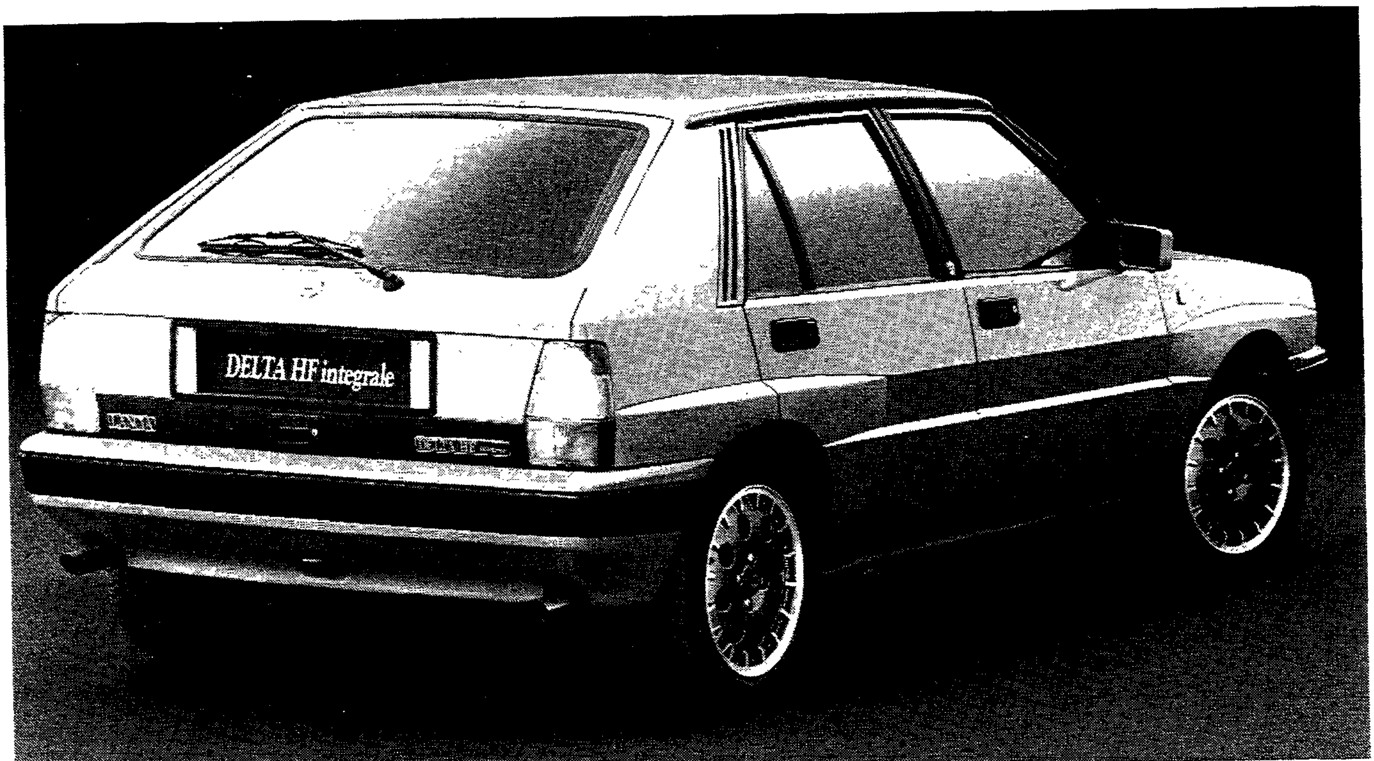
Contents

P1L01BS01

Front 3/4 view



P1L01BS02

Rear 3/4 view

PRECAUTIONS TO BE TAKEN WHEN REFUELLING

Use only unleaded petrol complying to the DIN 51607 standard.
The internal diameter of the tank filler prevents the car being accidentally filled with leaded petrol at petrol pumps:never try to refuel your car with leaded petrol using alternative means.

⚠ *The use of leaded petrol causes rapid deterioration of the catalytic converter and Lambda sensor.*

PRECAUTIONS TO BE TAKEN IN THE MAINTENANCE OF THE IGNITION SYSTEM ON CARS FITTED WITH CATALYTIC CONVERTER

The ignition system on these cars must always operate at maximum efficiency, as poor operation, even for short periods of time, will damage the catalytic converter.
Particular attention should therefore be given to routine maintenance of the ignition system (to ensure rust-free high tension cable contacts, efficient spark plugs, etc.).

FOR ANY ASPECTS NOT DEALT WITH IN THIS PUBLICATION, REFER TO THE HF INTEGRALE MANUAL (91 Range) (Print N° 504.787/12) FOR TECHNICAL DATA, TO THE 4WD MANUAL (Print N° 504.787/02/03/04/06/09) FOR OVERHAULING AND TO THE LANCIA PETROL ENGINE OVERHAUL MANUAL (Print N° 504.513), SECTION 2000 i.e. Turbo FOR INFORMATION ON THE ENGINE.

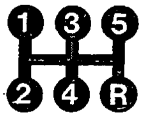
Print N° 504.605/21

GENERAL INFORMATION

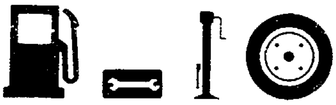
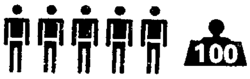
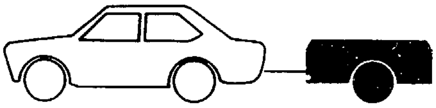
The Delta HF integrale with 2000 turbo i.e. engine differs from the standard model marketed in Italy/Central Europe in that it has been subjected to engine changes, and fitted with special devices for reducing the car's pollutant emissions(i.e. nitrogen oxides and carbon monoxide (NOx and CO) and unburned hydrocarbons (HC)), in order to bring them into line with the USA '83 Standards.
This engine can run on 95 non-ethylate petrol.

SPECIFIC CHANGES ON THE SWISS VERSION

The Swiss version has the following:
- special pistons for compression ratio reduction
- engine crankcase with lubricant spraying for piston cooling
- specific front and central parts of exhaust pipe; front part with metal mesh tube
- specific anti-knock and "over-boost" control devices
- exhaust emission control system which includes:
  - Weber-Marelli injection-ignition system with specific I.A.W. control unit with closed loop mixture strength control;
  - three-way catalytic converter with oxidation and reduction functions;
  - heated Lambda sensor for automatically adjusting the fuel-air mixture;
  - exhaust gas recirculation system with E.G.R. valve and modulator
- fuel evaporation control system
- engine crankcase gases recirculation system
- unleaded fuel filler with restrictor and diaphragm
- heat shields and thermal insulators

IDENTIFICATION DATA	CHASSIS	ENGINE	VERSION	N° of doors	GEARBOX
 Turbo	ZLA 831 AB0	831 C5.046	831 AB024S	5	

WEIGHTS (given in kg)

	1300
 + 450 =  Vehicle in running order	1750
	1300

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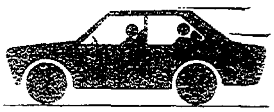
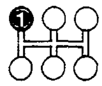
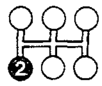
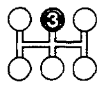
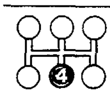
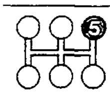
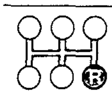
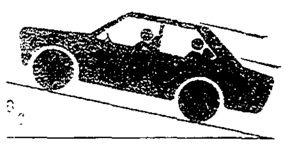
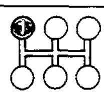
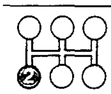
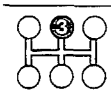
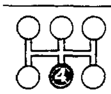
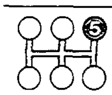
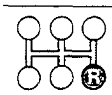
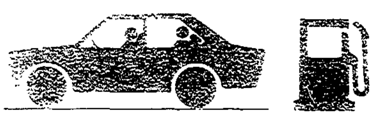
ENGINE VERSION	2000 ie Turbo

Speed km/h (with average load) 		60
		96
		137
		182
		212
		60
Gradient fully laden 		56
		39
		24
		17
		12
		66
Fuel consumption according to ECE regulations (litres/100 km) 	Urban cycle (A)	11.1
	Steady speed 90 km/h (B)	8.2
	Steady speed 120 km/h (C)	10.8
	Average consumption (CCMC proposal) $\frac{A + B + C}{3}$	10.0

The fuel consumption values given in the table were established during official testing in accordance with procedures stipulated in the EEC regulations. Simulated urban cycle consumption was measured on the test bench, whereas steady speedconsumption values (90 and 120 km/h) were measured both on a flat, dry road surface and during testing on the test bench.
These values may prove useful when comparing different vehicles.
Traffic conditions, type of driving, atmospheric conditionsand the overall state of the vehicle may result in the fuelconsumption varying from the values established in accordance with the above procedures.

Fluids	Unit		Quantity dm³(l)	Quantity (kg)
95 RON unleaded petrol with minimum allowed O.R. must be used			57	
50% + (▲)	Cooling system total capacity		6.3	-
VS Turbo Synthesis (SAE 15 W 40)	Total capacity		5.9	5.3
	Partial capacity (periodic replacement)		--	4.8
TUTELA DOT 4	Total capacity		0.56	
a = TUTELA ZC 80S		a	·	3.40
b = TUTELA GI A		b	-	-
TUTELA W90 M DA	a	a	-	-
	b Self-locking	b		1
a = TUTELA GI A	a	a	-	0.61
b = K 854	b	b	-	-
TUTELA DOT 4	Total capacity		-	0.56
+	3% / ~ - 10°C 50% / ~ - 20°C 100%		2	-

▲ distilled water

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EMISSION CONTROL SYSTEM MAINTENANCE ENGINE CODE: 831.C5.046	1st free serv. (*)	10000 km	20000 km	30000 km	40000 km	50000 km	60000 km	70000 km	80000 km
MAIN ENGINE COMPONENTS									
Valve clearance			I/A				I/A		
Alternator belt and water pump			I/A		I/A		I/A		I/A
Timing belt					I				I
Vacuum pipes and unions	I				I				I
Oil filter		R	R	R	R	R	R	R	R
Motor oil	R	R	R	R	R	R	R	R	R
FUEL SUPPLY									
Fuel pipes and unions			I		I		I		I
Idle speed and CO level	I/A		I/A		I/A		I/A		I/A
Air cleaner cartridge		R	R	R	R	R	R	R	R
Fuel filter		R	R	R	R	R	R	R	R
Injectors	T								
Lambda sensor					I				I
IGNITION									
Advance	I				I				I
Cap and rotor	I/R		I/R		I/R		I/R		I/R
Spark plugs		R	R	R	R	R	R	R	R
Ignition cables and connections			I/R		I/R		I/R	I/R	
EMISSION CONTROL									
Crankcase emission control system					C				C
Fuel evaporation control system			I		I		I		I

NOTE *If persistant poor ignition becomes a problem, examine the spark plugs before scheduled maintenance is due.*

I = Inspect
A = Adjust
R = Replace
C = Clean
T = Tighten
(*) 1000 - 1500 km

SPECIFICATIONS

Type	831 C5.046
Cycle	OTTO 4-stroke
Number of cylinders	4 in line
Cylinder liner (bore) mm	84
Stroke mm	90
Cylinder displacement cm³	1995
Compression ratio	7.5 ±0.15 Volume of combustion chamber in cylinder head cm³ 47.7
Maximum power kW (EEC) (CV) (DIN)	130 (177)
Maximum power 1/min	5250
Maximum torque daNm (EEC) (kgm) (DIN)	29 (29.6)
Maximum torque 1/min	2750

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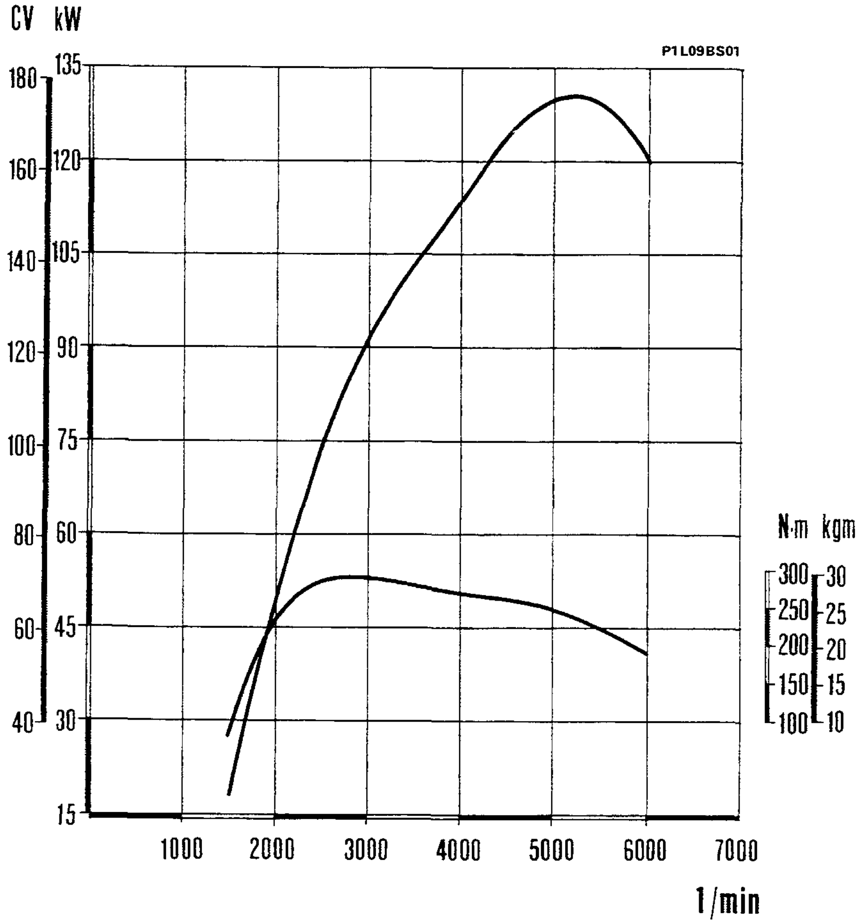


