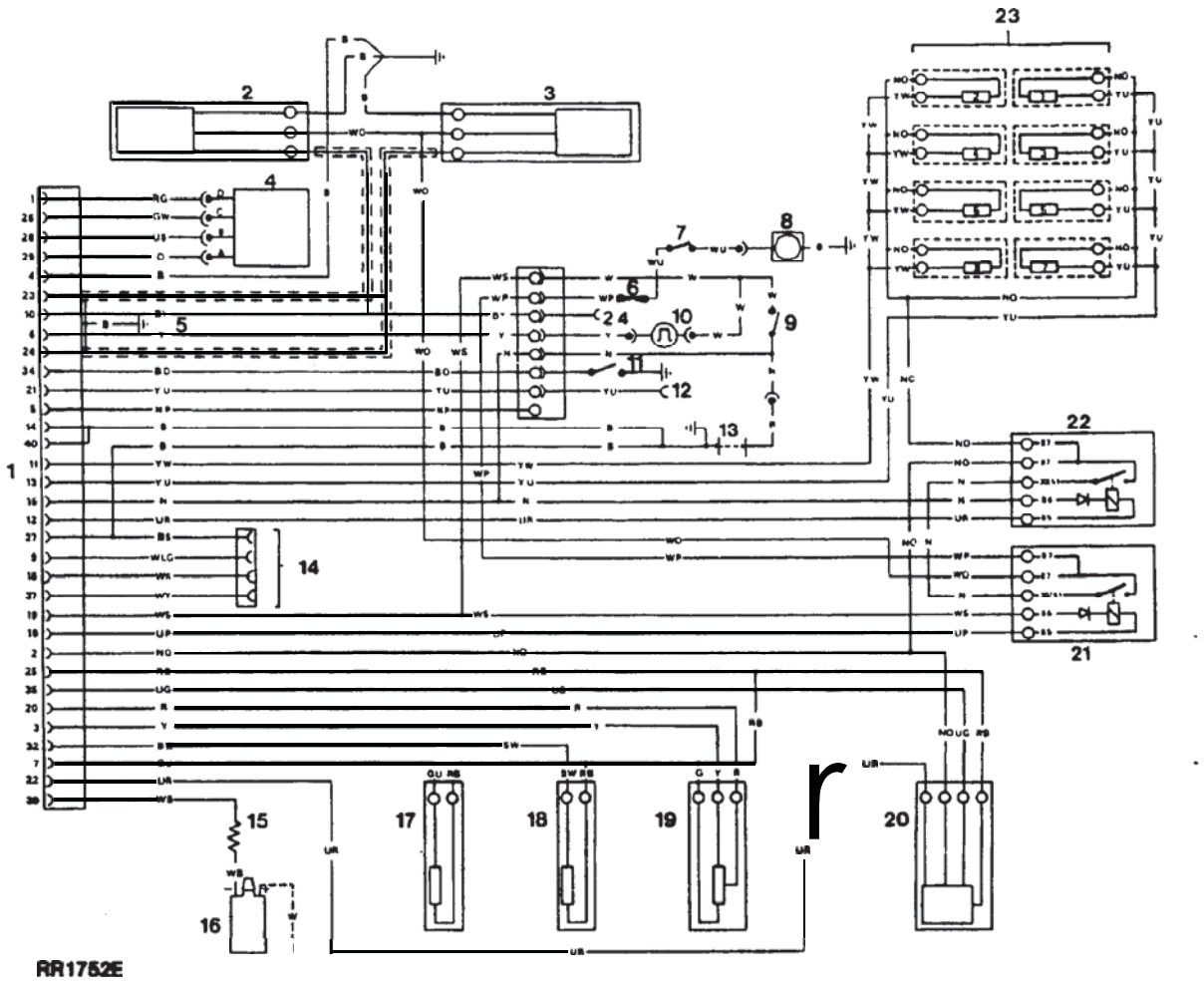


FUEL INJECTION - Circuit Diagram

1. 40 way connector to Electronic Control Unit (ECU).
2. Lambda sensor (left side - bank A).
3. Lambda sensor (right side - bank B).
4. By-pass air valve (stepper motor) (fast idle).
5. Lambda sensor screened ground.
6. Fuse 18 - main fuse panel.
7. Inertia switch.
8. Fuel pump.
9. Ignition switch.
10. Speed transducer (road speed input).
11. Neutral switch (automatic gearbox) (load input).
12. Pick-up point-air conditioning circuit (load input).
13. Battery.
14. Diagnostic plug.
15. In-line resistor.
16. Coil/-ve (engine RPM input).
17. Coolant temperature thermistor (sensor) (input).
18. Fuel temperature thermistor (sensor) (input).
19. Throttle potentiometer.
20. Air flow sensor.
21. Fuel pump relay.
22. Main relay.
23. Injectors-1 to 8.
24. Pick-up point E.F.I. warning symbol (instrument binnacle).

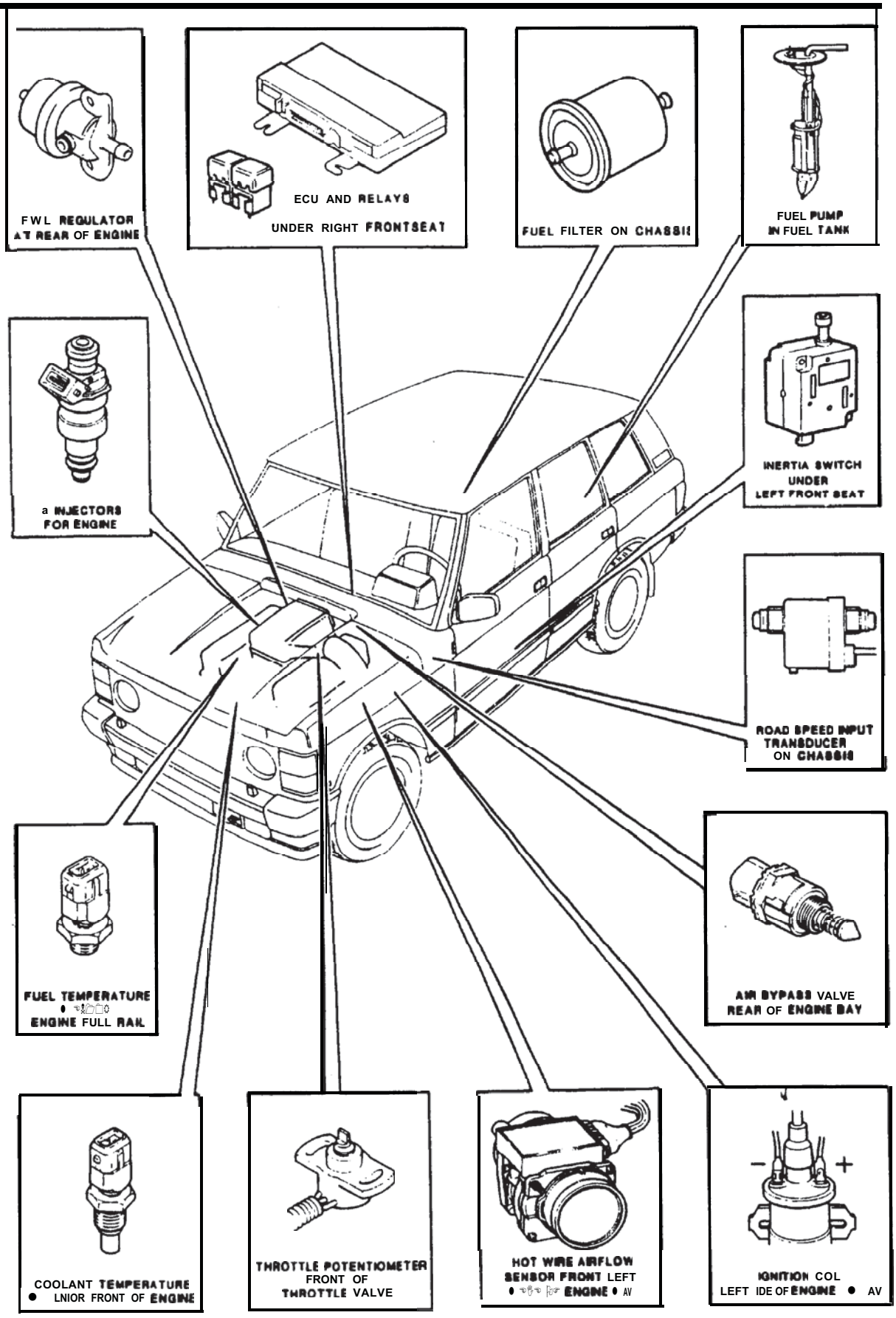
= = = Denotes screened ground.

