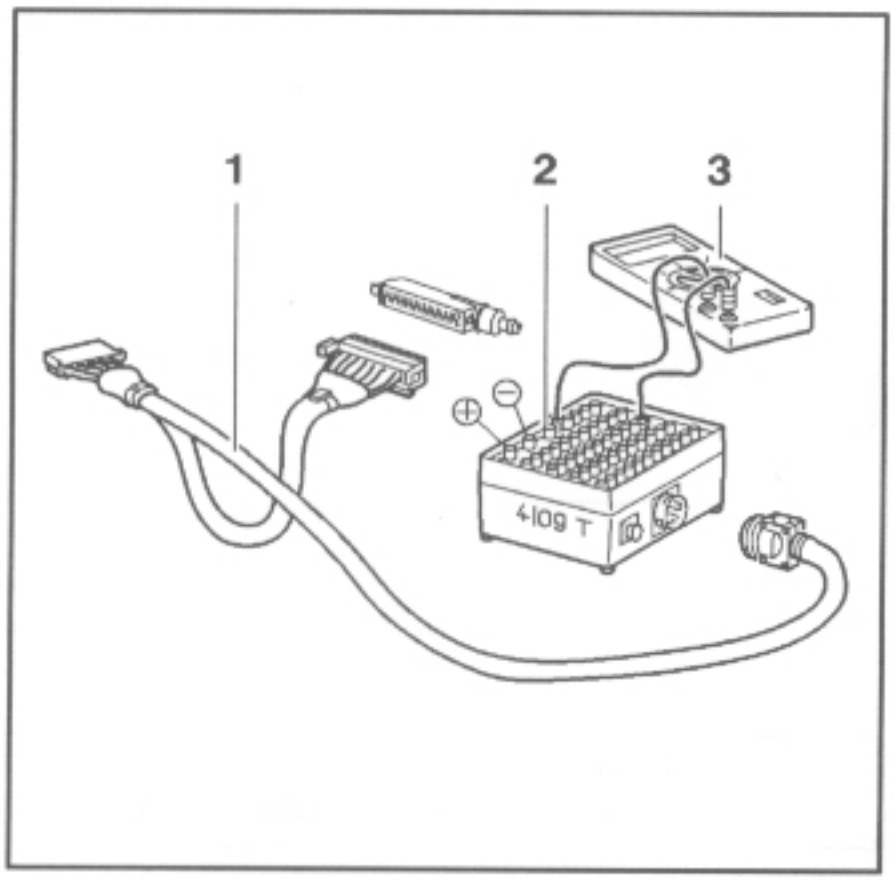


Fig : B1HP074C

(1) – 55–way wiring harness.

(2) – test connector box.

(3) – multimeter.

The box allows reading the voltages and resistances.

