BY APPOINTMENT TO
HER MAJESTY QUEEN ELIZABETH
THE QUEEN MOTHER
MANUFACTURERS OF DAIMLER AND JAGUAR CARS
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SERVICE MANUAL

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CABLE COLOUR CODES

N – Brown	B – Black	W – White	K – Pink	G – Green
R – Red	Y – Yellow	O – Orange	S – Slate	L – Light

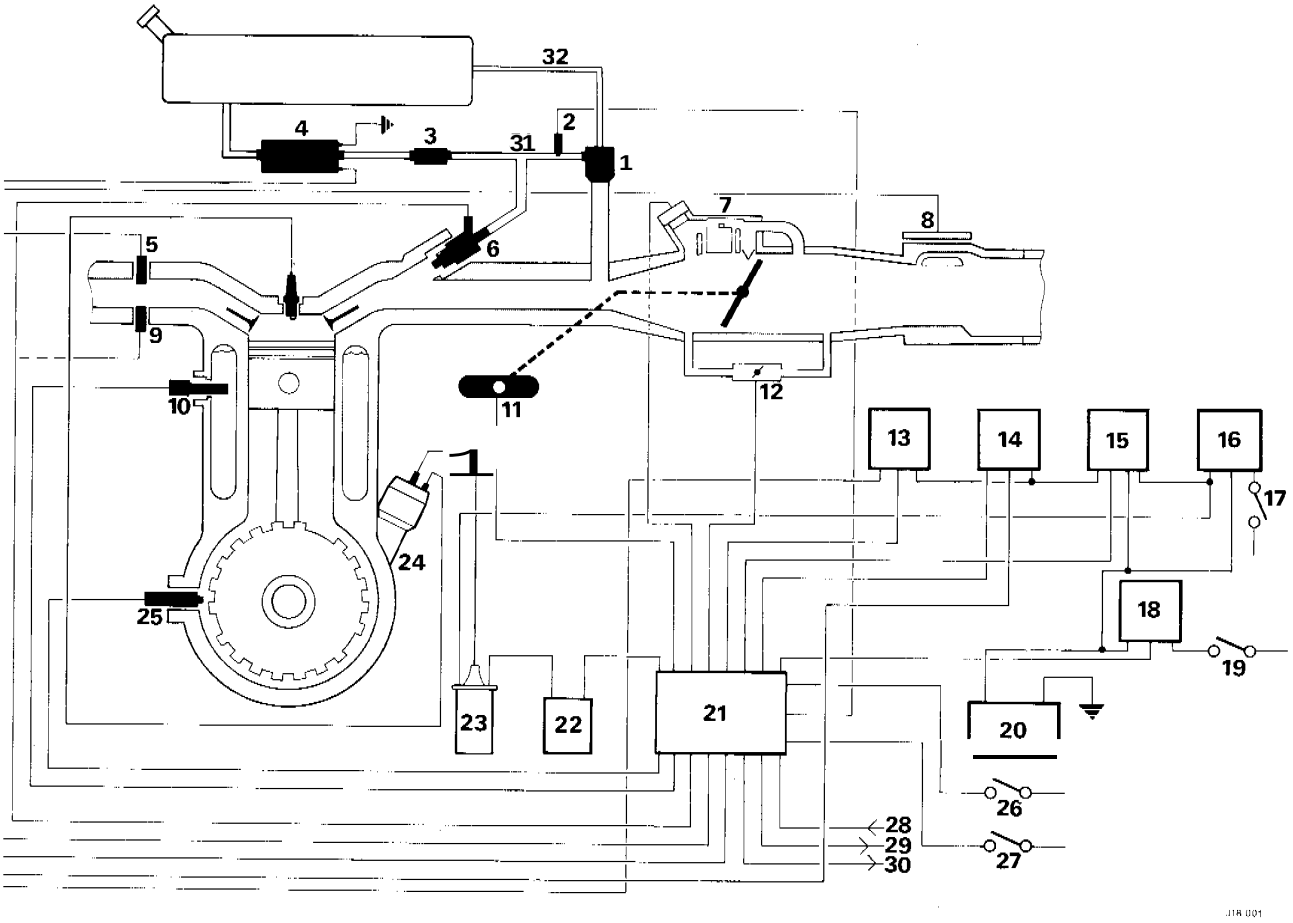


Fig 1 Engine management system

Key to Illustration

1. Pressure regulator
2. 6.8 kilohm resistor
3. Filter
4. Pump
5. Lambda sensor
6. Injector
7. Idle speed control valve
8. Air flowmeter
9. Air pump
10. Coolant temperature sensor
11. Throttle potentiometer
12. Supplementary air valve
13. Air pump relay
14. Fuel pump relay
15. Main relay
16. Ignition 'on' relay
17. Inertia switch
18. Start relay
19. Start switch
20. Battery
21. ECU
22. Ignition amplifier
23. Ignition coil
24. HT distributor
25. Crankshaft sensor
26. Gearbox sensor
27. Air conditioning clutch sensor
28. Idle override
29. VCM 1
30. VCM2
31. Fuel rail
32. Fuel return

INTRODUCTION

The engine management system maintains optimum engine performance over its entire operating range by metering the fuel into each cylinder's inlet tract and adjusting the ignition timing angle at the sparking plugs. Each of these functions is performed by an Electronic Control Unit (ECU) which, from data received from sensors located on and around the engine (Fig. 1), evaluates optimum ignition timing and fuel metering parameters relative to engine load and speed. Additional functions of the system include:

1 Fuel pump control to prevent fuel flooding and/or spillage when the engine is stationary with the ignition switch in position "II".
2 Cold start control to ensure sufficient fuel exits in the inlet manifold to create a combustible air/fuel mixture in the combustion chamber.
3 Idle speed control to compensate for varying engine temperature and load conditions, e.g. the engaging or disengaging of the transmission (automatic only) and/or the air conditioning clutch.
4 Fuel cut-off during engine overrun conditions to improve fuel economy by minimising the quantity of unburnt fuel discharged into the exhaust system.
5 Engine overspeed control to impose a maximum engine speed limit of 6300 rev/min.
6 Air pollution control to reduce exhaust contamination to levels which comply with different country exhaust regulations.
7 Fuel monitoring to provide precise fuelling information to the trip computer.
8 Fault monitoring to provide data to the instrumentation system for display.

The system also incorporates a "limp home" feature which permits continued engine operation on certain sensor failure, the sensor failure being indicated on the instrument pack.

Fuel Metering

Fuel is delivered to solenoid operated injectors, via a variable pressure regulator, by an electrically driven pump operating at a virtual constant pressure. Actual injector pressure, however, fluctuates between 35-45 lbf/in² depending on the absolute manifold pressure acting on the regulator at the time. The quantity of fuel injected for a given duration of injector 'on' (open) time is thus maintained constant, irrespective of the back pressure on the injector nozzles, and accurate fuel monitoring is achieved.

Injector operation is by means of an electrical pulse which actuates a solenoid valve within the injector body. The duration of the pulse, and hence the quantity of fuel injected, is determined by the ECU on a basis of intake air (engine load) and engine speed information derived from air flowmeter and crankshaft sensors. This information is used to access mapped data stored in 128 memory locations containing injector pulse durations pertaining to eight engine loads at 16 different speeds.

Correction factors are imposed on the basic injector pulses to compensate for varying conditions. The resultant pulses are then normally applied to the injectors twice per engine cycle, i.e. once per crankshaft revolution, with only half the amount of fuel being injected at each injector 'on' time.

Injector pulse adjustments are necessary to provide:

Cranking enrichment during starting.

Temperature enrichment during starting and warm-up.

After-start enrichment during warm-up.

Demand corrections during idle, full power and acceleration.

Voltage corrections for variations in the electrical system voltage.

Contamination corrections for emission control.

