WEBER-MARELLI INTEGRATED SPI INJECTION - IGNITION SYSTEM 06F.SB E 06F.S3

Foreword

The Weber-Marelli systems fitted to 1108 c.c. and 1242 c.c engines of the **"Punto"** belong to the category of integrated systems: electronic solid stage advance and distribution ignition and electronic single-point intermittent petrol injection, i.e. with only one injector.

PRINCIPLE OF OPERATION

In this system, fuel is injected by the injector upstream from the throttle valve upon each engine TDC, with a low output pressure (about 1 bar).
In order for a petrol engine to work efficiently, the mixture ratio (air-fuel weight ratio) should be maintained constant throughout all service speeds without being affected by changes in coolant temperature, air intake or absolute pressure - except under certain service conditions.

The amount of fuel to be injected is therefore directly proportional to the amount of air taken in by the engine. In fact the engine uses this parameter to control the injector opening time. In this system, the stoichiometric dose (= air-fuel weight ratio = 14.5) is also maintained constant by means of a Lambda probe. This continually monitors the amount of oxygen present in the exhaust gas to enable the ECU to correct the amount of fuel to be injected continuously in order to achieve a stoichiometric ratio throughout the required service range.

This injection system is known as **"angular engine rotation speed - intake air density - retro-active concentration control" type, more commonly known as Speed-density-lambda.**
Because for certain service conditions the amount of fuel required for each engine cycle is too little and thus difficult to calculate, the system is able to govern an asynchronous injection in addition to the usual synchronous injection (upon each ignition at TDC). The asynchronous injection is achieved by maintaining injection time for longer than calculated and modulating injector closure time.

The ignition is fully solid-state inductive discharge type, i.e. without a distributor, with a power module transferred inside the ignition-injection ECU. The ignition system consists of two coils with two high tension outlets connected directly to spark plugs (1-4 and 2-3). The primary winding of each coil is connected to both the power relay (i.e. supplied from the battery) and terminals 1 and 19 (respectively) of the ECU. The ECU activates the coils and computers, on the basis of information from the sensors, the correct instant for establishing the internal earth connection for the time necessary for activating the coils.

The optimum ignition system advance is calculated by the ECU on the basis of engine speed and absolute pressure in the inlet manifold and therefore implemented taking into account the time required to charge the ignition coil.
The high tension used to supply the spark plugs differs in intensity due to the nature of the secondary circuit (spark plugs in line). This is due to the fact that one of the two spark plugs activated is alternately positioned in a high pressure environment (compression stage) whereas the other is in a low pressure environment (exhaust stage). Because the current must overcome a greater dielectric gradient in the spark plug undergoing compression, a more powerful spark is produced, whereas the spark from the other is negligible.

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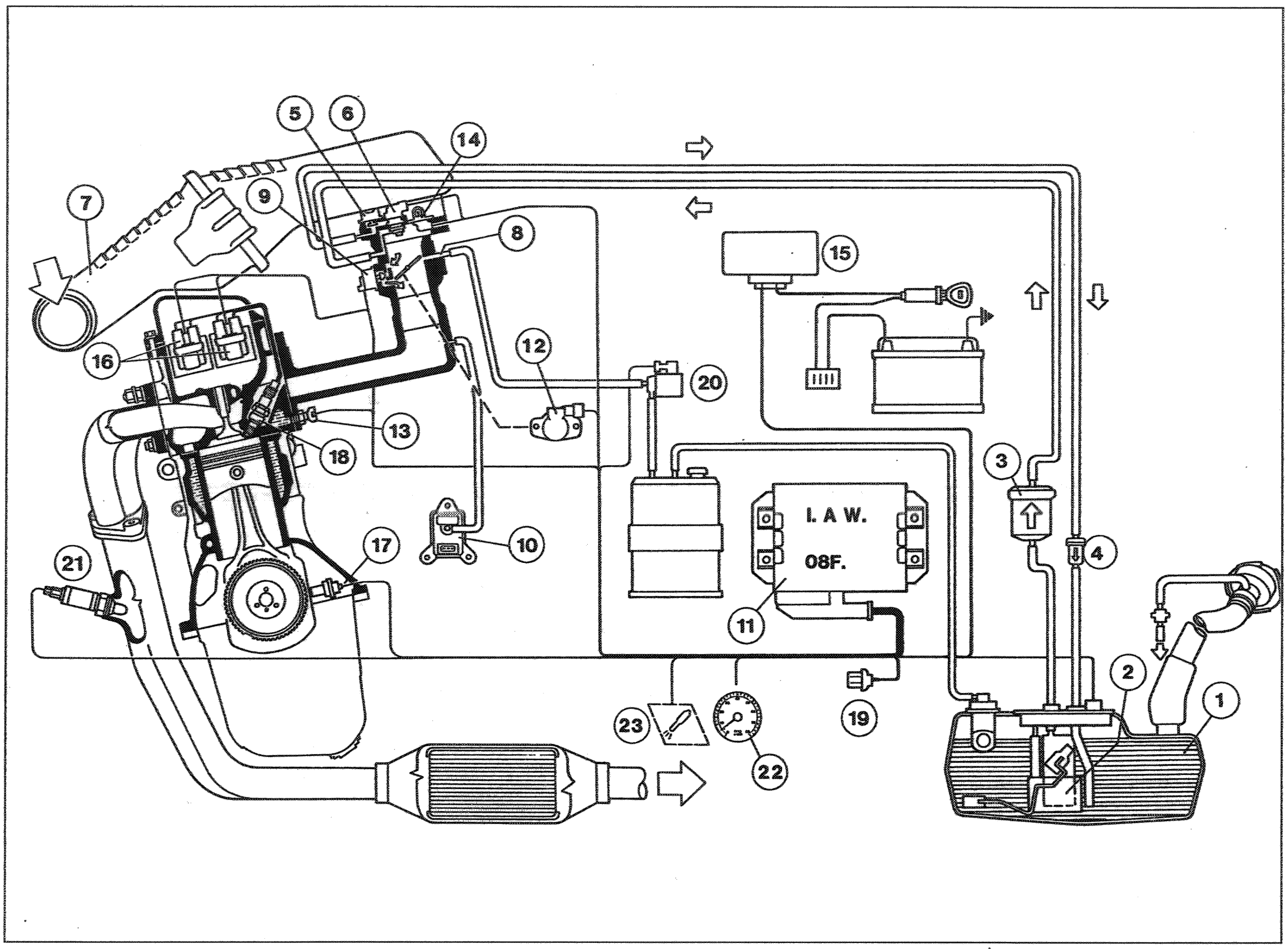
DIAGRAM OF WEBER-MARELLI IAW SPI INJECTION-IGNITION SYSTEM - 06F.SB - 06F.S3



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Key to Weber injection-ignition integrated system (SPI)

1 - Fuel tank
2 - Electric fuel pump
3 - Fuel filter
4 - Anti-reflux valve
5 - Fuel pressure regulator
6 - Injector
7 - Air cleaner
8 - Fuel vapour fitting
9 - Engine idle adjustment actuator
10 - Absolute pressure sensor
11 - Injection/ignition system ECU
12 - Throttle position sensor
13 - Engine coolant temperature sensor
14 - Intake air temperature sensor
15 - Injection/ignition system dual relay
16 - Ignition coils
17 - Rpm and TDC sensor
18 - Spark plugs
19 - Diagnostic socket for FIAT/LANCIA tester
20 - Vapour recirculation solenoid
21 - Lambda probe
22 - Rev counter (if present)
23 - IAW system failure warning light.

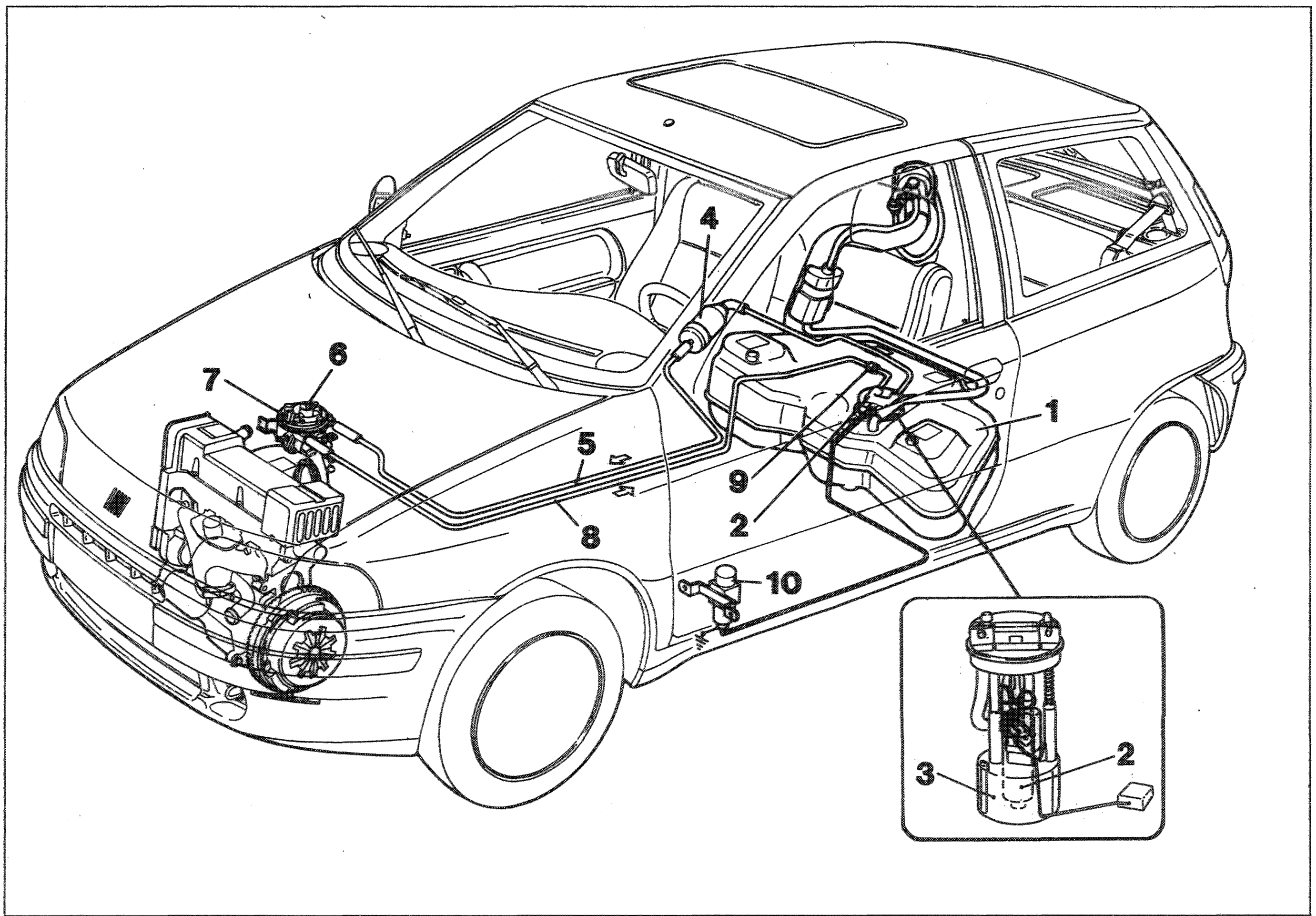
COMPONENTS OF IAW SPI SYSTEM

The Weber SPI injection/ignition system is made up of four interdependent circuits:

A. Fuel supply circuit
B. Air intake circuit
C. Electric/electronic circuit
D. Circuit for checking harmful exhaust emissions

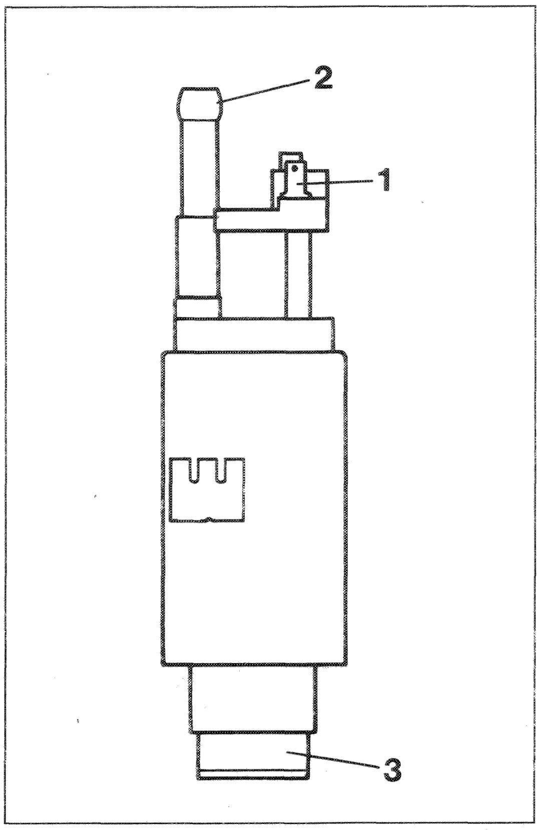
Two devices and their circuits strictly related to the injection system are also present. These are also designed to reduce vehicle harmful emissions in line with USA '83 standards. These are as follows: **fuel evaporation control and vapour recovery circuit; crankcase vapour recirculation and recovery circuit.**

A. FUEL SUPPLY CIRCUIT



Fuel system diagram

1. Reservoir
2. Pump submerged in tank
3. Mesh pre-filter located on pump intake
4. Paper main fuel filter
5. Outlet line
6. Injector (fitted to injector turret)
7. Fuel pressure regulator, built into injector turret
8. Return line
9. Fuel recirculation one-way valve (anti-reflux)
10. Inertia safety switch



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ELECTRIC FUEL PUMP (WALBRO MARVAL)

The pump is housed inside the tank in a basket with a mesh filter on the fuel intake.

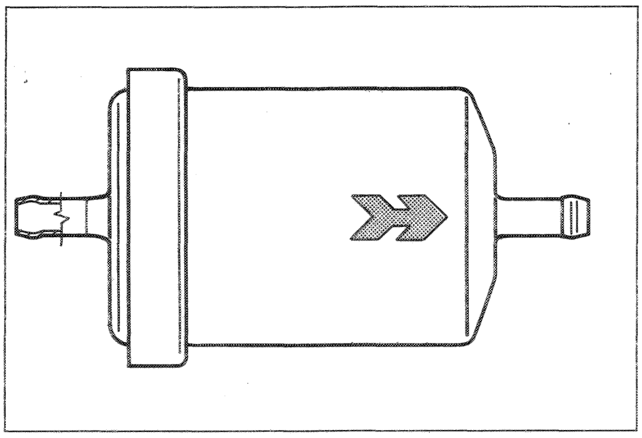
The pump used in this system is turbine type with plastic impeller, designed to work with both leaded and unleaded petrol. It contains a check valve and a pressure relief valve set to a value of 2.6 bar.

Rated pump output measured at a service pressure of 1 bar is 90 lt/h.
The pump is supplied directly from the ECU, to ensure:

- pump shut-off if engine rpm drops below a minimum threshold.
- timed enablement (15 seconds duration) of pump each time ignition key is inserted in MARCIA position without starting taking place.

- Operation enabled during running or with engine started up.

1. Electrical connectors
2. Fuel outlet
3. Fuel intake



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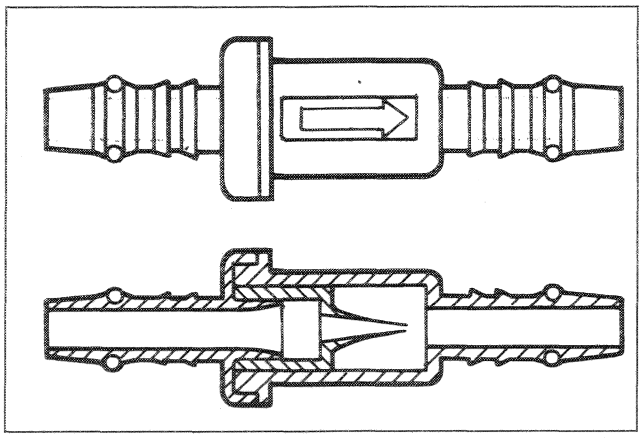
FUEL FILTER F1/03

The filter is fitted under the body near the fuel tank along the pipe carrying fuel to the throttle case.
It is made up of an outer case and an internal mount that holds a paper element with high filtering capacity.
This is essential for ensuring injector operation because the injector is extremely sensitive to foreign bodies in the supply circuit.

It is therefore advisable to replace the unit at the recommended intervals.



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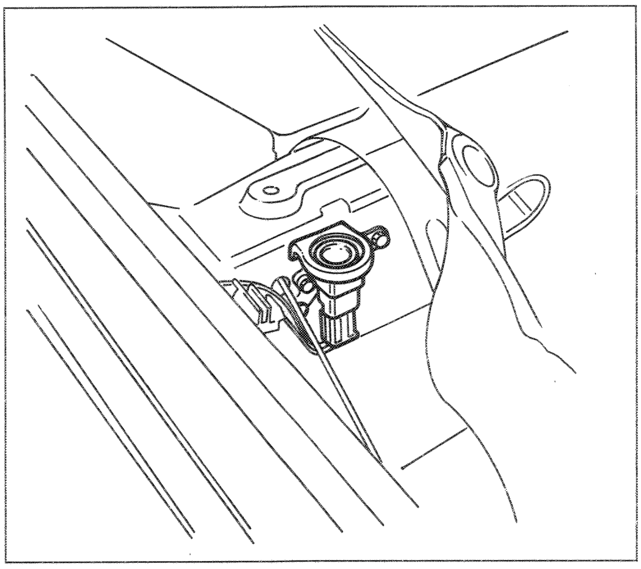
FUEL RECIRCULATION ONE-WAY OR ANTI-REFLUX VALVE

This is a safety valve fitted in the fuel return line near the tank. It allows fuel to return to the tank and prevents reflux in the case of an accident with consequent pipe breakage.



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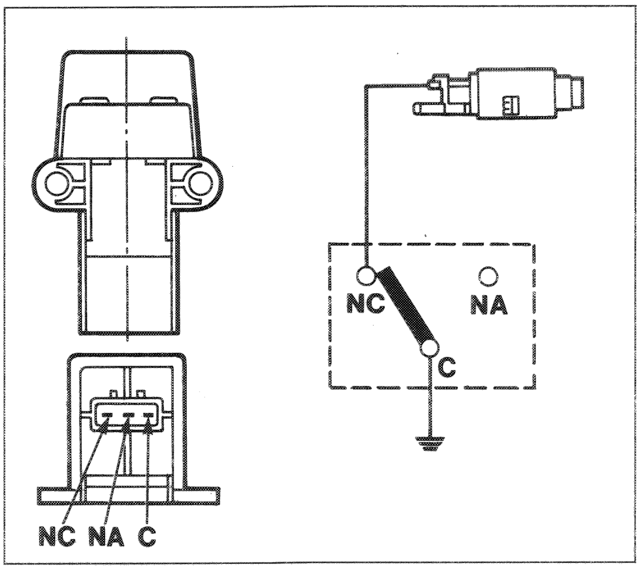

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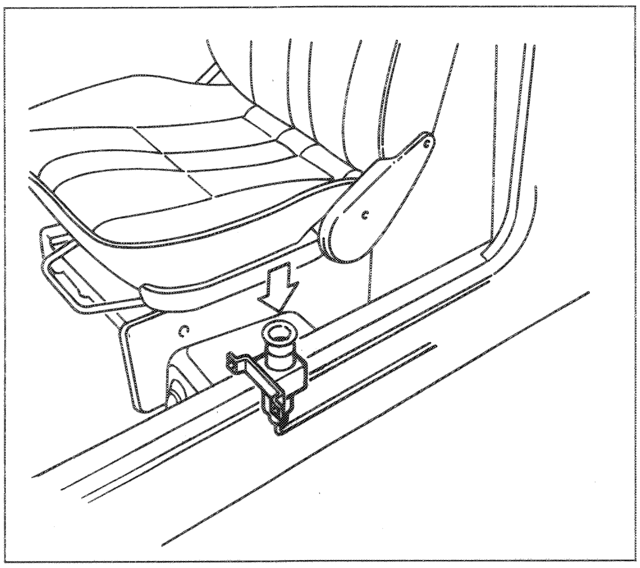

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INERTIA SAFETY SWITCH

Foreword

This switch is located alongside the driver's seat on the left hand side and triggered in the case of vehicle collision to cut off the earth connection to the fuel pump and thus the supply to the injection system.

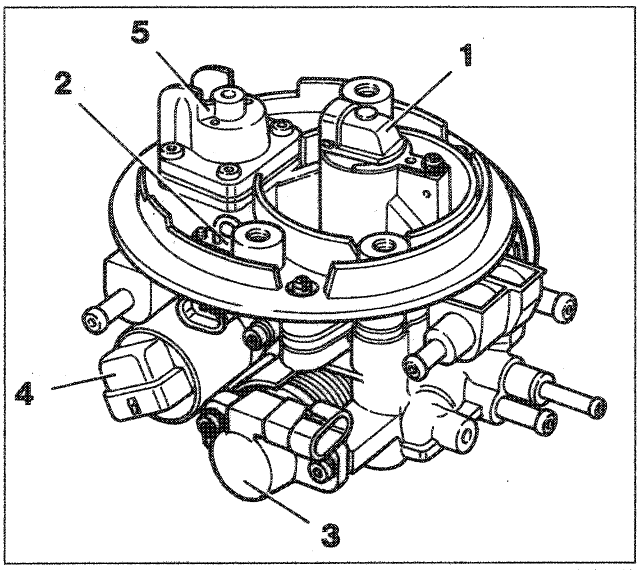
Principle of operation

A steel ball fitted inside a tapered housing is normally held in locked position through the attractive force of an adjacent magnet. In the case of specific acceleration loads, the ball is released from the magnetic attraction and gradually emerges from the tapered mount, following an upward movement according to cone angle.
A quick-release mechanism above the ball makes up a normally closed (N.C.) electrical circuit. When the mechanism is struck by the ball, it changes position from an N.C. circuit to a normally open circuit (N.A.) and thus breaks the fuel pump earth circuit.

