

NUOVA BRAVO 1.4 16v INTRODUCTION - PETROL FUEL INJECTION SYSTEM

SPECIFICATIONS

GENERAL SPECIFICATIONS

The Bosch Motronic ME7.3H4 system (microhybrid technology control unit) with a motorised throttle is an ignition system which incorporates timed, sequential electronic injection.

The fuel supply system is the returnless type.

The control unit electronically manages the air flow rate at the rotation speed set by the electronic throttle, regulates the fuel injection so that the (air/fuel) ratio is always within optimum values, calculating the moment of ignition, in order to allow the smooth operation of the engine when the environmental parameters and loads applied vary.

The ignition system is solid-state with a coil for each cylinder. The power modules are housed inside the control unit.

The self-adaptive engine management system can recognise the changes that take place in the engine. It compensates for them using the self-adaptive functions that correct the fuel mixture and air flow plans mapped in the control unit.

There are two adaptive functions, in particular, for the fuel mixture plan, depending on whether the evaporation control solenoid valve is open or closed, plus an idle adaptation plan: the latter is capable of compensating effectively for any air seepage.

The continuous self-adaptation of the fuel mixture plan makes it possible to ensure the correct amount of fuel in all temperature and altitude conditions.

As a result of this, after every intervention it is necessary to drive the vehicle for at least 15 minutes in various operating conditions in order for any changes that have taken place in the system to be memorised in the control unit and to end the adaptation.

The main system functions are as follows:

- injection time adjustment;
- ignition advance adjustment;
- cold starting check;
- enrichment during acceleration check;
- fuel cut-off during over-run;
- idle speed management (also dependent on battery voltage);
- restriction of the maximum engine speed;
- combustion control with Lambda sensor;
- petrol vapour recovery;
- fan control;
- climate control system engagement/disengagement;
- self-diagnostics.

There is also a special function that manages the connection with the body computer via a two-way signal for the CAN line. This includes:

- engine temperature for instrument panel (output);
- battery voltage (output);
- engine rpm (output) for instrument panel;
- engine overheating warning light for instrument panel (output);
- engine oil pressure warning light for panel (output);
- vehicle speed (input) + mileometer (input);
- Fiat code anti-theft device (input/output);
- key status;
- consumption signal (output) for trip computer.
- fuel level signal (input)

INJECTION SYSTEM

The essential conditions to be met by the air-fuel mixture for the efficient operation of engines with controlled ignition systems are mainly as follows:

- the metering (air/fuel ratio) must be kept as close as possible to the stoichiometric value to ensure that combustion is as fast as possible in order to avoid fuel wastage
- the mixture, consisting of petrol vapours, must be homogeneous, that is distributed throughout the air as finely and uniformly as possible.

The injection/ignition system uses an indirect measuring system known as "SPEED DENSITY-LAMBDA".

In other words, angular rotation speed, intake air density and control of mixture strength (feedback control).

In practice, the system uses the ENGINE SPEED data (rpm) and the 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 every engine cycle, also depends on the unit capacity and the volumetric efficiency as well as on the density of the intake air.

The density of the air refers to the air drawn in by the engine and is calculated according to the absolute pressure and temperature, both measured in the intake manifold.

Volumetric efficiency is the parameter that measures cylinder filling efficiency, measured on the basis of experiments conducted on the engine for the entire operating range and then stored in the electronic control unit memory.

Having established the quantity of intake air, the system must provide the amount of fuel dictated by the desired mixture strength.

The end of injection impulse or delivery timing is stored in a map in the control unit memory and varies according to the engine speed and the pressure in the intake manifold.

In practice, it involves processing carried out by the electronic control unit to manage the timed, sequential opening of the four injectors, one per cylinder, for the length of time strictly necessary to make the air/petrol mixture as close as possible to the stoichiometric ratio.

The fuel is injected directly into the manifold, near the inlet valves, at a pressure of around 3.5 bar.

The speed (rpm) and the density of the air (pressure and temperature) are used for measuring the quantity of intake air which, when established, is used for metering the amount of fuel needed for the desired mixture strength.

The other sensors in the system (coolant temperature, throttle valve position, battery voltage, etc.) allow the electronic control unit to correct the basic strategy for all the engine operating conditions.

It is vital for the air/fuel ratio to be close to the stoichiometric value for the correct and prolonged operation of the catalytic converter and for reducing pollutant emissions.

IGNITION SYSTEM

The ignition circuit is solid-state inductive discharge type, i.e. without an HT distributor, with power modules located inside the injection-ignition electronic control unit.

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

After the starting stage, the electronic unit manages the basic advance taken from special maps in accordance with:

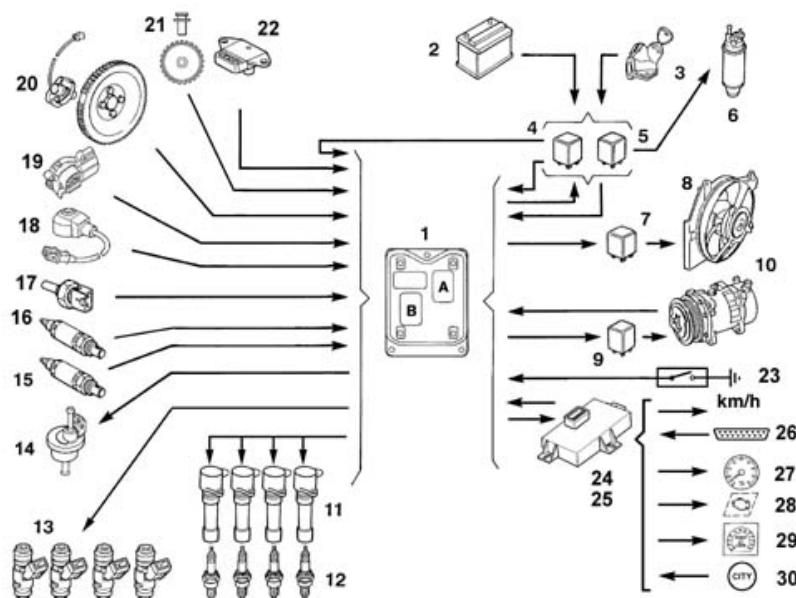
- engine rpm
- absolute pressure value (mmHg) measured in the intake manifold.