Typical engine curve obtained using the EEC method

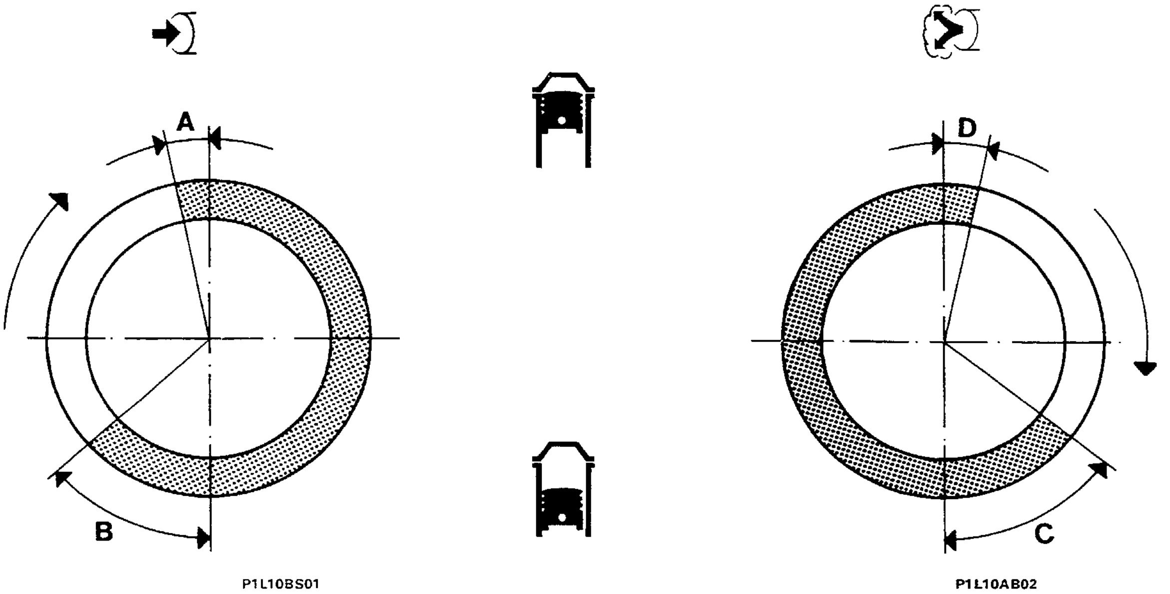
The power curve shown can be obtained with an overhauled and run-in engine (50 hours operation) without fan, with exhaust silencer and air cleaner, at sea level.

Overhauled engine bench test cycle

When bench-testing overhauled engines, keep to the values given in the table; do not run the engine at maximum speed. Complete engine running-in on the vehicle.

Test speed (1/min)	Time in minutes	Brake load
800 - 1000	10'	no load
1500	10'	no load
2000	10'	no load

TIMING DIAGRAMS
(with tappet clearance of 0.8 mm)



TIMING ANGLES

A	Intake	opens before TDC	8°
B	Intake	closes after BDC	42°
C	Exhaust	opens before BDC	42°
D	Exhaust	closes after TDC	1°

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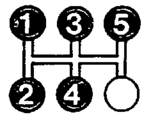
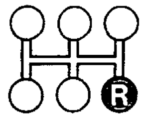
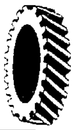
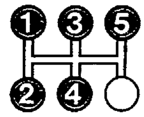
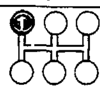
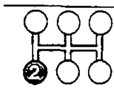
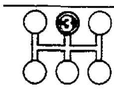
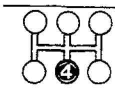
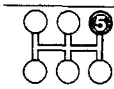
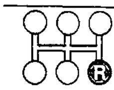
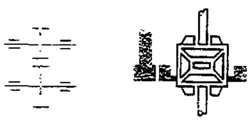
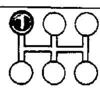
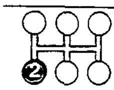
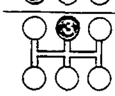
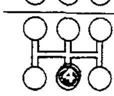
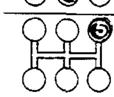
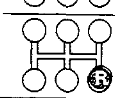
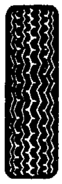
GEARBOX

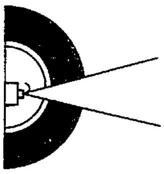
 Synchronizers	spring ring (Porsche type)		-
	baulk ring		
 Gears	straight toothed		
	helical toothed		
 Gear ratios			3.500
			2.176
			1.524
			1.156
			0.917
			3.545
	Reduction gear ratio		56/18 (3.111)
 Ratio at the wheels			10.889
			6.771
			4.741
			3.597
			2.852
			11.030

WHEELS

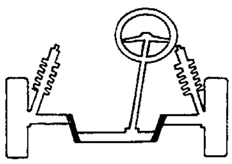
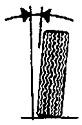
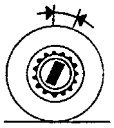
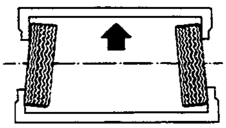
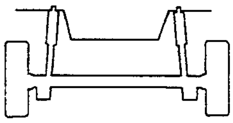
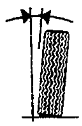
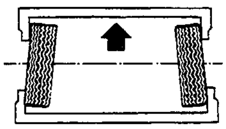
Tyre  		type	205/50 - ZR - 15"
	front	average load	2.2 bar
		full load	2.5 bar
	rear	average load	2.2 bar
		full load	2.5 bar
Rim 		type	made of light alloy 7½J x 15" AH2 - 37

NOTE Spare wheel with rim 3.5Bx16H2-37 and tyre T 115/70 R 16"
Speed limit: 80 km/h. Inflation pressure: 4.2 bar

WHEEL GEOMETRY



unladen car (*)

Front suspension 	camber (**)		-1° ±30'
	caster (**)		3° 10' ±30'
	toe-in		0-2 mm (●)
Rear suspension 	camber		-1°30' ±30'
	toe-in		3-5 mm (●)

(*) With tyres inflated to the correct pressure and vehicle in running order.
(**) Non-adjustable angles (●) Meaured on a diameter of 360 mm

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SUMMARY

STARTING MOTOR	M. Marelli 70R - 1.4 kW - 12 V
ALTERNATOR	M. Marelli AA125R - 14 V - 65 A
VOLTAGE REGULATOR	M. Marelli RTT 119 AC
BATTERY	12 V - 55 Ah - 255 A
IGNITION SYSTEM	Weber-Marelli electronic injection-ignition (MPI)
IGNITION DISTRIBUTOR	DT 453 G
IGNITION COIL	M. Marelli BAE 504 DK
IGNITION COIL WITH POWER MODULE	M. Marelli AEI 600 L
SPARK PLUGS	Bosch WR6 DTC

COMPONENTS IN THE WEBER-MARELLI I.A.W. MULTIPLE INJECTOR ELECTRONIC INJECTION-IGNITION SYSTEM

PART	QUANTITY	REFERENCE
ELECTRONIC CONTROL UNIT	1	WH47.08/8PP.SU
THROTTLE BODY	1	52 CFL 25/50
INJECTOR	4	IW 025/10
AUTOMATIC IDLE ADJUSTMENT AND STARTUP SOLENOID VALVE	1	VAE 06
PRESSURE REGULATOR	1	RP 01/3 bar
AIR TEMPERATURE SENSOR	1	ATS 04
COOLANT TEMPERATURE SENSOR	1	WTS 05
ABSOLUTE PRESSURE SENSOR	1	APS 02/03
THROTTLE VALVE POSITION SENSOR	1	PF 09/N 02
FUEL FILTER	1	FI 02/2
ELECTRIC FUEL PUMP	1	PI 022/13
LAMBDA SENSOR	1	0.280.003.009
KNOCK SENSOR	1	SEN 14B
OVER-BOOST SOLENOID VALVE	1	12 DC 256

CHECKING ENGINE IDLE SPEED AND CARBON MONOXIDE EMISSIONS

Engine idle rotation speed		1/min	825 ±50
CO emissions at idle	above catalytic converter	%	0.6 ±0.2
	at exhaust	%	⩽0.35
Ignition advance at idle			15° ±3°

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INTEGRATED ELECTRONIC INJECTION-IGNITION SYSTEM

	2000 ie Turbo
Type	I.A.W. (Weber-Marelli multi-point injection-ignition)

IGNITION COIL WITH POWER MODULE

Type and reference code		M. Marelli AEI 600L
Firing order		1 – 3 – 4 – 2

IGNITION DISTRIBUTOR

Type		M. Marelli
Reference code		DT 453 G
Electromagnetic impulse generator coil winding resistance at 20°C	Ω	758 - 872

IGNITION COIL

Type		M. Marelli
Reference code		BAE 504DK
Primary winding resistance at 20°C	Ω	0.405 - 0.495
Secondary winding resistance at 20°C	Ω	4020 - 5280

TDC AND RPM SENSOR

Type and reference code		M. Marelli SEN 8 I
Sensor winding resistance	Ω	612 - 748
Gap between sensor and crankshaft pulley tooth	mm	0.4 - 1

ADVANCE ON ENGINE

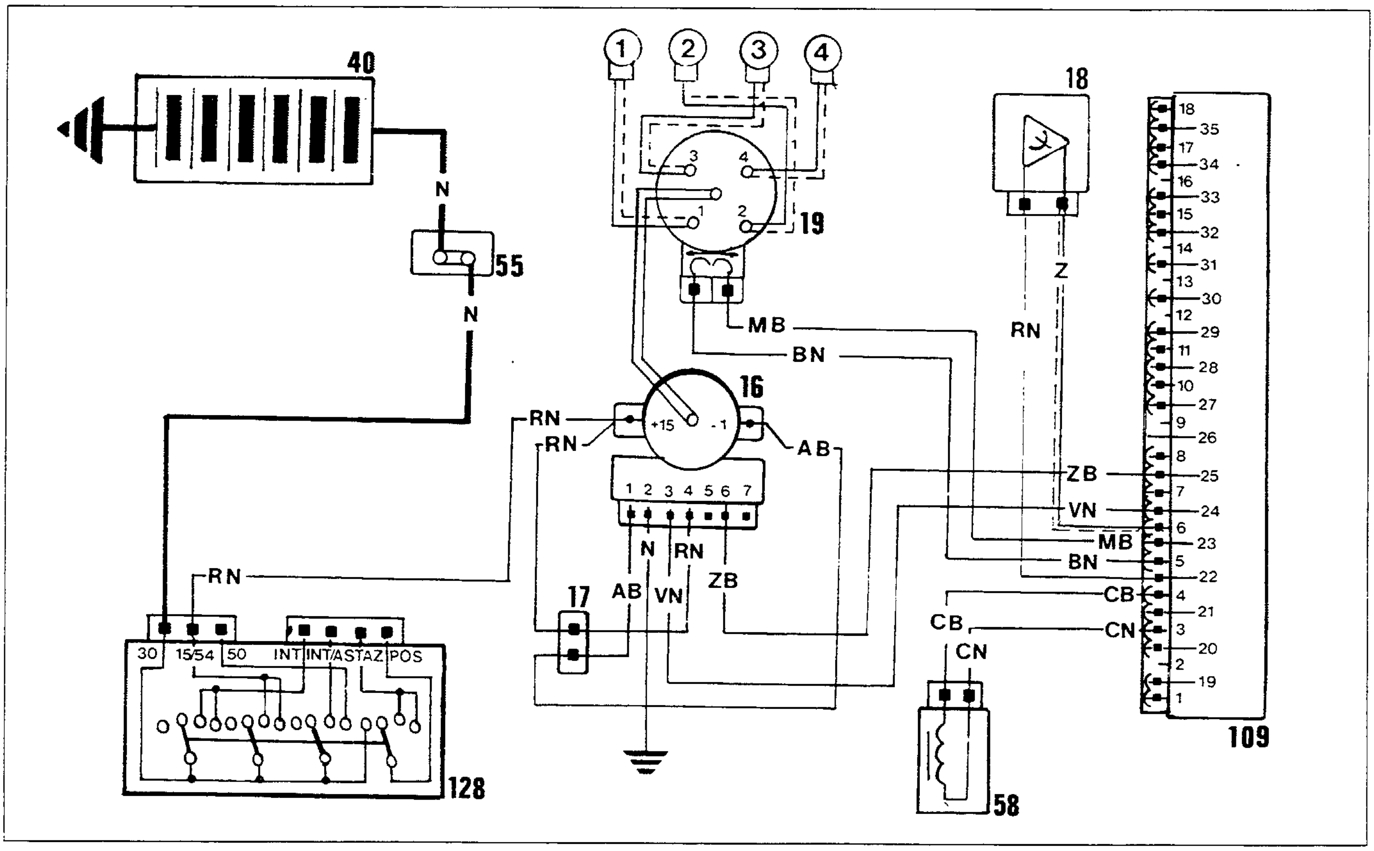
Minimum from 800 to 850/min at 1.8 bar	15° ±3°
Maximum 4550/min at 0.30 bar	35° ±3°

SPARK PLUGS

Type and reference code		Bosch WR6 DTC
Thread		M 14 x 1.25
Distance between electrodes	mm	0.8 - 1

DIAGRAM SHOWING INJECTION-IGNITION CONTROL UNIT CONNECTIONS (ONLY APPLIES TO ELECTRONIC IGNITION)

The numbers used to identify the various components are thesame as those used for the electrical diagrams.



