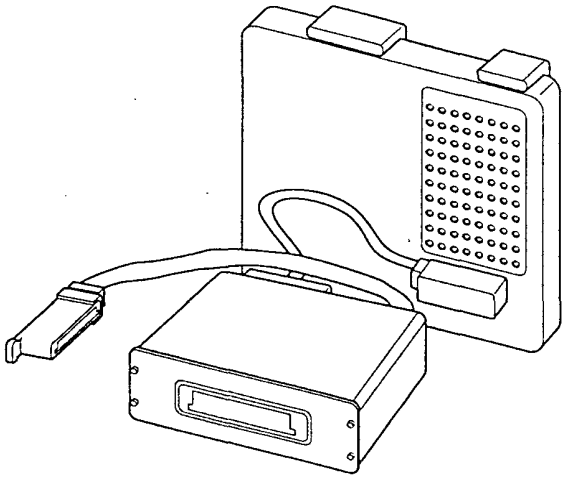
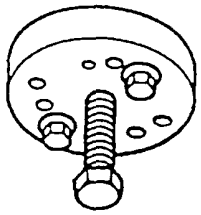
Special Tools

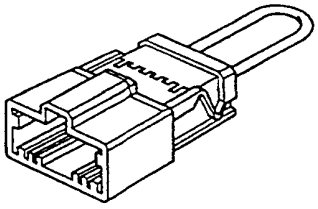
Ref. No.	Tool Number	Description	Q'ty	Remarks
①	HO 10042	Test Harness	1	VL–Churchill unique tool number
②	18G 1512B	Pull–off Device	1	
③	OZTAZ – ST30100	ABS Short Connector	1	



①



②

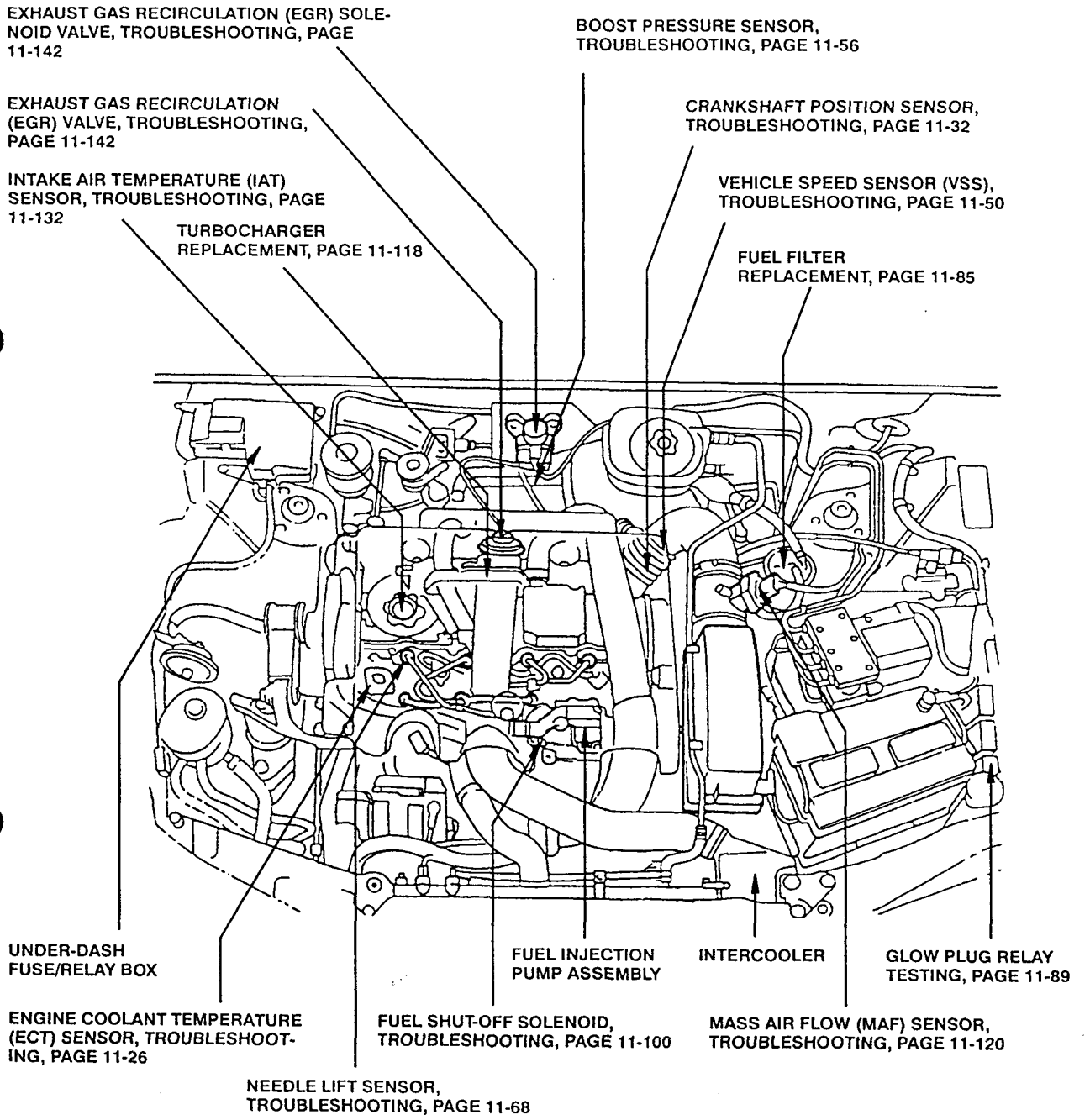


③

Component Locations

Index

Engine Compartment Component Locations

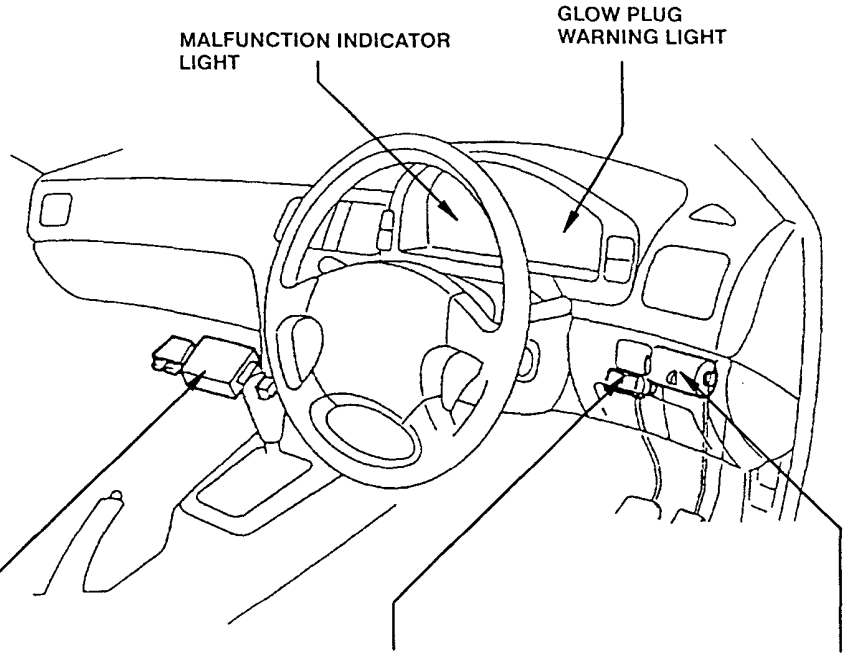


Component Locations

Index

Passenger Compartment Component Locations

RHD:

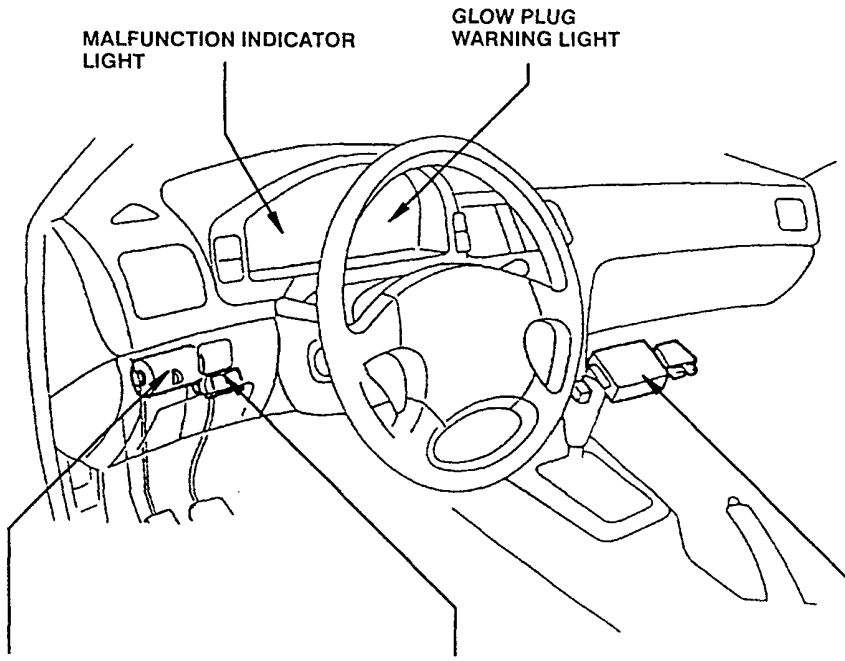


ENGINE CONTROL MODULE (ECM), TROUBLESHOOTING, PAGE 11-22

BRAKE LIGHT SWITCH TROUBLESHOOTING, PAGE 11-52

THROTTLE PEDAL POSITION SENSOR, TROUBLESHOOTING, PAGE 11-38

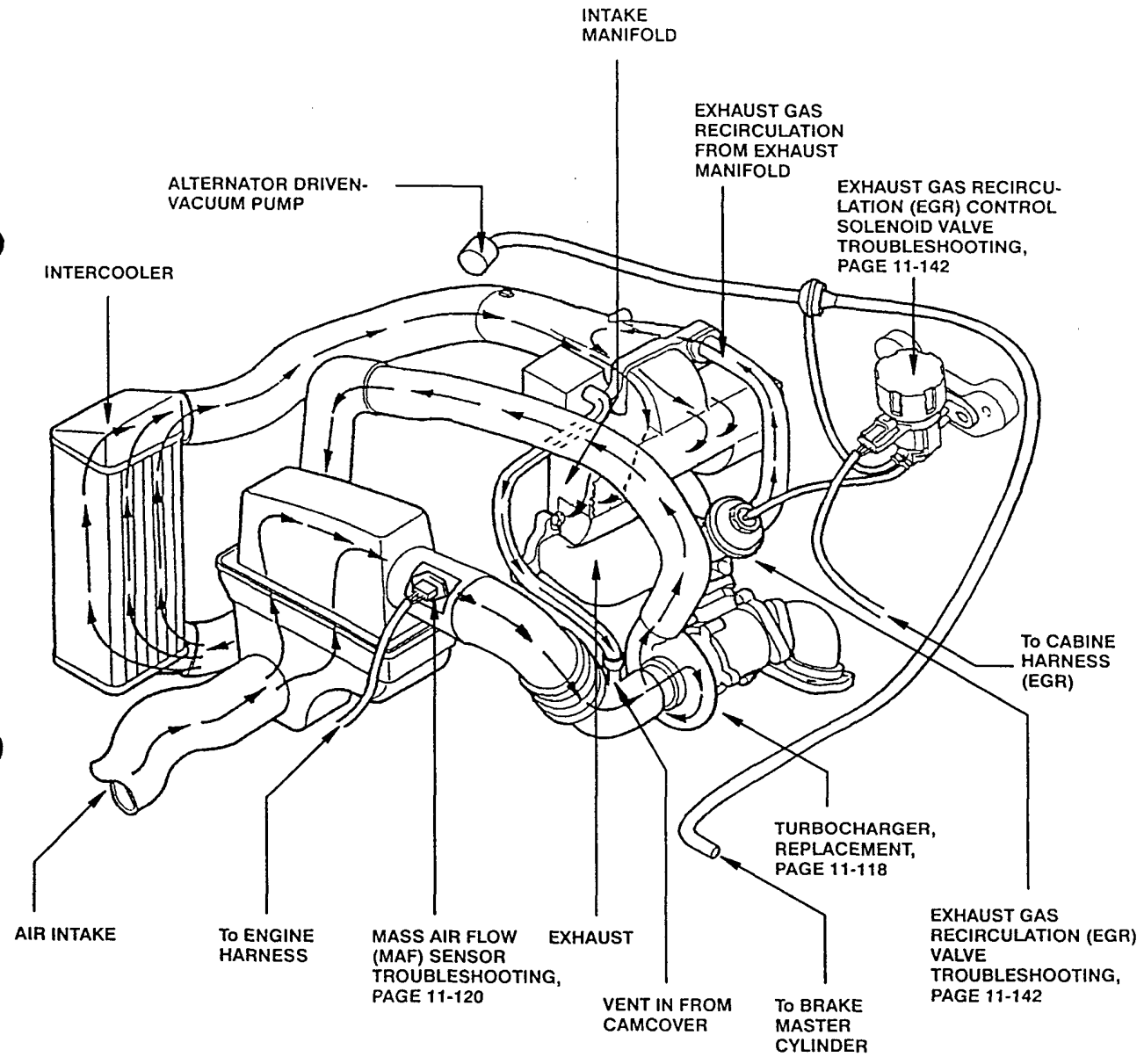
LHD:



THROTTLE PEDAL POSITION SENSOR, *TROUBLESHOOTING*, PAGE 11-38

BRAKE LIGHT SWITCH *TROUBLESHOOTING*, PAGE 11-52

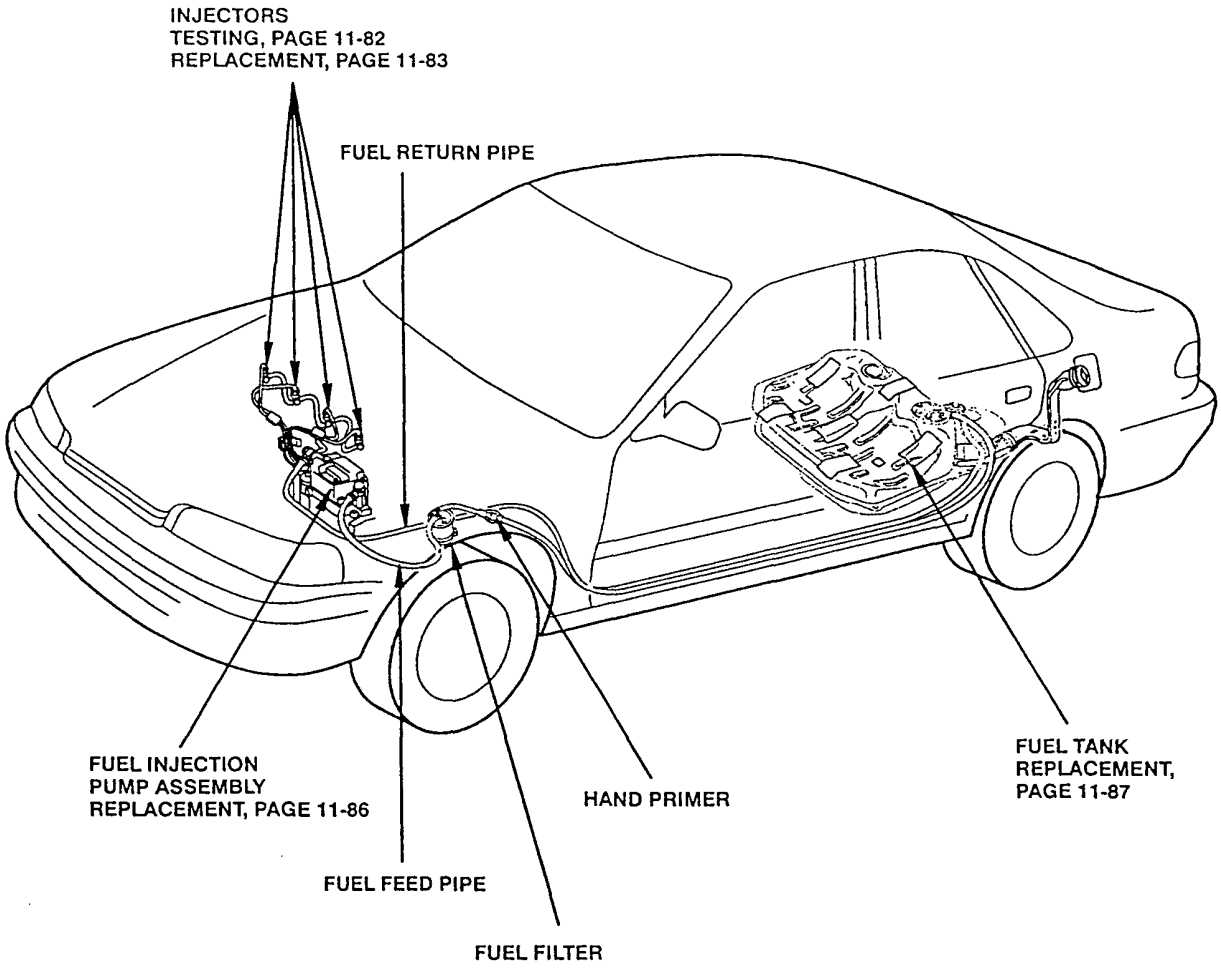
ENGINE CONTROL MODULE (ECM), TROUBLESHOOTING, PAGE 11-22


INTAKE MANIFOLD
EXHAUST GAS RECIRCULATION FROM EXHAUST MANIFOLD
ALTERNATOR DRIVEN-VACUUM PUMP
EXHAUST GAS RECIRCULATION (EGR) CONTROL SOLENOID VALVE TROUBLESHOOTING, PAGE 11-142
INTERCOOLER
To CABINE HARNESS (EGR)
TURBOCHARGER, REPLACEMENT, PAGE 11-118
AIR INTAKE
To ENGINE HARNESS
MASS AIR FLOW (MAF) SENSOR TROUBLESHOOTING, PAGE 11-120
EXHAUST
VENT IN FROM CAMCOVER
To BRAKE MASTER CYLINDER
EXHAUST GAS RECIRCULATION (EGR) VALVE TROUBLESHOOTING, PAGE 11-142

Compartment Locations

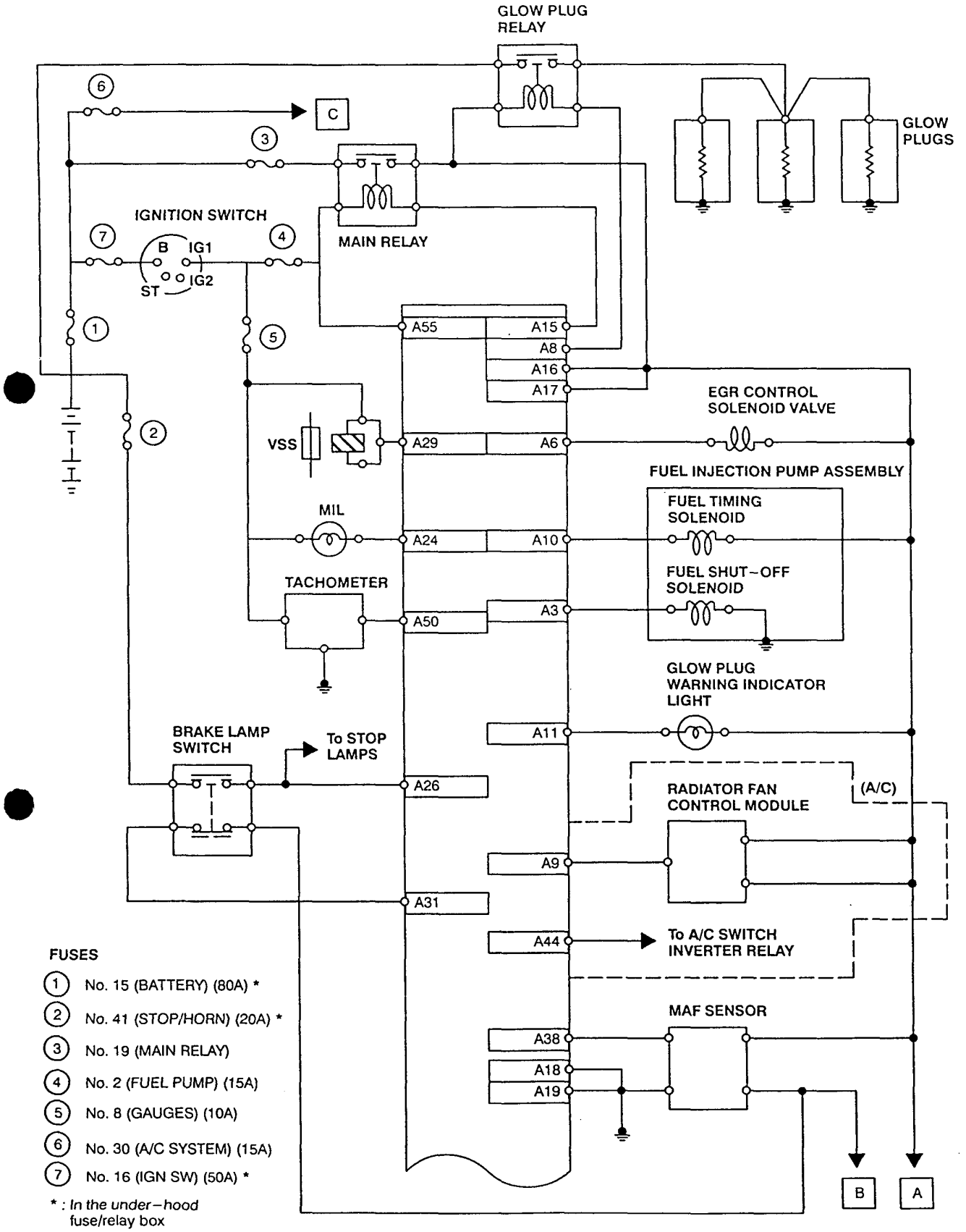
Index

Fuel Supply System



System Description

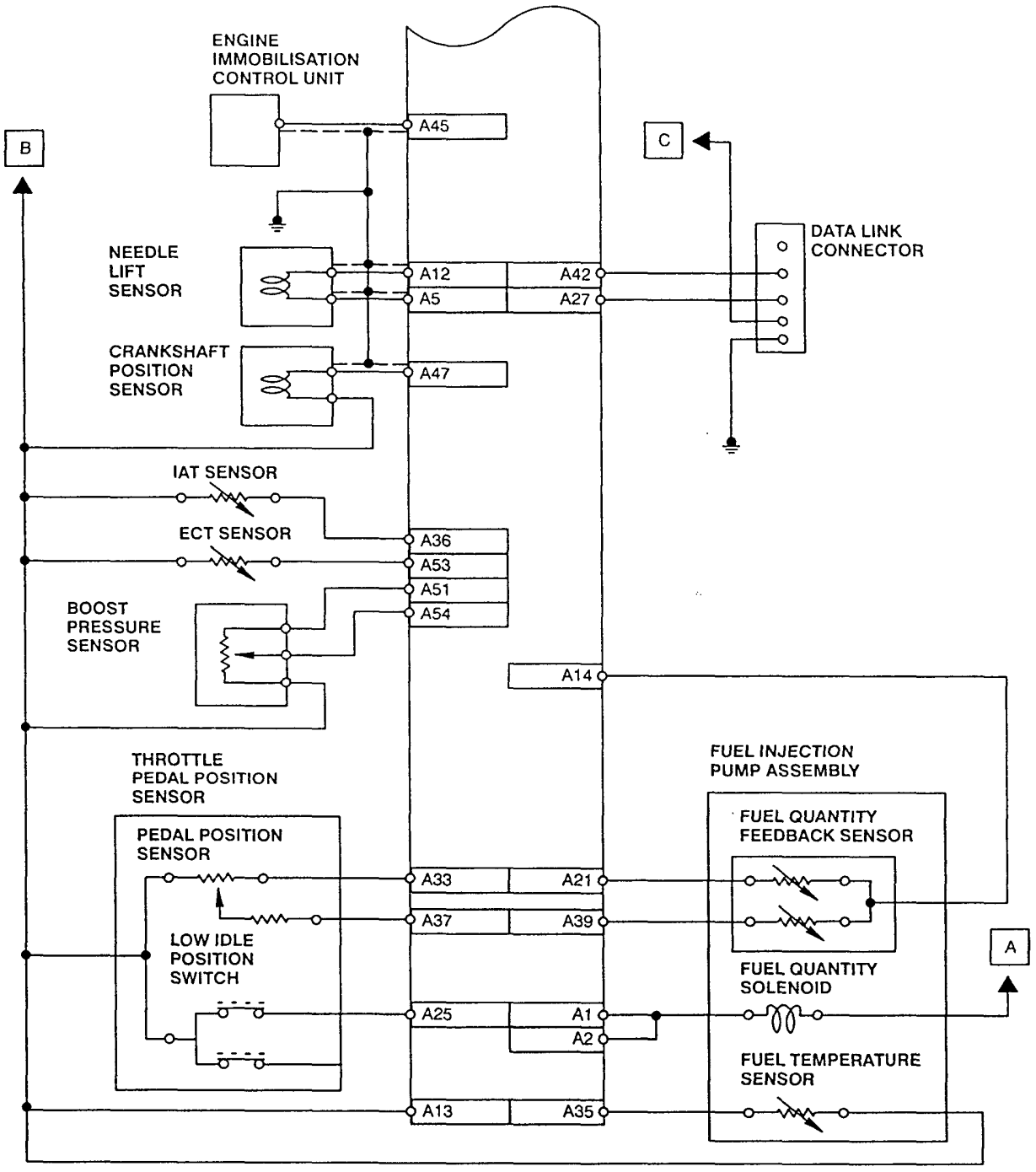
–Electrical Connections

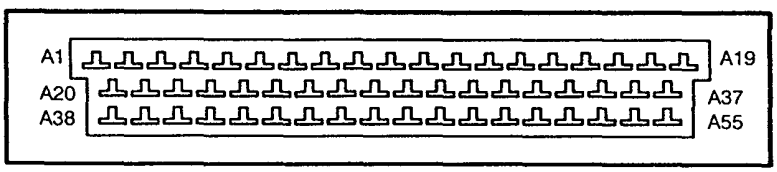


FUSES

1. No. 15 (BATTERY) (80A) *
2. No. 41 (STOP/HORN) (20A) *
3. No. 19 (MAIN RELAY)
4. No. 2 (FUEL PUMP) (15A)
5. No. 8 (GAUGES) (10A)
6. No. 30 (A/C SYSTEM) (15A)
7. No. 16 (IGN SW) (50A) *

* : *In the under–hood fuse/relay box*



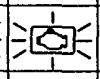
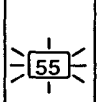
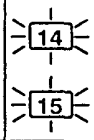
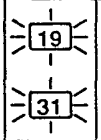
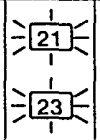
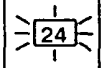
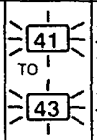
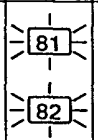


TERMINAL LOCATIONS

Troubleshooting

Troubleshooting Guide

NOTE: Across each row in the chart, the systems that could be sources of a symptom are ranked in the order they should be inspected starting with ①. Find the symptom in the left column, read across to the most likely source, then refer to the page listed at the top of that column. If inspection shows the system is OK, try the next most likely system ②, etc.

PAGE / SUBSYSTEM / SYMPTOM		MAIN RELAY	ENGINE MANAGEMENT SYSTEM								FUEL SUPPLY SYSTEM		
			ECM	ENGINE COOLANT TEMPERATURE SENSOR	CRANKSHAFT POSITION SENSOR	THROTTLE PEDAL POSITION SENSOR	VEHICLE SPEED SENSOR	BRAKE LIGHT SWITCH	BOOST PRESSURE SENSOR	NEEDLE LIFT SENSOR	FUEL SUPPLY SYSTEM	FUEL PUMP	FUEL INJECTION PUMP ASSEMBLY
		11-20	11-22	11-26	11-32	11-38	11-50	11-52	11-56	11-68	11-88	11-86	11-86
MALFUNCTION INDICATOR LAMP (MIL) TURNS ON													
MALFUNCTION INDICATOR LAMP (MIL) BLINKS													
ENGINE WON'T START	EMITS BLACK SMOKE												
	EMITS WHITE SMOKE												
	NO SMOKE APPARENT	①	⑥								③		
ENGINE STARTS, BUT STALLS ALMOST AT ONCE											①		
LOSS OF POWER				⑤	⑤	⑤							
LOSS OF POWER, ABNORMAL FUEL CONSUMPTION AND EXHAUST SMOKE				⑤									⑥
MISFIRING, UNEVEN RUNNING						③					②		④
MAXIMUM REV/MIN TOO LOW						⑤					④		
MAXIMUM REV/MIN TOO HIGH													
COMPRESSED AIR LEAK (BLOWING)													
KNOCKING IN ENGINE													②

FUEL SUPPLY SYSTEM								AIR INTAKE SYSTEM			EMISSION CONTROL SYSTEM	
FUEL FILTER	INJECTORS	FUEL TIMING SOLENOID	FUEL QUANTITY SOLENOID	FUEL QUANTITY FEEDBACK SENSOR	FUEL SHUT-OFF SOLENOID	FUEL TEMPERATURE SENSOR	GLOW PLUGS/ COLD STARTING SYSTEM	MASS AIR FLOW SENSOR	AIR CLEANER	TURBOCHARGER	EXHAUST-GAS RECIRCLATION (EGR) CONTROL SOLENOID	EXHAUST GAS RECIRCLATION (EGR) VALVE
11-85	11-81	11-98	11-112	11-104	11-100	11-92	11-89	11-120	11-116	11-118	11-142	11-142
			64	61 62	54	16 17		27 TO 29			33	33
	②	③	④						①	⑤		
		②					①					
②			⑤	⑥	④							
②		③	④									
②	①	③							④	⑥		
	②	③							①			④
	①											
③	②	①							①			
		①	②				②					
	①											
	③	①										

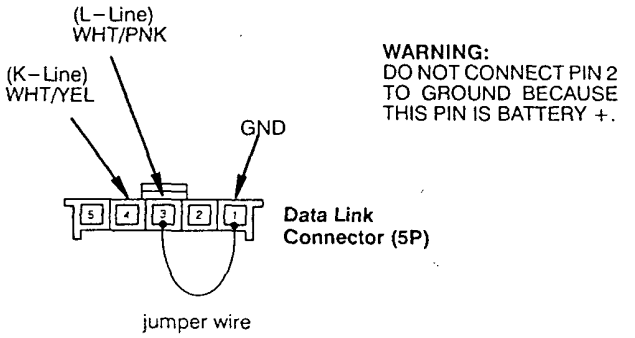
Self–diagnostic Procedures

I. When the Malfunction Indicator Lamp (MIL) has been reported on, do the following:

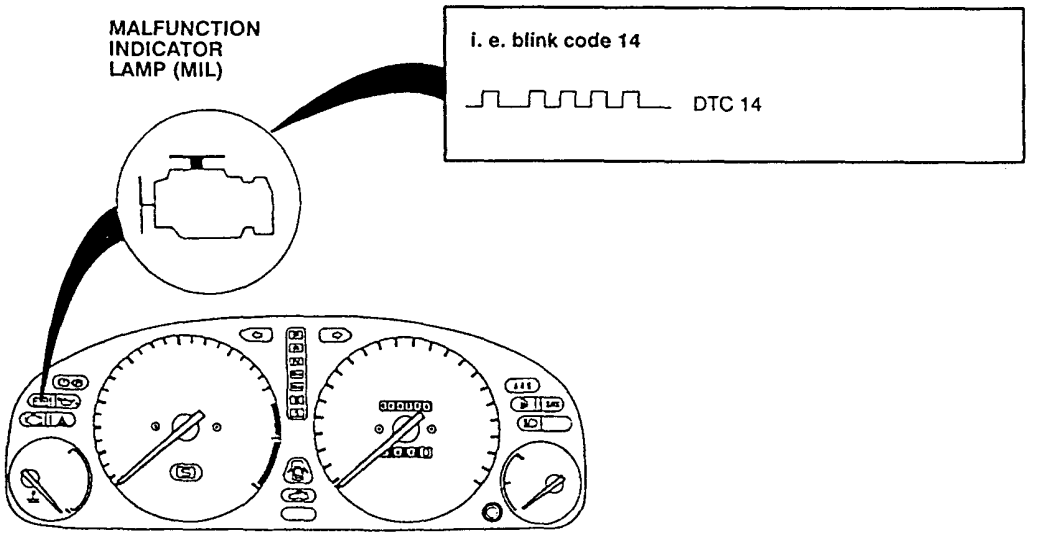
a) Procedure with PGM–Tester:
Connect the PGM–Tester with the 5P Data Link Connector (DLC) located under the dash on the driver's side of the car.
The PGM–Tester will display the trouble code.

b) Procedure without PGM–Tester:

Connect the Data Link Connector terminal 3 (L–Line) to terminal 1 (GND) with a jumper wire as shown or with ABS short–Connector (the Data Link Connector (5P) is located under the dash on the driver's side of the car). Turn the ignition switch on.



II. Note the Diagnostic Trouble Code (DTC): the MIL indicates a failure code by a number of blinks until the jumper wire is removed from the DLC (5P). Each blink code is indicated three times in succession, beginning with blink code 12 (initialisation code–OK).



III. Engine Control Module (ECM) Reset Procedure:

1. Turn the ignition switch off.

Reset Procedure:
If the PGM–Tester is available please use the PGM–Tester and follow the instructions in its manual for resetting the ECM.

If the PGM–Tester is not available please follow the instructions below:
Reset the ECM by switching on and off the ignition switch approximately 50 times.

IV. Final Procedure (this procedure must be done after any troubleshooting)

1. Remove the jumper wire.

NOTE: If the service check connector is jumped the MIL will stay on.

2. Do the ECM Reset Procedure.

(cont'd)

3/12

Troubleshooting

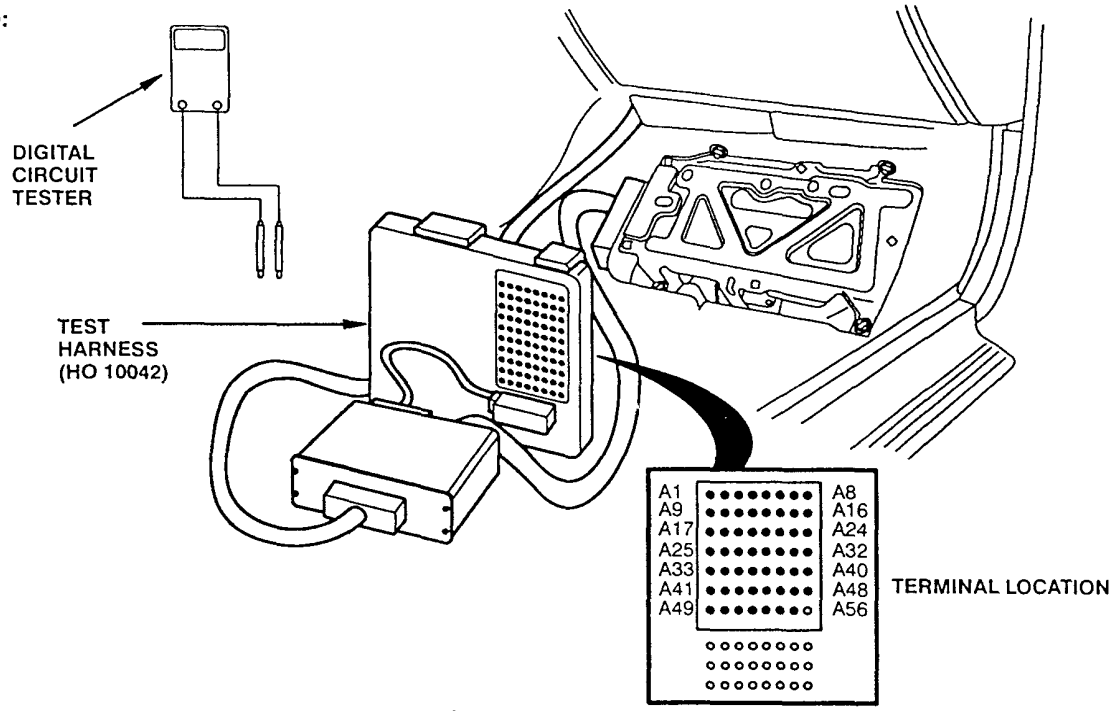
Self-diagnostic Procedures (cont'd)

DIAGNOSTIC TROUBLE CODE (DTC)	SYSTEM INDICATED	PAGE
12	INITIALISATION CODE – OK	—
14	ENGINE COOLANT TEMPERATURE SENSOR – BELOW SETPOINT	11-26
15	ENGINE COOLANT TEMPERATURE SENSOR – ABOVE SETPOINT	11-30
16	FUEL TEMPERATURE SENSOR – BELOW SETPOINT	11-92
17	FUEL TEMPERATURE SENSOR – ABOVE SETPOINT	11-96
19	CRANKSHAFT POSTION SENSOR – IMPLAUSIBLE	11-32
21	THROTTLE PEDAL POSITION SENSOR – ABOVE SETPOINT	11-38
22	THROTTLE PEDAL POSITION SENSOR – BELOW SETPOINT	11-42
23	THROTTLE PEDAL POSITION SENSOR – IMPLAUSIBLE WITH LOW IDLE SWITCH	11-46
24	VEHICLE SPEED SENSOR – IMPLAUSIBLE	11-50
27	MASS AIR FLOW SENSOR – BELOW SETPOINT	11-120
28	MASS AIR FLOW SENSOR – ABOVE SETPOINT	11-124
29	MASS AIR FLOW SENSOR – NOT PLAUSIBLE	11-128
31	CRANKSHAFT POSTION SENSOR – NO SIGNAL	11-36
33	EGR – SETPONT NOT ACHIEVABLE	11-142
34	FUEL TIMING SOLENOID – SETPOINT NOT ACHIEVABLE	11-98
37	BRAKE LIGHT SWITCH – IMPLAUSIBLE	11-52
41	BOOST PRESSURE – BELOW SETPOINT	11-56
42	BOOST PRESSURE – ABOVE SETPOINT	11-60
43	BOOST PRESSURE – IMPLAUSIBLE WITH ATHMOSPHERIC PRESSURE	11-64
48	BATTERY VOLTAGE TOO LOW	11-66
54	FUEL SHUT-OFF SOLENOID DEFECTIVE	11-100
55	ECU FAULT PRESENT	11-25
61	FUEL QUANTITY FEEDBACK SENSOR – ABOVE OR BELOW SETPOINT	11-104
62	FUEL QUANTITY FEEDBACK SENSOR – IMPLAUSIBLE WITH NEEDLE LIFT SENSOR	11-108
64	FUEL QUANTITY SOLENOID – SETPOINT NOT ACHIEVABLE	11-112
71	INTAKE AIR TEMPERATURE SENSOR – BELOW SETPOINT	11-132
72	INTAKE AIR TEMPERATURE SENSOR – ABOVE SETPOINT	11-136
81	NEEDLE LIFT SENSOR – NO SIGNAL	11-68
82	NEEDLE LIFT SENSOR – IMPLAUSIBLE WITH ENGINE SPEED SENSOR	11-72

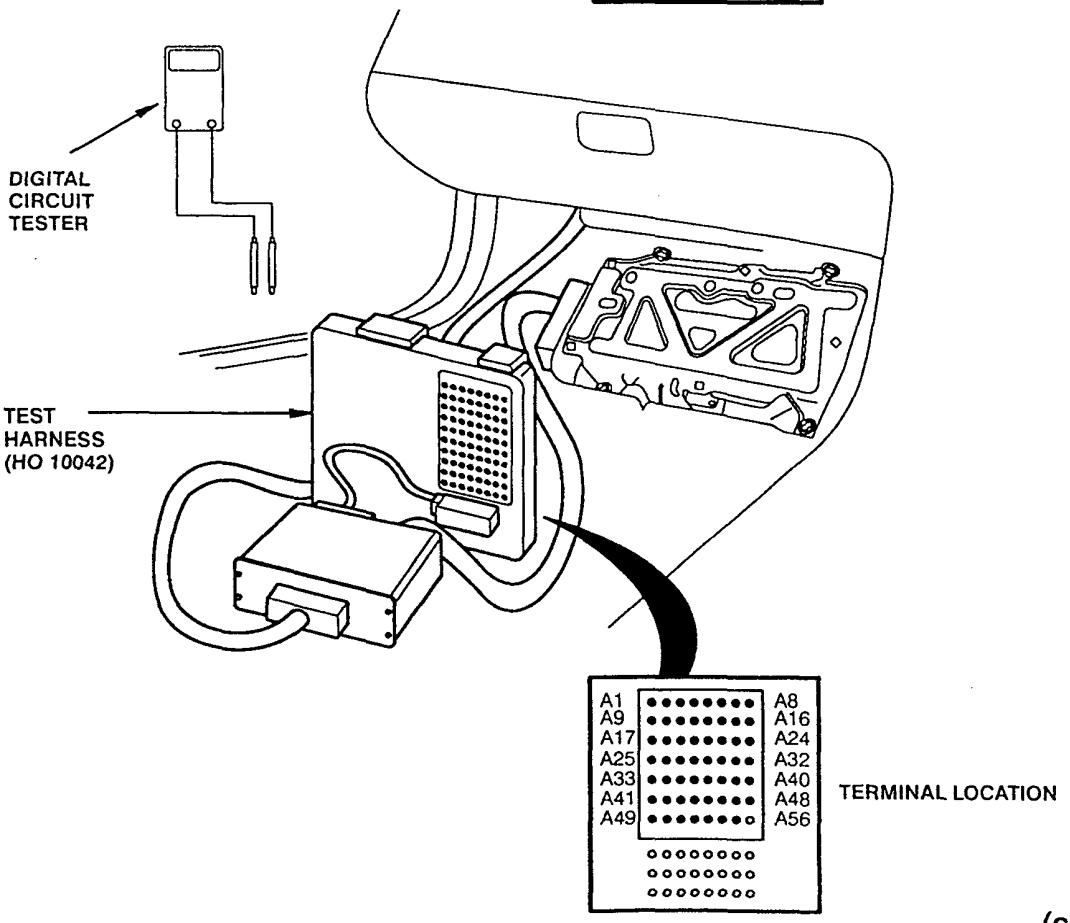
- If codes other than those listed above are indicated, verify the code. If the code indicated is not listed above, replace the ECM. (The only exception is DTC 29 for a defective Theft Alarm.)
- The Malfunction Indicator Lamp (MIL) may come on, indicating a system problem when, in fact, there is a poor or intermittent electrical connection. First check the electrical connections, clean or repair connections if necessary.