This advance setting is corrected according to the engine coolant temperature, intake air, detonation and throttle position. The spark plugs for the cylinders are connected directly to the coil secondary winding terminals (one per spark plug).

OPERATION

DIAGRAM SHOWING INFORMATION ENTERING/LEAVING THE CONTROL UNIT

The information entering/leaving the control unit is illustrated in the diagram below.



- 1, Engine management control unit
- 2, Battery
- 3, Ignition switch
- 4, Engine control system relay
- 5, Electric fuel pump relay
- 6, Fuel pump
- 7, Radiator fan relay(s)
- 8, Radiator fan
- 9, Compressor engagement relay
- 10, Compressor
- 11, Ignition coils
- 12, Spark plugs
- 13, Injectors
- 14, Charcoal filter scavenging solenoid
- 15, Lambda sensor (pre-catalyser)
- 16, Lambda sensor (post-catalyser)
- 17, Coolant temperature sensor
- 18, Detonation sensor
- 19, Throttle control actuator and throttle position sensor
- 20, Rpm and TDC sensor
- 21, Injection timing sensor
- 22, Air temperature/absolute pressure sensor
- 23, Oil pressure switch
- 24, Body computer:
- 25, CODE control unit (via CAN)
- 26, Diagnostic equipment connection (via CAN)
- 27, Rev counter (via CAN)
- 28, System failure lamp (via CAN)
- 29, City speed sensor
- 30, City speed sensor

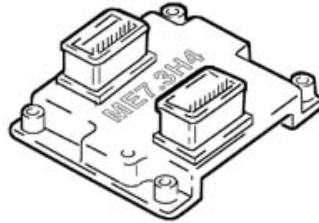
29, Speedometer (via CAN)

30, City button for power steering (via CAN)

SELF-LEARNING

The control unit implements the self-learning logic under the following conditions: *- removing/refitting or replacing the injection control unit
*- removing/refitting or replacing the throttle casing

The values stored by the control unit are retained when the battery is disconnected.



SYSTEM SELF-ADJUSTMENT

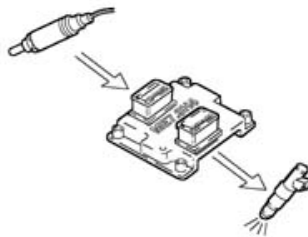
The control unit is equipped with a self-adjustment function that is designed to recognize the changes that take place in the engine due to the processes of bedding in and ageing of both the components and the engine itself in time.

These changes are memorised in the form of modifications to the basic map and are designed to adapt the operation of the system to the gradual alterations in the engine and the components, compared with when they were new.

This self-adjustment function also makes it possible to compensate for the inevitable differences in any replacement components (owing to production tolerances).

On the basis of exhaust gas analysis, the control unit modifies the basic map in relation to engine specifications when new.

The self-adjustment parameters are not deleted if the battery is disconnected.



AUTODIAGNOSIS AND RECOVERY

The control unit auto-diagnostic system checks that the system is working properly and signals any irregularities by means of an MIL warning light in the instrument panel with a standardised icon and colour, as laid down by European regulations.

This warning light indicates engine management faults and also faults detected by EOBD diagnostic strategies.

The MIL warning light operating logic is as follows.

The warning light comes on with the ignition on and remains on until the engine is started up; the control unit autodiagnostic system checks the signals coming from the sensors and compares them with the permitted data limits.

Fault indication during start up:

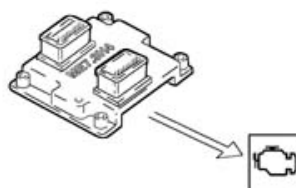
- the failure of the warning light to go out when the engine has been started indicates that there is an error memorized in the control unit.

Fault indication during operation:

- the warning light comes on in flashing mode to indicate possible catalytic converter damage due to misfiring.
- the warning light comes on in constant mode to indicate the presence of engine management or EOBD diagnostic errors.

The control unit defines the recovery settings on each specific occasion according to which components are faulty.

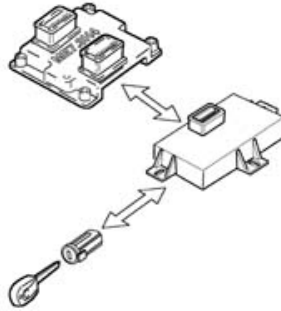
The recovery parameters are managed by non-faulty components.



SYSTEM CONTROLS AND MANAGEMENT

FIAT CODE RECOGNITION

The moment the control unit receives the MAR signal, it converses with the body computer to obtain the go-ahead for starting. The communication takes place via the two-way CAN line that connects the two control units.



COLD STARTING CHECK

The following occurs in cold starting conditions:

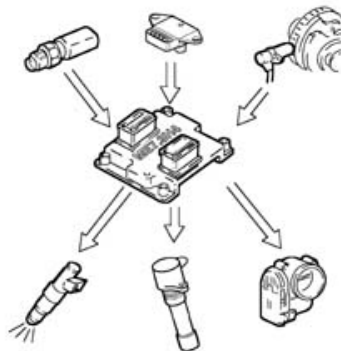
- a natural weakening of the mixture (which causes poor turbulence of the fuel particles at low temperatures)
- reduced evaporation of the fuel
- fuel condensation on inner walls of the intake manifold
- higher lubrication oil viscosity.

