1974-79 FUEL SYSTEMS
Lucas Electronic Fuel Injection

Jaguar: 1975-79 All Models

DESCRIPTION

Lucas Manifold Pressure Controlled (MPC) fuel injection system is a pulsed, port injection system with one injector per cylinder. The amount of fuel injected depends upon engine load, speed and atmospheric pressure. Manifold Pressure Control (MPC) regulator measures the amount of pressure differential in the intake manifold and transmits an electric signal to Electronic Control Unit (ECU). This signal modifies all other signals sent to ECU by the other sensors.

The ECU electronically analyzes all sensor information and transmits a signal to the injectors, which determines the amount of time each injector will be open. This Bosch electronic injection system consists of three sub-assemblies; fuel delivery, air induction system, and electronic sensing and control.

Major components of fuel delivery system include: fuel vibration damper, fuel pump, change-over valves, fuel rails, injectors, fuel pressure regulator, fuel cooler and fuel filter. Major components of the electronic sensing and control system are: ECU, power amplifier, thermo-time switch, incoming air and engine coolant temperature sensors, cold start injector valve, MPC sensor, throttle switch, distributor trigger unit, main relay, and pump relay.

ADJUSTMENTS

FUEL PRESSURE REGULATOR

NOTE: Fuel pressure regulator should only be adjusted after complete system has been thoroughly checked.

1) Remove bolts securing pressure regulators to intake manifold. Crimp off fuel line between "B" bank pressure regulator inlet and fuel rail. Loosen hose clamp securing left-hand cold start injector supply line to fuel rail and remove line from rail. Connect pressure gauge to fuel rail and tighten hose clamp.
2) Start engine and loosen lock nuts on both pressure regulators. Set adjusting bolt on bank "A" regulator, until pressure gauge reads 29.6 psi (2.1 kg/cm²). Release crimp on "B" bank regulator and transfer to "A" bank regulator. Set adjusting bolt on "B" bank regulator to read 29.6 psi (2.1 kg/cm²) on pressure gauge.
3) Release crimp on "A" bank inlet line to pressure regulator, tighten lock nuts on both regulators and install bolts securing both pressure regulators to intake manifold. Switch off ignition, depressurize fuel system and remove pressure gauge. Switch on ignition and check for leaks.

THROTTLE SWITCH

1) Disconnect battery, remove cross-rods from throttle pulley, and pull connector off throttle switch. Remove 4 nuts and washers securing throttle pulley plate to throttle pedestal and lift plate clear. Loosen 2 screws securing throttle switch. Insert a .050" (1.27 mm) feeler gauge between pulley and closed throttle stop.
2) Connect ohmmeter between terminals No. 12 and 17 of throttle switch. Turn throttle switch slowly until meter just indicates very high resistance. Tighten 2 screws securing throttle switch. Remove feeler gauge. Ohmmeter should read very low resistance when pulley is against closed stop. Reassemble and adjust throttle linkage, if necessary.

THROTTLE LINKAGE

1) To determine whether or not throttle linkage needs adjusting, make sure throttle return springs are correctly attached. Check that throttle pulley moves freely, coming to rest against the closed stop position. Check that throttle butterfly valve (closed) stop position screw has not been moved.
2) Check that throttle pulley can be rotated to full open position and that throttle butterfly valve arm is touching the throttle housing. If linkage position is not as specified, then it will be necessary to adjust the throttle linkage.

NOTE: If throttle valve stop screw has been tampered with, perform throttle linkage adjustment procedure until after the throttle valves have been properly adjusted.

3) To do so, release throttle cross-rods from throttle pulley. Loosen clamps securing levers to rear of throttle shafts. With butterfly valves closed against their stops, relay arm against its stop and play in coupling taken up in opening direction, tighten clamp-to-lever on rear of throttle shaft. Repeat this operation for the other side of engine.
4) Now try to refit cross-rods to ball connectors on pulley. Rods must fit on ball connectors without moving pulley or linkage. If rods will not fit without moving pulley or linkage, loosen lock nut on cross-rods and adjust length of rod until attachment can be accomplished without moving any part of linkage. Tighten lock nuts and make sure ball joints remain free.
5) Loosen lock nut on throttle pulley and back out stop screw to full extent of travel. Hold throttle relay arm pulley fully open and check that butterfly stop arms are against throttle housing. Adjust stop to just touch throttle pulley and tighten lock nut. Check operation of throttle switch and kickdown switch.