NOTE: Reference to left and right side is made when viewing vehicle from rear.

Cable colour code

B	Black	G	Green	R	Red	S	Grey
U	Blue	O	Orange	W	White	K	Pink
N	Brown	P	Purple	Y	Yellow	LG	Light green

The last letter of a colour code denotes the tracer.


FWL REGULATOR AT REAR OF ENGINE
ECU AND RELAYS UNDER RIGHT FRONTSEAT
FUEL FILTER ON CHASSIS
FUEL PUMP IN FUEL TANK
a INJECTORS FOR ENGINE
INERTIA SWITCH UNDER LEFT FRONT SEAT
ROAD SPEED INPUT TRANSDUCER ON CHASSIS
FUEL TEMPERATURE ENGINE FULL RAIL
AIR BYPASS VALVE REAR OF ENGINE BAY
COOLANT TEMPERATURE LNIOR FRONT OF ENGINE
THROTTLE POTENTIOMETER FRONT OF THROTTLE VALVE
HOT WIRE AIRFLOW SENSOR FRONT LEFT ENGINE AV
IGNITION COL LEFT IDE OF ENGINE AV

RR2178E

INTRODUCTION

The Electronic Fuel injection system provides a reliable and efficient microprocessor controlled fuel management system.

The function of the system is to supply the exact amount of fuel directly into the inlet manifold according to the prevailing engine operating conditions.

To monitor these conditions, various sensors are fitted to the engine to measure engine parameters. Data from the sensors is received by the Electronic Control Unit (E.C.U.), the E.C.U. will then determine the exact amount of fuel required at any condition.

The E.C.U. having received data from the sensors produces pulses, the length of which will determine the simultaneous open time of each bank of injectors in turn, which will govern the amount of fuel injected.

DESCRIPTION

ELECTRONIC CONTROL UNIT-ECU

The Electronic Fuel Injection system is controlled by the E.C.U. which is located under the front right hand seat. The control unit is a microprocessor with integrated circuits and components mounted on printed circuit boards. The E.C.U. is connected to the main harness by a 40 pin plug.

INJECTORS

The eight fuel injectors are fitted between the pressurized fuel rail and inlet manifold. Each injector comprises a solenoid operated needle valve with a movable plunger rigidly attached to the nozzle valve. When the solenoid is energized the plunger is attracted off its seat and allows pressurized fuel into the intake manifold.

ENGINE COOLANT TEMPERATURE THERMISTOR (SENSOR)

The coolant thermistor (sensor) is located by the front left hand branch of the intake manifold. The thermistor provides engine coolant information to the E.C.U. The E.C.U. on receiving the signal from the thermistor will lengthen slightly the time that the injectors are open, and reducing this time as the engine reaches normal operating temperature.

FUEL TEMPERATURE THERMISTOR (SENSOR)

The fuel temperature thermistor (sensor) is located in the fuel rail forward of the ram housing. The thermistor sends fuel temperature data to the E.C.U, the E.C.U on receiving the data will adjust the injector open time accordingly to produce good hot starting in high ambient temperatures.

BYPASS AIR VALVE (STEPPER MOTOR)

The bypass valve is screwed into a housing attached to the rear of the plenum chamber, between the plenum chamber and bulkhead. The bypass valve has two windings which enable the motor to be energised in both directions thus opening or closing the air valve as required by the E.C.U.
The bypass valve will open and allow extra air into the plenum chamber to maintain engine idle speed when the engine is under increased (Electrical and Mechanical) loads.
The bypass valve will control engine idle speed when the vehicle is stationary.

LAMBDA SENSORS (O_2 SENSORS)

The two Lambda sensors are located forward of the catalysts mounted in the exhaust downpipes.
The sensors monitor the oxygen content of the exhaust gases and provide feedback information of the air/fuel ratio to the E.C.U. Each sensor is heated by an electrical element to improve its response time when the ignition is switched on.

Continued

FUEL PRESSURE REGULATOR

The fuel pressure regulator is mounted in the fuel rail at the rear of the plenum chamber. The regulator is a mechanical device controlled by plenum chamber vacuum, it ensures that fuel rail pressure is maintained at a constant pressure difference of 2.5 bar above that of the manifold.
When pressure exceeds the regulator setting excess fuel is returned to the fuel tank.

FUEL PUMP

The electric fuel pump is located in the fuel tank, and is a self priming 'wet' pump, the motor is immersed in the fuel within the tank.

AIR FLOW SENSOR

The hot-wire air flow sensor is mounted on a bracket attached to the left hand valance, rigidly connected to the air cleaner and by hose to the plenum chamber inlet neck.
The air flow sensor consists of a cast alloy body through which air flows. A proportion of this air flows through a bypass in which two wire elements are situated: one is a sensing wire and the other is a compensating wire. Under the control of an electronic module which is mounted on the air flow sensor body, a small current is passed through the sensing wire to produce a heating effect. The compensating wire is also connected to the module but is not heated, but reacts to the temperature of the air taken in, as engine intake air passes over the wires a cooling effect takes place.

The electronic module monitors the reaction of the wires in proportion to the air stream and provides output signals in proportion to the air mass flow rate which are compatible with the requirements of the E.C.U.

THROTTLE POTENTIOMETER

The throttle potentiometer is mounted on the side of the plenum chamber inlet neck and is directly coupled to the throttle valve shaft.
The potentiometer is a resistive device supplied with a voltage from the E.C.U. Movement of the throttle pedal causes the throttle valve to open, thus rotating the wiper arm within the potentiometer which in turn varies the resistance in proportion to the valve position. The E.C.U. lengthens the injector open time when it detects a change in output voltage (rising) from the potentiometer.
In addition the E.C.U. will weaken the mixture when it detects the potentiometer output voltage is decreasing under deceleration and will shorten the length of time the injectors are open.
When the throttle is fully open, the E.C.U. will detect the corresponding throttle potentiometer voltage and will apply full load enrichment. This is a fixed percentage and is independent of temperature. Full load enrichment is also achieved by adjusting the length of the injector open time.
When the throttle is closed, overrun fuel cut off or idle speed control may be facilitated dependant on other inputs to the E.C.U.