The electronic control unit detects this condition and corrects the injection time on the basis of:

- coolant temperature
- intake air temperature
- battery voltage
- engine rpm.

The ignition advance is determined solely on the basis of rpm and coolant temperature.

The rotation speed decreases proportionally as the engine temperature increases, until the nominal value is reached when the engine has warmed up.



COMBUSTION - LAMBDA SENSOR CHECK

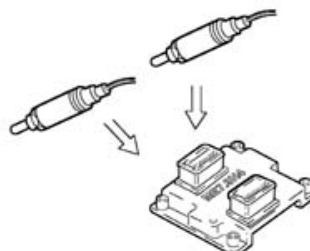
In EOBD systems, the Lambda sensors are all the same type and are located upstream of the catalytic conversion system and downstream of the converter.

The pre-converter sensor controls 1st loop mixture strength (upstream sensor closed loop).

The post-converter sensor is used for the fault diagnosis of the catalyser and for modulating the 1st loop control parameters.

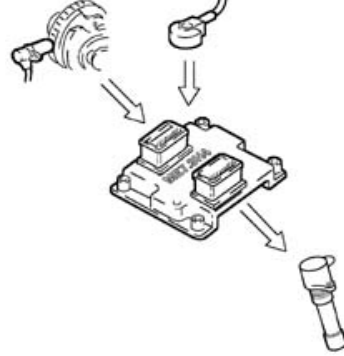
The second loop is therefore adaptive to make up for production discrepancies and slight drift that pre-catalyser sensor responses could experience due to ageing and contamination.

This control is known as 2nd loop control (post-catalyser sensor closed loop).



DETONATION CONTROL

The control unit detects the presence of detonation (engine knock) by processing the signal coming from the relevant sensor. The control unit continuously compares the signals coming from the sensor with a threshold which is, in turn, continually updated to take into account background noise and engine ageing. The control unit can therefore detect the presence of detonation (or the onset of detonation) in each individual cylinder and reduces the ignition advance in the cylinder involved (in steps of 3° up to a maximum of 6°) until the phenomenon disappears. Later on, the advance is gradually restored to the basic value (in steps of 0.8°). In acceleration conditions, a higher threshold is used in order to take into account the increased noise of the engine under such circumstances. The detonation control logic also has a self-adjustment function which memorises the reductions in the advance that are continuously repeated in order to adapt the map to the different conditions that may affect the engine.



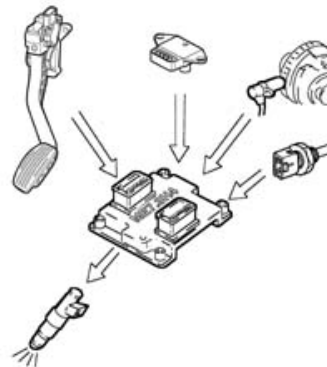
ENRICHMENT DURING ACCELERATION CHECK

During this stage, the control unit increases the amount of fuel supplied to the engine (to produce the maximum torque), according to the signals coming from the following components:

- throttle potentiometer
- rpm and TDC sensor

The basic injection time is multiplied by a coefficient depending on the temperature of the engine coolant, the opening speed of the accelerator throttle and the increase in pressure in the intake manifold.

If 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 be able to adjust the mixture strength as quickly as possible; the subsequent injections are already increased on the basis of the coefficients mentioned previously.



FUEL SUPPLY - ELECTRIC FUEL PUMP CHECK

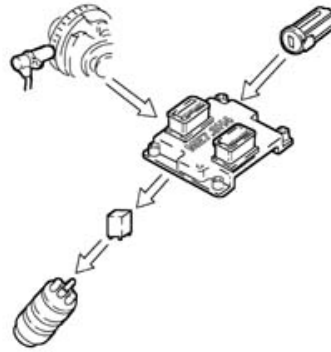
The control unit supplies the pump:

- with the key turned to MAR for 0.8 secs.
- with the key at AVV and the engine speed > 22.8 rpm

The control unit cuts off fuel supply to pump:

- with the ignition key in the STOP position
- with the engine speed < 22.8 rpm.

The returnless fuel supply system ensures a constant petrol pressure of 3.5 bar.

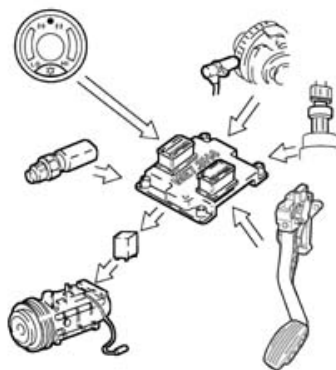


CONNECTION WITH CLIMATE CONTROL SYSTEM

When there is a request for power due to the compressor having been switched on, the control unit operates the motorised throttle to increase the air flow rate.

The control unit temporarily cuts off the supply to the compressor:

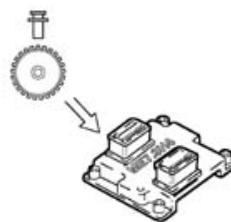
- during starting
- switching it off beyond 6200 rpm
- switching it off when the engine temperature is $> 112^{\circ}\text{C}$.
- during take off with the accelerator fully depressed.



RECOGNITION OF CYLINDER POSITION

The engine timing sensor, together with the engine rpm and top dead centre (TDC) signal, allows the control unit to recognise cylinder sequence when implementing timed injection.

This signal is produced by a Hall effect sensor, positioned on the cylinder head near the phonic wheel on the inlet camshaft.