Cranking enrichment

Cranking enrichment is provided, irrespective of prevailing temperature conditions, when the starter motor is activated. This is achieved by increasing the injector operating frequency from one pulse to three pulses per crankshaft revolution and is implemented by the ECU in response to an input from the starter solenoid. Cranking enrichment is terminated at an engine speed of 600 rev/min.

Temperature enrichment

Temperature enrichment is provided during starting and warm-up. This is achieved by increasing the injector 'on' time above that of basic requirements and is implemented **by** the ECU in response to an input from a coolant temperature sensor.

After-start enrichment

After-start enrichment is provided, irrespective of temperature, to supply added fuel during warm-up. This is achieved by the ECU which increases the injector 'on' time above that of basic requirements and then decreases the amount of additional fuel supplied at a fixed rate with time.

Demand corrections

Corrections are provided **for** idle, acceleration and full power demands. This is achieved by increasing the injector 'on' time above that of basic reqirements and is implemented by the ECU in response to an input from a throttle potentiometer.

Voltage corrections

The ECU constantly monitors the electrical system voltage, i.e. the state of the battery and electrical load, because the time taken for an injector to open is affected by voltage and results in a corresponding change in the quantity of fuel delivered. The ECU compensates for any voltage change detected by adjusting the injector 'on' time accordingly.

Contamination corrections

On certain vehicles exhaust pollution is reduced to a minimum by monitoring the oxygen content of the exhaust and correcting the fuel/air mixture to maintain an intake ratio of approximately 14.7:1. This is achieved by the ECU in response to an input from a Lambda sensor.

Additional air is also introduced into the exhaust system by a relay activated air pump and solenoid vacuum valve. The relay is actuated by the ECU at temperatures between 15°C and 45°C with the ignition 'on'.

Ignition timing

Ignition pulses are applied, via a separate ignition amplifier, to the ignition coil which generates high energy pulses **for** the sparking plugs via the distributor. Unlike conventional ignition systems, however, the distributor has no centrifugal **or** vacuum advance mechanisms and no LT circuit exists. The distributor is only required, therefore, to distribute the high energy pulses to the plugs.

Ignition timing is controlled by the ECU from information supplied by the air flowmeter and crankshaft sensor. This information is used to access mapped data stored in **128** memory locations containing ignition timing angles pertaining to eight engine loads at 16 different speeds.

Depending on the monitored engine speed and supply voltage, the dwell-period (dwell angle) is determined and the ignition energy is adapted to that required at any instant in time. The unnecessary consumption of energy in the ignition coil is thus prevented. In addition, a peak coil current cut-off facility prevents current flowing through the ignition coil below a specific engine speed and, therefore, prevents the battery being discharged and the ignition coil overheating.

Description

The ECU contains a microprocessor and discrete electronic component circuits that provide interfacing to peripheral input/output devices.

The microprocessor performs all system control functions and has a memory pre-loaded with system parameters that are accessed under software control. System response times are, therefore, reduced to a minimum and the system is rendered operational immediately the ignition switch is set to position **"II"**. System perhipherals are as follows:

1 Fuel injectors: solenoid actuated devices which spray quantities of fuel into the inlet manifold.
2 Ignition amplifer: an electronic device which, through the ignition coil, generates high energy electrical pulses for distribution to the sparking plugs.

3 Air flowmeter: a hot wire sensing device which monitors inlet manifold air flow for optimum fuelling and ignition control.
4 Idle speed control valve: a stepper motor driven device which controls the volume of air entering the engine to maintain a correct idle speed.
5 Crankshaft sensor: a device which generates engine speed and crankshaft position information for precise ignition timing and fuelling control.
6 Throttle potentiometer: a device which interprets the throttle position to identify idle, acceleration and full power demands.
7 Gearbox sensor: two linear gearbox selector actuated switches that induce idle speed corrections which compensate for engine load changes that occur when 'N' or 'P' is engaged or disengaged. On vehicles fitted with manual transmission units, the switch input to the ECU is connected to logic earth.
8 Fuel pump relay: a device which implements controlled fuel pump switching.
9 Coolant temperature sensor: a thermal device which monitors the coolant temperature to induce cold starting and warm-up enrichment.
10 Supplementary air valve: a solenoid actuated device which provides additional air during cold starting and warm-up at temperatures below - 10°C.
11 Lambda sensor: a device which monitors the oxygen content of the exhaust to induce contamination corrections on vehicles exported to specified countries.
12 Air conditioning sensor: an air conditioning compressor clutch actuated switch that induces idle speed corrections which compensate for engine load changes that occur when the clutch is engaged or disengaged.
13 Air pump relay: a device which controls exhaust system air pump and solenoid vacuum valve operation on vehicles fitted with exhaust emmission control.
14 Idle fuel potentiometer: a device which provides fine adjustment of engine idle fuel. This device is set during vehicle manufacture and only requires adjustment when the air flowmeter assembly, of which it forms an integral part, is renewed.

Other system devices and communications are as follows:

1 Ignition 'on' sensing: an input taken from contact 87 of the ignition 'on' relay which, in addition to applying power to the ignition coil, energises the main and fuel pump relays through the ECU. A timer is also initiated which, through the fuel pump relay, permits fuel pump operation for approximately 0.5 seconds to ensure the fuel rail is pressurised prior to cranking.
2 Cranking sensing: an input which induces cranking enrichment when the starter solenoid is activated.
3 Battery voltage sensing: an input taken from contact 87 of the main relay which, in adddition to applying power to the supplementary air valve, air flowmeter, fuel injectors and both fuel and air pump relays, induces fuelling corrections that compensate for battery voltage fluctuations.
4 Idle override: an input derived from the instrumentation system which, in addition to displaying the vehicle road speed on the instrument pack, inhibits engine idle control at road speeds greater than 3 mph (4.8 kph).
5 VCM 1: an output applied to the instrumentation system to provide indication of an engine management system fault on the instrument pack.
6 VCM 2: a dual purpose output applied to the instrumentation system to (1) identify individual engine management system faults when the ignition switch is initially set to to position "II", and (2) provide precise fuelling conditions to the trip computer when the engine is running.

OPERATION

A circuit diagram of the engine management system detailing interconnections between the ECU and the various input/output pheripheral devices is shown in Figure 4.

Ignition On

Power is applied to the various devices through contacts LI4-87/30 of the main relay which is energised, via contacts B17-87/30 of the ignition 'on' relay, when the vehicle ignition switch is in position "II", i.e. when O Volts is applied to B 17-85 of the ignition 'on' relay.

Application of power to the ECU at LI3-1 and LI2-10 generates a system reset which causes the microprocessor to perform an initialization routine (a sofware program stored in memory), condition input circuits for sensor scanning and initiates fuel pump operation to pressurise the fuel rail prior to cranking. The fuel pump is activated via contacts LI5-87/30 of the fuel pump relay which is energised by an output from the ECU at LI2-7.

On completion of the initialization routine, sensor scanning commences and analogue information from the sensors is converted into digital data for storage. The data thus stored is then evaluated to determine prevailing engine conditions and memory locations are accessed to obtain appropriate ignition timing and fuel metering parameters. In addition, the following functions are performed:

1 The stepper motor of the idle speed control valve is driven, via LI2-15/16 and LI2-18/19, to set the valve at a position suitable for engine starting. Rapid valve positioning is achieved for all conditions by extending or retracting its stem from a mid-travel position restored each time the ignition switch is set to "off".
2 The solenoid of the supplementary air valve is actuated, via LI2-20, to open the valve at temperatures below – 10°C.
3 Fuel pump operation is terminated, i.e. the output at LI2-7 is removed, after approximately 0.5 seconds to eliminate possible fuel flooding should an injector be stuck in the open position. This feature is also used to eliminate possible fuel spillage creating a hazardous condition at an accident scene if fuel line fracture occurs due to impact damage.
4 The exhaust system air pump and solenoid vacuum valve (if fitted) are activated by the air pump relay which is energised, via LI2-2, at temperatures between 15°C and 45°C.
5 A number relating to a fault which may have occurred during the last period that the engine was run is recalled from memory and displayed on the instrument pack fascia.
6 A breather pipe heater is actuated, via a breather pipe heater relay, under the control of a screenwash jet heater sensor.