ROAD SPEED TRANSDUCER

The road speed transducer is fitted between the upper and lower speedometer cables. It is mounted on a bracket located on the left hand chassis side member adjacent to the rear engine mounting. The transducer provides road speed data to the ECU. The ECU in turn detects vehicle movement from the road speed input and ensures that idle speed control mode is disengaged. Should the speed transducer fail in service the ECU idle speed control would become erratic.

INERTIA SWITCH

The inertia switch is a mechanically operated switch located under the left hand front seat attached to the seat base rear cross-member.
The switch is normally closed and is in the ignition feed (fuse to fuel pump). In the event of a sudden impact the switch opens, and disconnects the electrical feed to the fuel pump. The switch is reset by pressing down the button.

RELAYS

The two electronic fuel injection relays are located under the front right hand seat mounted forward of the E.C.U. The main relay is energized via the E.C.U when the ignition is switched on and supplies current to the fuel injection system. The fuel pump relay is energized by the E.C.U. which in turn operates the fuel pump to pressurize the fuel system.

E.F.I. WARNING SYMBOL (Instrument binnacle)

An E.F.I. warning symbol incorporated into the instrument binnacle will illuminate when the E.C.U. detects that it cannot maintain correct air/fuel ratio due to a fault in one of the following fuel injection system components.

Air flow sensor.
Lambda sensor.
Water temperature thermistor. (sensor)
Throttle potentiometer.

The symbol will illuminate on initial turn of the ignition key as part of the bulb check feature, and will go out after a few seconds.
If the symbol illuminates when the engine is idling or the vehicle is being driven it indicates a failure of one of the four functions, the vehicle should be driven with care, and the cause rectified, refer to test procedure for the particular functions. Should one of the functions fail, the vehicle can still be driven due to a limp home feature incorporated into the fuel injection system.

FUEL INJECTION SYSTEM

CAUTION: The fuel system incorporates fine metering components that would be affected by any dirt in the system; therefore it is essential that working conditions are scrupulously clean. If it is necessary to disconnect any part of the fuel injection system, the system MUST be depressurized. All openings left open after the removal of any component from the fuel system, MUST be sealed off to prevent ingress of dirt.

ENGINE SETTING PROCEDURE

If a major overhaul has been undertaken on the fuel injection/engine system, the following check and adjustments must be carried out before attempting to start the engine.

A. Throttle potentiometer setting - see 'Throttle potentiometer' setting procedure.
B. Spark plug gaps - see 'Section 05 Engine tuning data'.
C. Throttle levers - see 'Throttle lever setting procedure'.
D. Ignition timing - static - see 'Section 86 Electrical'.

CAUTION: IF THE ENGINE IS MISFIRING, IT SHOULD BE IMMEDIATELY SHUT DOWN AND THE CAUSE RECTIFIED. FAILURE TO DO SO WILL RESULT IN IRREPARABLE DAMAGE TO THE CATALYSTS.

NOTE: If the previous checks and adjustments are satisfactory but the engine will not start the ignition and fuel injection electrical circuitory must be checked using the appropriate recommended equipment.

Recommended Equipment -

Lucas 'Electronic Ignition Analyser'
Lucas Part Number - YWB 119.

Lucas Diagnostic Equipment
Lucas Part Number - 60600965 (complete kit)

Individual part numbers for the above kit are as follows:

Hand held test unit	- Model 2HHT
Lucas Part Number	- 84772
Interface unit	- Model 21U
Lucas Part Number	- 84773
Serial link lead	
Lucas Part Number	- 54744753
Memory card	
Lucas Part Number	- 54744754
Operating manual	
Lucas Part Number	. XXB825
Plastic case	
Lucas Part Number	- 54744755

NOTE: The Lucas diagnostic equipment can be connected to the diagnostic plug located by the E.C.U.

Use in conjunction with the Lucas Operating InstructionManuals.

If the above equipment is unavailable the tests can be carried out using a multi-meter, following the instructions given in the charts.

CAUTION: Ensure the multi-meter is correctly set to volts or ohms, dependent upon which test is being undertaken.

Carry out the following static checks before undertaking the continuity procedure:-

A. Fuse 18 - in main fuse panel - is intact.
B. Inertia switch - not tripped.
C. Fuel - ample fuel in fuel tank.
D. Battery Condition - state of charge.
E. Air Leaks - no unmetered air entering engine system.
F. Electrical Connections - dry, clean and secure.

CONTINUITY TEST PROCEDURE

The continuity procedure and instructions on the following pages must be followed precisely to prevent damage occurring to any of the fuel system components.

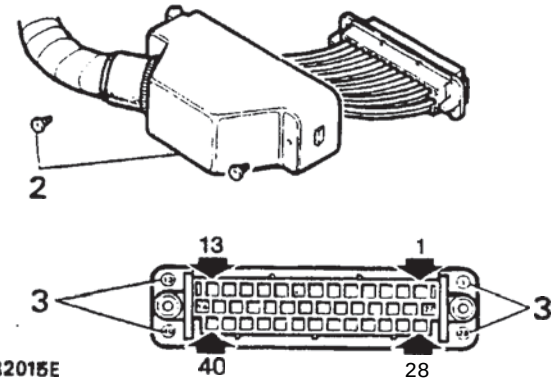
To enable the tests to be carried out when the 40 way multi-plug is connected to the E.C.U., it is necessary to remove the two screws securing the shroud to the plug to enable the multi-meter probes to be inserted into the back of the appropriate pin.

CAUTION: Tests that require the plug to be removed from the E.C.U., must also have the meter probes inserted into the back of the plug. If the probes are inserted into the plug sockets, damage will occur to the sockets resulting in poor connections when the plug is reconnected.

TESTING

1. Remove the E.C.U., and harness plug from beneath the front right hand seat, access is gained through the rear opening of the seat base.
2. Remove the plug shroud and maneuver it along the harness until there is enough clearance enabling meter probes to be inserted into the back of the plug.
3. There are 4 pin numbers, 1, 13, 28, 40 moulded onto the rear of the plug for pin position identification as shown in the illustration below, (for clarity the electrical leads have been omitted).

Pins 1 to 13 top row.
Pins 14 to 27 centre row (Pin 14 is below pin 13 but is not identified on the rear of the plug).
Pins 28 to 40 bottom row.