1.3 – 26 A diagnostic station

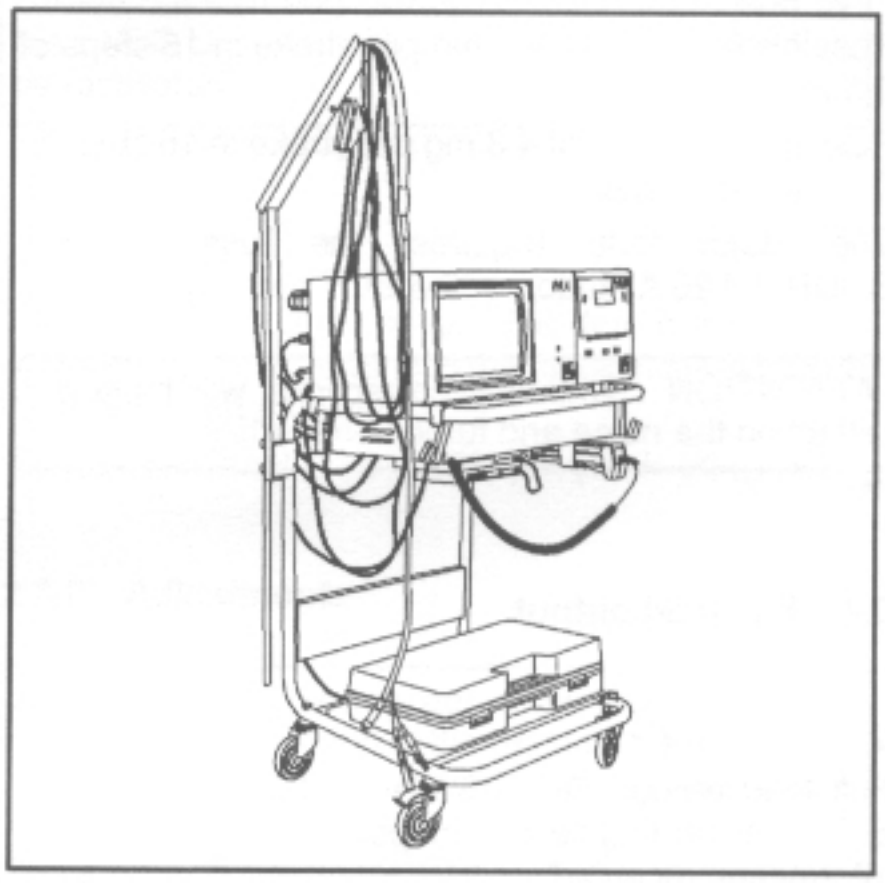


Fig : B3BP031C

The tool can be used for :
- reading the fault codes
- operating the actuating components
- checking the Diesel injection system
- checking the parameters

2 – FAULT FINDING CHART

2.1 – List of fault codes

NOTE : The autodiagnostic system warning lamp will light up if the following incident codes are displayed : 37,41,54,55,56,65.

13 – inlet air temperature sensor (907).

14 – engine coolant temperature sensor (909).

18 – power outlet short circuit.

21 – accelerator pedal sensor (773).

25 – brake switch (319).

26 – clutch switch (328).

27 – vehicle speed information (154).

33 – over pressure sensor (903).

36 – diesel fuel thermal sensor (922).

37 – stop electrovalve (429).

38 – cruise control.

41 – engine speed sensor (160).

43 – adjustment of advance (443).

51 – sliding block position (166).

52 – flow adjustment (445).

53 – electronic control unit (142) (battery voltage).

54 – electronic control unit (142).

57 – atmospheric pressure sensor (142).

58 – pre–heating (59).

65 – needle lift sensor (165).

2.2 – Fault code 13 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Air temperature sensor (907) (air inlet pipe)	Disconnected	13–52	 Grey	Diagnostic equipment : ohmmeter E.C.U. disconnected : measure the resistance of the sensor according to the temperature	Yes Fixed replacement value. Air temperature = 100 °C
	Connected			Diagnostic equipment : voltmeter Electronic control unit connected : ignition switched on, sensor disconnected Check the sensor supply voltage : U ≈ 5 V	

Graph for checking the sensor resistance according to the temperature.