16. Ignition coil with power module
17. Connection
18. Knock sensor
19. H.T. distributor with built-in timing sensor
40. Battery
55. Branching point
58. TDC and RPM solenoid sensor
109. Electronic injection-ignition control module
128. Ignition switch

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ANTI-KNOCK AND OVER-BOOST CONTROL DEVICES

The I.A.W. system fitted to the Delta HF integrale includesboth an anti-knock and an "over-boost" device. which control engine operation during supercharging. It is therefore possible to obtain maximum engine performance without adverselyaffecting the engine's durability.

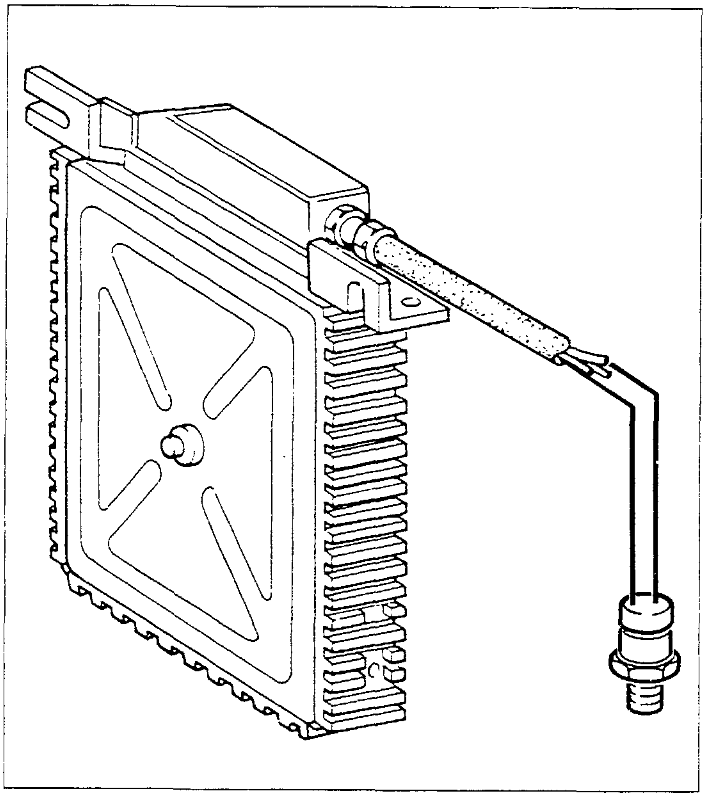
Anti-knock device

This device consists of a sensor screwed into the cylinder head and connected to terminals 6 and 22 on the injection-ignition control unit. This sensor picks up the intensity of the vibrations (knocking) caused by the dettnation in the combustion chamber during engine operation. When knocking occurs the sensor informs the injection-ignition control unit. which may intervene in one of the following two ways:

- if the engine is in over-boost. the electronic control unitfirst of all deactivates the over-boost solenoid to reduce the pressure in the combustion chamber. which should consequently reduce the knocking. If this is not sufficient. the control unit then progressively reduces the ignition advance stored in the curve maps by up to a maximum of 6°;
- if the engine is not in over-boost. the electronic control unit simply progressively reduces the advance by up to a maximum of 6°.

After a certain number of cycles without knocking. the advance will be progressively restored to the original value stored in the map and if necessary. the over-boost solenoid will be reactivated.

This device is of fundamental importance for the protectionof the engine as knocking may very easily occur during supercharging.



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"Over-boost" device

This device allows the turbocharger to operate at a higher supercharging pressure than normal.

In normal operating conditions (engine running with throttle partially open). the Pierburg three-way solenoid valve (1.in drawing overleaf). controlled by the I.A.W. control unit. is deenergized and closed pneumatically: duct (C) is cut off and ducts (A) and (B) are connected through a calibrated orifice (2).

In this case the full force of pressure P_2. measured below the compressor through calibrated union (3). presses on the diaphragm of waste-gate actuator (4).

When P_2 reaches the correct calibration value (approx. 660 mmHg).the force on the actuator diaphragm exceeds the spring loadand the waste-gate opens: part of the exhaust gases by-passes the turbine thus reducing the amount of pressure acting on it.

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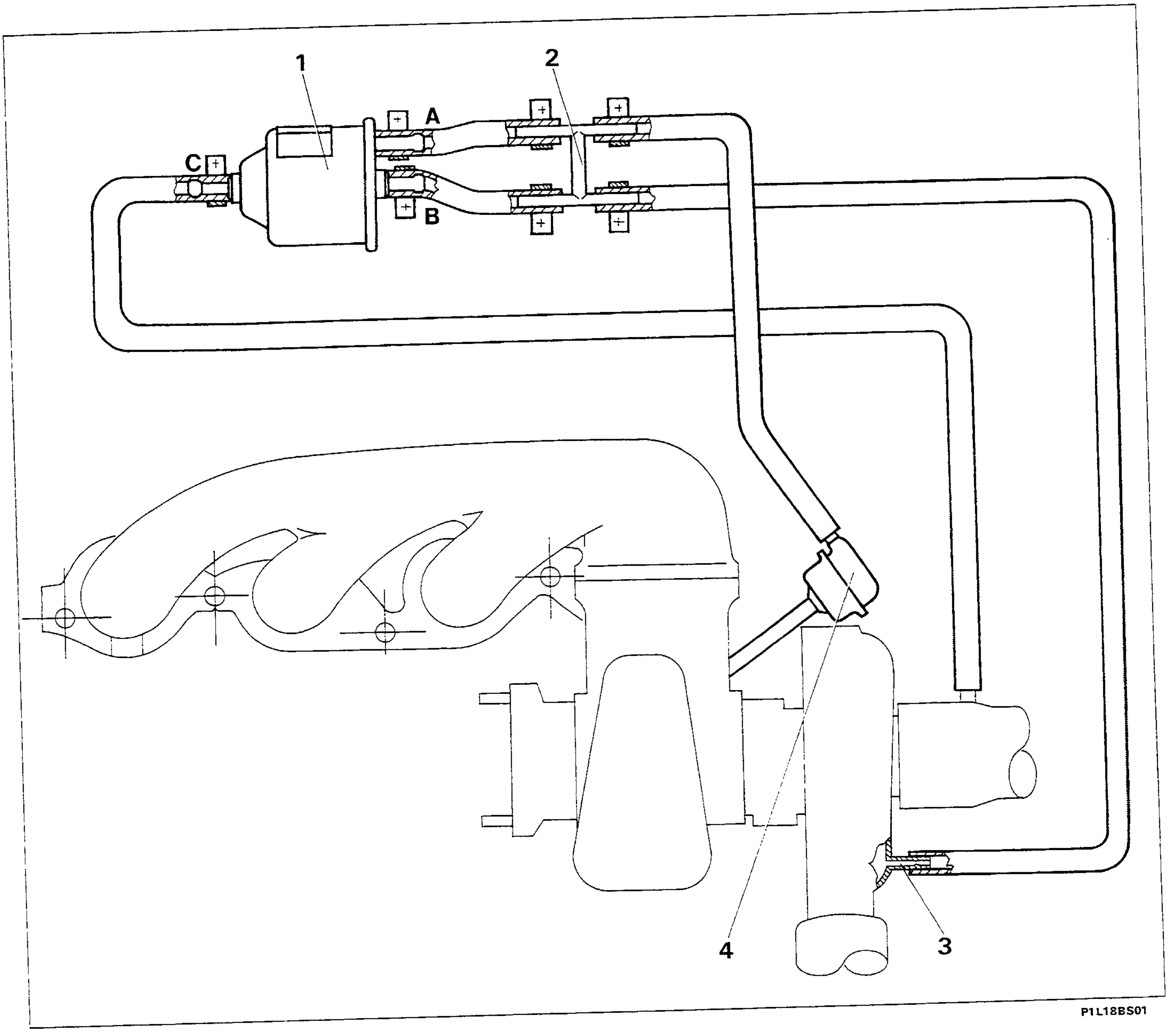
When more power is required, and the following three conditions occur simultaneously:

- throttle fully open,
- engine rotation speed greater than 2250/min,
- no engine knocking,

the Pierburg three-way solenoid valve (1) is energized by the I.A.W. control unit to give over-boost.

The opening of the solenoid valve connects ducts (A) and (B) to duct (C) at atmospheric pressure; the full force of supercharging pressure P_2 does not reach the waste-gate actuator, and therefore only a fraction of this pressure, which varies according to thesystem's fixed settings, diameters and calibrated orifice lengths, goes to the waste-gate's pneumatic capsule.
The drop in pressure on actuator (2) obtained in this way causes the waste-gate to close. This consequently prevents a considerable amount of exhaust gasfrom by-passing the turbine and therefore increases the supercharging pressure P_2, until the above conditions change.

If knocking occurs, the Pierburg three-way solenoid valve (1) will be disabled before reducing the advance stored in the map (see anti-knock device).



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EXHAUST EMISSION CONTROL SYSTEM

Introduction

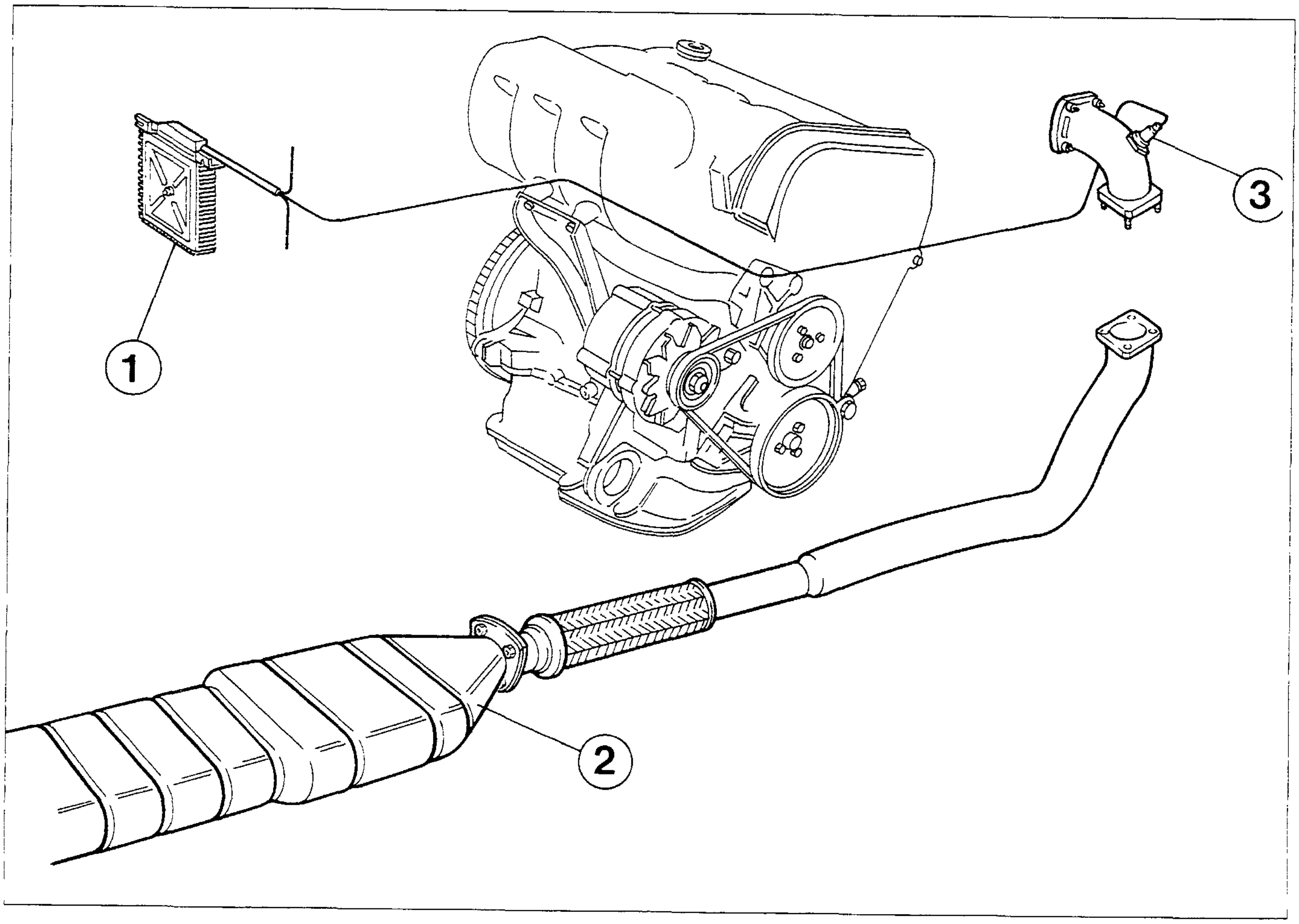
The exhaust emission control system mainly consists of an integrated electronic injection-ignition system. which is handled by a digital control unit (1) on the basis of information received.