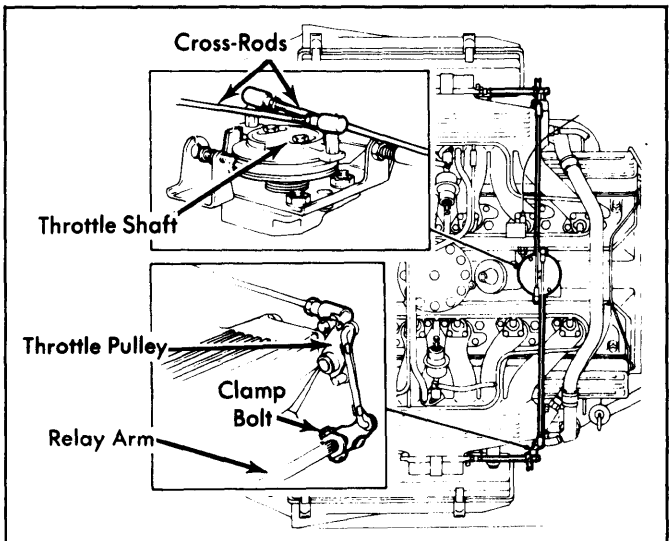

Fig. 1: Throttle Linkage Adjustment

THROTTLE VALVES

1) Remove both air cleaners, loosen lock nut on throttle butterfly stop screw and turn in screw until throttle valve is completely closed. Insert a .002" (.05 mm) feeler gauge between top of valve and housing, to hold valve open. *See Fig. 2.*
2) Set stop screw to just touch stop arm and tighten lock nut with feeler gauge still in position. Press stop arm against stop screw and withdraw feeler gauge. Repeat procedure on other side of engine. Seal threads of adjusting screws and install air cleaners.

NOTE: After adjusting throttle valves, check throttle linkage, operation of throttle switch and kickdown switch operation. Adjustment must be carried out on both throttle valves.

TESTING

FUEL PUMP

1) Turn ignition on. Fuel pump should run 1-2 seconds and then stop. Turn ignition off. If pump operates as described, end test procedure. If pump does not run or does not stop, go to next step.
2) Check inertia switch, located on right front kick panel, by removing screws attaching switch to kick panel and checking that both cables are secure. Pull cables off switch and check continuity across switch terminals.

1974-79 FUEL SYSTEMS
Lucas Electronic Fuel Injection (Cont.)

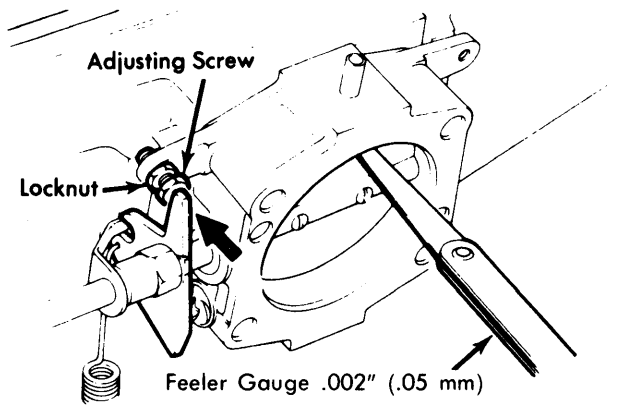

Fig. 2: Throttle Valve Adjustment

3) Pull switch button out and check that an open circuit exists. Push button inward and check that resistance is either zero or less than 5 ohms. If inertia switch is okay, go to next step.
4) Ground pump relay terminal No. 85 and turn ignition on. *See Fig. 3.* Use a voltmeter to check voltage at terminal No. 86 on main relay. If battery voltage is present, faulty pump or bad ground connection is indicated.
5) If no voltage is present, check voltage at terminal No. 87 on main relay. If voltage is present, a bad ground connection is indicated. If no voltage is present, faulty switch or wiring connection is indicated. If switch and wiring connections are okay, replace main relay.
6) Check for voltage at terminal No. 86 of fuel pump relay. If battery voltage is indicated, wire and connections between main relay and pump relay are okay. If no voltage, check wire from terminal No. 87 of main relay to terminal No. 86 on fuel pump relay. Repair if necessary.
7) Check for battery voltage at terminal No. 87 of fuel pump relay. If voltage is indicated, pump relay is okay. If no voltage, check for battery voltage between terminal No. 85 and ground on pump relay. If battery voltage is indicated, replace fuel pump relay.

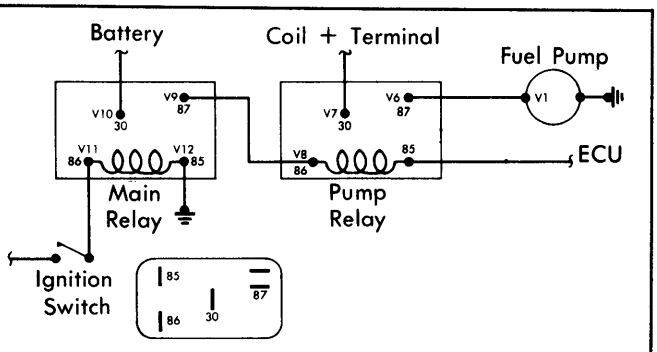

Fig. 3: Fuel Pump Wiring Schematic

FUEL PRESSURE REGULATOR

1) Depressurize fuel system. Loosen pipe clamp securing left-hand cold start injector to fuel rail and pull pipe from rail. Connect pressure gauge to fuel rail and tighten pipe clamp.
2) Pull negative "VE" lead from ignition coil and switch on ignition. Connect pump relay terminal 85 to ground. Check pressure gauge reading, it should be 28.5-30 psi. Remove ground connection to terminal No. 85 of fuel pump relay.
3) If satisfactory pressure readings are not obtained, it will be necessary to either adjust the pressure regulator or repair the leak-down condition, before proceeding with test procedure.
4) If satisfactory results were obtained, loosen pipe clamp and remove pressure gauge from fuel rail. Reconnect cold start injector supply pipe and tighten pipe clamp. Switch off ignition.