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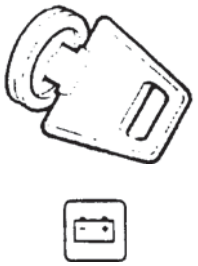
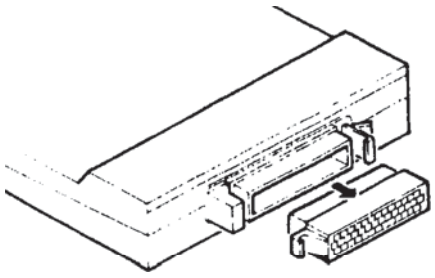
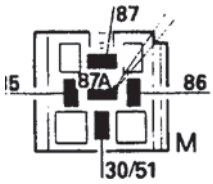
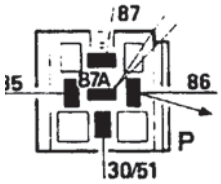
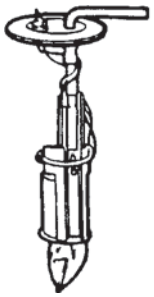
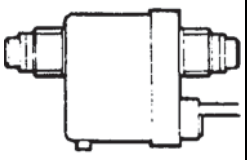
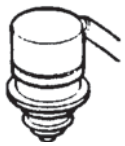
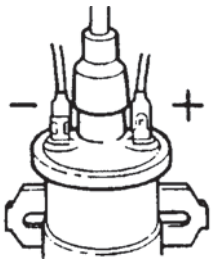
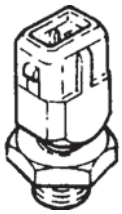
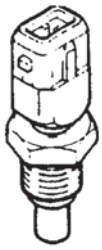
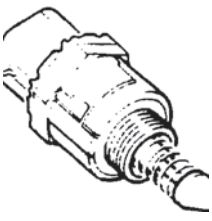
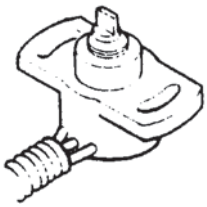
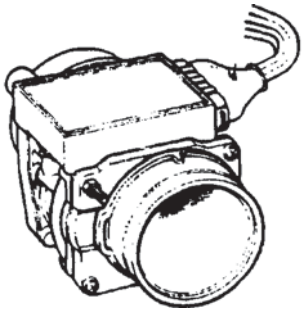
PIN NOS.	CABLE COLOUR
1.	Red/green
2.	Brown/orange
3.	Yellow
4.	Black
5.	Brown/purple
6.	Yellow
7.	Green/blue
8.	Not used
9.	White/light green
10.	Black/Yellow
11.	Yellow/white
12.	Blue/red
13.	Yellow/blue
14.	Black
15.	Brown
16.	Blue/purple
17.	Not used
18.	White/pink
19.	White/grey
20.	Red
21.	Yellow/blue
22.	Blue/red
23.	Blue
24.	Blue
25.	Red/black
26.	Green/white
27.	Black/grey
28.	Blue/grey
29.	Orange
30.	Not used
31.	Not used
32.	Grey/white
33.	Not used
34.	Black/orange
35.	Blue/green
36.	Not used
37.	White/yellow
38.	Not used
39.	White/black
40.	Black

The last colour denotes the wire tracer colour.

Continued

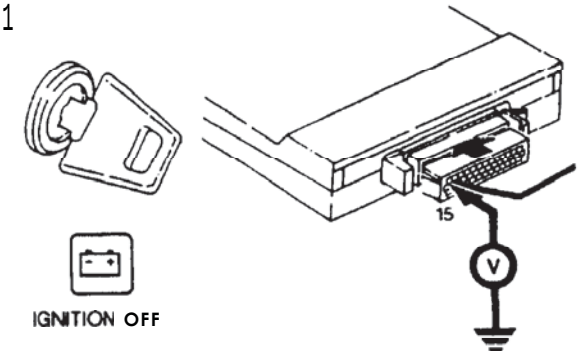
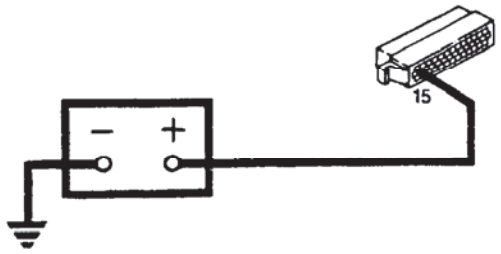
TESTS - Using a Multi-Meter

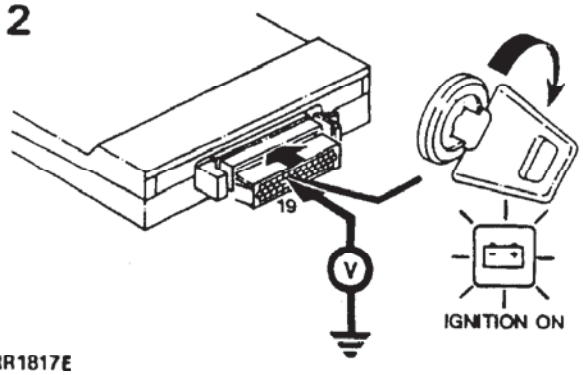
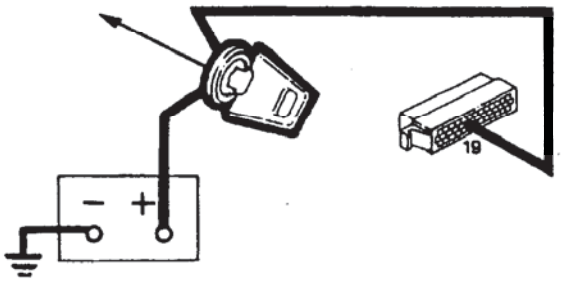
The following continuity tests are intended as a guide to identifying where a fault may be within a circuit; reference should be made to the fuel injection circuit diagram for full circuit information.

KEY TO SYMBOLS	 IGNITION SWITCH	 **ELECTRONIC CONTROL UNIT** AND MULTIPLUG		 TEMPORARY CONNECTION
 OHMMETER CONNECTIONS	 **VOLTMETER CONNECTIONS**	 MAIN RELAY	 **PUMP RELAY**	 **FUEL PUMP**
 ROAD SPEED INPUT (SPEED **TRANSDUCER)**	 **GEAR INPUT SWITCH (INHIBITOR SWITCH)**	 **INJECTOR**	 **IGNITION COIL**	 **FUEL TEMPERATURE SENSOR**
 **COOLANT** TEMPERATURE SENSOR	 **AIR** BYPASS **VALVE**	 **THROTTLE** POTENTIOMETER	 **HOT WIRE AIRFLOW SENSOR**	