Engine Cranking

Fuel pump operation is reinstated and any fault number displayed on the instrument pack fascia is erased when the engine is cranked, provided that the ECU detects a crankshaft sensor input at LI3-13 and 14. The Lambda sensor heater is also activated to heat the sensor on vehicles fitted with exhaust emission control.

As the engine rotates under the influence of the starter motor, fuel is introduced into the air flow of the inlet manifold by the fuel injectors which are actuated by the ECU under control of the crankshaft sensor input. Injector triggering occurs, through LI2-12, 13 and 25, three times per crankshaft revolution with appropriate correction factors imposed. The ignition amplifier is also actuated at the correct times, through LI2-1, to fire the sparking plugs.

Engine Running

When the engine starts, cranking enrichment is terminated at 600 rev/min, i.e. injector pulses occur once per crankshaft revolution, and both warm-up and after-start enrichment is imposed. In addition, any extra manifold air is delivered by the supplementary air valve which is driven in response to coolant temperature, throttle potentiometer and crankshaft sensor inputs.

The engine idle speed is controlled, through LI2-15/16 and LI2-18/19, by the ECU which drives the idle speed control valve stepper motor from coolant temperature, throttle position and crankshaft speed information. Compensation is also provided for fluctuating engine load by monitoring air conditioning clutch and gearbox (automatic only) sensor inputs at LI3-21 and 3 respectively. The engine idle speeds are set as follows:

1. Cold in neutral – 800 rev/min.
2. Hot in neutral – 700 rev/min.
3 Cold in drive – 650 rev/min.
4. Hot in drive – 580 rev/min.

If the supplementary air valve is deployed, i.e. temperature below -10°C. the idle speed control valve intercepts the engine speed on Supplementary air valve closure. This ensures that the desired engine idle speed is maintained without searching.

Fuel and ignition requirements are calculated at each sensor scanning to maintain optimum engine efficiency over its entire range, including full power and acceleration demands. Should a sensor failure be detected, an output is applied to the instrument pack to provide indication of the failure on the fascia. The nature of the fault is also stored in ECU memory and is output as a fault number the next time the ignition switch is set to position "II".

Exhaust emission regulation is implemented by the ECU under control of the Lambda sensor (if fitted) which monitors the oxygen content of the exhaust system and provides a corresponding signal to the ECU at LI3-17. This signal imposes corrections on the basic injector 'on' times to reduce exhaust emissions to a minimum. Power to the Lambda sensor heater is supplied from contact LI5-87/30 of the fuel pump relay and, therefore, exhaust emission control is only operational during periods that fuel pump operation is permitted.

Additional air is introduced into the exhaust system by a relay actuated air pump and solenoid vacuum valve (if fitted) to reduce the density of the gases emitted, the relay being actuated by an output from the ECU at LI2-2.

NOTE: During periods that the air pump is operating, Lambda sensor operation is inhibited.

Fault identification:

Definitions of fault numbers displayed on the instrument pack fascia are as follows:

1 Cranking signal failure: no crankshaft sensor signal detected after cranking for 6 seconds, or the cranking signal line at LI2-8 is active above 2000 rev/min.
2 Air flowmeter failure: either open-circuit or short-circuit to ground.
3 Coolant temperature sensor failure.
4 Feedback circuit failure (Federal/Japan only).
5 Air flowmeter failure: low throttle potentiometer voltage with high air flowmeter voltage.
6 Air flowmeter failure: high throttle potentiometer voltage with low air flowmeter voltage.
7 Idle fuel adjustment potentiometer failure.
8 Not allocated: should this fault number be displayed, a 6.8 kilohm resistor fitted in place of a hot start sensor is faulty.

INJECTORS

DESCRIPTION 18.00.00

Each fuel injector (Fig 1) contains a needle valve rigidly attached to the plunger of a solenoid which, when energised by an electrical pulse, moves the needle away from its seat against a helical pressure spring. This action permits a measured quantity of pressurised fuel to enter the inlet manifold, via an integral filter and nozzle, each time an injector pulse is applied.
Valve lift is approximately 0.15 mm (0.006in.) for the fully open position which is reached in a response time of approximately 1 millisecond. The amount of fuel delivered is dependent only on the period of time the injector is open, the precise open time being determined by the ECU and is typically 2.75 milliseconds at engine idle.

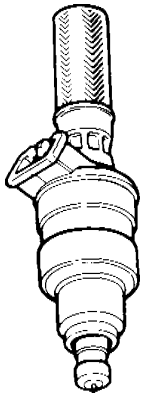


Fig 1

INJECTORS

RENEW 18.10.02

Open the passenger door.
Remove the screws securing the passenger dash liner and remove the liner.
Remove the relay from the fuel pump relay connector (yellow).
Open the drivers door and crank the engine for 10 seconds to depressurise the fuel system.
Close the drivers door, refit the relay and dash liner.
Open the bonnet.
Note the position and disconnect the injector connectors.
Remove the fuel rail securing bolts (Fig 2) and release the fuel feed hose union nut.
Disconnect the fuel feed hose.
Fit protective plugs to the fuel rail and hose.
Release the fuel rail to pressure regulator union nut.
Disconnect the fuel rail from the induction manifold and pressure regulator.
Place the fuel rail on a work bench.
Remove the injector retaining clips and withdraw each injector from the fuel rail.
Clean the fuel rail apertures and remove the injector protective caps.
Insert the new injectors into the fuel rail apertures and fit the injector retaining clips.
Fit the fuel rail assembly to the induction manifold ensuring that the injectors are fully seated.
Connect the fuel rail to the pressure regulator and tighten the union nut.
Remove the protective caps from the fuel rail and hose.
Connect the fuel hose to the rail and tighten the union nut.
Fit the injector connectors to the injectors as noted.
Close the bonnet.

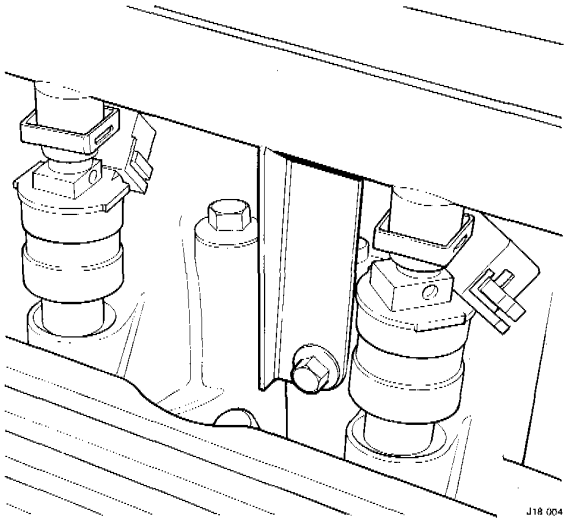


Fig 2

SPARK PLUGS

REMOVE, CLEAN, ADJUST AND REFIT 18.20.01

Open the bonnet.
Disconnect the plug leads from the spark plugs (Fig 1).
Ensure the engine is clean around the plugs then release and remove the plugs using a suitable plug spanner.
With the plugs removed ensure the plug apertures are clean.
Clean the plug electrodes using suitable equipment to remove all carbon deposits.
Set the electrode gap to 0.025 in. (0.64mm).
Refit the plugs to the engine and tighten to the correct torque.
Connect the plug leads to the spark plugs.
Close the bonnet.