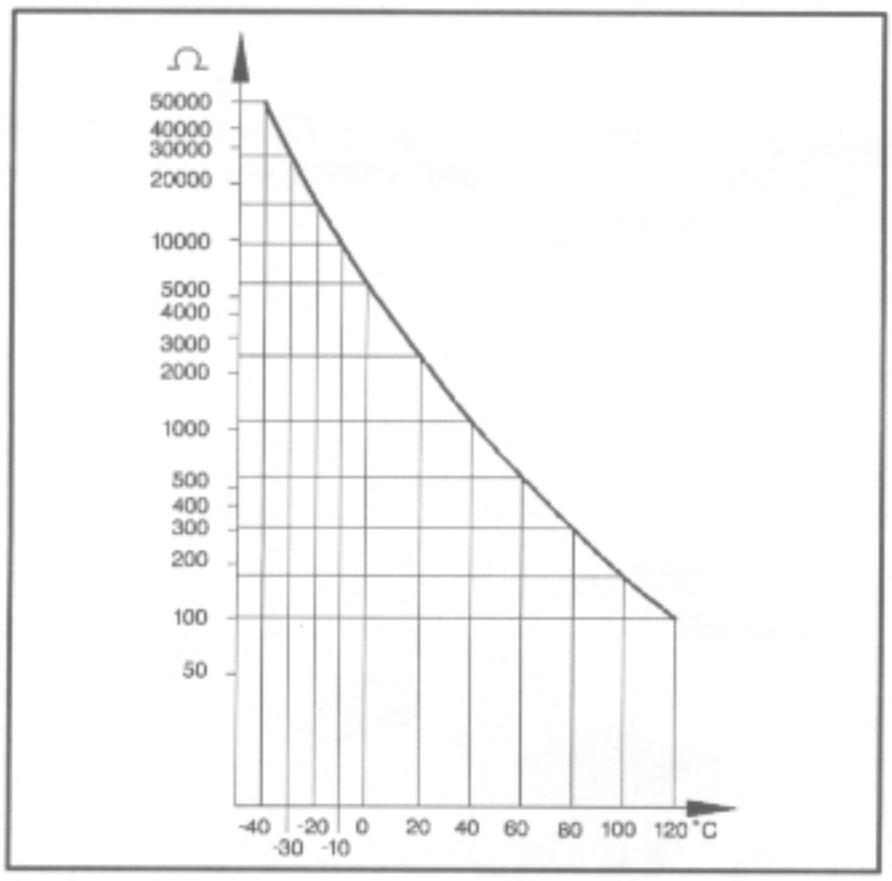


Fig : B1HP043C

2.3 – Fault code 14 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Engine coolant temperature sensor (909) (cylinderhead water outlet housing)	Disconnected	53–13	Green	Diagnostic equipment : ohmmeter E.C.U. disconnected : measure the resistance of the sensor according to the temperature	Yes
	Connected			Diagnostic equipment : voltmeter Electronic control unit connected : ignition switched on, sensor disconnected Check the sensor supply voltage : U ≈ 5 V	

Graph for checking the sensor resistance according to the temperature.

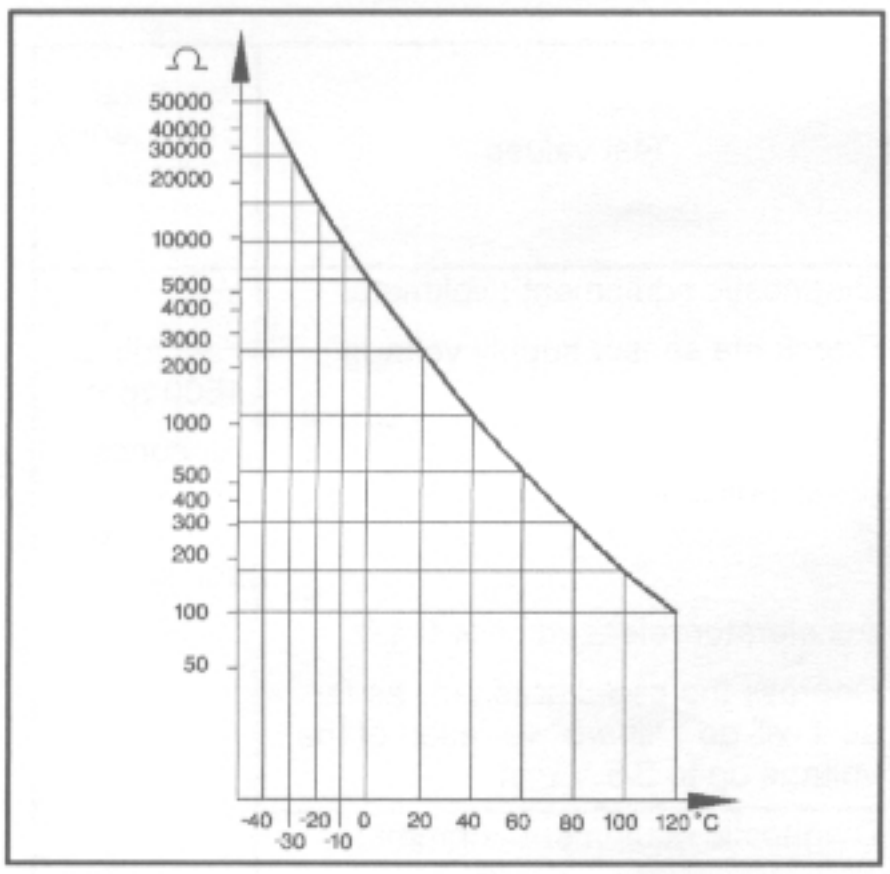


Fig : B1HP043C

2.4 – Fault code 18 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Power outlet short circuit (at +)	Disconnected			Diagnostic equipment : voltmeter	No
Advance electrovalve (443)		10–19		Check the voltage – ignition switched on : U ≈ 12 V ; ignition off : U ≈ 0 V	
EGR electrovalve (442)		6–19			
Pre–heating warning lamp		11–19			
Pre–heating control		8–19			
Air conditioning relay (822)		9–19			

