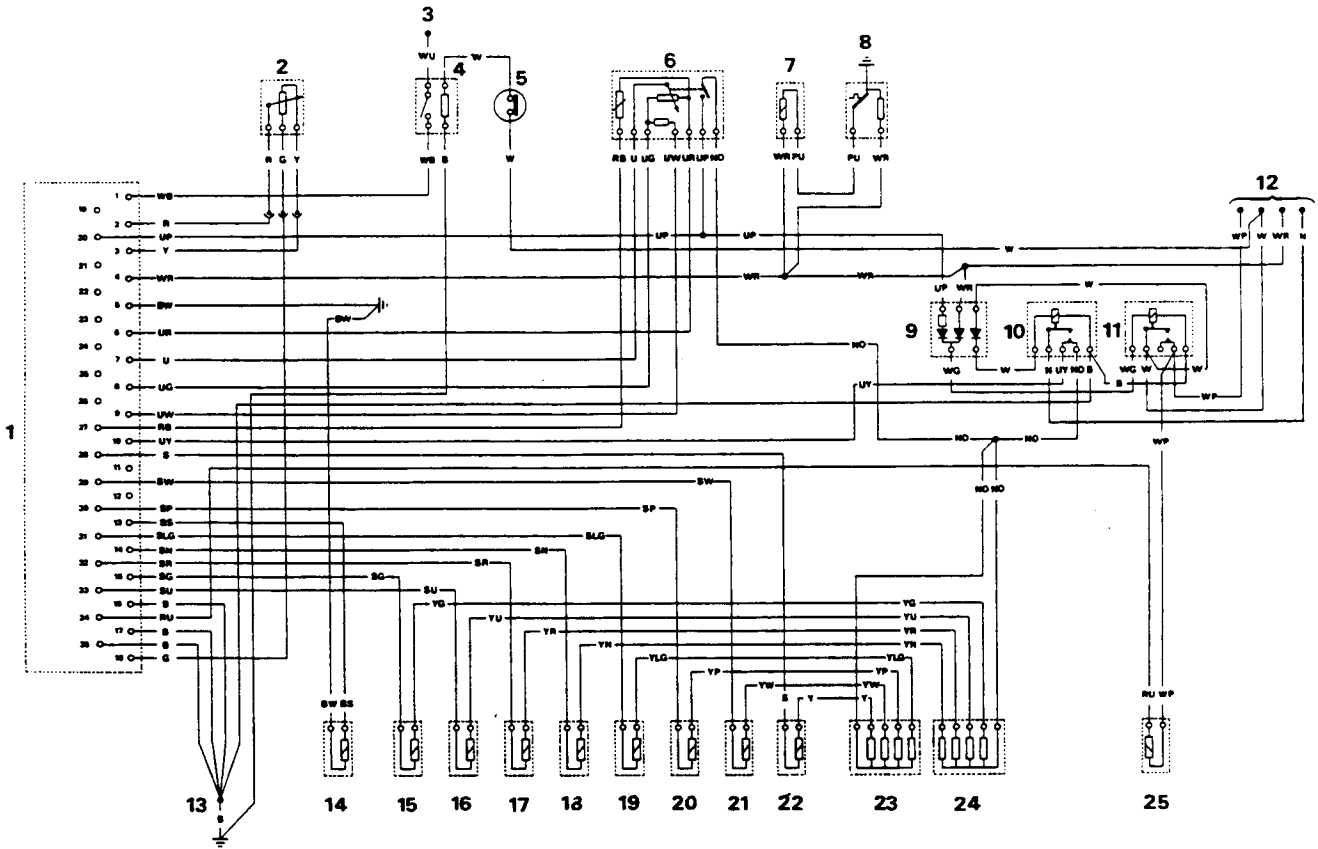


RR717M

FUEL INJECTION SYSTEM COMPONENTS — RANGE ROVER

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Breather flame trap 2. Vacuum switch 3. Cold start injector 4. Fuel pressure regulator 5. Solenoid operated air valve
(air conditioning versions only) 6. Engine crankcase breather 7. Idle speed adjustment screw 8. Airflow meter 9. Idle air mixture screw 10. Extra air valve 11. Coolant temperature switch | <ol style="list-style-type: none"> 12. Thermostime switch 13. Electronic distributor 14. Throttle potentiometer 15. Air cleaner 16. Constant energy unit
<i>Inset 'A'</i> 17. Injectors
<i>Inset 'B'</i> 18. Fuel feed rail
<i>Inset 'B'</i> 19. Over run fuel shut-off relay 20. Power resistor pack |
|---|--|



RR612M

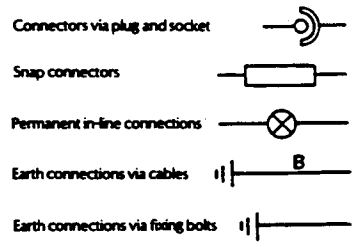
FUEL INJECTION—Circuit Diagram

- | | |
|--|-------------------------------|
| 1. Electronic control unit (ECU) | 13. Clinch |
| 2. Throttle potentiometer | 14. Temperature sensor |
| 3. Ignition pick-up point (142 on main circuit diagram) | 15. Injector (No. 1 cylinder) |
| 4. Over-run fuel shut-off relay | 16. Injector (No. 3 cylinder) |
| 5. Vacuum switch | 17. Injector (No. 5 cylinder) |
| 6. Air flow meter | 18. Injector (No. 7 cylinder) |
| 7. Cold start injector | 19. Injector (No. 2 cylinder) |
| 8. Thermostat switch | 20. Injector (No. 4 cylinder) |
| 9. Current steering module for fuel injection relays | 21. Injector (No. 6 cylinder) |
| 10. Main relay | 22. Injector (No. 8 cylinder) |
| 11. Fuel pump relay | 23. Power resistors |
| 12. Pick-up point fuel injection circuit (111 on main circuit diagram) | 24. Power resistors |
| | 25. Extra air valve |

Key to cable colours

B - Black	G - Green
K - Pink	L - Light
N - Brown	O - Orange
P - Purple	R - Red
S - Slate	U - Blue
W - White	Y - Yellow

The last letter of a colour code denotes the tracer colour



ELECTRONIC FUEL INJECTION

Description

Fuel Injection System

Fuel is drawn from the fuel tank by a high pressure electric pump located in the fuel tank. The fuel pump operates only when the pump relay and/or the starter motor circuits are energised. Fuel passes to the pressure regulator via an in-line filter. The pressure regulator varies pressure in direct proportion to manifold depression and thus varies injection pressure between 1.8 to 2.5 kgf/cm², 26 to 36 lbf/in². Excess fuel is returned to the fuel tank.

A fuel rail links the pressure regulator with the fuel injectors, one injector being fitted to each inlet manifold spur. The injectors are solenoid operated being pulse energised by the electronic control unit, ECU, completing a circuit to 'earth'. When 'open' the injectors spray fuel into the inlet manifold to be drawn into the engine cylinders at the next induction stroke of each piston.

Therefore there needs to be no fixed relationship between the injector timing and the engine ignition or valve timing.

The injectors are programmed to 'open' alternately in two banks of four, twice per engine operating cycle. The time that the injectors are 'open' governs the amount of fuel supplied to the engine and this 'open' time is computed by the ECU from the inputs it receives from the various sensors.

To assist cold starting, a separate cold start injector sprays a fine jet of fuel against the air stream entering the plenum chamber. The cold start injector is energised from the engine starter motor circuit and is in series with a thermostime switch which is dual activated by the engine coolant temperature (heat) and a heater coil around a bi-metal strip (time) the coil being energised from the starter motor circuit. The thermostime switch ensures that the cold start injector will not be energised when the engine is at normal operating temperature or during prolonged operation of the starter motor when the engine is below normal operating temperature. The switch will isolate the cold start injector after approximately 8 to 12 seconds at -20°C, -4°F, this time is decreased as the engine approaches its normal operating temperature.

Fuel Pump

The fuel pump is energised initially via a relay during operation of the starter motor solenoid and then by a switch operated by the air flow meter and is independent of the ECU.

Electronic Control Unit — ECU.

The ECU is a sealed unit and receives input signals from various sensors and computes from these an output signal to the fuel injector solenoid circuits. When activated the solenoids 'open' the injectors to spray fuel into the engine inlet manifold spurs, the injectors remaining open for between 1.5 and 10 milli-seconds depending on engine running requirements.

The ECU is protected by various devices: the diode pack protects against reversed battery connection. The main relay is controlled by the ignition switch and connects battery voltage directly to the ECU.

Engine Speed

Low tension circuit pulses from the ignition coil negative terminal, are passed to the ECU to be computed into an engine speed input.

Air Flow Meter

The air flow meter measures induction air flow mass. The plenum chamber absorbs any rapid fluctuations in air flow that might upset the air flow meter signals.

The movement of the measuring flap is dampened by a compensating flap which prevents flutter. The position of the flap is controlled by the air drawn into the engine and the action of a return spring. The mass of air drawn into the engine at any time is indicative of the engine load and a signal from a potentiometer, variable resistance, proportional to the flap position, is passed to the ECU. However, the air mass and air density is dependent upon air temperature. Therefore, an air temperature sensor is incorporated into the air flow meter and this sends a separate signal to the ECU.

Due to the action of the return spring, the measuring flap is almost closed when the engine is idling and an idle air by-pass channel is provided to assist the engine to breath at low speed. Air passing through the by-pass channel is not registered by the air flow meter measuring flap. The idle air mixture screw is fitted into the by-pass channel to regulate the air flow to adjust the air to fuel ratio CO content at idle speed.

Coolant Temperature Sensor

The sensor provides coolant temperature information to the ECU.

The sensor causes the ECU to lengthen slightly, the time that the main injectors are 'open' reducing this time as the engine warms up and cutting it off when normal engine operating temperature is reached.

Continued

Extra Air Valve

This valve is mounted above a water passage in the inlet manifold and registers engine coolant temperature. The valve provides the additional air required to maintain satisfactory cold start mixture until the engine reaches normal operating temperature. This air is taken after it has passed through the air flow meter, so that the air is registered by the ECU, and returned to the plenum chamber after the throttle butterfly.

The valve allows extra air to pass under cold start conditions, the extra air source is reduced and finally terminated as normal engine operating temperature is reached.

The valve is controlled by a bi-metal strip which is heated from two sources; the coolant and a heater coil around the strip. The heater coil is energised from the fuel pump circuit and comes into operation when the engine is under crank or running.

Throttle Potentiometer

The electrical signal from the potentiometer to the ECU depends upon the position of the throttle butterfly spindle and hence the accelerator pedal. By using the variable voltage output in conjunction with the information from the other sensors, the ECU adjusts fuel input to accommodate requirements for acceleration, deceleration and constant engine speed. When sudden acceleration is signalled to the ECU by the throttle potentiometer, all injectors are instantly pulsed to operate once simultaneously to ensure adequate engine response.

Over-run Fuel Cut-off — Vacuum Switch

The manifold depression switch senses manifold depression above 24 in Hg \pm 1 in Hg. The switch operates the over-run relay which interrupts the ignition signal to the ECU.

Air Temperature Sensor

The air temperature sensor is an integral part of the air flow meter and cannot be replaced as a separate item.

The sensor sends a separate signal to the ECU, the ECU then alters the length of time the injectors remain open, correcting the air/fuel mixture.

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 i.e. pipes, hoses, etc., these must be blocked off to prevent ingress of dirt.

ENGINE SETTING PROCEDURE — FUEL INJECTION

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 switch —potentiometer' setting procedure.
- B. **Spark plug gaps**—see 'Data section'.
- C. **Throttle levers**—see 'Throttle lever setting procedure'.
- D. **Ignition timing—static**—see 'Engine tuning data'.
- E. **By-pass idle screw**—see 'Engine tuning procedure'.

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

Recommended Equipment:

Lucas 'Electronic Ignition Analyser'

Lucas Part Number—TWB 119.

Lucas 'E.F.I. Throttle Potentiometer Adjustment Gauge'

Lucas Part Number—YWB 121.

Lucas 'Epitest' diagnostic system

Lucas Part Number—YWB 105.

Use in conjunction with the Lucas Operating Instruction Manuals.

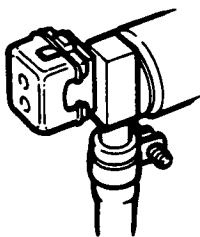



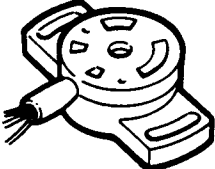
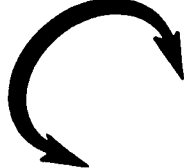
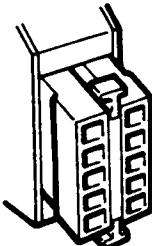


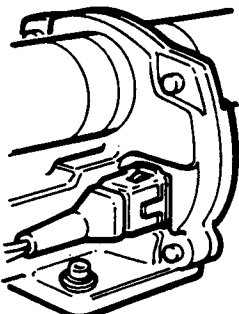
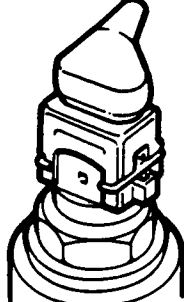
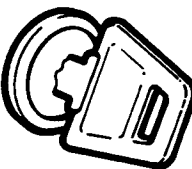
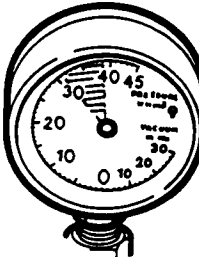

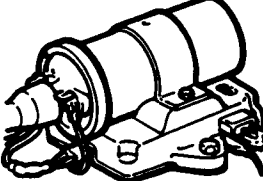
If the above equipment is unavailable the tests can be carried out using an AVO meter, following the instructions given in the charts.

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

CONTINUITY TESTS—Using an AVO meter

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

Key to Symbols

 <p>Cold Start Injector</p>	 <p>35 - Way Harness Multiplug</p>	 <p>P - Pump Relay M - Main Relay S - Steering Module</p>	 <p>Airflow Meter Harness Plug</p>	 <p>Throttle Switch (potentiometer type)</p>
 <p>Temporary Connection</p>	 <p>Resistor Box</p>	 <p>Injector</p>	 <p>Thermotime Switch</p>	 <p>Extra Air Valve</p>
 <p>Coolant Temp. Sensor</p>	 <p>Ignition</p>	 <p>Pressure Gauge</p>	 <p>Electrical Multiplug</p>	 <p>Constant Energy Unit</p>

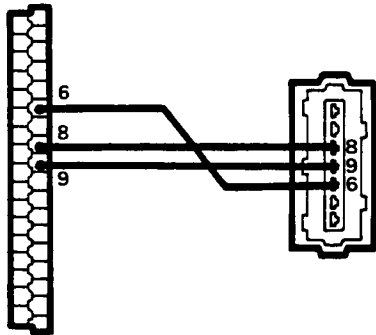
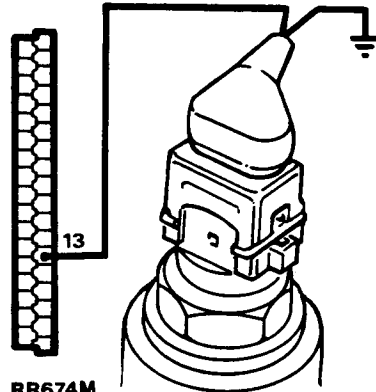
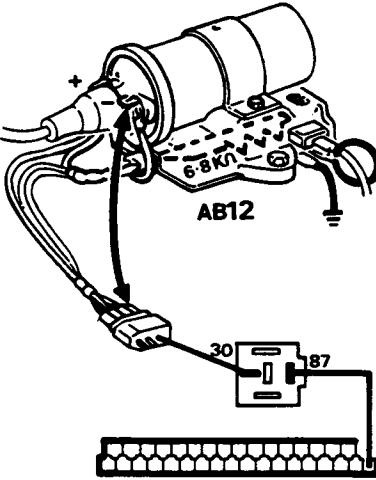
RR 716M

CONTINUITY TEST—Using an AVO meter

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

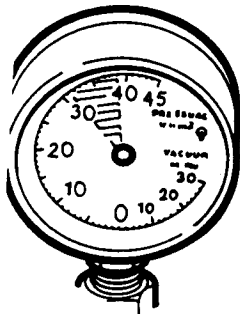
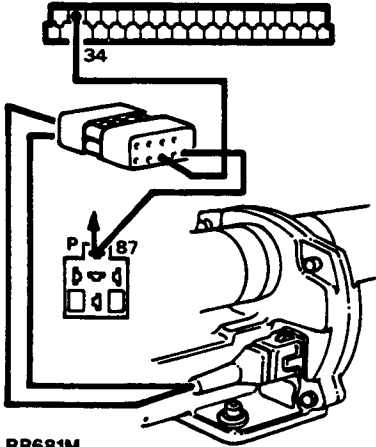
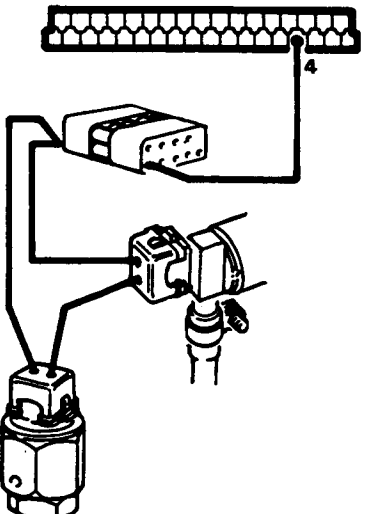
Continued

TEST	CIRCUIT TESTING	EXPECTED RESULTS	POSSIBLE FAULTS AND REMEDIES
<p>1. ECU SUPPLY Disconnect the multi-plug from the ECU. Switch on the ignition. Connect a voltmeter between pin 10 and earth.</p>	<p>RR670M</p>	<p>11–12.5 volts</p>	<p>No reading; check all wiring to main relay, check main relay by substitution. Below 11 volts; check battery. Check circuit for high resistance connection.</p>
<p>2. FUEL PUMP CONTACTS Switch on the ignition and connect a voltmeter between pin 20 and earth. Airflow meter flap closed.</p> <hr/> <p>Operate the flap in the airflow meter.</p>	<p>RR671M</p>	<p>0 volts</p> <hr/> <p>11–12.5 volts</p>	<p>If reading registered, check airflow meter switch action.</p> <hr/> <p>No reading, check wiring from main relay to airflow meter. Check wiring from airflow meter to fuel pump relay. Check pump relay by substitution. Check fuel pump operation by connecting a direct supply to the pump terminals.</p>
<p>3. CRANKING SIGNAL Connect a voltmeter between pin 4 and earth. Crank the engine.</p>	<p>RR672M</p>	<p>8–12 volts</p>	<p>No reading but starter motor operates; check wiring from starter relay to steering module and from steering module to ECU. No reading starter motor does not operate; check starter relay and starter motor. Below 8 volts check battery, check starter motor.</p>