FUEL CUT-OFF DURING OVER-RUN

When the accelerator pedal is released and beyond a pre-set engine speed level, the control unit: *- cuts off the supply to the injectors *- reactivates the supply to the injectors at 1300 - 1500 rpm

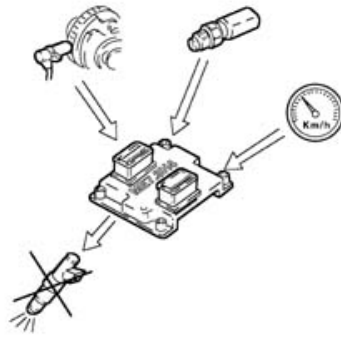
In the absence of fuel, the number of revs decreases at a rate determined by the vehicle driving conditions.

Before the idle speed is reached, the progress of the engine speed decrease is checked.

If the rpm decrease exceeds a given rate, the fuel supply is partly restored so that the speed drops smoothly down to the idle speed.

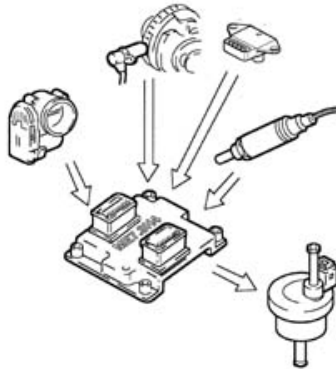
The levels for restoring the supply and for cutting off the fuel vary according to:

- engine coolant temperature
- vehicle speed
- engine rpm.



FUEL VAPOUR RECOVERY

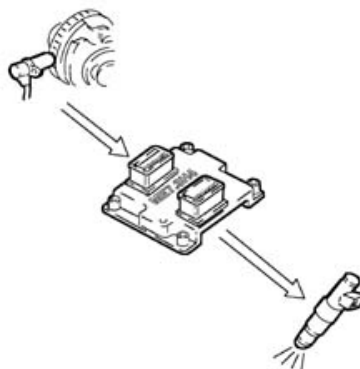
Fuel vapours (pollutants) collected in the activated carbon filter (canister) are directed to the intake ducts to be burnt. This is done by a solenoid controlled by the control unit only when the engine operating conditions allow. The control unit compensates for this additional amount of fuel with a reduction in the delivery to the injectors.



MAXIMUM RPM CHECK

According to the rpm level reached by the engine, the control unit:

- cuts off the supply to the injectors beyond 7000 rpm;
- allows injector control to resume below 7000 rpm.

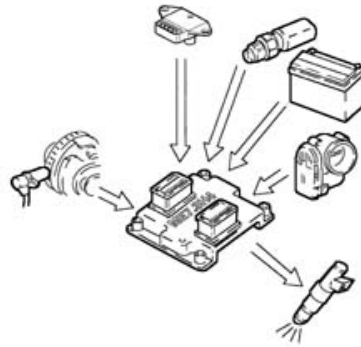


INJECTION TIME ADJUSTMENT

The control unit calculates the injector opening times and controls them with extreme precision and speed, according to the:

- engine load (number of revs and air flow rate)
- battery voltage
- engine coolant temperature.

The injection is the timed, sequential type for each cylinder and takes place corresponding to the optimum "start of injection" point, with the "end of injection" point remaining fixed.

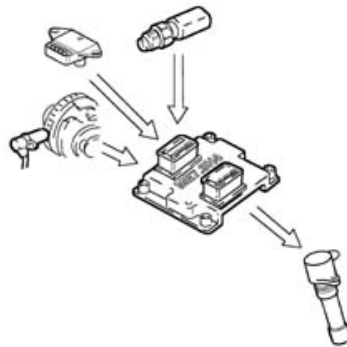


IGNITION ADVANCE ADJUSTMENT

Thanks to a map stored in its memory, the control unit is capable of calculating the ignition advance, according to:

- the engine load (minimum, partial, full, according to the number of revs and the air flow rate)
- the intake air temperature
- the engine coolant temperature.

The ignition can be selectively delayed at the cylinder with the greatest demand, which is determined by a combination of values recorded by the rpm and timing sensors.

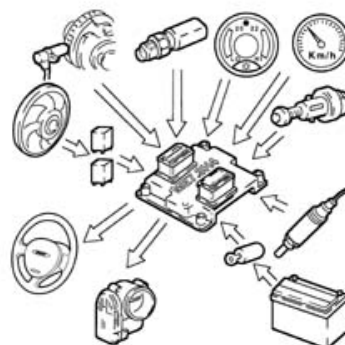


IDLE SPEED CHECK

The control unit detects idling status when the accelerator pedal is released.

To control the idle speed, depending on the consumers switched on and the brake/clutch pedal signals, the control unit controls the position of the motorised throttle.

The idle speed when warm is 700 ± 50 rpm.



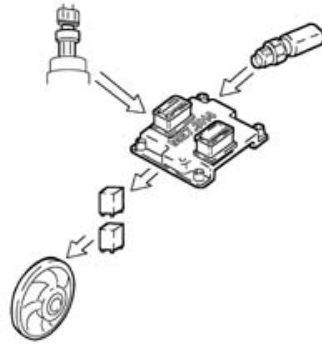
RADIATOR COOLING FAN CHECK

Depending on the temperature of the coolant, the control unit controls the engagement of the fan:

- 1st speed activation temperature 97°C
- 2nd speed activation temperature 101°C

There is then a further check (linear sensor signal) which switches on the fan at the 1st or 2nd speed depending on the pressure of the refrigerant gas when the air conditioning system is switched on.