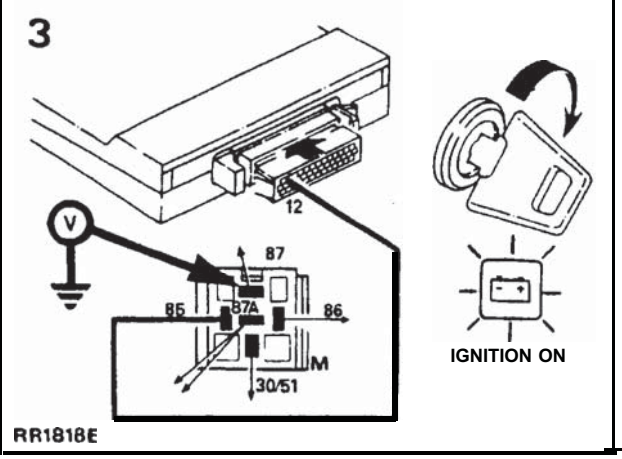
RR1782E

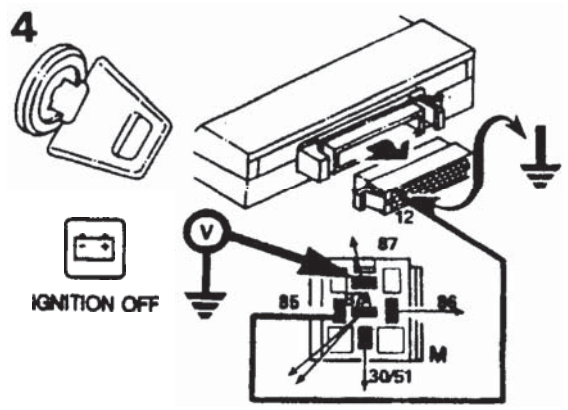
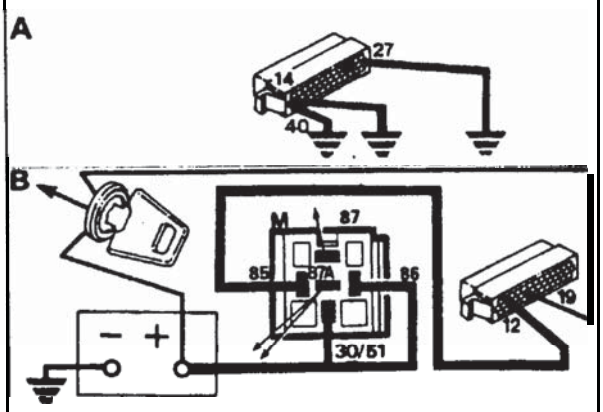
NOTE: All tests are carried out from the electronic control unit (ECU) harness multi-plug unless stated otherwise in the test procedure.

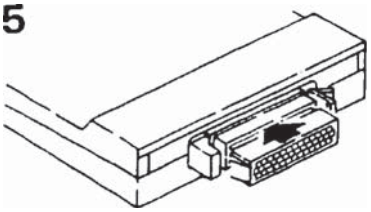
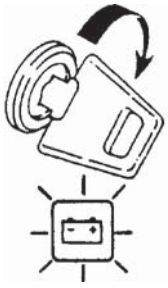
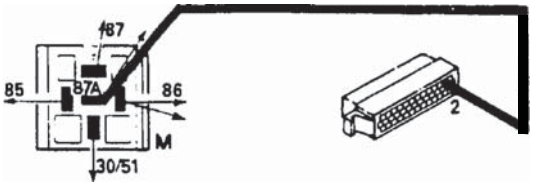
TEST PROCEDURE	RESULTS . Check cables and units shown in bold
1. **Check battery supply to ECU**	Voltmeter reading of battery volts - (mimimum battery voltage 10 volts) Proceed to Test 2 Voltmeter reading of zero volts Check:-
1  RR1816E	

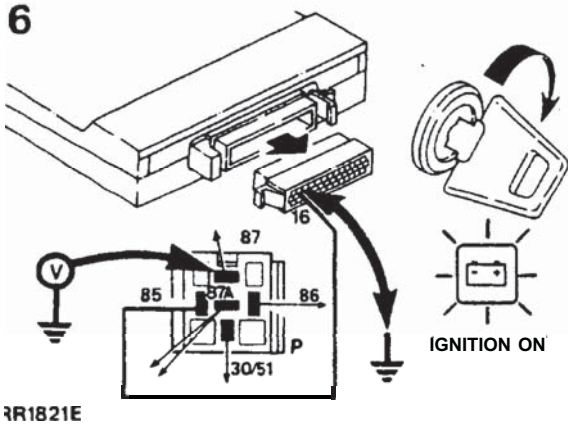
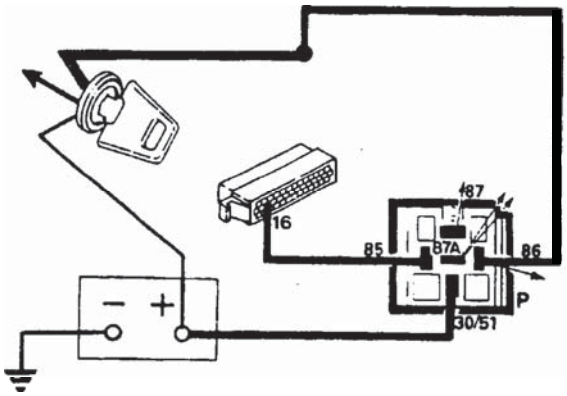
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
2. **Check ignition supply to ECU**	Voltmeter reading of battery volts - (minimum battery voltage 10 volts) Proceed to Test 3 Incorrect reading check:-
2  RR1817E	

Continued

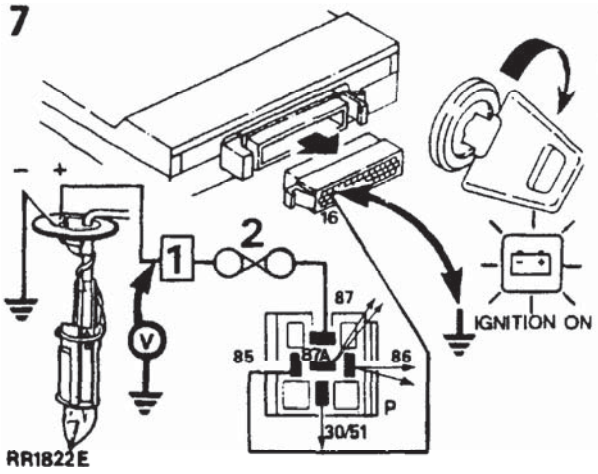
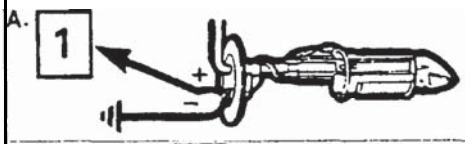
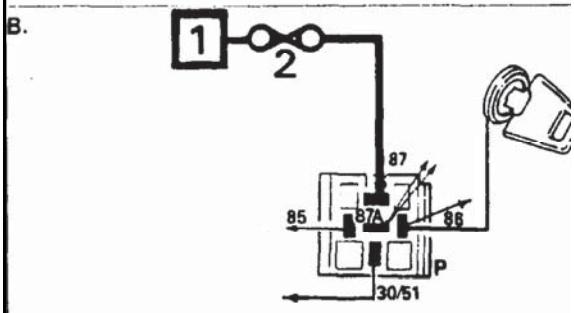
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
3. Check operation of Main relay	Voltmeter reading of battery volts - Proceed to Test 5 Voltmeter reading of zero volts - Proceed to Test 4
	

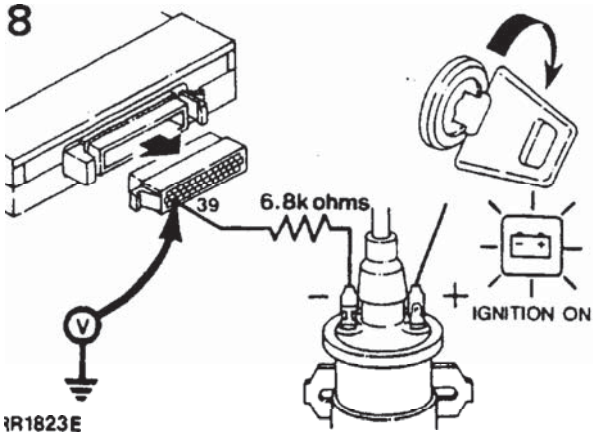
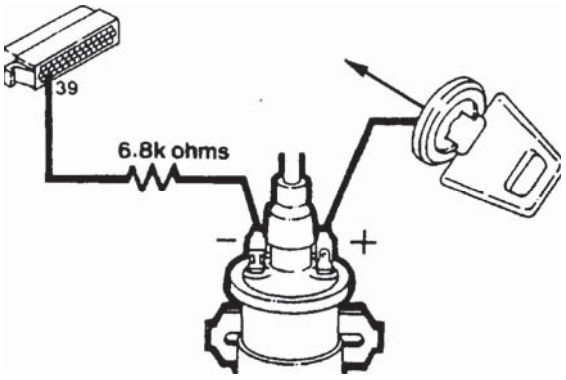
TESTPROCEDURE	RESULTS - Check cables and units shown in bold
4. Fault Diagnosis Main relay circuits	A. Voltmeter reading of battery volts - Check:- If OK Suspect ECU B. Voltmeter reading of zero volts Check:-
	