In the case of a collision in any one the three orthogonal directions, the switch will operate at a peak value of over 12 g equivalent to a speed of about 25 Km/h.
The switch may be reset by pushing the button protected by a flexible cover (used also to protect against foreign bodies that could impede operation or cause reprogramming to occur).

⚠ *After even an apparently light collision, if a smell of petrol is noted or fuel leaks are seen, do not activate the switch again until the fault has been found and corrected in order to avoid the risk of fire.*

If no leaks are noted and the vehicle is able to start, press the button to re-activate the pump.



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INJECTOR TURRET

Most of the sensors and actuators described in the following chapters are fitted to the turret.

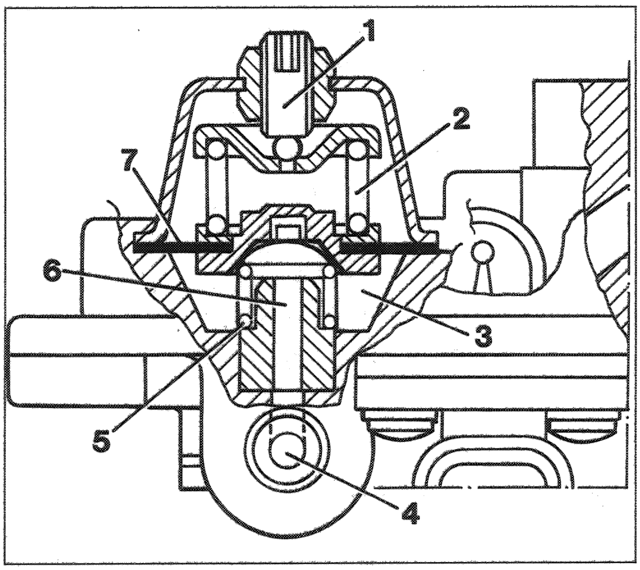
Perspective view of injector turret

1. Injector
2. Inlet air temperature sensor
3. Throttle position sensor
4. Idle speed regulation actuator
5. Fuel pressure regulator

FUEL PRESSURE REGULATOR

This component is responsible for maintaining the pressure at which fuel is sent to the injectors constant at 1 ± 0.2 bar.
Spring (2) exercises a pressure on membrane (7) connected to needle valve (6) in order to maintain the hole bringing fuel outlet duct to injector (3) into communication with fuel reflux port to tank (4) in closed position.
When the pressure of fuel in duct (3) exceeds a level of 1 ± 0.2 bar, the pressure exercised on membrane (7) overcomes the resistance of spring (2). Spring (2) compresses to move membrane and needle valve (6) in order to open up communication with reflux duct (4). Due to excess fuel returning to the tank, the pressure in outlet duct (3) drops to the established level.

The pressure regulator cut-in level is set during production by means of a hexagonal socket screw dowel (1).



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Cross section through pressure regulator

1. Hexagonal socket adjustment screw
2. Spring
3. Fuel delivery duct to injector
4. Fuel reflux duct to tank
5. Spring
6. Needle valve with spring
7. Membrane

BOTTOM FEED INJECTOR (IWM 523)

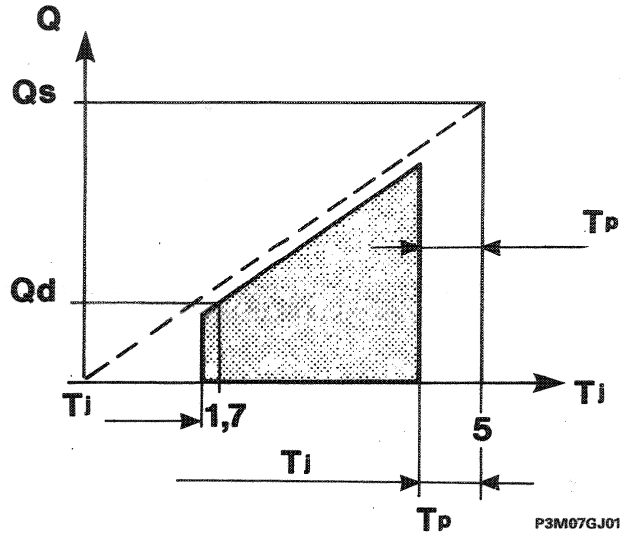
The injector is supplied from the bottom, through the fuel pump submerged in the tank, at a constant pressure of 1 ± 0.2 bar.
Excess fuel flows back to the tank through the injector. This helps keep the injector at a low temperature and remove any vapour bubbles.
The injector case is made out of oxidation resistant material to safeguard it against any inpurities (water, methanol, ethanol...) in commercial fuels.
The injector is governed by the ECU at a maximum frequency of 200 Hz at 6000 rpm with injection times between 1.5 and 3.5 ms.
The supply curve shown in the following graph corresponds to results obtained under the following test conditions:

Output -injection time graph

Test liquid: EXSOL D 40
Viscosity: 1.16 cst
Temperature: 25° C
Pressure: 100 KPa
Voltage: 14 Volt
Supply frequency: 200 Hz (5 ms)

Tj = Injection time
Tp = Pause time
Tpmin+Tjmax = 5 ms

Injector regulation range IWM 523



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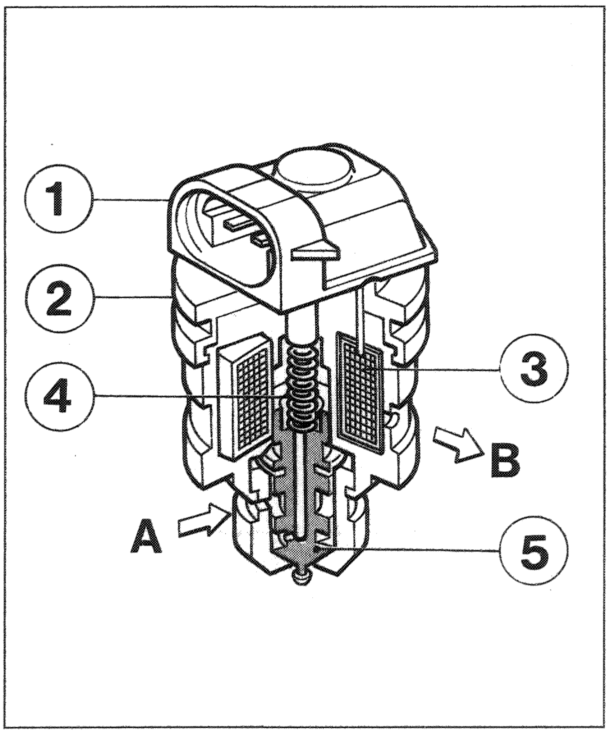
Characteristics of injector IWM 523

Static output (Qs)	465 cc/min
Dynamic output (Qd)	103 cc/min
Supply band	6-16 Volt
T minimum for feed	1.40 ms
T minimum for pause	0.80 ms
Convex cone spray shape	30° - 90°
Service temperature	-30° - 110° C
Duration	1×109 cycles
Vibrations	30 G

Longitudinal section through injector

1. Socket for supply connector
2. Injector case
3. Electromagnetic winding
4. Reaction spring
5. Tapered pin
A. Fuel intake
B. Fuel outlet



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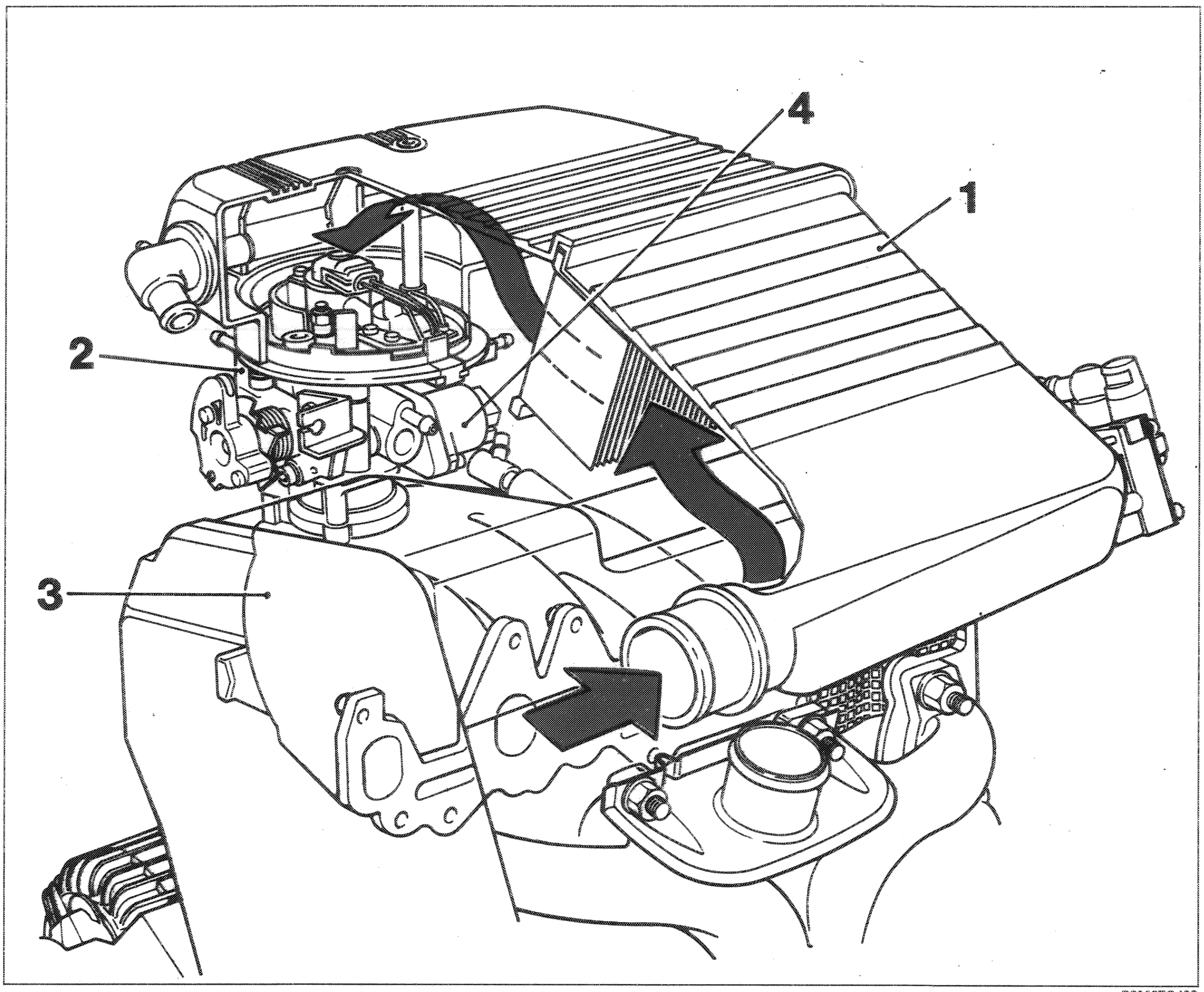
B. AIR INTAKE CIRCUIT

This consists of various components that ensure the correct air flow to the engine under different service conditions::
air cleaner (1)
throttle case (2)
inlet manifold (3)
engine idle speed regulation actuator (step motor) (4)



Air intake circuit diagram

ENGINE IDLE SPEED CONTROL ACTUATOR (Step motor)

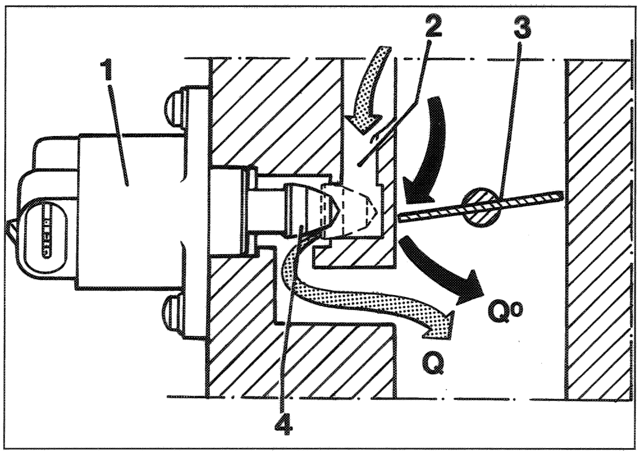
In order to idle (i.e. with throttle valve fully closed), the engine requires a certain amount of air and fuel to maintain its speed of rotation and overcome any internal engine friction. This quantity of air must increase if the engine is subjected to an additional load due to activation of an appliance.

Until the engine warms up, in addition to the extra air flow, an increase in the amount of fuel injected is also required. The ECU arranges this on the basis of signals from the coolant temperature sensor.

The quantity of air that leaks through the closed throttle valve when the engine is idling is supplemented by a further quantity of air when the engine is warming up or when electrical users are activated in order to maintain engine revs at the same level. This result is achieved through the modulated opening of an air by-pass duct connected in parallel with the throttle valve.

In order to achieve this result, the system uses a step motor (1) fastened to the ECU. During operation, this moves a rod equipped with a plunger that adjusts the cross section of the by-pass duct and, consequently, the amount of air (Qo + Q) taken up by the engine.

In order to regulate this type of action, the ECU uses engine angular speed and coolant temperature parameters obtained from specific sensors.



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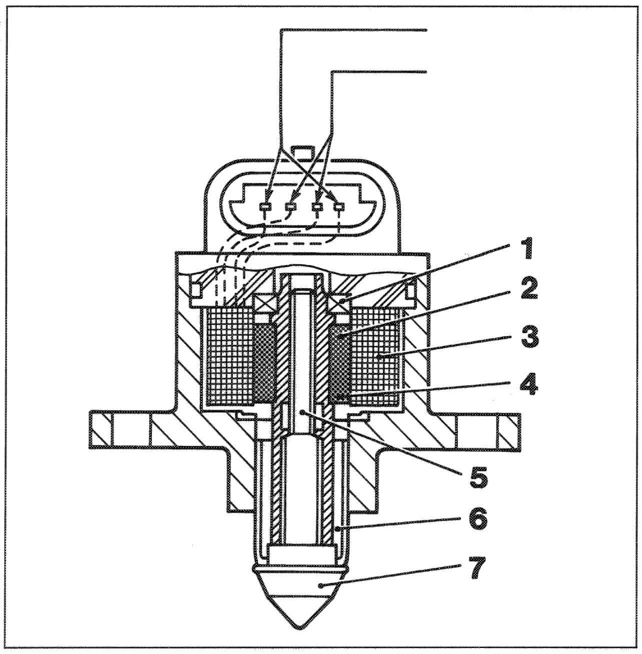
Air flow leaking through throttle (constant)

Air flow regulated by actuator (variable)

Cross section through additional air and idle adjustment actuator

1. Control step motor
2. By-pass duct
3. Throttle valve
4. Plunger



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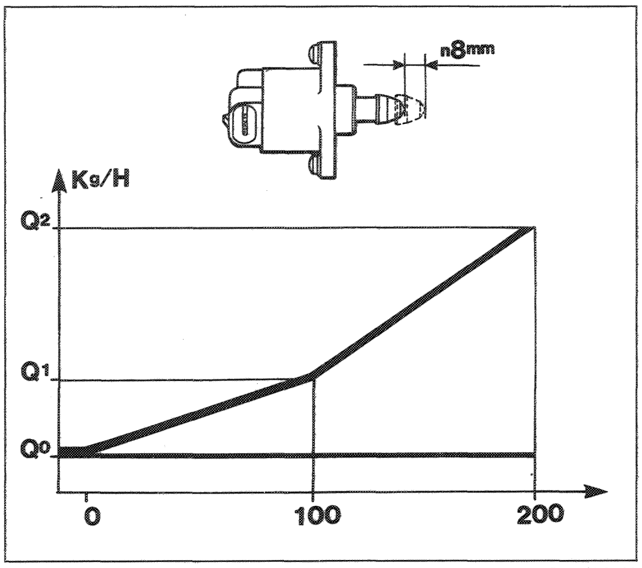
1. Bearing
2. Lead screw
3. Coils
4. Magnets
5. Screw
6. Antirotation splines
7. Plunger



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The step motor is characterized by high precision and resolution (about 20 revs).
Pulses sent by the ECU to the engine are transformed from rotary motion into linear translation movements (about 0.04 mm/step) through a screw/worm screw type mechanism. This operates a plunger whose movements alter the cross section of the by-pass duct.
The constant minimum air flow Qo is due to leakage under the throttle valve. This is set during manufacture and safeguarded by a protective plug. Maximum output Q_2 is ensured by the plunger in its position of maximum retraction (about 200 steps corresponding to 8 mm). Between these two values, the air flow follows the rules shown in the graph alongside.

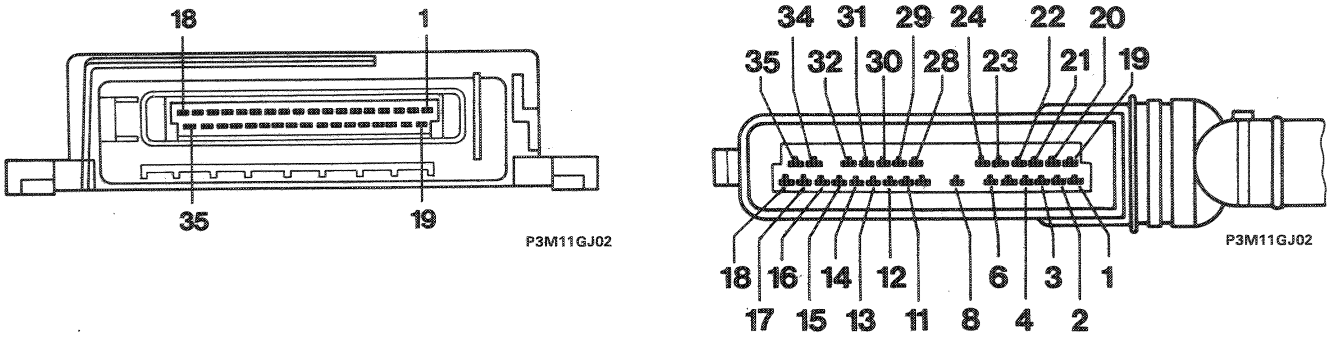
Step motor strategy

The number of working steps is determined by engine conditions:
- **Start-up stage**
  When the key is inserted, the step motor acts upon a command from the ECU and takes up position according to coolant temperature and battery voltage.
- **Warming up stage**
  The number of revs is corrected mainly as a function of coolant temperature.
- **Engine warm:**
  Idle control depends on a signal from the engine rpm sensor. When external loads are activated, the ECU controls idle to restore it to the established rpm level.
- **During over-run:**
  The ECU recognises the over-run stage from the position of the throttle potentiometer.
  It controls step motor position through the idle output law (DASH-POT law), i.e. slows the return of plunger (3) toward its seat. In this way, a quantity of air by-passing hole (2) reaches the engine and reduces the levels of pollutants in the exhaust gas.

C - ELECTRIC/ELECTRONIC CIRCUIT

Connects all injection/ignition system components and provides them with electricity.
This consists mainly of an ECU and the following components.
- Double system supply relay
- Throttle valve position sensor
- Coolant temperature sensor
- Fuel pump submerged in tank
- Injector
- Absolute pressure sensor
- Intake air temperature sensor
- Engine idle speed actuator (step motor)
- Rpm and TDC sensor
- Two ignition coils
- Lambda probe
- Fuel vapour control solenoid
- Four spark plugs
- Inertia safety switch
- Diagnostic socket for Fiat/Lancia Tester

INJECTION-IGNITION ELECTRONIC CONTROL UNIT



Terminal no.	Information received or transmitted
Input signals	
5	Available
7	Available
8	Air conditioner signal input
9	Available
10	Serial L line input for Fiat/Lancia tester diagnostic socket
11	Input for rpm sensor negative and synchronism
12	Input for oxygen sensor negative (or lambda probe)
13	Coolant sensor input
23	Earth (high or low)
26	Available - for automatic transmission (selection D/N)
27	Available
28	Rpm and synchronism sensor positive input
29	Input for oxygen sensor positive (or lambda probe)
30	Input for throttle open position potentiometer
31	Input for intake air temperature sensor signal
32	Input for absolute pressure sensor signal
34	Power earth
35	Input for 12 Volt supply: activates all ECU functions

Terminal no.	Information received or transmitted
Output signals	
1	Governor for supply to ignition coil primary winding n° 1
2	Governor for supply to step motor, stage B
3	Step motor supply, stage D
4	Internal earth (high or low) with electronic safety feature for governing ECU relay
6	Failure warning light control
14	Supply (+ 5V) absolute pressure and throttle position sensors
15	To serial line K for Fiat-Lancia tester diagnostic socket
16	Earth for sensors: throttle position, coolant, intake air temperature
17	Power earth
18	Governor for injector supply
19	Governor for supply to ignition coil primary winding n° 2
20	Governor for supply to step motor, stage A
21	Governor for supply to step motor, stage C
22	Activation of petrol vapour cut-off solenoid to active carbon filter
23	Signal for pump safety stop and rev counter control (if fitted)
24	Air conditioner relay control
25	Available
33	Available

SYSTEM OPERATION

Operating strategy

Injector opening time is calculated by the ECU by processing different engine operating parameters as described below:

1. First of all, a baseline injection time is calculated using certain one and two-dimensional maps whose input parameters are engine angular speed of rotation, absolute pressure in the inlet manifold and barometric pressure measured by the absolute pressure sensor.
2. The resulting value is corrected on the basis of inlet air temperature, using an eight point table, and battery voltage, using a sixteen point table.
3. The resulting value is then corrected using information from the lambda probe in order to maintain a stiochiometric ratio.