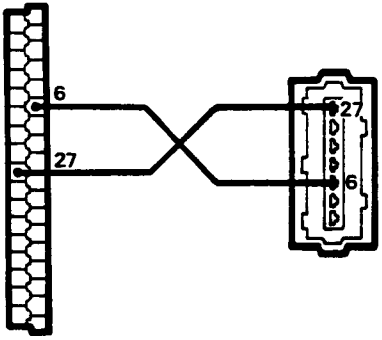
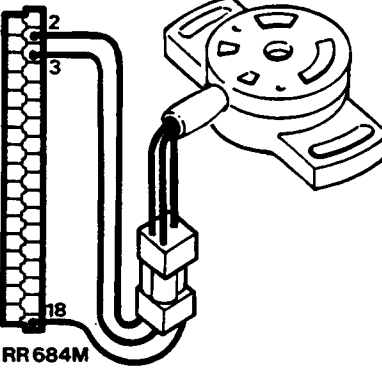
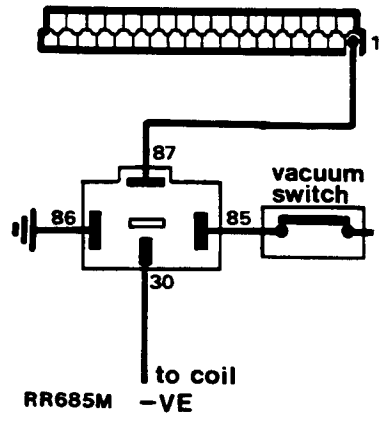
<p>4. AIRFLOW METER Connect ohmmeter between pin 6 and 8. ----- Connect ohmmeter between pins 6 and 9. ----- Connect ohmmeter between pins 8 and 9.</p>	 <p>RR673M</p>	<p>360 ± 10 Ω</p> <p>560 ± 10 Ω</p> <p>200 ± 10 Ω</p>	<p>Should readings be different from expected results; check harness continuity between ECU plug and airflow meter plug, i.e. pins 6-6, 8-8, 9-9. Check variable resistor circuit in airflow meter with ohmmeter, check that meter flap is closed before substituting airflow meter.</p>														
<p>5. WATER TEMPERATURE SENSOR Connect ohmmeter between pin 13 and earth.</p>	 <p>RR674M</p>	<table border="0"> <tr> <td>Temp °C</td> <td>K Ω</td> </tr> <tr> <td>-10</td> <td>7.0</td> </tr> <tr> <td>± 1 °C</td> <td>to 11.6</td> </tr> <tr> <td>+20</td> <td>2.1</td> </tr> <tr> <td>± 1 °C</td> <td>to 2.9</td> </tr> <tr> <td>+80</td> <td>0.27</td> </tr> <tr> <td>± 1 °C</td> <td>to 0.39</td> </tr> </table>	Temp °C	K Ω	-10	7.0	± 1 °C	to 11.6	+20	2.1	± 1 °C	to 2.9	+80	0.27	± 1 °C	to 0.39	<p>Incorrect reading; check wiring and electrical plug, renew sensor if readings do not comply with results.</p> <p>NOTE: Connect the AVO measuring leads to the sensor for short periods only, to minimise the effect of self heating due to the measuring current.</p>
Temp °C	K Ω																
-10	7.0																
± 1 °C	to 11.6																
+20	2.1																
± 1 °C	to 2.9																
+80	0.27																
± 1 °C	to 0.39																
<p>6. SPEED SIGNAL (Constant energy ignition) Fit a jump lead between the negative terminal on the ignition coil and pin 1. Connect voltmeter between pin 1 and earth. Crank engine.</p>	 <p>RR675M</p>	<p>6-9 volts fluctuating</p>	<p>No reading; check harness connections between coil and ECU.</p>														

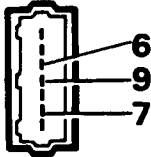
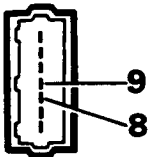
Continued

TEST	CIRCUIT TESTING	EXPECTED RESULTS	POSSIBLE FAULTS AND REMEDIES
<p>7. INJECTOR CHECK Numbers 7 and 8 Injector 7 Connect ohmmeter between pin 14 and 87 on main relay.</p> <p>-----</p> <p>Injector 8 Connect ohmmeter between pin 28 and 87 on main relay.</p>	<p>RR676M</p>	<p>7-10 K Ω</p> <p>-----</p> <p>7-10 K Ω</p>	<p>If reading is below expected results, disconnect each injector in turn to find injector with '00' or low reading; renew injector. If winding resistance of injector is satisfactory, check wiring circuits and resistor pack for open circuit condition.</p>
<p>7A. INJECTOR CHECK Numbers 2 and 4 Injector 2 Connect ohmmeter between pin 31 and 87 on main relay.</p> <p>-----</p> <p>Injector 4 Connect ohmmeter between pin 30 and 87 on main relay.</p>	<p>RR677M</p>	<p>7-10 K Ω</p> <p>-----</p> <p>7-10 K Ω</p>	<p>See injectors 7 and 8.</p>
<p>7B. INJECTOR CHECK Numbers 3 and 5 Injector 3 Connect ohmmeter between pin 15 and 87 on main relay.</p> <p>-----</p> <p>Injector 5 Connect ohmmeter between pin 29 and 87 on main relay.</p>	<p>RR678M</p>	<p>7-10 K Ω</p> <p>-----</p> <p>7-10 K Ω</p>	<p>See injectors 7 and 8.</p>
<p>7C. INJECTOR CHECK Numbers 1 and 6 Injector 1 Connect ohmmeter between pin 33 and 87 on main relay.</p> <p>-----</p> <p>Injector 6 Connect ohmmeter between pin 32 and 87 on main relay.</p>	<p>RR679M</p>	<p>7-10 K Ω</p> <p>-----</p> <p>7-10 K Ω</p>	<p>See injectors 7 and 8.</p>

<p>8. PRESSURISED FUEL RAIL Fit pressure gauge to cold start injector fuel hose. Switch the ignition on and operate the airflow meter spring return switch to energise the fuel pump.</p>	 <p>RR680M</p>	<p>2.4–2.6 kgf/cm² 34–37 lbf in²</p>	<p>No pressure build up; check fuel pump circuit with voltmeter. If a reading of 12 volts obtained, check fuel pump earth circuit, satisfactory. If earth circuit check pump. Check operation of fuel pump relay and main relay by substitution if pressure reading is zero. Fuel pressure above or below limits; check pipe work and regulator for blockages and falling pressure reading, check pipe work for leaks, check for leaking injectors, pressure regulator and fuel pump non-return valve.</p>
<p>9. EXTRA AIR VALVE Connect ohmmeter between pin 34 and 87 on fuel pump relay.</p>	 <p>RR681M</p>	<p>30–40 Ω</p>	<p>No reading; check wiring and connections between the pump relay, extra air valve and ECU. Check air valve for continuity with an ohmmeter.</p>
<p>10. COLD START INJECTOR Disconnect the thermotime switch. With each of the leads being connected to earth in turn. Connect ohmmeter between pin 4 and earth.</p>	 <p>RR682M</p>	<p>0–5.0 Ω</p>	<p>No reading; check wiring and connections between the ECU cold start injector and thermotime switch. Open circuit; check wiring and connections and cold start injector windings.</p>

Continued

<p>11. AIR TEMPERATURE SENSOR (Airflow meter) Connect ohmmeter between pin 6 and 27.</p> <p>NOTE: Connect the AVO measuring leads to the sensor for short periods only, to minimise the effect of self heating due to the measuring current.</p>	 <p>RR683M</p>	<table border="0"> <tr> <td>Temp °C</td> <td>K Ω</td> </tr> <tr> <td>-10</td> <td>8.26</td> </tr> <tr> <td>± 0.5 °C</td> <td>to 10.56</td> </tr> <tr> <td>+20</td> <td>2.28</td> </tr> <tr> <td>± 0.5 °C</td> <td>to 2.72</td> </tr> <tr> <td>+50</td> <td>0.76</td> </tr> <tr> <td>± 0.5</td> <td>to 0.91</td> </tr> </table>	Temp °C	K Ω	-10	8.26	± 0.5 °C	to 10.56	+20	2.28	± 0.5 °C	to 2.72	+50	0.76	± 0.5	to 0.91	<p>If reading is infinity; disconnect airflow meter, bridge terminals 6 and 27. If ohmmeter reads zero air temperature, sensor is faulty. If after replacement ohmmeter shows infinity, check wiring and connections to the ECU.</p>
Temp °C	K Ω																
-10	8.26																
± 0.5 °C	to 10.56																
+20	2.28																
± 0.5 °C	to 2.72																
+50	0.76																
± 0.5	to 0.91																
<p>12. THROTTLE POTENTIOMETER CAUTION: Ensure the AVO is set to volts. Reconnect the ECU switch ignition on. Measure voltage between green -VE lead and yellow +VE lead by inserting the meter probes into the rear of the multi plug.</p> <p>With ECU connected insert meter -VE lead to green wire and meter +VE lead to red wire measure voltage.</p> <p>ECU connected and with leads connected as above; open throttle voltage should steadily increase.</p>	 <p>RR684M</p>	<p>4.3 ± 0.2 volts</p> <p>0.3-0.36 volts</p> <p>Smooth swing within 0.3 to 4.5 volt range</p>	<p>No reading or low reading; check wiring and connections</p> <p>If meter reading drops and suddenly picks up through the voltage range—indicates faulty track—renew potentiometer.</p>														
<p>13. OVER-RUN RELAY Disconnect the negative lead from coil to relay. Ignition off, connect ohmmeter between pin 1 and 30 on relay.</p> <p>Ignition on, connect ohmmeter between pin 1 and 30 on relay.</p> <p>Disconnect the vacuum switch and repeat the above test.</p>	 <p>RR685M</p>	<p>Infinity Ω</p> <p>0 Ω</p> <p>Infinity Ω</p>	<p>Reading other than infinity; check wiring and connections for security. Substitute relay.</p> <p>Readings other than zero; check wiring and connections, renew vacuum switch if necessary.</p> <p>Readings other than infinity; renew relay.</p>														

<p>14. AIRFLOW METER (Potentiometer) Reconnect the ECU switch ignition on. Peel back rubber boot on plug. Insert +VE meter probe to pin 6 and -VE lead to pin 9</p> <hr/> <p>Connect -VE meter probe to pin 9 and +VE probe to pin 7 measure voltage</p> <hr/> <p>With leads connected as above gradually open air flap. Voltage should decrease.</p>	 <p>RR714M</p>	<p>1.55 ± 0.1 volts</p> <hr/> <p>3.7 ± 0.1 volts</p> <hr/> <p>1.6 ± 0.1 volts</p>	<p>No reading or low reading; check wiring and connections</p> <hr/> <p>Renew airflow meter if results are not within expected results.</p>
<p>15. AIRFLOW METER (Potentiometer) Disconnect the ECU. Switch ignition on. Peel back electrical plug rubber boot. Insert -VE meter probe to pin 9 and +VE probe to pin 8.</p>	 <p>RR715M</p>	<p>4.3 ± 0.2 volts</p>	<p>If actual results do not meet expected results, renew the airflow meter.</p>

After completing the tests with either the 'Epitest' equipment or AVO meter, retest the vehicle to ensure the faults have been rectified.

If faults still persist, check the ECU by substitution.

FAULT DIAGNOSIS—FUEL INJECTION—HOT START

SYMPTOM	POSSIBLE CAUSE	CURE
A. Engine will not start.	1. Battery discharged.	1. Remove battery from vehicle and recharge.
	WARNING: BEFORE CARRYING OUT THE NEXT TWO OPERATIONS, ENSURE THAT THE RECOMMENDED INSULATED EQUIPMENT IS USED WHEN HANDLING THE HIGH TENSION LEAD.	
	2. Ignition—coil.	2. Remove HT lead from distributor, turn ignition on and check for spark at HT to earth—no spark—renew coil and amplifier.
	3. Ignition—distributor.	3. Remove HT lead from spark plug, turn ignition on and crank engine—no spark—rectify or renew distributor.
	4. Injectors failing to operate.	4. Turn ignition on and operate the throttle briskly; injectors should be heard to click. If no clicking audible, check throttle potentiometer connections.
	5. Fuel tank ventilation.	5. Check ventilation pipe work and that a non-vented petrol cap is fitted, rectify or renew.
	6. Cold start system operating.	6. Cold start system should be inoperative at coolant temperatures above 35°C. If the cold start injector is operating it will cause over-richness of fuel and the vehicle will not start. Disconnect cold start injector, if vehicle starts renew thermostime switch and or cold start injector if injector is leaking.
	7. Loss of fuel pressure.	7. Disconnect the high tension lead from the coil. Insert a pressure gauge between fuel pump and fuel rail (between fuel rail and cold start injector), crank engine to pressurise fuel system, pressure under cranking should be 2.5 kgf/cm ² (36 lbf/in ²). Pressure should not drop by more than 0.7 kgf/cm ² (10 lbf/in ²) in first hour, if greater check for fuel leaks in system. Clamp fuel pipe between gauge and fuel rail, if pressure drops renew fuel pump.
	8. Loss of pressure due to faulty fuel pressure regulator.	8. Insert a pressure gauge between fuel pump and fuel rail. (Between fuel rail and cold start injector). Crank engine to pressurise fuel system, and clamp fuel pipe between pressure regulator and fuel rail; if pressure still drops rectify or renew pressure regulator. If regulator leaking it may be due to ingress of dirt or grit lodged on the valve seat. It is possible to clear this by clamping fuel return pipe after the regulator, run engine for no more than two seconds; release the clamp quickly. The resultant fuel flow may be sufficient to move the dirt or grit off the valve seat. If valve still loses pressure after re-testing—renew the pressure regulator.
9. Loss of fuel pressure due to leaking injectors.	9. Insert a pressure gauge between fuel pump and fuel rail; crank engine to pressurise fuel system. Clamp fuel pipe between pressure regulator and fuel rail; if pressure drops locate and renew a faulty injector or cold start injector.	

FAULT DIAGNOSIS CHART—GENERAL—FUEL INJECTION

SYMPTOM	POSSIBLE CAUSE	CURE
1. Fuel/air mixture weak.	Air leaks (unmetered air entering engine).	Check engine for air leaks, renew 'O' rings and gaskets as necessary.
	Low fuel pressure.	See fault diagnosis 'Hot start' tests 7, 8, 9.
	Blocked fuel injectors.	Remove injectors from manifold; do not disconnect from fuel rail. Using Lucas 'Epitest' diagnostic equipment locate faulty injector and renew.
2. Fuel/air mixture rich.	Fuel pressure high.	See fault diagnosis 'Hot start' test 8. Check for faulty pressure regulator; check fuel return pipes for blockages.
	Cold start system operating continuously.	Disconnect cold start injector; if mixture returns to correct levels, renew the thermostime switch or cold start injector.
	Exhaust leaks.	Check all exhaust joints, pipes, silencers for security and leaks; retighten or renew as necessary.
	Leaking injector.	Locate and renew faulty injector.
3. Engine erratic (hesitating/intermittent).	Engine compressions.	If pressure is considerably low, this indicates faulty valves or piston rings. Low pressure in other cylinders indicates faulty cylinder head gasket.
	Fuel injection electrical earth.	Check earth connection on rear of block, clean and check for security.
	Ignition system.	See fault diagnosis 'Hot start' test 2 and 3 for H.T. checks. Check low tension side of ignition using 'Lucas Electronic Ignition Analyser' Part number YWB 119.
	Electrical connections.	Check all connections for security.
	Air filter blocked.	Check filter—renew if necessary.
	Inadequate fuel pressure.	Insert pressure gauge into fuel system; check for correct operating pressure. If pressure low, investigate for blockages on fuel feed line.

ENGINE TUNING PROCEDURE

Before carrying out 'Engine Tuning' on fuel injection vehicles, it is important that all other engine related setting procedures are undertaken first; air meter and air cleaner correctly fitted, ignition and throttle potentiometer correctly set; all hoses correctly fitted and secured.

When the engine is running at its normal operating temperature; thermostat open, the following additional checks and adjustments can be made.

CHECK AND ADJUST IGNITION TIMING

1. Timing to be checked at not more than 600 rev/min from number 1 cylinder using a stroboscopic lamp.
2. If adjustment is necessary, slacken the distributor clamp bolt and rotate clockwise to retard or anti-clockwise to advance. When the required setting has been attained, tighten the clamp bolt and re-check the setting.

NOTE: Timing must be checked with vacuum pipe disconnected.

CHECK AND ADJUST IDLE SPEED

1. Remove tamperproof plug from the plenum chamber.
2. Rotate the idle adjustment screw to set the engine idle speed at 700 to 800 rev/min.
(Clockwise decreases speed — anti-clockwise increases speed.)

CHECK AND ADJUST IDLE CO LEVEL

The following measurements must be taken with the air cleaner connected, exhaust system correctly fitted and checked for leaks.

1. Remove the tamperproof blanking plug from the top of the air flow meter.
2. Adjust the screw until the CO level reading is to specification; 1% maximum.

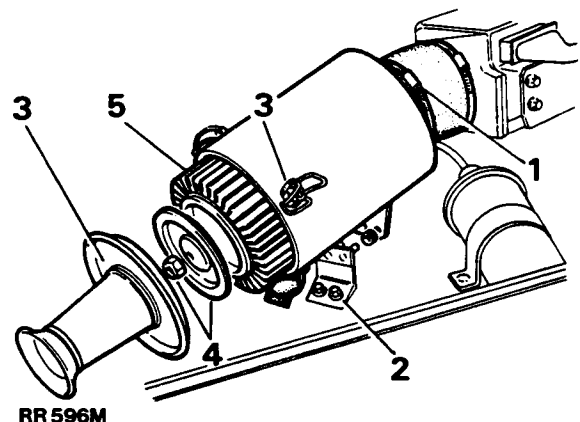
NOTE: Do not allow the engine to idle for longer than 3 minutes when setting.

3. Give engine a 'clear out' burst of 30 seconds at 2000 rev/min light load or longer if necessary to maintain normal running temperature.
4. Re-check CO level and idle speed; adjust if necessary.
5. Fit new tamperproof plugs to air flow meter and idle adjustment screws.

AIR CLEANER

Remove

1. Release the hose clip securing the hose to the rear of the air cleaner canister.
2. Remove the two nuts and bolts securing the air cleaner to the left-hand valance. Pull the canister from the hose and remove the air filter canister from the engine compartment.
3. Unclip the three catches securing the inlet tube to the air cleaner canister and remove the inlet tube.
4. Remove the nut and end plate securing the air cleaner element in position.
5. Withdraw the air cleaner element and discard.