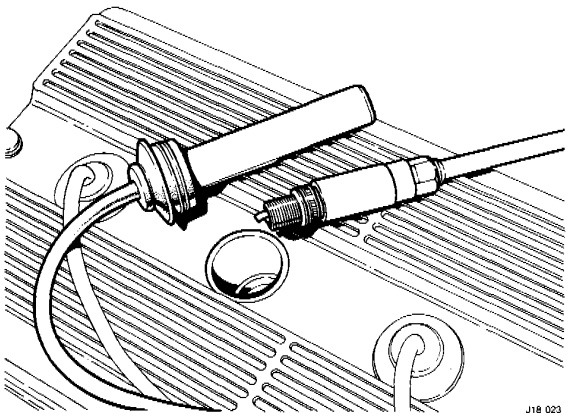


Fig 1

DATA

SERVICE TOOLS

Torque wrench.

TORQUE FIGURES

Sparkplugs 16.25-28.45Nm

SPANNER SIZES

5/8 AF.

SPARK PLUGS

RENEW 18.20.02

Open the bonnet.
Disconnect the plug leads from the spark plugs.
Ensure the engine is clean around the plugs then release and remove the plugs using a suitable plug spanner.
With the plugs removed ensure the plug apertures are clean.
Fit the new plugs to the engine and tighten to the correct torque.
Connect the plug leads to the spark plugs.
Close the bonnet.

DATA

SERVICE TOOLS

Torque wrench.

TORQUE FIGURES

Spark plugs 16.25-28.45Nm

SPANNER SIZES

5/8 AF.

DISTRIBUTOR CAP

RENEW **18.20.10**

Open the bonnet.
Release the distributor cap retaining clips and displace the cap.
Note the positions of the plug leads and remove the leads.
Remove the HT lead from the cap and remove the cap.
Remove the carbon brush from the cap and discard the cap.
Fit the carbon brush to the new cap.
Fit the HT and plug leads to the cap as noted.
Fit the cap to the distributor and engage the retaining clips.
Close the bonnet.

HT LEADS

RENEW **18.20.11**

Open the bonnet.
Disconnect the HT lead from the ignition coil.
Release the distributor cap retaining clips and displace the cap (Fig 1).
Detach the lead retaining bracket from the camshaft cover and disconnect the leads from the plugs.
Remove the lead and cap assembly to a work bench.
Note the positions of the leads and disconnect the leads from the cap.
Remove the lead retaining brackets from the leads and discard the leads.
Fit the lead retaining brackets to the new leads.
Secure the lead retaining bracket to the camshaft cover and connect the leads to the plugs.
Fit the cap to the distributor and engage the retaining clips.
Connect the HT lead to the ignition coil.
Close the bonnet.

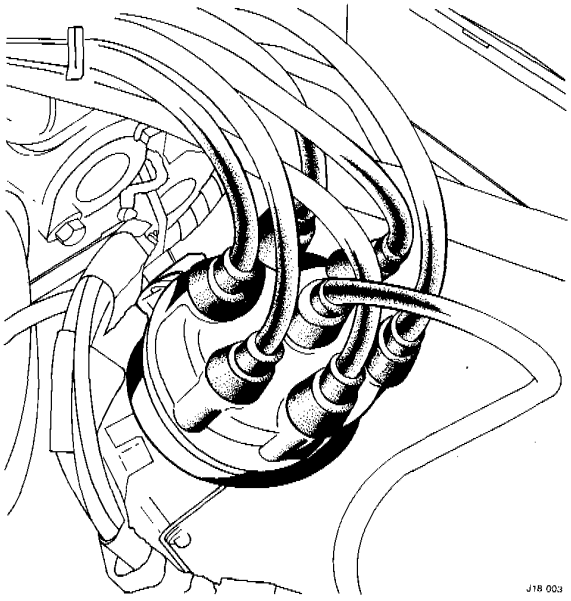


Fig 1

HT DISTRIBUTOR

RENEW **18.20.20**

Open the bonnet.
Remove the nuts securing the air cleaner to the inner wing valance.
Release the clips securing the air cleaner to the air flowmeter and remove the air cleaner for access to the engine T.D.C. indicator.
Release the distributor cap retaining clips and reposition the cap.

Jack up and place the vehicle on two stands.
Turn the engine to T.D.C. on number one cylinder.
Remove the distributor clamp bolt.
Note the position of the rotor arm and remove the distributor.
Note the position of the plug leads in the distributor cap and disconnect the leads from the cap.
Remove the cap of the new distributor and fit the leads to the new cap as noted.
Ensure that number one cylinder of the engine is at T.D.C.
Fit the distributor and position it so that the centre of the rotor electrode is in line with cylinder number one electrode in the distributor cap.
Fit and tighten the distributor clamp bolt (1 Fig 1) to the correct torque.
Fit the distributor cap (2 Fig 1) to the distributor and engage the retaining clips (3 Fig 1).
Fit the air cleaner to the air flowmeter and engage the securing clips.
Secure the air cleaner to the inner wing valance and tighten the securing nuts.
Close the bonnet.

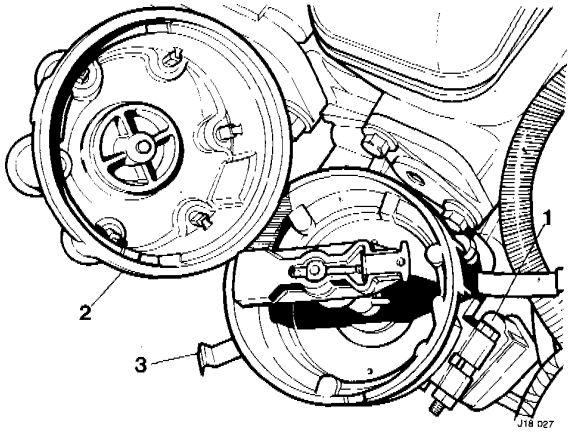


Fig 1

DATA

SERVICE TOOLS

Torque wrench.

TORQUE FIGURES

Distributor clamp bolt 9.5-12Nm

DISTRIBUTOR CAP CARBON BRUSH

RENEW **18.20.22**

Open the bonnet.
Release the distributor cap retaining clips and reposition the cap for **access** to the carbon brush.
Remove the carbon brush from the distributor cap and discard the brush (Fig 2).
Fit the new brush to the distributor cap, fit the cap to the distributor and engage the retaining clips.
Close the bonnet.

ROTOR ARM

RENEW **18.20.23**

Open the bonnet.
Release the distributor cap retaining clips and displace the cap.
Remove the rotor arm from the distributor and discard the arm (Fig 2).
Fit the new rotor arm to the distributor, fit the cap to the distributor **and** engage the retaining clips.
Close the bonnet.

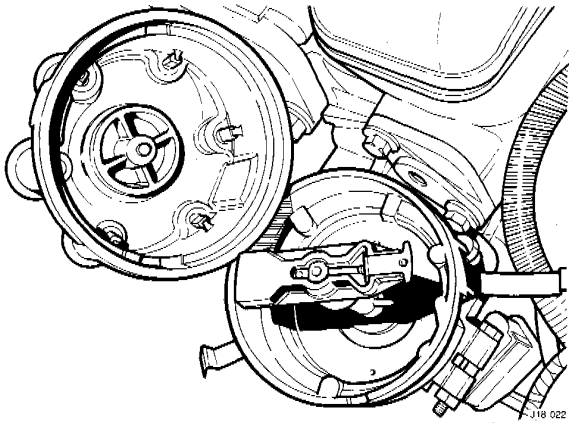


Fig 2

IGNITION AMPLIFIER

RENEW **18.20.30**

Open the bonnet and disconnect the battery earth lead.
Release and remove the screws (Fig 1) securing the amplifier to its mounting plate.
Disconnect the amplifier connector (black) and remove the amplifier.
Connect the amplifier connector (black) and position the amplifier on the mounting plate.
Secure the amplifier to the mounting plate and connect the battery earth lead.
Close the bonnet.