NOTE: Pressure reading may drop slowly though either regulator valve or pump non-return valve. A slow steady drop is permissible, but a fast drop should be investigated.

MANIFOLD PRESSURE CONTROL VALVE

Unplug pressure control valve connector. Use an ohmmeter to check resistance between terminals No. 7 and 15. Resistance should be 85-95 ohms. Check resistance between terminals No. 8 and 10. Resistance should be 346-354 ohms. Check resistance between all terminals and ground. Resistance should be infinity. If readings are incorrect, replace manifold pressure control valve. *See Fig. 4.*

INJECTORS

Injector Windings - 1) Use ohmmeter to measure resistance of each injector winding. This can be accomplished by disconnecting electrical connection to each injector and measuring across both terminals. Resistance should be 2.4 ohms at 68°F (20°C).
2) Now check for short circuit between windings and ground by connecting ohmmeter from injector terminals to ground (injector body). Resistance should be infinity. If injector fails either of these tests, replace injector.
Electrical Pulses & Cable - 1) Injectors are connected in groups to power amplifier and each group is divided into parallel sets of 3. *See Fig. 5.*
2) Disconnect coolant temperature sensor and terminal No. 85 of fuel pump relay. Disconnect injectors and connect a test light across terminals of each injector plug, start with injector at cylinder "1A".
3) Crank engine. Test light should flash as amplifier pulses. Repeat test for all injectors in first set, before continuing with second set of Group 1, then test Group 2. If only one injector test result is incorrect, check for faulty connection of that injector.
4) If all 3 injector test results in same set are incorrect, either amplifier is faulty or faulty connection is indicated. If all 6 injector test results are incorrect, defect could be faulty connection of cable, bad amplifier or bad ECU.

INJECTOR TEST GROUPS

Group 1		Group 2	
1A	6B	6A	1B
5A	2B	2A	5B
3A	4B	4A	3B

COLD START INJECTORS

1) Remove cold start injector valves from intake manifold. Place suitable container beneath each cold start valve, to catch discharged fuel. Disconnect negative "VE" connection at ignition coil.
2) With engine temperature below 58°F (15°C), turn ignition on. Check that injectors do not leak. Crank engine 1-2 revolutions and make sure that injectors spray fuel. If injectors operate, end test procedure. If any injectors fails to operate properly, go to next step.
3) Check for battery voltage at test point "V1" of cold start injectors. If battery voltage is present when cranking engine and injectors still do not spray, check electrical connections to each injector.
4) If both positive and negative connections are okay, the injector is bad and should be replaced. If no voltage was present at test point "V1", check for voltage at test point "V2". *See Fig. 6.*
5) If voltage is present at test point "V2", check cables between cold start injector relay and cold start injectors. If no voltage is present, check for voltage at test point "V3".
6) If no voltage is present at test point "V3", check supply voltage from fuel pump relay. If voltage is present at test point "V3", cold start relay is not functioning properly. Check for voltage at test point "V4".
7) If no voltage is present at "V4", check supply voltage from starter relay. If voltage is present at "V4", disconnect terminal No. 85 of cold start relay and check for voltage at terminal No. 86.
8) If no voltage is present at terminal No. 86, replace relay. If voltage is present, connect terminal No. 85 to ground and relay should energize. Now check voltage at terminal No. 87.

1974-79 FUEL SYSTEMS
Lucas Electronic Fuel Injection (Cont.)