If the inspection for a particular failure code requires the test harness, remove the carpet in the passengers footwell and expose the ECM cover. Unbolt the ECM cover. Connect the test harness. Then check the system according to the procedure described for the appropriate code(s) listed on the following pages.

LHD:



RHD:

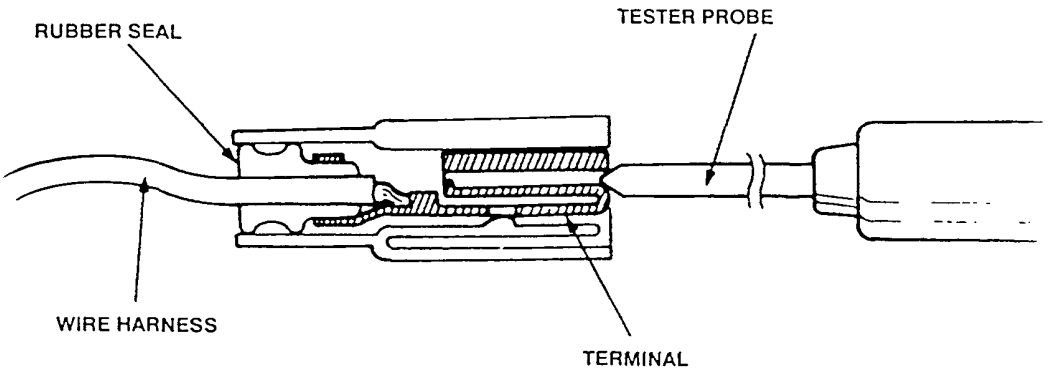


(cont'd)

Self–diagnostic Procedures (cont'd)

CAUTION:

- Puncturing the insulation on a wire can cause poor or intermittent electrical connections.
- For testing at connectors other than the test harness, bring the tester probe into contact with the terminal from the connector side of wire harness connectors in the engine compartment. For female connectors, just touch lightly with the tester probe and do not insert the probe.



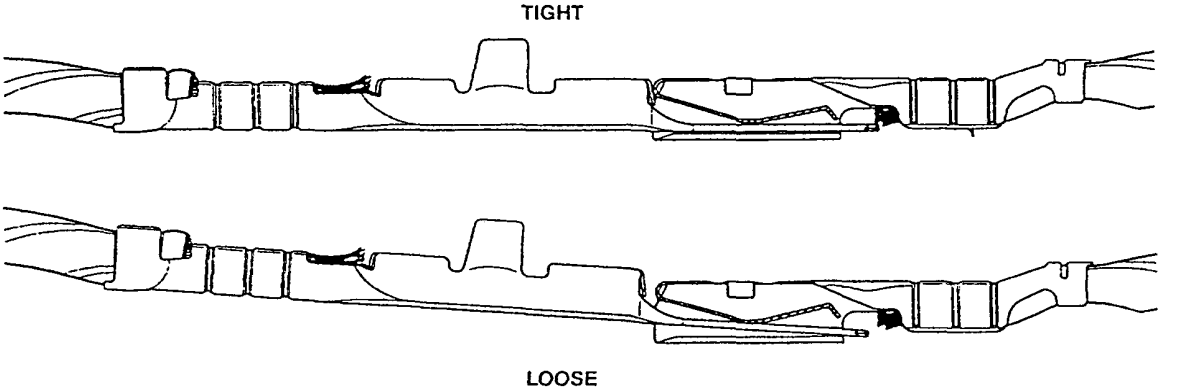
How to Read Flowcharts

A flowchart is designed to be used from start to final repair. It's like a map showing you the shortest distance. But beware: if you go off the "map" anywhere but a "stop" symbol, you can easily get lost.

START (bold type)	Describes the conditions or situation to start a troubleshooting flowchart.
ACTION	Asks you to do something; perform a test, set up a condition etc.
DECISION	Asks you about the result of an action, then sends you in the appropriate troubleshooting direction.
STOP (bold type)	The end of a series of actions and decisions, describes a final repair action and sometimes directs you to an earlier part of the flowchart to confirm your repair.

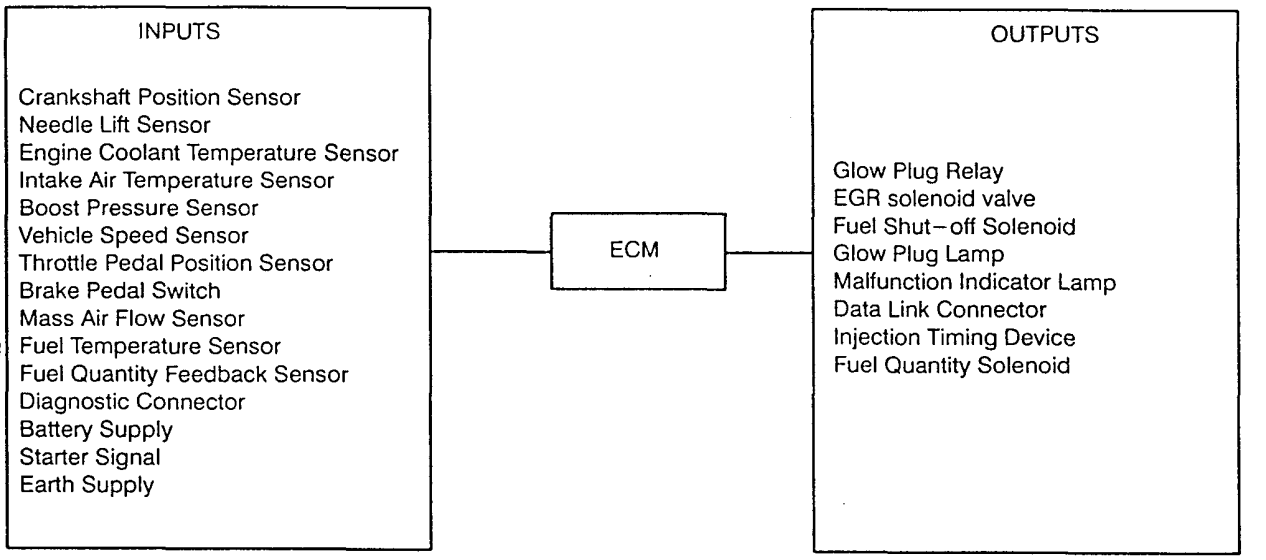
NOTE:

- The term "Intermittent Failure" is used in these charts. It simply means a system may have had a failure, but it checks out OK at this time. If the Malfunction Indicator Lamp (MIL) on the dash does not come on, check for poor connections or loose wires at all connectors related to the circuit that you are troubleshooting (see illustration below).
- Most of the troubleshooting flowcharts have you reset the Engine Control Module (ECM) and try to duplicate the Diagnostic Trouble Code (DTC). If the problem is intermittent and you can't duplicate the code, do not continue through the flowchart. To do so will only result in confusion, and possibly, a needlessly replaced ECM.
- "Open" and "Short" are common electrical terms. An open is a break in a wire or at a connection. A short is an accidental connection of a wire to ground or to another wire. In simple electronics, this usually means something won't work at all. In complex electronics (like ECM's), this can sometimes mean something works, but not the way it's supposed to.
- If the electrical readings are not as specified when using the test harness, check the test harness connections before proceeding.



Diesel Engine Management System

System Description



Diesel Engine Management System

Electronic diesel control operation is necessary in order to achieve optimum combustion of fuel in the cylinder using sensors located at strategic points around the engine. The signals from these sensors are used to adjust the fuel injection quantity and timing according to performance conditions.
The ECM therefore contains control maps for each sensor related to performance conditions which are updated during driving. The ECM incorporates short–circuit protection and can store intermittent faults on certain inputs. In case of system failure the ECM implements a back–up facility to continue functioning, although at a reduced level of performance.
A separate Data Link Connector is used to read out the diagnostic trouble codes without disconnecting the ECM.

Fuel Injector Timing and Duration

Fuel injection timing and quantity control is done with the ECM comparing the actual values of performance with the ones stored in so–called control maps in the ECM and then adjusting the solenoids and actuators as necessary.

Idle Control System

Idle Speed is controlled from the ECM only with the amount of fuel being injected into the cylinders.

Fuel Supply System

A close "cooperation" between ECM and Fuel Injection Pump is necessary to achieve an optimum in the combustion process. Therefore the Fuel Injection Pump Assembly contains different devices controlling the actual fuel injection quantity and timing. In case of any major fault or any problem in the electric supply circuit to the Fuel Injection Pump, the Fuel Shut–off Solenoid cuts off the fuel supply immediately.

Intake Air System

The Intake Air System contains Air Cleaner, Turbocharger, the Intake Manifold, Intercooler and Mass Air Flow Sensor.

Emission Control System

Effective Emission Control is done by use of an Exhaust Gas Recirculation (EGR) Solenoid Valve, Exhaust Gas Recirculation (EGR) Valve, Crankcase Emission Control and Fuel Vapour Evaporative Loss Control. When EGR is required for control of oxides of nitrogen (NOx) emissions, the ECM supplies ground to EGR Control Solenoid Valve which then supplies regulated vacuum to the EGR Valve and exhaust gas is drawn back into the Intake Manifold to decrease combustion temperatures and therefore emissions of NOx.

ECM Fail–safe/Back–up Functions

1. Fail–safe Function
   When an abnormality occurs in a signal from a sensor, the ECM ignores that signal and assumes a pre–programmed value for that sensor that allows the engine to continue to run, although at a reduced level of performance.
2. Back–up Function
   When an abnormality occurs in the ECM itself, the ECM implements back–up to allow the engine running although at a reduced level of performance.
3. Self–diagnosis Function (Malfunction Indicator Lamp (MIL)
   When an abnormality occurs in a signal from a sensor, the ECM lights the MIL and stores the Diagnostic Trouble Code (DTC) in erasable memory. When the ignition is initially turned on, the ECM supplies ground for the MIL for two seconds to check MIL bulb condition.

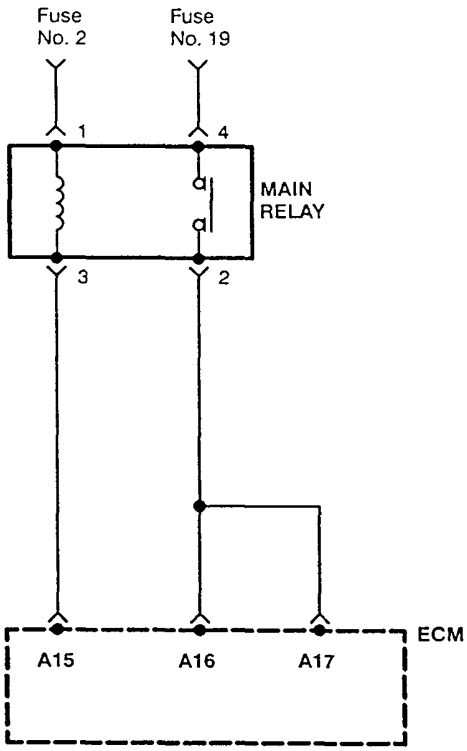
Main Relay

Main Relay

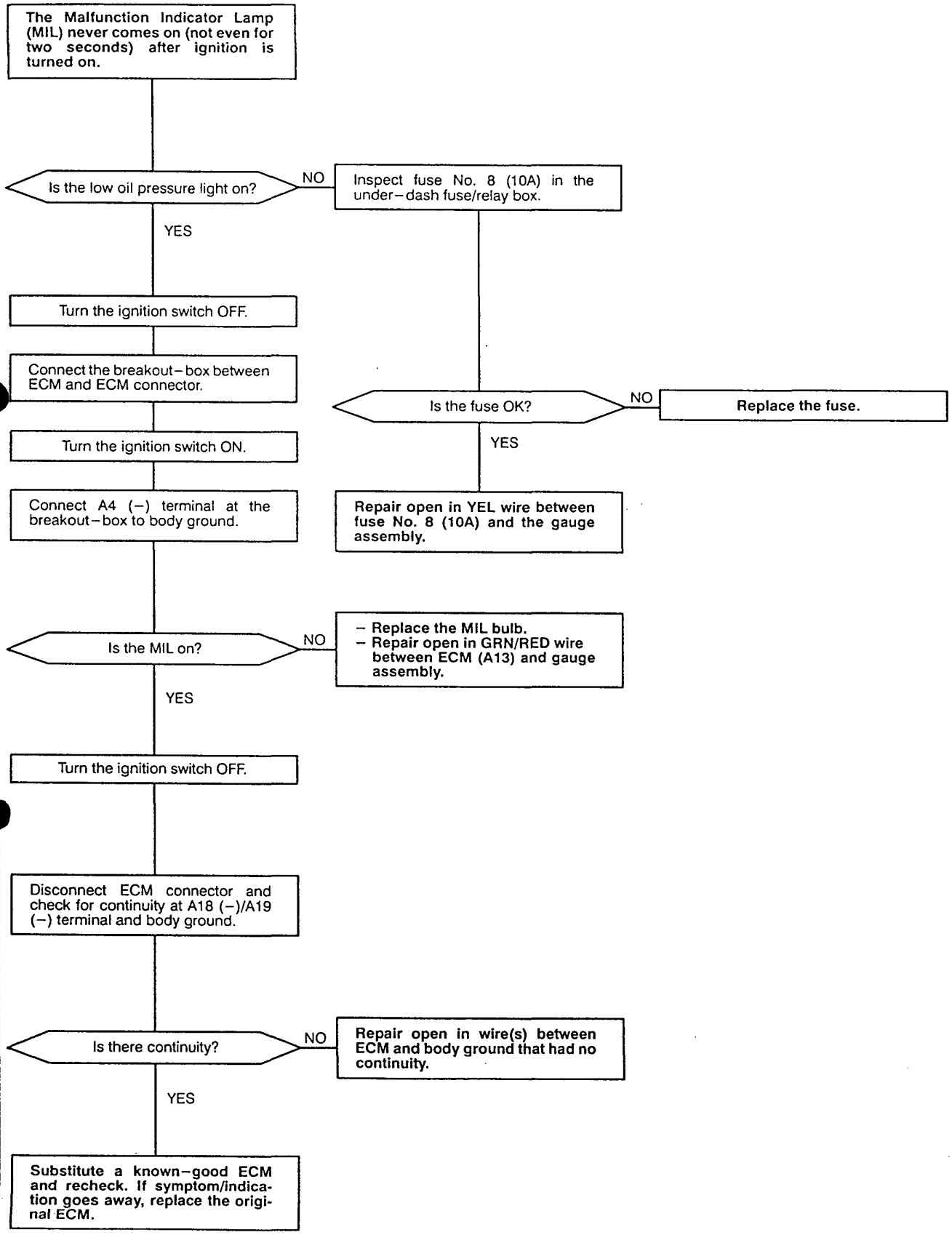
The Main Relay is energised by the ECM as soon as the ECM recieves the signal from the ignition switch. The Main Relay supplies battery voltage to the ECM and varying other sensors and actuators enabling the engine to start.

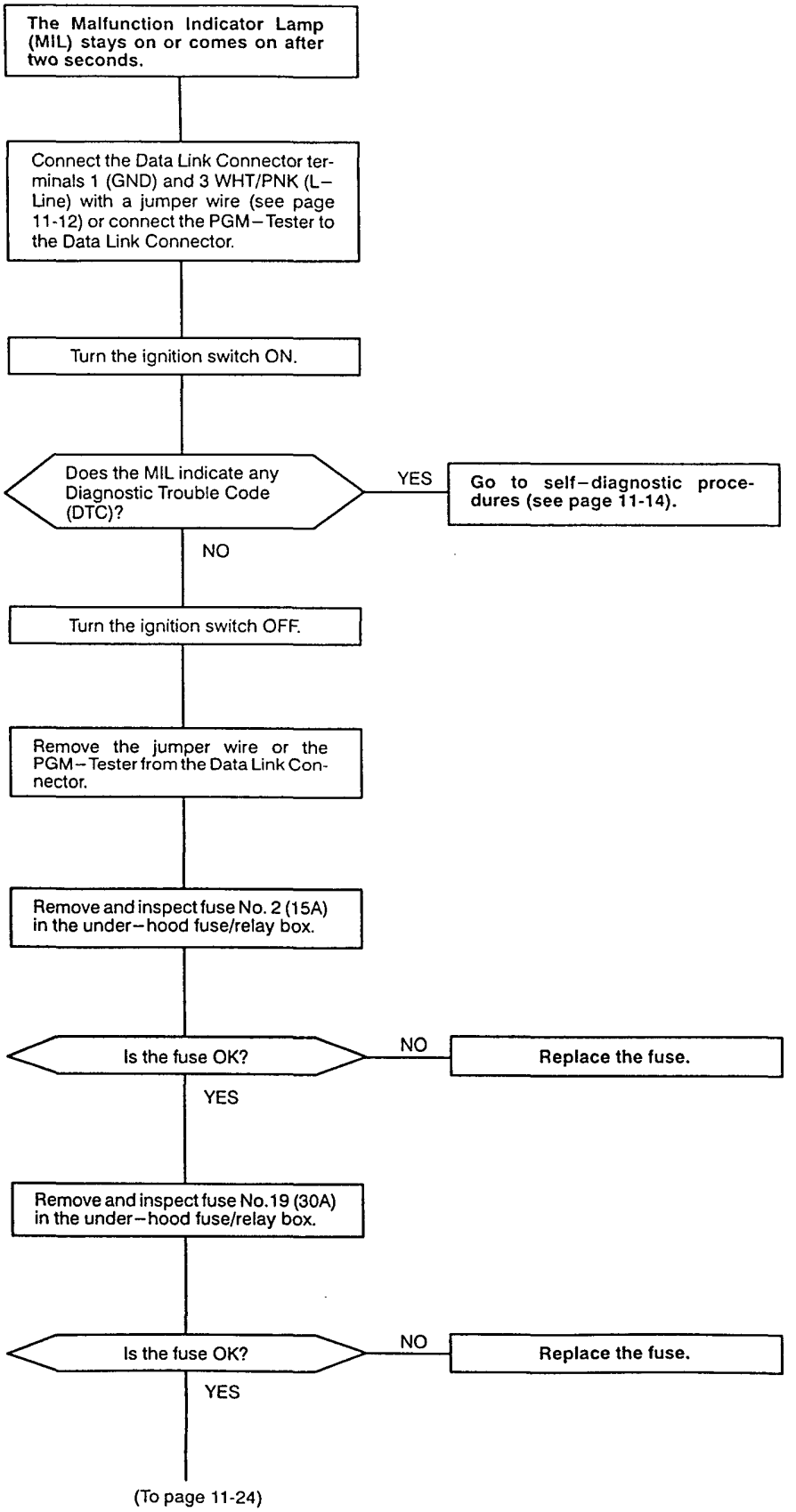
Main Relay Testing

1. Remove the Main Relay from the engine compartment fuse relay box.
2. Attache the battery positive terminal to the No.1 terminal and the battery negative terminal to the No.3 terminal of the Main Relay. Then check for continuity between the No.4 terminal and No.2 terminal of the Main Relay.
   - If there is no continuity, replace the Main Relay and retest.
   - If there is continuity, the Main Relay is ok.



Troubleshooting Flow – Engine Control Module (ECM)




The Malfunction Indicator Lamp (MIL) stays on or comes on after two seconds.
Connect the Data Link Connector terminals 1 (GND) and 3 WHT/PNK (L–Line) with a jumper wire (see page 11-12) or connect the PGM–Tester to the Data Link Connector.
Turn the ignition switch ON.
Does the MIL indicate any Diagnostic Trouble Code (DTC)?
YES
Go to self–diagnostic procedures (see page 11-14).
NO
Turn the ignition switch OFF.
Remove the jumper wire or the PGM–Tester from the Data Link Connector.
Remove and inspect fuse No. 2 (15A) in the under–hood fuse/relay box.
Is the fuse OK?
NO
Replace the fuse.
YES
Remove and inspect fuse No.19 (30A) in the under–hood fuse/relay box.
Is the fuse OK?
NO
Replace the fuse.
YES
(To page 11-24)

Troubleshooting Flowchart – Engine Control Modul (ECM) (cont'd)

(From page 11-23)

Turn the ignition switch ON.

Disconnect the connectors of each sensor one at a time:
- Crankshaft Position Sensor
- Needle Lift Sensor
- Throttle Pedal Position Sensor
- Fuel Shut-off Solenoid
- Fuel Quantity Solenoid
- Fuel Quantity Feedback Sensor
- Boost Pressure Sensor

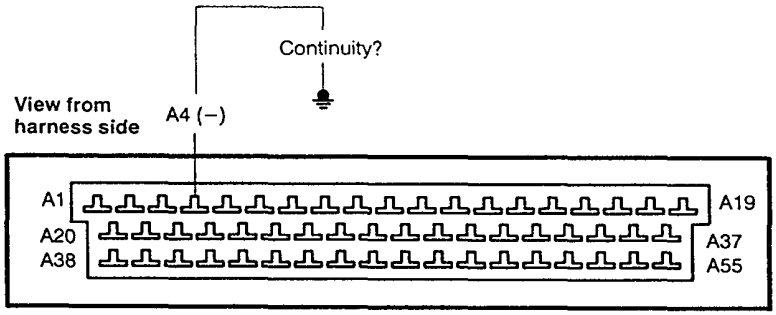
Does the MIL remain ON?

NO → **Replace the sensor that caused the light to go out.**

YES

Turn the ignition switch OFF.

Disconnect the 55 P connector from the ECM.



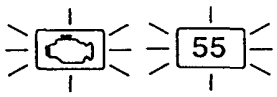
Check for continuity in GRN/RED wire between A4 (–) terminal on the ECM connector and body ground.

Is there continuity?

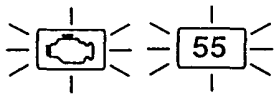
YES → **Repair short to ground in GRN/RED (–) wire between ECM (A4) and body ground.**

NO

Substitute a known-good ECM *and recheck. If symptom/indication* goes away, replace the original ECM.



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 55: A problem in the ECM.



– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 55 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does ist indicate code 55?

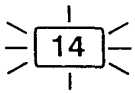
NO → **Intermittent failure, system is OK at this time, test drive may be necessary.**
Check for poor connections or loose wires at the ECM.

YES

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

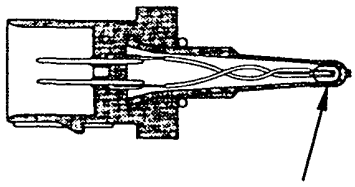
System Description

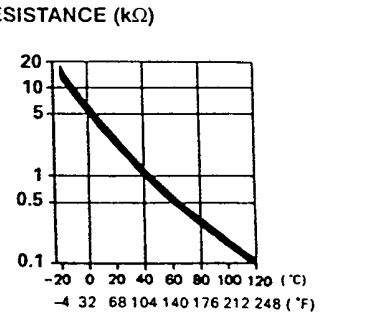
Troubleshooting Flowchart – Engine Coolant Temperature (ECT) Sensor

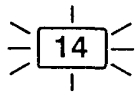


The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 14: A problem in the Engine Coolant Temperature (ECT) Sensor circuit (signal below setpoint).

The ECT sensor is a temperature dependant resistor (thermistor). The resistance of the thermistor decreases as the engine coolant temperature increases as shown below.







With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 14 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 14?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the ECT sensor and ECM.**

YES

Warm up engine to normal operating temperature (the radiator fan comes on).

Turn the ignition switch OFF.

Disconnect the 2P connector from the ECT sensor.

Measure resistance between the 2 terminals on the ECT sensor.

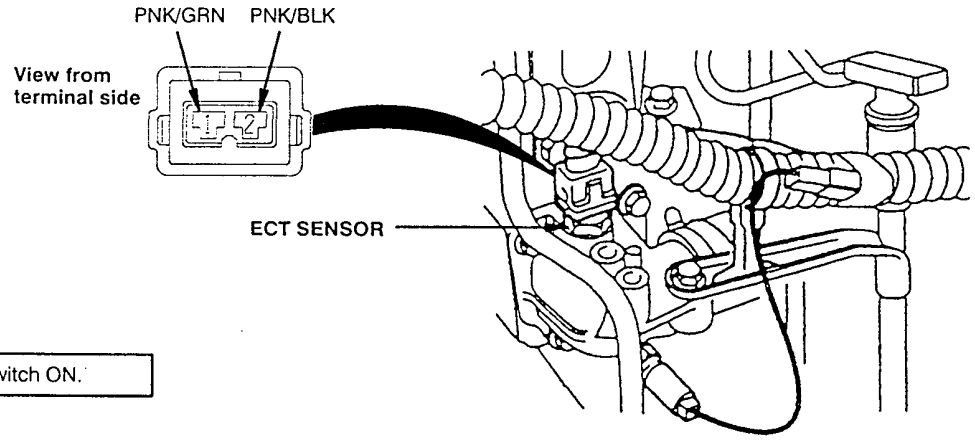
Is there 450-550Ω?

NO → **Replace the ECT sensor.**

YES

(To page 11-27)

(From page 11-26)



Turn the ignition switch ON.

Measure voltage between PNK/GRN (+) terminal and body ground.

Is there approx. 5V?

YES → Measure voltage between PNK/GRN (+) terminal and PNK/BLK (–) terminal of the ECT sensor connector.

NO

Is there approx. 5V?

NO → **Repair open in PNK/BLK (–) wire between ECM (A13) and ECT sensor.**

YES

Turn the ignition switch OFF.

Reconnect 2P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A13 (–) terminal of ECM connector.

Is there continuity?

YES → **Repair short in PNK/BLK (–) wire between ECM (A13) and ECT sensor.**

NO

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

(To page 11-28)

(cont'd)

Troubleshooting Flowchart – Engine Coolant Temperature (ECT) Sensor — (cont'd)

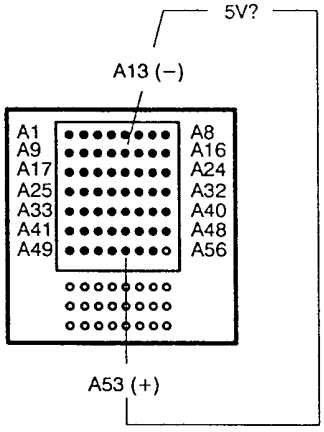
(From page 11-27)

Turn the ignition switch OFF.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A53 (+) terminal and A13 (–) terminal at the breakout–box.



Is there approx. 5V?

YES → **Repair open in PNK/GRN (+) wire between ECM (A53) and ECT sensor.**

NO

Turn the ignition switch OFF.

Reconnect 2P connector.

Disconnect the 55P connector from the ECM.

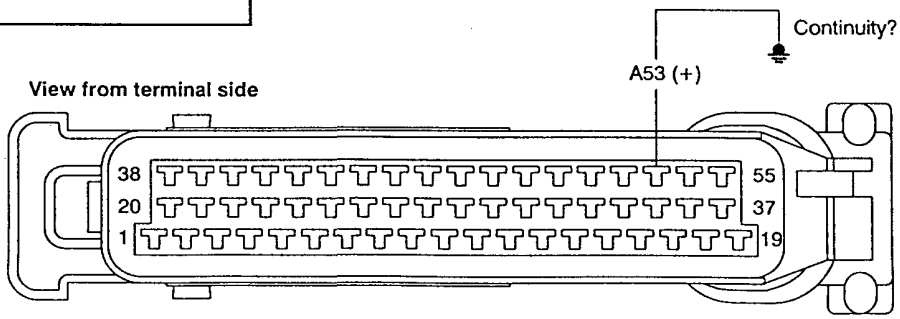
Check for continuity to body ground on A53 (+) terminal of the ECM connector.

Is there continuity?

YES → **Repair short in PNK/GRN (+) wire between ECM (A53) and ECT sensor.**

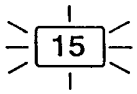
NO

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.



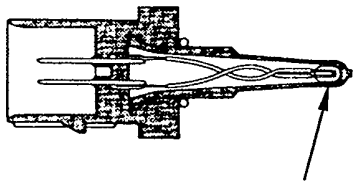
System Description

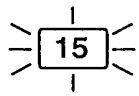
Troubleshooting Flowchart – Engine Coolant Temperature (ECT) Sensor

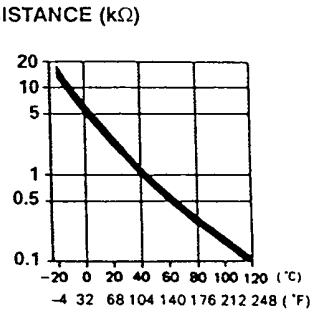


The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 15: A problem in the Engine Coolant Temperature (ECT) Sensor circuit (signal above setpoint).

The ECT sensor is a temperature dependant resistor (thermistor). The resistance of the thermistor decreases as the engine coolant temperature increases as shown below.







With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 15 is indicated.

↓

Do the ECM Reset Procedure (see page 11-13).

↓

Turn the ignition switch ON.

↓

Does the MIL indicate code 15?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the ECT sensor and ECM.**

YES ↓

Warm up engine to normal operating temperature (the radiator fan comes on).

↓

Turn the ignition switch OFF.

↓

Disconnect the 2P connector from the ECT sensor.

↓

Measure resistance between the 2 terminals on the ECT sensor.

↓

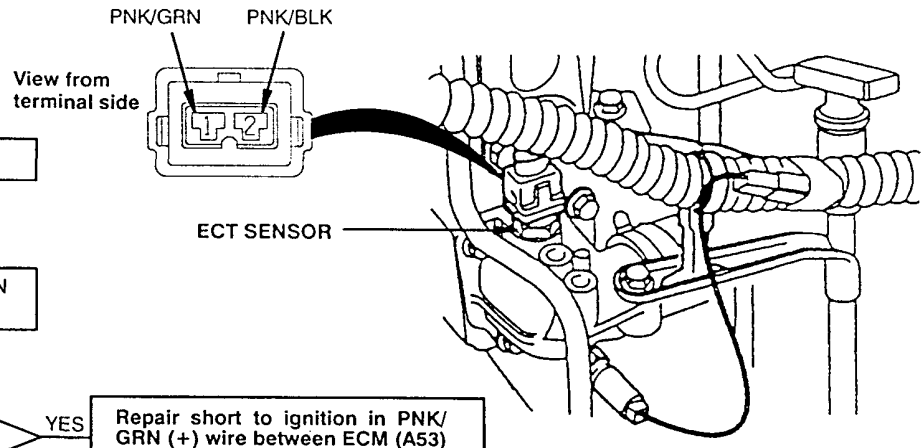
Is there 450-550Ω?

NO → **Replace the ECT sensor.**

YES ↓

(To page 11-31)

(From page 11-30)



Turn the ignition switch ON.

Measure voltage between PNK/GRN (+) terminal and body ground.

Is there battery voltage?

YES → **Repair short to ignition in PNK/GRN (+) wire between ECM (A53) and ECT sensor.**

NO

Is there approx. 5V?

YES → Measure voltage between PNK/GRN (+) terminal and PNK/BLK (−) terminal of the ECT sensor.

NO

Turn the ignition switch OFF.

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A53 (+) terminal and A13 (−) terminal at the breakout−box.

Is there approx. 5V?

YES → **Repair open in PNK/GRN (+) wire between ECM (A53) and ECT sensor.**

NO

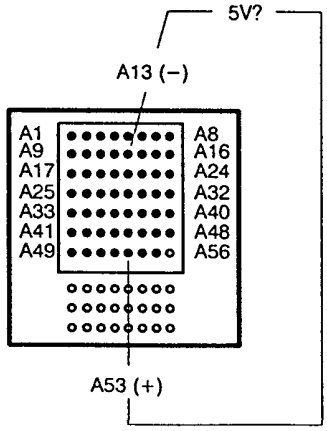
Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

Is there approx. 5V?

NO → **Repair open or short to ignition in PNK/BLK (−) wire between ECM (A13) and ECT sensor.**

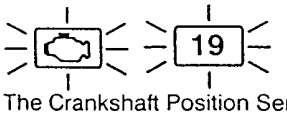
YES

Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

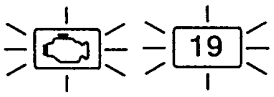


Diesel Engine Management System

Troubleshooting Flowchart – Crankshaft Position Sensor



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 19: A problem in the Crankshaft Position Sensor circuit (signal implausible).
The Crankshaft Position Sensor determines engine speed and position of the crankshaft.



- The MIL has been reported on.
- With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 19 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does it indicate code 19?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary).**
Check for poor connections or loose wires between the Crankshaft Position Sensor and ECM.

YES

Turn the ignition switch OFF.

Disconnect the 2P connector from the Crankshaft Position Sensor.

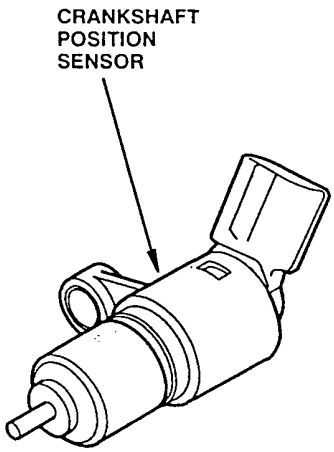
Measure resistance between the 2 terminals on the Crankshaft Position Sensor.

Is there 1,250-1,450Ω?

NO → **Replace the Crankshaft Position Sensor.**

YES

(To page11-33)



(From page 11-32)

Check for continuity to body ground on both terminals of the Crankshaft Position Sensor.

Is there continuity? YES → **Replace the Crankshaft Position Sensor.**

NO

Turn the ignition switch ON.

Measure voltage between YEL/BLK (+) terminal and body ground.

Is there approx. 5V? YES → **Measure voltage between YEL/BLK (+) terminal and PNK/BLK (–) terminal.**

NO

Is there approx. 5V? NO → **Substitute a known-good ECM and recheck. If symptom/indication goes away replace the original ECM.**

YES

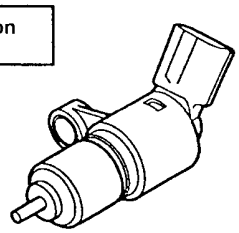
Turn the ignition switch OFF.

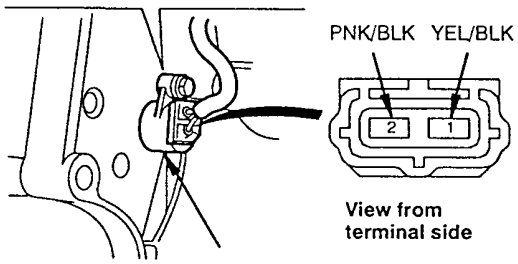
Reconnect the 2P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to ground on A13 (–) wire of ECM connector.

(To page 11-34)

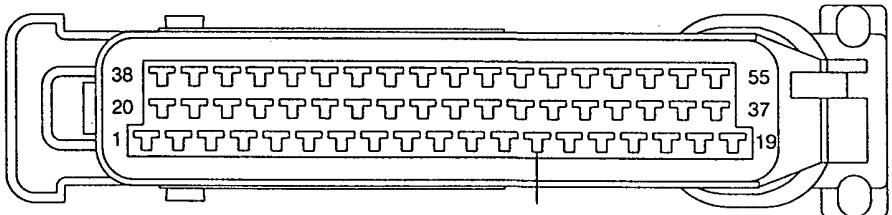




View from terminal side

(To page 11-34)

View from terminal side



A13 (–)

Continuity?

(cont'd)

Troubleshooting Flowchart – Crankshaft Position Sensor (cont'd)

(From page 11-33)

Turn the ignition switch OFF.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A47(+) terminal and A13 (–) terminal at the breakout–box.

Is there approx. 5V?

NO → **Repair open in YEL/BLK (+) wire between ECM (A47) and Crankshaft Position Sensor.**

YES

Turn the ignition switch OFF.

Reconnect the 2P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A47 (+) terminal of the ECM connector.

Is there continuity?

YES → **Repair short in YEL/BLK (+) wire between ECM (A47) and Crankshaft Position Sensor.**

NO

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

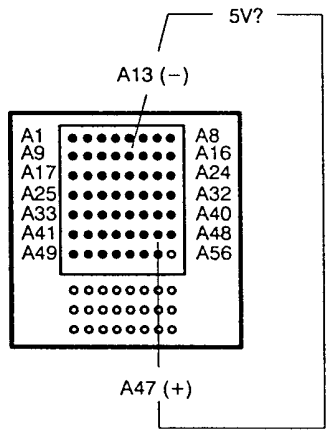
(From page 11-33)

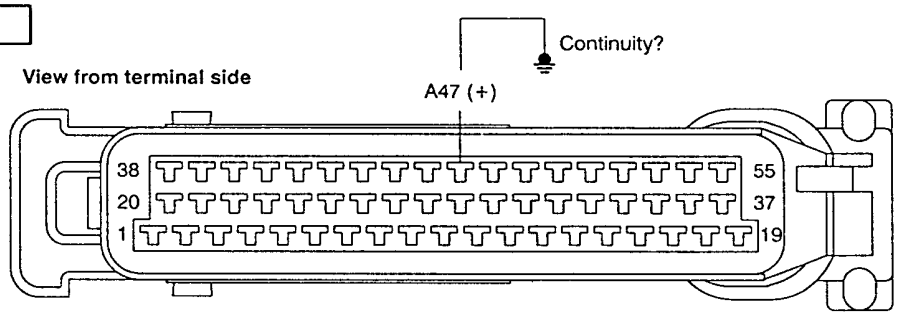
Is there continuity?

YES → **Repair short in PNK/BLK (–) wire between ECM (A13) and Crankshaft Position Sensor.**

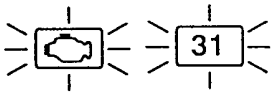
NO

Repair open in PNK/BLK (–) wire between ECM (A13) and Crankshaft Position Sensor.

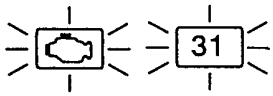




Troubleshooting Flowchart – Crankshaft Position Sensor



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 31: A problem in the Crankshaft Position Sensor circuit (no signal).
The Crankshaft Position Sensor determines engine position and speed.



- **The MIL has been reported on.**
- **With the Data Link Connector's diagnostic L-Line (WHT/PNK wire) connected to ground (see page 11-12), or the PGM-Tester connected to the Data Link Connector, code 31 is indicated.**

Do the ECM Reset Procedure (see page 11-13).

Start the engine.

Is the MIL on and does it indicate code 31?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Crankshaft Position Sensor and ECM.**

YES

Turn the ignition switch OFF.

Disconnect the 2P connector from the Crankshaft Position Sensor.

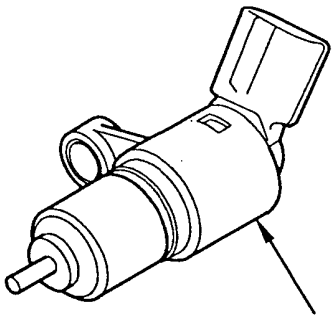
Measure resistance between the 2 terminals on the Crankshaft Position Sensor.

Is there 1,250-1,450Ω?

NO → **Replace the Crankshaft Position Sensor.**

YES

(To page 11-37)



CRANKSHAFT POSITION SENSOR

(From page 11- 36)

Check for continuity to body ground on both terminals of the Crankshaft Position Sensor.