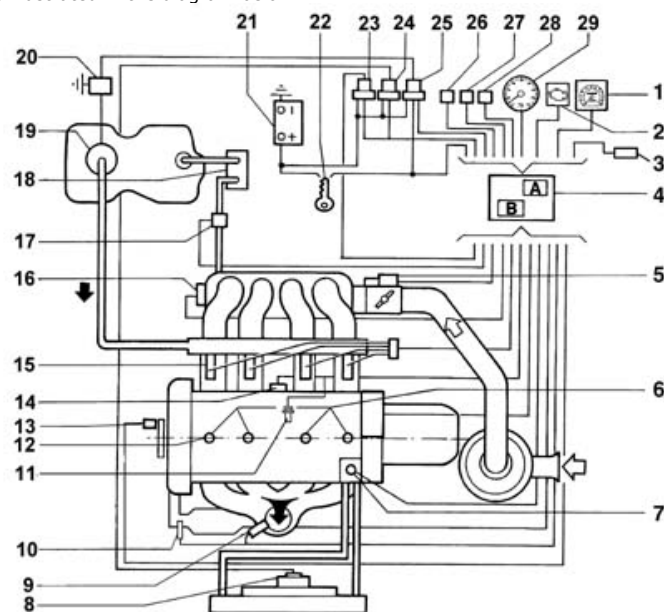
When no coolant temperature signal is present, the control unit implements the recovery function by activating the fan at the 2nd speed until the error disappears.



COMPOSITION

VIEW OF ASSEMBLY

The main system components are illustrated in the diagram below.



- 1, Speedometer (via CAN)
- 2, System failure lamp (via CAN)
- 3, CITY button (via CAN)
- 4, Engine management control unit
- 5, Throttle control actuator and throttle position sensor
- 6, Ignition coils
- 7, Coolant temperature sensor
- 8, Radiator fan
- 9, Lambda sensor (upstream)
- 10, Lambda sensor (downstream)
- 11, Injection timing sensor
- 12, Spark plugs
- 13, Rpm and TDC sensor
- 14, Detonation sensor
- 15, Injectors
- 16, Air temperature/absolute pressure sensor
- 17, Charcoal filter scavenging solenoid
- 18, Activated carbon filter
- 19, Drip tray (including electric pump, pressure regulator, filter, level sensor)
- 20, Inertia switch
- 21, Battery
- 22, Ignition switch
- 23, Engine control system relay
- 24, Electric fuel pump relay
- 25, Radiator fan relay(s)
- 26, Climate control connection
- 27, CODE connection (via CAN)
- 28, Diagnostic equipment connection (via CAN)
- 29, Rev counter (via CAN)

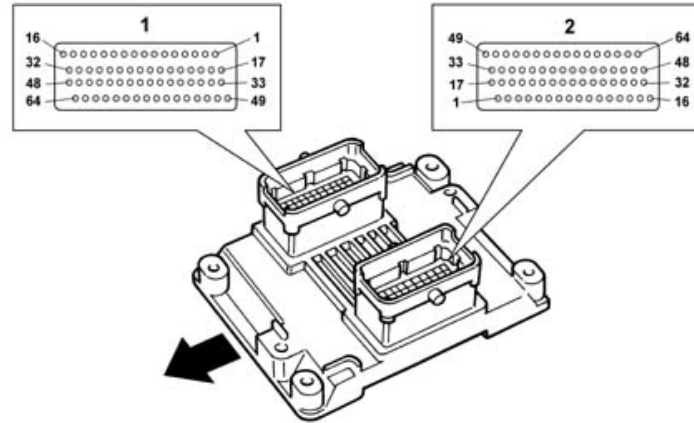
ME 7.3 H4 INJECTION/IGNITION CONTROL UNIT

SPECIFICATIONS

The control unit is fitted in the engine compartment above the throttle casing and is capable of withstanding high temperatures. The control unit memory is the flash EPROM type, i.e. it can be reprogrammed from the outside without affecting the hardware. Replacement of the injection control unit or the throttle body requires the self-learning procedure to be run.

CONTROL UNIT PIN OUT

The diagram below illustrates



ENGINE SIDE connector (1)

- 1, Not connected
- 2, Cylinder 3 injector control
- 3, Not connected
- 4, Not connected
- 5, Not connected
- 6, Pressure sensor
- 7, + 5 V Sensors
- 8, Pre-catalyser Lambda sensor signal (+)
- 9, Engine timing sensor earth
- 10, Engine rpm sensor
- 11, Throttle valve actuator earth
- 12, Not connected
- 13, Not connected
- 14, Not connected
- 15, Cylinder 4 coil control
- 16, Cylinder 2 coil control
- 17, Post-catalyser Lambda sensor signal (+)
- 18, Cylinder 2 injector control
- 19, Not connected
- 20, Not connected
- 21, Detonation sensor signal
- 22, Not connected
- 23, Throttle 1 potentiometer signal input
- 24, Not connected
- 25, Pre-catalyser Lambda sensor earth
- 26, Air pressure and temperature sensor earth
- 27, Not connected
- 28, Throttle valve actuator (positive)
- 29, Not connected
- 30, Not connected
- 31, Cylinder 3 coil control
- 32, Cylinder 1 coil control
- 33, Charcoal filter scavenging solenoid
- 34, Cylinder 4 injector control
- 35, Not connected
- 36, Engine timing sensor signal
- 37, Detonation sensor earth
- 38, Engine temperature sensor signal
- 39, Throttle 2 potentiometer signal input
- 40, Not connected
- 41, Post-catalyser Lambda sensor earth
- 42, Engine rpm sensor
- 43, Throttle valve actuator earth
- 44, Not connected
- 45, Not connected
- 46, Not connected
- 47, Not connected
- 48, Not connected
- 49, Pre-catalyser Lambda sensor heater
- 50, Not connected
- 51, Cylinder 1 injector control