According to the amount of fuel to be injected, a decision is taken over whether operation should be synchronous or asynchronous
Injection timing in relation to TDC is also determined in order to optimise fuel distribution. Injection time variation field ranges over 180° of engine rotation (from 0° in relation to TDC up to 180° after BDC).

Modification of operating strategy during transitory stages

The ECU controls additional air (when idling, during over-run etc.) through algorithms of the error in relation to memorized rpm values.
The following operations are carried out:

- **At idle speed**: comparison between actual rotating speed and an ideal speed mapped in the memory according to coolant temperature level and associated operation (check on by-pass duct section, injection time and advance angle) in order to achieve a displacement as close as possible to zero.

- **During start-up**: check on quantity of air taken in by the engine during start-up through plunger position (and thus by-pass duct effective cross section) according to coolant temperature and whether air conditioner is on or off.

- **During over-run**: during this stage of engine use, two strategies are superimposed:

1) A negative transitory strategy to reduce the amount of fuel required by the engine (lower fuel consumption). This stage is recognised by the ECU, when the throttle potentiometer signal undergoes negative changes.
2) A dash-pot strategy to damp the negative torque variation (less engine braking, lower pollution). This strategy is implemented when the potentiometer signal indicates the throttle level is at minimum and the speed is high. As a result, the step motor decreases air flow through the by-pass gradually.

Starting up engine and adjusting efficiency

Injection time is corrected according to the following parameters:
- coolant temperature;
- inlet air temperature;
- battery voltage (only during start-up)

Flooding

Injection time is further corrected according to the following parameters:
- coolant temperature;
- engine angular speed during start-up;
- engine timing number.

Throttle transit (i.e. throttle opening speed)

Throttle angle shift and engine load variations are used in computing injecting time, with the usual corrections due to coolant and inlet air temperature.

Over-run (cut-off)

Cut-off is implemented with the throttle in minimum opening position.

Fuel output is restored before the engine is adjusted to idle speed.
Engine angular speed, coolant temperature and inlet air temperature signals are considered during this stage.

Operation at full load

Under full load conditions, basic injection time is increased to obtain maximum power delivery by engine.

The ECU detects a full load condition via signals from throttle position and absolute pressure sensors.

The ECU uses this information to implement corrections by increasing baseline injection time and disenabling the lambda probe control if recognised to be active.

Protection against excessive rpm

When the engine speed of rotation exceeds the limit level imposed by the manufacturer, the power unit begins to operate under critical conditions.
When the ECU recognises that the limit value has been exceeded, it reduces injector governing time and ignition advance.
When the speed is restored to non-critical levels, normal system control is restored.

Air conditioner signal

When the air conditioner is turned on, the engine experiences a speed drop because the compressor takes up power. This involves a drop in rpm, which is particularly evident during idling.

To overcome this condition, ECU, which is informed of the air conditioner «On» signal, arranges to restore nominal speed by increasing the air flow through the step motor.

When the power demand is identified (throttle valve position exceeds a threshold), the ECU inhibits air conditioner operation for a time interval stored in its memory (10 seconds).

CHECKING IGNITION ADVANCE

The ECU also processes the solid state electronic ignition control strategy.

The optimal advance angle is computed as follows:

1. A baseline advance angle is computed using a memory map whose input parameters are engine angular speed of rotation and absolute pressure measured in the inlet manifold. Two different one-dimensional tables are used when idling and under full load according to engine speed.

2. The resulting values are added to the associated coolant temperature correction throughout the entire period when the engine is warming up from cold.

3. The idling table value is further corrected in the case of a sudden drop in idle speed (e.g. due to activation of an appliance).

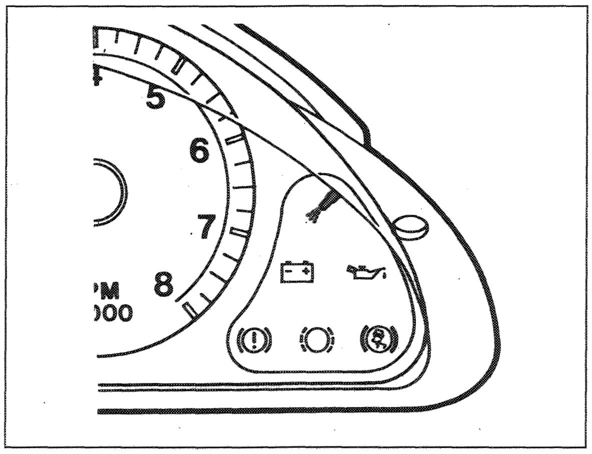
4. A negative correction is applied in the case of over-run and subsequent cut-off activation.

5. The advance angle is also subject to correction under the following conditions:
   - throttle transit;
   - return from cut-off due to throttle transit;
   - return from cut-off due to minimum rpm threshold.

SYSTEM SELF-DIAGNOSIS

The presence of a permanent memory even when the power is turned off permits the following self-diagnosis strategies:
The condition of the following sensors and actuators is diagnosed:
- rpm sensor
- absolute pressure sensor (AC or DC)
- coolant temperature sensor (AC or DC)
- intake air temperature sensor (AC or DC)
- throttle position sensor (AC or DC)
- actuator control port failure
- linear step motor controlling by-pass not operational
- DC injector at battery voltage
- ignition coils (AC or DC)

and also detect the following anomalies:
- ECU not synchronized with phonic wheel, during search stage and with engine running
- lambda probe (AC or DC)
- combination of several faults in one sensor.



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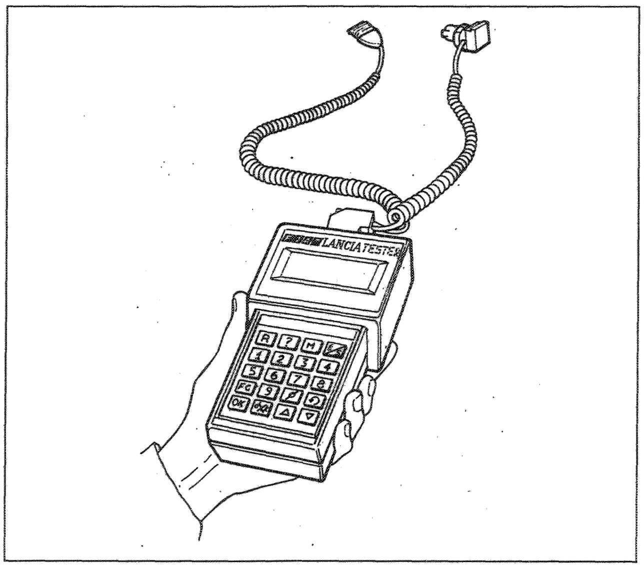
If sensor failure is detected (except rpm and TDC sensor) the ECU replaces the data from the faulty sensor with a memorized setting **(recovery)** in order to allow the engine to operate. When the fault is detected, it is memorized permanently and the sensor is cut out of the system until the signal is again compatible.

The same procedure is also applied if the fault affects an actuator or its control port.
Detection of a fault and replacement with recovery data involves a failure warning light coming on on the control panel, the light goes off only if the component is changed during service or the fault is not permanent. In this case, information on the fault is nevertheless stored in the permanent memory.



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ACTIVE DIALOGUE WITH FIAT/LANCIA TESTER

Connection of a FIAT/LANCIA TESTER allows the following operations to be carried out:
- display of temporary and permanent error codes
- programmed activation of:
  - injector
  - fuel pump
  - ignition module
  - linear step motor controlling by-pass
  - I.A.W. system failure warning light
  - active carbon fuel vapour trap filter solenoid

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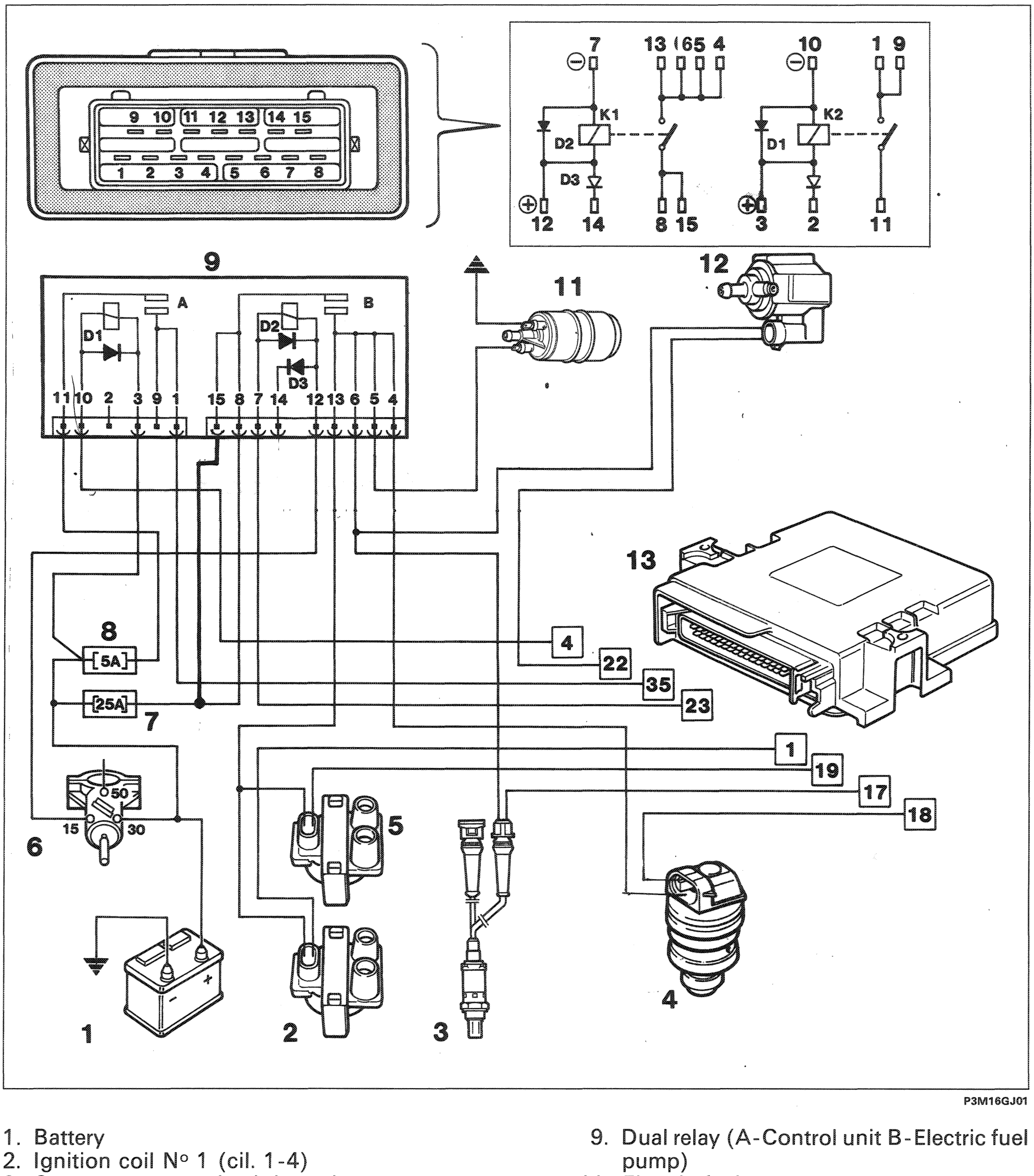
SYSTEM RELAY



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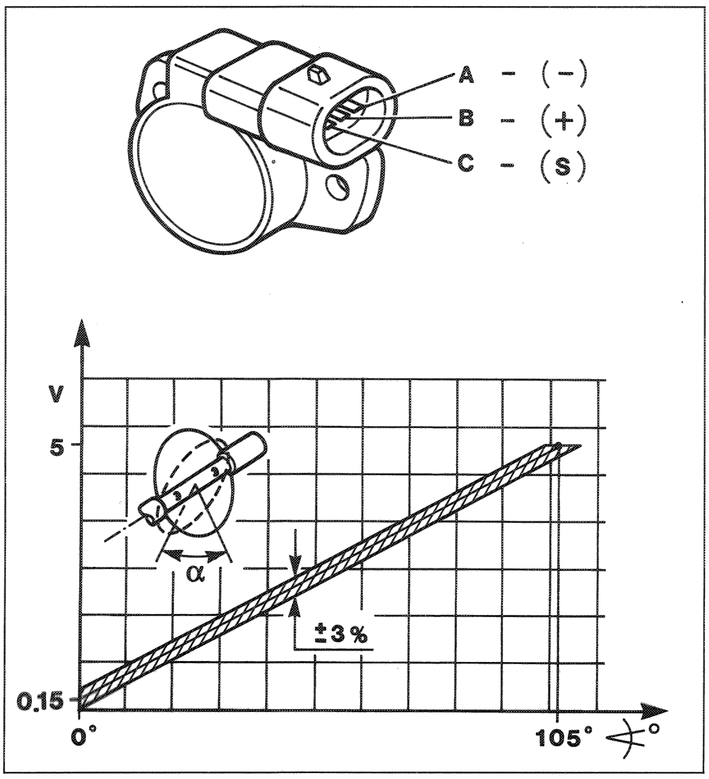
1. Battery
2. Ignition coil N° 1 (cil. 1-4)
3. Oxygen sensor or lambda probe
4. Injector
5. Ignition coil N° 2 (cil. 2-3)
6. Ignition switch
7. 25 A system fuse
8. 5 A ECU fuse
9. Dual relay (A-Control unit B-Electric fuel pump)
11. Electric fuel pump
12. Petrol vapour cut-off solenoid
13. Electronic control unit (ECU)



THROTTLE VALVE POSITION SENSOR

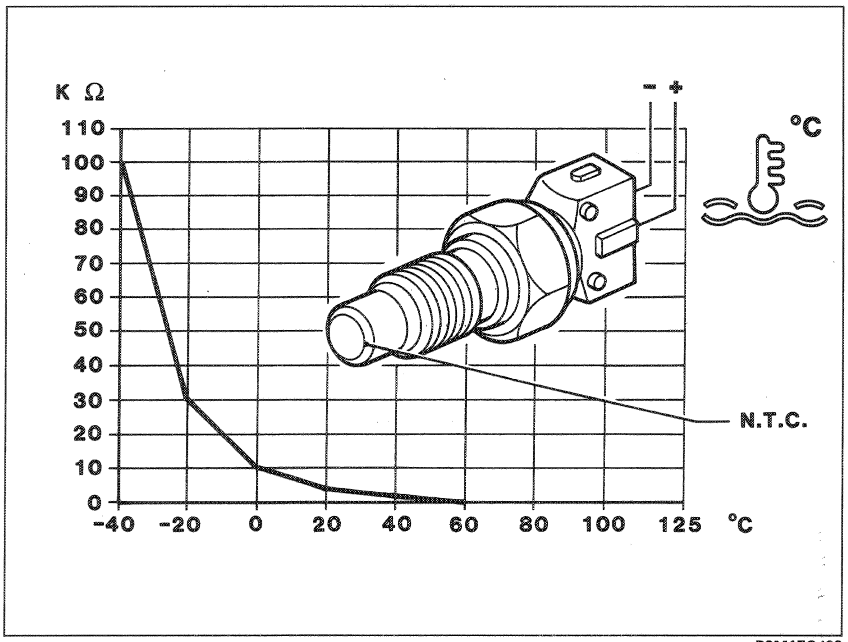
A- - (pin 16)
B- + 5V pin (14)
C- Signal (pin 30)

This consists of a potentiometer whose mobile part is controlled by the throttle valve spindle.
During operation, the ECU supplies the potentiometer with a voltage of 5 Volts. The measured parameter is throttle position from minimum to full opening for injection control mnagement.
According to output voltage, the ECU recognises throttle valve opening condition and corrects mixture concentration accordingly.

With the throttle closed, an electrical voltage signal is sent to the ECU, which recognises idling and cut-off conditions (differentiating between them on the basis of engine rpm).

The potentiometer is single ramp type; its main characteristics are as follows:
Effective electrical angle: 90° ± 2°
Mechanical angle: 105° ± 4°
Total mechanical travel: 110° ± 8°
Track resistance: 1200 ± 20% Ω
Temperature operating range: -30°C - +125°C

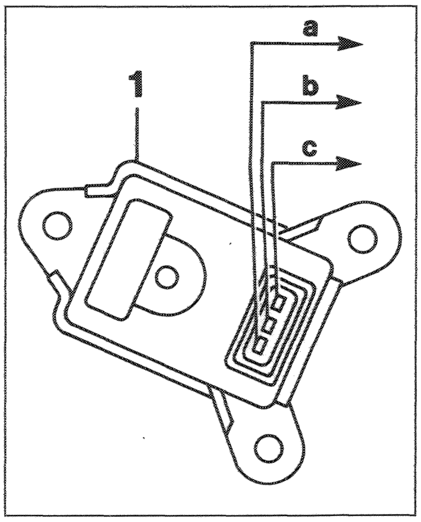
ENGINE COOLANT TEMPERATURE SENSOR



This sensor is installed in the coolant circuit.
It consists of a brass case and the actual resistance is made up of an NTC thermistor (negative temperature coefficient). In practice, sensor electrical resistance drops as temperature rises.

According to engine coolant temperature, the NTC thermistor alters its ohmic resistance in accordance with the graph in the figure.

10.



P3M18GJ01

a *Negative* *(pin 16)*
b *Positive + 5V* *(pin 14)*
c *Signal* *(pin 32)*

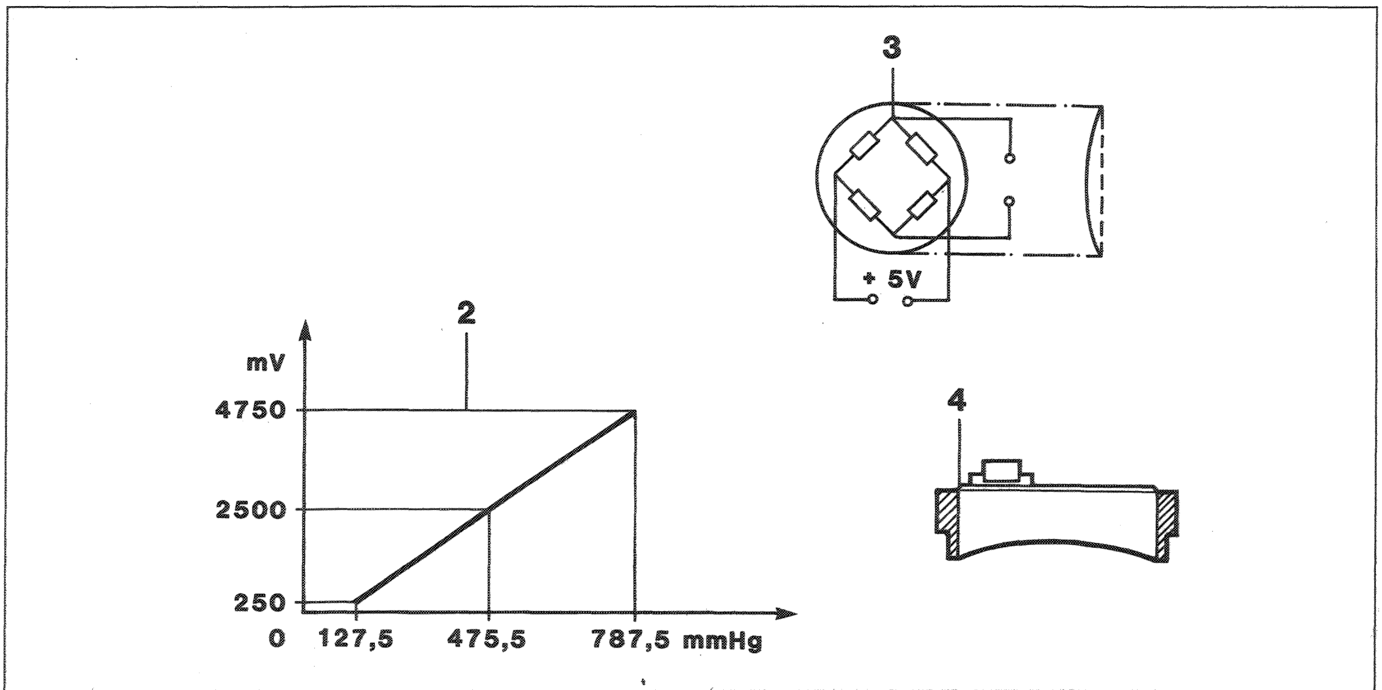
ABSOLUTE PRESSURE SENSOR

The sensor is housed inside the engine bay and connected to the inlet manifold via a pipe.
The absolute pressure sensor sensitive element consists of a Wheatstone bridge screen printed onto a ceramic membrane.