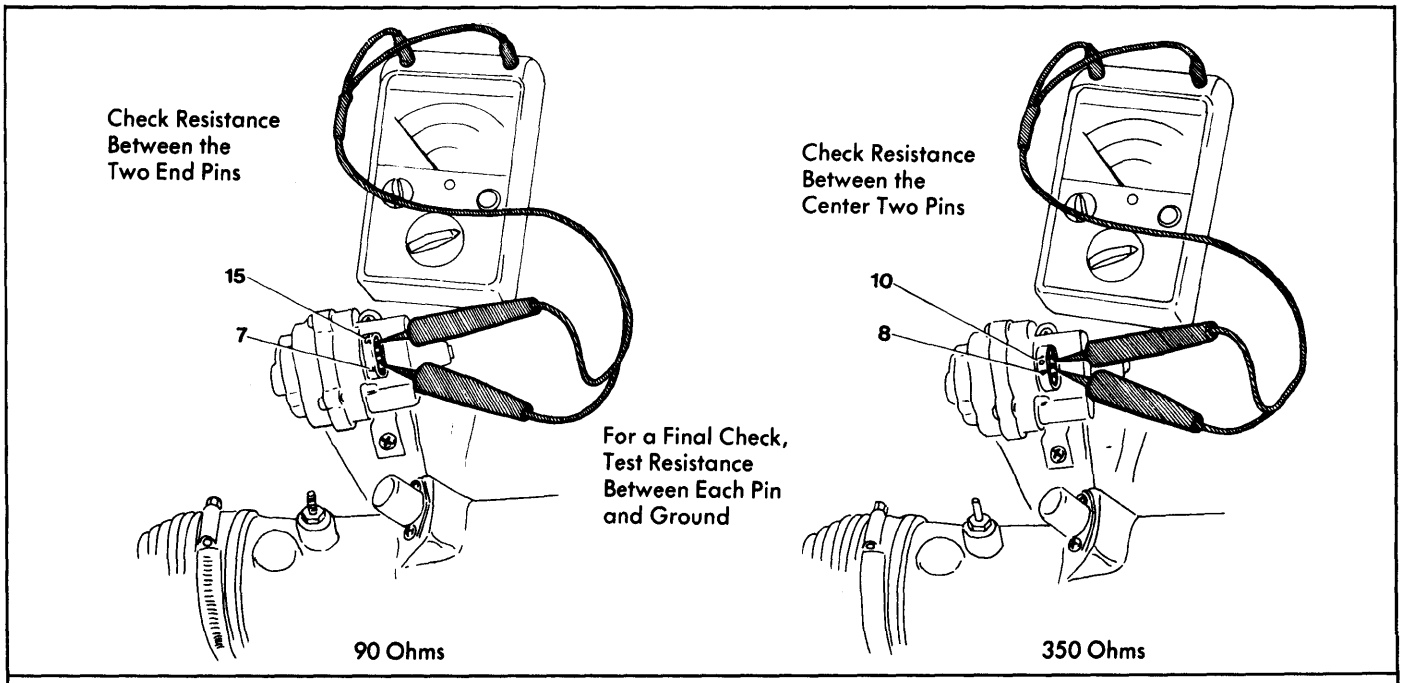

Fig. 4: Manifold Pressure Control Valve Test

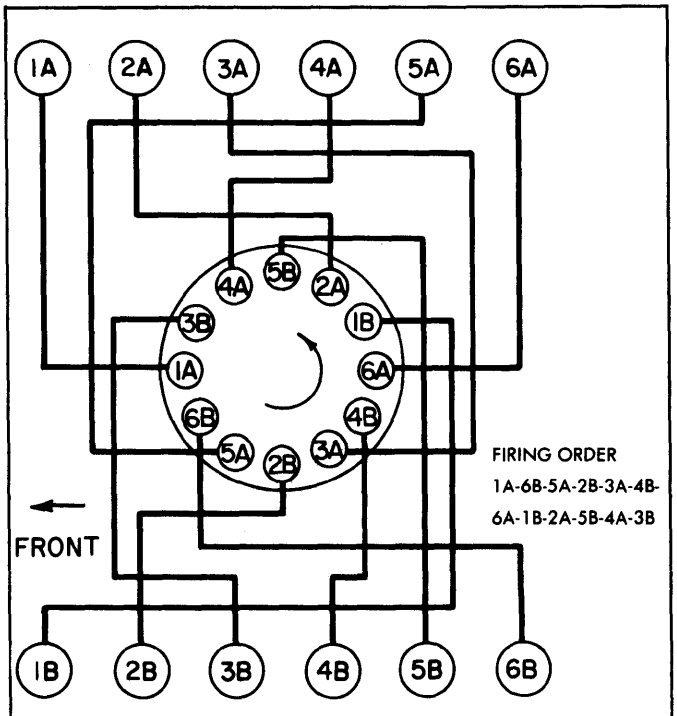

Fig. 5: V12 Engine Firing Order

9) If no voltage is present at terminal No. 87, replace relay. If voltage is present, check cable and connections to thermo-time switch. If cables are in good condition and making proper connections, go to next step.

10) Replace cold start injectors and all cables and connections. Crank engine and check for voltage at terminal No. 87. Voltage at terminal No. 87 should be zero volts.

11) If voltage is present at terminal No. 87, disconnect terminal No. 85. Crank engine and recheck for voltage at terminal No. 87. If terminal No. 87 has no voltage, thermo-time switch should be replaced. If voltage is present at terminal No. 87, replace relay.

NOTE: If injectors spray fuel while voltage at terminal No. 87 is zero, injector should be replaced.