Is there continuity? YES → **Replace the Crankshaft Position Sensor.**

NO

Reconnect the connector.

Disconnect the 55P connector from the ECM.

Measure the resistance between (A47) (+) terminal A 13 (−) terminal of the ECM connector.

Is there 1,250-1,450Ω? NO → **Repair open in YEL/BLK (+) wire and/or PNK/BLK (−) wire between ECM and Crankshaft Position Sensor.**

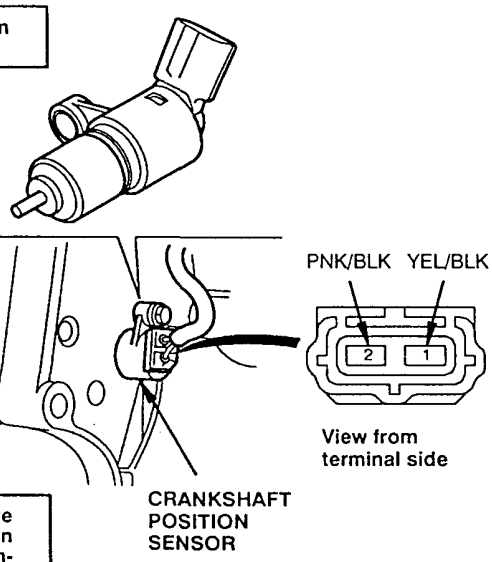
YES

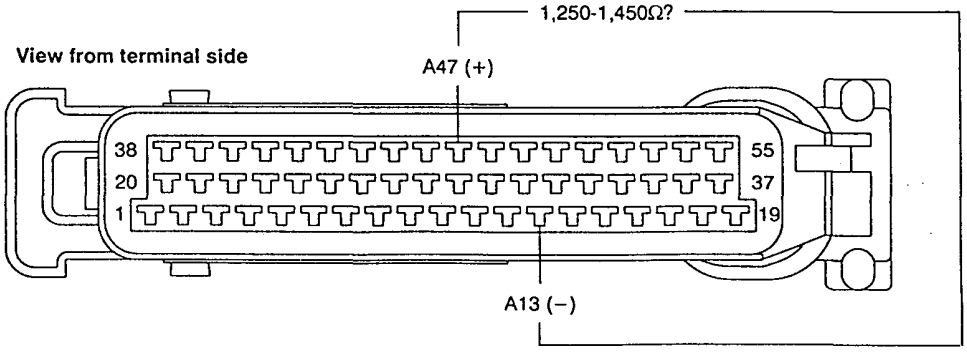
Check for continuity to body ground on A47 (+) terminal and A13 (−) terminal of the ECM connector.

Is there continuity? YES → **Repair short in YEL/BLK (+) wire and/or PNK/BLK (−) wire between ECM and Crankshaft Position Sensor.**

NO

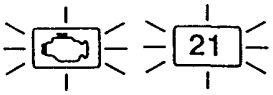
Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.





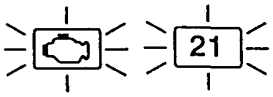
Diesel Engine Management System

Troubleshooting Flowchart – Throttle Pedal Position Sensor



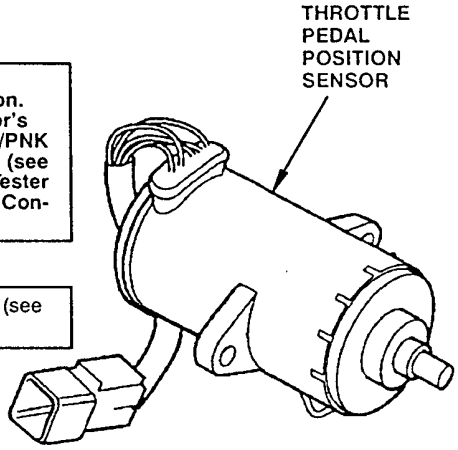
The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 21: A problem in the Throttle Pedal Position Sensor circuit (signal above setpoint).

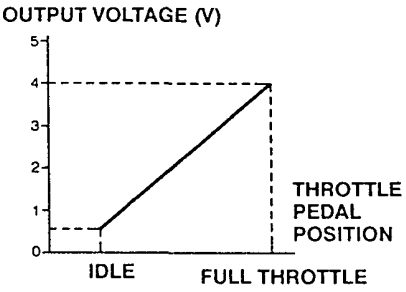
The Throttle Position Pedal Sensor consists of a potentiometer and a sender switch. When the throttle pedal has moved more than 9° the switch closes. This signal is used by the ECM to detect, if the sensor works correct.



- Engine is running.
- The MIL has been reported on.
- With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 21 is indicated.

Do the ECM Reset Procedure (see page 11-13).





Start the engine.

Is the MIL on and does it indicate code 21?

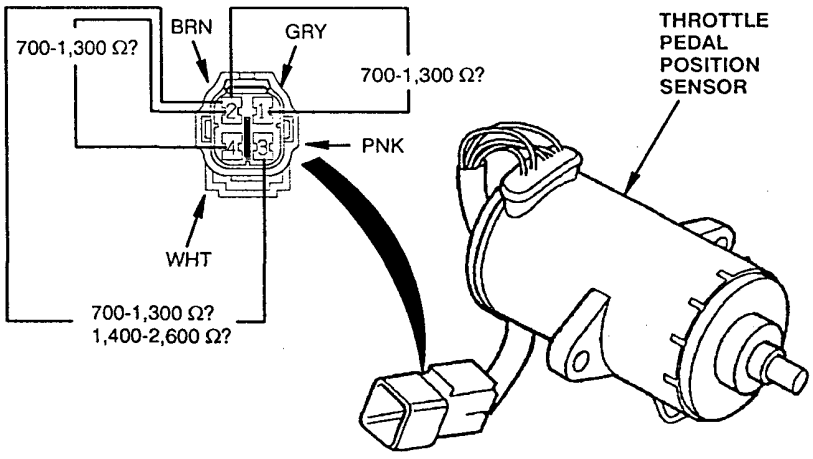
NO

Intermittent failure, system is OK at this time (test drive may be necessary).
Check for poor connections or loose wires between the Throttle Pedal Position Sensor and the ECM.

YES

Turn the ignition switch OFF.

View from terminal side



Disconnect the 4P connector from the Throttle Pedal Position Sensor.

Measure resistance between terminal 4 (+) and terminal 2 (–) of the Throttle Pedal Position Sensor.

Is there 700-1,300Ω?

NO

Replace the Throttle Pedal Position Sensor.

YES

Measure resistance between terminal 3 (+) and terminal 2 (–) of the Throttle Pedal Position Sensor connector.

(To page 11-39)

(From page 11-38)

Is resistance 700-1,300Ω with throttle pedal released, and 1,400-2,600Ω with throttle pedal fully depressed?
NOTE: There should be a smooth transition from the low resistance value to the high resistance value when the throttle pedal is depressed.

NO → **Replace the Throttle Pedal Position Sensor.**

YES

Turn the ignition switch ON.

Measure voltage between YEL/BLK (+) terminal of the Throttle Pedal Position Sensor harness connector and body ground.

Is there battery voltage?

YES → **Repair short to ignition in YEL/BLK (+) wire between ECM (A33) and Throttle Pedal Position Sensor.**

NO

Is there approx. 5V?

NO → Turn the ignition switch OFF.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A33 (+) terminal and A13 (-) terminal at the breakout-box.

YES

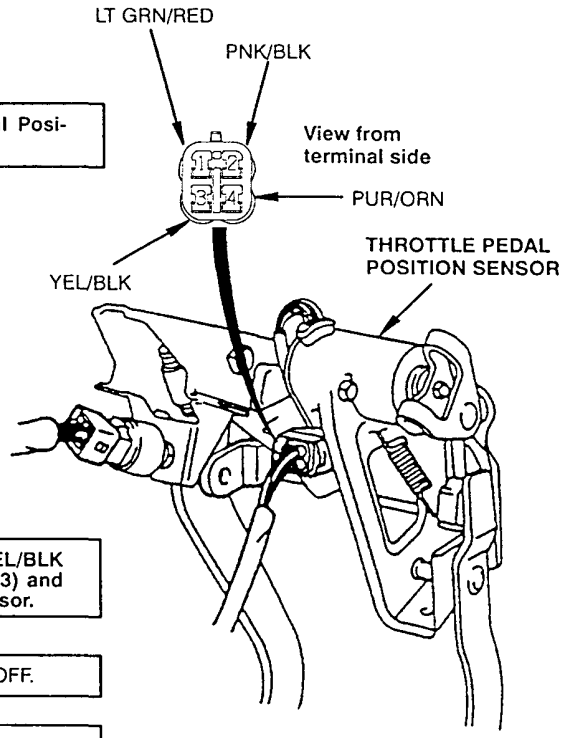
Measure voltage between YEL/BLK (+) terminal and PNK/BLK (-) terminal of the Throttle Pedal Position Sensor harness connector.

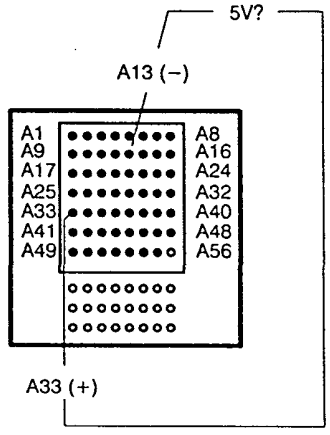
Is there approx. 5V?

YES → **Repair open in YEL/BLK (+) wire between ECM (A33) and Throttle Pedal Position Sensor.**

NO

Substitute a known-good ECM and recheck. If symptom/indication goes away, replace the original ECM.





(To page 11-40)

(cont'd)

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el Engine Management System

ubleshooting Flowchart – Throttle Pedal Position Sensor (cont'd)

(From page 11-39)

Is there approx. 5V?

NO → Repair open or short to ignition in PNK/BLK (–) wire between ECM (A13) and Throttle Pedal Position Sensor.

YES

Turn the ignition switch OFF.

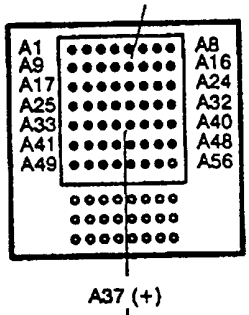
connect the 4P connector.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A37 (+) terminal and A 13 (–) terminal at the breakout box.

12V?
0.5V–4.0V?



Is there battery voltage?

YES → Repair short to ignition in PUR/ORN (+) wire between ECM (A37) and Throttle Pedal Position Sensor.

NO

Is voltage approx. 0.5V with throttle pedal released, and approx. 4.0V with throttle pedal fully depressed?
NOTE: There should be a smooth transition from 0.5V to 4.6V as the throttle pedal is depressed.

NO → Repair open in PUR/ORN (+) wire between ECM (A37) and Throttle Pedal Position Sensor.

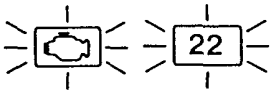
4.0

YES

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

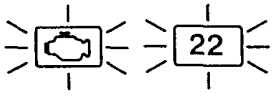
Diesel Engine Management System

Troubleshooting Flowchart – Throttle Pedal Position Sensor



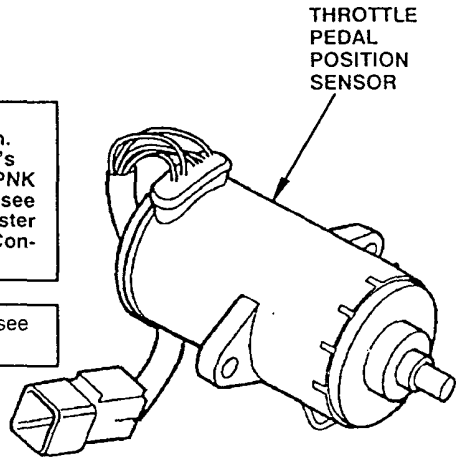
The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 22: A problem *in the Throttle Pedal Position Sensor circuit (signal below setpoint).*

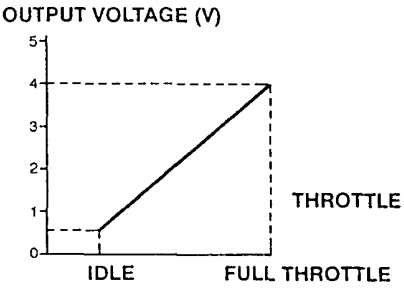
The Throttle Pedal Sensor consists of a potentiometer and a sender switch. When the throttle pedal has been moved more than 9° the switch closes. This signal is used by the ECM to detect if the sensor works correctly.



- Engine is running.
- The MIL has been reported on.
- With the Data Link Connector's *diagnostic L-Line* (WHT/PNK wire) connected to ground (see page 11-12) or the PGM-Tester connected to the Data Link Connector, code 22 is indicated.

Do the ECM Reset Procedure (see page 11-13).





Start the engine.

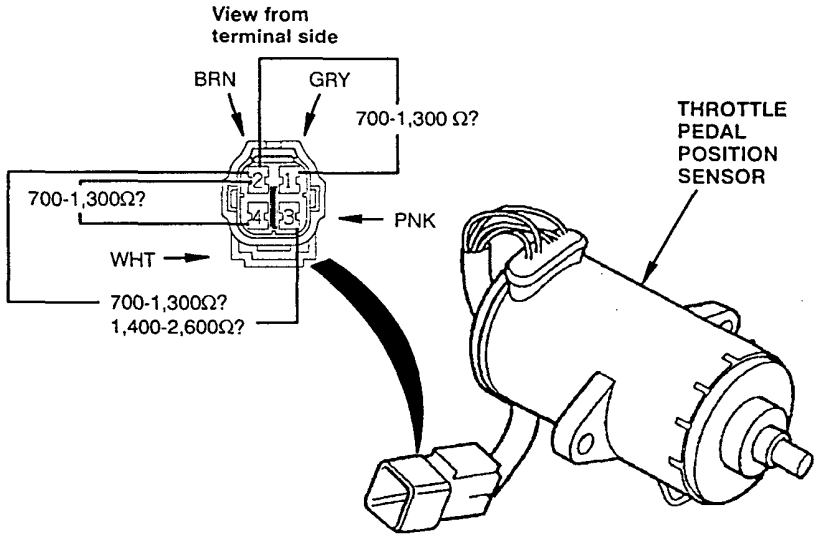
Is the MIL on and does it indicate code 22?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Throttle Pedal Position Sensor and the ECM.**

YES

Turn the ignition switch OFF.

Disconnect the 4P connector from the Throttle Pedal Position Sensor.



Measure resistance between terminal 4 (+) and terminal 2 (−) of the Throttle Pedal Position Sensor.

Is there 700-1,300Ω?

NO → **Replace the Throttle Pedal Position Sensor.**

YES

Measure resistance between terminal 3 (+) and terminal 2 (−) of the Throttle Pedal Position Sensor connector.

(To page 11-43)

(From page 11-42)

Is resistance 700-1,300Ω with throttle pedal released, and 1,400-2,600Ω with throttle pedal fully depressed?
NOTE: There should be a smooth transition from the low resistance value to the high resistance value when the throttle pedal is depressed.

NO → **Replace the Throttle Pedal Position Sensor.**

YES

Turn the ignition switch ON.

Measure voltage between YEL/BLK (+) terminal of the throttle pedal position sensor harness connector and body ground.

Is there approx. 5V?

NO → Turn the ignition switch OFF.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A33 (+) terminal and A 13 (−) terminal at the breakout-box.

Is there approx. 5V?

YES → **Repair open in YEL/BLK (+) wire between ECM (A33) and throttle position sensor.**

NO

Turn the ignition switch OFF.

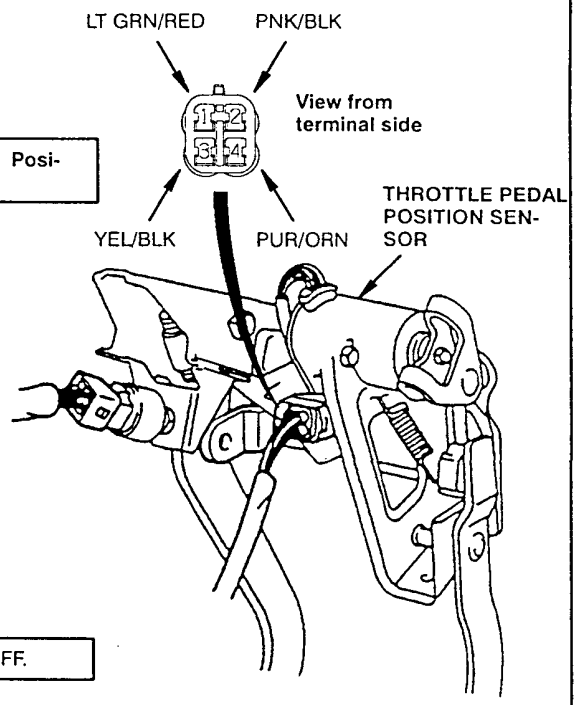
Reconnect the 4P connector.

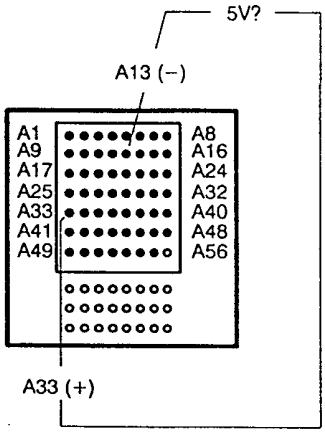
Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A33 (+) terminal of the ECM connector.

YES

Measure voltage between YEL/BLK (+) terminal and PNK/BLK (−) terminal of the Throttle Pedal Position Sensor harness connector.





(To page 11-44)

(To page 11-44)

(cont'd)

Diesel Engine Management System

Troubleshooting Flowchart – Throttle Pedal Position Sensor (cont'd)

(From page 11-43)

(From page 11-43)

Is there continuity?

YES → Repair short in YEL/BLK (+) wire between ECM (A33) and Throttle Pedal Position Sensor.

NO → Substitute a known-good ECM and recheck. If symptom/indication goes away, replace the original ECM.

Is there approx. 5V?

NO → Repair open in PNK/BLK (–) wire between ECM (A13) and Throttle Pedal Position Sensor.

YES

Turn the ignition switch OFF.

Reconnect the 4P connector.

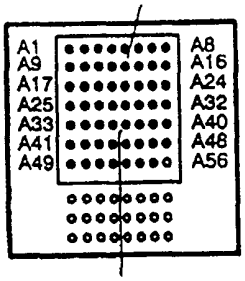
Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A37 (+) terminal and A 13 (–) terminal at the breakout-box.

0.5V–4.0V?

A13 (–)



A37 (+)

Is voltage approx. 0.5V with throttle pedal released, and approx. 4.0V with throttle pedal fully depressed?
NOTE: There should be a smooth transition from 0.5V to 4.5V as the throttle pedal is depressed.

4.0

YES → Substitute a known-good ECM and recheck. If symptom/indication goes away, replace the original ECM.

NO

(To page 11-45)

(From page 11-44)

Turn the ignition switch OFF.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A37 (+) terminal of the ECM connector.

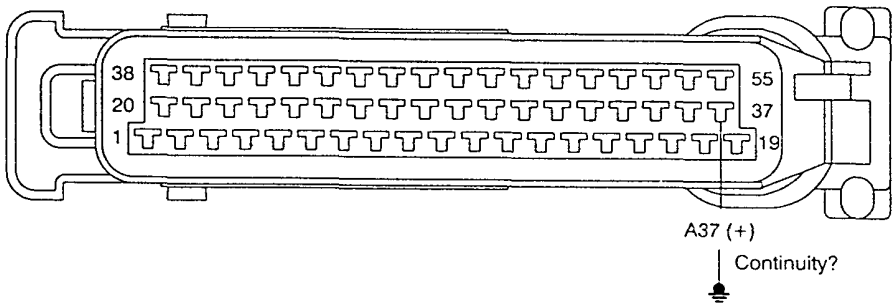
Is there continuity?

YES → **Repair short in PUR/ORN (+) wire between ECM (A37) and Throttle Pedal Position Sensor.**

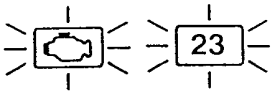
NO

Repair open in PUR/ORN (+) wire between ECM (A37) and Throttle Pedal Position Sensor.

View from terminal side

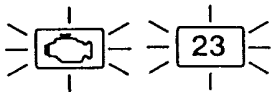


Troubleshooting Flowchart – Throttle Pedal Position Sensor



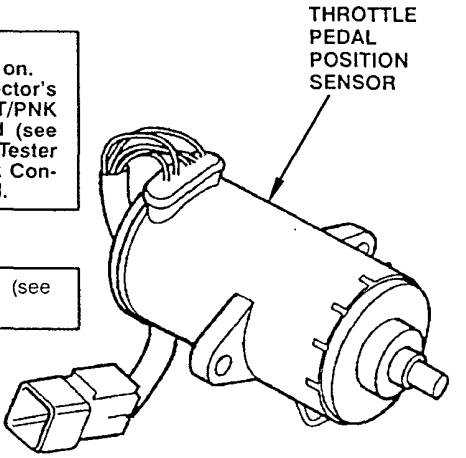
The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 23: A problem in the Throttle Pedal Position Sensor circuit (implausible with idle switch).

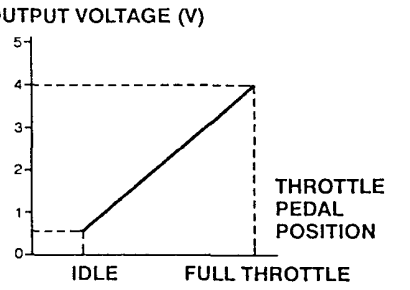
The Throttle Pedal Sensor consists of a potentiometer and a sender switch; when the throttle pedal has been moved more than 9° the switch closes. As the Throttle Pedal Position changes, the potentiometer sends a voltage signal to the ECM.



- Engine is running.
- The MIL has been reported on.
- With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), the PGM–Tester connected to the Data Link Connector, code 23 is indicated.

Do the ECM Reset Procedure (see page 11-13).





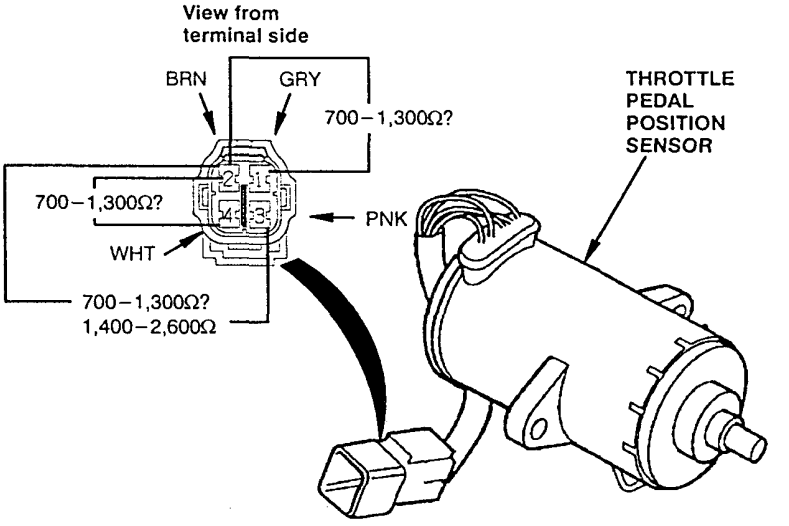
Start the engine.

Is the MIL on and does it indicate code 23?

NO → Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Throttle Pedal Position Sensor and the ECM.

YES

Turn the ignition switch OFF.



Disconnect the 4P connector from the Throttle Pedal Position Sensor.

Measure resistance between terminal 1 (+) and terminal 2 (–) of the Throttle Pedal Position Sensor.

Is there 700-1,300Ω with *throttle pedal released*, and infinite resistance with throttle pedal depressed more than 9°?

NO → Replace Throttle Pedal Position Sensor.

YES

(To page 11-47)

(From page 11-46)

Measure resistance between terminal 4(+) and terminal 2 (−) of the Throttle Pedal Position Sensor.

Is there 700-1,300Ω? NO → **Replace Throttle Pedal Position Sensor.**

YES

Measure resistance between terminal 3 (+) and terminal 2 (−) of the Throttle Position Sensor connector.

Is resistance 700-1,300Ω with throttle pedal released, and 1,400-2,600Ω with throttle pedal fully depressed?
NOTE: There should be a smooth transition from the low resistance value to the high resistance value when the throttle pedal is depressed. NO → **Replace the Throttle Pedal Position Sensor.**

YES

Turn the ignition switch ON.

Measure voltage between LT GRN/RED (+) terminal of the Throttle Pedal Position Sensor harness connector and body ground.

Is there battery voltage? YES → **Repair short to ignition in LT GRN/RED (+) wire between ECM (A25) and Throttle Pedal Position Sensor.**

NO

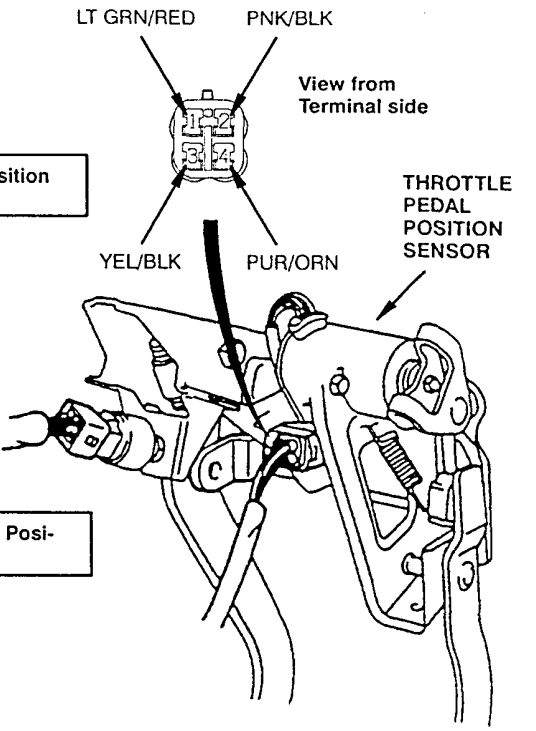
Is there approx. 6V? NO → Turn the ignition switch OFF.

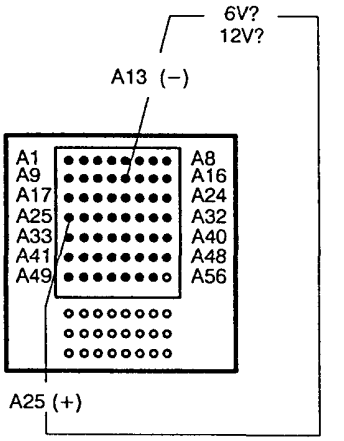
YES

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A25 (+) terminal and A13 (−) terminal at the breakout−box.





(To page 11-48)

(To page 11-48)

(cont'd)

Troubleshooting Flowchart – Throttle Pedal Position Sensor (cont'd)

(From page 11-47)

Measure voltage between LT GRN/RED (+) terminal and PNK/BLK (–) terminal of the Throttle Pedal Position Sensor harness connector.

Is there approx. 6V?

YES → **Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.**

NO → Turn the ignition switch OFF.

Reconnect the 4P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A13 (–) terminal of ECM connector.

Is there continuity?

YES → **Repair short in PNK/BLK (–) wire between ECM (A13) and Throttle Pedal Position Sensor.**

NO → **Repair open in PNK/BLK (–) wire between ECM (A13) and Throttle Pedal Position Sensor.**

(From page 11-47)

Is there approx. 6V?

YES → **Repair open in LT GRN/RED (+) wire between ECM (A25) and Throttle Pedal Position Sensor.**

NO → Turn the ignition switch OFF.

Reconnect the 4P connector.

Disconnect the 55P connector from the ECM.

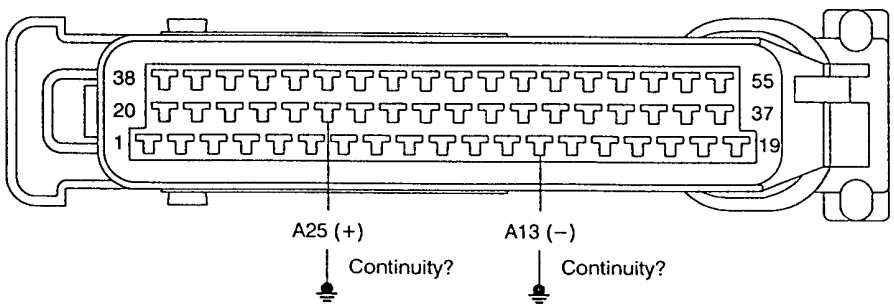
Check for continuity to body ground on A25 (+) terminal of the ECM connector.

Is there continuity?

YES → **Repair short in LT GRN/RED (+) between ECM (A25) and Throttle Pedal Position Sensor.**

NO → **Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.**

View from terminal side



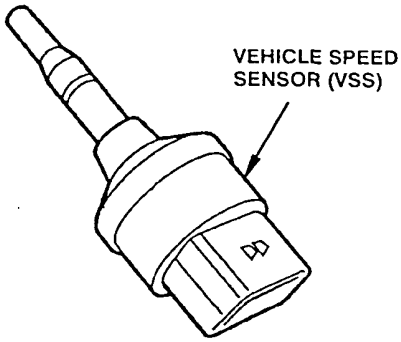
Troubleshooting Flowchart – Vehicle Speed Sensor (VSS)

24

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 24: A problem in the Vehicle Speed Sensor circuit.

The VSS is located on top of the differential housing. The VSS is driven by a shaft from the final drive gear and produces an electrical output signal (pulsing squarewave) proportional to the vehicle speed. The VSS signal is sent to the ECM and the speedometer. The ECM uses this signal to provide active surge damping and adjust idle stabilisation and the quantity of fuel being delivered to the injectors.

24



With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 24 is indicated.

Do the ECM Reset Procedure (see page 11-13).

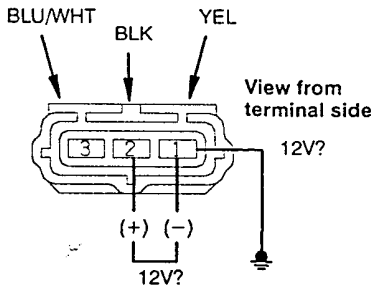
Road test necessary. Accelerate vehicle to 3,500 min⁻¹ (rpm), then decelerate to 1,500 min⁻¹ (rpm).

Does the MIL indicate code 24?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the VSS and ECM.**

YES

Disconnect the 3P connector from the VSS.



Turn the ignition switch ON.

Measure voltage between YEL (+) terminal and body ground.

Is there battery voltage?

NO → **Repair open in YEL (+) wire between under–dash fuse/relay box and VSS.**

YES

Measure voltage between YEL (+) terminal and BLK (–) terminal.

Is there battery voltage?

NO → **Repair open in BLK (–) wire between VSS and body ground.**

YES

Turn the ignition switch OFF.

(To page 11-51)

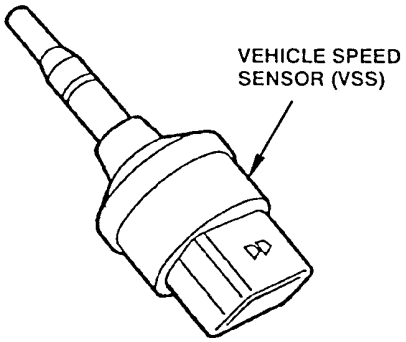
(From page 11-50)

Reconnect 3P connector.

Disconnect the 55P connector from the ECM.

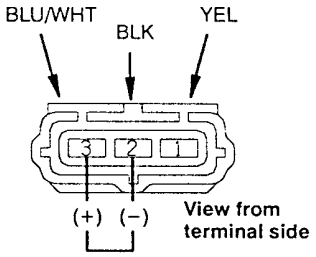
Block rear wheels and set the parking brake. Jack up the front of the car and support with safety stands.

⚠ WARNING Block rear wheels before jacking up front of car.



Turn the ignition switch ON.

Slowly rotate left front wheel and measure voltage between BLU/WHT (+) terminal and BLK (−) terminal of VSS by back−probing the VSS connector.



0 ↔ more than 5V?

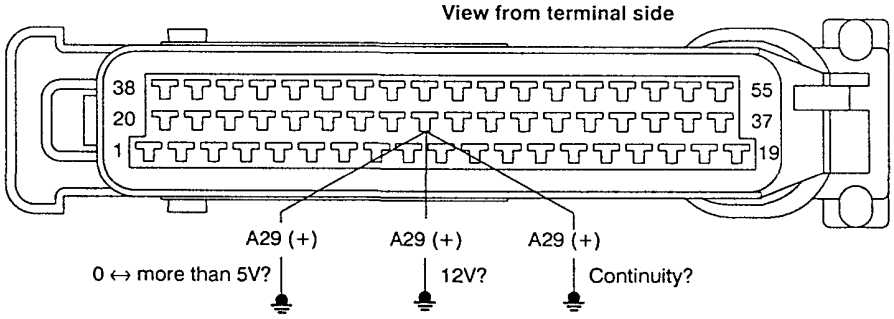
Does voltage pulse 0V and more than 5V?

NO → Replace VSS.

YES

Disconnect the 55P connector from the ECM.

Slowly rotate left front wheel and measure voltage between A29 (+) terminal of the ECM connector and body ground.



Does voltage pulse 0V and more than 5V?

NO → Measure voltage between A29 (+) terminal of the ECM connector and body ground.

YES

Substitute a known−good ECM and recheck. If symptom/indication goes away, replace original ECM.

Is there battery voltage?

YES → **Repair short to ignition in BLU/WHT (+) wire between VSS and ECM.**

NO

Check for continuity to ground on A29 (+) terminal of the ECM connector.

Is there continuity?

YES → **Repair short in BLU/WHT (+) wire between VSS and ECM.**

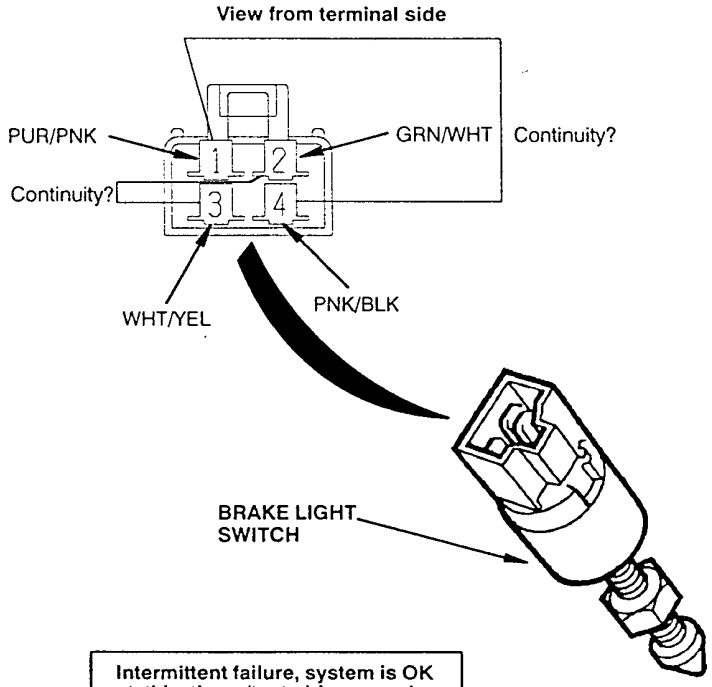
NO

Repair open in BLU/WHT (+) wire between VSS and ECM.

Troubleshooting Flowchart – Brake Light Switch

37

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 37: A problem in the Brake Light Switch circuit.
The ECM utilises two Brake Light Switch inputs, of opposite polarity, to termine brake pedal position.



37

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12)or the PGM–Tester connected to the Data Link Connector, code 37 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 37?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary).**
Check for poor connections or loose wires between the Brake Light Switch and ECM.

YES

Turn the ignition switch OFF.

Disconnect the 4P connector from the Brake Light Switch.

Check for continuity between terminals 1 (+) and 4 (–) of the Brake Light Switch.

Is there continuity when the brake pedal is released and open circuit when brake pedal is depressed?

NO → **Replace Brake Light Switch.**

YES

Check for continuity between terminals 3 (+) and 2 (–) of the Brake Light Switch.

(To page 11-53)

(From page 11-52)

Is there open circuit when the brake pedal is released and continuity when brake pedal is depressed?

NO → **Replace Brake Light Switch.**

YES

Reconnect 4P connector.

Do brake lights operate correctly?

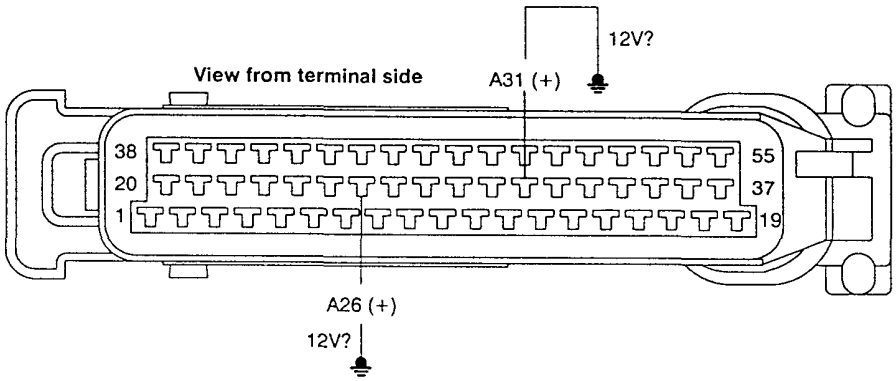
NO → **Test brake lights circuit.**

YES

Disconnect 55P connector form the ECM.

Turn the ignition switch ON.

Measure voltage between A26 (+) and body ground.



Is there 0V when brake pedal is released and battery voltage when brake pedal is depressed?

NO → **Repair open in GRN/WHT (+) wire between Brake Light Switch and ECM (A26).**

YES

Release brake pedal.

Measure voltage between A31 (+) and body ground.

Is there battery voltage?

YES → **Repair short to ignition in PUR/PNK (+) and/or PNK/BLK (–) wire(s) between Brake Light Switch and ECM (A31/A13).**

NO

Turn the ignition switch OFF.

Check for continuity to body ground on A31 (+) terminal of the ECM connector.

(To page 11-54)

(cont'd)

Troubleshooting Flowchart – Brake Light Switch (cont'd)

(From page 11-53)

Is there continuity?

YES → Repair short in PUR/PNK (+) and/or PNK/BLK (–) wire(s) between Brake Light Switch and ECM (A31/A13).

NO

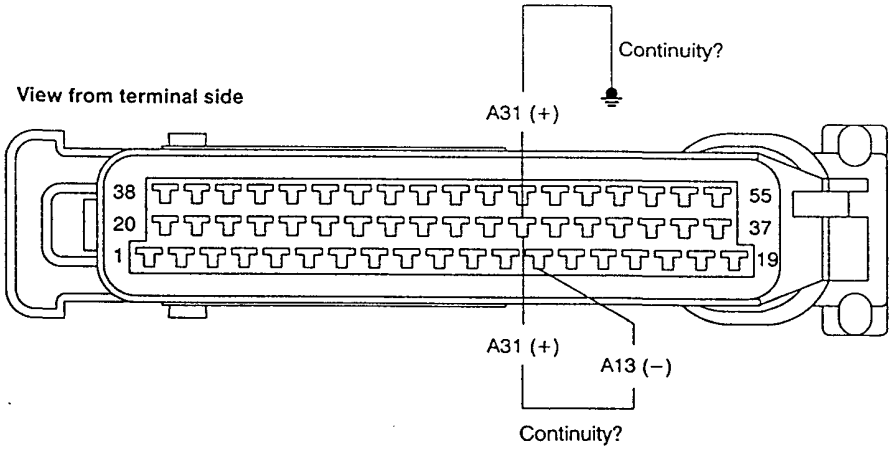
Check for continuity between terminal A31 (+) and A13 (–) of the ECM connector.

Is there continuity?

NO → Repair open in PUR/PNK (+) and/or PNK/BLK (–) wire(s) between Brake Light Switch and ECM (A31/A13).

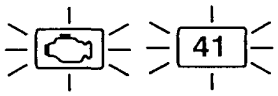
YES

Substitute a known–good ECM. If symptom/indication goes away, replace original ECM.