2.5 – Fault code 21 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Accelerator pedal sensor (773) (under the bonnet)	Connected	33–13	1–4	Diagnostic equipment : voltmeter Check the sensor supply voltage : U ≈ 5 V	Yes Fast idling : 1500 rpm Air conditioning compressor cut–off
		13–37	4–2	Check the voltages as a function of the conditions laid down Accelerator released : U ≈ 0.4 V Depress the pedal gradually as far as it will go : "linear" variation of the voltage up to 3.5 V min.	
	Disconnected	33–13	1–4	Diagnostic equipment : ohmmeter R ≈ 1000 ohms	
		25–13	3–4	In the accelerated position : R ≈ 1000 ohms R ≈ ∞ : accelerator released	
		13–37	4–2	1000 ohms < R < 2000 ohms : accelerator released	

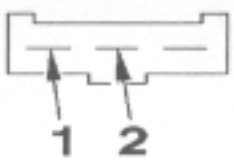
2.6 – Fault code 25 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Brake switch (319)	Disconnected	31 – terminal "_"		Diagnostic equipment : voltmeter Ignition switched on, check the voltage Brake pedal released : U ≈ 12 V Brake pedal depressed : U ≈ 0 V	No
		26 – terminal "_"		Brake pedal released : U ≈ 0 V Brake pedal depressed : U ≈ 12 V	

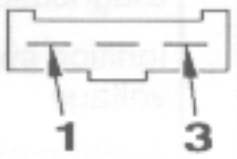
2.7 – Fault code 26 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Clutch switch (328)	Connected	28–18		Diagnostic equipment : voltmeter Ignition switched on U ≈ 0 V – "clutch engaged" position U ≈ battery U – "clutch released" position	Yes

2.8 – Fault code 27 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Vehicle speed sensor (154) (on the gearbox)	Connected		 White	Diagnostic equipment : voltmeter Make sure that the speedometer is correctly operating Ignition switched on – check the sensor supply voltage : U ≈ battery U	Yes
		29–18	 White	Diagnostic equipment : voltmeter Road wheels rotating – check the output voltage of the sensor : U ≈ 6 V	

2.9 – Fault code 33 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Over pressure sensor (903)	Connected	51–13	 Brown	Diagnostic equipment : voltmeter Ignition switched on – check the sensor supply voltage : U ≈ 5 V	Yes Replacement value : 1000 mbars
		54–13		The output voltage must be between 0.1V and 4V Engine stopped : U ≈ 1.5 V	
			 Brown	Diagnostic equipment : ohmmeter Sensor disconnected – check on the sensor : R ≈ 1360 ohms	

2.10 – Fault code 36 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Diesel fuel thermal sensor (922) (in the pump)	Connected	35–13		Diagnostic equipment : voltmeter 7–way KOSTAL connector disconnected Check the sensor supply voltage : U ≈ 5 V	Yes Replacement value : 45 °C
				Diagnostic equipment : ohmmeter 7–way KOSTAL connector (towards the injection pump) Check : the resistance R between the ways 4 and 7 of the 7–way connector (see table below)	

T °C	R ohms
10	3780
20	2500
30	1690
40	1170
50	820
60	590
70	430
80	320
90	240
100	185

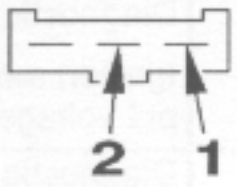
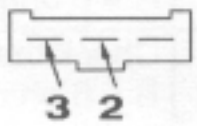
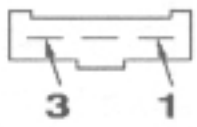
2.11 – Fault code 37 (serious fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Stop electrovalve (429)	Connected	18–3		Diagnostic equipment : voltmeter Check the item supply voltage : U ≈ battery U	Yes Engine stopped by the fuel delivery cut off
	Disconnected			Diagnostic equipment : ohmmeter Check the resistance of the electrovalve : R ≈ 7.5 ohms	