COOLANT TEMPERATURE SENSOR

Disconnect battery and pull connector from sensor. Connect ohmmeter between sensor terminals and note resistance reading. Compare reading obtained with COOLANT TEMPERATURE SENSOR SPECIFICATIONS table. Check each terminal to ground and make sure resistance is infinity. *See Fig. 7.*

COOLANT TEMPERATURE SENSOR SPECIFICATIONS

Temperature °F (°C)	Resistance (Ohms)
26 (-10)	9200
32 (0)	5900
50 (10)	3700
68 (20)	2500
86 (30)	1700
104 (40)	1180
122 (50)	840
140 (60)	600
158 (70)	435
176 (80)	325
194 (90)	250
212 (100)	190

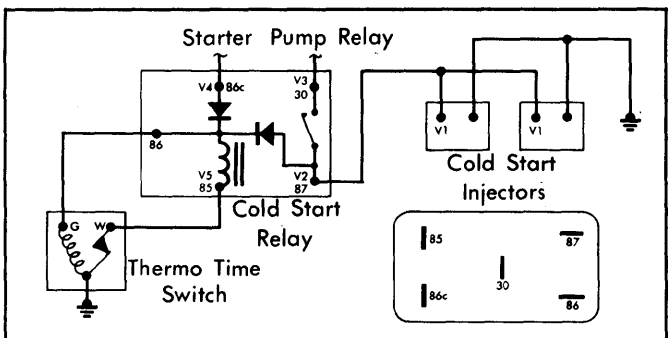

Fig. 6: Cold Start Injector Wiring Schematic

1974-79 FUEL SYSTEMS
Lucas Electronic Fuel Injection (Cont.)

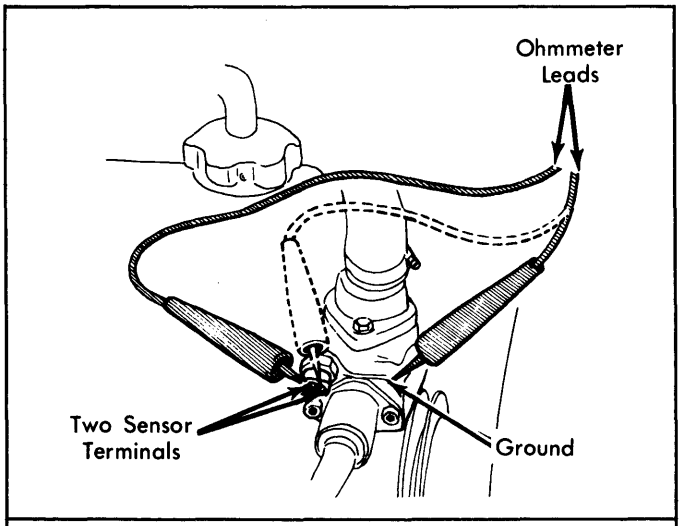

Fig. 7: Coolant Temperature Sensor Test

AIR TEMPERATURE SENSOR

Disconnect battery and pull electrical connector off sensor. Connect ohmmeter between sensor terminals and note resistance reading. Compare reading with AIR TEMPERATURE SENSOR SPECIFICATIONS table to determine whether or not sensor is functioning properly. If reading is outside range, replace sensor.

AIR TEMPERATURE SENSOR SPECIFICATIONS

Temperature °F (°C)	Resistance (Ohms)
26 (-10)	960
32 (0)	640
50 (10)	435
68 (20)	300
86 (30)	210
104 (40)	150
122 (50)	108
140 (60)	80

THROTTLE SWITCH

1) Ensure that throttle plates and throttle linkage are correctly adjusted. Disconnect battery ground cable and pull connector off throttle switch.

2) Connect ohmmeter between terminal No. 17 and ground. *See Fig. 8.* Meter reading should be very low resistance or zero. If reading is not very low, adjust throttle switch.

3) Connect ohmmeter between terminal No. 9 and ground. Observe ohmmeter and turn throttle by hand. Meter needle should swing smoothly between very low resistance and very high resistance (to point on open circuit). If meter does not swing smoothly, replace throttle switch.

AUXILIARY AIR VALVE

1) Remove auxiliary air valve and fully close adjustment screw. Immerse valve bulb in boiling water. With bulb immersed, watch valve action, through side port. Valve should move slowly to closed position. Apply air through a hose attached to side port; no air should pass.

2) Remove valve from boiling water and allow bulb to cool. Valve should move smoothly to open position. If valve does not operate as specified, it must be replaced. If valve action is acceptable, reset adjustment screw and install valve. *See Fig. 9.*

THERMO-TIME SWITCH

Unplug connector from thermo-time switch and use ohmmeter across terminals. Reading should be very low or zero ohms. Use stop watch and apply voltage to terminal "G" of switch. Compare delay time with THERMO-TIME SWITCH SPECIFICATIONS table. If time delay is clearly outside of specifications given in table, replace unit. *See Fig. 10.*

NOTE: If coolant temperature is above 50°F (10°C), connect ohmmeter between terminal "W" of switch and ground. Reading should be either very high or infinity.