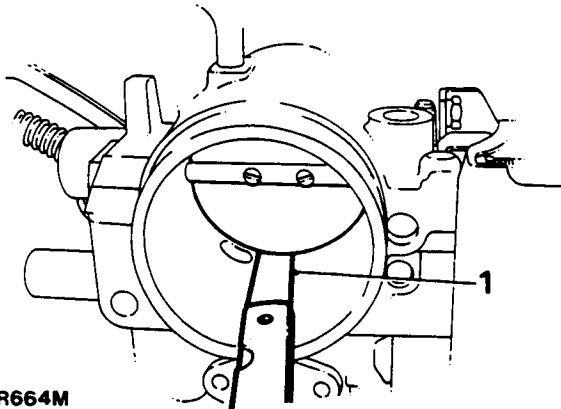
Refit

6. Fit new element and secure in position.
7. Refit the inlet tube to the air cleaner canister.
8. Refit the air cleaner to the mounting bracket and tighten the two nuts.
9. Fit the hose to the air cleaner outlet aperture and tighten the hose clip.

RESETTING THROTTLE LEVERS—fuel injection**Manual/Automatic Transmission**

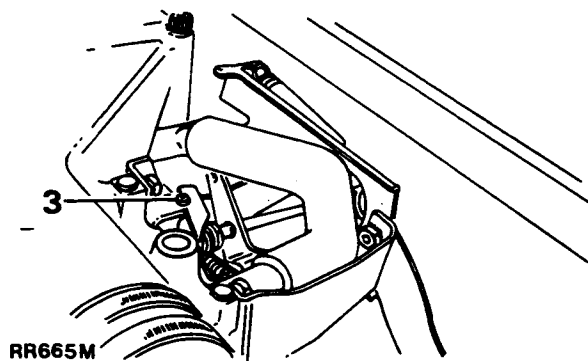
NOTE: The setting procedure outlined is applicable at minimum throttle condition only.

1. Set the throttle butterfly to a maximum of 0.05 mm (0.002 in) clearance, measured at the vertical centre line within $\pm 10^\circ$.



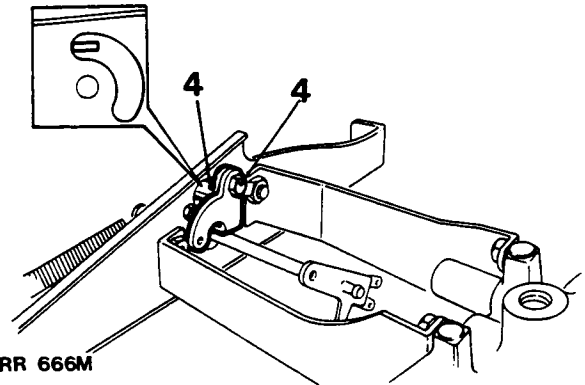
RR664M

2. Ensuring that the butterfly is retained at its setting, remove the stop adjustment screw tamperproof cap (if fitted).
3. Rotate the screw until contact is made with the stop lever, refit the tamperproof cap (if fitted).



RR665M

4. Release the throttle operating lever securing screw and adjust the lever until contact is made with the top end of the slot in the throttle lever mounting bracket; retaining the lever in this position re-tighten the screw.



RR 666M

NOTE: Re-check the throttle potentiometer setting after adjusting the throttle levers.

RENEW THE THROTTLE CABLE**Removing**

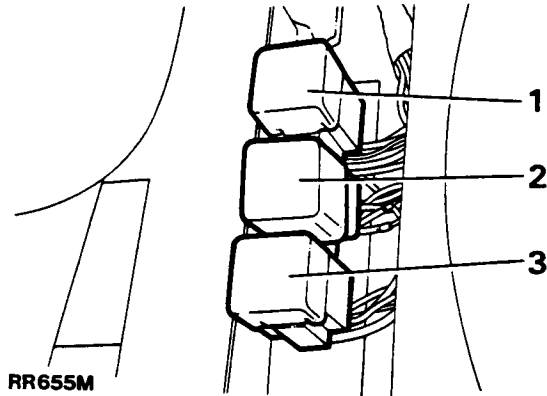
1. Remove the split pin, washer and clevis pin securing the throttle linkage end of the cable.
2. Carefully prise the throttle cable adjustment nut out of the linkage mounting bracket.
3. Withdraw the cable from the mounting bracket.
4. Release the outer cable from the retaining clips within the engine compartment.
5. Remove the lower fascia panel from beneath the steering column.
6. Disconnect the cable from the throttle pedal.
7. Feed the cable through the bulkhead grommet and into the engine compartment.

FIT NEW THROTTLE CABLE

8. Feed the new cable from the engine compartment through the bulkhead grommet.
9. Connect the cable to the throttle pedal.
10. Connect the cable to the throttle linkage, fit a new split pin and secure in position.
11. Clip the outer cable adjustment nut into the mounting bracket.
12. Adjust the outer cable to give 1.57 mm (0.062 in) free play in the throttle cable and check the throttle operation.

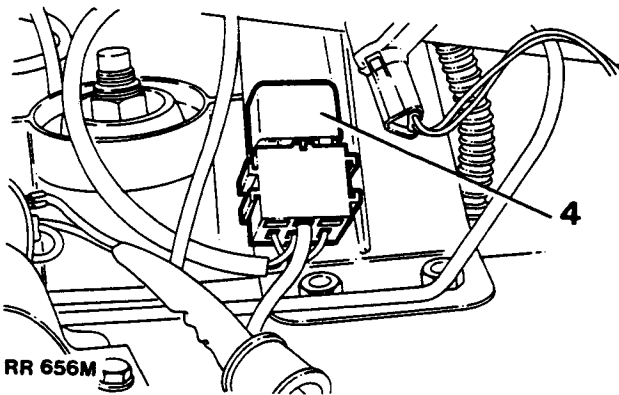
ELECTRONIC FUEL INJECTION RELAYS

Incorporated into the fuel injection electrical circuits are three relays and a current steering diode pack. Two of the relays and the steering diode pack are located beneath the front right-hand seat protected by a black cover. The remaining relay is located in the engine compartment attached to the air flow meter mounting bracket.



RR655M

Relays viewed from within the vehicle.



RR 656M

Relay viewed from engine compartment

1. Fuel pump relay (Item 11 on fuel injection circuit diagram).
2. Steering module (red case) (Item 9 on fuel injection circuit diagram).
3. Main relay (Item 10 on fuel injection circuit diagram).
4. Over-run fuel shut-off relay (Item 4 on fuel injection circuit diagram).

Removing

1. Disconnect the battery.
2. Remove the black protective cover (applicable only to the relays located under the right-hand seat).
3. Pull the relay(s) from the multi-plug(s).

Refitting

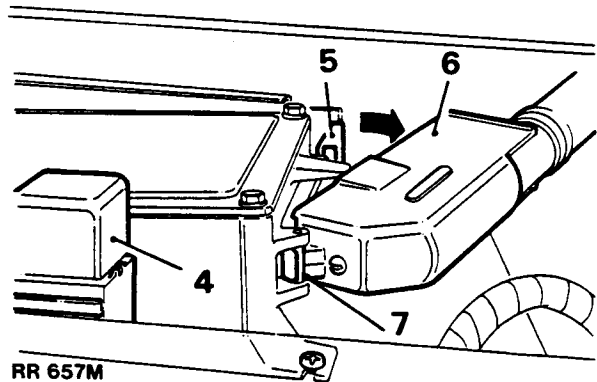
4. Reverse the removal procedure.

ELECTRONIC CONTROL UNIT—ECU

Remove and refit

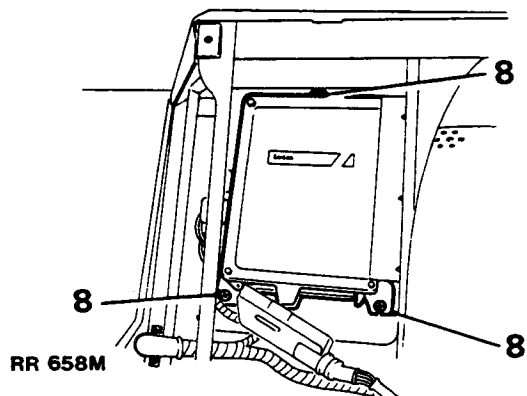
Removing

1. Disconnect the battery.
2. The ECU is located under the front right-hand seat and is accessible through the front aperture of the seat plinth.
3. Release the quarter turn screw and lift off the black protection cover.
4. Remove the three relays, noting their position for re-assembly.
5. Pull the ECU multi-plug retaining clip towards the rear of the seat.
6. Pull the rear of the multi-plug out of the ECU.
7. Manoeuvre the rear of the plug towards the gearbox tunnel to release the hooked front end of the plug from the retaining peg.



RR 657M

8. Release the three screws securing the ECU to the mounting bracket.



RR 658M

9. Withdraw the ECU from beneath the seat.

NOTE: The ECU is not itself a serviceable item, in the event of a unit failure, the ECU must be renewed.

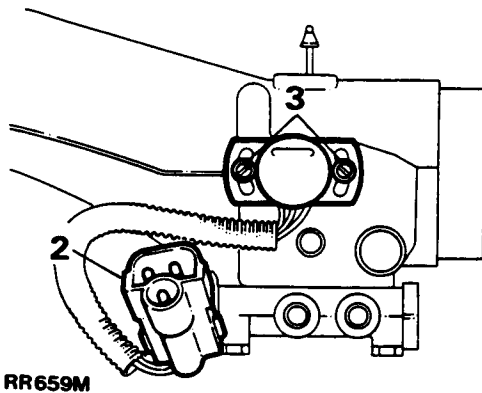
Refitting

10. Secure the ECU in position.
11. Push the multi-plug into the ECU until an audible click is heard denoting that the plug is fitted securely.
12. Refit the relays.
13. Refit the ECU protective cover.
14. Re-connect the battery.

THROTTLE POTENTIOMETER

Remove

1. Disconnect the battery.
2. Disconnect the electrical three pin plug.
3. Remove the two screws securing the switch to the plenum chamber and carefully pull the switch off the throttle butterfly spindle.



4. Remove the old gasket.

Refit

5. Fit a new gasket between the throttle switch and plenum chamber.
6. Align the switch and spindle flats; slide the switch onto the throttle spindle and secure the switch to the plenum chamber.
7. The throttle potentiometer must be reset using a potentiometer adjustment gauge.

Setting the potentiometer

Equipment required:—

Lucas electronic fuel injection throttle potentiometer adjustment gauge — Lucas Part Number YWB 121.

8. Slacken the potentiometer securing screws.
9. Disconnect the three-pin plug from the potentiometer electrical lead. Connect the adjustment gauge plug to the potentiometer.
10. Connect the two crocodile clips from the throttle potentiometer gauge to the appropriate battery terminals.

11. Rotate the potentiometer clockwise or anti-clockwise until the middle lamp of the three indication lamps remains illuminated.
12. Tighten the potentiometer securing screws.
13. Re-check the potentiometer setting.
14. Disconnect the adjustment gauge from the potentiometer and battery terminals.
15. Re-connect the harness three-pin plug to the potentiometer.

NOTE: If a potentiometer adjustment gauge is unavailable, the setting procedure can be carried out using a voltmeter.

IF AN AVO METER IS USED TO CARRY OUT THIS CHECK — ENSURE THE AVO IS SET TO VOLTS. AN AVO METER SETTING OTHER THAN VOLTS WILL RESULT IN DAMAGE TO THE POTENTIOMETER.

Setting the Potentiometer using a voltmeter

16. Slacken the potentiometer securing screws.
17. Switch on the ignition.
18. Connect a voltmeter between the red and green leads at the potentiometer electrical plug.
19. Rotate the potentiometer clockwise or anti-clockwise, until the volt meter reads 290 ± 20 Mv.
20. Tighten the potentiometer securing screws.
21. Re-check the voltmeter reading.

THERMOTIME SWITCH

Test

WARNING: When the cooling system is hot take care to avoid scalding.

1. Remove the pressure relief cap from the coolant expansion tank and remove the filler plug from the radiator. Use a thermometer and note the coolant temperature.
2. Disconnect the battery and pull the electrical connector from the thermotime switch.

Note the rated value stamped on body of the switch.

3. Connect ohmmeter between switch terminal 'W' and earth:
 - (a) Coolant temperature higher than the switch rated value; a very high resistance reading, (approximately 300 ohms at temperature greater than 40°C) open circuit, should be obtained. Renew the switch if a low resistance, short circuit, is shown.
 - (b) Coolant temperature lower than the switch rated value; a very low resistance reading, closed circuit, (approximately zero ohms at temperature less than 40°C) should be obtained. Renew the switch if a high reading, open circuit, is shown.
4. Connect a 12v supply via an isolating switch to terminal 'G' of the thermotime switch.

Use a stopwatch, check the time delay between making the isolating switch, and the ohmmeter showing the change from low to high resistance. The delay period must closely approximate to time, according to temperature:

Coolant Temperature °C	Delay in Seconds
-10	8
0	4.5
10	3.5
35	0

Renew the thermotime switch if necessary.

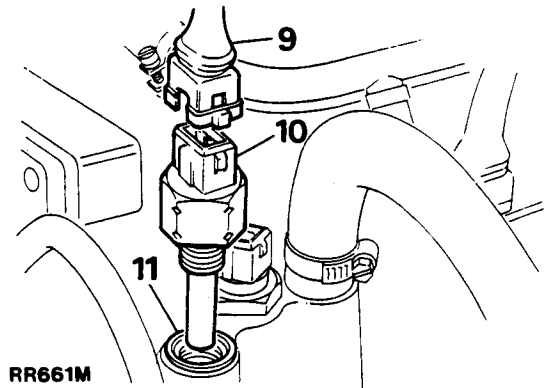
5. Re-connect the plug to the switch and connect the battery.

Removing

WARNING: When the cooling system is hot take care to avoid scalding

6. Remove the pressure relief cap from the coolant expansion tank.
7. Remove the radiator bottom hose and partially drain the cooling system.
8. Disconnect the battery.
9. Remove the electrical plug from the switch.

10. Unscrew the switch and remove it from the inlet manifold.
11. Remove the copper seating washer.



Refitting

12. Fit a new copper washer.
13. Reverse the removal instructions ensuring that the switch is firmly screwed into position.
14. Re-connect the electrical plugs.
15. Visually inspect for water leaks.

COOLANT TEMPERATURE SENSOR

Test

NOTE: When using an AVO connect the measuring leads to the sensor for short periods of time only to minimise the effects of self heating due to the measuring current.

1. Disconnect the battery and remove the electrical plug from the temperature sensor.
2. Connect an ohmmeter between the sensor terminals and note the resistance reading, disconnect the ohmmeter.

The reading should closely approximate the following according to temperature:

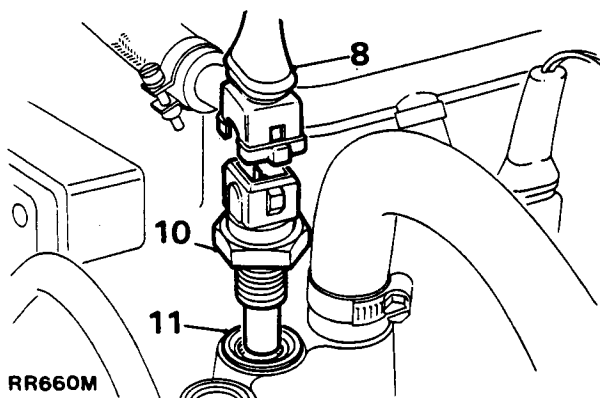
Coolant Temperature °C	Resistance Kilohms
-10	9.2
0	5.9
20	2.5
40	1.18
60	0.60
80	0.33

3. Check the resistance between each terminal in turn against the body of the sensor. A very high resistance reading, open circuit, must be obtained.
4. Re-connect the sensor and the battery.

Removing

WARNING: When the cooling system is hot take care to avoid scalding.

5. Remove the pressure relief cap from the coolant expansion tank.
6. Remove the radiator bottom hose and partially drain the cooling system.
7. Disconnect the battery.
8. Remove the electrical plugs from the coolant sensor and thermotime switch.
9. Unscrew the thermotime switch to give access to the coolant sensor.
10. Unscrew the coolant sensor and remove it from the inlet manifold.
11. Remove the copper washer from the manifold.



Refitting

12. Reverse the removal procedure ensuring that the switches are securely fitted. Fit new copper washers.
13. Re-connect the electrical plugs.
14. Visually inspect for water leaks.

AIR TEMPERATURE SENSOR

Test

NOTE: To prevent self heating of the sensor during the test procedure connect the measuring leads to the sensor for short periods of time only.

1. Disconnect the battery and the electrical multiplug from air flow meter.
2. Connect the ohmmeter between terminals 6 and 27 of the air flow meter and note the resistance reading. The reading should closely approximate the following, according to temperature:

Ambient air temperature (°C)	Resistance kilohms
-10	9.2
0	5.9
20	2.5
40	1.18
60	0.60

3. Disconnect the ohmmeter. Re-connect the multi-plug and the battery.

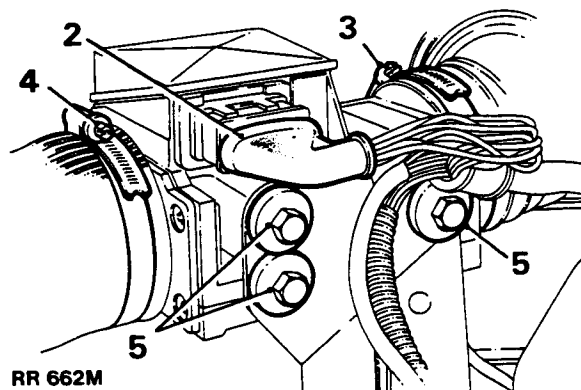
The air temperature sensor is not a serviceable item. If it does not meet the test requirements, the complete air flow meter must be renewed.

AIR FLOW METER

Remove and Refit

Removing

1. Disconnect the battery.
2. Disconnect the electrical multi-plug from the side of the air flow meter.
3. Release the hose clip and remove the plenum chamber hose from the rear of the meter.
4. Release the hose clip at the air intake side of the air flow meter.
5. Remove the three securing screws and plain washers retaining the meter to the mounting bracket.
6. Detach the air flow meter from the hose and withdraw it from the engine compartment.

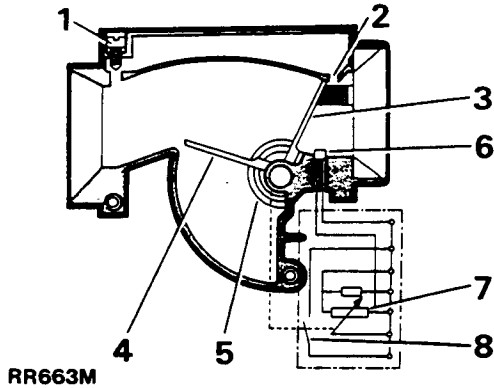


Refitting

7. Reverse the removal operations ensuring the multi-plug is firmly re-connected on re-assembly.

NOTE: The air flow meter is not a serviceable item. In the event of failure or damage the complete unit is to be renewed.

Continued



1. Idle mixture adjustment screw
2. Air by-pass channel
3. Measuring flap
4. Compensating flap
5. Coil spring—flap return
6. Air temperature sensor
7. Potentiometer
8. Fuel pump switch

POWER RESISTOR RACK

The power resistor pack is located under the air flow meter attached to the meter mounting bracket.