In the "clean air" version, the system shown in the figure below supplies an air-fuel mixture which is close to the stoichiometric ratio for all the operating conditions which require this ratio.

The stoichiometric air-fuel ratio is essential if the catalytic converter (2), which is fitted to this version to reduce pollutant emissions, is to last and operate correctly.

The stoichiometric air-fuel ratio is obtained by means of aLambda sensor (3), which constantly analyzes the quantity of oxygen present in the exhaust gases. This permits control unit (1) to continuously correct the strength of the mixtureif it fails to correspond to the stoichiometric ratio, and to constantly meter the quantity of fuel to be injected.

If the Lambda sensor and the relevant control unit circuit are working properly, the composition of the exhaust gases and the level of pollutant substances will consequently correspond to the specified values and there will therefore be noneed to correct the CO level at idle.



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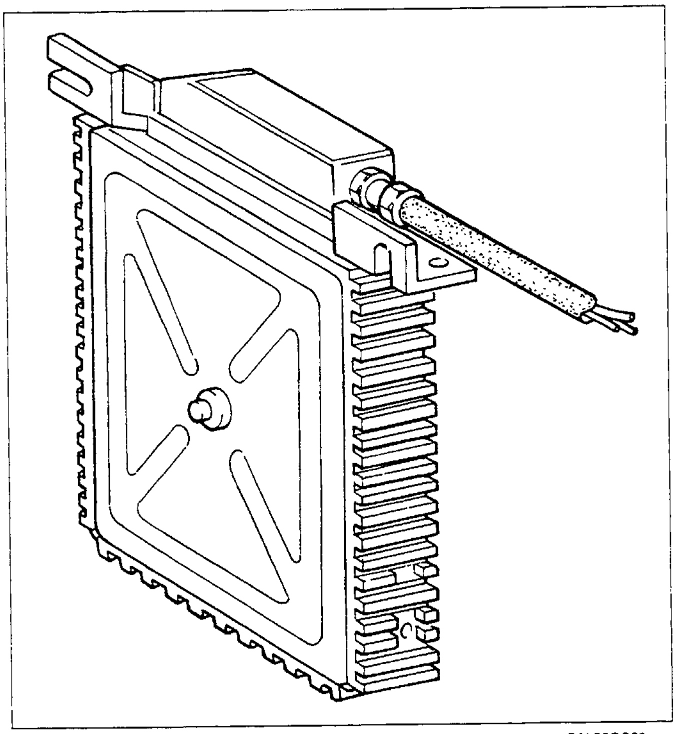
OPERATIONAL DESCRIPTION OF THE EXHAUST EMISSION CONTROL SYSTEM MAIN COMPONENTS

Electronic control unit

The control unit used in the I.A.W. system is a digital type unit with a microprocessor.
It receives all the data concerning the engine's running conditions from the various sensors, and handles all the actuators in the system on the basis of these signals and the maps/programs stored in its memory.



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The system is based on the following fundamental parameters:

- the **engine rotation speed** (picked up by a sensor facing a pulley with four teeth mounted at the end of the crankshaft);
- the **intake air density** which is calculated as the ratio between the absolute pressure in the intake manifold (read by the pressure sensor) andthe corresponding air temperature (read by the temperature sensor).

A pair of these parameters can be used to identify any particular engine operating point.
A "plan of injection values" and a "plan of advance values"have been stored in the control unit: these plans contain the injection time and ignition advance values for a given number of the aforesaid parameter pairs (injection and advancemapping).
These values are optimal for the respective engine operating points. Intermediate values can be obtained by interpolating between the two nearest values on the maps.
In this way, each operating point in the engine is assured of the mixture strength and ignition advance established at the tuning and experimental stage.
The system also includes other sensors, which permit the correction of the basic values in particular operating conditions (cold start, acceleration, etc.).
The information needed for correct injection and ignition timing is obtained from the signals coming from the TDC RPM sensor (mounted on the engine pulley) and from the timing sensor (built into the distributor).
The control unit has 2 functions it can use to reduce the injector command time to zero in the following conditions:

1) when the absolute pressure in the intake manifold reaches or exceeds 1305 - 1650 mmHg;
2) when the engine rotation speed reaches or exceeds 7000 min.

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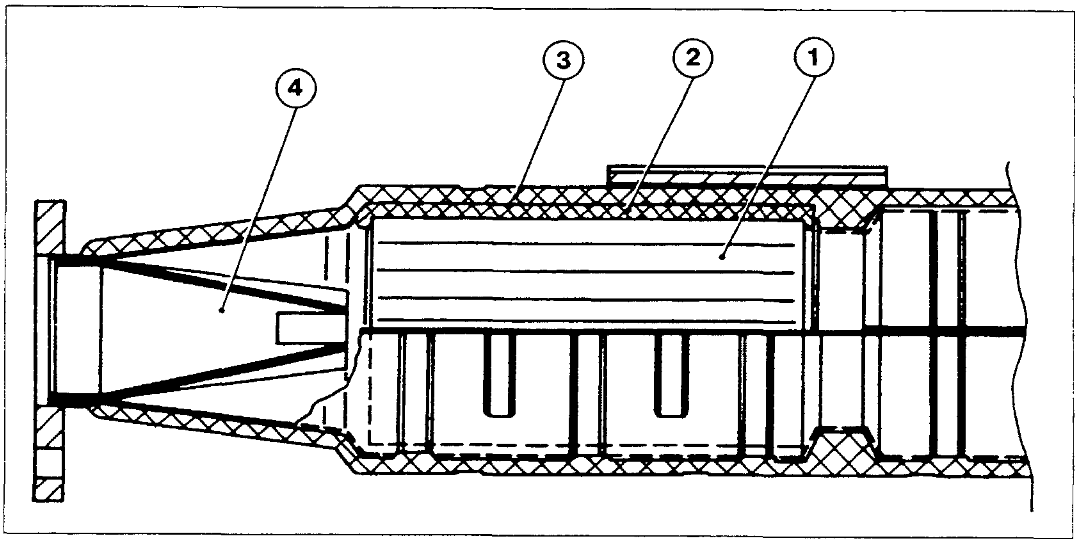
Three-way catalytic converter

The three-way catalytic converter is used to reduce the three pollutant substances (unburnt hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx)), which are present in the exhaust gases.
Two types of chemical reaction take place inside the catalytic converter:
- oxidation of CO and HC, which are converted into carbon dioxide (CO_2) and water (H_2O)
- reduction of nitrogen oxides NOx, which are converted into nitrogen (N_2).

The converter operates at its best if the air/fuel mixture supplied to the engine corresponds to the stoichiometric ratio.



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The converter is made up of a monolith (1), a metal mesh support (2), used to protect the monolith from bumps and vibrations, and a stainless steel casing (3), which can withstand high temperatures and atmospheric elements.
The monolith has a honeycomb structure made of a ceramic material coated with a thin layer of catalytically active substances (platinum or rhodium), which accelerate the chemical decomposition of the harmful substances contained in the exhaust gases. By passing through the monolith cells at temperatures of 300 to 350°C, these harmful substances activate the catalysts to bring about oxidation and reduction.
A perforated metal cone (4) improves the diffusion of the exhaust gases through the ceramic monolith cells to optimize catalyst efficiency and prolong its life.

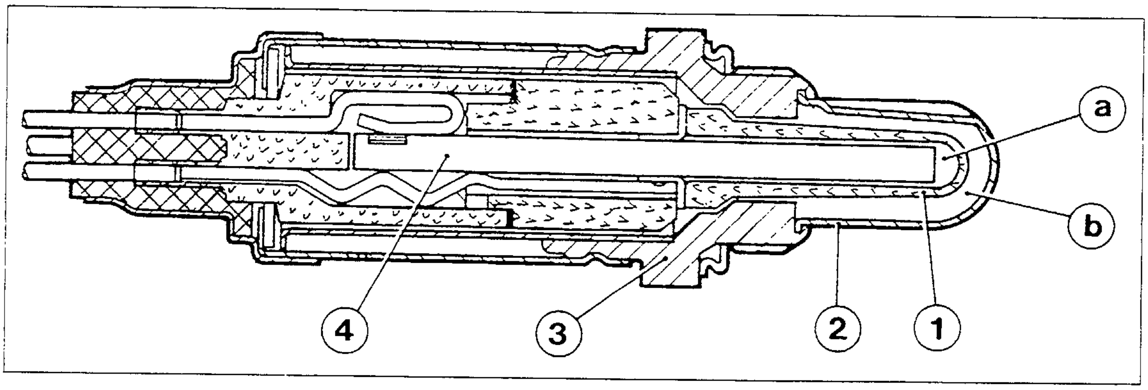
⚠ *The converter can be quickly and irreparably put out of action by the following:*
- *lead in the fuel: this will lower the degree of conversion to levels which make the converter useless;*
- *unburnt petrol in the converter; a flow of petrol lasting 30" at 800°C (temperature inside the catalytic converter) is sufficient to fuse and break the catalytic converter. The ignition system must always be in perfect working order, and therefore the spark plug cables must not be removed under any circumstances when the engine is running; the catalytic converter should consequently be substituted with an equivalent piece of piping when carrying out tests.*

If used properly, the catalytic converter should last for more than 80,000 km or for a period of at least five years.

Lambda sensor

This sensor is attached to the end of the first section of the exhaust pipe near the catalytic converter and is used to measure the oxygen content of the exhaust gases. The sensor's output signal is sent to the electronic control unit so that it can adjust the air/fuel mixture and therefore ensure that the catalytic converter operates at its most efficient.

It consists of a zirconium dioxide ceramic casing (1), coated with a thin layer of platinum, closed at one end, inserted in a protective tube (2) and housed in a metal casing (3), which protects the sensor and is used to mount the sensor on the exhaust manifold. The outer part (b) of the ceramic casing is exposed to the flow of exhaust gas, while the inner part (a) is in communication with the ambient air.



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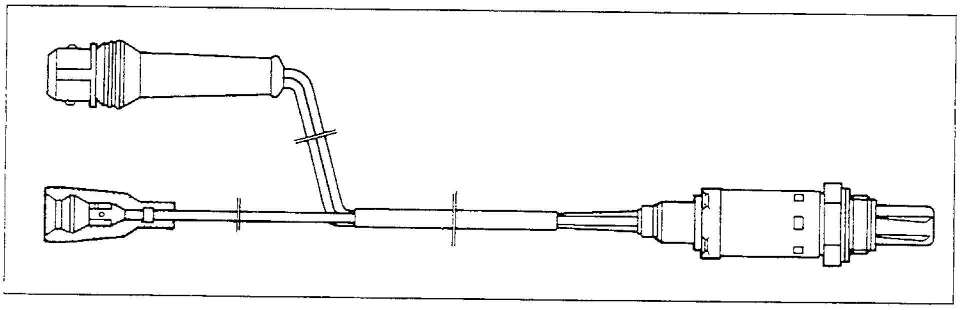
The sensor operates on the basis that when the temperature is above 300°C, the ceramic material used will become a conductor for oxygen ions. In these conditions, if the percentage of oxygen on the two sides (a-b) of the sensor is different, there is a difference in the voltage between the two. This variation in voltage indicates the difference in the quantity of oxygen on the two sides (air side and exhaust side) and it tells the control unit that the oxygen in the exhaust gases is not sufficient to guarantee combustion with a low harmful residue level.

Below 300°C, the ceramic material is not active, the sensor sends no significant signals and a special circuit in the control unit stops the mixture being adjusted while the engine is warming up.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To ensure that the sensor reaches its operating temperature quickly, it has been fitted with an electric resistor (4). When supplied with an electrical current, this resistor reduces the time needed for the ceramic to start conducting the ions, which means the sensor can be positioned in the cooler areas of the exhaust pipe.