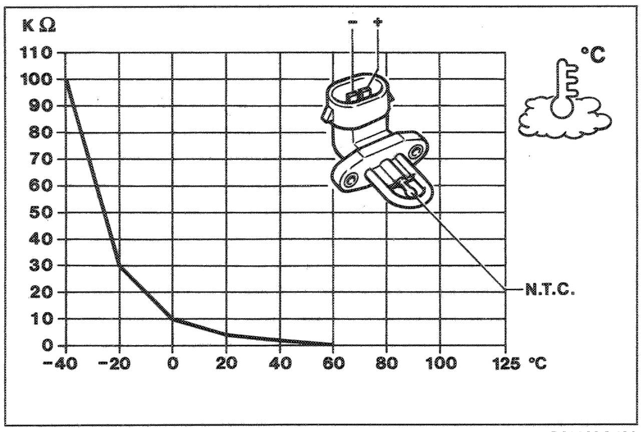
An absolute reference vacuum acts on one face of the membrane, whereas the pressure in the inlet manifold acts on the other.
A piezoresistant signal produced by the deformation experienced by the membrane is amplified by an electronic circuit in the support that houses the ceramic membrane before being sent to the ECU.

When the engine is off, the sensitive membrane deflects according to atmospheric pressure level (mmhg). With the ignition key inserted, the result is **exact information on altitude.**
During operation, the engine sets up a vacuum that brings about a mechanical action on the sensor ceramic membrane, whic deflects to alter the resistance value (3).
Because the supply is maintained strictly constant (5 V) by the ECU by altering the resistance value, the output voltage level alters according to the graph shown in the figure below.
We therefore obtain: **initial and significant information on the amount of air taken in.**
This information, together with the information from the air temperature sensor, is used by the ECU to establish inlet air density, taking into account engine load.

For correct transit operation, the pipe connecting vacuum socket and sensor must be of the same length and diameter as the original if replaced.



P3M18GJ02



P3M19GJ01

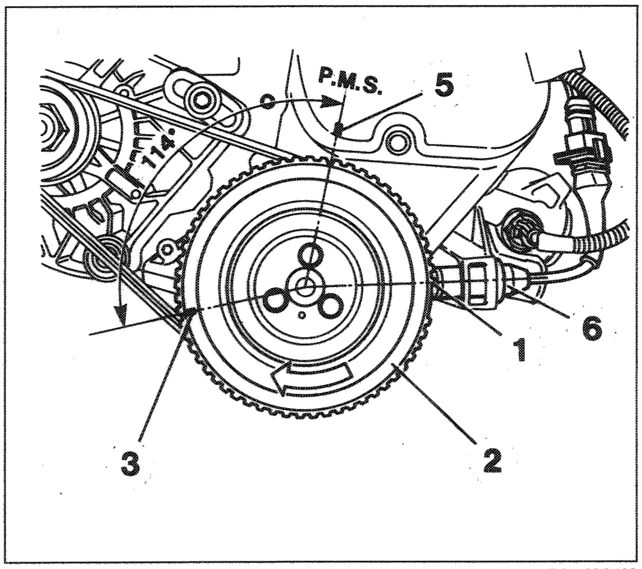
INTAKE AIR TEMPERATURE SENSOR

The sensor, located on the injector turret above the throttle valve, consists of a resistance that alters its value in a manner inversely proportional to temperature.

On the basis of a voltage signal reaching the sensor, the ECU is able to detect the exact temperature of intake air.

RPM AND SYNCHRONISM SENSOR

The rpm and synchronism sensor (1) consists of a variable reluctance (i.e. a coil on a ferrous core) within which is set up a small electromotive force (e.m.f.) each time a crankshaft pulley tooth (2) passes the core. The e.m.f. set up in the sensor each 6° (i.e. the distance between the teeth centre-lines) for 58 teeth (each engine revolution), provides an exact method for measuring (using frequency of signal generated) engine rpm by the ECU. The signal interval generated by the lack of two teeth upon each pulley revolution informs the ECU about the current engine stage.

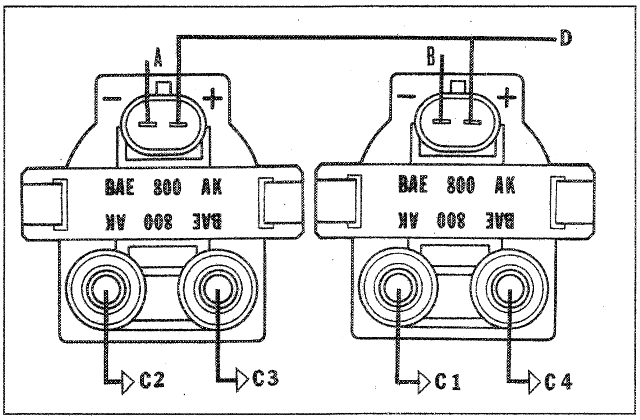


P3M19GJ02

1. Rpm and TDC sensor.
2. Phonic wheel
3. TDC reference notch on phonic wheel
5. TDC reference notch on timing cover
6. Synchronism tooth

PARTICULAR POSITIONS OF RPM AND SYNCHRONISM SENSOR

The phonic wheel consists of 58 teeth plus a space equivalent to the bulk occupied by two suppressed teeth.
The reference defined by the space of the two missing teeth is used as a basis for measuring the synchronism point (TDC).
The synchronism point is delimited by tooth (6). When this passes beneath the sensor, the crankshaft is located with piston pair 1-4 at 14° before TDC.
This signal is used by the ECU to compute the ignition advance angles.

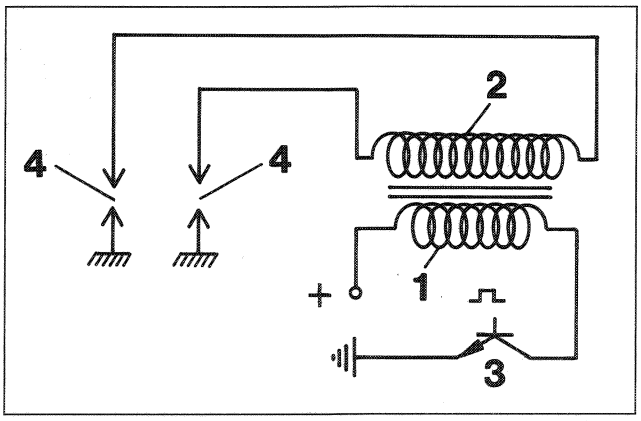


P3M20GJ01

A - B Connection to ECU terminals 1 and 19

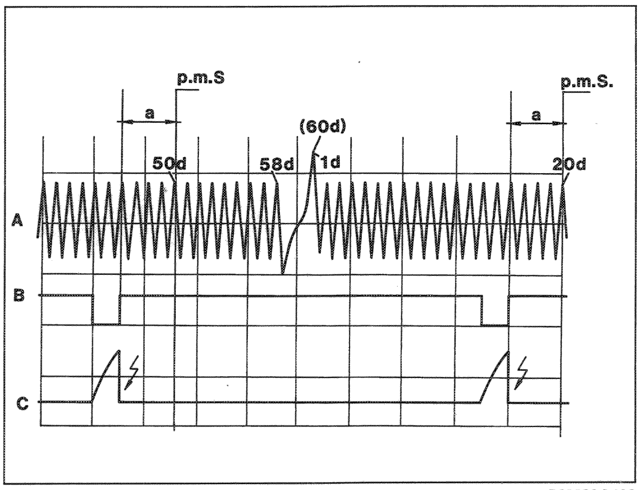
C1...C4. To spark plugs (as indicated by numbers engraved on ignition coil frames)

D. Supply: from power relay (to ignition switch turned to MAR)



P3M20GJ02

1. Primary circuit.
2. Secondary circuit.
3. Power module, located inside ECU.
4. Spark plugs.



P3M20GJ03

WEBER INTEGRATED IGNITION SYSTEM

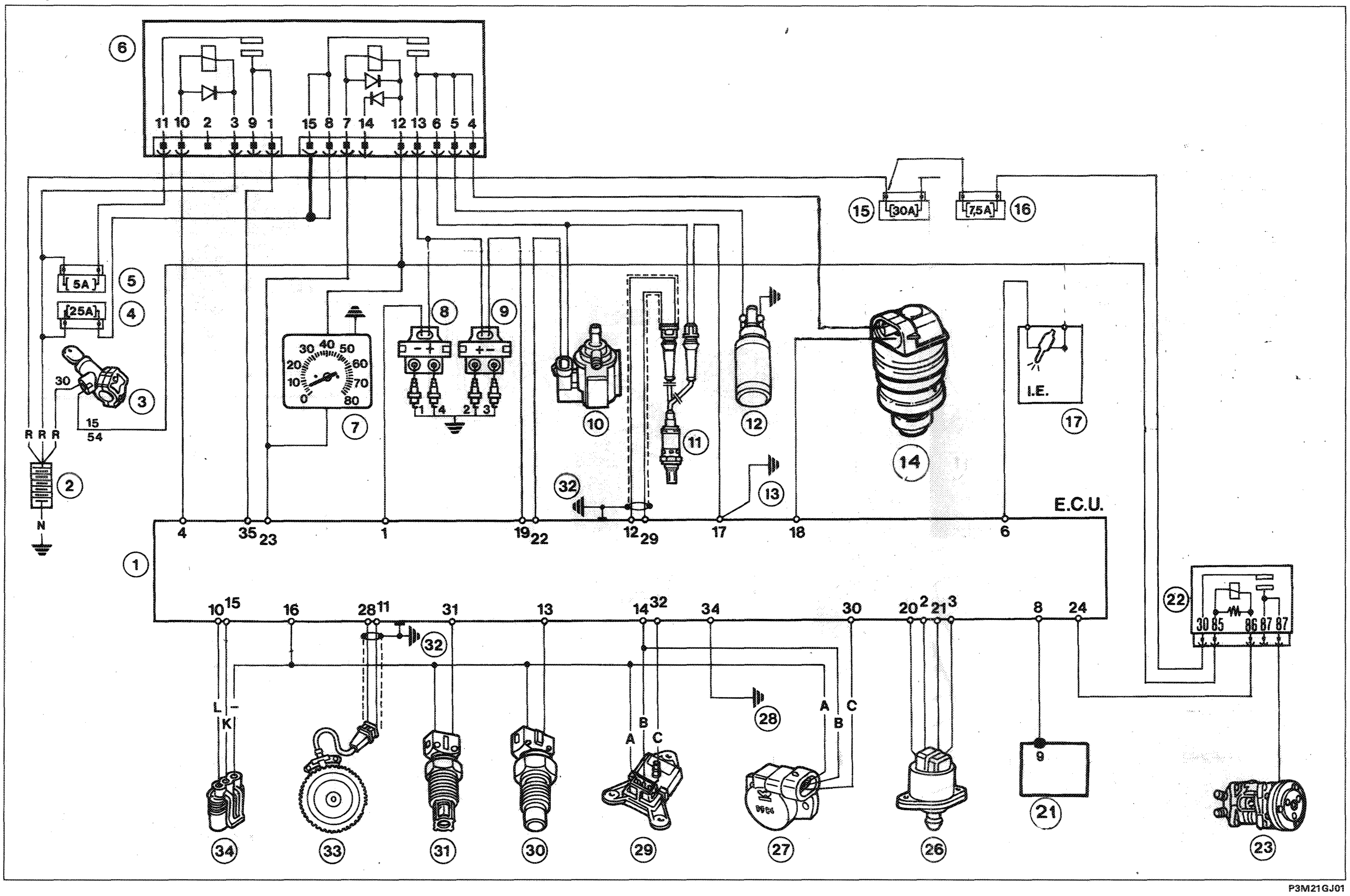
This is electronic **solid stage, breakerless,** with power module inside control unit (or electronic control unit) and lacks a distributor. It is fitted with two ignition coils with dual high tension outlets connected directly to the spark plugs of cylinders 3-2 and 4-1 respectively.
Each primary circuit is connected to the battery voltage through the system power relay - with ignition switch turned to MAR -and earthed directly by the injection-ignition control unit to which the two primary windings are connected (via terminals 1 and 19 respectively).

The spark plug (connected in line with high tension circuit) is supplied at a very high voltage when, upon the spark, the pressure inside the cylinder is high (compression stage) and gives a very low voltage when the pressure is low (exhaust stage).

The ignition advance angle, governed by the injection-ignition ECU, alters according to engine rpm and inlet manifold pressure level - according to tables memorized in the control unit - and is corrected in accordance with the following parameters: coolant temperature; sudden changes in idle speed; pressure changes; return from cut-off; excessive engine rpm and during start-up.

A. Engine rpm sensor signal
B. Power control in ECU
C. Current running within coil primary winding
a. Ignition advance in relation to cylinder TDC

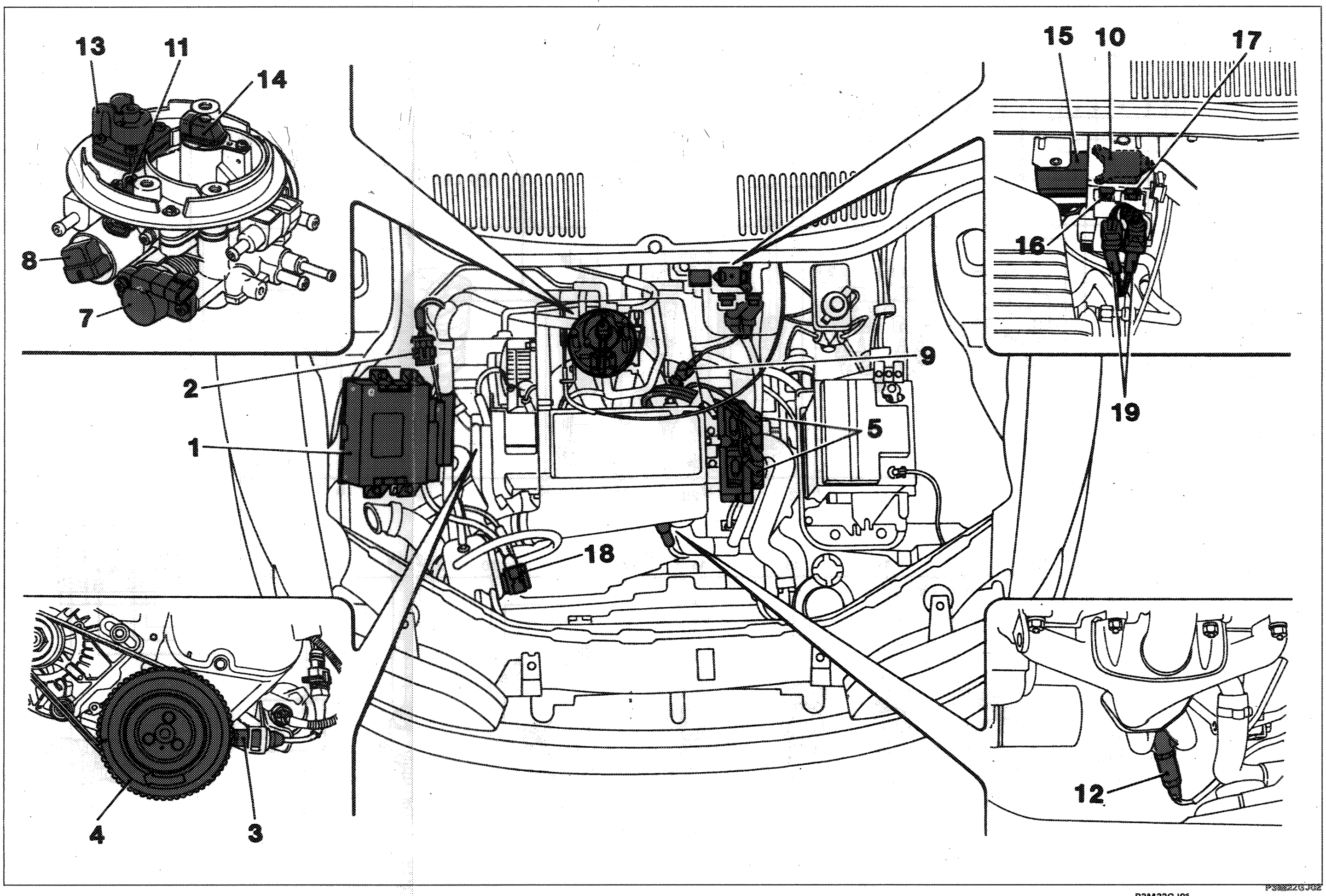
ECU/ACTUATOR SENSOR ELECTRICAL CONNECTION DIAGRAM



1. IAW injection-ignition ECU.
2. Battery
3. Ignition switch
4. 25A fuse protecting injection-ignition system
5. 5A fuse protecting electronic control unit
6. Dual relay
7. Rev counter (if present)
8. Ignition coil N°1 for spark plugs 1-4
9. Ignition coil N°2 for spark plugs 2-3
10. Petrol vapour cut-off solenoid
12. Electric fuel lift pump
13. Power earth
14. Injector
15. 30A fuse for air conditioning system
16. 7.5A fuse for air conditioning system
17. Instrument panel with electronic injection failure warning light
21. Nippodenso ECU for air conditioner compressor
22. Compressor coupling supply relay (located in air conditioner auxiliary ECU)
23. Compressor
26. Step motor
27. Throttle-potentiometer position sensor
28. Power earth
29. Absolute pressure sensor
30. Coolant temperature sensor
31. Air temperature sensor
32. Earth on case of screen ECU (11) and (28) of terminals of sensor (33)
33. Rpm and TDC sensor.
34. Diagnostic socket for Fiat/Lancia Tester

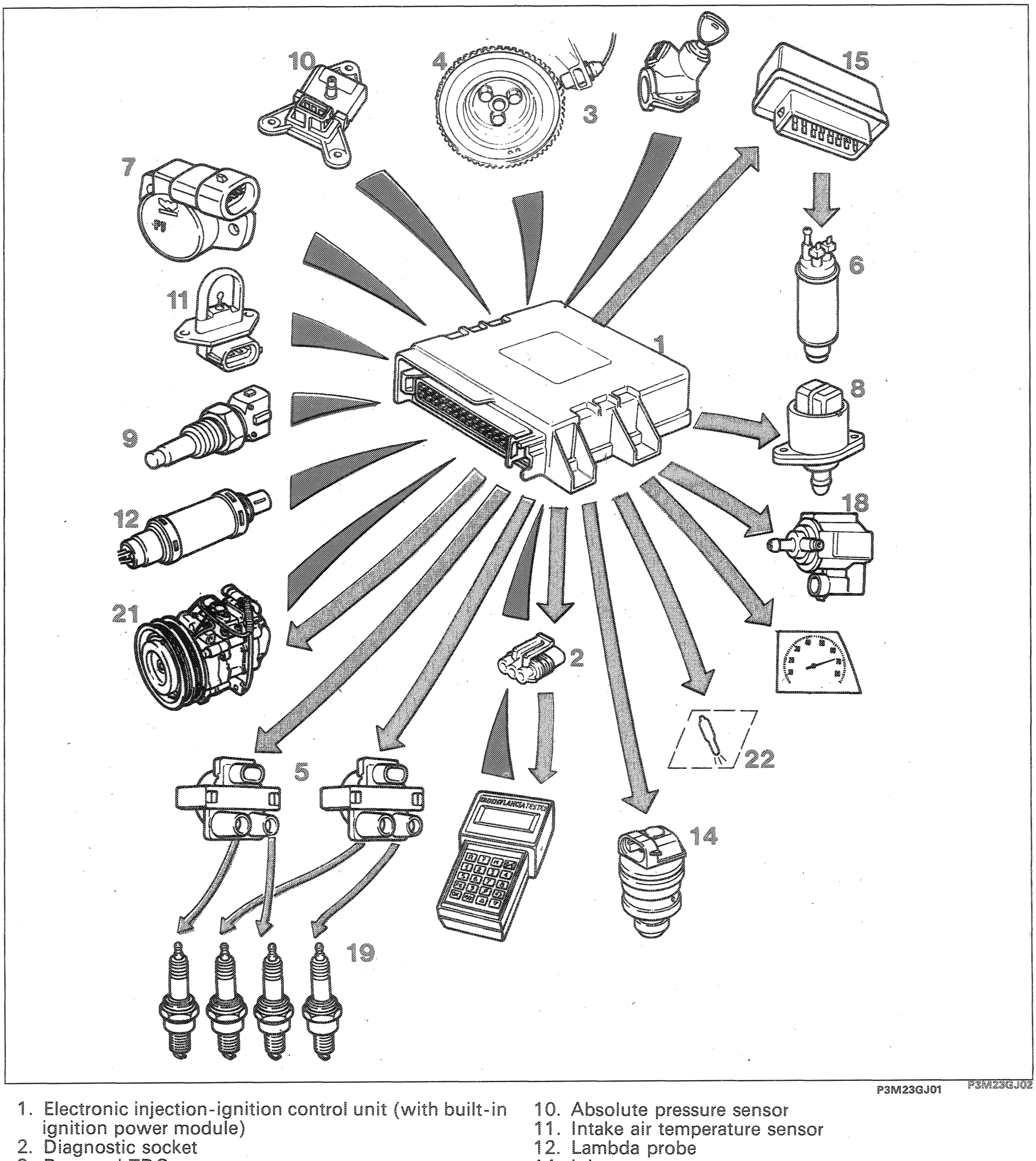
10.