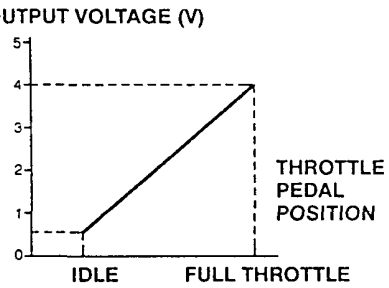


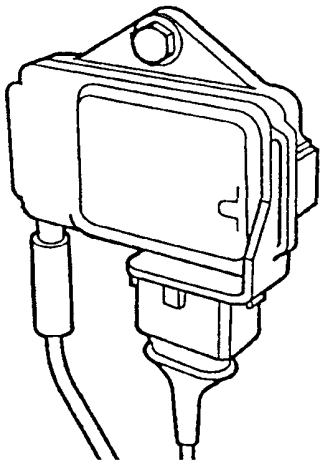
Diesel Engine Management System

Troubleshooting Flowchart – Boost Pressure Sensor

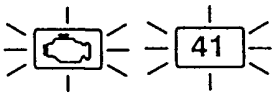


The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 41: A problem in the Boost Pressure Sensor (signal below setpoint).
The Boost Pressure Sensor converts turbocharger boost pressure into electrical signal inputs to the ECM.





BOOST PRESSURE SENSOR



– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 41 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Start the engine.

Is the MIL on and does ist indicate code 41?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary).**
Check for poor connections or loose wires between Boost Pressure Sensor and ECM.

YES

Turn the ignition switch OFF.

Disconnect the 3P connector from the Boost Pressure Sensor.

(To page 11-57)

(From page 11-56)

Measure resistance between terminal 1 (+) and terminal 2 (−) of the Boost Pressure Sensor.

Is there approx. 1,000Ω? NO → **Replace the Boost Pressure Sensor.**

YES

Measure resistance between terminal 1 (+) and terminal 3 (−) of the Boost Pressure Sensor.

Is there approx. 5,000Ω? NO → **Replace the Boost Pressure Sensor.**

YES

Turn the ignition switch ON.

Measure voltage between YEL/BLU (+) terminal of the Boost Pressure Sensor harness connector and body ground.

Is there approx. 5V? NO → Turn the ignition switch OFF.

YES

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

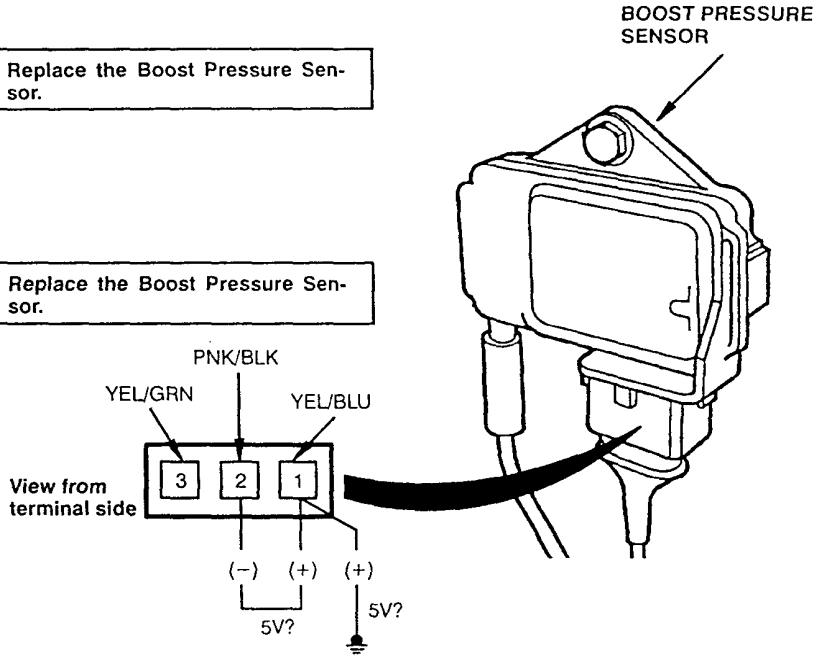
Measure voltage between A51 (+) terminal and A13 (−) terminal at the breakout−box.

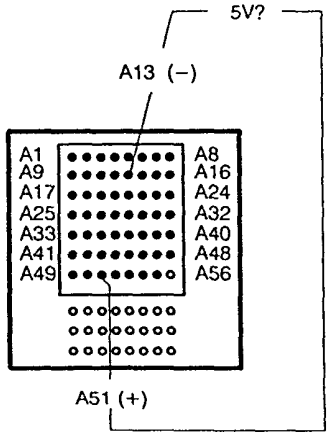
Is there approx. 5V? YES → **Repair open in YEL/BLU (+) wire between ECM (A51) and Boost Pressure Sensor.**

NO

Turn the ignition switch OFF.

Reconnect the 3P conector.





(To page 11-58)

(To page 11-58)

(cont'd)

Troubleshooting Flowchart – Boost Pressure Sensor

(From page 11-57)

(From page 11-57)

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A51 (+) terminal of the ECM connector.

Is there continuity?

YES

Repair short in YEL/BLU (+) wire between ECM (A51) and Boost Pressure Sensor.

NO

Substitute a known-good ECM and recheck. If symptom/indication goes away, replace original ECM.

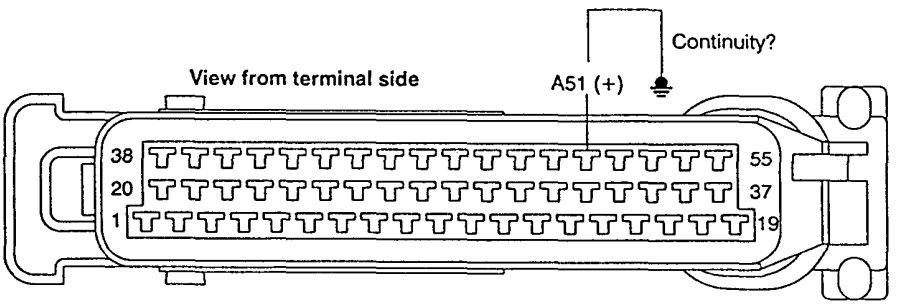
Measure voltage between YEL/BLU (+) terminal and PNK/BLK (–) terminal of the Boost Pressure Sensor harness connector.

Is there approx. 5V?

NO

Repair open in PNK/BLK (–) wire between ECM (A13) and Boost Pressure Sensor.

YES



(To page 11-59)

(From page 11-58)

Turn the ignition switch OFF.

Reconnect the 3P connector.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A54 (+) terminal and A13 (-) terminal at the breakout-box.

Is there approx. 2V?

YES → **Substitute a known-good ECM and recheck. If symptom/indication goes away, replace the original ECM.**

NO

Turn the ignition switch OFF and disconnect 55P connector from the ECM.

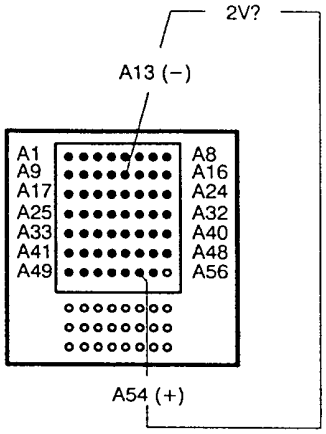
Check for continuity to body ground on A54 (+) terminal of ECM connector.

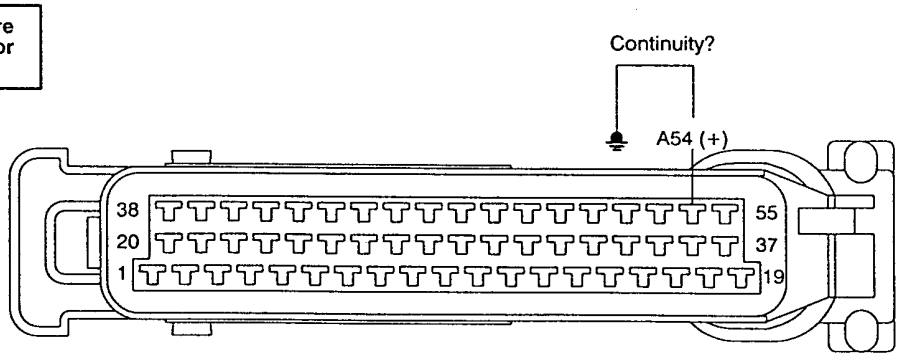
Is there continuity?

YES → **Repair short in YEL/GRN (+) wire between Boost Pressure Sensor and ECM (A54).**

NO

Repair open in YEL/GRN (+) wire between Boost Pressure Sensor and ECM (A54).

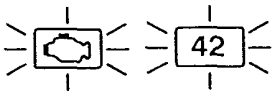




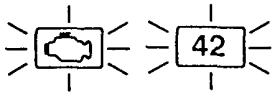
View from terminal side

Diesel Engine Management System

Troubleshooting Flowchart – Boost Pressure Sensor



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 42: An electrical problem in the Boost Pressure Sensor (signal above setpoint).
The Boost Pressure Sensor converts turbo charger Boost Pressure into electrical signal inputs to the ECM.



– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 42 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Start the engine.

Is the MIL on and does ist indicate code 42?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary).**
Check for poor connections or loose wires between the Boost Pressure Sensor and ECM.

YES

Turn the ignition switch OFF.

Disconnect the 3P connector from the Boost Pressure Sensor.

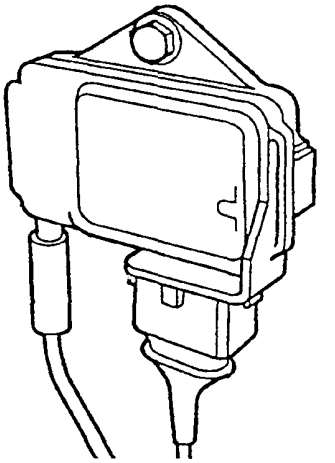
Measure resistance between terminal 1 (+) and terminal 2 (–) of the Boost Pressure Sensor.

Is there approx. 1,000Ω?

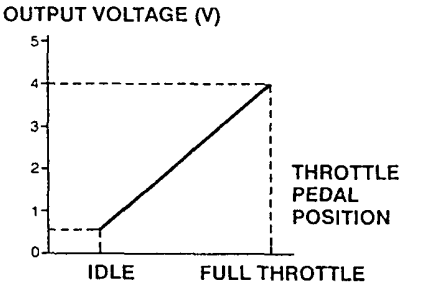
NO → **Replace Boost Pressure Sensor.**

YES

(To page 11-61)



BOOST PRESSURE SENSOR



(From page 11-60)

Measure resistance between terminal 1 (+) and terminal 3 (−) of the Boost Pressure Sensor.

Is there approx. 5,000Ω? NO → **Replace the Boost Pressure Sensor.**

YES

Turn the ignition switch ON.

Measure voltage between YEL/BLU (+) terminal of the Boost Pressure Sensor harness connector and body ground.

Is there battery voltage? YES → **Repair short to ignition in YEL/BLU (+) wire between ECM (A51) and Boost Pressure Sensor.**

NO

Is there approx. 5V? NO → Turn the ignition switch OFF.

YES

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A51 (+) terminal and A 13 (−) terminal at the breakout−box.

Measure voltage between YEL/BLU (+) terminal and PNK/BLK (−) terminal of the Boost Pressure Sensor harness connector.

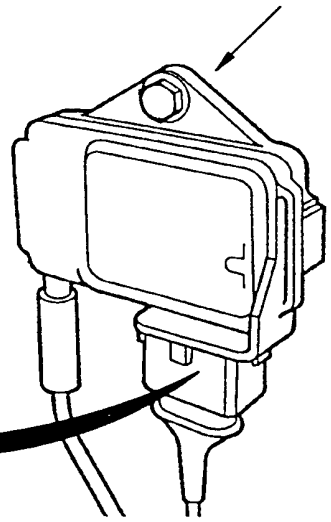
Is there approx. 5V? YES → **Repair open in YEL/BLU (+) wire between ECM (A51) and Boost Pressure sensor.**

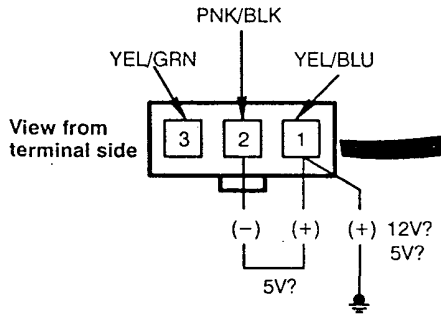
NO

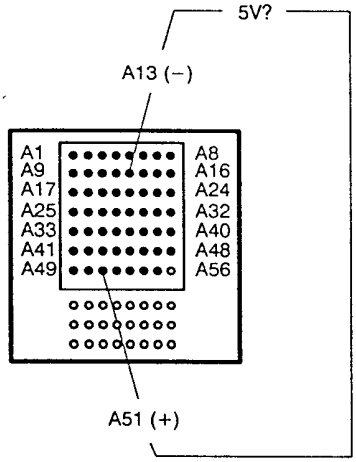
Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

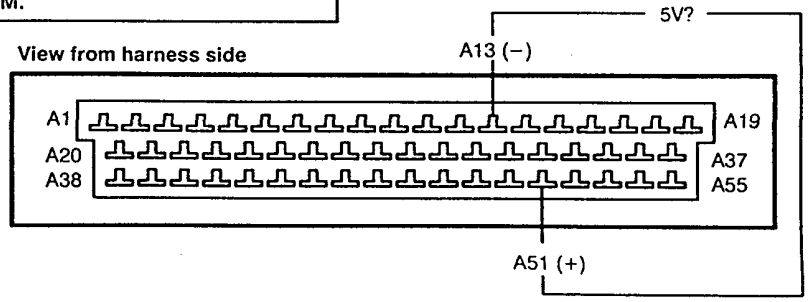
(To page 11-62)

BOOST PRESSURE SENSOR









(cont'd)

Troubleshooting Flowchart – Boost Pressure Sensor (cont'd)

(From page 11-61)

Is there approx. 5V?

NO → Repair open or short to ignition in PNK/BLK (–) wire between ECM (A13) and Boost Pressure Sensor.

YES

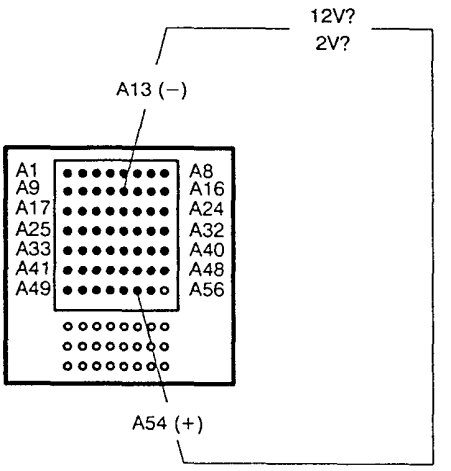
Turn the ignition switch OFF.

Reconnect the 3P connector.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A54 (+) terminal and A 13 (–) terminal at the breakout–box.



Is there battery voltage?

YES → Repair short to ignition in YEL/GRN (+) wire between ECM (A54) and Boost Pressure Sensore.

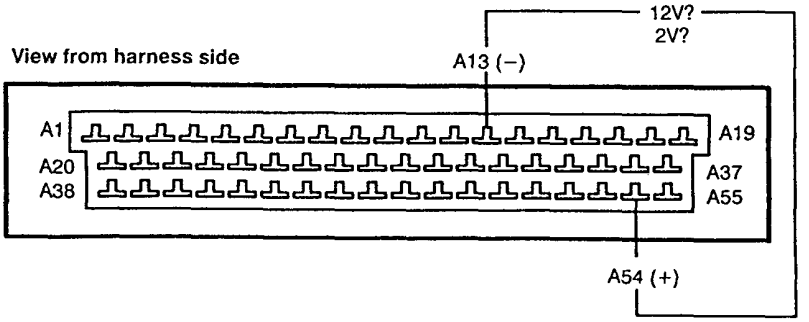
NO

Is there approx. 2V?

NO → Repair open in YEL/GRN (+) wire between ECM (A54) and Boost Pressure Sensor.

YES

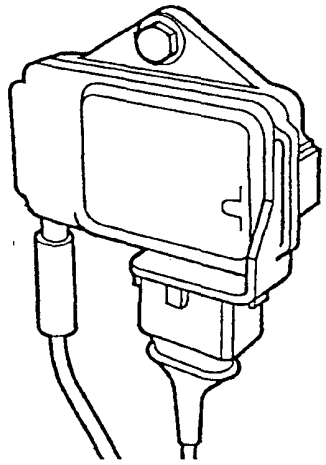
Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.



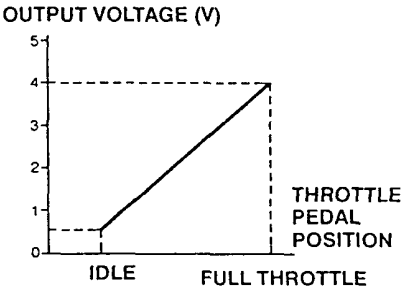
Troubleshooting Flowchart – Boost Pressure Sensor

43

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 43: An electrical problem in the Boost Pressure Sensor (implausible with atm. pressure sensor).
The Boost Pressure Sensor converts turbocharger boost pressure into electrical signal inputs to the ECM.



BOOST PRESSURE SENSOR



43

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 43 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Start the engine.

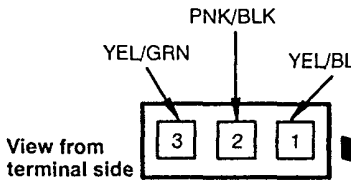
Does the MIL indicate code 43?

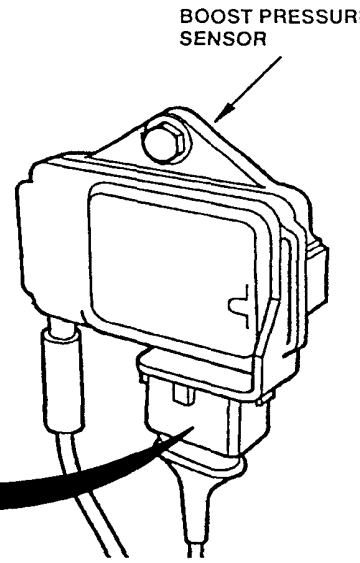
NO → Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between Boost Pressure Sensor and ECM.

YES

Turn the ignition switch OFF.

Disconnect the 8P connector from the Boost Pressure Sensor.





Measure resistance between terminal 1 (+) and terminal 2 (–) of the Boost Pressure Sensor.

Is there approx. 1,000Ω?

NO → Replace Boost Pressure Sensor.

YES

(To page 11-65)

(From page 11-64)

Measure resistance between terminal 1 (+) and terminal 3 (−) of the Boost Pressure Sensor.

Is there approx. 5,000 Ω? NO → **Replace Boost Pressure Sensor.**

YES

Measure voltage between YEL/BLU (+) terminal of the Boost Pressure Sensor harness connector and body ground.

Is there approx. 5V? NO → Turn the ignition switch OFF.

YES

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A51 (+) terminal and A13 (−) terminal at the breakout−box.

Is there approx. 5V? YES → **Repair open in YEL/BLU (+) wire between Boost Pressure Sensor and ECM (A51).**

NO

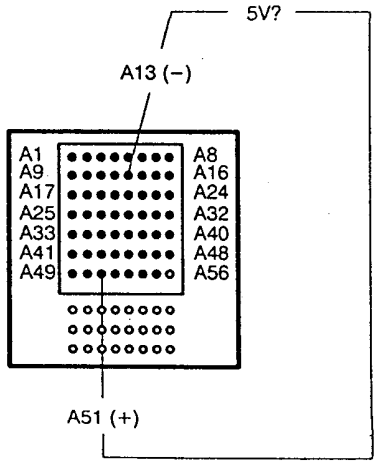
- **Repair short in YEL/BLU (+) wire between Boost Pressure sensor and ECM (A51).**
- **Substitute a known−good ECM and recheck. If symptom/indication goes away, replace original ECM.**

Measure voltage between YEL/BLU (+) terminal and PNK/BLK (−) terminal of the Boost Pressure Sensor harness connector.

Is there approx. 5V NO → **Repair open or short in PNK/BLK (−) wire between Boost Pressure Sensor and ECM.**

YES

- **Substitute a known−good Boost Pressure Sensor and recheck. If symptom/indication goes away, replace original Boost Pressure Sensor.**
- **If not, check YEL/GRN wire for an open or short and/or substitute a known−good ECM and recheck.**



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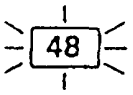
sel Engine Management System

oubleshooting Flowchart – Low Battery Voltage



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 48: A problem in the Battery circuit.

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), or the PGM–Tester connected to the Data Link Connector, code 48 is indicated.

Do the ECM Reset Procedure (see page 11-13).

the ignition switch ON

Does the MIL indicate code 48?

NO → Intermittent failure, system is OK at this time (test drive may be necessary). Check for faulty battery cables or poor terminal connections.

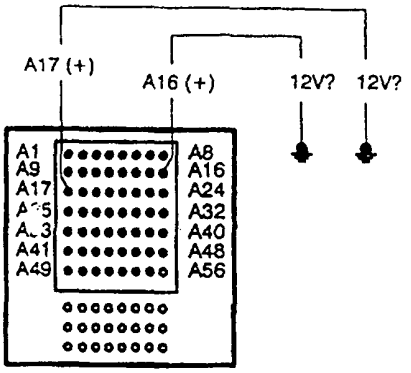
YES

Turn the Ignition switch OFF.

onnect the breakout–box between CM and ECM connector.

Turn the Ignition switch ON.

leasure voltage between A16/A17 +) at the breakout–box and body round.



there battery voltage?

NO → Test the battery.

YES

Turn the Ignition switch OFF.

Disconnect the 4P connector from the Throttle Pedal Position Sensor.

Is the battery OK?

YES → Repair bad battery cables or terminal connections.

NO

Test the charging system.

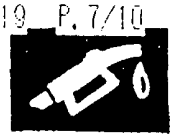
Is the charging system OK?

NO → Repair the charging system.

YES

Replace battery.

(To page 11-67)



7/10

(From page 11-66)

Measure voltage between A16/A17 (+) terminal and A18/A19 (–) terminal.

Is there battery voltage?

NO → Repair bad connections between BLK (–) wires and body ground.

YES

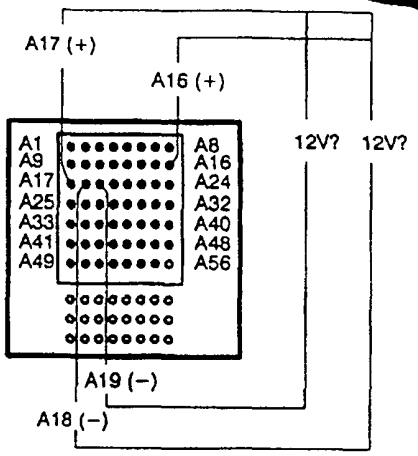
Turn the headlights (HI), blower motor, and rear window defogger on, and check the voltage.

Is there battery voltage?

NO → – Repair faulty battery cables or poor terminal connections.
– Replace battery.

YES

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.



Diesel Engine Management System

Troubleshooting Flowchart – Needle Lift Sensor

81

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 81: A problem in the Needle Lift Sensor circuit (no signal).

The needle lift sensor consists of a coil which surrounds the shaft of an extended injection needle. The coil is fed a DC supply from the ECM which produces a magnetic field. When the needle is moved under the influence of fuel pressure, the magnetic field is disturbed which induces an ac voltage in the coil. The induced voltage is sent to the ECM as a reference point for the start of the injection sequence.

AC

81

- The MIL has been reported on.
- With the Data Link Connector's diagnostic L-Line (WHT/PNK wire) connected to ground (see page 11-12), code 81 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 81?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Needle Lift Sensor and ECM.**

YES

Turn the ignition switch OFF.

Disconnect the 2P connector from Needle Lift Sensor.

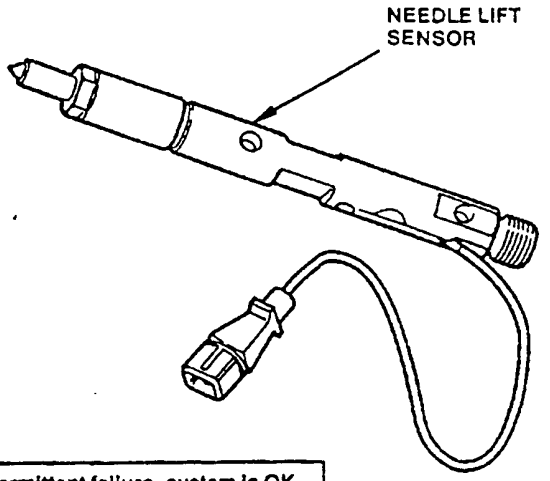
Measure resistance between both terminals of the Needle Lift Sensor.

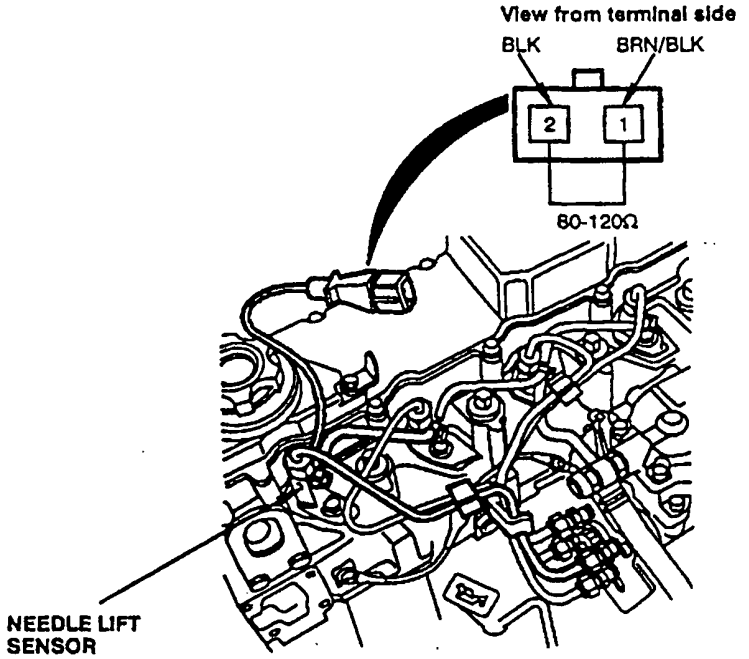
Is there 80-120Ω?

NO → **Replace Needle Lift Sensor.**

YES

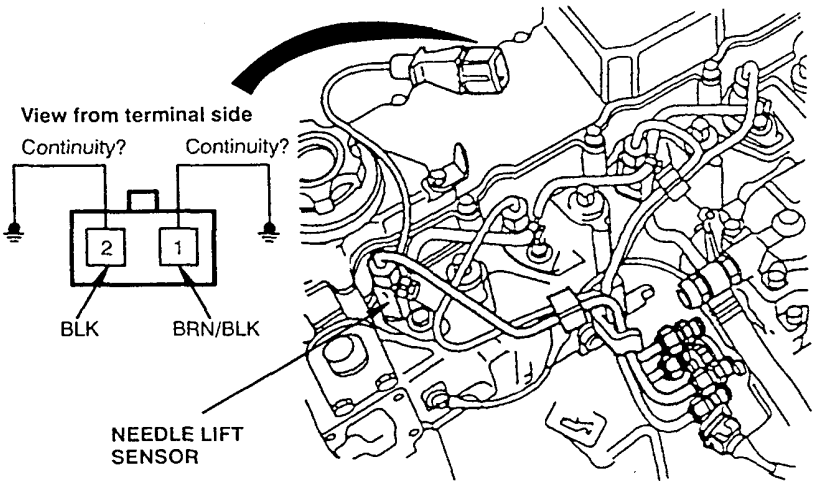
(To page 11-69)





(From page 11-68)

Check for continuity to body ground on both terminals of the Needle Lift Sensor.



Is there continuity? YES → Replace Needle Lift Sensor.

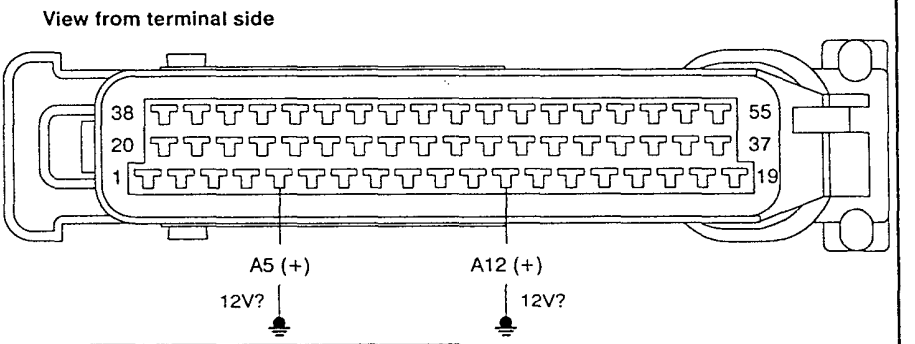
NO

Reconnect the 2P connector.

Disconnect the 55P connector from the ECM.

Turn ignition switch ON.

Measure voltage between A5 (+) terminal of the ECM connector and body ground.



Is there battery voltage? YES → **Repair short to ignition in BRN/BLK (+) wire between Needle Lift Sensor and ECM (A5).**

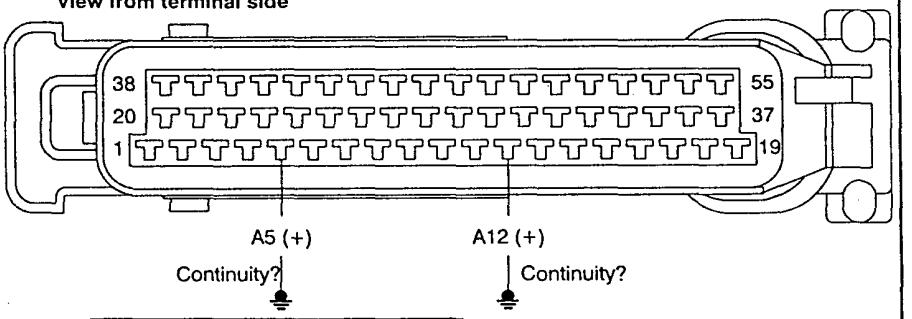
NO

Measure voltage between A12 (+) terminal of the ECM connector and body ground.

Is there battery voltage? YES → **Repair short to ignition in BLK (+) wire between Needle Lift Sensor and ECM (A12).**

NO

Turn ignition switch OFF.



Check for continuity to body ground on A5 (+) terminal of the ECM connector.

Is there continuity? YES → **Repair short in BRN/BLK (+) wire between Needle Lift Sensor and ECM (A5).**

NO

(To page 11-70)

(cont'd)

Troubleshooting Flowchart – Needle Lift Sensor (cont'd)

(From page 11-69)

Check for continuity to body ground on A12 (+) terminal of the ECM connector.

Is there continuity? YES → Repair short in BLK (+) wire between Needle Lift Sensor and ECM (A12).

NO

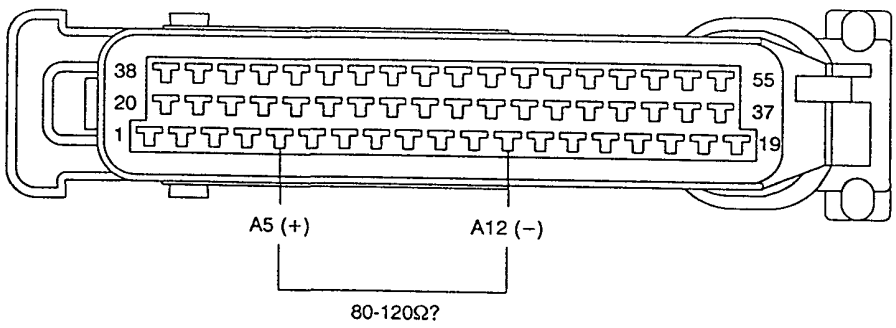
Measure resistance between terminals A5 (+) and A12 (–) of the ECM connector.

Is there 80-120Ω? NO → Repair open in BRN/BLK (+) and/or BLK (–) wire(s) between Needle Lift Sensor and ECM (A5/A12).

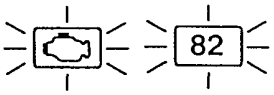
YES

Substitute a known – good ECM and recheck. If symptom/indication goes away, replace the original ECM.

View from terminal side

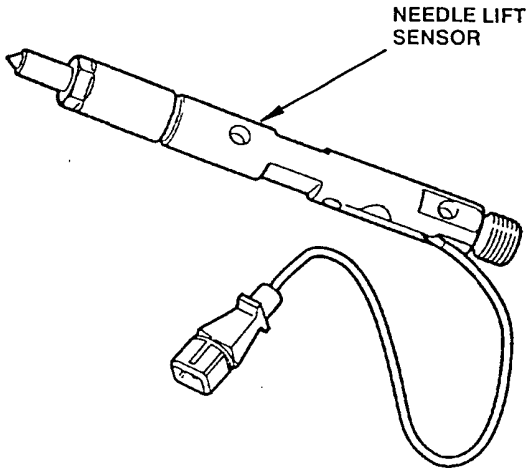


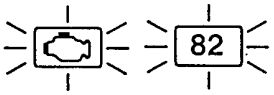
Troubleshooting Flowchart – Needle Lift Sensor



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 82: A problem in the Needle Lift Sensor circuit together with a problem in the Crankshaft Position Sensor circuit.

The Needle Lift Sensor consists of a coil which surrounds the shaft of an extended injection needle. The coil is fed a DC supply from the ECM which produces a magnetic field. When the needle is moved under the influence of fuel pressure, the magnetic field is disturbed which induces an AC voltage in the coil. The induced voltage is sent to the ECM as a reference point for the start of the injection sequence.





– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 82 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does it indicate code 82?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Needle Lift Sensor and the ECM.**

YES

Does the MIL also indicate code 31?

YES → **Go to page 11-36 and perform test for Crankshaft Position Sensor (code 31) before performing Needle Lift Sensor (code 82) test.**

NO

Turn the ignition switch OFF.

Disconnect the 2P connector from Needle Lift Sensor.

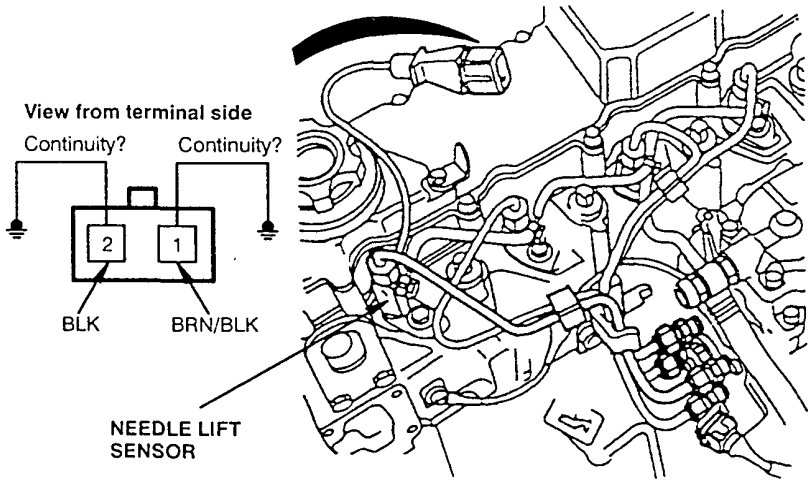
(To page 11-73)

(From page 11-72)

Measure resistance between both terminals of the Needle Lift Sensor.

Is there 80-120Ω? NO → **Replace Needle Lift Sensor.**

YES



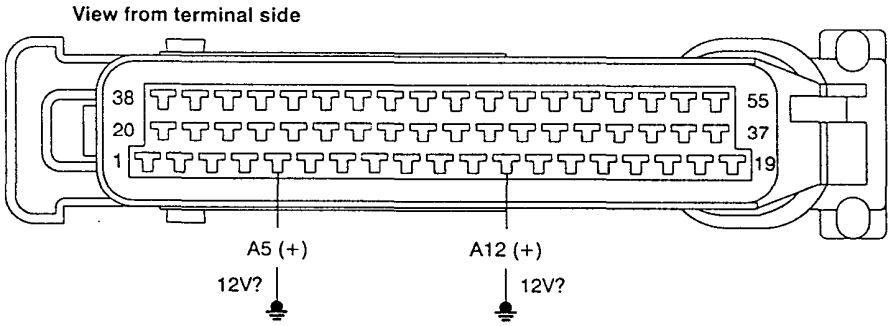
Check for continuity to body ground on both terminals of the Needle Lift Sensor.

Is there continuity? YES → **Replace Needle Lift Sensor.**

NO

Reconnect the 2P connector.

Disconnect the 55P connector from the ECM.



Turn ignition switch ON.

Measure voltage between A5 (+) terminal of the ECM connector and body ground.

Is there battery voltage? YES → **Repair short to ignition in BRN/BLK (+) wire between Needle Lift Sensor and ECM (A5).**

NO

Measure voltage between A12 (+) terminal of the ECM connector and body ground.

Is there battery voltage? YES → **Repair short to ignition in BLK (+) wire between Needle Lift Sensor and ECM (A12).**

NO

Turn ignition switch OFF.

(To page 11-74)

(cont'd)

Troubleshooting Flowchart – Needle Lift Sensor (cont'd)

(From page 11-73)

Check for continuity to body ground on A5 (+) terminal of the ECM connector.

Is there continuity? YES → Repair short in BRN/BLK (+) wire between Needle Lift Sensor and ECM (A5).

NO

Check for continuity to body ground on A12 (+) terminal of the ECM connector.

Is there continuity? YES → Repair short in BLK (+) wire between Needle Lift Sensor and ECM (A12).

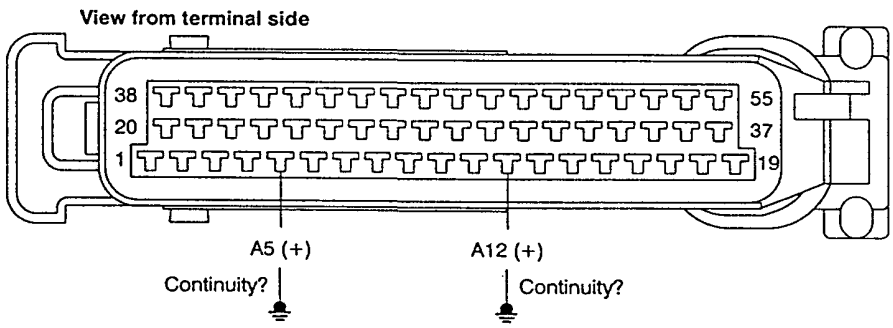
NO

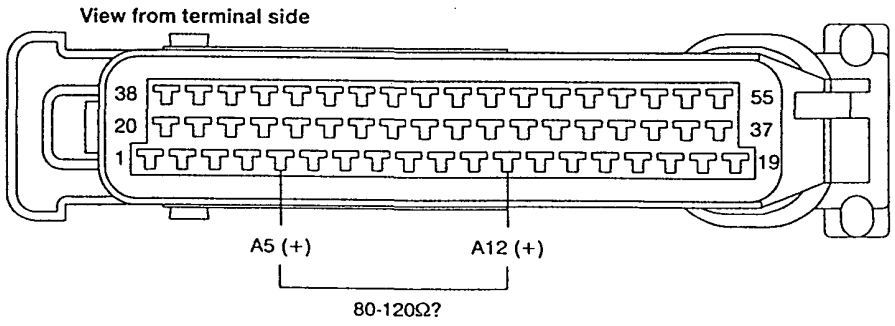
Measure resistance between terminals A5 (+) and A12 (–) of the ECM connector.

Is there 80-120Ω? NO → Repair open in BRN/BLK (+) and/or BLK (–) wire(s) between Needle Lift Sensor and ECM (A5/A12).

YES

Substitute a known – good ECM and recheck. If symptom/indication goes away, replace the original ECM.





Fuel Supply System

– System Troubleshooting Guide

NOTE: Across each row in the chart, the subsystems that could be sources of a symptom are ranked in the order they should be inspected starting with ①. Find the symptom in the left column, read across to the most likely source, then refer to the page listed at the top of that column. If inspection shows the system is OK, try the next most likely system ②, etc.