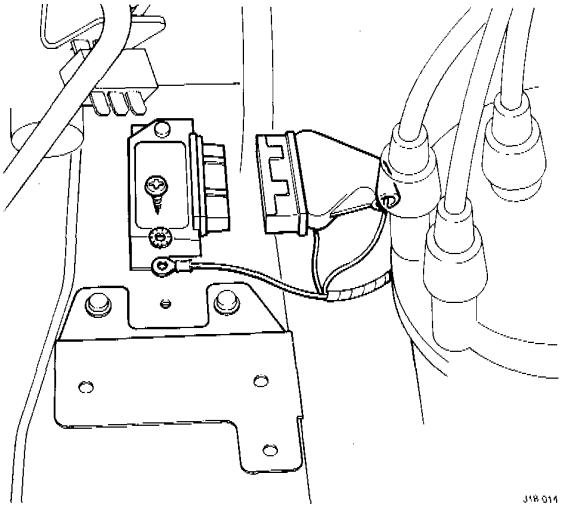


Fig 1

IGNITION COIL

RENEW **18.20.32**

The ignition coil is a Bosch type TC 1 and is secured to the right-hand inner wing valance.

Open the bonnet and disconnect the battery earth lead.
Displace the LT terminal rubber protective covers and disconnect the LT terminal connections from the coil (Fig 2).
Remove the coil retaining bracket inner and outer securing bolts.
Displace the suppression capacitor, disconnect the HT lead and remove the coil assembly.
Remove the bracket from the coil and discard the coil.
Fit the bracket to the new coil, position the coil and fit the bracket inner and outer securing bolts ensuring that the suppression capacitor bracket is below the inner bolt and the earth eyelet of the LT leads is below the outer bolt.
Tighten the bracket securing bolts to the correct torque and connect the LT leads.
Fit the LT terminal rubber protective covers and connect the HT lead.
Connect the battery earth lead and close the bonnet.

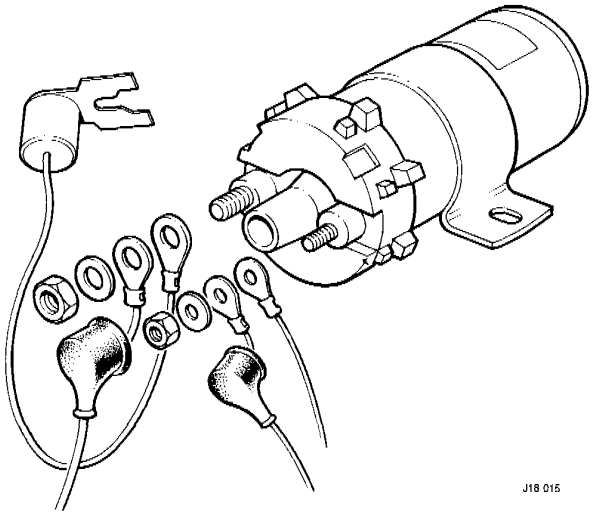


Fig 2

ELECTRONIC CONTROL UNIT

RENEW **18.30.01**

Open the bonnet and disconnect the battery earth lead.
Open the passenger door, remove the screws securing the passenger side dash liner and remove the liner.
Remove the four bolts securing the ECU.
Displace the ECU (1 Fig **3**) and disconnect the muti-pin connectors.
Remove the ECU.

Fitting a new ECU is the reversal of the removal procedure ensuring the connectors are secure, clean and tight.

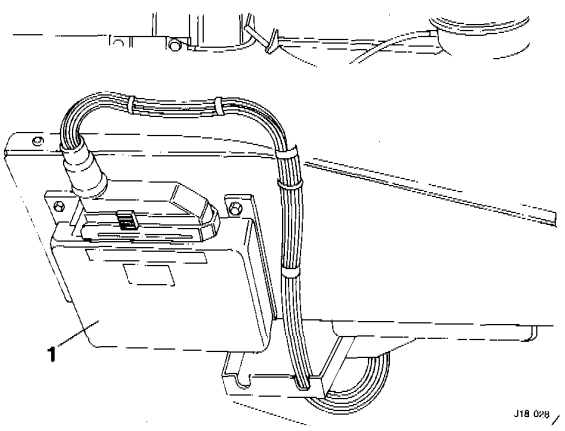


Fig 3

COOLANT TEMPERATURE SENSOR

DESCRIPTION 18.30.00

The coolant temperature sensor (Fig 1) is located at the rear of the thermostat housing and comprises a temperature-sensitive resistor having a negative temperature coefficient, i.e. its electrical resistance decreases conversely with increasing temperature. The sensor provides a temperature parameter to the ECU which triggers temperature enrichment circuits that increase the injector 'on' time during cold starting and warm-up.
The coolant temperature sensor, idle speed control valve and supplementary air valve combination form the equivalent to a carburettor automatic choke.

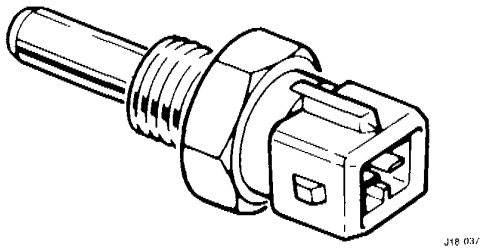


Fig 1

COOLANT TEMPERATURE SENSOR

RENEW 18.30.10

NOTE: This procedure must only be performed on a cold or cool engine.

Open the bonnet and disconnect the battery earth lead.
Disconnect the coolant temperature connector (brown).
Undo and remove the sensor (Fig 2).
Clean the sensor aperture, fit the new sensor and tighten to the correct torque.
Connect the coolant temperature sensor connector (brown).
Connect the battery earth lead and close the bonnet.

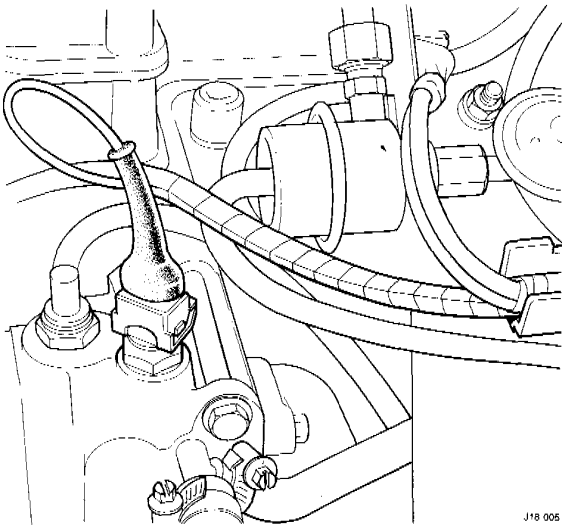


Fig 2

DATA

TORQUE FIGURES

Coolant ***temperature sensor 49-54 Nm***

CRANKSHAFT SENSOR

RENEW 18.30.12

The crankshaft sensor (Fig 3) provides both engine speed and crankshaft position information to the ECU. It comprises a toothed gear and a variable reluctance coil.
Open the bonnet and disconnect the battery earth lead.
Remove the clips securing the sensor cable.
Disconnect the rnult-pin cable connector.
Remove the bolts securing the sensor housing and remove the housing complete with the sensor.
With a suitable allen key remove the bolt securing the sensor and remove the sensor from its housing.

Fitting a new sensor is the reversal of the removal procedure ensuring the connector is secure, clean and tight.