LOCATION OF COMPONENTS OF SPI INJECTION-IGNITION SYSTEM I.A.W. 06F IN ENGINE BAY



1. Electronic injection-ignition control unit (with built-in ignition power module)
2. Diagnostic socket
3. Rpm and TDC sensor.
4. Engine pulley ring gear (phonic wheel)
5. Ignition coils with two high tension points
7. Throttle valve position sensor
8. Engine idle speed regulation actuator
9. Coolant temperature sensor on inlet manifold
10. Absolute pressure sensor
11. Intake air temperature sensor
12. Lambda probe
13. Fuel pressure regulator
14. Fuel manifold injector
15. Fuel pump ECU dual supply relay
16. System fuse (injection-ignition) (20A)
17. ECU fuse (5A)
18. Fuel vapour recirculation solenoid
19. Lambda probe connectors

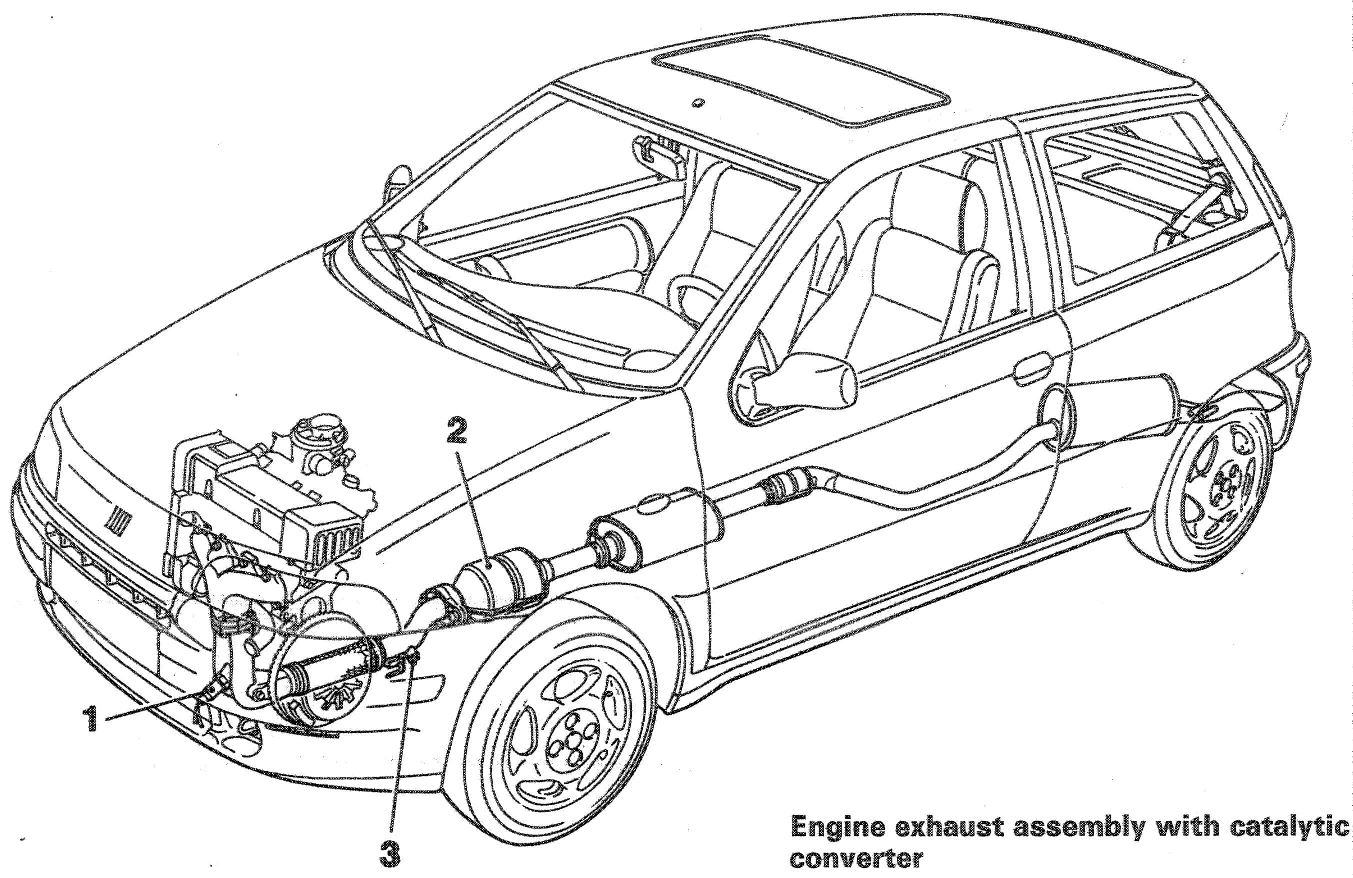
DIAGRAM OF INPUT AND OUTPUT BETWEEN ECU AND SYSTEM SENSORS AND ACTUATORS



P3M23GJ01 P3M23GJ02

1. Electronic injection-ignition control unit (with built-in ignition power module)
2. Diagnostic socket
3. Rpm and TDC sensor.
4. Engine pulley ring gear (phonic wheel)
5. Ignition coils with two high tension points
6. Electric fuel pump
7. Throttle valve position sensor
8. Engine idle speed regulation actuator
9. Coolant temperature sensor on inlet manifold
10. Absolute pressure sensor
11. Intake air temperature sensor
12. Lambda probe
14. Injector
15. Fuel pump ECU dual supply relay
18. Fuel vapour recirculation solenoid
19. Spark plugs
21. Air conditioner compressor
22. SPI system failure warning light.

D. SYSTEM FOR CONTROLLING HARMFUL EXHAUST EMISSIONS



Engine exhaust assembly with catalytic converter

P3M24GJ01

1. Lambda probe
2. Catalytic converter
3. Point for measuring CO upstream of catalytic converter

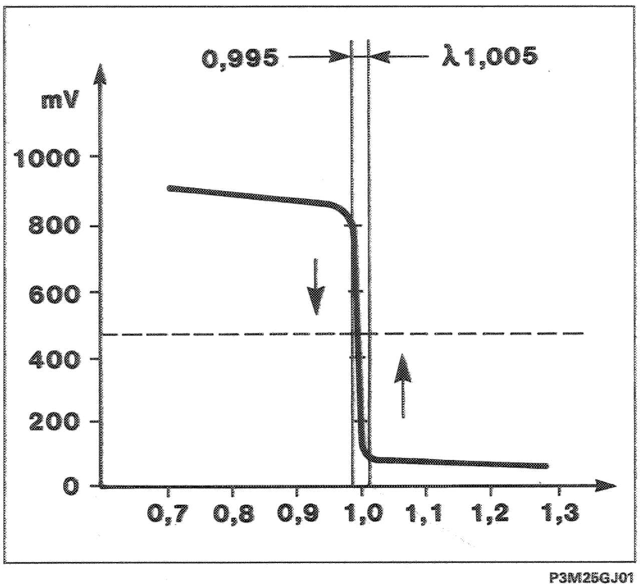
Lambda probe

This sensor measures exhaust gas oxygen content.
The sensor output signal is sent to the electronic control unit to adjust the air-fuel mixture in order to maintain the stoichiometric ratio as close as possible to theoretical levels.

To obtain an optimum mixture, the quantity of fuel injected must be as close as possible to a theoretical quantity that could be fully burnt for a given amount of air taken in by the engine.

In this case the Lambda factor (λ) is said to be 1; in fact:

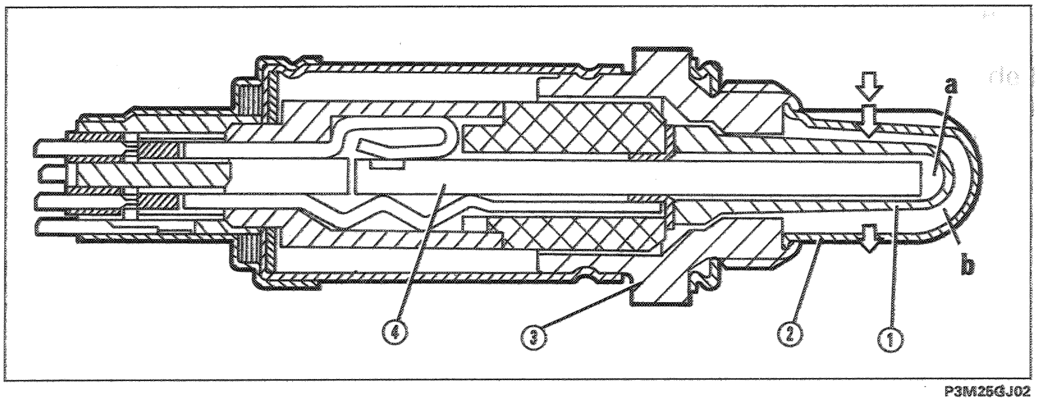
$$\lambda = \frac{\text{INTAKE AIR QUANTITY}}{\text{THEORETICAL QUANTITY OF AIR NECESSARY TO BURN ALL THE FUEL INJECTED}}$$



λ= 1 Ideal mixture
The CO is kept within specified limits
λ⩾ 1 Lean mixture
Excess of air; CO tends to be low
λ⩽ 1 Rich mixture
Lack of air; CO tends to be high

NOTE *While coefficient λ expresses an excess or lack of air supplied to the engine in relation to the theoretical required level, the air-fuel mixture is a ratio between these two substances that react chemically when combined. Present day engines require 14.7 parts of air to burn 1 part of petrol (14.8:1 with unleaded fuel).*

The probe is fastened upstream of the converter. It consists of a ceramic case (1) made up of a zirconium dioxide base covered by a light layer of platinum. It is sealed at one end, enclosed in protective pipe (2), and housed in metal case (3) that provides further protection and permits installation to the exhaust manifold. The outer part (A) of the ceramic case is exposed to the exhaust gas flow while inner part (A) communicates with the outside air.
The probe works on the principle that when the temperature exceeds 300 °C, the ceramic material used begins to conduct oxygen ions. Under these conditions, if the levels of oxygen at both ends (a-b) of the probe are different, a voltage variation is set up between the two ends. This signal notifies the ECU that the oxygen residues in the exhaust gas are not in proportions that will ensure lean burning of harmful residues.
Below 300 °C the ceramic material is not active and the probe does not send usable signals. A special circuit in the control unit blocks closed-loop mixture regulation. To ensure service temperature is reached quickly, the probe is equipped with electrical resistance (4) supplied by the battery. This also permits the probe to be located in cooler areas of the exhaust system.



1. Ceramic case
2. Protective pipe
3. Metal case
4. Electrical resistance

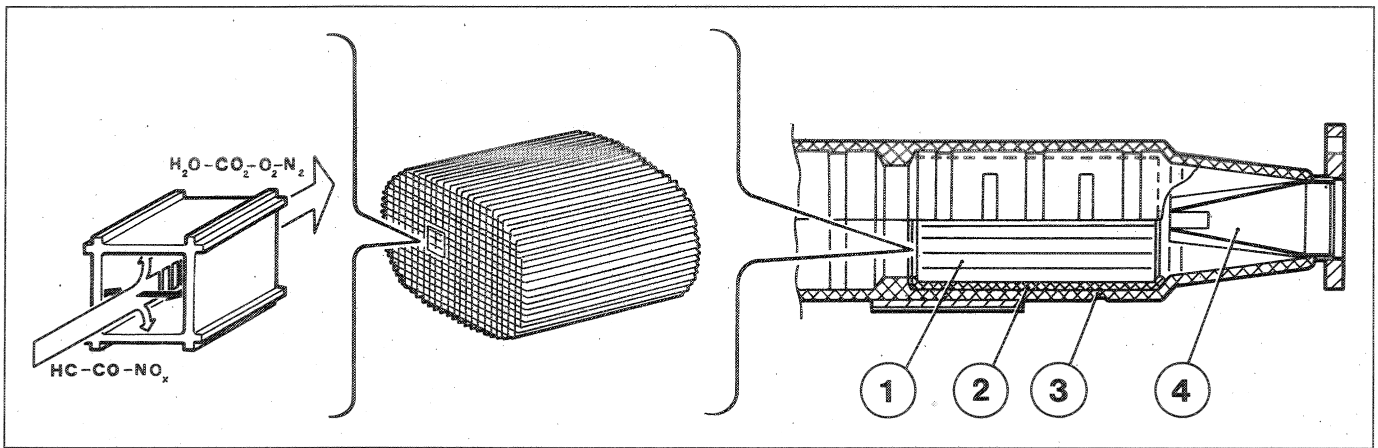
10.

Trivalent catalytic converter

In the IAW system, closed loop control of mixture concentration is activated by a lambda probe sensor that measures the amount of oxygen in the exhaust gas upstream of the catalytic converter.

The lambda probe readings allow the ECU to correct the concentration continually and maintain the fuel/air ratio constant.
In this way, harmful exhaust emissions are controlled and this operation is completed by the trivalent catalytic converter.
Efficient catalytic converter operation and thus effective containment of exhaust gas toxicity depends on the ratio of the air/fuel mixture supplied to the engine.
The trivalent catalytic converter allows the three pollutant gases in exhaust gases to be removed simultaneously: uncombusted hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NOx).

Two types of chemical reaction take place inside the catalytic converter:
- oxidation of CO and HC to carbon dioxide (CO_2) and water (H_2O)
- reduction of NOx to Nitrogen (N_2).



P3M26GJ01

1) Ceramic block
2) Metal support
3) Outer steel case
4) Sheet steel perforated cone

The catalytic converter consists of block (1) and steel mesh support (2) for protecting the core from knocks and vibrations and outer case (3) in stainless steel that is resistant to high temperatures and atmospheric agents.
The block is designed with a honeycomb structure with a very light covering of catalytically active material, platinum or rhodium, that accelerates the chemical breakdown of harmful substances in the exhaust gas. These pass through the core chambers at temperatures in excess of 300 - 350° C to activate the catalysts and trigger oxidation and reduction actions.

To optimise catalyzer efficiency and duration, a perforated sheet steel cone (4) improves the distribution of exhaust gas throughout the ceramic core chambers.
The catalytic converter can be swiftly and irreparably put out of action by the following causes:
- presence of lead in fuel, which lowers the level of conversion so far that its presence in the system is worthless;
- presence of uncombusted fuel in the converter: a fuel flow lasting 30s at a temperature of 800°C (temperature inside converter) is sufficient to bring about meltdown and failure of the converter. It is absolutely essential that the ignition system is working perfectly, therefore, **under no circumstances should the spark plug leads be disconnected with the engine running. When testing, therefore, the converter should be replaced with an equivalent section of pipe.**

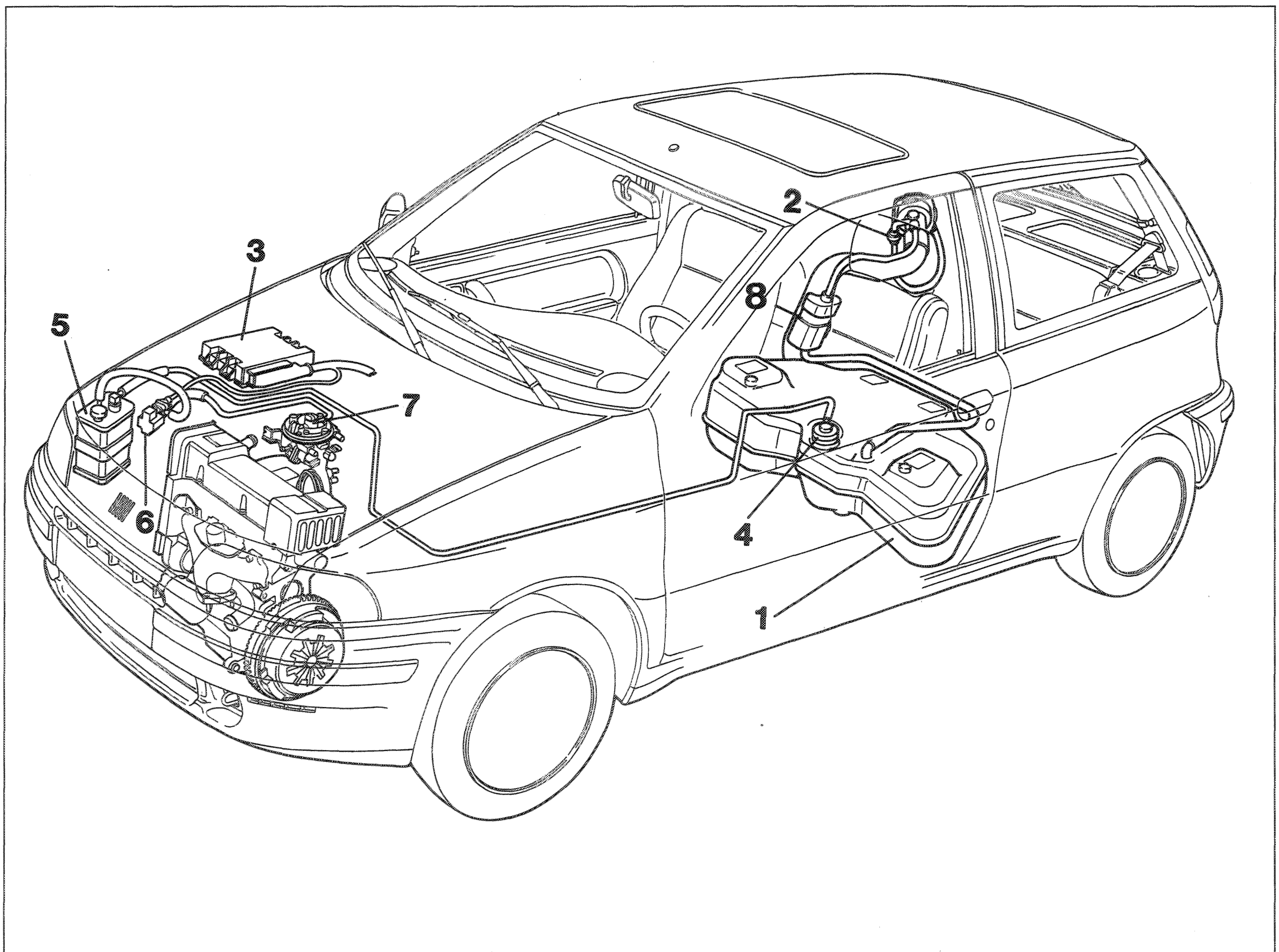
Correct use of the converter will permit efficient operation for not less than 80000 km or a period of at least five years.

FUEL EVAPORATION CONTROL AND VAPOUR RECOVERY CIRCUIT

The system adopted for tank ventilation is "closed" type.
This system prevents fuel vapours formed within the tank and fuel system from entering the atmosphere It also prevents the release of their load of polluting light hydrocarbons (HC).

The system consists of: tank (1) with plug on filler fitting without ventilation hole; a two-way safety valve (2); multifunctional valve (4) for controlling the flow of fuel vapours into the tank; an active carbon filter (or trap) (5); solenoid (Siemens) for cutting off fuel vapours (6), controlled by ECU (3) of IAW injection-ignition system, and lastly injector turret (7).

The system operates when, with high outdoor temperatures, after the vehicle has been at a standstill for a long time, the fuel temperature increases (because the tank is no longer cooled by the car's motion) and brings about a pressure increase inside the tank. This increase may occur with medium-low fuel levels or with the tank full - in particular:



P3M27GJ01

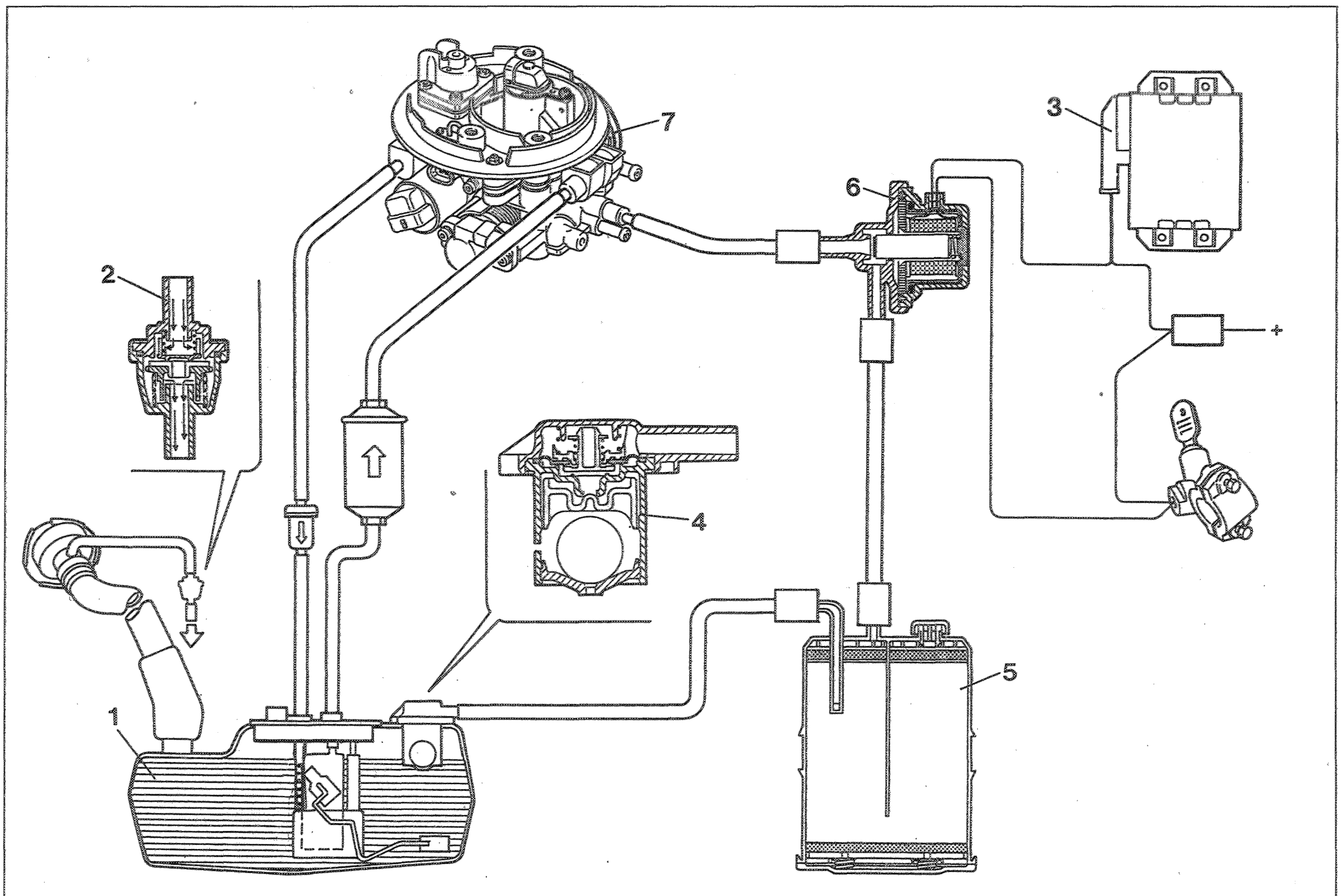
1 - Fuel tank (with filler plug without ventilation hole)
2 - Two-way safety valve
3 - Injection/ignition control unit
4 - Multifunction valve
5 - Active carbon trap filter (located in engine bay)
6 - Petrol vapour cut-off solenoid
7 - Throttle case
8 - expansion tank

10.