The resistor pack is not a serviceable item, in the event of failure or damage the unit must be renewed.

Removing

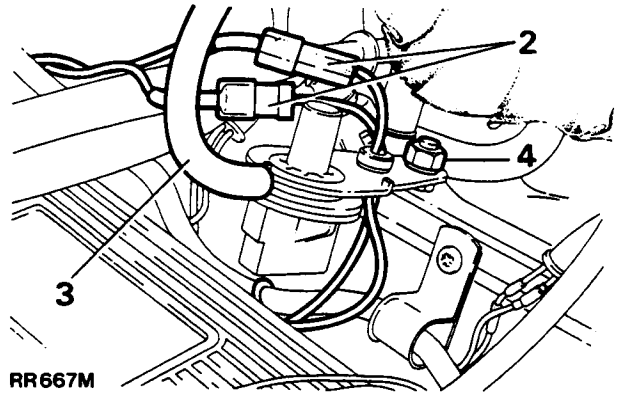
1. Disconnect the battery.
2. Disconnect the multi-plug from the bottom of the resistor pack.
3. Remove the two nuts, bolts and spring washers securing the resistor pack to the air flow meter mounting bracket.
4. Withdraw the resistor pack from the engine compartment.

Refitting

5. Reverse the removal instructions ensuring that the multi-plug is fitted securely.

OVER-RUN FUEL SHUT-OFF VALVE—VACUUM SWITCH

1. Disconnect the battery.
2. Disconnect the two electrical leads.
3. Remove the vacuum hose from the valve.
4. Remove the single nut and spring washer securing the valve to the injector retaining plate.
5. Withdraw the valve.



NOTE: In the event of failure or damage the valve is not serviceable.

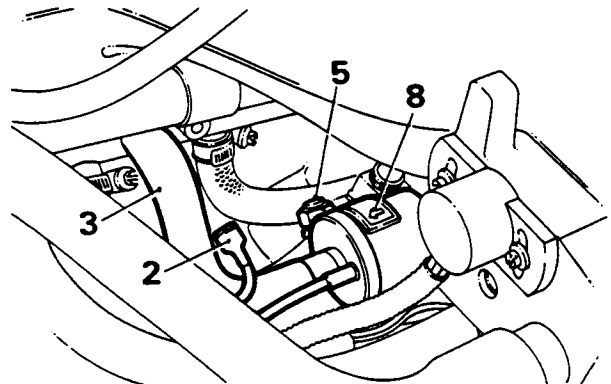
Refitting

6. Reverse the removal instructions.

SOLENOID OPERATED AIR VALVE

—fitted to vehicles with air conditioning only.

1. Disconnect the battery.
2. Disconnect the electrical lead.
3. Pull the front air valve pipe from the plenum chamber.
4. Pull the rear air valve pipe from the extra air valve air rail.
5. Remove the single nut and spring washer securing the valve to the injector retaining plate.
6. Withdraw the valve.
7. Remove the hoses from the valve.



RR668M

Refitting

8. Reverse the removal procedure, observing the direction of flow arrow on the air valve body. The direction of flow is from air rail to plenum chamber.

DEPRESSURISING THE FUEL SYSTEM

WARNING: Under normal operating conditions the fuel injection system is pressurised by a high pressure fuel pump, operating at 1.8 to 2.5 kgf/cm² (26 to 36 lbf/in²). When the engine is stationary this pressure is maintained within the system.

To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise the fuel injection system before any service operations are carried out.

1. Remove the ECU protective cover located under the front right hand seat.
2. Pull the fuel pump relay off its multi-plug (see Electronic fuel injection relays).
3. Start and run the engine.
4. When sufficient fuel has been used up causing the fuel line pressure to drop, the injectors will become inoperative, resulting in engine stall. Switch ignition off.

NOTE: Fuel at low pressure will still remain in the system. This low pressure can be removed by releasing the cold start injector from the plenum chamber and them placing the injector with hose still attached into a suitable container. Release the hose clip and carefully remove the hose from the injector to release any remaining pressurised fuel.

5. Disconnect the battery.

Refitting

6. Refit the cold start injector.
7. Refit the fuel pump relay, re-connect the battery.
8. Crank the engine (engine will fire within approximately 6 to 8 seconds).

FUEL PRESSURE REGULATOR**Test**

1. Depressurise the fuel system.
2. Release the clip and pull the cold start injector supply hose from the fuel rail. Connect a pressure gauge to the fuel rail.
3. Switch the ignition on and operate the flap in the air flow meter to energise the fuel pump.
4. Check that the pressure gauge reading is between 2.5 to 2.6 kgf/cm² (35 to 37 lbf/in²).
5. Switch off the ignition. The fuel pressure should be maintained between 2.1 to 2.6 kgf/in² (30 to 37 lbf/in²).

NOTE: The pressure reading may slowly drop through either the regulator valve or the fuel pump non-return valve. A slow steady drop is permissible; a rapid fall must be investigated.

6. If the pressure reading is unsatisfactory renew the pressure regulator.
7. After fitting a new regulator re-test the system, if the pressure continues to drop off, the fuel injectors, fuel pump, non-return valve and fuel system pipework should be checked for leaks.
8. Depressurise the fuel system. Remove the gauge and connect the cold start injector supply hose.
9. Check for fuel leaks around the hose connection.

Remove and Refit**Removing**

10. Depressurise the fuel system.
11. Disconnect the battery.
12. Pull the flexible rubber vacuum hose from the bottom of the regulator.
13. Release the spill return hose from the side of the regulator.
14. Release the clip and remove the spill return hose from the top of the regulator.
15. Release the single large nut securing the regulator to the regulator mounting bracket.
16. Withdraw the regulator.

Refitting

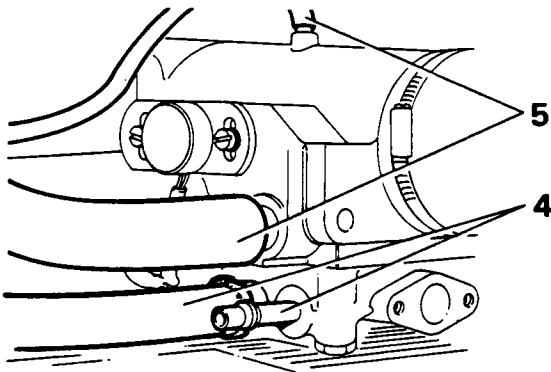
17. Reverse the removal instructions ensuring that all hose connections are secure.
18. Energise the fuel pump and visually inspect all hose connections for fuel leaks.

PLENUM CHAMBER

Remove and refit

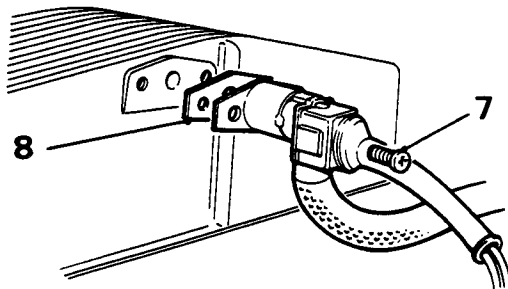
Removing

1. Disconnect the battery.
2. Release the hose clip at the rear of the air flow meter and remove the hose from its location.
3. Release the radiator bottom hose and partially drain the cooling system.
4. Release the two coolant hoses from the bottom of the plenum chamber inlet neck.
5. Disconnect the breather hose and vacuum pipe.



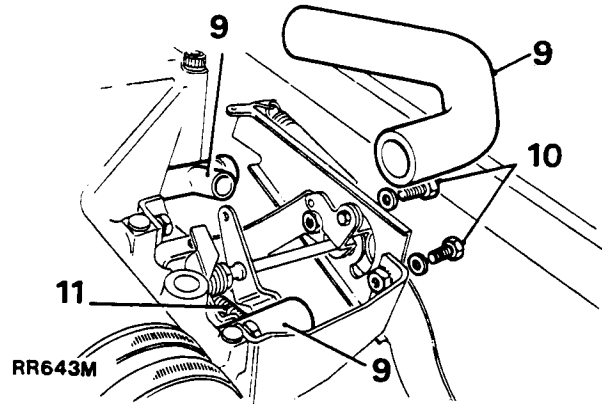
RR641M

6. Disconnect the throttle potentiometer electrical multi-plug.
7. Remove the two screws securing the cold start injector to the plenum chamber.
8. Withdraw the cold start injector and gasket.



RR642M

9. Disconnect the flexible rubber hose from the extra air valve rail and plenum chamber.
10. Remove the two bolts (with spring washers) securing the throttle cable anchor bracket to the throttle lever support bracket.
11. Unhook the small return spring from the throttle levers.



RR643M

12. Remove the small vacuum hose from the rear of the plenum chamber.
13. Remove the six socket head bolts securing the plenum chamber to the ram housing.
14. Manoeuvre the plenum chamber and lift it off the ram housing.

NOTE: To prevent dirt entering the ram tubes, place a protective cover over the ram tube apertures.

Refitting

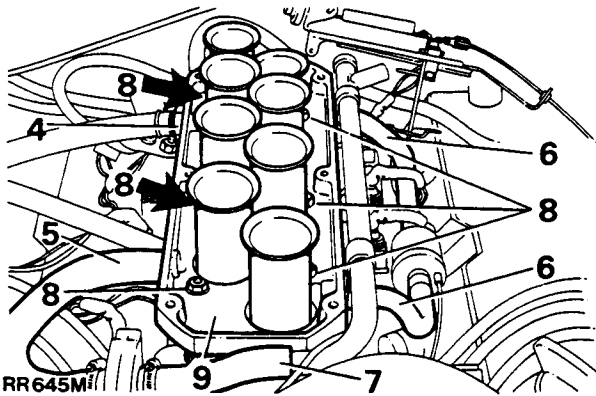
15. Ensure that all mating surfaces are free from any previous sealing compounds.
16. Smear the mating surfaces of the plenum chamber and ram housing with 'Hylomar' sealant.
17. Reverse the removal procedure.

RAM HOUSING

Remove and refit

Removing

1. Depressurise the fuel system.
2. Disconnect the battery.
3. Remove the plenum chamber (see plenum chamber remove and refit).
4. Release the brake servo hose from the ram housing.
5. Release the extra air valve hose at the ram housing.
6. Remove the solenoid operated air valve hoses from the front left-hand side of the ram housing and from the rear of the extra air valve rail.
7. Remove the extra air valve hose from the air valve rail.



8. Remove the six through bolts (with plain washers) securing the ram housing to the intake manifold.
9. Lift the ram housing off the intake manifold and remove it from the engine compartment.
10. Place a protective cover over the top of the intake manifold inlet bores to prevent ingress of dirt.

Refitting

11. Ensure that all mating faces are clean and free from dirt and any previous sealing compounds.
12. Apply 'Hylomar' sealant to the intake manifold face before refitting the ram housing.
13. Fit the ram housing and retighten the bolts, working from the two centre bolts, diagonally towards the outer four bolts.
14. See 'Data section' for correct tightening torque.

EXTRA AIR VALVE

Test

1. Disconnect the electrical multi-plug from the valve and connect a voltmeter across the terminals of the connector.
2. Operate the starter motor—battery voltage should be obtained on the voltmeter.

No voltage—check wiring for continuity and condition; Battery voltage—check the resistance of the heating coils.

3. Connect an ohmmeter between the terminals of the air valve. A resistance of 33 ohm should be obtained.

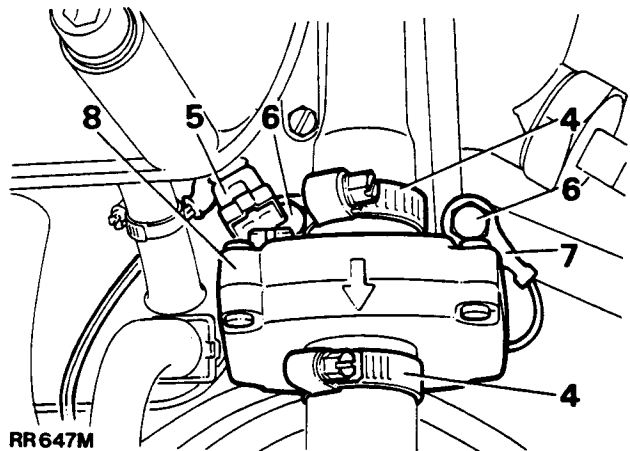
No resistance—renew the air valve.

Remove and refit

Removing

4. Release the two hose clips and detach the hoses from the air valve.

5. Disconnect the electrical multi-plug.
6. Remove the two bolts securing the air valve to the intake manifold.
7. Move the plug lead support bracket and earth lead aside.
8. Withdraw the air valve from the engine compartment.



Refitting

9. Refit the hoses securely.
10. Refit the plug lead support bracket and earth lead.
11. Reverse the removal operations.

FUEL RAILS

Remove

1. Depressurise the fuel system.
2. Remove the plenum chamber.
3. Remove the ram housing.
4. Disconnect the fuel feed pipe at the fuel rail.
5. Disconnect the spill return pipe from the pressure regulator at the fuel rail.
6. Release the eight injector hose clips at the fuel rail.
7. Remove the fuel rail from the hoses.

Refitting the fuel rails

8. Push the fuel rail outlet pipes onto the injector hoses.
9. Tighten the eight hose clips securely.
10. Re-connect the spill return and fuel feed pipes.
11. Refit the ram housing and plenum chamber, tighten bolts to correct torque. See 'Data section'.
12. Start the engine and visually check the fuel rails and connections for leaks.

INJECTORS—RH AND LH BANKS—COLD START INJECTOR

Test

1. Use an ohmmeter to measure resistance value of each injector winding, which should be 2.4 ohm at 20°C (68°F).
2. Check for short-circuit to earth on the winding, by connecting the ohmmeter probes between each injector terminal and injector body; meter should read infinity. Renew the injector if the winding is open circuit or short circuit.

Remove the injectors

1. Depressurise the fuel system.
2. Disconnect the battery.

Cold start injector

3. Disconnect the electrical plug from the injector.
4. Release the hose clip and remove the hose from the injector.
5. Remove the two screws (with spring washers) securing the injector to the plenum chamber.
6. Withdraw the cold start injector and remove the gasket.

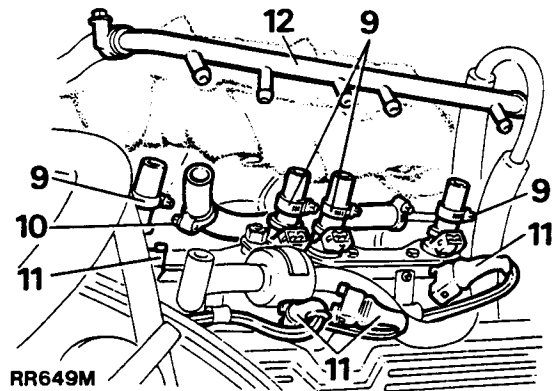
Manifold injectors—RH and LH

7. Remove the plenum chamber (see plenum chamber remove and refit).
8. Remove the ram housing (see ram housing remove and refit).

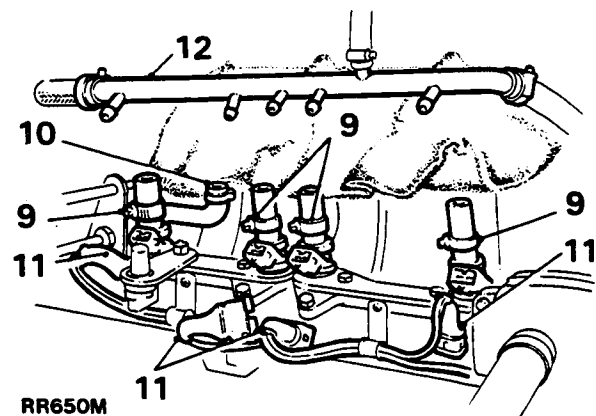
NOTE: To enable any pair of injectors to be released from their locations on either the left- or right-hand side of the intake manifold, it will be necessary to remove the fuel rail from all four injectors in that bank.

WARNING: Before releasing any hoses from the fuel rail, place a cloth around the hose connections to prevent any excess fuel which may be under pressure escaping.

9. Release the four clips securing the injector hoses to the fuel rail.
10. **Left-hand injectors**—release the clip and remove the fuel feed hose from the fuel rail.
Right-hand injectors—release the clip and remove the spill return hose to the pressure regulator at the fuel rail.
11. Remove the electrical plugs from the injectors.
12. Carefully prise the fuel rail out of the injector hoses.



Left-hand injectors



Right-hand injectors

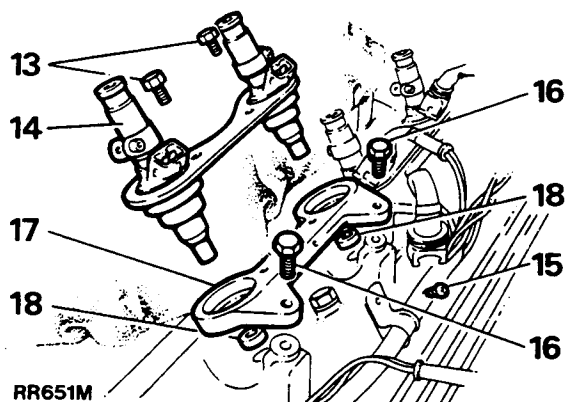
13. Remove the two bolts securing the injector retaining plate.

Continued

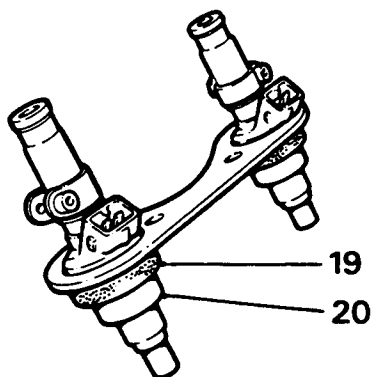
NOTE: Left-hand front injectors—remove the single nut securing the solenoid operated air valve to the injector retaining plate, remove the air valve to give access to the retaining plate securing nut.

Right-hand rear injectors—remove the single nut securing the over-run fuel shut off valve to the injector retaining plate, remove the valve to give access to the retaining plate securing nut.

14. Withdraw the pair of injectors complete with retaining plate.
15. Remove the single screw securing the injector harness retaining clip to the injector location plate.
16. Remove the two bolts securing the location plate to the intake manifold.
17. Remove the location plate to give access to the small rubber seating washers located in the intake manifold injector bores.
18. Pull the rubber seats from the bore and discard.



19. Remove the injectors from the retaining plate by releasing the large rubber seating washers from their registers.
20. Withdraw the injector(s) from the retaining plate.