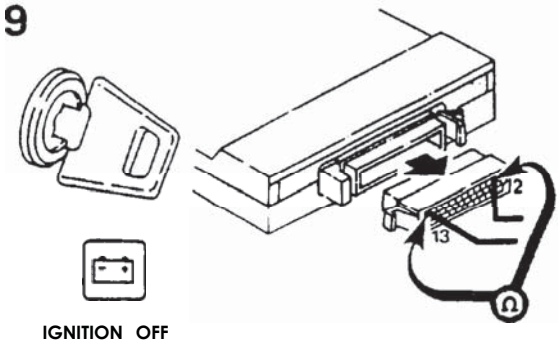
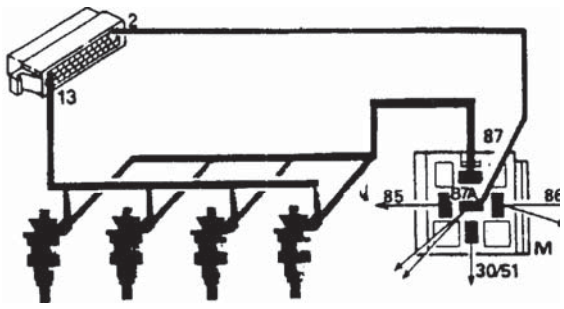
'EST PROCEDURE	RESULTS - Check cables and units shown in bold
5. Check operation of pump relay	Listen for audible 'click' from pump relay. If O.K - Proceed to Test 7
	No audible 'click' from pump relay Check:- If OK proceed to Test 6.
5   IGNITION ON RR1820E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
6. Fault diagnosis Pump relay circuits	Voltmeter reading of battery volts - Suspect ECU
	Voltmeter reading of zero volts Check:-
6  IGNITION ON RR1821E	

Continued

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
7. Check operation of Fuel pump NOTE: It is not possible lo place the multi-meter probes directly onto the pump terminals. A link lead attached to the pump is accessible behind the rear left hand wheel located between the chassis and stowage area floor panel. KEY: 1. Inertia switch 2. Fuse 18	Voltmeter reading of battery volts - Pump operating - Proceed to Test 8
	(A) Voltmeter reading of battery volts - Pump not operating Check:-
	(B) Voltmeter reading of zero volts Check:-
7  	A.  B. 

'ESTPROCEDURE	RESULTS - Check cables and units shown in bold
I. Check engine speed signal Cable and resistor	Voltmeter reading of battery volts - Proceed to Test 9
	Voltmeter reading of zero volts Check:-
8  ?R1823E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
9. Check injectors, Injector circuit	Ohm-meter reading of 4-5 Ohms - Proceed to Test 10
	Ohm-meter reading of 5-6 Ohms - Suspect 1 injector Ohm-meter reading of 8-9 Ohms - Suspect 2 injectors Ohm-meter reading of 16-17 Ohms - Suspect 3 injectors Check for open circuit injector(s) or wiring faults.
(Pin 13 left bank injectors 1,3,5,7).	Ohm-meter reading of Infinity Check:
9  IGNITION OFF IR1824E	

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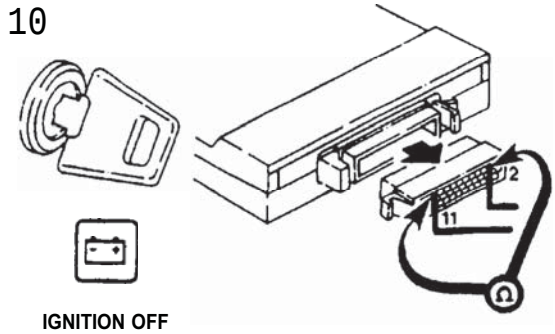
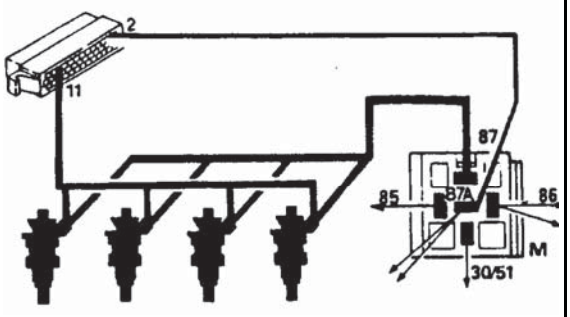
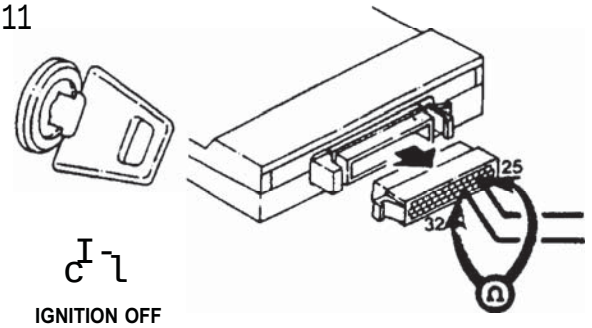
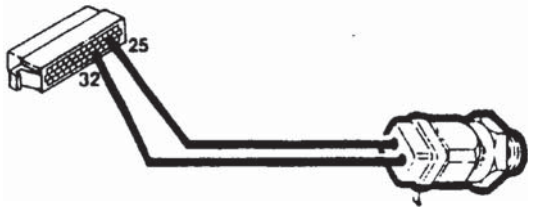
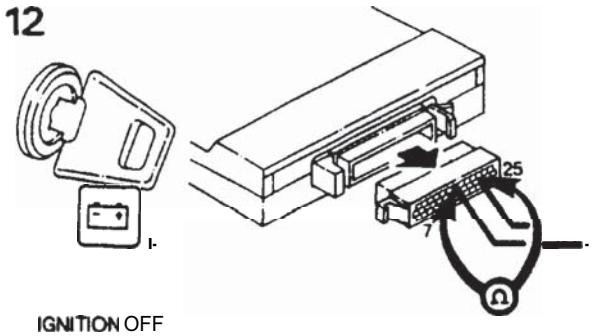
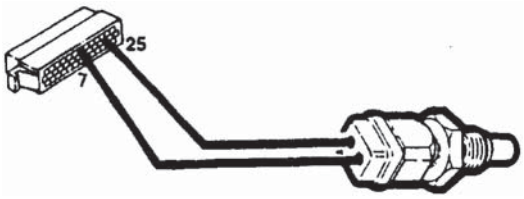
'ESTPROCEDURE	RESULTS - Check cables and units shown in bold
0. Check injectors Injector circuit pin 11 rightbank njectors 2,4,6,8)	Ohm-meter reading of 4-5 Ohms - Proceed to Test 11. Ohm-meter reading of 5-6 Ohms - Suspect 1 injector Ohm-meter reading of 8-9 Ohms - Suspect 2 injectors Ohm-meter reading of 16-17 Ohms - Suspect 3 injectors Check for open circuit injector(s) or wiring faults. Ohm-meter reading of Infinity Check:
10  IGNITION OFF RR1825E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
11. Check fuel temperature thermistor (sensor)	Correct reading-temperature to resistance - Proceed to Test 12 (Refer to Temperature Conversion Charts in Test 12 Incorrect Ohm-meter reading Check
11  IGNITION OFF RR1826E	