NOTE *Even small amounts of lead in the petrol will quickly put the sensor out of action.*

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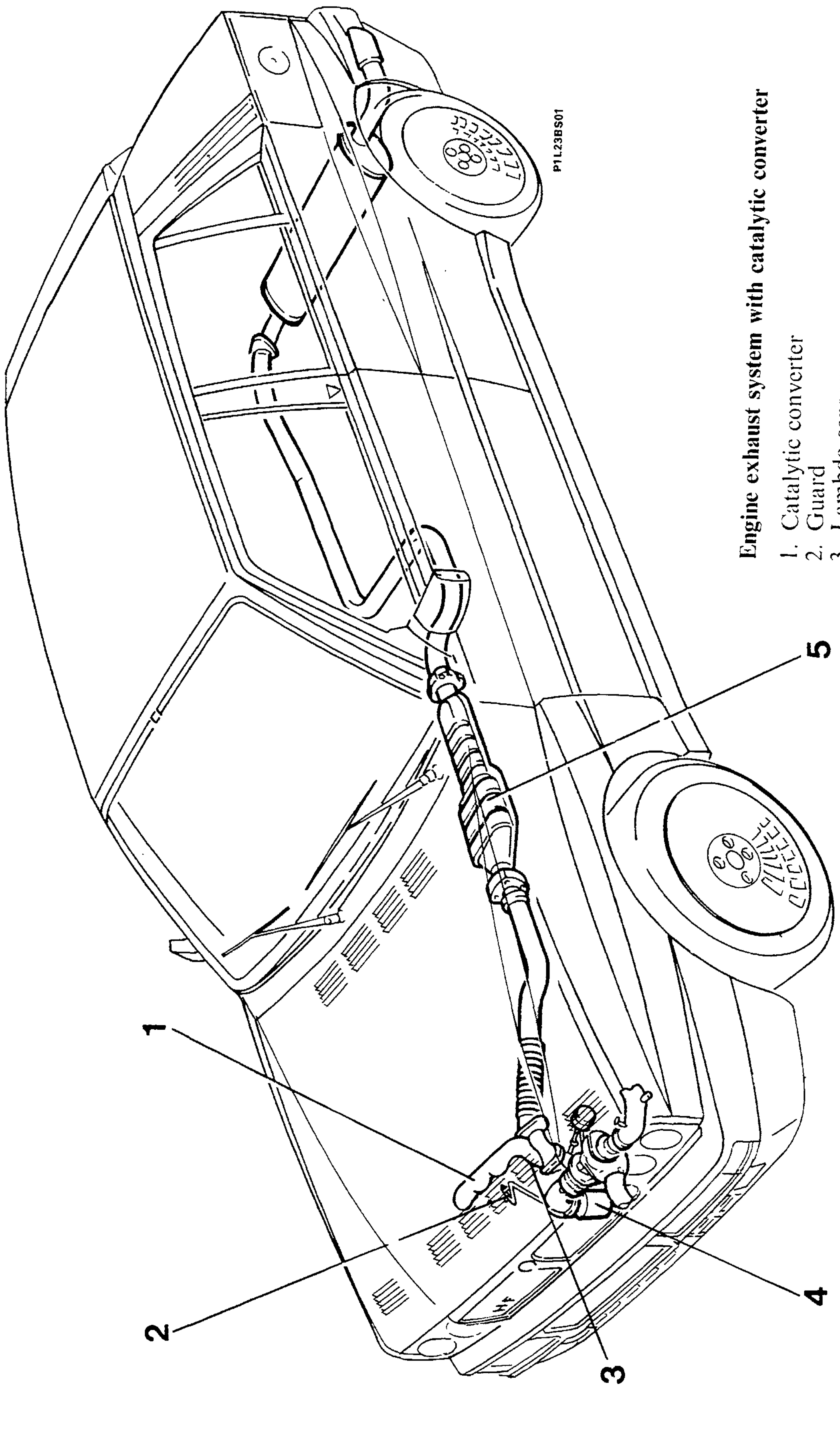


Engine exhaust system with catalytic converter

1. Catalytic converter
2. Guard
3. Lambda sensor
4. Outlet for measuring CO before the catalytic converter
5. Pre - catalytic converter

EXHAUST GAS RECIRCULATION DEVICE E.G.R.

INTRODUCTION

In certain engine operating conditions, this system sends a part (5 - 15%) of the exhaust gases to the air intake.

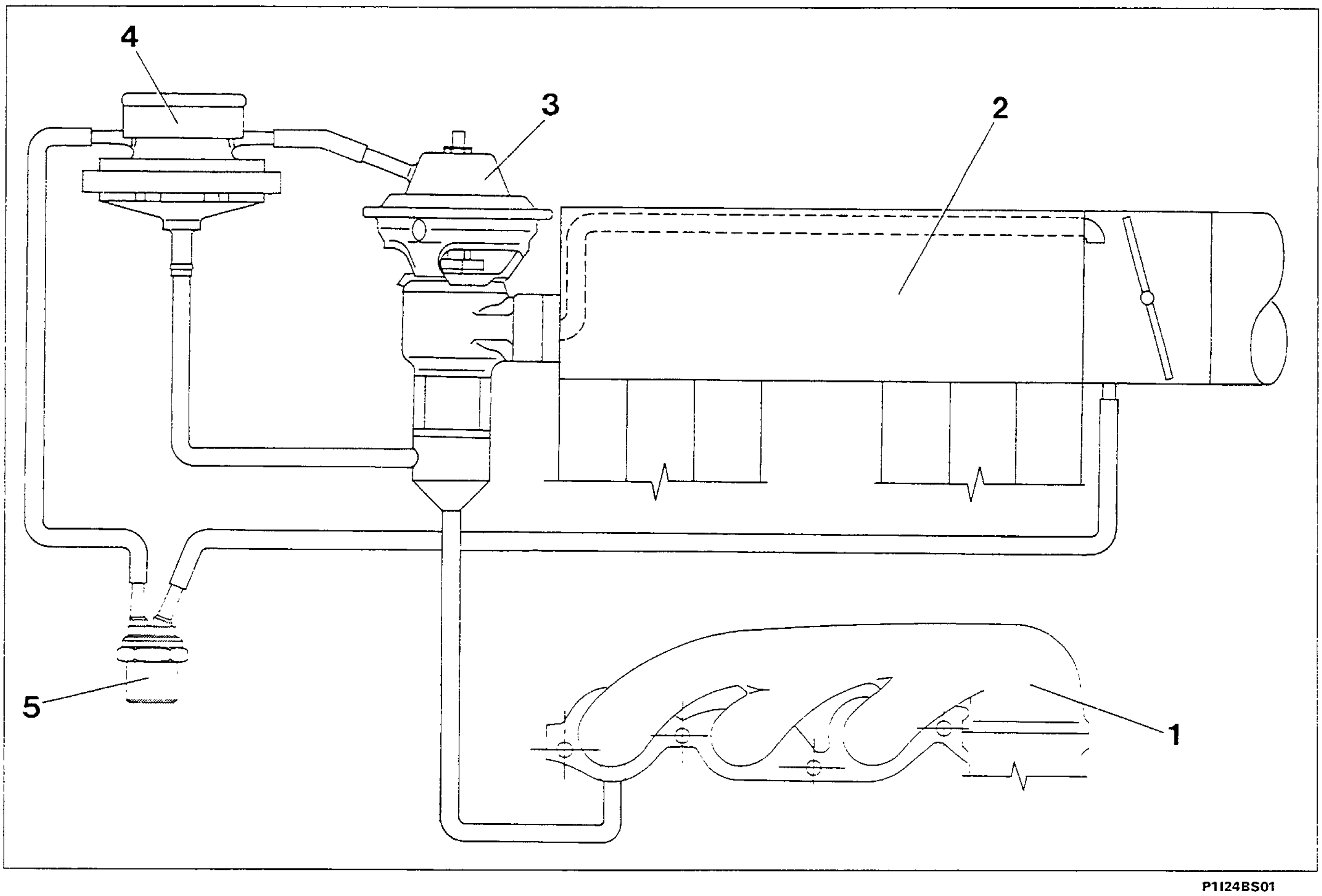
In doing this, the fuel mixture is made leaner, which lowers the peak temperature in the combustion chamber and limits the formation of nitrogen oxides (NOx).

The gases are recirculated through exhaust manifold (1) and intake manifold (2), which are connected when Pierburg valve (3) is made to open by a vacuum signal picked up from the intake manifold.

The device is controlled by a modulator (4), which regulates exhaust gas recirculation when the engine is operating normally and stops recirculation when the throttle is fully open.

A thermal vacuum switch (5), located between the manifold and the modulator, prevents the exhaust gases being circulated when the engine is operating cold.

DIAGRAM OF E.G.R. DEVICE



Key

1. Exhaust manifold
2. Intake manifold
3. Pierburg E.G.R. valve
4. Nippondenso E.G.R. modulator
5. Texas thermal vacuum switch

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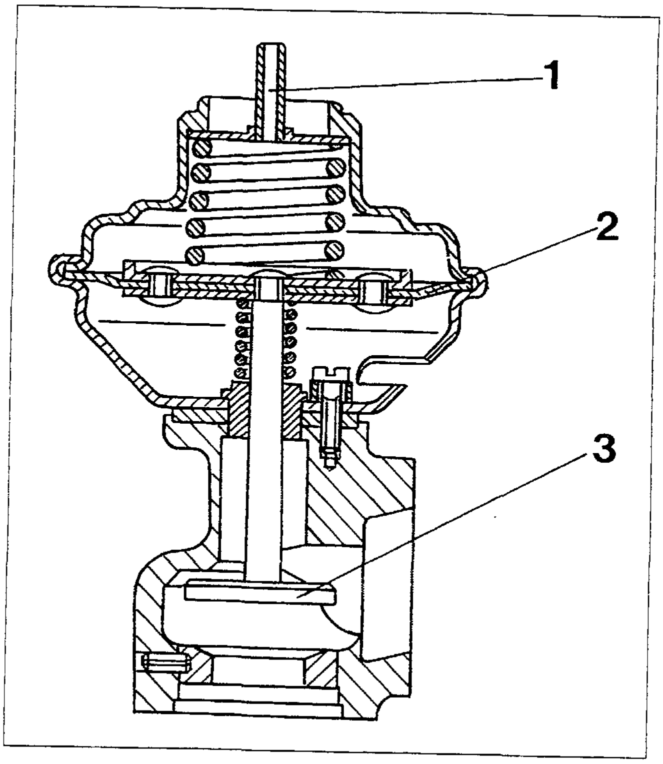
OPERATIONAL DESCRIPTION OF THE EXHAUST GAS RECIRCULATION DEVICE MAIN COMPONENTS

Pierburg E.G.R. valve

This valve is controlled by a vacuum signal picked up from the intake manifold, which can be cut off by the thermal vacuum switch and the modulator.

The E.G.R. valve operates in the following way:
- if the thermal vacuum switch and modulator allow the vacuum signal to pass, this signal can reach duct (1) and lift diaphragm (2), which is connected to plunger (3); this opens up a passage which allows a certain amount of exhaust gases to return to the intake manifold;
- if the thermal vacuum switch is closed (engine cold) or the vacuum signal is too weak (engine idling or full throttle), plunger (3) will drop: this stops the exhaust gases being recirculated, and guarantees correct engine operation when the engine is cold or when the engine is idling and the throttle fully open.

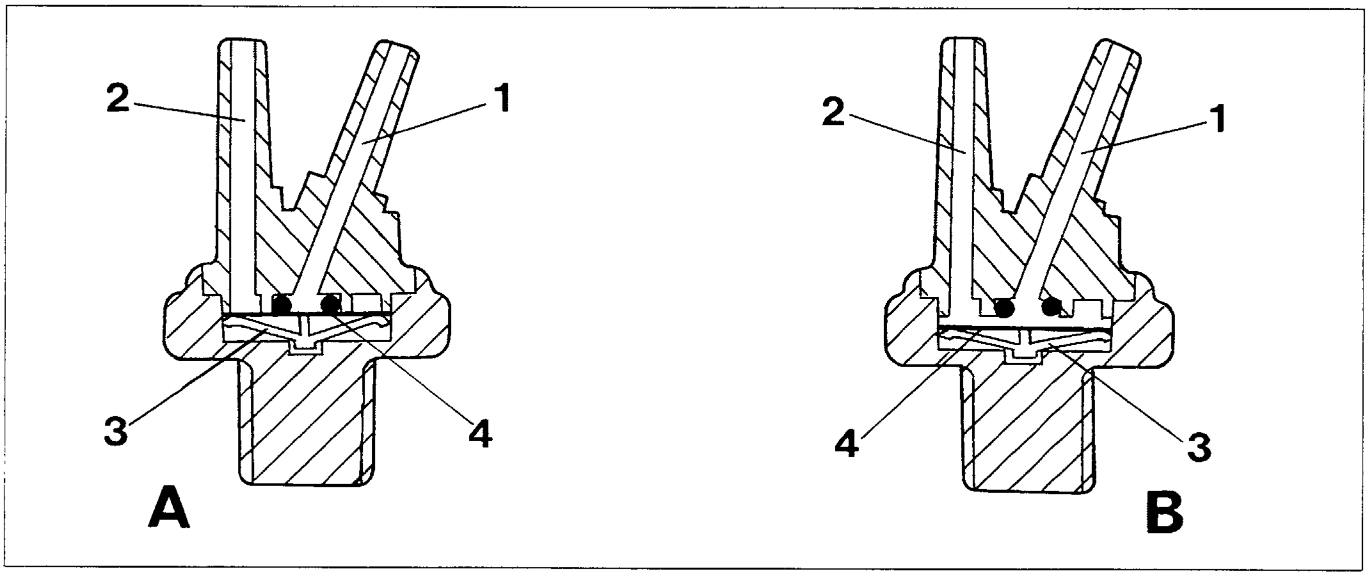


E.G.R valve cross-section

Thermal vacuum switch

The thermal vacuum control switch, illustrated in the figure, is mounted on the thermostat casing. It operates according to the changes in bimetallic strip (3) (see figure overleaf), which bends when the engine coolant temperature alters.