Refitting the injector(s)

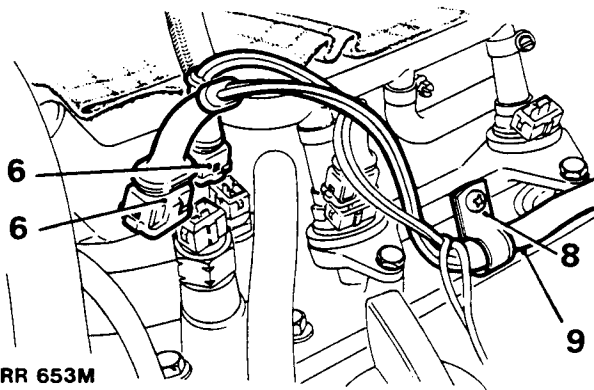
21. Fit new seating rubbers in the intake manifold before refitting the injectors.
22. Refit the injectors with the electrical plug connections facing away from the intake manifold.
23. Re-connect the fuel rail to the injector hoses ensuring that the rail is pushed firmly into position, tighten all hose clips securely.
24. Refit the ram housing and plenum chamber.
25. Refit all ancillary items.
26. Refit fuel pump relay and re-connect the battery.
27. Start the engine and visually inspect for fuel leaks around all hose connections.

INTAKE MANIFOLD

Removal and refit

Removing

1. Depressurise the fuel system.
2. Drain the cooling system.
3. Remove the plenum chamber and ram housing.
4. Remove the extra air valve.
5. Disconnect the electrical multi-plugs from the injectors.
6. Remove the multi-plugs from the thermotime switch and coolant sensor.



7. Disconnect the multi-plug from the cold start injector.
8. Release the four screws and clips securing the injector harness to the left- and right-hand side of the intake manifold.
9. Move the harness away from the intake manifold.
10. Disconnect the top hose from the thermostat housing.
11. Release the two flexible hoses from the rear of the water pump.
12. Disconnect the electrical lead from the water temperature sensor.

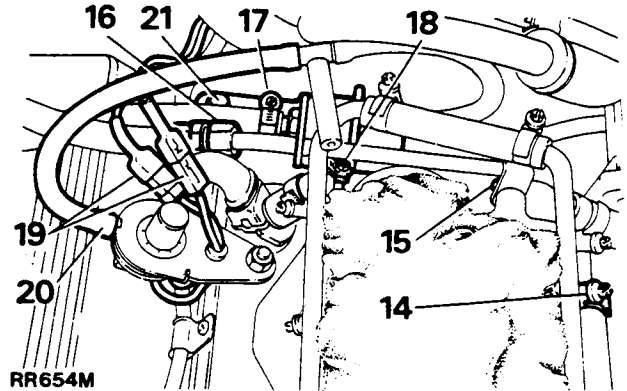
NOTE: If air conditioning is fitted, disconnect the two electrical leads from the sensor in the thermostat housing.

13. Release the two flexible heater hoses from the rear of the intake manifold.

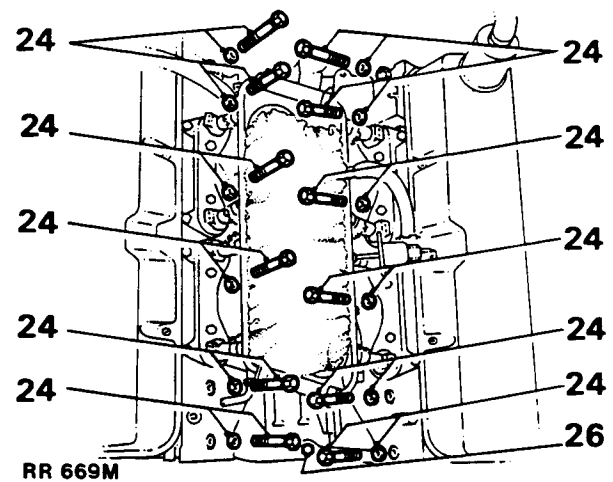
NOTE: To enable the intake manifold rear right-hand securing bolt to be removed it is necessary to remove the fuel pressure regulator, this is removed as follows.

14. Release the clip securing the flexible hose to the rigid fuel supply pipe and remove the hose from the pipe.
15. Remove the single bolt securing the rigid fuel supply pipe to the rear of the intake manifold.
16. Release the nut securing the flexible fuel feed hose to the rigid fuel supply pipe.
17. Release the hose clip and remove the spill return hose at the pressure regulator.

18. Release the hose clip and remove the flexible spill return hose at the side of the pressure regulator.
19. Disconnect the two electrical leads at the vacuum switch.
20. Release the flexible hose from the vacuum switch.
21. Remove the single bolt and spring washer securing the pressure regulator mounting bracket to the rear right-hand side of the intake manifold.



22. Manoeuvre the regulator and mounting bracket, withdraw the assembly from the engine compartment.
23. Release the sparking plug leads from the two plastic retaining clips located at the front of the intake manifold.
24. Remove the twelve bolts and washers securing the intake manifold to the cylinder heads.



NOTE: The two bolts securing the front of the manifold are of a longer type. Ensure that these two bolts are fitted in the correct positions on re-assembly.

25. Lift off the intake manifold.
26. Remove the two gasket clamps from the top of the cylinder block.
27. Lift off the gasket.
28. Remove the gasket seals.

Continued

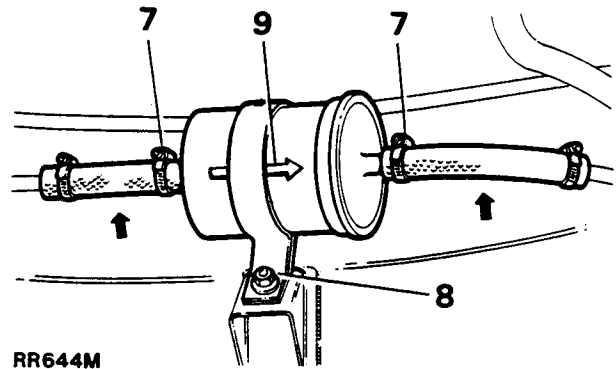
Refitting

29. Using new gasket seals, smear both sides of the seals with silicon grease.
30. Locate the seals in position with their ends engaged in the notches formed between the cylinder heads and block.
31. Apply 'Hylomar' sealant around the outside of the water passage apertures on the cylinder heads, manifold gasket and intake manifold.
32. Fit the manifold gasket with the word 'FRONT' to the front and the open bolt hole to the front right-hand side.
33. Fit the gasket clamps but DO NOT fully tighten the bolts at this stage.
34. Locate the intake manifold onto the cylinder heads, clean the threads of the manifold securing bolts and coat them with thread lubricant sealer 3M EC776.
35. Fit all manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre outwards.
36. Tighten to correct torque—see 'Data section'.
37. Tighten the gasket clamps to the correct torque—see 'Data section'.
38. Reverse removal procedure items 1–23.
39. Start the engine, check for water and fuel leaks.

RENEW FUEL LINE FILTER

WARNING: THE SPILLING OF FUEL IS UNAVOIDABLE DURING THIS OPERATION. ENSURE THAT ALL NECESSARY PRECAUTIONS ARE TAKEN TO PREVENT FIRE AND EXPLOSION.

1. Depressurise the fuel system.
2. The fuel line filter is located on right-hand chassis side member forward of the fuel tank filler neck. Access to the filter is gained through the right-hand rear wheel arch.
3. Chock the front road wheels.
4. Raise the rear of the vehicle and place on suitable axle stands.
5. Remove the right-hand rear road wheel.
6. Clamp the inlet and outlet hoses to the fuel filter (denoted by the two arrows).
7. Release the two hose clips and disconnect the hoses. Plug the open ends of the hoses to prevent ingress of dirt.
8. Release the filter clamp bolt and slide the filter out of the clamp.

**Refitting**

9. Fit a new filter observing the direction of flow arrows stamped on the filter body.
10. Reverse the removal procedure. Start the engine and inspect all hose connections for leakage.

REMOVE FUEL PUMP

The high pressure fuel pump is located within the fuel tank, and is accessible by removing the tank from the vehicle. The removal of the fuel tank from the vehicle requires the assistance of a second person to support the tank when the fuel feed pipe and electrical terminals are disconnected from the fuel pump.

WARNING: Ensure all the necessary precautions are taken against handling and spillage of fuel.

NOTE: The electrical supply to the fuel pump is taken from the starter motor solenoid and the air flow meter switch via the diode pack and relays. The pump should therefore only operate when the engine is being turned by the starter motor or whilst air flow holds the switch closed.

1. Drive the vehicle onto a suitable hydraulic ramp.
2. Depressurise the fuel system.
3. Disconnect the battery.
4. Remove the drain plug from the bottom of the tank and drain fuel into a suitable container.
5. Remove the inlet pipe from the fuel filter and plug the hose.
6. Disconnect the breather pipe and plug the hose.
7. Release the two hose clips at the top and bottom of the filler tube, manoeuvre the hose up the filler tube to withdraw the hose off the tank filler neck.

NOTE: If a tow bar is fitted the two tie bars from the towing plate to the chassis must be removed to allow the fuel tank to be removed from the vehicle.

Continued

19 FUEL INJECTION SYSTEM

8. Remove the four bolts securing the tank to the chassis.
9. With assistance, tilt the left-hand side of the tank downwards as far as the remaining connected fuel pipe will permit, giving access to the fuel feed pipe connection and electrical terminals at the fuel pump.
10. Disconnect the electrical leads from the fuel pump, place the fuel tank on a suitable workbench.

Remove the fuel pump

NOTE: Plug the ends of the fuel feed pipe and fuel pump outlet aperture to prevent ingress of dirt.

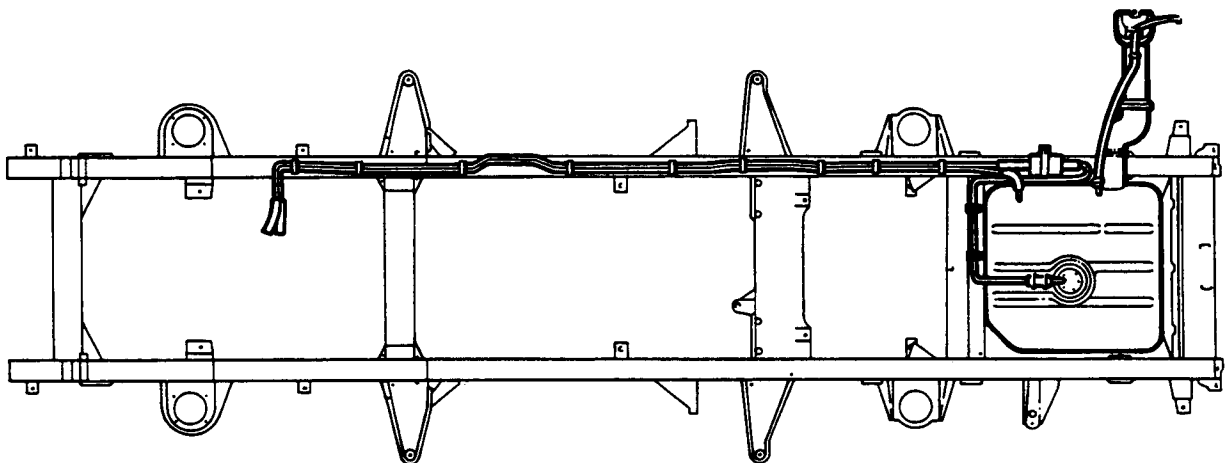
11. Remove the five screws securing the pump to the top of the tank.
12. Withdraw the fuel pump and pump seal from the tank.

Fit new fuel pump

13. Ensure sealing faces are free from dirt and grease.
14. Fit the fuel pump and a NEW seal to the tank.
15. Refit the fuel tank to the chassis, taking care to relocate the fuel feed pipe grommets between the fuel tank and chassis.
16. Re-connect all fuel pipes.
17. Re-connect the battery.
18. Refill the tank with fuel.
19. Refit fuel pump relay.
20. Start the engine and inspect for fuel leaks around the fuel pump and all hose connections.

FUEL PIPES—FUEL INJECTION SYSTEM

WARNING: Before disconnecting any part of the fuel pipe system ensure that all necessary precautions are taken against fuel spillage.

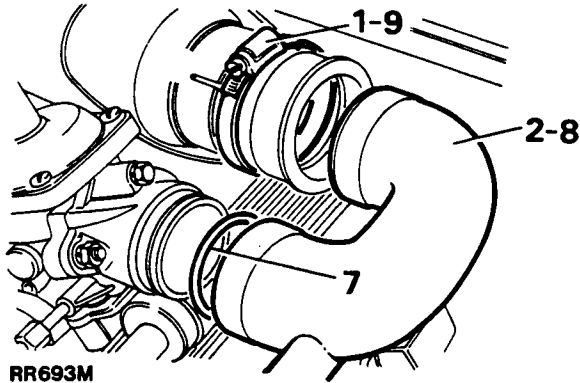


RR646M

FUEL SYSTEM—CARBURETTER

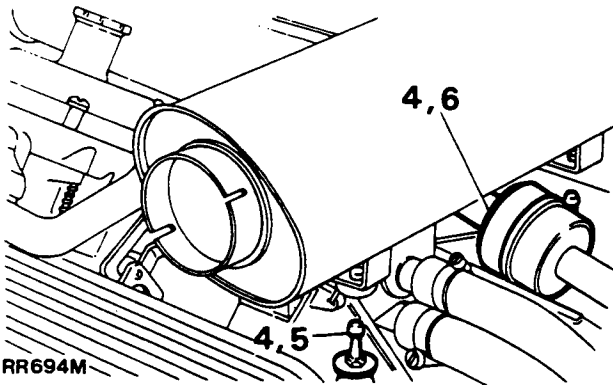
Remove the Air Filter

1. Release the hose clips each side of the air cleaner.
2. Withdraw the air cleaner elbows.



RR693M

3. Detach the choke cable from the clip on the air cleaner.
4. Withdraw the air cleaner from the retaining posts, at the same time disconnecting the hose from the engine breather filter.



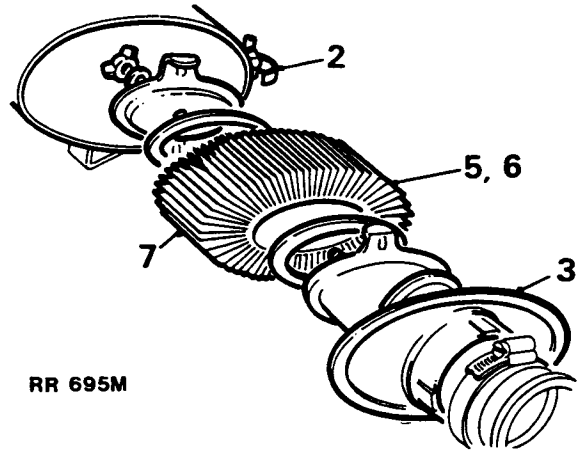
RR694M

Refitting

5. Fit the air cleaner, locating the rubber mountings over the retaining posts.
6. Connect the engine breather hose at the underside of the air cleaner.
7. Smear the 'O' rings at the carburetter intakes with MS4 grease.
8. Fit the air cleaner elbows.
9. Secure the hose clips.
10. Retain the choke cable in the clip at the front of the air cleaner.

RENEW THE AIR CLEANER ELEMENT

1. Remove the air cleaner.
2. Release the end plate clips.
3. Withdraw the end plates.
4. Remove the wing nut, washer and retaining plate.
5. Withdraw the air cleaner elements.
6. Fit new air cleaner elements.
7. Fit new sealing washers.



RR 695M

8. Reverse 1 to 4.

CARBURETTERS

Description

Variations in carburetters may be fitted to meet local territory legislation.

Tamperproofing

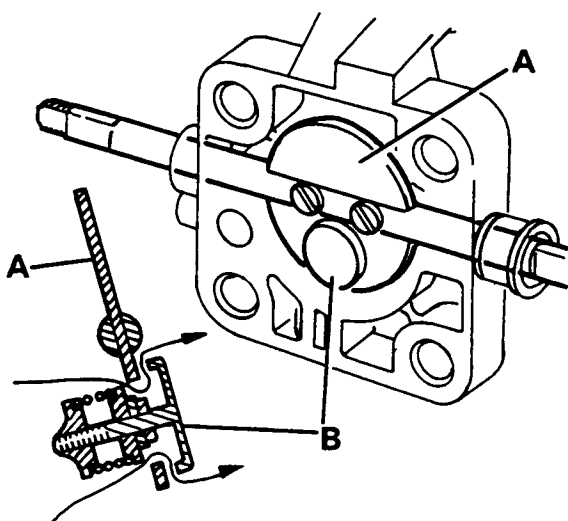
These carburetters may be externally identified by a tamperproof sealing tube fitted around the slow running adjustment screw.

The purpose of these carburetters is to more stringently control the air fuel mixture entering the engine combustion chambers and in consequence the exhaust gas emissions leaving the engine.

For this reason the only readily accessible external adjustment on these carburetters is to the throttle settings for fast idle speed and, on some later carburetters, this may require the use of a special tool to adjust the settings.

On all carburetters a deceleration (popet) valve is incorporated in the throttle (butterfly) disc (A) and consists of a precisely set, spring-loaded plate valve (B). With low manifold depression, the valve remains closed. Under high induction manifold depression conditions, for instance during over-run with the throttle closed, the valve opens thereby slightly reducing the depression, allowing a correct quantity of fuel and air mixture to sustain engine running which improves the combustion of fuel during these conditions and helps to prevent high-value hydrocarbon emissions.

The deceleration valve is not adjustable (See fault diagnosis).



RR181M

ENGINE TUNING PROCEDURE—CARBURETTER

Before carrying out 'Engine Tuning' to carburetters it is important that all other engine related setting procedures are undertaken first, i.e. sparking plugs correctly set, hoses and air cleaner correctly fitted and secure. When the engine is running at its normal operating temperature i.e. thermostat open, the following additional checks can be made.

Check and adjust ignition timing

Equipment required:

- Calibrated tachometer
- Stroboscopic timing lamp

1. Couple stroboscopic timing lamp and tachometer to engine, following the manufacturers instructions.
2. Disconnect the vacuum pipe from the distributor.
3. Start engine, with no load and not exceeding 3000 rev/min run engine until normal operating temperature is reached. Check that normal idle speed falls within that specified (see 'Engine Tuning Data' for required idle speed dependent upon market).
4. Idle speed should not exceed 750 rev/min and this speed should be achieved by removing a breather hose. NOT by adjusting the carburetter idle screws.
5. If adjustment is necessary, slacken the distributor clamping bolt and rotate the distributor (clockwise to retard or anti-clockwise to advance) until the timing flash coincides with the timing pointer and correct timing mark on the torsional vibration clumper.
6. Re-tighten the distributor clamping bolt securely and re-check the timing setting.
7. Refit vacuum pipe (for vehicle specification see 'Engine Tuning Data' section).

ADJUSTMENT PROCEDURE—CARBURETTER

To comply with ECE exhaust emission regulations, all carburetters are tamperproofed on the idle adjustment screws. When mixture and idle settings have been finalised, the carburetter must be tamperproofed by fitting a cap to the nylon shroud on the idle adjusting screw.

Should, for any reason, the cap require removal, this can be affected by piercing the cap with a sharp pointed tool and prising out.

The following tools will be required to adjust idle speed, mixture and tamperproof carburetter.