52, Not connected
 53, Not connected
 54, Air conditioner pressure sensor
 55, Air temperature sensor
 56, Throttle 1 and 2 potentiometers power supply (+5V)
 57, Post-catalyser Lambda sensor signal
 58, Throttle 1 and 2 potentiometers earth
 59, Not connected
 60, Throttle valve actuator positive
 61, Not connected
 62, Not connected
 63, Not connected
 64, Not connected
 VEHICLE SIDE connector (2)
 1, Not connected
 2, K line
 3, Not connected
 4, Accelerator pedal 2 potentiometer power supply (+5V)
 5, Accelerator pedal 2 potentiometer earth
 6, Not connected
 7, Clutch switch signal
 8, Cruise Control set-
 9, Cruise Control set+
 10, Not connected
 11, CAN (HIGH)
 12, Not connected
 13, Not connected
 14, Fan 1st speed control relay
 15, Not connected
 16, Not connected
 17, Supply from main relay
 18, Direct supply (+30)
 19, Main control relay
 20, Not connected
 21, Accelerator pedal 1 potentiometer power supply (+5V)
 22, Accelerator pedal 1 potentiometer earth
 23, Not connected
 24, Not connected
 25, Brake pedal switch signal
 26, Not connected
 27, Not connected
 28, Not connected
 29, Not connected
 30, Fan 2nd speed control relay
 31, Failure warning light "on" signal
 32, Not connected
 33, Main relay power supply
 34, Not connected
 35, Not connected
 36, Not connected
 37, Accelerator 2 potentiometer signal input
 38, Not connected
 39, Not connected
 40, Air conditioning engagement request
 41, Cruise Control resume
 42, Oil pressure signal
 43, CAN (LOW)
 44, Not connected
 45, Not connected
 46, Air conditioning compressor engagement control relay
 47, Not connected
 48, Not connected
 49, Direct power supply from main relay
 50, Not connected
 51, Signal from ignition switch (+15/54)
 52, Not connected
 53, Air conditioner pressure sensor power supply
 54, Accelerator 1 potentiometer signal input
 55, Not connected
 56, Not connected
 57, Second brake switch
 58, Cruise Control on-off
 59, Not connected
 60, Not connected
 61, Not connected
 62, Petrol pump control relay
 63, Not connected
 64, Not connected

INJECTORS

SPECIFICATIONS

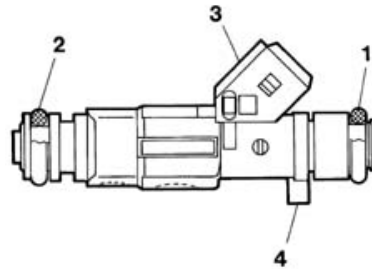
The twin jet injectors (with the spray at an angle in relation to the injector axis) are specially designed for engines with 4 valves per cylinder and make it possible to direct the jets towards the two inlet valves.

The injectors are top-feed, i.e. fuel is fed in through the top of the casing, which also houses the electrical winding connected to the terminals of connector (3).

When the current passes through the winding, the magnetic field created attracts the plunger, opening the injector and causing the flow of fuel.

There are two seals, one on the fuel manifold side (1) and one on the intake manifold side (2).

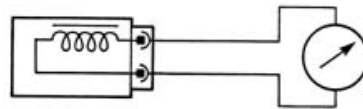
A notch (4) determines the angular position of the injector and the correct direction of the jets in relation to the inlet valves.



ELECTRICAL PROPERTIES

The injector resistance may be measured by detaching the connector and connecting an ohmmeter, as shown in the diagram.

Resistance value: $14.5 \pm 5\%$ ohm.



OPERATION

The jets of fuel leave the injector at a differential pressure of 3.5 bar, atomising instantly to form two propagation cones.

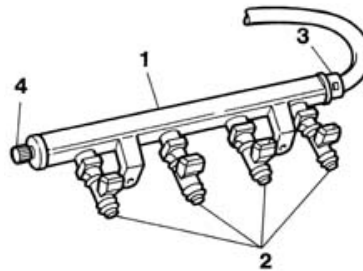
The injector operating logic is timed and sequential. In other words, the four injectors are operated depending on the engine cylinder inlet sequence, whilst the delivery for each cylinder can begin during the expansion stage until the inlet stroke has already started.

FUEL MANIFOLD

The fuel manifold, which distributes the fuel to the injectors, incorporates the seats for the injectors and the air bleed valve.

The fuel intake is achieved through a quick coupling.

Since the system is returnless, there is no fuel recirculation pipe.



- 1, Fuel manifold
- 2, Injector
- 3, Fuel supply connector
- 4, Bleed valve

ENGINE COOLANT TEMPERATURE SENSOR

SPECIFICATIONS

This is fitted to the thermostat cup and detects coolant temperature by means of an NTC thermistor with negative resistance coefficient.

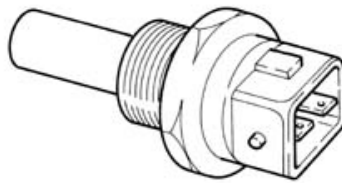
The variation in the resistance depending on the temperature is illustrated in the table below.

°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
100	176

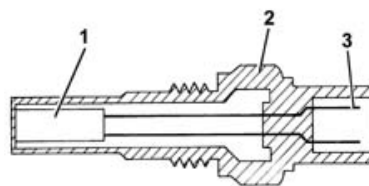
OPERATION

The reference voltage is 5V for the NTC element for the injection system. Because the control unit input circuit is designed as a voltage divider, this voltage is distributed between a resistance present in the control unit and the sensor NTC resistance. The control unit can therefore assess sensor resistance changes via changes in the voltage and thus obtain temperature information.