'ESTPROCEDURE	RESULTS - Check cables and units shown in bold
2. **Check coolant temperature thermistor (sensor)**	Correct reading-Temperature to resistance - Proceed to Test 13 (Refer to Temperature Conversion Chart below.
	Fuel and Coolant Temperature °C / °F — Ohm-meter Reading Should be Ohms -10° 14° 9100 - 9300 0° 32" 5700 - 5900 20° 68° 2400 - 2600 40° 104° 1100 - 1300 60" 140° 500 - 700 80° 176° 300 - 400 100° 212° 150 - 200
	Incorrect Ohm-meter reading Check:-
12  IGNITION OFF RR1827E	

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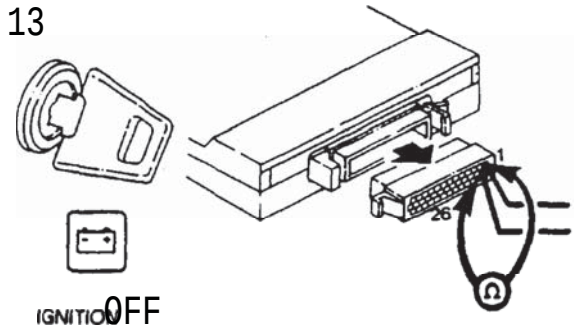
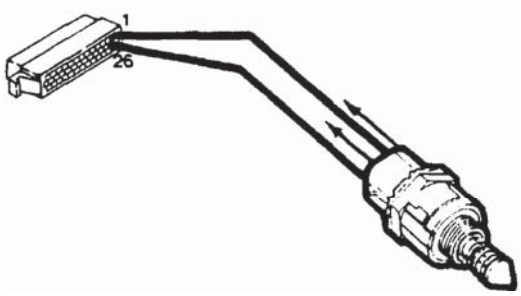
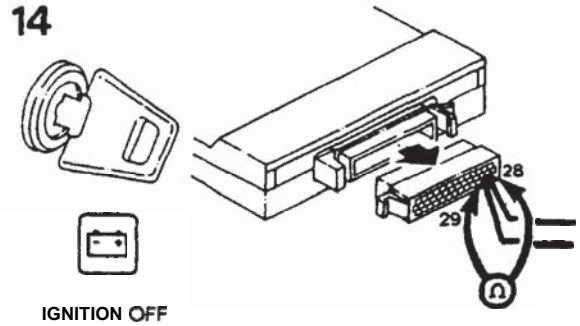
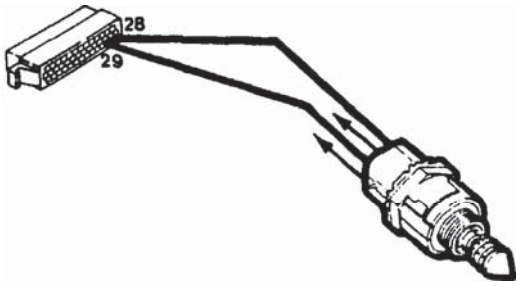
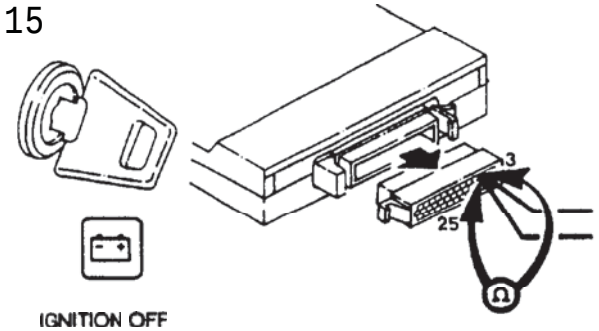
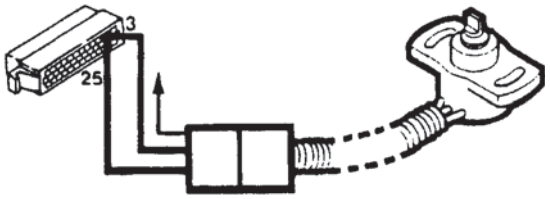
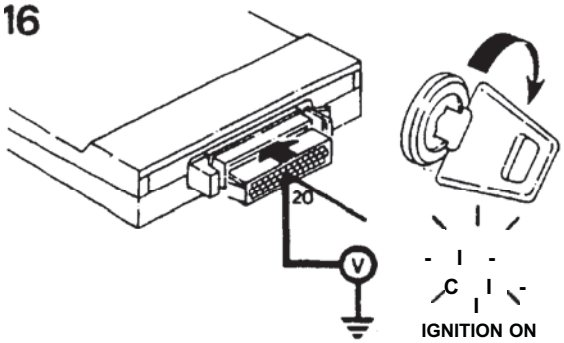
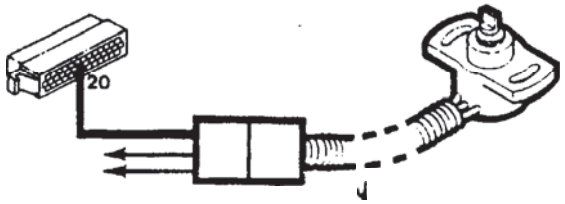
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
13. Check air bypass valve - Part 1	Ohm-meter reading of 48-58 Ohms - Proceed to Test 14
	Incorrect reading Check:-
13  IGNITION OFF RR1828E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
14. Check air bypass valve - Part 2	Ohm-meter reading of 48-58 Ohms - Proceed to Test 15
	Incorrect reading Check:-
14  IGNITION OFF RR1829E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
15. Check throttle potentiometer - Part 1	Ohm-meter reading of 5000 Ohms - Proceed to Test 16
	Incorrect reading of Infinity Check:-
15  IGNITION OFF RR1830E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
16. Check throttle potentiometer - Part 2	Correct voltmeter readings. Proceed to Test 17 Throttle closed: 0.29) smooth swing) 0.36 Throttle open: (4.6 Volts ((5.0 Volts
	Incorrect voltmeter readings Check:-
16  IGNITION ON RR1831E	