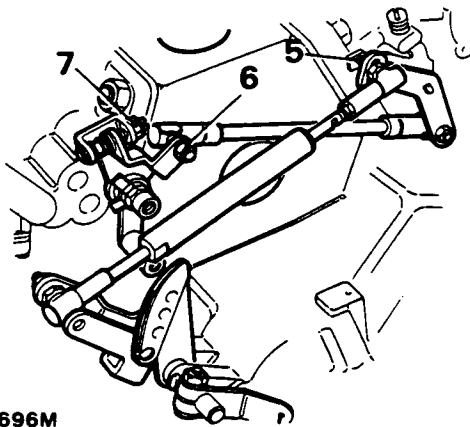
- Carburetter adjusting wrench—MS 86
- Carburetter jet adjusting tool—MS 80
- Tamperproof cap fitting tool—ERC 3786

A numerical code exists for the tamperproofed cap and must be adhered to. Cap fitted by Land Rover Service Departments—ERC 3429.

SLOW RUNNING (IDLE) ADJUSTMENT—Manual and Automatic

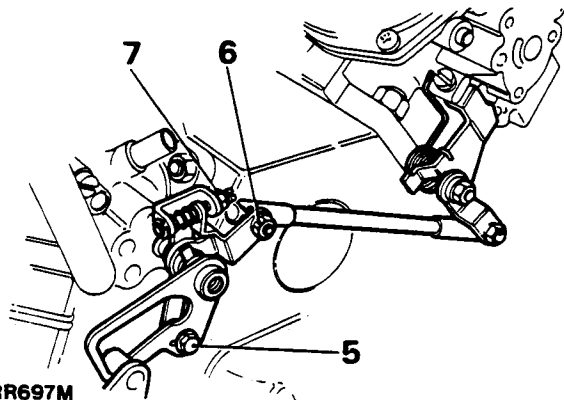
Assuming that mixture levels are correct

1. Check that the throttle control between the pedal and the carburetters is free and has no tendency to stick.
2. Check the throttle cable setting with the throttle pedal in the released position. The throttle linkage must not have commenced movement but commences with the minimum depression of the pedal.
3. Run the engine until it reaches normal operating temperature—thermostat open.
4. Turn ignition off and remove the air cleaner.
5. Slacken the nut which secures the kickdown cable to carburetter inter-connecting link at the right-hand carburetter lever (Automatic only).
Slacken the screw securing the throttle cam to the left-hand carburetter lever (Manual only).



RR696M

Automatic Version

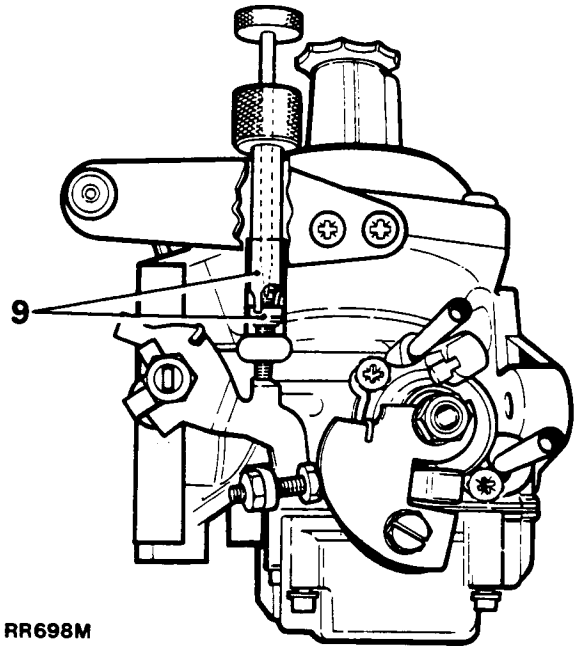


RR697M

Manual Version

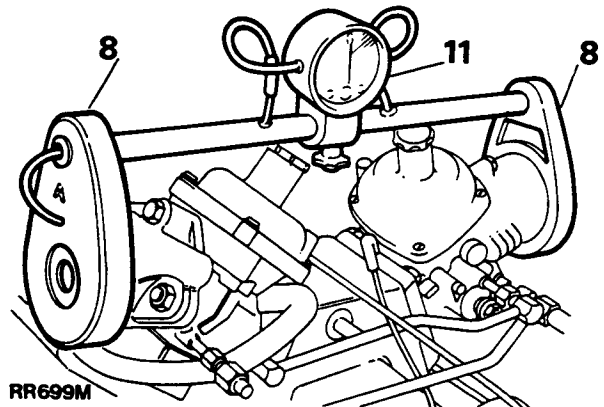
6. Disconnect the inter-connecting link between the carburetters, at the left-hand carburetter.
7. Slacken the locknut and release the lost motion adjusting screw on the left-hand carburetter, ensuring that the screw is well clear of the spring loaded pad.
8. Place suitable carburetter balancing equipment across the carburetter intake apertures.

9. Remove the tamperproof caps from the carburetter idle screws. Using idle screw adjustment tool MS 86 release the locknuts.



RR698M

10. Start the engine and check the idle speed using a reliable proprietary tachometer.
11. Check balancer gauge reading.

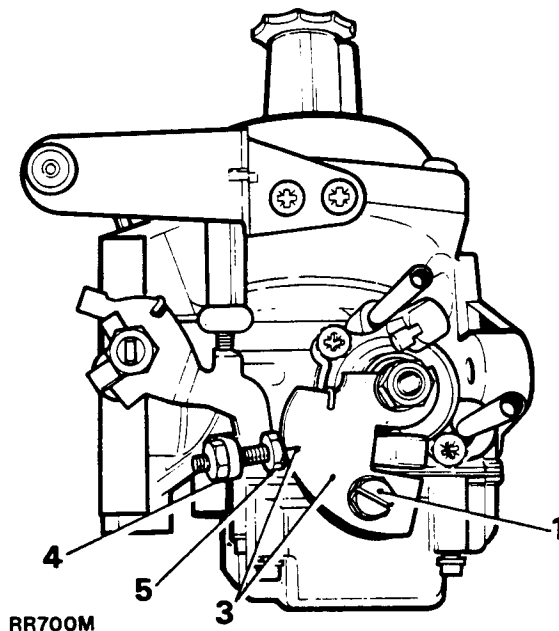


RR699M

12. If the gauge pointer is in the 'zero' sector no adjustment is required to balance carburetter.
13. If the gauge pointer moves to the right, decrease the air flow through the left-hand carburetter by unscrewing the left-hand idle adjustment screw or increase the air flow through the right-hand carburetter by turning the right-hand idle adjustment screw clockwise. Reverse the procedure if the pointer moves to the left.
14. If the engine idle speed rises too high or drops too low, re-adjust the idle screws on both carburetters ensuring that the pointer on the balancing gauge remains in the 'zero' sector.

Continued

15. When items 13 and 14 are satisfactory, tighten the idle screw locknuts.
16. Re-connect the inter-connecting link to the left-hand carburetter.
17. Hold the throttle lever against the throttle lever stop on the right-hand carburetter and adjust the lost motion screw until contact is made with the spring loaded pad and tighten the locknut.
18. Re-check idle speed and balance. Correct if necessary repeating checks 13 and 14.
19. Check idle CO level.
20. If all checks and adjustments are satisfactory; fit new tamperproof caps—part number ERC 3429 using tool—part number ERC 3786.
21. **Automatic version**—Ensuring that the right-hand carburetter countershaft lever is against the idle stop, tighten the inter-connecting link securing nut.
Manual version—Ensure that the roller in the throttle cam on the left-hand carburetter is seated in the corner of the cam slot, tighten the cam lever securing screw.



6. Push the choke control knob fully home and check that normal idle speed is regained.

FAST IDLE ADJUSTMENT—LH carburetter only

Automatic and Manual

Operation of the choke control from 'on' to 'off' should result in a fast idle speed of 1100 rev/min \pm 50 when the choke control is approximately 12.7 mm (0.5 in) from the choke off position.

Check and adjust

1. Slacken choke cable clamping screw at the left-hand carburetter.
2. Pull the choke control knob out and push it into a distance of approximately 12.7 mm (0.5 in) and lock in position.
3. Rotate the fast idle cam allowing the choke cable to slide through the trunnion until the punched mark on the cam flank aligns with the centre of the domed screw on the throttle lever, tighten the choke cable clamping screw.
4. With the cam held in this position release the fast idle adjustment screw locknut.
5. Turn the adjustment screw until contact is made with the face of the fast idle cam, continue adjusting until the specified fast idle speed is achieved. Tighten the locknut.

IDLE MIXTURE ADJUSTMENT

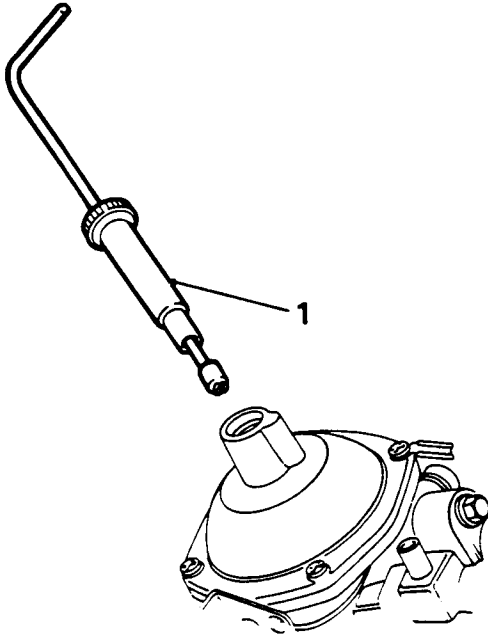
Automatic and Manual

Service Tools—MS 80 Mixture Adjustment Tool.
Carburetter Balancing Gauge.

Mixture adjustment should be carried out when the vehicle is up to normal operating temperature, i.e. warm air intake valve open.

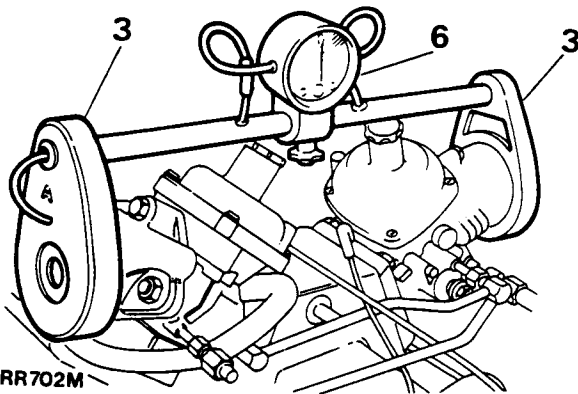
Check and adjust

1. Remove the piston damper plug, and using special tool MS 80 adjust the mixture. Locate the outer sleeve of the tool to engage a machined slot to prevent the air valve twisting. Turn the inner tool clockwise to enrich the mixture and anti-clockwise to weaken it. After every adjustment the tool should be removed from the carburetter to allow engine to stabilise. Run engine at 2000 rev/min to aid stabilisation.
2. When the mixture is correctly adjusted, the engine speed will remain constant or may fall slowly a small amount as the air valve is lifted.



RR 701M

3. Place balancer on the carburettor adaptors, ensuring that there are no air leaks. If the engine stalls or decreases considerably in speed, the mixture is too rich. If the engine speed increases, the mixture is too weak.
4. If necessary, remove balancer and re-adjust the mixture, then refit the tool.



RR 702M

5. Check balancer gauge reading.
6. If the gauge pointer is in the 'zero' sector, no adjustment is required.
7. If the gauge pointer moves to the right, decrease the air flow through the left-hand carburettor by unscrewing the slow running screw or increase the air flow through the right-hand carburettor by turning clockwise the slow running screw. Reverse the procedure if the pointer moves to the left.
8. If the engine idle speed (slow running) rises too high or drops too low during balancing adjust to the correct idle speed, whilst maintaining the gauge pointer in the zero sector.

9. Remove balancer. With the mixture setting and carburettor balance correctly adjusted the difference in engine rev/min with the balancing tool on or off will be negligible, approximately ± 25 rev/min.
10. Check CO levels.

NOTE: The flow test of the carburettor may require the needle to be set within the limits of $\pm \frac{1}{2}$ turn of adjuster from a 'flush' condition. Before any needle component is changed the setting of the needle from 'flush' should be noted and reproduced when refitting. If difficulty is experienced with carburation the needle should be set with the shoulder flush with the face of the piston for investigation.

When using the adjusting tool a positive stop will be felt when the needle reaches full rich position. In the anti-clockwise direction there is no stop and it is possible to disengage the needle from the adjusting screw if more than two turns are made from the datum position. Should disengagement occur it can be rectified by applying light pressure, in an upwards direction to the shoulder of the needle at the piston face, whilst turning in a clockwise direction.

CHECK CO LEVEL

Use a proprietary non-dispersive infra-red exhaust gas analyser.

11. Insert the probe of the analyser as far as possible into the exhaust tail pipe, start the engine and allow a one to one and a half minute stabilisation period.
12. Check that the correct idle speed (slow running) is maintained and observe the CO reading against that given in the data section. If necessary re-adjust the mixture setting to achieve the correct CO level.

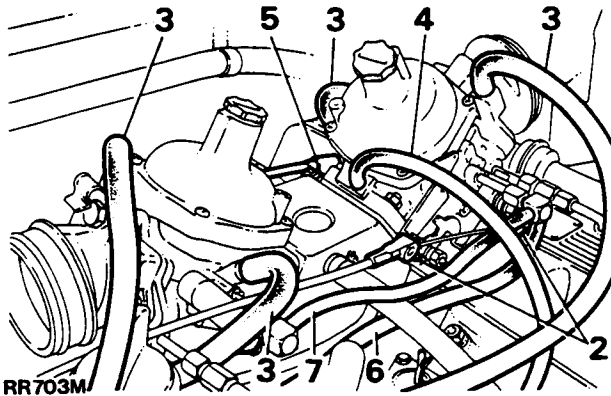
NOTE: For local territory emission level requirements see 'Engine Tuning Data' in specification section.

19 CARBURETTER FUEL SYSTEM

CARBURETTERS—Manual & Automatic

Removing

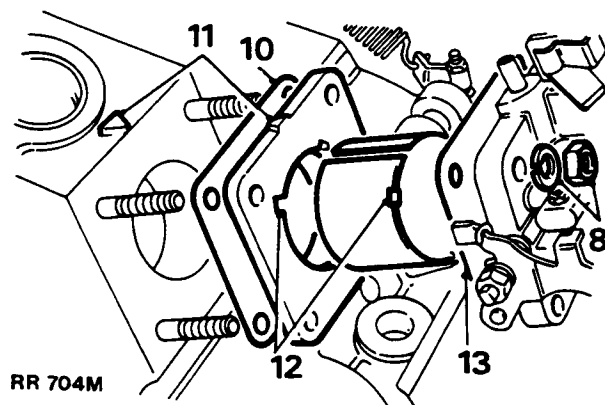
1. Remove the air cleaner.
2. Disconnect the choke cable.
3. Disconnect the emission control pipes.
4. Disconnect the distributor vacuum pipe.
5. Disconnect the throttle linkages.



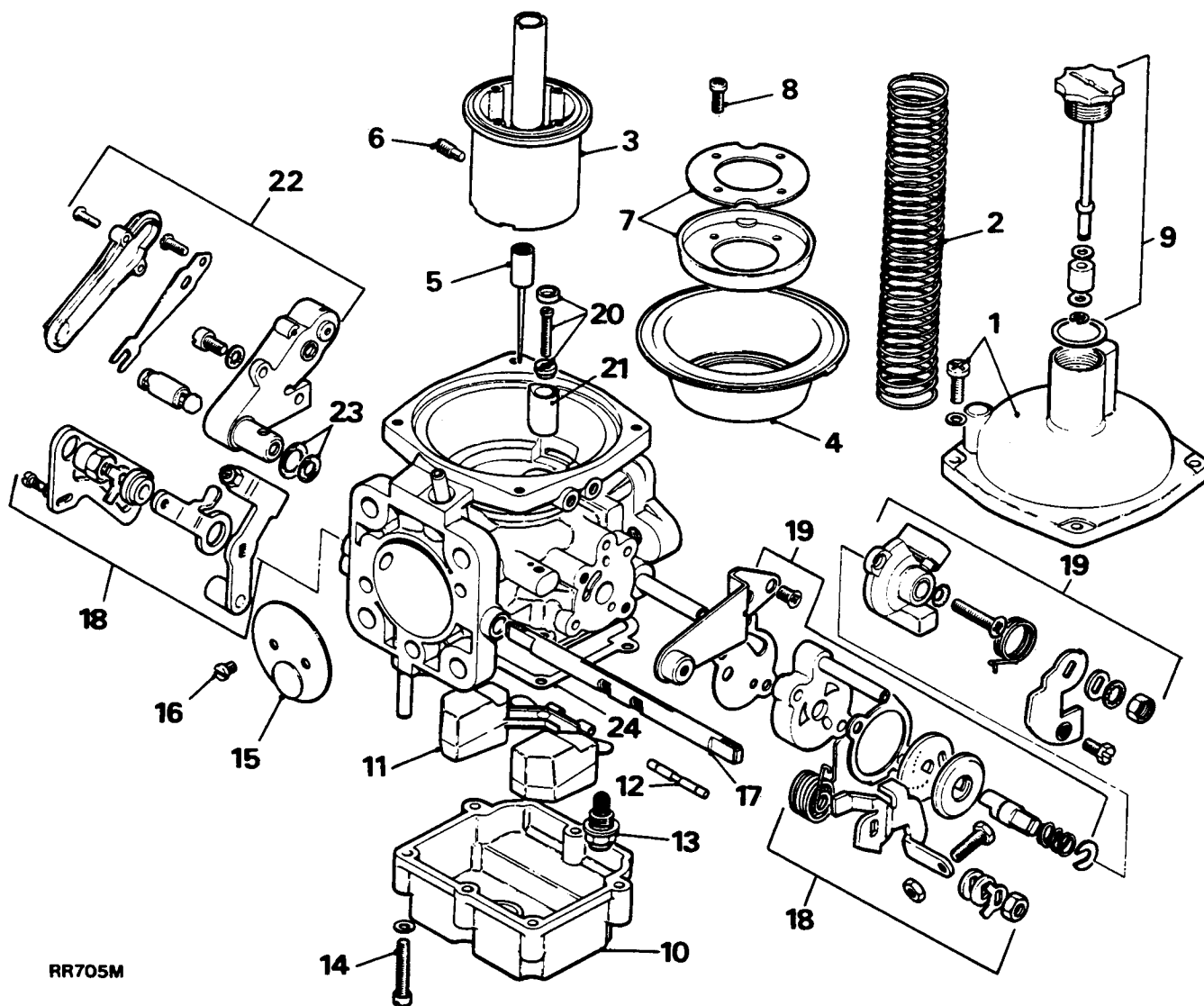
6. Disconnect the main fuel supply pipe.
7. Disconnect the choke fuel supply pipe.
8. Remove the eight retaining nuts and lift off the carburetters.
9. Withdraw the joint washers, insulator and liner.