- During tank filling, the pressure inside is more or less the same as atmospheric pressure. Because the multifunctional valve only allows fuel to pass through at excess pressures of 30-45 mbar this remains closed. Even when completely full, the tank still contains a pocket of air (about 7 litres) necessary for efficient operation of the evaporation control system when the vehicle is running.

- When the cap is closed and seals the system, the vapours generated inside the tank (with vehicle moving or while parked) build up due to fuel volatility and tank internal pressure also builds up until the valve opening level is exceeded. Under these conditions the vapours flow to the active carbon trap where they are absorbed. These vapours then reach the inlet manifold, when the injection/ignition system brings about opening of the vapour cut-off solenoid. While the vehicle is in motion, when the amount of fuel consumed is greater than the vapours produced, the multifunctional valve allows air back into the tank through the active carbon filter.

  If the system is not working properly, a two-way safety valve on the fuel filler is able to drain off excess pressure and allow air into the tank.



P3M28GJ01

Diagram of evaporation control and fuel vapour recovery circuit

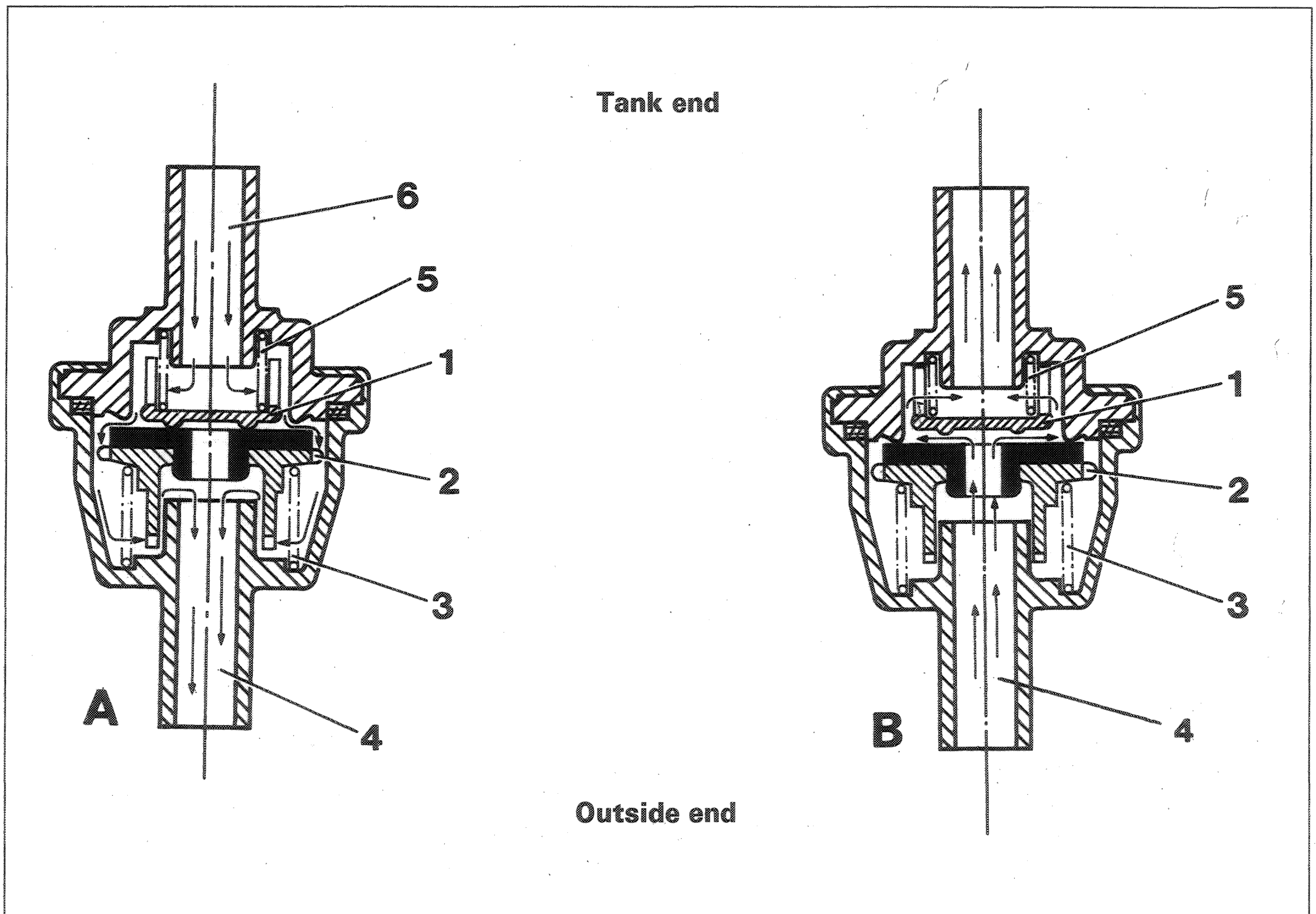
1 - Fuel tank
2 - Two-way safety valve
3 - Injection/ignition control unit
4 - Multifunction valve
5 - Active carbon trap filter
6 - Vapour cut-off solenoid
7 - Throttle case

OPERATION OF MAIN FUEL EVAPORATION CONTROL SYSTEM COMPONENTS:

Safety valve (two-way)

This valve operates in two different ways according to the pressure inside the tank:

- When the pressure inside the tank exceeds an established level 130-165 mbar (detail A) it pushes case (2) to overcome the load of spring (3) and allow excess pressure to drain off outside through breather pipe (4) to maintain conditions of safety;
- When a vacuum of <20 mbar is set up in the tank due to the removal of fuel (detail B), plate (1) overcomes the load of spring (5) to open a passage that allows air from vent pipe (4) to enter the tank and restore the pressure to specified values (ventilation function).



P3M29GJ01

The two-way safety valve is two-coloured (WHITE-LIGHT BLUE) and must be fitted the right way round: the white side bearing the word "TANK" (TANK END) must be postioned toward the tank.

10.

Multifunction valve

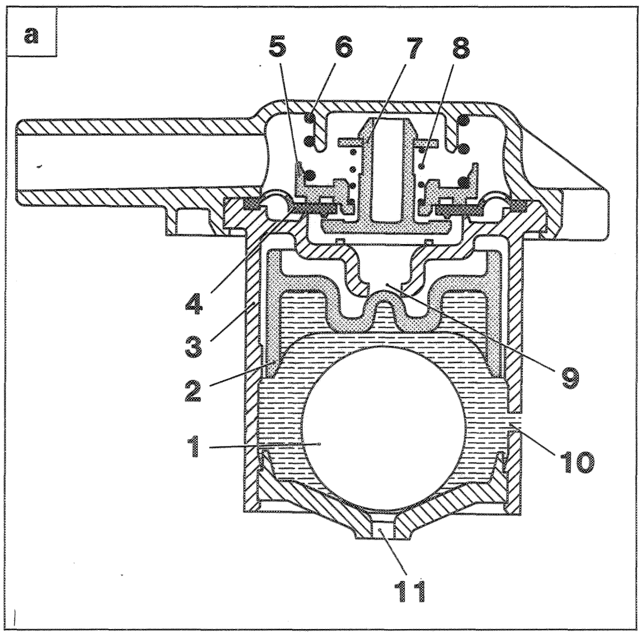
This valve performs the following functions:
- prevents fuel flowing out in case the vehicle overturns in an accident;
- vents fuel vapours from tank to the active carbon trap filter;
- ventilates the tank if a vacuum builds up inside.

This valve consists of: a float (2); a heavy ball (1); a plate (5), pushed against diaphragm (4) that in turn touches valve case (3); spring (6); plate (7), pushed against diaphragm (4), by spring (6).

With regard to fuel tank filling, multifunctional valve operation is as follows:

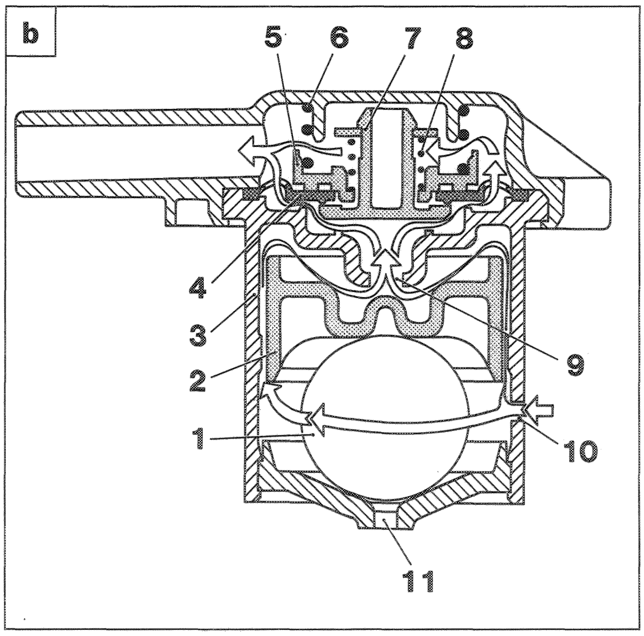
a) **if the tank is full** float (2) blocks hole (9) to prevent liquid fuel from reaching active carbon filter and avoid damage to the filter;
b) **the tank fuel level drops,** float (2) is lowered and rests upon ball (1) to open hole (9), which can be reached by gas through ring section between float (2) and inner seat of valve case (3). When the pressure exercised by fuel vapours on plate (7) and free ring section of diaphragm (4) exceeds a level of 0.038 up to 0.053 bar the force set up on (4 and 7) overcomes load of spring (6), to open a ring opening between diaphragm (4) and valve case (3) that allows fuel vapours to emerge from the tank and reach the active carbon filter.

Cross sections through multifunctional valve in service positions a and b



P3M30GJ01

a) Valve closure with tank full



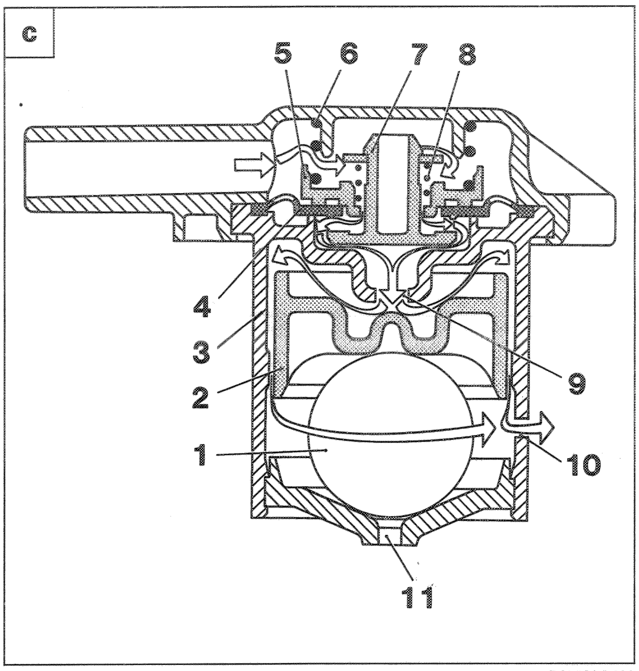
P3M30GJ02

b) Valve opening with vapour flow from tank to active carbon filter.

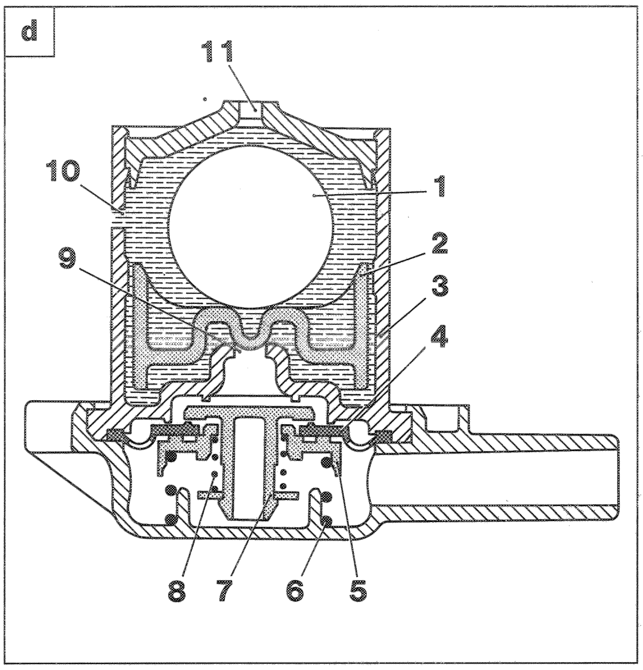
c) if the drop in tank fuel level is sufficient to set up a vacuum of 0 up to 0.015 bar it acts on plate (7) and overcomes load of spring (8) so that this moves down to allow tank ventilation through ring sections opened up between plate (5), plate (7), hole (9), float (2) inner seat of valve case (3) and hole (10).

d) if the vehicle overturns, however full the tank, the combined weight of ball (1) and the fuel act on float (2) to push the float against hole (9) and prevent a dangerous flow of fuel to the active carbon filter and then on to the injector turret with the attendant risk of the vehicle catching fire.

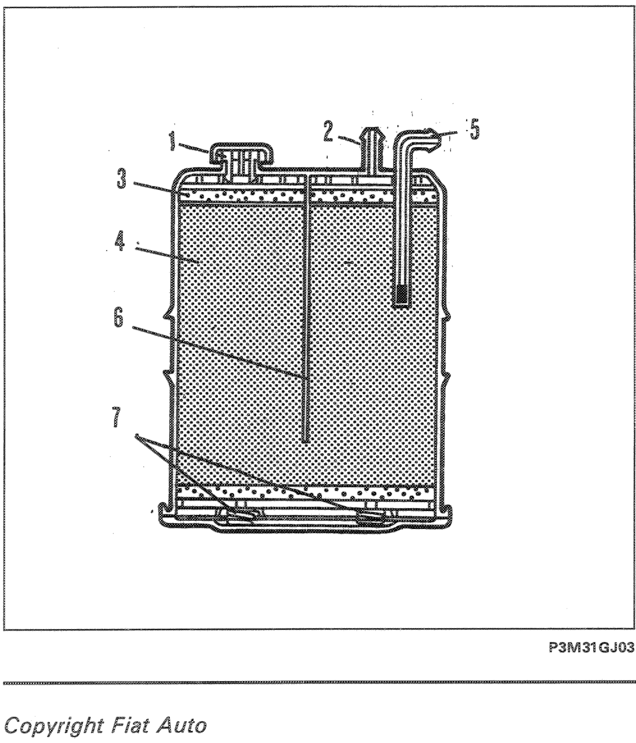
Cross sections through multifunctional valve in working positions



c) Valve opening for tank ventilation.



d) Valve safety closure in case of vehicle overturning.



Active carbon filter

This consists of carbon granules (4) that trap fuel vapour entering intake (5).

Flushing air enters intake (1), through paper filter (3) and flows over the carbon granules to remove fuel vapours and carry them toward the outlet (2) and then on toward the cut-off valve.
Air entering through intake (5) may also be pulled back by a vacuum in the tank, when it serves to ventilate the tank.
Partition (6) ensures that the flushing air flows over all the carbon granules and promotes the release of fuel vapour toward the inlet manifold.
Two springs (7) allow the mass of granules to expand when the pressure increases.

10.

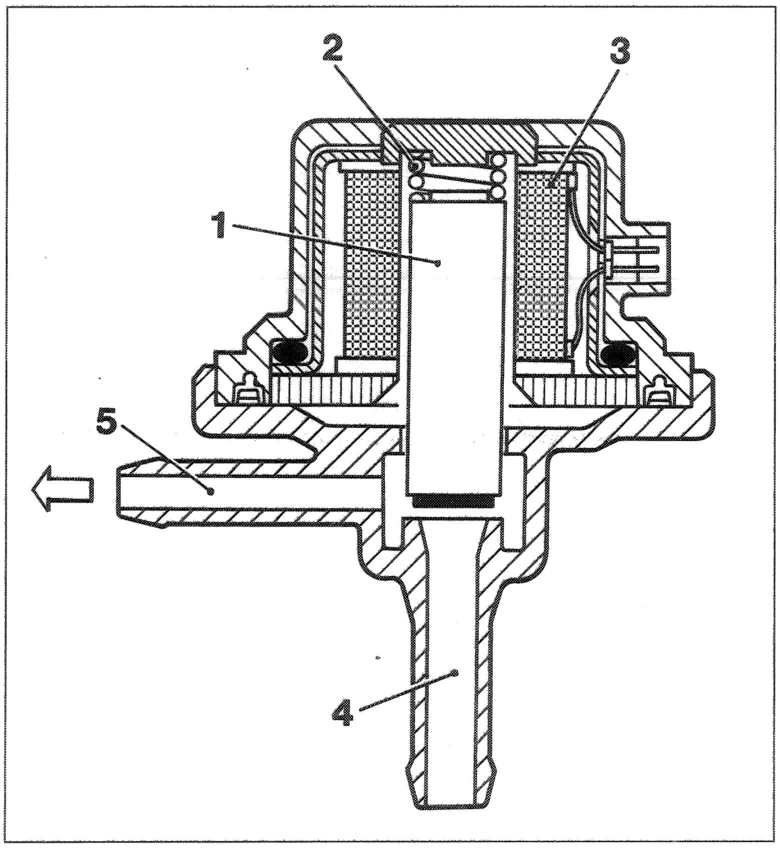
PETROL VAPOUR CUT-OFF SOLENOID (SIEMENS)

This solenoid controls, via the injection-igntion ECU, the amount of fuel vapour taken up by the active carbon filter and directed to the inlet manifold.

When not activated, this valve is closed to prevent fuel vapours enriching the mixture excessively.

Operation is controlled by the injection-ignition ECU as follows:

- during start-up, it remains closed to prevent fuel vapours enriching the mixture excessively. This condition is maintained until a certain coolant temperature level is reached.



Cross section through fuel vapour cut-off solenoid

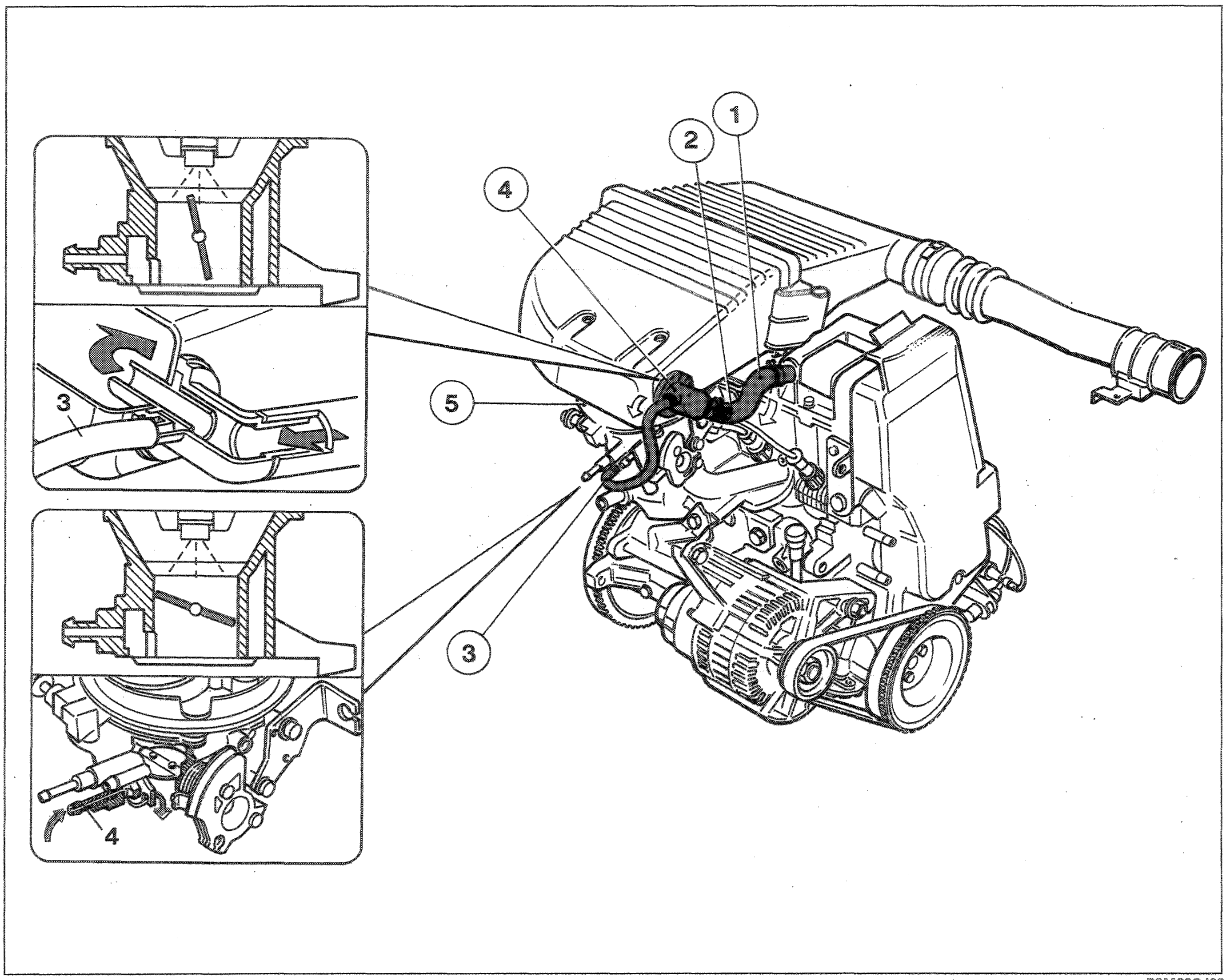
1. Valve core
2. Reaction spring
3. Magnetic winding
4. Duct to injector turret
5. Duct to active carbon filter

- when the engine is warm, the ECU sends the solenoid a square wave signal that modulates opening according to the full/empty ratio of the signal.
  In this way, the ECU controls the amount of fuel vapour sent to the intake and prevents significant changes in mixture concentration.