COMPOSITION

The composition of the sensor is illustrated in the diagram below



- 1, NTC resistance
- 2, Sensor casing
- 3, Electrical connector

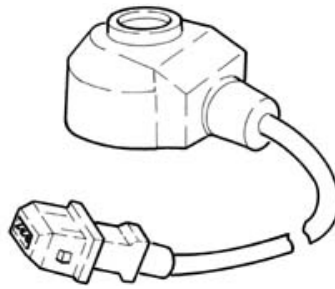
KNOCK SENSOR

SPECIFICATIONS

The piezoresistive knock sensor is fitted on the crankcase and measures the intensity of vibrations caused by knock in the combustion chambers.

This phenomenon has mechanical repercussions on a piezoelectric crystal that sends a signal to the control unit which, on the basis of this signal, reduces the ignition advance until the phenomenon disappears. Later on, the advance is gradually restored to the basic value.

Electrical specifications: resistance 532-588 ohm at 20°C.



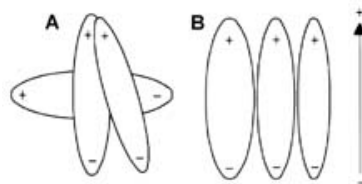
OPERATION

The molecules of a quartz crystal are electrically polarised.

In rest condition (A), the molecules do not display any particular orientation.

When the crystal is subject to pressure or impact (B), the degree of alignment is directly proportional to the pressure acting on the crystal.

This orientation generates a voltage at the crystal terminals.



A. Rest position

B. Position under pressure

RPM SENSOR

SPECIFICATIONS

It is fitted on the crankcase facing the phonic wheel on the crankshaft pulley.

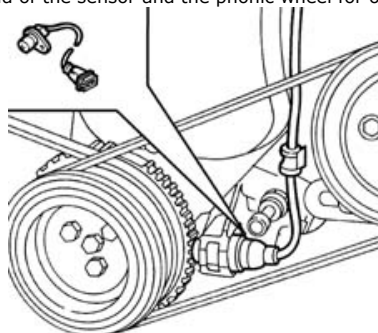
It is inductive, i.e. its operation is determined by magnetic field changes generated by the teeth passing in front of the phonic wheel (60-2 teeth).

The injection control unit uses the rpm sensor signal to:

- determine the rotation speed
- determine the crankshaft angular position.

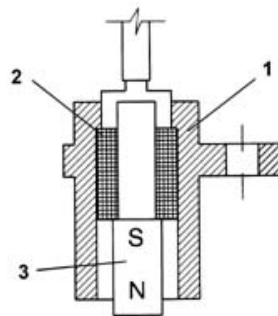
Electrical specifications: resistance 1134-1386 ohm at 20°C.

The recommended distance (gap) between the end of the sensor and the phonic wheel for obtaining correct signals should be 0.5 - 1.5 mm.



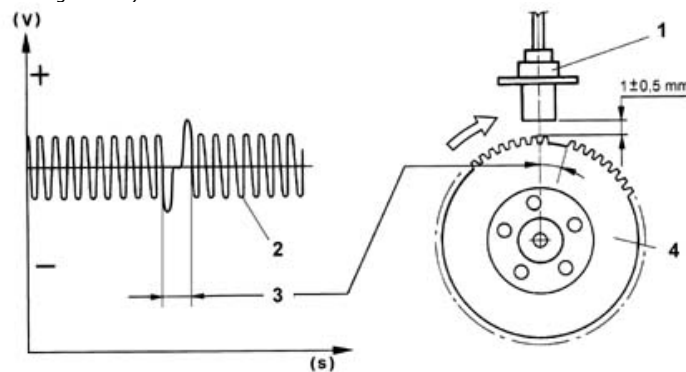
COMPOSITION

The sensor takes the form of a tubular case (1) containing a permanent magnet (3) and electrical winding (2).



OPERATION

Due to the passage of the phonic wheel teeth, the magnetic flux set up by magnet (3) undergoes fluctuations due to changes in the gap. These fluctuations set up an electromotive force in winding (2) and a voltage is set up at the terminals that alternates between positive (tooth facing sensor) and negative (gap facing sensor).



- 1, Sensor
- 2, Output signal
- 3, Signal corresponding to two missing teeth
- 4, Crankshaft pulley with phonic wheel

The sensor peak output voltage depends, all else being equal, on the distance between the sensor and the phonic wheel teeth (gap).

There are sixty teeth on the phonic wheel, two having been removed to produce a reference: the passing of the wheel therefore corresponds to an angle of 6° (360° divided by 60 teeth).

The synchronism point is recognised at the end of the first tooth following the gap left by the two missing teeth: when this passes beneath the sensor, the motor has piston pair 1-4 at 114° before TDC.

ACCELERATOR PEDAL POTENTIOMETER

SPECIFICATIONS

The accelerator pedal is equipped with two built-in potentiometers: *- a main one *- a stand-by one.

The injection control unit implements the following recovery strategies under the following conditions:

- if one of the two potentiometers fails, this allows the throttle to be opened to a maximum of 40° over a long time period;
- if both potentiometers fail completely, throttle opening is prevented.

OPERATION

The sensor consists of a case secured to the accelerator pedal mounting. This contains an axially-located shaft connected to a dual-track potentiometer.

A coil spring on the shaft ensures the correct amount of resistance to pressure while a second spring ensures return following release.

Operating field from 0° to 70° ; mechanical stop at 88° .



THROTTLE BODY

SPECIFICATIONS

This is fitted on the intake chamber and regulates the amount of air taken in by the engine.