Refitting

10. Locate a new joint washer on the inlet manifold.
11. Fit the insulator, aligning the arrows.
12. Fit the liner fully into the insulator, engaging the three tabs into the recesses.
13. Locate a joint washer on the insulator.



14. Reverse 1 to 8.
15. Fit the air cleaner.
16. Tune and adjust the carburetters.



RR705M

KEY TO LH CARBURETTER

- | | |
|---|--|
| 1. Top cover and retaining screws | 14. Float chamber retaining screws (6 off) |
| 2. Air valve return spring | 15. Butterfly |
| 3. Air valve | 16. Butterfly retaining screws (2 off) |
| 4. Diaphragm | 17. Butterfly (throttle) spindle |
| 5. Metering needle | 18. Throttle spindle lever assembly |
| 6. Metering needle retaining screw | 19. Cold start assembly (left-hand carburetter only) |
| 7. Diaphragm retaining ring and plate | 20. Slow running screw assembly |
| 8. Screw (4 off) retaining diaphragm to air valve | 21. Tamper-proof sleeve |
| 9. Damper assembly | 22. Temperature compensator assembly |
| 10. Float chamber | 23. Temperature compensator rubber seals (large and small) |
| 11. Float assembly | 24. Float chamber joint washer |
| 12. Float assembly spindle | |
| 13. Needle valve | |

CARBURETTER OVERHAUL**DISMANTLE****Remove the piston assembly**

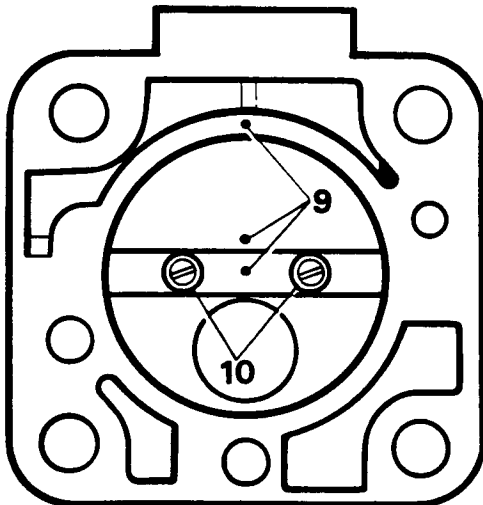
1. Remove the carburetters from the engine.
2. Release the four screws and withdraw the top cover and spring.
3. Withdraw the air valve, shaft and diaphragm assembly.
4. Remove the metering needle retained by a locking screw.
5. Release the four screws and separate the diaphragm from the air valve.

Remove the float chamber

6. Release the six screws and remove the float chamber and joint washer.
7. Release the float assembly and spindle from the two clips.
8. Unscrew the needle valve and washer from carburetter body.

Dismantle carburetter body

9. Make location marks, as illustrated, to assist correct assembly, on the throttle butterfly, spindle and carburetter body.
10. Right-hand carburetter. Release the two screws and remove the butterfly and withdraw the spindle.



ST1119M

11. Left-hand carburetter. Remove the left-hand lever assembly. Release the two screws, remove the butterfly and withdraw the spindle.
12. Left-hand carburetter. Release the two retaining screws and shake-proof washers and remove the cold start assembly and joint washers.

13. Dismantle the cold start assembly but DO NOT remove the discs from the spindle.
14. If necessary, dismantle the throttle spindle lever assemblies from both carburetters.

Slow running adjustment screws

Do not attempt to remove these screws or break the tamper-proof seals. See Cautionary note under 'Tune and Adjust'.

Remove temperature compensator

15. Release the two screws and withdraw the temperature compensator unit complete.
16. Remove the large and small rubber washers.

CLEANING AND INSPECTION**Cleaning**

17. When cleaning fuel passages do not use metal tools (files, scrapers, drills etc.) which could cause dimensional changes in the drillings or jets. Cleaning of all components should be affected using clean fuel and, where necessary, a moisture-free air blast.

Joint washers and seals

18. New gaskets and seals should be used throughout carburetter rebuild. A complete set of gaskets is available for replacement purposes. Inspect metering needle; it is machined to very close limits and should be handled with care. Examine for wear, bend and twist; renew if necessary.
19. Examine the faces for deep scores which would lead to leakage taking place when assembled.

Diaphragm

20. Examine the diaphragm for deterioration, damage and punctures. Do not use any cleaning chemicals on the diaphragm only clean lint free rag.

Float assembly

21. Examine the two plastic floats and check for punctures and damage.
22. Check the spindle and retaining clips for wear.
23. Inspect the needle valve assembly for wear. Renew the valve if there is any tendency for the needle to stick.

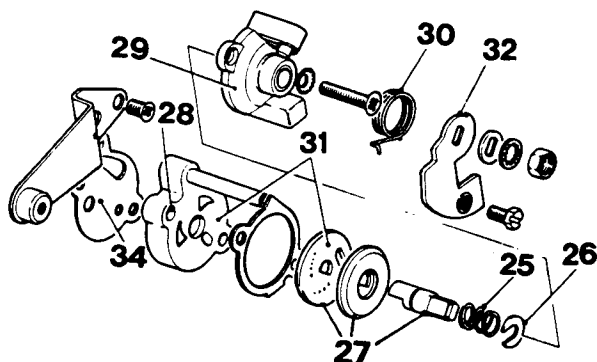
Cold start assembly

24. Examine all the cold start components for wear and corrosion and the machined faces for scores.

ASSEMBLE CARBURETTERS

Cold start—LH carburetter

25. Place the spring on the cold start spindle.
26. Fit the spring retaining clip.
27. Check that the discs slide easily on the spindle.
28. Place the cold start spindle on the starter face.
29. Place the starter cover in position.
30. Fit the return spring over the spindle.
31. Rotate the spindle until the oval port in the end disc is aligned with the oval port in the starter face.
32. Fit the cold start lever.
33. Engage the return spring over the lug on the starter cover and the back of the cold starter lever.
34. Place the cold start gasket onto the carburetter body.



ST1116M

35. Fit the cold start assembly to the carburetter body, and check for ease of operation.

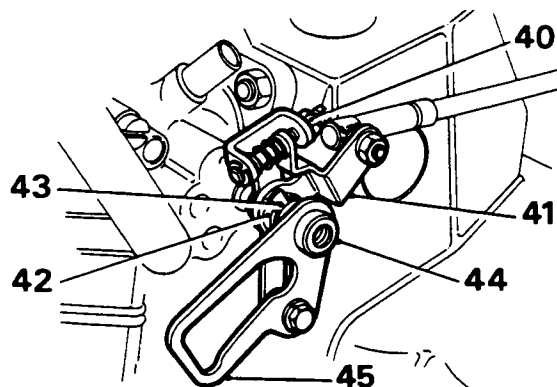
Throttle spindle, LH carburetter

36. Place the return spring over either end of the spindle.
37. Fit the throttle stop and fast idle lever and secure with spacers, tab washer and nut.
38. Insert the throttle spindle from the cold start side of the carburetter body and fit the throttle return spring on the fast idle adjustment lug. Tension the spring half a turn.

NOTE: To enable the throttle butterfly to be centralised, remove the tamperproof cap (if fitted) from the idle adjustment screw, slacken the screw until the lever is free to move without restrictions.

39. Fit the throttle butterfly, maintaining the previously marked alignment. Leave the retaining screws loose. Actuate the throttle several times to centralize the butterfly, then tighten the retaining screws and lock by peening ends.
40. Fit the lost motion lever to the opposite end of the spindle.
41. Fit the throttle lever locating the raised tab between the spring loaded pad and adjustment screw.
42. Place the spacer on the spindle.

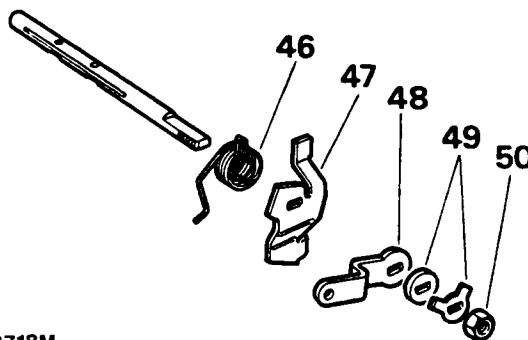
43. Place the tab washer on the spindle.
44. Fit the sleeve nut, sleeve end first, and engage the tab washer.
45. Fit the throttle adjusting lever (automatic gearbox carburetter versions are not fitted with this lever).



RR 713M

Throttle spindle—RH carburetter

46. Place the return spring over the threaded end of the spindle.
47. Fit the throttle stop lever.
48. Fit the throttle lever.
49. Fit the spacer and tab washer.
50. Fit the retaining nut.



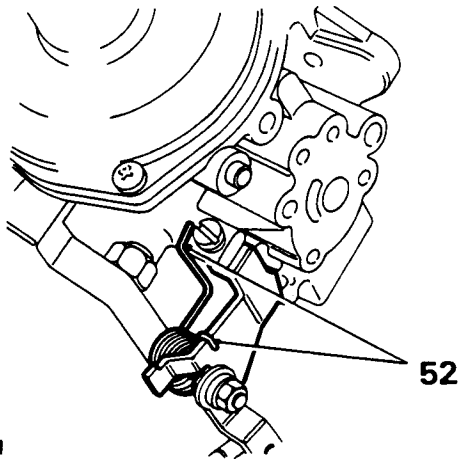
RR718M

51. Secure the assembly to the shaft with the tab washer.

Continued

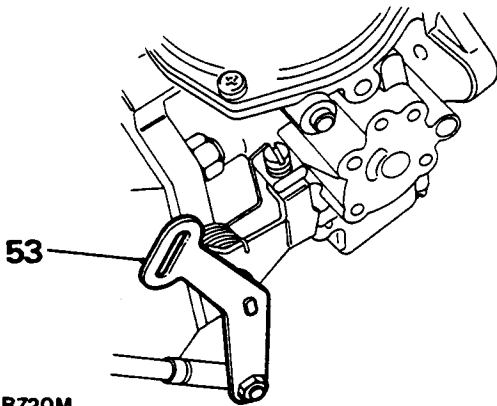
19 CARBURETTER FUEL SYSTEM

52. Fit the spindle to the carburettor and assemble the throttle butterfly as described in instruction 39. (See note preceding instruction 39.) Anchor the return spring as illustrated.



RR 719M

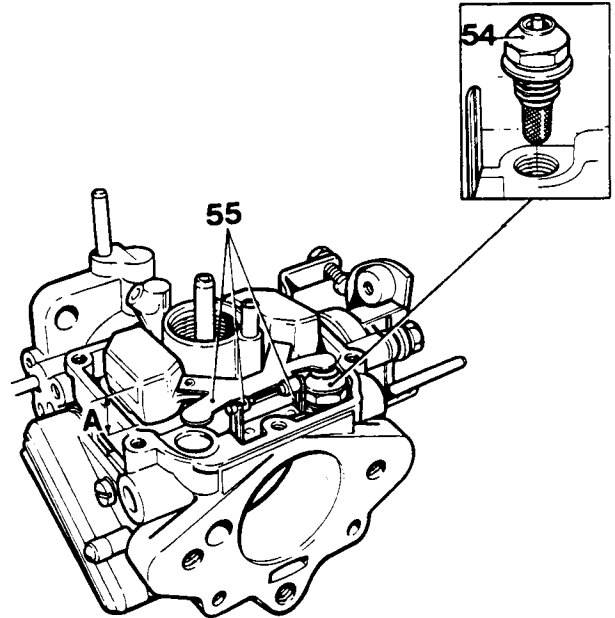
53. Fit the kick-down lever. (Automatic gearbox versions only.)



RR720M

Float chamber assembly

54. Fit the needle valve and new washer.
55. Locate the spindle in the float arm and fit the assembly into the retaining clips.

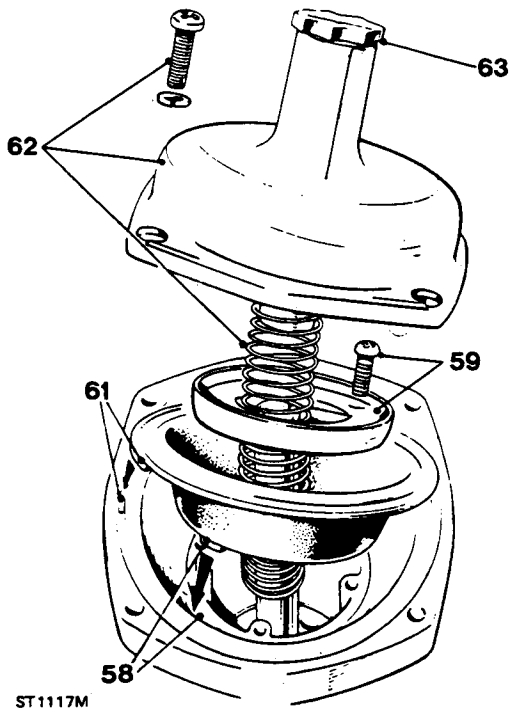


ST1123M

56. Invert the carburettor so that the needle is on its seating and the float tab is contacting the needle. Measure the dimension 'A' between the carburettor gasket face and the highest point on the floats. The correct measurement should be 17 to 18 mm (0.67 to 0.71 in). Adjust by bending the float tab. This dimension must be the same for both floats. The float carrier tab must be maintained at right angles to the needle in the closed position.
57. Fit the float chamber and new gasket and evenly tighten the retaining screws.

Air valve and diaphragm

58. Fit the diaphragm to the air valve with the inner tag locating in the air valve recess.
59. Fit the diaphragm retaining ring and secure with the four screws.
60. Fit the metering needle into the air valve and secure with the locking screw.
61. Insert the air valve and needle into the carburettor and locate the diaphragm outer tag into the recess in the carburettor body.
62. Fit the spring and top cover and secure with the four screws.
63. Fit the damper.



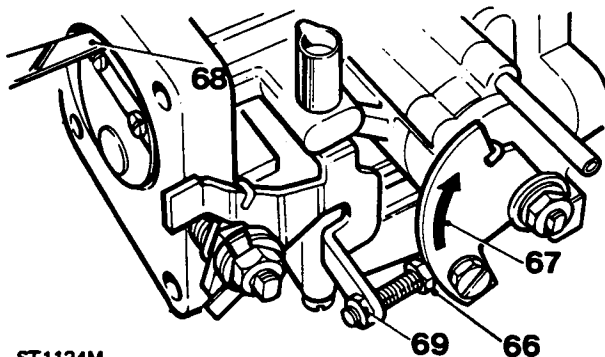
ST1117M

Temperature compensator

- 64. Clean the carburettor and compensator mating faces.
- 65. Fit a new inner and outer rubber washer and secure the temperature compensator with the two screws and shake-proof washers.

Fast idle adjustment—LH carburettor only

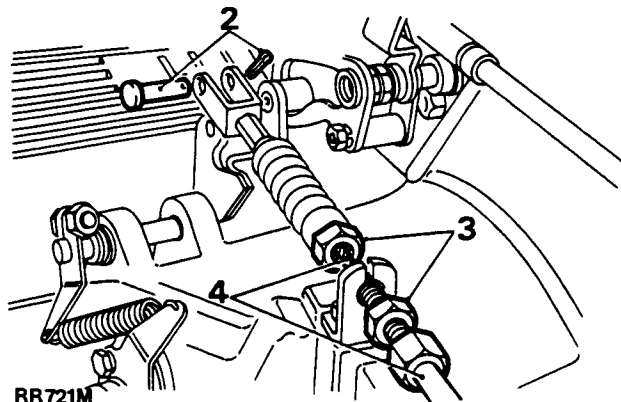
- 66. Slacken the fast idle adjusting screw.
- 67. Hold the cold start cam lever in the maximum position.
- 68. Adjust the fast idle adjusting screw against the cam lever until there is 0.61 to 0.66 mm (0.024 to 0.026 in) gap between the top edge of the throttle butterfly and the carburettor barrel wall. Use feeler gauges or a 0.65 mm diameter (No. 72) drill to measure the gap.
- 69. Secure the locknut on the fast idle adjusting screw without disturbing the adjustment.



ST1124M

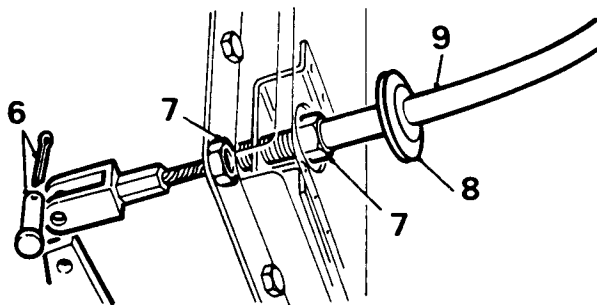
RENEW THE THROTTLE CABLE—manual gearbox

- 1. Remove the air cleaner.
- 2. Remove the split pin and clevis pin from the counter shaft lever.
- 3. Release the two locknuts securing the outer cable to the adjustment bracket.
- 4. Manoeuvre the inner and outer cable and remove from the adjustment bracket.



RR721M

- 5. Remove the six screws retaining the lower fascia within the vehicle. Disconnect the dimmer switch multi-plug to enable the fascia panel to be removed to give access to the throttle pedal linkage.
- 6. Remove the split pin and clevis pin from the top of the throttle pedal.
- 7. Release the two outer cable locknuts at the throttle cable retaining bracket on the inner bulkhead.
- 8. Prise out the rubber grommet accessible from the engine compartment.
- 9. Withdraw the throttle cable complete.



RR 722M

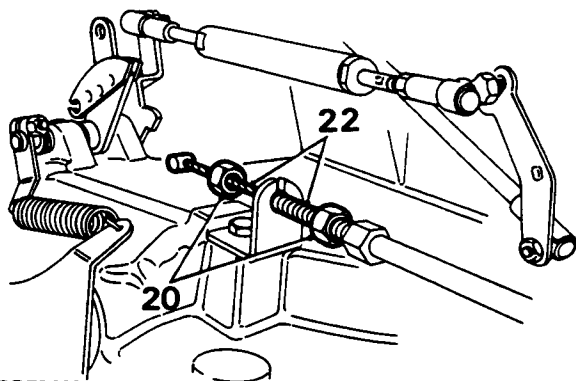
Fit new throttle cable

- 10. Fit new cable ensuring that new split pins are used.
- 11. Lightly grease linkage and clevis pins.
- 12. Adjustment of the cable should be undertaken with the throttle pedal in the fully released position.
- 13. Adjust the outer cable until the throttle levers operate with the minimum of throttle pedal pressure.
- 14. Refit the air cleaner and lower fascia panel.

Continued

Renew the throttle cable—Automatic gearbox

15. Remove the six screws securing the lower fascia within the vehicle, lower the fascia and disconnect the multi-plug at the dimmer switch to enable the fascia panel to be removed to give access to the top of the throttle pedal.
16. Remove the split pin and clevis pin from the throttle pedal.
17. Release the two outer cable locknuts at the throttle cable retaining bracket on the inner bulkhead panel.
18. Remove the air cleaner.
19. Prise the rubber grommet from the bulkhead to allow the cable to be manoeuvred into the engine compartment (see illustration RR722M).
20. Release the two outer cable locknuts from the adjustment bracket at the intake manifold.
21. Remove the nipple end of the cable from the cam lever and remove the complete cable assembly.
22. Manoeuvre the inner and outer cable to release it from the adjustment bracket.