Under these operating conditions: throttle in idle position; rpm less than a certain speed; inlet manifold pressure less than a certain level - solenoid control is inhibited to maintain the same closure position, i.e. improve engine operation.

CRANKCASE GAS RECYCLING SYSTEM

The system controls crankcase emissions of vented gases made up of air-fuel mixtures and combusted gases that leak through the piston rings, in addition to lubricant oil vapours, by causing them to recirculate to the intake.
With the accelerator throttle open, gas from the top cover reaches the air cleaner through pipe (1), which contains a flame trap (2) to prevent combustion due to the flame returning from the throttle case (5).
With the throttle closed (engine idling), the vacuum in the inlet manifold takes up the gas (in limited quantities) directly through pipe (3) and calibrated hole (4).



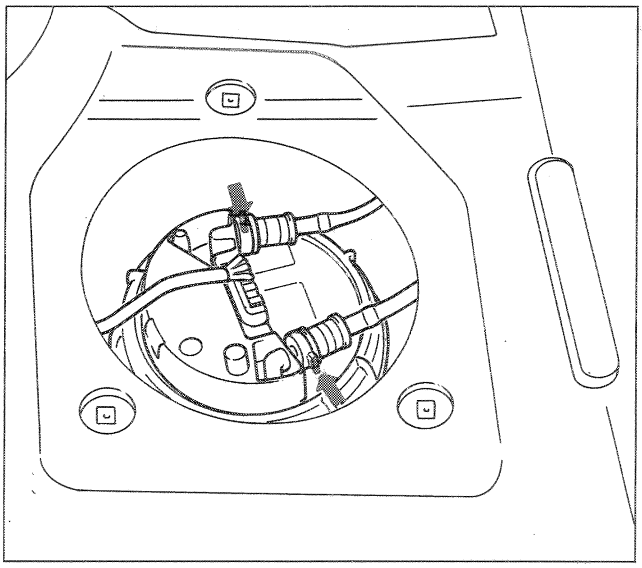
P3M33GJ01 P3M33GJ02

10.

CHECKS - ADJUSTMENTS AND REPAIRS TO WEBER INJECTION/IGNITION SYSTEM (S.P.I.) ADDITIONAL TO DIAGNOSES WITH FIAT/LANCIA TESTER

OBSERVE THE FOLLOWING PRECAUTIONS WHEN WORKING ON VEHICLES WITH IAW INJECTION-IGNITION SYSTEMS:
- *never start the engine when the electrical terminals are poorly connected or loose on the battery poles;*
- *never use a quick battery charger to start the engine;*
- *never disconnect the battery from the car circuit with the engine running;*
- *when charging the battery quickly, first disconnect the battery from the vehicle circuit;*
- *if the vehicle is placed in a drying oven after painting at a temperature of more than 80° C, first remove the injection/ignition ECU;*
- *never connect or disconnect the ECU multiple connector with the ignition key in MARCIA position;*
- *always disconnect battery negative lead before carrying out electrical welding on vehicle.*

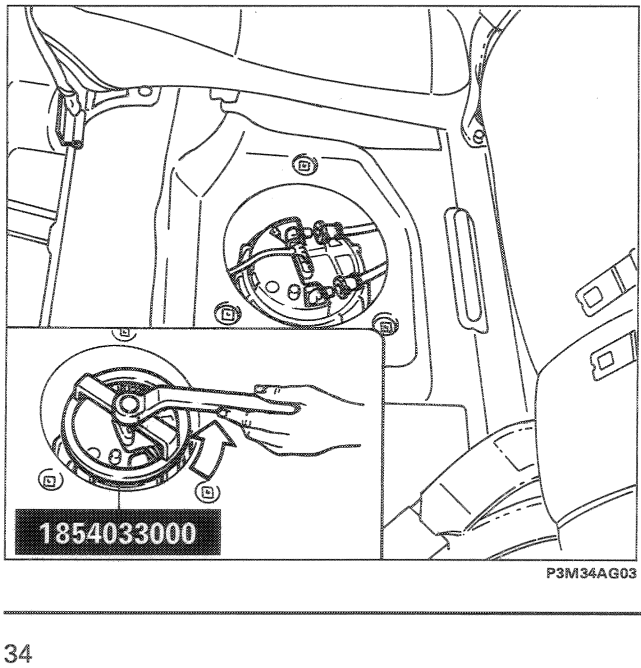
Note that system contains one memory that is always active (stand-by memory) that stores learnt self-adaptive values. Because this data is lost when the battery is disconnected, this operation should be carried out as infrequently as possible.



P3M34GJ01 P3M34GJ02

REMOVING-REFITTING ELECTRIC FUEL PUMP

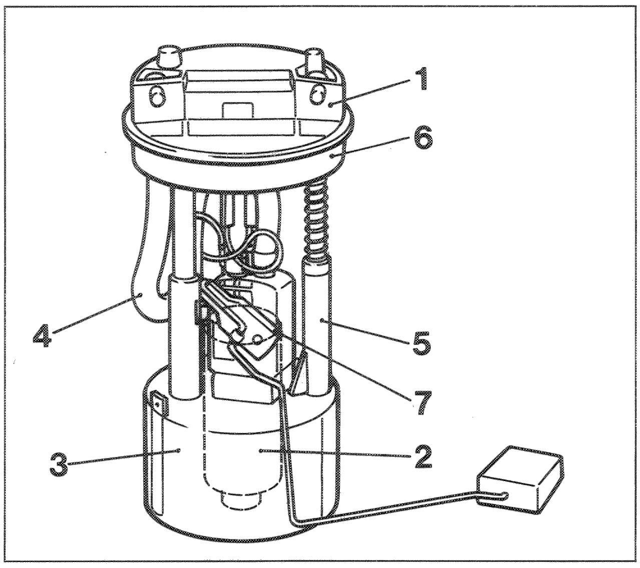
The electric pump is located inside the fuel tank.
In order to remove:
- raise rear seat;
- remove protective cover;
- disconnect electrical connection;
- disconnect fuel delivery and return line quick-release fittings by pressing the two tabs indicated by the arrows;



P3M34AG03

- unscrew lock-ring connecting pump to tank using tool 1854033000 and a polygonal wrench;
- remove pump.

Ensure that quick-release fuel line fittings are fitted properly onto pump fittings.



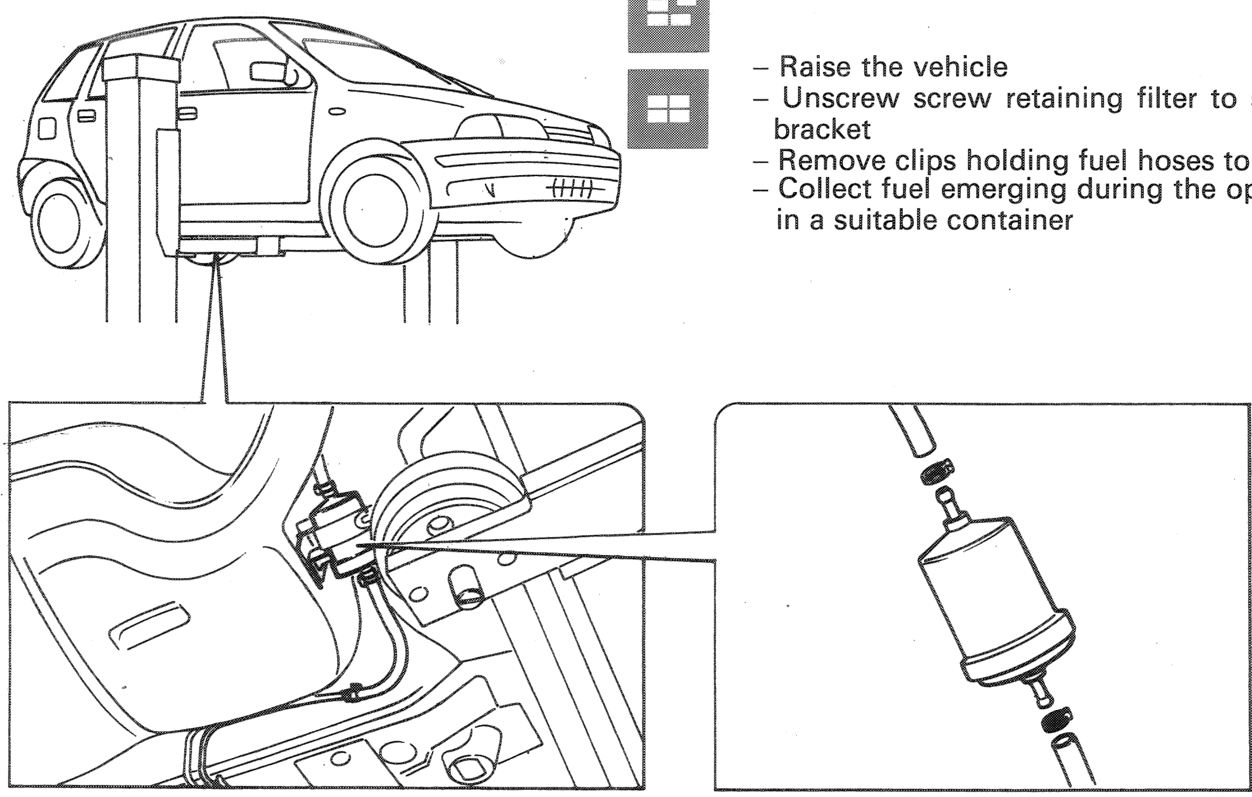
P3M35GJ01

Components of fuel pump assembly

1 – Retaining plate
2 – Electric fuel pump
3 – Mesh prefilter
4 – Delivery line
5 – Return line
6 – Gasket
7 – Fuel level gauge sender unit

REMOVING-REFITTING FUEL FILTER

- Raise the vehicle
- Unscrew screw retaining filter to support bracket
- Remove clips holding fuel hoses to filter
- Collect fuel emerging during the operation in a suitable container



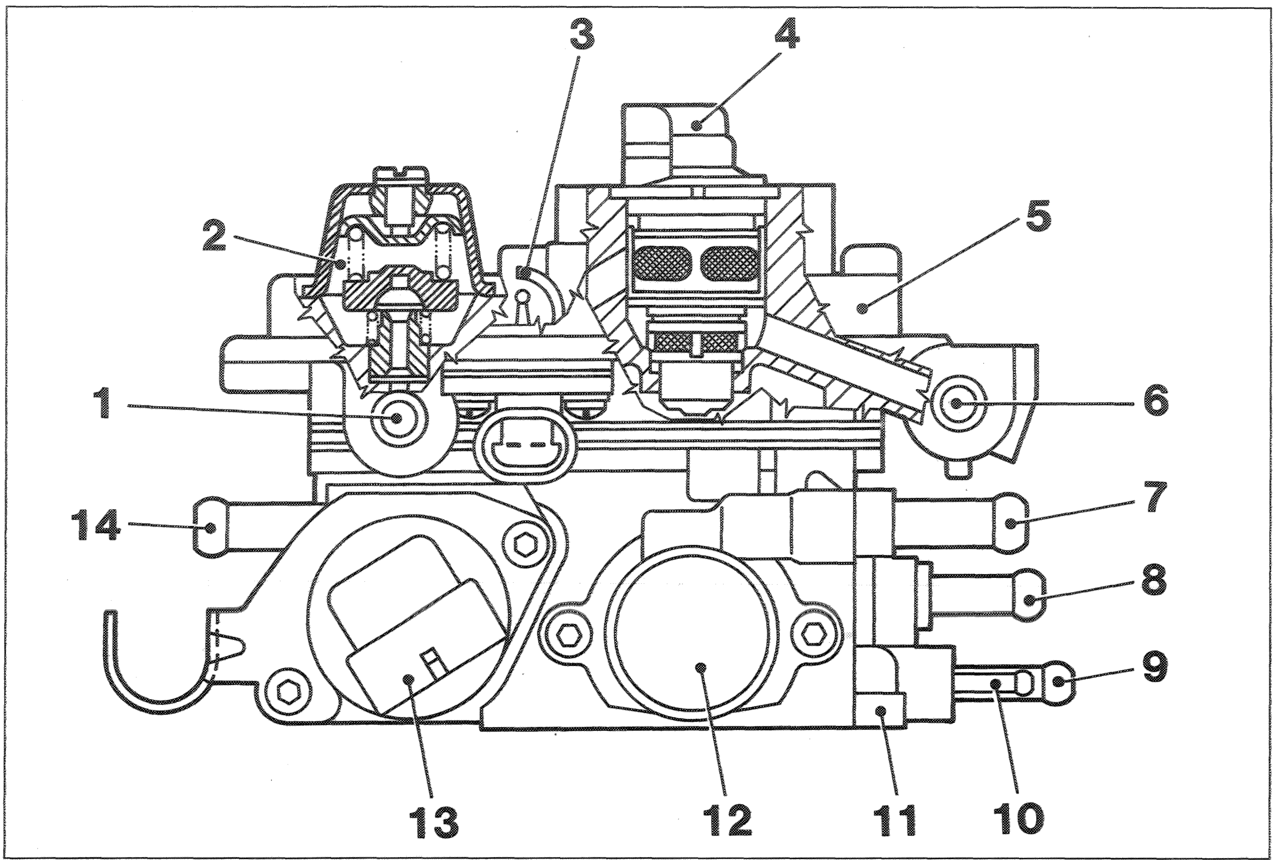
P3M35GJ02

The fuel filter must be replaced at intervals of 30,000 km.

NOTE *The filter MUST NEVER BE OVERTURNED, otherwise it must be replaced (even after only a short period of operation) The arrow stamped on the outer case indicates the fuel flow direction.*

10.

REMOVING - REFITTING COMPONENTS OF INJECTOR TURRET



P3M36GJ01

1. Fuel return to reservoir
2. Fuel pressure regulator
3. Intake air temperature sensor
4. Injector
5. Cover
6. Fuel intake to turret
7. Turret heating water intake
8. Fuel vapour cut-off solenoid vacuum point (blue bush) to active carbon filter
9. Blow-by point (brown bush)
10. Socket for absolute pressure sensor
11. Throttle case
12. Throttle position sensor
13. Idle control actuator
14. Turret heating water intake

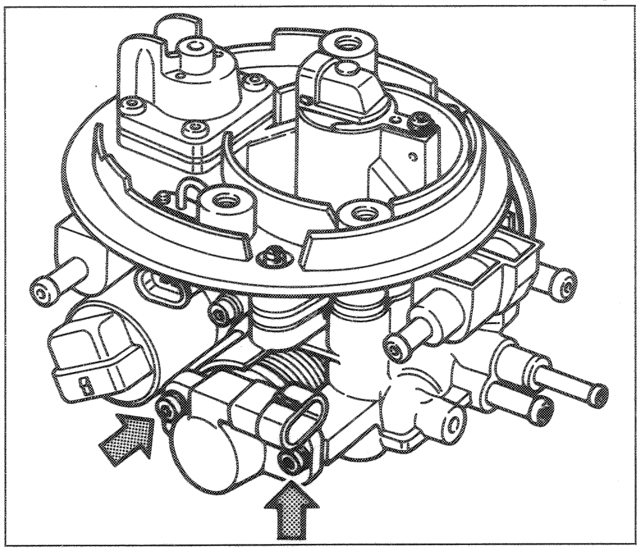
Observe the following precautions in order to avoid damage:

- The case and the various turret components must never be submerged in any type of washing fluid;
- the shaft and throttle must never be removed from their seats;
- carry out general cleaning only with compressed air and brush.

Never tamper with throttle valve anti-bind screw under any circumstances.
Whenever injector or pressure regulator component replacement is required, replace entire cover.

Tightening torque of screws retaining throttle case to inlet manifold 0.7 da Nm.

P3M37GJ01



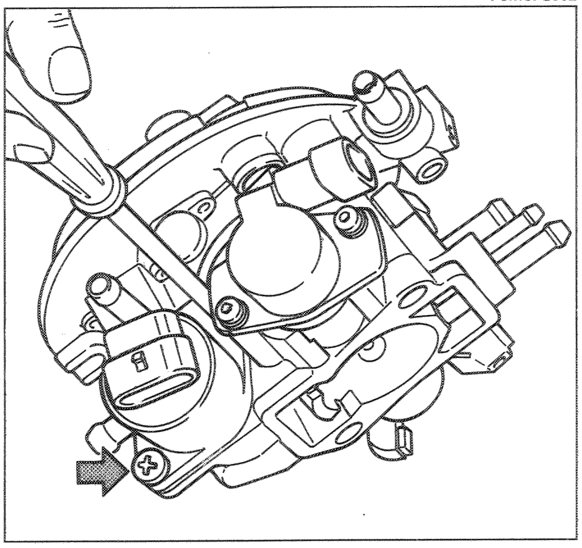
DISMANTLING-FITTING THROTTLE VALVE OPENING POSITION SENSOR (POTENTIOMETER) IN INJECTOR TURRET

- disconnect electrical connector from potentiometer;
- unscrew screws retaining potentiometer to injector turret;
- refit the potentiometer, taking care to fit throttle pin correctly into mobile part;
- screw in and tighten potentiometer retaining screws (0.2-0.3 daNm)
- turn the ignition key to MAR, **without connecting** the connector to the potentiometer and wait a few seconds;
- return the ignition key to STOP position;
- connect connector to potentiometer;
- connect Fiat/Lancia Tester, turn ignition switch to MAR and cancel error that will appear;
- then carry on until throttle position is displayed: value **should be 0° to 4°.**
  If the reading is **greater than 14°** check that the throttle valve cable is correctly adjusted and not too tight (see next page for cable adjustment instructions).

NOTE *When specified throttle opening angle cannot be obtained, replace the potentiometer because it is defective and potentiometer retaining screw holes cannot be adjusted.*

Whenever potentiometer screws are loosened or removed they should be changed, because the thread is covered with a light layer of loctyte and this is able to ensure a tight fit only once.