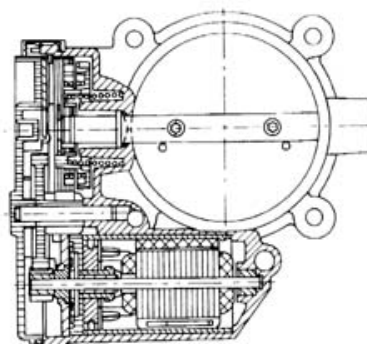
According to the signal received from the accelerator pedal potentiometer, the injection control unit controls the throttle opening by means of a direct current motor built into the throttle body.

Throttle opening takes place from 0° to 80°, i.e. including idle speed adjustment range. - The throttle body is equipped with two built-in potentiometers, each of which controls the other.

If both potentiometers should fail or in the case of a power cut, the control unit reduces drive torque on the basis of accelerator pedal position.

- with the pedal fully depressed, it cuts off fuel to one or more pistons until a maximum speed of 2500 rpm is reached
- in the intermediate positions, it cuts off the supply to one or more pistons until a speed of less than 2500 rpm is reached.

The self-learning procedure must be carried out if the injection control unit or the air chamber or the throttle body is replaced.



OPERATION

The opening of the throttle is managed by an electrically-operated motor.

The ME73H4 system operates the motorised throttle according to accelerator pedal demand; a potentiometer connected to it sends a voltage signal to the control unit, where the signal is processed and causes the throttle to open to different extents.

On SPORT versions, the system is capable of governing the movement of the throttle in accordance with two maps: one more sporty and the other more comfortable.

In addition to altering the electric steering power assistance, the driver can use the CITY button to change the response of the engine to the action of the accelerator pedal.

Specifically:

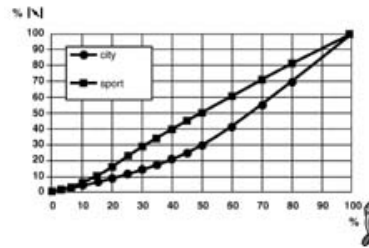
- with the CITY function on, the response of the throttle movement is smoother.
- with the CITY function off, the response of the throttle movement is quicker.

Engagement modes:

- press the CITY button;
- release the accelerator pedal.

The control unit activates the management

The throttle opening law is illustrated in the graph below.



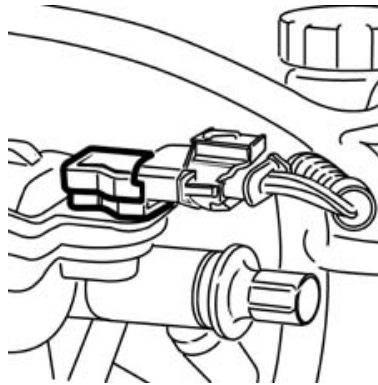
INTAKE AIR TEMPERATURE AND PRESSURE SENSOR

SPECIFICATIONS

The pressure and intake air temperature sensor is an integral component which is designed to measure the air pressure and temperature inside the intake manifold.

Both pieces of information are used by the injection control unit in defining the quantity of air drawn in by the engine and are then used for calculating the injection time and the ignition point.

The sensor is fitted on the intake manifold.



COMPOSITION

The air temperature sensor consists of an NTC thermistor (Negative Temperature Coefficient). The sensor resistance decreases as the temperature increases.

The control unit input circuit shares the 5 Volt reference voltage between the sensor resistance and a fixed reference value, producing a voltage that is proportional to the resistance and consequently to the temperature.

The sensitive element of the pressure sensor is made up of a Wheatstone bridge screen-printed onto a ceramic diaphragm. On one side of the diaphragm is the absolute reference vacuum, while on the other side is the vacuum from the intake manifold.

The (piezoresistant) signal, coming from the distortion suffered by the diaphragm, before being sent to the engine management control unit, is amplified by an electronic circuit contained in the mounting that houses the ceramic diaphragm.

With the engine off, the diaphragm bends according to atmospheric pressure. Exact reference information on altitude can therefore be obtained with the key on.

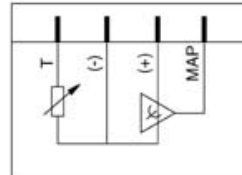
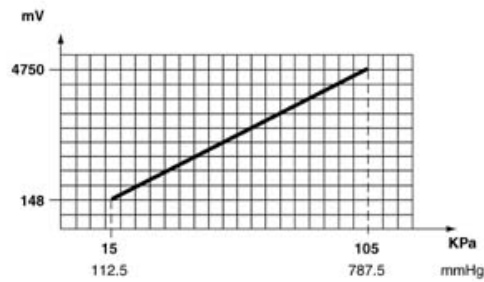
During engine operation, the vacuum exerts a mechanical action on the sensor diaphragm, which bends to alter the resistance value.

Because the power supply from the control unit is maintained strictly constant (5V), the output voltage changes when the resistance value is altered.

ELECTRICAL PROPERTIES

The electrical properties of the sensor are illustrated in the diagram below.

T °C	Ω	$\pm \Omega \%$
-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



IGNITION COILS

COMPOSITION

The coils are connected directly to the spark plugs and are the "cigar" type, comprising a magnetic internal core made up of a segmented silicon steel pack arranged along the axis of the coil and secondary and primary coils, which contain the electrical windings, coaxial to the magnetic core.

The windings are housed in a pressed plastic container fitted with a low voltage connector and bush for fastening to the cylinder head and they are insulated through immersion in an epoxide resin which has excellent dielectric, mechanical and also thermal properties, as the coils are exposed to high temperatures. The proximity of the primary winding to the magnetic core reduces the magnetic flux losses, ensuring the maximum coupling on the secondary winding.

Electrical specifications:

Primary circuit resistance: 0.5 ohms +/- 10% at 23°C

Secondary circuit resistance: 6300 ohms +/- 10% at 23°C.