PAGE / SUBSYSTEM / SYMPTOM	FUEL SUPPLY SYSTEM	FUEL PUMP	FUEL INJECTION PUMP ASSEMBLY	FUEL FILTER	FUEL TIMING SOLENOID	FUEL QUANTITY SOLENOID	FUEL QUANTITY FEEDBACK SENSOR	FUEL SHUT-OFF SOLENOID	FUEL TEMPERATURE SENSOR	INJECTORS	GLOW PLUGS/ COLD STARTING DEVICE
	11-88	11-86	11-86	11-85	11-98	11-112	11-104	11-100	11-92	11-81	11-89
ENGINE WON'T START				①	③			②			
DIFFICULT TO START ENGINE WHEN COLD				①	②						①
ROUGH IDLE				①						②	
FREQUENT STALLING				②						①	
MISFIRE OR TOUGH RUNNING	②		③							①	
LOSS OF POWER				②	③					①	
FUEL CONSUMPTION TOO HIGH		②								①	
KNOCKING IN ENGINE		②								①	

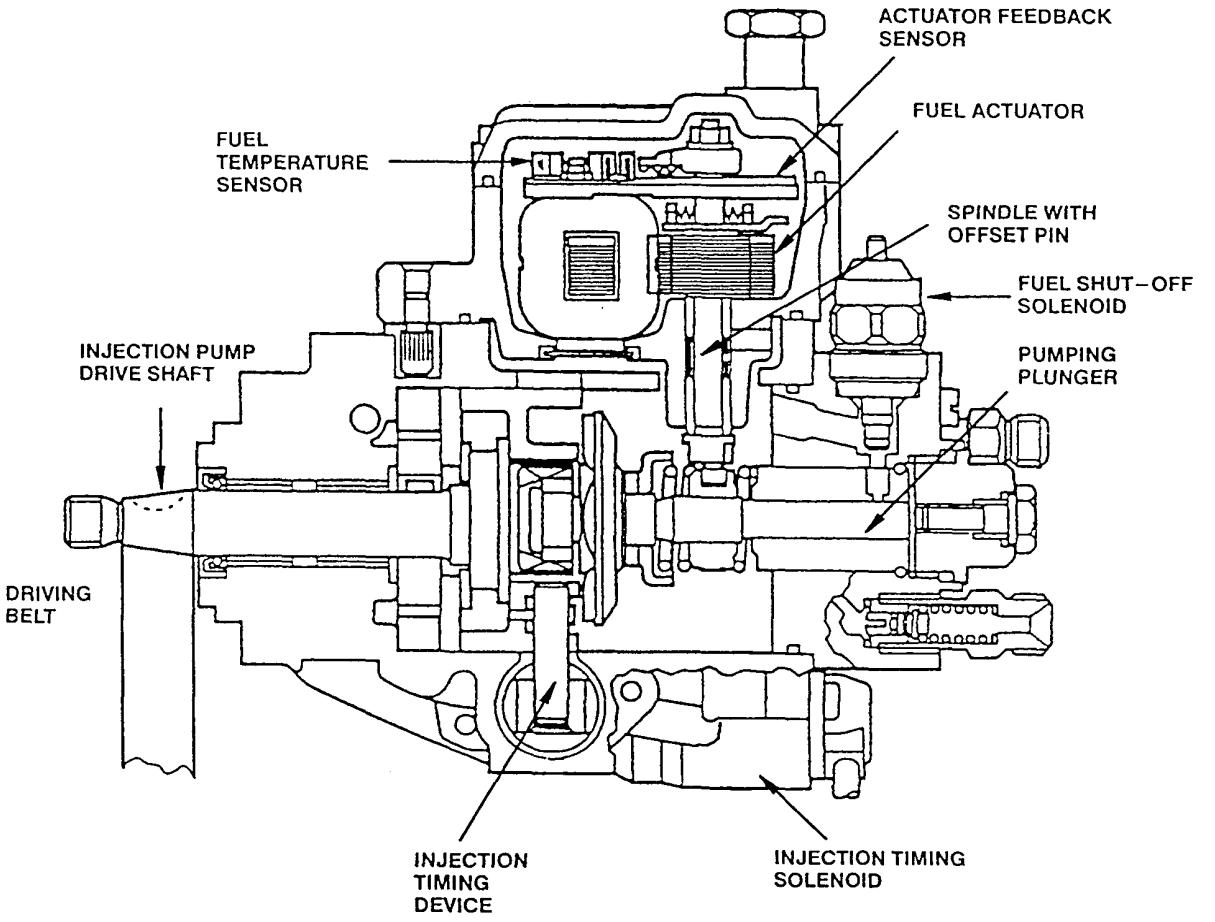
System Description

The Fuel Supply System contains the electronic Fuel Injection Pump Assembly (including fuel pump), fuel injectors, the fuel filter and the fuel tank. Additional sensors are located in the engine compartment in order to supply the control ECM with the necessary inputs to achieve an optimum in combustion.

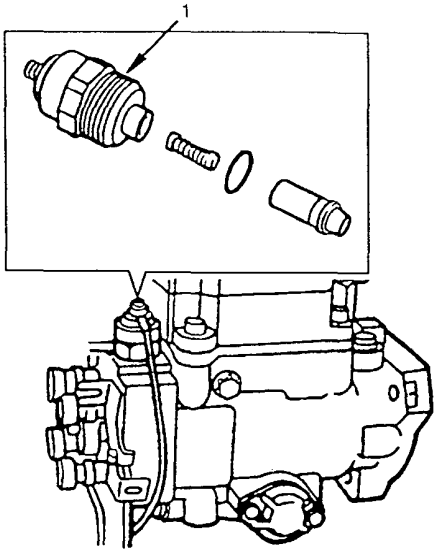
Fuel Supply System

System Description

Fuel Injection Pump Assembly



The injection pump assembly is driven by a belt from the rear end of the camshaft and is a vane–type pump. The control spool is used for the delivery of fuel from the fuel injection pump to the injectors. The amount of fuel to be injected into the cylinders is also controlled by the control spool. At the top of the pump a fuel temperature sensor is located to keep the amount of fuel injected into the cylinders constant independent of the fuel density (varying to temperature). In case of any major fault the fuel shut–off solenoid cuts off the fuel supply to the injectors immediately.



– **Fuel Shut–off Solenoid (1)**

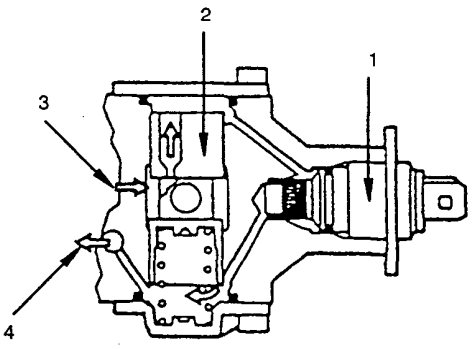
The Fuel Shut–off Solenoid is used to cut off the fuel delivery immediately after the ECM detects any major fault or when a problem occurs in the power supply to the Injection Pump Assembly.

When the engine is started, the Fuel Shut–off Solenoid is energised and opens the fuel delivery.

Diagnostic Trouble Code (DTC) 54 has been developed to detect a defect Fuel Shut–off Solenoid and/or a problem in its electrical circuit.

In case of failure the single Fuel Shut–off Solenoid can be replaced without replacing the entire Fuel Injection Pump Assembly.

Injection timing device



1 injection timing solenoid
2 spring loaded plunger
3 pump internal pressure
4 pump feed pressure

– **Injection Timing Device and Injection Timing Solenoid**

The timing device for the Injection Pump Assembly contains an Injection Timing Solenoid (1) and a spring loaded Pumping Plunger (2) moving under the influence of pump working pressure.
The timing solenoid is responsible for the 50Hz "buzzing" sound when the ignition is turned on. The ECM controls injection timing by varying the operating frequency which alters the fuel pressure on the plunger and moves it against spring tension.
This motion changes the height of the plunger and therefore the ignition is retarded.
Injection timing is controlled by the ECM by comparing the signal from the Needle Lift Sensor (actual start of injection) with the Fuel Timing Solenoid. The ECM then alters the signal to the timing solenoid in order to correct injection timing. In case a change does not occur or differs by a substantial amount the ECM assumes a fault and the amount of injected fuel will be reduced.
Diagnostic Trouble Code 34 has been developed for the Timing Solenoid to detect a defect Injection Timing Solenoid and/or a problem in its electrical circuits.

System Description

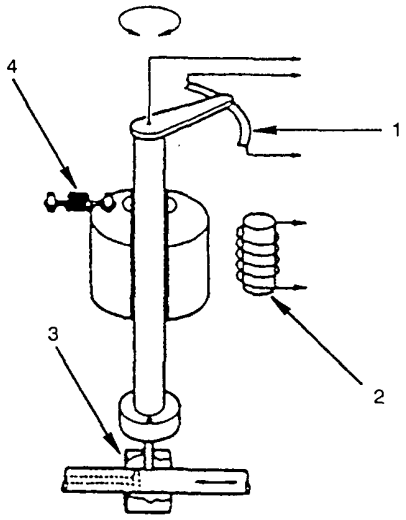
– **Fuel Quantity Solenoid and Control Spool**

This unit is used to accurrately control the amount of fuel delivered to the injectors. The amount of fuel is controlled by the use of a Fuel Quantity Solenoid (2) producing a magnetic field and causing the rotary magnet (mounted on an eccentric shaft) to rotate. This rotation is converted into a linear motion by the Control Spool (3). The Control Spool (3) position is proportional to the amount of fuel actually delivered to the injectors.

The Fuel Quantity Feedback Sensor (1) signals the quantity to the ECM. In case the fuel quantity actuator (2) is de–energised the return spring (4) causes the rotary magnet and eccentric shaft to move back to their initial position.

A failure of this sensor will cause the engine to stall or not to start as the ECM will activate the Fuel Shut–off Solenoid.

Diagnostic Trouble Code 64 has been developed to detect a defect Fuel Quantity Actuator or an electrical problem in this particular circuit.



Quantity servo control unit

– **Fuel Quantity Feedback Sensor (1)**

The Fuel Quantity Feedback Sensor located inside the injection pump assembly above the eccentric shaft is a rotary potentiometer. This potentiometer signals the ECM information regarding the position of the control speed (3) and therefore the amount of fuel actually delivered to the injectors.

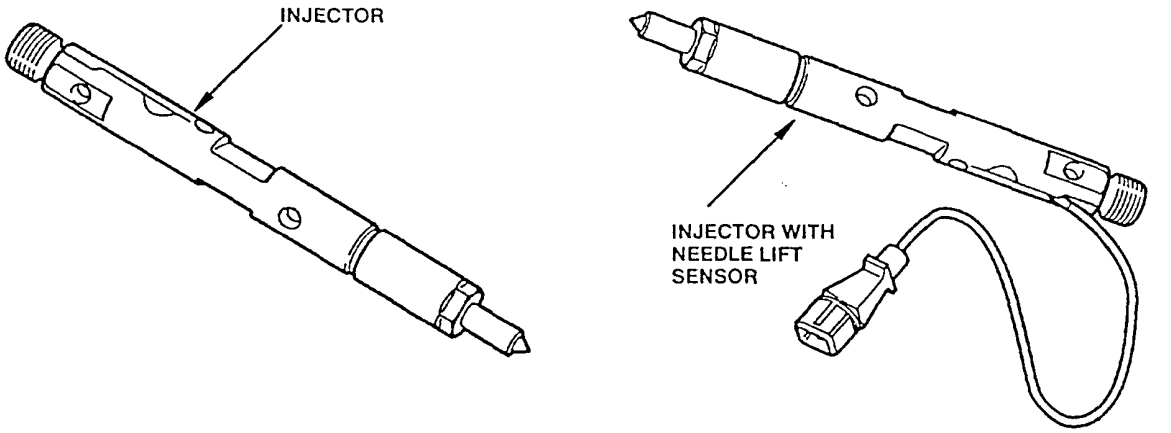
Failure of this sensor causes the engine to stall or not to start.

Diagnostic Trouble Codes (DTC) 61 and 62 have been developed to detect a detect Fuel Quantity Feedback Sensor or an electrical problem in its circuit. In case of a defect Fuel Quantity Feedback Sensor the complete fuel injection pump assembly has to be replaced.

Fuel Injectors

Injectors

The "Two Stage Injectors" are spring loaded valves, operated by fuel pressure. Injectors 2–4 are of the same type, injector No. 1 has the needle lift sensor located on top of the injector.
If the fuel pressure is much higher than the counterforce from the spring, the valve opens very fast and an accurately controlled amount of fuel is injected into the cylinder. In order to optimize combustion the injected fuel is atomized at the multi–hole end of the injector. If fuel pressure falls below spring pressure the valve closes and the fuel injection is interrupted.



Injector No. 1 contains the needle lift sensor. This sensor consists of a coil which surrounds the extended shaft of the injector needle. This coil is fed with DC–voltage, therefore producing a magnetic field around the shaft. While the needle is moving under the influence of the fuel pressure the magnetic flux is disturbed. A certain amount of disturbance in the magnetic flux signals the ECM the actual start of injection.

(cont'd)

Fuel Injectors (cont'd)

Testing

- **With the engine running:**

  With the engine idling, disconnect each fuel injector connector individually and inspect the change in idle speed.

  1. If the idle speed drop is almost the same for each cylinder, the Fuel Injectors are OK.
  2. If the idle speed remains the same when you disconnect a particular Fuel Injector, replace the *Fuel Injector and recheck.*

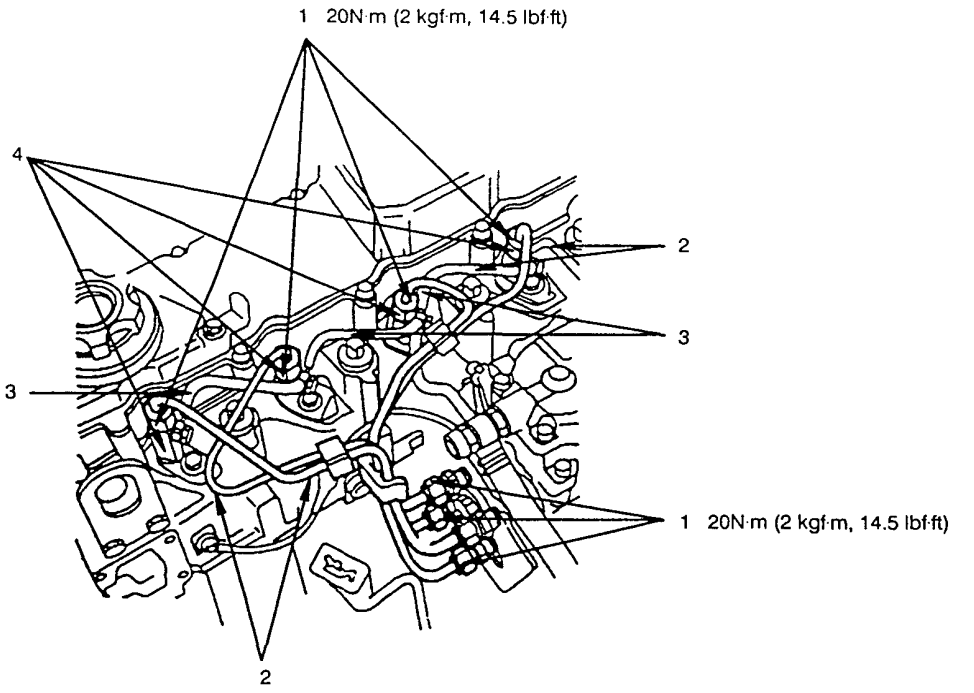
- **Without the engine running:**

  1. Remove the injectors (see page 11-83).
  2. Use an injector testing device and apply pressure manually.
     If the injector opens at 22,200 kPa (220 Kg/cm², 3150 psi) the injector is OK. Otherwise replace the Fuel Injectors.
  3. Check if fuel comes out of the injector hole after the Fuel Injector has closed again. In that instance, replace the Fuel Injector.

Replacement

⚠ WARNING **Do not smoke when working on the fuel system. Keep open flames away from your work area.**

1. Disconnect battery earth lead.
2. Remove sound deadening pad.
3. Remove Intercooler Top Hose from Intake Manifold and Inlet Manifold Intake Pipe.
4. Slacken Injector Pipe Unions (1) at Fuel Injector and Injection Pump Assembly.
5. Remove Injection Pipes (2).
6. Remove the spill return pipes (3).
7. Remove the Fuel Injectors (4).



Fuel Injectors (cont'd)

Refit:

8. Clean Fuel Injectors and Injector Seat in cylinder head.
9. Fit new sealing washer to each Fuel Injector and fit Fuel Injectors to cylinder head.
10. Fit the Injector Clamp Plate and tighten Injector Clamp Plate bold to 25 N·m (2.5 kgf·m,18 lbf·ft).
11. Connect spill return pipes to Fuel Injectors and secure retaining clips.
12. Tighten Injector Pipes to Injector Unions to 20 N·m (2 kgf·m,14.5 lbf·ft).
13. Tighten Injector Pipes to Injection Pump Unions to 20 N·m (2 kgf·m,14.5 lbf·ft).
14. Fit Inlet Manifold Intake Pipe and tighten bolts to 20 N·m (2 kgf·m,14.5 lbf·ft).
15. Fit EGR recirculation pipe to Inlet Manifold and tighten to 25 N·m (2.5 kgf·m,18 lbf·ft).
16. Fit bolt securing Inlet Manifold Intake Pipe to camshaft cover and tighten to 9 N·m (0.9 kgf·m. 6.5 lbf·ft).
17. Connect Intercooler Top Hose to Inlet Manifold and tighten clip.
18. Position sound deadening pad and connect battery earth lead.

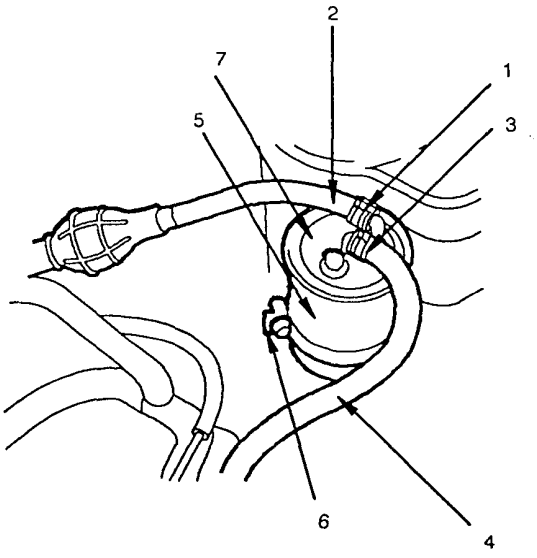
Fuel Filter

Replacement

⚠ WARNING **Do not smoke when working on the fuel system. Keep open flames away from your work area.**

The filter should be replaced every 20,000 km (12,000 miles) or 12 months, whichever comes first.

1. Disconnect battery earth lead.
2. Place a shop towel under and around the Fuel Filter.
3. Release the clip (1) and remove fuel inlet hose (2) from Fuel Filter.
4. Release the clip (3) and remove fuel outlet hose (4) from Fuel Filter.
5. Remove the Fuel Filter bracket (5) from body mounting.

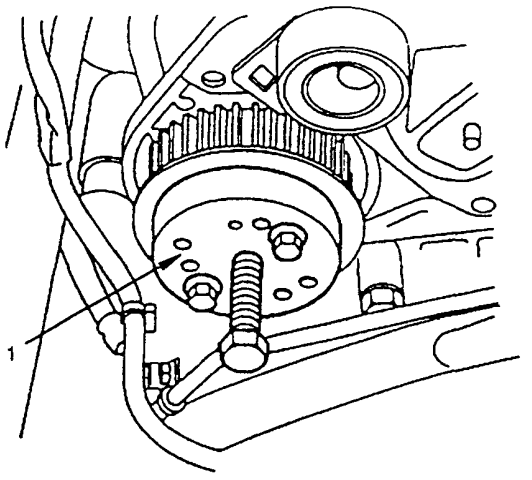


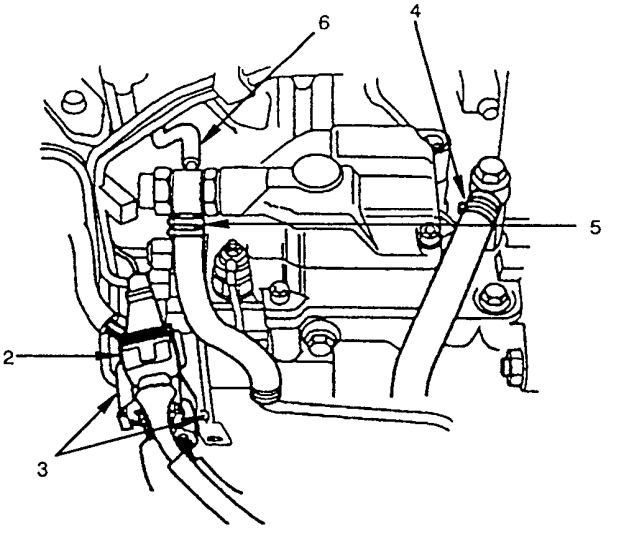
6. Slacken clamp bolt (6) from Fuel Filter bracket.
7. Remove Fuel Filter (7).
8. Refit in the reverse order of removal and use new washers.

Fuel Injection Pump Assembly

Replacement

1. Disconnect battery earth lead and remove sound deadening pad.
2. Remove Injector Pump Assembly timing belt (→ MAINTENANCE).
3. Loosen Injection Pump Assembly shaft clamp bolt, remove spacer and tighten clamp bolt again to 31 N·m (3.1 kgf·m, 22.5 lbf·ft)
4. Remove Injection Pump Assembly drive gear retaining nut 60 N·m (6.0 kgf·m, 43.5 lbf·ft).
5. Remove locking pin from drive gear.
6. Use special tool (1) to remove drive gear from tapes.
7. Remove Intercooler Hose and EGR recirculation pipe 9 N·m (0.9 kgf·m, 6.5 lbf·ft) from Inlet Manifold Intake Pipe.
8. Remove Inlet Manifold Intake Pipe from manifold chamber 25 N·m (2.5 kgf·m, 18 lbf·ft).
9. Disconnect multiplug (2) from Needle Lift Sensor and multiplugs (3) from Fuel Injection Pump Assembly.
10. Remove fuel feed hose (4), fuel return hose (5) and spill return hose (6).
11. Remove Injector Pipe Unions (→ REPLACEMENT OF INJECTORS).
12. Remove Fuel Injection Pump Assembly.
13. Refit in the reverse order of removal and discard gaskets. Position new spacer beneath clamp bolt (see 3.) and tighten bolt to 25 N·m (2.5 kgf·m, 18 lbf·ft).



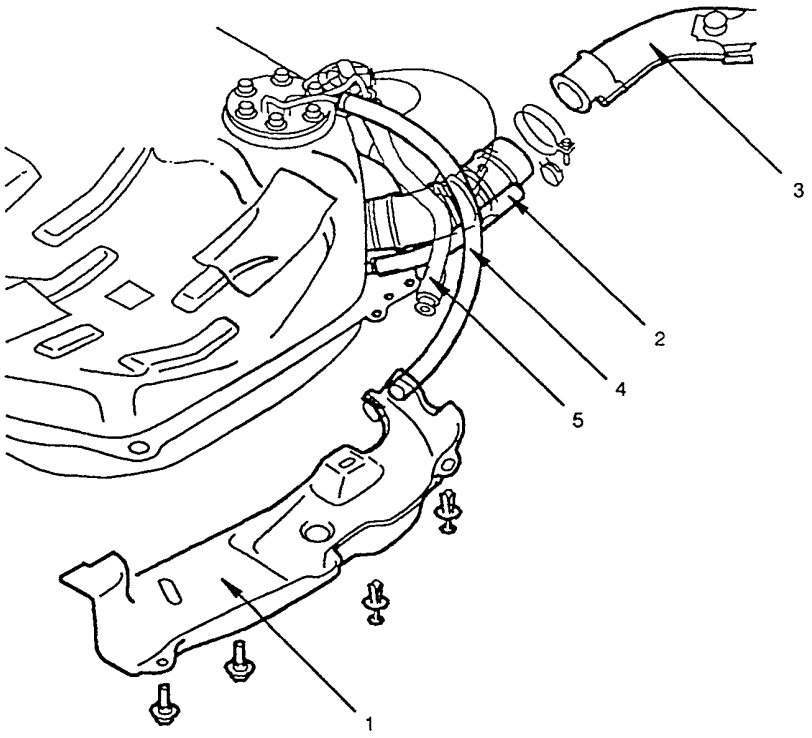


Fuel Tank

Replacement

⚠ WARNING Do not smoke when working on the fuel system. Keep open flames away from your work area.

1. Disconnect battery earth lead.
2. Jack up rear of the car, support with jack stands.
3. Drain the Fuel Tank and remove LH rear wheel.
4. Remove fuel pipe shield (1) and fuel pump harness mulitplug.
5. Disconnect breather hose (2), filler hose (3), fuel return hose (4) and fuel feed hose (5).
6. Place jack, or other support, under the Fuel Tank.
7. Remove the Fuel Tank mounting bolts and let the straps fall free.



8. Remove the Fuel Tank.
9. Install a new washer on the drain bolt, then install parts in the reverse order of removal.

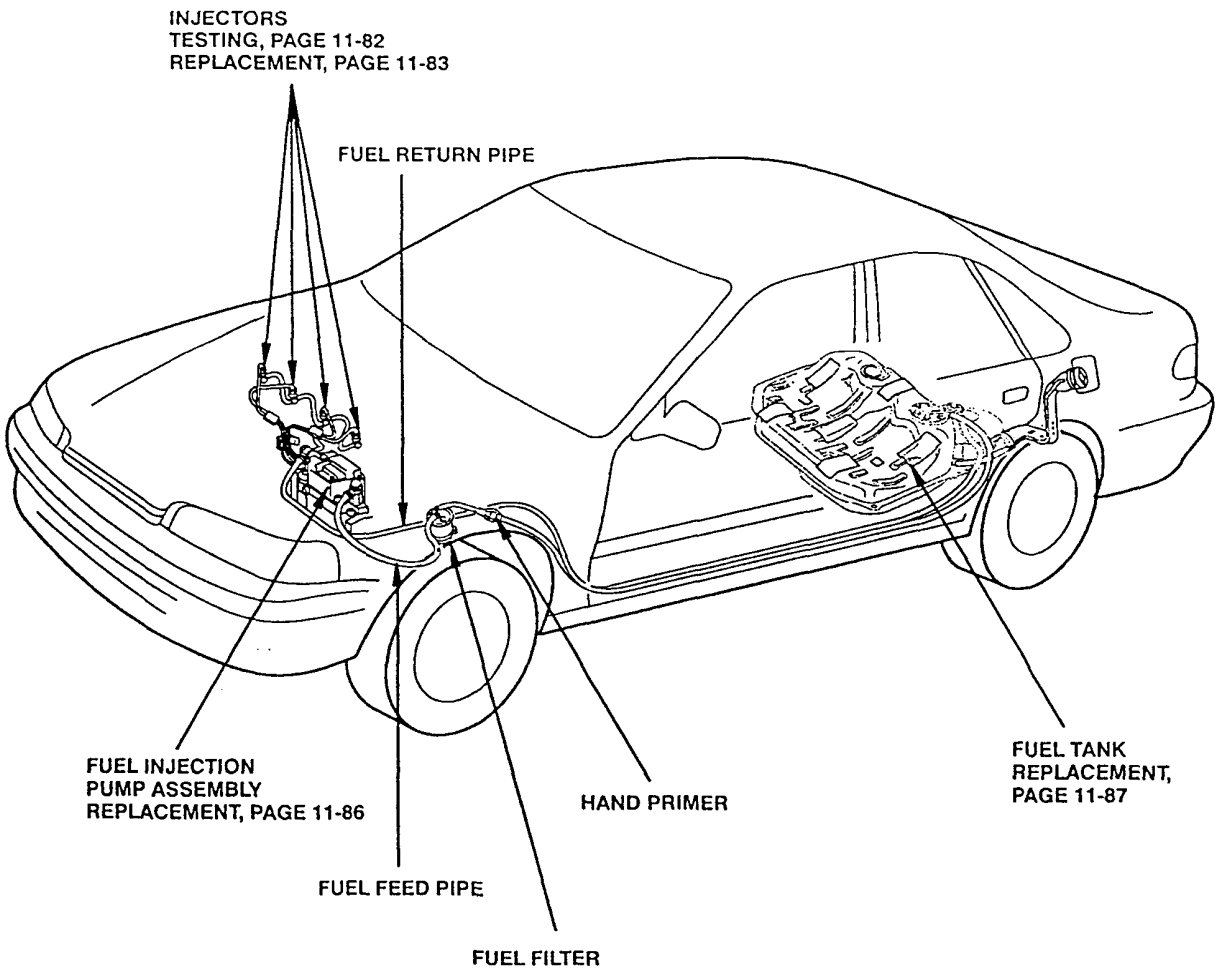
Fuel Hoses and Fuel Pipes

Inspection

1. Inspect the Fuel Hoses for damage, leaks, interference or twisting.
2. Check the Fuel Lines for damage, tipping, rusting or leakage. Also check for bent Fuel Lines.
3. Check for leaks at Hose and line joints or connections, and retighten if necessary.

CAUTION:

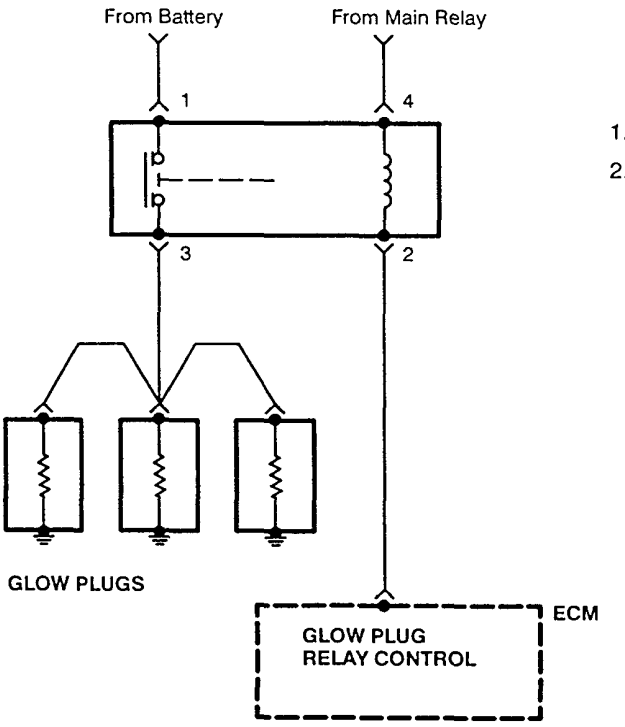
- When disconnecting the hoses, slide back the clamps, then twist hoses as you pull, to avoid damaging them.
- Clean the flared joint of high pressure hoses thoroughly before reconnecting them.



Glow Plug Relay

When the ignition switch is turned on the Glow Plug Relay is energised and a Glow Plug Indicator Lamp in the gauge assembly illuminates. The Glow Plug Relay supplies current from the battery to the three Glow Plugs (there is no Glow Plug in No. 4 cylinder) to increase the temperature of the compressed air in the cylinder to ignition point, especially at cold starting.

Relay Testing



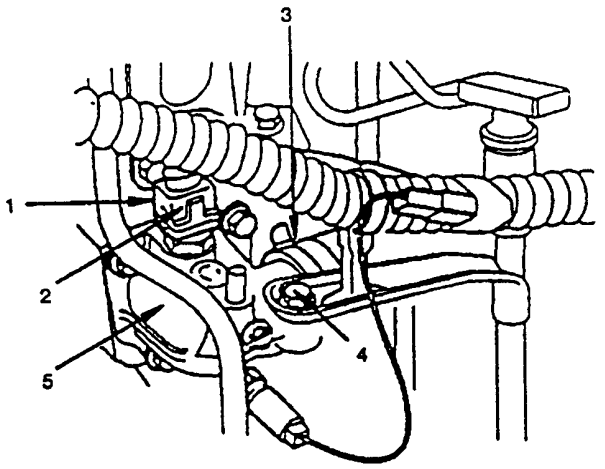
1. Remove the Glow Plug Relay.
2. Attach the battery positive terminal to the No. 4 terminal and the battery negative terminal to the No. 2 terminal of the Glow Plug Relay. Then check for continuity between the No. 1 terminal and No. 3 terminal.
   - If there is no continuity, replace the Glow Plug Relay and retest.
   - If there is continuity, the Glow Plug Relay is OK.

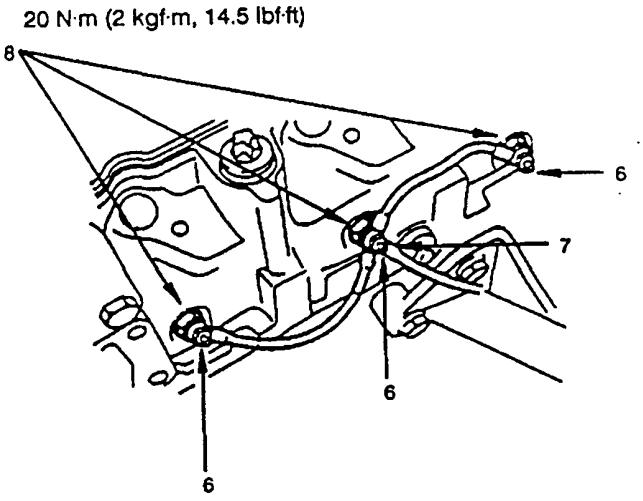
Fuel Supply System

Glow Plugs

Replacement

1. Remove battery earth lead.
2. Remove sound deadening pad.
3. Remove intercooler hose from intake manifold.
4. Remove alternator (only for models with a/c → ELECTRICAL). Drain cooling system.
5. Disconnect coolant temperature sensor connector (1). engine
6. Remove coolant temperature sensor (2) from harness.
7. Remove radiator top hose (3) from coolant outlet elbow.
8. Remove bolt (4) 25 N·m (2.5 kgf·m, 18 lbf·ft) securing the dipstick tube bracket to the coolant outlet elbow.
9. Unscrew 4 bolts and remove coolant outlet elbow (5).
10. Remove nuts (6), glow plugs leads (7) and Glow Plugs (8) 20 N·m (2 kgf·m, 14.5 lbf·ft).
11. Refit in the reverse order of removal.



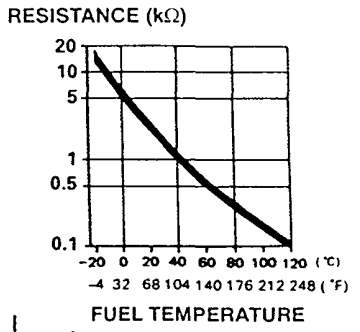


Troubleshooting Flowchart – Fuel Temperature Sensor

16

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 16: A problem in the Fuel Temperature Sensor circuit (signal below setpoint).

The Fuel Temperature Sensor is a temperature dependant resistor (thermistor). The resistance of the thermistor decreases as the fuel temperature increases as shown below. The Fuel Temperature Sensor is located inside the fuel injection pump assembly.



16

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 16 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 16?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Fuel Injection Pump Assembly (Fuel Temperature Sensor).**

YES

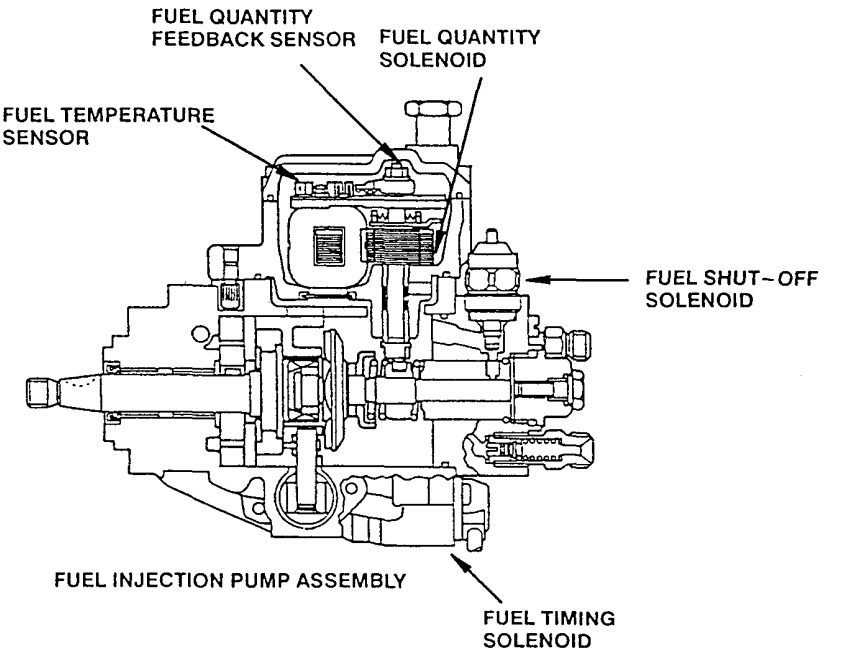
Warm up engine to normal operating temperature (the radiator fan comes on).

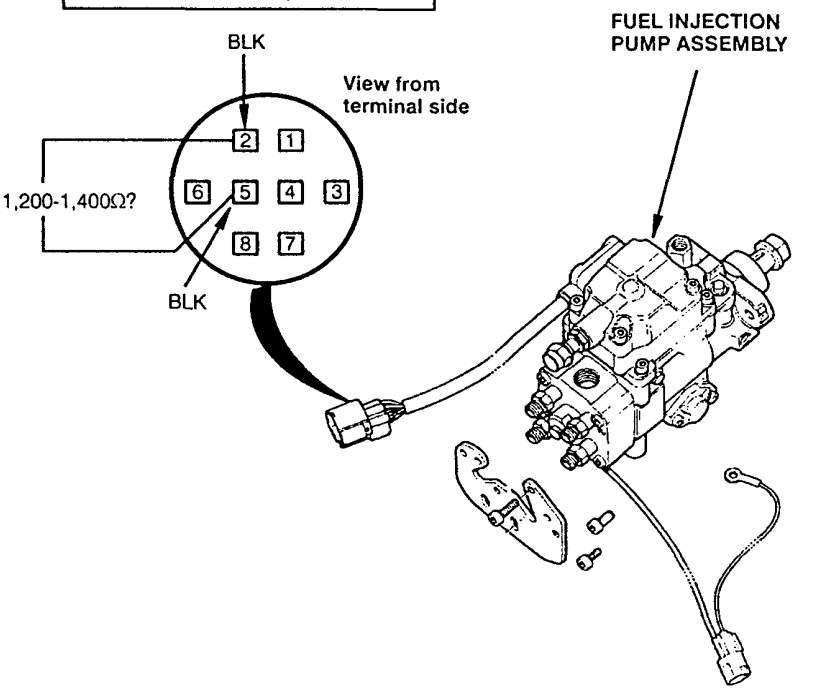
Turn the ignition switch OFF.

Disconnect the 8P connector from the Fuel Injection Pump Assembly.

Measure resistance between terminal 2 (+) and terminal 5 (–) of the Fuel Injection Pump Assembly connector.

(To page 11-93)





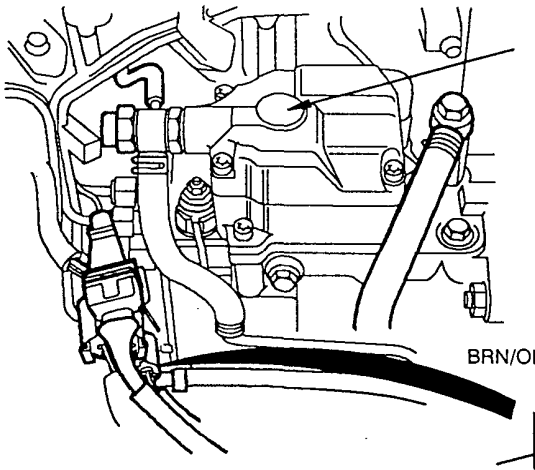
(From page 11-92)

Is there 1,200-1,400Ω?

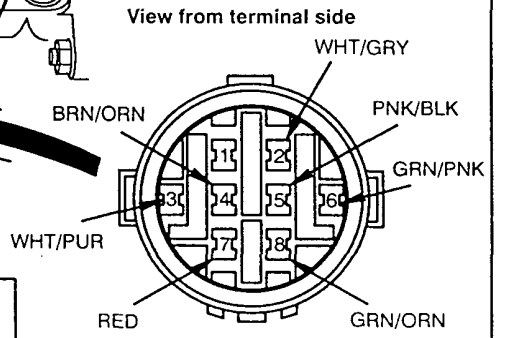
NO → Replace the Fuel Injection Pump Assembly.

YES

Turn the ignition switch ON.



Measure voltage between the WHT/GRY (+) terminal and body ground.



Is there approx. 5V?

YES → Measure voltage between WHT/GRY (+) terminal and PNK/BLK (−) terminal of the Fuel Injection Pump Assembly harness connector.

NO

Is there approx. 5V?

NO → **Repair open in PNK/BLK (−) wire between ECM (A13) and Fuel Injection Pump Assembly.**

YES

Turn the ignition switch OFF.

Reconnect the Fuel Injection Pump Assembly connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A13 (−) terminal of ECM connector.

Is there continuity?

YES → **Repair short in PNK/BLK (−) wire between ECM (A13) and Fuel Injection Pump Assembly.**

NO

Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

(To page 11-94)

(cont'd)

Troubleshooting Flowchart – Fuel Temperature Sensor (cont'd)

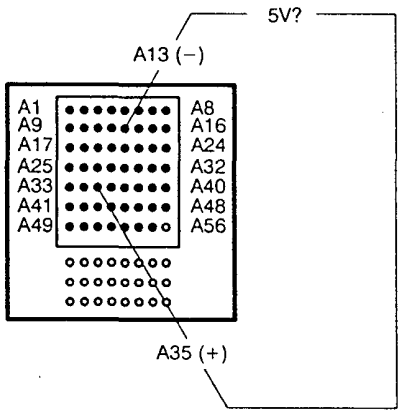
(From page 11-93)

Turn the ignition switch OFF.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A35 (+) terminal and A13 (–) terminal at the breakout–box.