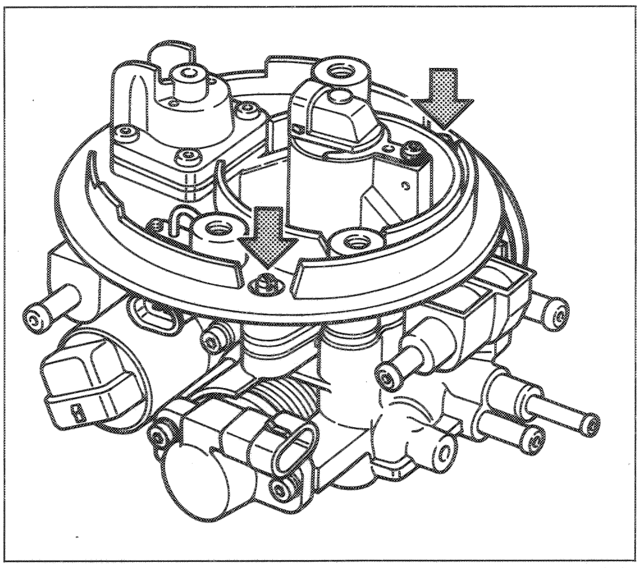
P3M37GJ02



DISMANTLING-FITTING ADDITIONAL AIR AND IDLE SPEED ACTUATOR (STEP MOTOR)

- disconnect battery negative terminal;
- unscrew both screws and remove actuator;
- check condition of thoroid seal and remove any contamination from seat on case;
- refit the actuator, checking that the plunger is inserted properly without forcing it in its seat. To do this, with the actuator fitted and the retaining screws in place but not tightened, operate the step motor using a Fiat/Lancia/Tester so that it moves through its entire range of travel. After checking plunger is properly aligned in its seat and electrical connector is positioned, tighten screws to a torque of 0.36-0.44 daNm

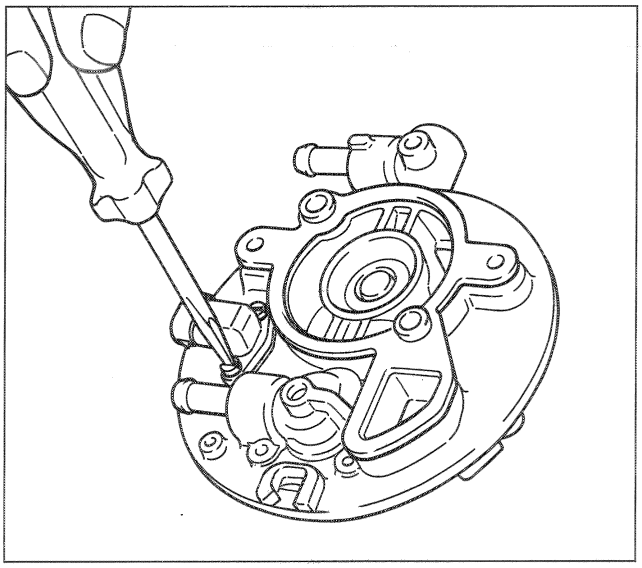
NOTE *It is advisable to leave the battery negative terminal disconnected for about 20 minutes. If this procedure is applied, the injection and ignition ECU will position the idle speed actuator correctly the first time the engine is started. Whenever the step motor screws are loosened or removed they should be changed because the thread is covered with a light layer of loctyte and this is able to ensure tightening once only.*



P3M38GJ01

REPLACING INLET AIR TEMPERATURE SENSOR

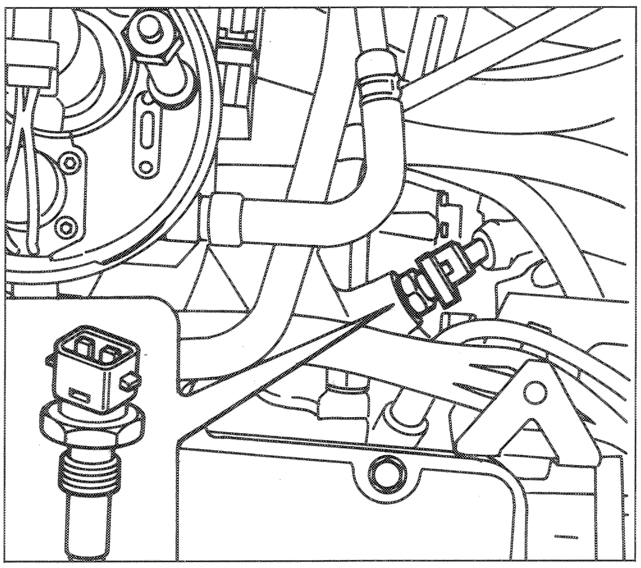
To replace the inlet air temperature sensor, remove the cover press-fitted to the throttle case (at the two points arrowed) by means of two plastic pins.



P3M38GJ02

Dismantling-fitting intake air temperature sensor

- unscrew the two screws retaining the inlet air temperature sensor and remove;
- refit the sensor, taking care not to damage the temperature measurement part.

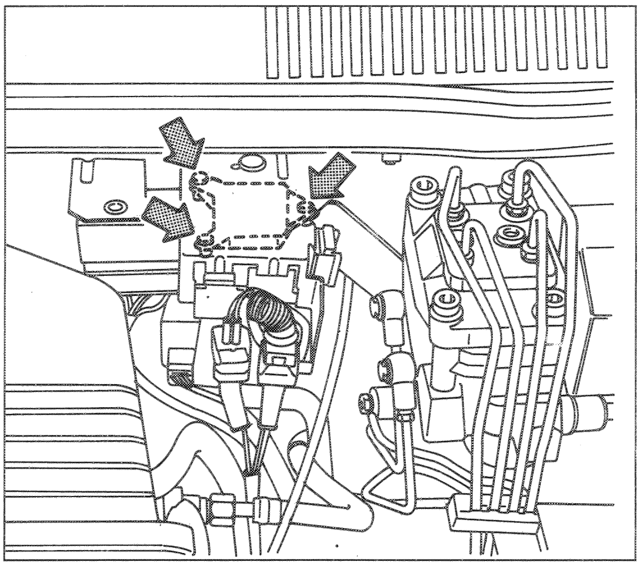


P3M38GJ03

REPLACING ENGINE COOLANT TEMPERATURE SENSOR

Refitting

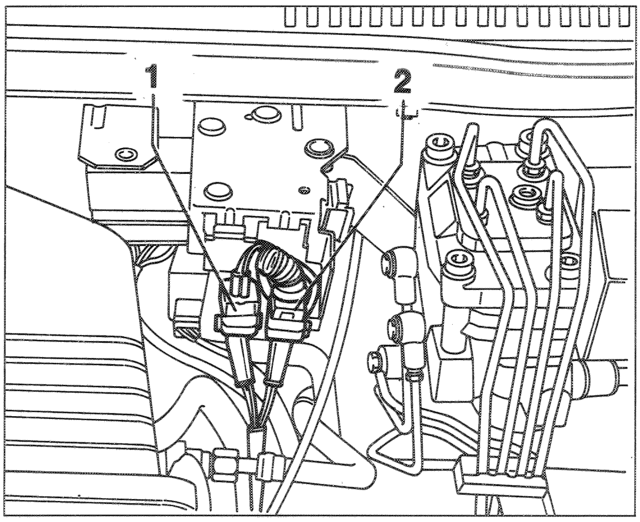
- Sensor must be screwed in in such a way as to prevent leaks through its seat and ensure a perfect seal.
- Maxmimum tightening torque must not exceed 0.25da Nm in order to prevent damage to the case or internal parts.
- When tightening, ensure that the key is perfectly centred on the hexagonal head in order not to damage the component irreparably.


P3M39GJ01

REPLACING ABSOLUTE PRESSURE SENSOR

0,30÷0,35 daNm

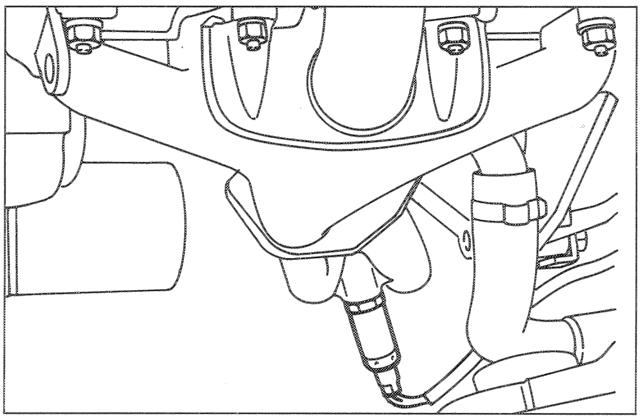
- To remove the sensor, unscrew the screws indicated by the arrows.
- Always check condition of rubber vacuum intake pipe and if necessary replace with a new part or use a rubber pipe with max inner diameter of 2.0 mm and max length of 700 mm (+/– 10 mm) in order to ensure operating conditions are exactly as before.
- Ensure that pipe is well fitted and fastened at both ends.
- Ensure that the connector and body earth electrical connections are clean and undamaged.



P3M39GJ02

REPLACING OXYGEN SENSOR OR LAMBDA PROBE

- Position vehicle on lift
- Disconnect electrical connections (1) and (2) from the Lambda probe
- Remove the Lambda probe from its seat
- When fitting, apply grease to retaining screw in order to ensure good thermal coupling. Recommended product is ANTI-SEIZE MATERIA-BORON NITRIDE N.GK. SPARK PLUG CO-LTD.

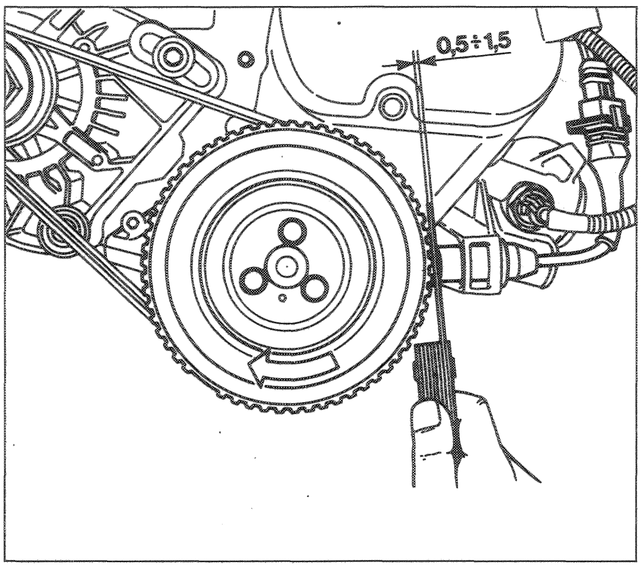

P3M39GJ03

0,50÷0,60 daNm

- When tightening, do not force components because they could be irreparably damaged.

The electrical resistance measured using a digital multimeter at ambient temperature must be between 2.5Ω and 4.5Ω.

NOTE *The probe can be swiftly put out of action by even small amounts of lead in the petrol. Functional checks are scheduled after 45,000 and 90,000 km in the programmed maintenance plan.*



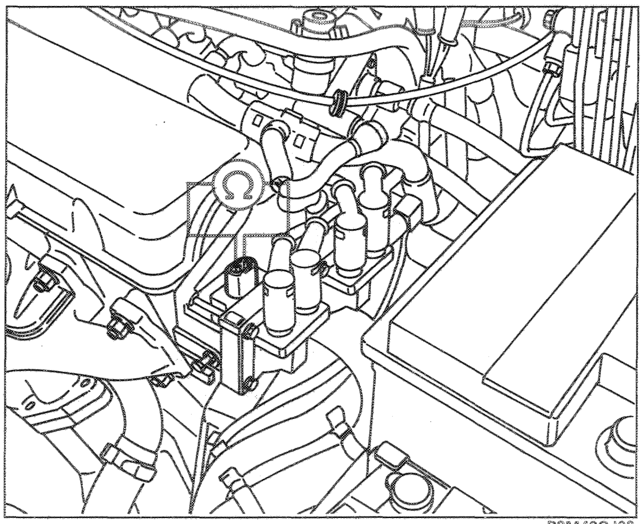
P3M40GJ01

CHECKS ON RPM AND TDC SENSOR

Checking gap
The gap between sensor and phonic wheel must be 0.5-1.5 mm.

Checking electrical resistance
The resistance measured with a digital multimeter must be between 650 and 720Ω at 20° C.

Because correct angular positioning of the rpm and TDC sensor is achieved by means of a rigid mount, this adjustment is not possible.

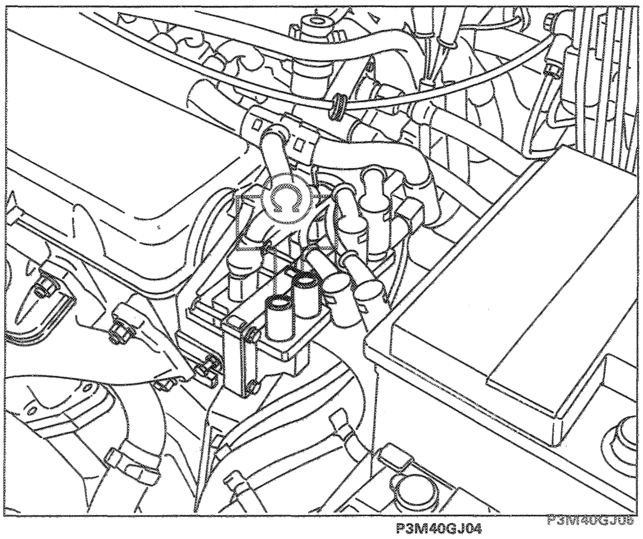


P3M40GJ02 P3M40GJ03

CHECKING IGNITION COIL PRIMARY WINDING RESISTANCE

Bring the probes of an ohmeter into contact with the positive terminal (marked +) and the negative terminal (marked –) respectively.

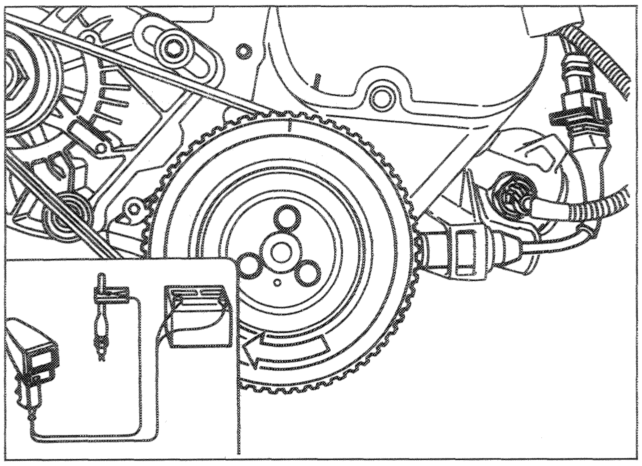
The primary winding resistance read off the instrument should be between 0.495 Ω and 0.605 Ω at 20° C.
If reading is less than 0.495 Ω or infinity, replace the ignition coil.



P3M40GJ04 P3M40GJ06

CHECKING IGNITION COIL SECONDARY WINDING RESISTANCE

Bring probes of an ohmeter into contact with the two high tension outputs.
The secondary winding resistance reading on the instrument should be between 6660 Ω and 8140 Ω at 20° C.
If a reading of infinity is obtained, replace the ignition coil.



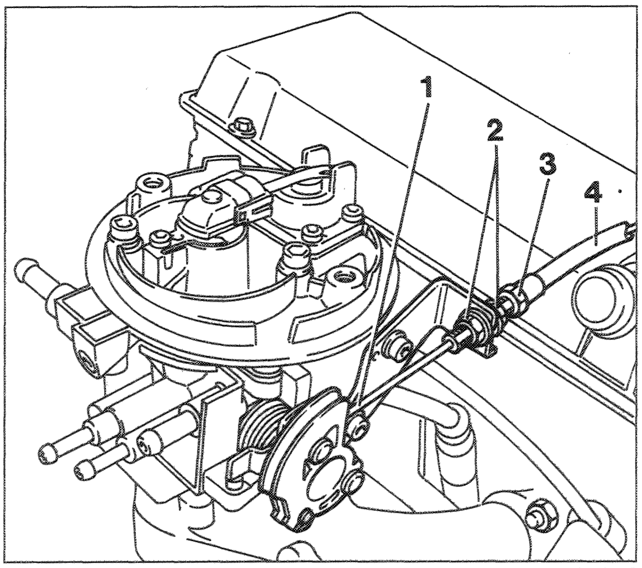
P3M41GJ01

APPROXIMATE CHECK ON IDLING IGNITION ADVANCE WITH STROBOSCOPIC LAMP

Connect inductive clip stroboscopic lamp with graduated scale and check that nominal advance when idling (900±50/min) is: 8°±3° (with electrical loads off, wheels aligned, air conditioner off, fan off etc..).

NOTE *Ignition advance fluctuations should be considered normal because the ECU corrects the value continually in order to maintain rpm stable.*

To check the ignition advance angles at different engine speeds, use a Fiat/ Lancia Tester.



P3M41GJ02

ADJUSTING ACCELERATOR CONTROL CABLE

Proceed as follows to adjust the accelerator cable:

- loosen the two locknuts (2) retaining hexagonal link (3) of sheath (4);
- tighten or unscrew hexagonal link (3) in order to adjust the position of the end of sheath (4) until - with accelerator pedal released - cable (1) is neither too taut or too loose;
- tighten the two locknuts (2) of hexagonal link (3);
- when accelerator pedal is pushed to the floor, check that throttle valve is fully open.

10.

CHECKING IDLE SPEED

If idle speed is not 900±50/min, because injection-ignition ECU is self-regulating, the adjustment cannot be carried out. The position of the accelerator linkage must therefore be checked and then the fault detected by means of full diagnosis using a Fiat/Lancia Tester.

CHECKING THE CONCENTRATION OF POLLUTING EMISSIONS

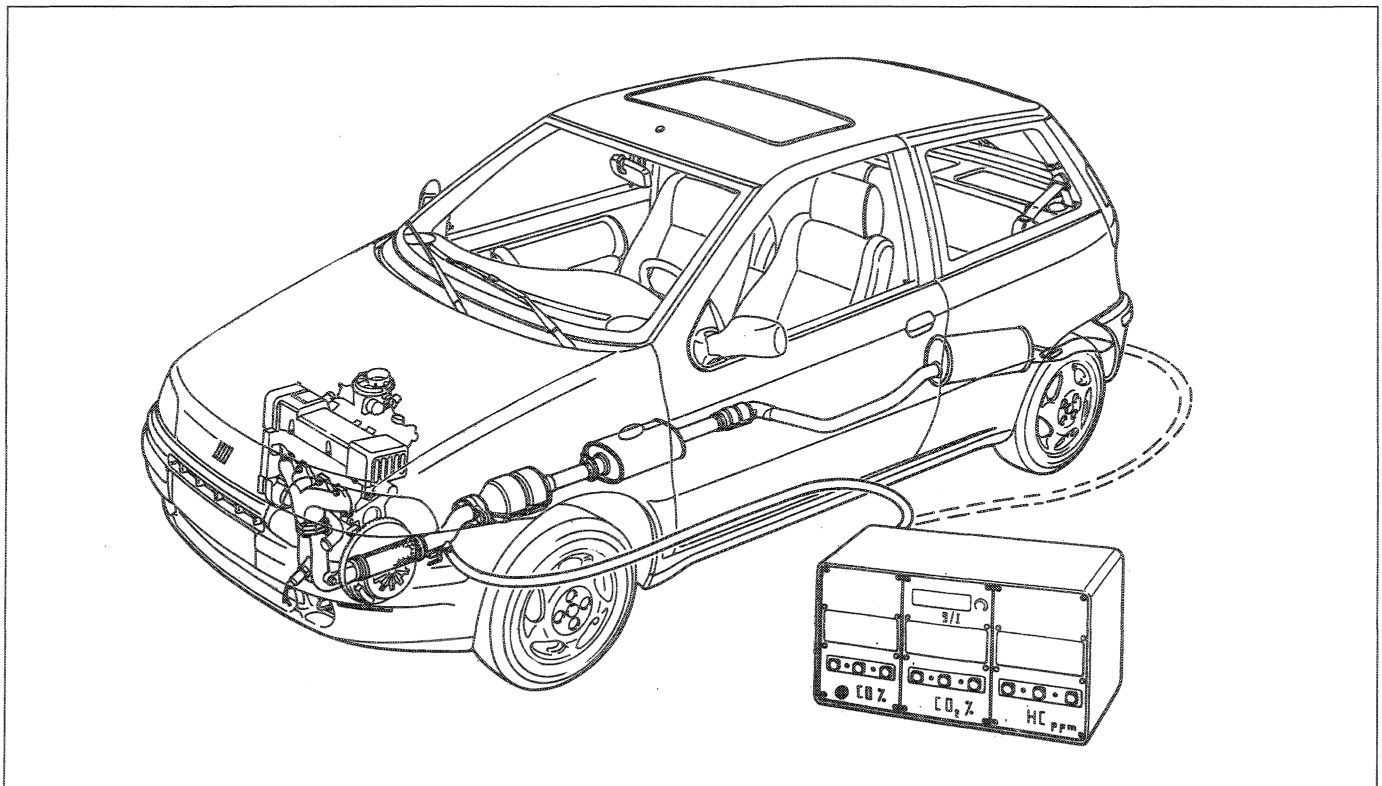
Foreword

This electronic injection/ignition system is able to control automatically advance, carbon monoxide (CO) level and idling air flow. No manual adjustments are therefore necessary. A check on exhaust emissions upstream and downstream from the catalytic converter can nevertheless provide valuable information on the condition of the injection-ignition system and engine or catalytic converter parameters.

Checking idling CO and HC levels upstream of catalytic converter

To check the levels of carbon monoxide (CO) and uncombusted hydrocarbons (HC) upstream of the converter, proceed as follows:

1. Unscrew the plug or nut located on the exhaust pipe upstream of the converter and tighten the tool in its place.
2. Connect the probe of a specially calibrated CO-tester in its place.
3. Start up the engine and allow to warm up.
4. Check that the rpm is as specified.
5. Check that idling CO level is as specified (see table); otherwise check:
   - Lambda probe operation, using a Fiat/Lancia Tester;
   - for air leaks in the area around the Lambda probe seat;
   - the injection system (**particularly the condition of the spark plugs**).
6. Check, under the same conditions, that HC level is lower than 500 p.p.m.
7. If these level are not as specified, adjust the engine and check the following in particular:
   - ignition advance angle
   - valve clearance
   - timing
   - engine compression



P3M42GJ01

Summary table showing emission level tolerances

	CO (%)	HC (p.p.m.)	Co_2 (%)
Upstream of converter	0.4-1	⩽600	⩾12
Downstream of converter	⩽0.35	⩽90	⩾13

Checking CO and HC levels at exhaust

Measure carbon monoxide (CO) and uncombusted hydrocarbon (HC) at the exhasut by inserting the probe of a calibrated tester into the end of the exhaust pipe by at least 30 cm as indicated in the figure on page 42.

If the shape of the exhaust tail pipe will not allow the probe to be fitted fully, add an extension pipe and ensure the joint area is well sealed.

1. Check that idling CO and HC levels are as specified (see table).

2. If the HC level is not as specified whereas level measured upstream of converter is correct, engine parameters should be considered correct and the cause of the anomaly must lie in reduced converter efficiency.