- When the engine is cold, the thermal vacuum switch is as shown in fig. A (closed), which cuts off the vacuum signal and prevents the exhaust gases being recirculated.
- If the temperature rises, bimetallic strip (3) will straighten which, at temperatues of above 40° ±3°C, will lower cap (4) until it is in the position shown in fig. B illustrating the thermal switch open: at this point the intake manifold, which is connected to duct (1), is in communication with the modulator, connected to duct (2), and the vacuum signal can consequently pass through.

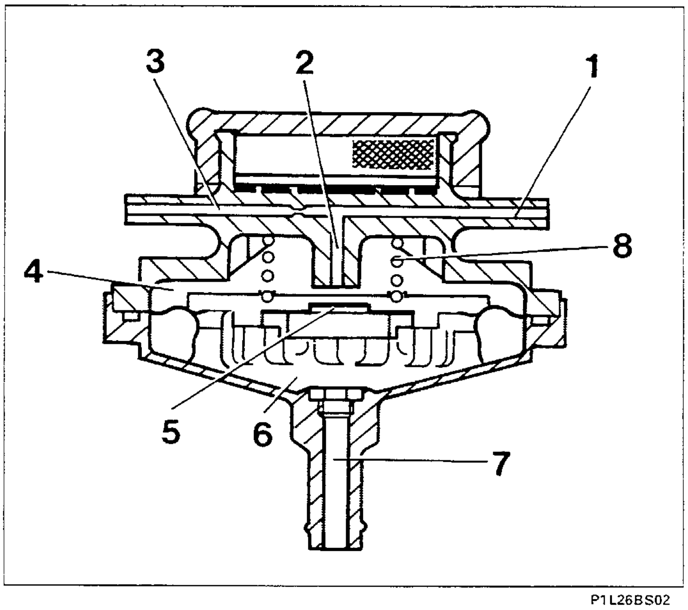


Thermal vacuum switch cross-section (A: closed – B: open)

- When the engine stops, the coolant temperature drops and bimetallic strip (3) contracts, which lifts cap (4). When the temperature falls below 30° ±3°C, the thermal vacuum switch closes again and therefore blocks the passage of the vacuum signal.

Nippondenso E.G.R. modulator

The modulator prevents exhaust gas recirculation during engine operation or supercharging.
It basically consists of a T duct, connected to the control capsule of the E.G.R. valve on side (1), indicated with the letter P, and to the intake manifold on side (3), indicated with the letter Q, while vertical duct (2) is in communication with upper chamber (4), which is at atmospheric pressure.



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If the pressure in bottom chamber (6), connected to the exhaust manifold via duct (7), overcomes spring (8), duct (2) is blocked by cap (5).

There are three different operating conditions, i.e.:

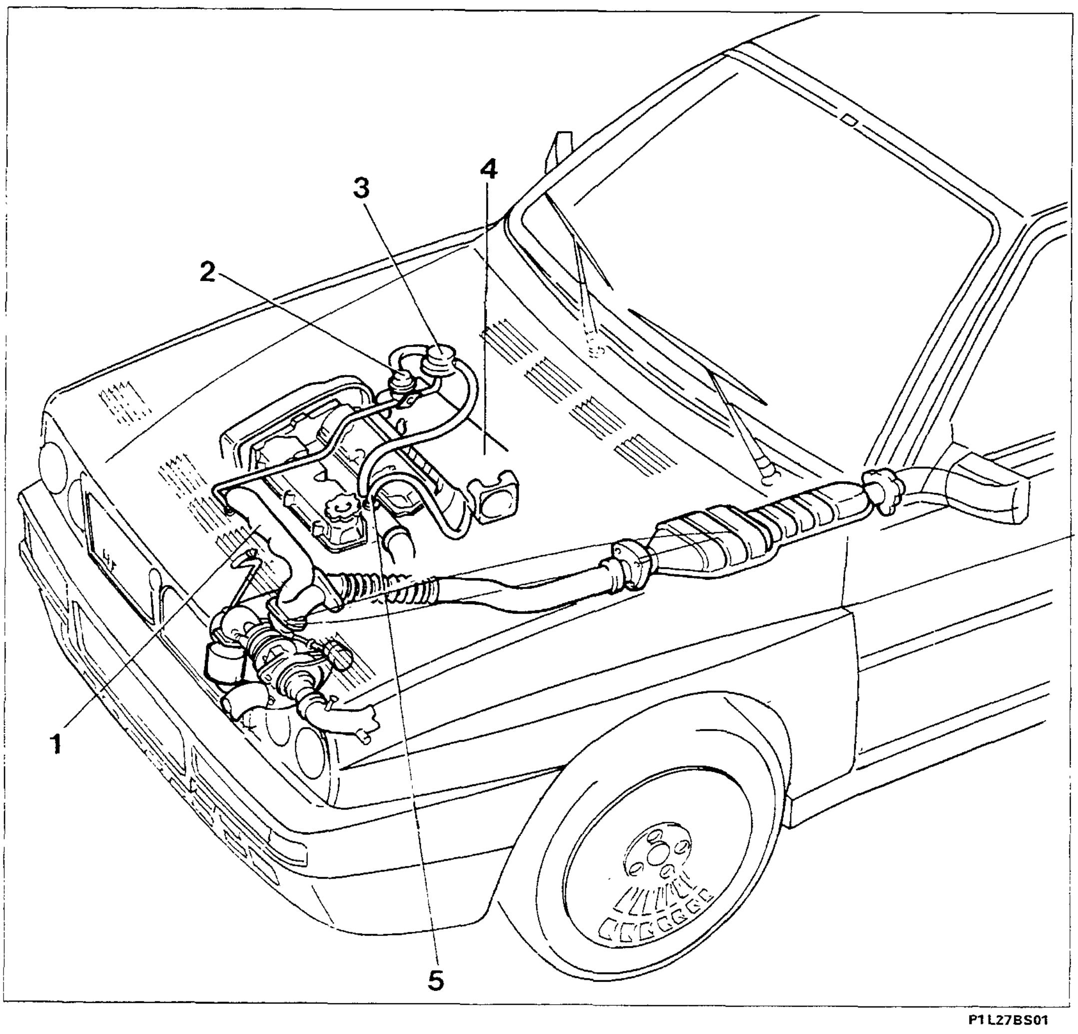
a) **Engine running in normal conditions (throttle slightly open)**
The pressure of the exhaust gases in lower chamber (6) pushes cap (5) upwards, which closes vertical duct (2) when the pressure exceeds 114 mmH_2O : the vacuum from the intake manifold reaches the E.G.R. valve capsule, which opens the valve thus allowing the exhaust gases to be recirculated towards the intake.

b) **Engine idling (throttle completely closed)**
The pressure of the exhaust gases in lower chamber (6) is insufficient to overcome the load of spring (8). An atmospheric pressure signal, taken from upper chamber (4), reaches the E.G.R. valve capsule via duct (2), which keeps the E.G.R. valve closed and prevents exhaust gas recirculation.

c) **Engine running during supercharging**
The high pressure of the exhaust gases in lower chamber (6) pushes cap (5) upwards, which closes vertical duct (2): at this point, however, the vacuum signal from the intake manifold is very weak, and consequently the E.G.R. valve remains closed and exhaust gas recirculation is prevented.

Diagram showing E.G.R. device assembly on the vehicle

1. Exhaust manifold
2. Pierburg E.G.R. valve
3. Modulator
4. Intake manifold
5. Texas thermal vacuum switch



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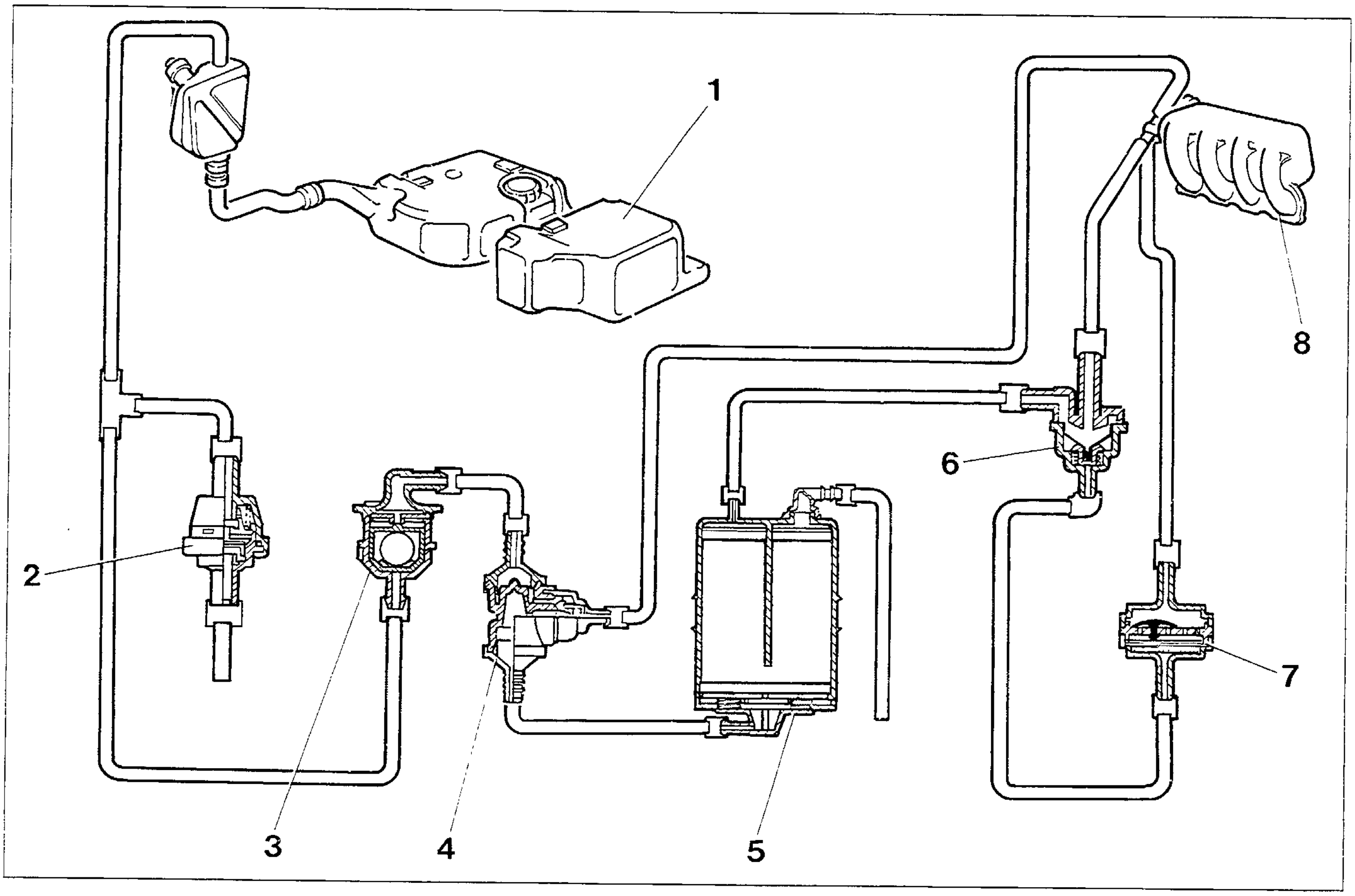
FUEL EVAPORATION CONTROL SYSTEM

A "closed" type system has been adopted for tank ventilation.
This system prevents petrol vapours which form inside the tank and fuel system being discharged into the atmosphere, and consequently polluting it by releasing the light hydrocarbons (HC) they contain.
The system consists of a tank (1) with a non-vented filler cap, a two-way tank relief and ventilation valve (2), a roll-over valve (3), a three-way breather valve (4) to control the flow of petrol vapours into the tank, an activated charcoal canister (5), a three-way cut-off valve (6) used during idling or in the start-up phase, a single-acting retarder valve (7), and an intake manifold (8).



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The system comes into action when the temperature of the petrol increases due to vehicle immobility and high outside temperatures (i.e. the tank is no longer ventilated as it would be if the vehicle were moving), and it perceives an increase in the pressure inside the tank. The petrol vapours pass through the roll-over valve (3) to the three-way breather valve (4), whose function is to control the flow of fuel vapours which may form in the tank and send them to the activated charcoal canister.
If a vacuum forms in the tank due fuel consumption, the ventilation relief valve (2) will open to ventilate the tank.