Is there approx. 5V?

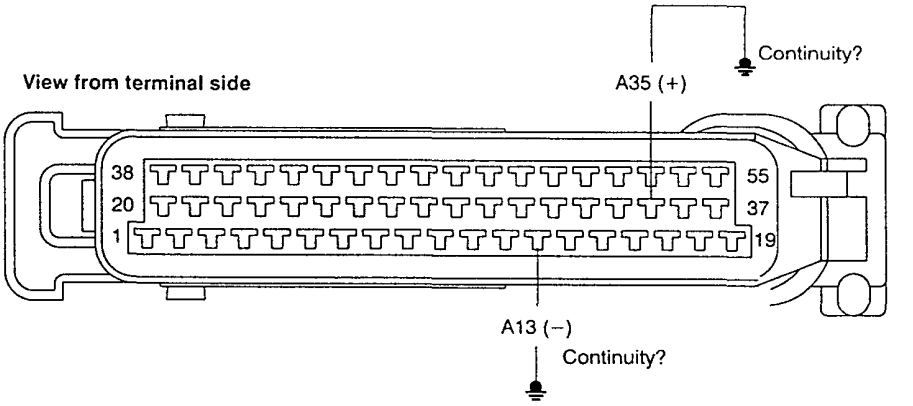
NO → **Repair open in WHT/GRY (+) wire between ECM (A35) and Fuel Injection Pump Assembly.**

YES

Turn the ignition switch OFF.

Reconnect the Fuel Injection Pump Assembly connector.

Disconnect the 55P connector from the ECM.



Check for continuity to body ground on A35 (+) terminal of the ECM connector.

Is there continuity?

YES → **Repair short in WHT/GRY (+) wire between ECM (A35) and Fuel Injection Pump Assembly.**

NO

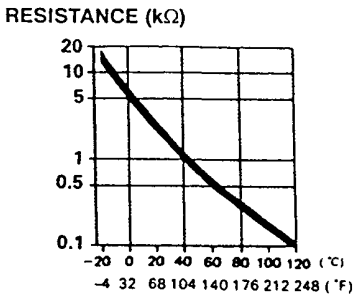
Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

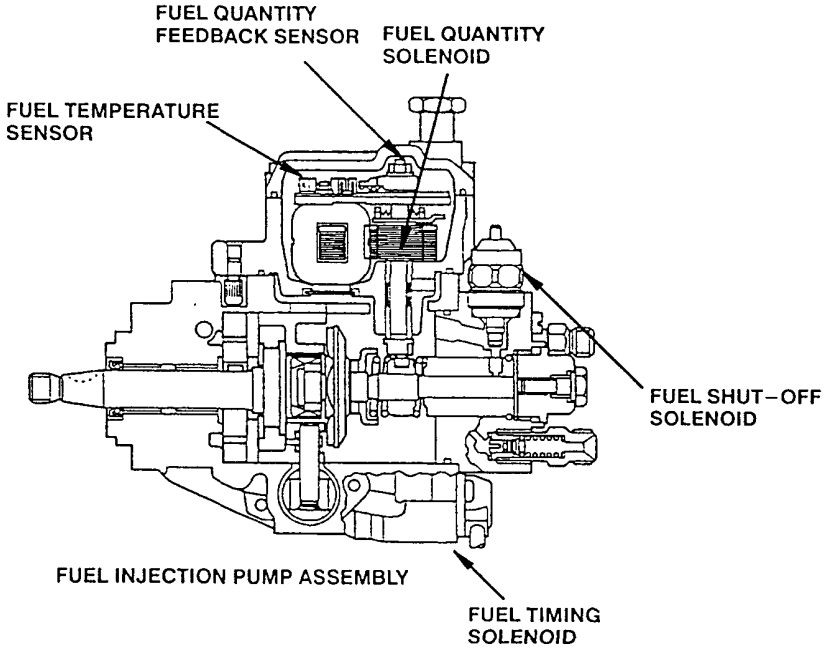
Troubleshooting Flowchart – Fuel Temperature Sensor

17

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 17: A problem in the Fuel Temperature Sensor circuit (signal above setpoint).

The Fuel Temperature Sensor is a temperature dependant resistor (thermistor). The resistance of the thermistor decreases as the fuel temperature increases as shown below. The Fuel Temperature Sensor is contained within the fuel injection pump assembly.





17

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 17 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 17?

NO → Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Fuel Injection Pump Assembly (Fuel Temperature Sensor).

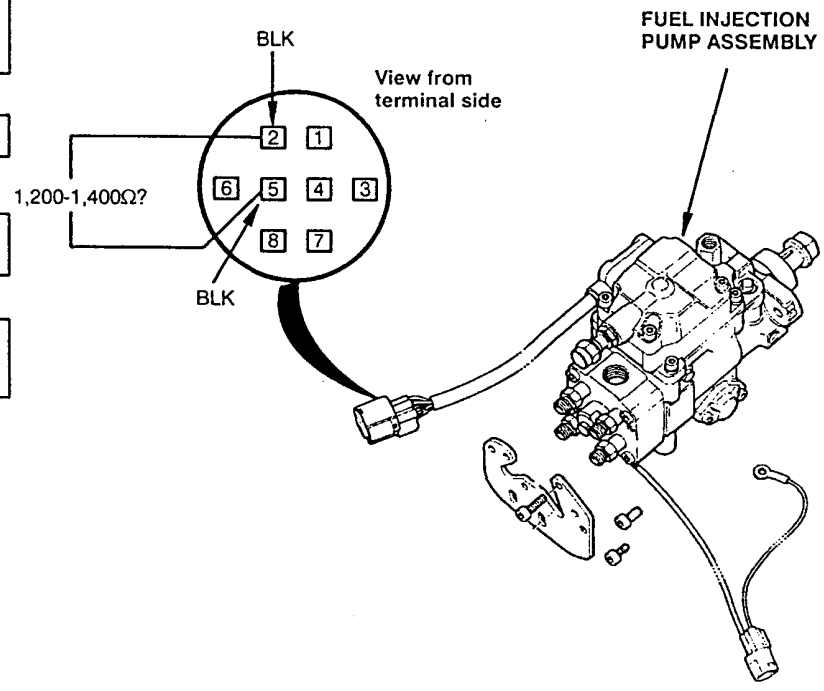
YES

Warm up engine to normal operating temperature (the radiator fan comes on).

Turn the ignition switch OFF.

Disconnect the 8P connector from the Fuel Injection Pump Assembly.

Measure resistance between terminal 2 (+) and terminal 5 (–)of.the Fuel Injection Pump Assembly connector.



(To page 11-97)

(From page 11-96)

Is there 1,200-1,400Ω?

NO → **Replace the Fuel Injection Pump Assembly.**

YES

Turn the ignition switch ON.

Measure voltage between the WHT/GRY (+) terminal and body ground.

Is there battery voltage?

YES → **Repair short to ignition WHT/GRY (+) wire between ECM (A35) and Fuel Injection Pump Assembly.**

NO

Is there approx. 5V?

YES → Measure voltage between WHT/GRY (+) terminal and PNK/BLK (−) terminal of the Fuel Injection Pump Assembly harness connector.

NO

Turn the ignition switch OFF.

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A35 (+) terminal and A13 (−) terminal at the breakout−box.

Is there approx. 5V?

YES → **Repair open in WHT/GRY (+) wire between ECM (A35) and Fuel Injection Pump Assembly.**

NO

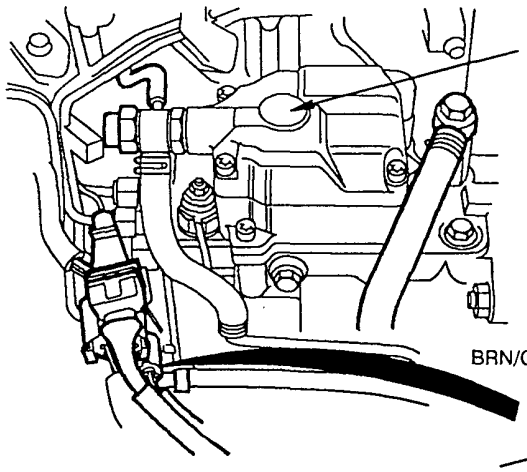
Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

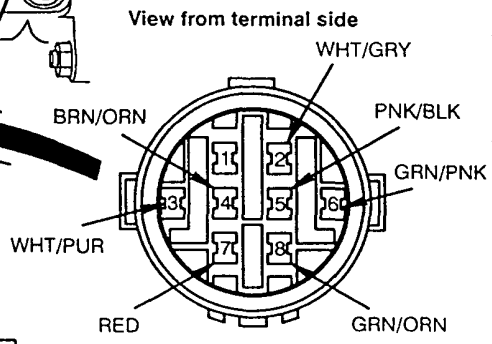
Is there approx. 5V?

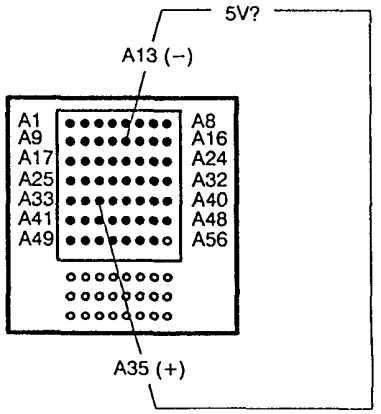
NO → **Repair open or short to ignition in PNK/BLK (−) wire between ECM (A13) and Fuel Injection Pump Assembly.**

YES

Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

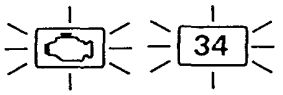






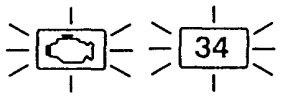
View from harness side

Troubleshooting Flowchart – Fuel Timing Solenoid



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 34: A problem in the Fuel Timing circuit.

The Fuel Timing Solenoid is controlled by the ECM to provide optimum fuel injection timing. The solenoid operates at 50 Hz and by varying the operating frequency the ECM controls injection timing.



– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 34 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does ist indicate code 34?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Fuel Injection Pump Assembly and the ECM.**

YES

Does the fuel timing solenoid inside the Fuel Injection Pump Assembly produce a 50 Hz buzzing sound?

YES → **Check for a sticking timing device and/or a defective pump housing pressure.**

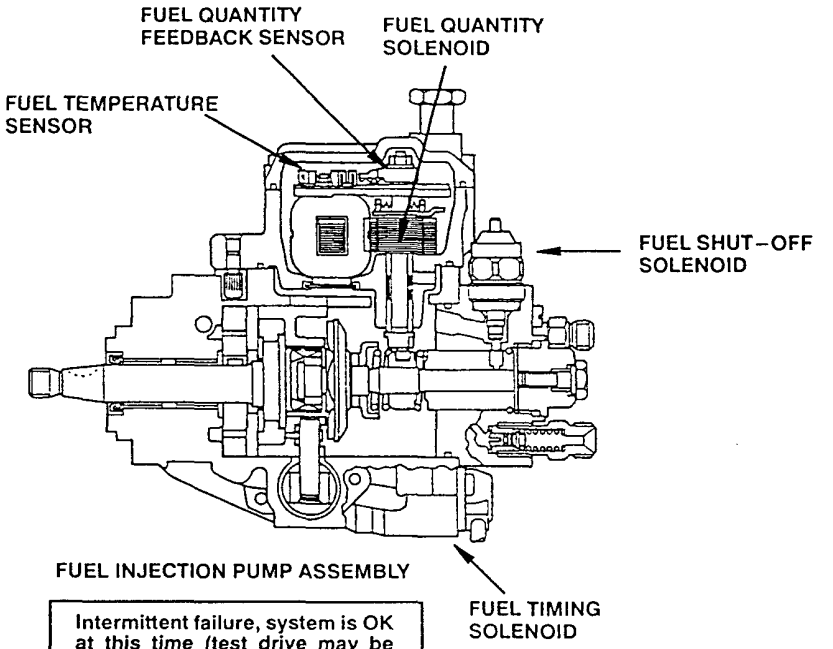
NO

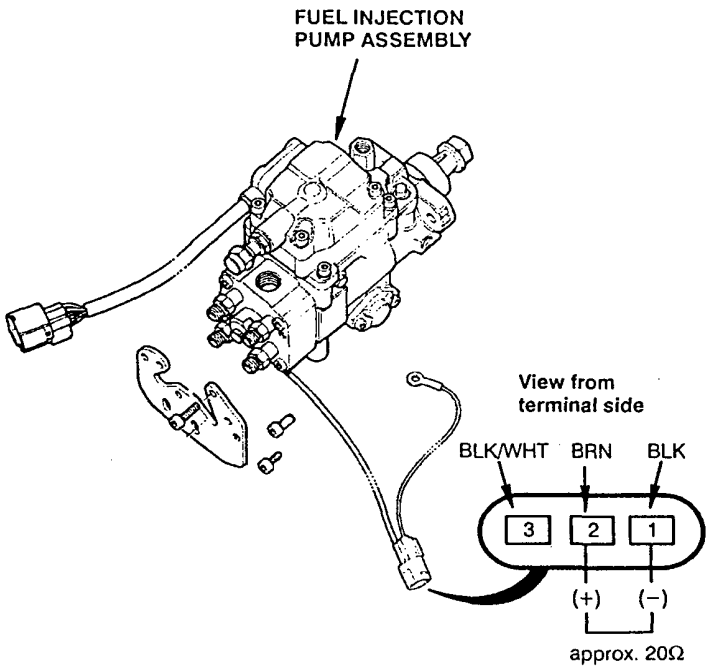
Turn the ignition switch OFF.

Disconnect the 3P connector from the Fuel Injection Pump Assembly.

Measure resistance between BRN/ORN (+) terminal and BLK/GRY (–) terminal on the Fuel Injection Pump Assembly.

(To page 11-99)





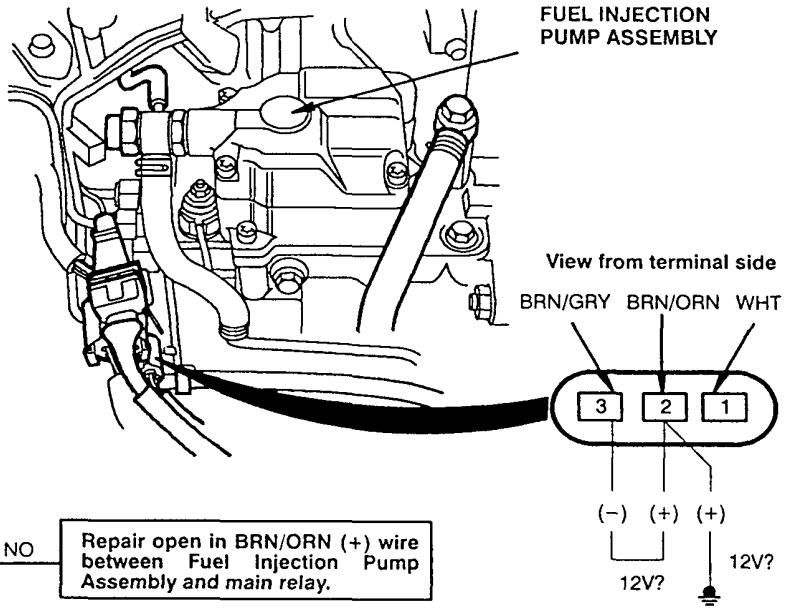
(From page 11-98)

Is there approx. 20Ω?

NO → Replace Fuel Injection Pump Assembly.

YES

Turn the ignition switch ON.



Measure voltage between BRN/ORN (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.

Is there battery voltage?

NO → Repair open in BRN/ORN (+) wire between Fuel Injection Pump Assembly and main relay.

YES

Measure voltage between BRN/ORN (+) terminal and BRN/GRY (−) terminal of the Fuel Injection Pump Assembly harness connector.

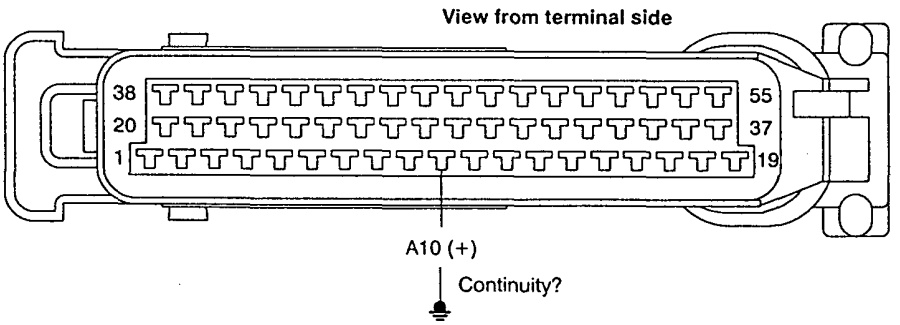
Is there battery voltage?

NO →
- Check for open circuit in BRN/GRY wire between Fuel Injection Pump Assembly and ECM (A10).
- Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

YES

Turn the ignition switch OFF and reconnect 3P connector.

Disconnect 55P connector form the ECM.



Check for continuity to body ground on terminal A10 (+) of the ECM connector.

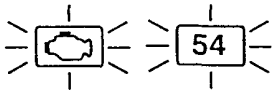
Is there continuity?

NO → Replace Fuel Injection Pump Assembly.

YES

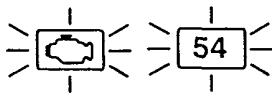
Repair short in BRN/GRY wire between Fuel Injection Pump Assembly and ECM (A10).

Troubleshooting Flowchart – Fuel Shut–off Solenoid



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 54: A problem in the Fuel Shut–off Solenoid (defective).

The Fuel Shut–off Solenoid is located in the high pressure section of the Fuel Injection Pump Assembly. The ECM opens the fuel supply by energising the solenoid and cuts off the fuel supply by de–energising the solenoid.



– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 54 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does ist indicate code 54?

NO

Intermittent failure, system is OK at this time (test drive may be necessary).
Check for poor connections or loose wires between the Fuel Shut–off Solenoid and ECM.

YES

Turn the ignition switch OFF.

Disconnect the 3P connector from the Fuel Injection Pump Assembly.

Measure resistance between terminal 1 (+) of the Fuel Injection Pump Assembly connector and body ground.

Is there approx. 5–10Ω

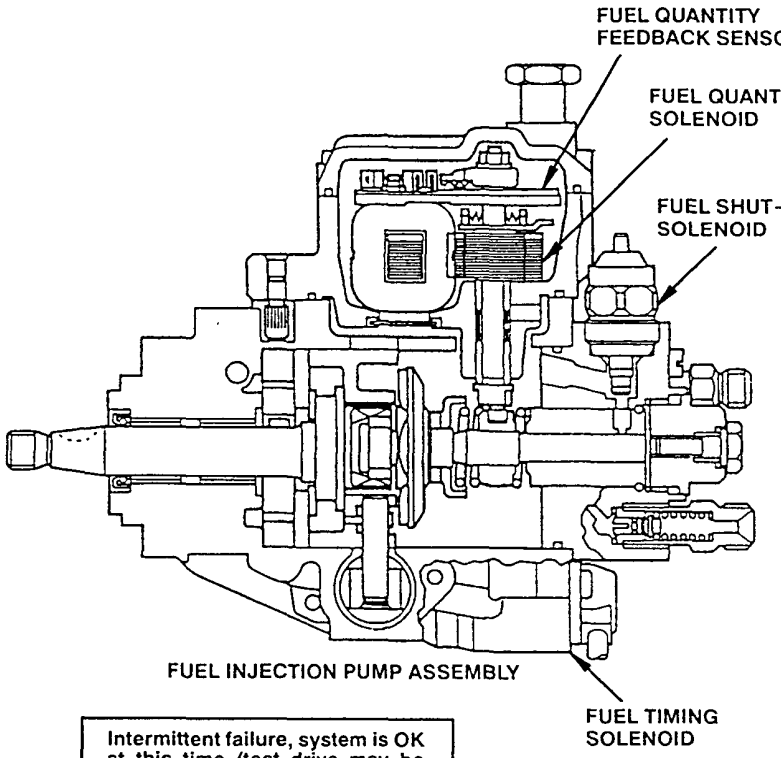
NO

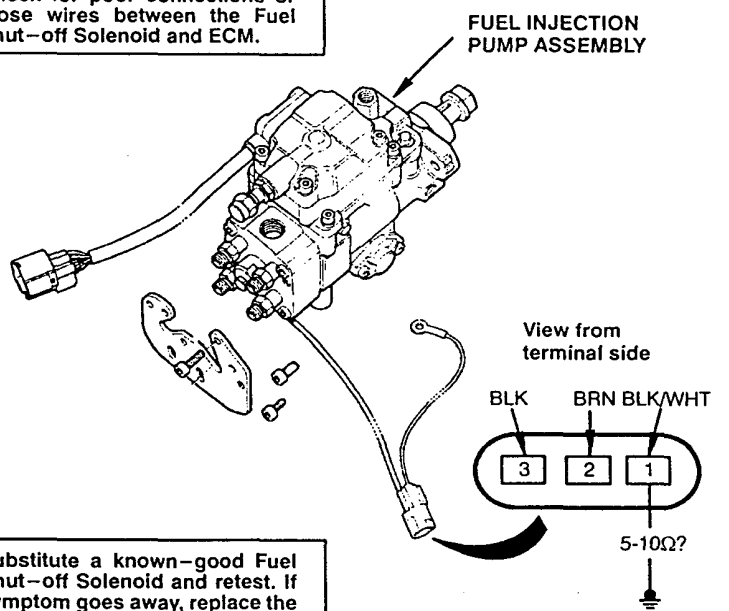
Substitute a known–good Fuel Shut–off Solenoid and retest. If symptom goes away, replace the original Fuel Shut–off Solenoid.

YES

Turn the ignition switch ON.

(To page 11-101)





(From page 11-100)

Measure voltage between WHT (+) terminal and body ground.

Is there battery voltage?

YES → **Substitute a known-good ECM and recheck. If symptom/indication goes away, replace original ECM.**

NO

Turn the ignition switch OFF.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A3 (+) terminal and body ground

Is there battery voltage?

NO → **Substitute a known-good ECM and recheck. If symptom/indication goes away, replace original ECM.**

YES

Turn the ignition switch OFF.

Reconnect the 3P connector.

Disconnect 55P connector from the ECM.

Turn the ignition switch ON.

Measure voltage between A3 (+) terminal and body ground.

Is there battery voltage?

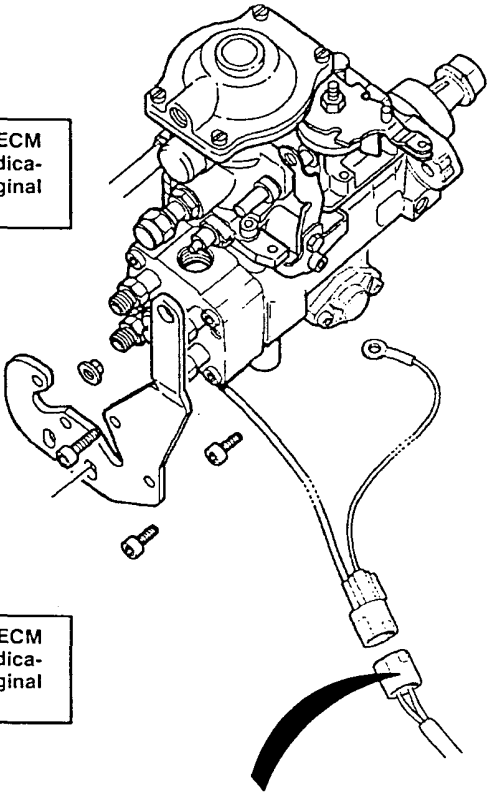
YES → **Repair short to ignition in WHT (+) wire between ECM (A3) and Fuel Injection Pump Assembly.**

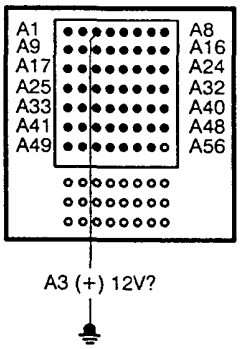
NO

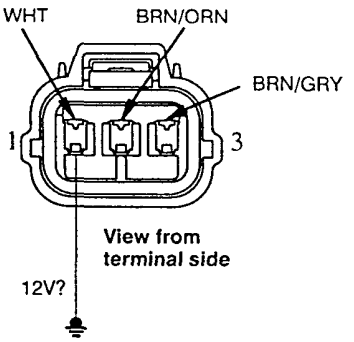
Turn the ignition switch OFF.

(To page 11-102)

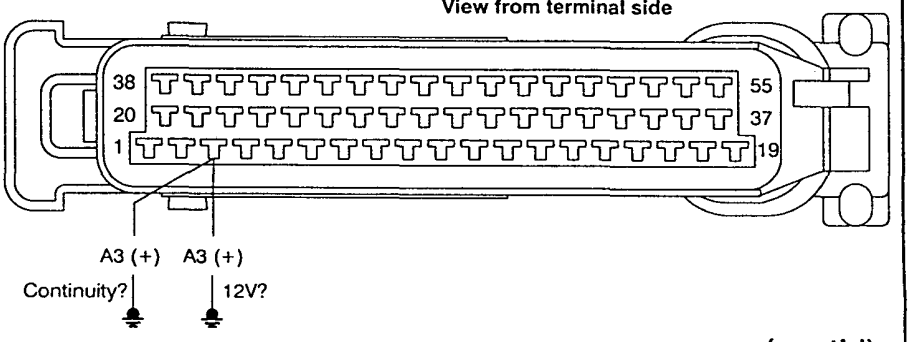
FUEL INJECTION PUMP ASSEMBLY





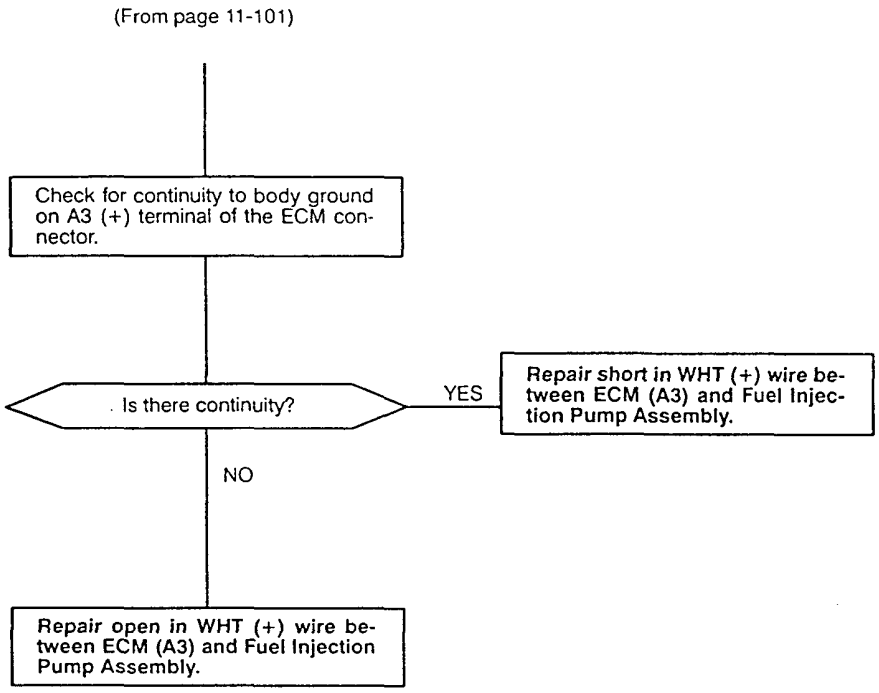


View from terminal side

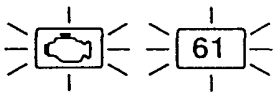


(cont'd)

Troubleshooting Flowchart – Fuel Shut–off Solenoid (cont'd)

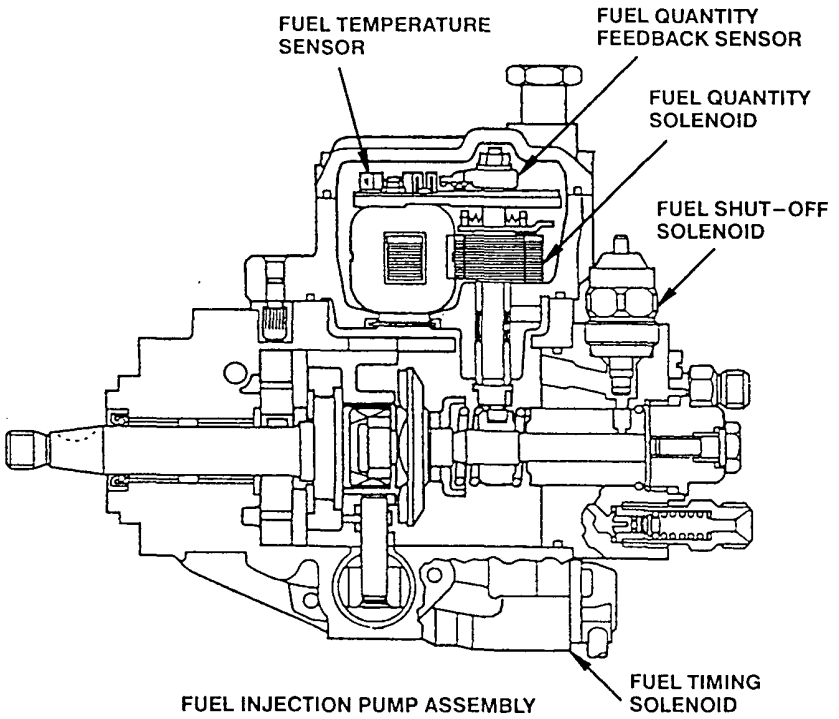


Troubleshooting Flowchart – Fuel Quantity Feedback Sensor

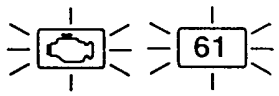


The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 61: A problem in the Fuel Quantity Feedback Sensor circuit (signal above or below setpoint).

The Fuel Quantity Feedback Sensor is a potentiometer mounted on top of the fuel quantity servo control unit inside the Fuel Injection Pump Assembly. The potentiometer sends a voltage signal, proportional to the amount of fuel being delivered, to the ECM.



FUEL INJECTION PUMP ASSEMBLY



– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 61 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does it indicate code 61?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary).**
Check for poor connections or loose wires between the Fuel Injection Pump Assembly (Fuel Quantity Feedback Sensor) and the ECM.

YES

Turn the ignition switch OFF.

Disconnect the 8P connector from the Fuel Injection Pump Assembly.

Measure resistance between terminal 6 (+) and terminal 7 (–) of the Fuel Injection Pump Assembly connector.

Is there approx. 6Ω?

NO → **Replace the Fuel Injection Pump Assembly.**

YES

Measure resistance between terminal 8 (+) and terminal 7 (–) of the Fuel Injection Pump Assembly connector.

(To page 11-105)

(From page 11-104)

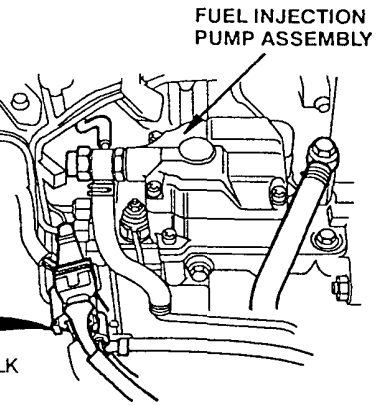
Is there approx. 6Ω?
NO → **Replace the Fuel Injection Pump Assembly.**
YES

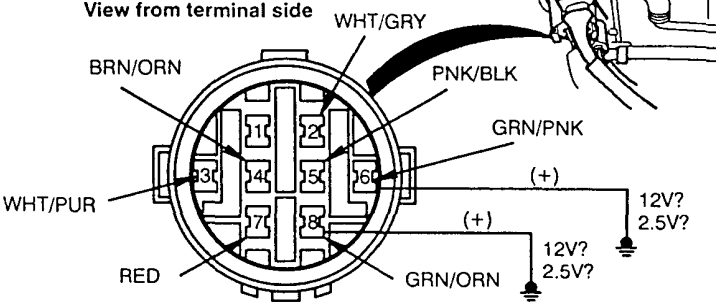
Measure resistance between terminal 6 (+) and terminal 8 (−) of the Fuel Injection Pump Assembly connector.

Is there approx. 12Ω?
NO → **Replace the Fuel Injection Pump Assembly.**
YES

Turn the ignition switch ON.

Measure the voltage between the GRN/ORN (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.





Is there battery voltage?
YES → **Repair short to ignition on GRN/ORN (+) wire between Fuel Injection Pump Assembly and ECM (A21).**
NO

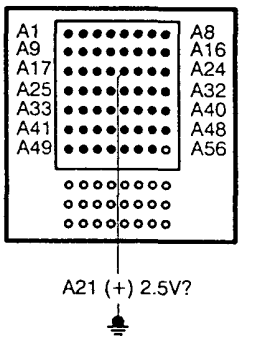
Is there approx. 2.5V?
NO → Turn the ignition switch OFF.
YES

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure the voltage between the GRN/PNK (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.

Measure voltage between A21 (+) terminal and body ground.



Is there approx. 2.5V?
YES → **Repair open in GRN/ORN (+) wire between Fuel Injection Pump Assembly and ECM (A21).**
NO

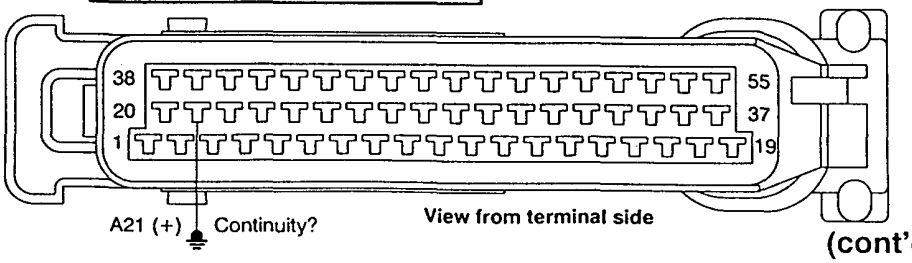
Turn the ignition switch OFF and reconnect the 8P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A21 (+) terminal of the ECM connector.

Is there continuity?
YES → **Repair short in GRN/ORN (+) wire between Fuel Injection Pump Assembly and ECM (A21).**
NO

Substitute a known−good ECM and recheck. If symptom/indication goes away, replace original ECM.



(To page 11-106)

(cont'd)

Troubleshooting Flowchart – Fuel Quantity Feedback Sensor (cont'd)

(From page 11-105)

Is there battery voltage?
- YES → Repair short to ignition on GRN/PNK (+) wire between Fuel Injection Pump Assembly and ECM (A39).
- NO →

Is there approx. 2.5V?
- NO → Turn the ignition switch OFF.
- YES →

Measure the voltage between the RED (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A39 (+) terminal and body ground.

Is there approx. 2.5V?
- YES → Repair open in GRN/PNK (+) wire between Fuel Injection Pump Assembly and ECM (A39).
- NO →

Turn the ignition switch OFF and reconnect the 8P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A39 (+) terminal of the ECM Connector.

Is there continuity?
- YES → Repair short in GRN/PNK (+) wire between Fuel Injection Pump Assembly and ECM (A39).
- NO → Substitute a known–good ECM and recheck. If symptom/indication goes away, replace original ECM.

Is there battery voltage?
- YES → Repair short to ignition on RED (+) wire between Fuel Injection Pump Assembly and ECM (A14).
- NO →

Measure the voltage between the GRN/PNK (+) terminal and RED (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.

Is there approx. 2.5V?
- NO → Turn the ignition switch OFF.
- YES →

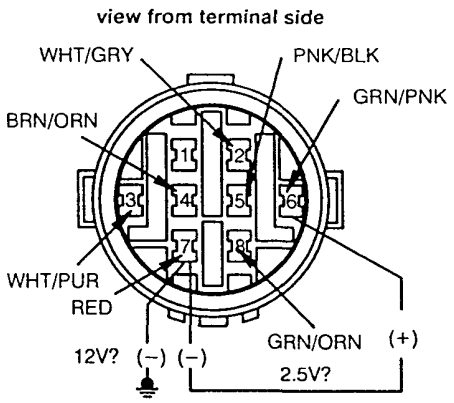
Connect the breakout–box between ECM and ECM connector.

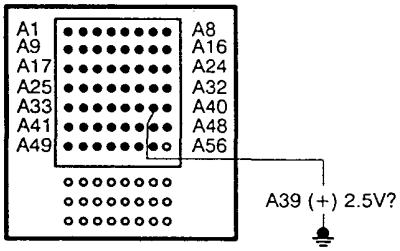
Turn the ignition switch ON.

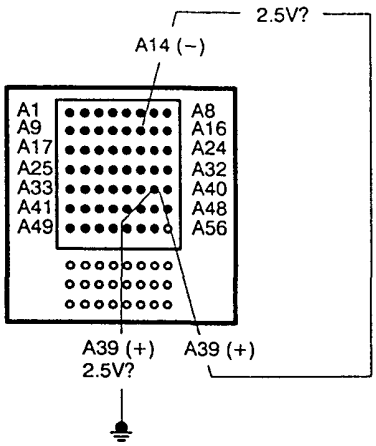
Measure voltage between A39 (+) terminal and A14 (–) terminal at the breakout–box.

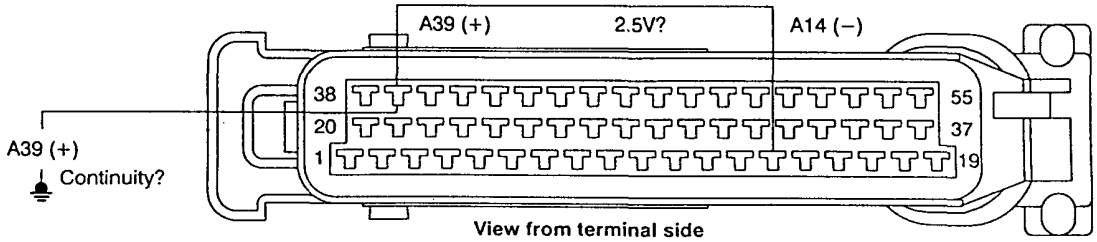
(To page 11-107)

(To page 11-107)









(From page 11-106)

Substitute a known-good ECM and recheck. If symptom/indication goes away, replace original ECM.

(From page 11-106)

Is there approx. 2.5V?

NO

Substitute a known-good ECM and recheck. If symptom/indication goes away, replace original ECM.

YES

Turn the ignition switch OFF and reconnect the 8P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A14 (+) terminal of the ECM connector.

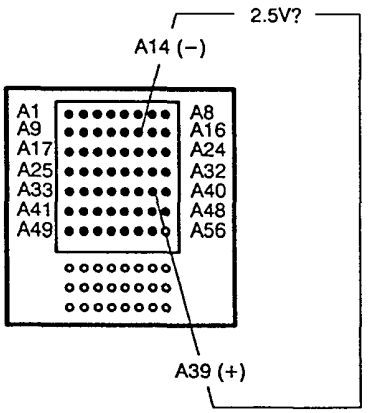
Is there continuity?

YES

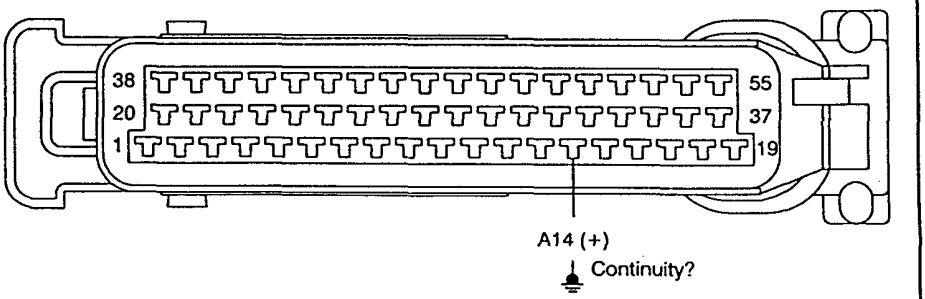
Repair short in RED (+) wire between Fuel Injection Pump Assembly and ECM (A14).

NO

Repair open in RED (+) wire between Fuel Injection Pump Assembly and ECM (A14).