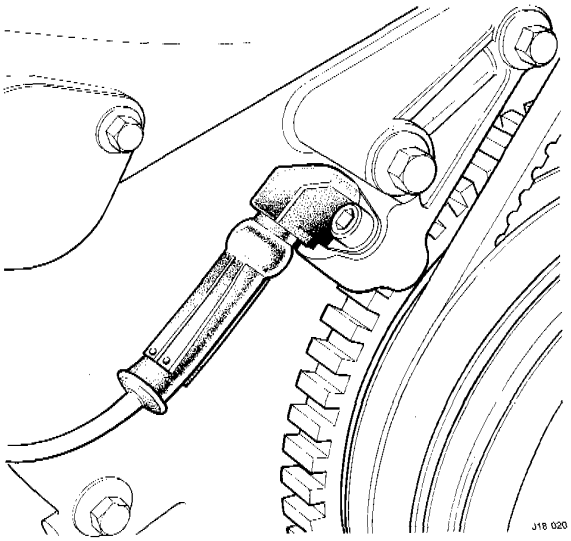


Fig 3

TOOTHED GEAR

RENEW **18.30.14**

The toothed gear is attached to the crankshaft and has 57 symmetrically spaced rectangular segments around its periphery. These segments induce a signal in the reluctance coil when the engine is running, the frequency of the signal being proportional to engine speed. Three omitted segments, which would give a total segment complement of 60, interrupt the induced signal to provide crankshaft position references.

Open the bonnet.
Unclip the air cleaner cover and remove the cover complete with element from the backplate.
Clean the cover, box and mating faces.
Remove the air conditioning drive pulley, slacken the alternator drive belt adjusting nut, the link arm adjusting nut, and the alternator pivot bolt.
Pivot the alternator towards the engine and remove the drive belt.
Note the position of the pulley relative to the damper.
Remove the bolts securing the pulley to the damper.
Note the position of the balance weights and remove from the pulley.
Remove the damper.
Fit Service Tool 18G 1837 to the front crankshaft damper and tighten the securing bolts.
Wedge the tool and remove the damper retaining bolt.
Remove Service Tool **18G 1837** from the damper.
Fit Service Tool 18G 1436 to the damper and tighten the securing bolts. Tighten the centre bolt, withdraw the pulley from the crankshaft (Fig 1) and remove the tool.
Remove the bolts securing the toothed gear to the damper and remove the gear from the damper.
Remove the roll pin from the damper and discard the damper.
Fit the roll pin to a new damper.
Refit the toothed gear to the damper and tighten the securing bolts, fit the damper to the engine, start the damper securing bolt and fit Service Tool 18G 1437.
Wedge the tool, torque up the securing bolt and remove Service Tool 18G 1437.
Reposition the alternator drive belt over the pulleys.
Tension the alternator drive belt and tighten all the securing bolts and nuts.
Align and fit the alternator drive belt pulley to the damper ensuring that the balance weights are fitted in their respective positions noted previously.
Secure the pulley with the bolts.
Fit the air cleaner element to the cover and fit the assembly to the backplate.
Secure the cover with the clips.
Close the bonnet.

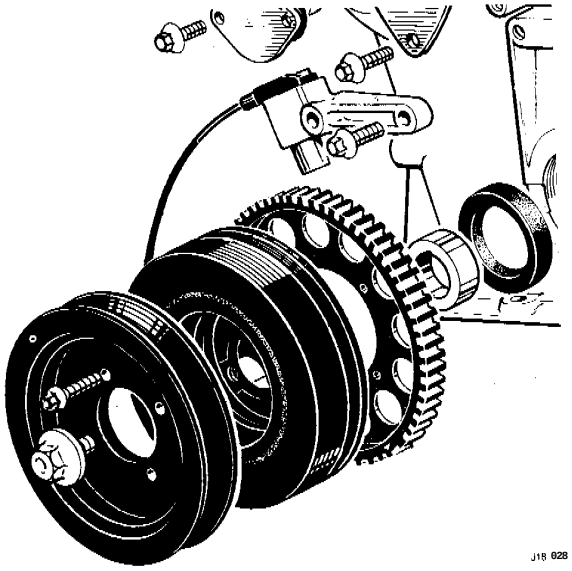


Fig 1

DATA

SERVICE TOOLS

Crank pulley remover 18G 1436
Front pulley lock 18G 1437

TORQUE FIGURES

Trunnion to alternator 23-27Nm
Alternator to timing cover 23-27Nm
Alternator to trunnion locknuts 12-14Nm
Alternator pivot bolt 23-27Nm
Alternator pivot bolt nut 23-27Nm
Crankshaft pulley to crankshaft 203.5Nm
Crankshaft pulley to damper 23-27Nm
Timing ring to damper 16-19Nm

SPANNER SIZES

8mm
10mm
13mm
19mm
1/2in AF
9/16in AF
3/4 WHITWORTH

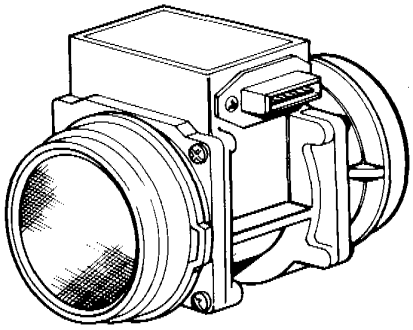
AIR FLOWMETER

DESCRIPTION 18.30.00

The air flowmeter (Fig 1) provides a measurement to the ECU of the air flow in the duct to the inlet manifold. The unit contains two sourcing elements; one at inlet air temperature, and the other which is heated by an electrical current. Both elements are situated in a by-pass, the heated element being subjected to cooling as air is drawn into the engine. The volume of air is thus determined by measuring the electrical current required to maintain the temperature differential of the elements constant.
The by-pass method of air flow measurement has a number of advantages which include:

1. Protection for the delicate sensing elements from shock loads.
2. Reduction in the scale of measurement error due to severe flow pulsations.
3. Minimal contamination of the sensing elements by dirt and backfire flows that exist in the main duct.

A potentiometer is incorporated in the air flowmeter to provide idle fuel adjustment. This potentiometer operates completely independent of the air flowmeter elements, but is incorporated in the flowmeter for ease of access to its adjustment screw which is sealed with a plastic plug.



J18 010

Fig 1

AIR FLOWMETER

RENEW 18.30.15

Open the bonnet and disconnect the battery earth lead.
Remove the nuts securing the air cleaner to the inner wing valance.
Release the clips securing the air cleaner to the air flowmeter and reposition the air cleaner for access.
Release the air flowmeter to intake elbow hose clip.

Remove the screw securing the air flowmeter earth lead and disconnect the earth lead.
Disconnect the air flowmeter connector (black) and remove the air flowmeter.
Connect the air flowmeter connector (black) to the new air flowmeter.
Connect the air flowmeter earth lead.
Fit the air flowmeter to to intake elbow hose and tighten the hose clip.
Fit the air cleaner to the air flowmeter and engage the securing clips.
Secure the air cleaner to the inner wing valance and tighten the securing nuts.
Connect the battery earth lead and close the bonnet.

THROTTLE POTENTIOMETER

RENEW **18.30.17**

The throttle Potentiometer (Fig 1) is mechanically coupled to the throttle butterfly spindle and provides a reference voltage to the ECU dependent on throttle position.

The ECU detects a linear increasing voltage produced **by** the potentiometer as the throttle is opened and triggers demand enrichment circuits which, due to increased manifold air, causes the engine to accelerate.