RR723M

Fit new throttle cable

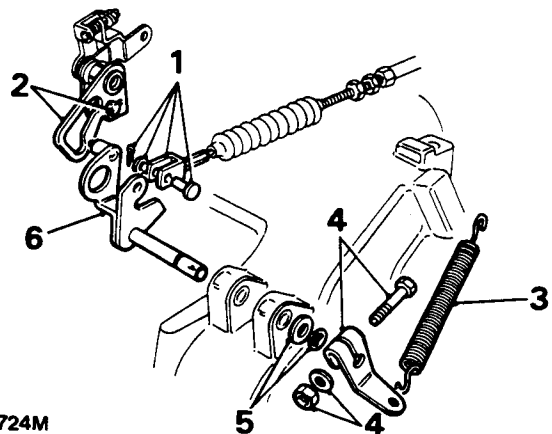
23. Fit new cable ensuring that a new split pin is used.
24. Lightly grease clevis pin and linkage at the throttle pedal.
25. Adjustment of the cable should be undertaken with the throttle pedal in the fully released position.
26. Adjust the outer throttle cable until the throttle levers operate with the minimum of throttle pedal pressure.
27. Refit air cleaner.
28. Refit the lower fascia panel.

THROTTLE LINKAGE—Manual gearbox version

Remove and refit

Removing

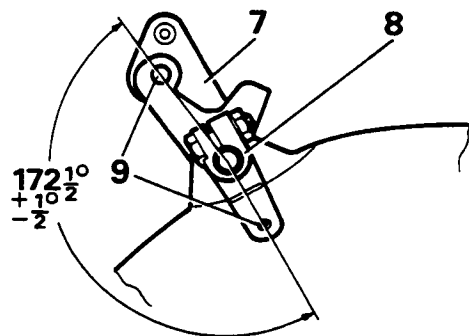
1. Release the throttle cable from the countershaft lever.
2. Remove the small bolt with spring washer securing the throttle adjustment lever to the left-hand carburetter spindle and remove the lever.
3. Disconnect the throttle return spring.
4. Release the nut and slide the return spring lever off the countershaft spindle.
5. Remove the circlip and plain washer from the countershaft lever.
6. Pull the countershaft spindle out of its location.



RR724M

Refitting

7. Fit the countershaft assembly and secure in position with the plain washer and circlip.
8. Fit the return spring lever to abut the circlip and lightly tighten the securing bolt.
9. Position the lever and countershaft lever so that the holes for the throttle cable and return spring connection are $172\frac{1}{2}^{\circ} \pm \frac{1}{2}^{\circ}$, and tighten the securing bolt.



RR725M

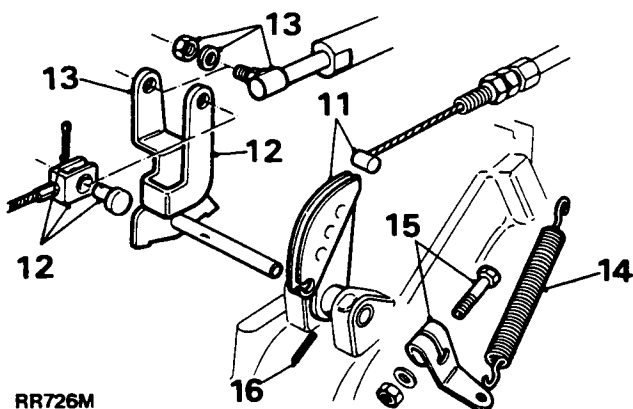
10. Reverse the remaining removal instructions 1 to 3.

THROTTLE LINKAGE—Automatic gearbox versions

Remove and refit

Removing

11. Disconnect the throttle cable from the cam lever.
12. Remove the split pin and clevis pin securing the kick-down cable to the countershaft lever.
13. Remove the nut (with spring washer) securing the carburetter inter-connecting link to the countershaft lever.
14. Disconnect the throttle return spring.
15. Release the spring return lever retaining bolt and remove the lever from the countershaft lever spindle.
16. Drift out the small roll pin securing the cam lever to the countershaft lever spindle.

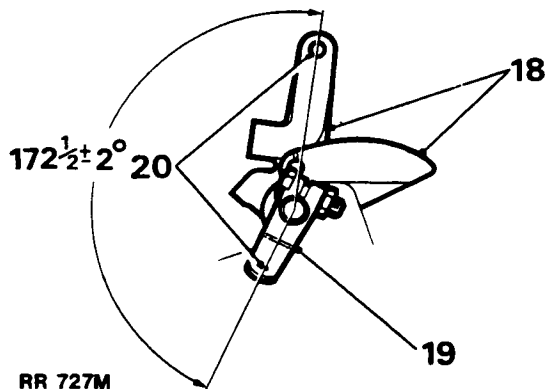


RR726M

17. Manoeuvre the countershaft lever and withdraw it from its location.

Refitting

18. Fit the countershaft lever and cam lever, secure the cam lever to the spindle using a new roll pin.
19. Fit the return spring lever and lightly tighten the securing bolt.
20. Position the return spring lever and countershaft lever so that the holes for the kickdown cable and return spring connection are $172\frac{1}{2} \pm 2^\circ$, and tighten the securing bolt.



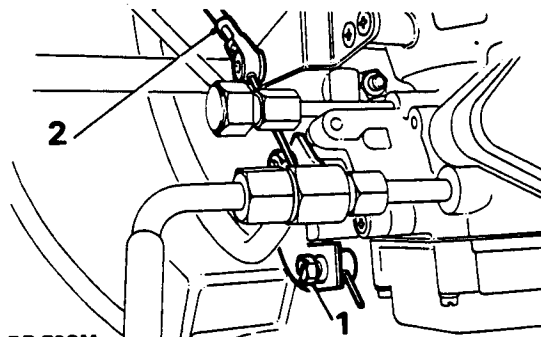
RR 727M

21. Reverse the remaining removal instructions 11 to 14.

RENEW CHOKE CONTROL CABLE—carburetter models only

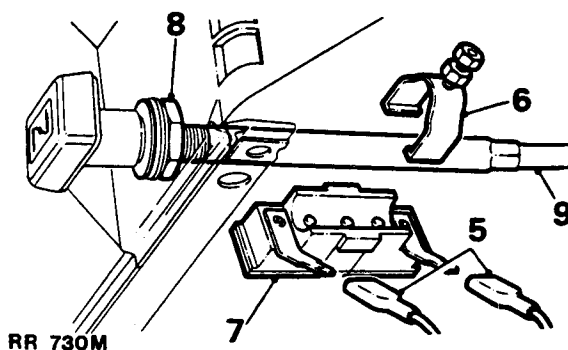
Manual and Automatic gearbox

1. Release the pinch screw and disconnect the choke cable from the left-hand carburetter fast idle cam.
2. Release the cable from the securing clip in the engine compartment.



RR 729M

3. To gain access to the rear of the choke control knob it is necessary to remove the lower fascia panel.
4. Remove the six lower fascia panel securing screws, lower the panel, disconnect the electrical multi-plug attached to the dimmer control switch and remove the fascia panel.
5. Disconnect the two electrical leads from the choke control switch.
6. Release the locknut and screw, slide the clamp off the switch.
7. Remove the switch from the cable.
8. Release the locknut at the rear of the choke control knob.
9. From within the vehicle, pull the cable assembly through the bulkhead and upper fascia panel.



RR 730M

Fit new choke cable

10. Feed the new choke cable through the upper fascia and slide the locknut over the cable.

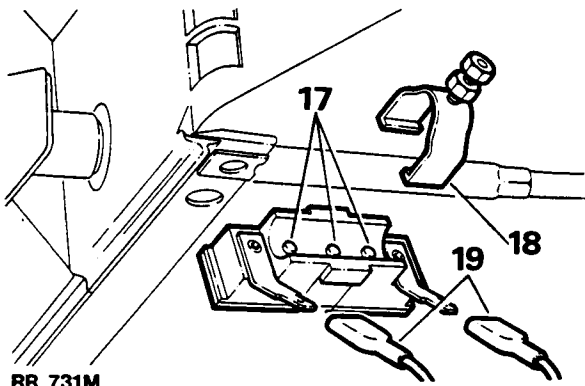
Continued

19 CARBURETTER FUEL SYSTEM

11. Push cable through bulkhead grommet into the engine compartment.

NOTE: Ensure that the grommet is secure in the bulkhead.

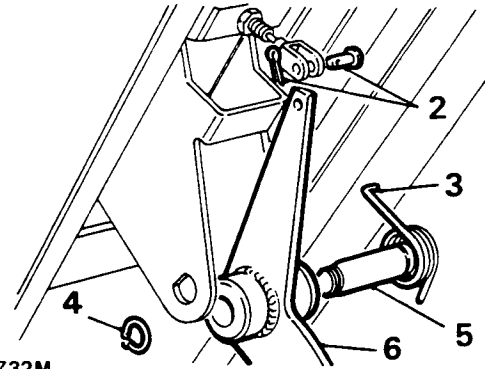
12. Tighten the locknut at the rear of the choke cable knob.
13. Feed the cable through the locking screw on the fast idle cam. Do not tighten the clamping screw at this stage.
14. Attach the outer choke cable to the securing clips.
15. Pull the choke control knob out approximately 12.7 mm (0.50 in), rotate the fast idle cam until the stamped mark on the cam flank aligns with the centre of the domed screw on the throttle lever, tighten the choke cable clamping screw.
16. Push the choke control knob in and check that the domed screw is not in contact with the fast idle cam.
17. Fit the choke warning light switch to the outer cable ensuring that the three small pegs on the switch locate with the indentations on the choke cable.
18. Slide the clamp over the switch and secure in position.



19. Re-connect the electrical leads to the switch.
20. Re-connect dimmer switch electrical leads and secure the lower fascia in position.

REMOVE THE THROTTLE PEDAL—all models

1. Release the six securing screws from the lower fascia panel, lower the panel and disconnect the two electrical leads from the dimmer switch, remove the panel from the vehicle.
2. Remove the split pin and clevis pin securing the throttle cable to the throttle pedal.
3. Release the tension from the pedal return spring.
4. Remove the circlip from the pedal pivot pin.
5. Withdraw the pivot pin.
6. Withdraw the throttle pedal.



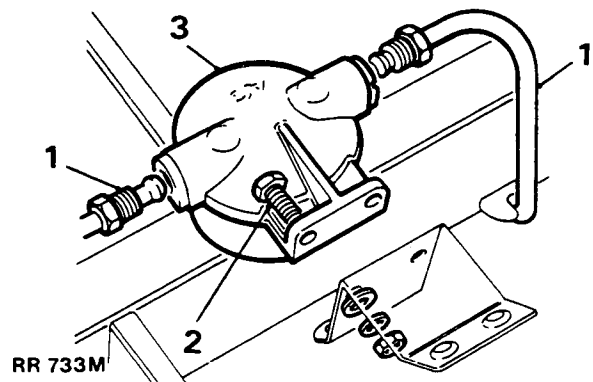
Fit throttle pedal

7. Lightly grease the pivot pin and clevis pin before re-assembly.
8. Fit a new split pin to the clevis pin.
9. Reverse the removal procedure.

REMOVE MAIN FUEL FILTER—carburettor versions only

WARNING: Ensure that all the necessary precautions are taken against the spillage of petrol when removing the filter assembly.

1. Release the two pipe unions securing the pipes to the filter. Plug the end of the pipes to prevent ingress of dirt.
2. Remove the two nuts, bolts and washers securing the filter to the inner wing mounting bracket.
3. Remove the filter assembly.

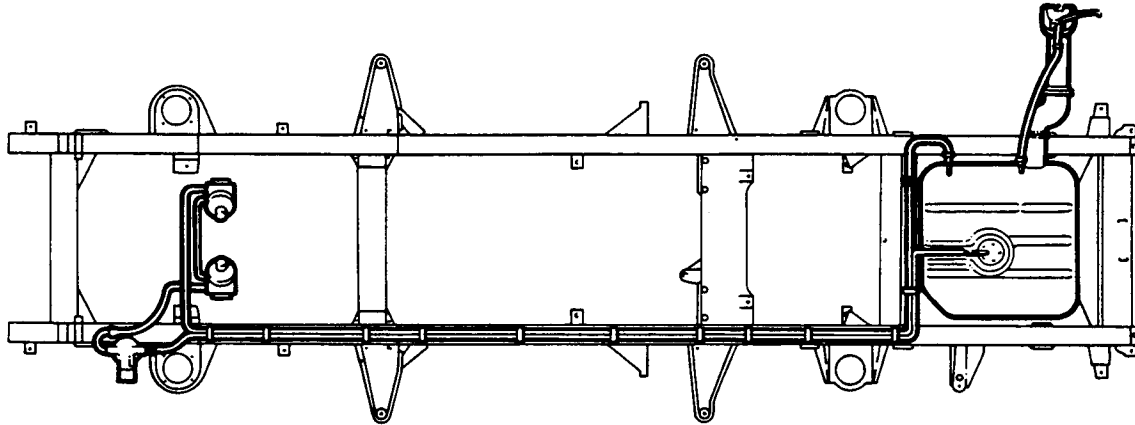


Refitting

4. Reverse the remove instructions 1 to 3, ensuring there are no fuel leaks around the pipe unions.

FUEL PIPES

WARNING: Before disconnecting any part of the fuel pipe system ensure that all necessary precautions are taken against fuel spillage.



RR686M

REMOVE THE FUEL TANK AND FUEL PUMP

NOTE: The removal of the fuel tank from the vehicle requires the assistance of a second person to support the tank when the fuel feed pipe is disconnected from the fuel pump.

The low pressure in-tank fuel pump is located on the top of the fuel tank, access to the pump is gained by removing the fuel tank from the vehicle.

WARNING: Ensure that all the necessary precautions are taken when draining the fuel from the tank.

Remove the fuel tank

1. Drive the vehicle onto a suitable ramp.
2. Disconnect the battery.
3. Remove the drain plug from the bottom of the fuel tank, drain the fuel into a suitable container. Refit the plug.
4. Disconnect the spill return pipe at the fuel tank, accessible through the rear right-hand wheel arch. Plug the end of the return pipe to prevent ingress of dirt.
5. Disconnect the flexible breather hose from the tank.
6. Release the two hose clips at the top and bottom of the filler tube. Manoeuvre the hose up the filler tube and withdraw the hose off the tank filler neck.

NOTE: If a tow bar is fitted, the two tie-bars from the towing plate to the chassis must be removed allowing the tank to be removed from the vehicle.

7. From beneath the vehicle remove the four bolts, nuts, washers and spring washers securing the tank to the chassis frame.

8. Tilt the left-hand side of the tank downwards as far as the remaining connected fuel pipe will permit, to give access to the fuel feed pipe connection and electrical terminals at the fuel pump.
9. With assistance from someone supporting the tank, disconnect the fuel feed pipe and electrical leads.
10. Carefully lower the tank and place on a suitable workbench.
11. Plug the ends of the fuel feed pipe and fuel pump to prevent ingress of dirt.

Remove the fuel pump

12. Remove the five screws and washers securing the pump in the tank.
13. Withdraw the fuel pump and sealing washer from the tank.

Fit the fuel pump

14. Ensure the area around the fuel pump aperture in the tank is free from dirt and grease.
15. Fit the pump and a NEW sealing washer to the tank, secure the pump in position.

Fit fuel tank

16. With assistance offer up the fuel tank to the chassis, remove the plugs from the fuel pipes and re-connect the hose to the pump. Re-connect the electrical leads.
17. Secure the tank to the chassis and refit all hoses and pipes.
18. Connect the battery, turn ignition on and check for fuel leaks at all hose and pipe connections.

V8 ENGINE CARBURETTER FAULT DIAGNOSIS		
SYMPTOM	POSSIBLE CAUSE	CURE
DIFFICULT STARTING WHEN COLD	Insufficient choke action	Check action of cold start unit to ensure that the choke is being applied fully—adjust choke cable. Check position of cold start adjuster—move outward.
	Fast idle adjustment incorrect	Check and adjust fast idle setting. Check linkage between choke and throttle for distortion.
	Float chamber level too low	Check needle valve for sticking—(closed). Check float level setting. Check inlet connection filter for blockage. Check external fuel system in accordance with fuel system fault diagnosis.
	Carburetter flooding	Check needle valve for sticking—(open). Float punctured. Fuel pump pressure too high. Float level too high.
	No fuel supply to carburetter	Check filters and pump for blockage. Check fuel tank breather and fuel lines for blockage. Remove fuel pump and check operation. Overhaul or fit new pump.
	No oil in damper or oil too thin	Check level of oil in damper, and fill to correct level with oil of a viscosity of S.A.E. 20.
DIFFICULT STARTING WHEN HOT	Choke sticking 'on'	Check to ensure choke is returning to fully 'off' position; reset as necessary.
	Blocked air cleaner	Fit new air cleaner elements.
	Float chamber level too high	Check float level setting. Check float arms for distortion. Check needle valve for sticking. Punctured float, fuel pump pressure too high.
LACK OF ENGINE POWER	No oil in damper or oil too thin	Check level of oil in damper, and fill to correct level with oil of a viscosity of S.A.E. 20.
	Air valve sticking	Check air valve assembly moves freely and returns under spring load—centre jet assembly. Check diaphragm for cracks or porosity.
	Water in fuel	If water is present in float chamber, the complete fuel system should be drained, fuel components should be dismantled, inspected for contamination, paying particular attention to filters.
ERRATIC SLOW RUNNING OR STALLING ON DECELERATION	Float level too low	Check float chamber level. Check for needle valve sticking.
	Incorrect jet setting	Check and reset jet settings in accordance with carburetter overhaul instructions.
	Carburetter air leaks	Check throttle spindle and bearings for wear.
	Manifold air leaks	Check inlet manifold gasket for leakage. Check inlet manifold for cracks and distortion of mating faces. Check gasket between carburetter and manifold. Check condition of vacuum advance pipe and connections. Check vacuum servo pipes and connections.
	Damper oil too thick. No oil in damper	Check and refill to correct level with oil specified.
	Air valve sticking	Check air valve assembly moves freely and returns under spring load—centre jet assembly. Check diaphragm for cracks or porosity.
EXCESSIVE FUEL CONSUMPTION	Blocked air cleaner	Fit new air cleaner elements.
	Damper oil too thick	Replace with correct grade.
	Incorrectly adjusted carburetter	Check and reset slow running in accordance with carburetter tune and adjust instructions.
	Float level too high	Check and reset float level.
	Incorrect needle	Check needle type.
	Worn jets and needle	Check and replace as necessary.
	Choke sticking 'on'	Check to ensure choke is returning to fully 'off' position, reset as necessary.
	Engine fault	See 'Engine Fault' diagnosis.