View from terminal side

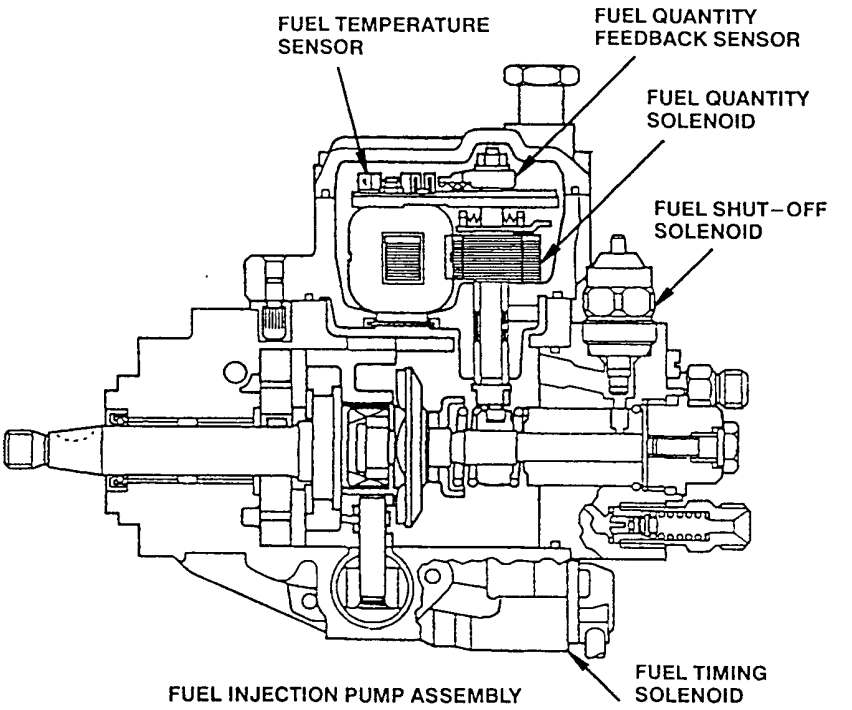


Troubleshooting Flowchart – Fuel Quantity Feedback Sensor

62

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 62: A problem in the Fuel Quantity Feedback Sensor (implausible with Needle Lift Sensor).

The Fuel Quantity Feedback Sensor is a potentiometer mounted on top of the fuel quantity servo control unit inside the Fuel Injection Pump Assembly. The potentiometer sends a voltage signal, proportional to the amount of fuel being delivered, to the ECM.



62

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 62 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does ist indicate code 62?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the Fuel Injection Pump Assembly (fuel quantity feedback sensor) and the ECM.**

YES

Turn the ignition switch OFF.

Disconnect the 8P connector from the Fuel Injection Pump Assembly.

Measure resistance between terminal 6 (+) and terminal 7 (–) of the Fuel Injection Pump Assembly connector.

Is there approx. 6Ω?

NO → **Replace the Fuel Injection Pump Assembly.**

YES

Measure resistance between terminal 8 (+) and terminal 7 (–) of the Fuel Injection Pump Assembly connector.

(To page 11-109)

(From page 11-108)

Is there approx. 6Ω? NO → **Replace the Fuel Injection Pump Assembly.**

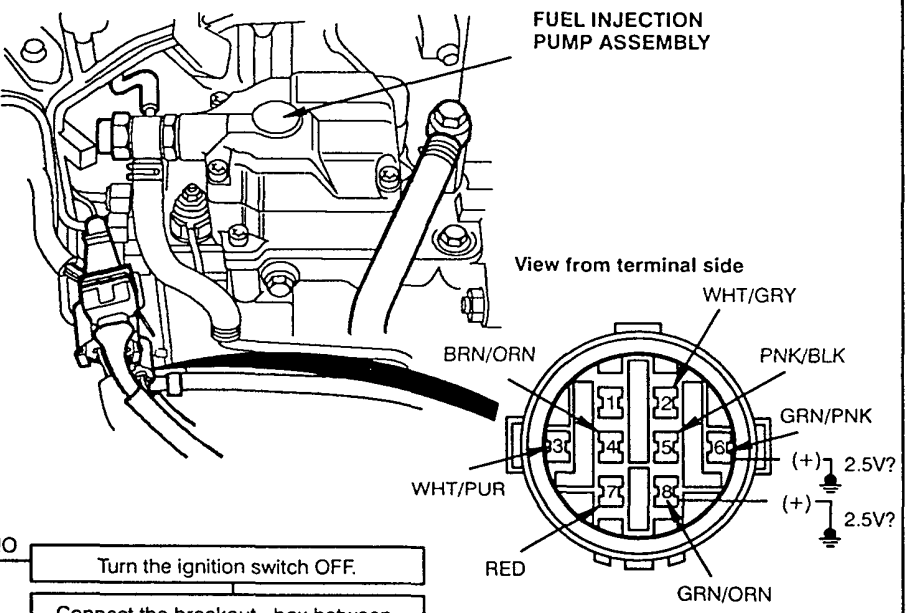
YES

Measure resistance between terminal 6 (+) and terminal 8 (−) of the Fuel Injection Pump Assembly connector.

Is there approx. 12Ω? NO → **Replace the Fuel Injection Pump Assembly.**

YES

Turn the ignition switch ON.



Measure the voltage between the GRN/ORN (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.

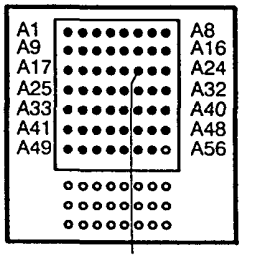
Is there approx. 2.5V? NO →
- Turn the ignition switch OFF.
- Connect the breakout-box between ECM and ECM connector.
- Turn the ignition switch ON.
- Measure voltage between A21 (+) terminal and body ground.

YES

Measure the voltage between the GRN/PNK (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.

Is there approx. 2.5V? YES → **Repair open in GRN/ORN (+) wire between Fuel Injection Pump Assembly and ECM (A21).**

NO → **Substitute a known-good ECM and recheck. If symptom/indication goes away, *replace original ECM.***



(To page 11-110)

(cont'd)

Troubleshooting Flowchart – Fuel Quantity Feedback Sensor (cont'd)

(From page 11-109)

Is there approx. 2.5V?

NO

Turn the ignition switch OFF.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A31 (+) terminal and body ground.

Is there approx. 2.5V?

YES

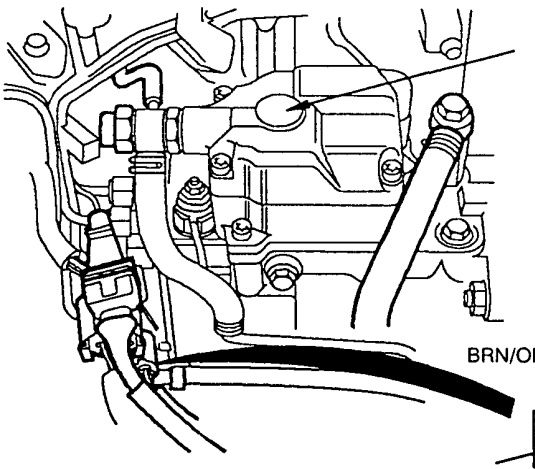
Repair open in GRN/PNK (+) wire between Fuel Injection Pump Assembly and ECM (A39).

NO

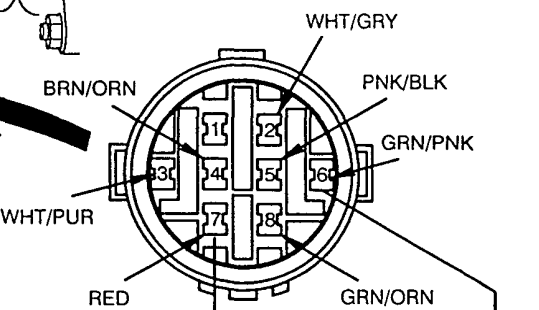
Substitute a known-good ECM and recheck. If symptom/indication goes away, replace original ECM.

YES

Measure the voltage between the GRN/PNK (+) terminal and RED (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.



View from terminal side



Is there approx. 2.5V?

NO

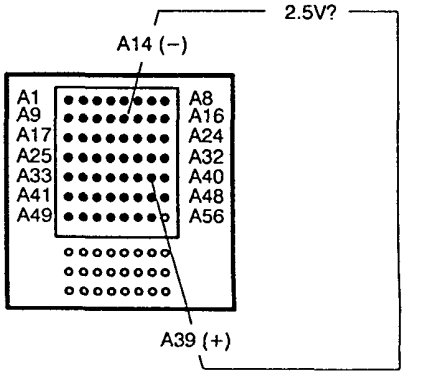
Turn the ignition switch OFF.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

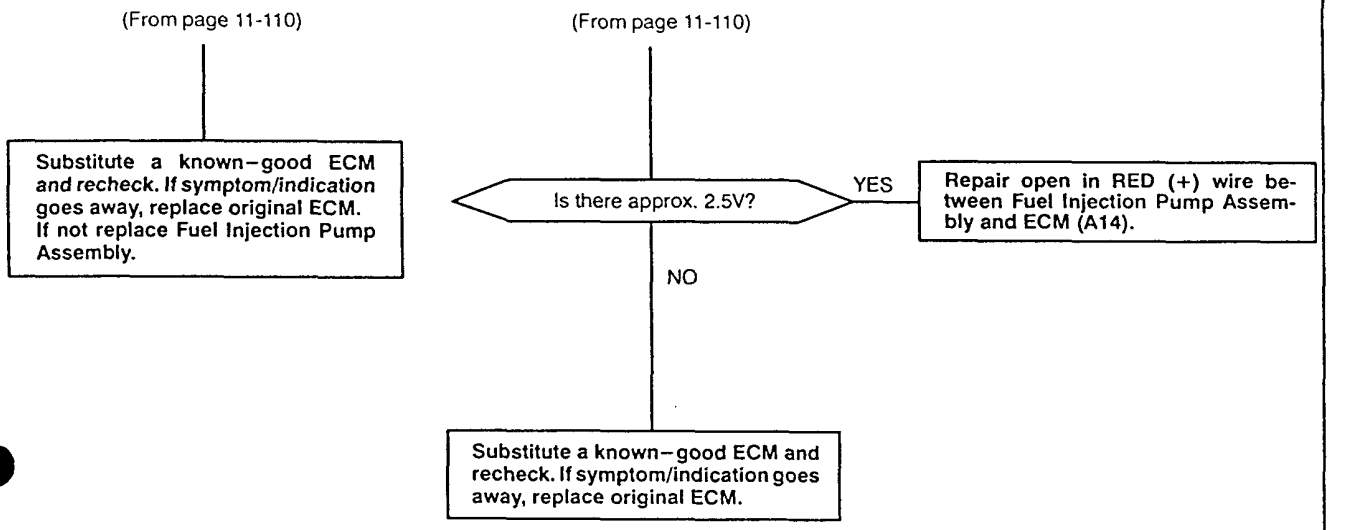
Measure voltage between A39 (+) terminal and A14 (–) terminal at the breakout-box.

YES

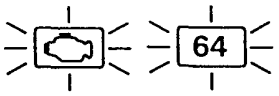


(To page 11-111)

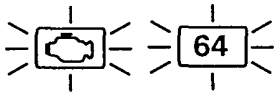
(To page 11-111)


(From page 11-110)
Substitute a known–good ECM and recheck. If symptom/indication goes away, replace original ECM. If not replace Fuel Injection Pump Assembly.
(From page 11-110)
Is there approx. 2.5V?
YES
Repair open in RED (+) wire between Fuel Injection Pump Assembly and ECM (A14).
NO
Substitute a known–good ECM and recheck. If symptom/indication goes away, replace original ECM.

Troubleshooting Flowchart - Fuel Quantity Solenoid



The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 64: A problem in the Fuel Quantity Solenoid circuit (setpoint not achievable).



– The MIL has been reported on.
– With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12) or the PGM–Tester connected to the Data Link Connector, code 64 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Is the MIL on and does ist indicate code 64?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary).**
Check for poor connections or loose wires between the Fuel Injection Pump Assembly (fuel quantity solenoid) and ECM.

YES

Turn the ignition switch OFF.

Disconnect the 8P connector from the Fuel Injection Pump Assembly.

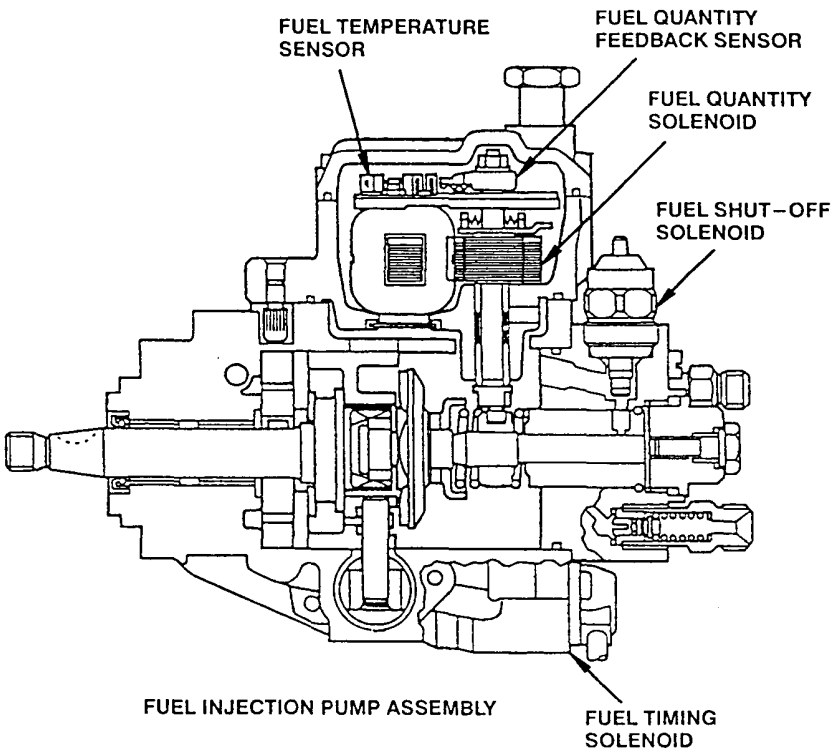
Measure the resistance between terminal 4 (+) and terminal 3 (–) of the Fuel Injection Pump Assembly connector.

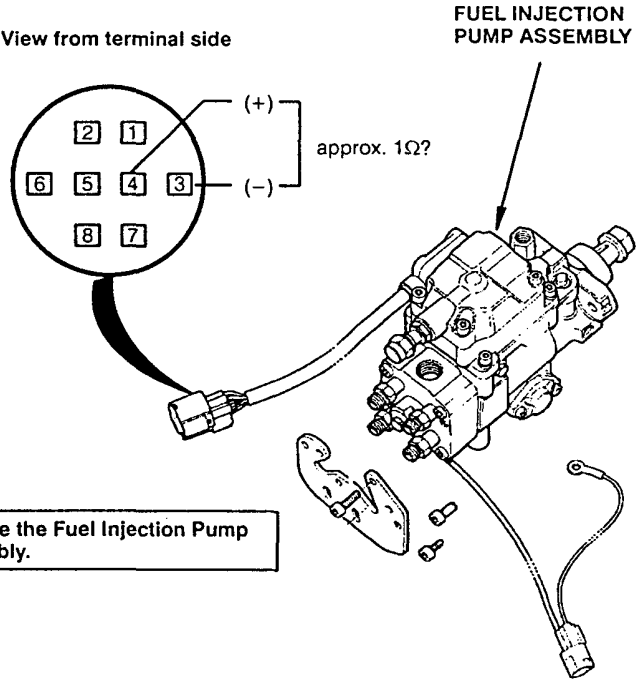
Is there approx. 1Ω?

NO → **Replace the Fuel Injection Pump Assembly.**

YES

(To page 11-113)





(From page 11-112)

Using fused jumper wires, connect terminal 4 (+) to battery voltage and terminal 3 (−) to body ground.

Does the fuel quantity solenoid make a clicking noise?

NO → **Replace the Fuel Injection Pump Assembly.**

YES

Measure voltage between the BRN/ORN (+) terminal of the Fuel Injection Pump Assembly harness connector and body ground.

Is there battery voltage?

NO → **Repair open in BRN/ORN (+) wire between Fuel Injection Pump Assembly and main relay.**

YES

Turn the ignition switch OFF.

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A1 /A2(+) terminal and body ground.

Is there battery voltage?

NO → Turn the ignition switch OFF and reconnect the 8P connector.

YES

Substitute a known−good ECM and recheck. If symptom/indication goes away, replace original ECM.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A1 (+) terminal of the ECM connector.

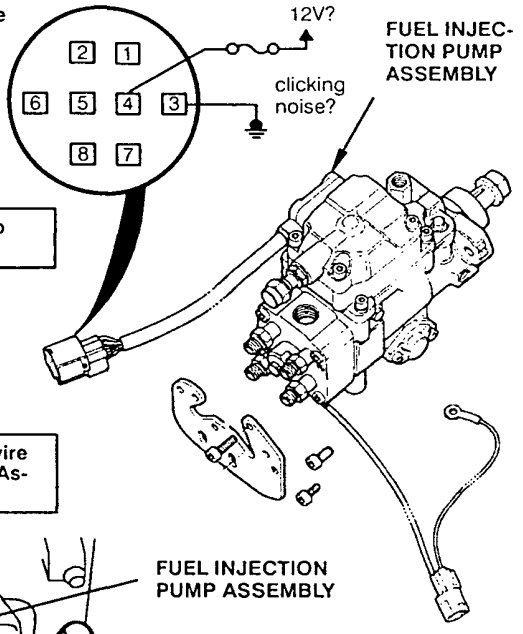
Is there continuity?

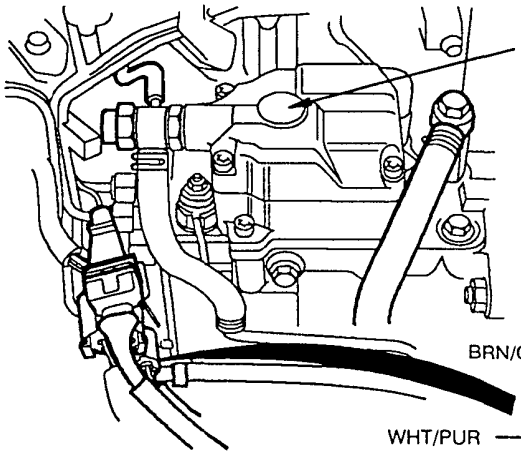
YES → **Repair short in WHT/PUR (+) wires between Fuel Injection Pump Assembly and ECM (A1/A2).**

NO

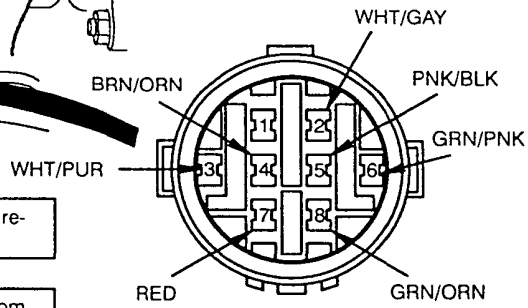
Repair open in WHT/PUR (+) wires between Fuel Injection Pump Assembly and ECM (A1/A2.)

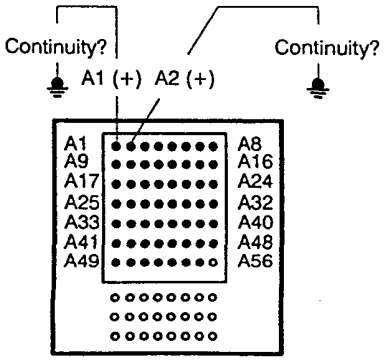
View from terminal side



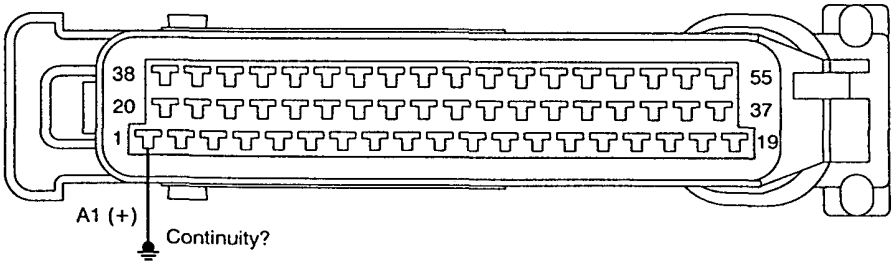


View from terminal side





View from terminal side



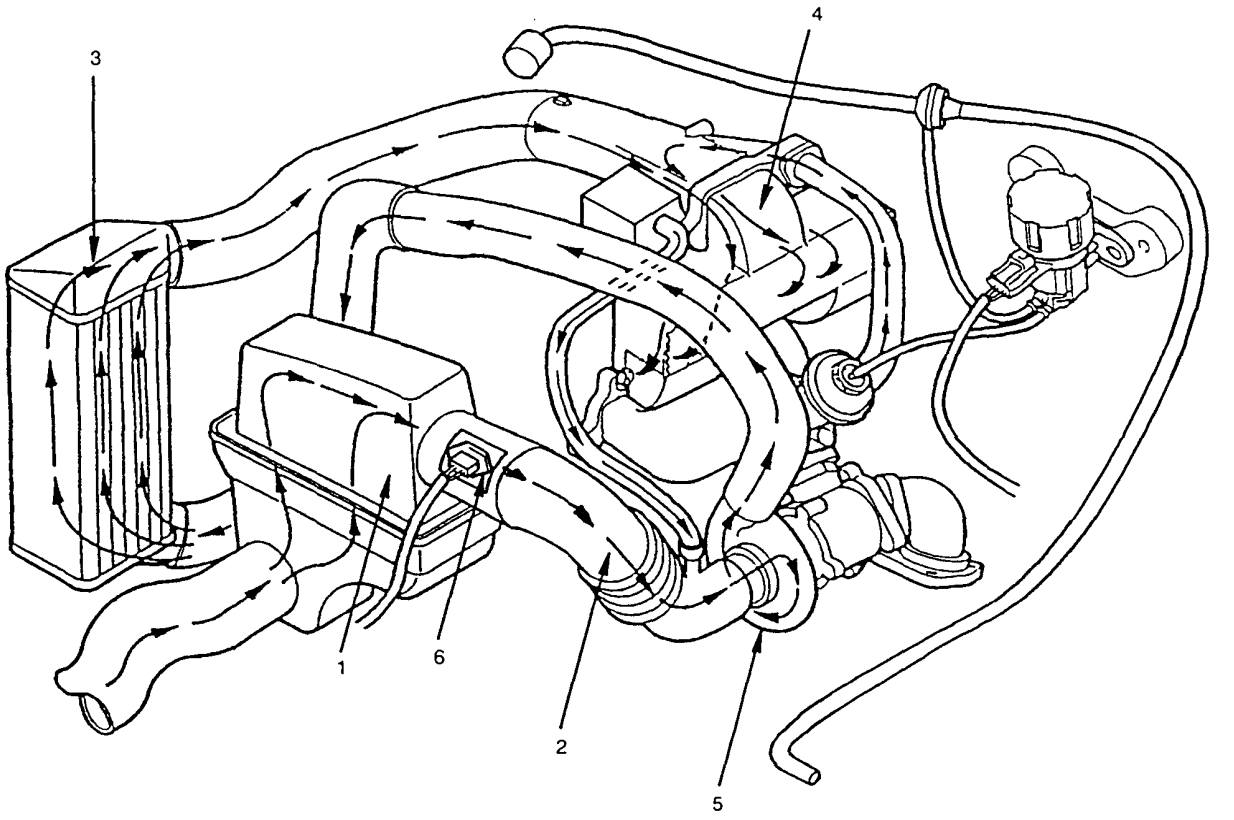
Intake Air System

System Troubleshooting Guide

NOTE: Across each row in the chart, the subsystems that could be sources of a symptom are ranked in the order they should be inspected starting with ①. Find the symptom in the left column, read across to the most likely source, then refer to the page listed at the top of that column. If inspection shows the system is OK, try the next most likely system ②, etc.

PAGE / SUBSYSTEM / SYMPTOM	AIR CLEANER AND INTAKE AIR DUCT	TURBOCHARGER
	11-116	11-118
LOSS OF POWER	①	②
WHEN WARM IDLE SPEED TOO HIGH	①	②

System Description



The intake air system consists of the Air Cleaner (1), Intake Air Duct (2), Intercooler (3), Inlet Manifold (4), Turbocharger (5) and Mass Air Flow Sensor (MAF) (6).

Intake Air System

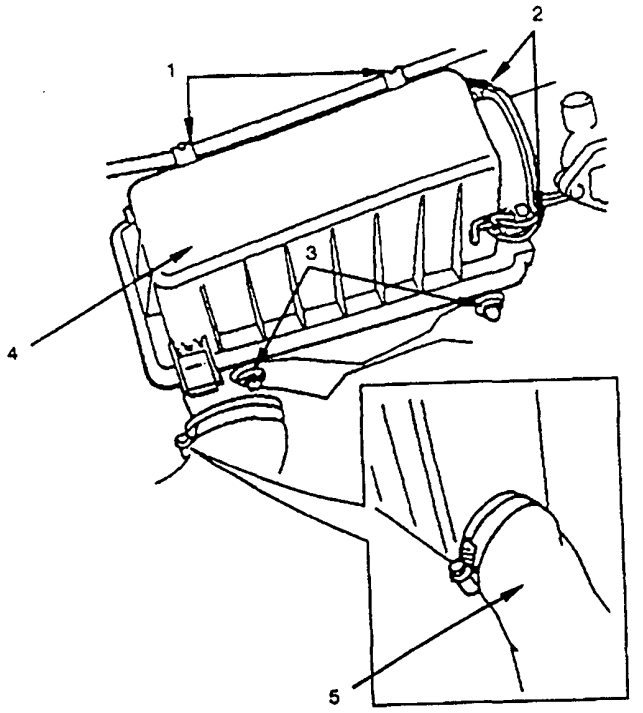
Air Cleaner

Air Cleaners are used to trap particles and only pass clean air through. Therefore they have to be cleaned every 20,000 km (12,000 miles) or 12 months and replaced every 40,000 km (24,000 miles) or 24 months whichever comes first under the severe conditions as a blocked Air Filter can cause air starvation and excessive heat. Air Cleaners are also necessary to avoid damage to the compressor blades of the Turbocharger and introduction of metallic particles into the engine.

replaced every 40,000 km (24,000 miles) or 24 months whichever comes first under the normal conditions, to be

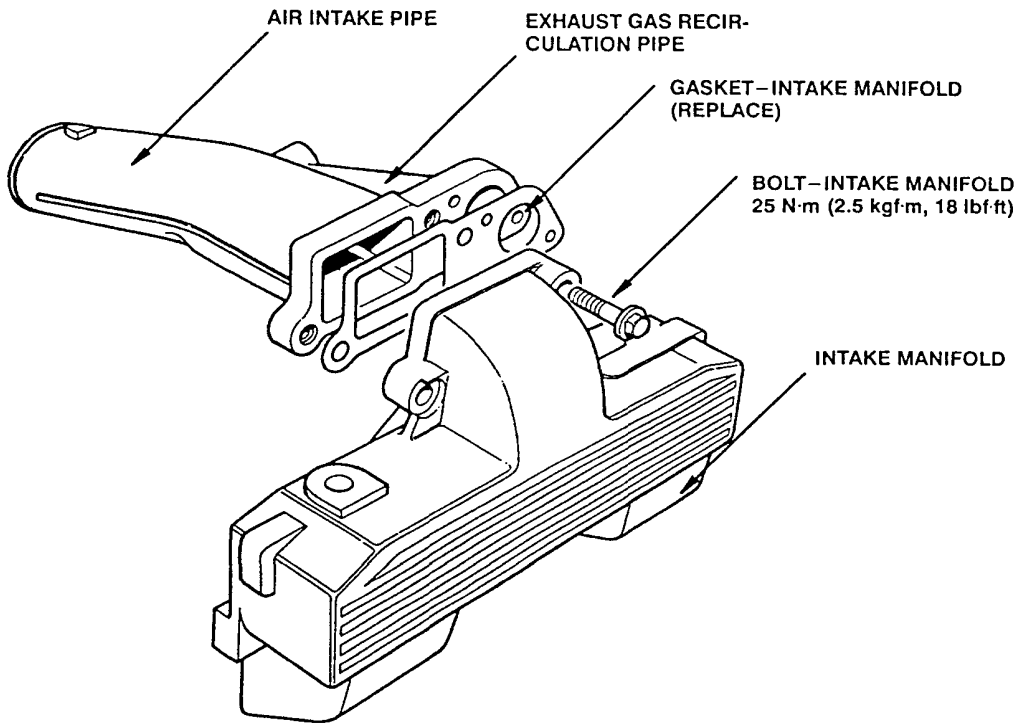
Replacement

1. Disconnect both battery leads.
2. Remove battery.
3. Release two clips (1) from expansion tank return pipe.



4. Release the two security clips (2) from the Mass Air Flow Sensor.
5. Remove two bolts (3).
6. Remove air cleaner (4).
7. Remove intake hose (5) from Air Cleaner.
8. Reinstall in the reverse order of removal.

Intake Manifold



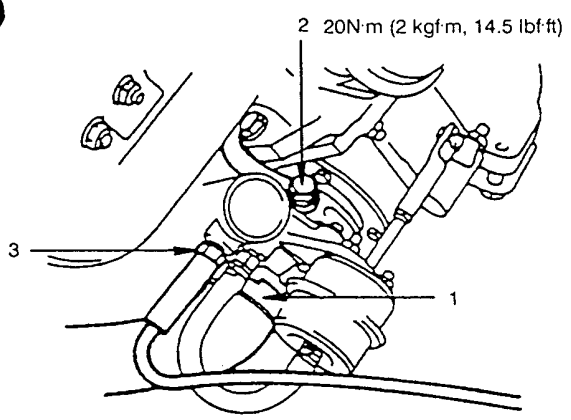
The Air Intake Pipe leads the compressed air from the Turbocharger into the cylinders. Depending on operating conditions a certain amount of exhaust gas is recirculated into the Intake Manifold to decrease combustion temperature and therefore the amount of NOx.

Turbocharger

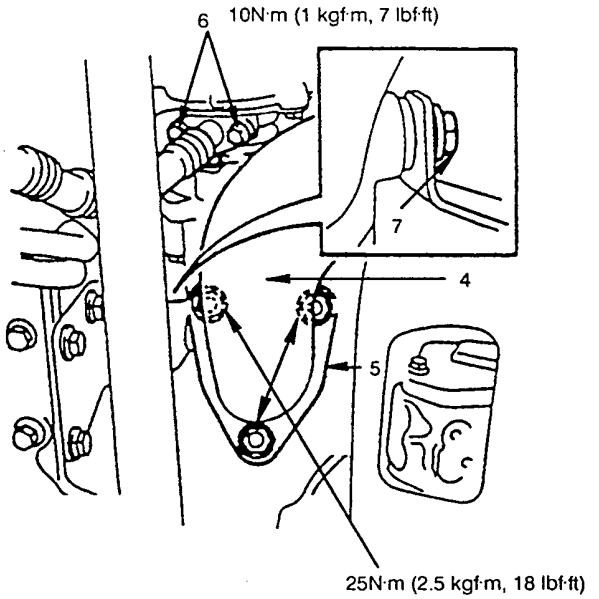
Turbochargers are used to increase the power output of an engine without any major changes in the engine design. They are driven by exhaust gases passing a radial turbine. On the other end of the turbine shaft a compressor wheel compresses the intake air.

Replacement

1. Disconnect battery earth lead.
2. Remove sound deadening pad.
3. Remove intercooler hose from Turbocharger Pipe.
4. Remove Turbocharger Pipe from cylinder head (Refit: Two bolts are securing Turbocharger Pipe to cylinder head: 25 N·m (2.5 kgf·m, 18 lbf·ft). One bolt is securing Turbocharger Pipe to front of cylinder head: 9 N·m (0.9 kgf·m, 6.5 lbf·ft)).



5. Remove Air Intake Hose (1) from Turbocharger.
6. Disconnect oil feed pipe (2).
7. Disconnect boost pressure sensing pipe (3) from Turbocharger.
8. Remove RH under tray (→ BODY).
9. Remove exhaust front pipe (4) from exhaust manifold (5).
10. Remove 2 bolts (6) securing oil drain pipe and discard gasket.
11. Remove bolt (7) securing exhaust manifold to mounting bracket.
12. Remove 3 nuts securing Turbocharger to exhaust manifold (Refit: 25 N·m (2.5 kgf·m, 18 lbf·ft)).
13. Remove Turbocharger.
14. Refit in the reverse order of removal.

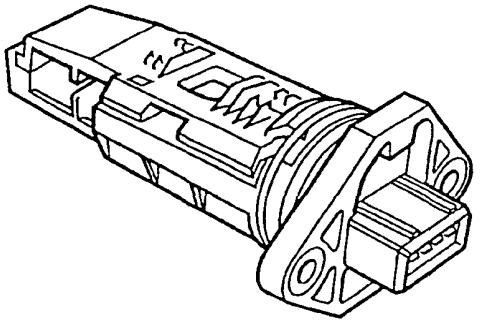


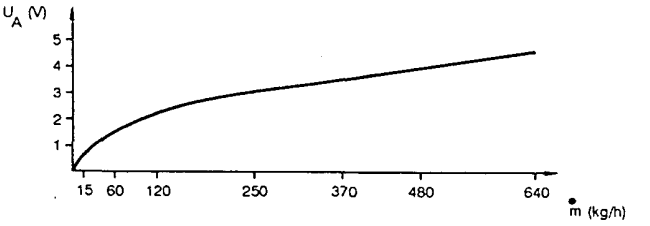
Troubleshooting Flowchart – Mass Air Flow (MAF) Sensor

27

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 27: A problem in the MAF Sensor circuit (signal below setpoint).

The Mass Air Flow Sensor determines the amount of intake air by its cooling effect while flowing over a hot–film sensor. The ECM uses this signal to monitor the recirculation of exhaust gases.





27

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), code 27 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 27?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the MAF sensor and ECM.**

YES

Turn the ignition switch OFF.

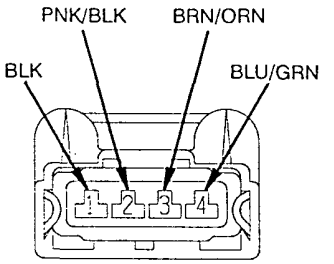
Disconnect the 4P connector from the MAF sensor.

Turn the ignition switch ON.

(To page 11-121)

(From page 11-120)

Measure voltage between BLU/GRN (+) terminal on the MAF sensor and body ground.



Is there approx. 0.15V?

NO → **Replace the MAF sensor.**

YES

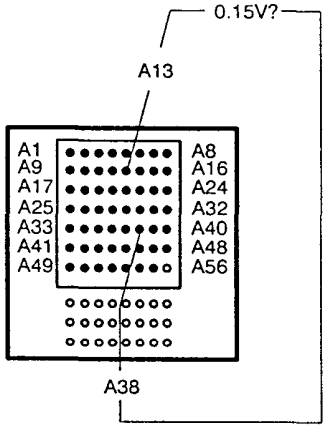
Measure voltage between BRN/ORN (+) terminal and body ground.

Is there battery voltage?

NO → **Repair open in BRN/ORN (+) wire between MAF sensor and Main Relay.**

YES

Measure voltage between BRN/ORN (+) terminal and BLK (−) terminal of the MAF sensor.



Is there battery voltage?

NO → **Repair open in BLK (−) wire between MAF sensor and body ground.**

YES

Measure voltage between BLU/ORN (+) terminal and body ground.

Is there approx. 0.15V?

NO → Turn the ignition switch OFF.

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A38 (+) terminal and A13 (−) terminal at the breakout−box.

Is there approx. 0.15V?

YES → **Repair open in BLU/GRN (+) wire between A38 (+) terminal and MAF sensor.**

NO

(To page 11-122)

(To page 11-122)

(cont'd)

Troubleshooting Flowchart – Mass Air Flow (MAF) Sensor (cont'd)

(From page 11-121)

Measure voltage between BLU/GRN (+) terminal and PNK/BLK (–) terminal.

Is there approx. 0.15V?

NO → Repair open in PNK/BLK (–) wire between A13 (–) terminal and MAF sensor.

YES

Turn the ignition switch OFF.

Reconnect the 4P connector.

Disconnect the 55P connector.

Check for continuity to body ground on A13 (–) terminal of ECM connector.

Is there continuity?

YES → Repair short in PNK/BLK (–) wire between A13 (–) and MAF sensor.

NO

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

(From page 11-121)

Disconnect the 55P connector from the ECM.

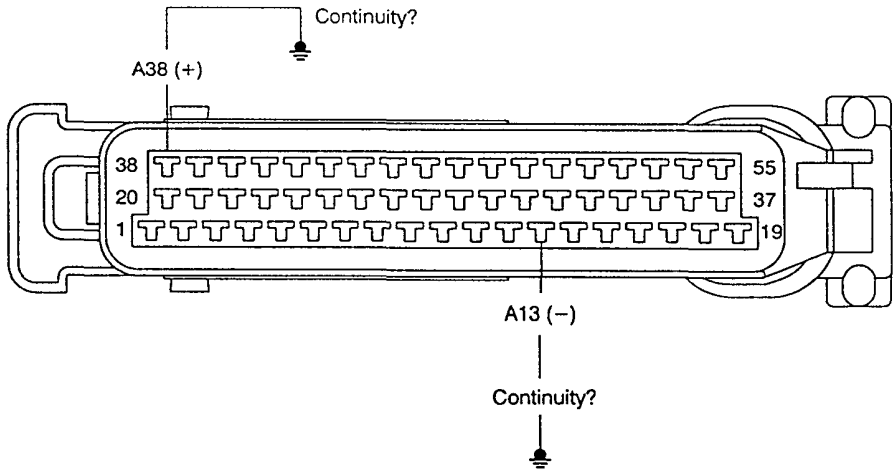
Check for continuity to body ground on A38 (+) terminal of the ECM connector and body ground.

Is there continuity ?

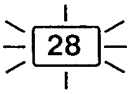
YES → Repair short in BLU/GR (–) wire between A38 (+) terminal MAF sensor.

NO

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

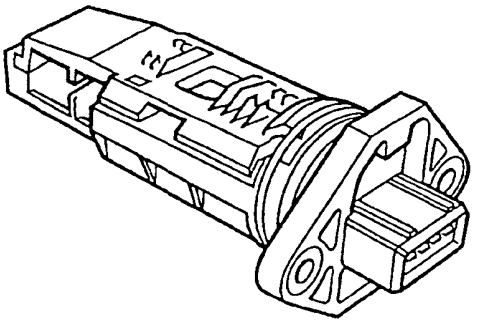


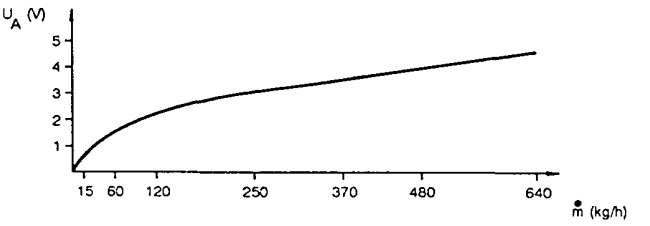
Troubleshooting Flowchart – Mass Air Flow (MAF) Sensor

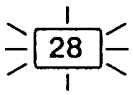


The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 28: A problem in the MAF Sensor circuit (signal above setpoint).

The Mass Air Flow Sensor determines the amount of intake air by its cooling effect while flowing over a hot–film sensor. The ECM uses this signal to monitor the recirculation of exhaust gases.







With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), code 28 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 28?

NO

Intermittent failure, system is OK at this time (test drive may be necessary).
Check for poor connections or loose wires between the MAF sensor and ECM.

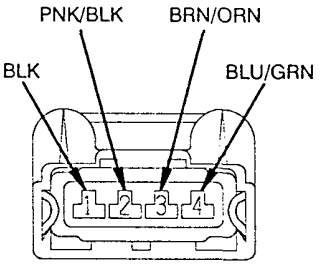
YES

Turn the ignition switch OFF.

(To page 11-125)

(From page 11-124)

Disconnect the 4P connector from the MAF sensor.



Turn the ignition switch ON.

Measure voltage between BLU/GRN (+) terminal on the MAF sensor harness connector and body ground.

Is there approx. 0.15V?

NO → **Replace the MAF sensor.**

YES

Measure voltage between BRN/ORN (+) terminal and body ground.

Is there battery voltage?

NO → **Repair open in BRN/ORN (+) wire between MAF sensor and Main Relay.**

YES

Measure voltage between BRN/ORN (+) terminal and BLK (−) terminal.

Is there battery voltage?

NO → **Repair open in BLK (−) wire between MAF sensor and body ground.**

YES

Measure voltage between BLU/GRN (+) terminal of the MAF sensor harness connector and body ground.

Is there battery voltage?

YES → **Repair short to ignition in BLU/GRN (+) wire between MAF sensor and ECM (A38).**

NO

(To page 11-126)

(cont'd)

Troubleshooting Flowchart – Mass Air Flow (MAF) Sensor (cont'd)

(From page 11-125)

Is there approx. 0.15V?