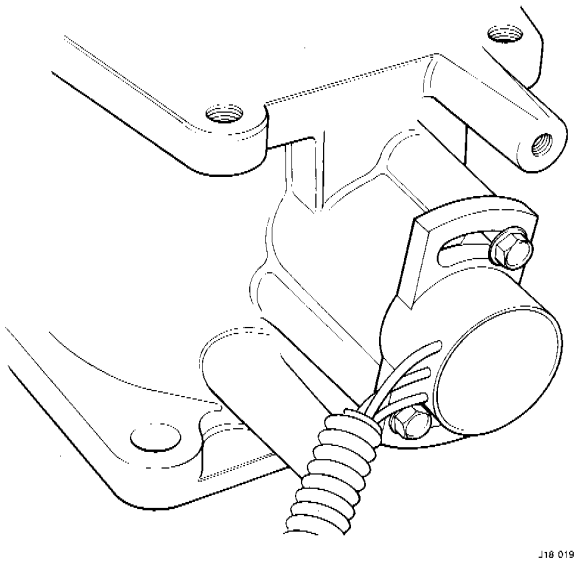


Fig 1

LAMBDASENSOR

DESCRIPTION **18.30.00**

The Lambda sensor (Fig 2) is installed in the exhaust system downpipe on vehicles exported to specifed countries. The purpose of the sensor is to provide an input proportional to the oxygen content of the exhaust gases monitored to the ECU.

LAMBDASENSOR

RENEW **18.30.20**

Open the bonnet and disconnect the battery earth lead.
Disconnect the lamda sensor connector (black).
Unscrew and remove the sensor from the downpipe.
Clean the downpipe aperture.
Smear the threads of the new sensor with anti-seize grease, fit the sensor and tighten to the correct torque.
Connect the Lambda sensor connector (black).
Connect the battery earth lead and close the bonnet.

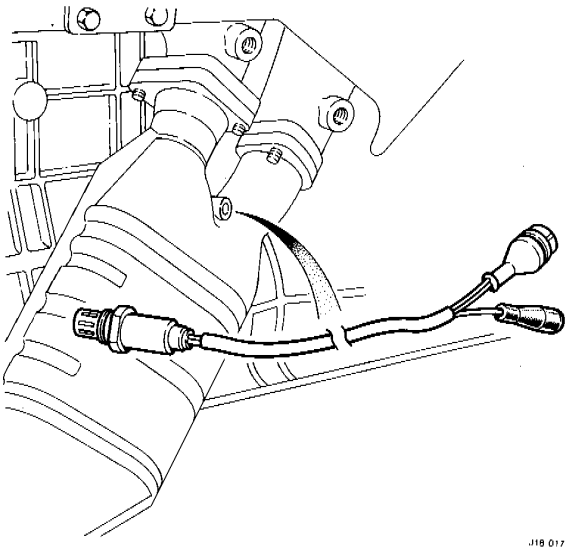


Fig 2

AIR CONDITIONING SENSOR

RENEW **18.30.24**

The air conditioning sensor provides indication to the ECU when the air conditioning clutch is engaged and disengaged.

FUEL PUMP RELAY

RENEW **18.30.30**

Open the bonnet and disconnect the battery earth lead.
Open the front passenger door.
Remove the passenger dash liner, locate and remove the relay from the fuel pump relay connector (yellow) (1 Fig 1).
Fit the new relay in fuel pump relay connector (yellow) and fit the passenger dash liner.
Close the front passenger door.
Connect the battery earth lead and close the bonnet.

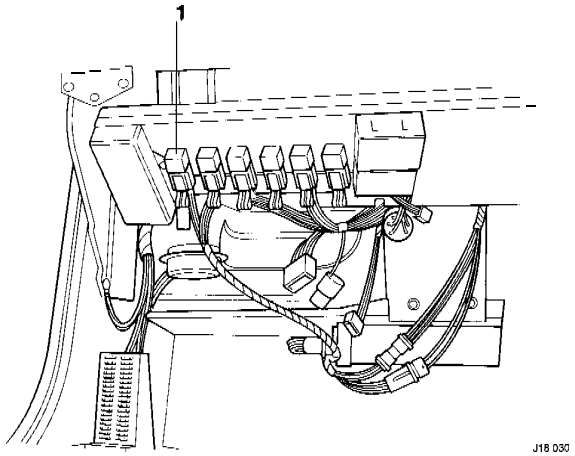


Fig 1

MAIN RELAY

RENEW 18.30.31

Open the bonnet and disconnect the battery earth lead.
Open the front passenger door.
Remove the passenger dash liner, locate and remove the relay from the main relay connector (red) (1 Fig 2).
Fit the new relay in the main relay connector (red) and fit the passenger dash liner.
Close the front passenger door.
Connect the battery earth lead and close the bonnet.

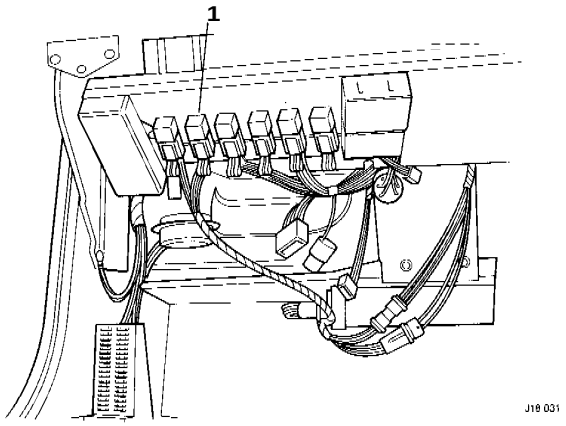


Fig 2

IGNITION 'ON' RELAY

RENEW **18.30.32**

Open the bonnet and disconnect the battery earth lead.
Open the front passenger door.
Remove the passenger dash liner, locate and remove the relay from the ignition 'on' relay connector (yellow).
Fit the new relay in the ignition 'on' relay connector (yellow) and fit the passenger dash liner.
Close the front passenger door.
Connect the battery earth lead and close the bonnet.

START RELAY

RENEW **18.30.33**

Open the bonnet and disconnect the battery earth lead.
Open the front passenger door.
Remove the passenger dash liner, locate and remove the relay from the start relay connector (yellow) (Fig 1).
Fit the new relay in the start relay connector (yellow) and fit the passenger dash liner.
Close the front passenger door.
Connect the battery earth lead and close the bonnet.

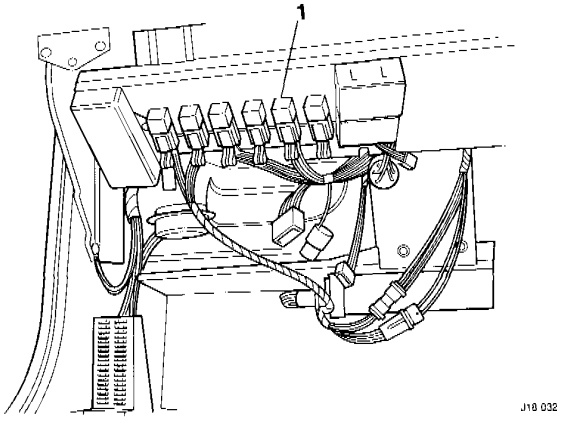


Fig 1

AIR PUMP RELAY

RENEW **18.30.34**

Open the bonnet and disconnect the battery earth lead.
Remove the relay from the air pump relay connector (green) located on the left-hand radiator support bracket.
Fit the new relay in the air pump relay connector (green), connect the battery earth lead and close the bonnet.

INERTIA SWITCH

DESCRIPTION **18.30.00**

The inertia switch is secured to the bulkhead, forward of the "A" post fuseblock on the driver side. It is a gravity actuated safety device which de-energises the ignition 'on' relay, inhibits fuel pump operation and activates the central locking system to open all door locks and close both the luggage compartment and fuel filler locks should the vehicle be subjected to heavy impact force.

INERTIA SWITCH

RENEW **18.30.35**

Open the bonnet and disconnect the battery earth lead.
Open the drivers door.
Remove the screws securing the **"A"** post fuseblock cover and remove the cover.
Disconnect the inertia switch connector (white), remove the inertia switch assembly securing screws and remove the assembly complete with bracket to a work bench.
Remove the screws securing the inertia switch (Fig **1)** to the bracket and remove the switch from the bracket.
Fit the new inertia switch to the bracket and tighten the screws.
Connect the inertia switch connector (white), fit the inertia switch assembly to the bulkhead and tighten the screws.
Fit the **"A"** post fuseblock cover and close **the** drivers door.
Connect the battery earth lead and close the bonnet.