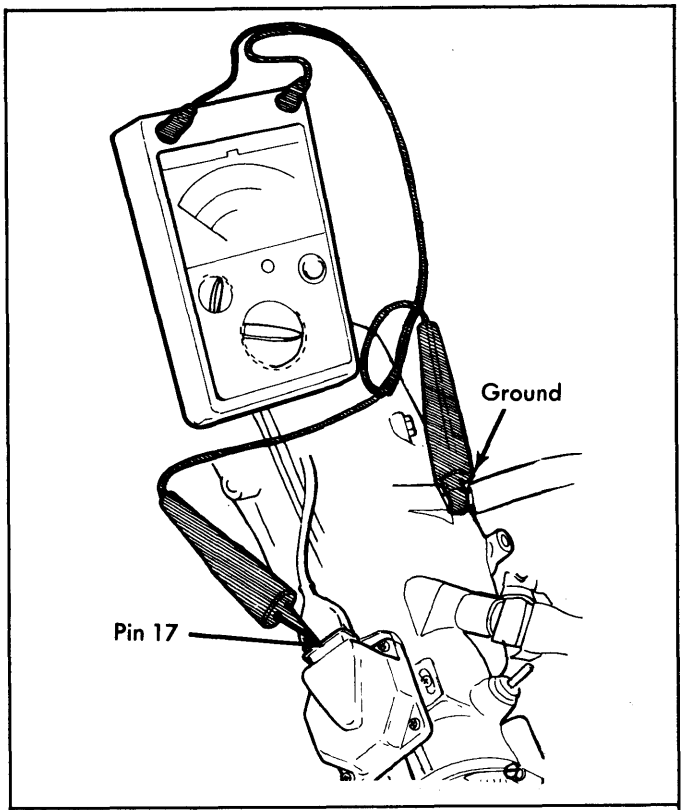

Fig. 8: Throttle Switch Test

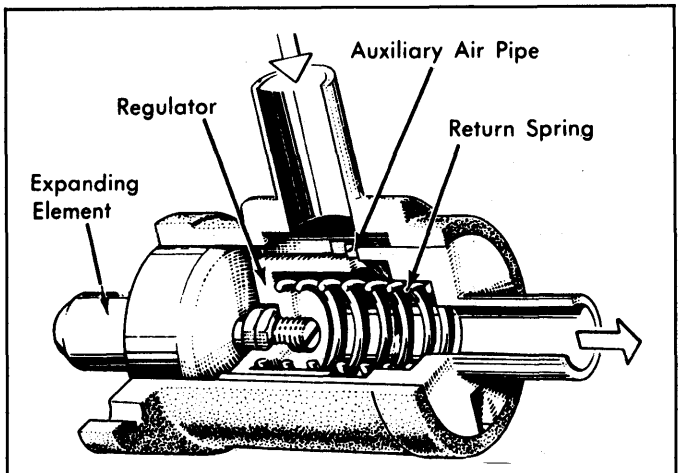

Fig. 9: Cutaway View of Auxiliary Air Valve

1974-79 FUEL SYSTEMS
Lucas Electronic Fuel Injection (Cont.)

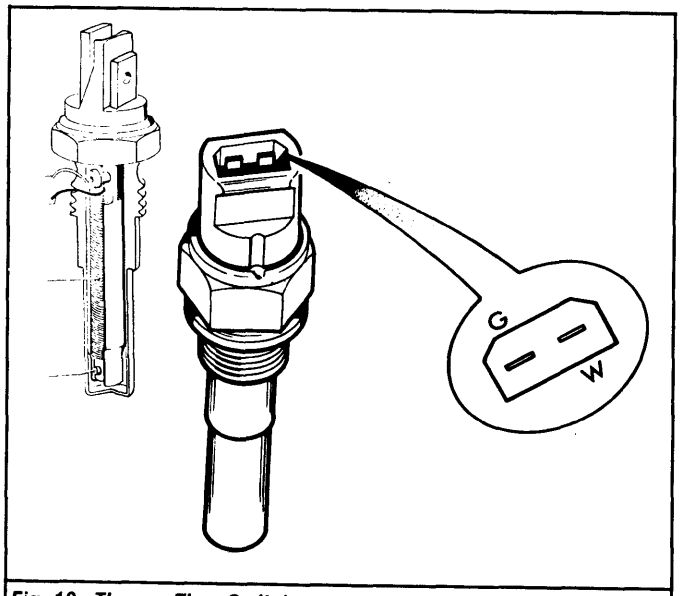

Fig. 10: Thermo-Time Switch

THERMO-TIME SWITCH SPECIFICATIONS

Temperature °F (°C)	[1] Delay 1 (Seconds)	[2] Delay 2 (Seconds)
-4 (-20)	8	8
26 (-10)	5.7	6.5
32 (0)	3.5	5
50 (10)	1.2	3.5
59 (15)	0	2.7
68 (20)	.....	2
86 (30)	.....	.5
95 (35)	.....	0

[1] - With 15°C stamped on switch body.
[2] - With 35°C stamped on switch body.