NO

Turn the ignition switch OFF.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A38 (+) terminal and A13 (–) terminal at the breakout–box.

Is there approx. 0.15V?

YES

Repair open in BLU/GRN (+) wire between ECM A38 and MAF sensor.

NO

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

YES

Measure voltage between BLU/GRN (+) terminal and PNK/BLK (–) terminal on the MAF sensor harness connector.,

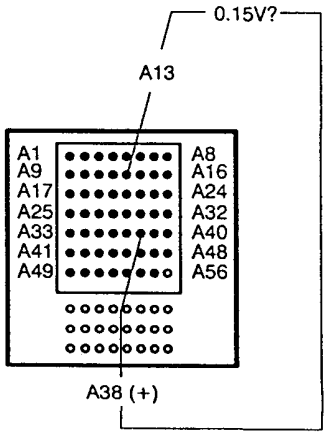
Is there approx. 0.15V?

NO

Repair open or short to ignition in INK/BLK (–) wire between MAF sensor and ECM (A13).

YES

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

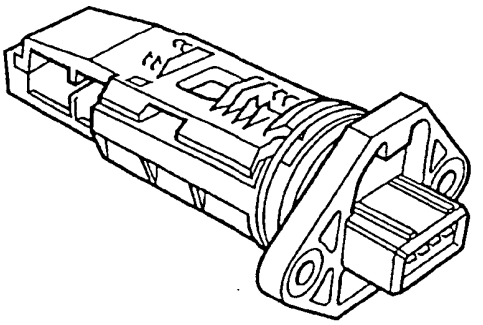


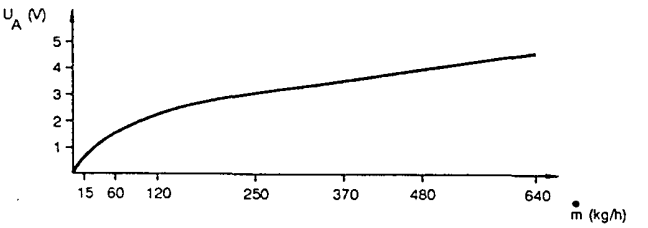
Troubleshooting Flowchart – Mass Air Flow (MAF) Sensor

29

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 29: An implausible signal from the MAF Sensor.

The Mass Air Flow Sensor determines the amount of intake air by its cooling effect while flowing over a hot–film sensor. The ECM uses this signal to monitor the recirculation of exhaust gases.





29

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), code 29 is indicated.

Do the ECM Reset procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 29?

Intermittent failure, system is at this time (test drive may be necessary).
Check for poor connections or loose wires between MAF sensor and ECM.

Turn the ignition switch OFF.

Disconnect the 4P connector from the MAF sensor.

(To page 11-129)

(From page 11-128)

Turn the ignition switch ON.

Measure voltage between BLU/ORN (+) terminal on the MAF sensor harness connector and bodyground.

Is there approx. 0.15V? NO → **Replace the MAF sensor.**

YES

Measure voltage between BRN/ORN (+) terminal and bodyground.

Is there battery voltage? NO → **Repair open in BRN/ORN (+) wire between MAF sensor and Main Relay.**

YES

Measure voltage between BRN/ORN (+) terminal and BLK (−) terminal.

Is there battery voltage? NO → **Replair open in BLK (−) wire between MAF sensor and body ground.**

YES

Measure voltage between BLU/GRN (+) terminal of the MAF Sensor harness connector and bodyground.

Is there approx. 0.15V? NO → Turn the ignition switch OFF.

YES

Connect the breakout−box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A38 (+) terminal and A13 (−) terminal at the breakout−box.

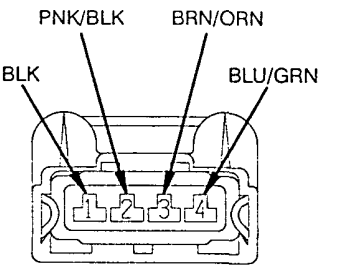
Is there approx. 0.15V? YES → **Repair open in BLU/GRN (+) wire between MAF sensor and ECM (A38).**

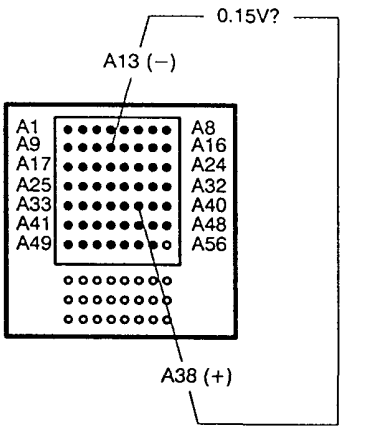
NO

Measure voltage between BLU/GRN (+) terminal and PNK/BLK (−) terminal on the MAF sensor harness connector.

(To page 11-130)

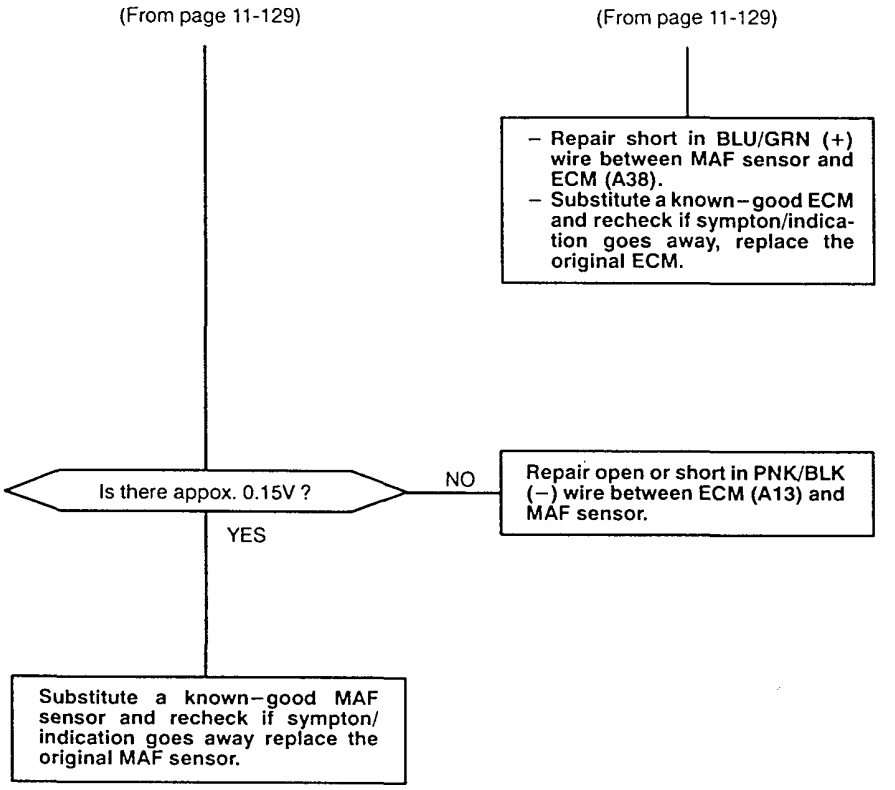
(To page 11-130)





(cont'd)

Troubleshooting Flowchart – Mass Air Flow (MAF) sensor (cont'd)

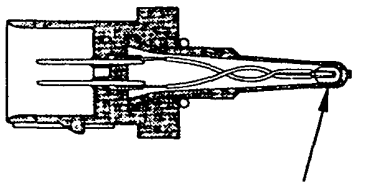


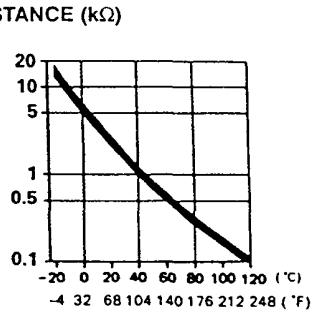
Troubleshooting Flowchart – Intake Air Temperature (IAT) Sensor

71

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 71: A problem in the Intake Air Temperature (IAT) Sensor circuit (signal below setpoint).

The IAT sensor is a temperature dependent resistor (thermistor). The resistance of the thermistor decreases as the intake air temperature increases as shown below.





71

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), or the PGM–Tester connected to the Data Link Connector, code 71 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 71?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the IAT sensor and ECM.**

YES

Warm up engine to normal operating temperature (the radiator fan comes on).

Turn the ignition switch OFF.

Disconnect the 2P connector from the IAT sensor.

Measure resistance between the 2 terminals on the IAT sensor.

Is there 900-1,100Ω?

NO → **Replace the IAT Sensor.**

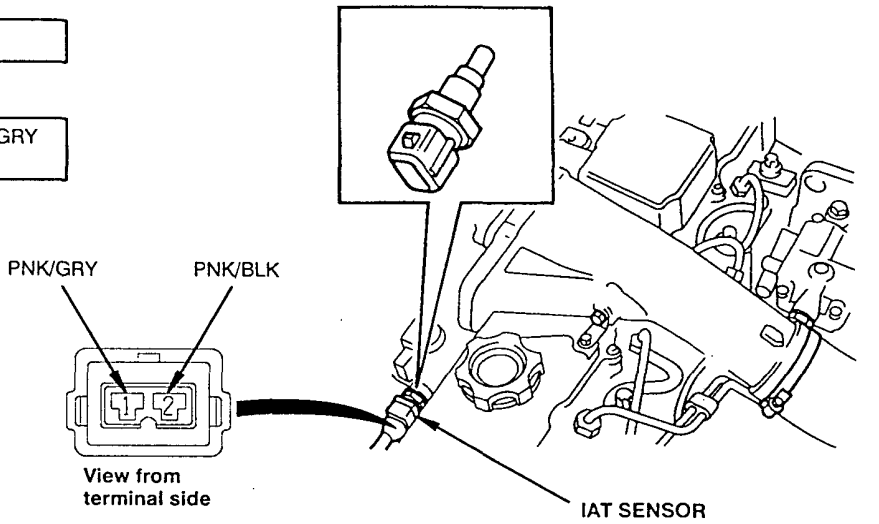
YES

(To page 11-133)

(From page 11-132)

Turn the ignition switch ON.

Measure voltage between PNK/GRY (+) terminal and body ground.



Is there approx. 5V?

YES → **Measure voltage between PNK/GRY (+) terminal and PNK/BLK (−) terminal of the IAT Sensor.**

NO

Is there approx. 5V?

NO → **Repair open in PNK/BLK (−) wire between ECM (A13) and IAT sensor.**

YES

Turn the ignition switch OFF.

Reconnect 2P connector.

Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A13 (−) terminal of ECM connector.

Is there continuity?

YES → **Repair short in PNK/BLK (−) wire between ECM (A13) and IAT sensor.**

NO

Substitute a known−good ECM and recheck. If symptom/indication goes away, replace the original ECM.

(To page 11-134)

(cont'd)

Troubleshooting Flowchart – Intake Air Temperature (IAT) Sensor (cont'd)

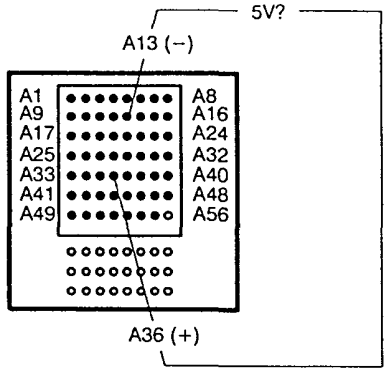
(From page 11-133)

Turn the ignition switch OFF.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A36 (+) terminal and A 13 (–) terminal at the breakout-box.



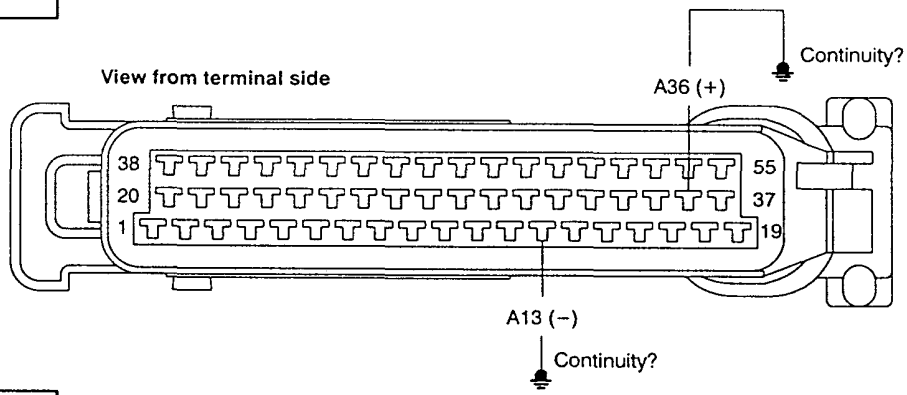
Is there approx. 5V?

YES → **Repair open in PNK/GRY (+) wire between ECM (A36) and IAT sensor.**

NO

Turn the ignition switch OFF.

Reconnect 2P connector.



Disconnect the 55P connector from the ECM.

Check for continuity to body ground on A36 (+) terminal of the ECM connector.

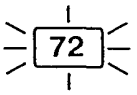
Is there continuity?

YES → **Repair short in PNK/GRY (+) wire between ECM (A36) and IAT sensor.**

NO

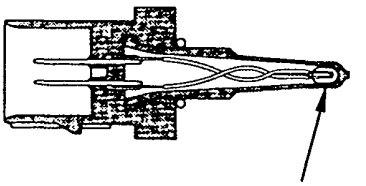
Substitute a known-good ECM and recheck. If symptom/indication goes away, replace the original ECM.

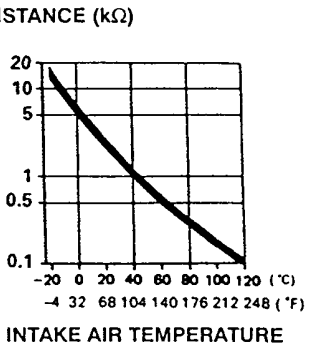
Troubleshooting Flowchart – Intake Air Temperature (IAT) Sensor

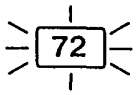


The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 72: A problem in the Intake Air Temperature (IAT) Sensor circuit (signal above setpoint).

The IAT sensor is a temperature dependent resistor (thermistor). The resistance of the thermistor decreases as the intake air temperature increases as shown below.







With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), or the PGM–Tester connected to the Data Link Connector, code 72 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Turn the ignition switch ON.

Does the MIL indicate code 71?

NO → **Intermittent failure, system is OK at this time (test drive may be necessary). Check for poor connections or loose wires between the IAT sensor and ECM.**

YES

Warm up engine to normal operating temperature (the radiator fan comes on).

Turn the ignition switch OFF.

Disconnect the 2P connector from the IAT sensor.

Measure resistance between the 2 terminals on the IAT sensor.

Is there 900-1,100Ω?

NO → **Replace the IAT Sensor.**

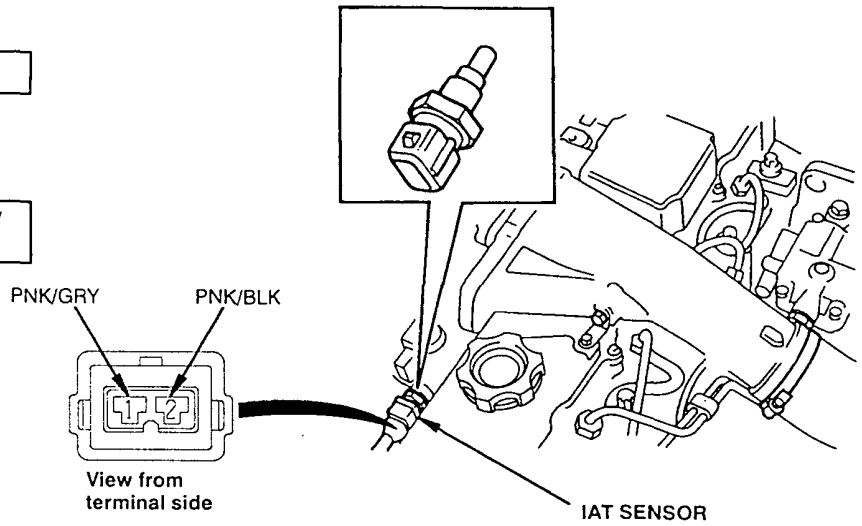
YES

(To page 11-137)

(From page 11-136)

Turn the ignition switch ON.

Measure the voltage between PNK/GRY (+) terminal and body ground.



Is there battery voltage?

YES — **Repair short to ignition in PNK/GRY (+) wire between ECM (A36) and IAT sensor.**

Is there approx. 5V?

YES — Measure the voltage between PNK/GRY (+) terminal and PNK/BLK (–) terminal.

NO

Turn the ignition switch OFF.

Connect the breakout–box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A36 (+) terminal and A 13 (–) terminal at the breakout–box.

Is there approx. 5V?

YES — **Repair open in PNK/GRY (+) wire between ECM (A36) and IAT sensor.**

NO

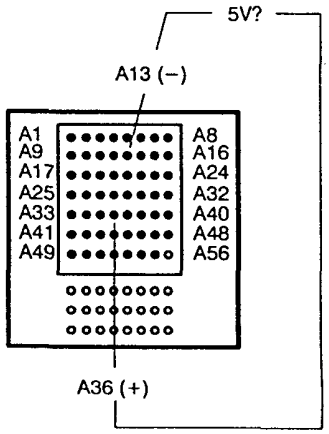
Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.

Is there approx. 5V?

NO — **Repair open or short to ignition in PNK/BLK (–) wire between ECM (A13) and IAT sensor.**

YES

Substitute a known–good ECM and recheck. If symptom/indication goes away, replace the original ECM.



Emission Control System

– System Troubleshooting Guide

Note: Across each row in the chart, the sub–systems that could be sources of a symptom are ranked in the order they should be inspected starting with ①. Find the symptom in the left column, read across to the most likely source, then refer to the page listed at the top of that column. If inspection shows the system is OK, try the next most likely system ②, etc.

PAGE / SUBSYSTEM / SYMPTOM		OXIDATION CATALYTIC CONVERTER	EXHAUST GAS RECIR-CULATION SYSTEM
		11-141	11-142
ROUGH IDLE			①
FREQUENT STALLING			①
POOR PERFORMANCE	MISSFIRING OR ROUGH RUNNING		①
	FAIL EMISSION TEST	①	②
	LOSS OF POWER	①	②

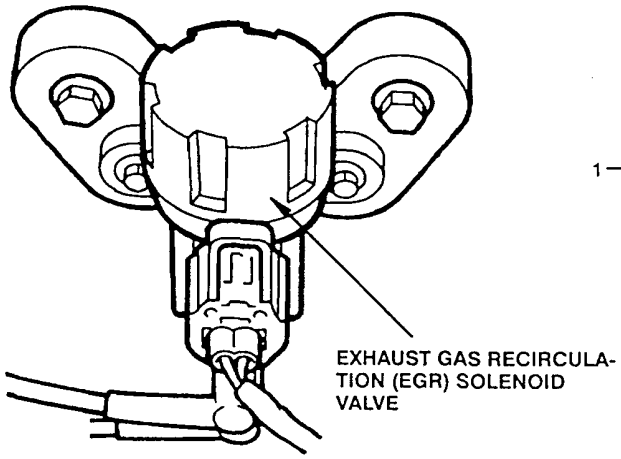
Emission Control System

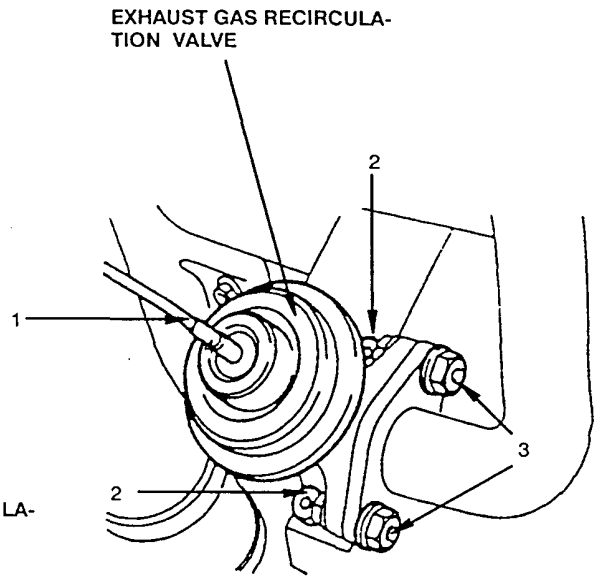
System Description

The Emission Control System includes an Oxidation Catalytic Converter, Exhaust Gas Recirculation (EGR) system, Crankcase Emission Control and a Fuel Vapour Evaporative Loss Control.
The Crankcase Emission Control System leads gases from the camcase to the intake manifold. The amount of gases to be drawn into the intake air is controlled via a depression limiting valve closing progressively as engine speed increases.
Exhaust emission control is done by measuring the oxygen content of the exhaust gases to adapt the amount of fuel injected to the cylinders. The amount of carbon monoxid (CO), oxides of nitrogen (NOx) and hydro carbons (HC) is decreased by the use of an Oxidation Catalytic Converter. The correct operation of the Oxidation Catalytic Converter depends on the oxygen concentration in the exhaust gases. Dependent on the oxygen concentration the ECM determines the rate of change of fuel being injected to achieve an optimum in combustion and thereby minimising the emissions.

Exhaust Gas Recirculation (EGR) Control Solenoid and Exhaust Gas Recirculation (EGR) Valve

Description





During certain operating conditions exhaust gases are drawn back into the intake manifold to reduce combustion temperatures and therefore the amount of exhaust gases.

If the ECM determines that exhaust gas recirculation is necessary, the EGR Control Solenoid Valve is modulated and the EGR Valve opens because of vacuum supplied by the alternator driven vacuum pump.

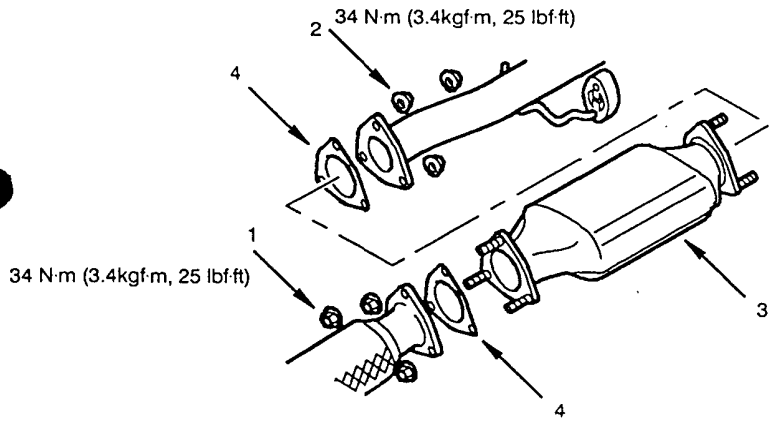
The correct amount of Exhaust Gas Recirculation is calculated by the use of a mass air flow sensor. An increase in intake air flow leads to a decrease in exhaust gas.

Oxidation Catalytic Converter

Description

The Oxidation Catalytic Converter is used to reduce the emission of carbon monoxide (CO), and hydrocarbons (HC) in the exhaust gas.

Replacement



1. Raise the vehicle on four post ramps.
2. Remove three nuts (1) securing Oxidation catalytic converter to front pipe.
3. Remove three nuts (2) securing Oxidation catalytic converter to intermediate pipe.
4. Remove Oxidation Catalytic Converter (3).
5. Remove and discard gaskets (4).
6. Refit in the reverse order of replacement.

Troubleshooting Flowchart – Exhaust Gas Recirculation (EGR) System

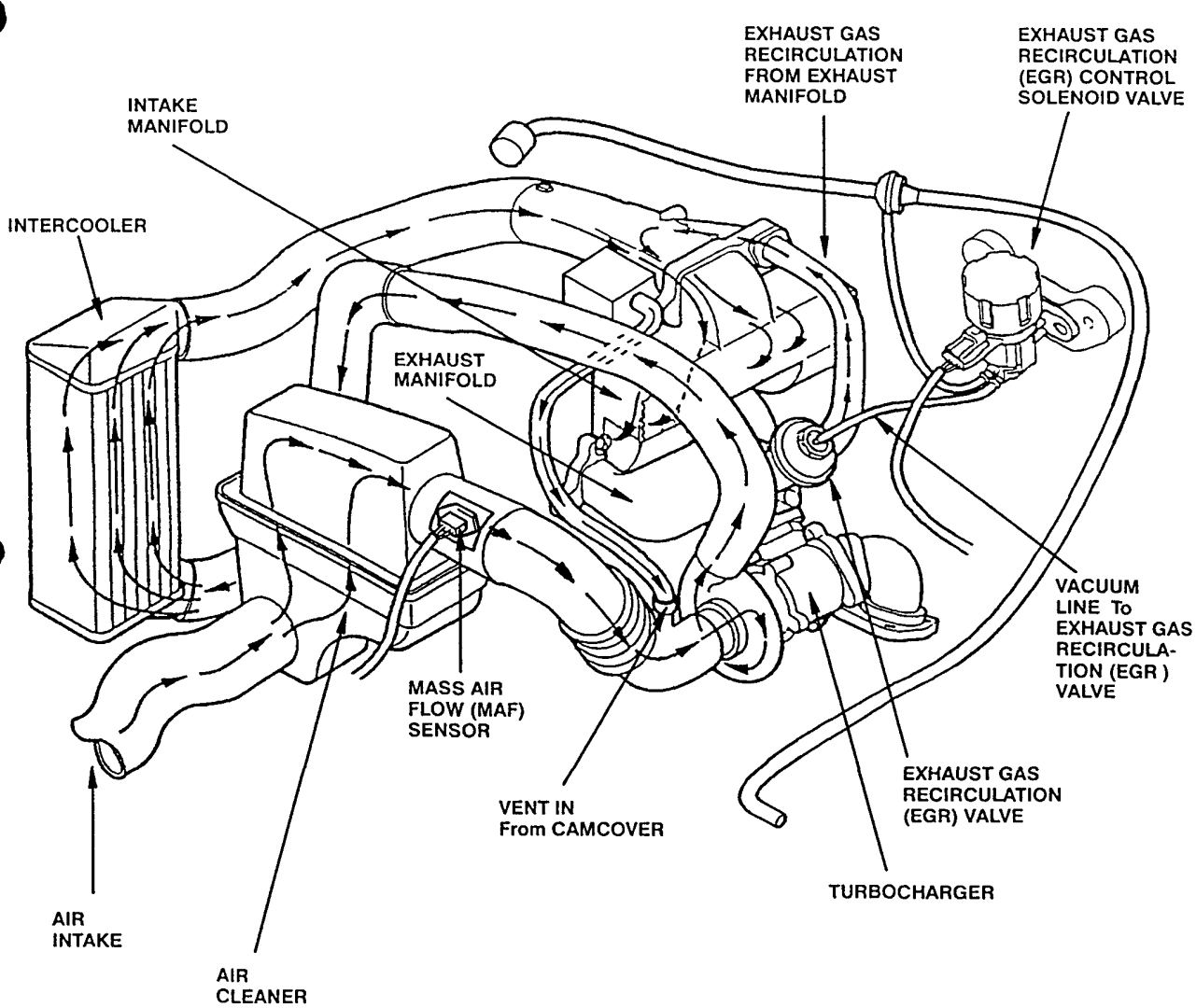
33

The Malfunction Indicator Lamp (MIL) indicates Diagnostic Trouble Code (DTC) 33: A problem in the Exhaust Gas Recirculation (EGR) system.

The EGR system is designed to reduce oxides of nitrogen emissions (NOx) by recirculating exhaust gas through the EGR Valve and the intake manifold into the combustion chambers. It is composed of the EGR Valve, EGR Control Solenoid, ECM and various sensors.

The ECM memory contains ideal EGR Valve lifts for varying operating conditions. The EGR Valve is vacuum operated and controlled by the EGR Control Solenoid. When the ECM determines that EGR is needed, the EGR Control Solenoid is energised and vacuum is applied to the EGR Valve. The EGR Valve opens and exhaust gases are fed through a pipe into the exhaust manifold.

The MAF sensor, mounted in the air intake pipe, senses the volume of air entering the intake. Due to the fact that an increase in EGR will cause a decrease in the intake air flow, the MAF sensor is used by the ECM to monitor the amount of EGR. This signal enables the ECM to accurately control the volume of exhaust gases being recirculated.



33

With the Data Link Connector's diagnostic L–Line (WHT/PNK wire) connected to ground (see page 11-12), code 33 is indicated.

Do the ECM Reset Procedure (see page 11-13).

Road test necessary: Warm up the engine to normal operating temperature (the radiator fan comes on). Drive the car on the road for approx. 10 minutes. Keep the engine speed in the 1,700–2,500 min⁻¹ (rpm) range.

Does the MIL indicate code 33?

NO

Intermittent failure, system is OK at this time. Check for poor connections or loose wires between the EGR control solenoid valve, MAF sensor, and ECM.

YES

With the engine at idle, disconnect the hose from the EGR valve and connect a vacuum pump/gauge to the hose.

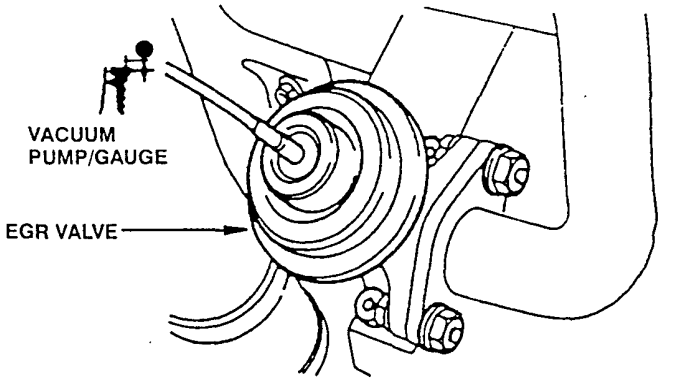
Is there any vacuum?

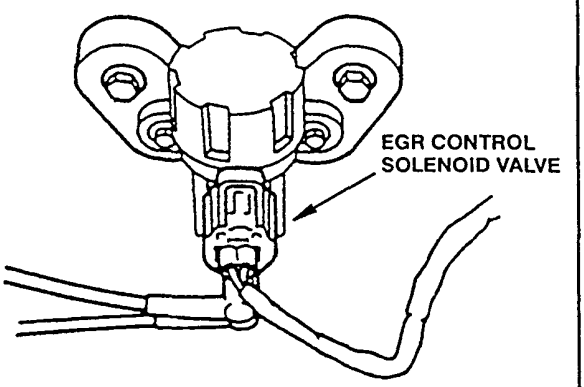
YES

Disconnect 2P connector from the EGR control solenoid valve and check the hose for vacuum again.

NO

Move the vacuum pump/gauge to the EGR valve.





(To page 11-144)

(To page 11-144)

(cont'd)

Troubleshooting Flowchart – Exhaust Gas Recirculation (EGR) System (cont'd)

(From page 11-143)

With the engine at idle, apply 500 mm Hg (20 in. Hg) of vacuum to the EGR valve.

Does the engine stall or run rough and does the EGR valve hold vacuum?

NO → **Replace the EGR valve.**

YES

Turn the ignition switch OFF.

Disconnect the 2P connector from the EGR control solenoid valve.

Turn the ignition switch ON.

Measure voltage between BRN/ORN (+) terminal on the EGR control solenoid valve harness connector and body ground.

Is there battery voltage?

NO → **Repair open in BRN/ORN wire between the EGR control solenoid valve and Main Relay.**

YES

Reconnect the vacuum pump/gauge to the hose.

Start the engine and allow it to idle.

(To page 11-145)

(From page 11-143)

Is there any vacuum?

YES → **Check vacuum hose routing of the entire EGR system. If hose routing is OK, replace EGR control solenoid valve.**

NO

Turn the ignition switch OFF and disconnect the 55P connector from the ECM.

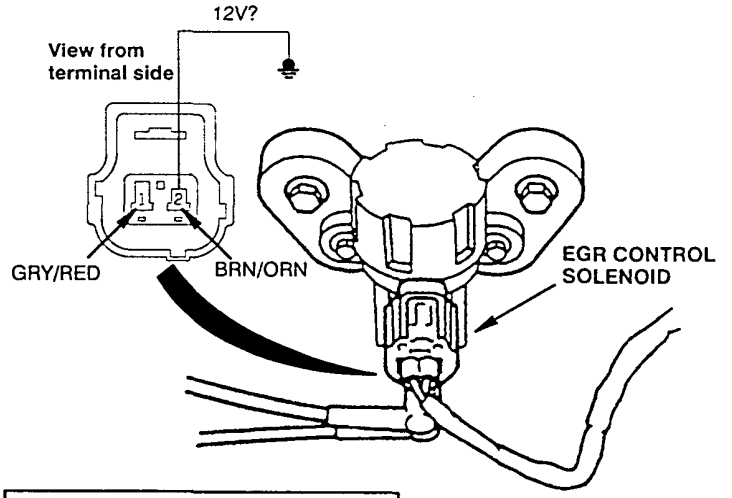
Check for continuity to ground on terminal A6 (+) of the ECM harness connector.

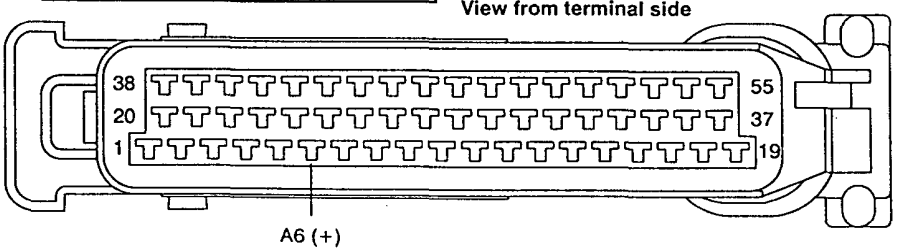
Is there continuity?

YES → **Repair short in GRY/RED wire between EGR control solenoid valve and ECM (A6).**

NO

Substitute a known-good ECM and retest. If symptom/indication goes away, replace the original ECM.





(From page 11-144)

Connect battery power to terminal 2 of the EGR Control Solenoid valve. While watching the vacuum gauge, ground terminal 1 of the EGR control solenoid valve.

Is there approx. 760 mm Hg (30 in. Hg) within 1 second?

NO → Turn the ignition switch OFF and inspect all vacuum hoses for leaks, restrictions, or misrouting.

YES

Turn the ignition switch OFF and reconnect the 2P connector to the EGR control solenoid valve.

Turn the ignition switch OFF.

Connect the breakout-box between ECM and ECM connector.

Turn the ignition switch ON.

Measure voltage between A 6 (+) terminal at the breakout-box and body ground.

(To page 11-146)

Are the hoses OK?

NO → **Correct as necessary.**

YES

Disconnect the lower hose on EGR Control Solenoid valve and connect a vacuum gauge to the hose.

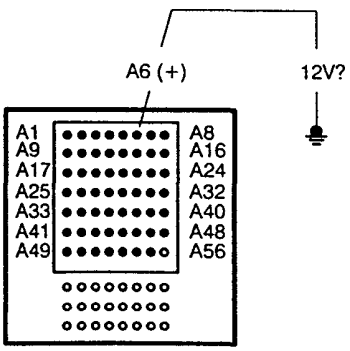
Start the engine and allow it to idle.

Is there approx. 600 mm Hg (24 in. Hg) of vacuum?

NO → **Replace vacuum pump.**

YES

Replace the EGR control solenoid valve.



(cont'd)

Troubleshooting Flowchart – Exhaust Gas Recirculation (EGR) System (cont'd)

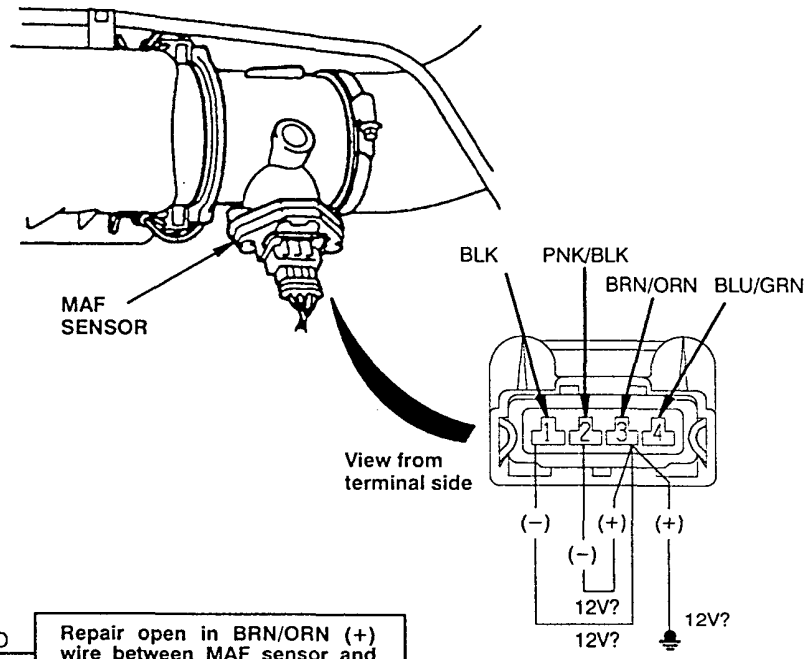
(From page 11-145)

Is there battery voltage?
NO → **Repair open in GRY/RED (+) wire between EGR control solenoid valve and ECM (A6).**
YES

Turn ignition off and disconnect 4P connector from the MAF sensor.

Turn the ignition switch ON.

Measure voltage between BRN/ORN (+) terminal of the MAF sensor harness connector and body ground.



Is there battery voltage?
NO → **Repair open in BRN/ORN (+) wire between MAF sensor and main relay.**
YES

Measure voltage between BRN/ORN (+) terminal and BLK (–) terminal of the MAF sensor harness connector.

Is there battery voltage?
NO → **Repair open in BLK (–) wire between MAF sensor and body ground.**
YES

Measure voltage between BRN/ORN (+) terminal and PNK/BLK (–) terminal of the MAF sensor harness connector.

Is there battery voltage?
NO → **Repair open in PNK/BLK (–) wire between MAF sensor and ECM (A13).**
YES

Measure voltage between BLU/GRN (+) terminal and PNK/BLK (–) terminal of the MAF sensor harness connector.

(To page 11-147)

(From page 11-146

Is there battery voltage?

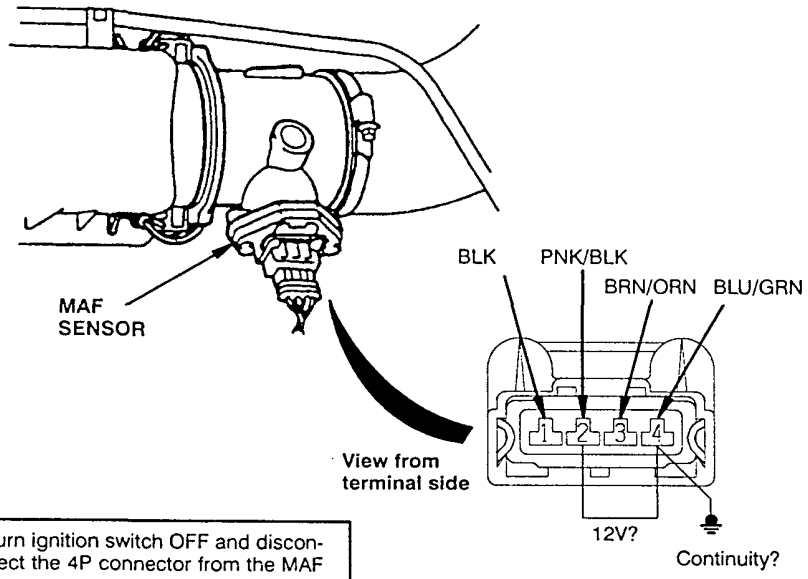
YES → **Repair short to ignition in BLU/GRN (+) wire between MAF sensor and ECM (A38).**

NO

Turn the ignition switch OFF and reconnect the 4P connector.

Start the engine and allow it to idle.

Measure voltage between BLU/GRN (+) terminal and PNK/BLK (−) terminal of the MAF sensor by back−probing the 4P connector.



Is there approx. 1.5 V?
NOTE: The voltage will fluctuate slightly.

NO → Turn ignition switch OFF and disconnect the 4P connector from the MAF sensor.

YES

Disconnect the 55P connector from the ECM.

Check for continuity to ground on the BLU/GRN (+) terminal of the MAF sensor harness connector.

Is there continuity?

YES → **Repair short in BLU/GRN (+) wire between MAF sensor and ECM (A38).**

NO

Replace MAF sensor.

Measure voltage between A38 (+) terminal and A13 (−) terminal of the breakout−box.

Is there approx. 1.5V?
NOTE: The voltage will fluctuate slightly.

NO → **Repair open in BLU/GRN wire between MAF sensor and ECM (A38).**

YES

Substitute a known−good MAF sensor and/or ECM and recheck. If symptom/indication goes away, replace original MAF sensor and/or ECM.