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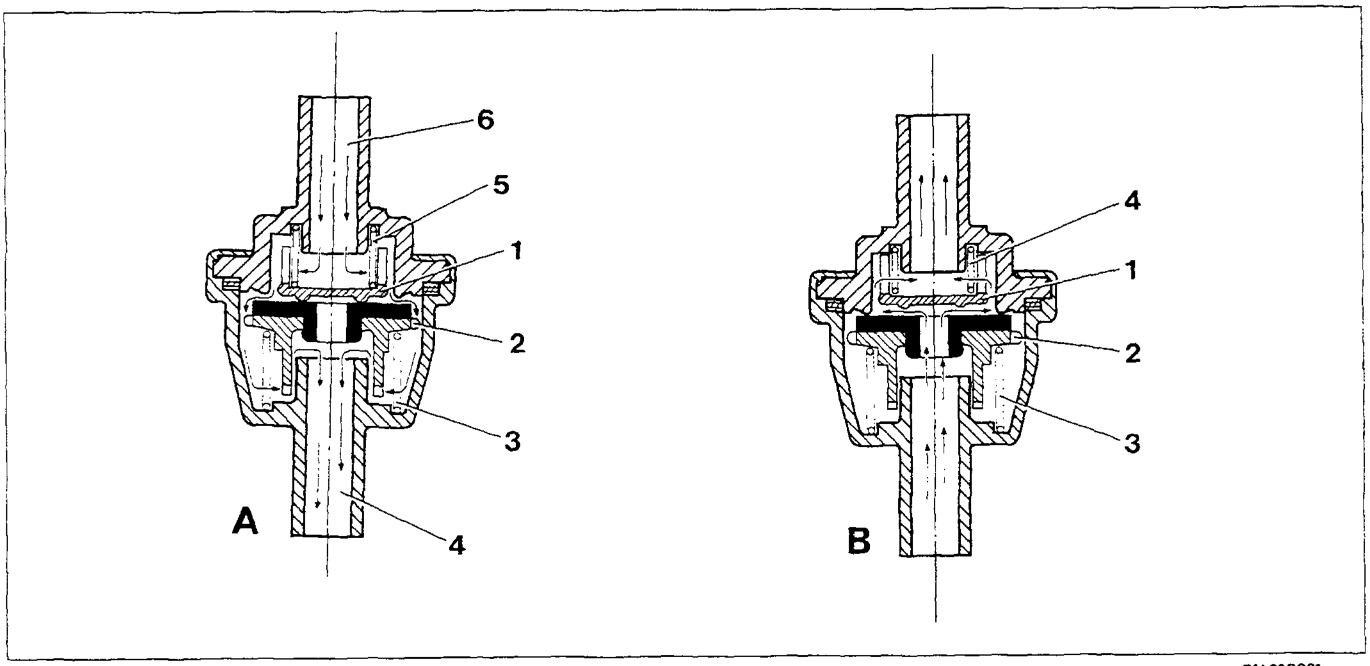
OPERATIONAL DESCRIPTION OF THE FUEL EVAPORATION CONTROL SYSTEM MAIN COMPONENTS

Relief and ventilation valve

This valve operates in two different ways depending on the pressure inside the tank:

- in rest conditions, all the valve's passages are closed;
- when the pressure inside the tank and expansion chamber rises above 0.065 - 0.085 bar (fig. A), cap (1) pushes body (2), overcomes the load of spring (3) and allows the surplus pressure to be released through breather pipe (4): the function of the valve in this case is that of relief valve;



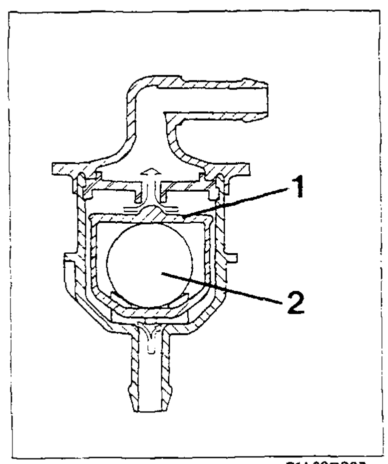
P1L29BS01

- if, however, a vacuum of 0 - 0.020 bar is created inside the fuel tank due to a drop in the petrol level (fig. B), cap (1) overcomes the load of spring (5) and opens up the passage along which the air from breather pipe (4) can pass into the tank (tank ventilation) in order to bring the pressure in the tank to the correct value.

NOTE *The relief and ventilation valve has two functions, which correspond to the colours white and red: it is therefore essential to mount this valve correctly with the white side (with "TANK" written on it) facing the tank.*

Roll-over valve

The vapours sent from the separator to the breather valve must pass through this valve, which closes when the vehicle inclines more than 40°. The valve closes as the result of the pressure exerted by the petrol trying to escape, and the reduced weight of the ball.



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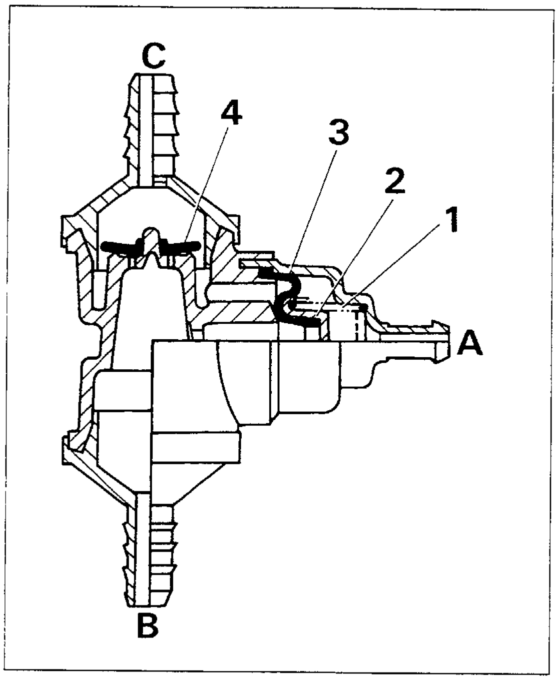


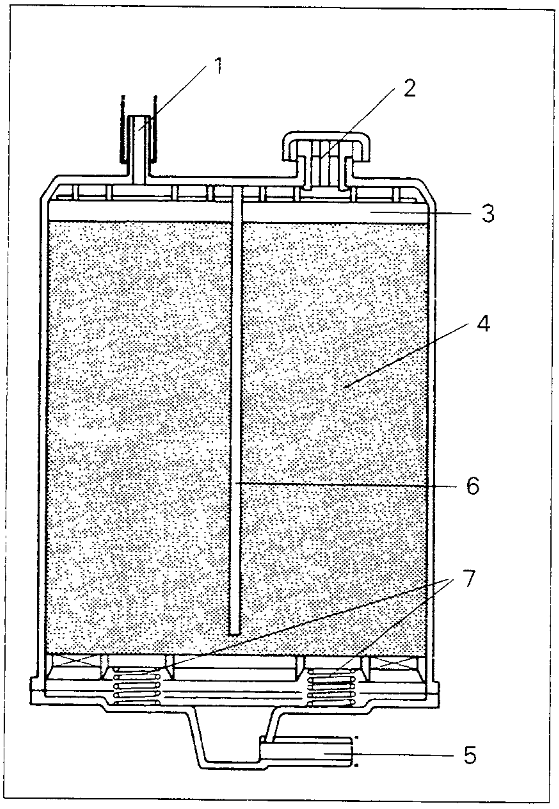
P1L30BS01

Three-way breather valve

Used to control the petrol vapour flow from the tank to the activated charcoal canister, this valve is driven by a vacuum signal picked up from the intake manifold.

The valve functions as follows:

- with the throttle closed, the vacuum sent from the intake manifold to duct (A) overcomes the preload of spring (1), draws cap (2) connected to diaphragm (3) to the right and thus allows the petrol vapours to pass from the tank through duct (B) to the activated charcoal canister along duct (C);
- when there is no vacuum, spring (1) pushes diaphragm (3) upwards to close duct (C): for pressures greater than 0.04 - 0.06 bar spring (1) yields to allow the petrol vapours to pass through;
- when there is a vacuum in the tank, rubber disk (4) bends to allow the tank to be ventilated.



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Activated charcoal canister

The function of this canister is to trap light hydrocarbons (HC) leaving the fuel tank, and send them to the intake manifold at the appropriate moment.
It contains charcoal granules (4), which retain the petrol vapours entering via inlet (5).
The warm flush-out air, which enters via inlet (2), passes through paper filter (3), then flows over the charcoal granules, extracts the petrol vapours and takes them to outlet (1), and from there to the cut-off valve. The air entering through inlet (2), may also be drawn in by a vacuum in the fuel tank to ventilate the tank.
Partition (6) ensures that the warm flush-out air flows
over all the charcoal granules to improve the release of petrol vapours into the intake manifold.
Two springs (7) are also used to allow the mass of granules to expand when the pressure increases.

Three-way cut-off valve

This valve is used to cut off the flow of petrol vapours to the intake manifold when the engine is stationary, idling or being supercharged. It is controlled by a vacuum signal picked up above the throttle valve.

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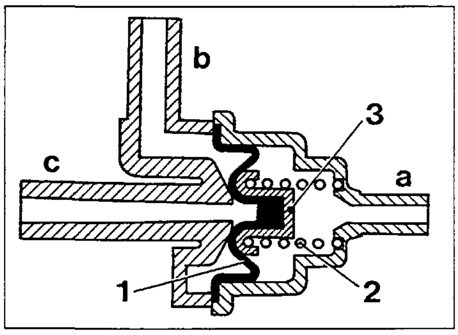
The valve functions as follows:

- when the engine is running and the throttle valve slightly open, the vacuum overcomes the preload of spring (2) to reach duct (a), then draws cap (3), connected to diaphragm (1), downwards to open up communication between ducts (b) and (c);
- when there is no vacuum (engine idling or supercharging), spring (2) pushes diaphragm (1) upwards to close duct (c).



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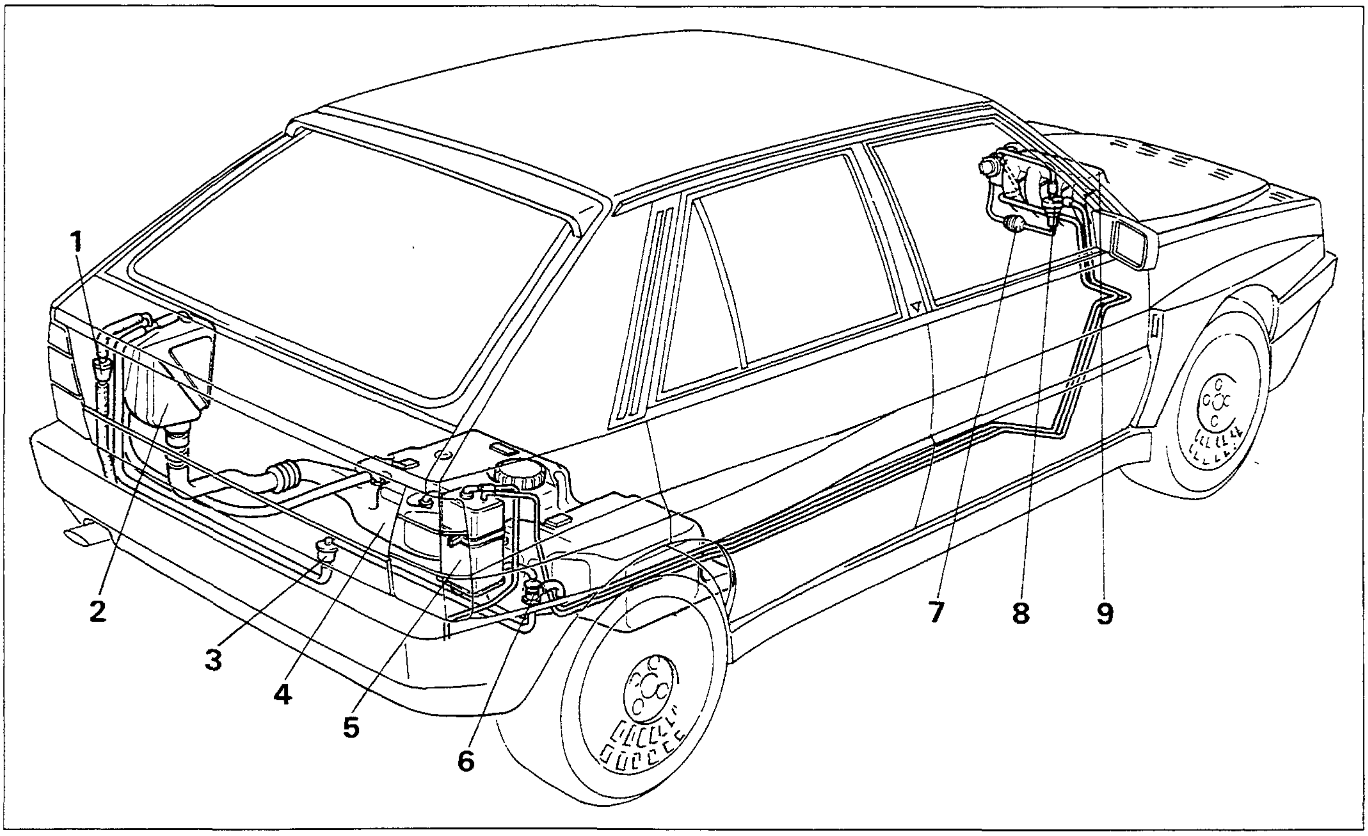
For pressures greater than 0.04 - 0.06 bar, however, the diaphragm will bend to allow petrol vapours to pass through.
The cut-off valve is controlled by a single-acting retarder valve. A pressure signal sent from the throttle body (engine supercharging) will be transmitted to the cut-off valve with a certain amount of delay so that the valve will remain open during short accelerator bursts.