DISTRIBUTOR TRIGGER UNIT

1) Disconnect cable from fuel pump relay terminal No. 85. Disconnect negative "VE" terminal from ignition coil. Separate in-line connector to distributor trigger unit.
2) Connect ohmmeter between terminals No. 21 and 12 on distributor side of in-line connector. Crank engine. Ohmmeter should show even swing between low resistance (a current limiting resistor is fitted inside trigger unit) and very high resistance.
3) Connect ohmmeter to terminals No. 22 and 12, an identical result should be obtained. If meter reading remains steady during cranking or if the swing is uneven or intermittent, the trigger unit should be replaced.

REMOVAL & INSTALLATION

NOTE: Relieve fuel pressure when removing fuel system components. To do so, disconnect terminal No. 85 from fuel pump relay. Start and run engine for a few seconds until fuel pressure is reduced. Switch off ignition and reconnect cable to terminal No. 85 of fuel pump relay.

ELECTRONIC CONTROL UNIT

Removal & Installation - 1) Disconnect negative battery cable. Locate ECU in trunk compartment. On XJ12 models, remove ECU panel at front end of trunk (against rear seat panel). On XJS models, remove right side trunk trim panel.
2) Disconnect ECU retainer band or clamp. Remove cable clamp screws and clip. Remove end cover. Locate handle on cable harness plug and withdraw plug. To install, reverse removal procedure.

FUEL PRESSURE REGULATOR

Removal & Installation - 1) Relieve fuel pressure and disconnect negative battery cable. Locate fuel pressure regulators between the 3rd and 4th intake manifold runners on each side of engine.
2) Remove screws securing regulator bracket. Carefully lift regulator and bracket up, noting how regulator is installed in bracket (which line goes to pump and which goes to fuel rails).
3) Clamp fuel lines, then disconnect fuel lines from regulator. Remove regulator from bracket. To install, reverse removal procedure. Be sure to install regulator in bracket the same way it was removed.

MANIFOLD PRESSURE CONTROL VALVE

Removal & Installation - Locate manifold pressure control valve on top, left side of radiator. Disconnect battery and unplug connector from valve. Disconnect hose from valve and remove screws securing valve to bracket. To install, reverse removal procedure.

INJECTORS

Removal & Installation - 1) Relieve fuel pressure and disconnect negative battery cable. Clamp fuel line between filter and fuel rails. Unplug connector from injector(s) being removed.
2) Remove screws securing fuel rail to intake manifold, then release clips attaching supply fuel rail to return fuel rail. Remove the 12 screws attaching injectors to intake manifold.
3) Carefully lift fuel rail, with injectors, clear of intake manifold. Plug injector holes and wipe up any spilled fuel. Now disconnect injector(s) from fuel rail as needed.
4) As injector(s) are removed, note location of electrical socket for installation reference. To install, reverse removal procedure. Use new "O" rings on all injectors. Make sure the electrical plug is located in the same direction as removed.

COLD START VALVE

Removal & Installation - Relieve fuel pressure and disconnect negative battery cable. Clamp fuel line and remove electrical connector. Remove screws securing cold start valve(s) and remove valve(s). To install, reverse removal procedure.

COOLANT TEMPERATURE SENSOR

Removal & Installation - 1) Disconnect negative battery cable. Relieve pressure from cooling system by loosening radiator cap. Unplug connector from sensor.
2) Drain coolant or have replacement sensor ready to install the moment the old sensor is removed. Remove coolant temperature sensor. To install, reverse removal procedure. Apply sealer to threads of coolant sensor.

AIR TEMPERATURE SENSOR

Removal & Installation - 1) Locate air temperature sensor on left side of air cleaner. Unplug connector and remove sensor. To install, reverse removal procedure.

THROTTLE SWITCH

Removal & Installation - 1) Disconnect negative battery cable. Locate throttle switch beneath throttle pulley. Remove throttle cross-rods from throttle pulley. Unplug connector from switch.
2) Remove 4 nuts securing throttle pulley plate to throttle pedestal and lift plate clear. Remove 2 screws and washers securing throttle switch and remove switch from spindle.
3) To install switch, place switch on spindle so that connector socket faces to rear. To complete installation, reverse removal procedure. Be sure to adjust switch after installation.

1974-79 FUEL SYSTEMS
Lucas Electronic Fuel Injection (Cont.)