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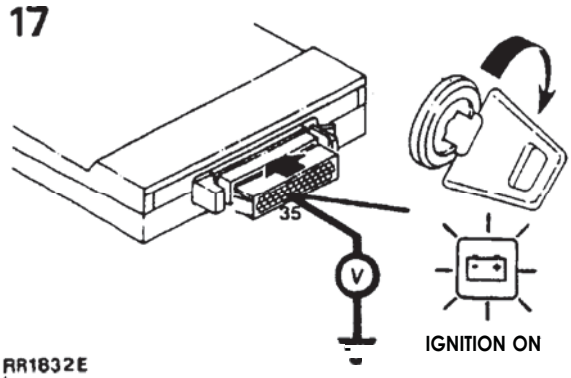
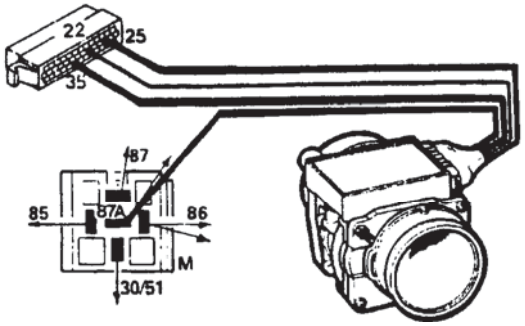
'EST PROCEDURE	RESULTS . Check cables and units shown in bold
17. Check output of Airflow sensor	Voltmeter reading of 0.3-0.6 volts- Proceed to Test 18
	Incorrect voltmeter reading Check:-
17  RR1832E	

PRECAUTION:

Depressurize the fuel system when fitting the fuel pressure gauge or disconnecting/replacing fuel system components.

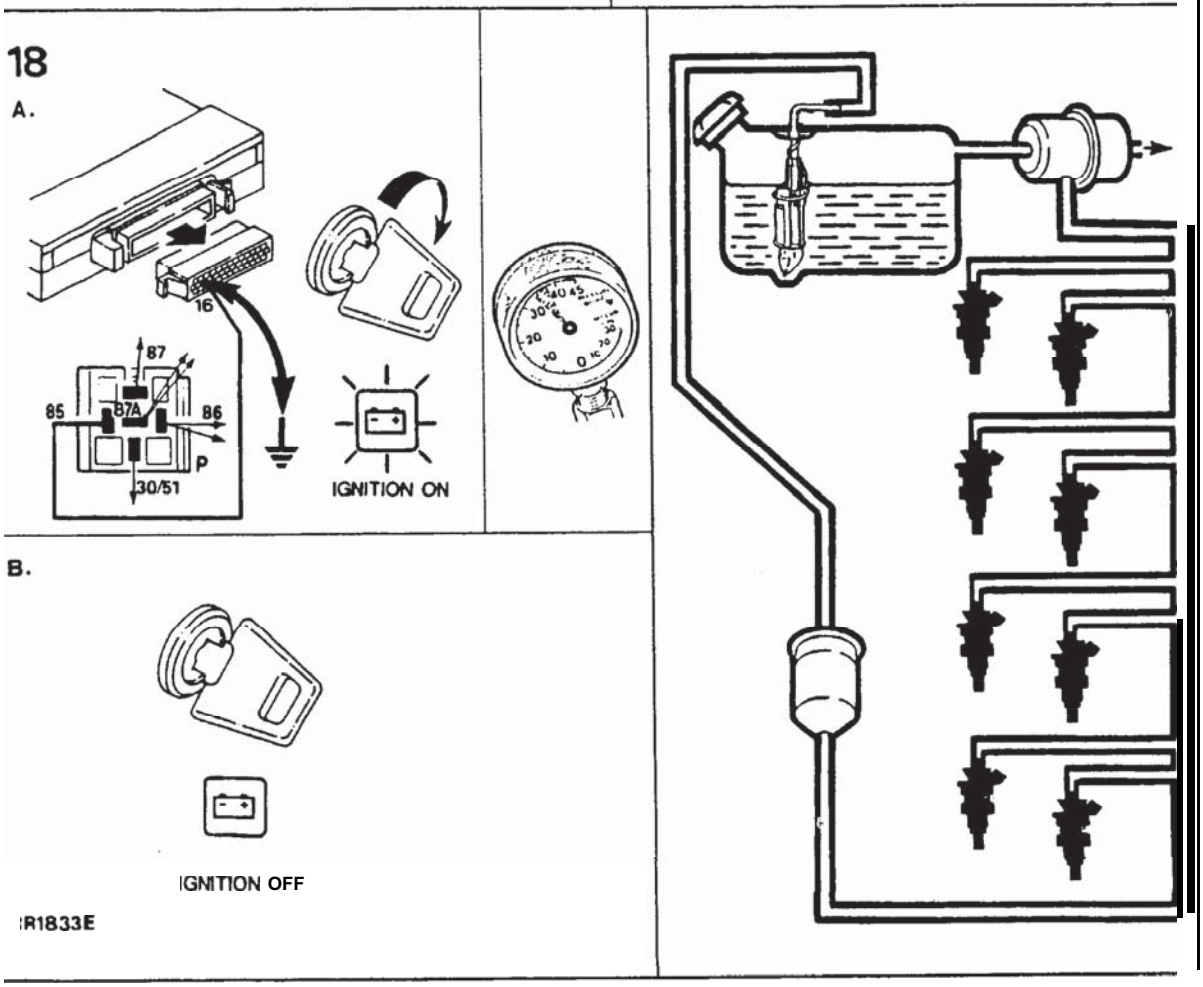
CAUTION: Thoroughly clean the immediate area around the fuel filter and hose connections before disconnecting the fuel feed line from the filter. Failure to do so could cause foreign matter to be present in the fuel system which would be detrimental to the fuel system components.

WARNING: The spillage of fuel from the fuel filter is unavoidable when disconnecting the fuel feed line, ensure that all necessary precautions are taken to prevent fire and explosion due to fuel vapour and fuel seepage.

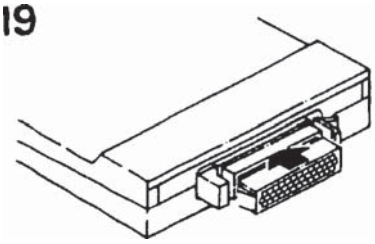
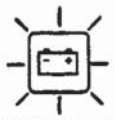
DEPRESSURIZING PROCEDURE

a) Ignition off, pull pump relay off its terminal block.
b) Crank engine for a few seconds - engine may fire and run until fuel pressure is reduced.
c) Switch off the ignition.
d) Connect fuel pressure gauge in the fuel supply line between the fuel rail and the fuel filter, adjacent to the filter (see Test 18).
e) Reconnect the pump relay.

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
18. Check fuel system pressure Service tool 18G 1500 **NOTE: Insert the pressure gauge in the fuel feed line immediately after the fuel line filter. The filter is located beneath the right hand rear wheel arch attached to the chassis**	(A) Expected reading 2,4-2,6 kgf/cm² (34.0-37.0 p.s.i.) (B) **Pressure drop-max 0.7 kgf/cm² (IO p.s.i.) in one minute**



Continued

EST PROCEDURE	RESULTS - Check cables and units shown in bold
9. Check for leaking injector NOTE: Before removing any of the injectors, remove and examine the spark plugs. check for consistent colouration of plugs. A leaking injector will result in the appropriate spark plug being 'sooted up'. Remove all injectors from manifold but do not disconnect from fuel rail	WARNING: Ensure that all necessary precautions are taken IO prevent fire and explosion. Replace any injector which leaks more than 2 drops of fuel per minute.
19    IGNITION ON IR1834E