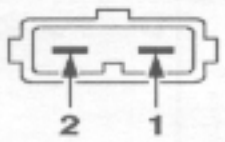
2.12 – Fault code 38 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Cruise control	Disconnected	30–45–48		Diagnostic equipment : ohmmeter Check the continuity and insulation of the wires between cruise control (214) and E.C.U. (142)	Yes Cruise control stopped

2.13 – Fault code 41 (serious fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Engine speed sensor (160)	Disconnected	13–47	 Brown	Diagnostic equipment : ohmmeter Check the resistance value : R = 360 + 45 ohms	Yes Use of the signal from the needle lift sensor
		19–13		Coil insulated from the earth R ≈ ∞	
		19–47		Air gap value 0.8 to 1.6 mm The air gap is not adjustable	

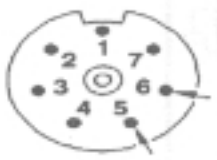
2.14 – Fault code 43 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Adjustment of advance (443) (on the pump)	Connected	10 – terminal "–"		Diagnostic equipment : voltmeter Ignition switched on, check the voltage : U ≈ 12 V	Yes Reduction of the fuel delivery and performance
	Disconnected	10–16 ; 10–17	 Black	Diagnostic equipment : ohmmeter Check the resistance value : R ≈ 15 ohms	Exhaust gas recycling stopped

2.15 – Fault code 51 (serious fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Sliding block position (166) (in the pump)	Connected	14 – terminal "–"		Diagnostic equipment : voltmeter Ignition switched on, check the output voltage of the item : U ≈ 2.5 V	No Engine stopped
	Disconnected	39–14		Diagnostic equipment : ohmmeter Check the resistance R value : R ≈ 6 ohms	
		21–14		Check the resistance R value : R ≈ 6 ohms	
		21–39		Check the resistance R value : R ≈ 12 ohms	

2.16 – Fault code 52 (serious fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Flow adjustment (445) (in the pump)	Disconnected	1 – terminal "–" 2 – terminal "–" ; 16 – terminal "–"		Diagnostic equipment : voltmeter Ignition switched on, check the item supply voltage : U ≈ 12 V	No Engine cut–off above 1200 rpm
	Disconnected	1–16 ; 2–16		Diagnostic equipment : ohmmeter Check the resistance of the actuator : R ≈ 1 ohms	

2.17 – Fault code 53 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
E.C.U. (battery voltage) (142)	Connected	16–18 ; 17–18 16–19 ; 17–19		Diagnostic equipment : voltmeter Ignition switched on, check the supply voltage of the E.C.U. : U ≈ 12 V	Yes Replacement value : U ≈ 8.3 V

2.18 – Fault code 54 (serious fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
E.C.U. (142)				Other fault codes present ? repair the faulty functions The engine runs : check the E.C.U. supply and earth. Otherwise : E.C.U. not operating	Yes Air con. switch–off. Cruise control stopped

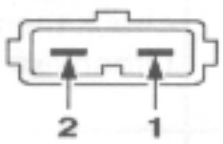
2.19 – Fault code 57 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Atmospheric pressure sensor (142) (incorporated in the E.C.U.)				Using SOURIAU 26A station or ELIT test unit, check the value of the atmospheric pressure – measure parameters Engine stopped, ignition on, pressure reading < 650 mbars or > 1075 mbars = sensor not operating = replacement of the ECU	Yes Replacement value : 1000 mbars

2.20 – Fault code 58 (minor fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Pre–heating (59)	Connected	8–18		Diagnostic equipment : voltmeter Check the control voltage of the pre–heater control unit : U ≈ battery U The plugs are supplied by twos ; the E.C.U. monitors the difference in current between the 2 units. The test is carried out if U > 9 volts	No

2.21 – Fault code 65 (serious fault)

Location of components	E.C.U. connector	Test connector box terminals	Component connections	Test values	Emergency mode
Needle lift sensor (165) on cylinder 3	Connected	5–12	 White	Diagnostic equipment : voltmeter Ignition switched on, check the sensor supply voltage : U ≈ 3.5 V	Yes
	Disconnected			Diagnostic equipment : ohmmeter Check the resistance value : R = 100 + 10 ohms at 20 °C	