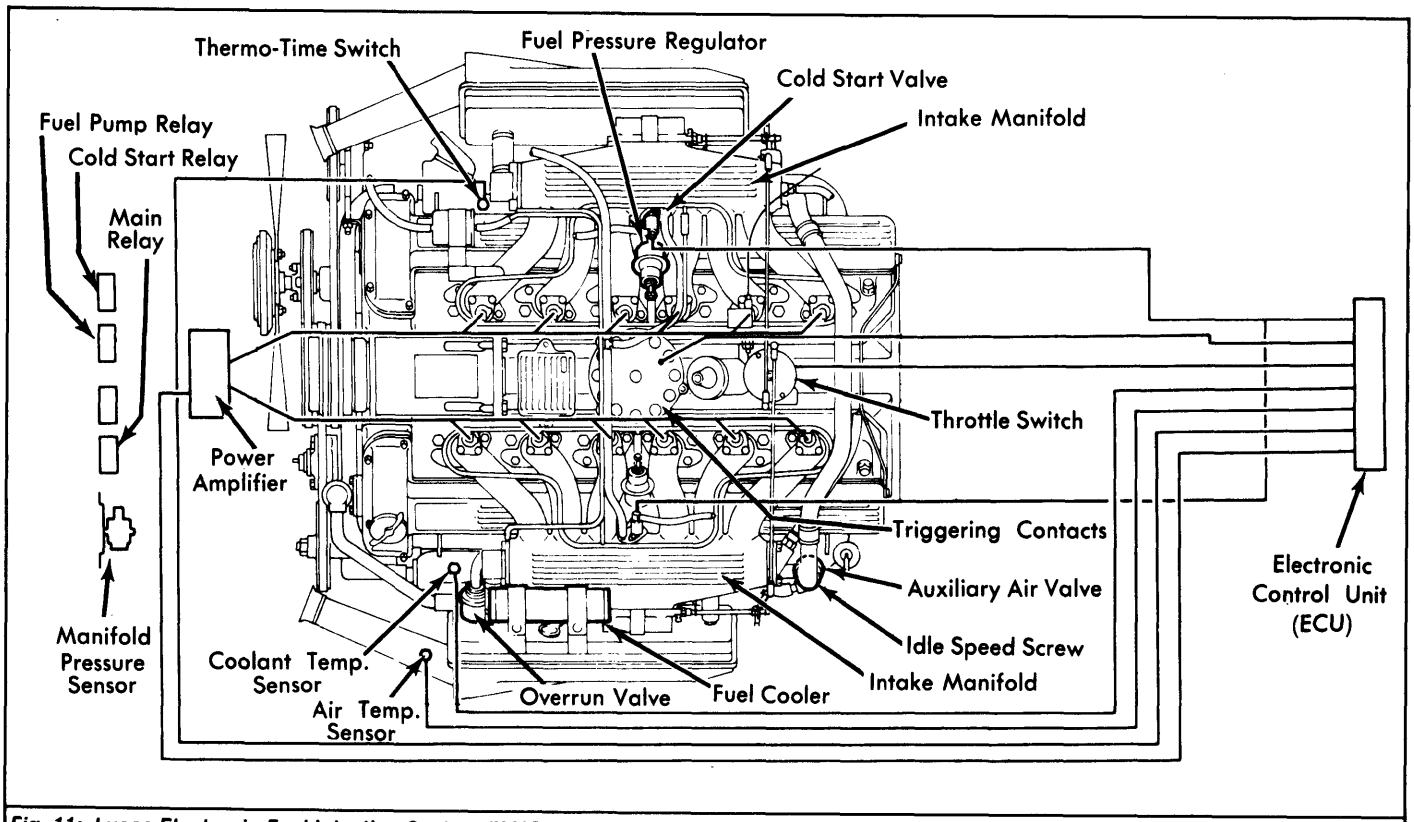

Fig. 11: Lucas Electronic Fuel Injection System (XJ12)

AUXILIARY AIR VALVE

Removal & Installation - **1)** Disconnect negative battery cable and relieve coolant pressure. Locate auxiliary air valve on left cylinder head, rear coolant pipe. Disconnect air hoses connected to air valve. **2)** Remove auxiliary air valve from coolant pipe. Clean gasket material from coolant pipe. Scribe a mark on adjusting screw and on air valve. Now count the number of turns it takes to fully seat adjusting screw. **3)** On the new auxiliary air valve, seat adjusting screw then turn out the same number of turns counted in step **2)**. To complete installation, reverse removal procedure.

THERMO-TIME SWITCH

Removal & Installation - Disconnect negative battery cable and relieve coolant pressure. Locate switch in thermostat housing. Unplug connector and remove switch. To install, reverse removal procedure. Apply sealer to threads of thermo-time switch. Make sure a new washer is installed on switch.

TRIGGERING CONTACTS

Removal & Installation - **1)** Disconnect negative battery cable. Separate manifold pressure sensor hose at "T" and set hoses aside. Mark spark plug wires and disconnect them from distributor cap or spark plugs. Remove distributor cap and rotor.

2) Remove 4 screws securing triggering contact plate to distributor housing. Remove triggering plate, disengaging the rubber grommet from distributor housing at same time. Disconnect triggering contact cable from pump relay. To install, reverse removal procedure.