NOTE *Since the retarder valve is single-acting, it must be installed the right way round: the green side should be positioned facing the ignition distributor, whereas the black side should face the vacuum inlet on the carburettor.*



P1L31BS02

Diagram showing fuel evaporation control system on vehicle

1. Two-way ventilation and relief valve
2. Expansion tank
3. Roll-over valve
4. Fuel tank
5. Activated charcoal canister
6. Three-way breather valve
7. Single-acting retarder valve
8. Petrol vapours cut-off valve
9. Intake manifold

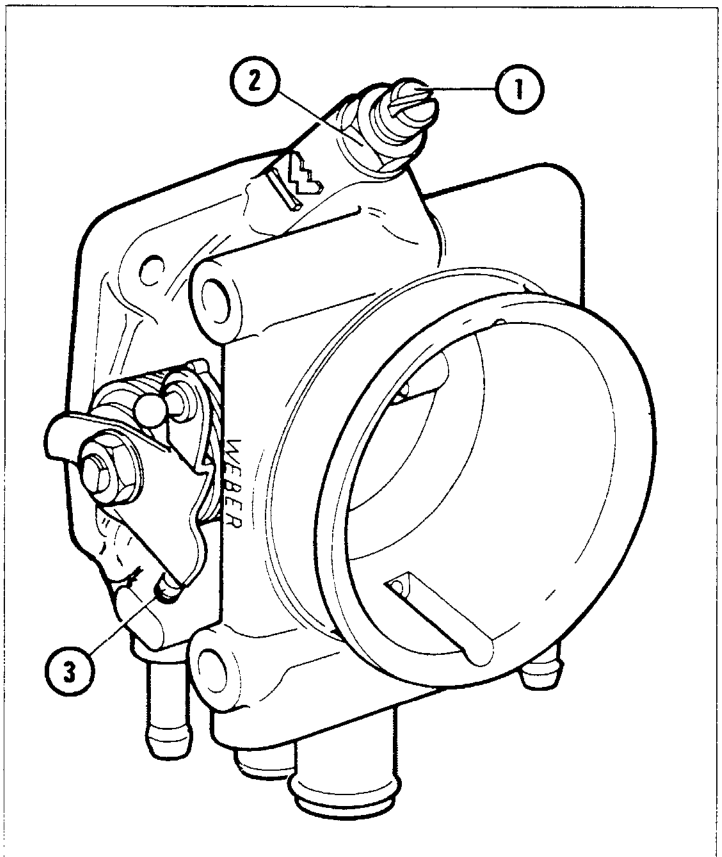
10.

CHECKING AND ADJUSTING THE ENGINE IDLE SPEED

The I.A.W. system is fitted with a solenoid air valve controlled by the electronic control unit. This valve keeps the engine's idle speed constant when hot, regardless of any electrical charges. It thus provides the amount of air needed for startup and engine running at low temperatures.
Proceed as follows when checking and adjusting engine idle:

1. Start the engine and bring it to normal operating temperature after the cooling fan has cut in twice.
2. Using a rev counter check that the idle speed, with all electrical accessories switched off, is **850 ± 50/min**; adjust if it is not.
3. Disconnect the connector of the solenoid air valve and check that the idling speed is **850 ± 50/min** with the electric fan off; if it is not, adjust the speed by means of screw (1). This is done by first unscrewing lock-nut (2), and then screwing screw (1) to reduce the speed, and unscrewing it to increase it until the specified value is reached.
4. Reconnect the valve connector and check that the speed continues to be **850 ± 50/min** without any oscillating.

NOTE *Throttle setscrew (3) must not be tampered with as it is factory-calibrated.*



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1. Idle adjustment by-pass screw (large screw)
2. Lock nut to screw (1)
3. Setscrew

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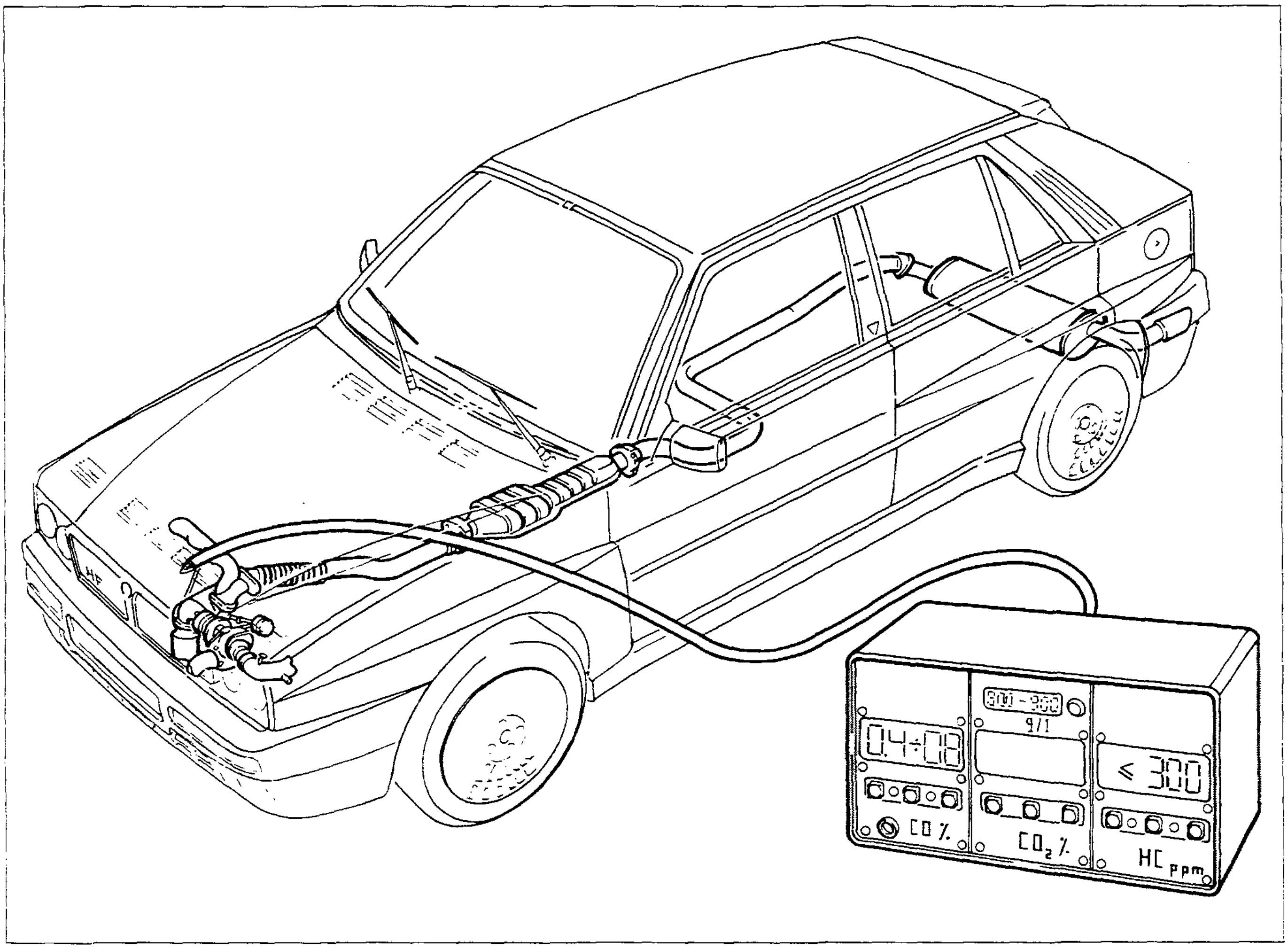
CHECKING THE LEVEL OF POLLUTANT EMISSIONS

Checking the level of CO and HC at idle upstream of the catalytic converter

Proceed as follows to check the level of carbon monoxide (CO) and unburnt hydrocarbons (HC) upstream of the catalytic converter:

1. Unscrew the cap or nut on the exhaust pipe before the catalytic converter and screw the tool in its place.
2. Connect the probe of the CO tester (suitably set) to the tool.
3. Start the engine and bring it to operating temperature.
4. Make sure that the rpm corresponds to the data given, otherwise adjust according to the procedure described previously.
5. Wait for the pointers on the CO tester (f.s. 2% and allowed error 0.1%) and on the HC tester (f.s. 1000 p.p.m. and allowed error 1%) to settle.
6. Check that the CO level at idle is between 0.4% and 1%; if it is not, check for the following:
   - correct Lambda sensor supply;
   - air leaks in the area around the Lambda sensor seat.
7. In the same conditions, check that the level of hydrocarbons (HC) is lower than or equal to 300 p.p.m.
8. If these values are not read, tune the engine and check the following:
   - injection and ignition system
   - valve clearance
   - timing



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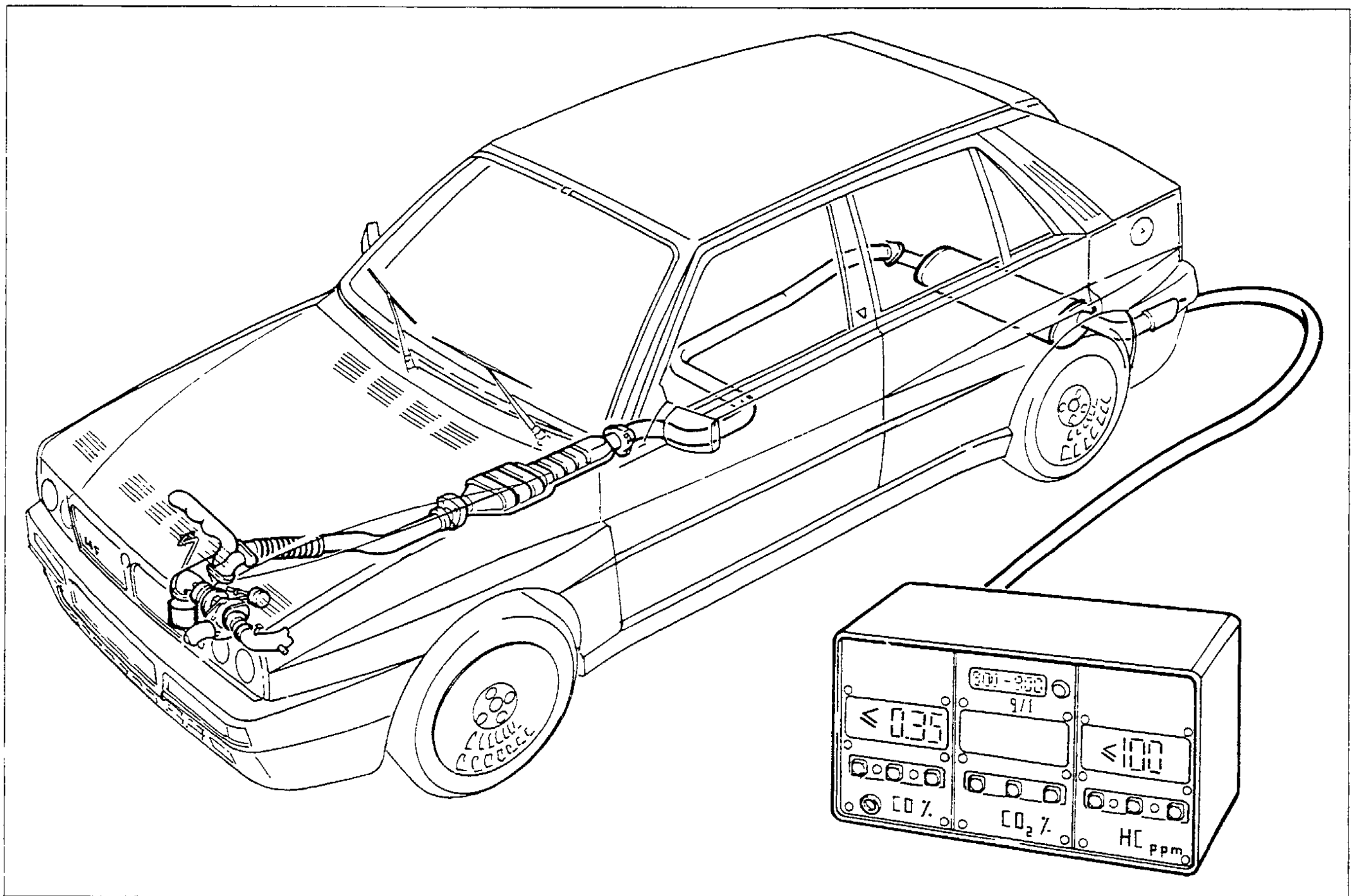
Checking the CO and HC level in the exhaust

The CO and HC* levels in the exhaust are measured by inserting the probe of a suitably set tester into the end of the exhaust pipe for at least 30 cm, as shown in the figure.
If the probe cannot be fully inserted into the exhaust pipe due to the shape of the end of the pipe, an extension tube must be used: the join between the extension tube and the pipe, however, must be air-tight.



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This check must be performed with all the emission control devices activated, as follows:

1. Start the engine and bring it to operating temperature.
2. Check that the rpm speed corresponds to that specified, if not, adjust according to the procedure described previously.
3. Wait for the pointers to settle on the CO tester (f.s. 1% and allowed error 0.1%) and on the HC tester (f.s. 500 p.p.m. and allowed error 1%).
4. Check that the CO and HC levels at idle are less than or equal to 0.5% and 100 p.p.m. respectively.
5. If the HC value is not within the specified limits, whereas the value read above the catalytic converter was correct, the engine parameters are to be considered correct and the fault lies in reduced efficiency of the catalytic converter.

* Check only for the Swiss market.

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