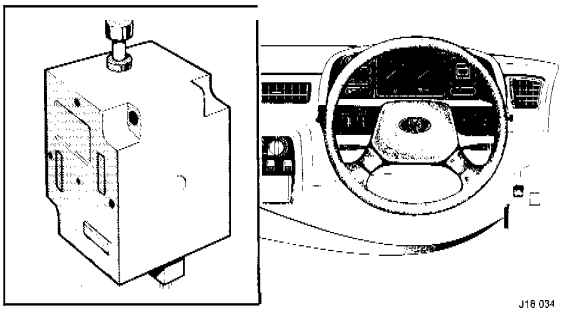


Fig 1

INERTIA SWITCH

RESETTING **18.30.38**

Reset the inertia switch by depressing the plunger located on the upper surface of the switch housing.

SUPPLEMENTARY AIR VALVE

RENEW **18.30.40**

Open the bonnet and disconnect the battery earth lead.
Remove the screws securing the supplementary air valve and displace the valve'.
Slacken the clips securing the hoses and withdraw the hoses from the valve.
Disconnect the multi-pin connector (yellow) and remove the valve.

Fitting a new valve is the reversal of the removal procedure.

IDLE SPEED CONTROL VALVE

The idle speed control valve is attached to the inlet manifold and contains a stepper motor driven valve which permits intake air to bypass the throttle butterfly valve. The volume of air passed by the actuator is controlled by the ECU so that correct idle speeds are maintained irrespective of engine temperature and load.

IDLE SPEED CONTROL VALVE (Non cruise control vehicles only)

RENEW **18.30.45**

Open the bonnet and disconnect the battery earth lead.
Release the clip securing the air hose to the idle speed control valve and disconnect the hose from the valve.
Remove the bolts securing the idle speed control valve to the inlet manifold, disconnect the idle speed control valve connector (black) and remove the valve (Fig 1).
Clean the idle speed control valve aperture in the inlet manifold.
Connect the idle speed control valve connector (black) and position the valve on the inlet manifold.
Insert the idle speed control valve securing bolts and tighten the bolts to the correct torque.
Fit the air hose to the idle speed control valve and tighten the hose clip.
Connect the battery earth lead and close the bonnet.
To be determined.

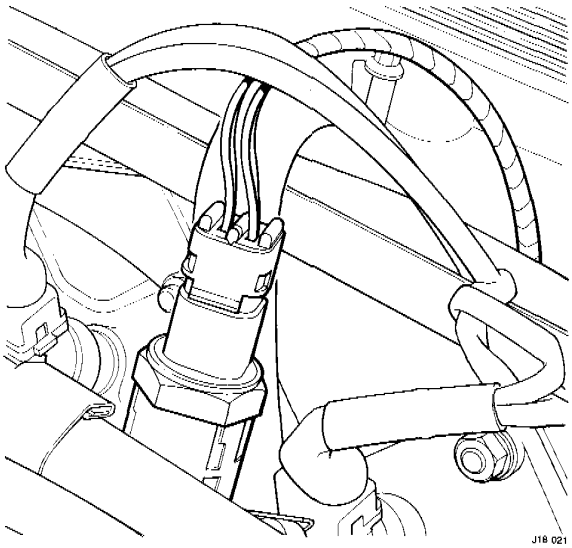


Fig 1

IDLE SPEED CONTROL VALVE (Cruise control vehicles only)

RENEW **18.30.45**

Open the bonnet and disconnect the battery earth lead.
Remove the bolts securing the speed control actuator bracket to the inlet manifold and displace the actuator for access to the idle speed control valve.
Release the clip securing the air hose to the idle speed control valve and disconnect the hose from the valve.
Remove the bolts securing the idle speed control valve to the inlet manifold, disconnect the idle speed control valve connector (black) and remove the valve (Fig 1).
Clean the idle speed control valve aperture in the inlet manifold.
Connect the idle speed control valve connector (black) and position the valve on the inlet manifold.
Insert the idle speed control valve securing bolts and tighten the bolts to the correct torque.
Fit the air hose to the idle speed control valve and tighten the hose clip.
Position the speed control actuator on the inlet manifold, insert the securing bolts and tighten the bolts to the correct torque.
Connect the battery earth lead and close the bonnet.

INTAKE ELBOW TO THROTTLE

RENEW **18.40.12**

Open the bonnet and disconnect the battery earth lead.
Unclip the air cleaner cover and remove the cover complete with element from the backplate.
Remove the nuts securing the air cleaner backplate to the inner wing valance.
Release the clips securing the air cleaner backplate to the air flowmeter and reposition the backplate for access.
Release the air flowmeter to intake elbow hose clip.
Remove the screw securing the air flowmeter earth lead and disconnect the earth lead.
Disconnect the air flowmeter connector (black) and remove the air flowmeter.
Release the intake elbow to idle speed control valve hose clip and disconnect the hose from the elbow.
Release the intake elbow to filler tube hose clip and disconnect the hose from the elbow.
Release and remove the elbow mounting securing nut.
Release the elbow to throttle housing hose clip and remove the elbow from the hose.
Release the throttle housing hose clip and remove the hose from the housing.
Remove the clips from the hose and discard the hose.
Fit the hose clips to the new elbow to throttle hose, fit the hose to the throttle housing and tighten the hose clip.
Fit the elbow to the throttle housing hose and tighten the hose clip.
Secure the elbow to the inner wing valance and tighten the retaining nut.
Fit the filler tube hose to the elbow and tighten the hose clip.
Fit the throttle housing hose to the elbow and tighten the hose clip.
Connect the air flowmeter connector (black) to the air flowmeter.
Connect the air flowmeter earth lead.
Fit the air flowmeter to the intake elbow hose and tighten the hose clip.
Fit the air cleaner backplate to the air flowmeter and engage the securing clips.
Secure the air cleaner backplate to the inner wing valance and tighten the securing nuts.
Fit the air cleaner element to the cover and fit the assembly to the backplate.
Secure the cover with the clips.
Connect the battery earth lead and close the bonnet.

INTAKE ELBOW

RENEW **18.40.13**

Open the bonnet and disconnect the battery earth lead.
Unclip the air cleaner cover and remove the cover complete with element from the backplate.
Remove the nuts securing the air cleaner backplate to the inner wing valance.
Release the clips securing the air cleaner 'backplate to the air flowmeter and reposition the backplate for access.
Release the air flowmeter to intake elbow hose clip.
Remove the screw securing the air flowmeter earth lead and disconnect the earth lead.
Disconnect the air flowmeter connector (black) and remove the air flowmeter.
Release the intake elbow to idle speed control valve hose clip and disconnect the hose from the elbow.
Release the intake elbow to filler tube hose clip and disconnect the hose from the elbow.
Release and remove the elbow mounting securing nut.
Release the elbow to throttle housing hose clip and remove the elbow from the hose.
Release the elbow to air flowmeter hose clip and remove the hose from the elbow.
Fit the air flowmeter hose to the new elbow and tighten the hose clip.
Fit the elbow to the throttle housing hose and tighten the hose clip.
Secure the elbow to the inner wing valance and tighten the retaining nut.
Fit the filler tube hose to the elbow and tighten the hose clip.
Fit the throttle housing hose to the elbow and tighten the hose clip.
Connect the air flowmeter connector (black) to the air flowmeter.
Connect the air flowmeter earth lead.
Fit the air flowmeter to the intake elbow hose and tighten the hose clip.
Fit the air cleaner backplate to the air flowmeter and engage the securing clips.
Secure the air cleaner backplate to the inner wing valance and tighten the securing nuts.
Fit the air cleaner element to the cover and fit the assembly to the backplate.
Secure the cover with the clips.
Connect the battery earth lead and close the bonnet.